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Service manual

580SR
580SR+
590SR
695SR

SERIES 3

Print No. 87643852B

CASE CONSTRUCTION

580SR
580SR+
590SR
695SR

SERIES 3

Service manual

Print No. 87643852B

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TO READER

This manual has been printed for a skilful engineer to supply necessary technical information to carry out service operations on this machine.

Read carefully this manual to collect correct information relevant to repair procedures.

For any question or remark, or in case of any error relevant the contents of this manual, please contact:

CNH ITALIA S.p.A.
Technical Information
Viale delle Nazioni, 55
41100 MODENA - Italy

REFERENCE

Beyond this Service Manual, also refer to documents hereunder listed:

- Operator's Manual
- Parts Catalogue

COMPLETE HANDBOOK FOR INSTRUCTIONS AND REPAIRS

The complete Service Manual consists of two volumes:

- 580SR / 580SR+ / 590SR / 695SR Service Manual for "Loader backhoe"
- 580SR / 580SR+ / 590SR / 695SR Service Manual "Engine"

The Service Manuals for "Loader backhoe" and "Engine" contain the necessary technical information to carry out service and repair on machine and on engine, necessary tools to carry out those operations and information on service standard, on procedures for connection, disconnection, disassembly and assembly of parts.

The complete Service Manual which covers the loader backhoe models 580SR / 580SR+ / 590SR / 695SR consists of the following volumes, which can be identified through their print number as stated below:

VOLUME	MACHINE TYPE	PRINT NUMBER
Service Manual - "Loader backhoe"	580SR / 580SR+ / 590SR / 695SR	87643852B
Service Manual - "Engine"	580SR / 580SR+ / 590SR / 695SR	87659057A

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PREVENT ACCIDENTS

The majority of accidents and injuries which occur in industry, on the farm, at home or on the road, are caused by the failure of some individual to follow simple and fundamental safety rules or precautions. For this reason MOST ACCIDENTS CAN BE PREVENTED by recognizing the real cause and taking the necessary precautions, before the accident occurs.

Regardless of the care used in design and construction of any type of equipment, there may be conditions that cannot be completely safeguarded against, without interfering with reasonable accessibility and efficient operation.

A careful operator and / or technician is the best insurance against accidents. The complete observance of one simple rule would prevent many thousands of serious injuries each year.

This rule is: never attempt to clean, lubricate or adjust a machine while it is in motion.

⚠ WARNING

Before carrying out any maintenance operation, adjustment and or repair on machines equipped with attachments, controlled hydraulically or mechanically, make sure that the attachment is lowered and safely set on the ground. If it is necessary to have the equipment partially or fully raised to gain access to certain items, be sure the equipment is suitably supported by means other than the hydraulic lift cylinders, cable and /or mechanical device used for controlling the equipment.

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LOADER BACKHOE MODELS

The complete range of Loader Backhoe models described in this manual are identified below:

	580SR	580SR+	590SR	695SR
Powershift	/	●	●	●
Powershuttle	●	●	●	/
Stabilizer sideshift	●	●	●	●
Stabilizer center pivot	/	/	/	●
Cab	●	●	●	●
Rops	●	/	/	/
2WD	●	/	/	/
4WD	●	●	●	●
4WS	/	/	/	●
Pilot control	●	●	●	●
Mechanical control	●	●	●	●
Engine 72 kW-97 HP model F4GE948C*601 (mechanical)	●	/	/	/
Engine 72 kW-97 HP model F4HE0484C*J102 (electronic)	/	●	/	/
Engine 82 kW-110 HP model F4HE9484C*J102 (electronic)	/	/	●	/
Engine 82 kW-110 HP model F4HE9484C*J103 - 4WS (electronic)	/	/	/	●
Short dipper	/	/	/	/
Long dipper	●	●	●	●

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SECTION 00 - SAFETY PRECAUTIONS

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This warning symbol points out important messages involving personal safety.
Carefully read the safety rules contained herein and follow advised precautions to avoid potential hazards and safeguard your safety and personal integrity.
In this manual you will find this symbol together with the following keywords:
WARNING - it gives warning about improper repair operations and deriving potential consequences affecting the service technician's personal safety.
DANGER - it gives specific warning about potential dangers for personal safety of the operator or other persons directly or indirectly involved.



TO PREVENT ACCIDENTS

Most accidents and personal injuries that occur in the work site or on the road, are caused by the failure of some individual to follow simple and fundamental safety rules or precautions.

For this reason, MOST ACCIDENTS CAN BE PREVENTED: by recognizing the real cause and taking the necessary precautions, before the accident occurs.

Regardless of the care used in design and construction of any type of equipment, there may be conditions that cannot be completely safeguarded against, without interfering with reasonable accessibility and efficient operation.

A careful operator or technician is the best precaution against accidents. The complete observance of one simple rule would prevent many thousands of serious injuries each year.

This rule is: never attempt to clean, lubricate or adjust a machine while it is in motion.

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SAFETY PRECAUTIONS

- Carefully follow specified repair and maintenance procedures.
- Do not wear rings, wristwatches, jewels, unbuttoned or flapping clothing such as: ties, torn clothes, scarves, open jackets or shirts with open zips which could get hold into moving parts.
  We advise to use approved safety clothing such as: anti-slipping footwear, gloves, safety goggles, helmets, etc.
- Never carry out any repair on the machine if someone is sitting on the operator's seat, except if they are certified operators to assist in the operation to be carried out.
- Never operate the machine or use attachments from a place other than sitting at the operator's seat.
- Never carry out any operation on the machine when the engine is running, except when specifically indicated.
- Stop the engine and ensure that all pressure is relieved from hydraulic circuits before removing caps, covers, valves, etc.
- All repair and maintenance operations should be carried out with the greatest care and attention.
- Service stairs and platforms used in a workshop or in the field should be built in compliance with the safety rules in force.
- Disconnect the batteries and label all controls to warn that the Machine is being serviced. Block the machine and all equipment which should be raised.
- Never check or fill fuel tanks and accumulator batteries, nor use starting liquid if you are smoking or near open flames as such fluids are flammable.
- Brakes are inoperative when they are manually released for maintenance purposes. In such cases, the machine should be kept constantly under control using blocks or similar devices.
- The fuel filling gun should remain always in contact with the filler neck.
  Maintain this contact until the fuel stops flowing into the tank to avoid possible sparks due to static electricity buildup.
- Use exclusively specified towing points for towing the machine. Connect parts carefully. Ensure that foreseen pins and/or locks are steadily fixed before applying traction.
  Do not stop near towing bars, cables or chains working under load.
- To transfer a failed machine, use a trailer or a low loading platform trolley if available.
- To load and unload the machine from the transportation mean, select a flat area providing a firm support to the trailer or truck wheels. Firmly tie the machine to the truck or trailer platform and block wheels as required by the forwarder.
- For electrical heaters, battery-chargers and similar equipment use exclusive auxiliary power supplies with a efficient ground to avoid electrical shock hazard.
- Always use lifting equipment and similar of appropriate capacity to lift or move heavy components.
- Pay special attention to bystanders.
- Never pour gasoline or diesel oil into open, wide and low containers.
- Never use gasoline, diesel oil or other flammable liquids as cleaning agents. Use non-flammable non-toxic proprietary solvents.
- Wear protection goggles with side guards when cleaning parts using compressed air.
- Do not exceed a pressure of 2.1 bar, in accordance with local regulations.
- Do not run the engine in a closed building without proper ventilation.
- Do not smoke, use open flames, cause sparks in the nearby area when filling fuel or handling highly flammable liquids.
- Do not use flames as light sources when working on a machine or checking for leaks.
- Move with caution when working under a Machine, and also on or near a Machine. Wear proper safety accessories:
  helmets, goggles and special footwear.
- During checks which should be carried out with the engine running, ask an assistant to sit at the operator's seat and keep the service technician under visual control at any moment. In case of operations outside the workshop, drive the machine to a flat area and block it. If working on an incline cannot be avoided, first block the Machine carefully. Move it to a flat area as soon as possible with a certain extent of safety.
- Ruined or plied cables and chains are unreliable. Do not use them for lifting or trailing. Always handle them wearing gloves of proper thickness.
- Chains should always be safely fastened. Ensure that fastening device is strong enough to hold the load foreseen. No persons should stop near the fastening point, trailing chains or cables.
- The working area should be always kept CLEAN and DRY. Immediately clean any spillage of water or oil.
- Do not pile up grease or oil soaked rags: they constitute a great fire hazard. Always place them into a metal container. Before starting the Machine or its attachments, check, adjust and block the operator's seat. Also ensure that there are no persons within the Machine or attachment operating range.
- Do not keep in your pockets any object which might fall unobserved into the Machine's inner compartments.

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- Whenever there is the possibility of being reached by ejected metal parts or similar, use protection eye mask or goggles with side guards, helmets, special footwear and heavy gloves. Whenever it is necessary to carry out welding operations, it is necessary to wear suitable personal protective devices: tinted eye protection, helmets, special clothing, gloves and safety shoes. All persons standing in the vicinity of the welding process should wear tinted eye protection. NEVER LOOK AT THE WELDING ARC IF YOUR EYES ARE NOT SUITABLY PROTECTED.
- Metal cables with the use get frayed. Always wear adequate protections (heavy gloves, eye protection, etc.).
- Handle all parts with the greatest caution. Keep your hands and fingers far from gaps, moving gears and similar. Always use approved protective equipment, such as eye protection, heavy gloves and protective footwear.

START UP

- Never run the engine in confined spaces which are not equipped with adequate ventilation for exhaust gas extraction.
- Never bring your head, body, arms, legs, feet, hands, fingers near fans or rotating belts.

ENGINE

- Always loosen the radiator cap very slowly before removing it to allow pressure in the system to dissipate. Coolant should be topped up only when the engine is stopped or idle if hot.
- Do not fill up fuel tank when the engine is running, mainly if it is hot, to avoid ignition of fires in case of fuel spilling.
- Never check or adjust the fan belt tension when the engine is running. Never adjust the fuel injection pump when the machine is moving.
- Never lubricate the machine when the engine is running.

ELECTRICAL SYSTEMS

- If it is necessary to use auxiliary batteries, cables must be connected at both sides as follows: (+) to (+) and (-) to (-). Avoid short-circuiting the terminals. GAS RELEASED FROM BATTERIES IS HIGHLY FLAMMABLE. During charging, leave the battery compartment uncovered to improve ventilation. Avoid checking the battery charge by means of “jumpers” made by placing metallic objects across the terminals. Avoid sparks or flames near the battery area. Do not smoke to prevent explosion hazards.
- Prior to any service, check for fuel or coolant leaks. Remove these leaks before going on with the work. Do not charge batteries in confined spaces. Ensure that ventilation is appropriate to prevent accidental explosion hazard due to build-up of gasses relieved during charging.
- Always disconnect the batteries before performing any type of service on the electrical system.

HYDRAULIC SYSTEMS

- Some fluid slowly coming out from a very small port can be almost invisible and be strong enough to penetrate the skin. For this reason, use a piece of cardboard or a piece of wood for checking. NEVER USE YOUR HANDS. If any fluid is injected into the skin, seek medical aid immediately. Lack of immediate medical attention, serious infections or dermatitis may result.
- Always take system pressure readings using the appropriate gauges.

WHEELS AND TYRES

- Check that the tyres are correctly inflated at the pressure specified by the manufacturer. Periodically check possible damages to the rims and tyres.
- Keep off and stay at the tyre side when correcting the inflation pressure.
- Check the pressure only when the machine is unloaded and tyres are cold to avoid wrong readings due to over-pressure. Do not reuse parts of recovered wheels as improper welding, brazing or heating may weaken the wheel and make it fail.
- Never cut, nor weld a rim with the inflated tyre assembled.
- To remove the wheels, block both front and rear Machine wheels. Raise the Machine and install safe and stable supports under the Machine in accordance with regulations in force.
- Deflate the tyre before removing any object caught into the tyre tread.
- Never inflate tyres using flammable gases as they may originate explosions and cause injuries to bystanders.

REMOVAL AND INSTALLATION

- Lift and handle all heavy components using lifting equipment of adequate capacity. Ensure that parts are supported by appropriate slings and hooks. Use lifting eyes provided to this purpose. Take care of the persons near the loads to be lifted.
- Handle all parts with great care. Do not place your hands or fingers between two parts. Wear approved protective clothing such as safety goggles, gloves and footwear.
- Do not twist chains or metal cables. Always wear protection gloves to handle cables or chains.

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IMPORTANT ECOLOGICAL CONSIDERATIONS

The following are recommendations which may be of assistance:

- Become acquainted with and ensure that you understand the relative legislation applicable to your country.
- Where no legislation exists, obtain information from suppliers of oils, fuels, antifreeze, cleaning agents, etc., with regard to their effect on man and nature and how to safely store, use and dispose of these substances.

Helpful hints

- Avoid filling tanks using jerry cans or inappropriate pressurized fuel delivery systems which may cause considerable spillage.
- In general, avoid skin contact with all fuels, oils, acids, solvents, etc.
  Most of them contain substances which can be harmful to your health.
- Modern oils contain additives. Do not burn contaminated fuels and/or waste oils in ordinary heating systems.
- Avoid spillage when draining off used engine coolant mixtures, engine, transmission and hydraulic oils, brake fluids, etc.
  Do not mix drained brake fluids or fuels with lubricants. Store them safely until they can be disposed of in a proper way to comply with local legislation and available resources.
- Modern coolant mixtures, i.e. antifreeze and other additives, should be replaced every two years. They should not be allowed to get into the soil but should be collected and disposed of safely.
- Do not open the Air-Conditioning system yourself. It may contain gases which should not be released into the atmosphere. Your air conditioning specialist has special equipment for discharging and charging the system.
- Repair any leaks or defects in the engine cooling or hydraulic system immediately.
- Do not increase the pressure in a pressurized system as this may lead to a catastrophic failure of the system components.
- Protect hoses during welding as penetrating weld chips may burn a hole or weaken them, causing the loss of oils, coolant, etc.

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SECTION 01 - MAINTENANCE

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All maintenance and repair operations described in this manual should be carried out exclusively by authorized workshops. All instructions detailed should be carefully observed and special equipment indicated should be used if necessary. Everyone who carries out service operations described without carefully observing these prescriptions will be directly responsible of deriving damages.

GENERAL

Clean the exterior of all components before carrying out any form of repair. Dirt and dust can reduce the efficient working life of a component and lead to costly replacement.
Time spent on the preparation and cleanliness of working surfaces will pay dividends in making the job easier and safer and will result in overhauled components being more reliable and efficient in operation. Use cleaning fluids which are known to be safe. Certain types of fluid can cause damage to O-rings and cause skin irritation. Solvents should be checked that they are suitable for the cleaning of components and also that they do not risk the personal safety of the user. Replace O-rings, seals or gaskets whenever they are disturbed. Never mix new and old seals or O-rings, regardless of condition. Always lubricate new seals and O-rings with hydraulic oil before installation. When replacing component parts, use the correct tool for the job.

HOSES AND TUBES

Always replace hoses and tubes if the cone end or the end connections on the hose are damaged.
When installing a new hose, loosely connect each end and make sure the hose takes up the designed position before tightening the connection. Clamps should be tightened sufficiently to hold the hose without crushing and to prevent chafing. After hose replacement to a moving component, check that the hose does not foul by moving the component through the complete range of travel. Be sure any hose which has been installed is not kinked or twisted. Hose connections which are damaged, dented, crushed or leaking, restrict oil flow and the productivity of the components being served. Connectors which show signs of movement from the original swagged position have failed and will ultimately separate completely.
A hose with a chafed outer cover will allow water entry. Concealed corrosion of the wire reinforcement will subsequently occur along the hose length with resultant hose failure.
Ballooning of the hose indicates an internal leakage due to structural failure. This condition rapidly deteriorates and total hose failure soon occurs.
Kinked, crushed, stretched or deformed hoses generally suffer internal structural damage which can result in oil restriction, a reduction in the speed of operation and ultimate hose failure.
Free-moving, unsupported hoses must never be allowed to touch each other or related working surfaces. This causes chafing which reduces hose life.

O-RING FLAT FACE SEAL FITTINGS

When repairing O-ring face seal connectors, the following procedures should be observed.

⚠ WARNING

Never disconnect or tighten a hose or tube that is under pressure, if in doubt, actuate the operating levers several times with the engine switched off prior to disconnecting a hose or tube.

Release the fittings and separate the hose or tube assembly, then remove and discard the O-ring seal from the fitting. Dip a new O-ring seal into clean hydraulic oil prior to installation. Install a new O-ring into the fitting and, if necessary, retain in position using petroleum jelly. Assemble the new hose or tube assembly and tighten the fitting finger tight, while holding the tube or hose assembly to prevent it from turning. Use two suitable wrenches and tighten the fitting to the specified torque according to the size of the fitting.

NOTE: to ensure a leak-free joint is obtained, it is important that the fittings are not over or under torqued.

SHIMMING

At each adjustment, select adjusting shims, measure them individually using a micrometre and then sum up recorded values.
Do not rely on measuring the whole shimming set, which may be incorrect, or on rated value indicated for each shim.

ROTATING SHAFT SEALS

To correctly install rotating shaft seals, observe the following instructions:

- let the seal soak into the same oil as it will seal for at least half an hour before mounting;
- thoroughly clean the shaft and ensure that the shaft working surface is not damaged;

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- place the sealing lip towards the fluid. In case of a hydrodynamic lip, consider the shaft rotation direction and orient grooves in order that they deviate the fluid towards the inner side of the seal;
- coat the sealing lip with a thin layer of lubricant (oil rather than grease) and fill with grease the gap between the sealing lip and the dust lip of double lip seals;
- insert the seal into its seat and press it down using a flat punch. Do not tap the seal with a hammer or a drift;
- take care to insert the seal perpendicularly to its seat while you are pressing it. Once the seal is settled, ensure that it contacts the thrust element if required;
- to prevent damaging the sealing lip against the shaft, place a suitable protection during installation.

O-RINGS

Lubricate the O-rings before inserting them into their seats. This will prevent the O-rings from rolling over and twisting during mounting which will jeopardize sealing.

BEARINGS

It is advisable to heat the bearings to 80 to 90 °C before mounting them on their shafts and cool them down before inserting them into their seats with external tapping.

SPRING PINS

When mounting split socket spring pins, ensure that the pin notch is oriented in the direction of the effort to stress the pin.
Spiral spring pins should not be oriented during installation.

HARDWARE TORQUE VALUES

Check the tightness of hardware periodically. Use the following charts to determine the correct torque when checking, adjusting or replacing hardware on the Backhoe loader.

IMPORTANT: Torque values listed are for general use only. Make sure fastener threads are clean and not damaged.

NOTE: a torque wrench is necessary to properly torque hardware.

NOTES FOR SPARE PARTS

Only genuine parts guarantee same quality, life, safety as original components as they are the same as mounted in production. Only the genuine spare parts can offer this guarantee.
All spare parts orders should be complete with the following data:
- machine model (commercial name) and chassis number;
- engine type and number;
- part number of the ordered part, which can be found on the “Spare Parts Catalogue”, which is the base for order processing.

NOTES FOR EQUIPMENT

Equipment which proposes and shows in this manual are as follows:
- studied and designed expressly for use on company machines;
- necessary to make a reliable repair;
- accurately built and strictly tested to offer efficient and long-lasting working means.

We also remind the repair personnel that having these equipment means:
- work in optimal technical conditions;
- obtain best results;
- save time and effort;
- work more safely.

CAUTION

Wear limits indicated for some details should be intended as advised, but not binding values. The words “front”, “rear”, “right hand”, and “left hand” referred to the different parts should be intended as seen from the operator’s seat oriented to the normal sense of movement of the machine.

HOW TO MOVE THE MACHINE WITH THE BATTERY REMOVED

Cables from the external power supply should be connected exclusively to the respective terminals of the Machine positive and negative cables using pliers in good condition which allow proper and steady contact.
Disconnect all services (lights, wind-shield wipers, etc.) before starting the Machine.
If it is necessary to check the machine electrical system, check it only with the power supply connected. At check end, disconnect all services and switch the power supply off before disconnecting the cables.

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580SR
580SR+
590SR
695SR

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1. LOADER BACKHOE MODELS

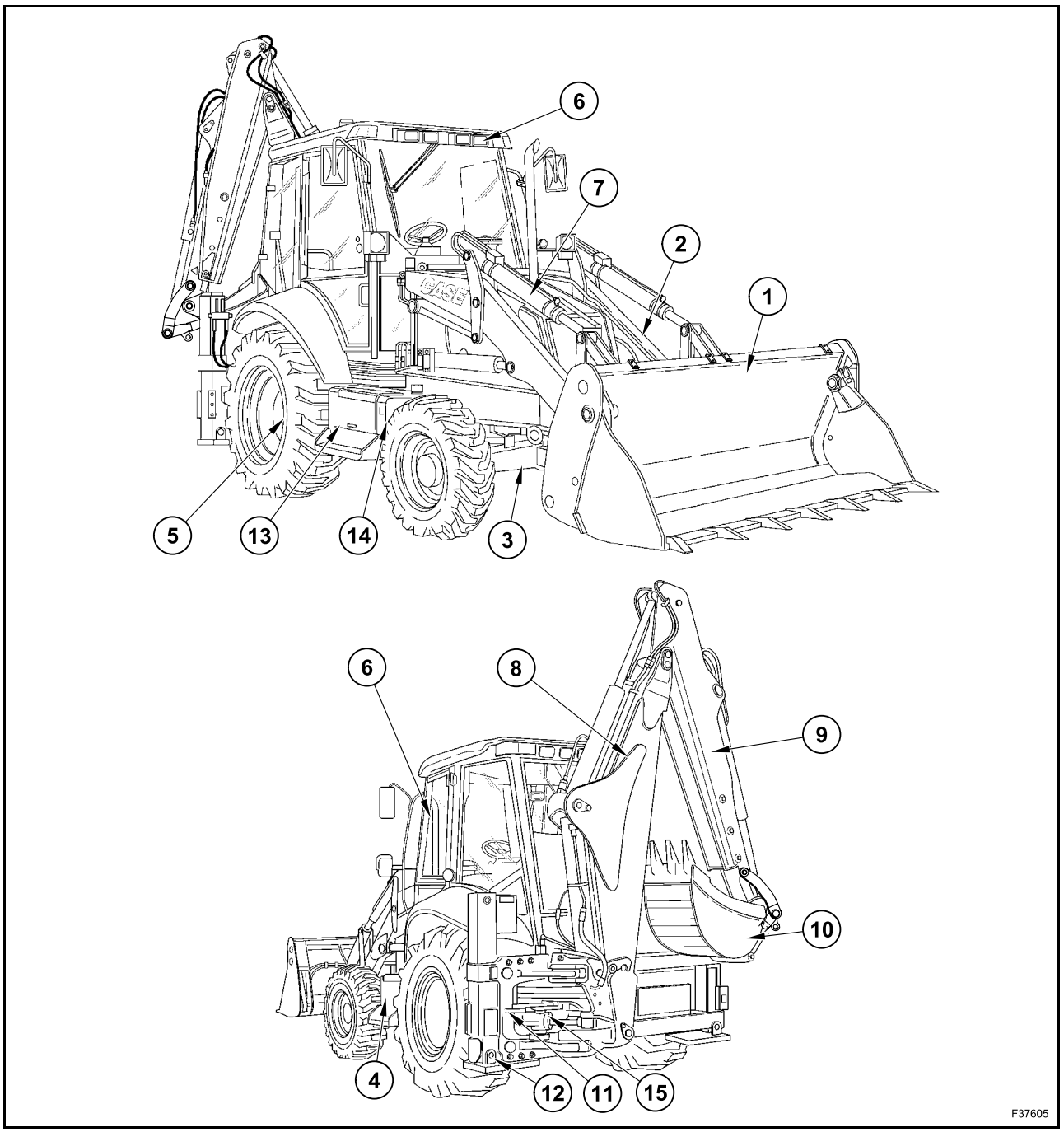
	580SR	580SR+	590SR	695SR
Powershift	/	●	●	●
Powershuttle	●	●	●	/
Stabilizer sideshift	●	●	●	●
Stabilizer center pivot	/	/	/	●
Cab	●	●	●	●
Rops	●	/	/	/
2WD	●	/	/	/
4WD	●	●	●	●
4WS	/	/	/	●
Pilot control	●	●	●	●
Mechanical control	●	●	●	●
Engine 72 kW-97 HP model F4GE948C*601 (mechanical)	●	/	/	/
Engine 72 kW-97 HP model F4HE0484C*J102 (electronic)	/	●	/	/
Engine 82 kW-110 HP model F4HE9484C*J102 (electronic)	/	/	●	/
Engine 82 kW-110 HP model F4HE9484C*J103 - 4WS (electronic)	/	/	/	●
Short dipper	/	/	/	/
Long dipper	●	●	●	●

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2. IDENTIFICATION OF MAIN COMPONENTS

SIDESHIFT VERSION (590SR for example)

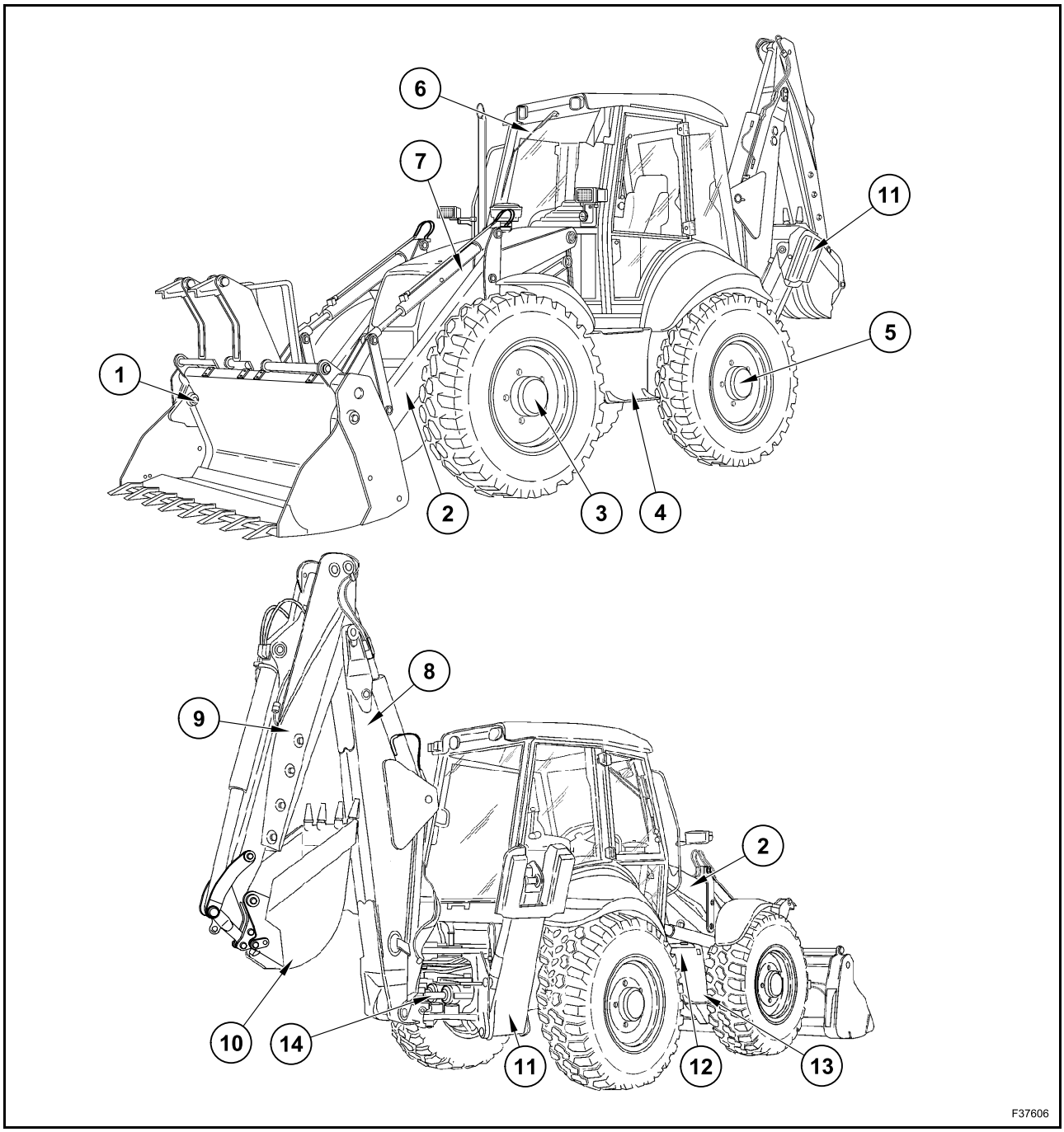


1. Loader bucket
2. Loader arm
3. Front axle
4. Fuel tank
5. Rear axle
6. Operator's compartment
7. Engine guard
8. Backhoe attachment boom
9. Dipper or telescopic dipper
10. Backhoe bucket
11. Backhoe attachment sideshift carriage
12. Stabilizers
13. Battery box
14. Hydraulic oil tank
15. Swing cylinders

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CENTER PIVOT VERSION (695SR for example)



1. Loader bucket
2. Loader arm
3. Front axle
4. Fuel tank
5. Rear axle
6. Operator's compartment
7. Engine guard
8. Backhoe attachment boom
9. Dipper or telescopic dipper
10. Backhoe bucket
11. Stabilizers
12. Battery box
13. Hydraulic oil tank
14. Swing cylinders

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3. SPECIFICATIONS

3.1 DIESEL ENGINE

72 kW - 97 HP ENGINE (580SR)

Specifications (EEC 88/195) ..... 72 kW - 97 HP @ 2200 rpm
Model F4GE9484C*601
Type ..... diesel, mechanical
No. of cylinders 4
Valves per cylinder 2
Bore ..... 104 mm
Stroke ..... 132 mm
Displacement ..... 4485 cm^3
Compression ratio 17.5:1
Maximum torque (EC) ..... 400 Nm @ 1400 rpm
Low idle speed at no load ..... 1000 ± 50 rpm
High idle speed at no load (engine not installed) ..... 2430 ± 50 rpm
High idle speed at no load (engine not installed on the vehicle) ..... 2380 ± 60 rpm
Maximum speed at full load ..... 2200 rpm
Air intake ..... TAA (turbocharged with aftercooler)

Supply

Type ..... direct injection
Injection pump ..... BOSCH ROTARY VE 4/12 F1100L
Injection sequence 1-3-4-2
Cold-start device ..... “grid heater” (optional)

Cooling

Pump type ..... H_2O pump
Pump drive ..... belt drive
Temperature switch (opening start) ..... 81 ± 2 °C

72 kW - 97 HP ENGINE (580SR+)

Specifications (EEC 88/195) ..... 72 kW - 97 HP @ 2200 rpm
Model F4HE0484G*J102
Type ..... diesel, electronic
No. of cylinders 4
Valves per cylinder 4
Bore ..... 104 mm
Stroke ..... 132 mm
Displacement ..... 4485 cm^3
Compression ratio 17.5:1
Maximum torque (EC) ..... 453 Nm @ 1400 rpm
Low idle speed at no load ..... 950 ± 50 rpm
High idle speed at no load (engine not installed) ..... 2430 ± 50 rpm
High idle speed at no load (engine not installed on the vehicle) ..... 2380 ± 60 rpm
Maximum speed at full load ..... 2200 rpm
Air intake ..... TAA (turbocharged with aftercooler)

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Supply

Type ..... high-pressure, common rail
Injection pump ..... CP3 high-pressure pump
Control unit EDC7
Injection sequence 1-3-4-2
Cold-start device ..... “grid heater” (optional)

Cooling

Pump type ..... H_2O pump
Pump drive ..... belt drive
Temperature switch (opening start) ..... 81 ± 2 °C

82 kW - 110 HP ENGINE (590SR / 695SR)

Specifications (EEC 88/195) ..... 82 kW - 110 HP @ 2200 rpm
Model (590SR) F4HE9484C*J102
Model (695SR) F4HE9484C*J103
Type ..... diesel, electronic
No. of cylinders 4
Valves per cylinder 4
Bore ..... 104 mm
Stroke ..... 132 mm
Displacement ..... 4485 cm^3
Compression ratio 17.5:1
Maximum torque (EC) ..... 516 Nm @ 1400 rpm
Low idle speed at no load ..... 950 ± 50 rpm
High idle speed at no load (engine not installed) ..... 2430 ± 50 rpm
High idle speed at no load (engine not installed on the vehicle) ..... 2380 ± 60 rpm
Maximum speed at full load ..... 2200 rpm
Air intake ..... TAA (turbocharged with aftercooler)

Supply

Type ..... high-pressure, common rail
Injection pump ..... CP3 high-pressure pump
Control unit EDC7
Injection sequence 1-3-4-2
Cold-start device ..... “grid heater” (optional)

Cooling

Pump type ..... H_2O pump
Pump drive ..... belt drive
Temperature switch (opening start) ..... 81 ± 2 °C

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3.2 TRANSMISSION

2WD/2WS TRANSMISSION - POWERSHUTTLE (580SR)

Model ..... Turner COM-T4-2025
Type (4x4) ..... 4 forward and 4 reverse travel gears
Torque converter ratio 2.38
Transmission ratios:

1st forward travel	gear 4.824:1	reverse travel gear 4.020:1
2nd forward travel	gear 2.998:1	reverse travel gear 2.496:1
3rd forward travel	gear 1.408:1	reverse travel gear 1.173:1
4th forward travel	gear 0.792:1	reverse travel gear 0.660:1

4WD/2WS TRANSMISSION - POWERSHUTTLE (580SR+ / 590SR)

Model ..... Turner COM-T4-2025
Type (4x4) ..... 4 forward and 4 reverse travel gears
Torque converter ratio 2.38
Transmission ratios:

1st forward travel	gear 4.824:1	reverse travel gear 4.020:1
2nd forward travel	gear 2.998:1	reverse travel gear 2.496:1
3rd forward travel	gear 1.408:1	reverse travel gear 1.173:1
4th forward travel	gear 0.792:1	reverse travel gear 0.660:1

4WD/2WS TRANSMISSION - POWERSHIFT (580SR+ / 590SR)

Model ..... Dana T16000
Type (4x4) ..... 4 forward and 2 reverse travel gears
Torque converter ratio 2.261
Transmission ratios:
(upper output)

1st forward travel	gear 4.863:1	reverse travel gear 4.085:1
2nd forward travel	gear 2.571:1	reverse travel gear 2.160:1
3rd forward travel	gear 1.284:1	
4th forward travel	gear 0.679:1	

(lower output)

1st forward travel	gear 4.625:1	reverse travel gear 3.885:1
2nd forward travel	gear 2.446:1	reverse travel gear 2.055:1
3rd forward travel	gear 1.221:1	
4th forward travel	gear 0.646:1	

4WD/4WS TRANSMISSION - POWERSHIFT (695SR)

Model ..... Dana T16000
Type (4x4) ..... 4 forward and 2 reverse travel gears
Torque converter ratio 2.261
Transmission ratios:
(upper output)

1st forward travel	gear 4.863:1	reverse travel gear 4.085:1
2nd forward travel	gear 2.571:1	reverse travel gear 2.160:1
3rd forward travel	gear 1.284:1	
4th forward travel	gear 0.679:1	

(lower output)

1st forward travel	gear 4.625:1	reverse travel gear 3.885:1
2nd forward travel	gear 2.446:1	reverse travel gear 2.055:1
3rd forward travel	gear 1.221:1	
4th forward travel	gear 0.646:1	

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3.3 AXLES

FRONT AXLES

Front 2WD/2WS axle (580SR)
Model ..... CARRARO 26.00
Type ..... steering

Front 4WD/2WS axle (580SR / 590SR)
Model ..... CARRARO 26.16
Type ..... steering

Front 4WD/4WS axle (695SR)
Model ..... CARRARO 26.28
Type ..... steering

REAR AXLES

Rear 2WS axle (580SR / 590SR)
Model ..... CNH D46
Type ..... rigid
Differential lock (powershuttle axle) ..... mechanical
Differential lock (powershift axle) ..... electrical

Rear 4WS axle (695SR)
Model ..... CARRARO 26.32M
Type ..... steering
Differential lock ..... electrical

3.4 BRAKES

BRAKES - 2WS

Service brake
Type ..... wet multi-discs, 8 x axle (4 x half axle)
Braking surface ..... 1440 cm^2

Parking brake
Type ..... single disc on transmission

BRAKES - 4WS

Service brake
Type ..... wet multi-discs, 6 x axle (3 x half axle)
Braking surface ..... 1440 cm^2

Parking brake
Type ..... single disc on transmission

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3.5 STEERING

2WS ..... 2 wheel steer
4WS ..... 4 wheel steer
System pressure ..... 177 ± 3 bar

POWER STEERING

2WS
Model ..... DANFOSS OSPC 125 LS
Displacement ..... 125 cm^3/rev
Shock valve adjustment ..... 225 bar
Pressure relief valve adjustment ..... 170 bar

4WS
Model ..... DANFOSS OSPC 160 LS
Displacement ..... 160 cm^3/rev
Shock valve adjustment ..... 225 bar
Pressure relief valve adjustment ..... 170 bar

3.6 HYDRAULIC SYSTEM

HYDRAULIC PUMP

Pump 72 kW - 97 HP (580SR)
Model ..... CASAPPA KP 30.34 - 05 S6 - LMF
Type ..... double gear pump: hydraulic system and priority steering system
Displacement ..... 35.427 + 35.427 cm^3/rev

Pump 82 kW - 110 HP (590SR / 695SR)
Model ..... CASAPPA KP 30.38 - 05 S6 - LMF
Type ..... double gear pump: hydraulic system and priority steering system
Displacement ..... 40.258 + 35.427 cm^3/rev

3.7 FRONT COUNTERWEIGHT

Weight ..... 160 kg

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3.8 NOISE AND VIBRATION LEVELS

NOISE LEVEL

Certified by the Manufacturer.
In compliance with European Directive 2000/14/EC - Stage II.
Internal noise level (LpA) ..... 77 db
External noise level (LwA) (580SR) ..... 102 db
External noise level (LwA) (590SR / 695SR) ..... 103 db

VIBRATION LEVEL INSIDE THE CAB

Upper limbs ..... level lower than 2.5 m/s^2
Abdomen ..... level lower than 0.5 m/s^2

3.9 BUCKETS

LOADER BUCKETS

	Type	0.88 m^3 standard	1 m^3 standard	4x1	6x1 (with forks)
2WS	Heaped capacity	0.88 m^3	1.0 m^3	1.0 m^3	1.0 m^3
	Width	2,250 mm	2,250 mm	2,250 mm	2,250 mm
	Weight	310 kg	410 kg	800 kg	960 kg
4WS	Heaped capacity	-	1.15 m^3	1.15 m^3	1.15 m^3
	Width	-	2,400 mm	2,400 mm	2,400 mm
	Weight	-	426 kg	830 kg	990 kg

BACKHOE BUCKETS

Struck capacity SAE J 296	Width	Weight
76 l	305 mm	108 kg
109 l	457 mm	130 kg
153 l	610 mm	160 kg
196 l	762 mm	180 kg
238 l	914 mm	208 kg

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3.10 TYRES

TYRE TYPES

Tyres - 2WS

	Front tyres	Rear tyres
2WD	11L-16 F3 12PR	18.4-26 R4 12PR
	11L-16 F3 12PR	16.9-28 R4 12PR
4WD	12.5/80 - 18 L3 10PR	18.4-26 R4 10PR
	12.5/80 - 18 L3 10PR	16.9-28 R4 10PR
	320/80 R18 IT 520	480/80 R26 IT520

Tyres - 4WS

Front and rear tyres
16.9/24 R4 12PR
16.9/28 R4 12PR
440/80 R28 IT520
440/80 R28 IT530

NUT TORQUES

Front nuts (2WS).....330 Nm
Rear nuts (2WS) .....540 Nm
Front and rear nuts (4WS) .....700 Nm

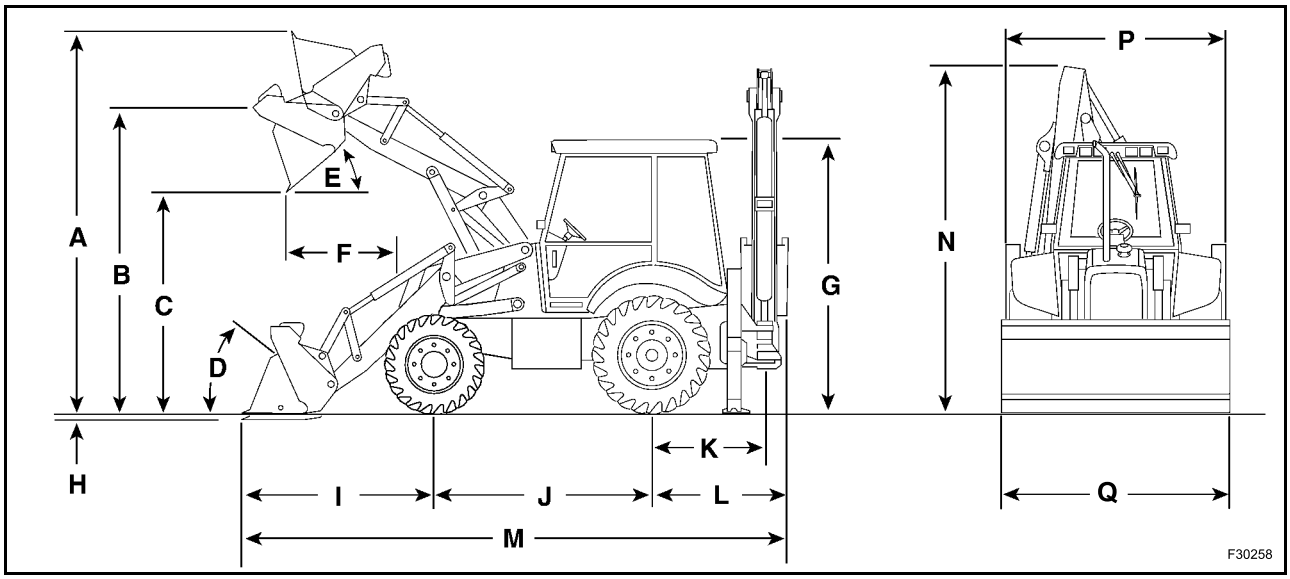
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4. DIMENSIONS AND PERFORMANCE

4.1 LOADER ATTACHMENT DIMENSIONS AND PERFORMANCE

580SR / 580SR+ / 590SR



A. Maximum height
B. Maximum height of loader bucket pin/pivot
C. Maximum dumping height
D. Angle of lowered closed bucket
E. Angle of closed bucket at maximum height
F. Loader attachment reach when raised in dumping position
G. Cab height
H. Digging depth
I. Loader bucket reach
J. Wheel base
K. Rear wheel base - backhoe attachment swing support
L. Backhoe bucket dimensions
M. Overall machine length
N. Maximum machine height
O. Stabilizer width
P. Loader bucket width

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TYRES	FRONT	REAR
2WD	11L-16F	18.4-26
4WD	12.5/80-18	18.4-26

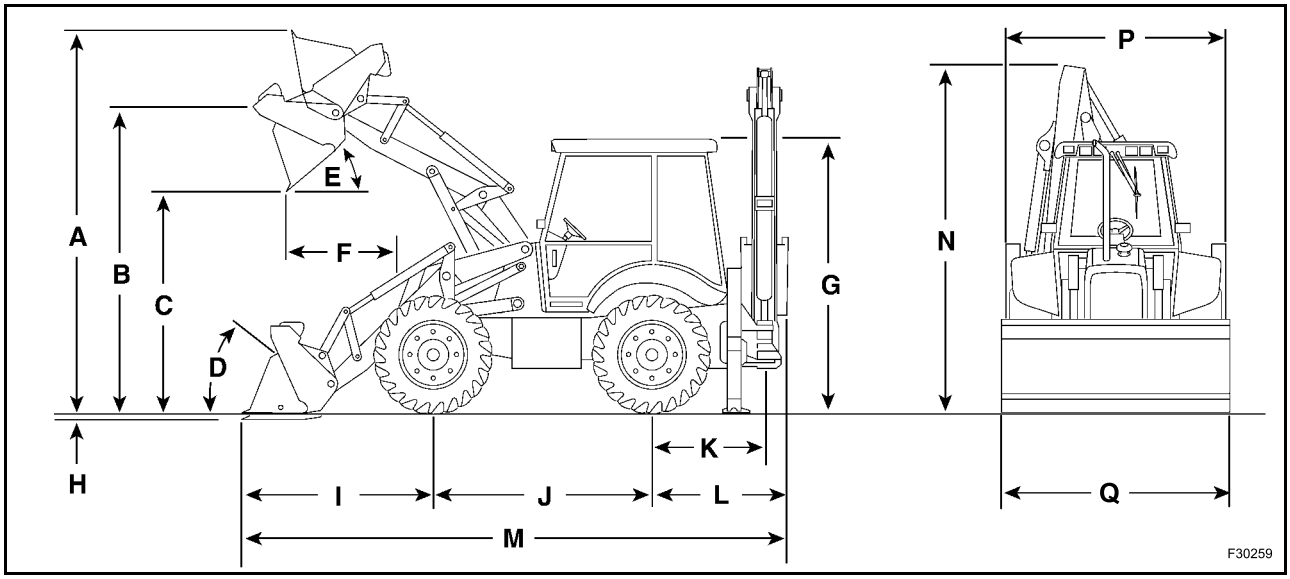
Dimensions	2WD with standard bucket	4WD with standard bucket
A	4130 mm	4250 mm
B	3345 mm	3460 mm
C	2550 mm	2685 mm
D	45°	45°
E	45°	45°
F	875 mm	830 mm
G	2950 mm	2950 mm
H	240 mm	120 mm
I	2060 mm	1973 mm
J	2175 mm	2175 mm
K	1325 mm	1325 mm
L	1630 mm	1630 mm
M	5865 mm	5778 mm
N	4000 mm	4000 mm
P	2430 mm	2430 mm
Q	2250 mm	2250 mm
Performance	**2WD**	**4WD**
Lifting capacity at maximum height	3325 kg	3450 kg
Breakout force	6556 daN	6537 daN

LOADER BUCKETS			
Type	**Normal operation**	**4x1**	**6x1 (with forks)**
Heaped capacity	1.00 m^3	1.00 m^3	1.00 m^3
Width	2250 mm	2250 mm	2250 mm
Weight	410 kg	800 kg	960 kg

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695SR (SIDESHIFT)



A. Maximum height
B. Maximum height of loader bucket pin/pivot
C. Maximum dumping height
D. Angle of lowered closed bucket
E. Angle of closed bucket at maximum height
F. Loader attachment reach when raised in dumping position
G. Cab height
H. Digging depth
I. Loader bucket reach
J. Wheel base
K. Rear wheel base - backhoe attachment swing support
L. Backhoe bucket dimensions
M. Overall machine length
N. Maximum machine height
O. Stabilizer width
P. Loader bucket width

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TYRES	FRONT	REAR
	440/80R28	440/80R28

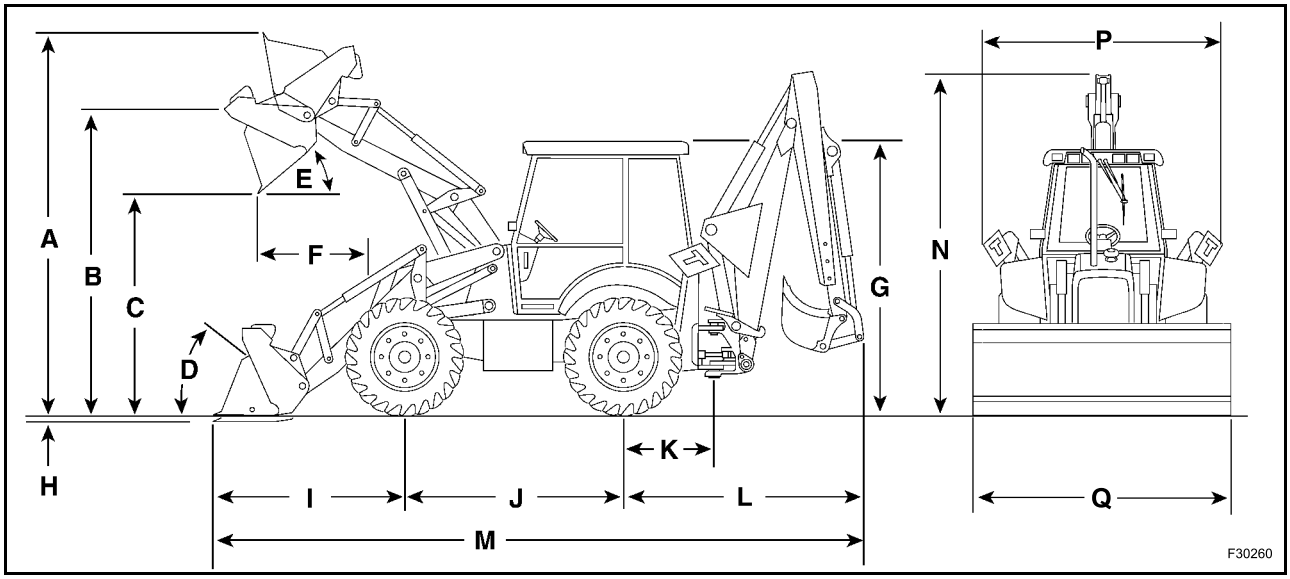
Dimensions	Standard bucket	Bucket 4x1	6x1 bucket (with forks)
A	4347 mm	4460 mm	4460 mm
B	3491 mm	3518 mm	3518 mm
C	2717 mm	2753 mm	2753 mm
D	45°	45°	45°
E	45°	45°	45°
F	744 mm	690mm	690mm
G	2900 mm	2900 mm	2900 mm
H	113 mm	90 mm	90 mm
I	1975 mm	1980 mm	1980 mm
J	2200 mm	2200 mm	2200 mm
K	1324 mm	1324 mm	1324 mm
L	1630 mm	1630 mm	1630 mm
M	5783 mm	5788 mm	5788 mm
N	3935 mm	3935 mm	3935 mm
P	2480 mm	2480 mm	2480 mm
Q	2400 mm	2400 mm	2400 mm
Performance	**Standard bucket**	**Bucket 4x1**	**6x1 bucket (with forks)**
Lifting capacity at maximum height	3386 kg	3075 kg	2950 kg
Breakout force	5413 daN	5600 daN	5600 daN

LOADER BUCKETS			
Type	**Normal operation**	**4x1**	**6x1 (with forks)**
Heaped capacity	1.15 m^3	1.15 m^3	1.15 m^3
Width	2400 mm	2400 mm	2400 mm
Weight	426 kg	830 kg	990 kg

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695SR (CENTER PIVOT)



A. Maximum height
B. Maximum height of loader bucket pin/pivot
C. Maximum dumping height
D. Angle of lowered closed bucket
E. Angle of closed bucket at maximum height
F. Loader attachment reach when raised in dumping position
G. Cab height
H. Digging depth
I. Loader bucket reach
J. Wheel base
K. Rear wheel base - backhoe attachment swing support
L. Backhoe bucket dimensions
M. Overall machine length
N. Maximum machine height
O. Stabilizer width
P. Loader bucket width

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TYRES	FRONT	REAR
	16.9-28	16.9-28

Dimensions	Standard bucket	Bucket 4x1	6x1 bucket (with forks)
A	4347 mm	4460 mm	4460 mm
B	3491 mm	3518 mm	3518 mm
C	2717 mm	2753 mm	2753 mm
D	45°	45°	45°
E	45°	45°	45°
F	744 mm	690 mm	690 mm
G	2900 mm	2900 mm	2900 mm
H	113 mm	90 mm	90 mm
I	1975 mm	1980 mm	1980 mm
J	2200 mm	2200 mm	2200 mm
K	1324 mm	1324 mm	1324 mm
L	3040 mm	3040 mm	3040 mm
M	7220 mm	7225 mm	7225 mm
N	3935 mm	3935 mm	3935 mm
P	2230 mm	2230 mm	2230 mm
Q	2400 mm	2400 mm	2400 mm
Performance	**Standard bucket**	**Bucket 4x1**	**6x1 bucket (with forks)**
Lifting capacity at maximum height	3386 kg	3075 kg	2950 kg
Breakout force	5413 daN	5600 daN	5600 daN

LOADER BUCKETS			
Type	**Normal operation**	**4x1**	**6x1 (with forks)**
Heaped capacity	1.15 m^3	1.15 m^3	1.15 m^3
Width	2400 mm	2400 mm	2400 mm
Weight	426 kg	830 kg	990 kg

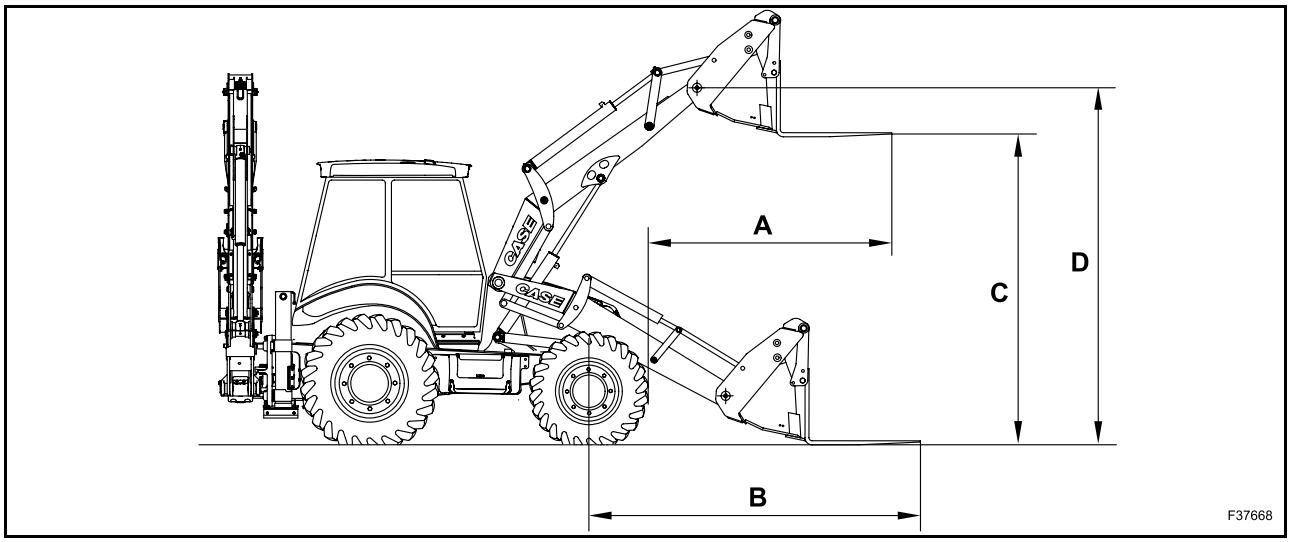
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4.2 DIMENSIONS AND PERFORMANCE OF LOADER ATTACHMENT WITH FORKS

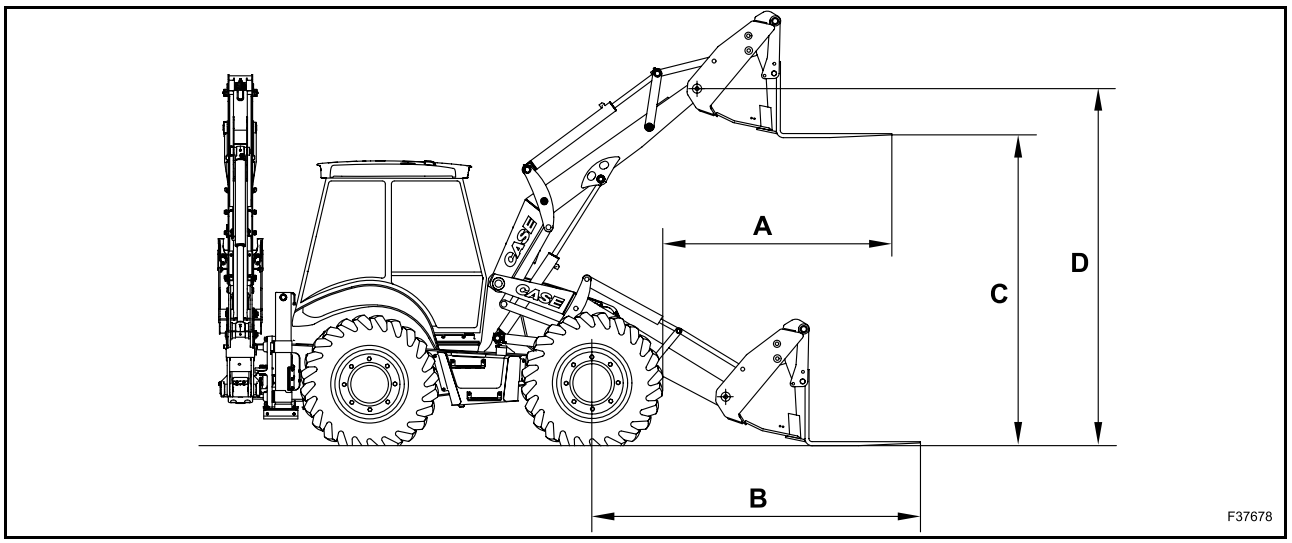
Fork spacing - Minimum centres ..... 275 mm
Fork spacing - Maximum centres ..... 1773 mm
Fork length ..... 1026 mm
Fork width ..... 80 mm

580SR / 580SR+ / 590SR



A. Reach full height ..... 2319 mm
B. Reach ground level ..... 3186 mm
C. Lift height ..... 2998 mm
D. Lift height ..... 3458 mm

695SR



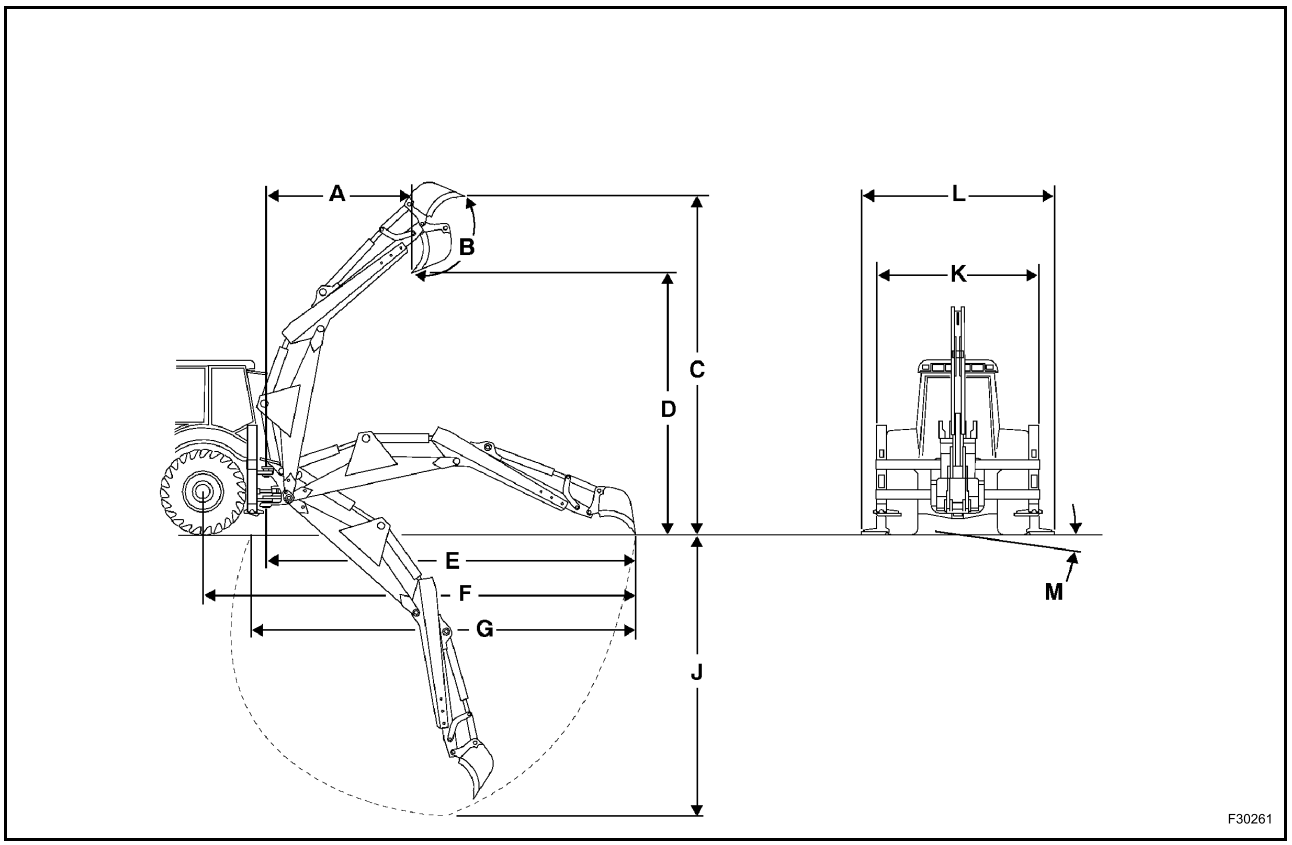
A. Reach full height ..... 2194 mm
B. Reach ground level ..... 3186 mm
C. Lift height ..... 3059 mm
D. Lift height ..... 3518 mm

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4.3 BACKHOE ATTACHMENT DIMENSIONS AND PERFORMANCE

580SR / 580SR+ / 590SR



A. Maximum reach when loaded
B. Bucket rotation
C. Operating height, fully raised
D. Maximum height at full load
E. Reach from swing post
F. Reach from rear axle centre line
G. Maximum length of surface excavation
H. Maximum digging depth
I. Stabilizer spread - transport
J. Stabilizer spread - working
K. Stabilizer pad levelling angle

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TYRES	FRONT	REAR
	12.5/80-18	18.4-26

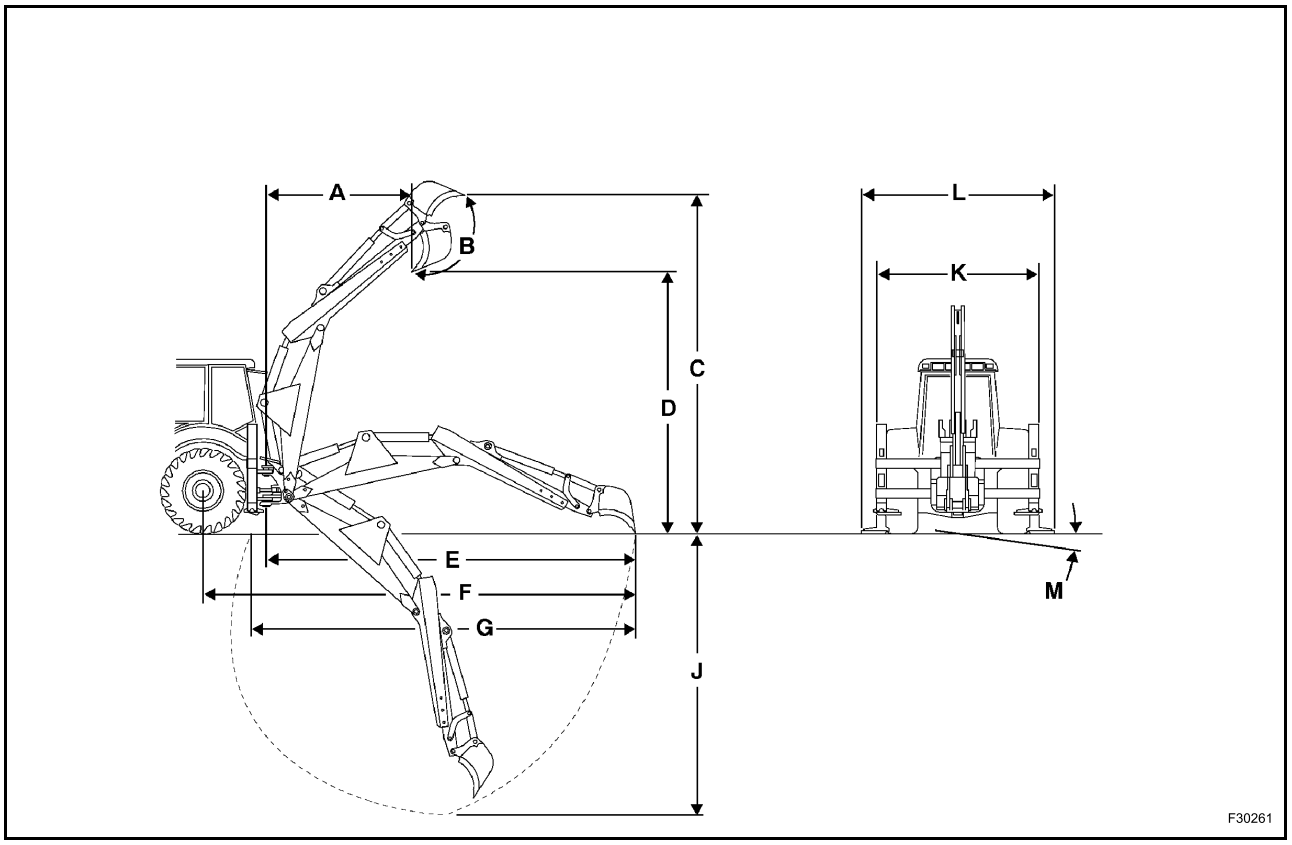
Dimensions	standard dipper	telescopic dipper (extended)
A	1828 mm	2757 mm
B	200°	204°
C	5837 mm	6537 mm
D	3917 mm	4645 mm
E	5906 mm	6992 mm
F	7231 mm	8317 mm
G	6454 mm	7540 mm
J	4612 mm	5799 mm
K	2280 mm	2280 mm
L	2790 mm	2790 mm
M	14°	14°
Performance	**standard dipper**	**telescopic dipper (extended)**
Swing arc	180°	180°
Maximum digging force - dipper cylinder	3623 daN	2581 daN
Maximum digging force - bucket cylinder	5234 daN	5234 daN
Lift capacity through dipper arc	1975 kg	1470 kg
Lift capacity, dipper 3.66 m above ground	2040 kg	1490 kg
Lift capacity at 4.26 m above ground	1590 kg	1040 kg
Telescopic dipper extension length	-	1200 mm

BACKHOE BUCKETS		
Struck capacity SAE J 296	**Width**	**Weight**
76 l	305 mm	108 kg
109 l	457 mm	130 kg
153 l	610 mm	160 kg
196 l	762 mm	180 kg
238 l	914 mm	208 kg

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695SR (SIDESHIFT)



A. Maximum reach when loaded
B. Bucket rotation
C. Operating height, fully raised
D. Maximum height at full load
E. Reach from swing post
F. Reach from rear axle centre line
G. Maximum length of surface excavation
H. Maximum digging depth
I. Stabilizer spread - transport
J. Stabilizer spread - working
K. Stabilizer pad levelling angle

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TYRES	FRONT	REAR
	440/80R28	440/80R28

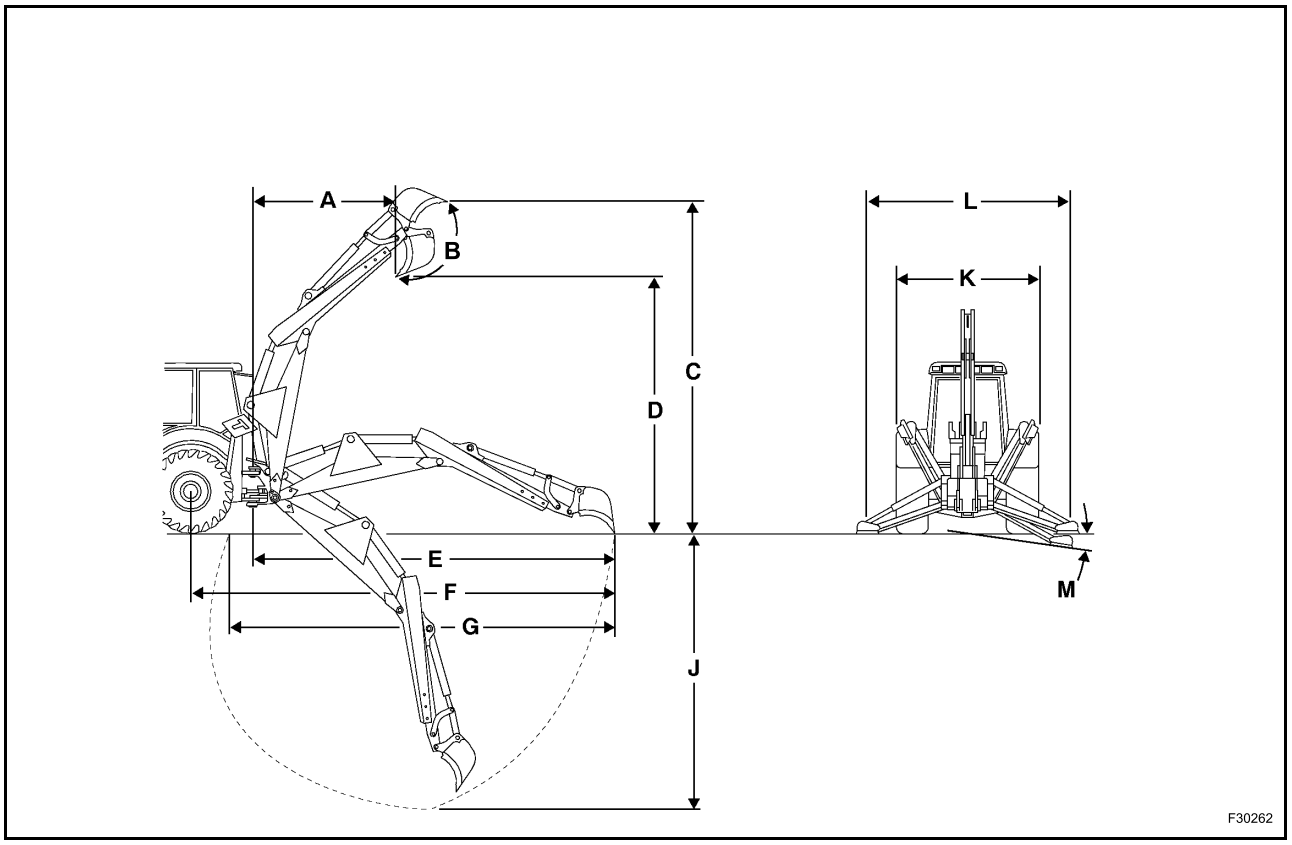
Dimensions	standard dipper	telescopic dipper (extended)
A	1899 mm	2844 mm
B	200°	200°
C	5815 mm	6492 mm
D	3908 mm	4615 mm
E	5903 mm	6990 mm
F	7228 mm	8315 mm
G	6518 mm	7605 mm
J	4623 mm	5805 mm
K	2280 mm	2280 mm
L	2790 mm	2790 mm
M	14°	14°
Performance	**standard dipper**	**telescopic dipper (extended)**
Swing arc	180°	180°
Maximum digging force - dipper cylinder	3623 daN	2591 daN
Maximum digging force - bucket cylinder	5234 daN	5234 daN
Lift capacity through dipper arc	2260 kg	1610 kg
Lift capacity, dipper 3.66 m above ground	2325 kg	1610 kg
Lift capacity at 4.26 m above ground	1520 kg	1000 kg
Telescopic dipper extension length	-	1200 mm

BACKHOE BUCKETS		
Struck capacity SAE J 296	**Width**	**Weight**
76 l	305 mm	108 kg
109 l	457 mm	130 kg
153 l	610 mm	160 kg
196 l	762 mm	180 kg
238 l	914 mm	208 kg

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695SR (CENTER PIVOT)



A. Maximum reach when loaded
B. Bucket rotation
C. Operating height, fully raised
D. Maximum height at full load
E. Reach from swing post
F. Reach from rear axle centre line
G. Maximum length of surface excavation
H. Maximum digging depth
I. Stabilizer spread - transport
J. Stabilizer spread - working
K. Stabilizer pad levelling angle

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TYRES	FRONT	REAR
	440/80R28	440/80R28

Dimensions	standard dipper	telescopic dipper (extended)
A	1870 mm	2855 mm
B	200°	200°
C	5737 mm	6421 mm
D	4002 mm	4686 mm
E	5836 mm	6922 mm
F	7161 mm	8247 mm
G	6346 mm	7432 mm
J	4556 mm	5738 mm
K	2280 mm	2280 mm
L	2790 mm	2790 mm
M	14°	14°
Performance	**standard dipper**	**telescopic dipper (extended)**
Swing arc	180°	180°
Maximum digging force - dipper cylinder	3744 daN	2643 daN
Maximum digging force - bucket cylinder	5603 daN	5603 daN
Lift capacity through dipper arc	2350 kg	1560 kg
Lift capacity, dipper 3.66 m above ground	2475 kg	1560 kg
Lift capacity at 4.26 m above ground	1470 kg	950 kg
Telescopic dipper extension length	-	1200 mm

BACKHOE BUCKETS		
Struck capacity SAE J 296	**Width**	**Weight**
76 l	305 mm	108 kg
109 l	457 mm	130 kg
153 l	610 mm	160 kg
196 l	762 mm	180 kg
238 l	914 mm	208 kg

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5. BACKHOE ATTACHMENT LIFTING CAPACITY

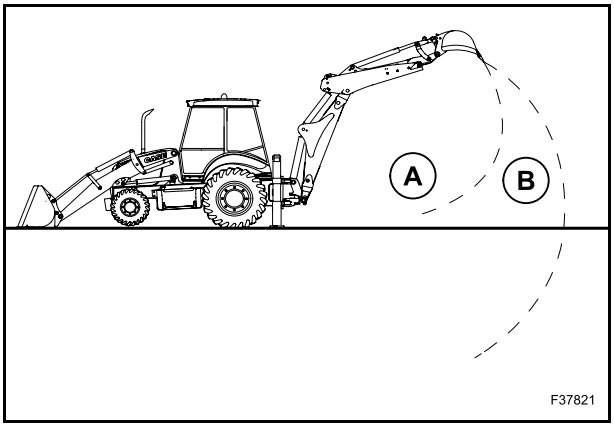
580SR / 580SR+ / 590SR

Lifting capacity in normal operating mode - SAE rated

The following table reports the lifting capacities of the dipper (A) and the boom (B).

NOTE: the capacities indicated may slightly vary from one machine to another, according to the accessories mounted, the pressure settings and the market requirements.

Lifting capacities are given in kg for a standard dipper and a telescopic dipper.



Standard dipper		Telescopic dipper (retracted)		Telescopic dipper (extended)		Height/Depth
Dipper - A	Boom - B	Dipper - A	Boom - B	Dipper - A	Boom - B	m
					610	+5.4
	1200		1120		920	+4.9
	1590		1490	1515	1040	+4.3
2040	1690	1930	1580	1490	1100	+3.6
1975	1710	1870	1590	1470	1125	+3.0
2010	1650	1900	1540	1490	1135	+2.4
2165	1560	2050	1440	1555	1135	+1.8
2630	1510	2495	1390	1685	1105	+1.2
3860	1490	3690	1370	1950	1090	+0.6
	1500		1375	2785	1090	0 (ground)
	1540		1405	3850	1100	-0.6
	1530		1380		1110	-1.2
	1520		1370		1115	-1.8
	1540		1380		1125	-2.4
	1605		1435		1155	-3.0
	1875		1675		1210	-3.6
					1360	-4.2
					1930	-4.8

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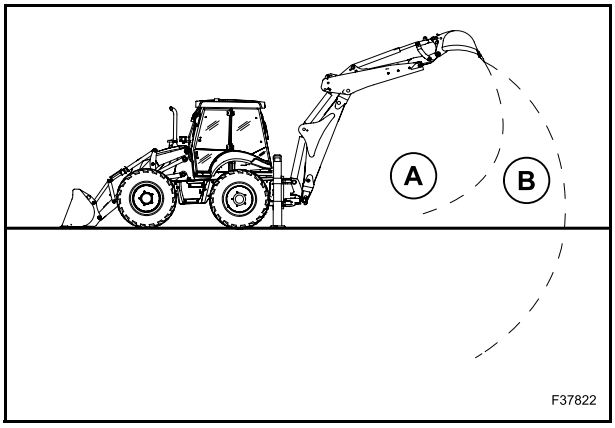
695SR (SIDESHIFT)

Lifting capacity in normal operating mode - SAE rated

The following table reports the lifting capacities of the dipper (A) and the boom (B).

NOTE: the capacities indicated may slightly vary from one machine to another, according to the accessories mounted, the pressure settings and the market requirements.

Lifting capacities are given in kg for a standard dipper and a telescopic dipper.



Standard dipper		Telescopic dipper (retracted)		Telescopic dipper (extended)		Height/Depth
Dipper - A	Boom - B	Dipper - A	Boom - B	Dipper - A	Boom - B	m
					570	+5.4
	1120		1040		865	+4.9
	1520		1415	1510	1000	+4.3
2325	1650	2215	1535	1610	1070	+3.6
2260	1680	2150	1560	1645	1105	+3.0
2300	1675	2190	1550	1670	1120	+2.4
2480	1660	2360	1530	1760	1125	+1.8
3015	1630	2885	1500	1885	1130	+1.2
4400	1605	4230	1470	2135	1125	+0.6
	1580		1440	3250	1125	0 (ground)
	1560		1415	4420	1120	-0.6
	1550		1400		1125	-1.2
	1550		1400		1130	-1.8
	1575		1415		1145	-2.4
	1660		1490		1180	-3.0
	2025		1815		1245	-3.6
					1420	-4.2
					2155	-4.8

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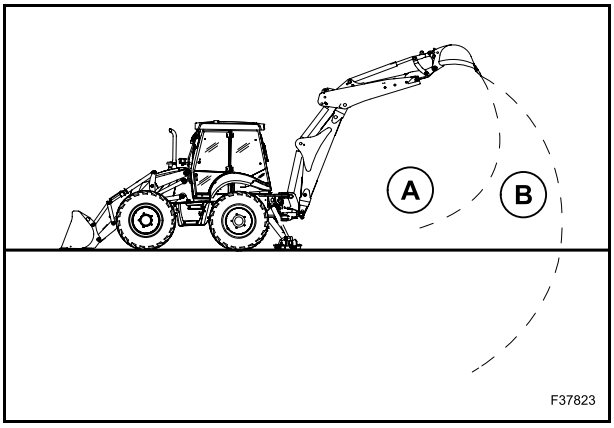
695SR (CENTER PIVOT)

Lifting capacity in normal operating mode - SAE rated

The following table reports the lifting capacities of the dipper (A) and the boom (B).

NOTE: the capacities indicated may slightly vary from one machine to another, according to the accessories mounted, the pressure settings and the market requirements.

Lifting capacities are given in kg for a standard dipper and a telescopic dipper.



Standard dipper		Telescopic dipper (retracted)		Telescopic dipper (extended)		Height/Depth
Dipper - A	Boom - B	Dipper - A	Boom - B	Dipper - A	Boom - B	m
					605	+5.4
	1075		990		905	+4.9
	1470		1365	1460	950	+4.3
2270	1600	2165	1485	1560	1020	+3.6
2195	1630	2090	1510	1595	1055	+3.0
2240	1625	2135	1500	1620	1070	+2.4
2445	1610	2330	1480	1700	1075	+1.8
3090	1580	2960	1450	1835	1080	+1.2
4960	1555	4790	1420	2080	1075	+0.6
	1530		1390	3425	1075	0 (ground)
	1510		1365	5065	1070	-0.6
	1500		1350		1075	-1.2
	1500		1345		1080	-1.8
	1525		1365		1090	-2.4
	1610		1440		1130	-3.0
	1970		1760		1195	-3.6
					1370	-4.2
					2105	-4.8

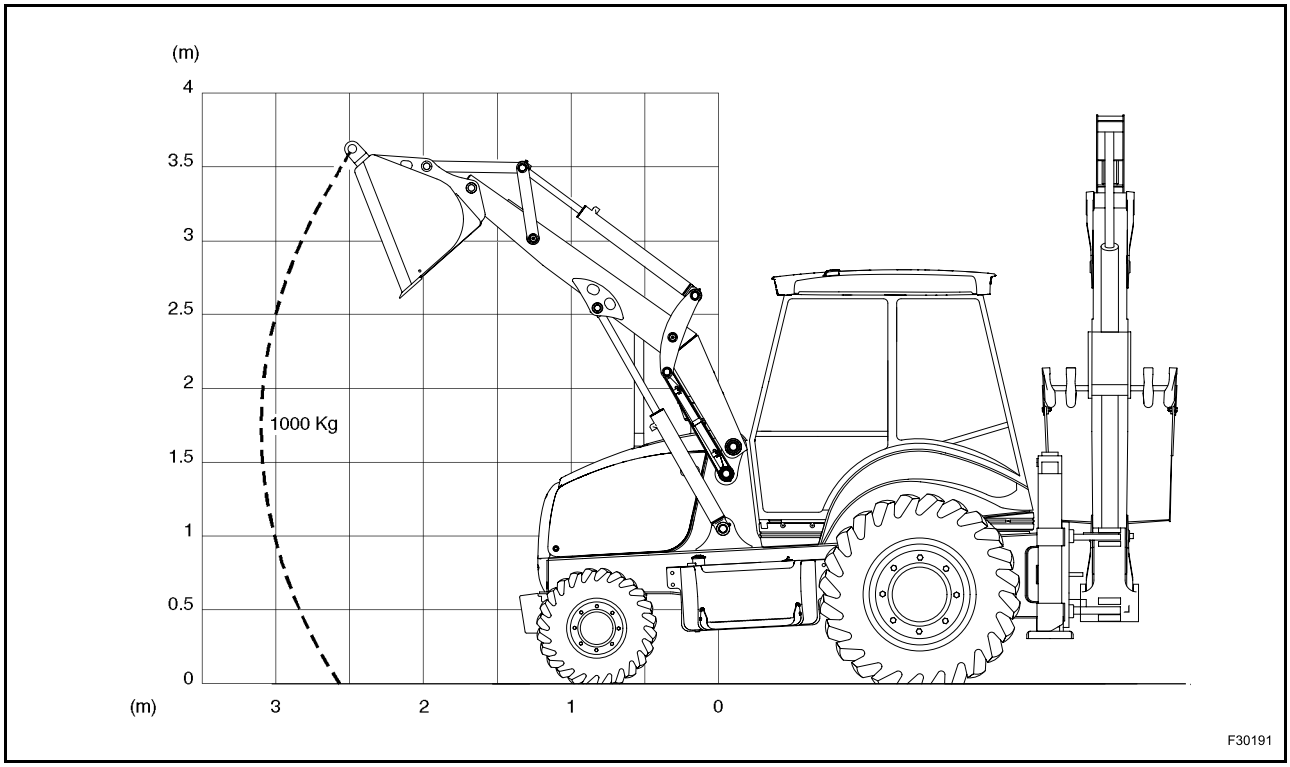
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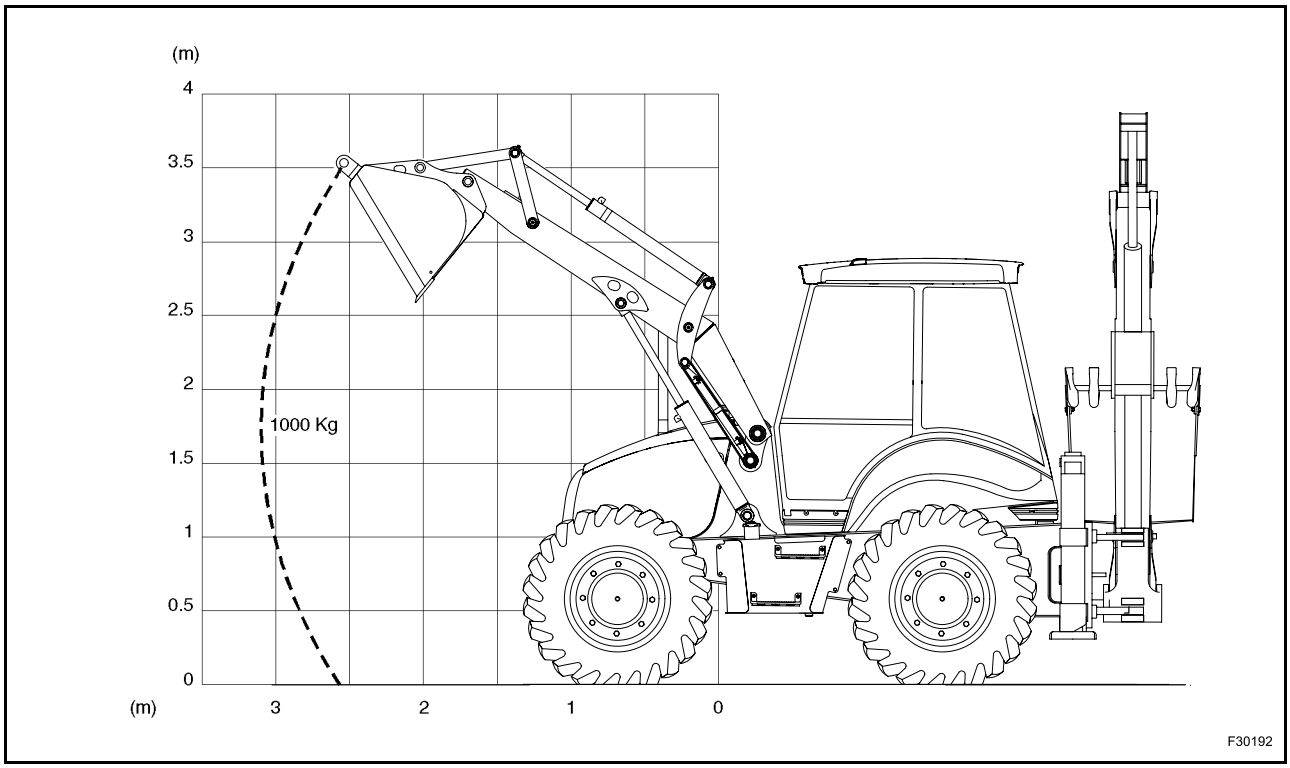
6. MAXIMUM LIFTING LOADS

6.1 LOADER ATTACHMENT MAXIMUM LIFTING LOAD TABLE

2WS



4WS

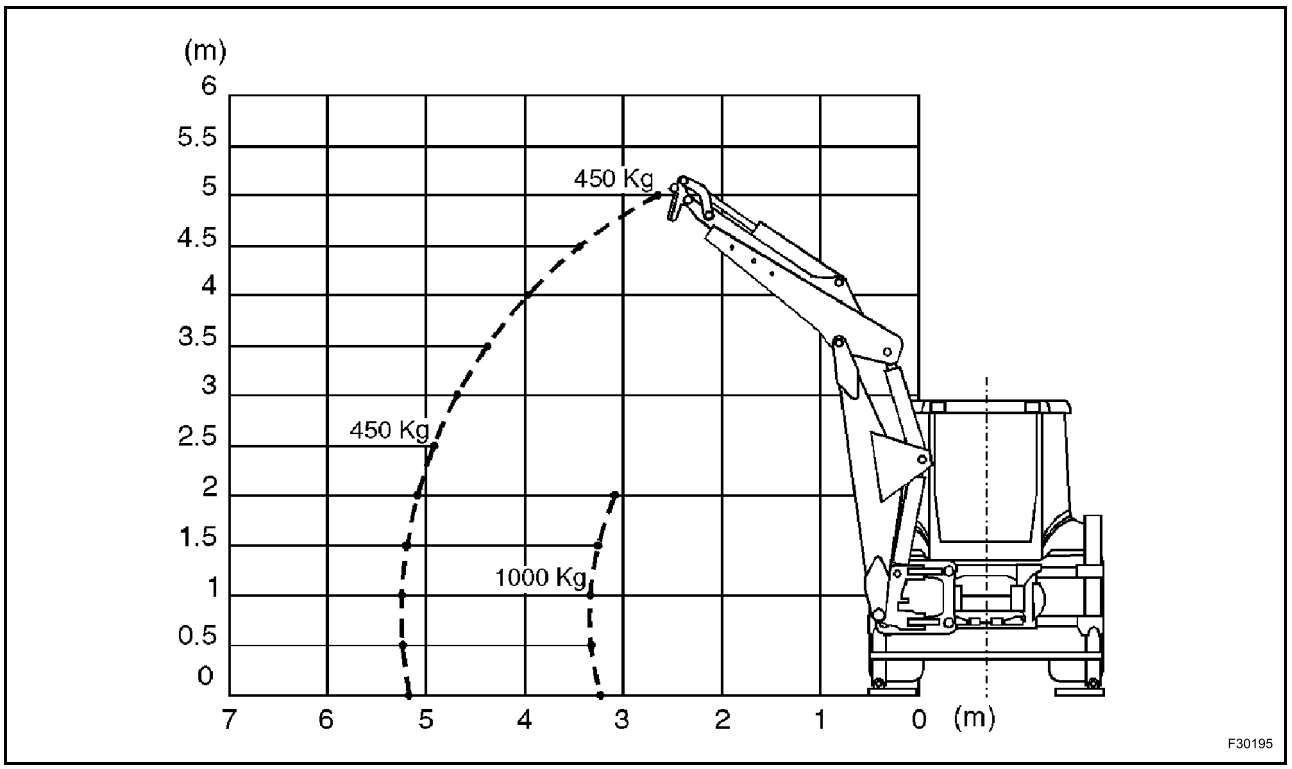


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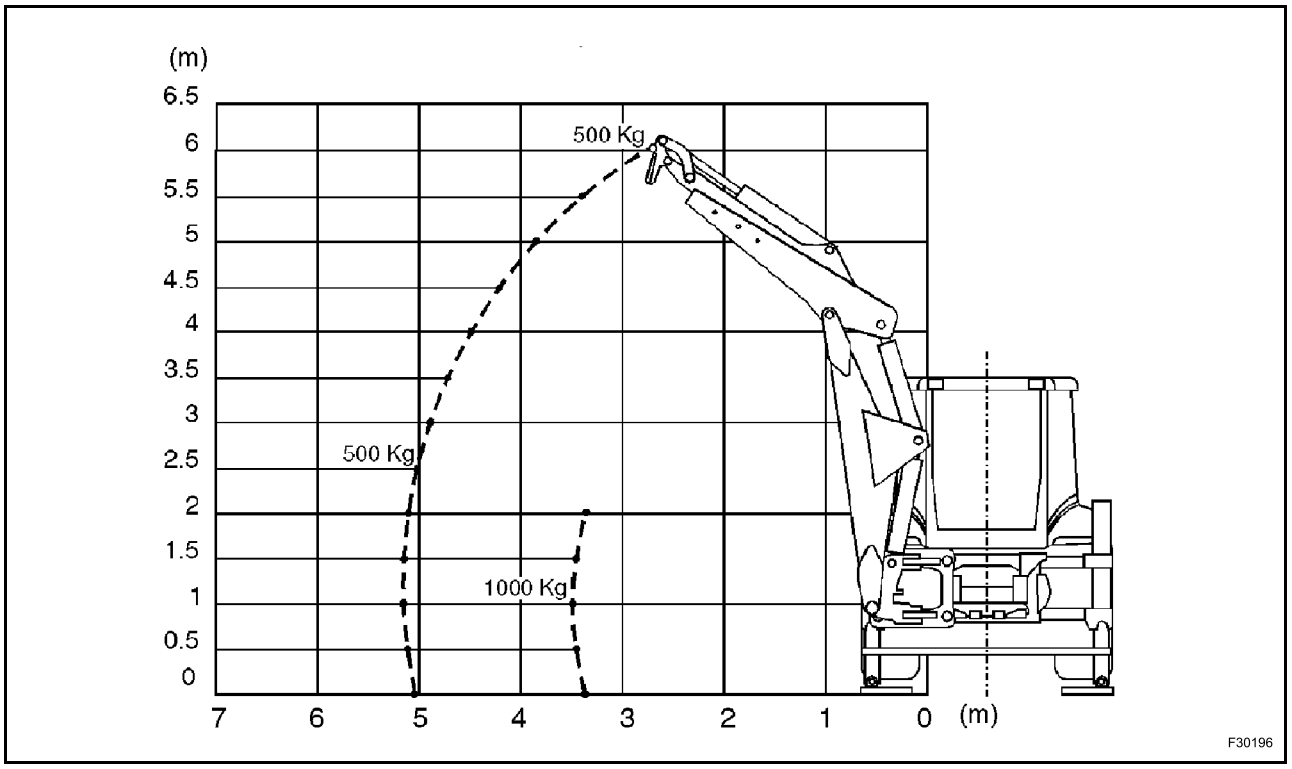
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6.2 BACKHOE ATTACHMENT MAXIMUM LIFTING LOAD TABLE

2WS



4WS



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7. SUPPLY SUMMARY TABLE

RECOMMENDED FLUIDS AND APPLICATION	CASE Specifications	INTERNATIONAL Specifications	MODELS	QUANTITY Litres
ENGINE - OIL Akcela No 1 Engine oil (15W40)	MA 1121	API CH-4, ACEA E5	2WS - with filter 4WS - with filter	14 12.8
COOLING SYSTEM Akcela Premium Anti-freeze antifreeze 50% water 50%	MA 1710	CUNA NC 956-16	ALL	24
HYDRAULIC SYSTEM Akcela Nexplore	MA 3525	API GL4 ISO VG 32/46	2WS 4WS	140 118
Akcela Hydraulic Excavator Fluid Bio	MS 1230	ISO VG 46 DIN 51524 - part II	2WS 4WS	140 118
POWERSHUTTLE TRANSMISSION Akcela Nexplore	MAT 3525	API GL4 ISO VG 32/46	ALL	18
POWERSHIFT TRANSMISSION Akcela Trans XHD		ATF DEXRON III	ALL	14
FRONT AXLE (2WS) Akcela Hy-Tran Ultra	MAT 3525		Differential	6.5
			Wheel reduction gear (each)	0.7
FRONT AXLE (4WS) Akcela Nexplore	MAT 3525	API GL4 ISO VG 32/46	Differential	10.5
			Wheel reduction gear (each)	1.3
REAR AXLE (2WS) Akcela Hy-Tran Ultra + AOA axle oil additive	MAT 3525			21.2 0.8
REAR AXLE (4WS) Akcela Nexplore	MAT 3525	API GL4 ISO VG 32/46	Differential	11
			Wheel reduction gear (each)	1.3
BRAKE SYSTEM Akcela LHM Fluid Mineral oil		ISO 7308	ALL	1
FUEL Decanted and filtered diesel fuel			2WS 4WS	145 124
VARIOUS JOINTS Akcela Multi-purpose grease	251H EP	NLGI 2	ALL	As required
TELESCOPIC DIPPER Akcela Moly Grease	251 H EP-M	NLGI 2	ALL	As required
AIR CONDITIONING COMPRESSOR PAG SP 20 oil			ALL	240 cc

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NOTES:

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SECTION 17 - TORQUE CONVERTERS

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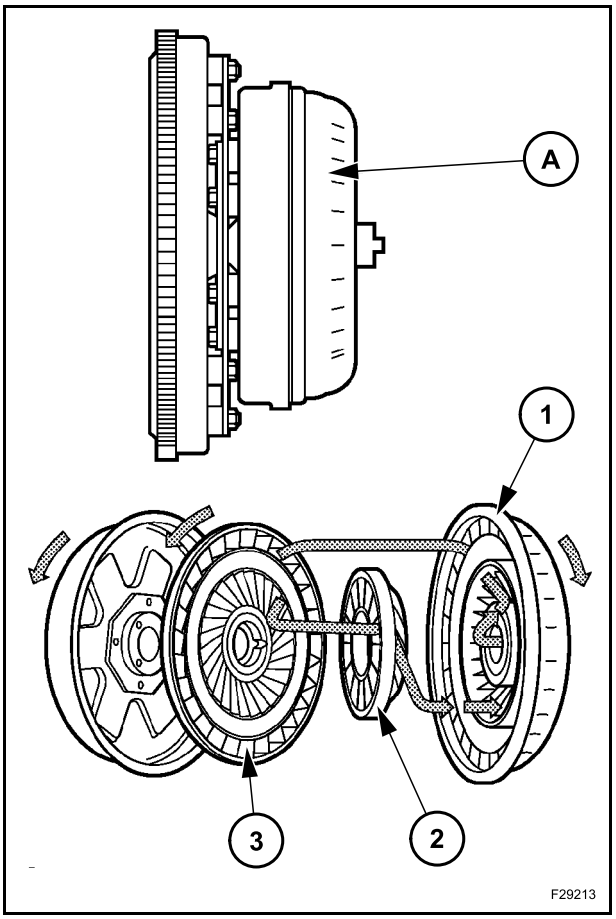
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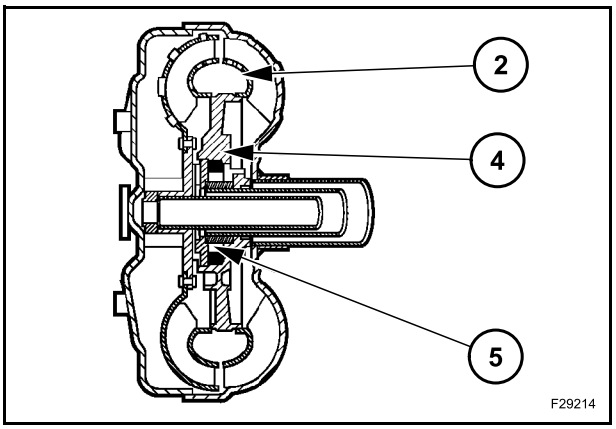
1. POWERSHUTTLE TORQUE CONVERTER

1.1 DESCRIPTION AND OPERATION

The torque converter is the connection between the engine and the transmission and is hydraulically actuated. The main parts of the torque converter (A) are the impeller (pump), the turbine, the stator and the front and rear covers. The impeller is integral with the rear cover and is driven by the engine flywheel by means of a drive plate. The stator, is splined to a stationary shaft (stator support) through a one-way clutch that permits the stator to rotate only in the same direction as the impeller. All of the converter parts are enclosed in an oil-filled housing. The front and rear cover, being welded together, form the housing. The turbine (2), splined to the front input shaft, is splined to a stationary shaft (stator support) through a one-way clutch that permits the stator (3) to rotate only in the same direction as the impeller (1). All of the converter parts are enclosed in an oil-filled housing. When the engine is running, the oil in the converter flows from the impeller (1) to the turbine (2) and back to the impeller through the stator (3). This flow produces a maximum torque increase. When enough oil flow is developed by the impeller, the turbine begins to rotate, driving the front input shaft. The torque multiplication gradually decreases as turbine speed approaches impeller speed, and becomes 1 to 1 when the turbine is being driven at nine tenths impeller speed.



When the turbine (2) is rotating at approximately nine tenths impeller speed, the converter stops multiplying torque because the oil is now acting on the rear face of the stator blades (4). The action of the oil on the rear face of the stator unlocks the one-way clutch (5), permitting the stator to rotate in the same direction as the turbine (2) and impeller (1). Through this action the converter becomes an efficient fluid coupling by transmitting engine torque from the impeller to the turbine. To achieve optimum operation the engine performance, transmission ratios, hydraulic power delivery and converter torque multiplication are all “Matched” to provide the necessary vehicle drive torque when required. When the turbine is rotating less than nine tenths impeller speed (1), the converter is multiplying torque through the action of the stator (3). This action, produced by oil acting on the front face of the stator blades, tends to rotate the stator in the opposite direction of the impeller (1) and turbine (2). However, the one-way clutch prevents this opposite rotation and allows the stator to direct oil back to the impeller, thereby producing torque multiplication. Maximum torque multiplication is achieved when the impeller is driven at stall speed and the turbine is stationary.



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1.2 SPECIFICATIONS

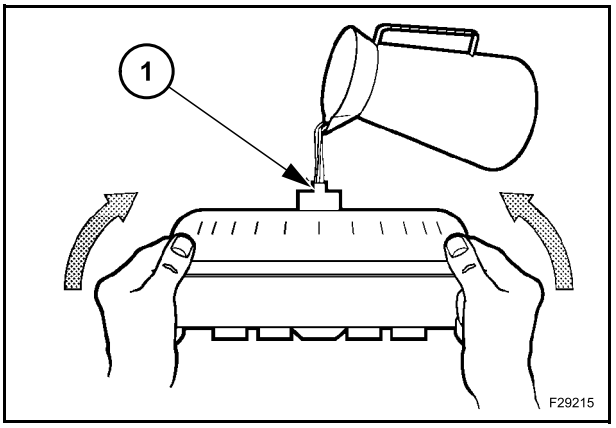
Torque converter ratio 2.38:1
Weight ..... 17.4 kg
Torque of retaining screws for transmission ..... 58 Nm
Torque of retaining screw for flywheel ..... 41 Nm
Torque of screw for drive plate to the convertor ..... 53 Nm
Torque of screw for drive plate to the flywheel ..... 41 Nm

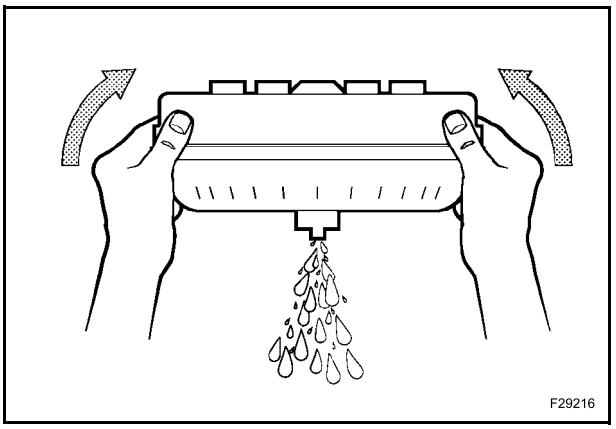
Hydraulic tests
Tachometer setting ..... 2000 rpm
Test temperature, oil ..... 80-85 °C
Cold start valve (for reference only) ..... 26 bar
System pressure test ..... 13.7-15.2 bar
Torque converter ..... 7-11 bar

1.3 OVERHAUL

The torque converter, is a welded unit and cannot be disassembled. The only maintenance performed on the converter, other than the stall test, is cleaning and visual inspection. A commercial torque converter cleaner may be used to clean the converter. However, if a commercial cleaner is not available, the converter should be cleaned as outlined below.

- Drain as much oil as possible from the hub of the converter by tilting the converter in all directions.
- Fill the converter about half full, through the hub (1), with paraffin base solvent or any cleaning solvent specified for cleaning transmissions.
- Plug the opening in the hub, then circulate the solvent inside the converter by rotating and shaking.
- Drain the solvent from the converter.
- Repeat previous steps, as required, until the solvent that is drained from the converter is clean.





1.4 INSPECTION

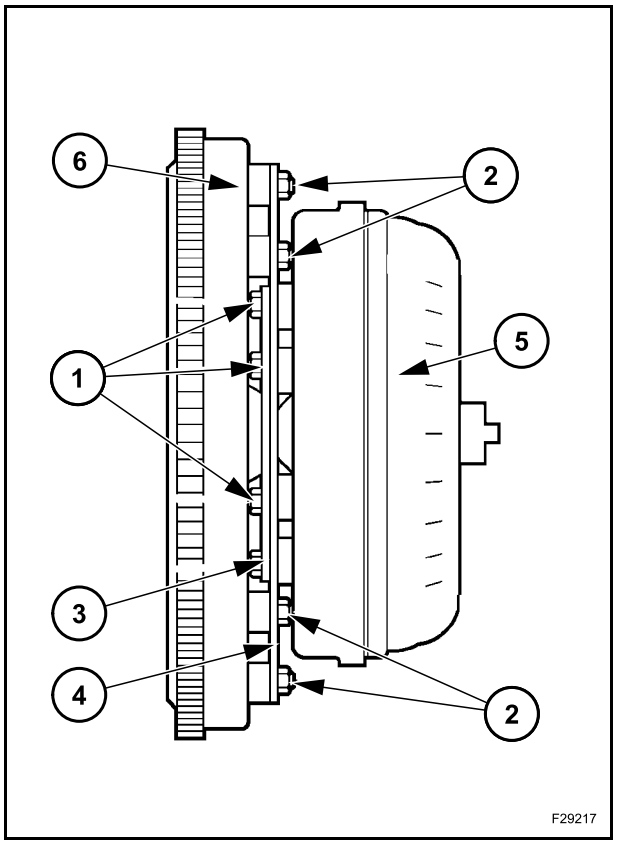
Inspect the splines on the converter hub for wear or damage and the weld joints for cracks. If the hub is worn or damaged and/or the weld joints cracked, a new converter must be installed. A new drive plate should also be installed if it is warped.

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1.5 DISASSEMBLY AND ASSEMBLY

- Secure the drive plate (3) to the torque converter (5), with the attaching bolts and flat washers (1).
- Tighten bolts to 53 Nm.
- Prior to fitting the transmission place the torque converter carefully over the transmission shaft and into the transmission housing.
- With the transmission bolted to the engine secure the drive plate to the flywheel (6) accessed through the starter motor aperture, with the attaching bolts and washers (2). Tighten bolts to 41 Nm.



1.6 STALL TEST

The purpose of this test is to determine if the torque converter and hydraulic clutch assemblies are operating satisfactorily.
For the test to be conclusive, the transmission hydraulic pump and pressure regulating valve must be operating correctly.
They can be checked by performing the “Line Pressure Test”.
The engine and brakes must also be in good working order.

- Check the coolant level in the radiator and the oil level in the transmission. If low, add fluid as required to bring to the proper level.
- With the gearshift lever and the shuttle lever in neutral, start the engine and run at 800-1000 rpm until the transmission temperature reaches 29 °C - 35 °C.
- Lock the brakes and shift into fourth gear, increase engine speed to approximately 900 rpm, then shift the power reversing lever to the forward position. This will position the control valve so as to direct high pressure oil to the front clutch.
- Ensure the brakes are firmly locked so the unit will not move, gradually depress the foot accelerator and note the maximum engine speed obtained. Move the power reversing lever to the neutral position. The stall speed should be:

Engine 97 HP..... 1750 ÷ 1850 rpm
Engine 110 HP..... 1990 ÷ 2140 rpm

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IMPORTANT: to prevent the transmission from overheating, do not allow the engine to operate at wide open throttle for more than fifteen seconds.

- Allow the transmission oil to cool to 29 °C - 35 °C. Check the rear hydraulic clutch by repeating previous steps, but with the power reversing lever in the rearward position. Again, cool the transmission oil by allowing the engine to run at approximately 1000 rpm for one minute.
- The engine speed noted previously (stall speed) for both the front and rear clutch assemblies should be within 150 rpm of each other. If the stall speed is not within these limits, refer to the diagnosis guide for possible causes.
- With the gearshift lever and power reversing lever in neutral, set the engine speed at 600-800 rpm, then shift into any gear ratio. If the gears clash, either the front or rear hydraulic clutch assembly is transmitting power, even though the power reversing lever is in neutral.

NOTE: if the unit creeps forward and the gears clash, the front clutch is at fault. The rear clutch is at fault if the unit creeps backward. If the unit does not creep and the gears still clash, use the stabilizers to raise the rear wheels off the ground, move the power reversing lever to neutral and shift into first gear. Check the rear wheels for rotational direction; if the wheel rotate rearward, then the rear clutch is at fault.

1.7 FAULT FINDING

PROBLEM	CAUSE	CORRECTION
Low stall speed	Hydraulic clutch not releasing Stator support broken Defective torque converter Low engine power	Replace the torque converter. Replace the torque converter. Replace the torque converter. Check and correct output.
High stall speed	Hydraulic clutch not applying or is slipping Low line pressure Sealing rings on rear input shaft broken Defective torque converter	Replace. Check pump output. Replace the seals. Replace the torque converter.

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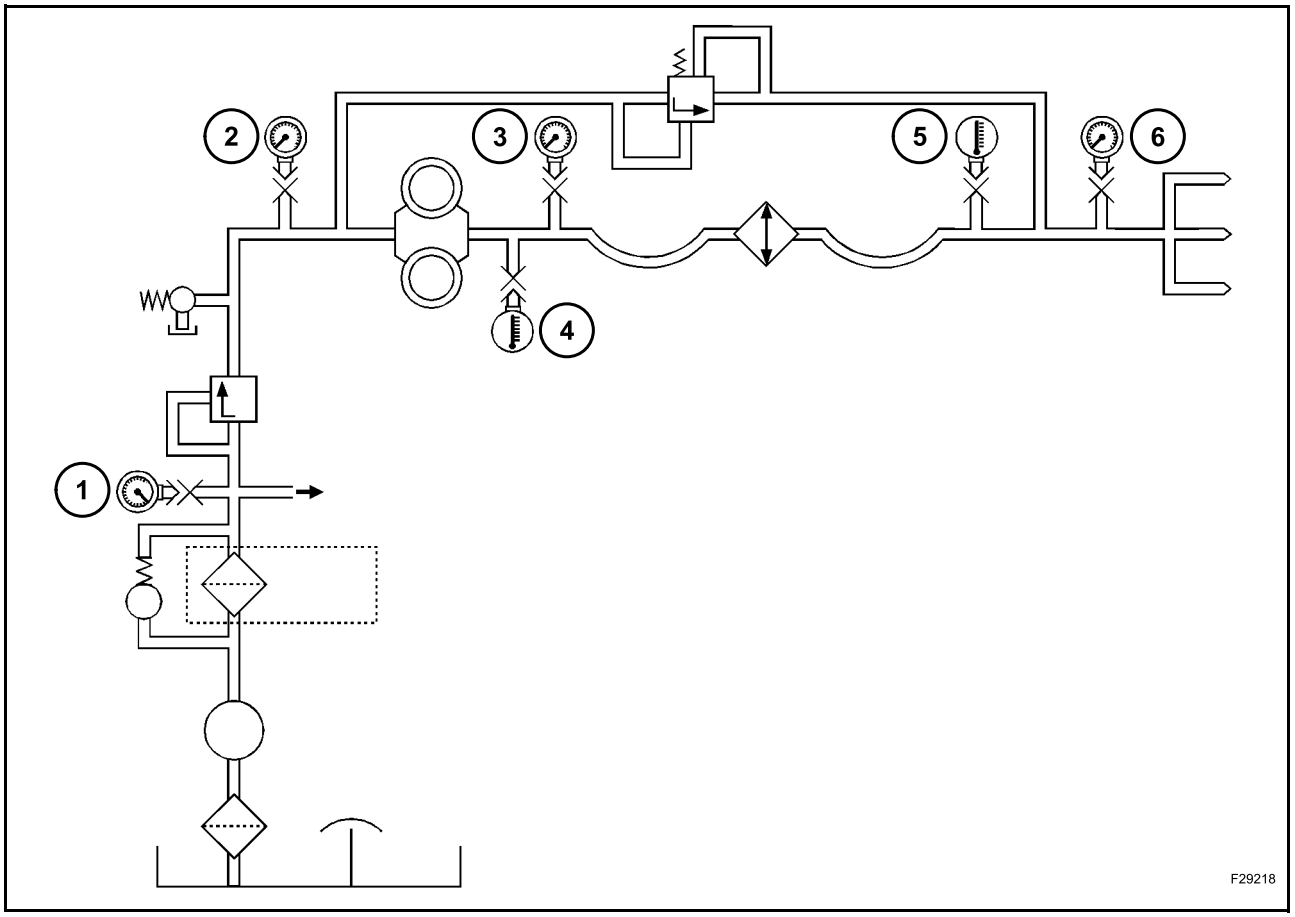
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2. POWERSHIFT TORQUE CONVERTER

2.1 DESCRIPTION AND OPERATION

Engine power is transmitted from the engine flywheel to the impeller through the impeller cover.
This element is the pump portion of the torque converter and is the primary component which starts the oil flowing to the other components which results in torque multiplication. This element can be compared to a centrifugal pump in that it picks up fluid at its centre discharges at its outer diameter. The torque converter turbine is mounted opposite the impeller and is connected to the turbine shaft or clutch shaft. This element receives fluid at its outer diameter and discharges at its centre. The stator of the torque converter is located between and at the centre of the inner diameters of the impeller and turbine elements. Its function is to take the fluid which is exhausting from the inner portion of the turbine and change its direction to allow correct entry for recirculation into the impeller element. This recirculation causes the converter to multiply torque. The torque multiplication depends on the regularity of certain elements (fan, turbine and stator) and on the output speed of the converter (turbine speed). The converter will multiply engine torque to its designed maximum multiplication ratio when the turbine shaft is at zero RPM (stall). Therefore we can say that as the turbine shaft is decreasing in speed, the torque multiplication is increasing. In the impeller cover a splined shaft is fitted which runs inside and through the turbine shaft to drive a hydraulic pump which is fitted at the back of the transmission. Since the shaft is connected to the centre of the impeller cover, the pump speed will be the same as engine speed. The rear side of the impeller cover has a tanged drive which drives the transmission charging pump located in the converter housing. The transmission charging pump speed is also the same as the engine speed.

TORQUE CONVERTER AND LUBRICATION PRESSURE TEST PORTS



1. System pressure port
2. Torque converter in port
3. Torque converter out port
4. Oil temperature converter out port
5. Oil temperature cooler out port
6. Lubrication pressure port

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2.2 SPECIFICATIONS

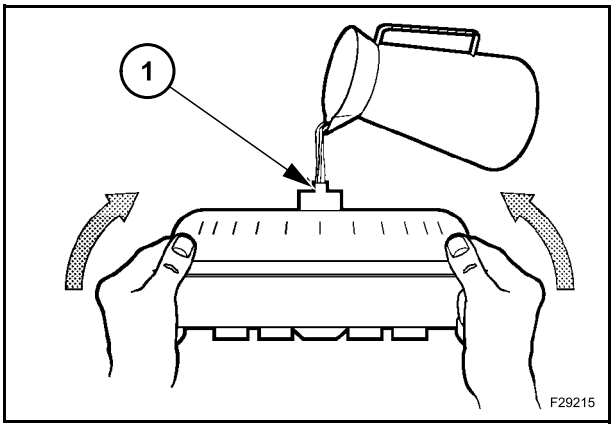
Torque converter ratio 2.38:1
Torque of retaining screws for transmission ..... 26 Nm
Torque of retaining screw for flywheel ..... 43 Nm
Torque of screw for drive plate ..... 43 Nm

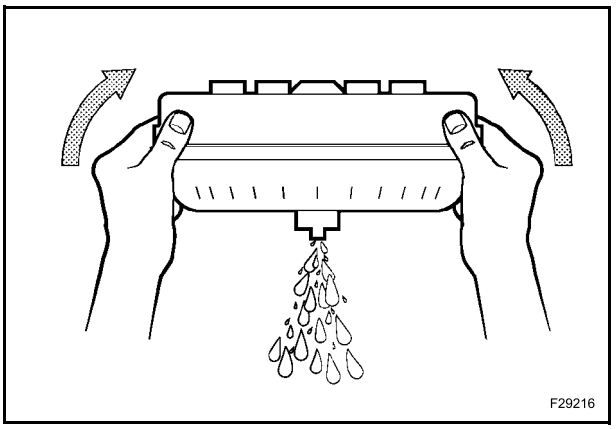
Hydraulic tests
Tachometer setting ..... 2200 rpm
Test temperature, oil ..... 82-93 °C
Torque converter relief valve ..... 10 bar
Oil temperature converter out:
Normal operating range ..... 80-90 °C
Maximum temperature ..... 120 °C

2.3 OVERHAUL

The torque converter, is a welded unit and cannot be disassembled. The only maintenance performed on the converter, other than the stall test, is cleaning and visual inspection. A commercial torque converter cleaner may be used to clean the converter. However, if a commercial cleaner is not available, the converter should be cleaned as outlined below.

- Drain as much oil as possible from the hub of the converter by tilting the converter in all directions.
- Fill the converter about half full, through the hub (1), with paraffin base solvent or any cleaning solvent specified for cleaning transmissions.
- Plug the opening in the hub, then circulate the solvent inside the converter by rotating and shaking.
- Drain the solvent from the converter.
- Repeat previous steps, as required, until the solvent that is drained from the converter is clean.





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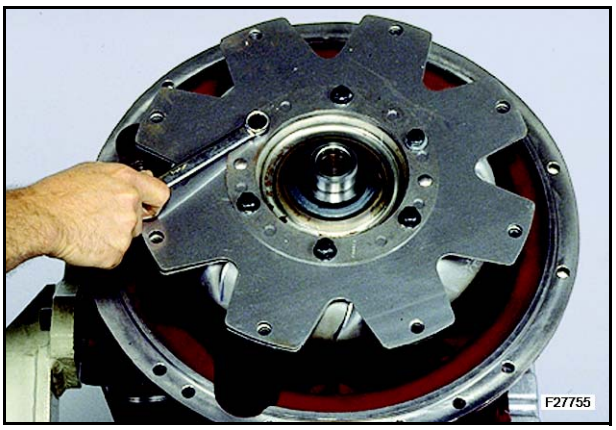
2.4 INSPECTION

Inspect the splines on the converter hub for wear or damage and the weld joints for cracks. If the hub is worn or damaged and/or the weld joints cracked, a new converter must be installed. A new drive plate should also be installed if it is warped.

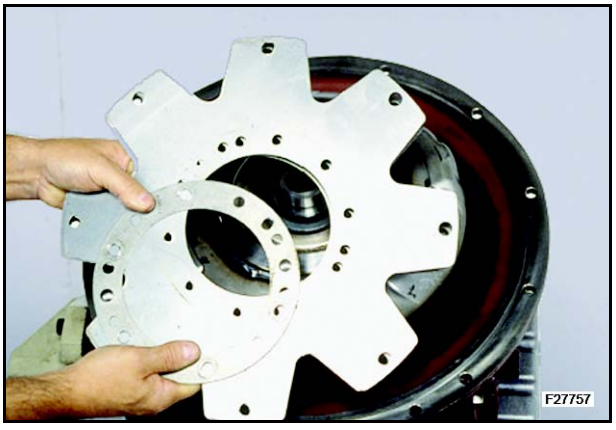
2.5 DISASSEMBLY AND ASSEMBLY

DISASSEMBLY

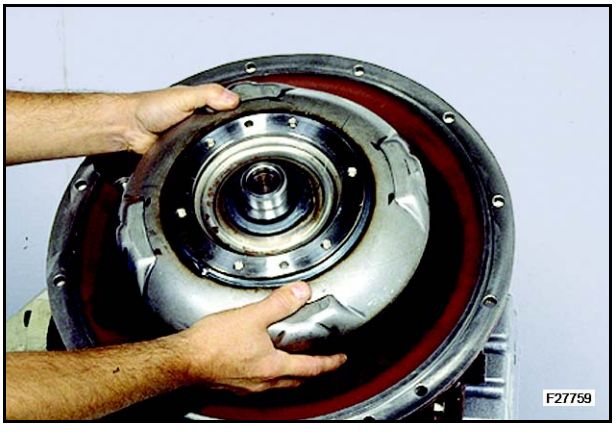
Remove the drive plate screws.



Remove the drive plates.



Remove the torque converter assy.

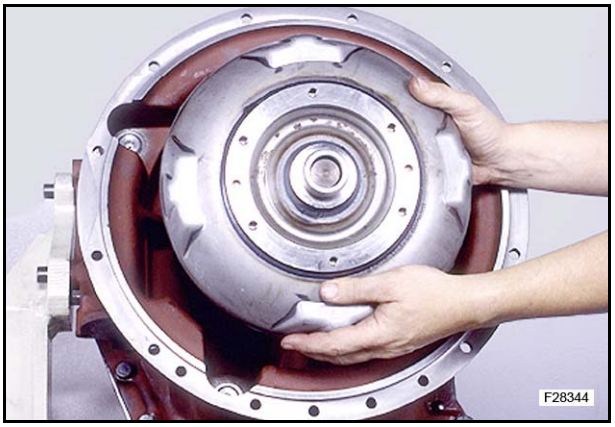


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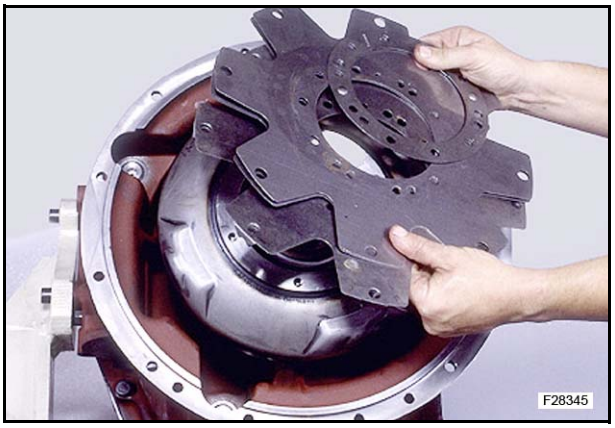
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ASSEMBLY

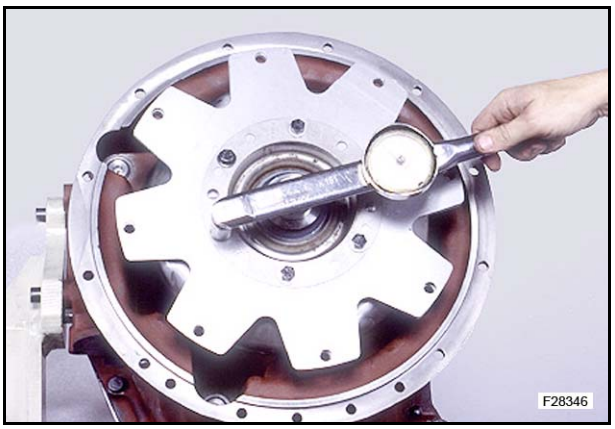
Install the converter assembly on the input shaft.



Install the drive plates on the converter.



Install the drive plates screws and the lock washers and tighten the screws to the specified torque 43 Nm.



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2.6 STALL TEST

The purpose of this test is to determine if the torque converter and hydraulic clutch assemblies are operating satisfactorily.
For the test to be conclusive, the transmission hydraulic pump and pressure regulating valve must be operating correctly.
They can be checked by performing the “Line Pressure Test”.
The engine and brakes must also be in good working order.

- Check the coolant level in the radiator and the oil level in the transmission. If low, add fluid as required to bring to the proper level.
- With the gearshift lever and the shuttle lever in neutral, start the engine and run at 800-1000 rpm until the transmission temperature reaches 29 °C - 35 °C.
- Lock the brakes and shift into fourth gear, increase engine speed to approximately 900 rpm, then shift the power reversing lever to the forward position. This will position the control valve so as to direct high pressure oil to the front clutch.
- Ensure the brakes are firmly locked so the unit will not move, gradually depress the foot accelerator and note the maximum engine speed obtained. Move the power reversing lever to the neutral position. The stall speed should be:

Engine 97 HP..... 1750 ÷ 1850 rpm
Engine 110 HP..... 1990 ÷ 2140 rpm

IMPORTANT: to prevent the transmission from overheating, do not allow the engine to operate at wide open throttle for more than fifteen seconds.

- Allow the transmission oil to cool to 29 °C - 35 °C. Check the rear hydraulic clutch by repeating previous steps, but with the power reversing lever in the rearward position. Again, cool the transmission oil by allowing the engine to run at approximately 1000 rpm for one minute.
- The engine speed noted previously (stall speed) for both the front and rear clutch assemblies should be within 150 rpm of each other. If the stall speed is not within these limits, refer to the diagnosis guide for possible causes.
- With the gearshift lever and power reversing lever in neutral, set the engine speed at 600-800 rpm, then shift into any gear ratio. If the gears clash, either the front or rear hydraulic clutch assembly is transmitting power, even though the power reversing lever is in neutral.

NOTE: if the unit creeps forward and the gears clash, the front clutch is at fault. The rear clutch is at fault if the unit creeps backward. If the unit does not creep and the gears still clash, use the stabilizers to raise the rear wheels off the ground, move the power reversing lever to neutral and shift into first gear. Check the rear wheels for rotational direction; if the wheel rotate rearward, then the rear clutch is at fault.

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2.7 FAULT FINDING

PROBLEM	CAUSE	CORRECTION
Low stall speed	Hydraulic clutch not releasing Stator support broken Defective torque converter Low engine power	Replace the torque converter. Replace the torque converter. Replace the torque converter. Check and correct output.
High stall speed	Hydraulic clutch not applying or is slipping Low line pressure Sealing rings on rear input shaft broken Defective torque converter	Replace. Check pump output. Replace the seals. Replace the torque converter.

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580SR
580SR+
590SR
695SR



SECTION 21 - TRANSMISSION

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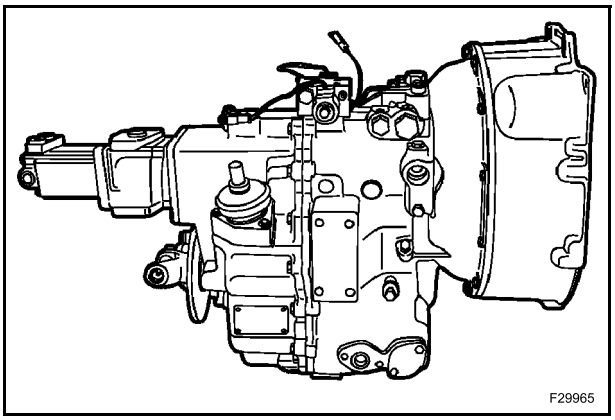
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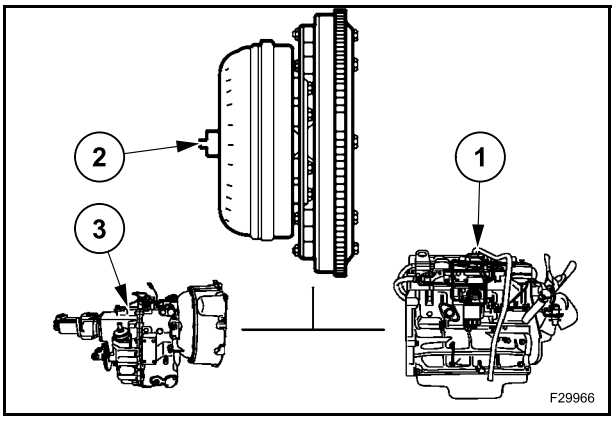
1. POWERSHUTTLE TRANSMISSION “TURNER MODEL COM-T4-2025”

This transmission is used on powershuttle loader backhoe models 580SR / 580SR+ / 590SR.
The transmission consists of a torque converter, an internal rotor-type hydraulic pump, an oil distributor, a solenoid control valve assembly, two hydraulically operated clutches, a 4-speed synchromesh geartrain, transmission case and oil cooler tubes.



NOTE: a conventional clutch is not used with this transmission.

The transmission case serves as an oil tank for the torque converter and hydraulic clutch assemblies. The transmission receives power from the engine (1) by a fluid coupling in the torque converter (2) and hydraulic clutch assemblies in the transmission (3).



1.1 SPECIFICATIONS

GEAR RATIO

Forward				Reverse			
1	2	3	4	1	2	3	4
4.824	2.998	1.408	0.792	4.020	2.496	1.173	0.660

COLD START BY-PASS VALVE SPRING

Free length ..... 53.4 mm ± 0.96 mm

FORWARD CLUTCH SPRING

Free length ..... 76.6 mm

CLUTCH PISTON SPRING

Free length ..... 75.9 mm

DETENT SPRING

Free length (Approximately) ..... 42.06 mm

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END FLOAT

Input forward Primary Shaft	0.0508-0.41 mm
Input reverse Primary Shaft	0.0508-0.41 mm
Output shaft	1st Gear - 0.33-0.508 mm
	2nd Gear - 0.35-0.558 mm
	3rd Gear - 0.38-0.838 mm
	4th Gear - 0.20-0.558 mm
4WD Shaft	0.050-0.28 mm
Bearing End Floats	0.025-0.076 mm
Bearing End Float Shims available	0.050/0.076/0.127/0.177/0.381/0.508 mm

HYDRAULIC TESTS

Tachometer setting	2000 rpm
Test temperature, oil	80-85 °C
Cold start valve (for reference only)	26 bar
System pressure test	13.7-15.2 bar
Torque converter	7-11 bar
Reverse Clutch	13.7-15.2 bar
Forward Clutch	13.7-15.2 bar
4WD Supply	13.7-15.2 bar

COOLER FLOW TEST

Oil temperature 80-85 °C	Rpm	Oil flow l/min
	700	12.5 litres
	1000	18.2 litres
	1500	22.1 litres
	2000	24.0 litres
	2200	24.5 litres
	2500	25.0 litres

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1.2 MOUNTING SCREW TORQUE

Strainer bolts	18 to 31 Nm
Pump retaining bolts	18 to 31 Nm
Output Yoke bolts	68 to 88 Nm
Pressure test plugs	41 to 54 Nm
Main transmission case bolts	45 to 64 Nm
Shift detent plug	41 to 54 Nm
Shift fork screws	18 to 25 Nm
Shift lever assembly screws	16 to 24 Nm
Drain plugs	34 to 54 Nm
Relief valve	23 to 30 Nm
Pressure regulator valve	46 to 60 Nm
Cold start valve	46 to 60 Nm
4WD solenoid valve spool	20 to 27 Nm
4WD Solenoid coil retaining nut	5.4 Nm
Control valve retaining screws	6.8 to 8.5 Nm
4WD hydraulic pipe connections	6.8 to 10.2 Nm
Filter housing bolts	45 to 64 Nm
Oil filter	7 to 10 Nm
Temperature sender	20 to 27 Nm

RECOMMENDED SEALANTS

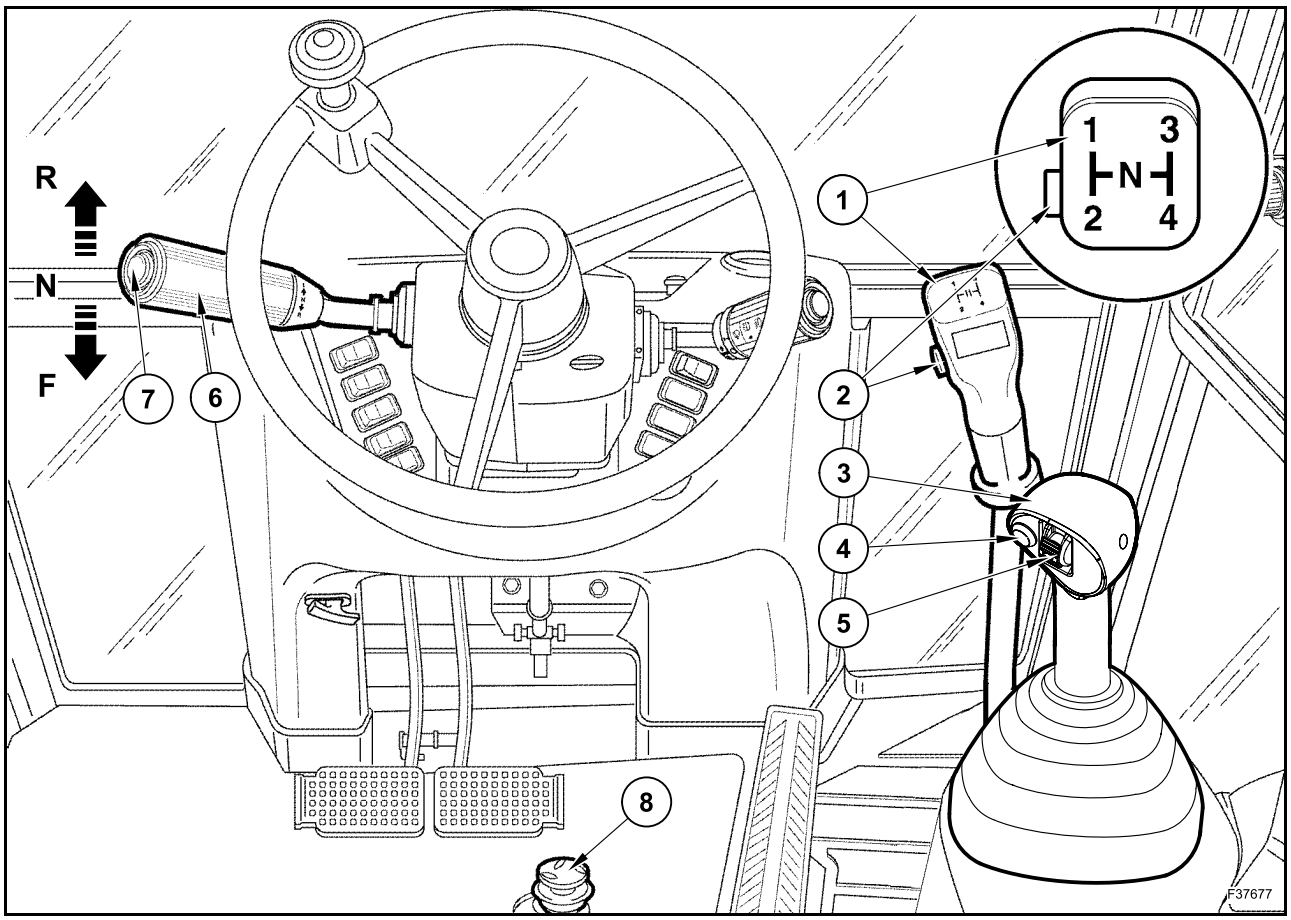
Transmission case joint	Loctite 5203
4WD Output gear	Loctite 649
4WD gear (Permanent 4WD assy)	Loctite 649
4WD clutch supply pipe	Loctite 542
Gear lever housing	Loctite 5900 RTV
Shimming access plug	Loctite 649

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1.3 TRANSMISSION CONTROLS

4x4 POWERSHUTTLE TRANSMISSION CONTROLS



1

1. GEAR LEVER: it is possible to select four forward and four rearward travel gears.
2. TRANSMISSION DISCONNECT BUTTON: prior to changing gear depress and hold down this switch which disengages transmission drive, select the required gear with the gear lever and release the switch to re-engage drive.
3. LOADER ATTACHMENT CONTROL LEVER
4. TRANSMISSION DISCONNECT BUTTON: (on loader attachment control lever) this button is used to disengage the transmission in order to increase loader attachment power.
5. ROLLER FOR THE PROPORTIONAL CONTROL OF LOADER BUCKET 4x1
6. POWERSHUTTLE TRANSMISSION DIRECTION LEVER: the movement of this lever from the neutral position will engage the forward or reverse travel.

NOTE: in reverse gear an audible alarm device sounds.

7. HORN BUTTON
8. MECHANICAL DIFFERENTIAL LOCK PEDAL: pressing this pedal enables the differential lock by locking the two rear wheels together, thus balancing the drive; they unlock when the torque of the two wheels are the same or when the brake pedal is deeply pressed.

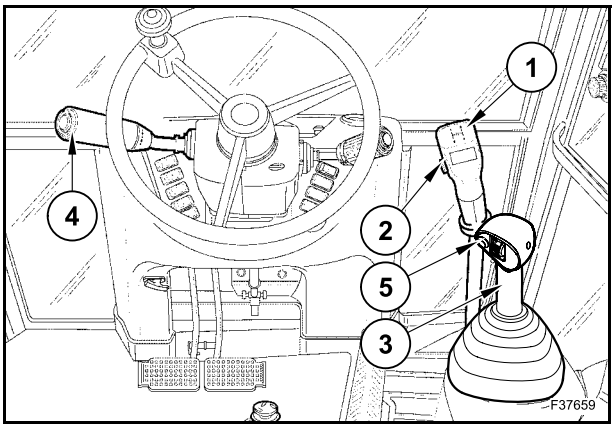
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Transmission

The transmission is fully synchronised providing four forward and four reverse speeds allowing gear ratio changes on the move. A torque converter is used to connect the engine to the transmission and the column mounted powershuttle lever (4) enables shifts between forward and reverse travel without disengaging gear ratios.

A device for “transmission disconnect” is activated by pushing button (2), placed on the gearshift lever (1) or by pushing button (5), placed on the loader control lever (3).



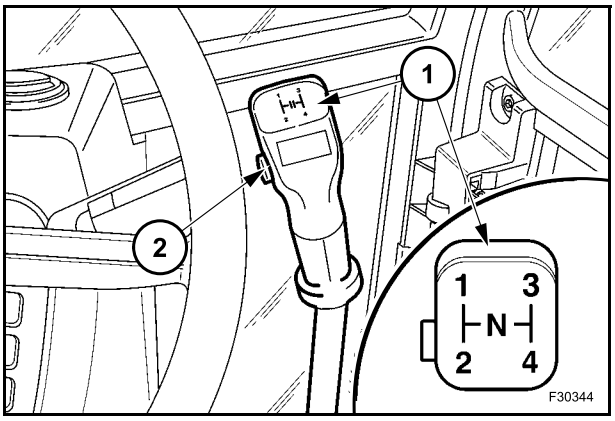
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⚠ WARNING

Always apply the parking brake whenever the machine is parked as the machine is free to roll even though the transmission gearshift lever and power reversing lever may be “In Gear” and the engine is turned OFF.

Gearshift lever

The single gearshift lever (1) is used to select any one of the four gear ratios. The transmission disconnect button (2) is depressed and held as the lever is shifted from one gear to another and then released to re-connect transmission drive.



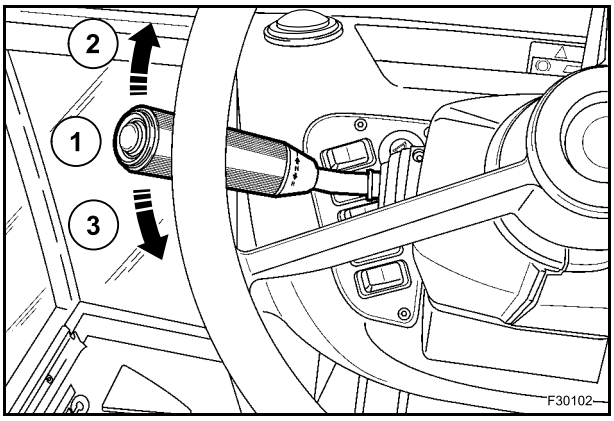
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Forward/reverse powershuttle lever

To select FORWARD travel, engage the required gear ratio with the gearshift lever, then with the engine idling lift the powershuttle lever from the neutral lock position (1) and move to the forward position (2). Use the accelerator pedal to control the engine rpm and the ground speed.

To reverse the direction of travel, reduce engine speed and move the power reversing from neutral lock position (1) and rearwards (3) for reverse travel an audible alarm device sounds.



NOTE: the powershuttle lever is equipped with a neutral lock to prevent inadvertent engagement of the transmission. With this design, the powershuttle lever moves through a “T” slot to the forward or reverse positions.

IMPORTANT: when operating at low environmental temperatures with cold transmission oil, allow the oil to warm up before attempting to shift the powershuttle lever. The transmission can be shifted normally after the oil warms up.

NOTE: the audible alarm sounds if the powershuttle lever is operated (forward or reverse) with the parking brake engaged.

NOTE: the powershuttle lever can be shifted at any engine speed, however, for safe, smooth operation the engine speed should be reduced to approximately 1200 rpm. This action is easily controlled by using the foot accelerator to control engine and ground speed.

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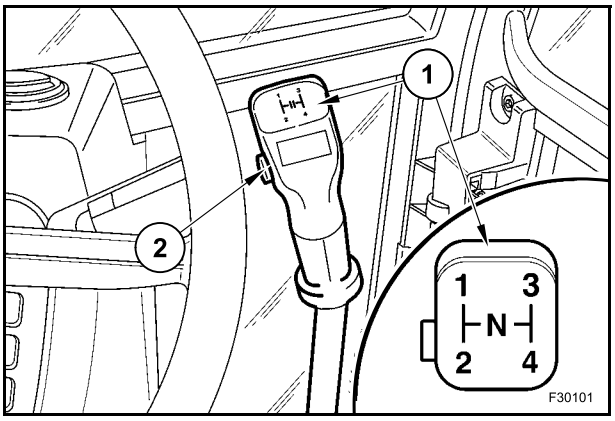
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Transmission disconnection

The 4x4 transmission provides for easy upward and downward gear ratio changes on the move. However, as a clutch is not used between the engine and transmission, the power flow from the engine to the transmission must be interrupted to shift from one gear ratio to another. This is accomplished by using a transmission disconnect (dump) button.

The finger operated button (2) on the main gearshift lever knob (1) is easy to operate.



⚠ WARNING

To avoid personal injury do not use the disconnect switch control to coast down hill. Excessive speed may cause loss of control, personal injury to a bystander or failure of the transmission.

To make upward gear ratio changes simply depress and hold the button (2) on the gearshift lever (1), while moving the lever from one gear ratio to another. When the desired gear ratio has been selected release the button and allow the unit to gain engine speed and ground speed. If another higher ratio is required repeat the procedure.

IMPORTANT: to prevent possible damage to the transmission hydraulic clutches, never use the disconnect switch for inching the machine forward. Inching the machine forward with the button will cause the clutches to slip excessively and overheat.

To make downward gear ratio changes or reduce ground speed, simply lower the engine speed, depress and hold the gearshift lever button and downshift the transmission.

When the desired gear ratio has been selected release the button and adjust the engine speed to suit ground speed required.

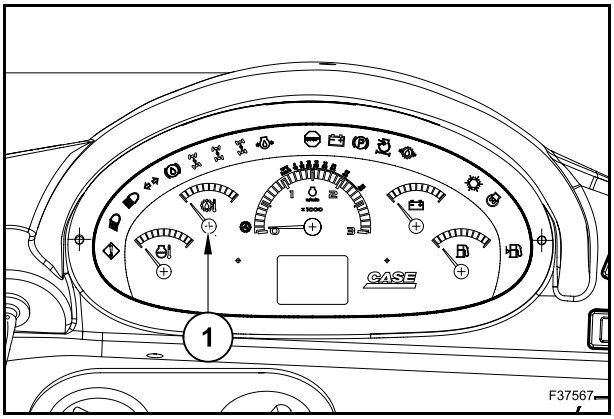
Operating the machine in a too high gear or under a too heavy load will cause the torque converter to slip excessively and overheat. If the machine is overloaded, the engine speed will not exceed a range of 1800-2200 rpm at maximum accelerator and the torque converter will “stall” bringing the machine to a complete stop.

If “stall” does occur, there is still sufficient engine power to operate the loader however, to prevent the transmission from overheating, either reduce the load on the machine or select a lower gear ratio.

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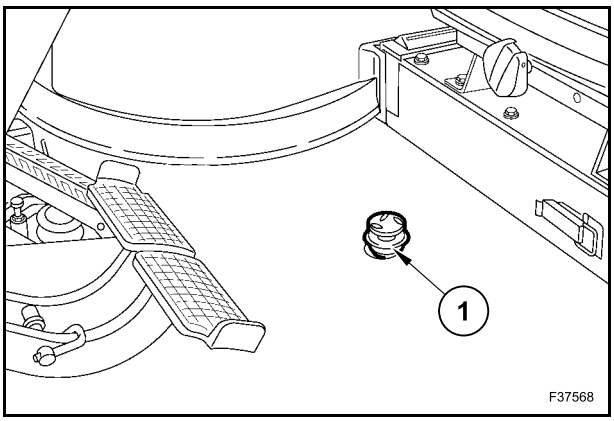
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IMPORTANT: operating at a “stall” for more than 20 seconds can cause the transmission to overheat and can possibly damage the transmission. If the transmission overheats, the indicator needle (1) moves to the red zone. Shift both the powershuttle lever and the gearshift lever to neutral. Idle the engine at 1000 rev/min. until the transmission oil is cooled sufficiently for the indicator needle to drop into the green zone. Once done, operations may resume.



DIFFERENTIAL LOCK PEDAL (MECHANICAL)

In conditions inducing wheel slip, hold down the differential lock pedal (1) with your heel until the differential lock engages. The lock will automatically disengage when traction at the rear wheels equalizes. If a rear wheel spins at speed, reduce the engine speed to idle before engaging the differential lock to minimize shock loads on the rear axle.



⚠ WARNING

Never use the differential lock at speeds above 8 km/h or when turning the machine.
When engaged the lock will prevent the machine turning and personal injury could result.

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1.4 LUBRICATION

To ensure proper lubrication and operating temperatures it is most important that appropriate lubricants are used and that the correct oil level is maintained.

Oil level checking
The oil level should be checked daily and corrected if necessary.
The oil level must be checked with the engine idling and with the transmission oil cold.
In this condition the oil level should fall between the maximum and minimum marks on the dipstick.
At normal operating temperature, (80 °C) the oil level will rise to 20 - 30 mm above the maximum mark on the dipstick.

Do not overfill the transmission as this may result in oil breakdown due to excessive heat and aeration from the churning action of the gears. Early breakdown of the oil will result in heavy sludge deposits that block oil ports and build up on splines and bearings. Overfilling may also cause oil leaks.

Oil changes
An initial oil change and flush is recommended after the transmission is placed in actual service.
This change should be made at any time following 50 hours in service, but should not exceed 100 hours.
When changing the oil it is essential to renew the oil filter and clean out the suction strainer.
The object in draining the oil is to eliminate possible bearing surface abrasion and attendant wear. Minute particles of metal, the result of normal wear in service are deposited in and circulated with the oil. Oil changes are best carried out when the transmission is thoroughly warm.

⚠ WARNING
To prevent oil starvation and possible seizure of the transmission whilst towing the vehicle, it is imperative that the propeller shafts are disconnected.
Failure to observe this precaution may result in extensive damage to the transmission.

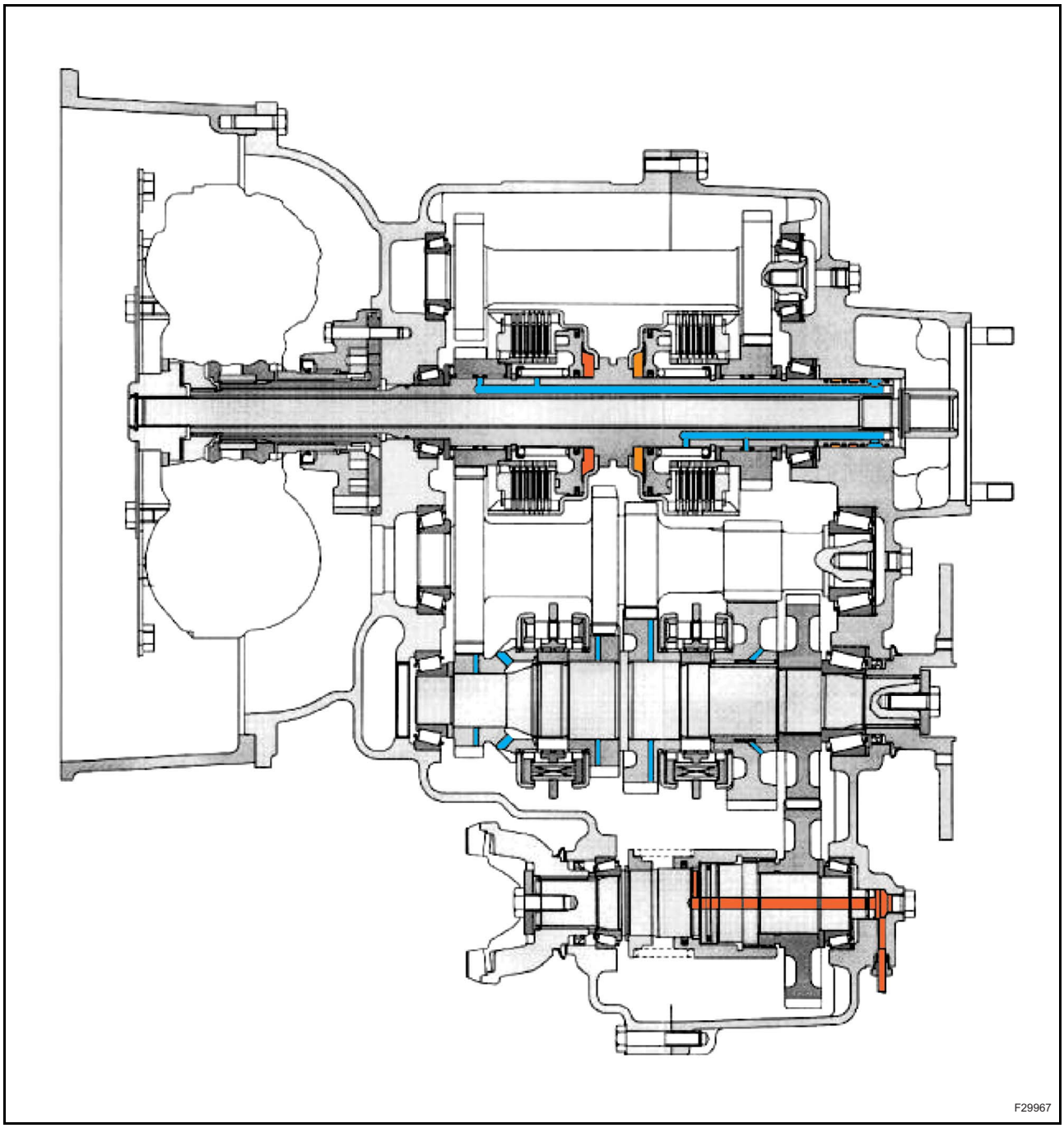
Oil capacity: 18 litres

Suggested oil:
10W or 10W30 Grade mineral oils or automatic transmission fluids which meet at least one of the following specifications are allowable for use in ambient temperatures of between -20 and 40 °C:
Akcela Nexplore MAT3525.

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1.5 TRANSMISSION OIL FLOW AND SUPPLY

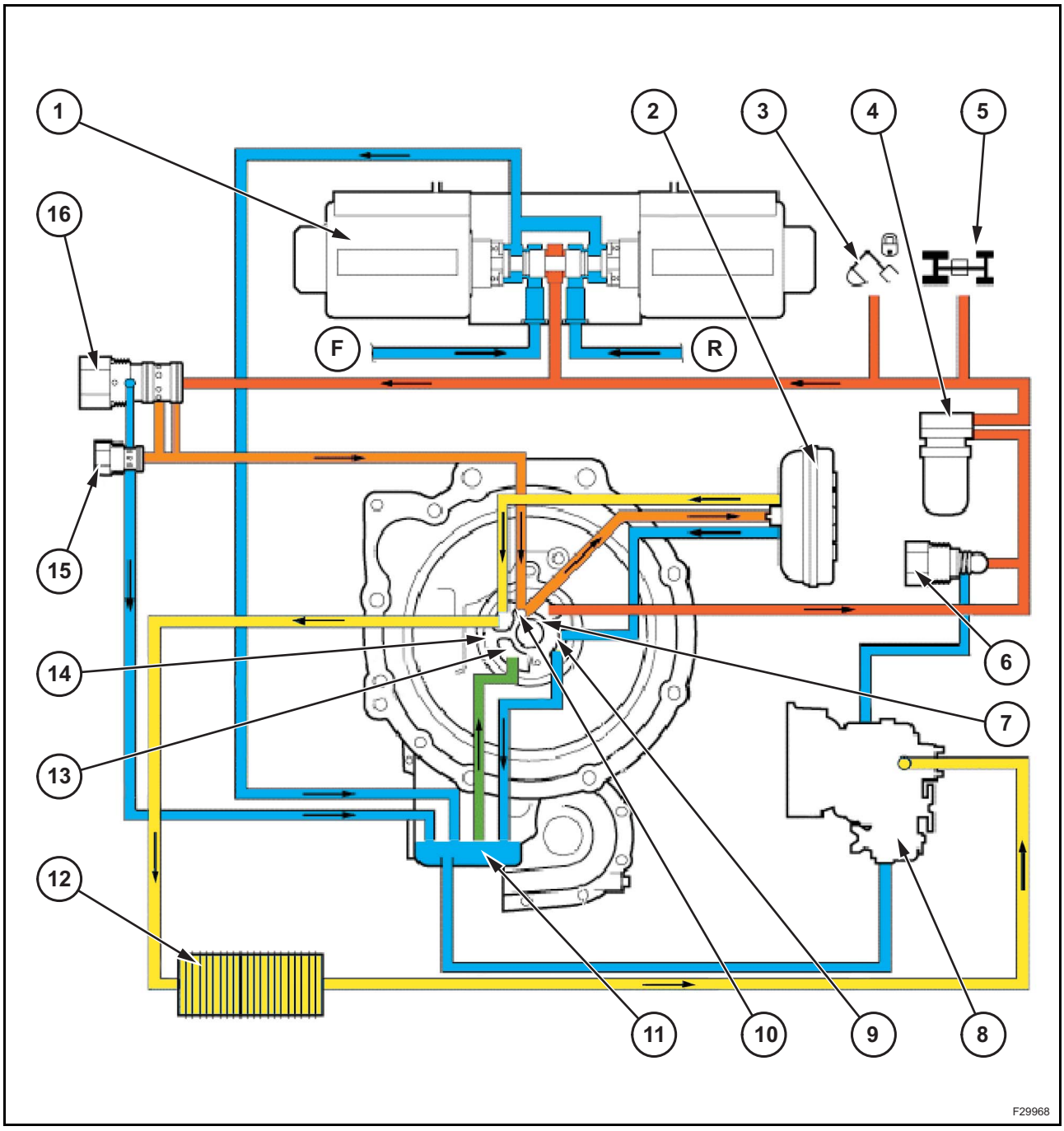


Pressure oil
Disengaged
Lubrication

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OIL FLOW AND SUPPLY IN NEUTRAL POSITION



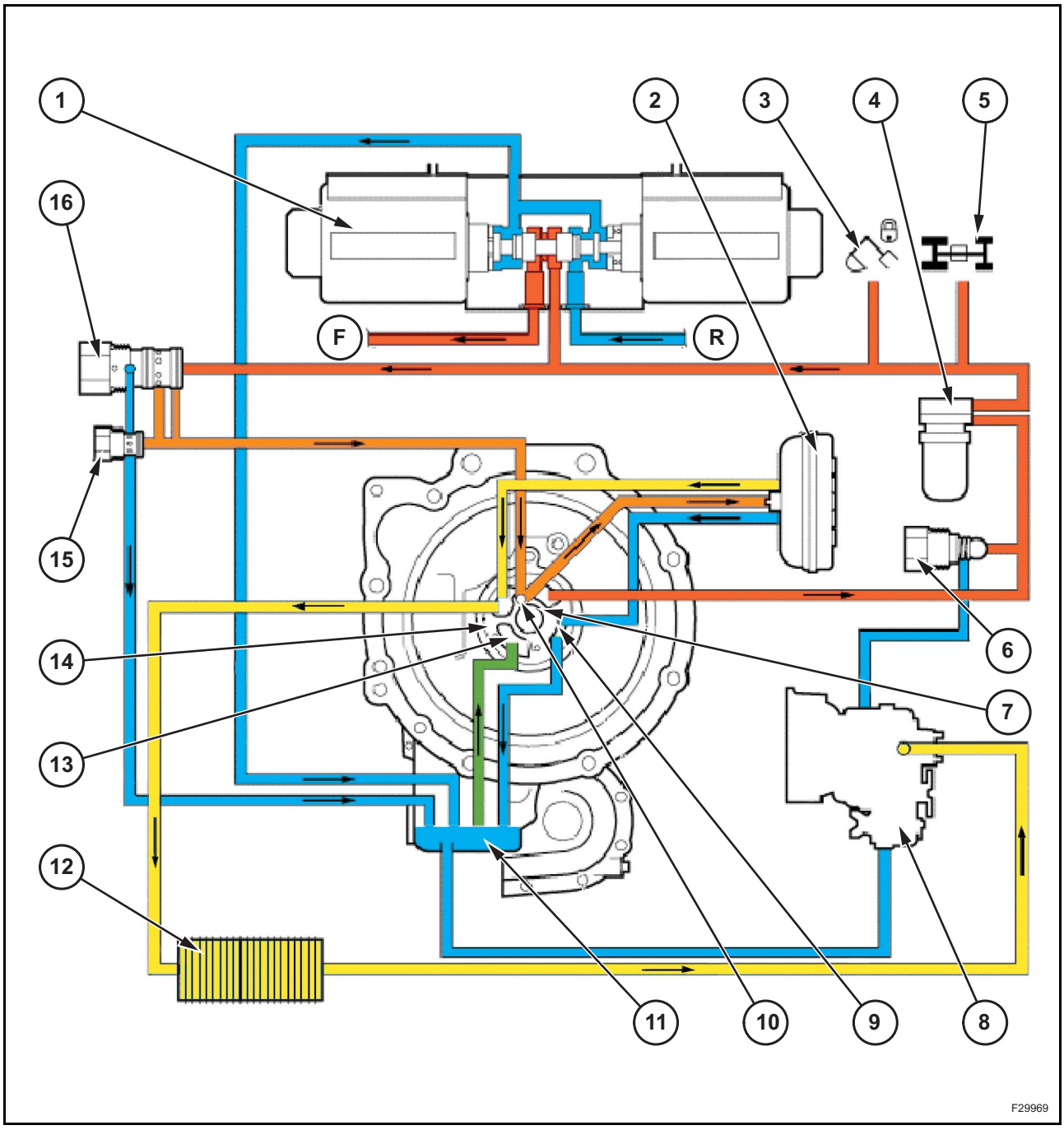
Pump pressure
Return to Sump
Torque converter flow
Lubrication
Suction

1. Powershuttle control solenoid valve oil 14 bar.
2. Torque Converter - Receives low pressure system oil at maximum 10 bar and returns oil to port (10).
3. Backhoe Boom Lock oil flow 14 bar.
4. Pressure filter - Mounted to the left of the transmission viewed looking forward.
5. FWD - Low pressure system oil supply received from the filter at 14 bar and fed by external tube to rear of transmission to the FWD.
6. Cold start pressure protection valve - prevents system pressure exceeding 26 bar at initial cold start.
7. Oil Pump Port OUT, to oil filter assembly through internal drillings.
8. Oil returned from the oil cooler lubricates shafts, gears and bearings and returns oil to tank.

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OIL FLOW AND SUPPLY IN FORWARD POSITION



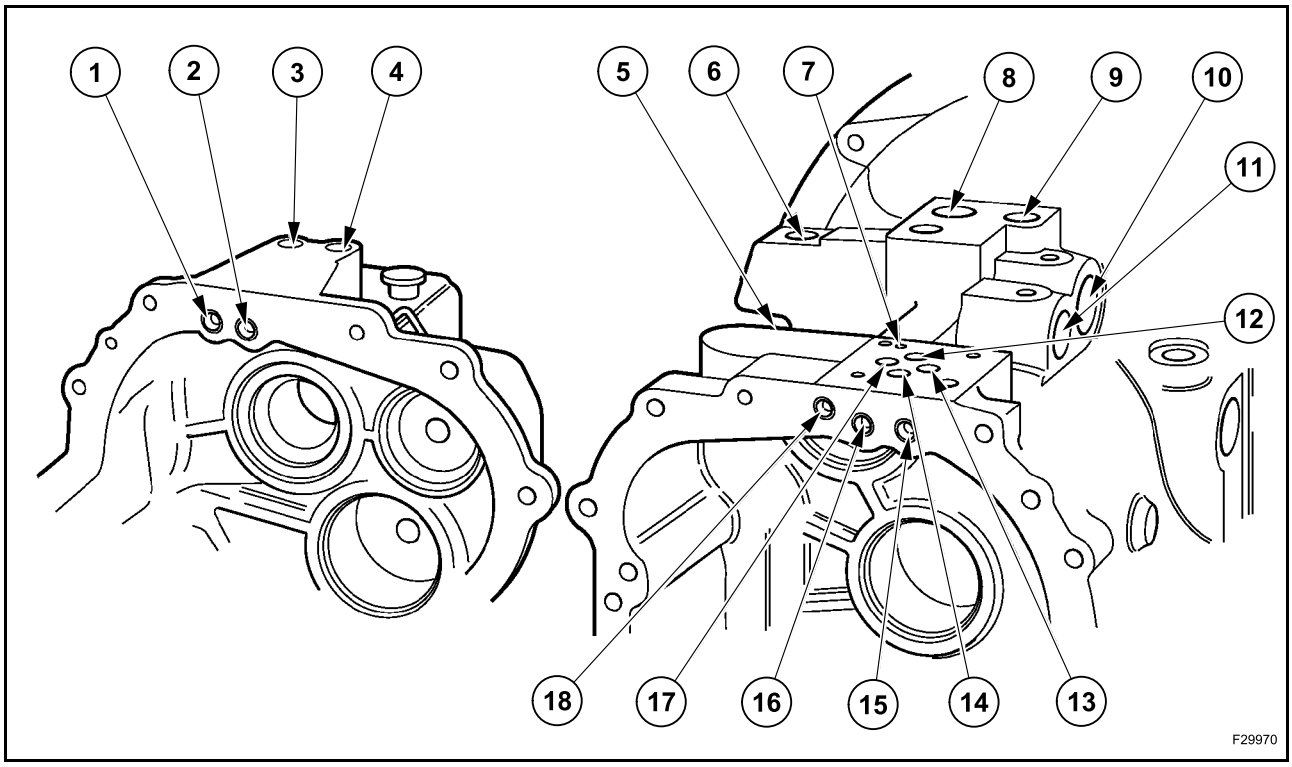
Pump pressure
Return to Sump
Torque converter flow
Lubrication
Suction

1. Returned lubrication oil from the pump shaft bush to tank.
2. Torque Converter oil supply IN, received at maximum 10 bar.
3. Transmission tank/system capacity: 17 litres (2WD) 18 litres (4WD).
4. Oil Cooler - Mounted below the engine coolant radiator.
5. Oil pump suction port IN, from the tank.
6. Torque Converter oil OUT, to oil cooler.
7. Torque Converter pressure regulating valve, receives oil from the sequencing valve (16) and returns oil in excess of 10 bar to tank.
8. System pressure sequencing valve - Maintains system oil at 14 bar and supplies a continuous oil feed to the torque converter regulating valve.

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TRANSMISSION OIL SUPPLY PORT



Viewed from front and rear housings

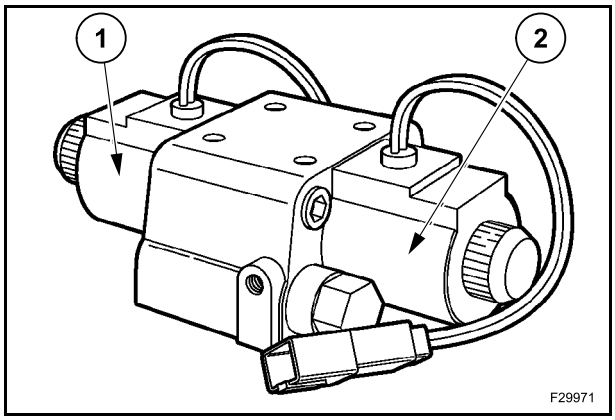
1. Oil supply port to reverse clutch pack, rear casing.
2. Oil supply port to forward clutch pack, rear casing.
3. Oil supply port to pressure test reverse clutch pack.
4. Oil supply port too pressure test forward clutch pack.
5. 4WD solenoid.
6. System pressure test point, connected to test block.
7. Locating dowel.
8. Cold start oil pressure protection valve.
9. Torque converter pressure test point, connected to test block.
10. System pressure sequencing valve.
11. Torque converter pressure regulating valve.
12. Oil supply from pump to solenoid valve pack.
13. Oil supply port to reverse clutch pack, front casing.
14. Oil port to tank (dump) from solenoid.
15. Oil supply port to reverse clutch pack, front casing.
16. Oil supply port to forward clutch pack, front casing.
17. Oil supply port to forward clutch pack, front casing.
18. Manufacturing drilling only.
19. Forward oil supply port (front casing).
20. Forward oil supply port (rear casing).

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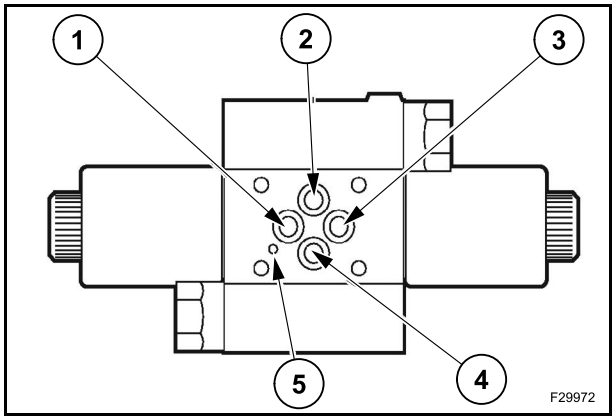
TRANSMISSION OIL FLOW THROUGH SOLENOID VALVE

The forward (1) or reverse (2) solenoid valves fitted at the top of the transmission housing control the oil flow to the forward and/or reverse clutch packs in the transmission.

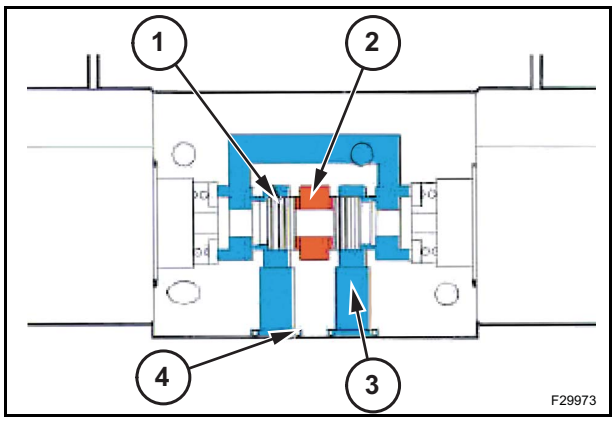


On the underside of the solenoid valve are the 4 ports for directional oil flow to and from the solenoid valve.

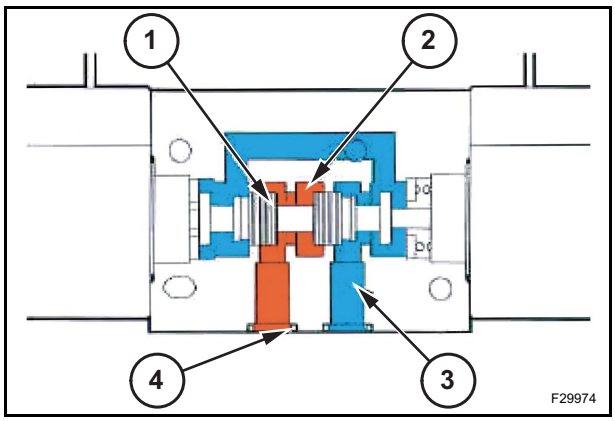
1. Oil supply from the valve to the forward clutch pack
2. Return oil to tank
3. Oil supply from the valve to the reverse clutch pack
4. Oil supply from the pump into the valve
5. Locating pin



When the powershuttle lever in the cab is in neutral position the solenoid valve spool (1) will be static and oil (2) will not flow into either reverse (3) or forward (4) clutch pack oil gallery.



When forward direction is selected on the power-shuttle lever the solenoid valve spool (1) will move to the left (as shown) and the oil (2) will flow into the forward clutch pack oil gallery (4).
When reverse direction is selected on the power-shuttle lever the solenoid valve spool (1) will move to the right (not shown) and the oil (2) will flow into the reverse clutch pack oil gallery (3).

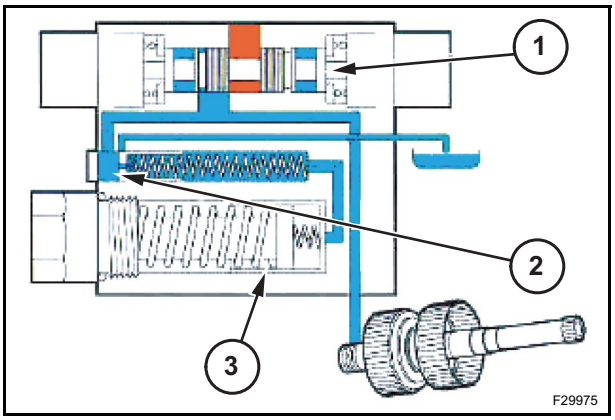


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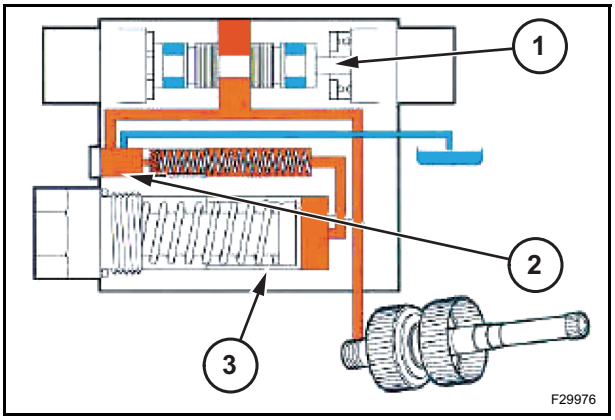
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OIL FLOW SOLENOID CONTROL VALVE OPERATION (FORWARD DRIVE ONLY SHOWN)

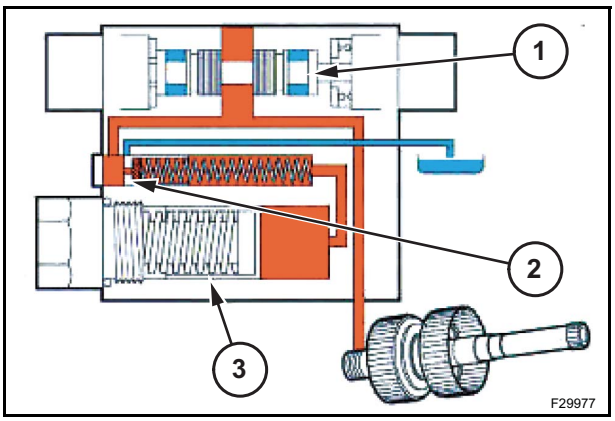
The solenoid valve when in neutral position dead heads the oil flow at the spool (1) from the supply port and no oil is allowed to pass through the valve. Therefore the oil in the galleries beyond the spool at the fill time metering valve (2) remains static.



Selection of the forward / reverse powershuttle lever in the cab directs a current flow to the forward or reverse solenoid and the spool (1) will move in the direction selected, reverse shown. The oil then flows past the spool to the clutch pack and applies pressure to the fill time metering valve (2), a small bore allows oil to flow into the clutch feathering valve.
When valve (2) moves it partially uncovers a port to the tank and also opens the control orifice within the valve. Therefore a precisely metered flow of oil is fed to the pressure regulating (feathering) piston (3). As this piston is pushed back against its spring the pressure at the clutch builds up gradually to give a smooth jerk free clutch engagement.



When the piston reaches the end of its travel, clutch pressure quickly builds up to full system pressure either side of valve (2) so the light spring pushes the valve covering the port to the tank.
The oil is dead headed at system pressure at the clutch so ensuring full torque can be transmitted by the clutch.



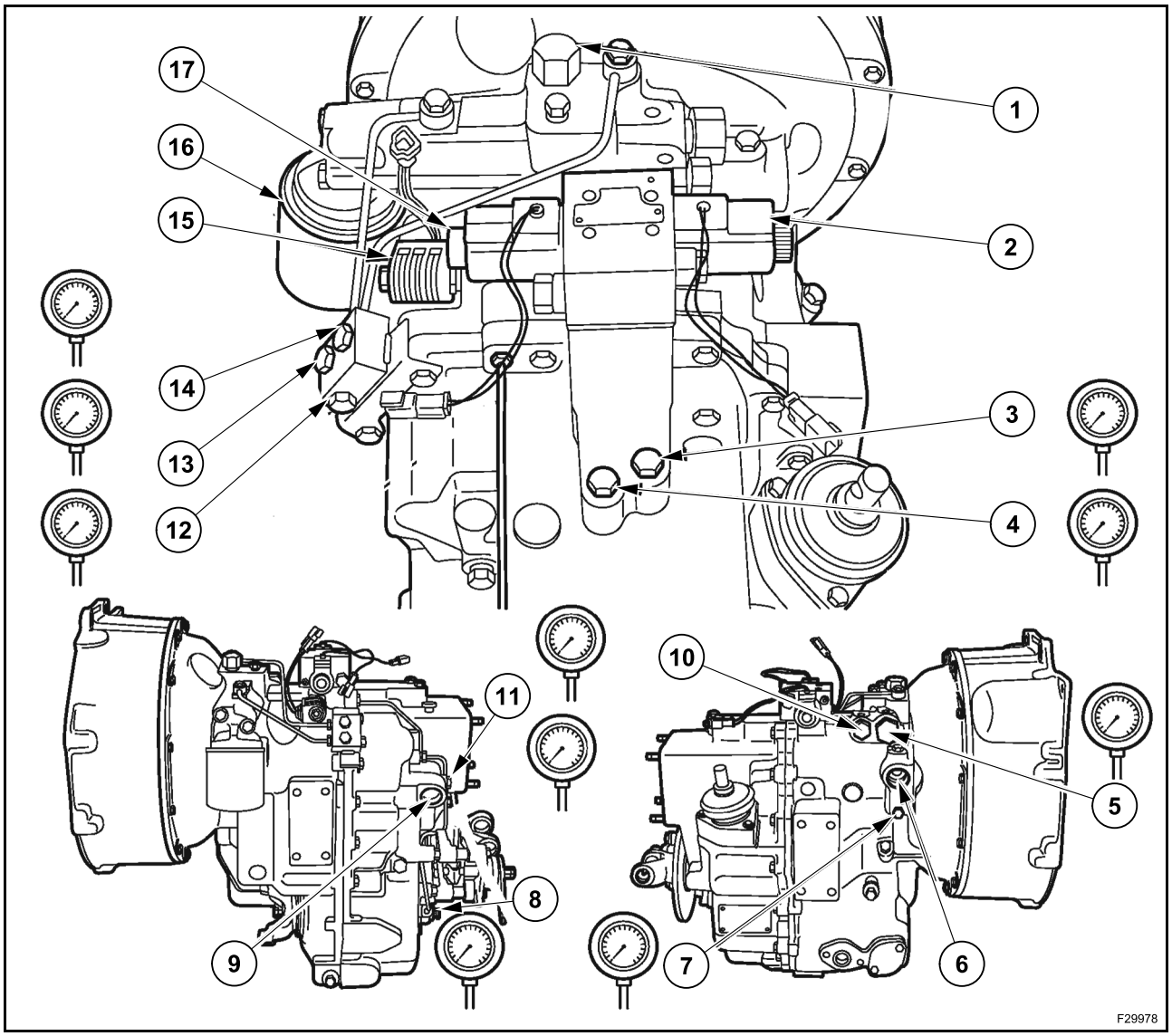
NOTE: the control valve also includes a pressure regulating (feathering) valve and a fill time metering valve for the reverse clutch pack.

Regulated pressure oil
Return oil
Pressure oil

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1.6 TRANSMISSION HYDRAULIC VALVES AND PRESSURE TEST POINTS



NOTE: all pressure test ports are 9/16 in UNF thread size.

1. **Cold start oil pressure relief valve**
   26 bar reference only
2. **Forward travel solenoid valve**
   13.7-15.2 bar
3. **Test port for reverse clutch pack**
   13.7-15.2 bar
4. **Test port for forward clutch pack**
   13.7-15.2 bar
5. **System pressure sequencing valve**
   13.7-15.2 bar
6. **Oil flow OUT to cooler**
7. **Oil OUT to cooler, test port**
   6.5 bar
8. **Front wheel drive test point**
   13.7-15.2 bar
9. **Oil flow IN from cooler**
10. **Torque converter pressure regulating valve**
    7-11 bar
11. **Oil in from cooler, test port**
    3.5 bar
12. **Backhoe attachment boom lock supply**
    13.7-15.2 bar
13. **System pressure test point**
    13.7-15.2 bar
14. **Converter pressure oil test port**
    7-11 bar
15. **Front wheel drive solenoid**
    13.7-15.2 bar
16. **Oil filter**
17. **Reverse solenoid valve**
    13.7-15.2 bar

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1.7 TRANSMISSION POWER FLOW

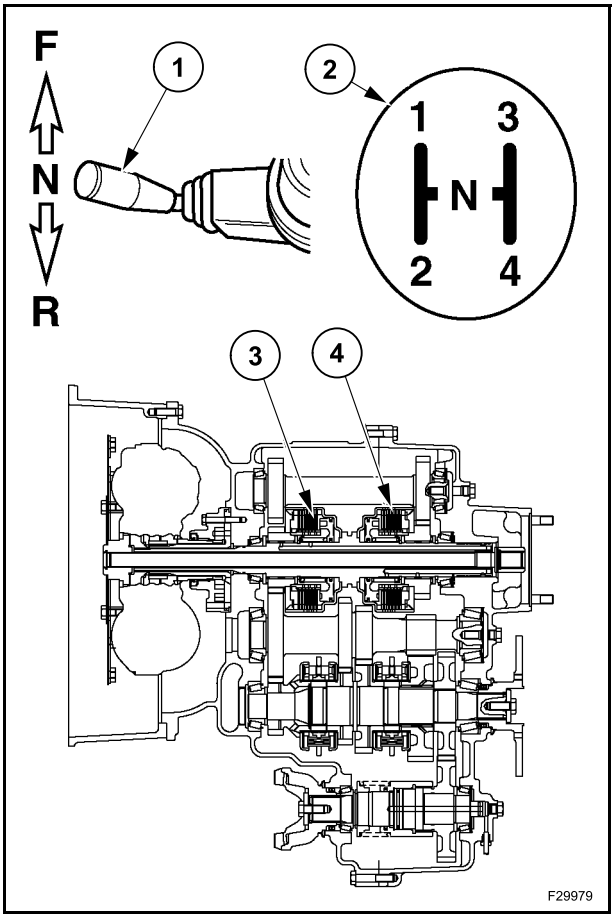
When neutral is selected on the powershuttle lever (1), the transmission forward (3) and reverse hydraulic clutch packs or (4) are free to rotate and hence there is no drive in the transmission.

With forward or reverse selected on the powershuttle lever (1) power will be directed through the clutch packs (3) or (4) to the gear train and selection of gear on lever (2) will result in engagement of gears to the output shafts.

Power for all four forward gear ratios is transmitted from the front hydraulic clutch (3) on the input shaft. The input shaft then transmits power to the counter shaft forward gear and the countershaft in turn transmits power to the output shaft.

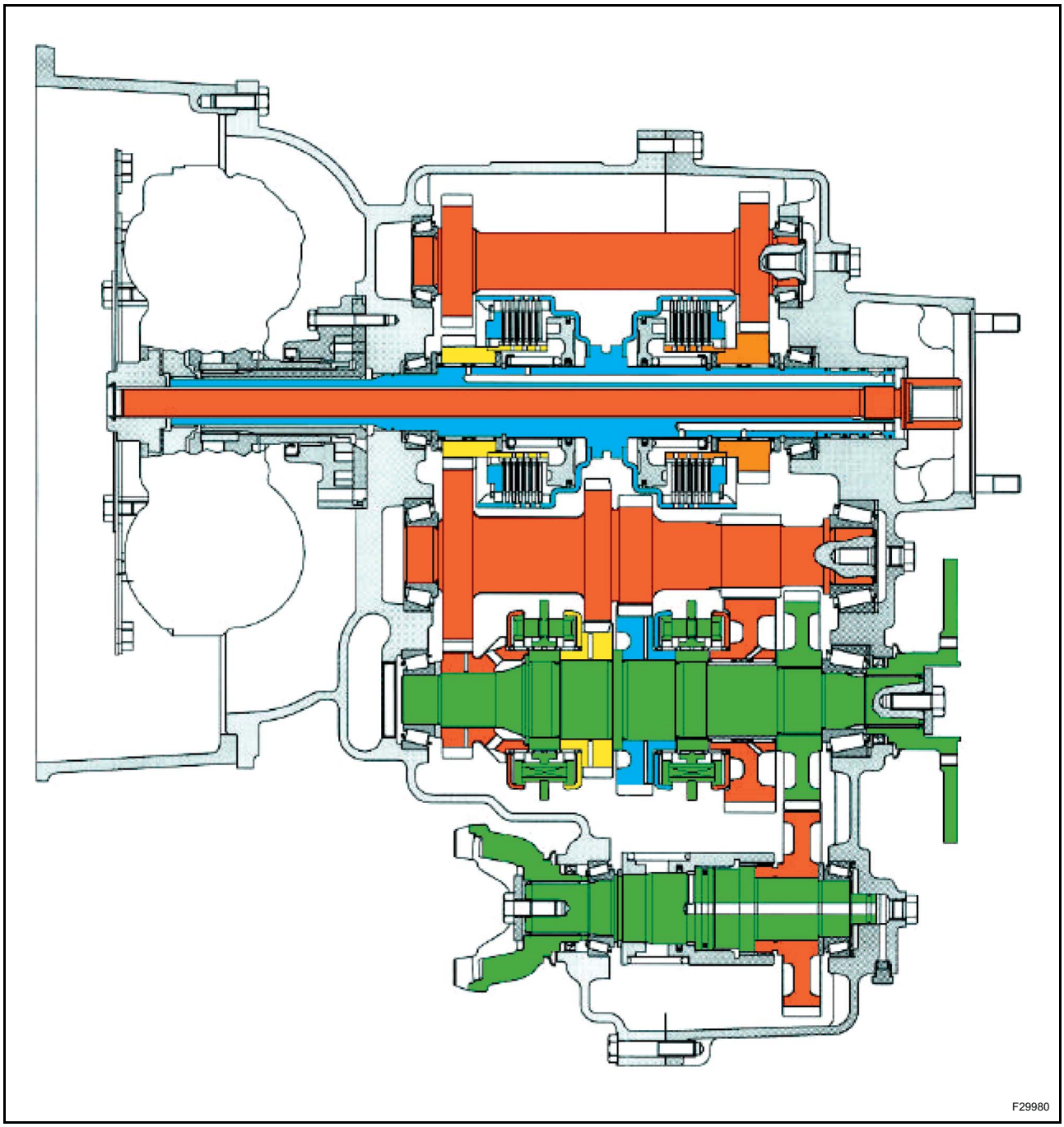
Power flow for all four reverse gear ratios is the same as for all four forward gear ratios except that the rear clutch (4) is engaged to transmit power to the reverse idler gear. The reverse idler gear in turn transmits power to the gear on the countershaft and in turn transmits power to the output shaft.

Because power is being transmitted through the reverse idler gear, the countershaft and output shaft will rotate in the opposite direction as for forward gear ratios. The rear input shaft will also rotate in the opposite direction.



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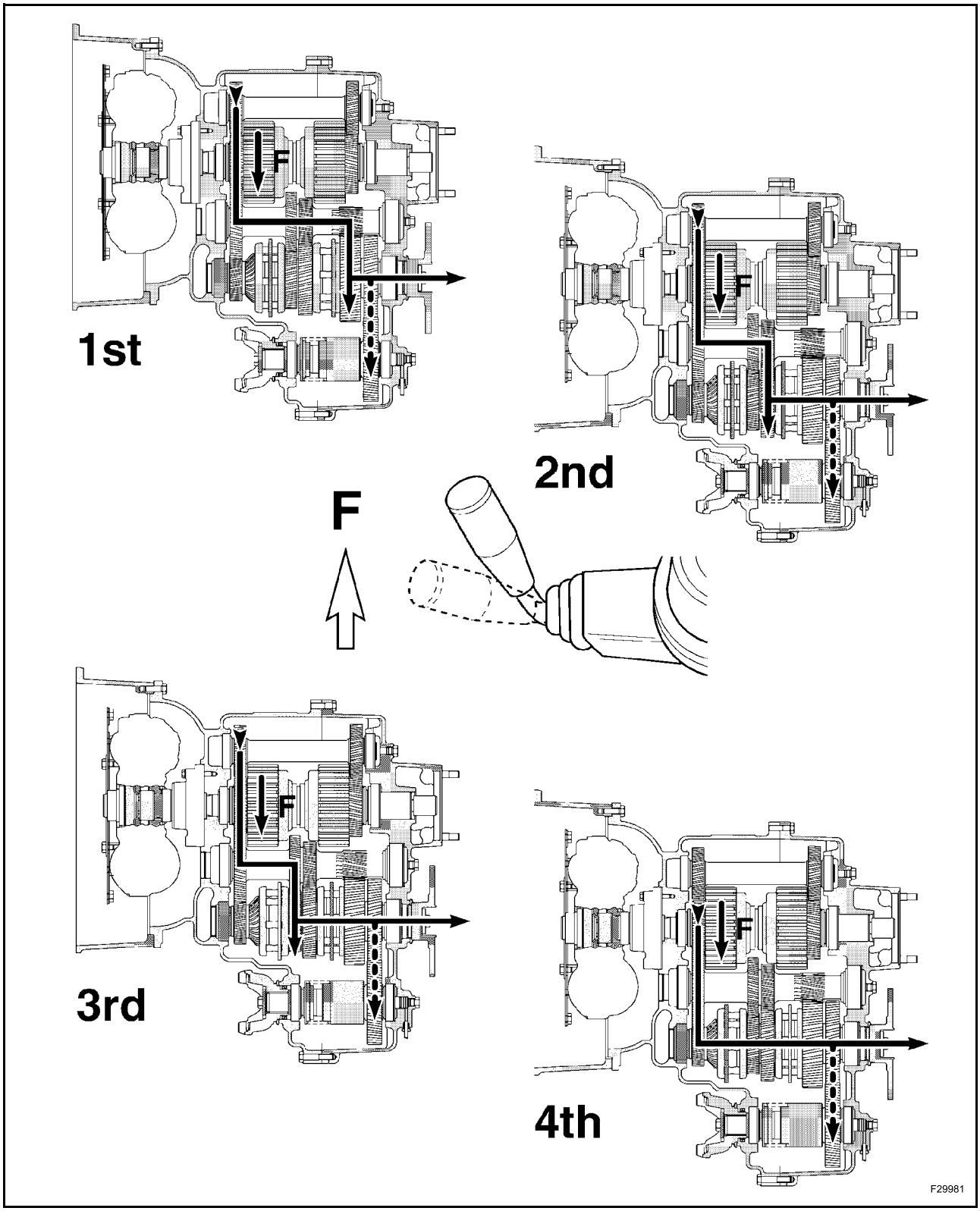
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Input
Intermediate
Output

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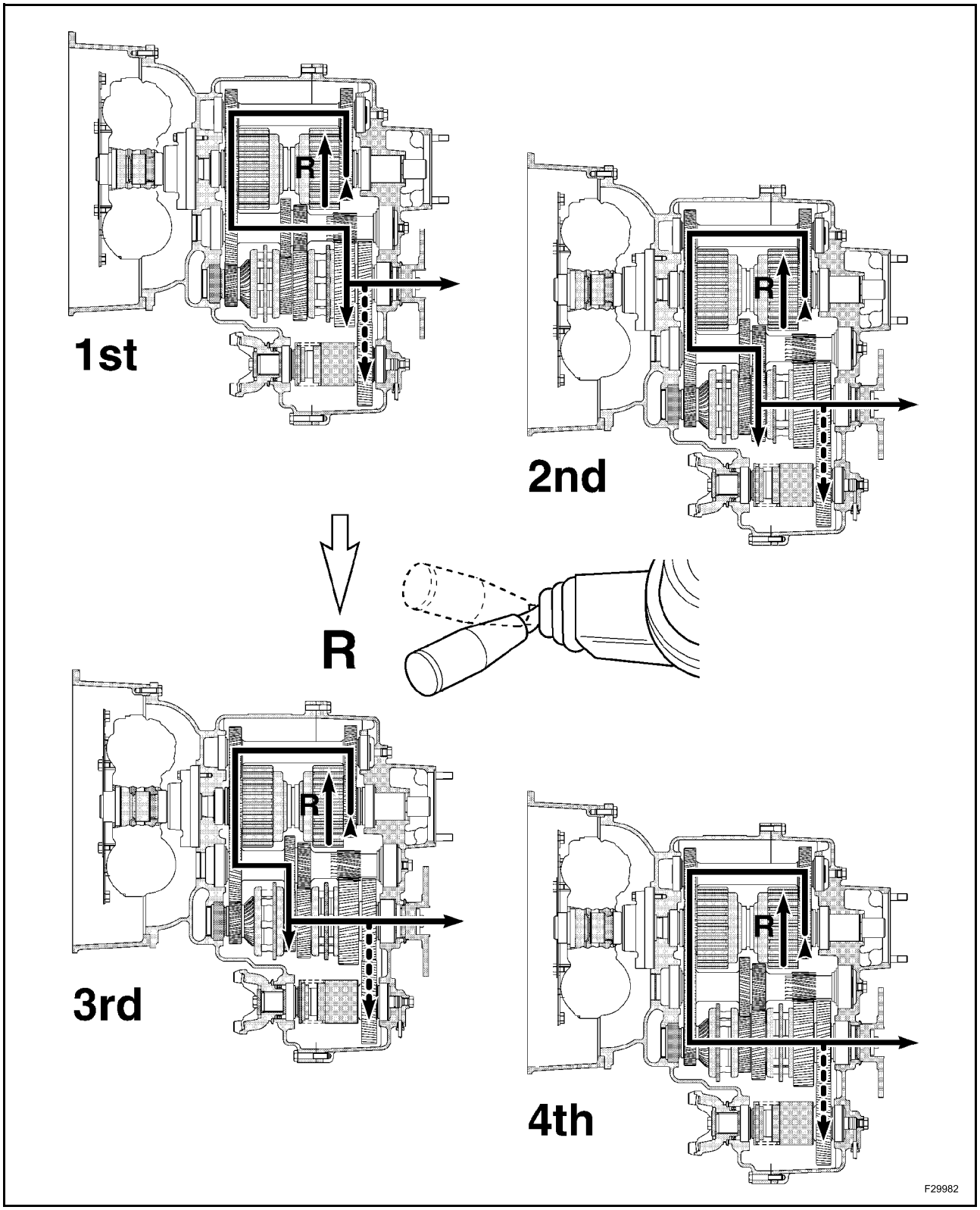
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NOTE: 4WD shown.

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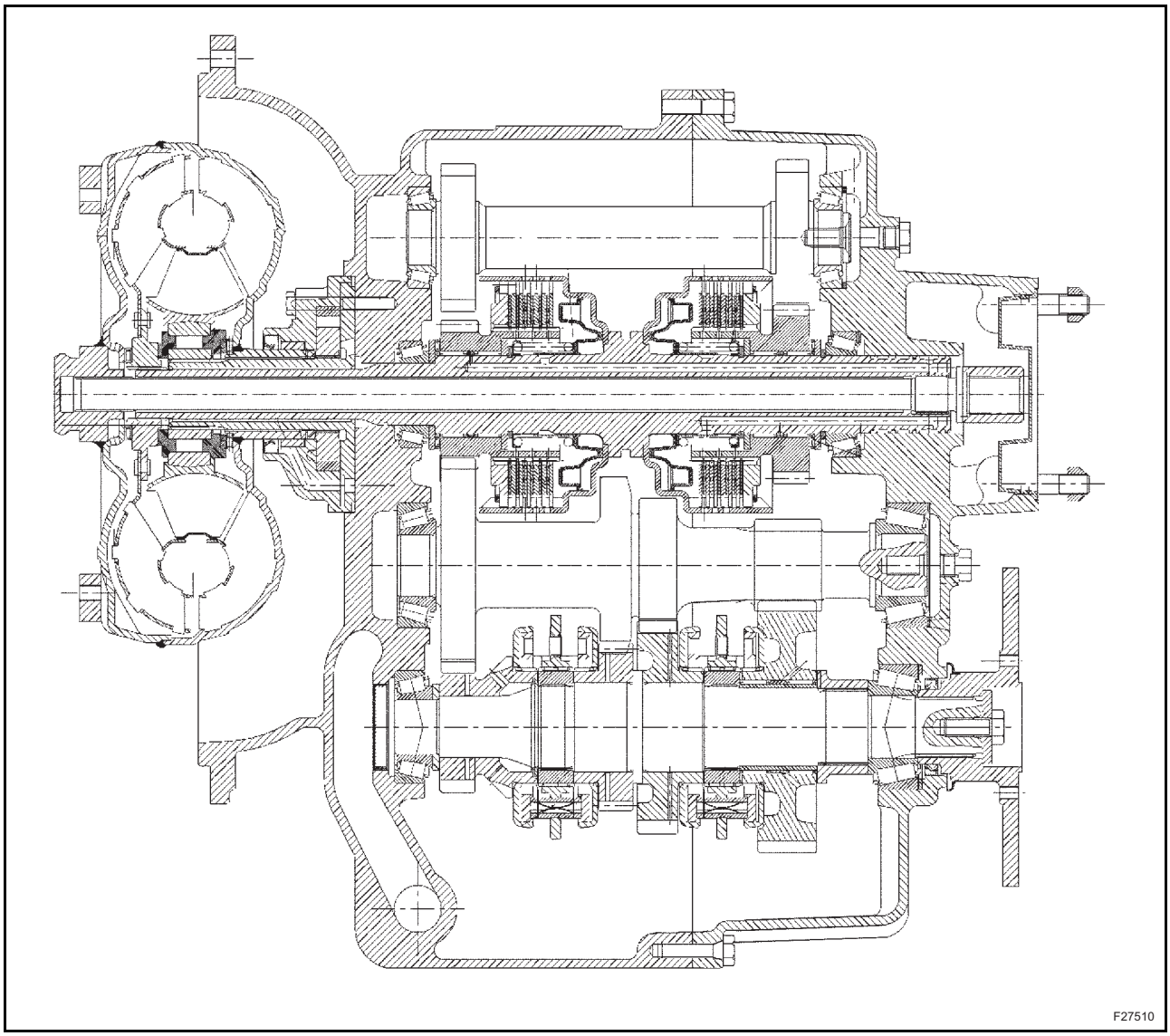


NOTE: 4WD version shown.

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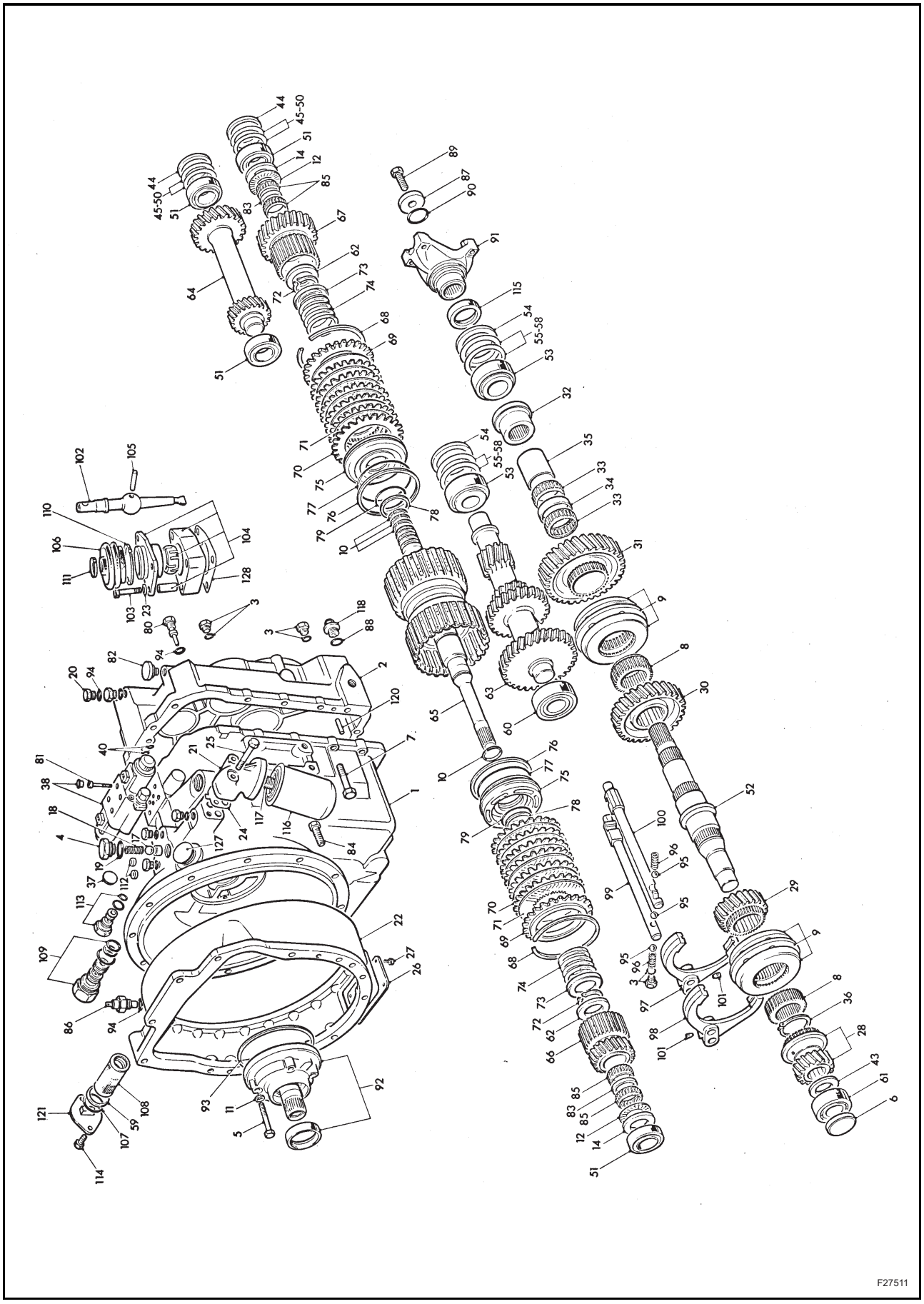
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1.8 TRANSMISSION 2WD COMPONENTS



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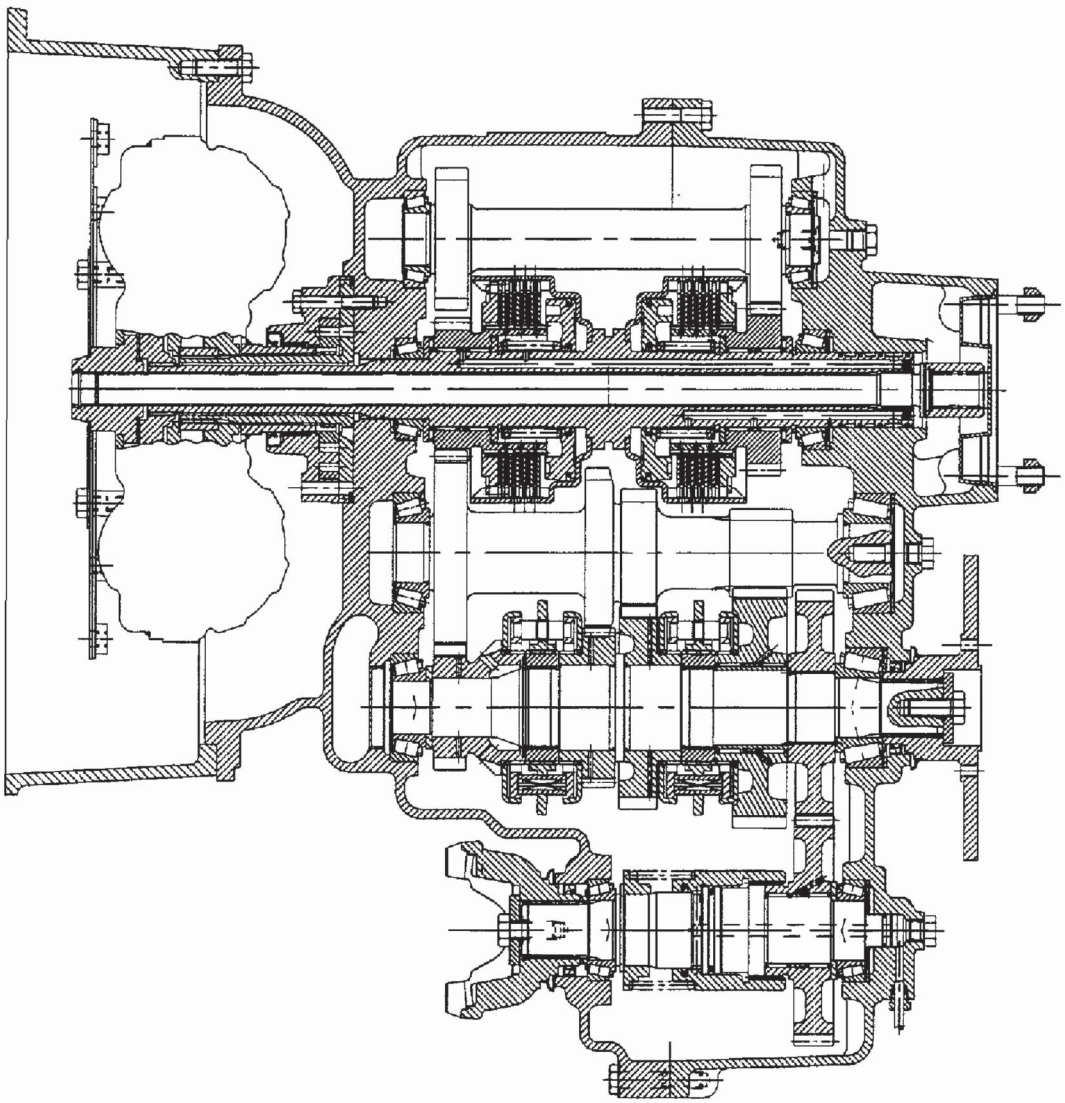
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1. Front gear case assembly
2. Rear gear case assembly
3. Plug and O-ring
4. Cold start spring housing
5. Screw
6. Sealing cap
7. Screw
8. Reverse shift hub sleeve
9. Synchronizer assembly
10. Ring seal
11. Copper washer
12. Thrust bearing
14. Thrust washer
17. Ball
18. Cold start spring
19. O-ring
20. Plug
21. Oil filter housing
22. Flywheel housing
23. Washer
24. Filter housing gasket
25. Screw
26. Cover plate
27. Adjuster screw
28. 4th gear output shaft
29. 3rd gear output shaft
30. 2nd gear output shaft
31. 1st gear output shaft
32. Spacer
33. Bearing
34. 1st gear bearing spacer
35. 1st gear bearing sleeve
36. Circlip
37. Expansion plug
38. Directional valve
40. O-ring
43. 4th gear thrust washer
44. Bearing spacer
45. Shim
50. Shim
51. Bearing
52. Output shaft
53. Bearing
54. Bearing spacer
55. Shim
58. Shim
59. Support washer
60. Bearing
61. Bearing
62. Thrust washer
63. Countershaft
64. Reverse idler gear
65. Input shaft assembly
66. Forward primary gear
67. Reverse primary gear
68. Clutch pack retaining clip
69. Clutch pack retaining plate
70. Clutch plate
71. Clutch plate (friction)
72. Circlip
73. Spring retainer
74. Piston return spring
75. Piston
76. Piston sealing ring outer
77. O-ring
78. Piston sealing ring inner
79. O-ring
80. Breather plug
81. Capscrew
82. Breather
83. Needle bearing spacer
84. Screw
85. Bearing - needle
86. Temperature sender
87. Output yoke washer
88. O-ring
89. Screw
90. O-ring
91. End yoke assembly
92. Pump assembly
93. Pump sealing ring
94. O-ring
95. Detent ball
96. Detent spring
97. 1st/2nd shift fork
98. 3rd/4th shift fork
99. 1st/2nd shift rod
100.3rd/4th shift rod
101. Shift fork screw
102. Gearshift lever
103. Screw
104. Gear lever seating
105. Pin
106. Rubber boot
107.O-ring
108. Suction strainer
109. Pressure regulator valve
110. Plastic clip
111. Plastic clip
112. Plug
113. Converter relief valve
114. Adjuster screw
115. Oil seal
116. Oil filter
117. Oil filter adapter
118. Drain plug
120. Dowel
121. Strainer cover plate
127. Plug

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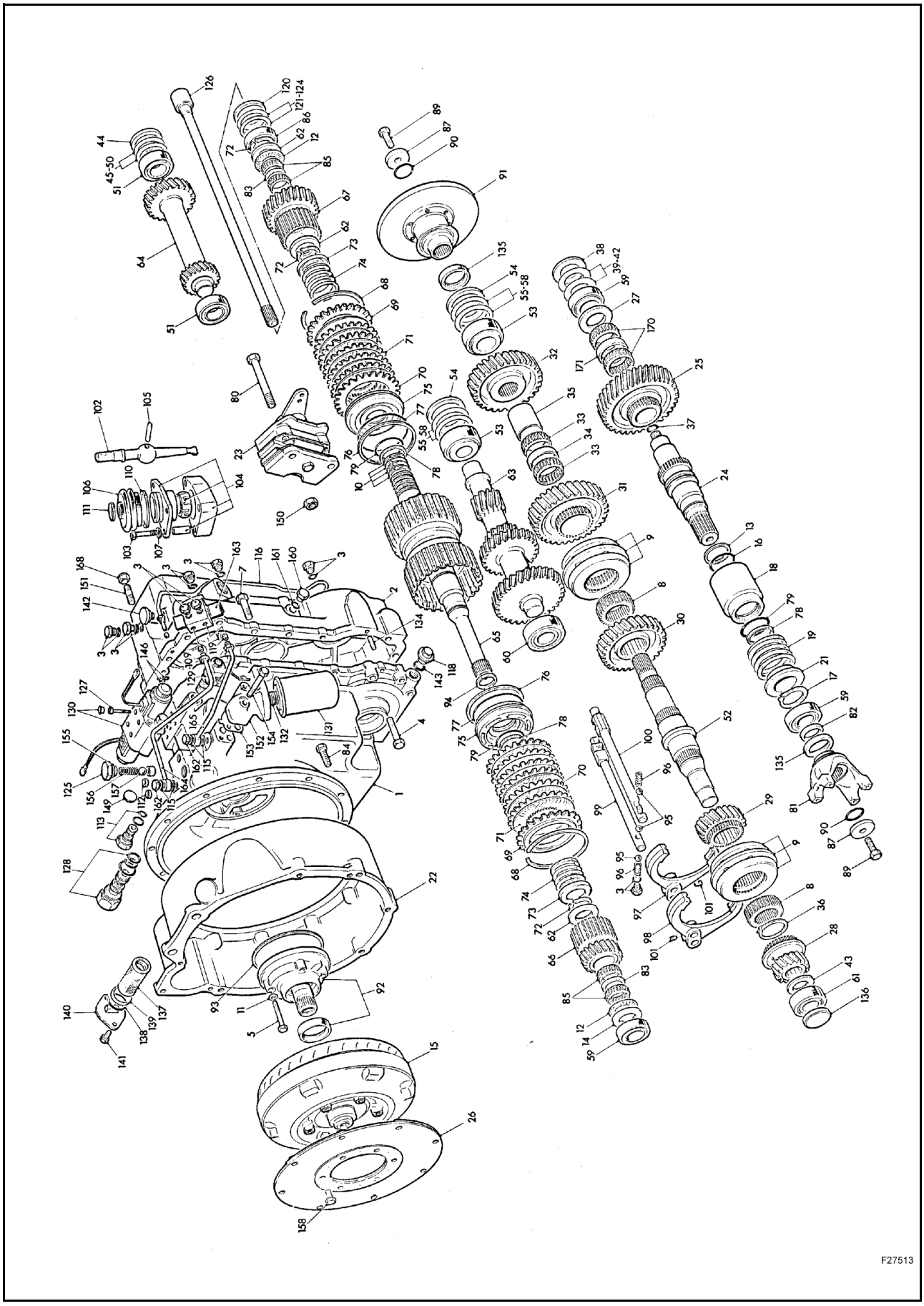
1.9 TRANSMISSION 4WD COMPONENTS



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1. Front gear case assembly
2. Rear gear case assembly
3. Plug assembly
4. Screw
5. Screw
7. Screw
8. Reverse shift hub sleeve
9. Synchronizer assembly
10. Sealing ring
11. Copper washer
12. Thrust bearing
13. 4WD piston sealing ring
14. Support washer
15. Torque converter
16. O-ring 4WD piston
17. Circlip
18. Clutch collar
19. Spring 4WD
21. Spring support
22. Flywheel housing
23. Parking brake assembly
24. 4WD shaft
25. 4WD gear
26. Converter drive plate
27. Thrust washer
28. 4th gear output shaft
29. 3rd gear output shaft
30. 2nd gear output shaft
31. 1st gear output shaft
32. 4WD gear output shaft
33. Bearing 1st gear output shaft
34. Bearing spacer
35. Bearing sleeve
36. Circlip
37. Sealing ring 4WD shaft
38. Bearing spacer
39. Shim
42. Shim
43. Thrust washer
44. Bearing spacer
45. Shim
46. Shim
47. Bearing
52. Output shaft
53. Bearing
54. Bearing spacer
55. Shim
58. Shim
59. Bearing
60. Bearing
61. Bearing
62. Thrust washer
63. Countershaft
64. Reverse idler gear
65. Input shaft assembly coaxial
66. Forward primary gear
67. Reverse primary gear
68. Clutch pack retaining ring
69. Clutch pack retaining plate
70. Clutch plate - steel
71. Clutch plate - friction
72. Circlip
73. Spring retainer
74. Piston return spring
75. Clutch piston
76. Piston sealing ring
77. O-ring
78. Piston sealing ring
79. O-ring
80. Brake caliper bolt
81. End yoke
82. Spacer ring
83. Needle bearing spacer
84. Screw
85. Bearing - needle
86. Bearing
87. Output flange washer
89. Screw
90. O-ring
91. Brake flange assembly
92. Pump assembly
93. Sealing ring
94. Sealing ring
95. Detent ball
96. Detent spring
97. 1st/2nd shift fork
98. 3rd/4th shift fork
99. 1st/2nd shift rod
100.3rd/4th shift rod
101. Shift fork screw
102. Gear stub lever
103. Screw
104. Gear lever seating
105. Pin
106. Rubber boot
107. Washer
109. Hydraulic pipe nut
110. Plastic clip
111. Plastic clip
112. Plug
113. Converter relief valve
114. Adjuster screw
115. Banjo bolt washer
116.4WD clutch supply pipe
118. Drain plug assembly
119. Hydraulic pipe sleeve
120. Bearing spacer
121. Shim
124. Shim
125. Cold start spring housing
126. Coaxial drive shaft
127. Capscrew
128. Pressure regulator valve
129.4WD solenoid
130. Directional control valve
131. Oil filter
132. Oil filter adapter

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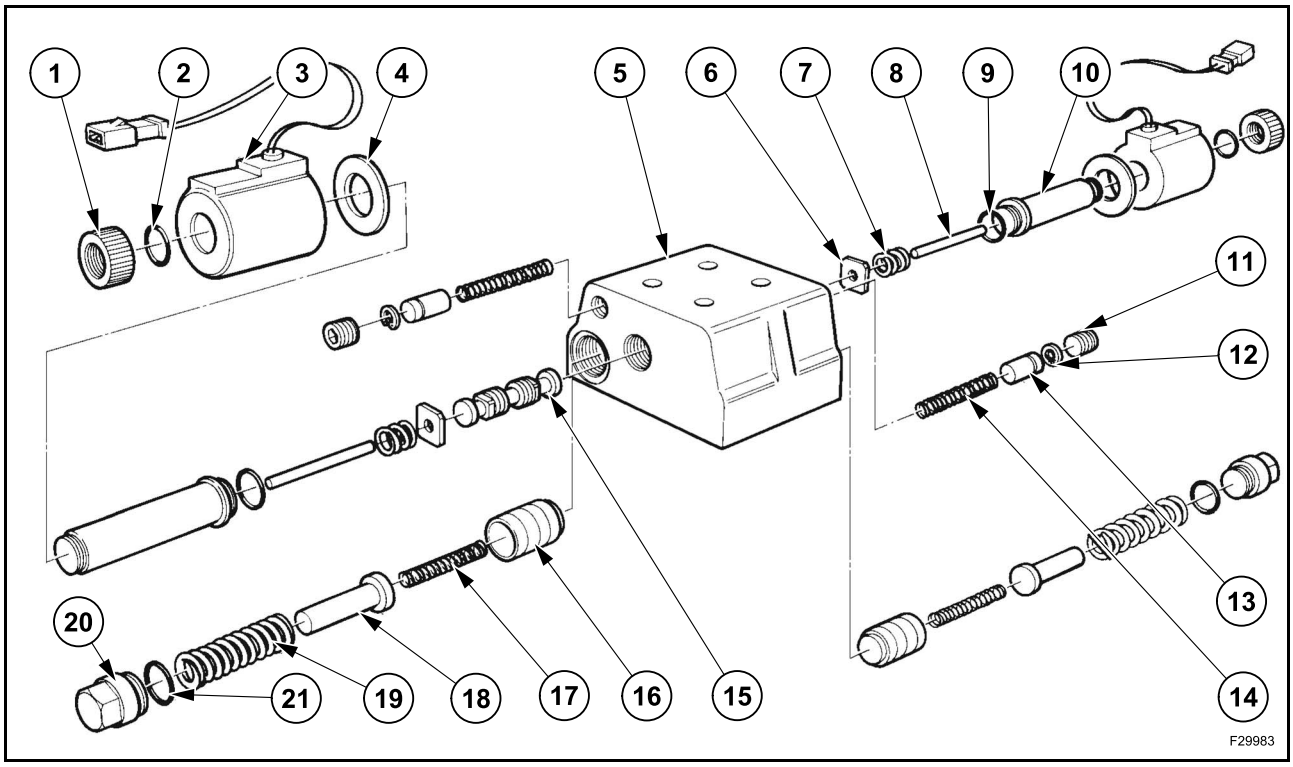
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134. Dowel
135. Oil seal
136. Sealing cap
137. Suction strainer
138.O-ring suction strainer
139. Support washer
140. Strainer cover plate
141. Adjuster screw
142. Breather
143.O-ring
146.O-ring
149. Expansion plug
150. Brake caliper nut
151. Pump mounting stud
152. Oil filter housing
153. Filter housing gasket
154. Screw
155.O-ring
156. Cold start spring
157. Ball
158. Adjuster screw
160. Adjuster screw
161. Copper washer
162. Screw
163. Remote test port assembly
164. Remote test port pipe
165. Remote test port pipe
168. Pump mounting stud nut
170.4WD gear bearing
171. Spacer 4WD gear bearings

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SOLENOID VALVE COMPONENTS



1. Solenoid retainer
2. Dust seal
3. Solenoid
4. Washer
5. Solenoid body
6. Guide
7. Spring
8. Solenoid pin
9. Seal
10. Support body solenoid
11. End cap
12. Circlip
13. Clutch fill metering valve
14. Spring
15. Spool
16. Piston clutch fill
17. Spring
18. Retainer
19. Spring
20. Seal
21. Plug

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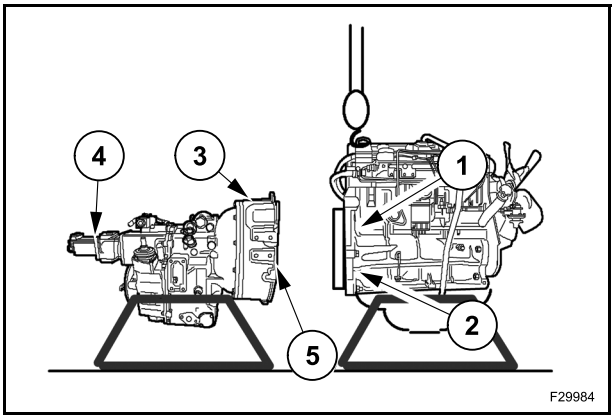
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1.10 TRANSMISSION REMOVAL

Remove the transmission and engine as a complete unit from the vehicle and place on a suitable stand for disassembly.

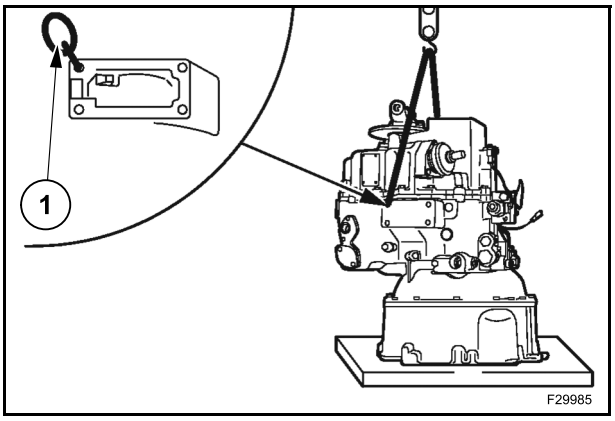
NOTE: prior to disassembly drain the oils into suitable containers for disposal.

Prior to separating the transmission from the engine.
Remove the starter motor (1).
Engine timing tab (2).
Torque converter back plate attaching bolts through the starter motor aperture (1).
Bell housing attachment bolts (3).



IMPORTANT: prior to positioning the transmission vertically remove the vehicle system oil pump (4) and torque converter unit (5) from the transmission bell housing (3).

Using eye bolts (1), one on each side capable of lifting a weight of 250 kg hoist the transmission vertically and place in a safe, clean and suitable workshop environment.



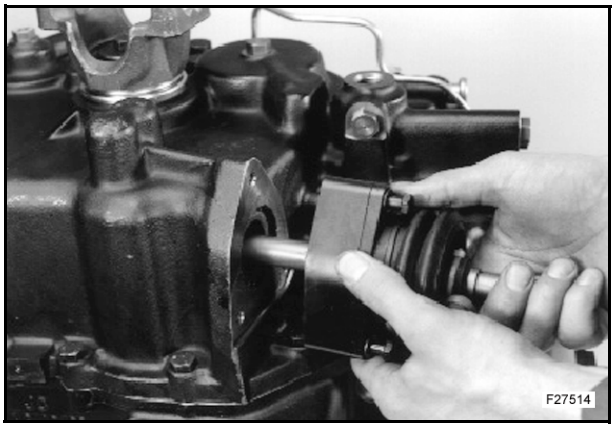
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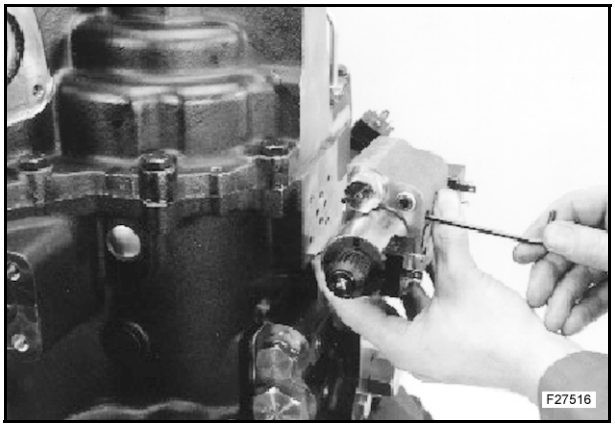
1.11 DISASSEMBLY AND ASSEMBLY

TRANSMISSION DISASSEMBLY

Invert the transmission on a suitable bench.
For convenience the bench top should have a hole in it to accommodate the input shaft and pump. Remove 3 screws and withdraw the gearshift lever assembly.



Remove the plastic plugs and 4 cap screws and withdraw the direction control valve.



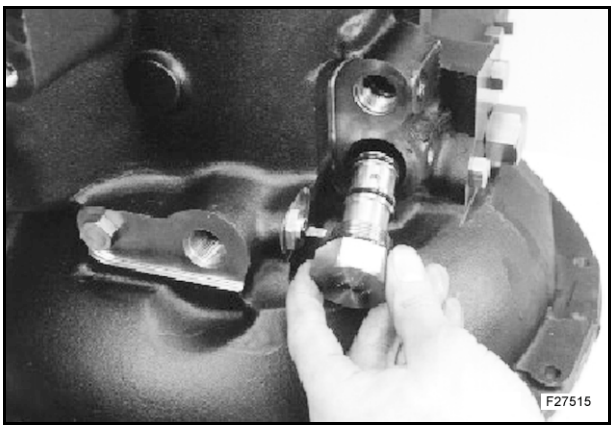
Remove the converter relief valve.



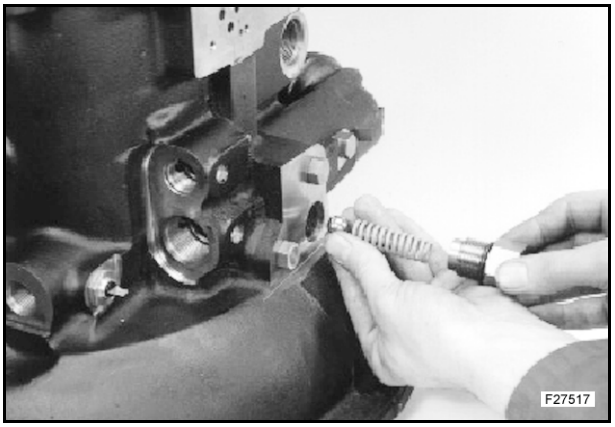
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Remove the pressure regulator valve.



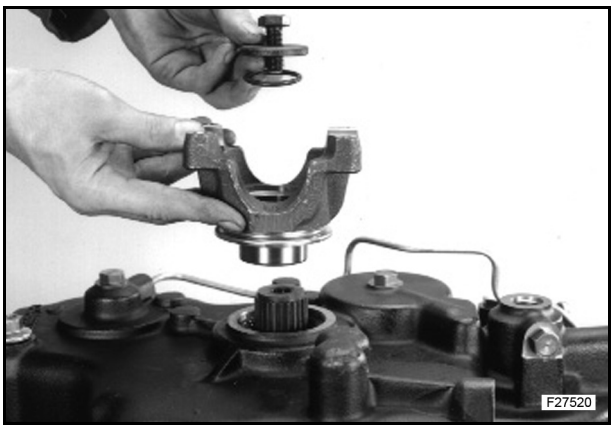
Remove the cold start housing, the spring and the ball.



Remove the temperature sender.



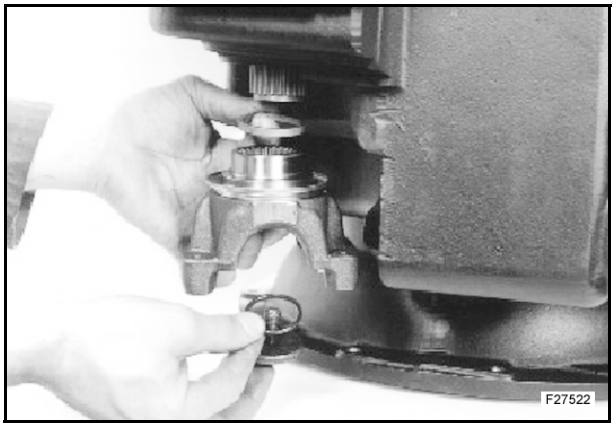
Remove the bolt, the washer and the O-ring and withdraw the output yoke.



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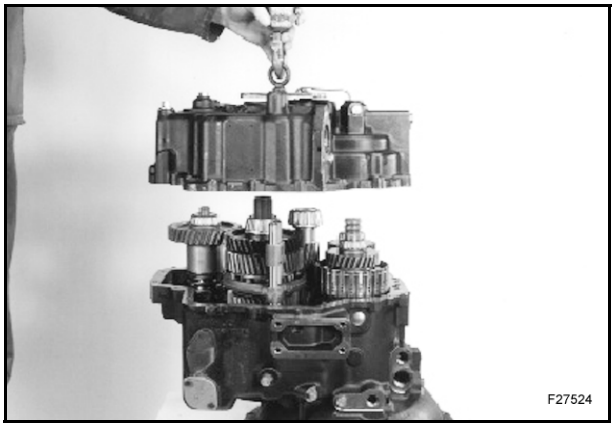
Remove the screw, the washer, the O-ring and extract the 4WD yoke and the spacer (on 4WD models only).



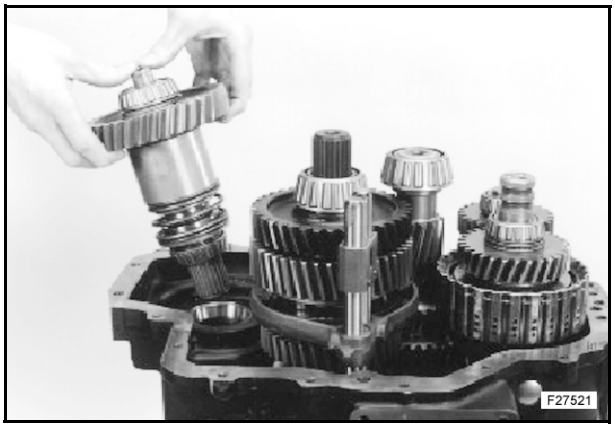
Remove 17 screws and using a suitable hoist take off the rear transmission case.
Lever slots are provided to assist removal.

NOTE: the bearing cones and shims may fall from the rear case during removal.

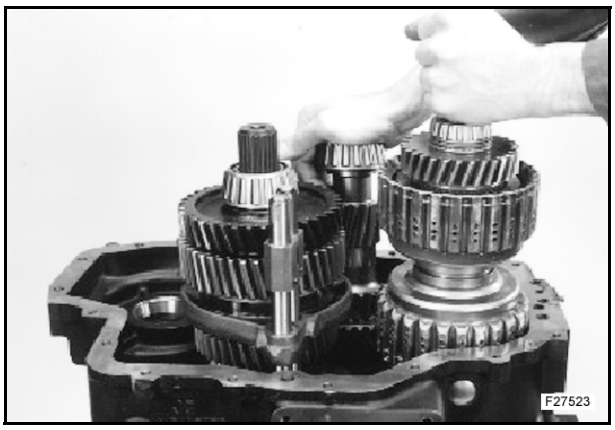
IMPORTANT: for proper reassembly, take note and mark which bearings and shims come from which locations.



Remove the 4WD shaft assembly (on 4WD models only).



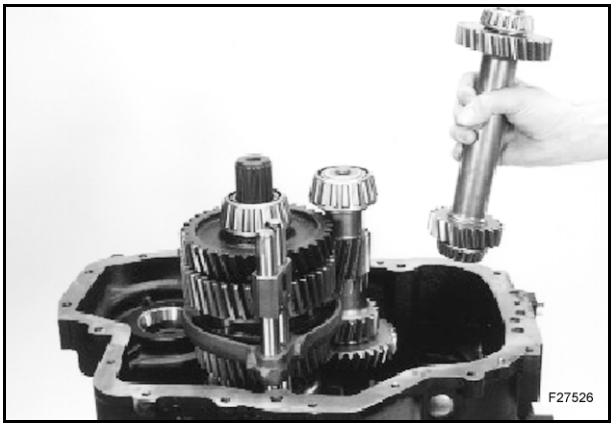
Tilt the countershaft and withdraw the input shaft assembly.



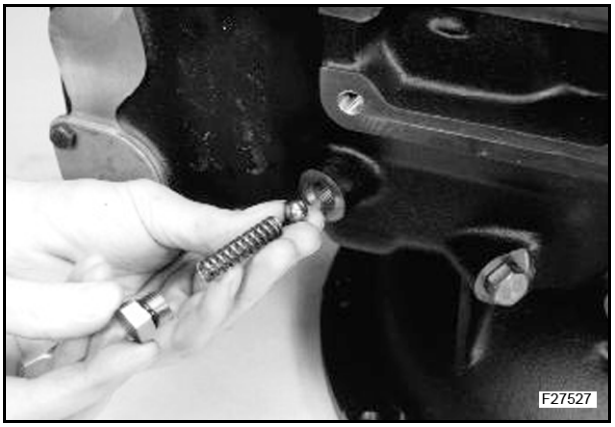
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Remove the reverse idler shaft assembly.



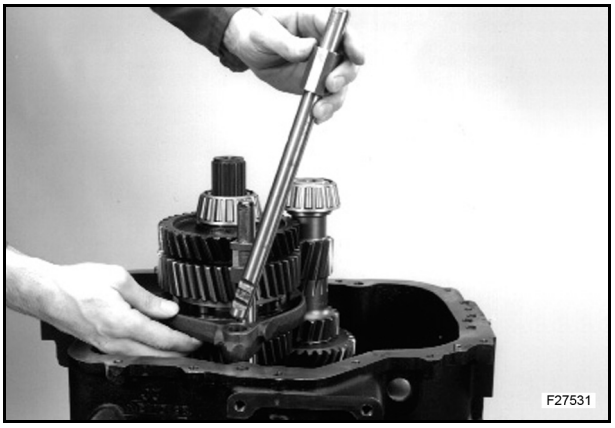
Remove the by-pass plug, the spring and the ball.



Ensure both synchronizers are in the neutral position then remove the 1st/2nd shift fork screw.



Withdraw the 1st/2nd shift rod from the housing. Then using a magnetic probe remove the interlock ball from the detent, bore.

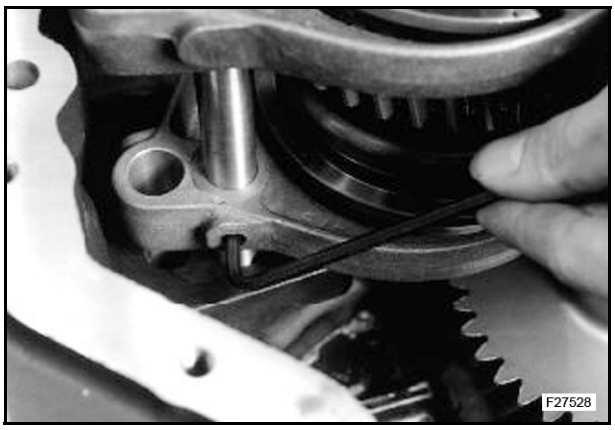


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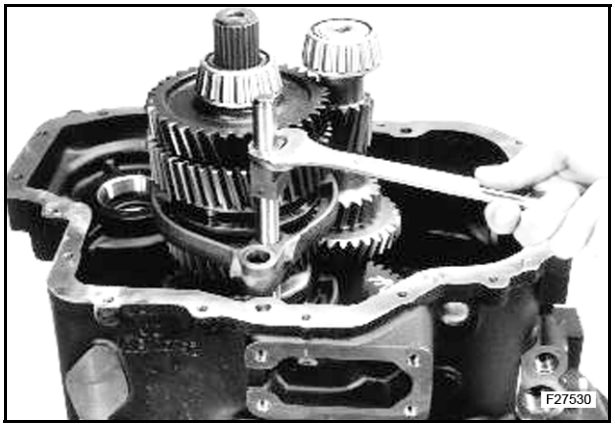
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Remove the 3rd/4th shift fork screw.

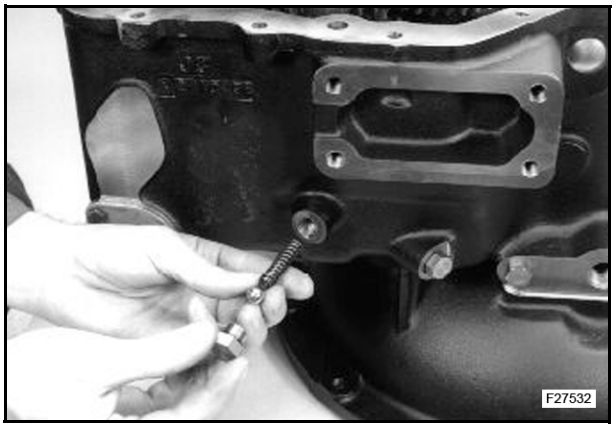
NOTE: before attempting to remove the 3rd/4th shift rail, replace the detent plug as the ball and spring may shoot out and cause injury.



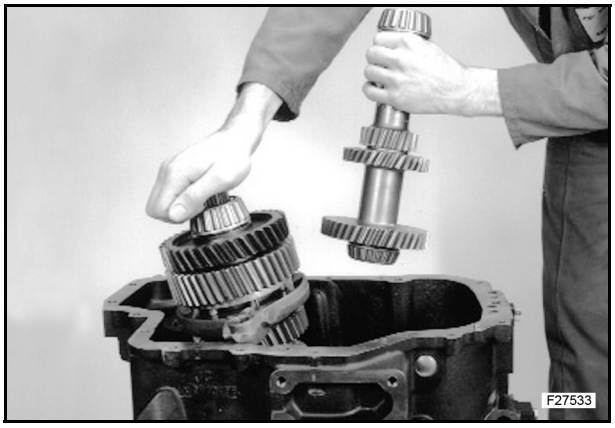
Turn the 3rd/4th shift rod through 90° and withdraw from the housing.



Remove the detent plug, the inner detent ball and the spring.



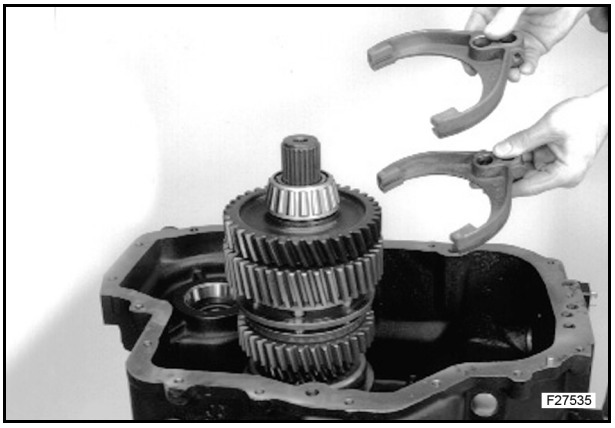
Remove the counter shaft assembly.



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Remove the 1st/2nd and 3rd/4th shift forks.



Remove the output shaft front assembly.



Remove the 4th gear lock out screw (if fitted).



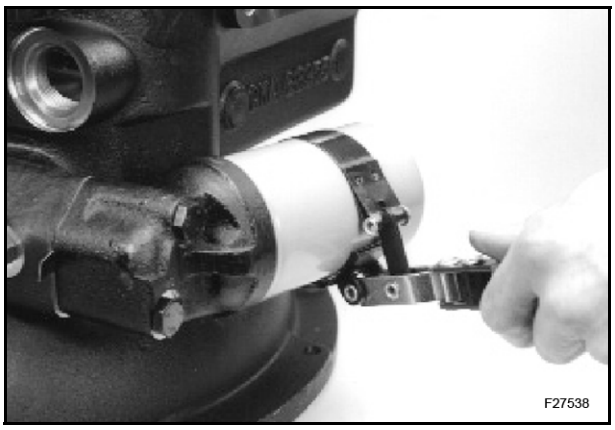
Remove 2 screws and withdraw the strainer cover, the O-ring, the spacer and the strainer.



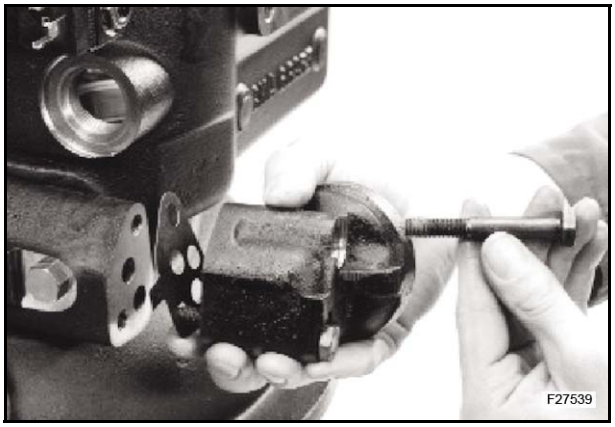
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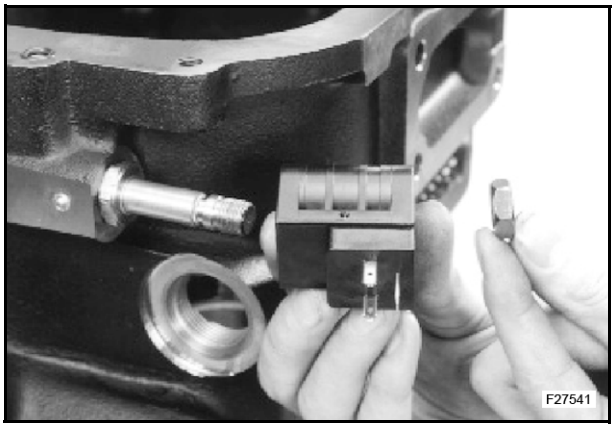
Using a strap wrench remove and discard the oil filter.



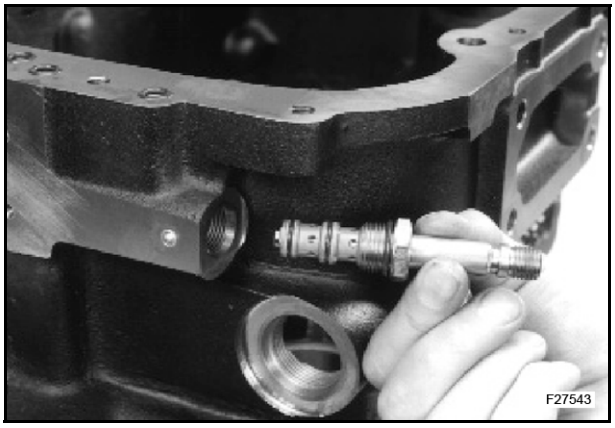
Remove 2 bolts and take of the oil filter housing and the gasket.



Remove the 4WD solenoid coil and the retaining nut (on 4WD models only).



Remove the 4WD solenoid spool (on 4WD models only).



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Remove and discard the expansion plug from the shimming access hole.



Invert the case. Remove 4 screws and copper washers then withdraw the pump assembly and the sealing ring.

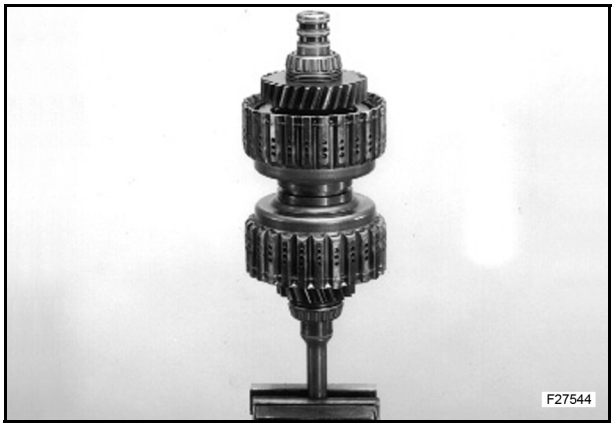


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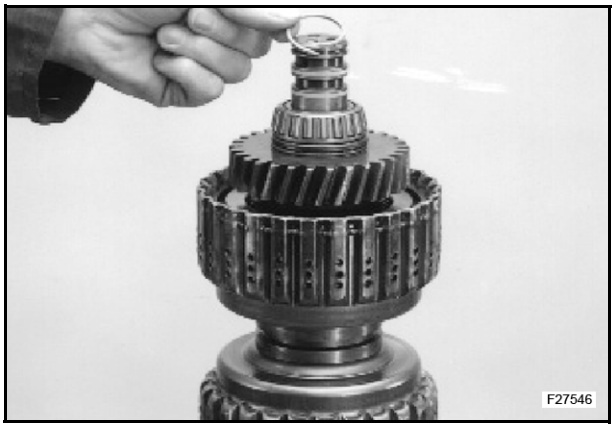
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INPUT SHAFT DISASSEMBLY

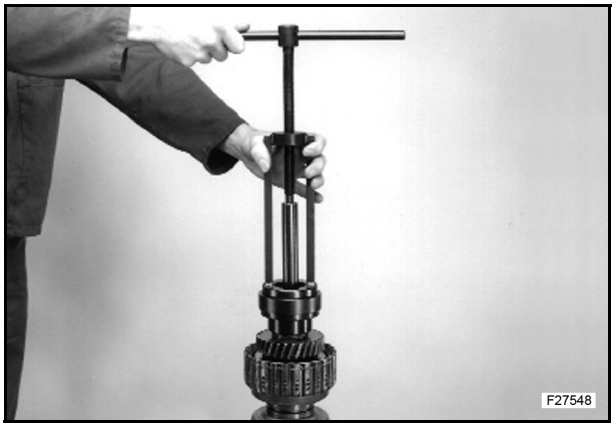
Position the shaft in a soft jawed vice as shown.



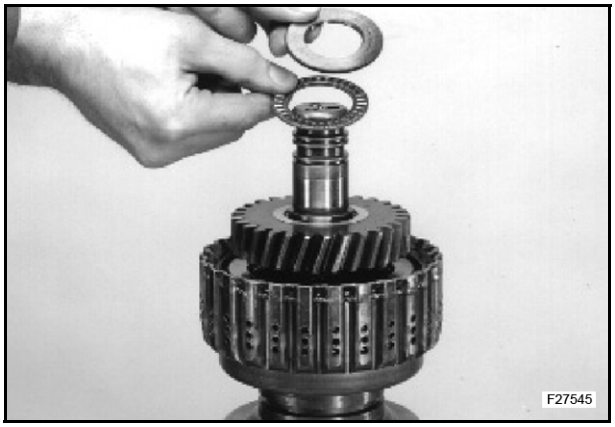
Remove and discard the 3 sealing rings.



Using the appropriate bearing puller **380002683** remove the rear bearing.



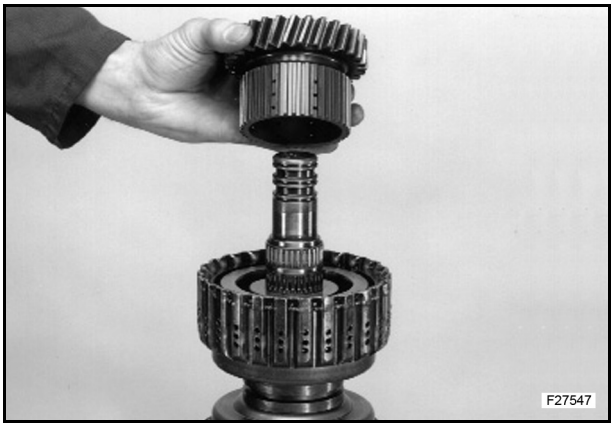
Remove the thrust washer and needle bearing.



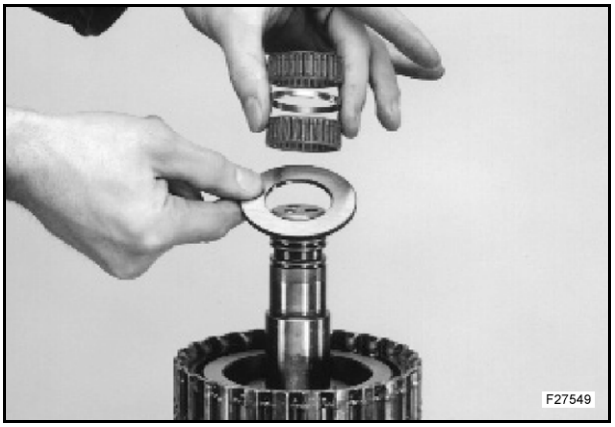
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Remove the reverse primary gear.



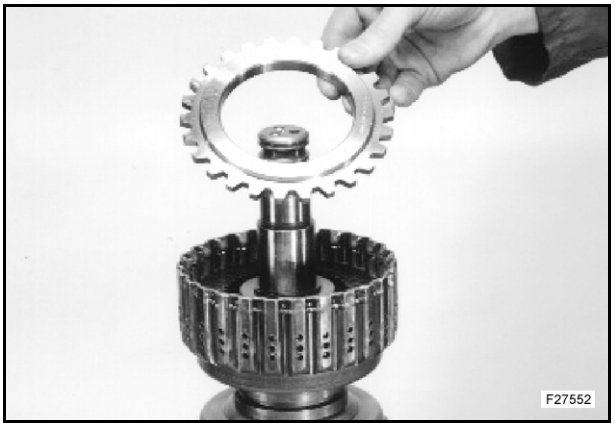
Remove the bearing, the spacer, the bearing and the thrust washer.



Remove the clutch pack retaining ring.



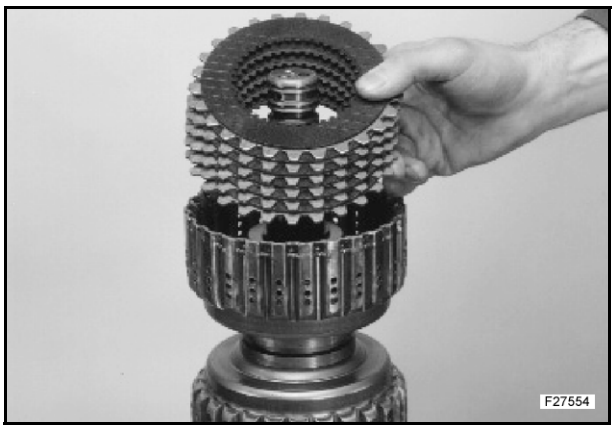
Remove the clutch pack retaining plate.



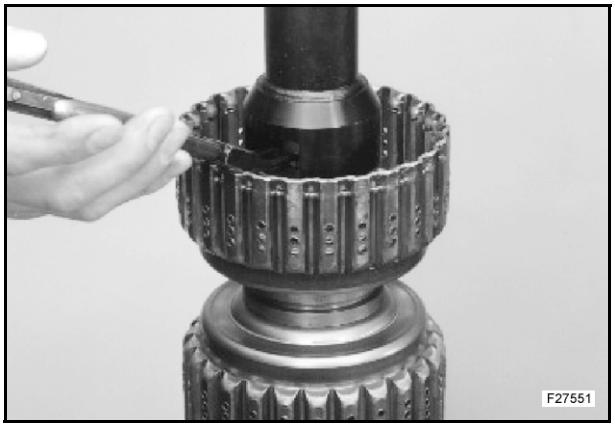
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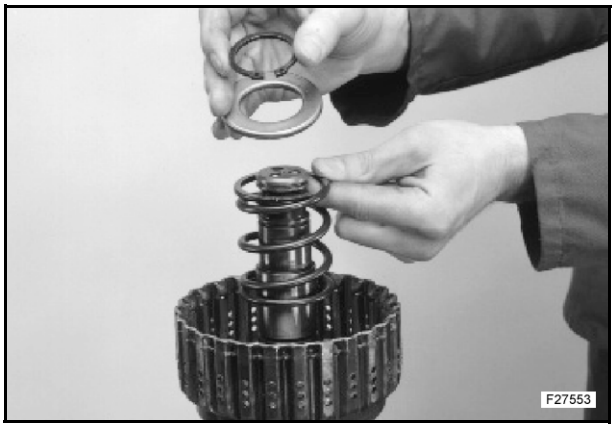
Remove the clutch pack.



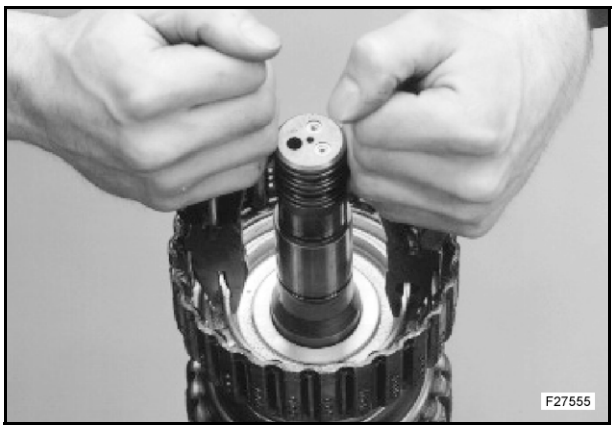
Using the appropriate tool **380002689** compress the piston spring and release the circlip.



Replace the spring, the retainer and the circlip.



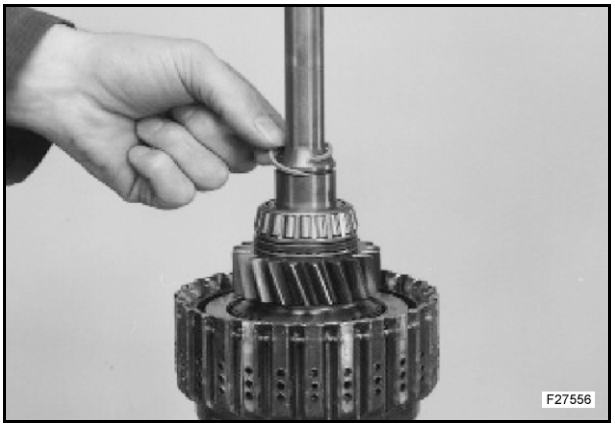
Using pliers, as shown, pull the piston out of the drum.



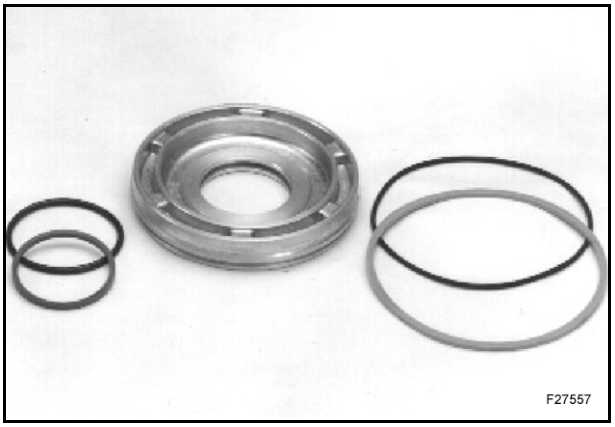
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Invert the shaft and remove the sealing ring. Repeat steps described above to dismantle the forward clutch pack.



Remove and discard the piston sealing rings and the O-rings.



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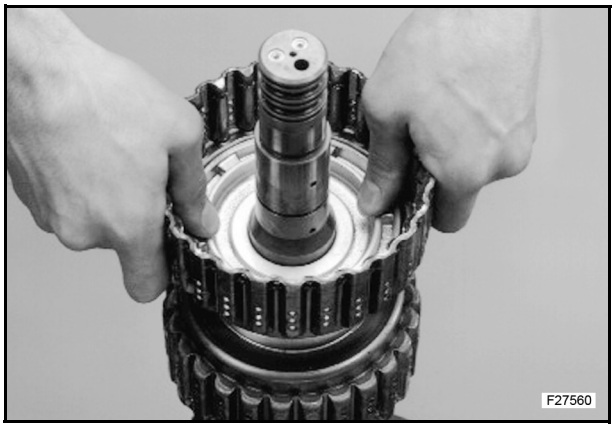
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INPUT SHAFT ASSEMBLY

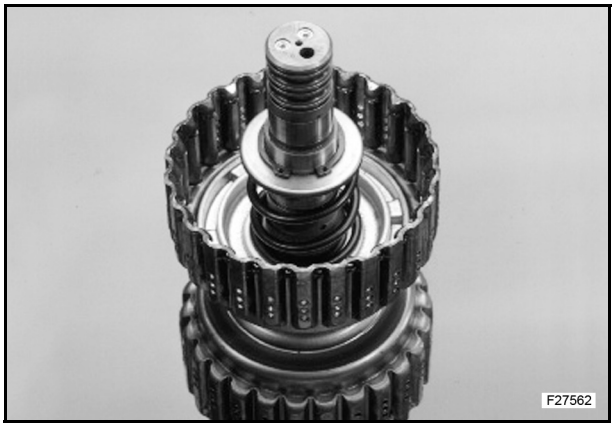
Re-new the piston sealing rings and the O-rings. To assist assembly bend the inner sealing ring into a heart shape as shown.



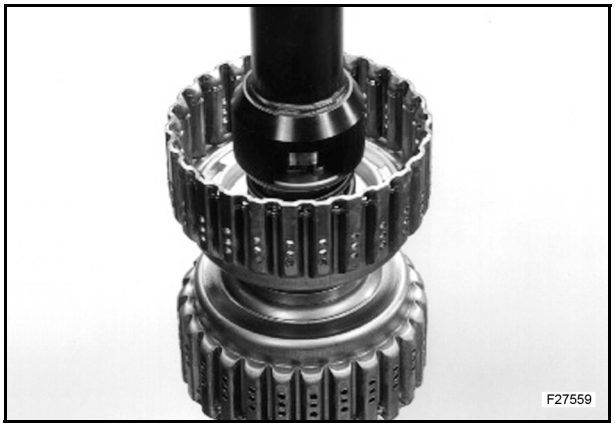
Using transmission fluid to lubricate the seals push the piston into the drum.



Replace the spring, the retainer and the circlip.



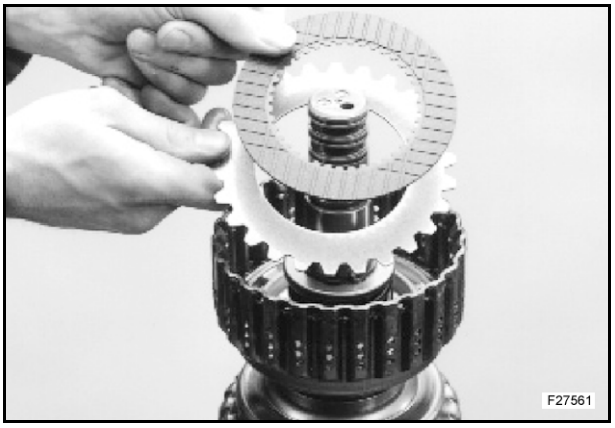
Using the tool **380002689** compress the spring and locate the circlip into its groove.



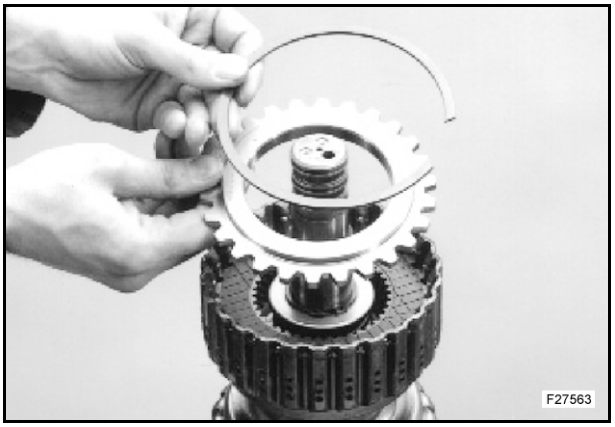
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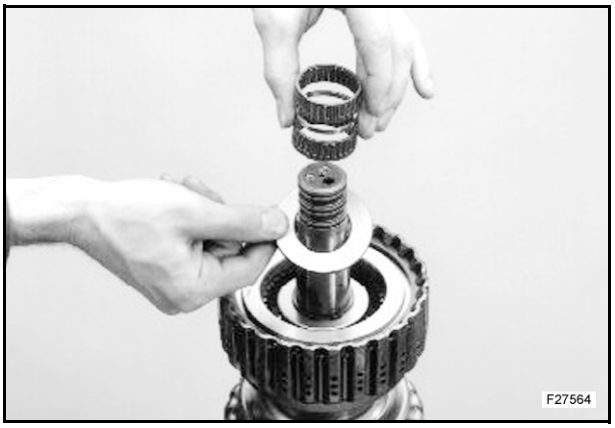
Replace an externally splined (plain) disc and then an internally splined (friction) disc alternately until six of each have been replaced.



Replace the clutch pack retaining plate and refit the retaining clip.

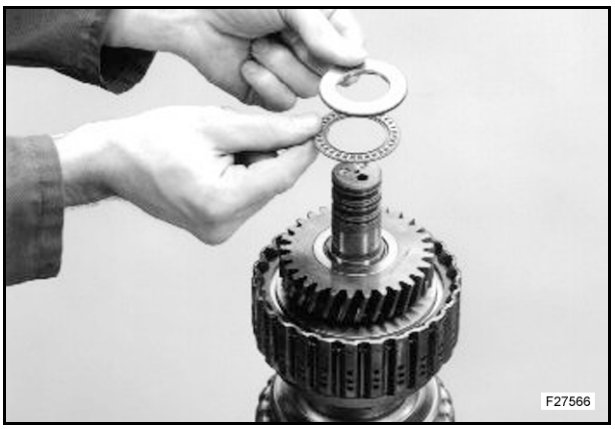


Replace the thrust washer, the bearing, the spacer and the bearing.



Line up the clutch plate splines and replace the primary gear. Remove the needle bearing and the thrust washer.

NOTE: the needle bearing should be fitted with the closed side of its cage against the gear.



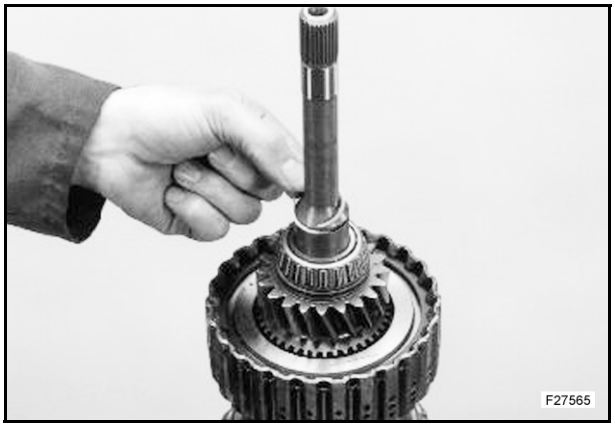
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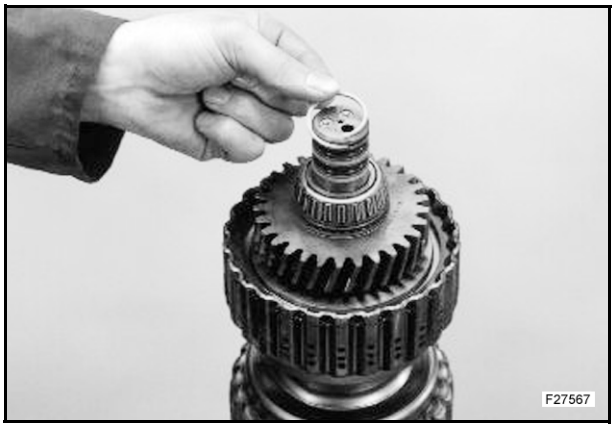
Using an appropriately sized tube replace the bearing.



Invert the shaft and repeat previous operation. Then fit a new sealing ring as shown.



Finally fit 3 new sealing rings to the rear of the shaft as shown. (To avoid damage the sealing rings should be left off until all shimming operations have been completed).

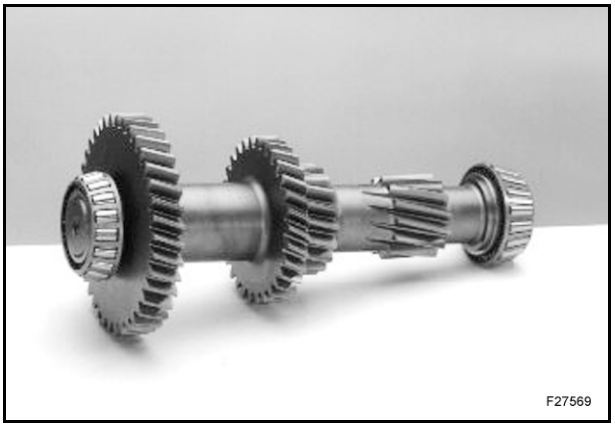


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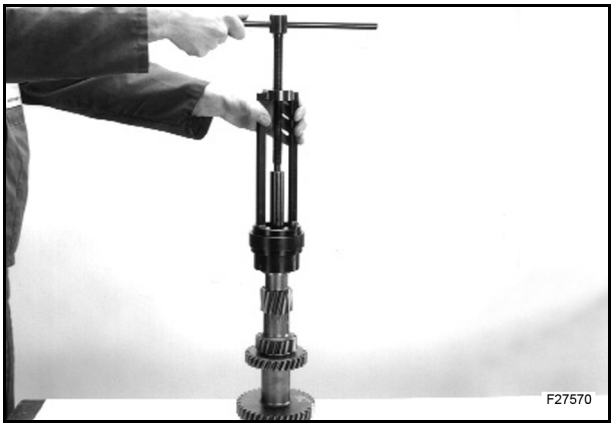
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DISASSEMBLY AND ASSEMBLY OF THE COUNTERSHAFT

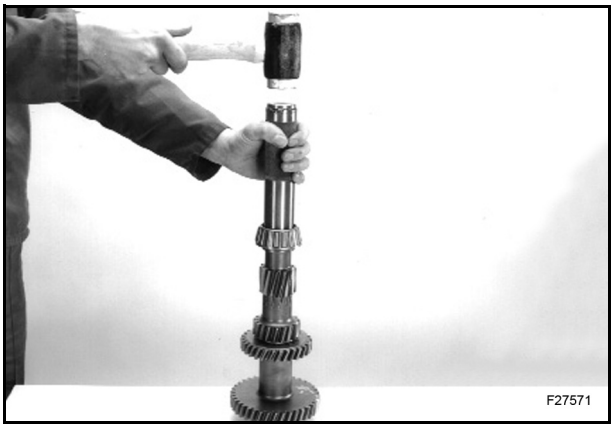
The countershaft assembly.



Using the appropriate bearing pullers **380002691** and **380002687** remove the countershaft front and the rear bearings.



Using an appropriately sized tube replace the countershaft front and the rear bearings.

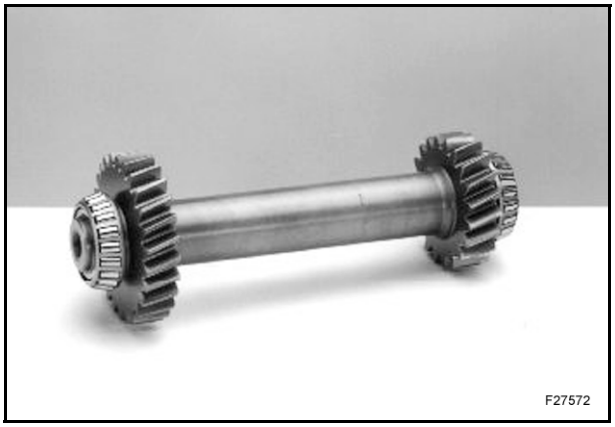


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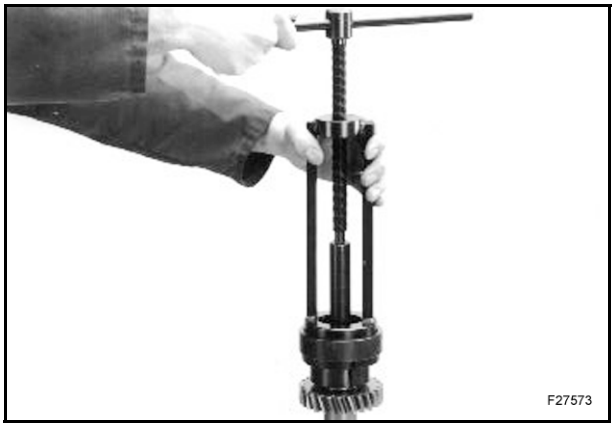
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DISASSEMBLY AND RE-ASSEMBLY OF THE REVERSE IDLER SHAFT

The reverse idler assembly.



Using the appropriate bearing puller **380002683** remove the front and the rear bearings.



Using an appropriately sized tube replace the front and the rear bearings.

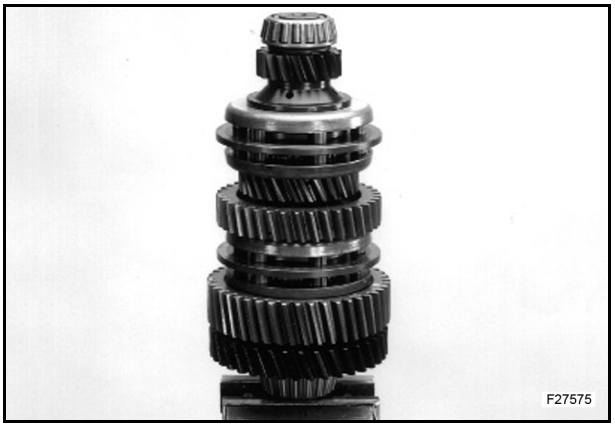


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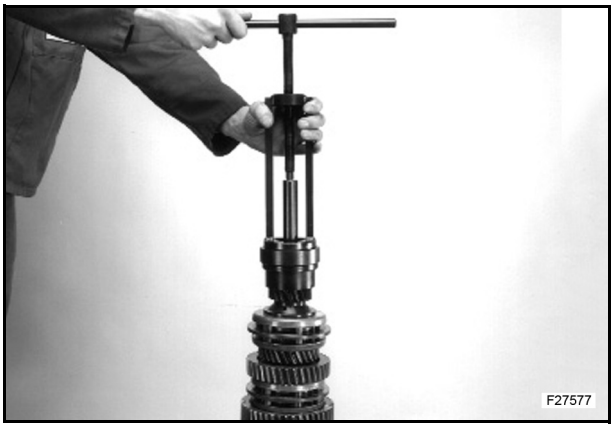
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OUTPUT SHAFT DISASSEMBLY

Position the shaft assembly in a soft jawed vice as shown.



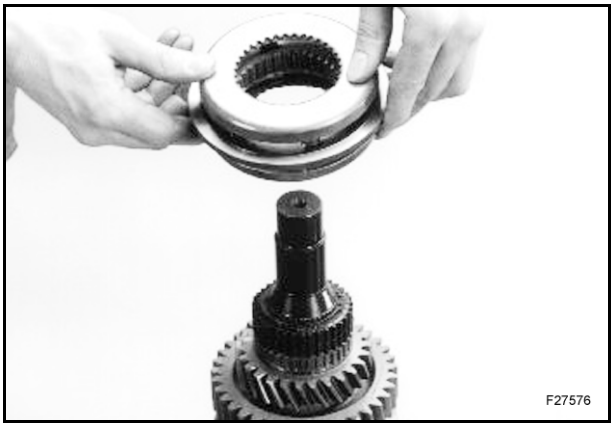
Using the appropriate bearing puller **380002686** remove the front bearing.



Refit the 4th gear and the thrust washer.



Remove the 3rd/4th synchro assembly.



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Remove the circlip and the synchro hub.



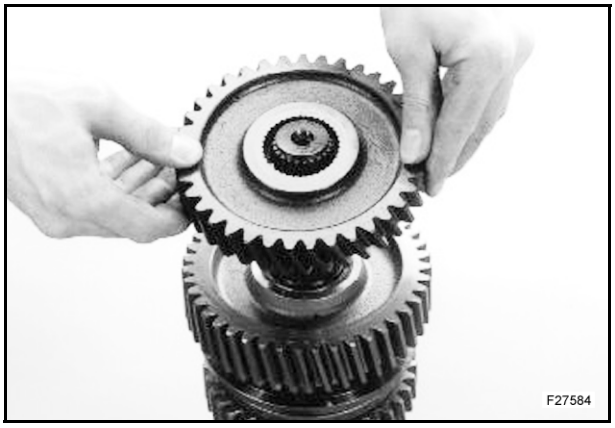
Remove the 3rd gear.



Invert the shaft and using the appropriate bearing puller **380002687** remove the rear bearing.



Remove the 4WD gear (on 2WD models, a spacer is fitted instead of the gear).



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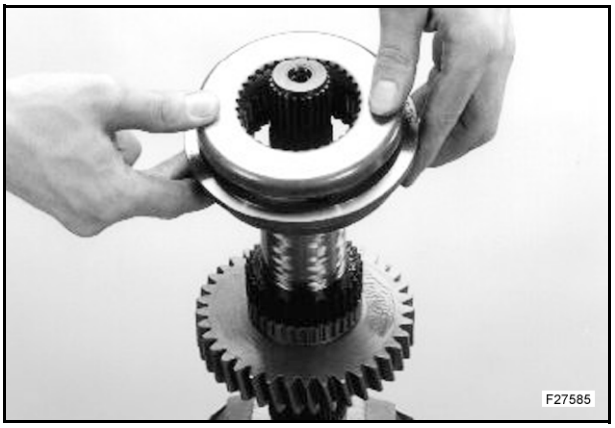
Remove the 1st gear.



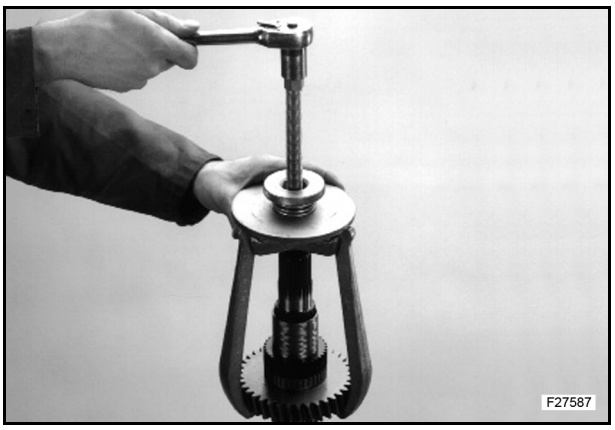
Remove the needle bearings and the spacer.



Remove the 1st/2nd synchronizer assembly.



Using a suitable bearing puller or press.
Remove the bearing sleeve, the synchro hub and the 2nd gear.



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Remove the bearing sleeve, the synchro hub and the 2nd gear.

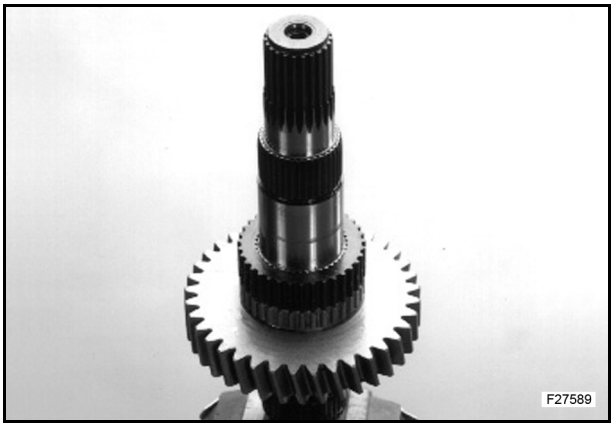


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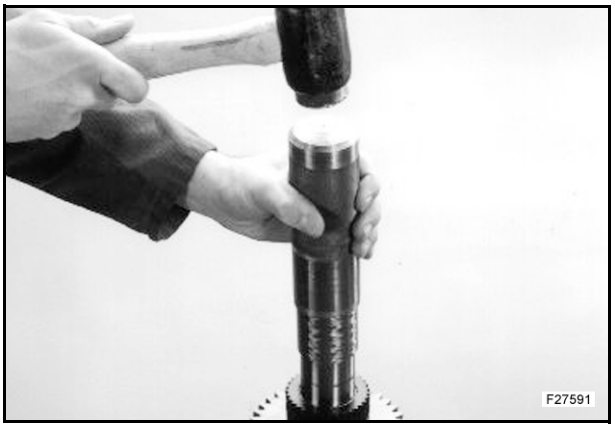
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OUTPUT SHAFT ASSEMBLY

Replace the 2nd gear and the synchro hub.



Using an appropriately sized tube refit the 1st gear bearing sleeve.



Replace the 1st/2nd synchronizer assembly.



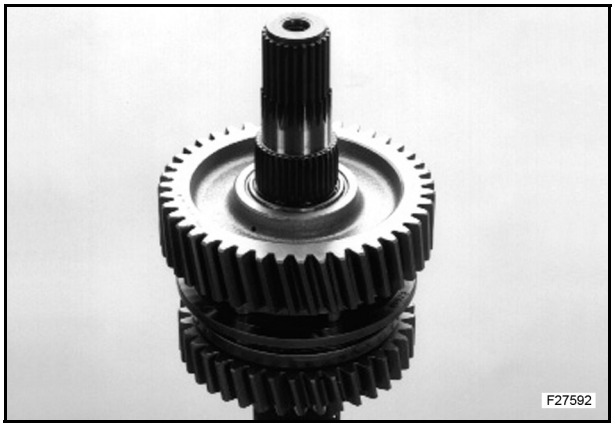
Replace the 1st gear needle bearings and the spacer.



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Replace the 1st gear.



Replace the 4WD gear using Loctite 649 spline lock or equivalent.

NOTE: assemble the gear with the splined bushing against the 1st speed gear (on 2WD models, a spacer is fitted instead of the gear).



Using an appropriately sized tube refit the rear bearing.



Invert the shaft and refit the 3rd gear, the synchro hub and the circlip.



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Refit the 3rd/4th synchronizer assembly.



Refit the 4th gear and the thrust washer.



Using an appropriately sized tube replace the front bearing.

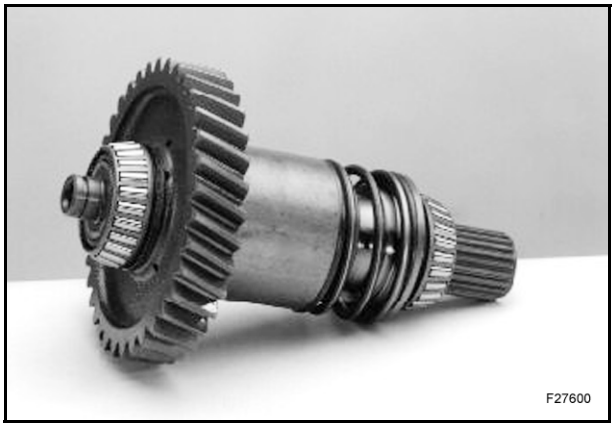


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HYDRAULIC DOG CLUTCH 4WD DISASSEMBLY

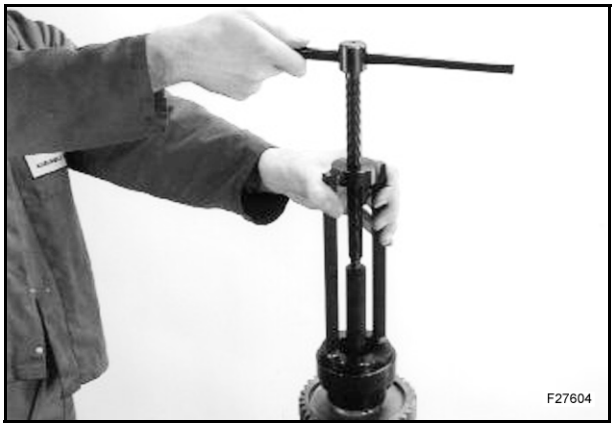
The hydraulic dog clutch 4WD assembly.



Position the shaft in a soft jawed vice and remove the sealing ring.



Using the appropriate bearing puller **380002685** remove the rear bearing.



Remove the thrust washer.



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Remove the 4WD gear.



Remove the two needle bearings and the spacer.



Invert the shaft and using the appropriate bearing puller **380002685** remove the front bearing.



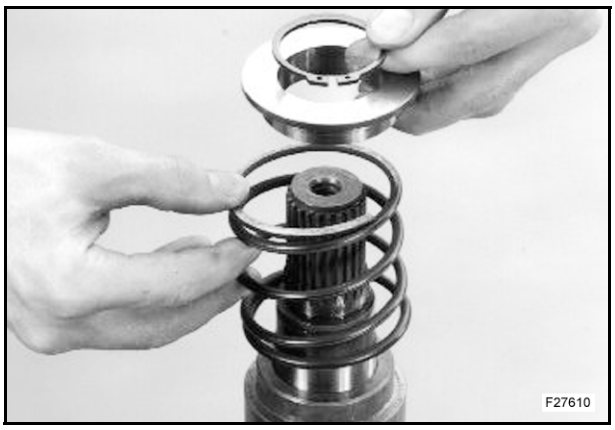
Using the appropriate tool **380002692** compress the spring and release the circlip.



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Replace the spring, the retainer and the circlip.



Remove the piston drum assembly.



Remove the piston seal and the O-ring from the shaft and discard.



Remove and discard the piston seal and the O-ring from the piston drum.



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HYDRAULIC DOG CLUTCH 4WD ASSEMBLY

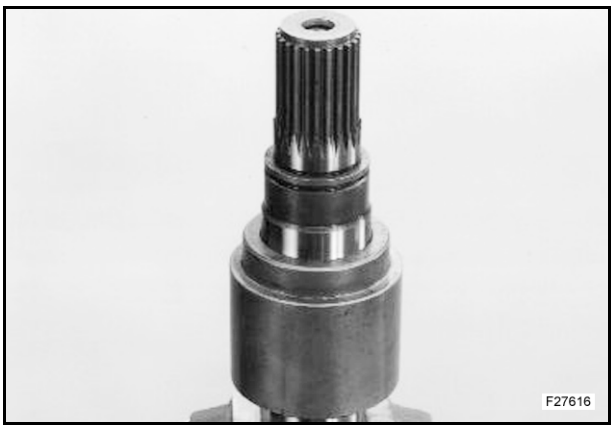
Fit a new O-ring and sealing ring to the shaft.



Fit a new O-ring and sealing ring into the piston. Bend the sealing ring into a heart shape as shown to assist assembly.



Lubricate the seals with a light grease and refit the piston to the shaft.



Replace the piston spring and the clip retainer.



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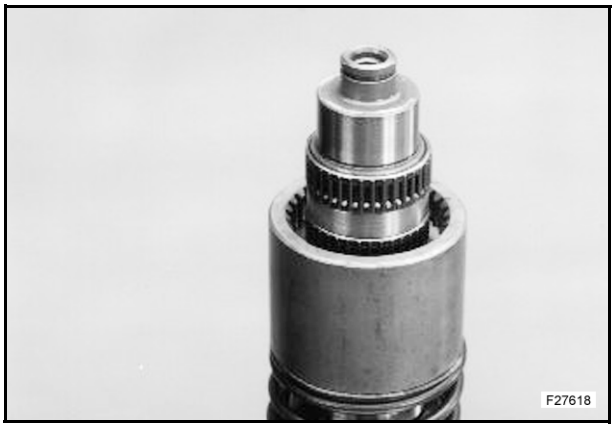
Using the appropriate tool **80002692** compress the spring and retainer and refit the circlip.



Using an appropriately sized tube refit the front bearing.



Invert the shaft and refit the two needle bearings and spacer as shown.



Replace the 4WD gear.



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Replace the thrust washer.



Using an appropriately sized tube replace the rear bearing.



Fit a new seal ring. (To avoid damage the sealing ring should be left off until all shimming operations have been completed).

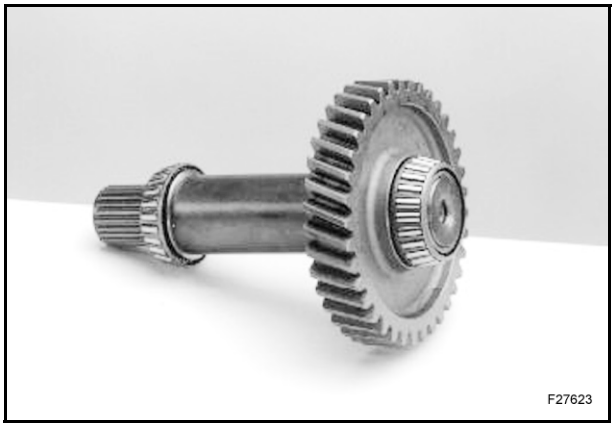


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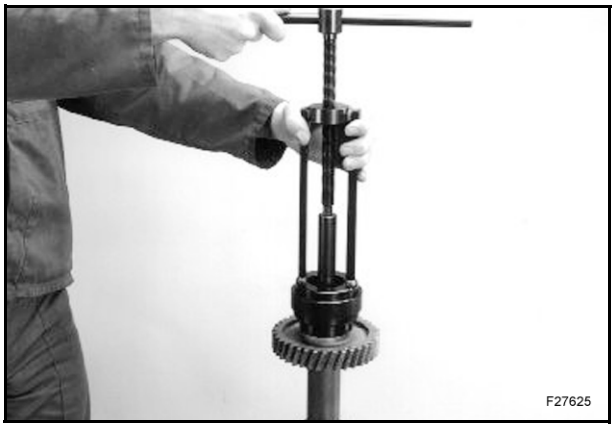
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PERMANENT 4WD SHAFT ASSEMBLY

The permanent 4WD shaft.



Using the appropriate bearing puller **380002685** remove the front and the rear bearings.



Remove the 4WD gear.



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PERMANENT 4WD SHAFT ASSEMBLY

Replace the 4WD gear using Loctite 649, or equivalent, on the shaft splines.
Then using a suitably sized tube refit the front and the rear bearings.

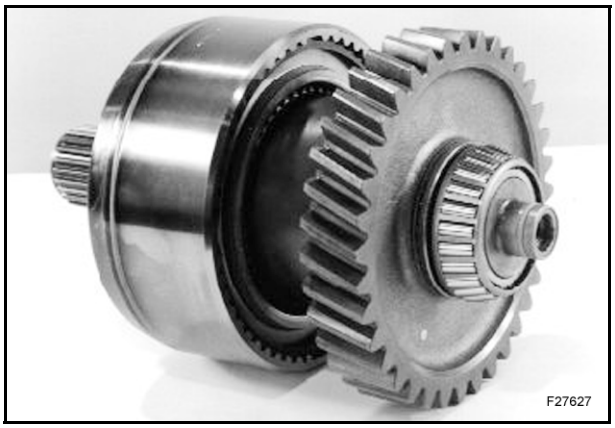


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HYDRAULIC MULTI PLATE CLUTCH 4WD SHAFT DISASSEMBLY

The hydraulic multiplate clutch 4WD shaft assembly.



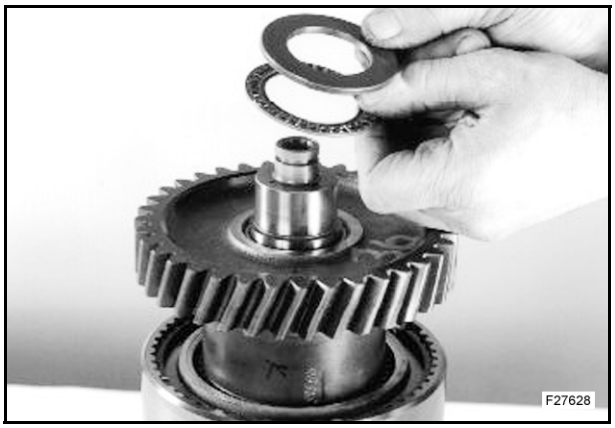
Mount the shaft assembly in a suitable soft jawed vice and remove the rear sealing ring.



Using the appropriate bearing puller **380002685** remove the rear bearing.



Remove the thrust washer and the thrust bearing.



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Remove the 4WD gear.



Remove the needle bearings and the spacer.



Remove the needle bearing and the thrust washer.



Remove the clutch pack retaining clip.



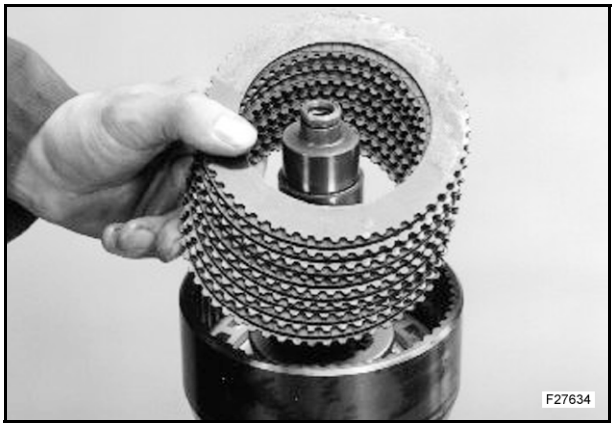
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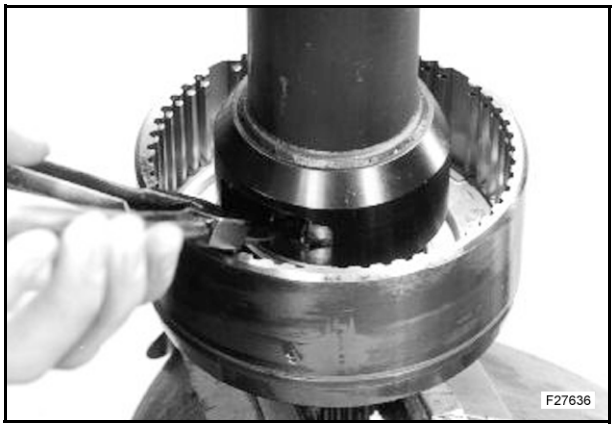
Remove the clutch pack retaining plate.



Remove the clutch pack.



Using the appropriate tool **380002690** compress the piston return spring and release the circlip.



Remove the clip retainer and the spring.



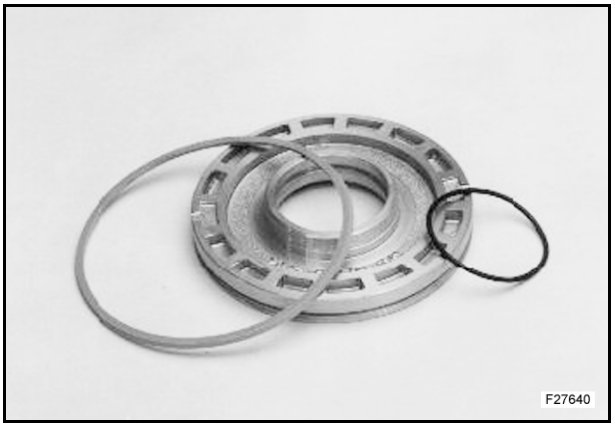
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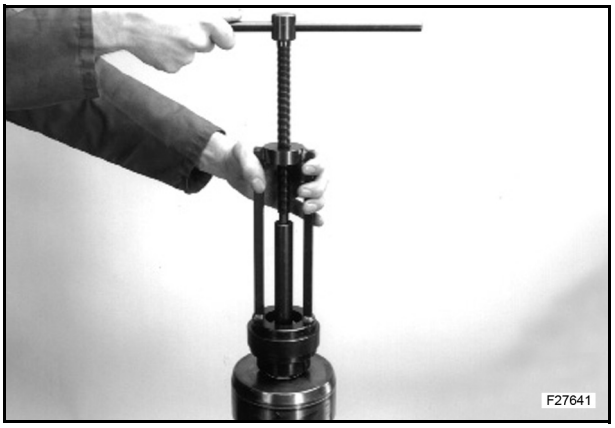
Remove the piston from the drum.



Remove and discard the piston sealing rings.



Invert the shaft and remove the front bearing using the appropriate tool **380002685**.



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HYDRAULIC MULTI PLATE CLUTCH 4WD SHAFT ASSEMBLY

Using an appropriately sized tube refit the front bearing.



Replace the piston sealing rings to facilitate assembly: the seals may be warmed in lukewarm water prior to assembly.

NOTE: the outer seal must be fitted with the open edge facing away from the clutch pack.



Using the appropriate tool **380002684** compress the piston sealing rings. The seals should be left in the tool **380002684** for a minimum of 30 minutes prior to assembly into the clutch drum.



Lubricate the seals with a light grease and refit the piston into the clutch drum. Then replace the spring, retainer and circlip.



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Using the appropriate tool **380002690** compress the piston return spring and locate the circlip into its groove.



Replace an externally splined (plain) disc then an internally splined (friction) disc alternately until 8 plain discs and 8 friction discs have been fitted.



Replace the retaining plate and fit a new retaining clip.



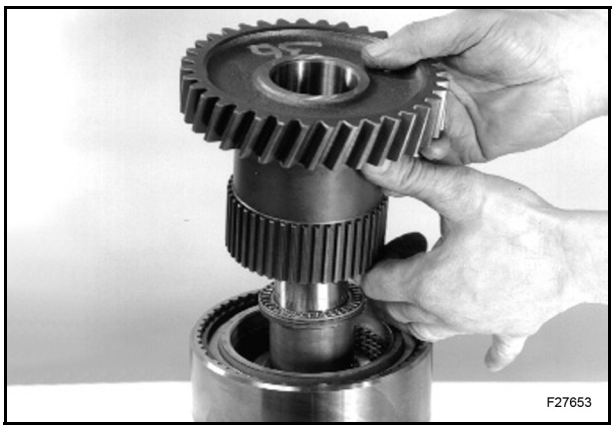
Refit the thrust washer and the needle bearing.



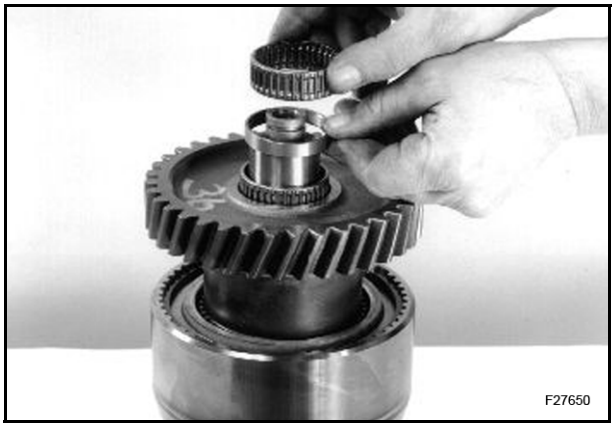
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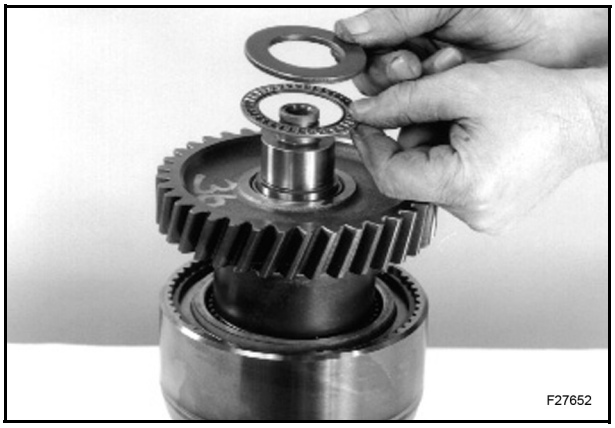
Refit the 4WD gear.



Refit the needle bearings and the spacer.



Refit the needle bearing and the thrust washer.



Using an appropriately sized tube refit the rear bearing.



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Refit a new sealing ring and lubricate with a light grease. (To avoid damage the sealing ring should be left off until all shimming operations have been completed).



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THE OIL PUMP DISASSEMBLY AND ASSEMBLY

Individual components of the oil pump are non serviceable. The pump may, however, be stripped for cleaning and examination purposes.

View showing a dismantled pump assembly.



The pump oil seal may be replaced using an appropriately sized tube.



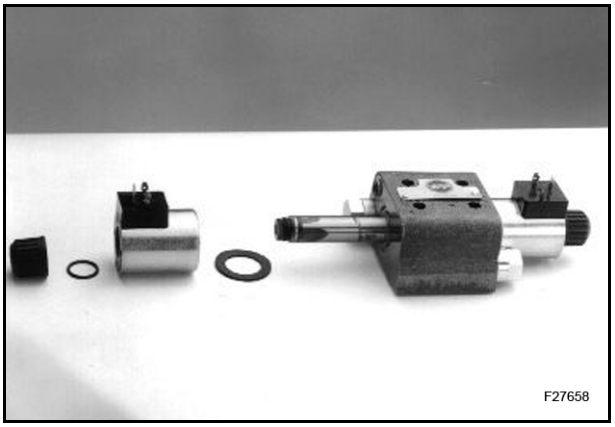
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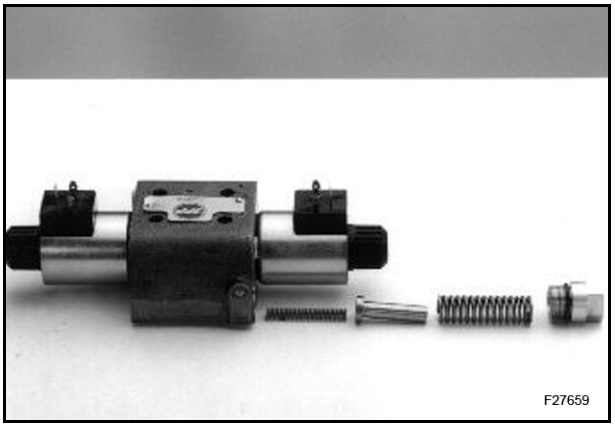
DIRECTION CONTROL VALVE DISASSEMBLY AND ASSEMBLY

Disassembly of the control valve is not generally recommended as, with the exception of the solenoids, individual parts are non serviceable. It may however be dismantled for cleaning and examination.
The valve fitted may be either the modulated type or the non-modulated type.

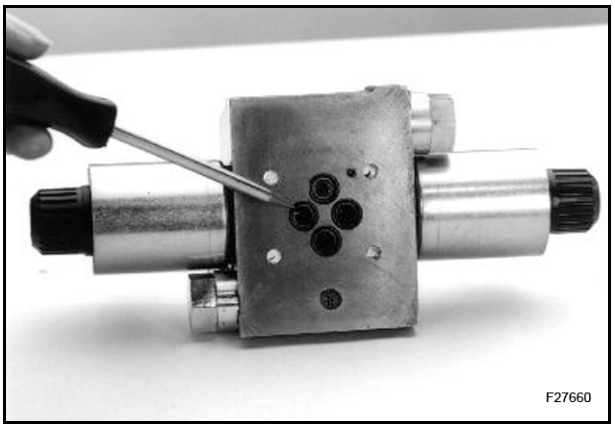
The retaining nut, coil and washer removed.



The modulation components removed.



There are 4 O-rings fitted to the underside of the valve which may be renewed if necessary.



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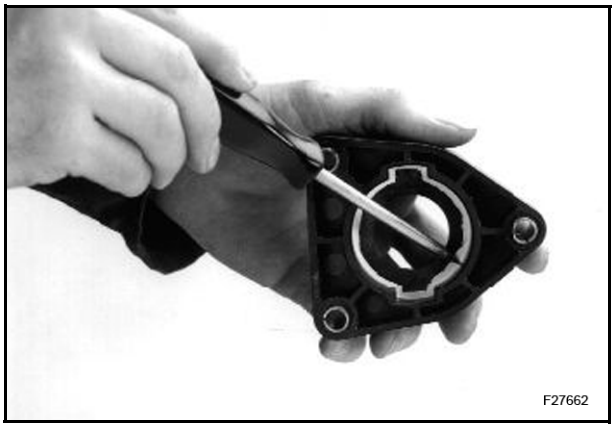
GEAR LEVER HOUSING DISASSEMBLY AND ASSEMBLY

Remove the plastic ties from the rubber gaiter and pull the assembly apart.

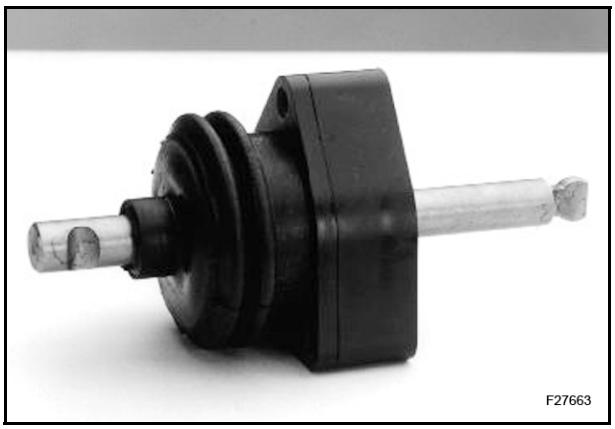


Before re-assembly remove all traces of old sealant from the joint faces.

Apply a bead of RTV joint compound (Loctite 5900) to the sealing face.



Lubricate the ball seating with a light grease and push the two halves of the assembly together. Secure the rubber boot with two new plastic ties.



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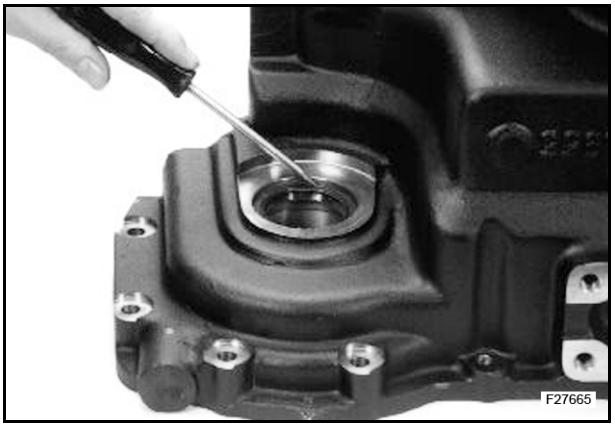
TRANSMISSION ASSEMBLY

All nylon patch bolts may be re-used 5 to 6 times provided a prevailing thread torque of 20 to 25 Nm is recorded.

All shafts and bearings should be lubricated with transmission fluid prior to assembly.

To prevent possible contamination of hydraulic parts lint or cotton rags should not be used.

Position the front case as shown and using a suitably sized tube fit a new output shaft oil seal to a depth of 6 mm below the housing face. Fill the seal lip with grease (on 4WD models only).



If previously removed, replace the two plug and O-ring assemblies and tighten to a torque of 41-54 Nm.



Refit the oil pump assembly and sealing ring. Tighten 4 bolts to a torque of 18-31 Nm.

New copper washers must be fitted under the bolt heads. Finally check for free rotation of pump rotor.



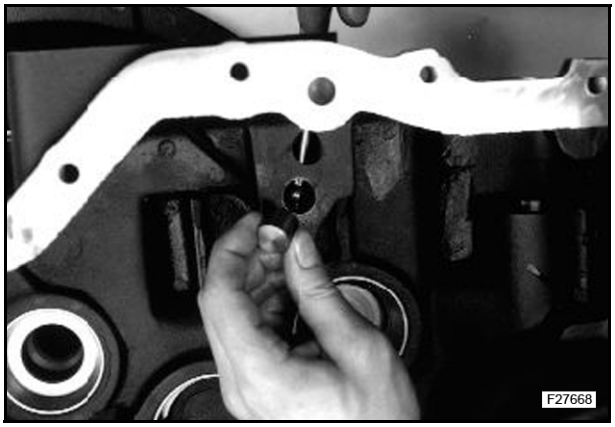
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Invert the case and then refit the bearing cups if previously removed.



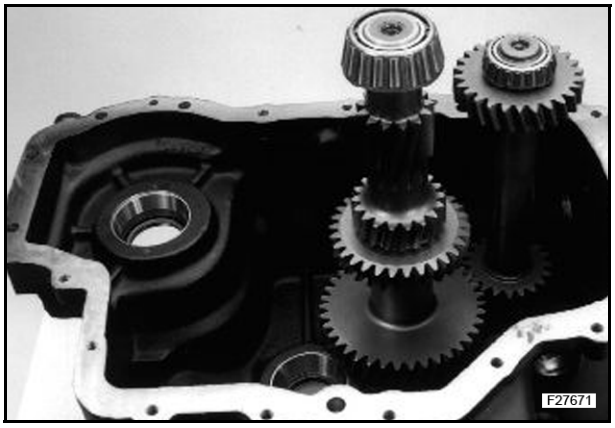
Using a suitable tool push the inner detent spring and ball into the case and secure in place with a dummy plug as shown.



Dummy plug in place.



Replace the countershaft and reverse idler shaft assemblies.



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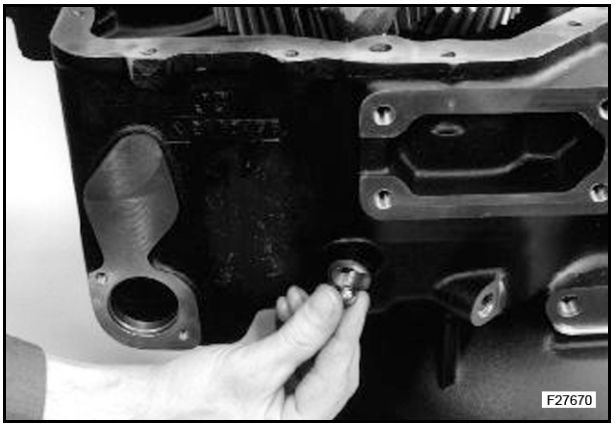
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Slide the 1st/2nd fork onto the 3rd/4th rail then refit the 3rd/4th shift fork and tighten the screw to a torque of 18-25 Nm. Hold the forks and rail in place on the output shaft then refit the complete assembly into the case. The shift rail should displace the dummy plug as it enters the bore.

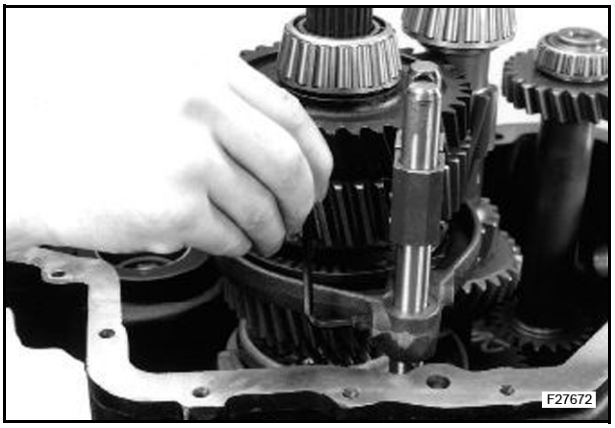


NOTE: check that the inner detent spring and ball have not become displaced and remove the loose dummy plug from the case sump.

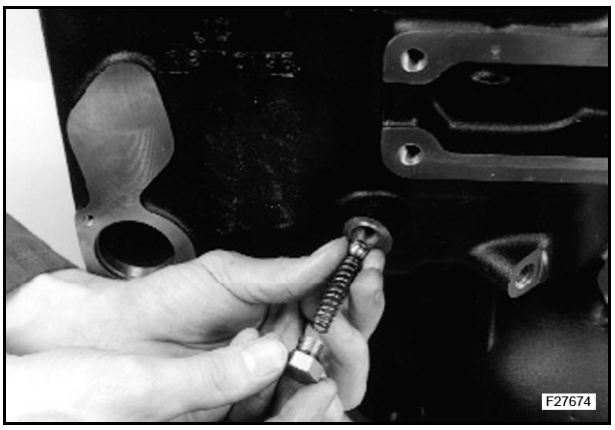
Push the interlock ball into the detent bore.



Refit the 1st/2nd shift rail and tighten the shift fork screw to a torque of 13-18 Nm.
Check that the interlock ball is correctly positioned in between the two rails.



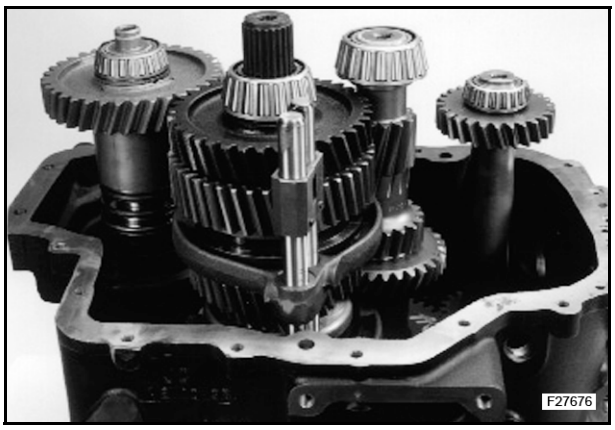
Replace the outer detent ball and the spring.
Tighten the plug to a torque of 41-54 Nm.



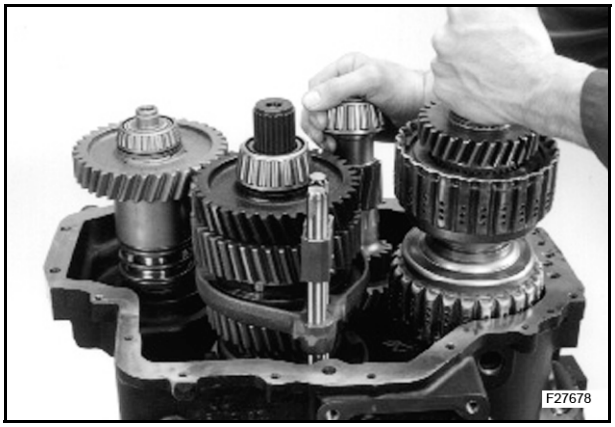
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Remove the 4WD shaft assembly (on 4WD models only).
Lubricate the rear seal with a light grease.



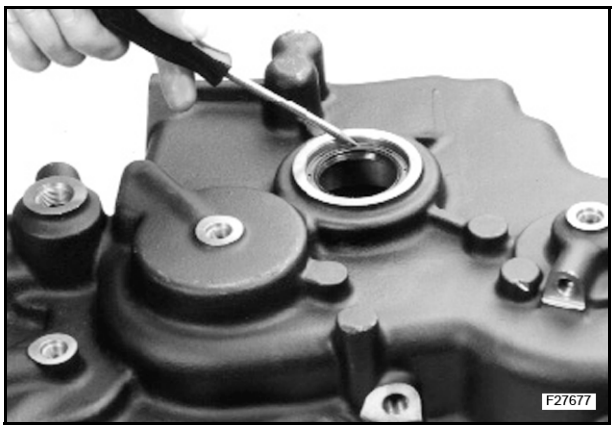
Lubricate the input shaft front and rear seals with a light grease and refit the shaft assembly into the case.



Rear case with all shaft assemblies fitted.



Position the rear case as shown and using a suitably sized tube fit a new output shaft oil seal to a depth of 6 mm below the housing face. Fill the seal lip with a light grease.



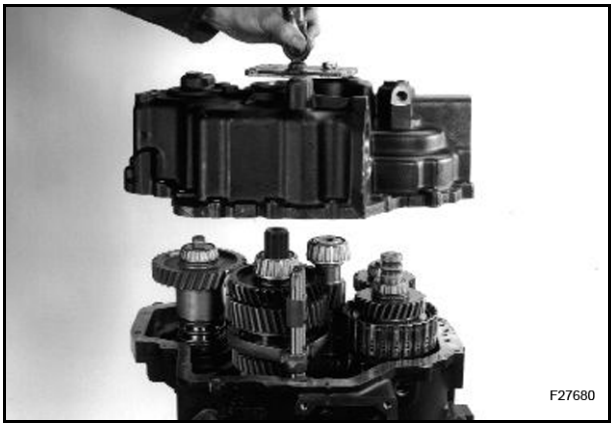
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Invert the case and replace the shim packs and bearing cups. The 2 mm thick spacer shim should be fitted into the case first, then fit the remaining shims followed by the bearing cup.
A light grease may be used to help hold the cups in the case.


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Refit the rear case, (without sealant at this stage), and secure with at least 6 equally spaced bolts. When fitting the rear case be careful to avoid damaging the input shaft sealing rings.

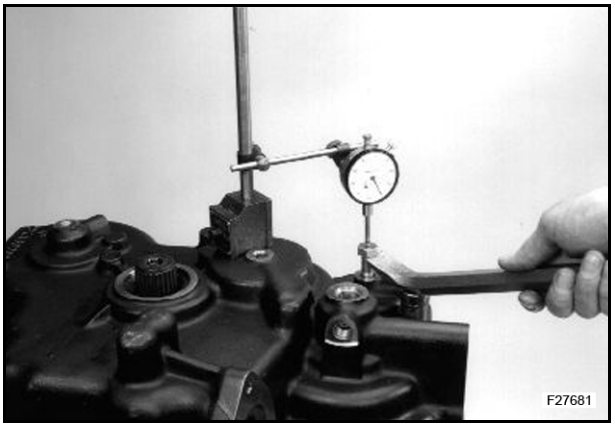

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Position a D.T.I. on the end of the input shaft as shown, and using a suitable pry bar through the side access hole, measure and note the shaft end float.

NOTE: all shaft assemblies should be rotated several times to seat the bearings prior to measuring the end float.


F27684

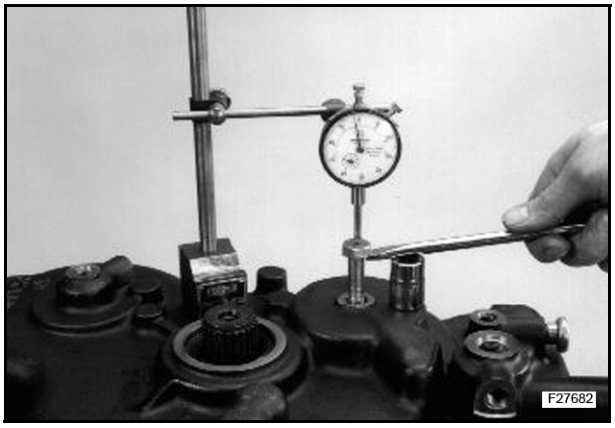
Attach a suitable shimming tool **380002693**, to the end of the reverse idler shaft. Position a D.T.I. as shown, and using a pry bar lift the shaft, then measure and note the end float.


F27681

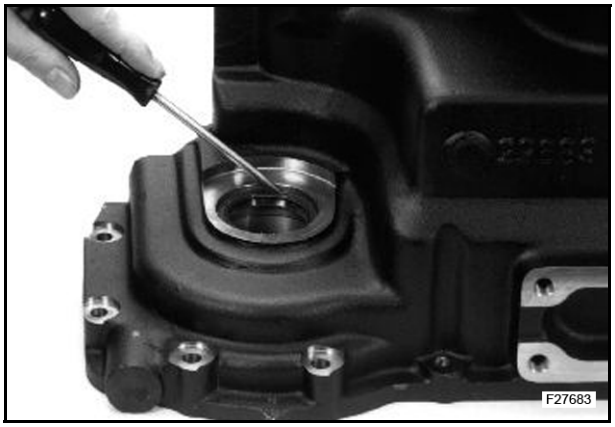
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Attach a suitable shimming tool **380002693**, to the end of the countershaft.
Position a D.T.I. as shown, and using a pry bar lift the shaft, then measure and note the end float.



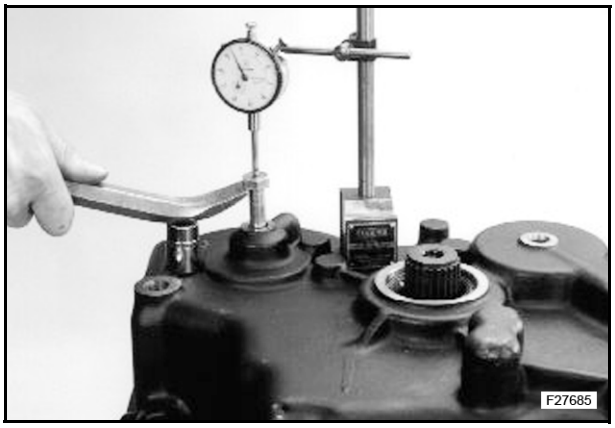
Attach a suitable shimming tool **380002693**, to the end of the output shaft. Position a D.T.I. as shown, and using a pry bar lift the shaft, then measure and note the end float.



Attach a suitable shimming tool **380002693**, to the end of the 4WD shaft. Position a D.T.I. as shown and, using a pry bar, lift the shaft, then measure and note the end float (on 4WD models only).

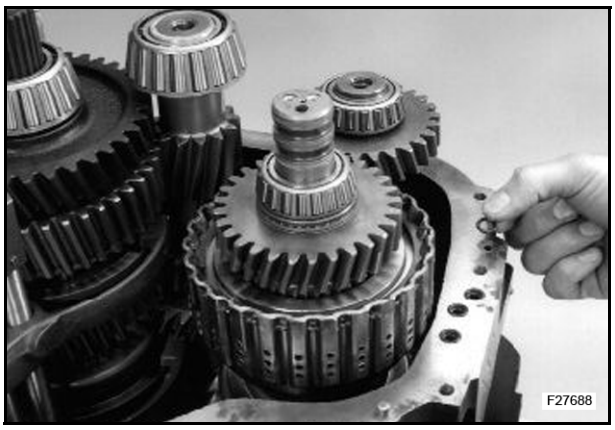
Remove the rear case and add or remove shims as necessary to give 0.025 to 0.076 mm end float on all shafts.

Repeat steps 17 to 22 until all shaft end floats are correct.



Replace the 4 O-rings in the front case (on 2WD models, there are only 3 O-rings).

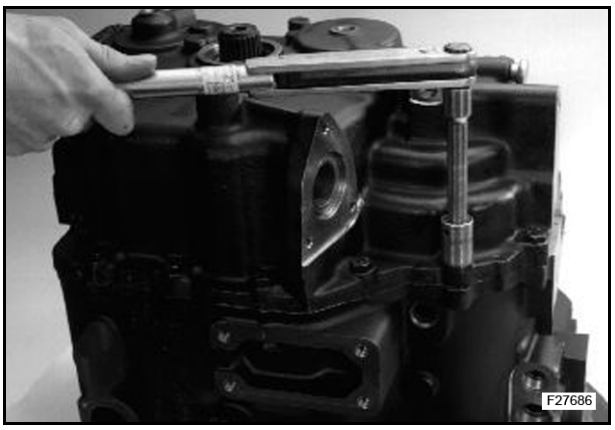
NOTE: the input shaft and 4WD shaft sealing rings should now be fitted.



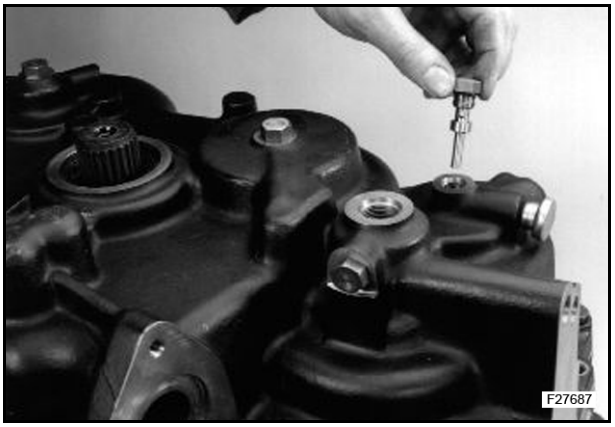
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Refit the rear case using an approved liquid gasket (Loctite 5203) taking care not to damage the input shaft or 4WD shaft sealing rings. Tighten the 17 bolts to a torque of 45-64 Nm.



Replace the shaft end plug and O-ring assemblies. Note the special breather plug is fitted in the reverse idler position. Tighten to a torque of 41-54 Nm.



Fit a new expansion plug to the shimming access hole using an approved sealant. (Loctite 649).



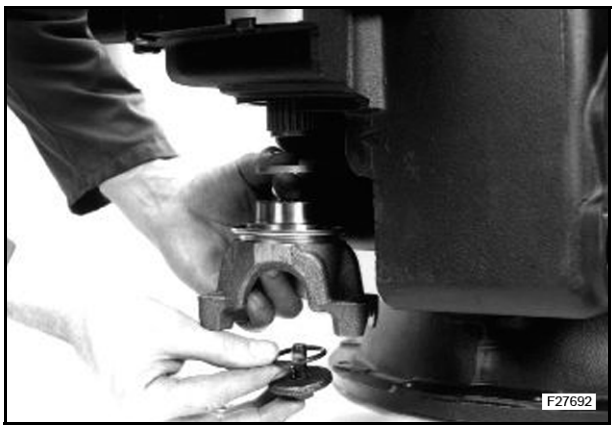
Replace the output yoke, the O-ring, the washer and the bolt. Then tighten to a torque of 68-88 Nm.



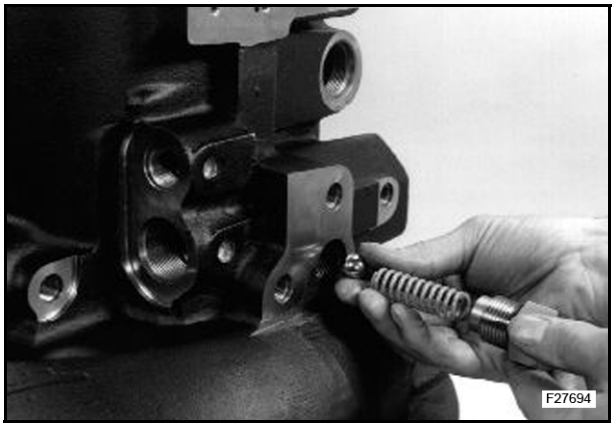
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Replace the spacer, the 4WD yoke, the O-ring, the washer and the bolt. Then tighten to a torque of 68-88 Nm.



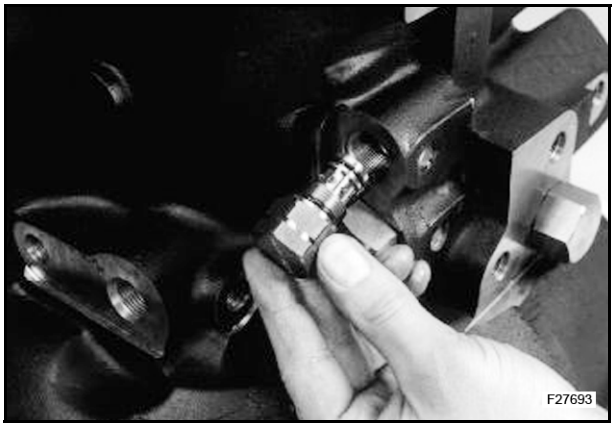
Refit the cold start ball, the spring and the housing. Then tighten to a torque of 46-60 Nm.



Lubricate the seals with transmission fluid then refit the pressure regulator valve and tighten to a torque of 46-60 Nm.



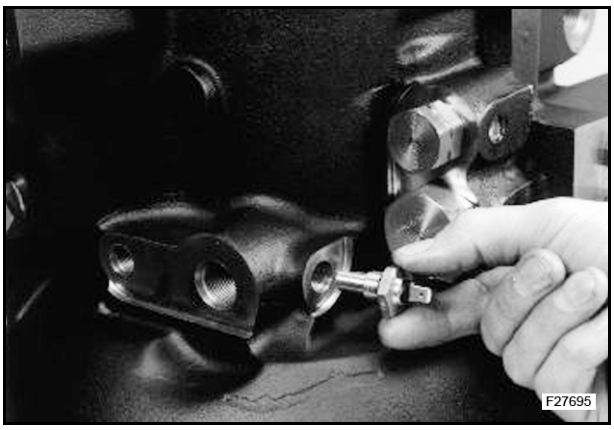
Lubricate the seals with transmission fluid then refit the converter regulator valve and tighten to a torque of 23-30 Nm.



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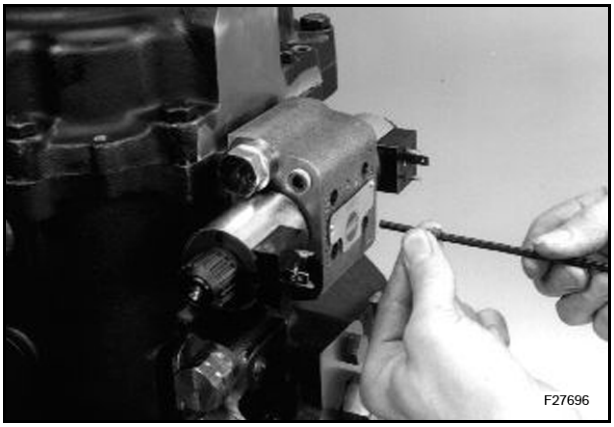
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Refit the temperature sender and tighten to a torque of 20-27 Nm.



Ensure the 4 O-rings are in place then refit the control valve assembly, tighten the 4 cap screws to a torque of 6.8 to 8.5 Nm. Refit the 4 plastic caps to the capscrew holes.

NOTE: the valve can only be fitted one way round as it is located by a small dowel pin.



Refit the strainer, the spacer, the O-ring and the cover plate. Then tighten the two screws to a torque of 18-31 Nm.



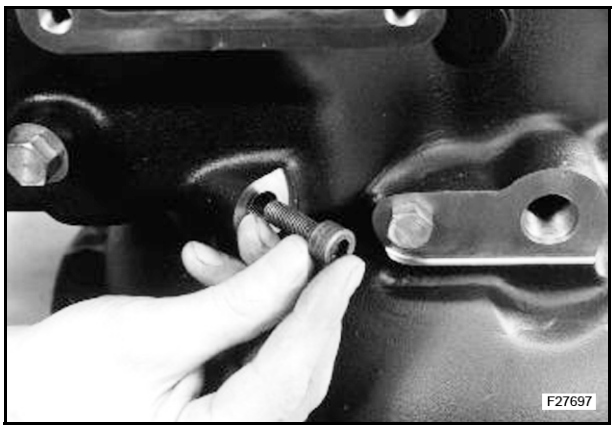
Refit the drain plug and the O-ring assembly. Tighten to a torque of 34-54 Nm.



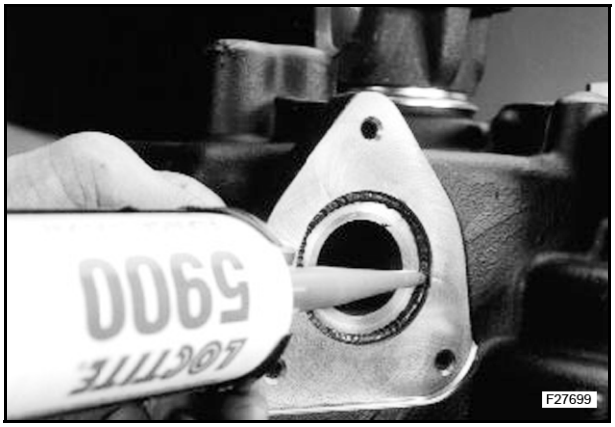
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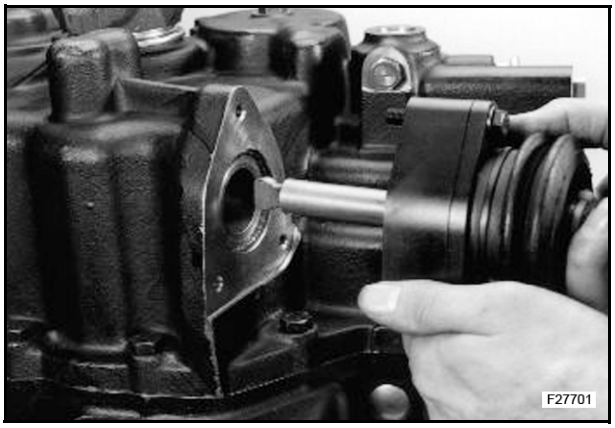
Refit the 4th gear lock out screw, (when this feature is not required a shorter blanking screw is fitted). On some applications an additional sealing plug may be fitted.



Apply a bead of RTV joint compound (Loctite 5900) to the gear case.

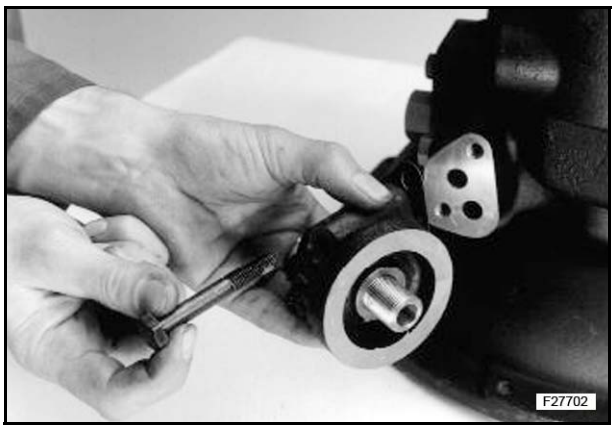


Refit the gear lever assembly and tighten the three bolts to a torque of 16-24 Nm.



Refit the filter housing and gasket. Tighten the two bolts to a torque of 45-64 Nm.

NOTE: do not use sealant on this gasket as it is graphite coated.



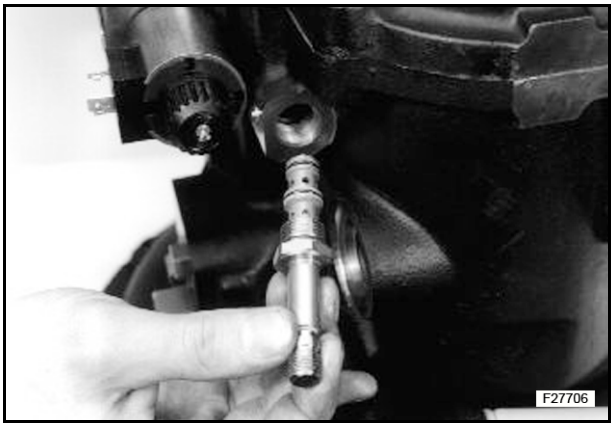
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Lubricate the seal with a light grease and screw on a new oil filter. Tighten to a torque of 7 to 10 Nm, or a half to three quarters of a turn after initial seal contact.



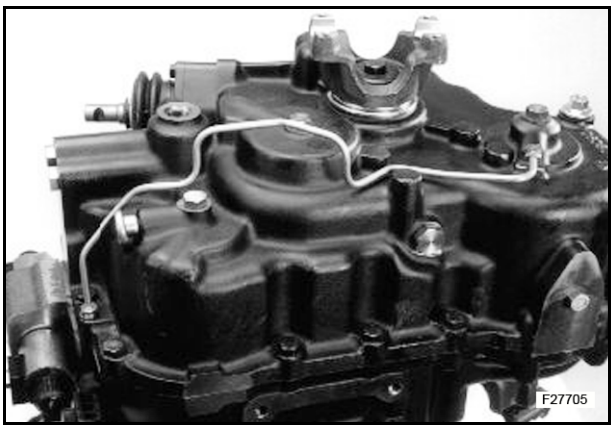
Slightly lubricate the seals and refit the 4WD solenoid valve spool (on 4WD models only).
Tighten to a torque of 20-27 Nm.



Remove the 4WD solenoid coil and the nut (on 4WD models only). Tighten to a torque of 5.4 Nm maximum.



If previously removed refit the 4WD clutch supply pipe, apply sealant (Loctite 542) to threads and tighten nuts to a torque of 6.8-10.2 Nm.



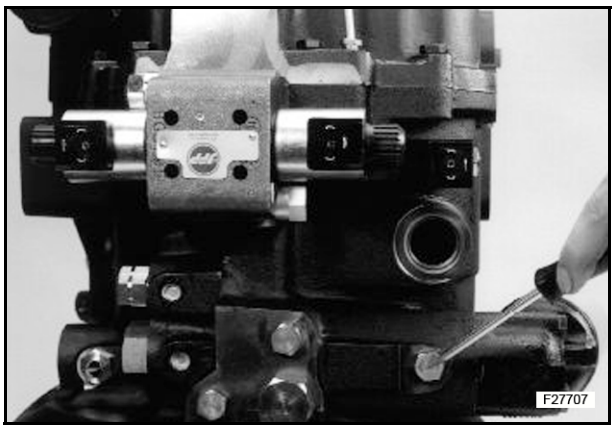
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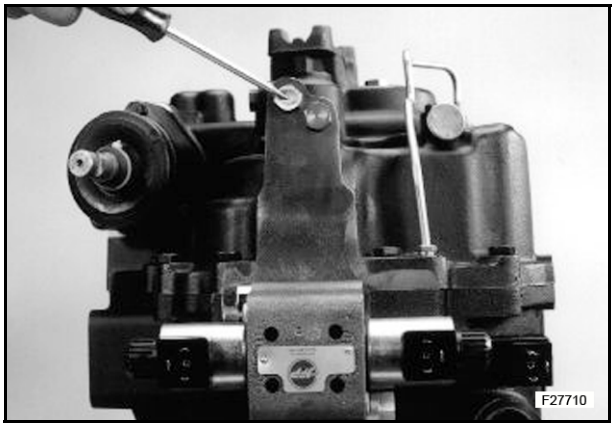
TEST PORT

The transmission oil, should be at an approximate temperature of 80 °C during pressure tests.
All pressure test ports have a 9/16” UNF thread.
Forward, reverse and 4WD clutch pack pressures should not be more than 1 bar lower than the oil pump pressure.

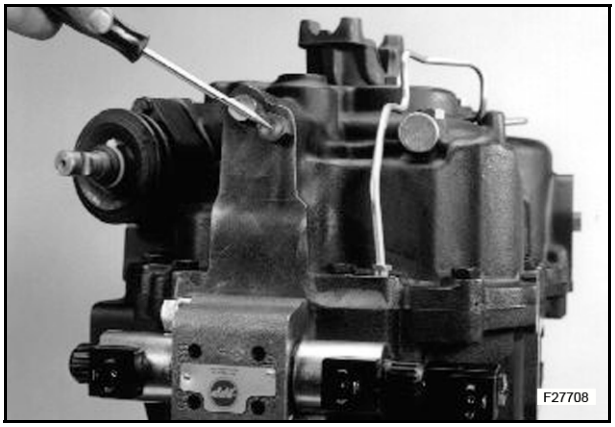
Oil pump pressure test port. Pressure should be 13.5 to 15.5 bar at maximum engine speed. (Approximately 2500 rpm).



Reverse clutch pressure test point.
Pressure should be 12.5 to 15.5 bar at maximum engine speed. (Approximately 2500 rpm).



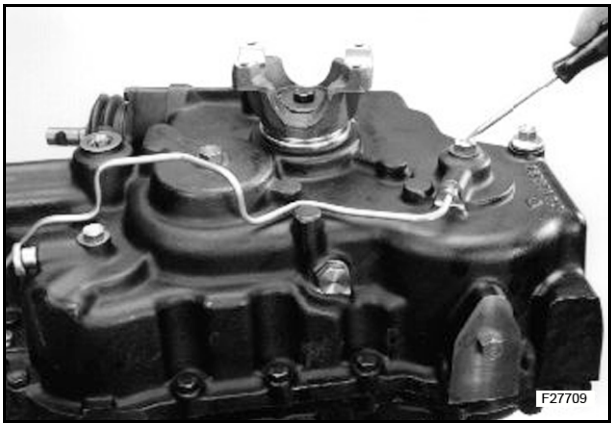
Forward the clutch pressure test point.
Pressure should be 12.5 to 15.5 bar at maximum engine speed. (Approximately 2500 rpm).



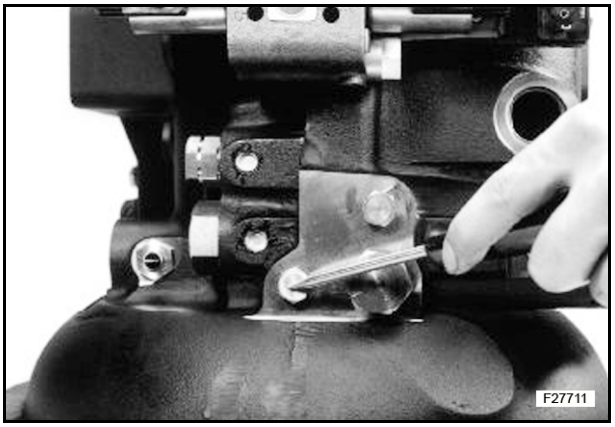
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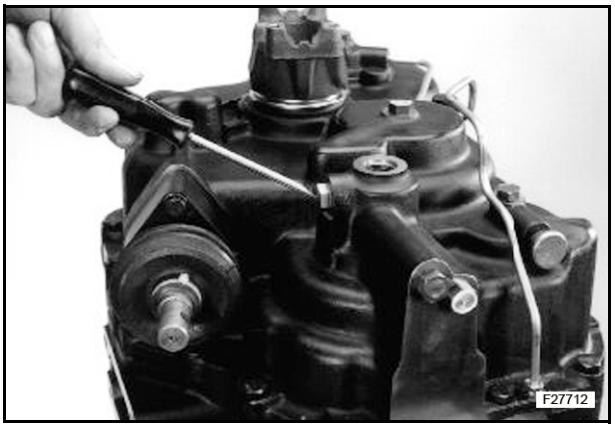
4WD pressure test point.
Pressure should be 12.5 to 15.5 bar at maximum engine speed. (Approximately 2500 rpm).



Converter relief pressure test point.
Pressure should not exceed 7.5 bar at maximum engine speed. (Approximately 2500 rpm).
For Coaxial transmissions max pressure should be 10.5 bar.



Lubrication pressure test point. Pressure should be 0.5 to 2.5 bar at maximum engine speed. (Approximately 2500 rpm).
If a malfunction of the transmission is indicated a systematic pressure checking procedure should be followed. These checks should be carried out while the transmission is still in the vehicle so that true operating conditions are created. Pressure checks are essential since a failure in the hydraulic system may not be easily traceable when the transmission is stripped down on a bench.
All pressure checks should be carried out with the transmission gear lever in the neutral position, the oil temperature at 80 to 85 °C, and the engine speed maintained at 2000 to 2500 rpm. As a safety precaution the vehicles parking brake should be applied.
All pressure test ports have a 9/16” UNF thread. A pressure gauge is required that will measure up to 20 bar.
For test port locations refer to illustrations at page 18.

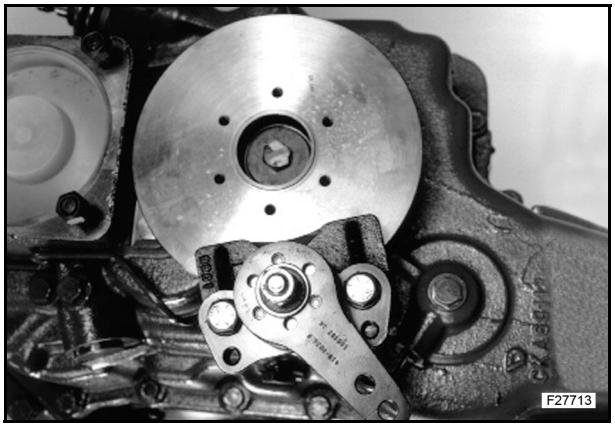


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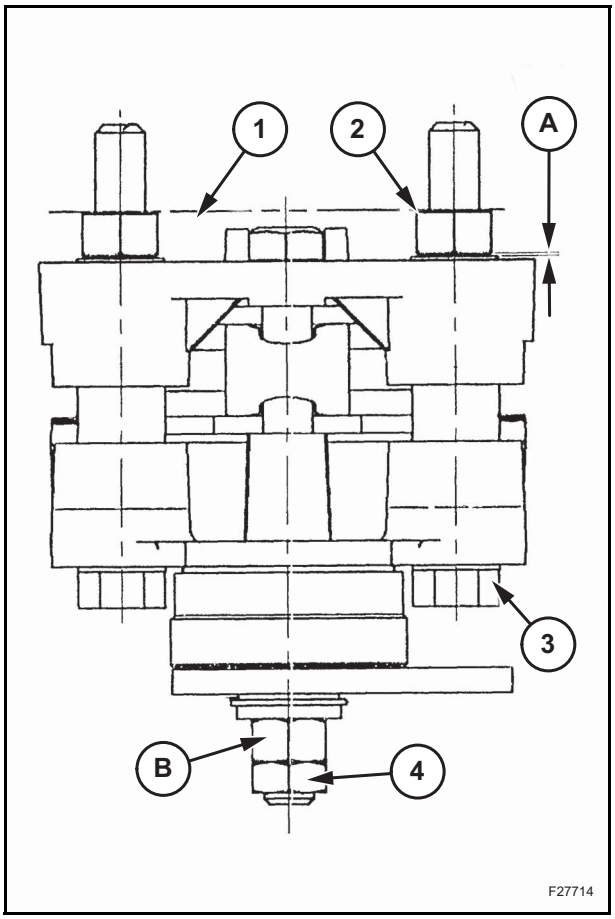
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PARKING BRAKE

The caliper assembly is mounted directly onto the rear face of the transmission housing.



1. Mounting face
2. Locknut
3. Mounting bolt
4. Outer locknut
A. Adjust the two mounting bolts and locknuts to leave a 0.25/1.50 mm gap between the locknut and sleeve.
Then torque locknuts against mounting surface to 155 Nm.
B. Adjust this nut until pads are in contact with the brake pads.
Then loosen 1/2 turn.
Finally torque outer locknut to 60-70 Nm.



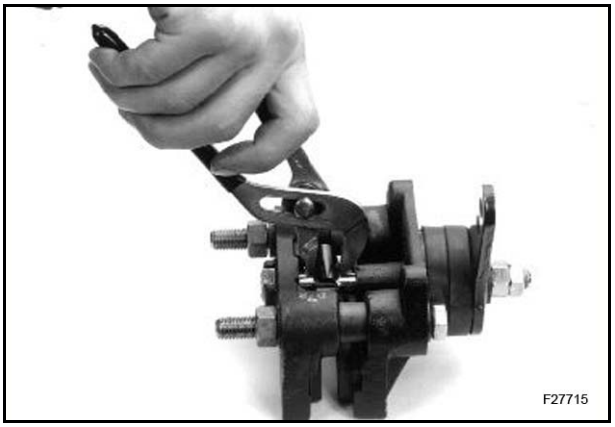
IMPORTANT:
BRAKE PAD: the minimum acceptable thickness of the brake pads is 2.286 mm.
BRAKE DISC: the nominal thickness of the disc is 9.5 mm.
The maximum total wear limit for the disc is 1.524 mm.
Based on the nominal thickness of 9.5 mm this would give a minimum thickness of 7.976 mm.

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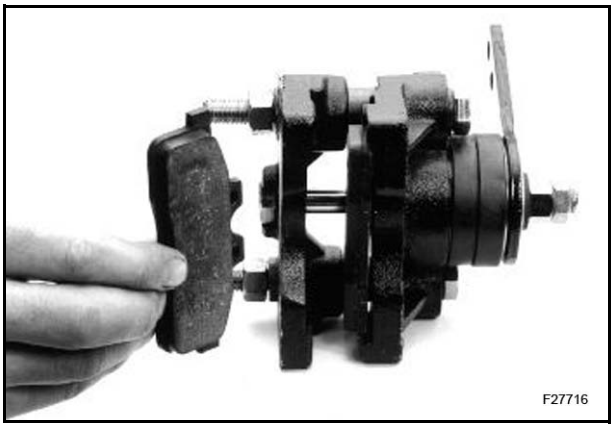
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Brake pad replacement

Remove the retaining spring clip.



Withdraw the friction pads.



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1.12 FAULT FINDING

PROBLEM	CAUSE
Transmission fails to drive in either direction	Low or no pump pressure. Low or no oil in transmission. Mechanical failure in transmission. Worn or broken input shaft seal rings. Pressure relief solenoid valve faulty. Direction control solenoid valve inoperative. Blockage of restricted flow in oil ports.
Transmission drives in one direction only	Low oil pressure on one clutch pack due to leaks. Clutch piston seals worn or damaged. Clutch pack excessively worn. Direction control solenoid valve or coil faulty. Mechanical failure in transmission. Blockage of restricted flow in oil ports. Worn or broken input shaft seal ring.
Delay in taking up drive	Low converter pressure. Low oil level. Low clutch pressure. Faulty modulation in direction control solenoid valve. Blocked direction control solenoid valve. Blockage of restricted flow in oil ports.
No drive from 4WD	4WD solenoid valve or coil not operating. Mechanical failure in transmission. Low 4WD clutch pack pressure. Worn 4WD clutch pack.
Transmission overheating	Oil level too high or low. Cooler flow restricted. Low oil pressure. Clutch packs slipping due to low pressure or wear. Mechanical failure in transmission. Excessive stall operation.
Operating in too high of gear range for conditions	Shift to lower gear.
Difficult gear selection	Forward or reverse travel clutch pack pressurised when not selected. Direction control solenoid valve faulty. Input shaft seal rings leaking. Mechanical failure in transmission. Forward or reverse travel clutch pack not releasing due to a mechanical failure.
Vehicle moves with direction valve in neutral position	See “Difficult gear selection”.
High stall speed	Low oil level. Air in oil. Clutch plates slipping due to low pressure or wear. Torque converter faulty. Converter relief valve faulty. Wrong torque converter installed.
Low stall speed	Poor engine performance. Torque converter faulty. Wrong torque converter installed.

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Low pump pressure	Worn or broken pump. Pump seal ring leaking. Restricted oil strainer or filter. Blockage in oil ports between transmission sump and oil pump. Pressure regulator valve stuck open. Cold start valve stuck open.
High pump pressure	Pressure relief solenoid valve faulty. Has normal operating oil temperature been reached?
Low forward or reverse clutch pack pressure	Direction control solenoid valve faulty. Piston seal or O-ring leaking. Input shaft seal ring leaking.
High forward/reverse clutch pack pressure	Pressure relief solenoid valve faulty.
Converter pressure low	Converter relief valve faulty. Leak in converter, oil cooler or connection hoses. Very hot oil.
Converter pressure high	Converter relief valve faulty. Blockage or restriction in the oil cooler. Very cold oil.
Low 4WD clutch pack pressure	4WD piston seals leaking. 4WD shaft seal ring leaking. Leak from 4WD clutch supply pipe. Faulty 4WD solenoid valve. Blockage or restriction in 4WD clutch supply pipe.
High 4WD clutch pack pressure	Pressure relief solenoid valve faulty.
Low lubrication pressure	Blockage or restriction in the oil cooler. Input shaft front seal ring leaking. Very hot oil.

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FAULT DIAGNOSIS MECHANICAL SYSTEM

PROBLEM	CAUSE
Noise	Vehicle driveline problem: Axles, propshafts, engine, engine mounts. Misalignment of transmission/engine. Worn or damaged bearings. Gear teeth damaged or broken. Excessive end float of shafts or gears. Clutch plate failure forward, reverse or 4WD. Incorrect grade of oil in transmission. Low oil level. Gear or thrust washer beginning to seize.
Difficult gear selection	Shift rods worn or bent. Shift forks worn, loose or twisted. Synchronizer assemblies worn or damaged. Clutch pack not releasing due to mechanical fault. Clutch pack not releasing due to hydraulic fault. Gearshift lever worn or damaged. Incorrect grade of oil in transmission. Low oil level.
Jumping out of gear	Detent springs worn or broken. Synchronizer or gear dog teeth worn or damaged. Synchronizer assemblies worn or damaged. Shift forks worn, loose or twisted. Restriction or wear in gear linkage or stub lever assy. not allowing gears to be fully selected. Excess end float on output shaft assembly or gears.

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1.13 SPECIAL TOOLS

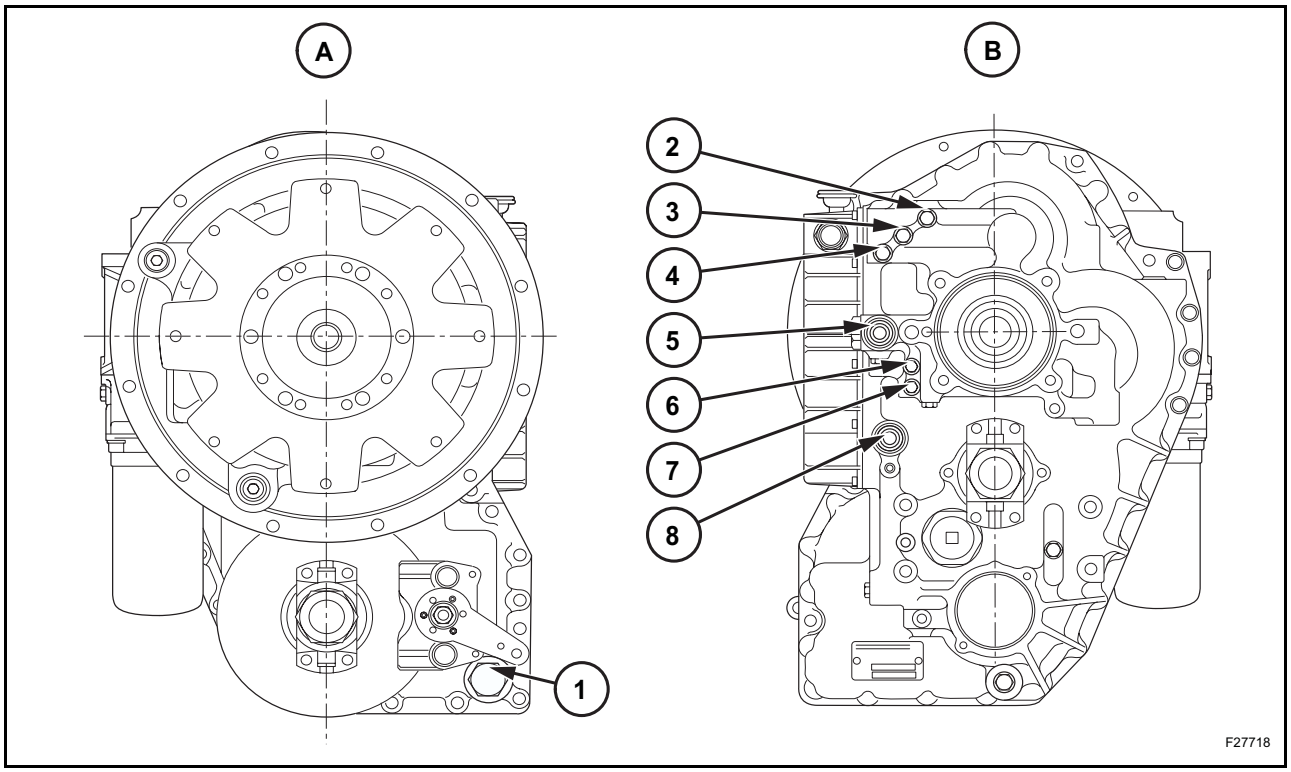
P/N CNH	DESCRIPTION
380002683	Input and reverse idler shaft bearing removal collect
380002684	Piston seal sizing ring (on 4WD models only)
380002685	Removal/installation of the front/rear bearing of the 4WD shaft and of the front bearing of the coaxial input shaft
380002686	Output shaft front bearing removal collect
380002687	C/shaft and output shaft rear bearing removal collect
380002689	Input shaft spring compressor
380002690	4WD shaft spring compressor (on 4WD models only)
380002691	C/shaft front bearing removal collect
380002692	Coaxial input shaft and hydraulic dog clutch 4WD shaft spring compressor
380002693	Shimming adapter

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2. POWERSHIFT TRANSMISSION “DANA T16000”

This transmission is used only on powershift loader backhoe models 580SR+ / 590SR / 695SR.



2.1 SPECIFICATIONS

HYDRAULIC SPECIFICATIONS

Suitable for operation from ambient to 120 °C continuous operating temperature.
Must withstand a 20 bar continuous pressure and a 40 bar variable pressure.
Conform SAE J1019 and SAE J517, 100RI.

Weight ..... 290 kg

BOLT TORQUES

Output flanges ..... 339 - 407 Nm
Filter torque ..... 30 - 38 Nm
Control valve, connector nut to cover ..... 6 - 8 Nm

ELECTRICAL SPECIFICATIONS

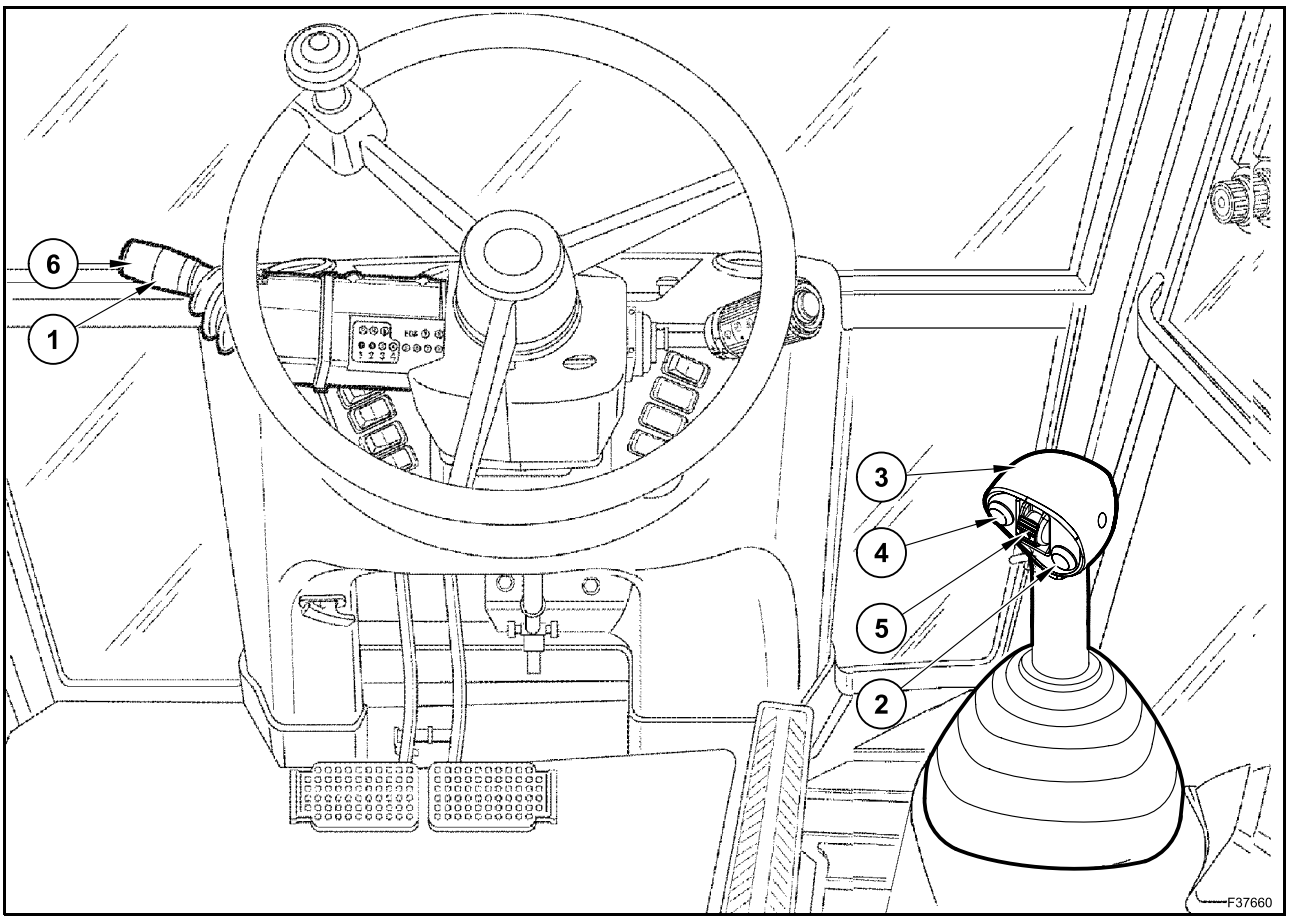
Solenoid coil resistance (forward-reverse travel, high/low, 2nd/1st gear, modulation, disconnection) ..... 28 Ω ± 2 Ω at 20 °C
Electronic controlled modulation valve, coil resistance .....3.55 Ohm (± 0.25 Ohm) at 20 °C
Speed sensor:
- type ..... magneto resistive sensor with 7/14 mA current loop
- frequency .....0 - 25000 Hz
- sensing distance ..... 0 - 2.5 mm

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2.2 CONTROLS

4X2 POWERSHIFT TRANSMISSION CONTROL



3

1. POWERSHIFT TRANSMISSION GEARSHIFT AND DIRECTION LEVER: four gears are selectable for the required ground speed in forward and two gears for reverse travel.

IMPORTANT: the gearshifts and the direction of travel are governed by the microprocessor, which enables smooth and safe changes, irrespective of the selected gear. Therefore upshifting, downshifting or change of travel direction by means of the gears will only occur when the monitored machine speed is safe to do so.

2. DIFFERENTIAL LOCK SWITCH: depressing the spring loaded switch will lock both rear wheels together giving equal drive and will disengage when wheel torque equalises or the foot brakes are applied.
3. LOADER ATTACHMENT CONTROL LEVER
4. TRANSMISSION DISCONNECT BUTTON
5. ROLLER FOR THE PROPORTIONAL CONTROL OF LOADER BUCKET 4x1
6. KICKDOWN SWITCH: if the machine is in 2nd gear and 1st is required for loader work engaging kickdown instantly drops the gear from 2nd to 1st. When reverse is selected the transmission reverts to 2nd gear.

4x2 powershift transmission

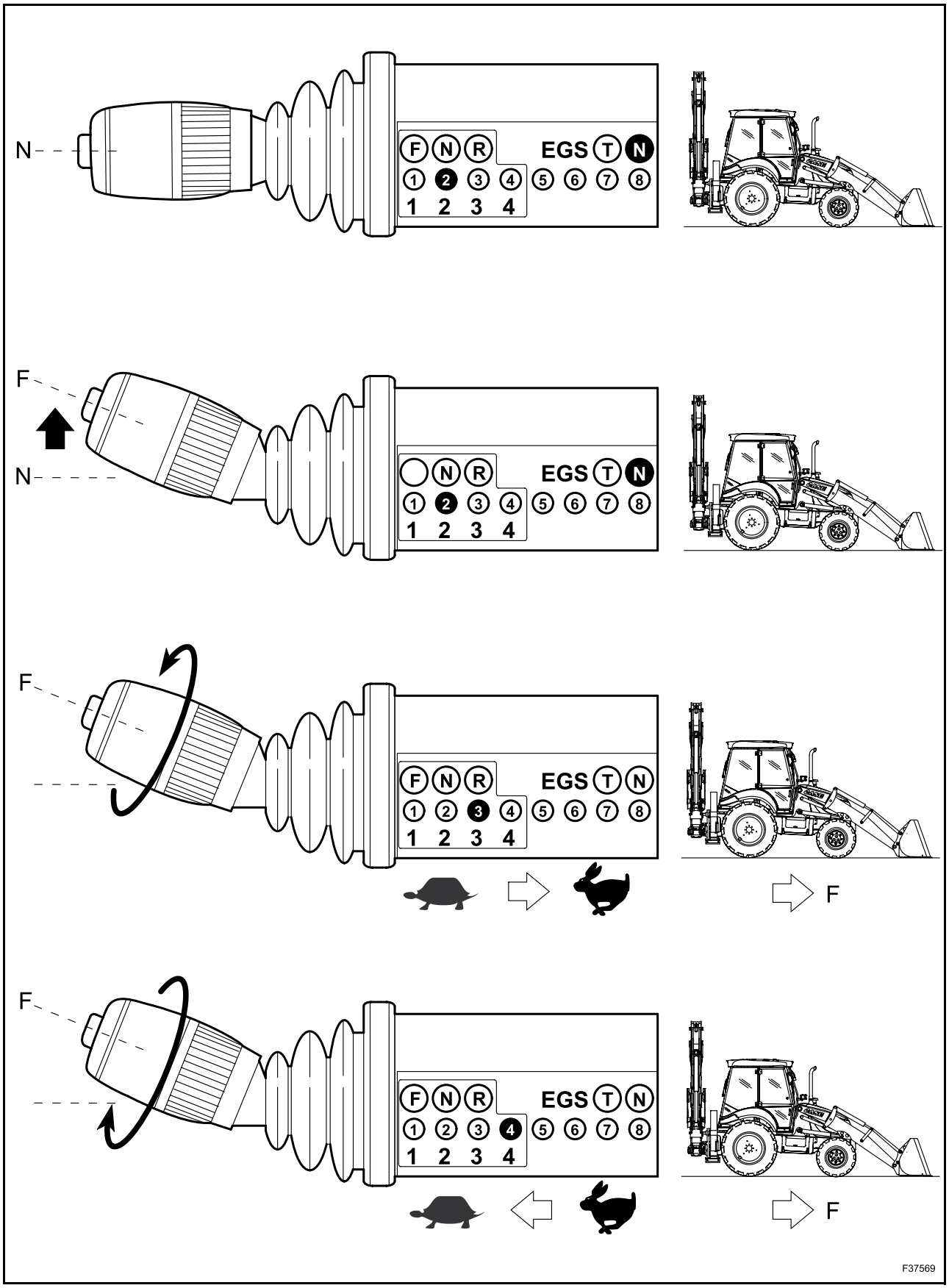
The transmission installed on this machine has been designed for gearshifting, although it continues driving the wheels, according to the selected ratio and travel direction. The transmission is controlled by a microprocessor located in the powershift gearshift lever unit (1).

The gearshift lever (1) with electronic gear selection actuates the powershift gearshift with 4 forward and 2 reverse speeds.

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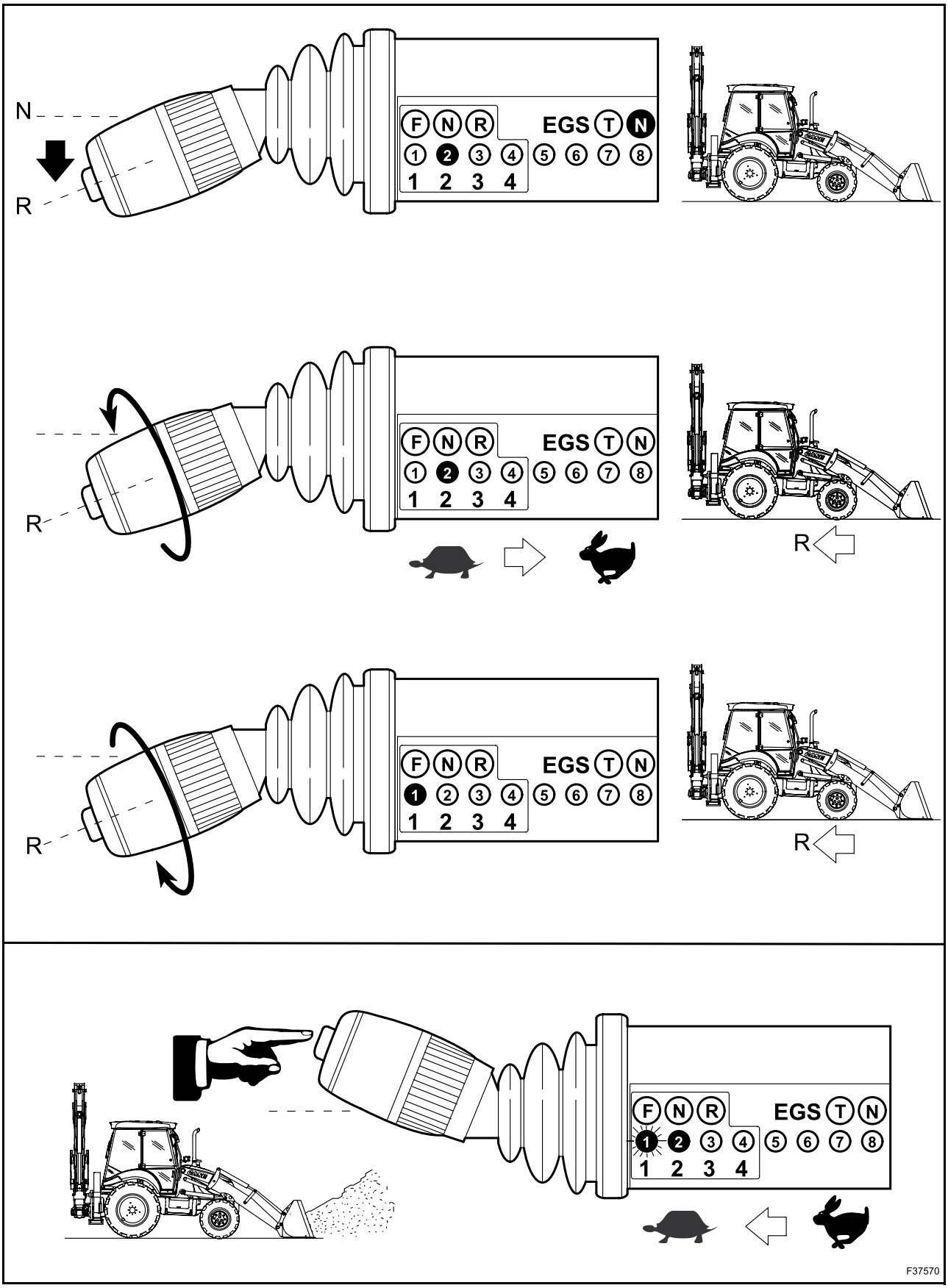
Powershift 4x2 (EGS) transmission display - Forward travel selection



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Powershift 4x2 (EGS) transmission display - Reverse travel selection

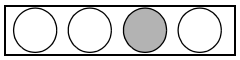


5

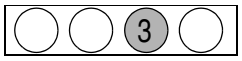
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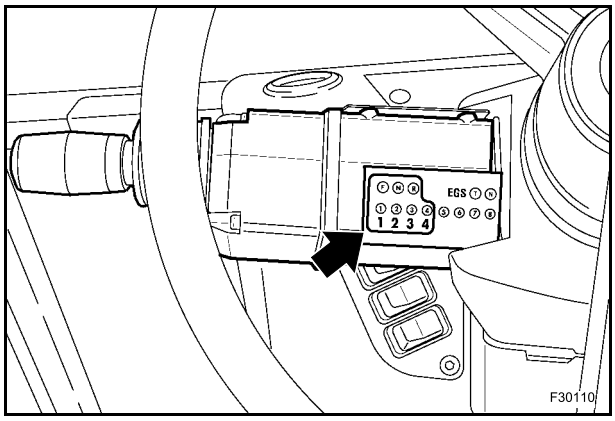
Powershift lever display - (LEDs)
LEDs - Numbered 1 to 4:
Indicate the direction of travel by the colour of the LED
Forward = Green
Neutral = Red
Reverse = Orange



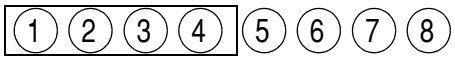
and they also indicate the selected gear.



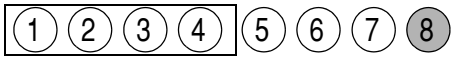
STEADILY ILLUMINATED LED: indicates selected transmission gear.
FLASHING LED: indicates the actual transmission gear engaged (if different from that selected).



LEDs - Numbered 1 to 8: used during test modes

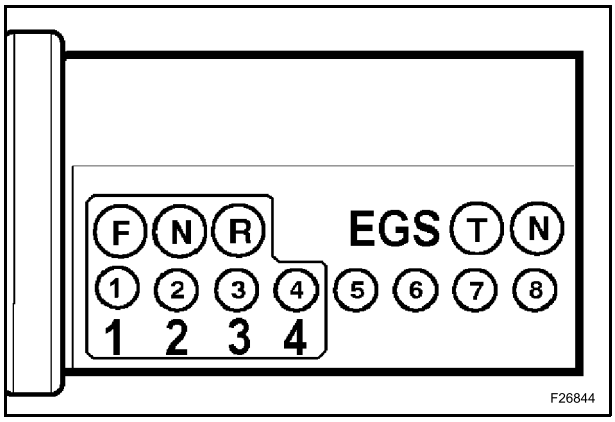


LED - Number 8: illuminates green when the machine is at a standstill (in normal mode).



LED - Letter T = Self-diagnostic mode: (T)

Used in self-diagnostic test mode and will illuminate during self test.

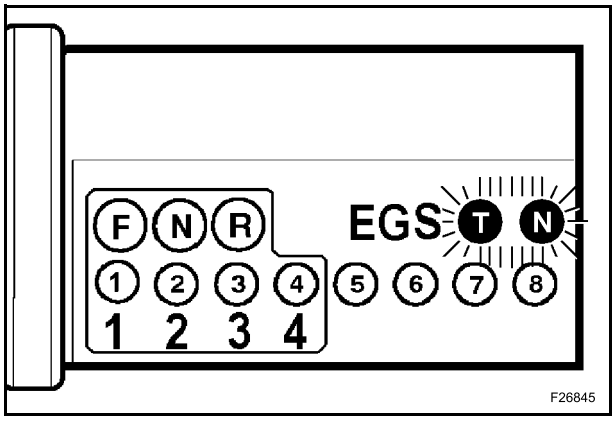


NOTE: in the event of a fault, (the light will flash), Contact your Authorized Dealer for assistance.

LED - Letter N indicates Neutral: (N)

Illuminates when the transmission is shifted to neutral.

Powershift lever and microprocessor functions
The microprocessor controls the transmission and self checks its own memory continuously to ensure that gear selection and range changes are always performed in a safe manner.
Should a fault occur in the transmission or the microprocessor, the microprocessor will default to the reset mode.



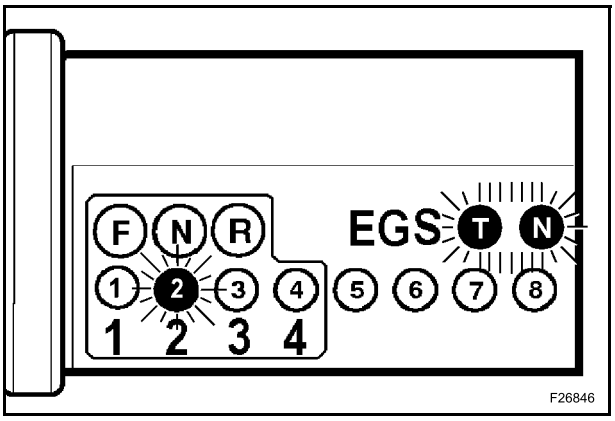
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Reset Mode:
When the microprocessor defaults to reset mode both the T and N LEDs are displayed simultaneously to indicate that a reset has taken place.
If no critical faults are active the microprocessor selects N2 and goes to the Neutral lock state. See “Driving with powershift” chapter.

Limp home function:
If a fault is detected at power-up, the limp home function is automatically selected.

IMPORTANT: if limp home is active, only 1st and 2nd gear will be selectable but without modulation.
The limp home function is active when the following LEDs are on.
- Consult your Dealer.

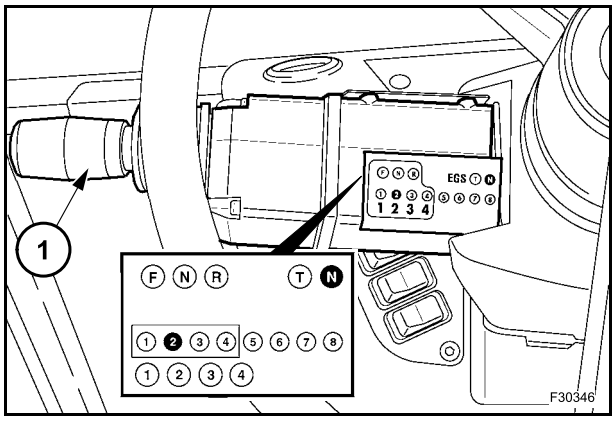


LED - T	LED - N	CONDITION
Flashing	ON	Last fault currently shown on display
Flashing	Slower flashing	Input error detected
Flashing	Flashing in phase	Non-critical output error detected
Flashing	Faster flashing	Safety critical output error detected

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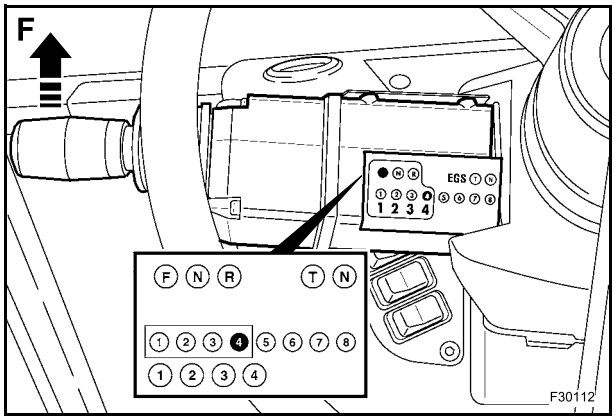
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Selecting neutral position
At power up, “Neutral and 2nd Gear” are automatically selected regardless of the powershift lever position (1). The LED-2 and the LED-N are illuminated in RED (neutral, 2nd) and the microprocessor is in a neutral lock state. If, after driving, neutral is selected and the shift lever stays in neutral for more than 3 seconds, the microprocessor automatically defaults to the neutral lock state for safety reasons. In neutral position, an automatic shift routine activates to prevent damage to the transmission due to overspeed.



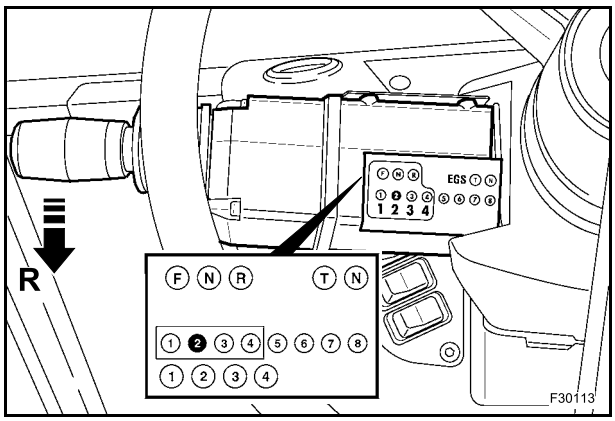
Neutral state
A feature of the powershift lever is the neutral lock state, which does not allow forward or reverse direction drive to be selected. This feature prevents the machine accidentally moving should the lever be knocked into forward or reverse. To leave the neutral lock state, you select drive direction followed by an upshift by rotating the shift lever.

Selecting forward travel
To select forward travel push the lever away from you and the “F” LED will illuminate green.



NOTE: when forward is selected you will not be given any indication of gear selected, only the maximum selected gear the transmission will shift too. The microprocessor is programmed to be an automatic gearshift system. In addition, if the forward travel is now actually engaged, according to the status of the machine (for example, if it is moving), the microprocessor considers the road travel speed and the travel direction before any gearshift takes place.

Selecting reverse travel
To select reverse travel pull the lever towards you and the reverse “R” LED will illuminate orange.



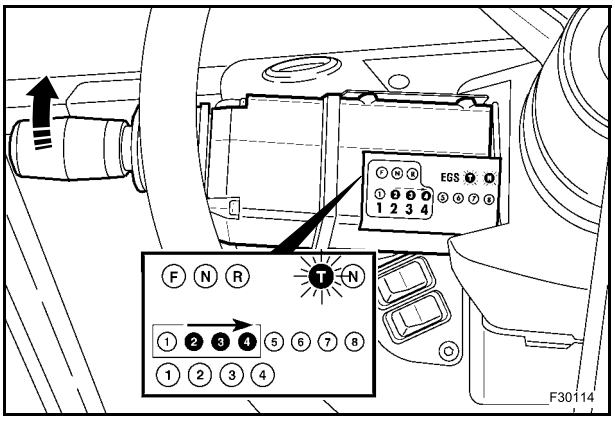
NOTE: when reverse is selected you will not be given any indication of gear selected, only the maximum selected gear the transmission will shift too. The microprocessor is programmed to be an automatic gearshift system.
In addition, if the reverse travel is now actually engaged, according to the status of the machine (for example, if it is moving), the microprocessor considers the road travel speed and the travel direction.

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Upshifting

Upshifting is achieved by turning the handgrip counterclockwise (+) in single movements. If this position is held, the processor advances the gear selection from 2nd to 4th with intervals of 1.8 seconds.



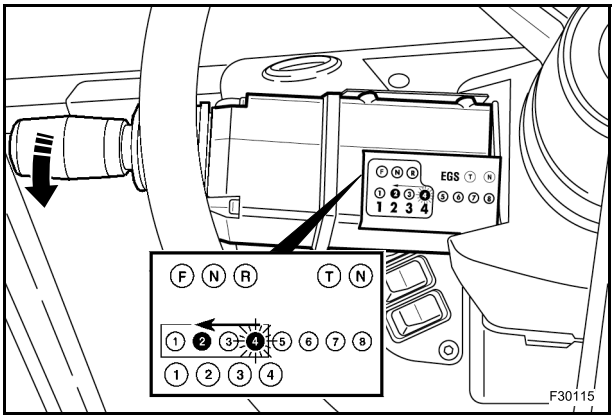
NOTE: an upshift request after a downshift is delayed for 2 seconds. Should an error occur with the speed sensor the microprocessor will not allow upshifts above 2nd gear and will be indicated by the “T” LED flashing and the “N” LED flashing slower.

NOTE: if climbing up a steep incline select 2nd and proceed, if speed and power allow upshift into 3rd and 4th.

Downshifting

⚠ WARNING

If descending down a steep slope, select the second gear, upshifting only when it is safe to do so. You cannot downshift to reduce speed if the machine speed is above 15 km/h.



Downshifting to the desired gear is achieved by twisting the knob clockwise (-) in single movements. If the knob is held in this position, the processor will downshift from the fourth (if the gearshift lever is in this position) to the first gear in intervals of 1.5 seconds.

NOTE: if the gear requested and the shift attainable are not the same because of torque converter turbine rpm being too high, the gear position LED (e.g. LED 4) will flash and the shift lever position will illuminate, not flashing, (e.g. LED 2), until the requested gear is reached. When a gear position LED is flashing this indicates that the machine has to reduce speed to reach the requested gear.

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Direction Changes

Changing driving direction is achieved simply by shuttling the powershift lever between forward and reverse and vice versa which is allowed at any time. The system response however depends on machine speed and currently engaged gear. When driving in 1st or 2nd gear direction changes are unrestricted and are granted immediately.

F1 - R1	F2 - R2
R1 - F1	R2 - F2

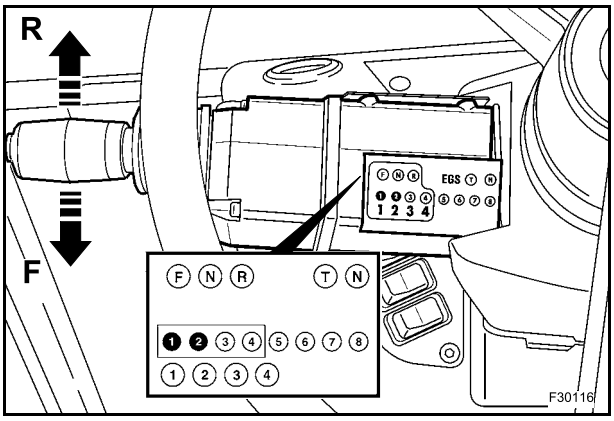
When driving forward in 3rd or 4th gear two responses are possible depending on machine speed.

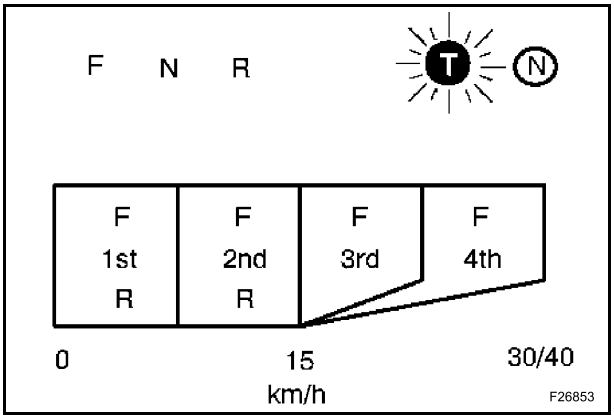
RESPONSE 1: if the machine speed in forward is above 15 km/h and reverse is selected downshift engages but momentum forward remains, until the speed lowers sufficiently to allow downshift to take place when reverse is achieved in 2nd gear.

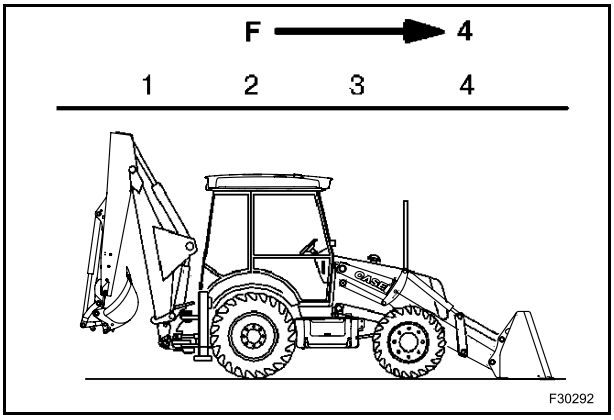
RESPONSE 2: if the machine speed in forward is less than 15 km/h reverse takes place immediately into 2nd gear.

Should a speed sensor fault be detected while in F3 or F4 a downshift sequence to 2nd gear will take place and is indicated by the LED “T” flashing fast and the LED “N” flashing slowly.

NOTE: if the transmission is in 1st gear forward after a quick downshifting, the travel direction change determines the selection of the second reverse travel in order to guarantee an efficient response. Refer to kickdown for more information.







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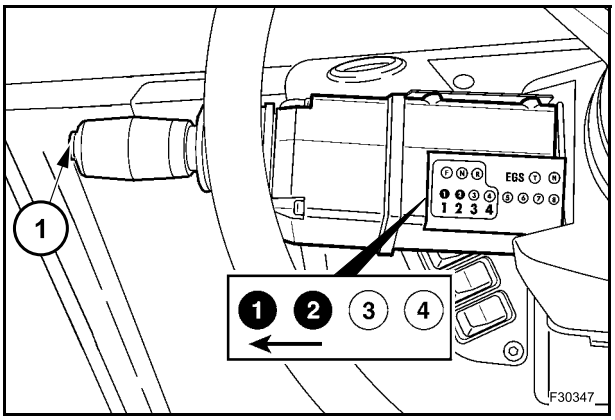
Powershift transmission

In the previous paragraphs shift changes have been shown as precise movements and twist actions of the powershift lever. However the transmission can change gear automatically in forward or reverse as described in the following paragraph:

Select the 4th forward gear with the powershift lever; then, with the parking brake disengaged, press the accelerator pedal. As the engine revs and machine speed increase the transmission will start from 2nd gear and change up through 3rd and 4th gears up to maximum road speed. When you require to slow down or stop release the foot accelerator and apply the foot brake, the transmission will automatically downshift through 4th, 3rd and 2nd gear as the machine speed decreases. Once stopped, engage the parking brake; now the neutral position will be selected by the microprocessor. To start travelling again, simply twist the handgrip to select the 4th gear and, with the parking brake disengaged, press the accelerator pedal.

Kickdown

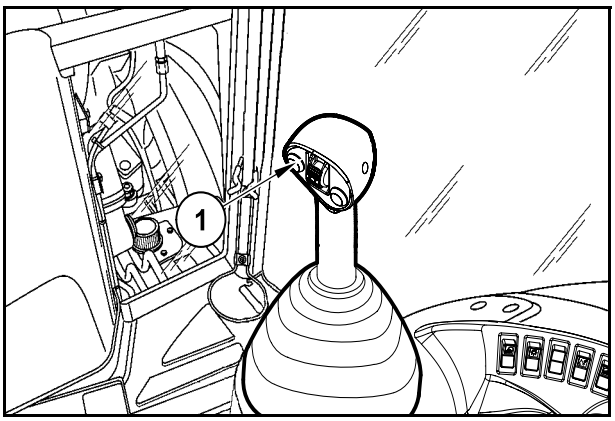
The kickdown facility (2nd to 1st gear only) on this transmission increases torque instantly to the driving wheels and hence pushing power. For example when the loader is pushing into a pile and more torque is required at the wheels. This is achieved by the instant gearshift from 2nd to 1st by the use of the button (1) without the need to use the twist grip on the powershift lever.



NOTE: the kickdown function is available only when the transmission is in 2nd gear and the appropriate button (1) is pressed. If downshifting is impossible (machine speed too high), the LED 1 is on and the LED 2 flashes.

Transmission disconnection

The disconnect feature is useful when loading, for example; when pushing the loader into a pile and you have sufficient dirt in the bucket press the disconnect switch (1) which disengages the transmission and allows the full power of the engine to be directed to the hydraulic oil pump. Disconnect is available in 1st and 2nd gear.



NOTE: transmission disconnect is selectable, when the machine speed is less than 5 km/h and by depressing the button on the loader lever and remains active until the pedals or switch are released.

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Speed Ranges

The microprocessor controlling the powershift transmission is pre-programmed to control the speed at which the gearshifts take place.

This effectively protects the transmission from excess forces, should gearshifts be selected at higher speeds than is desirable.

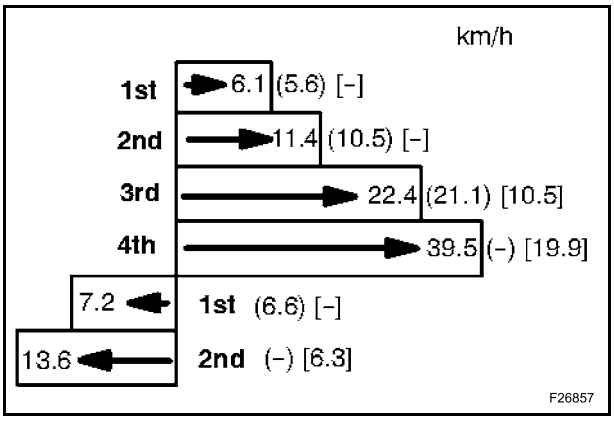
(Except 695SR) shown in the chart opposite with an 18.4 X 26 R4 tyre fitted is the approximate (within 10%) maximum speed available and at which speed an automatic shift takes place in each gear.

(...) = Automatic upshift speed

[...] = Automatic downshift speed

As it can be seen, when downshifting from the 4th gear at a maximum speed of 39.5 km/h, the microprocessor will not allow the downshift to take place until the speed has dropped to approximately 19.9 km/h.

Refer to the chart for the details regarding upshifting and downshifting.



NOTE: in some countries the road speed of 40 km/h is not allowed. In these circumstances the transmission is governed to a maximum of 30 km/h and the shift speed range reduces accordingly.

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2.3 LUBRICATION

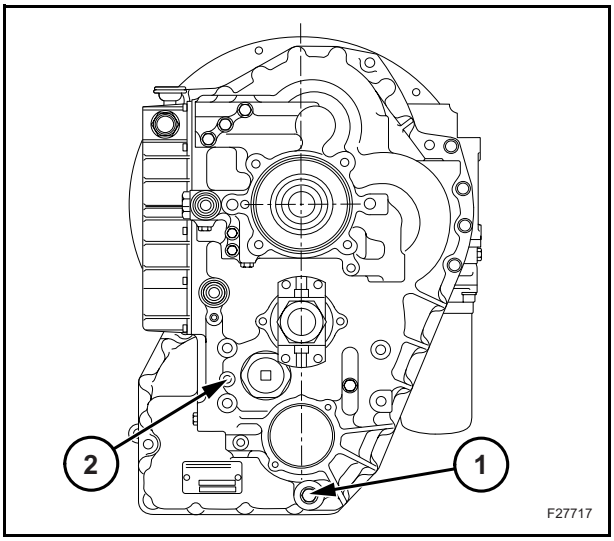
Oil capacity ..... 14 litres
Suggested oil ..... Axcela Trans XHD MAT3525

Daily
Check oil level daily with engine running at idle (600 rpm) and oil at 82 - 93 °C.
Maintain oil level at full mark.

Normal drain period
Normal drain period and oil filter change are for average environment and duty cycle condition.
Severe or sustained high operating temperature or very dusty atmospheric conditions will cause accelerated deterioration and contamination.
For extreme conditions judgement must be used to determine the required change intervals.

- Every 1000 hours change oil filter.
- Every 1000 hours drain and refill system as follows: drain with oil at 65 - 93°C.
  - Drain transmission.
  - Oil filter, remove and discard, install new filter.
  - Refill transmission (14 litres).
  - Run engine at idle (600 rpm) to prime converter and lines.
  - When oil temperature is at 82 - 93 °C adjust oil level to full mark.

NOTE: it is recommended that oil filter be changed after 100 hours of operation on new, rebuilt or repaired unit.



1. Drain plug
2. Oil level plug

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2.4 PRESSURE SPECIFICATIONS AND CHECK POINTS

Normal operating temperature 70 - 120 °C measured at temperature check port to cooler.

Maximum allowed transmission temperature 120 °C.

Transmission regulator pressure (*) - (neutral 2nd speed).
- at 600 rpm: 16.5 bar.
- at 2200 rpm: 19.6 - 23.1 bar.

Pump delivery (*):
- at 2200 rpm in neutral 2nd speed: 64.9 l/min minimum.
- at 2200 rpm in reverse 1st, 2nd, forward 1st, 2nd maximum 3 l/min less than in neutral 2nd.
- at 2200 rpm in forward 3rd and 4th: maximum 5 l/min less than in neutral 2nd.

Clutch pressures (*) at 2200 rpm:
- 18.1 - 21.5 bar clutch activated.
- 0 - 0.2 bar clutch released.

Filter by-pass valve set to 4.1 - 5 bar (*).

Lube pressure (*) 0.3 - 0.5 bar at 47 l/min pump flow (±1800 rpm).

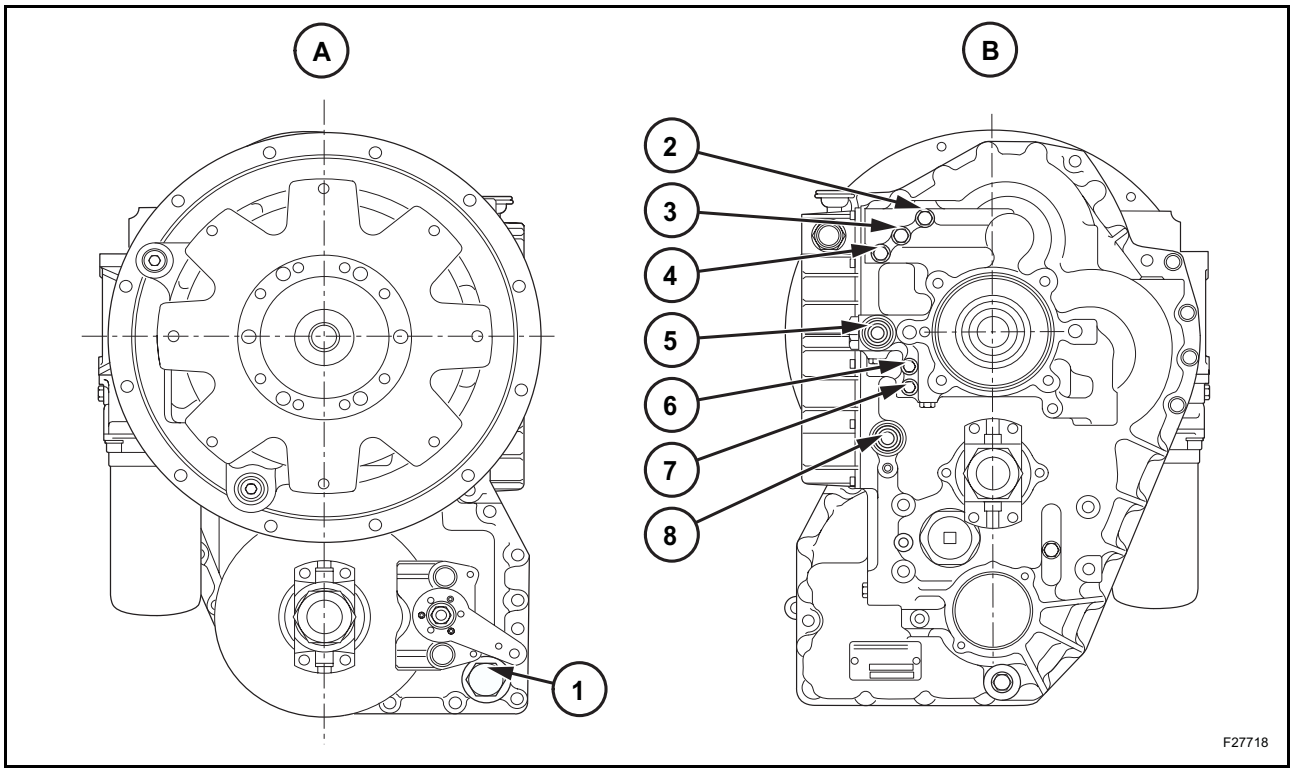
Internal leakage (*) 1.5 - 3.0 l/min for each clutch. Maximum total leakage 6.8 l/min (clutch leakage + range + converter leak + valve leak) without disconnect clutch.

Safety valve: cracking pressure (*) 9.5 - 10.5 bar.

To cooler (converter out) pressure (*) 2 bar minimum at 2000 rpm and maximum 5 bar at no load governed speed.

Converter by-pass valve set to 5-7 bar (*).

(*) All pressures and flows to be measured with oil temperature of 82 - 93 °C.

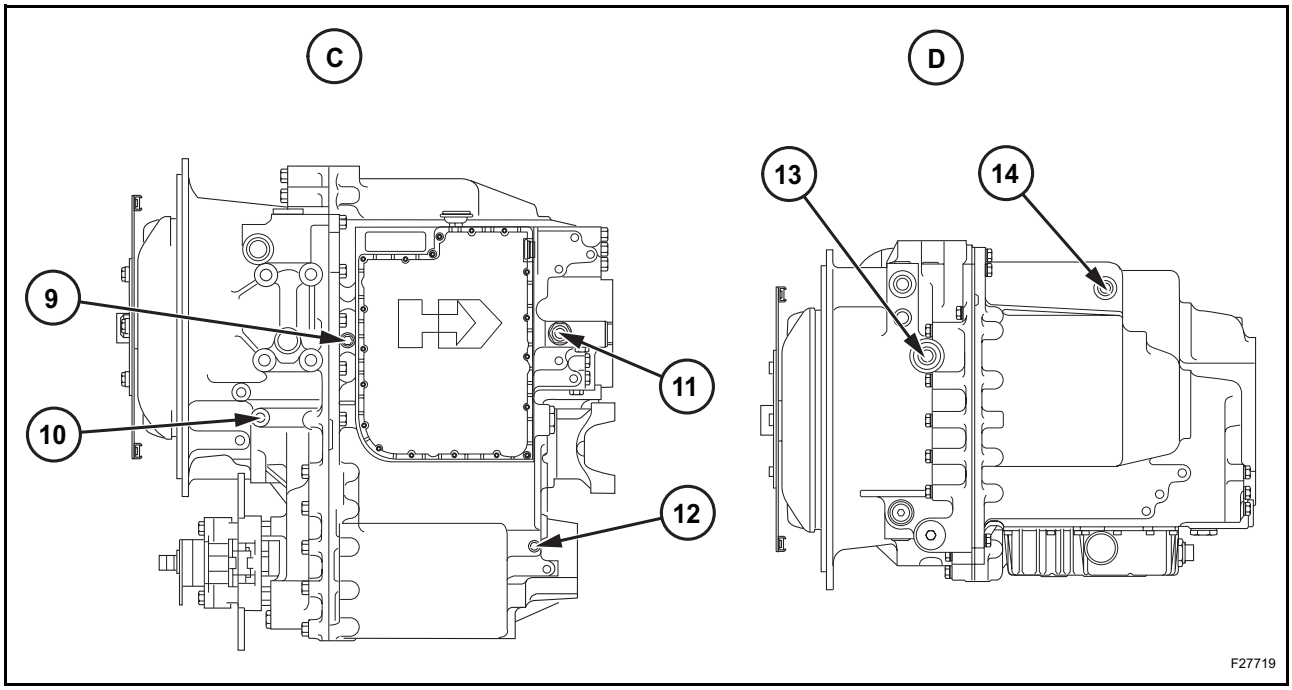


A. Front view
B. Rear view

1. Dipstick hole M27 x 2.5
2. Pressure check port forward hi clutch (forward 3rd and forward 4th) 18.1-21.5 bar
3. Pressure check port from cooler (lube pressure)
4. Pressure check port forward port forward low clutch (forward 1st and forward 2nd)
5. To cooler 18.1-21.5 bar
6. Pressure check port reverse clutch (reverse 1st and reverse 2nd) 18.1-21.5 bar
7. Pressure check port 1st clutch (forward 1st, forward 3rd, reverse 1st) 18.1-21.5 bar
8. From cooler

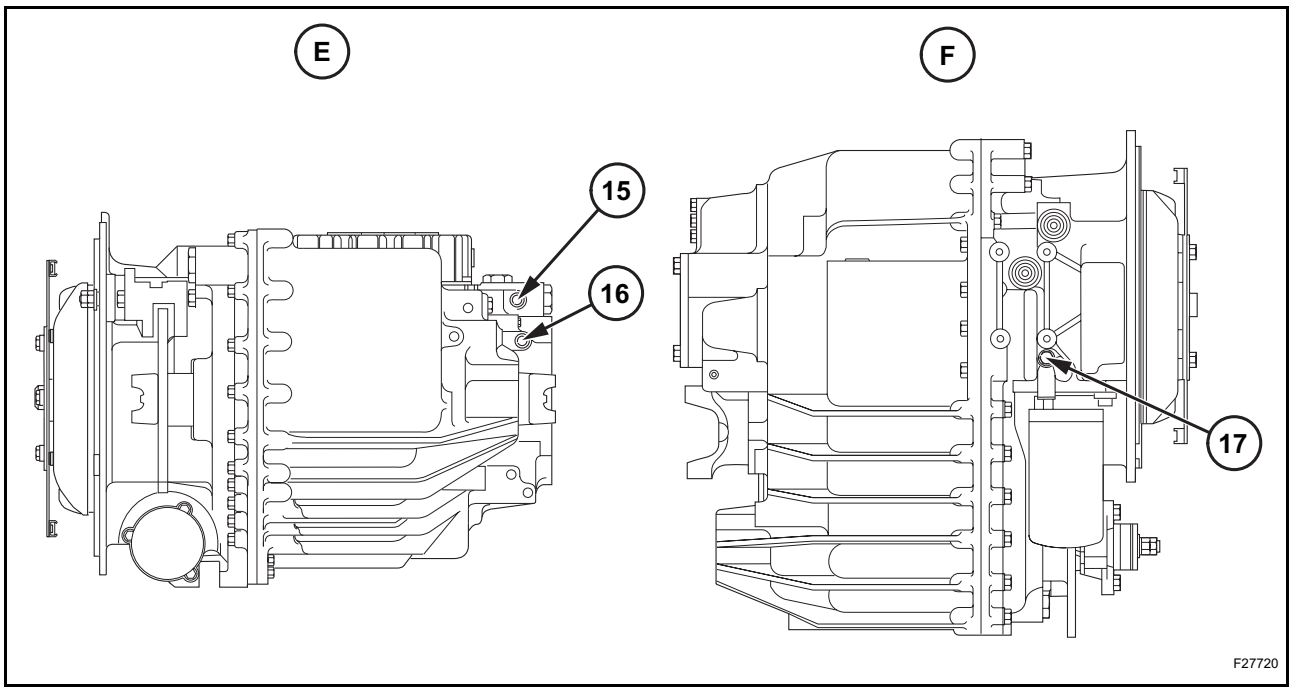
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C. Left side view
D. Top view

9. Pressure check port converter in 5-11 bar
10. Pressure check port 2nd clutch (forward 2nd - forward 4th - reverse 2nd) 18.1-21.5 bar
11. To cooler
12. Pressure check port 4WD 18.9-27.5 bar
13. Pressure check port regulator pressure 19.6-23.7 bar
14. Filter plug M22 x 1.5



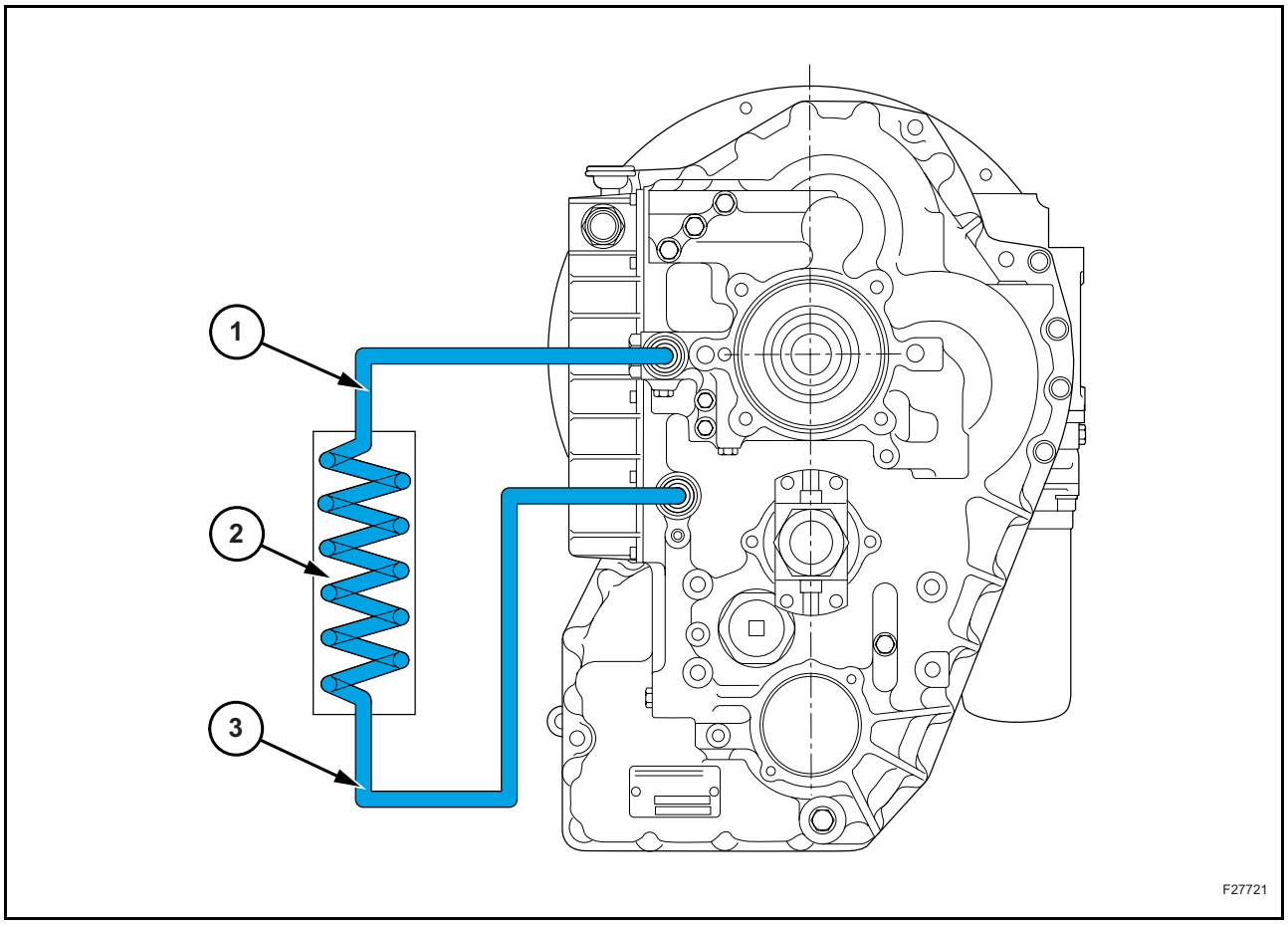
E. Bottom view
F. Right side view

15. Temperature check port converter out to cooler M10 x 1
16. Pressure check port converter out to cooler 1.0625-12 UN2B SAE
17. Pressure before filter

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2.5 TRANSMISSION COOLER



1. To cooler from converter
2. Transmission cooler
3. From cooler to transmission lube distributor

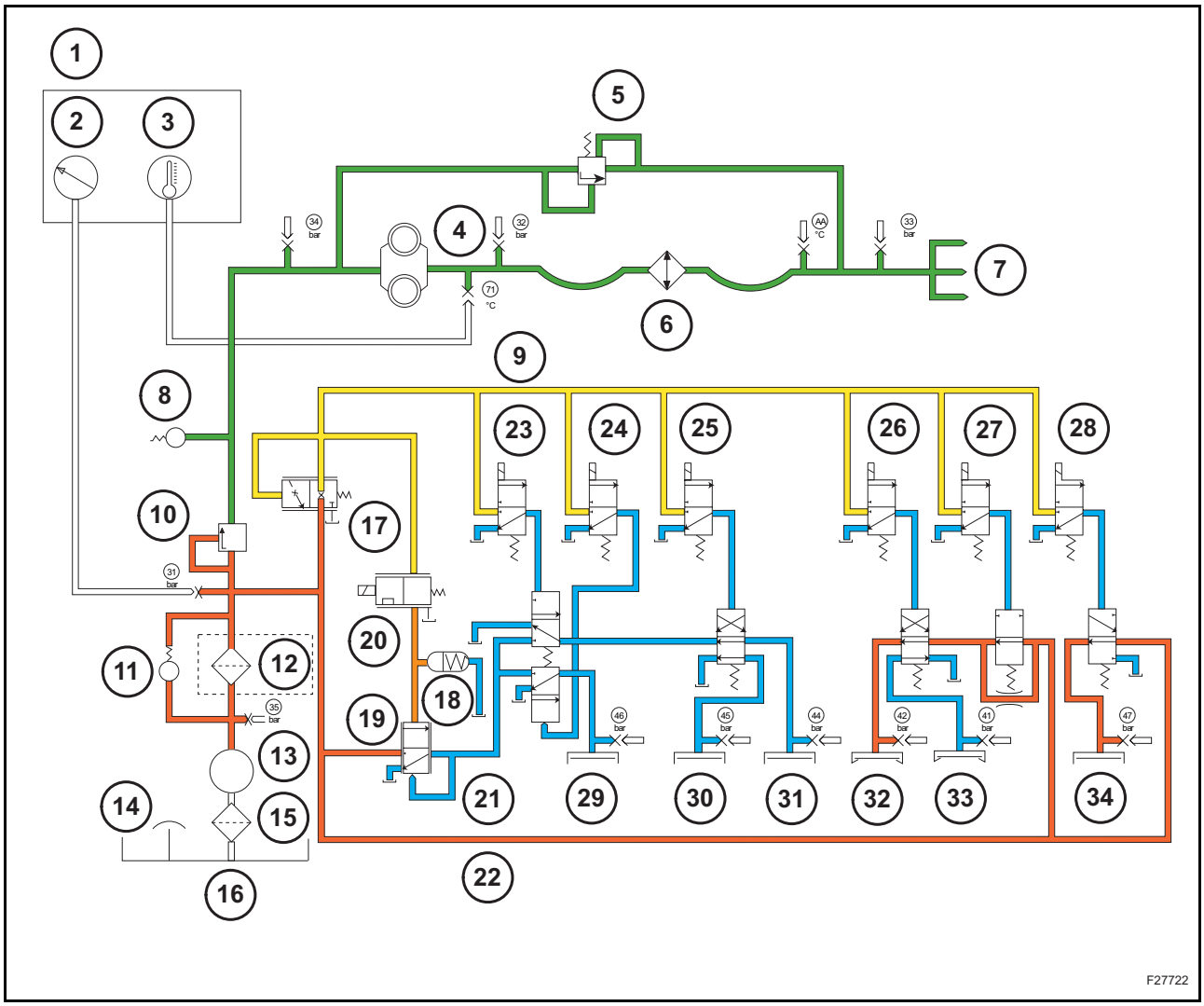
COOLING SYSTEM SPECIFICATIONS

Suitable for operation from ambient to 120 °C continuous operating temperature.
Must withstand a 20 bar continuous pressure and a 40 bar variable pressure.
Confirm SAE J1019 and SAE J517, 100RI.

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2.6 HYDRAULIC DIAGRAM



ⓧ bar Pressure check port

ⓧ °C Temperature check port

1. Operator's compartment
2. Pressure gauge
3. Thermometer
4. Torque converter
5. Torque converter (pressure difference 4 bar) by-pass valve
6. Radiator
7. Lubrication
8. Safety valve 10 bar cracking pressure
9. Solenoid pressure 5 bar
10. Pressure regulator valve 20 bar
11. By-pass valve pressure difference 4.3 bar
12. Filter
13. Pump
14. Air breather
15. Filter
16. Oil sump
17. Pressure reducer to 5.5 bar
18. Accumulator
19. Pressure booster 0 - 5.5 to 0 - 20 bar
20. Electronic controlled modulation valve 5.5 to 0 bar
21. Modulated pressure 0 to 20 bar
22. Clutch pressure 20 bar
23. Solenoid N/forward
24. Solenoid N/reverse
25. High/low solenoid
26. Solenoid 2nd/1st
27. Solenoid range modulation
28. Solenoid disconnect
29. Reverse clutch
30. Forward low clutch
31. Forward high clutch
32. 2nd clutch
33. 1st clutch
34. Disconnect clutch

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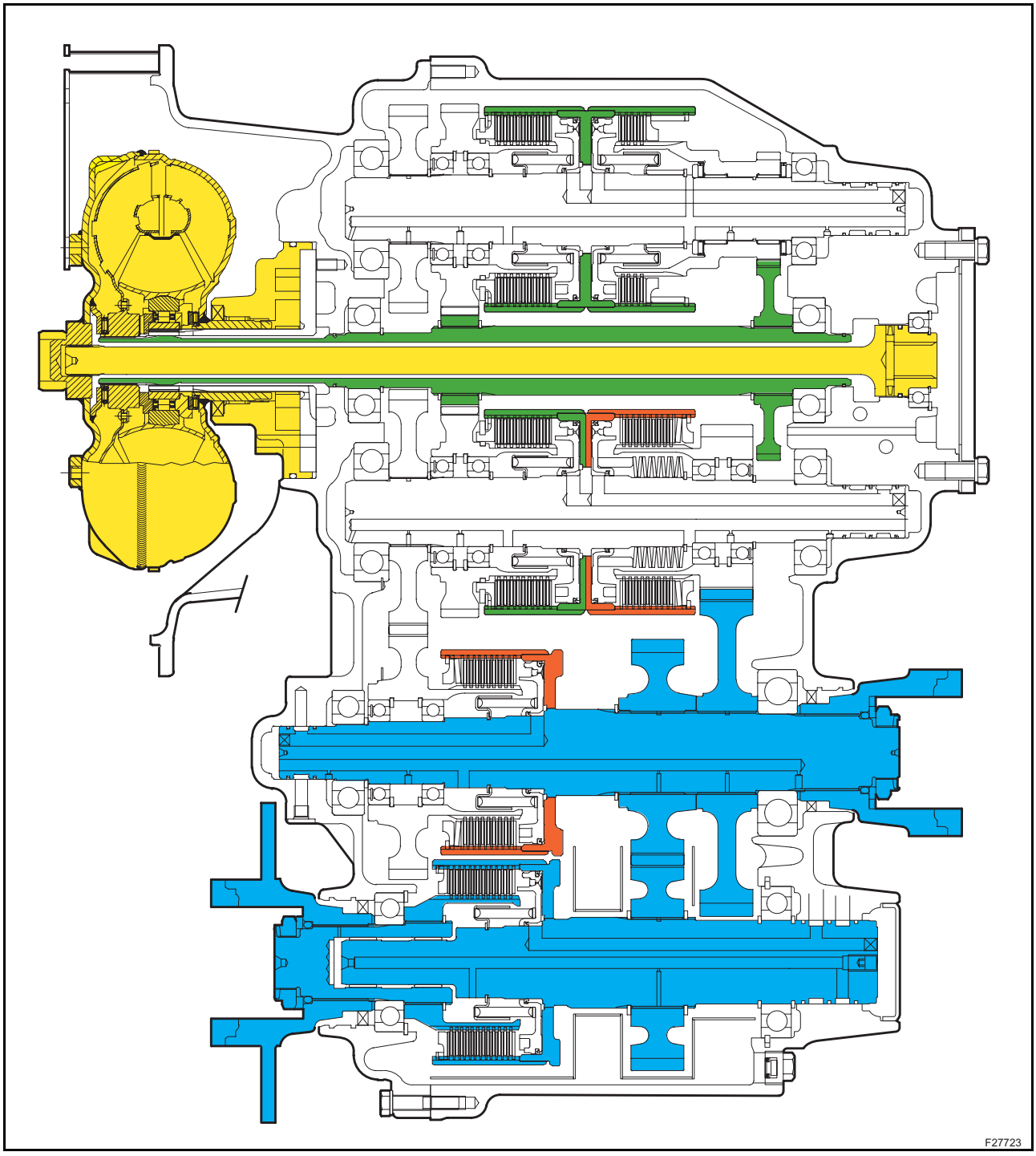
2.7 OPERATION

The transmission and hydraulic torque converter of the power train enacts an important role in transmitting engine power to the driving wheels. In order to properly maintain and service these units it is important to first understand their function and how they operate.
The transmission and torque converter function together and operate through a common hydraulic system.
With the engine running, the transmission charging pump draws oil through the oil suction filter and directs it through the oil filter and pressure regulating valve.
Across the oil filter is a filter by-pass valve which will open if the pressure difference becomes higher than 4.3 bar.
The pressure regulating valve maintains pressure for the control valve and clutches at 20 bar.
Excess oil volume is bled off into the converter system. A safety valve is fitted between the pressure regulator and converter.
The valve will open if pressure in this system becomes higher than 10 bar.
After entering the converter the oil is directed through the converter blade cavity and exits in the passage between the turbine shaft and pump drive shaft. Flows to the cooler.
After leaving the cooler the oil is directed to a fitting on the transmission.
Then through a series of tubes and passages lubricates and cools the transmission bearings and clutches.
The oil then gravity drains back to the transmission sump.
Across the converter and oil cooler is a converter by-pass valve which will open if the pressure difference is higher than 4 bar (during start up from cold or at high rpm).

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Basically the transmission is composed of five main assemblies:



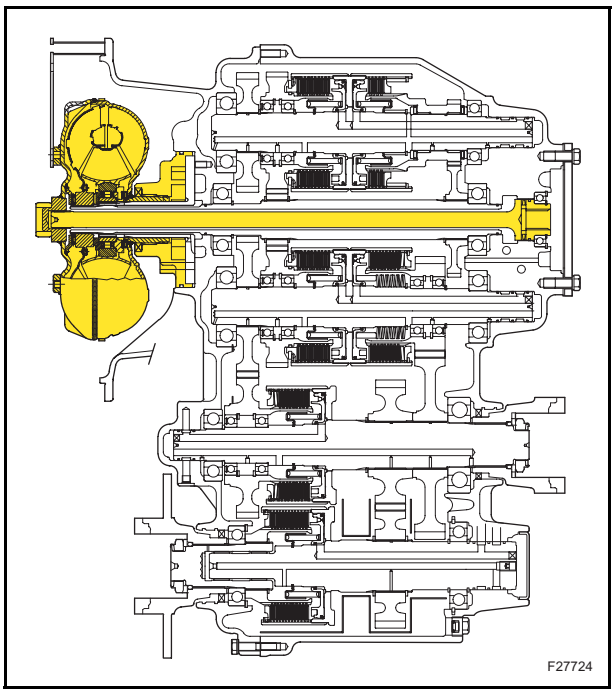
The converter and pump drive section
The input or directional clutches
The range clutches
The output section

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THE CONVERTER AND PUMP DRIVE SECTION

Engine power is transmitted from the engine flywheel to the impeller through the impeller cover.
This element is the pump portion of the torque converter and is the primary component which starts the oil flowing to the other components which results in torque multiplication. This element can be compared to a centrifugal pump in that it picks up fluid at its centre discharges at its outer diameter.
The torque converter turbine is mounted and discharge opposite the impeller and is connected to the turbine shaft or directional clutch shaft.
This element receives fluid at its outer diameter and discharges at its centre.
The stator of the torque converter is located between and at the centre of the inner diameters of the impeller and turbine elements. Its function is to take the fluid which is exhausting from the inner portion of the turbine and change its direction to allow correct entry for recirculation into the impeller element.
This recirculation causes the converter to multiply torque.
The converter will multiply engine torque to its designed maximum multiplication ratio when the turbine shaft is at zero RPM (stall).
Therefore we can say that as the turbine shaft is decreasing in speed, the torque multiplication is increasing.
In the impeller cover a splined shaft is fitted which runs inside and through the turbine shaft to drive a hydraulic pump which is fitted at the back of the transmission.
Since the shaft is connected to the centre of the impeller cover, the pump speed will be the same as engine speed.
The rear side of the impeller cover has a tanged drive which drives the transmission charging pump located in the converter housing. The transmission charging pump speed is also the same as the engine speed.



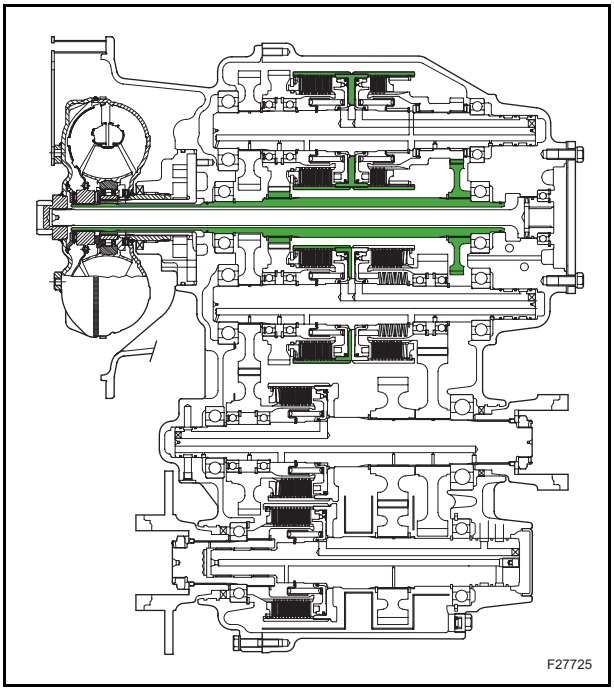
The converter and pump drive section

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THE INPUT OR DIRECTIONAL CLUTCHES

The turbine shaft driven from the turbine transmits power to the forward or reverse clutches.
These clutches consists of a drum with splines and a bore to receive a hydraulic actuated piston.
The piston is oil tight by the use of sealing rings.
A steel disc with external splines is inserted into the drum and rests against the piston.
Next, a friction disc with splines at the inner diameter is inserted.
Discs are alternated until the required total is achieved.
A back up plate is then inserted and secured with a snap ring.
A hub with outer diameter splines is inserted into the splines of discs with teeth on the inner diameter.
The discs and hub are free to increase in speed or rotate in the opposite direction as long as no pressure is present in that specific clutch.
To engage the clutch, the control valve which is fitted on the side of the transmission will direct oil under pressure through tubes and passages to the selected clutch shafts.
Oil seals are located on the clutch shafts.
These rings direct the oil through a drilled passage in the shaft to the desired clutch.
Pressure of the oil forces the piston and discs against the back up plate.
The discs with splines on the outer diameter clamping against discs with teeth on the inner diameter enables the drum and hub to be locked together and allows them to drive as one unit.
When the clutch is released, a return spring will push the piston back and oil will drain back via the control valve into the transmission sump.
The T16000 transmission has one reverse clutch and two forward clutches (forward low and forward high).
This in combination with the two range clutches result in the transmission having 4 forward speeds and 2 reverse speeds.
The engagement of the directional clutches is modulated; which means that clutch pressure is built up gradually.
This will enable the unit to make forward, reverse shifts while the vehicle is still moving and will allow smooth engagement of drive.
The modulation is controlled electronically in the control valve.



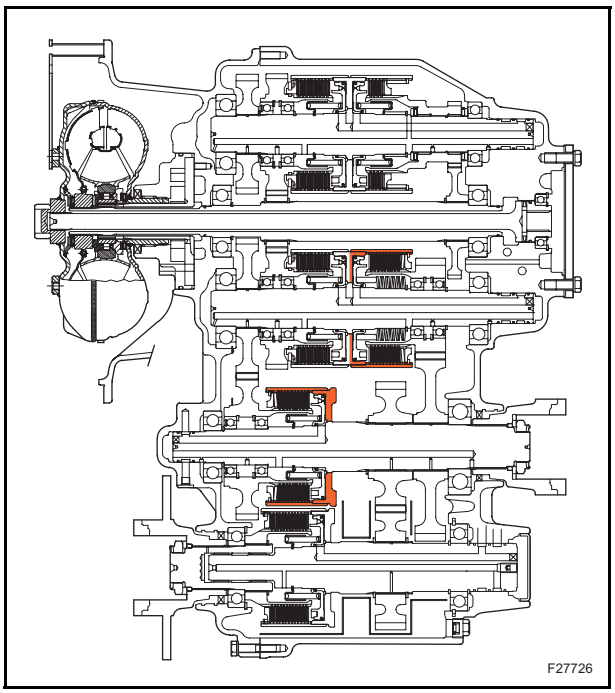
The input or directional clutches

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THE RANGE CLUTCHES

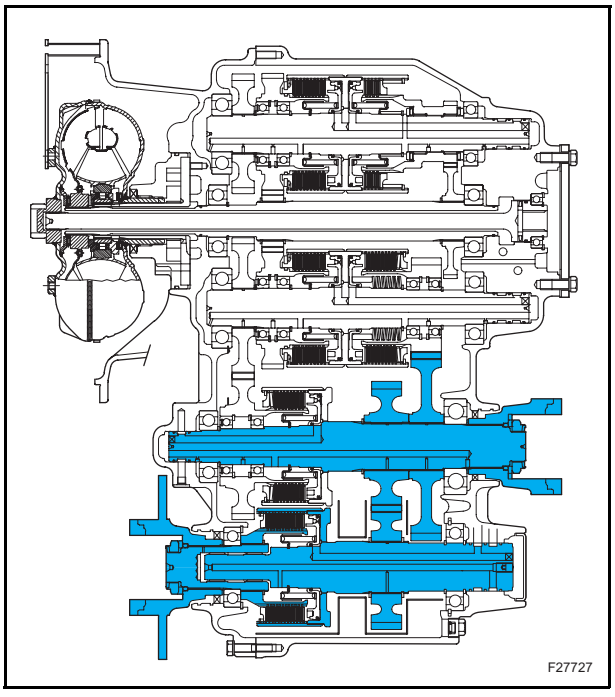
Once a directional clutch is engaged power is transmitted to the range clutches (1st or 2nd).
Operation and actuation of the range clutches is similar as the directional clutches.
The engagement of the range clutches is also modulated to enable a smooth engagement.
The modulation of these clutches is achieved by means of a restrictor valve fitted in the control valve and controlled electronically. It also limits the oil flow to the clutch during shifts.
In the clutch itself the plate before the end plates is dished to build up the clamping force of the clutch gradually.



The range clutches

THE OUTPUT SECTION

With a range clutch engaged power is finally transmitted to the output shafts.
The transmission can have an upper output or lower output at the rear side of the unit, and a lower output at the front side. The rotation of the rear upper output is opposite to the engine rotation when forward travel is selected. The rotation of the rear lower output and of the front output is the same as the engine rotation when forward travel is selected.
Ratio between upper and lower output is 0.951:1.
The lower front output has an axle disconnect clutch to enable 4WD.
The clutch is similar as the other clutches except that it has no modulation.
The disconnect is controlled electronically. Without an electrical signal the clutch is always engaged.



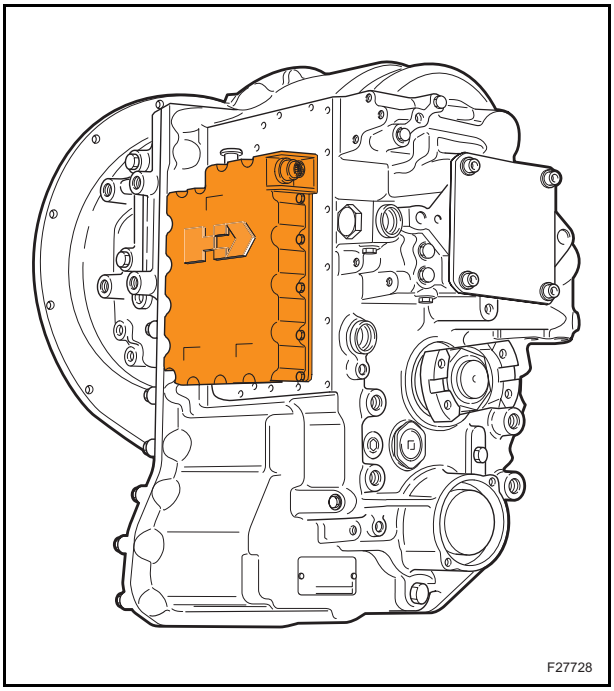
The output section

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THE TRANSMISSION CONTROLS

The transmission is controlled by an electronic gear selector (EGS). This unit has a microprocessor which receives certain inputs (gear selector position, speed sensor...) which are processed and will give output signals to the control valve.
The valve assembly has: 6 solenoid, 6 shift spools, a pressure reducer, an electronic controlled modulation valve, an accumulator, a pressure booster and a speed sensor.
Operation of the valve is as follows:
Regulated pressure 20 bar is directed to the shift spools, pressure booster and pressure reducer.
In the pressure reducer, regulated pressure is reduced to 5.5 bar. This reduced pressure is used as supply for the solenoid and electronic controlled modulation valve.
When activated, the electronic controlled modulation valve will give an output pressure curve from 0 to 5 bar.
This pressure curve is multiplied in the pressure boost valve. In this way, for the directional clutches a curve of 0-20 bar is available.
Between the electronic modulation valve and the booster is an accumulator to damper any hydraulic vibration.
When forward is selected the electronic modulation valve and the forward solenoid are activated.
The pilot pressure of the forward solenoid will move the shift spool so that a forward clutch can be fed with modulated pressure.
If the high/low solenoid is not activated the forward high clutch is engaged, if it is activated the forward low clutch is engaged.
When reverse is selected the electronic modulation valve and the reverse solenoid are activated, the pilot pressure of the reverse solenoid will move the shift spool so that the reverse clutch can be fed with modulated pressure.
The shift spools from forward and reverse are located against each other with a return spring in between; this is to make sure that only one direction can be selected.
Range is selected as follows:
if the range solenoid (2nd/1st) is not activated, regulated pressure is fed through the modulation shift spool and through the 2nd/1st shift spool to the 2nd clutch.
If the range solenoid (2nd/1st) is activated, the pilot pressure will move the shift spool so that 1st clutch is fed.



The transmission controls

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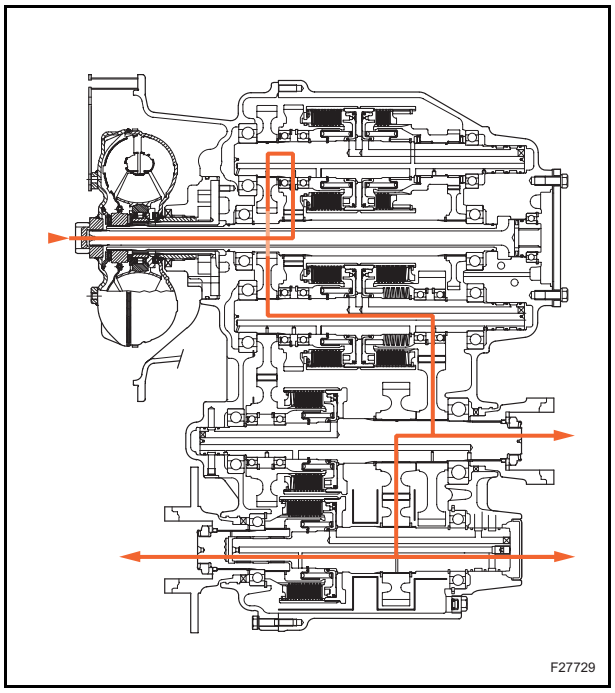
The range clutches also have modulation which operates as follows:
When the range is changed, oil will flow through the modulation shift spool to the chosen range clutch momentary until the friction discs are closed against the dished plate. At that moment the range modulation solenoid is activated. The pilot pressure will move the modulation shift spool so that oil supply is fed through a restrictor which is in by-pass of the valve. The controlled volume of oil is used to push in the dished outer plate gradually until the clutch is fully closed.
This will give a smooth build up of torque. At that moment the range modulation solenoid is released, so that the modulation shift spool return to its rest position and allowing full oil flow to the clutch. The control valve also controls the front lower output disconnect clutch. If the solenoid is not activated full oil pressure is fed through the disconnect shift spool to the disconnect clutch. If the solenoid is activated, pilot pressure will move the disconnect shift spool to block oil supply to the disconnect clutch to release it. The control valve also has a speed sensor. This sensor will pick up upper output gear speed.
This information is used in the electronic gear selector to determine shift logic.
Since the sensor picks up upper output gear speed, the signal will be in direct relation of the turbine speed if any directional clutch is engaged.

Transmission gear	Activated solenoids	Activated clutches
Forward 4	Forward	Forward high, 2nd
Forward 3	Forward, 2nd/1st	Forward high, 1st
Forward 2	Forward, forward high/low	Forward low, 2nd
Forward 1	Forward, forward high/low, 2nd/1st	Forward low, 1st
Reverse 1	Reverse, 2nd/1st	Reverse, 1st
Reverse 2	Reverse	Reverse, 2nd
Disconnect off	Disconnect	----------
Disconnect on	----------	Disconnect

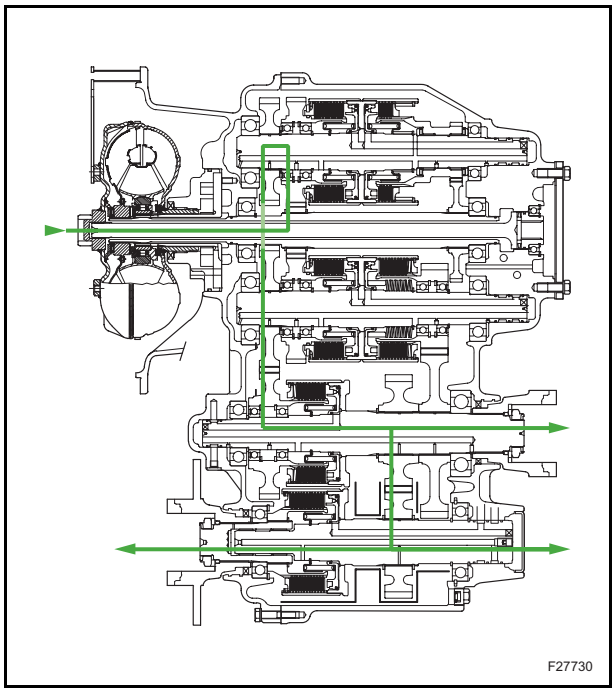
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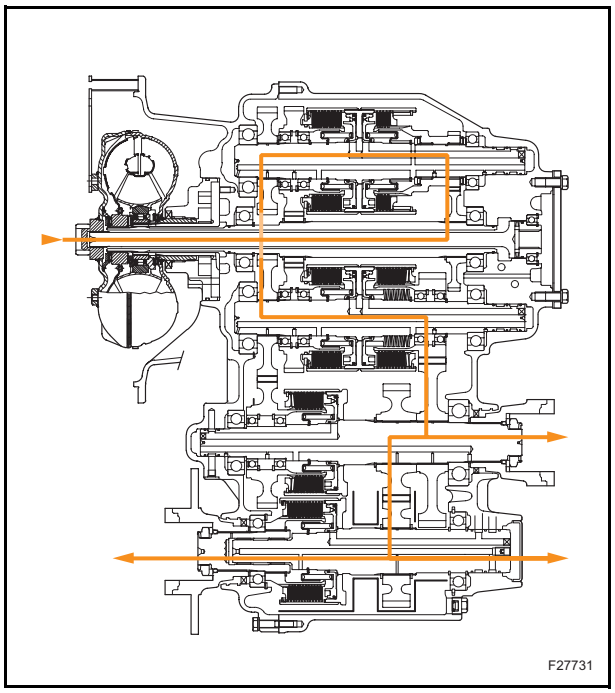
2.8 POWER FLOWS



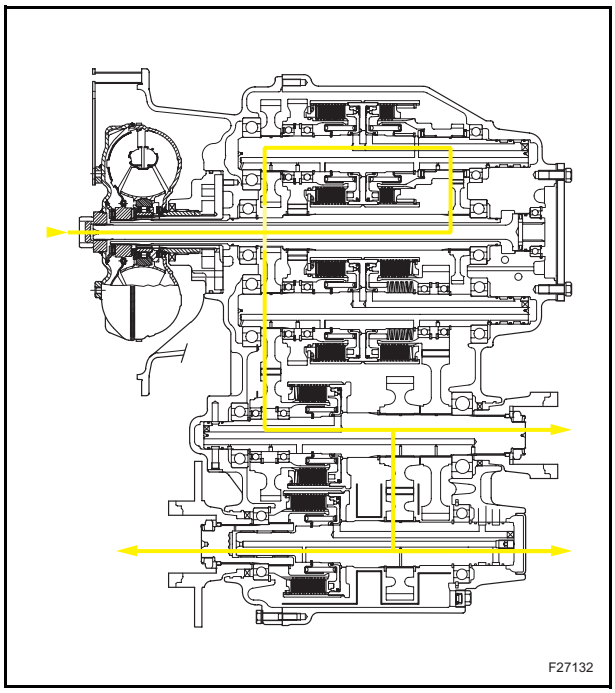
1st speed forward



2nd speed forward



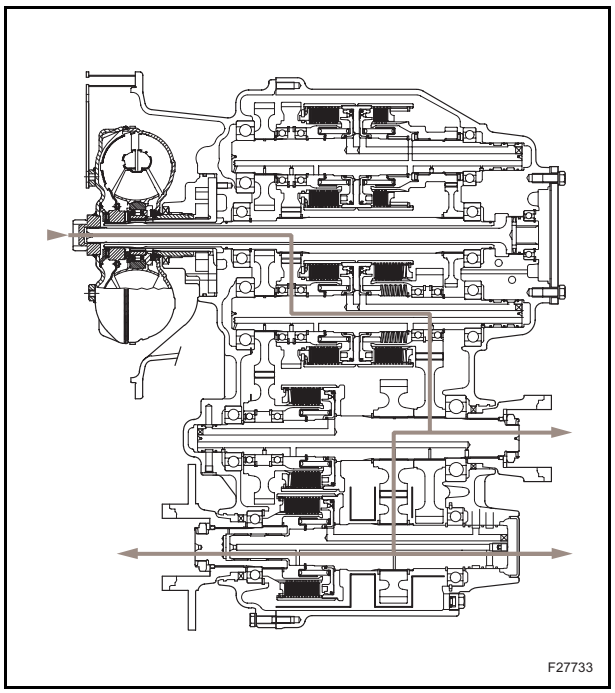
3rd speed forward



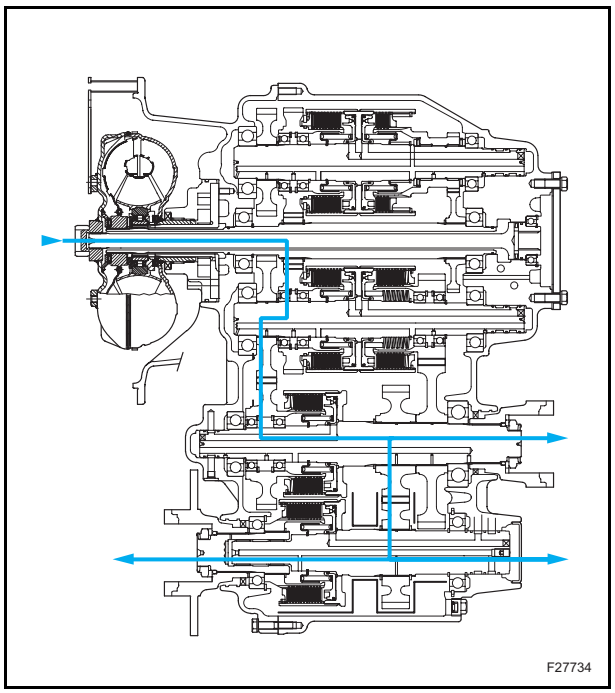
4th speed forward

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1st speed reverse

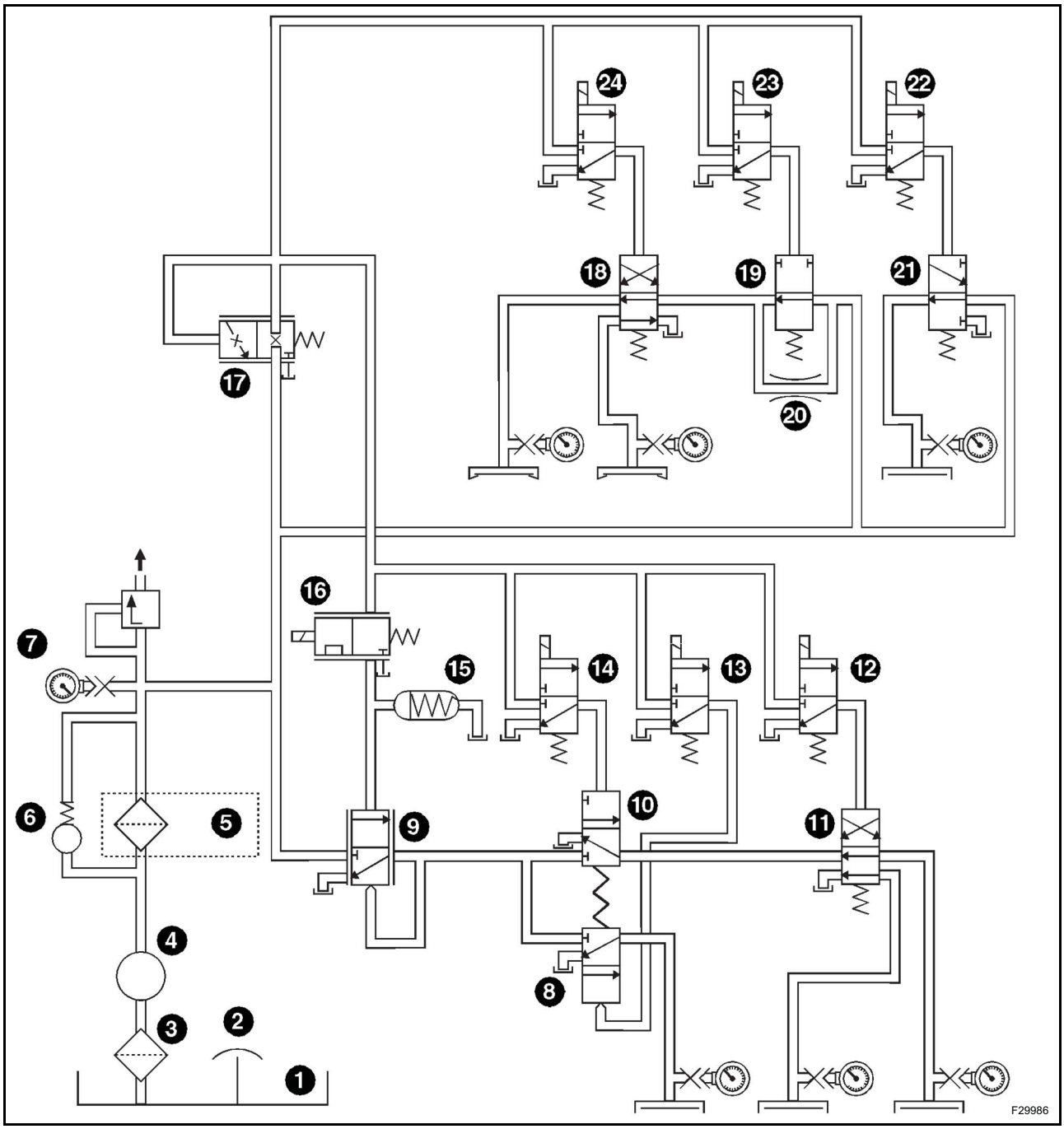


2nd speed reverse

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OPERATING VALVES AND SOLENOIDS

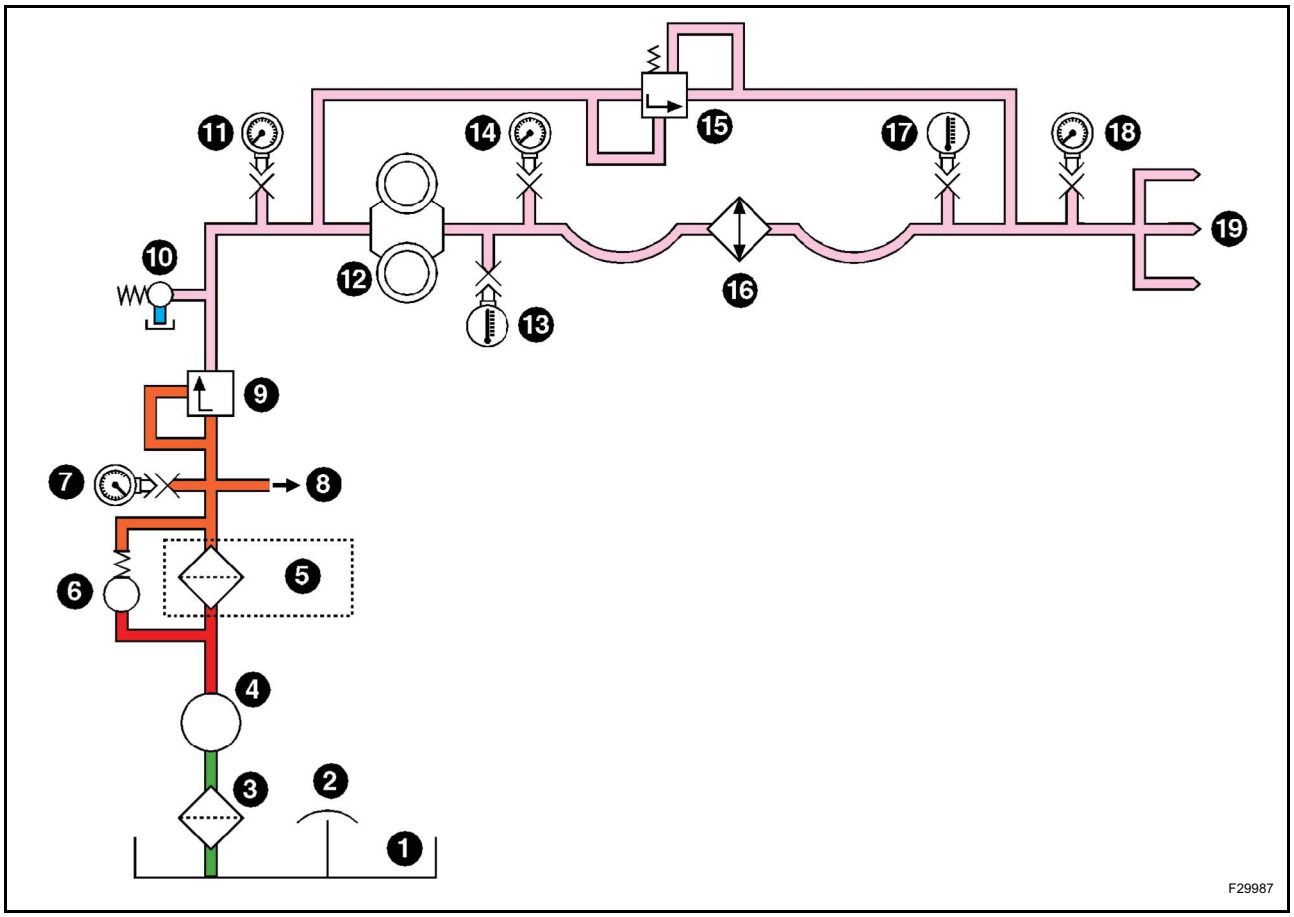


1. Transmission sump
2. Transmission breather
3. Suction strainer
4. Gerotor oil pump
5. Pressure oil filter
6. Filter by-pass valve 4.3 bar
7. System pressure regulating valve 20 bar
   Oil to converter system
8. Neutral reverse shift spool
9. Pressure booster 0-20 bar
10. Neutral forward solenoid
11. High/low shift spool
12. High/low solenoid
13. Neutral reverse solenoid
14. 1st gear clutch
15. Accumulator
16. Electronic modulation valve 0-5.5 bar
17. Pressure reducing valve 5.5 bar
18. 2nd/1st shift spool
19. Range modulation spool
20. Range modulation restriction
21. 4WD shift spool
22. 4WD solenoid
23. Range modulation solenoid
24. 2nd/1st Solenoid

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TORQUE CONVERTER AND COOLER SYSTEM



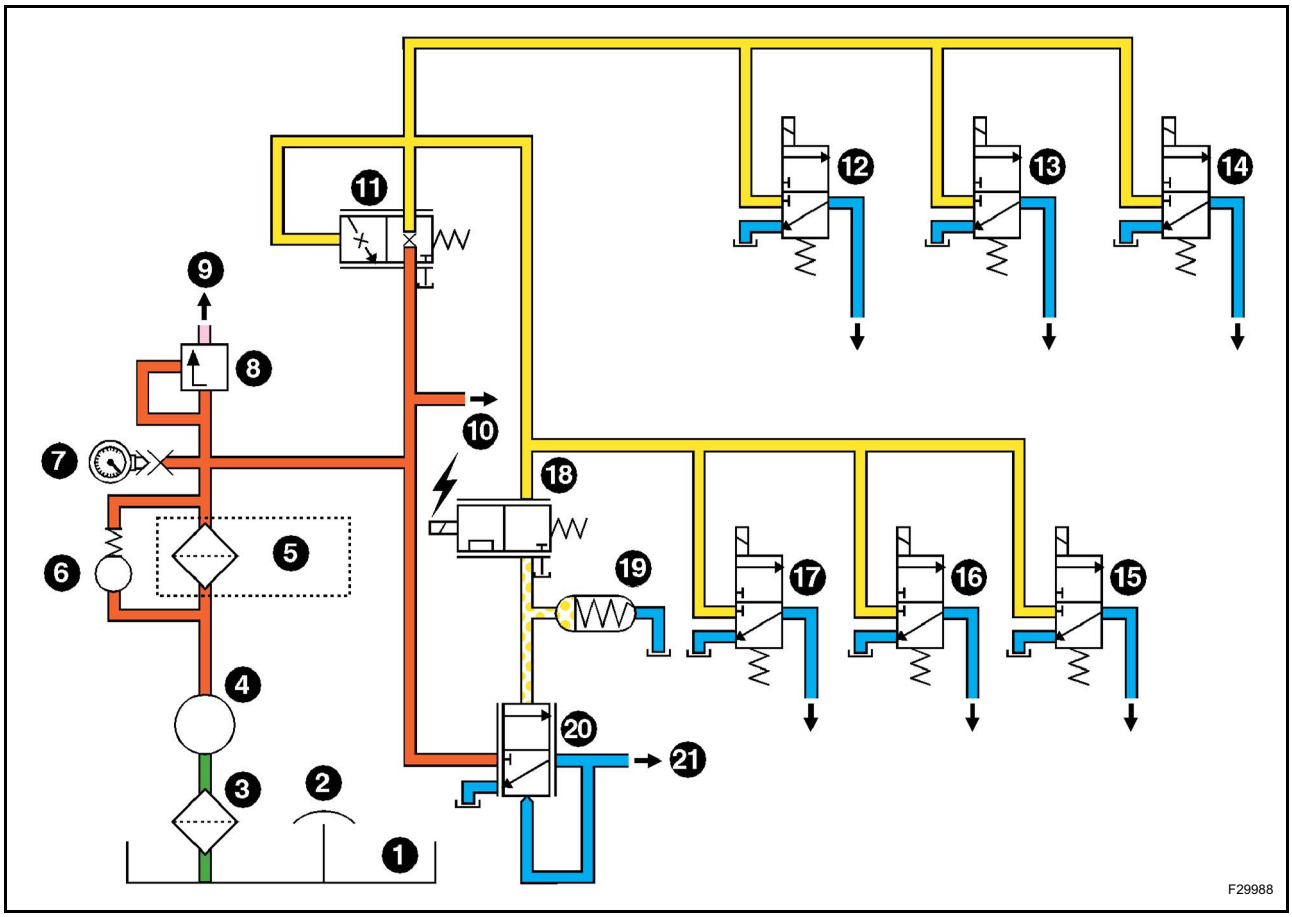
Suction oil
Return to oil tank
High pressure oil
Torque Converter and Lubrication Oil

1. Transmission sump
2. Transmission breather
3. Suction strainer
4. Gerotor oil pump
5. Pressure oil filter
6. Filter by-pass valve 4.3 bar
7. System pressure test port 20 bar
8. Oil flow to control valve
9. System pressure regulating valve 20 bar
10. Torque converter system relief valve 10 bar
11. Converter system pressure test port 5 bar
12. Torque converter
13. Converter oil temperature port
14. Oil cooler pressure test port
15. Converter pressure by-pass valve 4 bar
16. Oil cooler
17. Aftercooler oil temperature port
18. Lubrication pressure port
19. Lubrication galleries

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SERVO CONTROL PRESSURE SYSTEM



Suction oil
High pressure oil
Torque Converter and Lubrication Oil
Return to oil tank
Pilot pressure
Modulated pilot oil

1. Transmission sump
2. Transmission breather
3. Suction strainer
4. Gerotor oil pump
5. Pressure oil filter
6. Filter by-pass valve 4.3 bar
7. System pressure test port 20 bar
8. System pressure regulating valve 20 bar
9. Oil flow to converter
10. Oil flow to shift spools
11. Pressure reducing valve 5.5 bar
12. 2nd/1st Solenoid
13. Range modulation solenoid
14. 4WD solenoid
15. High/low solenoid
16. Neutral reverse solenoid
17. Neutral forward solenoid
18. Electronic modulation valve 0-5.5 bar
19. Accumulator
20. Pressure booster 0-20 bar
21. Modulated pressure to shift spools 0-20 bar

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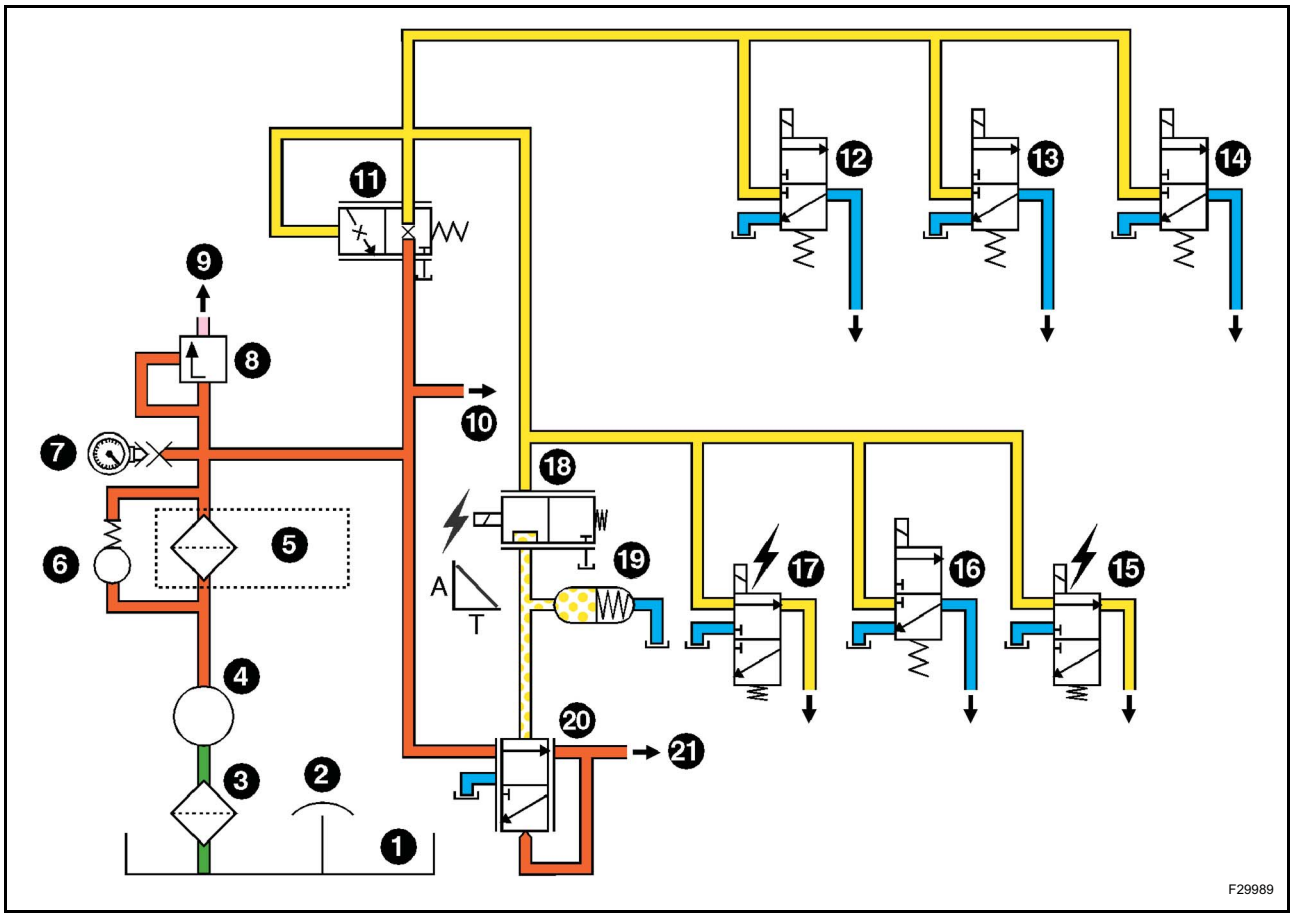
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SERVO CONTROL FORWARD SECOND GEAR 4WD ENGAGED

System pressure is reduced to 5.5 bar by the pressure reducer this oil then supplies the 6 solenoids and electronic modulation valve.
When the powershift lever is moved forward and twisted anti clockwise an electrical signal is sent to:

- The high low solenoid which energizes allowing pilot oil to flow to the shift spool.
- The neutral forward solenoid which energizes allowing pilot oil to flow to the shift spool.
- The powershift lever will then reduce the current to the modulation valve which gives an output pressure curve from 0 to 5.5 bar to the pressure booster valve.
- The modulation pressure curve is multiplied by 4 in the pressure booster so that a curve of 0-20 bar is available for the directional clutches.

Between the modulation valve and the booster is accumulator to dampen any hydraulic vibration.



Suction oil
High pressure oil
Torque Converter and Lubrication Oil
Return to oil tank
Pilot pressure
Modulated pilot oil

1. Transmission sump
2. Transmission breather
3. Suction strainer
4. Gerotor oil pump
5. Pressure oil filter 20 bar
6. Filter by-pass valve 4.3 bar
7. System pressure test port 20 bar
8. System pressure regulating valve 20 bar
9. Oil flow to converter
10. Oil flow to shift spools 0-20 bar
11. Pressure reducing valve 5.5 bar
12. 2nd/1st Solenoid
13. Range modulation solenoid
14. 4WD solenoid
15. High/low solenoid
16. Neutral reverse solenoid
17. Neutral forward solenoid
18. Electronic modulation valve 0-5.5 bar
19. Accumulator
20. Pressure booster 0-20 bar
21. Modulated pressure to shift spools

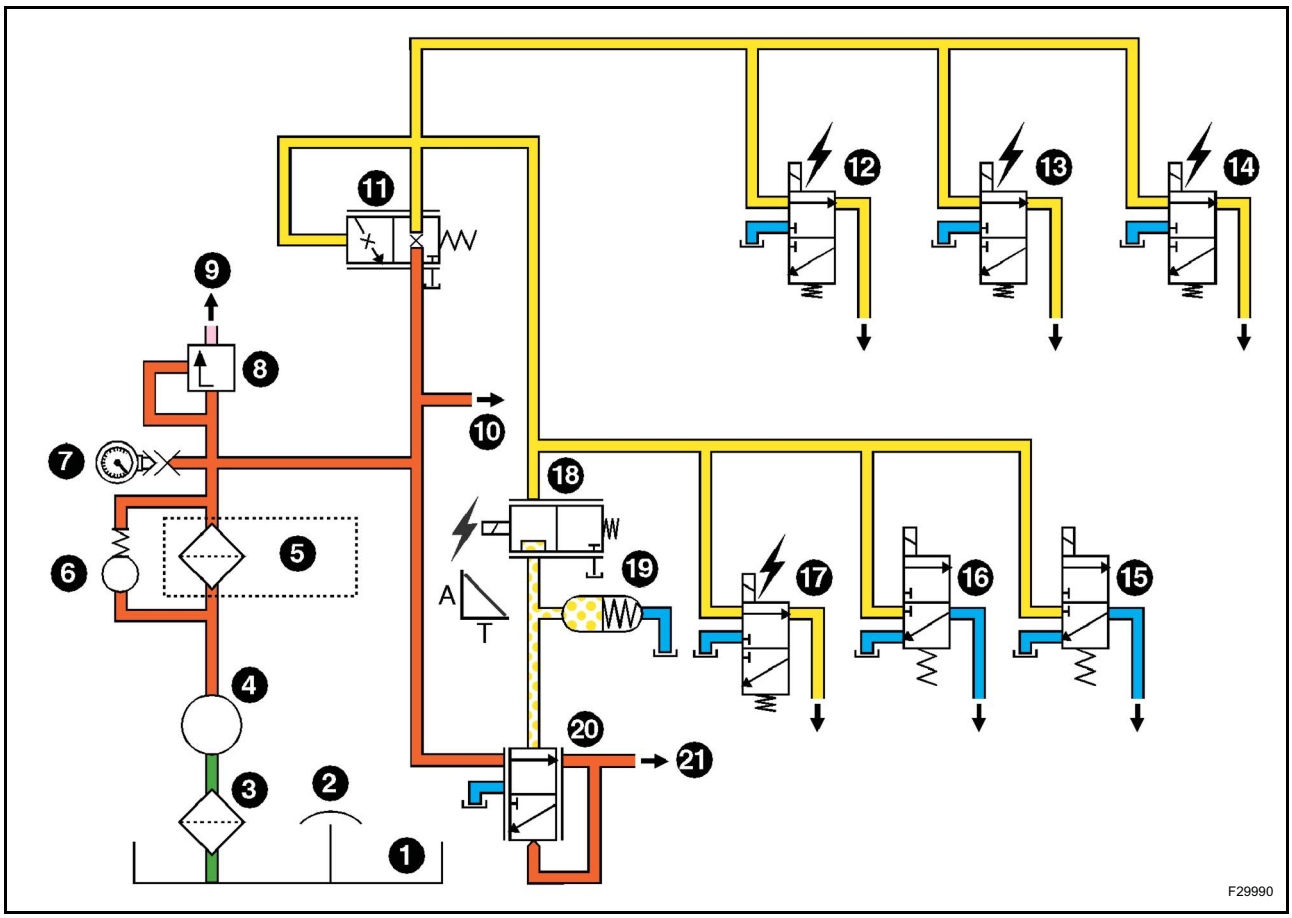
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SERVO CONTROL FORWARD THIRD GEAR 4WD ENGAGED

System pressure is reduced to 5.5 bar by the pressure reducer this oil then supplies the 6 solenoids and electronic modulation valve.

- When the powershift lever is moved forward and twisted anti clockwise an electrical signal is sent to:
- The range modulation solenoid sending pilot pressure to the spool.
- The 1st 2nd solenoid sending pilot pressure to the spool.
- Once the 3rd gear has been engaged the range modulation solenoid will be de-energized.
- The high/low solenoid prevents pilot oil to flow to the shift spool.
- The neutral forward solenoid allowing pilot oil to flow to the shift spool.
- The powershift electronics will then reduce the current to the modulation valve which gives an output pressure curve from 0-5.5 bar to the pressure booster valve.
- The modulation pressure curve is multiplied by 4 in the pressure booster so that a curve of 0-20 bar is available for the directional clutch.
  Between the modulation valve and the booster is accumulator to dampen any hydraulic vibration.
- The 4WD solenoid supplies pilot oil to the shift spool.



Suction oil
High pressure oil
Torque Converter and Lubrication Oil
Return to oil tank
Pilot pressure
Modulated pilot oil

1. Transmission sump
2. Transmission breather
3. Suction strainer
4. Gerotor oil pump
5. Pressure oil filter
6. Filter by-pass valve 4.3 bar
7. System pressure test port 20 bar
8. System pressure regulating valve 20 bar
9. Oil flow to converter
10. Oil flow to shift spools
11. Pressure reducing valve 5.5 bar
12. 2nd/1st Solenoid
13. Range modulation solenoid
14. 4WD solenoid
15. High/low solenoid
16. Neutral reverse solenoid
17. Neutral forward solenoid
18. Electronic modulation valve 0-5.5 bar
19. Accumulator
20. Pressure booster 0-20 bar
21. Modulated pressure to shift spools 0-20 bar

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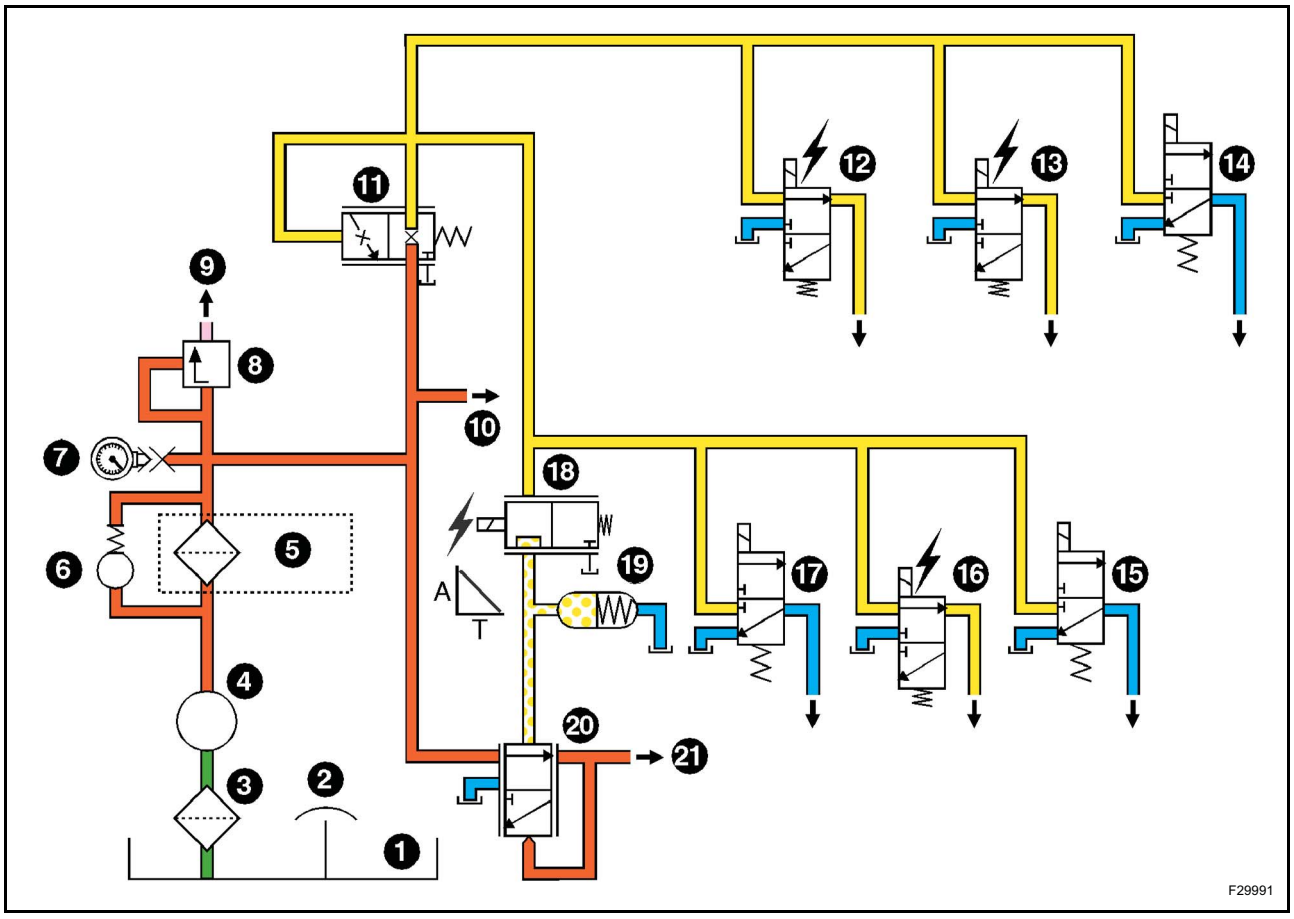
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SERVO CONTROL REVERSE FIRST GEAR 4WD ENGAGED

System pressure is reduced to 5.5 bar by the pressure reducer this oil then supplies the 6 solenoids and electronic modulation valve.
When the powershift lever is moved rearward and twisted clock wise a electrical signal is sent to:

- The range modulation solenoid sending pilot pressure to the spool.
- The 1st 2nd solenoid sending pilot pressure to the spool.
- Once the 1st gear has been engaged the range modulation solenoid will be de-energized.
- The low/high solenoid sends pilot oil to the shift spool.
- The neutral reverse solenoid allowing pilot oil to flow to the shift spool.
- The powershift lever microprocessor will then reduce the current to the modulation valve which gives an output pressure curve from 0-5.5 bar to the pressure booster valve.
- The modulation pressure curve is multiplied by 4 in the pressure booster so that a curve of 0-20 bar is available for the directional clutches.

Between the modulation valve and the booster is accumulator to dampen any hydraulic vibration.



Suction oil
High pressure oil
Torque Converter and Lubrication Oil
Return to oil tank
Pilot pressure
Modulated pilot oil

1. Transmission sump
2. Transmission breather
3. Suction strainer
4. Gerotor oil pump
5. Pressure oil filter
6. Filter by-pass valve 4.3 bar
7. System pressure test port 20 bar
8. System pressure regulating valve 20 bar
9. Oil flow to converter
10. Oil flow to shift spools
11. Pressure reducing valve 5.5 bar
12. 2nd/1st Solenoid
13. Range modulation solenoid
14. 4WD solenoid
15. High/low solenoid
16. Neutral reverse solenoid
17. Neutral forward solenoid
18. Electronic modulation valve 0-5.5 bar
19. Accumulator
20. Pressure booster 0-20 bar
21. Modulated pressure to shift spools 0-20 bar

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CONTROL VALVE OPERATION FORWARD, SECOND GEAR WITH 4WD ENGAGED

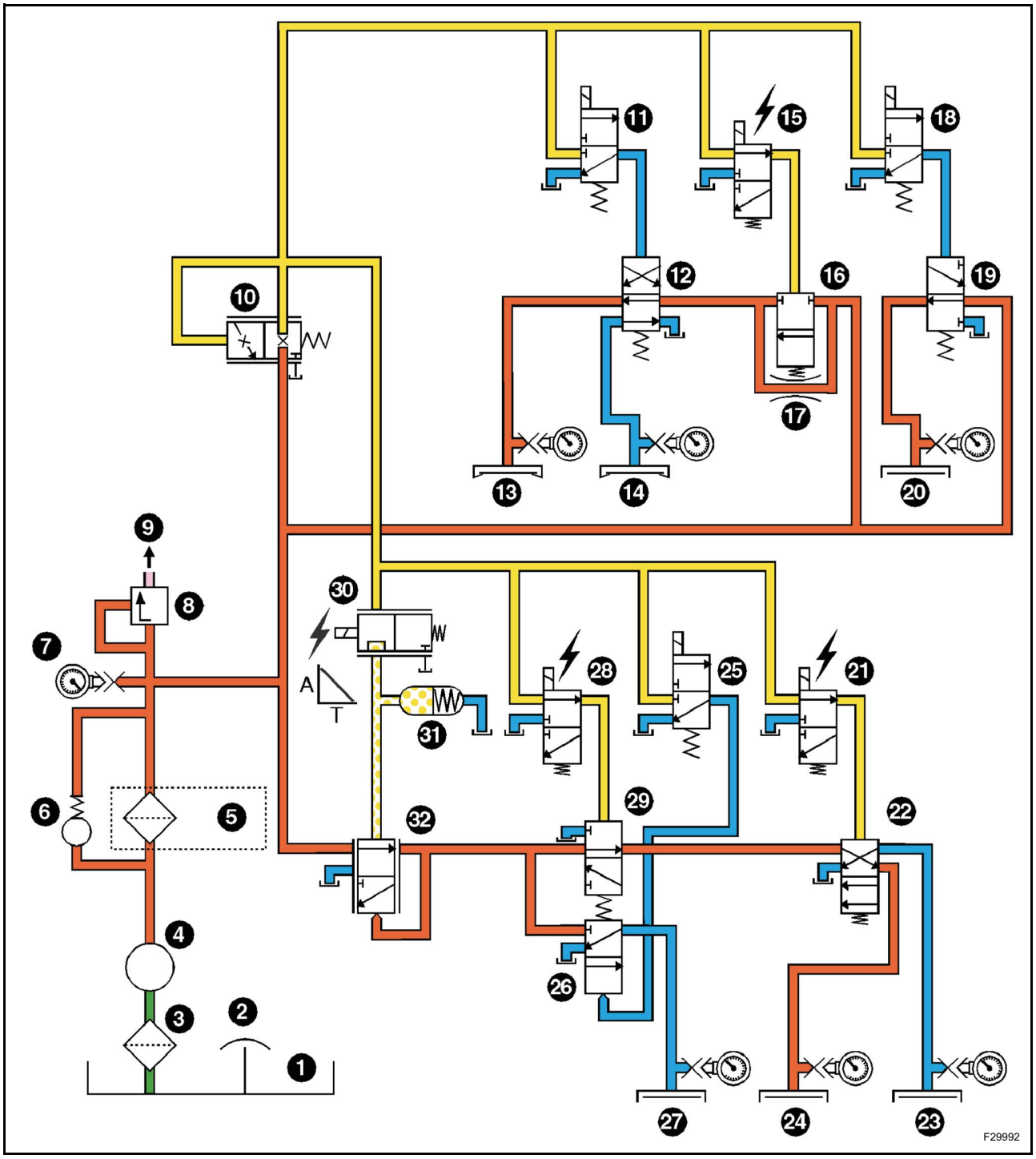
Pressure oil from the system regulating valve flows to the pressure reducing valve.
The pressure lowers to 5.5 bar. This oil flows to the 6 solenoids.
Oil also supplies the modulation valve.
When the powershift lever is moved forward and twisted anti clock wise a electrical signal is sent to:

- Oil flows from the system pressure regulating valve at 20 bar through the 4WD spool to engage the 4WD clutch.
- System pressure also flows through the range modulation valve, then through the 1st 2nd spool to engage the 2nd gear clutch.
- The high low solenoid which energizes allowing pilot oil to flow to the shift spool. This will allow oil to flow to the low clutch.
- The neutral forward solenoid which energizes allows pilot pressure to flow to the shift spool this will allow oil to flow on to the forward low shift spool.
- The modulation valve has a reducing current from the microprocessor, pilot pressure gradually increases acting on the boost valve and it multiplies pilot pressure.
- The oil from the boost valve is modulated allowing a steady increase of pressure to act on the forward low clutch pack which gradually takes up drive until clutch pressure reaches 20 bar.

1. Transmission sump
2. Transmission breather
3. Suction strainer
4. Gerotor oil pump
5. Pressure oil filter
6. Filter by-pass valve 4.3 bar
7. System pressure test port 20 bar
8. System pressure regulating valve 20 bar
9. Oil to converter system
10. Pressure reducing valve 5.5 bar
11. 2nd/1st Solenoid
12. 2nd/1st shift spool
13. 2nd gear clutch
14. 1st gear clutch
15. Range modulation solenoid
16. Range modulation spool
17. Range modulation restriction
18. 4WD solenoid
19. 4WD shift spool
20. 4WD clutch
21. High/low solenoid
22. High/low shift spool
23. Forward high clutch
24. Forward low clutch
25. Neutral reverse solenoid
26. Neutral reverse shift spool
27. Reverse clutch
28. Neutral forward solenoid
29. Neutral forward shift spool
30. Electronic modulation valve 0-5.5 bar
31. Accumulator
32. Pressure booster 0-20 bar

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Suction oil
High pressure oil
Torque Converter and Lubrication Oil
Return to oil tank
Pilot pressure
Modulated pilot oil

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CONTROL VALVE OPERATION FORWARD, THIRD GEAR WITH 4WD DISENGAGED

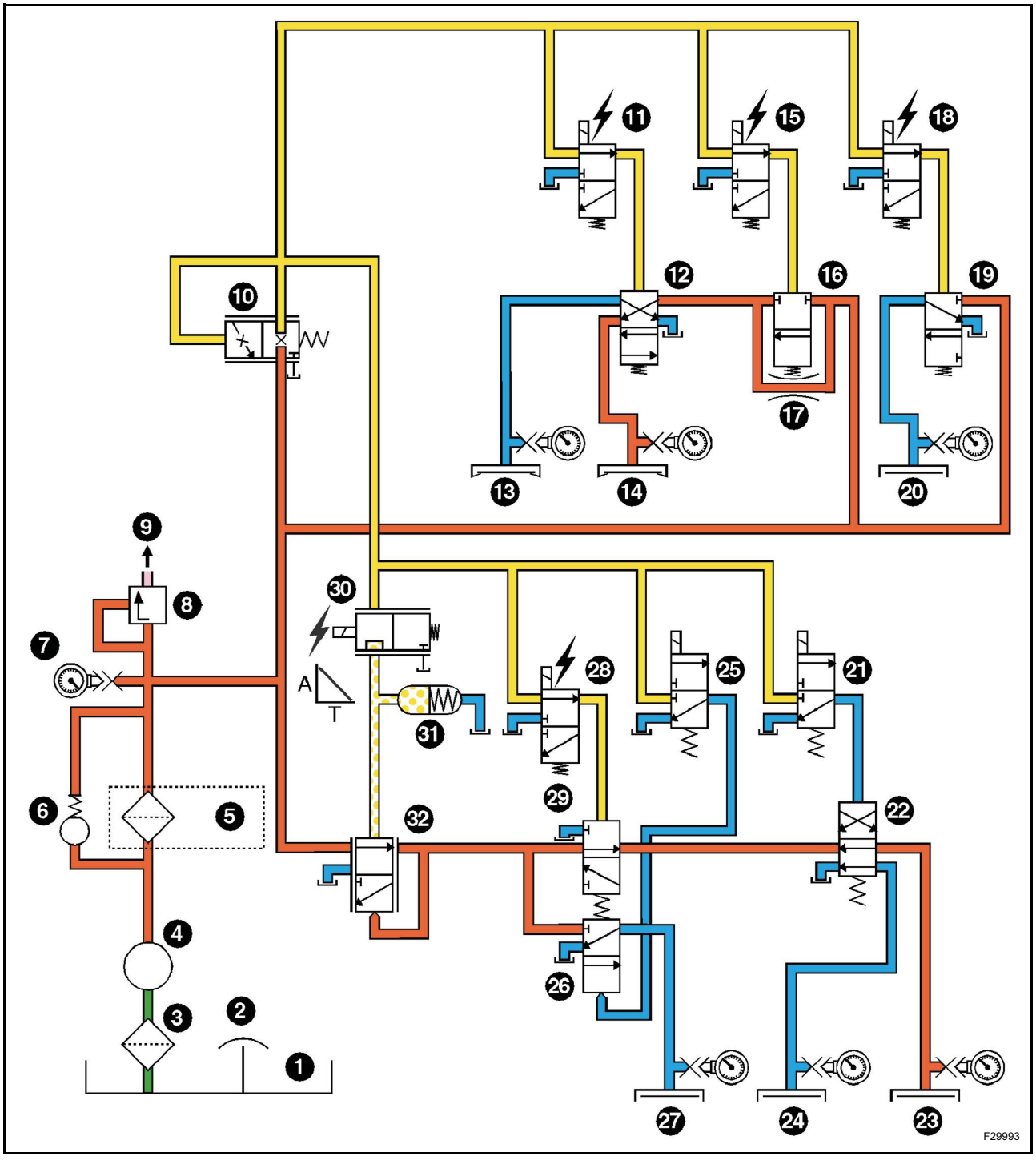
Pressure oil from the system regulating valve flows to the pressure reducing valve.
The pressure lowers to 5.5 bar. This oil flows to the 6 solenoids. Oil also supplies the modulation valve.
When the powershift lever is moved forward and twisted anti clock wise and the 4WD is switched off a electrical signal is sent to:

- The 4WD solenoid supplies pilot oil to the shift spool.
  This will move the spool preventing oil flowing to the clutch disengaging 4WD.
- The range modulation solenoid allowing pilot oil to the range modulation valve, which restricting oil flow to the 1st 2nd shift spool.
- The 1st 2nd solenoid, sending pilot pressure to the 1st 2nd shift spool which directs oil to the 1st clutch.
- Once the 1st gear clutch is engaged the range solenoid is de-energized and full flow will go to the 1st gear clutch.
- The neutral forward solenoid which energizes allows pilot pressure to flow to the shift spool this will allow oil to flow on to the forward high shift spool.
- The modulation valve has a reducing current from the microprocessor, pilot pressure gradually increases acting on the boost valve and it multiplies pilot pressure by 4.
  The oil from the boost valve is modulated allowing a steady increase of pressure to act on the forward high clutch pack which gradually takes up drive until clutch pressure reaches 20 bar.

1. Transmission sump
2. Transmission breather
3. Suction strainer
4. Gerotor oil pump
5. Pressure oil filter
6. Filter by-pass valve 4.3 bar
7. System pressure test port
8. System pressure regulating valve 20 bar
9. Oil to converter system
10. Pressure reducing valve 5.5 bar
11. 2nd/1st Solenoid
12. 2nd/1st shift spool
13. 2nd gear clutch
14. 1st gear clutch
15. Range modulation solenoid
16. Range modulation spool
17. Range modulation restriction
18. 4WD solenoid
19. 4WD shift spool
20. 4WD clutch
21. High/low solenoid
22. High/low shift spool
23. Forward high clutch
24. Forward low clutch
25. Neutral reverse solenoid
26. Neutral reverse shift spool
27. Reverse clutch
28. Neutral forward solenoid
29. Neutral forward shift spool
30. Electronic modulation valve 0-5.5 bar
31. Accumulator
32. Pressure booster 0-20 bar

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Suction oil
High pressure oil
Torque Converter and Lubrication Oil
Return to oil tank
Pilot pressure
Modulated pilot oil

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CONTROL VALVE OPERATION REVERSE, FIRST GEAR WITH 4WD ENGAGED

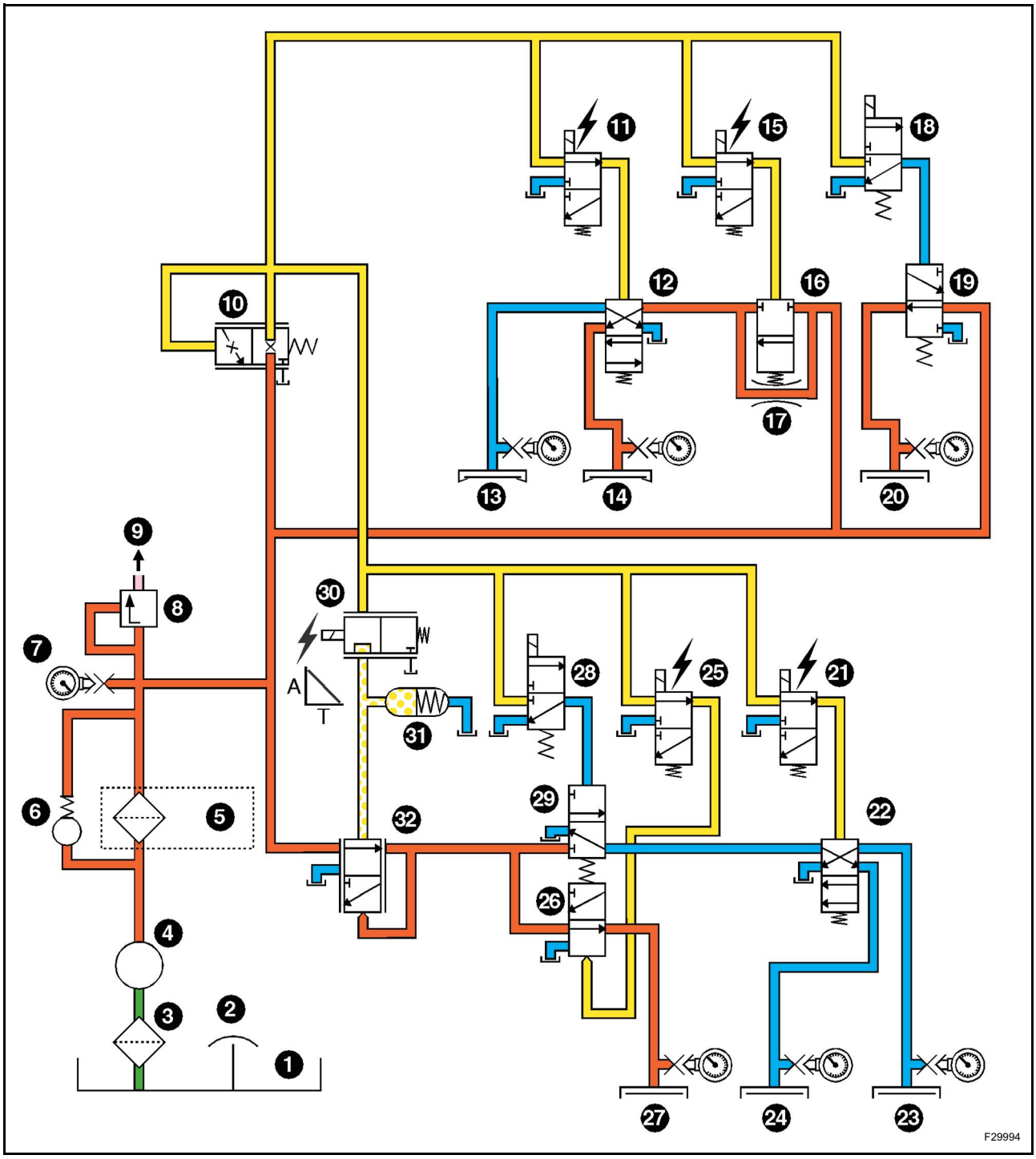
Pressure oil from the system regulating valve flows to the pressure reducing valve. The pressure lowers to 5.5 bar. This oil flows to the 6 solenoids.
Oil also supplies the modulation valve. When the powershift lever is moved rearwards, the kickdown button is pressed and the 4WD is switched off, an electrical signal is sent to:

- The range modulation solenoid allowing pilot oil to the range modulation valve, which restricting oil flow to the 1st 2nd shift spool.
- The 1st 2nd solenoid, sending pilot pressure to the 1st 2nd shift spool which directs oil to the 1st clutch.
- Once the 1st gear clutch is engaged the range solenoid is de-energized and full flow will go to the 1st gear clutch.
- The neutral reverse solenoid which energizes allows pilot pressure to flow to the shift spool. This will allow oil to flow on to the reverse shift spool.
- The modulation valve has a reducing current from the microprocessor, pilot pressure gradually increases acting on the boost valve and it multiplies pilot pressure.
- The oil from the boost valve is modulated allowing a steady increase of pressure to act on the reverse clutch pack which gradually takes up drive until clutch pressure reaches 20 bar.

1. Transmission sump
2. Transmission breather
3. Suction strainer
4. Gerotor oil pump
5. Pressure oil filter
6. Filter by-pass valve 4.3 bar
7. System pressure test port 20 bar
8. System pressure regulating valve 20 bar
9. Oil to converter system
10. Pressure reducing valve 5.5 bar
11. 2nd/1st Solenoid
12. 2nd/1st shift spool
13. 2nd gear clutch
14. 1st gear clutch
15. Range modulation solenoid
16. Range modulation spool
17. 4WD solenoid
18. Range modulation restriction
19. 4WD shift spool
20. 4WD clutch
21. High/low solenoid
22. High/low shift spool
23. Forward high clutch
24. Forward low clutch
25. Neutral reverse solenoid
26. Neutral reverse shift spool
27. Reverse clutch
28. Neutral forward solenoid
29. Neutral forward shift spool
30. Electronic modulation valve 0-5.5 bar
31. Accumulator
32. Pressure booster 0-20 bar

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Suction oil
High pressure oil
Torque Converter and Lubrication Oil
Return to oil tank
Pilot pressure
Modulated pilot oil

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PRESSURE TESTING TORQUE CONVERTER AND COOLER CIRCUIT

All pressure and flow testing should be measured with an oil temperature of 82 - 93 °C.
For operating speed refer to each test.

Port 1 System pressure.
- Engine set to 750 rpm minimum pressure 15 bar.
- Engine set to 2200 rpm 19.6-23.1 bar.

Port 2 Torque converter in.
- Engine set to 2200 rpm oil pressure range 5-11 bar.

Port 3 Torque converter out.
- Engine speed 2000 rpm minimum pressure 2 bar.
- Engine speed 2200 rpm maximum pressure 5 bar.

Port 4 Oil temperature converter out.
- Normal operating temperature 80-90 °C.
  Maximum temperature 120 °C.

Port 5 Oil temperature cooler out.
- T.B.A.

Port 6 Lubrication pressure.
- Engine speed 2000 rpm pressure range 0.8-2.0 bar.

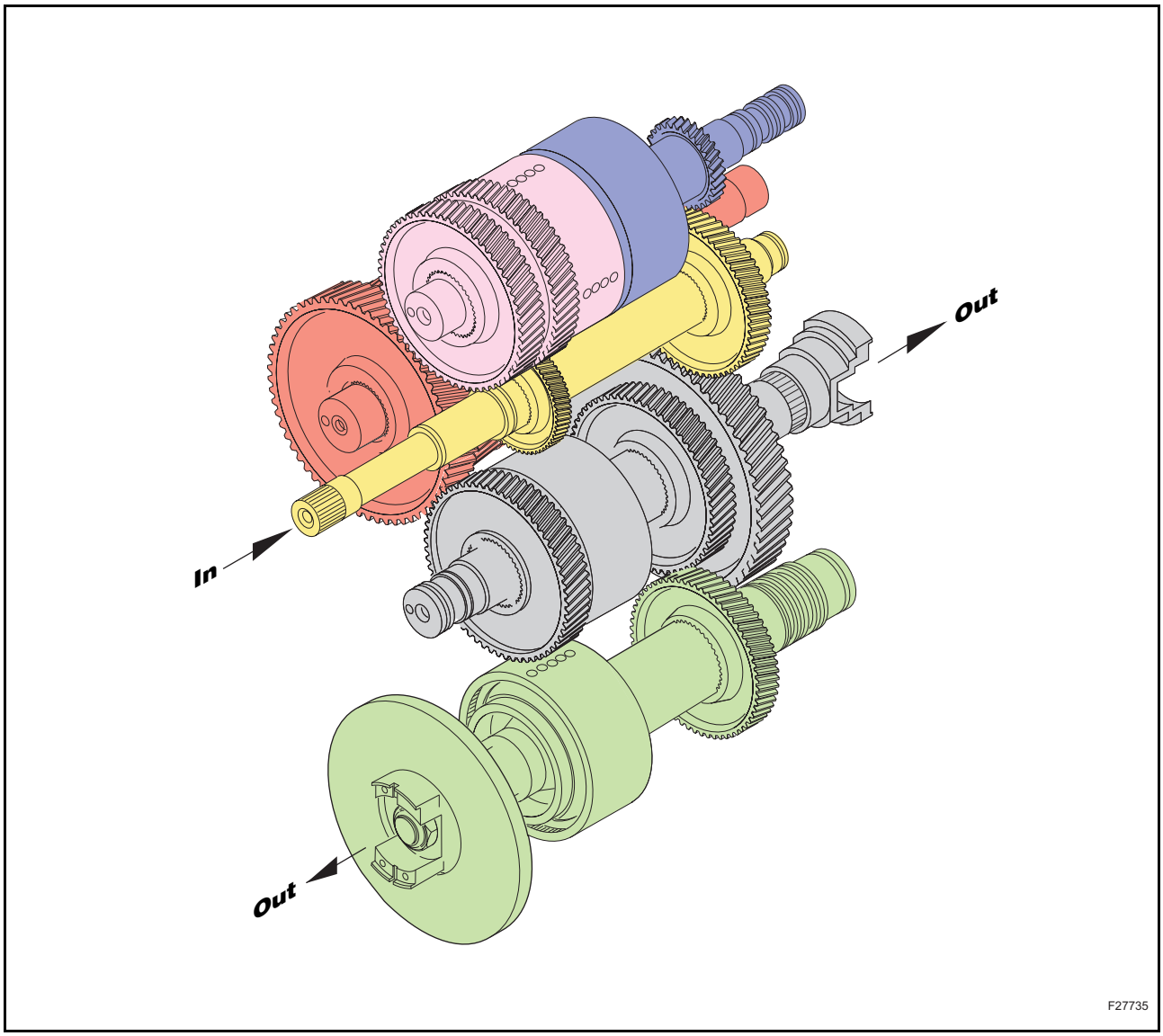
HYDRAULIC OIL FLOWS

Oil flows to the pressure regulating valve, maintaining system pressure to the control valve and clutches at 20 bar.
Excess oil flow is bled to the converter system which is protected by a 10 bar safety valve.
Oil enters the converter through the converter blade cavity and exits in the passage between the turbine shaft and pump drive.
Oil then flow to the external cooler.
Across the converter and the oil cooler system a by-pass valve is fitted; if the pressure difference is more than 4 bar, the valve will open. Excess oil is directed to the lubrication system.
This protects the system during start up from cold oil or at high rpm.
After leaving the cooler the oil is directed via a single fitting on the rear of the transmission to a series of tubes and passages, to lubricate and cool the transmission bearings and clutches.
Oil is drawn up from the sump, via an internal strainer, through the inlet port of the hydraulic pump.
Oil is pumped out to the pressure filter.
Across the oil filter is a filter by-pass valve which will open if the pressure difference becomes higher than 4.3 bar.
The oil then gravity drains back to the transmission sump.

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2.9 GEAR AND CLUTCH LAY OUT



- Forward low
- Forward high
- Reverse and 1st
- 2nd
- Disconnect
- Input shaft

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2.10 TRANSMISSION REMOVAL AND INSTALLATION

REMOVAL

⚠ WARNING

Before performing any service or maintenance on the machine ensure the wheels are chocked/blocked to prevent the machine from moving.

1. Lower the loader to the ground or raise and secure (dependent upon lifting apparatus) and release any pressure in the system as required. Engage the parking brake and block the wheels.
2. Stop the engine.
3. Isolate battery.
4. Remove all engine panels.
5. Remove front cast cowling.
6. Drain engine coolant and remove hoses.

IMPORTANT: air conditioning where fitted - Do not disconnect the air conditioning hoses from the compressor or condenser unless a refrigerant reclaim system is to be used. Engine/Transmission removal from the machine does not require the system to be discharged.

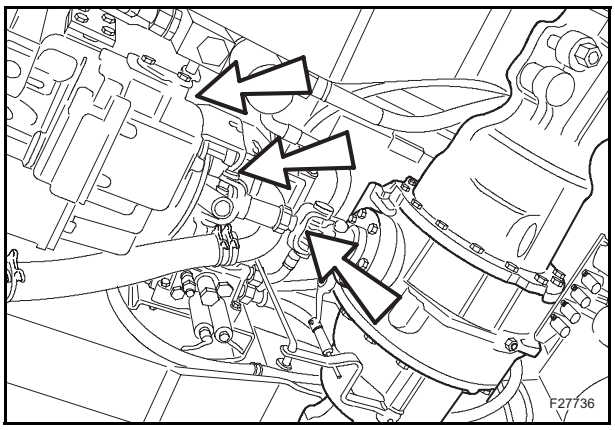
Remove the condenser from the front radiator and place the condenser to one side of the chassis.
Disconnect the air conditioning compressor attaching hardware and place the compressor to one side of the chassis.
Disconnect the expansion bottle connections from the radiator.

7. Remove all attaching bolts from radiator.
8. Disconnect transmission cooler pipes.
9. Remove radiator, taking care not to damage the fan or hydraulic oil cooler.
10. Remove the air filter assembly.
11. Disconnect all electrical connections.
12. Disconnect hydraulic pipe clamps.
13. Disconnect the fuel tank feed and return pipes.
14. Disconnect the foot throttle cable at the fuel injection pump.
15. Remove the cab mat.
16. Remove the cab floor access panel.

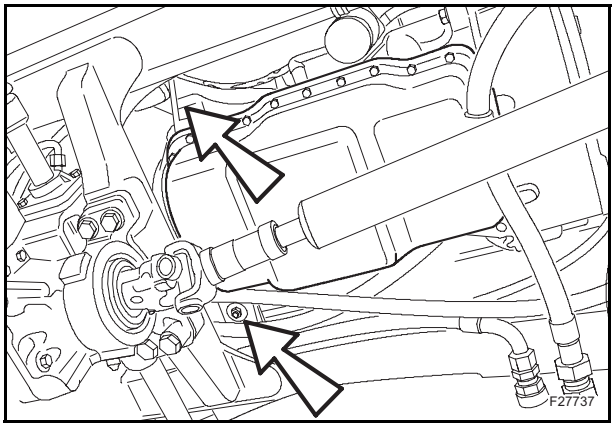
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17. Disconnect the 12 pin connector from the transmission valve chest mounted to the left hand side of the of the transmission.
18. Disconnect the transmission to lock out valve pipe.
19. Disconnect lock out return pipe and plug the hole (oil will leak out of transmission).



20. Remove front drive shaft (where fitted) and remove rear drive shaft.
21. Disconnect the parking brake cable.
22. Disconnect and pull back hydraulic pump (leaving all pipes attached). Check that the oil pump drive shaft does not slide out with the pump.
23. Check return from steering motor is on the outside of transmission oil level tube.

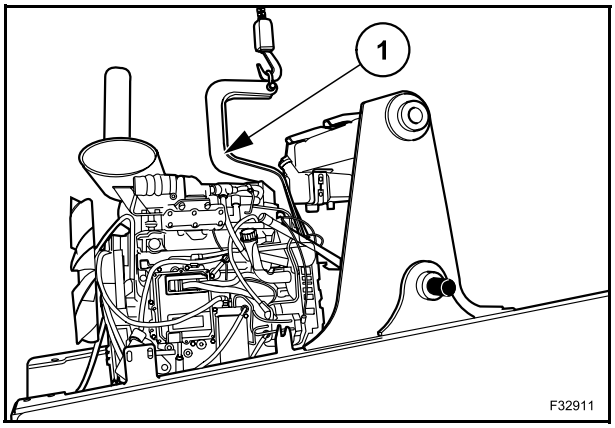


24. With the engine supported and using a “hoist” capable of supporting a total weight of 800 kg loosen and remove the engine and transmission mounting bolts.

IMPORTANT: if the hydraulic oil pump is removed from the transmission / engine assembly the balance of the assembly when hoisted will be front end heavy.

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25. Using the lifting tool for the engine-transmission assy (1) **380300030**, raise and extract the engine/transmission assy from the vehicle.

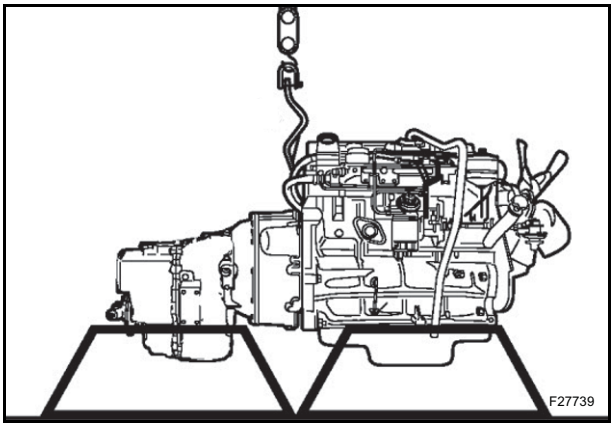


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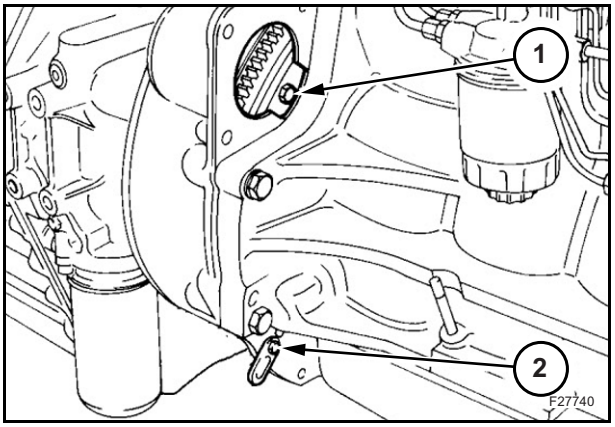
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SEPARATING ENGINE FROM TRANSMISSION

1. Place the engine/transmission assembly on a suitable splitting stand.
2. Remove the starter motor assembly.

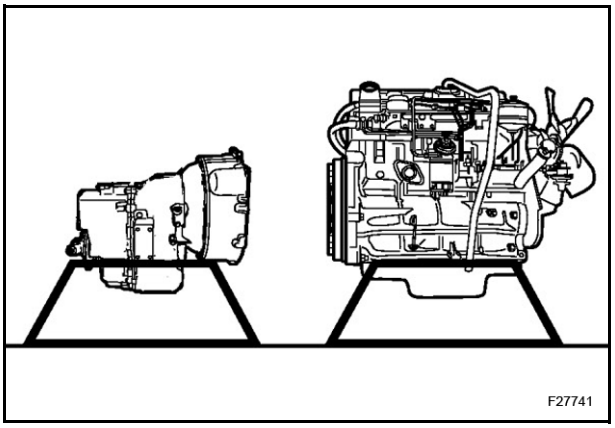


3. Unscrew and remove the torque converter attaching bolts accessed through the starter motor aperture (1).
4. Remove the engine timing tab (2).
5. Unscrew and remove the bell housing bolts.
6. Gently slide the transmission with the torque converter from the engine.



INSTALLATION

Place a stud in one tang of the flexi plate and as the transmission is assembled up to the engine guide the stud through a bolt hole of the flywheel, remove the stud and refit a bolt.
Refit the attaching bolts which couple the transmission to engine.
Turn the engine crankshaft using a torque bar to expose in turn each attaching bolt hole of the flywheel through the flexi plate and refit all of the bolts.
Hoist the engine/transmission assembly back into the vehicle and centralize in the machine using a measure between the chassis and centre line of the crankshaft pulley. This ensures the engine is centrally positioned before torque up of the engine/transmission to chassis bolts.
Reconnect all ancillary equipment as previously described.
Ensure all attaching hardware is tightened to the correct torque value as detailed in the specifications.
Ensure after installation that all fluid levels are correct prior to start up.
Start and run the engine until correct operating temperature is achieved to purge air from cooling system.
Stop engine, check for leaks, rectify as required and recheck fluid levels.

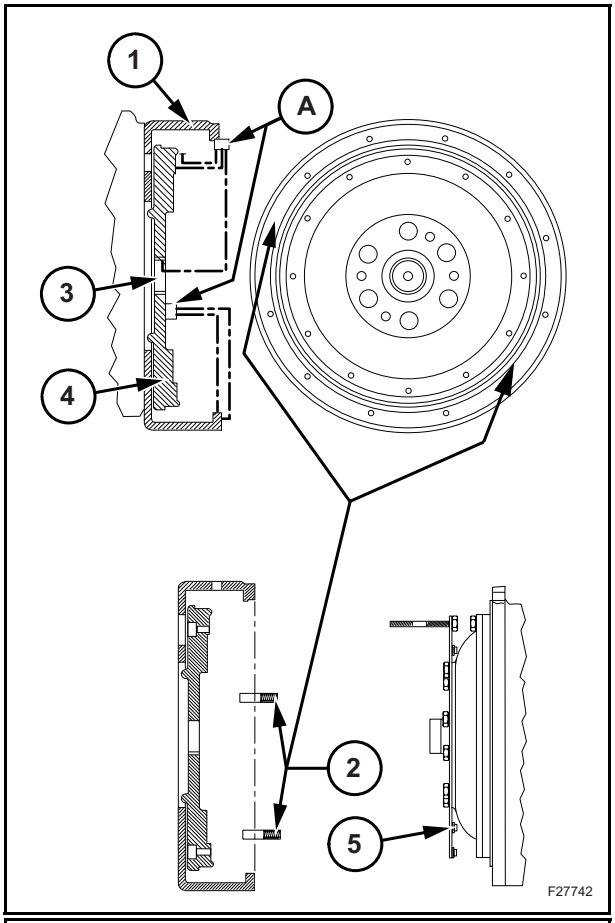


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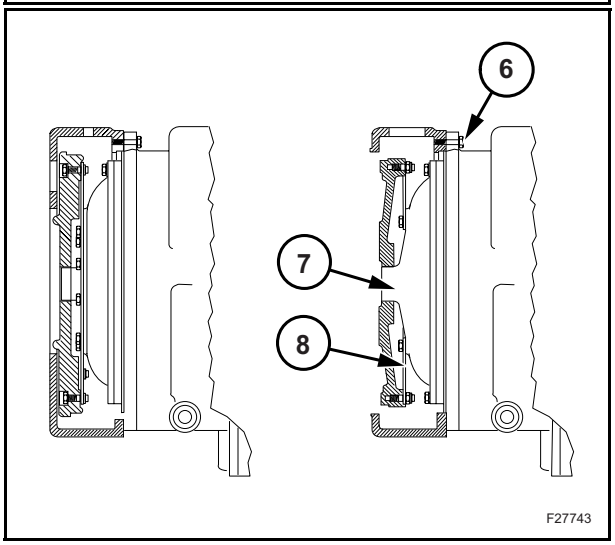
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TRANSMISSION TO ENGINE INSTALLATION PROCEDURE

Remove all burrs from flywheel (1) mounting face and nose pilot bore (3). Clean drive plate surface with solvent.
Check engine flywheel (4) and housing (1).
Measure and record engine crankshaft end play.
Install two 63.5 mm long transmission to flywheel housing guide studs in the engine flywheel housing as shown. Rotate the engine flywheel to align a drive plate mounting screw hole with the flywheel housing access hole (3).
Install a 101.60 mm long drive plate locating stud fine thread in a drive plate nut. Align the locating stud in the drive plate with the flywheel drive plate (5) mounting screw hole.
(Does not apply to units having 3 intermediate drive plates).
Rotate the transmission torque converter to align the locating stud in the drive plate with the flywheel drive plate mounting screw hole (3). Locate transmission on flywheel housing (1).
Aligning drive plate to flywheel and transmission to flywheel housing guide studs, install transmission to flywheel housing screws. Tighten screws to specified torque. Remove transmission to engine guide studs. Install remaining screws and tighten to specified torque.



Remove drive plate locating stud.
Install drive plate attaching screw and washer.
Snug screw but do not tighten. Some engine flywheel housings have a hole located on the flywheel housing circumference in line with the drive plate screw access hole. A screwdriver or pry bar used to hold the drive plate against the flywheel will facilitate installation of the drive plate screws. Rotate the engine flywheel and install the remaining seven flywheel to drive plate attaching screws. Snug screws but do not tighten.
After all eight screws are installed torque one torque 35 - 39 Nm. This will require tightening each screw and rotating the engine flywheel until the full amount of eight screws have been tightened to specified torque. Measure engine crankshaft end play after transmission has been completely installed on engine flywheel.
This value must be lower than 0.025 mm.



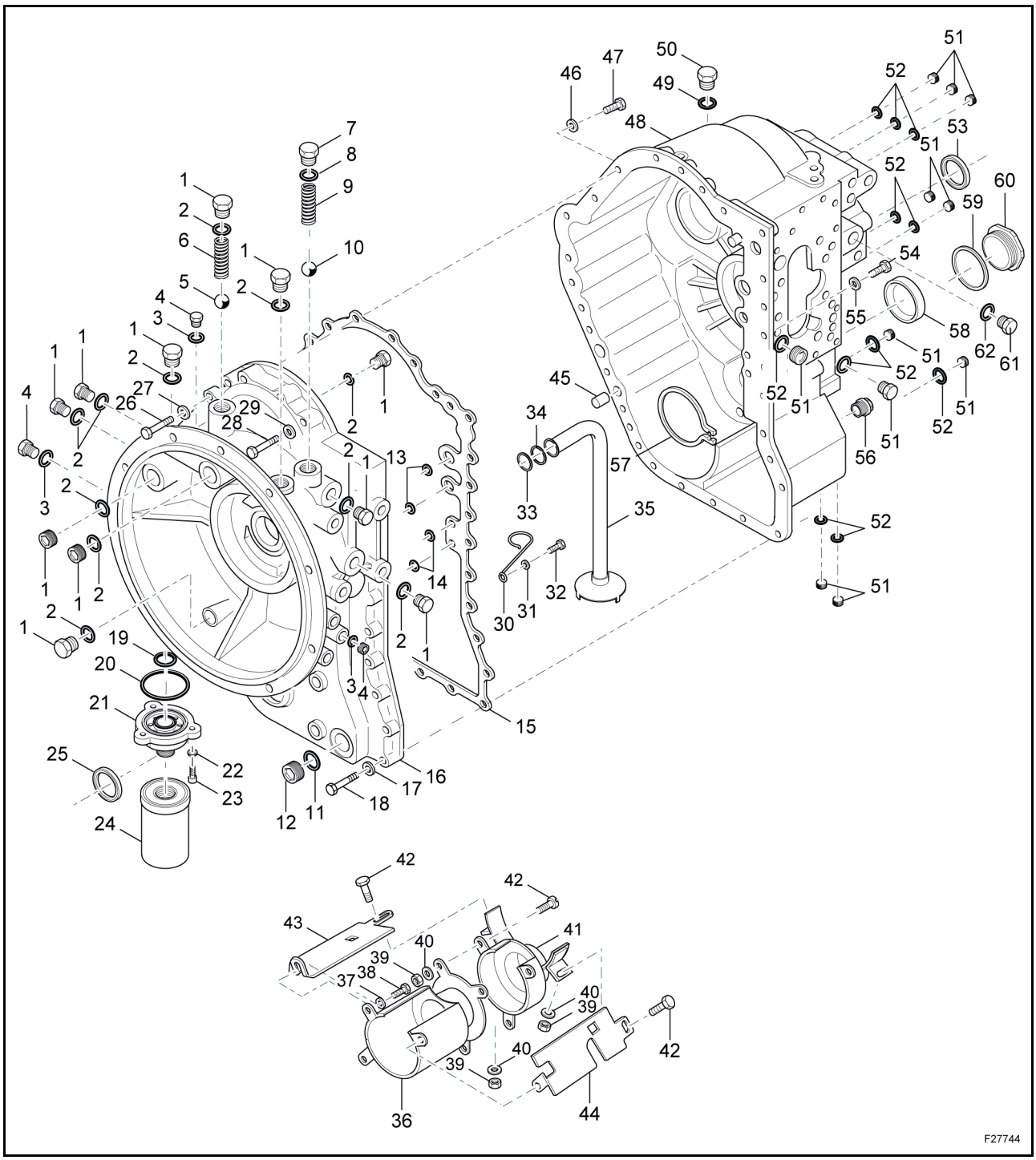
6. Special stud, washer and self locknut furnished by engine manufacturer
7. Impeller cover
8. Intermediate drive plate

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2.11 TRANSMISSION COMPONENTS

CONVERTER HOUSING AND TRANSMISSION



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ITEM	DESCRIPTION	QUANTITY
1	Plug	11
2	O-ring	11
3	O-ring	3
4	Plug	3
5	Ball	1
6	Spring	1
7	Plug	1
8	O-ring	1
9	Spring safety valve	1
10	Ball	1
11	O-ring	1
12	Plug	1
13	O-ring converter housing to transmission case	2
14	O-ring converter housing to transmission case	2
15	Gasket converter housing to transmission case	1
16	Housing converter	1
17	Lock washer - converter housing to transmission case screw	14
18	Screw - converter housing to transmission case	14
19	O-ring filter adaptor	1
20	O-ring filter adaptor	1
21	Filter - adaptor	1
22	Lock washer - filter adaptor screw	3
23	Screw - filter adaptor	3
24	Assembly - filter	1
25	Oil seal - output shaft front	1
26	Screw - converter housing to transmission case	1
27	Lock washer - converter housing to transmission case screw	1
28	Screw - converter housing to transmission case	5
29	Lock washer - converter housing to transmission case screw	5
30	Clip - suction tube	1
31	Lock washer - suction tube screw	1
32	Screw - suction tube	1
33	O-ring suction tube	1
34	Retainer - suction tube	1
35	Assembly - tube and filter	1
36	Oil seal	1
37	Lock washer - oil baffle mounting screw	3
38	Screw - oil baffle mounting	3
39	Nut - oil baffle mounting screw	5
40	Lock washer - oil baffle mounting screw	5

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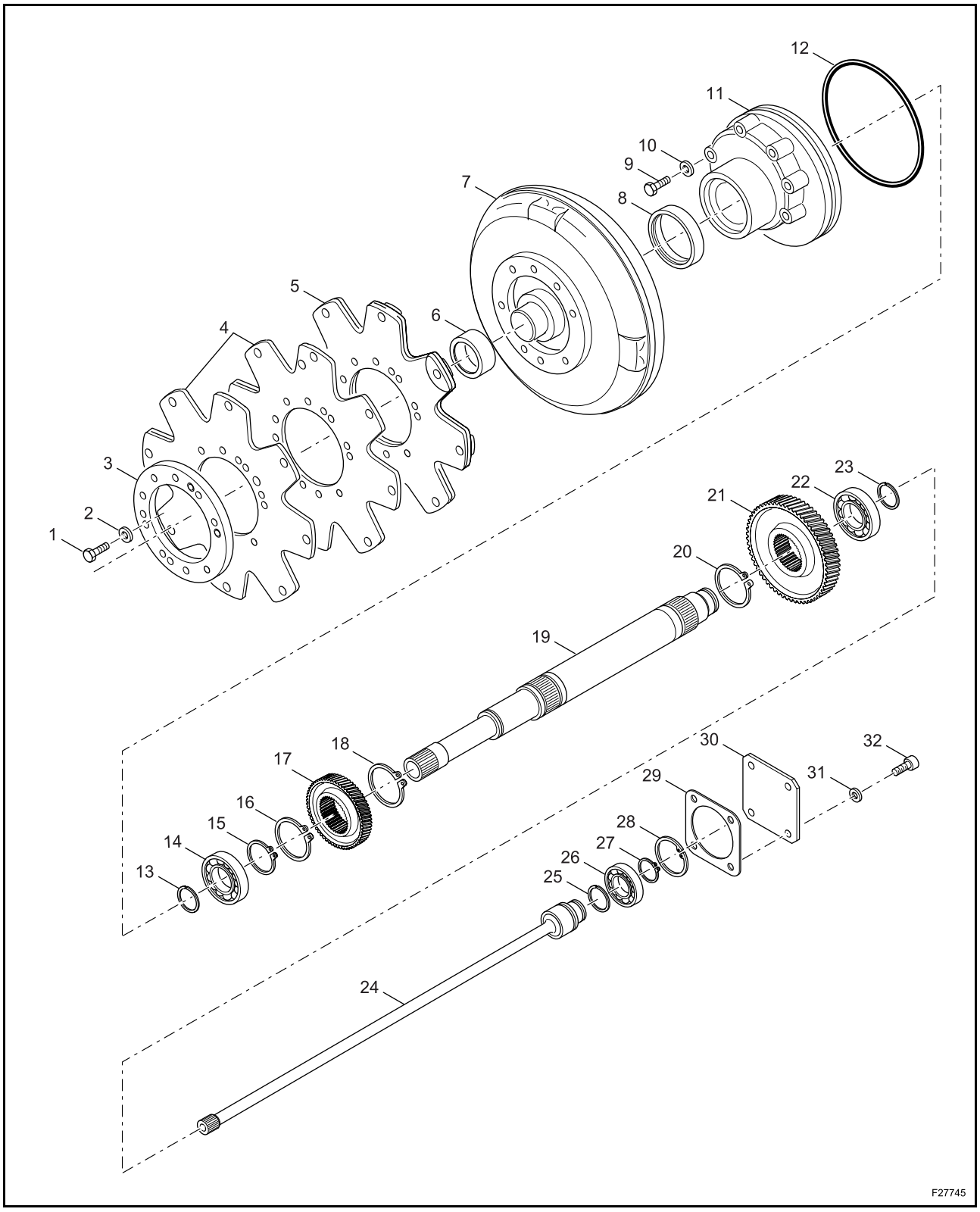
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ITEM	DESCRIPTION	QUANTITY
41	Oil seal	1
42	Screw - oil baffle mounting	5
43	Plate - oil baffle	1
44	Plate - oil baffle	1
45	Pin - transmission case to converter dowel	2
46	Lock washer - converter housing to transmission case screw	4
47	Screw - converter housing to transmission case	4
48	Case - transmission	1
49	O-ring	1
50	Plug	1
51	Plug	11
52	O-ring	11
53	Seal upper output	1
54	Screw - converter housing to transmission case	5
55	Lock washer - converter housing to transmission case screw	5
56	Plug - magnetic drain	1
57	Snap ring - output shaft rear bearing	1
58	Plug - output shaft bore	1
59	Sealing ring - plug	1
60	Plug	1
61	Plug	1
62	Plug	1

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INPUT SHAFT, TORQUE CONVERTER, PUMP DRIVE, INTERNAL CHARGING PUMP AND DRIVE PLATE



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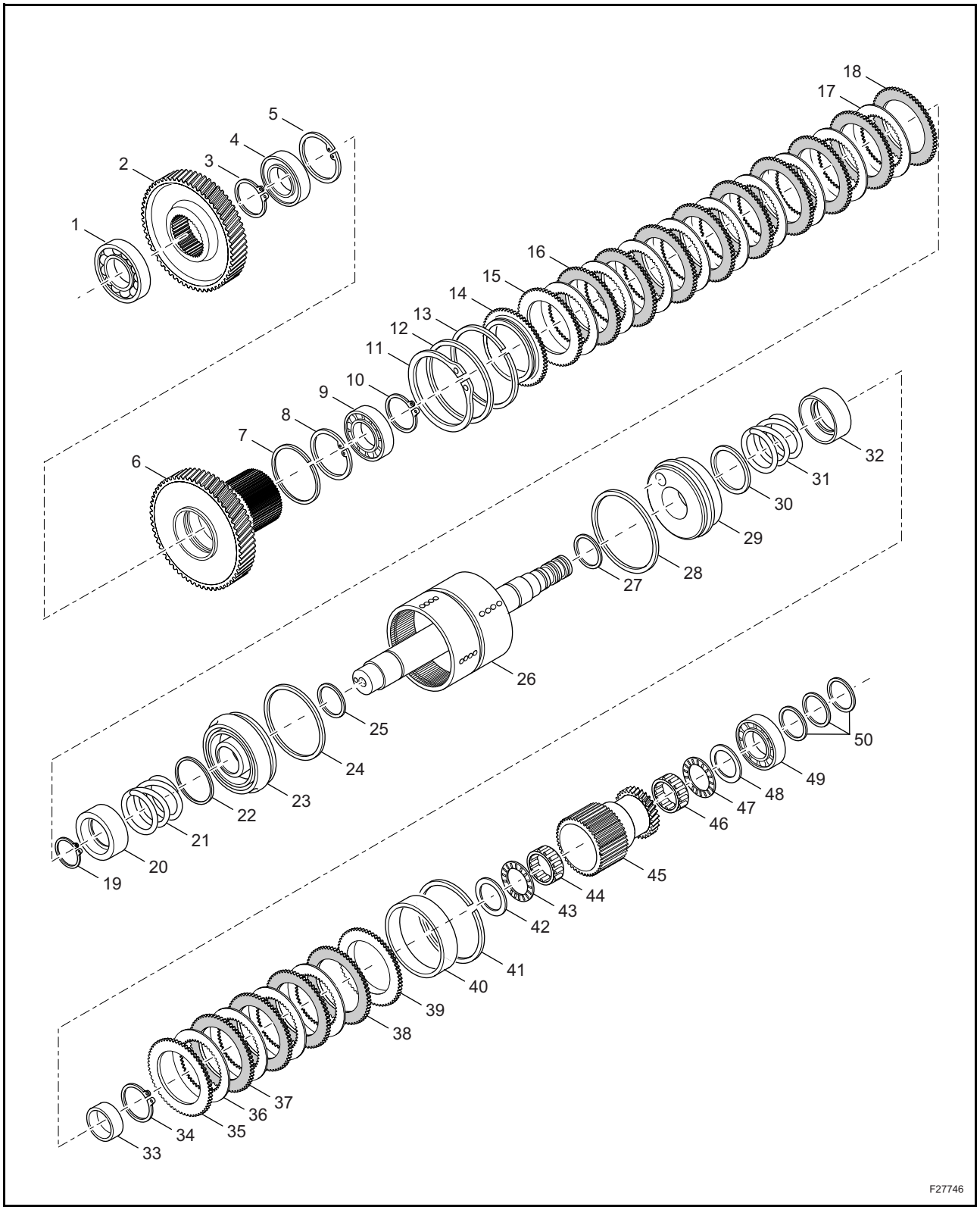
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ITEM	DESCRIPTION	QUANTITY
1	Screw - drive plate mounting	6
2	Lock washer - drive plate mounting screw	6
3	Ring - drive plate	1
4	Plate - drive	2
5	Assembly - drive plate	1
6	Bushing - converter pilot	1
7	Assembly - torque converter	1
8	Oil seal - charging pump	1
9	Screw - pump mounting	6
10	Seal washer - pump mounting screw	6
11	Assembly - charging pump	1
12	O-ring charging pump	1
13	Ring - piston	1
14	Bearing - input shaft front	1
15	Snap ring	1
16	Snap ring	8
17	Gear - forward low and reverse drive	9
18	Snap ring	1
19	Input shaft	1
20	Snap ring	1
21	Gear - forward high drive	1
22	Bearing - input shaft rear	1
23	Ring - piston	1
24	Assembly - pump drive shaft and sleeve	1
25	Ring - piston	1
26	Bearing - pump drive shaft	1
27	Snap ring	1
28	Retaining ring	1
29	Gasket - permanent pump adapter cover	1
30	Cover - permanent pump adapter	1
31	Lock washer - permanent pump adapter cover screw	4
32	Screw - permanent pump adapter cover	4

FORWARD LOW AND FORWARD HIGH SHAFT

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ITEM	DESCRIPTION	QUANTITY
1	High/low forward travel shaft bearing	1
2	Gear - forward driven	1
3	Snap ring	1
4	Bearing - clutch gear	1
5	Retaining ring - clutch gear bearing	1
6	Gear forward low clutch	1
7	Ring - clutch gear piston	1
8	Retaining ring - clutch gear bearing	1
9	Bearing - clutch gear	1
10	Snap ring	1
11	Snap ring	1
12	Washer	1
13	Snap ring - backing plate	1
14	Plate - clutch disc backing	1
15	Disc - outer half	1
16	Disc - outer	8
17	Disc - inner	9
18	Disc - outer half	1
19	Retaining ring	1
20	Retainer spring	1
21	Spring - piston return	1
22	Plate spring - clutch piston wear	1
23	Assembly - clutch piston and seals	1
24	Seal - clutch piston - outer	1
25	Seal - clutch piston - inner	1
26	Assembly forward low/forward high, shaft drum and plug	1
27	Seal - clutch piston - inner	1
28	Seal - clutch piston - outer	1
29	Assembly - clutch piston and seals	1
30	Plate spring - clutch piston wear	1
31	Spring - piston return	1
32	Retainer spring	1
33	Spacer clutch spring forward high	1
34	Retaining ring	1
35	Disc - outer half	1
36	Disc - inner	4
37	Disc - outer	3
38	Disc - outer half	1
39	Plate - clutch disc backing	1
40	Spacer - clutch disc backing plate forward/high	1

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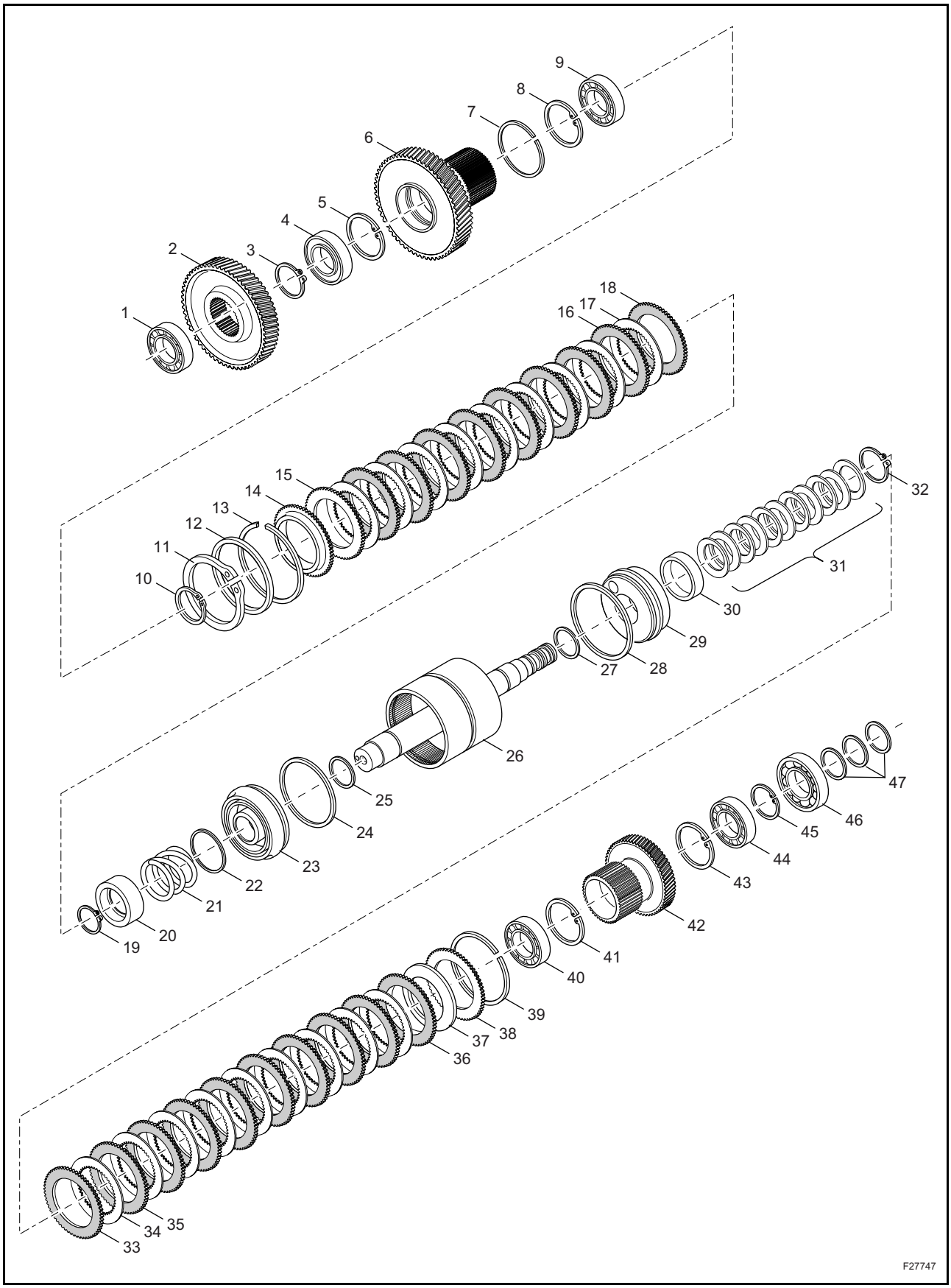
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ITEM	DESCRIPTION	QUANTITY
41	Snap ring spacer	1
42	Thrust washer	1
43	Thrust bearing	1
44	Bearing - needle	1
45	Gear - forward high clutch	1
46	Bearing - needle	1
47	Thrust bearing	1
48	Thrust washer	1
49	Bearing - rear forward low/forward high shaft	1
50	Ring - piston	3

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REVERSE / 1ST SHAFT AND GEARS



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ITEM	DESCRIPTION	QUANTITY
1	Bearing - front reverse: 1st shaft	1
2	Gear - reverse driven	1
3	Snap ring	1
4	Bearing - clutch gear	1
5	Retaining ring - clutch gear bearing	1
6	Gear forward low clutch	1
7	Ring - clutch gear piston	1
8	Retaining ring - clutch gear bearing	1
9	Bearing - clutch gear	1
10	Snap ring	1
11	Snap ring	1
12	Washer	1
13	Snap ring - backing plate	1
14	Plate - clutch disc backing	1
15	Disc - outer half	1
16	Disc - outer	8
17	Disc - inner	9
18	Disc - outer half	1
19	Retaining ring	1
20	Retainer spring	1
21	Spring - piston return	1
22	Plate spring - clutch piston wear	1
23	Assembly - clutch piston and seals	1
24	Seal - clutch piston - outer	1
25	Seal - clutch piston - inner	1
26	Assembly reverse / 1st, shaft drum and plug	1
27	Seal - clutch piston - outer	1
28	Seal - clutch piston - inner	1
29	Assembly - clutch piston and seals	1
30	Plate clutch piston wear	1
31	Assembly - spring disc	1
32	Retaining ring	1
33	Disc - outer half	1
34	Disc - inner	9
35	Disc - outer	8
36	Disc - outer half	1
37	Modulation spring	1
38	Plate - clutch disc backing	1
39	Snap ring - clutch disc backing plate	1
40	Bearing - clutch gear	1

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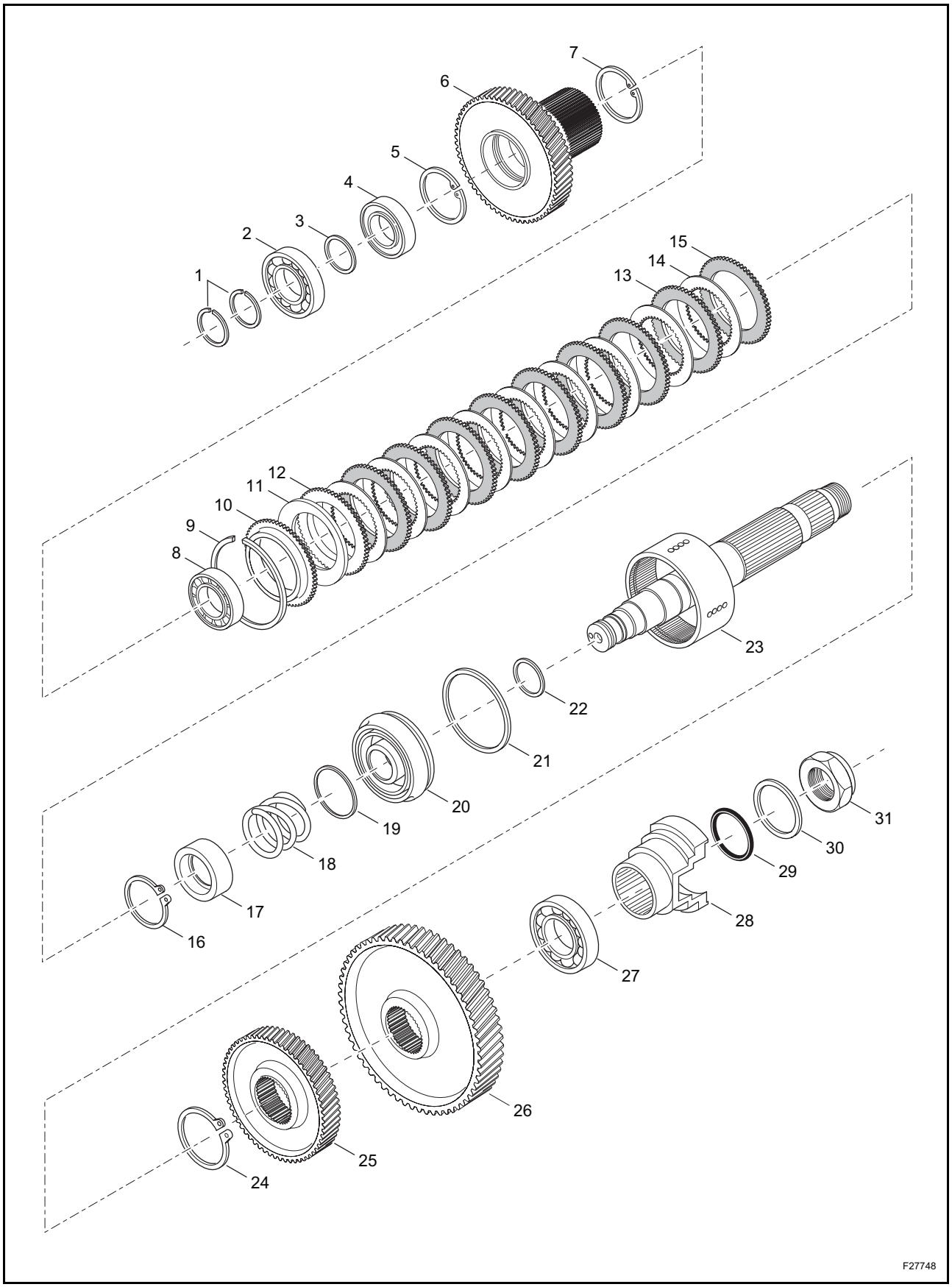
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ITEM	DESCRIPTION	QUANTITY
41	Retaining ring - clutch gear bearing	1
42	Gear - 1st clutch	1
43	Retaining ring - clutch gear bearing	1
44	Bearing - clutch gear	1
45	Snap ring	1
46	Bearing - rear reverse / 1st shaft	1
47	Ring - piston	3

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2ND SHAFT



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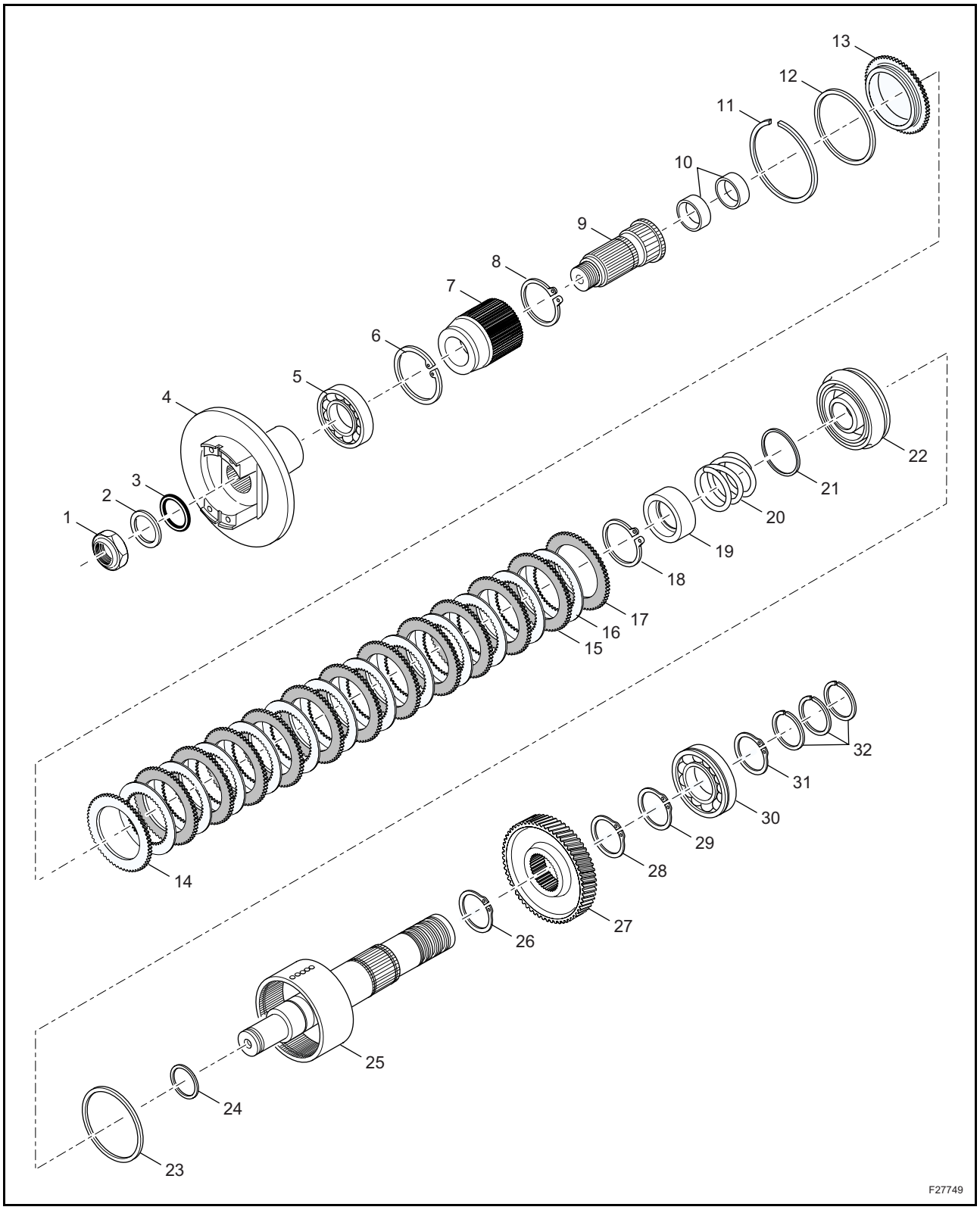
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ITEM	DESCRIPTION	QUANTITY
1	Ring - piston	2
2	Bearing - front 2nd shaft	1
3	Washer - bearing support	1
4	Bearing - clutch gear	1
5	Retaining ring - clutch gear bearing	1
6	Gear - 2nd clutch	1
7	Retaining ring - clutch gear bearing	1
8	Bearing - clutch gear	1
9	Snap ring - clutch disc backing plate	1
10	Plate - clutch disc backing	1
11	Modulation spring	1
12	Disc - outer half	1
13	Disc - outer	8
14	Disc - inner	9
15	Disc - outer half	1
16	Retaining ring	1
17	Retainer spring	1
18	Spring clutch - piston return	1
19	Plate spring - clutch piston wear	1
20	Assembly - clutch piston and seals	1
21	Seal - clutch piston - outer	1
22	Seal - clutch piston - inner	1
23	Assembly - 2nd shaft, drum and plug	1
24	Snap ring - gear retainer	1
25	Gear - lower output drive	1
26	Gear - upper output	1
27	Bearing rear - 2nd shaft	1
28	Flange yoke 1410 - upper output	1
29	O-ring - flange	1
30	Washer - flange nut	1
31	Nut - flange	1

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OUTPUT SHAFT WITH INTERNAL DISCONNECT



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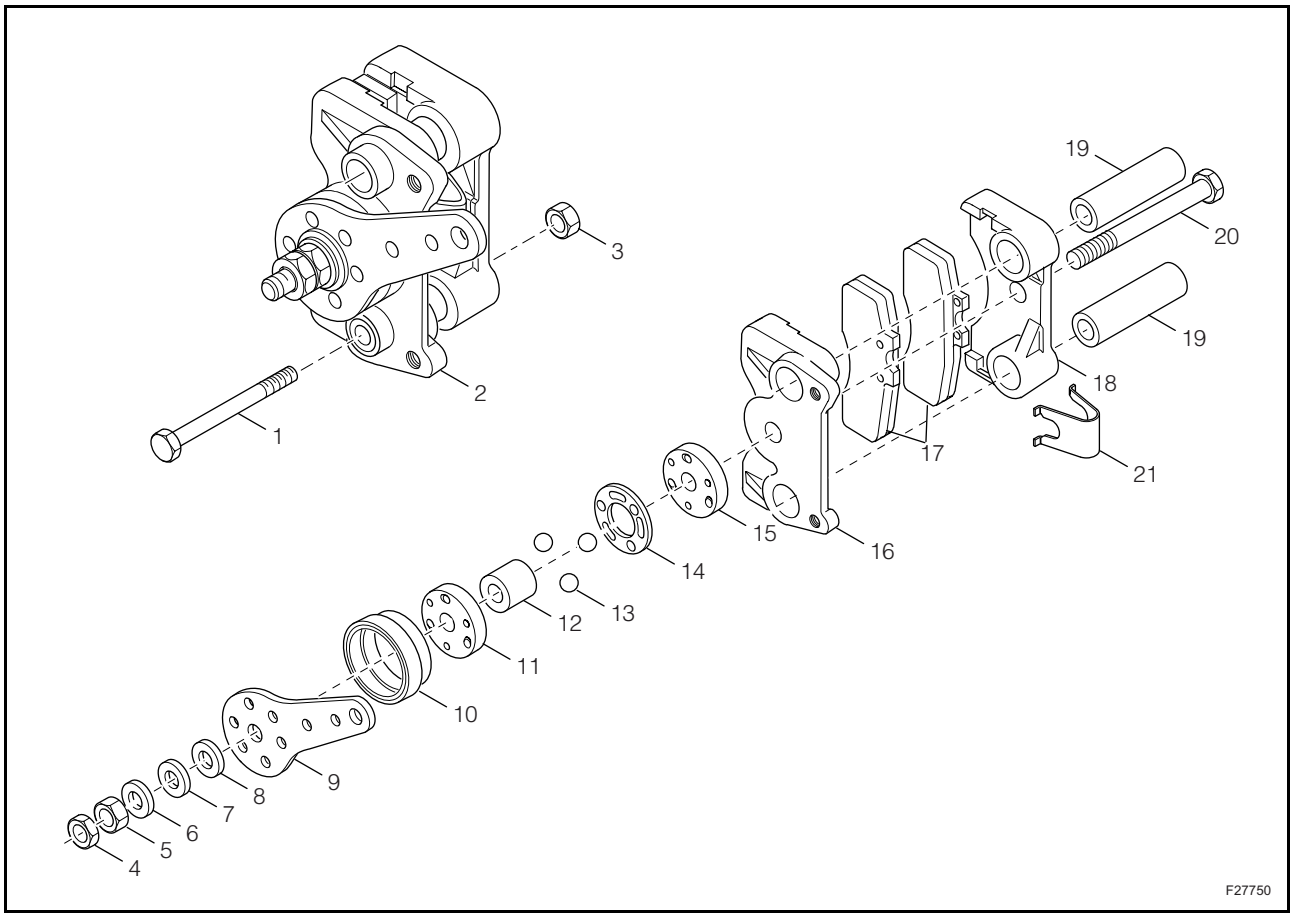
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ITEM	DESCRIPTION	QUANTITY
1	Nut - flange	1
2	Washer - flange nut	1
3	O-ring - flange	1
4	Output flange front yoke 1410 with brake pads	1
5	Bearing - output shaft front	1
6	Retaining ring	1
7	Disconnect hub	1
8	Snap ring - gear retainer	1
9	Assembly - output shaft front	1
10	Bushing	2
11	Snap ring - clutch disc backing plate	1
12	Spacer	1
13	Plate - clutch disc backing	1
14	Disc - outer half	1
15	Disc - outer	11
16	Disc - inner	12
17	Disc - outer half	1
18	Retaining ring	1
19	Retainer spring	1
20	Spring - piston return	1
21	Plate spring - clutch piston wear	1
22	Assembly - clutch piston and seals	1
23	Seal - clutch piston - outer	1
24	Seal - clutch piston - inner	1
25	Assembly - output shaft rear, drum and plug	1
26	Snap ring - gear retainer	1
27	Gear lower output	1
28	Snap ring - gear retainer	1
29	Snap ring - rear bearing	1
30	Bearing - output shaft rear	1
31	Snap ring - rear bearing	1
32	Ring - piston	3

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PARKING BRAKE



ITEM	DESCRIPTION	QUANTITY
1	Screw - brake mounting	2
2	Assembly - caliper	1
3	Nut - brake mounting screw	2
4	Nut - jam adjustment	1
5	Nut - adjustment	1
6	Washer - hardened	1
7	Washer - stainless steel	1
8	Thrust washer	1
9	Lever	1
10	Boot	1
11	Cam	1
12	Oil seal	1
13	Ball bearing	3
14	Plastic retainer	1
15	Cam	1

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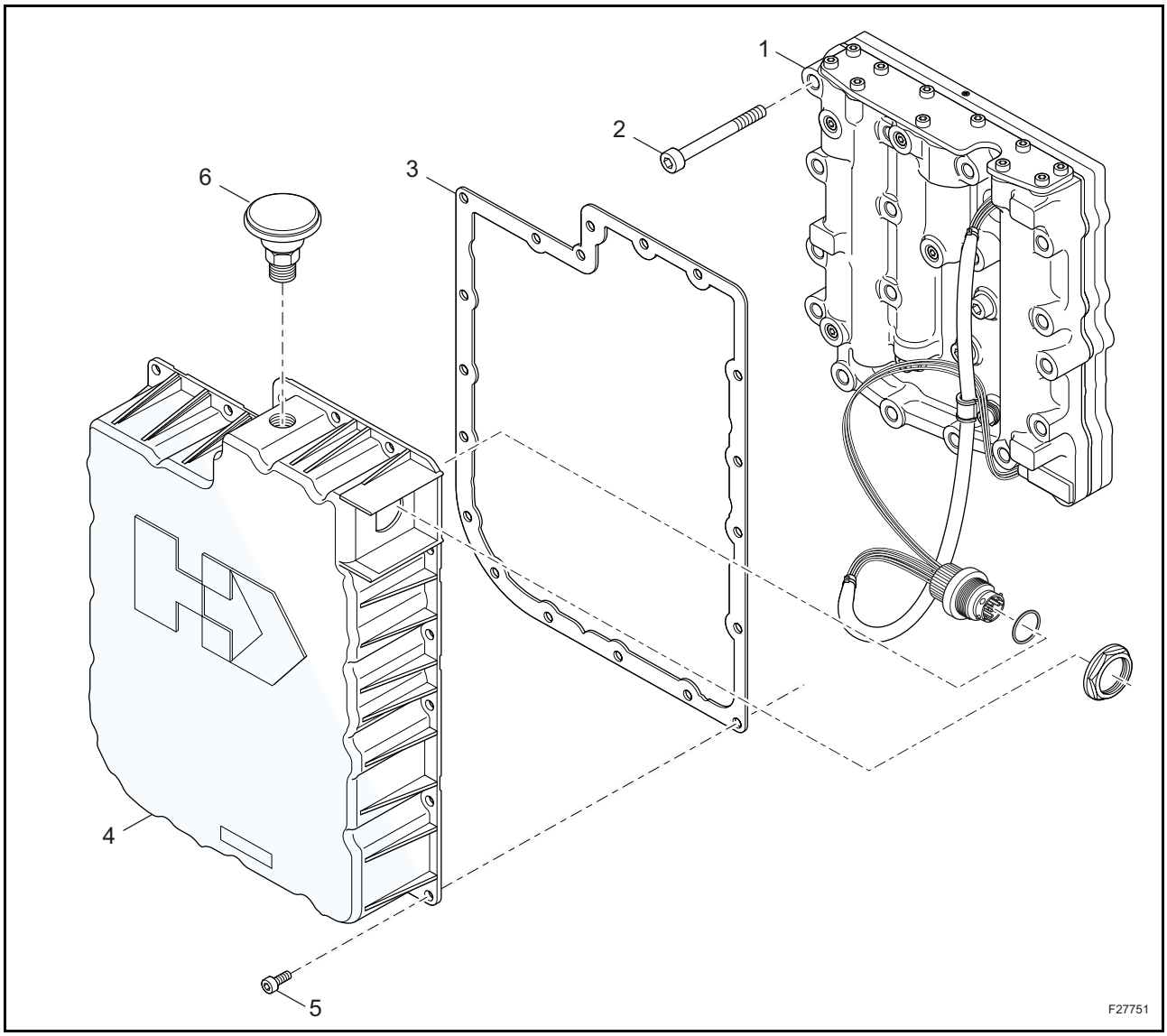
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ITEM	DESCRIPTION	QUANTITY
16	Torque plate - front	1
17	Pads assembly	2
18	Torque plate - rear	1
19	Sleeve mounting	2
20	Adjuster screw	1
21	Spring	1

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ELECTRICAL CONTROL VALVE



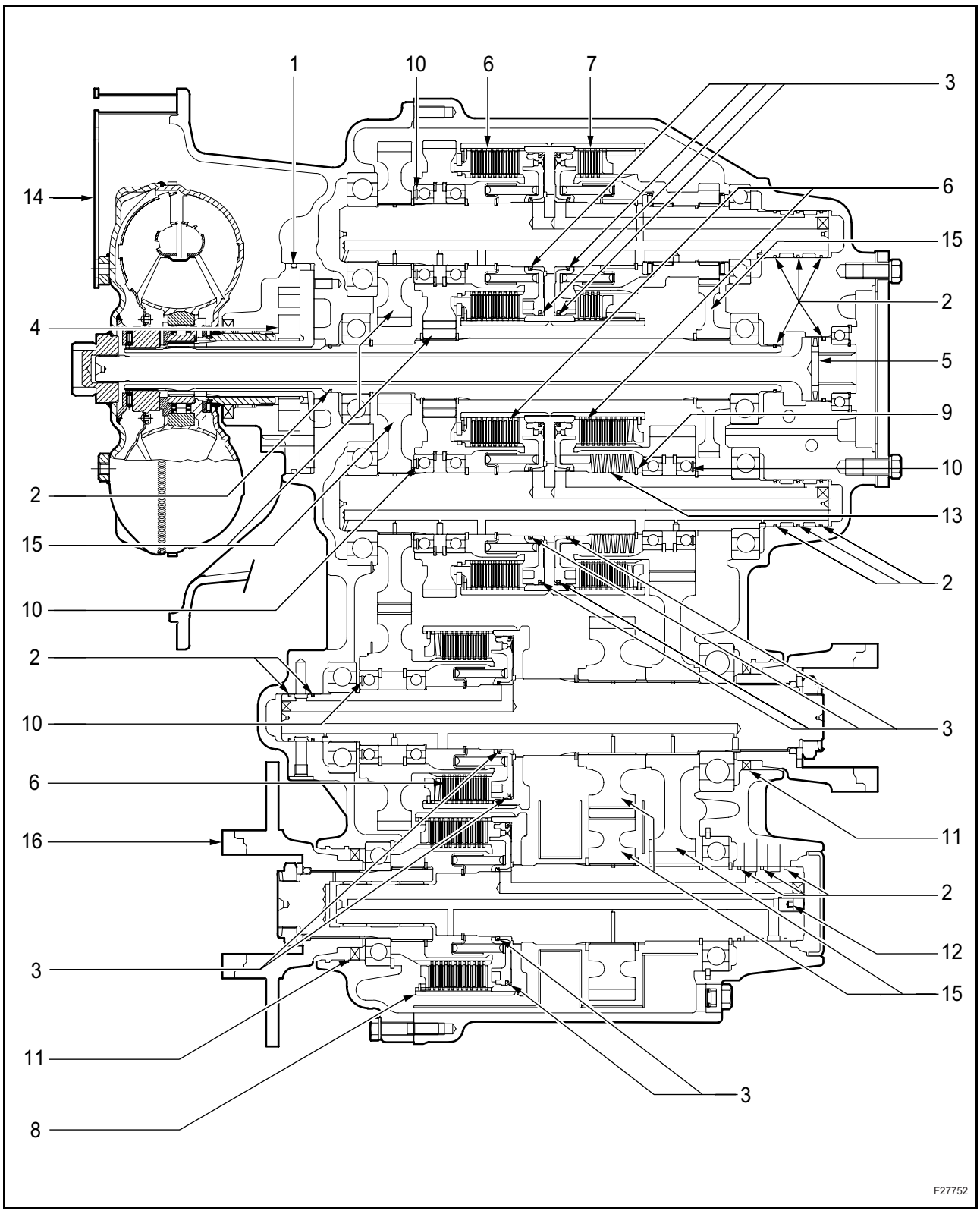
ITEM	DESCRIPTION	QUANTITY
1	Control valve assembly	1
2	Control valve mounting screws	17
3	Control valve protection cover gasket	1
4	Control valve protection cover	1
5	Protection cover screw	20
6	Air breather	1

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2.12 DISASSEMBLY AND ASSEMBLY

ASSEMBLY INSTRUCTIONS



1. Add some grease to O-ring before assembly.

2. Add some grease to piston rings before assembly slots of the piston rings are not allowed to pass bores in housings.

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3. Teflon seals must be sized prior to assembly. Grease the inner and outer diameter of the clutch drum before assembly.

4. Pump must be filled up with test oil prior to assembly.

5. Pump drive shaft must be installed after torque converter.

6. Forward low, reverse, 1st, and 2nd clutch: 9 separator plates with inner splines. 8 friction plates (friction material both sides) with outer splines, 2 1-side friction plates (friction material 1 side) with outer splines.
Start with one 1-side friction plate, metal against piston, then alternately separator and friction plate.
End with a 1-side friction plate, metal side against end plate or disc spring.
Be sure disc spring is mounted as shown.
- Clearance: forward low and reverse:
  min. clearance = 2.79 mm (for carbon plates)
  max. clearance = 5.21 mm (for carbon plates)
  If clearance is more than 4.79 mm, add one separator plate upon last separator plate.
- Clearance: first and second:
  min. clearance = 2.54 mm
  max. clearance = 5.41 mm
  If clearance is more than 4.54 mm, add one separator plate upon last separator plate.

7.
- Forward high clutch: 4 separator plates, 3 friction plates and two 1-side friction plates.
- Assembly see (6)
- Clearance:
  min. clearance = 1.24 mm (for carbon plates)
  max. clearance = 2.76 mm (for carbon plates)

8.
- Disconnect clutch: 12 separator plates, 11 friction plates and two 1-side friction plates.
- Assembly see (6)
- Clearance:
  min. clearance = 3.66 mm (for carbon plates)
  max. clearance = 6.78 mm (for carbon plates)
  If clearance is more than 5.66 mm, add one separator plate upon last separator plate.

9. Installation force of disc spring is 3280 N.

10. Be sure that shielded and sealed bearings are mounted as shown.

11. Seals must be pressed in perpendicular upon shaft axis from bearing side. Except lower rear output.

12. Plug to be screwed in and torqued but without Loctite.

13. Place the concave side of the spring of the first clutch first disc against the wear sleeve of the clutch piston.
Remaining 10 springs to be stacked alternately reversed as shown.

14. Shipping strap: only used during shipment of the individual transmission.

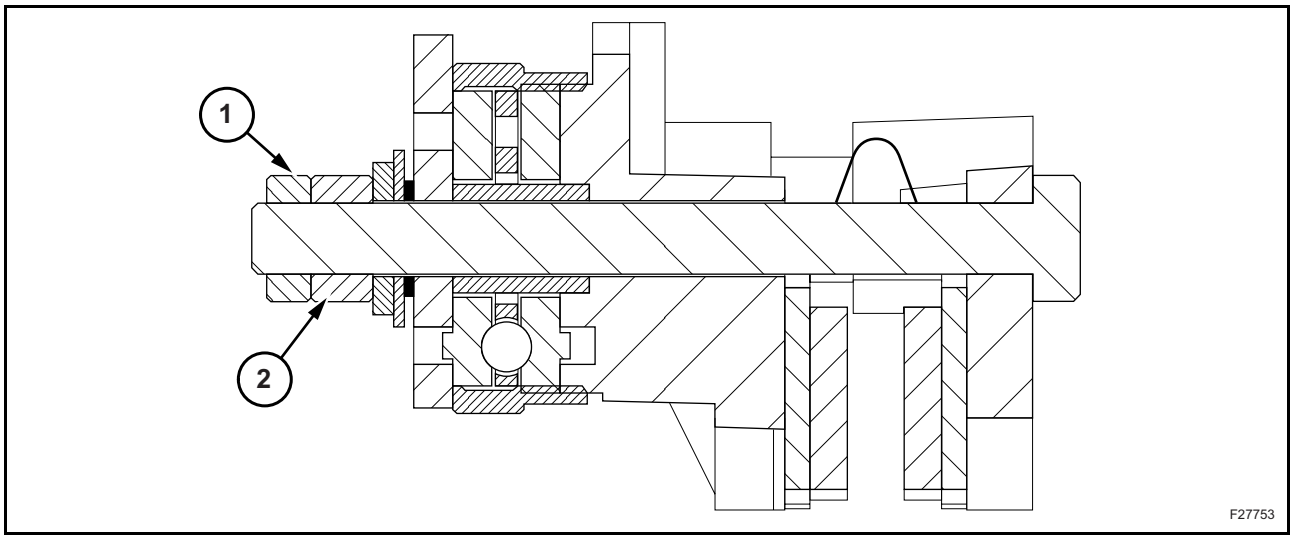
NOTE: check if safety valve and valve block are tested before assembly.

---

15. Heat gears up to 150 °C before assembling.

16. Parking brake.

17. Mounting: tighten locking nuts with 0.25 to 1.25 mm clearance between nuts and sleeves.
Adjustment: loosen the (2) adjustment locking nuts (1 and 2). Put lever in correct position.
Tighten inner adjustment nut (2) with 11 Nm. Back off inner adjustment nut (2).
Tighten outer locking nut (1) against inner adjustment nut (2). Clearance must be from 0.8 to 1.1 mm.



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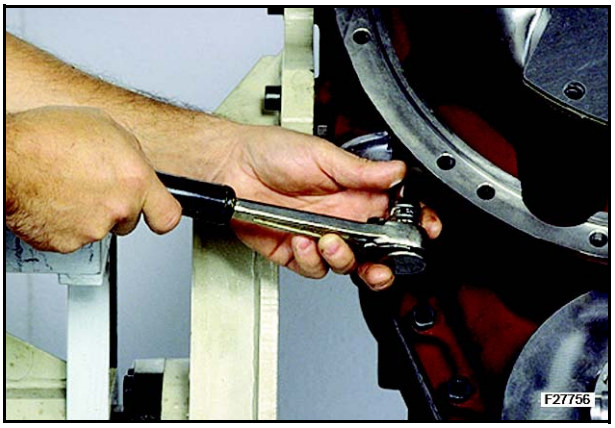
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TRANSMISSION DISASSEMBLY

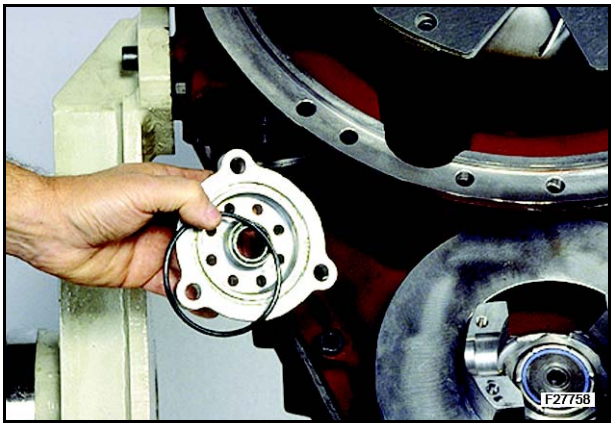
Remove the oil filter.



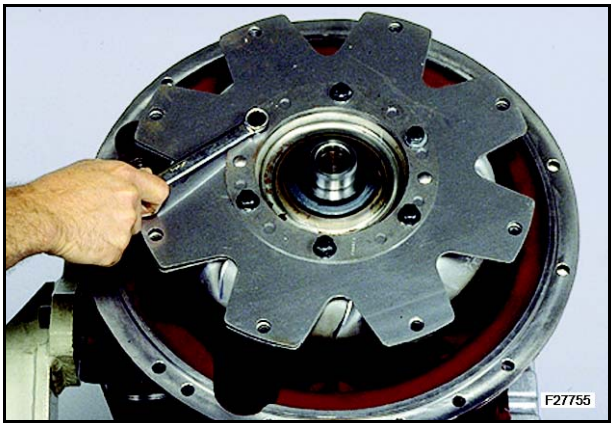
Remove the filter adapter screws.



Remove the filter adapter with the O-ring.



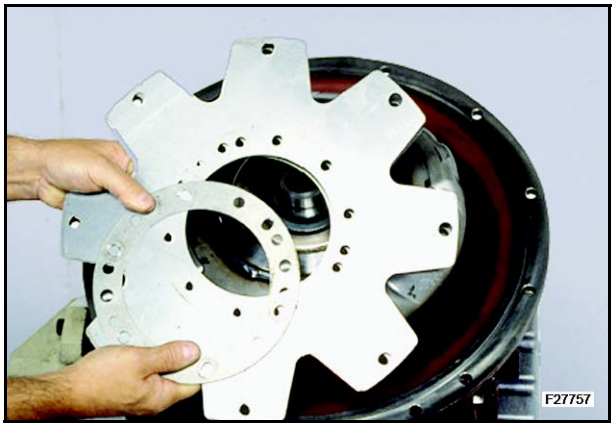
Remove the drive plate screws.



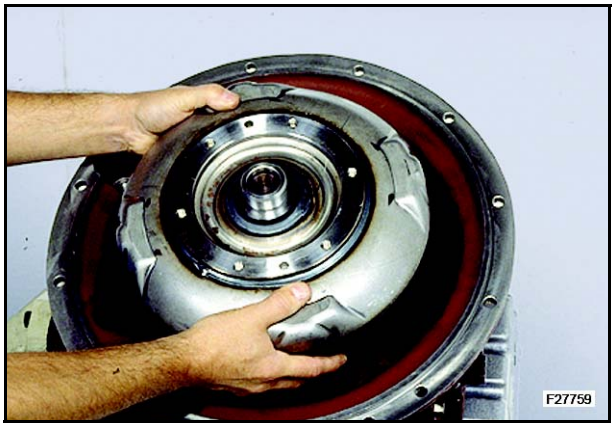
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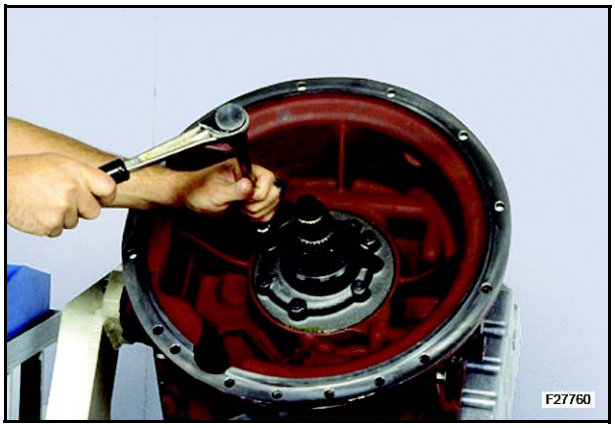
Remove the drive plates.



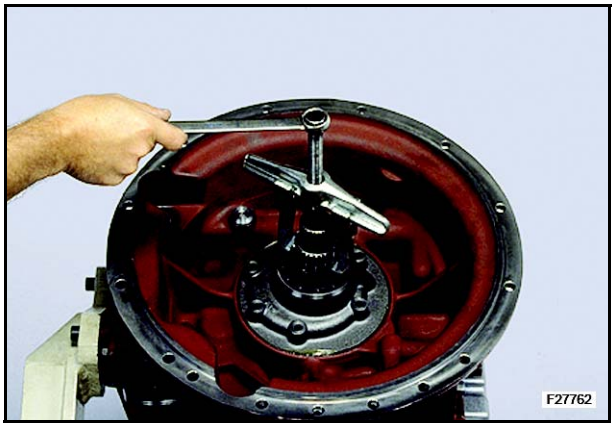
Remove the torque converter assy.



Remove the charging pump screws.



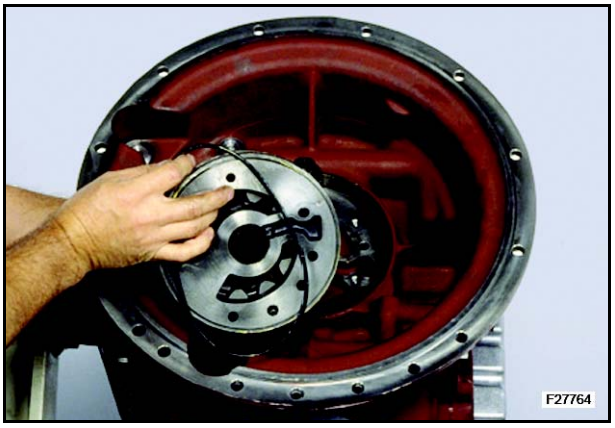
Use a bearing puller to remove the charging pump.



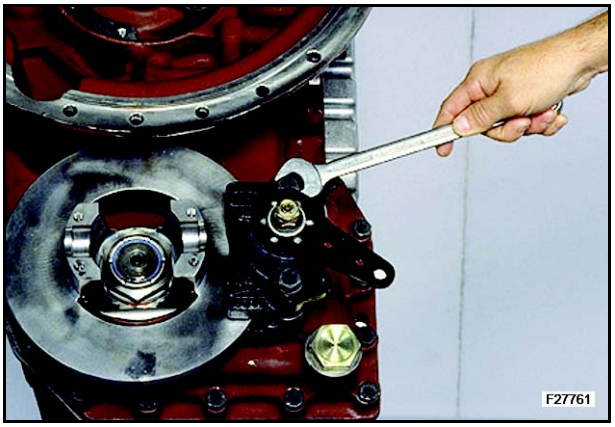
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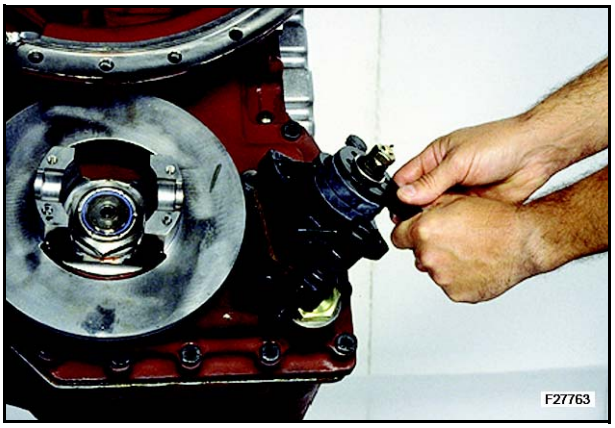
Remove the charging pump assy, remove the O-ring.



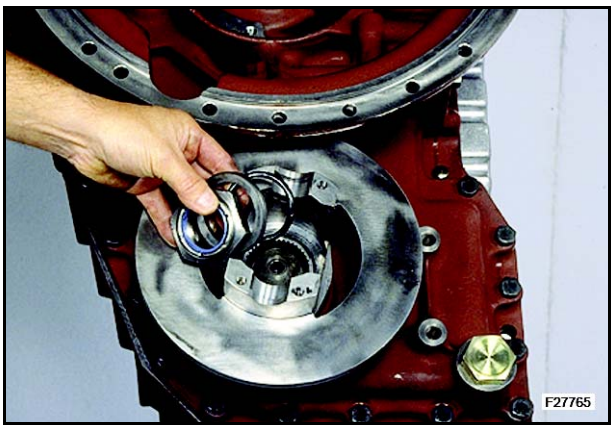
Remove the parking brake mounting screws.



Remove the parking brake assy.



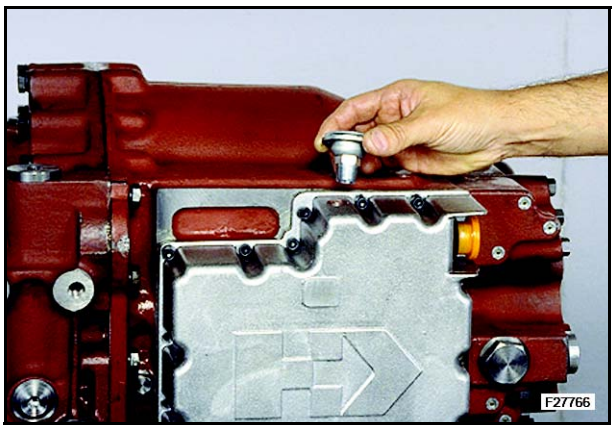
Remove the upper output nut, the washer, the O-ring and the flange.



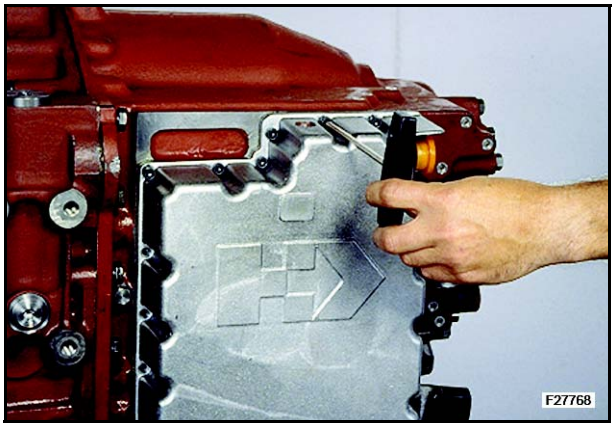
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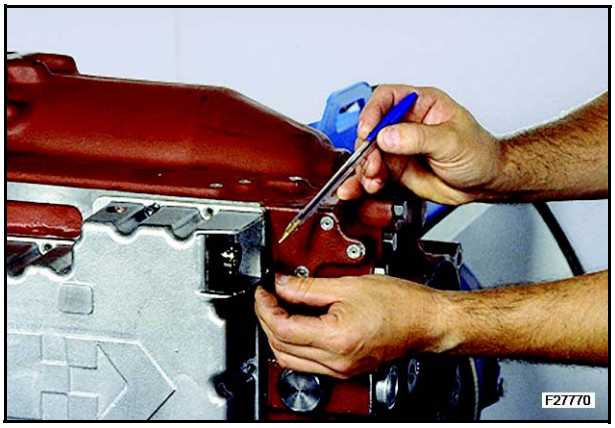
Remove the air breather.



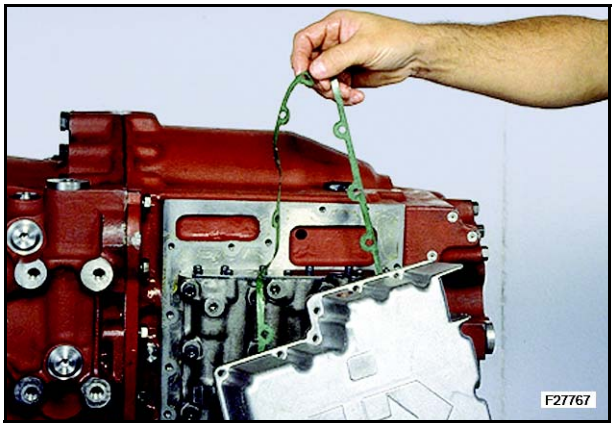
Remove the control valve protection cover mounting screws.



Remove the wiring connector mounting nut.



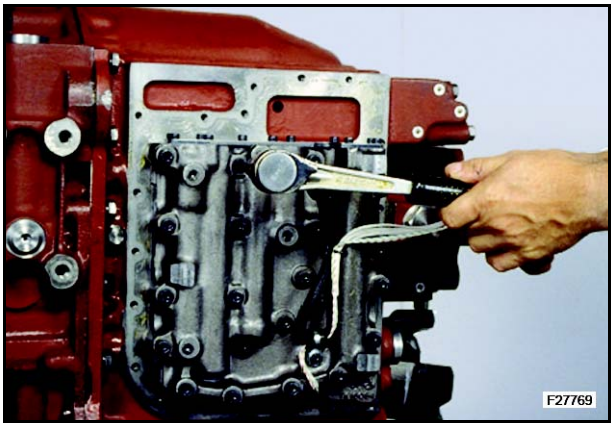
Remove the control valve protection cover and the gasket.



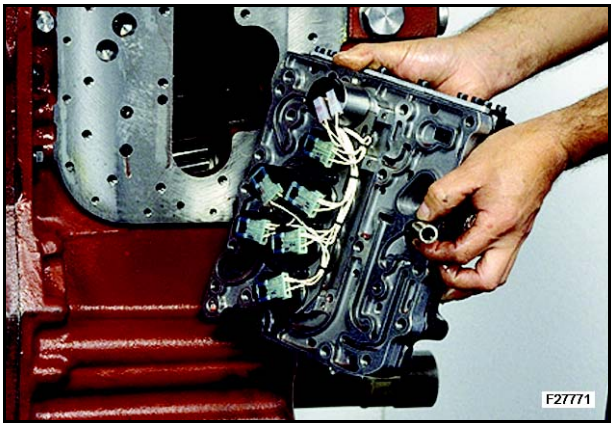
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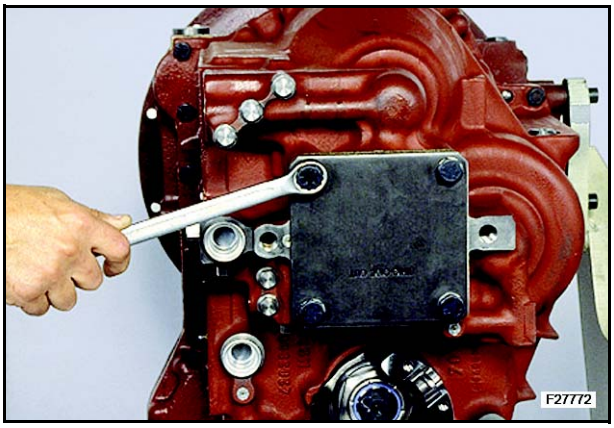
Remove the control valve mounting screws.



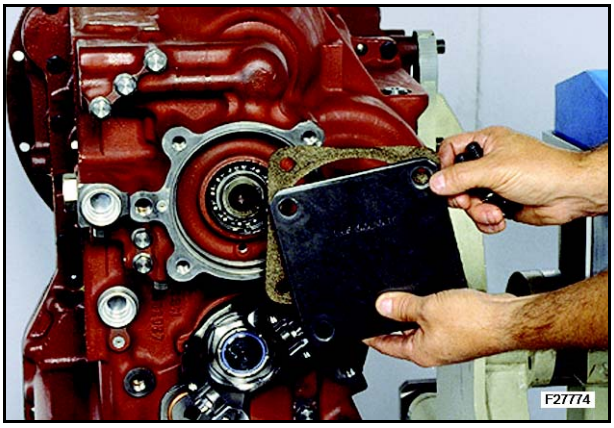
Remove the control valve assy: remove the by-pass valve spool and the spring in the meantime.



Remove the auxiliary pump hole cover screws.



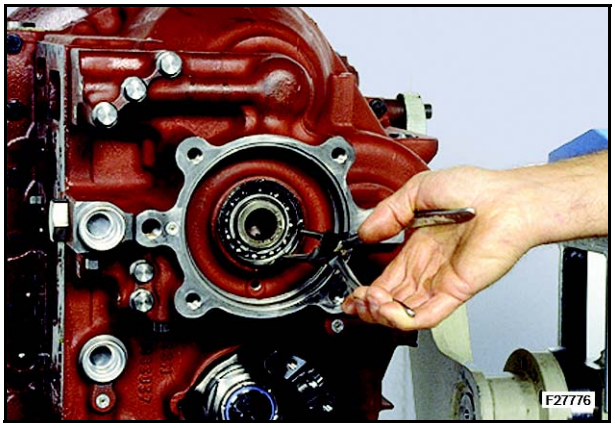
Remove the auxiliary pump hole cover and the gasket.



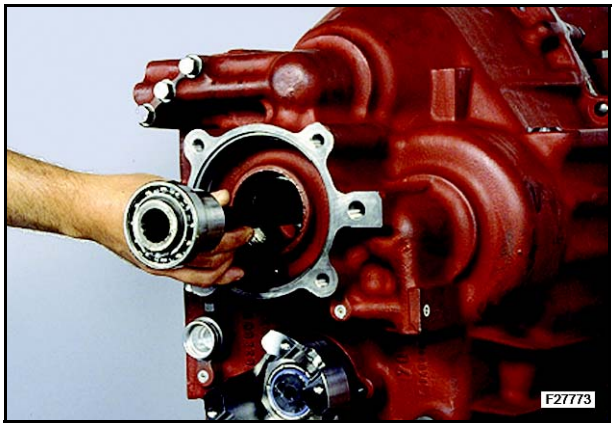
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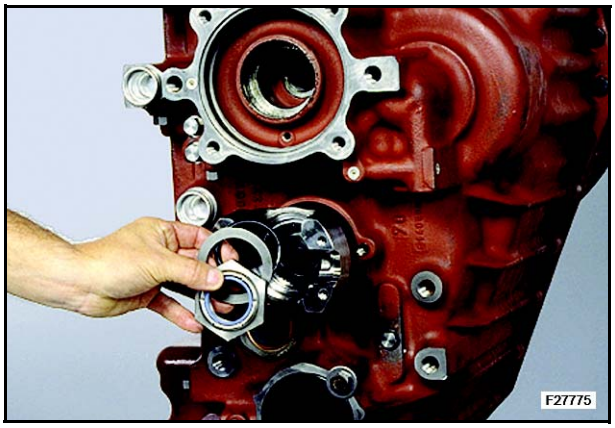
Remove the pump drive shaft and the bearing assy.



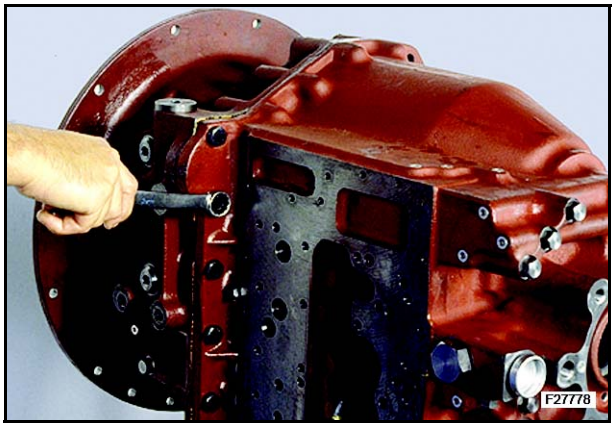
Remove the pump drive shaft and the bearing assy.



Remove the upper output nut, the washer, the O-ring and the flange.



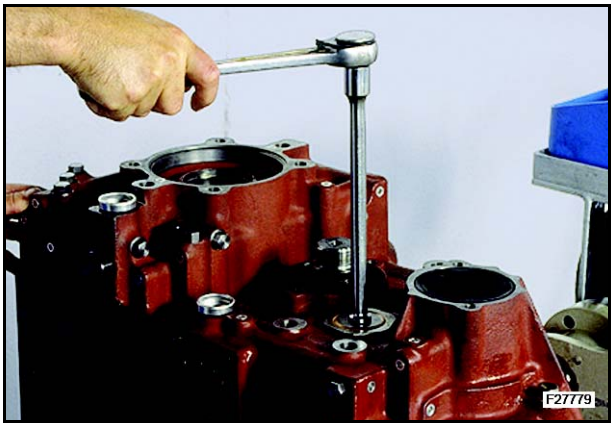
Remove the converter housing to the transmission case screws and the lock washers.



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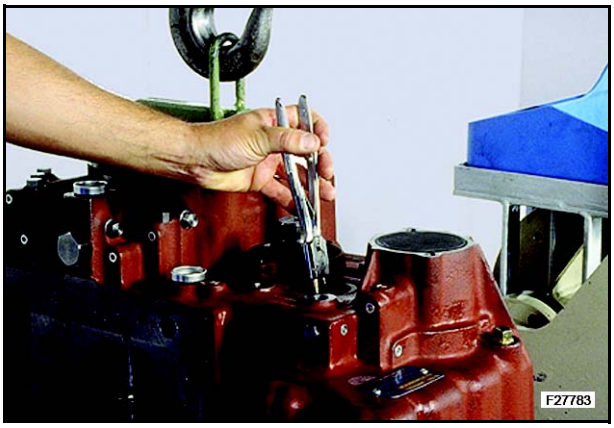
Remove the transmission case plug.



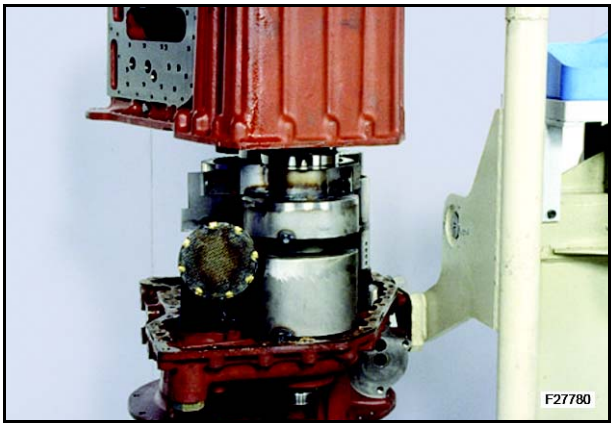
Transmission case plug and gasket removed.



Spread ears on output shaft rear bearing retaining ring. Hold snap ring open. Tap on the output shaft and transmission case to remove the case from the converter housing.
Lift transmission case from converter housing (using lifting bracket).



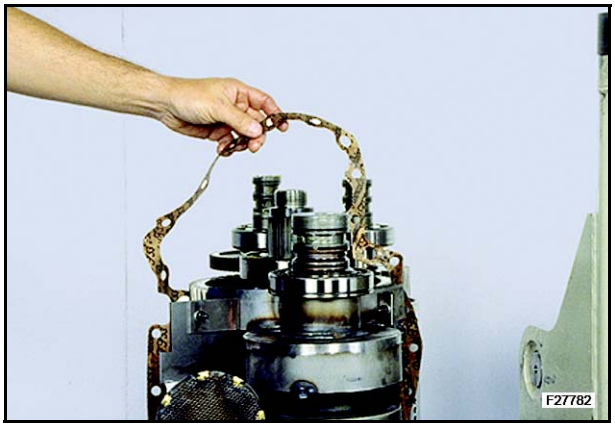
Transmission case removed all drums and shafts remain in converter housing.



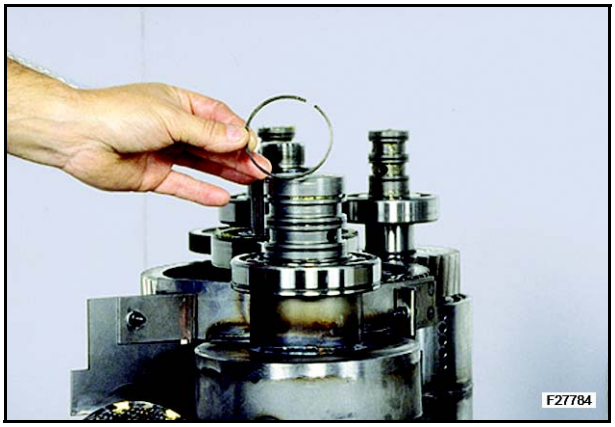
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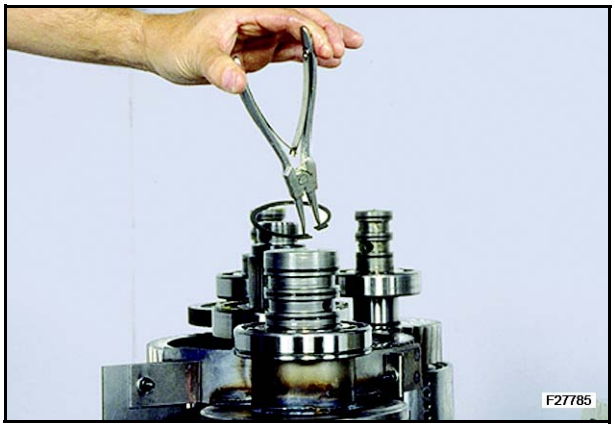
Remove the transmission case to converter housing gasket.



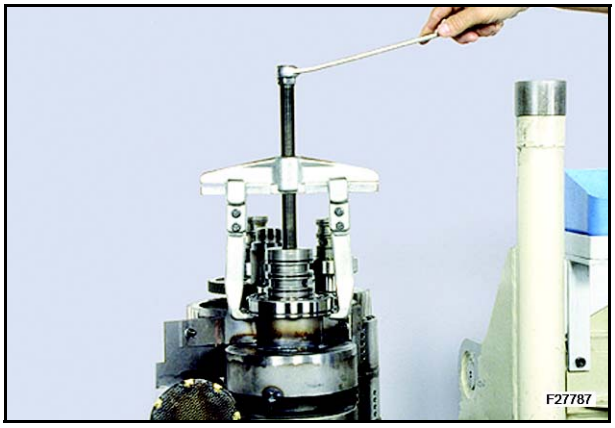
Remove the output shaft sealing rings.



Remove the output shaft rear bearing retaining ring.



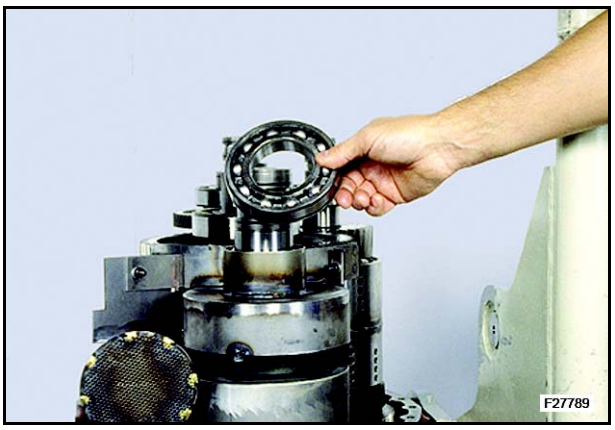
Use bearing puller to remove the output shaft rear bearing.



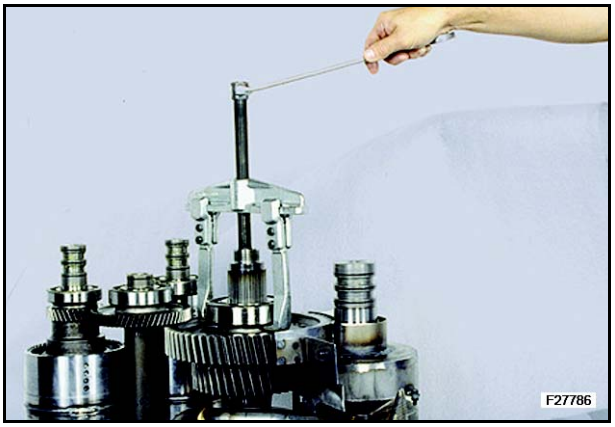
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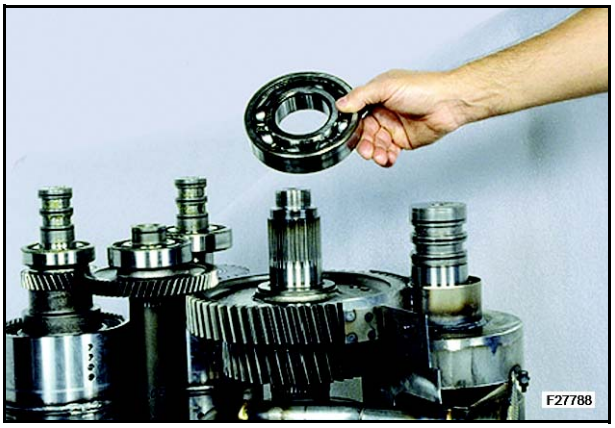
Output shaft rear bearing removed.



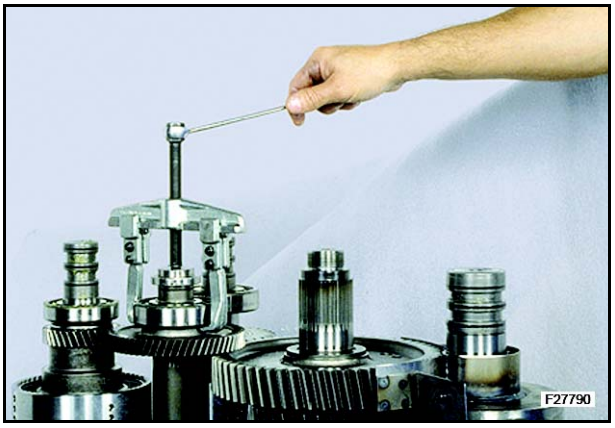
Using bearing puller to remove the 2nd shaft rear bearing.



2nd shaft rear bearing removed.



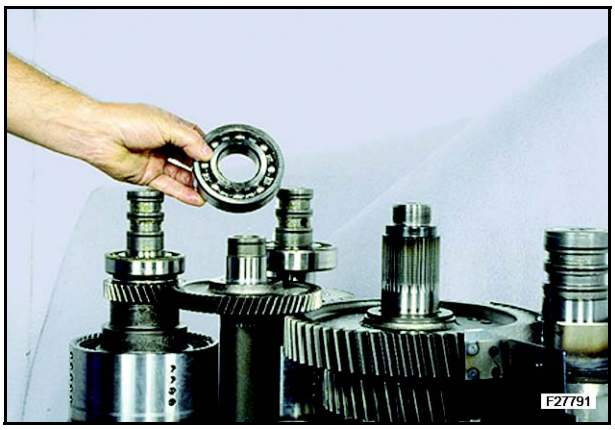
Using bearing puller to remove the input shaft rear bearing.



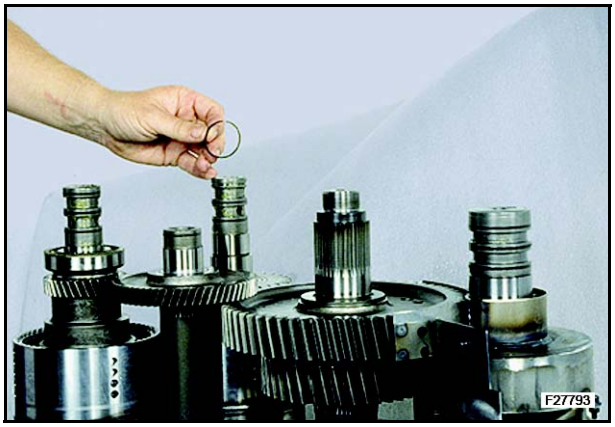
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Input shaft rear bearing removed.



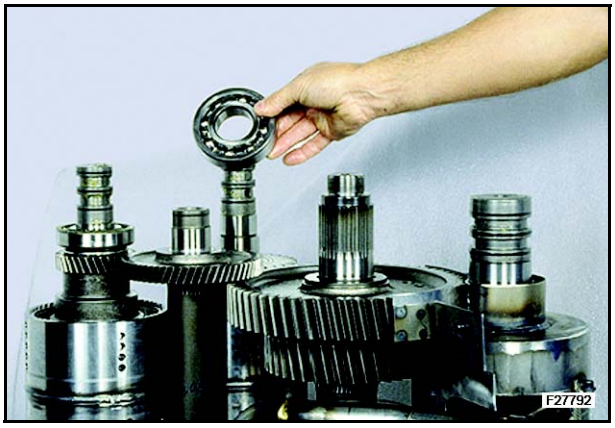
Remove the reverse and 1st shaft sealing rings.



Using bearing puller to remove the reverse and 1st shaft rear bearing.



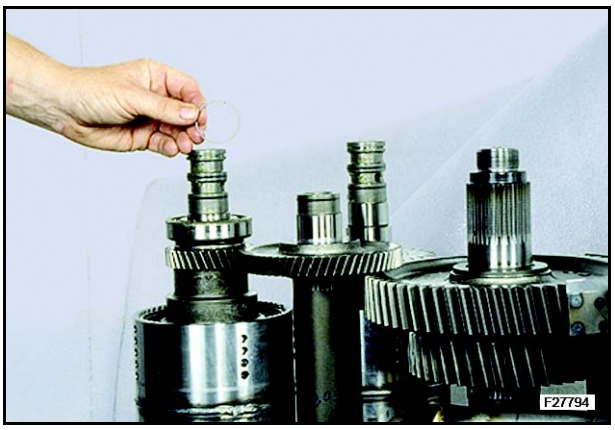
Reverse and 1st shaft rear bearing removed.



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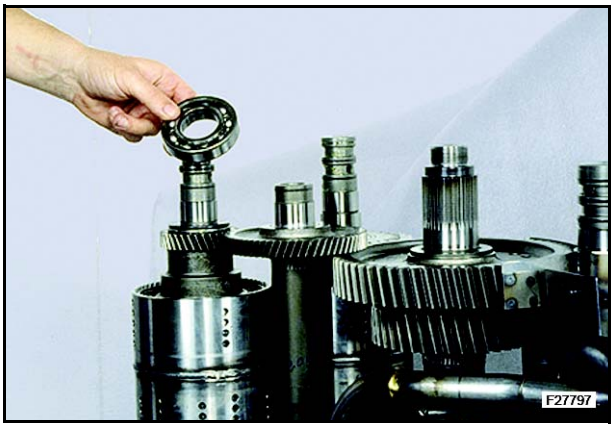
Remove the forward low and forward high shaft sealing rings.



Using bearing puller to remove the forward low and the forward high shaft rear bearing.



Forward the low and forward high shaft rear bearing removed.



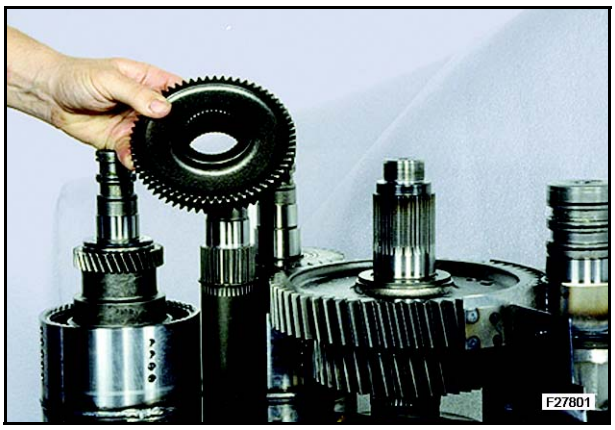
Use bearing puller to remove the forward high gear from the input shaft.



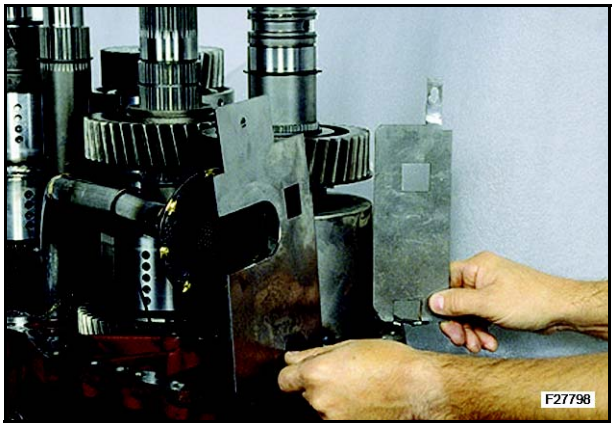
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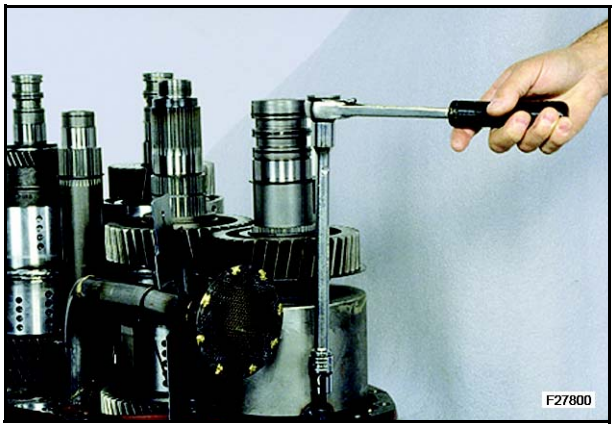
Forward high gear removed.



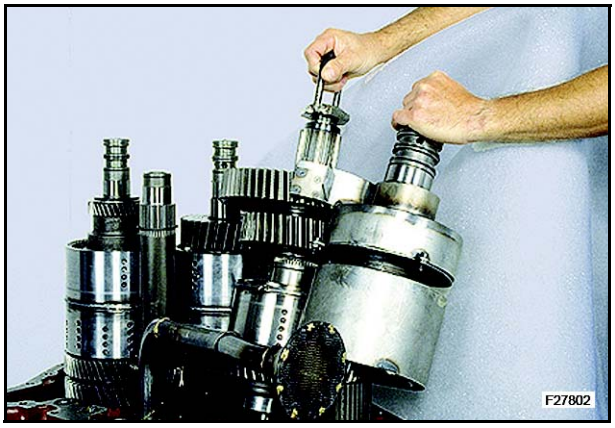
Remove the baffle plate screws, remove the baffle plates.



Remove the oil baffle to the converter housing screws, do not remove the oil baffle from the output shaft.



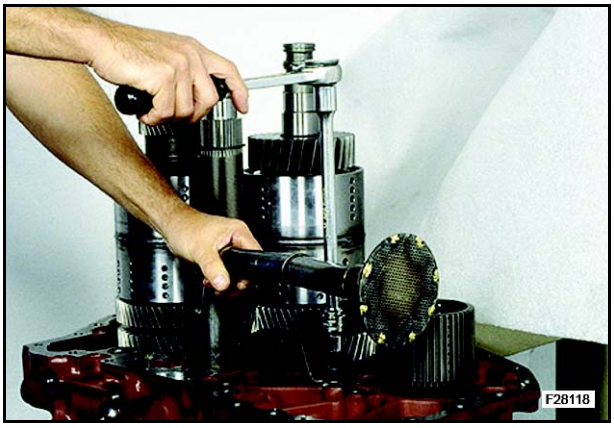
Remove the output shaft, the 2nd shaft and the oil baffle at the same time.



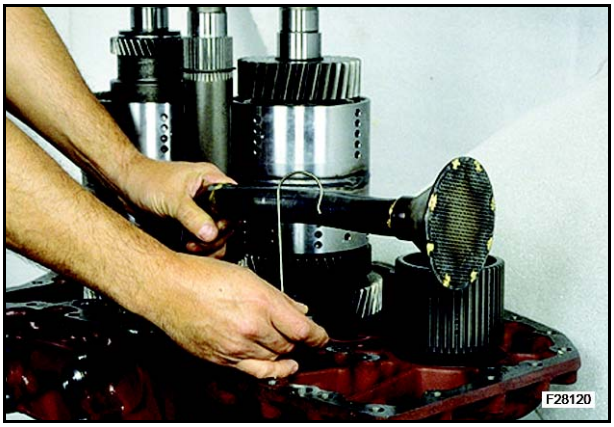
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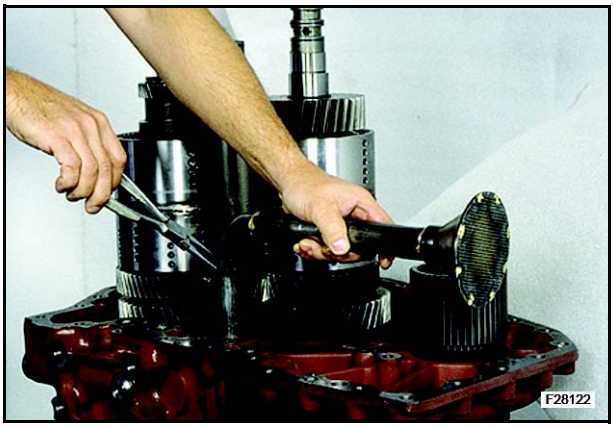
Loosen the suction tube retainer screw.



Remove suction tube retainer screw and lock washer.



Remove the suction tube retainer ring.



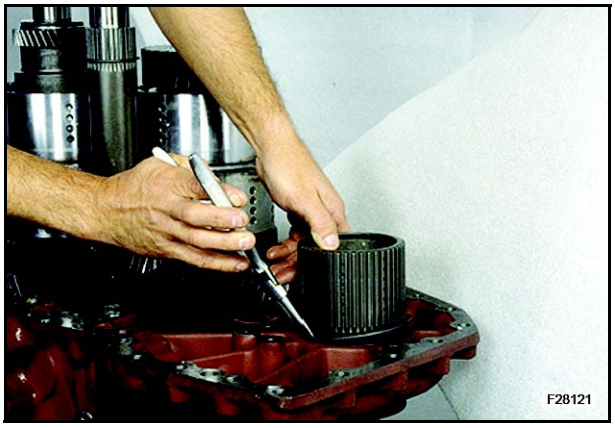
Remove the suction tube O-ring and the washer.



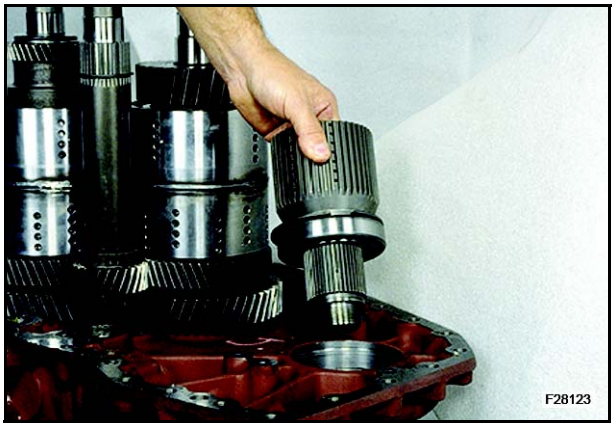
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Remove the output shaft front bearing retainer ring.



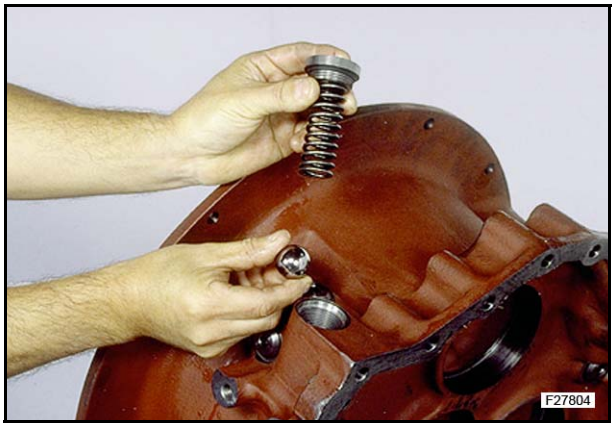
Remove the output shaft front assembly.



Remove the input shaft, the reverse and the forward shaft at the same time.



Remove the by-pass plug, the spring and the ball.



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Remove the by-pass plug, the spring and the ball.



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FORWARD HIGH CLUTCH DISASSEMBLY

Remove the clutch shaft sealing rings.



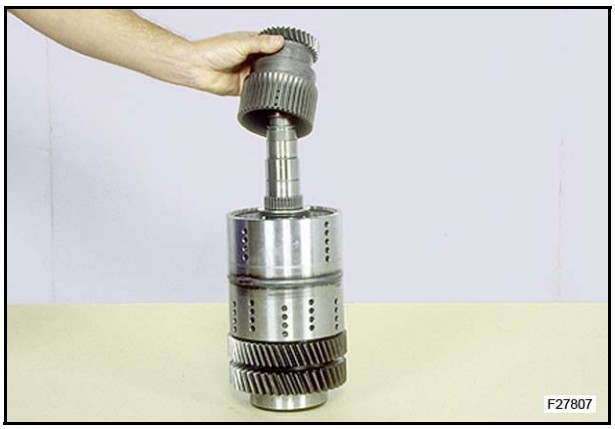
Remove the thrust washer and the thrust bearing.



Remove the clutch gear outer needle bearing.



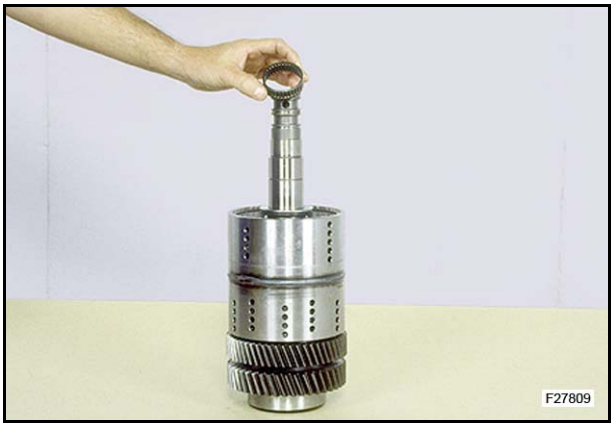
Remove the clutch gear.



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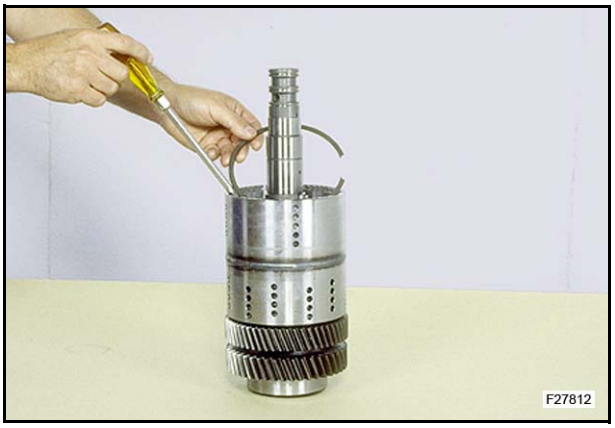
Remove the clutch gear inner needle bearing.



Remove the thrust washer and the thrust bearing.



Remove the backing plate retainer ring.



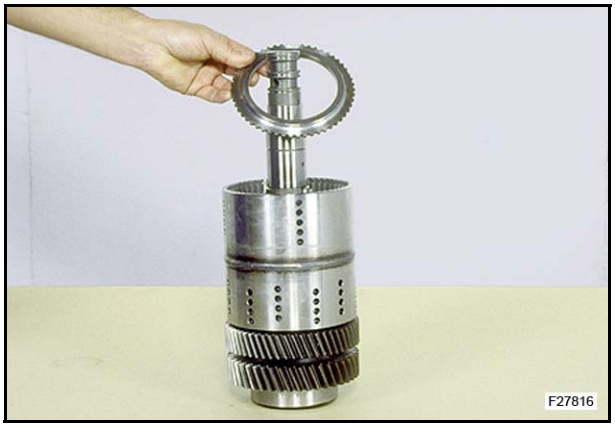
Remove the clutch plate spacer.



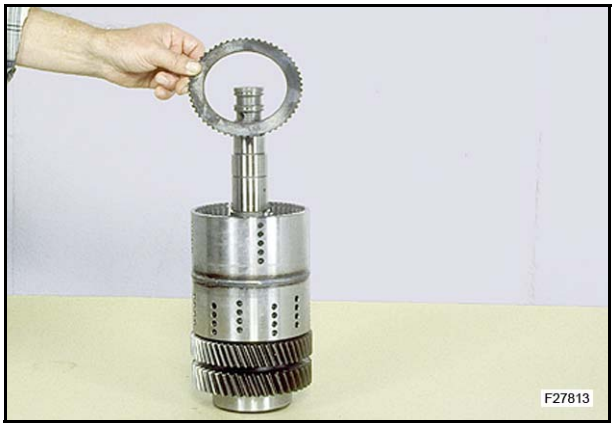
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Remove the clutch disc backing plate.



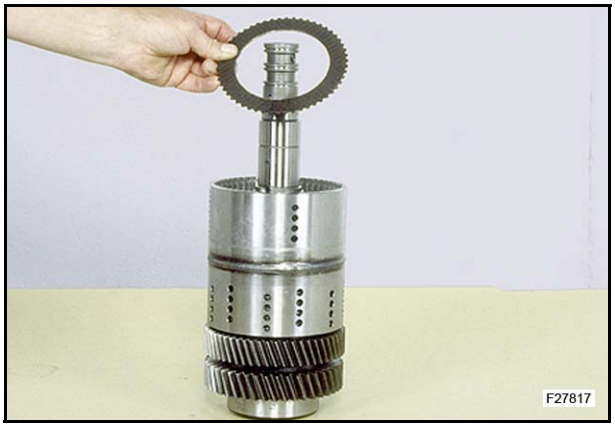
Remove the one outer half disc.



Remove the inner and the outer discs.



Remove the one outer half disc.



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Compress the spring to remove the spring retainer snap ring.



Remove the spring retainer snap ring.



Remove the clutch spring spacer.



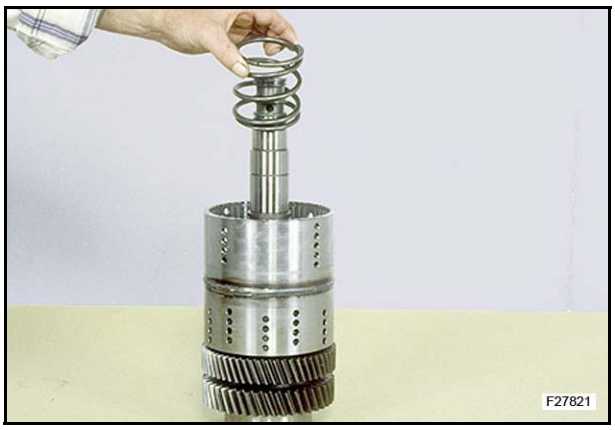
Remove the clutch piston spring retainer.



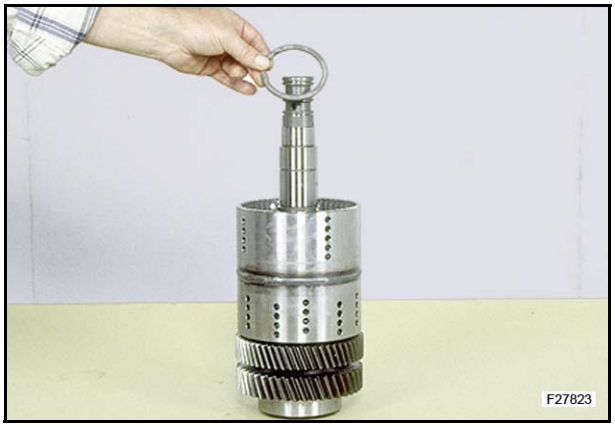
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Remove the clutch piston spring.



Remove the clutch piston wear plate.



Remove the clutch piston assy.



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FORWARD LOW CLUTCH DISASSEMBLY

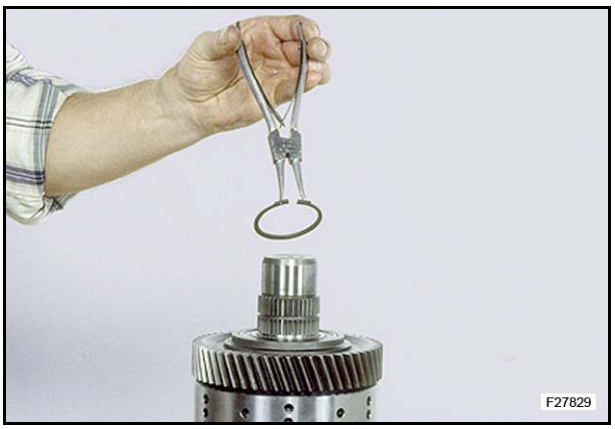
Use bearing puller to remove the front bearing and gear.



Front bearing and gear removed.



Remove the gear retaining ring.



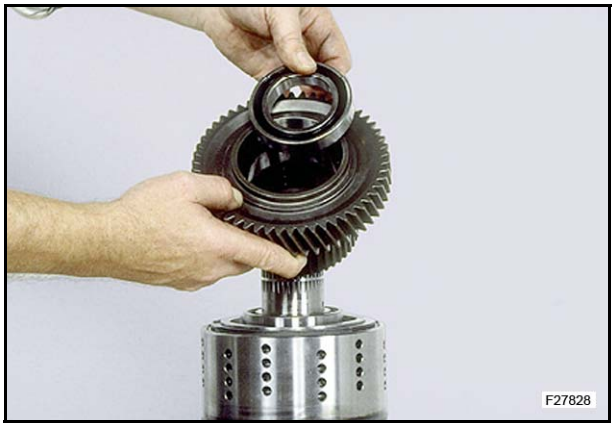
Use a bearing puller to remove the clutch gear and the clutch gear outer bearing.



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Clutch the gear and the outer bearing removed.



Remove the spacer snap ring.



Remove the spacer.



Remove the backing plate retainer ring.



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Remove the clutch disc backing plate.



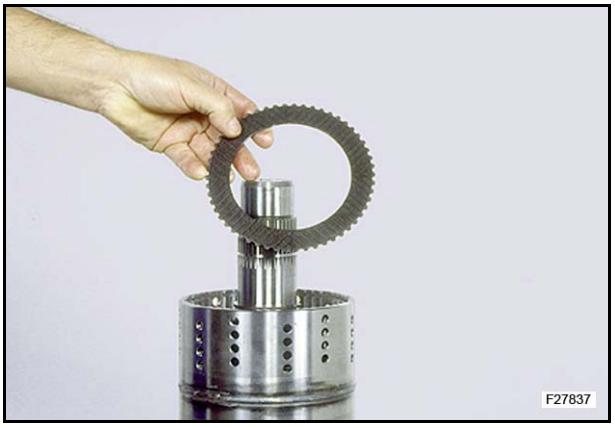
Use bearing puller to remove the clutch gear inner bearing.



Clutch gear inner bearing removed.



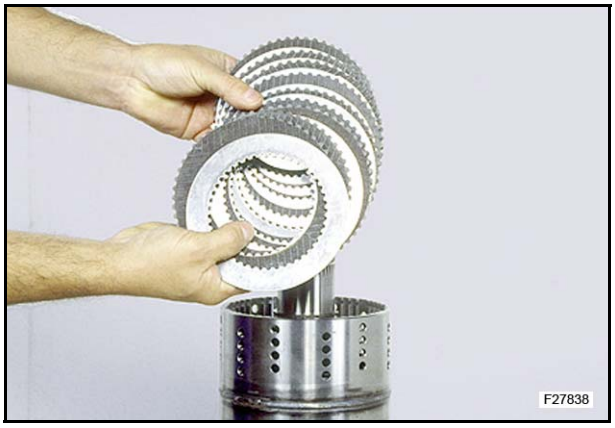
Remove the one outer half disc.



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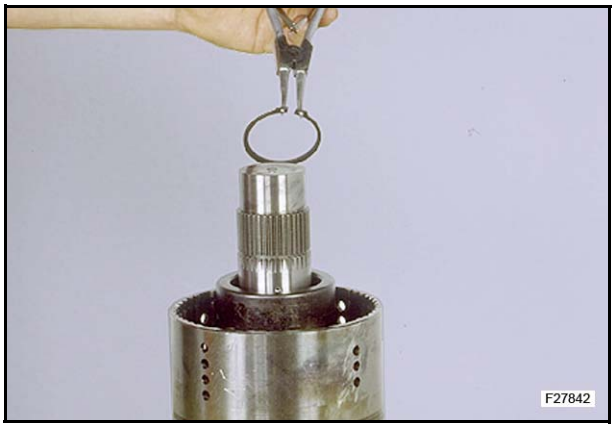
Remove the inner and the outer discs.



Remove the one outer half disc.



Remove the clutch gear inner bearing locating ring.



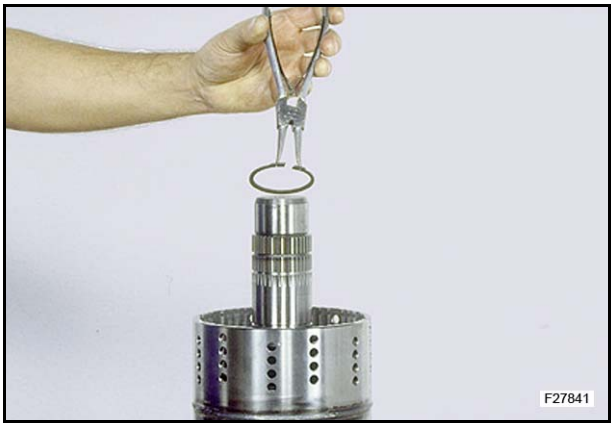
Compress the spring to remove the spring retainer snap ring.



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Remove the spring retainer snap ring.



Remove the clutch piston spring retainer.



Remove the clutch piston spring.



Remove the clutch piston wear plate.



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Remove the clutch piston assy.



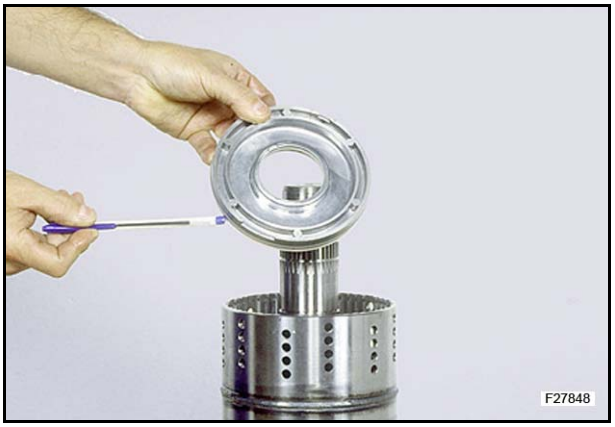
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FORWARD LOW CLUTCH ASSEMBLY

Install the clutch piston outer seal.

NOTE: ring must be sized before installing in clutch drum. Sizing is best accomplished by rotating piston while holding a round object against the new sealing ring. Rotate piston until sealing ring is flush with outer diameter of the piston.



Install the clutch piston inner seal.
Install the clutch piston in clutch drum, use caution as not to damage the sealing rings.



Install the clutch piston wear plate on the piston.



Install the clutch piston spring retainer.



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Install the clutch piston spring retainer.



Install the clutch spring retainer snap ring.



Use a sleeve with the proper diameter to fit over shaft and against retainer ring. A sharp blow with a soft hammer will compress the spring and seat retainer ring.
Be sure ring is in full position in the groove.



Install one outer half disc, with friction material away from the piston.



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Install one steel disc.
Alternate friction and steel discs until the proper amount of discs are installed.
First and last discs are steel.



Install one outer half disc with friction material down.



Install the backing plate.



Install the backing plate snap ring.



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Install the spacer.



Install the spacer snap ring.



Install the inner bearing snap ring.



Install the clutch gear inner bearing.



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Tap the inner bearing into the place.



Install the clutch gear bearing locating rings.



Install the clutch gear sealing ring. Install the clutch gear in the clutch drum. Align splines on clutch gear with internal teeth of steel discs. Do not force this operation. Gear splines must be in full position with internal teeth of all inner discs.



Install clutch gear outer bearing.
Be sure that bearing shield is on the outside.



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Tap the outer bearing into the place.



Install the outer bearing snap ring.



Warm the gear to 150 °C, install the gear.



Warm the front bearing to 120 °C, install the bearing.



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FORWARD HIGH CLUTCH ASSEMBLY

Install the clutch outer seal.

NOTE: ring must be sized before installing in clutch drum. Sizing is best accomplished by rotating piston while holding a round object against the new sealing ring. Rotate piston until sealing ring is flush with outer diameter of the piston.



Install the piston inner seal and install the clutch piston in clutch drum. Use caution as not to damage the sealing rings.



Install the clutch piston wear plate on the piston.



Install the clutch piston return spring.



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Install the piston return spring retainer.



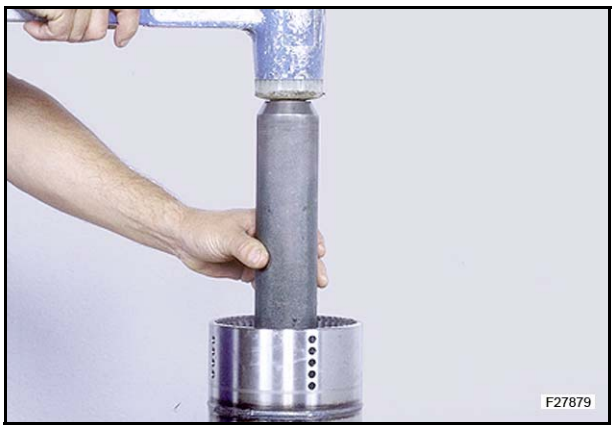
Install the spring retainer spacer.



Install the clutch spring retainer snap ring.



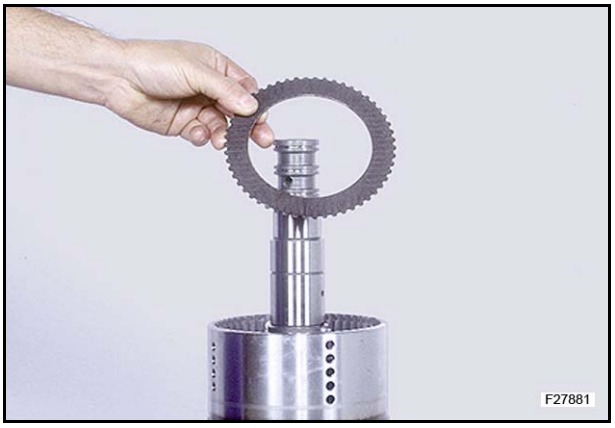
Use a sleeve with the proper diameter to fit over shaft and against retainer ring. A sharp blow with a soft hammer will compress the spring and seat retainer ring.
Be sure ring is in full position in the groove.



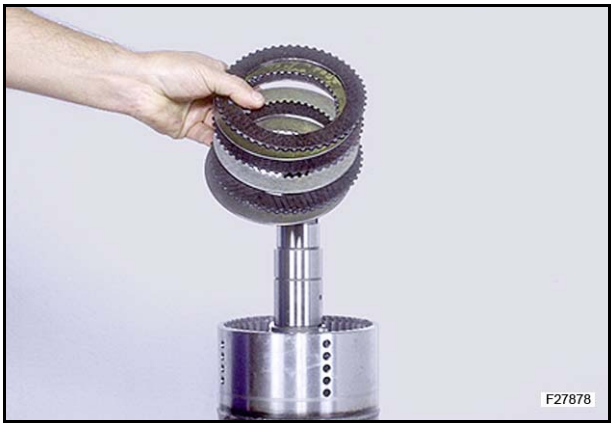
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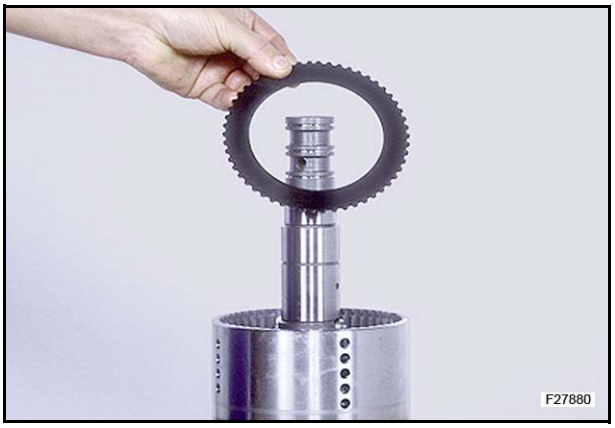
Install one outer half disc, with friction material away from the piston.



Install one steel disc.
Alternate friction and steel discs until the proper amount of discs are installed, first and last discs are steel.



Install one outer half disc with friction material down.



Install the backing plate.



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Install the backing plate spacer.



Install the backing plate spacer retainer ring.



Install the thrust washer and the thrust bearing.



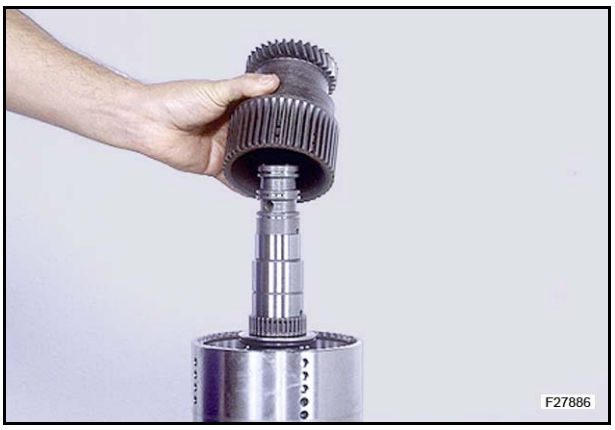
Install the clutch gear inner needle bearing.



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Install the clutch gear in the clutch drum. Align splines on clutch gear with internal teeth of steel discs.
Do not force this operation. Gear splines must be in full position with internal teeth of all inner discs.



Install the clutch gear outer needle bearing.



Install the thrust washer and the thrust bearing.



Install the clutch shaft sealing rings.



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FIRST CLUTCH DISASSEMBLY

Remove the clutch shaft sealing rings.



Remove the clutch gear bearing retaining ring.



Use a bearing puller to remove the clutch gear and the clutch gear outer bearing.



Clutch the gear and the outer bearing removed.



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Remove the backing plate retainer ring.



Remove the backing plate.



Remove the modulation spring.



Use bearing puller to remove the clutch gear inner bearing.



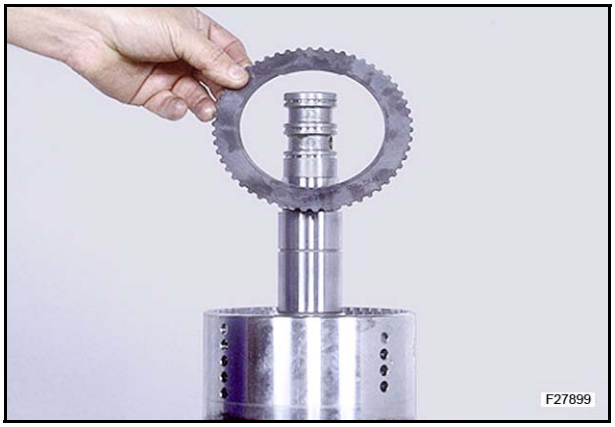
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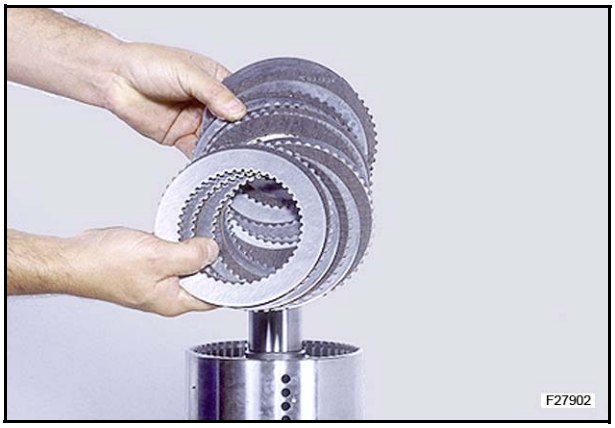
Clutch gear inner bearing removed.



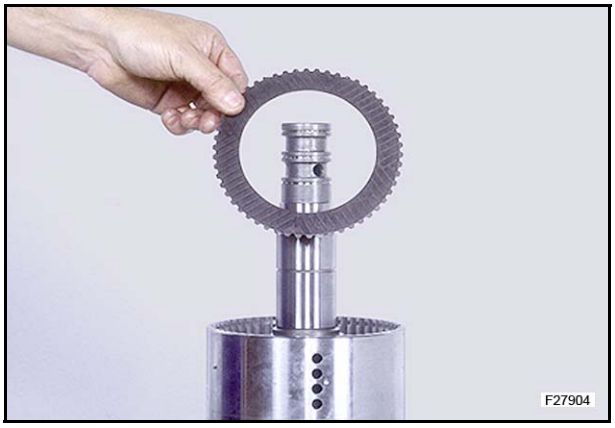
Remove the one outer half disc.



Remove the inner and the outer discs.



Remove the one outer half disc.



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Compress the clutch piston belleville washer spring. Remove spring snap ring.

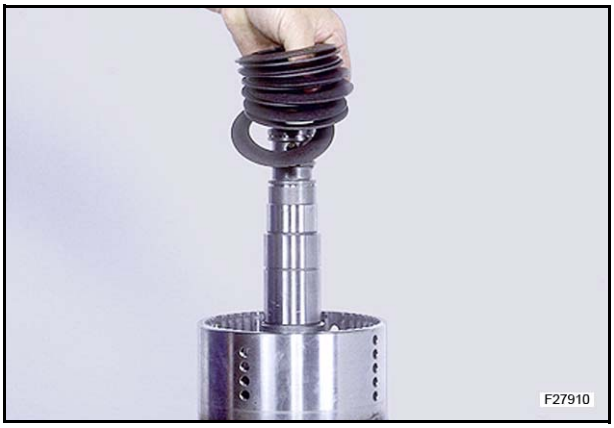
NOTE: force of disc spring is 3280N.



Spring retainer ring removed.



Remove the disc belleville washer spring.



Remove the clutch piston wear sleeve.



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Remove the clutch piston assy.



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REVERSE CLUTCH DISASSEMBLY

Use a bearing puller to remove the gear and the front bearing.



Gear and front bearing removed.



Remove the clutch gear bearing retaining ring.



Use a bearing puller to remove the clutch gear and the clutch gear outer bearing.



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Clutch the gear and the outer bearing removed.



Remove the spacer snap ring.



Remove the spacer.



Remove the backing plate retainer ring.



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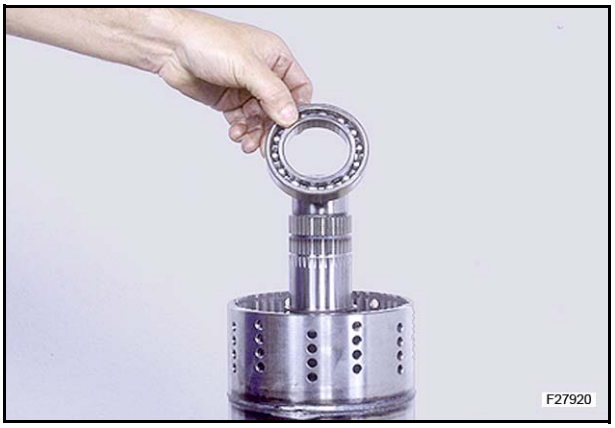
Remove the clutch disc backing plate.



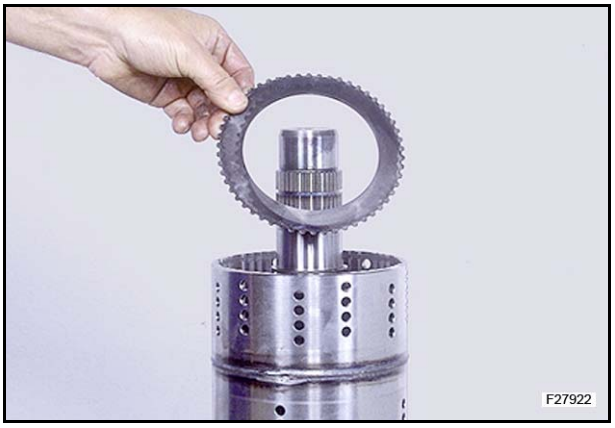
Use bearing puller to remove the clutch gear inner bearing.



Clutch gear inner bearing removed.



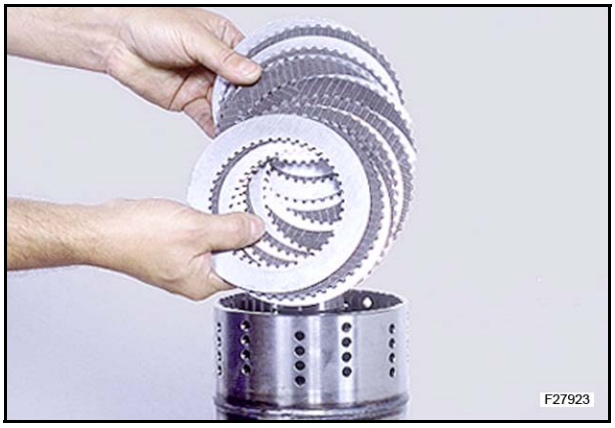
Remove the one outer half disc.



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Remove the inner and the outer discs.



Remove the one outer half disc.



Remove the inner bearing locating ring.



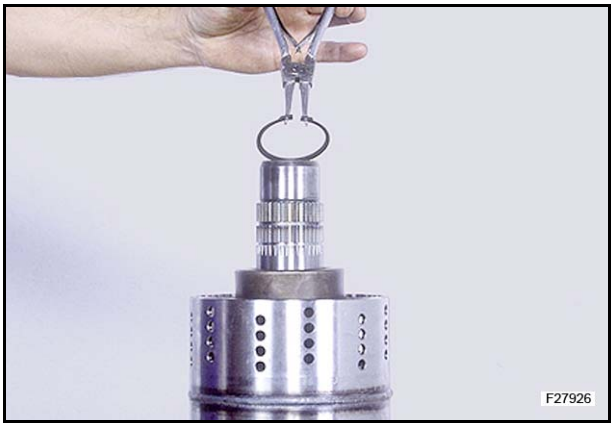
Compress the spring to remove the spring retainer snap ring.



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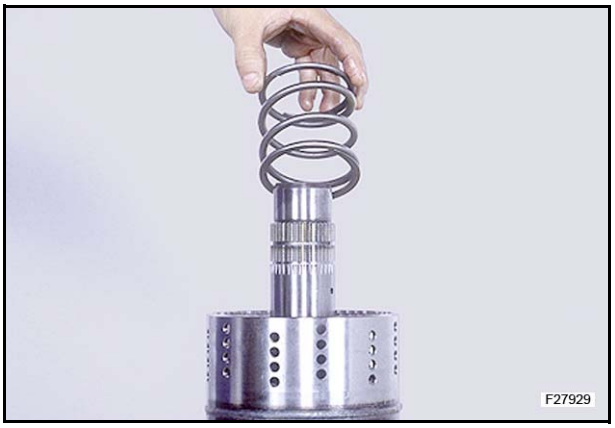
Remove the spring retainer snap ring.



Remove the clutch piston spring retainer.



Remove the clutch piston spring.



Remove the clutch piston wear plate.



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Remove the clutch piston assy.



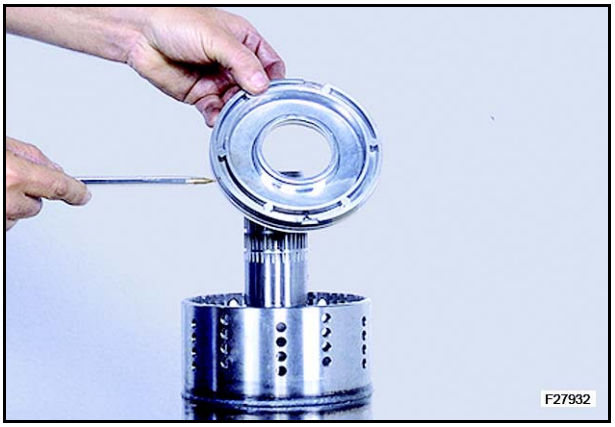
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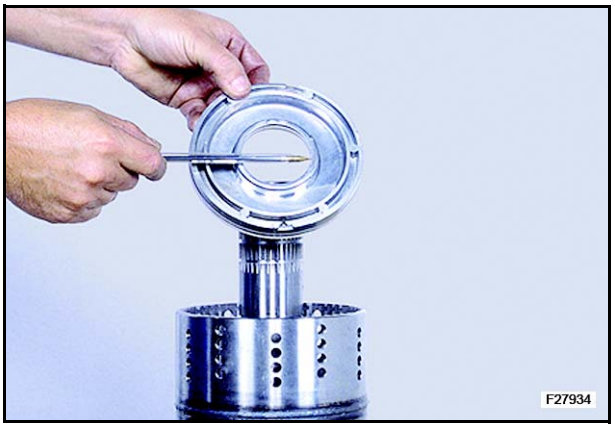
REVERSE CLUTCH ASSEMBLY

Install the clutch piston outer seal.

NOTE: ring must be sized before installing in clutch drum. Sizing is best accomplished by rotating piston while holding a round object against the new sealing ring. Rotate piston until sealing ring is flush with outer diameter of the piston.



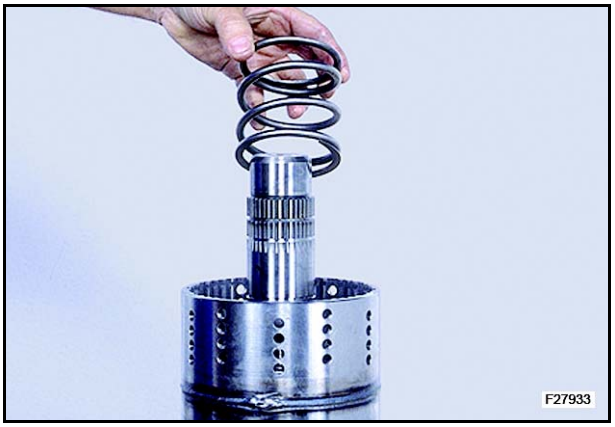
Install the clutch piston inner seal. Install the clutch piston in clutch drum, use caution as not to damage the sealing rings.



Install the piston wear plate.



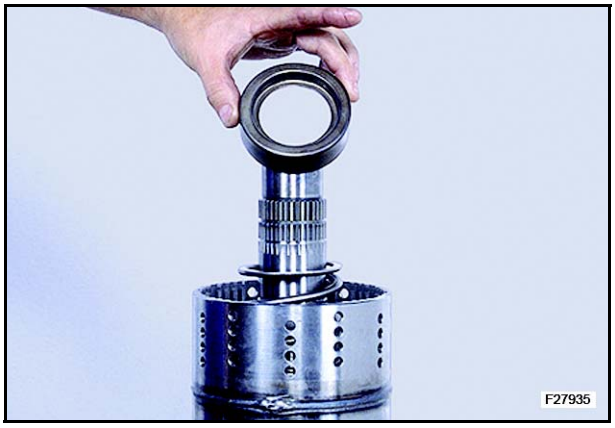
Install the clutch piston spring retainer.



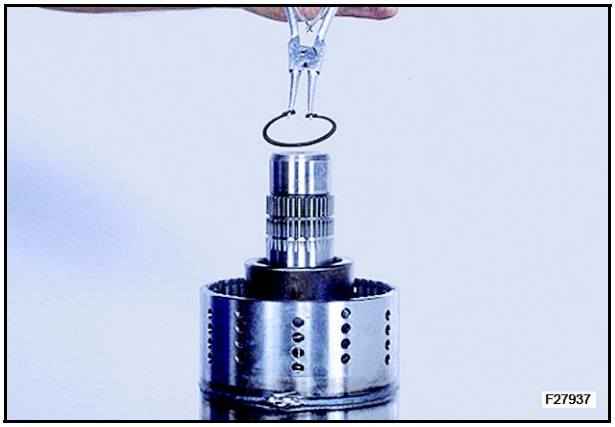
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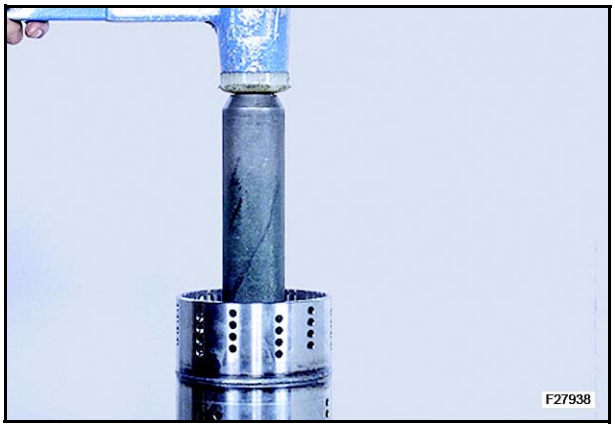
Install the clutch piston spring retainer.



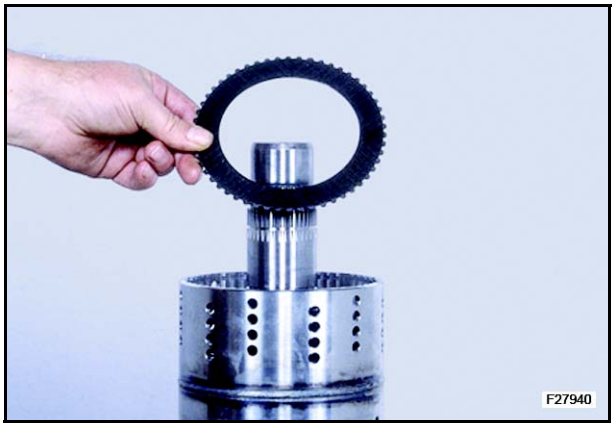
Install the clutch spring retainer snap ring.



Use a sleeve with the proper diameter to fit over shaft and against retainer ring. A sharp blow with a soft hammer will compress the spring and seat retainer ring.
Be sure ring is in full position in the groove.



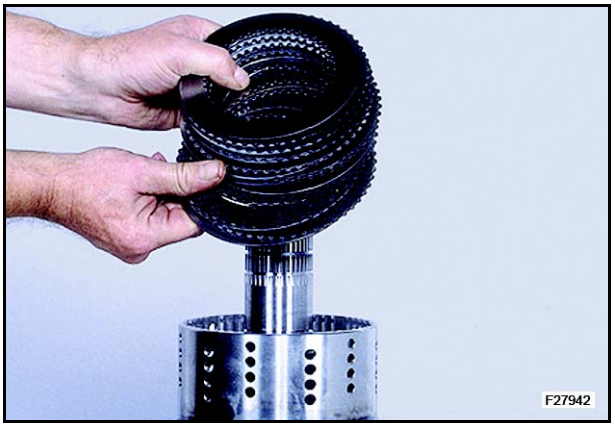
Install one outer half disc, with friction material away from the piston.



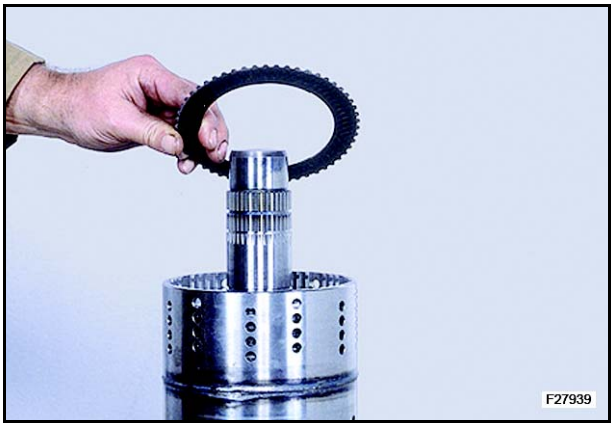
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Install one steel disc.
Alternate friction and steel discs until the proper amount of discs are installed.
First and last discs are steel.



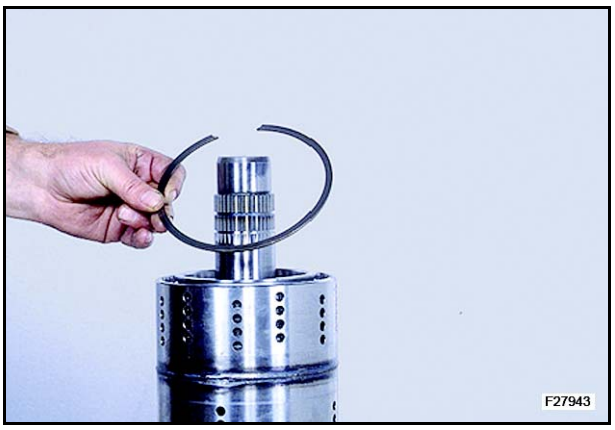
Install one outer half disc with friction material down.



Install the backing plate.



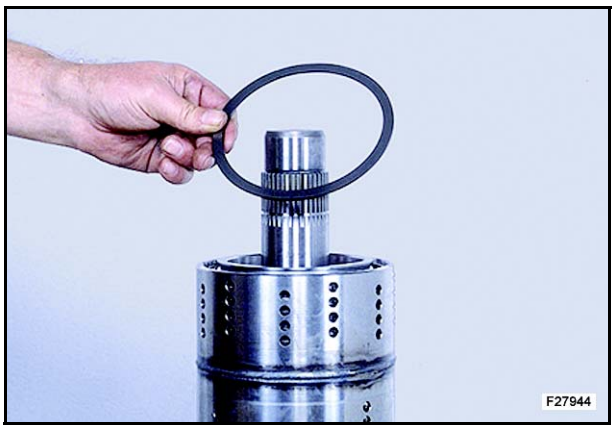
Install the backing plate snap ring.



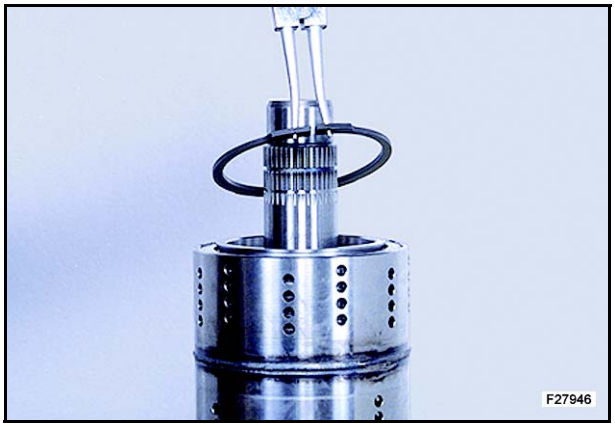
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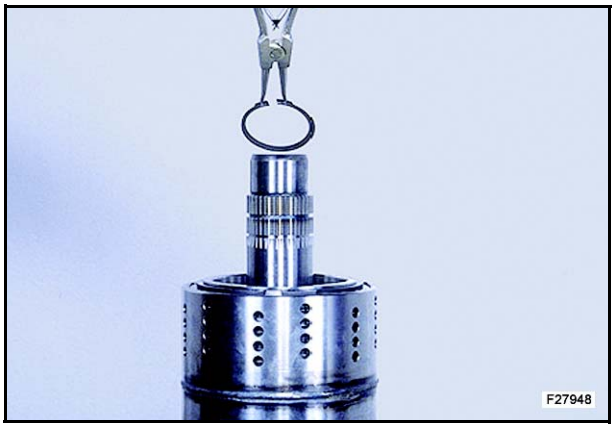
Install the spacer.



Install the spacer snap ring.



Install the inner bearing snap ring.



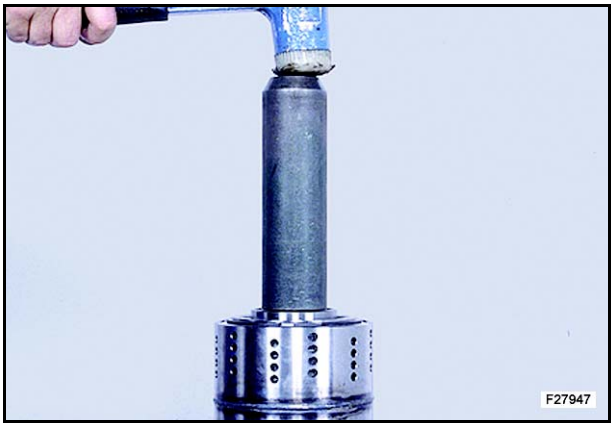
Install the clutch gear inner bearing.



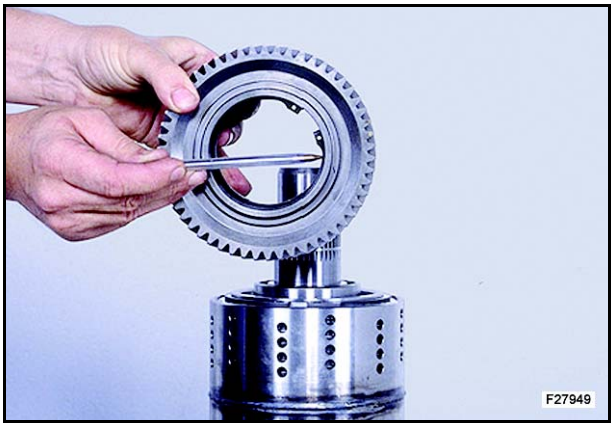
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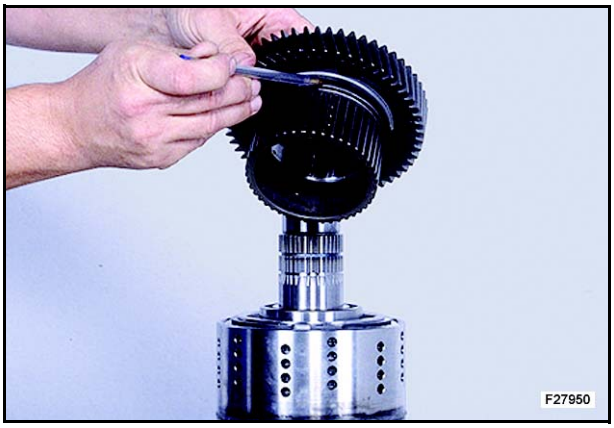
Tap the inner bearing into the place.



Install the clutch gear bearing locating rings.



Install the clutch gear sealing ring. Install the clutch gear in the clutch drum. Align splines on clutch gear with internal teeth of steel discs. Do not force this operation. Gear splines must be in full position with internal teeth of all inner discs.



Install clutch gear outer bearing.

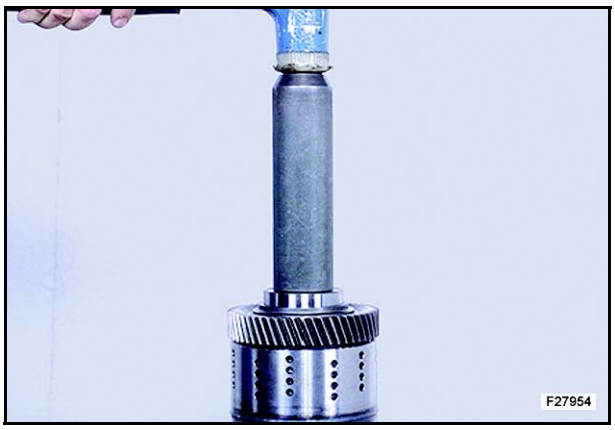
⚠ WARNING
Be sure that bearing shield is on the outside.



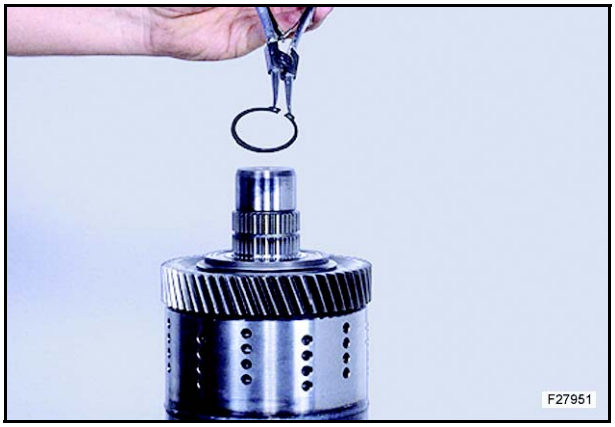
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Tap the outer bearing into the place.



Install the outer bearing snap ring.



Warm the gear to 150 °C, install the gear.



Warm the front bearing to 120 °C, install the bearing.



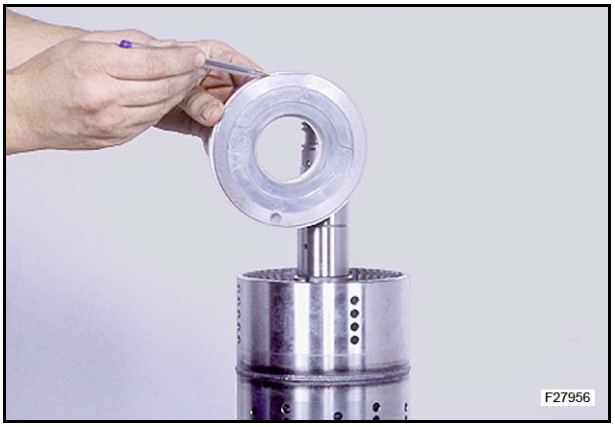
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FIRST CLUTCH ASSEMBLY

Install the clutch piston outer seal.

NOTE: ring must be sized before installing in clutch drum. Sizing is best accomplished by rotating piston while holding a round object against the new sealing ring. Rotate piston until sealing ring is flush with outer diameter of the piston.



Install the piston inner seal. Install the clutch piston in the clutch drum. Use caution as not to damage the sealing rings.



Install the clutch piston wear sleeve.



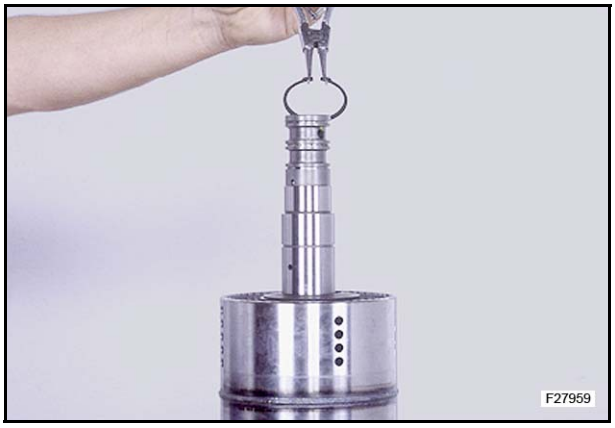
Install the piston return disc springs. First spring with large diameter of bevel toward wear sleeve. Alternate eleven (11) springs.



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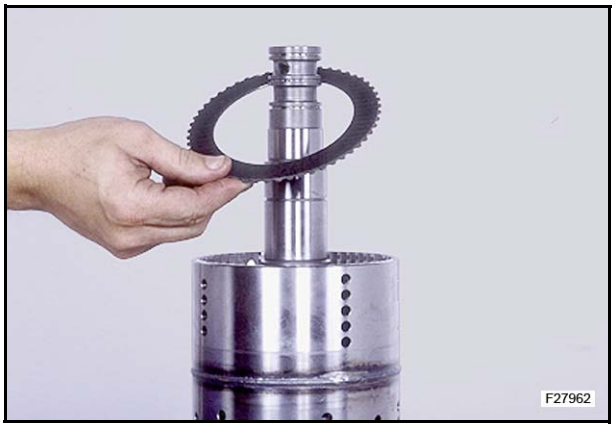
Install the disc belleville washer spring retainer ring.



Compress the spring to install the spring retainer ring.
Be sure ring is in full position in the groove.



Install one outer half disc, with friction material away from the piston.



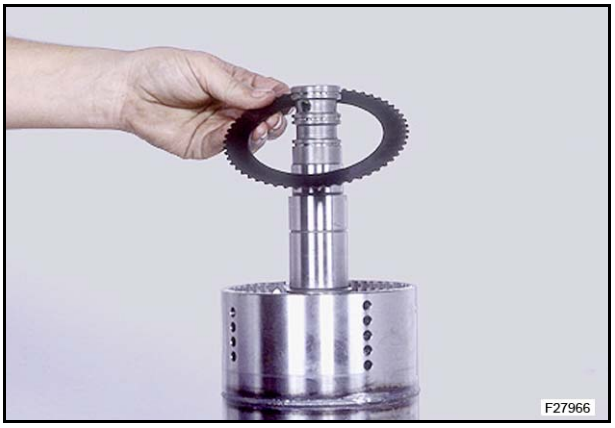
Install one steel disc.
Alternate friction and steel discs until the proper amount of discs are installed.
First and last discs are steel.



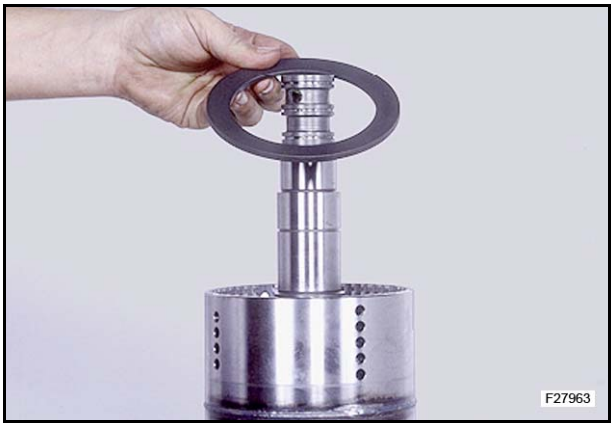
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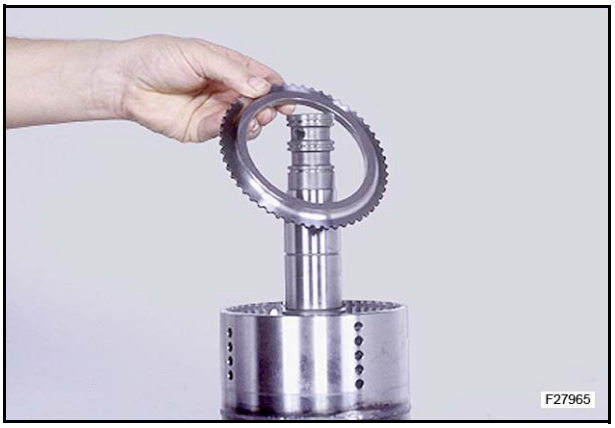
Install one outer half disc with friction material down.



Install the modulator spring with large diameter up to the backing plate.



Install the backing plate.



Install the backing plate snap ring.



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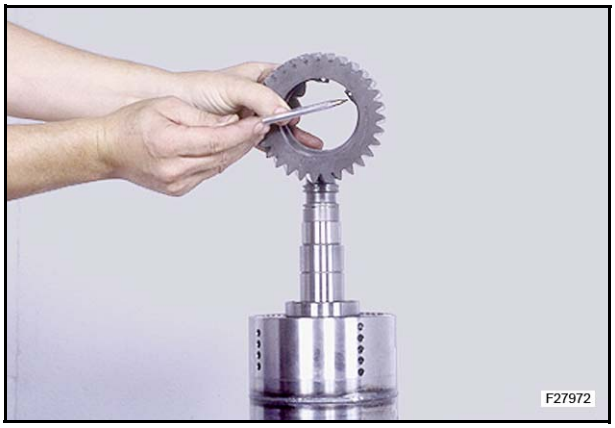
Install the clutch disc hub inner bearing.



Tap the inner bearing into the place.



Install the clutch hub bearing locating rings. Install the clutch gear in the clutch drum. Align splines on clutch gear with internal teeth of steel discs. Do not force this operation. Gear splines must be in full position with internal teeth of all steel discs.



Install the clutch hub outer bearing.
Be sure that bearing shield is on the outside.



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Tap the outer bearing into the clutch hub.



Install the outer bearing retaining ring.



Install the clutch shaft sealing rings.

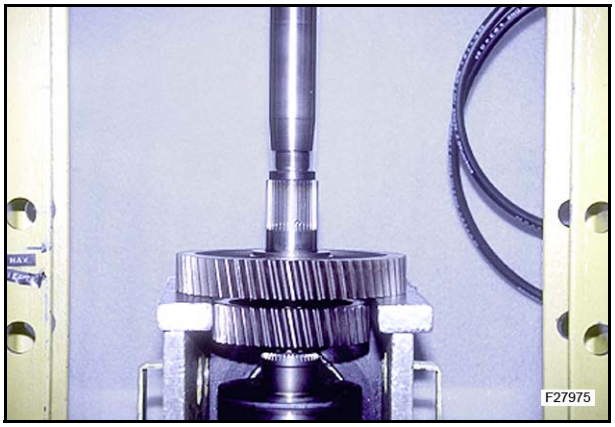


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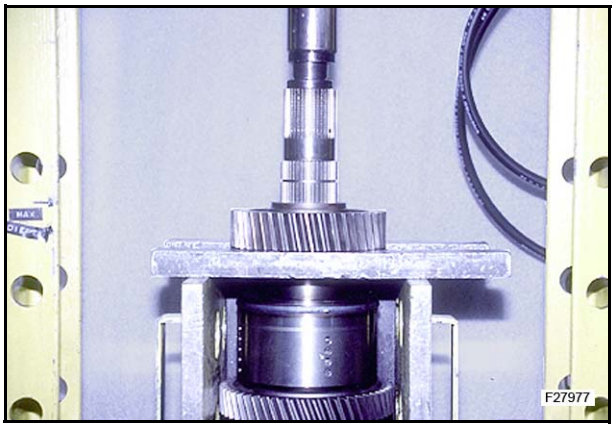
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SECOND CLUTCH DRUM DISASSEMBLY

Press the upper output gear from the second shaft.



Press the gear from second shaft.



Remove the gear retaining ring.



Remove the clutch shaft sealing rings.



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Use bearing puller to remove the clutch hub and the front bearing.



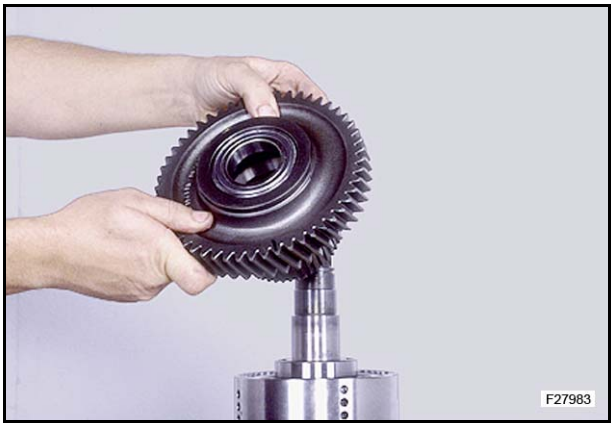
Remove the clutch shaft front bearing.



Remove the bearing washer.



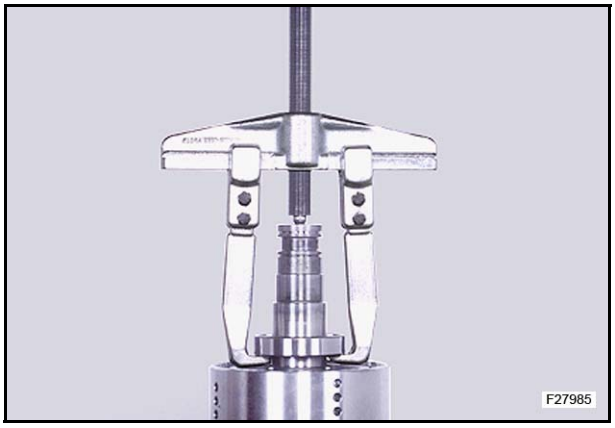
Remove the clutch hub and the outer bearing.



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Use a bearing puller to remove the clutch hub inner bearing.



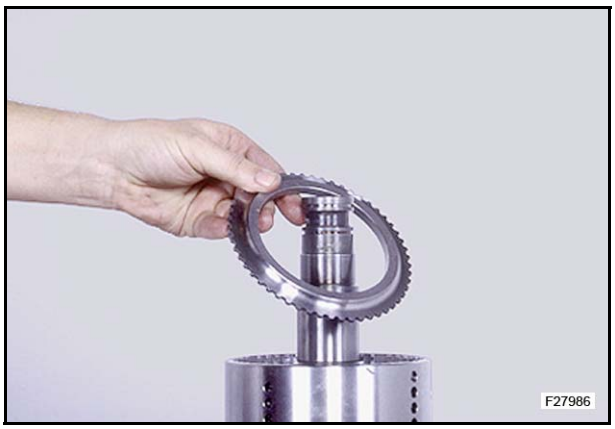
Remove the clutch hub inner bearing.



Remove the backing plate snap ring.



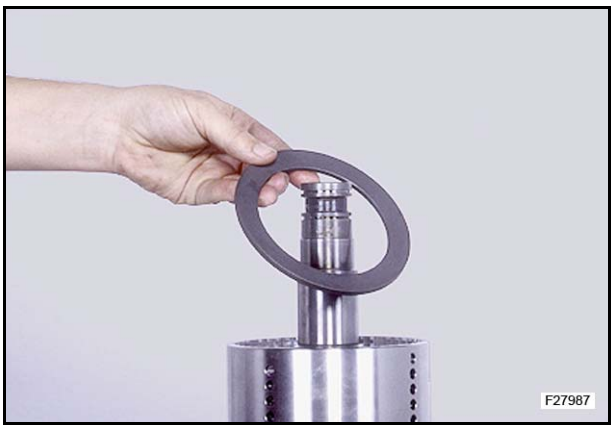
Remove the backing plate.



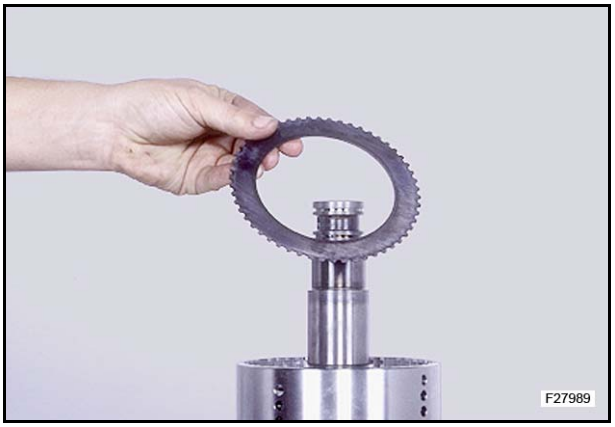
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Remove the modulation spring.



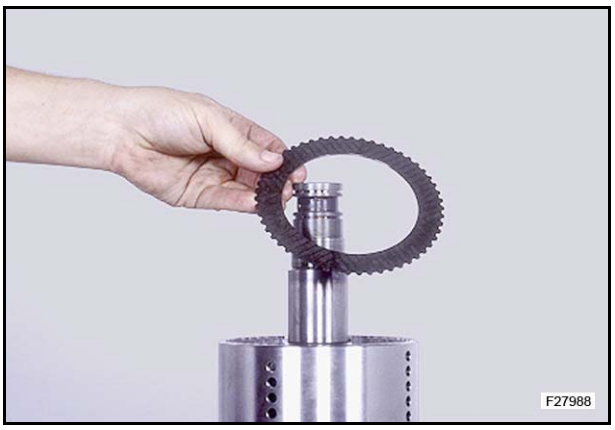
Remove the one outer half disc.



Remove the inner and the outer discs.



Remove the one outer half disc.



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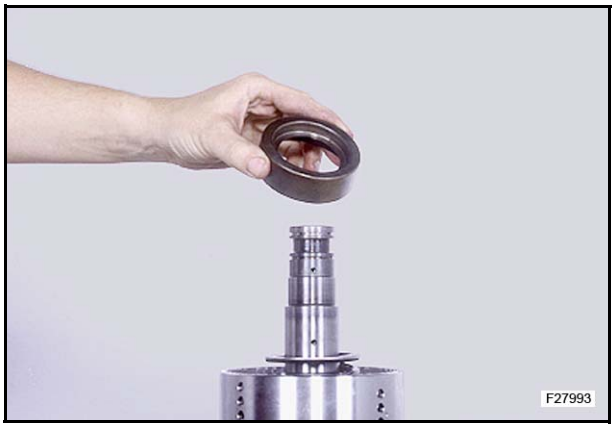
Compress the spring to remove the spring retaining ring.



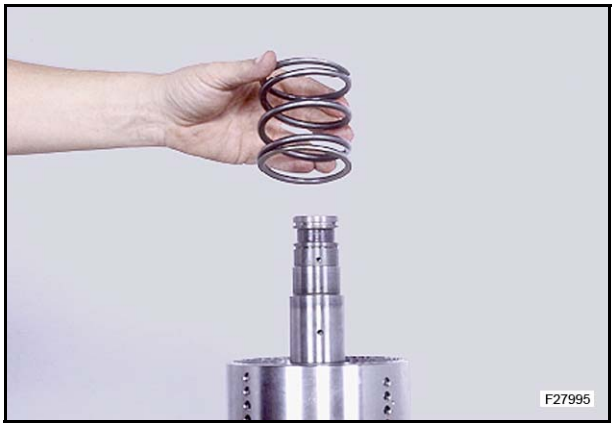
Remove the spring retaining ring.



Remove the spring retainer.



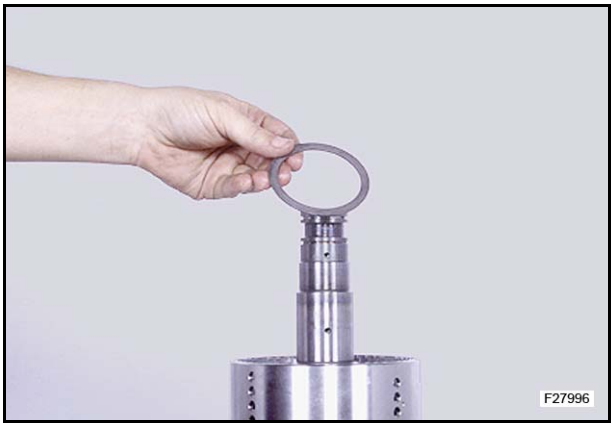
Remove the clutch piston return spring.



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Remove the piston wear plate.



Remove the clutch piston assy.



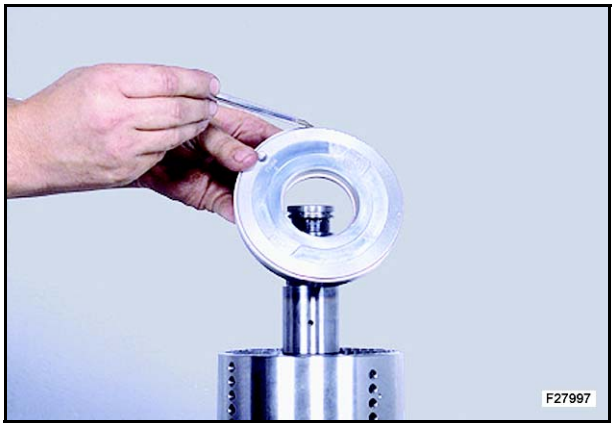
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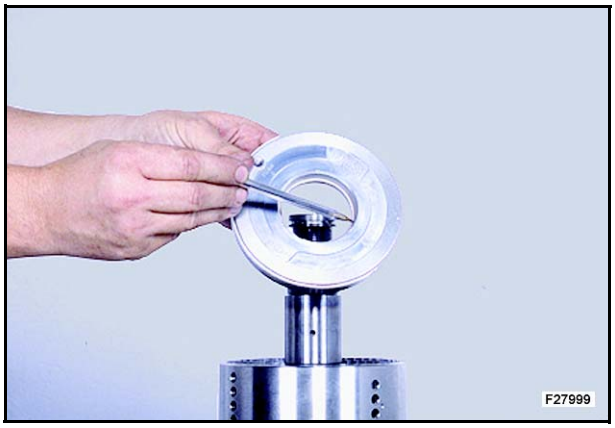
SECOND CLUTCH DRUM ASSEMBLY

Install the piston outer seal.

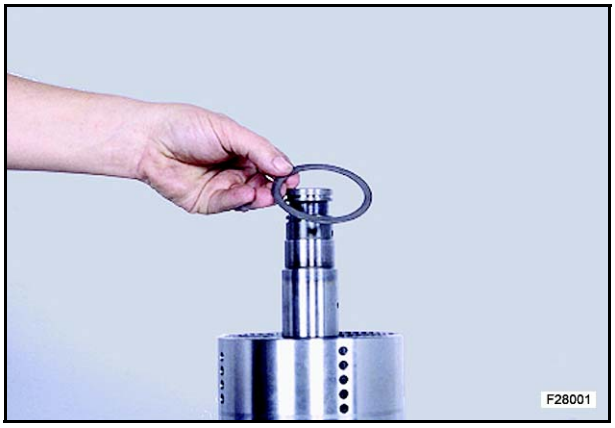
NOTE: ring must be sized before installing in clutch drum. Sizing is best accomplished by rotating piston while holding a round object against the new sealing ring. Rotate piston until sealing ring is flush with outer diameter of the piston.



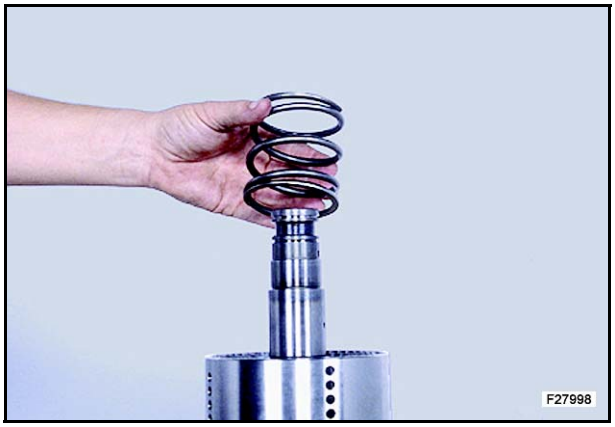
Install the clutch piston inner seal.
Install the clutch piston in the clutch drum.
Use caution as not to damage the sealing rings.



Install the piston wear plate.



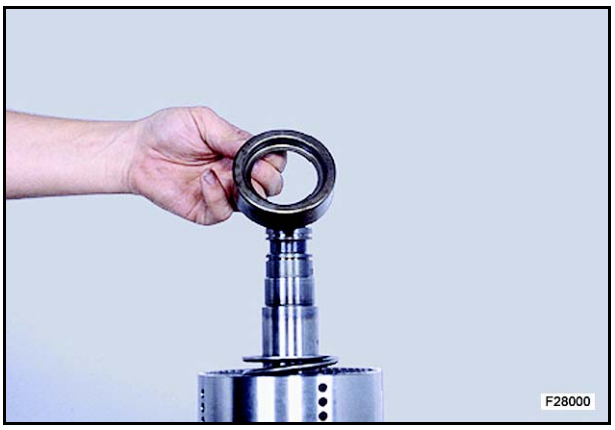
Install the piston return spring.



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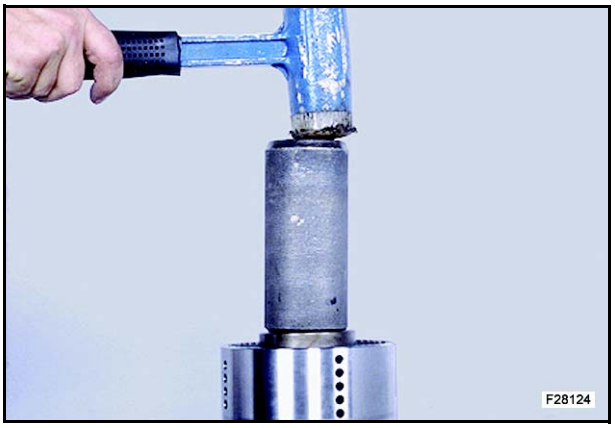
Install the spring retainer.



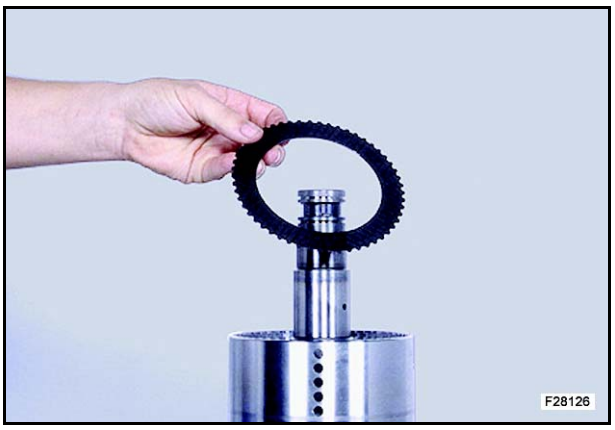
Install the spring retainer snap ring.



Use a sleeve with the proper inner diameter to fit over shaft and against retainer ring. A sharp blow with a soft hammer will compress the spring and seat retainer ring. Be sure ring is in full position in the groove.



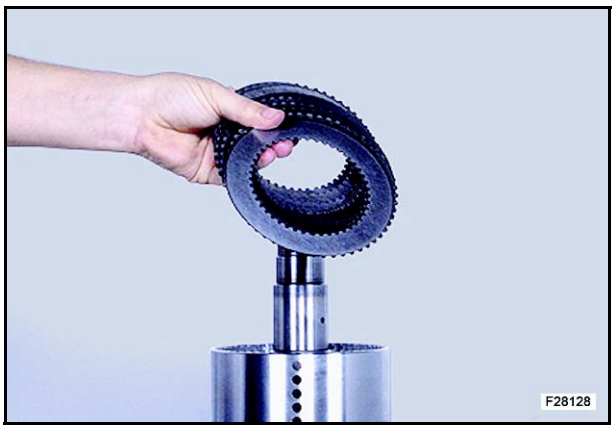
Install one outer half disc, with friction material away from the piston.



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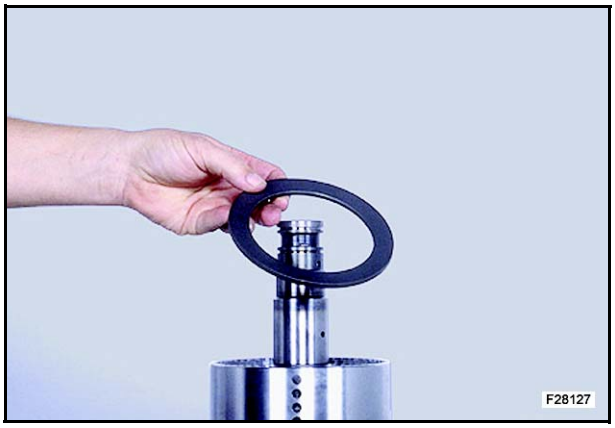
Install one steel disc.
Alternate friction and steel discs until the proper amount of discs are installed.
First and last discs are steel.



Install one outer half disc with friction material down.



Install the modulator spring with large diameter up to the backing plate.



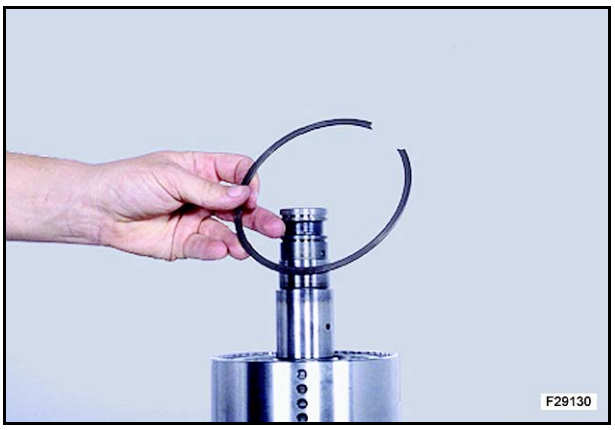
Install the backing plate.



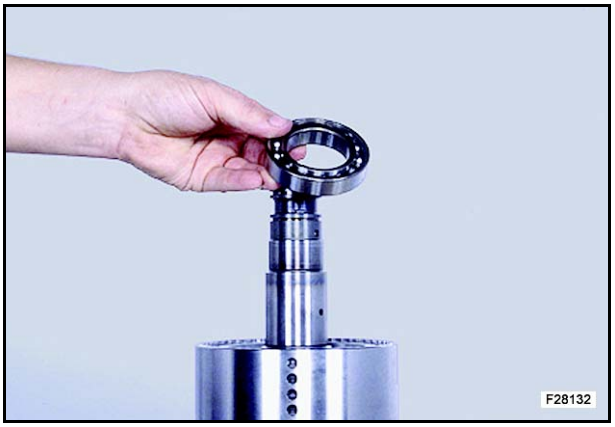
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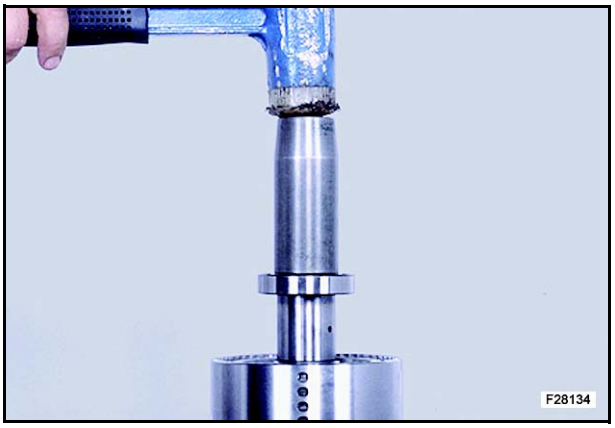
Install the backing plate retainer ring.



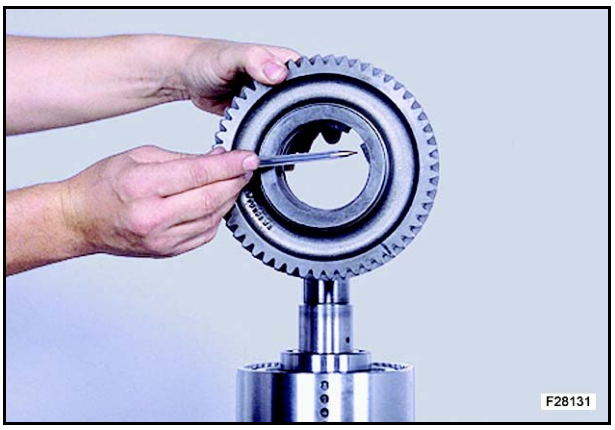
Install the clutch hub inner bearing.



Tap the clutch gear inner bearing into the place.



Install the clutch hub bearing locating rings. Install the clutch gear in the clutch drum. Align splines on clutch gear with internal teeth of steel discs. Do not force this operation.
Gear splines must be in full position with internal teeth of all steel discs.



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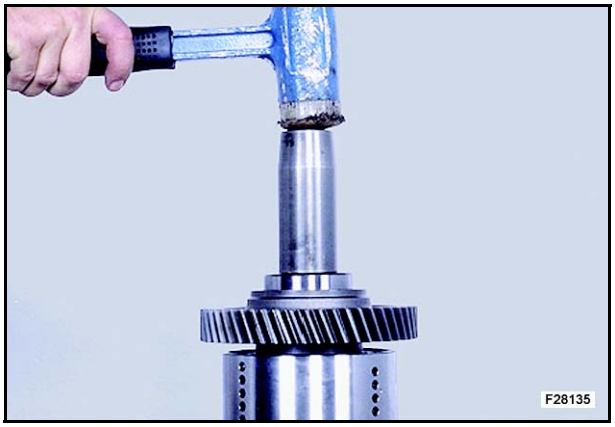
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Install the clutch hub outer bearing.

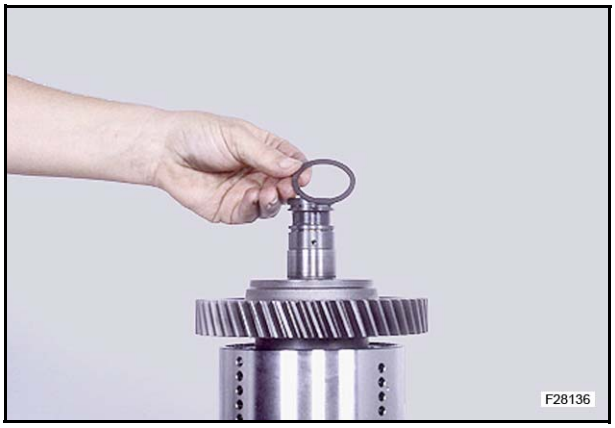
⚠ WARNING
Be sure that bearing shield is on the outside.



Tap the outer bearing into the place.



Install the bearing washer.



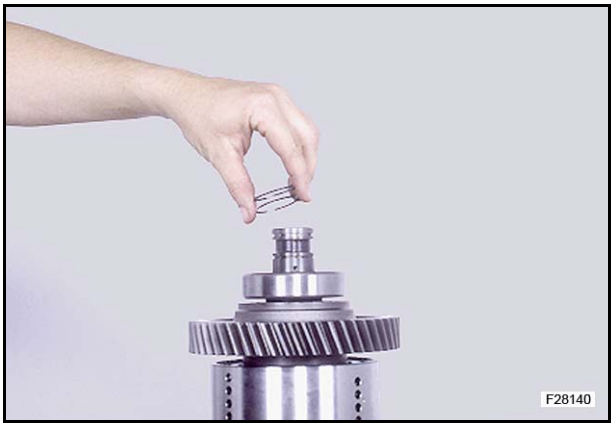
Warm the front bearing to 120 °C, install the bearing.



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Install the clutch shaft sealing rings.



Install the gear retaining ring.



Warm the gear to 150 °C, install the gear.



Warm upper output gear to 150 °C install gear.

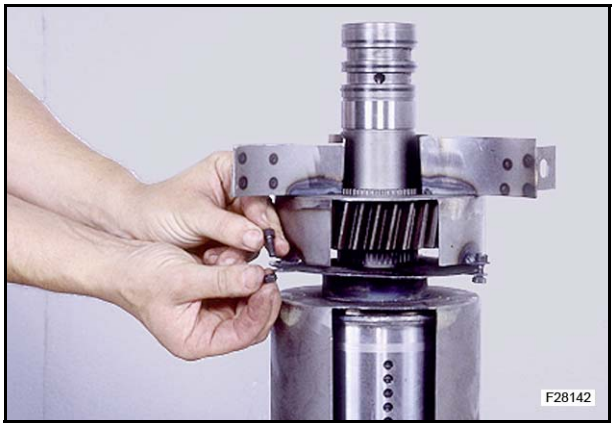


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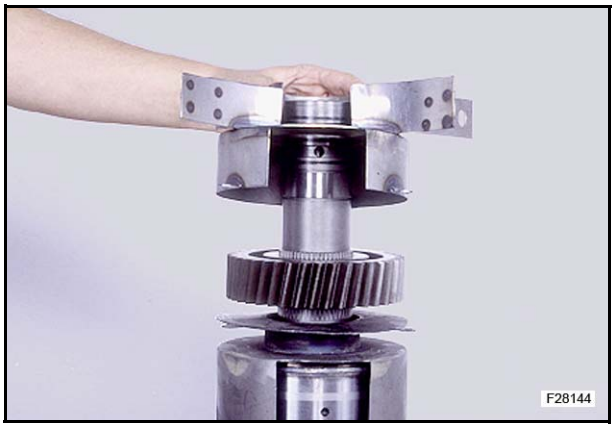
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OUTPUT SHAFT DISASSEMBLY

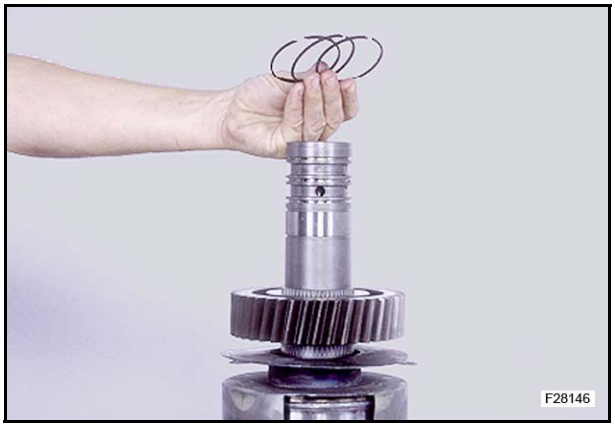
Remove the oil baffle screws and the nuts.



Remove the oil baffle.



Remove the output shaft sealing rings.



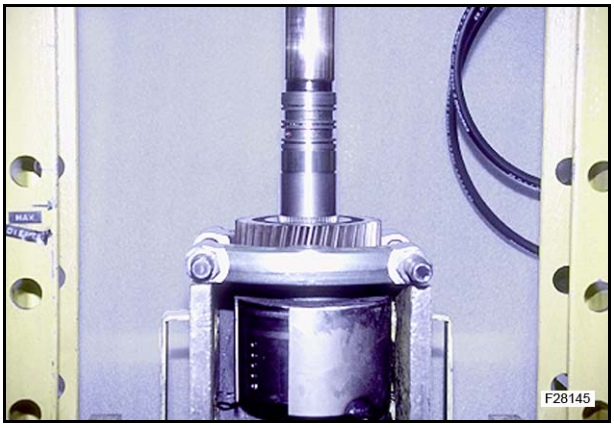
Remove the output shaft gear retaining ring.



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Press the output gear from the shaft.



Remove the output gear.



Remove the oil baffle from the output shaft.



Remove the gear retaining ring.



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Remove the backing plate snap ring.



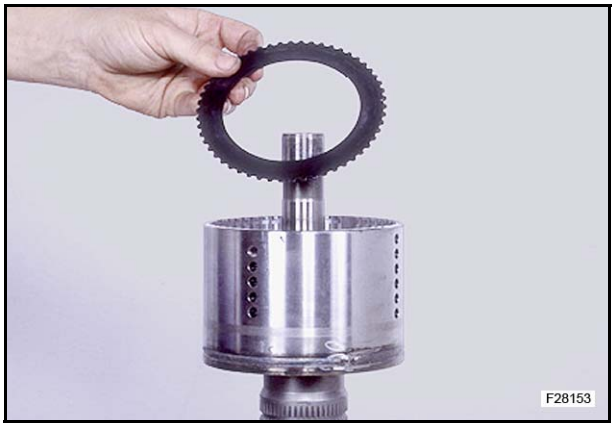
Remove the backing plate spacer.



Remove the backing plate.



Remove the one outer half disc.



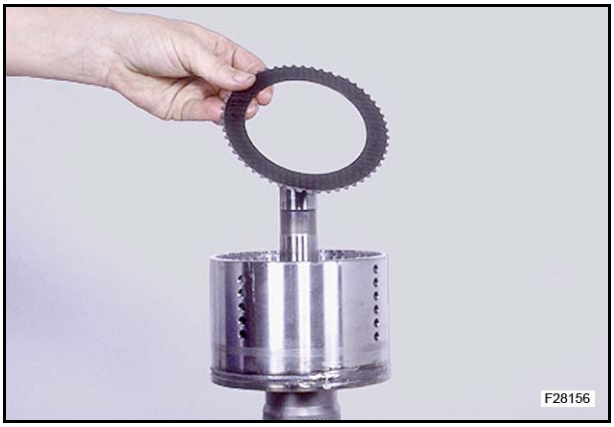
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Remove the inner and the outer discs.



Remove the one outer half disc.



Compress the spring to remove the spring retaining ring.



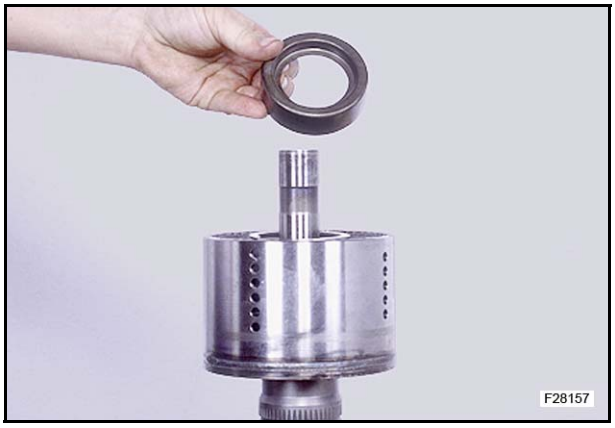
Remove the spring retaining ring.



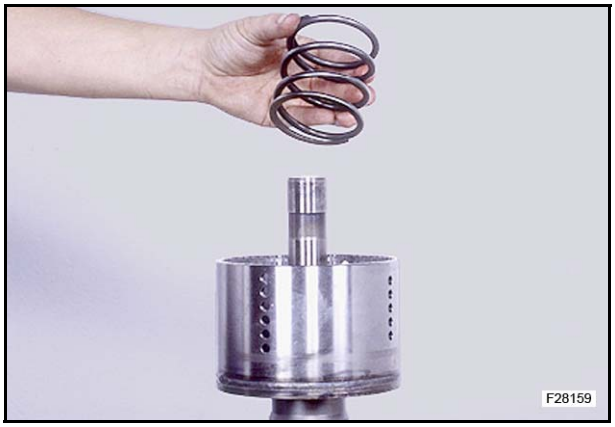
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Remove the spring retainer.



Remove the clutch piston spring.



Remove the piston wear plate.



Remove the piston assy.



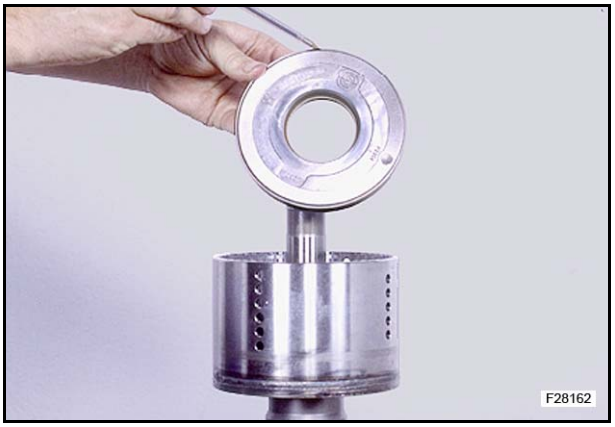
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OUTPUT SHAFT ASSEMBLY

Install the piston outer seal.

NOTE: ring must be sized before installing in clutch drum. Sizing is best accomplished by rotating piston while holding a round object against the new sealing ring. Rotate piston until sealing ring is flush with outer diameter of the piston.



Install the clutch piston inner seal.
Install the clutch piston in the clutch drum.
Use caution as not to damage the sealing rings.



Install the piston wear plate.



Install the clutch piston spring retainer.



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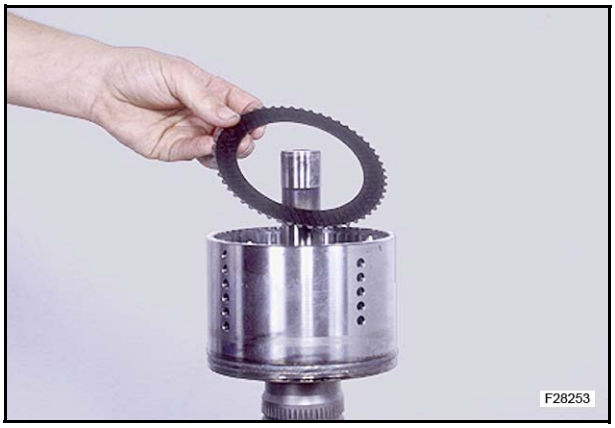
Install the spring retainer.



Install the spring retainer snap ring. Use a sleeve with the proper inner diameter to fit over shaft and against snap ring. A sharp blow of a soft hammer will compress the spring and the seat retainer ring. Be sure ring is in full position in the groove.



Install one outer half disc, with friction material away from the piston.



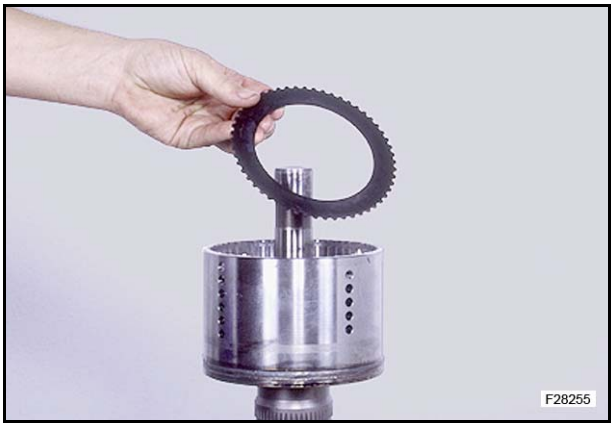
Install one steel disc.
Alternate friction and steel discs until the proper amount of discs are installed.
First and last discs are steel.



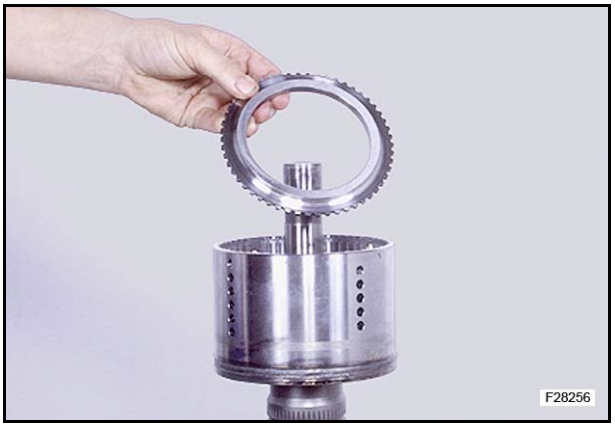
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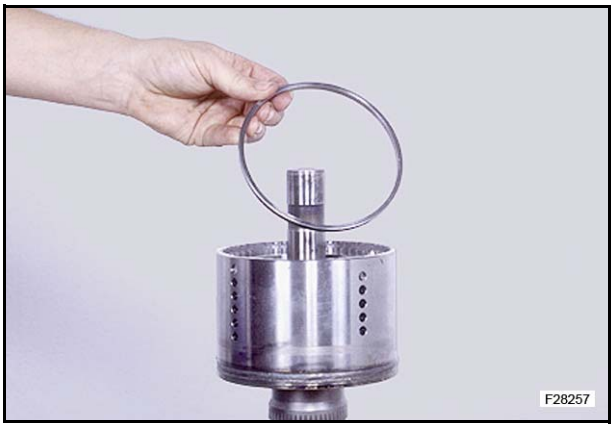
Install one half disc with friction material down.



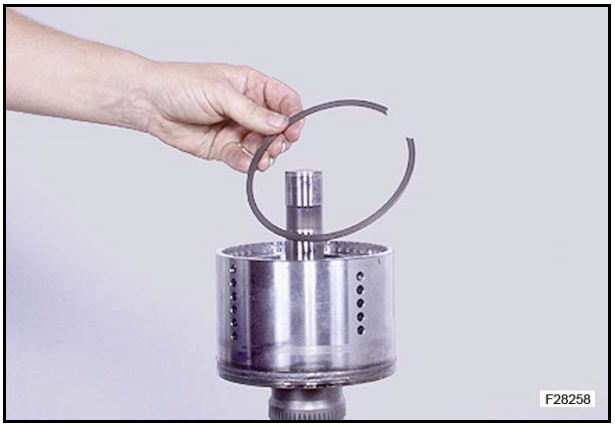
Install the backing plate.



Install the backing plate spacer.



Install the backing plate snap ring.



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Install the oil baffle on the output shaft.



Install the output gear retaining ring.



Warm the gear to 150 °C, install the gear.



Install the output gear retaining ring.



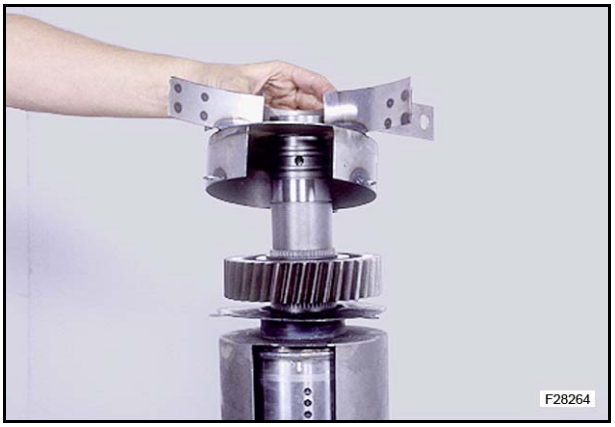
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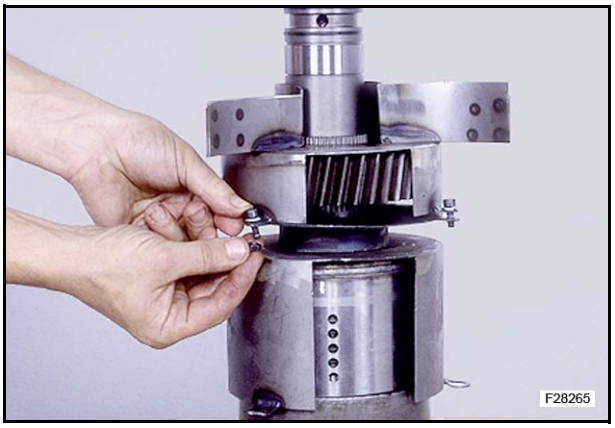
Install the output shaft sealing rings.



Install the rear oil baffle on the output shaft.



Install the oil baffle mounting screws, the washer and the nuts and tighten the nuts to the specified torque (Use Loctite 243).



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DISCONNECT SHAFT DISASSEMBLY

Use bearing puller to remove the disconnect shaft front bearing.



Remove the front bearing.



Remove the front bearing retaining ring.



Remove the clutch hub from the shaft.



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Remove the clutch hub locating ring from the shaft.



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DISCONNECT SHAFT ASSEMBLY

Install the bushing if necessary.



Install the clutch hub locating ring.



Install the clutch hub on the shaft.



Install the front bearing retaining ring.



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Install the front bearing on the shaft.



Tap the bearing on the shaft.

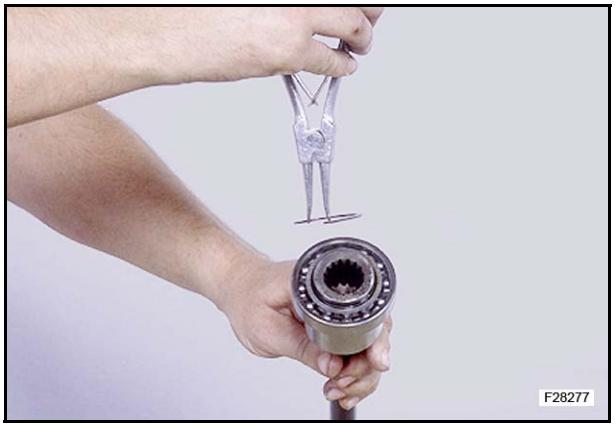


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PUMP DRIVE SHAFT DISASSEMBLY

Remove the rear bearing snap ring.



Use bearing puller to remove the rear bearing.



Remove the rear bearing from the shaft.



Remove the sealing ring from the shaft.



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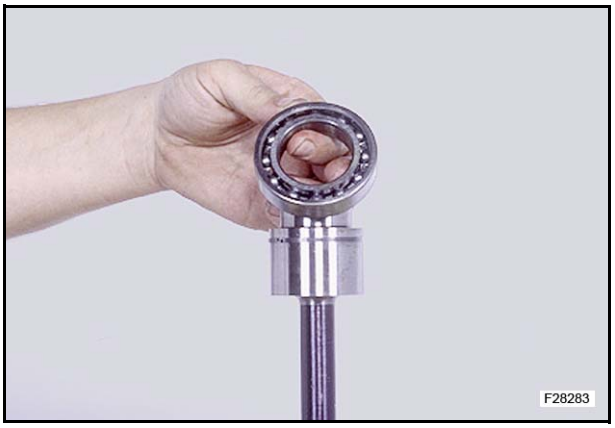
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PUMP DRIVE SHAFT ASSEMBLY

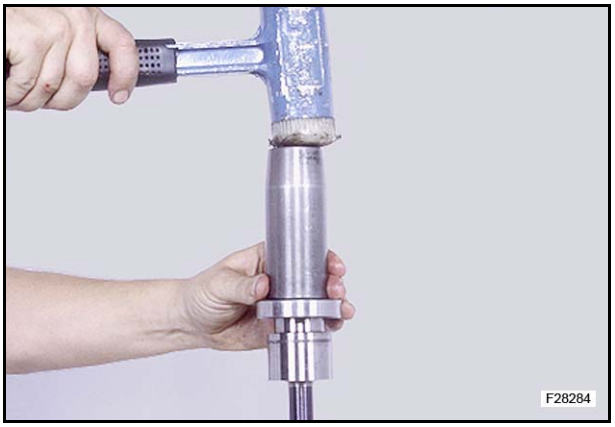
Install the sealing ring on the shaft.



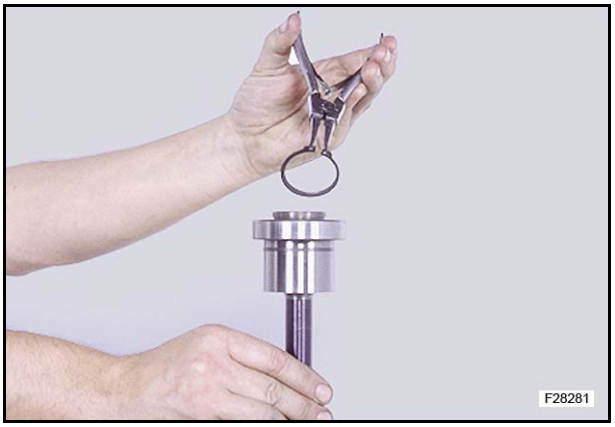
Install the rear bearing on the shaft.



Tap the bearing into the place.



Install the rear bearing retainer ring.

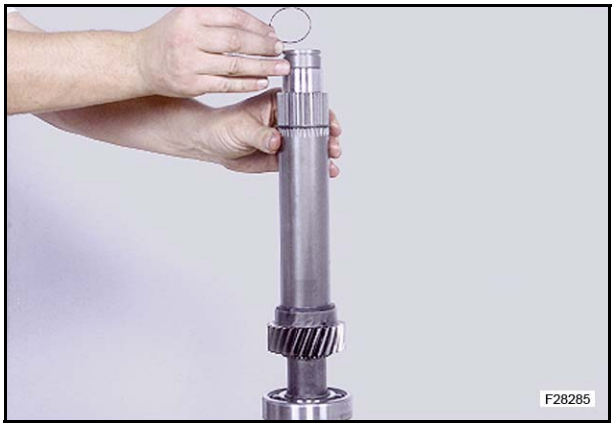


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INPUT SHAFT DISASSEMBLY

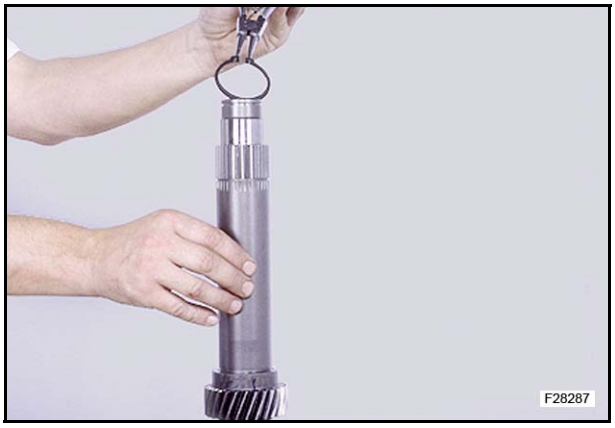
Remove the input shaft rear sealing ring.



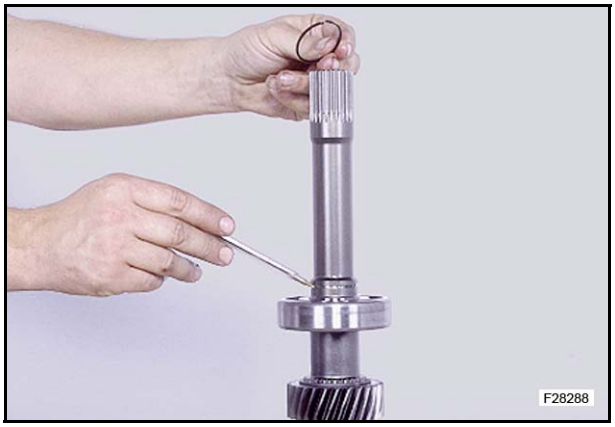
Remove the forward high gear retaining ring.



Remove the forward low gear retaining ring.



Remove the input shaft front sealing ring.



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Use bearing puller to remove the input shaft front the bearing.



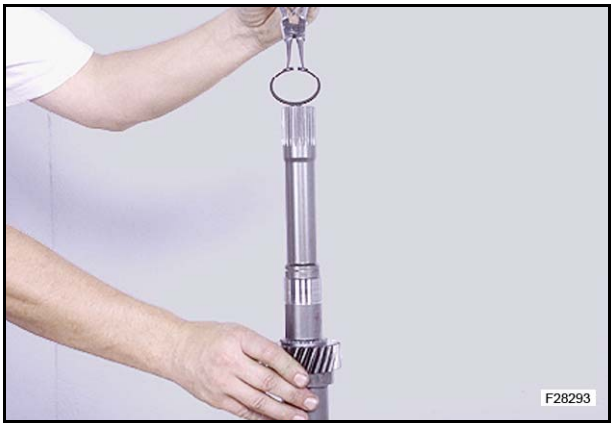
Remove the input shaft front bearing.



Remove the input shaft front bearing retaining ring.



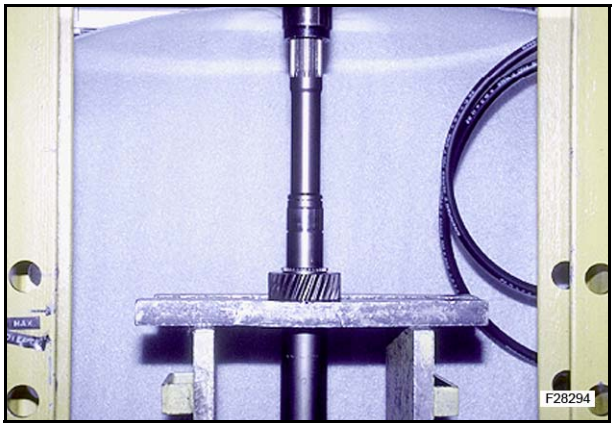
Remove the forward low gear retaining ring.



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Press the forward low gear from the shaft.



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INPUT SHAFT ASSEMBLY

Install the forward low gear retaining ring.



Warm the gear to 150 °C, install the gear.



Install the forward low gear retaining ring.



Install the input shaft front bearing retaining ring.



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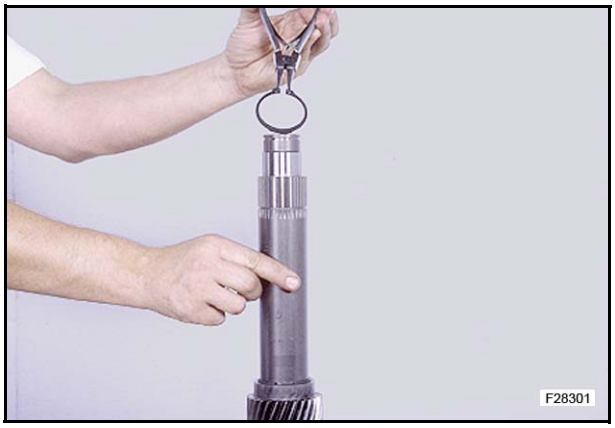
Install the input shaft front sealing ring.



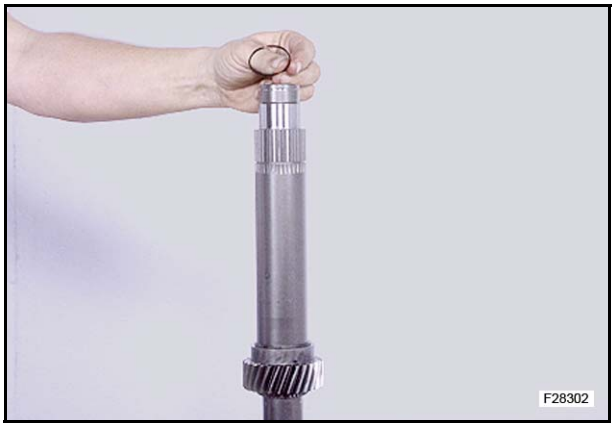
Warm the input shaft front bearing to 120 °C, install the bearing.



Turn the shaft and install the input shaft forward high gear retaining ring.



Install the input shaft rear sealing ring.

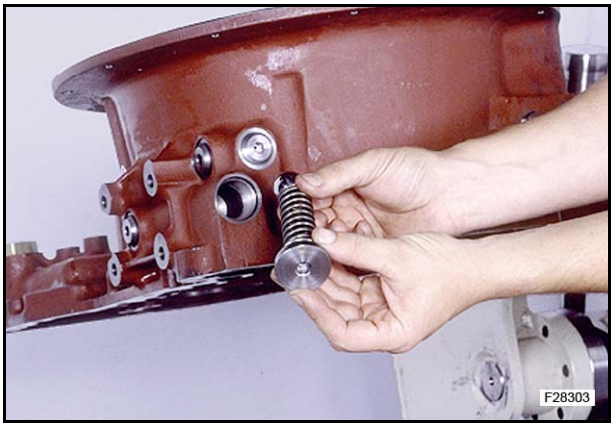


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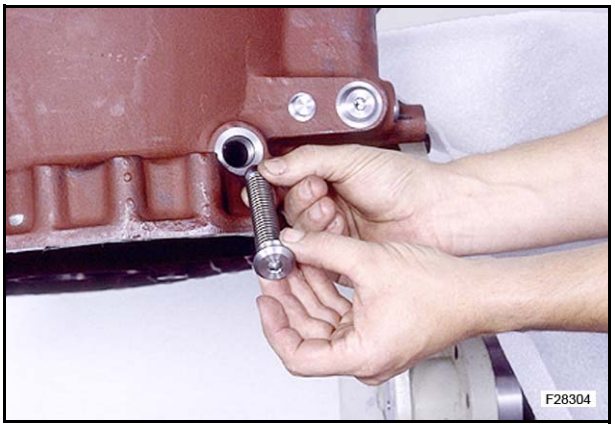
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CONVERTER HOUSING ASSEMBLY

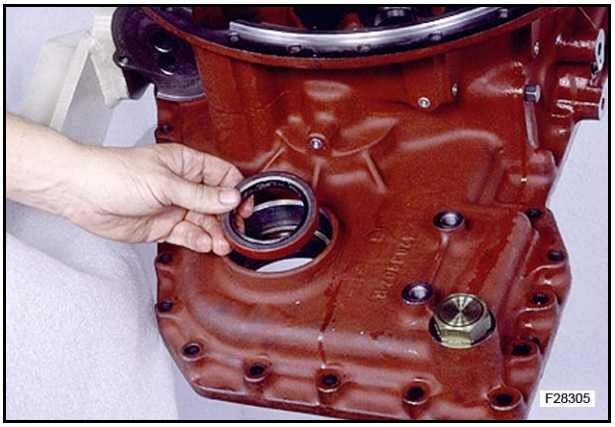
Install the safety valve ball spring and the plug.



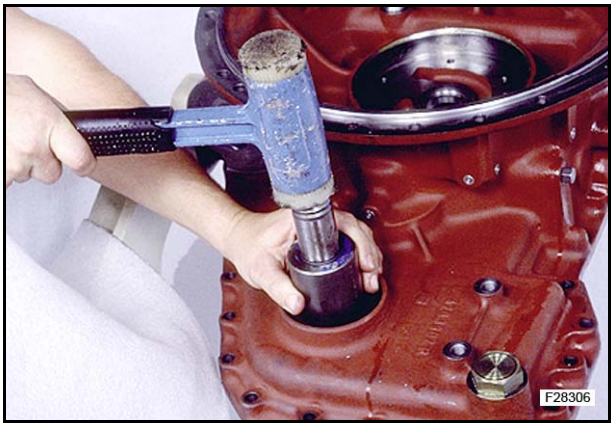
Install the by-pass valve ball spring and the plug.



Install the output shaft front oil seal.



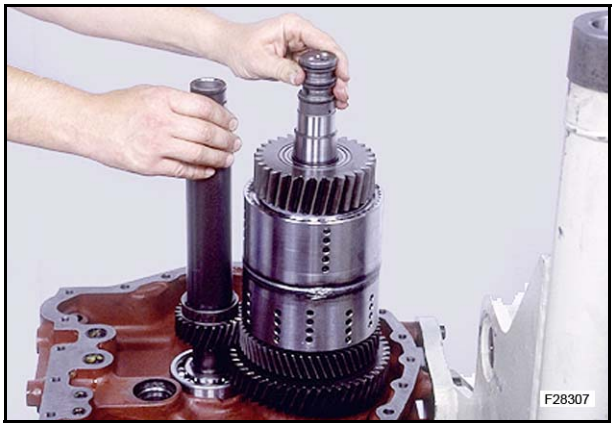
Using suitable seal installer, tap seal in place.



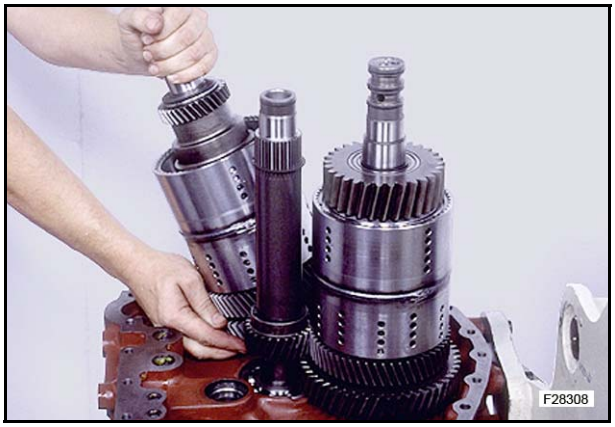
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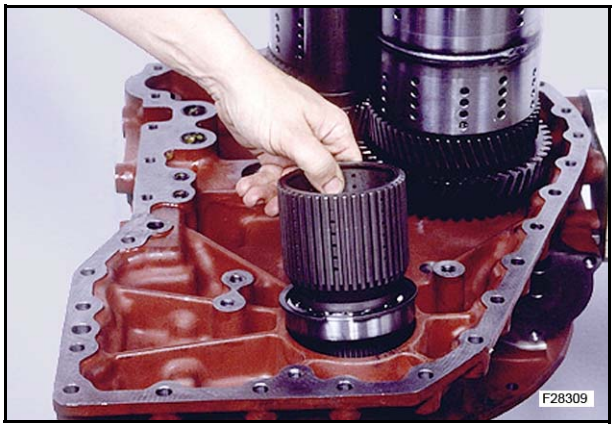
Install the input shaft into housing and in the meantime install reverse and first shaft (they have to be installed together). Using caution as not to damage any of the first shaft sealing rings.



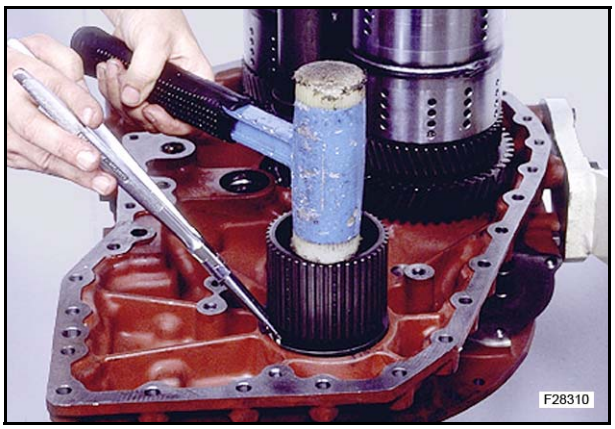
Install the forward low shaft and the high shaft into the housing. Use caution as not to damage the sealing rings.



Install the disconnect shaft assembly into the housing.



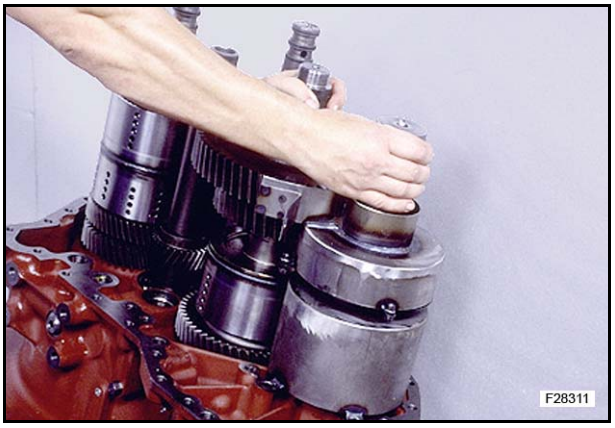
Open the bearing retaining ring. Tap the shaft into the place. Be sure ring is in the groove.



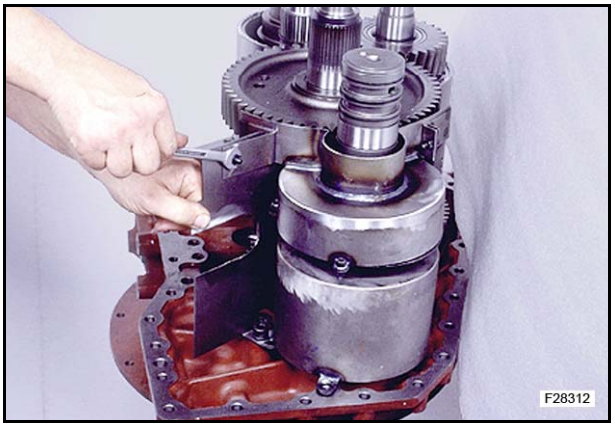
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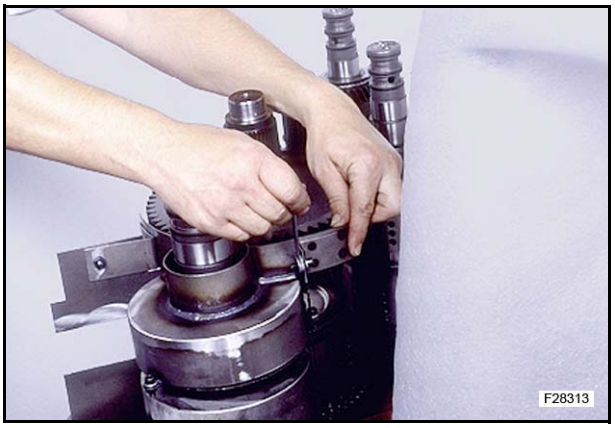
Install the upper and the lower output at the same time.
Do not force this operation, be sure discs of disconnect are in full position. Using caution as not to damage any of the lower shaft sealing rings.



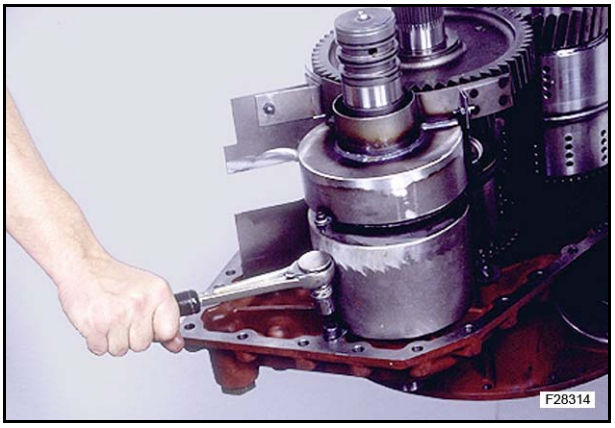
Install the baffle plate, the mounting screws, the washers and the nuts. Tighten the nuts to the specified torque. (Use Loctite 243).



Install the baffle plate, the mounting screws, the washers and the nuts. Tighten the nuts to the specified torque. (Use Loctite 243).



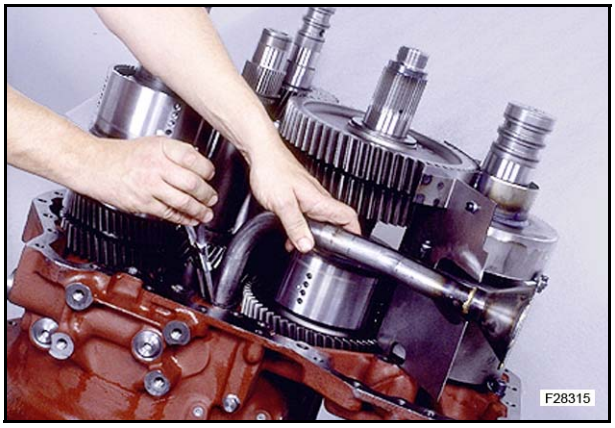
Install the oil baffle, the mounting screws and the washers. Tighten the screws to the specified torque. (Use Loctite 243).



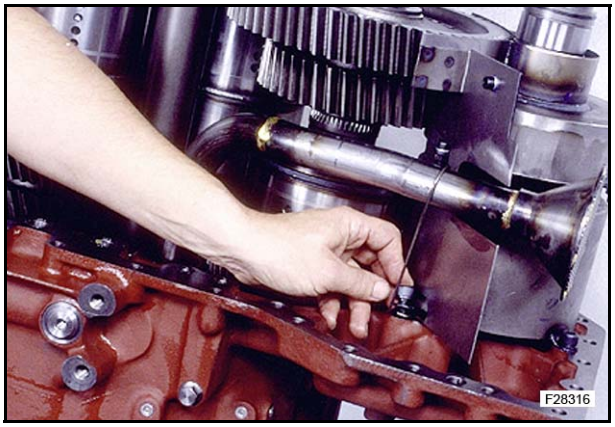
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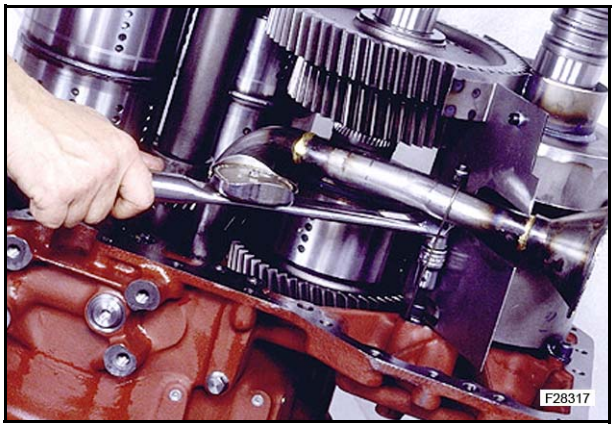
Install the O-ring, the spacer and the snap ring on the suction tube. Install the suction tube into the housing. Be sure ring is in the groove.



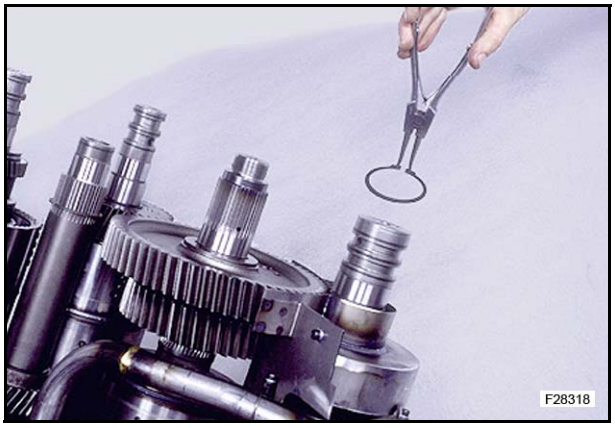
Install the suction tube retainer, the mounting screw and the lock washer (Use Loctite 243).



Tighten the mounting screw to the specified torque.



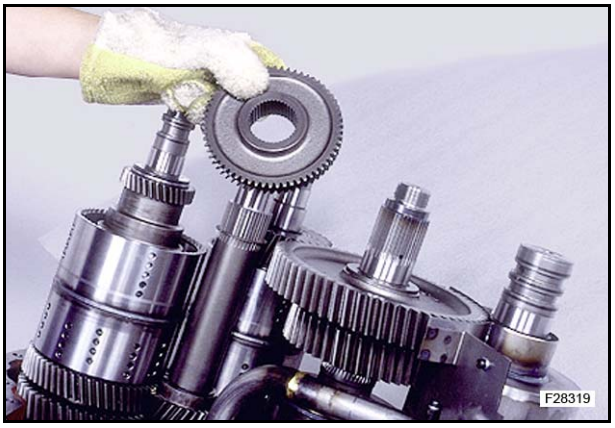
Install the output shaft rear bearing retaining ring.



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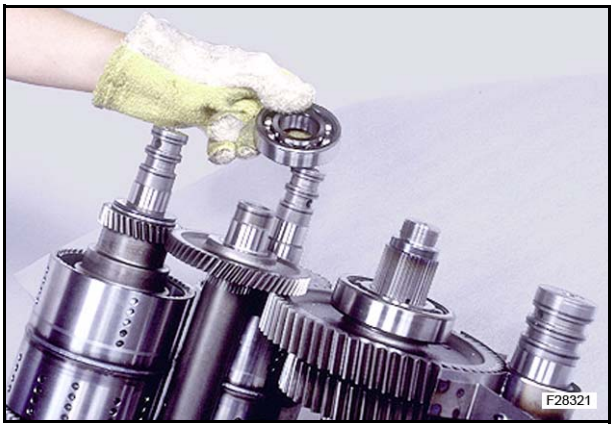
Warm the forward high gear to 150 °C, install the gear.



Warm the upper output rear bearing to 120 °C, install the bearing.



Warm the reverse and 1st shaft rear bearing to 120 °C, install the bearing.



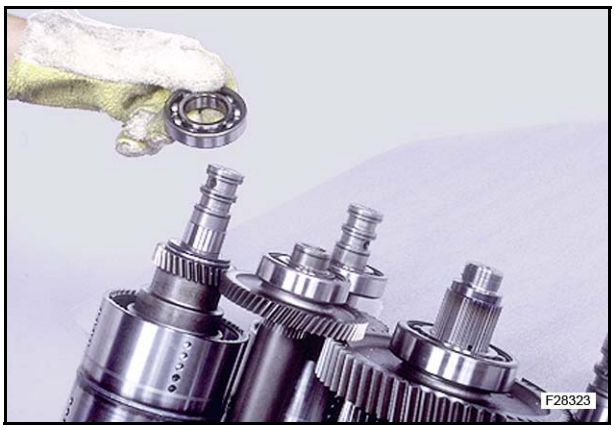
Warm the input shaft rear bearing to 120 °C, install the bearing.



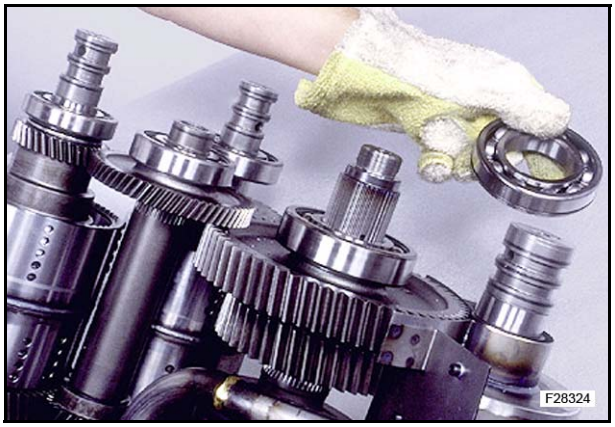
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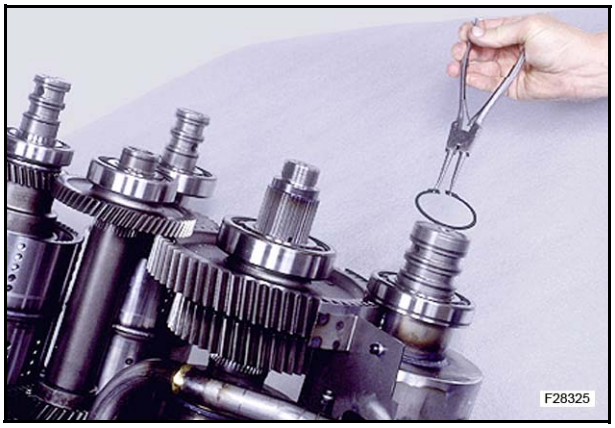
Warm the forward low and high shaft rear bearing to 120 °C, install the bearing.



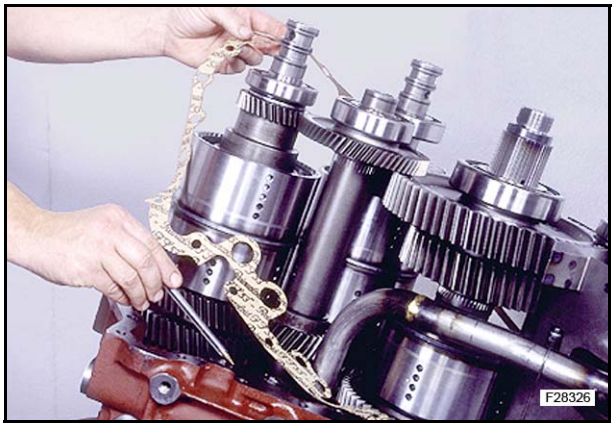
Warm the lower output shaft rear bearing to 120 °C, install the bearing.



Install the output shaft rear bearing retaining ring.



Install the gasket and the clutch pressure O-rings (4) into the O-ring grooves.

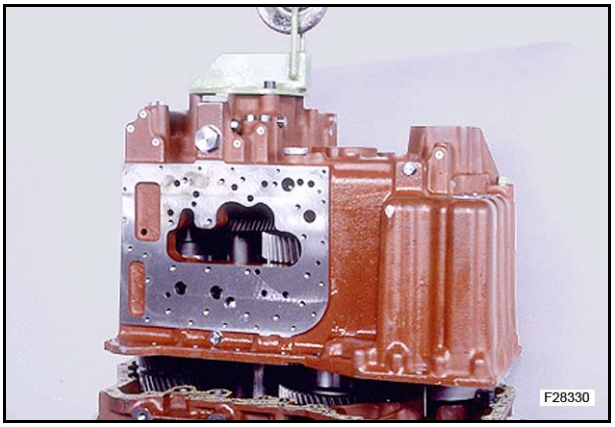


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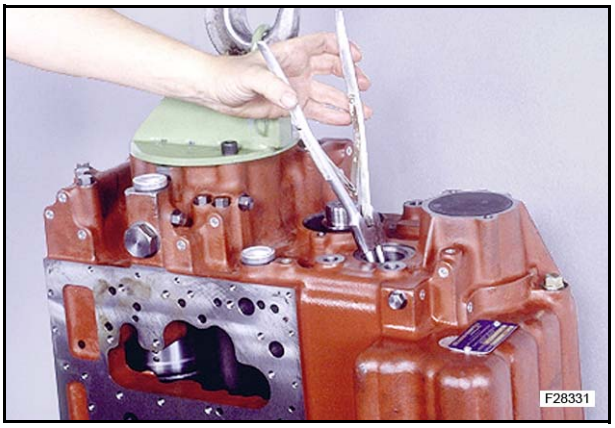
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TRANSMISSION ASSEMBLY

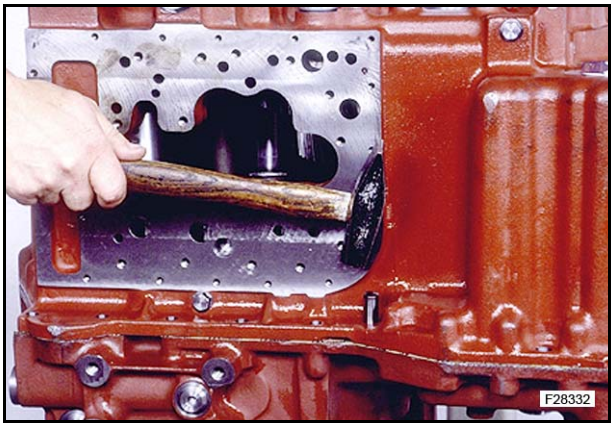
Remove the lower output bore plug. Position the transmission case on the converter housing (using lifting bracket).



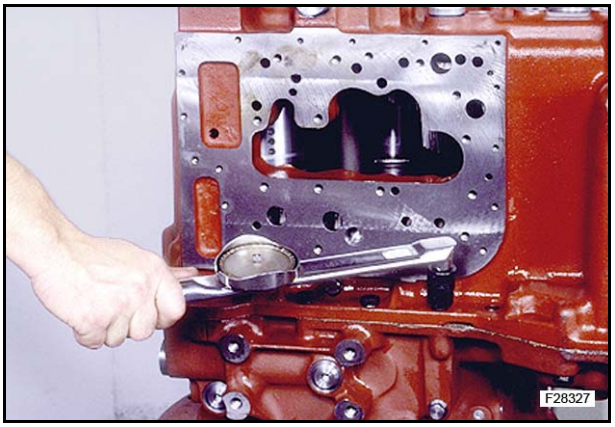
Using spreading type snap ring pliers, spread ears on output shaft rear bearing retaining ring. Hold snap ring open. Tap the transmission case into the place.



Tap the dowel pin in the transmission case and the converter housing.



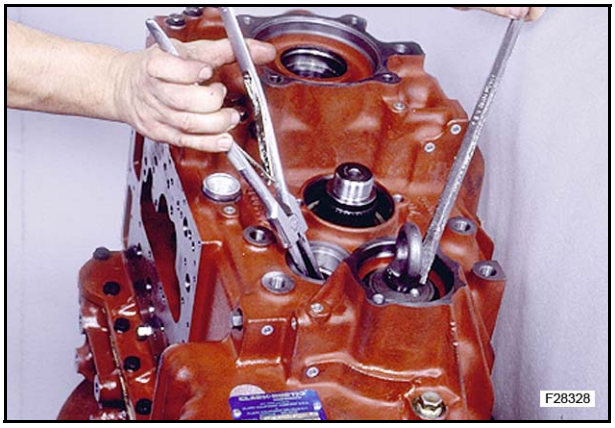
Install the transmission case to the converter housing mounting screws and the lock washers.
Tighten the mounting screws to the specified torque.



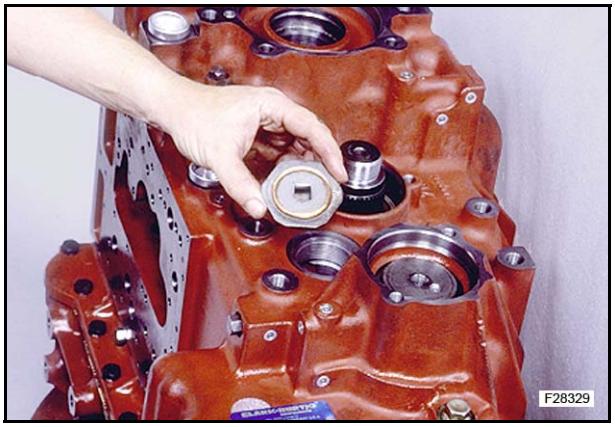
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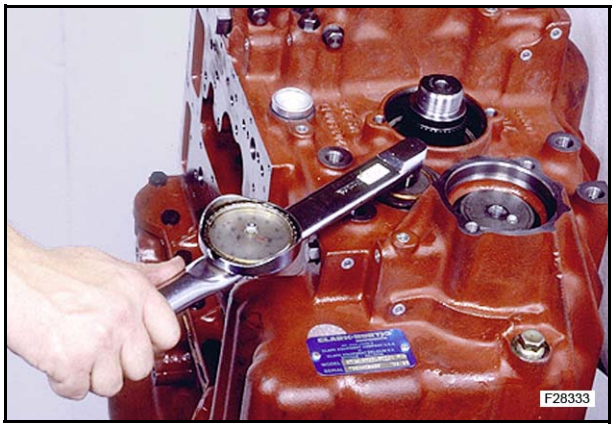
Using spreading type snap ring pliers, spread ears on output shaft rear bearing retaining ring. Hold snap ring open, pry or lift output shaft. Be sure retaining ring is complete in the bearing groove. (Using a lifting eye or screw M12).



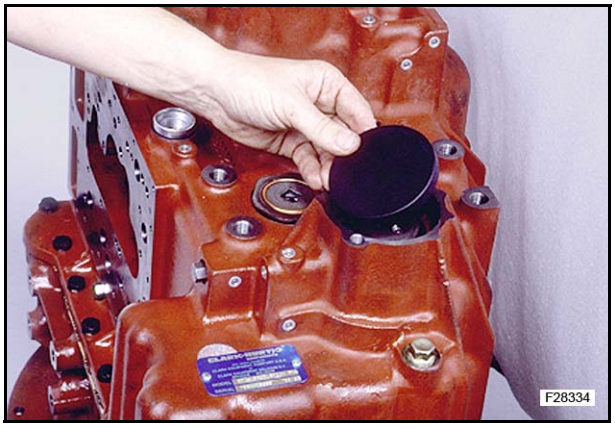
Install the hole plug and the gasket.



Tighten the plug to 13.6 - 20.3 Nm.



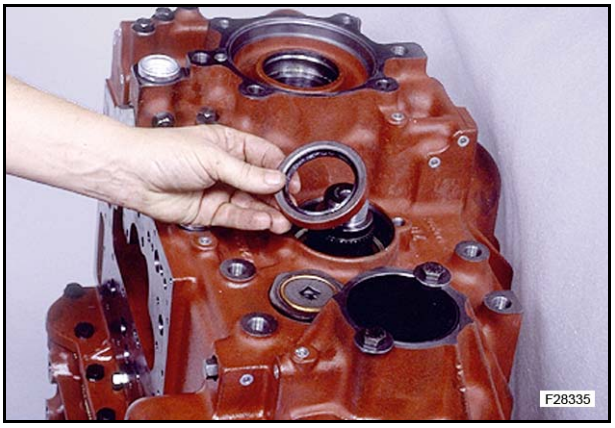
Position the lower output bore plug and the tap bore plug into the place.



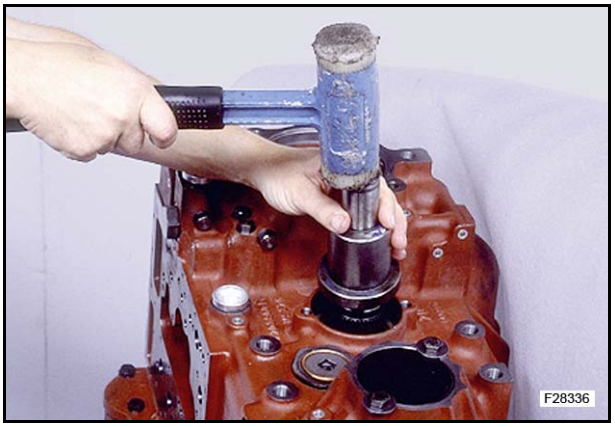
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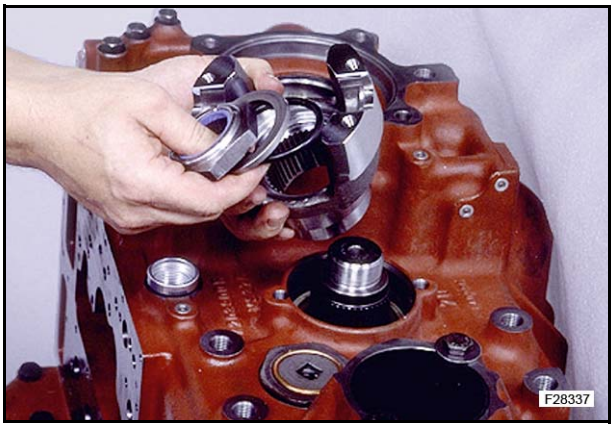
Position the upper output seal.



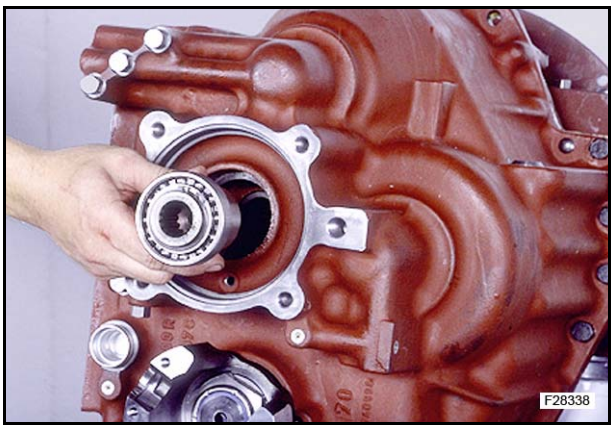
Tap the seal into the place.



Install the upper output flange, the O-ring, the washer and the nut and tighten the nut to 339 - 407 Nm.



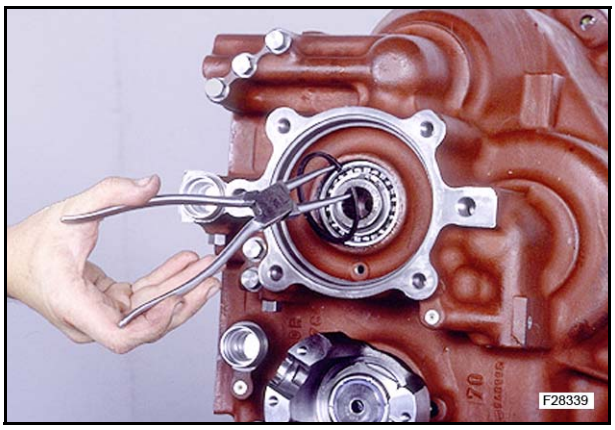
Install the pump drive shaft assy into the housing.



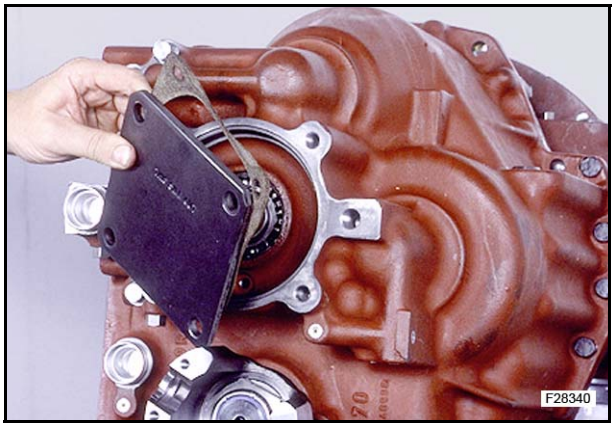
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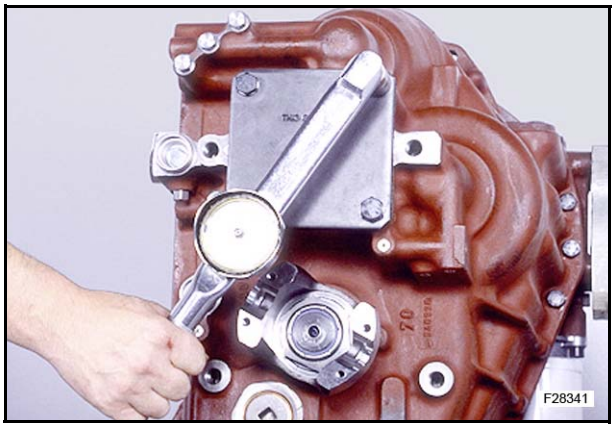
Install the pump drive shaft rear bearing retaining ring.



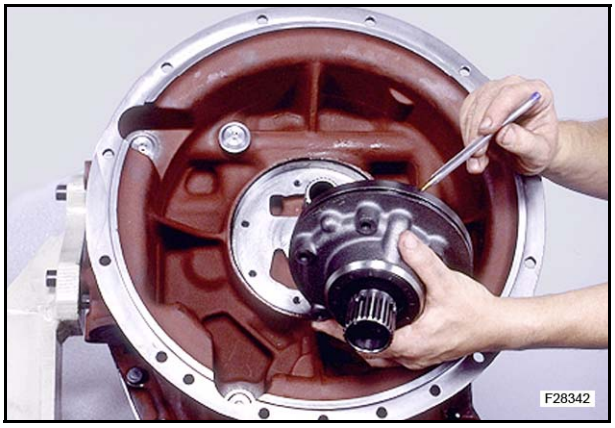
Install the pump hole cover, the gasket, the screws and the lock washers.



Tighten the pump hole cover screws.



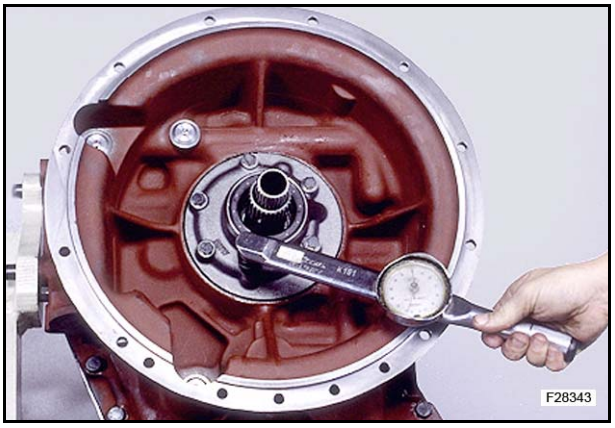
Install the pump and the O-ring into the converter housing.



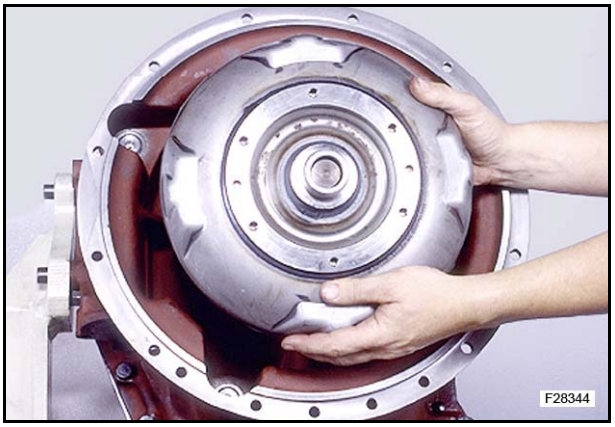
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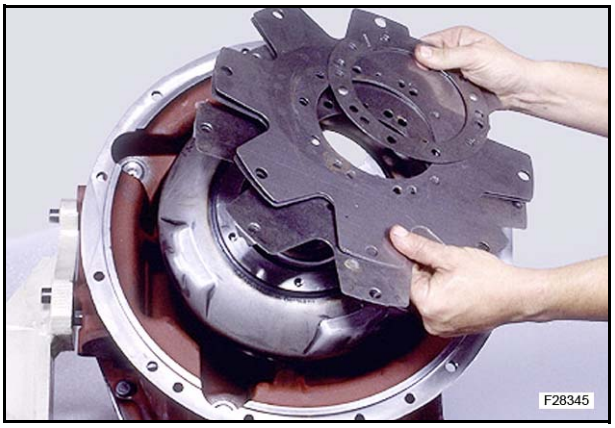
Install the pump mounting screws and the lock washers, then tighten the screws.



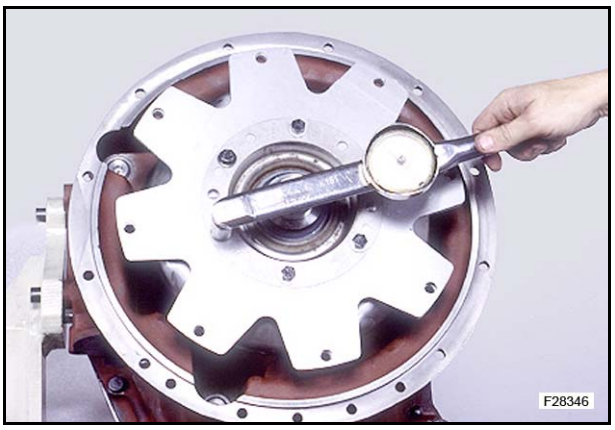
Install the converter assembly on the input shaft.



Install the drive plates on the converter.



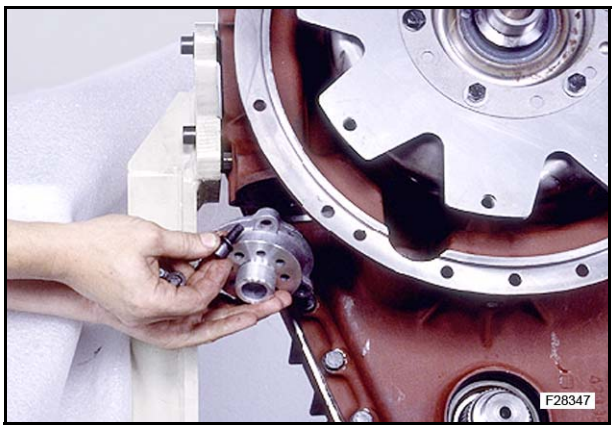
Install the drive plate screws and the lock washers, then tighten the screws.



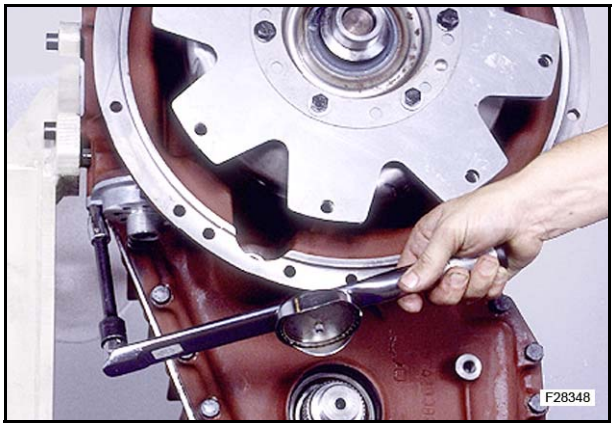
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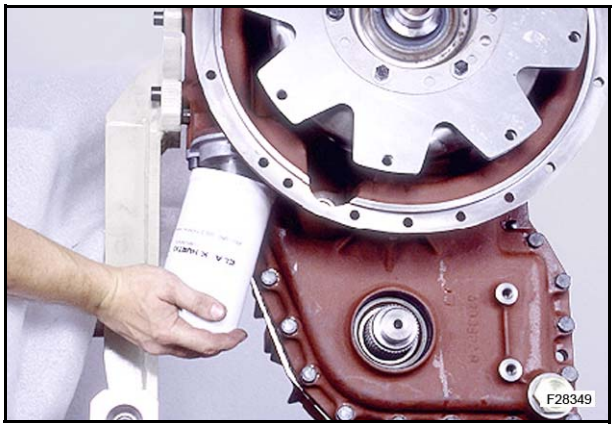
Install the filter adapter, the O-ring, the lock washers and the mounting screws.



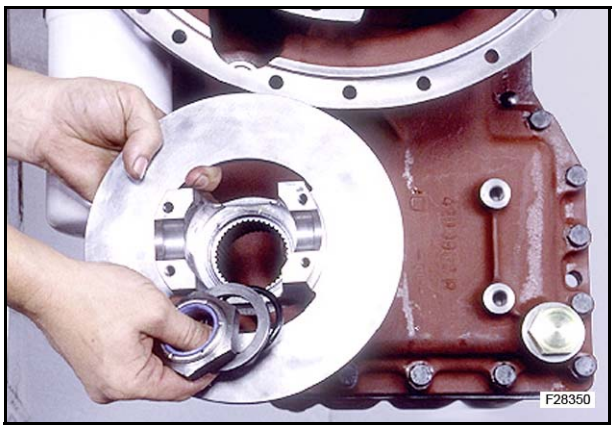
Tighten the screws.



Install the oil filter and tighten to 30 - 38 Nm.



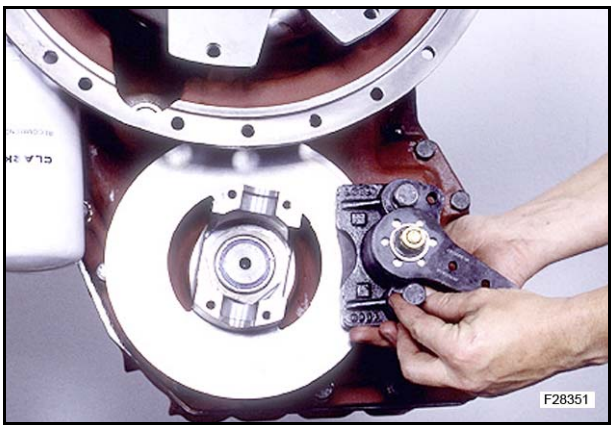
Install the output shaft front flange, the O-ring, the washer and the nut. Tighten the nut to 339 - 407 Nm.



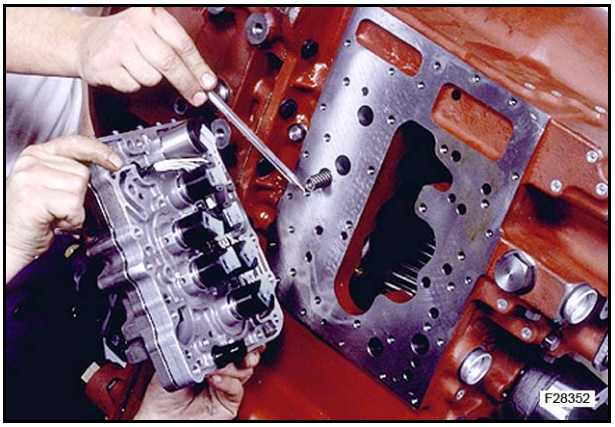
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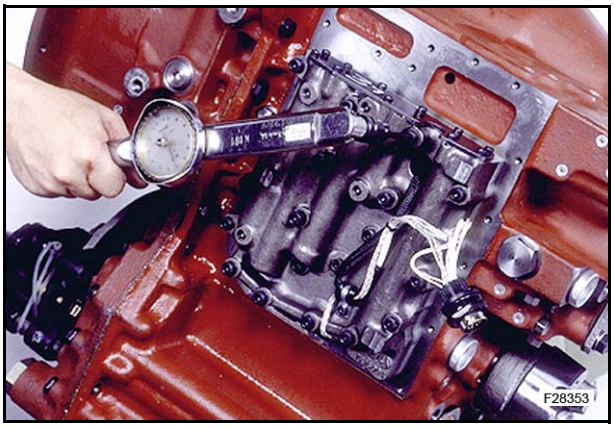
Position the parking brake, install the mounting screws (See parking brake adjustment).



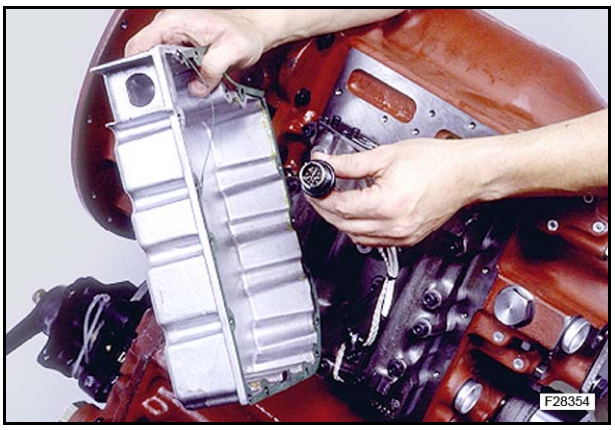
Install the by-pass valve spool into the solenoid housing and the spring into the transmission case. Place the control valve on the transmission case.



Install the control valve mounting screws and the lock washers, tighten the screws.



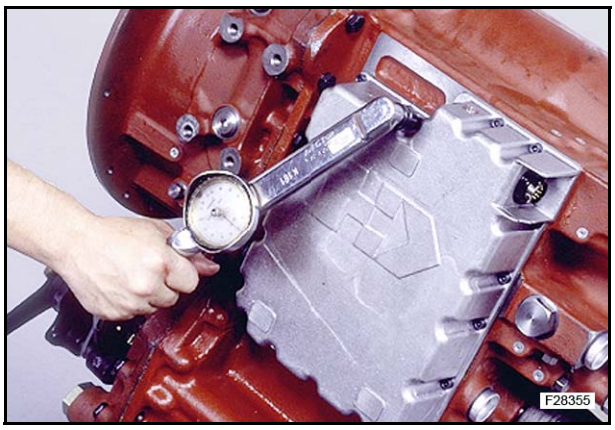
Position the wiring connector in the valve protection cover.



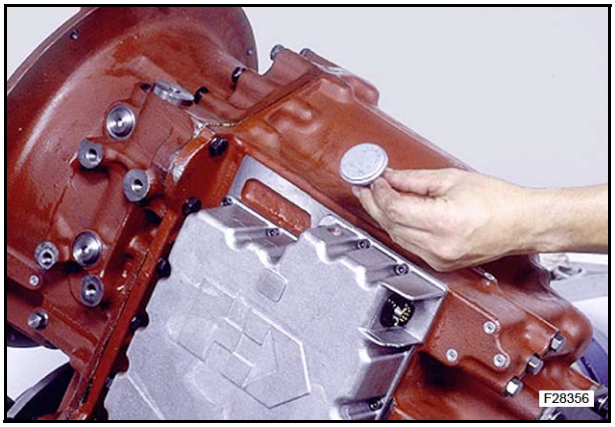
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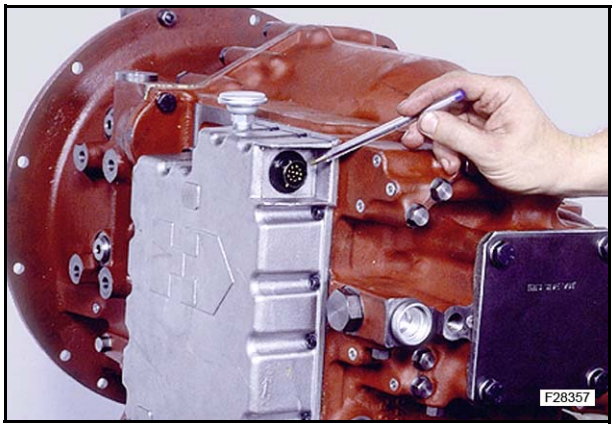
Install the gasket and the valve protection cover mounting screws, then tighten the screws.



Install the air breather and tighten to 34 - 41 Nm.



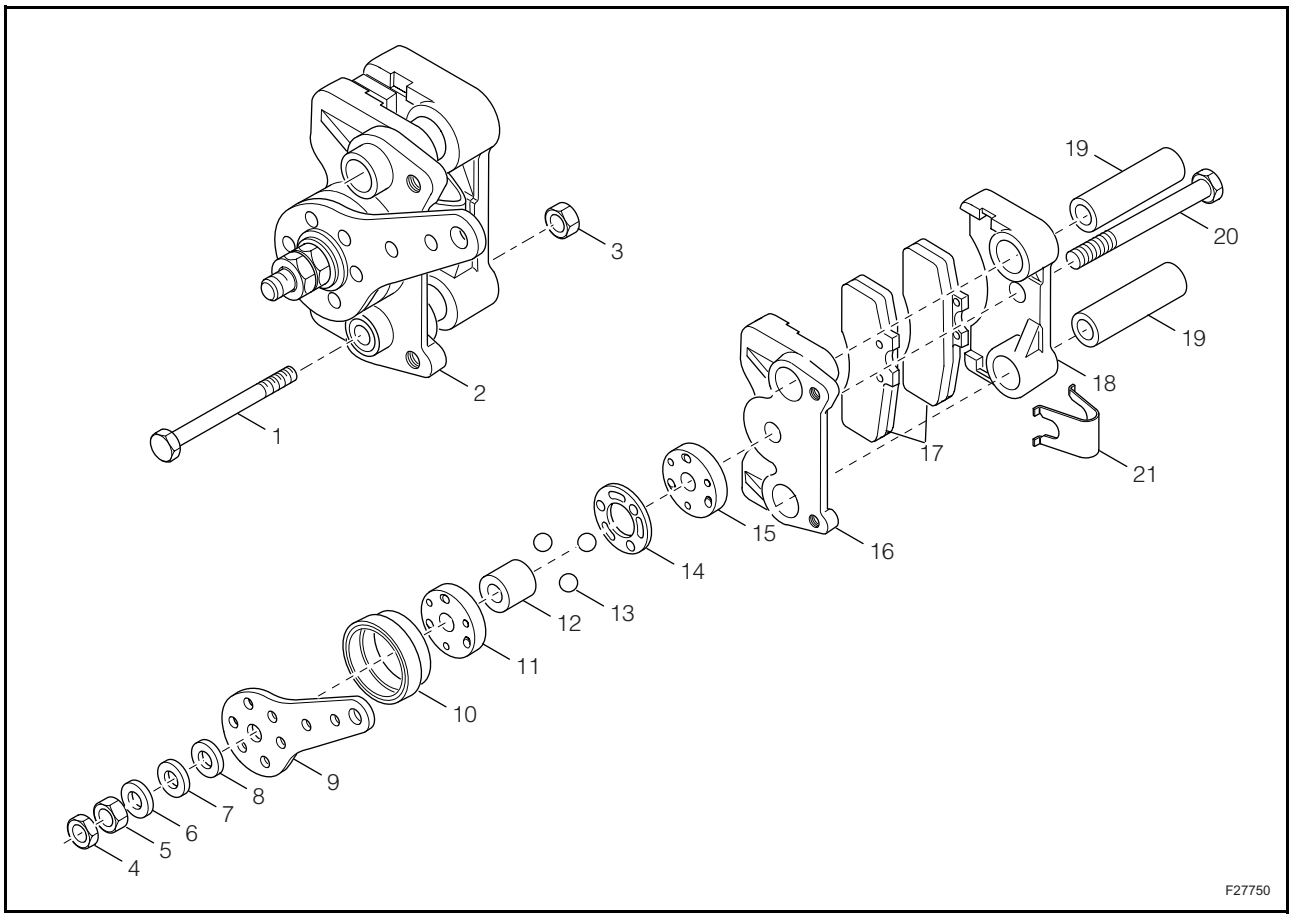
Install the wiring connector nut and tighten to 6 -8 Nm.



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Replacement and adjustment of parking brake



- Loosen two adjustment locking nuts (4 and 5) enough to slide each torque plate (16 and 18) away from disc far enough to provide clearance to remove old pads assembly and install new ones. (It may be necessary to remove one or both nuts).
- Collapse pad retraction spring (21) and remove from brake head assembly.
- Slide torque plates (16 and 18) away from disc, move pads assembly (17) out of pockets, and remove from the brake head assembly from the side.
- Install new pads assembly (17) in each torque plate (16 and 18).
- Install pad retention spring (21) into brake head assembly. Be sure spring's "feet" are positioned properly in holes in both pads assembly (17).
- Tighten inner adjusting nut (5) until firm contact is made with the disc by the pads. Torque to 11 Nm make certain lever is in proper operating position for application.
- Back off inner adjusting nut (5) and check that disc is free to move (total clearance 0.8 - 1.1 mm).
- Tighten outer locking nut (4) against inner adjusting nut to lock adjustment bolt in place. Torque to 61 - 75 Nm.

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2.13 SPECIAL TOOLS

P/N CNH	DESCRIPTION
380000676	Lifting tool

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2.14 FAULT FINDING

STALL TEST

Use a stall test to identify transmission, converter, or engine problems.

TRANSMISSION PRESSURE CHECKS

Transmission problems can be isolated by the use of pressure tests. When the stall test indicates slipping clutches, then measure clutch pack pressure to determine if the slippage is due to low pressure or clutch plate friction material failure.
In addition, converter charging pressure and transmission lubrication pressure may also be measured.

MECHANICAL AND ELECTRICAL CHECKS

Prior to checking any part of the system for hydraulic function (pressure testing), the following mechanical and electrical checks should be made:

- Check the parking brake for correct adjustment.
- Be sure all lever linkage is properly connected and adjusted in each segment and at all connecting points.
- The controls are actuated electrically. Check the wiring and electrical components.
- Be sure that all components of the cooling system are in good condition and operating correctly.
  The radiator must be clean to maintain the proper cooling and operating temperatures for the engine and transmission. Air clean the radiator, if necessary.
- The engine must be operating correctly. Be sure that it is correctly tuned and adjusted to the correct idle and maximum no-load governed speed specifications.

HYDRAULIC CHECK

Also, before checking the transmission clutches, torque converter, charging pump, and hydraulic circuit for pressure and rate of oil flow, it is important to make the following transmission fluid check:
Check oil level in the transmission. The transmission oil must be at the correct (full) level. All clutches and the converter and its fluid circuit lines must be fully charged (filled) at all times. See note below.

NOTE: the transmission fluid must be at operating temperature of 82 - 93 °C to obtain correct fluid level and pressure readings. Do not attempt to make these checks with cold oil.

To raise the oil temperature to this specification it is necessary to either operate (work) the vehicle or run the engine with converter at “stall”. (Refer to converter stall procedure).

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PROBLEM	CAUSE	CORRECTION
Low clutch pressure	Low oil level Clutch pressure regulating valve stuck open Faulty charging pump Broken or worn clutch shaft or piston sealing rings	Fill to proper level. Clean valve spool and housing. Replace the pump. Replace seal rings.
Low charging pump output	Low oil level Suction filter plugged Defective charging pump	Fill to proper level. Clean the pump section. Replace the pump.
Overheating	Worn oil sealing rings Worn charging pump Low oil level Dirty oil cooler Restriction in cooler lines	Remove, disassemble and reassemble the converter. Replace. Fill to proper level. Clean the cooler. Replace cooler lines.
Noisy converter	Worn charging pump Worn or damaged bearings	Replace. A complete disassembly will be necessary to determine which bearing is faulty.
Lack of power	Too low engine rpm. The converter stalls See “Overheating” and make same checks	Adjust the engine governor. Make corrections as explained in “Overheating”.

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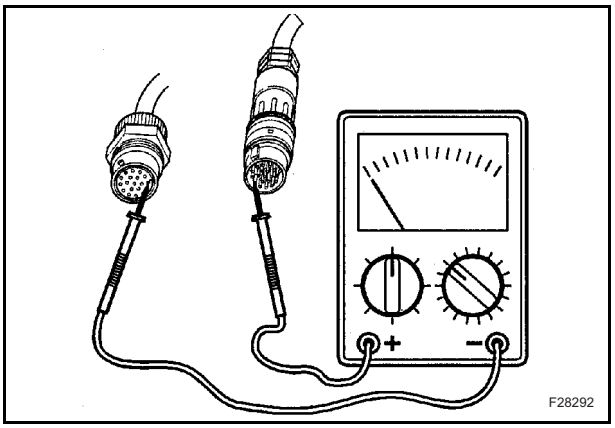
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2.15 FAULT FINDING

Before attempting any fault finding ensure you have a suitable multimeter for checking component continuity. When fault finding remember that with an electrical concern it is often a minor fault that may have occurred and could be as simple as:

- Poor continuity between connector pins.
- Condensation in the connectors.
- Disconnected cables.
- Damaged or broken wires all of which could result in a no drive situation but easily remedied when found and corrected.

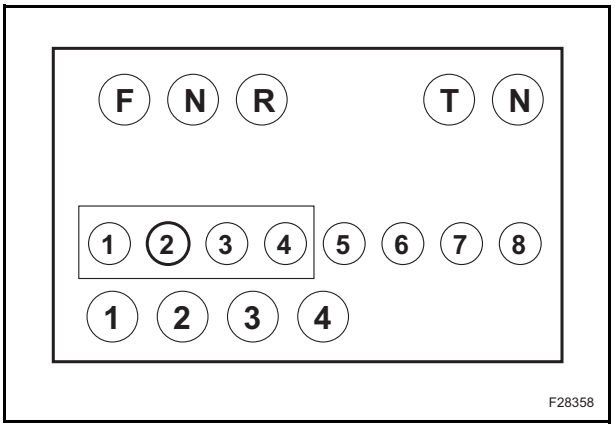
It should also be remembered that mechanical problems could result in fault codes appearing on the LED display.



INDICATION OF FAULTS

In case a fault is present during normal operation and is detected by the microprocessor, both the T-LED and N-LED may be blinking in some way as shown in the table below.

NOTE: on an open circuit or on a battery connection (+), at the ON/OFF outputs, a detection is made only when the corresponding output is in the OFF position.
Also a short to ground is only detected while the output is on.



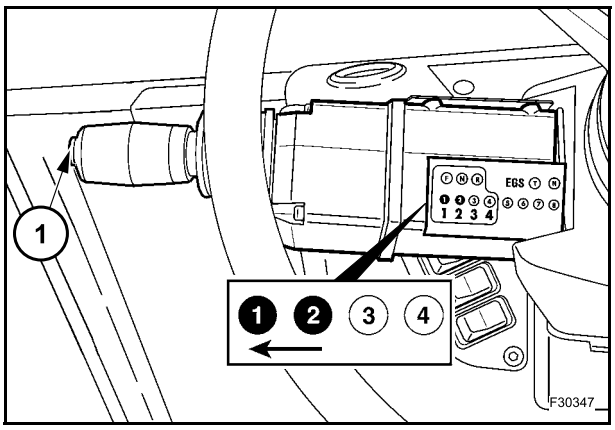
LED - T (Orange)	LED - N (Red)	CONDITION	SITUATION
Off	Off	Normal operation	-
Off	On	Normal operation - N selected	-
Off	Blinks	Blinks Normal operation - N selected/speed too high	-
On	Off	Diagnostic mode was activated at power up	-
On	On	Controller in RESET - malfunction	Fault
On	Blinks	Self calibration in progress	-
Blinks	On	Last fault currently shown on display	Fault
Blinks	Blinks slower	Input fault detected	Fault
Blinks	Blinks in phase	Non critical output fault detected	Fault
Blinks	Blinks faster	Safety critical output fault detected	Fault
Blinks fast	Blinks out of phase	System shutdown - Neutral till power down	Fault

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LED DISPLAYED FAULTS

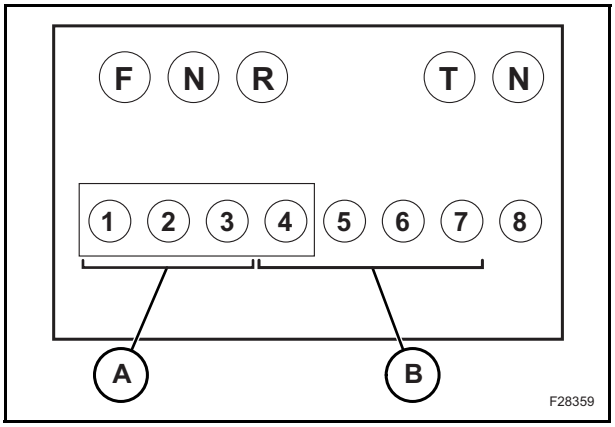
If a fault is, or there have been (intermittent faults) present, a detailed fault display can be selected by placing: the Powershift lever in neutral position and pressing the kickdown button. The indicated fault on the LED display can then be localized by using the table below, until power down.



FAULT GROUP

The faults are displayed using 2 LEDs on the 8 LED display. Faults are displayed as 3 subgroups - Group A:

FAULT SUBGROUP A	GROUP INDICATION
Input related	LED 1 blinks red
Output related	LED 2 blinks red
Other	LED 3 blinks red



Within each group several faults are possible. The second LED's position - Group B, indicates the fault area, where the colour indicates the fault type. Typically an open circuit condition is shown using an orange LED where a short circuit condition is indicated with a red LED. Once the fault code has been determined proceed to fault codes.

FAULT GROUP LED (A)	FAULT GROUP LED (B)	PROBLEM	FAULT CODE
None	None	No fault active	-
1 Red	4 Orange	Shift lever input fault	F1
1 Red	5 Orange	Speed sensor open circuit	F2
1 Red	5 Red	Speed sensor in short	F3
1 Red	7 Green	Battery over voltage	F4
2 Red	4 Orange	Open circuit on one or both direction outputs	F5
2 Red	4 Red	Direction output forced to plus - critical fault	F6
2 Red	5 Orange	Other output open circuit	F7
2 Red	5 Red	Red Other output short circuit	F8
2 Red	6 Orange	Modulation output open circuit	F9
2 Red	6 Red	Modulation output short circuit	F10
3 Red	5 Red	Start-up fault - limp home mode selected	F11

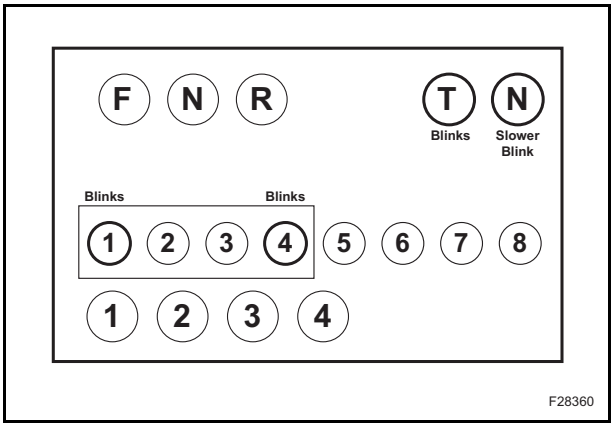
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SHIFT LEVER INPUT FAULT CODE F1

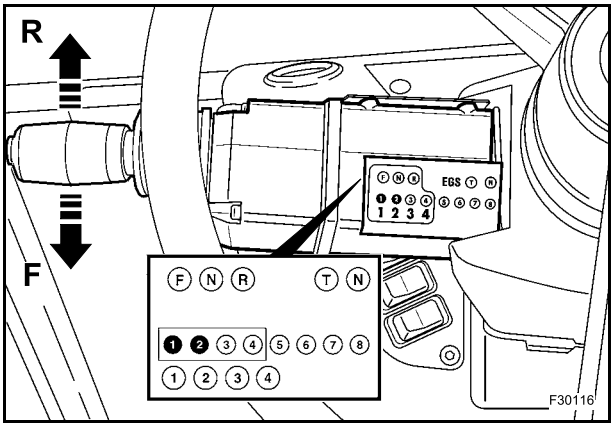
Perform input test
This test is used to verify operation of the shift lever and its inputs.
In this mode driving is possible.

NOTE: the gear position indicators on the microprocessor top cover are used to display the test information.



INPUT TEST REQUIREMENTS: with the powershift lever in forward position and set to upshift (keep the lever in this position during start-up), start the machine. The microprocessor shifts to the input test mode. As shown in the table below placing the shift lever in different positions in this mode illuminates its respective LED (only 2 at the same time).

IMPORTANT: self test modes can only be started WHILE POWERING UP (ignition on). Leaving the self test mode is done by switching OFF the power of the Microprocessor (ignition off).

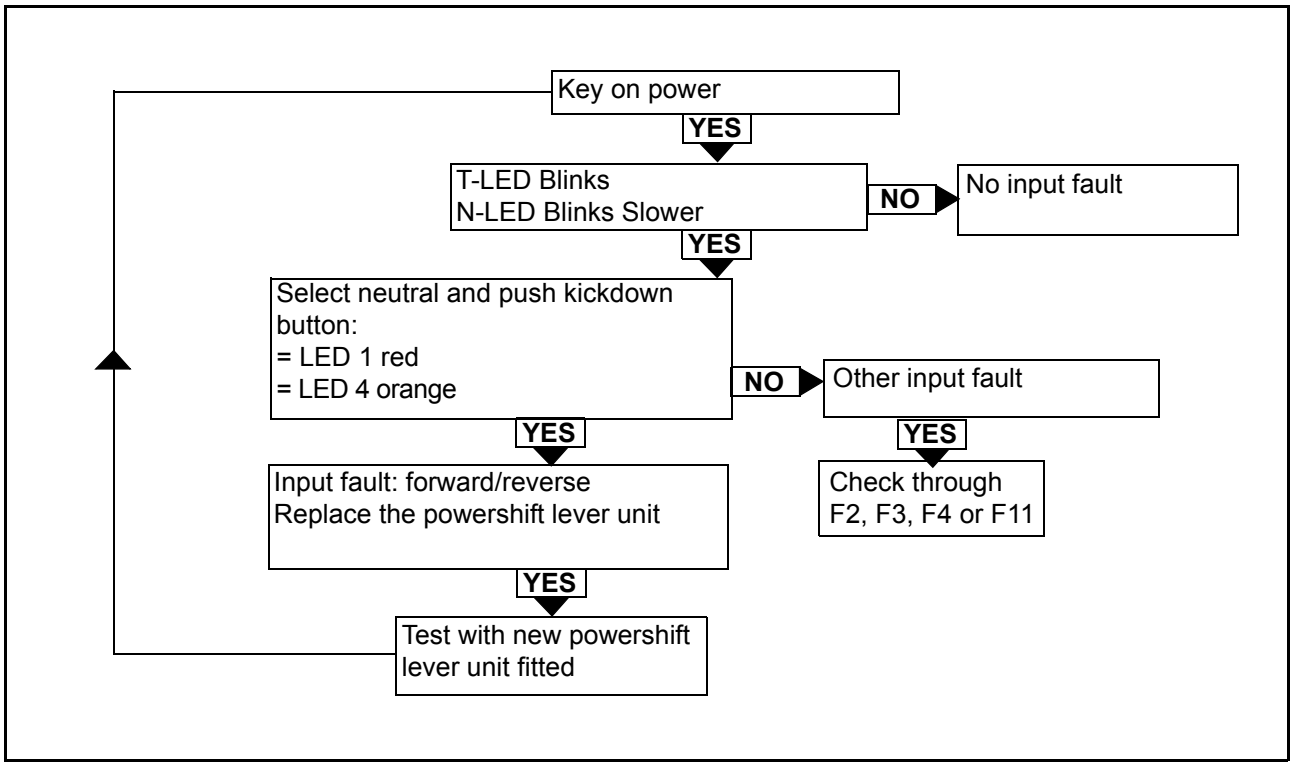


POWERSHIFT LEVER POSITIONS - WITH UP AND DOWNSHIFT SELECTION	NUMBER	
Neutral	2	RED
Neutral and upshift	3	RED
Neutral and downshift	1	RED
Forward	2	GREEN
Forward and upshift	3	GREEN
Forward and downshift	1	GREEN
Reverse	2	ORANGE
Reverse and upshift	3	ORANGE
Reverse and downshift	1	ORANGE
Operate disconnect button on loader lever	5 (*) (**)	GREEN
Operate 4WD switch on instrument panel	6 (*) (**)	GREEN
Foot brake test + 4WD	6 (**)	GREEN
Foot brake test + 4WD	7 (*)	RED
Transmission in automatic mode	7 (*)	RED
Temperature and speed sensor: to test disconnect lead on the sensor and short to ground	8	RED

*= Auto transmission only
**= Auto/Manual override

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SPEED SENSOR / FAULT CODE F2 AND F3

A fault indication on the display is given to warn of this problem.
If a speed sensor fault is detected the microprocessor will modify its behaviour in the following areas:

- no upshifts will be allowed above second gear.
- direction change while in F3 or F4: the actual reversal is preceded by a downshift sequence until second gear is obtained.
- 4WD braking remains operative.

NOTE: that the system response in this case is identical to the response in case of a power supply overvoltage.

Speed sensor test using the turbine speed display

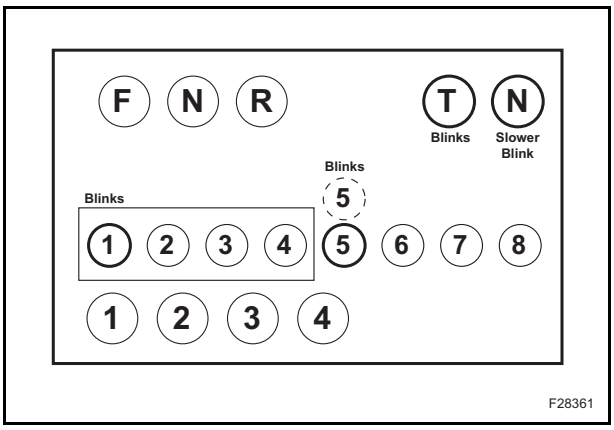
NOTE: a lamp test is performed prior to the speed sensor test and monitors all LEDs are operational.

SPEED SENSOR TEST REQUIREMENTS: powershift lever to be in reverse position, twist to upshift (keep the shift lever in this position during power up) turn the ignition on and start the engine.
With engine running return Powershift lever to neutral position and then place lever in forward and twist to upshift. Increase engine speed and compare with the table opposite.

IMPORTANT: self test modes can only be started WHILE POWERING UP (ignition on). Leaving the self test mode is done by switching OFF the power to the Microprocessor (ignition off).

In this mode driving is possible.
The LED corresponding with the table opposite illuminates to indicate the torque converter turbine speed and increases with engine revs.

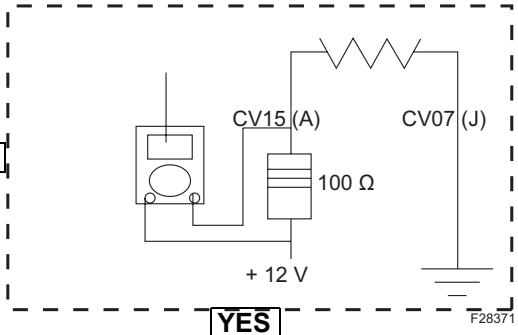
NOTE: application of the foot brakes during this test will reduce the turbine speed to zero.



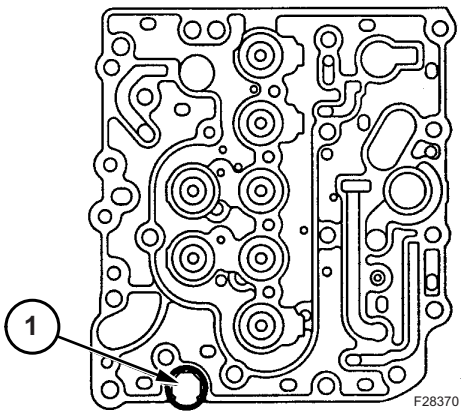
Turbine rpm	LED
0	1 blinks
0 - 249	1 on
250 - 499	2 on
500 - 749	3 on
750 - 999	4 on
1000 - 1249	5 on
1250 - 1499	6 on
1500 - 1749	7 on
1750 - 1999	8 on
above 2000	8 blinks

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Speed sensor test okay
NO
Key on power
YES
YES
End
T-LED Blinks
N-LED Blinks Slower
NO
No input fault
YES
Select neutral and push kickdown button:
= LED 1 red
= LED 5 orange (F2)
NO
= LED 1 red
= LED 5 red (F3)
NO
Other input fault
YES
YES
YES
Repair
NO
Check wires from speed sensor CV pin A to Powershift lever unit pin A or CV pin J to pin U, and continuity test. Does it test OK?
Refer to F1, F4 or F11
YES
Check speed sensor has it failed
NO


Change lever unit
NO
If static is 0.6 - 0.8 V or 1.3 - 1.5 V
YES
Replace sensor
If static is not 0.6 - 0.8 V or 1.3 - 1.5 V



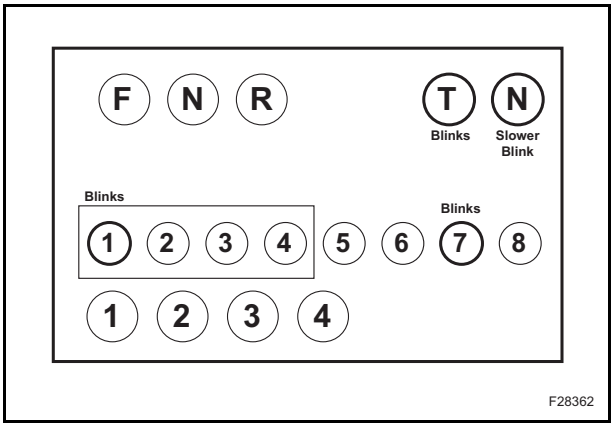
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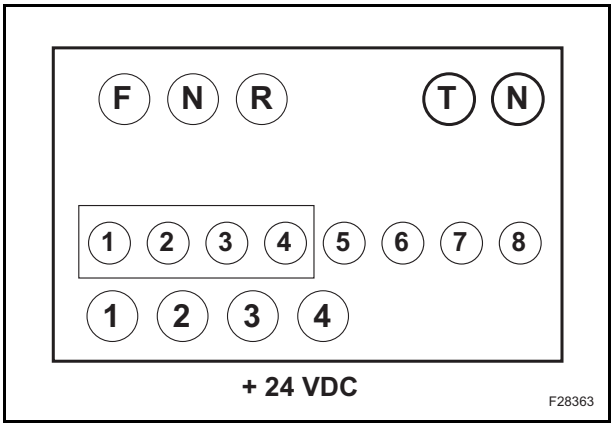
FAULT CODE F4 / BATTERY OVERVOLTAGE (17 V +)

Over voltage
Even power supply levels up to 30 V will not damage system components.
Above a power supply of 17 Vdc:
Group Fault 1 - Fault code 7.

NOTE: the speed sensor system will not operate when an overvoltage is present.

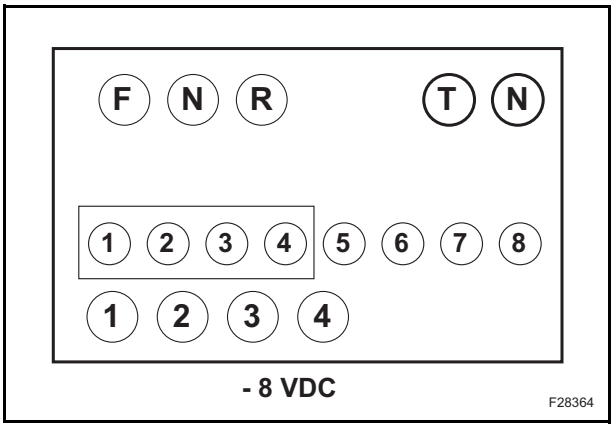


Above a power supply of 24 Vdc:
the analogue signals are not reliable to convert any more.
Over voltage: when the voltage exceeds 17 Vdc.
Action of the Microprocessor:
- no upshifts above second gear.
- direction change while in Forward 3 or Forward 4: the actual reversal is preceded by a downshift sequence until second gear is obtained.



- brake switch activation always engages 4WD.

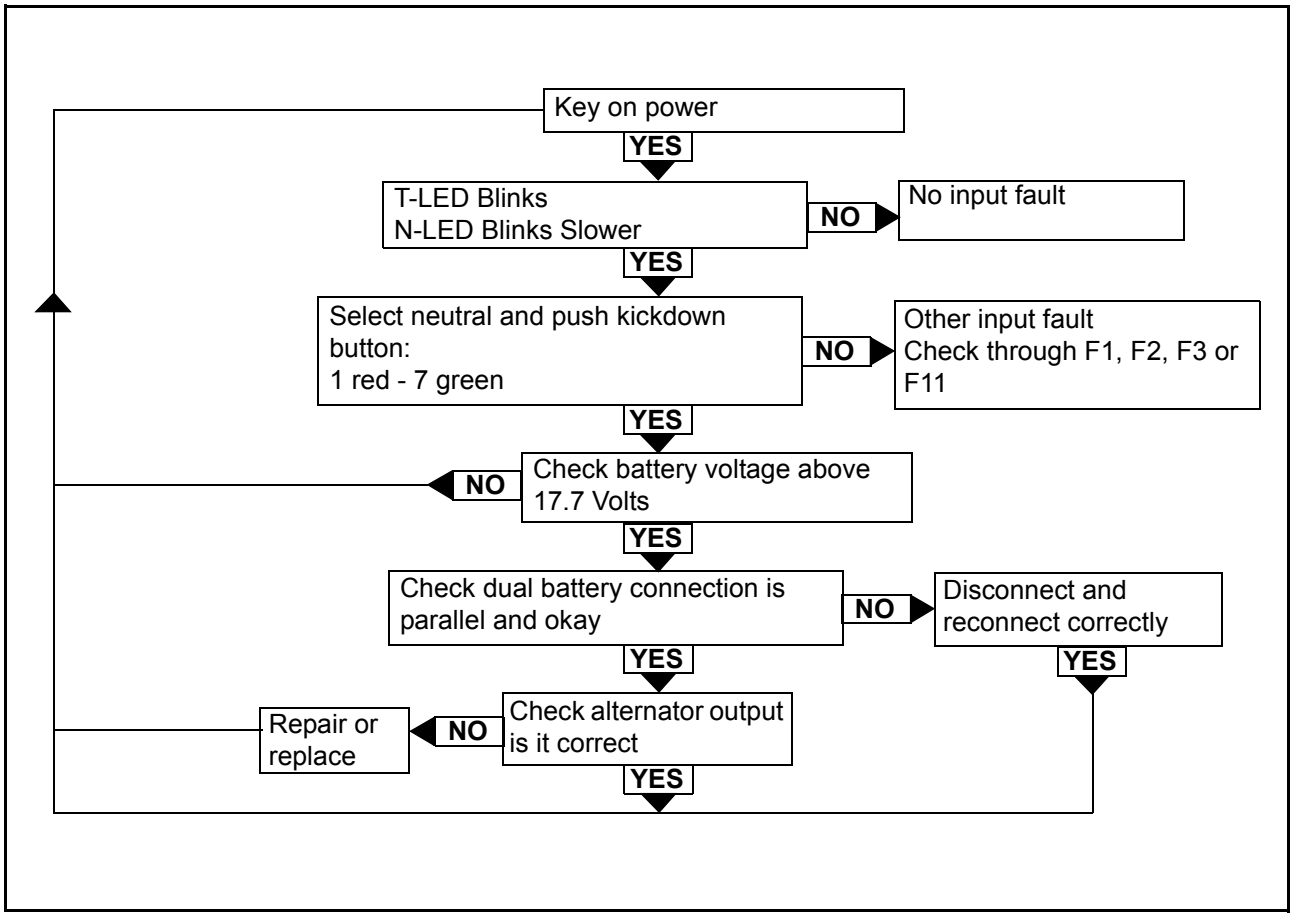
NOTE: with voltages below 8 Vdc, the microprocessor enters the reset mode.



Intermittent power loss
After power is restored, the microprocessor goes through the reset mode.

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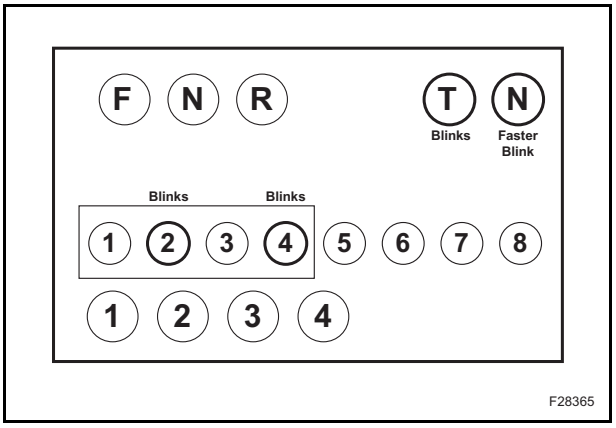


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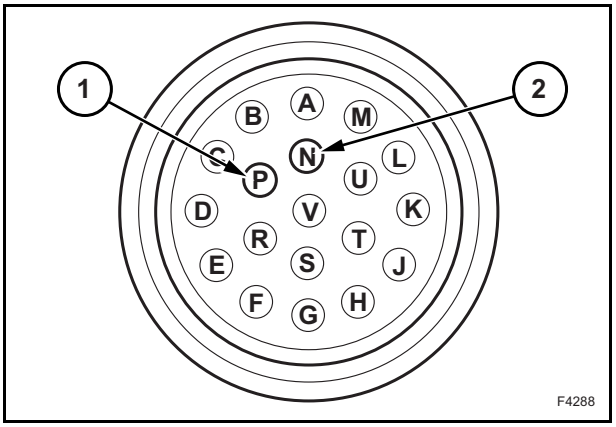
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FAULT CODE F5 AND F6 / OPEN CIRCUIT DIRECTION OUTPUTS

Direction selection related outputs (E06-Pin P, E07-Pin N):
A short to plus is considered as a critical fault. Shorts to plus usually result in being blocked in either Forward or Reverse. If both are on simultaneously, the transmission Behaviour depends on the state of a mechanical interlock inside the transmission.



In this case the Microprocessor normally turns on the pressure modulator (E03-Pin T). This results in immediate selection of neutral regardless of the origin of the fault. Indeed even in case the short to plus is applied externally, this response effectively blocks the transmission in neutral.
If however at the time the fault was detected a fault was also present on the pressure modulator, the microprocessor reverts to shutdown mode and remains this way until power is removed. Shutdown mode is a state in which power is removed from the microprocessor outputs by opening the internal redundant shutdown path.
This only helps if the fault was caused by the microprocessor internally.
Additionally, during program execution, critical variables are continuously checked for contents integrity.

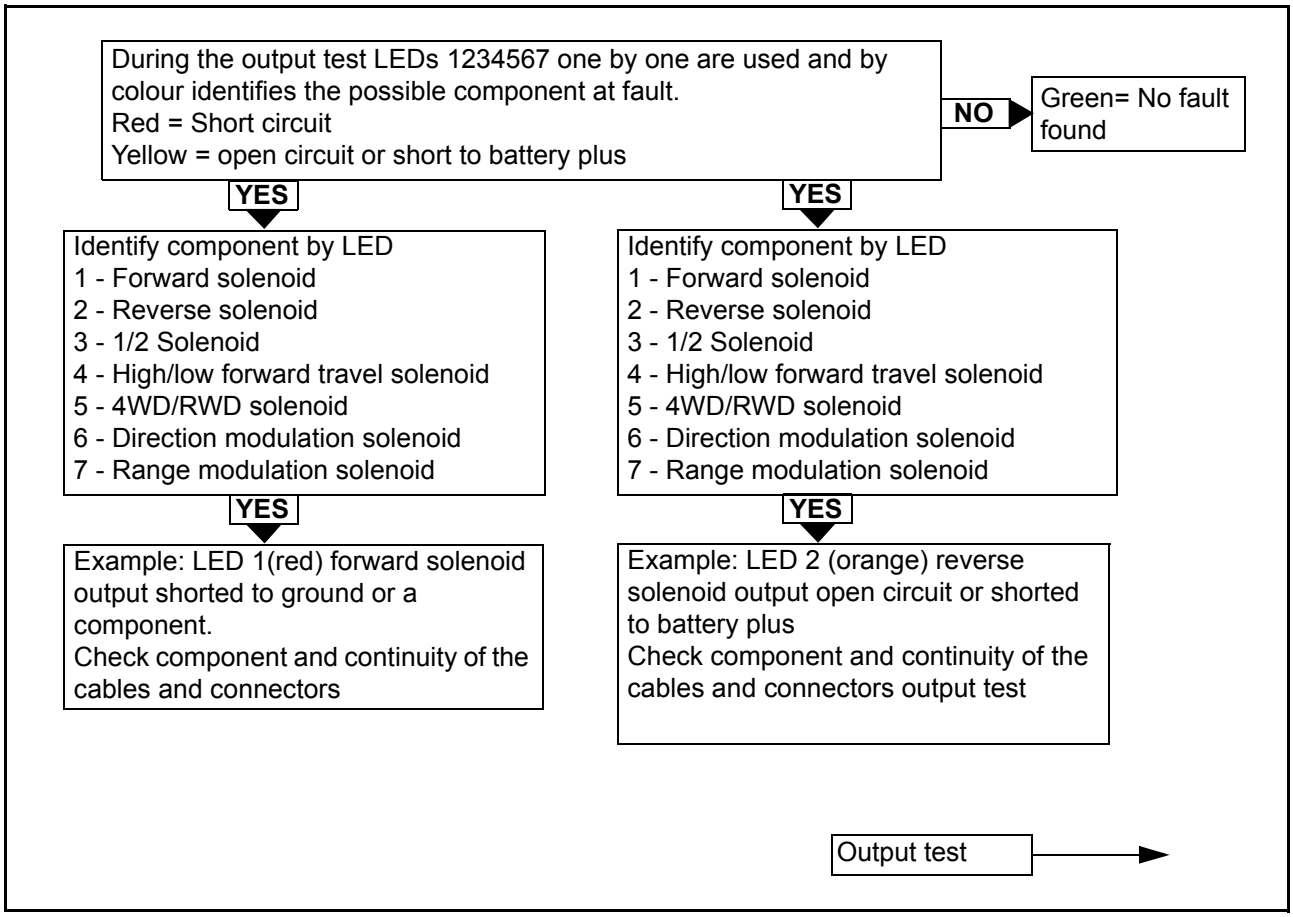


Gearshifts
low/high solenoid:
inactive = forward high is selected
active = forward low is selected

SHIFT DIAGRAM - SOLENOIDS	FORWARD	REVERSE
	1 2 3 4	1 2
reverse/n		X X
forward/n		
low/high	X X X X	
1st/2nd	X X	X

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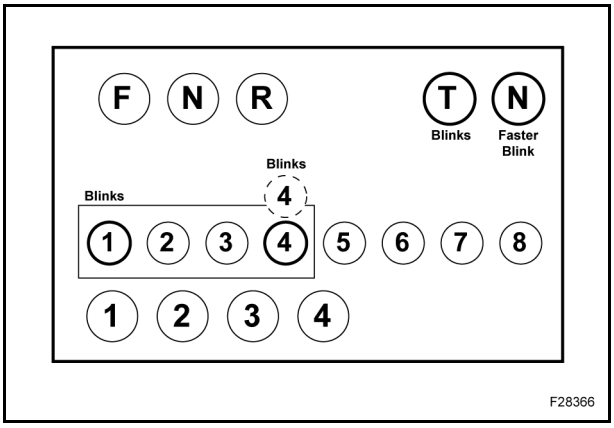
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OUTPUT FAULT - LED COLOUR

OUTPUT TEST REQUIREMENTS: powershift lever to be in forward position, twist clockwise to downshift and turn ignition on.
In this mode, driving is not possible, since all microprocessor outputs remain off until the test mode is left.
The colour and number of the LED indicates its status:

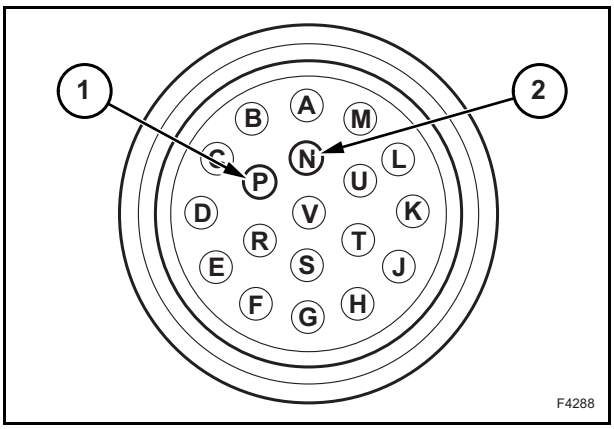
COLOUR	STATUS
GREEN	Output OK
ORANGE	Output not connected or shorted to battery plus
RED	Output shorted to ground (or to another output)



Output test - Fault by LED Number

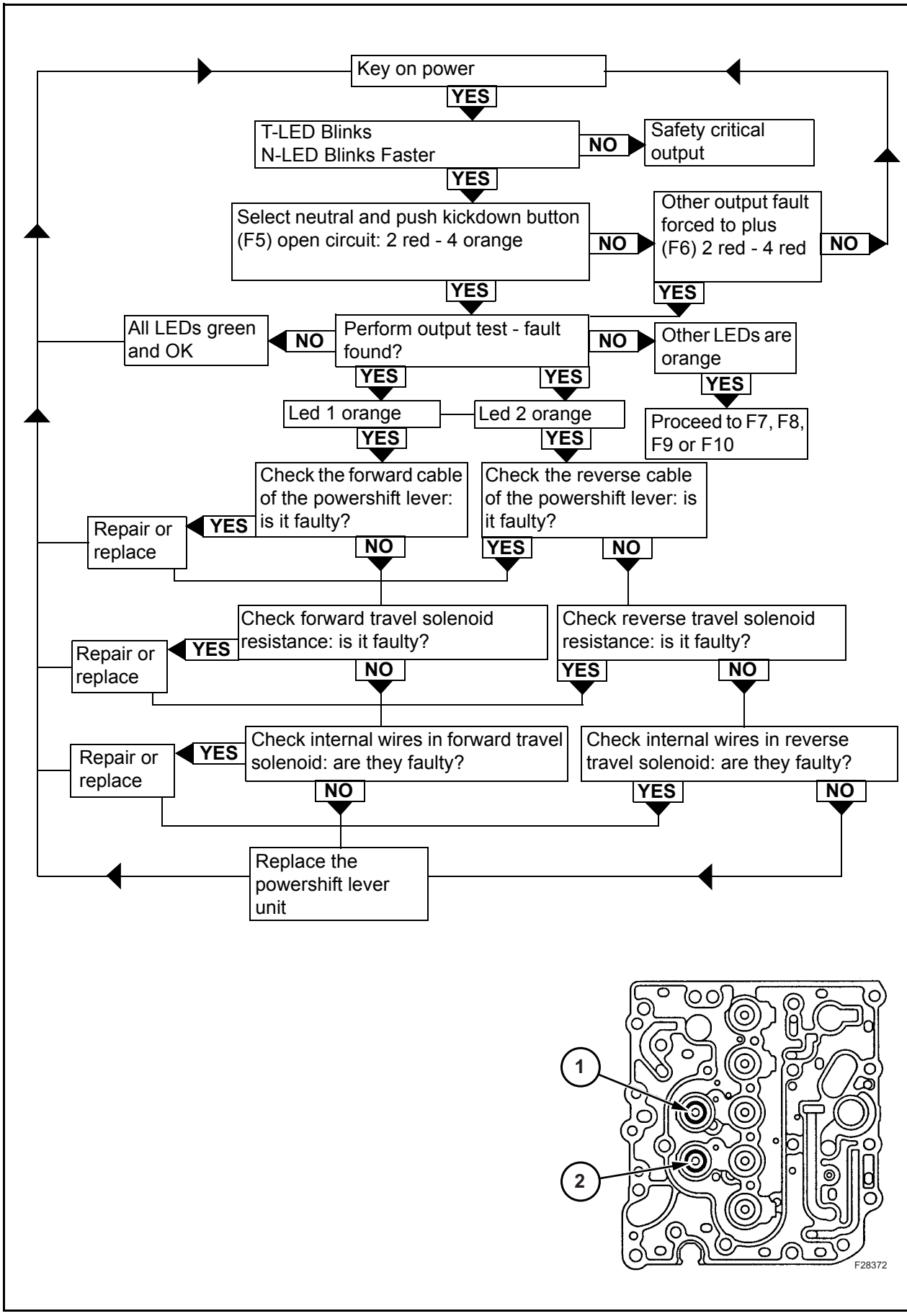
The LED numbers correspond to the connector output wires as follows:
Example:
LED 1 = Forward solenoid - colour
Orange = (Output not connected or shorted to battery plus)

LED NUMBER	OUTPUT WIRE	OUTPUT FUNCTION
1	E06	Forward solenoid
2	E07	Reverse solenoid



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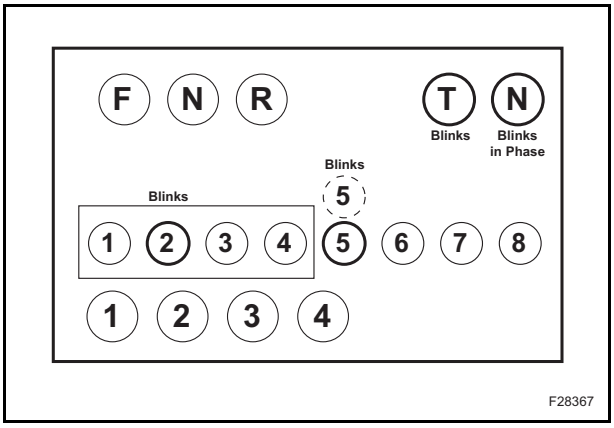
FAULT CODE F7 AND F8 / OUTPUT FAULT - STATUS BY LED COLOUR

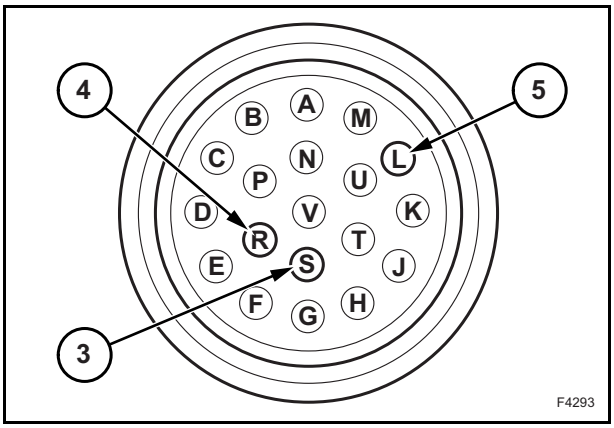
OUTPUT TEST REQUIREMENTS: powershift lever to be in forward position, twist clockwise to downshift and turn ignition on.
In this mode, driving is not possible, since all microprocessor outputs remain off until the test mode is left.
The colour and number of the LED indicates its status:

COLOUR	STATUS
GREEN	Output OK
ORANGE	Output not connected or shorted to battery plus
RED	Output shorted to ground (or to another output)

Output test - Fault by LED Number
The LED numbers correspond to the connector output wires as follows:
Example:
LED colour Red and numbered 3 = 1/2 solenoid output shorted to ground.

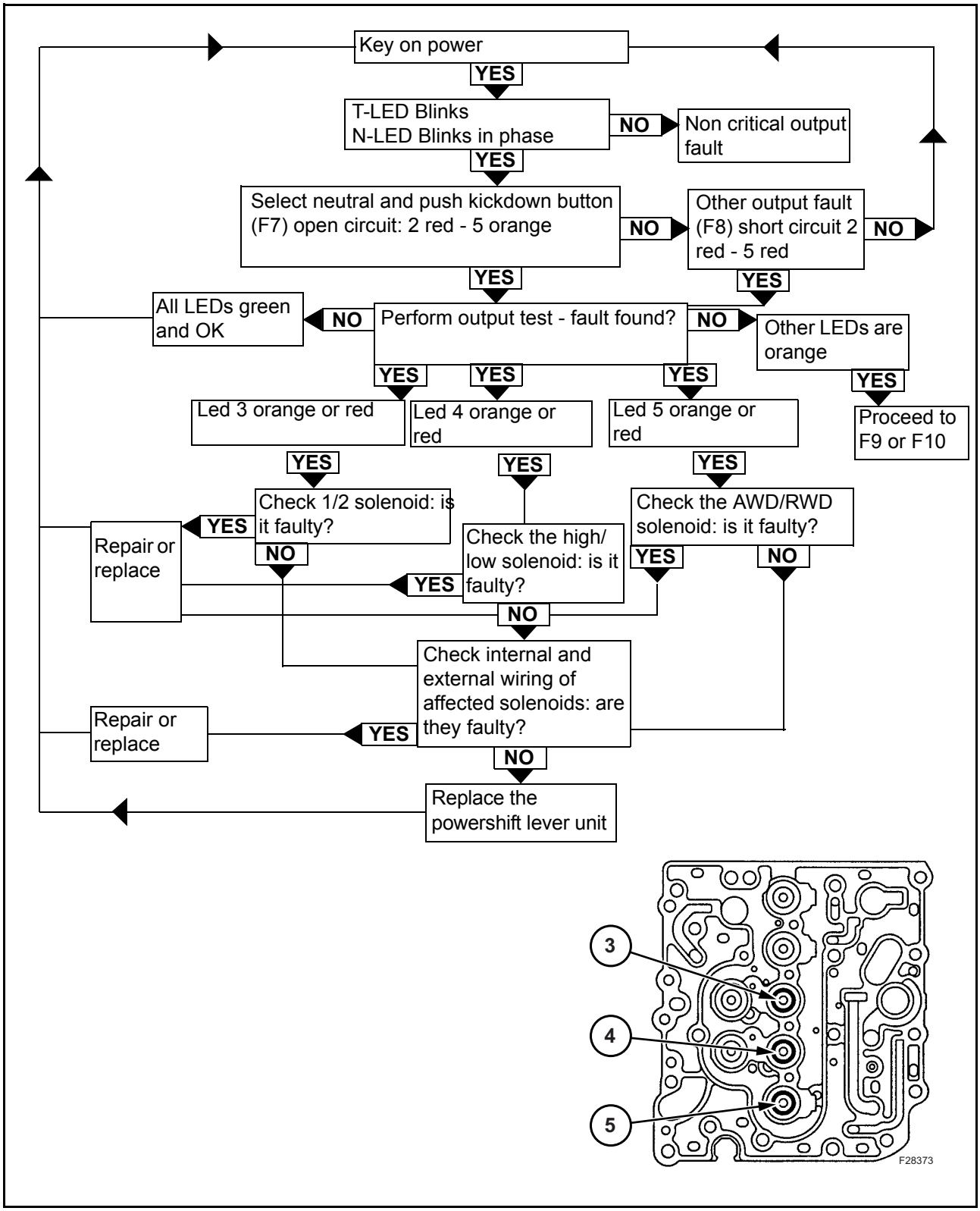
LED NUMBER	OUTPUT WIRE	OUTPUT FUNCTION
3	E04	1/2 Solenoid
4	E05	High/low forward travel solenoid
5	E09	AWD/RWD solenoid





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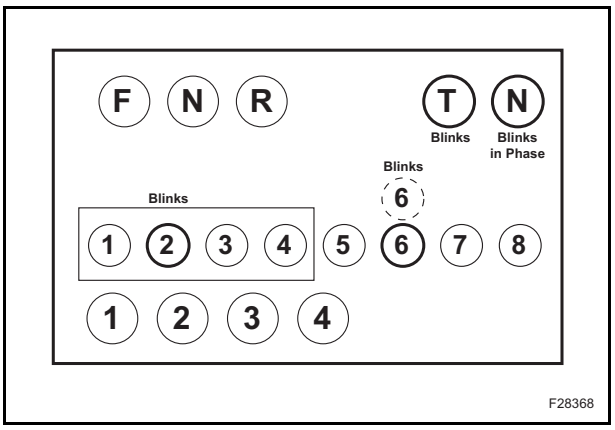


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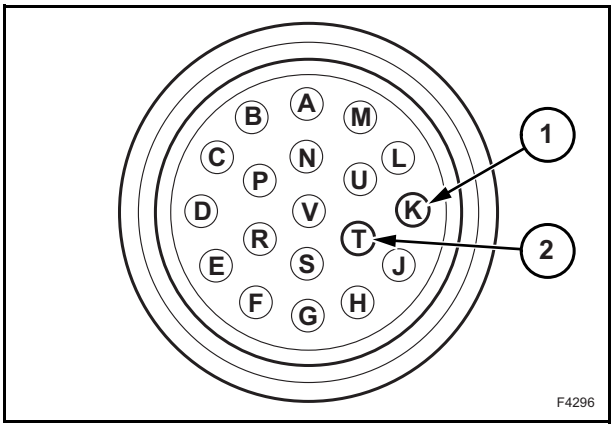
FAULT CODE F9 AND F10 / DIRECTION MODULATION OUTPUT SHORT OR OPEN CIRCUIT

A fault on this output is considered as a problem potentially reducing transmission life.
For this reason while a fault is persistent, the allowable direction change speed limit is decreased gradually (10%) each time a direction change was inhibited, down to a minimum of 20% of the maximum allowable shift speed.
After a while, this can result in a severely degraded performance (only low speed reversals are possible), but it has the advantage that the driver cannot be surprised by a sudden performance loss, which could constitute a safety hazard in itself.



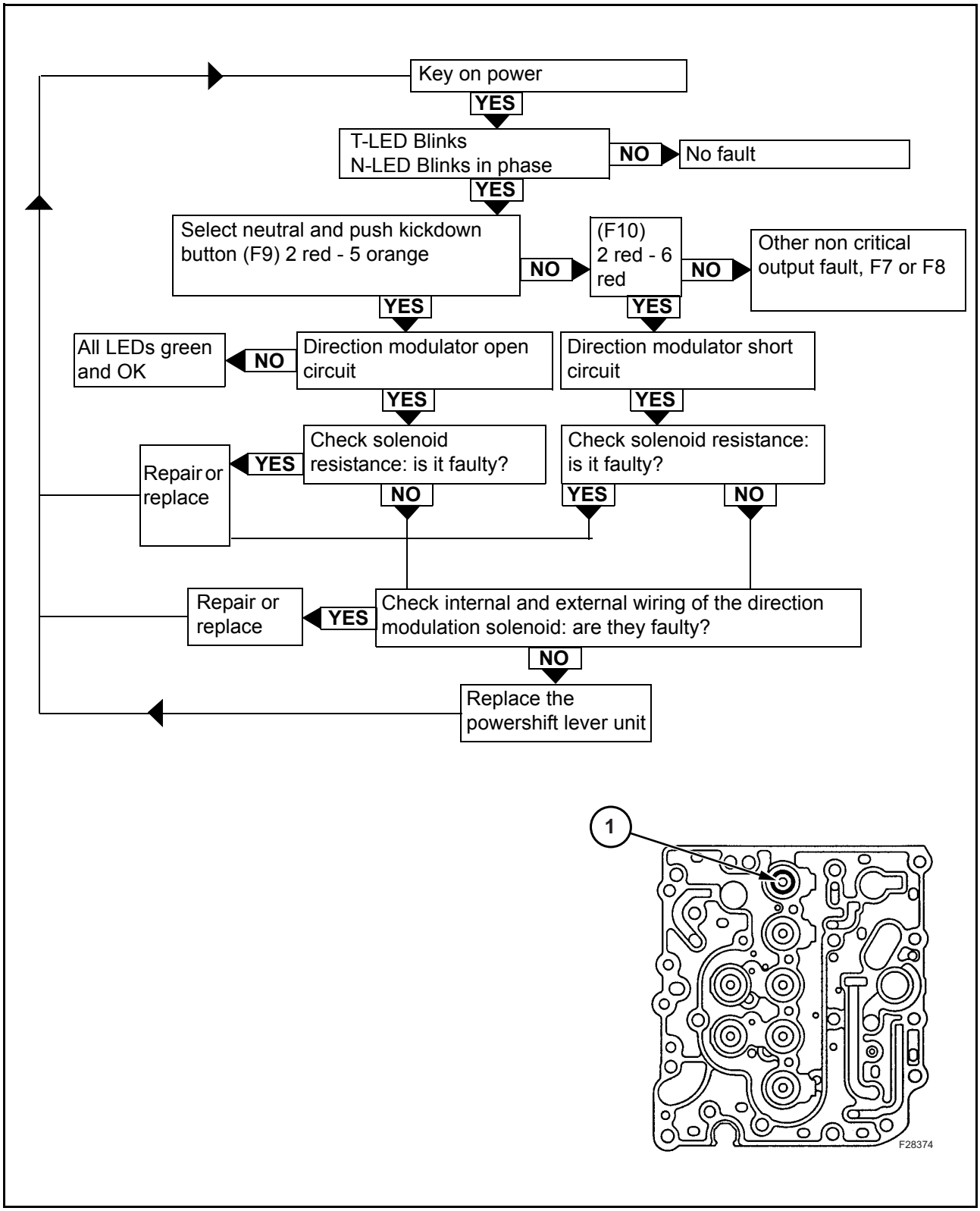
Direction Modulation Solenoid (E03) Pin T

The variable Current solenoid for direction modulation is connected to the modulation Common Plus (Pin K) at one side and to (Pin T) at the other side.
A programmable current is increased or reduced to the solenoid controlling the modulating pressure.
No current corresponds to maximum pressure.
Approximately 1 Amp corresponds with no pressure.



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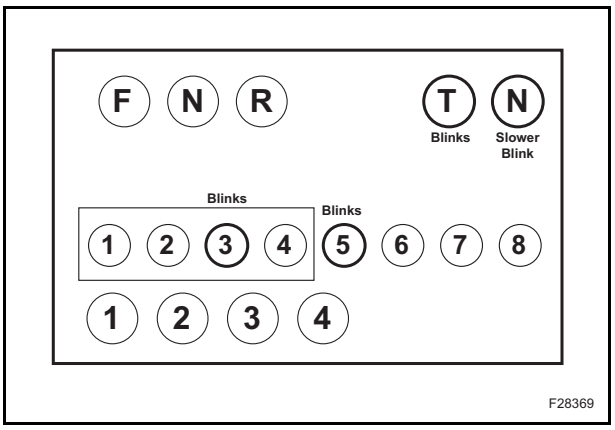
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FAULT CODE F11 / START UP FAULT LIMP HOME SELECTED

Internal faults

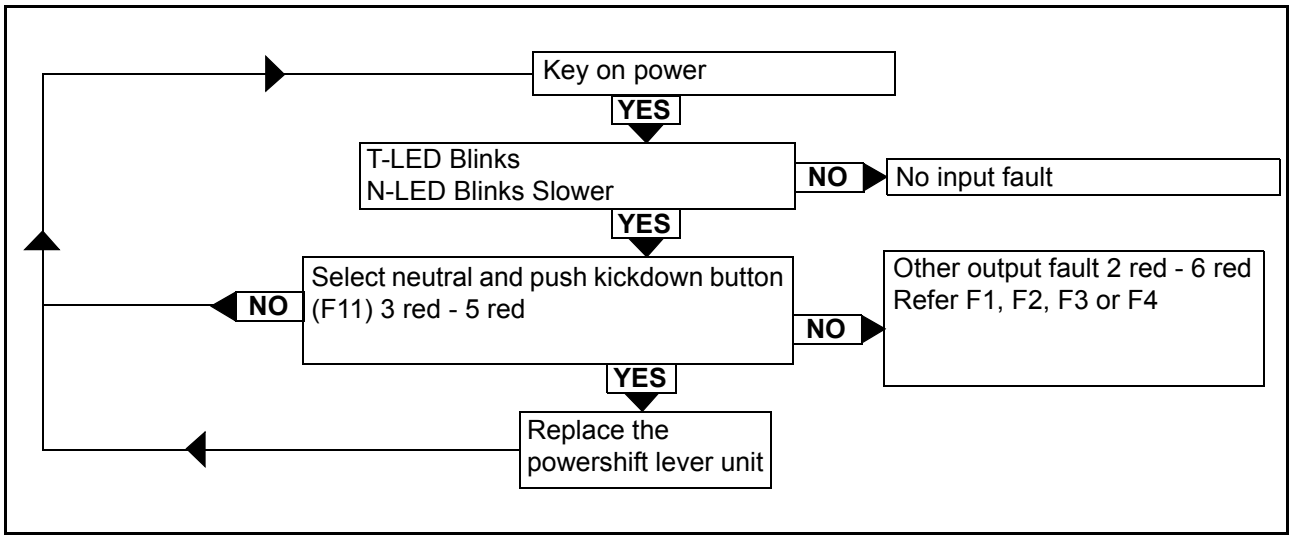
At power up a series of integrity checks is done.
If a fault is detected:

- and the fault prevent operation as a transmission controller: the microprocessor locks itself in a reset state.
- and controlling the transmission is still possible: the microprocessor reverts to limp home mode.



Limp Home mode

Defaulted to if an internal problem is detected at power up.
This model automatically selected at power up if the integrity tests show that EPROM parameters are corrupt, but the microprocessor can still function as a transmission controller (other component's integrity are intact).
In this mode the user can operate the transmission in either direction in 1st and 2nd. There are no protections: all shifts are unmodulated.



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FAULTS OTHER F12

NOT IDENTIFIED BY THE LEDS

There may be situations when an individual component develops a fault but it is not highlighted by the LEDs. If a component is in doubt proceed to input test as follows:

Perform Input test:

This test is used to verify the inputs.
In this mode driving is possible.

NOTE: the gear position indicators on the microprocessor top cover are used to display the test information.

INPUT TEST REQUIREMENTS: the powershift lever must be in forward position. Set it to upshift and start the machine. The microprocessor shifts to the input test mode.
As shown in the table below placing the shift lever in different positions in this mode illuminates its respective LED.

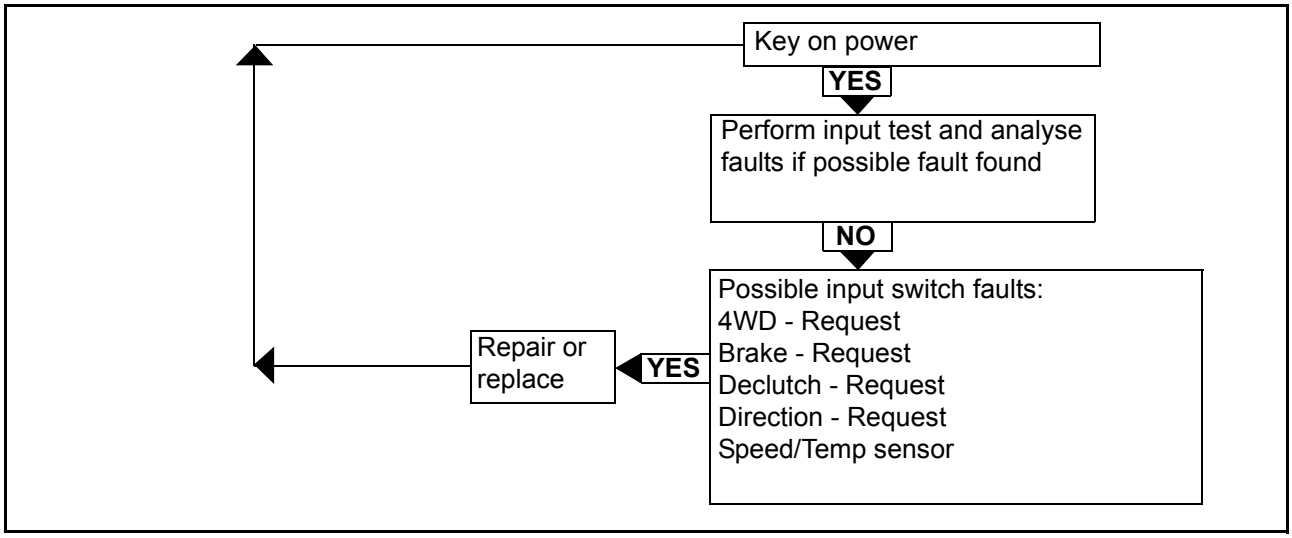
IMPORTANT: selftest modes can only be started WHILE POWERING UP (ignition on). Leaving the selftest mode is done by switching OFF the power of the microprocessor.

CHECKING OF INPUT REQUESTS	LED - NUMBER	LED COLOUR - DISPLAYED
Confirm input test is okay (lever forward, neutral, reverse) and in order check as below:		
1. Operate disconnect button on loader lever	5	GREEN = OKAY
2. Operate 4WD switch on instrument panel and foot brakes	6	GREEN = OKAY
3. Foot brake test on later models	7	RED = OKAY
4. Temperature and speed sensor: to test disconnect lead on the sensor and short to ground	8	RED = OKAY

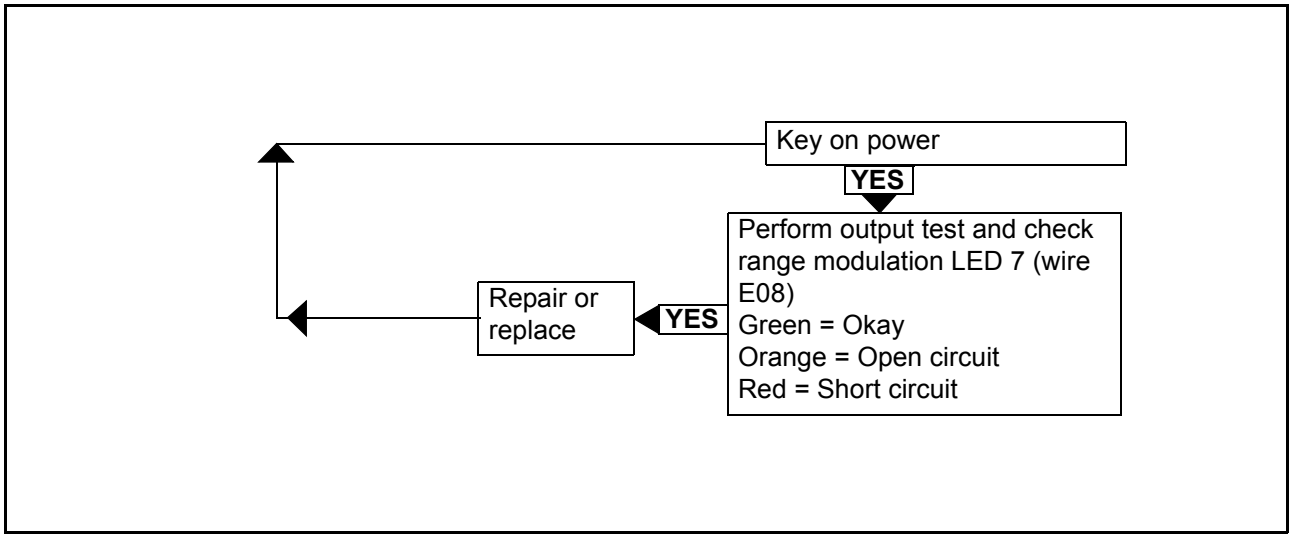
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F12



F13

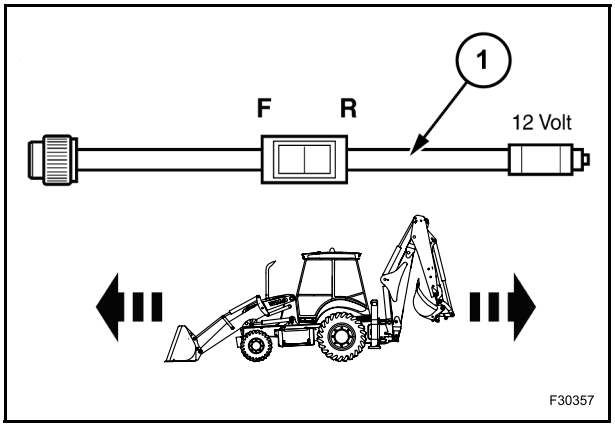


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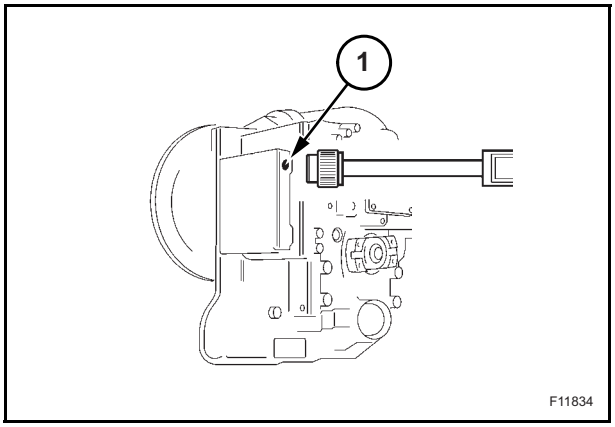
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LIMP HOME LEAD

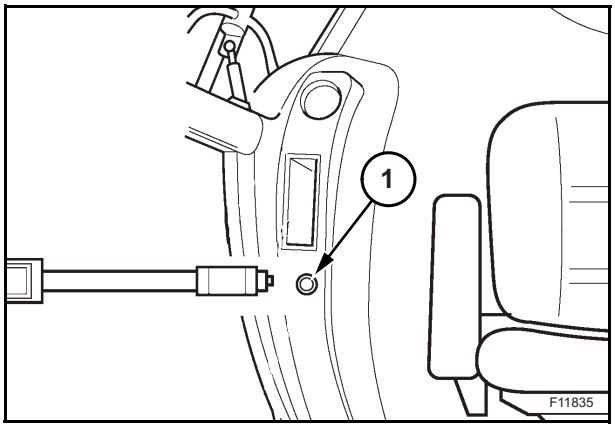
In the event of a total failure of the microprocessor such as a serious cab or loom fire the vehicle can be moved by using the limp home lead to by-pass the microprocessor.
Tool No. - **380000715**



Mounted to the left hand side and to the top of the transmission is the microprocessor loom connector. Disconnect the damaged loom and connect the limp home lead in its place.

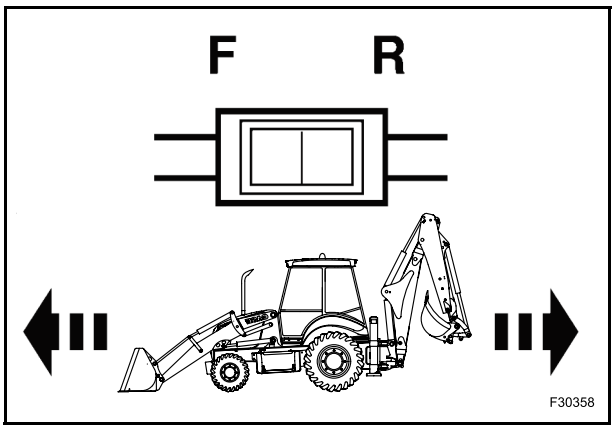


Connect the plug end into the 12 V auxiliary socket or any available 12 V supply.



When seated in the cab, start the engine and make sure that the personnel stays away from the machine. Select forward or reverse travel on the switch and the machine will move accordingly.

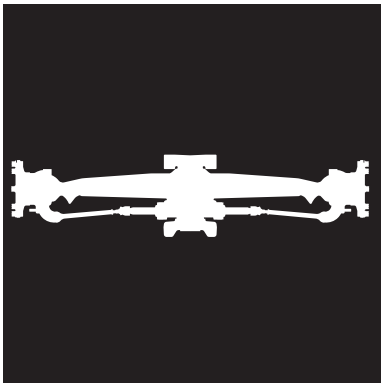
NOTE: when using the limp home lead only second gear (forward or reverse) is selectable no other gearshift or modulation is available.



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580SR
580SR+
590SR
695SR



SECTION 25 - FRONT AXLES

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4. SPECIAL TOOLS 140

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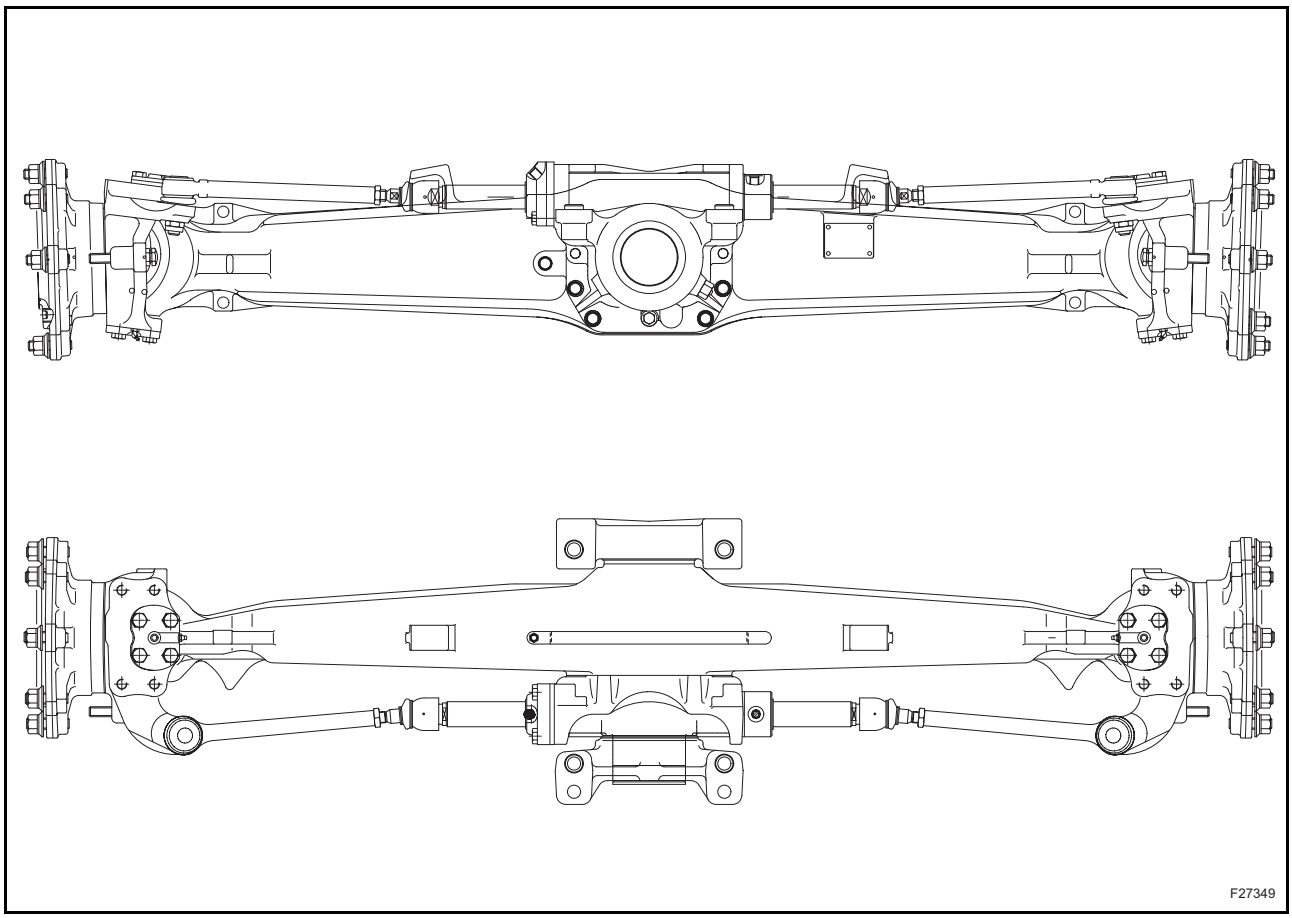
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1. FRONT AXLE 2WD “CARRARO”

1.1 SPECIFICATIONS

TYPE

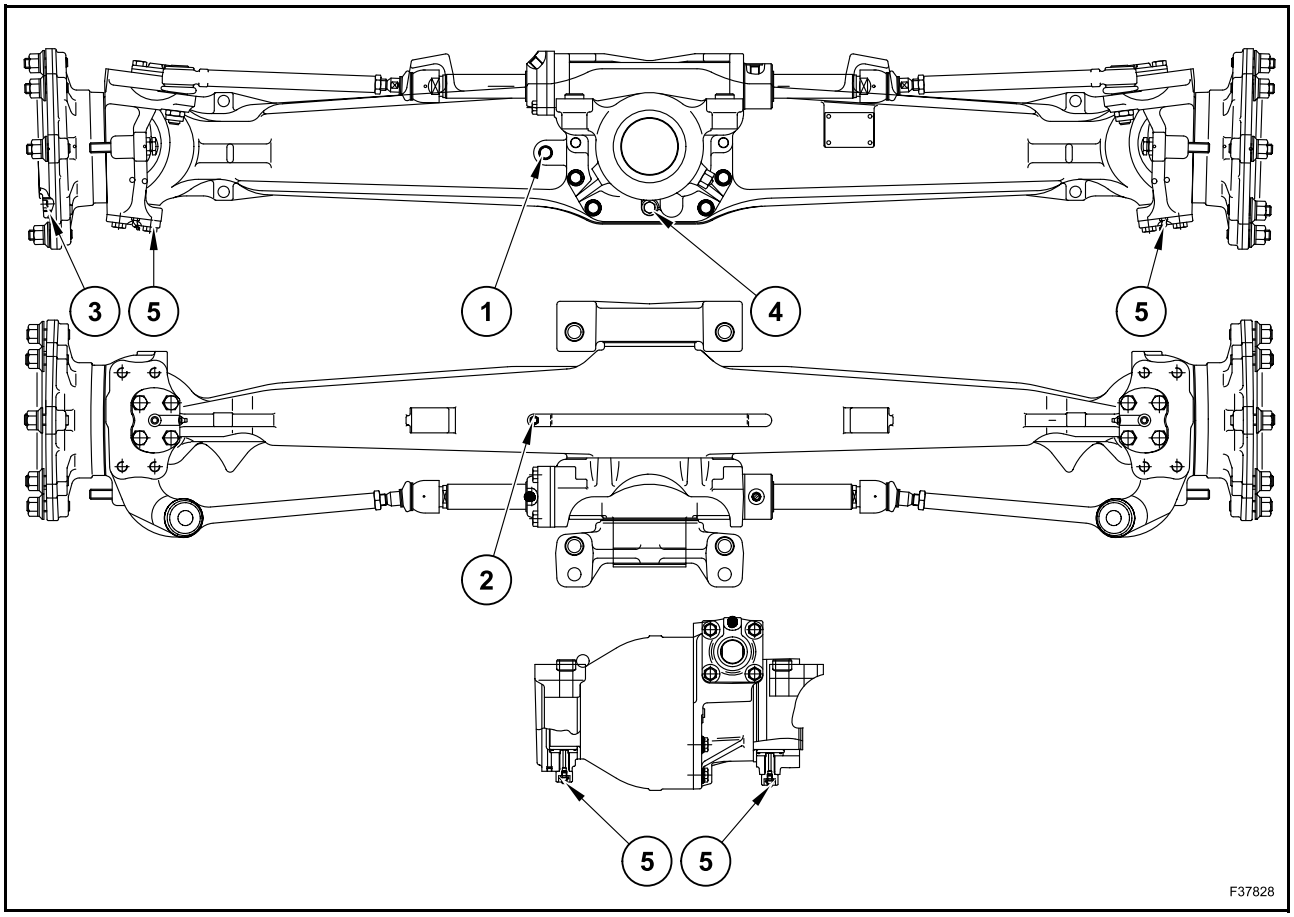
Front steering axle, model 26.00



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GREASING AND LUBRICATION



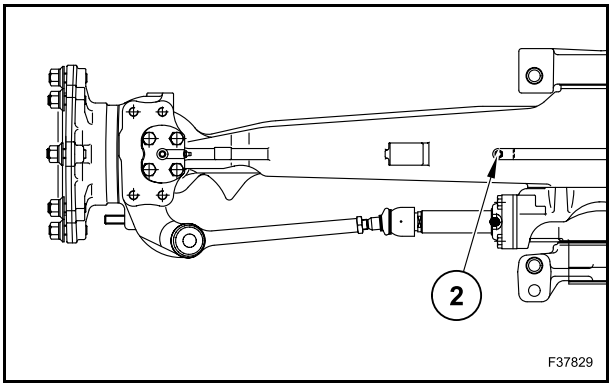
DESCRIPTION	POSITION
Oil level plug	1
Air breather	2
Level, fill and drain plug for reduction gear oil	3
Oil drain plug	4
Greasing points	5

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Before draining the oil from axle housing, use the breather (2) to release possible internal pressure.

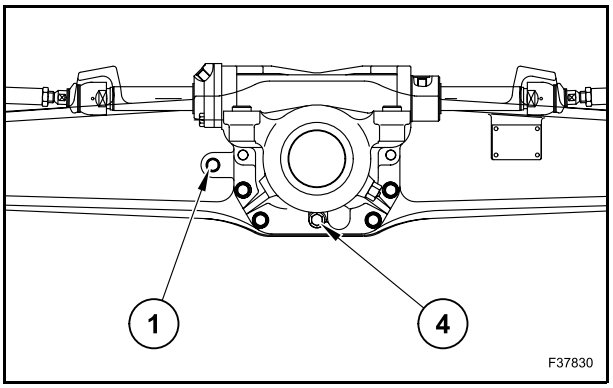
⚠ WARNING
Risk of violent oil ejection.



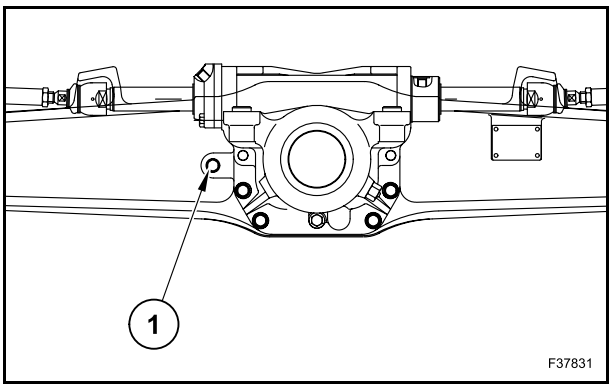
To drain the oil remove the level plug (1) and the drain plug (4).

⚠ WARNING
Risk of violent oil ejection.

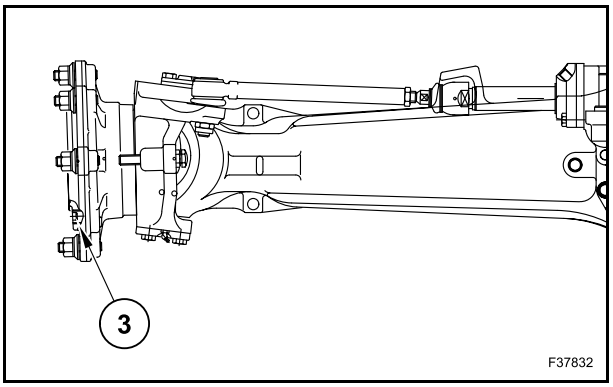
Drain all oil.
Clean the drain plug (4) and tighten to the requested torque.



Always use the oil breather (2) to release possible internal pressure.
Unscrew the level plug (1) and fill to the bottom of the level plug hole with the specified oil.
Wait to allow the oil to flow through the axle. Check oil level and fill to the specified level if necessary.
Screw the level plug (1) to the prescribed torque.



Before draining the oil from the wheel hub, rotate it so that the plug (3) is in the lowest possible position and partially unscrew the plug to release any possible internal pressure.
Remove the plug and drain the oil.

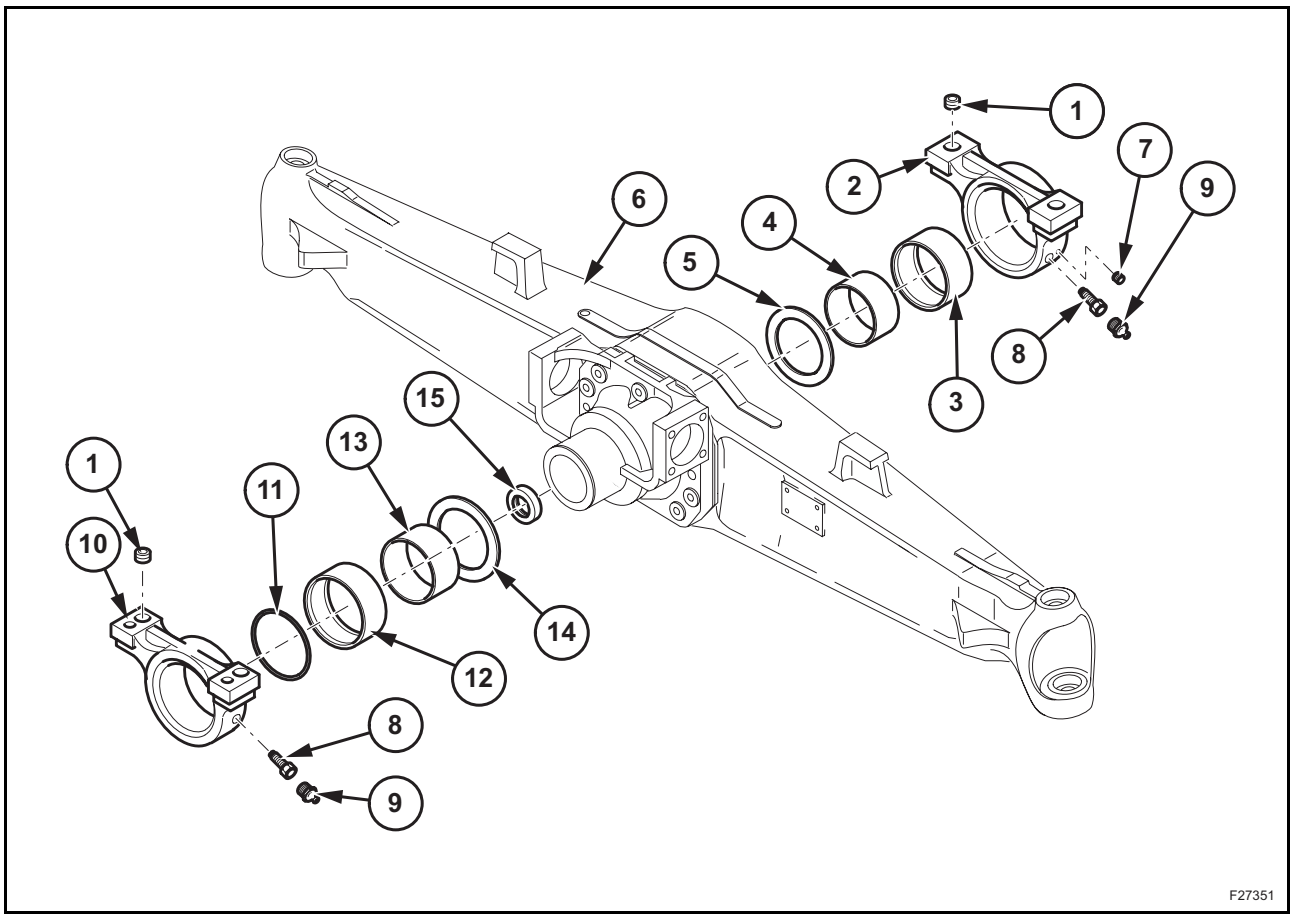


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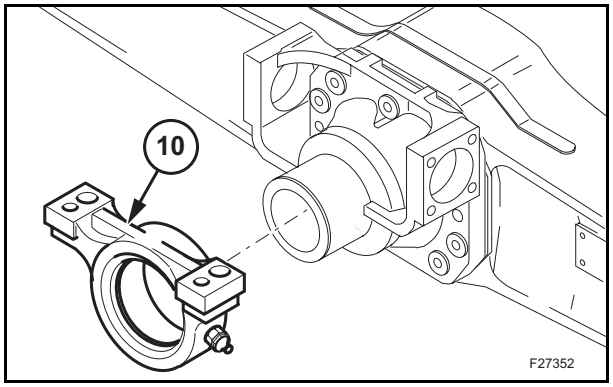
1.2 DISASSEMBLY AND ASSEMBLY

FRONT AND REAR SUPPORT



Disassembly

Remove the rear support (10) from the differential support.

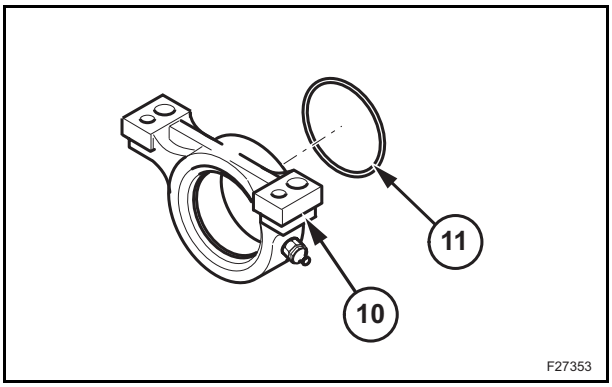


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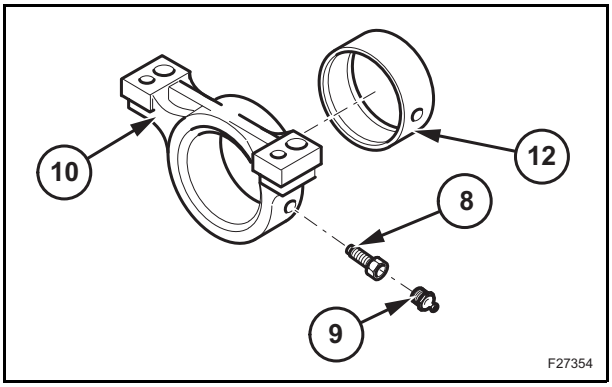
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Remove the O-ring (11) from the rear support (10).

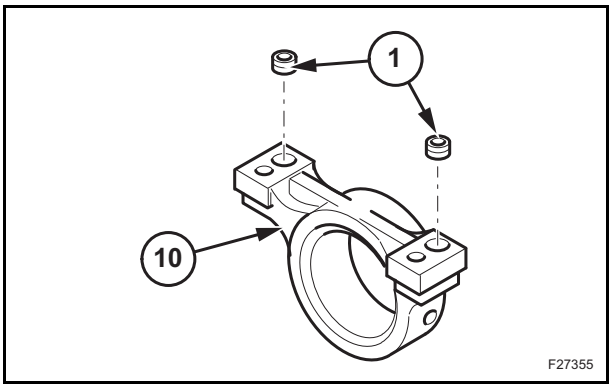
NOTE: this is a destructive operation for the O-ring.



Remove the bolt (8) with the lube nibble (9).
Remove the bush (12) from the rear support (10).

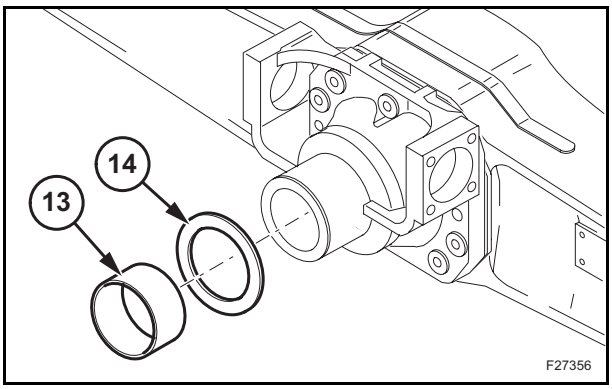


Remove the bushes (1) from the rear support (10).



Remove the bush (13) and the thrust washer (14) from differential support only if necessary.

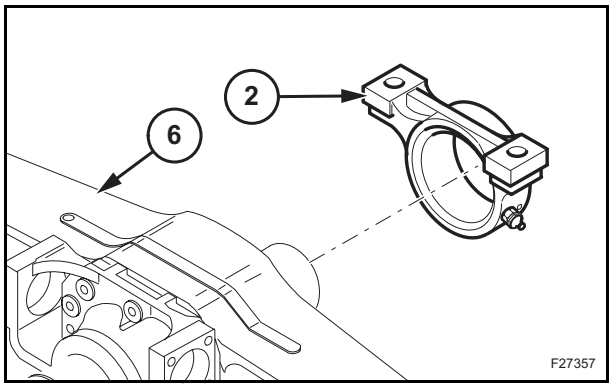
NOTE: it is advisable to heat the bush (13) to make easy this operation; this is a destructive operation for the bush.



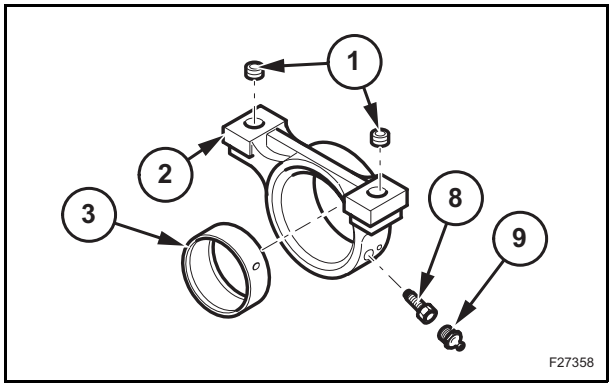
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Take the front support (2) out from the axle housing (6).

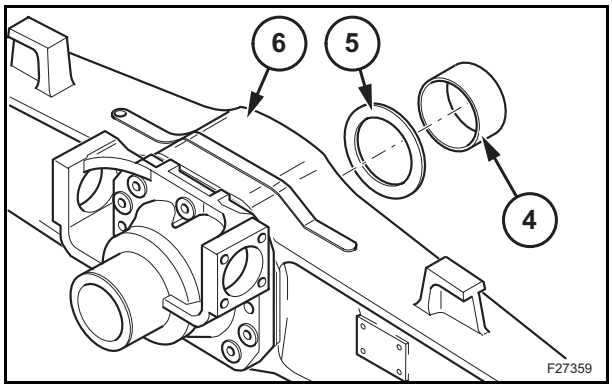


Remove the bolt (8) with the lube nibble (9).
Remove the bush (3) from the front support (2).
Remove the bushes (1) from front support (2).



Remove the bush (4) and the thrust washer (5) from axle housing (6) only if necessary.

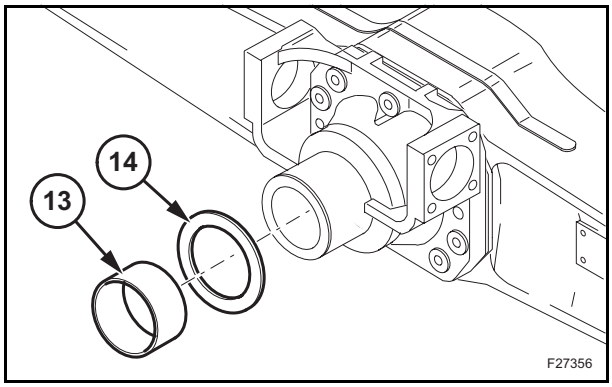
NOTE: it is advisable to heat the bush (4) to make easy this operation; this is a destructive operation for the bush.



Assembly

Insert the thrust washer (14) into the differential support.
Heat the bush (13) at 110 ÷ 120 °C then assemble it to the differential support.

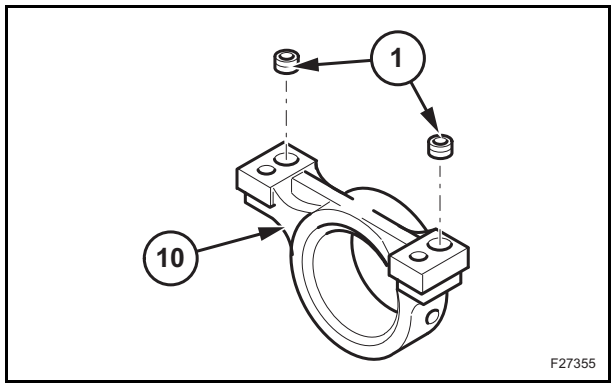
NOTE: if necessary assemble the bush (13) with a pad and a hammer.



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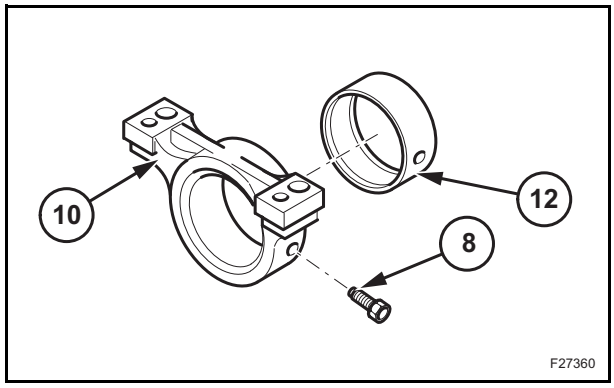
Apply sealant on the bushes (1) contact surface.
Assemble the bushes (1) to the rear support (10) with a pad and a hammer.



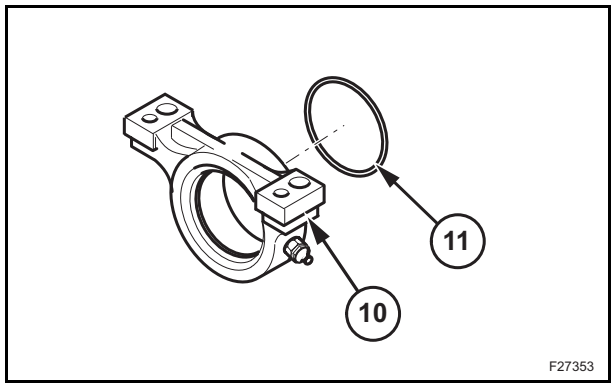
Assemble the bush (12) in the rear support (10).

⚠ WARNING
Align the bush hole with the bolt (8) hole.

Mount the bolt (8).



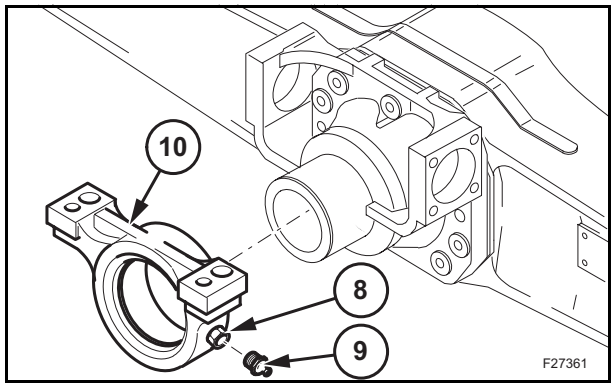
Lubricate with grease a new O-ring (11).
Insert the O-ring (11) in the rear support (10).



Insert the rear support (10) on the differential support.

⚠ WARNING
Do not damage the O-ring when inserting the rear support on the axle housing.

Tighten the bolt (8) to the request torque and tighten the lube nibble (9).

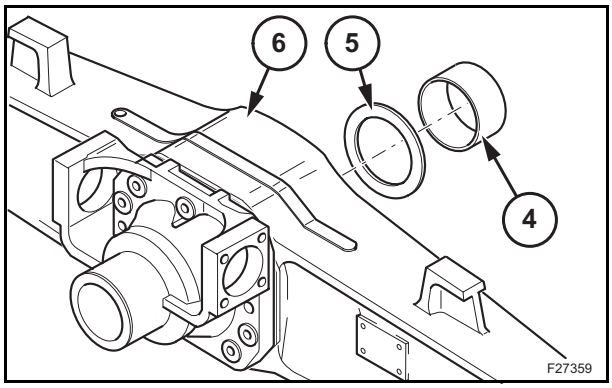


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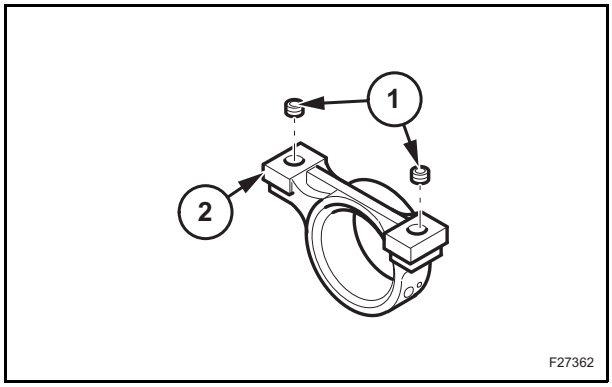
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Insert the thrust washer (5) into the front support seat.
Heat the bush (4) at 110 ÷ 120 °C then assemble it to the axle housing (6).

NOTE: if necessary assemble the bush (4) with a pad and a hammer.



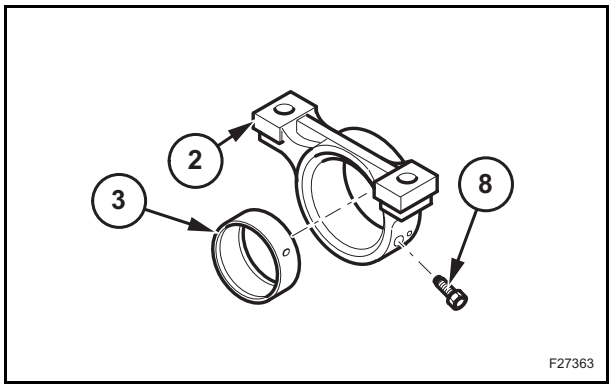
Apply sealant on the bushes (1) contact surface.
Assemble the bushes (1) to the front support (2) with a pad and a hammer.



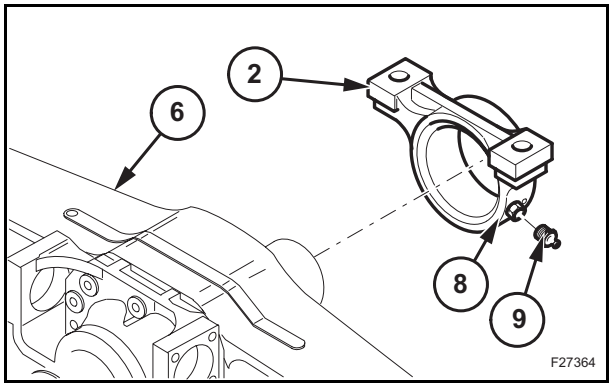
Assemble the bush (3) into the front support (2) with a suitable driver and a hammer.

⚠ WARNING
Align the bush hole with the bolt (8) hole.

Mount the bolt (8).



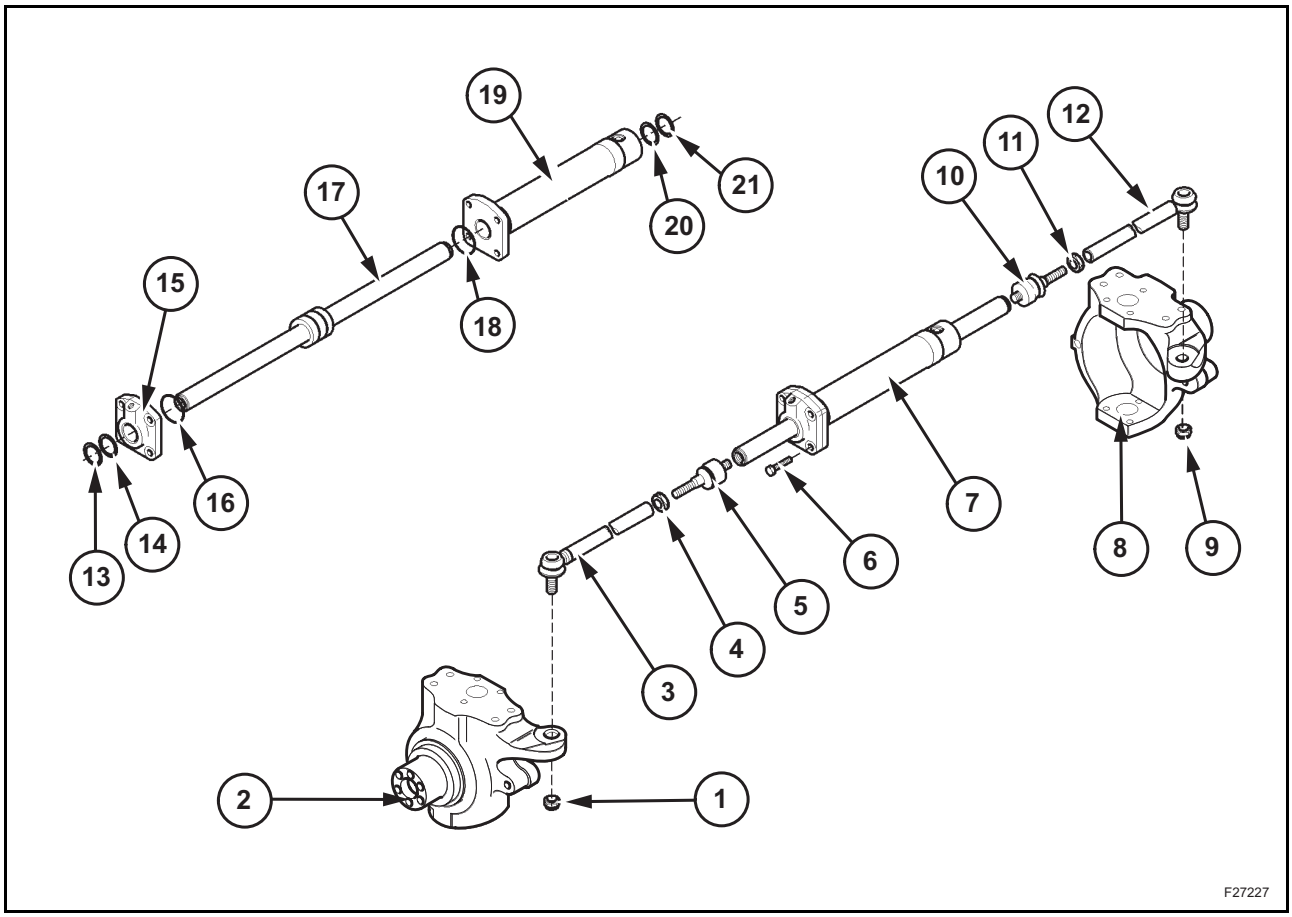
Insert the front support (2) on the axle housing (6).
Tighten the bolt (8) to the request torque and tighten the lube nibble (9).



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STEERING CYLINDER



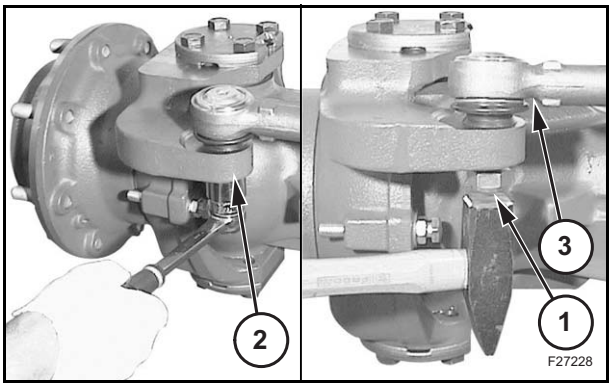
Disassembly

Loosen the nut (1) with enough turns till it is protruding over the threaded pin end of the tie rod (3).
Hit the nut (1) with an appropriate hammer in order to separate the tie rod (3) from the swivel housing (2).

⚠ WARNING
Don't beat on the threaded pin end of the tie rod (3).

NOTE: this is a destructive operation for the nut (1).

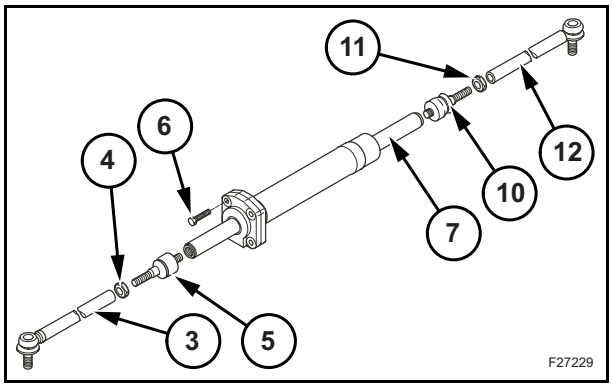
Repeat the whole sequence at the other side.



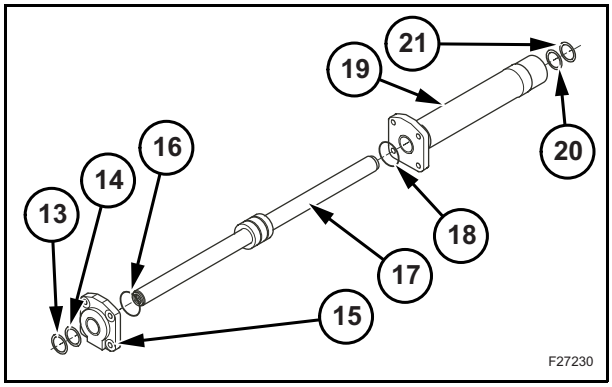
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Remove the tie rods (3) and (12) by loosening the nuts (4) and (11) with a suitable wrench, then check their conditions.
Unscrew the fastening screws (6) and take the steering cylinder (7) out of its housing; if necessary, use a rubber hammer.
Remove only parts that need to be overhauled and/or replaced.

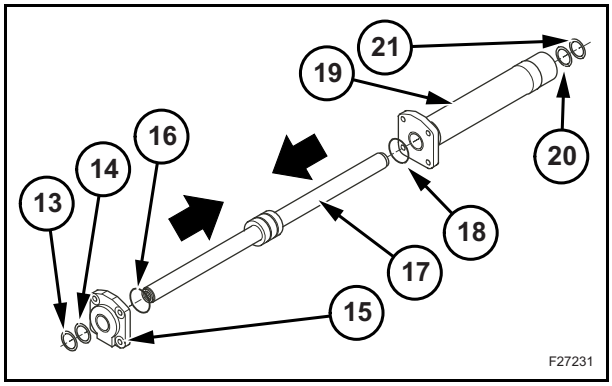


Remove the cylinder head (15) from the cylinder body (19) and remove it from the rod (17).
Remove the rod (17) from the cylinder body (19).
Remove all the seals and O-rings (13, 14, 16, 18, 20 and 21) from the cylinder body (19), the cylinder head (15), and the rod (17).

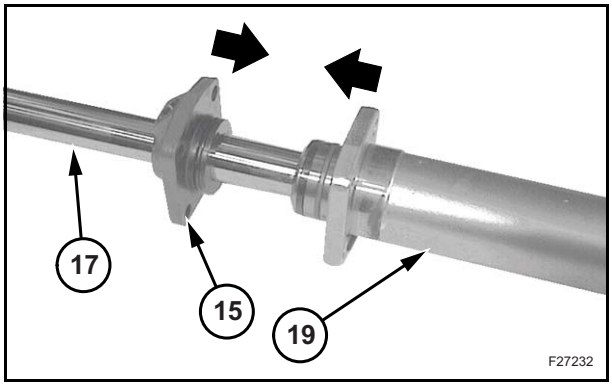


Assembly

Assemble new seals and O-rings (13, 14, 16, 18, 20 and 21) on the cylinder head (15), on the piston rod (17) and on the cylinder body (19).



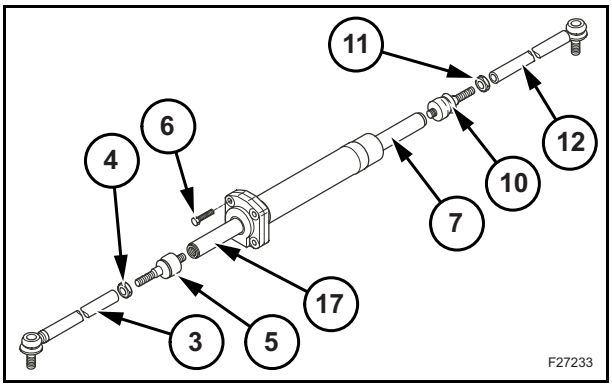
Assemble the cylinder head (15) on the rod (17).
Slide the pre-assembled rod (17) into the cylinder body (19).



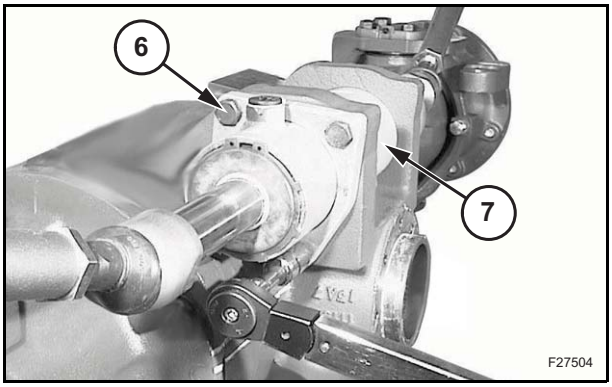
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Assemble the tie rods (3) and (12), the ball joints (5) and (10), the nuts (4) and (11) to the ends of the rod (17), then tighten to the requested torque.



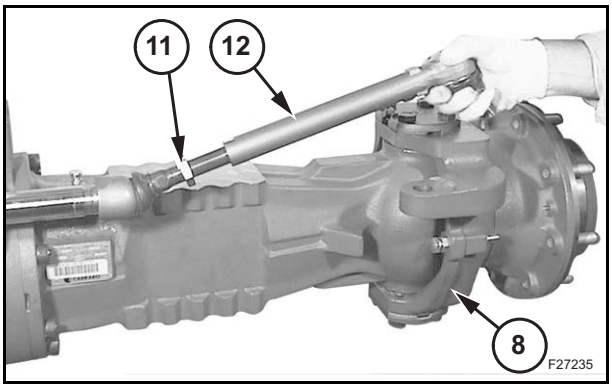
Install the steering cylinder (7) already assembled on the central body.
Assemble and tighten the screws (6) to the specified torque.



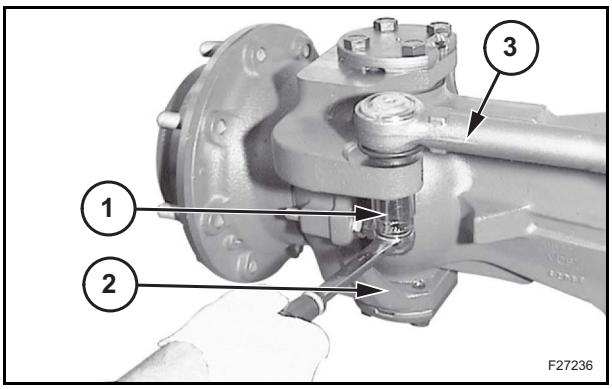
Align the swivel housing (8) with the axle.
Screw the tie rod (12) so that its ball joint can be inserted into the swivel housing (8).

NOTE: it is important to unscrew the locknut (11) to carry out this operation.

Repeat the whole sequence of the mentioned operations to the other side.



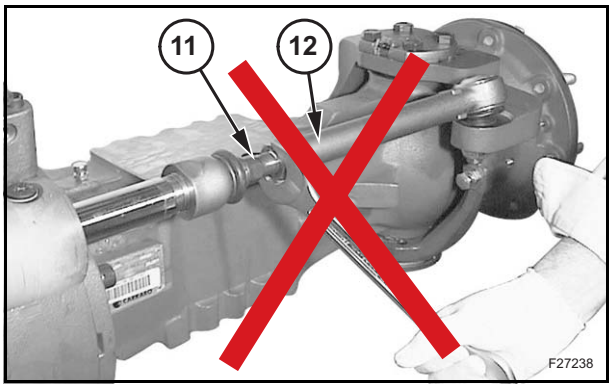
Assemble the ball joint of the tie rod (3) into its housing in the swivel housing (2).
Assemble and tighten the locknut (1) to the specified torque.
Repeat the whole sequence of the mentioned operations to the other side.



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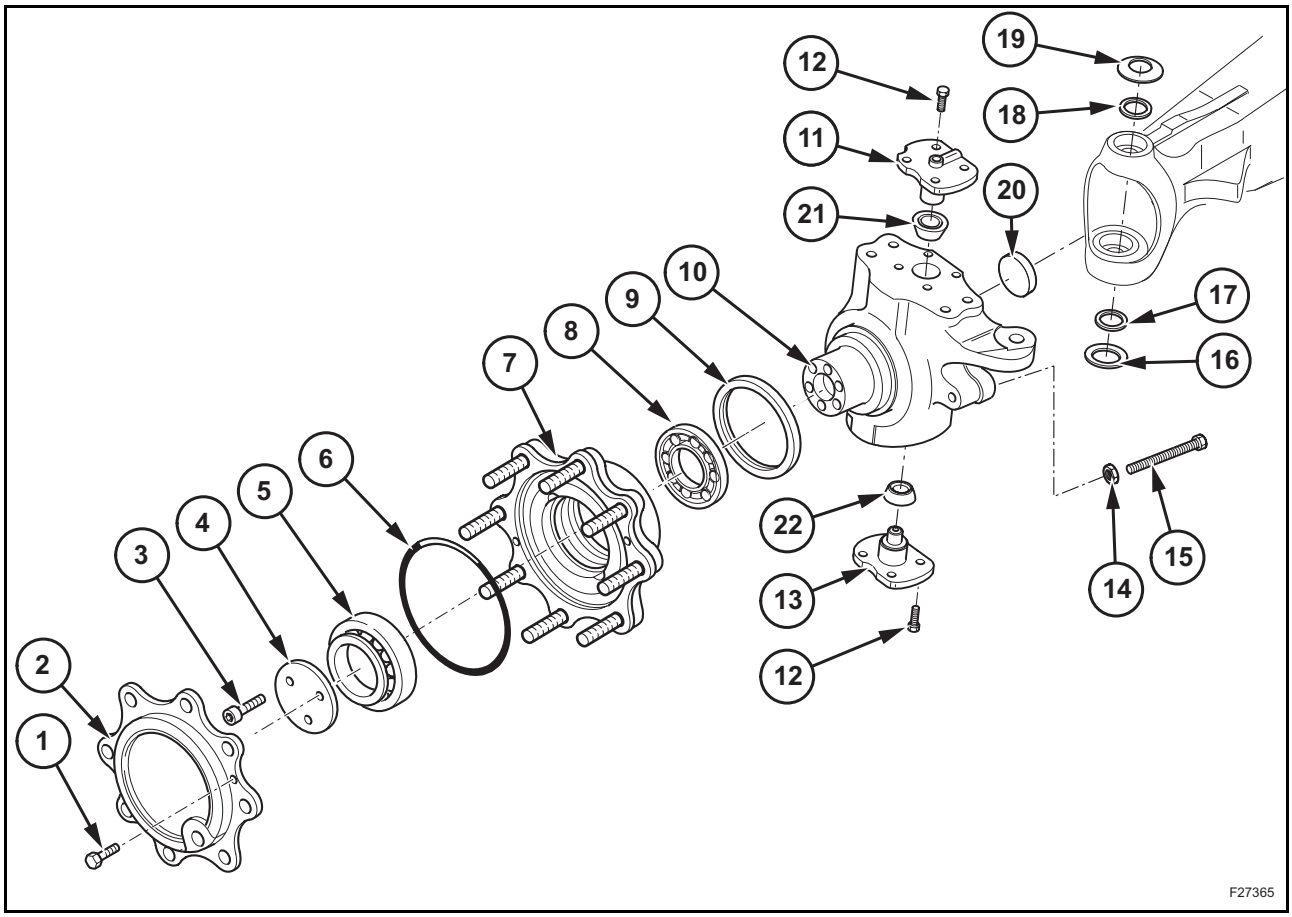
Screw the locknuts (4) and (11) of the tie rods (3) and (12) only when the toe-in adjustment has been carried out.



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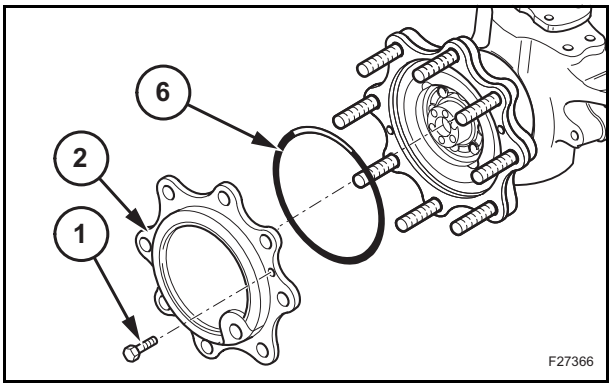
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WHEEL HUB



Disassembly

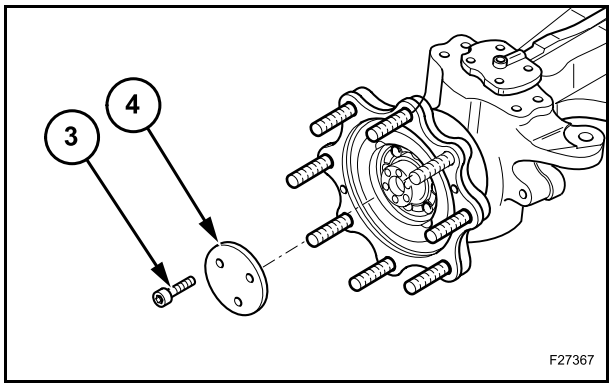
Unscrew and remove the fastening screws (1) of the cover (2). Remove the cover (2) and the O-ring (6).



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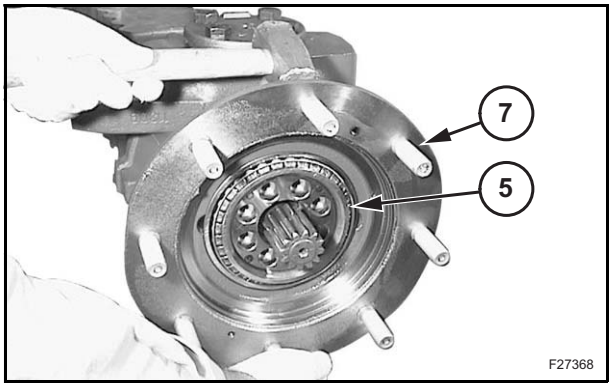
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Loosen and remove the screws (3). Remove the thrust washer (4).



Remove the wheel hub (7) using levers and a hammer to facilitate the operation.

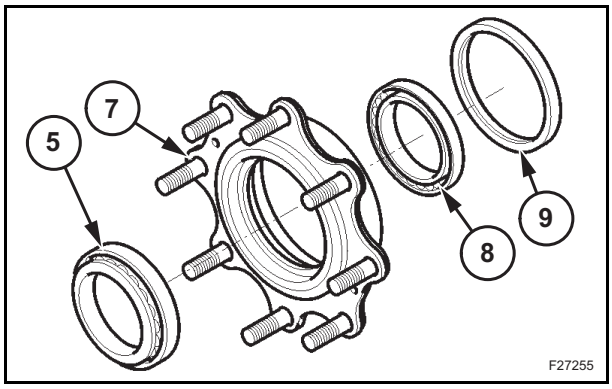
NOTE: collect the bearing cone (5).



Position the wheel hub (7) on a flat surface and remove the seal ring (9) with a lever.

NOTE: destructive operation for the seal ring (9).

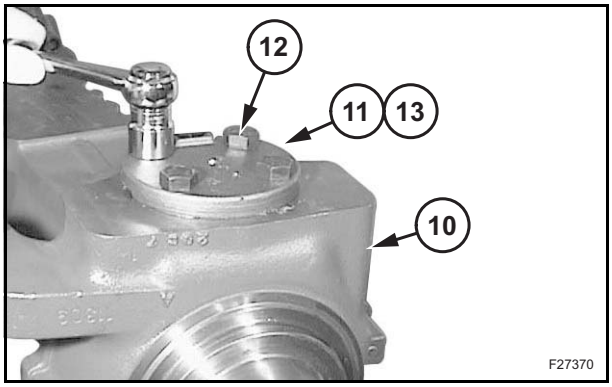
Remove the bearing cups (5) and (8) using a hammer and a suitable drift.
Remove the bearing cone (8) from the swivel housing end, using a suitable extractor.



Unscrew and remove the fastening bolts (12) from the upper (11) and lower (13) king pin.

⚠ WARNING
Before removing the king pins (11) and (13), secure the swivel housing (10) to a rope or a hoist or to any other supporting device; observe all current safety regulations to guarantee the operator's safety.

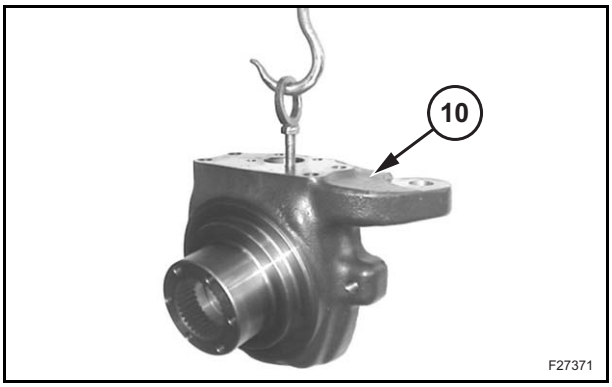
Remove the king pins (11) and (13).



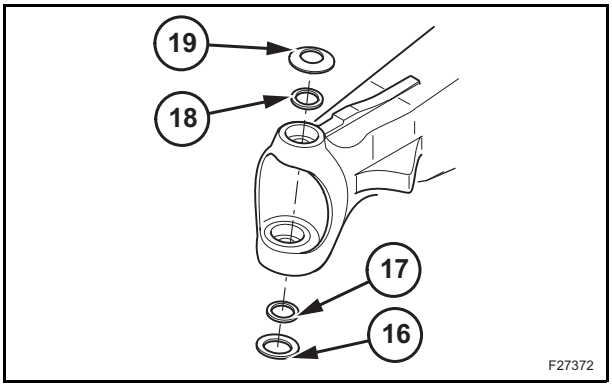
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Remove the swivel housing (10) from the axle shaft.



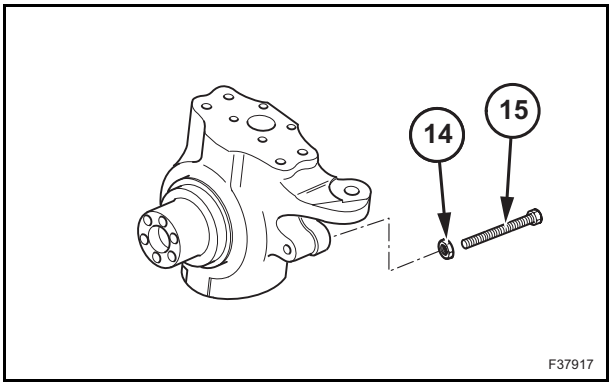
Remove the thrust washers (16) and (19) with the bushes (17) and (18).



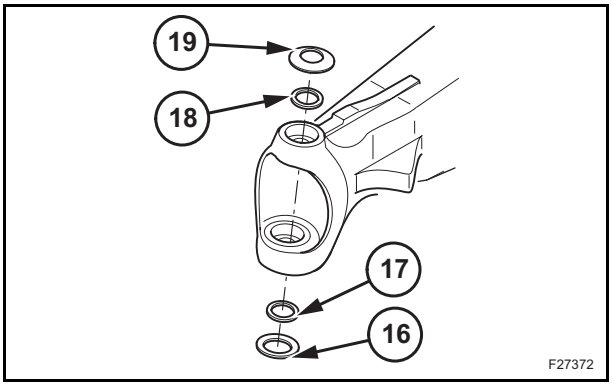
Assembly

If it has been previously removed, reassemble the steering stop composed by the screw (15) and nut (14).

NOTE: do not tighten the nut (14) until the steering angle adjustment has been done.



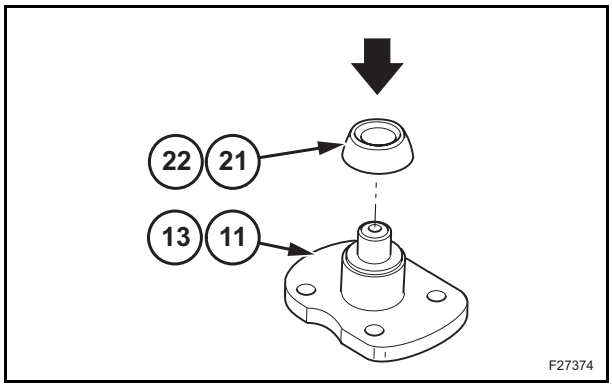
Insert the thrust washers (16) and (19) and the bushes (17) and (18).



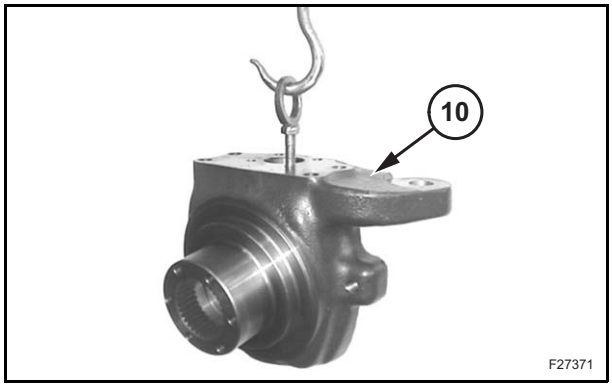
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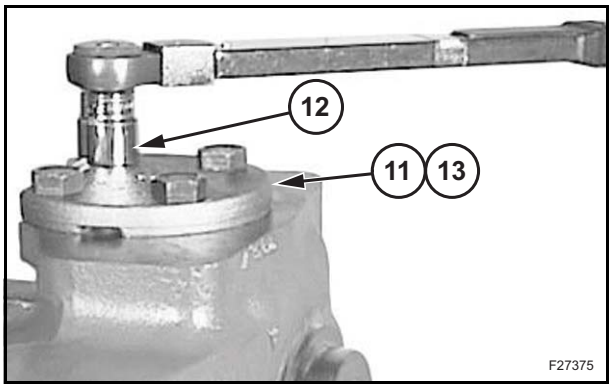
If ball joints (21) and (22) have been previously removed, reassemble them on the upper (11) and lower king pin (13).



Secure the swivel housing (10) with a belt or a rope to a hoist or to any other supporting device.
Protect the splined end of the axle shaft by winding it with an adhesive tape to avoid damage to the seal ring.
Assemble the swivel housing (10) on the axle shaft.

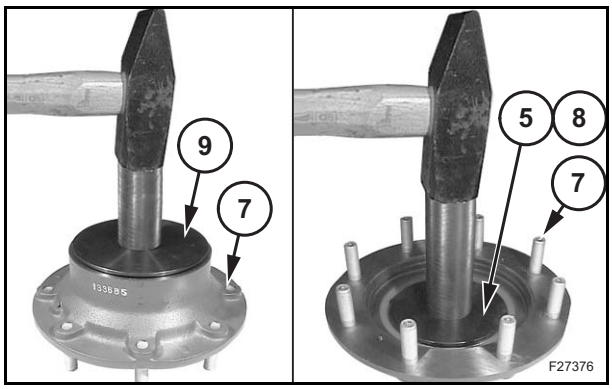


Assemble the king pins, the lower (13) and the upper (11), and tighten the retaining screws (12) to the requested torque.



Assemble both bearing cups (5) and (8) to their wheel hub (7) housings using the special tool **380002663** under a press or with a hammer.
Insert the seal ring (9) into the wheel hub (7) with the special tool **380002227** and a hammer.

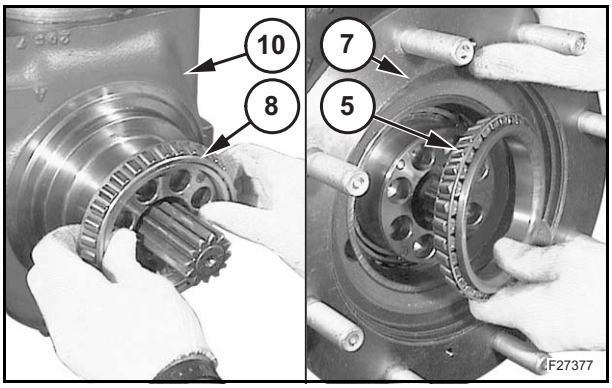
NOTE: do not lubricate the seal ring (9).



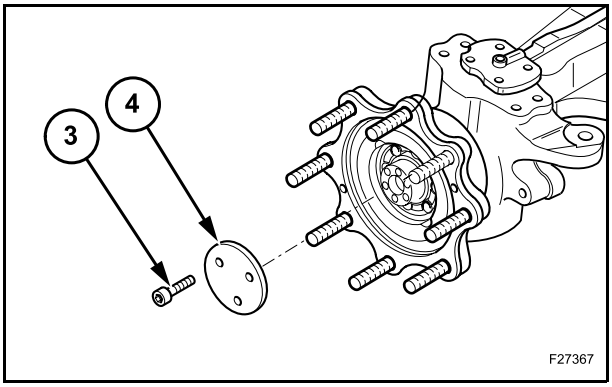
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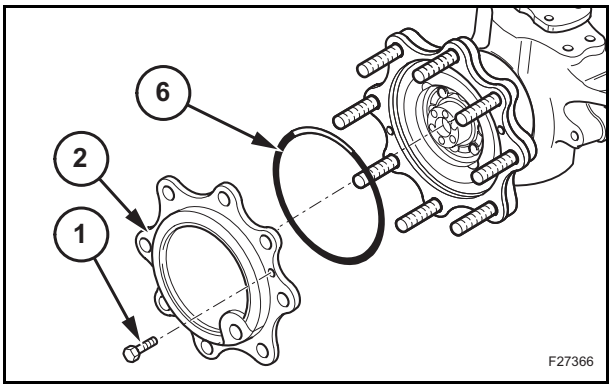
Assemble the bearing cone (8) on the swivel housing (10).
Assemble the wheel hub (7) on the swivel housing (10) and insert the bearing cone (5).



Assemble the thrust washer (4). Screw the screws (3).



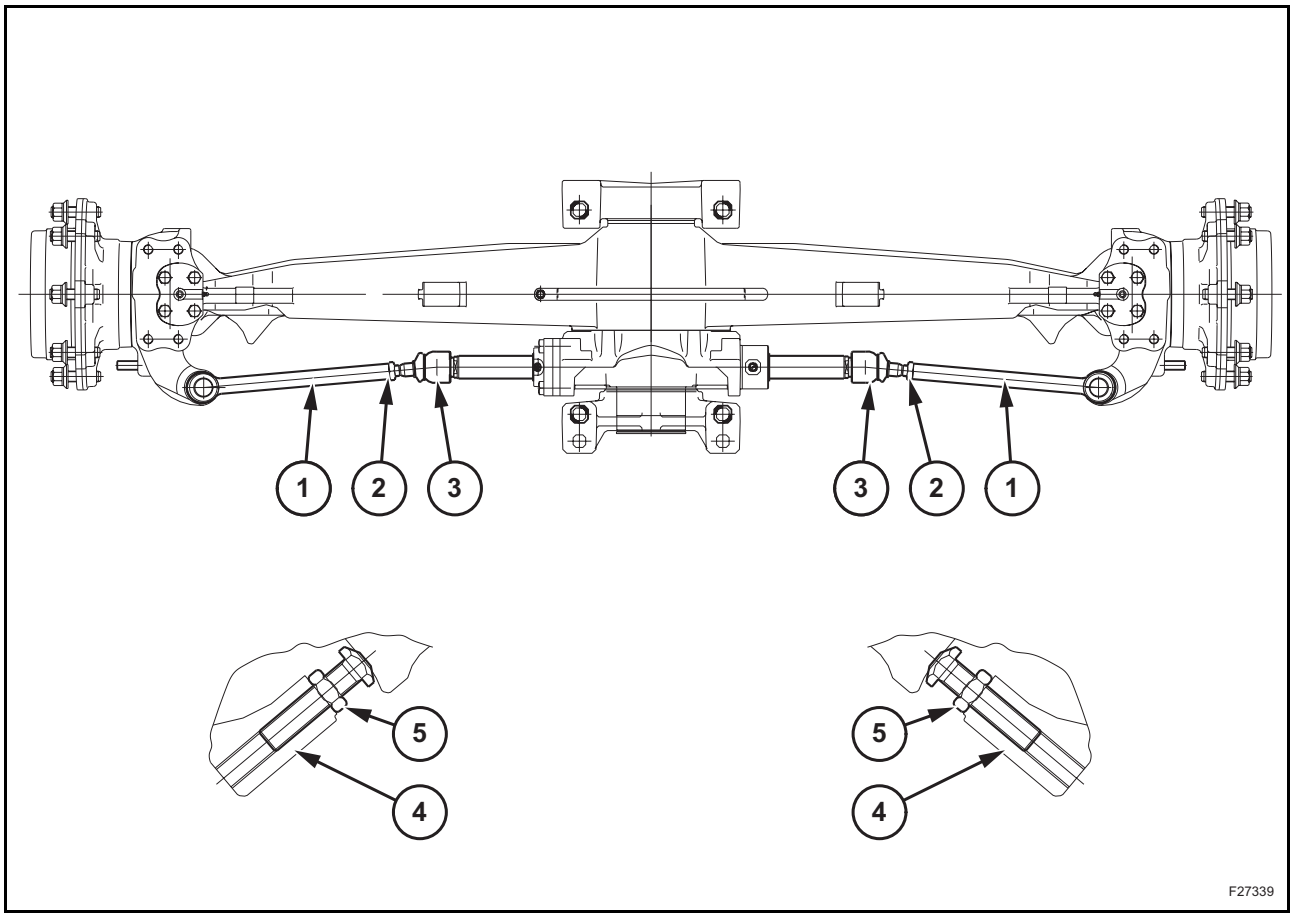
Assemble a new O-ring (6). Assemble the cover (2) and screw two screws (1). Tighten the screws (1) to the specified torque.



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TOE-IN / STEERING ANGLE

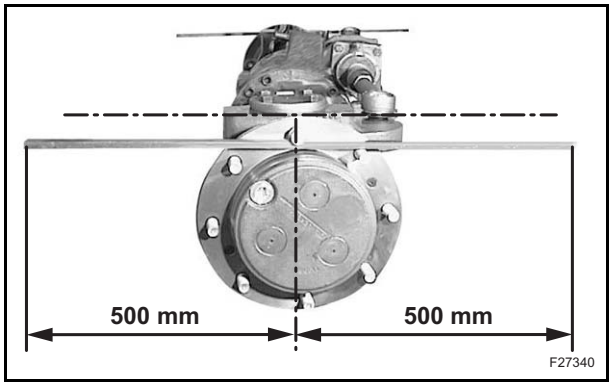


Toe-in

Put two equal 1 m long linear bars on the wheel sides and lock them with two nuts on the wheel hub stud bolt.

⚠ WARNING

The two bars should be fixed on their middle so that they are perpendicular to the supporting surface and parallel to the pinion shaft axis; align the two bars.

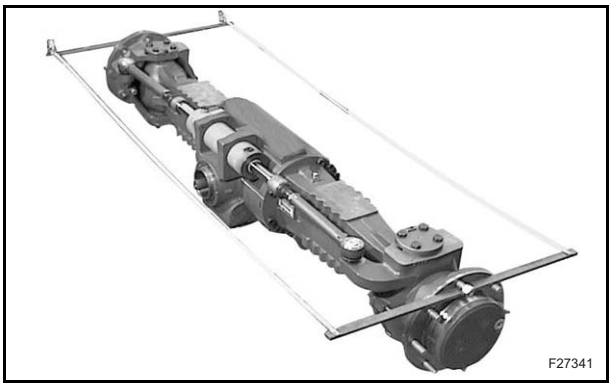


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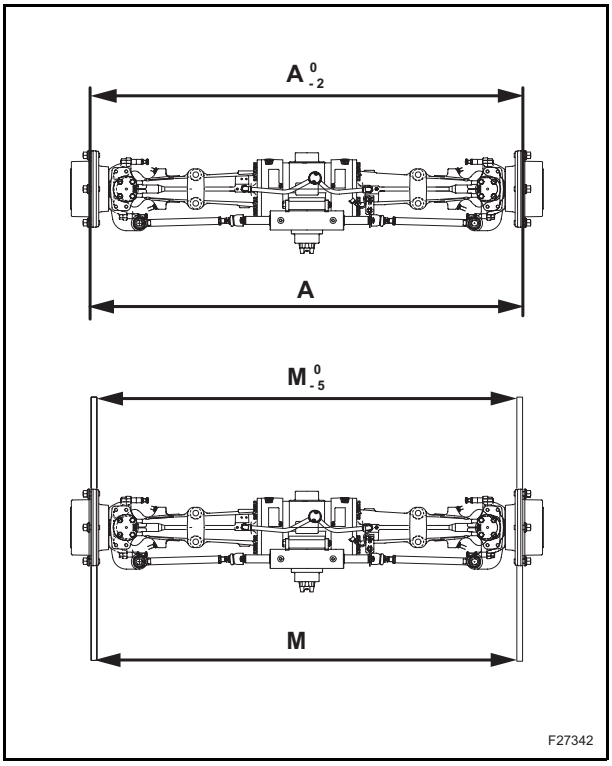
Measure the distance in mm M between the bars ends with a tapeline.

NOTE: keep the minimum value, swinging the measurement point.

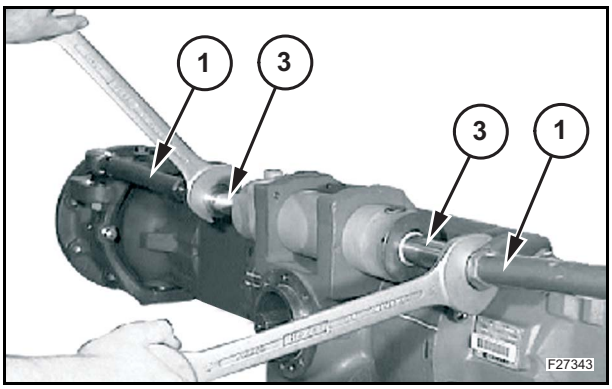


Check that the difference of the measurements between the wheel hubs diameters ends is within the requested tolerance range.
The nominal toe-in value (A) is referred to the external diameter of the wheel hubs flange, therefore the measured value (M) at the bars ends must be related to the ratio between length of the bar and flange diameter:

nominal toe-in = A^{0}_{-2} ⟶ measured toe-in = M^{0}_{-5}



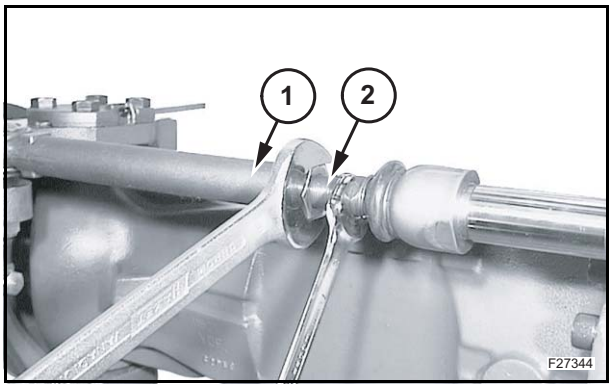
If toe-in is incorrect, operate with two wrenches on the guide rods (1) screwing in and out the two joint tie rods (3) equally till the toe-in is within the requested tolerance.



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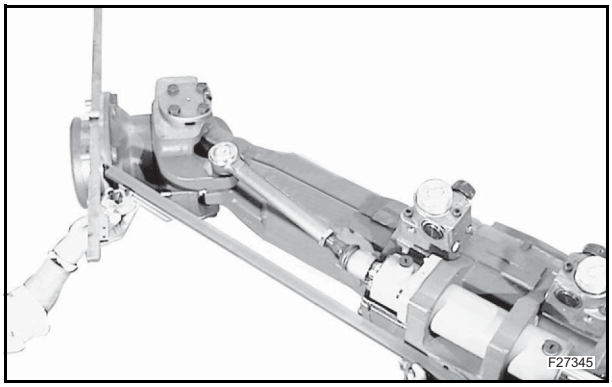
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After adjusting, screw in the locknuts (2) of the guide rods (1) to the requested tightening torque.

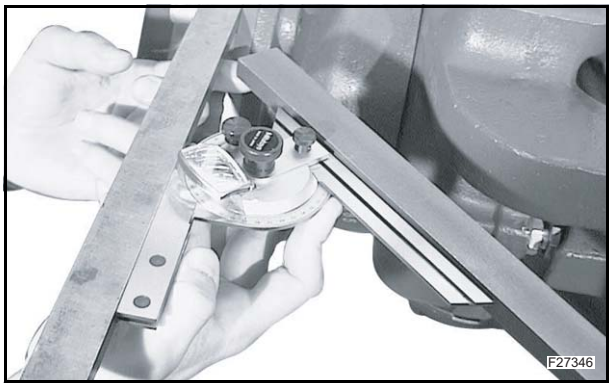


Steering angle adjustment

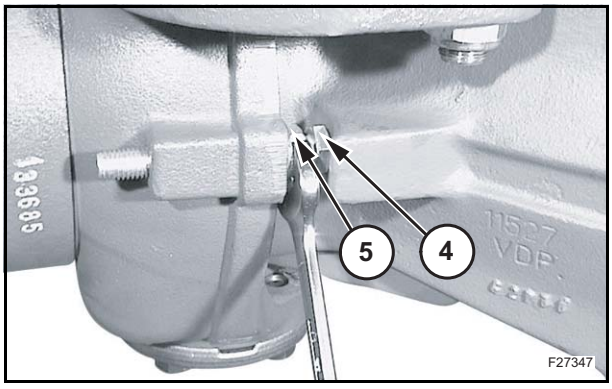
Use the same bars assembled for the toe-in adjustment and a long bar perfectly leaned over the machined part of the central body (pinion side), so that the two bars form an acute angle at the maximum steering.



Adjust a protractor to the requested angle and position it on the long bar.
Move a wheel side till it forms, with the two bars, the angle fixed by the protractor.



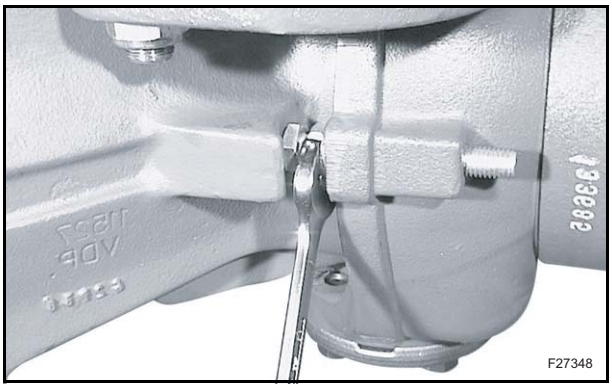
Adjust the mechanical steering stop, screwing in or off the stop screw (4), locking it with the locknut (5) to the requested tightening torque.



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Steer completely towards the other side and repeat the same operation.



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1.3 FAULT FINDING

PROBLEM	CAUSE								
	1	2	3	4	5	6	7	8	9
Wheel vibration; front tyre resistance; half shaft breakage	●	●	●		●				●
Steering is difficult; vehicle goes straight while it's turning	●	●	●	●					●
Transmission excessively noisy	●	●	●	●	●	●		●	●
Uneven wear of tyre	●	●	●	●	●	●			●
Friction noise	●			●	●		●	●	●
Vibration during forward drive, intermittent noise	●	●	●		●				●

1. Incorrect installation / defective axle
Correct installation or repair or replace the differential in case it does not survive any one of the test phases.

2. Overloading / incorrect weight distribution
Remove excessive weight and redistribute load, following instructions related to the vehicle.

3. Different rotation radius of the tyres
If one tyre has a smaller radius, it will cause partial wheel slipping when force is applied. The other tyre with bigger radius will have to support all the work. Replace the tyre or adjust pressure to have same radius on both tyres.

4. Broken half shaft
It is not advisable to operate the vehicle with a broken half shaft. It is acceptable to move the vehicle (engine off unloaded) a few metres away only.

5. Bent half shaft
Replace the half shaft.

6. Incorrect wheel adjustment
Verify group integrity and wheel side bearings.
Adjusting according.

7. Damaged or worn axle parts
Check the bearings conditions, etc.
Replace whenever necessary.

8. Contamination in the axle box or incorrect assembly of parts
Look for foreign particles.
Check assembly of the various parts of the axle.

9. Incorrect use of the product
See the vehicle Manufacturer's instructions once again.

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PROBLEM	CAUSE	CORRECTION
Axle beam body bent	Vehicle overloaded Vehicle's accident Load bump	Replace axle beam body.
Worn out or pitted bearings	Insufficient lubrication Contaminated oil Excessive use Normal wear out	Replace bearings. Use proper lubrication, fill up to right level and replace at recommended intervals.
Oil leakage form gaskets and seals	Prolonged functioning at high temperature of the oil Oil gasket assembled incorrectly Seal lip damaged Contaminated oil	Replace the gasket and the matching surface if damaged. Use correct lubrication and replace at recommended intervals.
Bent or broken half shaft	Vehicle intensively operated or overloaded	Replace.
Half shaft broken at wheel side	Wheel support loose Beam body bent	Replace. Check that wheel support is not worn out or wrongly adjusted.

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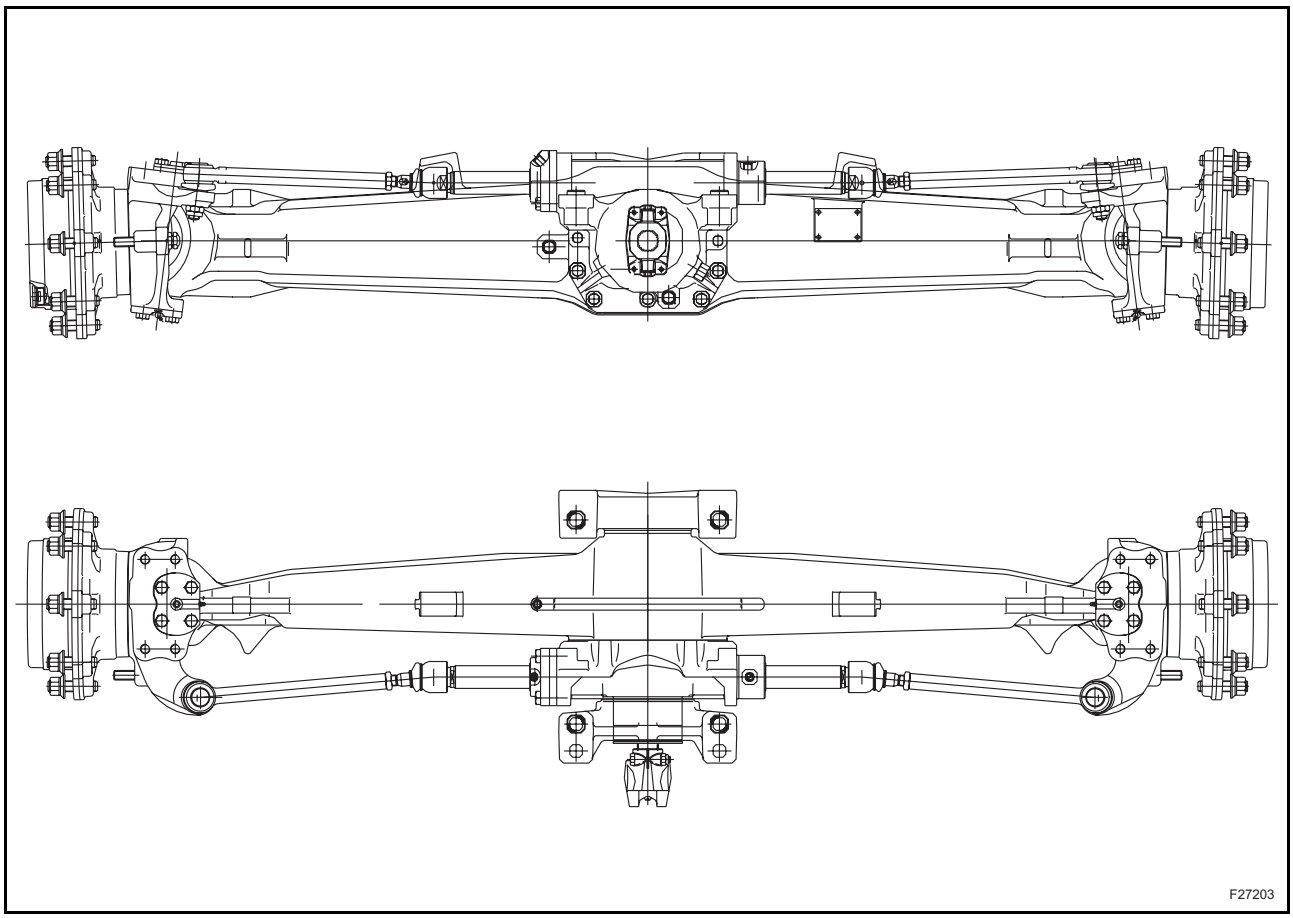
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2. FRONT AXLE 4WD “CARRARO”

2.1 SPECIFICATIONS

TYPE

Front steering axle, model 26.16



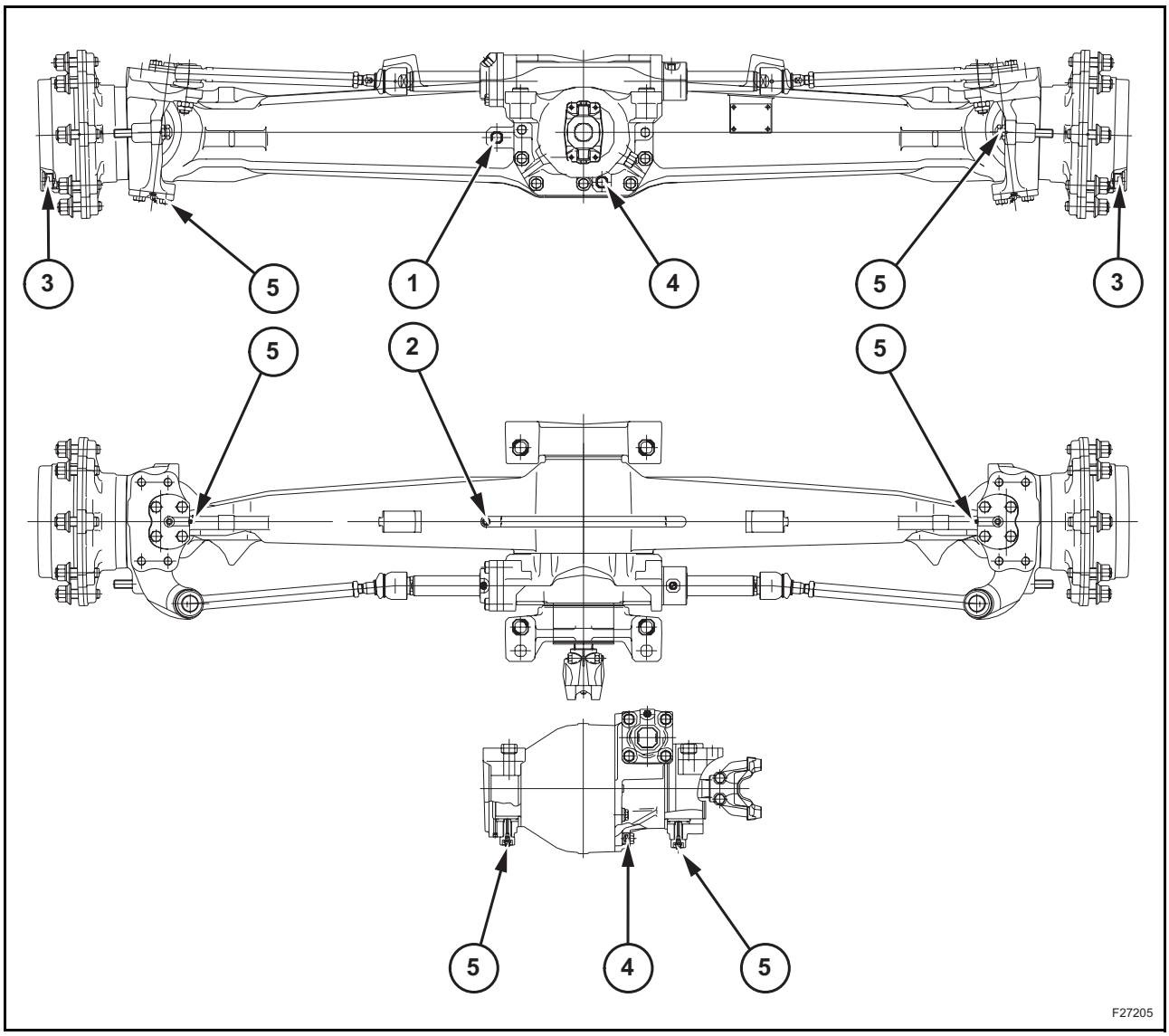
POWERSHIFT	POWERSHUTTLE	RATIO
•	•	12.8
•	/	12.333
/	•	13.714
/	•	14.308

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LUBRICATION AND GREASING

Differential oil capacity	6.5 litres
Reduction gear oil capacity, on each side	0.7 litres
Oil specification: use recommended oil enriched in additives Note: do not use synthetic or vegetable oil without consent of the axle manufacturer	Amber Mastertran NH 410 C



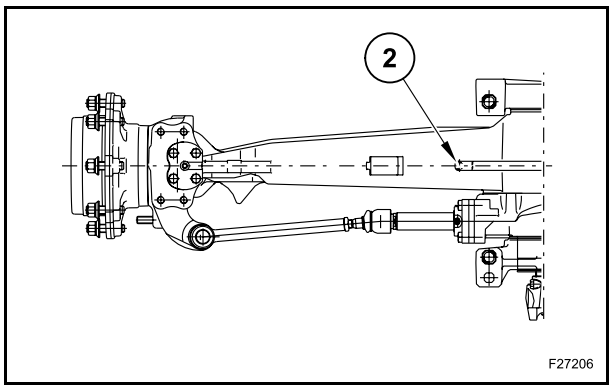
DESCRIPTION	POSITION
Oil level plug	1
Air breather	2
Level, fill and drain plug for reduction gear oil	3
Oil drain plug	4
Greasing points	5

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Before draining the oil from axle housing, use the oil breather (2) to release possible internal pressure.

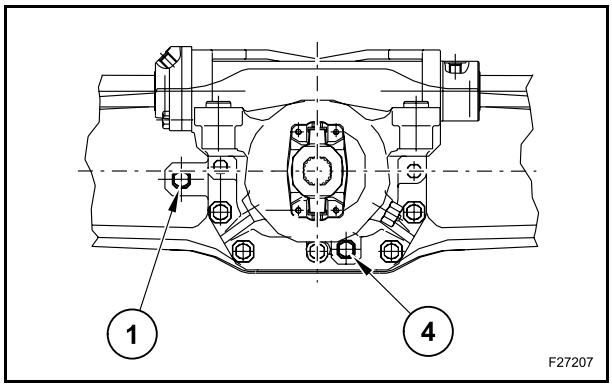
⚠ WARNING
Risk of violent oil ejection.



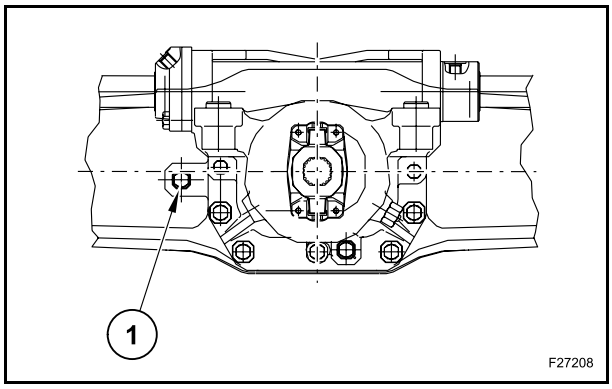
To drain the oil remove the level plug (1) and the drain plug (4).

⚠ WARNING
Risk of violent oil ejection.

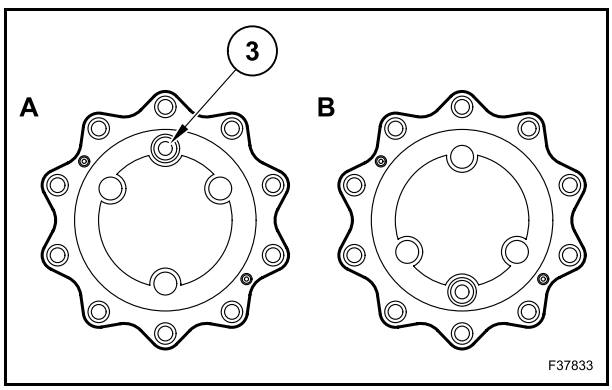
Drain all oil.
Clean the drain plug (4) and tighten to the requested torque.



Always use the oil breather (2) to release possible internal pressure.
Unscrew the level plug (1) and fill to the bottom of the level plug hole with the specified oil.
Wait to allow the oil to flow through the axle. Check oil level and fill to the specified level if necessary.
Screw the plug (1) to the prescribed torque.



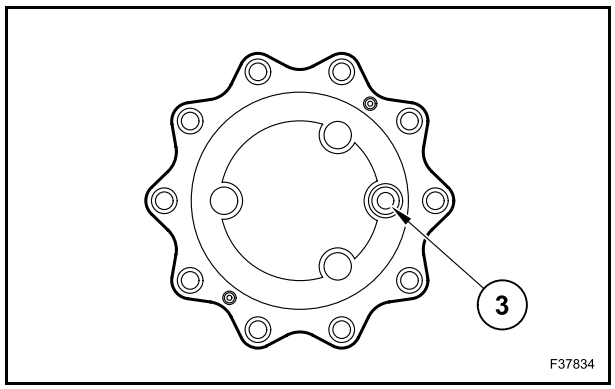
Before draining the oil from the reduction gear, rotate it so that the oil plug (3) is in the highest position [position A] and partially unscrew the plug to release any possible internal pressure.
Rotate the wheel end so that the plug (3) is toward the ground [position B].
Remove the plug and drain the oil.



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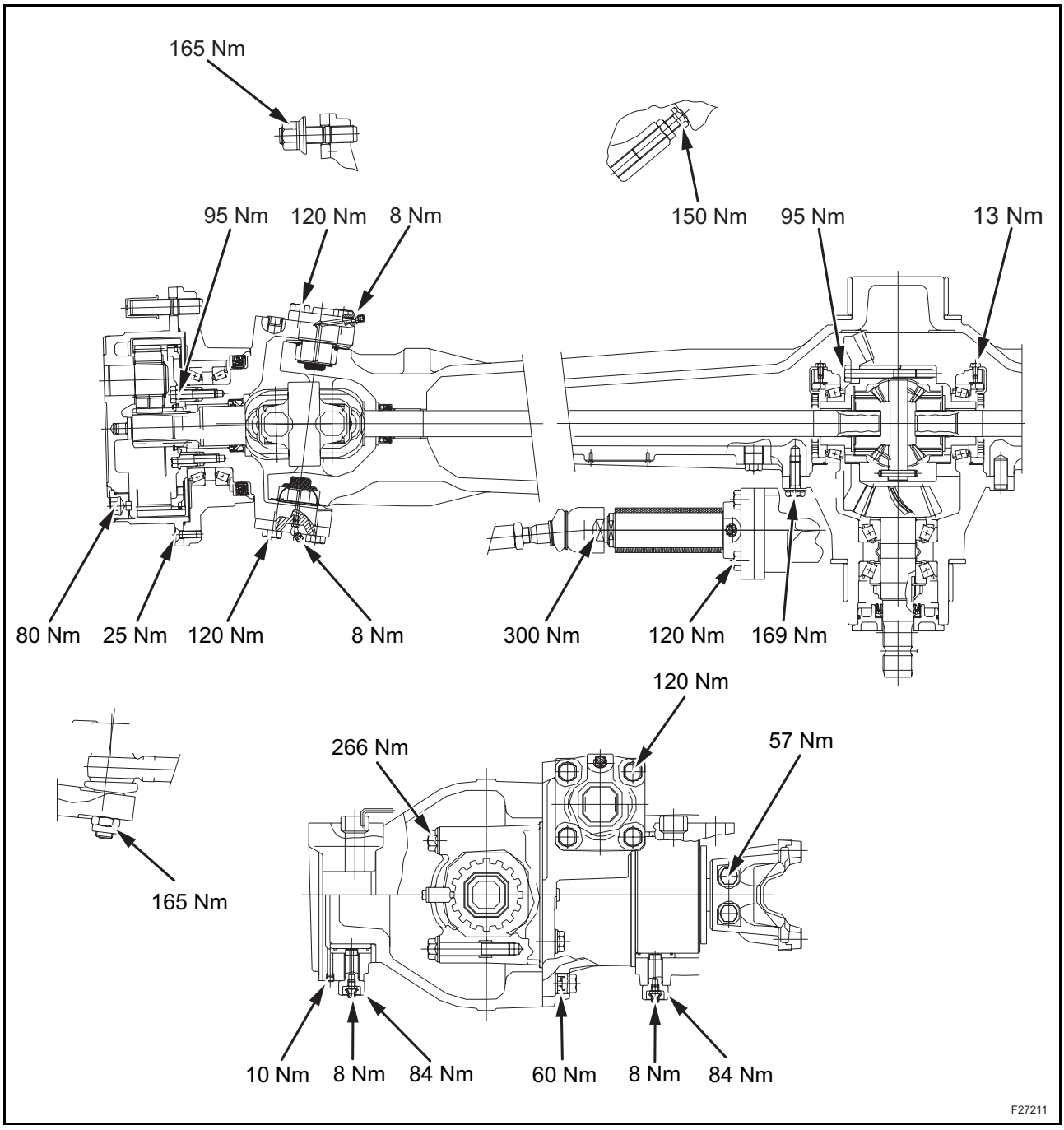
Rotate the wheel end so that the hole (3) is in the position shown in figure.
Fill to the bottom of the fill plug hole with specified oil.
Tighten the plug (3) to the requested torque.



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MOUNTING SCREW TORQUE

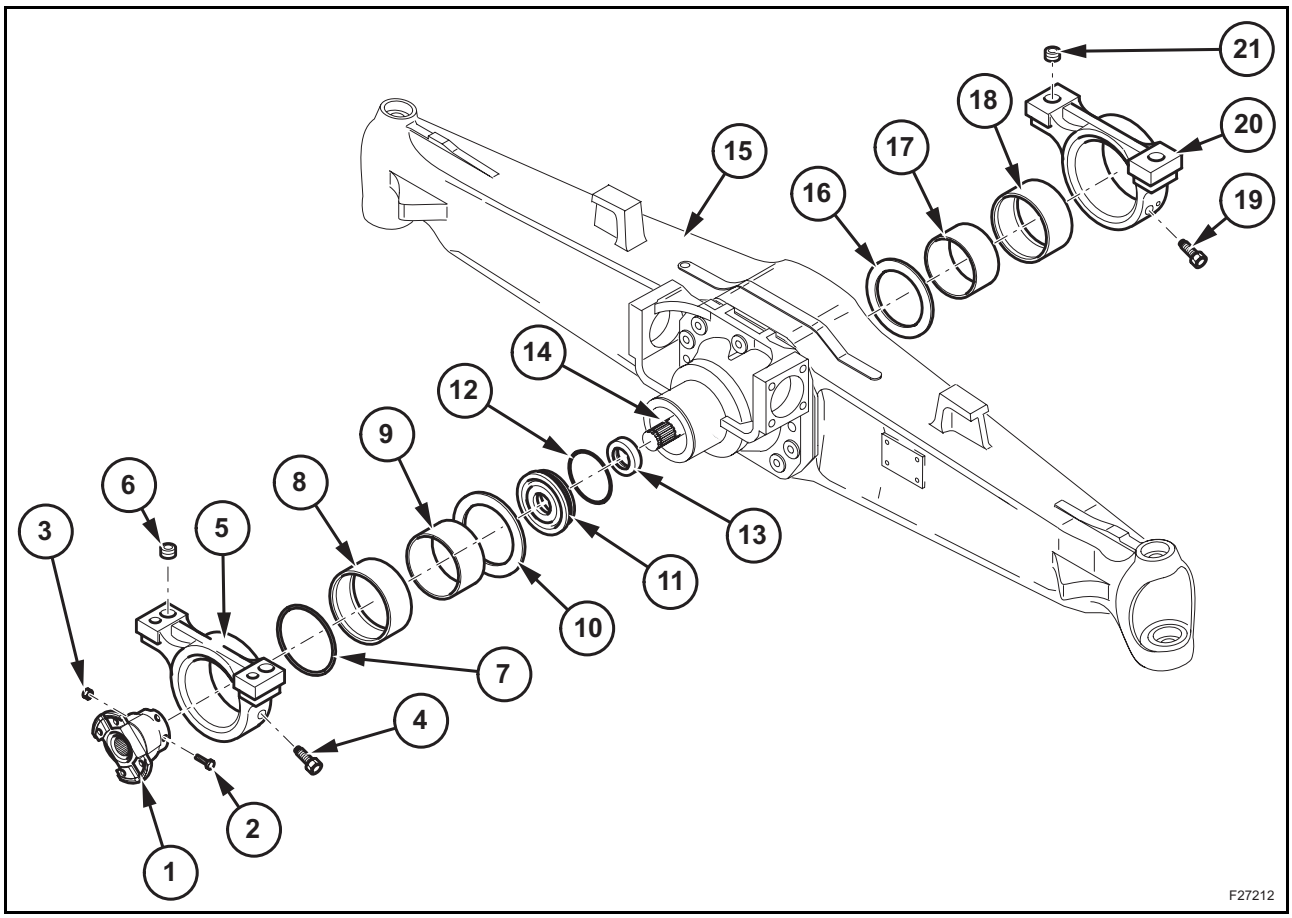


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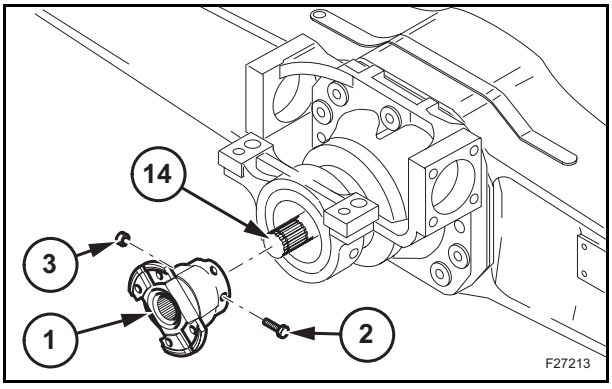
2.2 DISASSEMBLY AND ASSEMBLY

FRONT AND REAR SUPPORT



Disassembly

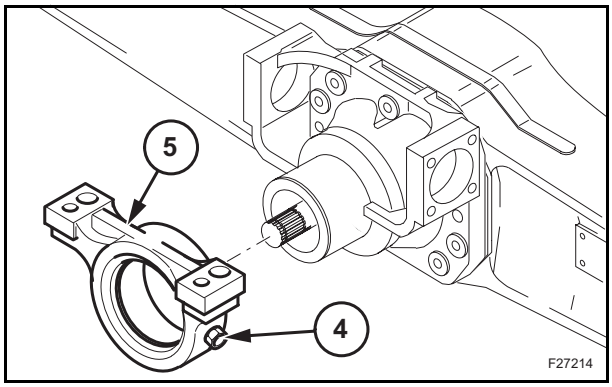
Remove the nut (3) and the bolt (2) and extract the flange (1) from the pinion shaft end (14).



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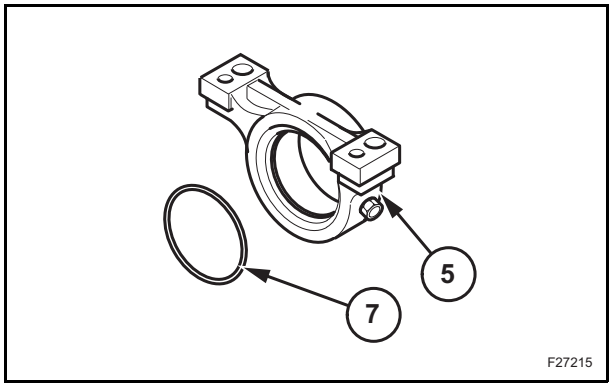
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Loosen the bolt (4).
Take the rear support (5) out from the differential support.

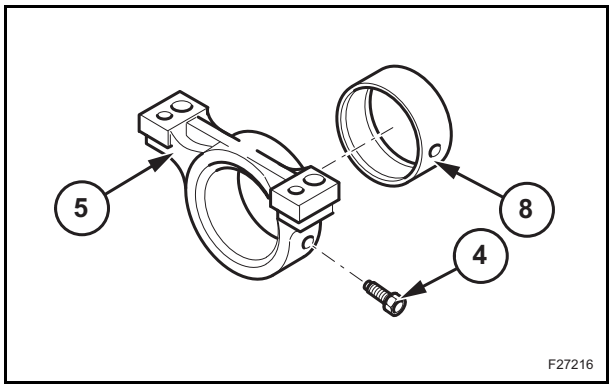


Remove the O-ring (6) from the bush (8) in rear support (5).

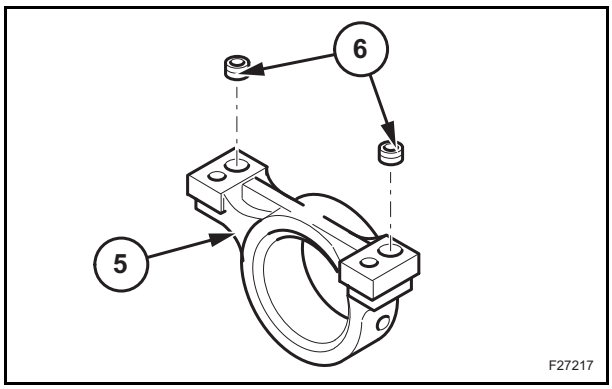
NOTE: this is a destructive operation for the O-ring.



Remove the bolt (4).
Remove the bush (8) from the rear support (5).



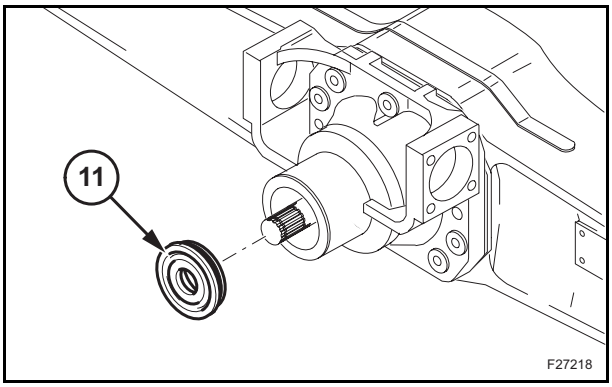
Remove the bushes (6) from the rear support (5).



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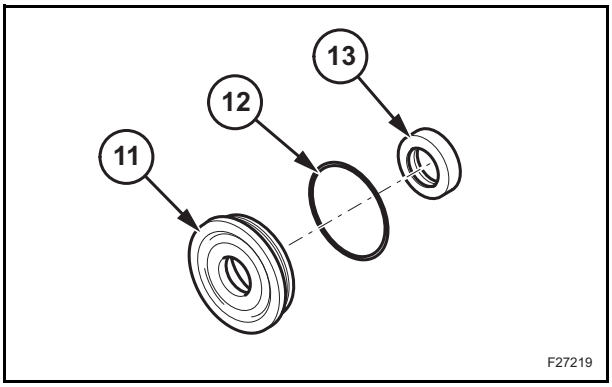
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Remove the cover (11) from differential support with a lever.



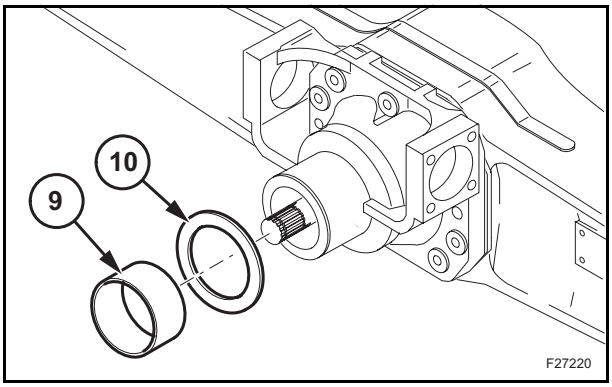
Remove the O-ring (12) and the seal ring (13) from the cover (11).

NOTE: destructive operation for the seal rings.

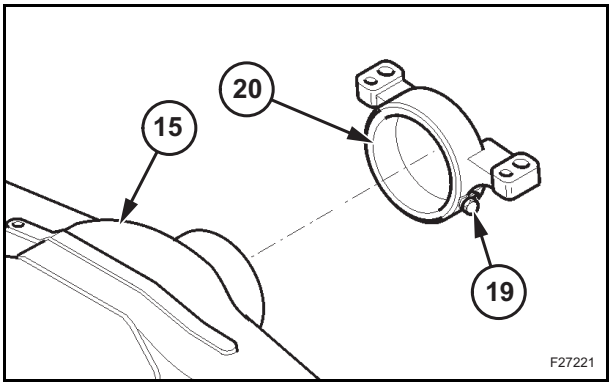


Remove the bush (9) and the thrust washer (10) from differential support only if necessary.

NOTE: it is advisable to heat the bush (9) to make easy this operation; this is a destructive operation for the bush.



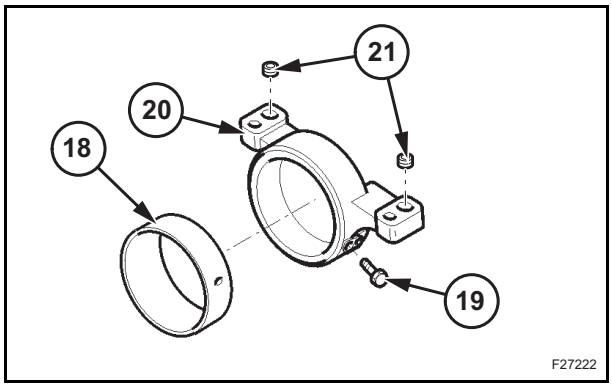
Loosen the bolt (19).
Take the front support (20) out from the axle housing (15).



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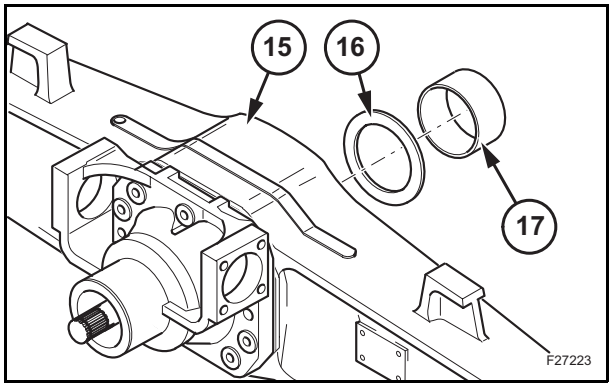
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Remove the bolt (19).
Remove the bush (18) from the front support (20).
Remove the bushes (21) from front support (20).



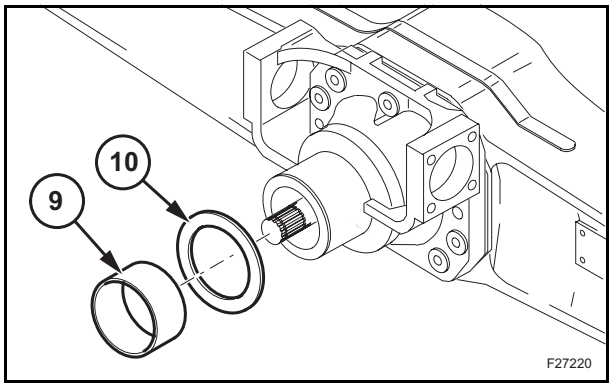
Remove the bush (17) and the thrust washer (16) from axle housing (15) only if necessary.

NOTE: it is advisable to heat the bush (17) to make easy this operation; this is a destructive operation for the bush.

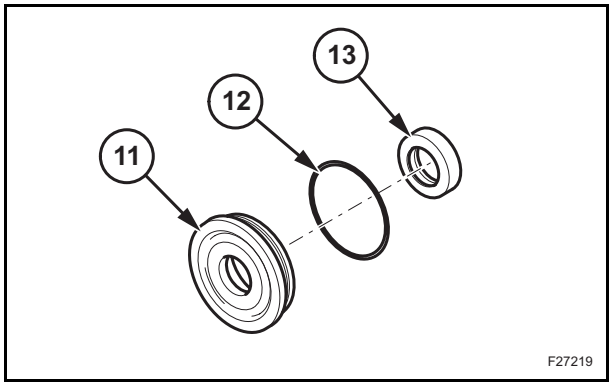


Assembly

Insert the thrust washer (10) into the differential support.
Heat the bush (9) at 110÷120 °C then assemble it to the differential support.
If necessary assemble the bush (9) with a pad and a hammer.



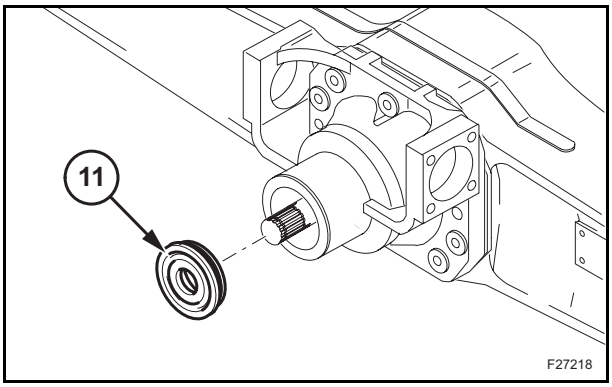
Assemble the seal ring (13) to the cover (11) with the special tool **380002432** and a hammer.
Assemble the new O-ring (12) into the cover (11).
Lubricate the O-ring (12) and the seal ring (13).



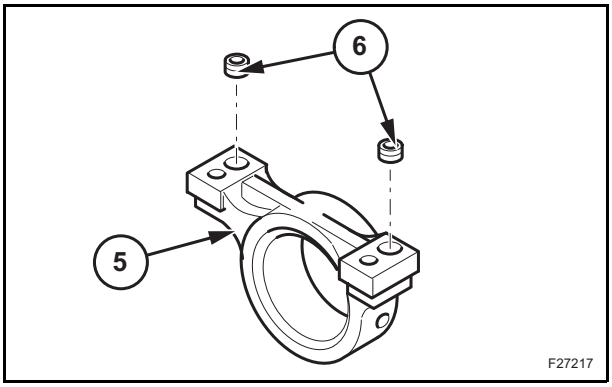
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Assemble the cover (11) to the differential support.



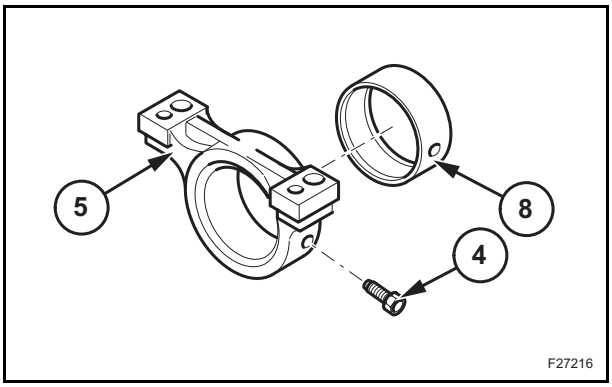
Apply sealant on the bushes (6) contact surface.
Assemble the bushes (6) to the rear support (5) with a pad and a hammer.



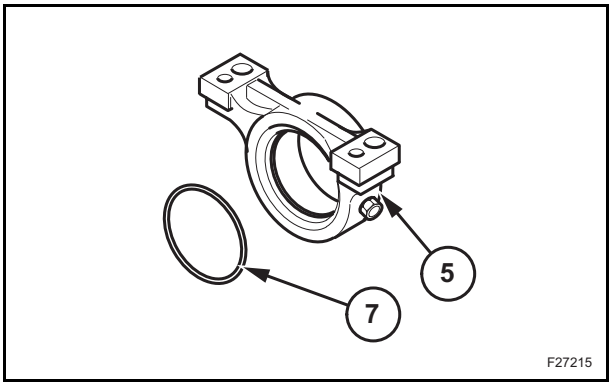
Assemble the bush (8) in the rear support (5).

⚠ WARNING
Align the bush hole with the bolt (4) hole.

Mount the bolt (4).



Lubricate with grease a new O-ring (7).
Insert the O-ring (7) in the rear support (5).



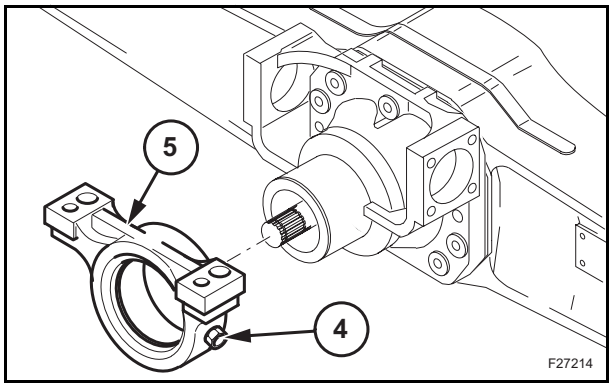
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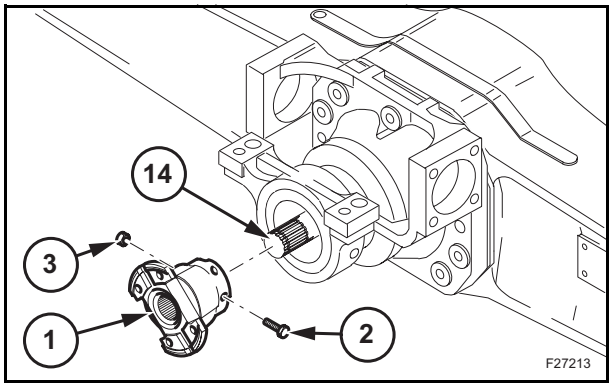
Insert the rear support (5) on the differential support.

⚠ WARNING
Do not damage the O-ring when inserting the rear support on the central body.

Tighten the bolt (4) to the requested torque.

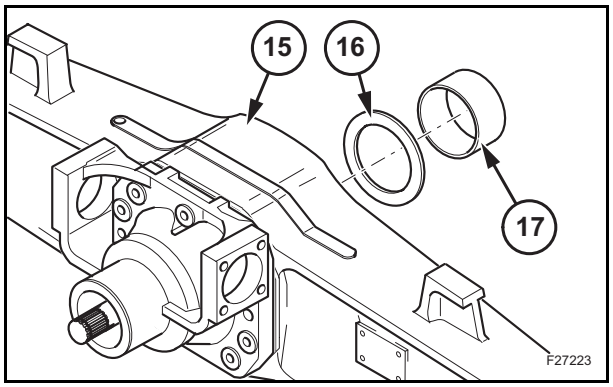


Assemble the flange (2) to the pinion shaft end (14).
Lock the flange (1) with the bolt (2) and the nut (3).
Tighten the nut (3) to the requested torque.

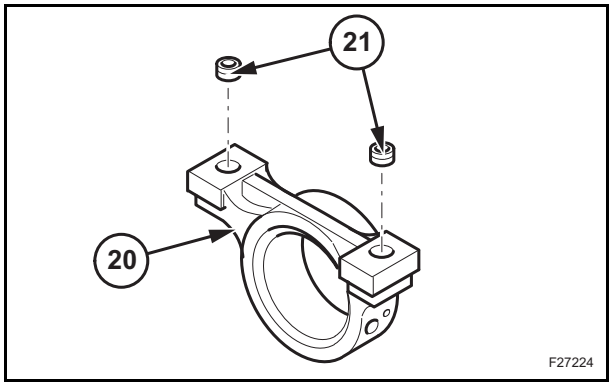


Insert the thrust washer (16) into the front support seat.
Heat the bush (17) at 110÷120 °C then assemble it to the axle housing (15).

NOTE: if necessary assemble the bush (17) with a pad and a hammer.



Apply sealant on the bushes (21) contact surface.
Assemble the bushes (21) into the front support (20) with a pad and a hammer.



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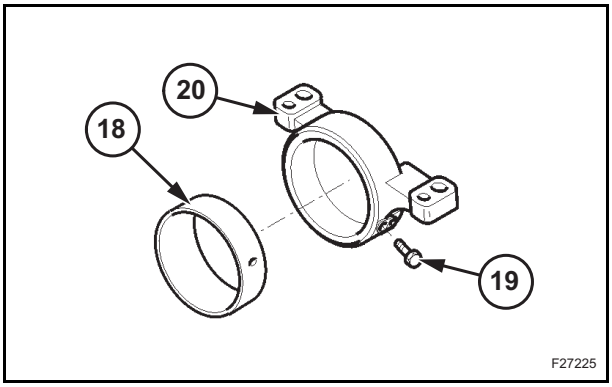
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Assemble the bush (18) into the front support (20) with a suitable driver and a hammer.

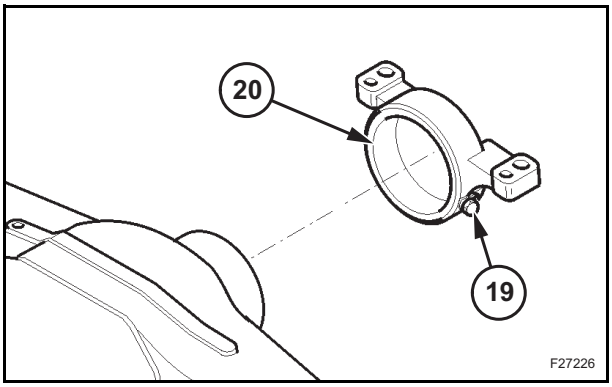
⚠ WARNING

Align the bush hole with the bolt (19) hole.

Mount the bolt (19).



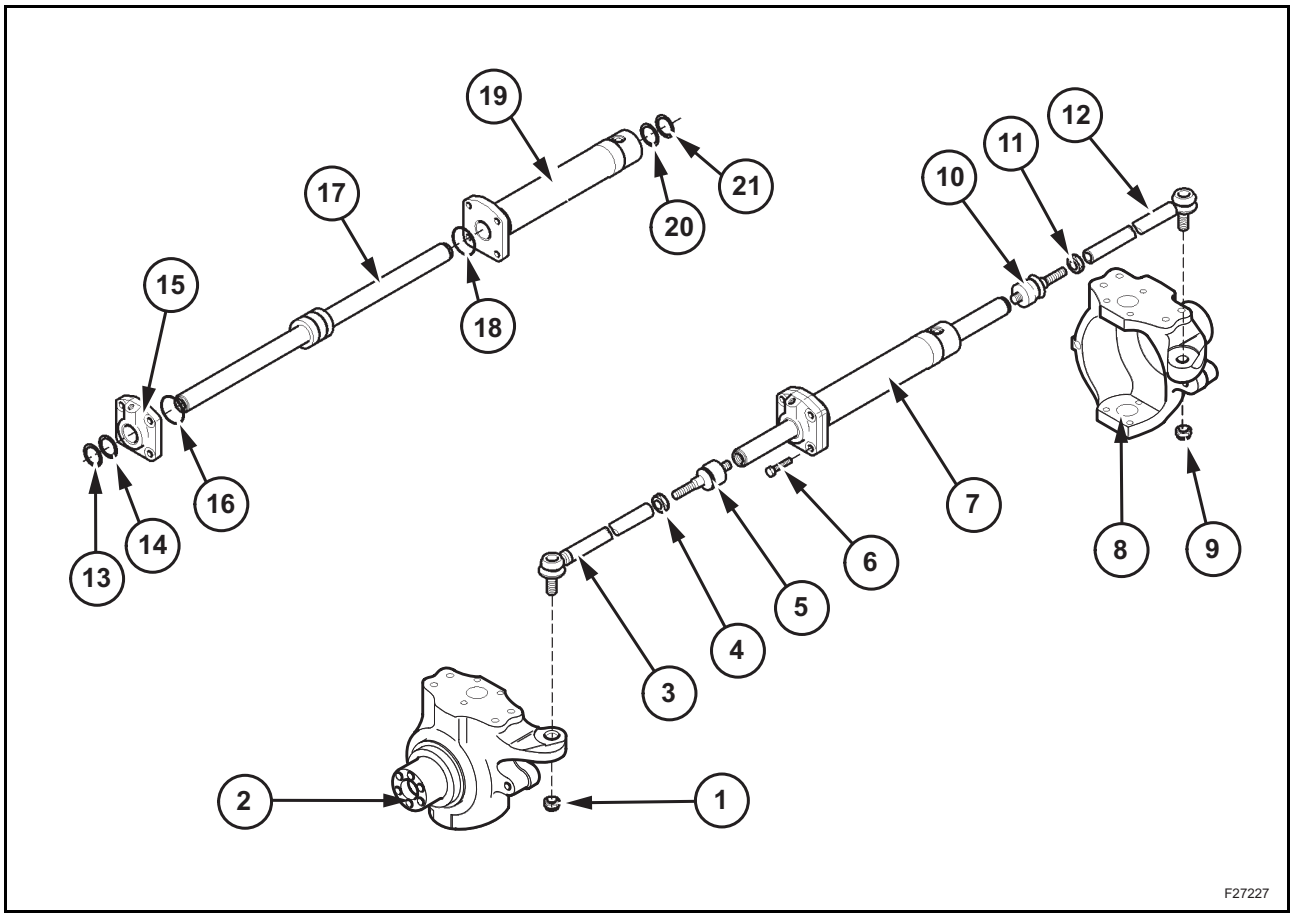
Insert the front support (20) on the axle housing. Tighten the bolt (19) to the requested torque.



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STEERING CYLINDER



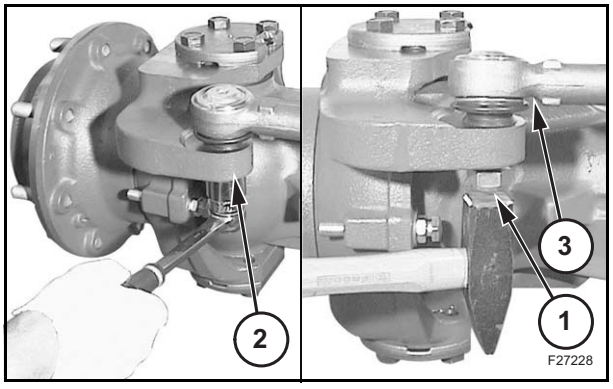
Disassembly

Loosen the nut (1) with enough turns till it is protruding over the threaded pin end of the tie rod (3).
Beat on the nut (1) with an appropriate hammer in order to disjoin the tie rod (3) from the swivel housing (2).

⚠ WARNING
Don't beat on the threaded pin end of the tie rod (3).

NOTE: this is a destructive operation for the nut (1).

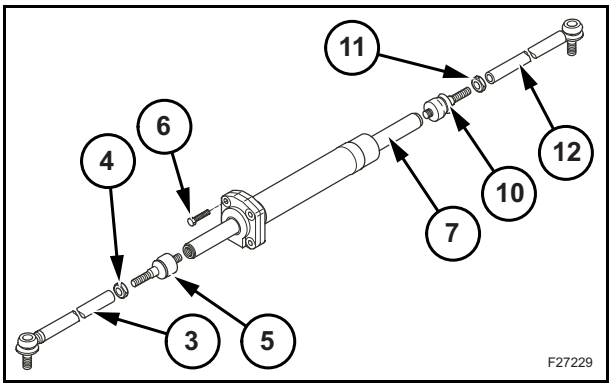
Repeat the whole sequence at the other side.



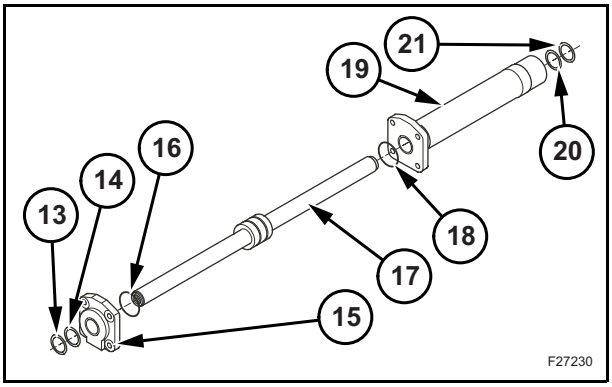
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Remove the tie rods (3) and (12) by loosing the nuts (4) and (11) with a suitable wrench, then check the conditions.
Unscrew the fastening screws (6) and take the steering cylinder (7) out of its housing, if necessary use a rubber hammer.
Remove only parts that need to be overhauled and/ or replaced.

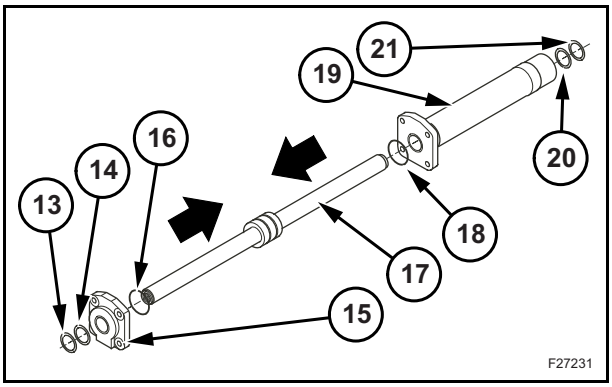


Remove the cylinder head (15) from the cylinder body (19) and remove it from the rod (17).
Remove the rod (17) from the cylinder body (19).
Remove all the seals and O-rings (13, 14, 16, 18, 20 and 21) from the cylinder body (19), the cylinder head (15), and the rod (17).

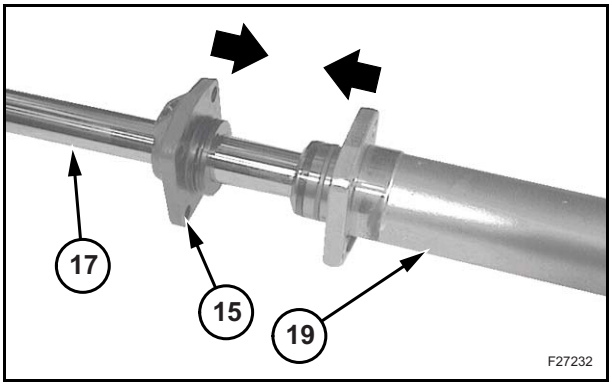


Assembly

Assemble new seals and O-rings (13, 14, 16, 18, 20 and 21) on the cylinder head (15), on the rod (17) and on the cylinder body (19).



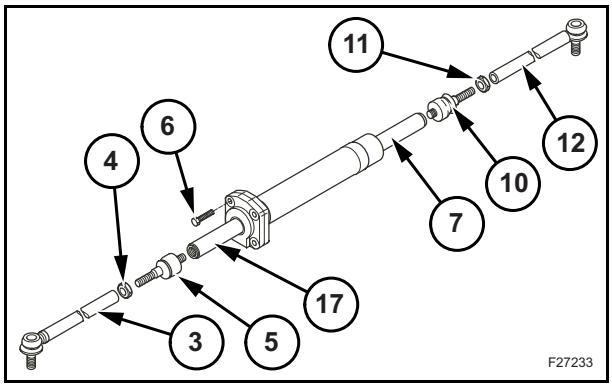
Assemble the cylinder head (15) on the rod (17).
Slide the pre-assembled rod (17) into the cylinder body (19).



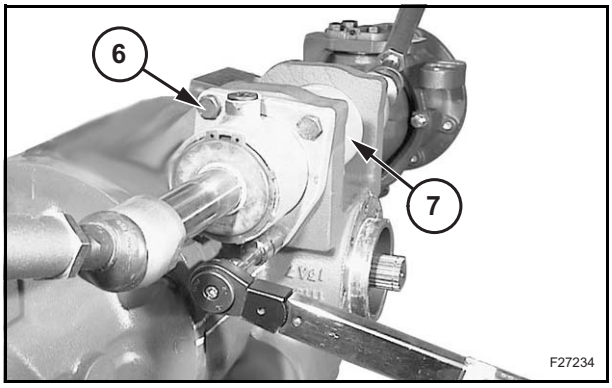
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Assemble the tie rods (3) and (12), the ball joints (5) and (10), the nuts (4) and (11) to the ends of the rod (17), then tighten to the requested torque.



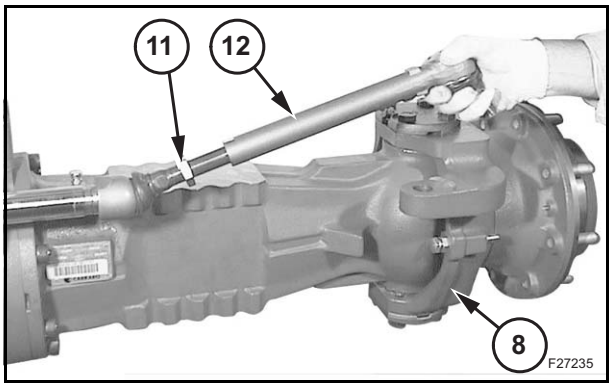
Install the steering cylinder (7) already assembled on the central body.
Assemble and tighten the screws (6) to the requested torque.



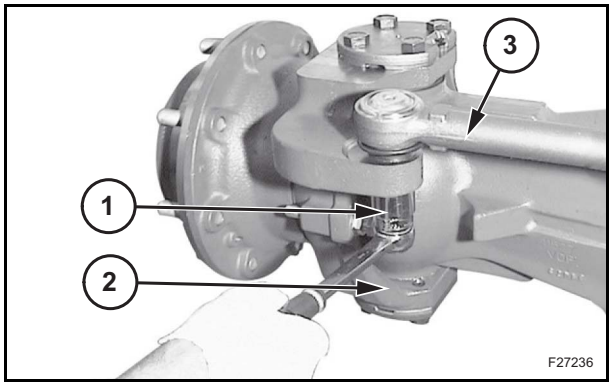
Align the swivel housing (8) with the axle.
Screw the tie rod (12) so that its ball joint can be inserted into the swivel housing (8).

NOTE: it is important to unscrew the locknut (11) to carry out this operation.

Repeat the whole sequence of the mentioned operations to the other side.



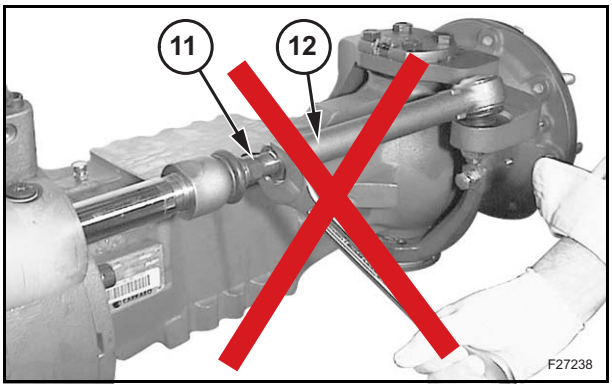
Assemble the ball joint of the tie rod (3) into its housing in the swivel housing (2).
Assemble and tighten the locknut (1) to the specified torque.
Repeat the whole sequence of the mentioned operations to the other side.



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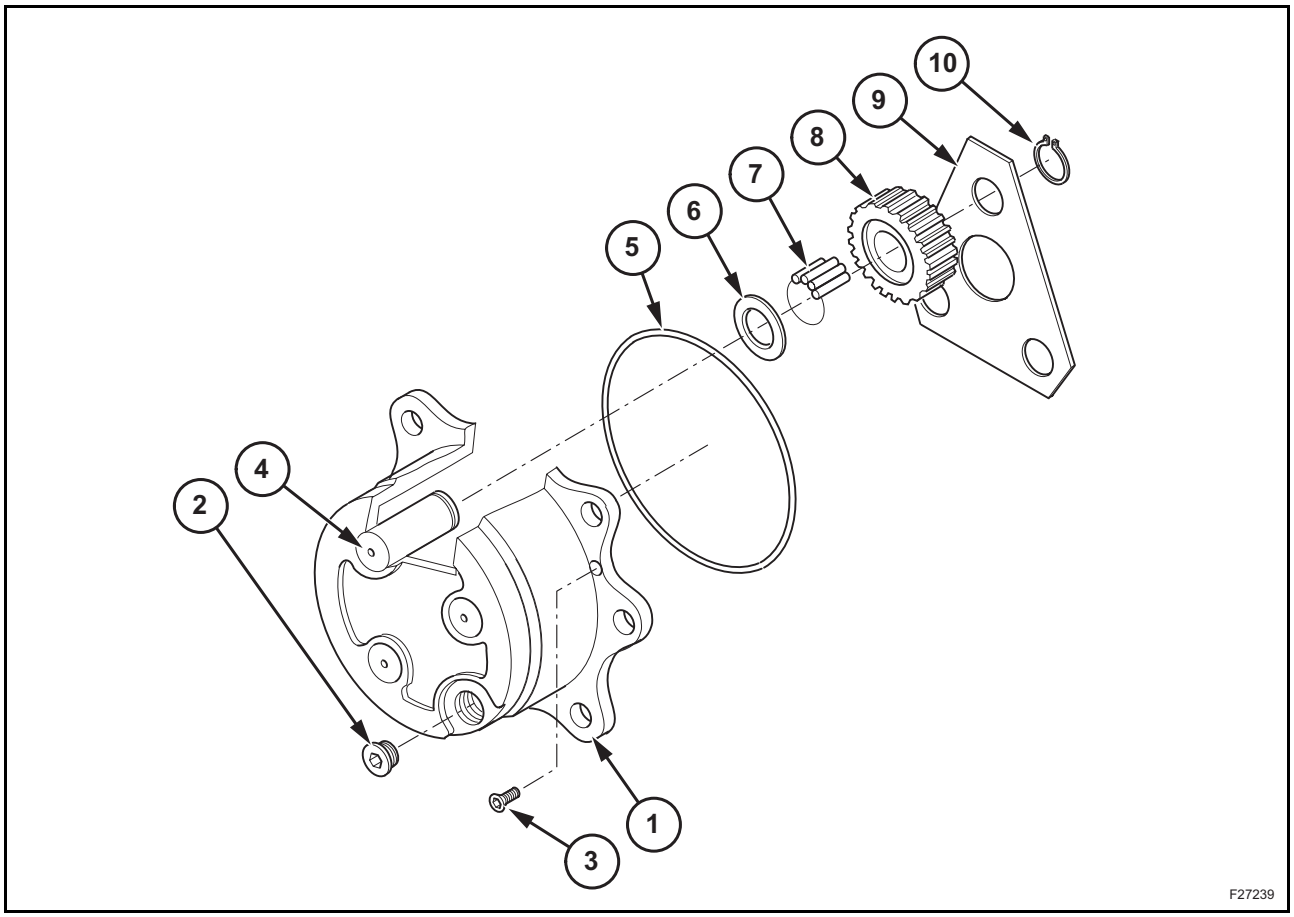
Screw the locknuts (4) and (11) of the tie rods (3) and (12) only when the toe-in adjustment has been carried out.



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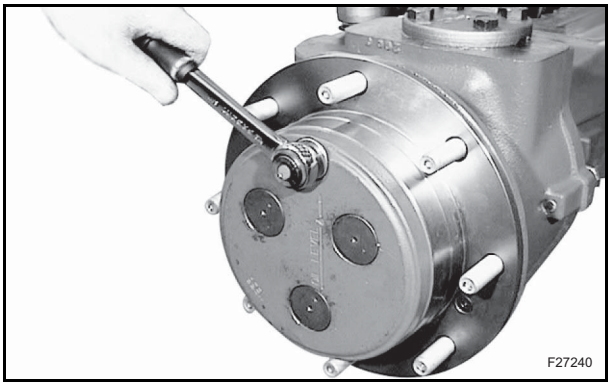
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REDUCTION GEAR



Disassembly

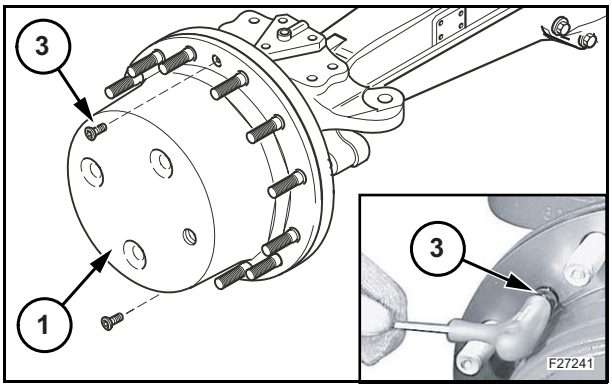
Drain the oil completely from the planetary carrier.



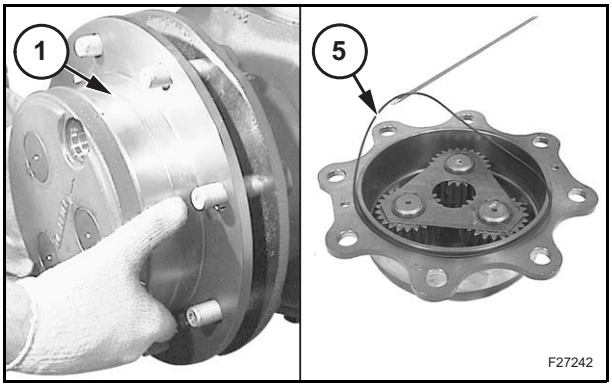
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Unscrew and remove both fastening screws (3) of the planetary carrier cover (1).

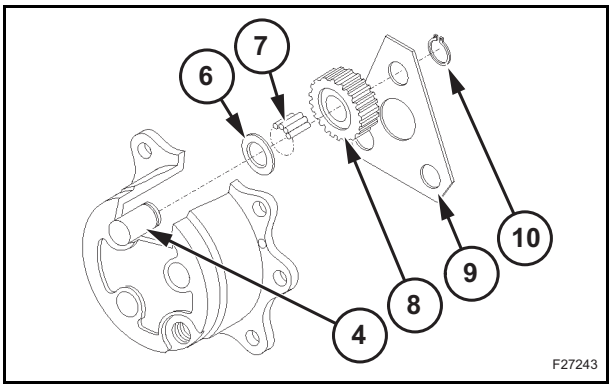


Remove the planetary carrier cover (1), the swivel housing and collect the relevant O-ring (5).
Position the planetary carrier (1) on a workbench and check its wear conditions.



If necessary, replace the gears as follows:
- remove the snap rings (10) on every pin (4);
- remove the triangular plate (9);
- extract the gears (8) from the pins;
- collect the bearings (7) and check their conditions;
- collect the thrust washer (6).

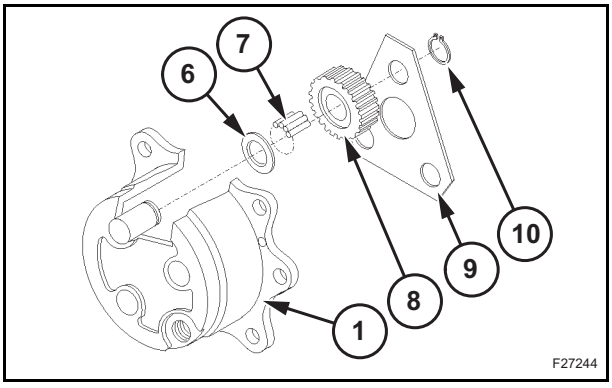
NOTE: with the new gears it is advisable to assemble new needles.



Assembly

Collect all reduction gear parts: the planetary carrier cover (1), the thrust washers (6), the needle bearings (7), the gears (8), the triangular plate (9) and the snap rings (10) of every pin.

NOTE: with the new gears it is advisable to assemble new needles.



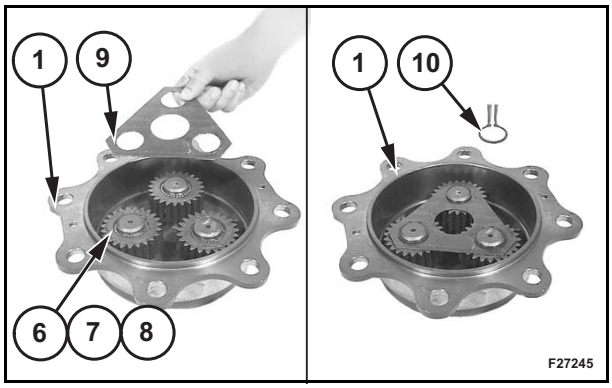
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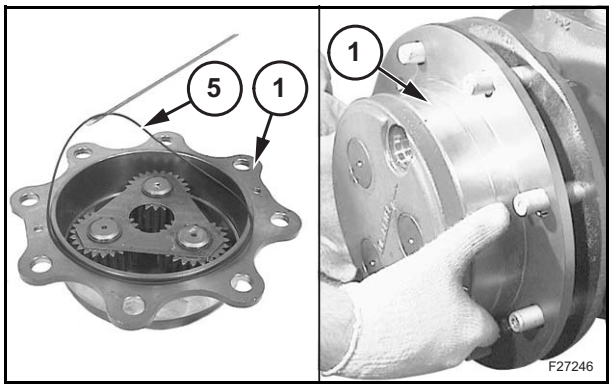
Position the planetary carrier cover (1) on a work-bench.
Insert the thrust washers (6) and the gears (8) into the planetary carrier pins.
Insert the needle bearings (7) into the gears (8).

NOTE: grease well the needles.

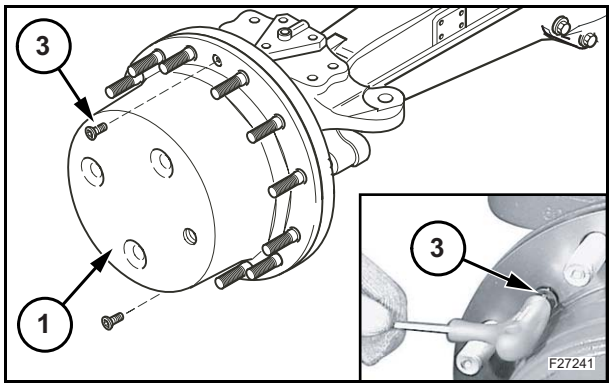
Assemble the triangular plate (9) and the related snap rings (10).



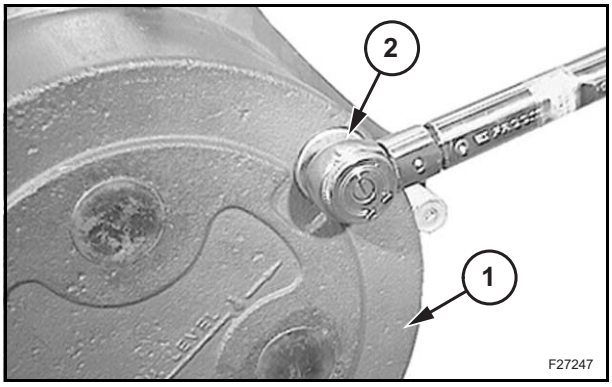
Insert a new O-ring (5) on the planetary carrier cover (1).
Assemble the planetary carrier cover (1) onto the wheel hub.



Assemble the screws (3) and tighten to the specified torque.



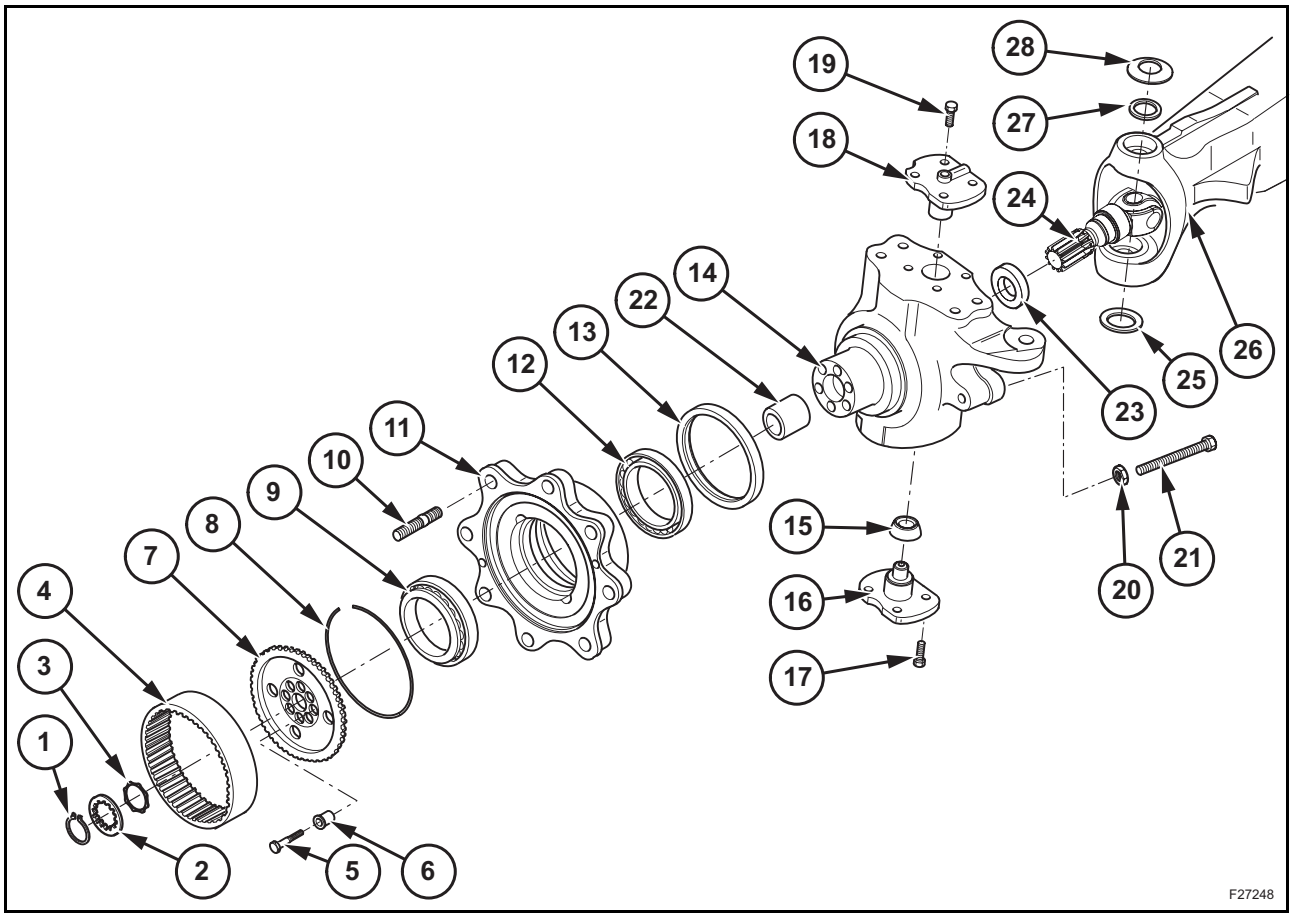
To up the oil on the wheel hub.
Assemble the plug (2) onto the planetary carrier cover (1) and tighten to the specified torque.



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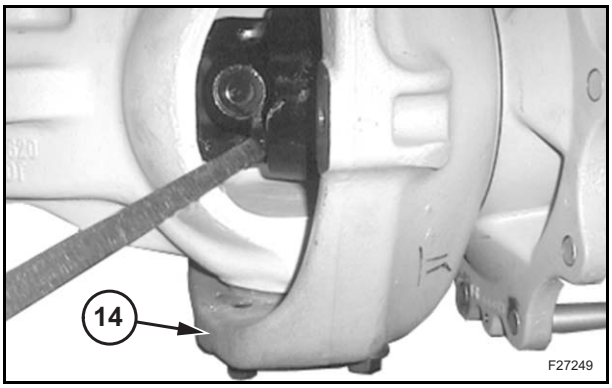
WHEEL HUB



Disassembly

Insert a lever between the swivel housing (14) and the axle shaft and fit into the cardan shaft.
With the lever, push the cardan shaft in the direction of the wheel hub to allow the removal of the snap ring.

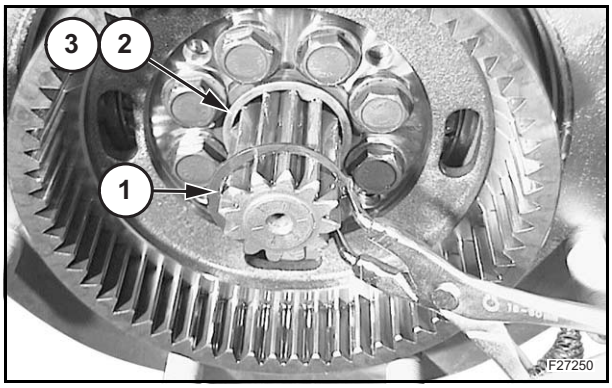
⚠ WARNING
Do not damage the cardan shaft.



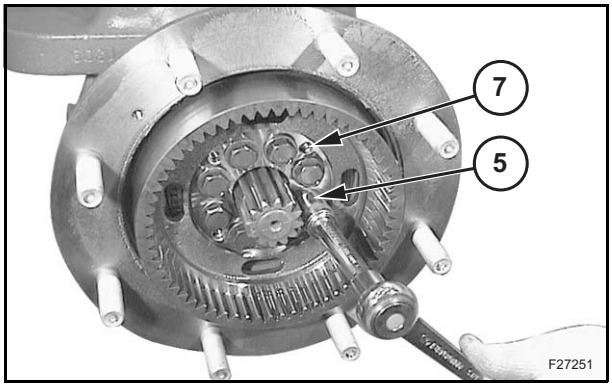
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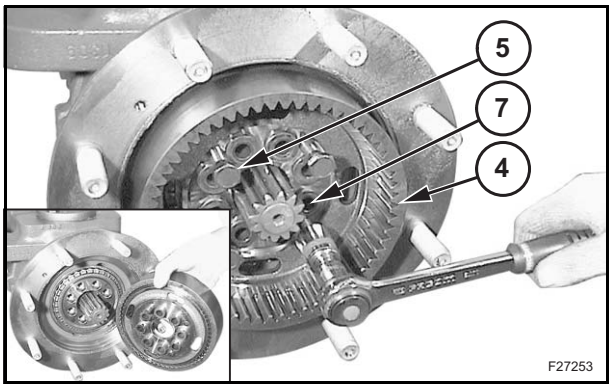
Remove the snap ring (1) from the cardan shaft.
Collect the washers (2) and (3) of the cardan shaft.



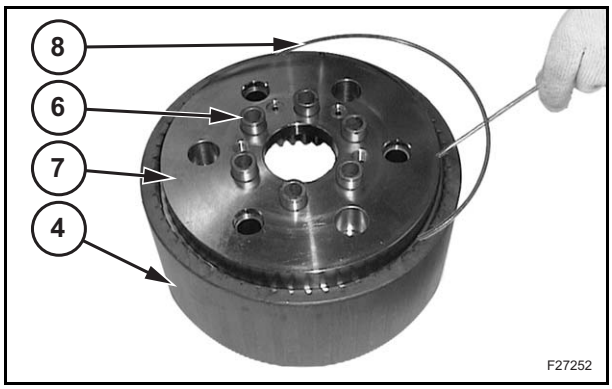
Unscrew and remove the fastening screws (5) from the ring gear carrier (7).



In order to extract the ring gear carrier from its housing, screw in two of the just removed screws (5) in the threaded extraction holes.
Extract and remove the ring gear carrier (7) together with the ring gear (4).



Remove the retaining ring (8) and separate the ring gear carrier (7) from the ring gear (4).
Only if necessary, remove the bushes (6) from the ring gear carrier using a hammer and the special tool **380002223**.

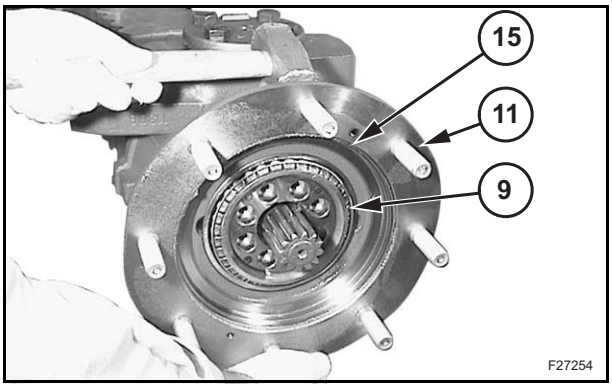


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Remove the wheel hub (11) using levers and a hammer to facilitate the operation.

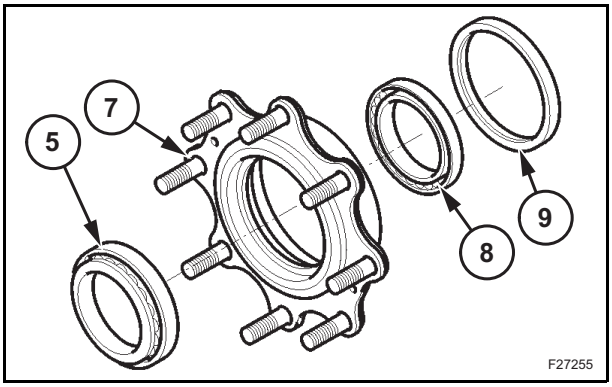
NOTE: collect the bearing (9).



Position the wheel hub (11) on a flat surface and remove the seal ring (13) with a lever.

NOTE: destructive operation for the seal ring (13).

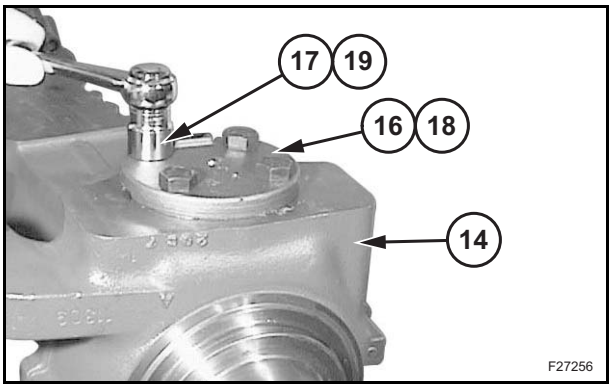
Remove the bearing cups (9) and (12) using a hammer and a suitable drift.
Remove the bearing (12) from the swivel housing end using a suitable extractor.



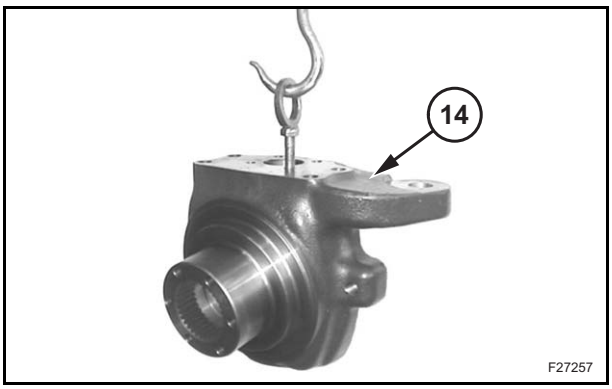
Unscrew and remove the fastening bolts (19) and (17) from the upper (18) and lower (16) king pin.

⚠ WARNING
Before removing the king pins (16) and (18), secure the swivel housing (14) to a rope or a hoist or to any other supporting device; observe all current safety regulations to guarantee the operator's safety.

Remove the king pins (16) and (18).



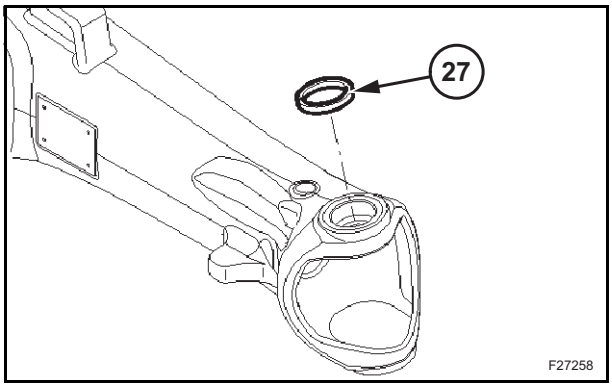
Extract the swivel housing (14) from the axle shaft and the cardan shaft.



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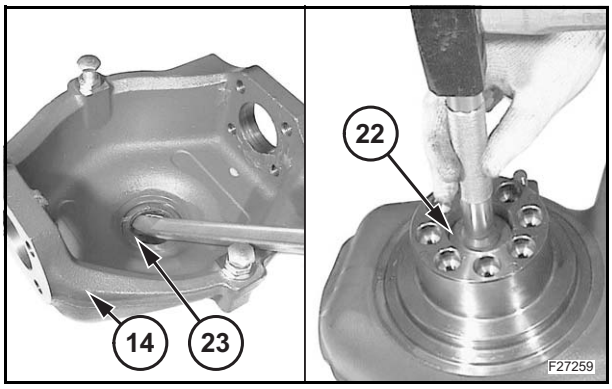
Remove the spacer (27) from the upper king pin housing.



Position the swivel housing (14) on a flat surface and extract the seal ring (23) with a lever.

NOTE: destructive operation for the seal ring (23).

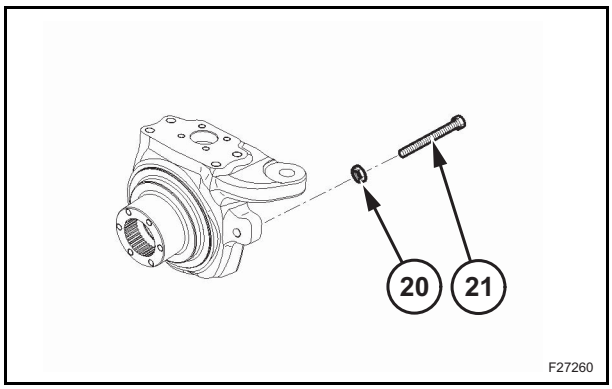
Turn the swivel housing and take the bush (22) out, using a suitable drift and a hammer.



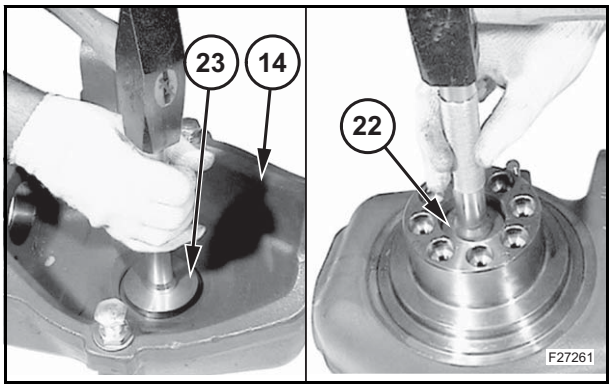
Assembly

If it has been previously removed, reassemble the steering stop composed by the screw (21) and nut (20).

NOTE: do not tighten the nut (20) until the steering angle adjustment has been done.



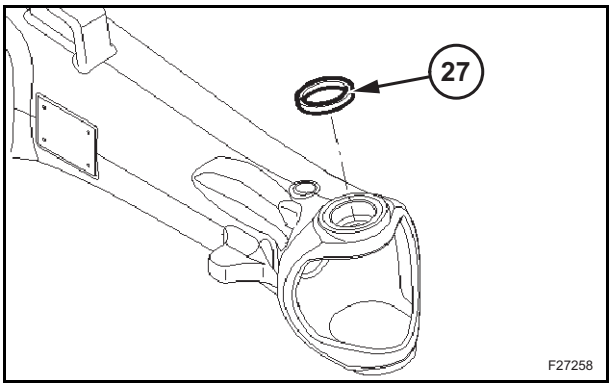
Insert the bush (22) into the swivel housing (14) with the special tool **380002660** and a hammer or a press.
Insert the seal ring (23) into the swivel housing (14) with the special tool **380002661** and a hammer.
Grease carefully the seal ring (23).



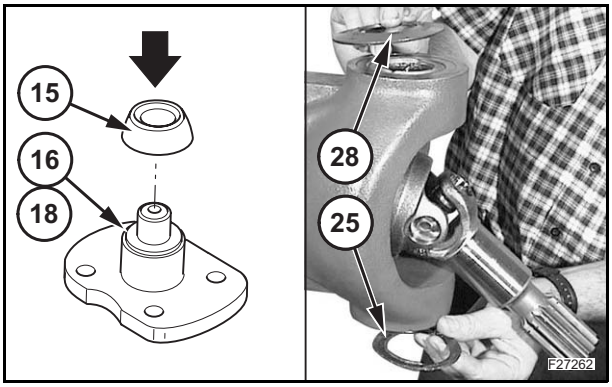
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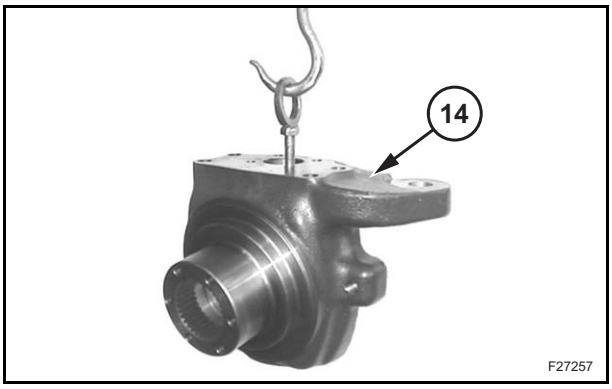
Assemble the spacer (27) in the upper king pin housing.



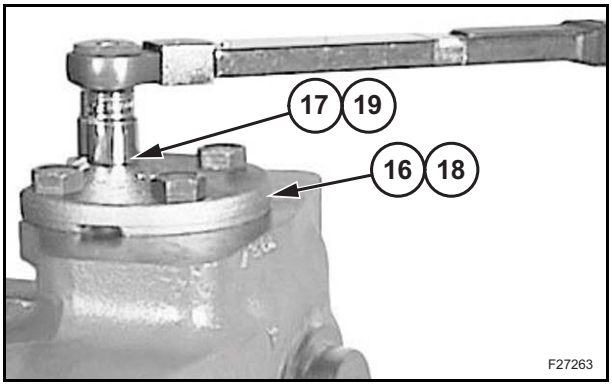
If the cone (15) of the spherical joint has been previously removed, reassemble it to the lower king pin (16) using the special tool **380002662** under a press.
Grease carefully the seats of king pin (16) and (18) with specific grease.
Position the belleville washers (25) and (28) on the king pin (16) and (18) housings.



Secure the swivel housing (14) with a belt or a rope to a hoist or to any other supporting device.
Protect the splined end of the axle shaft by winding it with an adhesive tape to avoid damage to the seal ring.
Assemble the swivel housing (14) on the axle shaft.



Assemble the king pins, the lower (16) and the upper (18), and tighten the retaining screws (17) and (19) to the requested torque.

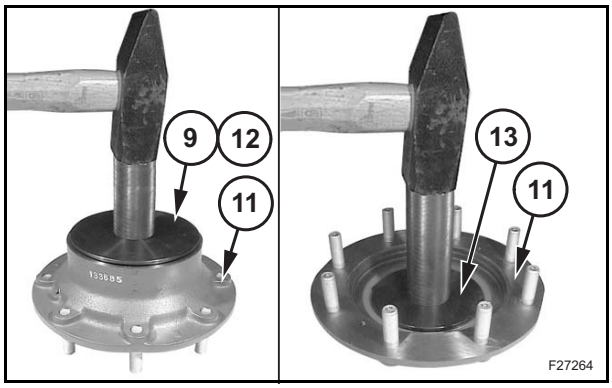


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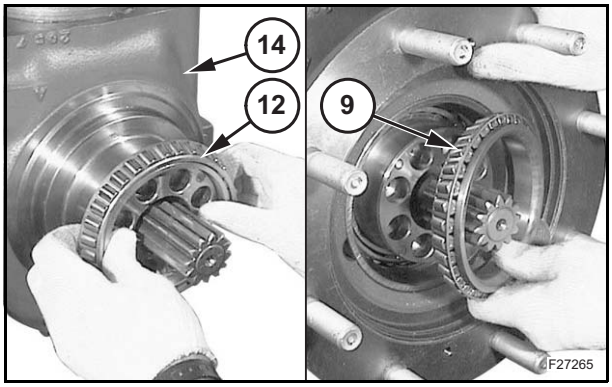
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Assemble both bearing cups (9) and (12) to their wheel hub (11) housings using the special tool **380002663** under a press or with a hammer.
Insert the seal ring (13) into the wheel hub (11) with the special tool **380002227** and a hammer.

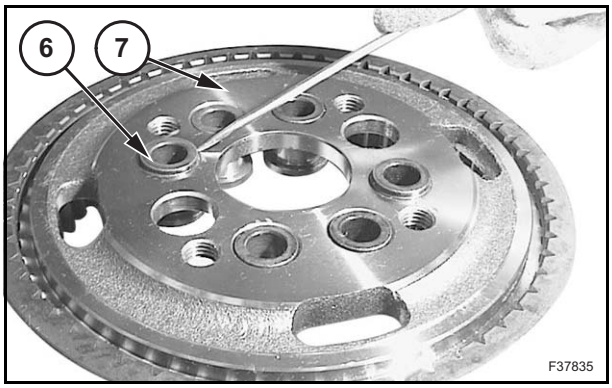
NOTE: do not lubricate the seal ring (13).



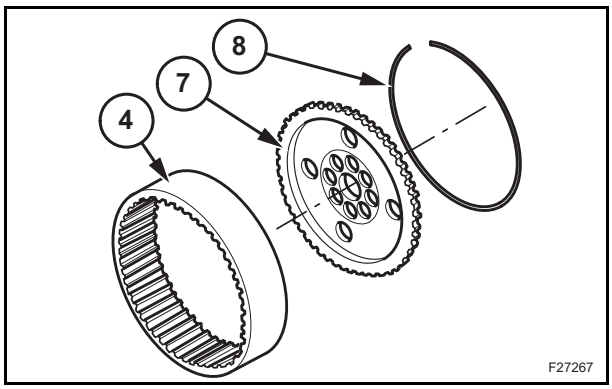
Assemble the bearing (12) on the swivel housing (14) end.
Assemble the wheel hub (11) on the swivel housing (14) and fit the bearing (9).



Position the ring gear carrier (7) on a workbench and force the bushes (6) to the carrier (7) surface level with the special tool **380002223**.
At least two bushes (diametrically-opposed) should be set slightly higher than the carrier surface level to be used as dowel pins.



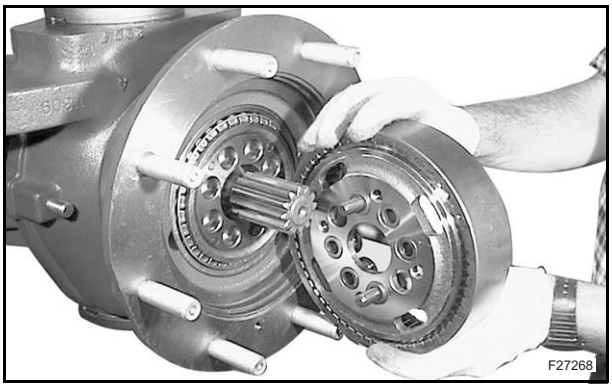
Preassemble the ring gear carrier (7) and the ring gear (4) with the retaining ring (8).



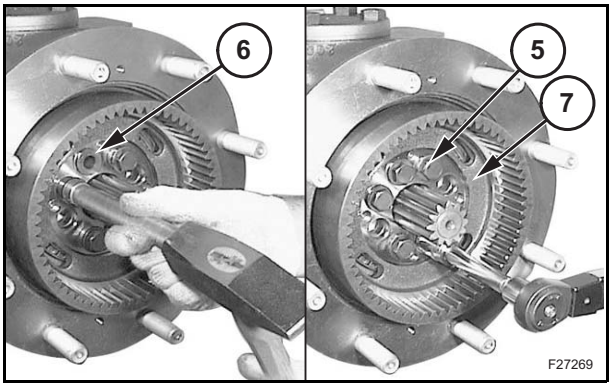
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Assemble the ring gear carrier assy on the wheel hub using the two projecting bushes as dowel pins and screw in the relevant screws in order to put the ring gear in contact with the wheel hub.

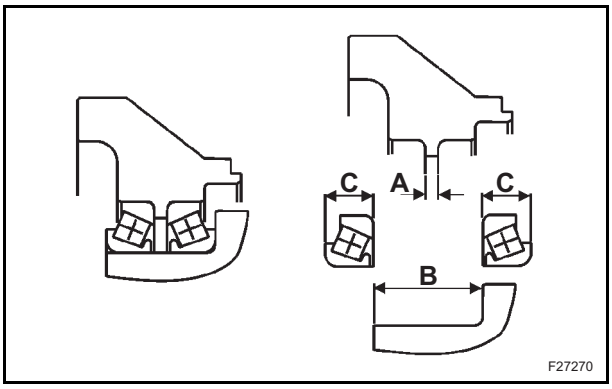


Insert all the hub dowel bushes (6) completely with the special tool **380002223** and a hammer.
Apply sealant on fastening bolts (5) thread.
Assemble the screws (5) fastening the ring gear carrier (7) and tighten to the specified torque.

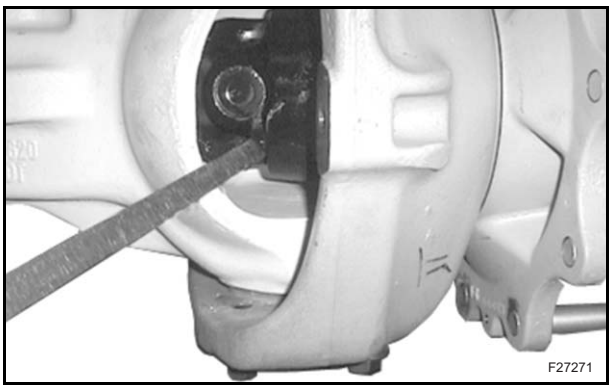


The special operation “Set Right” of the bearings (9) and (12) does not require preload or backlash adjustment. Anyway, before assembling new components check the indicated dimensions.

A= 11.975 ÷ 12.025
B= 52.229 ÷ 52.279
C= 20.000 ÷ 20.100



Insert a lever between the swivel housing and the axle shaft and fit into the cardan shaft.
With the lever, push the cardan shaft in the direction of the wheel hub to allow an easier fitting of the retaining ring.



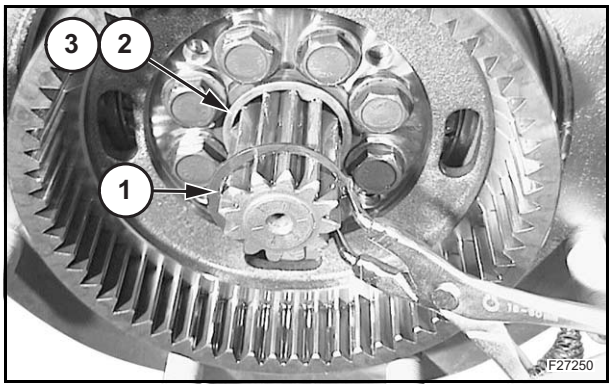
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Assemble the thrust washers (2) and (3) on the end of the cardan shaft.
Insert the snap ring (1) on the end of the shaft and push it into its seat.

NOTE: check that the snap ring (1) is correctly fitted in its seat.

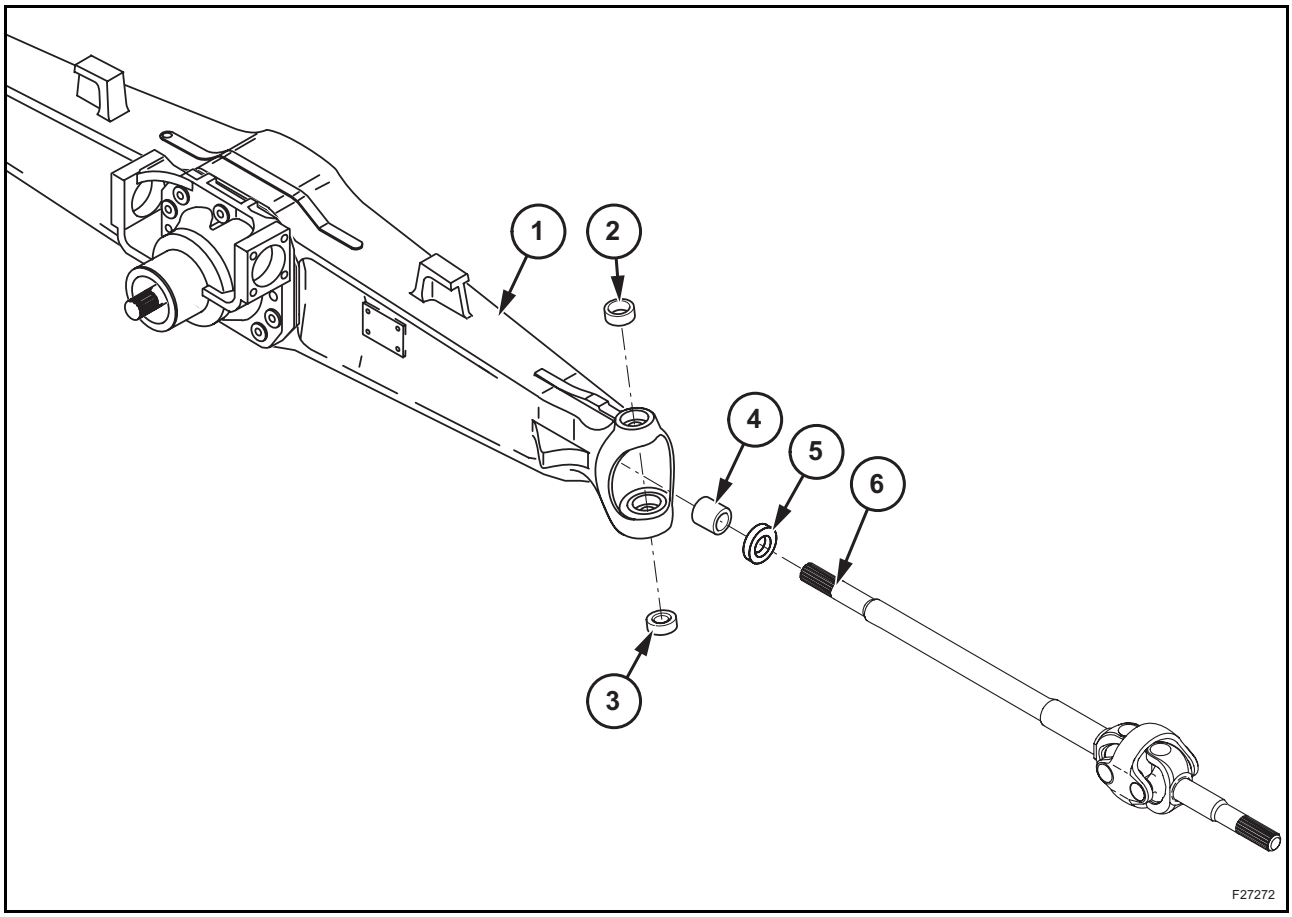
Push in the cardan shaft completely.



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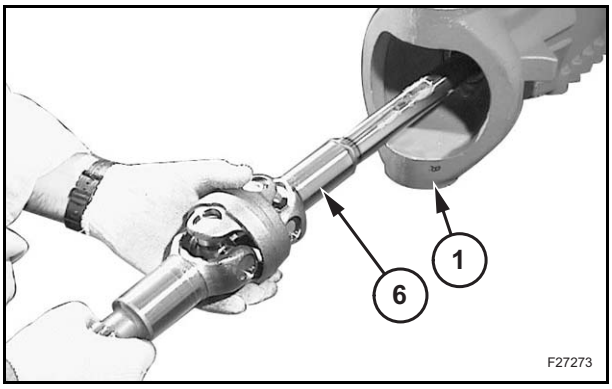
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CARDAN SHAFTS



Disassembly

Remove the cardan shaft (6) from the axle shaft (1).



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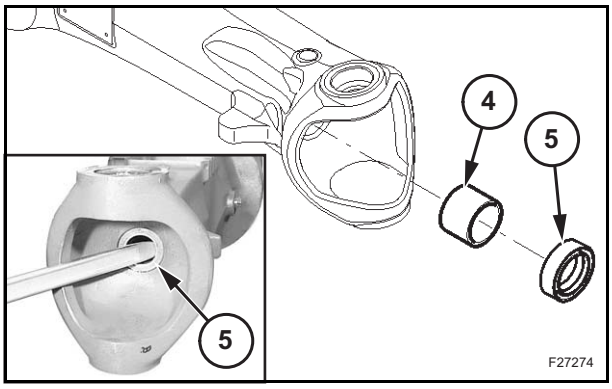
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Remove the seal rings (5) from the axle beam.

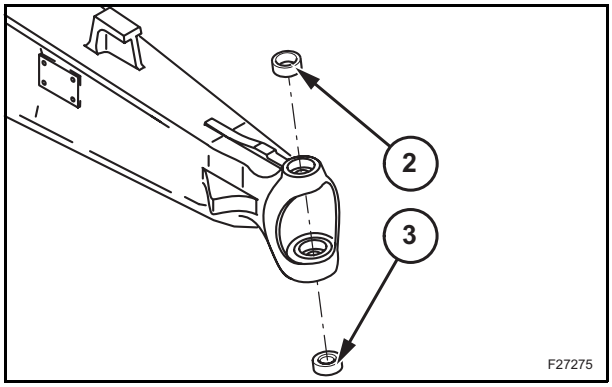
NOTE: destructive operation for the seal rings (5).

Remove the bush (4) from the axle beam only if the wear conditions require this.

⚠ WARNING
Be careful not to damage the bush seat.



Remove the upper king pin bush (2) and the bearing cup (3) from the king pin seats using a suitable extractor only if wear conditions require it.

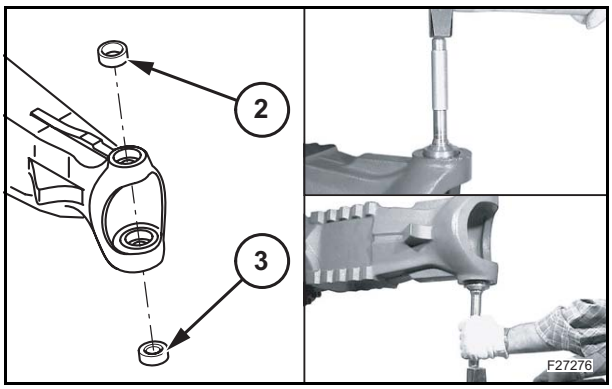


Assembly

Cool the upper king pin bush (2) and the bearing cup (3) at a temperature lower than -100 °C with liquid nitrogen.

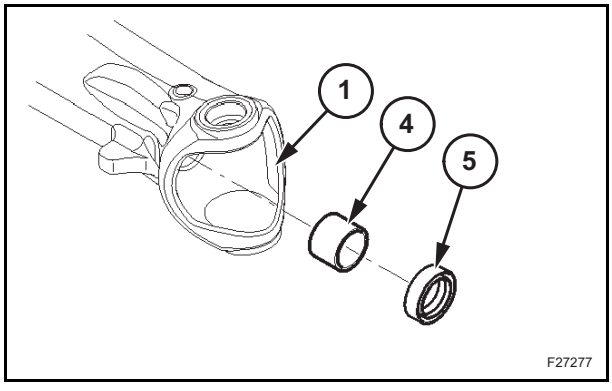
⚠ WARNING
Wear safety gloves.

Assemble the bush (2) on the upper king pin seat with the special tool **380002664** and a hammer.
Assemble the bearing cup (3) on the lower king pin seat with the special tool **380002662** and a hammer.



Assemble the bush (4) on the axle beam (1) with the special tool **380002665** and a hammer.
Assemble the seal ring (5) on the axle beam with the special tool **380002666** and a hammer.

NOTE: grease carefully the seal rings.

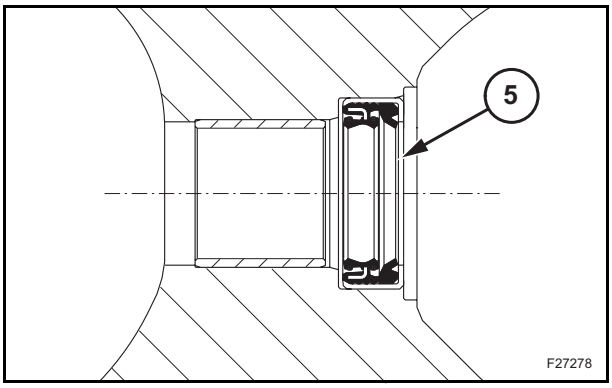


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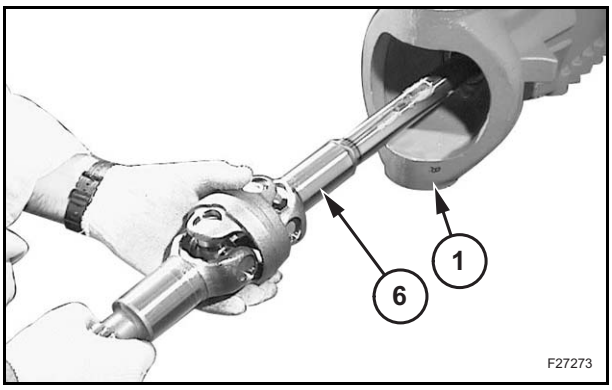
Assemble the seal ring (5).

⚠ WARNING
Positioning the seal ring (5) as in figure.



Insert the cardan shaft (6) into the axle shaft (1).

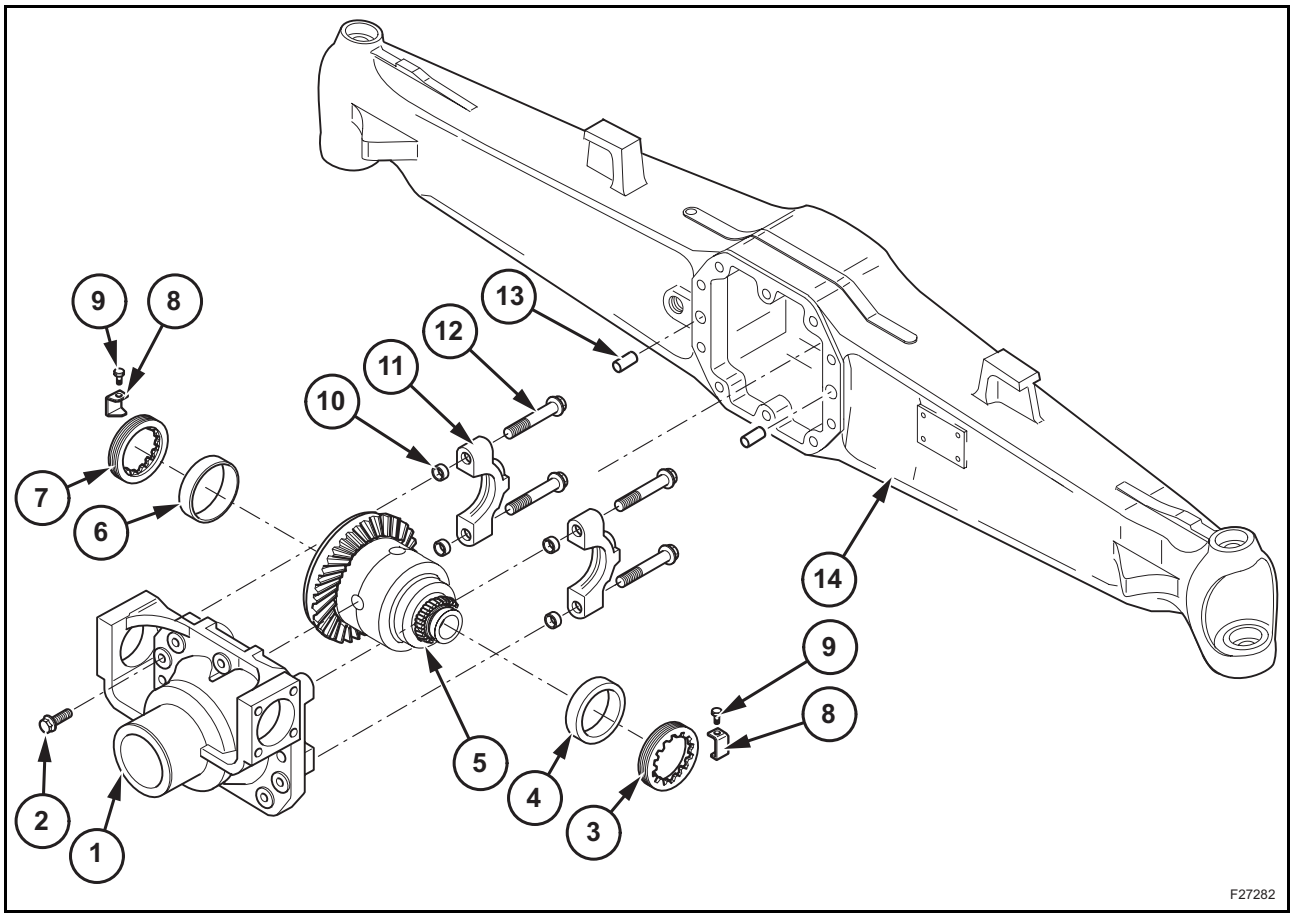
⚠ WARNING
Be careful not to damage the seal ring.



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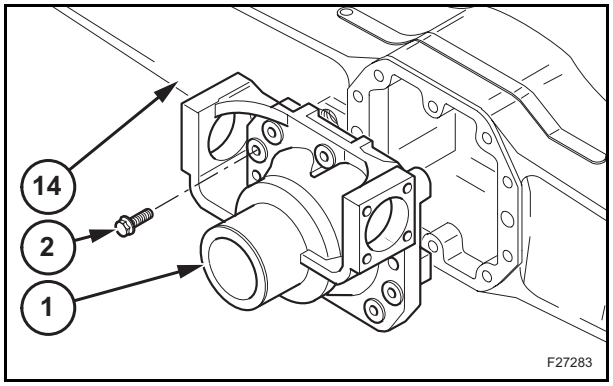
DIFFERENTIAL SUPPORT



Disassembly

Drain the oil completely from the differential.
Loosen and remove the screws (2) of the differential support (1).
Remove the differential support (1) from the axle housing (14).

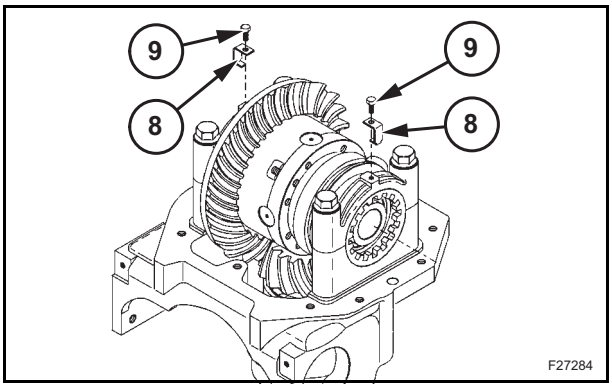
⚠ WARNING
Support the differential support with a rope or other appropriate means.



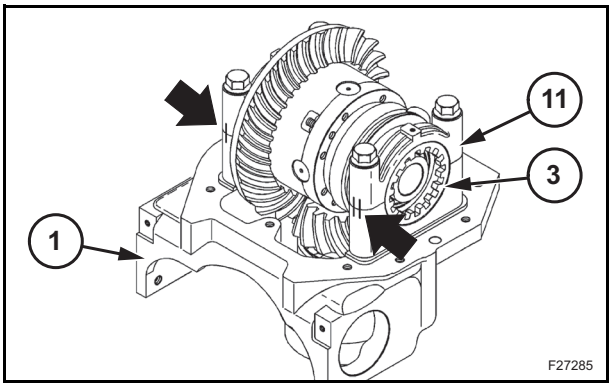
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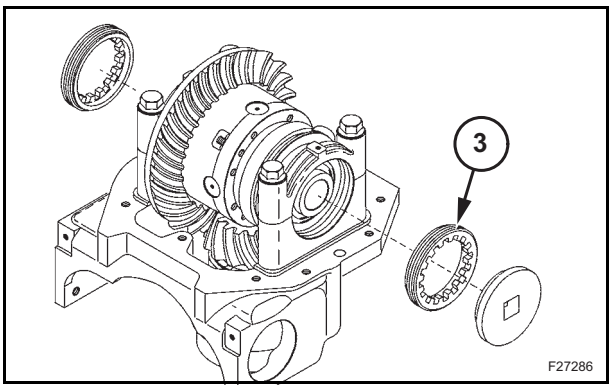
Loosen and remove the screws (9) to take out the two ring nut retainers (8).



Before removing the bolts, mark both half-collars (11) and the differential support with permanent reference marks to avoid inverting them during re-assembly. Mark the area between the ring nuts (3) and (7) and the differential support (1) as well.

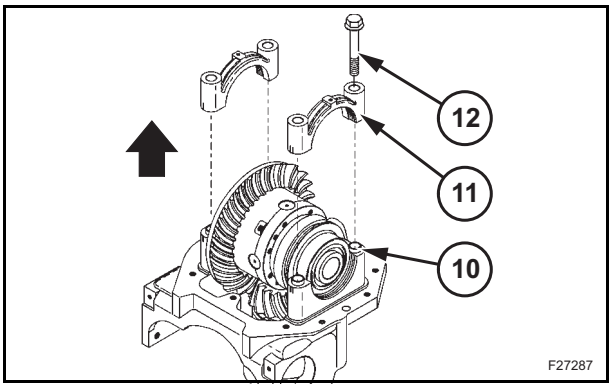


Unscrew the adjuster ring nuts (3) and (7) using tool **380000406** and a wrench.



Remove the 4 screws (12) and remove both half-collars (11).

NOTE: check that the bushes (10) remains in their housings.

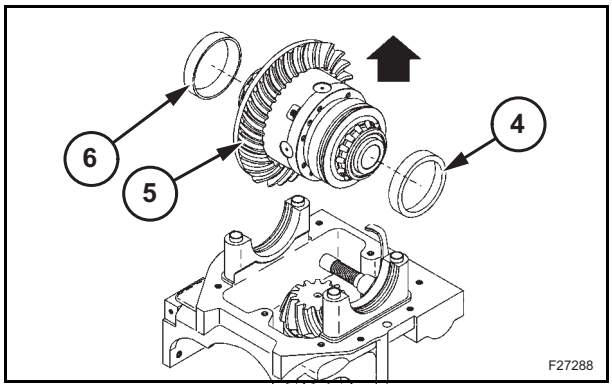


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Remove differential unit (5).
Remove the bearing (4) and (6) together with the differential assy.

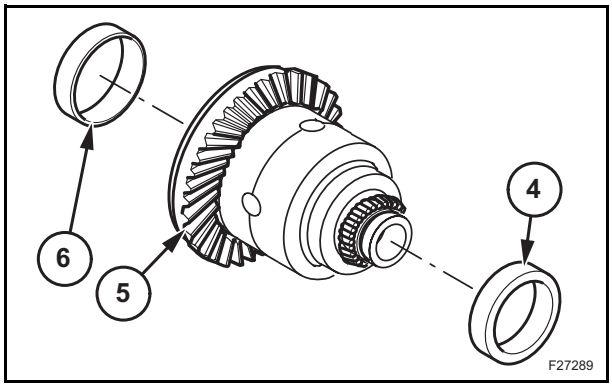
⚠ WARNING
Do not invert the bearing cone if the bearings are not replaced.



Assembly

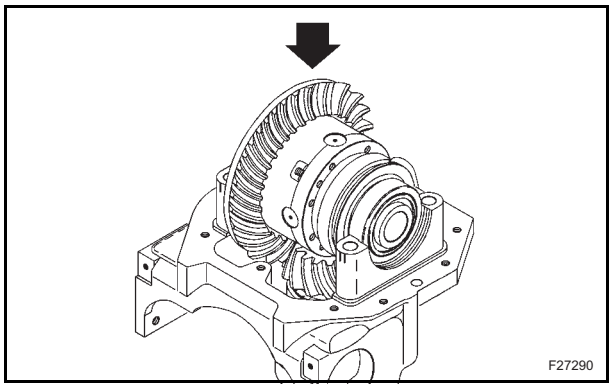
Assemble the bearings (4) and (6) on the differential assy (5).

⚠ WARNING
Do not invert the bearing cones if the bearings are not replaced.

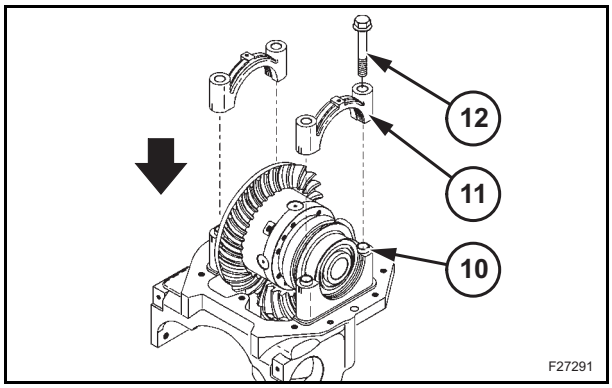


Assemble the differential assy complete with bearings on the differential carrier.

⚠ WARNING
Check the correct assembly side of the ring gear.



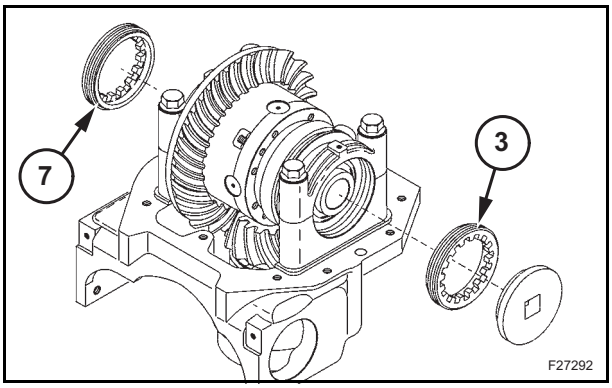
Move the differential assy so that the ring gear is placed against the pinion.
Check that all bushes (10) are in their housings and position both half collars (11) on their seats using the previously traced reference marks.
Lock both half collars with their fastening screws (12).



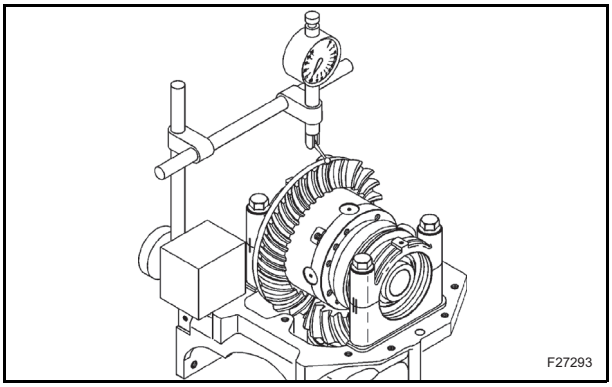
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Assemble the adjuster ring nuts (3) and (7) to the differential support.
Tighten both ring nuts (3) and (7) with special tool **380000406**, till the backlash is eliminated and the differential bearings are slightly preloaded.
Check that the differential bearings are well settled; if necessary, knock slightly with a soft hammer, in order to properly set the bearings in position.



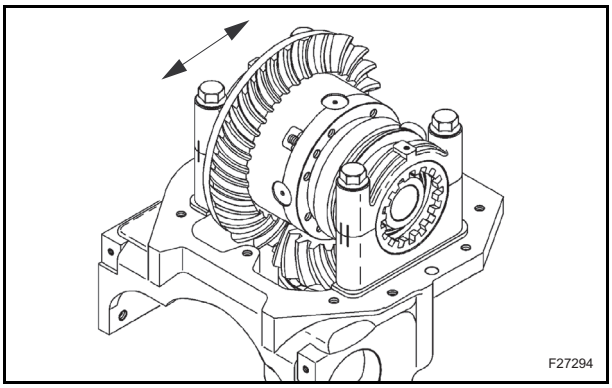
Position a magnetic-base dial gauge on the differential support, so that the feeler stylus touches the surface of one tooth of the ring gear with a 90° angle.



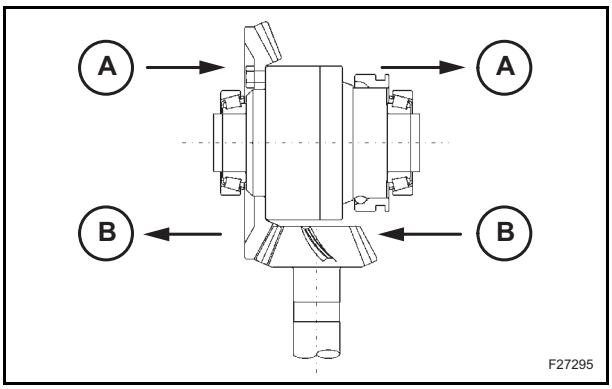
Lock the pinion and move the crown gear alternatively and note the pinion-ring gear backlash, measured with the comparator.
Repeat the operation on 2 or more points (teeth), rotating the crown gear, so that to obtain an average value.
Check if the measured backlash value is within the requested range:

0.18÷0.25 mm

Carry out the adjustment by operating on the ring nuts with the appropriate tool **380000406**.



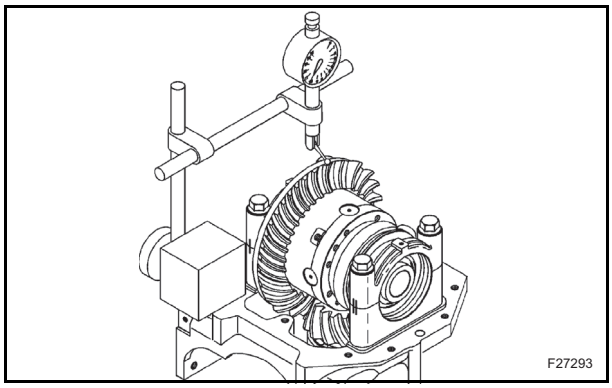
Adjust the ring nuts (3) and (7), remembering that:
(A)- if the measured backlash is greater than the given tolerance range, unscrew the adjuster ring nut (3) and screw in the adjuster ring nut (7) by the same measure.
(B)- if the measured backlash is less than the given tolerance range, unscrew the adjuster ring nut (7) and screw in the adjuster ring nut (3) by the same measure.



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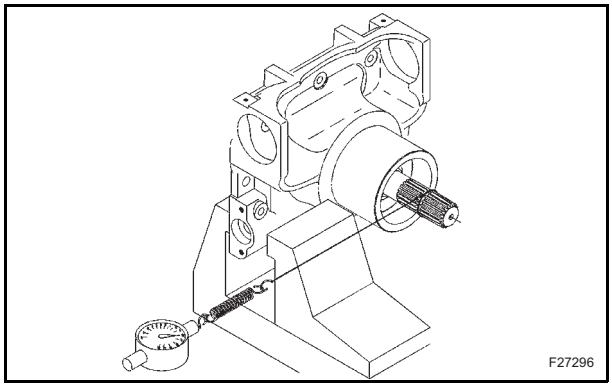
Once the adjustment of the pinion-ring gear backlash has been carried out, check also that there is a minimum preloading on the differential box bearings.
Repeat the whole sequence of the above mentioned operations till the indicated conditions are reached.



Once the pinion-ring gear backlash has been established, measure the total preloading (T) of the bearings (pinion-ring gear system), using a dynamometer, whose cord is wound on the splined end of the pinion. The measured value should be within the following range:

T = (P+3.90) ÷ (P+5.90) daN

where P is the effectively measured pinion preloading.
See section “Pinion assembly”.



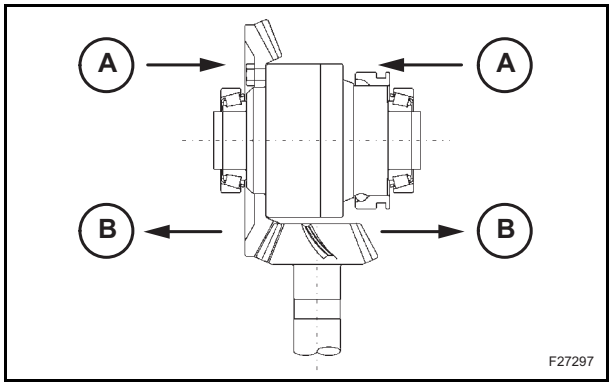
⚠ WARNING

All preloadings must be measured without the seal ring.

If the measurement is not within the requested range, check well the assembly of each component and operate on the adjuster ring nuts (3) and (7) of the differential support:

(A)- if the total preloading is less than the given range, screw in both adjuster ring nuts (3) and (7) by the same measure, keeping the pinion-ring gear backlash value unchanged.

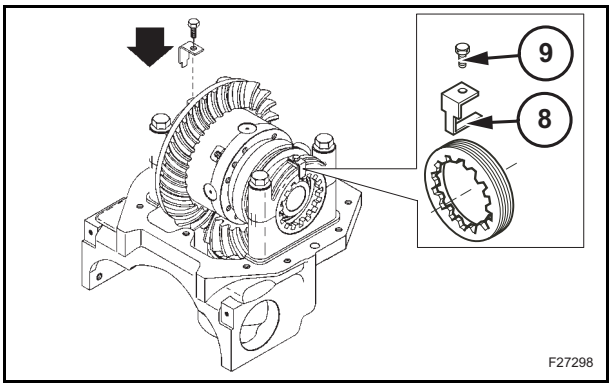
(B)- if the total preloading is higher than the given range, screw in both ring nuts (3) and (7) by the same measure, keeping the pinion-ring gear backlash value unchanged.



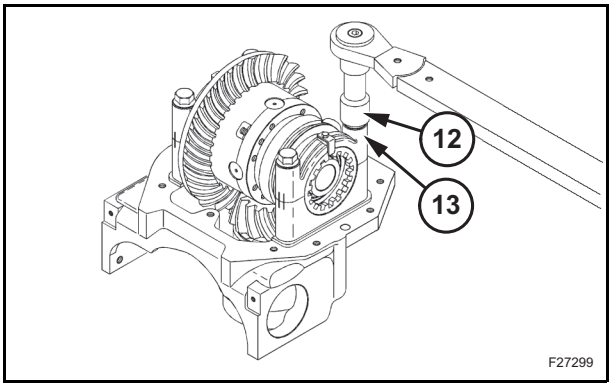
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Once all the adjustment operations have been completed, fit the ring nut retainers (8) and their screws (9), tightening them to the requested torque.

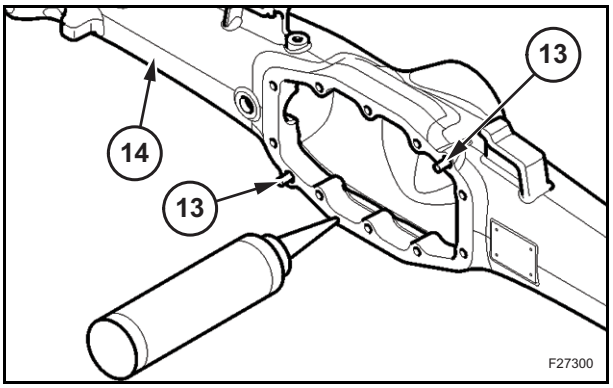


Tighten the bolts (12) of both half collars (11) to the requested torque.

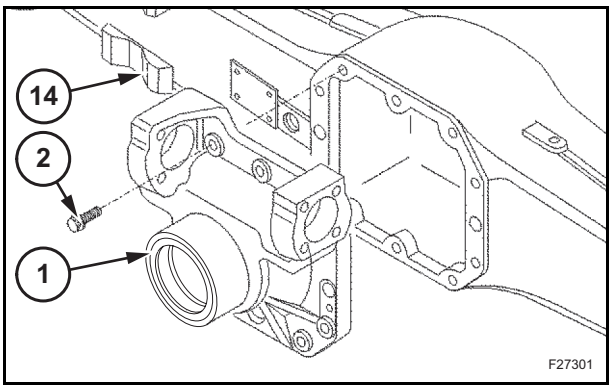


Before matching surfaces, make sure that they are perfectly clean, degrease and clean them with appropriate detergents.
Spread a film of adhesive on the contact surface between the axle beam (14) and the differential carrier.

NOTE: check that the two pins (13) are in their housing.



Position the differential support (1) on the axle housing (14), and tighten the retaining screws (2) to the requested torque.

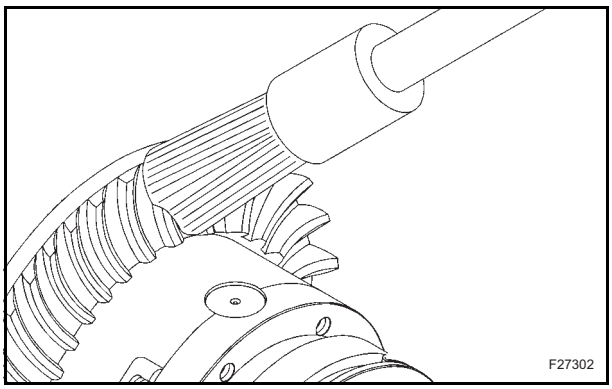


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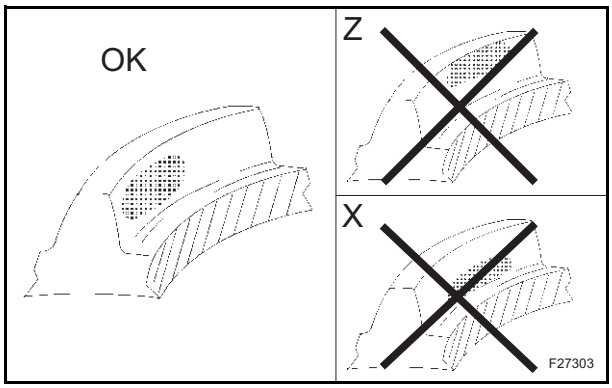
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Bevel gear marking test

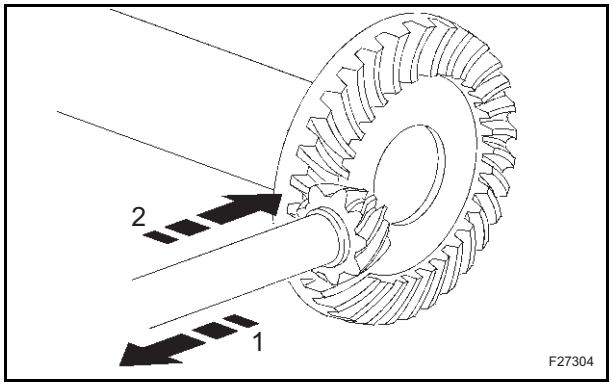
To test the marks of the bevel gear teeth, paint the ring gear with red lead paint.
The marking test should always be carried out on the ring gear teeth and on both sides.



OK -> Correct contact:
If the bevel gear is well adjusted, the mark on the teeth surfaces will be regular.
Z -> Excessive contact on the tooth tip:
Approach the pinion to the ring bevel gear and then move the ring bevel gear away from the pinion in order to adjust the backlash.
X -> Excessive contact at the tooth base:
Move the pinion away from the ring bevel gear and then approach the ring bevel gear to the pinion in order to adjust the backlash.



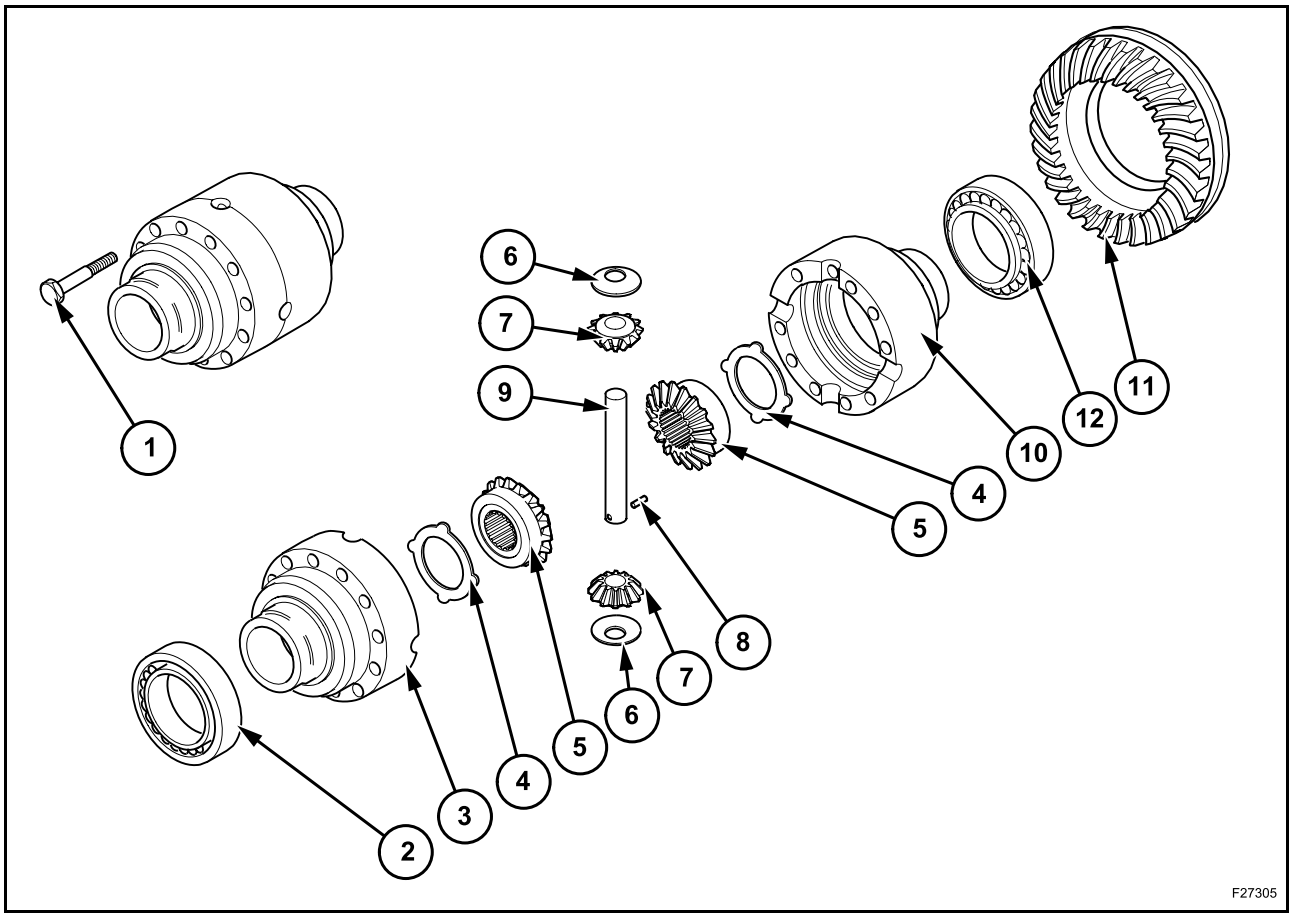
Movements to correct:
1 -> move the pinion for type X contact adjustment.
2 -> move the pinion for type Z contact adjustment.



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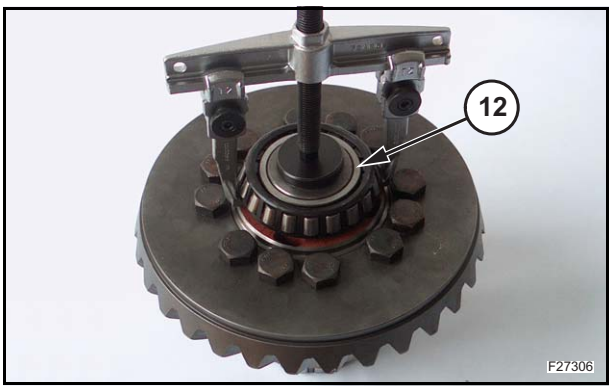
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DIFFERENTIAL GROUP



Disassembly

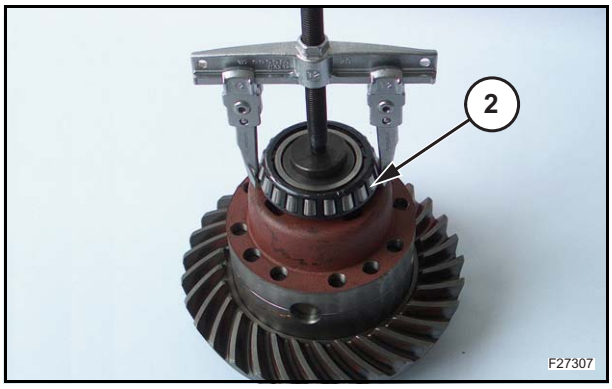
Use an extractor to remove bearing (12).



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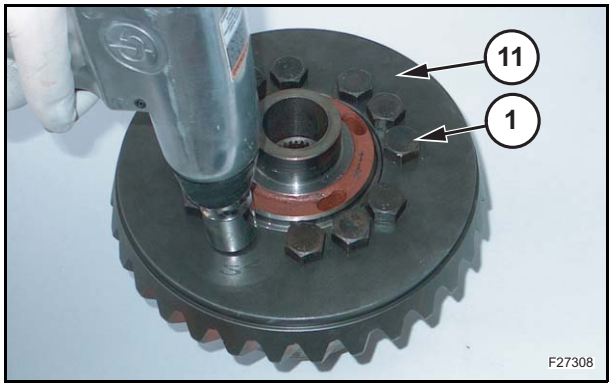
Use an extractor to remove bearing (2).



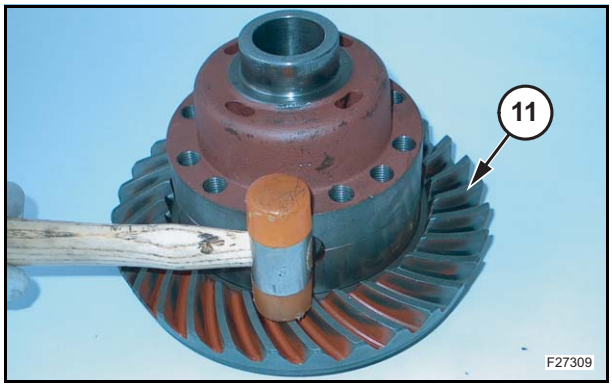
Loosen all fastening screws (1) of the ring gear (11).

⚠ WARNING

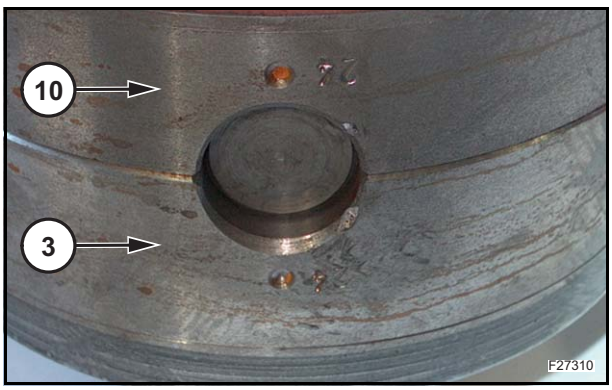
This operation makes both differential half boxes free, so take care not to lower the inner components.



Remove the ring gear (11) by means of a hammer.



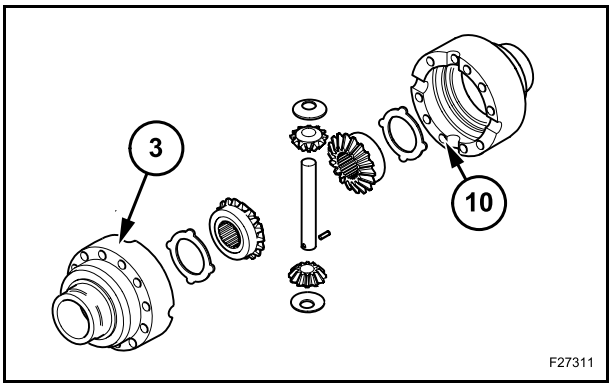
Check the marking points (3) and (10) that will be useful during the assemblage.



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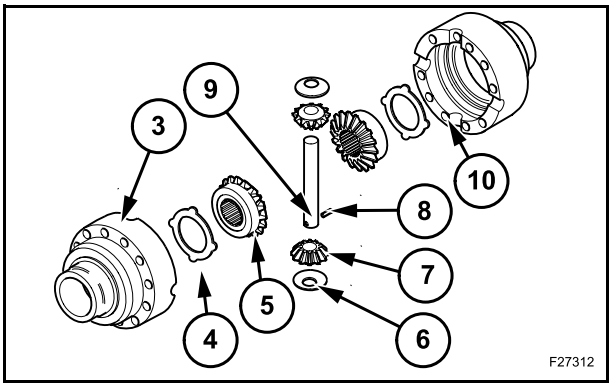
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Assemble the two half housings of the differential unit (3) and (10).
Disassemble all the components.
Check the operating and wear conditions of the components.



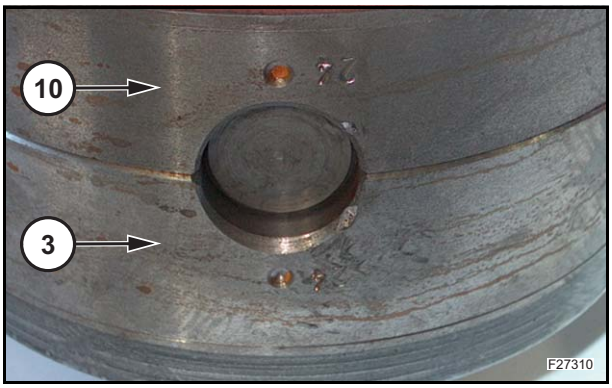
Assembly

Position a half housing (3) on a workbench and assemble all inner components: the discs (4), the gears (5), the shaft (9), the gears (7), the spherical washers (6) and the pin (8).

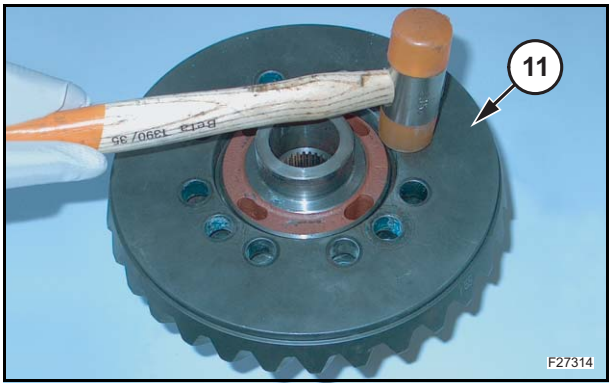


Assemble the two half housings of the differential unit (3) and (10).

⚠ WARNING
Carefully check that the marks of both differential half housings coincide.



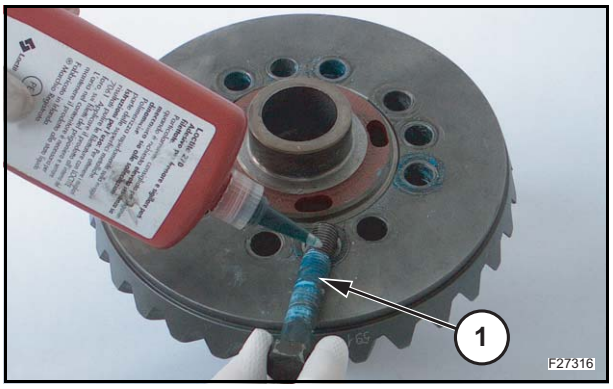
Assemble the ring gear (11) by means of a hammer.



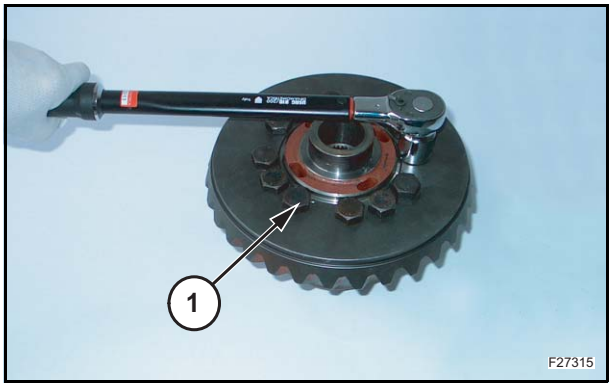
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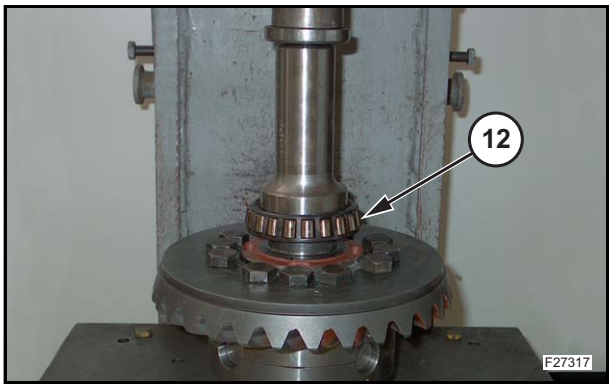
Apply Loctite 242 on the thread of screws (1).



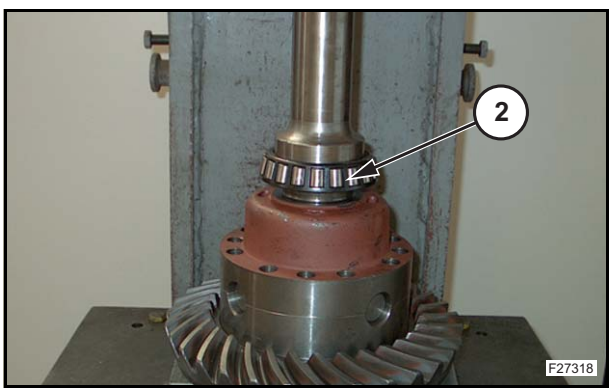
Tighten the screws (1) to the specified torque.



Press the bearing (12) or assemble after preheating.



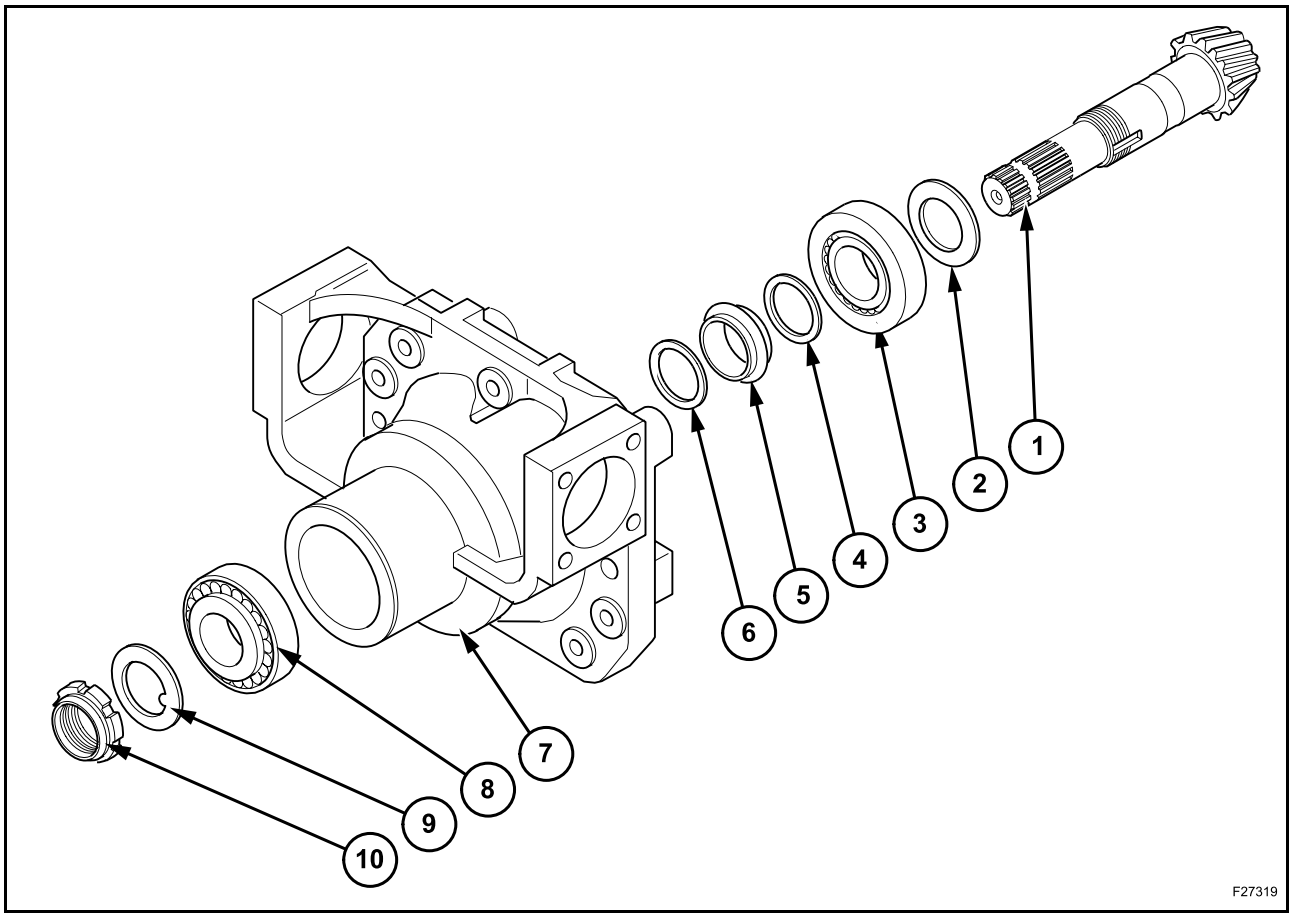
Press the bearing (2).



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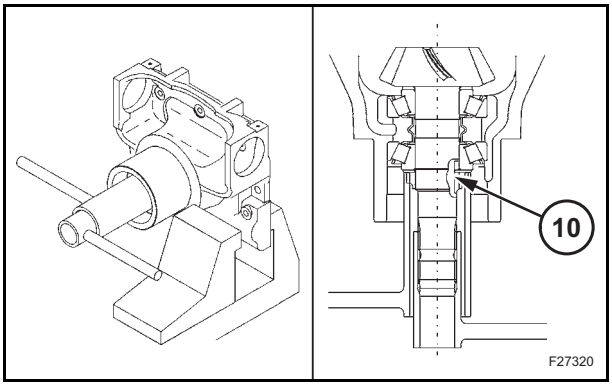
PINION GROUP



Disassembly

Position the differential carrier in a vise.
Unscrew the ring nut (10) using the special tool **380002218**.

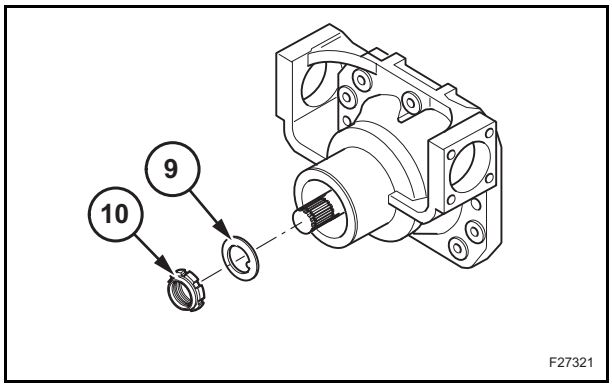
NOTE: this operation will irretrievably damage the ring nut (10).



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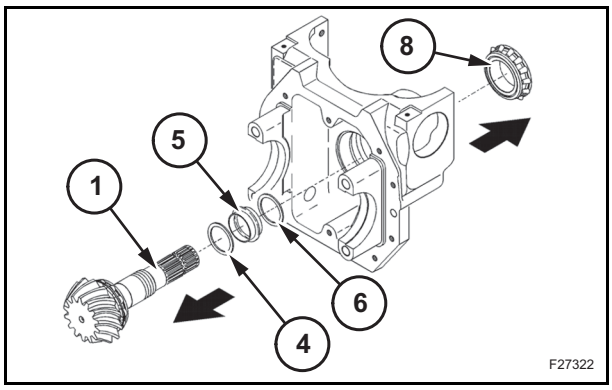
Remove the ring nut (10) and collect its washer (9).



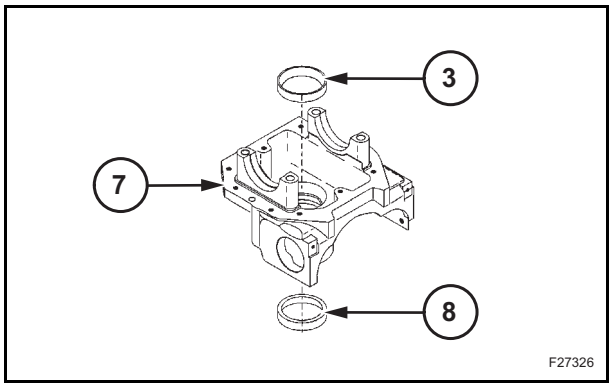
Tap with a soft hammer to extract the pinion (1).

⚠ WARNING
Take care not to lower the pinion (1).

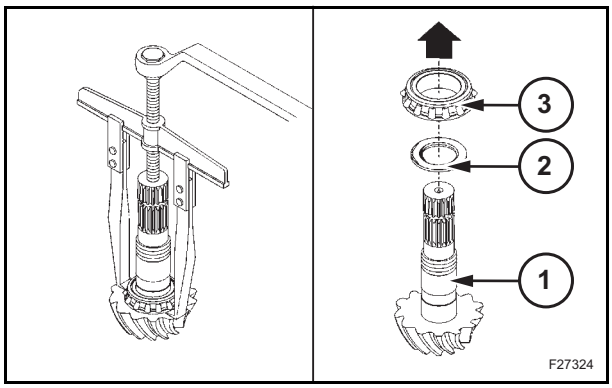
Collect the washers (4) and (6), the spacer (5) and the bearing (8).



Place the differential carrier (7) on a flat surface and remove the bearing cups (3) and (8) using a drift and a hammer.



To remove the bearing (3) of the pinion (1), use an extractor.
Collect the bearing (3) and the shim (2).

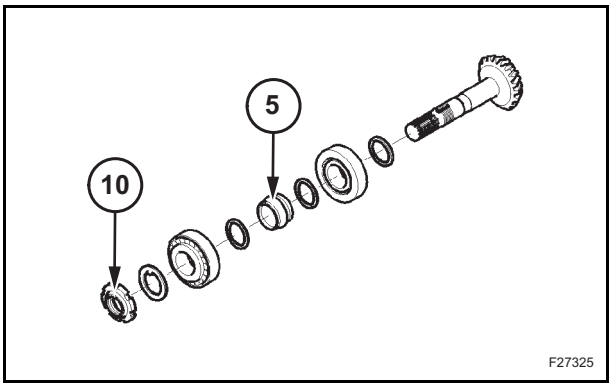


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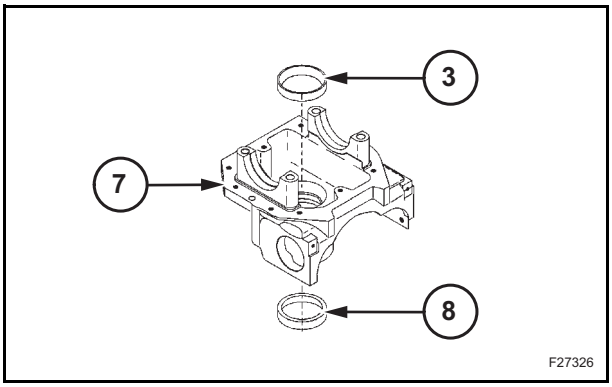
Check all pinion components for wear.

⚠ WARNING
The ring nut (10) and the spacer (5) must be replaced when reassembling the unit.

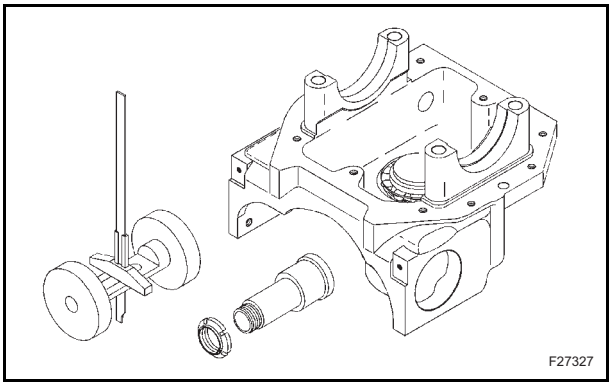


Assembly

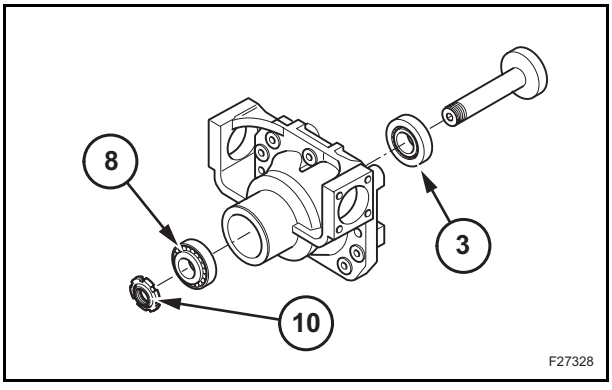
Place the differential support (7) on a workbench.
Assemble the bearing cups (3) and (8).



Prepare the kit consisting of the special tools called “false pinion” **380002219** and “false differential box” **380000407** + **380000440** and a depth gauge.



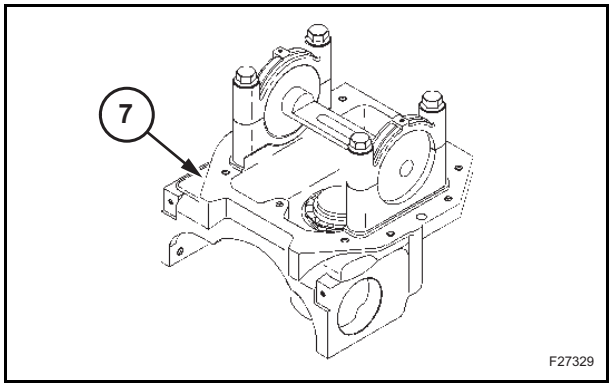
Insert the bearing (3) and (8) in their housings.
Assemble the “false pinion” **380002219** and its ring nut (10).
Tighten without exceeding the ring nut, till the backlash is eliminated.



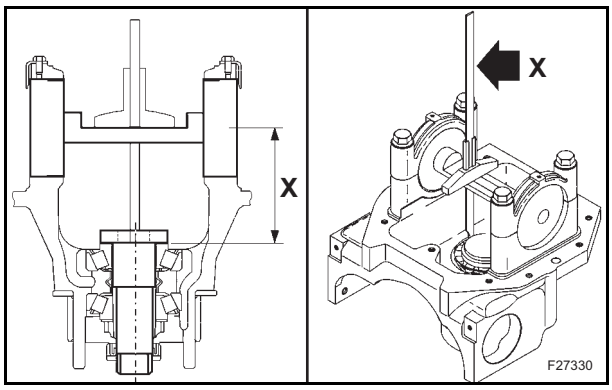
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Install “false differential box” special tools **380000407** + **380000440** to the differential group supports (7) and lock it with the half collar bolts.

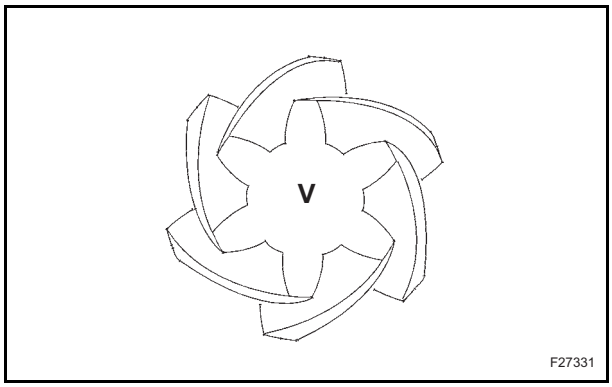


Assembly diagram of the “false differential box” tools **380000407** + **380000440** on the bearing differential support seats.
Use a depth gauge to measure distance “X” (distance between the axis of the differential bearings and the point at which the pinion head is supported, or base of the bearing).

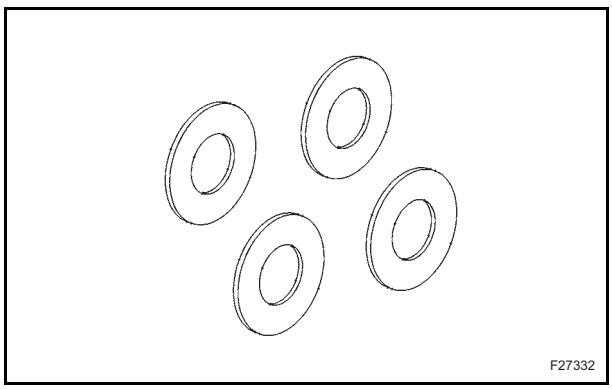


In order to determine the necessary thickness value (S) between the pinion and the bearing, subtract the value (V), stamped on the pinion head (V = requested conical distance), from the measured value (X).

S = X-V mm



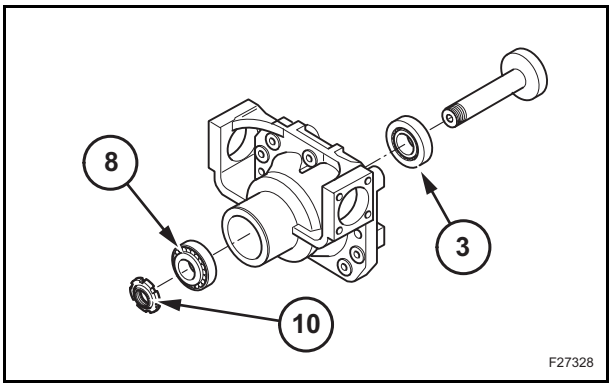
Select the shim (2) of thickness value (S) among the range of available shims.



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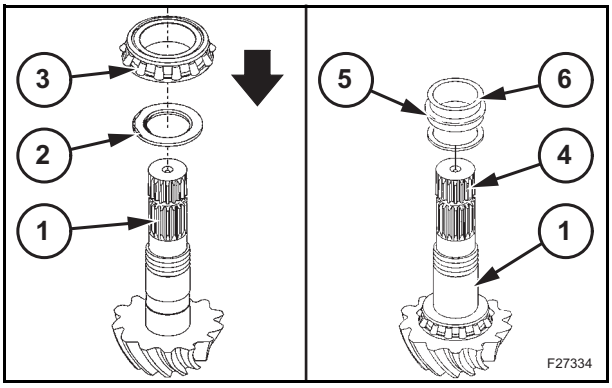
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Remove the “false differential box” special tool from the differential supports (7).
Remove the ring nut (10), the “false pinion” and the bearing (3) and (8).

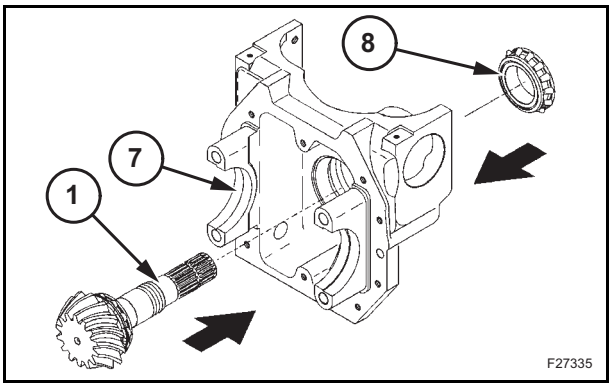


Once you have chosen and inserted the suitable shim (2) with the chamfer against the gear, force the bearing (3) into the pinion shaft (1) with the special tool **380002224** under a press, making sure that it is well set.
Insert the shims (4) and (6) and a new spacer (5).

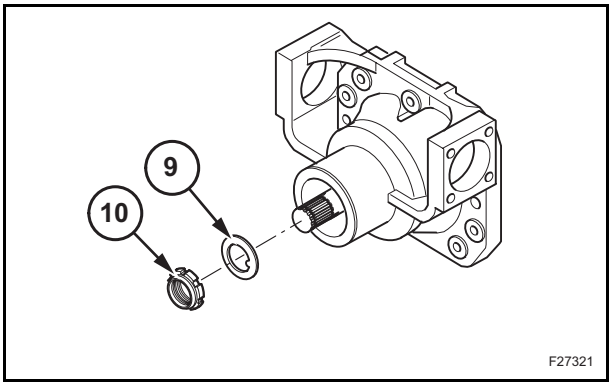
NOTE: use always a new spacer (5).



Insert the pinion assy (1) into the differential support housing (7) and the bearing cone (8).
To force the bearing into position (8), use a hammer. It is advisable to offer resistance, for example a sledge, to the beating force.



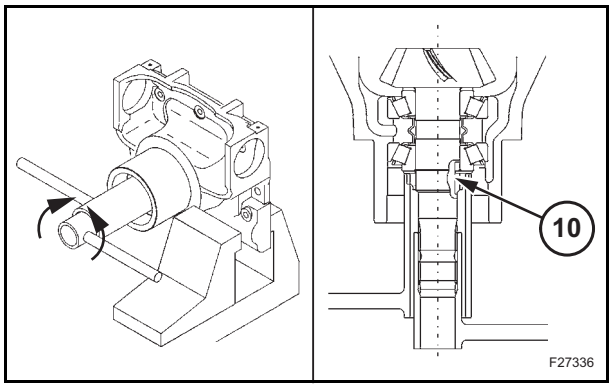
Insert the washer (9) and screw in a new ring nut (10) on the pinion.



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Screw the ring nut (10) in, using the wrench **380002218** for ring nut and for pinion retainer.



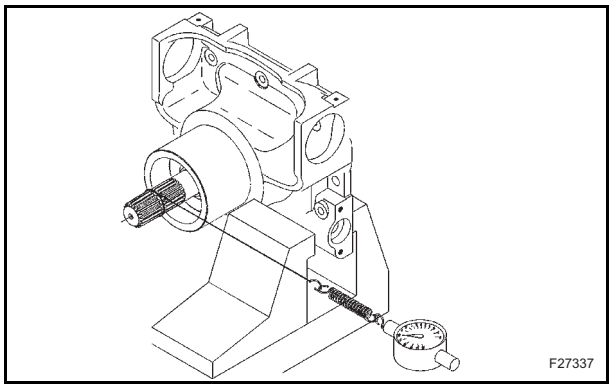
⚠ WARNING

The torque setting is given by the preloading measurement on bearings; tighten the ring nut (10) gradually.

NOTE: if the tightening is excessive, the collapsible spacer must be replaced and the procedure repeated. When you check the preloading, it is advisable to beat slightly both pinion ends with a soft hammer, so as to help setting the bearings.

Carry out the preloading measurement P of the pinion taper roller bearings, using a dynamometer whose cord is wound on the end of pinion spline.
The adjustment is carried out by increasing the ring nut torque gradually, being careful not to exceed.

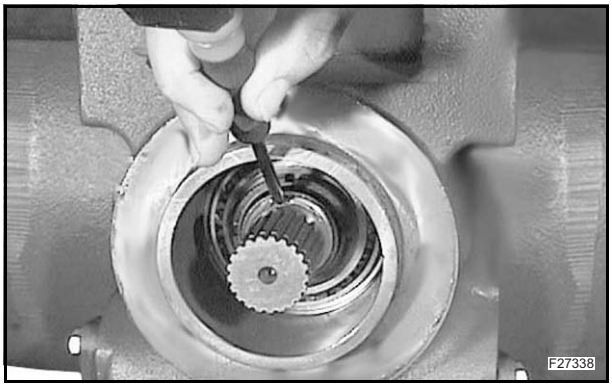
P = 9.2÷13.7 daN



⚠ WARNING

All preloadings must be measured without the seal ring.

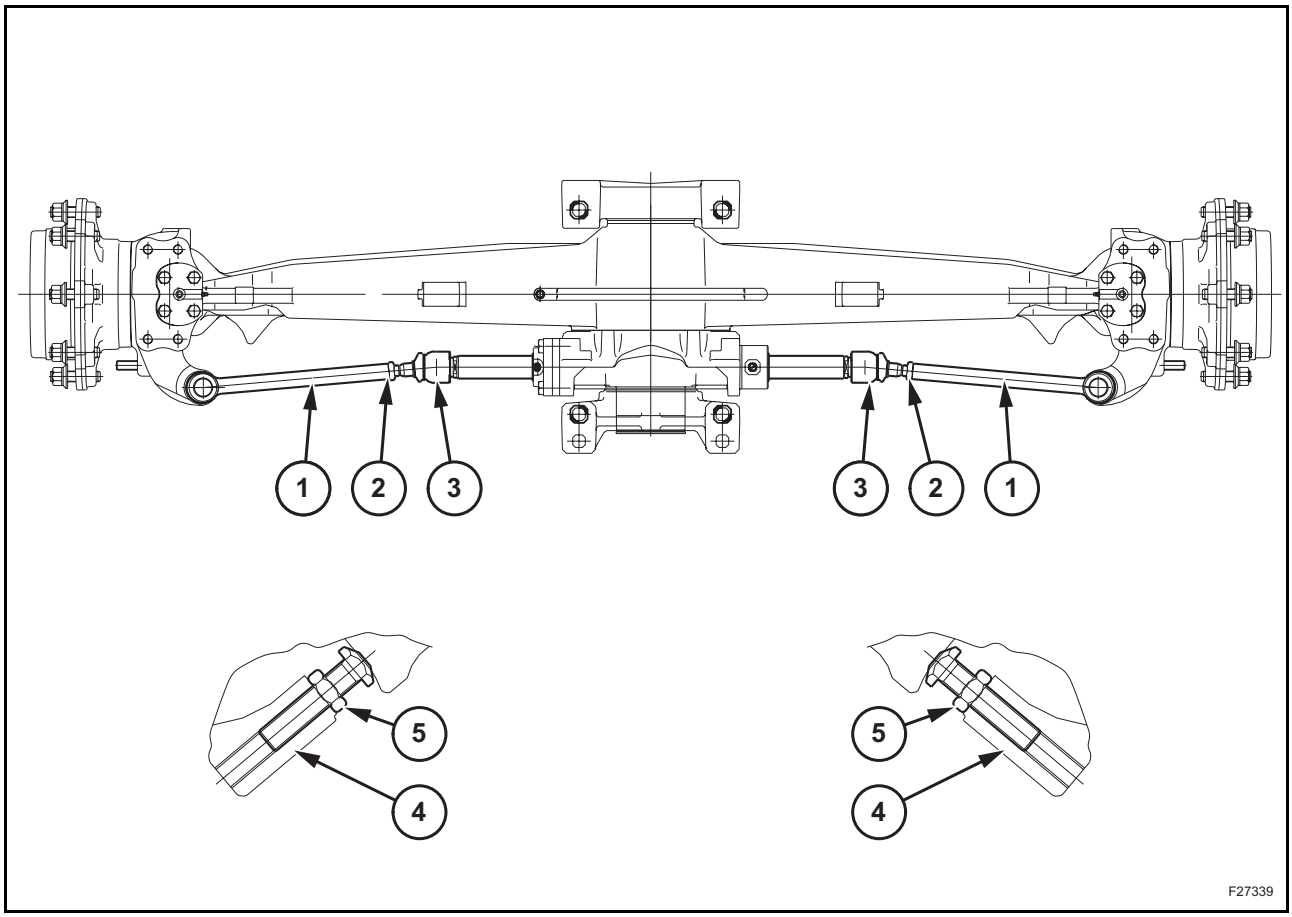
Once the requested preloading value is achieved, stake the ring nut, using a hammer and a chisel.



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TOE-IN / STEERING ANGLE

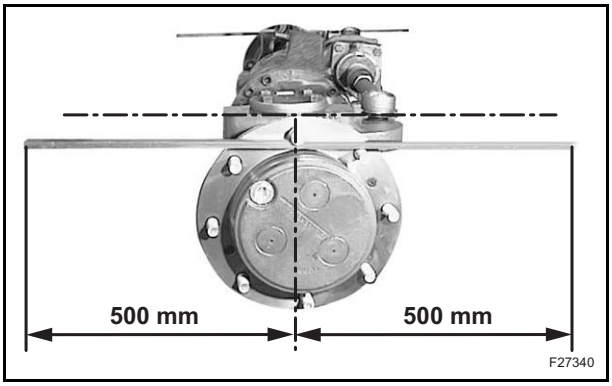


Toe-in

Put two equal 1 m long linear bars on the wheel sides and lock them with two nuts on the wheel hub stud bolt.

⚠ WARNING

The two bars should be fixed on their middle so that they are perpendicular to the supporting surface and parallel to the pinion shaft axis; align the two bars.

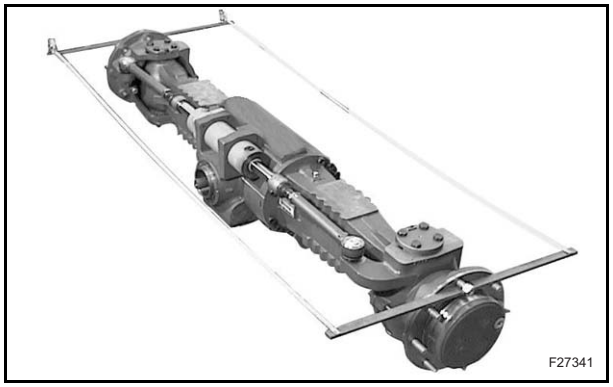


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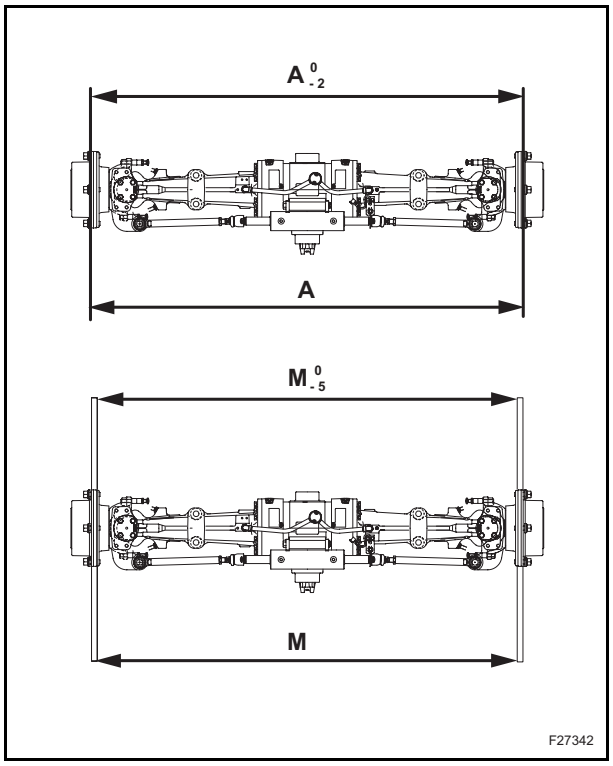
Measure the distance in mm M between the bars ends with a tapeline.

NOTE: keep the minimum value, swinging the measurement point.

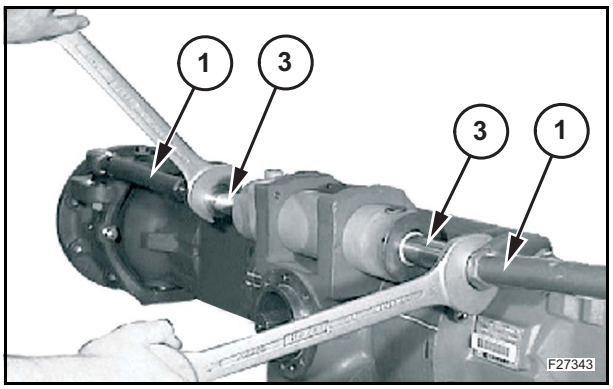


Check that the difference of the measurements between the wheel hubs diameters ends is within the requested tolerance range.
The nominal toe-in value (A) is referred to the external diameter of the wheel hubs flange, therefore the measured value (M) at the bars ends must be related to the ratio between length of the bar and flange diameter:

nominal toe-in = A^{0}_{-2} ⟶ measured toe-in = M^{0}_{-5}



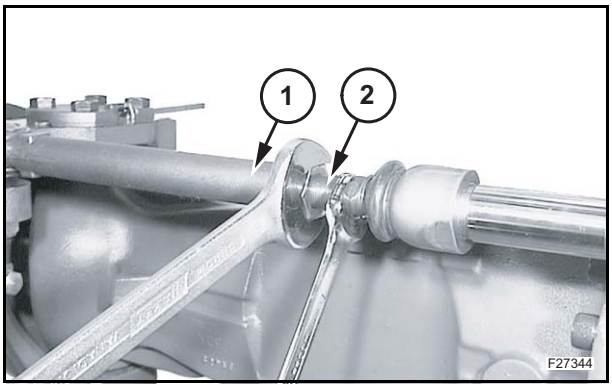
If toe-in is incorrect, operate with two wrenches on the guide rods (1) screwing in and out the two joint tie rods (3) equally till the toe-in is within the requested tolerance.



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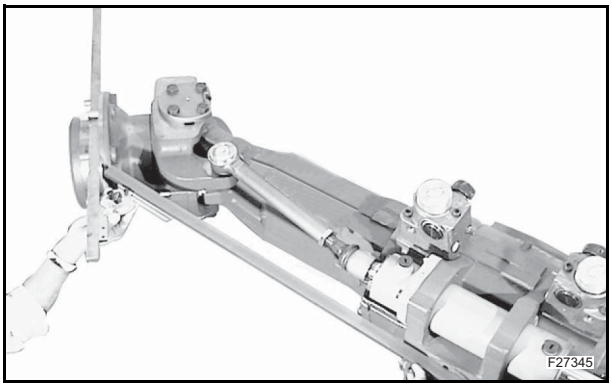
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After adjusting, screw in the locknuts (2) of the guide rods (1) to the requested tightening torque.

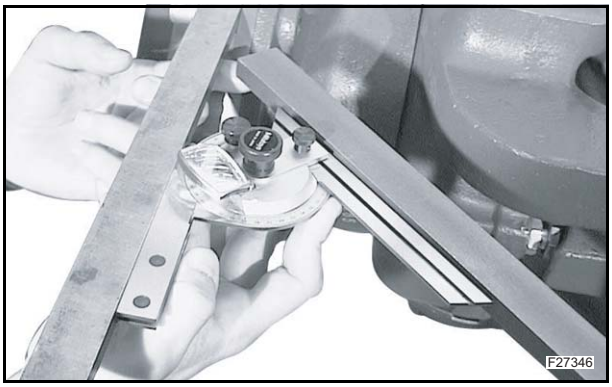


Steering angle adjustment

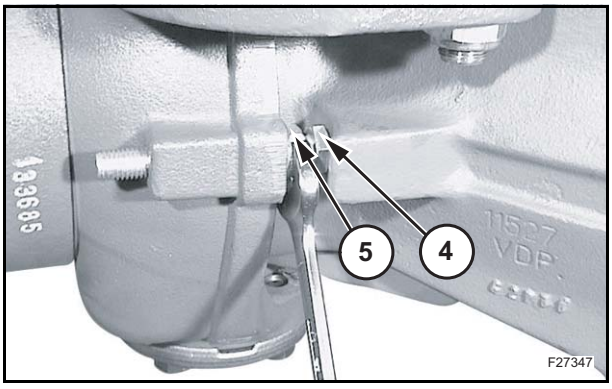
Use the same bars assembled for the toe-in adjustment and a long bar perfectly leaned over the machined part of the central body (pinion side), so that the two bars form an acute angle at the maximum steering.



Adjust a protractor to the requested angle and position it on the long bar.
Move a wheel side till it forms, with the two bars, the angle fixed by the protractor.



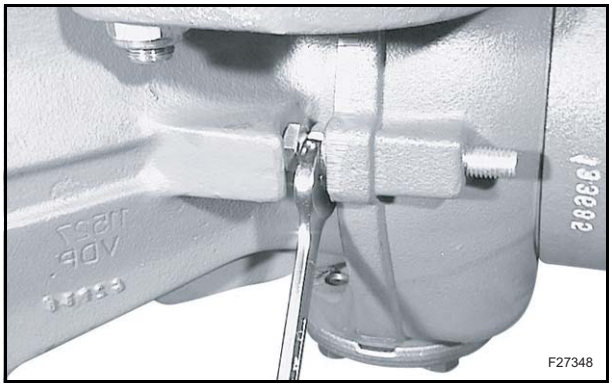
Adjust the mechanical steering stop, screwing in or out the stop bolt (4), locking it with the locknut (5) to the specified tightening torque.



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Steer completely towards the other side and repeat the same operation.



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2.3 FAULT FINDING

PROBLEM	CAUSE										
	1	2	3	4	5	6	7	8	9	10	11
Wheel vibration; front tyre resistance; half shaft breakage	●	●	●		●						●
Steering is difficult; vehicle goes straight while it's turning	●	●	●	●							●
No differential action; jamming while steering	●			●	●						●
Transmission excessively noisy	●	●	●	●	●		●		●		●
Uneven wear of tyre	●	●	●	●	●	●	●				●
Friction noise	●			●	●			●	●	●	●
Vibration during forward drive, intermittent noise	●	●	●		●						●

1. Incorrect installation / defective axle
Correct installation or repair or replace the differential in case it does not survive any one of the test phases.

2. Overloading / incorrect weight distribution
Remove excessive weight and redistribute load, following instructions related to the vehicle.

3. Different rotation radius of the tyres
If one tyre has a smaller radius, it will cause partial wheel slipping when force is applied. The other tyre with bigger radius will have to support all the work. Replace the tyre or adjust pressure to have same radius on both tyres.

4. Broken half shaft
It is not advisable to operate the vehicle with a broken half shaft. It is acceptable to move the vehicle (engine off unloaded) a few metres away only.

5. Bent half shaft
Replace the half shaft.

6. Blocked differential
Abnormal functioning of the differential or breakage/blockage of command device. Verify assembly and all components.
Vehicles with wide steering angle may proceed with kicks, have steering difficulty or cause pneumatic wearing at sharp turns. Reduce the steering angle to minimum and decelerate when the vehicle begins to kick.

7. Incorrect wheel adjustment
Verify group integrity and wheel side bearings.
Adjusting according.

8. Damaged or worn axle parts
Check the condition of ring gear, pinion gear, bearings etc.
Replace whenever necessary.

9. Contamination in the axle box or incorrect assembly of parts
Look for foreign particles. Check assembly of the various parts of the axle.

10. Incorrect adjustment of the bevel gear set: Parts of the transmission worn out
(Transmission gears, U joints, etc.). Replace or adjust as required.

11. Incorrect use of the product
See the vehicle Manufacturer's instructions once again.

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PROBLEM	CAUSE	CORRECTION
Ring gear tooth broken on the outer side	Excessive gear load compared to the one foreseen Incorrect gear adjustment (excessive backlash) Pinion nut loose	Replace bevel gear set. Follow carefully the recommended operations for the adjustment of the bevel gear set backlash.
Ring gear tooth broken side	Load bump Incorrect gear adjustment (insufficient backlash) Pinion nut loose	Replace bevel gear set. Follow carefully the recommended operations for the adjustment of the bevel gear set backlash.
Pinion or ring gear teeth worn	Insufficient lubrication Contaminated oil Incorrect lubrication or depleted additives Worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring	Replace bevel gear set. Follow carefully the recommended operations for the adjustment of the bevel gear set backlash. Use correct lubricants, fill up to the right levels and replace according to the recommended program.
Overheated ring and pinion teeth See if gear teeth have faded	Prolonged functioning at high temperatures Incorrect lubrication Low oil level Contaminated oil	Replace bevel gear set. Use proper lubrication, fill up to right level and replace at recommended program.
Pinion teeth pitting	Excessive use Insufficient lubrication	Replace bevel gear set. Use correct lubrication, fill up to the right level and substitute at recommended intervals.
Axle beam body bent	Vehicle overloaded Vehicle's accident Load bump	Replace axle beam body.
Worn out or pitted bearings	Insufficient lubrication Contaminated oil Excessive use Normal wear out Pinion nut loose	Replace bearings. Use correct lubrication, fill up to the right level and substitute at recommended intervals.
Oil leakage form gaskets and seals	Prolonged functioning at high temperature of the oil Oil gasket assembled incorrectly Seal lip damaged Contaminated oil	Replace the gasket or seal and matching surface if damaged. Use correct lubrication and replace at recommended intervals.

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Excessive wearing out of input flange spline	Exhaustive use Pinion nut loose Pinion axle backlash	Replace the flange. Check that the pinion spline is not excessively worn out. Replace bevel gear set if required.
Fatigue failure of pinion teeth See if the fracture line is well defined (wave lines, beach lines)	Exhaustive use Continuous overload	Replace bevel gear set.
Pinion and ring teeth breakage	Crash load of differential components	Check and/or replace other differential components.
Side gear spline worn out Replace all scratched washers (Excessive backlash)	Excessive use	Replace differential gear group. Replace half shaft if required.
Thrust washer surface worn out or scratched	Insufficient lubrication Incorrect lubrication Contaminated oil	Use correct lubrication and fill up to right level. Replace at intervals recommended. Replace all scratched washers and those with a thickness by 0.1 mm lower than the new ones.
Inner diameter of tapered roller bearing worn out	Excessive use Excessive pinion axial backlash Insufficient lubrication Contaminated oil	Replace bearing. Check pinion axial backlash. Use proper lubrication, fill up to right level and replace at recommended intervals.
Bent or broken half shaft	Vehicle intensively operated or overloaded	Replace.
Half shaft broken at wheel side	Wheel support loose Beam body bent	Replace. Check that wheel support is not worn out or wrongly adjusted.

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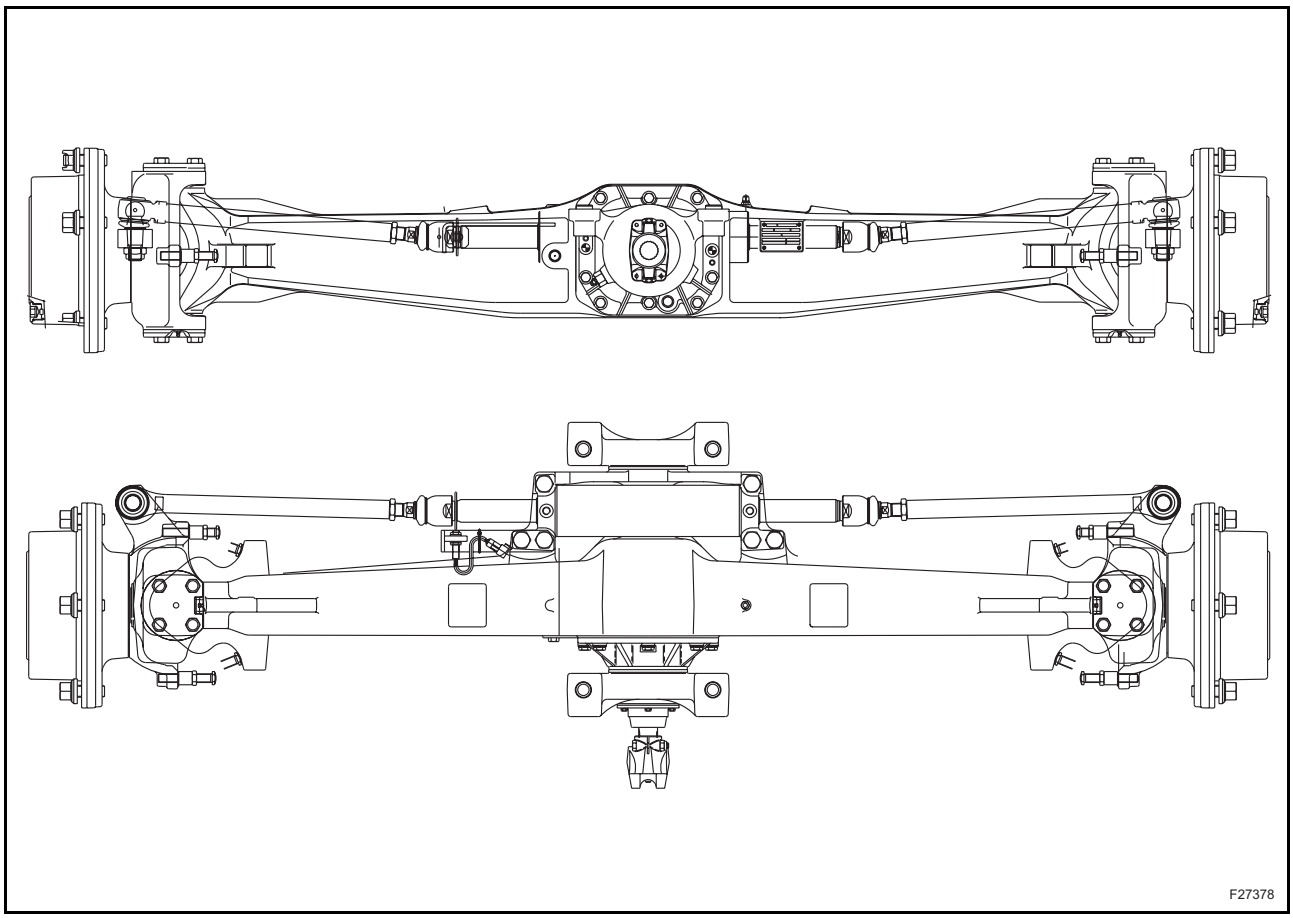
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3. FRONT AXLE 4WS “CARRARO”

3.1 SPECIFICATIONS

TYPE

Front steering axle, model 26.28



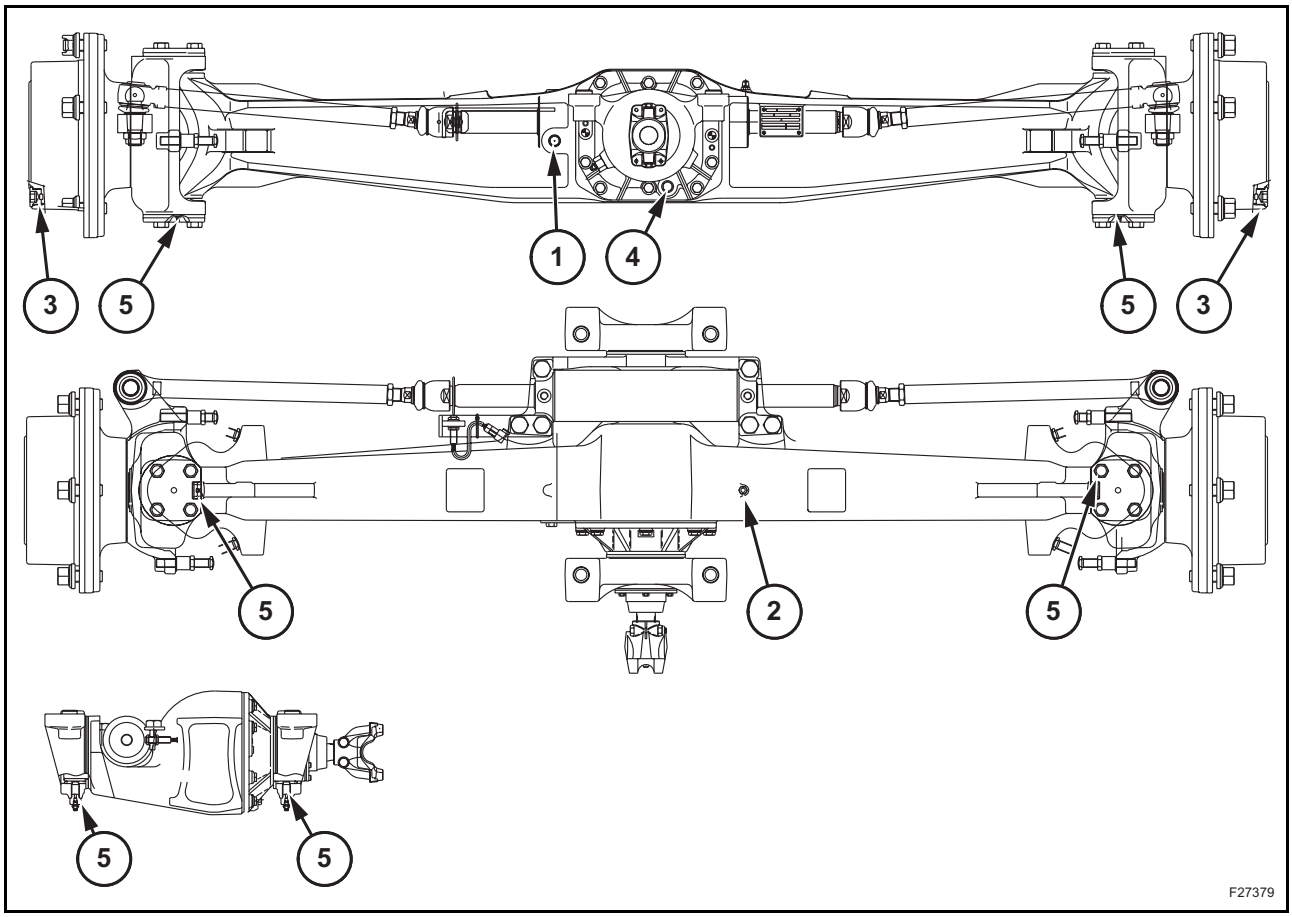
POWERSHIFT	SELF LOCKING	RATIO
•	•	18.46

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LUBRICATION AND GREASING

Oil capacity	11.0 litres
Oil specification: use recommended oil enriched in additives Note: do not use synthetic or vegetable oil without consent of the axle manufacturer	Akcela Nexplore MAT3525



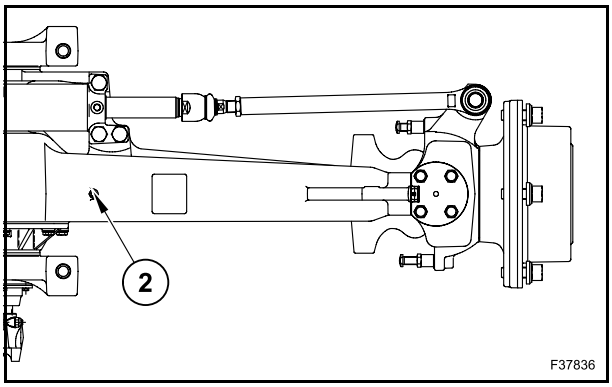
DESCRIPTION	POSITION
Oil level plug	1
Air breather	2
Level, fill and drain plug for reduction gear oil	3
Oil drain plug	4
Greasing points	5

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Before draining the oil from axle housing, use the breather (2) to release possible internal pressure.

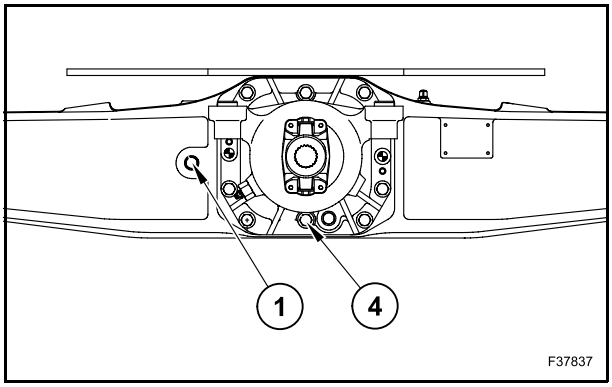
⚠ WARNING
Risk of violent oil ejection.



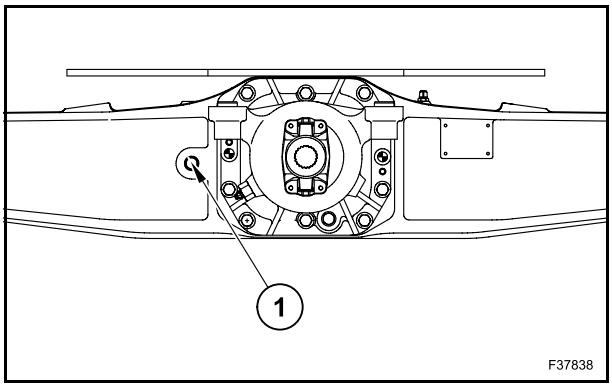
To drain the oil remove the level plug (1) and the drain plug (4).

⚠ WARNING
Risk of violent oil ejection.

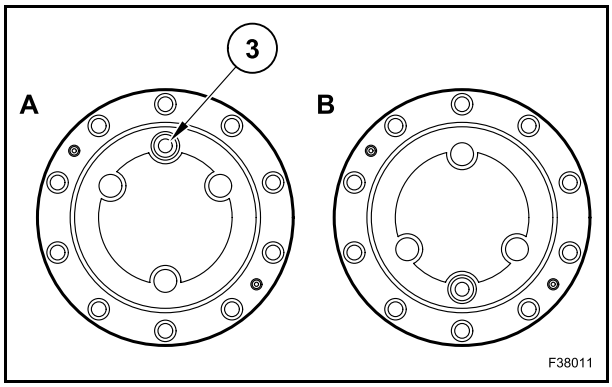
Drain all oil.
Clean the drain plug (4) and tighten to the requested torque.



Always use the oil breather (2) to release possible internal pressure.
Unscrew the level plug (1) and fill to the bottom of the level plug hole with the specified oil.
Wait to allow the oil to flow through the axle. Check oil level and fill to the specified level if necessary.
Screw the level plug (1) to the prescribed torque.



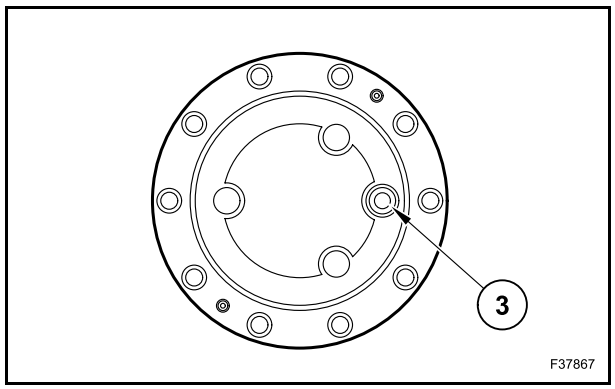
Before draining the oil from the reduction gear, rotate it so that the oil plug (3) is in the highest position [position A] and partially unscrew the plug to release any possible internal pressure.
Rotate the wheel end so that the plug (3) is toward the ground [position B].
Remove the plug and drain the oil.



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Rotate the wheel end so that the hole (3) is in the position shown in figure.
Fill to the bottom of the fill plug hole with specified oil.
Tighten the plug (3) to the requested torque.

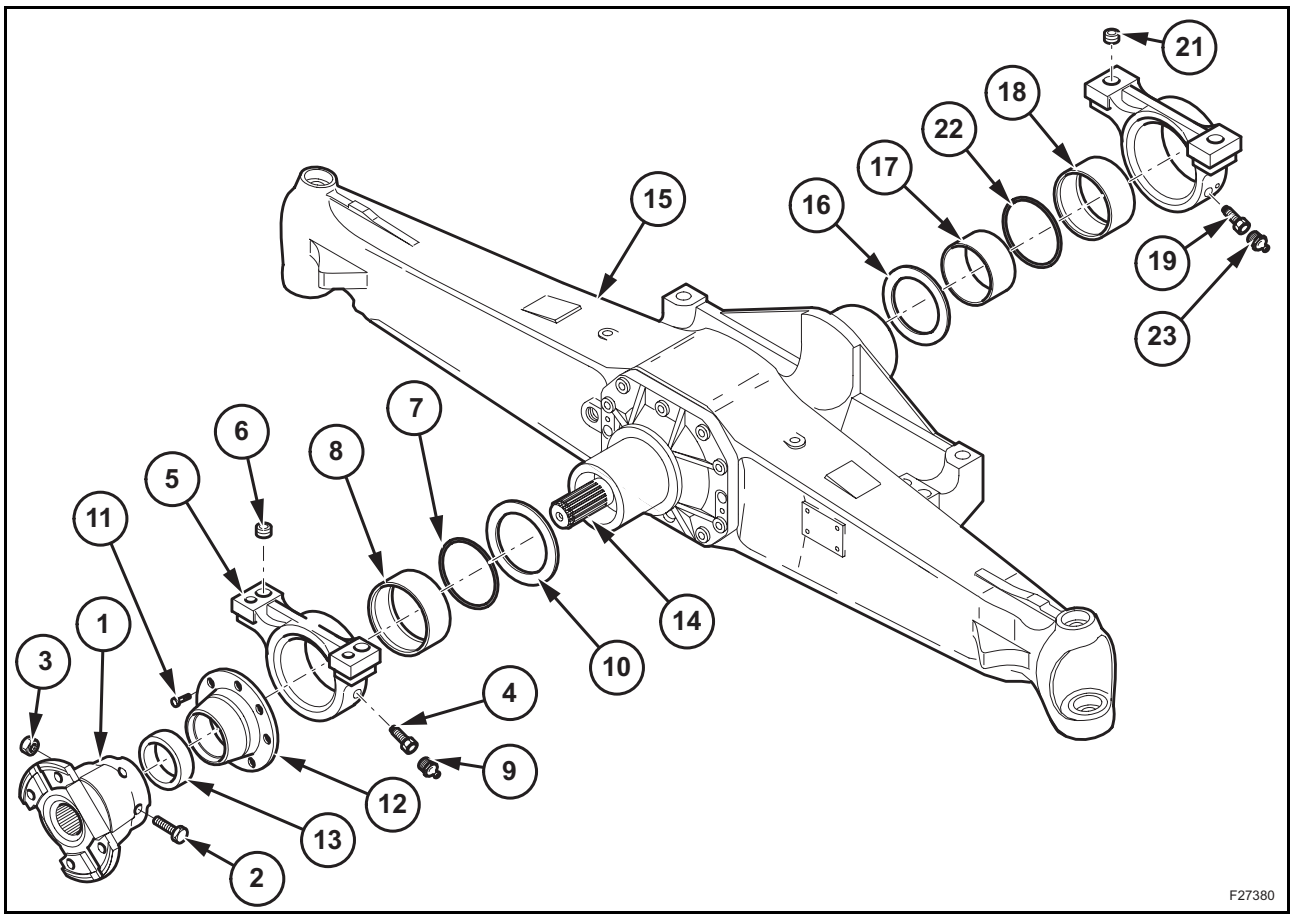


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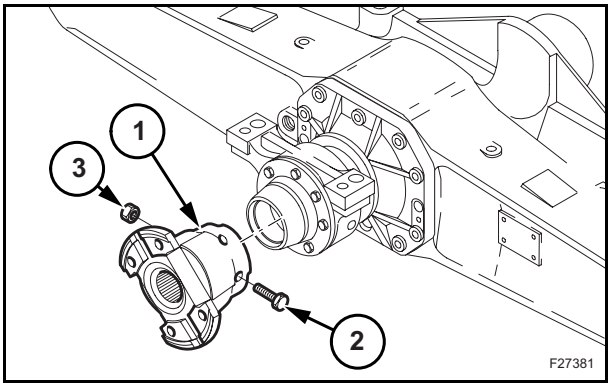
3.2 DISASSEMBLY AND ASSEMBLY

FRONT AND REAR SUPPORT



Disassembly

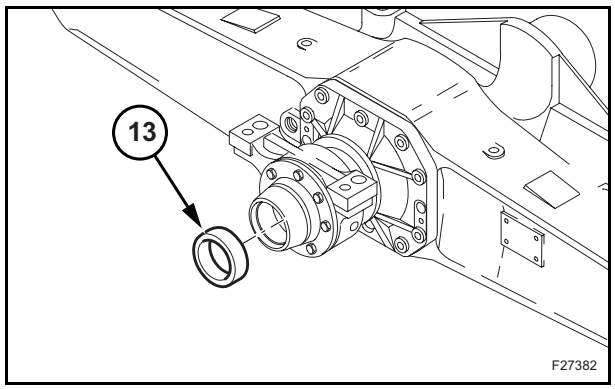
Remove the nut (3) and the bolt (2) and extract the flange (1).



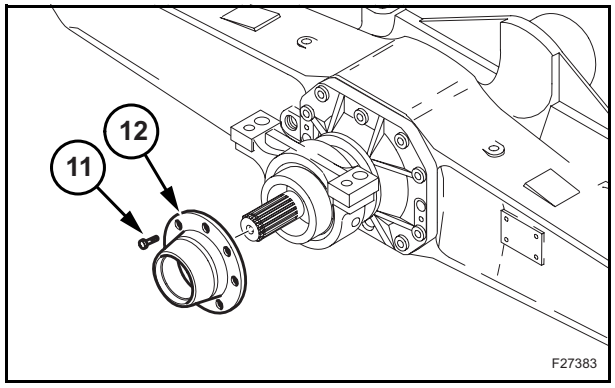
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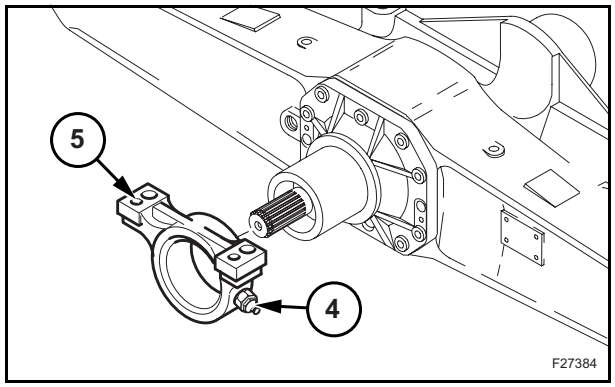
Remove the seal ring (13).



Unscrew the screws (11) and remove the flange (12).

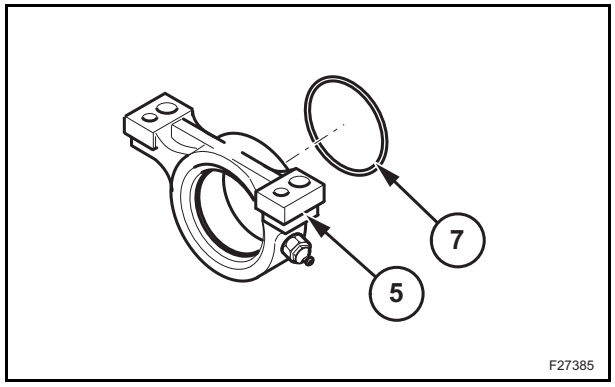


Loosen the bolt (4).
Take the rear support (5) out from the differential support.



Remove the O-ring (7) from the rear support (5).

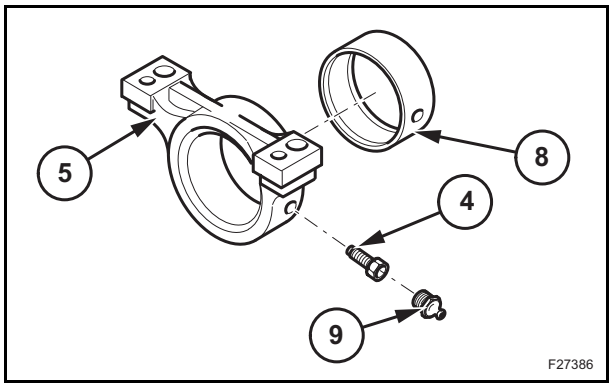
NOTE: this is a destructive operation for the O-ring (7).



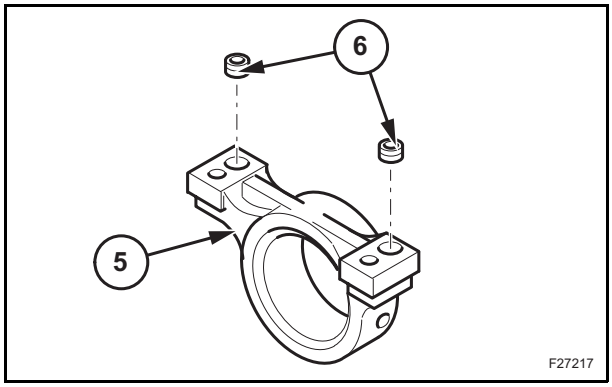
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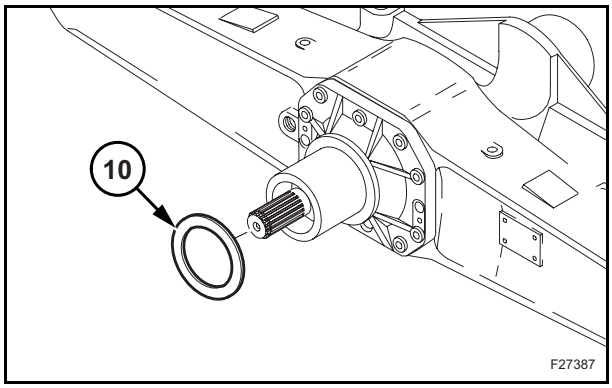
Remove the bolt (4) and the lube nibble (9).
Remove the bush (8) from the rear support (5).



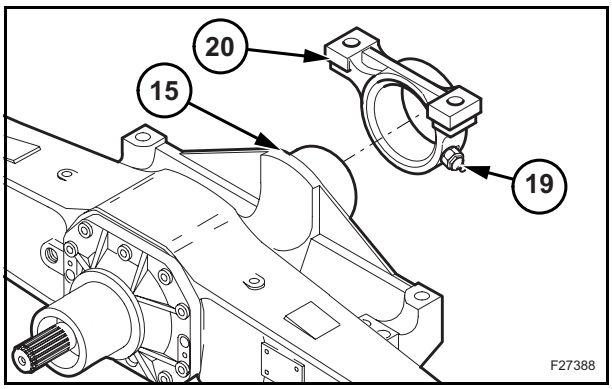
Remove the bushes (6) from the rear support (5).



Remove the washer (10) from the differential support only if necessary.



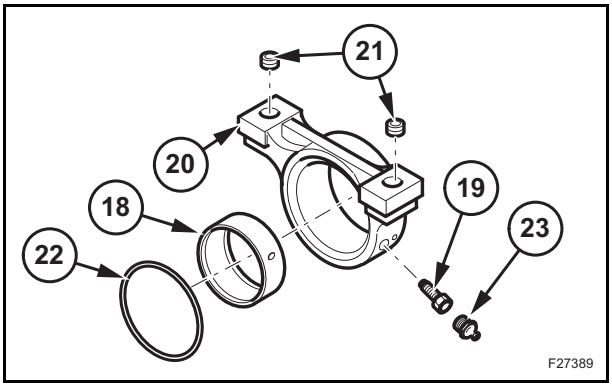
Loosen the bolt (19).
Take the front support (20) out from the axle housing (15).



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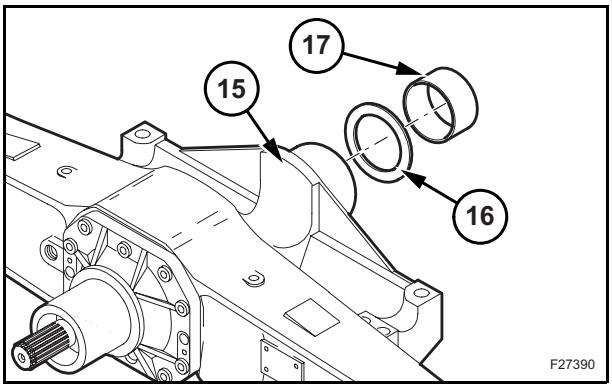
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Remove the O-ring (22).
Remove the bolt (19) and the lube nibble (23).
Remove the bush (18) from the front support (20).
Remove the bushes (21) from front support (20).



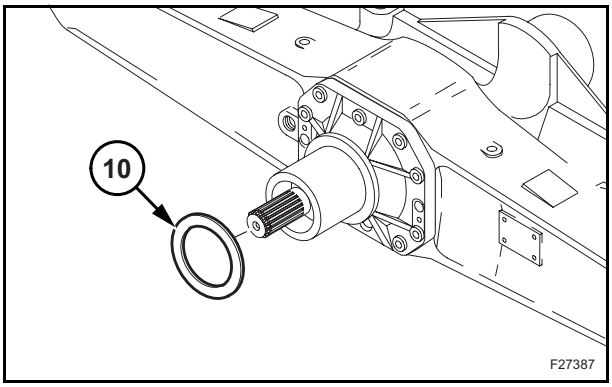
Remove the bush (17) and the washer (16) from the axle housing (15) only if necessary.

NOTE: it is advisable to heat the bush (17) to make easy this operation; this is a destructive operation for the bush.

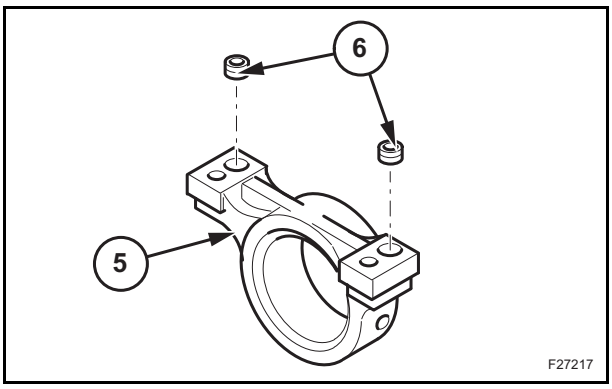


Assembly

Insert the washer (10) into the differential support.



Apply sealant on the bushes (6) contact surface.
Assemble the bushes (6) to the rear support (5) with a pad and a hammer.



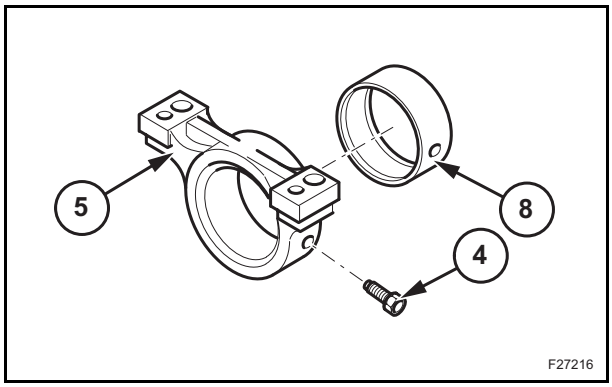
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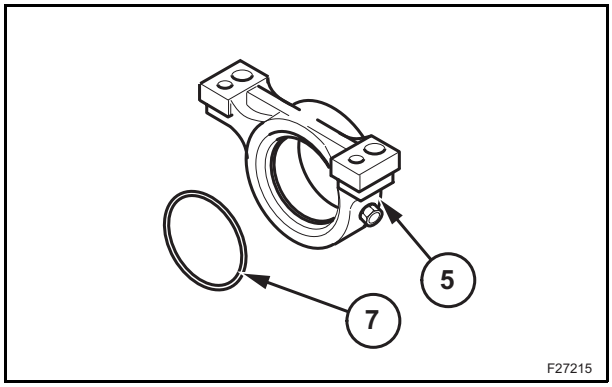
Assemble the bush (8) in the rear support (5).

⚠ WARNING
Align the bush hole with the bolt (4) hole.

Mount the bolt (4).



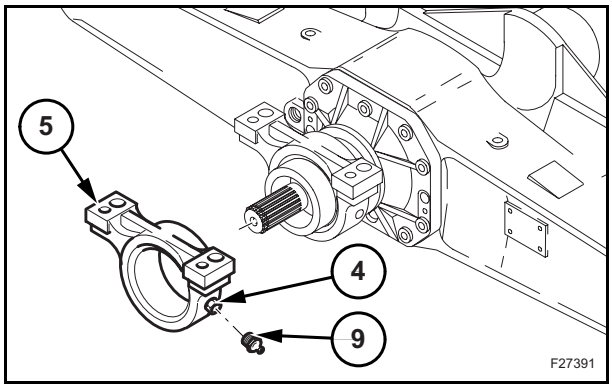
Lubricate with grease a new O-ring (7).
Insert the O-ring (7) in the rear support (5).



Insert the rear support (5) on the differential support.

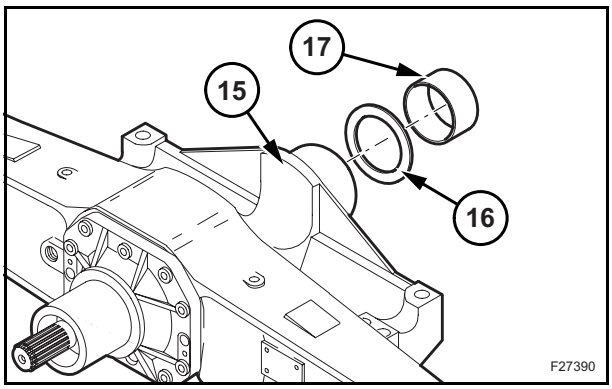
⚠ WARNING
Do not damage the O-ring when inserting the rear support on the central body.

Tighten the bolt (4) to the specified torque.
Assemble the lube nibble (9).



Insert the washer (16) into the front support seat.
Heat the bush (17) at 110÷120 °C then assemble it to the axle housing (20).

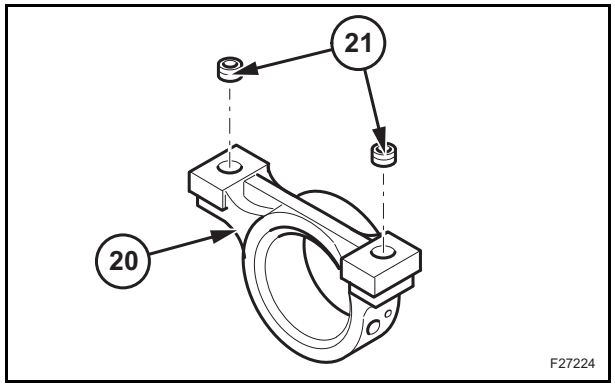
NOTE: if necessary assemble the bush (17) with a pad and a hammer.



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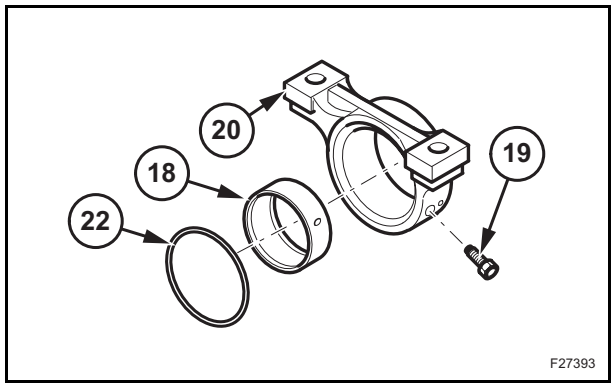
Apply sealant on the bushes (21) contact surface.
Assemble the bushes (21) to the front support (20) with a pad and a hammer.



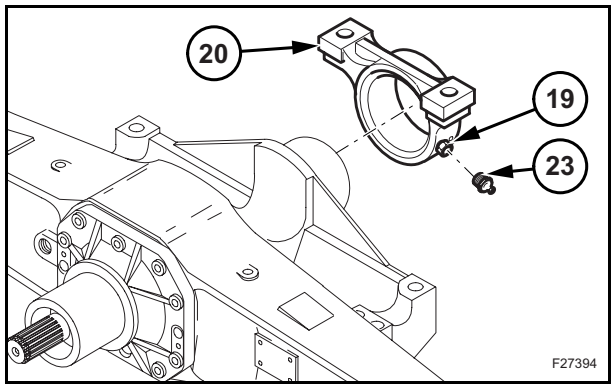
Assemble the bush (18) into the front support (20) with a suitable driver and a hammer.

⚠ WARNING
Align the bush hole with the bolt (19) hole.

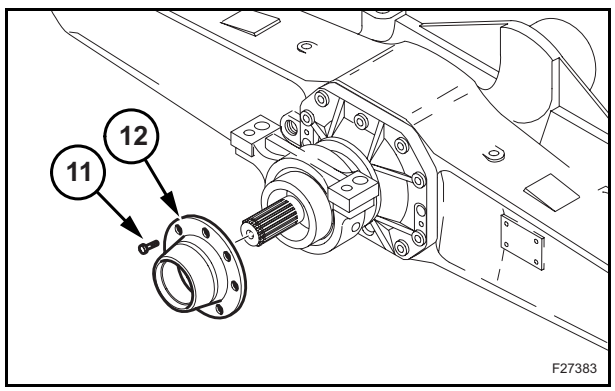
Mount the bolt (19).
Assemble O-ring (22).



Insert the front support (20) on the axle housing.
Tighten the bolt (19) to the specified torque.
Assemble the lube nibble (23).



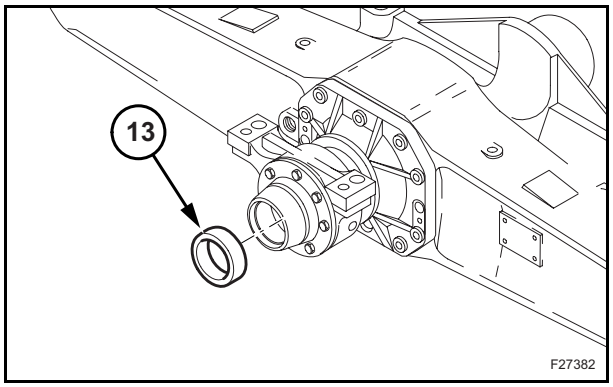
Assemble the flange (12) and fasten by tightening the screws (11).



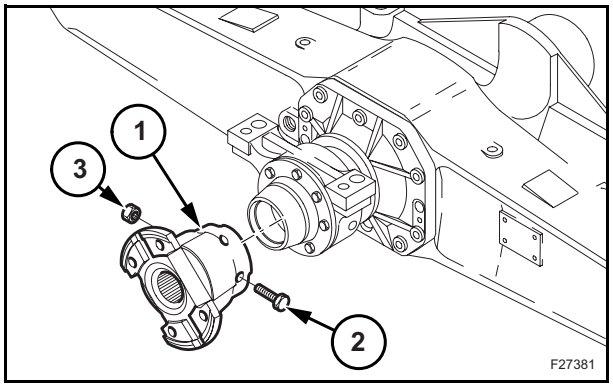
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Assemble the seal ring (13) use the special tool **380002225**.



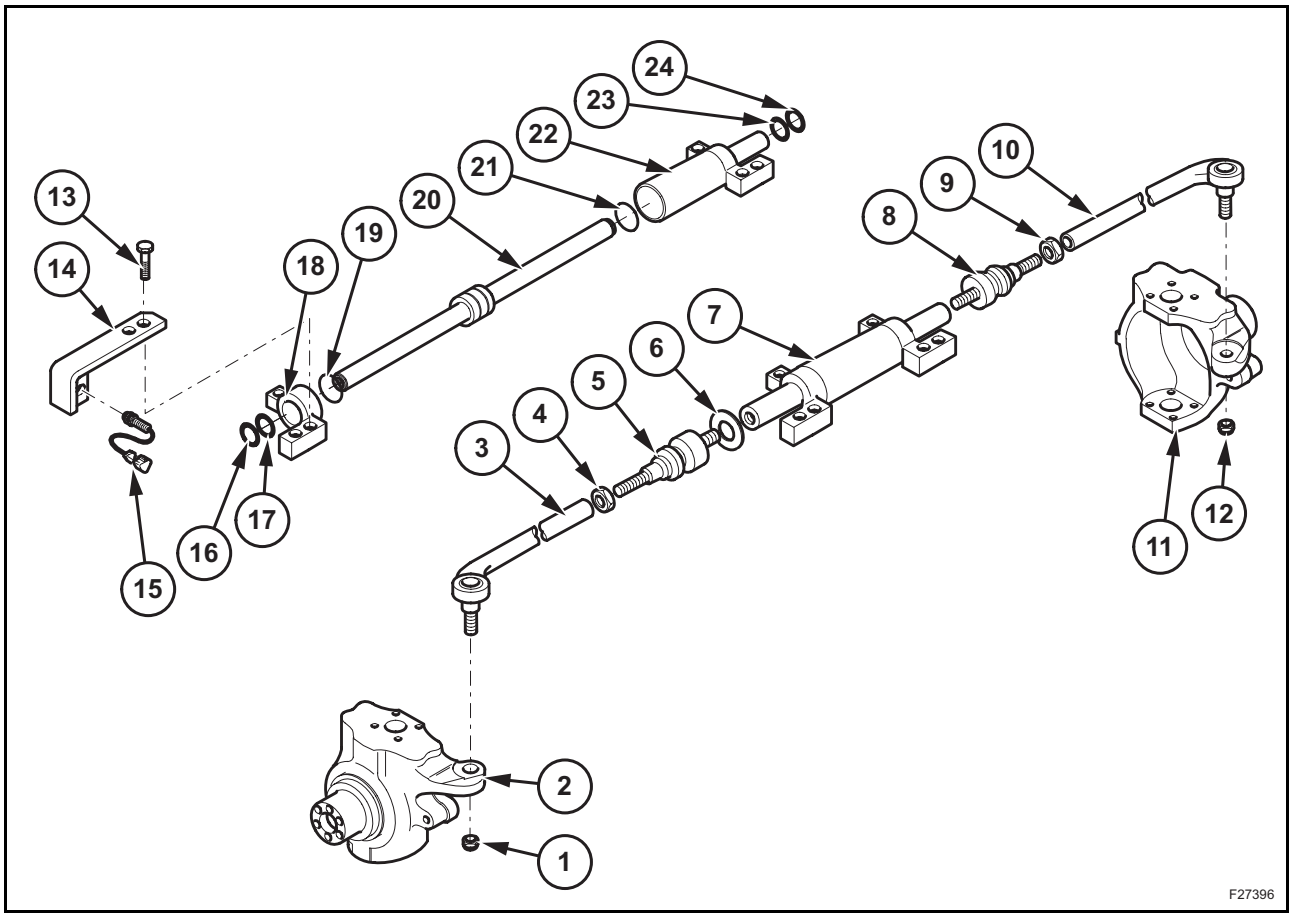
Assemble the flange (1). Lock the flange (1) with the bolt (2) and the nut (3).
Tighten the nut (3) to the specified torque.



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STEERING CYLINDER



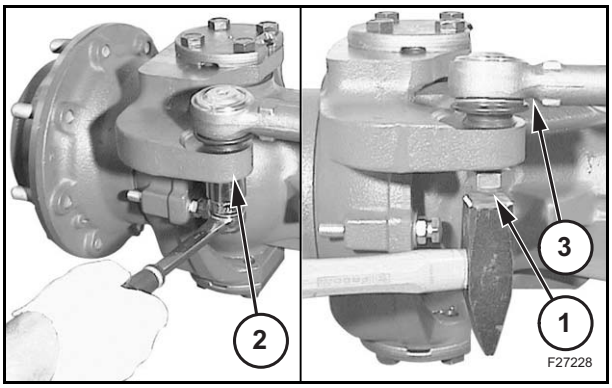
Disassembly

Loosen the nut (1) with enough turns till it is protruding over the threaded pin end of the tie rod (3).
Hit the nut (1) with an appropriate hammer in order to separate the tie rod (3) from the swivel housing (2).

⚠ WARNING
Don't beat on the threaded pin end of the tie rod (3).

NOTE: this is a destructive operation for the nut (1).

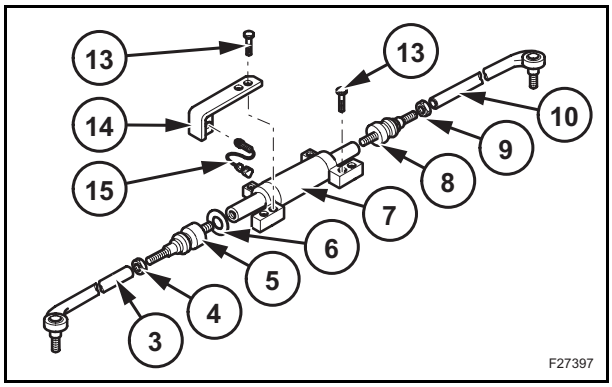
Repeat the whole sequence at the other side.



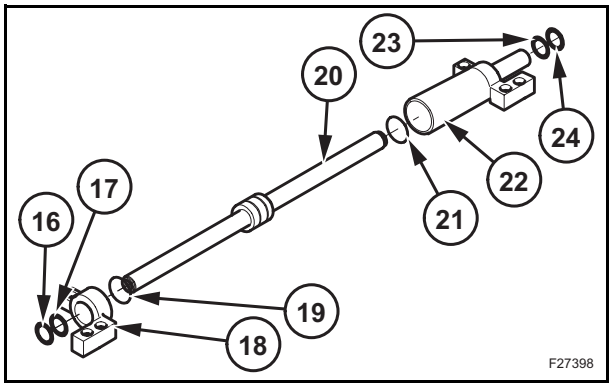
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Remove the tie rods (3) and (10) by loosening the nuts (4) and (9) with a suitable wrench, then check their conditions.
Unscrew the fastening screws (13) and take the steering cylinder (7).
Remove only parts that need to be overhauled and/or replaced.

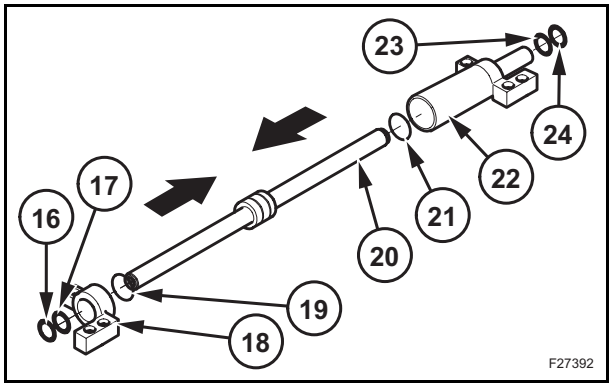


Remove the cylinder head (18) from the cylinder body (22) and remove it from the rod (20).
Remove the rod (20) from the cylinder body (22).
Remove all the seals and O-rings (16, 17, 19, 21, 23 and 24) from the cylinder body (22), the cylinder head (18), and the rod (20).

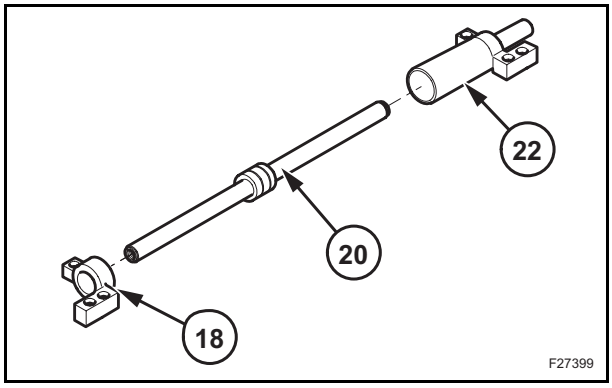


Assembly

Assemble new seals and O-rings (16, 17, 19, 21, 23 and 24) on the cylinder head (18), on the rod (20) and on the cylinder body (22).



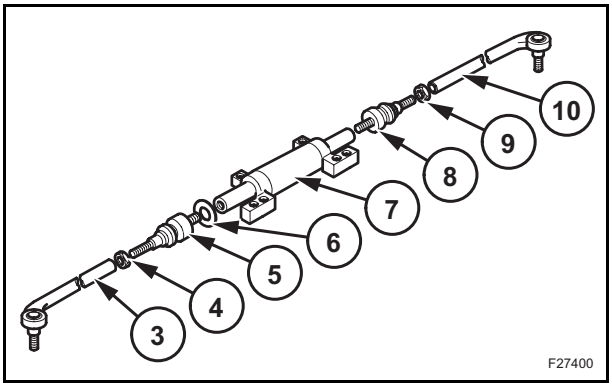
Assemble the cylinder head (18) on the rod (20).
Slide the pre-assembled rod (20) into the cylinder body (22).



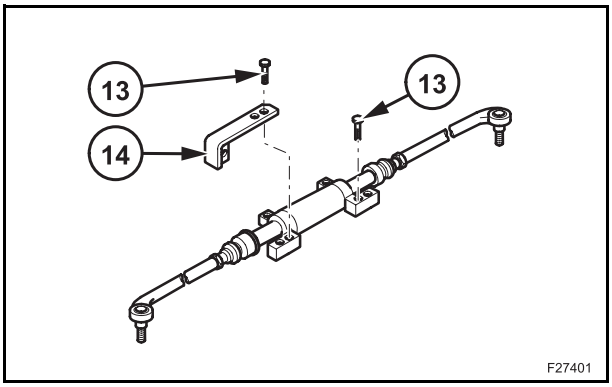
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Assemble the tie rods (3) and (8), the ball joints (3) and (10), the nuts (4) and (9) to the ends of the rod, then tighten with a dynamometric wrench to the requested torque.



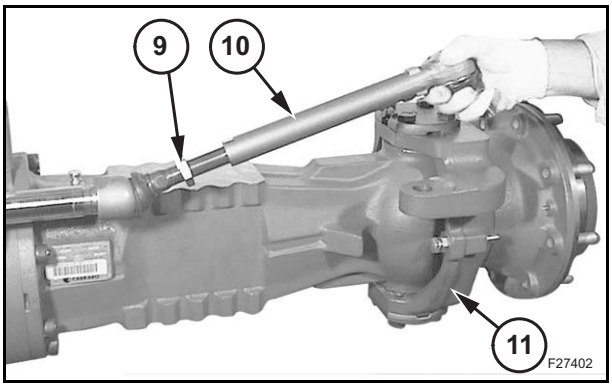
Install the steering cylinder (7) already assembled on the central body.
Assemble and tighten the screws (13) with dynamometric wrench to the requested torque.
Assemble bracket (14).



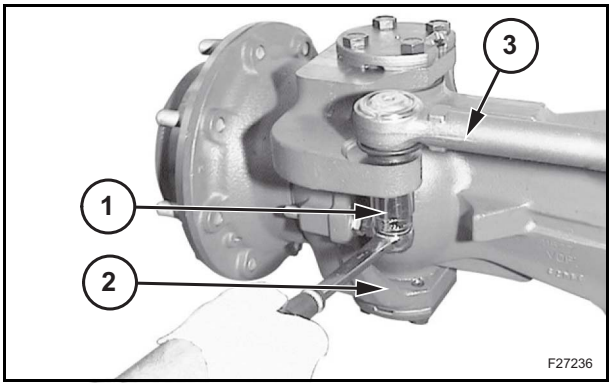
Align the swivel housing (11) with the axle.
Screw in the tie rod (10) so that its ball joint can be inserted into the swivel housing arm (11).

NOTE: it is important to unscrew the locknut (9) to carry out this operation.

Repeat the whole sequence of the mentioned operations to the other side.



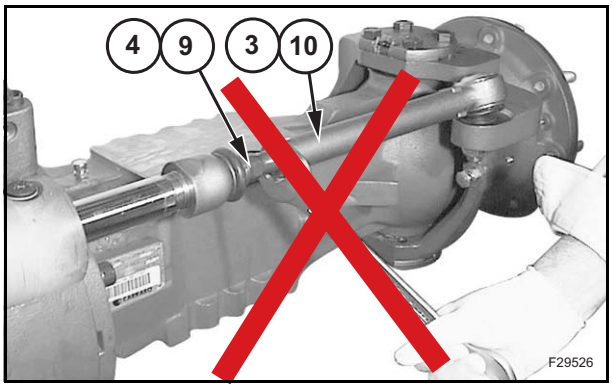
Insert the ball joint of the tie rod (3) into its housing in the swivel housing (2).
Assemble and tighten the locknut (1) to the specified torque.
Repeat the whole sequence of the mentioned operations to the other side.



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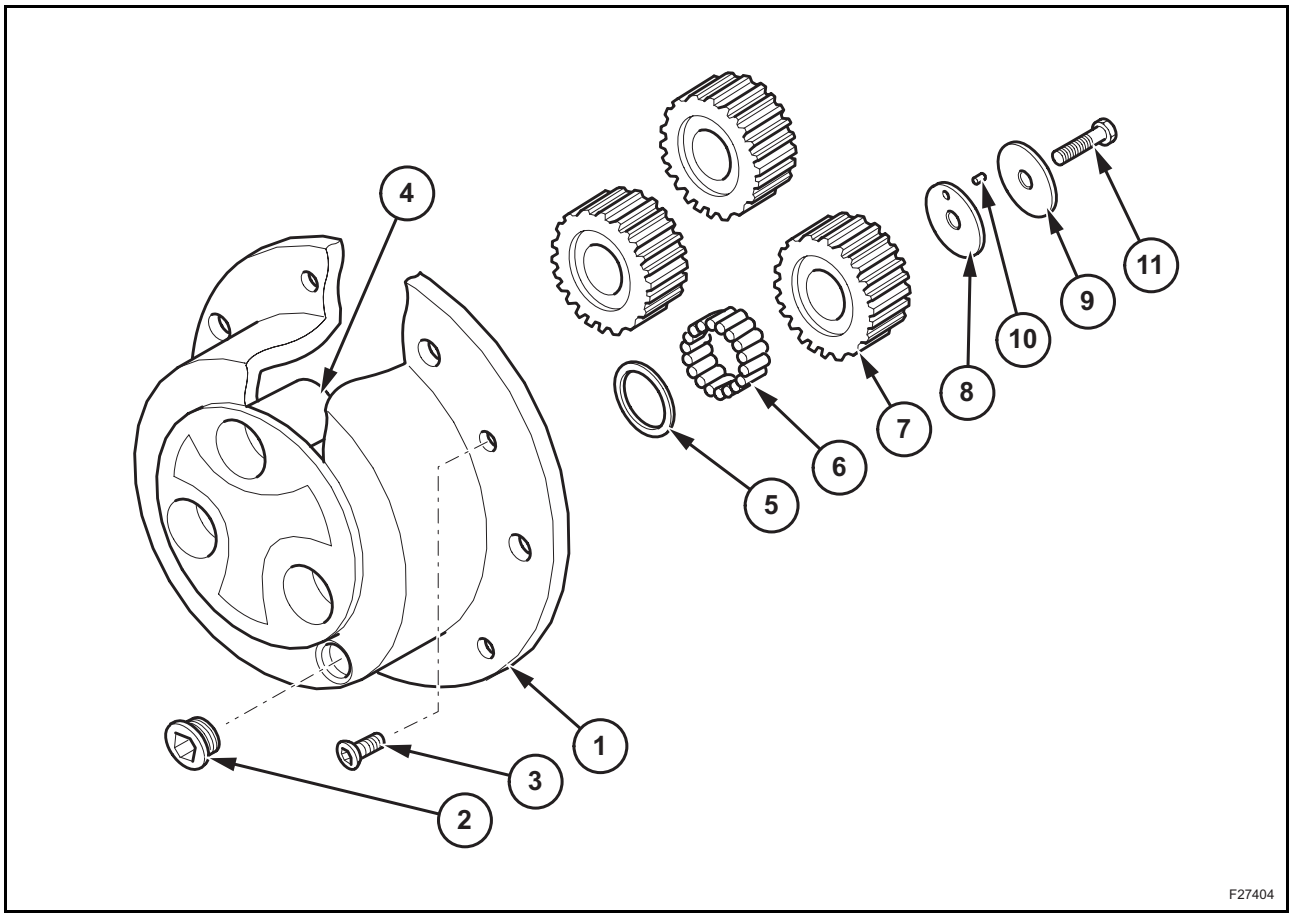
Screw the locknuts (4) and (9) of the tie rods (3) and (10) only when the toe-in adjustment has been carried out.



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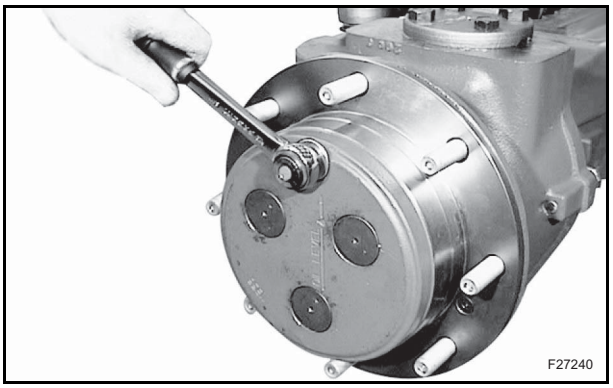
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REDUCTION GEAR



Disassembly

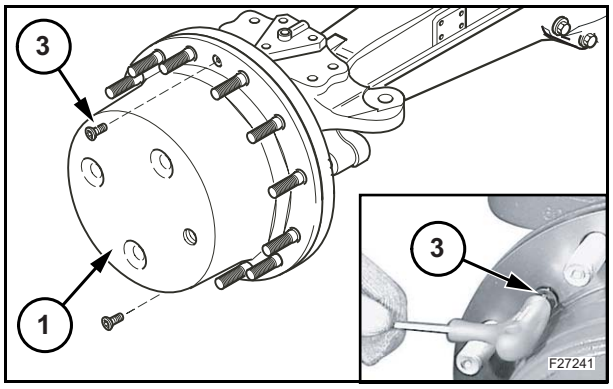
Drain the oil completely from the planetary carrier.



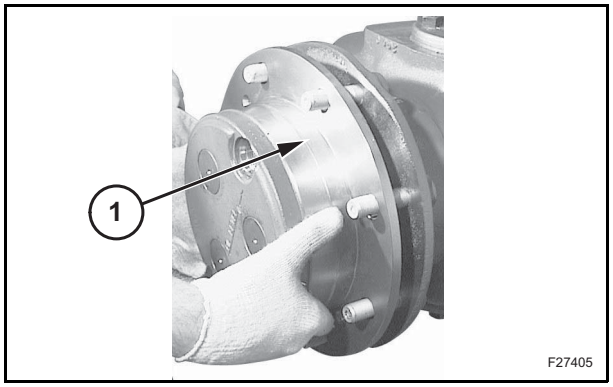
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Unscrew and remove both fastening screws (3) of the planetary carrier cover (1).

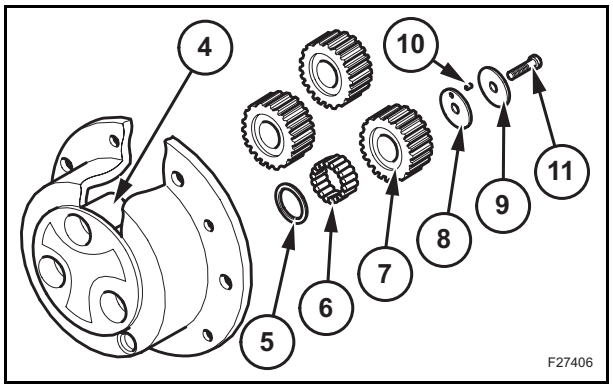


Remove the planetary carrier cover (1) from the wheel hub.
Position the planetary carrier cover (1) on a work-bench and check its wear conditions.



If necessary, replace the gears as follows:
- unscrew the screws (11) on every pin (4);
- remove the washers (8) and (9);
- extract the gears (7) from the pins;
- collect the bearings (7) and check their conditions;
- collect the washer (6).

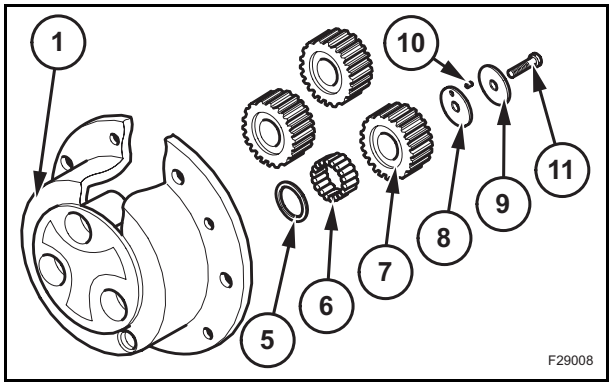
NOTE: with the new gears it is advisable to assemble new needles.



Assembly

Position the planetary carrier cover (1) on a work-bench. Insert the washers (5) and the gears (7) complete with the rollers (6) in the pins of the planetary gear carrier.
Assemble the washers (8) and fasten them with the pins (10).
Fit the washers (9) and screw in the screws (11) by tightening them at the prescribed torque.

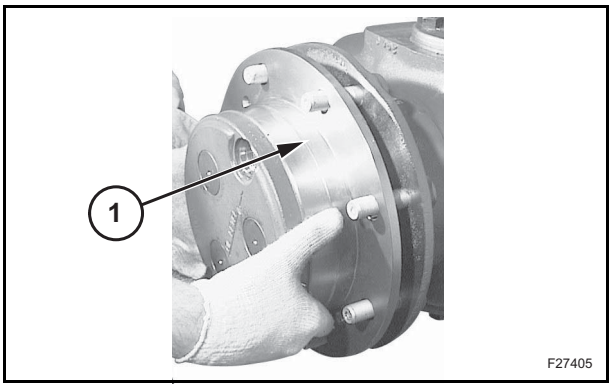
NOTE: with the new gears it is advisable to assemble new needles.



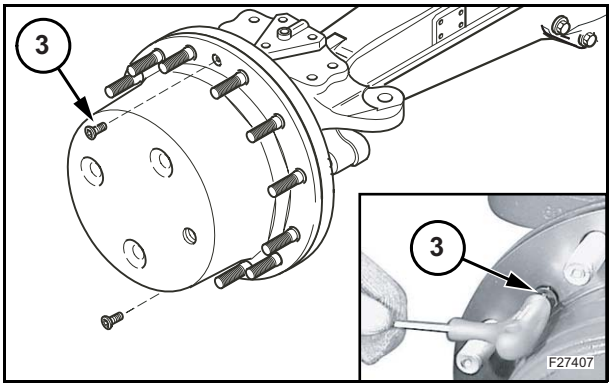
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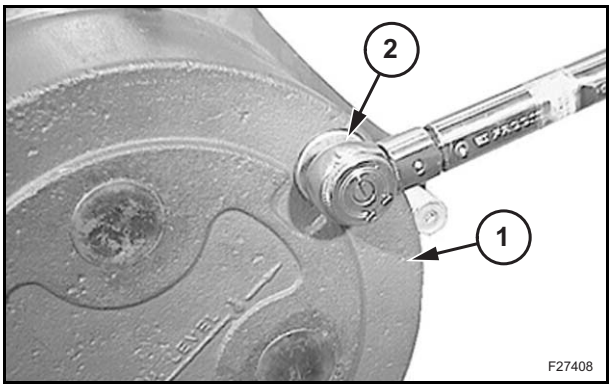
Assemble the planetary carrier cover (1) onto the wheel hub.



Assemble the screws (3) and tighten to the specified torque.



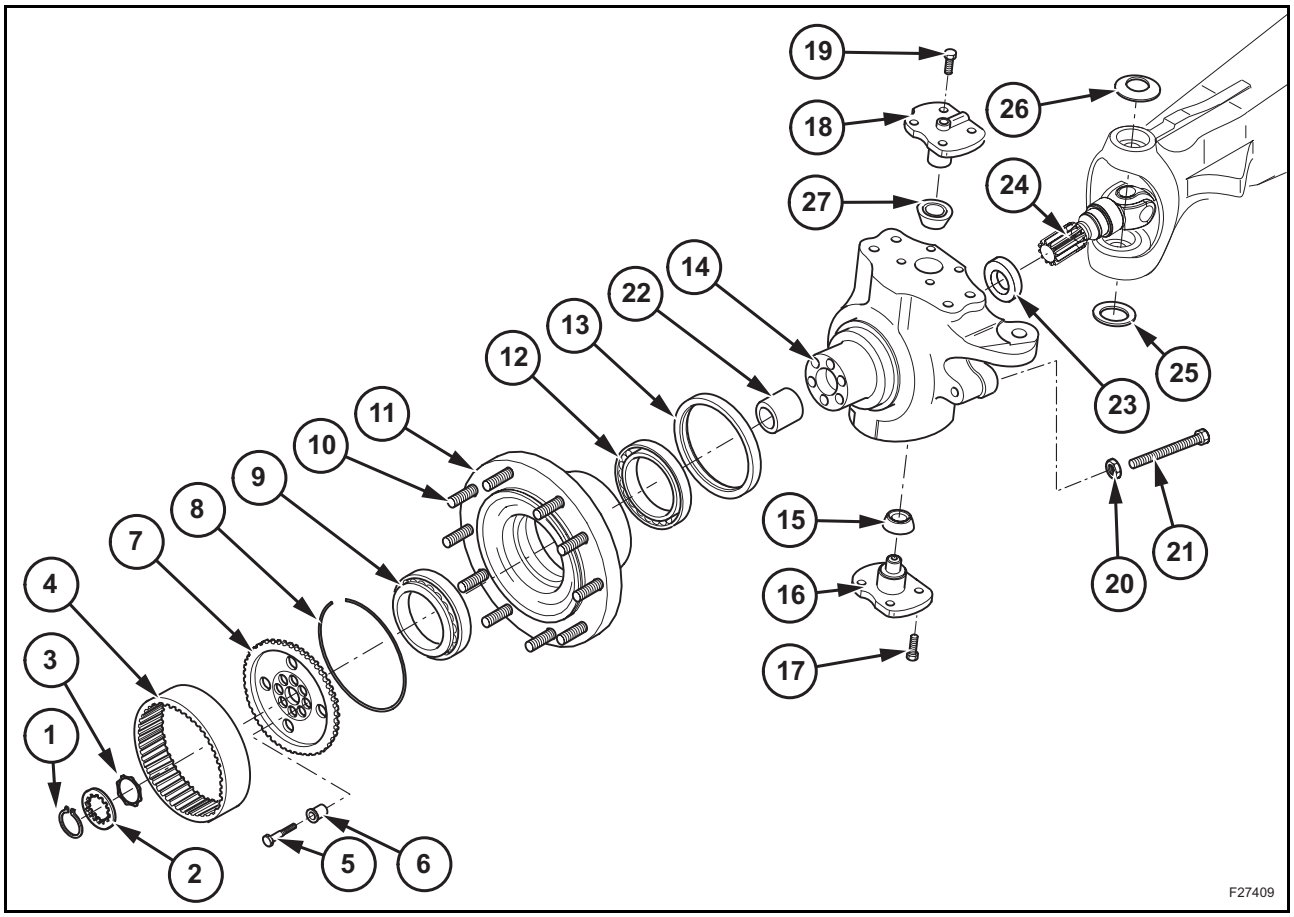
To up the oil on the wheel hub.
Assemble the plug (2) onto the planetary carrier cover (1) and tighten to the specified torque.



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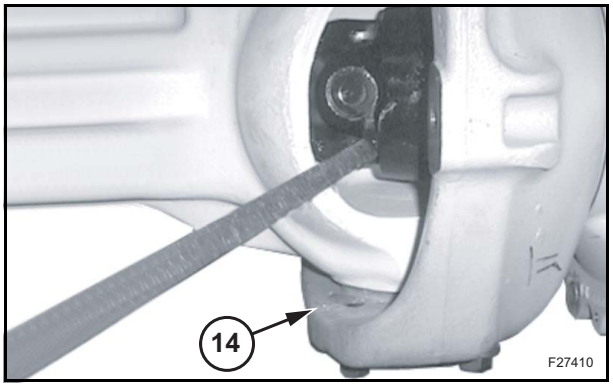
WHEEL HUB



Disassembly

Insert a lever between the swivel housing (14) and the axle shaft and fit into the cardan shaft.
With the lever, push the cardan shaft in the direction of the wheel hub to allow the removal of the snap ring.

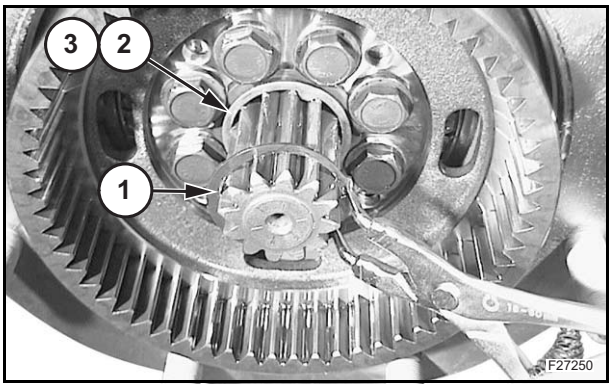
⚠ WARNING
Do not damage the cardan shaft.



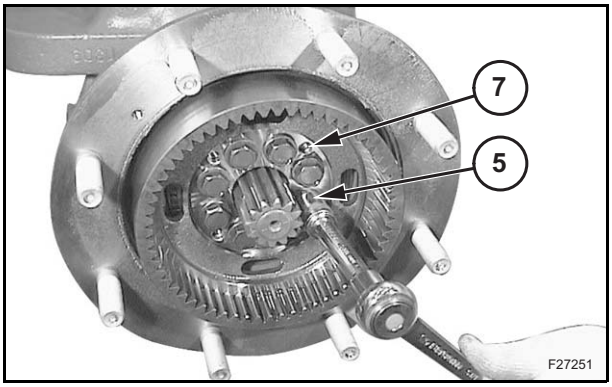
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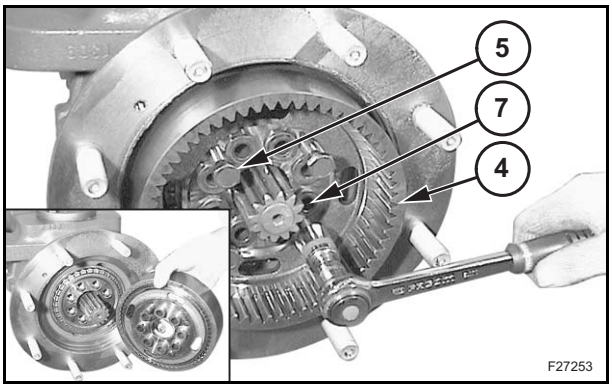
Remove the snap ring (1) from the cardan shaft.
Collect the washers (2) and (3) of the cardan shaft.



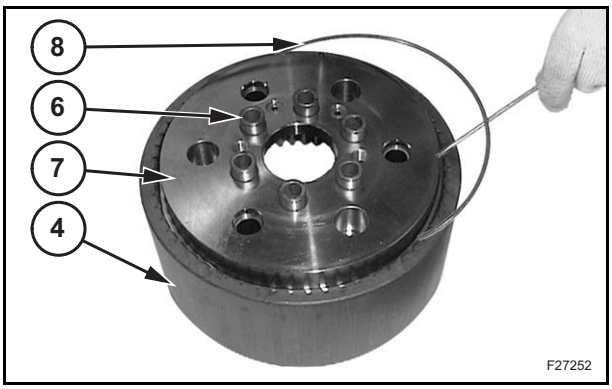
Unscrew and remove the fastening screws (5) from the ring gear carrier (7).



In order to extract the ring gear carrier from its housing, screw in two of the just removed screws (5) in the threaded extraction holes.
Extract and remove the ring gear carrier (7) together with the ring gear (4).



Remove the retaining ring (8) and separate the ring gear carrier (7) from the ring gear (4).
Only if necessary, remove the bushes (6) from the wheel carrier using a hammer and the special tool **380002667**.

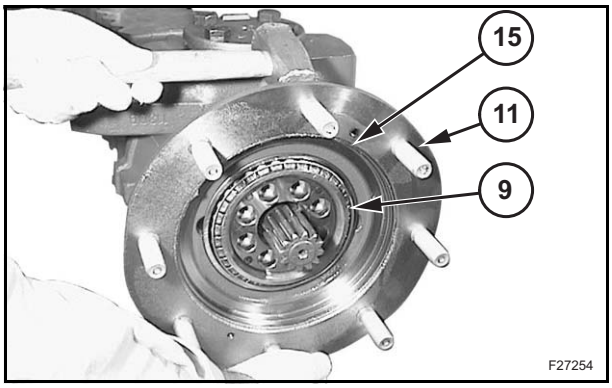


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Remove the wheel hub (11) using levers and a hammer to facilitate the operation.

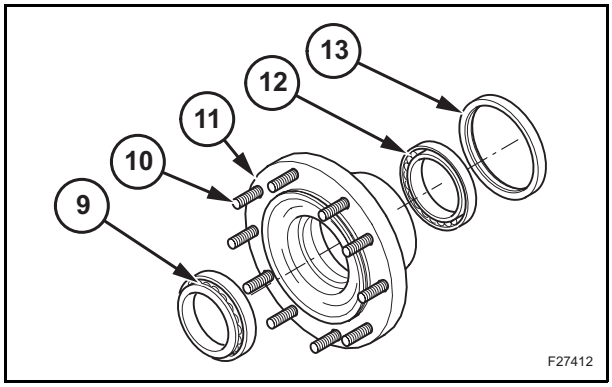
NOTE: collect the bearing cone (9).



Position the wheel hub (11) on a flat surface and remove the seal ring (13) with a lever.

NOTE: destructive operation for the seal ring (13).

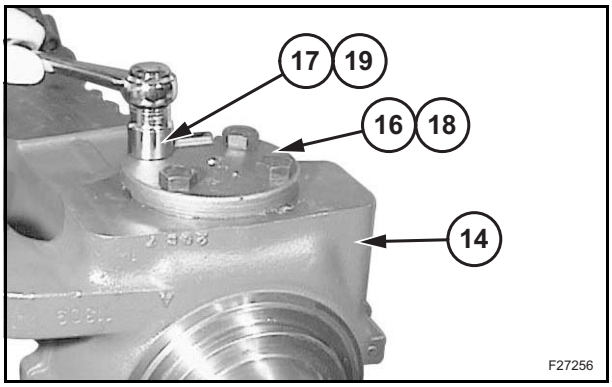
Remove the bearing cups (9) and (12) using a hammer and a suitable drift.
Remove the bearing cone (12) from the swivel housing end using a suitable extractor.



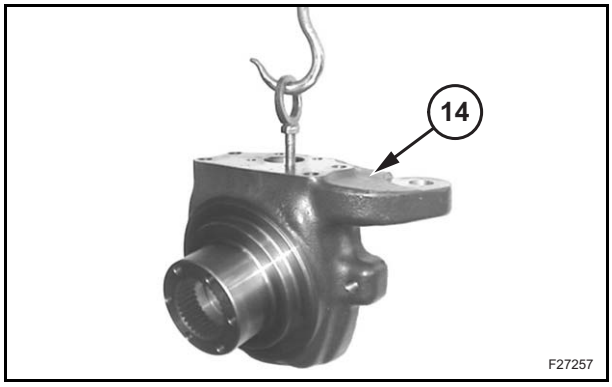
Unscrew and remove the fastening bolts (19) and (17) from the upper (18) and lower (16) king pin.

⚠ WARNING
Before removing the king pins (16) and (18), secure the swivel housing (14) to a rope or a hoist or to any other supporting device; observe all current safety regulations to guarantee the operator's safety.

Remove the king pins (16) and (18).



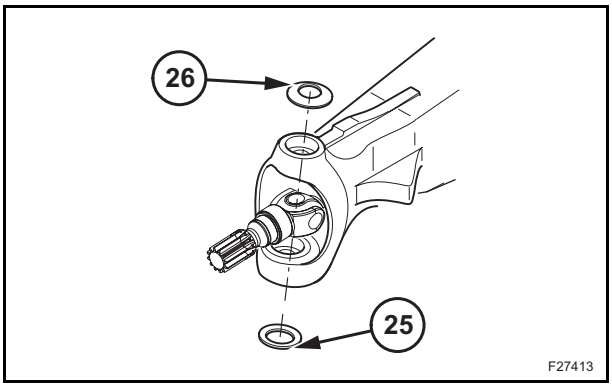
Extract the swivel housing (14) from the axle shaft and the cardan shaft.



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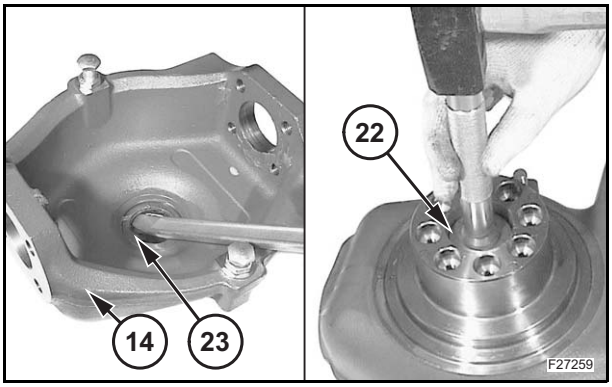
Collect the belleville washers (25) and (26).



Position the swivel housing (14) on a flat surface and extract the seal ring (23) with a lever.

NOTE: this is a destructive operation for the seal ring.

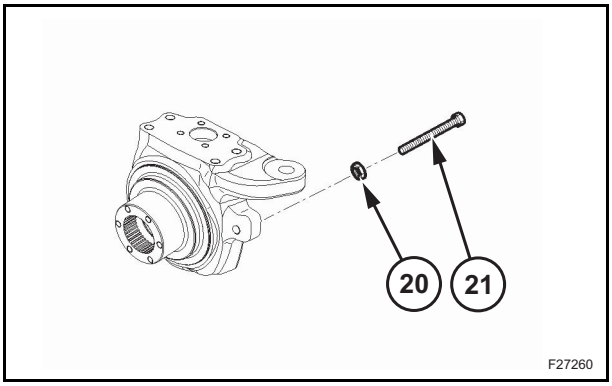
Turn the swivel housing and extract the bush (22) using a suitable drift and a hammer.



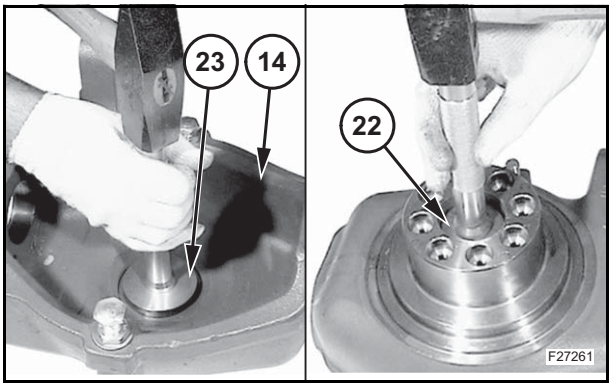
Assembly

If it has been previously removed, reassemble the steering stop composed by the screw (21) and nut (20).

NOTE: do not tighten the nut (20) until the steering angle adjustment has been done.



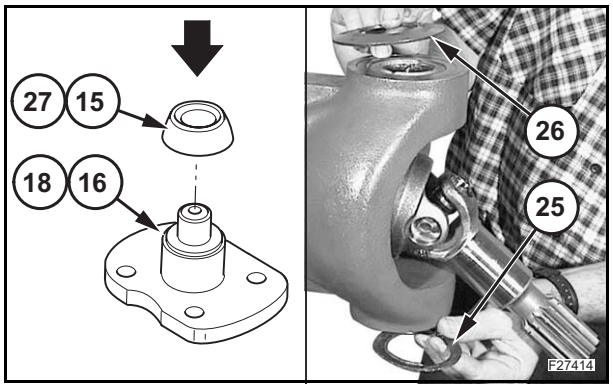
Insert the bush into the swivel housing (14) with the special tool **380002668** and a hammer or a press.
Insert the seal ring (23) into the swivel housing (14) with the special tool **380002669** and a hammer.
Grease carefully the seal ring (23).



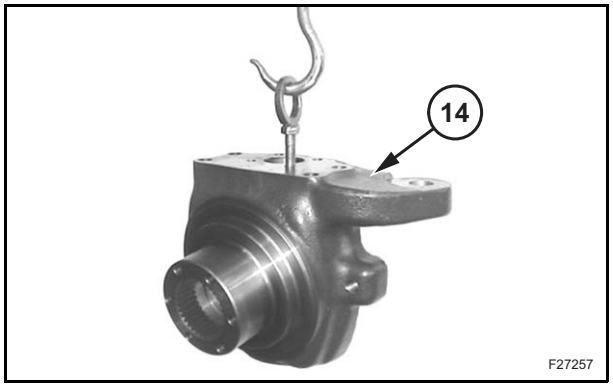
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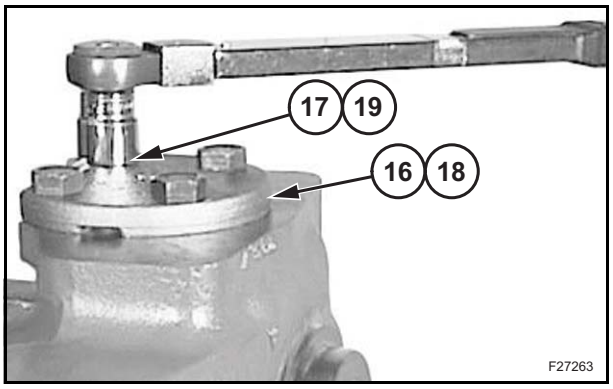
If ball joints (15) and (27) have been previously removed, reassemble them on the lower (16) and upper king pin (18).
Grease carefully the seats of king pin (16) and (18) with specific grease.
Position the Belleville washers (25) and (28) on the king pin housings.



Secure the swivel housing (14) with a belt or a rope to a hoist or to any other supporting device.
Protect the splined end of the axle shaft by winding it with an adhesive tape to avoid damage to the seal ring.

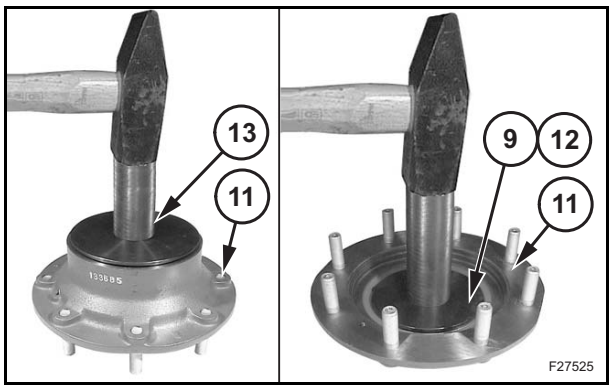


Assemble the king pins, the lower (16) and the upper (18), and tighten the retaining screws (17) and (19) to the requested torque.



Assemble both bearing cups (9) and (12) to their wheel hub (11) housings using the special tool **380002222** under a press or with a hammer.
Insert the seal ring (13) into the wheel hub (11) with the special tool **380002213** and a hammer.

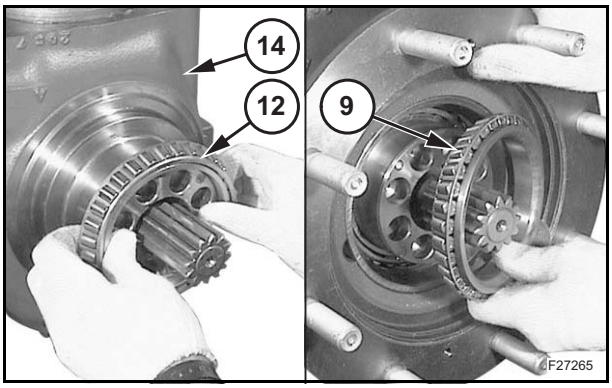
NOTE: do not lubricate the seal ring (13).



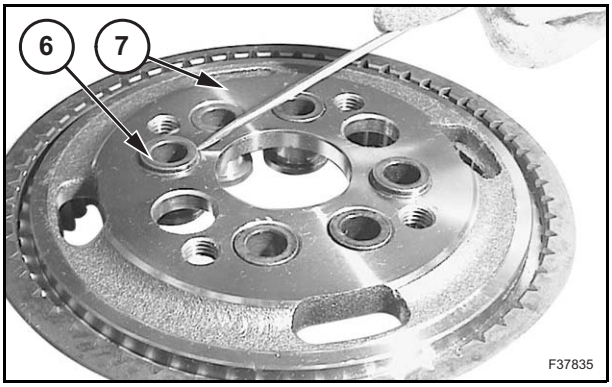
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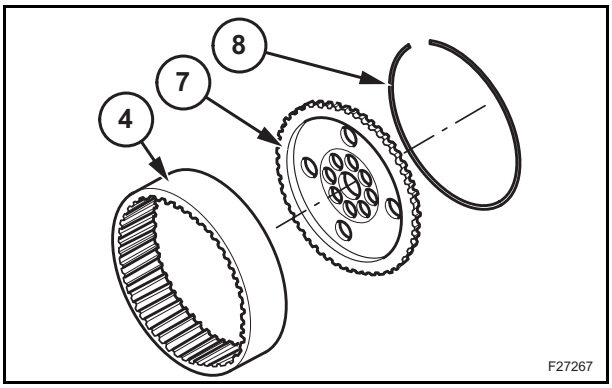
Assemble the bearing (12) onto the swivel housing end (14).
Assemble the wheel hub (11) on the swivel housing (14) and fit the bearing (9).



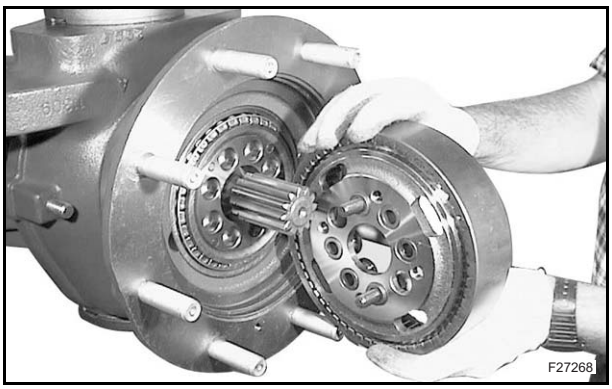
Position the ring gear carrier (7) on a workbench and force the bushes (6) to the carrier (7) surface level with the special tool **380002667**.
At least two bushes (diametrically-opposed) should be set slightly higher than the carrier surface level to be used as dowel pins.



Preassemble the ring gear carrier (7) and the ring gear (4) with the retaining ring (8).



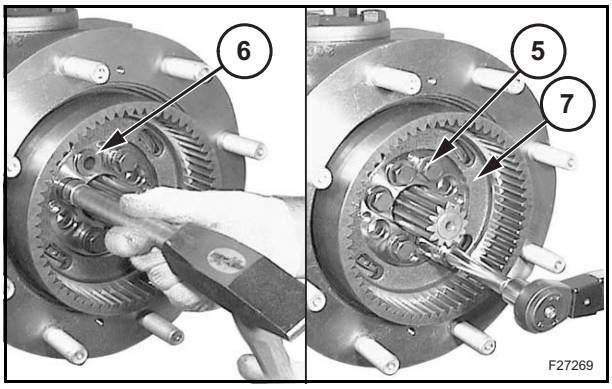
Assemble the ring gear carrier assy on the wheel hub using the two projecting bushes as dowel pins and screw in the relevant screws in order to put the ring gear in contact with the wheel hub.



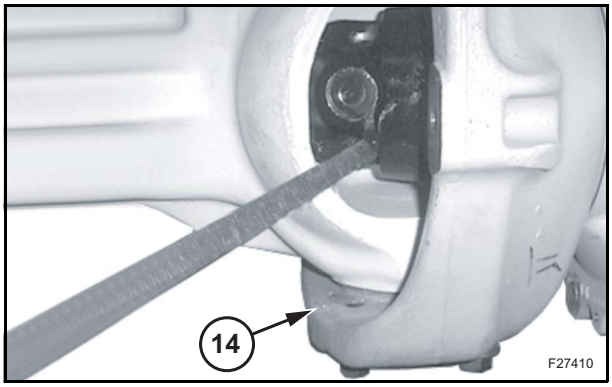
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Completely insert all bushes (6) using the special tool **380002667** and a hammer.
Apply sealant on fastening bolts (5) thread.
Assemble the screws (5) fastening the ring gear carrier (7) and tighten to the specified torque.

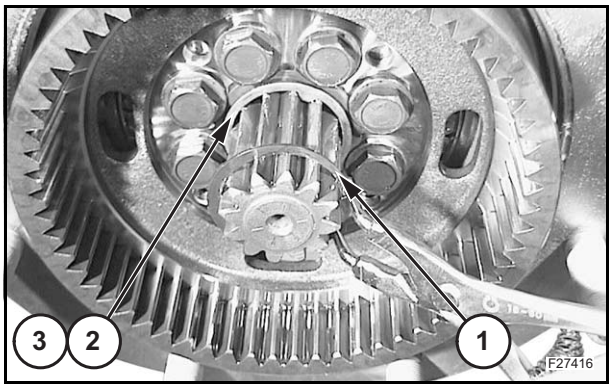


Insert a lever between the swivel housing (14) and the axle shaft and fit into the cardan shaft.
With the lever, push the cardan shaft in the direction of the wheel hub to allow an easier fitting of the snap ring.



Assemble the thrust washers (2) and (3) on the end of the cardan shaft.
Insert the snap ring (1) on the end of the splined hub and push it into its seat.

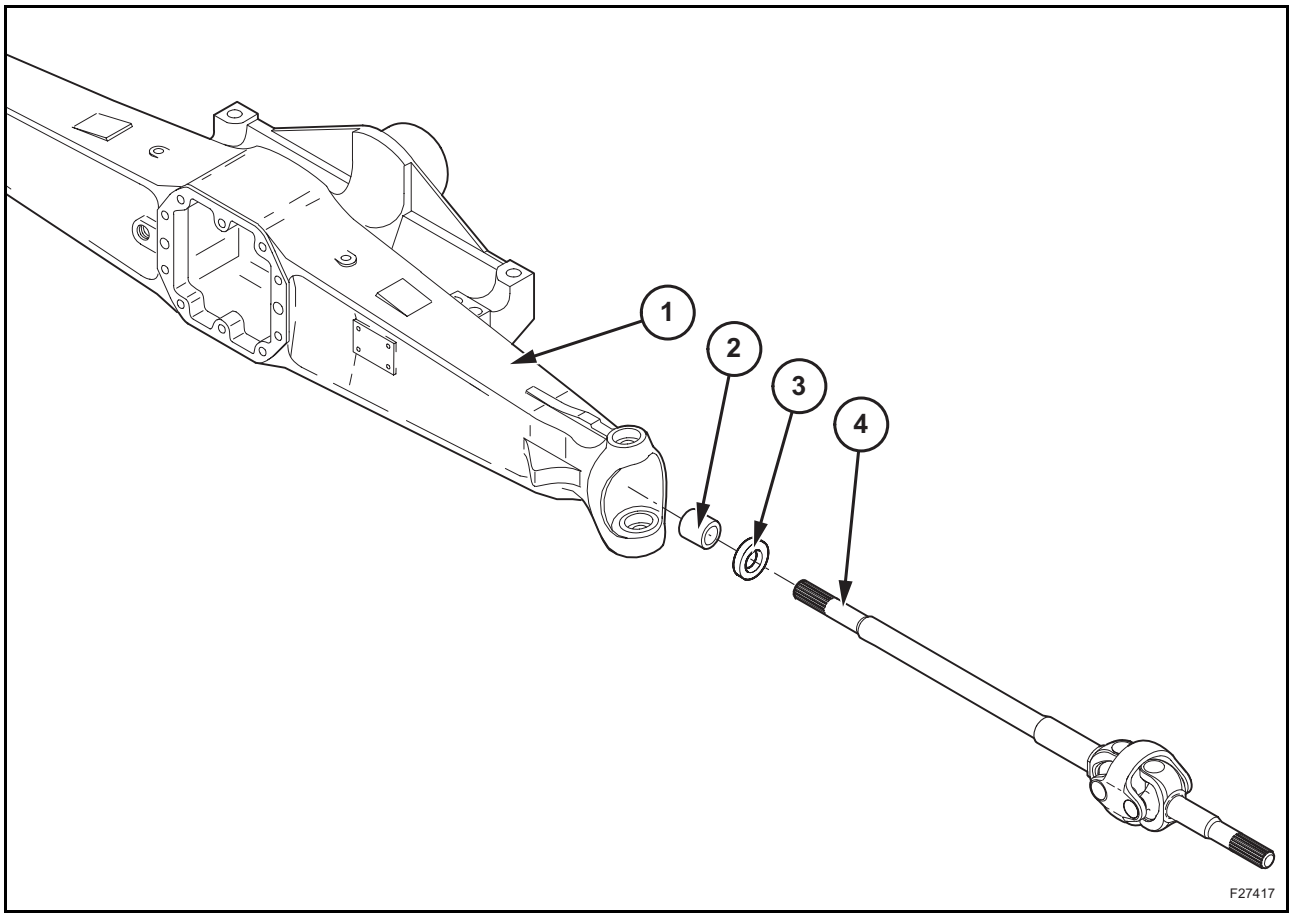
NOTE: check that the snap ring (1) is correctly fitted in its seat.



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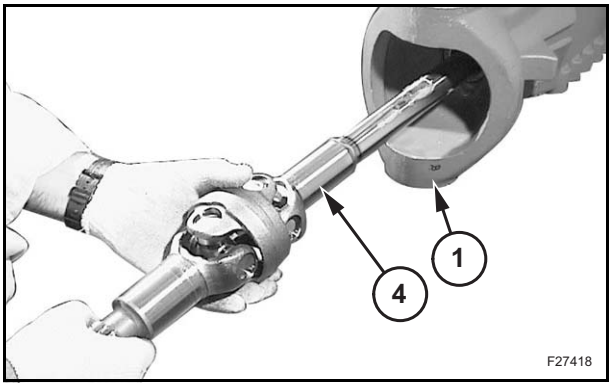
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CARDAN SHAFTS



Disassembly

Remove the cardan shaft (4) from the axle shaft (1).



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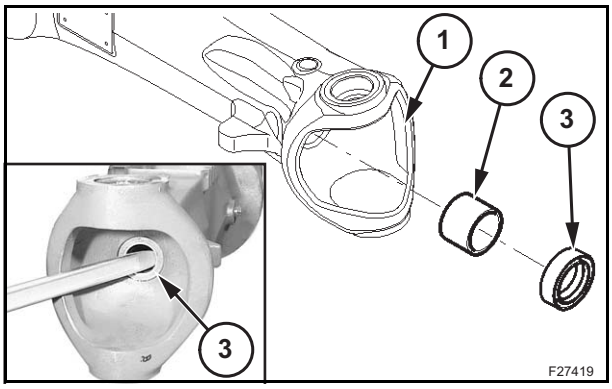
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Remove the seal rings (3) from the axle beam (1).

NOTE: destructive operation for the seal rings (3).

Remove the bush (2) from the axle beam (1) only if the wear conditions require this.

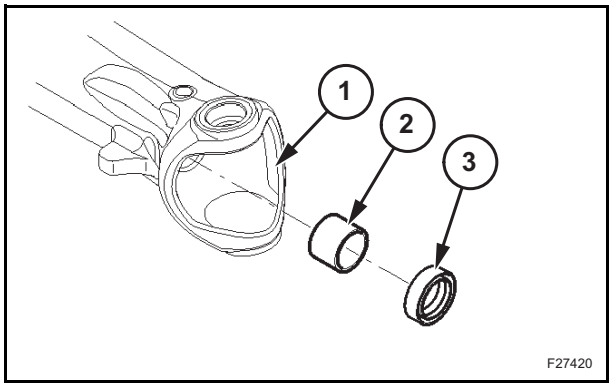
⚠ WARNING
Be careful not to damage the bush seat.



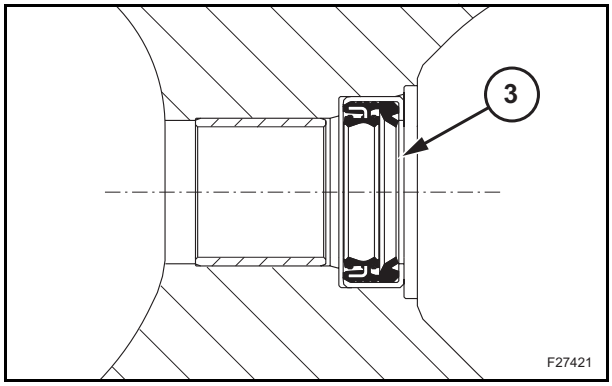
Assembly

Assemble the bush (2) on the axle beam (1) with the special tool **380002226** and a hammer.
Assemble the seal ring (3) on the axle beam with the special tool **380002670** and a hammer.

NOTE: grease carefully the seal rings.

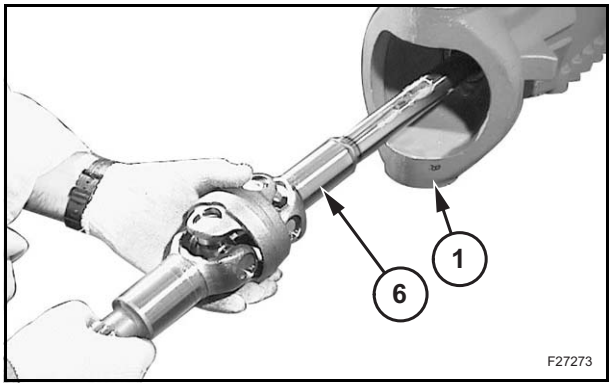


Assemble the seal ring (3).



Insert the cardan shaft (4) into the axle shaft (1).

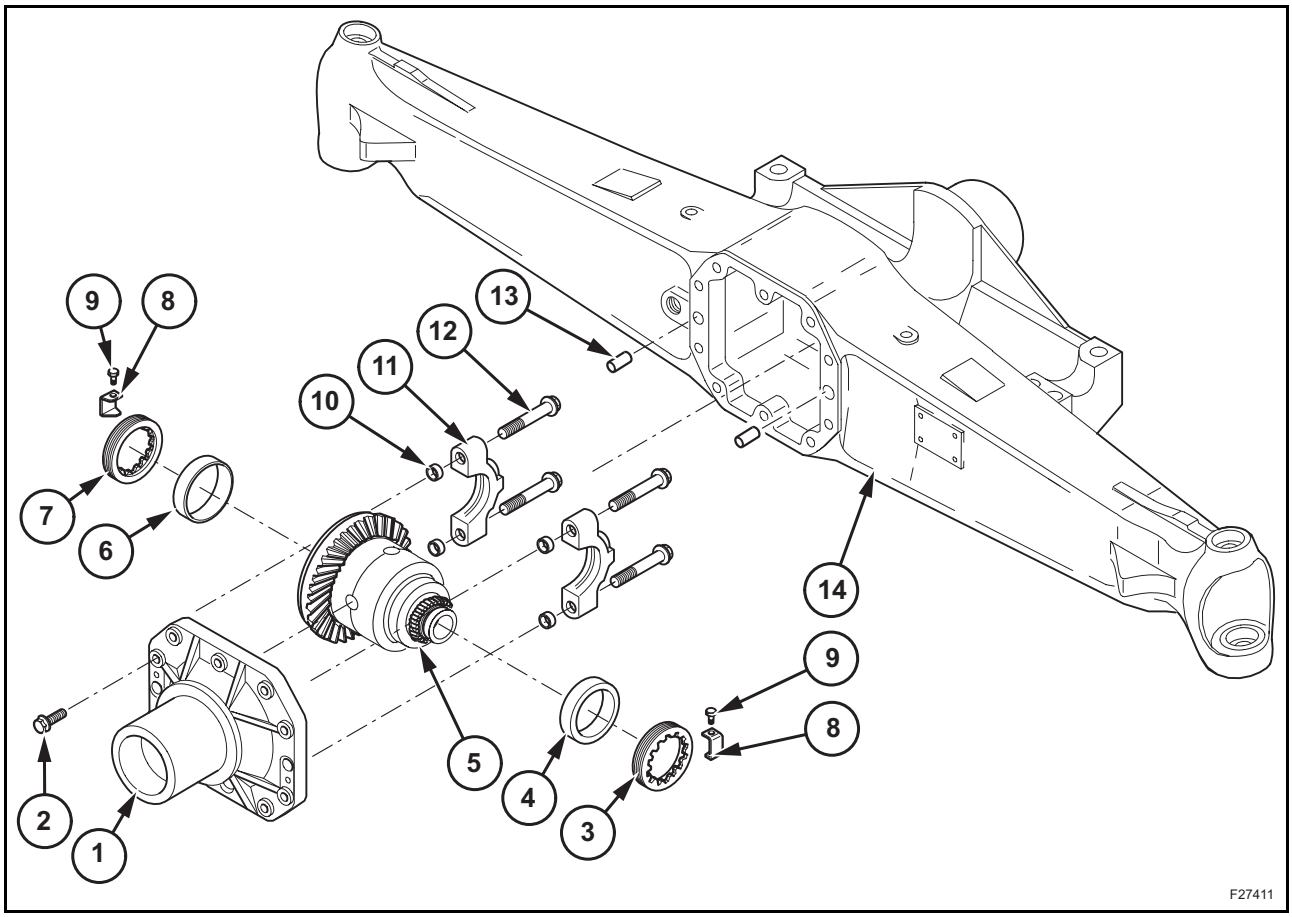
⚠ WARNING
Be careful not to damage the seal ring.



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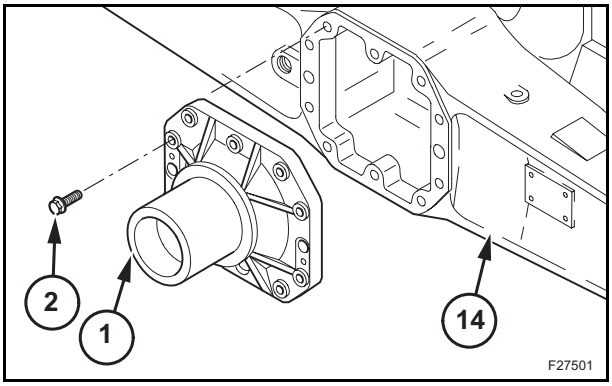
DIFFERENTIAL SUPPORT GROUP



Disassembly

Drain the oil completely from the differential.
Loosen and remove the screws (2) of the differential support (1).
Remove the differential support (1) from the axle housing (14).

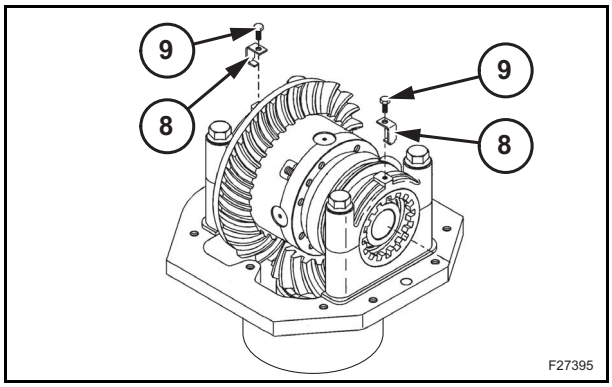
⚠ WARNING
Support the differential support with a rope or other appropriate means.



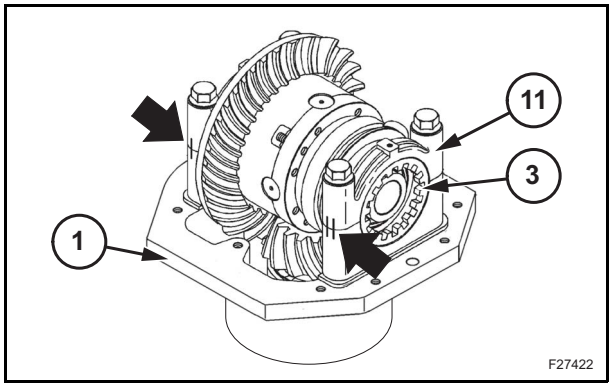
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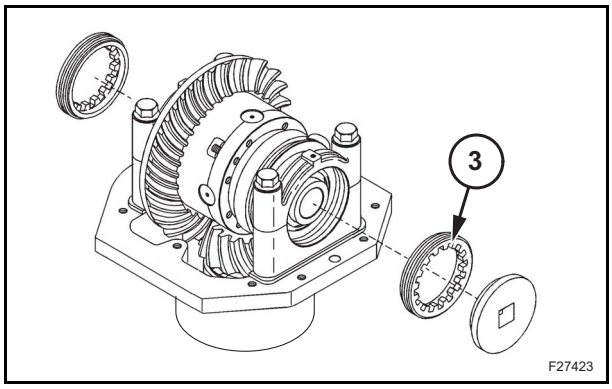
Loosen and remove the screws (9) to take out the two ring nut retainers (8).



Before removing the bolts, mark both half-collars (11) and the differential support with permanent reference marks to avoid inverting them during re-assembly. Mark the area between the ring nuts (3) and (7) and the differential support (1) as well.

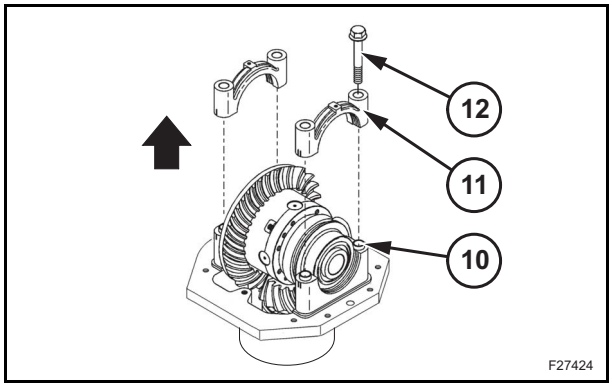


Unscrew the adjuster ring nuts (3) and (7) using tool **380000406** and a wrench.



Remove the 4 screws (12) and remove both half-collars (11).

NOTE: check that the bushes (10) remains in their housings.

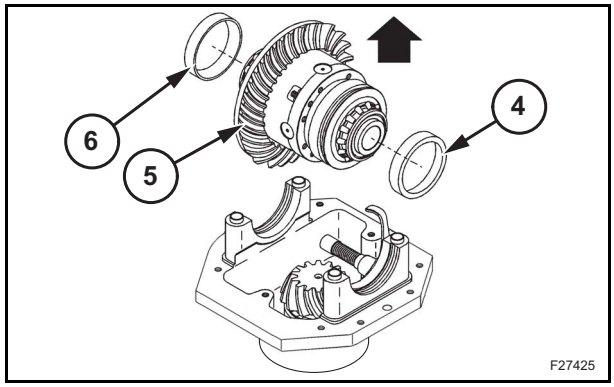


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Remove differential unit (5).
Remove the bearing (4) and (6) together with the differential assy.

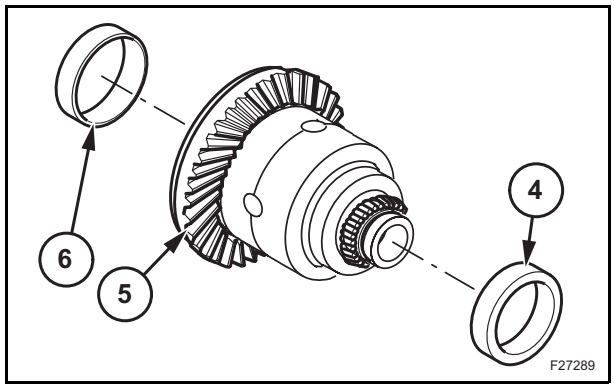
⚠ WARNING
Do not invert the bearing cone if the bearings are not replaced.



Assembly

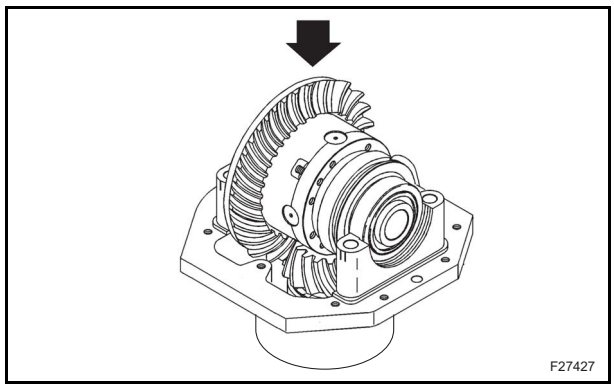
Assemble the bearings (4) and (6) on the differential assy (5).

⚠ WARNING
Do not invert the bearing cones if the bearings are not replaced.

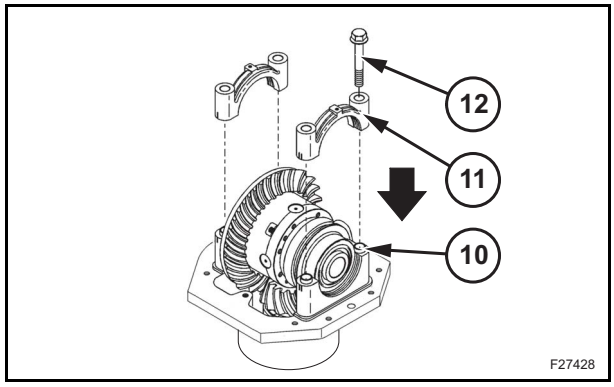


Assemble the differential assy complete with bearings on the differential carrier.

⚠ WARNING
Check the correct assembly side of the ring gear.



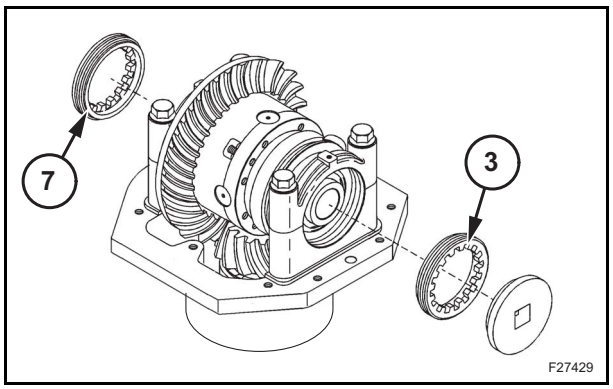
Move the differential assy so that the ring gear is placed against the pinion.
Check that all bushes (10) are in their housings and position both half collars (11) on their seats using the previously traced reference marks.
Lock both half collars with their fastening screws (12).



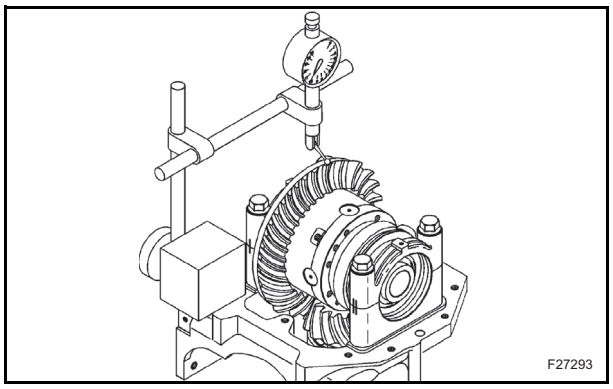
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Assemble the ring nuts (3) and (7) into the differential support.
Tighten both ring nuts (3) and (7) with special tool **380000406**, till the backlash is eliminated and the differential bearings are slightly preloaded.
Check that the differential bearings are well settled; if necessary, knock slightly with a soft hammer, in order to properly set the bearings in position.



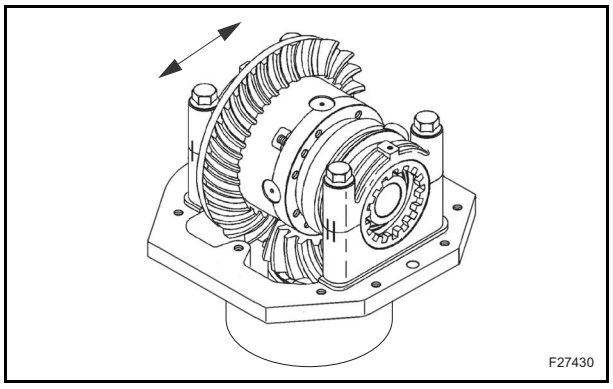
Position a magnetic-base dial gauge on the differential support, so that the feeler stylus touches the surface of one tooth of the ring gear with a 90° angle.



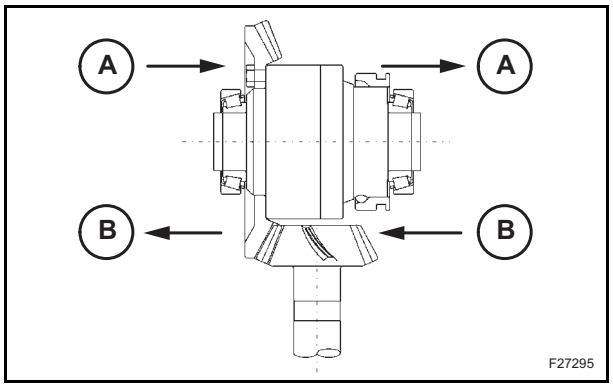
Lock the pinion and move the crown gear alternatively and note the pinion-ring gear backlash, measured with the comparator.
Repeat the operation on 2 or more points (teeth), rotating the crown gear, so that to obtain an average value.
Check if the measured backlash value is within the requested range:

0.18÷0.25 mm

Carry out the adjustment by operating on the ring nuts with the appropriate tool **380000406**.



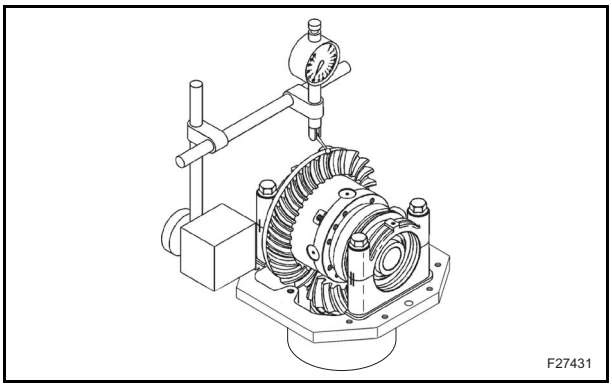
Adjust the ring nuts (3) and (7), remembering that:
(A)- if the measured backlash is greater than the given tolerance range, unscrew the adjuster ring nut (3) and screw in the adjuster ring nut (7) by the same measure.
(B)- if the measured backlash is less than the given tolerance range, unscrew the adjuster ring nut (7) and screw in the adjuster ring nut (3) by the same measure.



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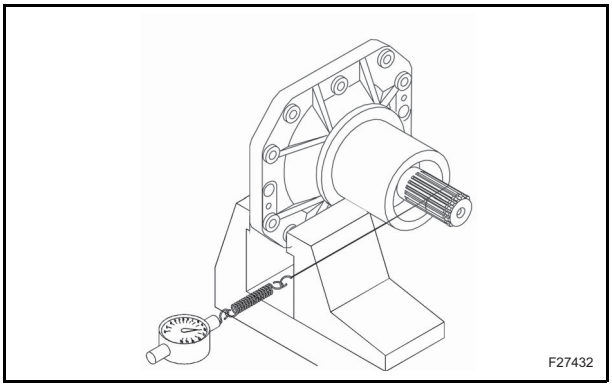
Once the adjustment of the pinion-ring gear backlash has been carried out, check also that there is a minimum preloading on the differential box bearings.
Repeat the whole sequence of the above mentioned operations till the indicated conditions are reached.



Once the pinion-ring gear backlash has been established, measure the total preloading (T) of the bearings (pinion-ring gear system), using a dynamometer, whose cord is wound on the splined end of the pinion. The measured value should be within the following range:

T = (P+3.90) ÷ (P+5.90) daN

where P is the effectively measured pinion preloading.
See section “Pinion assembly”.



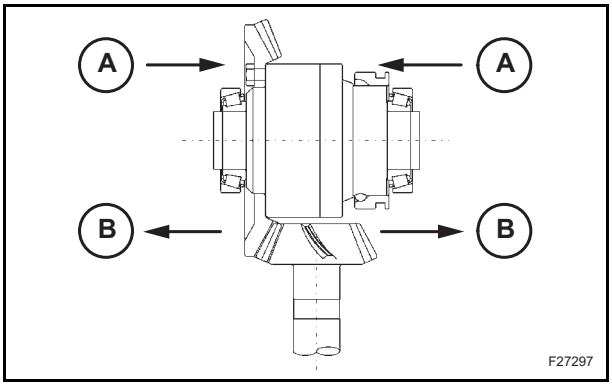
⚠ WARNING

All preloadings must be measured without the seal ring.

If the measurement is not within the requested range, check well the assembly of each component and operate on the adjuster ring nuts (3) and (7) of the differential support:

(A)- if the total preloading is less than the given range, screw in both adjuster ring nuts (3) and (7) by the same measure, keeping the pinion-ring gear backlash value unchanged.

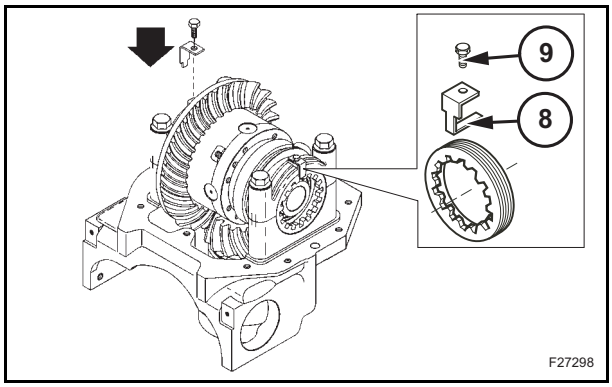
(B)- if the total preloading is higher than the given range, screw in both ring nuts (3) and (7) by the same measure, keeping the pinion-ring gear backlash value unchanged.



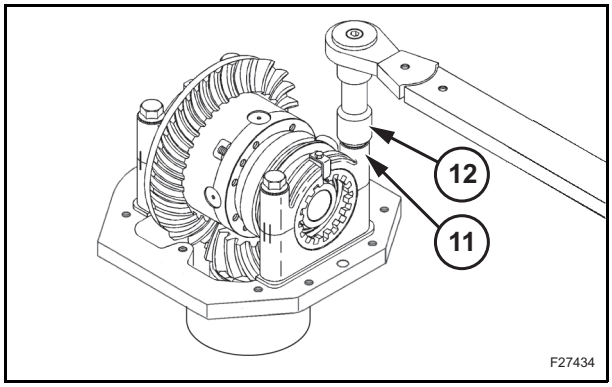
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Once all the adjustment operations have been completed, fit the ring nut retainers (8) and their screws (9), tightening them to the requested torque.

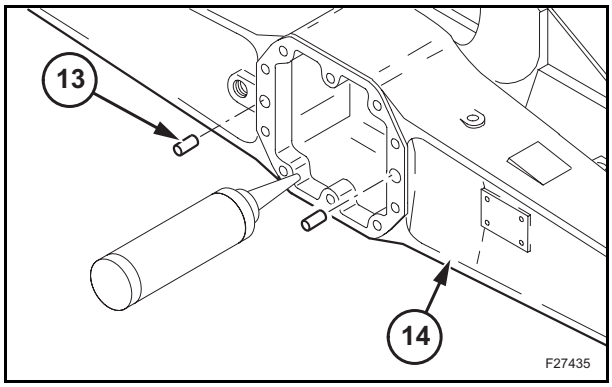


Tighten the screws (12) of both half collars (11) to the specified torque.

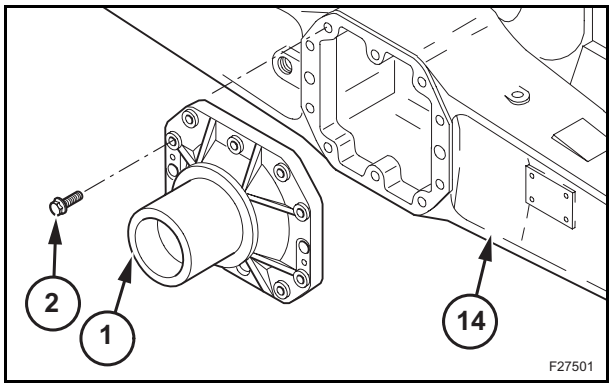


Before matching surfaces, make sure that they are perfectly clean, degrease and clean them with appropriate detergents.
Spread a film of adhesive on the contact surface between the axle beam (14) and the differential carrier (1).

NOTE: check that the two pins (13) are in their housing.



Position the differential support (1) on the axle housing (14), and tighten the retaining screws (2) to the requested torque.

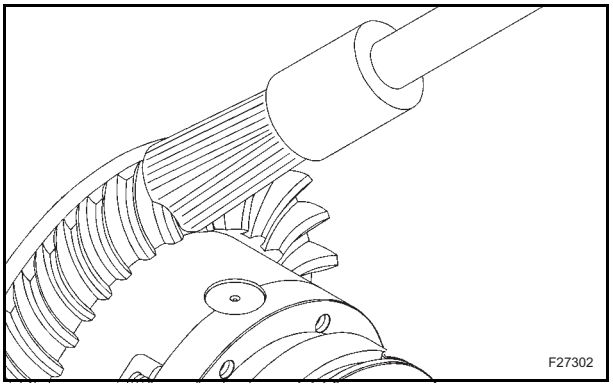


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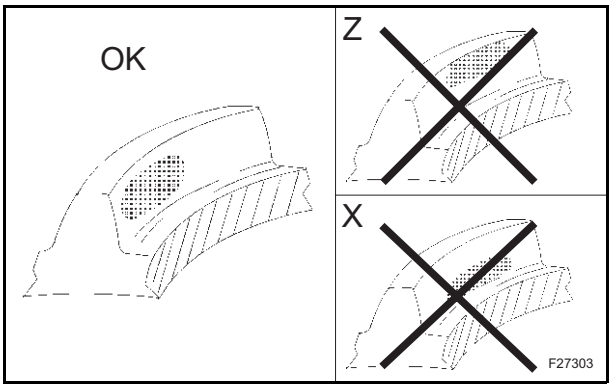
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Bevel gear marking test

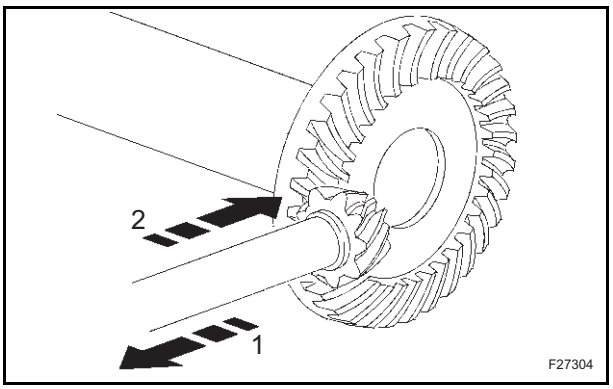
To test the marks of the bevel gear teeth, paint the ring gear with red lead paint.
The marking test should always be carried out on the ring gear teeth and on both sides.



OK -> Correct contact:
If the bevel gear is well adjusted, the mark on the teeth surfaces will be regular.
Z -> Excessive contact on the tooth tip:
Approach the pinion to the ring bevel gear and then move the ring bevel gear away from the pinion in order to adjust the backlash.
X -> Excessive contact at the tooth base:
Move the pinion away from the ring bevel gear and then approach the ring bevel gear to the pinion in order to adjust the backlash.



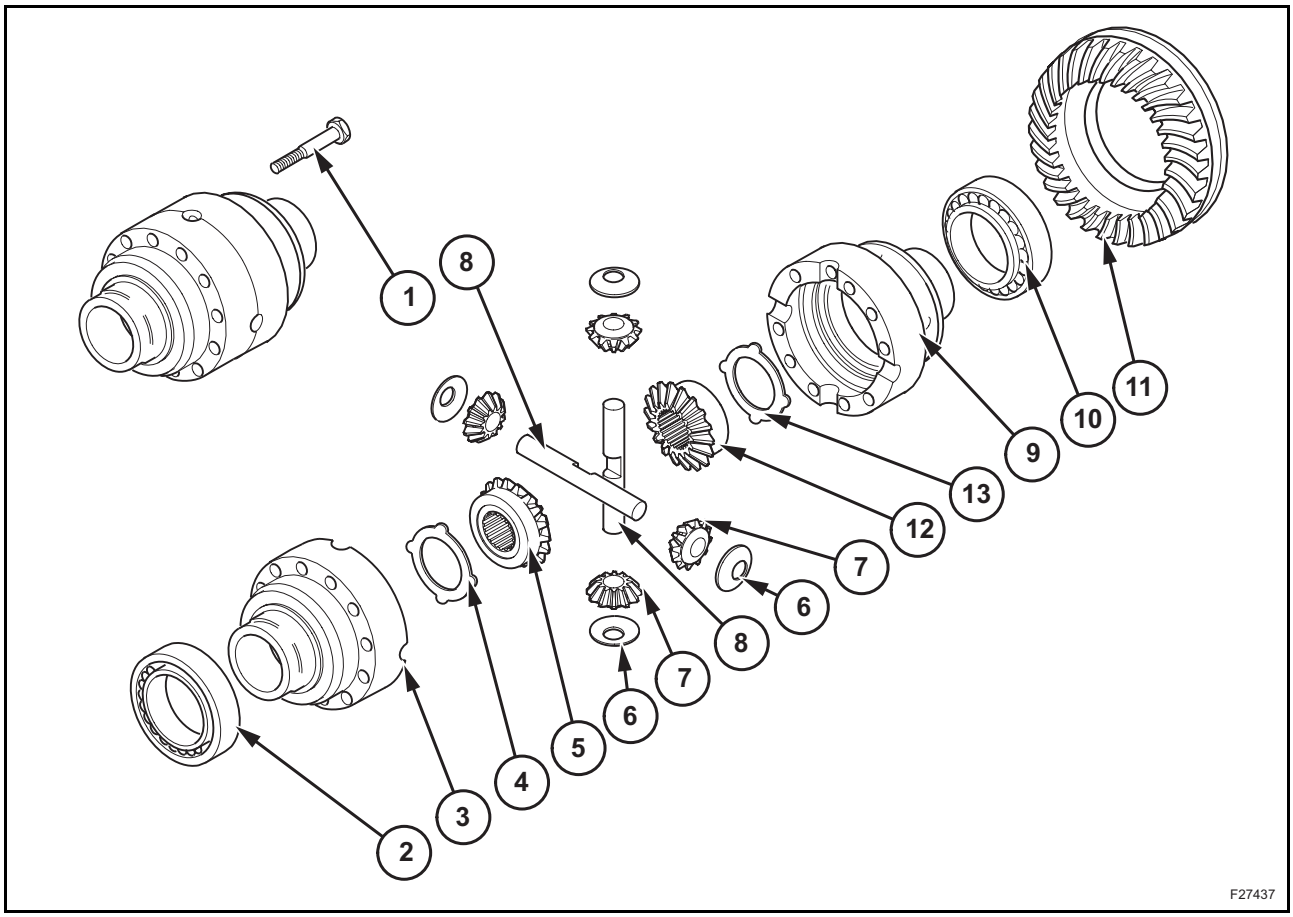
Movements to correct:
1 -> move the pinion for type X contact adjustment.
2 -> move the pinion for type Z contact adjustment.



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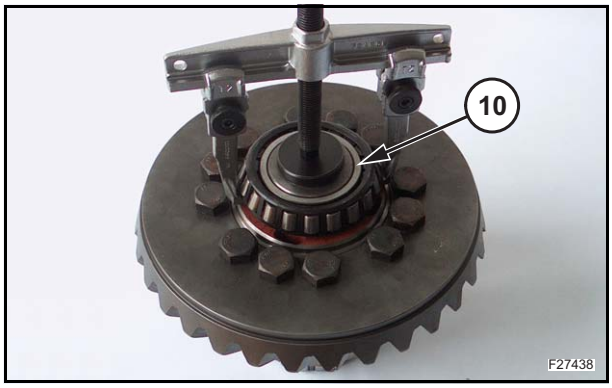
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DIFFERENTIAL GROUP (STANDARD)



Disassembly

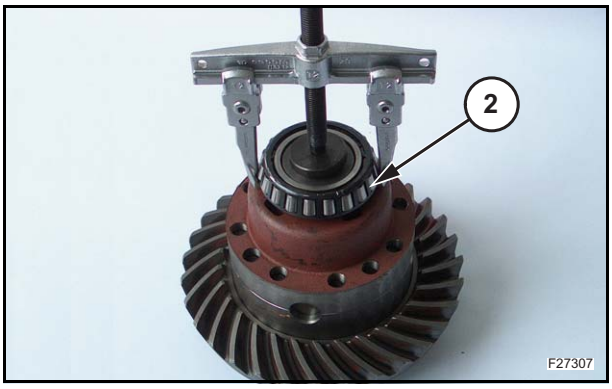
Use an extractor to remove bearing (10).



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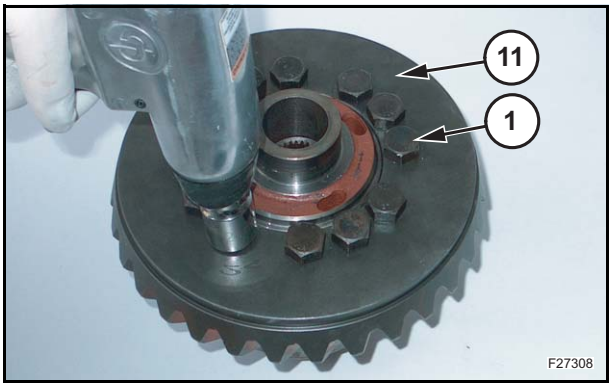
Use an extractor to remove bearing (2).



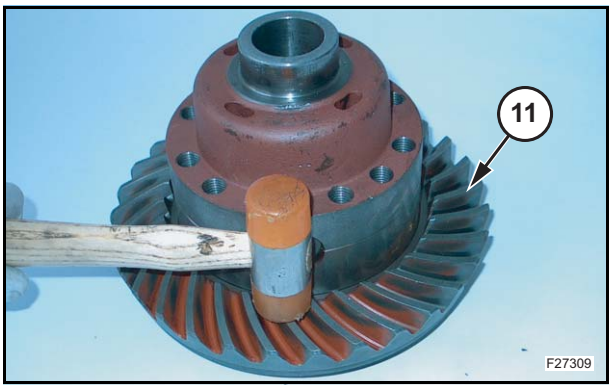
Loosen all fastening screws (1) of the ring gear (11).

⚠ WARNING

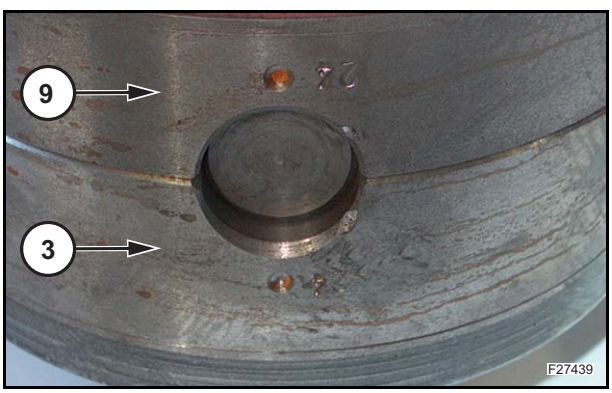
This operation makes both differential half boxes free, so take care not to lower the inner components.



Remove the ring gear (11) by means of a hammer.



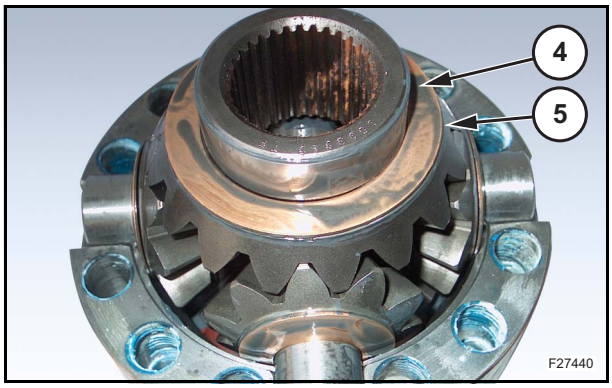
Check the marking points (3) and (9) that will be useful during the assemblage.



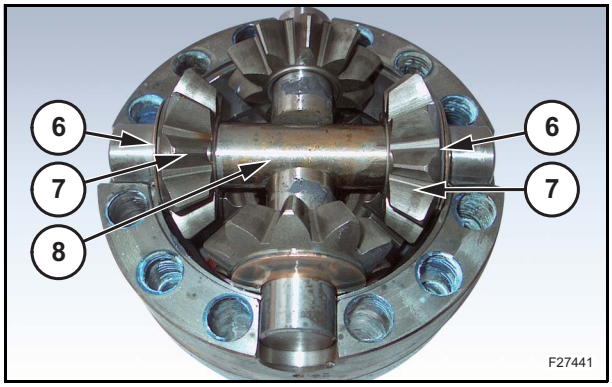
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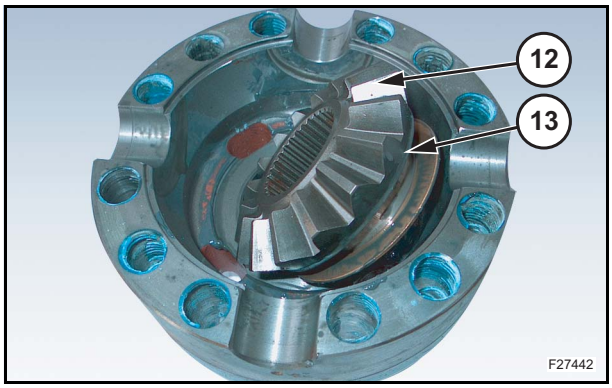
Remove the gear (5) and the shim (4).



Remove the shaft (8), the gears (7) and the spherical washers (6).



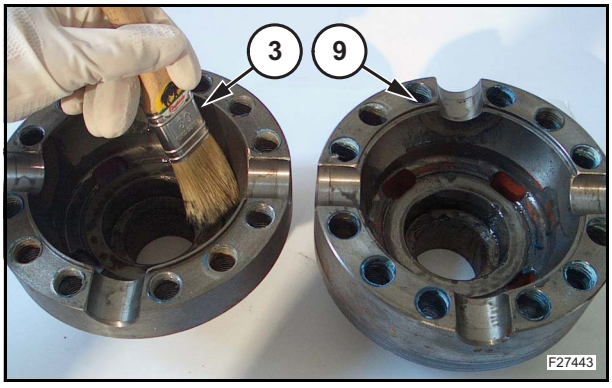
Remove the gear (12) and the shim (13).



Assembly

Apply a thin layer of Molicote G-n plus paste on the half housings of differential (3) and (9).

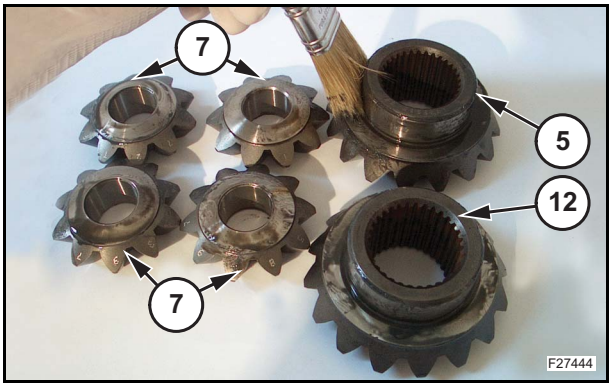
⚠ WARNING
Remove rests of dope.



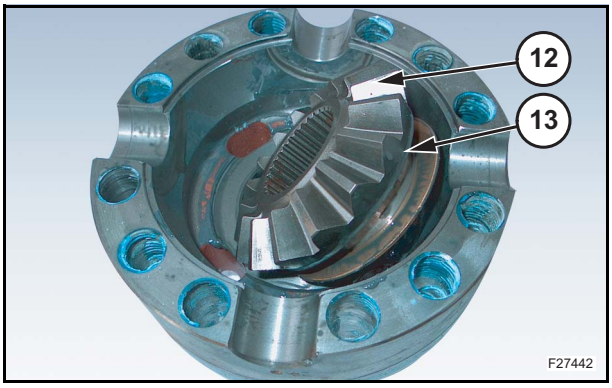
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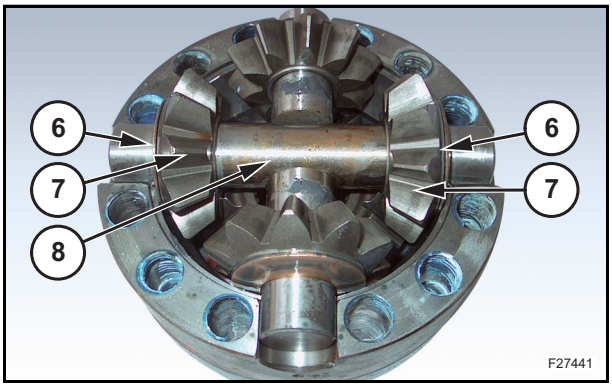
Apply a thin layer of Molicote G-n plus on the gears (5) and (12) and on the gears (7).



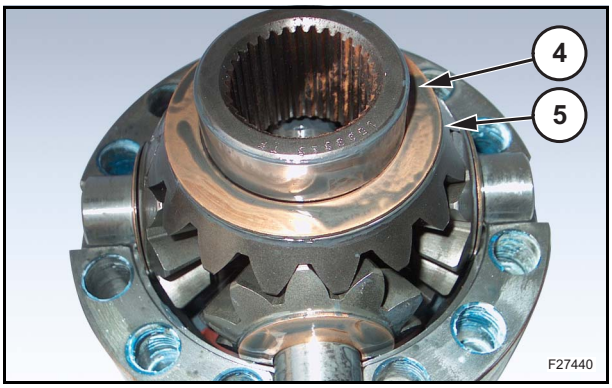
Assemble the gear (12) and the shim (13).



Position the shaft (8), the gears (7) and the spherical washers (6).



Assemble the gear (5) and the shim (4).



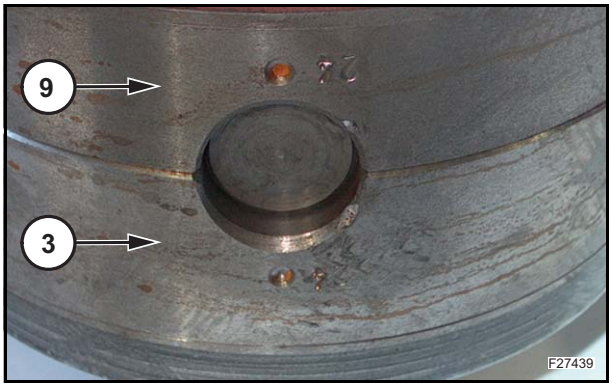
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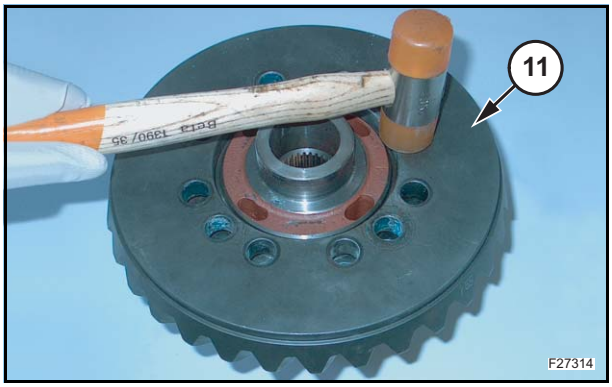
Assemble the two half housings of the differential unit (3) and (9).

⚠ WARNING

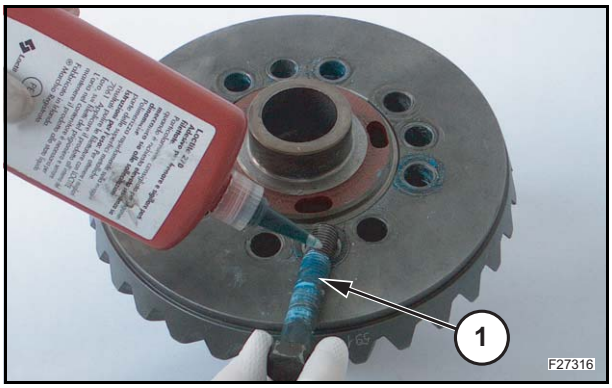
Carefully check that the marks of both differential half housings coincide.



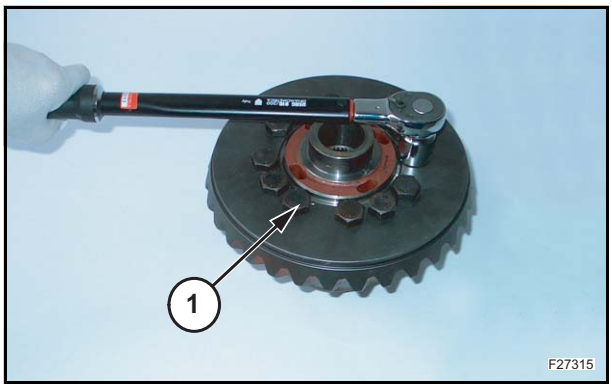
Assemble the ring gear (11) by means of a hammer.



Apply Loctite 242 on the thread of screws (1).



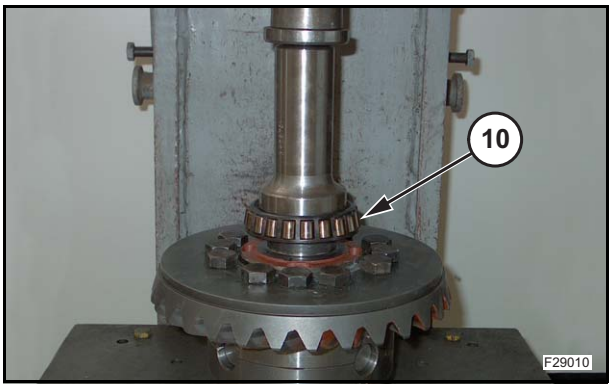
Tighten the screws (1) to the specified torque.



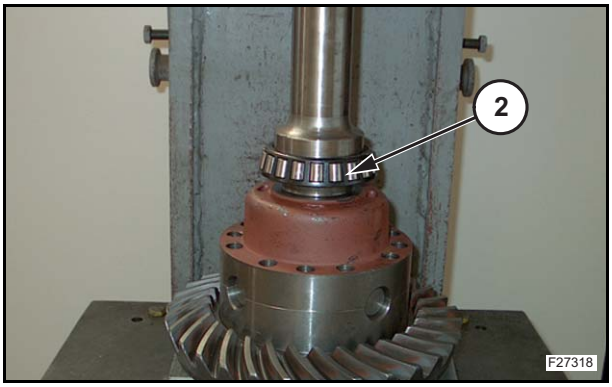
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Press the bearing (10) or assemble after preheating.



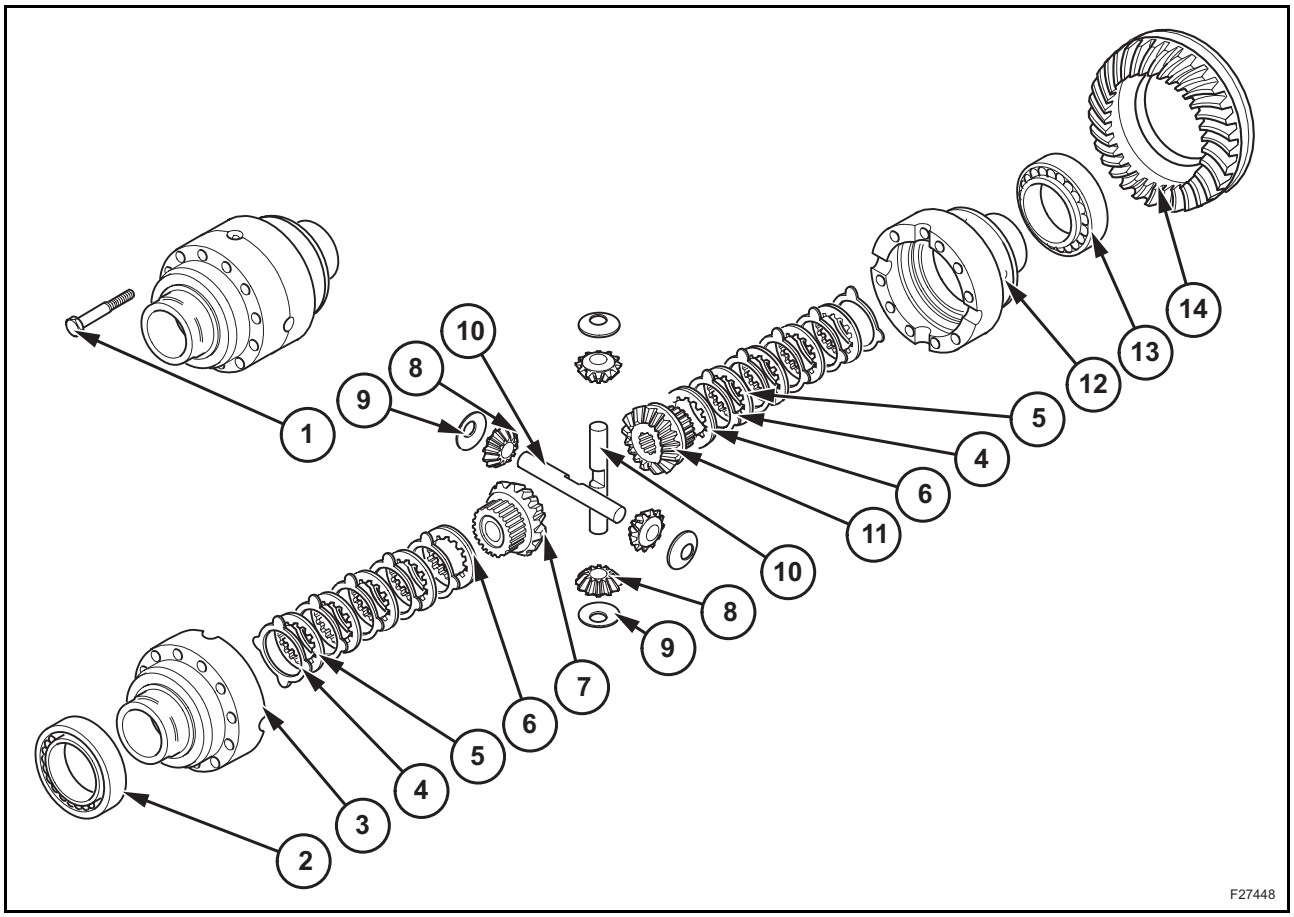
Press the bearing (2).



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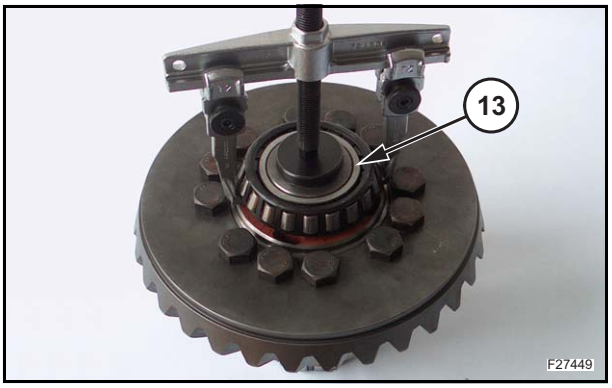
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DIFFERENTIAL GROUP (SELF-LOCKING)



Disassembly

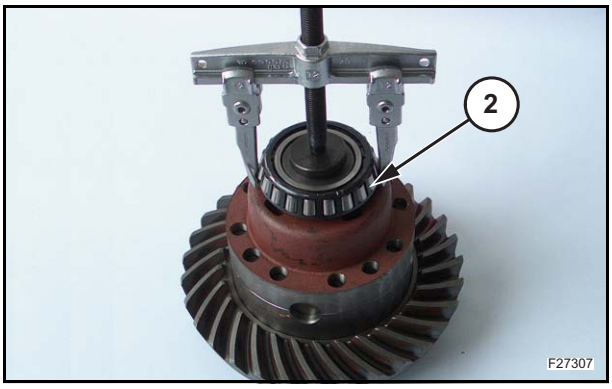
Use an extractor to remove bearing (13).



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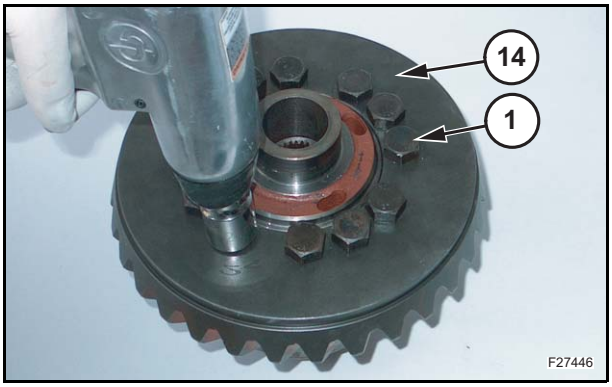
Use an extractor to remove bearing (2).



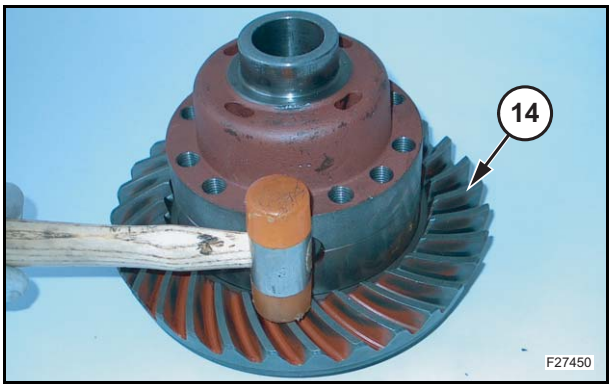
Loosen all fastening screws (1) of the ring gear (14).

⚠ WARNING

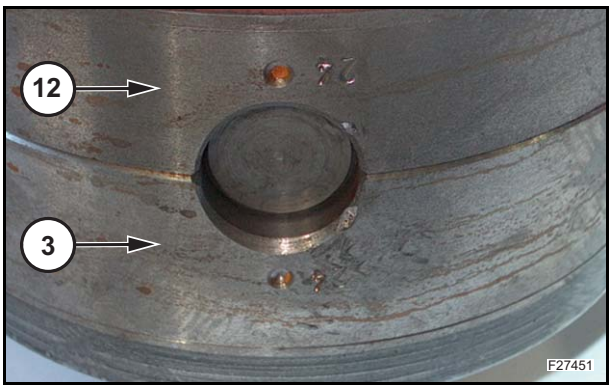
This operation makes both differential half boxes free, so take care not to lower the inner components.



Remove the ring gear (14) by means of a hammer.



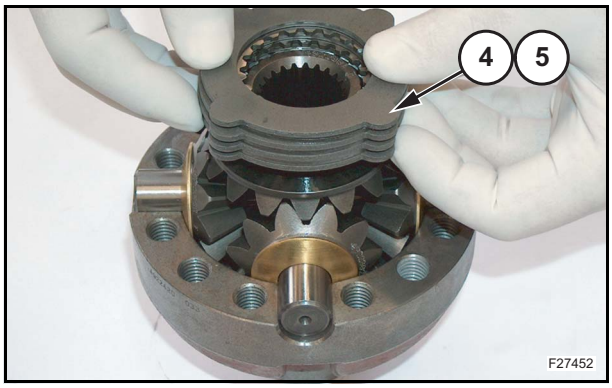
Check the marking points (3) and (12) that will be useful during the assemblage.



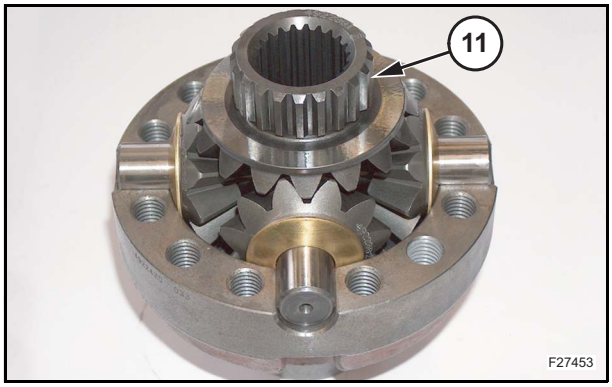
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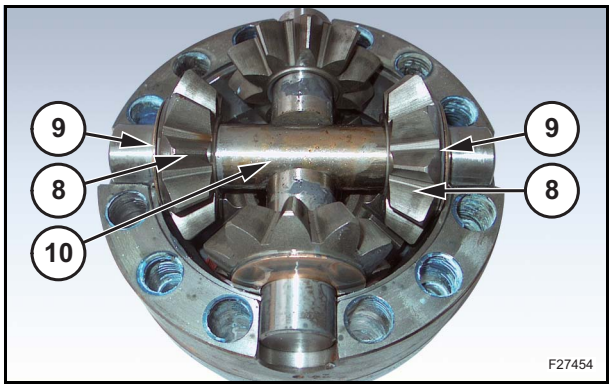
Assemble the discs (4) and (5).



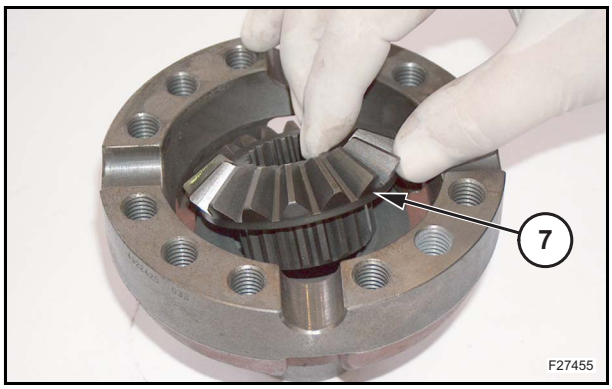
Remove the sun gear (11).



Remove the shaft (10), the gears (8) and the spherical washers (9).



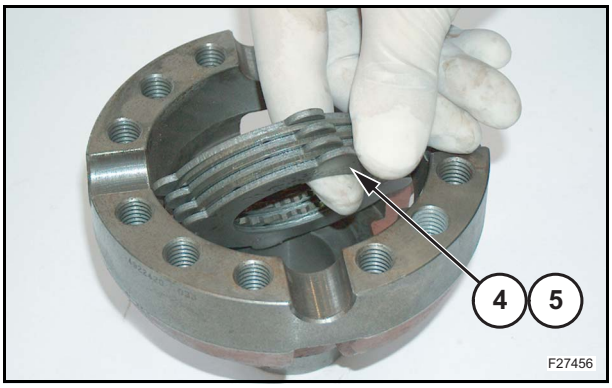
Remove the sun gear (7).



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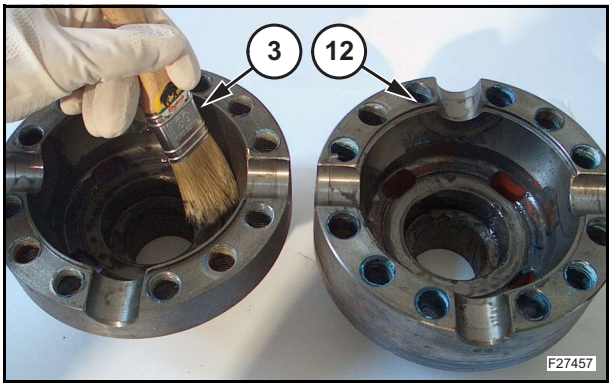
Assemble the discs (4) and (5).



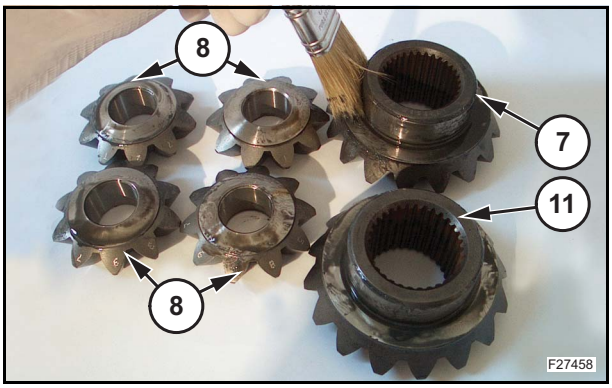
Assembly

Apply a thin layer of Molicote G-n plus paste on the half housings of differential (3) and (12).

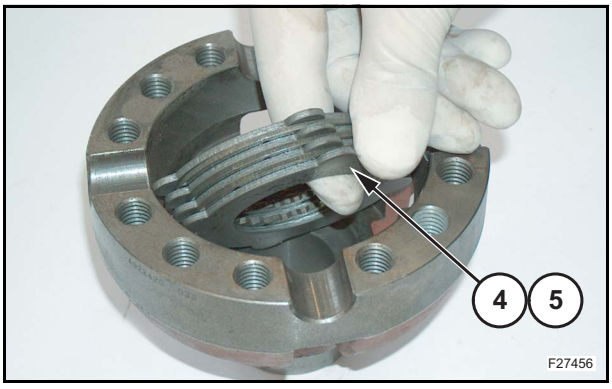
⚠ WARNING
Remove rests of dope.



Apply a thin layer of Molicote G-n plus on the gears (7) and (11) and on the gears (8).



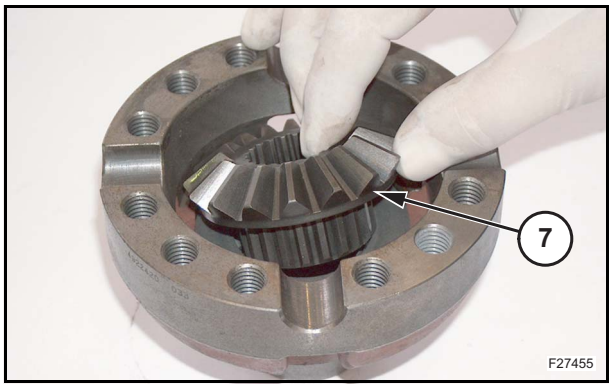
Assemble discs (4) and (5).



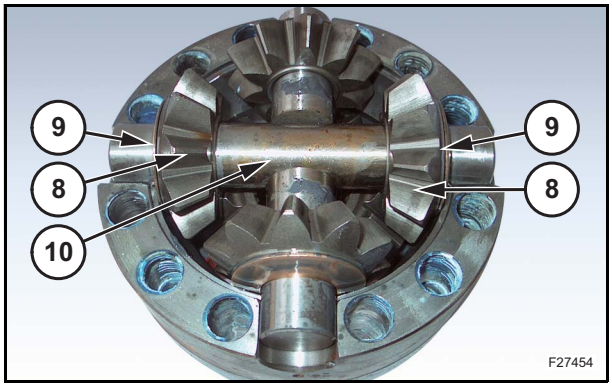
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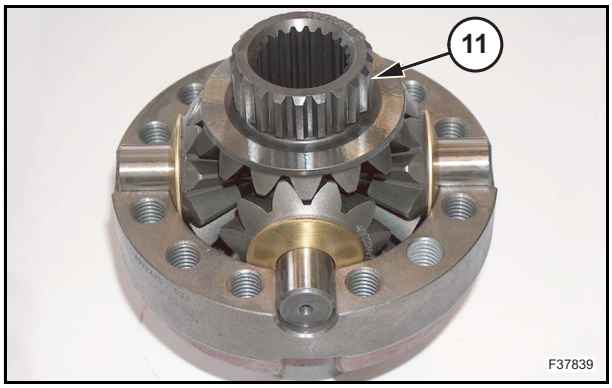
Assemble the gear (7).



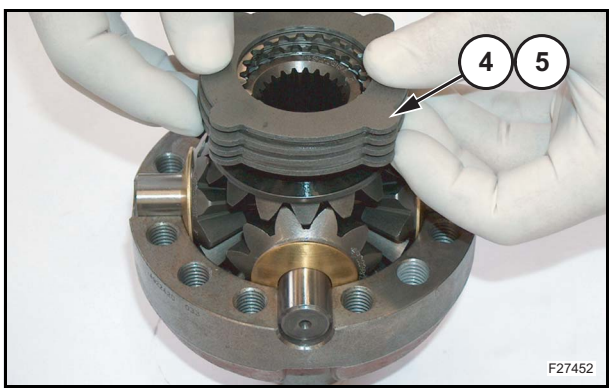
Position the shaft (10), the gears (8) and the spherical washers (9).



Assemble the gear (11).



Assemble discs (4) and (5).



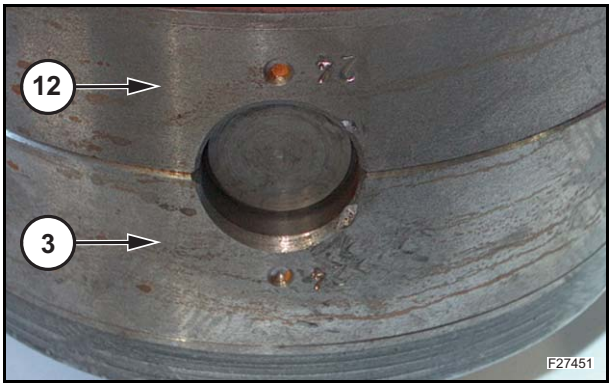
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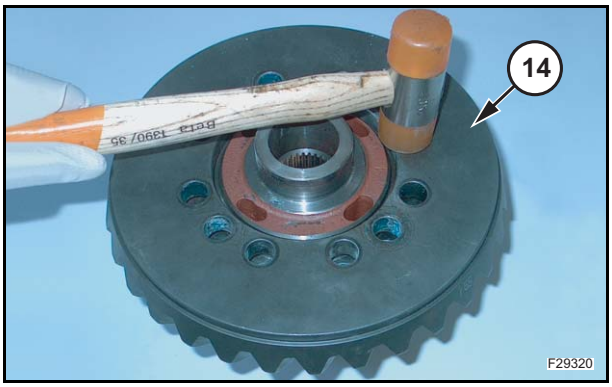
Assemble the two half housings of the differential unit (3) and (12).

⚠ WARNING

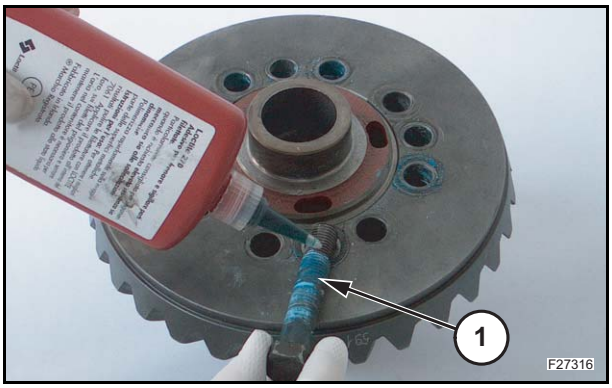
Carefully check that the marks of both differential half housings coincide.



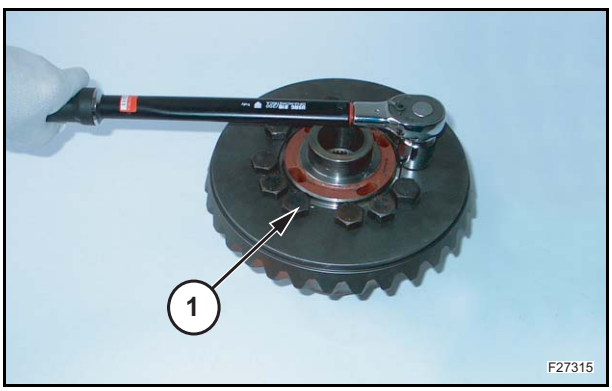
Assemble the ring gear (14) by means of a hammer.



Apply Loctite 242 on the thread of screws (1).



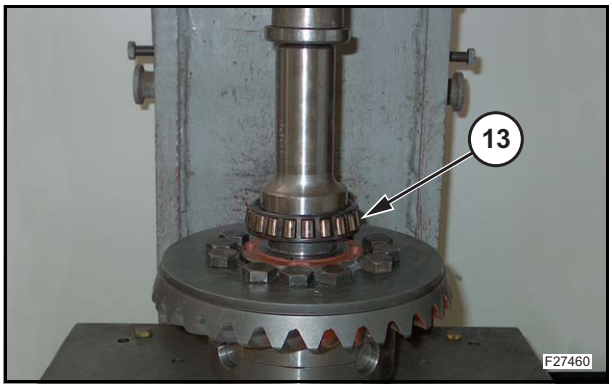
Tighten the screws (1) to the specified torque.



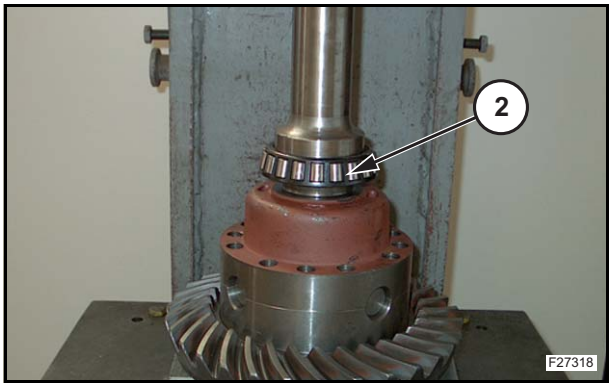
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Press the bearing (13) or assemble after preheating.



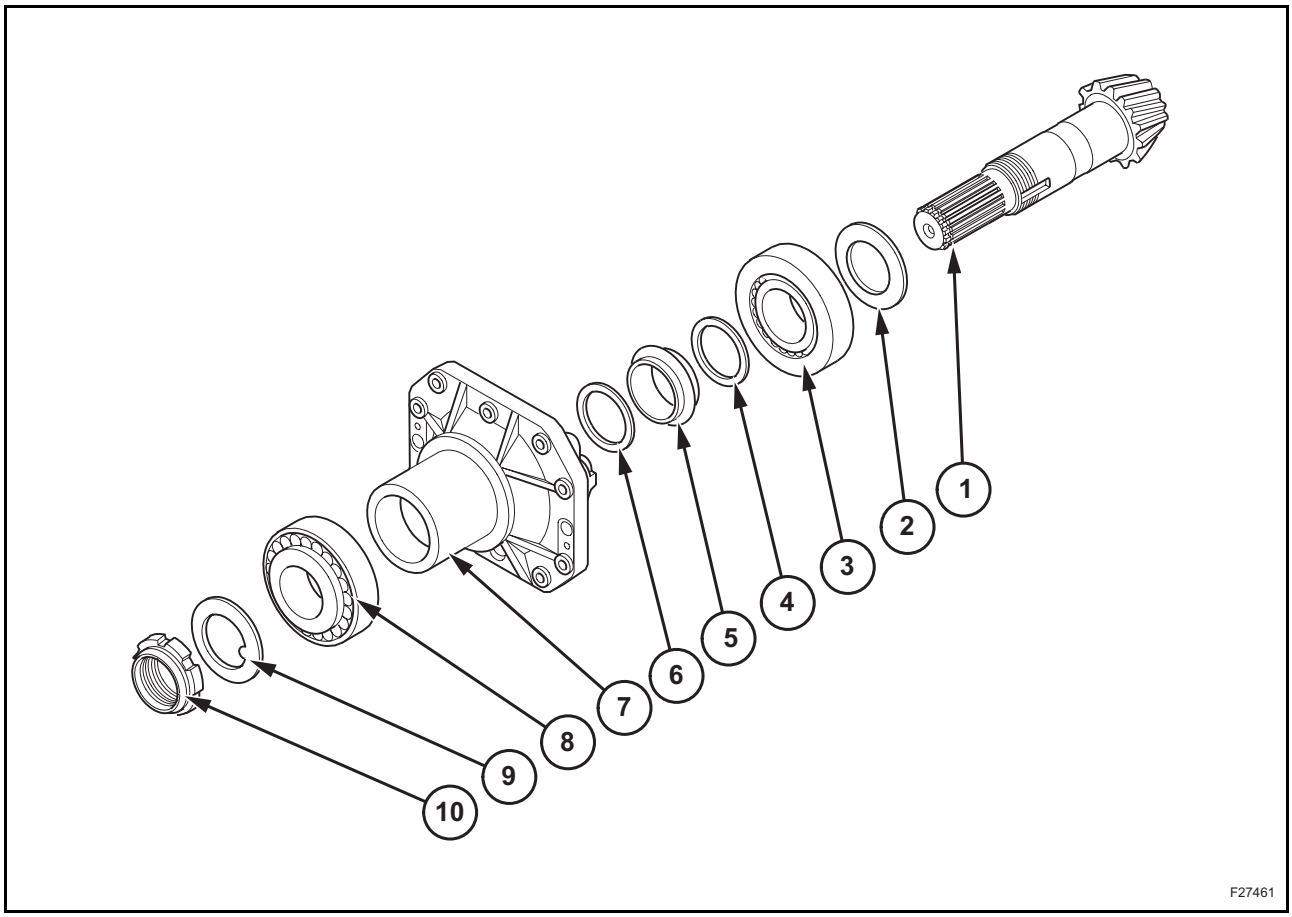
Press the bearing (2).



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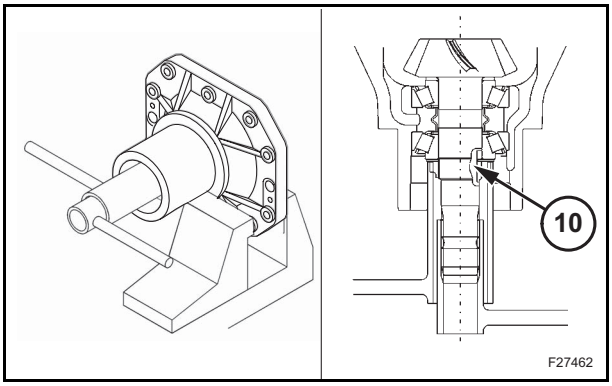
PINION GROUP



Disassembly

Position the differential carrier in a vise.
Unscrew the ring nut (10) using the special tool **380002218**.

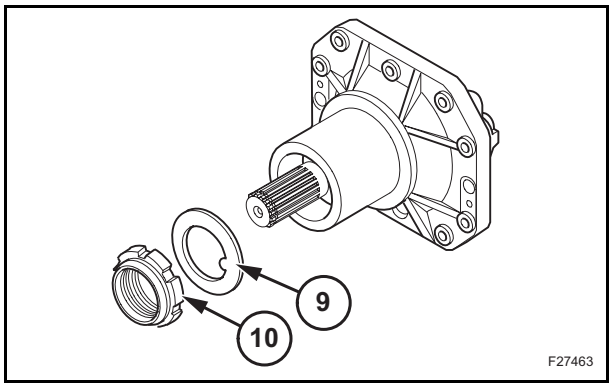
NOTE: this operation will irretrievably damage the ring nut (10).



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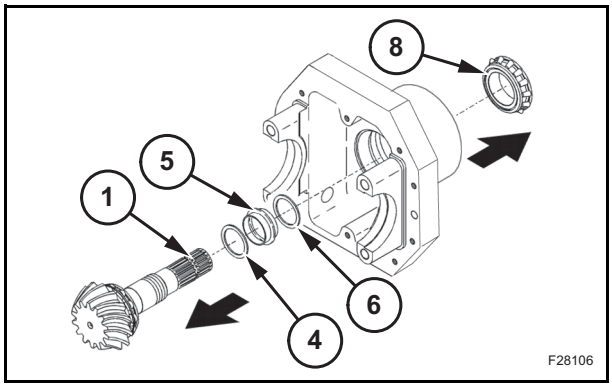
Remove the ring nut (10) and collect its washer (9).



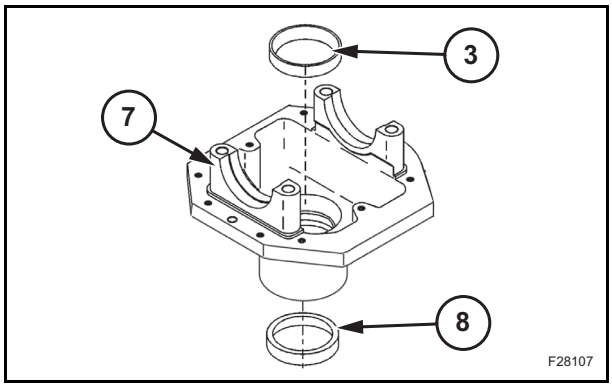
Tap with a soft hammer to extract the pinion (1).

⚠ WARNING
Take care not to lower the pinion (1).

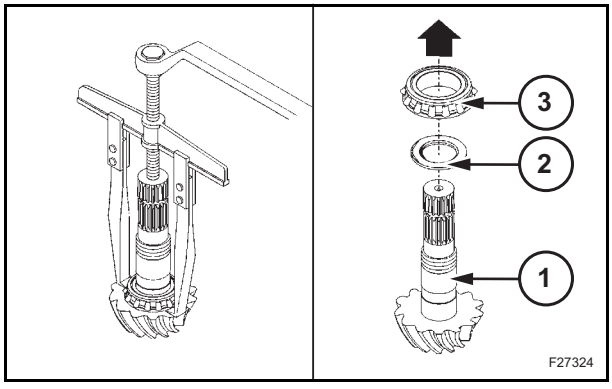
Collect the washers (4) and (6), the spacer (5) and the bearing (8).



Place the differential carrier (7) on a flat surface and remove the bearing cups (3) and (8) using a drift and a hammer.



To remove the bearing (3) of the pinion (1), use an extractor.
Collect the bearing (3) and the shim (2).

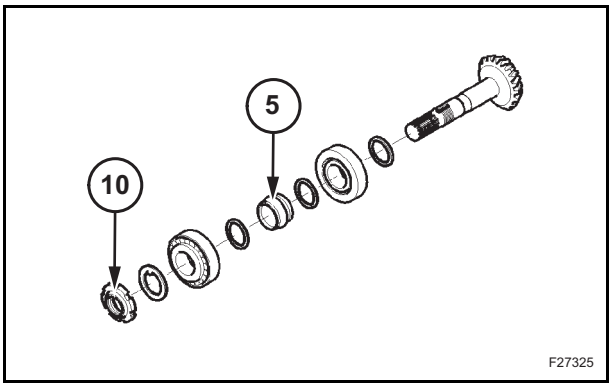


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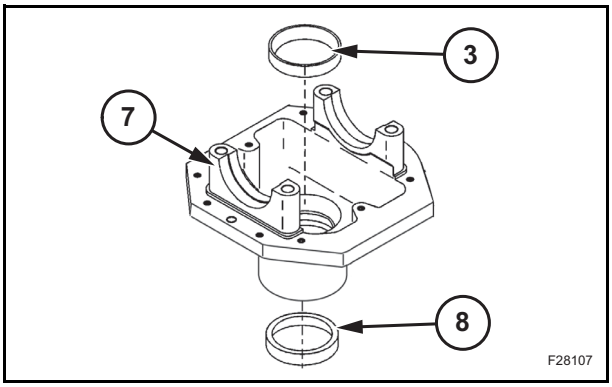
Check all pinion components for wear.

⚠ WARNING
The ring nut (10) and the spacer (5) must be replaced when reassembling the unit.

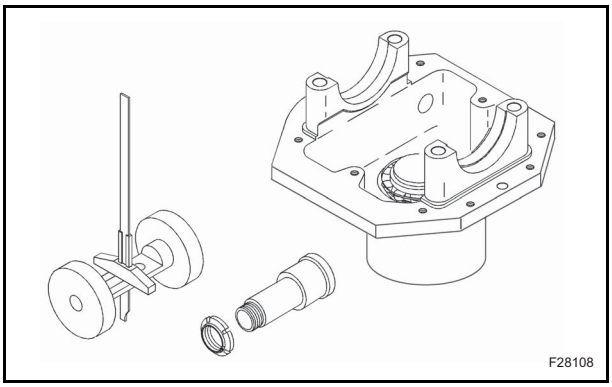


Assembly

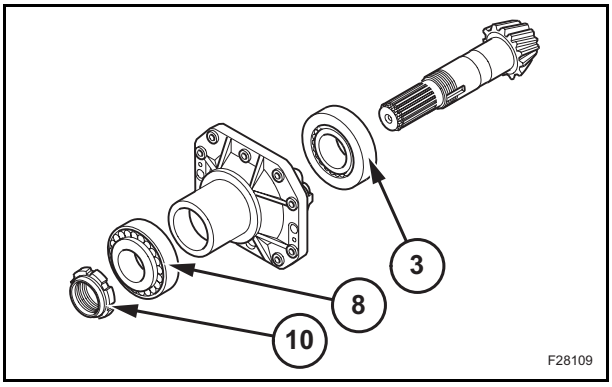
Place the differential support (7) on a workbench.
Assemble the bearing cups (3) and (8).



Prepare the kit consisting of the special tools called “false pinion” **380002219** and “false differential box” **380000407** + **380000440** and a depth gauge.



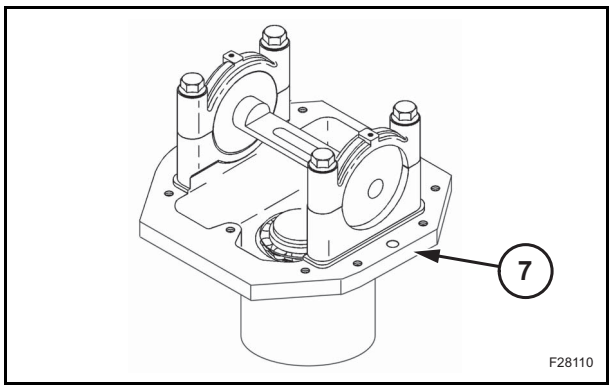
Insert the bearing (3) and (8) in their housings.
Assemble the “false pinion” **380002219** and its ring nut (10).
Tighten without exceeding the ring nut, till the backlash is eliminated.



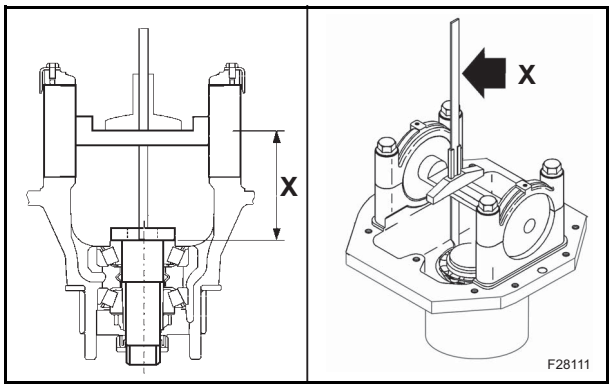
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Install “false differential box” special tools **380000407** + **380000440** to the differential group supports (7) and lock it with the half collar bolts.

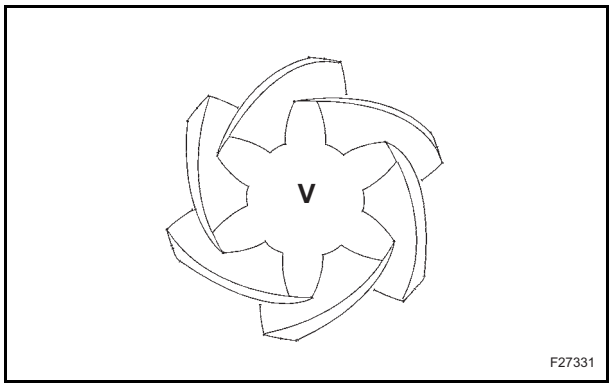


Assembly diagram of the “false differential box” tools on the bearing differential support seats.
Use a depth gauge to measure distance “X” (distance between the axis of the differential bearings and the point at which the pinion head is supported, or base of the bearing).

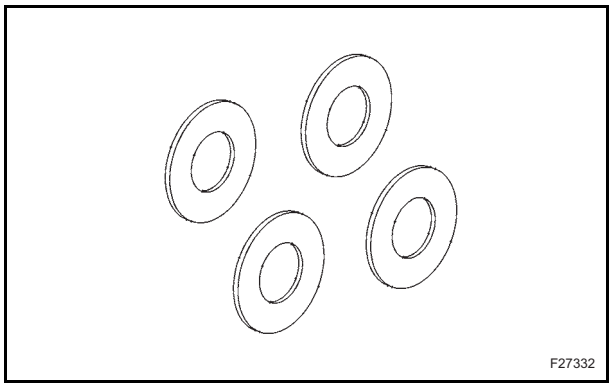


In order to determine the necessary thickness value (S) between the pinion and the bearing, subtract the value (V), stamped on the pinion head (V = requested conical distance), from the measured value (X).

S = X-V mm



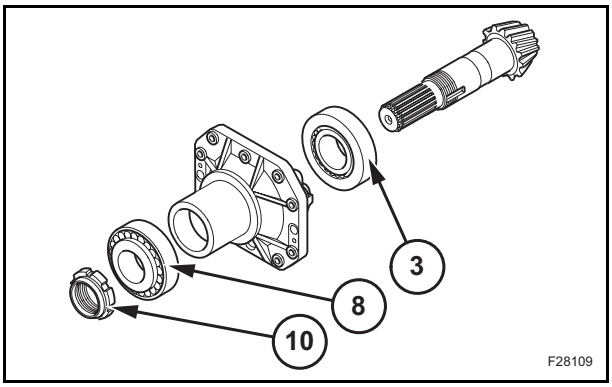
Select the shim (2) of thickness value (S) among the range of available shims.



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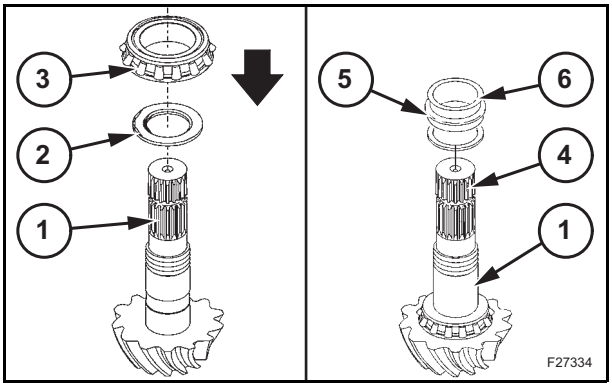
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Remove the “false differential box” special tool from the differential supports (7).
Remove the ring nut (10), the “false pinion” and the bearing (3) and (8).

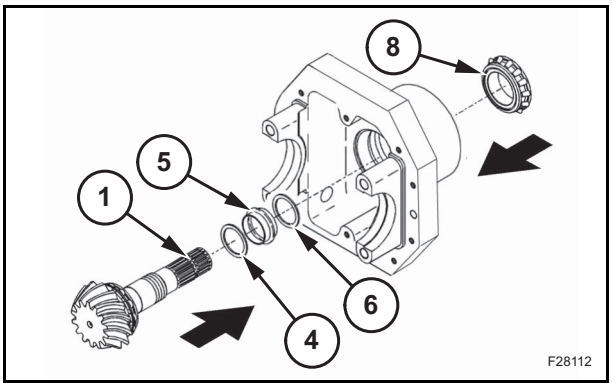


Once you have chosen and inserted the suitable shim (2) with the chamfer against the gear, force the bearing (3) into the pinion shaft (1) with the special tool **380002224** under a press, making sure that it is well set.
Insert the shims (4) and (6) and a new spacer (5).

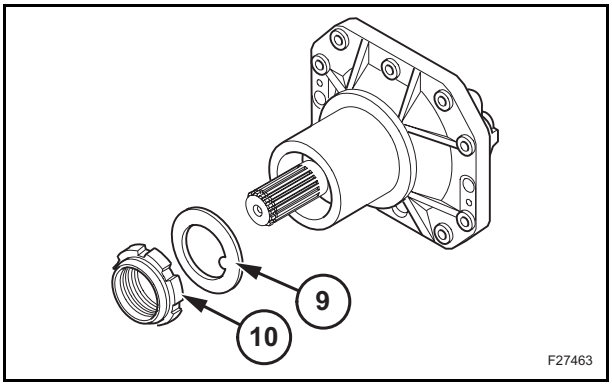
NOTE: use always a new spacer (5).



Insert the pinion assy (1) into the differential support housing (7) and the bearing (8).
In order to force the bearing (8) into position, use the special tool **380002224** and a hammer.
It is advisable to offer resistance, for example a sledge, to the beating force.



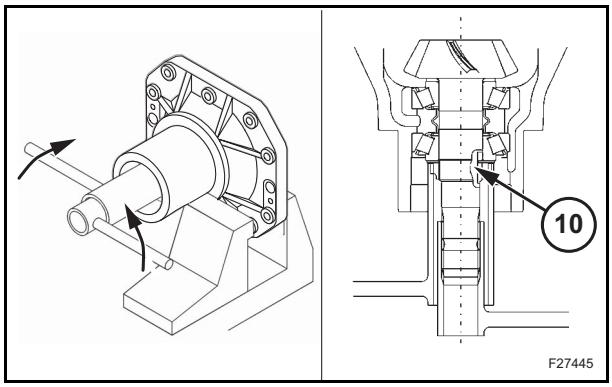
Insert the washer (9) and screw in a new ring nut (10) on the pinion.



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Screw the ring nut (10) in, using the wrench **380003218** for ring nut and for pinion retainer.



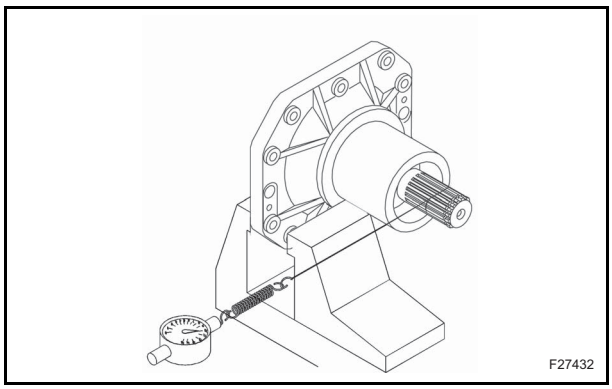
⚠ WARNING

The torque setting is given by the preloading measurement on bearings; tighten the ring nut (10) gradually.

NOTE: if the tightening is excessive, the collapsible spacer must be replaced and the procedure repeated. When you check the preloading, it is advisable to beat slightly both pinion ends with a soft hammer, so as to help setting the bearings.

Carry out the preloading measurement P of the pinion taper roller bearings, using a dynamometer whose cord is wound on the end of pinion spline. The adjustment is carried out by increasing the ring nut torque gradually, being careful not to exceed.

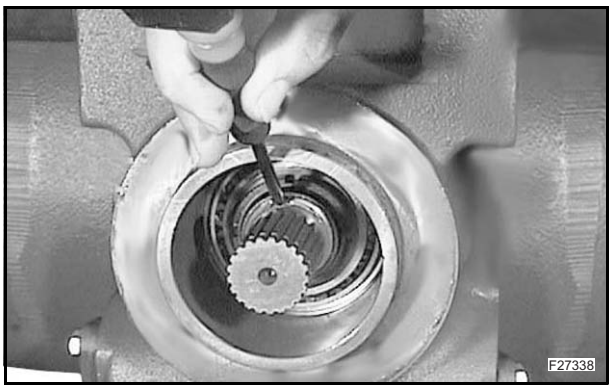
P = 9.2÷13.7 daN



⚠ WARNING

All preloadings must be measured without the seal ring.

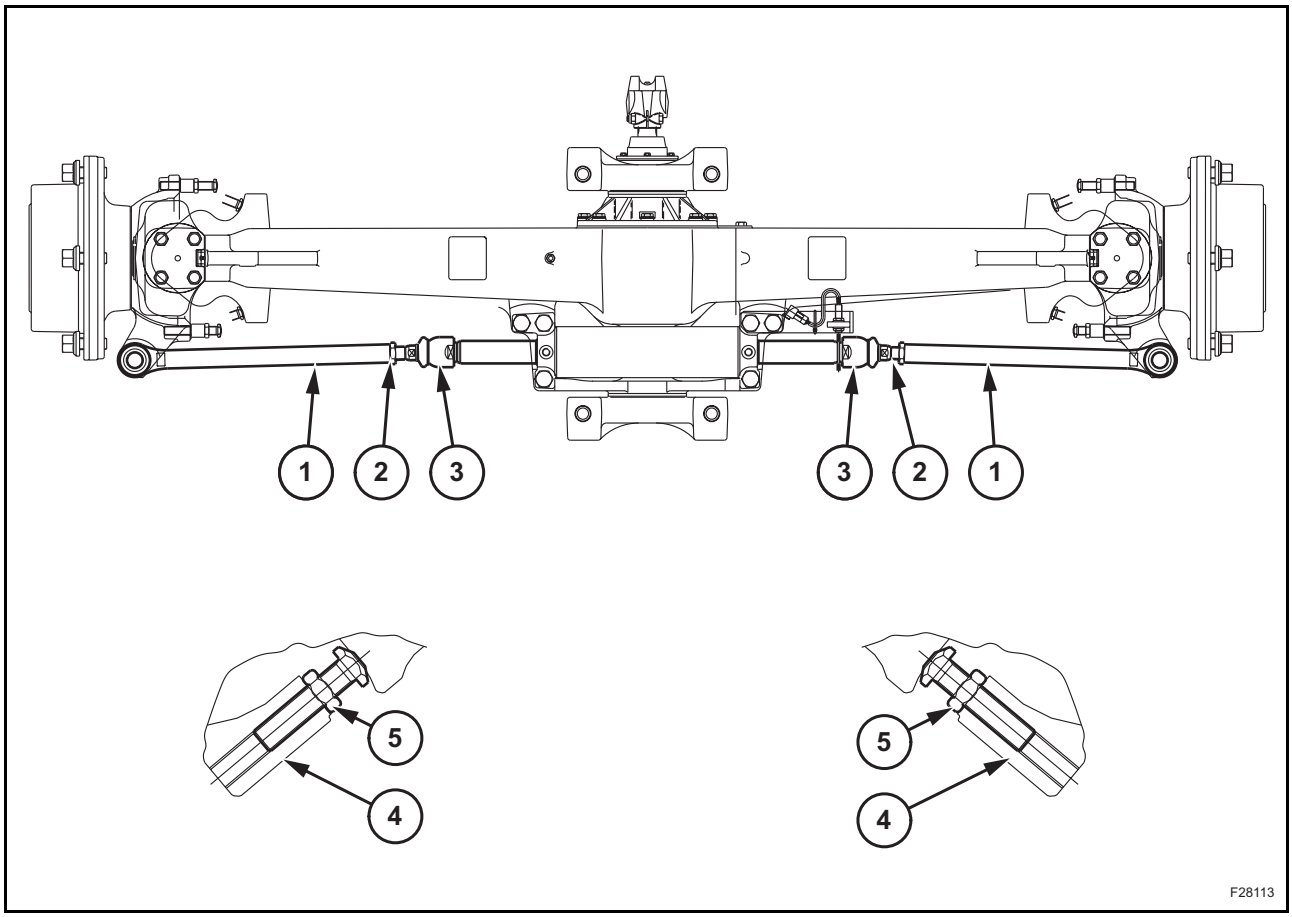
Once the requested preloading value is achieved, stake the ring nut, using a hammer and a chisel.



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TOE-IN / STEERING ANGLE

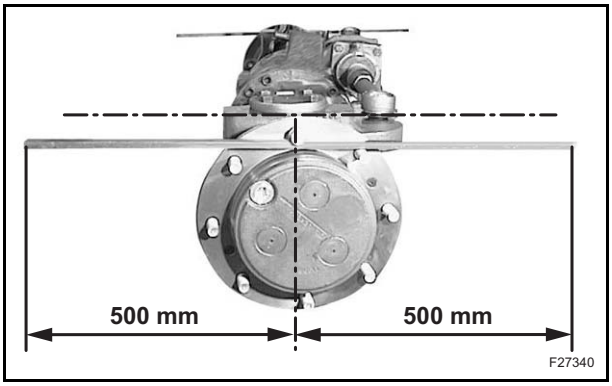


Toe-in

Put two equal 1 m long linear bars on the wheel sides and lock them with two nuts on the wheel hub stud bolt.

⚠ WARNING

The two bars should be fixed on their middle so that they are perpendicular to the supporting surface and parallel to the pinion shaft axis; align the two bars.

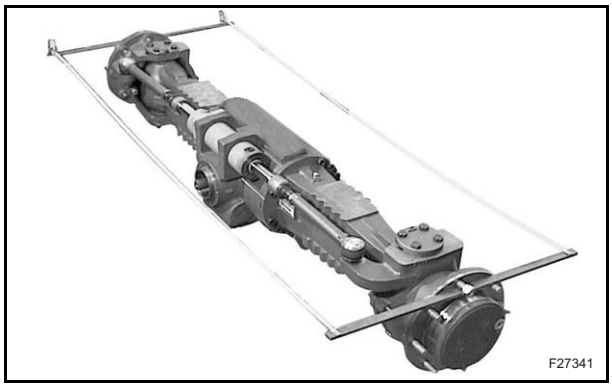


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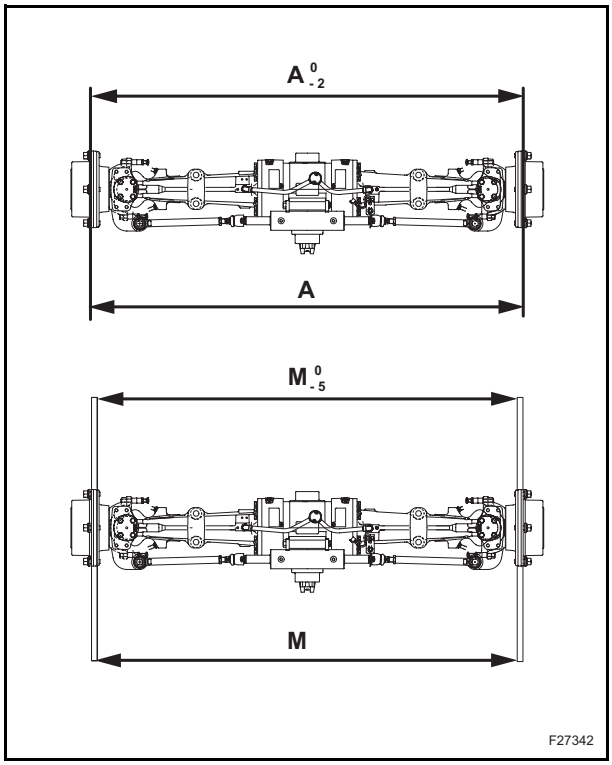
Measure the distance in mm M between the bars ends with a tapeline.

NOTE: keep the minimum value, swinging the measurement point.

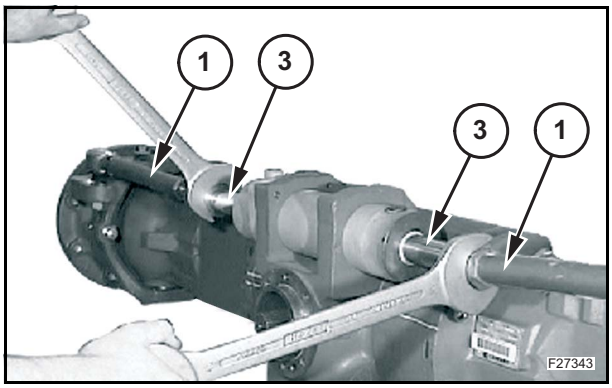


Check that the difference of the measurements between the wheel hubs diameters ends is within the requested tolerance range.
The nominal toe-in value (A) is referred to the external diameter of the wheel hubs flange, therefore the measured value (M) at the bars ends must be related to the ratio between length of the bar and flange diameter:

nominal toe-in = A^{0}_{-2} ⟶ measured toe-in = M^{0}_{-5}



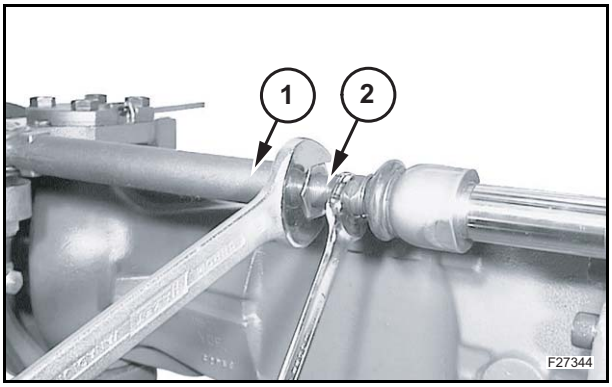
If toe-in is incorrect, operate with two wrenches on the guide rods (1) screwing in and out the two joint tie rods (3) equally till the toe-in is within the requested tolerance.



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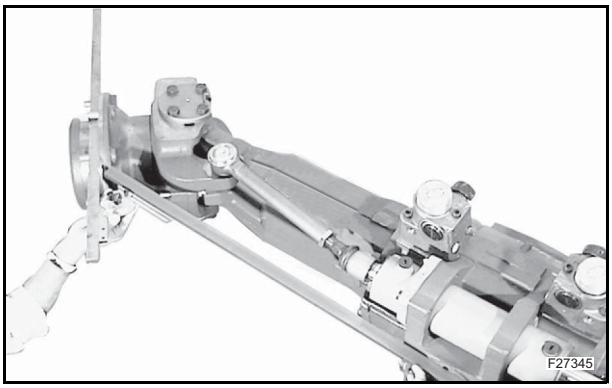
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After adjusting, screw in the locknuts (2) of the guide rods (1) to the prescribed tightening torque.

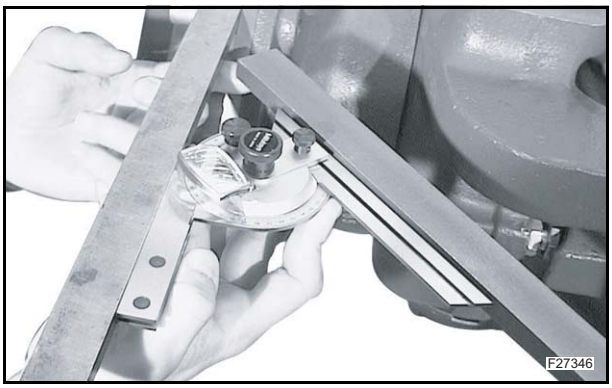


Steering angle adjustment

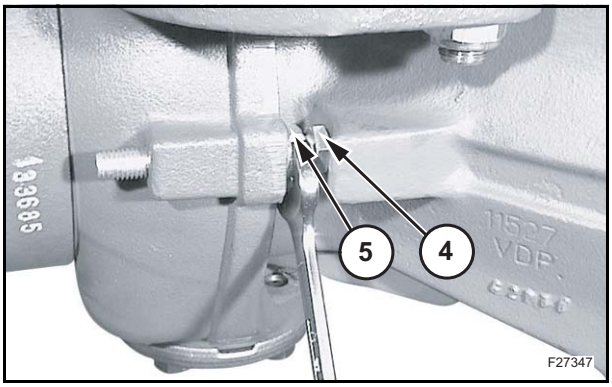
Use the same bars assembled for the toe-in adjustment and a long bar perfectly leaned over the machined part of the central body (pinion side), so that the two bars form an acute angle at the maximum steering.



Adjust a protractor to the requested angle and position it on the long bar.
Move a wheel side till it forms, with the two bars, the angle fixed by the protractor.



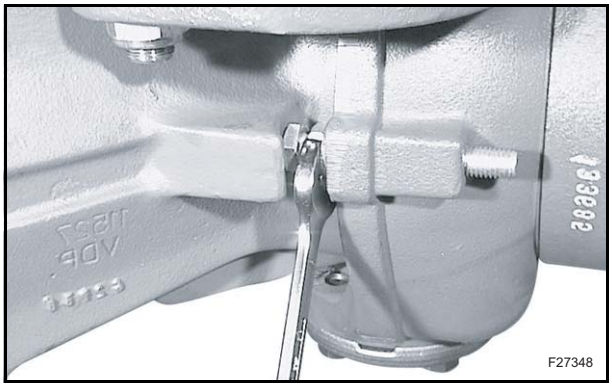
Adjust the mechanical steering stop, screwing in or out the stop bolt (4), locking it with the locknut (5) to the specified tightening torque.



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Steer completely towards the other side and repeat the same operation.



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3.3 FAULT FINDING

PROBLEM	CAUSE										
	1	2	3	4	5	6	7	8	9	10	11
Wheel vibration; front tyre resistance; half shaft breakage	●	●	●		●						●
Steering is difficult; vehicle goes straight while it's turning	●	●	●	●							●
No differential action; jamming while steering	●			●	●						●
Transmission excessively noisy	●	●	●	●	●		●		●		●
Uneven wear of tyre	●	●	●	●	●	●	●				●
Friction noise	●			●	●			●	●	●	●
Vibration during forward drive, intermittent noise	●	●	●		●						●

1. Incorrect installation / defective axle
Correct installation or repair or replace the differential in case it does not survive any one of the test phases.

2. Overloading / incorrect weight distribution
Remove excessive weight and redistribute load, following instructions related to the vehicle.

3. Different rotation radius of the tyres
If one tyre has a smaller radius, it will cause partial wheel slipping when force is applied. The other tyre with bigger radius will have to support all the work. Replace the tyre or adjust pressure to have same radius on both tyres.

4. Broken half shaft
It is not advisable to operate the vehicle with a broken half shaft. It is acceptable to move the vehicle (engine off unloaded) a few metres away only.

5. Bent half shaft
Replace the half shaft.

6. Blocked differential
Abnormal functioning of the differential or breakage/blockage of command device. Verify assembly and all components. Vehicles with wide steering angle may proceed with kicks, have steering difficulty or cause pneumatic wearing at sharp turns. Reduce the steering angle to minimum and decelerate when the vehicle begins to kick.

7. Incorrect wheel adjustment
Verify group integrity and wheel side bearings.
Adjusting according.

8. Damaged or worn axle parts
Check the condition of ring gear, pinion gear, bearings etc.
Replace whenever necessary.

9. Contamination in the axle box or incorrect assembly of parts
Look for foreign particles. Check assembly of the various parts of the axle.

10. Incorrect adjustment of the bevel gear set: Parts of the transmission worn out
(Transmission gears, U joints, etc.). Replace or adjust as required.

11. Incorrect use of the product
See the vehicle Manufacturer's instructions once again.

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PROBLEM	CAUSE	CORRECTION
Ring gear tooth broken on the outer side	Excessive gear load compared to the one foreseen Incorrect gear adjustment (excessive backlash) Pinion nut loose	Replace bevel gear set. Follow carefully the recommended operations for the adjustment of the bevel gear set backlash.
Ring gear tooth broken side	Load bump Incorrect gear adjustment (insufficient backlash) Pinion nut loose	Replace bevel gear set. Follow carefully the recommended operations for the adjustment of the bevel gear set backlash.
Pinion or ring gear teeth worn	Insufficient lubrication Contaminated oil Incorrect lubrication or depleted additives Worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring	Replace bevel gear set. Follow carefully the recommended operations for the adjustment of the bevel gear set backlash. Use correct lubricants, fill up to the right levels and replace according to the recommended program.
Overheated ring and pinion teeth See if gear teeth have faded	Prolonged functioning at high temperatures Incorrect lubrication Low oil level Contaminated oil	Replace bevel gear set. Use proper lubrication, fill up to right level and replace at recommended program.
Pinion teeth pitting	Excessive use Insufficient lubrication	Replace bevel gear set. Use correct lubrication, fill up to the right level and substitute at recommended intervals.
Axle beam body bent	Vehicle overloaded Vehicle's accident Load bump	Replace axle beam body.
Worn out or pitted bearings	Insufficient lubrication Contaminated oil Excessive use Normal wear out Pinion nut loose	Replace bearings. Use correct lubrication, fill up to the right level and substitute at recommended intervals.
Oil leakage form gaskets and seals	Prolonged functioning at high temperature of the oil Oil gasket assembled incorrectly Seal lip damaged Contaminated oil	Replace the gasket or seal and matching surface if damaged. Use correct lubrication and replace at recommended intervals.
Excessive wearing out of input flange spline	Exhaustive use Pinion nut loose Pinion axle backlash	Replace the flange. Check that the pinion spline is not excessively worn out. Replace bevel gear set if required.

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Fatigue failure of pinion teeth See if the fracture line is well defined (wave lines, beach lines)	Exhaustive use Continuous overload	Replace bevel gear set.
Pinion and ring teeth breakage	Crash load of differential components	Check and/or replace other differential components.
Side gear spline worn out Replace all scratched washers (Excessive backlash)	Excessive use	Replace differential gear group. Replace half shaft if required.
Thrust washer surface worn out or scratched	Insufficient lubrication Incorrect lubrication Contaminated oil	Use correct lubrication and fill up to right level. Replace at intervals recommended. Replace all scratched washers and those with a thickness by 0.1 mm lower than the new ones.
Inner diameter of tapered roller bearing worn out	Excessive use Excessive pinion axial backlash Insufficient lubrication Contaminated oil	Replace bearing. Check pinion axial backlash. Use proper lubrication, fill up to right level and replace at recommended intervals.
Bent or broken half shaft	Vehicle intensively operated or overloaded	Replace.
Half shaft broken at wheel side	Wheel support loose Beam body bent	Replace. Check that wheel support is not worn out or wrongly adjusted.

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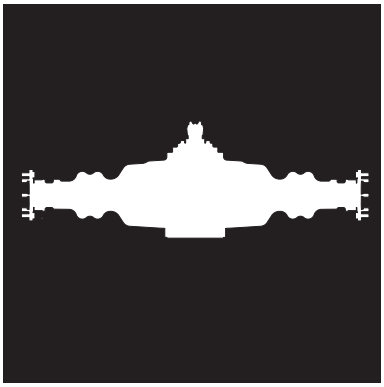
4. SPECIAL TOOLS

P/N CNH	USE	2WD	4WD	4WS
380000406	Disassembly/assembly of differential ring nuts	/	•	•
380000407 + 380000440	Calculation of pinion shims	/	•	•
380002213	Assembly of seal ring in the wheel hub	/	/	•
380002218	Disassembly/assembly of pinion rings	/	•	•
380002219	Calculation of pinion shims	/	•	•
380002222	Assembly of bearing cups in the wheel hub	/	/	•
380002223	Disassembly and assembly bushings in the crown retainer hub	/	•	/
380002224	Assembly of pinion bearing	/	•	•
380002225	Assembly of front flange seal connection	/	/	•
380002226	Assembly of bushing in the half beam	/	/	•
380002227	Assembly of seal ring in the wheel hub	•	•	/
380002432	Assembly of sliding block in the swivel housing	/	•	/
380002660	Assembly of bushing in the swivel housing	/	•	/
380002661	Assembly of seal ring in the swivel housing	/	•	/
380002662	Assembly of spherical joint on lower and upper king pin	/	•	/
380002663	Assembly of bearing cups in the wheel hub	•	•	/
380002664	Assembly of bushing in the seat of the upper king pin	/	•	/
380002665	Assembly of bushing in the half beam	/	•	/
380002666	Assembly of seal ring in the half beam	/	•	/
380002667	Disassembly/Assembly of bushings in the crown retainer hub	/	/	•
380002668	Assembly of bushing in the swivel housing	/	/	•
380002669	Assembly of seal ring in the swivel housing	/	/	•
380002670	Assembly of seal ring in the half beam	/	/	•

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580SR
580SR+
590SR
695SR



SECTION 27 - REAR AXLE

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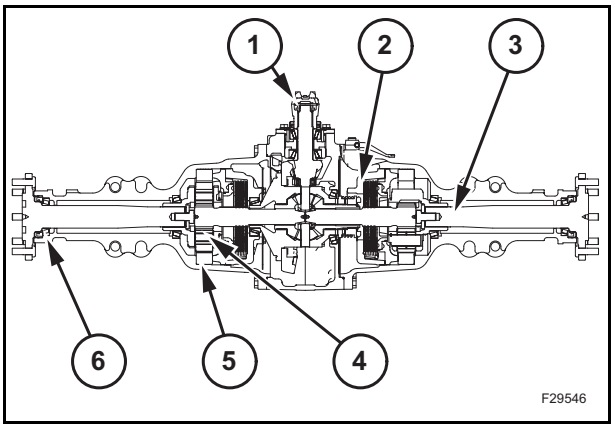
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1. REAR AXLE 2WS

1.1 DESCRIPTION AND OPERATION

The rear axle is a rigid axle and is fixed by 4 screws to the chassis with a torque value of 800 Nm.
It incorporates the following features:
- mechanically operated differential unit;
- hydraulically operated oil immersed foot brakes fitted with four disc brakes;
- planetary gear carrier with 3 gears.

Power from the transmission output shaft is transmitted to the rear axle through the flange (1), the brake pads (2) and the half shaft (3) to the rear fire.
The pinion is located on preloaded bevel roller bearings.
The differential is located on two roller bearings, the right hand bearing supported by an internal web of the axle centre housing.
The crown is fixed to the differential housing. Drive from the housing is transmitted through a four pinion differential to sun gear shafts which are splined into the differential side gears.
The differential lock sliding coupling is located on the splines of the right hand differential side gear. The coupling has dog teeth which engage with the dog teeth on the differential housing lock adaptor.
If the dog teeth are not aligned, the spring engagement link will be preloaded, ensuring rapid and full tooth engagement when the dog teeth align.
The differential lock will remain engaged due to dog tooth side loading as long as the rear wheels have unequal traction.
The return spring disengages the lock when both wheels have equal traction or drive is disengaged.
The brakes are mounted on the final reduction sun gears. These brakes are wet disc type with hydraulic piston actuator operated by foot pedals, independently for turning assistance, or together for transport.
The gears (4) are mounted in a carrier and are positioned around the sun gear and within the ring gear (5). The rear axle shafts (3) are located into the internal splines in the carriers.
As the sun gear is driven by the differential, the gears revolve inside the stationary planetary ring gear and drive the carrier and axle shaft at reduced speed.
The rear axle shaft is supported on taper roller bearings (6). Preload is adjusted by means of selective shims held under the retaining plate and screws.



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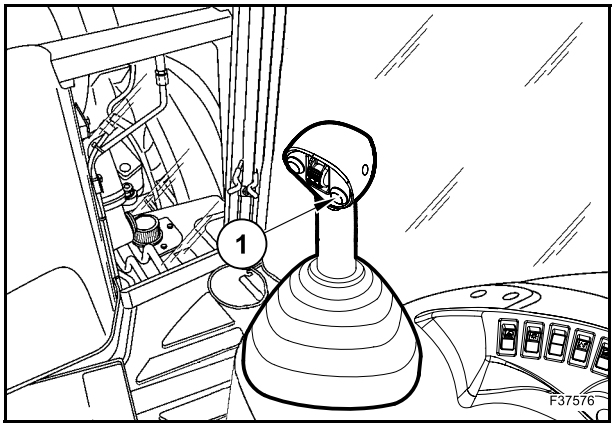
ELECTRICAL DIFFERENTIAL LOCKING OPERATION (Powershift)

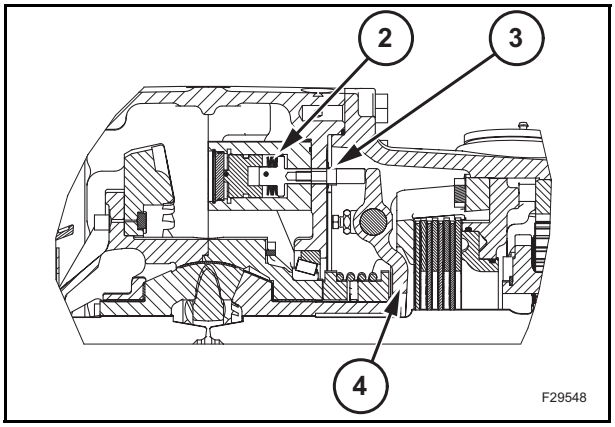
⚠ WARNING

The differential lock fitted to this machine is operated by oil pressure and controlled by an electrically operated solenoid. The solenoid valve is energized by means of the button (1) mounted in the right control lever.

The differential lock effectively places both rear wheels into a direct drive when selected, this action stops one rear wheel spinning.

In conditions inducing wheel slip (differential lock not yet engaged), press down the differential lock switch and the lock will engage giving direct drive to both rear wheels.
The lock will remain engaged until either of the foot brakes are applied and the machine stops or by disengaging the switch. The warning lamp on the instrument panel will turn off when the differential lock has disengaged.
When selecting switch (1) on gauge cluster, the differential is activated with the oil pressure supplied by the transmission, which acts on piston (3) for differential locking.
This oil under a pressure of 13-14 bar, always available when the engine is running, is controlled by a solenoid valve. When the switch is released (differential locking not necessary) oil is diverted to the filler of the level dipstick (discharged) and the piston spring (2) of the differential releases the locking (4).





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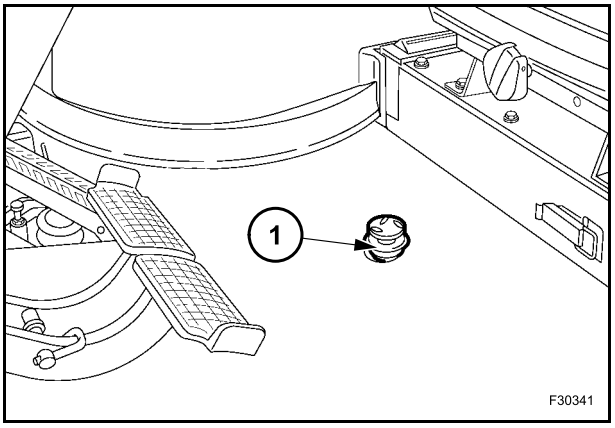
MECHANICAL DIFFERENTIAL LOCKING OPERATION (Powershuttle)

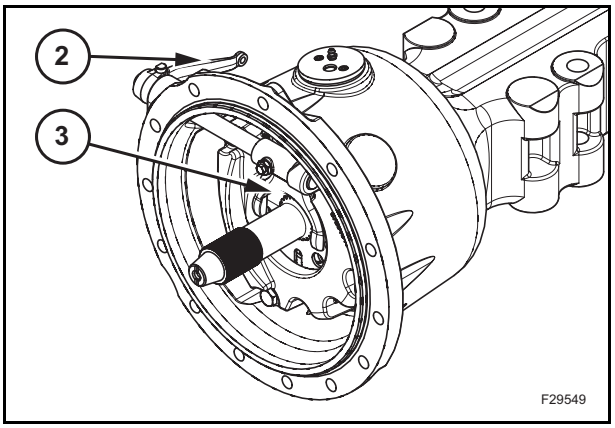
⚠ WARNING

Never use the differential lock at speeds above 8 km/h or when turning the machine. When engaged, the differential lock prevents the machine from turning: this could cause accidents.

In conditions inducing wheel slip, hold down the differential lock pedal (1) with your heel until the lock is felt to engage. The lock will automatically disengage when traction at the rear wheels equalizes. If a rear wheel spins at speed, reduce the engine speed to idle before engaging the differential lock to minimize shock loads on the rear axle.

When pedal (1) is pressed, a system of levers activates outer lever (2) that on its turn acts on bracket (3) locking the differential. By releasing pedal (1) the lever is also released and the differential is unlocked.

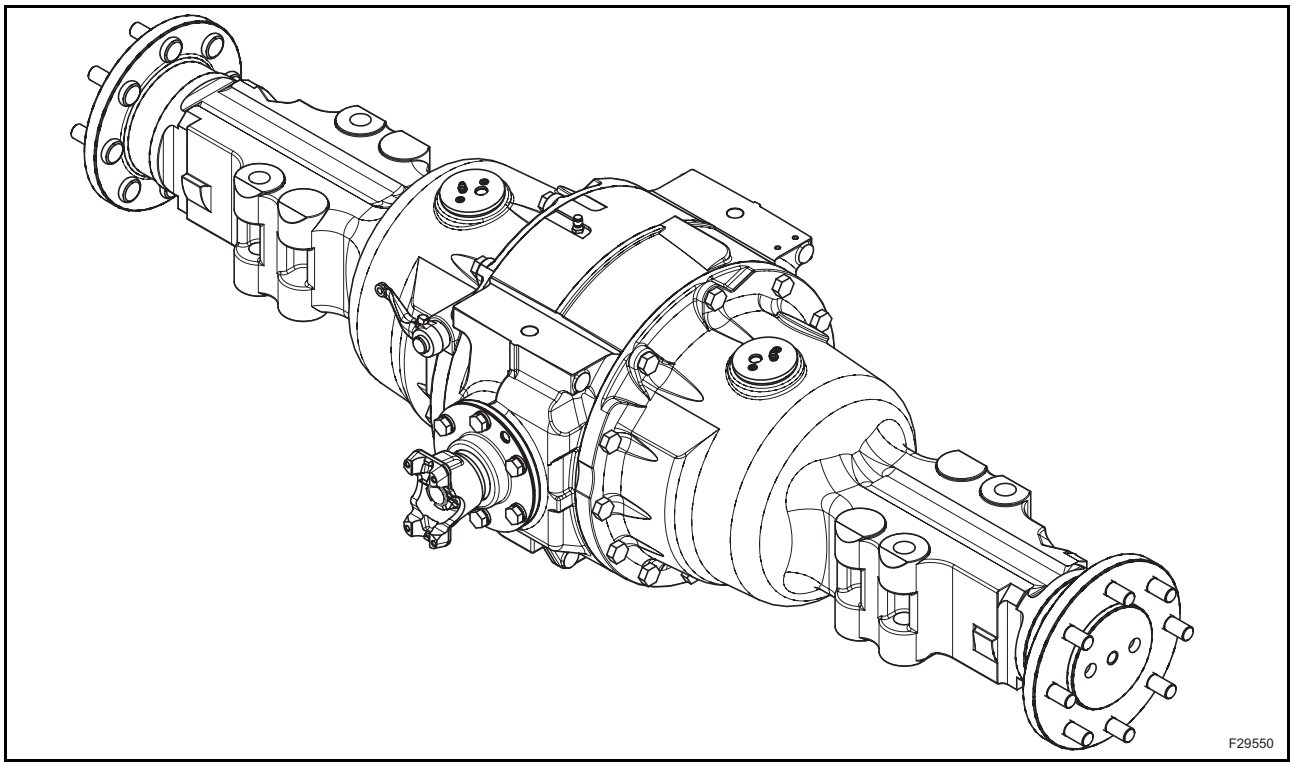




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1.2 SPECIFICATIONS



POWERSHIFT	POWERSHUTTLE	RATIO
/	•	4.62:1
•	/	4.11:1

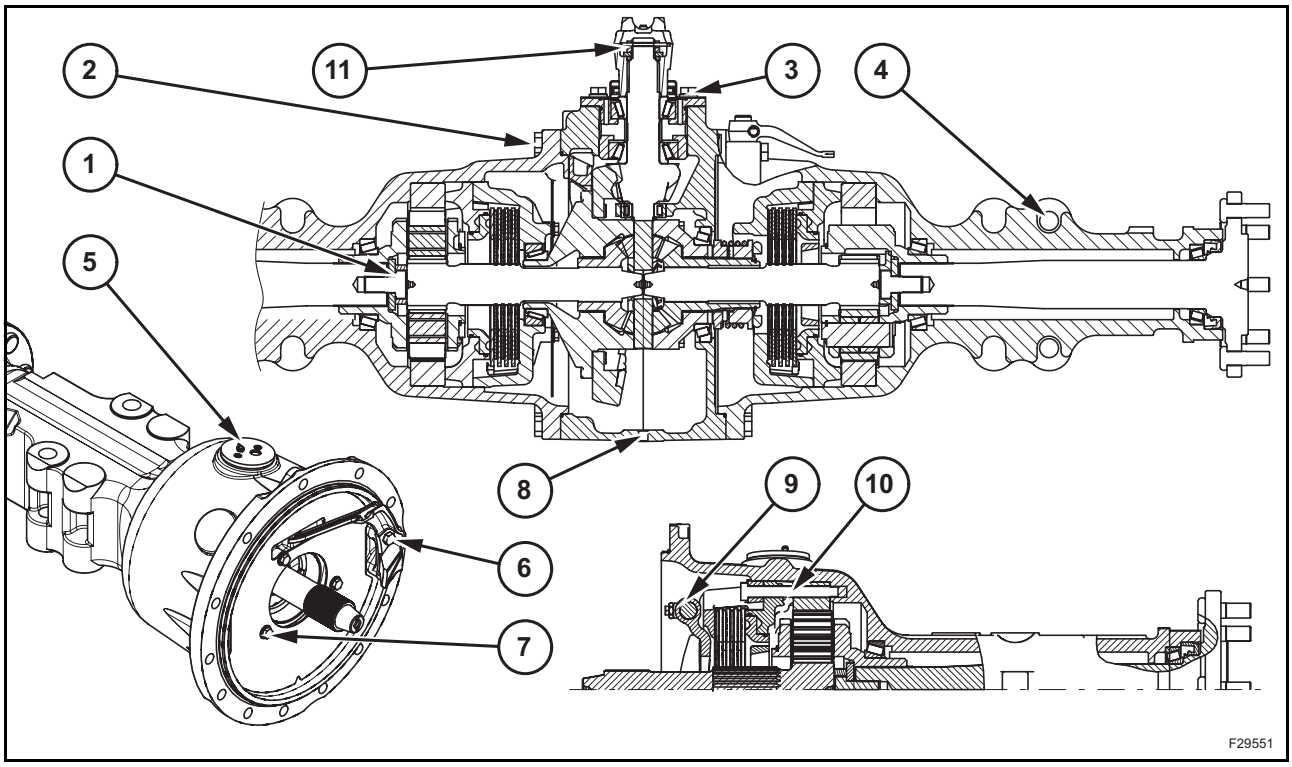
LUBRICATION

Oil capacity: 21.2 litres
Oil specification: Akcela Hy-Tran Ultra MAT3525 + AoA Axle oil additive (0.8 litres)

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MOUNTING SCREW TORQUE



1. Screw of half shaft: 554÷626 Nm
2. Screw of axle assy - rear RH or LH: 190÷231 Nm
3. Screw of front flange: 136÷170 Nm
4. Screw to fixed rear axle to the chassis: 800 Nm
5. Screw: 11÷14 Nm
6. Screw of block: 57÷76 Nm
7. Screw of baffle oil: 43÷51 Nm
8. Plug: 27÷34 Nm
9. Screw: 32÷41 Nm
10. Screw of housing rear brake: 204÷245 Nm
11. Right nut: 406 Nm

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1.3 DISASSEMBLY AND ASSEMBLY

REAR AXLE REMOVAL

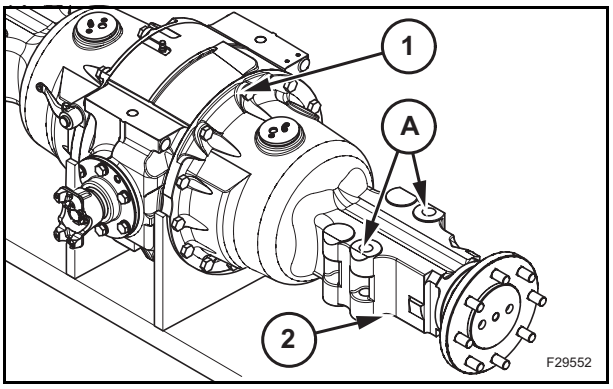
For servicing of any rear axle component the axle must be removed.
Prior to removal of the axle place a suitable clean container under the axle, capable of holding 21.2 litres and drain the oil from the plug at the base of the axle.
Disconnect the differential lock lever.
Gain access from the top of the rear axle, disconnect and drain the residual brake oil into a suitable clean container. Remove the pipes from both sides of the axle half shafts. Plug the brake pipes to prevent any dirt or contamination entering the brake system.
Remove the 4 attaching screws from the drive shaft coupling and remove from the axle.
Before removal of the axle make sure the machine is on level ground with the loader fully lowered and backhoe resting on the ground. The stabilizers must be lowered to the ground and the front wheels chocked.
Support the axle and remove the retaining screws, gently lower the axle to the ground.
Place the axle on a suitable stand to facilitate the repairs.

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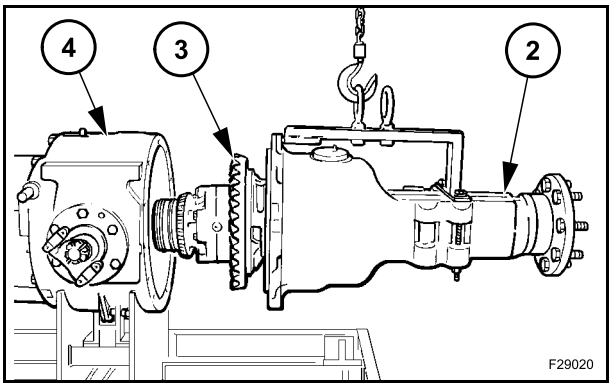
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DIFFERENTIAL REMOVAL

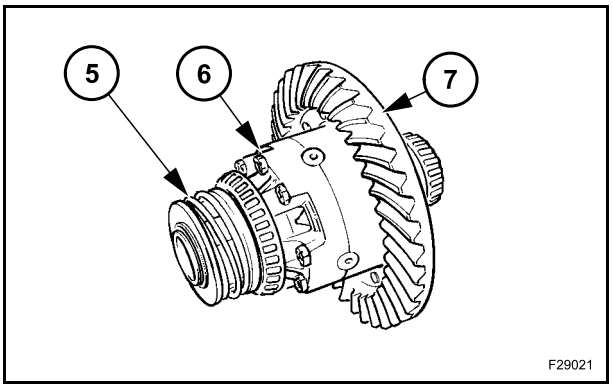
Unscrew the upper screw (1). Use the hole of this screw and holes (A) to install tool **380000990** for the lifting of half-beam housing (2).
Unscrew and remove the remaining screws (1).



Remove the left housing of the half-beam (2) with the differential (3) using the tool **380000990**, from the axle central body (4).



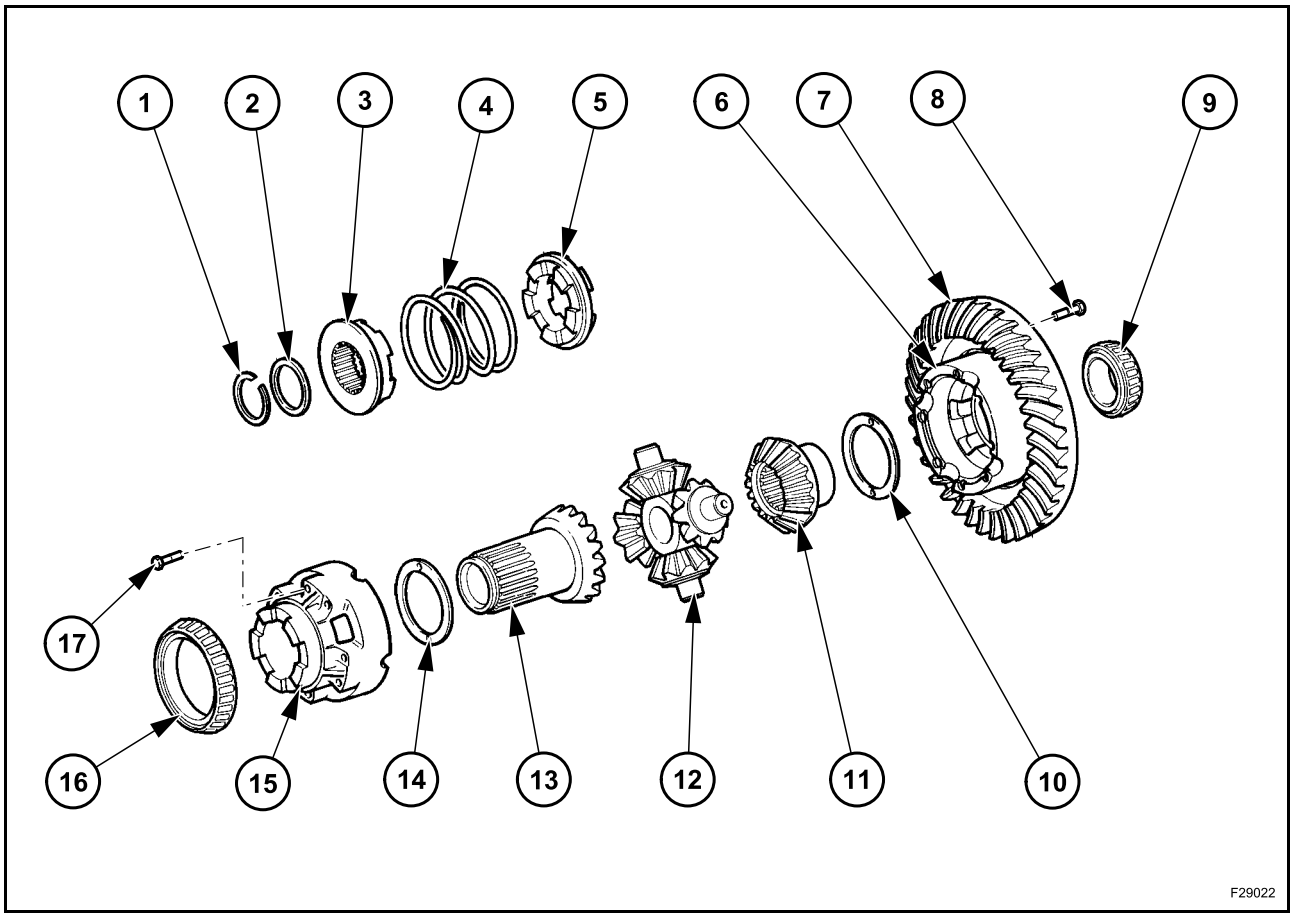
At this point it is possible to remove from the left housing of the half-beam the differential group assy.
The differential consists of:
• differential lock spring (5);
• differential housing (6);
• crown wheel (7).



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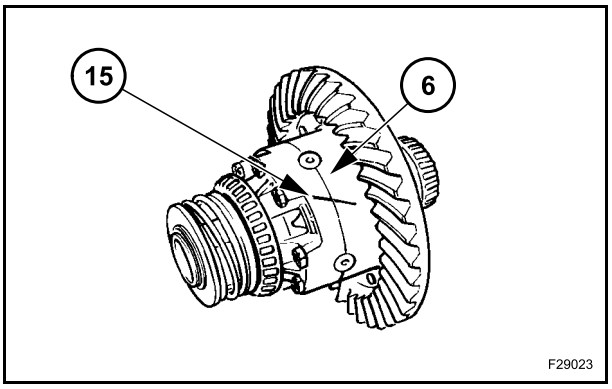
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DIFFERENTIAL DISASSEMBLY



1. Safety ring
2. Washer
3. Dog gear
4. Spring
5. Dog
6. Differential half housing
7. Crown wheel
8. Screw
9. Bearing
10. Thrust washer
11. Side gear
12. Spider assembly
13. Side gear
14. Thrust washer
15. Differential half housing
16. Bearing screw

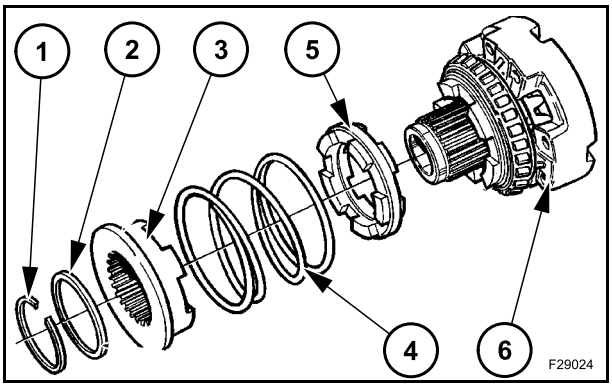
Prior to separating the differential, mark the two half housings (6) and (15) to ensure correct reassembly. Replace the differential lock coupling and adaptor if worn or damaged.



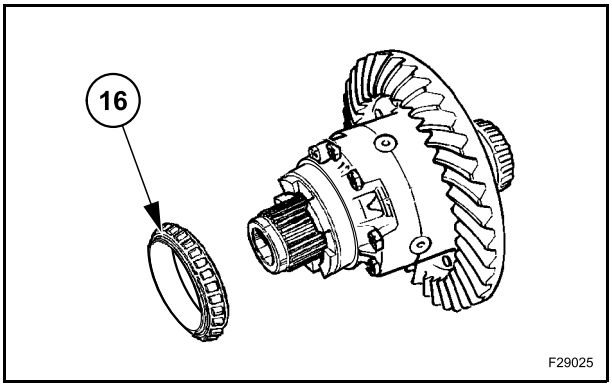
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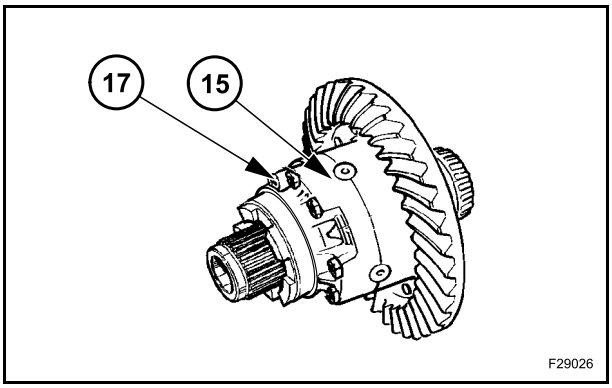
The differential lock can be disassembled by compressing the spring and carefully detaching the snap ring (1).
With the snap ring removed disassemble the: washer (2), outer dog (3), spring (4), inner dog (5) from the housing (6).
Carefully inspect all moving parts for signs of scoring, wear, or damage, if evident replace with new parts.



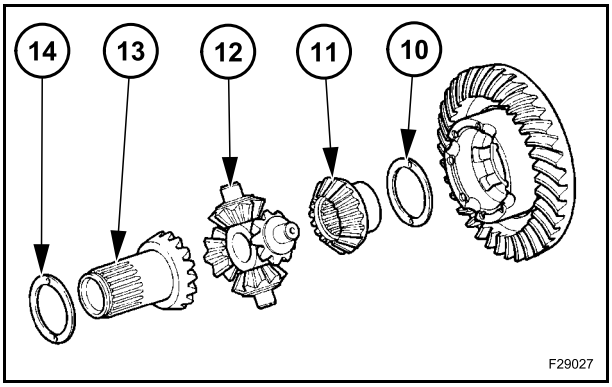
By means of an extractor remove the bearing (16).



Loosen and remove the screws (17). Disassemble the half-housing of differential (15).



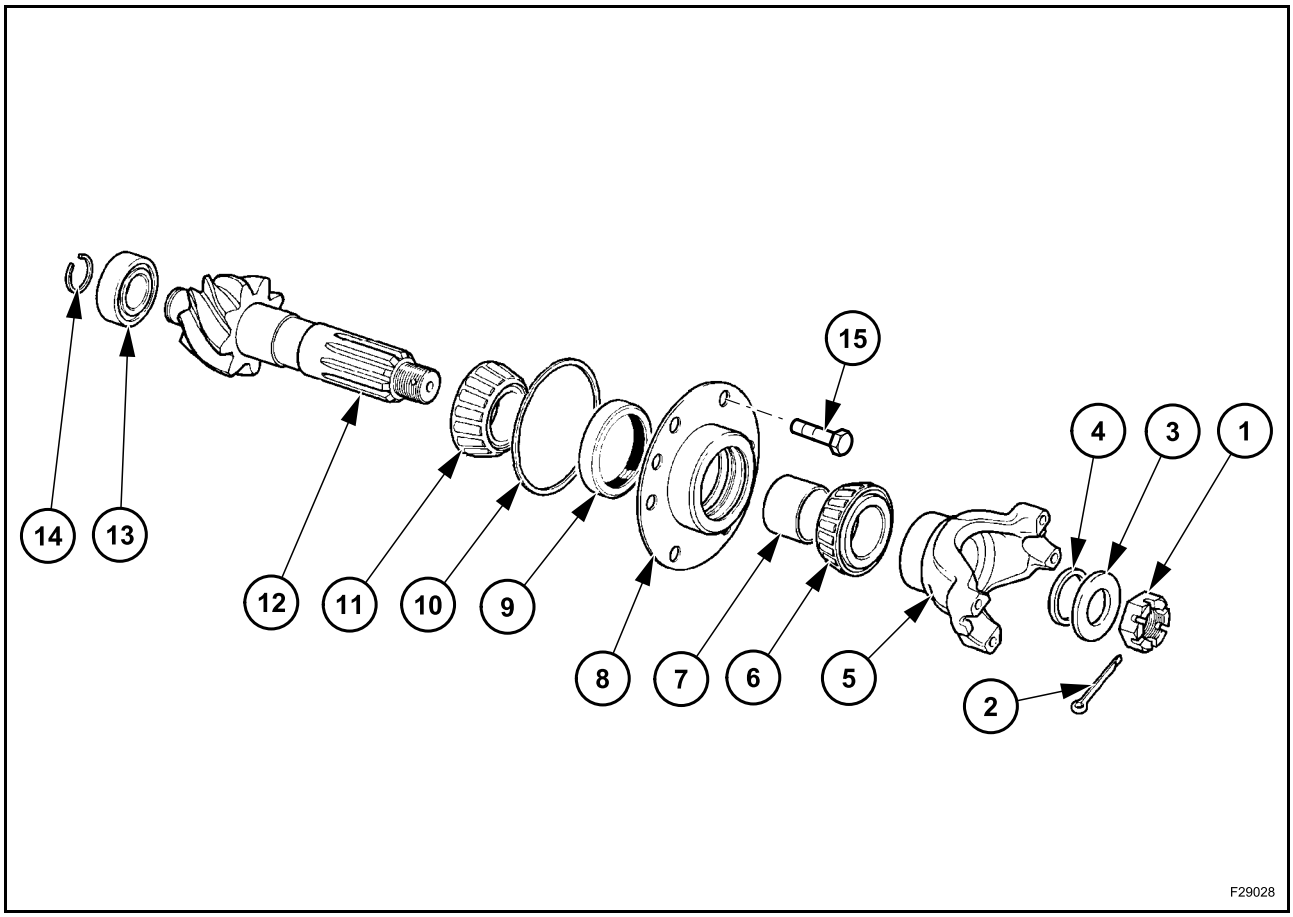
Now it is possible to remove the thrust washers (10) and (14), the gears (11) and (13) and the spider gears (12).



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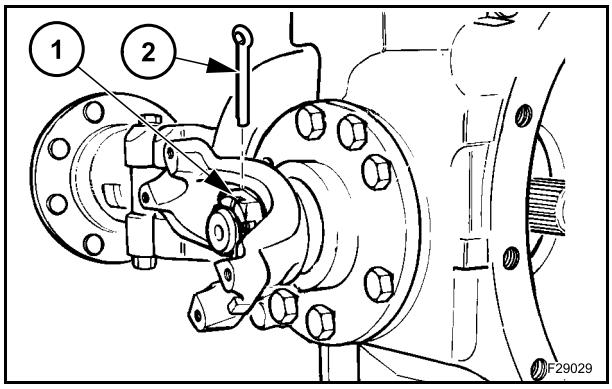
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PINION REMOVAL



1. Ring nut
2. Lock pin
3. Washer
4. Seal
5. Coupling
6. Bearing
7. Spacer
8. Flange
9. Disc
10. Seal
11. Bearing
12. Pinion
13. Bearing
14. Safety ring
15. Screw

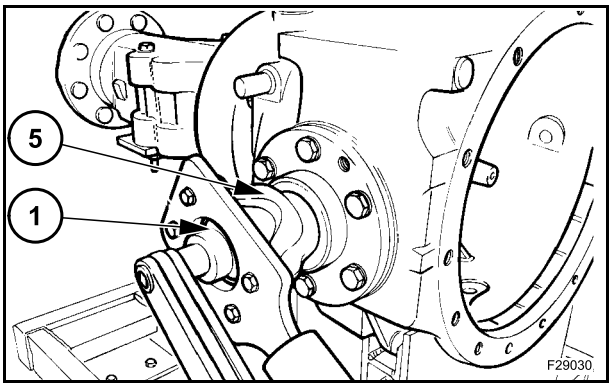
Remove the lock pin (2) to unlock the ring nut (1).



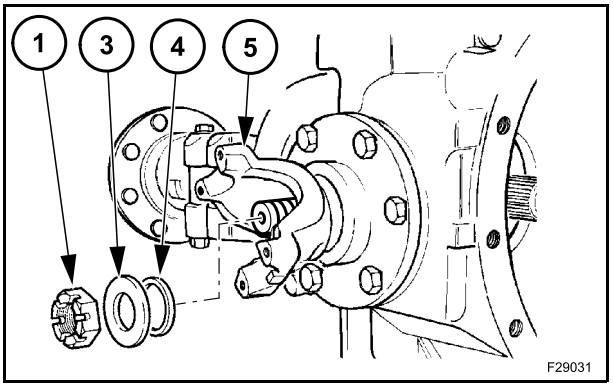
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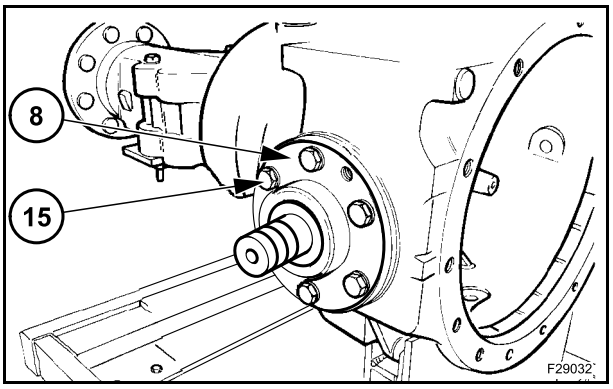
Using the special tool **380002675** hold the coupling (5) steady while loosening the ring nut (1).



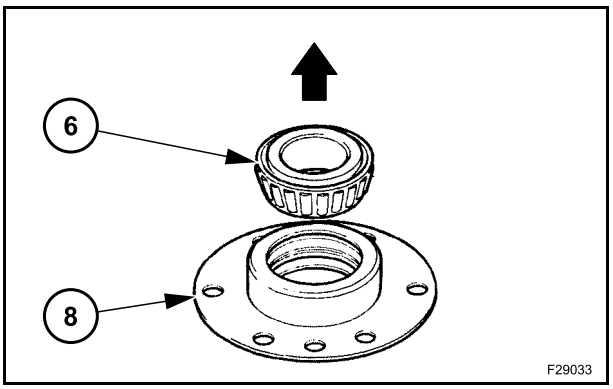
Remove the ring nut (1), the washer (3) and the gasket (4).
Remove the coupling (5).



Loosen and remove the screws (15).
Remove flange (8).



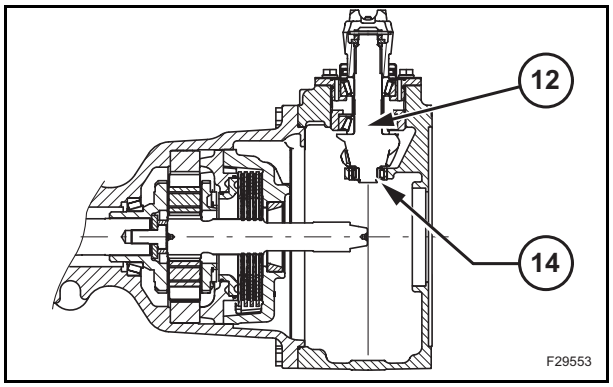
Remove the bearing (6) from the flange (8).



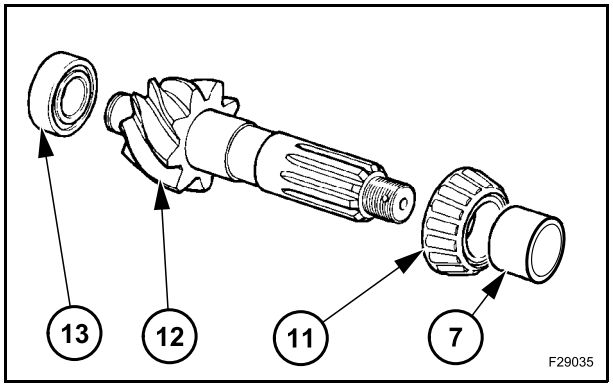
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Remove the snap ring (14) from the axle inner central body.
Using an rubber hammer, take out the pinion (12).



Remove from the pinion (12), the spacer (7) and by means of extractors, the bearings (11) and (13).

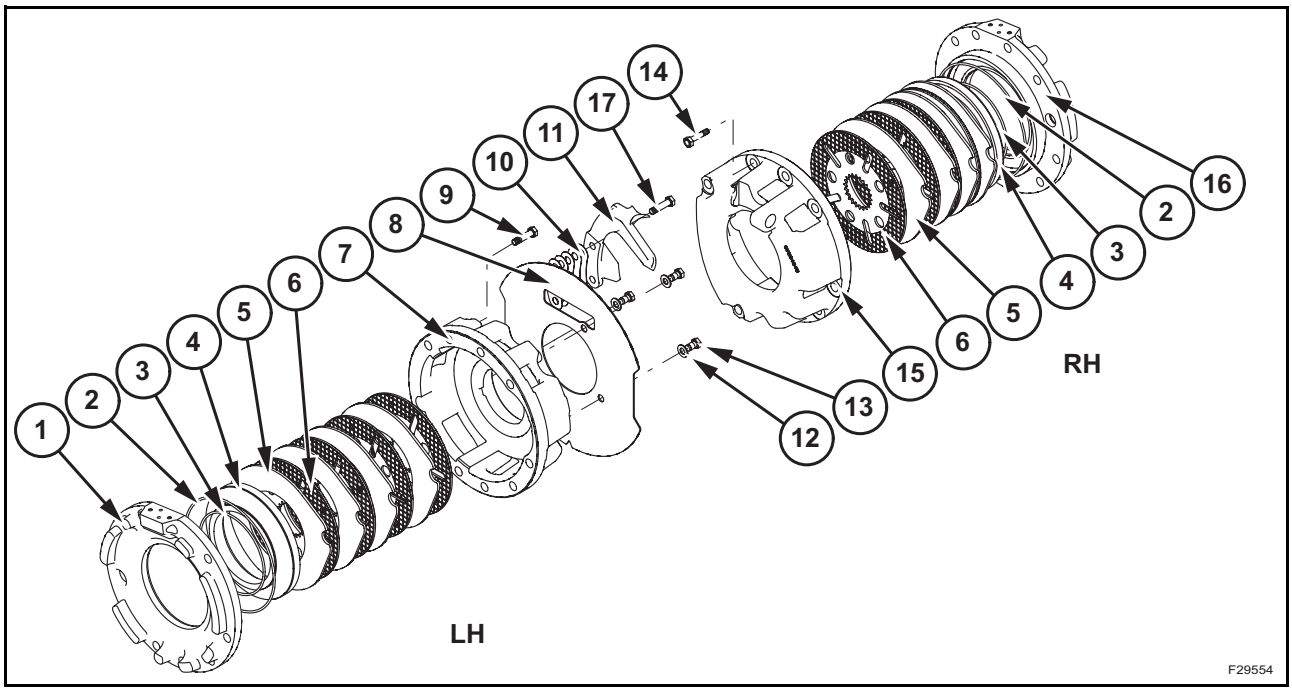


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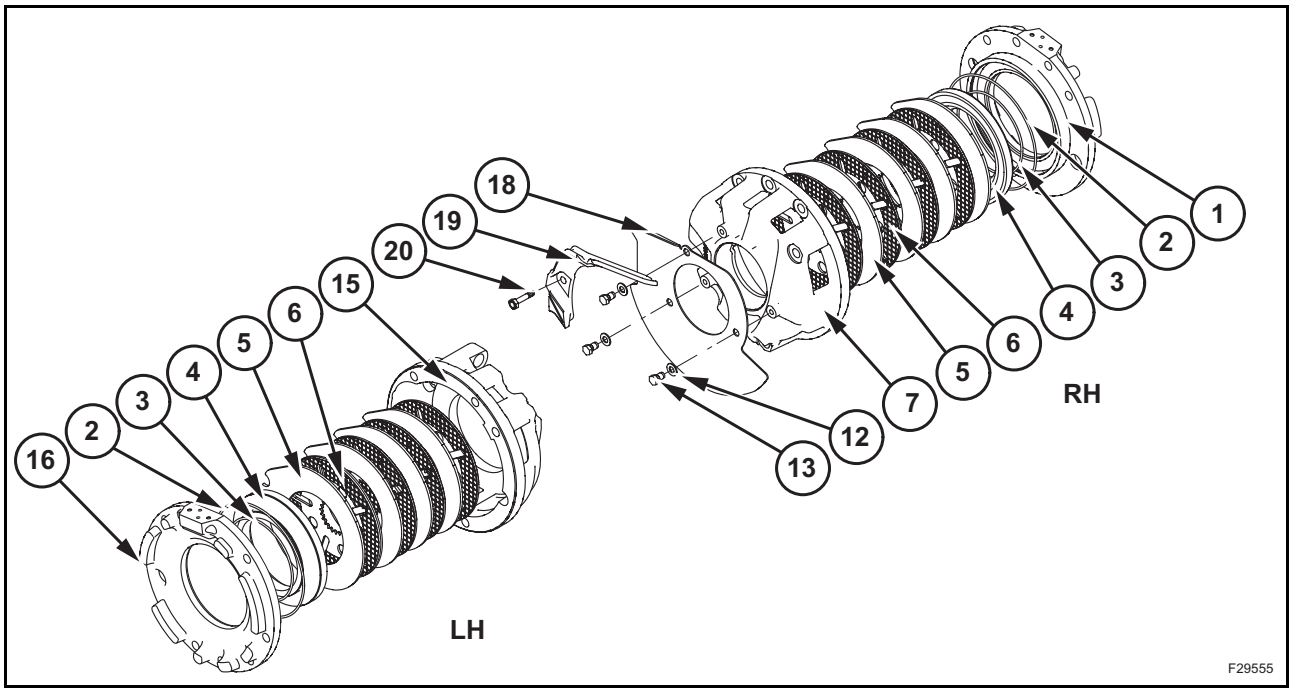
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BRAKE GROUP DISASSEMBLY

Powershuttle



Powershift

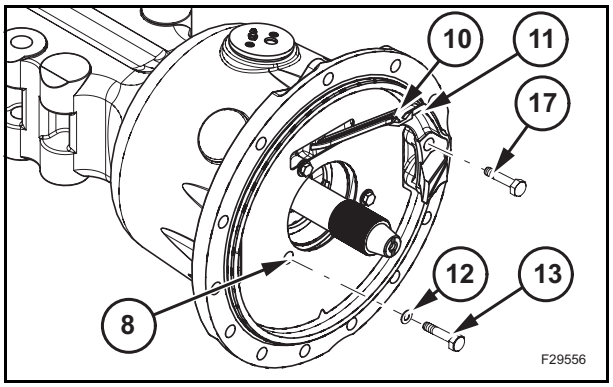


1. Housing brake outer
2. O-ring
3. O-ring
4. Piston brake
5. Disc brake intermediate
6. Disc brake
7. Housing brake inner
8. Baffle oil (powershuttle)
9. Screw
10. Shim
11. Block (powershuttle)
12. Washer
13. Screw
14. Screw
15. Housing brake inner
16. Housing brake outer
17. Screw
18. Baffle oil (powershift)
19. Block (powershift)
20. Screw

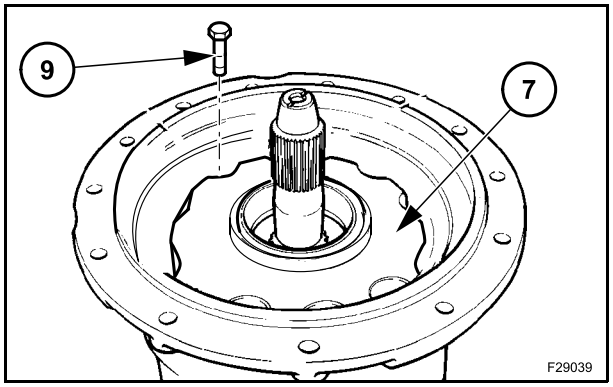
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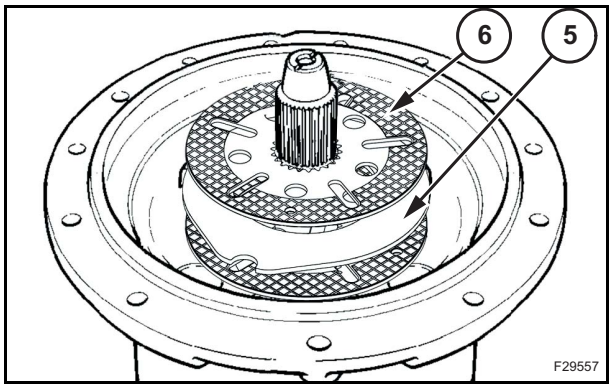
Unscrew and remove the screws (17) then disassemble the block (11) with the shims (10).



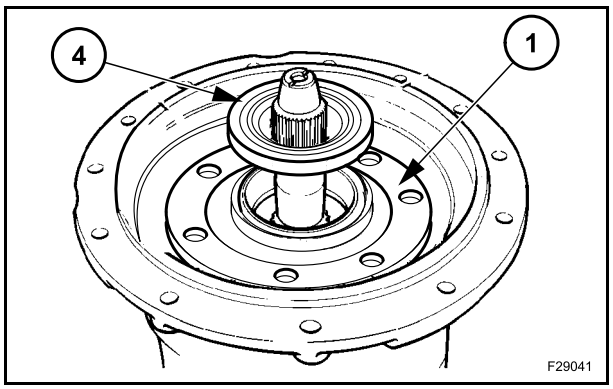
Loosen and remove the screws (9). Remove the housing brake inner (7).



Remove the brake pads (6) and the intermediate disks (5).



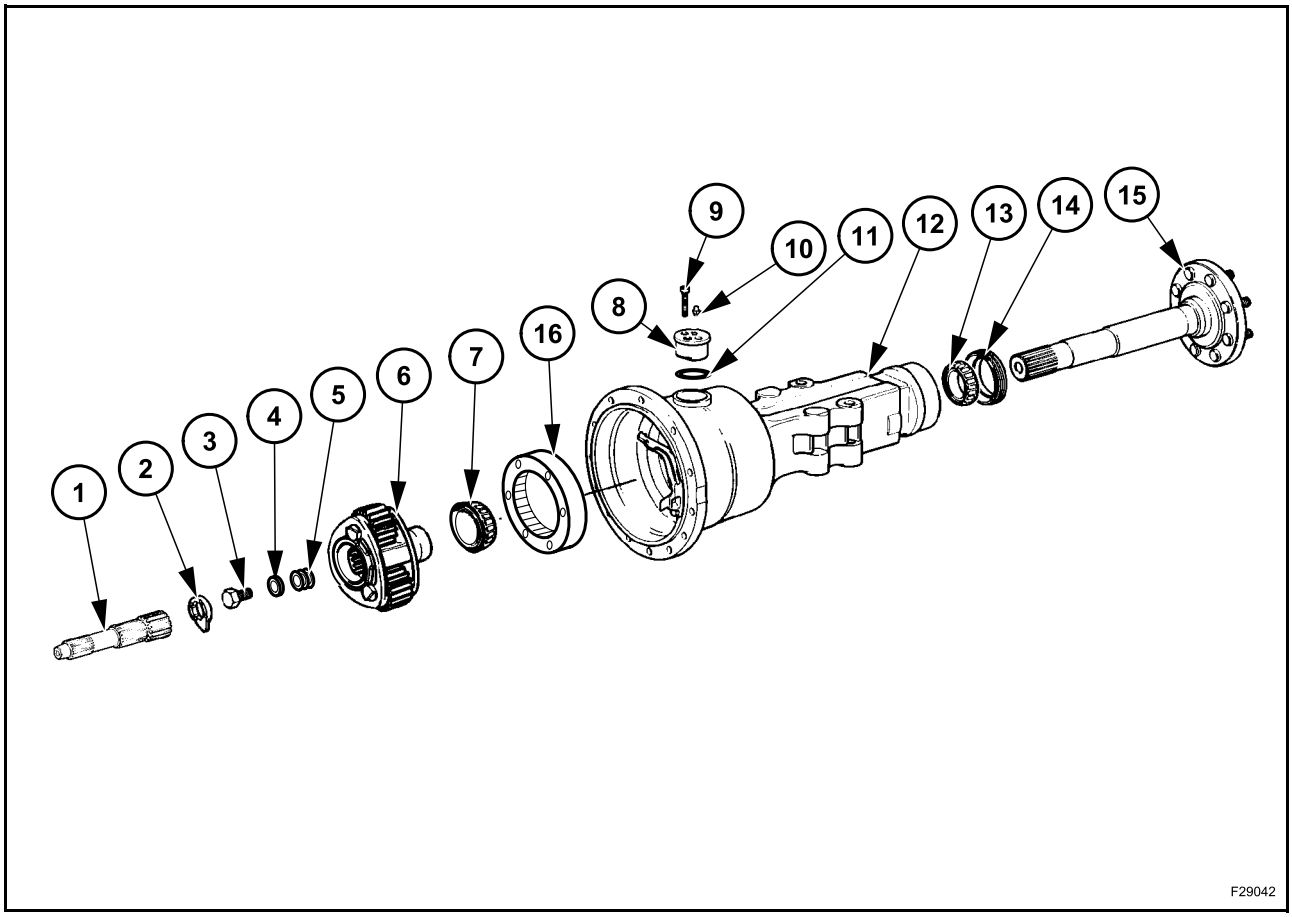
Remove the brake piston (4) and the outer housing brake (1).



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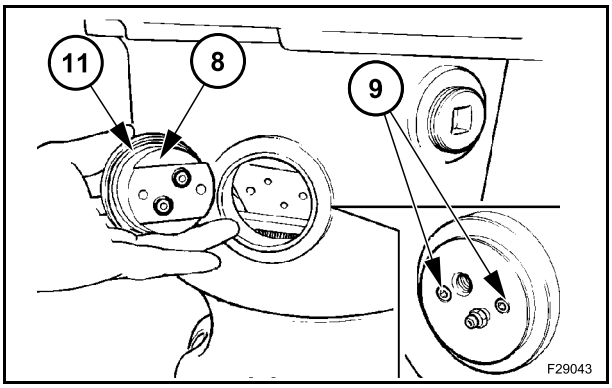
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AXLE SHAFT ASSY RIGHT AND LEFT DISASSEMBLY



1. Sun gear
2. Retainer
3. Screw
4. Washer
5. Shim
6. Gear carrier
7. Bearing
8. Manifold brake tube
9. Screw
10. Screw bleeder
11. O-ring
12. Axle housing assy right or left
13. Bearing
14. Seal
15. Shaft with wheel hub
16. Ring gear

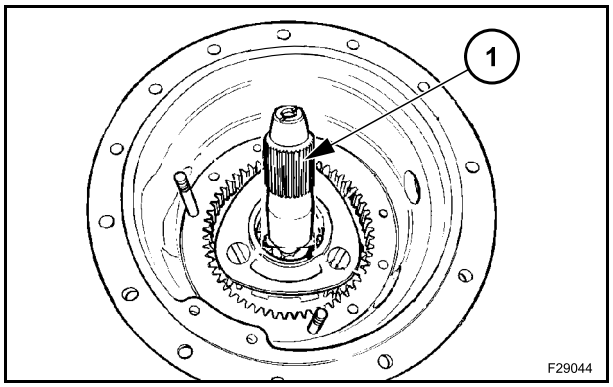
The brake manifold (8) can be removed by loosening and removal of the screws (9). Before reassembly fit a new O-ring (11). On reassembly torque the attaching screws to 11 - 14 Nm.



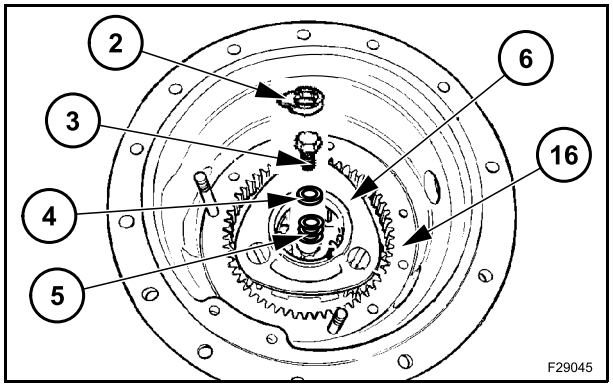
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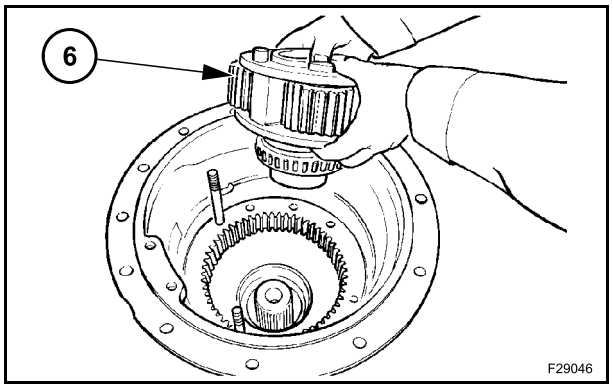
Remove the sun gear (1).



To remove the gear carrier assy (6) from the support (16), remove the retainer (2), the retaining screws (3), the washer (4) and the shim (5).

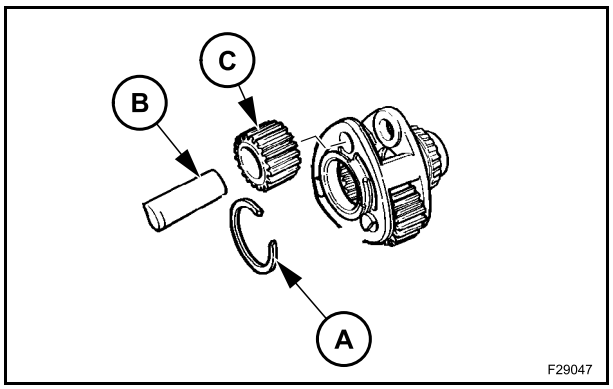


Remove the gear carrier assy (6).



If necessary, it is possible to disassemble the gear carrier assy:

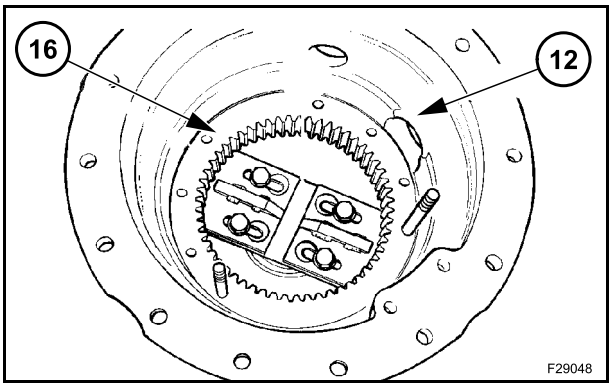
- Remove the retaining ring (A).
- Extract the gear pins (B) and remove the gears (C).



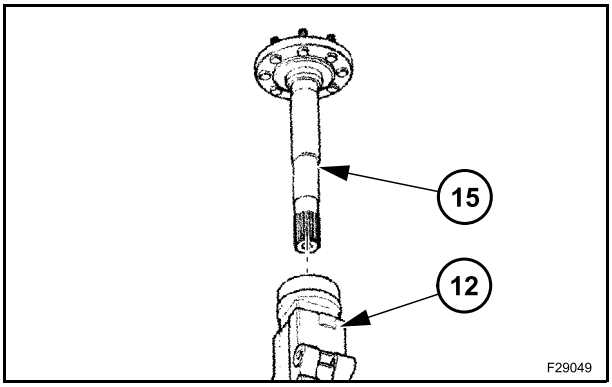
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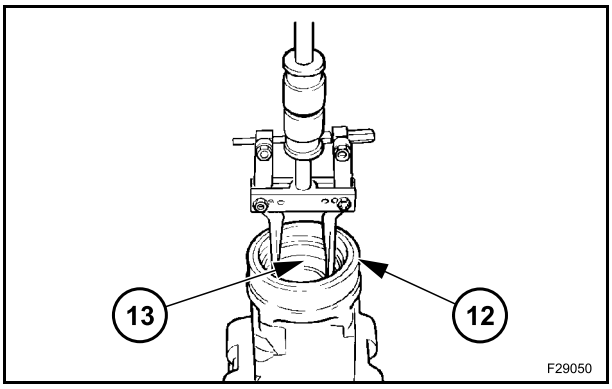
The ring gear (16) can be removed from the axle (12) with the aid of tool **380000816**. Position the tool beneath the ring gear, expand the plates and tighten the screws. Invert the axle and press out the gear from the wheel hub side.
Inspect the gear for wear, scoring or damage and repair or replace.



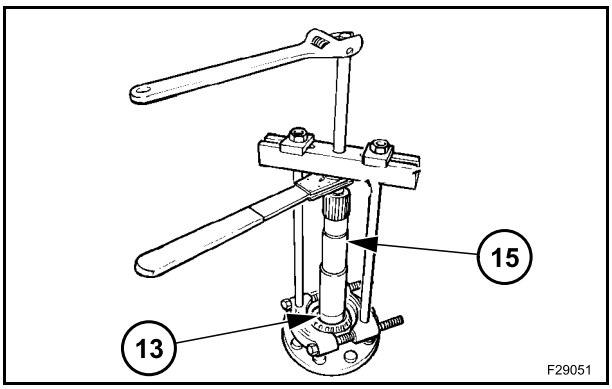
Position the axle housing (12) to allow removal of the shaft with wheel hub (15).



Using the puller tool **380000986** and the slide hammer **380000987**, remove the bearing cups (13) from the axle housing (12).



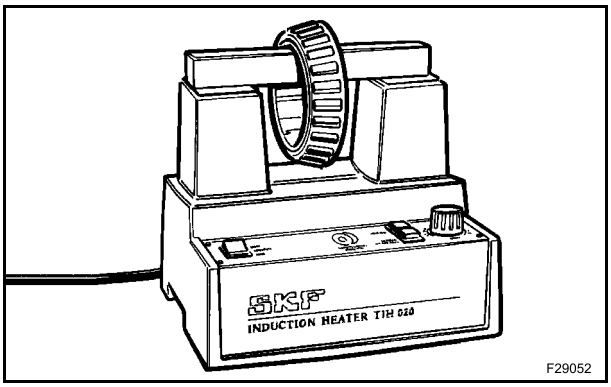
By means of extractor **380002676** remove the bearing (13) from the axle shaft (15).
Applying gradual pressure to the tool, the bearing will separate from the half axle.
Inspect the bearing for wear, scoring or damage and replace if in any doubt.



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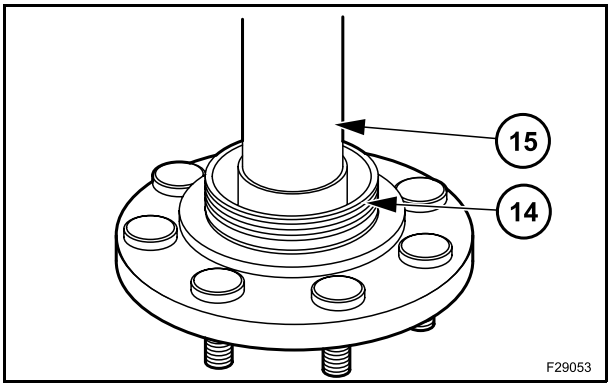
Reassembly of the bearing is the reverse procedure. Using an induction heater, heat the bearing sufficiently to expand it enough to allow it to easily seat onto the half shaft.



IMPORTANT:

After bearing removal, disassemble the seal (14) from the shaft with wheel hub (15).

NOTE: always fit a new axle seal if the axle bearing is removed for any reason.



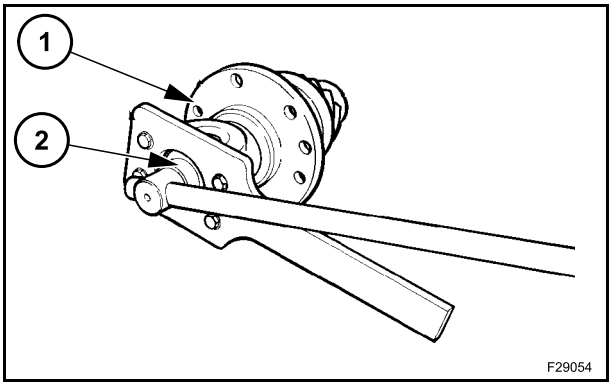
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MEASUREMENTS AND ADJUSTMENTS

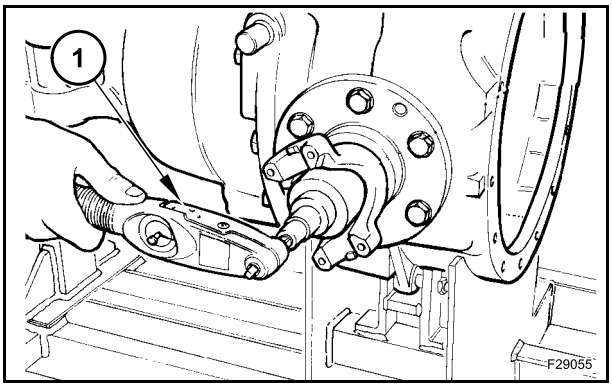
PRELOAD OF PINION BEARING

The pinion bearing preload is set by selecting the correct shim (spacer) which is placed between the bearings.
Reassemble the pinion assembly, attach the fabricated spanner **380002675** to the flange (1) and torque to 406 Nm with spanner to the locknut (2).



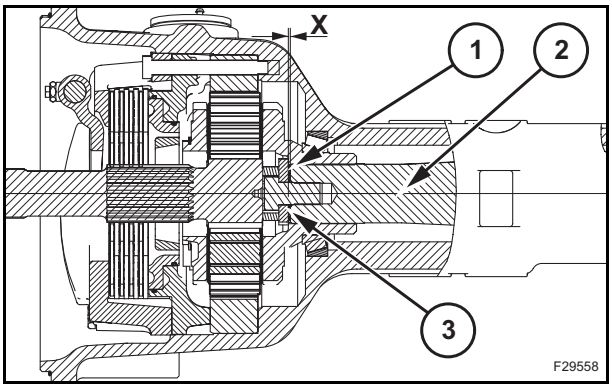
MEASURING OF PINION ROLLING TORQUE

Use a torque metre (1) to check rolling resistance when the assembly is fitted back into the axle.
The rolling resistance should be: 1.3 Nm. Leave pinion retainer screws loose for this check.
If under specification, fit a smaller shim. If over specification, fit a larger shim.



AXLE SHAFT BEARING PRELOAD

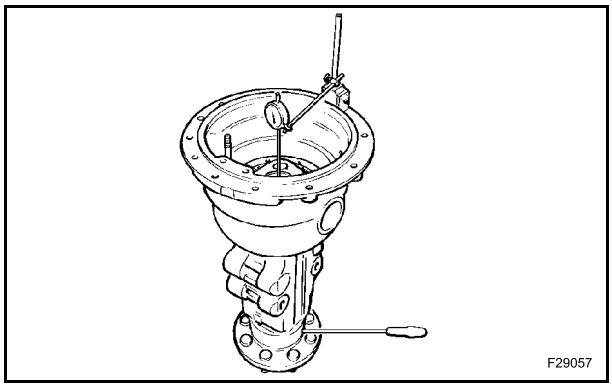
The preload of the axle shaft bearing is realized by placing the shims (1) between axle shaft (2) and washer (3) as many as necessary to achieve value **X**.



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The procedure to determine value X occurs in the following manner:
- install the largest shim (for instance 2.286 mm);
- position the gear assy;
- screw and tighten screw at 554÷626 Nm;
- by means of a dial gauge, find out the axle backlash (for instance 0.562 mm);
- subtract endfloat from shim already fitted, for example 2.286 - 0.562 mm = 1.724 mm.
  The “Resultant value” is obtained.
- starting from the “Resultant value”, refer to the table for the correct shim to replace the 2.286 one.



IMPORTANT: increasing shim thickness will reduce preload. Decreasing shim thickness will increase preload.

- fit selected shim and re-tighten retained screw to correct torque and allow lock plate to locate.

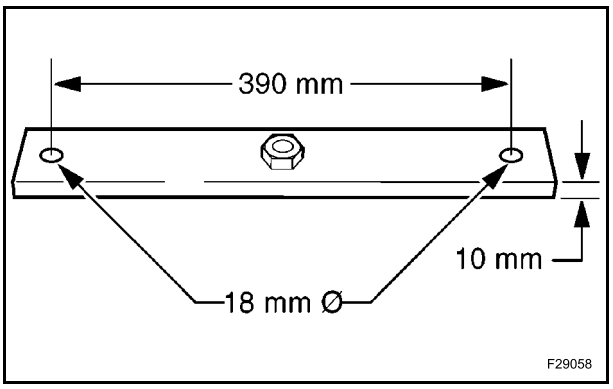
RESULTANT VALUE	SHIM TO BE INSTALLED
1.245 - 1.270 mm	81803491
1.346 - 1.372 mm	81803502
1.448 - 1.473 mm	81803503
1.549 - 1.575 mm	81803504
1.651 - 1.676 mm	81803505
1.753 - 1.778 mm	81803506
1.854 - 1.880 mm	81803507
1.956 - 1.981 mm	81803508
2.057 - 2.083 mm	81803509
2.159 - 2.184 mm	81803510
2.261 - 2.286 mm	81803511

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MEASURING OF AXLE SHAFT ROLLING TORQUE

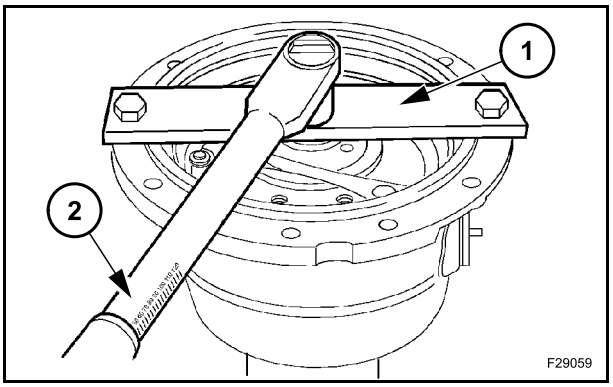
After fitting the correct shim to set the preload: manufacture a bridging bar to span opposing screw holes to the dimensions shown.



Fit bridging bar (1) across the rear axle housing flange and use a torque metre (2) to check rolling resistance which should be 2.3 - 10 Nm.

NOTE: the brake housing, brake pads and sun gear should not be installed but all bearings well lubricated.

If out of specification the shim should be adjusted and rolling resistance rechecked.

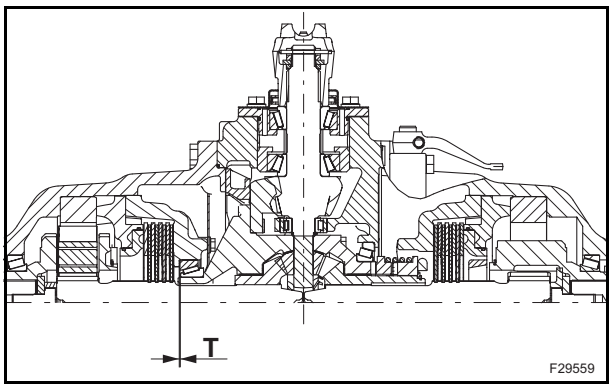


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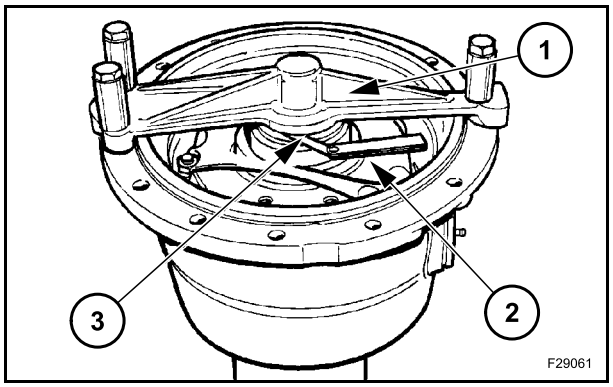
DIFFERENTIAL BEARING PRELOAD

This adjustment is made by shimming the right hand differential bearing cone.
The value of following shimming is required: dimension "**T**".



VALUE "T" mm	SHIMS
0.034 ÷ 0.039	81803515
0.040 ÷ 0.045	81803516
0.046 ÷ 0.051	81803517
0.052 ÷ 0.057	81803518
0.058 ÷ 0.063	81803519
0.064 ÷ 0.069	81803520
0.070 ÷ 0.075	81803521
0.076 ÷ 0.081	81803522

Remove the differential bearing cone and shim from the outer brake housing.
Place the gauge ring of tool **380000991** (1) into the vacant bearing location.
Screw bridge tool **380000991** (1) across the rear axle housing flange with spacers (2) located between the axle housing flange and the tool.
Measure the gap between the bridge tool and the gauge ring using a feeler gauge (3).
Refer to the table to determine the correct size shim which should be installed between the brake housing and bearing cone, thus preloading the bearing back to specifications.

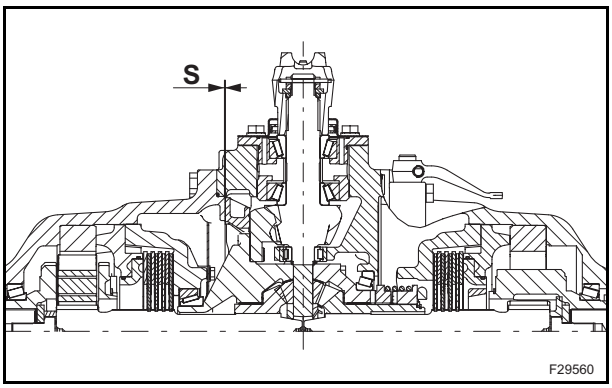


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MEASURING OF RANGE BETWEEN THE FACE THRUST BLOCK AND THE BACK FACE OF DIFFERENTIAL

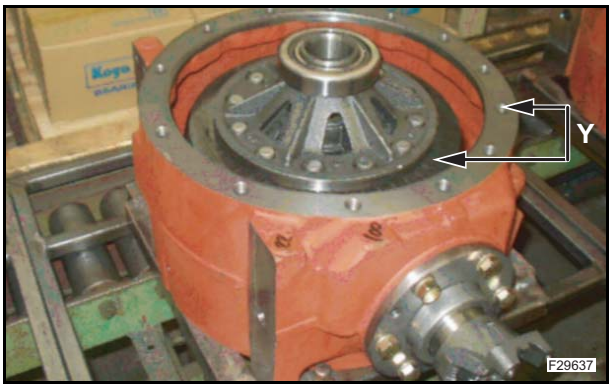
For dimensions "**S**" outside normal gap range use as required the minimum number of shims to provide design gap of 0.10 - 0.20 mm.



VALUE "S" mm	SHIMS
0.80 ÷ 0.89	87346232 + 87346228
0.90 ÷ 0.99	87346232 + 87346231
1.00 ÷ 1.10	87346232 + 87346427

This procedure has the goal to get a clearance of 0.10 mm to 0.20 mm between the thrust face of the thrust block and the back face of the differential bevel gear.
To get this setting we perform two measurements to calculate the shim pack to be used.

- On the centre housing, with the differential assy installed and centered, we check the distance from the back of the bevel gear to the trumpet mounting face. During this measurement rotation of the differential is needed to get the shortest reading. This is to take the run-out of the back face in calculation thus to avoid interference afterwards (dimension **Y**).
  Y: dimension from back of differential bevel gear to trumpet mounting face.



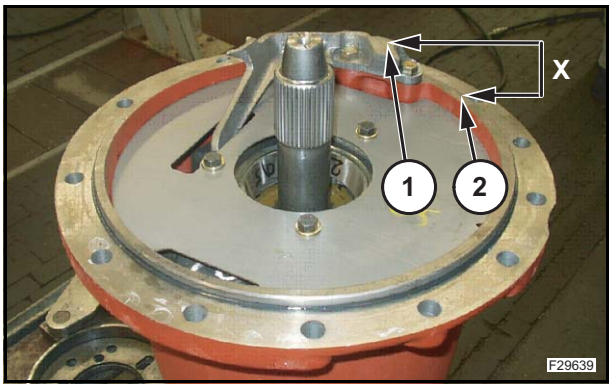
A: gauge clamped on housing and differential aligned to check the dimension "**Y**".



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- Assemble the thrust block to the trumpet housing (NO SHIMS mounted in between the parts!). Check the distance from the thrust face of the thrust block (1) to the centre housing mounting face of the trumpet housing (2) (dimension **X**).



B: gauge on trumpet housing.



S= Y-X will give you the minimum gap between the thrust block and the back of the differential bevel gear. Based on this calculation and the attached shimming chart people find the shims to be used. Shim pack thickness to be checked prior installation. Disassemble the thrust block, fit the shim pack in between the thrust block and the trumpet housing and reassemble thrust block again.

Check free rotation of axle input on the completed axle sub-group.

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1.4 FAULT FINDING

PROBLEM	CAUSE	CORRECTION
Differential lock not engaging (mechanical differential lock)	External linkage damaged or broken	Replace/repair as required.
	Internal linkage, cross shaft rod, fork or pivot shaft damaged/ broken	Remove and inspect.
	Damaged or broken teeth on differential lock adaptor or coupling	Remove differential and inspect differential lock assembly.
Differential lock not disengaged (mechanical differential lock)	Spring broken between adaptor and coupling	Remove differential and replace spring.
	Teeth of adaptor or coupling damaged/burred	Remove differential and replace damaged parts.
Differential lock not engaging (electrical differential lock)	Internal linkage, cross shaft rod, fork or pivot shaft damaged/ broken	Remove, inspect and repair.
	Damaged or broken teeth on differential lock adaptor or coupling	Remove differential and inspect differential lock assembly.
	Solenoid valve sticking not operating	Replace/repair as required.
	Solenoid valve electrical connection poor or coil not energizing	Replace/repair as required.
Differential lock not disengaged (electrical differential lock)	Spring broken between adaptor and coupling	Remove differential and replace spring.
	Teeth of adaptor or coupling damaged/burred	Remove differential and replace damaged parts.
	Internal linkage, cross shaft rod, fork or pivot shaft damaged/ broken	Remove and inspect.
	Damaged or broken teeth on differential lock adaptor or coupling	Remove differential and inspect differential lock assembly.
	Solenoid valve electrical connection poor or coil not energizing	Replace/repair as required.

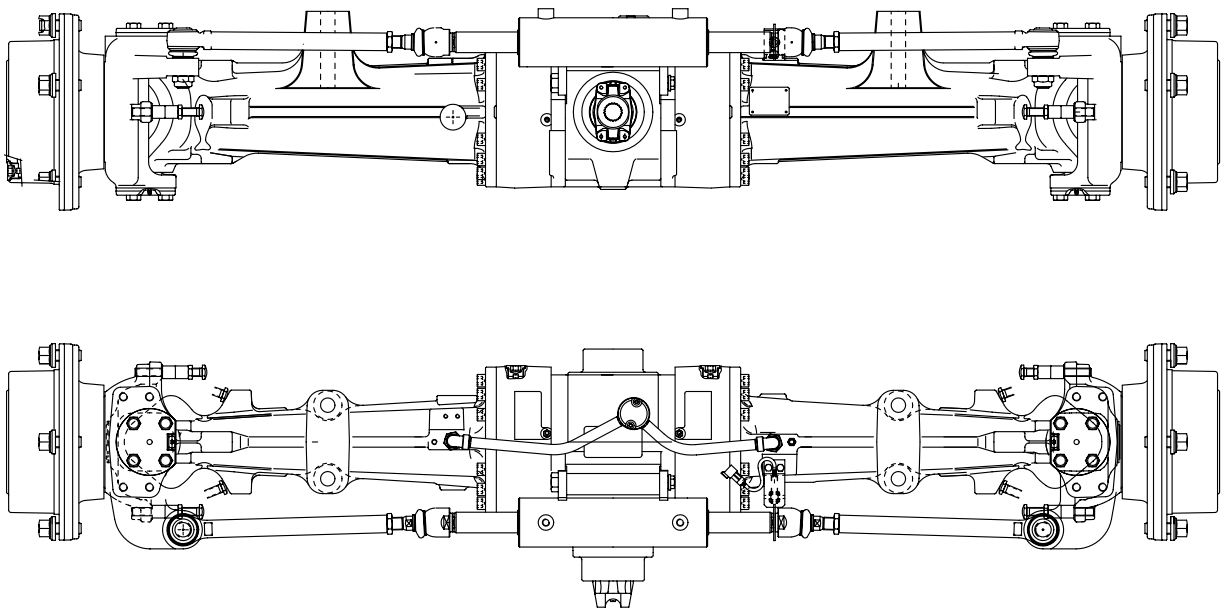
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2. REAR AXLE 4WS “CARRARO”

2.1 SPECIFICATIONS

Rear steering axle, model 26.32M



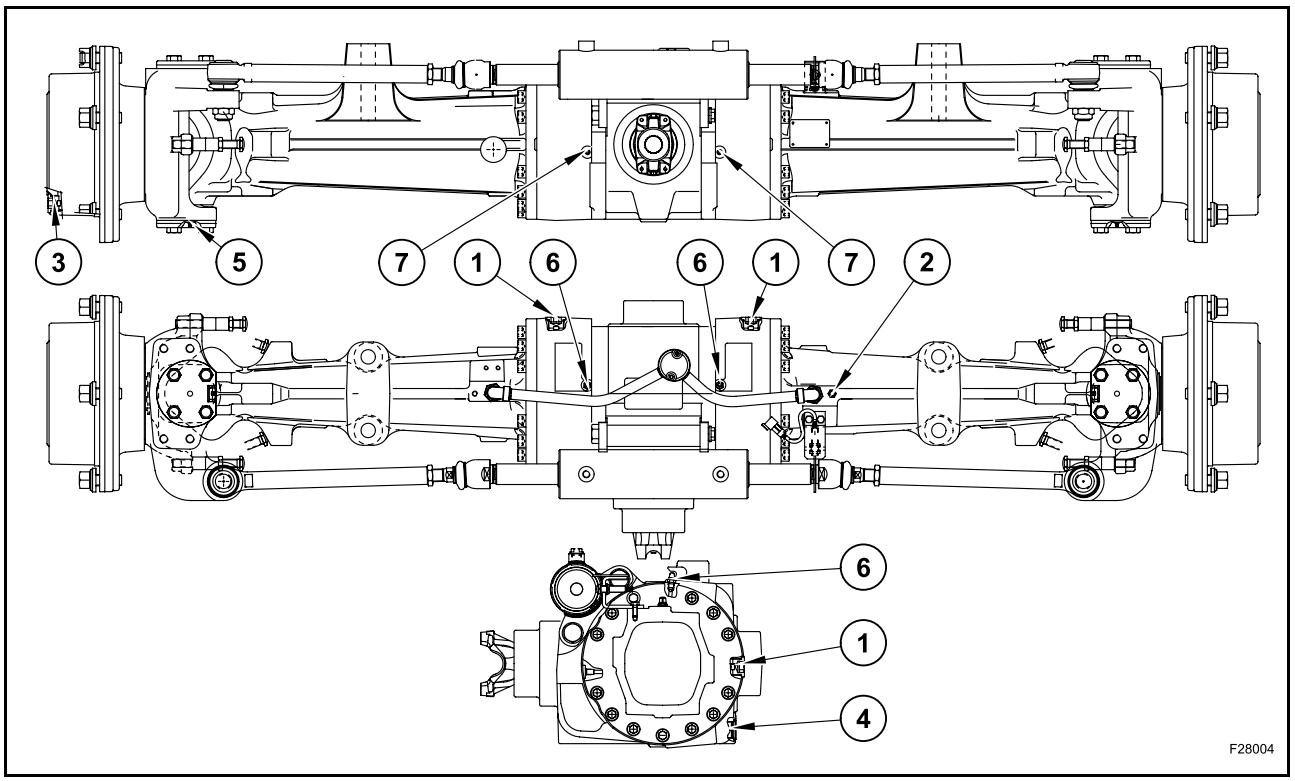
POWERSHIFT	SELF LOCKING	RATIO
•	•	19,038

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LUBRICATION AND GREASING

Differential oil capacity	11 litres
Reduction gear oil capacity, on each side	1.3 litres
Oil specification: use recommended oil enriched in additives Note: do not use synthetic or vegetable oil without consent of the axle manufacturer	Akcela Nexplore MAT3525

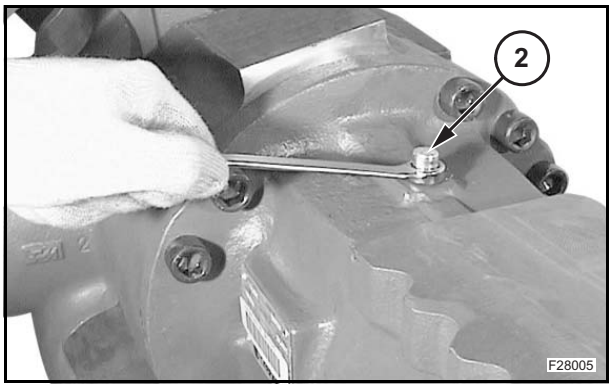


DESCRIPTION	POSITION
Level and fill plug for differential oil	1
Air breather	2
Level, fill and drain plug for reduction gear oil	3
Differential oil drain plug	4
Greasing points	5
Brake bleed plug	6
Service brake oil inlet	7

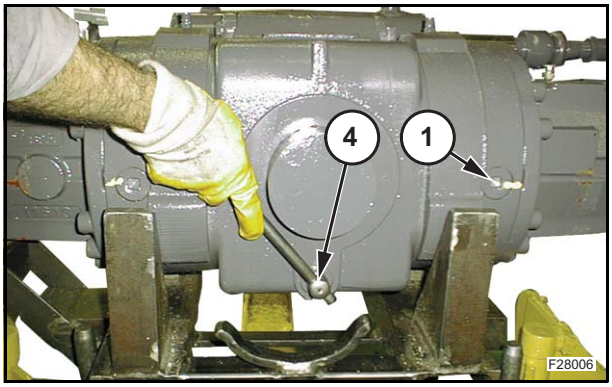
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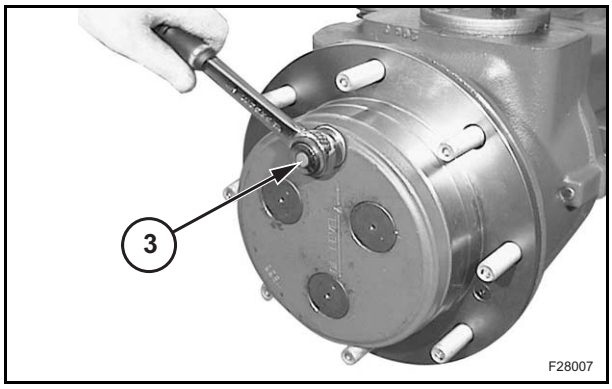
Before draining the oil, loosen the oil breather (2) to release possible internal pressure, then tighten the plug to the requested torque.



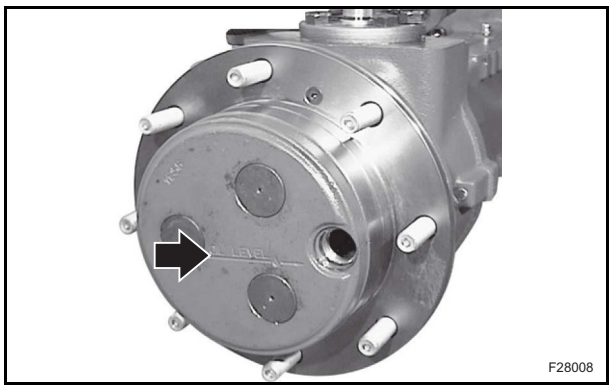
To drain the oil from the central body unscrew the plug of the draining hole (4) and level hole (1).
Then tighten them to the specified torque.



Before draining the oil, position the wheel hub so that the filler cap is in the highest point, then loosen the plug (3) to release possible internal pressure.



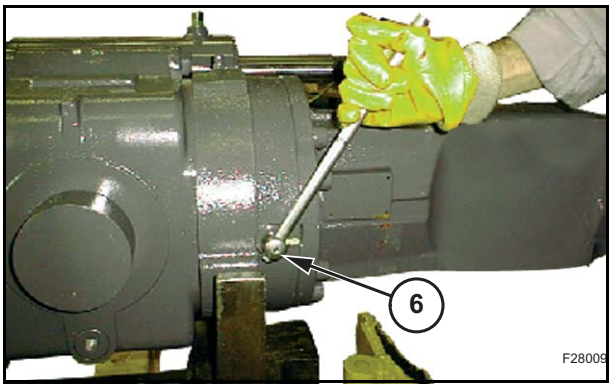
Position the wheel hub so that the filler cap is on the centre line of the horizontal axis.
Check oil level and top up if necessary.
Tighten the plug with a torque wrench to the prescribed torque.



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Before draining the oil, loosen the breather (6) to release possible internal pressure.
Check oil level and top up if necessary.
Tighten the plug with a torque wrench to the prescribed torque.

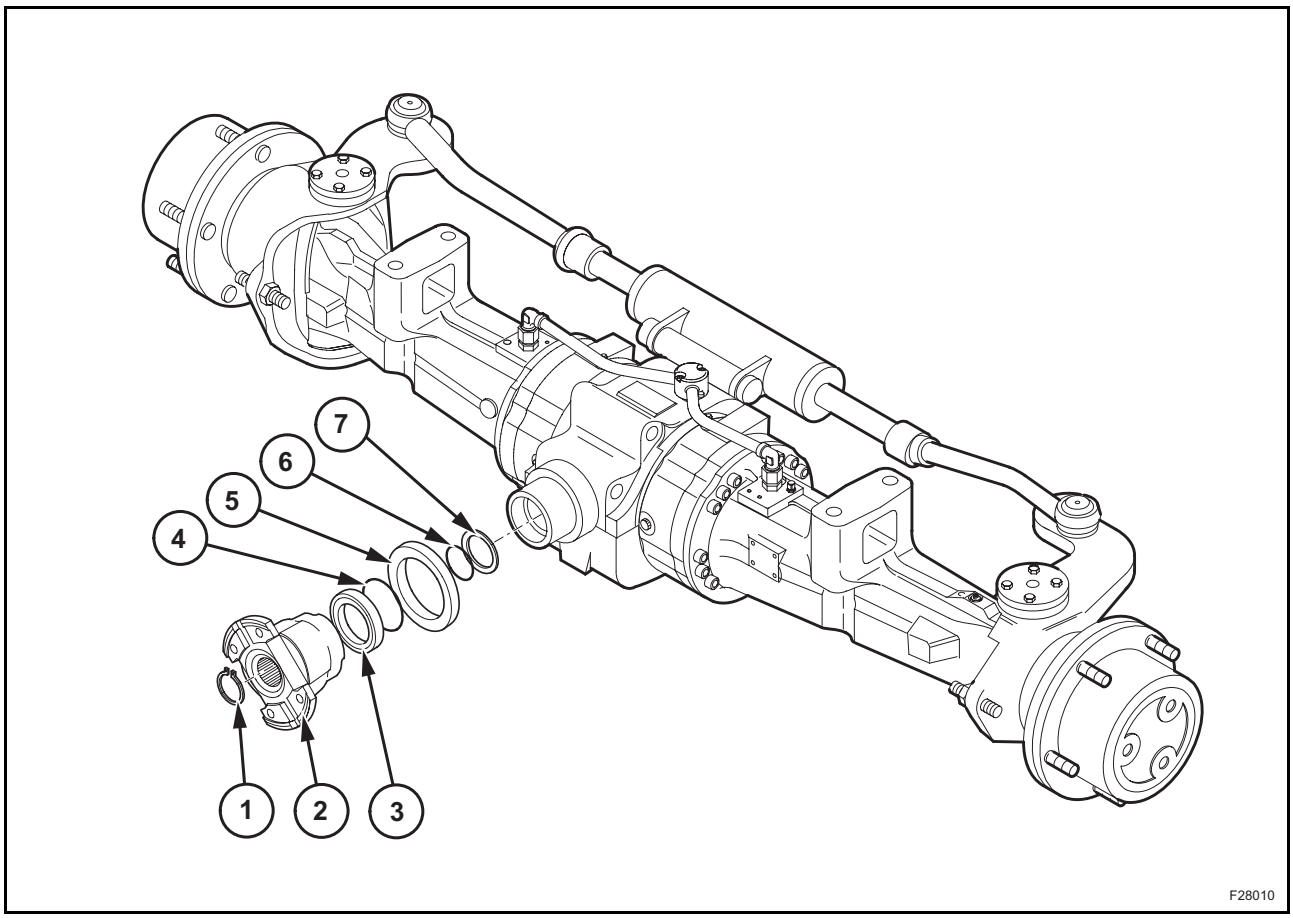


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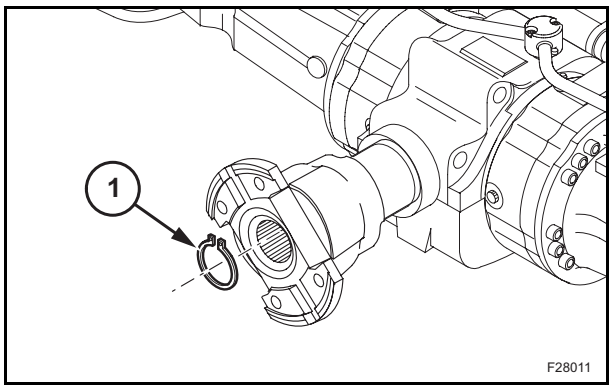
2.2 DISASSEMBLY AND ASSEMBLY

FRONT FLANGE



Disassembly

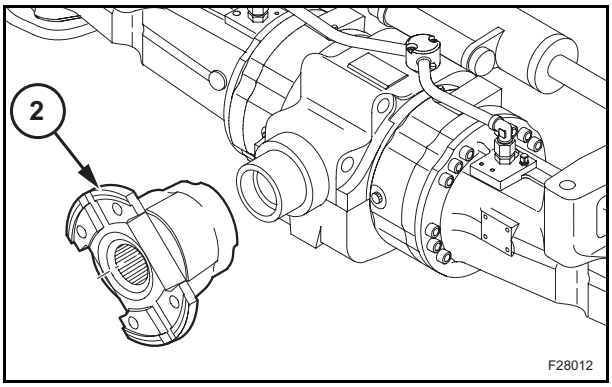
Remove the snap ring (1).



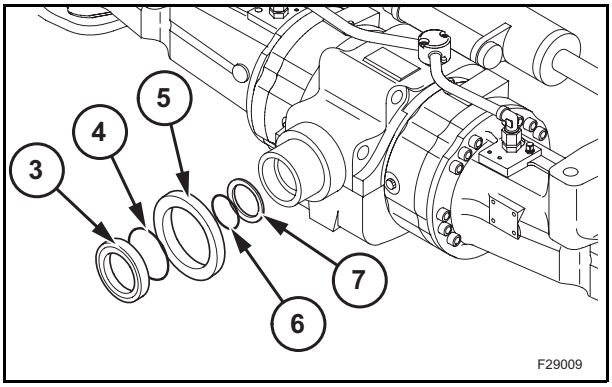
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Remove the front flange (2).

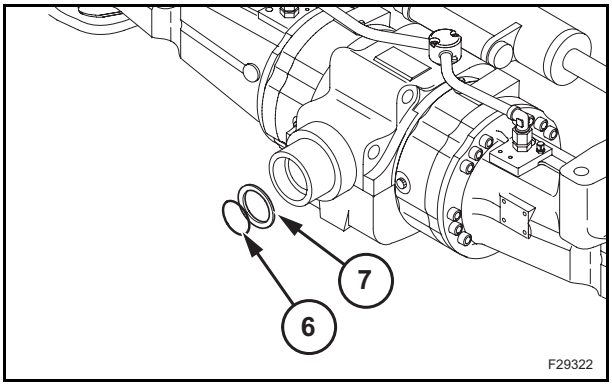


Remove the seal ring (3), the O-ring (4), the gasket (5), the O-ring (6) and the washer (7).

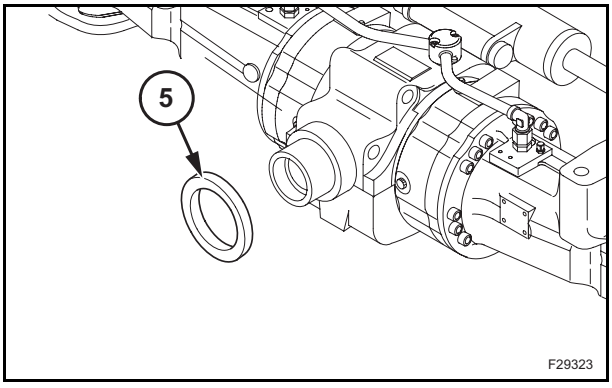


Assembly

Assemble the washer (7) and the new O-ring (6).



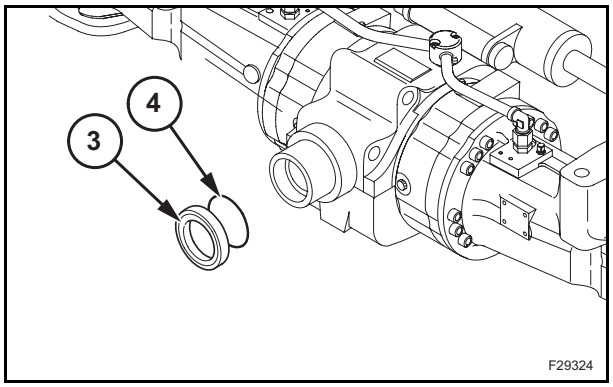
Assemble the gasket (5).



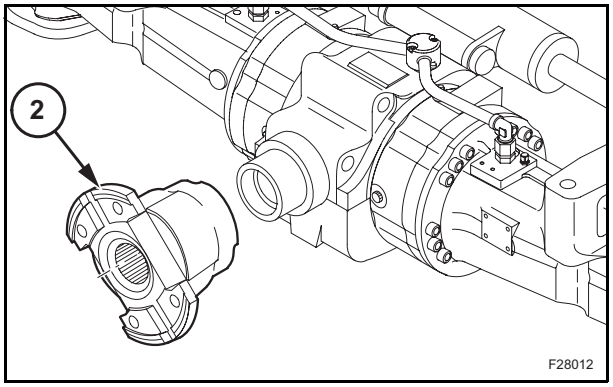
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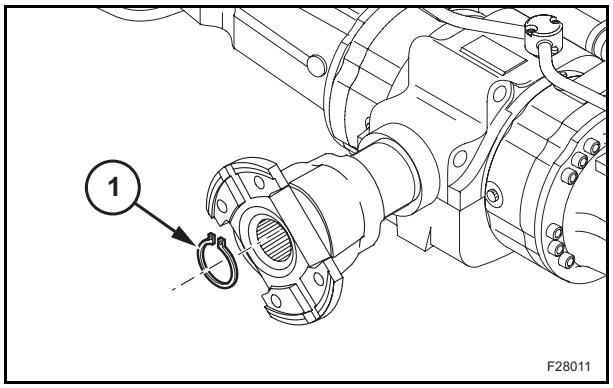
Assemble the new O-ring (4) and the seal ring (3).



Assemble the front flange (2).



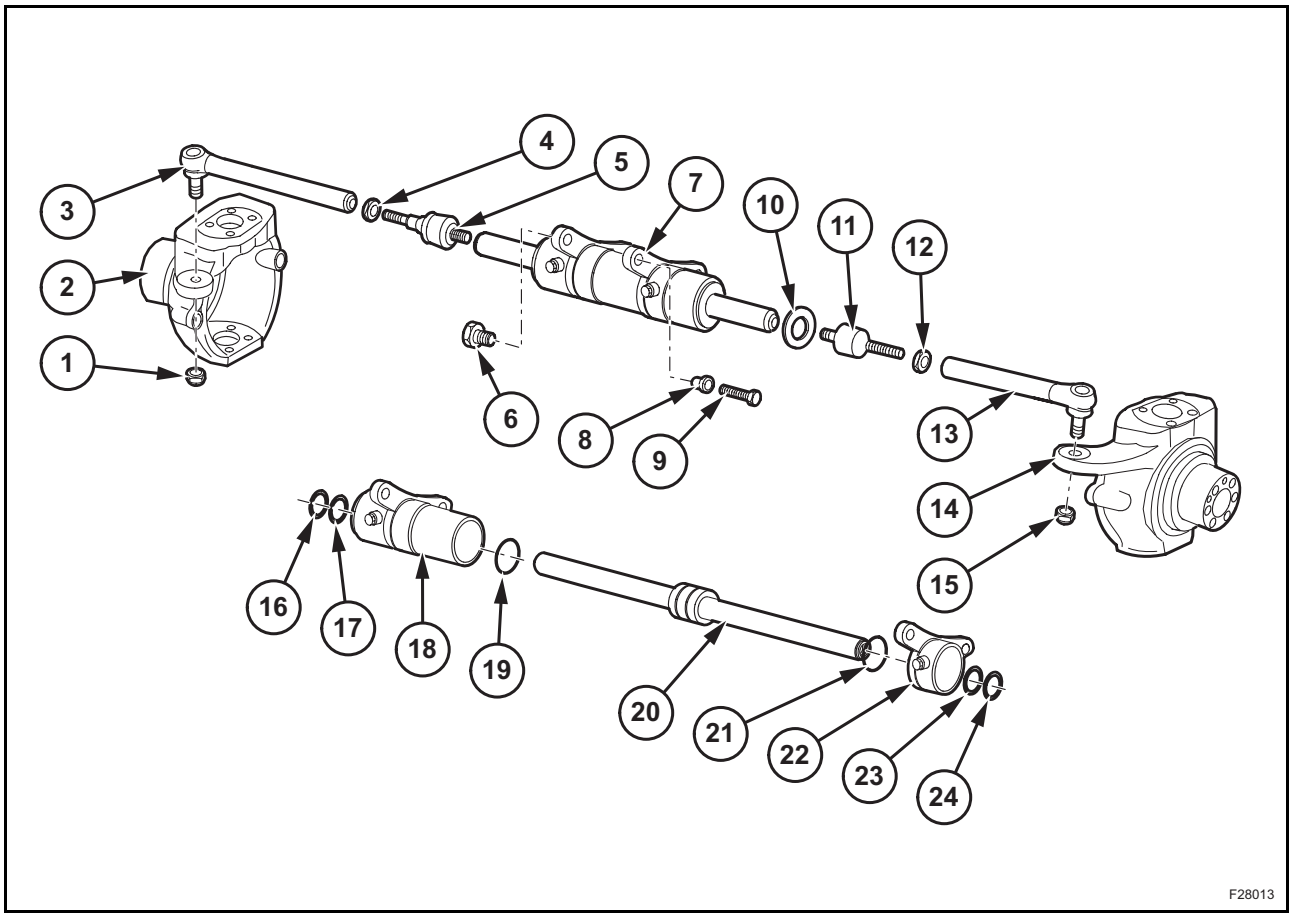
Assemble the snap ring (1).



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STEERING CYLINDER



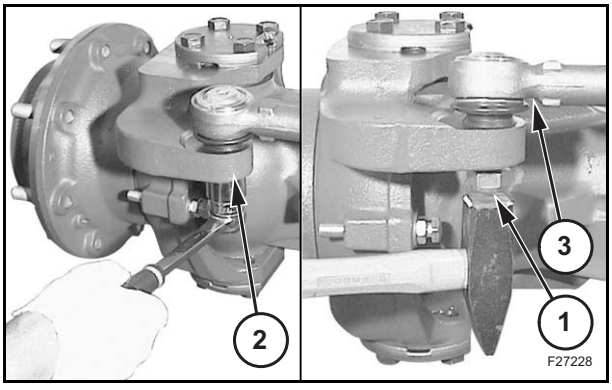
Disassembly

Loosen the nut (1) with enough turns till it is protruding over the threaded pin end of the tie rod (3).
Hit the nut (1) with an appropriate hammer in order to separate the tie rod (3) from the swivel housing (2).

⚠ WARNING
Don't beat on the threaded pin end of the tie rod (3).

NOTE: this is a destructive operation for the nut (1).

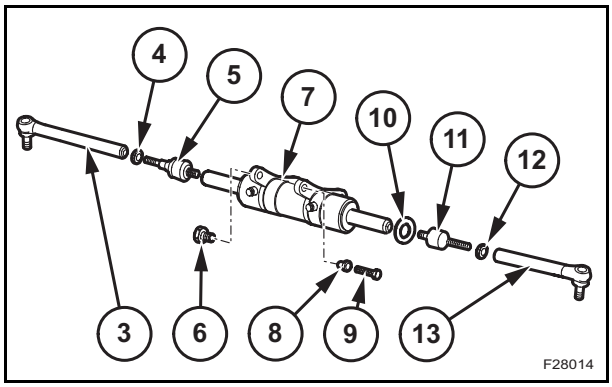
Repeat the whole sequence at the other side.



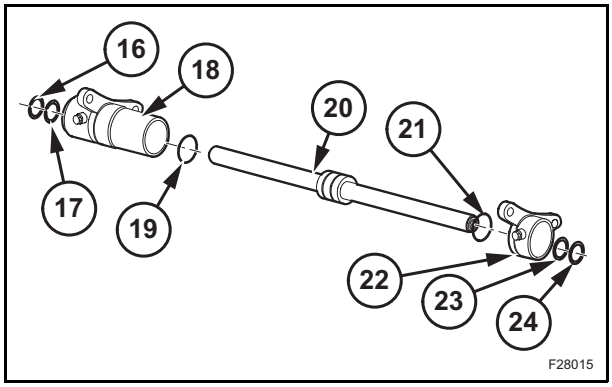
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Remove the tie rods (3) and (13) by loosening the nuts (4) and (12) with a suitable wrench, then check their conditions.
Unscrew the fastening screws (6) and (9) and take the steering cylinder (7) out of its housing, if necessary use a rubber hammer.
Remove only parts that need to be overhauled and/or replaced.

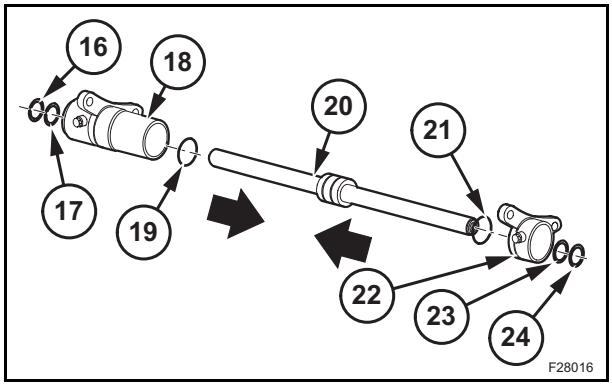


Remove the cylinder head (22) from the cylinder body (18) and remove it from the rod (20).
Remove the rod (20) from the cylinder body (18).
Remove all the seals and O-rings (16, 17, 19, 21, 23 and 24) from the cylinder body (18), the cylinder head (22), and the rod (20).

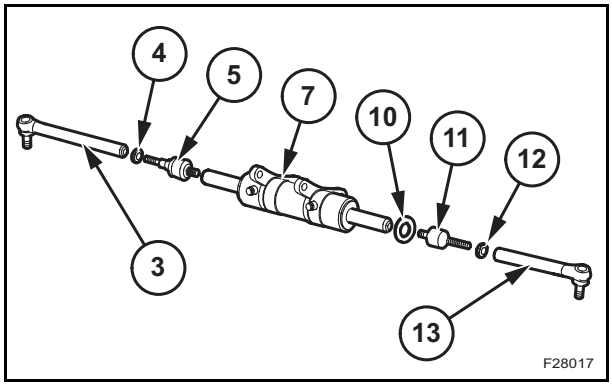


Assembly

Assemble new seals and O-rings (16, 17, 19, 21, 23 and 24) on the cylinder head (22), on the rod (20) and on the cylinder body (18).



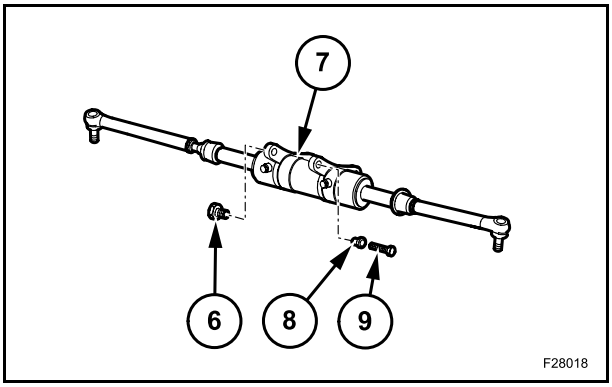
Assemble the tie rods (3) and (13), the ball joints (5) and (11), the nuts (4) and (12) to the ends of the rod, then tighten with a dynamometric wrench to the requested torque.



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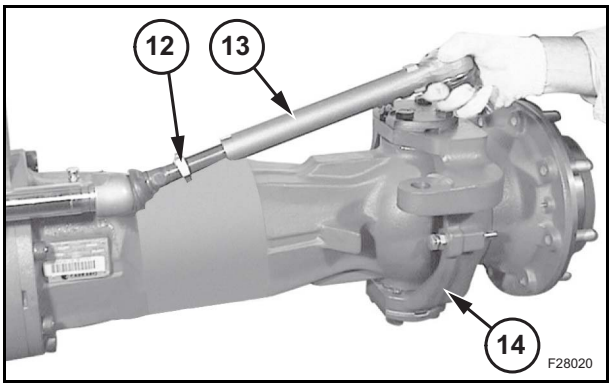
Install the steering cylinder (7) already assembled on the central body.
Assemble and tighten the screws (6) and (9) to the specified torque.



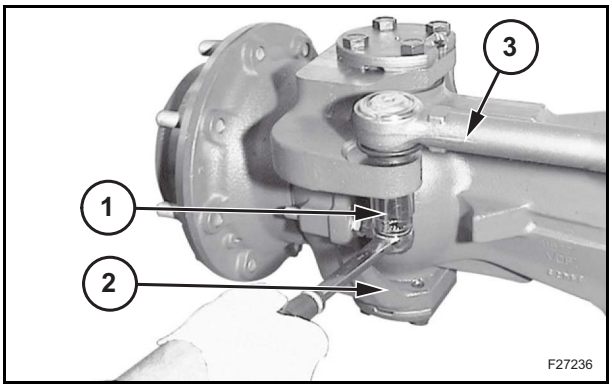
Align the swivel housing (14) with the axle.
Screw in the tie rod (13) so that its ball joint can be inserted into the swivel housing arm (14).

NOTE: it is important to unscrew the locknut (12) to carry out this operation.

Repeat the whole sequence of the mentioned operations to the other side.



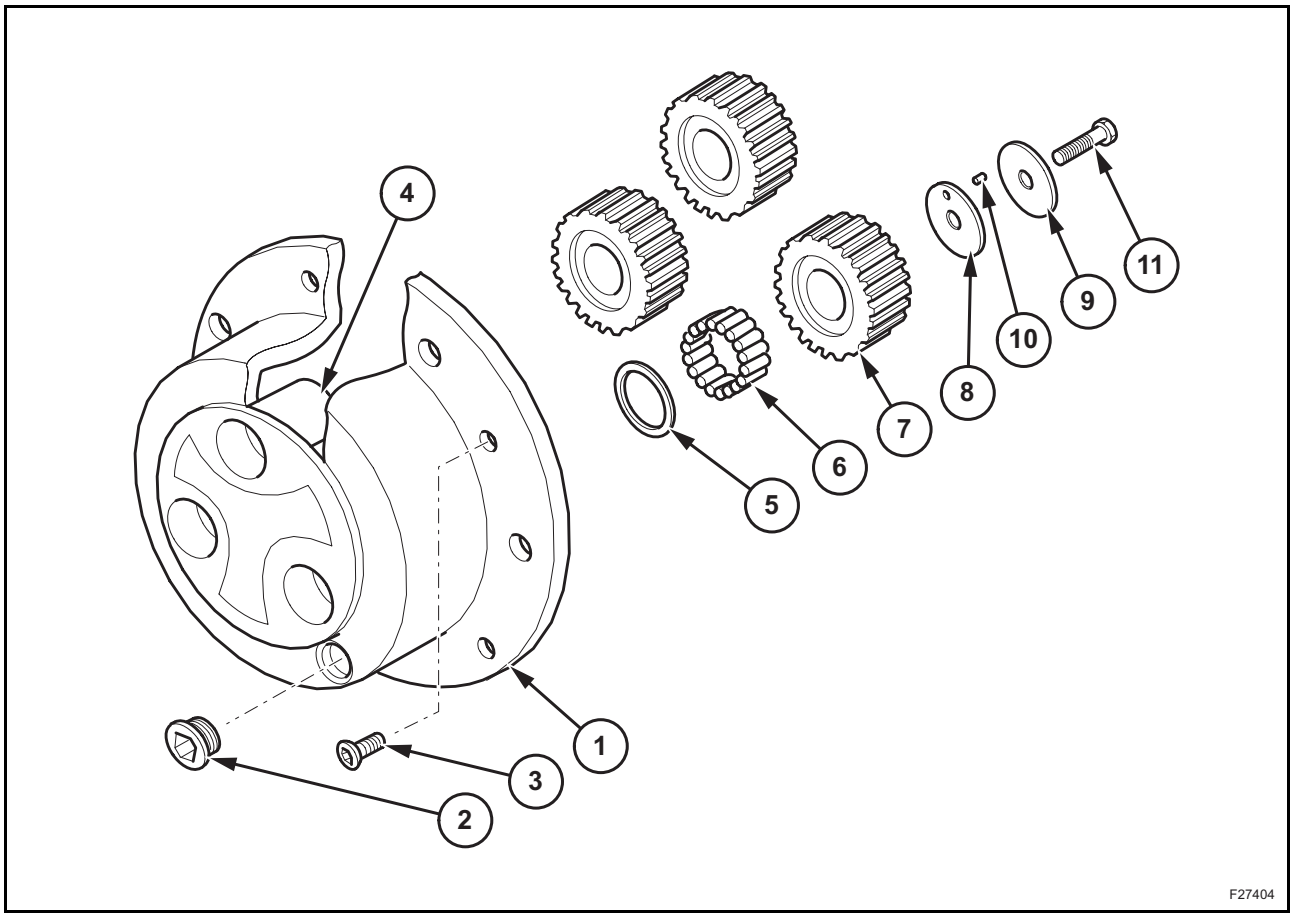
Insert the ball joint of the tie rod (3) into its housing in the swivel housing (2).
Assemble and tighten the locknut (1) to the specified torque.
Repeat the whole sequence of the mentioned operations to the other side.



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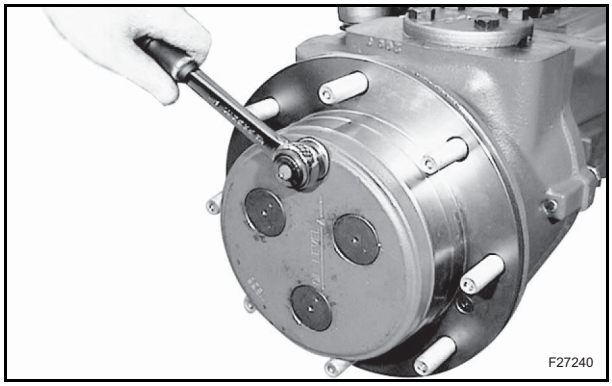
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REDUCTION GEAR



Disassembly

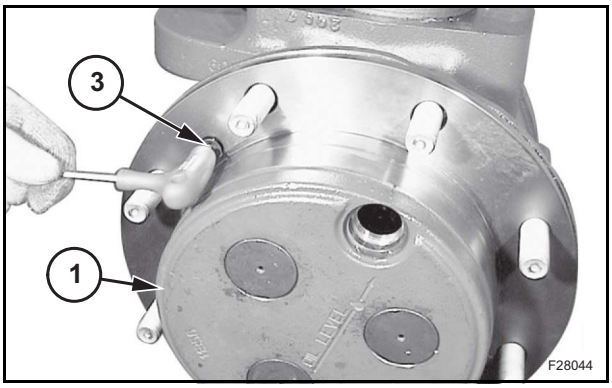
Drain the oil completely from the planetary carrier.



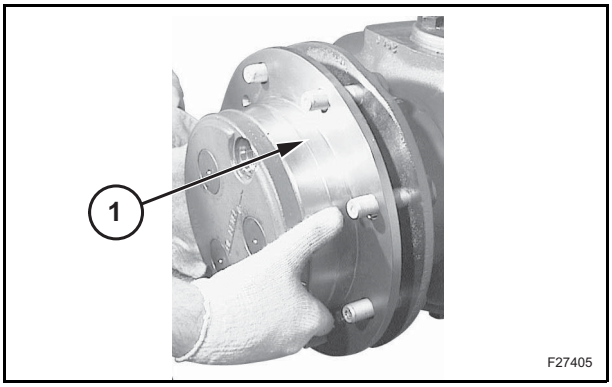
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Unscrew and remove both fastening screws (3) of the planetary carrier cover (1).

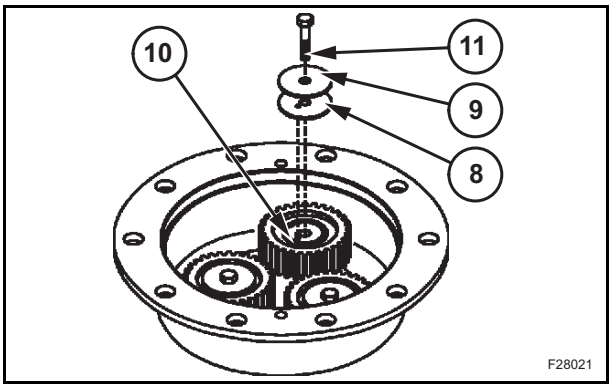


Remove the planetary carrier cover (1) from the wheel hub.
Position the planetary carrier cover (1) on a work-bench and check its wear conditions.

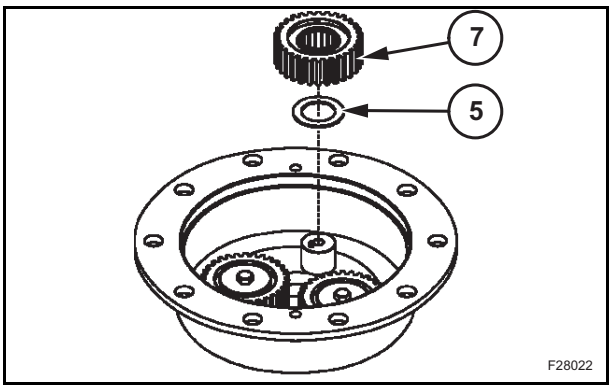


To replace the gears, if necessary, remove the screw (11) and the relevant washers (8) and (9).

NOTE: treat the pin (10) with care.



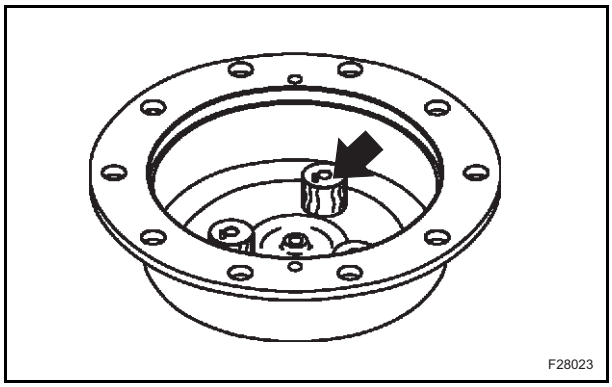
Remove the gear (7) from its seat, taking care not to lose the rollers inside it.
Remove the shim (5).



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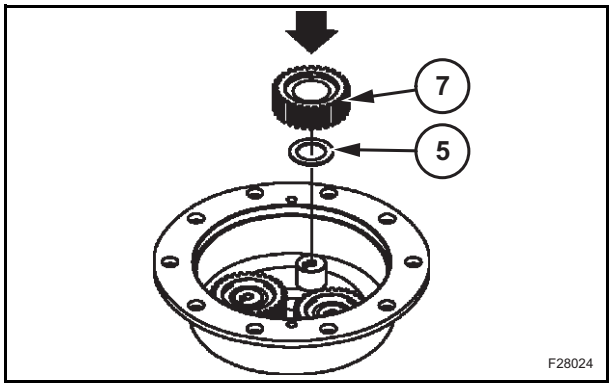
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If the pins of the gears are in poor conditions, replace the entire planetary train with pre-fitted pins.



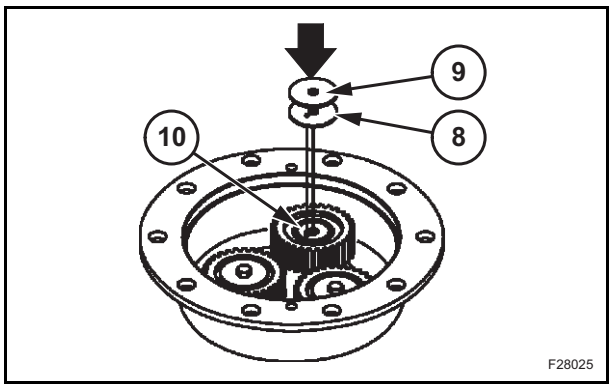
Assembly

Place the planetary carrier on a workbench and fit the gears (7) and the relevant shims (5).

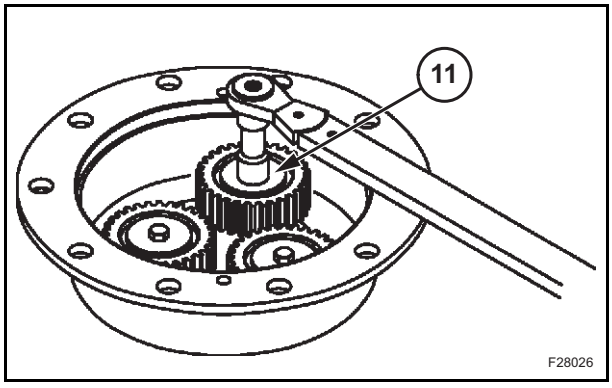


Insert all the rollers into the gears, then position the two washers (8) and (9).

NOTE: the first washer must be aligned with the dowel (10) pin.



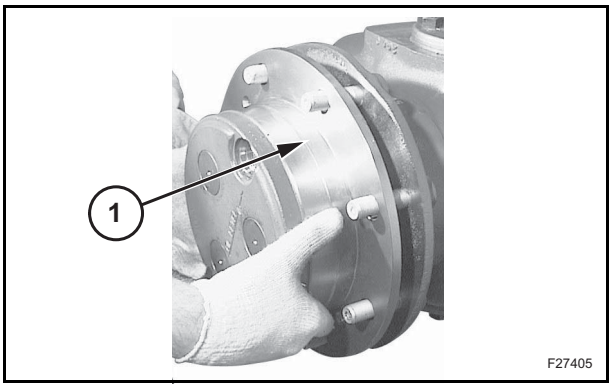
Screw in and tighten the screws (11) to the specified torque.



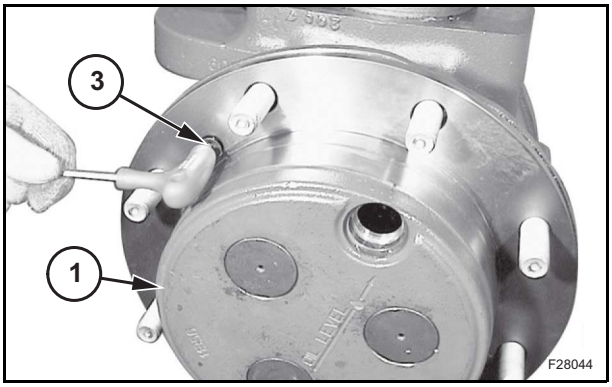
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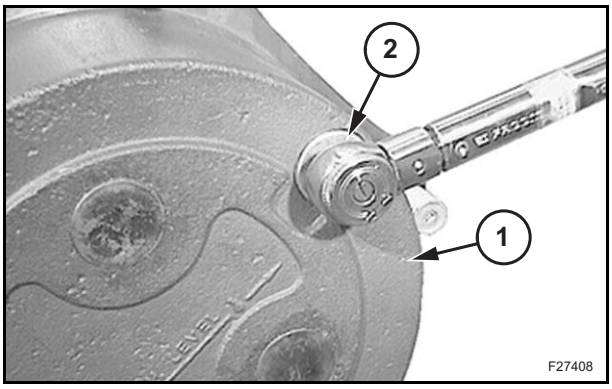
Assemble the planetary carrier cover (1) onto the wheel hub.



Assemble the screws (3) and tighten to the specified torque.



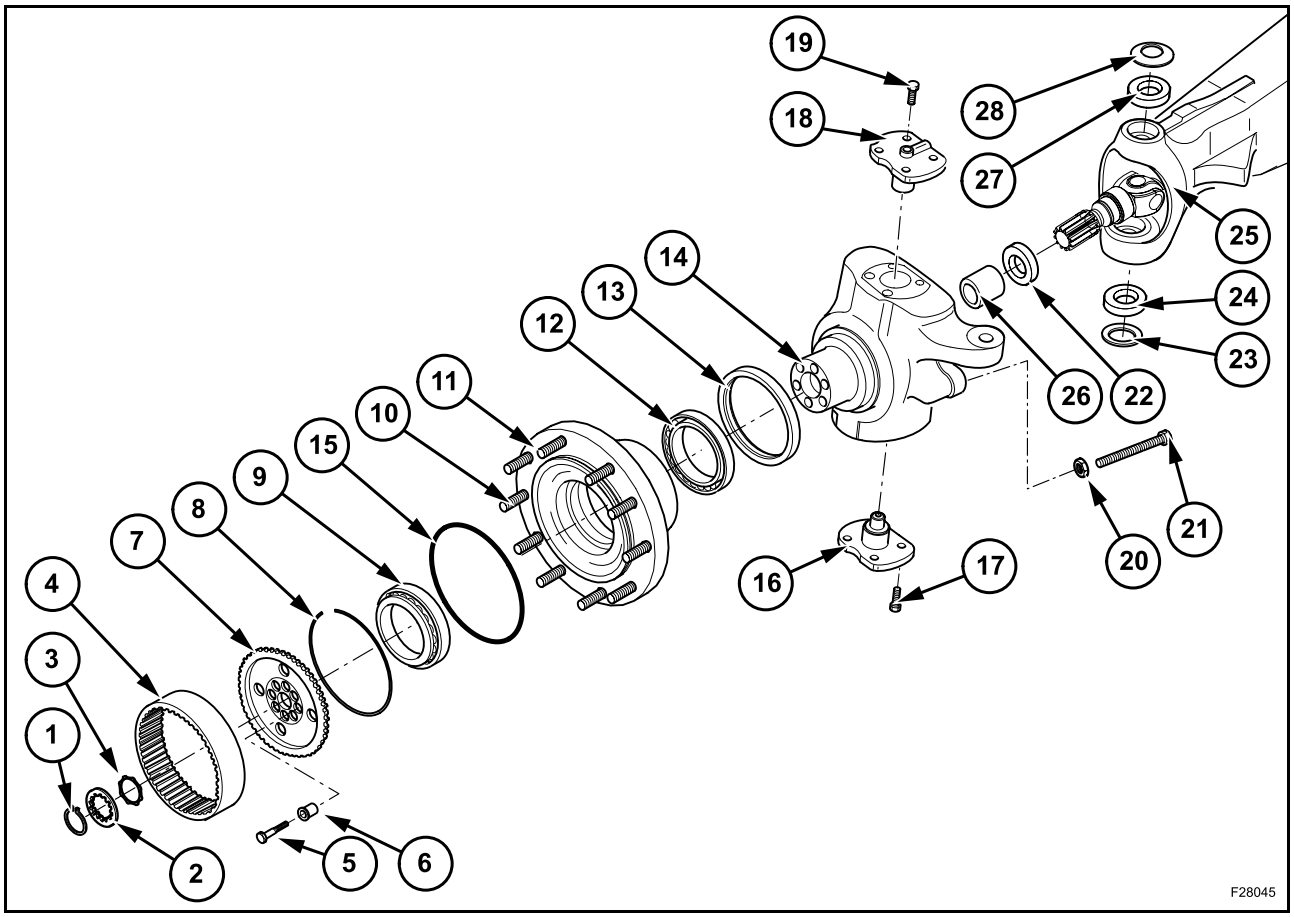
To up the oil on the wheel hub.
Assemble the plug (2) onto the planetary carrier cover (1) and tighten to the specified torque.



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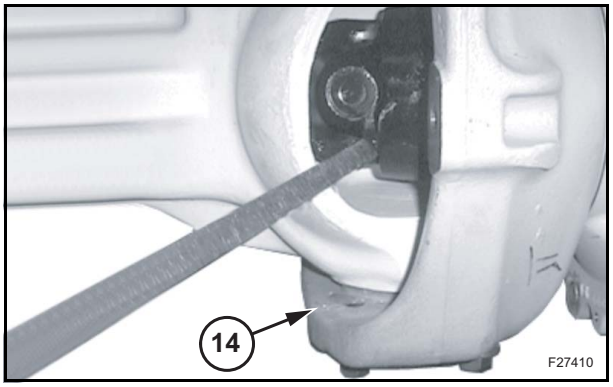
WHEEL HUB



Disassembly

Insert a lever between the swivel housing (14) and the axle shaft and fit into the cardan shaft.
With the lever, push the cardan shaft in the direction of the wheel hub to allow the removal of the snap ring.

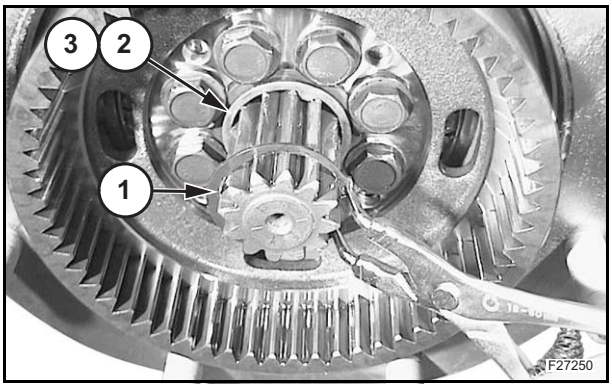
⚠ WARNING
Do not damage the cardan shaft.



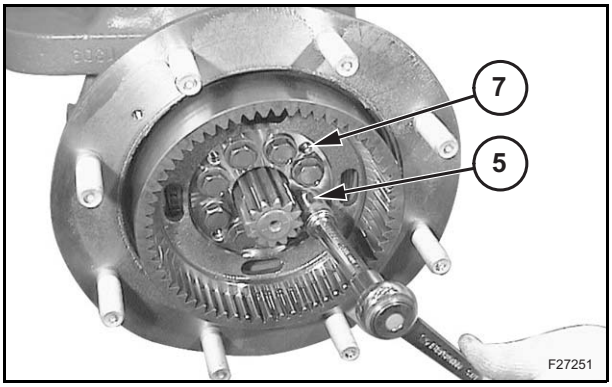
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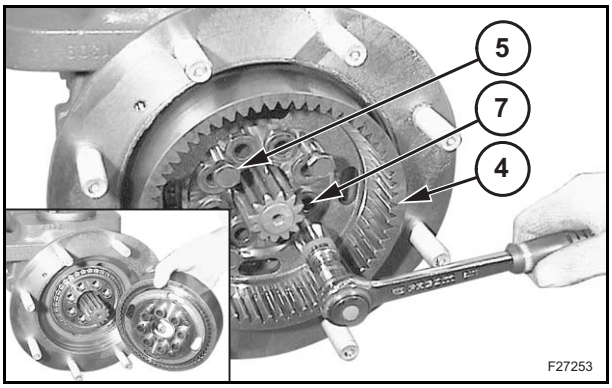
Remove the snap ring (1) from the cardan shaft.
Collect the washers (2) and (3) of the cardan shaft.



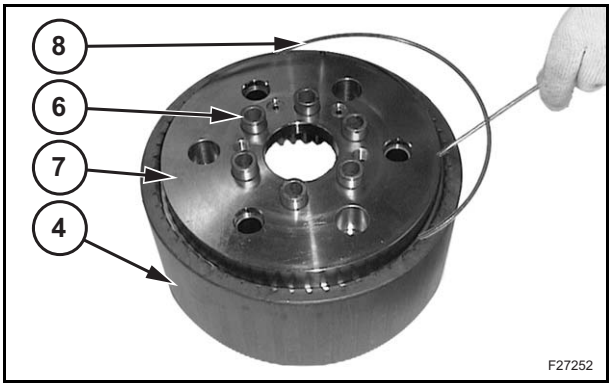
Unscrew and remove the fastening screws (5) from the ring gear carrier (7).



To extract the ring gear carrier, screw in two of the just removed screws (5) into the threaded holes.
Remove the ring gear carrier (7) with the ring gear (4).



Remove the retaining ring (8) and separate the ring gear carrier (7) from the ring gear (4).
Only if necessary, remove the bushes (6) from the ring gear carrier using a hammer and the special tool **380002667**.

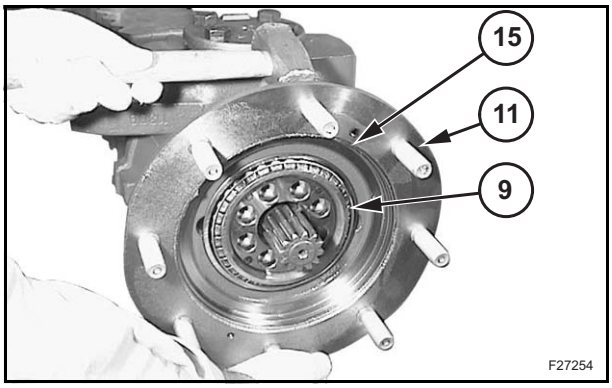


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Remove the O-ring (15).
Remove the wheel hub (11) using levers and a hammer to facilitate the operation.

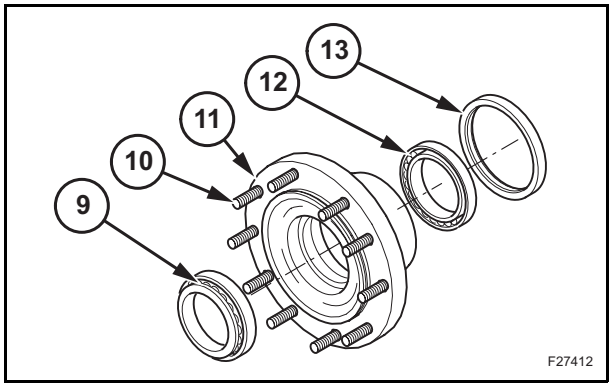
NOTE: collect the bearing cone (9).



Position the wheel hub (11) on a flat surface and remove the seal ring (13) with a lever.

NOTE: destructive operation for the seal ring (13).

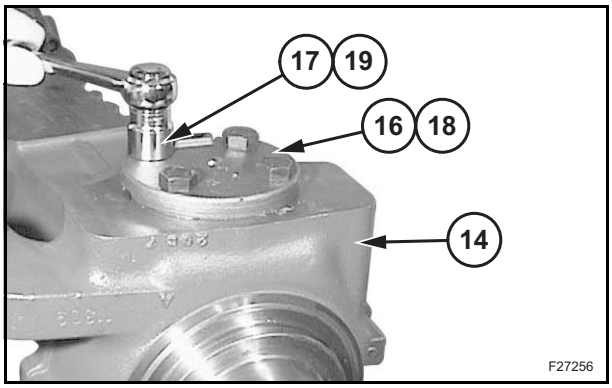
Remove the bearing cups (9) and (12) using a hammer and a suitable drift.
Remove the bearing cone (12) from the swivel housing end using a suitable extractor.



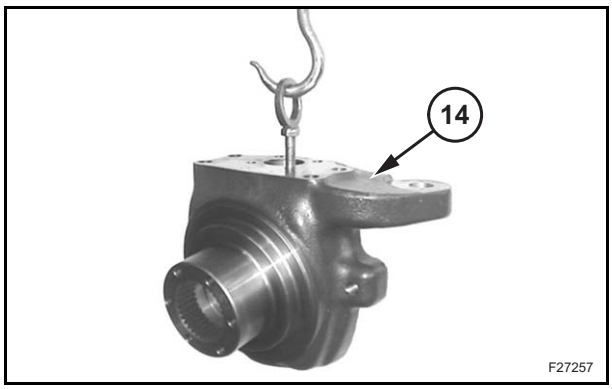
Unscrew and remove the fastening bolts (19) and (17) from the upper (18) and lower (16) king pin.

⚠ WARNING
Before removing the king pins (16) and (18), secure the swivel housing (14) to a rope or a hoist or to any other supporting device; observe all current safety regulations to guarantee the operator's safety.

Remove the king pins (16) and (18).



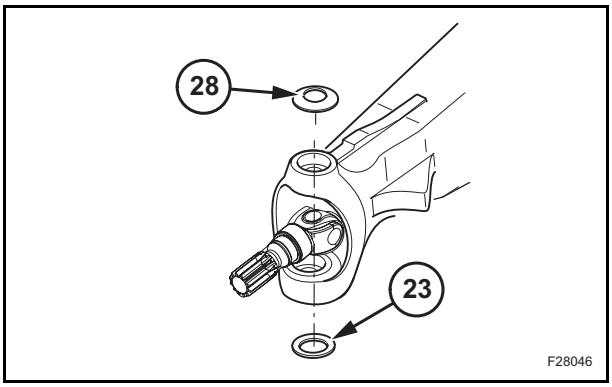
Extract the swivel housing (14) from the axle shaft and the cardan shaft.



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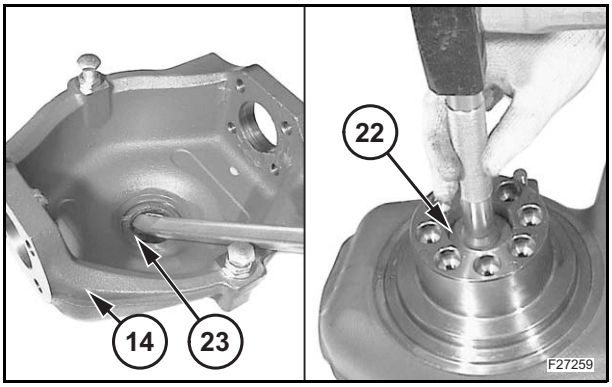
Collect the belleville washers (23) and (28).



Position the swivel housing (14) on a flat surface and extract the seal ring (22) with a lever.

NOTE: this is a destructive operation for the seal ring.

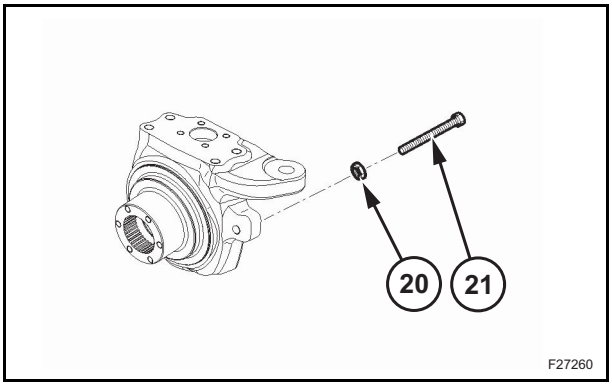
Turn the swivel housing and take the bush (26) out, using a suitable drift and a hammer.



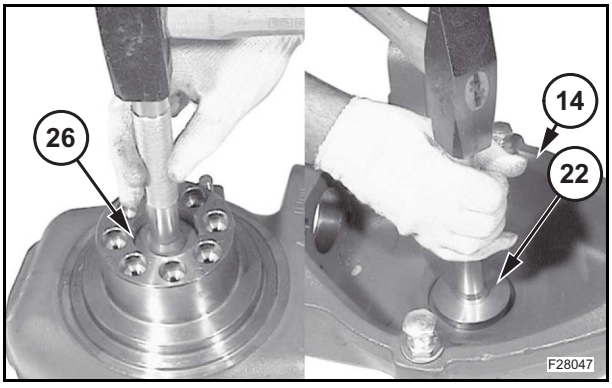
Assembly

If it has been previously removed, reassemble the steering stop composed by the screw (21) and nut (20).

NOTE: do not tighten the nut (20) until the steering angle adjustment has been done.



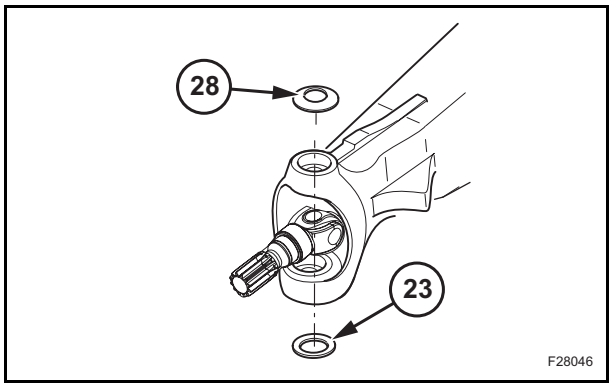
Force the bush (26) into the swivel housing (14) using the special tool **380002668** and a hammer.
Insert the seal ring (22) into the swivel housing (14) with the special tool **380002669** and a hammer.
Grease carefully the seal ring (22).



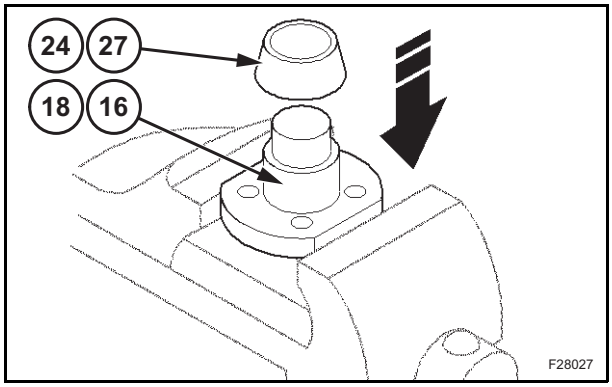
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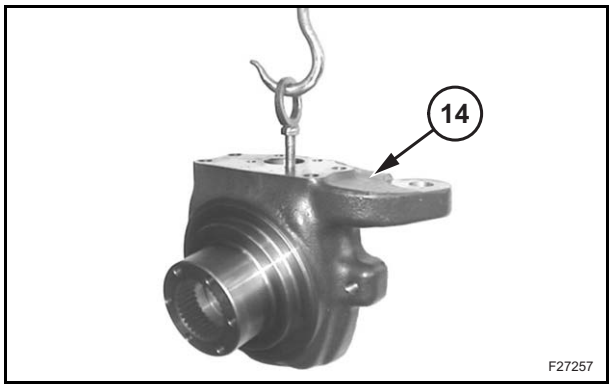
Grease well the king pin housings with specific grease.
Position the belleville washers (23) and (29).



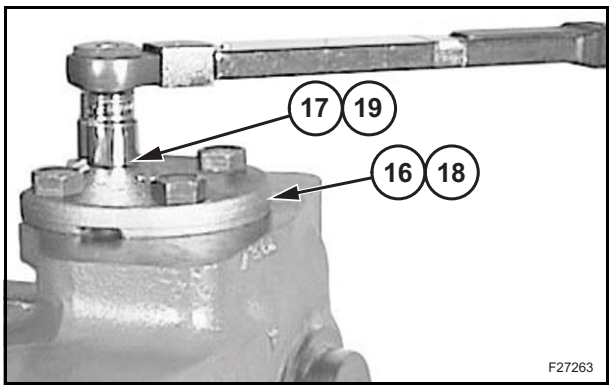
If previously removed, assemble the king pins (24) and (27) onto the king pins (16) and (18).



Secure the swivel housing (14) with a belt or a rope to a hoist or to any other supporting device.
Protect the splined end of the axle shaft by winding it with an adhesive tape to avoid damage to the seal ring.



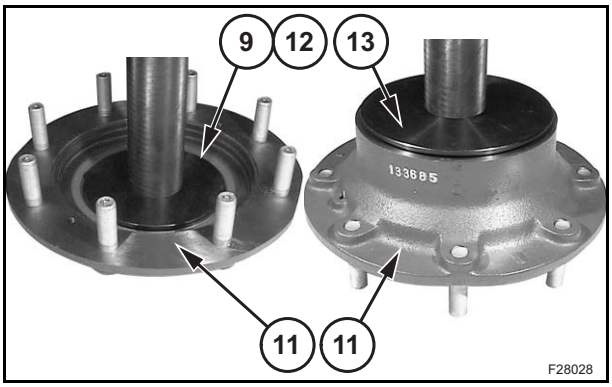
Assemble the king pins, the lower (16) and the upper (18), and tighten the retaining screws (17) and (19) to the requested torque.



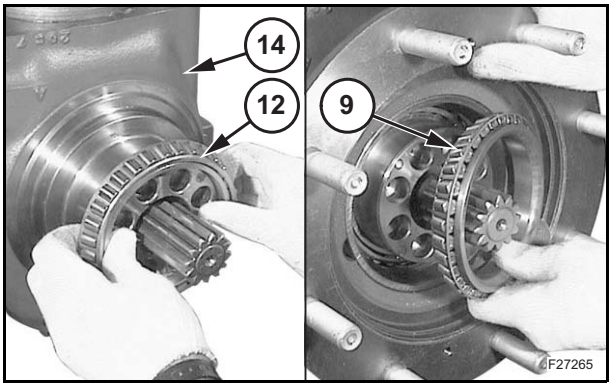
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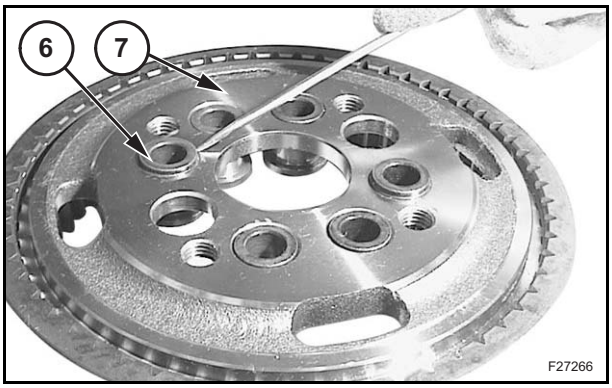
Position the wheel hub (11) on a workbench and assemble the bearing cups (9) and (12) in position with the special tool **380002222** under a press or with a hammer.
Assemble the seal ring (13) into the wheel hub (11) with the special tool **380002213** and a hammer.



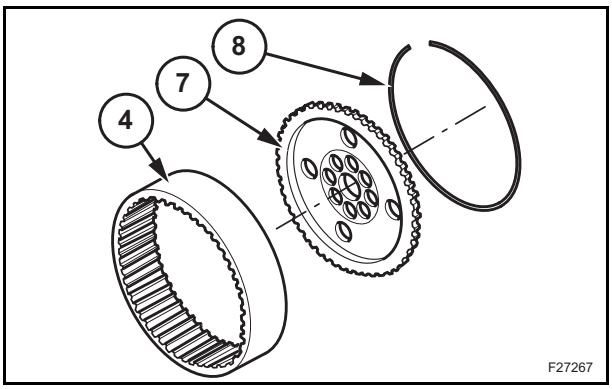
Assemble the bearing (12) onto the swivel housing end (14).
Assemble the wheel hub (11) on the swivel housing (14) and fit the bearing (9).



Position the ring gear carrier (7) on a workbench and force the bushes (6) to the carrier (7) surface level with the special tool **380002667**.
At least two bushes (diametrically-opposed) should be set slightly higher than the carrier surface level to be used as dowel pins.



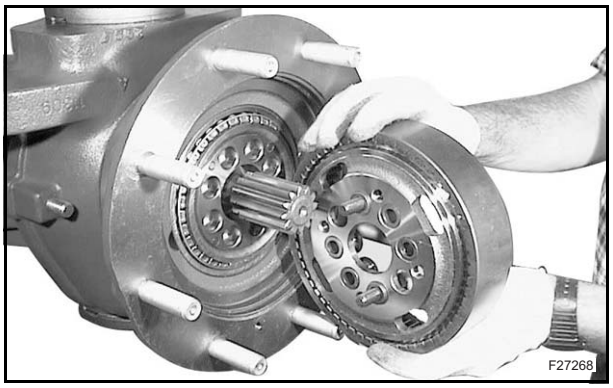
Preassemble the ring gear carrier (7) and the ring gear (4) with the retaining ring (8).



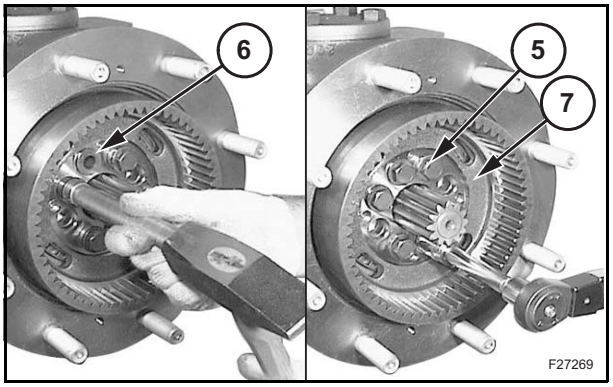
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Assemble the ring gear carrier assy on the wheel hub using the two projecting bushes as dowel pins and screw in the relevant screws in order to put the ring gear in contact with the wheel hub.

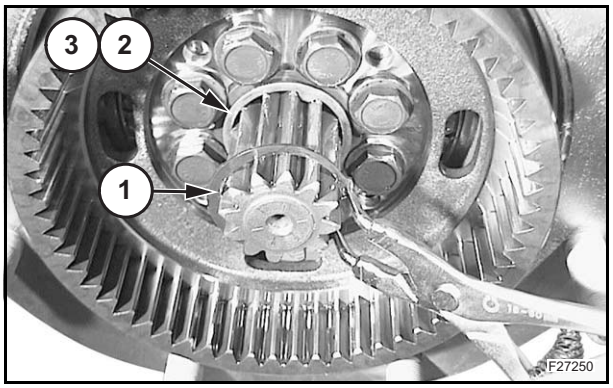


Completely insert all bushes (6) using the special tool **380002667** and a hammer.
Apply sealant on fastening bolts (5) thread.
Assemble the wheel carrier (7) fastening screws (5) and tighten to the specified torque.



Assemble the washers (2) and (3) on the end of the cardan shaft.
Insert the snap ring (1) on the end of the splined hub and push it into its seat.

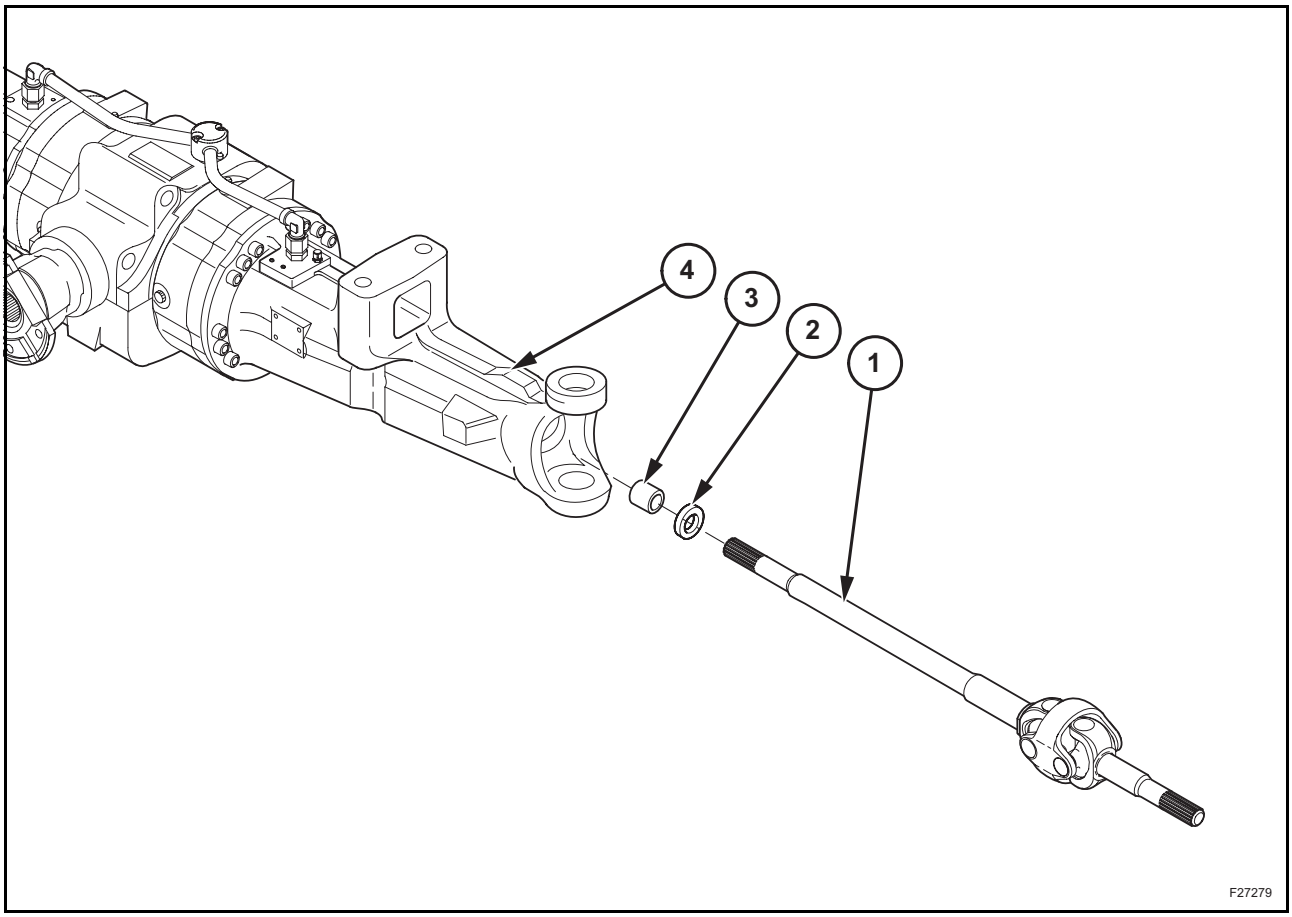
NOTE: check that the snap ring (1) is correctly fitted in its seat.



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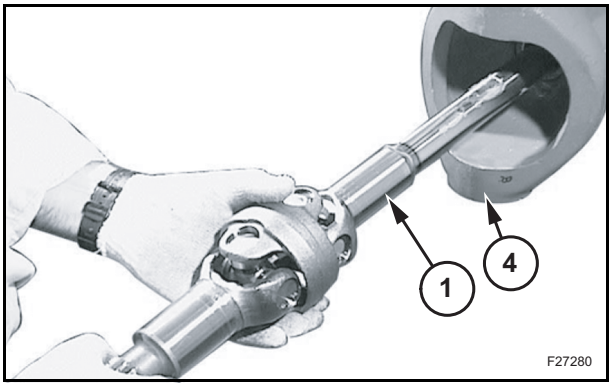
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CARDAN SHAFTS



Disassembly

Remove the cardan shaft (1) from the axle shaft (4).



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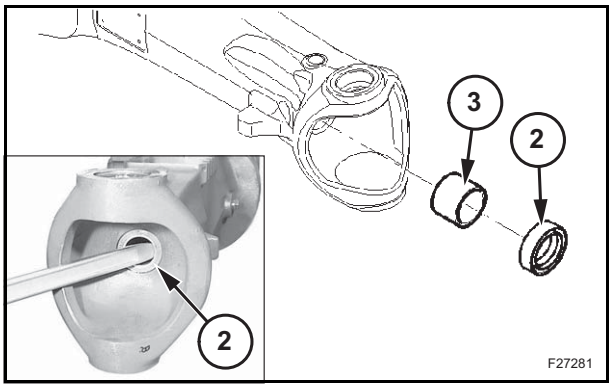
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Remove the seal rings (2) from the axle beam (4).

NOTE: destructive operation for the seal rings (3).

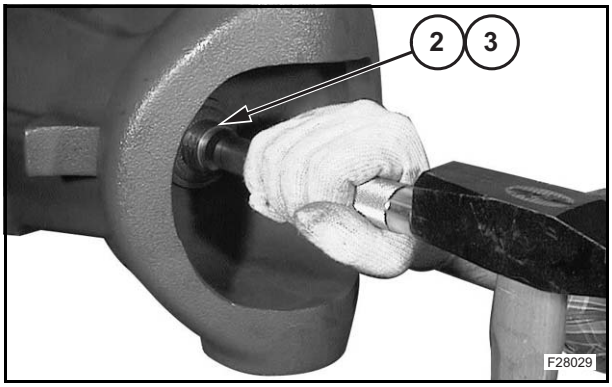
Remove the bushing (3) from the axle shaft (4) only if the wear conditions require it.

⚠ WARNING
Be careful not to damage the bush seat.

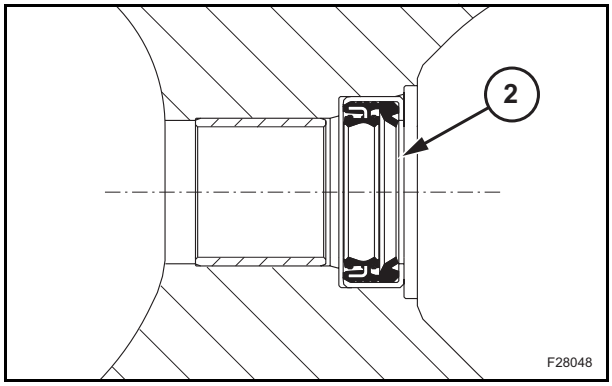


Assembly

Assemble the bush (3) on the axle beam with the special tool **380002226** and a hammer.
Assemble the seal ring (2) on the axle beam with the special tool **380002670** and a hammer.

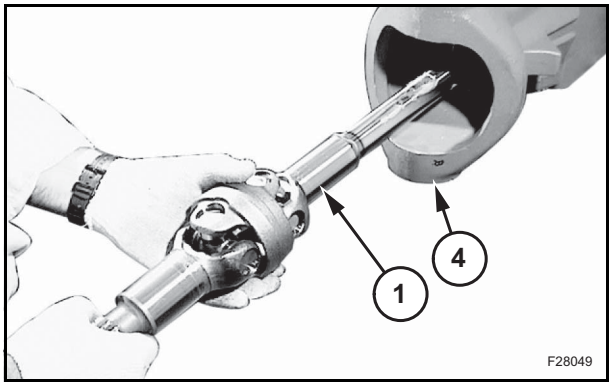


Assemble the seal ring (2).



Insert the cardan shaft (1) into the axle shaft (4).

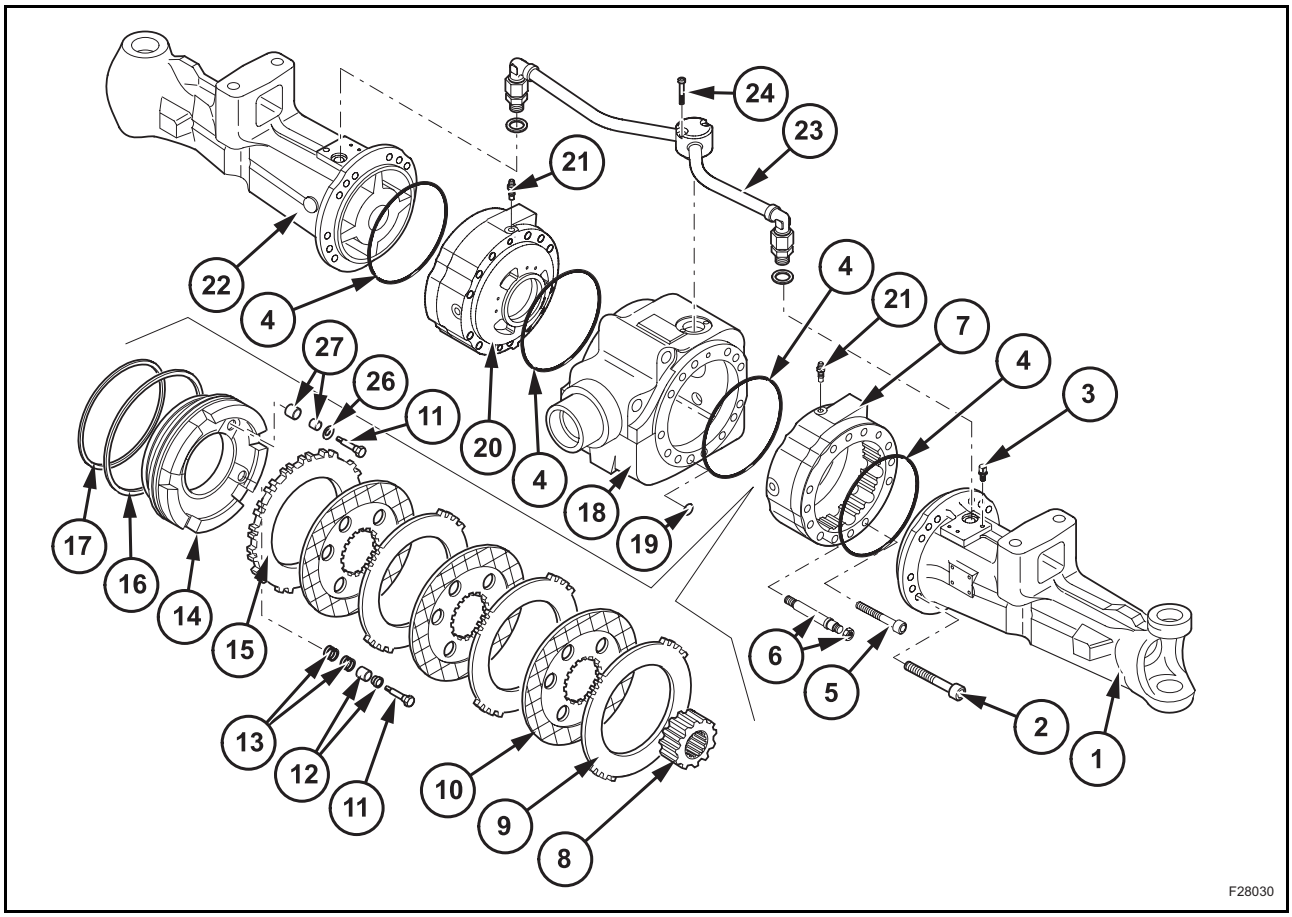
⚠ WARNING
Be careful not to damage the seal ring.



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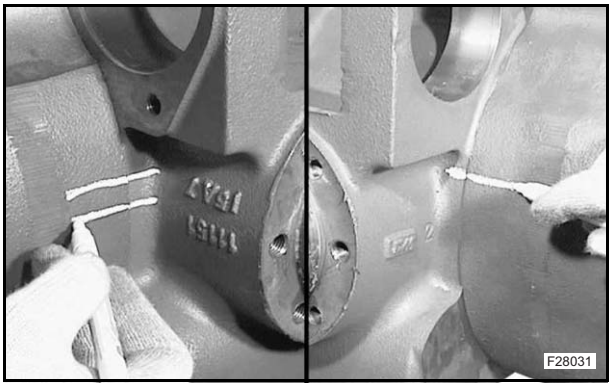
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AXLE BODY AND BRAKES



Disassembly

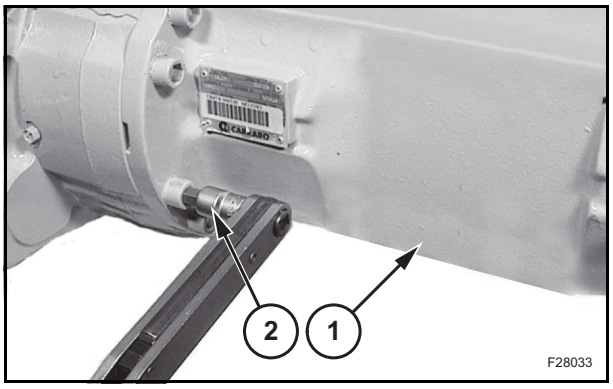
Put alignment marks on the axle beam body and on the differential supporting flanges, in order to identify the right side and the left side with certainty.



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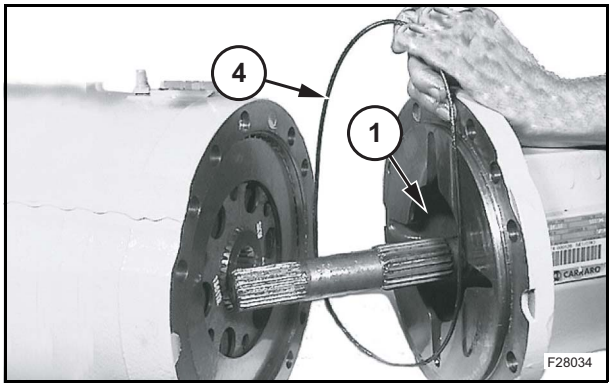
Position the axle on supports fitted to hold either the central body or the axle-beam, even after their disjunction, or secure the three disjointed groups to a lifting device with ropes or belts.
Unscrew the screws (2) to disassemble the axle beam trumpet (1).



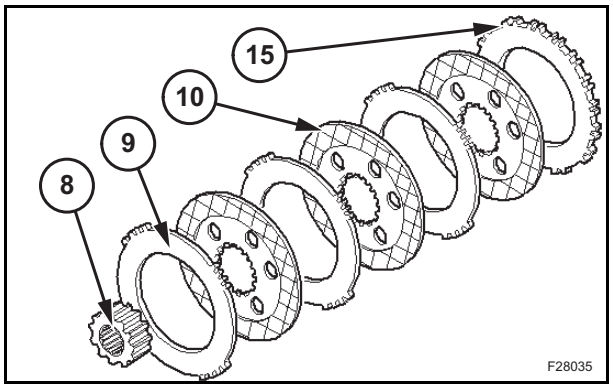
Remove the axle beam trumpet (1).

⚠ WARNING
Once the axle beam trumpet has been removed, the brake disks are free.

Remove the O-ring (4).

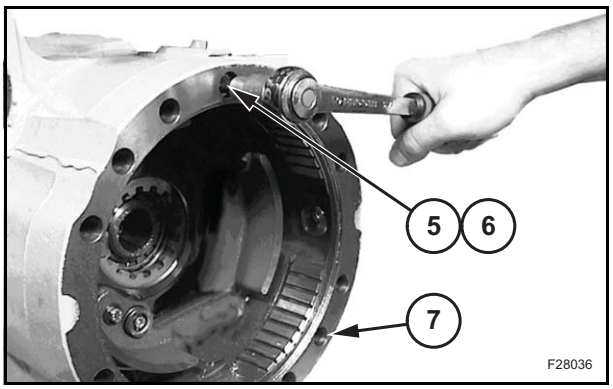


Remove the disks (9) and the intermediate disks (10).
Remove the gear (8), the remaining brake disk and the brake counterdisc (15).



Secure the brake flange (7) to a hoist with ropes or safety belts.
Unscrew the upper screw (5) and the lower screw (6). Remove the flange (7) from the central body, together with the bevel gear backlash-adjusting ring nut.

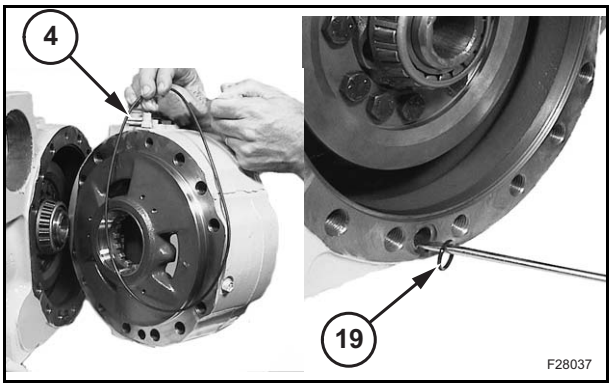
⚠ DANGER
This operation frees the differential box, that accidentally could fall.



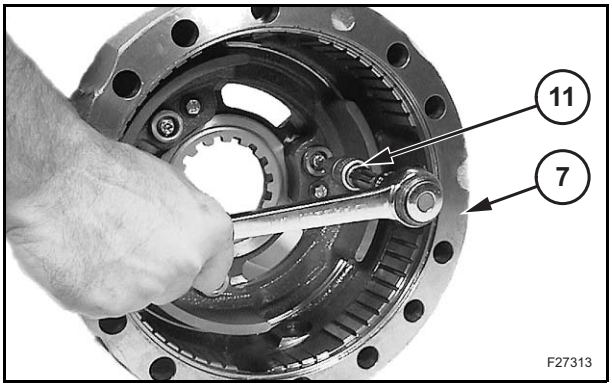
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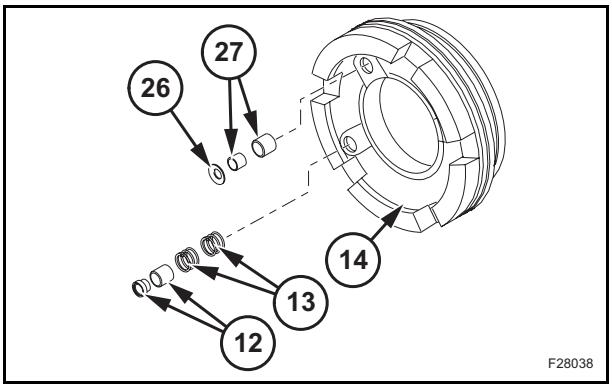
Remove the O-ring (4) and (19) from its housing and from oil pipe hole and check its conditions.



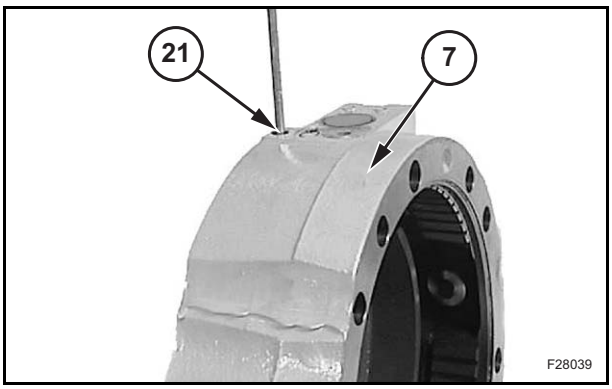
Collect the brake flange (7) and place it on a work-bench or fix it in a clamp.
Unscrew screws (11).



Take from the piston (14), the springs (13) and the bushes (12) and (27) and spacer (26).



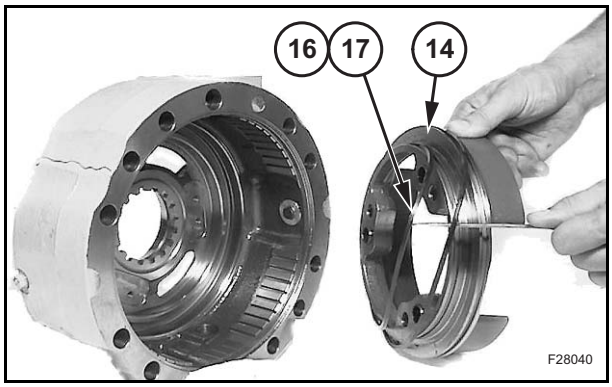
Unscrew the breather (21) from the brake flange (7).



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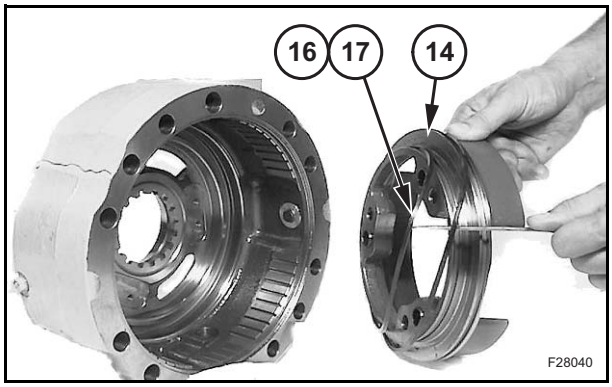
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Take the piston out (14).
If necessary, blow in air through the brake bleeder vent to eject the piston, using the minimum pressure.
Remove the O-rings (16) and (17) from the piston (14) and check their conditions.

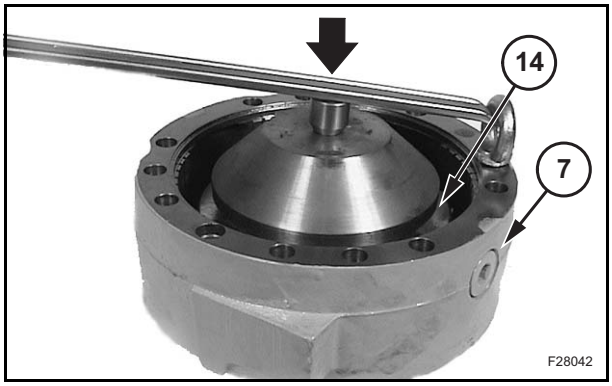


Assembly

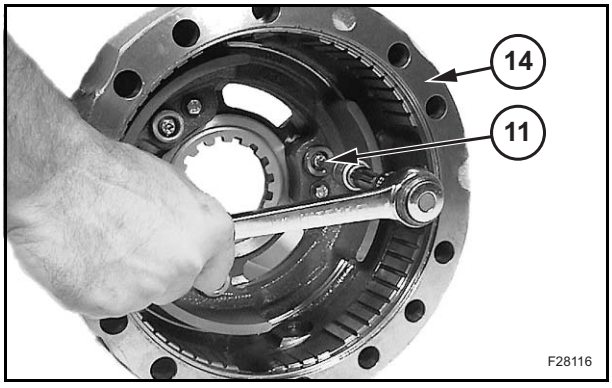
Assemble the O-rings (16) and (17) on the piston (14) and lubricate the fraying surface piston/flange with a light layer of grease.



Install the piston (14) into the brake flange (7) and then a support flat disk on the piston and with a lever anchored to an eyescrew, exert a pressure just enough to insert the piston (14) into the brake flange (7).



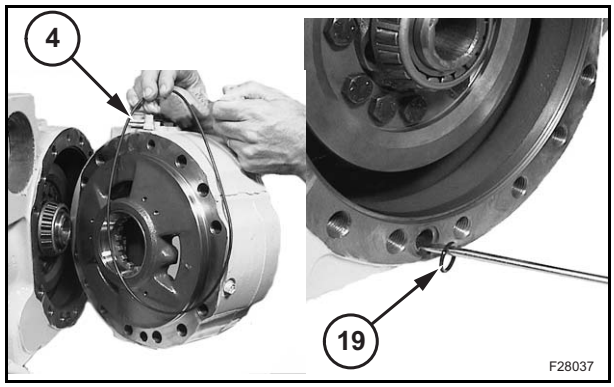
Collect the self-adjust kits components and insert them in the piston (14).
Insert the fastening screws (11) and tighten them to the specified torque.



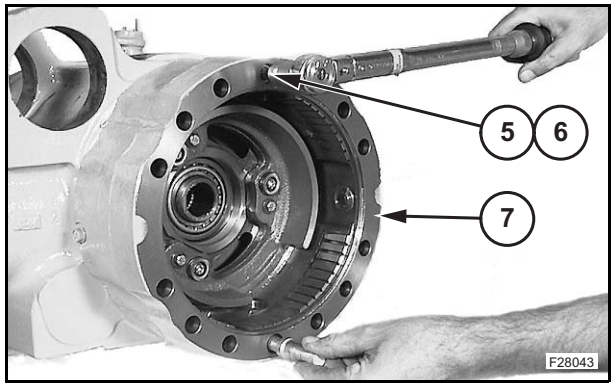
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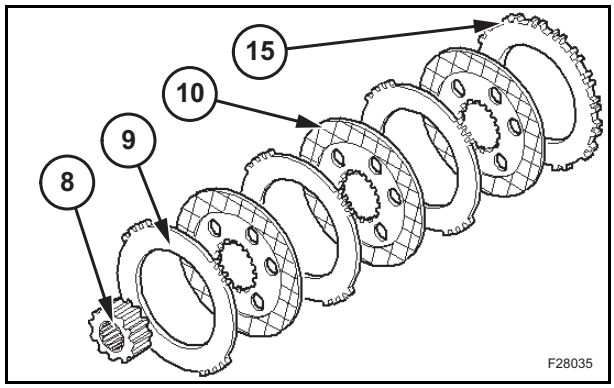
Assemble the new O-rings (4) and (19).



Assemble and tighten the upper screw (5) and the lower screw (6) fastening the brake flange (7) to the specified torque.

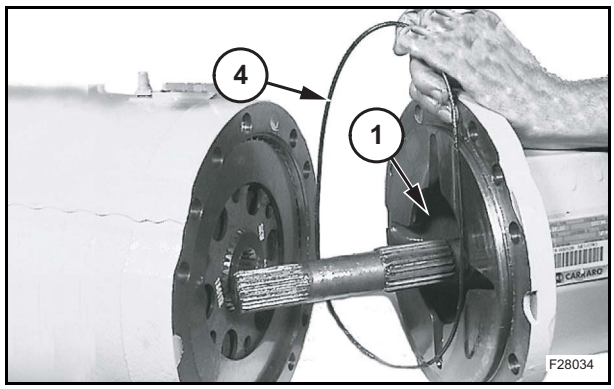


Assemble the brake disks (9), the intermediate brake disks (10), the gear (8) and the brake counter-disc (15).



Assemble the new O-ring (4).
In order to place the axle beam correctly, position the half-beam (1) check the reference marks carried out during disassembly.

NOTE: if new brake pads are installed, before assembling, they should be dipped in the required oil.



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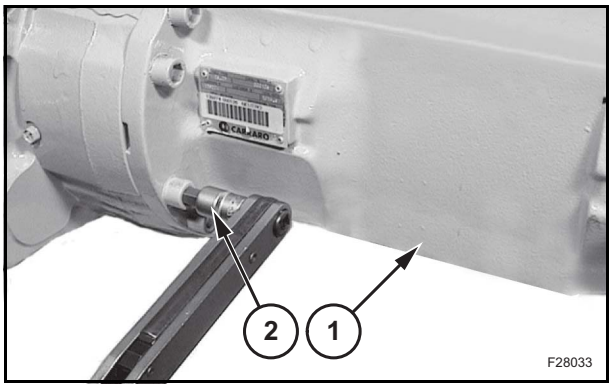
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Assemble the axle-beam (1) on the flange, being careful to the fastening holes' alignment.

⚠ WARNING

Support the groups properly as already pointed out for disassembly phase.

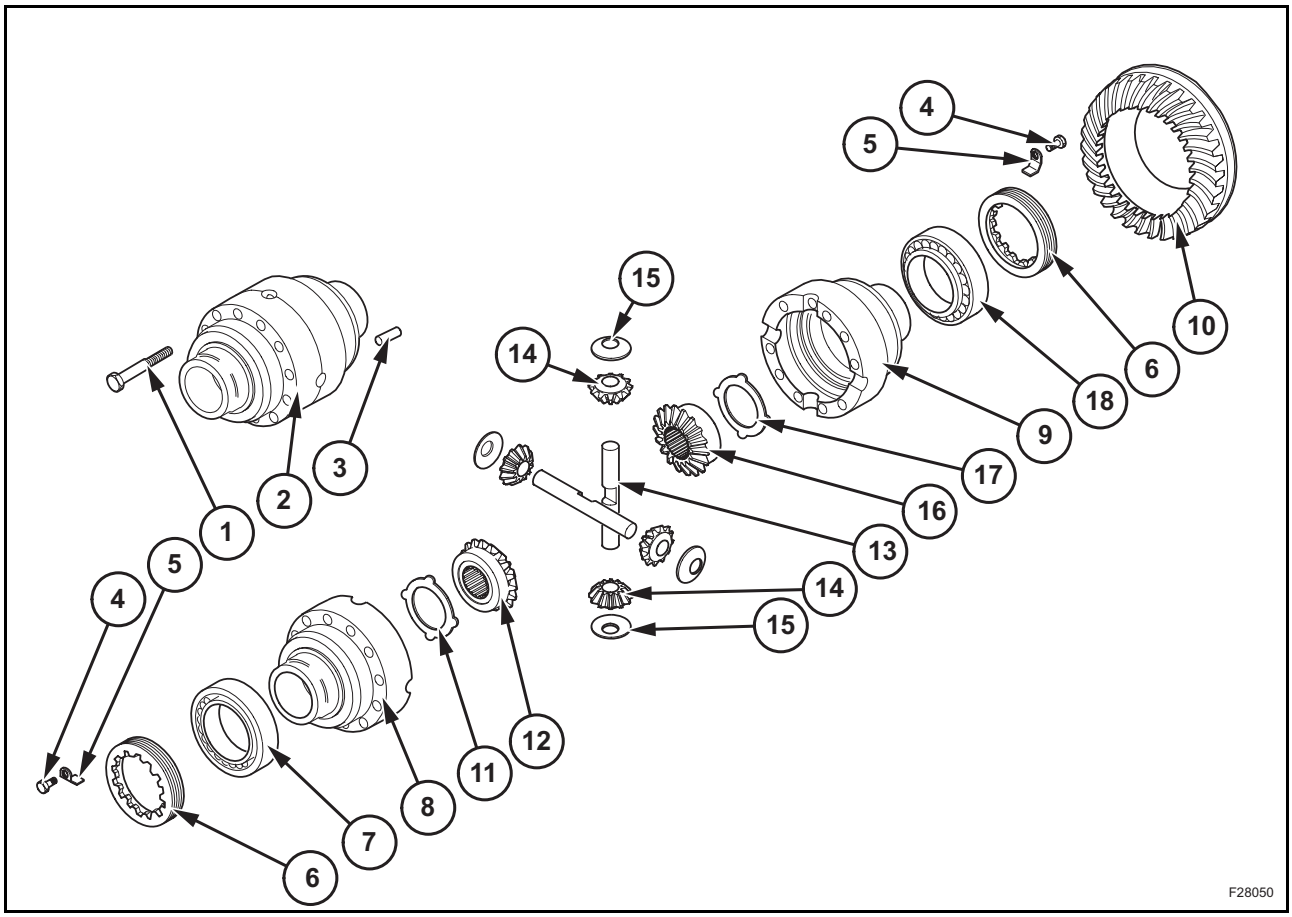
Screw in and tighten the screws (2) of the axle shaft drum to the specified torque.



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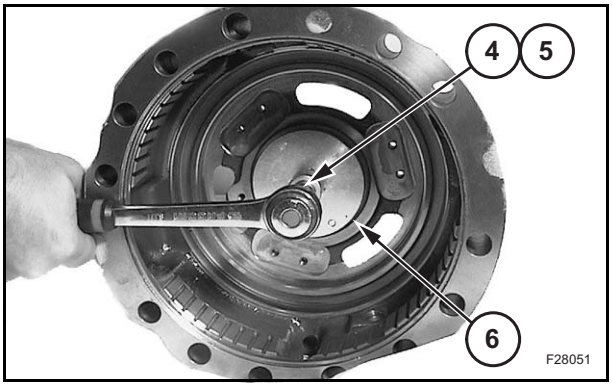
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DIFFERENTIAL GROUP (STANDARD)



Disassembly

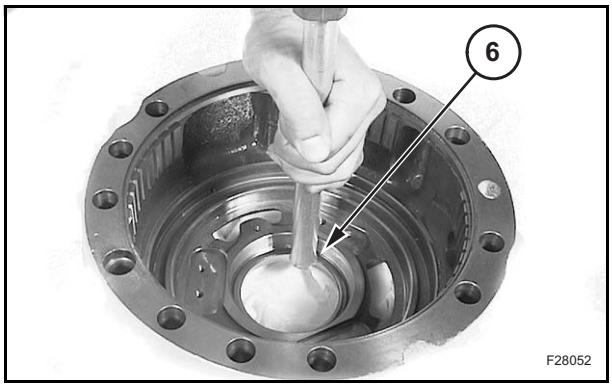
Loosen the screw (4) and remove the ring nut retainer (5).
Unscrew the ring nut with suitable special tool **320002218**.
Remove the ring nut (6).



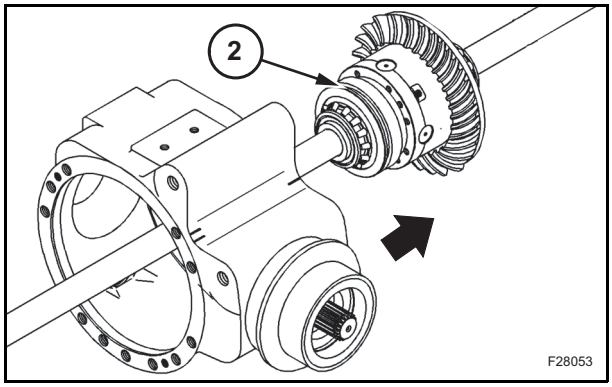
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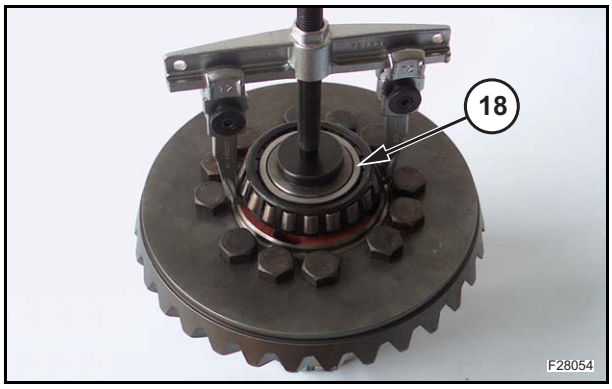
Remove the bearing cups (6).



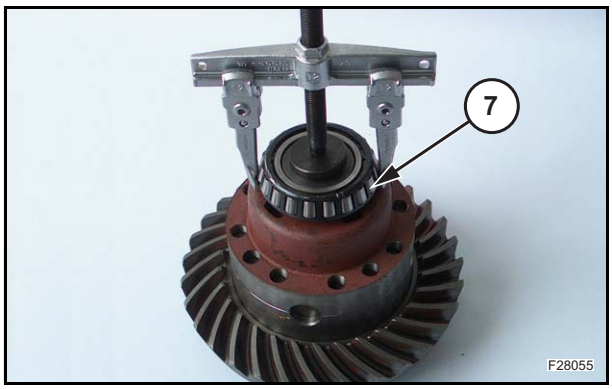
Support the differential assy (2) with a rod and remove it.



Use an extractor to remove bearing (18).



Use an extractor to remove bearing (7).



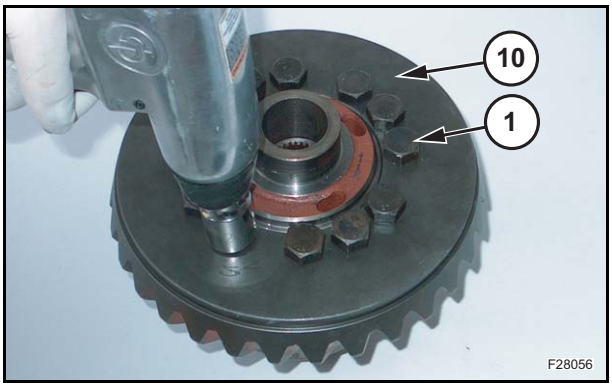
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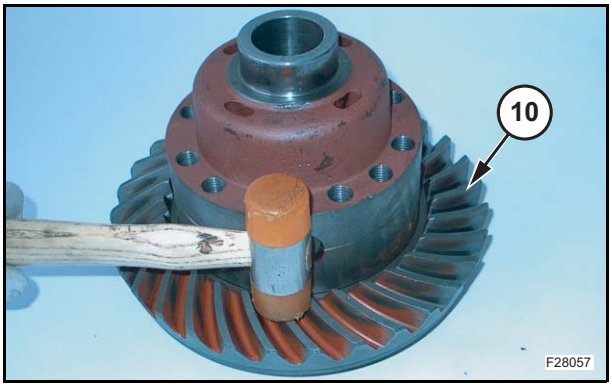
Loosen all screws (1) of the ring gear (10).

⚠ WARNING

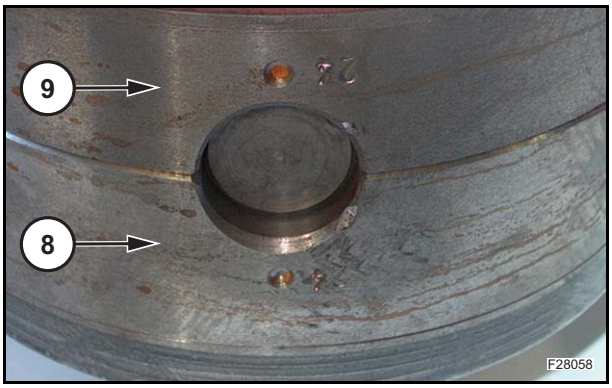
This operation makes both differential half boxes free, so take care not to lower the inner components.



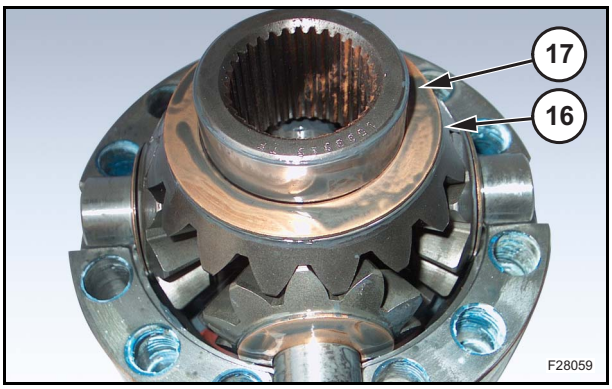
Remove the ring gear (10) by means of a hammer.



Check the marking points (8) and (9) that will be useful during the assemblage.



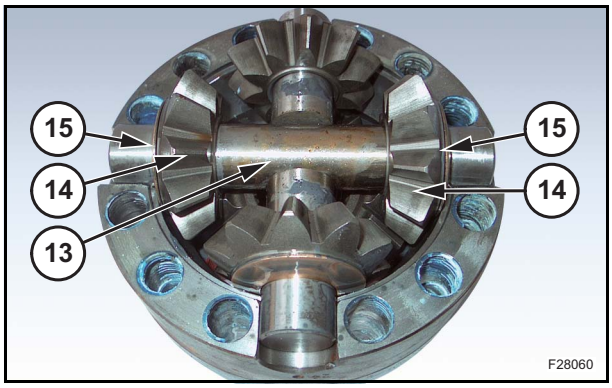
Remove the gear (16) and the shim (17).



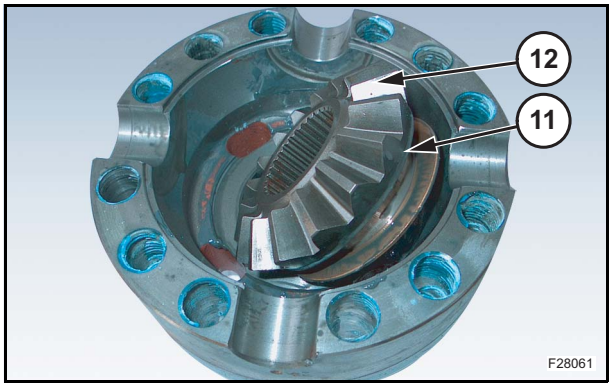
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Remove the shaft (13), the gears (14) and the spherical washers (15).



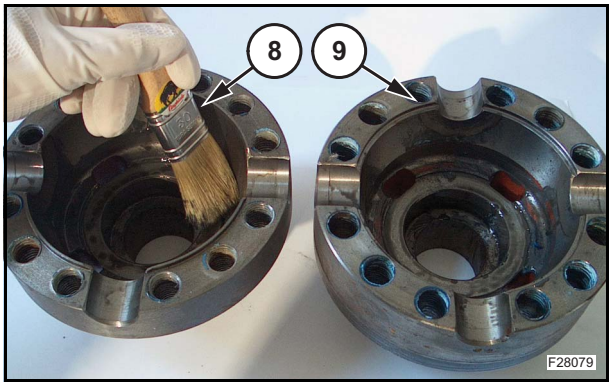
Remove the gear (12) and the shim (11).



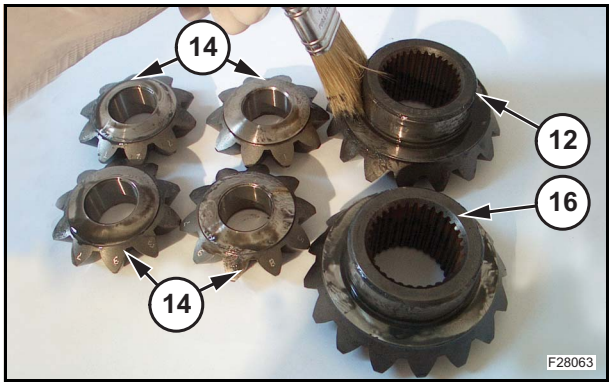
Assembly

Apply a thin layer of Molicote G-n plus paste on the half housings of differential (8) and (9).

⚠ WARNING
Remove rests of dope.



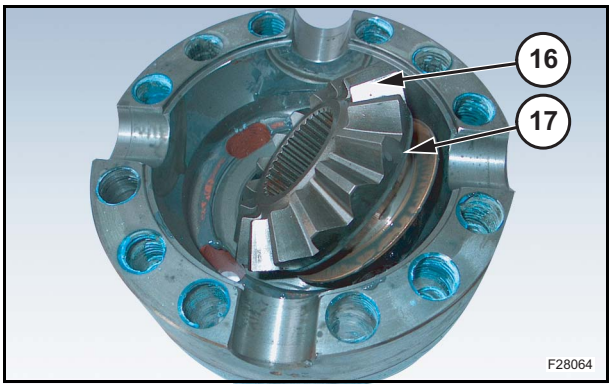
Apply a thin layer of Molicote G-n plus on the gears (12) and (16) and on the gears (14).



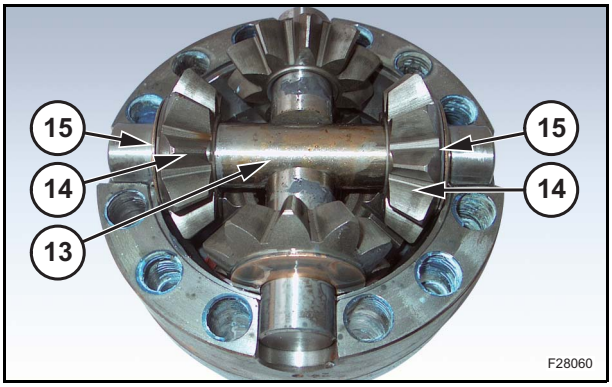
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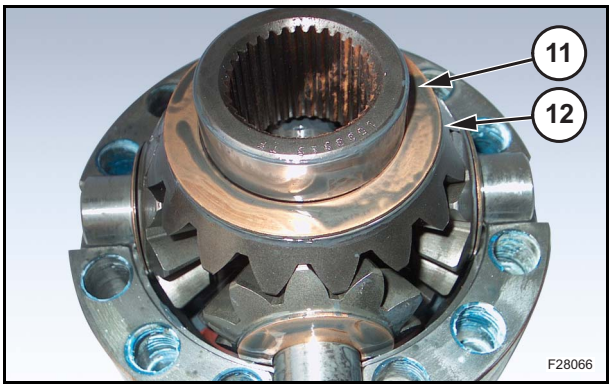
Assemble the gear (16) and the shim (17).



Position the shaft (13), the gears (14) and the spherical washers (15).



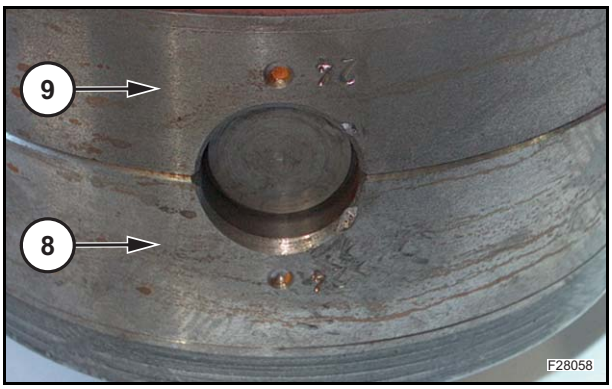
Assemble the gear (12) and the shim (11).



Assemble the two half housings of the differential unit (8) and (9).

⚠ WARNING

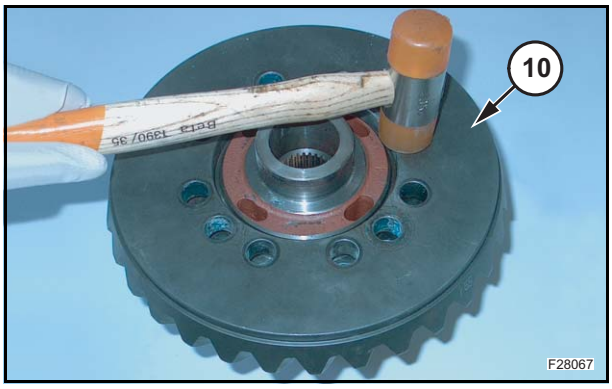
Carefully check that the marks of both differential half housings coincide.



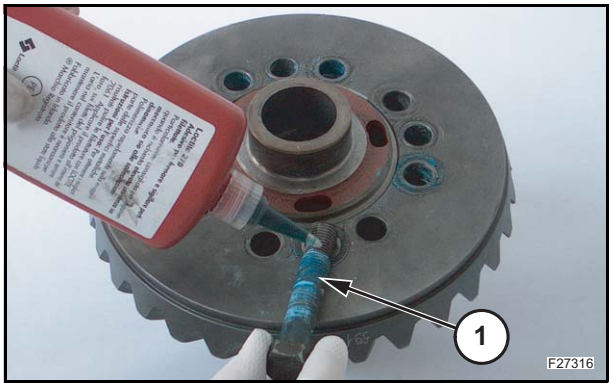
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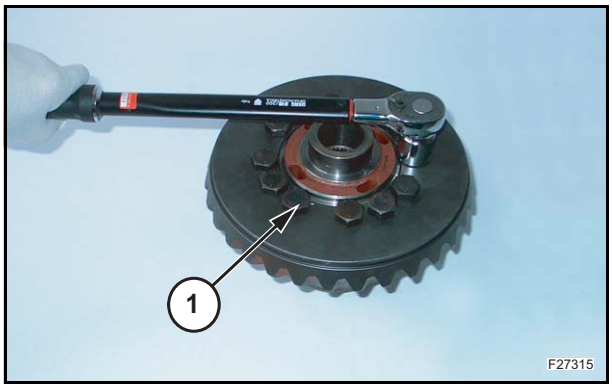
Assemble the ring gear (10) by means of a hammer.



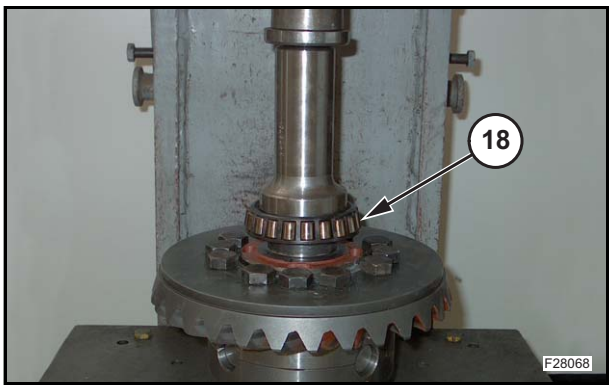
Apply Loctite 242 on the thread of screws (1).



Tighten the screws (1) to the specified torque.



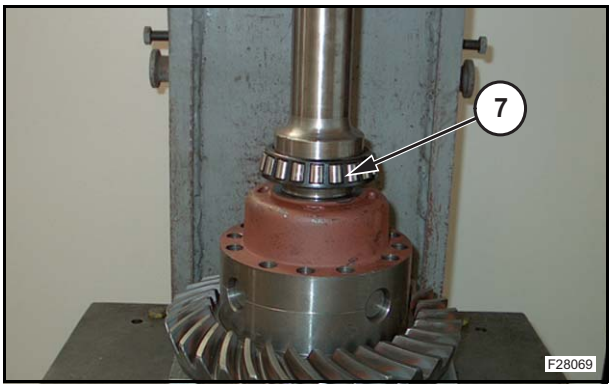
Press the bearing (18) or assemble after preheating.



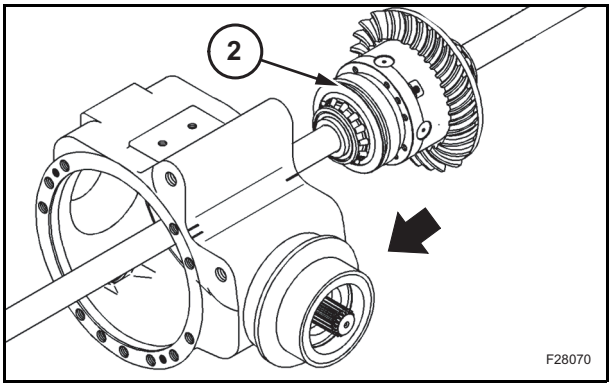
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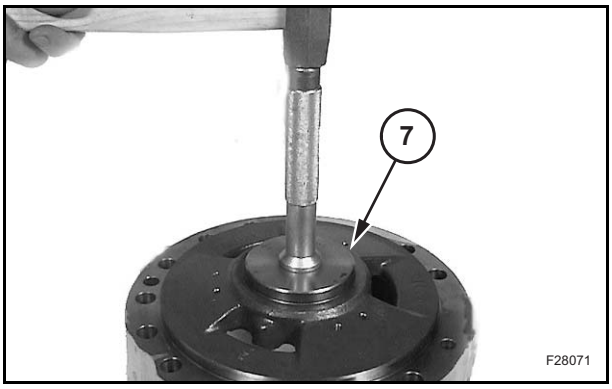
Press the bearing (7).



Support the differential assy (2) with a rod and assemble it.



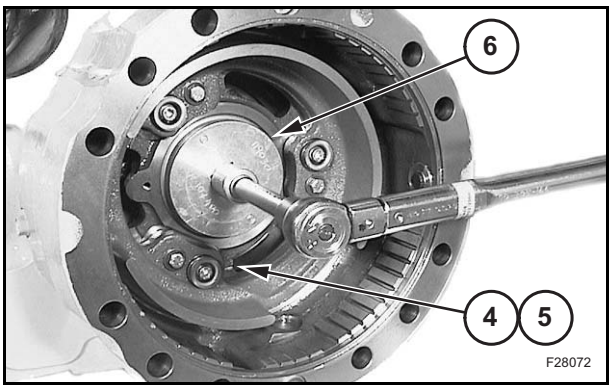
Fit the outer cups of the bearings (7) by means of the special tool **380002671** and a hammer.



Insert and tighten the ring nuts (6), using the wrench **380002218** until the clearance of the bearings is removed.

NOTE: tighten the ring nuts gradually but not excessively.

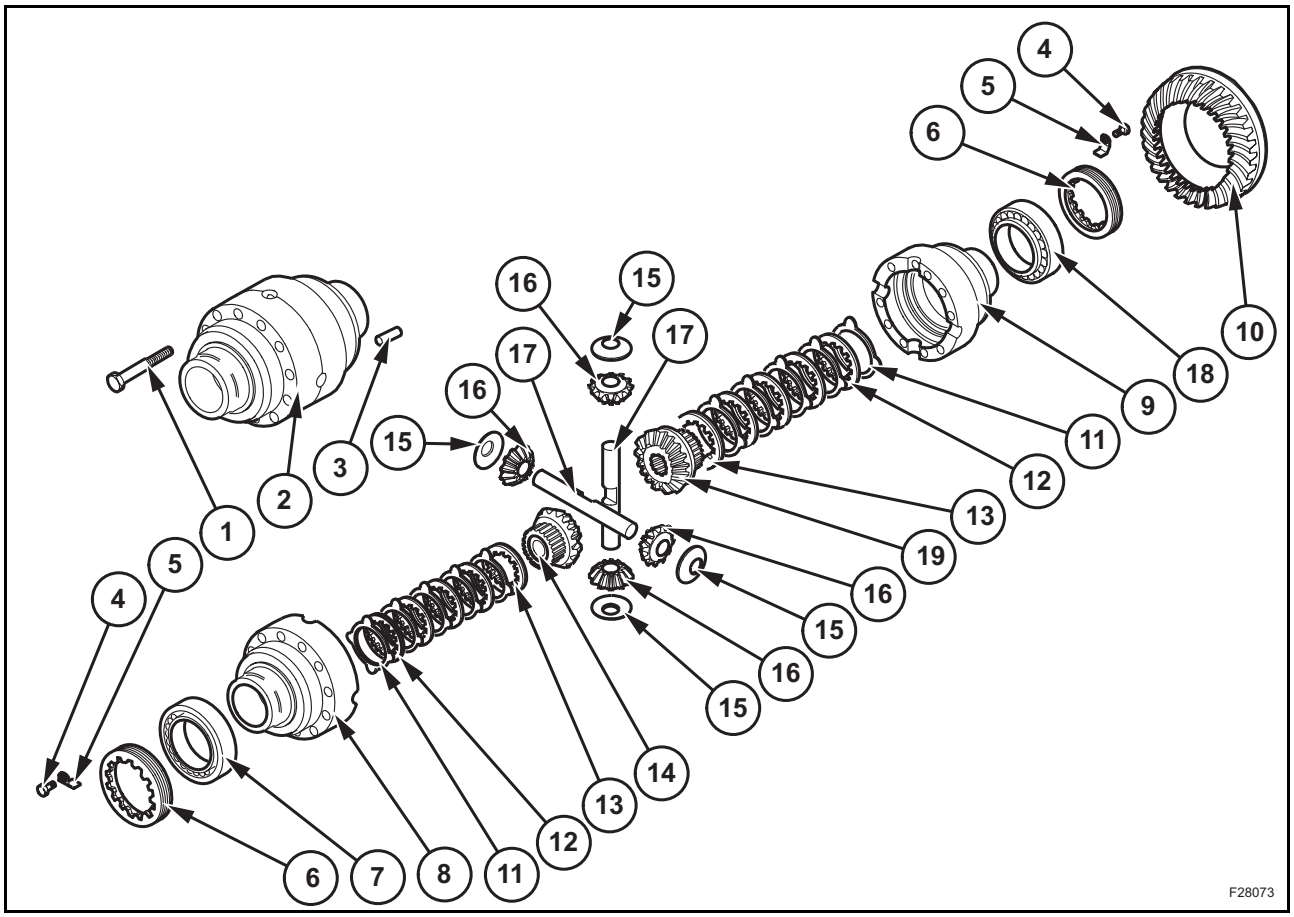
Assemble the ring nut retainer (5) and fasten it by means of the screw (4).



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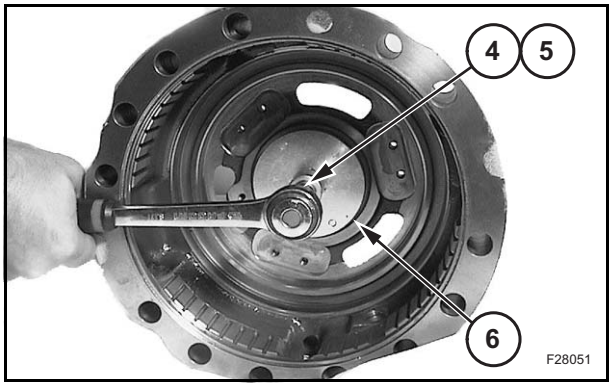
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DIFFERENTIAL GROUP (SELF-LOCKING)



Disassembly

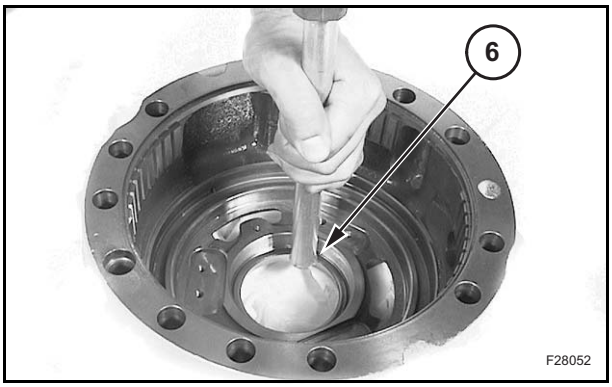
Loosen the screw (4) and remove the ring nut retainer (5).
Unscrew the ring nut with suitable special tool **380002218**.
Remove the ring nut (6).



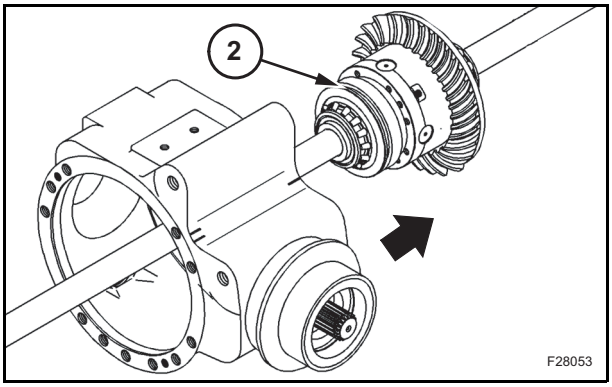
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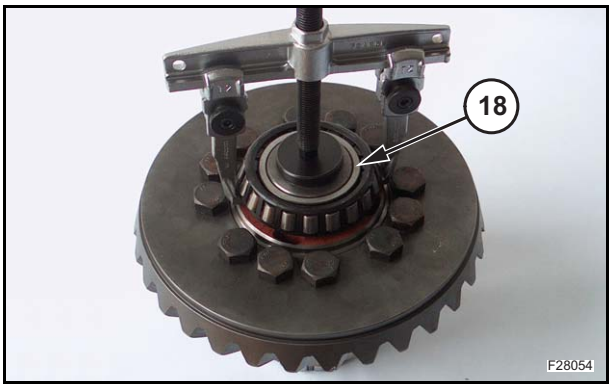
Remove the bearing cups (6) with a hammer.



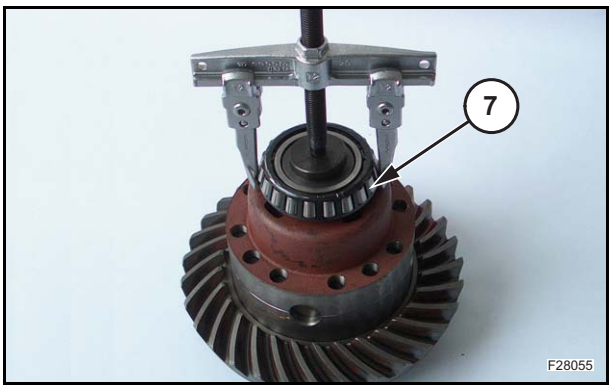
Support the differential assy (2) with a rod and remove it.



Use an extractor to remove bearing (18).



Use an extractor to remove bearing (7).



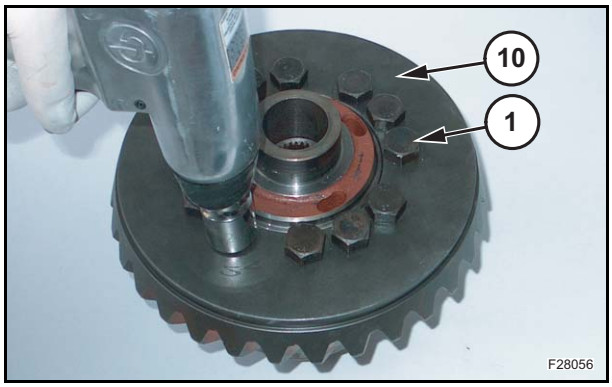
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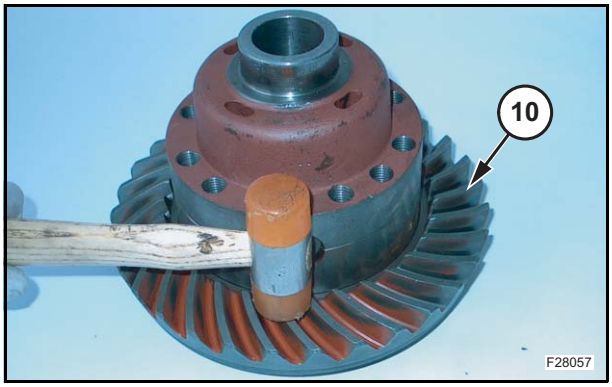
Loosen all screws (1) of the ring gear (10).

⚠ WARNING

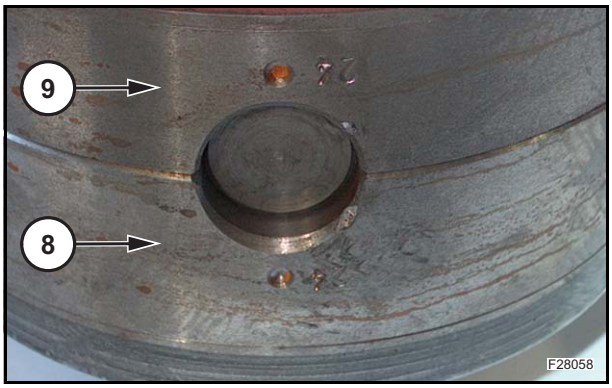
This operation makes both differential half boxes free, so take care not to lower the inner components.



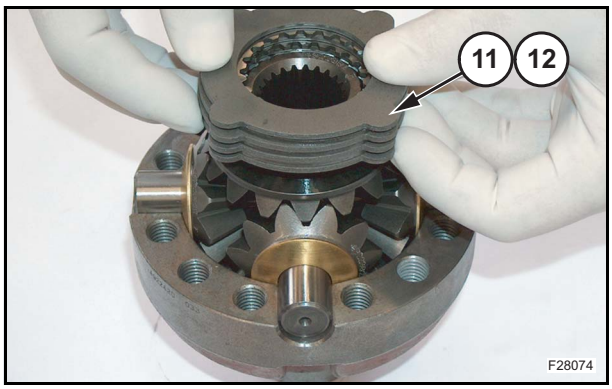
Remove the ring gear (10) by means of a hammer.



Check the marking points (8) and (9) that will be useful during the assemblage.



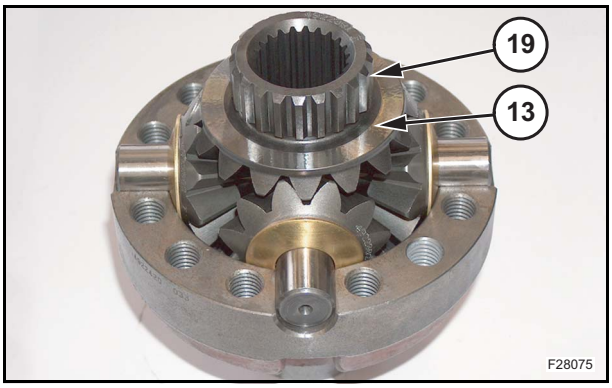
Assemble the discs (11) and (12).



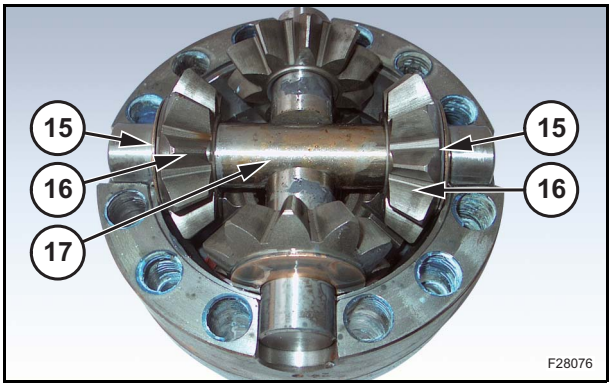
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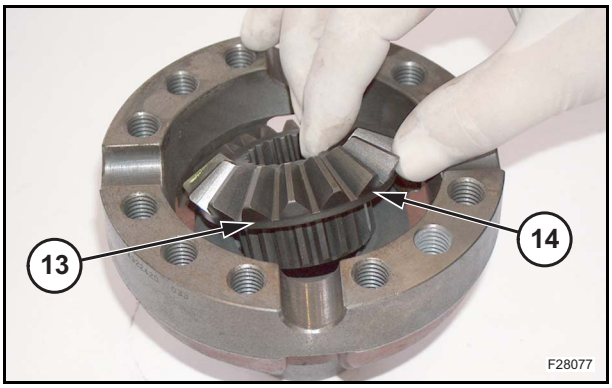
Remove the gear (19) and the shim (13).



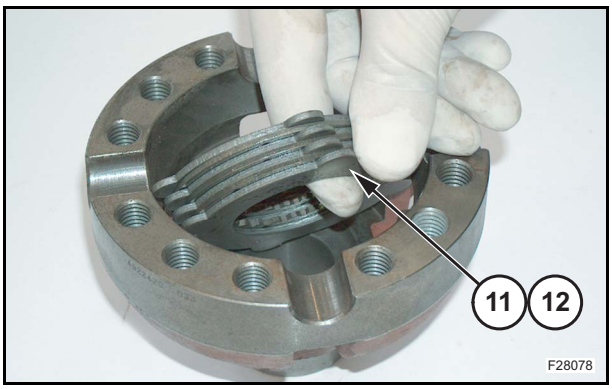
Remove the shaft (17), the gears (16) and the spherical washers (15).



Remove the gear (14) and the shim (13).



Assemble the discs (11) and (12).



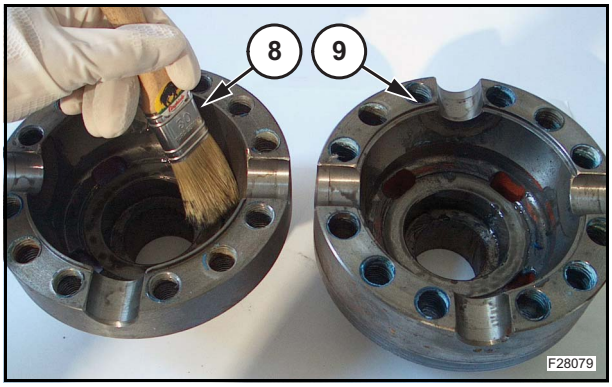
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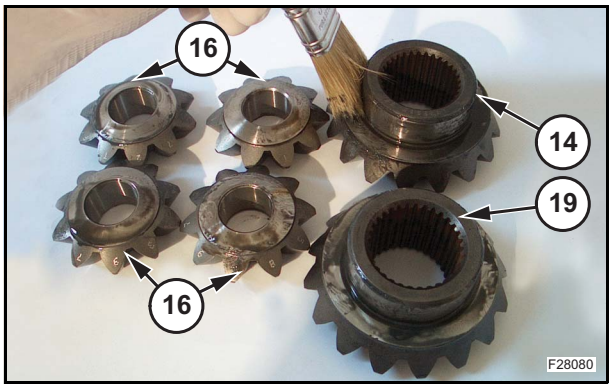
Assembly

Apply a thin layer of Molicote G-n plus paste on the half housings of differential (8) and (9).

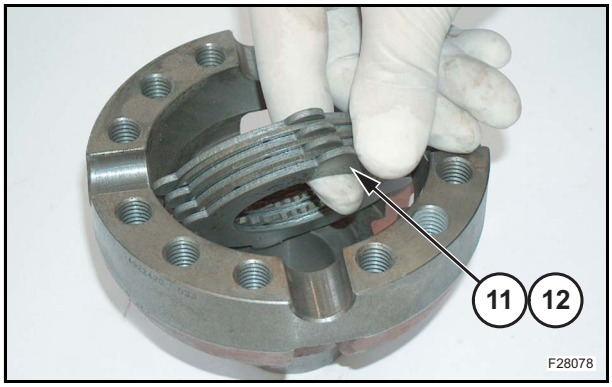
⚠ WARNING
Remove rests of dope.



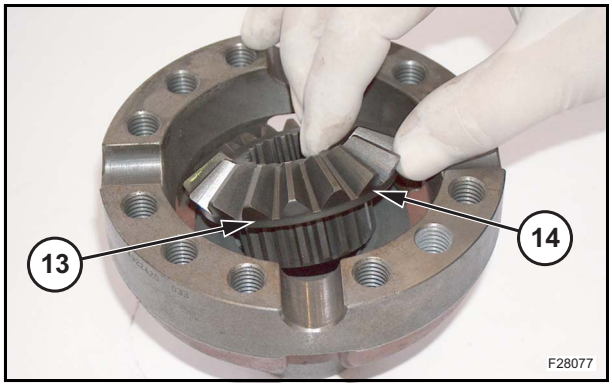
Apply a thin layer of Molicote G-n plus on the gears (14) and (19) and on the gears (16).



Assemble discs (11) and (12).



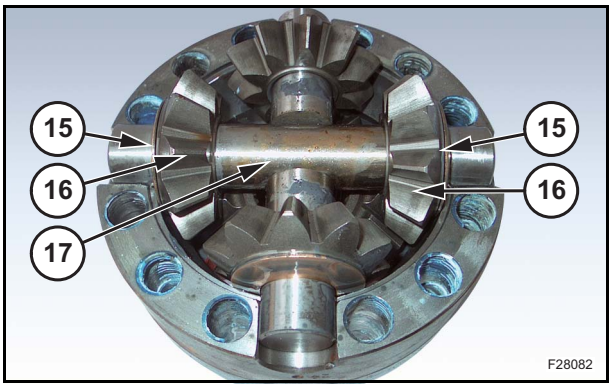
Assemble the gear (14) and the shim (13).



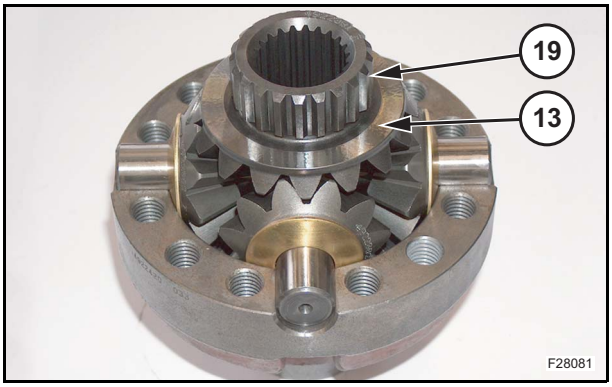
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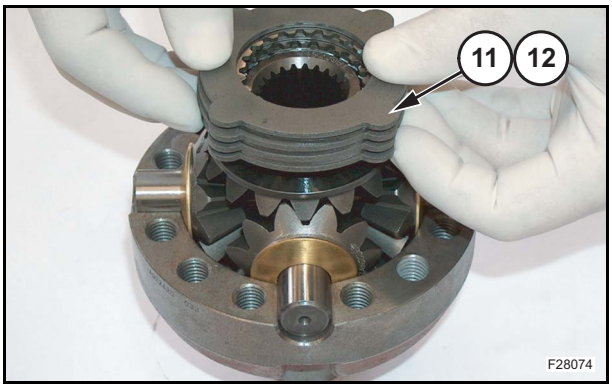
Position the shaft (17), the gears (16) and the spherical washers (15).



Assemble the gear (19) and the shim (13).



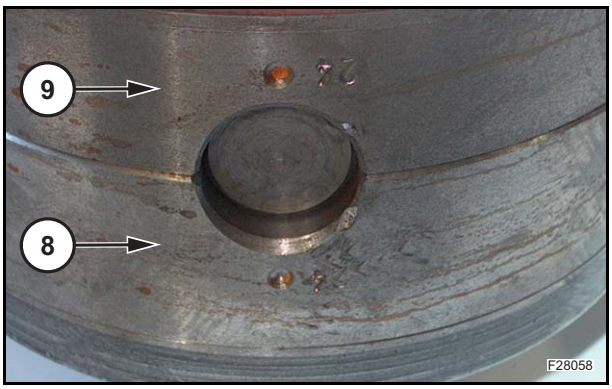
Assemble discs (11) and (12).



Assemble the two half housings of the differential unit (8) and (9).

⚠ WARNING

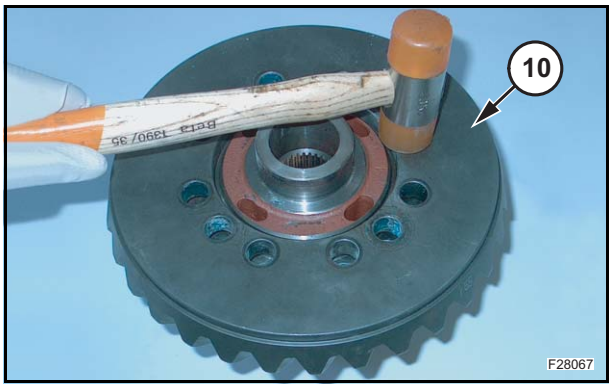
Carefully check that the marks of both differential half housings coincide.



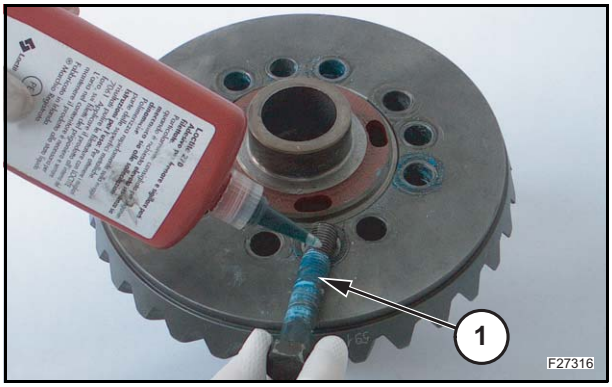
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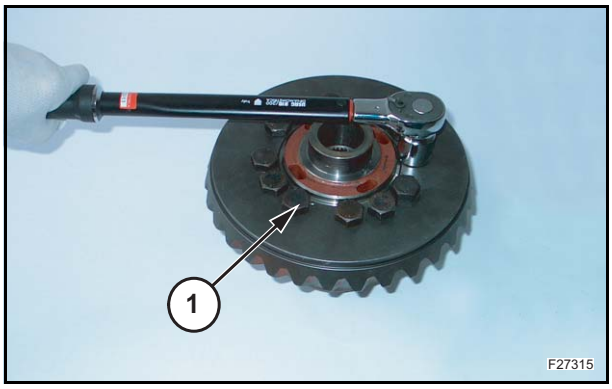
Assemble the ring gear (10) by means of a hammer.



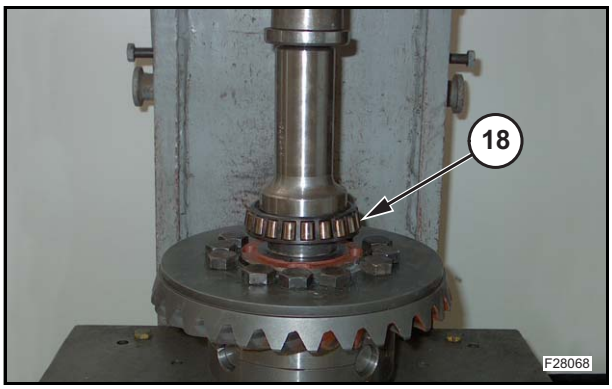
Apply Loctite 242 on the thread of screws (1).



Tighten the screws (1) to the specified torque.



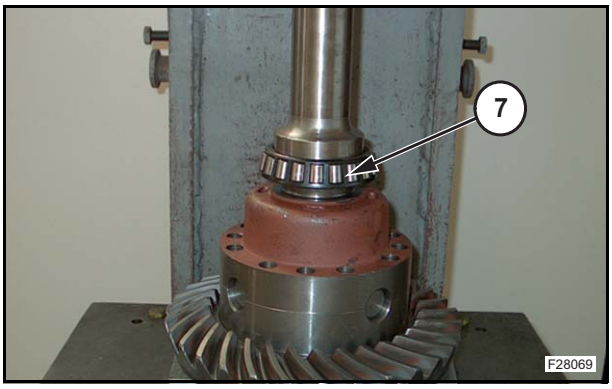
Press the bearing (18) or assemble after preheating.



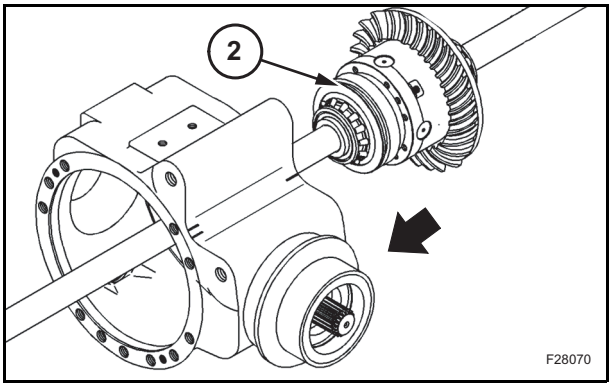
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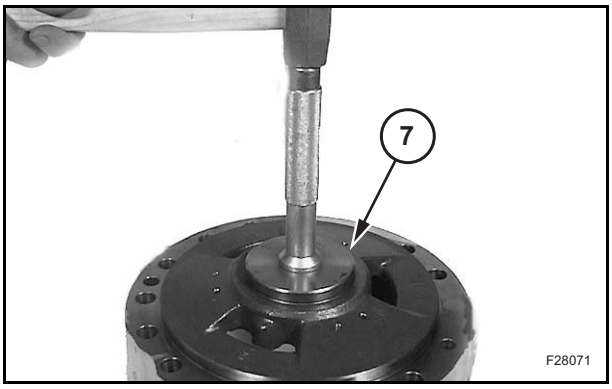
Press the bearing (7).



Support the differential assy (2) with a rod and assemble it.



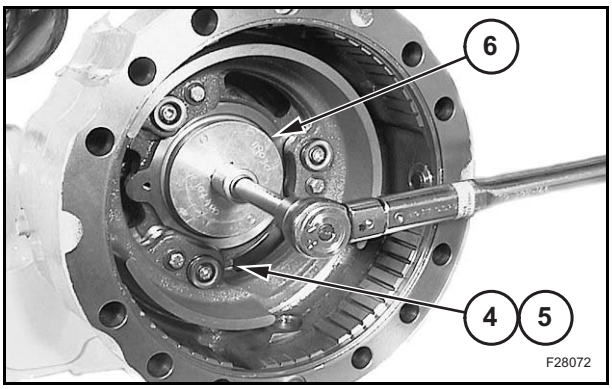
Fit the outer cups of the bearings (7) by means of the special tool **380002671** and a hammer.



Insert and tighten the ring nuts (6), using the wrench **380002218** until the clearance of the bearings is removed.

NOTE: tighten the ring nuts gradually but not excessively.

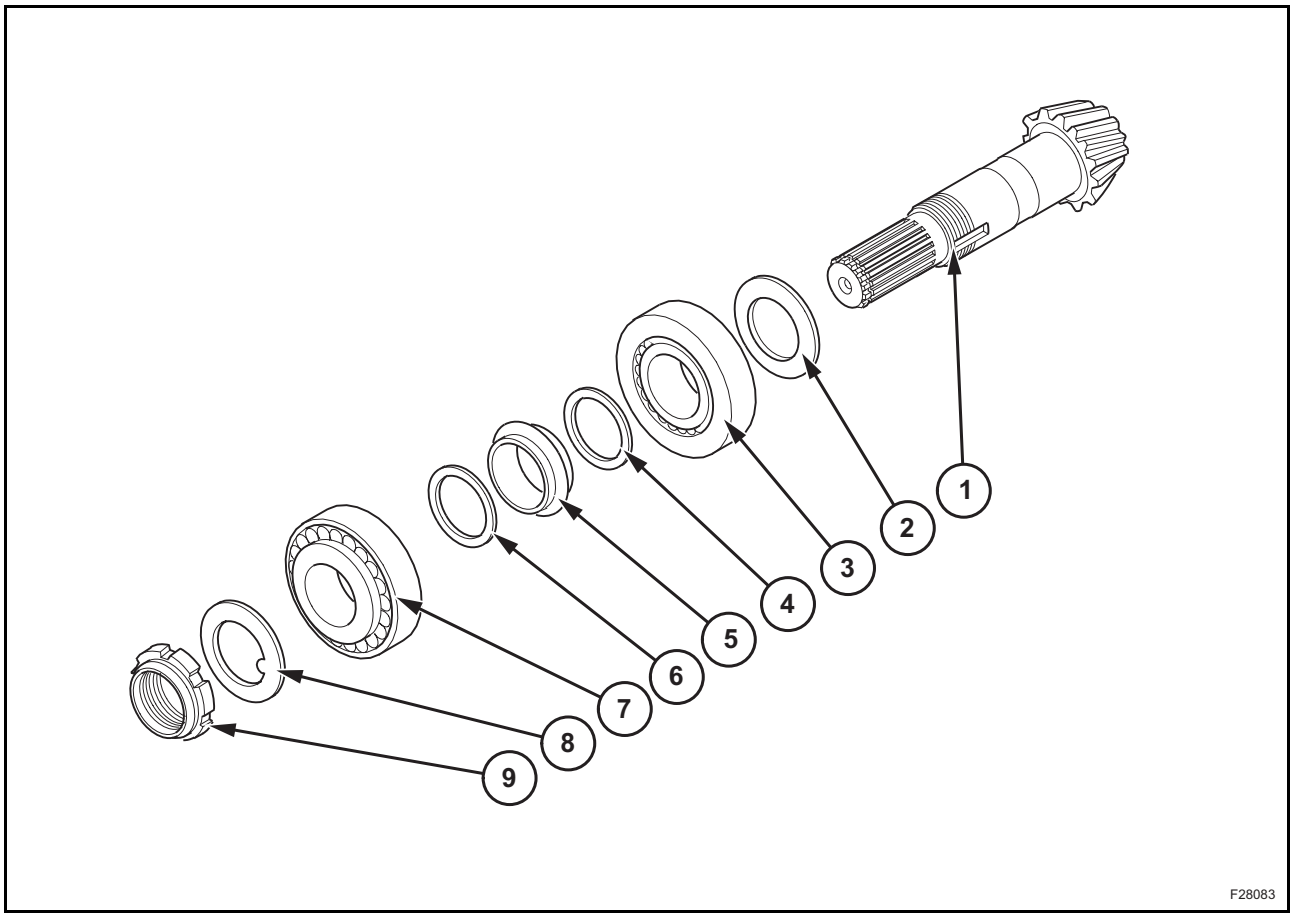
Assemble the ring nut retainer (5) and fasten it by means of the screw (4).



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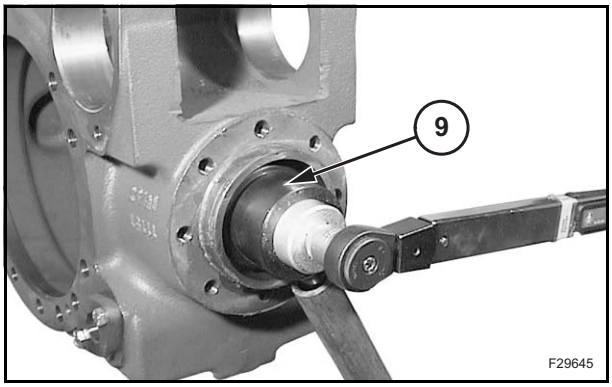
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PINION GROUP



Disassembly

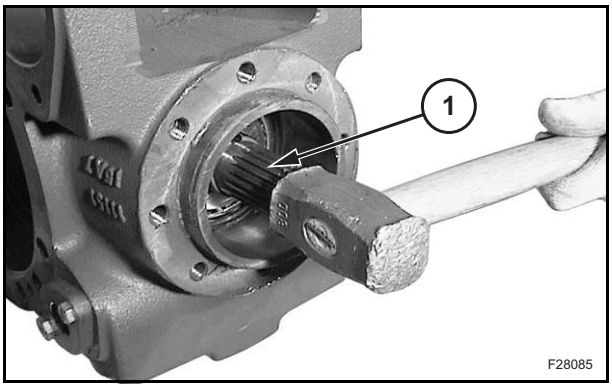
In order to prevent serious damage to the pinion thread, unscrew the ring nut (9) with the special tool **380000406**.



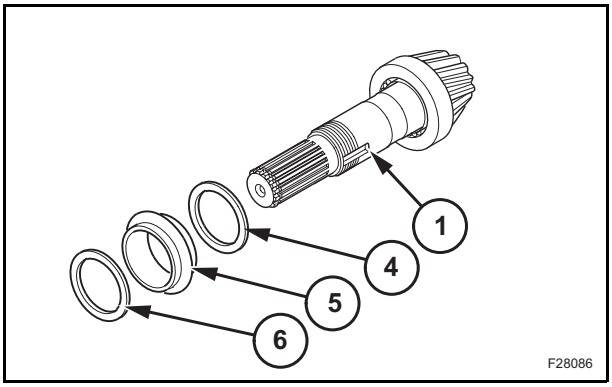
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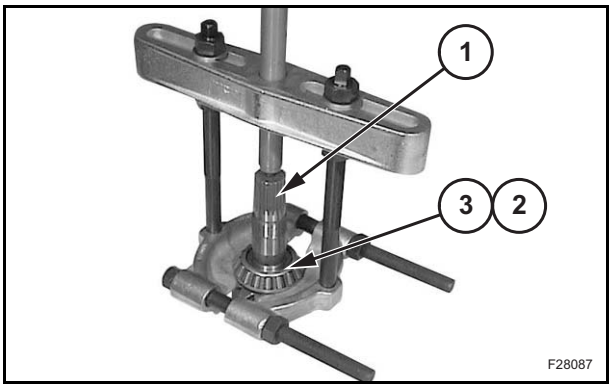
Once the ring nut washer has been removed, extract the pinion (1) from its housing by hitting it with a hammer made of soft material on the splined end.



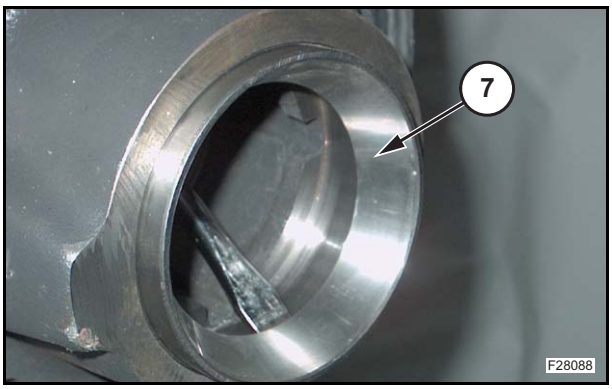
Remove the washer (6), the spacer (5) and the shims (4) from the pinion (1).



Remove the bearing (3) from the pinion (1) using an extractor.
Remove the shim (2) located under the bearing and check its wear conditions.



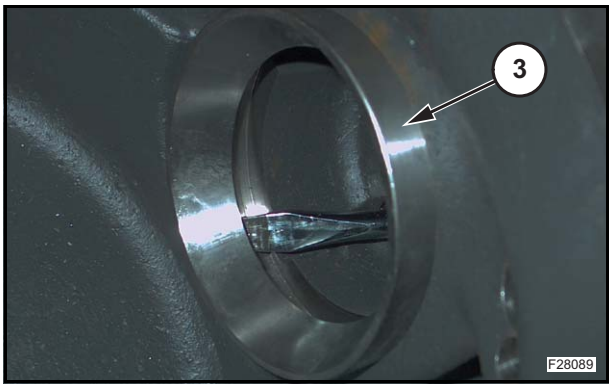
Remove the bearing cup (7) from the central body.



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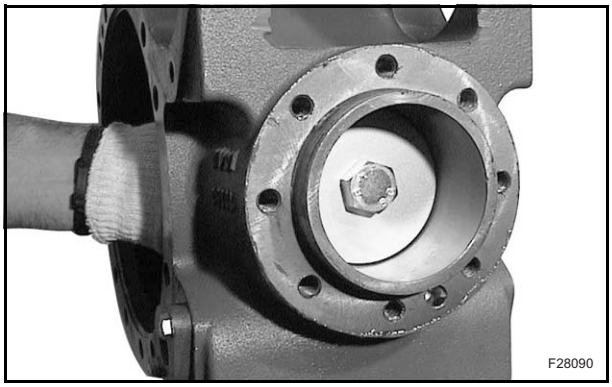
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Remove the bearing cup (3) from the central body.

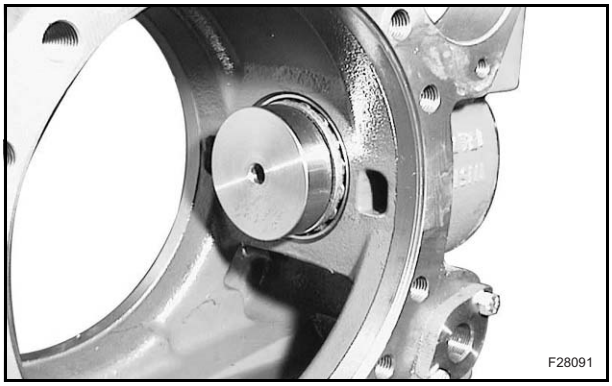


Assembly

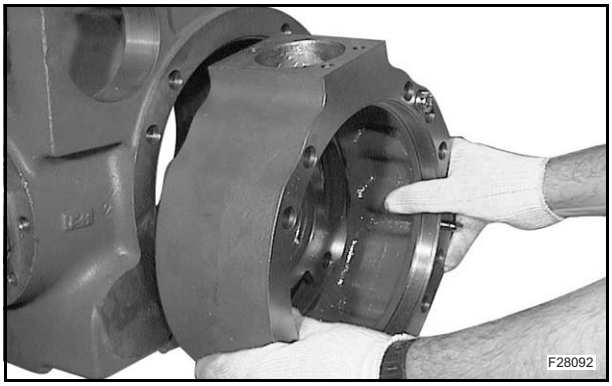
Position the central body on a workbench.
Force the cups of the bearings on their housings using the special tool **380002215** for outer bearing race and for inner bearing race.



In order to measure the distance, the kit composed of the special tools, respectively called “false pinion” **380002673** and “false differential box” **380002674**, is used.
Insert the false pinion, together with its bearings and its ring nut, in the just mounted housings for the bearings.
Tighten without exceeding, till the backlash is eliminated.



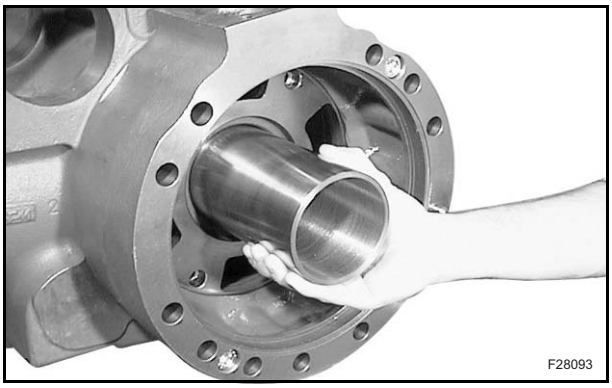
Check the correct positioning of the right and left flanges, using the reference marks on them and on the central body.
Assemble the two brake flanges and fix them with their screws (screw in at least two ones diametrically-opposed for each flange).



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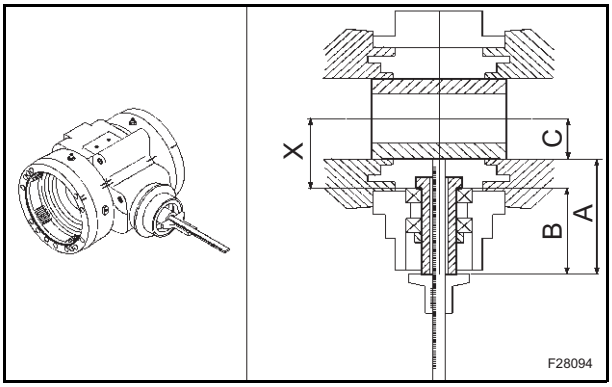
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Insert the false differential box **380002674** into the central body to measure the distance.
Check that the false box is inserted in both brake flanges' housings.



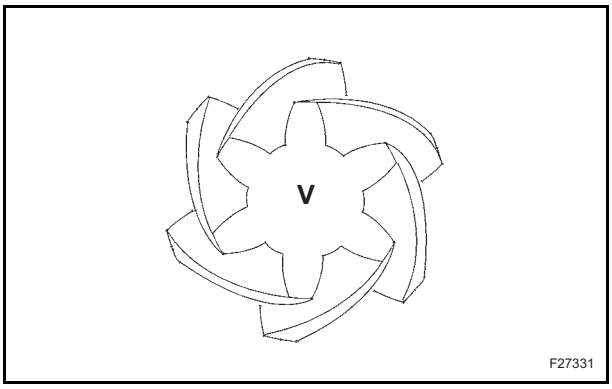
Carry out the measurement with a depth gauge through the suitable false pinion hole.
X = (conical distance to be measured)
A = (measured value)
B= (known value)= 100 mm
C= (known value)= 50 mm

(A+C) - B = X

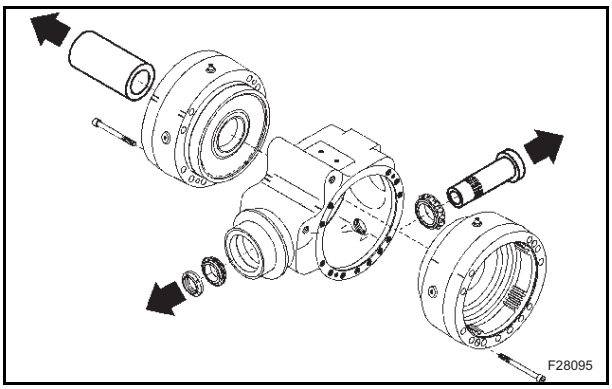


In order to determine the shim (S) necessary between the pinion and the bearing, you should subtract the (V) value stamped on the pinion head (V = requested conical distance) from the (X) value.

S = X-V



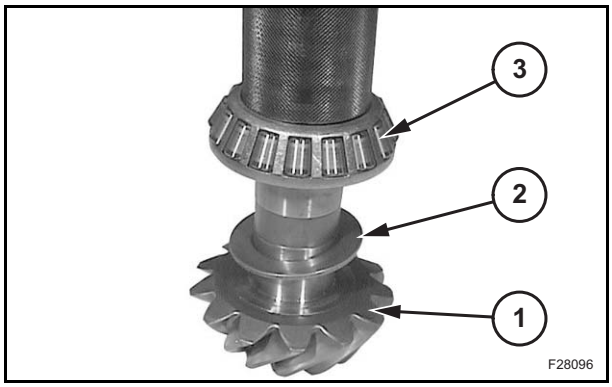
Remove the false pinion, the bearings and the ring nut from the central body.
Disassemble the false differential box from the flanges and then unscrew the screws to remove the flanges.



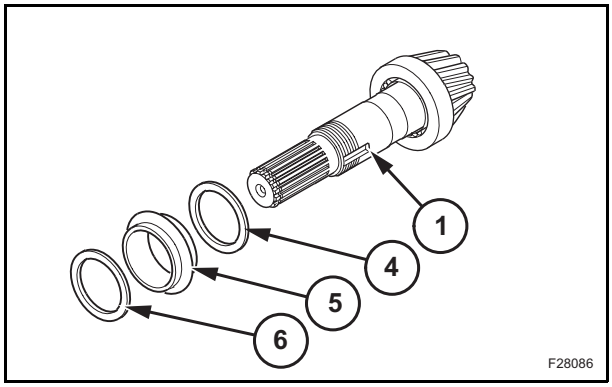
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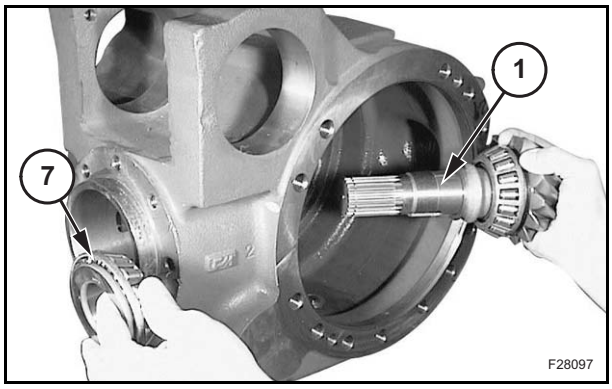
Insert the shim (2) on the pinion (1) with the chamfer against the gear.
Press the bearing (3) into the pinion, making sure that it is well set.



Insert the shims (4) and (6) and the spacer (5) into the pinion (1).

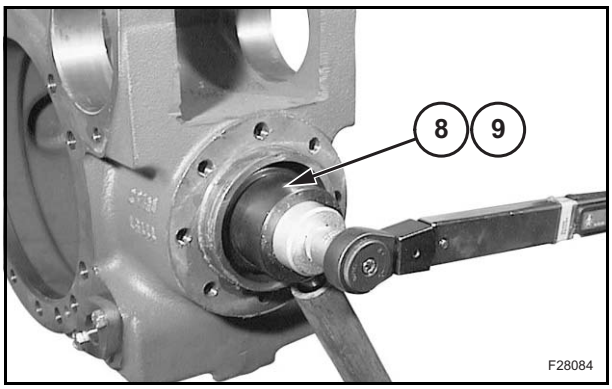


Insert the pinion (1) into its seat in the central body housing and the bearing (7) into the pinion end.



Insert a new washer (8) and a new ring nut (9).
Screw the ring nut in, using the wrench **380000406** for ring nut and for pinion retainer.

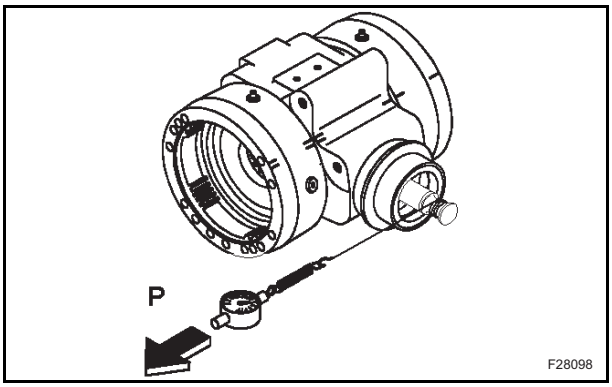
⚠ WARNING
The torque setting is given by the preloading measurement on bearings.



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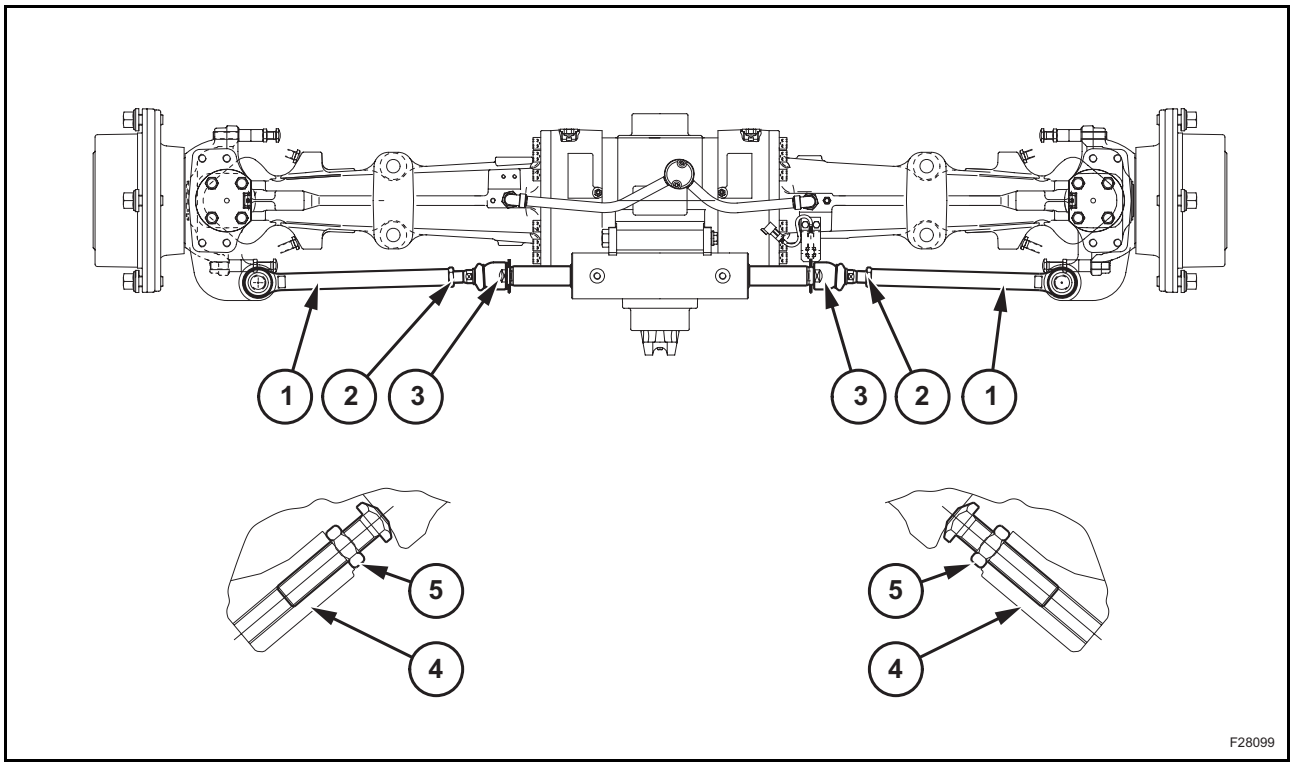
Carry out the preloading measurement (P) of the pinion taper roller bearings, using a dynamometer **380002672**.
The adjustment is carried out by increasing the ring nut torque gradually, being careful not to exceed.
Once you got the requested preloading value, caulk the ring nut.



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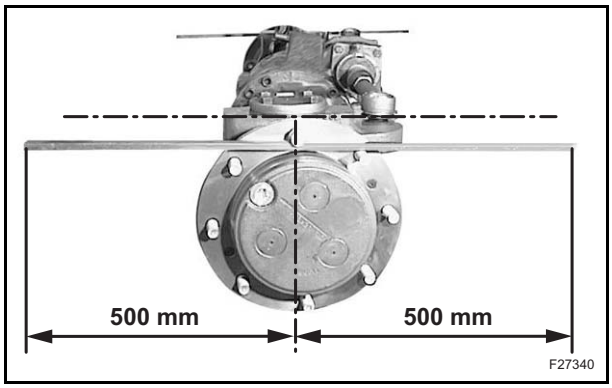
TOE-IN/STEERING ANGLE ADJUSTMENT



Toe-in

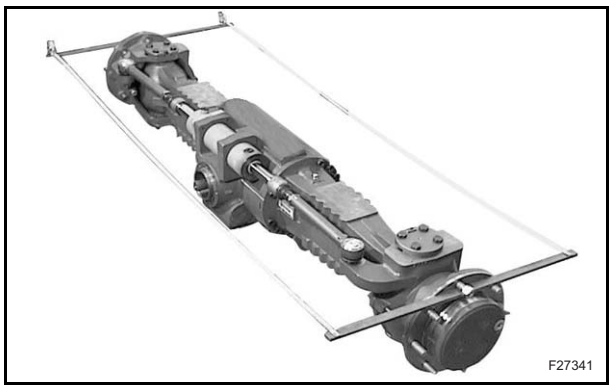
Put two equal one-metre-long linear bars on the wheel sides and lock them with two nuts on the wheel hub stud bolt.

⚠ WARNING
The two bars should be fixed on their middle so that they are perpendicular to the supporting surface and parallel to the pinion shaft axis; align the two bars.



Measure the distance in mm (M) between the bars ends with a tapeline.

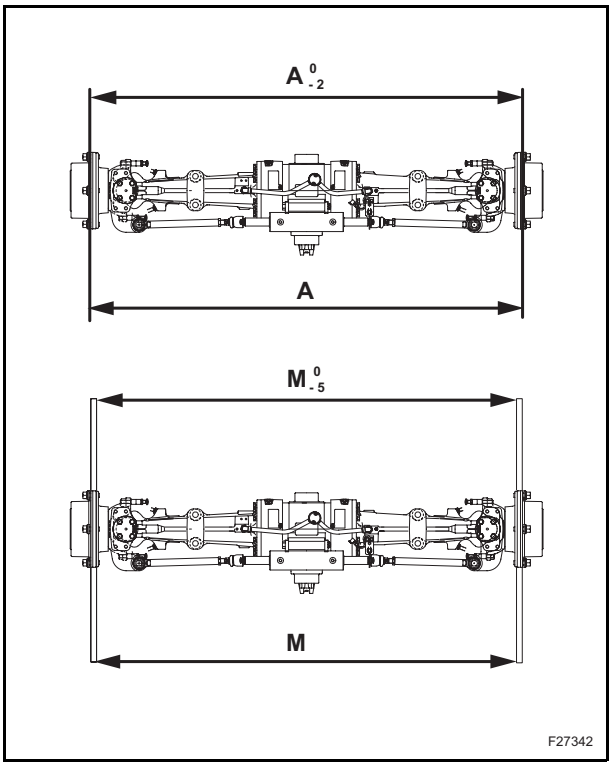
NOTE: keep the minimum value, swinging the measurement point.



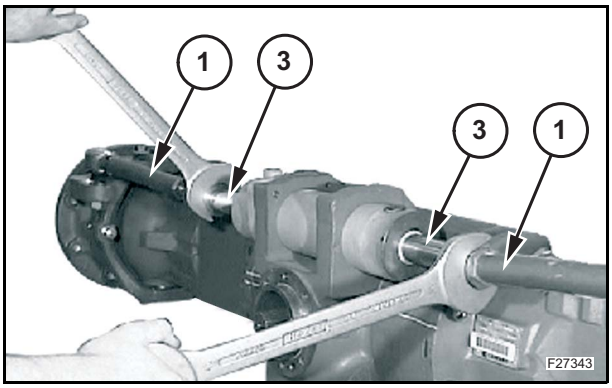
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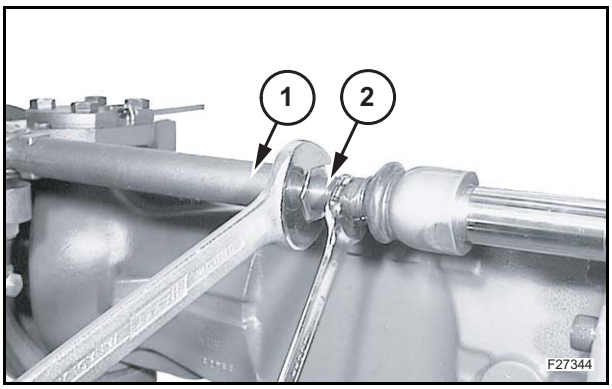
Check that the difference of the measurements between the wheel hubs diameters ends is within the requested tolerance range.
The nominal toe-in value (A) is referred to the external diameter of the wheel hubs flange, therefore the measured value (M) at the bars ends must be related to the ratio between length of the bar and flange diameter
nominal toe-in= A_{-2} → measured toe-in= M_{-5}



If toe-in is incorrect, operate with two wrenches on the guide rods (1) screwing in and out the two joint tie rods (3) equally till the toe-in is within the requested tolerance.



After adjusting, screw in the locknuts (2) of the guide rods (1) to the specified torque.

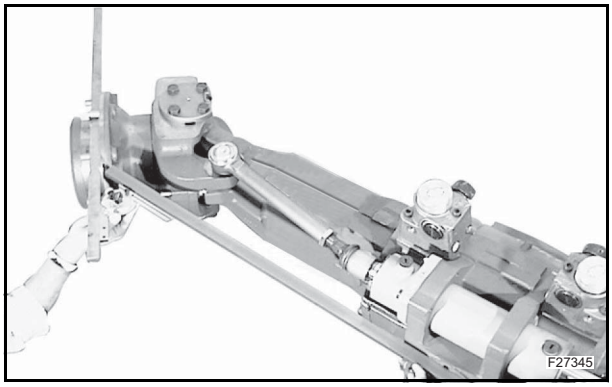


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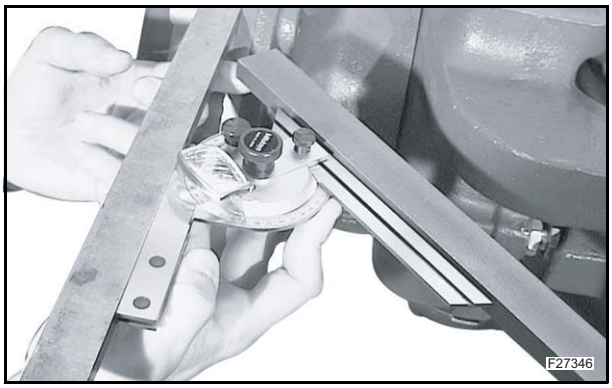
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Steering angle

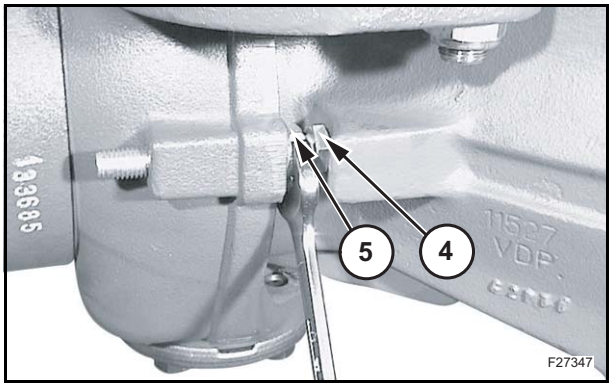
Use the same bars assembled for the toe-in adjustment and a long bar perfectly leaned over the machined part of the central body (pinion side), so that the two bars form an acute angle at the maximum steering.



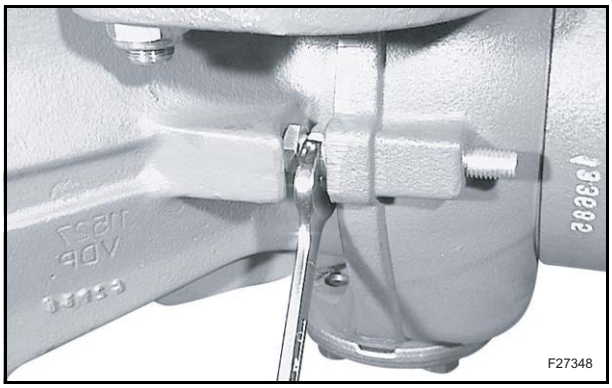
Adjust a protractor to the requested angle and position it on the long bar.
Move a wheel side till it forms, with the two bars, the angle fixed by the protractor.



Adjust the mechanical steering stop, screwing in or off the stop screw (4), locking it with the locknut (5) to the prescribed tightening torque.



Steer completely towards the other side and repeat the same operations.



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2.3 FAULT FINDING

PROBLEMS	CAUSE										
	1	2	3	4	5	6	7	8	9	10	11
Wheel vibration; front tyre resistance; half shaft breakage	●	●	●		●						●
Steering is difficult; vehicle goes straight while it's turning	●	●	●	●							●
No differential action; jamming while steering	●			●	●						●
Transmission excessively noisy	●	●	●	●	●		●		●		●
Uneven wear of tyre	●	●	●	●	●	●	●				●
Friction noise	●			●	●			●	●	●	●
Vibration during forward drive, intermittent noise	●	●	●		●						●

1. Incorrect installation / defective axle
Correct installation or repair or replace the differential in case it does not survive any one of the test phases.

2. Overloading / incorrect weight distribution
Remove excessive weight and redistribute load, following instructions related to the vehicle.

3. Different rotation radius of the tyres
If one tyre has a smaller radius, it will cause partial wheel slipping when force is applied. The other tyre with bigger radius will have to support all the work. Replace the tyre or adjust pressure to have same radius on both tyres.

4. Broken half shaft
It is not advisable to operate the vehicle with a broken half shaft. It is acceptable to move the vehicle (engine off unloaded) a few metres away only.

5. Bent half shaft
Replace the half shaft.

6. Blocked differential
Abnormal functioning of the differential or breakage/blockage of command device. Verify assembly and all components.
Vehicles with wide steering angle may proceed with kicks, have steering difficulty or cause pneumatic wearing at sharp turns. Reduce the steering angle to minimum and decelerate when the vehicle begins to kick.

7. Incorrect wheel adjustment
Verify group integrity and wheel side bearings.
Adjusting according.

8. Damaged or worn axle parts
Check the condition of ring gear, pinion gear, bearings etc.
Replace whenever necessary.

9. Contamination in the axle box or incorrect assembly of parts
Look for foreign particles. Check assembly of the various parts of the axle.

10. Incorrect adjustment of the bevel gear set: parts of the transmission worn out
(Transmission gears, U joints, etc.). Replace or adjust as required.

11. Incorrect use of the product
See the vehicle Manufacturer's instructions once again.

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PROBLEM	CAUSE	CORRECTION
Ring gear tooth broken on the outer side	Excessive gear load compared to the one foreseen Incorrect gear adjustment (excessive backlash) Pinion nut loose	Replace bevel gear set. Follow carefully the recommended operations for the adjustment of the bevel gear set backlash.
Ring gear tooth broken side	Load bump Incorrect gear adjustment (insufficient backlash) Pinion nut loose	Replace bevel gear set. Follow carefully the recommended operations for the adjustment of the bevel gear set backlash.
Pinion or ring gear teeth worn	Insufficient lubrication Contaminated oil Incorrect lubrication or depleted additives Worn out pinion bearings that cause an incorrect pinion axle backlash and wrong contact between pinion and ring	Replace bevel gear set. Follow carefully the recommended operations for the adjustment of the bevel gear set backlash. Use correct lubricants, fill up to the right levels and replace according to the recommended program.
Overheated ring and pinion teeth See if gear teeth have faded	Prolonged functioning at high temperatures Incorrect lubrication Low oil level Contaminated oil	Replace bevel gear set. Use proper lubrication, fill up to right level and replace at recommended program.
Pinion teeth pitting	Excessive use Insufficient lubrication	Replace bevel gear set. Use correct lubrication, fill up to the right level and substitute at recommended intervals.
Axle beam body bent	Vehicle overloaded Vehicle's accident Load bump	Replace axle beam body.
Worn out or pitted bearings	Insufficient lubrication Contaminated oil Excessive use Normal wear out Pinion nut loose	Replace bearings. Use correct lubrication, fill up to the right level and substitute at recommended intervals.
Oil leakage form gaskets and seals	Prolonged functioning at high temperature of the oil Oil gasket assembled incorrectly Seal lip damaged Contaminated oil	Replace the gasket or seal and matching surface if damaged. Use correct lubrication and replace at recommended intervals.
Excessive wearing out of input flange spline	Exhaustive use Pinion nut loose Pinion axle backlash	Replace the flange. Check that the pinion spline is not excessively worn out. Replace bevel gear set if required.

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Fatigue failure of pinion teeth See if the fracture line is well defined (wave lines, beach lines)	Exhaustive use Continuous overload	Replace bevel gear set.
Pinion and ring teeth breakage	Crash load of differential components	Check and/or replace other differential components.
Side gear spline worn out Replace all scratched washers (Excessive backlash)	Excessive use	Replace differential gear group. Replace half shaft if required.
Thrust washer surface worn out or scratched	Insufficient lubrication Incorrect lubrication Contaminated oil	Use correct lubrication and fill up to right level. Replace at intervals recommended. Replace all scratched washers and those with a thickness by 0.1 mm lower than the new ones.
Inner diameter of tapered roller bearing worn out	Excessive use Excessive pinion axial backlash Insufficient lubrication Contaminated oil	Replace bearing. Check pinion axial backlash. Use proper lubrication, fill up to right level and replace at recommended intervals.
Bent or broken half shaft	Vehicle intensively operated or overloaded	Replace.
Half shaft broken at wheel side	Wheel support loose Beam body bent	Replace. Check that wheel support is not worn out or wrongly adjusted.

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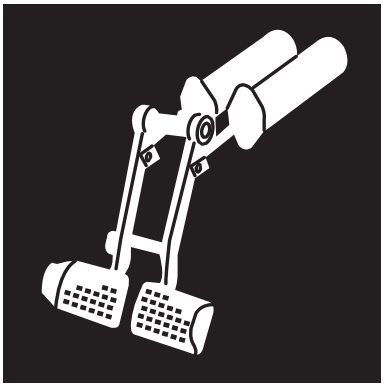
3. SPECIAL TOOLS

P/N CNH	APPLICATION	2WS	4WS
380000406	Disassembly/Assembly of differential ring nuts	/	•
380000816	Planetary carrier disassembly	•	/
380000986 + 380000987	Disassembly bearing cups from the axle housing	•	/
380000990	Axle housing lifting	•	/
380000991	Bearings pre-load measurement	•	/
380002213	Assembly of seal ring of the swivel housing	/	•
380002215	Assembly of pinion bearing outer cup	/	•
380002218	Disassembly/Assembly of pinion ring nut	/	•
380002222	Assembly of bearing cups in the wheel hub	/	•
380002226	Assembly of bushing in the half-beam	/	•
380002667	Assembly of bushings in the crown retaining hub	/	•
380002668	Assembly of bushing in the swivel housing	/	•
380002669	Assembly of seal ring in the swivel housing	/	•
380002670	Assembly of seal ring in the half-beam	/	•
380002671	Assembly of differential bearing cups	/	•
380002672	Preload measure of pinion bearing	/	•
380002673	Measurement of pinion shims	/	•
380002674	Measurement of pinion shims	/	•
380002675	Connection flange disassembly	•	/
380002676	Disassembly of wheel carrier hub shaft bearings	•	/

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SECTION 33 - BRAKES SYSTEM

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1. SPECIFICATIONS

2WS

BRAKES OPERATION	HYDRAULIC
Brakes	Wet disc, piston operated
Oil brake	Akcela LHM
Number discs (on side)	4
Brakes disc total friction area	1,440 cm^2

4WS

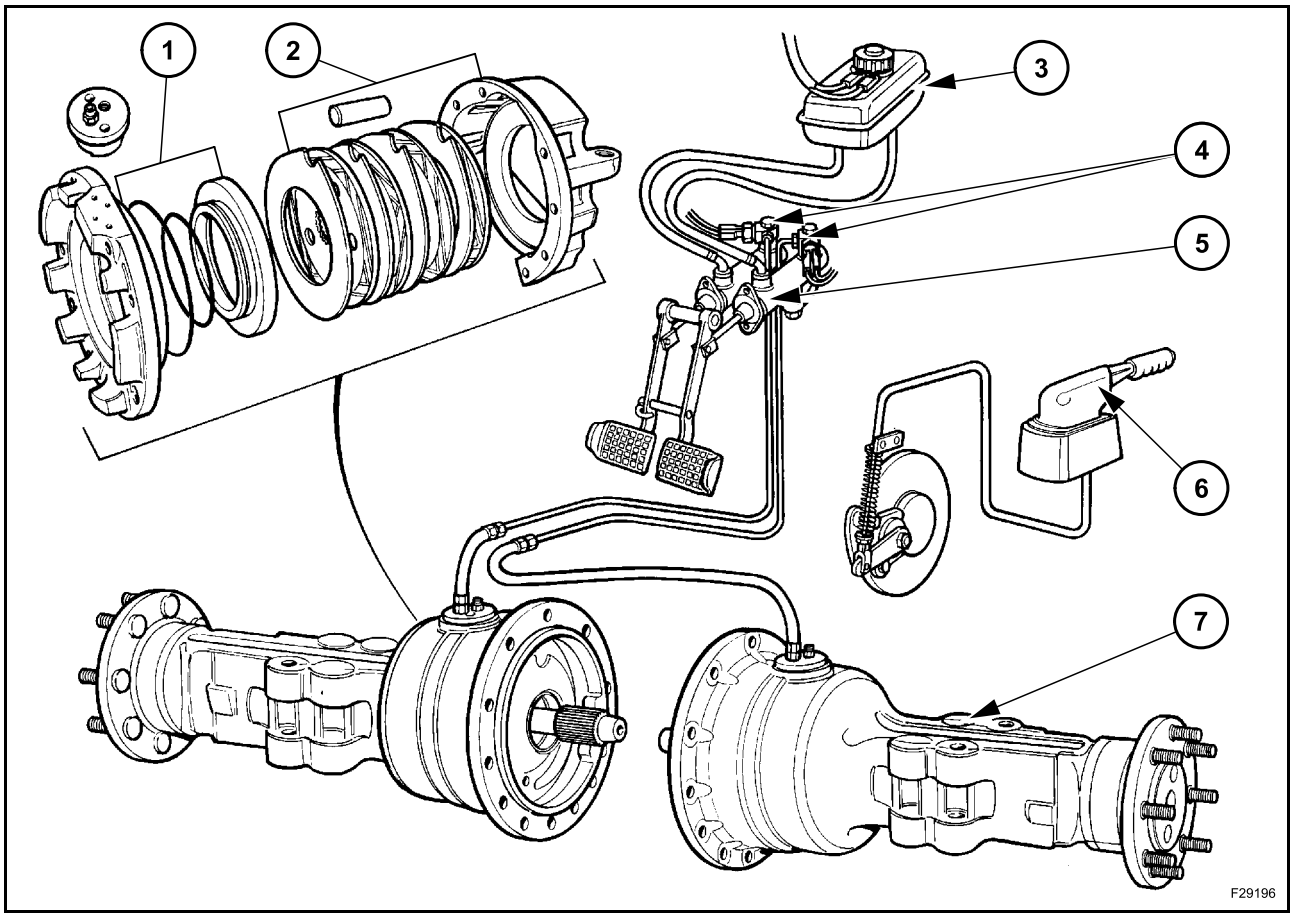
BRAKES OPERATION	HYDRAULIC
Brakes	Wet disc, piston operated
Oil brake	Akcela LHM
Number discs (on side)	3
Brakes disc total friction area	1,440 cm^2

The loader backhoe has two braking systems:
a parking brake with two free floating friction pads;
hydraulically operated inboard wet disc brakes in the rear axle.
The parking brake, when engaged, locks the brake disc on the rear of the transmission.
Operation of the foot brake, instead, pressurizes the brake fluid in the master cylinders which feeds the brake pistons in the axle housing. The brake pistons then compress the brake friction discs and separation discs, which locks the axle shaft to the axle housing.

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BRAKE SYSTEM LAYOUT (2WS)

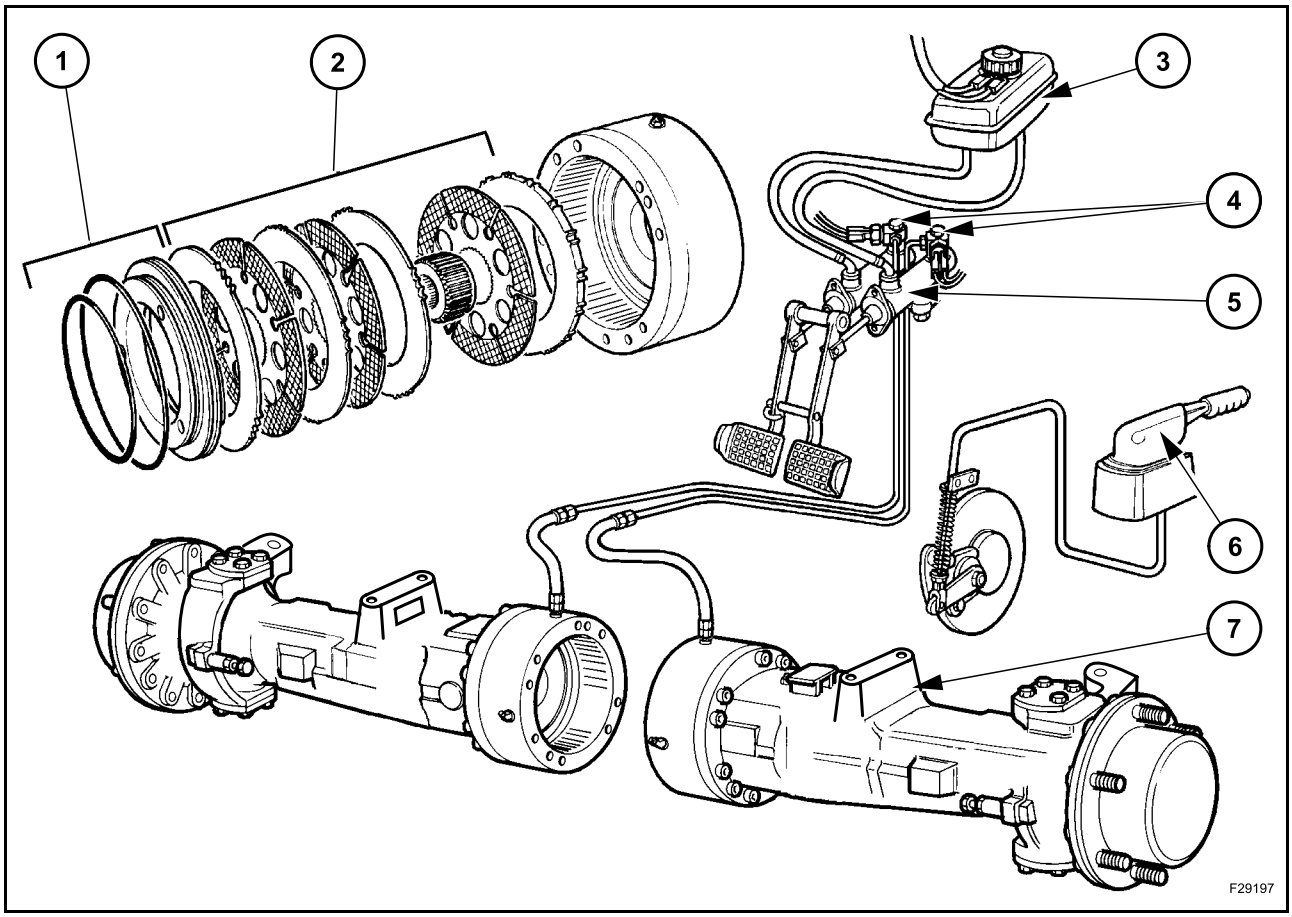


1. Brake piston assembly
2. Brake discs
3. Brake tank
4. Pressure switch
5. Master cylinders
6. Parking brake
7. Axle shaft

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BRAKE SYSTEM LAYOUT (4WS)



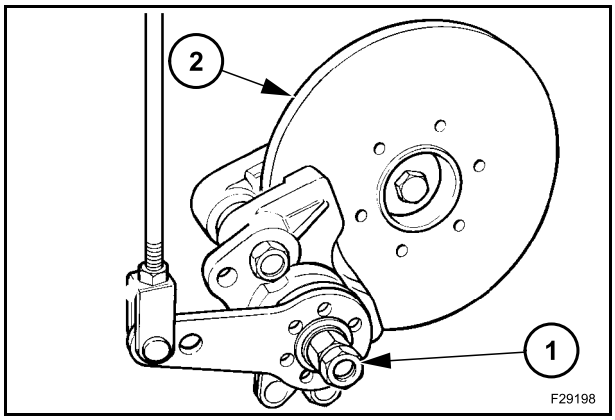
1. Brake piston assembly
2. Brake discs
3. Brake tank
4. Pressure switch
5. Master cylinders
6. Parking brake
7. Axle shaft

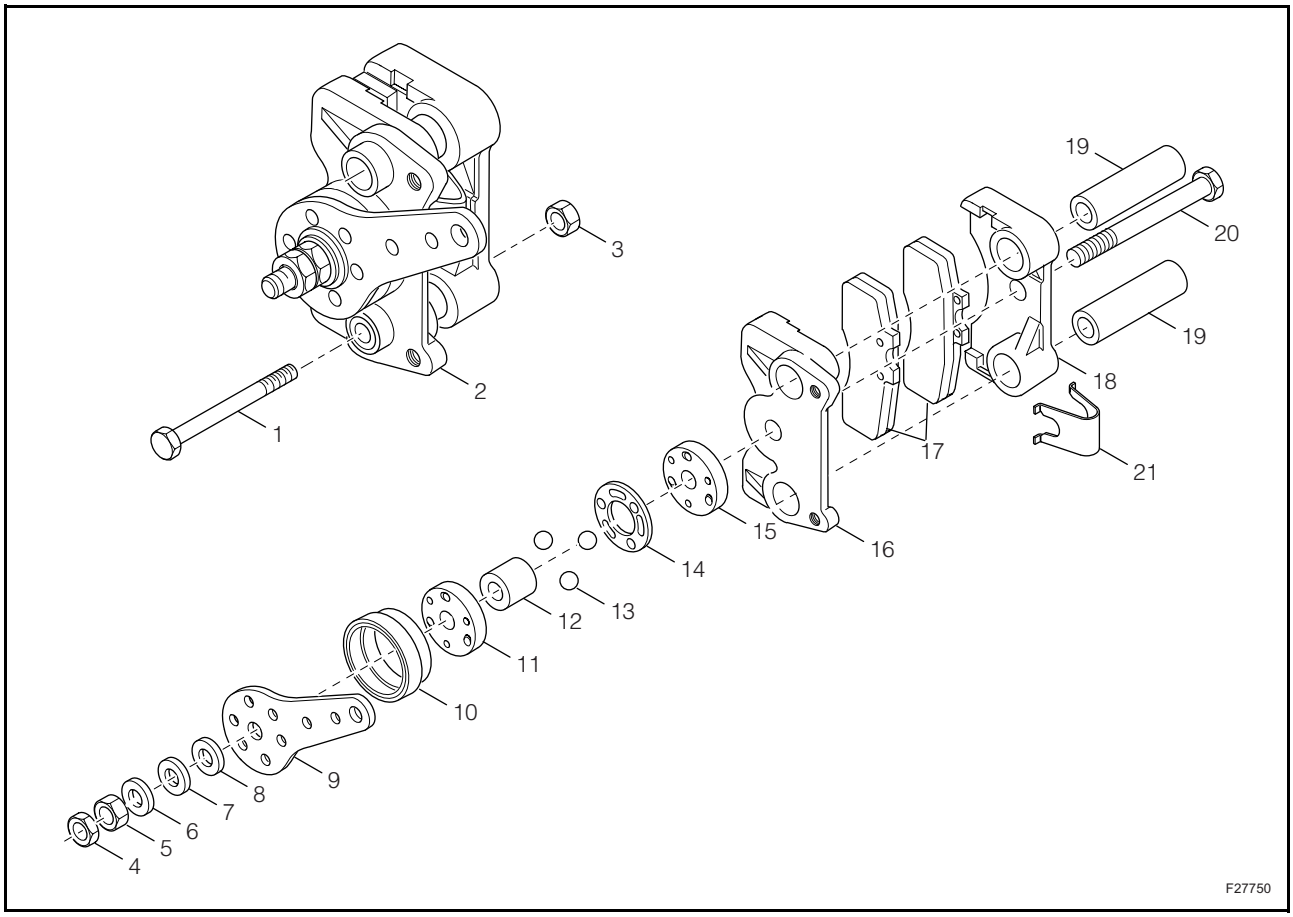
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2. PARKING BRAKE

The parking brake is fitted to all models and incorporates two free floating friction pads.
When operated the cam (1) forces the friction pads against the disc (2), effecting a braking action on the output shaft from the transmission, locking the drive shaft to the rear and front axles.





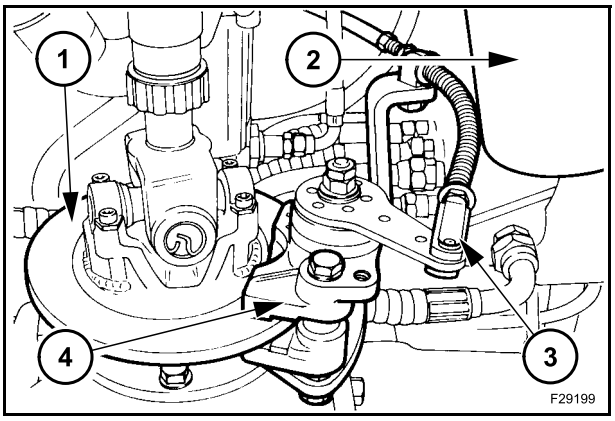
1. Screw - brake mounting
2. Assembly - caliper
3. Nut - brake mounting screw
4. Nut - adjustment
5. Nut - adjustment
6. Washer
7. Washer
8. Thrust washer
9. Lever
10. Boot
11. Cam
12. Oil seal
13. Bearing
14. Retainer
15. Cam
16. Torque plate - front
17. Carrier and lining assembly
18. Torque plate - rear
19. Sleeve mounting
20. Adjuster screw
21. Spring

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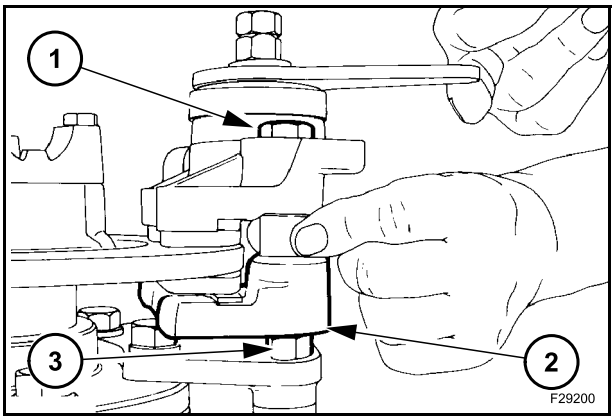
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2.1 PARKING BRAKE ADJUSTMENT

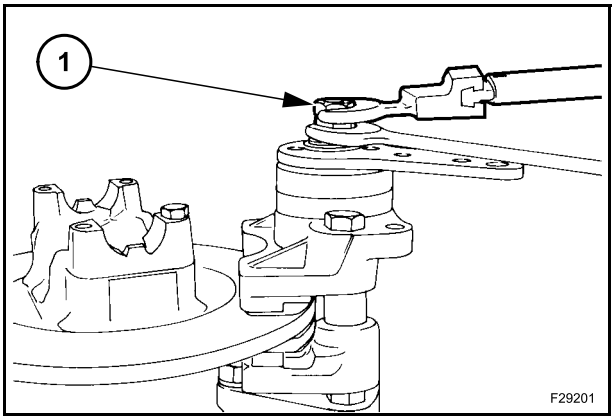
The parking brake is located on the transmission output shaft on the 4x4 transmission and on the rear axle on the 4x2 transmission.
The 4x2 transmission parking brake is located on the rear axle brake disc splined to the pinion shaft (1), hydraulic oil filter (2), parking brake cable (3), parking brake caliper (4).



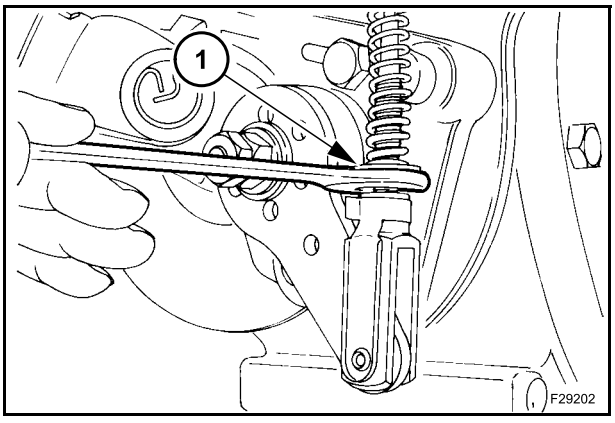
When refitting the caliper unit (2) insert the two screws (1) through the caliper. It will be necessary to apply Loctite 270 to the locknuts (3). Tighten the screws while holding the locknuts. Once the screws are tightened, torque the nuts to 150 Nm. Ensure that the tubes can move.



Adjust the clearance between the brake pads and disc to 0.5 mm using the nut and locknut (1).



Adjust the cable and lock the nut (1) to get 4-5 clicks on the parking brake lever.

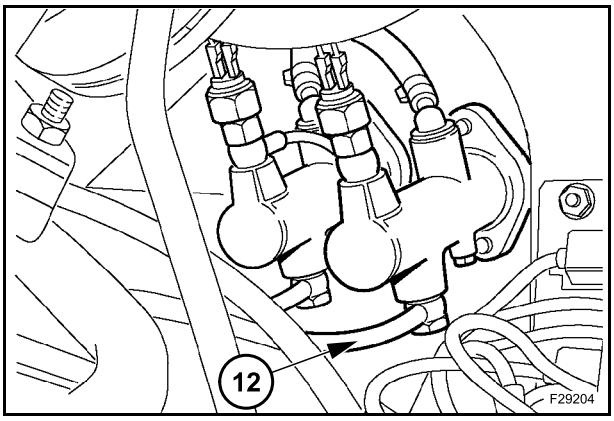


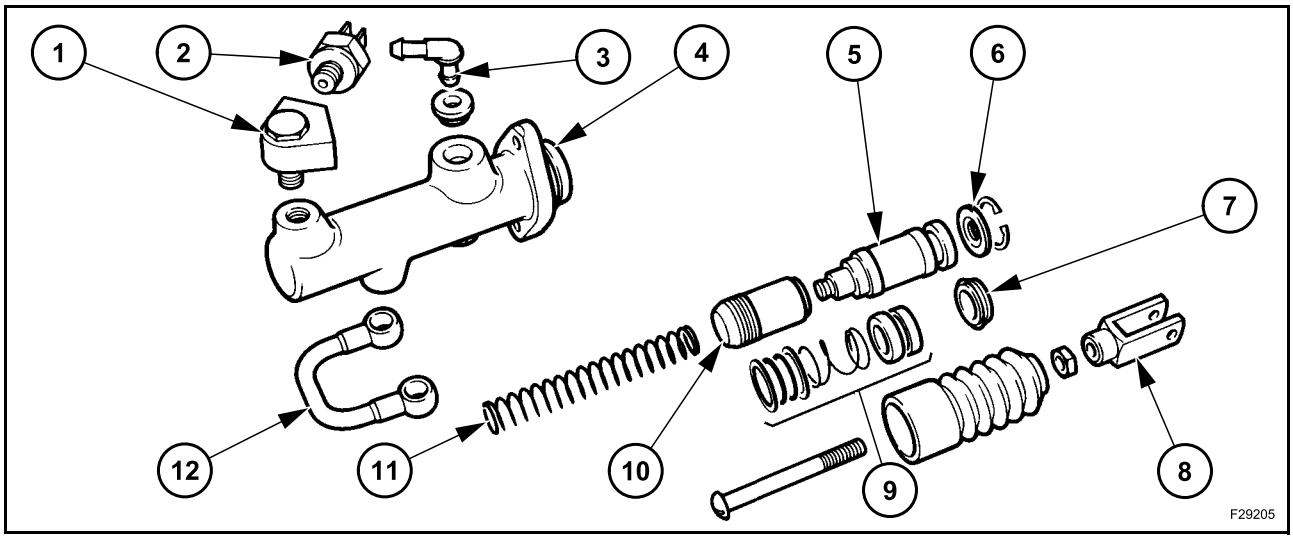
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3. BRAKE CYLINDERS

Brake cylinders are accessible from the engine compartment.
The brake cylinders are linked by a balancing pipe (12) situated below the cylinders to maintain equal oil pressure between the two cylinders.



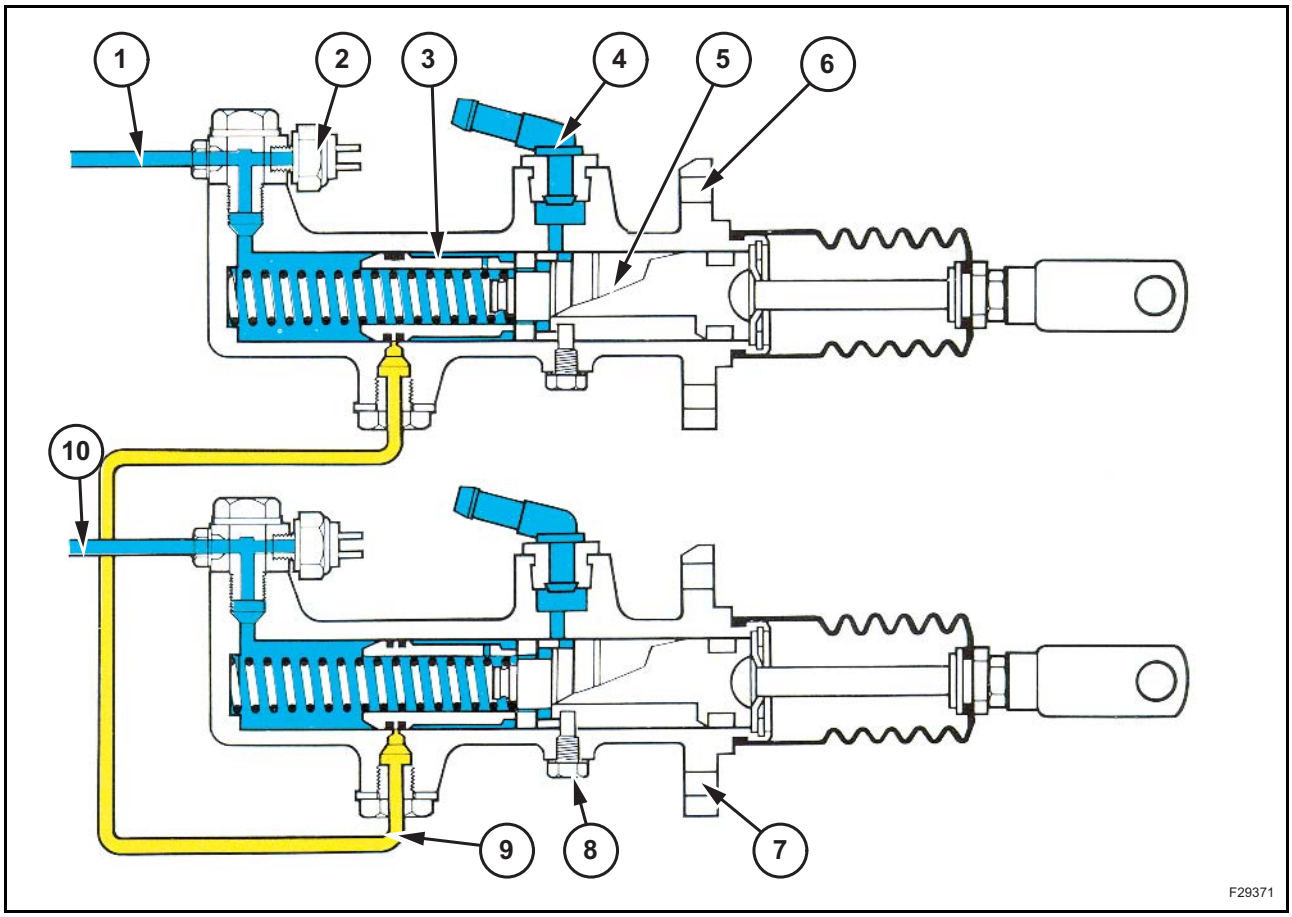


1. Fitting
2. Pressure switch
3. Fitting
4. Body
5. Primary spool
6. Bottom
7. Seal
8. Clevis
9. Seals
10. Secondary spool
11. Spring
12. Balancing pipe

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MASTER CYLINDER WITH BRAKES RELEASED



Trapped oil
Tank oil (no pressure)

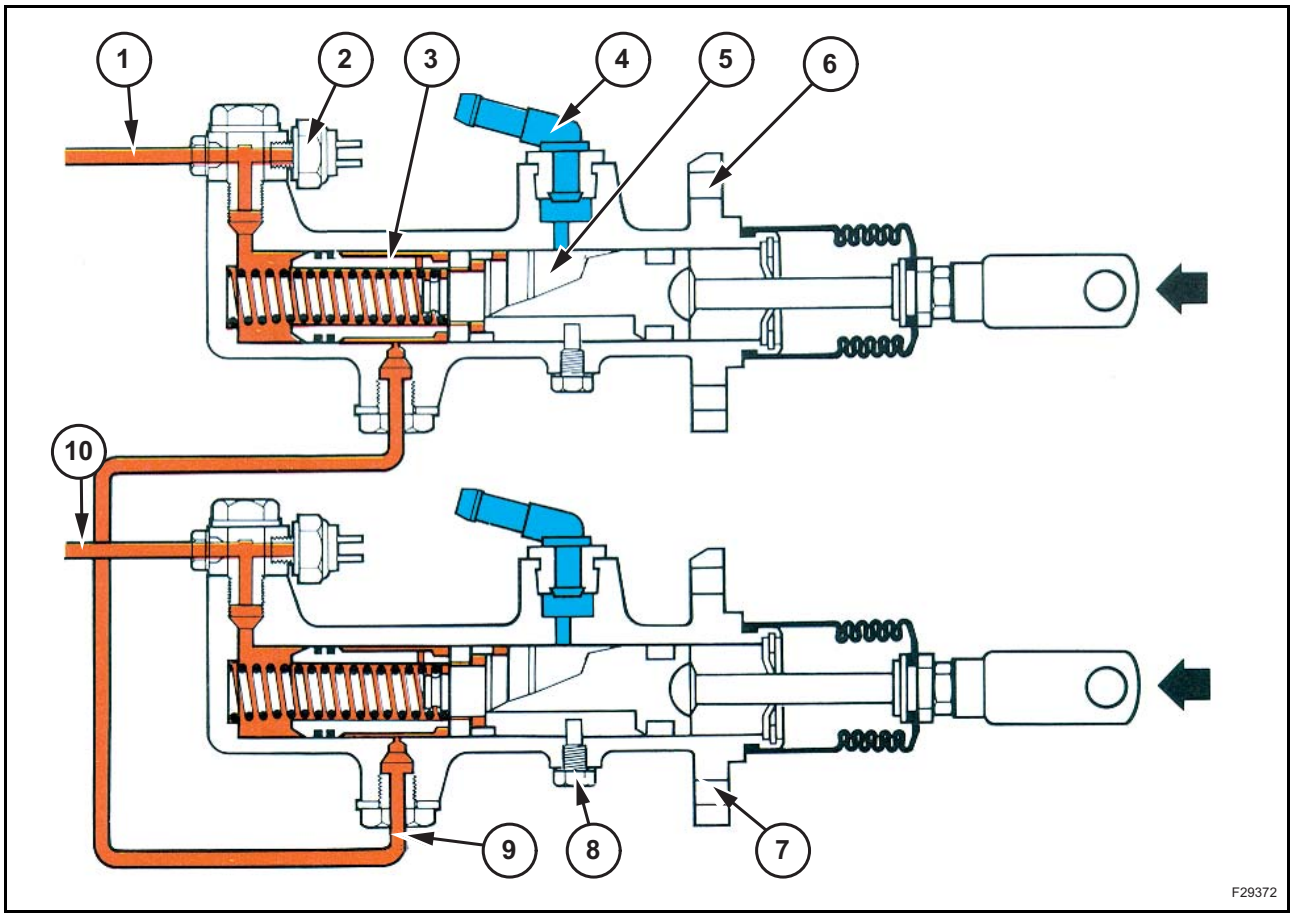
1. Oil to cylinder (right hand side)
2. Pressure switch
3. Secondary spool
4. Tank inlet
5. Primary spool
6. Cylinder body
7. Cylinder body
8. Primary spool stop
9. Balancing pipe
10. Oil to cylinder (left hand side)

With the brakes released the brake lines are open to the tank to allow the brakes to release. The cylinders are also open to tank through the centre of the valve.

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CYLINDER WITH BRAKE PEDALS DEPRESSED



Pressurized brake oil
Tank oil (no pressure)

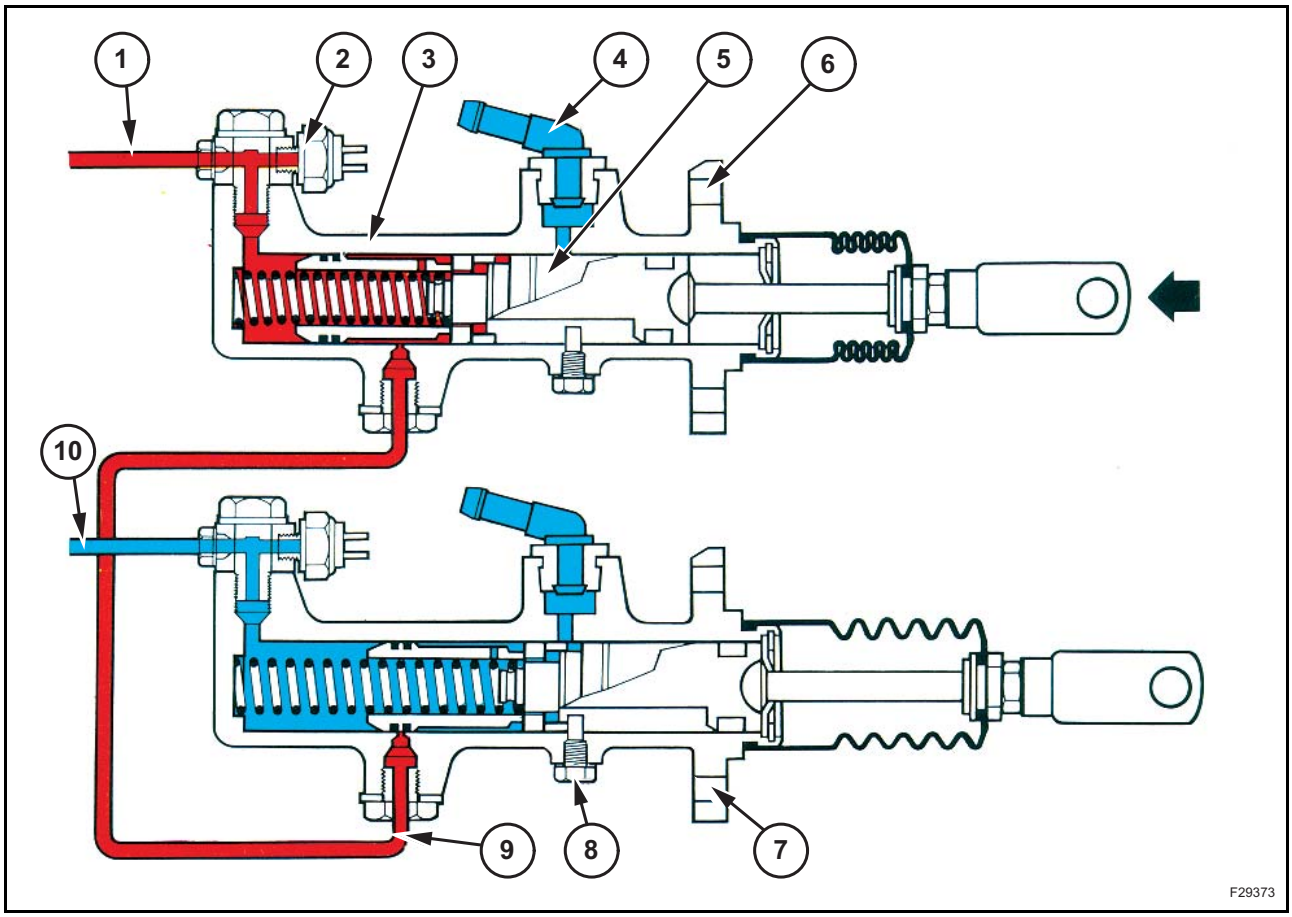
1. Oil to cylinder (right hand side)
2. Pressure switch
3. Secondary spool
4. Tank inlet
5. Primary spool
6. Cylinder body
7. Cylinder body
8. Primary spool stop
9. Balancing pipe
10. Oil to cylinder (left hand side)

As the brake pedals are depressed initial movement of the cylinder piston closes the centre port to isolate the tank.
Further piston movement creates brake oil pressure to apply the brakes. The pressure ports are both open as the two seals on both cylinders have exposed the two ports, therefore allowing equal pressure in both cylinders.

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CYLINDER WITH ONE BRAKE PEDAL DEPRESSED



Pressurized brake oil
Tank oil (no pressure)

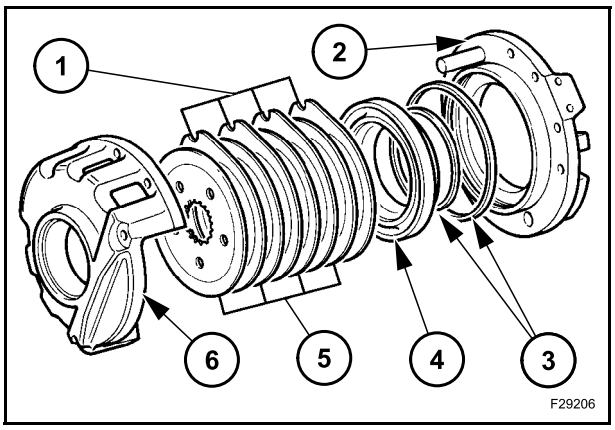
1. Oil to cylinder (right hand side)
2. Pressure switch
3. Secondary spool
4. Tank inlet
5. Primary spool
6. Cylinder body
7. Cylinder body
8. Primary spool stop
9. Balancing pipe
10. Oil to cylinder (left hand side)

When using one brake to assist turning, the brake cylinder being applied operates only one brake. This is achieved by the pressure port being blocked by the two seals on the cylinder not being operated.

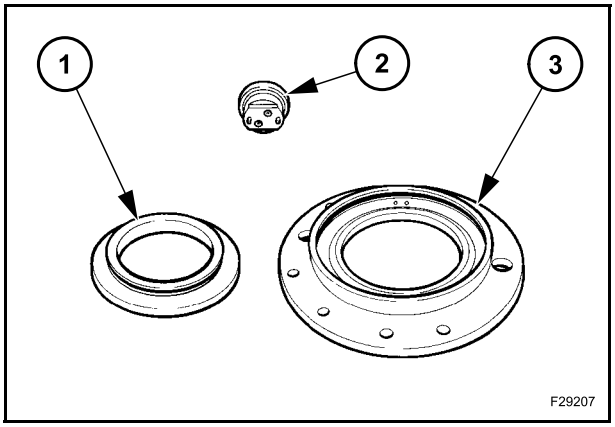
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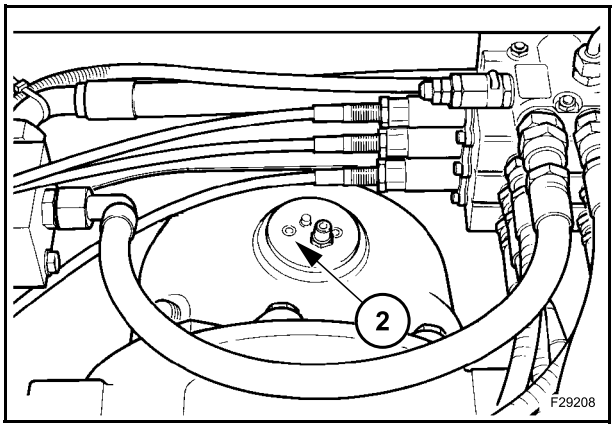
Discs and piston layout
1. Steel plates
2. Outer housing
3. Seals
4. Piston
5. Friction plates
6. Outer housing



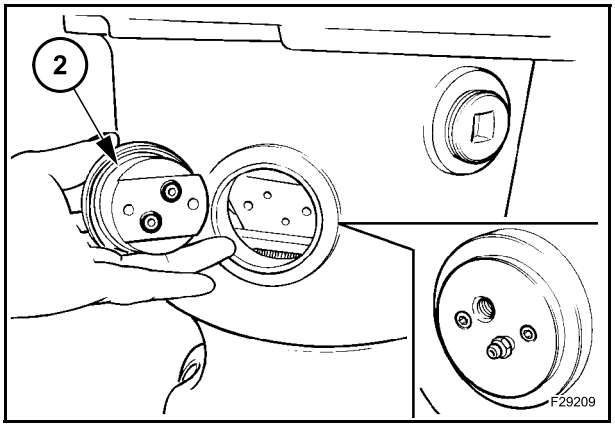
Piston and seals
1. Piston
2. Fitting
3. Outer housing



The brakes are supplied oil from the brake pedal tank and into the axle by tubes into each half axle through the fitting (2) which is sealed to the piston by two O-rings.



When the fitting (2) is removed ensure the O-rings are replaced with new.

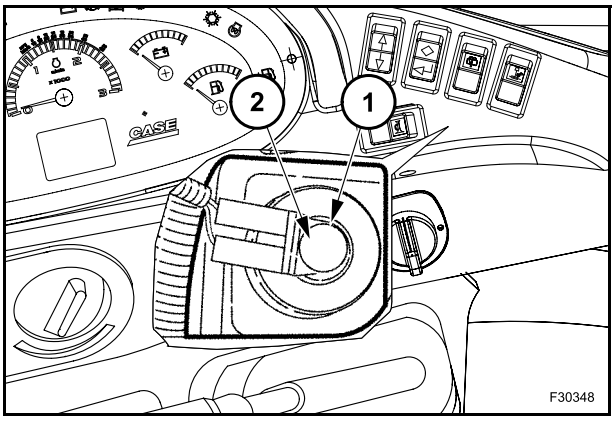


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4. OIL BRAKE TANK

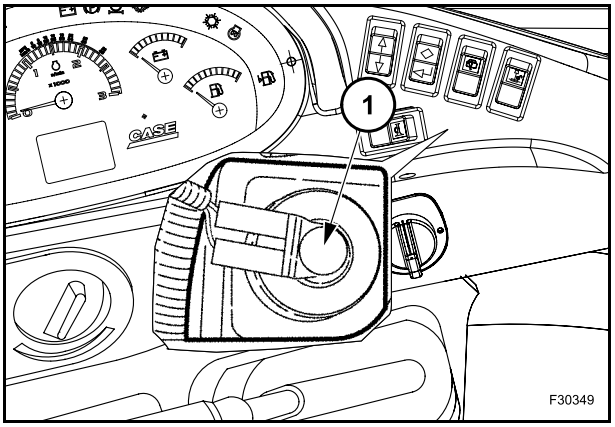
1. Oil brake tank
2. Low level switch



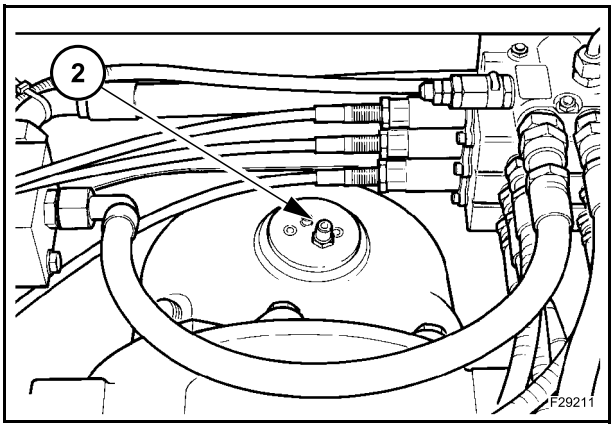
NOTE: to test the warning light system, press the low level button on the tank cap. The lamp illuminated is that of the parking brake, mounted on the right-hand instrument console; it indicates that the parking brake is disengaged.

5. BLEEDING PROCEDURE

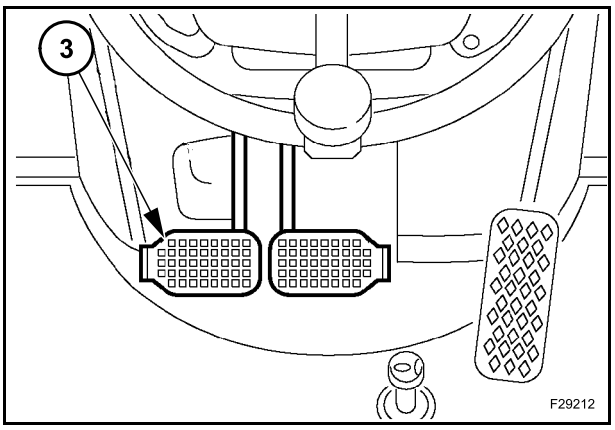
1. Oil brake tank is full (1)



2. Open left hand brake bleed valve (2)



3. Press repeatedly on both brake pedals (3) to purge the system
4. Hold pedals down
5. Lock bleed valve (2)
6. Release pedals
7. Repeat steps 4-6
8. Repeat steps 2-6 on right hand brake
9. Test brakes repeat if necessary



NOTE: when the brake pedals are operated, both together, the electrical supply to the front wheel drive switch is cut. In this way the clutch de-energizes thus engaging the front wheel drive, providing four wheel braking.

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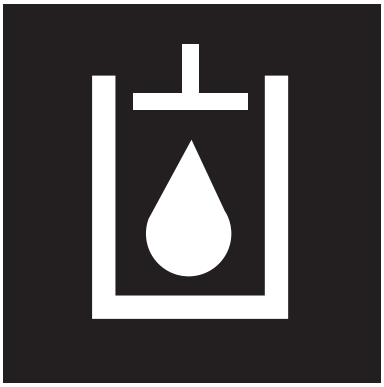
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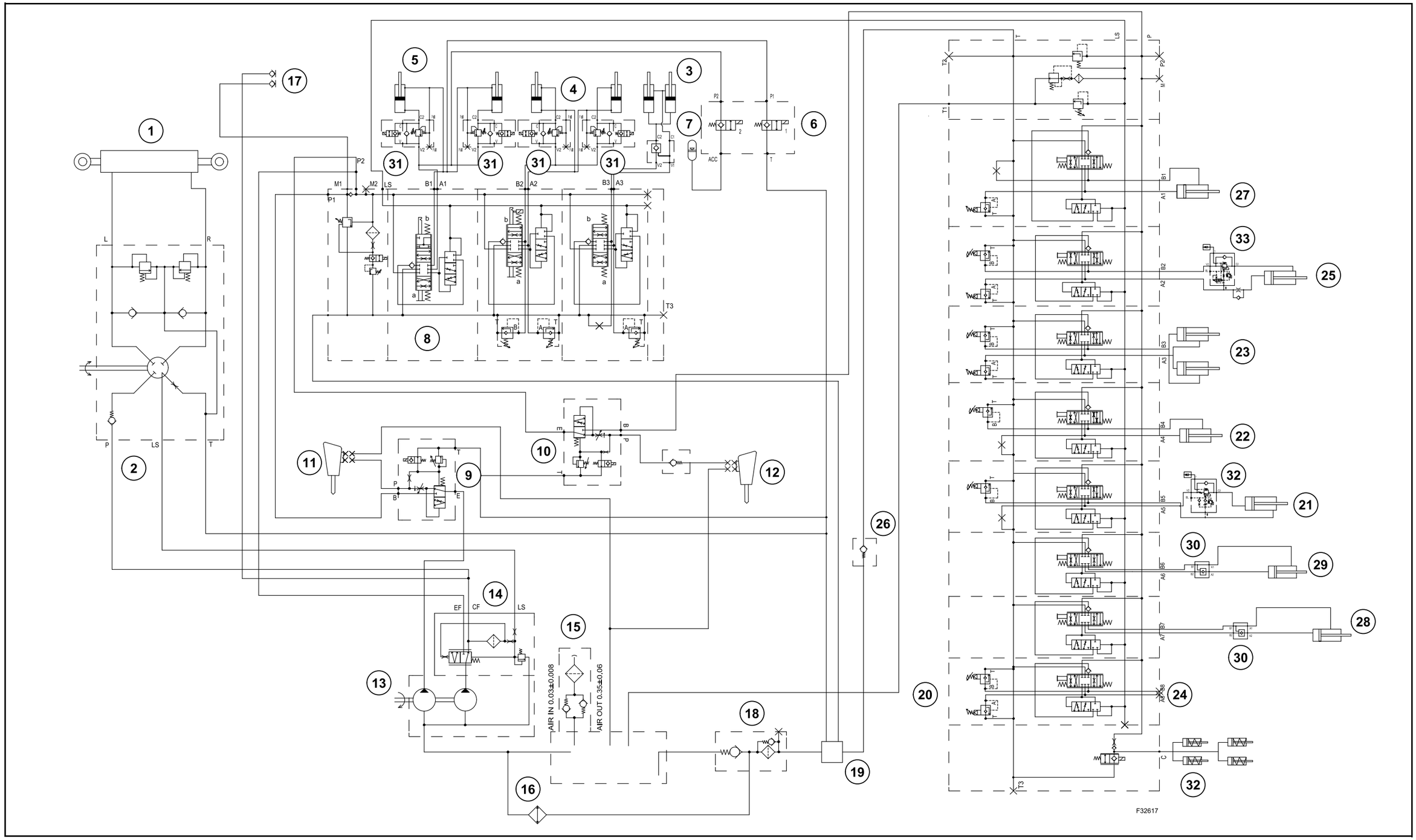
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1. HYDRAULIC DIAGRAMS

1.1 HYDRAULIC DIAGRAM - 2WS SIDESHIFT MECHANICAL MODELS



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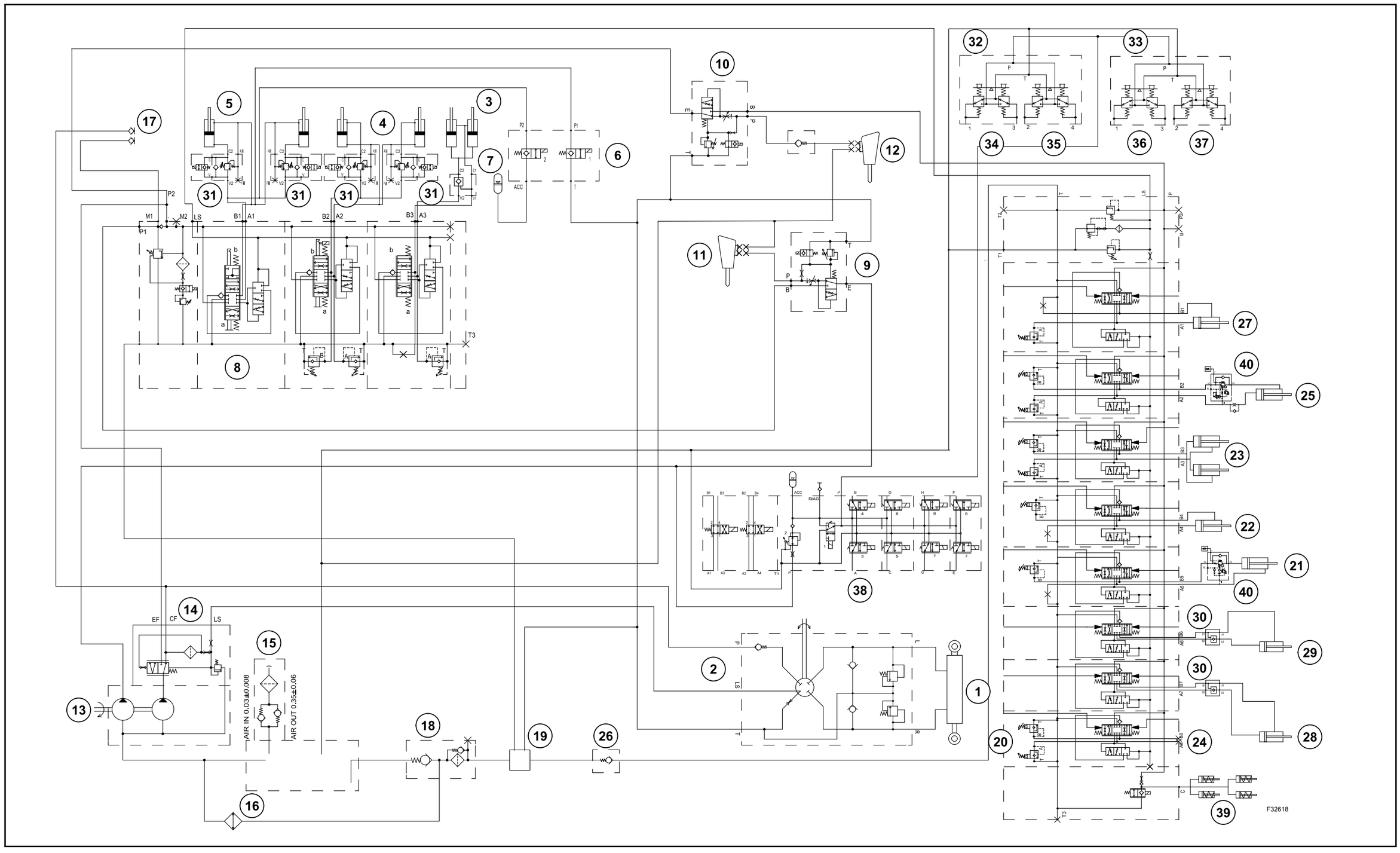
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1. Front axle
2. Steering control valve
3. 4x1 bucket cylinders
4. Dipper cylinders
5. Boom cylinders
6. Ride control valve (optional)
7. Ride control accumulator (optional)
8. Loader attachment control valve
9. Hand hammer control valve (optional)
10. Backhoe hammer control valve (optional)
11. Hand hammer (optional)
12. Backhoe hammer (optional)
13. Hydraulic pump
14. Priority valve
15. Air filter
16. Hydraulic oil cooler
17. Diagnostic
18. Oil filter
19. Return filter
20. Backhoe attachment control valve
21. Dipper cylinder
22. Bucket cylinder
23. Swing cylinders
24. Bi-directional auxiliary
25. Boom cylinder
26. Backpressure valve
27. Telescopic cylinder
28. Stabilizer right cylinder
29. Stabilizer left cylinder
30. Check valve
31. Check valve (optional)
32. Backhoe attachment travel lock cylinders (sideshift)
33. Check valve (optional)

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1.2 HYDRAULIC DIAGRAM - 2WS SIDESHIFT PILOT MODELS



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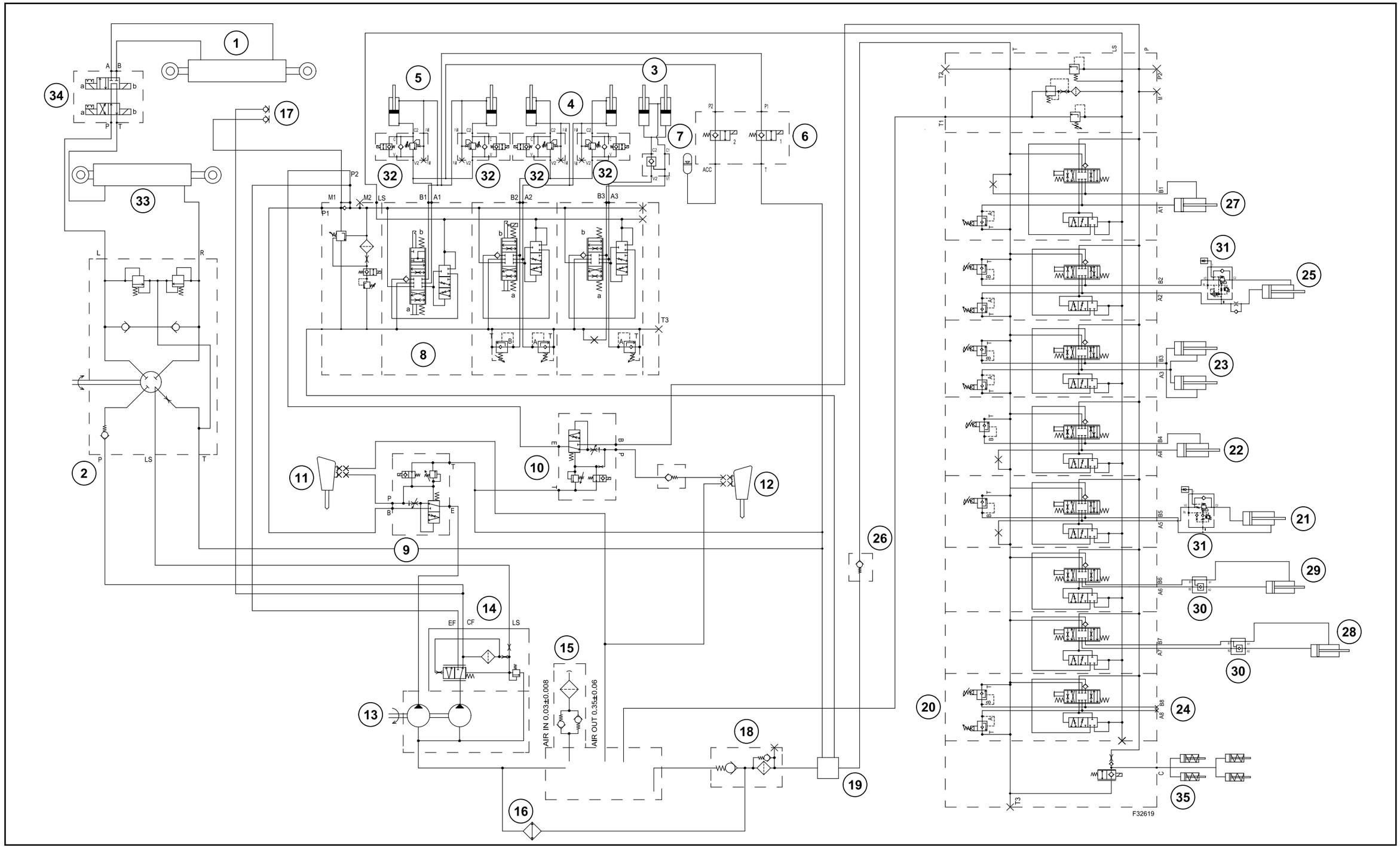
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1. Front axle
2. Steering control valve
3. 4x1 bucket cylinders
4. Dipper cylinders
5. Boom cylinders
6. Ride control valve (optional)
7. Ride control accumulator (optional)
8. Loader attachment control valve
9. Hand hammer control valve (optional)
10. Backhoe hammer control valve (optional)
11. Hand hammer (optional)
12. Backhoe hammer (optional)
13. Hydraulic pump
14. Priority valve
15. Air filter
16. Hydraulic oil cooler
17. Diagnostic
18. Oil filter
19. Return filter
20. Backhoe attachment control valve
21. Dipper cylinder
22. Bucket cylinder
23. Swing cylinders
24. Bi-directional auxiliary
25. Boom cylinder
26. Backpressure valve
27. Telescopic cylinder
28. Stabilizer right cylinder
29. Stabilizer left cylinder
30. Check valve
31. Check valve (optional)
32. Left-hand hydraulic control lever
33. Right-hand hydraulic control lever
34. Boom or dipper left hydraulic control lever
35. Hydraulic control lever left-swing
36. Boom or dipper right hydraulic control lever
37. Hydraulic control lever right-bucket
38. Backhoe attachment control valve pilot solenoid valve
39. Backhoe attachment travel lock cylinders (sideshift)
40. Check valve (optional)

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1.3 HYDRAULIC DIAGRAM - 4WS SIDESHIFT MECHANICAL MODELS



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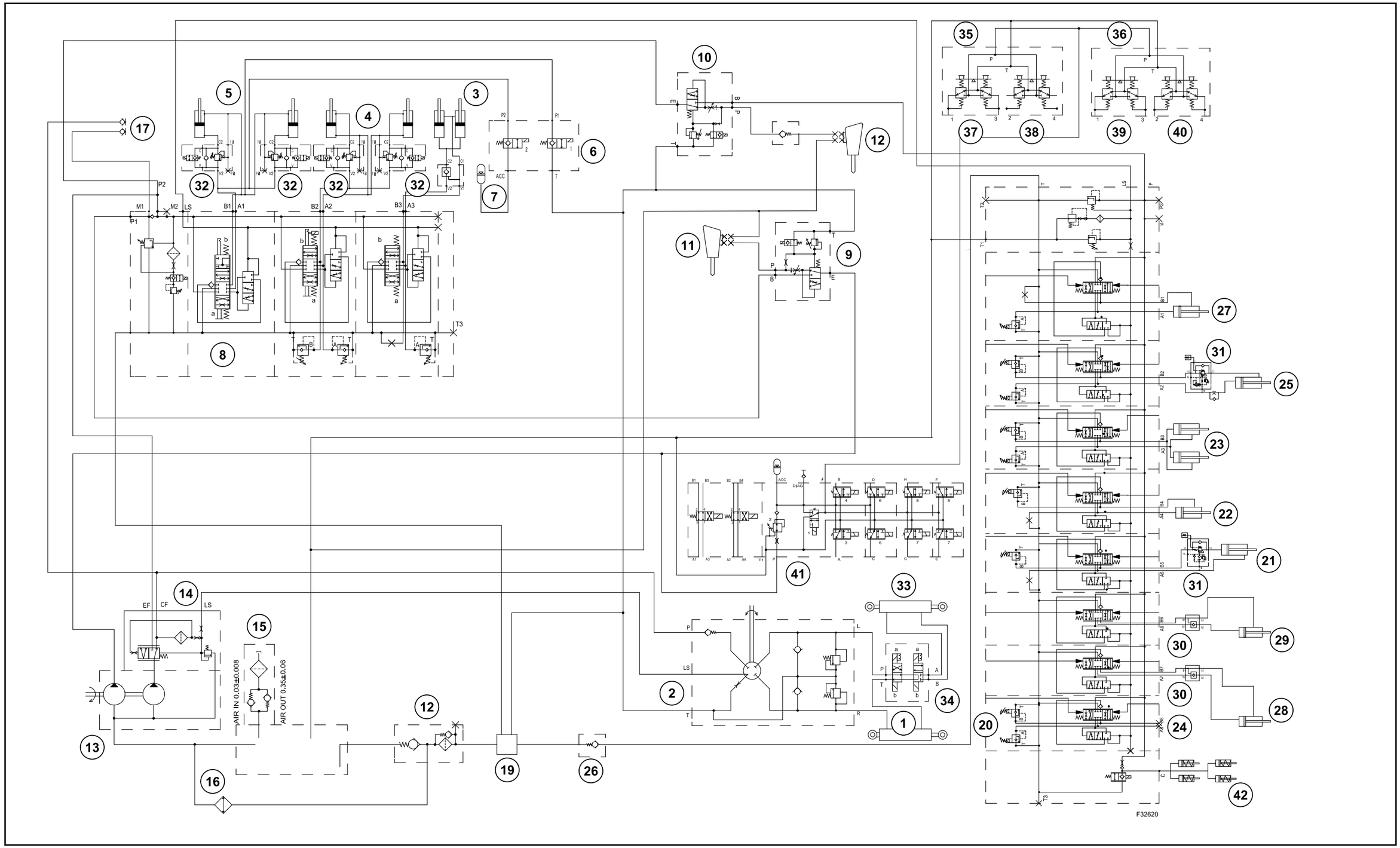
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1. Front axle
2. Steering control valve
3. 4x1 bucket cylinders
4. Dipper cylinders
5. Boom cylinders
6. Ride control valve (optional)
7. Ride control accumulator (optional)
8. Loader attachment control valve
9. Hand hammer control valve (optional)
10. Backhoe hammer control valve (optional)
11. Hand hammer (optional)
12. Backhoe hammer (optional)
13. Hydraulic pump
14. Priority valve
15. Air filter
16. Hydraulic oil cooler
17. Diagnostic
18. Oil filter
19. Return filter
20. Backhoe attachment control valve
21. Dipper cylinder
22. Bucket cylinder
23. Swing cylinders
24. Bi-directional auxiliary
25. Boom cylinder
26. Backpressure valve
27. Telescopic cylinder
28. Stabilizer right cylinder
29. Stabilizer left cylinder
30. Check valve
31. Check valve (optional)
32. Check valve (optional)
33. Rear axle
34. 4WS steering control valve
35. Backhoe attachment travel lock cylinders (sideshift)

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1.4 HYDRAULIC DIAGRAM - 4WS SIDESHIFT PILOT MODELS



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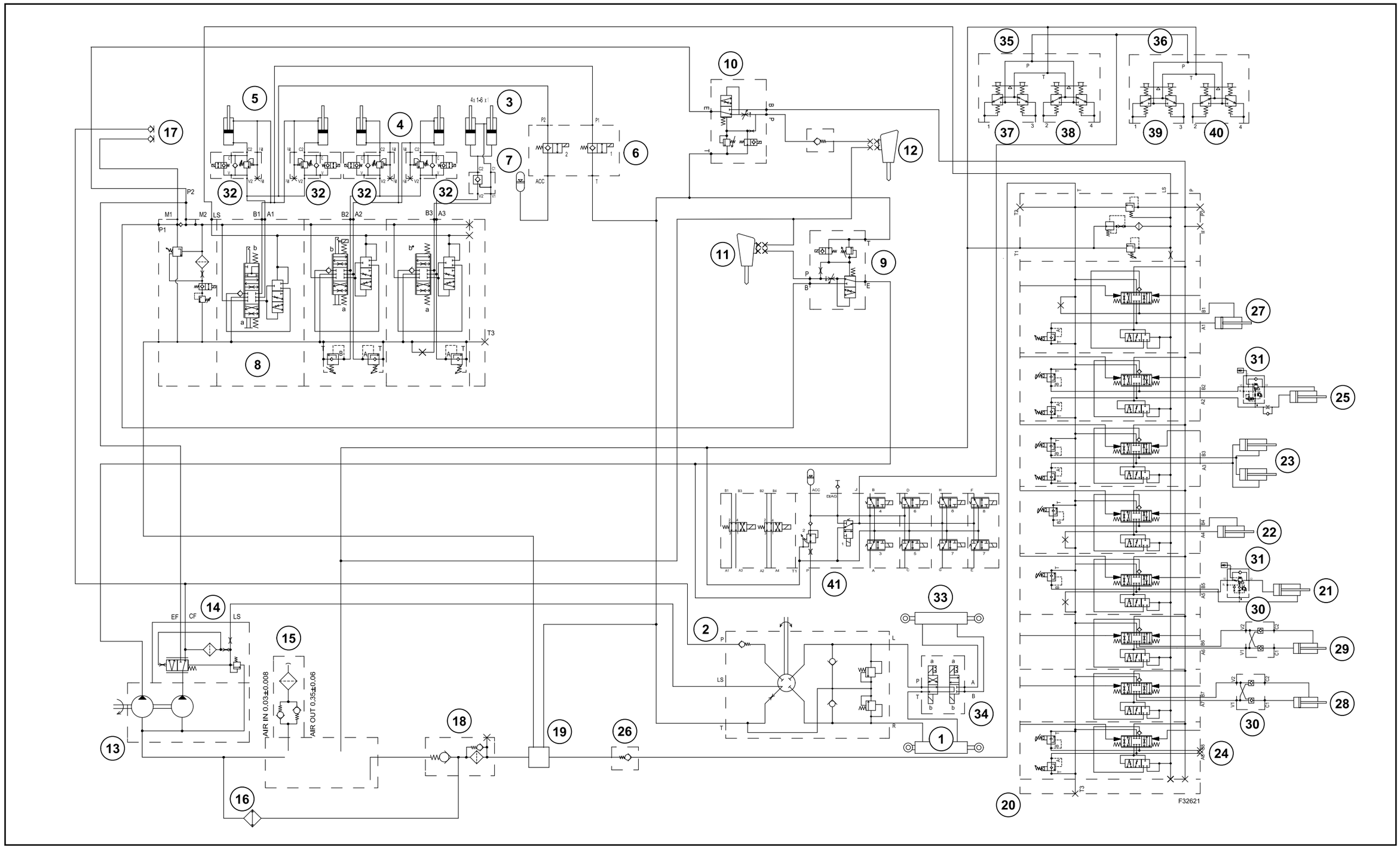
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1. Front axle
2. Steering control valve
3. 4x1 bucket cylinders
4. Dipper cylinders
5. Boom cylinders
6. Ride control valve (optional)
7. Ride control accumulator (optional)
8. Loader attachment control valve
9. Hand hammer control valve (optional)
10. Backhoe hammer control valve (optional)
11. Hand hammer (optional)
12. Backhoe hammer (optional)
13. Hydraulic pump
14. Priority valve
15. Air filter
16. Hydraulic oil cooler
17. Diagnostic
18. Oil filter
19. Return filter
20. Backhoe attachment control valve
21. Dipper cylinder
22. Bucket cylinder
23. Swing cylinders
24. Bi-directional auxiliary
25. Boom cylinder
26. Backpressure valve
27. Telescopic cylinder
28. Stabilizer right cylinder
29. Stabilizer left cylinder
30. Check valve
31. Check valve (optional)
32. Check valve (optional)
33. Rear axle
34. 4WS steering control valve
35. Left-hand hydraulic control lever
36. Right-hand hydraulic control lever
37. Boom or dipper left hydraulic control lever
38. Hydraulic control lever left-swing
39. Boom or dipper right hydraulic control lever
40. Hydraulic control lever right-bucket
41. Backhoe attachment control valve solenoid valve
42. Backhoe attachment travel lock cylinders (sideshift)

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1.5 HYDRAULIC DIAGRAM - 4WS CENTER PIVOT PILOT MODELS



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1. Front axle
2. Steering control valve
3. 4x1 bucket cylinders
4. Dipper cylinders
5. Boom cylinders
6. Ride control valve (optional)
7. Ride control accumulator (optional)
8. Loader attachment control valve
9. Hand hammer control valve (optional)
10. Backhoe hammer control valve (optional)
11. Hand hammer (optional)
12. Backhoe hammer (optional)
13. Hydraulic pump
14. Priority valve
15. Air filter
16. Hydraulic oil cooler
17. Diagnostic
18. Oil filter
19. Return filter
20. Backhoe attachment control valve
21. Dipper cylinder
22. Bucket cylinder
23. Swing cylinders
24. Bi-directional auxiliary
25. Boom cylinder
26. Backpressure valve
27. Telescopic cylinder
28. Stabilizer right cylinder
29. Stabilizer left cylinder
30. Check valve
31. Check valve (optional)
32. Check valve (optional)
33. Rear axle
34. 4WS steering control valve
35. Left-hand hydraulic control lever
36. Right-hand hydraulic control lever
37. Boom or dipper hydraulic control lever
38. Hydraulic control lever left-swing
39. Boom or dipper right hydraulic control lever
40. Hydraulic control lever right-bucket
41. Backhoe attachment control valve solenoid valve

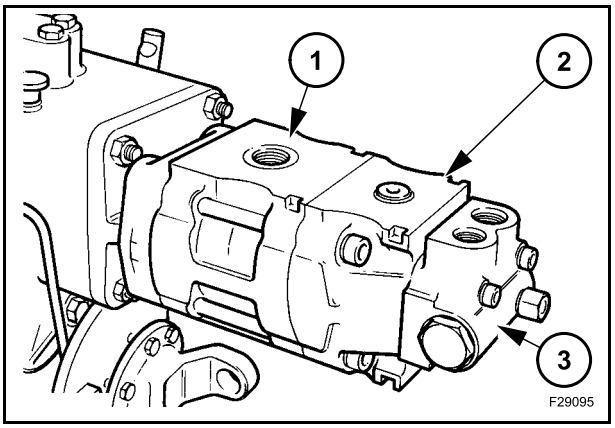
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2. HYDRAULIC PUMP

2.1 DESCRIPTION AND OPERATION

There are two types of pumps:
• for 97 HP engine;
• for 110 HP engine.
The gear type hydraulic pump assembly is mounted on the rear of the transmission and driven by a shaft directly connected to the engine flywheel splined to the torque converter housing.
The pump comprises of two pumping elements, the front pump (1) rear pump (2) and load sensing steering flow divider control valve (3).
Oil is drawn through the common inlet port into both pumping elements.
Front pump flow is directed to the loader and backhoe attachment control valves and to the sideshift locking cylinders.
Rear pump flow passes through the flow divider valve which maintains priority oil flow to the steering system with remaining flow directed for operation of stabilizers, loader and backhoe elements.



2.2 SPECIFICATIONS

PUMP (97 HP ENGINE)		1st PUMP	2nd PUMP
Direction of rotation (looking on drive shaft)		Clockwise (D)	
Displacement		40.258 (cm^3/rev)	35.427 (cm^3/rev)
Inlet pressure range for pump		0.7 - 3 bar	
Maximum continuous pressure	P 1	260 bar	260 bar
Maximum intermittent pressure	P 2	280 bar	280 bar
Maximum peak pressure	P 3	300 bar	300 bar
Operating temperature		-25 to -80 (°C)	
Speed	min P1	350 (min^{-1})	
	max P1	3000 (min^{-1})	
Viscosity range	recommended	12 to 100 mm 2/s (cSt)	
	permitted	max 750 mm 2/s (cSt)	
Contamination class	Dp > 200 bar bx = 75 - 10 mm	8 - Nas 1638	
		19 / 17 /14 - ISO 4406	
	Dp < 200 bar bx = 75 - 25 mm	10 - Nas 1638	
		21 / 19 /16 - ISO 4406	
Relief valve		177 ± 3 bar	
Stand by pressure load sensing valve		7 bar	
Weight		30 kg	

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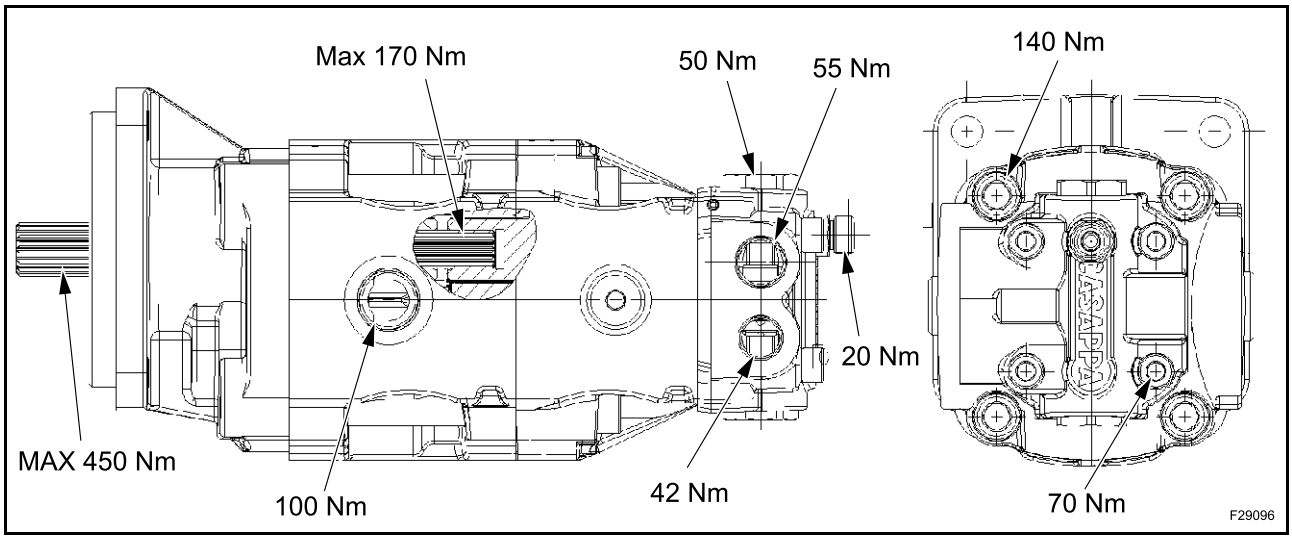
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PUMP (110 HP ENGINE)		1st PUMP	2nd PUMP
Direction of rotation (looking on drive shaft)		Clockwise (D)	
Displacement		40.258 (cm^3/rev)	35.427 (cm^3/rev)
Inlet pressure range for pump		0.7 - 3 bar	
Maximum continuous pressure	P 1	260 bar	260 bar
Maximum intermittent pressure	P 2	280 bar	280 bar
Maximum peak pressure	P 3	300 bar	300 bar
Operating temperature		-25 to -80 (°C)	
Speed	min P1	350 (min^{-1})	
	max P1	3000 (min^{-1})	
Viscosity range	recommended	12 to 100 mm 2/s (cSt)	
	permitted	max 750 mm 2/s (cSt)	
Contamination class	Dp > 200 bar bx = 75 - 10 mm	8 - Nas 1638	
		19 / 17 /14 - ISO 4406	
	Dp < 200 bar bx = 75 - 25 mm	10 - Nas 1638	
		21 / 19 /16 - ISO 4406	
Relief valve		177 ± 3 bar	
Stand by pressure load sensing valve		7 bar	
Weight		30 kg	

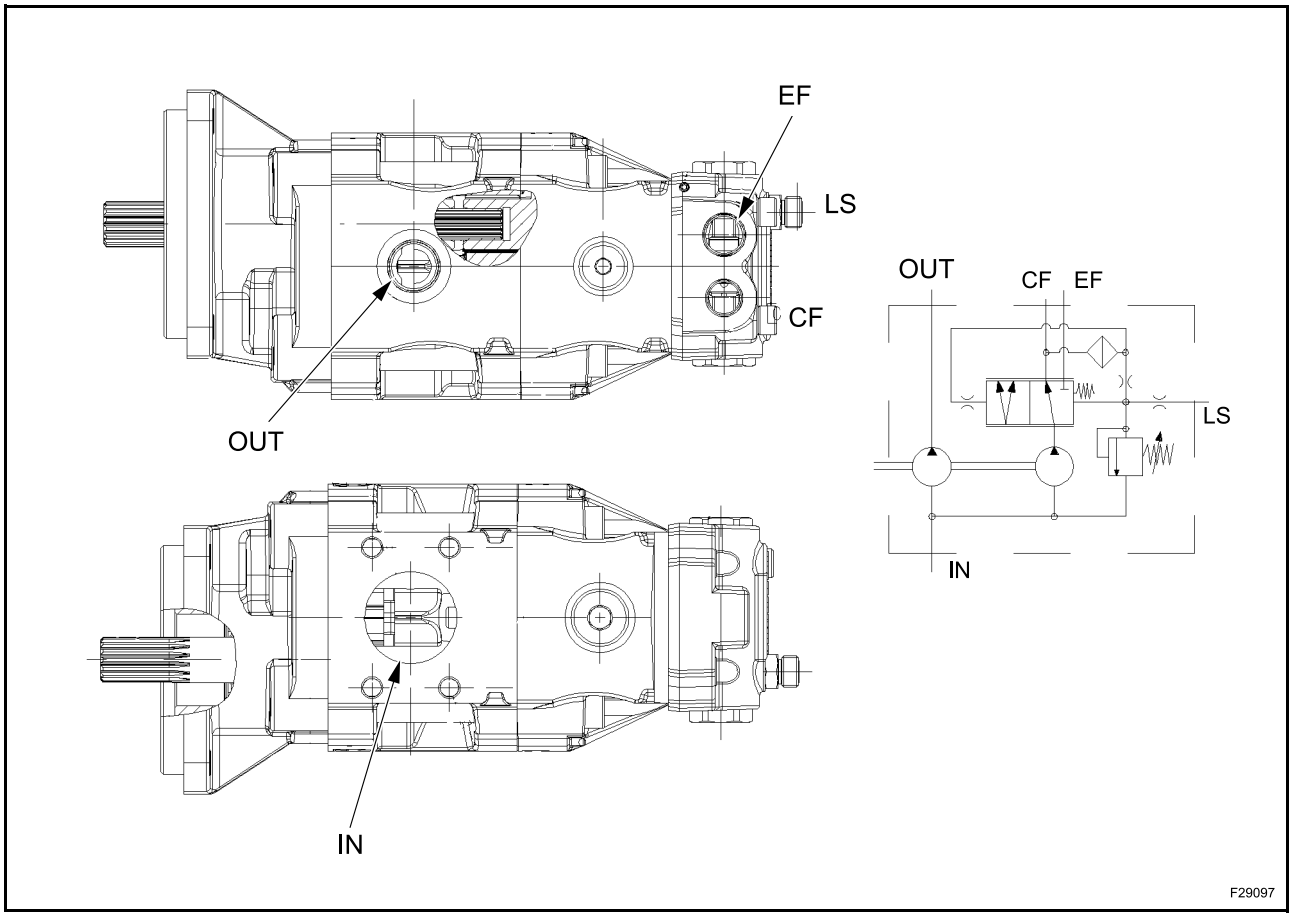
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MOUNTING SCREW TORQUE



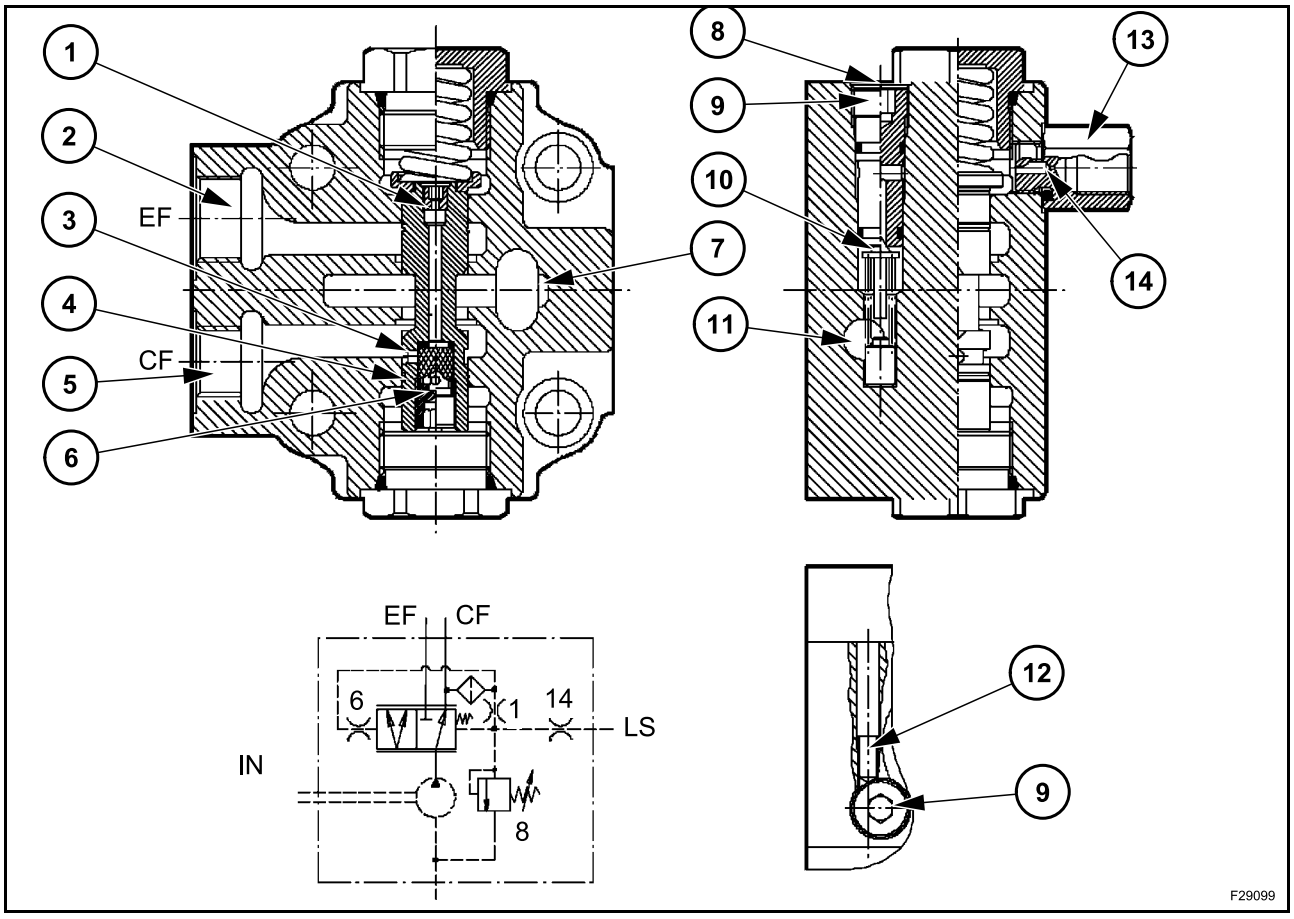
HYDRAULIC DIAGRAM



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2.3 LOAD SENSING VALVE

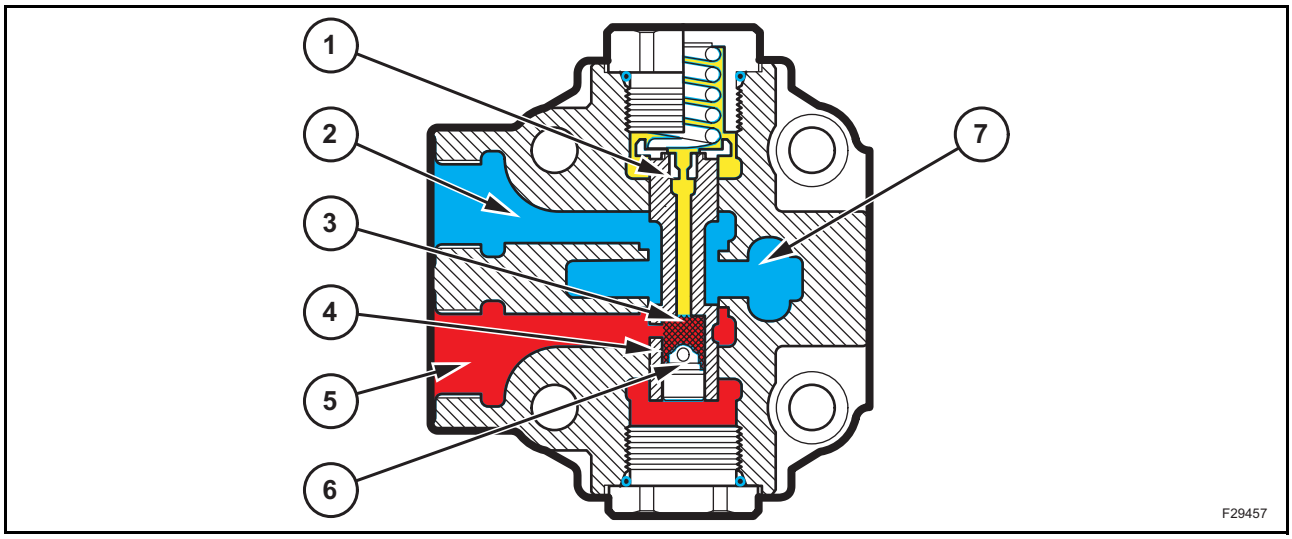


1. Orifice
2. Rear systems (EF)
3. Filter
4. Spool
5. To steering priority flow (CF)
6. Orifice
7. Inlet port from rear pump (IN)
8. Steering relief valve
9. Relief valve adjuster
10. Poppet
11. Return to inlet pump port
12. Lock plug
13. Load sensing signal (LS)
14. Orifice

When the steering is in neutral the LS port is connected to the unload (through the steering) and the steering inlet port (CF) is open.

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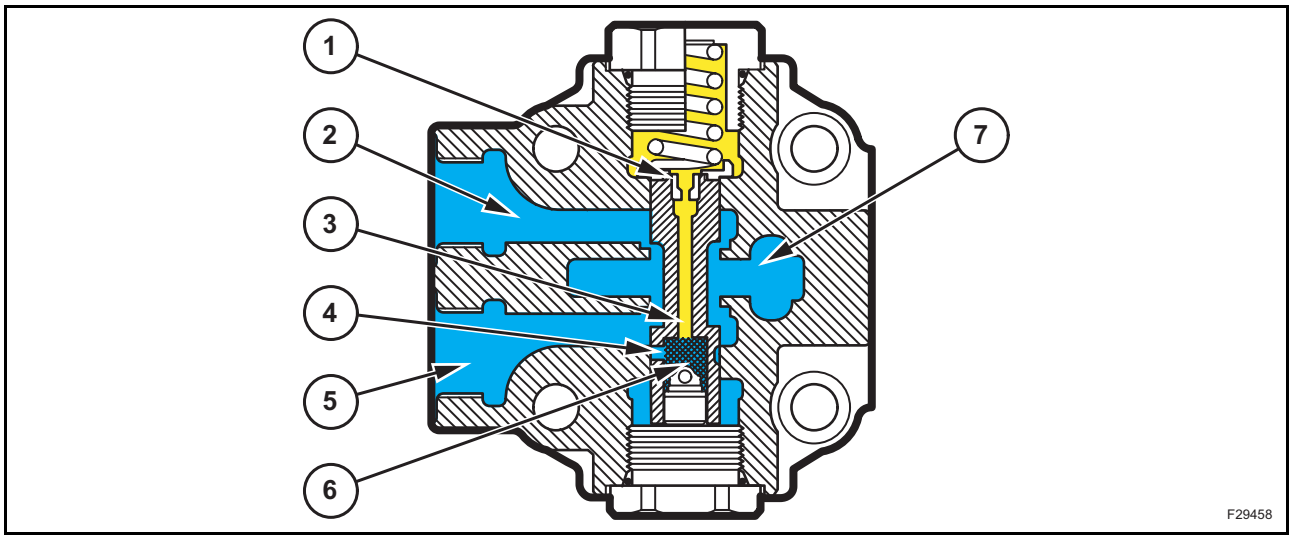


Load sensing valve with pump running - Steering in neutral

Return to oil tank
Trapped oil
Pressure oil

1. Orifice
2. Rear systems (EF)
3. Filter
4. Spool
5. To steering priority flow (CF)
6. Orifice
7. Inlet port (from rear port)

The pressure on (CF) increases until the pressure value (stand-by pressure) is sufficient to move the spool valve in a way to divert the flow toward (EF).



Load sensing valve with pump running - Steering working

Trapped oil
Return to oil tank

1. Orifice
2. Rear systems (EF)
3. Filter
4. Spool
5. To steering priority flow (CF)
6. Orifice
7. Inlet port (from rear port)

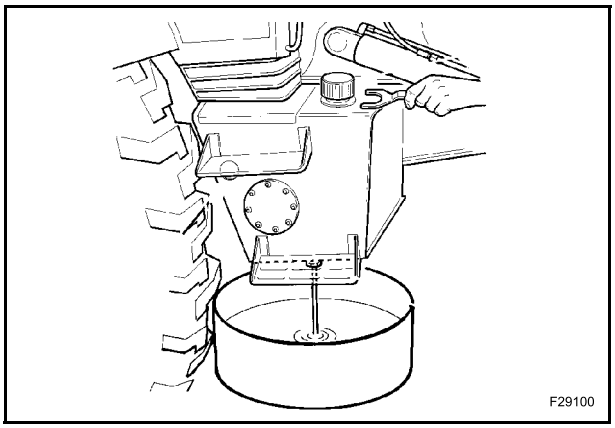
During steering two actions are performed:
1. The fluid moves to the steering through (CF).
2. The (LS) signal is in communication to the steering.

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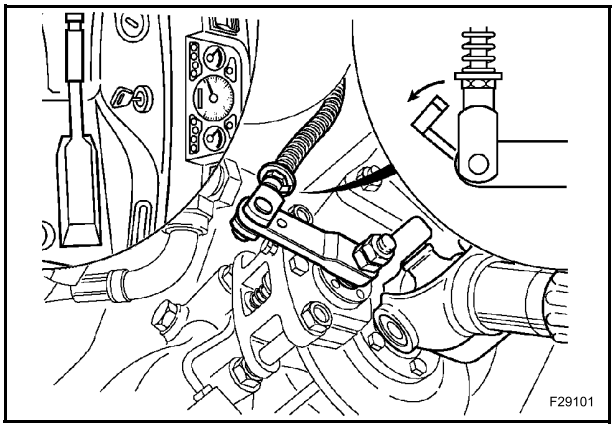
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2.4 REMOVAL

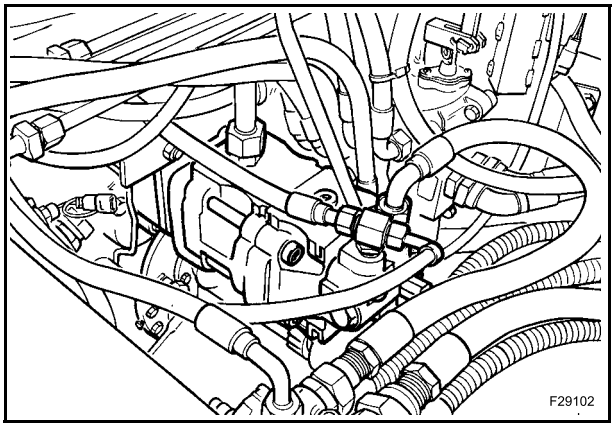
1. Drain the oil tank into a container capable of holding up to 75 litres.



2. Disconnect the parking brake cable and the transmission-to-rear-axle drive shaft.



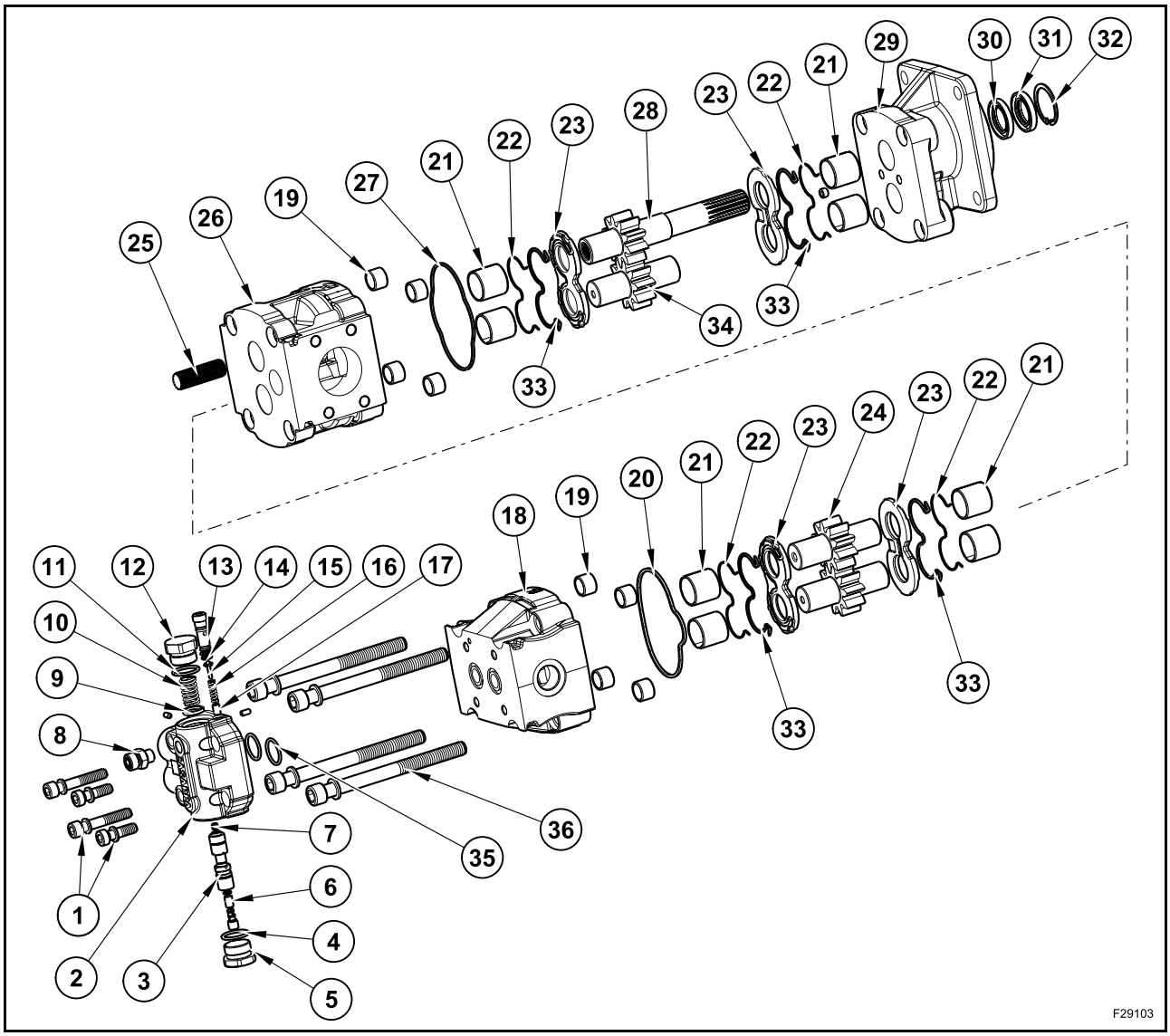
3. Disconnect and plug pump inlet and pressure hoses.
Remove the pump flange mounting screws and remove the pump.



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2.5 COMPONENTS



1. Screw
2. Steering control valve
3. Spool
4. O-ring
5. Plug
6. Valve
7. Filter
8. Fitting
9. Spring seat
10. Spring
11. O-ring
12. Cover
13. Relief valve
14. O-ring
15. Poppet
16. Spring
17. Seat
18. Rear pump body
19. Bushing
20. Gasket
21. Bushing
22. Elastic retainer
23. Bearing
24. Gear
25. Gear
26. Front pump body
27. Gasket
28. Gear
29. Flange
30. Ring seal
31. Ring seal
32. Circlip
33. Pressure seal
34. Gear
35. O-ring
36. Screw

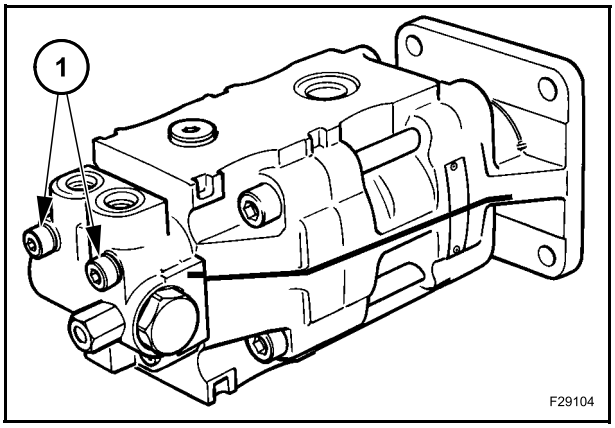
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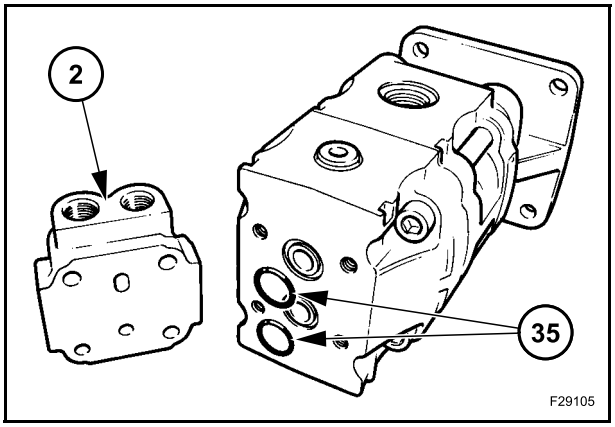
2.6 DISASSEMBLY AND ASSEMBLY

DISASSEMBLY STEERING CONTROL VALVE

To aid reassembly draw an alignment line along the total length of the pump assembly.
Remove the screws (1).



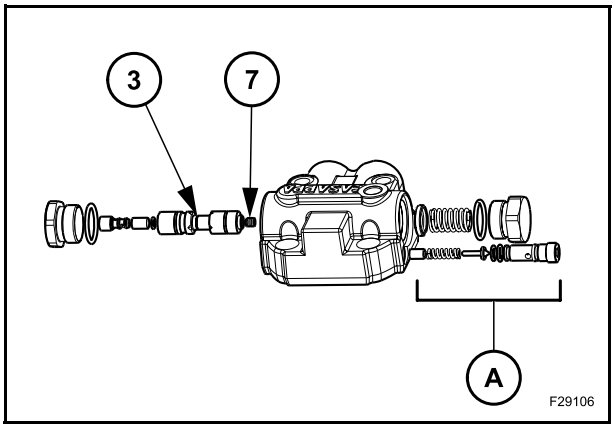
Remove the load sensing steering control valve (2).
Check and eventually replace the O-rings (35).



DISASSEMBLY STEERING CONTROL VALVE

Do not disassemble the steering system relief valve (A) if the steering circuit relief valve pressure was to specification when pressure testing the pump prior to overhaul.

NOTE: if the steering system relief valve is disassembled then the valve must be reset as described in the trouble shooting pressure and flow testing chapter before the vehicle is recommissioned.



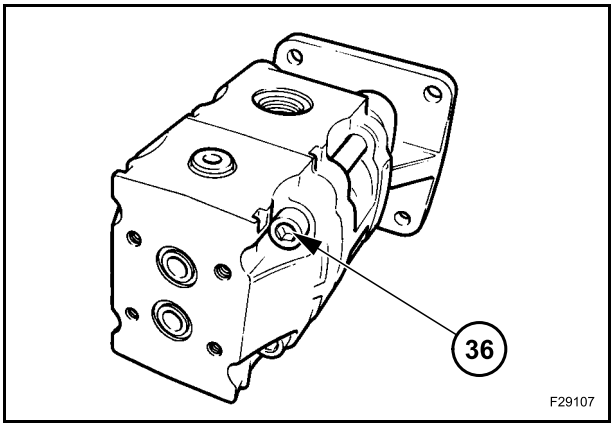
Wash all components in an approved degreasant and inspect for the following.
Valve bore must be free from scoring and damage to metering edges.
The spool (3) should slide freely in the bore and be free of scoring and damage.
Ensure all orifices are clean.
The relief valve seat should be free from pitting and damage. A small chamfer on the mouth of the bore is permissible.
Examine the filter (7) which fit inside the unload and relief valves. The filter must be replaced if contaminated.
Pressure and flow test the pump.

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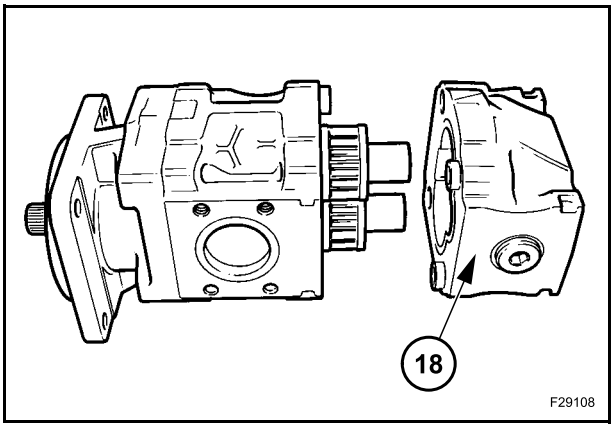
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DISASSEMBLE REAR PUMP

Remove the screws (36).

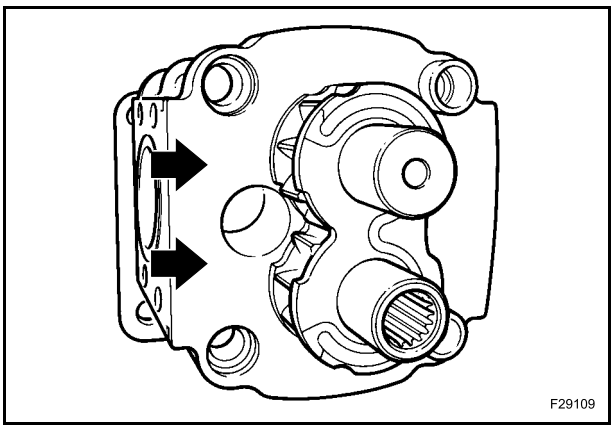


Remove the rear pump assembly (18).



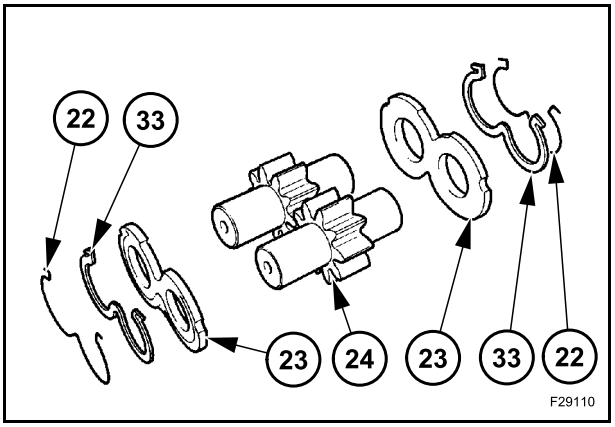
IMPORTANT: prior to disassembly and to ensure correct reassembly identify the position of each bearing block in the pump body as described below.

Scribe an identifying letter “A” and “B”, “C” and “D” on the pump housing and in the channel of each bearing block.



NOTE: orientation of bearing block seals relative to oil port.

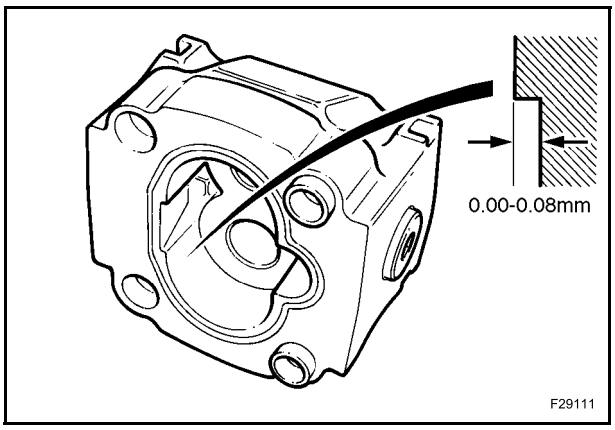
If scribe is not available take care to keep bearing blocks in pairs.
Disassemble the gears (24), the seals (33), the elastic retainers (22) and the bearings (23). Wash all components in approved degreasant.



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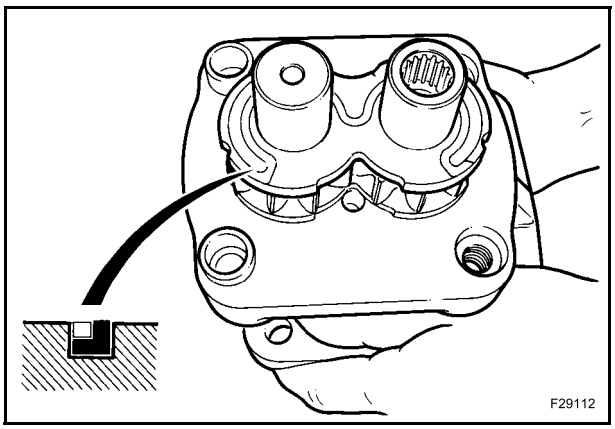
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Inspect the wear track cut by the gears in pump body. The body can be reused if the track is bright and polished and does not exceed 0.08 - 0.076 mm in depth.
Examine bearing block faces for scoring and flatness paying particular attention to the face which abuts the gears. Examine bearing block bushes for scoring. Examine pump gears for scored or worn side faces, journals and damaged teeth.



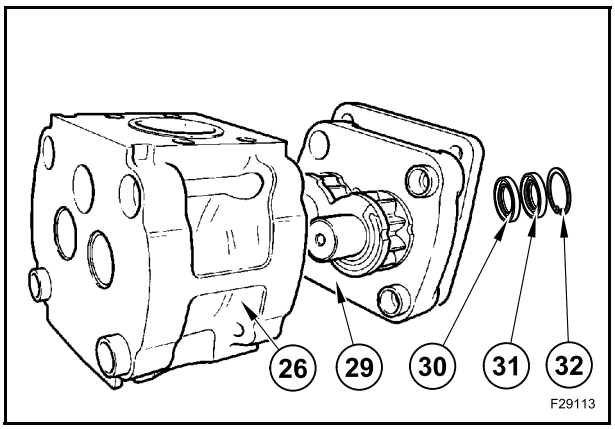
If pump block, gears or bearing blocks are worn and require replacement the pump assembly must be replaced. Reassembly follows the disassembly procedure in reverse whilst observing the following:

- Ensure all parts are perfectly clean and lubricate bushes and gears with clean hydraulic fluid.
- Replace all seals and O-rings.
- Install bearing blocks into the same positions from which they were removed using identification letters scribed during disassembly.
- Ensure plastic back-up seals are correctly positioned in the rubber seal.

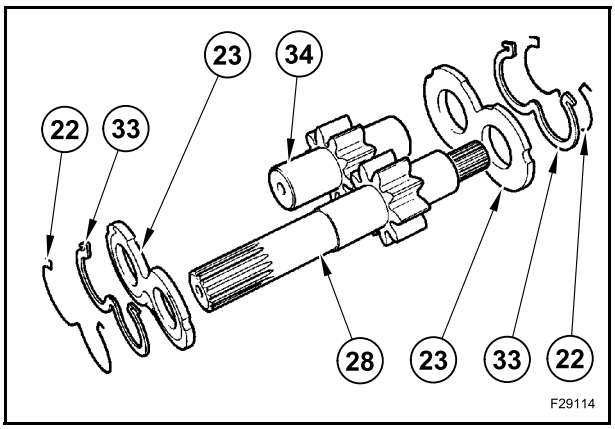


DISASSEMBLY FRONT PUMP

To remove from the pump assembly (26) from the flange (29) it's necessary to remove the snap ring (32).
Remove and replace the seal rings (30) and (31).



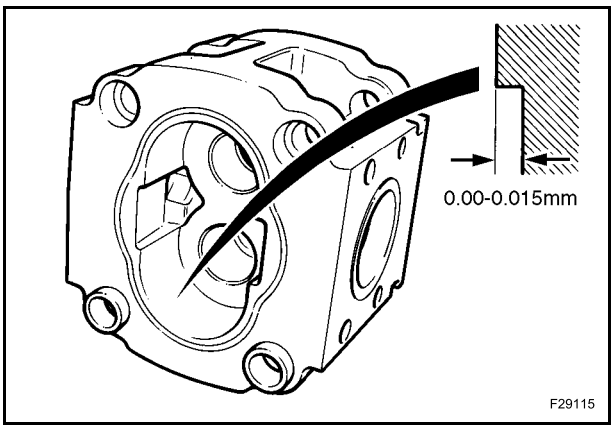
Identify and note the position of each bearing block to ensure correct reassembly.
Disassemble the gears (28) and (34), the seals (33), the elastic retainers (22) and the bearings (23). Wash all components in approved degreasant.



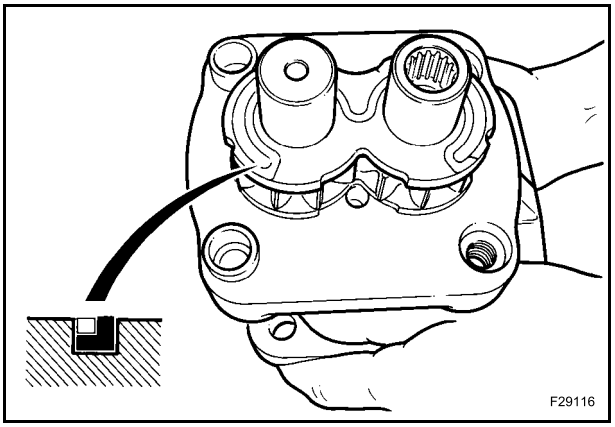
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Inspect the wear track cut by the gears in the inlet side of the pump body. The body can be reused if the track is bright and polished and does not exceed 0.15 mm in depth.
Examine bearing block faces for scoring.
Inspect PTFE coated bearings in body or flange for wear. If bearings are worn the bronze backing will be revealed.
Examine pump gears for scored or worn side faces, journals and damaged teeth.
Examine flange seal contact area on driveshaft. If pump block, gears, bearing blocks or drive shaft are worn the pump assembly must be replaced.



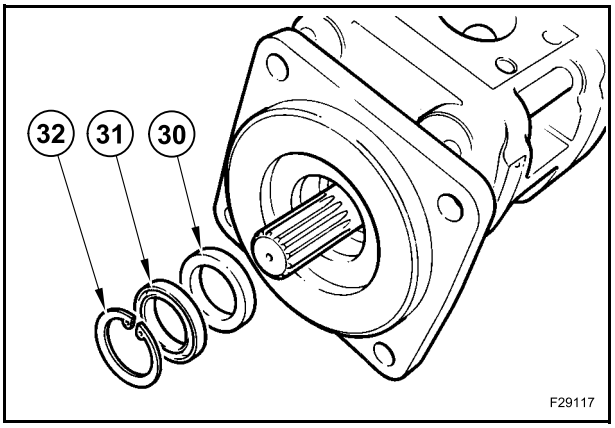
Reassembly follows the disassembly procedure in reverse whilst observing the following:
- Ensure all parts are perfectly clean and lubricate bushes and gears with clean hydraulic fluid.
- Replace all seals and O-rings.
- Install bearing blocks into the same positions from which they were removed.
- Ensure back-up seals are correctly positioned in the seal.



Assemble the inner seal, (30), with the spring and the lip facing the pump. Install the outer seal (31), with the spring and the lip facing outwards and refit the snap ring (32).
Coat seal rings with high melting point grease.

NOTE: ensure seal rings are fitted back to back.

NOTE: if the seal ring recess has been scored during seal removal, coat the outside diameter of the seal ring with flexible gasket sealant to prevent leakage.



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3. CONTROL VALVES

3.1 CONTROL VALVES “REXROTH” (MECHANICAL MODELS)

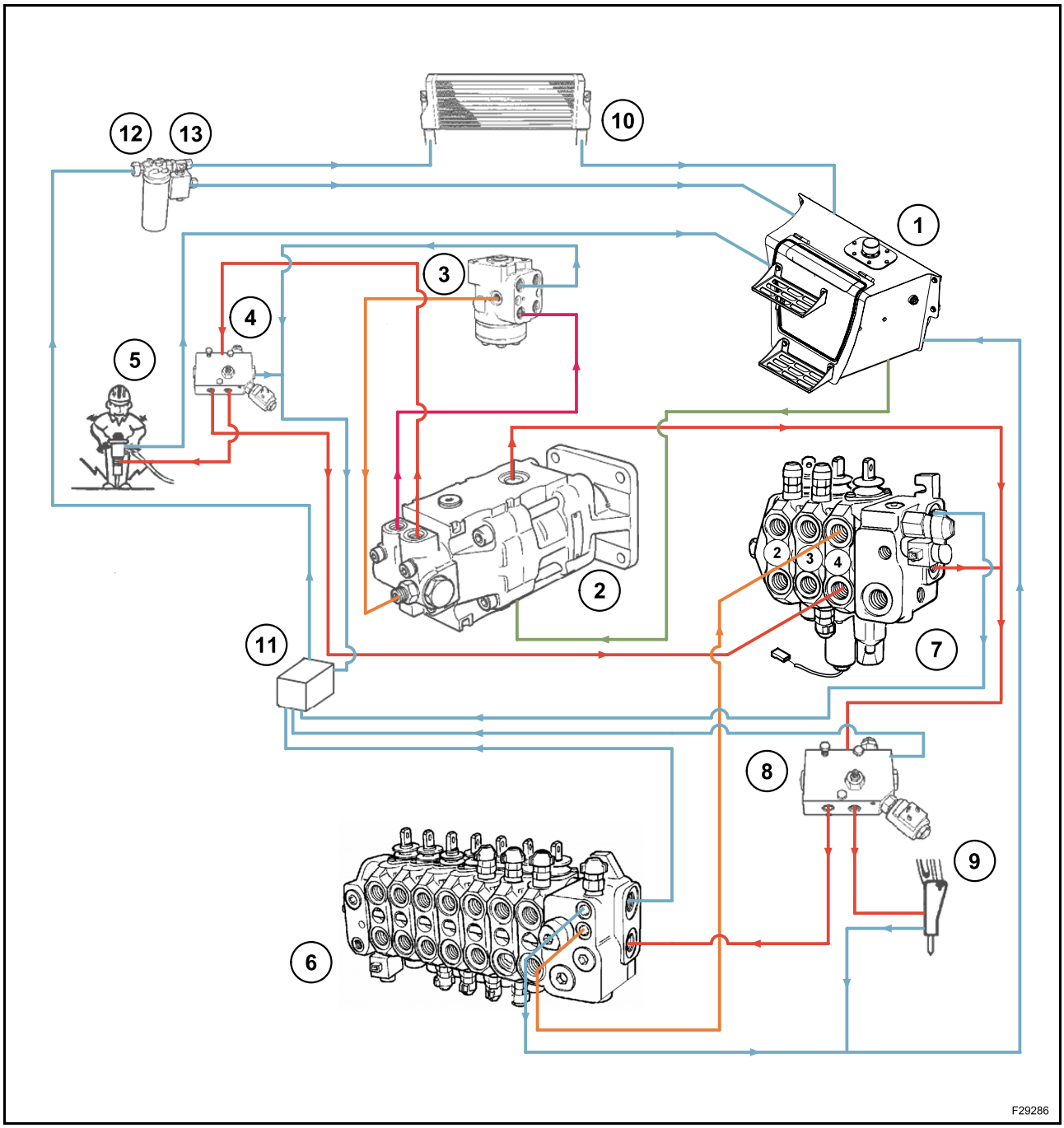
The hydraulic circuit is a load sensing flow sharing system working in conjunction with a fixed displacement gear type hydraulic pump.
This system has the advantage that at any time the distribution of flow to the services being operated is in proportion to the openings of the control valve spools.
The flow distribution to the backhoe and loader control valves is independent of the load and it is therefore possible to operate two or more spools satisfactorily at the same time.
The principal components of the load sensing flow sharing system are the pressure compensator valves in each control valve section, together with the load sense line which connects all the spool sections in both the loader and backhoe control valve assemblies.
Because the hydraulic pump is a fixed displacement gear type pump it should be noted that the load sense line only connects the loader and backhoe control valve assemblies and does not have any connection to the hydraulic pump.
The hydraulic pump draws oil from the tank and flow from the front pump is directed to the centre galleries of the loader and backhoe control valves assemblies.
The flow coming from the rear section of the pump passes through the load sensing flow divider valve mounted on the pump and sends the priority flow to the steering system, while the remaining flow adds to the flow from the front pump, directed to the loader and backhoe attachment systems.
The centre gallery of both the loader and backhoe control valves are blocked by the end plate.
Pressure in the supply system is controlled by the pump flow balancer valve in accordance with the pressure in the load sensing line.
Consequently the higher the load sense pressure the less flow is returned to tank with corresponding increase in flow/pressure to the hydraulic circuits.
Maximum system pressure is limited by the load sense pressure relief valve which relieves pressure in the load sense line when it reaches 210 bar.
Because the pump flow balancer valve is influenced by load sense pressure the valve diverts sufficient flow back to tank to maintain the maximum system pressure of 210 bar.

Loader attachment control valve
The loader control valve is mounted on the right hand side of the machine adjacent to the pump.
The valve assembly consists of a maximum of three spool operated sections and provides oil flow to the loader boom, bucket and auxiliary services where fitted.

Backhoe attachment control valve
The backhoe control valve is located at the rear of the chassis.
The control valve consists of a maximum of seven sections of spool control valves and provides the oil flow for operating the lifting, the digging, the bucket, the stabilizers, the swing and telescopic arm (optional).

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Hydraulic system oil
Steering system oil
Load sensing oil
Suction oil
Return to oil tank

1. Hydraulic tank
2. Hydraulic pump
3. Power steering
4. Hand hammer control valve
5. Hand hammer
6. Backhoe attachment control valve
7. Loader attachment control valve
8. Backhoe hammer control valve
9. Backhoe hammer
10. Oil cooler
11. Return line distributor block
12. Filter
13. Oil cooler by-pass valve

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OIL FLOW OPERATION

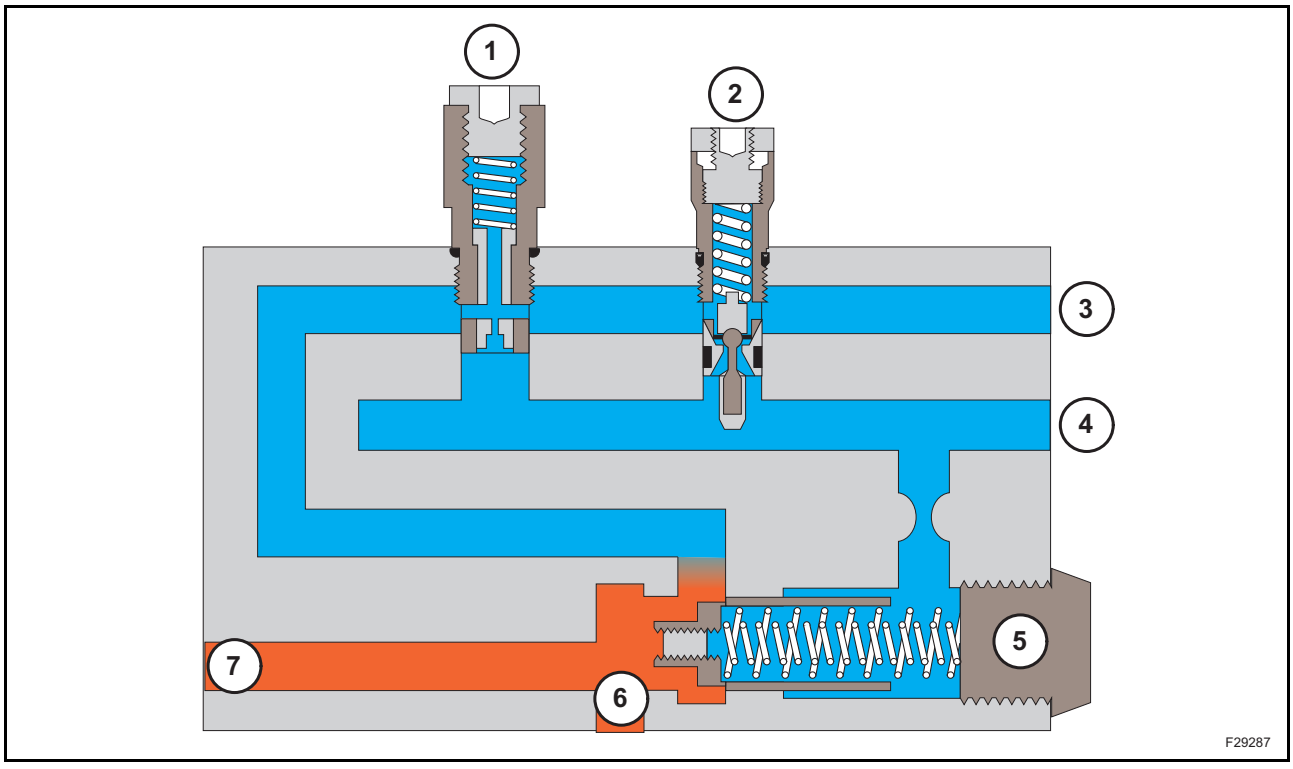
All loader/backhoe circuits in neutral

Each control valve section within the backhoe or loader control valve assemblies contains a spool, two check valves and a load sensing pressure compensator.

A load sensing gallery connects the compensators in each control valve section.

When all control valves are in neutral position, the spools stop the oil flow in each system and the pressure of the load sensing line can bleed to the tank through the relevant 1 litre/min return-to-tank port in the inlet cover of the backhoe attachment control valve.

Because there is no load sense pressure being applied to the rear face of the flow balancer valve, the valve will move against the spring and off its seat when pump pressure reaches 15 bar. Pump flow is now diverted back to tank and the balancer valve maintains a stand-by pressure of 15 bar while the circuits are in neutral.



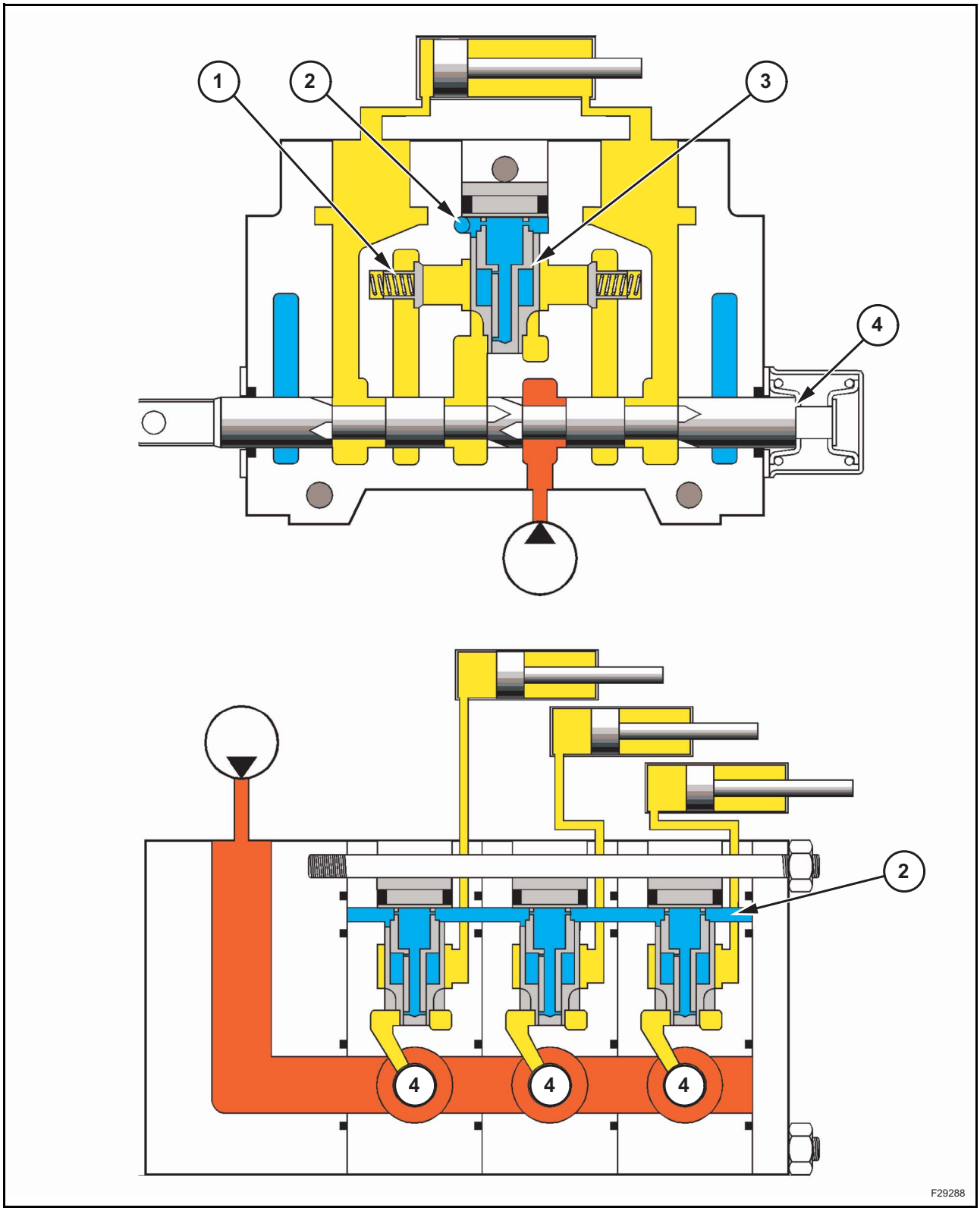
Flow balancer valve operation - All spools in neutral

Pump stand-by pressure 15 bar
Return to oil tank

1. Load sense bleed orifice 1 l/min
2. Load sense limiter (system relief valve)
3. Return to tank
4. Load sense line
5. Pump flow balancer (unload) valve
6. Pump flow IN
7. To backhoe control valves

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Load sensing flow sharing - All spools in neutral

Pump pressure
Trapped oil
Return to oil tank

1. Load non-return check valve
2. Load sense line
3. Pressure compensator
4. Spool

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One hydraulic circuit operating

When a single hydraulic circuit is operated the spool in the control valve section is moved allowing oil to flow past the lands of the spool and apply pressure to the metering element of the pressure compensating valve.

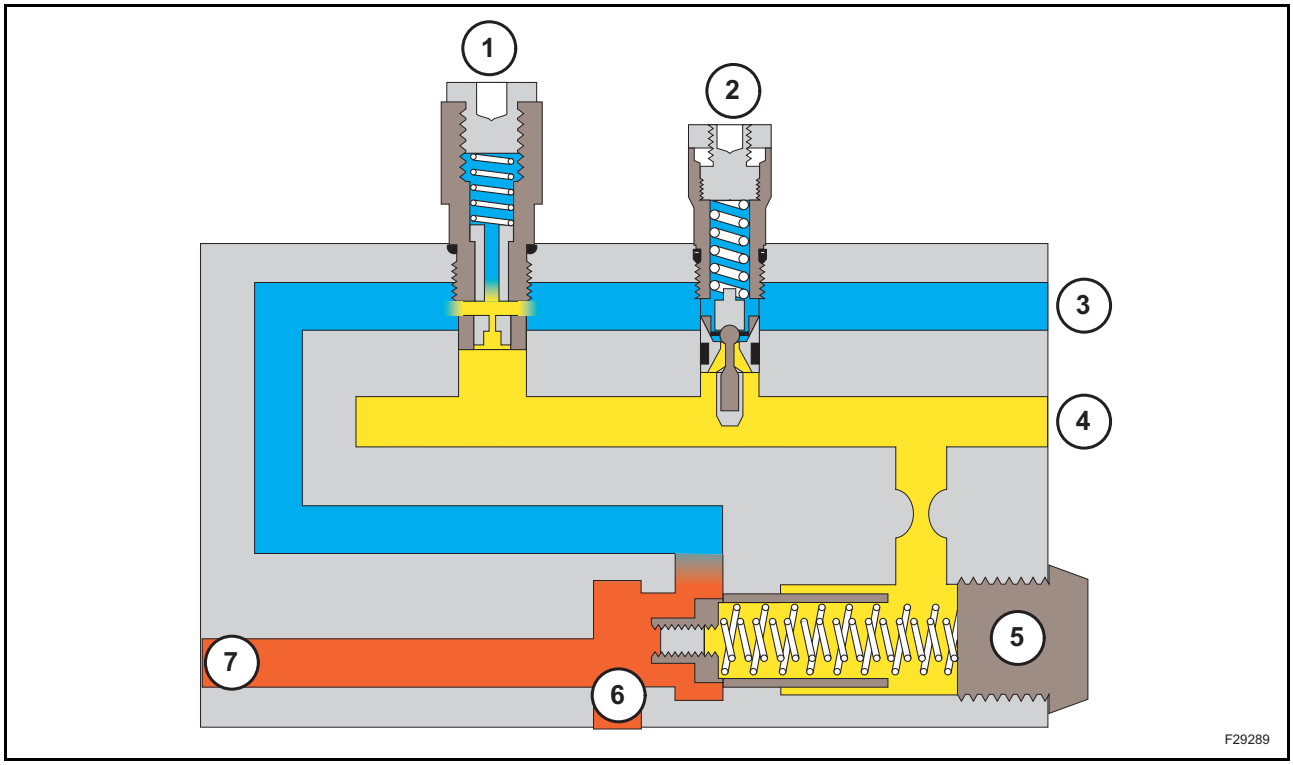
The metering element moves upwards to allow oil to flow to the load check valve and at the same time uncovers the drilling in the spool portion of the pressure compensator valve enabling operating pressure to be sensed in the load sense gallery.

As pressure increases to open the load check valve, load sense pressure is applied to the spring side of the flow balancer valve in the backhoe control valve end cover. A higher pressure is now required to operate the flow balancer valve and pump pressure increase accordingly.

When pump pressure overcomes the pressure behind the load check valve, the valve opens allowing oil to flow into the cylinder port.

Exhaust oil from the cylinder returns to tank through the other port in the control valve section.

If pressure in a load sensing system reaches 195 bar, the safety valve in the side cover of the backhoe attachment control valve will operate. Pump pressure is now limited to 210 bar. This is the pressure required to overcome the pressure of the flow balancing valve spring (15 bar) plus the load sensing pressure controlled at 195 bar.



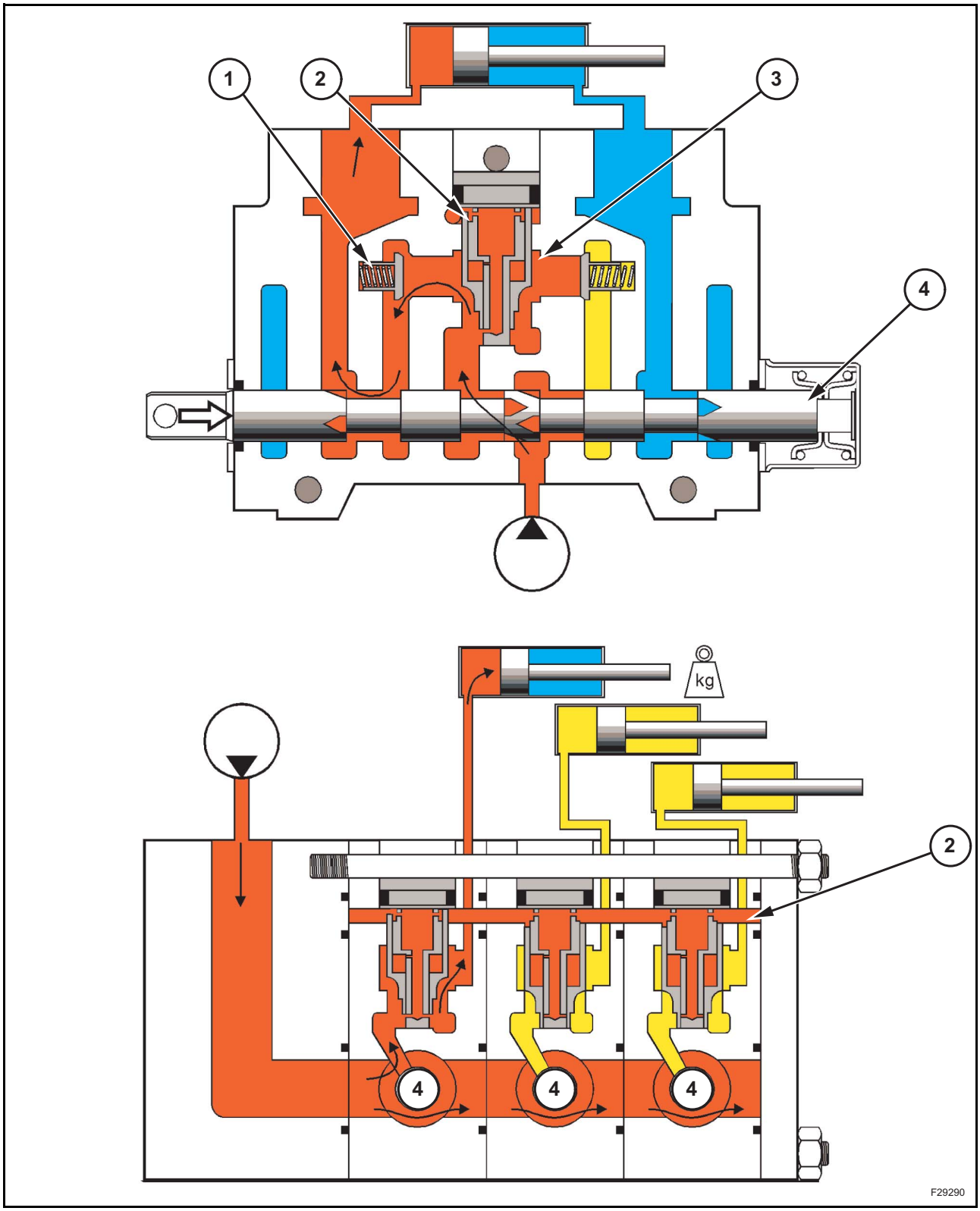
Flow balancer valve operation - Hydraulic circuits operating

Pump pressure
Load sense pressure
Return to oil tank

1. Load sense bleed orifice 1 l/min
2. Load sense limiter (system relief valve)
3. Return to oil tank
4. Load sense line
5. Pump flow balancer (unload) valve
6. Pump flow IN
7. To backhoe control valves

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Load sensing flow sharing - One spool operating

Pump pressure
Trapped oil
Return to oil tank

1. Load non-return check valve
2. Load sense line
3. Pressure compensator
4. Spool

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Two or more hydraulic circuits operating

When two or more hydraulic systems operate, each system will operate at a different pressure.

If pump flow to a specific system is not controlled, the system requiring a lower operating pressure will work faster than the system requiring a higher pressure, because the flow will have to overcome less resistance.

To prevent this situation, the pressure compensating valve regulates the oil flow directed to the system operating at a lower load.

When two spools are operated simultaneously pump pressure is applied to the metering element of the pressure compensating valve in both valve sections.

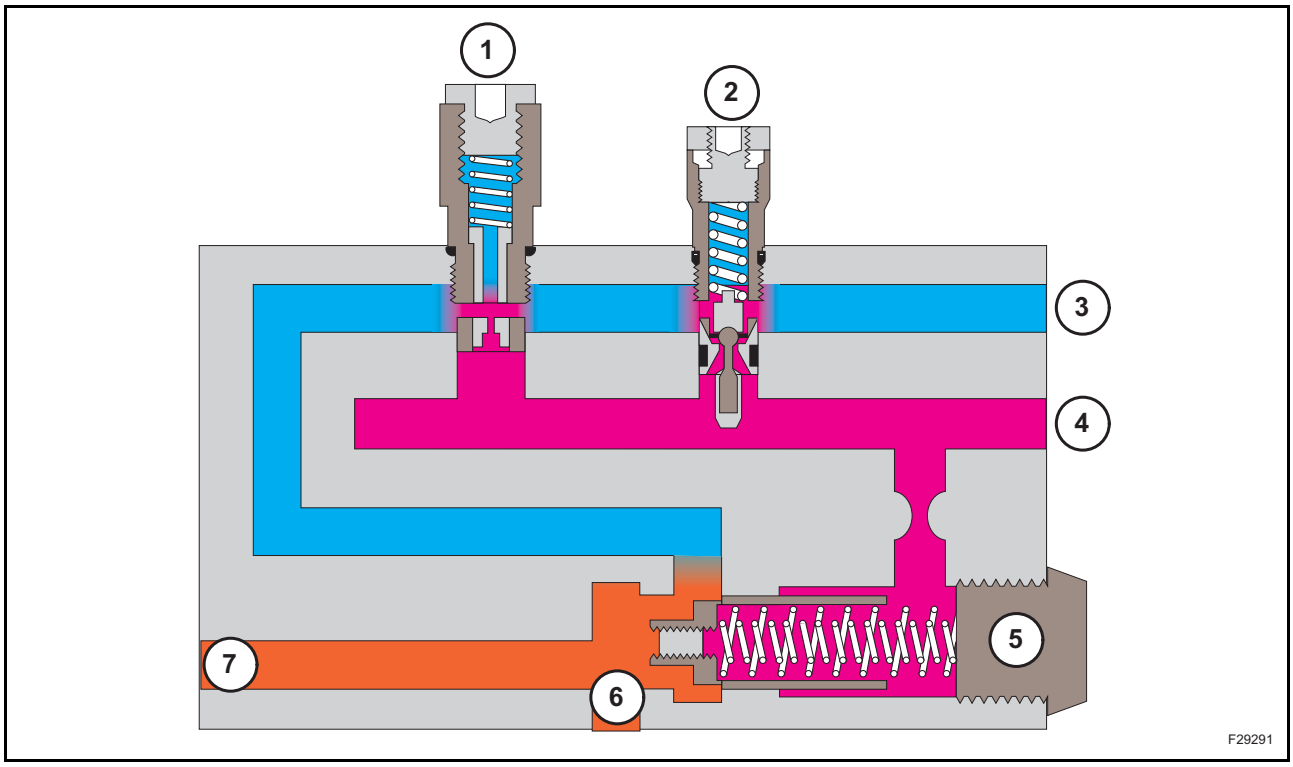
Both metering elements therefore move upwards allowing oil to flow to the load check valves. At the same time the aperture in the spool portion of the pressure compensating valve is uncovered to allow operating pressure to be sensed in the load sensing gallery.

Pump pressure will rise until it exceeds the pressure of the check valve of the system operating at the heaviest load and the pressure in the load sensing line has a value similar to that of the high pressure.

The pressure required to operate the system with a lower load is now too high and, if not limited, it will result in this system operating instead of and faster than the system with a higher load.

To compensate for this condition, the load sensing pressure moves the metering element of the pressure compensating valve in the system with a lower load downwards and restricts the flow to the system.

This balancing of flow and pressure according to the load ensures that both systems operate simultaneously and at a balanced flow rate.



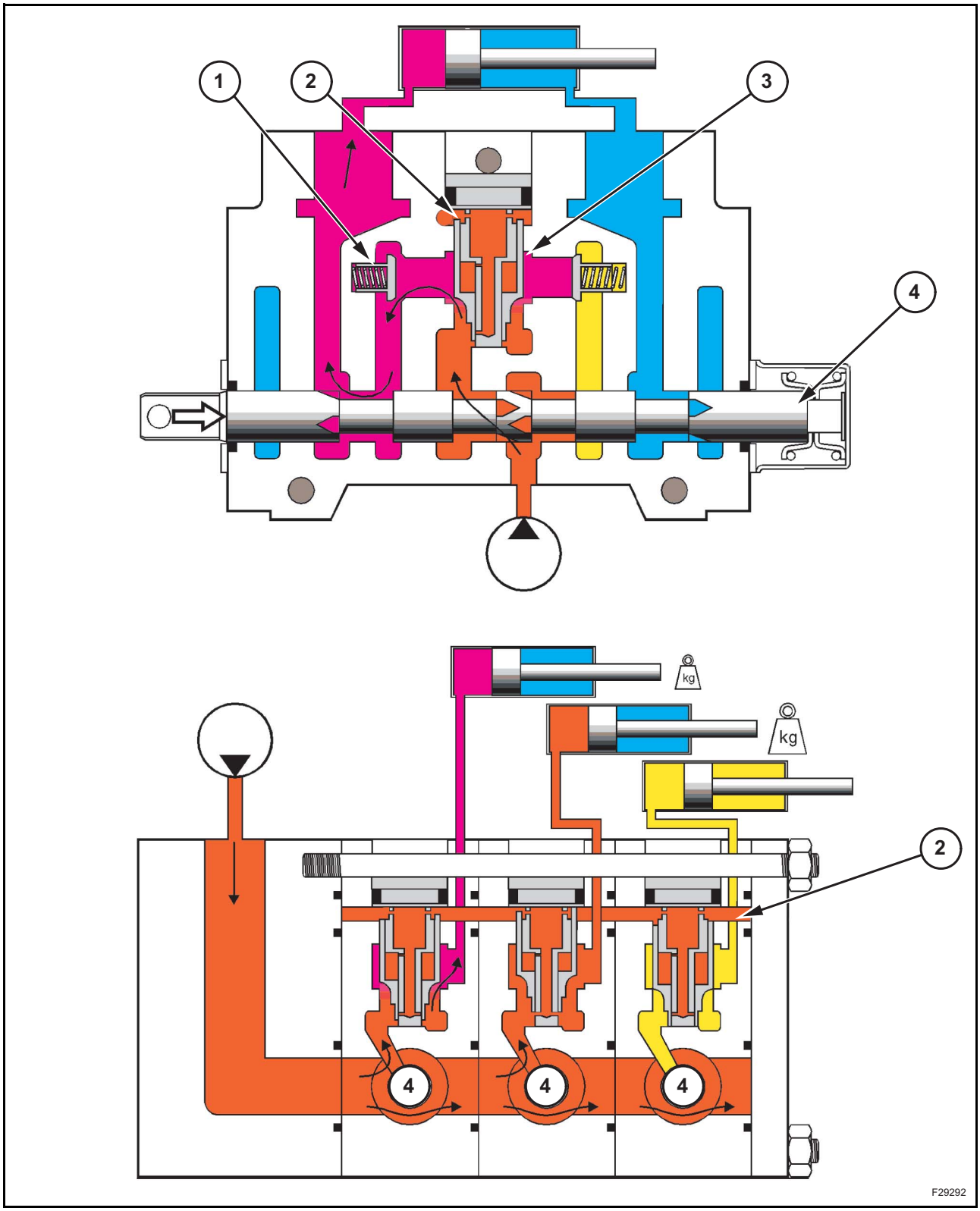
Load sense relief valve operating

Pump pressure at 210 bar
Load sense pressure at 195 bar
Return to oil tank

1. Load sense bleed orifice 1 l/min
2. Load sense limiter (system relief valve)
3. Return to oil tank
4. Load sense line
5. Pump flow balancer (unload) valve
6. Pump flow IN
7. To backhoe control valves

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Load sensing flow sharing - Two spools operating

- 1st spool operating pressure
- 2st spool operating pressure
- Trapped oil
- Return to oil tank

1. Load non-return check valve
2. Load sense line
3. Pressure compensator
4. Spool

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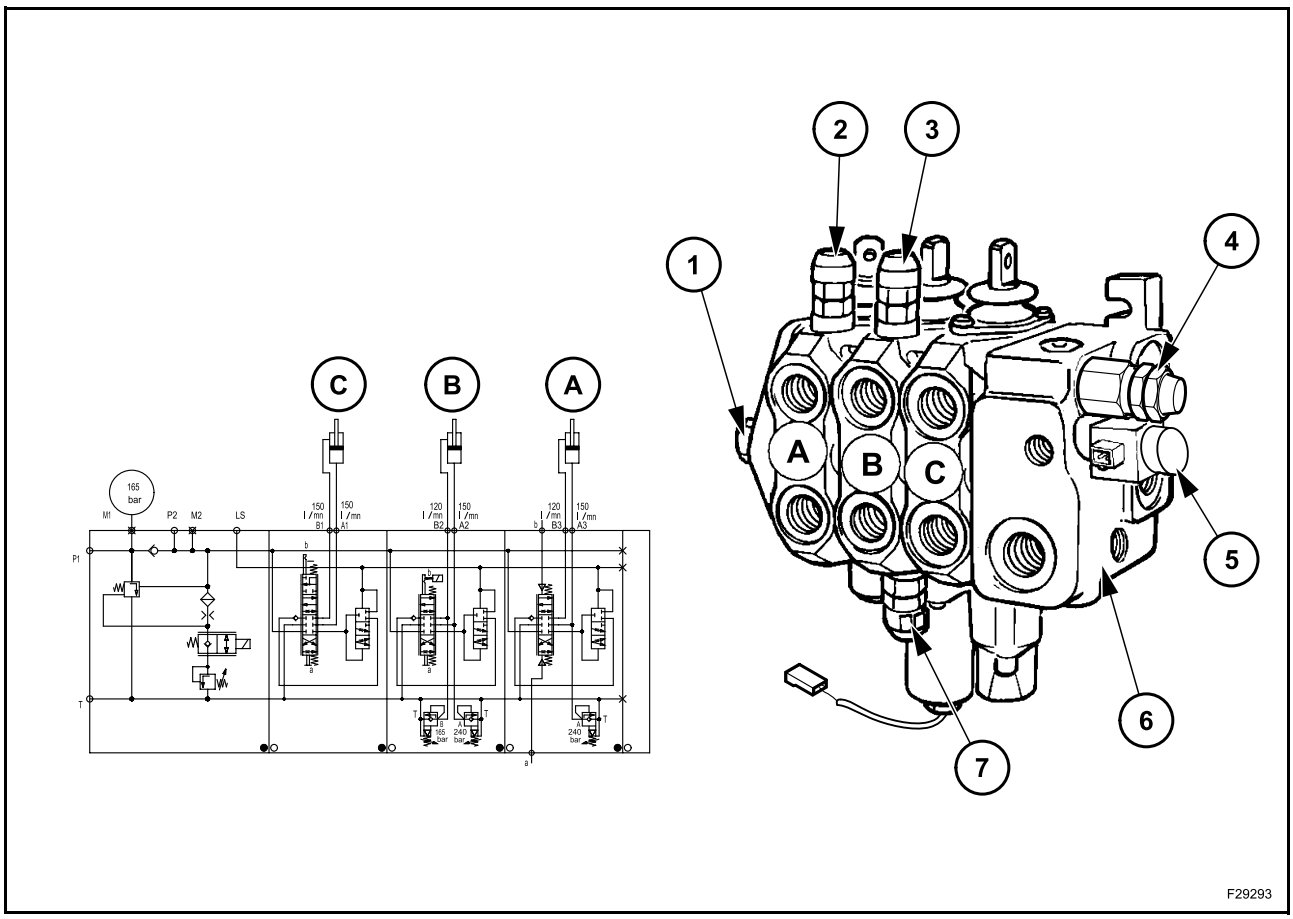
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LOADER CONTROL VALVE

The loader control valve is mounted on the right side of the machine adjacent to the pump. The valve assembly consists of two or three spool operated sections:

- Loader lifting
- Loader bucket
- 4x1 loader bucket

Usually the loader control valve has three valve sections when is installed on the loader backhoe the 4x1 bucket.



A. 4x1 loader bucket section
B. Loader bucket section
C. Lifting section
1. End cover
2. 4x1 loader bucket relief valve
3. Loader bucket relief valve (rod end) 240 bar
4. Hydraulic speed relief valve 165 bar
5. Hydraulic speed solenoid
6. Inlet section
7. Loader bucket relief valve (piston end) 165 bar

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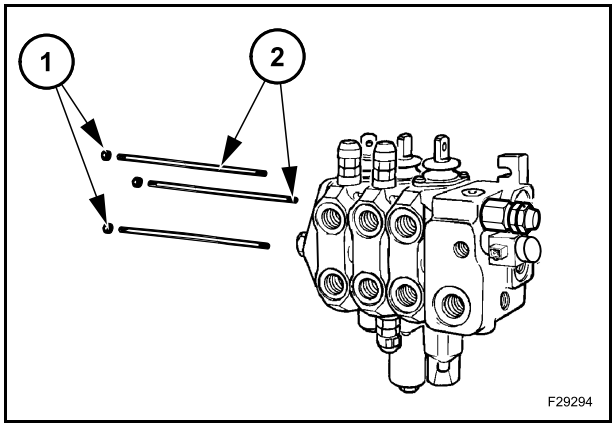
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Removal

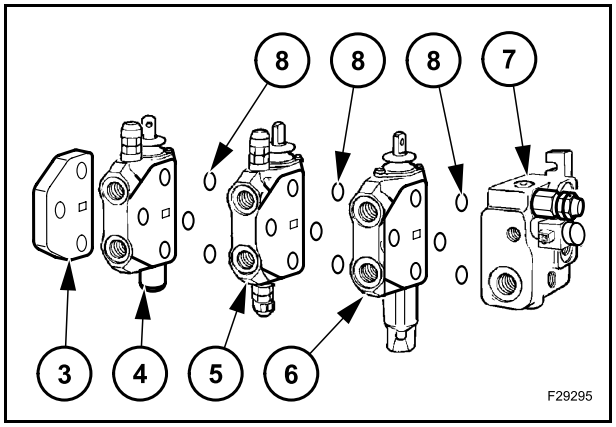
- Lower the loader to the ground, with the bucket firmly placed on the ground.
- Stop the engine and relieve any residual pressure in the backhoe and loader attachment systems by moving the relevant control levers through all operating positions.
- Disconnect the battery.
- Clean the area around the control valve.
- Identify and disconnect linkage, cables and each hose connection to the control valve and plug the hose ends. A drip tray will be required to catch oil draining from inside the hoses.
- Unscrew and remove clamping screws to chassis.
- Remove the valve assembly from the machine.
- Installation is the reverse of the removal procedure.

Disassembly

Unscrew and remove the three nuts (1). Tightening torque 27 ± 2 Nm. Slide out the three tie bars (2).



Disassemble the end cover (4), the section control valve (4), (5) and (6), and the inlet section (7).
Check and possibly replace the O-rings (8) located between the section control valves.

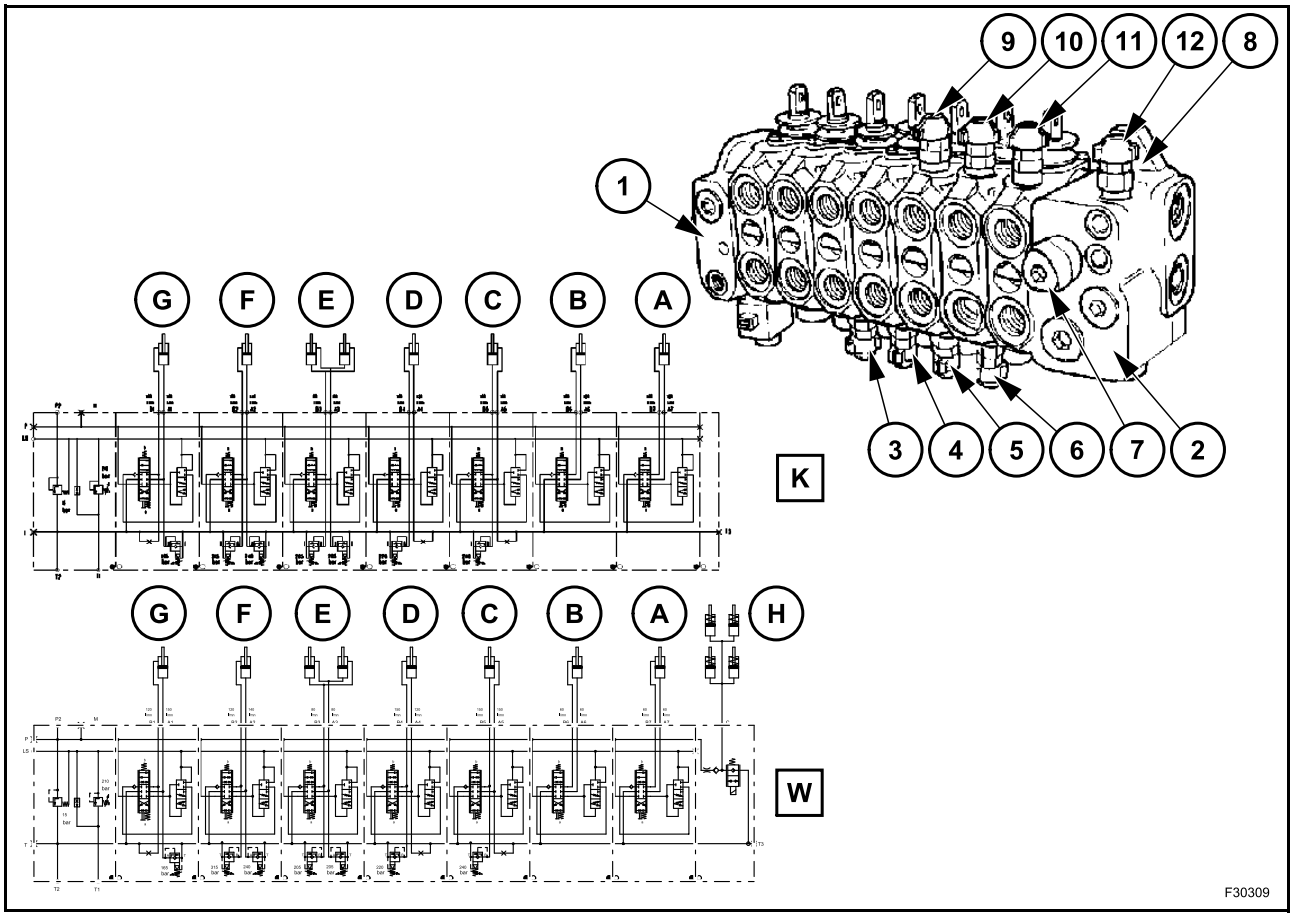


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REAR CONTROL VALVE (WITH MECHANICAL CONTROL)

The rear control valve is located in the rear part of the loader backhoe. It consists of six or seven valve sections together with an inlet and outlet end cover.
Valve sections are:
- Right-hand stabilizer
- Stabilizer left
- Lifting
- Crowd
- Swing
- Bucket
- Telescopic (optional)



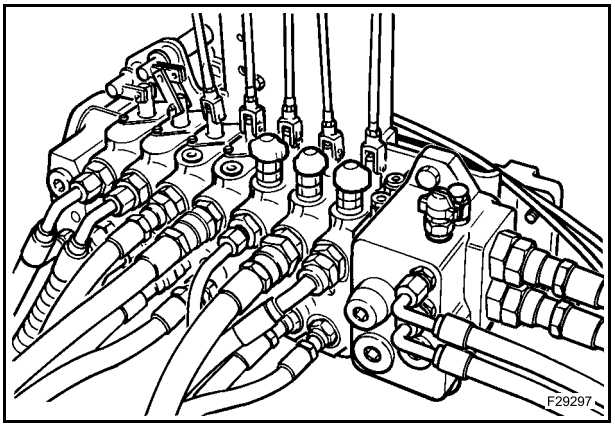
K. Hydraulic diagram for center pivot models (4WS)
W. Hydraulic diagram for sideshift models
A. Right stabilizer section
B. Left stabilizer section
C. Dipper section
D. Bucket section
E. Swing section
F. Lifting section
G. Telescopic dipper section
H. Backhoe attachment travel lock valve (sideshift)
1. End cover
2. Inlet section
3. Dipper circuit relief valve (piston end) - 240 bar
4. Backhoe bucket circuit relief valve (piston end) - 220 bar
5. Swing circuit relief valve (piston end) - 205 bar
6. Boom system relief valve (piston end) - 315 bar
7. Pump flow balancer - 15 bar
8. Load sensing return to tank
9. Swing circuit relief valve (rod end) - 205 bar
10. Boom relief valve (rod end) - 240 bar
11. Telescopic relief valve (rod end) - 205 bar
12. Load sensing relief valve - 210 bar

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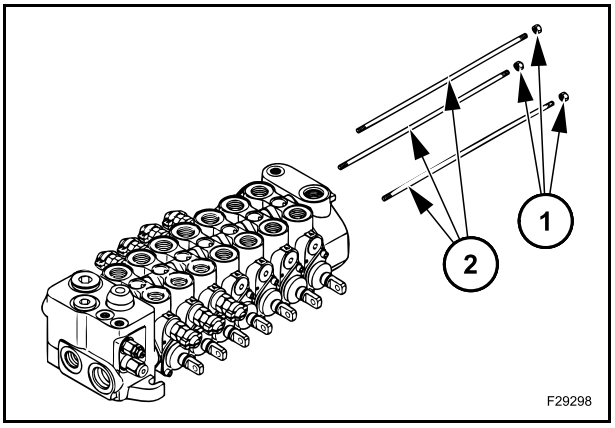
Removal

- Position the loader backhoe on a hard level surface.
- Lower the loader attachment to the ground.
- Lower the stabilizers.
- Position the dipper in the vertical position, with the bucket firmly placed on the ground.
- Stop the engine and relieve any residual pressure in the backhoe and loader attachment systems by moving the relevant control levers through all operating positions.
- Disconnect the battery.
- Clean the area around the control valve.
- Tag and identify the position of all hoses.
- Disconnect and plug all the hoses.
- Disconnect the levers of the manual control.
- Unscrew and remove clamping screws to chassis.
- Remove the valve assembly from the loader backhoe.
- Installation is removal procedure in reverse.

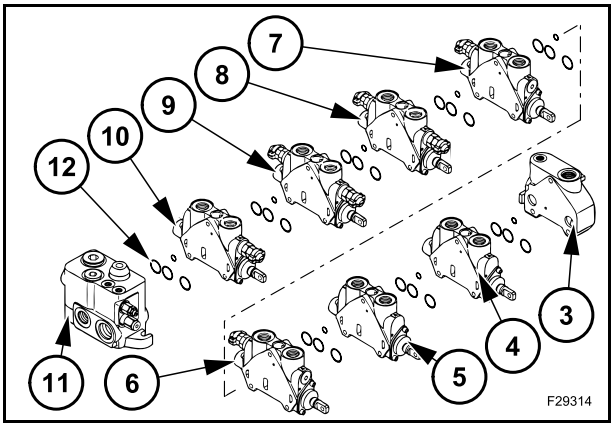


Disassembly

Unscrew and remove the three nuts (1), tightening torque 27 ± 2 Nm.
Slide out the three tie bars (2).



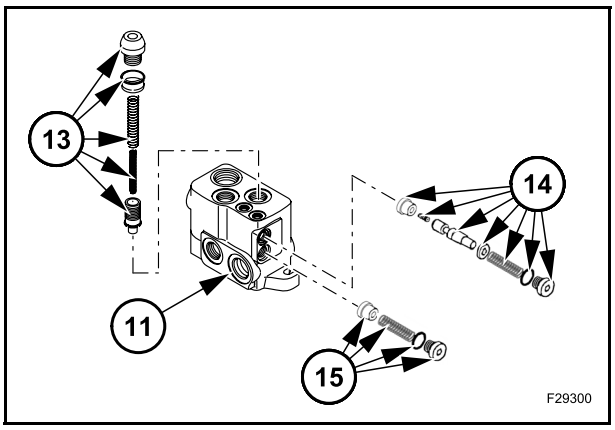
Disassemble the end cover (3), the sections control valves (4), (5), (6), (7), (8), (9) and (10), the inlet section (11).
Check and possibly replace the O-rings (12) located between the section control valves.



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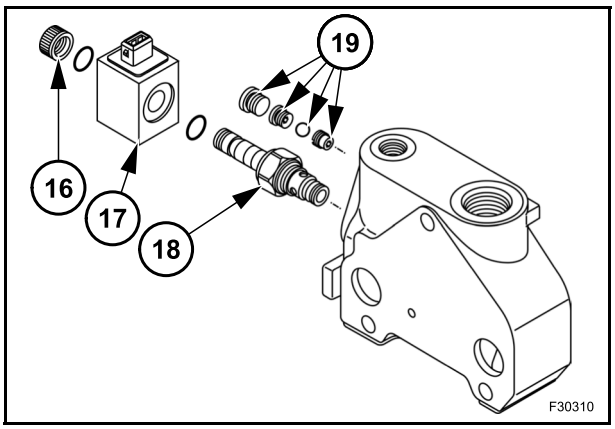
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Disassembly the inlet section.
Remove the pump flow balancer valve (13), the load sensing relief valve (14) and the check valve (15) from the inlet section (11).



Disassembly the outlet section.
(Sideshift version)

Unscrew the knob (16).
Remove the solenoid (17) and the 2 way valve (18).
Disassembly the shuttle valve (19).

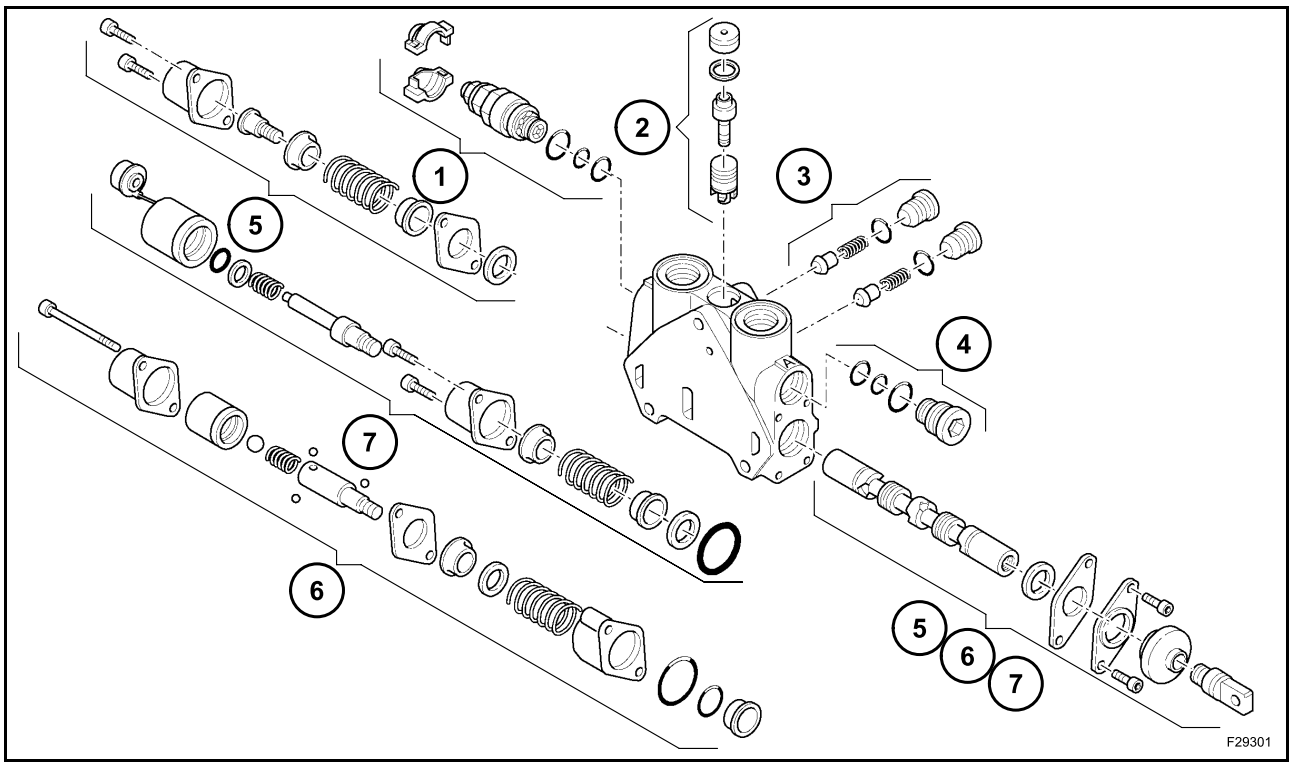


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Disassembly of control valve sections (with mechanical control)

There are indicated all possible solutions relevant to backhoe control sections with mechanical control.



1. Secondary relief valve
2. Pressure compensator
3. Check valves
4. Plug
5. Spool with spring return system
6. Spool with mechanical detent system (loader boom element)
7. Spool with electrical detent system (loader bucket element)

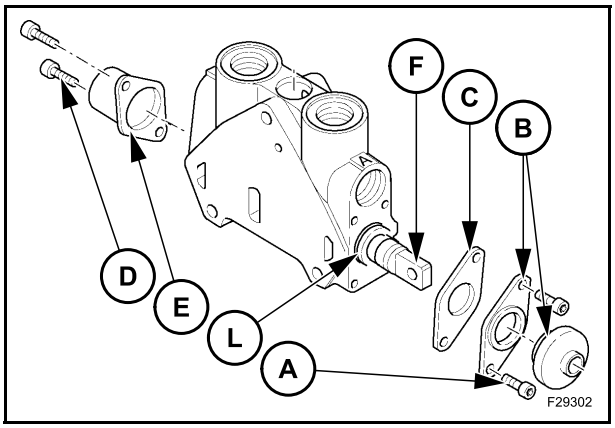
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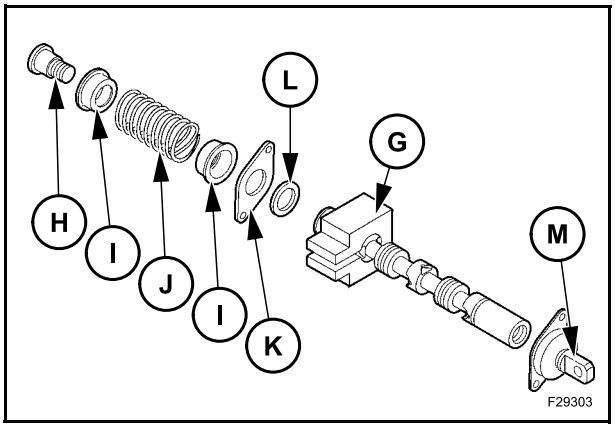
Disassembly and reassembly mechanical control spool

Disassembly

- Remove the screws (A), the boot along with its plate (B) and the plate (C).
- Remove the mounting screws (D) and the cover (E).
- Remove the spool (F) from the valve section.
- Remove the lip seal (L).

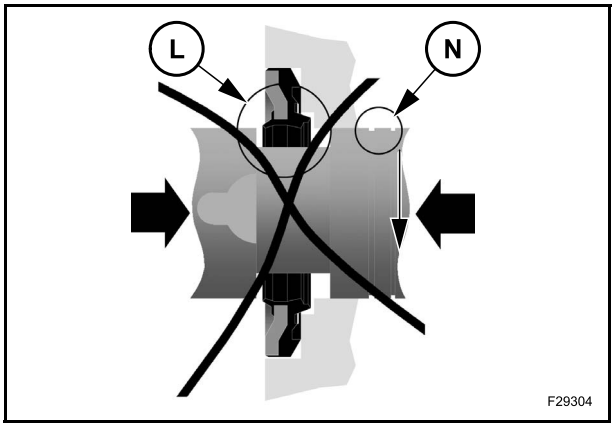


- Use a spool clamp (G) and a vice to secure the spool.
- Heat the spool to 200 °C in an oven or with a heat gun.
- Remove the adapter (H), the retainers (I), the spring (J), the plate (K) and the lip seal (L).
- Remove the tongue (M) if necessary.



Reassembly

- Reassemble parts in reverse order after greasing the spring.
- Position the metal part of the lip seal (L) on the outside of the spool.
- The lip seal must be fitted on the end of the spool so that it is not damaged by the spool grooves (N) and its tightness is not damaged.
- Slide the lip seal perpendicularly onto the spool.
- Tighten the screws (A and D), the adapter (H) and the tongue (M) from 9 to 11 Nm.



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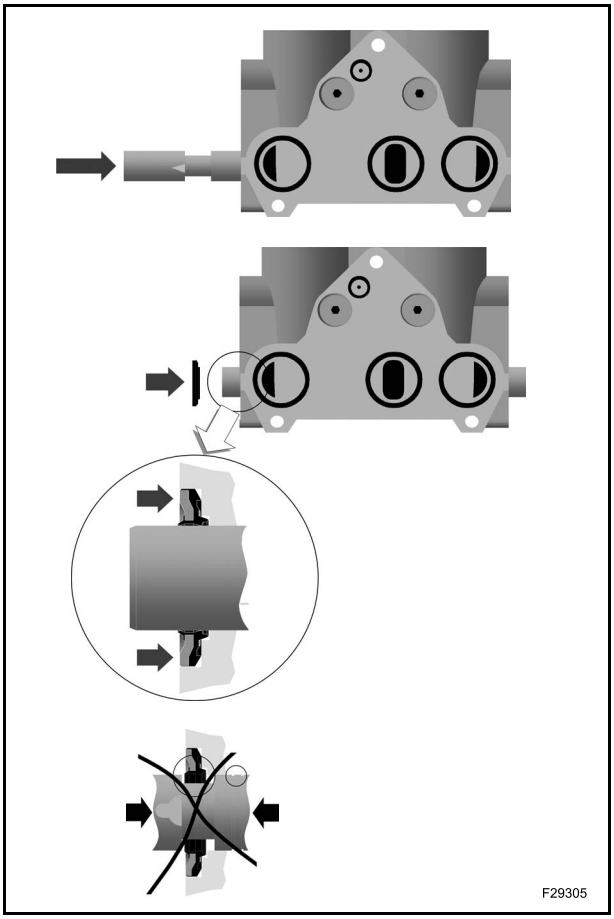
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Precautions to be taken for replacing the spool lip seal.

- Place the spool in the working section.
- Slide the lip seal perpendicularly onto the spool, positioning the metal part of the lip seal on the outside of the spool.

⚠ WARNING

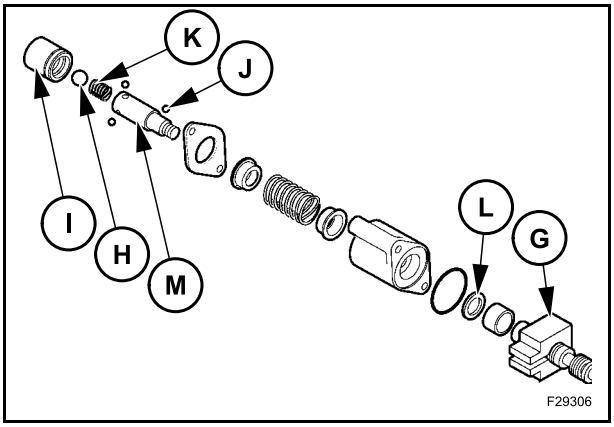
The lip seal must be fitted on the end of the spool so that it is not damaged by the spool grooves (N) and its tightness is not damaged.



Mechanical detent system spool

Disassembly

- Remove the tongue and the cover sides.
- Use a spool clamp (G) and a vice to secure the spool.
- Using a metal rod (minimum length = 80 mm, diameter 6) push the central ball (H) while extracting the detent bush (I).
- Mark the orientation of the detent bush for the reassembly.
- Remove the balls (J) and the spring (K) from the adapter (M).



Reassembly

- Introduce the spring (K) into the adapter (M).
- Place the 3 balls (J) into the radial holes of the adapter (M) and use grease to prevent them from falling.
- Position the central ball (H) against the spring (K).
- Slip the detent bush (I) onto a metal rod.
- Using the metal rod, press the central ball (H) into the adapter (M), then slide the detent bush (I) onto the adapter, making sure that the 3 balls are still in place.

NOTE: make sure that the orientation of the detent bush is respected.

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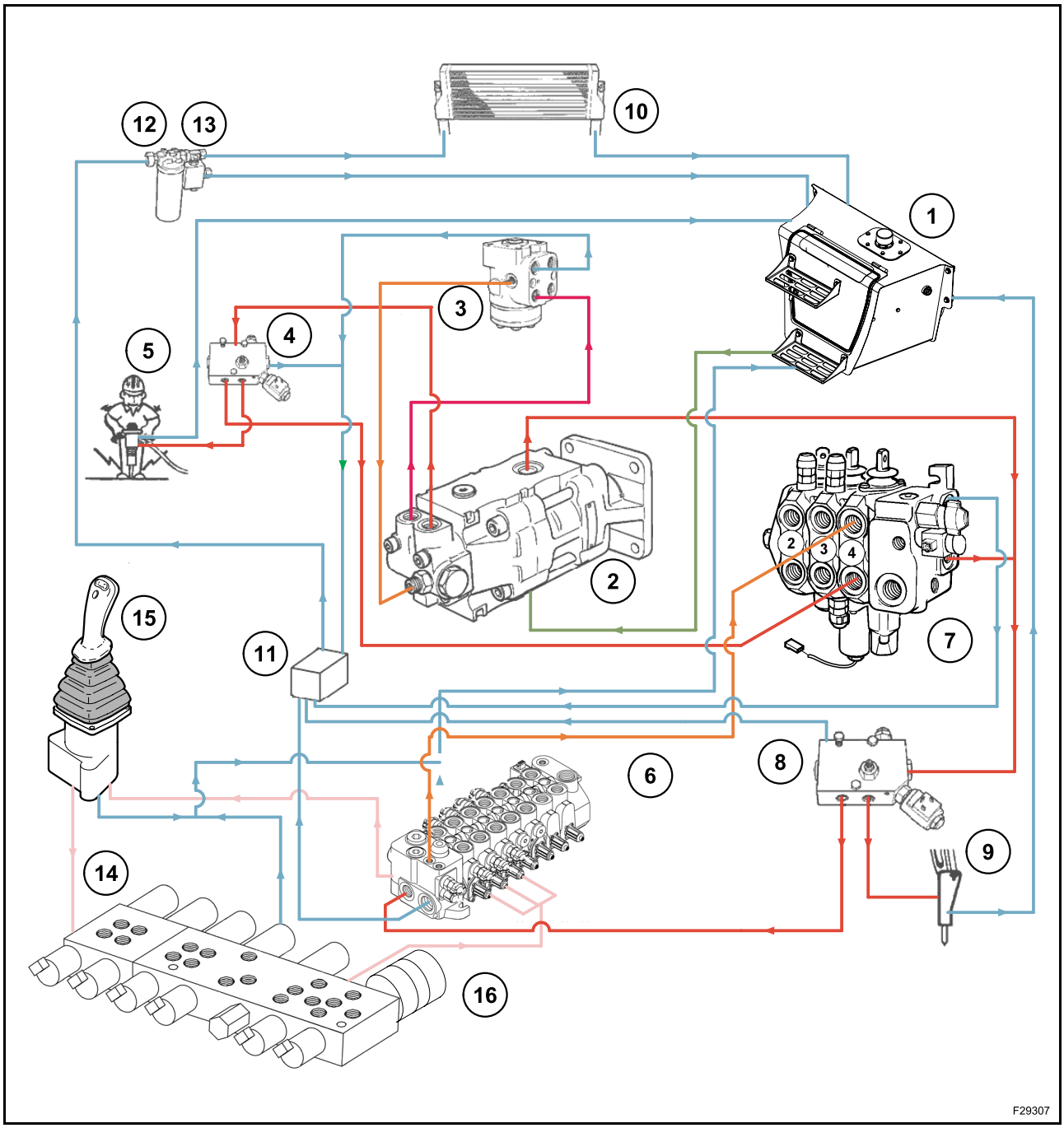
3.2 "REXROTH" CONTROL VALVES (PILOT MODELS)

The loader backhoe with hydraulic control (pilot models) differs basically from the mechanical loader backhoe models for the reason that the controls driving the loader attachment and the stabilizers are hydraulic instead of being mechanical. By means of the control levers located in the cab a control valve is driven, that on its turn drives hydraulically the backhoe control valve, monitoring the backhoe loader and the stabilizers.
The backhoe loader with hydraulic control is equipped with two control valves:

- **Loader control valve**: mounted on the right hand side of the backhoe loader and provides oil flow to the loader boom and front bucket.
- **Backhoe control valve**: located in the rear part of the chassis, it provides the oil flow to the backhoe attachment, to the stabilizers and to the backhoe bucket.

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Hydraulic system oil
Steering system oil
Load sensing oil
Suction oil
Return to oil tank
Control circuit oil

1. Hydraulic tank
2. Pump
3. Power steering
4. Hand hammer control valve
5. Hand hammer
6. Backhoe attachment control valve
7. Loader attachment control valve
8. Backhoe hammer control valve
9. Backhoe hammer
10. Oil cooler
11. Return line distributor block
12. Filter
13. Oil cooler by-pass valve
14. Solenoid valve for piloting hydraulic backhoe control valve
15. Hydraulic control lever
16. Accumulator

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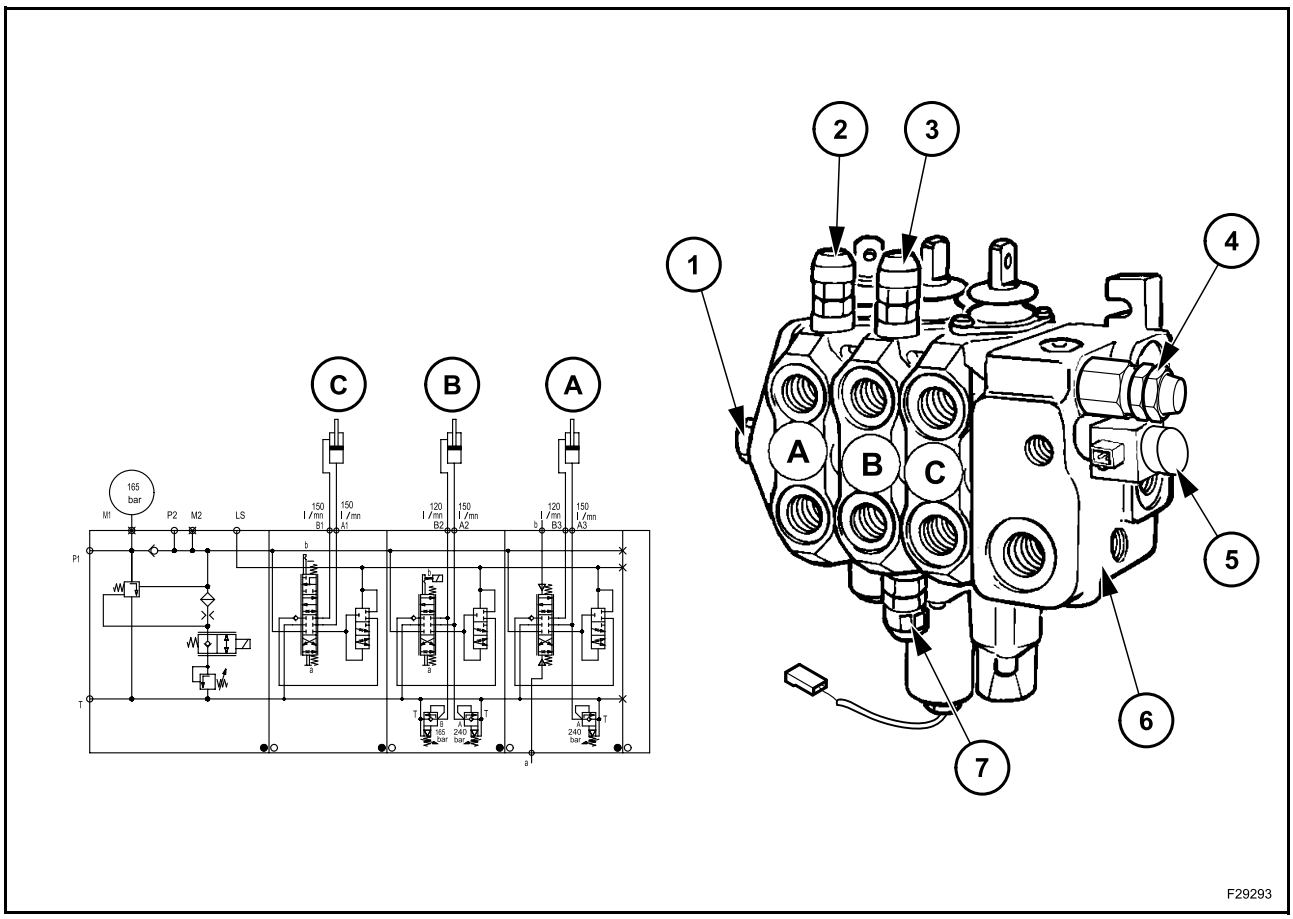
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LOADER CONTROL VALVE

The loader control valve is mounted on the right side of the machine adjacent to the pump. The valve assembly consists of two or three spool operated sections:

- Loader lifting
- Loader bucket
- 4x1 loader bucket

Usually the loader control valve has three valve sections when is installed on the loader backhoe the 4x1 bucket.



A. 4x1 loader bucket section
B. Loader bucket section
C. Lifting section
1. End cover
2. 4x1 loader bucket relief valve
3. Loader bucket relief valve (rod end) 240 bar
4. Hydraulic speed relief valve 165 bar
5. Hydraulic speed solenoid
6. Inlet section
7. Loader bucket relief valve (piston end) 165 bar

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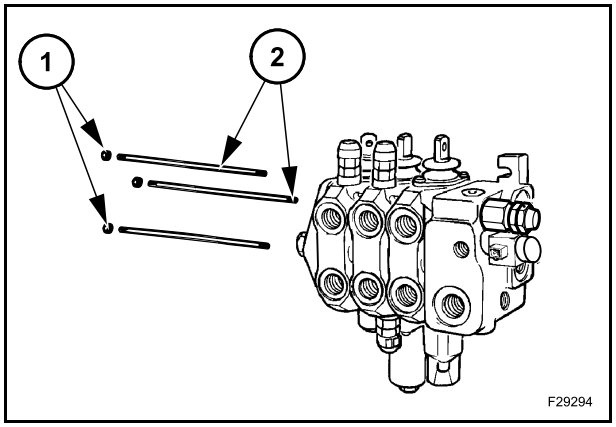
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Removal

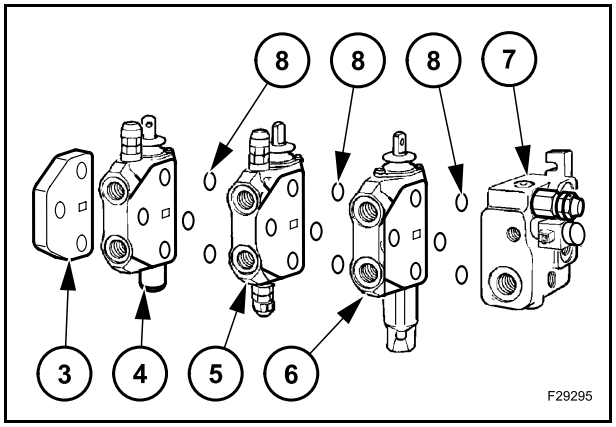
Lower the loader to the ground, with the bucket firmly placed on the ground.
Stop the engine and relieve any residual pressure in the backhoe and loader attachment systems by moving the relevant control levers through all operating positions.
Disconnect the battery.
Clean the area around the control valve.
Identify and disconnect linkage, cables and each hose connection to the control valve and plug the hose ends. A drip tray will be required to catch oil draining from inside the hoses.
Unscrew and remove clamping screws to chassis.
Remove the valve assembly from the machine.
Installation is the reverse of the removal procedure.

Disassembly

Unscrew and remove the three nuts (1). Tightening torque 27 ± 2 Nm. Slide out the three tie bars (2).



Disassemble the end cover (4), the section control valve (4), (5) and (6), and the inlet section (7).
Check and possibly replace the O-rings (8) located between the section control valves.

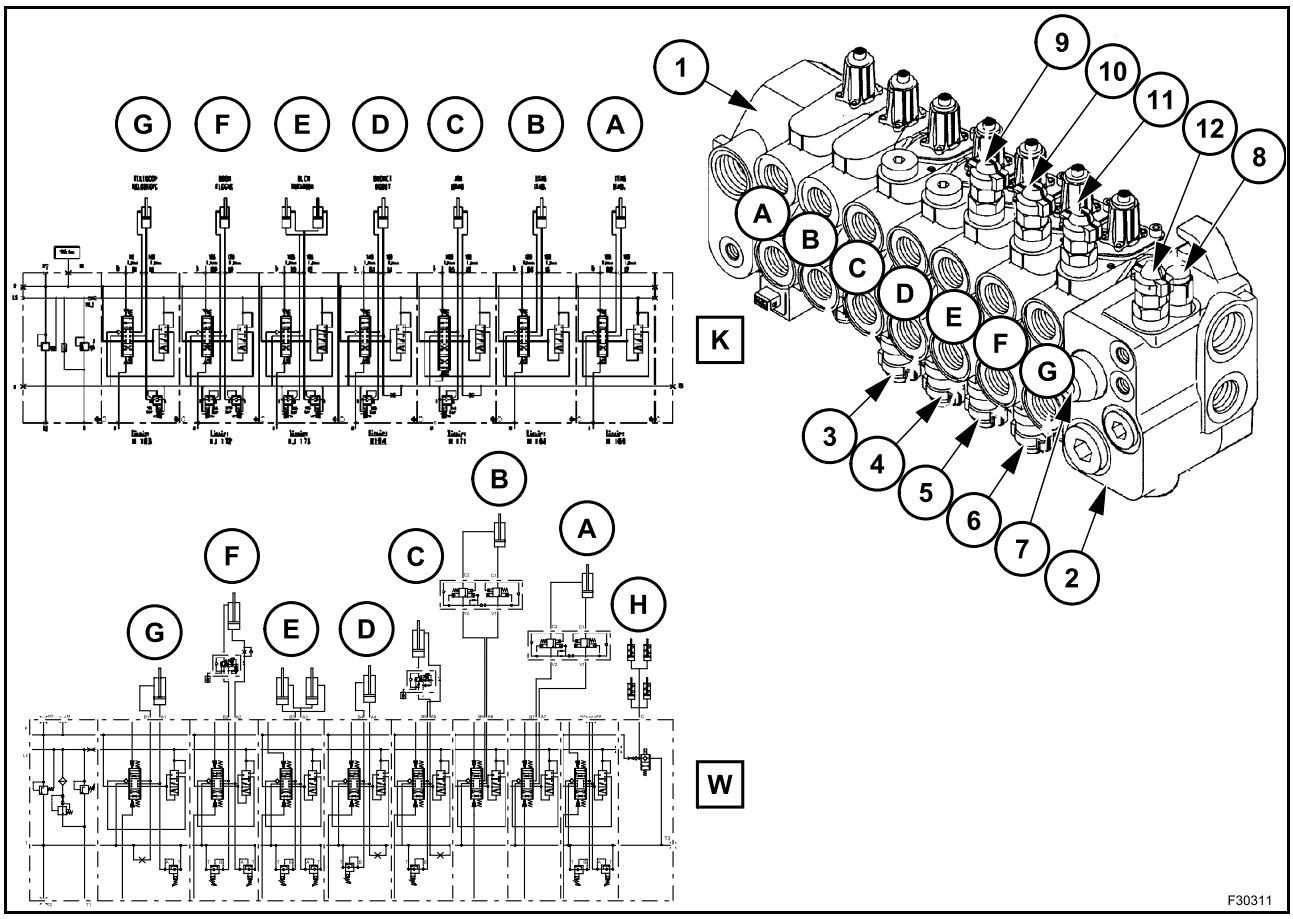


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BACKHOE CONTROL VALVE (WITH HYDRAULIC CONTROL)

The rear control valve is located in the rear part of the loader backhoe. It consists of six or seven valve sections together with an inlet and outlet end cover.
Valve sections are:
- Right-hand stabilizer
- Stabilizer left
- Lifting
- Crowd
- Swing
- Backhoe bucket
- Telescopic (optional)



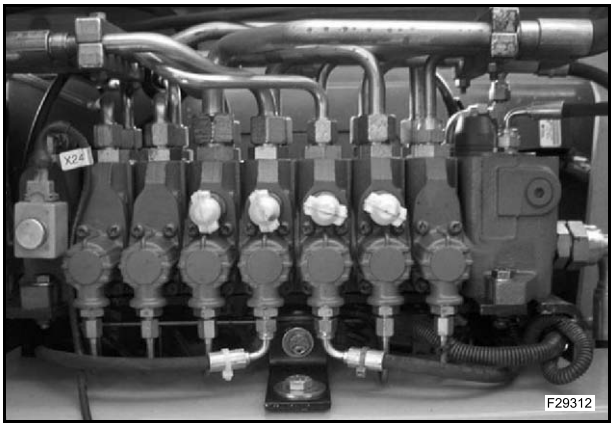
K. Hydraulic diagram for center pivot models (4WS)
W. Hydraulic diagram for sideshift models (4WS)
A. Right stabilizer section
B. Left stabilizer section
C. Dipper section
D. Bucket section
E. Swing section
F. Lifting section
G. Telescopic dipper section
H. Backhoe attachment travel lock valve (sideshift)
1. End cover
2. Inlet section
3. Dipper circuit relief valve (piston end) - 240 bar
4. Backhoe bucket circuit relief valve (piston end) - 220 bar
5. Swing circuit relief valve (piston end) - 205 bar
6. Boom system relief valve (piston end) - 315 bar
7. Pump flow balancer valve - 15 bar
8. Load sensing return to tank
9. Swing circuit relief valve (rod end) - 205 bar
10. Boom relief valve (rod end) - 240 bar
11. Telescopic relief valve (rod end) - 205 bar
12. Load sensing relief valve - 210 bar

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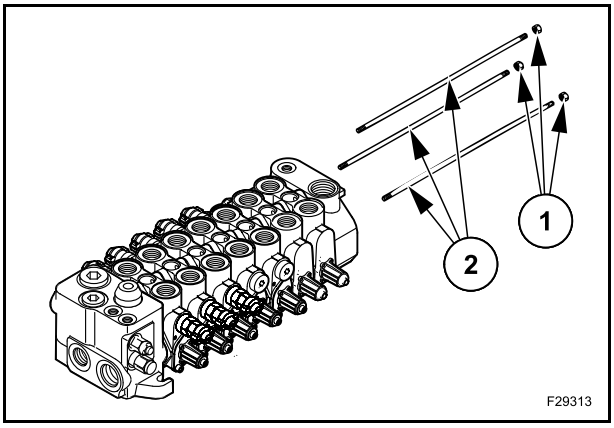
Removal

Position the loader backhoe on a hard level surface.
Lower the loader attachment to the ground.
Lower the stabilizers.
Position the dipper in the vertical position, with the bucket firmly placed on the ground.
Stop the engine and relieve any residual pressure in the backhoe and loader attachment systems by moving the relevant control levers through all operating positions.
Disconnect the battery.
Clean the area around the control valve.
Tag and identify the position of all hoses and hydraulic tubes.
Disconnect and plug all the hoses and all the hydraulic tubes.
Unscrew and remove clamping screws to chassis.
Remove the valve assembly from the loader backhoe.
Installation is removal procedure in reverse.

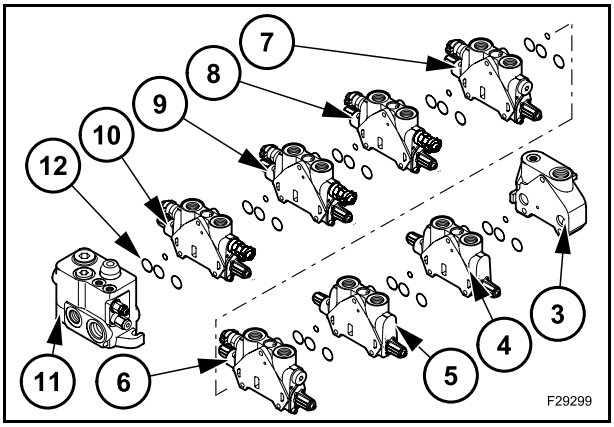


Disassembly

Unscrew and remove the three nuts (1), tightening torque 27 ± 2 Nm.
Slide out the three tie bars (2).



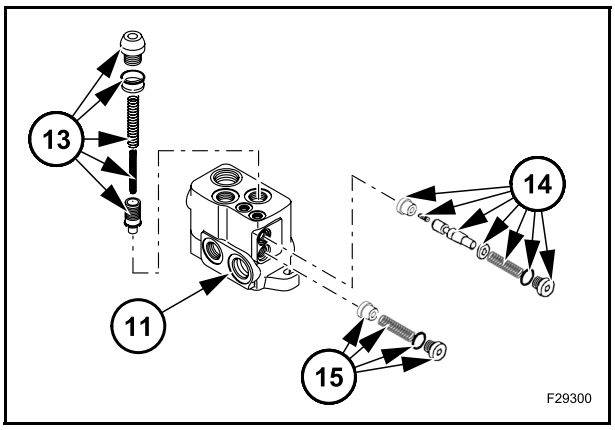
Disassemble the end cover (3), the sections control valves (4), (5), (6), (7), (8), (9) and (10), the inlet section (11).
Check and possibly replace the O-rings (12) located between the sections.



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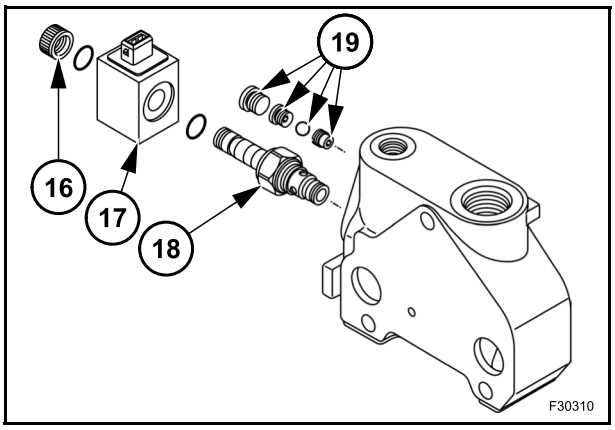
Disassembly the inlet section.
Remove the pump flow balancer valve (13), the load sensing relief valve (14) and the check valve (15) from the inlet section (11).



Disassembly the outlet section.
(Sideshift version)

Unscrew the knob (16).
Remove the solenoid (17) and the 2 way valve (18).

Disassembly the shuttle valve (19).

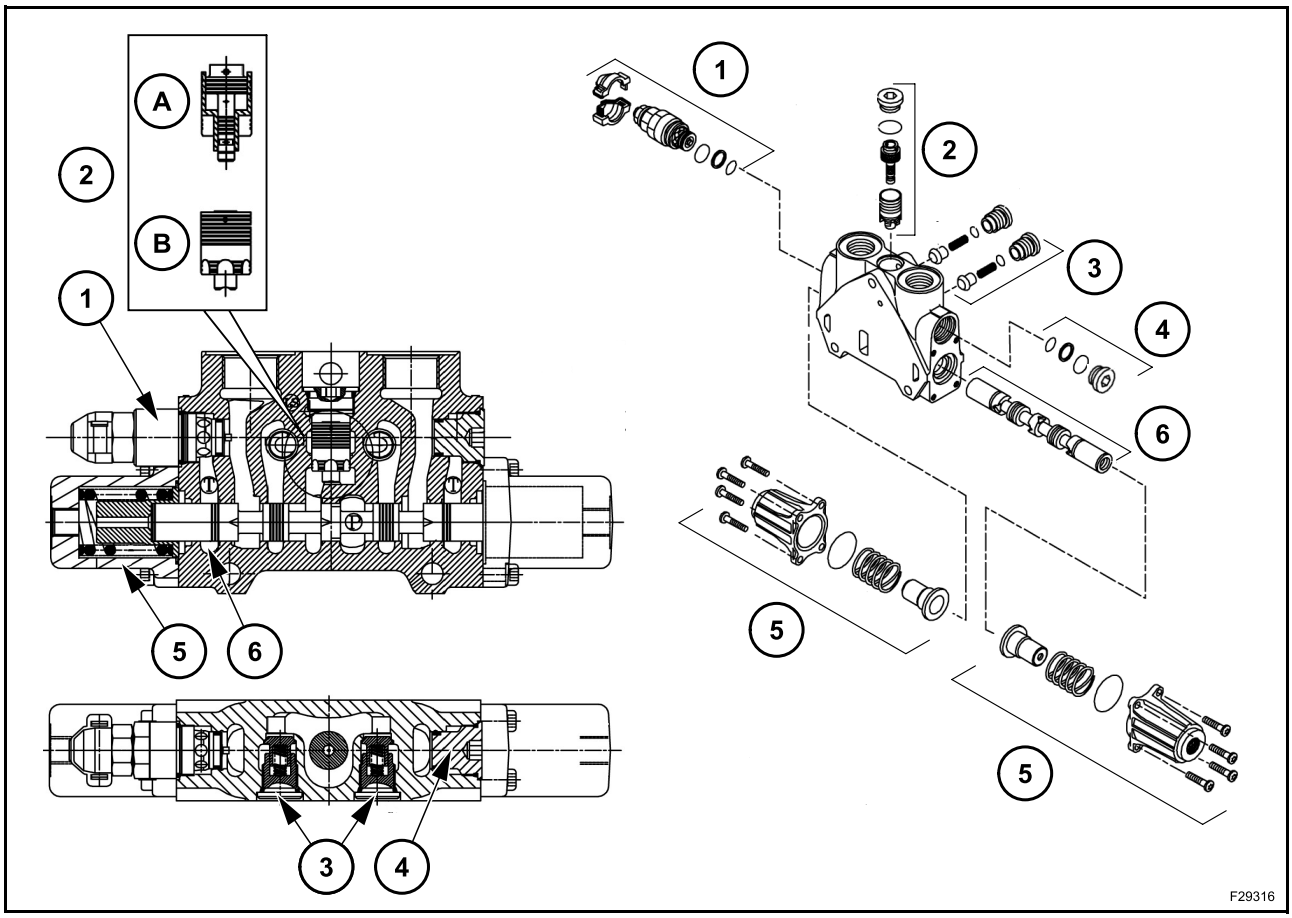


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Disassembly of control valve sections (with hydraulic control)

In this section are indicated all possible solutions relevant to backhoe control valve sections with hydraulic control.



1. Secondary relief valve
2. Pressure compensator
2A. Pressure compensator with shock absorber
2B. Fixed pressure compensator
3. Check valve
4. Plug
5. Spring return system with guide
6. Spool

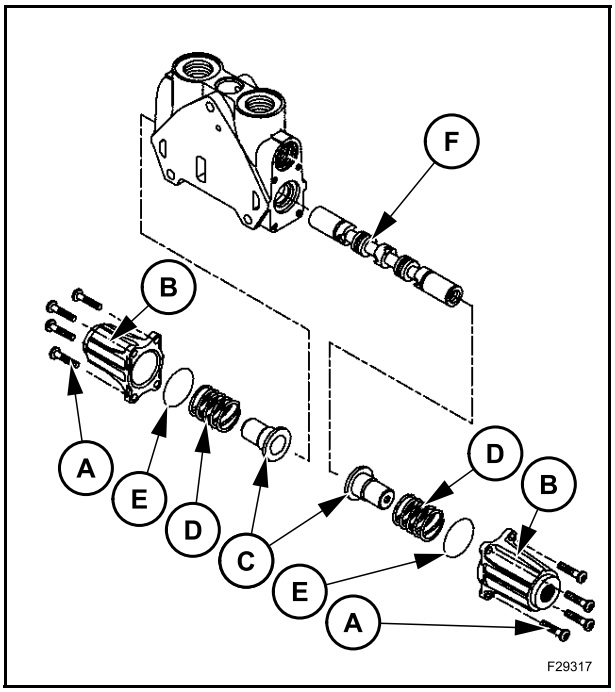
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Disassembly and reassembly hydraulic control spool

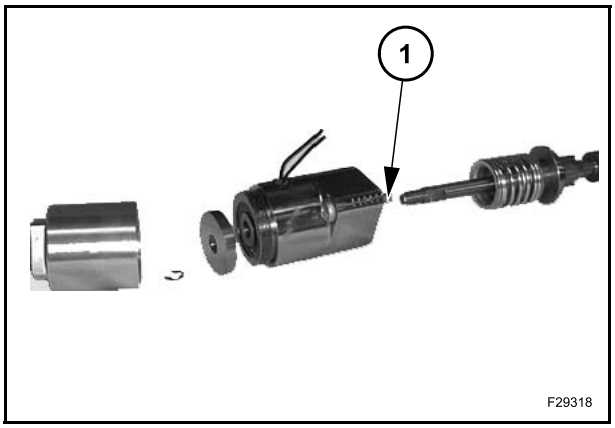
Disassembly
- Remove the screws (A), and the plate (B).
- Extract the spring guides (C) and the springs (D).
- Discard the seals (E).
- Remove the spool (F) from the valve section.

Reassembly
- Grease and install the spool (F) in the valve section.
- Install the springs (D) in the caps (B).
- Install the spring guides (C) in the springs (D).
- Install new seals (E).
- Install the cap assemblies on the valve section, install and tighten the screws (A) to a torque of 9 to 11 Nm.

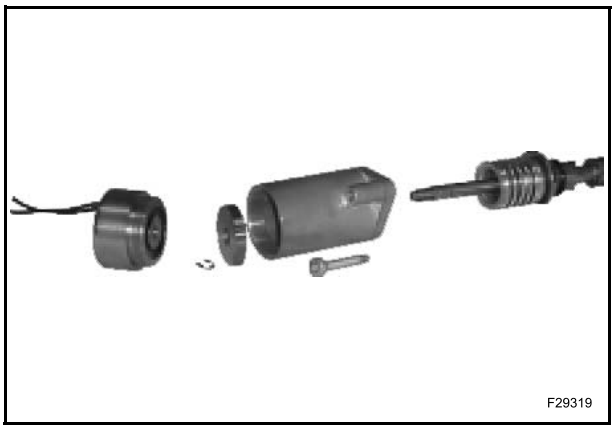


Electrical detent system spool

Solenoid replacement (with spool pulled out)
- Remove the 2 mounting screws (A) and the detent system.
- Unscrew the rear housing (B).
- Remove the circlip (C), the spring and the coil.
- Install a new solenoid (D).
- Reassemble parts in reverse order.
- Tightening torque:
  screws (A) - 9 to 11 Nm
  rear housing (B) - 1.8 to 2.2 Nm



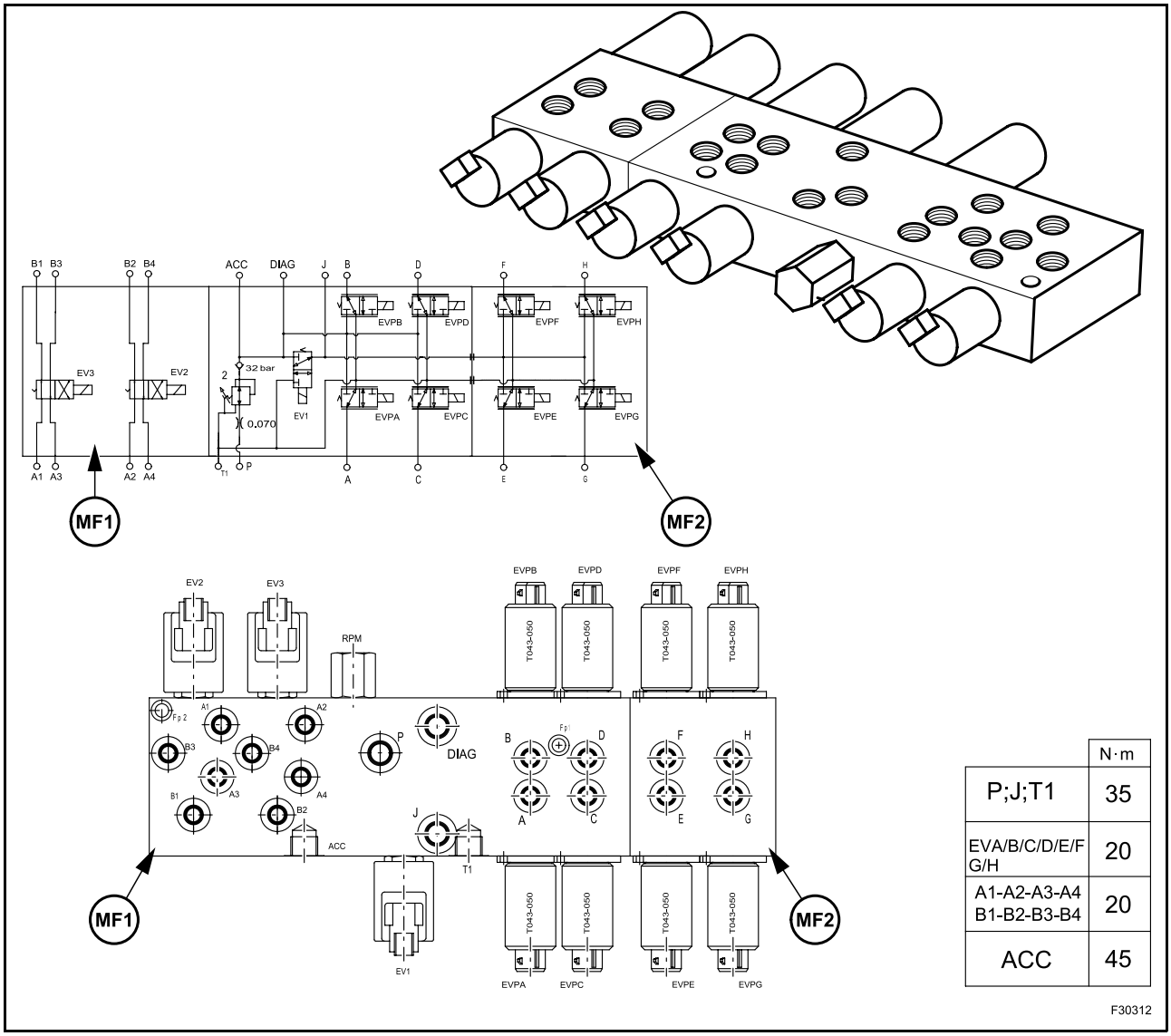
Solenoid replacement (with spool pushed in)
- Remove the solenoid (A).
- Install a new solenoid.
- Tightening torque - 18 to 22 Nm.



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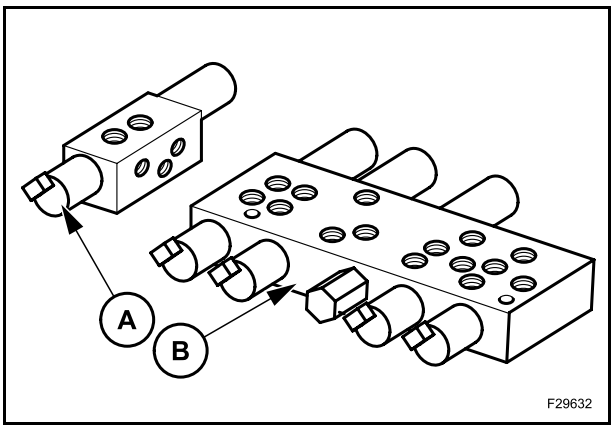
3.3 SOLENOID VALVE FOR PILOTING THE BACKHOE CONTROL VALVE (WITH HYDRAULIC CONTROL)



	N·m
P;J;T1	35
EVA/B/C/D/E/F G/H	20
A1-A2-A3-A4 B1-B2-B3-B4	20
ACC	45

F30312

Solenoid valve is located under the cab floor and is installed directly in the lower part of the chassis that supports the operating levers. The solenoid valve is installed with the pilot models and has the task to transform the electrical controls, received from the hydraulic control levers, in hydraulic controls and to send them to the backhoe attachment control valve. The module (A) is installed only on the machines versions with telescopic dipper. If the machine is not equipped with telescopic dipper, the solenoid valve installed is of type (B); while if the telescopic dipper is installed the solenoid valve can be of type (A) + (B).

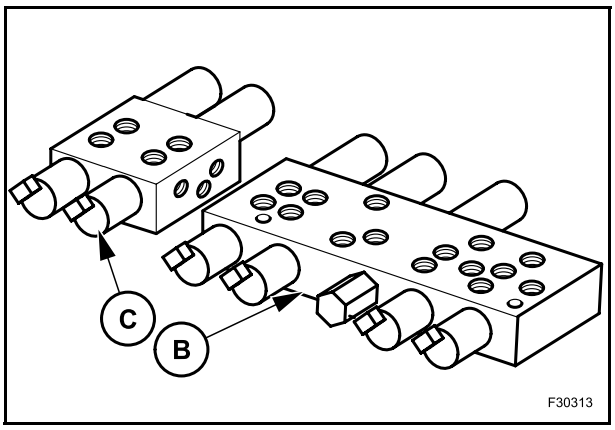


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If the loader backhoe is equipped with a telescopic dipper and if the rear control valve contains an auxiliary section, the solenoid valve consists of valve (B) and module (C).

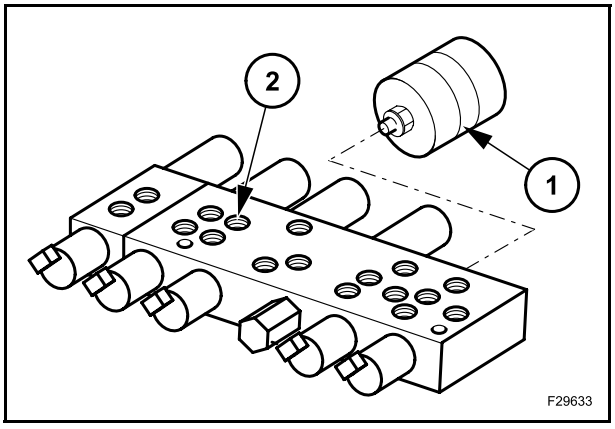


Removal

- Position the loader backhoe on a hard level surface.
- Lower the loader attachment to the ground.
- Lower the stabilizers.
- Position the dipper in the vertical position, with the bucket firmly placed on the ground.
- Stop the engine and relieve any residual pressure in the backhoe and loader attachment systems by moving the relevant control levers through all operating positions.
- Disconnect the battery.
- Clean the area around the solenoid valve.
- Tag and identify the position of all hoses and hydraulic tubes.
- Disconnect and plug all the hoses and all the hydraulic tubes.
- Unscrew and remove clamping screws to chassis supporting the operating levers.
- Remove the solenoid from the loader backhoe.
- Installation is removal procedure in reverse.

Disassembly

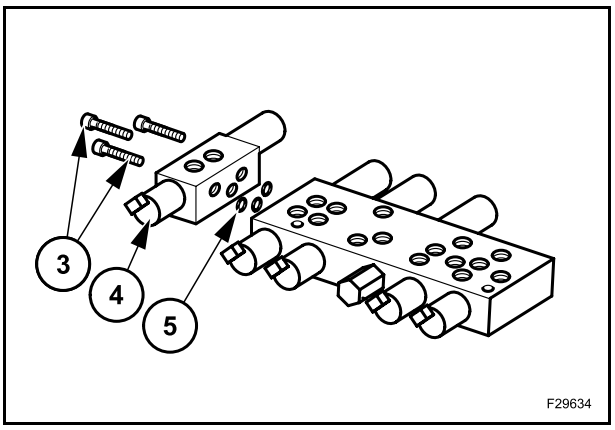
Unscrew and remove the accumulator (1) from the solenoid valve assy (2).



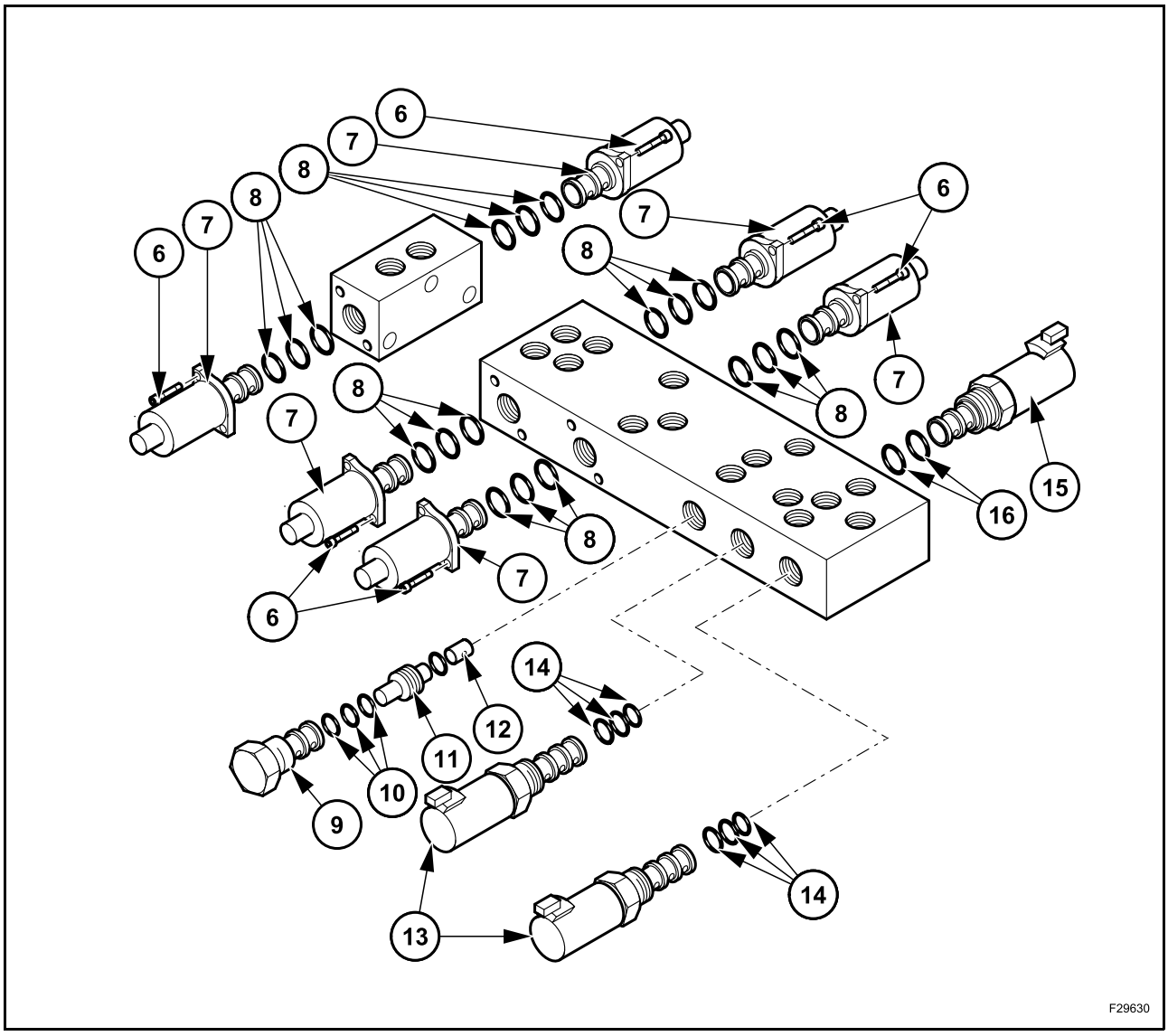
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Loosen and remove the three screws (3) and disassemble valve (4).
Check and eventually replace the O-rings (5).



In case of necessity it is possible to disassemble the various solenoid valves from the manifold blocks.
Loosen and remove the screws (6).
Disassemble the solenoid valves (7).
Check and eventually replace the O-rings (8).
Loosen and remove the valve (9).
Check and eventually replace the O-rings (10).
Remove the check valve (11) and the orifice (12).
Loosen and remove the solenoid valves (13).
Check and eventually replace the O-rings (14).
Loosen and remove the solenoid valves (15).
Check and eventually replace the O-rings (16).

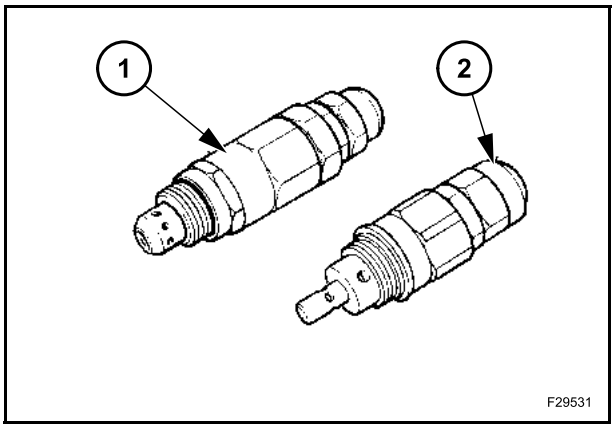


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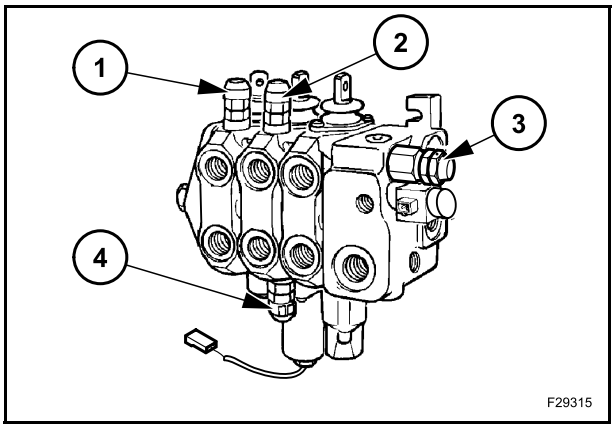
3.4 RELIEF VALVES

The relief valves may be operated with anti-cavitation feature (1) or direct acting (2) and protect individual circuits from excessive pressure.



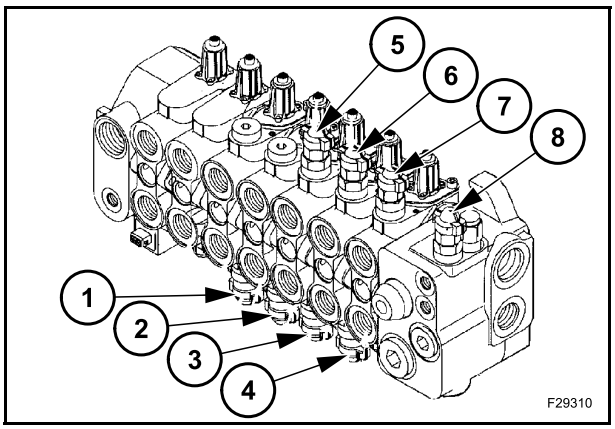
The backhoes, having this kind of control valves installed, are equipped with different relief valves.
Some of them are installed on the loader control valve:

1. 4x1 loader bucket relief valve
2. Loader bucket relief valve (rod end) - 240 bar
3. Hydraulic speed relief valve - 165 bar
4. Loader bucket relief valve (piston end) - 165 bar



Some of them are installed on the backhoe control valve:

1. Dipper circuit relief valve (piston end) - 240 bar
2. Loader bucket relief valve (piston end) - 220 bar
3. Swing circuit relief valve (piston end) - 205 bar
4. Boom relief valve (piston end) - 315 bar
5. Swing circuit relief valve (rod end) - 205 bar
6. Boom relief valve (piston end) - 240 bar
7. Telescopic relief valve (rod end) - 205 bar
8. Load sensing relief valve - 210 bar



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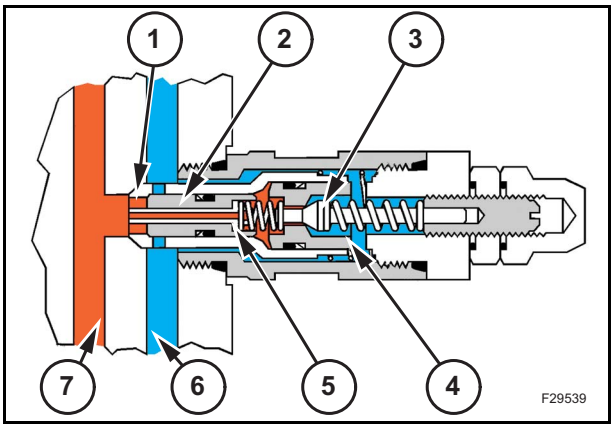
Circuit relief valves operating

Relief valve inoperative

When the system is not subject to overload conditions pressure in the system is insufficient to overcome pilot valve spring pressure and move the valve of its seat.

System pressure sensed on the larger rear face of the poppet valve maintains the poppet and sleeve firmly on their seats.

1. Sleeve
2. Poppet valve
3. Pilot valve
4. Pilot valve body
5. Piston
6. Control valve (cylinder) exhaust gallery
7. Cylinder supply gallery

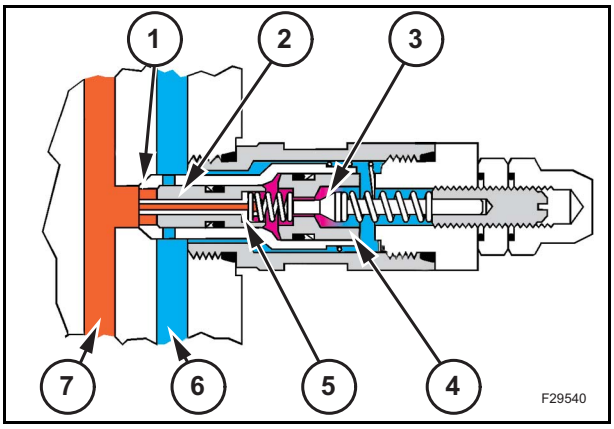


Exhaust oil
High pressure oil

Pilot valve operation

When the cylinder is subjected to shock forces, the pressure increase in the cylinder supply gallery exceeds the pilot valve spring pressure: this valve lifts off its seat. System pressure on the rear face of the poppet valve escapes to tank between the sleeve poppet and valve body causing a pressure differential between the front and rear face of the poppet valve. The higher pressure in the cylinder supply gallery unseats the poppet valve and moves the piston to seat against the pilot valve.

1. Sleeve
2. Poppet valve
3. Pilot valve
4. Pilot valve body
5. Piston
6. Control valve (cylinder) exhaust gallery
7. Cylinder supply gallery



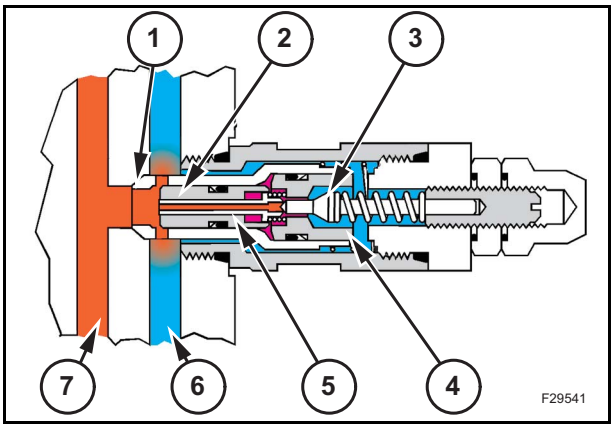
Exhaust oil
High pressure oil
Reduced pressure oil

Pilot and poppet valve operation

The excessive system pressure in the cylinder supply gallery now flows past the poppet valve to the cylinder exhaust gallery and back to tank.

NOTE: during this operation the sleeve poppet is held in the fully seated position by pressure oil.

1. Sleeve
2. Poppet valve
3. Pilot valve
4. Pilot valve body
5. Piston
6. Control valve (cylinder) exhaust gallery
7. Cylinder supply gallery



High pressure oil
Exhaust oil
Reduced pressure oil

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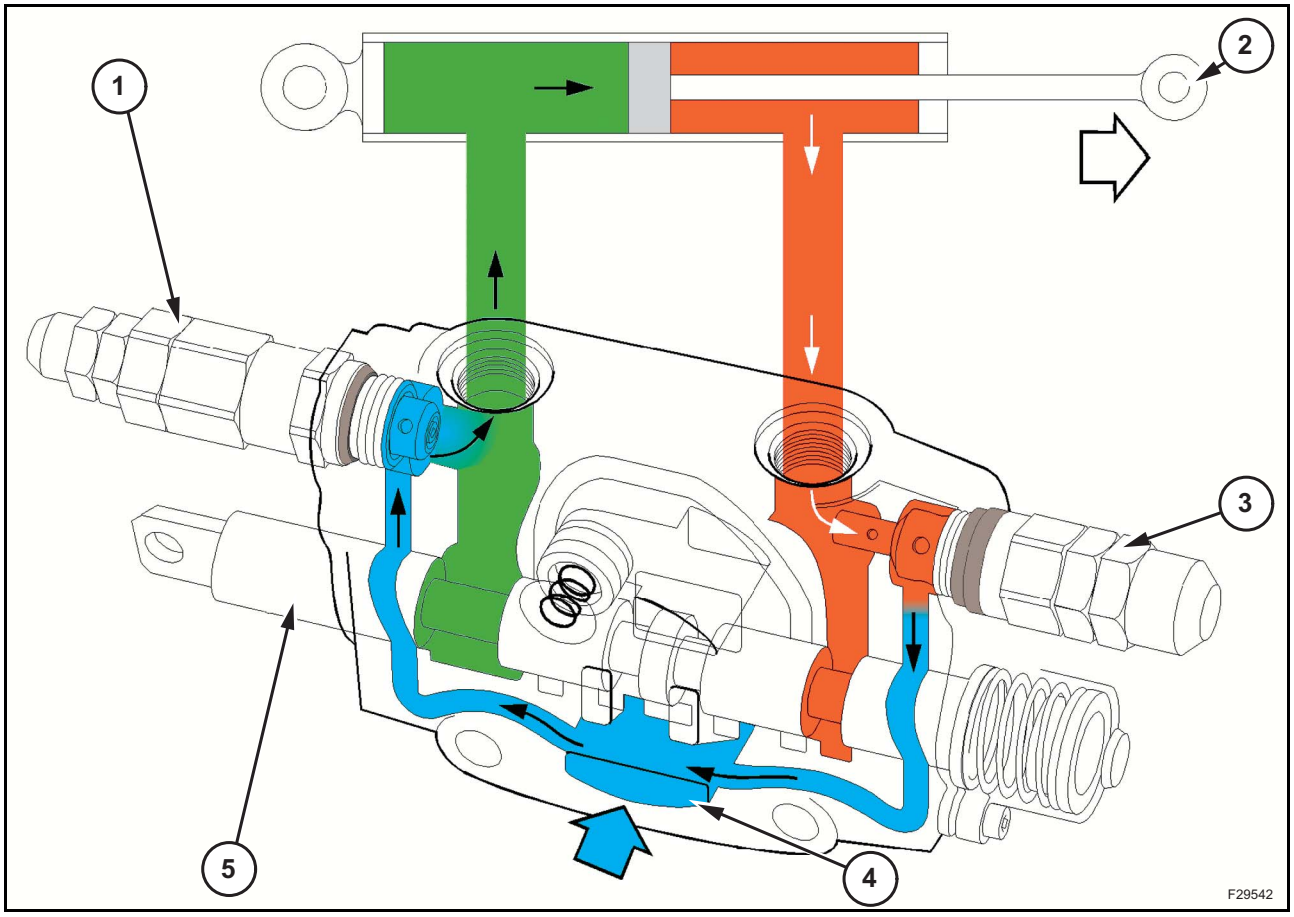
Anti-cavitation operation

Circuit relief valves with an anti-cavitation feature are fitted in circuits where rapid extension of the cylinder could create a void condition and permit the transfer of oil from the high pressure side of a cylinder to the lower pressure (void) end of the cylinder.

When for example the boom is rapidly lowered and the cylinder rod end circuit relief valve operates, oil has been removed from the rod end of the cylinder and a void created in the piston end. This oil is automatically replenished by the anti-cavitation device in the opposite circuit relief valve as follows:

The void creates a pressure lower in the cylinder supply gallery and back pressure in the control valve exhaust gallery acts on the outer face of the sleeve poppet moving it to the right.

Exhaust oil is then directed into the cylinder supply gallery to stop cavitation.



High pressure oil
Anti-cavitation oil supply to cylinder
Relief valve exhaust oil

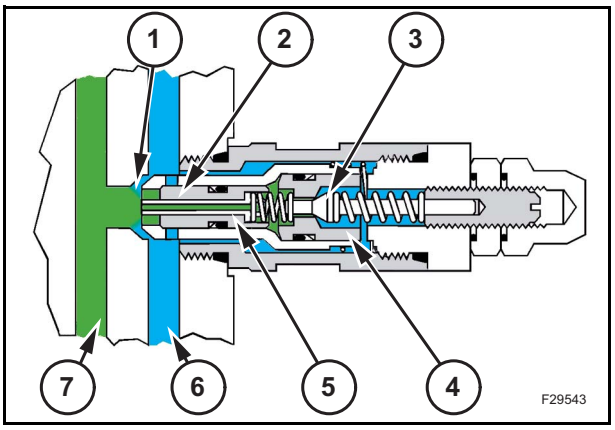
1. Anti-cavitation system pressure relief valve
2. Cylinder rod
3. System pressure relief valve
4. Control valve exhaust gallery
5. Spool

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Pilot-operated pressure relief valve with anti-cavitation feature subjected to overload and fully relieving high-pressure oil

1. Sleeve
2. Poppet valve
3. Pilot valve
4. Pilot valve body
5. Piston
6. Control valve (cylinder) exhaust gallery
7. Cylinder supply gallery

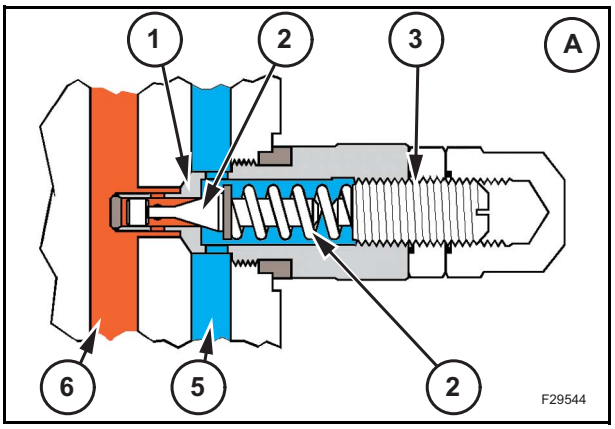


Anti-cavitation cylinder resupply oil
Exhaust oil

Direct-acting pressure relief valve operation

High-pressure oil in the system is sensed in the cylinder supply gallery and acts on the surface of the pressure relief valve poppet.

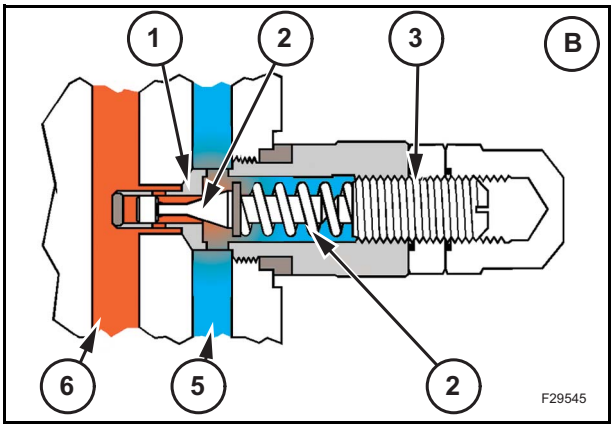
When pressure in the system exceeds the pressure relief valve setting, the oil pressure lifts the poppet, allowing excess pressure in the overloaded cylinder to escape to the drain gallery.



A. Direct acting circuit relief valve
Valve not subjected to overload conditions

B. Direct acting circuit relief valve
Valve subjected to overload conditions

1. Relief valve seat
2. Relief valve poppet
3. Valve pressure adjusting screw
4. Spring
5. Control valve exhaust gallery
6. Cylinder supply oil



Exhaust oil
High-pressure system oil

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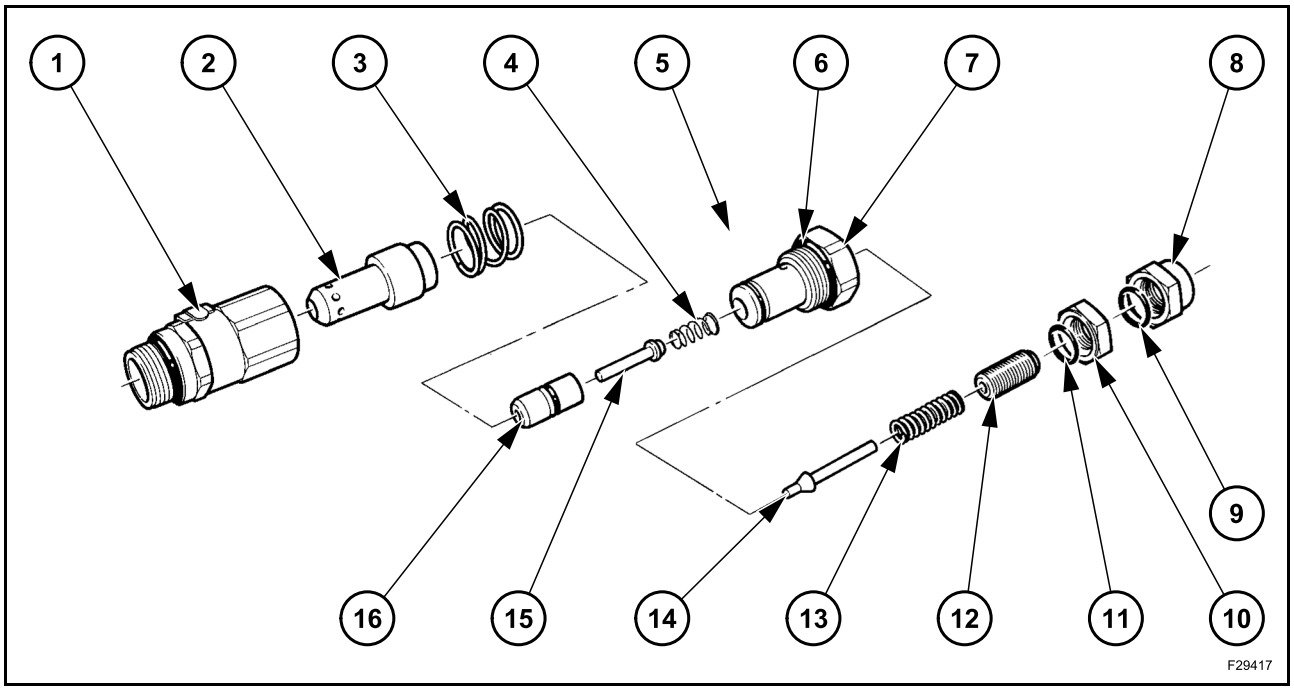
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Overhaul

IMPORTANT: before removing relief valves from the machine lower the loader and backhoe to the ground, switch engine off and relieve all pressure in circuits by moving the backhoe, loader, and telescopic dipper controls through all operating positions. If the pressure relief valves are suspected of contamination, they may be disassembled and inspected for wear. However, remember to restore the correct pressure.

The relief valves contain no serviceable components with the exception of the external O-rings and square section seals.
During disassembly examine the poppet and seat in the plunger assembly for a complete seating surface.

Pilot operated relief valve

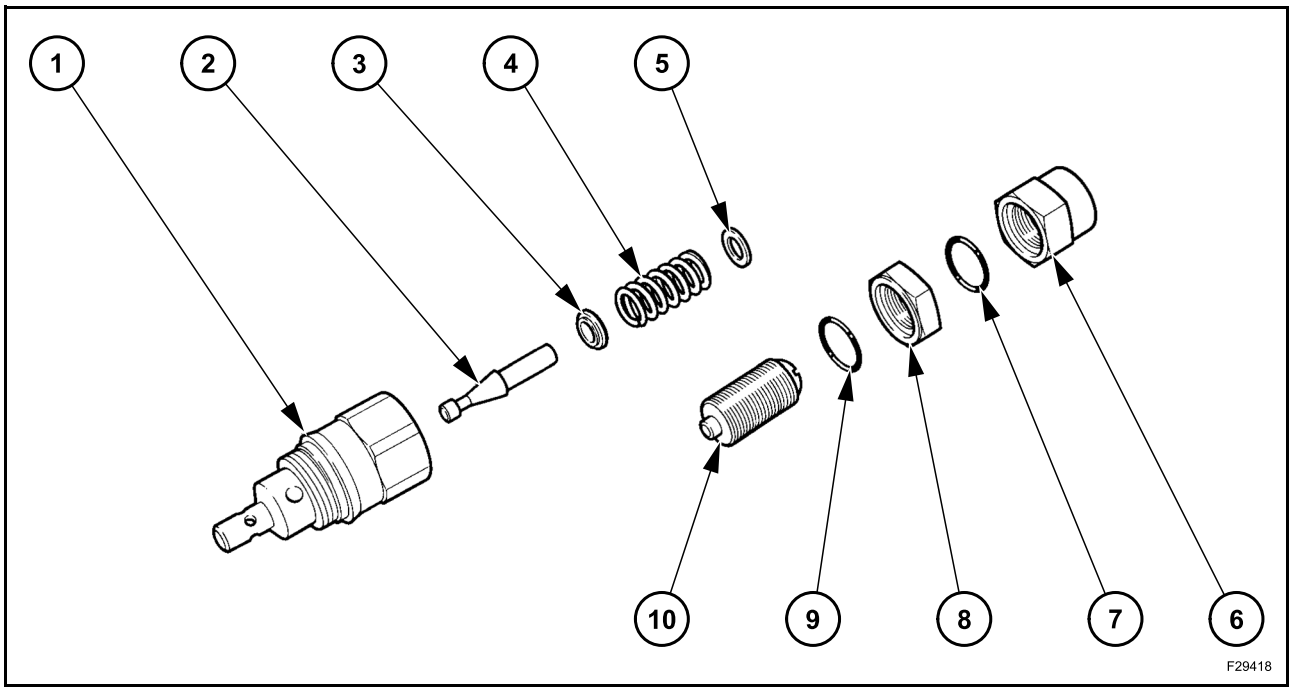


1. Body
2. Shutter
3. Spring
4. Spring
5. O-ring
6. O-ring
7. Valve
8. Cover
9. O-ring
10. Nut
11. O-ring
12. Adjuster screw
13. Spring
14. Pilot valve
15. Poppet
16. Piston

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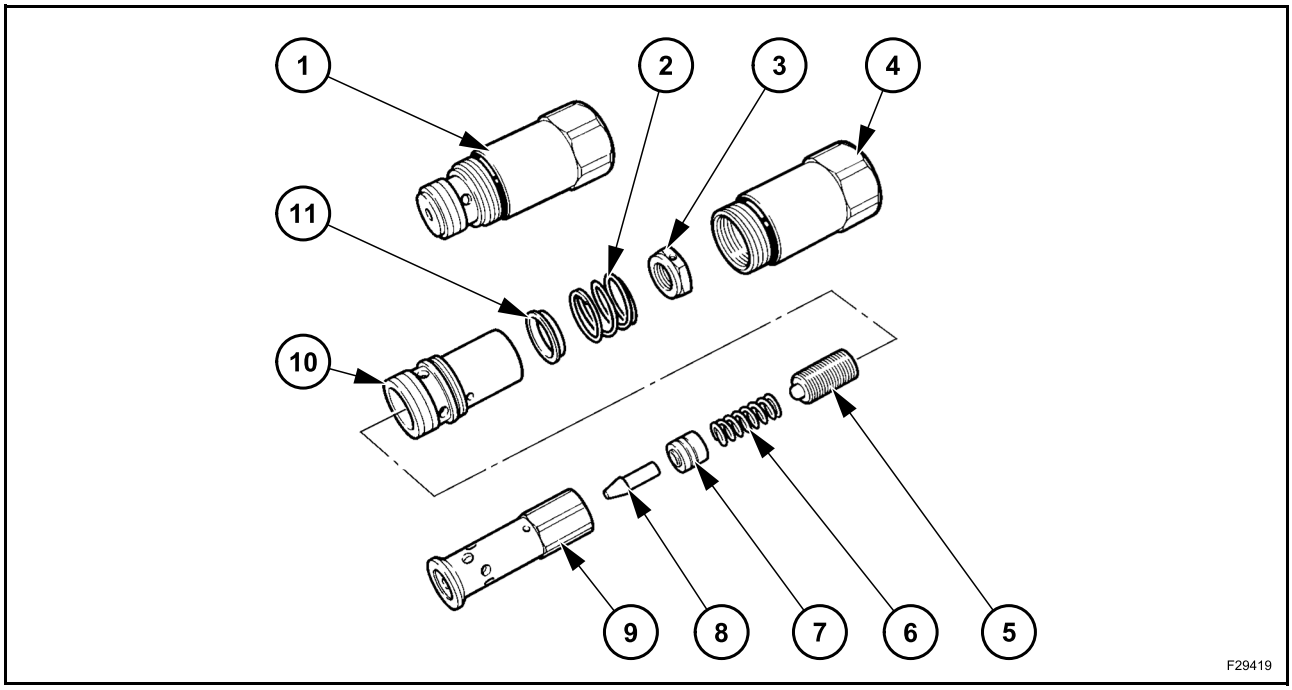
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Direct acting circuit relief valve



1. Body
2. Poppet
3. Spring
4. Spring
5. Shim
6. Cover
7. O-ring
8. Nut
9. O-ring
10. Adjuster screw

Loader bucket relief valve



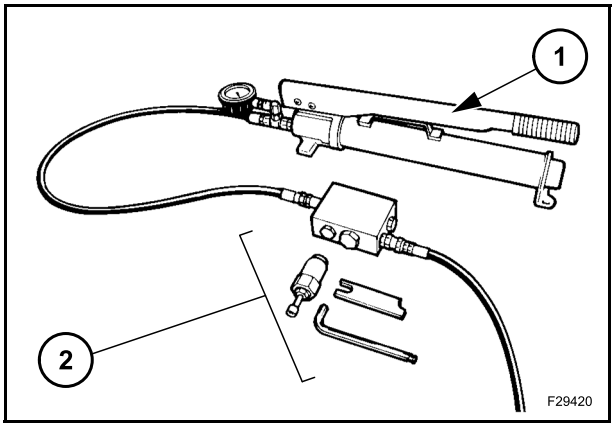
1. Relief valve assembly
2. Spring
3. Nut
4. Body
5. Adjuster screw
6. Spring
7. Piston
8. Poppet
9. Valve
10. Inner body
11. Spring seat

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System pressure relief valve adjustment

After overhaul, the pressure relief valves of the system must be tested and adjusted using a suitable hand pump (1), a 275 bar pressure gauge and a V. L. Churchill test kit (2).

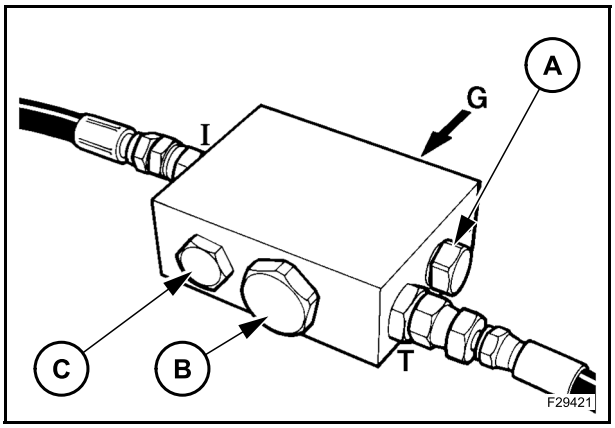


The hand pump must be attached to inlet port I and the drain hose to the outlet port T of test block using suitable 1/2 inch BSP (British Standard Pipe) adaptors.

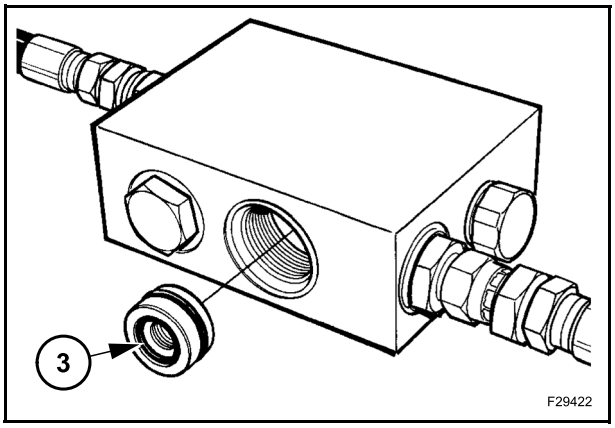
The pressure gauge may be connected to either the hand pump as shown or to the 3/8 UNF threaded port G in the test block.

Remove plug and insert valve to be tested into the appropriate port in the test block as follows:

A. Stabilizer and backhoe relief valves
B. Loader bucket relief valves
C. Unload valve

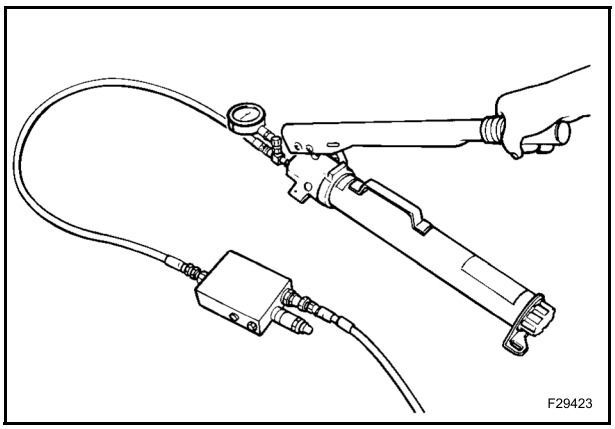


NOTE: a special removable insert, which is part of the test block, is installed in the bottom part of the port used for testing the loader attachment valve. If difficulty is experienced in screwing the loader valve into the test block, check that the insert is fully seated and correctly installed. When correctly installed the O-ring (3) on the face of the insert should be visible.



Operate hand pump and record maximum pressure reading on gauge. Compare pressure values with previous specifications.

IMPORTANT: before removing the valve from the test block, release the pressure in the system using the vent valve on the hand pump.

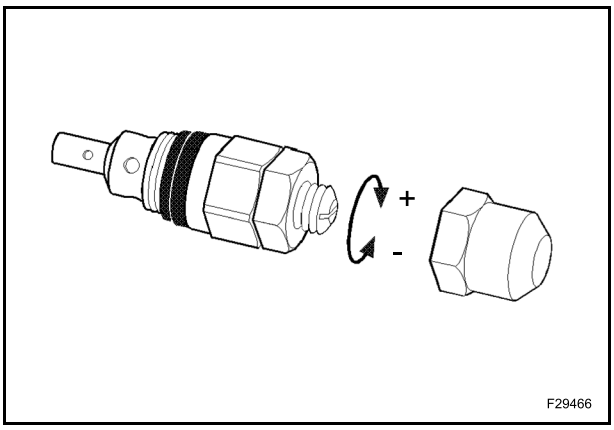


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To adjust all relief valves with the exception of the loader bucket relief valve remove the valve cap, loosen locknut and turn adjuster to obtain correct pressure.

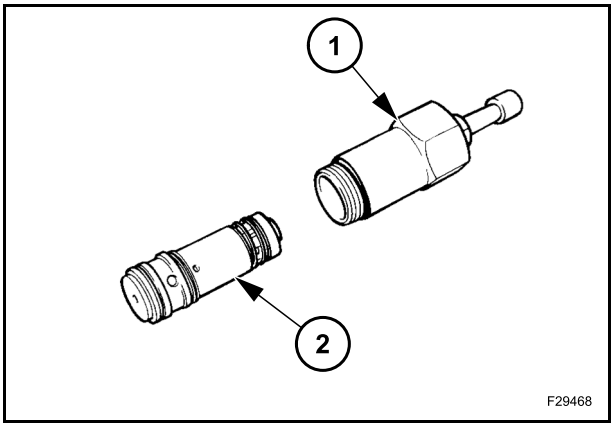
NOTE: relief valves **must not** be set outside off the specified range.



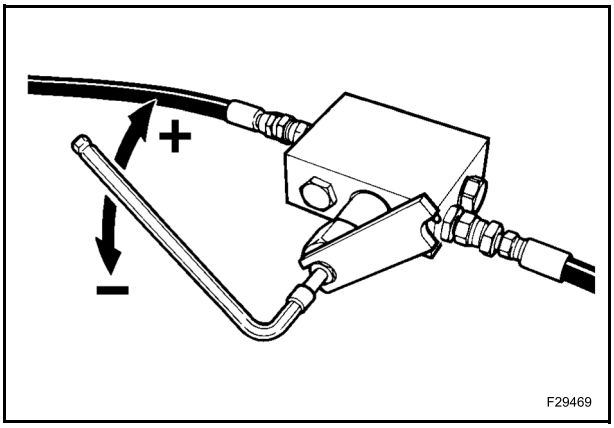
Loader bucket relief valve adjustment

NOTE: if the loader bucket circuit relief valve requires adjustment, the special adjusting tool supplied with the test kit is required as described below.

Hold relief valve in vice and using wrench supplied with tool, unscrew the internal valve assembly from the valve body.
Screw the internal valve assembly (2) into the body of the adjusting tool (1).

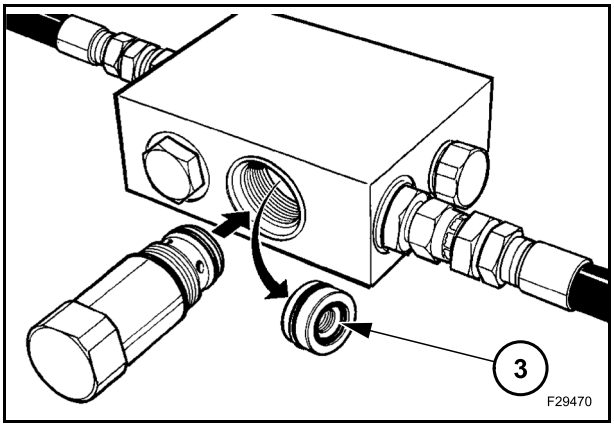


Install valve into test block and operate hand pump until valve is pressurized to 170 bar.
Using the special spanner supplied, loosen the locknut on the end of the valve and adjust pressure setting using Allen wrench.
Operate hand pump and recheck pressure.
When pressure setting is correct tighten locknut and release pressure in circuit using the vent valve on the hand pump.
Remove the valve and, using a 3/8” 16 UNC screw, remove the insert. Reassemble the valve and install it on the test block.
Operate hand pump and recheck pressure.



If pressure is now lower than that recorded with the insert installed it is an indication that the anti-cavitation feature of the valve is leaking and the valve requires overhaul or replacement.

NOTE: the insert isolates the anti-cavitation feature of the valve. When reassembling the insert into the test block ensure it is installed correctly. When correctly installed the O-ring (3) on the face of the insert should be visible.



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3.5 ACCUMULATOR “GLIDE RIDE” PARKER

Technical specifications

Capacity (gas) ..... 2 litres
Capacity (oil) ..... 1.84 litres
Precharge ..... 30 ± 1 bar

Maintenance

- Check the gas pre-charge pressure regularly during the first few weeks of operation, and then at suitable intervals afterwards based on this initial experience.
- Carry out a visual examination of the accumulator periodically in order to detect any early signs of deterioration such as corrosion, deformation etc.
- Comply with the regulatory provisions concerning the monitoring of operational equipment.
- Before removal, it is vital to ensure that there is no residual hydraulic pressure in the accumulator. Discharge the gas side of the accumulator using a Parker UCA charging and gauging assembly before carrying out any maintenance operations.

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.
Parker 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 Manufacturer.

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 p_o should be adjusted to reflect the operating temperature of the system, using the correction factor equations and relevant table.

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.

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Checking and Adjusting Precharge Pressure

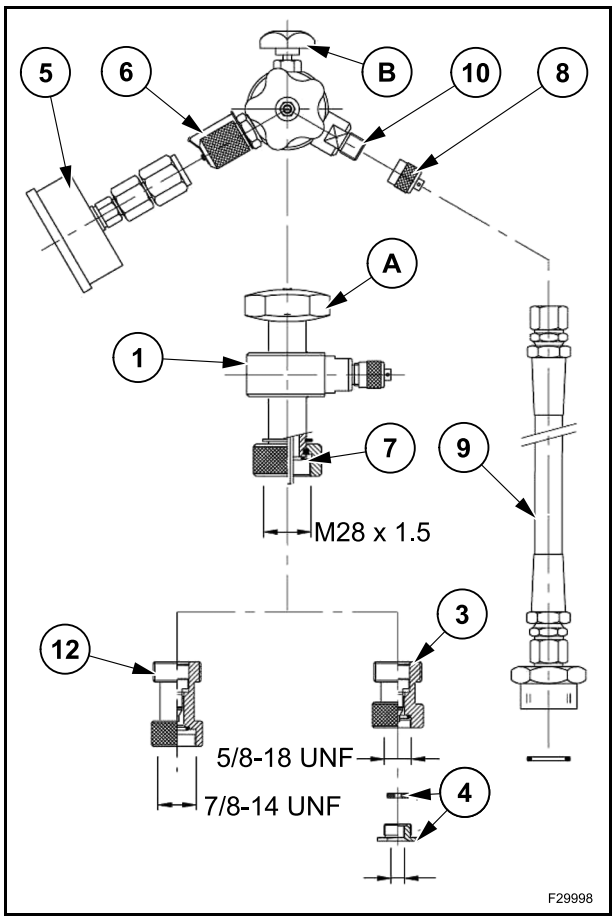
The precharge pressure of an ACP Series accumulator may be checked, and nitrogen filled or vented, using the UCA Universal Charging & Gauging kit tool **380002714**.

The kit 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 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.

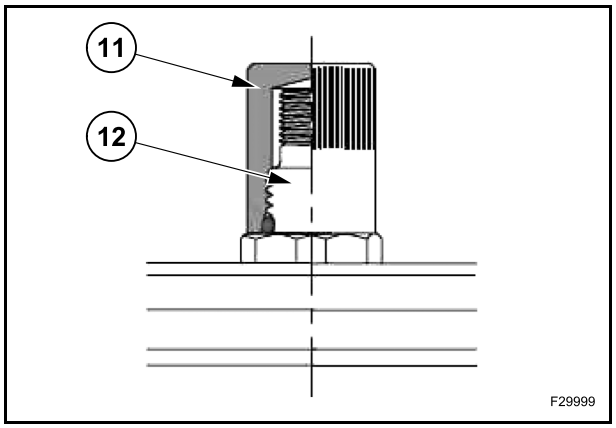
UCA kit **380002714** see drawing

A. Inflation valve
B. Bleed valve

1. UCA
2. Adapter (long)
3. Adapter (short)
4. Adapter (insert)
5. Pressure gauge
6. Protective cap - gauge port
7. Collar - gas port
8. Knurled protective cap - filling port
9. Hose (G1/4 fitting, 60° cone) with O-ring
10. Valve



- Remove the protective cover and cap (11) from the accumulator, to gain access to the gas valve (12).
- Select the appropriate pressure gauge (5) for the pressure to be checked, remove the protective cap (6) and attach the gauge to the UCA (1).
- Make sure that the bleed valve (B) is fully closed and that the inflation valve (A) is in the fully raised position by turning the handwheel in an counter-clockwise direction.
- Assemble the short adapter and adapter insert (3 and 4), screw onto the gas valve (13) and hand tighten.
- Screw the UCA onto the adapter. Position the assembly to permit easy reading of the gauge, then hand tighten the collar (7).
- Open the inflation valve (A) by screwing the handwheel clockwise until the inflation pressure registers on the gauge.



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Readings and Results

One of three conditions will apply: the precharge pressure in the accumulator will be correct, or it will be too high or too low.

Nitrogen Pressure p_o is Correct

- Screw the handwheel (A) counterclockwise to close the accumulator gas valve.
- Slacken the bleed valve (B) to release pressure in the UCA.
- Unscrew the UCA from the adapter.
- Unscrew the adapters from the accumulator gas valve.

Nitrogen Pressure p_o is Too High

- Slacken the bleed valve (B) to vent nitrogen from the accumulator until, after stabilization, the desired pressure p_o is registered. Nitrogen vents into the air.
- Tighten the bleed valve (B) once the desired filling pressure is reached.
- Screw the handwheel (A) counterclockwise to close the accumulator gas valve.
- Slacken the bleed valve (B) to release pressure in the UCA.
- Unscrew the UCA from the adapter.
- Unscrew the adapters from the accumulator gas valve.

Nitrogen Pressure p_o is Too Low

- Close the inflation valve (A) by screwing the handwheel counterclockwise.
- Remove the cap (8).
- Connect the end of the hose (9) to the valve (10).
- Connect the other end of the hose to the nitrogen source.
- Progressively open the valve on the nitrogen source.
- Screw the handwheel (A) clockwise to admit the pressurized gas, taking particular care if the accumulator has a small capacity.
- When pressure p_o is reached, close the valve on the nitrogen source. 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.
- Screw the handwheel (A) counterclockwise to close the accumulator gas valve.
- Slacken the bleed valve (B) to release pressure in the UCA.
- Remove the hose carefully, to release internal pressure.
- Refit the cap (8) on the valve (10).
- Unscrew the UCA from the adapter(s).

Unscrew the adapters from the accumulator gas valve. After removing the UCA and adapter(s), make sure that the accumulator gas valve (13) is sealing effectively. Refit the gas valve dust cap (12) and replace the protective cover (11).

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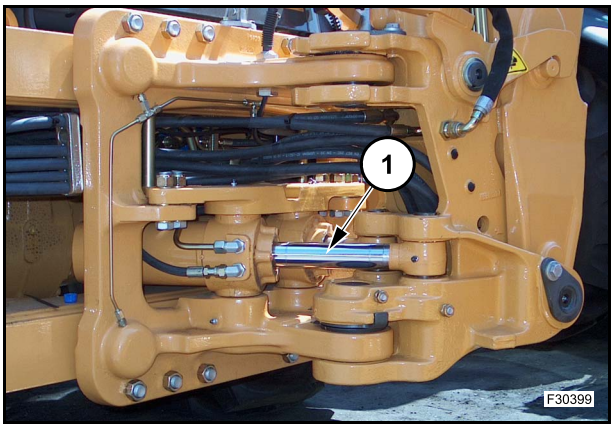
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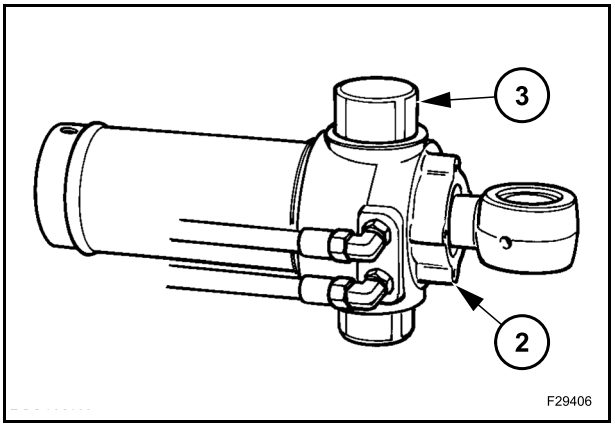
4. HYDRAULIC SWING SYSTEM

4.1 DESCRIPTION AND OPERATION

The hydraulic swing system has two versions:
- it can shift laterally with the backhoe attachment because installed directly on the sideshift carriage performing the shifting. This is possible only on the loader backhoes with sideshift version.
- it is fixed because it is installed directly on the chassis. This is possible only on loader backhoes with center pivot version.

The backhoe boom and digging elements can be moved in an arc about the main chassis of 180 degrees.
This movement is obtained by the use of two hydraulic cylinders (1) coupled between the main chassis and swing post.
The cylinders act directly on the swing post, without the use of any connecting links or bell cranks.
Each cylinder is free to rotate, around two pivots (3), while the stem comes out or retracts inside of the cylinder body (2).
As each cylinder extends or retracts and the swing post rotates, the cylinders turn in a horizontal plate, pivoting on the headstocks within the carriage.
Each cylinder is double acting and as hydraulic oil is fed to a cylinder to turn the swing post, one cylinder pushes and the other cylinder pulls to perform the swing cycle.





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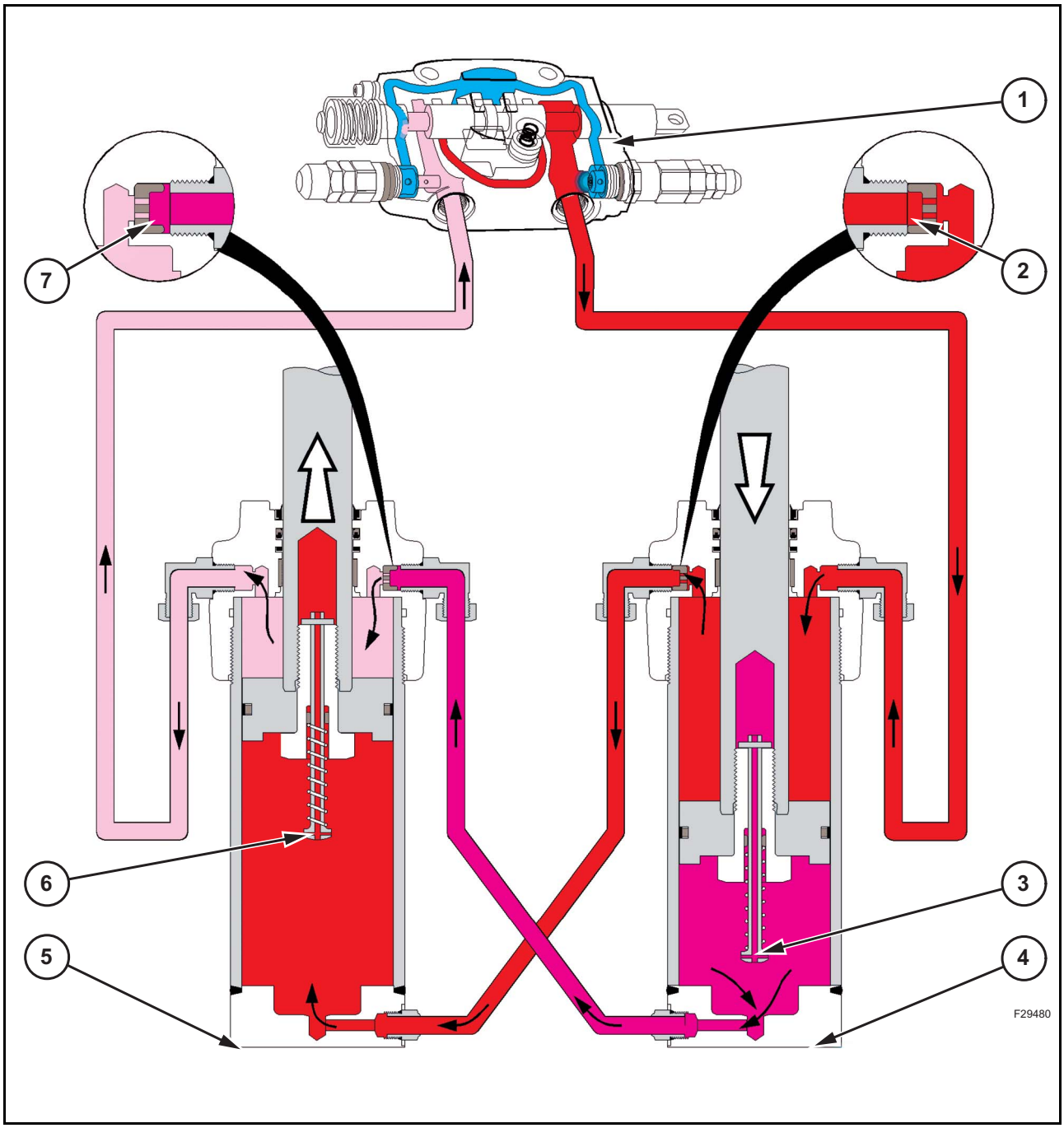
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4.2 HYDRAULIC OIL FLOW

Hydraulic feed to the swing cylinders is controlled by the swing section of the backhoe attachment control valve, which contains pilot-operated pressure relief valves with anti-cavitation feature to protect the system and the cylinders, should an overload condition occur.
The diagram illustrates the operation of the swing circuit when retracting the right-hand cylinder (4) and extending the left-hand cylinder (5) in order to swing the backhoe attachment to the right.
When swinging the backhoe to the left the oil flows are reversed and exactly the same principle of operation applies.
Oil flow for a right hand swing is as follows:
When the swing control is operated the control valve directs oil flow to the rod end of the right hand cylinder.
The flow of oil at pump pressure lifts the one way restrictor (2) of its seat allowing the flow to continue unrestricted to the inlet port of the piston end of the left hand cylinder.
System pressure increases causing the right hand cylinder to retract and the left hand cylinder to extend.
As the cylinders move, displaced oil on the piston side of the left hand cylinder flows towards the one way restrictor (7) in the inlet port on the rod end of the right hand cylinder.
The oil flow moves the restrictor to the restrict position which limits the flow of oil and creates a back pressure (1st stage restricted return oil) in the right hand cylinder.
The restricted flow of oil passes through restrictor (7) into the rod end of the left hand cylinder before returning to the control valve and back to tank.
The spool in the swing control valve assembly (1) is designed such that during operation oil can flow freely through the port directing oil flow to the swing cylinders but restricts the flow returning oil back to tank.
This restriction is achieved using metering lands machined into the lands of the spool and creates a secondary back pressure (2nd stage restricted return oil) in the rod end of the cylinder.
By allowing oil to flow unrestricted to the power side of the cylinder and be restricted on the exhaust side a smooth controlled swing of the backhoe at optimum speed is achieved.
When the swing system reaches the last 20-25° of travel the sliding restrictor in the end of the piston rod touches the outlet port in the cylinder barrel. This further restricts the flow of oil drained from the cylinder. As the piston moves towards the end of its stroke, the sliding restrictor is gently pushed down towards the centre of the cylinder rod, allowing a progressive and controlled stop of the swing cycle.
If the swing control valve is suddenly returned to neutral mid-way through a full power swing the supply and exhaust ports in the main control valve are totally blocked.
The momentum of the swinging backhoe assembly if not controlled will make the machine extremely unstable.
To prevent this from occurring, the system pressure relief valves operate and drain the oil until an excess pressure is detected. When the relief valve operates the cylinder rod will move and a void will be created in the low pressure side of the cylinder. The anti-cavitation feature in the relief valves prevents the void from creating by transferring the drain oil from the side of the system where an excess pressure occurred to the low pressure side.

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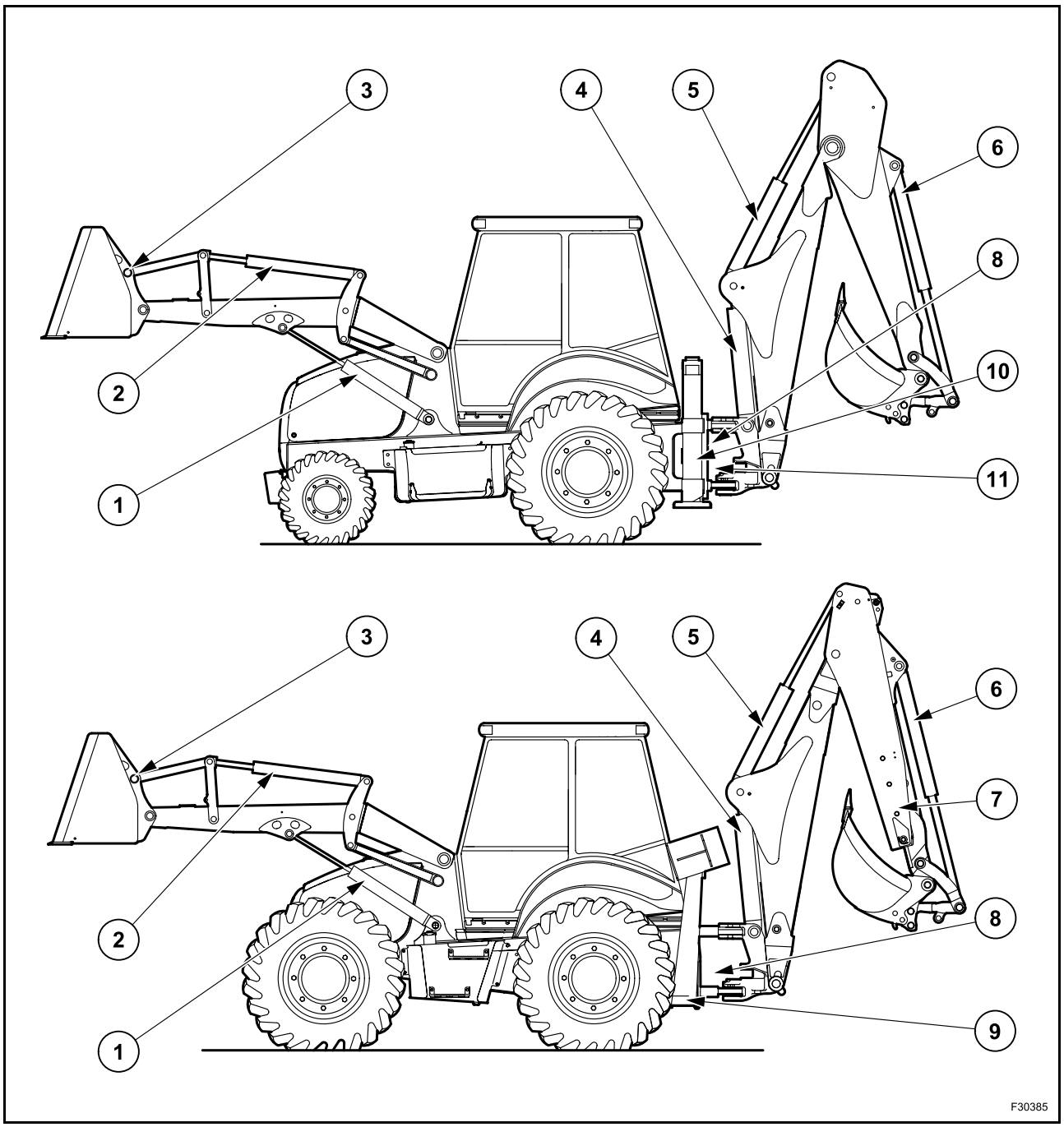
Pump pressure oil
1st stage restricted return oil
2nd stage restricted return oil
Return to oil tank

1. Control valve swing section
2. One way restrictor
3. Cushioning rod
4. Right hand cylinder
5. Left hand cylinder
6. Cushioning rod
7. One way restrictor

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5. HYDRAULIC CYLINDERS



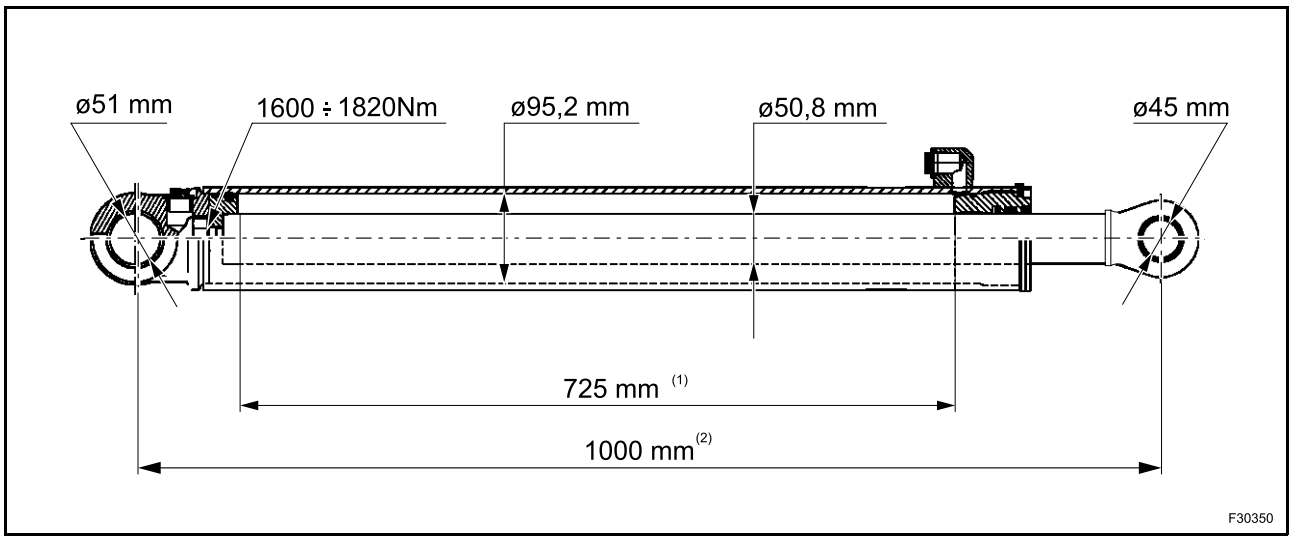
1. Loader attachment boom cylinder
2. Loader bucket cylinder
3. 4x1 loader bucket cylinder
4. Backhoe boom cylinder
5. Backhoe dipper cylinder
6. Backhoe bucket cylinder
7. Telescopic cylinder
8. Swing backhoe cylinder
9. Stabilizer cylinder (center pivot models)
10. Stabilizer cylinder (sideshift models)
11. Backhoe attachment travel lock cylinder (sideshift models)

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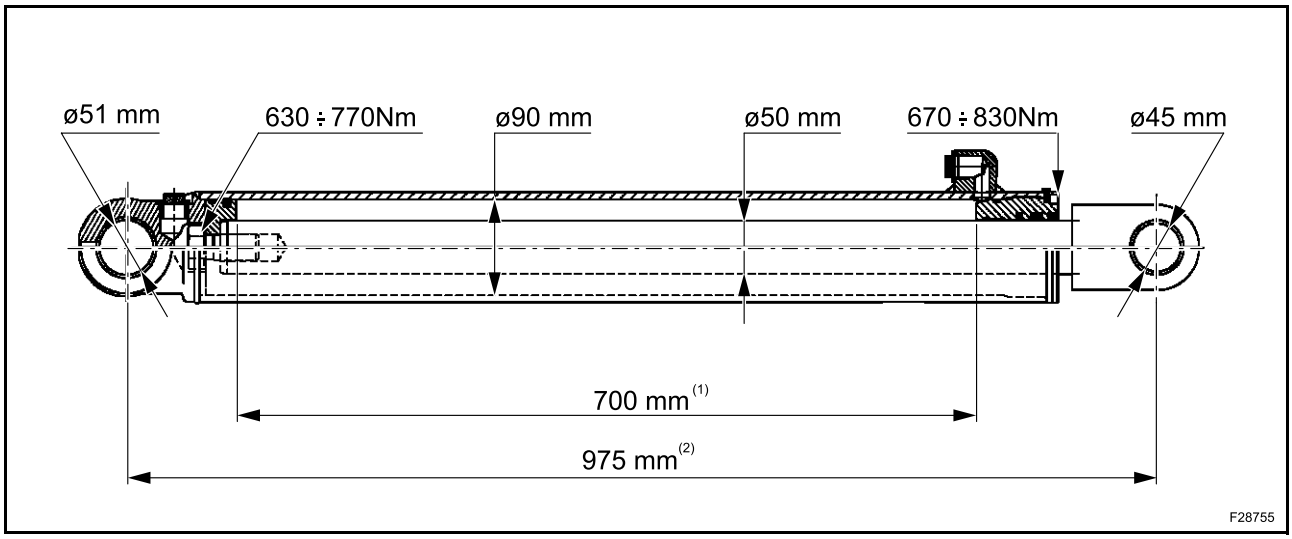
5.1 LOADER ATTACHMENT BOOM CYLINDER

2WS



(1) Stroke
(2) Completely retracted

4WS



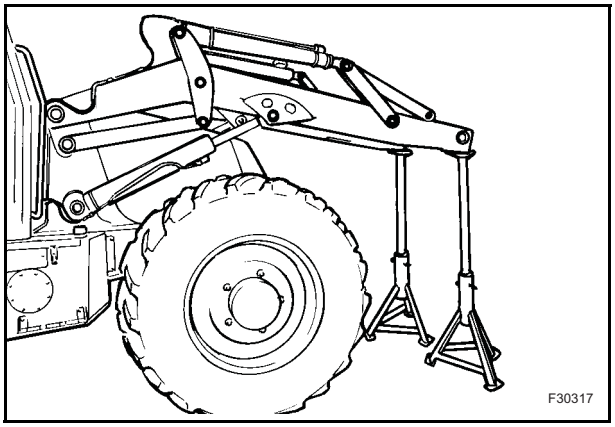
(1) Stroke
(2) Completely retracted

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CYLINDER REMOVAL

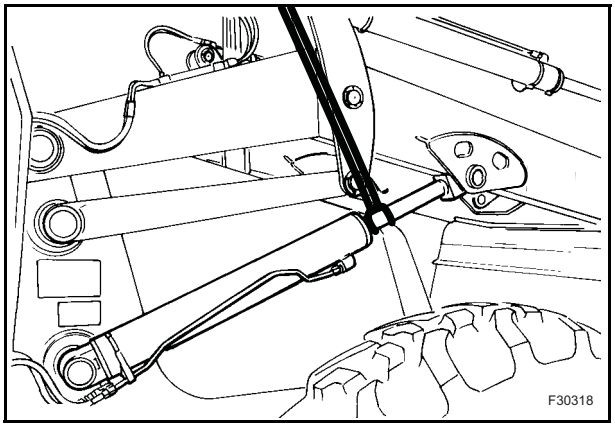
Park machine on a flat surface. Raise the loader sufficiently to allow the loader cylinder pin to be removed.
Remove the loader bucket and support the arm using a suitable stand or hoist.



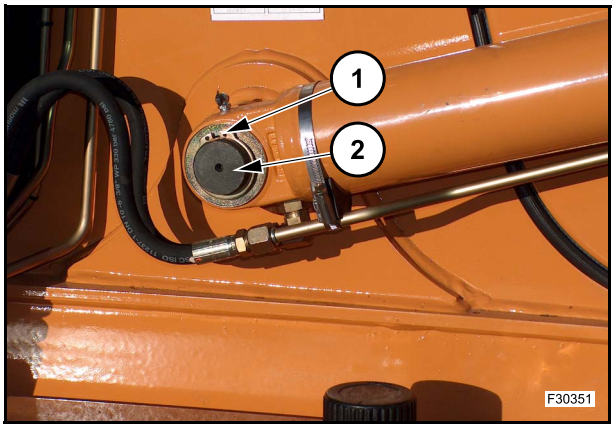
⚠ WARNING

Always ensure loader is fully supported. Do not work under or near an unsupported loader or personal injury may occur.

Relieve the residual pressure in the system by moving the loader control lever through all operating positions.
Stop the engine.
Support the cylinder using sling and suitable hoist. Disconnect the hydraulic hoses. Cap or plug all exposed openings.



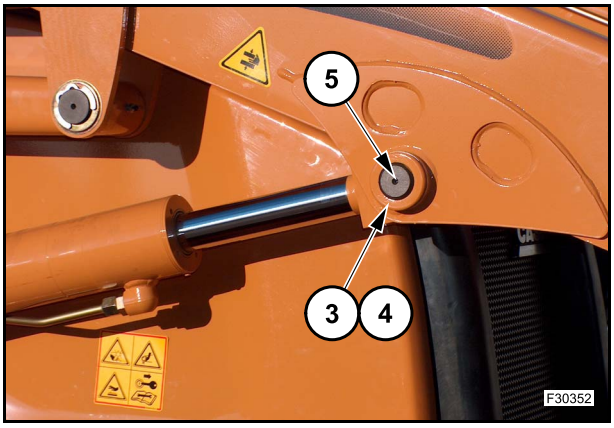
Disconnect the hydraulic hoses.
Remove the snap ring (1) and the spacer (2).



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Remove the ring (3) and the pin (4).
Use a hammer to extract the rod pin (5).

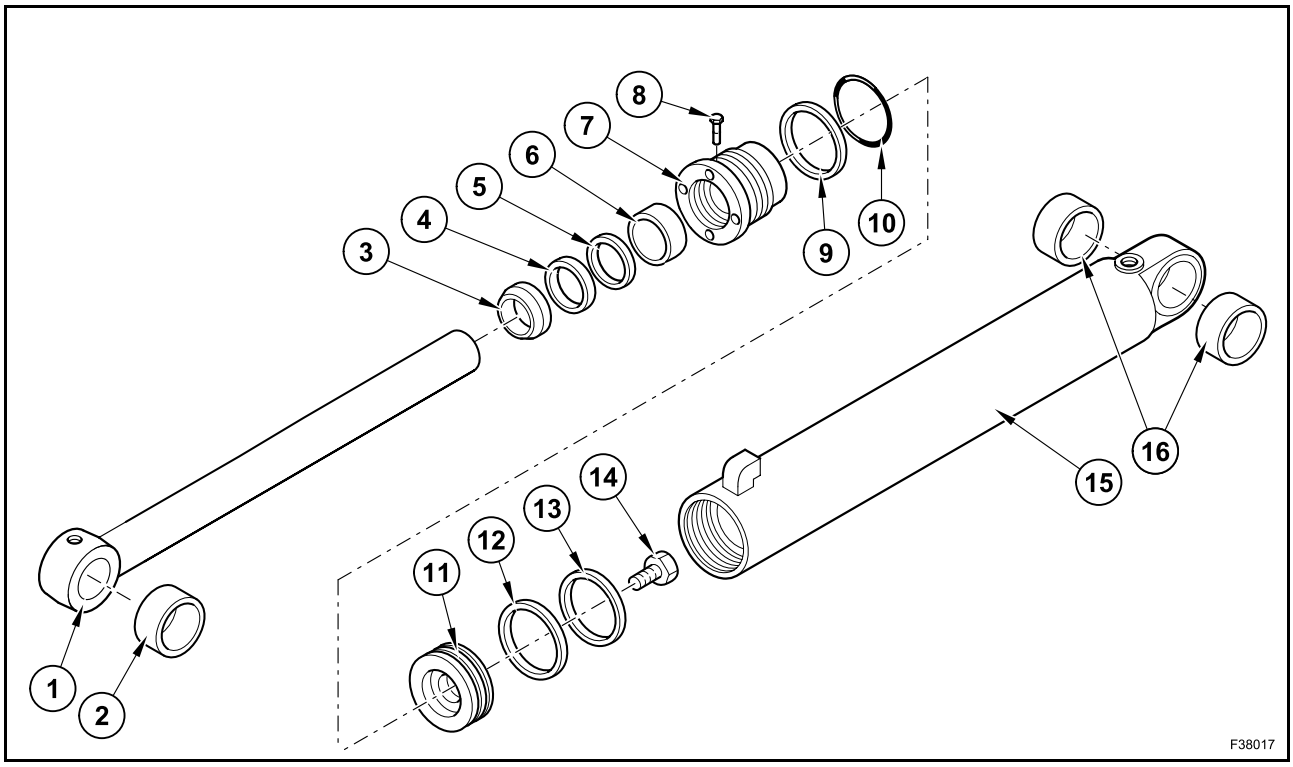


Remove the loader attachment boom cylinder.

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DISASSEMBLY CYLINDER



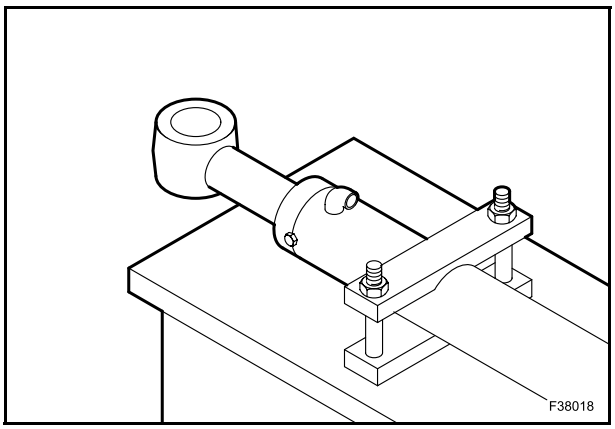
1. Cylinder rod
2. Bushing
3. Wiper ring
4. Ring seal
5. Ring seal
6. Guide bush
7. Cylinder head
8. Safety screw
9. Back-up ring
10. O-ring
11. Piston
12. Piston gasket
13. Piston guide
14. Screw
15. Cylinder tube
16. Bushing

The disassembly procedure below starts on the premise that the hydraulic lines have already been removed.

⚠ WARNING

Cylinder weight (2WS) = 32.5 kg.
Cylinder weight (4WS) = 41.3 kg.

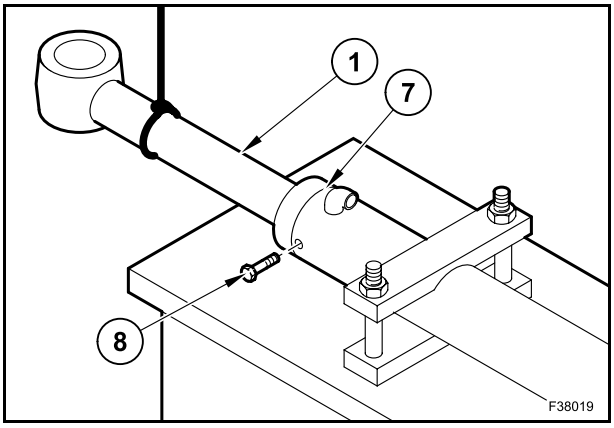
Lift and securely place the cylinder on a workbench. Be sure that the cylinder is placed horizontally. Drain hydraulic oil from the cylinder.



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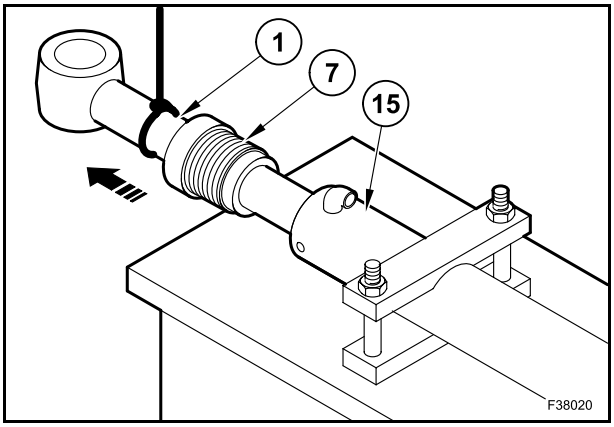
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Support the cylinder rod (1).
Unscrew and remove the safety screw (8).
Use the wrench **380000725** to loose the cylinder head (7).
If necessary gently heat the gland carrier to soften the thread sealant applied during manufacture.

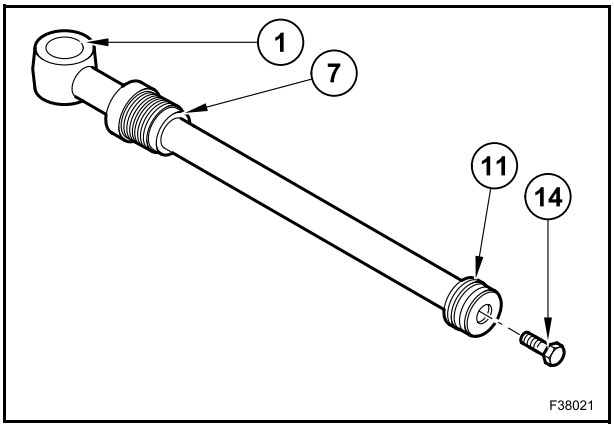


Remove the cylinder head (7) from the cylinder barrel (15) using a plastic hammer. Remove the cylinder rod (1) and the cylinder head (7).

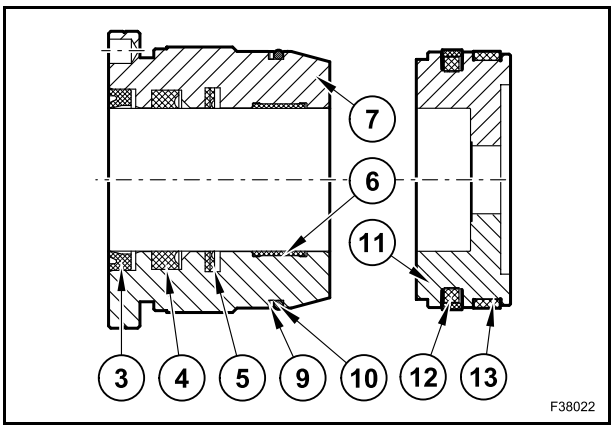
IMPORTANT: be sure to pull the cylinder rod (1) straight so as not to damage the sliding surfaces.



Loosen and remove the screw (14). Extract the piston (11) and the cylinder head (7) from the cylinder rod (1).



Only if necessary:
- Remove the wiper ring (3), the seal rings (4) and (5), the guide bush (6) and the back-up ring (9) with the O-ring (10) from the cylinder head (7).
- Remove the piston seal (12) and the piston guide ring (13) from the piston (11).

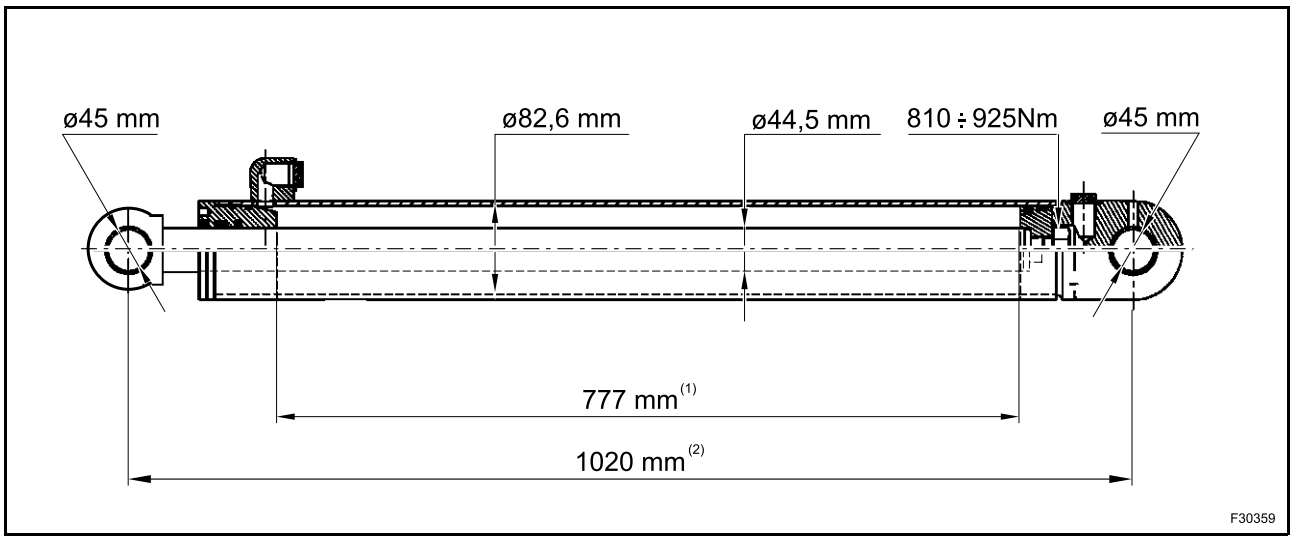


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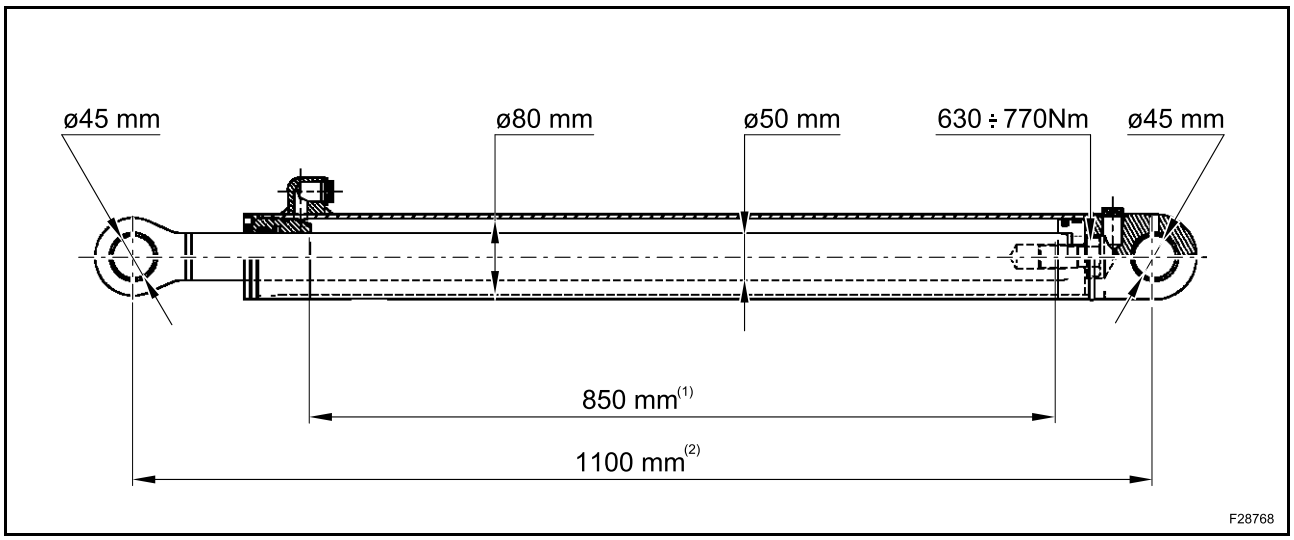
5.2 LOADER BUCKET CYLINDER

2WS



(1) Stroke
(2) Completely retracted

4WS



(1) Stroke
(2) Completely retracted

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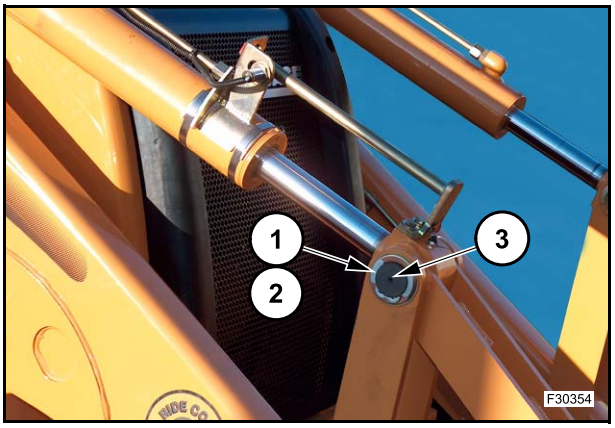
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CYLINDER REMOVAL

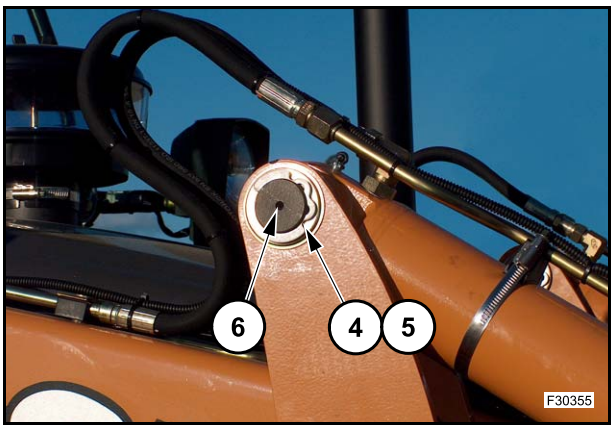
Park machine on a flat surface and position the bucket firmly on the ground.
Relieve the residual pressure in the system by moving the loader control lever through all operating positions.
Support the cylinder using sling and suitable hoist.
Disconnect the hydraulic hoses.



Support the link rods.
Remove the snap ring (1) with the spacer (2).
Remove the pin (3) using an hammer.



Remove the snap ring (4) with the spacer (5).
Remove the pin (6) using an hammer.

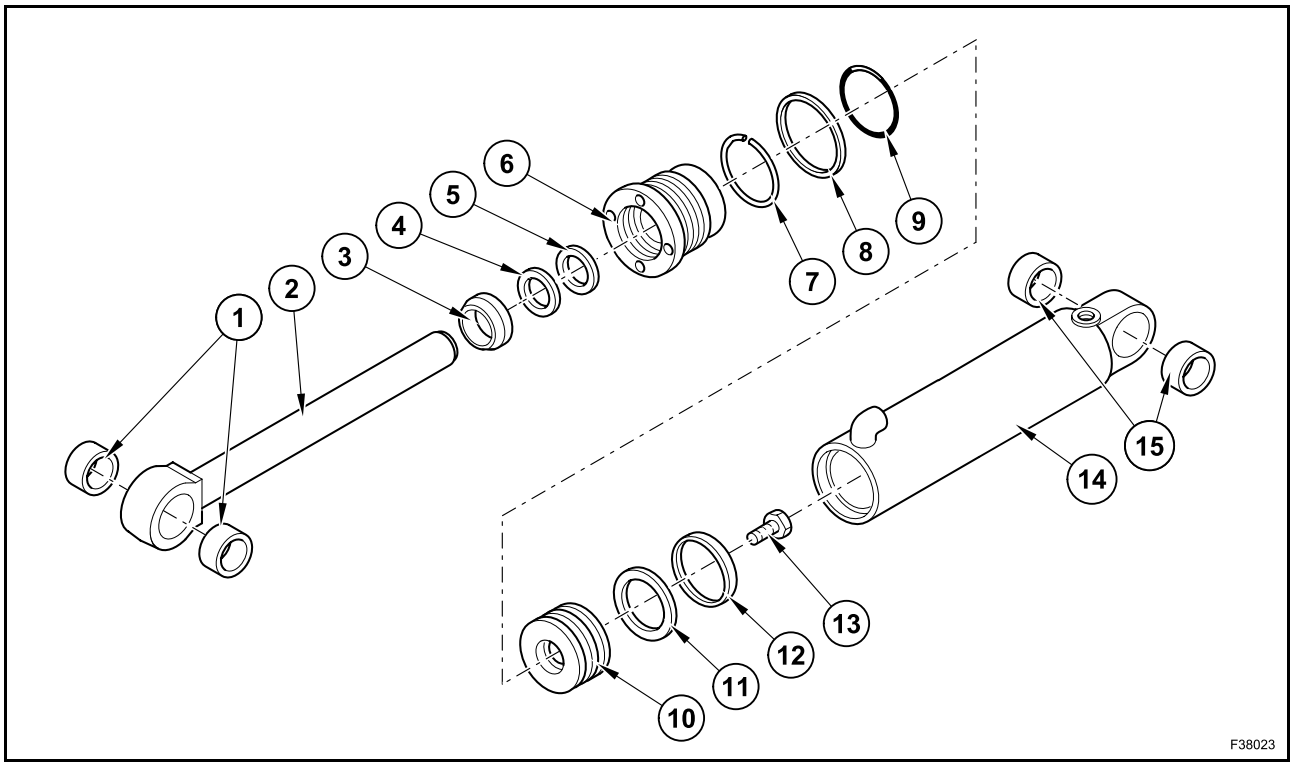


Remove the loader bucket cylinder.

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DISASSEMBLY CYLINDER



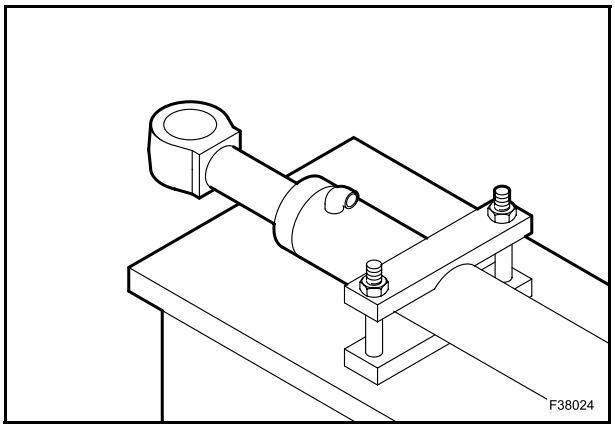
1. Bushing
2. Cylinder rod
3. Wiper ring
4. Ring seal
5. Ring seal
6. Cylinder head
7. Snap ring
8. Back-up ring
9. O-ring
10. Piston
11. Piston gasket
12. Piston guide
13. Screw
14. Cylinder tube
15. Bushing

The disassembly procedure that follows takes into consideration the hydraulic piping already disassembled.

⚠ WARNING

Cylinder weight: 32.5 kg

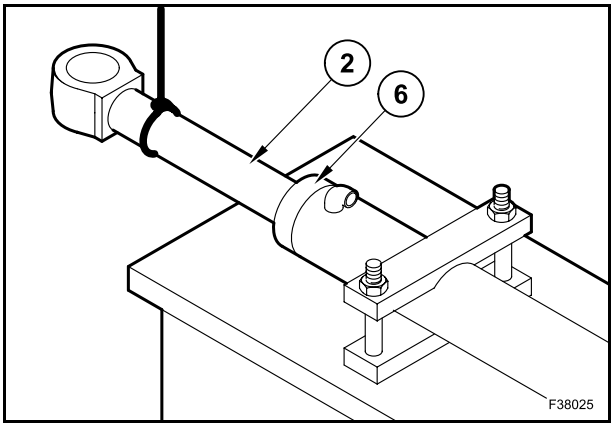
Lift and securely place the cylinder on a workbench. Be sure that the cylinder is placed horizontally. Drain hydraulic oil from the cylinder.



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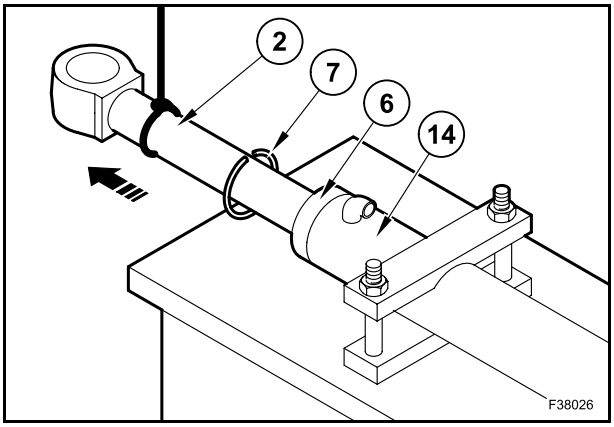
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Support the cylinder rod (2) and use the wrench **380000722** to loosen the cylinder head (6).
If necessary gently heat the gland carrier to soften the thread sealant applied during manufacture.

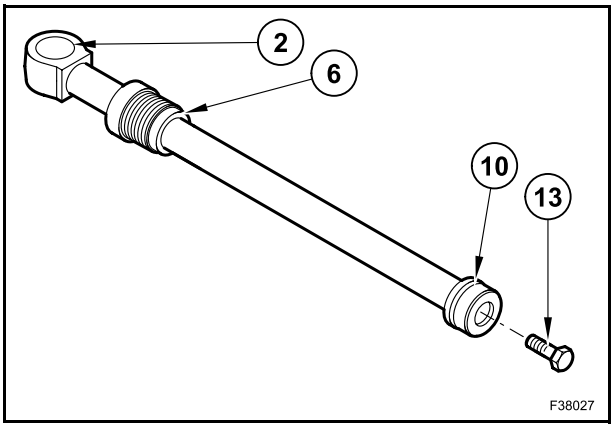


Remove the stop ring (7)
Extract the cylinder head (6) from the cylinder barrel (14) by tapping it with a plastic hammer. Remove the cylinder rod (2) and the cylinder head (6).

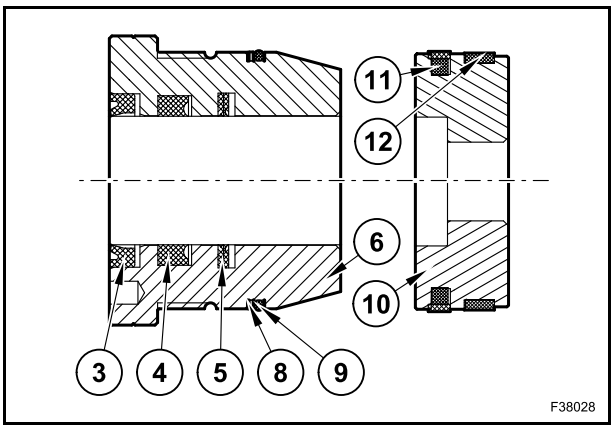
IMPORTANT: be sure to pull the cylinder rod (2) straight so as not to damage the sliding surfaces.



Loosen and remove the screw (13).
Extract the piston (10) and the cylinder head (6) from the cylinder rod (2).



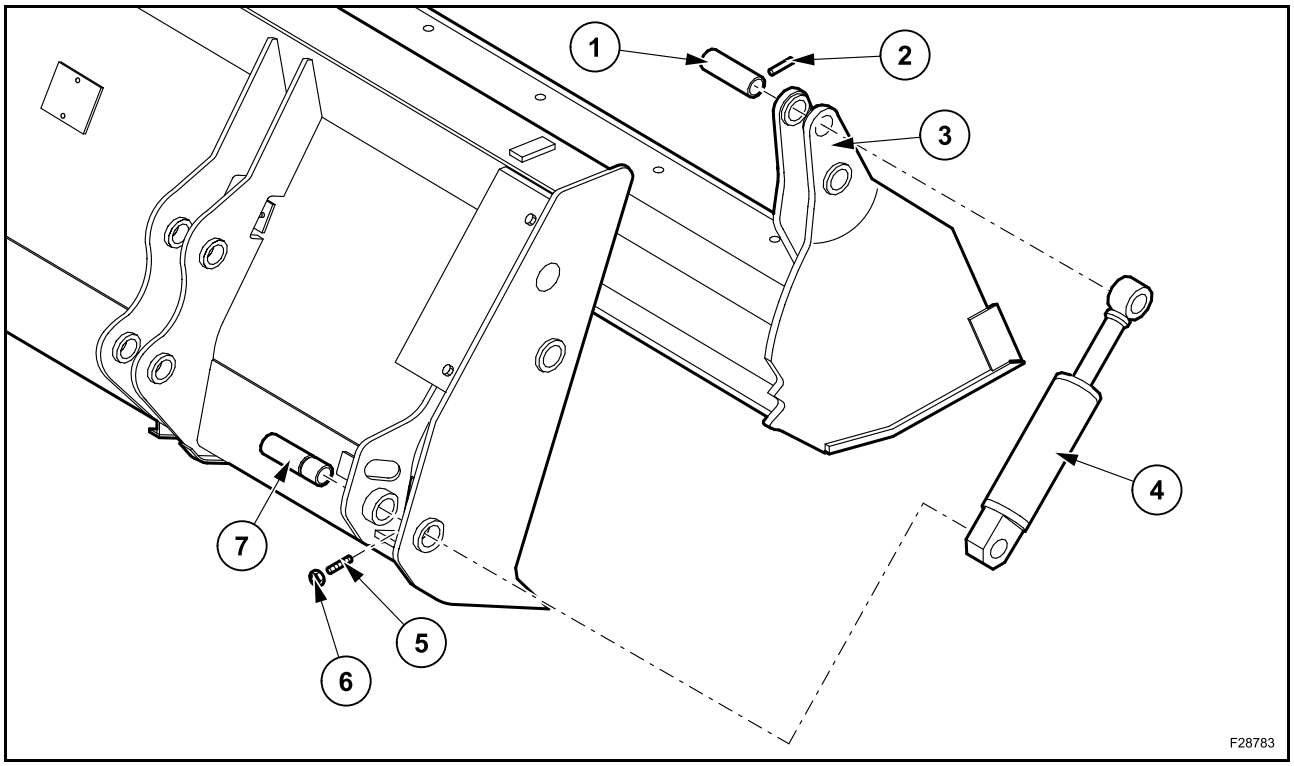
Only if necessary:
- remove the wiper ring (3), the seal rings (4) and (5), the back-up ring (8) with the O-ring (9) from the cylinder head (6);
- remove the piston seal (11) and the piston guide ring (12) from the piston (10).



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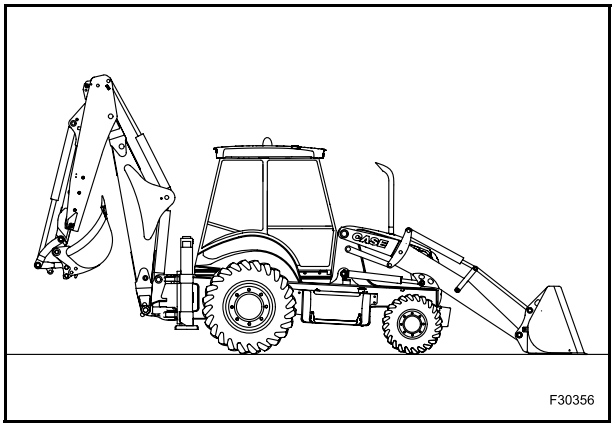
5.3 4X1 LOADER BUCKET CYLINDER



1. Cylinder rod pin
2. Dowel
3. Bucket
4. Cylinder
5. Dowel
6. Nut
7. Cylinder bottom pin

CYLINDER REMOVAL

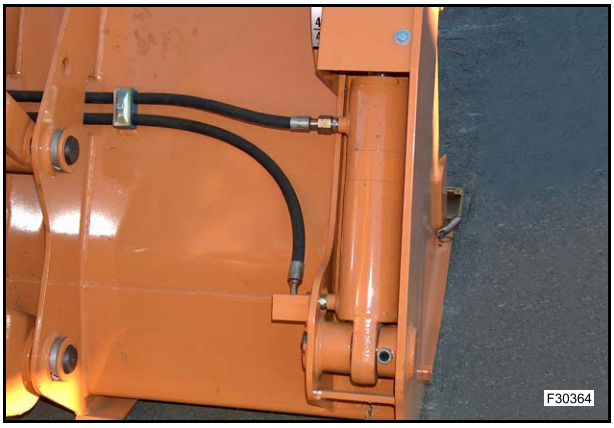
Park machine on a flat surface and position the bucket firmly on the ground.
Relieve the residual pressure in the system by moving the loader control lever through all operating positions.



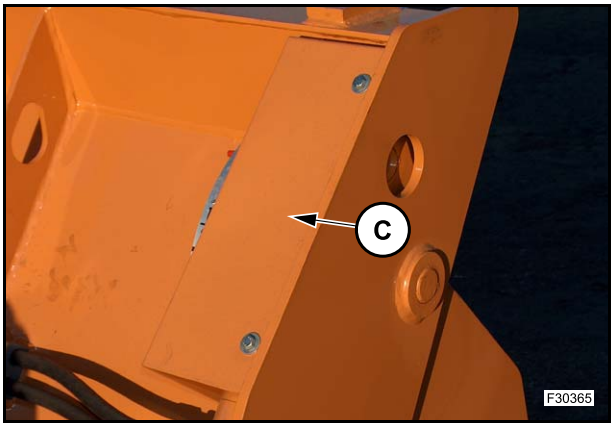
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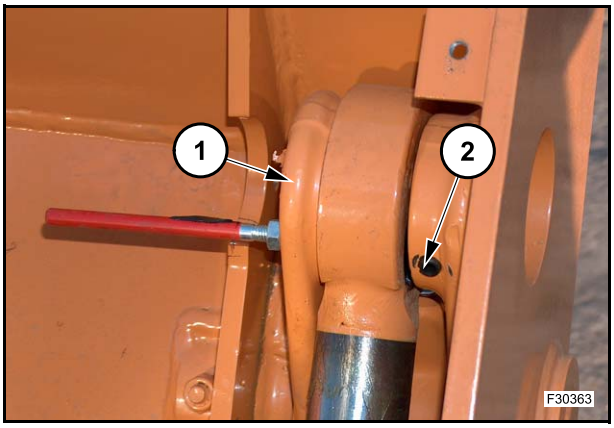
Disconnect the hydraulic hoses.



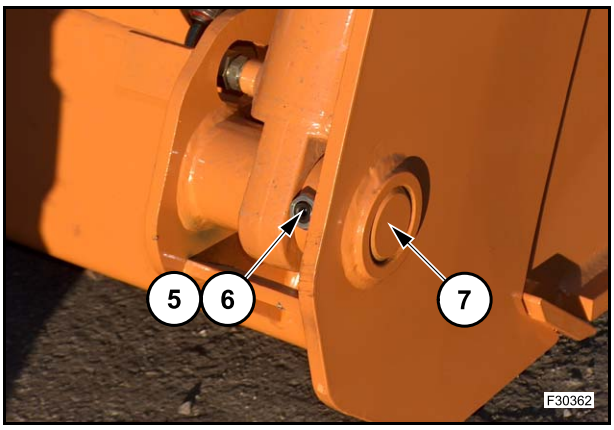
Unscrew and remove the clamping screws of the cover (C). Remove the cover (C).



Remove the pin (2). Slide out the rod pin (1) with an hammer.



Unscrew and remove the nut (6) and the dowel (5). Slide out the lower pin (7) with an hammer.

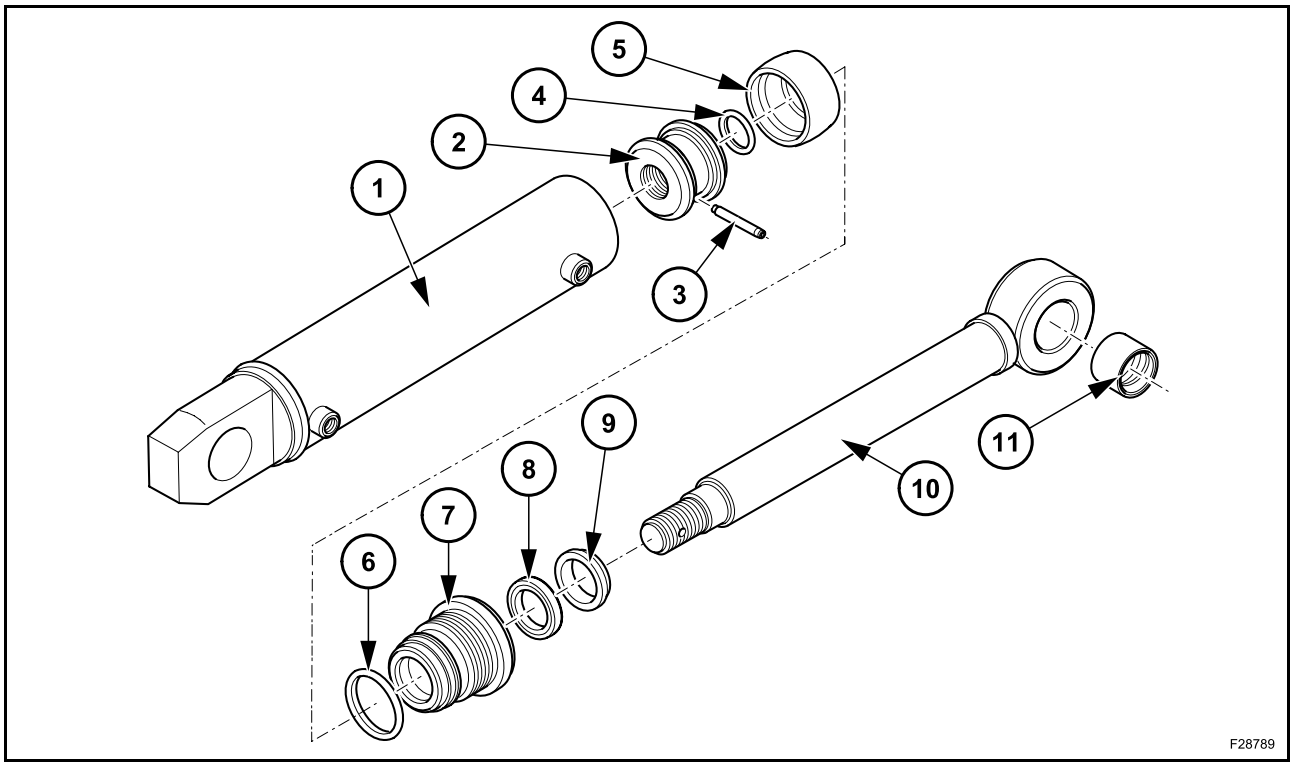


Remove the 4x1 loader bucket cylinder.

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DISASSEMBLY CYLINDER

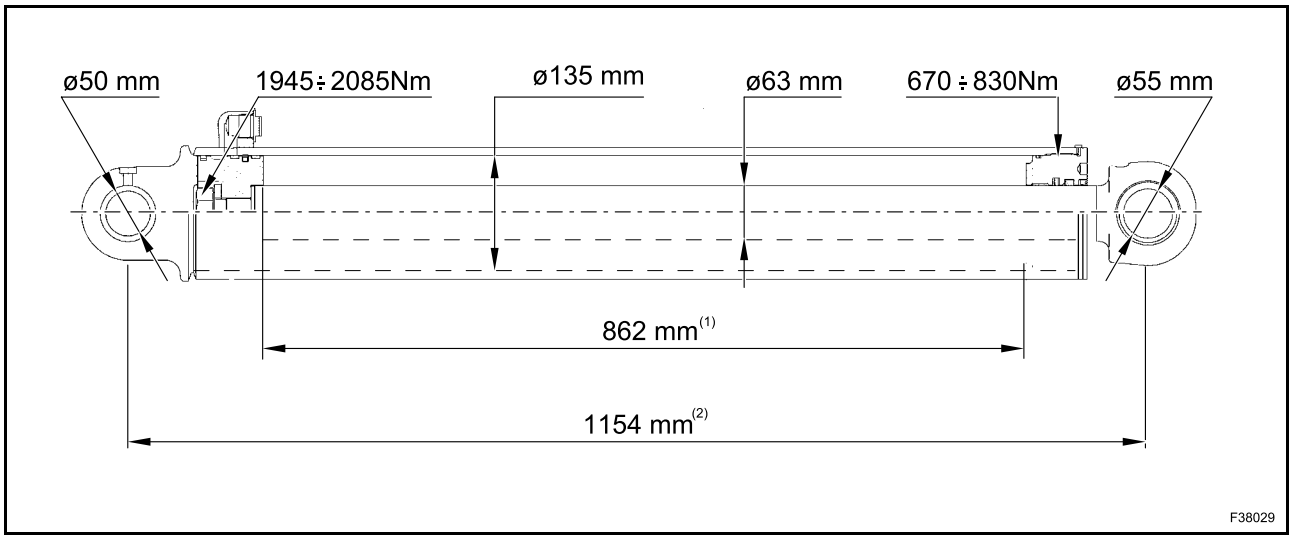


1. Cylinder tube
2. Piston
3. Pin
4. O-ring
5. Piston guide
6. O-ring
7. Cylinder head
8. Gasket
9. Wiper ring
10. Cylinder rod
11. Bushing

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5.4 BACKHOE BOOM CYLINDER



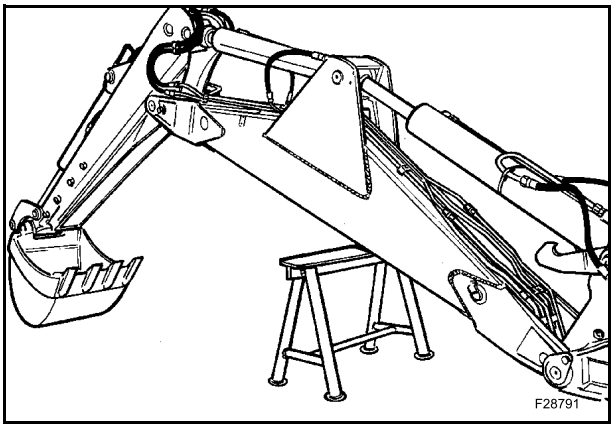
(1) Stroke
(2) Completely retracted

CYLINDER REMOVAL

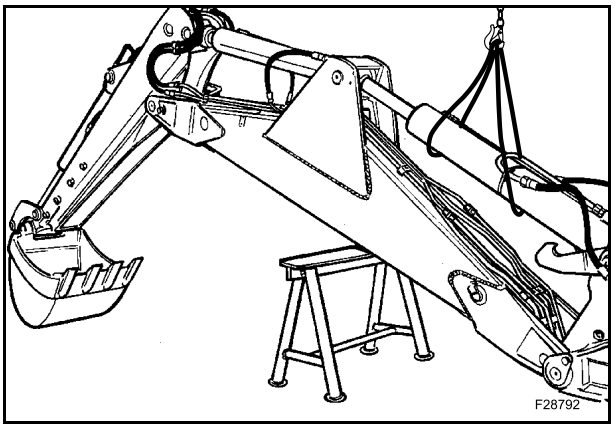
Park the machine on a flat surface and position the backhoe on the ground. Support the backhoe elements for cylinder removal using a suitable stand.

⚠ WARNING
Always support the structural members so that they will be stable and safe to work around.

Stop the engine and move the backhoe attachment control levers through all operating positions to relieve any residual pressures in the system.



Position a sling or other suitable lifting equipment around the cylinder.



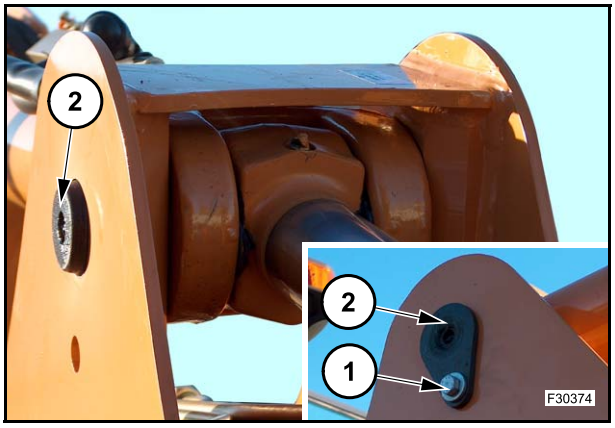
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Loosen and remove the screw (1). Slide out the rod pin (2) with an hammer.

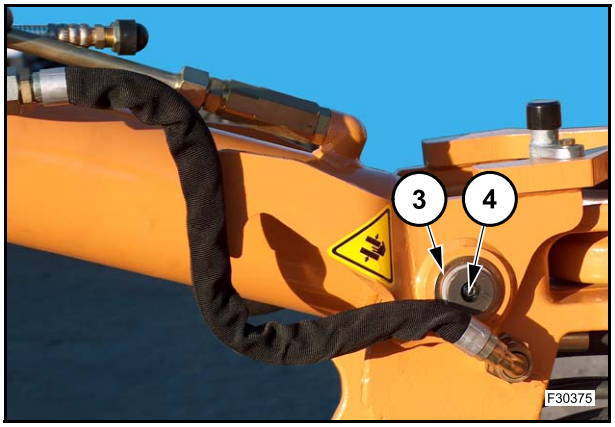
NOTE: the barrel end of the dipper cylinder and the rod end of the boom cylinder use a common pin (2).

If the boom cylinder has to be disassembled, slide out the pin (2) only partially, then remove the cylinder rod and finally reinsert the pin.
If necessary, use hydraulic power to very slowly retract the cylinder. In this way, the rod moves away from the attaching point.



Disconnect the hydraulic hoses. Remove the stop ring (3) and slide out the head pin (4).

NOTE: accurate positioning of the cylinder prior to hose disconnection will aid pin removal.

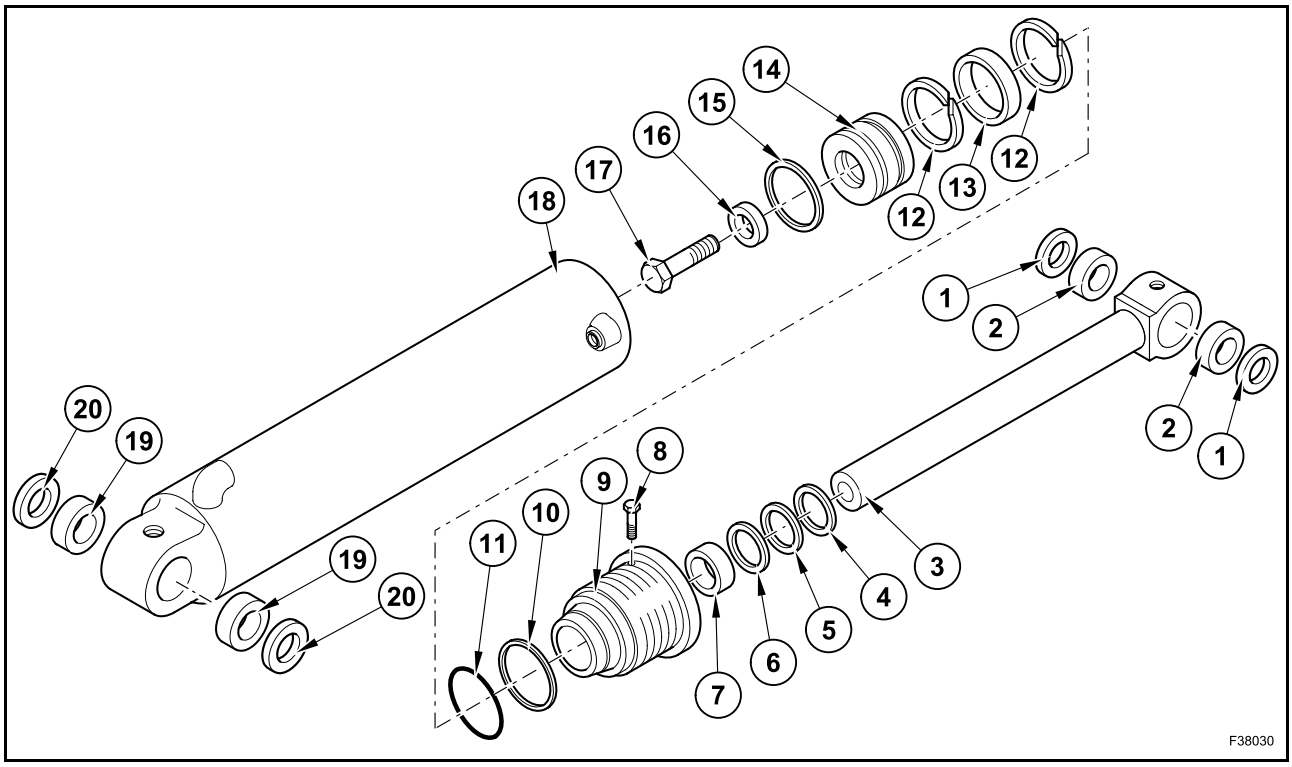


Remove the backhoe attachment boom cylinder.

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DISASSEMBLY CYLINDER



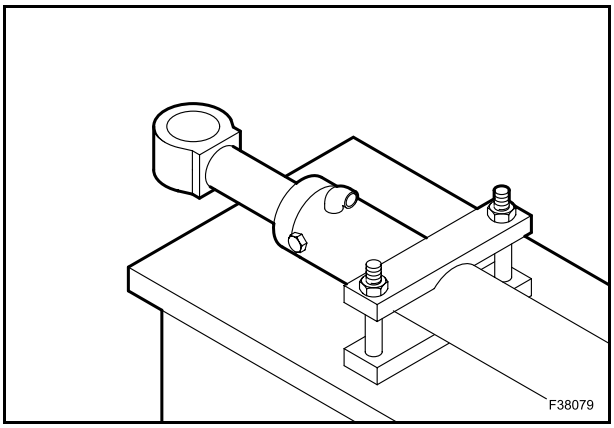
1. Wiper ring
2. Bushing
3. Cylinder rod
4. Wiper ring
5. Ring seal
6. Ring seal
7. Guide bush
8. Safety screw
9. Cylinder head
10. Back-up ring
11. O-ring
12. Piston guide
13. Piston gasket
14. Piston
15. Piston gasket
16. Washer
17. Screw
18. Cylinder tube
19. Bushing
20. Wiper ring

The disassembly procedure that follows takes into consideration the hydraulic piping already disassembled.

⚠ WARNING

Cylinder weight: 80.5 kg

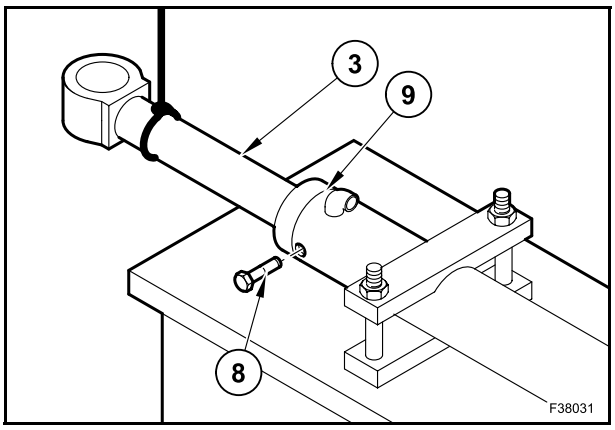
Lift and securely place the cylinder on a workbench. Be sure that the cylinder is placed horizontally. Drain hydraulic oil from the cylinder.



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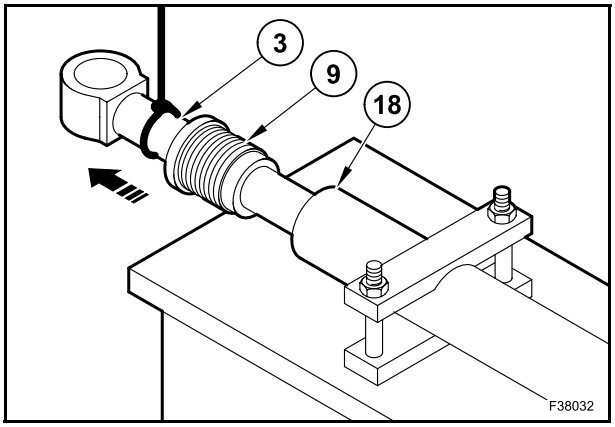
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Support the cylinder rod (3).
Remove the safety screw (8). Use the wrench **380000724** to loose the cylinder head (9).
If necessary gently heat the gland carrier to soften the thread sealant applied during manufacture.

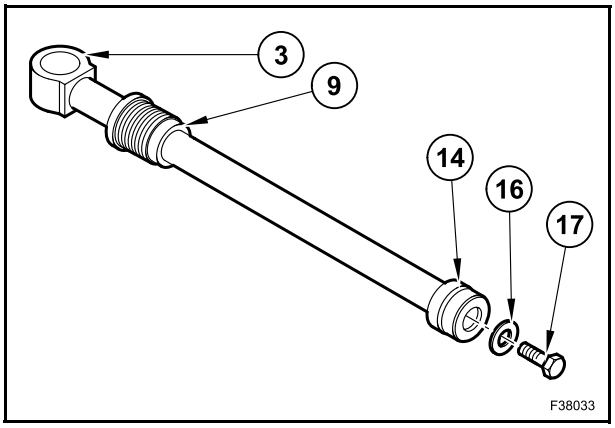


Extract the cylinder head (9) from the cylinder barrel (18) by tapping it with a plastic hammer. Remove the cylinder rod (3) and the cylinder head (9).

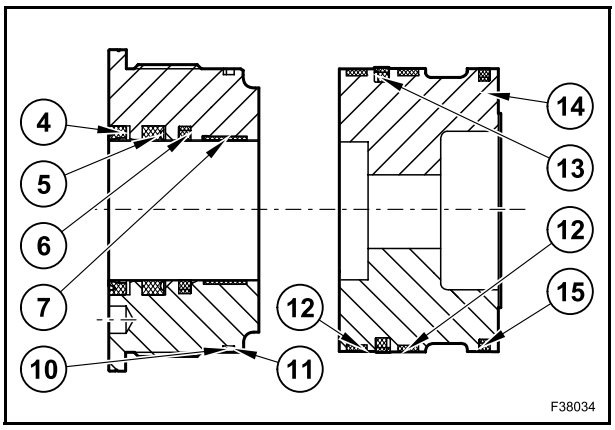
IMPORTANT: be sure to pull the cylinder rod (3) straight so as not to damage the sliding surfaces.



Loosen and remove the screw (17) with the relevant washer (16). Extract the piston (14) and the cylinder head (9) from the cylinder rod (3).



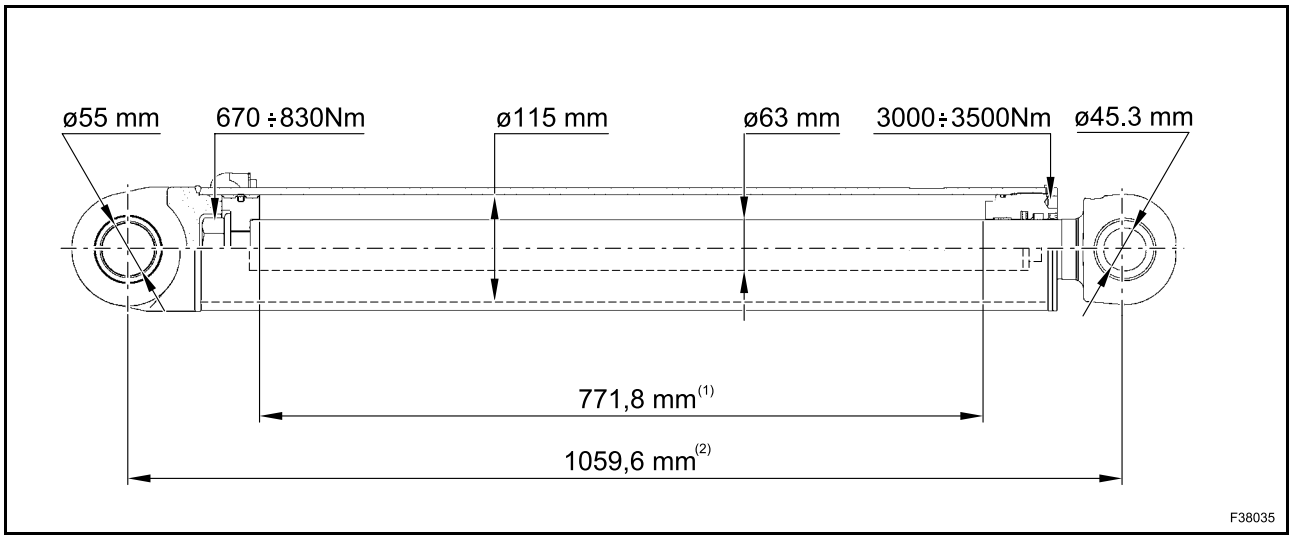
Only if necessary:
- remove the wiper ring (4), the seal rings (5) and (6), the guide bush (7) and the back-up ring (10) with the O-ring (11) from the cylinder head (9);
- remove the piston guide ring (12) and the piston seals (13) and (15) from the piston (14).



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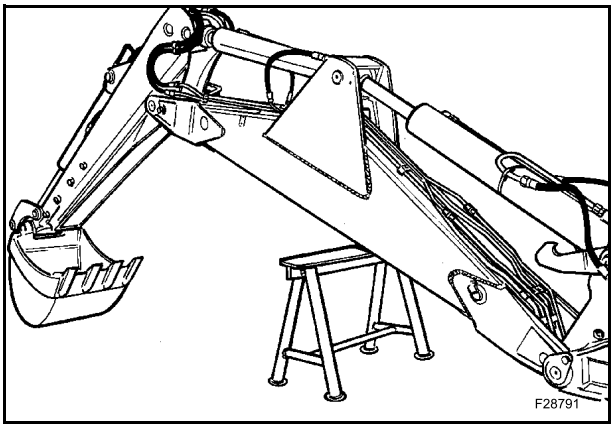
5.5 BACKHOE ATTACHMENT DIPPER CYLINDER



(1) Stroke
(2) Completely retracted

CYLINDER REMOVAL

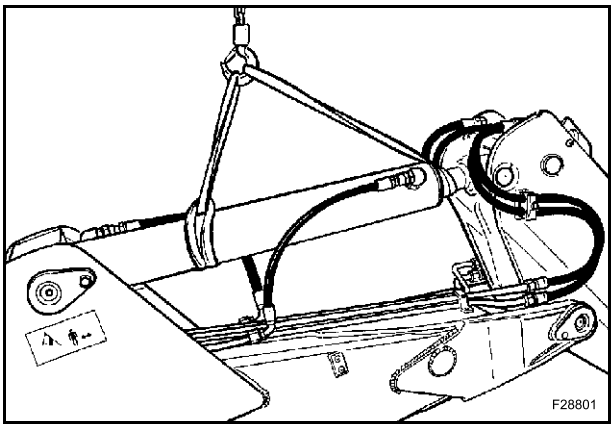
Park the machine on a flat surface and position the backhoe on the ground. Support the backhoe elements for cylinder removal using a suitable stand.



⚠ WARNING
Always support the structural members so that they will be stable and safe to work around.

Stop the engine and move the backhoe attachment control levers through all operating positions to relieve any residual pressures in the system.

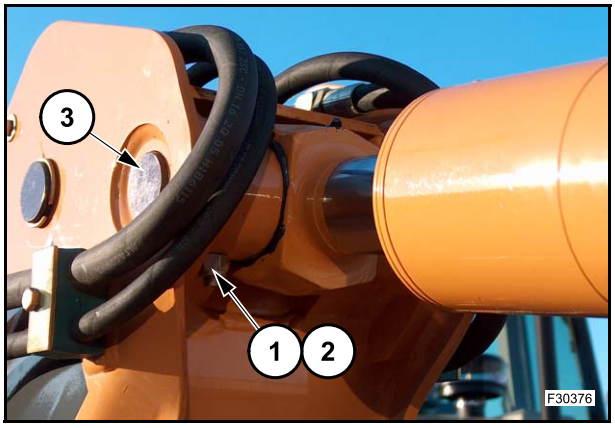
Position a sling or other suitable lifting equipment around the cylinder.



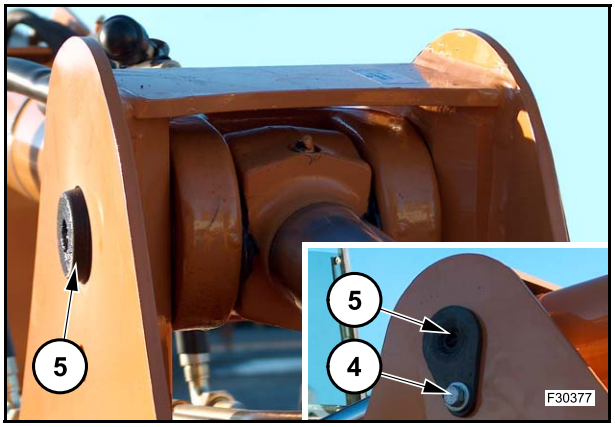
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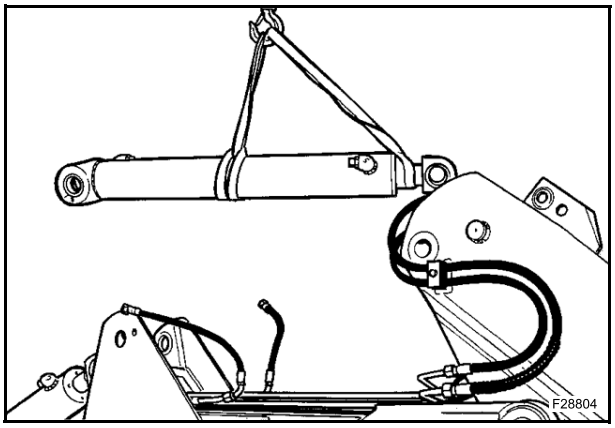
Loosen and remove the nut (1) and the screw (2). Slide out the rod pin (3) with an hammer.
If necessary, use hydraulic power to very slowly retract the cylinder. In this way, the rod moves away from the attaching point.



Disconnect the hydraulic hoses. Loosen and remove the screw (4). Slide out the rod pin (5) with an hammer.
The tube end of the dipper cylinder and rod end of the boom cylinder use a common pin (5).
Therefore before shifting the dig cylinder, support the boom cylinder with a rope or an hoist.



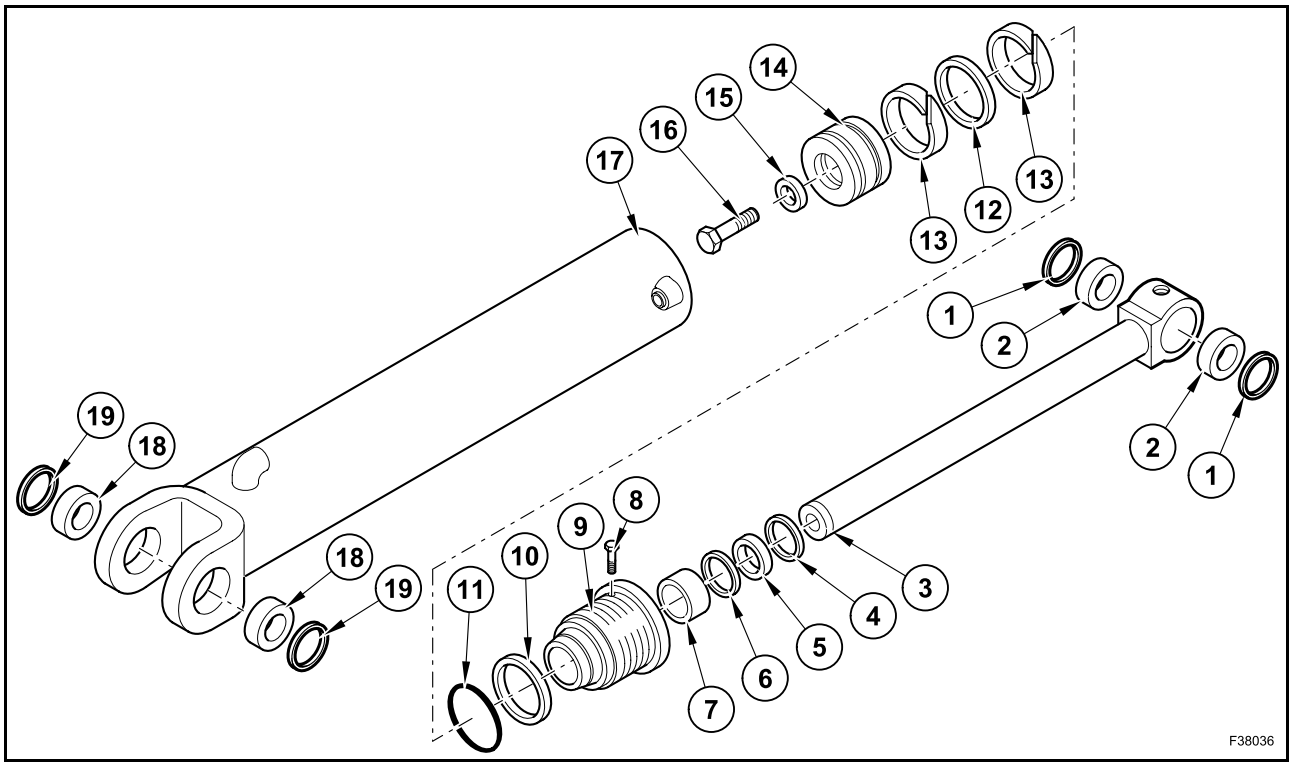
Remove the backhoe dipper cylinder.



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DISASSEMBLY CYLINDER

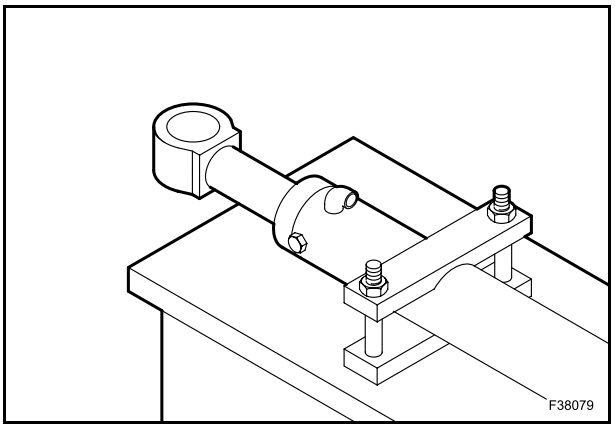


1. Wiper ring
2. Bushing
3. Cylinder rod
4. Wiper ring
5. Ring seal
6. Ring seal
7. Guide bush
8. Safety screw
9. Cylinder head
10. Back-up ring
11. O-ring
12. Piston gasket
13. Piston guide
14. Piston
15. Washer
16. Screw
17. Cylinder tube
18. Bushing
19. Wiper ring

The disassembly procedure that follows takes into consideration the hydraulic piping already disassembled.

⚠ WARNING
Cylinder weight: 64 kg

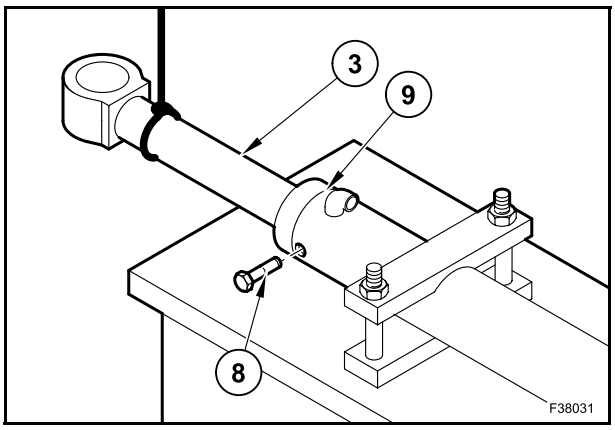
Lift and securely place the cylinder on a workbench. Be sure that the cylinder is placed horizontally. Drain hydraulic oil from the cylinder.



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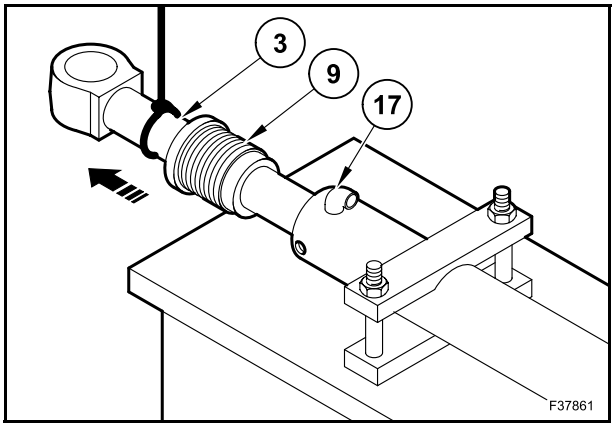
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Support the cylinder rod (3).
Unscrew and remove the safety screw (8). Use the wrench **380000724** to loose the cylinder head (9).
If necessary gently heat the gland carrier to soften the thread sealant applied during manufacture.

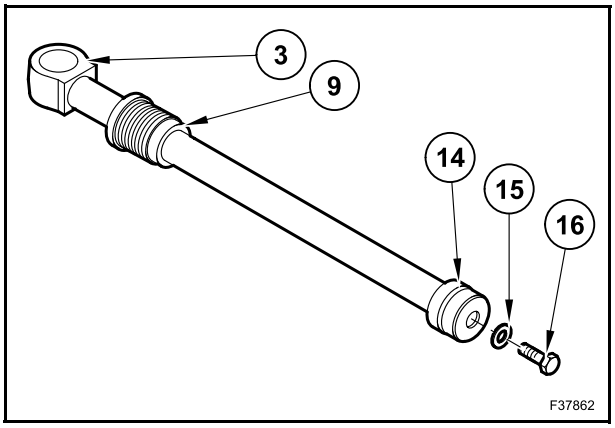


Extract the cylinder head (9) from the cylinder barrel (17) by tapping it with a plastic hammer. Remove the cylinder rod (3) and the cylinder head (9).

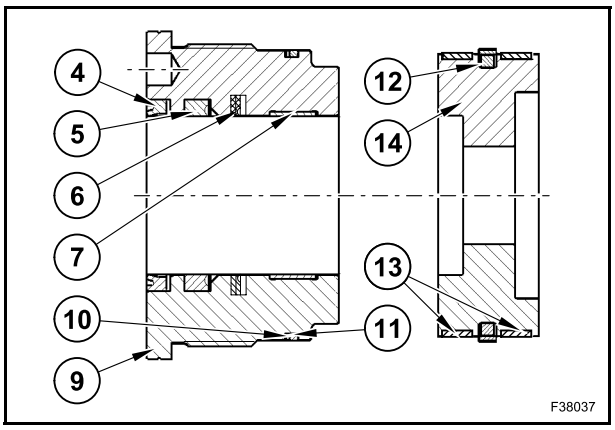
IMPORTANT: be sure to pull the cylinder rod (3) straight so as not to damage the sliding surfaces.



Loosen and remove the screw (16) with the washer (15). Extract the piston (14) and the cylinder head (9) from the cylinder rod (3).



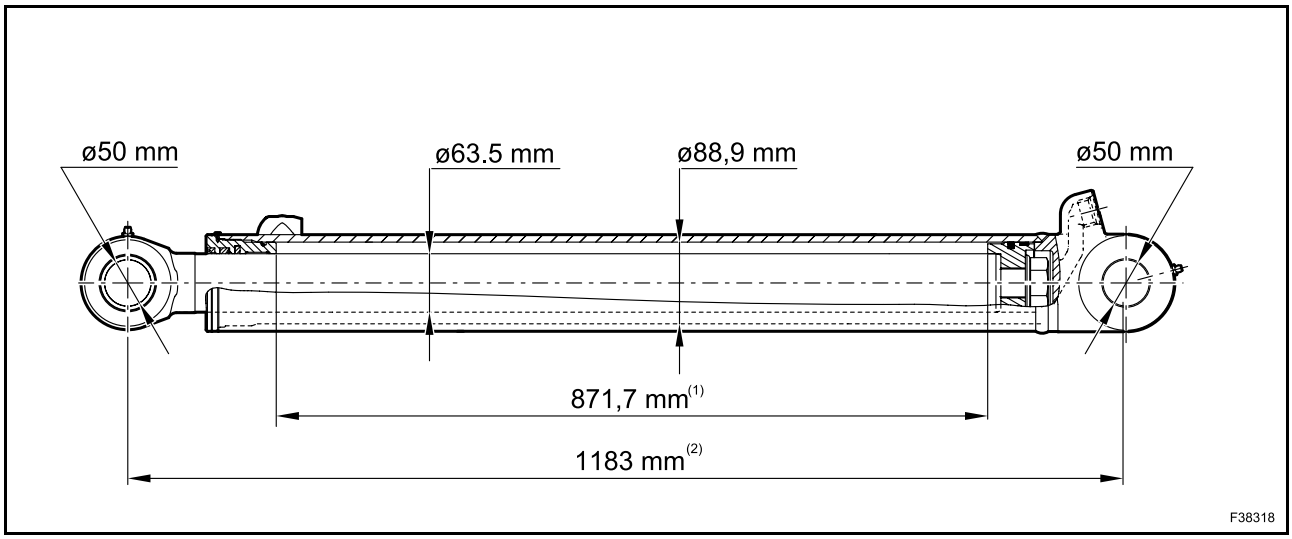
Only if necessary:
- remove the wiper ring (4), the seal rings (5) and (6), the guide bush (7) and the back-up ring (10) with the O-ring (11) from the cylinder head (9);
- remove the piston guide rings (13) and the piston seal (12) from the piston (14).



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5.6 BACKHOE BUCKET CYLINDER



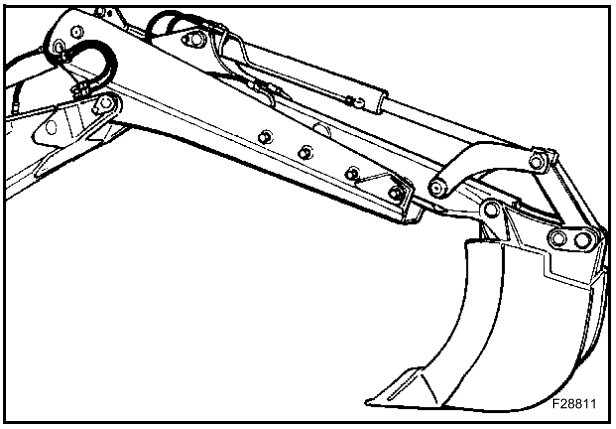
(1) Stroke
(2) Completely retracted

CYLINDER REMOVAL

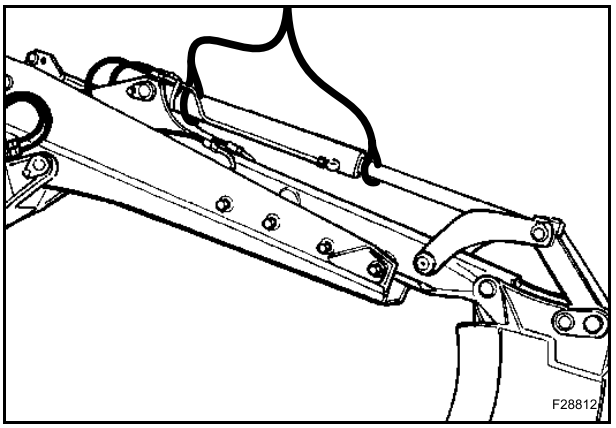
Park the machine on a flat surface. Lay the backhoe bucket firmly on the ground.

⚠ WARNING
Always support the structural members so that they will be stable and safe to work around.

Stop the engine and move the backhoe attachment control levers through all operating positions to relieve any residual pressures in the system.



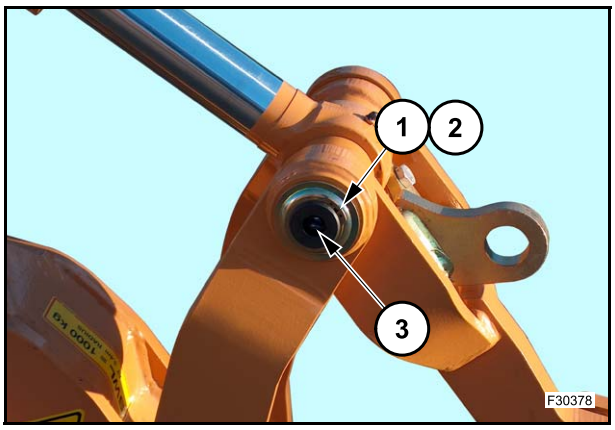
Position a sling or other suitable lifting equipment around the cylinder.



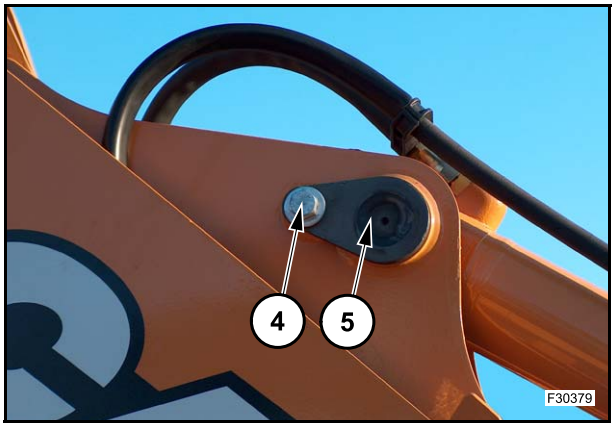
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Remove the stop ring (1) with the shim (2). Slide out the pin (3) with an hammer and pay attention to levers.
If necessary use hydraulic power to very slowly retract the cylinder.



Disconnect the hydraulic hoses. Unscrew and remove the screw (4) and slide out the pin (5) with an hammer.

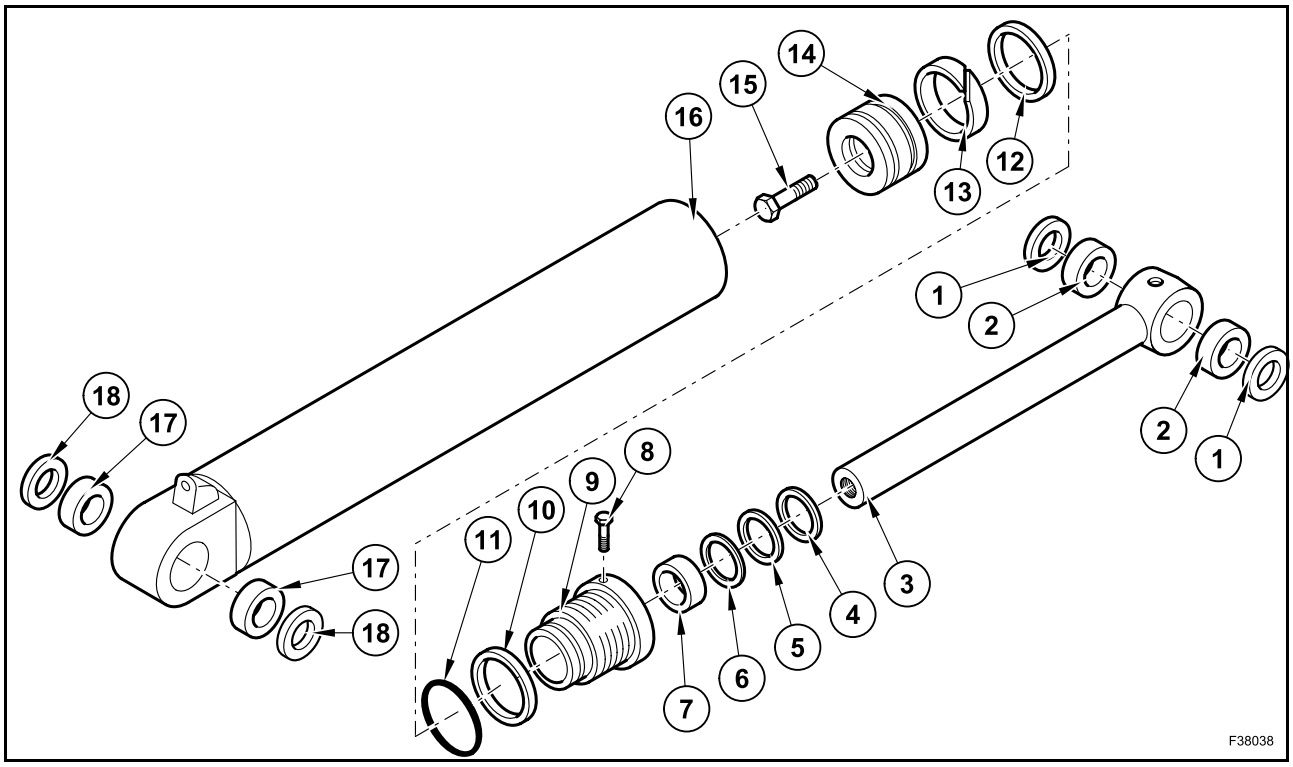


Remove the backhoe bucket cylinder.

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DISASSEMBLY CYLINDER



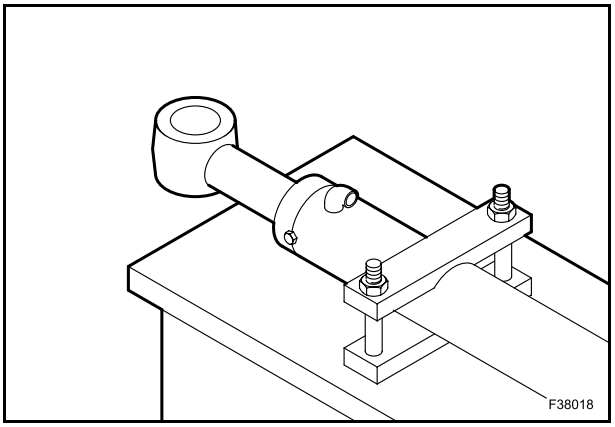
1. Wiper ring
2. Bushing
3. Cylinder rod
4. Wiper ring
5. Ring seal
6. Ring seal
7. Guide bush
8. Safety screw
9. Cylinder head
10. Back-up ring
11. O-ring
12. Piston gasket
13. Piston guide
14. Piston
15. Screw
16. Cylinder tube
17. Bushing
18. Wiper ring

The disassembly procedure that follows takes into consideration the hydraulic piping already disassembled.

⚠ WARNING

Cylinder weight: 96 kg

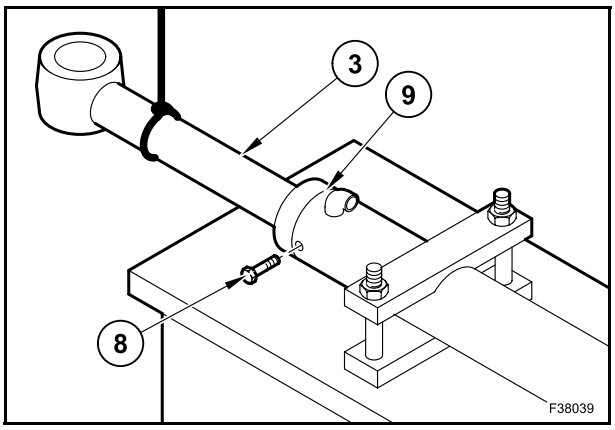
Lift and securely place the cylinder on a workbench. Be sure that the cylinder is placed horizontally. Drain hydraulic oil from the cylinder.



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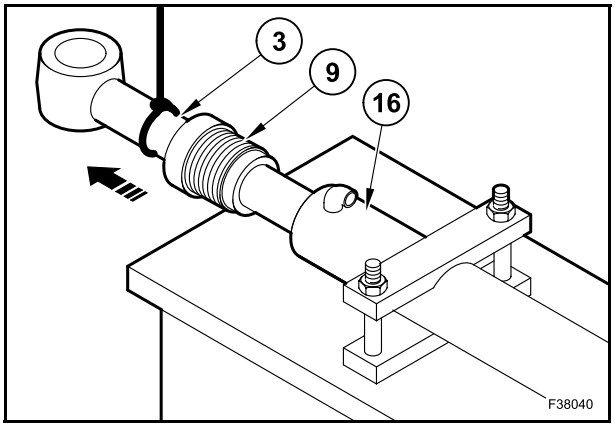
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Support the cylinder rod (3).
Remove the safety screw (8). Use the wrench **380000725** to loose the cylinder head (9).
If necessary gently heat the gland carrier to soften the thread sealant applied during manufacture.

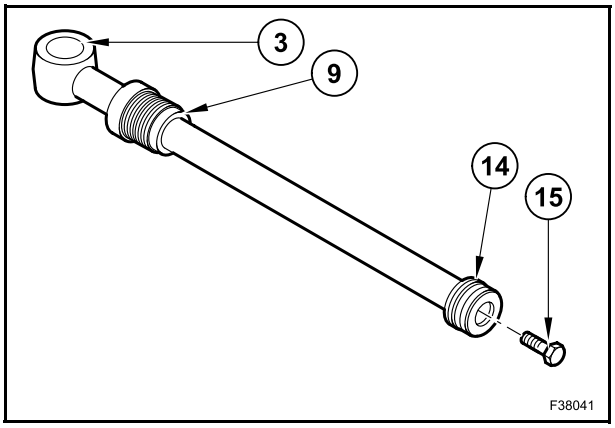


Extract the cylinder head (9) from the cylinder barrel (16) by tapping it with a plastic hammer. Remove the cylinder rod (3) and the cylinder head (9).

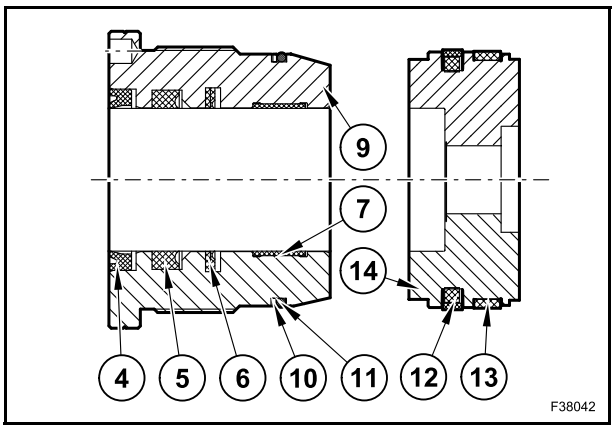
IMPORTANT: be sure to pull the cylinder rod (3) straight so as not to damage the sliding surfaces.



Loosen and remove the screw (15). Extract the piston (14) and the cylinder head (9) from the cylinder rod (3).



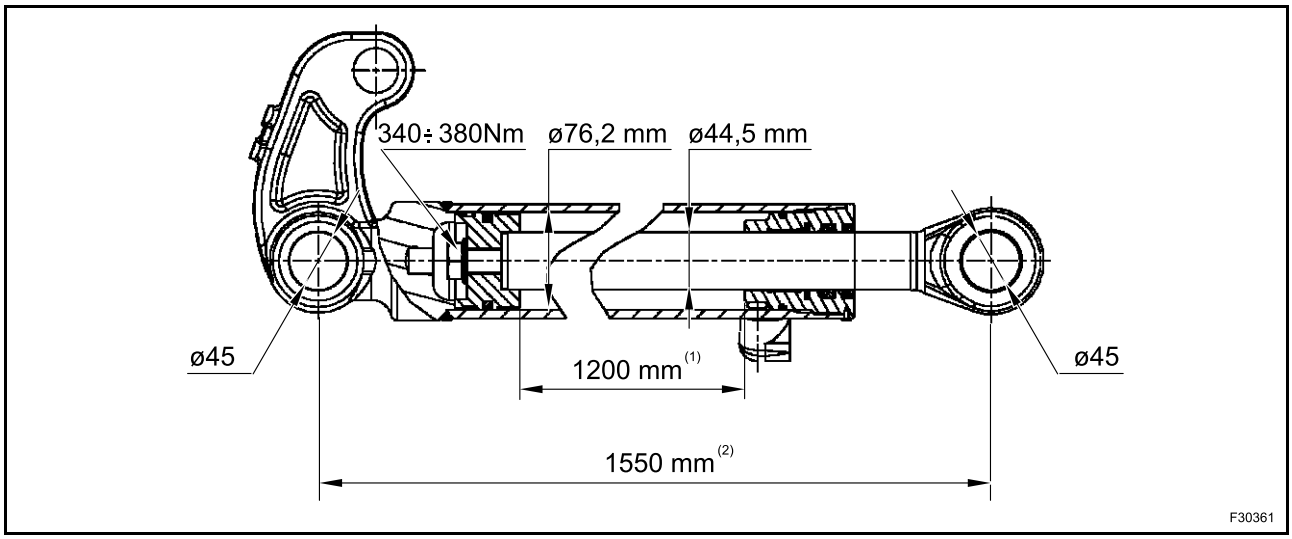
Only if necessary:
- remove the wiper ring (4), the seal rings (5) and (6), the guide bush (7) and the back-up ring (10) with the O-ring (11) from the cylinder head (9);
- remove the piston guide ring (13) and the piston seal (12) from the piston (14).



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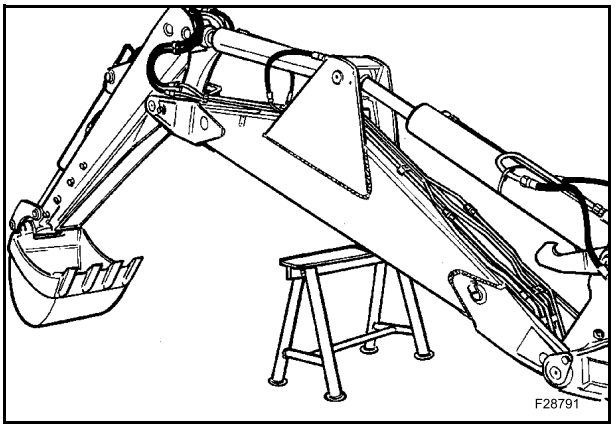
5.7 TELESCOPIC CYLINDER



(1) Stroke
(2) Completely retracted

CYLINDER REMOVAL

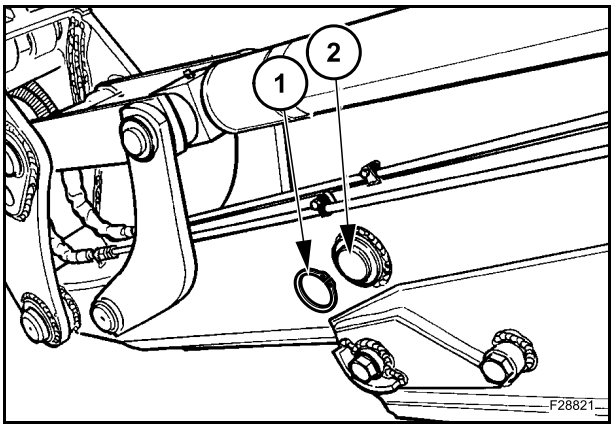
Park the machine on a flat surface and position the backhoe on the ground. Support the backhoe elements for cylinder removal using a suitable stand.



⚠ WARNING
Always support the structural members so that they will be stable and safe to work around.

Stop the engine and move the backhoe attachment control levers through all operating positions to relieve any residual pressures in the system.

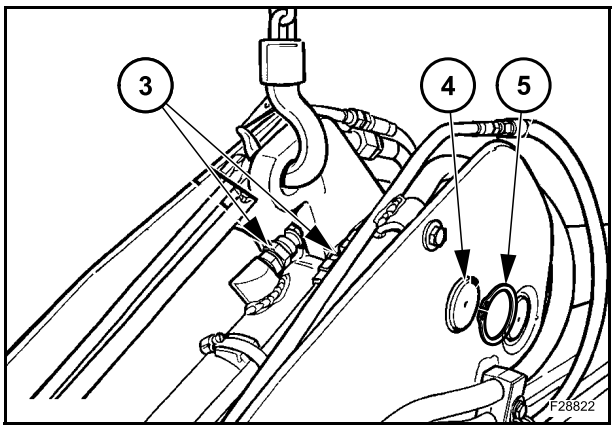
Remove the snap ring (1). Hammer to slide out the pin (2) from the other side.



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Disconnect the hydraulic hoses (3), at dipper cylinder and support cylinder using suitable hoist. Remove the snap ring (5). Hammer to slide out the pin (4) from the other side.

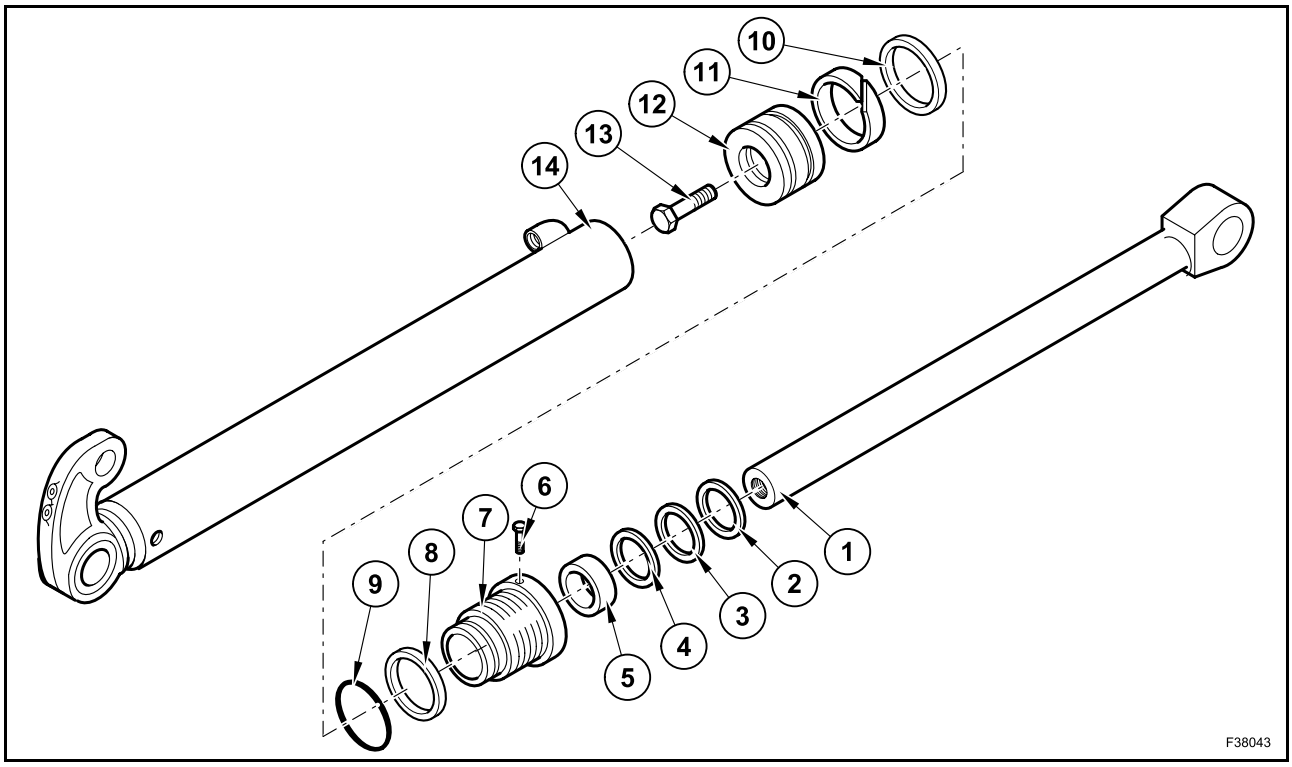


Remove the telescopic cylinder.

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DISASSEMBLY CYLINDER

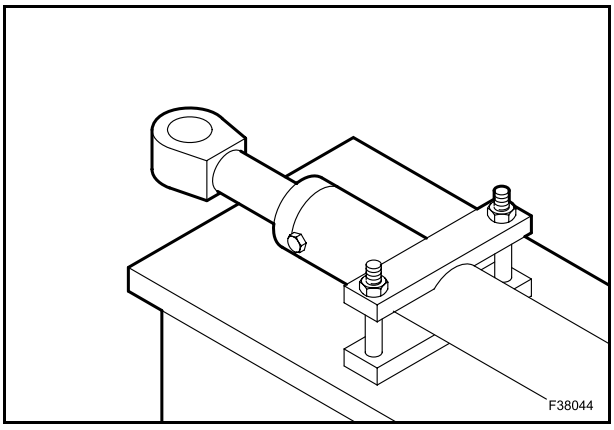


1. Cylinder rod
2. Wiper ring
3. Ring seal
4. Ring seal
5. Guide bush
6. Safety screw
7. Cylinder head
8. Back-up ring
9. O-ring
10. Piston gasket
11. Piston guide
12. Piston
13. Screw
14. Cylinder tube

The disassembly procedure that follows takes into consideration the hydraulic piping already disassembled.

⚠ WARNING
Cylinder weight: 45 kg

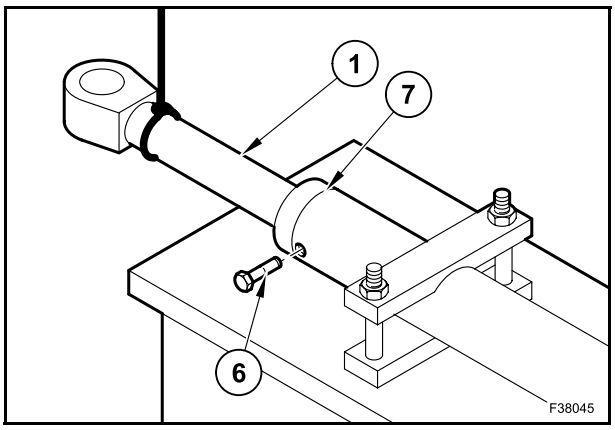
Lift and securely place the cylinder on a workbench. Be sure that the cylinder is placed horizontally. Drain hydraulic oil from the cylinder.



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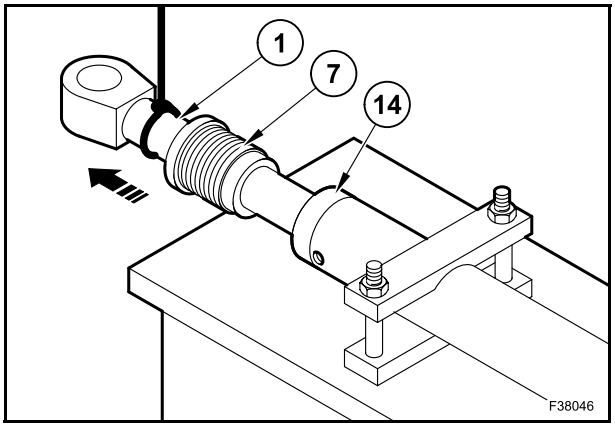
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Support the cylinder rod (1).
Unscrew and remove the safety screw (6). Use the wrench **380000721** to loose the cylinder head (7).
If necessary gently heat the gland carrier to soften the thread sealant applied during manufacture.

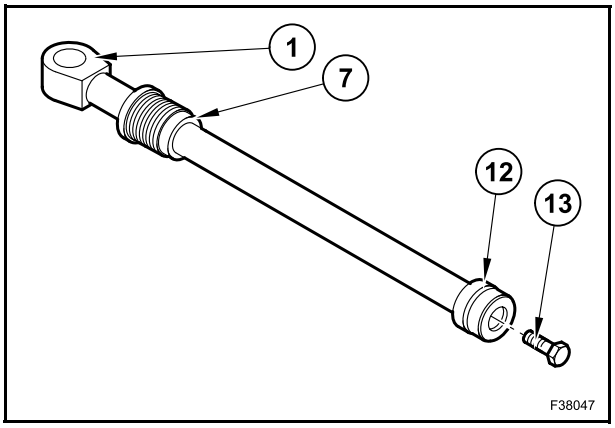


Extract the cylinder head (7) from the cylinder barrel (14) by tapping it with a plastic hammer. Remove the cylinder rod (1) and the cylinder head (7).

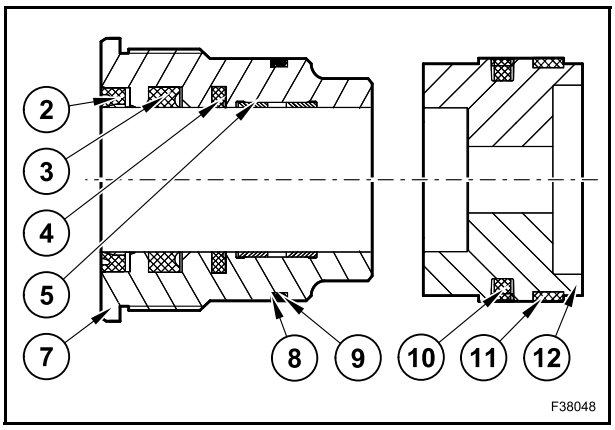
IMPORTANT: be sure to pull the cylinder rod (1) straight so as not to damage the sliding surfaces.



Loosen and remove the screw (13). Extract the piston (12) and the cylinder head (7) from the cylinder rod (1).



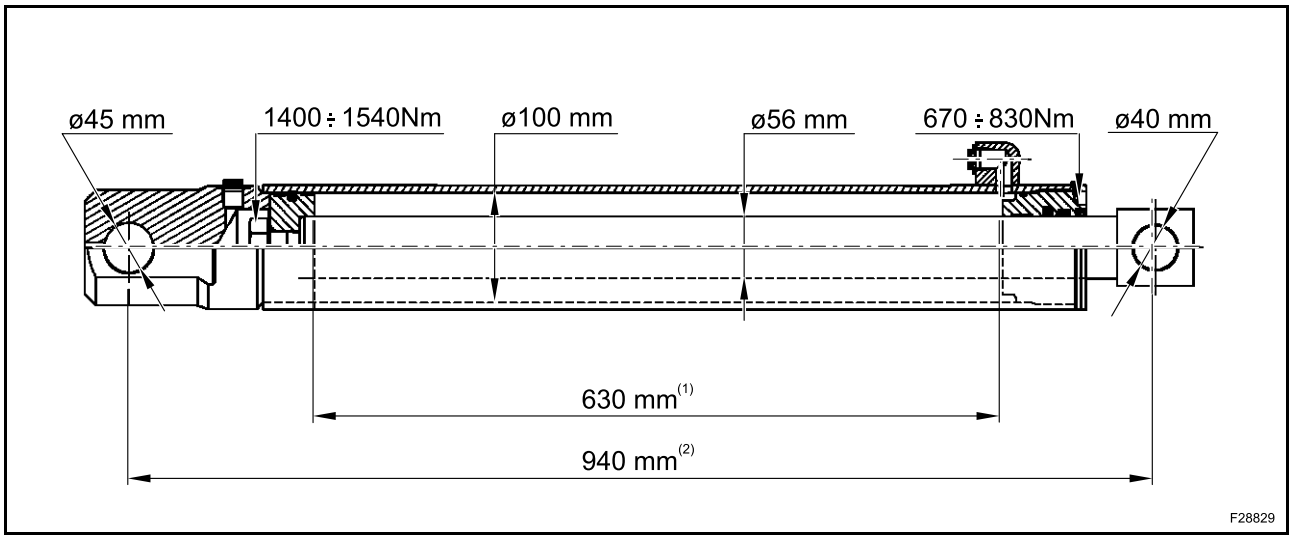
Only if necessary:
- remove the wiper ring (2), the seal rings (3) and (4), the guide bush (5), the O-ring (9) with the back-up ring (8) from the cylinder head (7);
- remove the piston guide ring (11) and the piston seal (10) from the piston (12).



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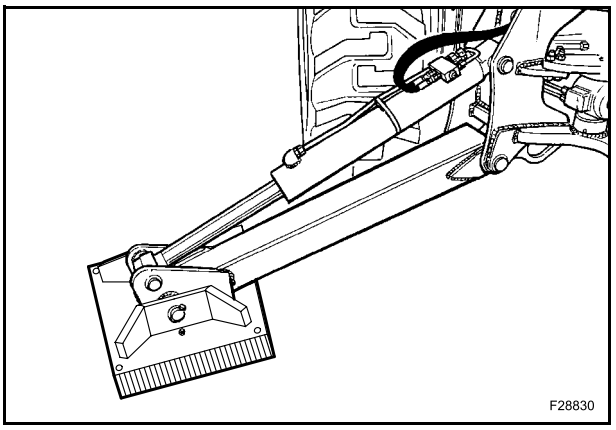
5.8 4WS STABILIZER CYLINDER - CENTER PIVOT



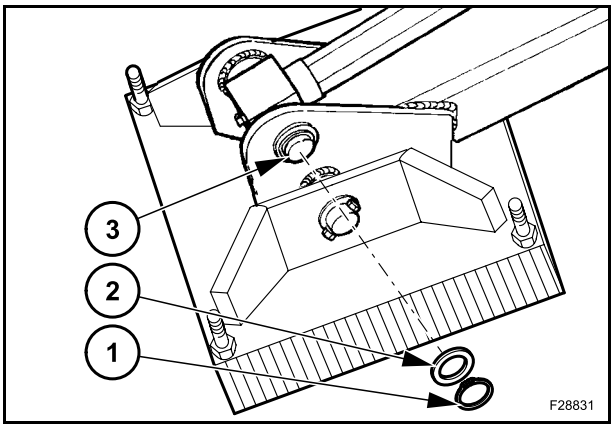
(1) Stroke
(2) Completely retracted

CYLINDER REMOVAL

Make sure that the backhoe loader is locked in the transfer position or parked in a safety work position. Lower the stabilizers to the ground.



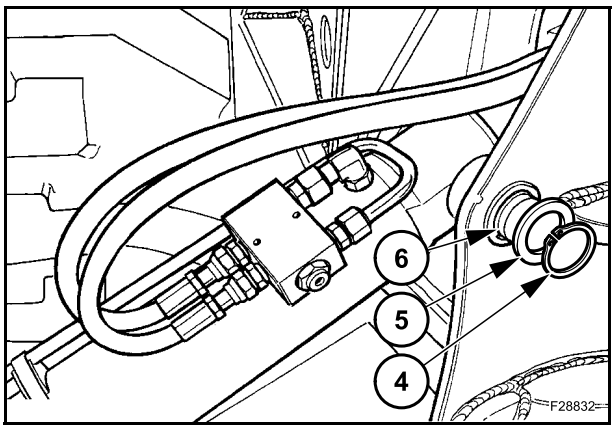
Support the cylinder safely with suitable belt and hoist.
Remove the snap ring (1) and the shim (2).
Extract the pin (3) with a hammer. Using the hydraulic power, retract the cylinder very slowly.



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With engine stopped, release any residual pressure by moving the control levers of stabilizers.
Disconnect all hydraulic hoses. Remove the snap ring (4) and the shim (5). Hammer to slide out the pin (6).

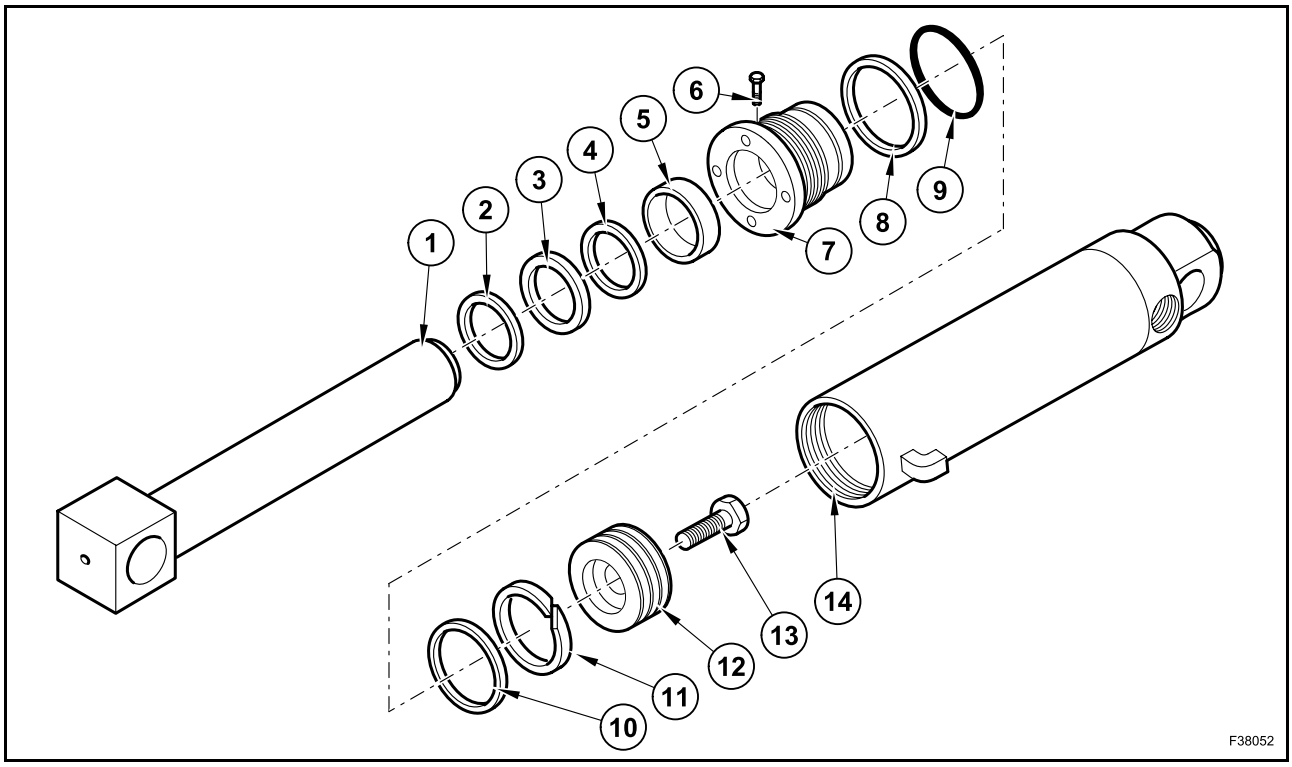


Remove the stabilizer cylinder.

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DISASSEMBLY STABILIZER CYLINDER - CENTER PIVOT



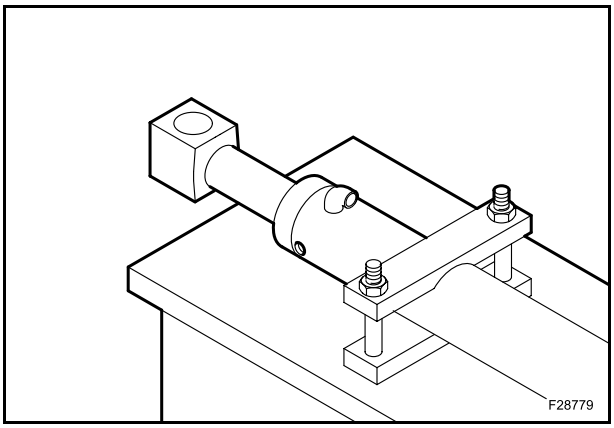
1. Cylinder rod
2. Wiper ring
3. Ring seal
4. Ring seal
5. Guide bush
6. Safety screw
7. Cylinder head
8. Back-up ring
9. O-ring
10. Piston gasket
11. Piston guide
12. Piston
13. Screw
14. Cylinder tube

The disassembly procedure that follows takes into consideration the hydraulic piping already disassembled.

⚠ WARNING

Cylinder weight: 43.5 kg

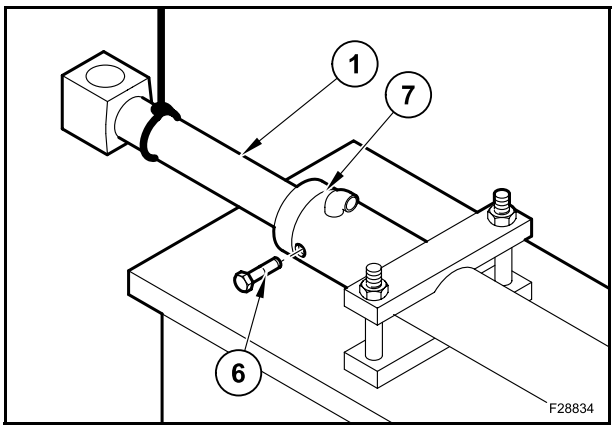
Lift and securely place the cylinder on a workbench. Be sure that the cylinder is placed horizontally. Drain hydraulic oil from the cylinder.



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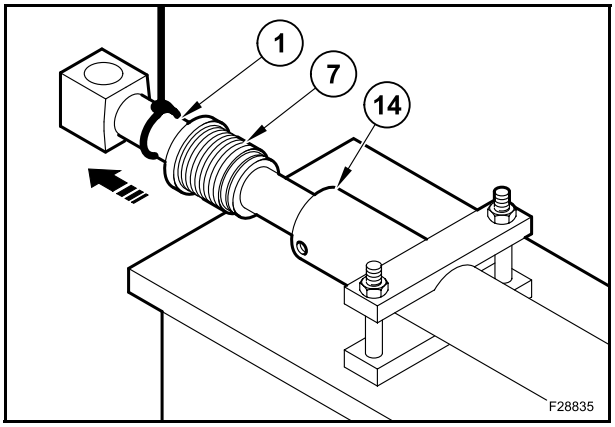
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Support the cylinder rod (1).
Unscrew and remove the safety screw (6). Use the wrench **380000726** to loose the cylinder head (7).
If necessary gently heat the gland carrier to soften the thread sealant applied during manufacture.

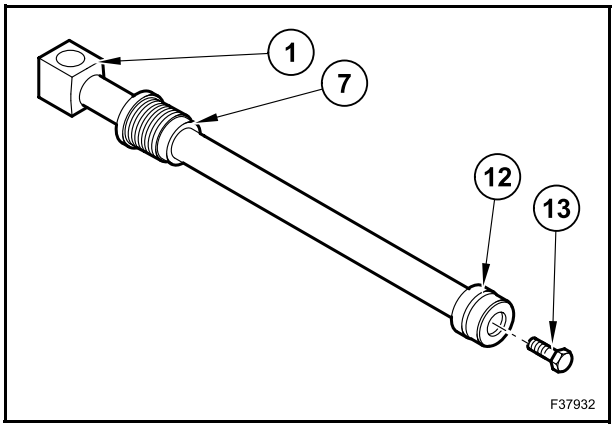


Extract the cylinder head (7) from the cylinder barrel (14) by tapping it with a plastic hammer. Remove the cylinder rod (1) and the cylinder head (7).

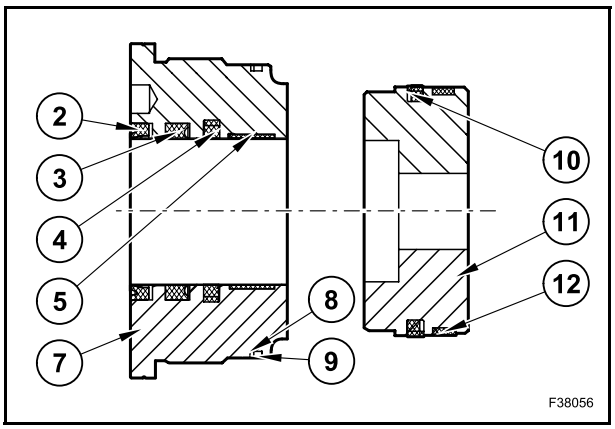
IMPORTANT: be sure to pull the cylinder rod (1) straight so as not to damage the sliding surfaces.



Loosen and remove the screw (13). Extract the piston (12) and the cylinder head (7) from the cylinder rod (1).



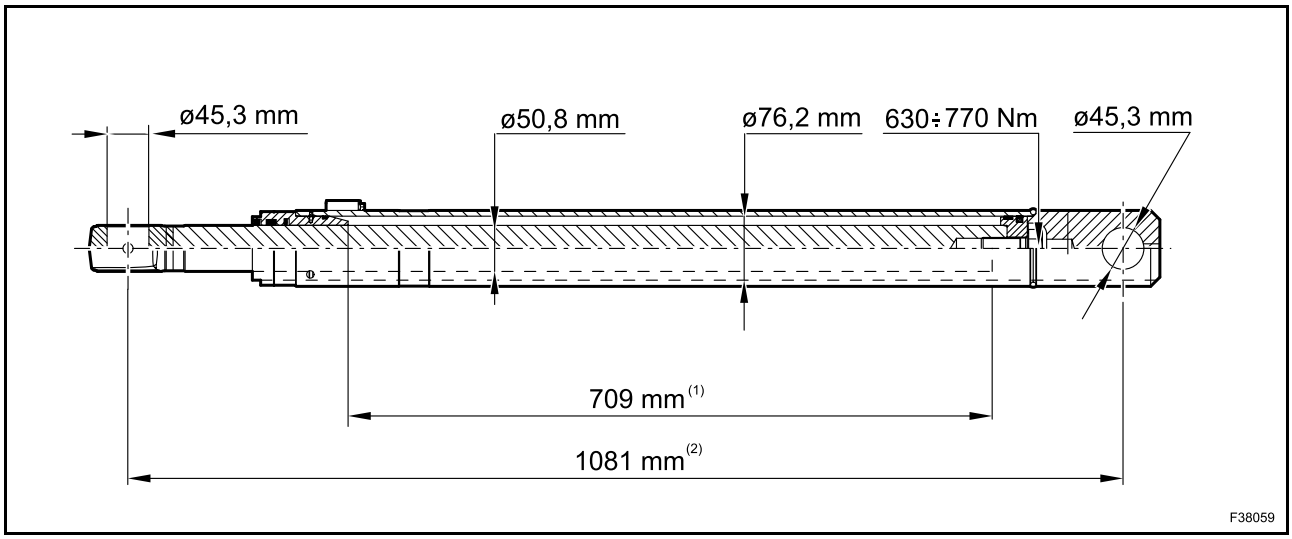
Only if necessary:
- remove the wiper ring (2), the seal rings (3) and (4), the guide bush (5), the O-ring (9) with the back-up ring (8) from the cylinder head (7);
- remove the piston guide ring (11) and the piston seal (10) from the piston (12).



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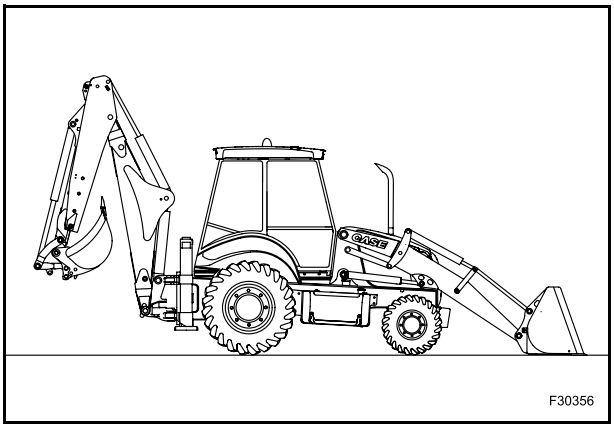
5.9 STABILIZER CYLINDER - SIDESHIFT



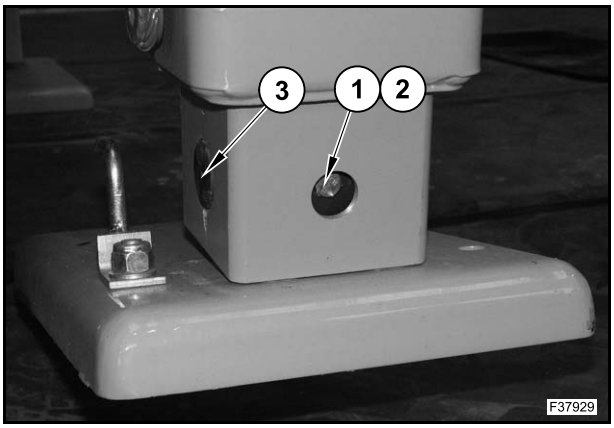
(1) Stroke
(2) Completely retracted

CYLINDER REMOVAL

Park the machine on a flat surface and position the bucket on the ground.



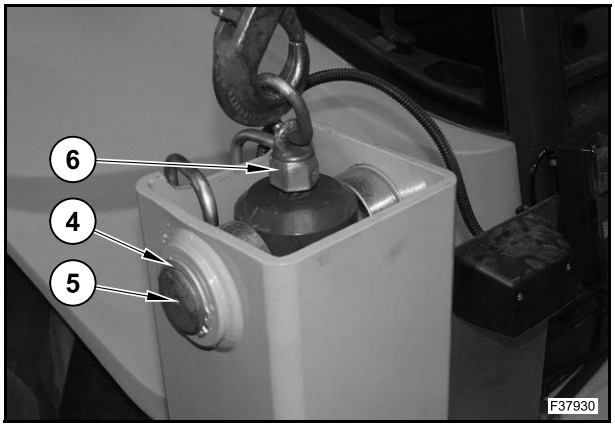
Lower the stabilizers to the ground.
Relieve possible residual pressures in the system by moving the loader attachment control lever through all operating positions.
Loosen and remove the screw (1) and the nut (2).
Extract the pin (3) to release the cylinder rod.



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Disconnect the hydraulic tubes at the top of the stabilizer.
Remove the snap ring (4) and extract the pin (5). Screw in an eye screw (6) on the cylinder and connect a rope or a chain.

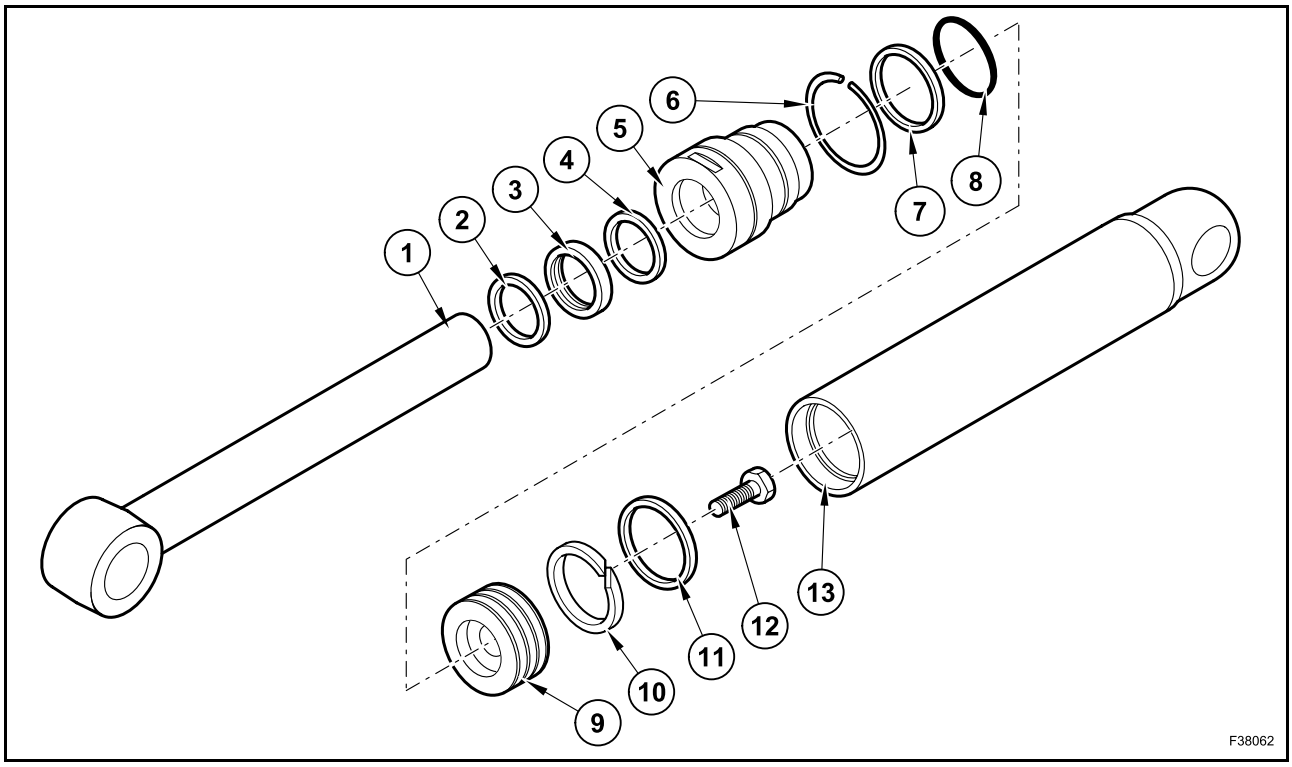


Lift and remove the stabilizer cylinder.

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DISASSEMBLY CYLINDER

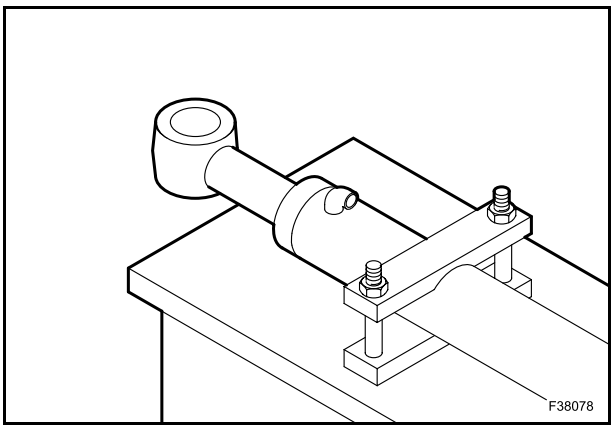


1. Cylinder rod
2. Wiper ring
3. Ring seal
4. Ring seal
5. Cylinder head
6. Snap ring
7. Back-up ring
8. O-ring
9. Piston
10. Piston guide
11. Piston gasket
12. Screw
13. Cylinder tube

The disassembly procedure that follows takes into consideration the hydraulic piping already disassembled.

⚠ WARNING
Cylinder weight: 34.5 kg

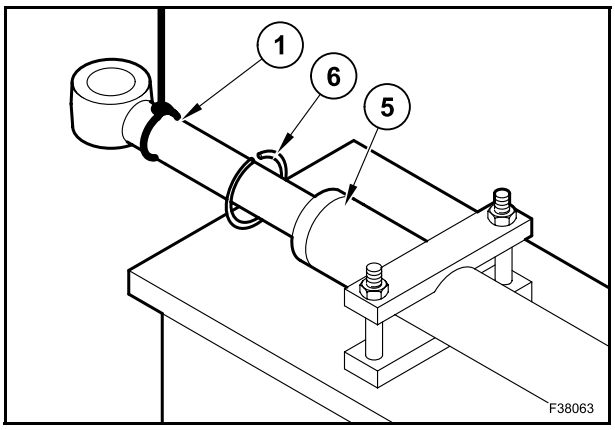
Lift and place the cylinder on a workbench and secure it to a vice. Be sure that the cylinder is placed horizontally. Drain hydraulic oil from the cylinder.



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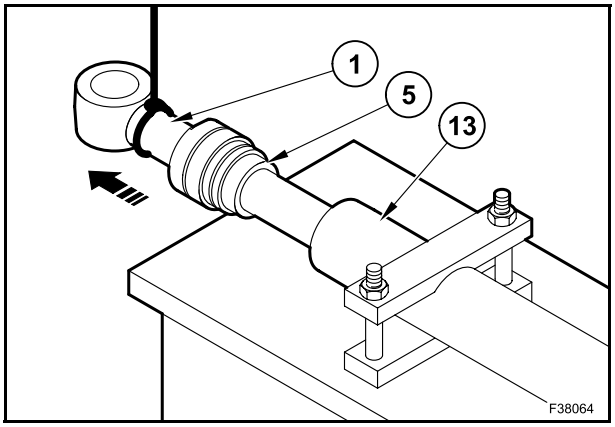
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Support the cylinder rod (1).
Remove the stop ring (6). Use the wrench **380000721** to loose the cylinder head (5).
If necessary gently heat the gland carrier to soften the thread sealant applied during manufacture.

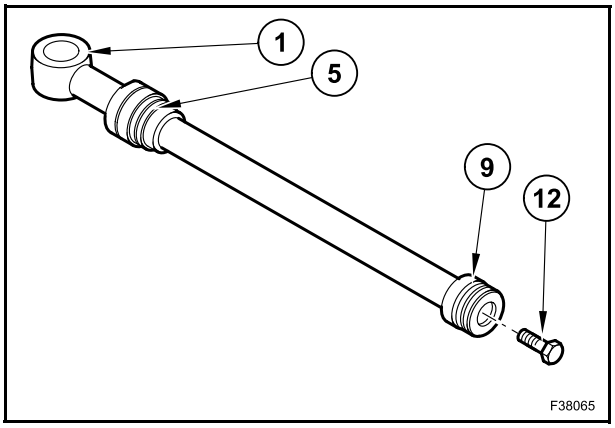


Extract the cylinder head (5) from the cylinder barrel (13) by tapping it with a plastic hammer. Remove the cylinder rod (1) and the cylinder head (5).

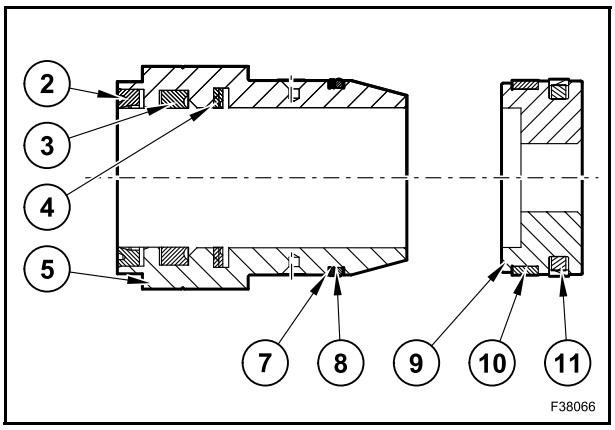
IMPORTANT: be sure to pull the cylinder rod (1) straight so as not to damage the sliding surfaces.



Loosen and remove the screw (12). Extract the piston (9) and the cylinder head (5) from the cylinder rod (1).



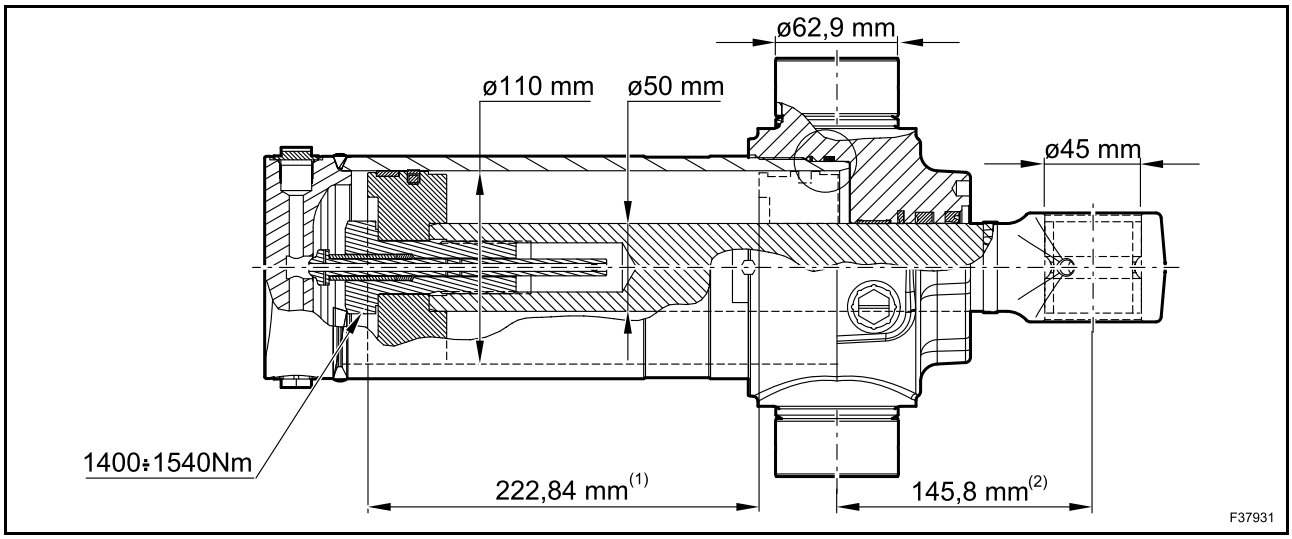
Only if necessary:
- remove the wiper ring (2), the seal rings (3) and (4) and the back-up ring (7) with the O-ring (8) from the cylinder head (5);
- remove the piston guide ring (10) and the piston seal (11) from the piston (9).



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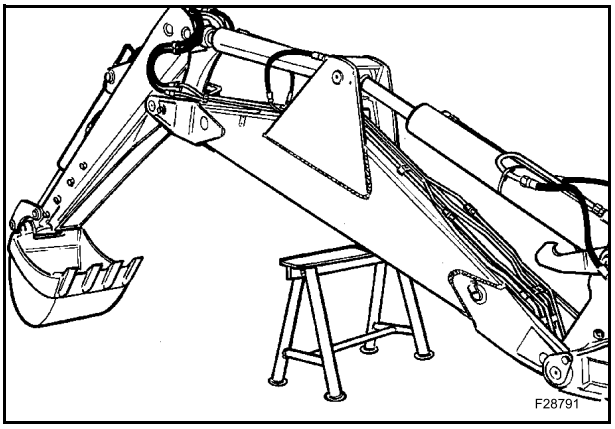
5.10 SWING CYLINDER



(1) Stroke
(2) Completely retracted

CYLINDER REMOVAL

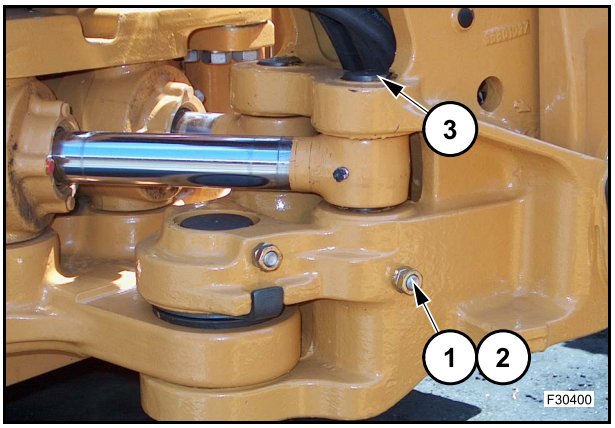
Park the machine on a flat surface and position the backhoe on the ground. Support the backhoe elements for cylinder removal using a suitable stand.



⚠ WARNING
Always support the structural members so that they will be stable and safe to work around.

Stop the engine and move the backhoe attachment control levers through all operating positions to relieve any residual pressures in the system.

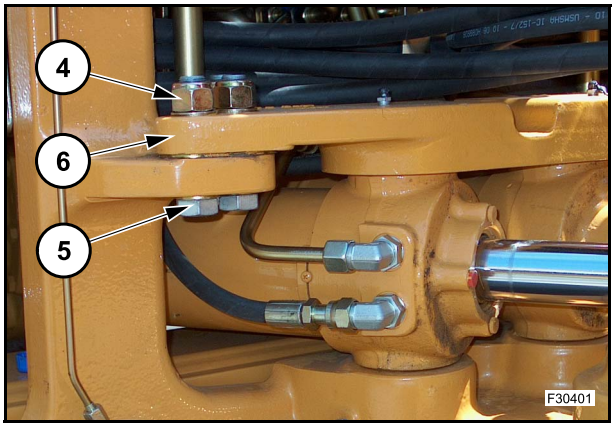
Loosen and remove the nuts (1). Slide out the screw (2) from the opposite side. Now the pin (3) can come out and release the rod cylinder. If necessary hammer to help the pin (3) to come out.



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Disconnect the feed and return hose to the cylinders and cap all exposed openings.
Loosen and remove the nuts (4) and the screws (5) (from both sides).
Now it is possible to remove the support (6).

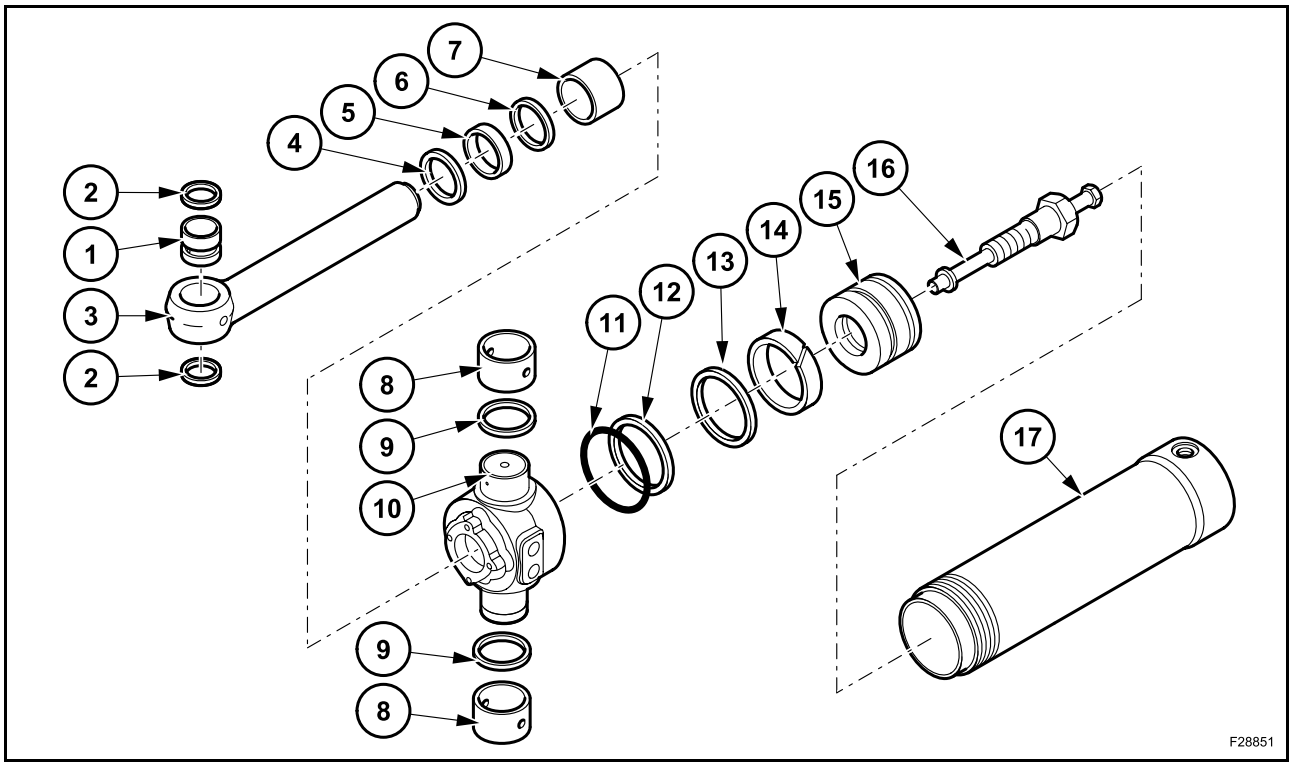


Carefully lift and remove the swing cylinder from the swing bracket.

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DISASSEMBLY CYLINDER



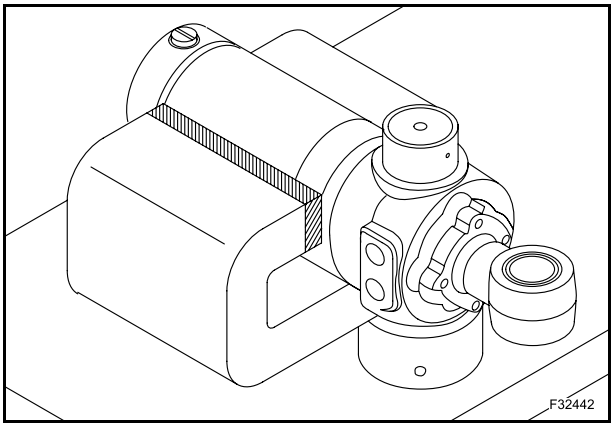
1. Bushing
2. Wiper ring
3. Cylinder rod
4. Wiper ring
5. Ring seal
6. Ring seal
7. Guide bush
8. Bushing
9. Ring seal
10. Trunnion
11. O-ring
12. Back-up ring
13. Piston gasket
14. Piston guide
15. Piston
16. Lock retaining piston
17. Cylinder tube

The disassembly procedure that follows takes into consideration the hydraulic piping already disassembled.

⚠ WARNING

Cylinder weight: 31 kg

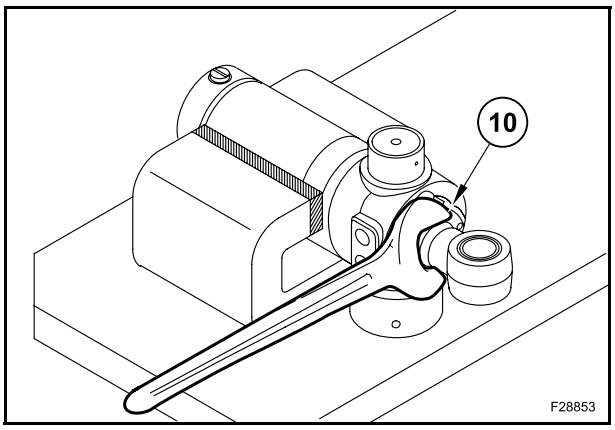
Lift and place the cylinder on a workbench and secure it to a vice. Be sure that the cylinder is placed horizontally. Drain hydraulic oil from the cylinder.



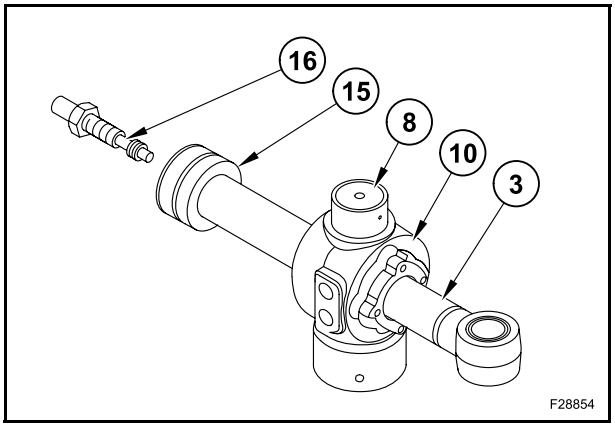
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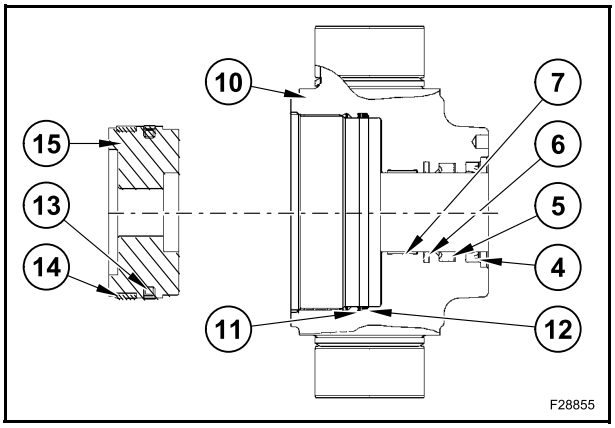
Use the wrench **380000725** to loose the trunnion (10).
If necessary gently heat the gland carrier to soften the thread sealant applied during manufacture.
Remove the rod assy with the trunnion and the piston assy.



Unscrew and remove the piston lock (16). Disassembly the cylinder rod (3) and piston assy (15) and the trunnion (10) complete with gaskets.
Check the bushings (8) status.



Only if necessary:
- remove the wiper ring (4), the seal rings (5) and (6), the guide bush (7) and the back-up ring (12) with the O-ring (11) from the king pin (10).
- remove the piston seal (13) and the piston guide ring (14) from the piston (15).



ASSEMBLY AND INSTALLATION

Reassembly follows the disassembly procedure in reverse whilst observing the following:

1. Tighten the piston lock retaining to a torque of 1400 - 1540 Nm.
2. Tighten swing cylinder plate retaining screws to a torque of 607 Nm.

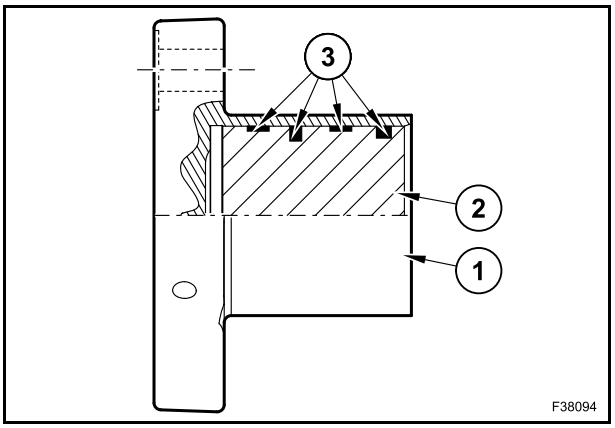
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5.11 BACKHOE ATTACHMENT SIDESHIFT CYLINDER - SIDESHIFT

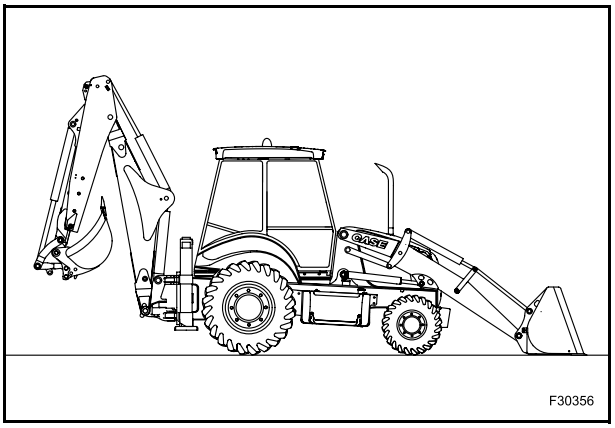
On the loader backhoe there are 4 sideshift lock cylinders for the backhoe attachment. Their function is to lock the carriage once the backhoe attachment is ready in the digging position.
The cylinder consists of:

1. Body
2. Cylinder
3. Seals

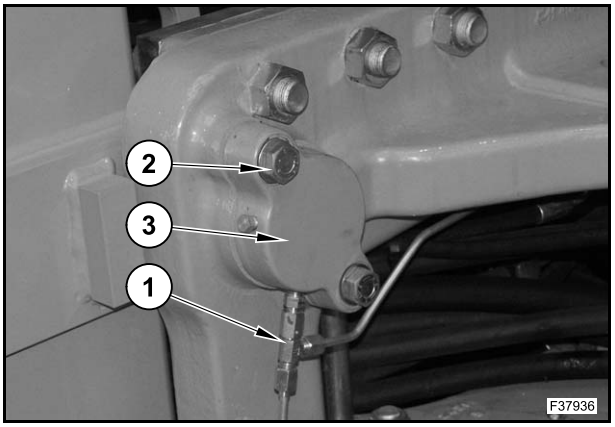


CYLINDER REMOVAL

Park machine on a flat surface and position the bucket on the ground.
Position the backhoe support in the centre of the machine and lower the backhoe on the ground.
Lower the stabilizers to the ground.
Relieve the residual pressure in the system by moving the control levers through all operating positions.



Disconnect the line (1).
Loosen and remove the two screws (2). Now it is possible to remove the whole cylinder (3).



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5.12 SPECIAL TOOLS

P/N CNH	DESCRIPTION	APPLICATION
380000721	Wrench	Telescopic dipper cylinder head Stabilizer cylinder head (sideshift)
380000722	Wrench	Loader bucket cylinder head
380000724	Wrench	Backhoe boom cylinder head Backhoe dipper cylinder head
380000725	Wrench	Backhoe bucket cylinder head Swing cylinder head Loader cylinder head
380000726	Wrench	Stabilizer cylinder head (center pivot)

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6. HYDRAULIC CONTROL LEVERS

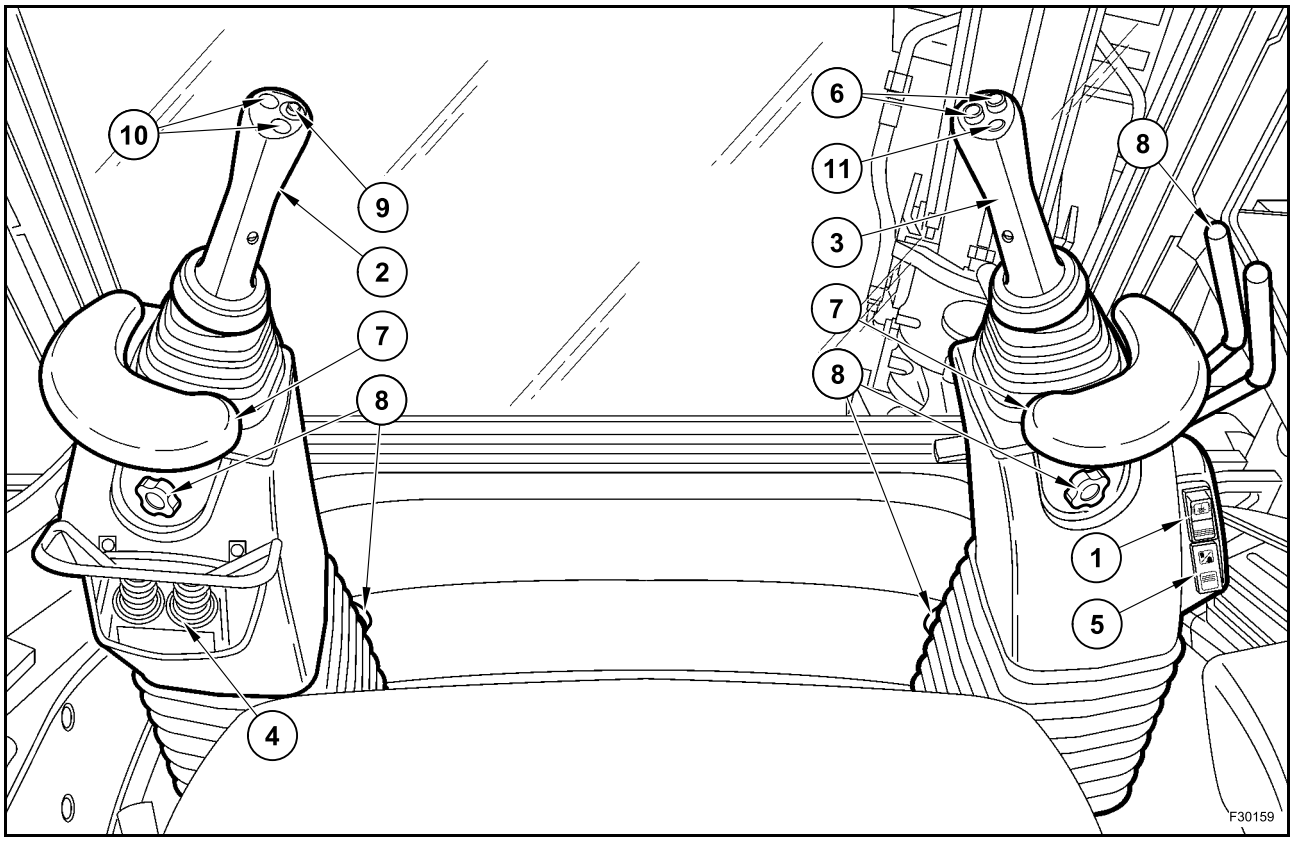
6.1 SPECIFICATIONS

Weight	5.1 ÷ 5.3 kg
Spool stroke	7.55 mm
SPECIAL TORQUE SETTINGS	
Maximum permissible on the hydraulic control lever	80 Nm
Control block retaining screw	30 Nm
Control block universal joint	50 Nm
Control block nut	40 Nm
Lower body screw	50 Nm

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6.2 DESCRIPTION AND OPERATION



1. CONTROL CANCELLATION SWITCH: with this switch in the ON (alight) position, all the backhoe attachment hydraulic controls are functional.
2. LEFT-HAND HYDRAULIC CONTROL LEVER: the left-hand hydraulic control lever controls attachment swing and the boom or the dipper (depending on the control pattern adopted).
3. RIGHT-HAND HYDRAULIC CONTROL LEVER: the right-hand hydraulic control lever controls the bucket and the boom or the dipper (depending on the control pattern adopted).

NOTE: the operating speed depends on the angle of movement of the control levers. In intermediate position, two movements may be obtained simultaneously.

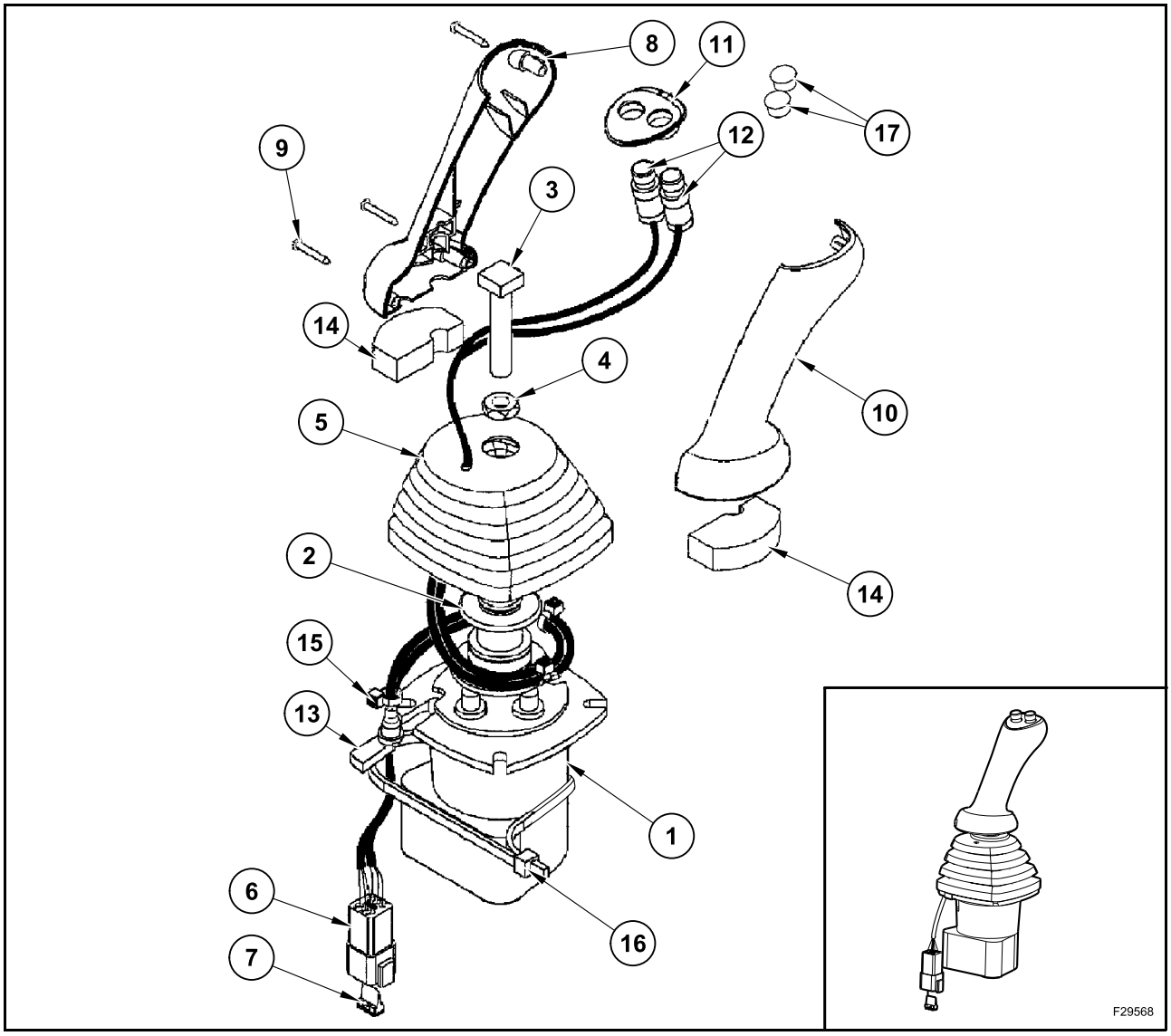
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4. STABILIZER CONTROLS: the right-hand control is for the right-hand stabilizer and the left-hand control is for the left-hand stabilizer.
5. CONTROL PATTERN CHANGE SWITCH: this switch is used for changing the standard control pattern to the ISO pattern.
6. TELESCOPIC DIPPER CONTROLS: (proportional controls) (If fitted).
   Press the right-hand button to extend the telescopic dipper.
   Press the left-hand button to retract the telescopic dipper.
7. WRIST RESTS: the wrist rests may be adjusted to the required height.
8. HYDRAULIC CONTROL ARM TILT ADJUSTMENT: these controls are used for the fore/aft and left/right adjustment of the arm.
9. WARNING HORN BUTTON: press the tip of the left-hand hydraulic control lever to sound the horn (momentary action).
10. CONTROLS OF AUXILIARY BIDIRECTIONAL SECTION (If fitted): proportional buttons for the activation of the additional attachment.
11. DECELERATOR BUTTON:
    By pressing this button the engine rpm sets to idle run. During this phase, the accelerator knob and pedal are disabled.
    By pressing the button again, the engine rpm is restored and the accelerator knob and pedal are functional again.

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RIGHT HAND HYDRAULIC CONTROL LEVER

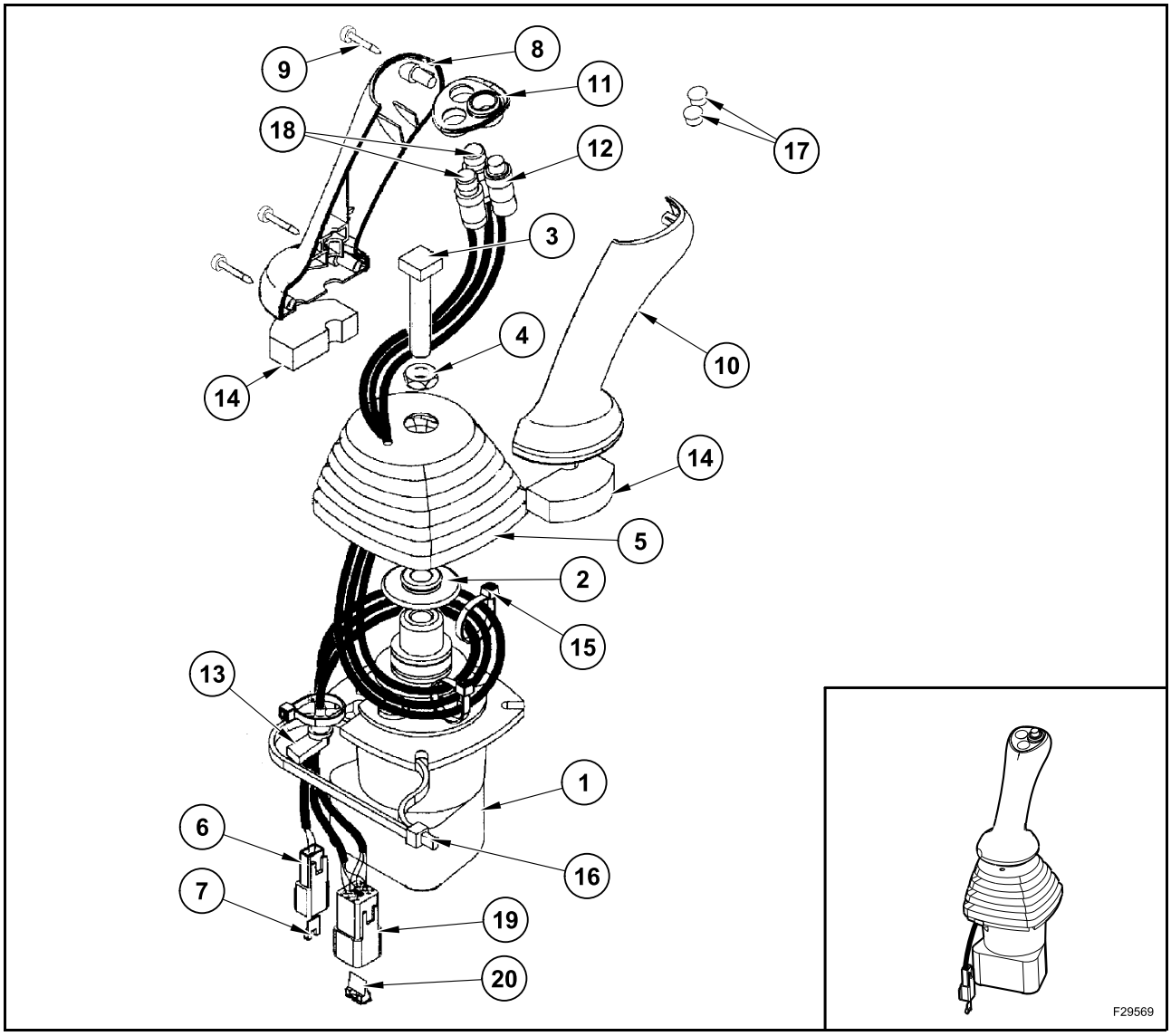


1. Valve
2. Plate
3. Screw
4. Nut
5. Boot
6. Connector
7. Wedge
8. Half handle
9. Screw
10. Half handle
11. Cover
12. Switches
13. Washer
14. Spacer
15. Clip
16. Clip
17. Plugs [if the switches (12) are not fitted]

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LEFT HAND CONTROL LEVER



1. Valve
2. Plate
3. Screw
4. Nut
5. Boot
6. Connector
7. Wedge
8. Half handle
9. Screw
10. Half handle
11. Cover
12. Switch push button (horn)
13. Washer
14. Spacer
15. Clip
16. Clip
17. Plugs [if the switches (18) are not fitted]
18. Switch push buttons (aux bi-dir)
19. Connector
20. Wedge

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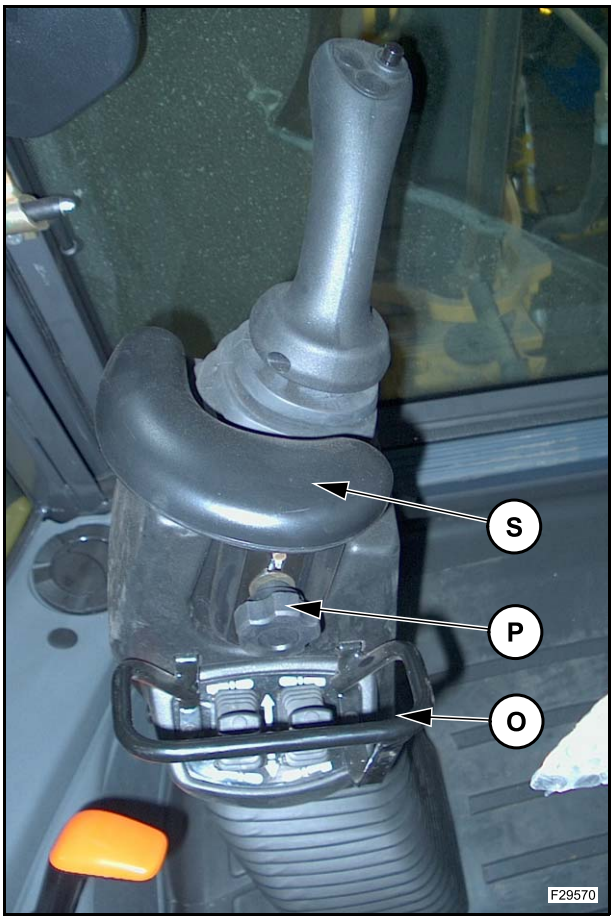
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6.3 DISASSEMBLY AND ASSEMBLY

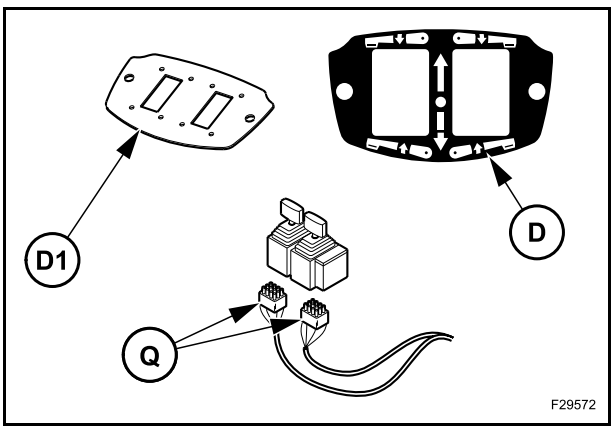
Disassembly

Release pressure in the hydraulic circuits using the following procedure: turn the starter switch key to ON but do not start the engine. Turn pilot control cancellation switch to the ON position. Move both joysticks in all directions. Turn the starter switch key to OFF. Disconnect the negative battery cables.

- Mark the position of the lever parts (see the exploded view on previous pages).
- Remove the knob (P) and the support (S).
- Remove the bracket (O) with the relevant screws (with left hydraulic control lever).



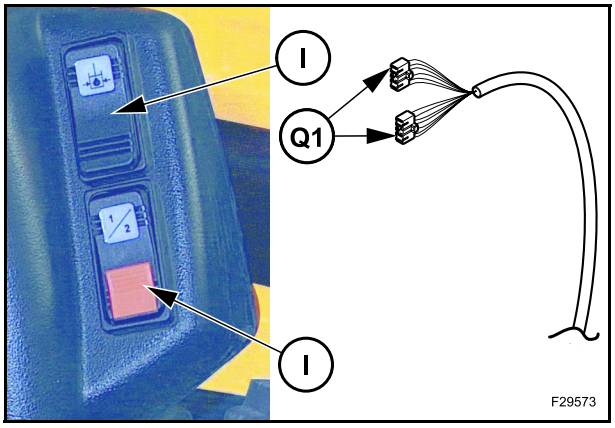
- Remove the decal (D), the mounting plate (D1) and the detach the connectors (Q) (with left hydraulic control lever).



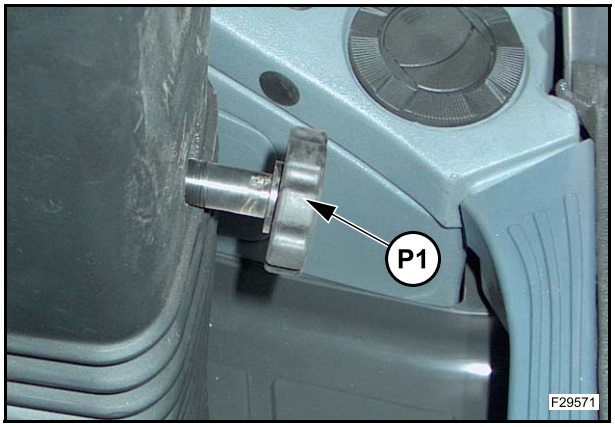
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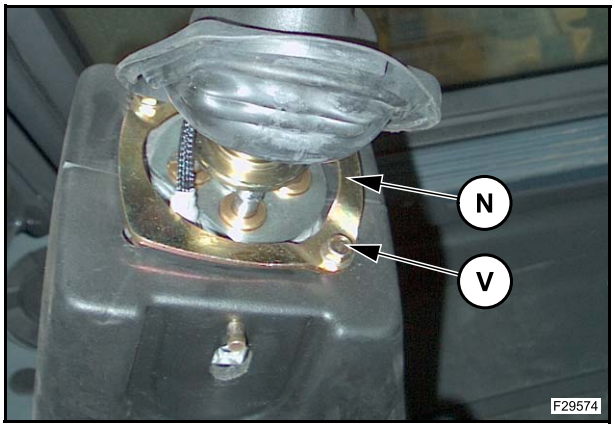
• Pull out both switches (I) and the detach relevant connectors (Q1) (with right control lever).



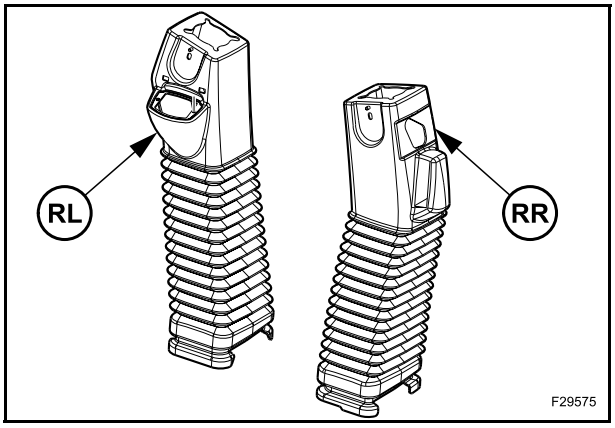
• Remove the knob (P1) in the rear section of control lever.



• Remove the screws (V) and the plate (N).



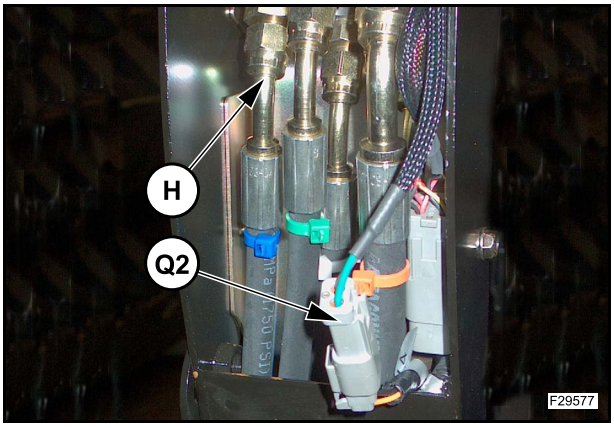
• Lift the rubber boot (RL) for left control lever and the rubber boot (RR) for right control lever.



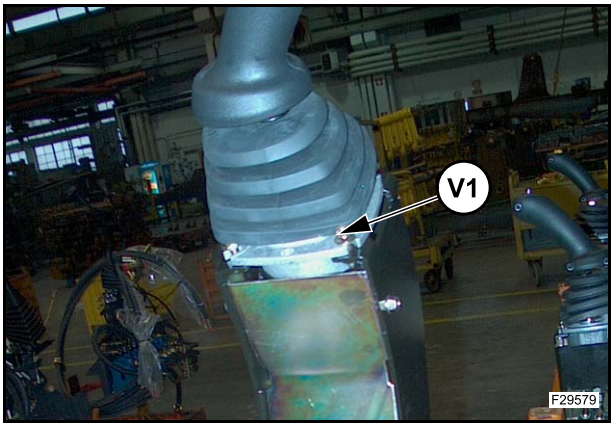
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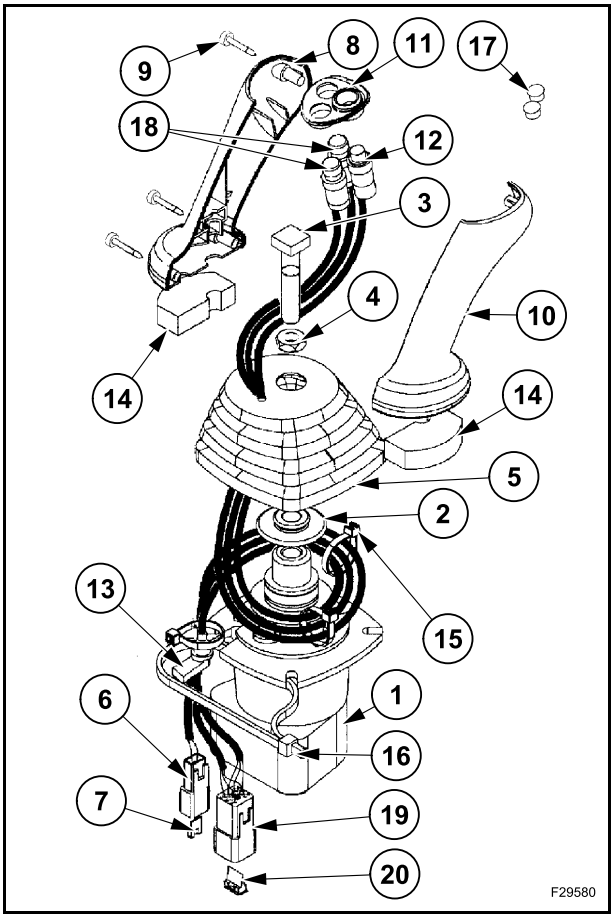
- Tag all hydraulic hoses before disconnecting them. Disconnect all hoses (H).
- Disconnect all connectors (Q2).



- Remove the screws (V1) and take out control lever from the column.



- Remove the screws (9). Separate the half handles (8) and (10). Remove the cap (11). Unscrews the nut (4) and remove the screw (3). Remove the spacers (14). Remove the boots (5). Remove the plate (2).



Reassembly

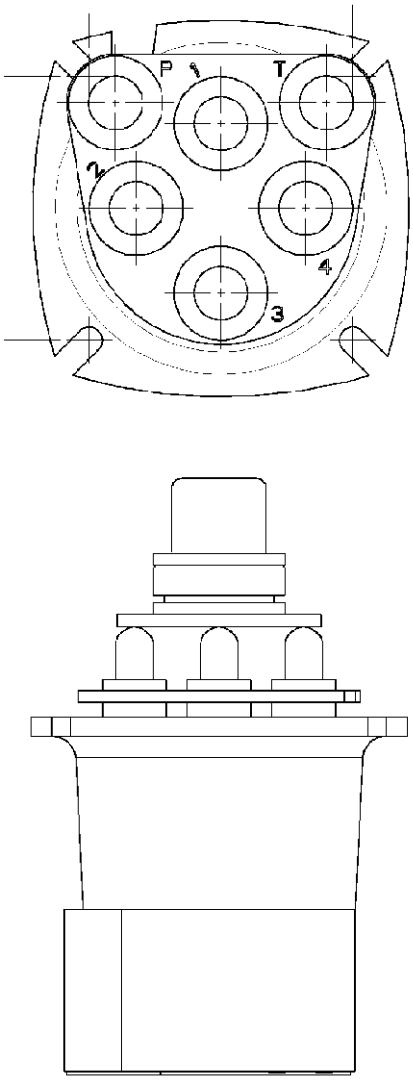
To reassemble the control levers, proceed in the reverse order to that of removal.

Follow the marks made during disassembly, and tighten the nut (4) to a torque of 36 to 44 Nm.

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6.4 CONTROL LEVER VALVE



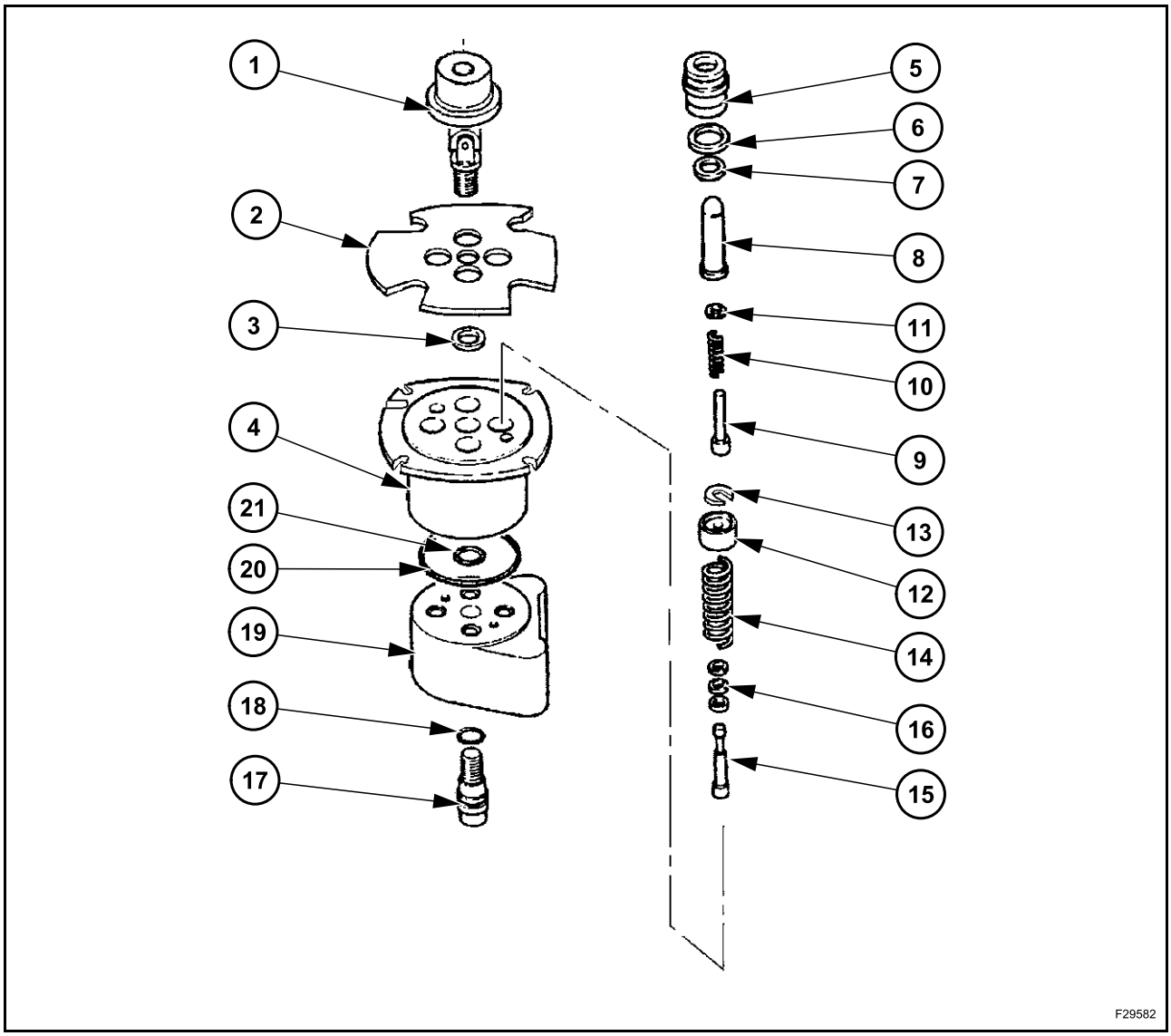
P. Supply
T. Return to tank

Right valve (dipper/bucket)
1. Retracting the dipper
2. Opening the backhoe bucket
3. Extending the dipper
4. Closing the backhoe bucket

Left valve (backhoe/swing)
1. Lifting
2. Right swinging
3. Lowering
4. Left swinging

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1. Universal joint cam
2. Plate
3. Shim
4. Upper body
5. Rod guide
6. Ring seal
7. Ring seal
8. Rod
9. Spring guide
10. Spring
11. Shim
12. Cover
13. Safety ring
14. Spring
15. Spool
16. Shims
17. Valve
18. O-ring
19. Lower body
20. O-ring
21. O-ring

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HYDRAULIC CONTROL LEVER VALVE OVERHAUL

Disassembly

1. Mark the direction of installation of all disassembled parts.
2. Remove the U/J cam (1) using a key.
3. Remove the plate (2).
4. Remove the shim (3) from the upper body (4).
5. Extract the rod guide (5) and replace the seal rings (6) and (7).
6. Drift the rod (8) out.
7. Remove the spring guide (9), the spring (10) and the shims (11).
8. Extract the spool assembly.
9. Hold the cover (12) and remove the safety ring (13).
10. Remove the spring (14) and the spool (15).
11. Remove and note the thickness of the shims (16).
12. Proceed in the same manner for the other rods.
13. Secure the upper body (4) in a vice.
14. Loosen and remove the screw (17) using a key and replace the O-ring (18).
15. Separate the upper (4) and lower (19) bodies and replace the seal rings (20) and (21).

Reassembly

1. To reassemble, proceed in the reverse order to that of removal.
2. In the case of reassembly without changing the U/J cam (1), put the same value of shims (3) as those in place.
3. After changing the U/J cam (1) adjust the pressure of the cam on the rods.
4. Install a 2 mm shim (3), check that the recessing of the push-rods is less than 0.2 mm, modify the shimming to more or less if required.
5. Assemble the new seal rings (6), (7) and O-rings (18), (20) and (21).
6. Lubricate the moving parts.
7. Apply brake thread fluid on the threads of the U/J cam (1) and the screw (17).
8. Tighten the cam (1) to 50 Nm and the screw (17) to 50 Nm.

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7. FAULT FINDING

7.1 PRELIMINARY CHECKS

If fault finding, pressure and flow testing is carried out in a systematic manner and the results analyzed, the malfunction can be readily and accurately identified. If short-cuts, assumptions and guesses are made, unnecessary component disassembly or replacement could result. Follow the step-by-step procedures outlined below.

As a first step in the fault finding procedure, several preliminary checks should be made. These checks are important because, once they have been performed, they need no longer be considered as a possible cause of the immediate or reported malfunction.

- Check that the hydraulic oil is at the correct level and of the correct specification.
- Check the loader, backhoe or any additional accessory such as hydraulic bucket, hammers etc., for correct assembly or installation and additionally for signs of external damage that might cause gross misalignment of structural members.
- Check in more detail for other mechanical damage such as kinked, twisted, worn or decayed hoses, damaged cylinders and bent elements.
- Do not forget to check underneath the unit for damaged steel tubes, particularly if the unit has been known to have operated in arduous conditions, been grounded, or bogged down.
- Ensure optimum operating temperature of the hydraulic oil is achieved.
- Perform the system pressure and rear pump relief valve pressure tests.

The above-described preliminary checks assume that the failure is not linked to the engine performance. Having performed these checks and failed to locate the cause of the malfunction, the following procedures should be adopted:

- If possible, operate the backhoe and make notes of the operating characteristics. Cycle each control lever to operate each of the cylinders to the fully extended and retracted positions.
- Compare the operating characteristics in the preceding stage with the malfunctions listed hereunder.

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7.2 FAULT FINDING

GENERAL

PROBLEM	CAUSE	CORRECTION
All systems fail to operate	Pump drive inoperative	Check and repair as necessary.
	Low oil level	Check and top up.
	Restricted pump suction line	Inspect the suction line and the tank and repair as necessary.
Slow operation or loss of power in all circuits	Worn pump	Perform pump performance test and replace/reseal as necessary.
	Restricted pump suction line	Inspect the suction line and the tank and repair as necessary.
	Load sense pressure relief valve incorrectly adjusted	Make a system pressure test.
	Hydraulic speed solenoid valve inoperative	Make a system pressure test.

LOADER

PROBLEM	CAUSE	CORRECTION
The lifting system fails to operate, is slow or loses power	Valve spool leakage	Examine lift section of loader control valve assembly for wear or scoring.
	Piston seals leaking or cylinder barrel damaged	Examine/reseal piston and gland.
Bucket fails to operate, is slow or has loss of power	The relief valves are stuck open, set to a too low value or there is a leak in the seat	Check the bucket system relief valve.
	Valve spool leakage	Examine bucket section of loader control valve assembly for wear or scoring.
	Piston seals leaking or cylinder barrel damage	Examine/reseal piston and gland.
Cylinder leak (spools in neutral)	Damaged piston barrel	Examine/reseal piston and gland.
	Internal valve leakage	Examine appropriate valve section of loader control valve assembly for wear or scoring.
Hesitation in the raising movement of the loader attachment or of the bucket cylinders when the control is initially actuated	Load check valve between control valve sections damaged	Disassemble and inspect.

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BACKHOE

Refer to the following backhoe fault finding chart after first considering the preceding charts. This chart should only be referred to if the supply system is operating normally, thereby confirming that the hydraulic supply systems and the pump are correctly operating. See also “Fault finding hydraulic pump”.

PROBLEM	CAUSE	CORRECTION
The lifting system is inoperative, is too slow, loses power or does not hold	Lifting system relief valve stuck open, set too low or seat leaking Valve spool leakage Piston seals leaking or cylinder barrel damaged	Test the pressure of the lifting system relief valve. Examine lift section of backhoe control valve assembly for wear and scoring. Examine/reseal piston and gland.
The digging control fails to operate, is slow or loses power	Digging system relief valve (piston end) stuck open, set too low or seat leaking Valve spool leakage Piston seals leaking or cylinder barrel damaged	Test the pressure of the digging system relief valve. Examine digging section of backhoe control valve assembly for wear and scoring. Examine/reseal piston and gland.
The digging control fails to operate, is slow or loses power	Bucket circuit relief valve (rod end) stuck open, set too low, or seat is leaking Valve spool leakage Piston seals leaking or cylinder barrel damaged	Test the pressure of the bucket relief valve. Examine bucket section of backhoe control valve assembly for wear and scoring. Examine/reseal piston and gland.
The telescopic dipper fails to operate, is slow or loses power	The telescopic dipper system relief valve (piston end) is stuck open, set to a too low value or there is a leak in the seat Valve spool leakage Piston seals leaking or cylinder barrel damaged	Test the pressure of the telescopic dipper relief valve. Examine telescopic dipper section of backhoe control valve assembly for wear and scoring. Examine/reseal piston and gland.
Stabilizer pads leaking	Stabilizer safety valve leaking Piston seals leaking or cylinder barrel damaged	Inspect and overhaul the stabilizer safety valve. Examine/reseal piston and gland.

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SWING

PROBLEM	CAUSE	CORRECTION
Right or left direction swing fails to operate, is slow, or has loss of power	Swing system relief valves not seating, set too low or seat leaking	Test the swing system relief valve.
	Valve spool leakage	Examine swing section of backhoe control valve assembly for wear or scoring.
	Piston seals leaking or cylinder barrel damaged	Examine/reseal piston and gland.
The swing fails to slow down (bearing stop) at stroke end	Integral sliding restrictor damaged	Disassemble and inspect.
	Piston seals leaking or cylinder barrel damage	Examine/reseal piston and gland.
The swing does not stop when the control lever returns to neutral (one direction only)	The system relief valve (return side) is stuck open, set to a too low value or there is a leak in the seat	Test the swing system relief valve.
	Valve spool leakage	Examine swing section of backhoe control valve assembly for wear or scoring.
Cylinder leak (spools in neutral)	Internal valve leakage	Examine appropriate valve section of backhoe control valve assembly for wear or scoring.
	Piston seals leaking or cylinder barrel damaged	Examine/reseal piston and gland.
A system temporarily lowers when given the control to lift	Load check valve between control valve sections damaged	Disassemble and inspect.

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HYDRAULIC PUMP

PROBLEM	CAUSE	CORRECTION
System noisy	Worn or damaged pump gears or pressure plates	Make a hydraulic pump performance test.
	Aeration: air entering the systems at: suction tube, pump shaft, fittings or cylinder ring nuts	Make a hydraulic pump performance test.
	Cavitation: restrictions in the system at the suction line or at the suction screen in the tank	Make a visual check and/or a hydraulic pump performance test.
	Water in the system	Visual check.
	The system relief valve vibrates	Check system relief valve, adjust/ overhaul as necessary.
	Vibrations in the lines	Visual check.
	Cold hydraulic oil	Check the hydraulic oil operating temperature.
	Wrong type oil being used	Investigate/drain and top up.
Hydraulic oil drain through tank breather	Tank overfilled	Check the hydraulic oil level.
	Aeration: air entering the system at: suction tube, pump shaft, fittings or cylinder ring nuts	Make a hydraulic pump performance test.
	Cavitation: Restriction of the suction filter in the tank	Make a visual check and/or a hydraulic pump performance test.
Oil heating	Oil supply low	Fill the tank.
	Contaminated oil	Drain the tank and refill with clean oil.
	Setting of relief valve too high or too low	Drain the tank and refill with clean oil. Test relief valves.
	Oil in system too light	Drain the tank and refill with oil with the correct viscosity.
	Oil cooler fins blocked	Clean the oil cooler.
Shaft seal oil leakage	Worn shaft seal	Replace shaft seal and inspect pump.
Foaming oil	Low oil level	Fill the tank.
	Air in the suction system	Check/tighten suction line.
	Wrong oil type	Drain and refill with correct oil.

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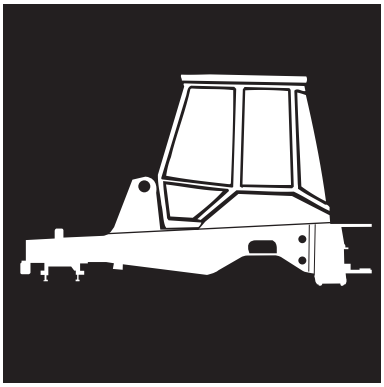
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SECTION 39 - CHASSIS

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1. DESCRIPTION AND OPERATION

This section can be used as a quick reference for general disassembly of the machine and its components.

The chassis of the Backhoe Loader is manufactured as a one piece unit on which the major assemblies are attached or supported from.
The chassis are mainly of two kinds and differ from one other according to the kind of backhoe attachment that the backhoe loader should carry:

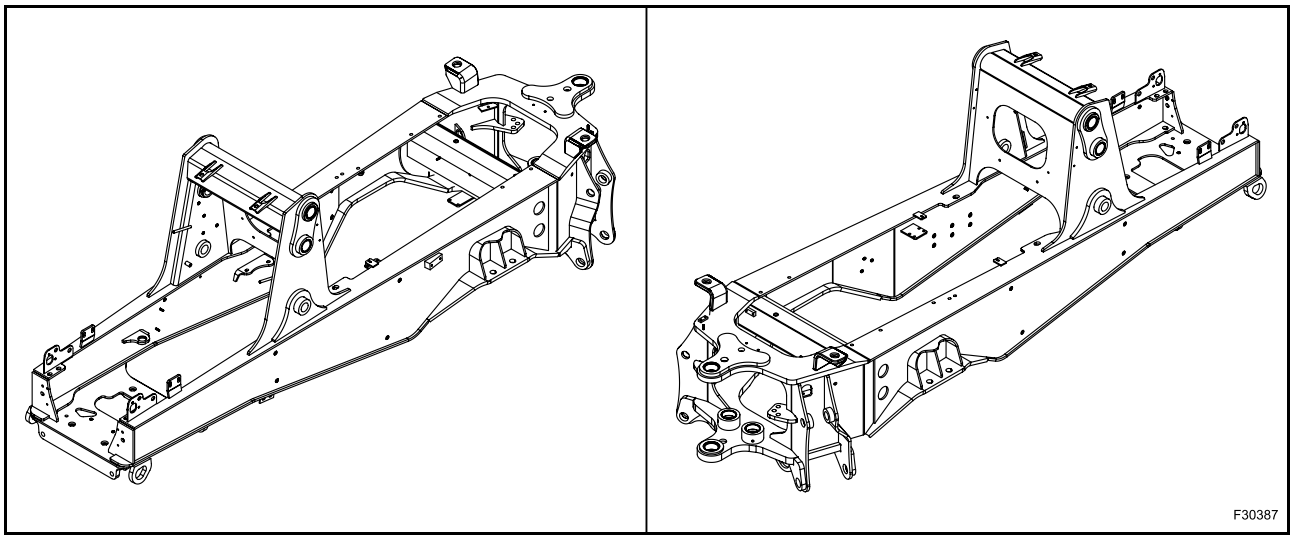
- Center pivot: means that the backhoe is connected directly to the chassis and cannot shift laterally (only for 4WS).
- Sideshift: means that the backhoe is installed on the side shift support and can shift laterally on the chassis guides.

The chassis change according to the machine steering (2WS or 4WS) because of the different wheel shape; or because the machine can be equipped either with “straight” loader arm (2WS machines) or with “bent” loader arm (4WS machines).

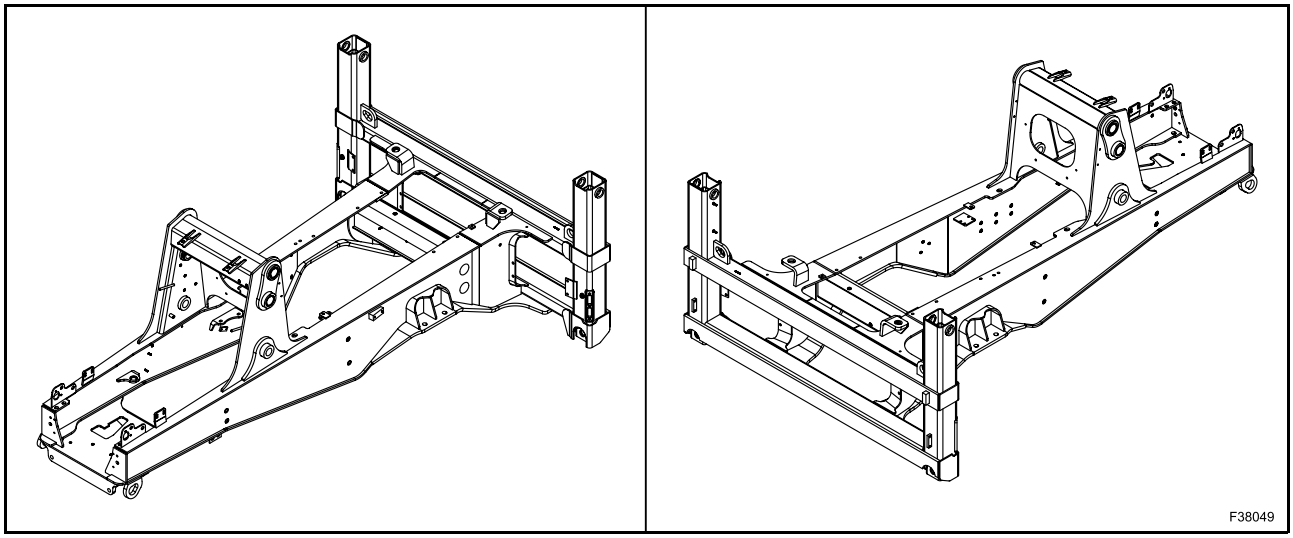
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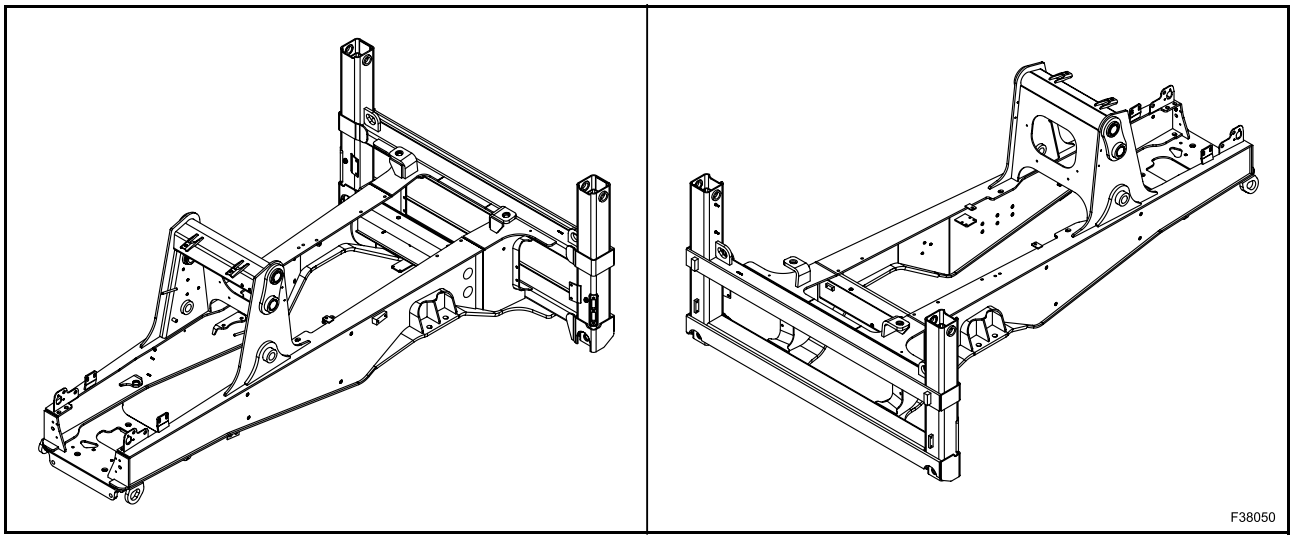
CENTER PIVOT 4WS CHASSIS



SIDESHIFT 2WS CHASSIS



SIDESHIFT 4WS CHASSIS

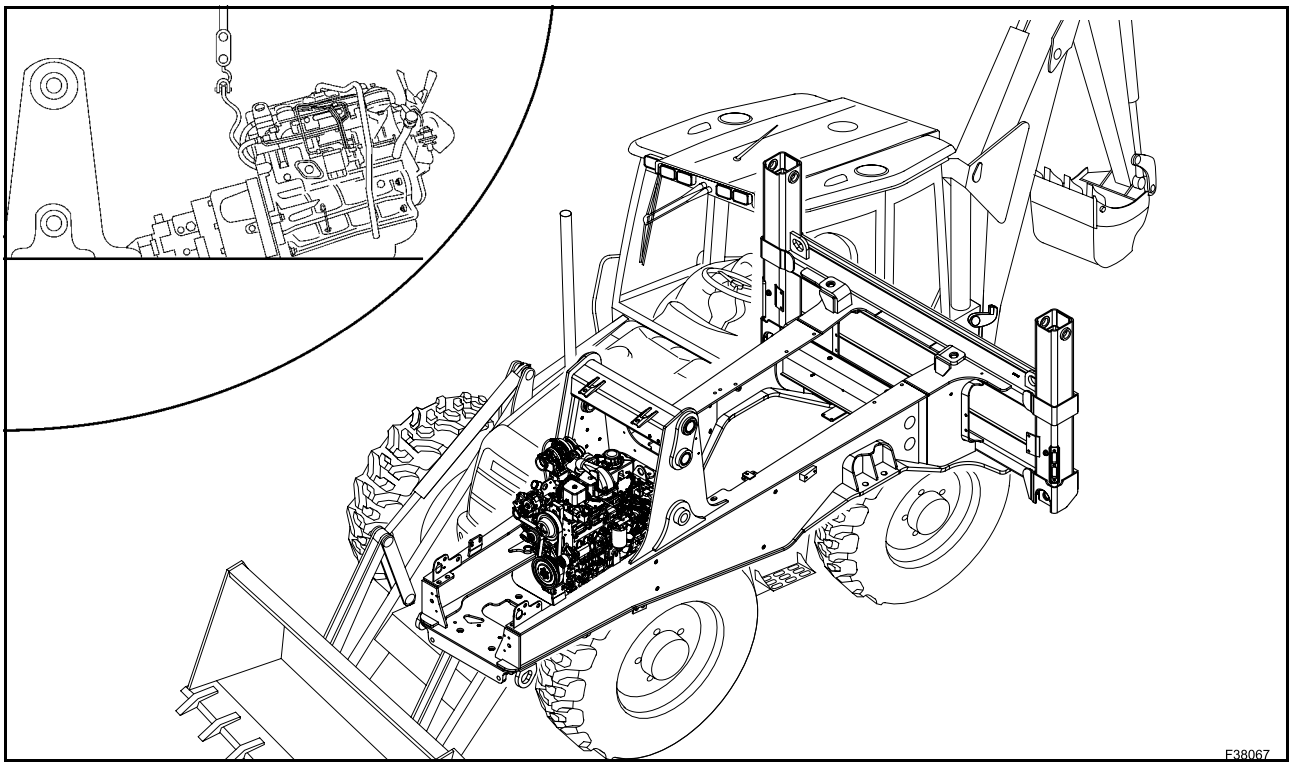


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2. REMOVAL AND INSTALLATION COMPONENTS

2.1 COMPONENTS WITHIN THE CHASSIS



ENGINE

Supported by 2 rubber silent blocks and held in position by 2 support brackets. The brackets, which are welded to the frame one either side of the engine are positioned just ahead of the loader posts.

⚠ WARNING

The engine and transmission bolted together act as a one piece unit. If separated in the machine they are not self supporting and will collapse causing injury or damage to the machine.

TORQUE CONVERTER

Fitted between the engine and the transmission can only be removed when the engine/transmission assembly are separated.

TRANSMISSION

Attached to the rear of the engine and supported in rubber silent blocks in fixed brackets and held within the frame just at the rear of the loader post.
To make repairs that require disassembly of the transmission or engine it will be necessary to remove the engine/transmission as a complete unit from the chassis.

To remove the engine/transmission from the machine it will be necessary to remove or disconnect the following:

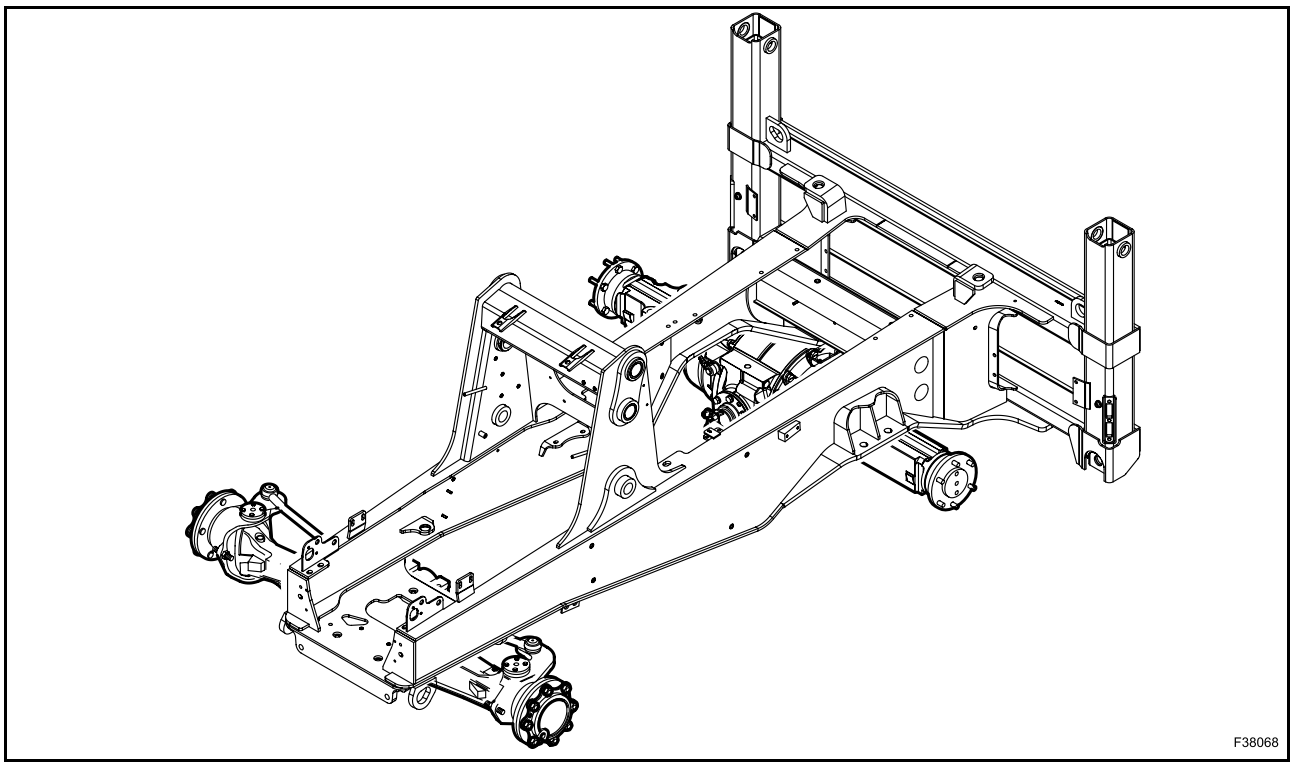
Remove:
Air filter
Engine guard
Radiator's and related hoses (Or pivot forward where possible)
Front support cowling (if required)

Disconnect:
Fuel pump throttle cable and electric shut off
Engine harness
Fuel tank connection and leak off return pipes
Hydraulic pump and related pipework (plug all ports as required)
Transmission Lever
Transmission harness connectors
Engine supports (with engine supported by hoist)
Transmission supports

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2.2 COMPONENTS BELOW THE CHASSIS



FRONT AXLE

The front axle is attached to the underside of the chassis by 6 through screws (2WS) or 4 through screws (4WS).
To remove front axle from the machine:
- Park the machine on a level ground.
- Stop the engine, remove the key and relieve any residual pressure in the backhoe and loader attachment systems by moving the loader and backhoe attachment control levers through all operating position.
- Lower the stabilizers to the ground.
- Lower the loader bucket on the ground.
- Using the loader bucket raise the front of the machine, high enough to remove the front wheels.
- Place stands under the chassis, supporting appropriately the machine.
  Place under the axle the appropriate supporting/removing tool.
- Remove the nuts on the wheels and then remove them.
- Disconnect the steering cylinder hoses.
- Remove the axle swivel pin attaching bolts (4WD).
- Disconnect the spider coupling (4WD).
- Remove the axle bolts.
- Remove the front axle.

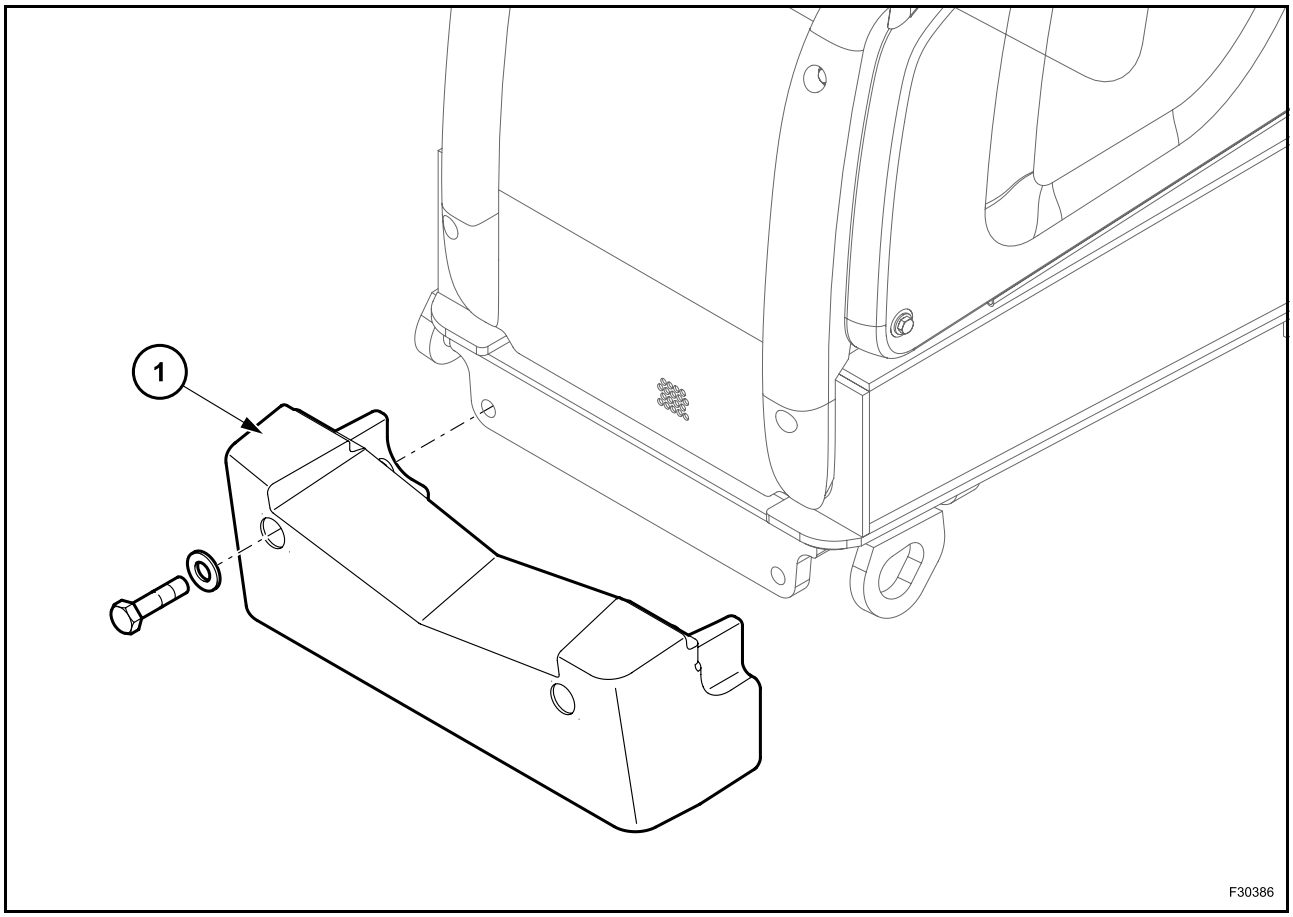
REAR AXLE

The rear axle is attached to the frame at the rear of the machine by 4 through bolts.
To remove rear axle from the machine:
- Park the machine on a level ground.
  Stop the engine, remove the key and relieve any residual pressure in the backhoe and loader attachment systems by moving the loader and backhoe attachment control levers through all operating position.
- Lower the stabilizers to the ground.
- Lower the loader bucket on the ground.
- Using the stabilizers, raise the rear of the machine, high enough to remove the rear wheels.
- Place stands under the chassis, supporting appropriately the machine.
- Remove the nuts on the wheels and then remove them.
- Disconnect the steering cylinder hoses (4WS).
- Disconnect the brake system hoses.
- Disconnect the connector of harness of the differential lock (electrically controlled version).
- Remove axle swivel pin attaching bolts.
- Disconnect spider coupling.
- Remove the axle bolts.
- Remove the rear axle.

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COUNTERWEIGHT

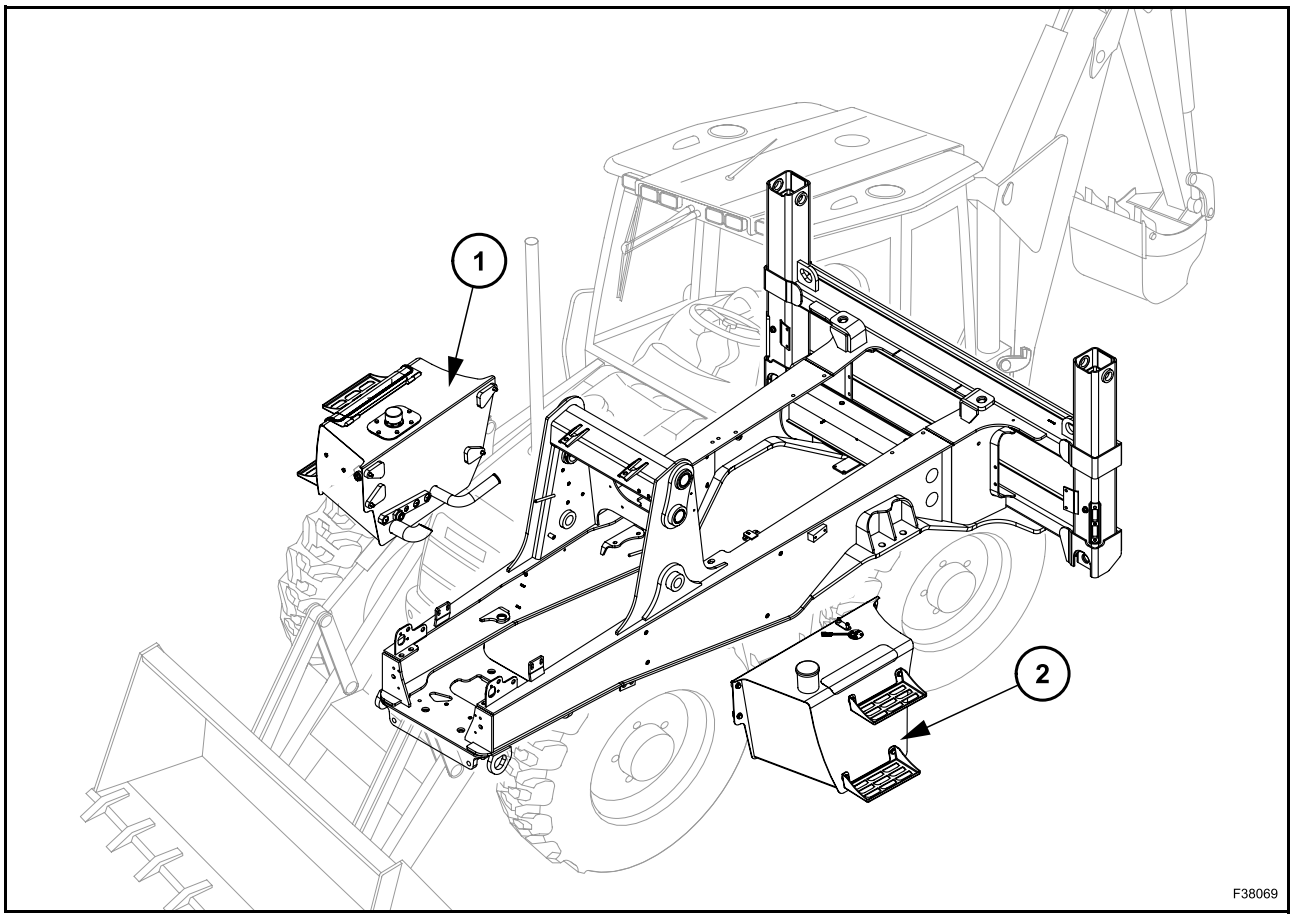


Counterweight: is installed under the chassis in the front section of the machine with two bolts.
The weight of the counterweight (1): 160 kg

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2.3 COMPONENTS ATTACHED OUTSIDE THE CHASSIS



TANKS

Attached to the chassis below the cab are the tanks for hydraulic oil (1) mounted to the right hand side of the machine and the fuel tank (2) mounted to the left hand side of the machine.
Both tanks when drained of their contents can be removed from the machine by removal of the attaching pipe work and supporting bolts.

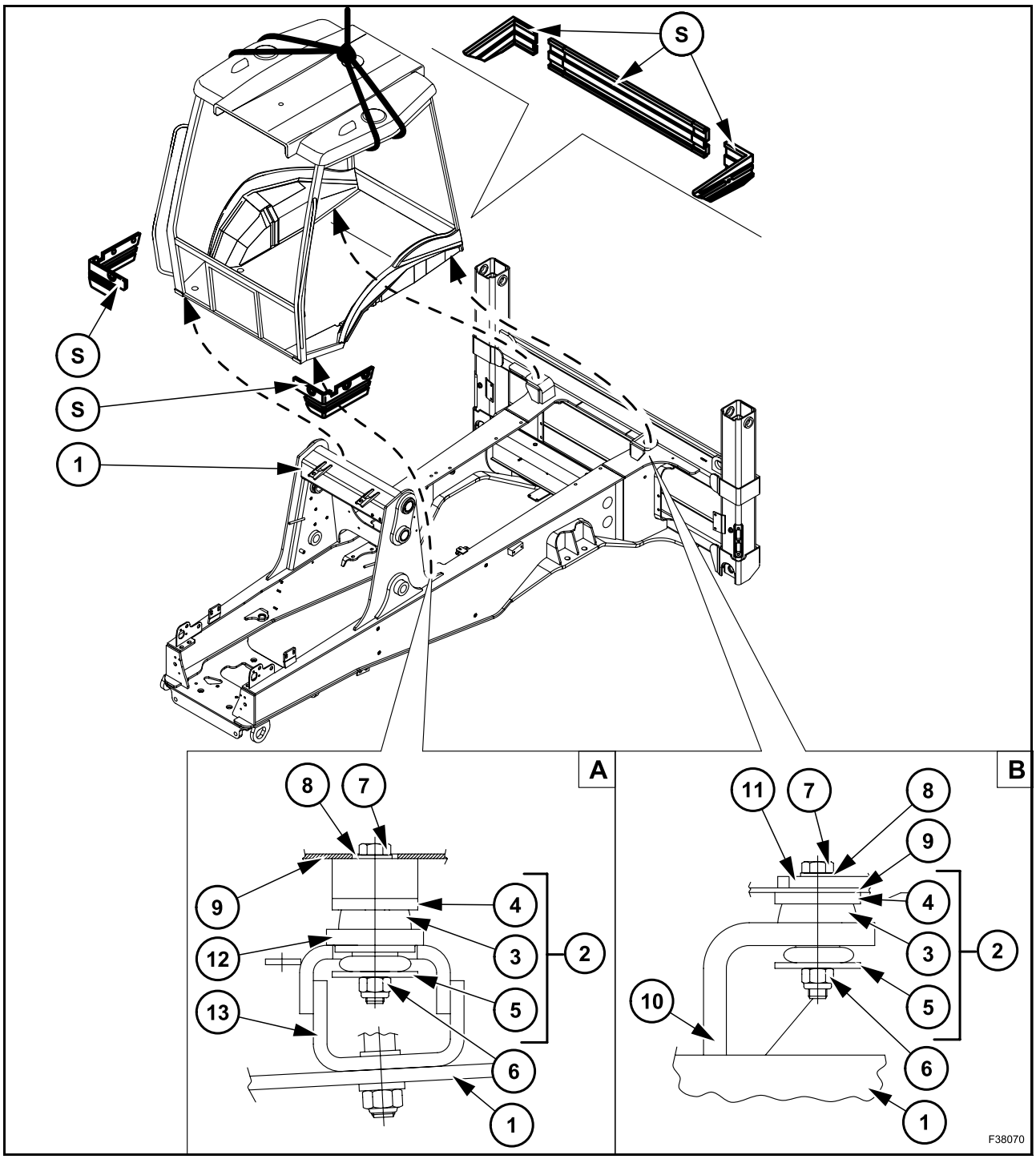
IMPORTANT: ensure all ports and pipes are plugged or blanked off to prevent dirt ingress.

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2.4 COMPONENTS ATTACHED ON THE CHASSIS

CAB



A. Front fixing
B. Rear fixing
S. Cab skirts
1. Main frame
2. Anti-vibration
3. Dampener
4. Washer
5. Washer
6. Nut
7. Retaining screw
8. Washer
9. Cab floor
10. Cab support (rear)
11. Support
12. Bushing
13. Cab support (front)

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The cab frame is a one piece unit mounted on top of the chassis. The mains operations that have to be done in order to remove the cab are:

- Remove the cab skirts (S) all around the cab.
- Disconnect the two electrical connectors from the main harness and engine harness.
- Remove the two front fixing bolts (7) between the cab floor and the cab support (13) (detail A).
- Remove the two rear fixing bolts (7) between the cab floor and the rear supports (10) on the main frame (1) (detail B).
- Disconnect the two steering cylinder hoses (left side).
- Disconnect the pump - power steering valve hose.
- Disconnect the power steering valve - oil tank hose.
- Disconnect the load sensing valve hose.
- Disconnect the stabilizers cables (mechanical version).
- Disconnect the parking brake cable.
- Disconnect the water - heater hoses (after water discharge).
- Disconnect the air conditioning hoses (after refrigerant drain).
- Disconnect the transport lock cable (mechanical version).
- Disconnect the telescopic dipper control pedal (mechanical version).
- Turn the knobs and the boots of the various levers (front and rear)
- Lift the cab with the crane after its anchorage to lifting hook.

IMPORTANT: when lifting the cab ensure the hydraulic brake tanks are not caught and damaged on the loader support frame.

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2.5 MOUNTING SCREW TORQUE

In the following table are the torques for the various assemblies that should be removed to affect repair.

IMPORTANT: always ensure prior to carrying out repairs on the machine that the vehicle parking brake is on and the wheels are chocked.

ENGINE/TRANSMISSION

COMPONENTS	TORQUES
Engine/Transmission retaining bolts and nuts	95 Nm
Engine/Transmission bolts	95 Nm
Retaining bolts air filter-frame	25 Nm
Coolant radiator bolts to frame	95 Nm
Radiator retaining bolts to frame	95 Nm
Front cardan joint to axle	38 Nm
Front cardan joint to transmission	38 Nm
Rear cardan joint to axle	38 Nm
Rear cardan joint to transmission (Powershift)	38 Nm
Rear cardan joint to transmission (Powershuttle)	70 Nm

FRONT AND REAR AXLE

COMPONENTS	TORQUES
Front axle retaining bolts to frame (2WS)	500 Nm
Front axle retaining bolts to frame (4WS)	500 Nm
Rear axle to frame retaining bolts (2WS)	800 Nm
Rear axle to frame retaining bolts (4WS)	900 Nm

HYDRAULIC SYSTEM

COMPONENTS	TORQUES
Power steering hoses to support frame	55 Nm
Backhoe control valve to frame bolts	90 Nm
Loader control pipes clamp to frame	25 Nm

TANKS

COMPONENTS	TORQUES
Oil tank bolts	85 Nm
Fuel tank bolts	85 Nm

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FRONT COUNTERWEIGHT

COMPONENTS	TORQUES
Counterweight	700 Nm

LOADER

COMPONENTS	TORQUES
Loader control pipe bracket to frame	25 Nm

BACKHOE

COMPONENTS	TORQUES
Backhoe to frame hose retaining clamps	52 Nm
Boom to swing support	320 Nm
Stabilizers upper pins retaining bolt	80 Nm
Fastening pin of boom cylinder	320 Nm
Fastening pin of dipper cylinder	320 Nm
Fastening pin of bucket cylinder	320 Nm

CAB

COMPONENTS	TORQUES
Cab support	450 Nm
Front cab retaining bolts	210 Nm
Rear cab retaining bolts	180 Nm

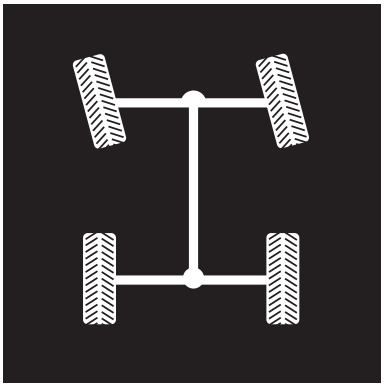
WHEELS

COMPONENTS	TORQUES
Front/rear wheels (4WS)	700 Nm
Front wheel (2WS)	330 Nm

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SECTION 41 - STEERING SYSTEM

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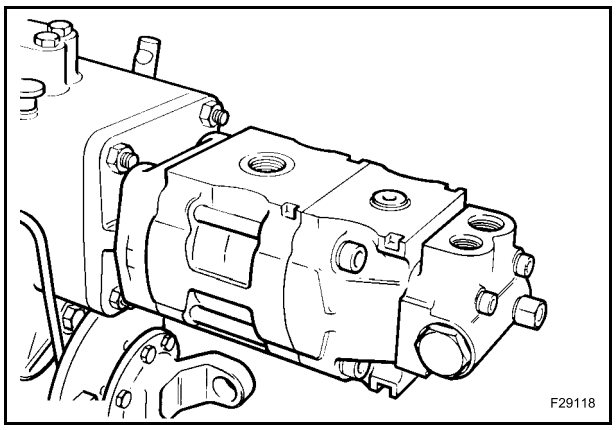
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The steering system shows these features:

- double acting, type steering cylinder on both 2 and 4WD axles;
- common oil tank with the main hydraulic system;
- a tandem gear pump located on the rear of the transmission; both pumps are driven by a shaft running directly off the flywheel.
  Oil is drawn through the common inlet port into both pumping elements.
  The front pump flow is directed to the loader and backhoe control valves and side shift clamping system.
  Rear pump flow passes through the flow divider valve which maintains priority oil flow to the steering system with remaining flow directed for stabilizers, loader and backhoe elements.
  The flow divider, located on the rear of the pump, comprises a load sensing valve and steering system pressure relief valve.
  The valve ensures a priority oil flow to the steering system while the steering is operated, with the remaining flow directed to the stabilizer, loader and backhoe circuits;
- Load sensing power steering.

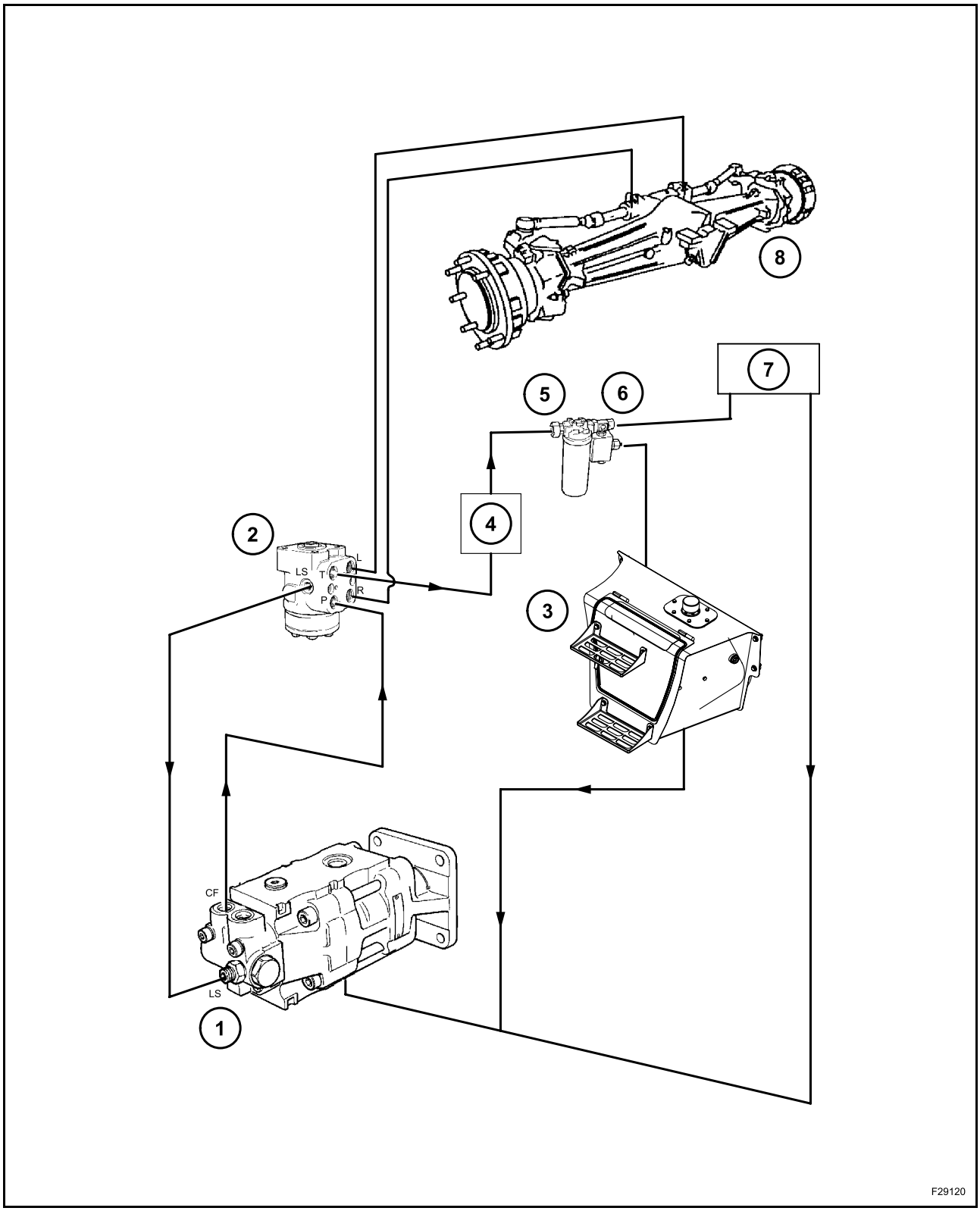


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1. STEERING SYSTEM 2WS

COMPONENTS

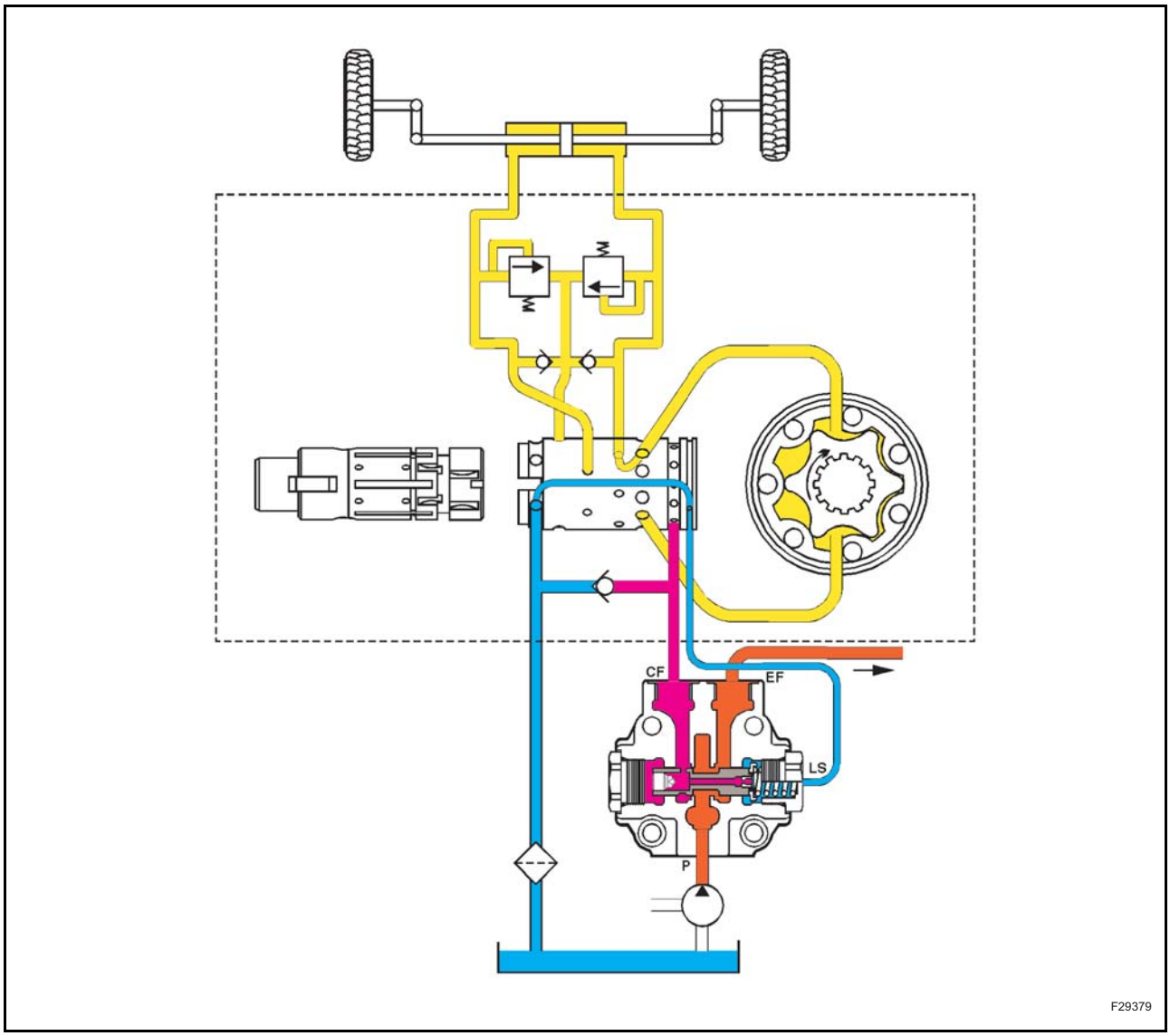


1. Flow divider
2. Power steering
3. Hydraulic tank
4. Return manifold
5. Oil filter
6. By-pass valve
7. Radiator
8. Front axle

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POWER STEERING - NEUTRAL



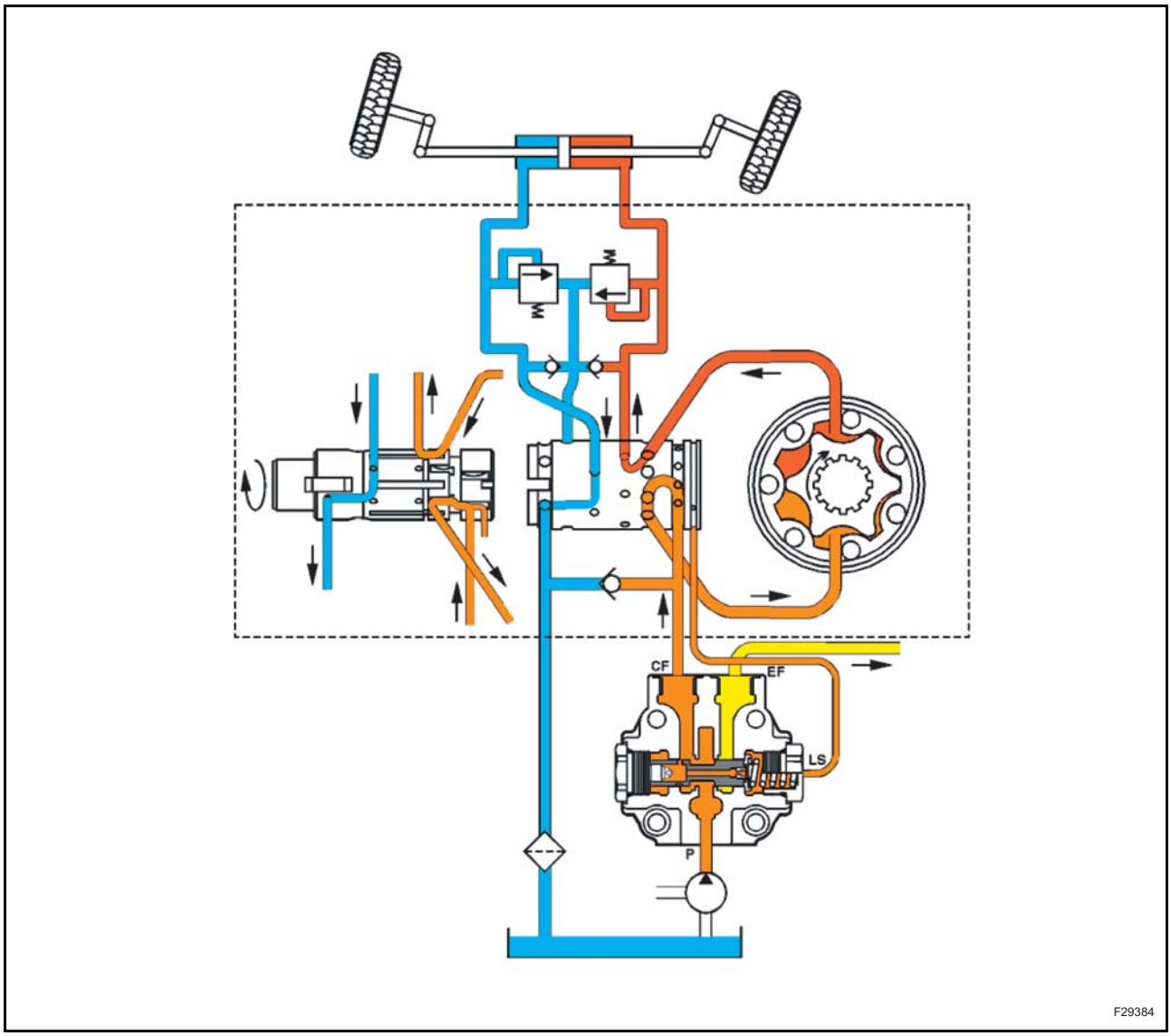
Pump pressure
Stand-by pressure
Trapped oil
Return to oil tank

When the steering wheel is held still, the leaf springs return and hold the power steering spool in the neutral position.
This ensures no more oil is supplied to the steering cylinder. The spool also traps the oil in the steering cylinder and allows oil in the sensing lines to return to tank therefore allowing the priority flow divider to move to the left.

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POWER STEERING - TURNING RIGHT



Pump pressure
Metered pressure
Trapped oil
Return to oil tank

When the steering wheel is turned, the movement of the power steering spool forms a series of passages. During right turn, oil flows through the spool along a groove and into a passage in the housing which leads to the metering unit. A gallery is also lined up to allow pressure oil to flow down the sensing line to the priority flow divider.

As the metering unit is turned by the drive shaft, it directs a measured quantity of oil along another set of passages in the spool then from these to the steering cylinder.

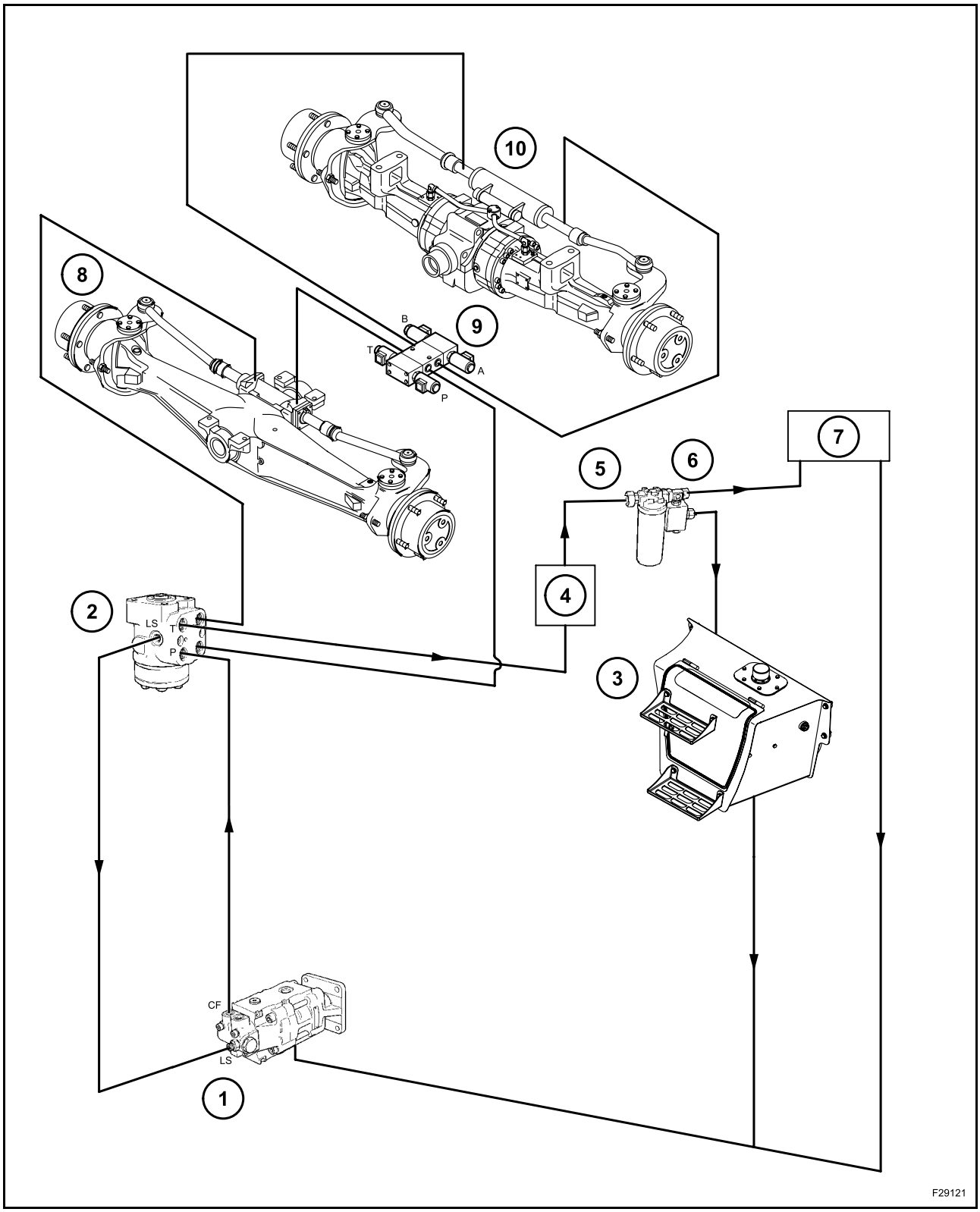
Return oil from the other side of the cylinder is directed through the spool to a return passage in the housing.

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2. STEERING SYSTEM 4WS

COMPONENTS



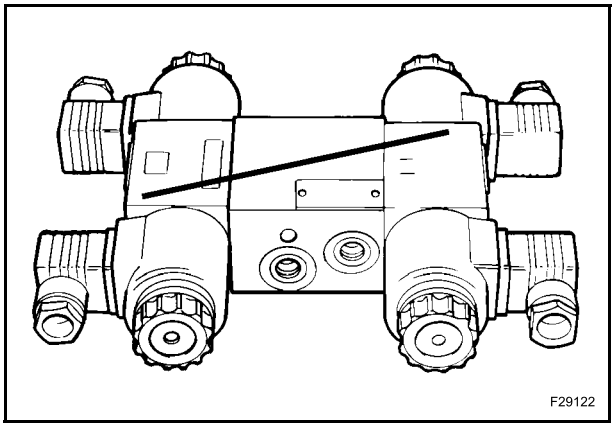
1. Flow divider (hydraulic pump)
2. Power steering
3. Hydraulic tank
4. Return manifold
5. Oil filter
6. By-pass valve
7. Radiator
8. Front axle
9. Steering control valve
10. Rear axle

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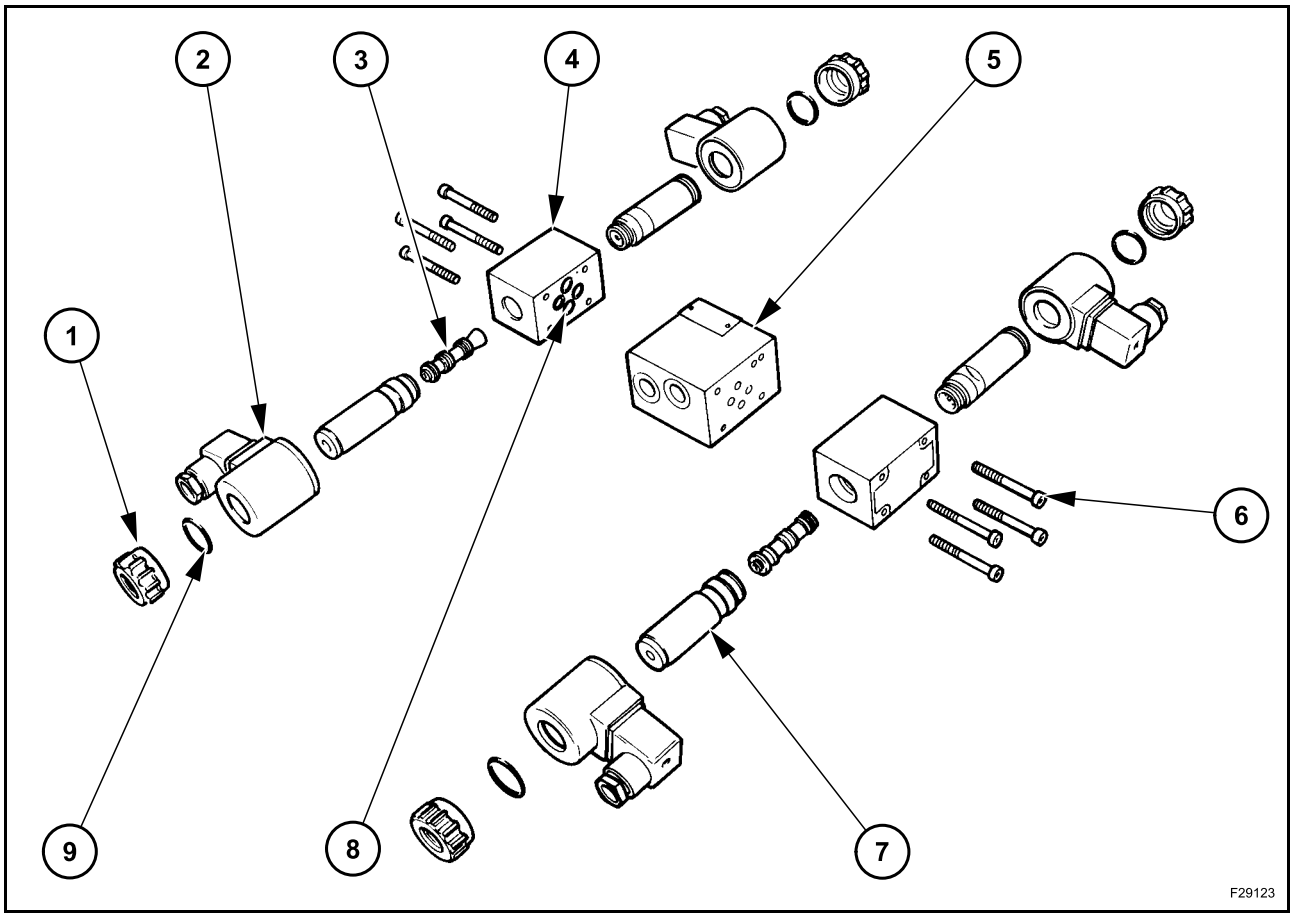
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STEERING CONTROL VALVE

The steering control valve is located just above the rear axle attached to the main chassis.
Remove the four pipes and then the 2 chassis fixing bolts, then withdraw the valve for overhaul.
Draw a diagonal line across the complete valve block this will assist in the correct reassembly later.



The valve consists of a central manifold block which all input and output pipes are attached to. On each side of this block is a solenoid valve. The solenoid valves have two positions: both of these positions are working positions and there is no neutral point.
Each spool is detented and therefore the solenoids are only energized momentarily to move the spool.
On the end of each solenoid is an emergency hand operating pin which moves the control spool without energizing the solenoid. The switching of the steering valve is normally controlled by a microprocessor located underneath the right hand side console.

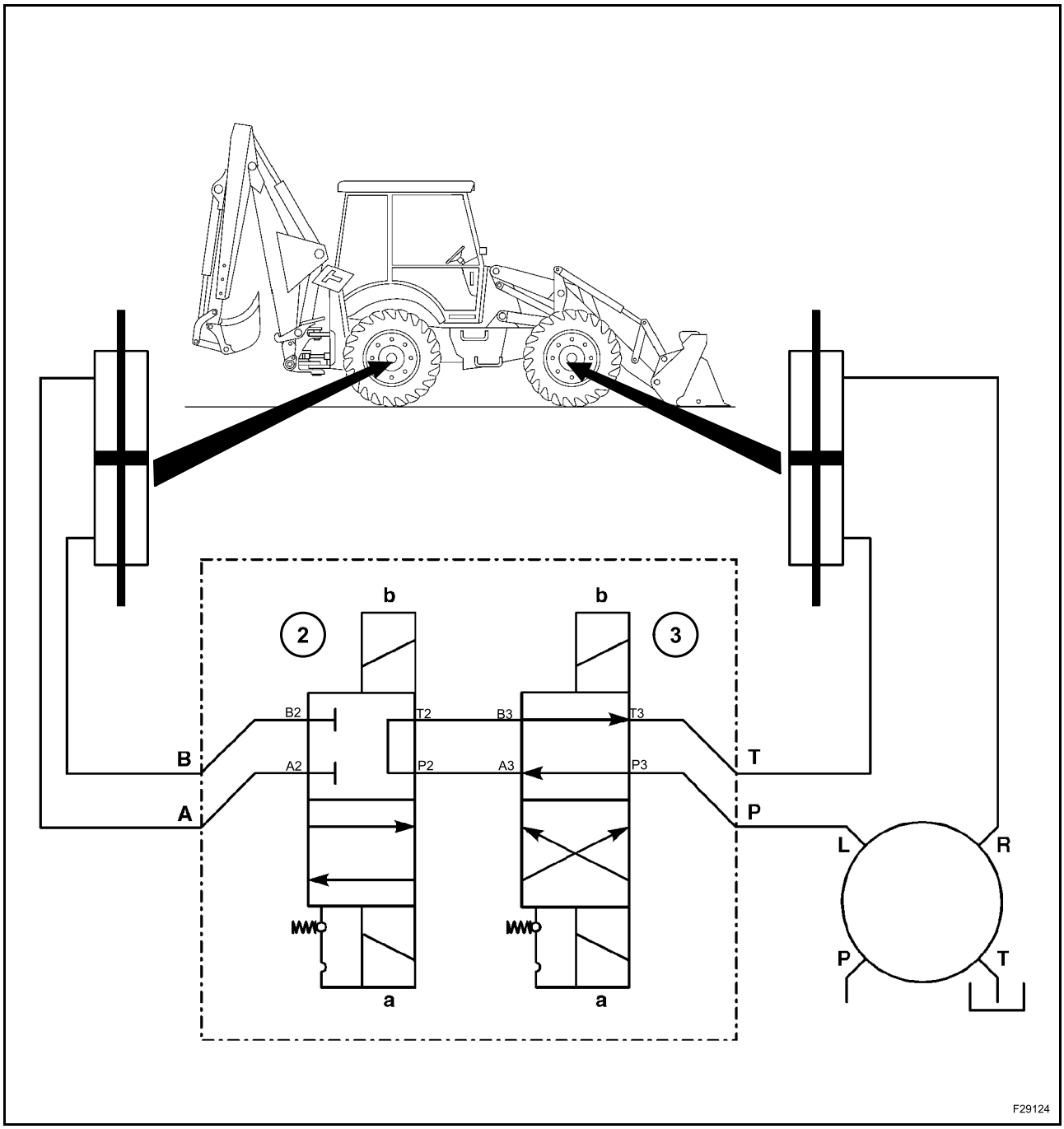


1. Solenoid knob
2. Solenoid
3. Control spool
4. Block
5. Central block
6. Fixing screws
7. Piston
8. O-ring
9. O-ring

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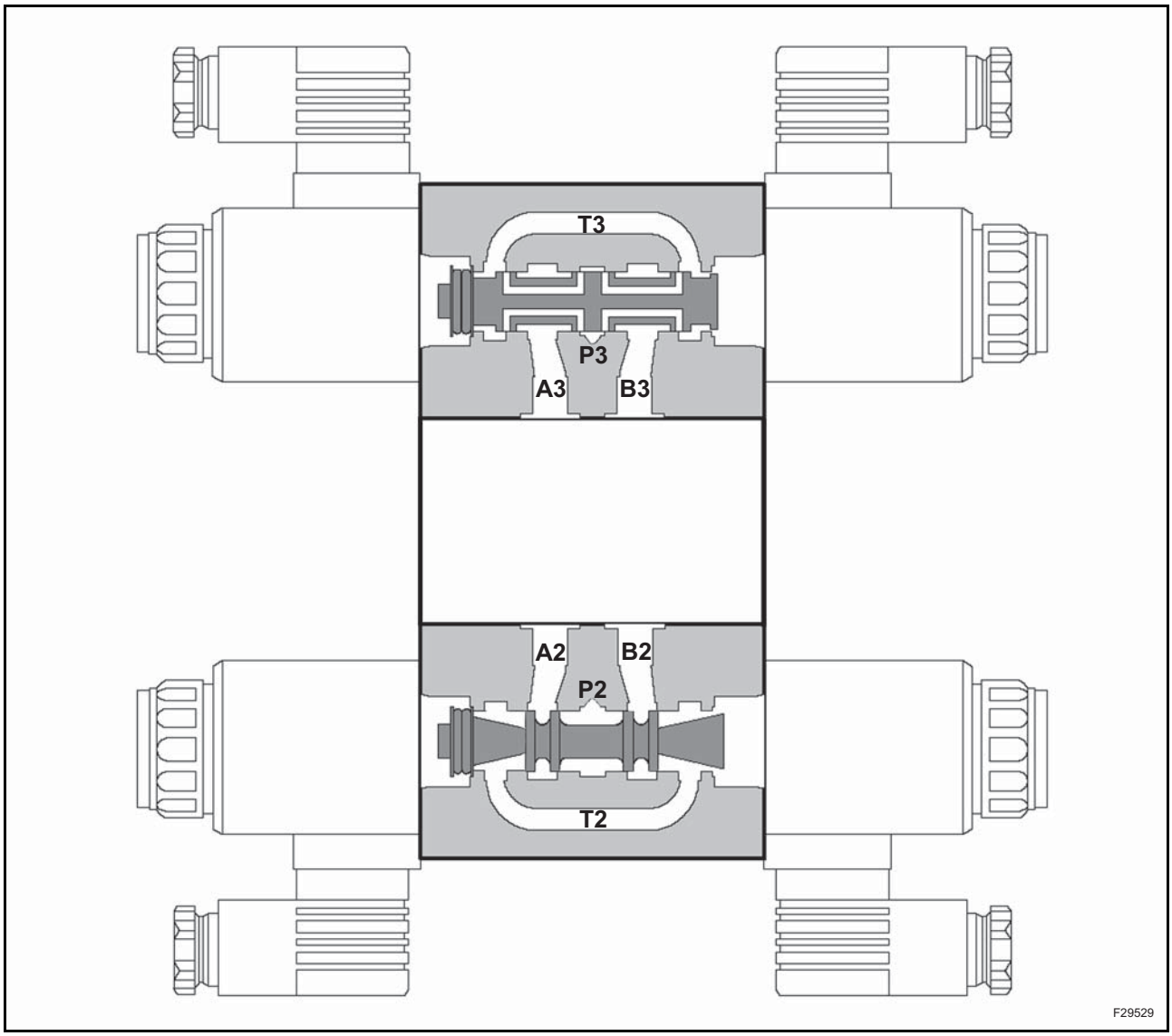
STEERING VALVE DIAGRAM



In the position shown both spools have been moved by solenoids (2b) and (3b). The detents on the (a) side of the solenoid hold the spool in this position until another solenoid is pulsed.

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The spool in valve (3) was last moved by solenoid (3b): oil flowing in from P3 flows through the internal galleries of the spool and exits at port A3. From here, oil enters valve (2), whose spool was last moved by solenoid (2b). Oil flows through port P2 and exits through port T2, cutting off flow to the rear steering cylinder. Now the oil returns in valve (3), entering through port B3 and flowing out through port T3. From here, oil enters the front steering cylinder.

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The three modes of steering are as follows:

Front wheel only steering 

Front and rear wheel steer 

Front and rear wheel crab 

The solenoids energized are shown in the table below.
These are also the pins which need to be pressed when changing steering mode manually in an emergency.

X = Energized
O = Not Energized

		3a	3b	2a	2b
2WS		O	X	O	X
2WS		X	O	O	X
4WS		O	X	X	O
CRAB		X	O	X	O

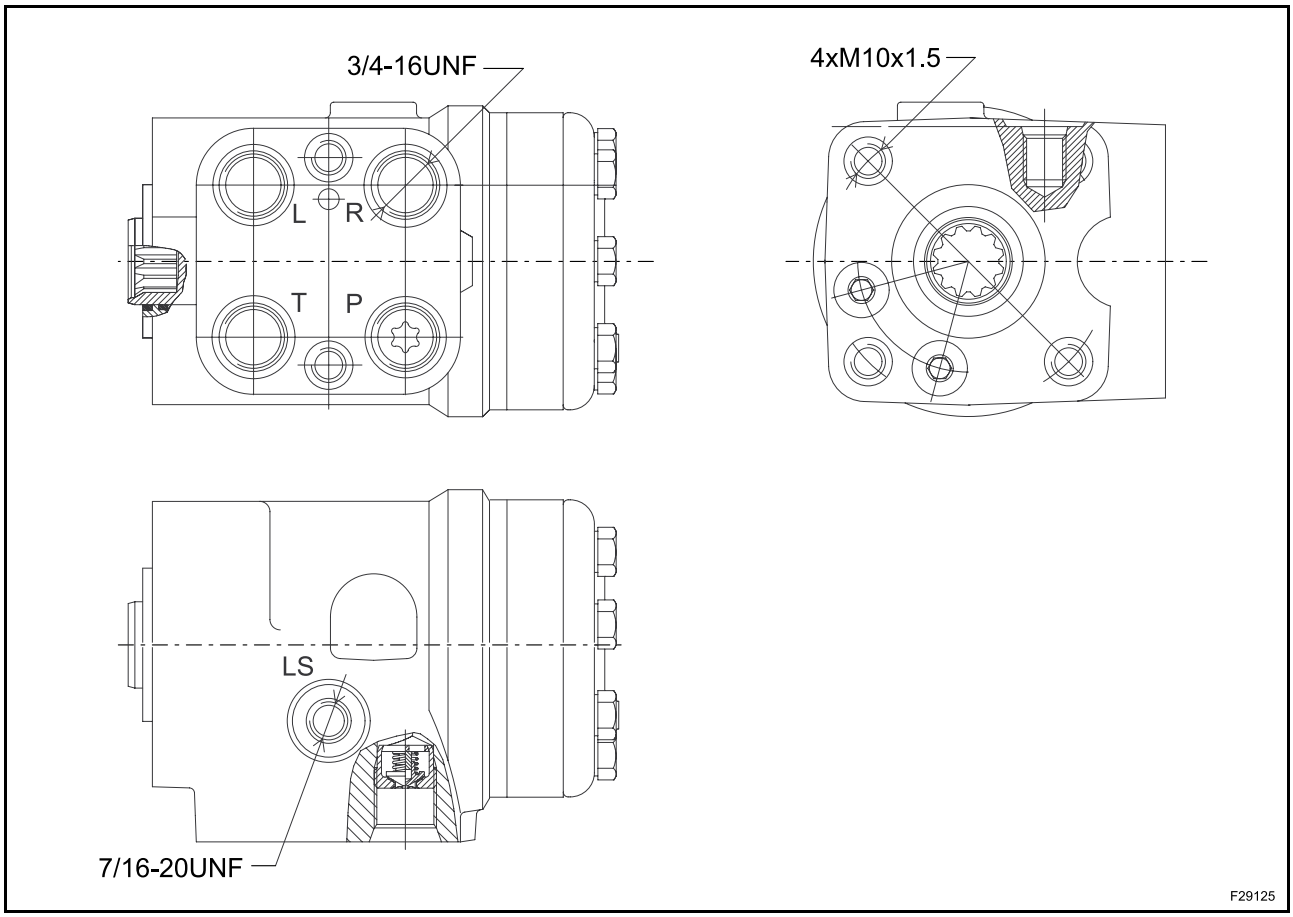
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3. POWER STEERING

The steering unit consists of a metering pump that includes:

- A gear wheel assembly with fixed stator (with inner teeth) and a rotor (with outer teeth).
- A 4 ways rotary distributor consisting of an outer sleeve and an inner selection rotor.
  The selection rotor is connected to the steering wheel, through column, that can be of two types: fixed or adjustable.
- A cardan shaft, mechanically tied to gear wheel assembly and to outer sleeve, allows the movement transmission.
- Set of centering springs between outer sleeve and inner rotor.



L. Left control port (steering cylinder)
R. Right control port (steering cylinder)
P. Inlet to steering pump
T. Outlet to oil tank
LS. Outlet to steering pump

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3.1 SPECIFICATIONS

Displacement (2WS)	125 cc/rev
Displacement (4WS)	160 cc/rev
Shock valve adjustment (2WS)	200 ÷ 220 bar
Shock valve adjustment (4WS)	240 ÷ 260 bar

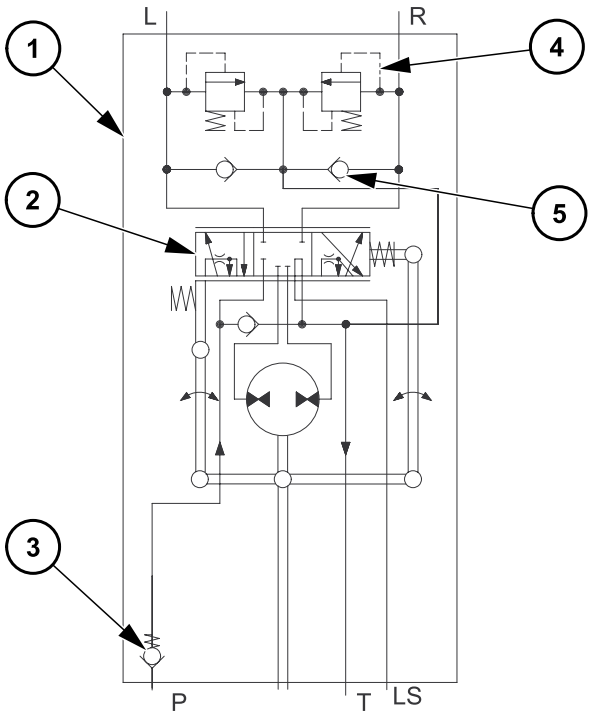
MOUNTING SCREW TORQUE

3/4 - 16 UNF	Nm	60
7/16 - 20 UNF	Nm	20
Steering wheel nut	Nm	55
Steering motor to steering column bracket	Nm	23
Power steering end cover	Nm	30
Power steering pipe connection	Nm	45
Steering motor pipe adaptors	Nm	55
Check valve bolt	Nm	30
Shock valve (4WS)	Nm	30

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HYDRAULIC DIAGRAM

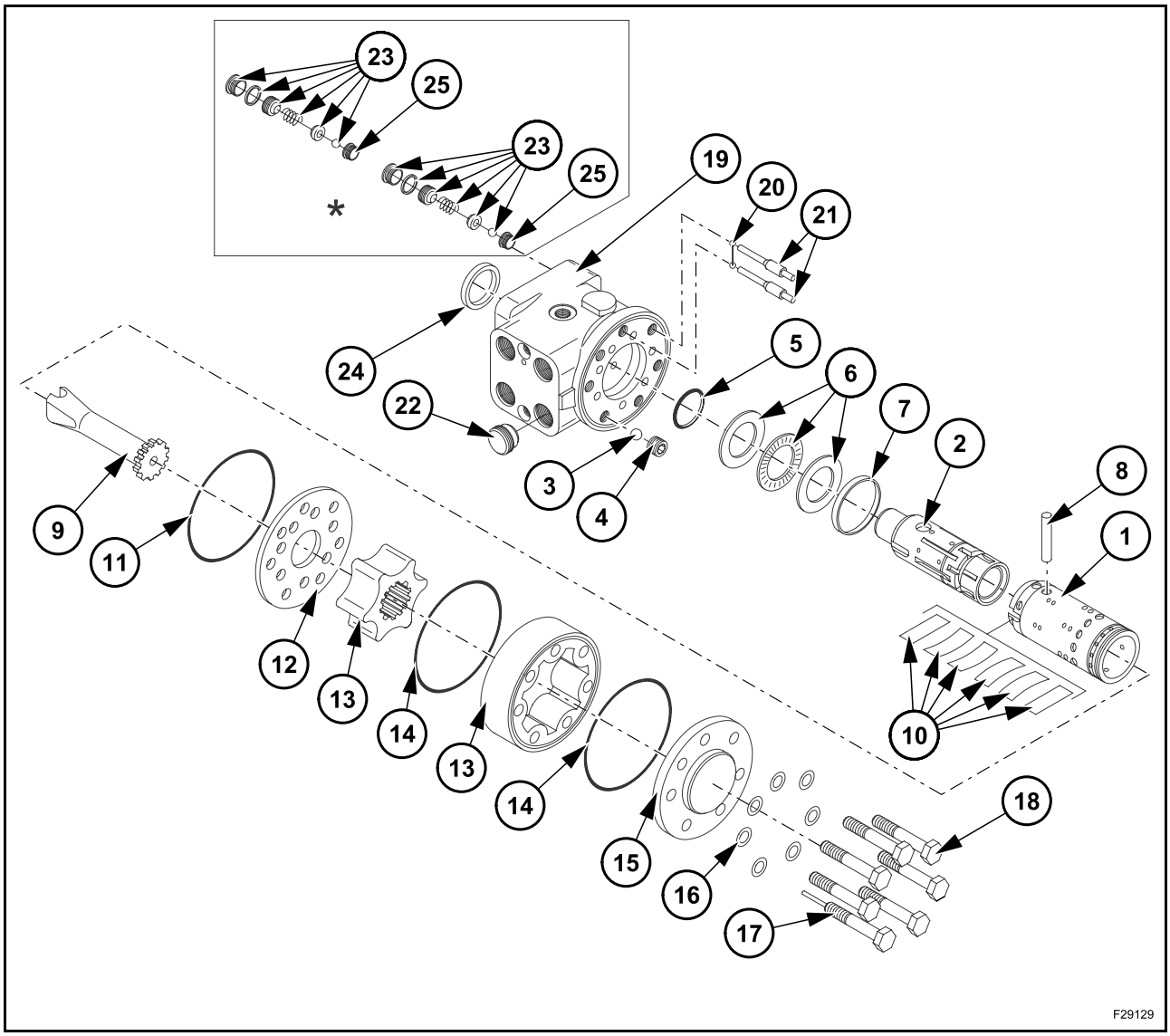


1. Power steering
2. Power steering control valve
3. Check valve
4. Anti-shock valve set at 240 ÷ 260 bar
5. Anticavitation valve

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3.2 COMPONENTS



* Only with 4WS models

1. Sleeve
2. Spool
3. Ball
4. Thread bushing
5. O-ring
6. Bearing
7. Ring
8. Cross pin
9. Cardan shaft
10. Set of springs
11. O-ring
12. Distributor plate
13. Rotor/stator gear
14. O-ring
15. End cover
16. Washer
17. Special screw
18. Screw
19. Body
20. Ball
21. Pin
22. Check valve
23. Shock absorbing valve
24. Ring seal
25. Seat

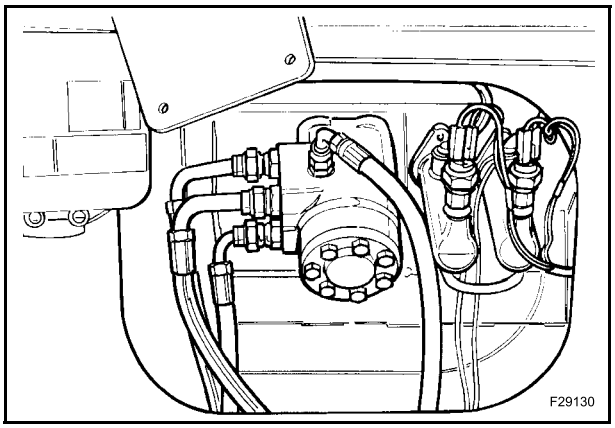
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3.3 DISASSEMBLY AND ASSEMBLY

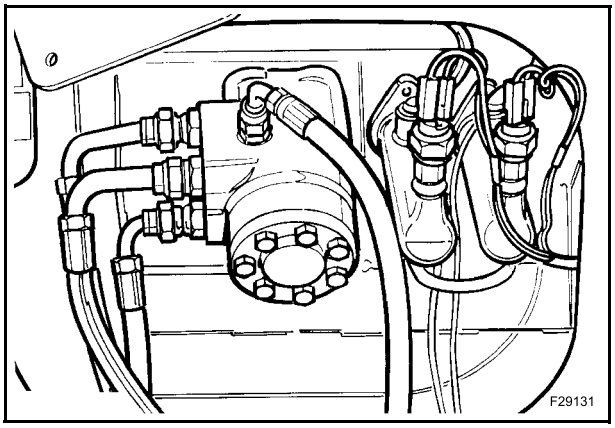
DISASSEMBLY

To gain access to the power steering, remove the hood and the air filter.

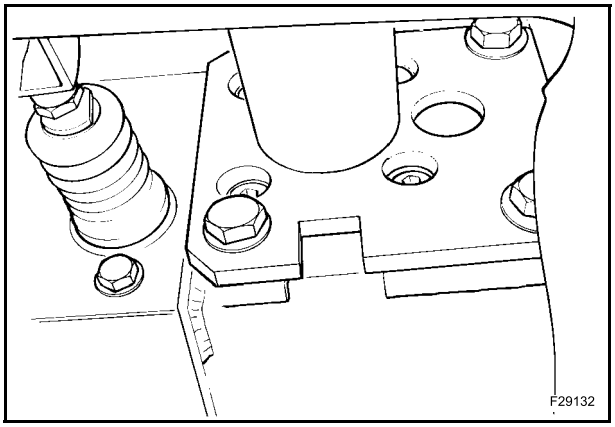


Removing power steering

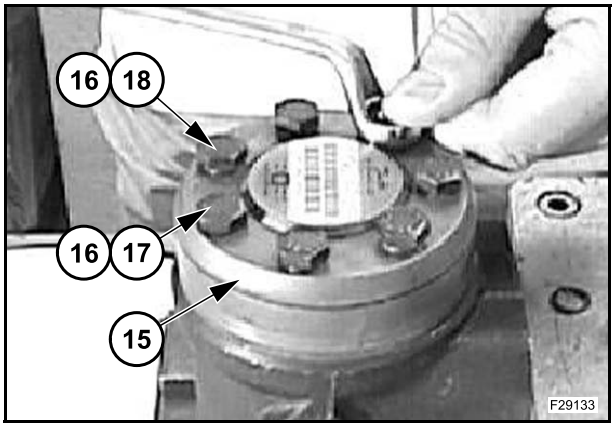
Disconnect the four connectors and collect the O-ring seals, noting the connector positions.



Remove the four screws from within the cab.
The power steering can be removed from the front of the cab through the engine compartment. Place the steering unit in the holding tool.



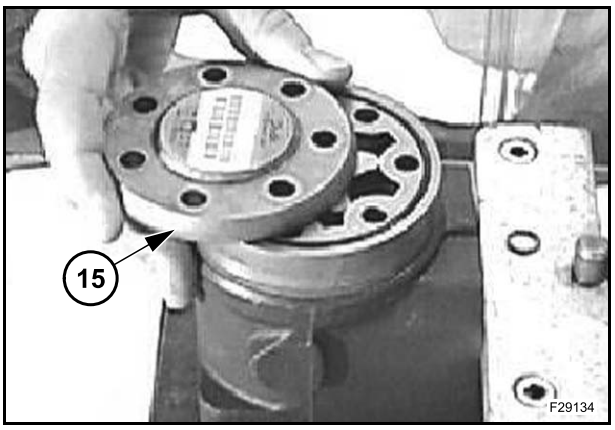
Screw off the screws (18), the special screw (17) and the washers (16) from the end cover (15).



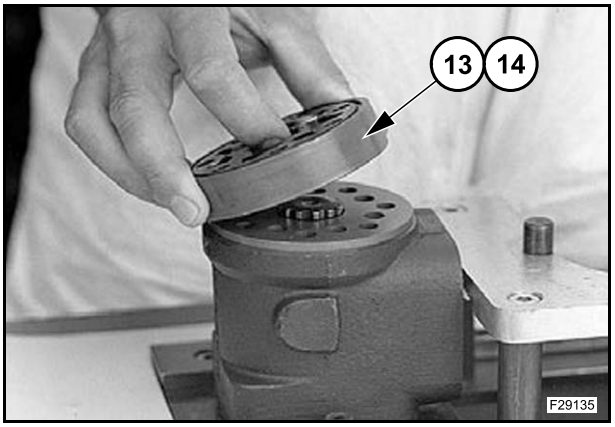
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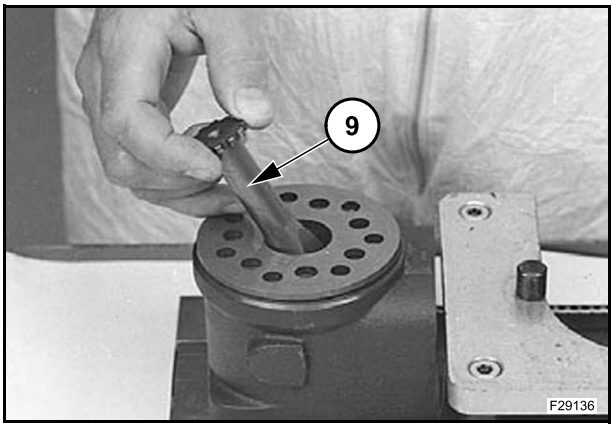
Remove the end cover (15).



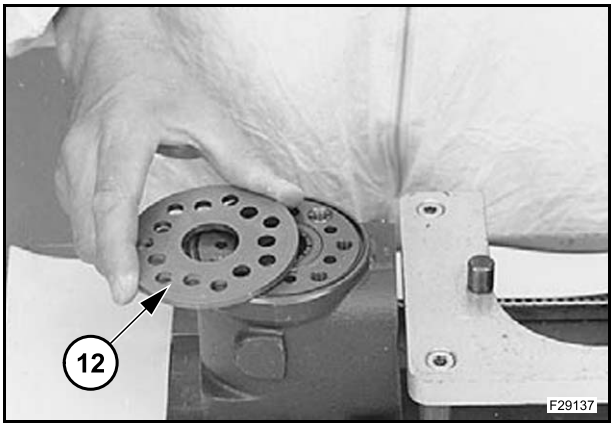
Extract the rotor/stator gear (13) (with spacer, if fitted). Extract the two O-rings (14).



Remove the cardan shaft (9).



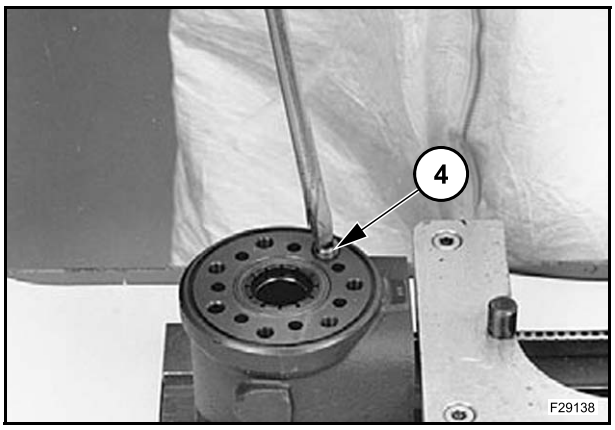
Remove the distributor plate (12).



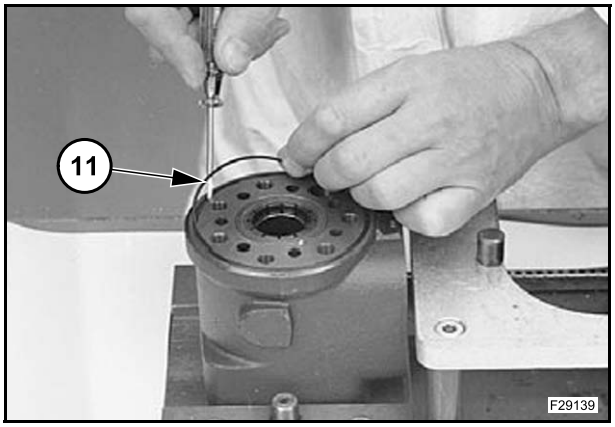
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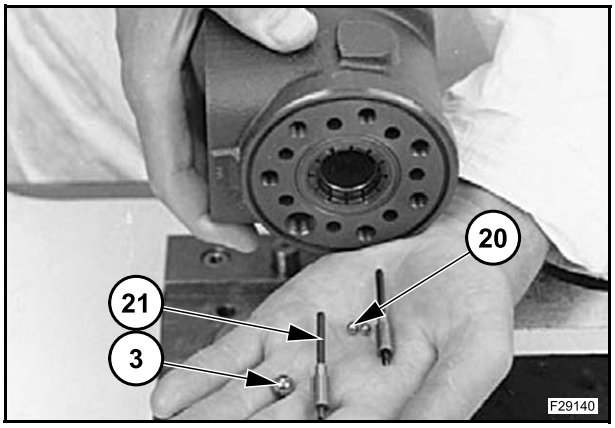
Screw out the threaded bush (4) over the check valve.



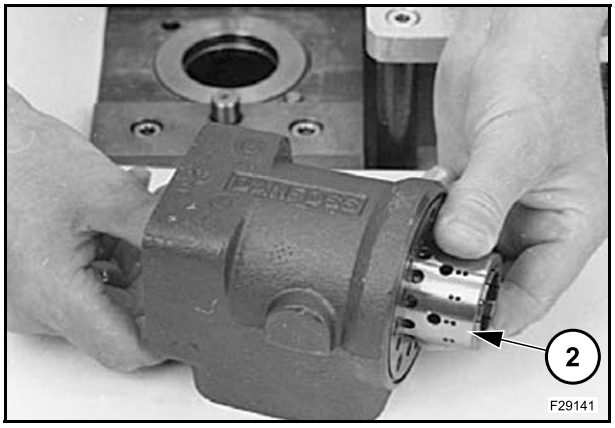
Remove the O-ring (11).



Shake out the check valve ball (3) and the suction valve pins (21) and the balls (20). Replace the pins (21) prior to the reassembly.



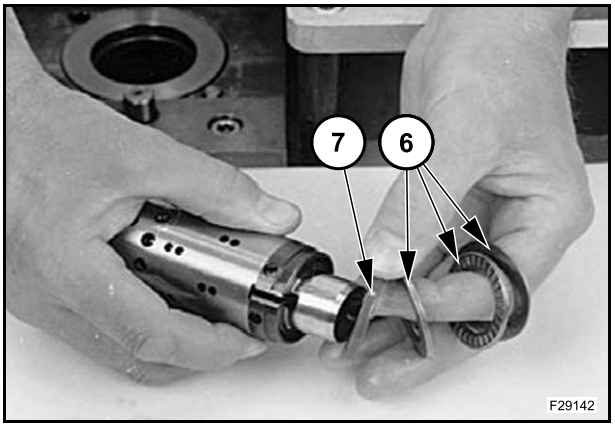
Take care to keep the cross pin in the sleeve and spool horizontal. The pin can be seen through the open end of the spool. Press the spool (2) inwards and the sleeve, the ring, the races and the needle bearing will be pushed together out of the housing.



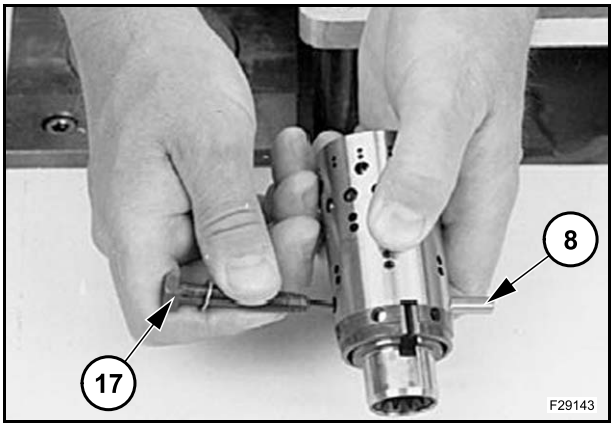
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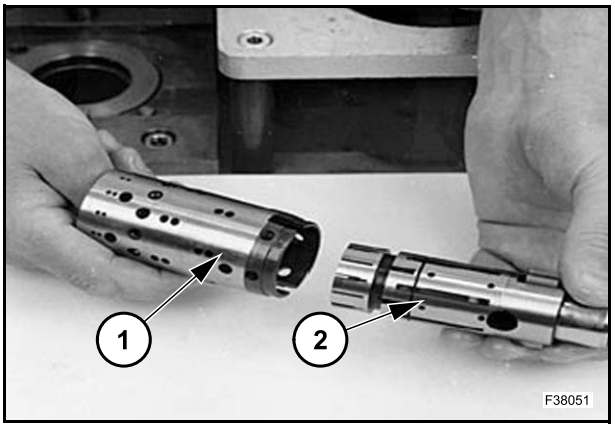
Extract the ring (7), the races and the bearing (6) from the sleeve and the spool. The outer (thin) bearing race can sometimes “stick” in the housing, therefore check that is has come out.



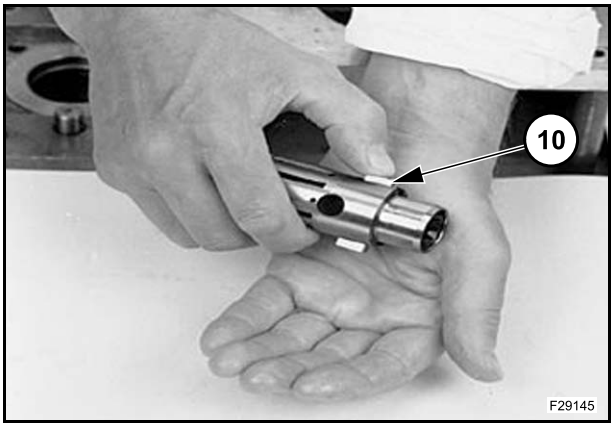
Press out the cross pin (8). Use the special screw (17). A small mark has been made with a pumice stone on both spool and sleeve close to one of the slots for the neutral position springs (see drawing). If the mark is not visible, remember to leave a mark of your own on sleeve and spool before the neutral position springs are dismantled.



Carefully press the spool (2) out of the sleeve (1).



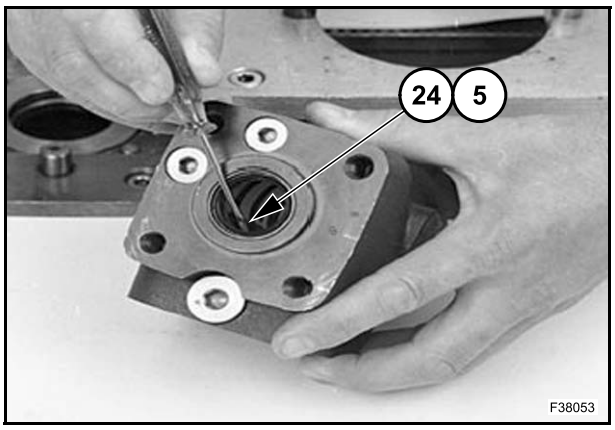
Press the springs (10) out of their slots in the spool.



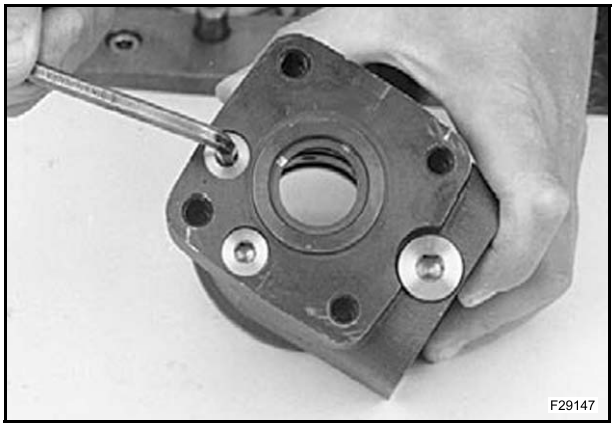
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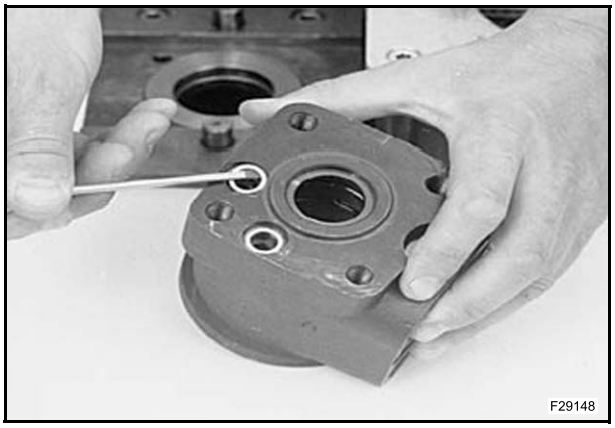
Remove the seal ring (24) and the O-ring (5).



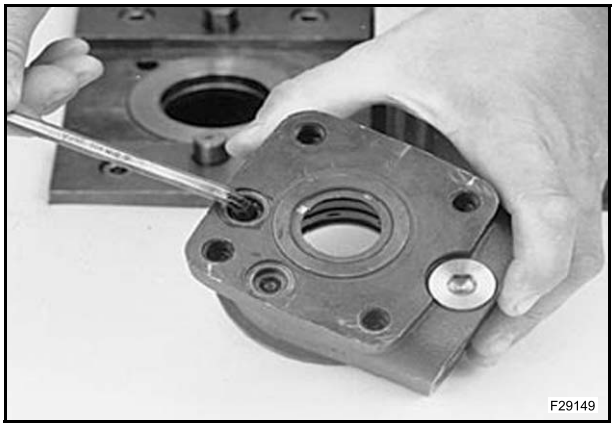
Remove the plugs from the shock valves using a 6 mm hexagon socket spanner.



Remove the seal washers.



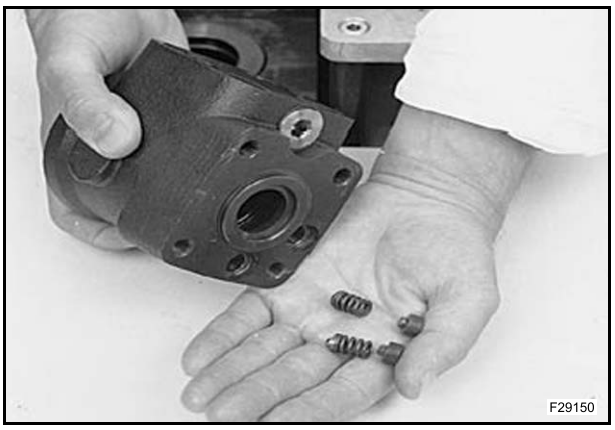
Unscrew the setting screws using a 6 mm hexagon socket spanner.



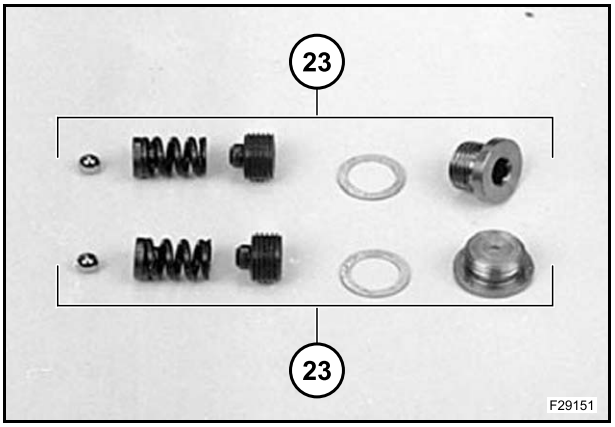
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Shake out the two springs and two valve balls into your hand. The valve seats are bonded into the housing and cannot be removed.



The shock valves (23) are now dismantled.



CLEANING

Clean all parts carefully.

INSPECTION AND REPLACEMENT

Check for signs of wear in the following areas:
- Rotor and stator of metering unit move freely.
- Check the drive pin is not cracked or bent.
- Check the rollers in thrust bearing are free to rotate.
- Ensure thrust washers are not warped or cracked.
- Ensure check valve ball is free to move.
- Check control valve, spool and sleeve for wear or scoring.
- Replace all seals and O-ring.

LUBRICATION

Before assembly, lubricate all parts with hydraulic oil.

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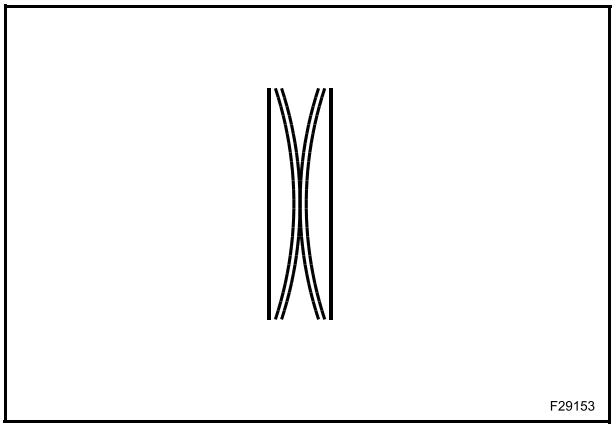
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ASSEMBLY

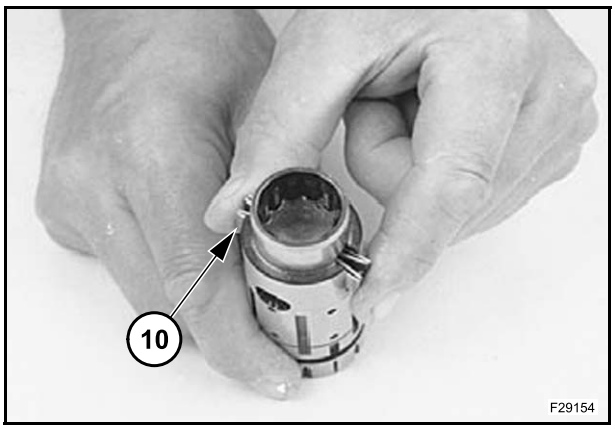
NOTE: great care should be taken during re-assembly.

Place the two flat neutral position springs in the slot. Place the curved springs between the flat ones and press them into place.

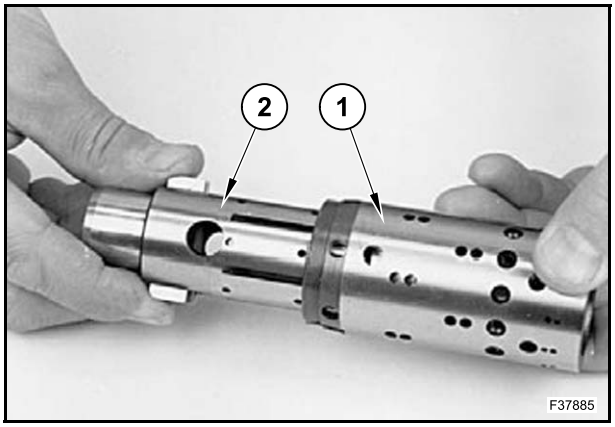




Line up the spring set (10).



Guide the spool (2) into the sleeve (1). Make sure that spool and sleeve are placed correctly in relation to each other.



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Assemble spool and sleeve.
When assembling spool and sleeve only one of two possible ways of positioning the spring slots is correct. There are three slots in the spool and three holes in the sleeve in the end of the spool/sleeve opposite to the end with spring slots. Place the slots and holes opposite each other so that parts of the holes in the sleeve are visible through the slots in the spool.



Press the springs together and push them into the sleeve.

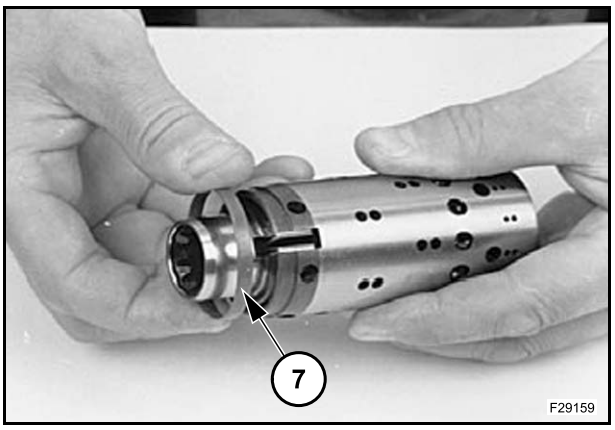


Line up the springs and centre them.



Guide the ring (7) down over the sleeve.

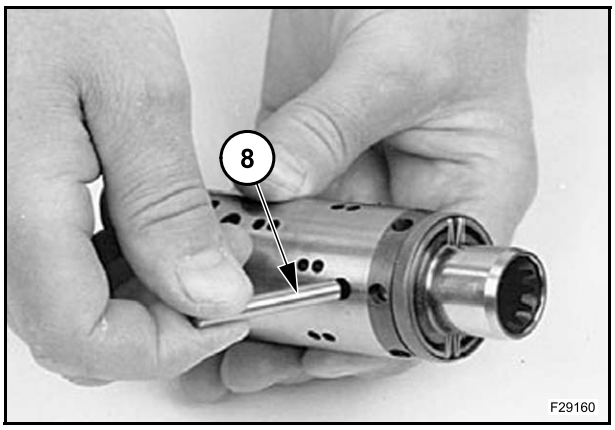
NOTE: the ring should be able to move - free of springs.



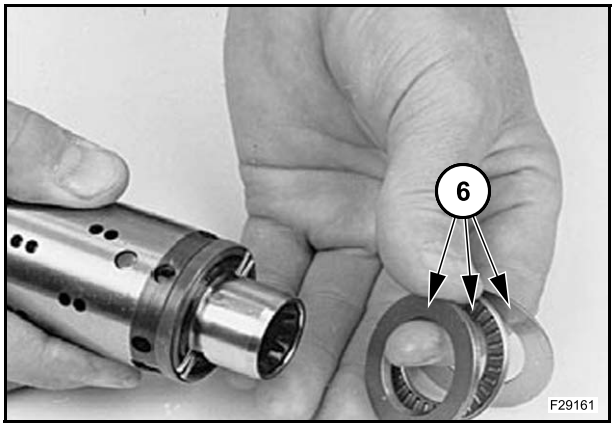
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Fit the cross pin (8) into the spool/sleeve.

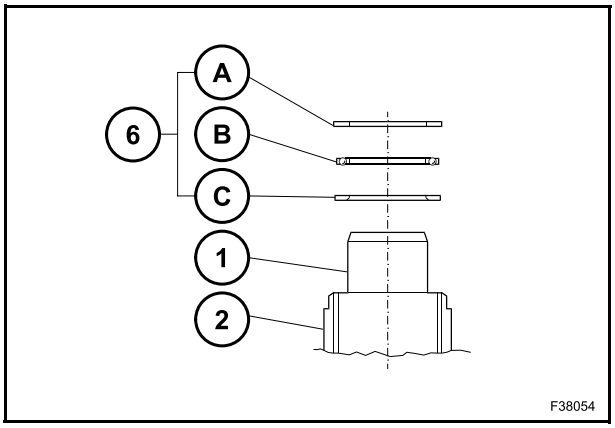


Fit bearing races and needle bearings (6) as shown on the next drawing.

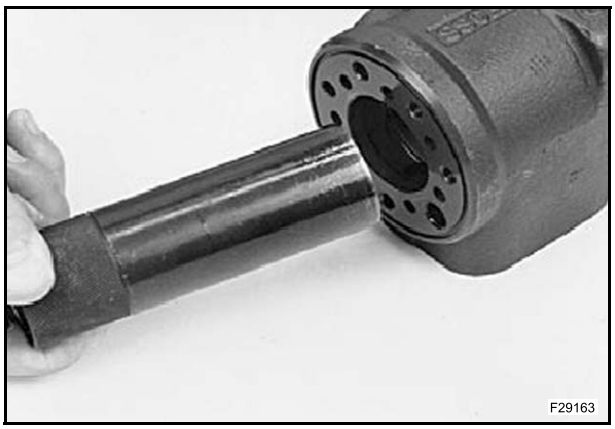


1. Spool
2. Sleeve
6. Bearing - needle
6A. Outer bearing race
6B. Needle bearing
6C. Inner bearing race

The inside chamfer on the inner bearing race must face the inner spool.



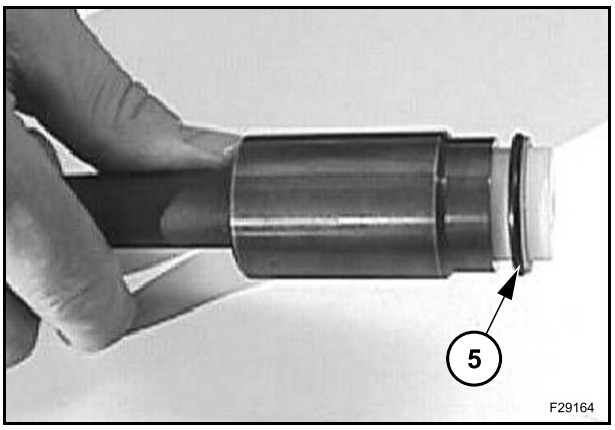
Turn the steering unit until the bore is horizontal. Guide the outer part of the assembly tool into the bore for the spool/sleeve.



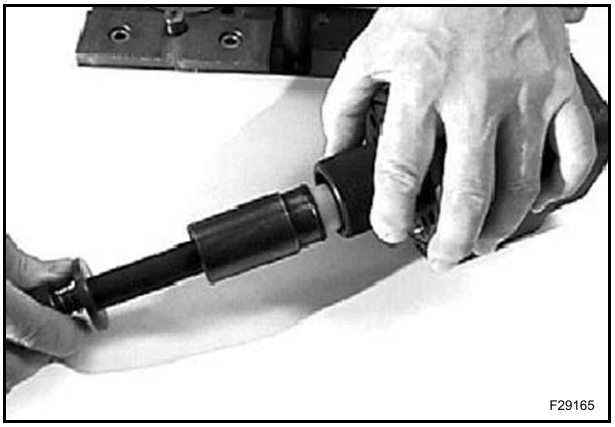
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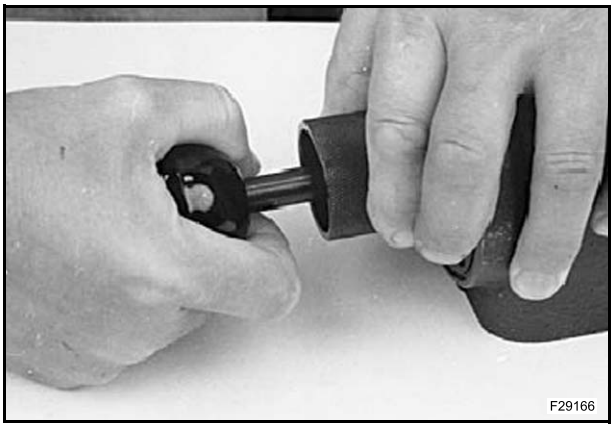
Grease the O-ring (5) with hydraulic oil and install it on the attachment.



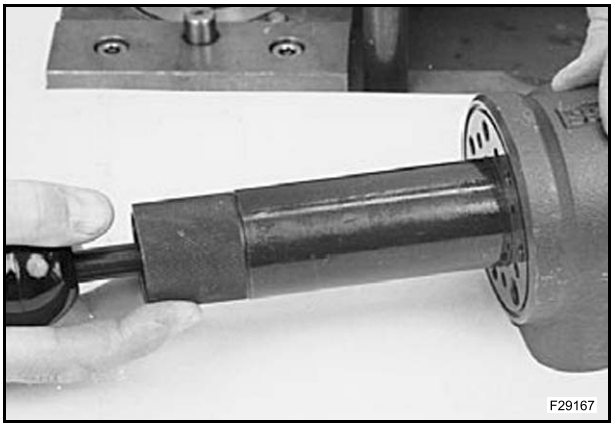
Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.



Press and turn the O-ring into position in the housing.



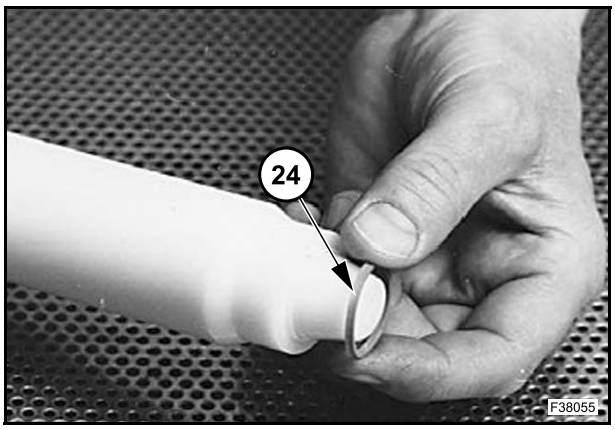
Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.



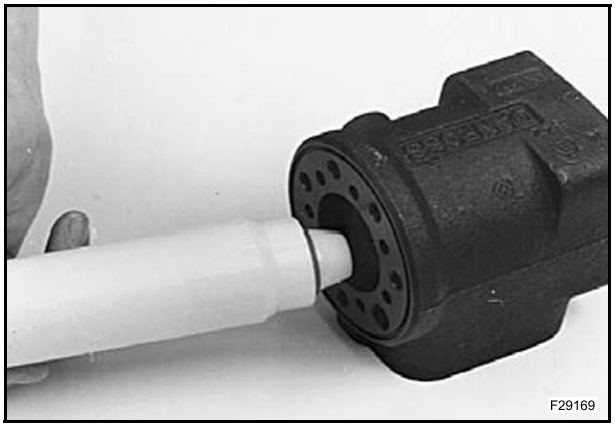
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Lubricate the seal ring (24) with hydraulic oil and place it on the assembly tool.



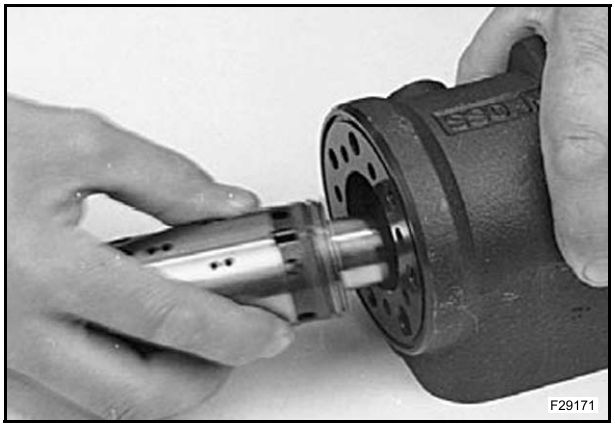
Guide the assembly tool right to the bottom.



Press and turn the seal ring into the housing.



With a light turning movement, guide the spool and sleeve into the bore.
Fit the spool set holding the cross pin horizontal.



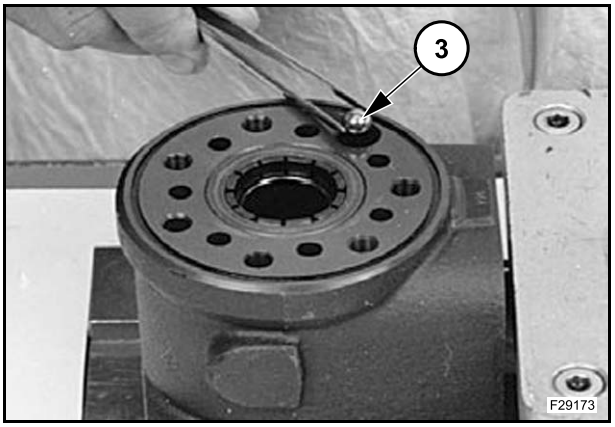
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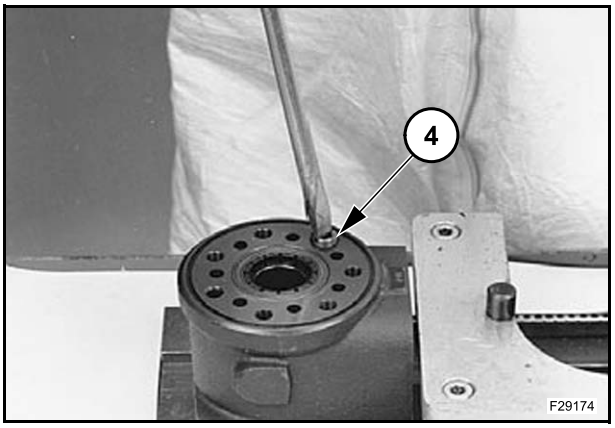
The spool set will push out the assembly tool guide. The O-ring is now in position.



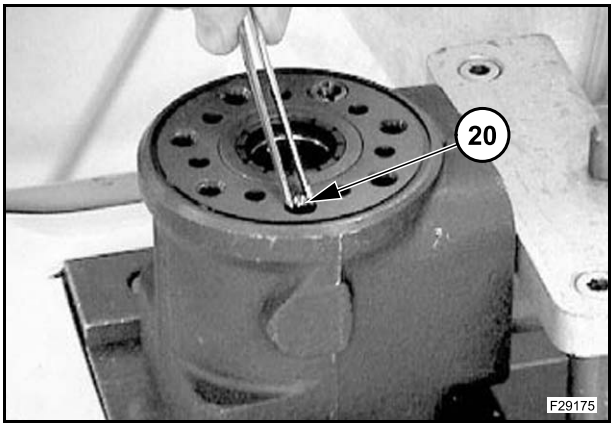
Turn the steering unit until the bore is vertical again. Put the check valve ball (3) into the hole indicated in the picture.



Screw the threaded bush (4) lightly into the check valve bore. The top of the bush must lie just below the surface of the housing.



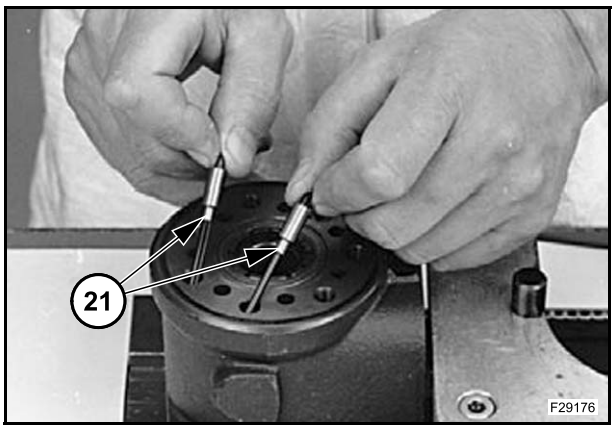
Place a ball (20) in the two holes indicated in the picture.



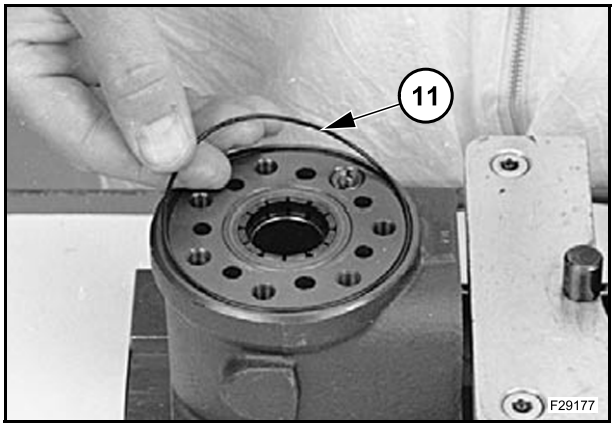
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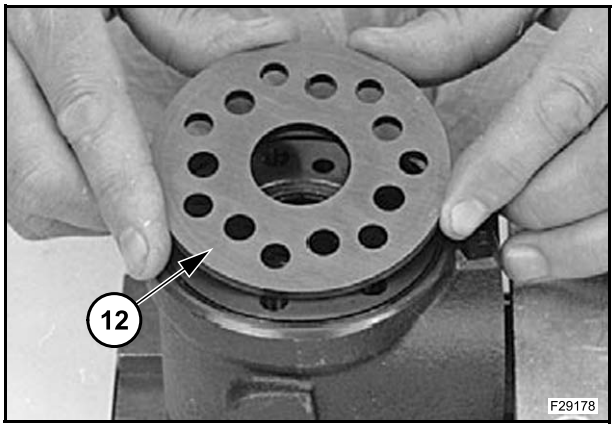
Insert the pins (21) into the same two holes.



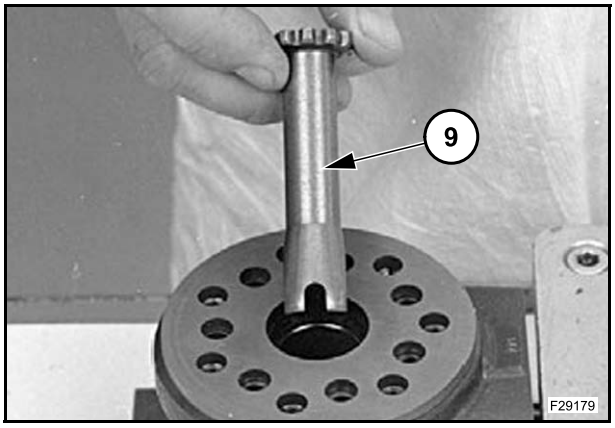
Grease the O-ring (11) with mineral oil.



Position the distributor plate (12) so that the channel holes match the holes in the housing.



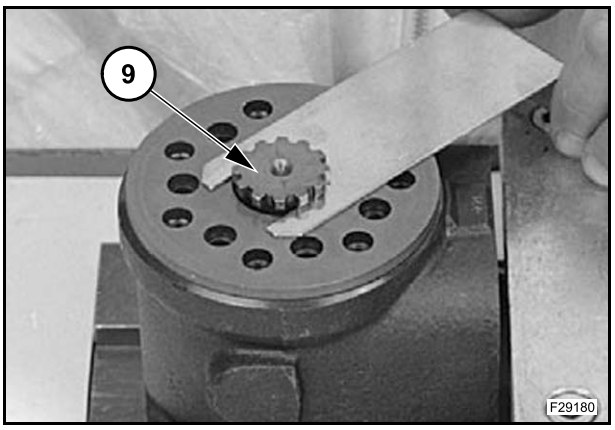
Guide the cardan shaft (9) down into the bore so that the slot is parallel with the connection flange.



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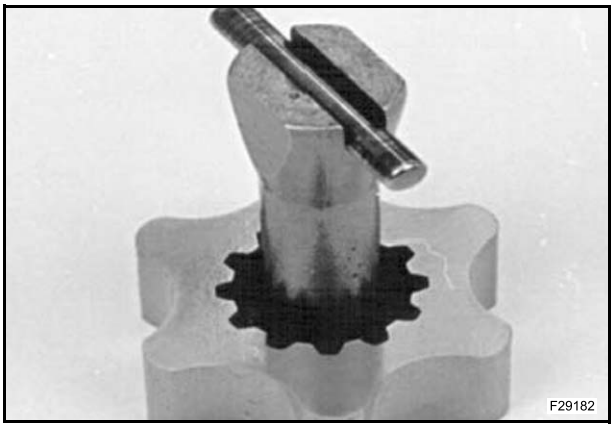
Place the cardan shaft (9) as shown - so that it is held in position by the mounting fork.



Grease the two O-rings and place them in the two grooves in the gear rim. Insert the rotor/stator gear and the rim on the cardan shaft.



Fit the gearwheel (rotor) and cardan shaft so that a tooth base in the rotor is positioned in relation to the shaft slot as shown. Turn the gear so that the seven through holes match the holes in the housing.

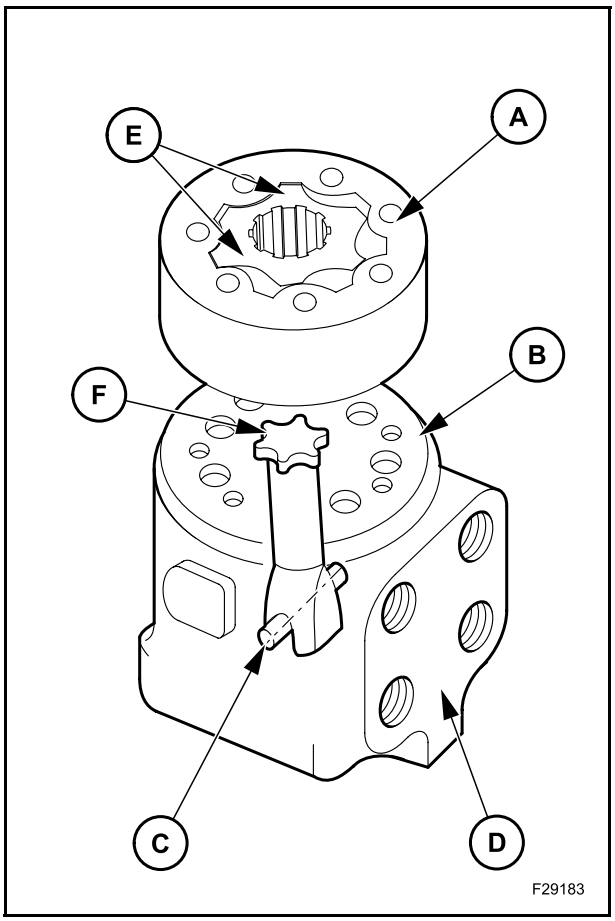


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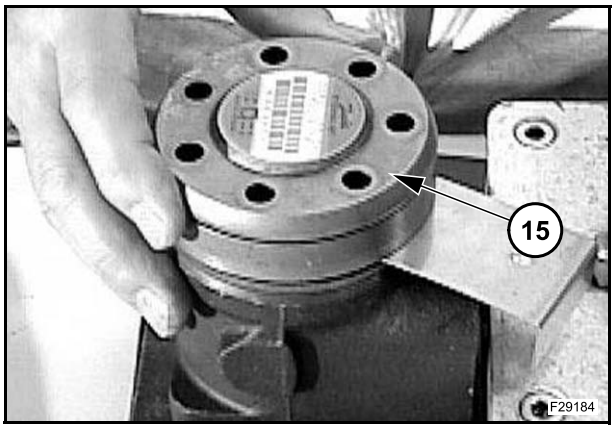
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For precise keying and alignment of steering control valve, pay attention to the parallelism of (A), (B), (C) and (D) reference marks.

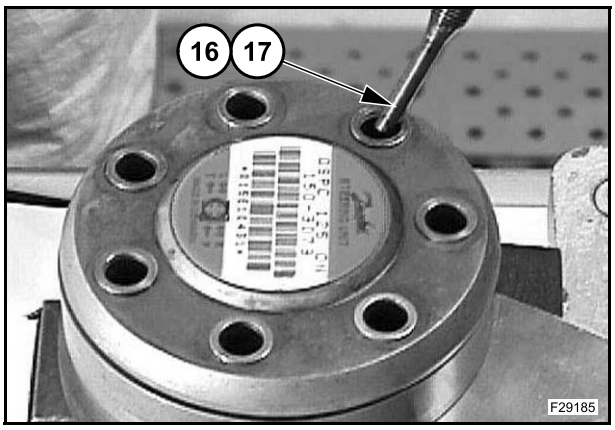
A. Rotor/stator surface
B. Distributor plate surface
C. Pin axis
D. Housing surface
E. Rotor gear
F. Cardan shaft



Position the end cover (15).



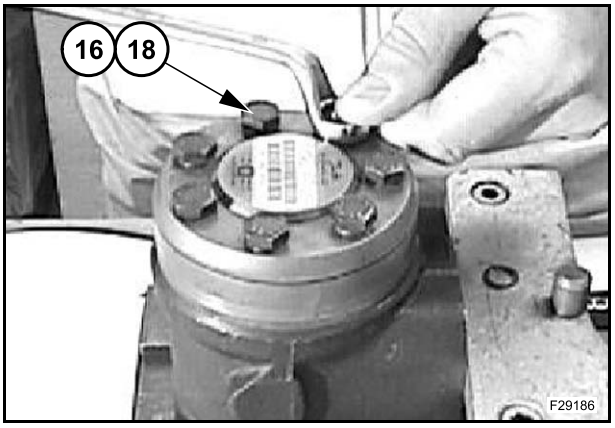
Assemble the special screw (17) with the washer (16).



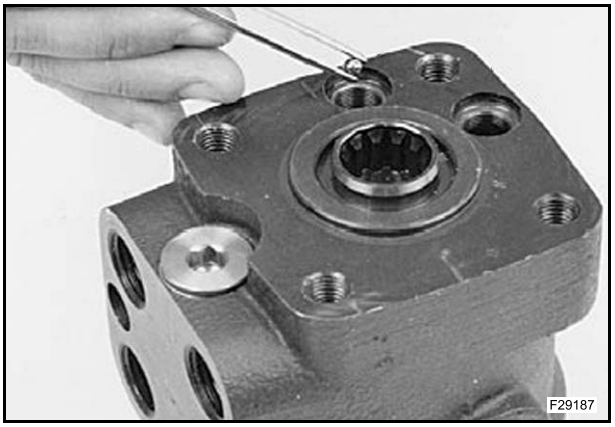
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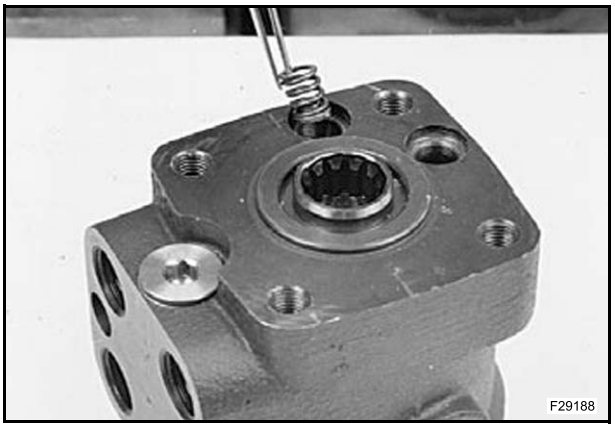
Fit the 6 screws (18) with the relevant washers (16). Cross-tighten all the screws and the roller pin to a torque of 30 ± 6 Nm in the sequence shown. The initial torque is 10.8 Nm.



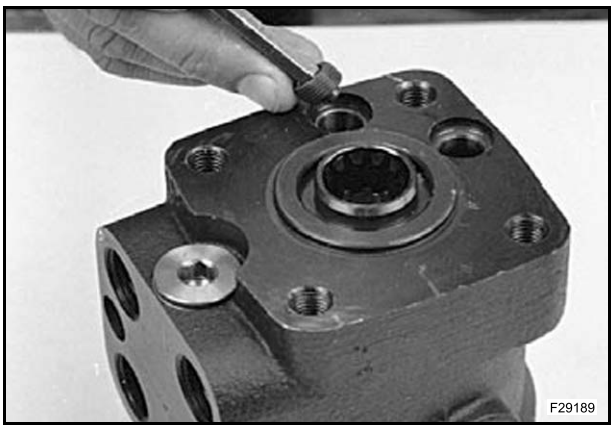
Put a ball in the two holes.



Place springs and valve cones over the two balls.



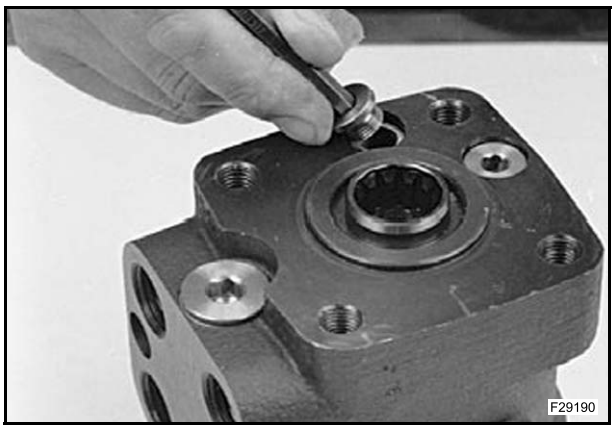
Screw in the two setting screws.



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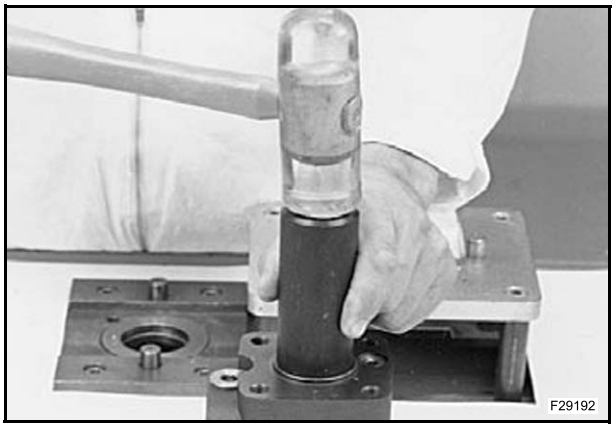
Screw plug with seal ring into the two shock valves and tighten them with a torque of 30 ± 10 Nm.



Position the seal ring (24) into the housing.



Install the seal ring into the housing using the special tool and a plastic hammer.



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3.4 SPECIAL TOOLS

P/N CNH	DESCRIPTION
380000281	Assembly tool for seal ring.
380002677	Assembly tool for ring.
380002679	Assembly tool for cardan shaft.
380002680	Assembly tool for O-ring.

3.5 FAULT FINDING

PROBLEM	CAUSE	CORRECTION
No steering or excessive effort required to steer	Incorrect oil level in tank Air in system Pump relief valve faulty Worn pump Leaking power cylinder Damaged valve spool Broken or damaged steering column Damaged or worn metering element	Fill with the correct oil type and quantity. Check for loose connections or damaged lines. Bleed the system. Check the system pressure. Inspect and repair. Inspect and repair. Inspect and replace. Inspect and replace.
Steering wanders	Excessive clearance in the ball joints of the steering connecting rods Leaking power cylinder Control valve spool sticking or worn Damaged or worn metering element	Inspect and replace. Inspect and repair. Inspect and replace. Inspect and replace.
Front wheels surge when steering	Leaking power cylinder Control valve spool sticking Damaged or worn metering element	Inspect and repair. Inspect and repair. Inspect and replace.
Noisy pump	Incorrect oil level in tank Air in system Water in oil Worn pump	Fill with the correct oil type and quantity. Check for loose connections or damaged lines. Drain the oil from the system. Drain and change the oil. Replace the pump.

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NOTES:

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580SR
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590SR
695SR



SECTION 50 - CAB HEATING AND AIR CONDITIONING

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1. SPECIFICATIONS

HEATING	
ENGINE RADIATOR COOLANT	
Antifreeze - Ambra Agriflu	12 litres
Water	12 litres
System type	Pressurized FULL FLOW by-pass with expansion chamber
FAN BELT DEFLECTION	
Naturally aspired	13 - 19 mm
Turbocharged	10 - 16 mm
THERMOSTAT	
Start to open at	82 °C
Fully open at	95 °C
Radiator cap	0.90 bar
TORQUE VALUES	
Coolant/hot water hose connections	5 Nm
Air hose ducting connections	5 Nm
Heater housing to floor mounting bolts	6.2 Nm

Refrigerant	HFC 134a
Refrigerant charge	1.2 kg
Compressor oil	SP20 (PAG Type, Viscosity index 100)
Oil change amount	135 cc

CHECK CONDITIONS	
Air inlet temperature	37.8 °C
Rated air inlet moisture	40%
Evaporation temperature	0 °C
Overheating	5 °C
Inlet air speed	1.0 - 2.0 - 3.0 m/s
Condensation temperature	58 °C (absolute 16 bar)
Undercooling	2 °C

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PERFORMANCE CALCULATED AT m/s (191.72 m^3/h)		
Exchanged warmth	5.48 kW	4718.28 kcal/h
Air outlet temperature	5.64 °C	
Air side load loss	2.97 daPa	0.30 mmH_20
Coolant side load loss	13.1 kPa	0.13 bar
PERFORMANCE CALCULATED AT 2.0 m/s (383.4 m^3/h)		
Exchanged warmth	9.29 kW	7998.69 kcal/h
Air outlet temperature	10.30 °C	
Air side load loss	9.34 daPa	0.95 mmH_20
Coolant side load loss	32.7 kPa	0.33 bar
PERFORMANCE CALCULATED AT 3.0 m/s (575.1 m^3/h)		
Exchanged warmth	12.00 kW	10332.00 kcal/h
Air outlet temperature	13.70 °C	
Air side load loss	18.30 daPa	1.87 mmH_20
Coolant side load loss	51.20 kPa	0.51 bar

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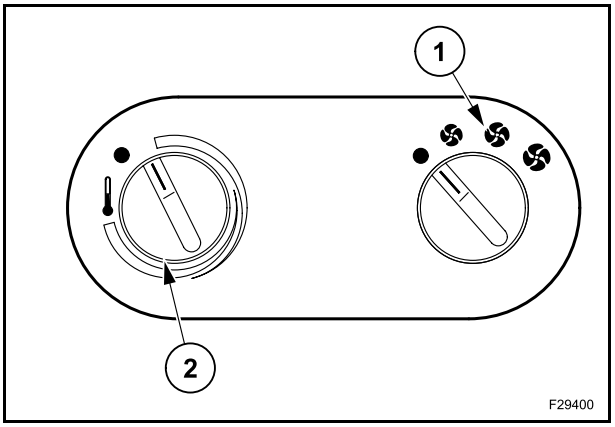
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2. CAB HEATING

2.1 DESCRIPTION AND OPERATION

Cab heating
The cab is heated by a radiator mounted below the cab seat, which is supplied hot water from the engine coolant system. A blower motor mounted behind the cab radiator is used to transfer the heat into the cab.

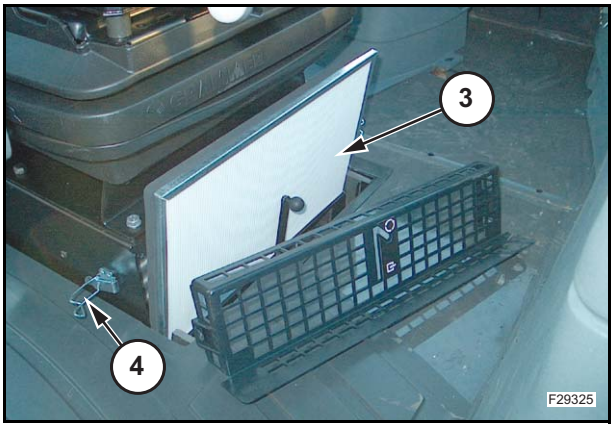
Heater blower control
The three speed blower is controlled by switch (1) mounted in the instrument console to the right of the cab seat. Turn the switch clockwise to the first position for slow speed. Further rotation of the switch in a clockwise direction selects medium and fast speeds. The blower draws outside air from beneath the cab floor and through a filter medium into the cab.



Temperature control
The temperature of the air from the radiator is adjusted by rotation of the control knob (2) which opens or closes the radiator valve increasing or decreasing the water flow as required. Turn the control clockwise to increase the temperature of air from the heater and counter clockwise to reduce the temperature.

⚠ WARNING
The cab air filters are designed to remove dust from the air but may not exclude chemical vapour. When working in an enclosed area ensure there is adequate ventilation as exhaust fumes can suffocate you.

Cab air filter
Before servicing the air filter situated under the drivers seat, switch off the blower and close all windows and one door. Forcibly close the other door. The resulting back pressure will dislodge loose dirt from the underside of the filters. To remove the filter (3) release the retaining straps (4) and remove the filter element. Ensure the element, and sealing faces are not damaged on removal.



IMPORTANT: in humid conditions, such as occur on most early mornings, do not switch on the blower prior to servicing the filters. Damp particles drawn into the filter may solidify and prove difficult to remove without washing.

The filter element is made of specially treated paper with a sealing strip bonded to the outer face.
Clean this element by blowing with compressed air from the clean side through to the dirty side. The compressed air should not exceed 2 bar and the air line nozzle should be at least 300 mm from the element.

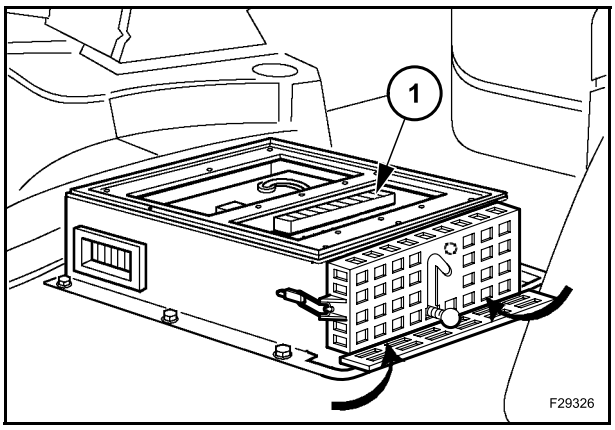
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Heater radiator

The heater radiator (1) is fitted in a housing under the cab seat for central displacement of warm or cold air flow.

IMPORTANT: to ensure a good flow of air through the heater radiator the filter should be cleaned more frequently when operating in extremely dusty conditions.



Air flow vents

Air flow vents are connected to the heater container and receive air from the blower motor, to direct warm or cold air onto the windscreen and side windows or to the cab interior as required.

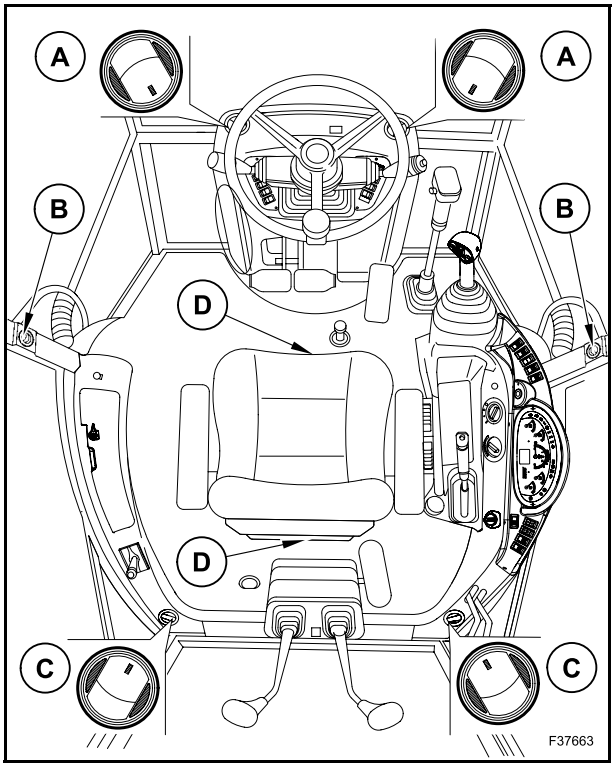
Each vent may be swivelled and adjusted to control the flow of air.

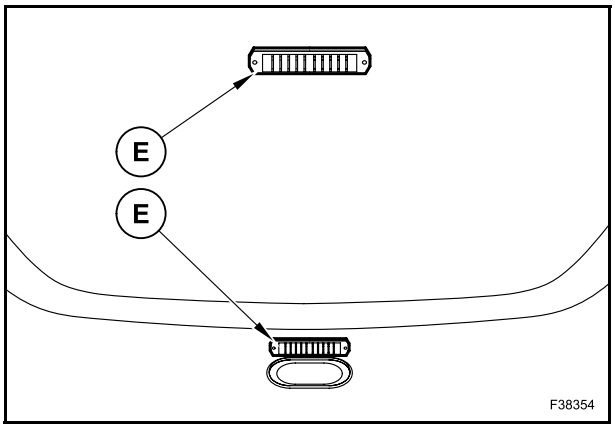
To open a vent, press one side of the disc and turn it, as required, to direct the air flow.

The vents are located as follows:

- two on the top of the front control panels (A);
- two to the rear of the seat (C);
- two under the seat, one in front, the other on the rear (D);
- two on the cab posts, right and left (B);
- two on the ceiling, in front and back of operator's head (E).

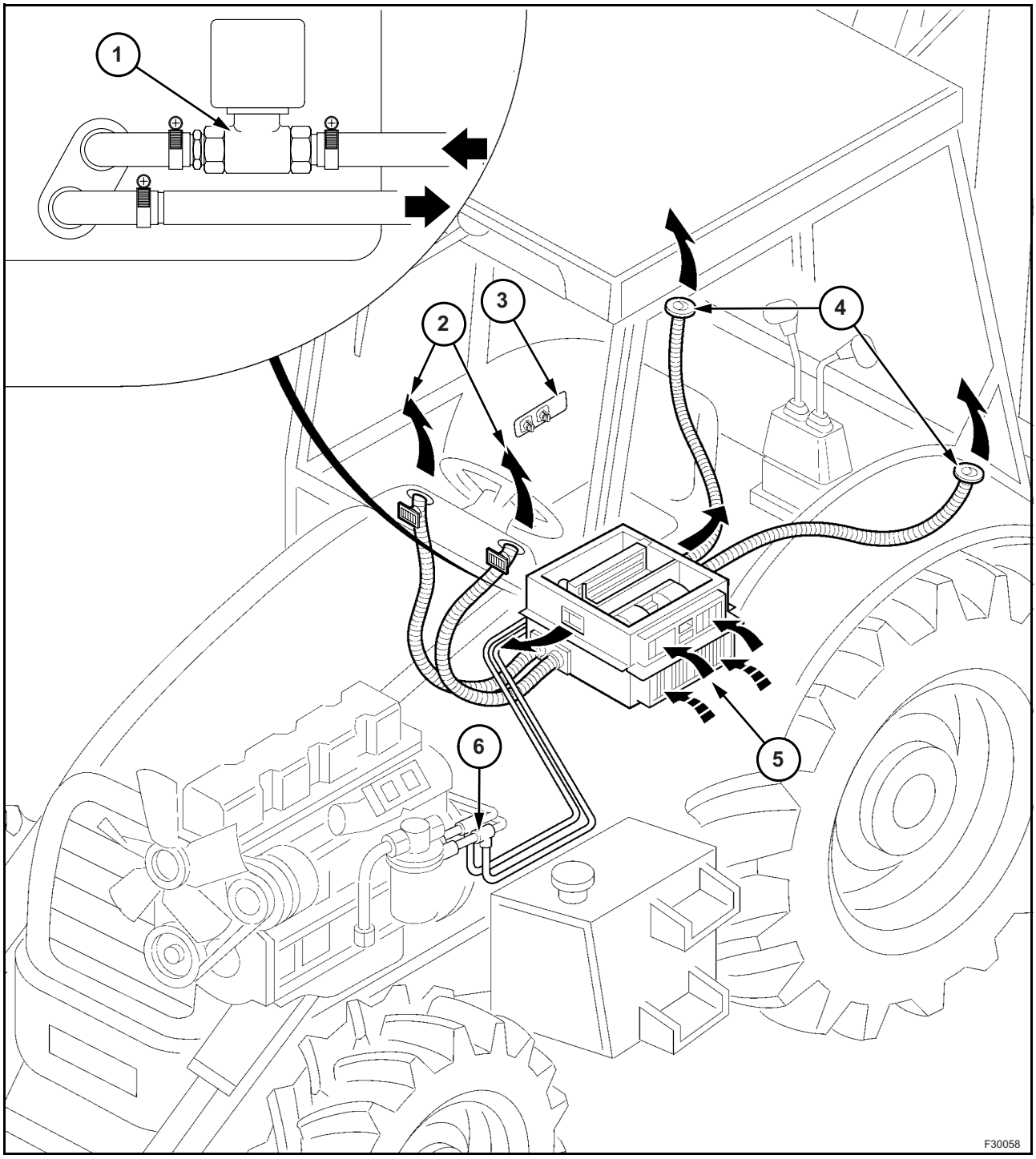
NOTE: the vents (B) and (E) are mounted only when air conditioning (optional) is fitted.





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Schematic - Heater system

1. Heater valve mounted to the right of the heater housing
2. Air ducting to the front windscreen
3. Radiator hoses of the heater control panel
4. Air ducting to the rear windscreen below the cab floor
5. Air intake to the heater housing from below the cab floor
6. Heater pipes to and from heater taken from the engine oil

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Electrical heater valve

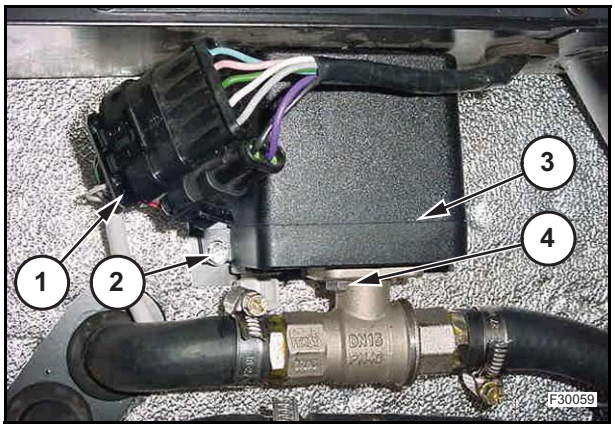
The electrical valve is equipped with a software that, each time the supply of the cock is delayed (therefore also at backhoe loader start), carries out the momentary positioning of the cock to “completely closed” and returns to the position set by the temperature regulation handle located on the control dashboard. This enables the software to carry out a self-control on the cock drive so as to always obtain an optimal regulation of the ball for the water flow.
This is part of the cock normal operation and is not to be considered as a fault.

Release of the electrical heater valve

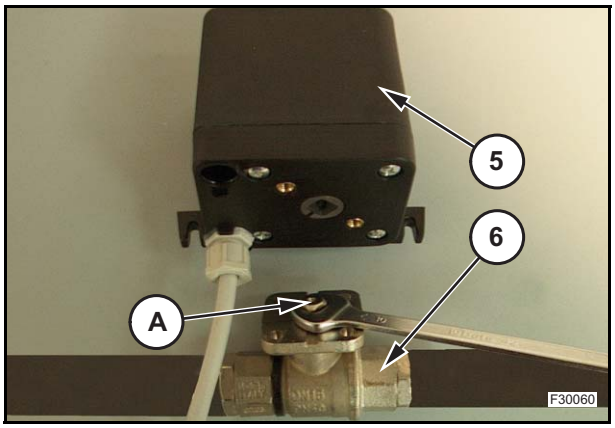
IMPORTANT: the release of the valve has to be performed if this valve remains idle for long periods.

Carry out this operation observing the following procedure:

- Disconnect the electrical connectors (1).
- Loosen the screws (2) and take out the electrical valve (3) from the evaporator.
- Loosen and remove the screws (4).



- Separate the driving unit (5) from the cock (6).
- By means of a wrench turn pin (A) of the cock so as to unlock it.



⚠ WARNING

Once this operation is complete, reset pin (A) in the correct start position.

Reinstall the heater valve, repeating the previous operation in the reverse order.

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FAULT FINDING -GENERAL

Items that may cause a concern are suggested in the fault finding chart but as a general rule apply the following steps:
Ensure water flow to the heater radiator is steady and all air has been removed from the system.
Hoses are unrestricted and not leaking.
Check the electrical connections are good and the blower motor is operational.
The operating cable to the heater valve and valve is operational.

FAULT FINDING

PROBLEM	CAUSE	CORRECTION
Dust enters the cab	Improper seal around filter element	Check the seal condition.
	Blocked filter	Clean or replace the filter.
	Defective filter	Replace the filter.
	Excessive air leak (s) around doors and windows	Repair and Seal air leak(s).
Blower motor air flow low	Blocked filter or recirculation filter	Clean or replace the filter(s).
	Heater radiator core blocked	Clean radiator core thoroughly.
Blower motor not working	Fuse blown	Replace fuse.
Cab does not heat up	Engine not reaching operating temperature. Thermostat stuck open	Replace the temperature switch.
	Heater hose from engine to cab radiator, kinked or blocked	Ensure water flow to heater radiator is adequate and not restricted.
Cab does not cool	Heater control turned on	Turn the temperature control knob fully counterclockwise for maximum cooling.
	Heater control valve stuck in open position	Free up valve or change as required.
Temperature not stable	Low engine coolant	Top up coolant recovery tank.

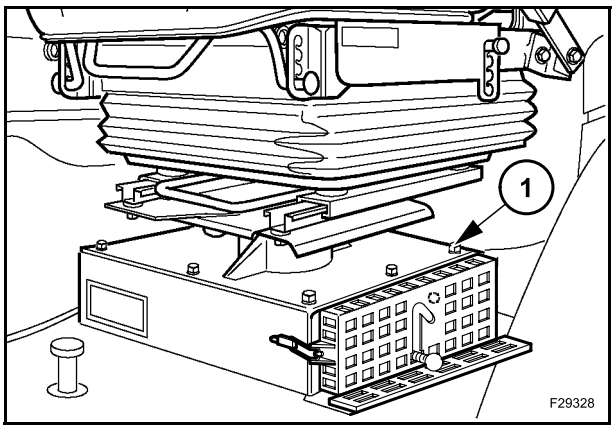
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OVERHAUL

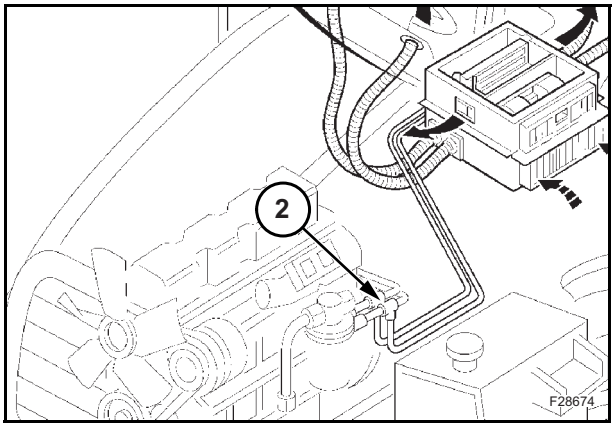
IMPORTANT: when overhauling the heating system remember that, with the engine running or shortly after it is turned off, the system will be at engine temperature and therefore the water will be hot and under pressure.

To effect repairs to the heater core or blower motor, it will be necessary to remove the attaching bolts (1) from the seat and remove seat from the heater housing.



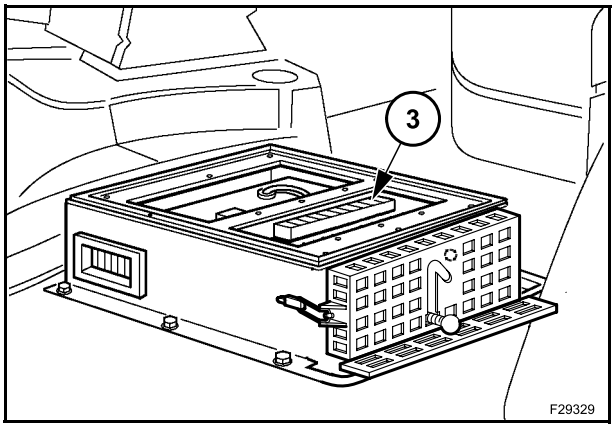
Draining the system

To drain the cooling system down disconnect either hose at the T junction (2) found at the rear of the engine oil filter mounted to the left hand side of the engine.



Heater radiator

With the system drained remove the heater radiator hose connections, attaching bolts and remove from the vehicle.
Inspect the heater radiator (3).
Check water flow through the heater pipe which should be free running; if not, clear any blockage.
Fins should be free of all debris and not damaged; clean and or repair.
Clean the heater radiator using compressed air not exceeding 7 bar taking care not to damage the radiator fins.
Ensure the radiator is not leaking under pressure; repair or replace as required.
Clean the chamber with a damp, cloth and re-assemble the housing filter element with the seal facing the inside of the cover.



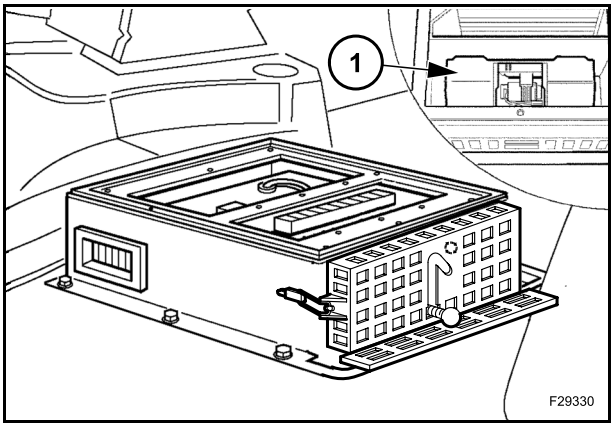
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Blower motor

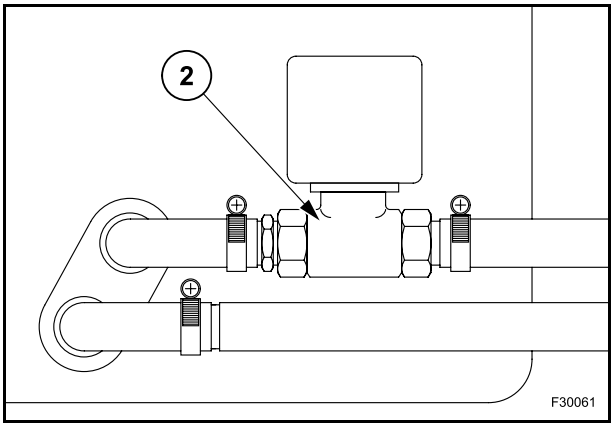
The blower motor (1) can be removed by removal of the attaching hardware and disconnection of the wiring connector.

Check the blower is working, if not check fuse and continuity of blower motor. If defective replace the blower unit as an assembly.



Heater control valve

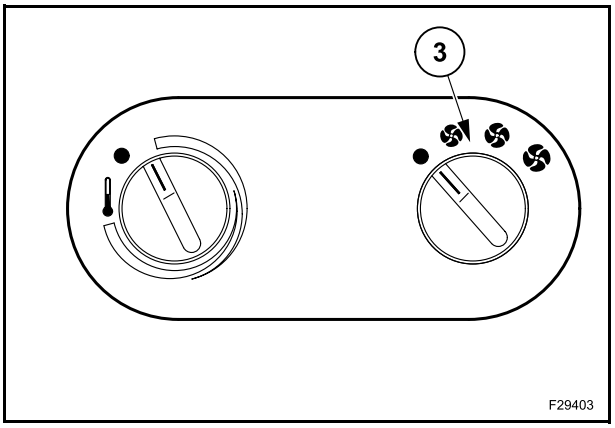
To service the control valve (2) disconnect the hoses and the control cable and remove. Check the operation of the valve and if tight or worn replace.



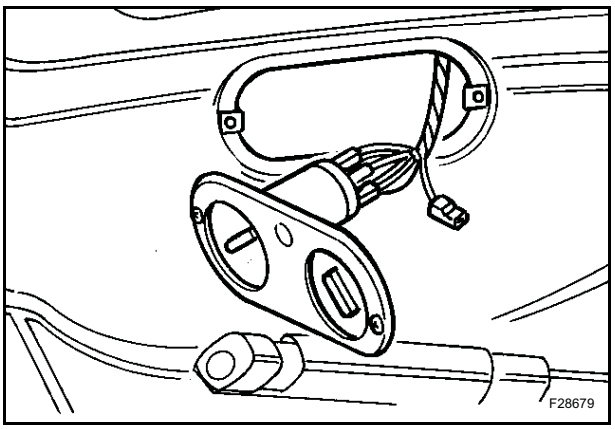
Heater control panel

The blower motor is operated by a 3 position switch (3) which through a variable potentiometer increases or decreases voltage to the blower motor.

The heater valve is operated by a control cable which will push or pull the valve into an open or closed position.



Both of the above are mounted to the right of the driver's seat and can be accessed by removal of the control panel for repair or replacement.



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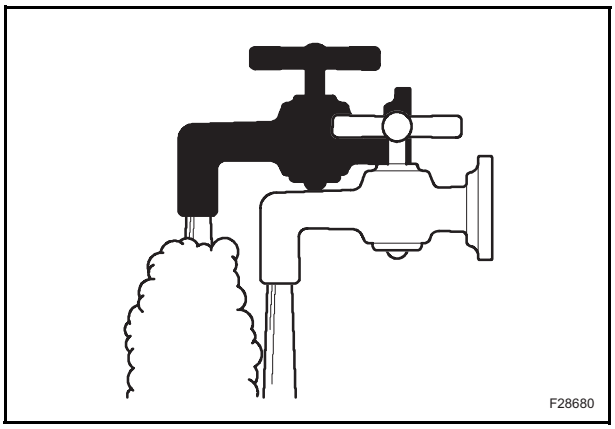
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3. AIR CONDITIONING

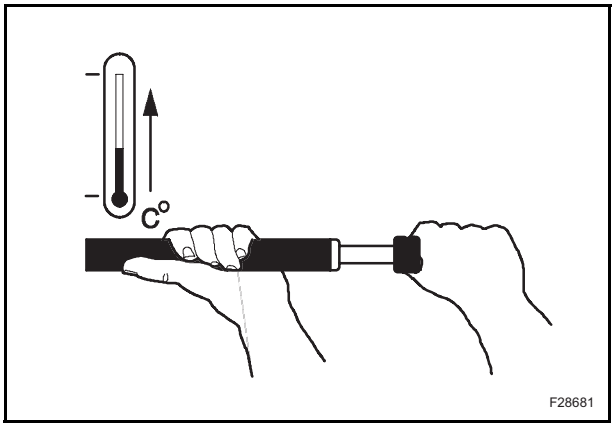
3.1 PRINCIPALS OF AIR CONDITIONING

The function of the air conditioning system is to improve the operator's comfort by cooling the air temperature inside the cab and reducing the humidity level. In order to achieve this heat transfer the following principals of heat generation and transfer are applied within the air conditioning system.

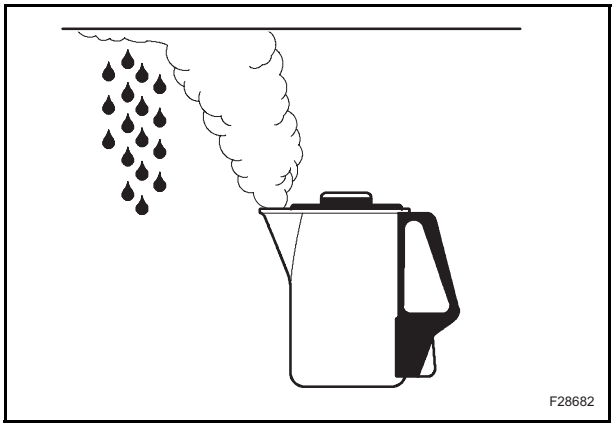
1. When two bodies of different temperature come together heat is transferred from one to another. On air conditioning systems an evaporator is used to hold the low temperature refrigerant which absorbs the heat from the air within the cab.



2. When a gas is pressurized the temperature of the gas will rise. In air conditioning systems the increase in pressure is achieved using a compressor.



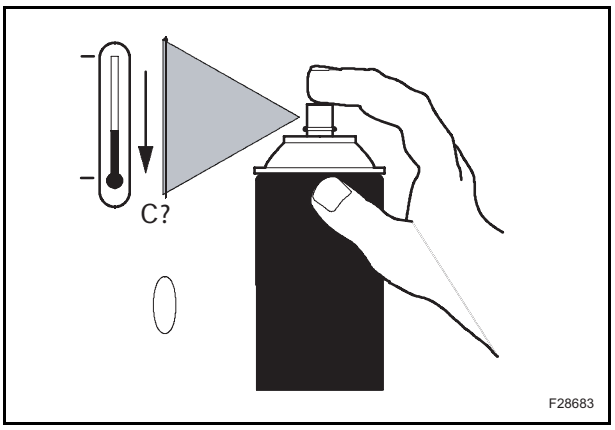
3. When a gas is cooled it will condense into a liquid. In the air conditioning system a condenser is used to cool the gas and the resulting liquid is stored in a receiver dryer.



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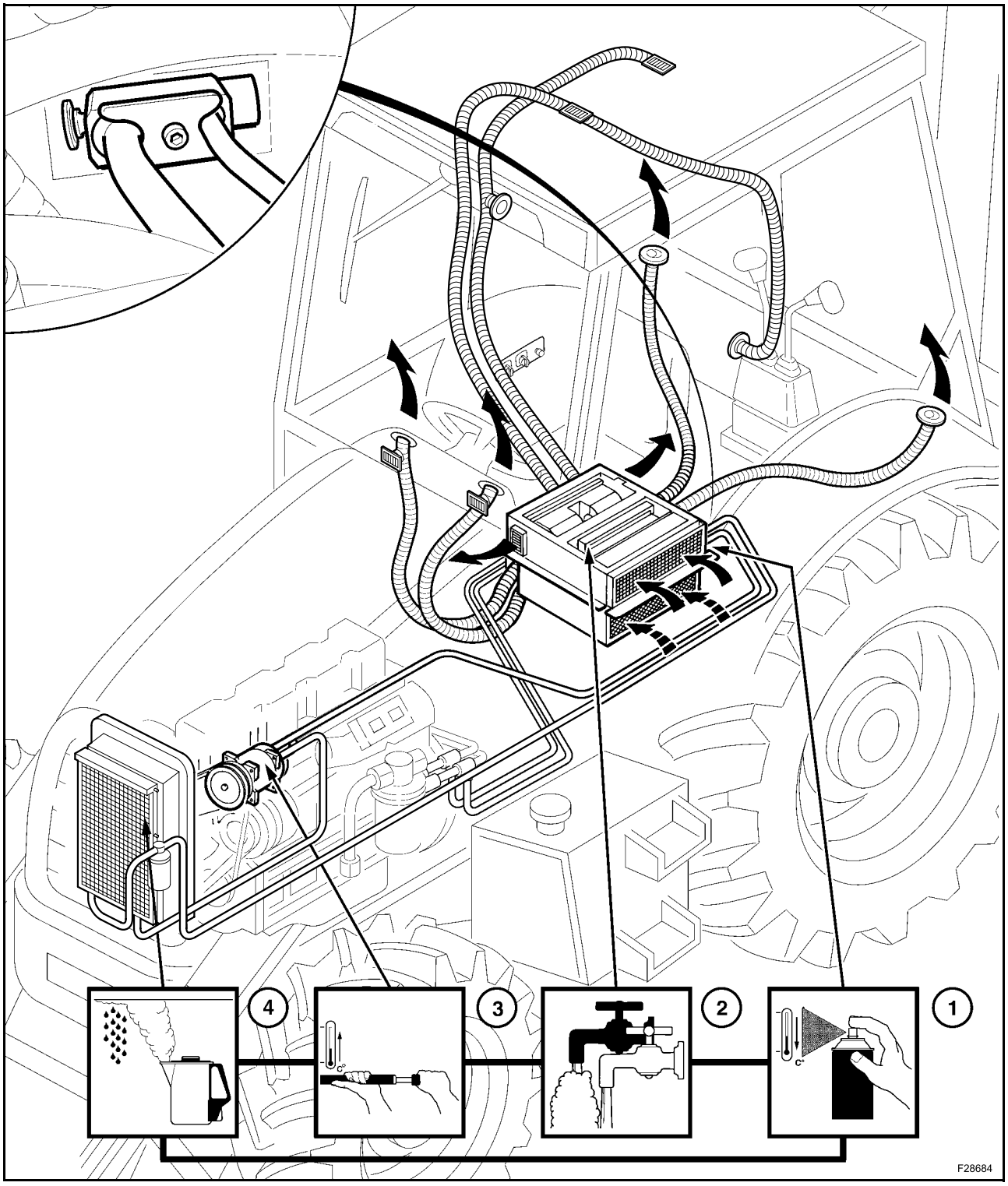
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4. When a liquid is atomized through an orifice, the temperature of the resultant vapour will lower. The low temperature of the atomized liquid will then absorb heat from its surrounding. On air conditioning systems the refrigerant is atomized using an expansion valve.



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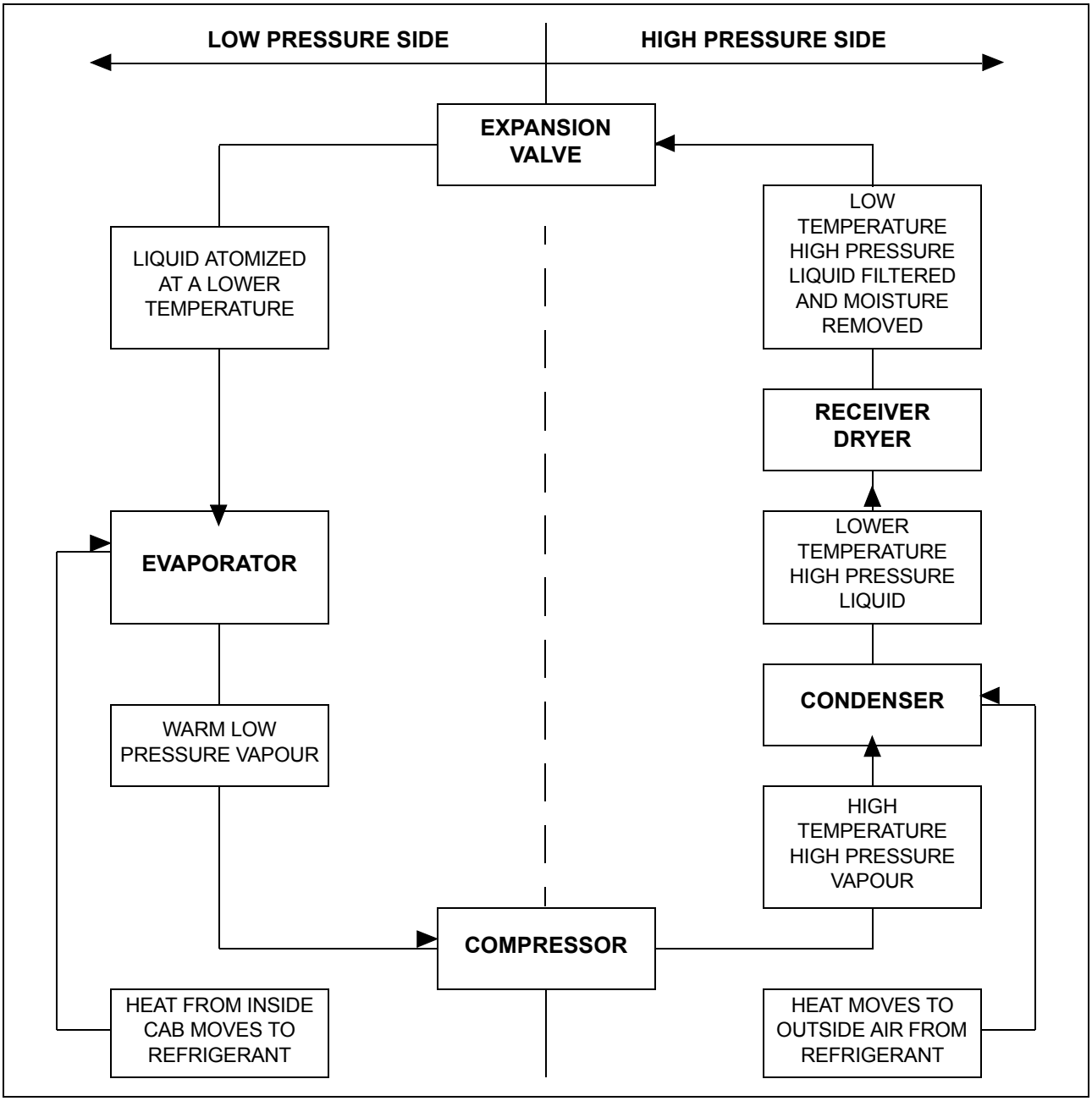


Air conditioning principle of operation

1. Expansion valve-atomizes liquid refrigerant before passing to evaporator
2. Evaporator-absorbs heat from air in cab
3. Compressor-compresses and raises temperature of refrigerant gas
4. Condenser and receiver dryer-converts refrigerant from gas to a liquid

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Air conditioning flow diagram

It can now be seen that the principal components of an air conditioning system are:
- Refrigerant
- Compressor
- Condenser
- Receiver dryer
- Expansion valve
- Evaporator

The figure in the previous page uses the examples above to illustrate the air conditioning cycle.

The figure in the this page shows in schematic form the flow of refrigerant through the five major components of an air conditioning system.
Refrigerant is drawn into the compressor as a cool, low pressure vapour which is compressed and then pumped out as a hot, high pressure vapour to the condenser.
As the hot, high pressure vapour passes through the condenser core it gives off heat to the cooler outside air, being drawn past the fins by the engine cooling fan.

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By giving off heat to the outside air, the vapour is condensed to a liquid which moves under high pressure to the receiver dryer where it is stored until released to the evaporator by the temperature sensing expansion valve.
As liquid refrigerant passes through the metered orifice in the expansion valve the refrigerant changes from a high pressure liquid to a low pressure atomized liquid with a lower temperature.
This low pressure, low temperature, atomized liquid enters the evaporator coils and absorbs heat from the cab warm air blown across the coils and fins by the cab blower motor. The refrigerant now changes from a cold low pressure atomized liquid to a warm low pressure vapour and leaves the evaporator outlet, moving to the suction (low pressure) side of the compressor to repeat the cycle.
As this heat loss is taking place, moisture (humidity) in the cab air will condense on the outside of the evaporator and drain off as water through the drain hoses attached to the evaporator drain pan, thereby reducing the humidity level of the cab.

3.2 SAFETY PRECAUTIONS

⚠ WARNING

Before overhauling an air conditioning system read and observe the following safety precautions. If a repair or replacement becomes necessary, ensure that only certified air conditioning technicians are employed, using approved equipment to effect repairs.
Do not attempt to disassemble the air conditioning system. It is possible to be severely frostbitten or injured by escaping refrigerant.

IMPORTANT: do not allow refrigerant to escape into the atmosphere.

Refrigerant must be handled with care in order to AVOID HAZARDS.
Undue direct contact with liquid refrigerant can produce freezing of skin and eyes.
Keep the refrigerant container and air conditioning system away from flame or heat sources; the resulting pressure increase can cause the container or system to explode.
If in direct contact with open flames or heated metal surfaces, the refrigerant will decompose and produce products that are toxic and acidic.

Make sure to comply with the following indications and simple precautions to avoid any risk of injury:

- Never discharge refrigerant into the atmosphere. When servicing air conditioning units a certified refrigerant recovery unit operated by a certified technician must be used.
- When discharging the refrigerant in the system make sure you are operating in well-ventilated premises with good air circulation and far away from open flames.
- When charging and discharging the system always wear goggles and take suitable precautions to protect the face in general and the eyes in particular, from accidental spillage of the refrigerant fluid.
- The oil and refrigerant mixture inside the air conditioning system is pressurized. Consequently, never loosen fittings or tamper with lines unless the system has been properly discharged.
- Before loosening any connection, cover the fitting in question with a cloth and wear gloves and goggles in order to prevent refrigerant from reaching the skin or eyes.
- In the event of an accident, proceed as follows:
  If the refrigerant has reached the eyes, wash them immediately with copious amounts of sterilized water or mains pressure tap water and transfer to hospital for immediate medical help.
  If the refrigerant has touched the skin, wash with cold water and transfer to hospital for immediate medical help.

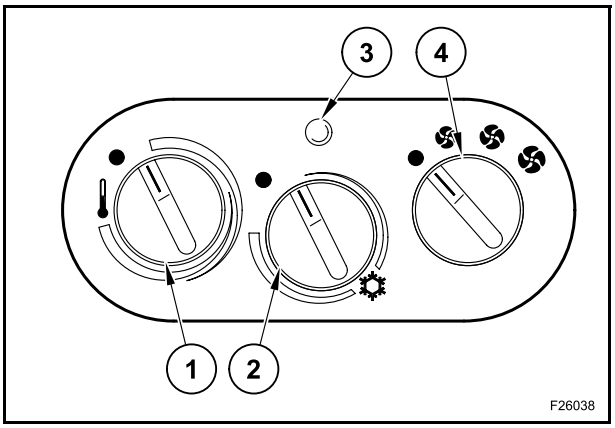
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3.3 CONTROLS AND OPERATION

CONTROLS (580SR)

The air conditioning control can be adjusted to obtain the desired temperature in the cab.
To activate air conditioning, turn the selector (2). Upon activation, the warning lamp (3) turns on. The selector (1) allows choosing the ideal temperature according to your requirements. Positioning selector (1) to “0” and turning selector (2) you will obtain more or less cold according to the selector (2) position. By positioning selector (1) to any other position different from “0”, you will obtain instead a mixture of warm and cold air and the desired climate inside the cab.



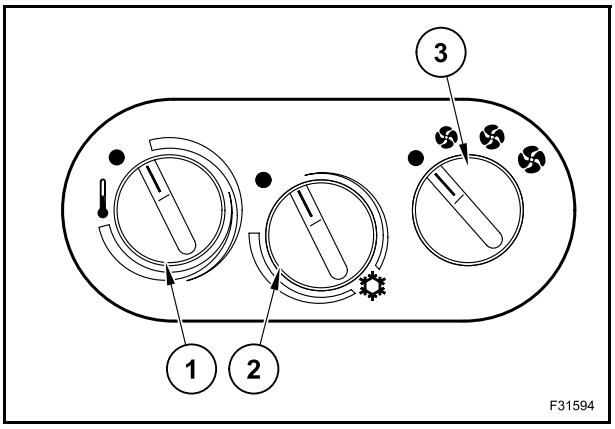
1

NOTE: the air conditioning can be operated only if the ventilation selector (4) is not set to the stop position.

Turn the selector (4) for air capacity according to your requirements.

CONTROLS (580SR+ / 590SR / 695SR)

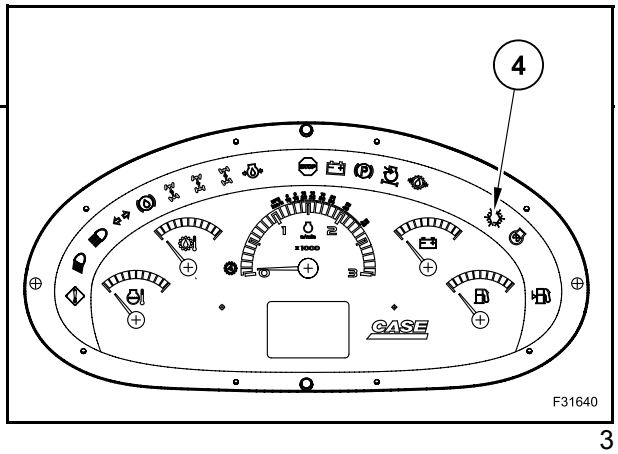
The air conditioning control can be adjusted to obtain the desired temperature in the cab.
To activate air conditioning, turn the selector (2). Upon activation, the warning lamp (4) on the side instrument cluster turns on. The selector (1) allows choosing the ideal temperature according to your requirements. Positioning selector (1) to “0” and turning selector (2) you will obtain more or less cold according to the selector (2) position. By positioning selector (1) to any other position different from “0”, you will obtain instead a mixture of warm and cold air and the desired climate inside the cab.



2

NOTE: the air conditioning can be operated only if the ventilation selector (3) is not set to the stop position.

Turn the selector (3) for air capacity according to your requirements.



3

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OPERATION

IMPORTANT: when using the air conditioning, it is essential that all the windows of the operator's compartment are completely closed.

NOTE: to ensure correct operation and full efficiency of the air conditioning system, it must be used at least once a week, even for a short time.

The air-conditioner filter is located on the left hand side of the seat pod.

⚠ WARNING

The air filter is designed to remove dust from the air but may not exclude chemical vapour. Refer to chemical manufacturers directions regarding protection from dangerous chemicals.

If the machine has been parked in the sun, quicken the cooling by operating the air-conditioning for 2-3 minutes at its coldest setting. Set maximum blower speed with a window left partially open to force most of the warm air from the cab.
With the air cooled sufficiently, close the window and adjust the controls to the desired temperature. To ensure proper operation of the system be sure the cab filter is regularly serviced. Refer to filter maintenance.
It is the normal function of the air-conditioner to extract water from the air. As such it is possible pools of water will collect beneath the drain hose outlets under the cab when the machine is stationary.

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COOLANT

To achieve the absorption and the release of heat which is, in essence, the function of an air conditioning system, requires the use of a suitable “refrigerant” a liquid that has a relatively low temperature boiling point, plus certain desirable safety and stability features.
The refrigerant used in the air conditioning system is refrigerant **HFC 134a**.

NOTE: to help protect the environment legislation has been introduced in most territories banning the release into the atmosphere of refrigerants, including HFC 134a. All service procedures contained in this manual can be carried out without the need to release refrigerant into the atmosphere.

In order to prevent the incorrect type of refrigerant being charged to the system the service valves fitted to the Backhoe Loader and necessary to connect up refrigerant recovery, evacuation and recycling/recharging equipment will be of two different sizes as recognized and specified by the air conditioning industry.

⚠ WARNING

Coolant HFC 134a **is not compatible** with coolant R-12. **Do not** try to replace coolant HFC 134a with coolant R-12 or to test the system using instruments or attachments previously used with R12, as the system could get damaged.

HFC 134a refrigerant is stable at all operating temperatures and able to absorb great quantities of heat.
The boiling point of HFC 134a is -22 °C at atmospheric pressure.
If the pressure is increased, HFC 134a will readily vaporize to absorb heat at temperatures between -11.7 °C at 1.9 bar and 0 °C at 2.9 bar in the evaporator.
At higher pressures, HFC 134a will condense and give off heat at temperatures between 48 °C at 12.4 bar and 58 °C at 15.85 bar in the condenser.

⚠ WARNING

HFC 134a can be dangerous if improperly handled. Therefore it is important the following warning and directions are adhered to.
Never expose any part of the air-conditioner system to flame or excessive heat because of risk of fire or explosion, and the production of phosgene gas.
Never disconnect or disassemble any part of the air-conditioning system as escaping refrigerant can cause frostbite.

⚠ WARNING

If refrigerant should contact the skin use the same treatment as for frostbite.
Warm the area with your hand or lukewarm water 32 °C, cover the area loosely with a bandage to protect affected area against infection and consult a doctor immediately.
If refrigerant should contact the eyes wash immediately in cold clean water for at least 5 minutes and consult a doctor immediately.

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COMPRESSOR



The air conditioning compressor is mounted on the left hand side of the engine and is belt driven from the crankshaft pulley.

The compressor separates the low and high pressure sides of the system and has two functions:

1. To raise the refrigerant temperature by compression to a higher degree of temperature than the ambient (outside air) temperature.
2. To circulate the required volume of refrigerant through the system.

The refrigerant compressor is a seven cylinder wobble plate unit housed in a die cast aluminium housing.

Drive to the wobble plate is from the pulley, through the electro-magnetic clutch to the main driveshaft.

Attached to the driveshaft is a cam rotor which oscillates the wobble plate. The wobble plate is prevented from rotating by a static gear engaging with teeth formed in the face of the plate. The seven pistons are connected to the wobble plate by rods located in ball sockets.

Refrigerant is drawn in on the downward stroke of a piston through the reed valves located either end of the cylinder assembly. Refrigerant enters the cylinder assembly through a gallery in the outer circumference of the cylinder assembly.

During the upward stroke, the piston compresses the refrigerant and expels it through another reed valve into an inner gallery in the cylinder and, from here, out into the coolant system.

The compressor is lubricated with a Polyalklene Glycol (PAG) oil Type SP20. This oil can be mixed with coolant and is carried around in the coolant system itself.

The compressor is activated by an electro-magnetic clutch which functions to engage or disengage the compressor as required in the operation of the air conditioning system.

The clutch is primarily activated by the:

- temperature control
- low pressure cut-out switch

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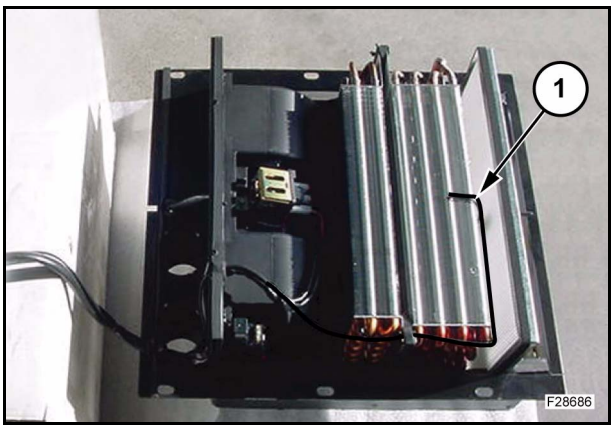
Temperature control

The air conditioner temperature control switch is mounted on the blower motor assembly.

The switch is a device which turns the compressor clutch on and off to maintain a constant average evaporator temperature and senses the evaporator temperature using a thermistor (1).

The temperature control switch compares the voltage of the thermistor, which is dependent on the temperature of the evaporator, with the voltage across the potentiometer of the “in cab” temperature control switch.

The switch upon comparing the two voltages determines whether the compressor clutch should be switched “on” or “off” in order to maintain the desired in cab temperature control.



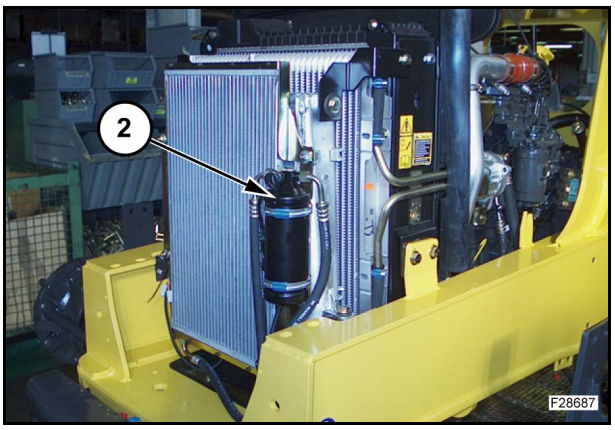
Low pressure cut-out switch

The low pressure switch (1) is mounted in the top of the filter (2) mounted in front of the radiator behind the battery.

The purpose of the switch is to shut off the compressor pump in the event of low pressure in the refrigerant system.

Low refrigerant pressure may occur due to a faulty expansion valve, icing up of the expansion valve orifice or refrigerant loss. Low refrigerant pressure may result in damage to the compressor pump.

The low pressure switch is factory set and cannot be adjusted.

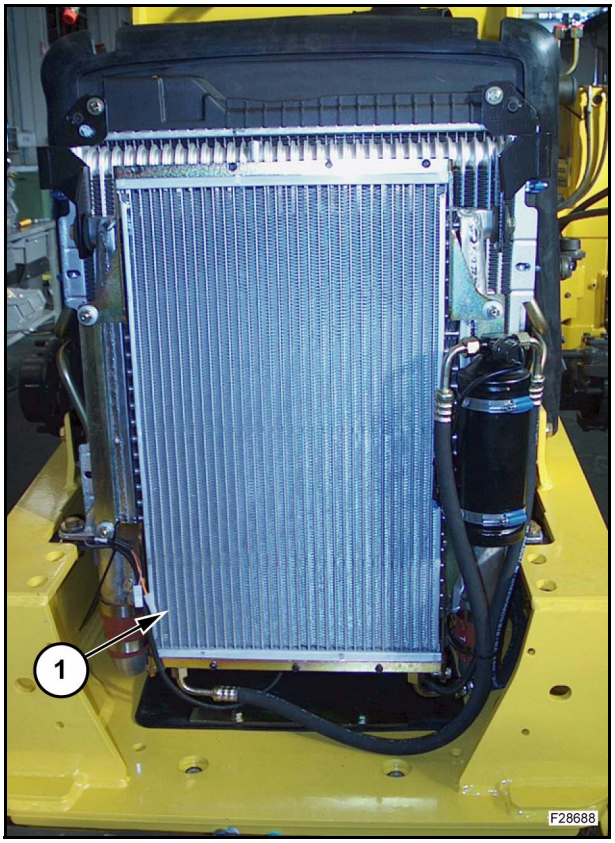


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CONDENSER

The condenser (1), located at the front of the machine in front of the engine radiator consists of a number of turns of continuous coil mounted in a series of thin cooling fins to provide a maximum of heat transfer in a minimum amount of space.

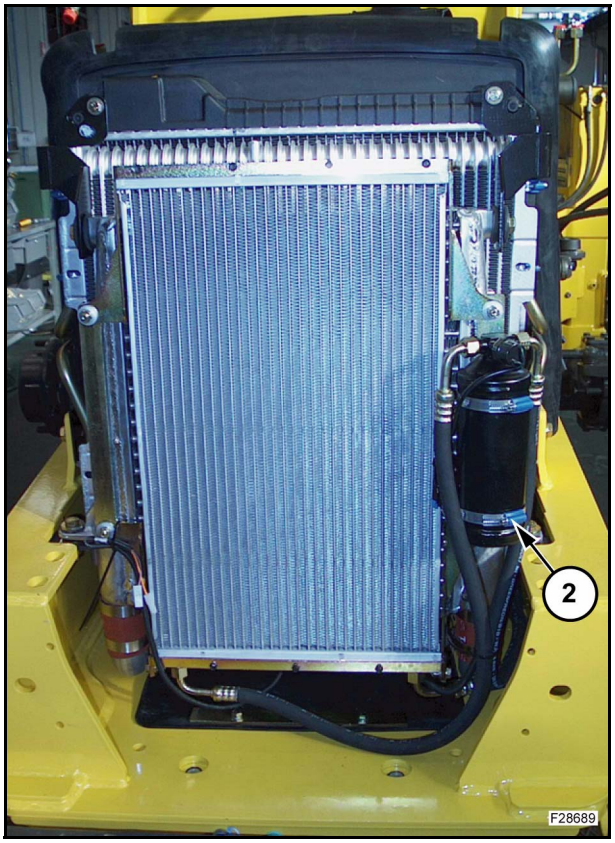


NOTE: the condenser after removal of the attaching bolts can be slid out for cleaning.

The condenser receives the hot, high pressure refrigerant vapour from the compressor. The hot vapour passes through the condenser coils and outside air is drawn through the condenser by the engine cooling fan.
Heat moves from the hot refrigerant vapour into the cooler outside air flowing across the condenser coils and fins.
When the refrigerant vapour reaches the pressure and temperature that will induce a change of state, a large quantity of heat is transferred to the outside air and the refrigerant changes to a high pressure warm liquid.
The warm liquid refrigerant continues onto the receiver/drier where it is filtered and desiccated, to remove any moisture, before passing through an outlet line to the thermostatic expansion valve.

RECEIVER DRYER

The receiver/dryer (2) situated behind the battery stores the liquid refrigerant to be sure a steady flow to the thermostatic expansion valve is maintained under widely different operating conditions.
The drier section contains a desiccant (Molecular sieve) to absorb any moisture within the system and a filter prevents the entry of foreign particles.



NOTE: any moisture in the air conditioning system is extremely harmful. Moisture not absorbed by the dehydrator will circulate with the refrigerant and droplets may collect and freeze in the thermostatic expansion valve orifice. This action will block the refrigerant flow and stop the cooling action. Moisture will also react with refrigerant HFC 134a and the lubricant to form a corrosive acid.

The desiccant can only absorb a limited amount of moisture before reaching saturation point. Because of this, after any system component replacement or repairs requiring entry into the system, the receiver/dryer should be replaced.

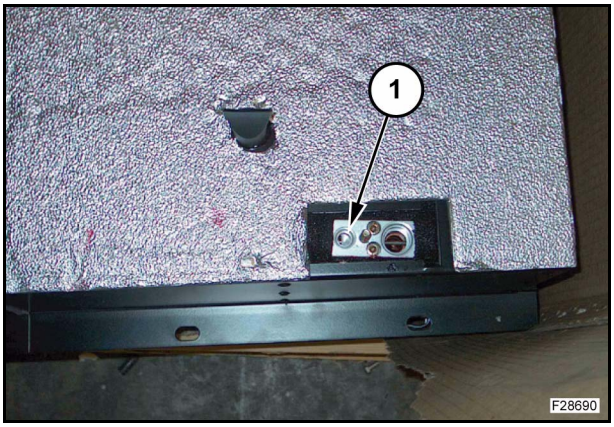
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EXPANSION VALVE

The expansion valve is located underneath the evaporator in the pressure line leading from the receiver/dryer and performs the following functions:

1. METERING ACTION
   A metered orifice changes the liquid refrigerant from a high pressure low temperature liquid to a low pressure, lower temperature atomized liquid.
2. MODULATING ACTION
   A thermostatically controlled valve within the expansion valve body controls the volume of liquid refrigerant passing through the orifice and makes sure the refrigerant is fully vaporized within the evaporator. Liquid refrigerant at would damage the compressor reed valves or freeze the pistons.
3. CONTROLLING ACTION
   The valve responds to changes in the cooling requirements. When increased cooling is required, the valve opens to increase the refrigerant flow and when less cooling is required the valve closes and decreases the refrigerant flow.



Expansion valve - operation

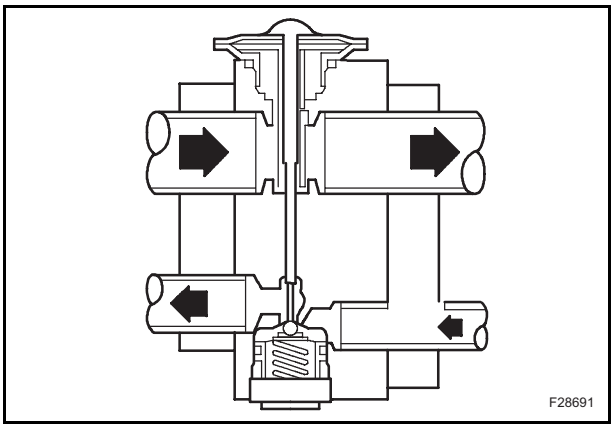
All of the needed temperature sensing and pressure sensing functions are consolidated into this basic unit and no external tubes are required for these purposes. The refrigerant from the condenser and receiver dryer enters the thermostatic expansion valve as a high pressure warm liquid. Upon passing through the ball and spring controlled metering orifice, the pressure and temperature of the refrigerant is reduced and the refrigerant leaves the thermostatic expansion valve as a low pressure, lower temperature atomized liquid.

The atomized liquid now passes through the evaporator where it absorbs heat before returning via the expansion valve to the compressor as a warm low pressure vapour. There are two refrigerant passages in the valve. One passage is in the refrigerant line from the condenser to the evaporator and contains the ball and spring type orifice valve.

The other passage is in the refrigerant line from the evaporator to the compressor and contains the valve's temperature sensing element.

Liquid refrigerant flow from the condenser and receiver dryer is controlled by a push-rod forcing the orifice valve ball off its seat and the spring exerting pressure on the ball to keep it on its seat.

During stabilized (vehicle shutdown) conditions, the pressure on the bottom of the expansion valve diaphragm rises above the pressure on the top of the diaphragm allowing the valve spring to close the orifice.



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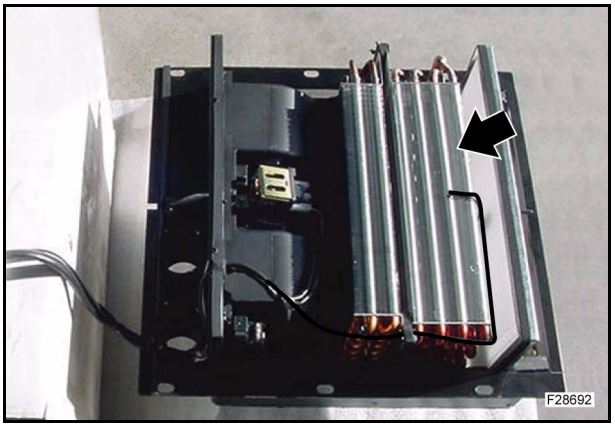
When the system is started, the pressure on the bottom of the diaphragm lowers rapidly, allowing the orifice to open and metre atomized liquid refrigerant to the evaporator where it begins to vaporize.
Suction from the compressor draws the vaporized refrigerant out of the evaporator and back through a gallery in the top of the valve which asses the temperature sensor.
The temperature sensor reacts to variations in refrigerant gas pressure returning from the evaporator.
When heat from the passenger compartment is absorbed by the refrigerant the pressure of the gas increases causing a differential pressure above and below the temperature sensor diaphragm. The diaphragm reacts to this pressure differential and a push rod forces the ball in the expansion valve orifice further off its seat. This reaction allows an increase in the atomized refrigerant to flow through the valve, to the evaporator, so that more heat can be absorbed by the air conditioning system.
Similarly when the temperature of the gas returning from the evaporator decreases the pressure of the gas decreases. This causes the diaphragm to react accordingly and allow the ball in the orifice to move closer towards its seat thus reducing the flow of refrigerant through the valve to the evaporator.

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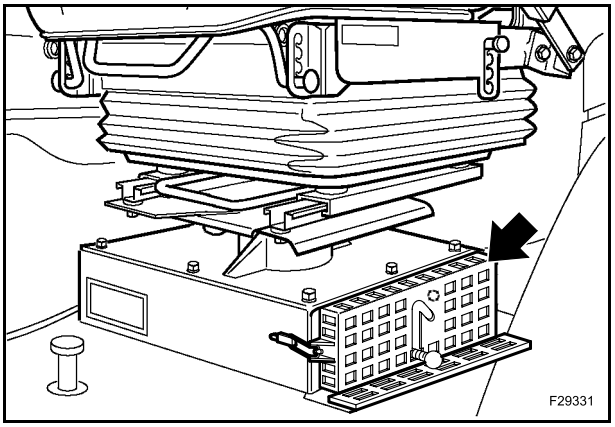
EVAPORATOR

The evaporator is located beneath the cab seat and consists of a number of turns of continuous coils mounted in a series of thin cooling fins to provide a maximum of heat transfer in a minimum amount of space.
Low temperature refrigerant in the evaporator absorbs heat from the hotter air in the operator's compartment, thereby cooling the air.



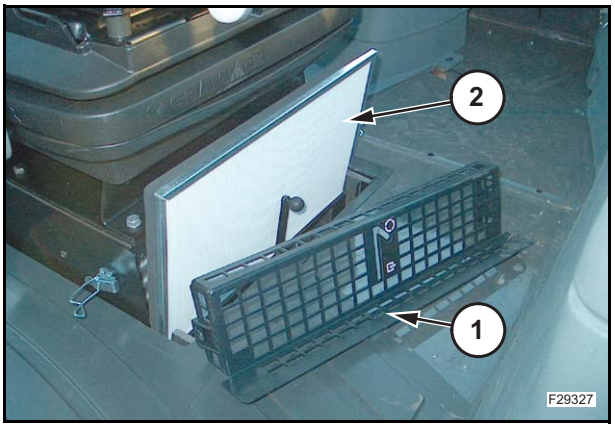
Air Recirculation

An intake grille is located on the left side of the seat base. A portion of the air flow will recirculate through the evaporator.



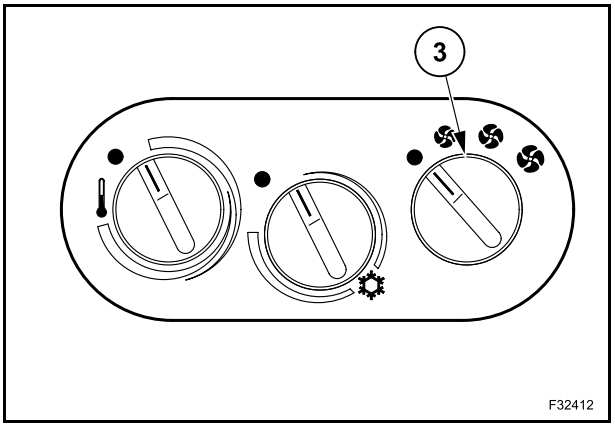
Filter General

The blower fan, draws warm air from outside the cab through the intake filter (2) below the cab floor and a ready cooled dehumidified air through the recirculation grille (1). The air passes over the evaporator then into the cab through the six louvered vents.
Two vents are located on the front instrument panel to direct air onto the windshield. Two are located at the base of the rear posts to direct air onto the rear window. Two additional vents are located at the front and rear of the seat base to direct air at the operator's feet.



Blower Fan

The blower motor is controlled by a three-speed switch (3) which uses a variable resistor to change the fan speed.
High blower speed provides the greatest volume of circulated air, however, a slower speed will allow the air to contact the cooling fins and coils of the evaporator for a longer period resulting in the warm air giving up more heat to the cooler refrigerant. Therefore, the coldest air temperature is obtained when the blower fan is operated at the lowest speed.



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3.4 FAULT FINDING AND TESTING

Overhaul of the air conditioning system should only be undertaken by a certified specialist refrigeration engineer using a comprehensive air conditioning test kit, including a gas leak detector, suitable for HFC 134a refrigerant gas.

⚠ WARNING

Before dismantling an air conditioning system for repair the gas within the system must be discharged and recovered using a certified recovery unit designed for the type of refrigerant gas used in the system.
NEVER release refrigerant gas into the atmosphere.
ALWAYS wear safety goggles and gloves when servicing any part of the air conditioning system.

To prevent the entry of any foreign material, observe the following points:

- Ensure all tools, gauges, hoses and replacement parts are kept clean and dry and are suitable for the type of refrigerant gas used in the system.
- Clean all hoses and fittings before disconnecting.
- Cap or plug all openings when disconnected.
- When adding lubricating oil to the system always uncap and re-cap the oil container immediately before and after use. Always ensure the oil remains free of moisture.

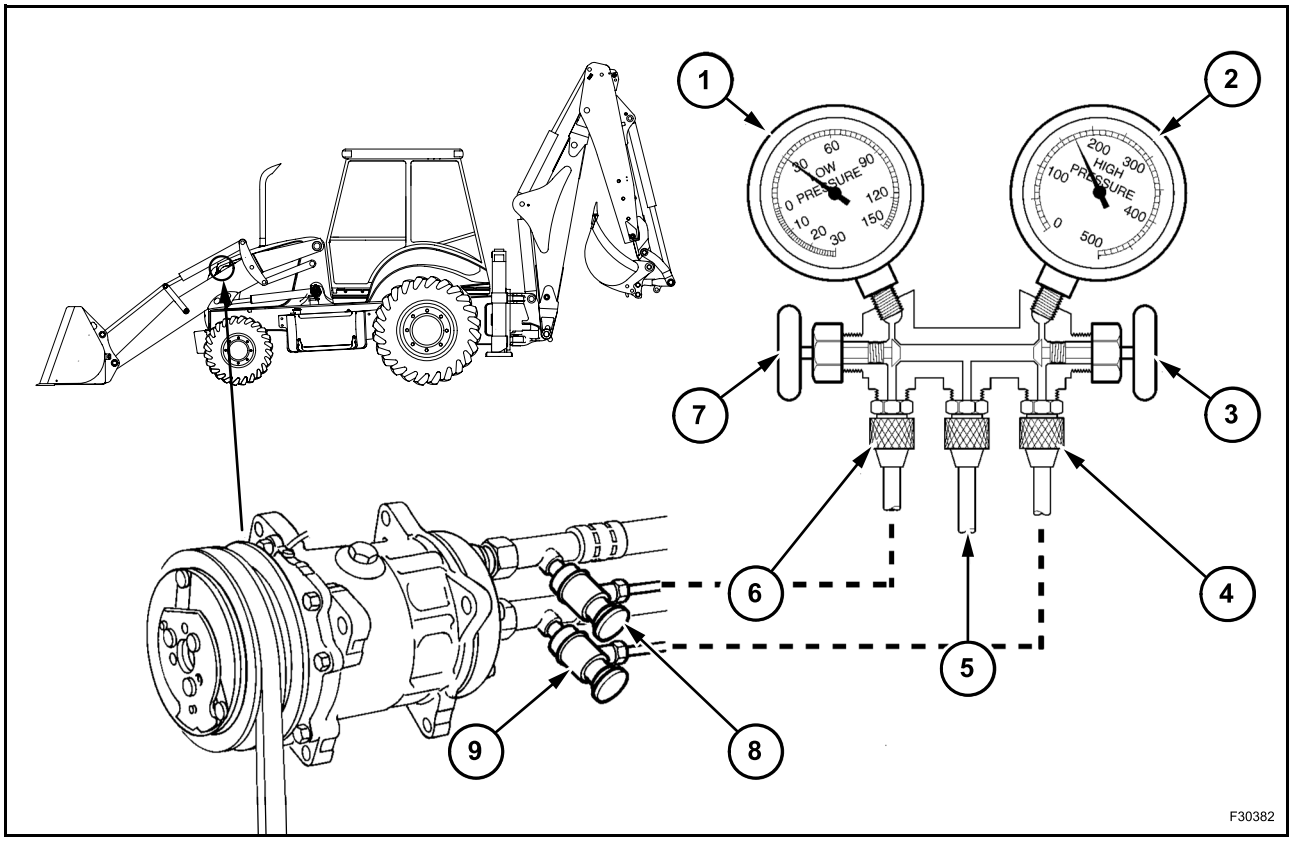
Preliminary fault finding

Always conduct the preliminary fault finding checks before performance testing the system.

1. Run the engine at 1000-1200 rpm for 10 minutes with the air conditioner set to maximum cooling and the blower at high speed.
2. Check that the heater temperature control is switched OFF.
3. Check that the blower fan is operating at all speeds.
4. Check that the compressor clutch engages when the temperature control switch is turned from OFF to ON position. A clicking sound indicates the clutch is engaging. If the clutch fails to operate it may indicate an electrical problem in the high low pressure cut out switches or malfunction of the electrical drive clutch on the compressor.
5. Check the engine cooling fan is drawing cool air through the condenser.
6. Check the compressor drive belt tension.
7. Check the condenser core and grid is clean and free of obstruction.
8. Check the cab air filter is clean and free of obstruction.
9. Check the evaporator fins are not plugged or excessively dirty.

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Attaching The Gauge Set To The Loader Backhoe

1. Low side gauge
2. High side gauge
3. Shut-off Valve
4. Test Hose to High Side Service Connector
5. Centre Hose (Not Used)
6. Test Hose to Low Side Service Connector
7. Shut-off Valve
8. Low Pressure (Suction) Side Service Valve
9. High Pressure (Discharge) Side Service Valve

Performance Testing The Air Conditioning System

The manifold gauge set is the most important tool used in testing and servicing the air conditioning system.

NOTE: for Dealers who posses the latest design level of refrigerant recovery, recycling and recharging station, these gauges are an integral part of the machine.

The following instructions for performance testing the air conditioning system is based on the use of the gauge set shown. The principal of operation is however similar when testing the system using a recovery and recharging station with integral gauges. When using this type of equipment **always** consult the manufacturers operating instructions.

Operating Precautions

IMPORTANT: always ensure the shut-off valves are **closed** (turn clockwise until seated) during all test operations.

In the closed position, refrigerant circulates around the valve stems to the gauges. Therefore, when the manifold gauge set is connected into a system, pressure is registered on both gauges.

- **NEVER** open the HIGH SIDE shut off valve when the system is operating.
- **ALWAYS** open the LOW SIDE shut off valve when adding refrigerant.

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Attaching The Gauge Set To The Loader Backhoe

⚠ WARNING

To avoid personal injury, stop the loader backhoe engine during connection of the manifold gauge set.

1. Check that the gauge set shut off valves are closed (turned fully clockwise).
2. Connect the high side gauge hose (normally red) to the high pressure (discharge) side service valve and the low side gauge hose (normally blue) to the low pressure (suction) side service valve on the loader backhoe. Ensure the hose connections are fully tightened.

IMPORTANT: prior to connection of the manifold gauge set, identify the suction (low pressure) and discharge (high pressure) service gauge ports. The high pressure service valve is always in the line from the compressor to the condenser.

The high and low pressure service valves on the loader backhoe are spring loaded valve and will be automatically opened when the test hose is connected.

NOTE: the test hose must incorporate a valve depressor to actuate this type of valve.

The service valves have a protective cap. This cap must be removed for test gauge connections and replaced when service operations are completed.

Test Procedure

After the manifold gauge set has been connected and before pressure tests can be made, the system must be stabilized as follows:

1. Apply the parking brake, check the gearshift levers are in neutral and close the cab windows and doors.
2. Re-check that both the high and low side shut off valves on the manifold gauge set are fully closed.
3. Run the engine at 1000-1200 rpm.
4. Turn the heater temperature control OFF.
5. Operate the system at maximum cooling, with the blower fan at high speed for 10 minutes to stabilize all components.
6. Check the manifold low pressure gauge reading is within the specified range of approximately 0.28-2.48 bar.
7. Check the manifold high pressure gauge reading and compare the reading to the pressure indicated on the pressure temperature chart below.
8. Measure and compare the temperature of conditioned air entering the cab through the louvered air vents with the ambient air at the air intake filters on the outside of the cab.
   If the system is operating correctly the conditioned air entering the cab should be 6-9 °C cooler than the ambient temperature of the outside air.
9. If it is confirmed that the system is not operating correctly refer to the fault diagnostic charts and performance test gauge reading examples on the following pages for possible corrective action.

⚠ WARNING

A significant amount of refrigerant vapour may have condensed to a liquid at the service fitting at the high side of the compressor. Use a cloth or other protective material when disconnecting the manifold hose from this fitting to prevent personal injury to hands and face.

APPROXIMATE HIGH PRESSURE GAUGE READINGS

Ambient air temperature	High pressure gauge reading
°C	bar
27	10.0/11.6
29	11.2/12.7
32	12.3/13.8
35	13.3/15.2
38	14.5/16.7
41	16.0/18.3
43	17.3/20.0

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PERFORMANCE TEST DIAGNOSIS

Pressure gauge values: Low pressure - Low
High Pressure - Low

PROBLEM	POSSIBLE CAUSE	CORRECTION
Evaporator air not cold	Low refrigerant charge	Perform leak tests and repair. Evacuate the system. Charge system, re-test system.
Evaporator air warm	Extremely low refrigerant charge	Perform leak tests and repair. Evacuate the system. Charge system, re-test system.
Evaporator air cool but not sufficiently cold Low pressure switch cutting out Expansion valve to evaporator tube shows considerable condensation or frost Too cold to touch	Expansion valve not permitting sufficient flow Stuck valve	Check expansion valve as follows: Set for maximum cooling. Low pressure gauge should lower slowly. If expansion valve is defective: Discharge the system. Replace the expansion valve. Evacuate the system. Charge the system. Re-test.

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PERFORMANCE TEST DIAGNOSIS CHART

Pressure gauge values: Low pressure - High
High Pressure - High

PROBLEM	POSSIBLE CAUSE	CORRECTION
Evaporator air warm Liquid line hot (condenser outlet to expansion valve tube)	Improper operation of condenser	Inspect for dirty condenser restricting air flow and cooling. Check operation of condenser cooling fans. Repair or replace as needed. Check for overcharge as follows:
High pressure switch cutting out	Overcharged with refrigerant Air in system	Stop the engine. Recover and recycle the charge using correct recovery equipment. Recharge the system with the correct quantity of refrigerant, replacing any lost lubricant. Recheck performance of air conditioning system.
Evaporator air not cold	Expansion valve allowing too much refrigerant to flow through the evaporator	Check expansion valve as follows: Set for maximum cooling. Low pressure gauge should lower slowly. If expansion valve is defective: Discharge the system. Replace the expansion valve. Evacuate the system. Charge the system. Re-test.

PERFORMANCE TEST DIAGNOSIS CHART

Pressure gauge values: Low pressure - Low
High Pressure - High

PROBLEM	POSSIBLE CAUSE	CORRECTION
Insufficient cooling	Restriction in liquid line	Discharge the system. Replace receiver/drier. Inspect all lines and tubing from compressor outlet to expansion valve. Replace if needed. Evacuate the system. Charge the system. Re-test.

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PERFORMANCE TEST DIAGNOSIS CHART

Pressure gauge values: Low pressure - High
High Pressure - Low

PROBLEM	POSSIBLE CAUSE	CORRECTION
Evaporator air not cold	Internal leak in compressor (reed valves, gasket, worn or scored piston rings or cylinder)	Discharge the system. Replace the compressor. Evacuate the system. Charge the system. Re-test.

PERFORMANCE TEST DIAGNOSIS CHART

Pressure gauge values: Low pressure - Normal
High Pressure - Normal

PROBLEM	POSSIBLE CAUSE	CORRECTION
Insufficient cooling Low pressure reading does not fluctuate with changes in temperature control switch (pressure should lower until compressor cycles) Evaporator air not cold	System low on charge. Air or moisture present in system	Perform leak test. Discharge the system. Repair leaks. Replace receiver/drier. Check oil level. Evacuate the system. Charge the system. Re-test.

PERFORMANCE TEST DIAGNOSIS CHART

Pressure gauge values: Low pressure - High
High Pressure - Normal

PROBLEM	POSSIBLE CAUSE	CORRECTION
Compressor cycles ON and OFF too frequently	Defective temperature control (thermostatic) switch	Stop engine and shut off A/C. Replace temperature control switch. Re-test system and check compressor cycling.

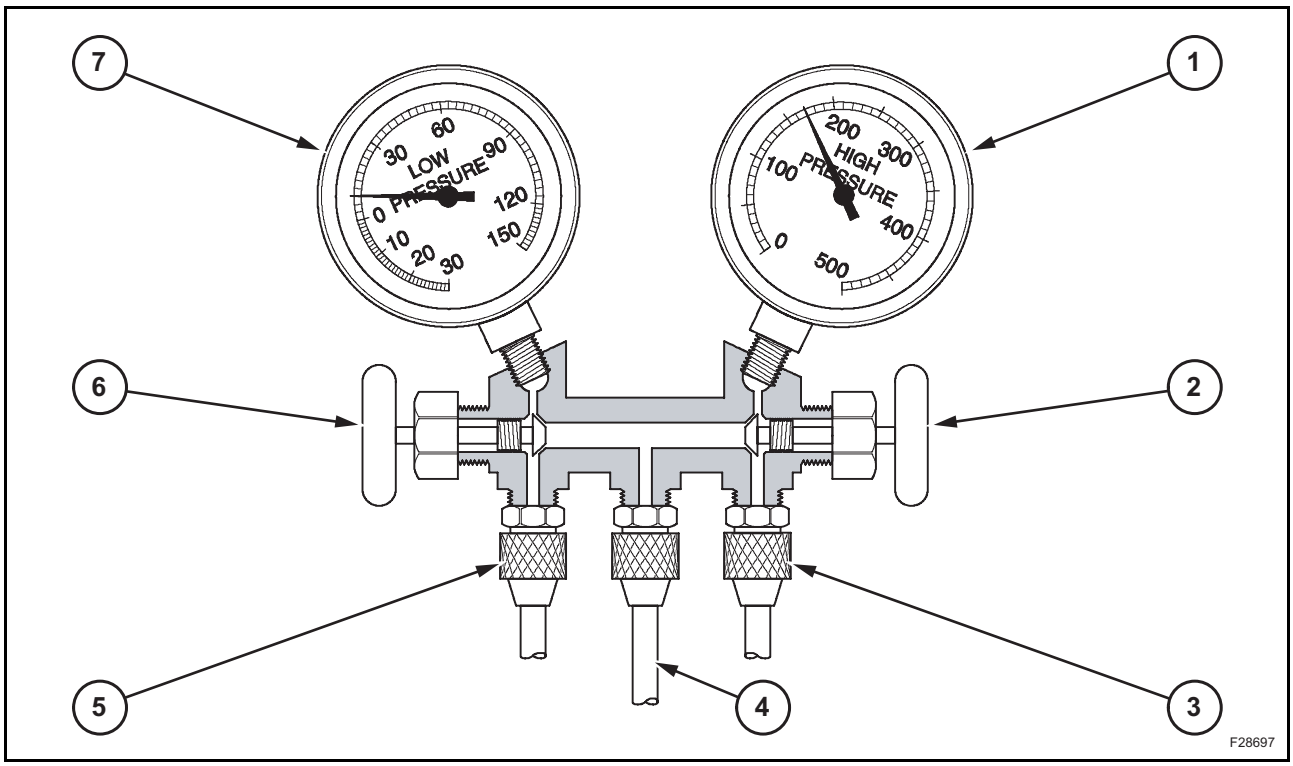
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EXAMPLES OF MANIFOLD GAUGE READINGS AND INTERPRETATIONS

The following examples show typical low and high pressure gauge readings obtained when performance testing the air conditioning system with an ambient temperature of 35 °C.
The recommended corrective action is based on a similar fault as identified in the performance test diagnosis charts.

PERFORMANCE TEST EXAMPLE 1



Performance Test Example 1

1. High side low
2. High side hand valve closed
3. High side hose connected to high side service connector
4. Not used
5. Low side hose connected to low side service connector
6. Low side hand valve closed
7. Low side low

PROBLEM
Little or no cooling.

CAUSE
Refrigerant slightly low.

CONDITIONS*
Low side pressure too low.
Gauge should read 1-2 bar.

High side pressure too low.
Gauge should read 13.3-14.8 bar.
Evaporator air not cold.

CORRECTIVE PROCEDURES
1. Leak test the system.
2. Repair leaks. (Discharge and recover the refrigerant from the system; replace lines or components).
3. Check compressor oil to ensure no loss.
4. Evacuate the system.
5. Charge the system.
6. Performance test the system.

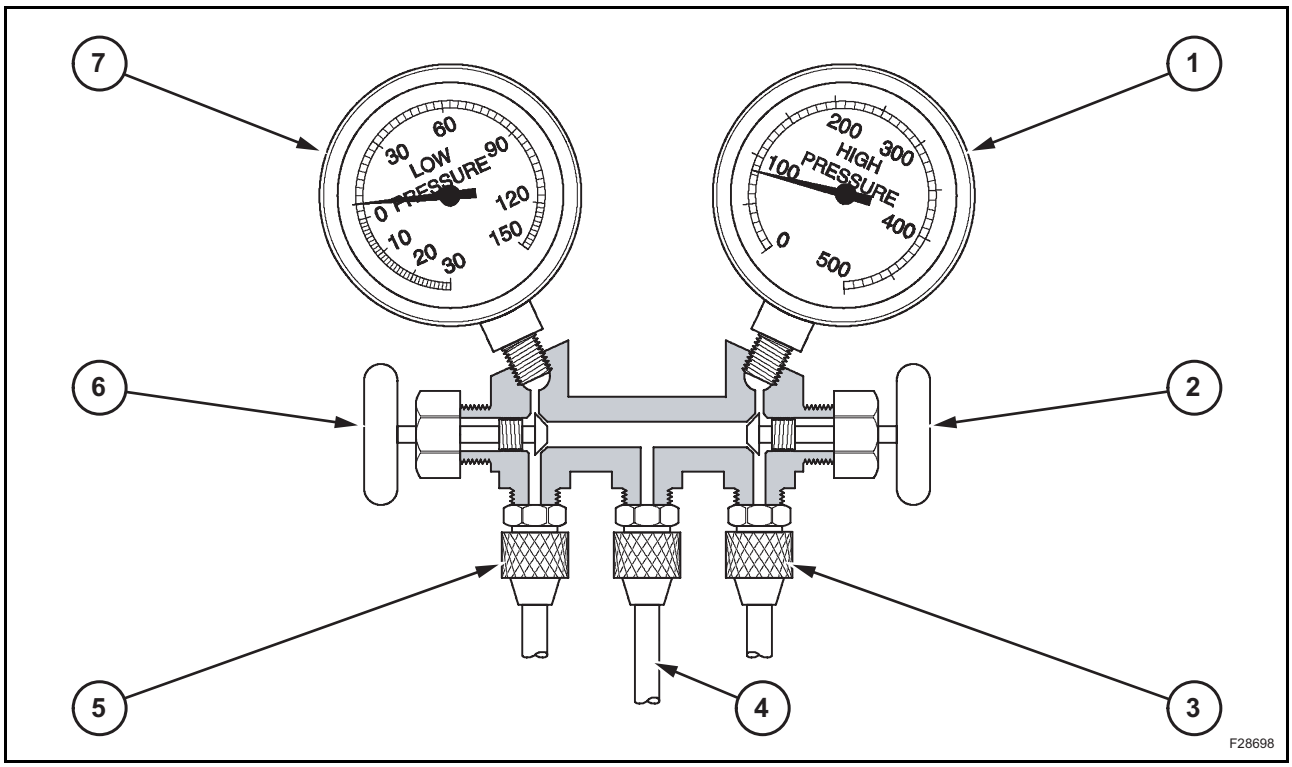
DIAGNOSIS
System refrigerant is low. May be caused by a small leak.

NOTE: * test procedure based upon ambient temperature of 35 °C.
For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.

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PERFORMANCE TEST EXAMPLE 2



Performance Test Example 2

1. High side low
2. High side hand valve closed
3. High side hose connected to high side service connector
4. Not used
5. Low side hose connected to low side service connector
6. Low side hand valve closed
7. Low side normal

PROBLEM
Insufficient cooling.

CAUSE
Refrigerant excessively low.

CONDITIONS*
Low side pressure very low.
Gauge should read 1-2 bar.

High side pressure too low.
Gauge should read 13.3-14.8 bar.

Evaporator air warm.
Low pressure switch cutting out.

CORRECTIVE PROCEDURES
1. Leak test the system.
2. Discharge and recover the refrigerant from the system.
3. Repair leaks.
4. Check compressor oil to ensure no loss.
5. Evacuate the system.
6. Charge the system.
7. Performance test the system.

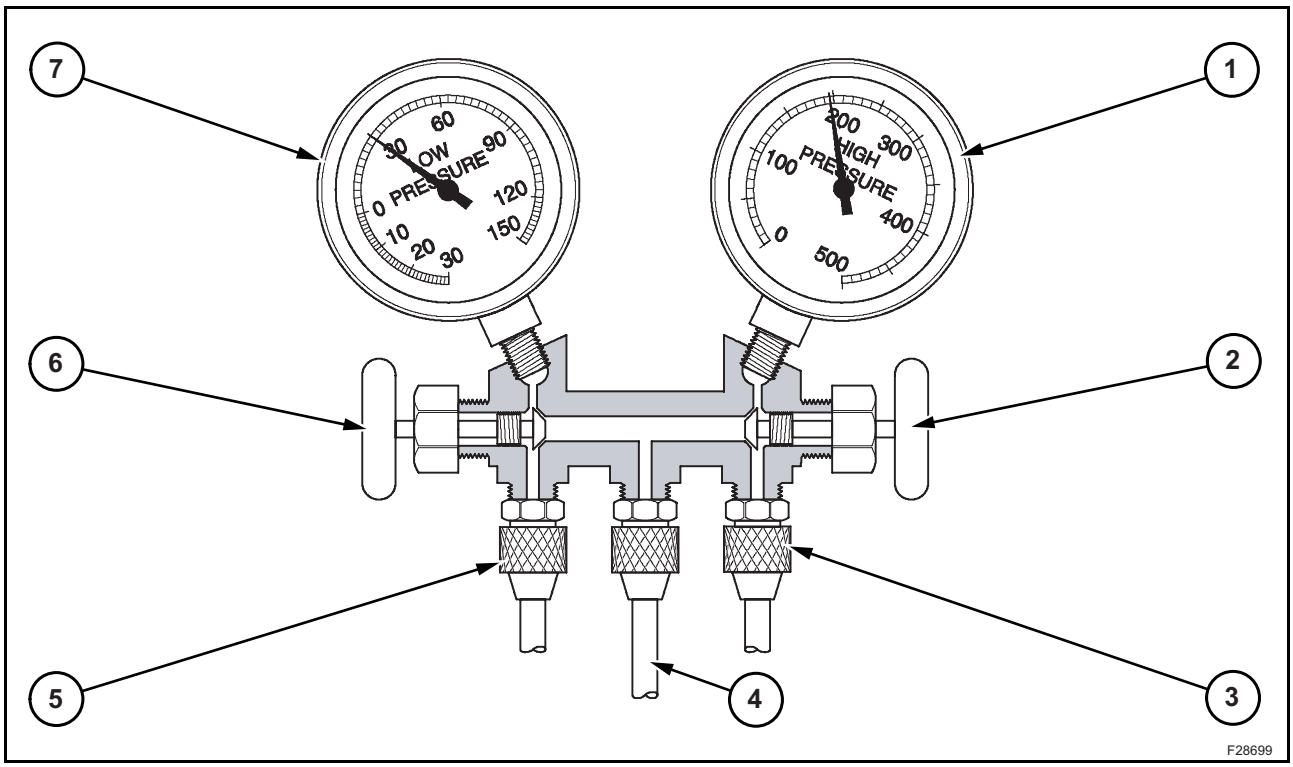
DIAGNOSIS
System refrigerant is extremely low. A serious leak is indicated.

NOTE: * test procedure based upon ambient temperature of 35 °C.
For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.

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PERFORMANCE TEST EXAMPLE 3



Performance Test Example 3

1. High side normal
2. High side hand valve closed
3. High side hose connected to high side service connector
4. Not used
5. Low side hose connected to low side service connector
6. Low side hand valve closed
7. Low side low

PROBLEM
Insufficient cooling.

CAUSE
Air in the system.

CONDITIONS*
Low side pressure reading does not change when compressor cycles ON and OFF.

High side pressure slightly high or slightly low. Gauge should read 13.3-14.8 bar.

Evaporator air not cold.

CORRECTIVE PROCEDURES
1. Leak test the system. Give special attention to the compressor seal area.
2. Discharge and recover the refrigerant from the system.
3. Repair leaks.
4. Replace receiver/drier.
5. Check compressor oil to ensure no loss.
6. Evacuate the system.
7. Charge the system.
8. Performance test the system.

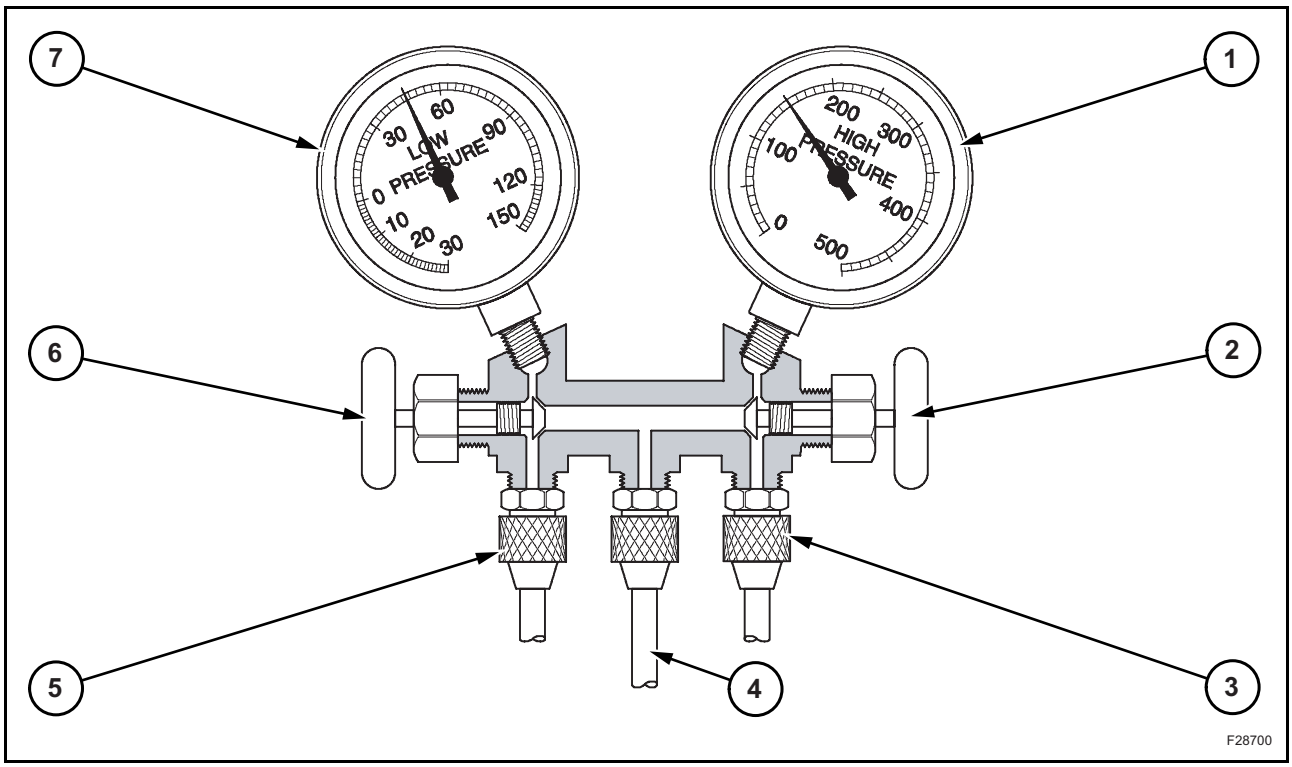
DIAGNOSIS
Air or moisture in system. System not fully charged.

NOTE: * test procedure based upon ambient temperature of 35 °C.
For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.

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PERFORMANCE TEST EXAMPLE 4



Performance Test Example 4

1. High side low
2. High side hand valve closed
3. High side hose connected to high side service connector
4. Not used
5. Low side hose connected to low side service connector
6. Low side hand valve closed
7. Low side high

PROBLEM
Insufficient cooling.

CAUSE
Compressor malfunction.

CONDITIONS*
Low side pressure too high. Gauge should read 1-2 bar.

High side pressure too low. Gauge should read 13.3-14.8 bar.

Evaporator air not cold.

CORRECTIVE PROCEDURES
1. Replace the compressor.

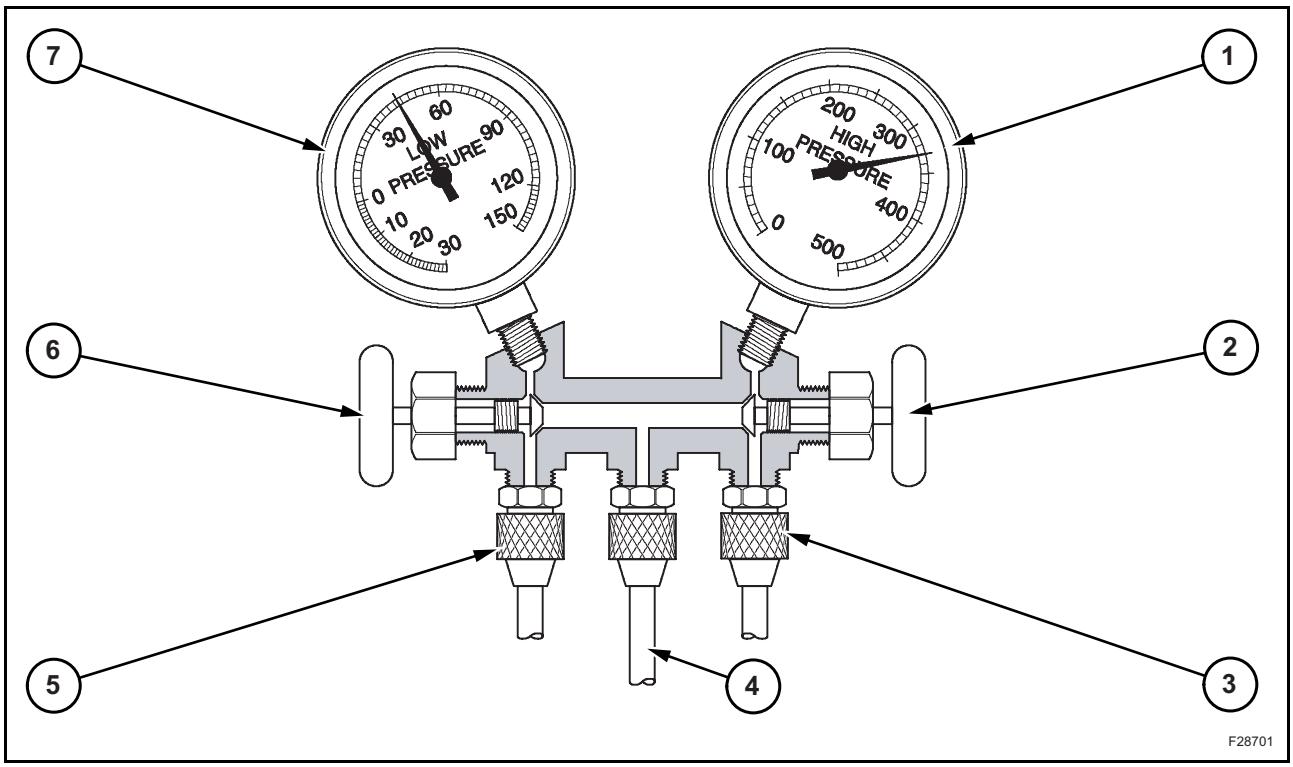
DIAGNOSIS
Internal leak in compressor caused by worn or scored pistons, rings, or cylinders.

NOTE: * test procedure based upon ambient temperature of 35 °C.
For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.

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PERFORMANCE TEST EXAMPLE 5



Performance Test Example 4

1. High side high
2. High side hand valve closed
3. High side hose connected to high side service connector
4. Not used
5. Low side hose connected to low side service connector
6. Low side hand valve closed
7. Low side high

PROBLEM
Little or no cooling. Engine overheats in some cases.

CAUSE
Condenser not functioning properly.

CONDITIONS*
Low side pressure too high. Gauge should read 1-2 bar.
High side pressure too high. Gauge should read 13.3-14.8 bar.
Liquid line hot.
Evaporator air warm.
High pressure switch cutting out.

CORRECTIVE PROCEDURES
1. Check belt. Loose or worn drive belts could cause excessive pressures in the compressor head.
2. Look for clogged passages between the condenser fins and coil, or other obstructions that could reduce condenser airflow.
3. If engine is overheating replace engine thermostat and radiator pressure cap.

At this point, operate the system and check its performance. If still unsatisfactory, proceed as follows:
4. Discharge and recover the refrigerant from the system.
5. Remove the condenser and clean and flush it to ensure a free flow of refrigerant. Or, if the condenser appears to be unduly dirty or plugged, replace it.
6. Replace receiver/drier.
7. Evacuate the system, and recharge it with the correct quantity of refrigerant.
8. Performance test the system.

DIAGNOSIS
Lack of cooling caused by pressure that is too high on the high side, resulting from improper operation of condenser. (Refrigerant charge may be normal or excessive).

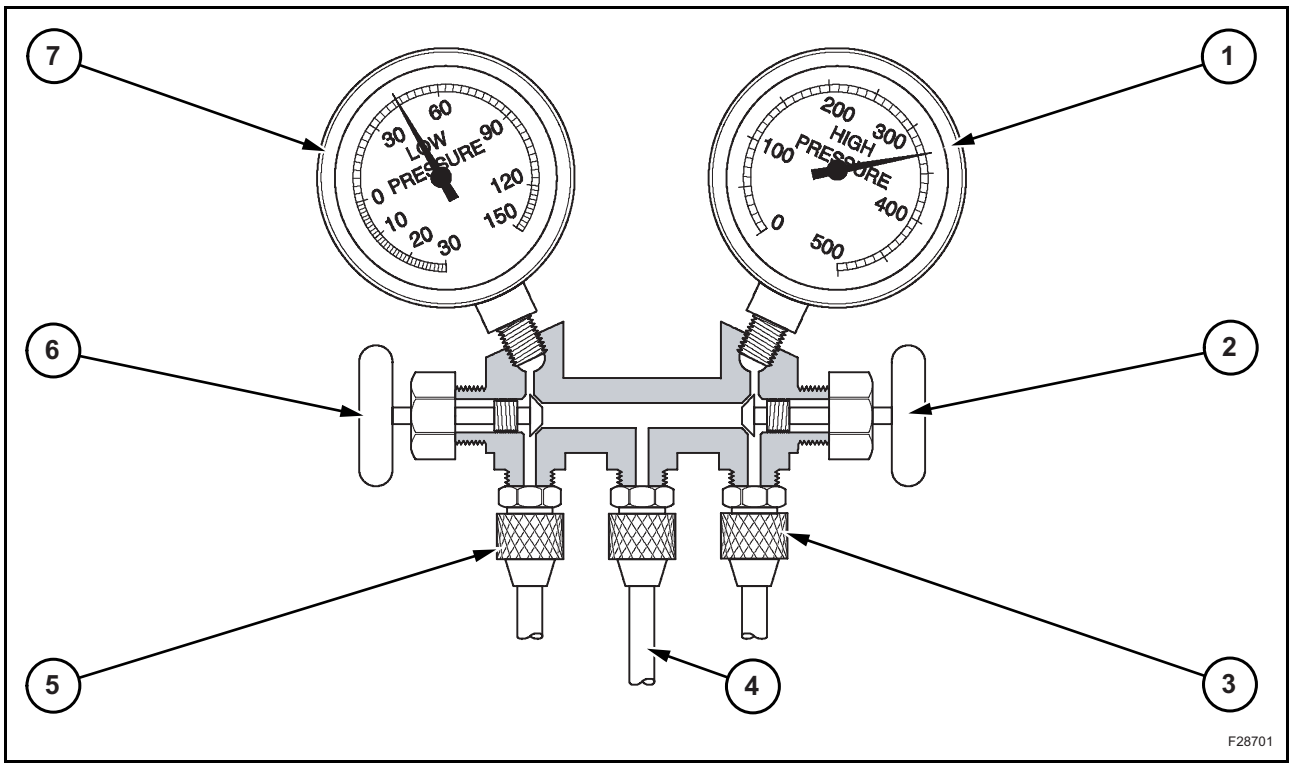
NOTE: * test procedure based upon ambient temperature of 35 °C.
For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.

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PERFORMANCE TEST EXAMPLE 6



Performance Test Example 6

1. High side normal
2. High side hand valve closed
3. High side hose connected to high side service connector
4. Not used
5. Low side hose connected to low side service connector
6. Low side hand valve closed
7. Low side normal

PROBLEM
Little or no cooling.

CAUSE
Large amount of air in system.

CONDITIONS*
Low side pressure too high. Gauge should read 1-2 bar.

High side pressure too low. Gauge should read 13.3-14.8 bar.

Evaporator air not cold.

CORRECTIVE PROCEDURES
1. Discharge and recover the refrigerant from the system.
2. Replace receiver/drier.
3. Evacuate the system.
4. Charge the system.
5. Performance test the system.

DIAGNOSIS
Air in the system. Air and humidity contained in it contaminate the system: therefore, it will operate incorrectly.

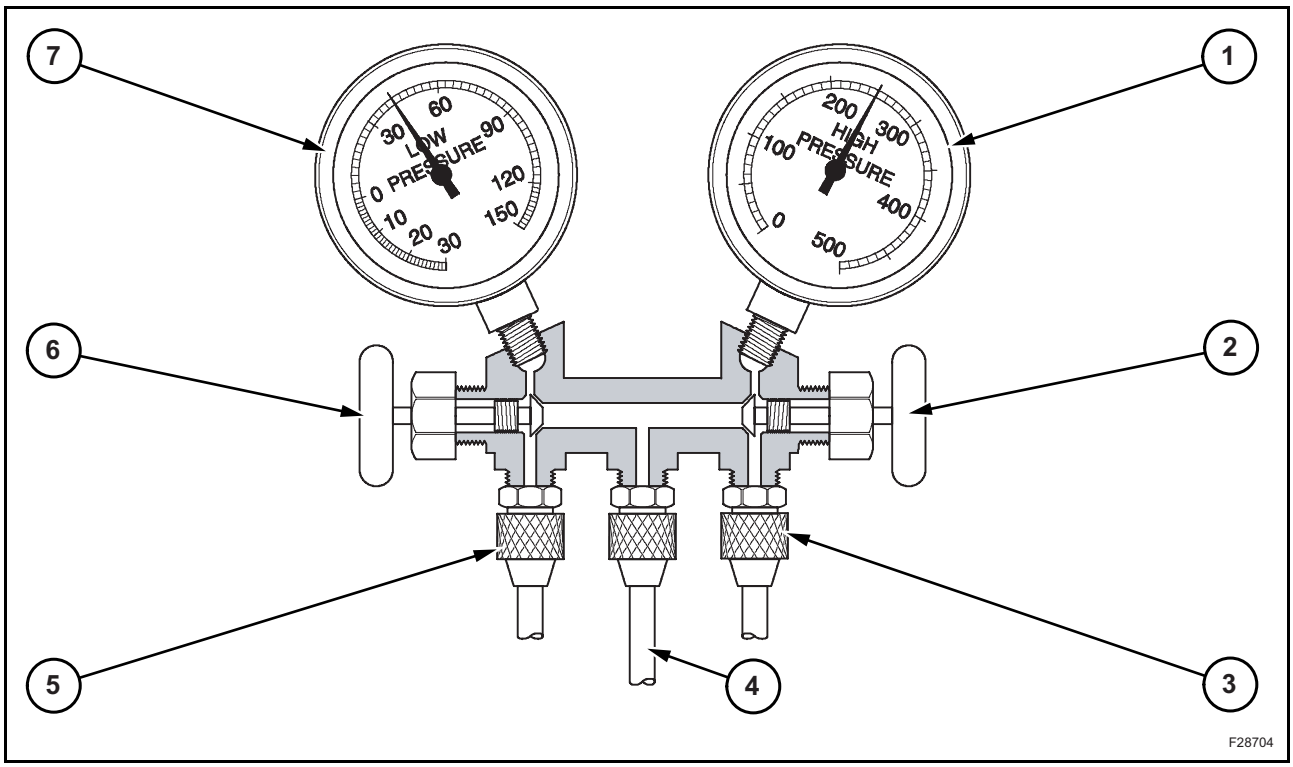
NOTE: * test procedure based upon ambient temperature of 35 °C.
For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.

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PERFORMANCE TEST EXAMPLE 7



Performance Test Example 7

1. High side high
2. High side hand valve closed
3. High side hose connected to high side service connector
4. Not used
5. Low side hose connected to low side service connector
6. Low side hand valve closed
7. Low side hide

PROBLEM
Little or no cooling.

CAUSE
Improper operation of thermostatic expansion valve (stuck open).

CONDITIONS*
Low side pressure too high. Gauge should read 1-2 bar.

High side pressure too high. Gauge should read 13.3-14.8 bar.

Evaporator air warm.

Evaporator and suction hose (to compressor) surfaces show considerable moisture.

CORRECTIVE PROCEDURES

1. Check for sticking expansion valve as follows:
   Operate the system at maximum cooling.
   Check the low side gauge. The pressure should lower slowly.
2. If the test indicates that the expansion valve is defective, proceed as follows:
   Discharge and recover the refrigerant from the system.
   Replace the expansion valve.
   Evacuate the system.
   Charge the system.
   Performance test the system.

DIAGNOSIS
Thermostatic expansion valve is allowing too much refrigerant to flow through the evaporator coils. Valve may be stuck open.

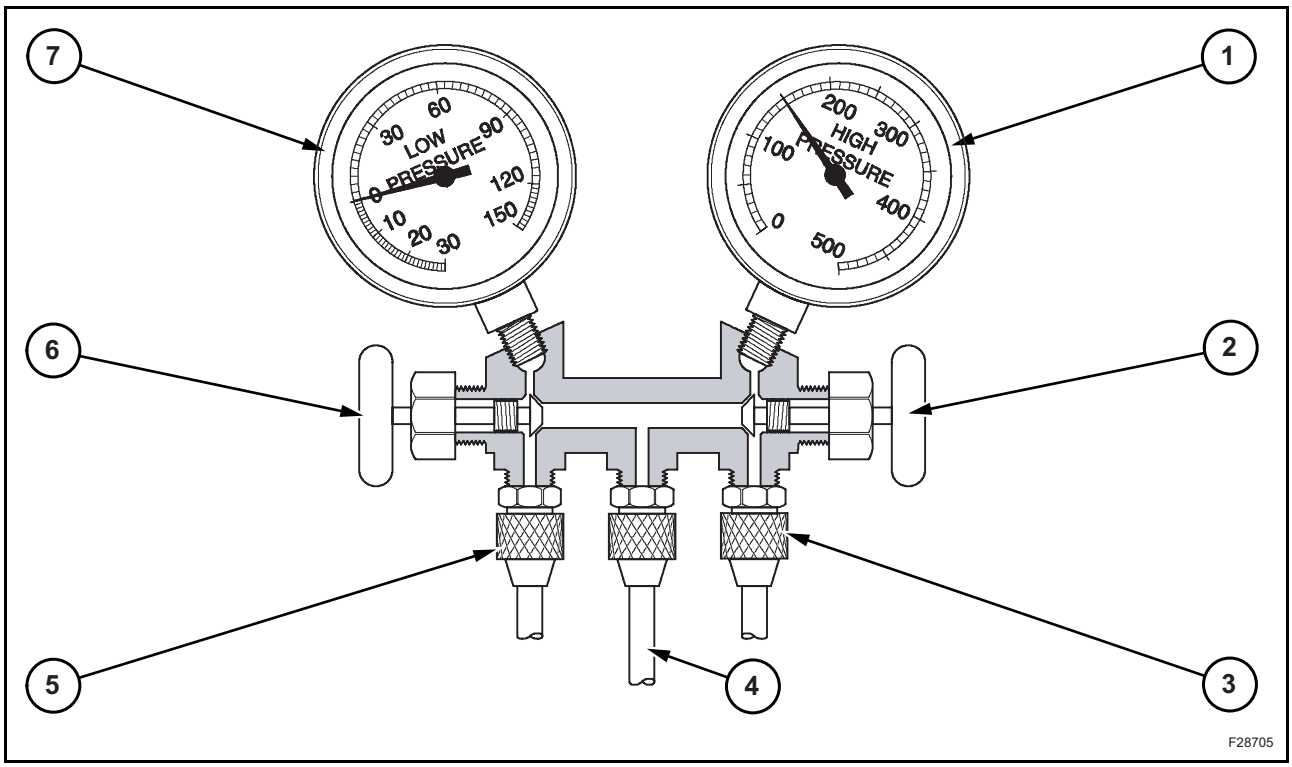
NOTE: * test procedure based upon ambient temperature of 35 °C.
For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.

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PERFORMANCE TEST EXAMPLE 8



Performance Test Example 8

1. High side low
2. High side hand valve closed
3. High side hose connected to high side service connector
4. Not used
5. Low side hose connected to low side service connector
6. Low side hand valve closed
7. Low side low

PROBLEM
Insufficient cooling.

CAUSE
Improper operation of thermostatic expansion valve (stuck open).

CONDITIONS*
Low side pressure too low (zero or vacuum). Gauge should read 1-2 bar.

High side pressure low. Gauge should read 13.3-14.8 bar.

Evaporator air cool, but not sufficiently cold.

Evaporator inlet pipe surface shows considerable moisture or frost.

Low pressure switch cutting out.

CORRECTIVE PROCEDURES
1. Place finger on expansion valve to evaporator tube. If too cold to touch, proceed as follows:
   Operate the system at maximum cooling.
   Check the low side gauge. The pressure should lower slowly.
2. If the procedure outlined in Step 1 shows that the expansion valve is defective, proceed as follows:
   Discharge the system.
   Replace the expansion valve.
   Evacuate the system.
   Charge the system.
   Performance test the system.

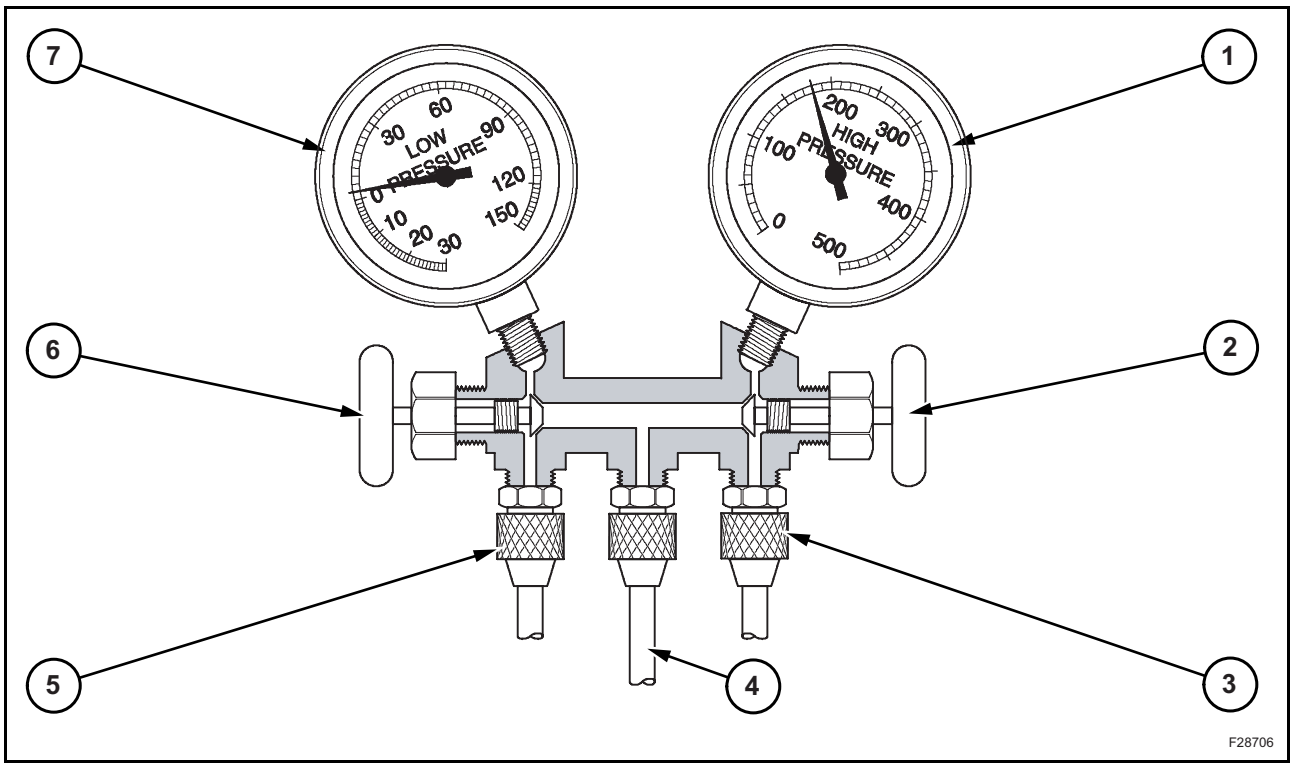
DIAGNOSIS
Expansion valve is not permitting a sufficient flow of refrigerant. May be caused by valve stuck in restricted or closed position.

NOTE: * test procedure based upon ambient temperature of 35 °C.
For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.

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PERFORMANCE TEST EXAMPLE 9



Performance Test Example 9

1. High side low
2. High side hand valve closed
3. High side hose connected to high side service connector
4. Not used
5. Low side hose connected to low side service connector
6. Low side hand valve closed
7. Low side low

PROBLEM
Little or no cooling.

CAUSE
Restriction in high side of system.

CONDITIONS*
Low side pressure too low. Gauge should read 1-2 bar.

High side pressure too low. Gauge should read 13.3-14.8 bar.

NOTE: a normal or high reading of the high side pressure gauge under these conditions indicates the system is overcharged or the condenser or receiver/dryer is too small.

Evaporator only slightly cool.

Liquid line and receiver/dryer are cool to touch and show frost or considerable moisture.

CORRECTIVE PROCEDURES

1. Check for sticking expansion valve as follows:
   Operate the system at maximum cooling.
   Check the low side gauge. The pressure should lower slowly.
2. If the test indicates that the expansion valve is defective, proceed as follows:
   Discharge and recover the refrigerant from the system.
   Replace the expansion valve.
   Evacuate the system.
   Charge the system.
   Performance test the system.

DIAGNOSIS
Thermostatic expansion valve is allowing too much refrigerant to flow through the evaporator coils. Valve may be stuck open.

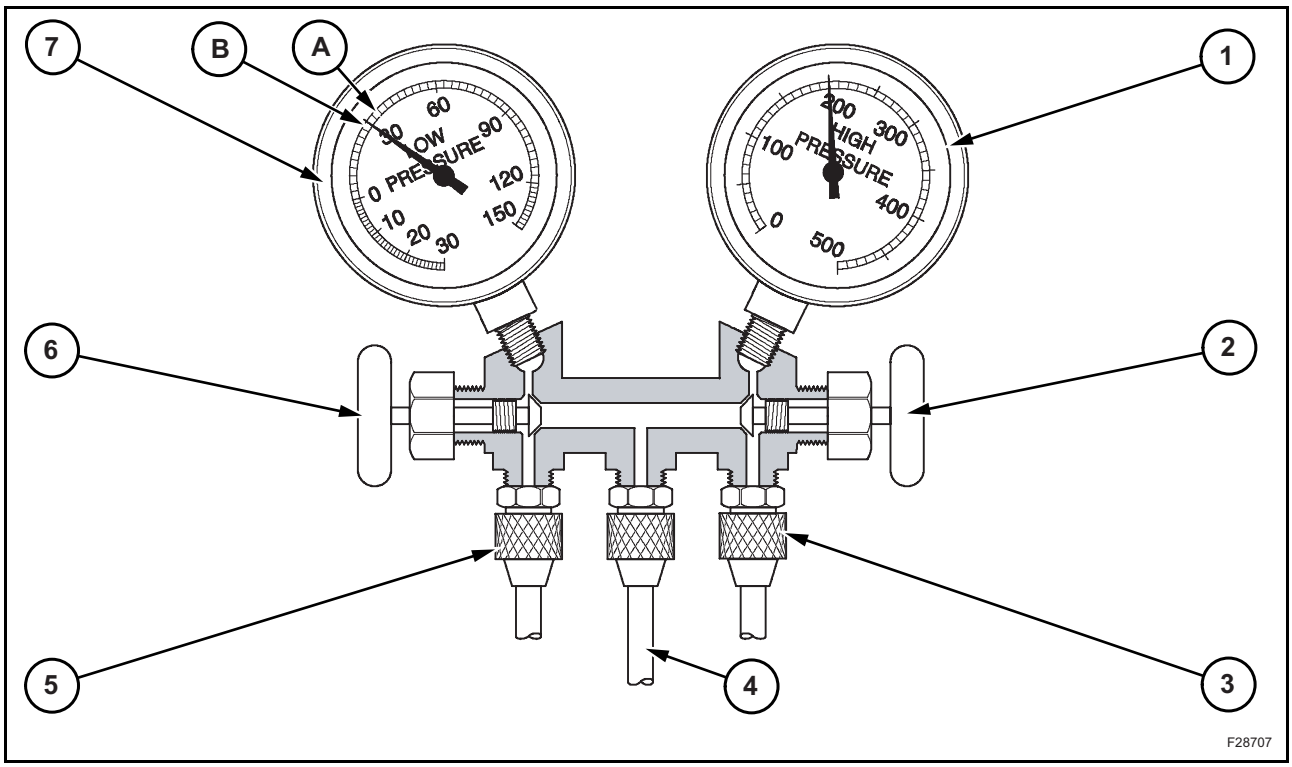
NOTE: * test procedure based upon ambient temperature of 35 °C.
For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.

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PERFORMANCE TEST EXAMPLE 10



Performance Test Example 10

1. High side normal
2. High side hand valve closed
3. High side hose connected to high side service connector
4. Not used
5. Low side hose connected to low side service connector
6. Low side hand valve closed
7. Low side gauge
   Compressor cycles on at 2.3 bar
   Compressor cycles off at 1.9 bar

PROBLEM
Compressor cycles (cuts in and out) too rapidly.

CAUSE
Thermostatic switch defective.

CONDITIONS*
Low side pressure readings too high during both ON and OFF compressor cycles and between cycles.
Readings should be:
0.8-1.0 bar - cycle (OFF)
2.5-2.7 bar - cycle (ON)
1.7-1.9 bar - between cycles.

High side pressure normal. Gauge should read 13.3-14.8 bar.

CORRECTIVE PROCEDURES
1. Stop engine and shut off A/C.
2. Replace thermostatic switch with switch of same type.
3. Make sure the switch's temperature sensor is installed in the same position and depth (in evaporator core) as previous.
4. Performance test the system.

DIAGNOSIS
Defective thermostatic switch.

NOTE: * test procedure based upon ambient temperature of 35 °C.
For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.

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LEAK TESTING, DISCHARGING AND CHARGING THE AIR CONDITIONING SYSTEM

Leak Testing

To perform a leak test if refrigerant leakage is suspected, use a leak detector following the manufacturer's instructions.

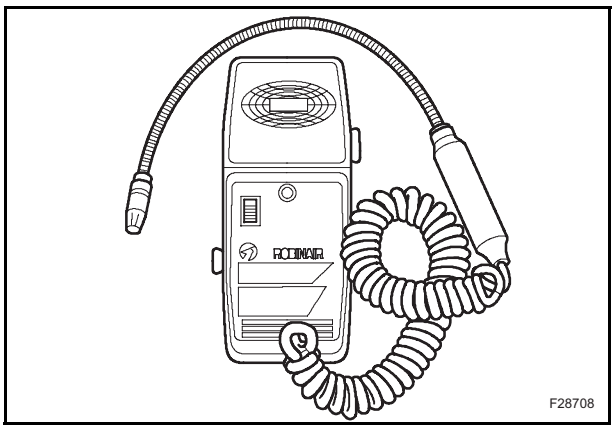
Leak detectors use light or sound dependent upon the type used to alert the operator of a leak. If the leak detector's sensitivity is adjustable, be sure you calibrate the detector according to the manufacturer's instructions before use.

When using a leak detector, keep in mind that a very slight amount of leakage in the compressor pulley area is normal and does not necessarily indicate a repair is required.

When a leak is located, follow these steps.

- Discharge the system using a certified refrigerant recovery system.
- Repair the leak.
- Evacuate the system.
- Partially charge the system with 400 g of refrigerant.
- Check system for leaks.
- Fully charge the system.

Always check the system for leaks as a final test after evacuating and before recharging. Refer to "Evacuating the system".



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Discharging the system

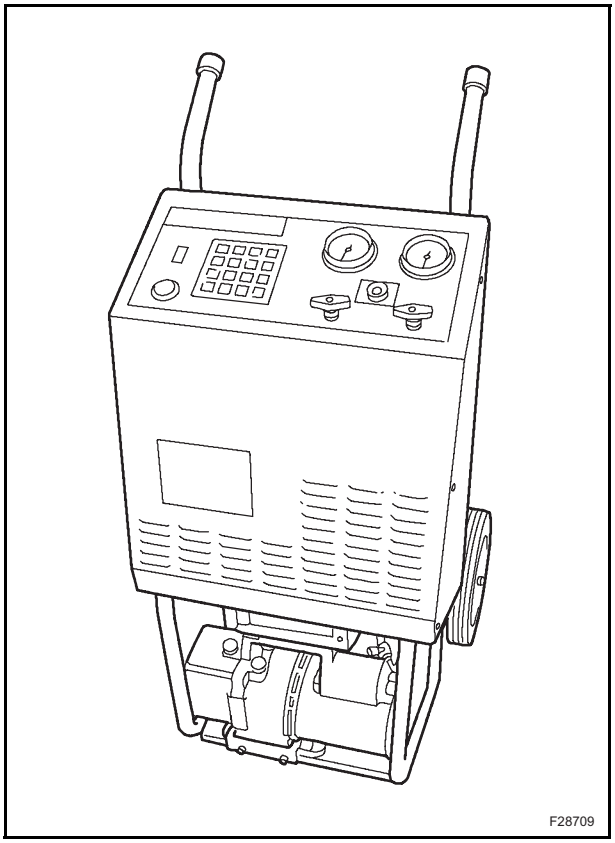
Legislation has been introduced banning the release of refrigerant into the atmosphere.

Whenever overhauling the air conditioning system or performing other tasks which require the air conditioning system to be dismantled it is necessary to discharge the refrigerant gas before commencing repair.

Before you can dismantle an air conditioning system for repairs, you must discharge and recover the refrigerant using a **certified** recovery unit in accordance with the manufacturer's instructions.

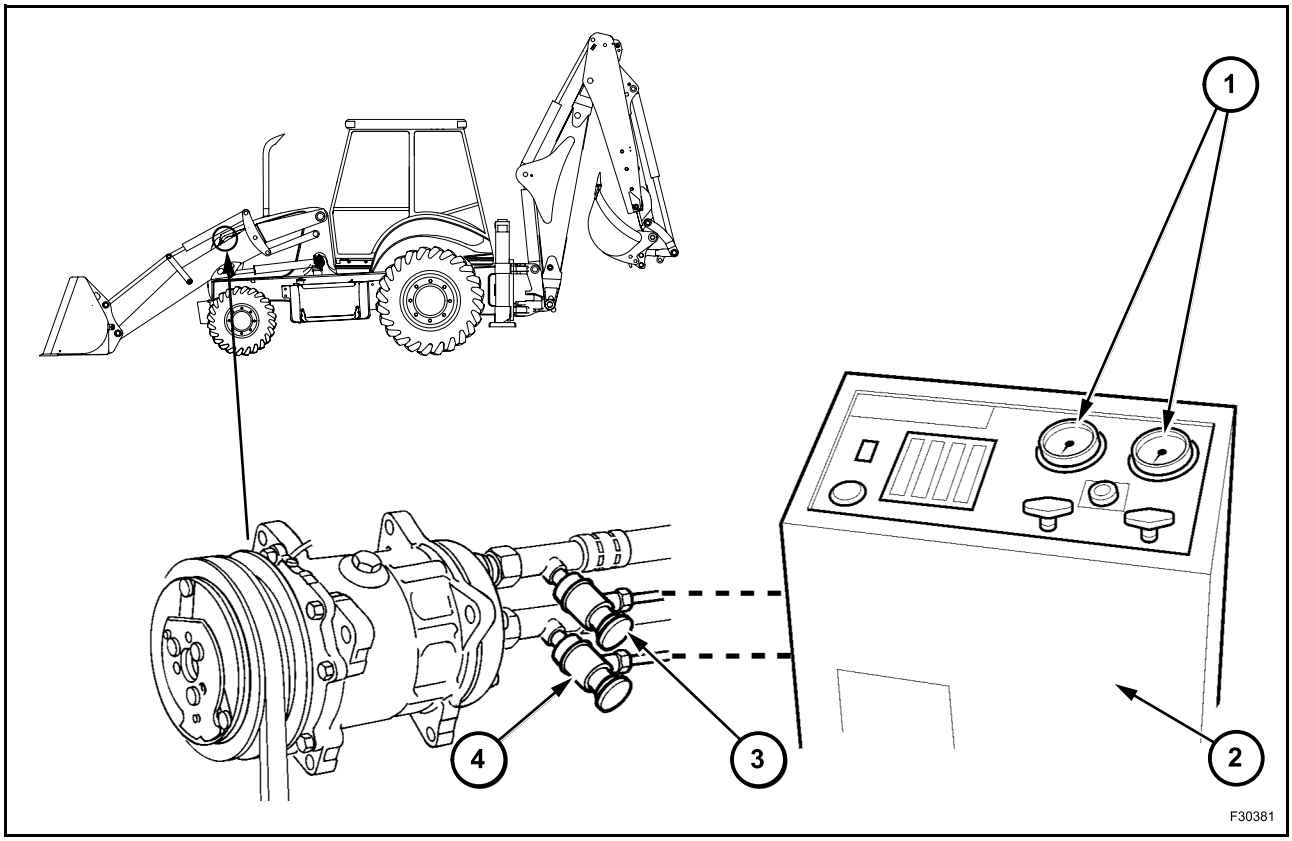
Shown is a combined refrigerant recovery, evacuation and recycling/charging station. This equipment removes HFC 134a refrigerant from the air conditioning system, recycles and recharges all in one hook up.

The unit is designed to be used with the manifold gauge set built into the control panel.


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Connecting recovery evacuation and recycling/charging station to the loader backhoe

1. Built in manifold gauge set
2. Recovery/recharging unit
3. Low side (suction) service valve (blue hose)
4. High side (discharge) service valve (red hose)

Other recovery systems are available where the manifold gauges are not an integral part of the machine. When this type of equipment is used a separate manifold gauge set must be used.
The following is a summary of the steps for discharging the system using a recovery/recycling unit.

⚠ WARNING

Never discharge refrigerant gas into the atmosphere. Always wear safety goggles and gloves when working with refrigerant. Only use authorized refrigerant tanks.

IMPORTANT: always follow the manufactures instructions when operating recovery equipment.

1. Run the vehicle's air conditioning system for a few minutes.
2. Set up the recovery unit following manufacturer's instructions. Ensure that the units red (high side) hose is connected to the high side (discharge) fitting and the blue (low side) hose to the low side (suction) fitting.

NOTE: if a unit requiring the manifold gauge set is being used, the low and high sides of the manifold set are connected to the low and high sides of the loader backhoe air conditioning system. The hose from the recovery unit is then connected to the manifold centre port.

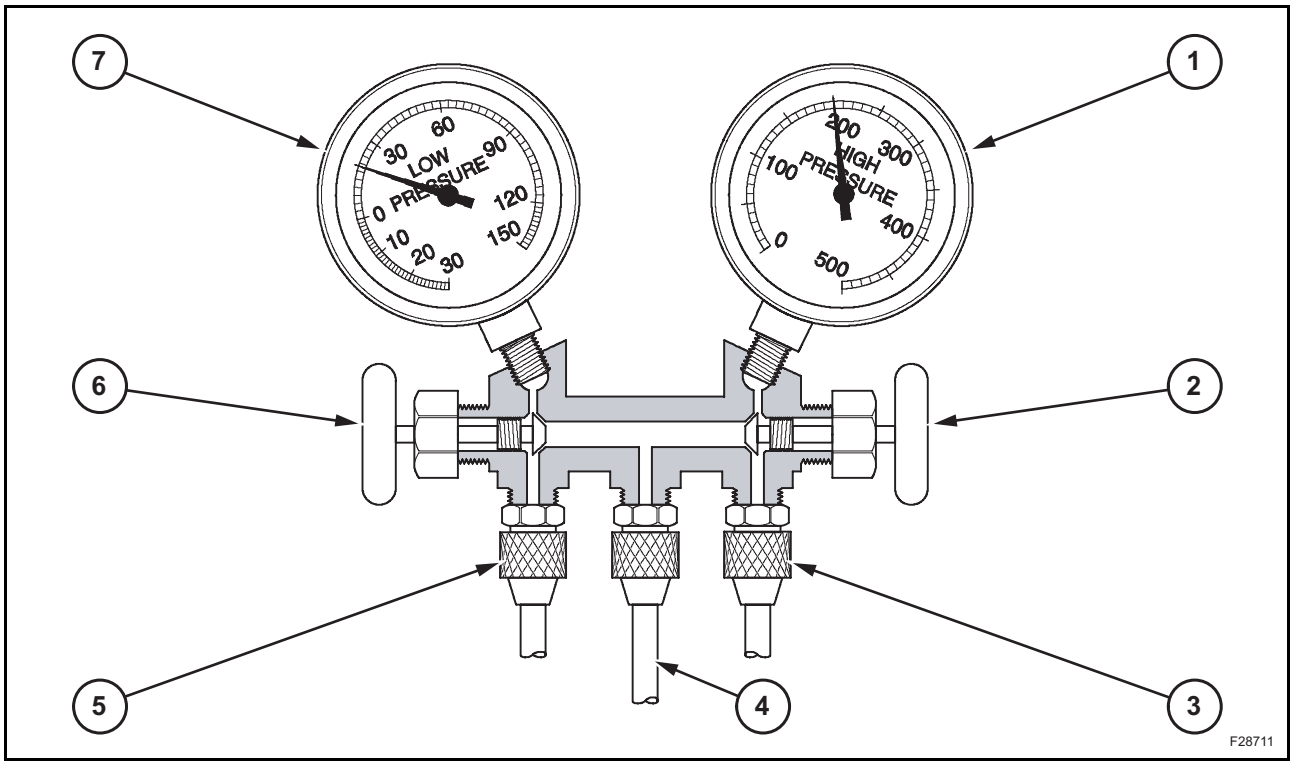
3. To recover refrigerant, open both high and low side valves on the control panel or the valves on the manifold gauge set if being used.
4. Open the valves labelled "gas" and "liquid" on the recovery unit refrigerant tank.
5. Plug in the unit's power cord.
6. Operate the recovery system in accordance with the manufacturers instructions.

The compressor will shut off automatically when the recovery is complete.

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3.5 FLUSHING THE SYSTEM



Manifold side gauge

1. High side gauge
2. High side shut-off valve
3. High side hose
4. Centre service hose
5. Low side hose
6. Low side shut-off valve
7. Low side gauge

Air conditioning systems may occasionally become contaminated with solid particles. This contamination may be the result of allowing dirt to enter the system while it was open, from aluminium corrosion or sludge, or from disintegrated compressor reed plates. Contamination of this nature can result in plugged evaporators, condensers and expansion valves.

Flush System with dry nitrogen.

Each individual component must be flushed after disconnecting every hose fitting.

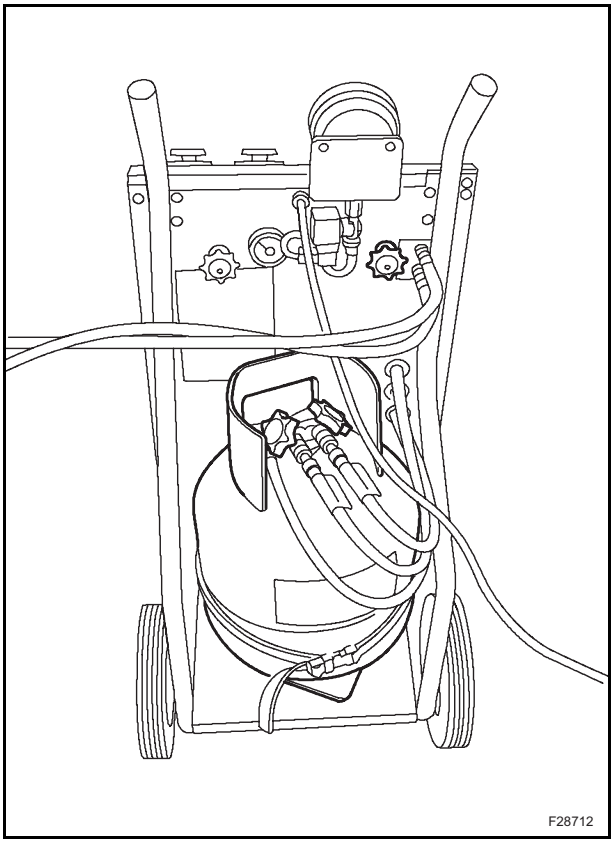
The compressor and expansion valve can not be flushed, therefore, the compressor should be disassembled and cleaned or replaced and the expansion valve should be replaced. When flushing the system always replace the receiver/drier.

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NOTE: never use any solvent for flushing an air conditioning system other than a special flush solvent made specifically for air conditioning systems. Always follow the manufacturer's recommendations and directions for using the flushing equipment and solvent.

Re-assemble and evacuate the system to remove air and moisture as described in "Evacuating the System".



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3.6 EVACUATING THE SYSTEM

IMPORTANT: a system in which the refrigerant has been recovered to facilitate repairs, must be evacuated before new refrigerant is installed.

Air and moisture are removed by evacuating the system using a vacuum pump.
The automatic recycling, recharge and evacuation stations or evacuating and charging stations available throughout the air conditioning industry incorporate a vacuum pump within the assembly. If this type of equipment is not available a separate vacuum pump and manifold gauge set must be used.
As the system is evacuated the boiling point of any moisture within the system is similarly lowered. As the vacuum increases, the boiling point decreases to below that of the ambient temperature and, consequently, the moisture is boiled away.
The relationship of system vacuum to the boiling temperature at which the water vapour is removed from the system is as follows:

System Vacuum	System Vacuum	Temperature
In Mercury	In Cm. of Mercury	°C
28.0	71.0	38
28.9	73.4	27
29.4	74.6	16
29.7	75.4	5
29.8	75.7	-7
29.9	75.9	-18

NOTE: for every 305 m above sea level, the vacuum gauge reading must be corrected by adding 2.54 cm of mercury to compensate for the change in atmospheric pressure.

IMPORTANT: be sure the system is completely discharged as refrigerant will damage the vacuum pump.

1. If the manifold gauge set is being used connect the low and high sides of the manifold to the low and high sides of the vehicle air conditioning system as described for discharging the system. Connect the manifold centre hose to the vacuum pump suction port as per the manufacturers instructions.
   Fully open both the low and high side gauge shut off valves.
2. If a combined recovery/evacuation unit is to be used attach the unit to the air conditioning system in accordance with the manufacturers instructions. Be sure to read all installation and operating instructions carefully before starting the unit.
3. After starting the evacuation cycle, note the low side gauge to be sure the system pulls down into a vacuum.
4. Time the evacuation for a minimum of 30 minutes from the point when lowest vacuum is attained.
5. Thirty minutes later when the low side gauge attains the lowest steady vacuum, stop the evacuation process.

NOTE: the vacuum pump achieves ultimate vacuum with the vented exhaust valve closed. Do not evacuate too quickly as oil may be drawn from the system.

6. Check the system by closing the gauge shut-off valves, turning the vacuum pump off and noting the low side gauge reading. A loss of more than 5 cm of vacuum in 5 minutes indicates either a leak or moisture in the system.
7. If the gauge needle remains stationary and the vacuum is maintained for 3-5 minutes, close both the high and low side manifold hand valves, turn off and disconnect the centre hose from the pump. The system is now ready for charging.
8. If a leak is detected, charge the system with approximately 400 g of refrigerant, see charging the system and locate the leak using a leak detector.
9. Once the leak is located discharge and recover the refrigerant in the system, repair the leak, then repeat the evacuation procedure.

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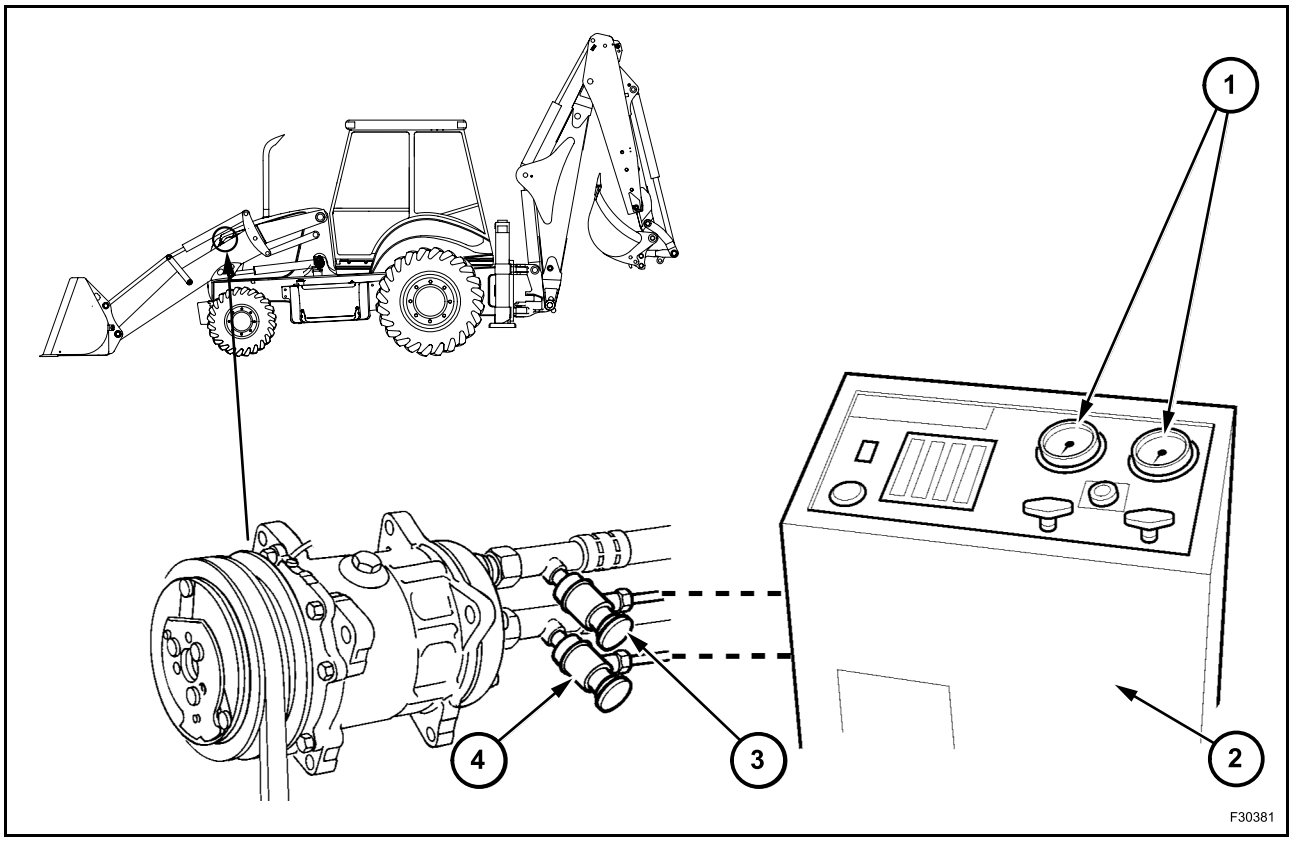
3.7 CHARGING THE SYSTEM

IMPORTANT: be sure there are no leaks in the system and the system has been fully evacuated. Observe all safety recommendations when handling refrigerant HFC 134a, see “Precautions when Handling Refrigerant HFC 134a” in this Section.

1. Ensure the charging unit is correctly connected to the loader backhoe air conditioning system in accordance with the manufacturers instructions.
2. If a charging unit, in conjunction with the manifold gauge set is used, open the high and low side hand valves on the manifold.
3. Charge the system with 0.75 kg of refrigerant as per the manufacturers instructions.
4. If the charging rate becomes very slow **close the high side valve carefully,** start the loader backhoe and set engine speed to idle. Turn ON the air conditioning so that the compressor can pull the remainder of the refrigerant into the system.
5. If the refrigerant charge will not completely transfer to the air conditioning system, recover and recharge the system.
6. Close the high and low side valves on the units control panel, or manifold gauge set if being used and test the air conditioning as detailed in Performance testing the air conditioning system on page 26.

NOTE: after charging a system use the following start up procedure to ensure the lubricating oil is properly dispersed around the system.

- Ensure air conditioning is switched OFF.
- Start the engine and bring speed down to idle.
- Turn the air conditioning ON and allow system to operate for at least one minute before increasing engine speed.



Connecting recovery evacuation and recycling/charging station to the loader backhoe

1. Built in manifold gauge set
2. Recovery/recharging unit
3. Low side (suction) service valve (blue hose)
4. High side (discharge) service valve (red hose)

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3.8 COMPONENTS OVERHAUL

GENERAL

⚠ WARNING

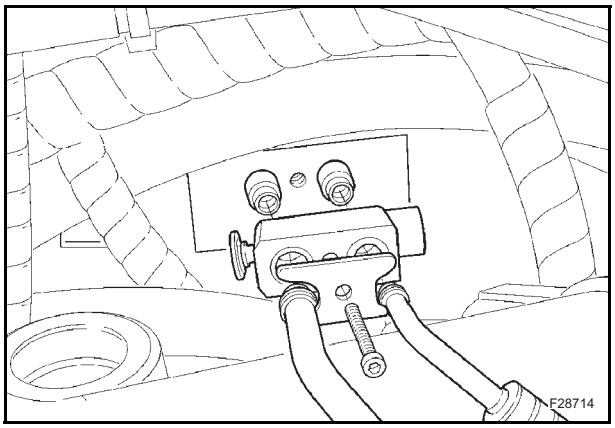
Before disconnecting components in the air conditioning system the refrigerant gas must be discharged and recovered using a certified recovery system. Refer to Discharging the system. **Do Not** discharge the gas into the atmosphere.

If an air conditioning component is to be replaced during a system overhaul it is necessary to drain any refrigerant oil that has collected in the component being replaced into a clean calibrated container.
A volume of clean refrigerant oil equivalent to that removed from the replaced component must then be added to the new item before being installed onto the loader backhoe.
Upon completion of the repair evacuate, recharge, leak test and performance test the system to ensure correct operation.

EXPANSION VALVE

The expansion valve is not a serviceable item and must be replaced if defective.

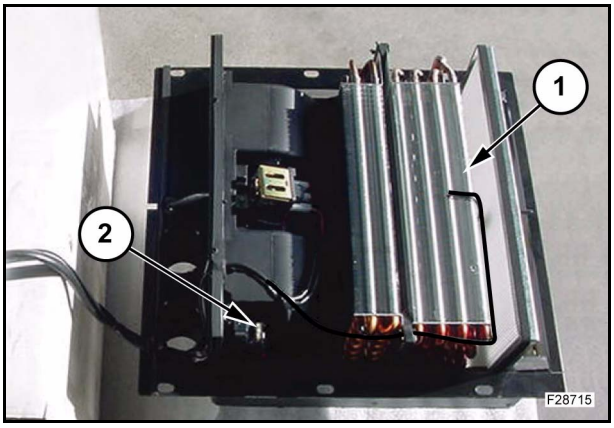
1. Fully discharge the air conditioning system.
2. Remove the seat to gain access to the valve.
3. To gain access to the expansion valve partially lift the evaporator core from its position in the cab floor.
4. Remove the screw securing the inlet and outlet connections to the valve and pull valve from tubing.
5. Replace the O-ring seals and lubricate with refrigerant oil prior to installing the valve using disassembly procedure in reverse.
6. Evacuate, leak test and recharge the system.



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EVAPORATOR



1. Discharge and reclaim refrigerant gas using certified recovery systems.
2. Remove the seat and cover plate to reveal evaporator assembly (1).
3. Remove temperature cycling control thermocouple.
4. Disconnect tubing to expansion valve.
5. Remove evaporator.
6. Check the evaporator assembly fins for damage. Straighten fins if necessary.
7. Clean the evaporator core of all foreign material to be sure it is free of obstructions.
8. Check the evaporator assembly for indications of refrigerant leakage. If damage or leaks are evident, replace the evaporator core.

If a new evaporator is to be installed drain the refrigerant oil in the evaporator into a clean calibrated container. Measure the quantity of oil obtained and add the same quantity of new refrigerant oil directly into the replacement evaporator core.

Install evaporator using disassembly procedure in reverse.

Evacuate, leak test and recharge the system.

AIR CONDITIONER TEMPERATURE CYCLING CONTROL

1. Remove the seat mounting plate.
2. The temperature cycling switch (2) is mounted to the side of the blower motor assembly.
3. Carefully pull and disconnect the switch wiring at the connector.
4. Remove temperature control switch and replace as required.

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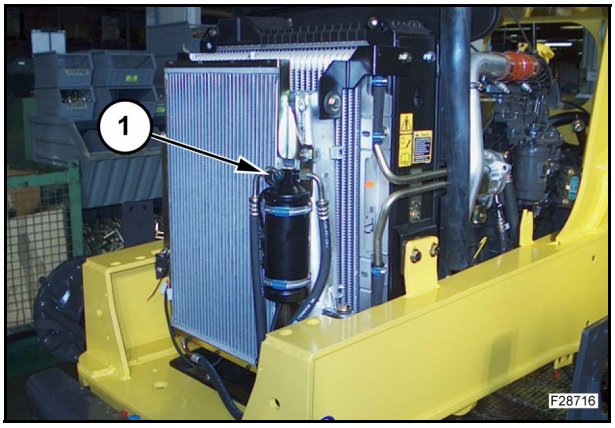
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LOW PRESSURE CUT-OUT SWITCH

1. With the engine OFF check continuity across the switch contacts. If the switch (1) indicates an open circuit, replace it as described below.

IMPORTANT: the pressure switch can not be replaced without discharging the system.

2. Remove switch by unscrewing from self sealing Schrader valve.
3. Replace with new switch and connect to harness.



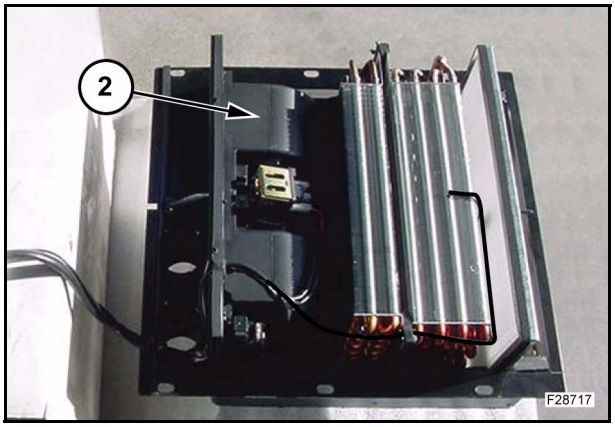
BLOWER MOTOR ASSEMBLY

If necessary, the blower motor can be removed without discharging the system as follows:

1. Remove the cab seat mounting plate.

NOTE: take care not to damage hoses during this operation. If the cab heater hoses restrict movement of the housing drain the heater assembly and disconnect the hoses.

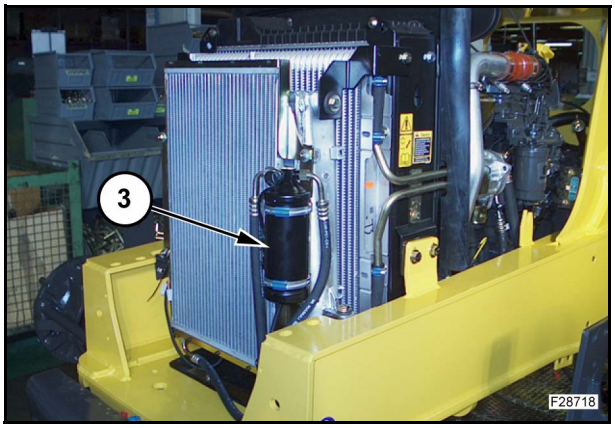
2. Disconnect the motor wiring connector block.
3. Remove the remaining motor securing screws and withdraw motor.
4. Re-assembly follows the disassembly procedure in reverse.



RECEIVER DRYER

The receiver/dryer (3) cannot be overhauled and must be replaced as an assembly. The receiver/dryer assembly should be replaced if it is suspected that moisture is in the system.
The receiver dryer must also be replaced if the system has been discharged and the air conditioning joints disconnected.

1. Discharge and reclaim refrigerant gas using certified recovery systems.
2. Disconnect the hoses and switch and remove the dryer from the loader backhoe.
3. Drain the refrigerant oil from the receiver dryer into a clean calibrated container. Measure the quantity of oil obtained and add the same quantity of new refrigerant oil directly into the new item.
4. Cap and plug all fittings to prevent any dirt entering the system.
5. Install a new receiver dryer.

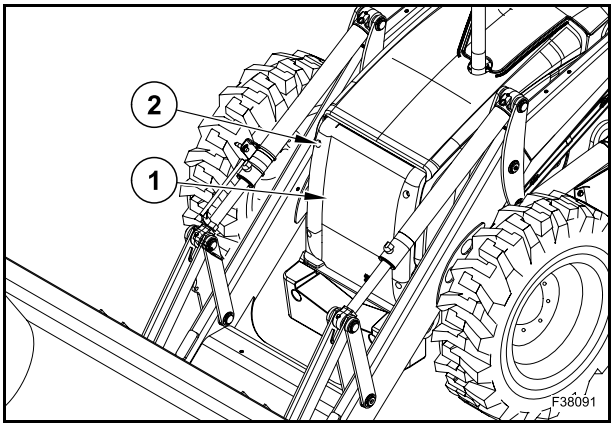


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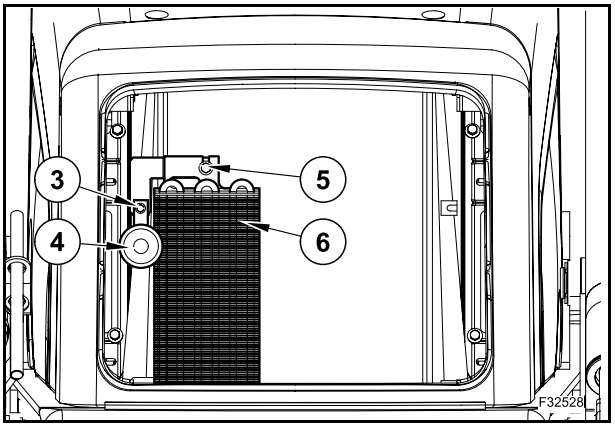
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CONDENSER

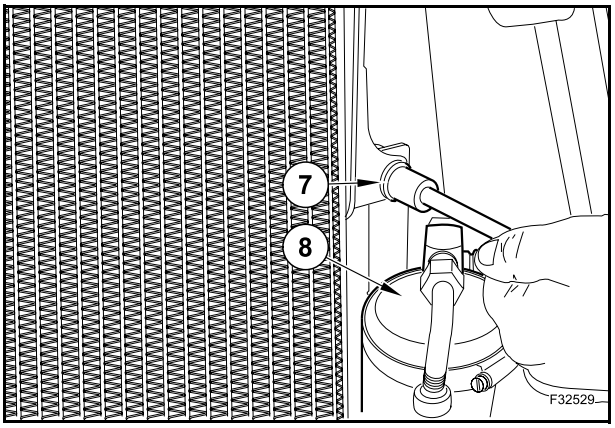
1. Unscrew and remove the fastening screws (2). Remove the front grill (1).



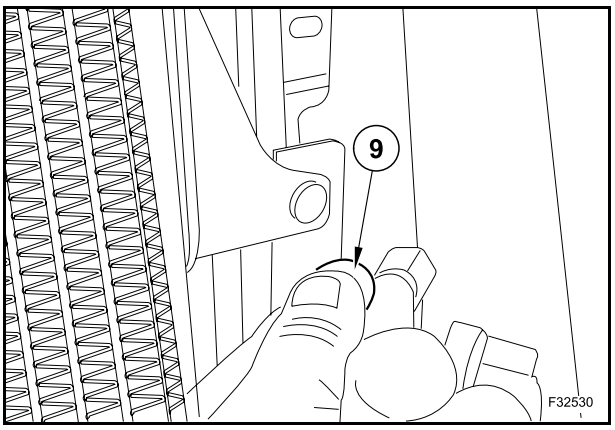
2. Unscrew and remove the nut (3). Remove the horn (4). Unscrew and remove the nut (5). Remove the fuel cooler (6).



3. Unscrew and remove the fixing upper nut (7) and loosen the fixing lower nut. Move the dryer filter (8) to the right side.



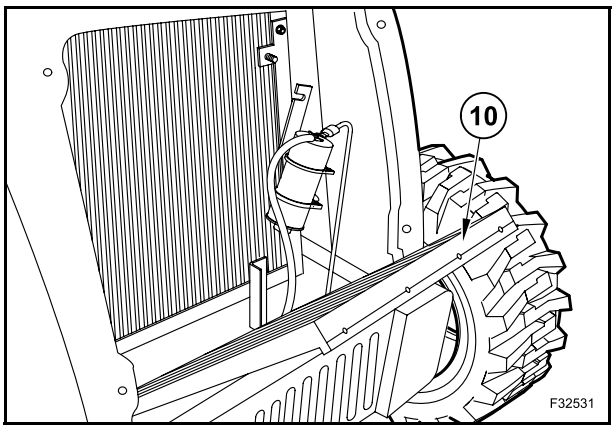
4. Unscrew and remove the nuts (9).



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5. Move the condenser (10) forward.
   Clean the condenser (10) by compressor air.

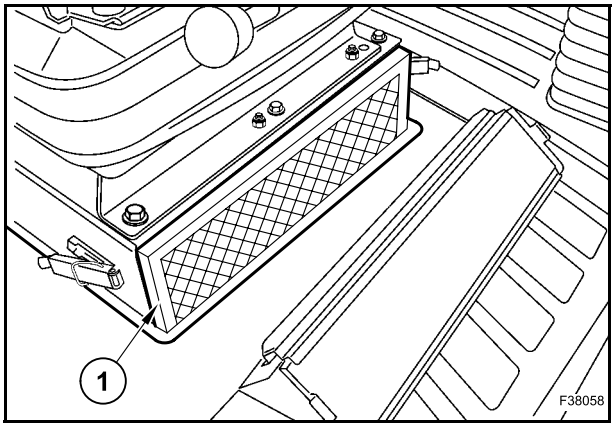


CAB AIR FILTER

1. Before servicing the filter (1), switch off the blower and close all windows and one door. Slam the final door closed and the resulting back pressure will dislodge most of the loose dirt from the underside of the filter.
2. Remove the filter and clean it by blowing with compressed air not exceeding 2 bar.

IMPORTANT: make sure you protect your face before using compressed air.

   Blow the dust from the upper surface through the element to the underside. Hold the nozzle at least 300 mm from the element to prevent damage to the paper pleats.
3. Clean both filter chambers with a damp, lint free cloth.
4. Replace the filter element with the rubber seal uppermost and re-install the covers.



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3.9 COMPRESSOR

SPECIFICATIONS

Basic compressor specifications

Displacement ..... 155 cc
Weight ..... 9.9 kg
Oil type SP20
Rotation ..... CW (Clockwise only)
Air gap, clutch, compressor and pulley ..... 0.9-0.8 mm

Belt tension

Measure at the widest gap ..... 10 mm deflection with 1 kg force applied midway between the pulleys

Speed rating

MAXIMUM RPM	
Constant	Downshift
6000	8000

Tightening torques

COMPONENT	Nm
Armature retaining nut, M8	17.7±2.9
Cylinder head bolts, M6	13.7±2.9
Cylinder head bolts, M8	34.3±4.9
Clutch dust cover screw, M5	9±2
Oil filler plug	19.6±4.9

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FAULT FINDING

During diagnosis follow the inspections procedures in the sequence shown until a default is found. Then perform the repair in the “Cause and Remedy” section. If this repair does not fully solve the problem, proceed to the next inspection step.

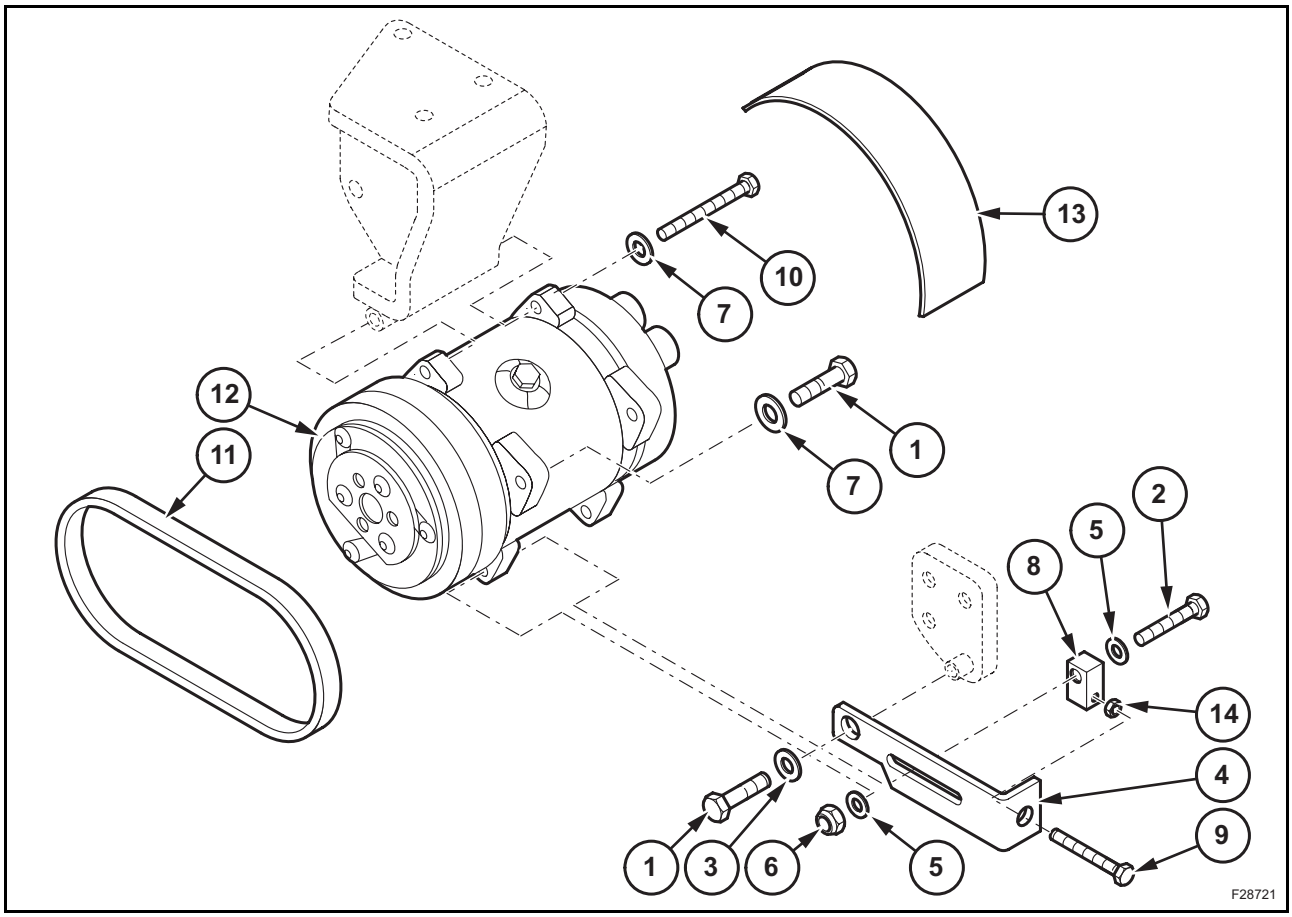
PROBLEM	CAUSE	CORRECTION
Unusually high suction pressure with unusually low discharge pressure	Valve plate test	Replace or repair: Broken head or block gasket. Broken or deformed reed valve. Foreign substance under reed valve or gasket.
Unusually low suction and discharge pressure	Check for low refrigerant charge Leak check compressor Leak check and diagnose system	Replace or repair: Shaft seal leak. Cylinder head leak. Gasket leak. Oil filler plug leak. Cracked cylinder block. Front housing O-ring leak.
Intermittent or inoperative	Check belt tension Check clutch air gap Check clutch volts, amps, coil lead wire	Replace. Adjust air gap. Replace or repair: Broken lead wire. Clutch coil defect - Internal. System ground (see system manual).
Rough running	Shaft turning smoothness test	Compressor failure - Internal.

PROBLEM	CAUSE	CORRECTION
Clutch engaged	Check compressor mounting components Check engine components Check for intermittent or slipping clutch Check for proper refrigerant charge Check clutch bearing Oil level procedure Shaft turning smoothness test Remove valve plate and inspect	Replace or repair. Replace or repair. Adjust air gap - defective coil. Recharge and recheck. Replace rotor / Armature assembly. Fill to proper level. Compressor failure (Internal). Replace or repair: Broken discharge valve reed or retainer. Broken suction valve reed. Broken gasket.
Clutch disengaged “chattering”	Check air gap	Replace or repair: Adjust air gap. Defective clutch pulley or front plate.

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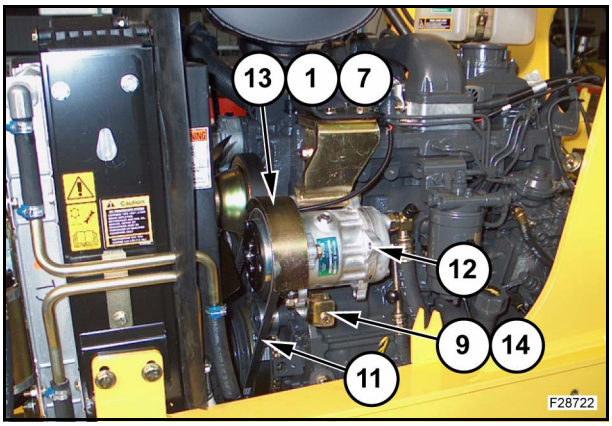
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REMOVAL AND INSTALLATION



Removal

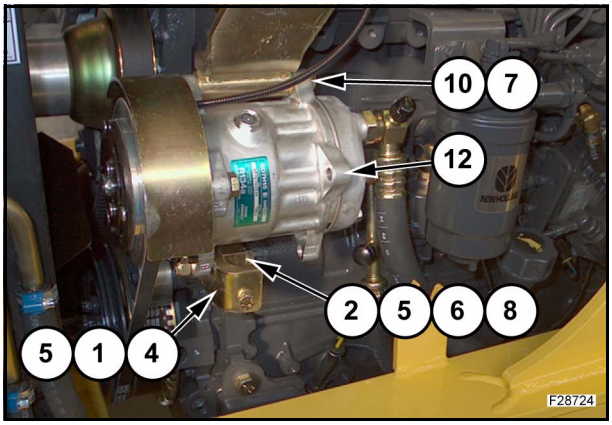
Discharge the air conditioning system. Disconnect the electrical harness of the compressor (12) from the electrical harness of the engine. Disconnect tubing to compressor. Remove the washer (7) and the screw (1). Remove the protective guard (13). Remove the bolt (11). Remove the nut (14) and the screw (9).



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Remove the washers (5), the nut (6), the screw (2) and the block (8). Remove the screw (1), the washers (3) and the belt tensioner (4). Remove the screw (10), the washers (2) and the compressor (12).



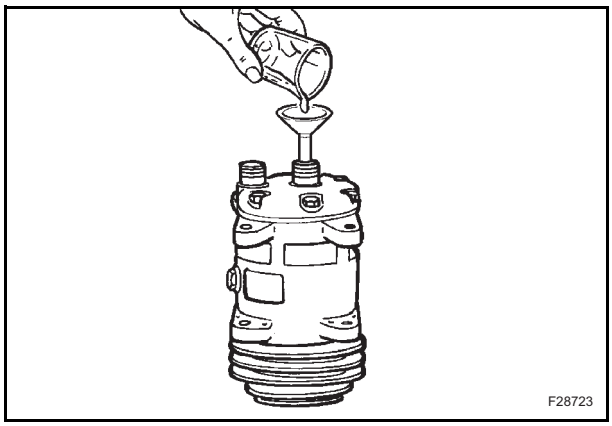
Installation

Installation is the reversal of the removal but the following points should be noted.

- Torque the fixing bolts to 40-51 Nm.

NOTE: it is recommended that a new receiver/drier assembly is installed after any system component replacement or any repair that requires entry into the system.

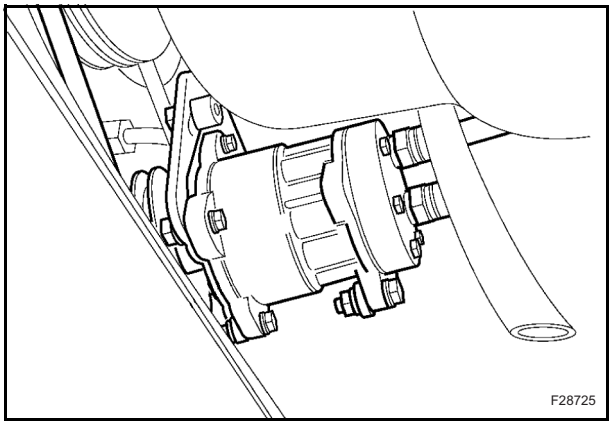
- Drain the oil from the new compressor to be fitted into a clean container, or if the old compressor is to be refitted, obtain a new can of refrigerant oil.
- Calculate the amount of oil to be installed and refill the compressor.
- Reconnect the hoses to the compressor and tighten all bolts and hoses.



After charging a system use the following start up procedure to ensure the lubricating oil is properly dispersed around the system:

- Ensure air conditioning is switched OFF.
- Start the engine and bring speed down to idle.
- Turn the air conditioning ON and allow system to operate for at least five minutes before increasing engine speed.

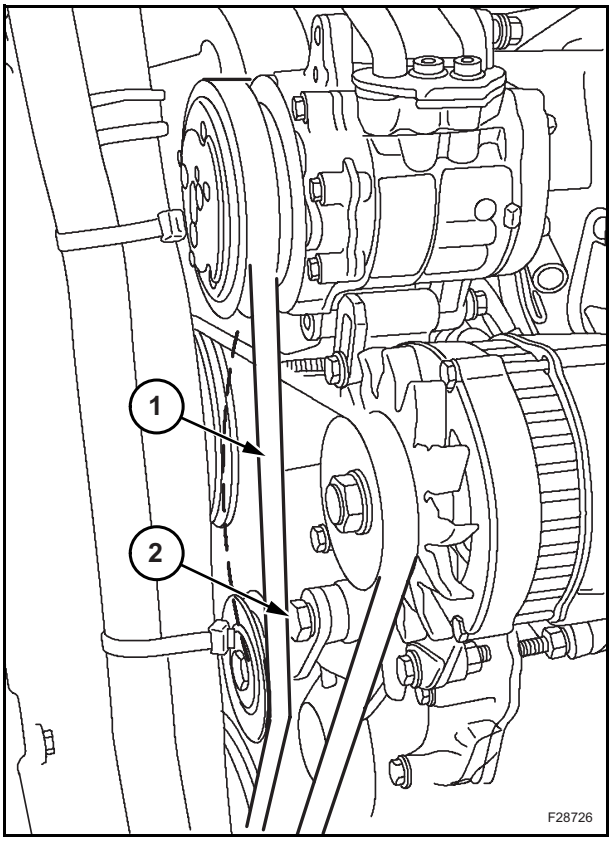
A correctly tensioned belt can be deflected 13-19 mm when hand pressure is applied midway between the alternator and crankshaft pulley.
Once adjusted re-torque the tension arm bolt to 33.9 Nm.



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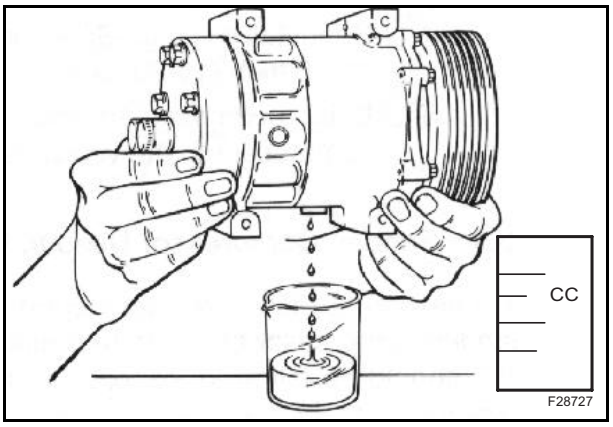
The compressor drive belt (1) can be tensioned by rotation of the idler arm (2). Slacken the idler arm bolt and adjust the arm to a belt deflection of 16 mm. Once adjusted re-torque the tension arm bolt to 33.9 Nm.



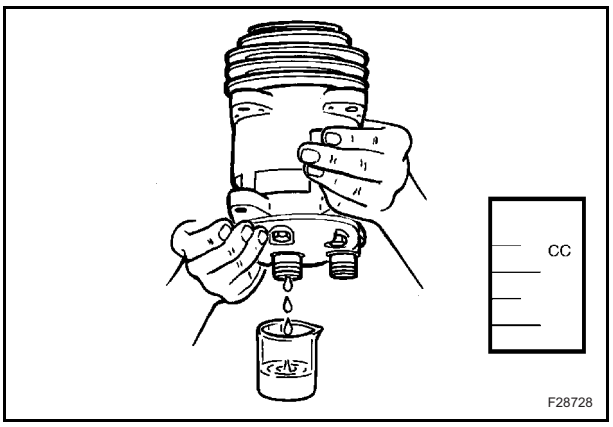
OVERHAUL COMPRESSOR

Before any internal repair is done, drain the oil from the compressor:

- Remove the oil plug and drain as much oil as possible into a suitable container.
- Remove the caps (if present) from suction and discharge ports.
- Drain oil from the section and discharge ports into suitable container while turning the shaft clockwise only with a socket wrench on the armature retaining nut.



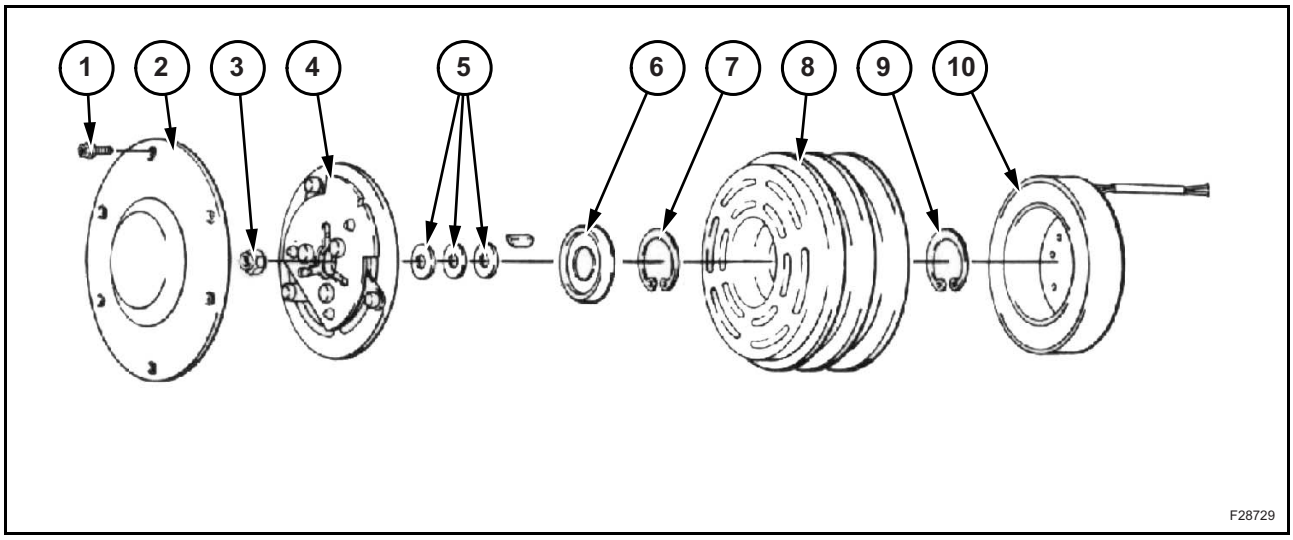
- Measure and record the amount of oil discharged.
- Inspect the oil for signs of contamination such as discoloration of foreign material.



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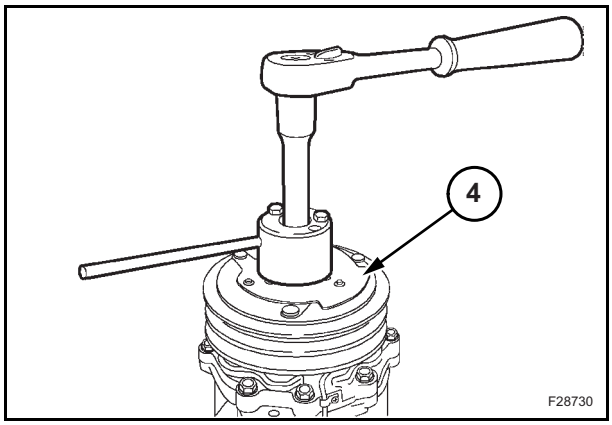
CLUTCH



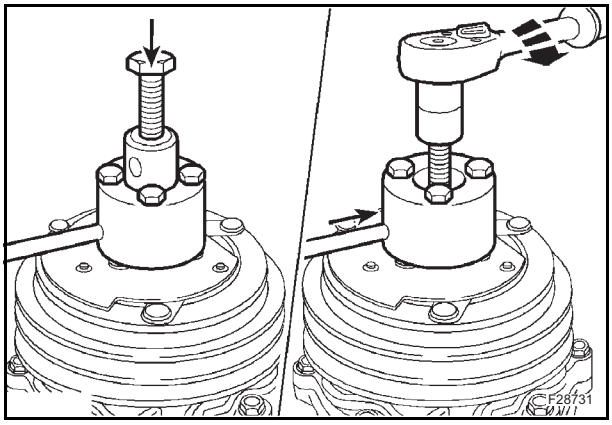
1. Cover screw
2. Dust cover
3. Nut
4. Plate
5. Shims
6. Cover
7. Snap ring
8. Rotor assembly
9. Snap ring
10. Field coil

Disassembly

All clutch servicing should be done with the compressor removed from the vehicle. Support the compressor. If using a vice, do not hold on to the housing. If dust cover (2) is present, remove the 3 or 6 bolts (1) holding it in place and remove cover. If auxiliary sheet metal pulley is present, remove the screws holding it in place. Then remove pulley.
Attach tool to the cover on the front of the clutch plate and placing a socket and ratchet through the tool remove the cover attaching nut (3).



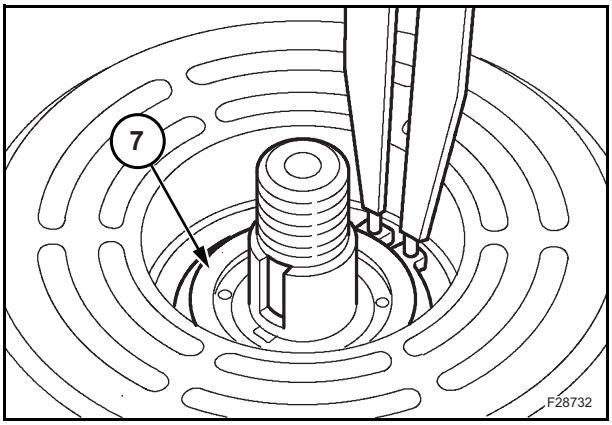
Using the front plate tool and a tommy bar hold the clutch plate stationary.
Place the bolt into the tool and by tightening the bolt onto the end of the shaft the front plate will be extracted from the shaft.
If shims (5) are above shaft key, remove them now. If shims (5) are below shaft key, the key and bearing dust cover (if present) must be removed before shims can be removed.
Remove dust cover (6) (if present). Use caution to prevent distorting cover when removing it.
Remove shaft key by tapping loose with a flat blade screwdriver and hammer. Remove shims (5). Use a pointed tool and a small screwdriver to prevent the shims from binding on the shaft.



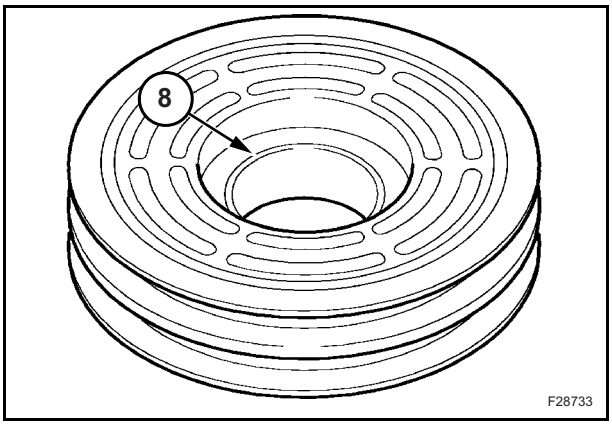
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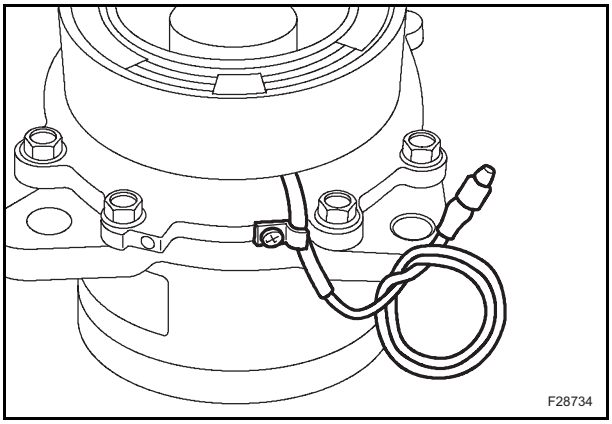
Remove the snap ring (7), remove the shaft key and lift the pulley assembly from the compressor.



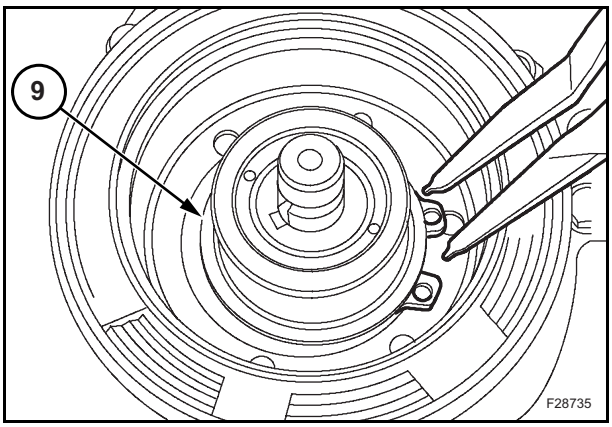
Inspect the rotor assembly (8) for wear and replace the assembly as necessary.



Remove the field coil wire retaining clip.



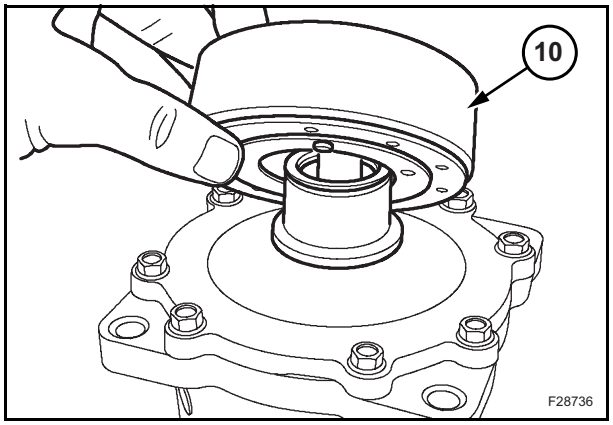
Remove the snap ring (9) of the coil.



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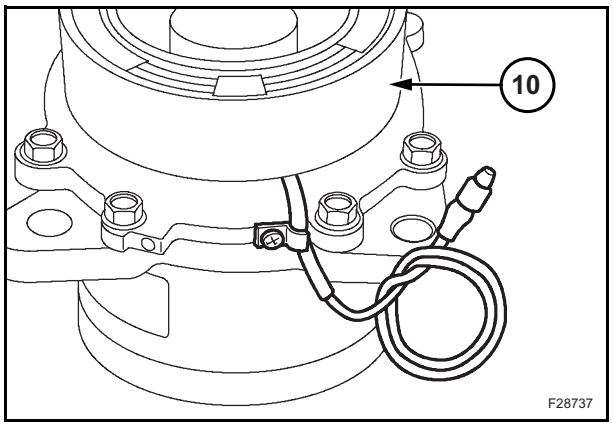
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Lift the coil (10) from the housing and replace as required.

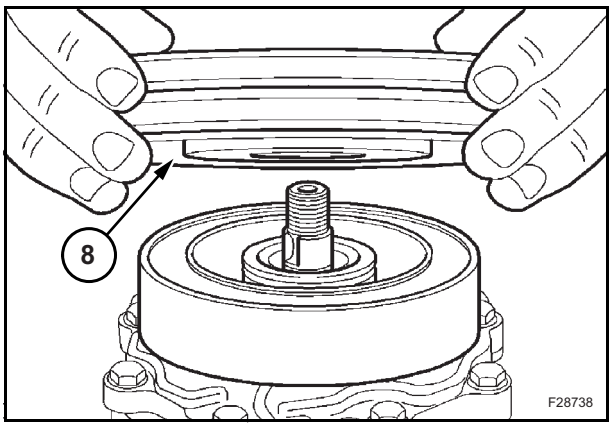


Assembly

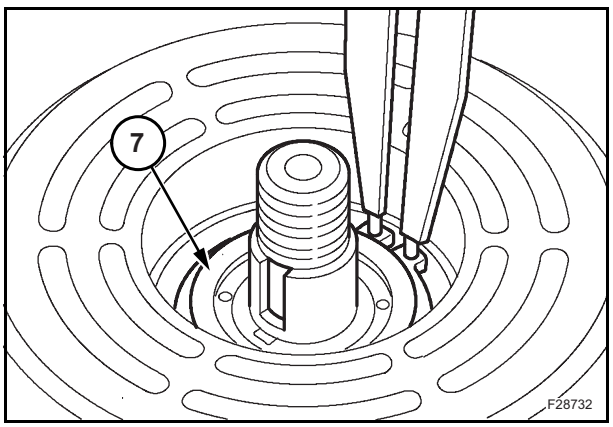
Install the coil (10), making sure that the wire is located behind the clip on the outside of the body and that the snap ring (9) is located in the groove.



Position the rotor (8) on the housing hub and carefully slide the rotor (8) down the shaft.



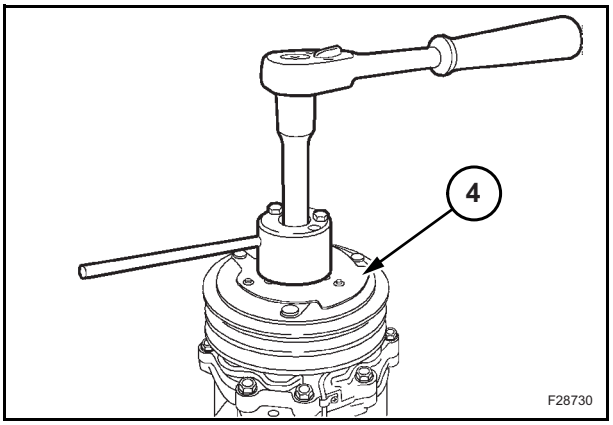
Install the snap ring (7).



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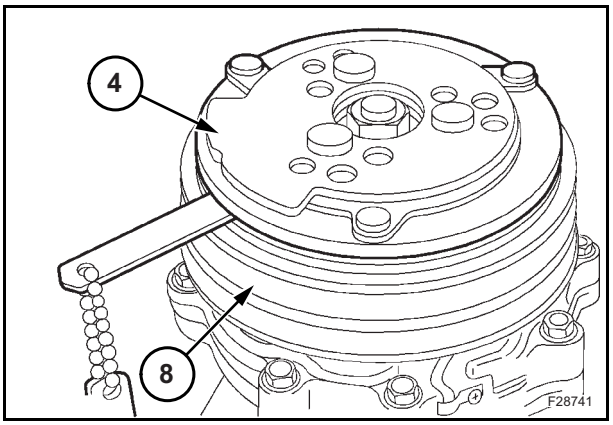
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Replace the plate (4) and retaining nut and tighten to a torque of 18 Nm.



Check the clearance between the plate (4) and rotor (8). This should be consistent around the circumference and be between 0.4-0.8 mm.

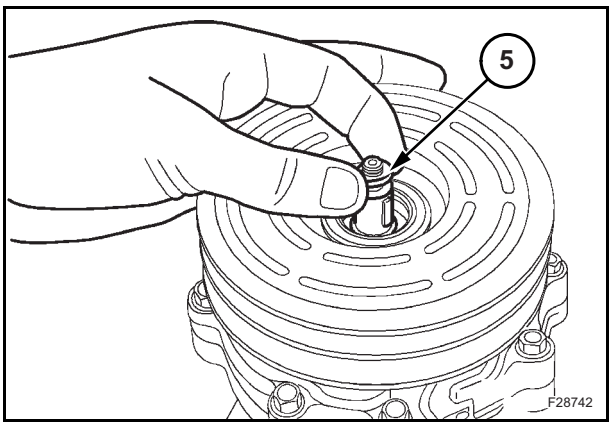
NOTE: if the air gap is not consistent, lightly pry up on the counter weighted front plate at the low spots or lightly tap down at the high spots.



If the clearance is not within specification the shims (5) under the front plate should be added to or subtracted from, until the correct clearance is obtained.

NOTE: new shims are available in sizes 1.00, 0.50 and 0.13 mm.

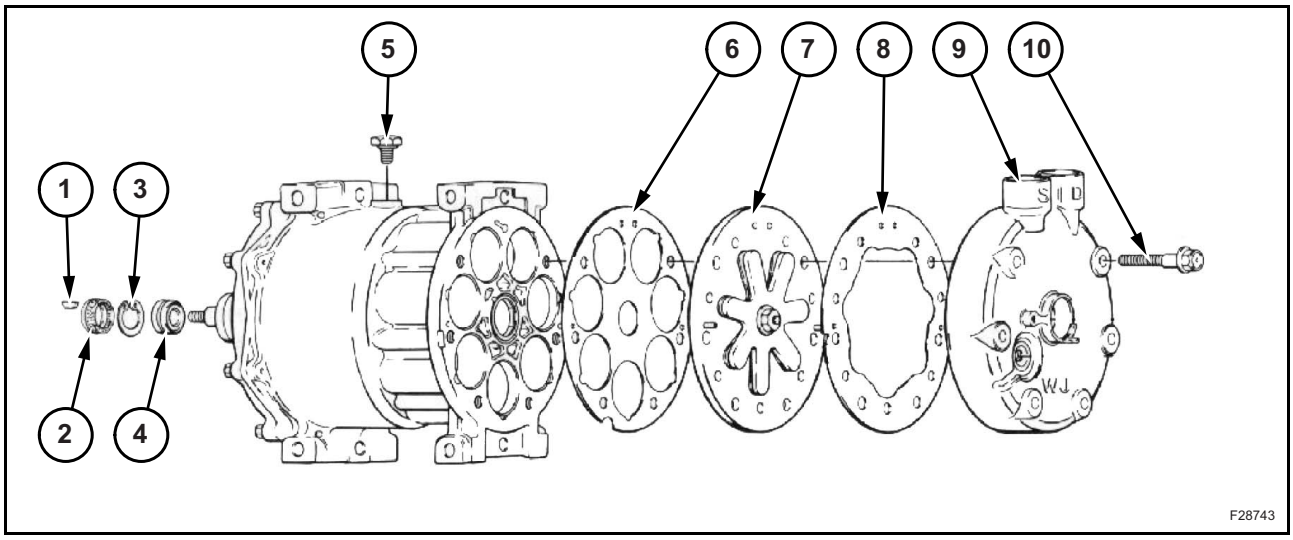
Replace dust cover (2) if present and torque 3 on 6 bolts (1).



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COMPRESSOR



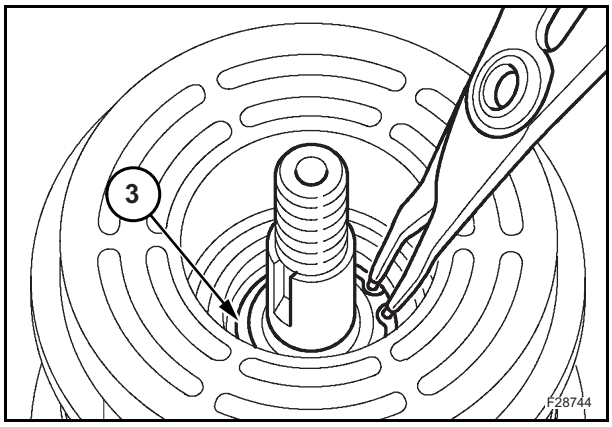
Air conditioning refrigerant compressor

1. Shaft key
2. Ring
3. Circlip
4. Gasket
5. Plug
6. Gasket
7. Plate
8. Head gasket
9. Cylinder head
10. Screw

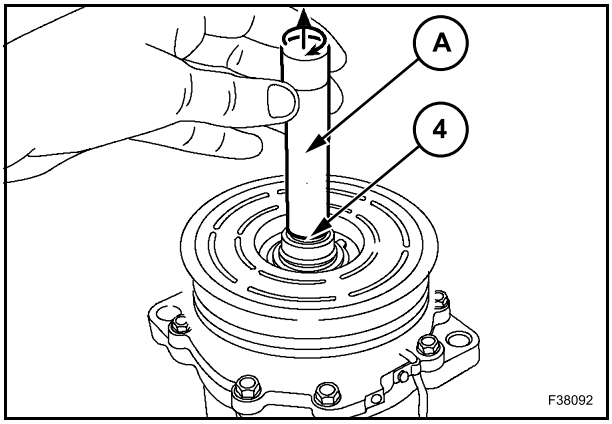
Removal

The refrigerant must be discharged from the system and the compressor removed from the vehicle prior to replacing the shaft seal.

- Remove the armature plate, as detailed in the steps of clutch disassembly.
- Remove the shaft key (1), shims and ring (2) to expose the snap ring (3).
- Remove the snap ring (3).



Insert the seal remover/installer tool (A).
Twist the tool to engage the slots in the seal. Pull up to remove and discard the seal (4).

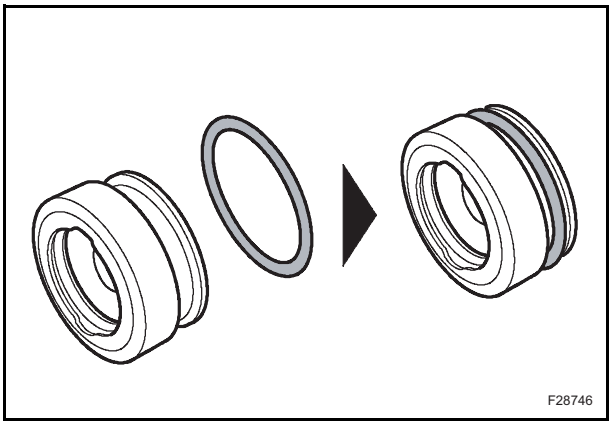


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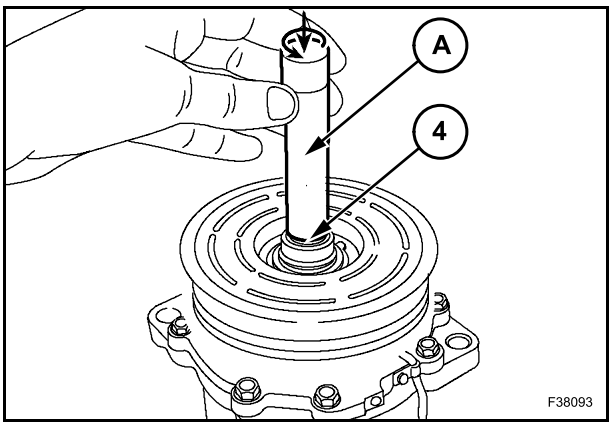
Installation

Thoroughly clean the seal cavity in the hub. Use “lint free” cloth only.
Ensure the new hub O-ring is installed onto the seal assembly. Dip the new seal assembly in clean refrigerant oil and attach to the seal remover/installer tool.

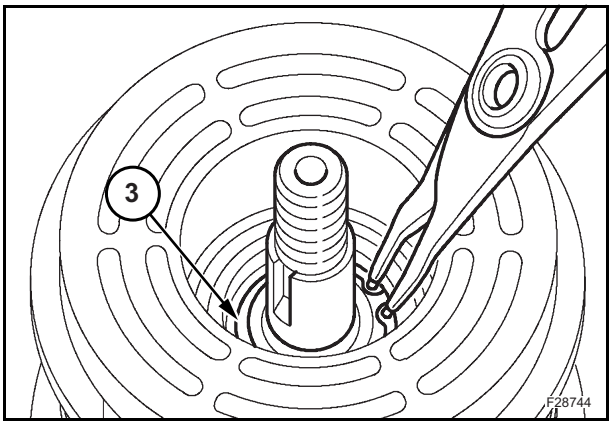


Completely insert the new seal (4).

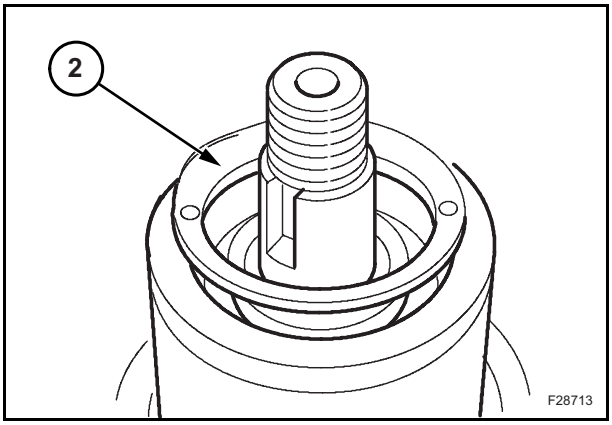
NOTE: if remover/installer tool (A) is not available, position the seal squarely in the hub and tap gently until fully seated.



Install the snap ring (3). If the snap ring has a bevelled edge this should face outwards.



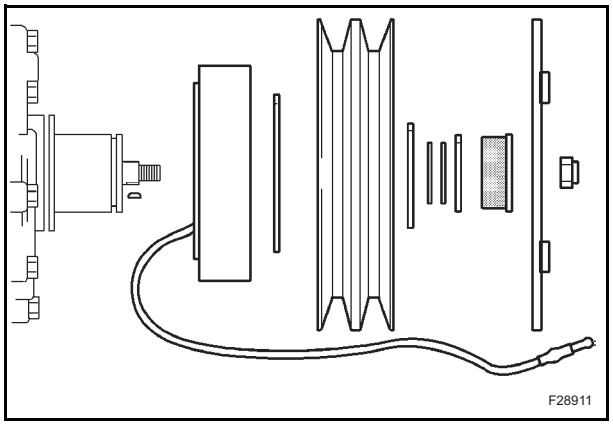
Install a new ring (2) and push into position.



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Position the shims over the shaft and refit the shaft key.
Reinstall the plate as described in clutch reassembly.



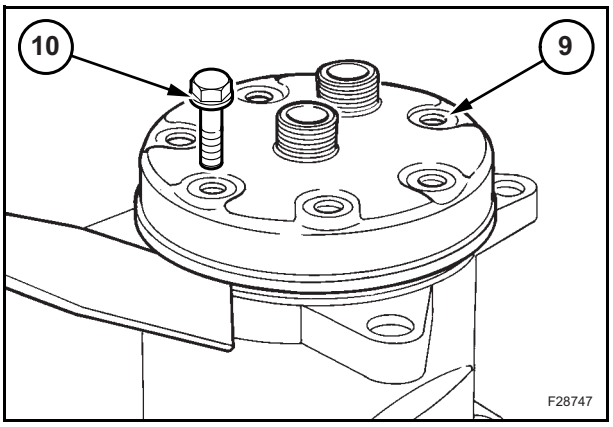
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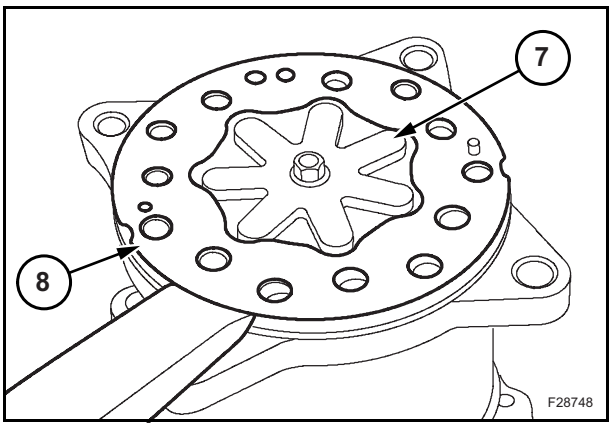
CYLINDER HEAD

Disassembly

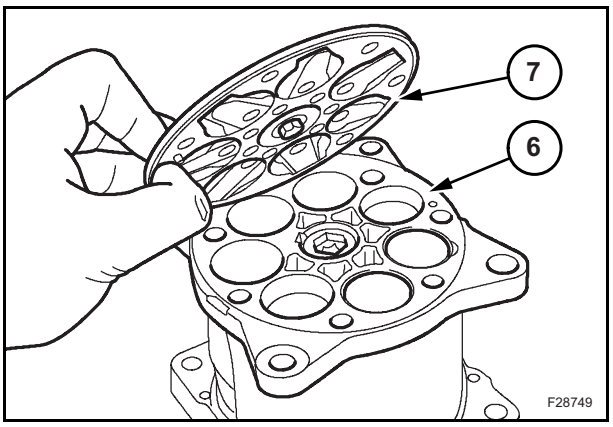
Drain the refrigerant oil from the compressor into a clean calibrated container. Measure and record the quantity of oil obtained. This information is required during installation of the new or overhauled unit.
Remove the six cylinder head bolts (10) and using a hide mallet, gently tap the cylinder head (9) free. The use of a gasket scraper may also be required to free the cylinder head from the compressor body.



If the plate (7) and/or cylinder head are to be reused, carefully remove the gasket (8) using a suitable scraper.

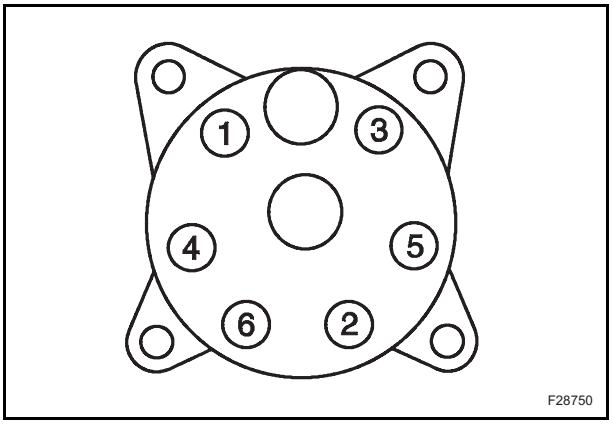


Gently pry the plate (7) free from the cylinder block and remove the gasket (6).
Inspect the plate (7) for damage.



Reassembly

Coat the top of the valve plate with clean refrigerant oil and reassemble the cylinder head using the reverse of the disassembly procedure.
When installing the gaskets and valve plate ensure they are correctly positioned over the locating pins in the cylinder block.
Install the cylinder head bolts and tighten using the sequence shown. Torque initially to 20 Nm.
When the overhaul is complete add to the compressor a volume of oil equivalent to that drained prior to disassembly, or as the reclaim measured fill.



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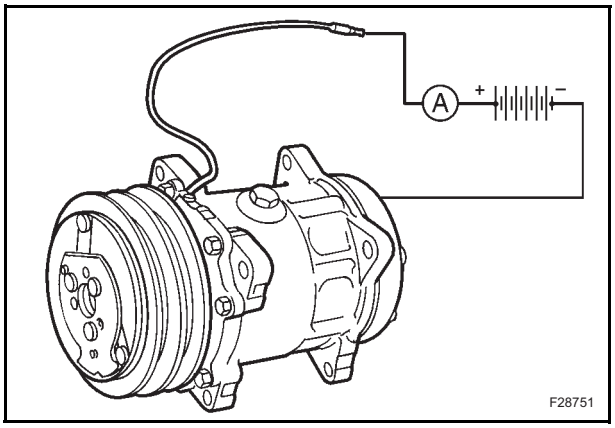
OIL RETAINED IN SYSTEM COMPONENTS

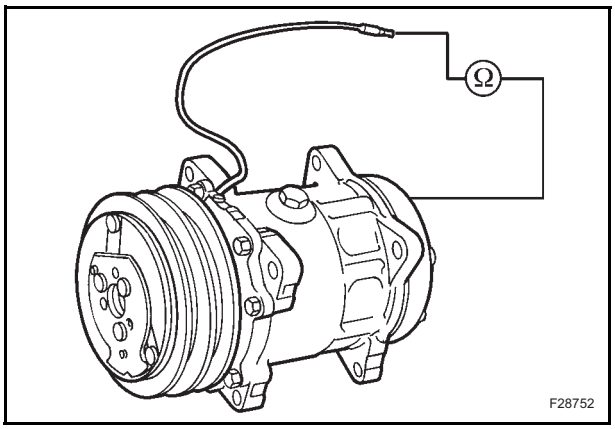
After replacement of individual system components it will be necessary to add some oil to the system to make up the amount lost in the removed component. The table below shows some typical volumes for the components. It is, however, still recommended that the oil level measurement, described previously is carried out after a new component has been installed to establish correct oil quantity.

Component	Typical oil amount	
	fl.oz.	cc
Accumulator	2.0	60
Evaporator	2.0	60
Condenser	1.0	30
Receiver dryer	0.5	15
Hoses	0.3	10

Preliminary Inspection

1. Rotate the compressor shaft. Use a suitable socket on the hub centre bolt or by hand using the rubber dampers.
   If severe roughness is felt while rotating the hub, the compressor should be disassembled.
2. Using a 12 V battery, test the current absorption of the field coil: it must be between 3.6 and 4.2 A. Very high current readings indicate a short circuit in the field coil and no current reading indicate an open circuit. Replace coil with either fault. Resistance of the coil using an ohmmeter should be approximately 3.0 Ω at 20 °C.
   A poor ground connection of the field coil will result in a low voltage.
3. Ensure clutch is disengaged and rotate pulley by hand. If roughness in the bearing is felt, it will be necessary to replace the pulley and bearing as an assembly.





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3.10 SPECIAL TOOLS

Only certified refrigerant recovery, recycling and recharge equipment suitable for the type of refrigerant gas HFC 134a should be used on these vehicles when servicing the air conditioning system.
This special equipment is available through recognized suppliers of air conditioning equipment.

P/N	DESCRIPTION	USE
380000315	Recovery / recharge portable system	Discharging and recovering of the refrigerant
380000312	Evaporator and condenser cleaner	Evaporator and condenser cleaning
380000314	Electronic gas leak detector	Leak testing

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NOTES:

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580SR
580SR+
590SR
695SR



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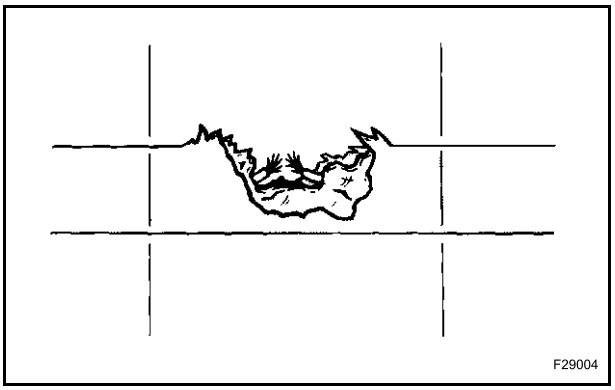
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1. GENERALITIES

1.1 TEMPORARY WIRING HARNESS REPAIR

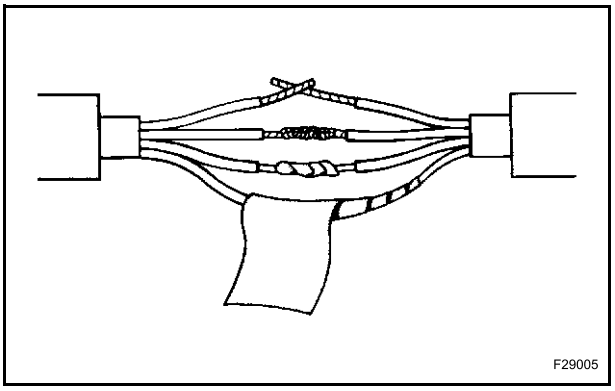
The following method to repair wiring is a temporary expedient only. Wiring should be replaced as soon as possible. Replacement of temporary repaired cables with new is particularly important if the loader backhoe is to be used for spraying as chemicals can enter the repaired area, travel up the cable and damage electrical components. Do not attempt to repair the wire on any system sensors as these are sealed and should only be replaced with a new component.


F29004

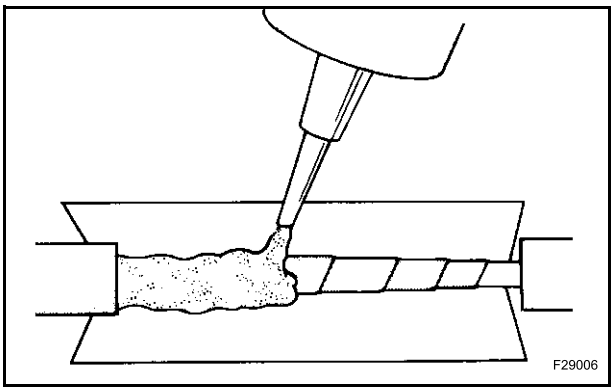
NOTE: when conducting a cable repair it is important that only RESIN CORED SOLDER is used. Use of other types of solder ma result in further cable damage.

To carry out a temporary repair, proceed as follows:

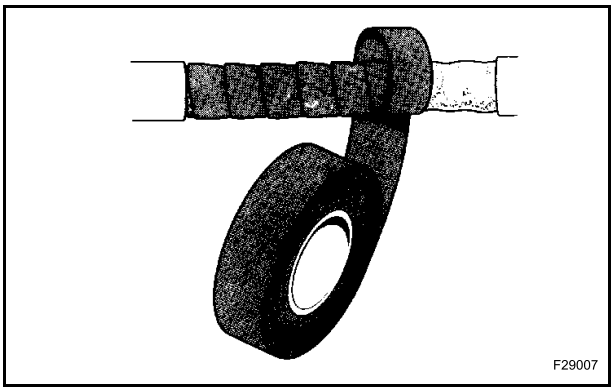
- Locate damaged portion of cable then cut away outer protective cover on both sides of the damaged area.
- Peel back the cable from both ends of the damaged area and carefully cut away the inner cable cover at the damaged area and strip about 13 mm of insulation from the wires. Do not cut away any wire strands.
- Using a suitable solvent, clean about 50 mm from each cover end. Clean the grey cable cover and the individual leads.


F29005

- Twist two bare leads together for each damaged lead, being careful to match wire colours, then solder the leads using resin cored solder. Tape each repaired lead with vinyl insulation tape.
- Wind a layer of vinyl insulation tape up to the grey cable cover at each end of the repair section. Make a paper trough, then apply silicon rubber compound (non hardening sealant) over the repaired section up to the cover ends. Sufficient sealant must be used to fill the ends of the cut away area.


F29006

- Allow the compound to cure then cover the area with insulating tape taking the tape well over each end of the repair. An overlap of at least 50 mm of tape at each end is necessary.
- Check to ensure the repair is satisfactory and secure the repaired cable so that repeat damage is avoided.


F29007

NOTE: this is a temporary repair only. Ensure the damaged cable is replaced as soon as possible to prevent ingress of water or chemicals.

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1.2 FAULT FINDING

PROBLEM	CAUSE	CORRECTION
Electrical system is inoperative	Loose or corroded battery connections	Check that the battery voltage with open circuit is at least 12.6 V.
	Clean and tighten connections Sulphated batteries	Check the electrolyte level and density.
	Battery Isolator switch turned OFF	Restore the battery isolator switch.
	Main machine fuse link blown	Find the reason of the failure and replace the connection fuse.
Starter motor speed too low, the engine cranks slowly	Loose or corroded connections	Clean and tighten loose connections.
	Low battery output voltage	Check that the battery voltage with open circuit is at least 12.6 V. Check the electrolyte level and density.
	Incorrect viscosity of the engine oil	Use an oil with correct viscosity for the temperature conditions.
Starter motor inoperative	Transmission shift lever in gear	Move gearshift lever to neutral.
	Loose or corroded connections	Clean and tighten loose connections.
	Dead batteries	Charge or replace the batteries.
Charge indicator lamp stays on with engine running	Low engine idle speed	Increase idle speed.
	Loose belt	Check belt tension.
	Malfunctioning battery	Check that the battery voltage with open circuit is at least 12.6 V. Check the electrolyte level and density.
	Malfunctioning alternator	Check alternator.
Batteries will not charge	Loose or corroded terminal connections	Clean and tighten the connections.
	Sulphated batteries	Check that the battery voltage with open circuit is at least 12.6 V. Check the electrolyte level and density.
	Loose or worn belt	Check the automatic belt tensioner. Replace belt if required.
Charge indicator flashing indicating excessive charging voltage	Malfunctioning alternator	Check alternator.

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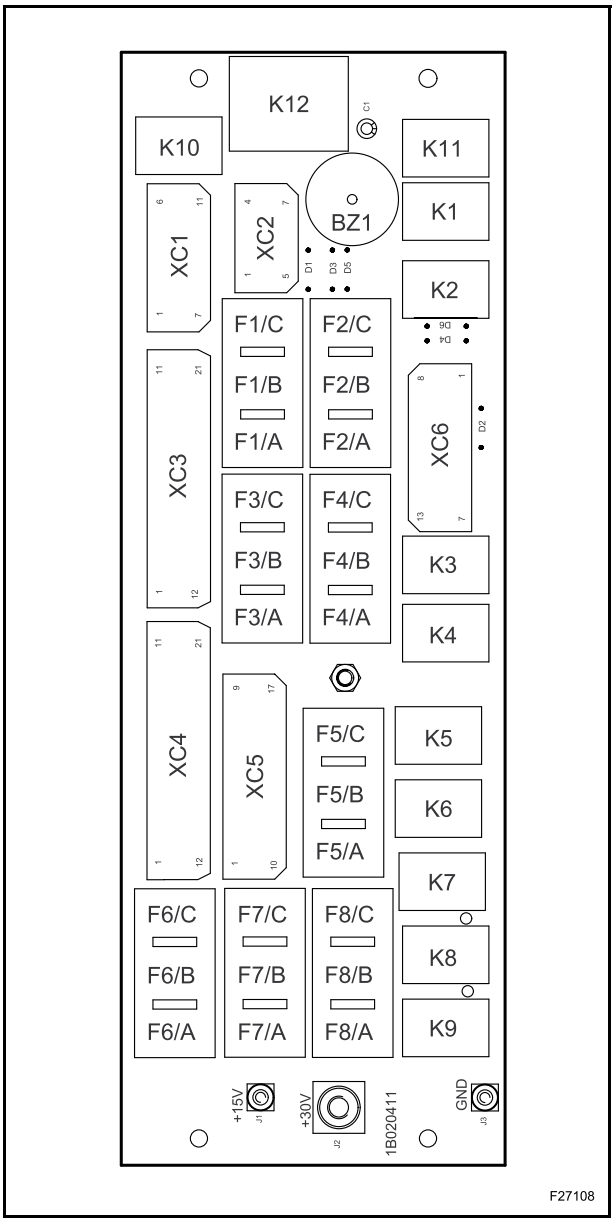
2. ELECTRICAL DIAGRAMS

2.1 ELECTRICAL DIAGRAMS - POWERSHUTTLE ROPS (580SR)

FUSE AND RELAY DESCRIPTION

Fuse No.	Rating	Function
F1A	7.5 A	Stopping the engine
F1B	7.5 A	(+15) anti-theft device, “grid heater”
F1C	10 A	Stop light switch
F2A	15 A	Instrument power supply, switch lamps, brake oil level sensor, pneumo-electric seat, buzzer
F2B		
F2C	15 A	Pilot control
F3A	3 A	Rear right/front left side light, instrument backlighting
F3B	3 A	Rear left/front right side lights, number plate light
F3C	10 A	Front work light switch, ride control, double delivery
F4A	5 A	Reverse buzzer, gearshift lever
F4B	10 A	Rear hammer button, bucket level solenoid valve + sensor, clutch disconnect buttons
F4C	10 A	Backhoe attachment lock, backhoe attachment travel lock, rear work light
F5A	15 A	Inner front work lights
F5B	10 A	Low beams
F5C	15 A	Main beams
F6A	7.5 A	Rotating beacon
F6B	7.5 A	(+15) hazard warning lights
F6C	7.5 A	Hand hammer, 4WD
F7A	10 A	(+30) hazard warning lights, horn
F7B	15 A	
F7C	6 A	
F8A	15 A	Outer rear work lights
F8B	15 A	Outer front work lights
F8C	15 A	Inner rear work lights

K1	Forward-reverse travel gearshift lever relay
K2	Parking brake relay
K3	Starting relay
K4	Bucket level solenoid valve relay
K5	Low and main beam relay
K6	Inner front work light relay
K7	Inner rear work light relay
K8	Outer front work light relay
K9	Outer rear work light relay
K10	Reverse travel relay
K11	Forward travel relay
K12	Hazard warning light relay



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COMPONENTS AND CONNECTORS

NAME	DESCRIPTION
BZ1	Alarm buzzer
EV1	Double delivery solenoid valve (optional)
EV2	Hand hammer control valve (optional)
EV3	Rear hammer solenoid valve (optional)
EV4	Backhoe attachment travel solenoid valve
EV5	Backhoe attachment lock solenoid valve (optional)
EV6	Bucket level solenoid valve
EV7	Fuel shut off solenoid valve
EV8	4WD solenoid valve (optional)
EV9	Reverse travel solenoid valve
EV24	Lifting solenoid valve
EV25	Lifting solenoid valve
FG1	General fuse 80A
FG2	A/C fuse (not connected)
H1	Backhoe attachment lock warning light (optional)
H2	Front left light
H3	Front right light
H4	Rear left light
H5	Number plate light
H6	Rear right light
H11	Outer front left work light
H12	Outer front right work light
H13	Outer rear left work light
H14	Outer rear right work light
H15	Rotating beacon
H16	Rotating beacon
H19	Inner front left work light (optional)
H20	Inner front right work light (optional)
H21	Inner rear left work light (optional)
H22	Front right work light (optional)
HA1	Reverse buzzer
HA2	Horn
HA3	Optional buzzer
K01	Starting relay
K02	A/C relay
K13	Antitheft unit

NAME	DESCRIPTION
KC	Fuse and relay control unit
M1	Starter motor
M10	Air conditioning compressor (not connected)
R2	Engine water temperature sender
R3	Fuel level gauge
R4	Transmission temperature sender
S2	4WD switch (optional)
S3	Hand hammer switch (optional)
S4	Double delivery switch (optional)
S5	Ride control switch (optional)
S7	Backhoe attachment travel lock switch
S8	Backhoe attachment lock switch (optional)
S9	Lights switch
S11	Front work light switch
S12	Rear work light switch
S15	Beacon lamp switch
S17	Start switch
S18	Parking brake switch
S20	Engine oil low pressure switch
S21	Air filter blocked switch
S24	Trasmission oil pressure switch
S26	Clutch disconnect button
S27	Clutch disconnect button
S28	Bucket sensor
S30	Rear hammer pedal (optional)
S31	Brake oil level sender
S32	Stop light switch
S33	Stop light switch
S40	Gearshift lever
S41	Light / windshield wiper control lever
S42	Warning switch
S44	Pneumo-electric seat (optional)
S47	Battery master switch
S48	Cold start temperature switch
S49	Air conditioning pressure switch (not connected)
S52	Solenoid valves lock switch (optional)
S54	Rear horn button (optional)
ST2	Side instrument cluster

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NAME	DESCRIPTION
ST3	4x1 bucket control lever
X1	General line - engine line - 18-way connector
X2	“Grid heater” - 6-way connector
X3	Engine stop - 1-way connector
X4	Air filter - 2-way connector
X6	Forward gear - 2-way connector
X7	Reverse travel - 2-way connector
X8	General line - rear lights - 12-way connector
X10	Solenoid valve line - general line - 29-way connector
X13	General line - front instrument cluster - 17-way connector
X14	Anti-theft device - 11-way connector
X15	Start switch - 10-way connector
X17	Pneumo-electric seat - 4-way connector
X21	Left light / horn - 7-way connector
X22	Right light - 5-way connector
X23	Clutch disconnect button - 2-way connector
X24	Backhoe attachment travel lock solenoid valve - 2-way connector
X25	Backhoe attachment lock solenoid valve - 2-way connector
X26	Bucket sensor - 3-way connector
X27	Horn button on pilot control - 2-way connector
X28	Clutch disconnect button - 2-way connector
Y29	Bucket level - 2-way connector
X30	Rear hammer pedal (optional)
X31	Quick coupler solenoid valve - 2-way connector
X32	Rear hammer solenoid valve - 2-way connector
X34	Ride control solenoid valve - 2-way connector
X35	Hand hammer solenoid valve - 2-way connector
X36	Rear hammer button - 2-way connector
X38	Rear right work light - 4-way connector
X40	Rear right work light (optional) - 4-way connector
X41	Blower motor (optional) - 2-way connector

NAME	DESCRIPTION
X44	Front right work light - 4-way connector
X45	Front right work light (optional) - 4-way connector
X46	Rear left work light (optional) - 4-way connector
X47	Rear left work light - 4-way connector
X50	Front left work light (optional) - 4-way connector
X51	Front left work light - 4-way connector
X61	Light / windshield wiper control lever - 12-way connector
X62	Gearshift lever - 6-way connector
X63	Number plate light - 2-way connector
X64	Air conditioning compressor - 1-way connector
X67	Alternator - 3-way connector
X68	Engine water temperature switch - 3-way connector
X69	Air conditioning pressure switch - 2-way connector
X70	Front instrument cluster - 12-way connector
X71	Start switch - 10-way connector
X72	Pilot control line - 1-way connector
X73	Engine oil low pressure switch - 1-way connector
X80	Beacon lamp - 2-way connector
X81	Beacon lamp - 2-way connector
X82	Control unit - 10-way connector
X83	Relay - 2-way connector
X87	General line - left side instrument cluster line - 13-way connector
X89	Left light - 6-way connector
X101	Right light - 6-way connector
X104	Valve block switch kit - 1-way connector
X124	Lifting solenoid valve - 2-way connector
X125	Lifting solenoid valve - 2-way connector
XA	Start - 1-way connector
XC1	Control unit - 11-way connector
XC2	Control unit - 7-way connector
XC3	Control unit - 21-way connector
XC4	Control unit - 21-way connector

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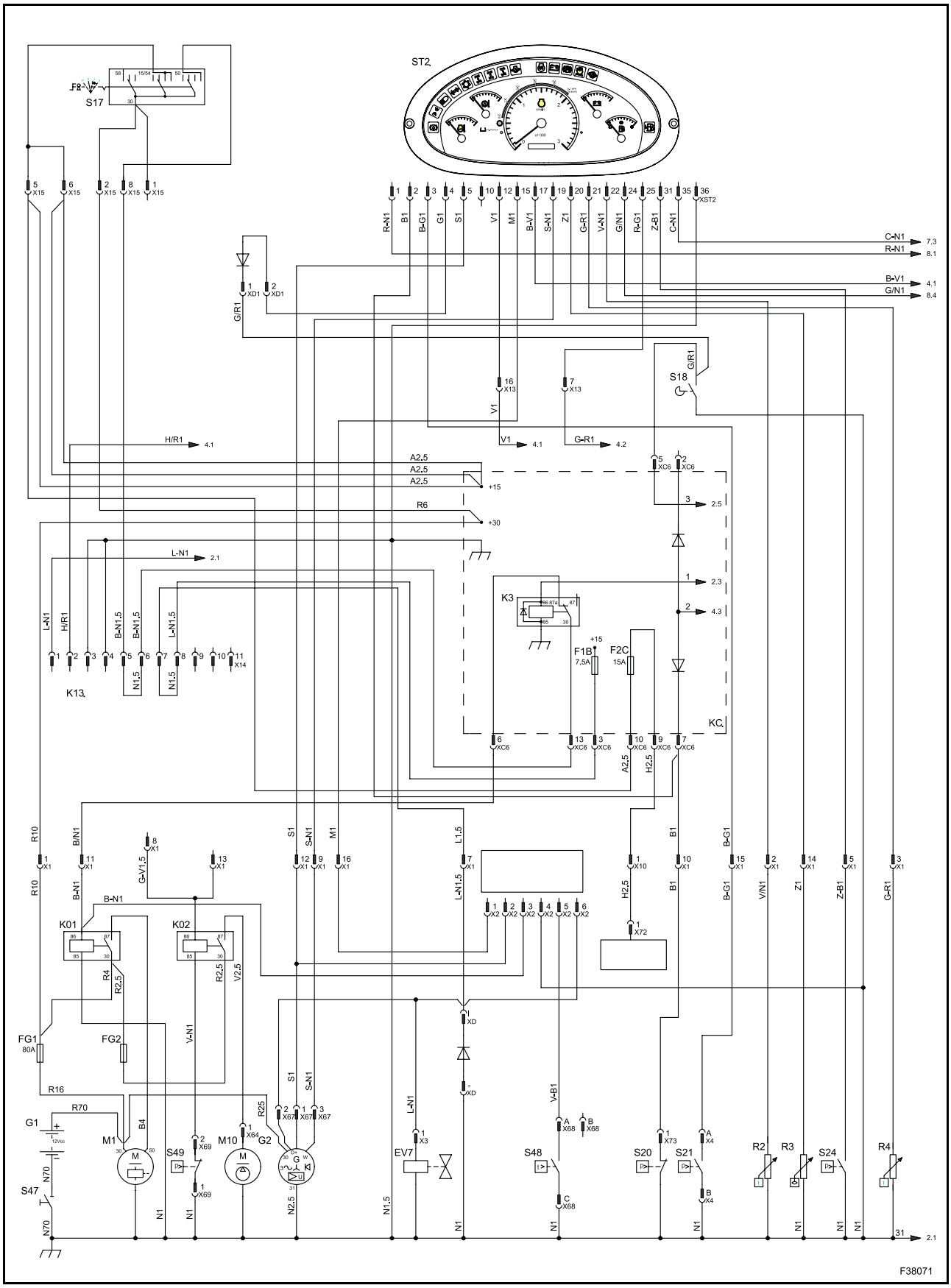
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NAME	DESCRIPTION
XC5	Control unit - 17-way connector
XC6	Control unit - 13-way connector
XD	Engine stop diode - 2-way connector
XD1	Parking brake diode - 2-way connector
XST2	Side instrument cluster - 36-way connector
Y12	Proportional solenoid valves

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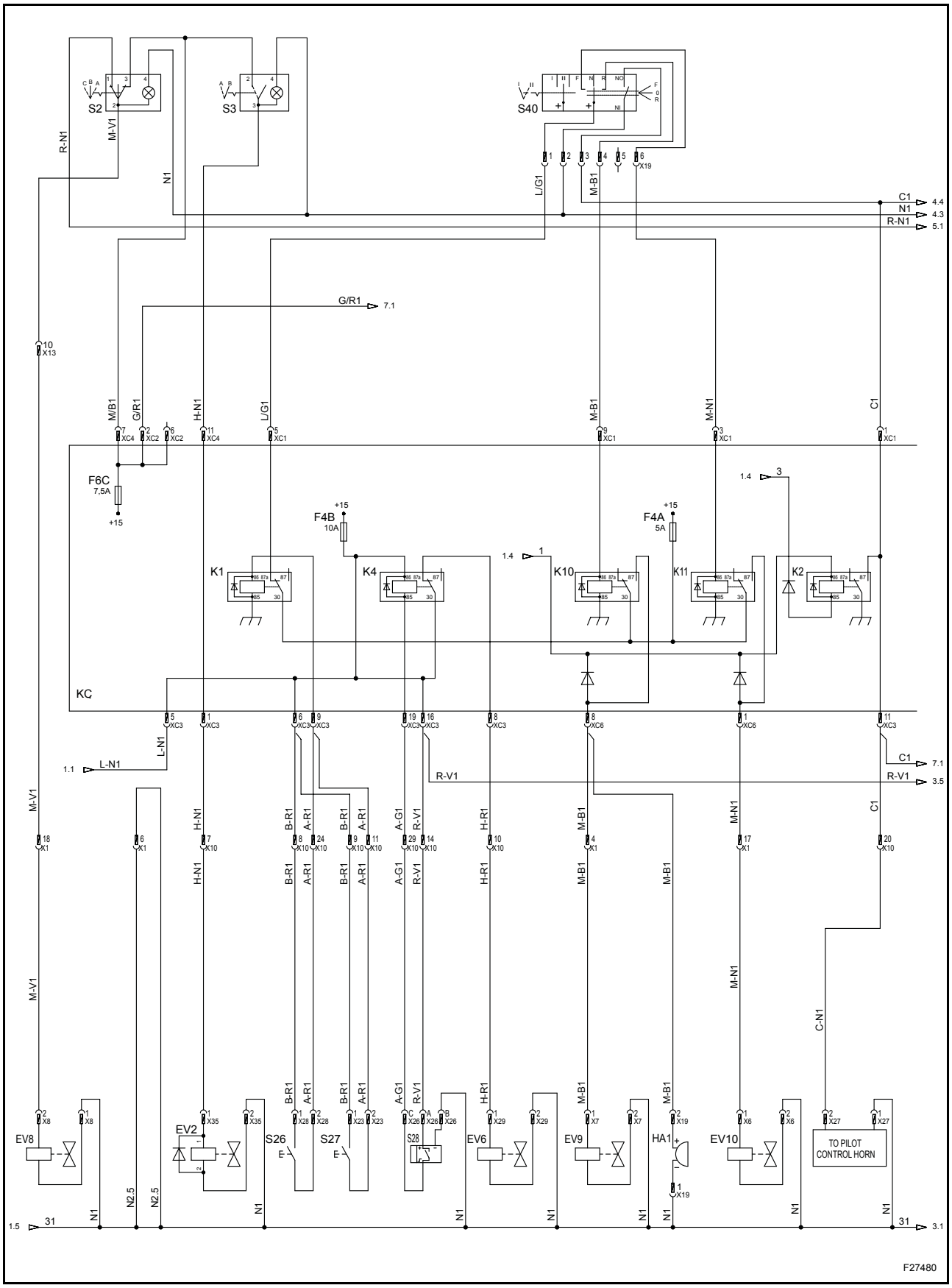
ENGINE LINE DIAGRAM



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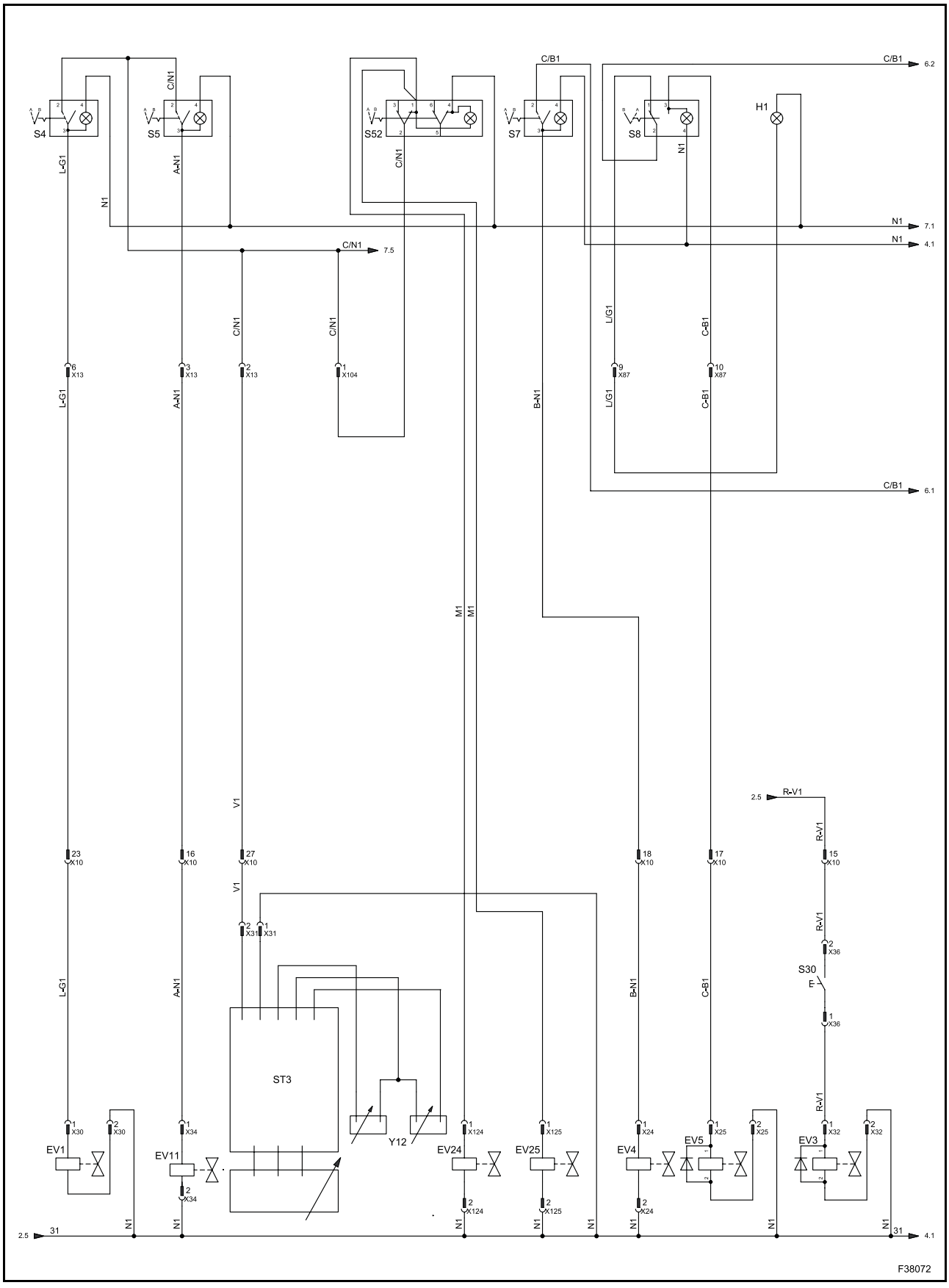
SOLENOID VALVE LINE DIAGRAM



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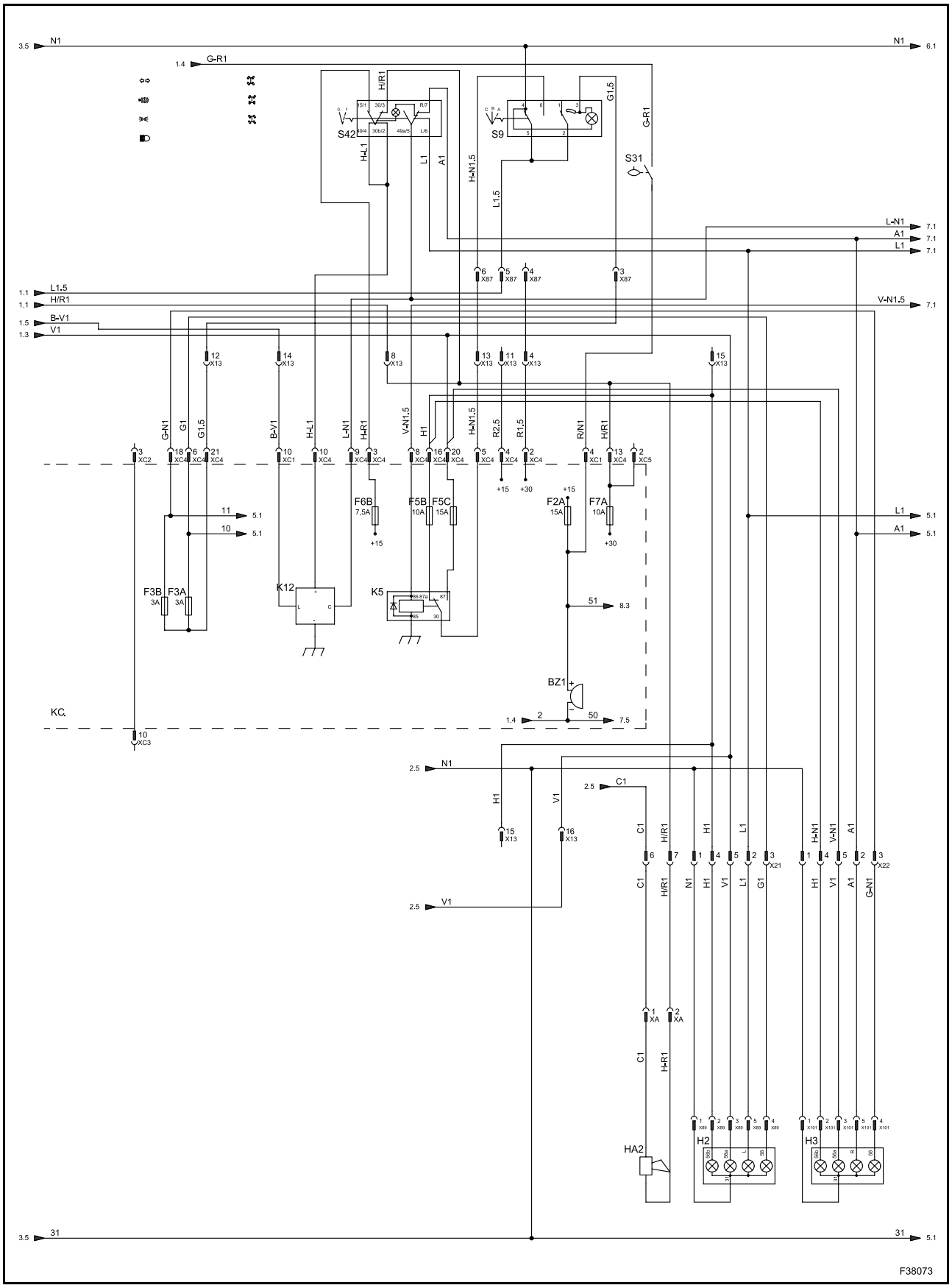
SOLENOID VALVE LINE DIAGRAM



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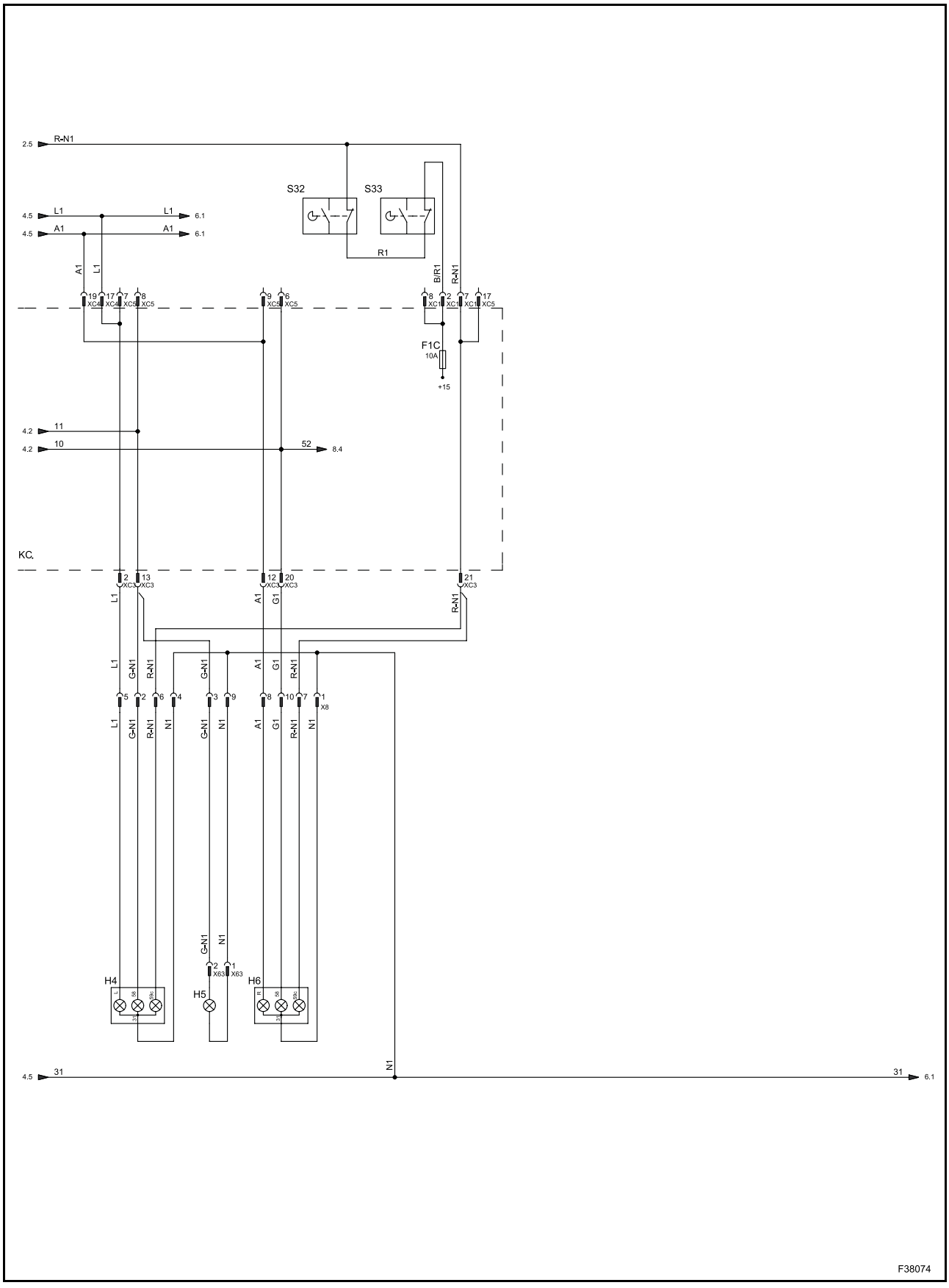
LIGHT LINE DIAGRAM



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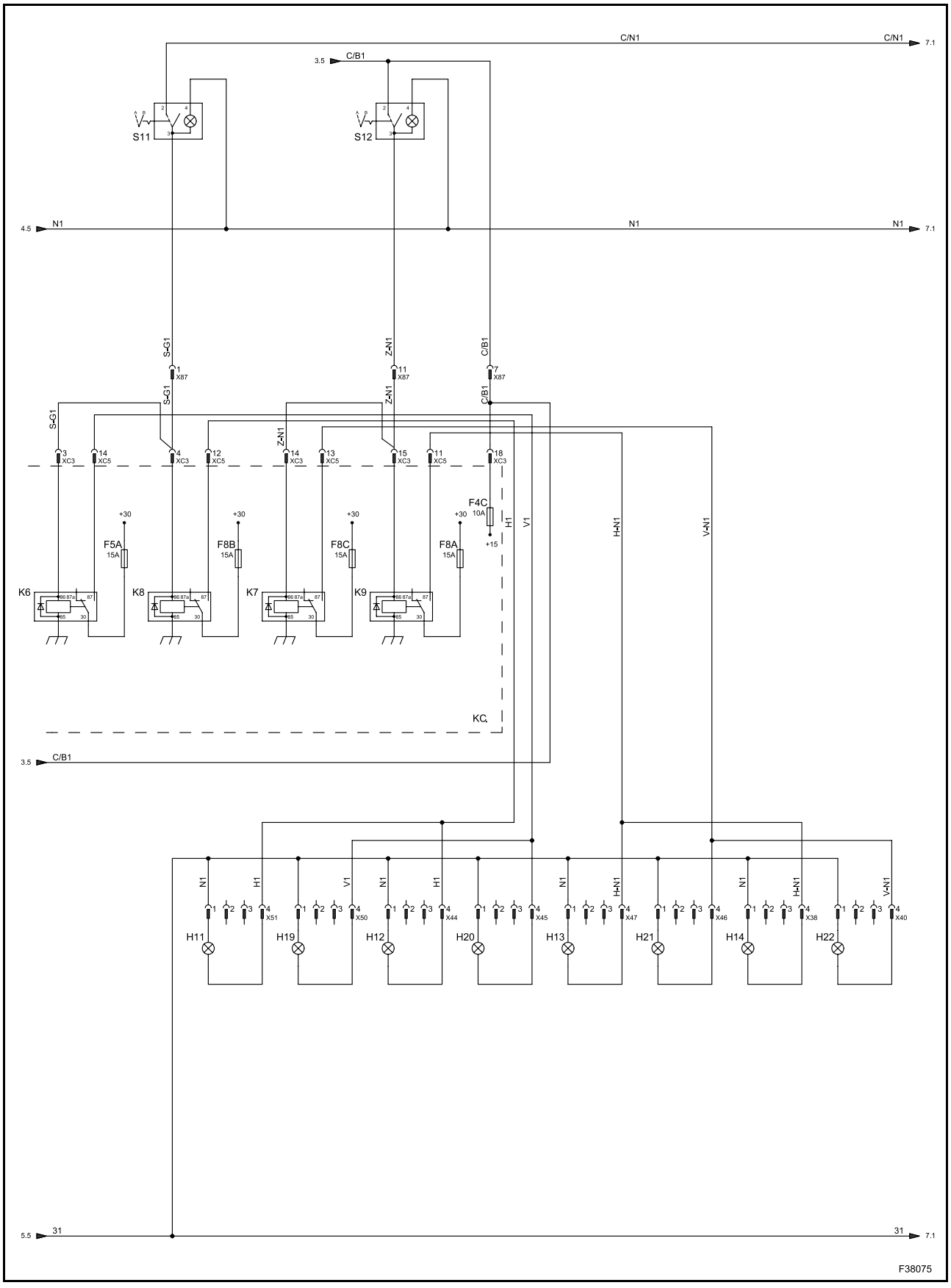
REAR LIGHT LINE DIAGRAM



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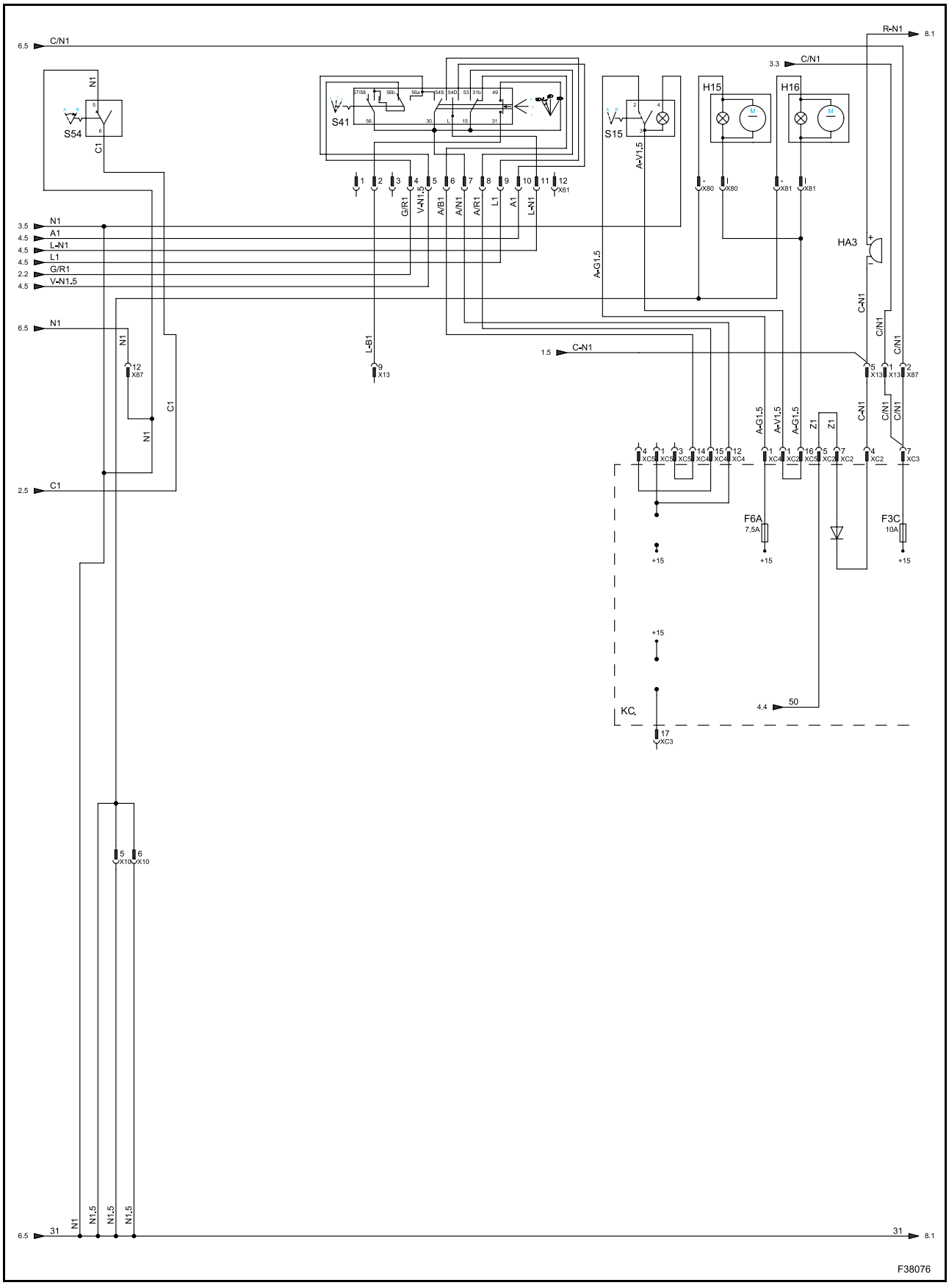
WORK LIGHT LINE DIAGRAM



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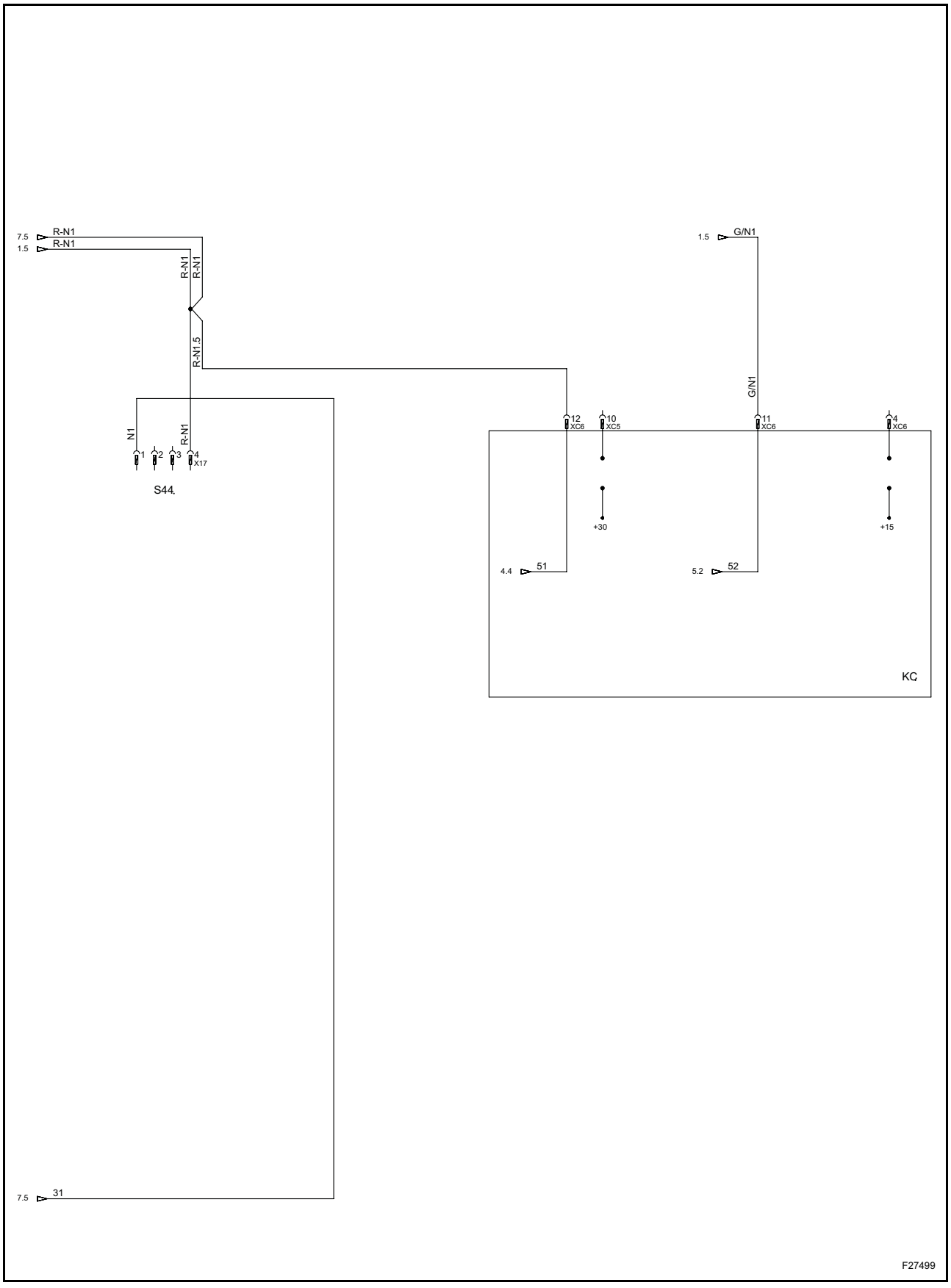
WINDSHIELD WIPER - WASHER LINE DIAGRAM



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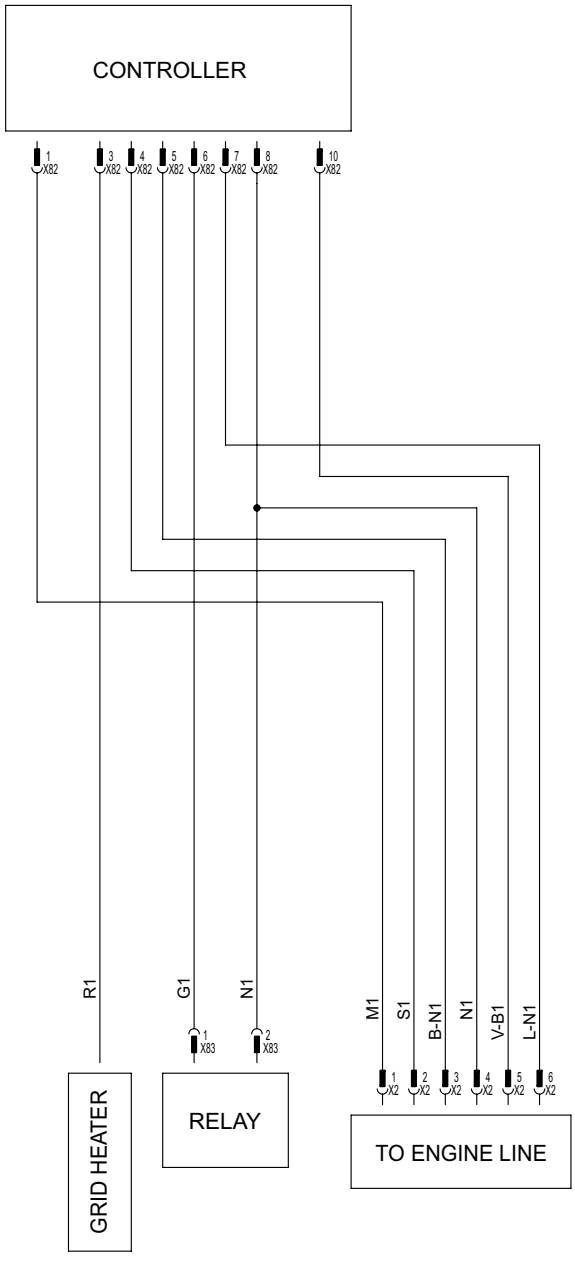
HEATER LINE



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COLD START DIAGRAM

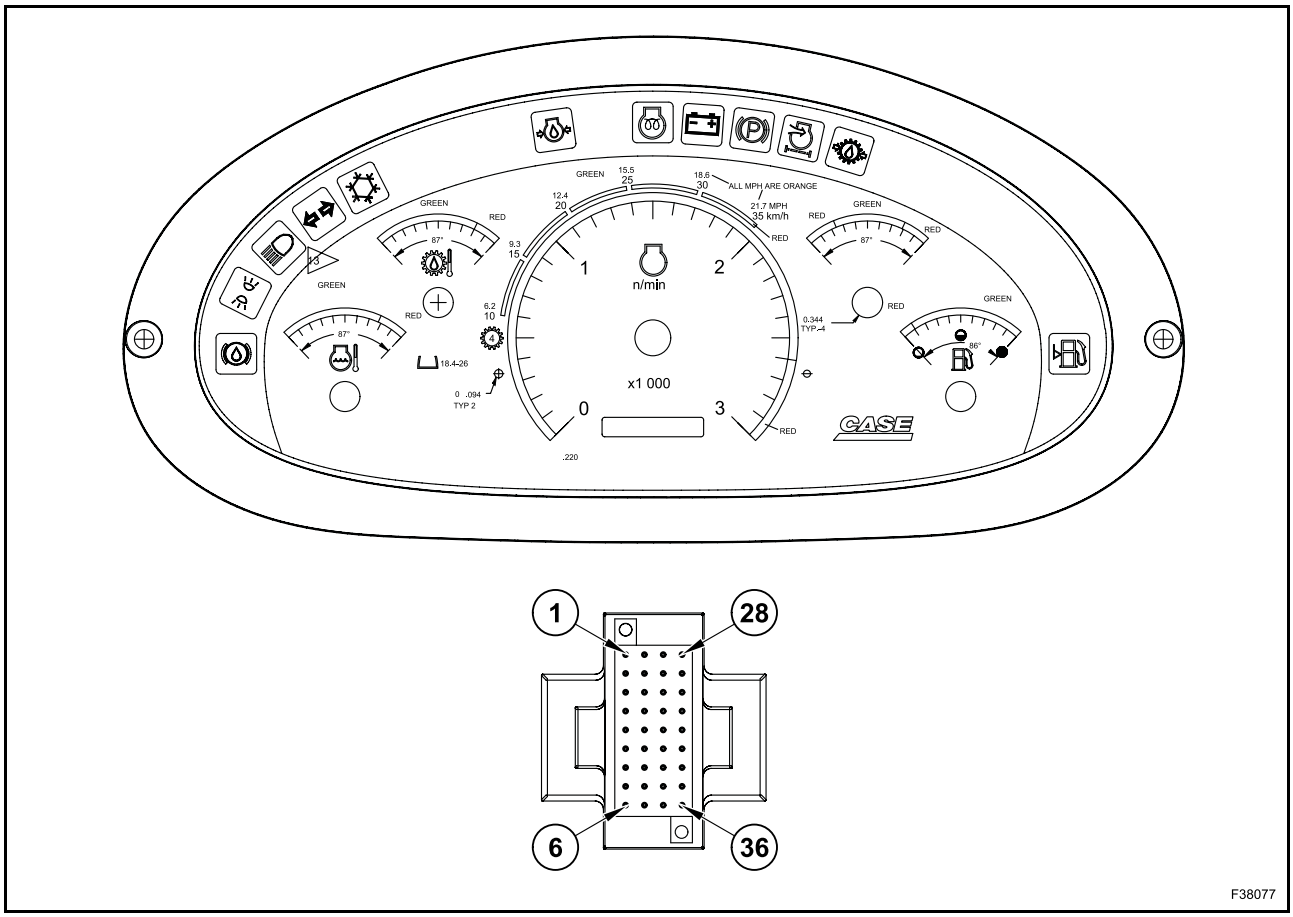


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SIDE INSTRUMENT CLUSTER



Calibrations

Gage type	Input	Reading	Pointer tolerance	Input tolerance	Calibration direction
Speedometer	0 HZ	0 rpm	±3°	N/A	Descending
	307 HZ	1000 rpm	N/A	± 60 rpm	Ascending
	736 HZ	2400 rpm	N/A	± 60 rpm	Ascending
Level fuel	240 OHMS	Empty	+0/-6°	230-240 OHMS (REF)	Descending
	102 OHMS	1/2 Tank	±3° (REF)	98-108 OHMS	Descending
	33 OHMS	Full	+4/-2°	33-42 OHMS	Ascending
Transmission temperature	900 OHMS	Point B	+0/-6°	N/A	Descending
	114 OHMS	106 °C (Red/green line)	±5°	111-117 OHMS (REF)	Ascending
Coolant temperature	700 OHMS	Point A	+0/-5°	N/A	Descending
	95 HMS	106 °C (Red/green line)	±3°	93-97 OHMS (REF)	Ascending
VOLT	11V	Red/green left line	±3°	10.7-11.3 V (REF)	Descending
	15.9V	Red/green right line	±5°	15.0-15.6 V (REF)	Ascending

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PIN #	NAME	FUNCTION	WARNING LAMP No.
1	Ignition	10V-16V INPUT	
2	Low oil pressure	Low side switch input	LP1
3	Air filter restriction	Low side switch input	LP2
4	Parking brake	Low side switch input	LP3
5	Alternator	Alternator D+ input	LP4
6	Not used		
7	Crab steer	Low side switch input	LP6
8	Neutral	High side switch input	
9	Seat switch	Low side switch input	
10	A/C system pressure	High side switch input	LP7
11	Not used		
12	Driving lights	High side switch input	LP9
13	Not used		
14	Not used		
15	Engine pre-heat	High side switch input	LP12
16	Not used		
17	Direction	High side switch input	LP14
18	Not used		
19	Tachometer signal	Alternator w input	
20	Fuel level sender	Speed sensor input	LP27
21	Water temperature sender	Speed sensor input	
22	Transmission temperature sender	Speed sensor input	
23	Not used		
24	Driving lights	High side switch input	LP8
25	Brake	High side switch input	LP28
26	Not used		
27	Not used		
28	Not used		
29	Not used		
30	Not used		
31	Transmission oil temperature	Low side switch input	LP23
32	Not used		
33	Front steering	Low side switch input	LP25
34	Crab steering	Low side switch input	LP26
35	Audible alarm	Open collector output	
36	Ground	Ground	

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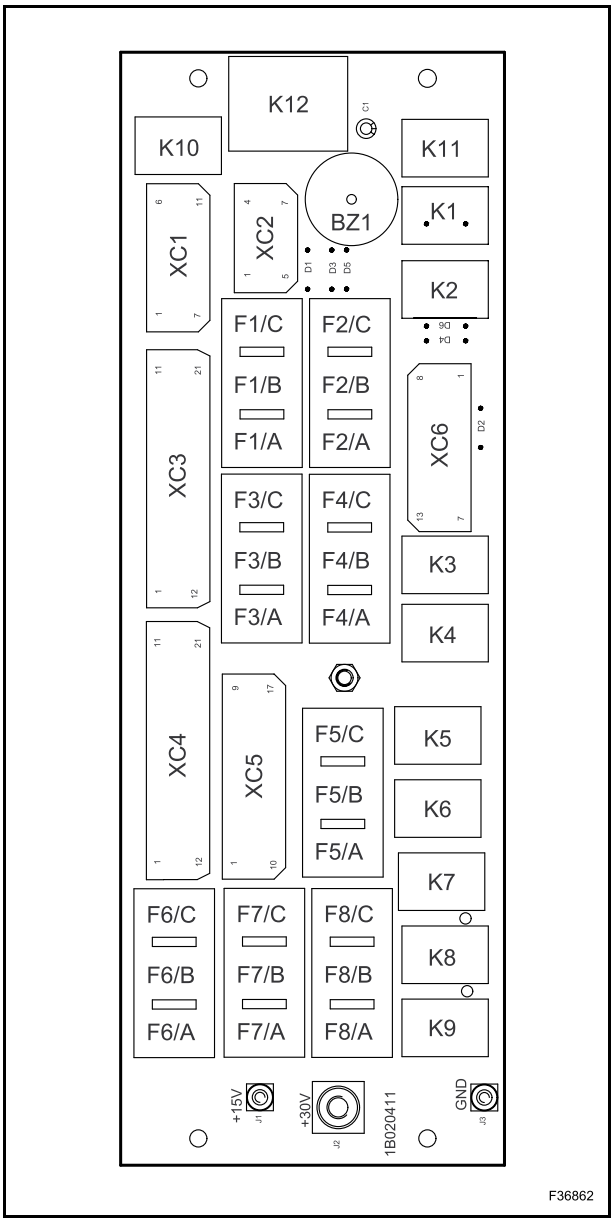
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2.2 ELECTRICAL DIAGRAMS - POWERSHUTTLE CAB (580SR)

FUSE AND RELAY DESCRIPTION

Fuse No.	Rating	Function
F1A	15 A	Rear windshield wiper and rear windshield washer
F1B	7.5 A	Engine stop, (+15) anti-theft device, “grid heater”
F1C	10 A	Stop light switch
F2A	15 A	Instrument power supply, switch lamps, brake oil level sensor, pneumo-electric seat, buzzer
F2B	15 A	Air conditioning
F2C	15 A	Pilot control
F3A	3 A	Rear right/front left side light, instrument backlighting
F3B	3 A	Rear left/front right side lights, number plate light
F3C	10 A	Front work light switch, ride control, double delivery
F4A	5 A	Reverse buzzer, gearshift lever
F4B	10 A	Rear hammer button, bucket level solenoid valve + sensor, clutch disconnect buttons
F4C	10 A	Backhoe attachment lock, backhoe attachment travel lock, rear work light
F5A	15 A	Inner front work lights
F5B	10 A	Low beams
F5C	15 A	Main beams
F6A	7.5 A	Rotating beacon
F6B	7.5 A	(+15) hazard warning lights
F6C	7.5 A	Hand hammer, 4WD
F7A	10 A	(+30) anti-theft device, horn
F7B	10 A	Electrical socket, radio, cab light
F7C	6 A	Front windshield wiper
F8A	15 A	Outer rear work lights
F8B	15 A	Outer front work lights
F8C	15 A	Inner rear work lights

K1	Forward-reverse travel gearshift lever relay
K2	Parking brake relay
K3	Starting relay
K4	Bucket level solenoid valve relay
K5	Low and main beam relay
K6	Inner front work light relay
K7	Inner rear work light relay
K8	Outer front work light relay
K9	Outer rear work light relay
K10	Reverse travel relay
K11	Forward travel relay
K12	Hazard warning light relay



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COMPONENTS AND CONNECTORS

NAME	DESCRIPTION
BS1	Right speaker (optional)
BS2	Left speaker (optional)
BZ1	Alarm buzzer
EV1	Double delivery solenoid valve (optional)
EV2	Hand hammer control valve (optional)
EV3	Rear hammer solenoid valve (optional)
EV4	Backhoe attachment travel lock solenoid valve
EV5	Backhoe attachment lock solenoid valve (optional)
EV6	Bucket level solenoid valve
EV7	Fuel shut off solenoid valve
EV8	4WD solenoid valve (optional)
EV9	Reverse travel solenoid valve
EV10	Forward speed solenoid valve
EV11	Ride control solenoid valve (optional)
EV24	Lifting solenoid valve
EV25	Lifting solenoid valve
FG1	General fuse 80 A
FG2	A/C fuse 10A
G1	Battery
G2	Alternator
H1	Backhoe attachment lock warning light (optional)
H2	Front left light
H3	Front right light
H4	Rear left light
H5	Number plate light
H6	Rear right light
H11	Outer front left work light
H12	Outer front right work light
H13	Outer rear left work light
H14	Outer rear right work light
H15	Rotating beacon
H16	Rotating beacon
H17	Current intake illumination
H18	Cab light
H19	Inner front left work light (optional)
H20	Inner front right work light (optional)

NAME	DESCRIPTION
H21	Inner rear left work light (optional)
H22	Inner rear right work light (optional)
HA1	Reverse buzzer
HA2	Horn
HA3	Optional buzzer
K01	Starting relay
K02	A/C relay
K13	Antitheft unit
KC	Fuse and relay control unit
M1	Starter motor
M4	Rear windshield wiper motor
M5	Front windshield wiper motor
M6	Rear windshield washer pump
M7	Front windshield washer pump
M9	Blower (optional)
M10	A/C compressor
R2	Engine water temperature sender
R3	Fuel level gauge
R4	Transmission temperature sender
S2	4WD switch (optional)
S3	Hand hammer switch (optional)
S4	Double delivery switch (optional)
S5	Ride control switch (optional)
S7	Backhoe attachment travel lock switch
S8	Backhoe attachment lock switch (optional)
S9	Lights switch
S11	Front work light switch
S12	Rear work light switch
S15	Beacon lamp switch
S17	Start switch
S18	Parking brake switch
S20	Engine oil low pressure switch
S21	Air filter blocked switch
S24	Trasmission oil pressure switch
S26	Clutch disconnect button
S27	Clutch disconnect button
S28	Bucket sensor
S30	Rear hammer pedal (optional)
S31	Brake oil level sender

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NAME	DESCRIPTION
S32	Stop light switch
S33	Stop light switch
S34	Left cab light switch
S35	Right cab light switch
S40	Gearshift lever
S41	Light / windshield wiper control lever
S43	Radio (optional)
S44	Pneumo-electric seat (optional)
S45	Blower and air conditioner switch
S46	Current intake
S47	Battery master switch
S48	“Grid heater” temperature switch
S49	A/C pressure switch
S52	Solenoid valves lock switch (optional)
S53	Rear windshield washer + wiper button
S54	Rear horn button (optional)
ST2	Side instrument cluster
ST3	4x1 bucket control lever
X1	General line - engine line - 18-way connector
X2	“Grid heater” - 6-way connector
X3	Engine stop - 1-way connector
X4	Air filter - 2-way connector
X6	Forward gear - 2-way connector
X7	Reverse travel - 2-way connector
X8	General line - rear lights - 12-way connector
X10	Solenoid valve line - general line - 29-way connector
X12	General line - upper cab line - 5-way connector
X13	General line - front instrument cluster - 17-way connector
X14	Anti-theft device - 11-way connector
X15	Start switch - 10-way connector
X16	Optional - 1 way connector
X17	Pneumo-electric seat - 4-way connector
X21	Horn/left light - 7-way connector
X22	Right light - 5-way connector
X23	Clutch disconnect button - 2-way connector

NAME	DESCRIPTION
X24	Backhoe attachment travel lock solenoid valve - 2-way connector
X25	Backhoe attachment lock solenoid valve - 2-way connector
X26	Bucket sensor - 3-way connector
X27	Pilot control audible alarm button - 2-way connector
X28	Clutch disconnect button - 2-way connector
X29	Bucket level - 2-way connector
X30	Delivery doubling solenoid valve - 2-way connector
X31	Quick coupler solenoid valve - 2-way connector
X32	Rear hammer solenoid valve - 2-way connector
X34	“Glide ride” control solenoid valve - 2-way connector
X35	Hand hammer solenoid valve - 2-way connector
X36	Rear hammer button - 2-way connector
X37	Rear right light arrangement - 4-way connector
X38	Rear right work light - 4-way connector
X39	Rear windshield wiper - 4-way connector
X40	Rear right work light (optional) - 4-way connector
X41	Blower motor (optional) - 2-way connector
X42	Front right direction indicator arrangement - 4-way connector
X43	Beacon lamp - 4-way connector
X44	Front right work light - 4-way connector
X45	Front right work light (optional) - 4-way connector
X46	Rear left work light (optional) - 4-way connector
X47	Rear left work light - 4-way connector
X48	Rear left light arrangement - 4-way connector
X49	Front windshield wiper - 6-way connector
X50	Front left work light (optional) - 4-way connector
X51	Front left work light - 4-way connector

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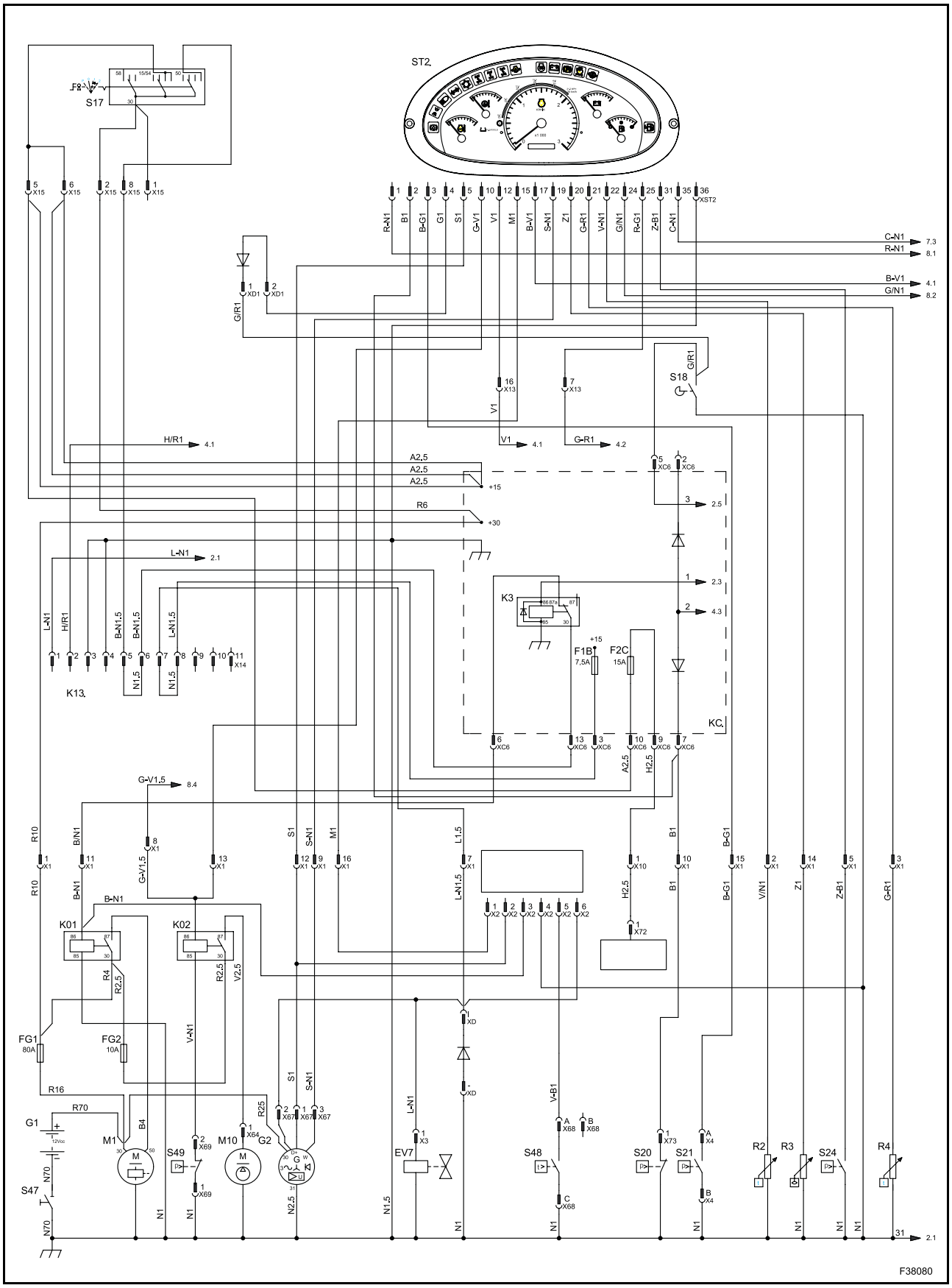
NAME	DESCRIPTION
X52	Front left direction indicator arrangement - 4-way connector
X53	Radio (brown) - 8-way connector
X54	Radio (black) - 8-way connector
X55	Electrical socket - 2-way connector
X56	Front windshield wiper - 2-way connector
X57	Rear windshield wiper - 2-way connector
X61	Light / windshield wiper control lever - 12-way connector
X62	Gearshift lever - 6-way connector
X63	Number plate light - 2-way connector
X64	Air conditioning compressor - 1-way connector
X67	Alternator - 3-way connector
X68	Engine water temperature switch - 3-way connector
X69	Air conditioning pressure switch - 2-way connector
X70	Front instrument cluster - 12-way connector
X71	Start switch - 10-way connector
X72	Pilot line - 1-way connector
X73	Engine oil low pressure switch - 1-way connector
X80	Beacon lamp - 2-way connector
X81	Beacon lamp - 2-way connector
X82	Control unit - 10-way connector
X83	Relay - 2-way connector
X87	General line - left side instrument cluster line - 13-way connector
X88	General line - right side instrument cluster line - 9-way connector
X89	Left light - 6-way connector
X101	Right light - 6-way connector
X104	Valve block switch kit - 1-way connector
X110	Air conditioner - 2-way connector
X111	Air conditioner - 9-way connector
X124	Lifting solenoid valve - 2-way connector
X125	Lifting solenoid valve - 2-way connector
XA	Horn - 2-way connector
XC1	Control unit - 11-way on-board connector
XC2	Control unit - 7-way on-board connector
XC3	Control unit - 21-way on-board connector
XC4	Control unit - 21-way on-board connector

NAME	DESCRIPTION
XC5	Control unit - 17-way on-board connector
XC6	Control unit - 13-way on-board connector
XD	Engine stop diode - 2-way connector
XD1	Parking brake diode - 2-way connector
XST2	Side instrument cluster - 36-way connector

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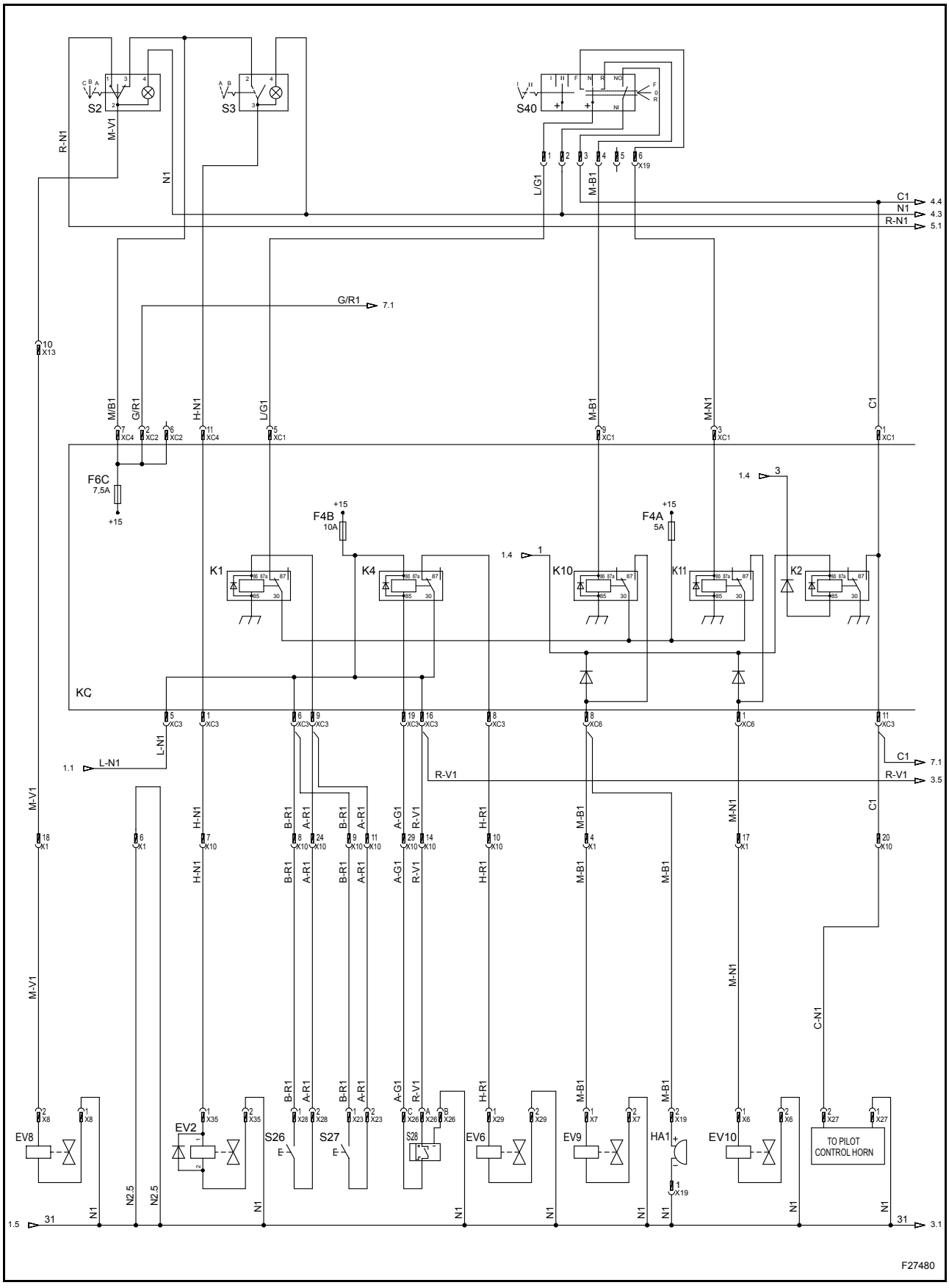
ENGINE LINE DIAGRAM



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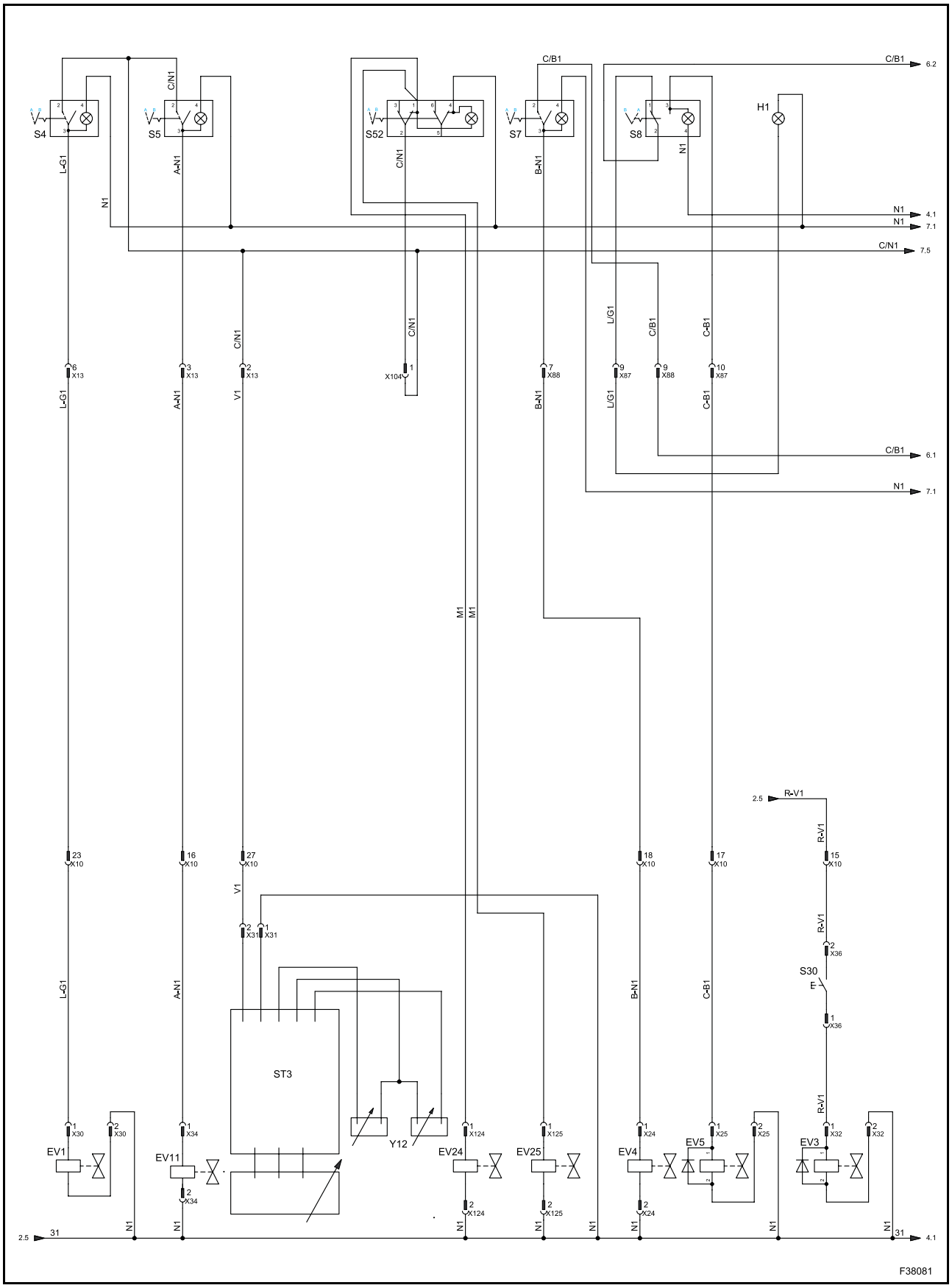
SOLENOID VALVE LINE DIAGRAM



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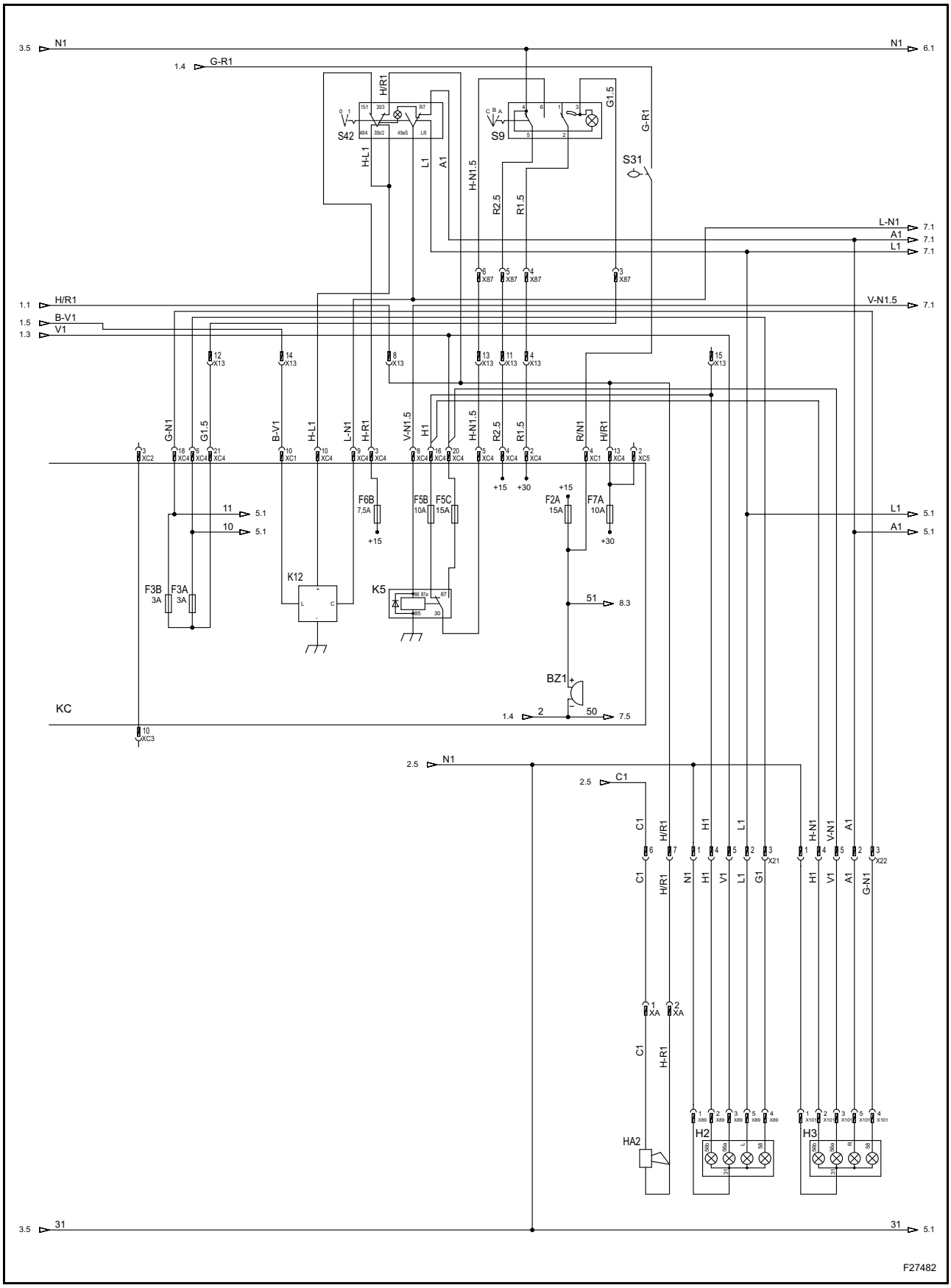
SOLENOID VALVE LINE DIAGRAM



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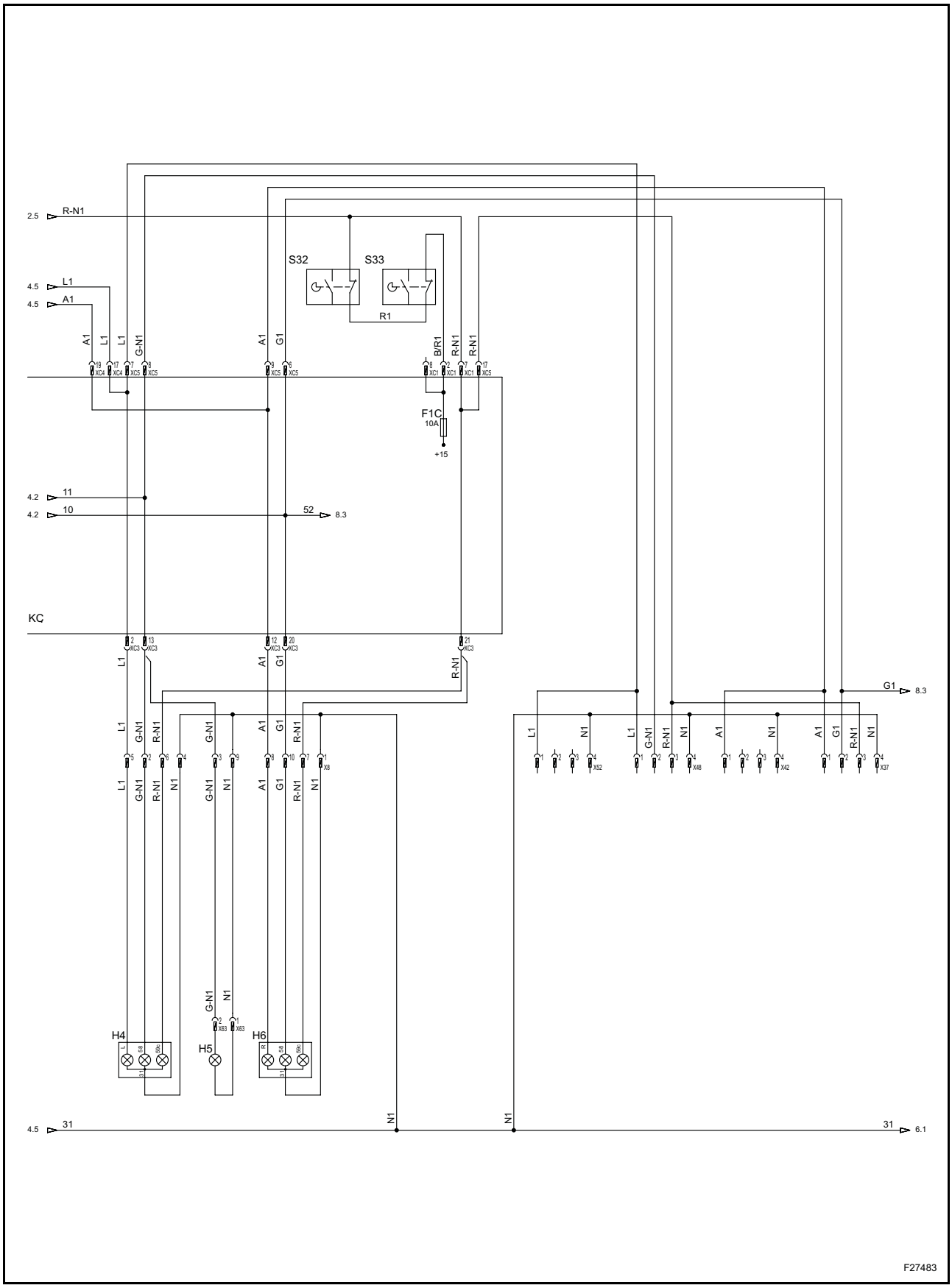
LIGHT LINE DIAGRAM



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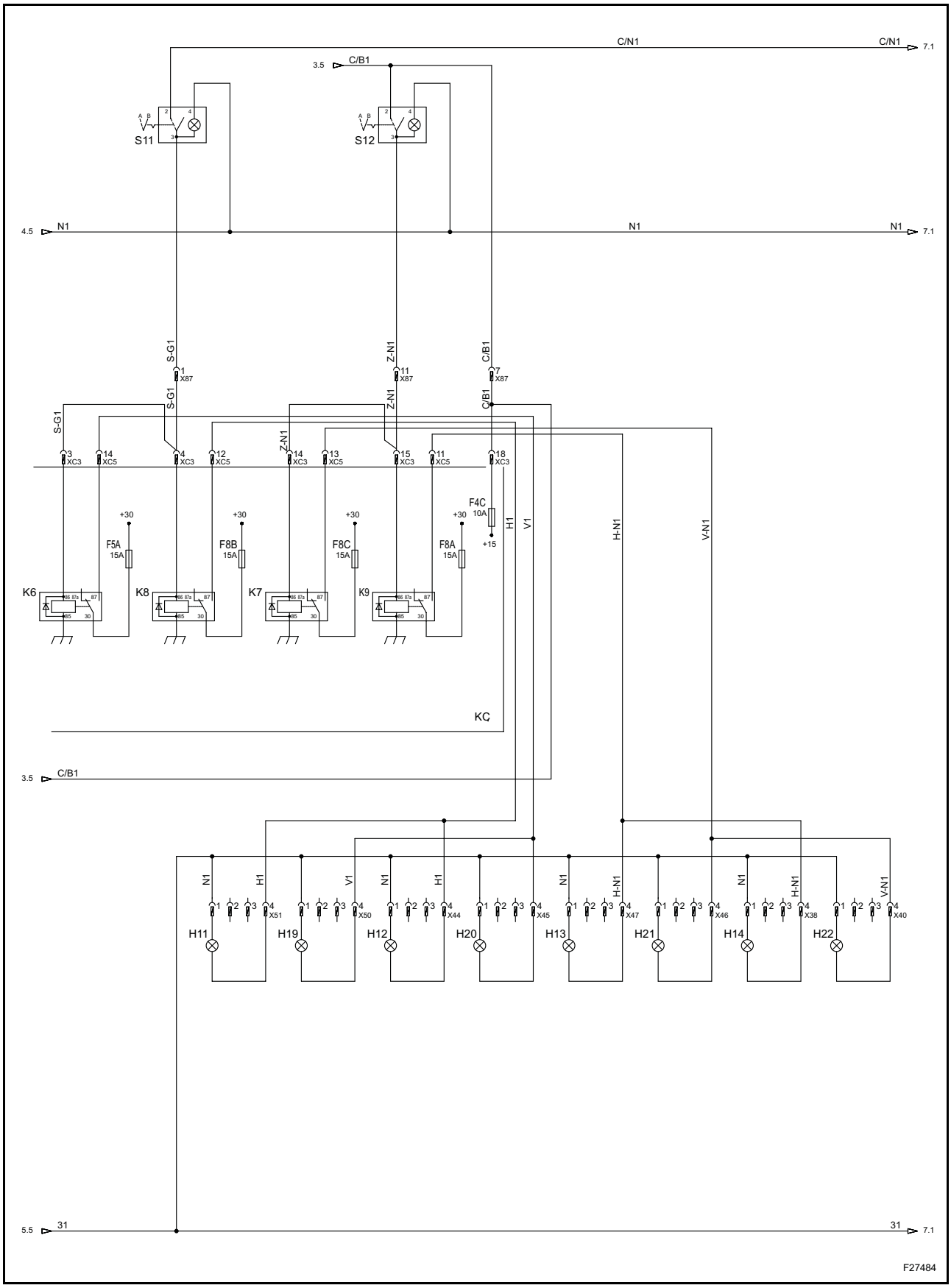
REAR LIGHT LINE DIAGRAM



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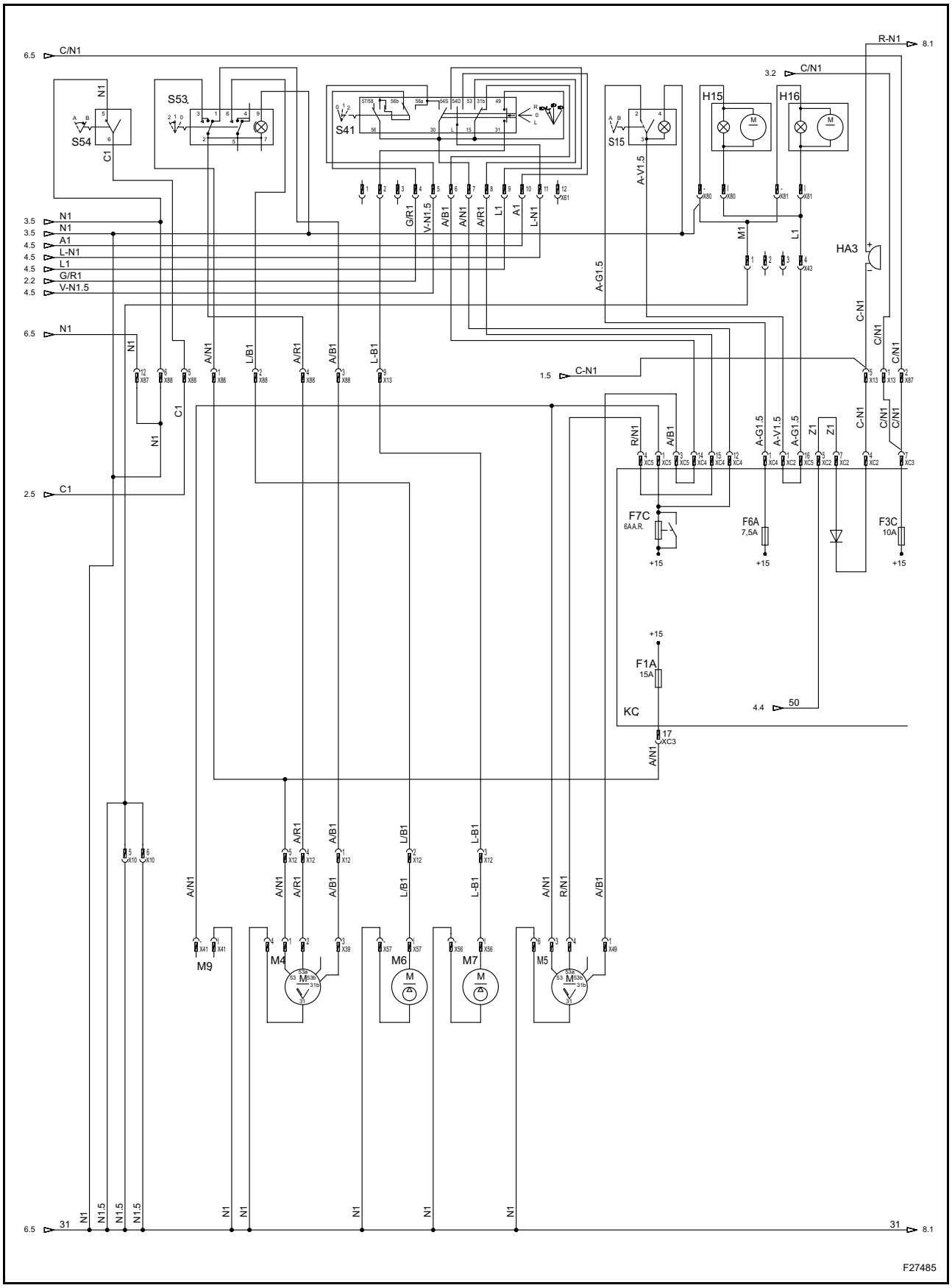
WORK LIGHT LINE DIAGRAM



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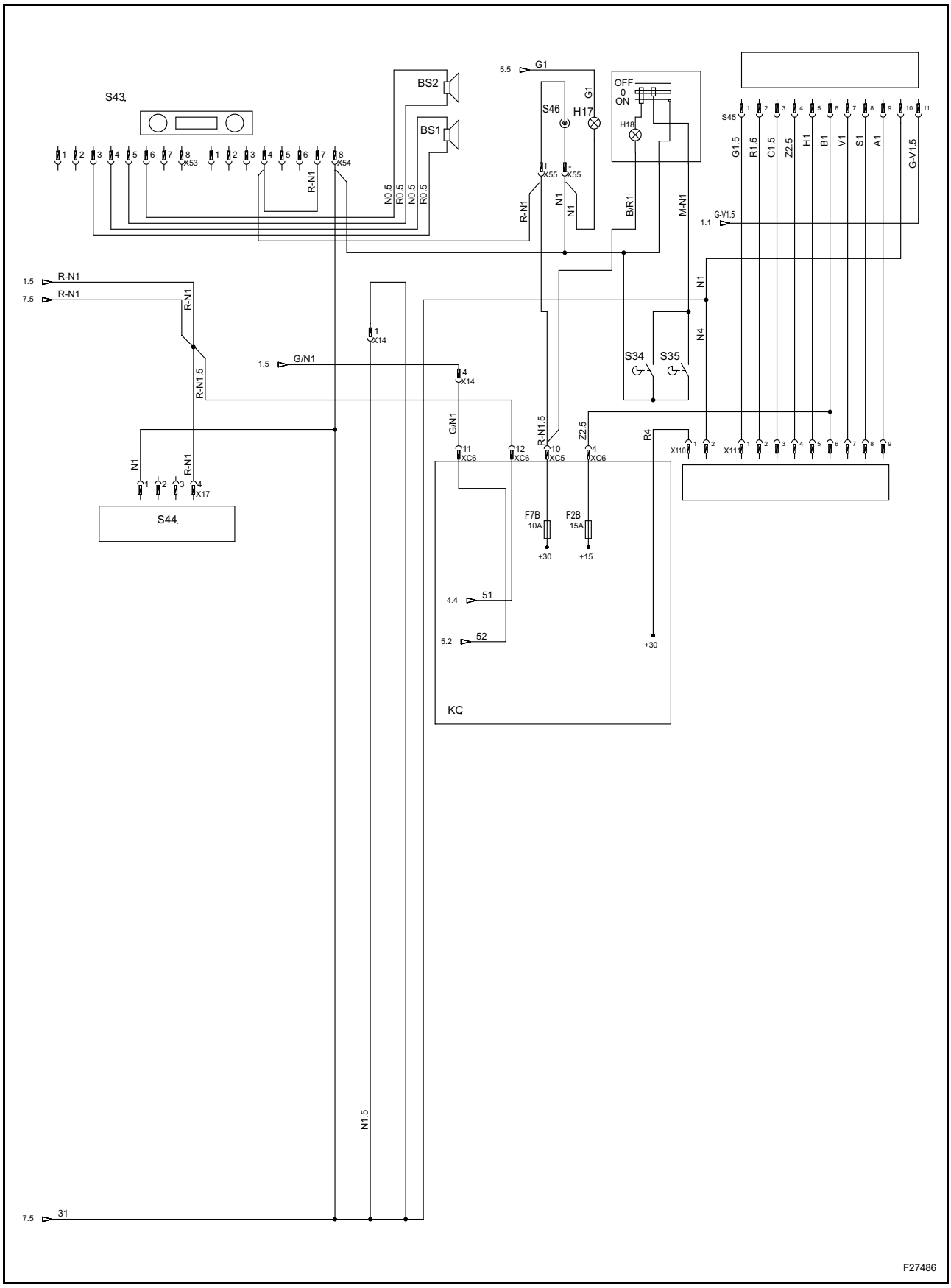
WINDSHIELD WASHER/WIPER LINE DIAGRAM



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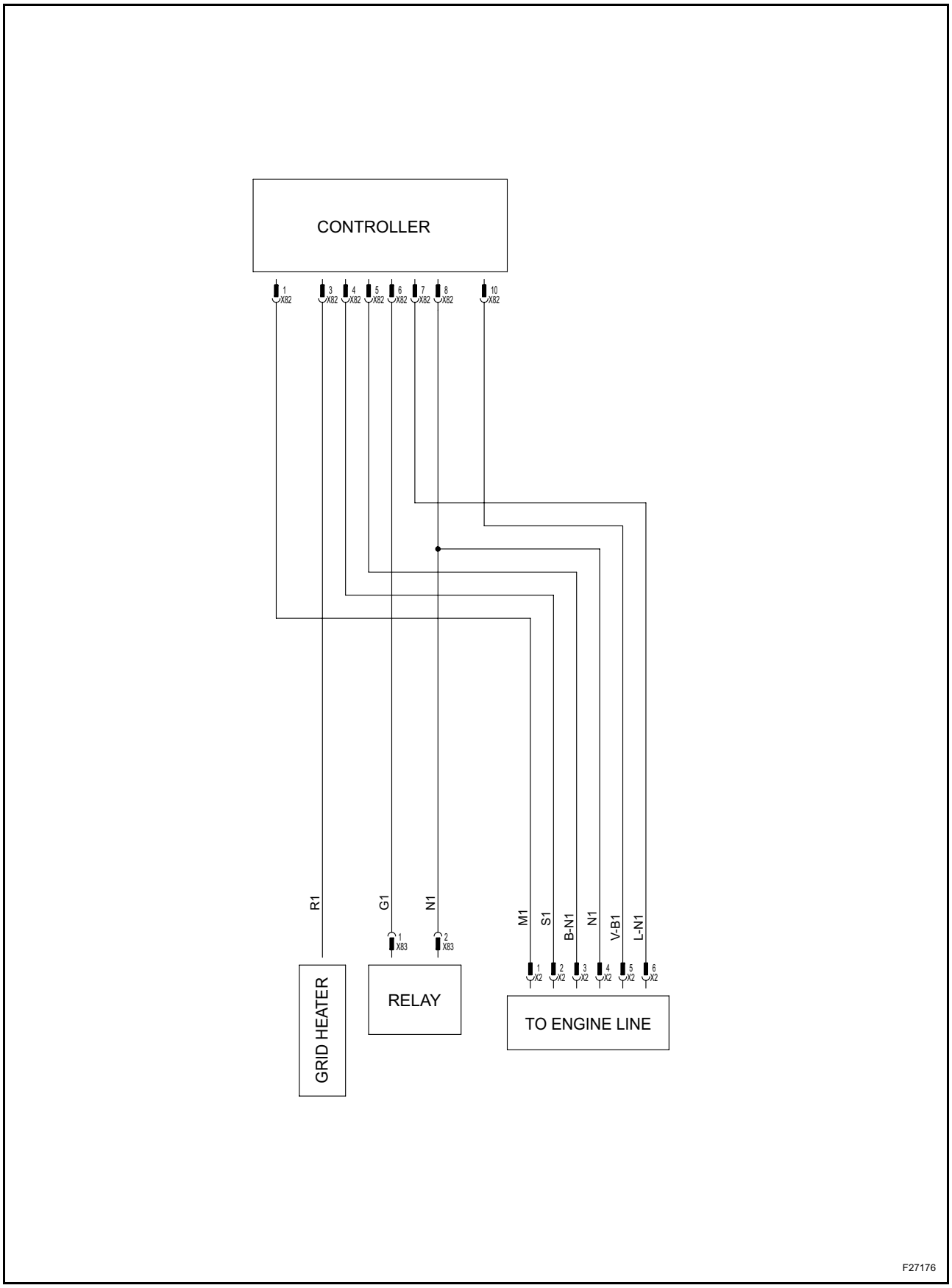
HEATER AND RADIO LINE DIAGRAM



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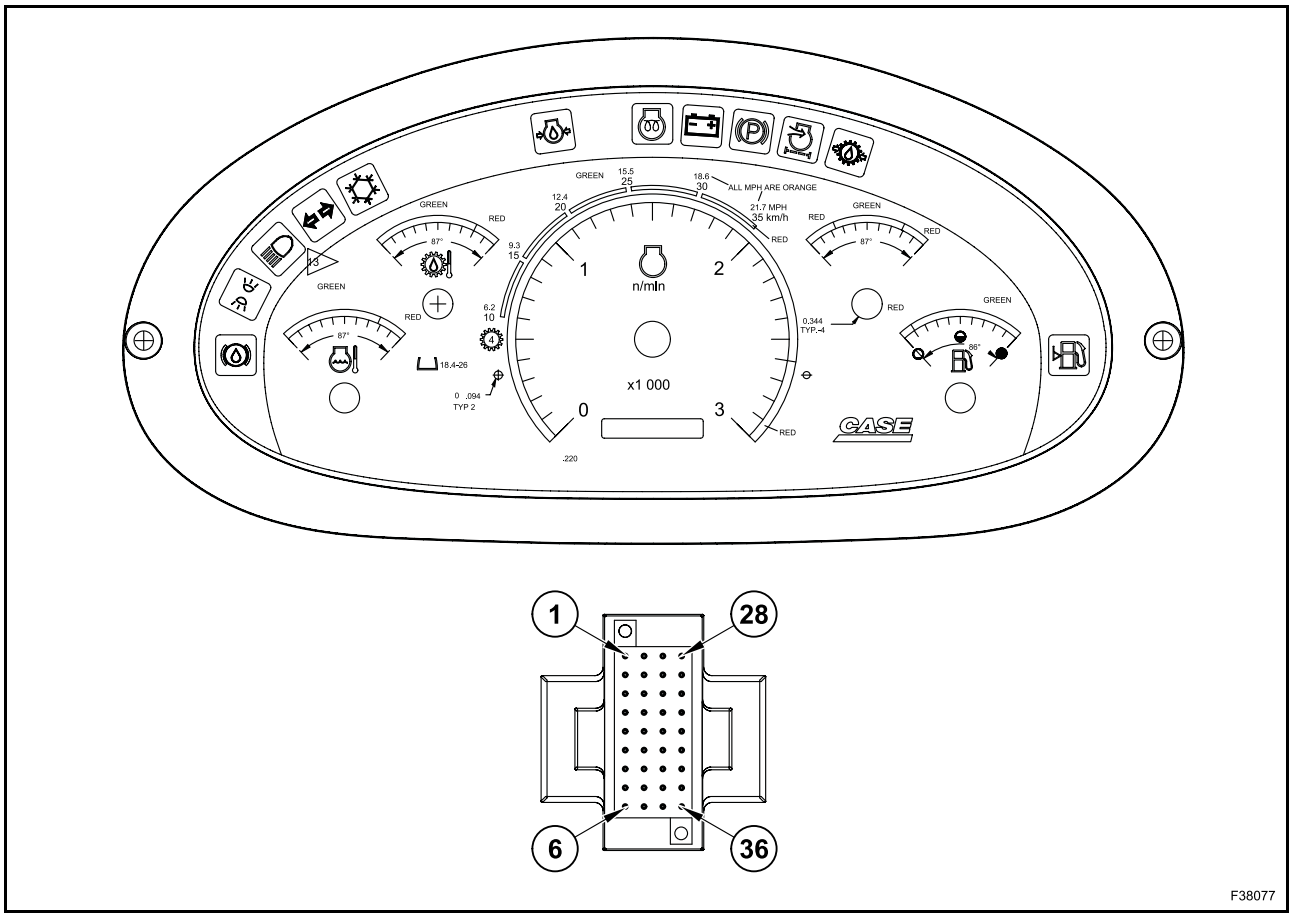
COLD START DIAGRAM



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SIDE INSTRUMENT CLUSTER



Calibrations

Gage type	Input	Reading	Pointer tolerance	Input tolerance	Calibration direction
Speedometer	0 HZ	0 rpm	±3°	N/A	Descending
	307 HZ	1000 rpm	N/A	± 60 rpm	Ascending
	736 HZ	2400 rpm	N/A	± 60 rpm	Ascending
Level fuel	240 OHMS	Empty	+0/-6°	230-240 OHMS (REF)	Descending
	102 OHMS	1/2 Tank	±3° (REF)	98-108 OHMS	Descending
	33 OHMS	Full	+4/-2°	33-42 OHMS	Ascending
Transmission temperature	900 OHMS	Point B	+0/-6°	N/A	Descending
	114 OHMS	106 °C (Red/green line)	±5°	111-117 OHMS (REF)	Ascending
Coolant temperature	700 OHMS	Point A	+0/-5°	N/A	Descending
	95 HMS	106 °C (Red/green line)	±3°	93-97 OHMS (REF)	Ascending
VOLT	11V	Red/green left line	±3°	10.7-11.3 V (REF)	Descending
	15.9V	Red/green right line	±5°	15.0-15.6 V (REF)	Ascending

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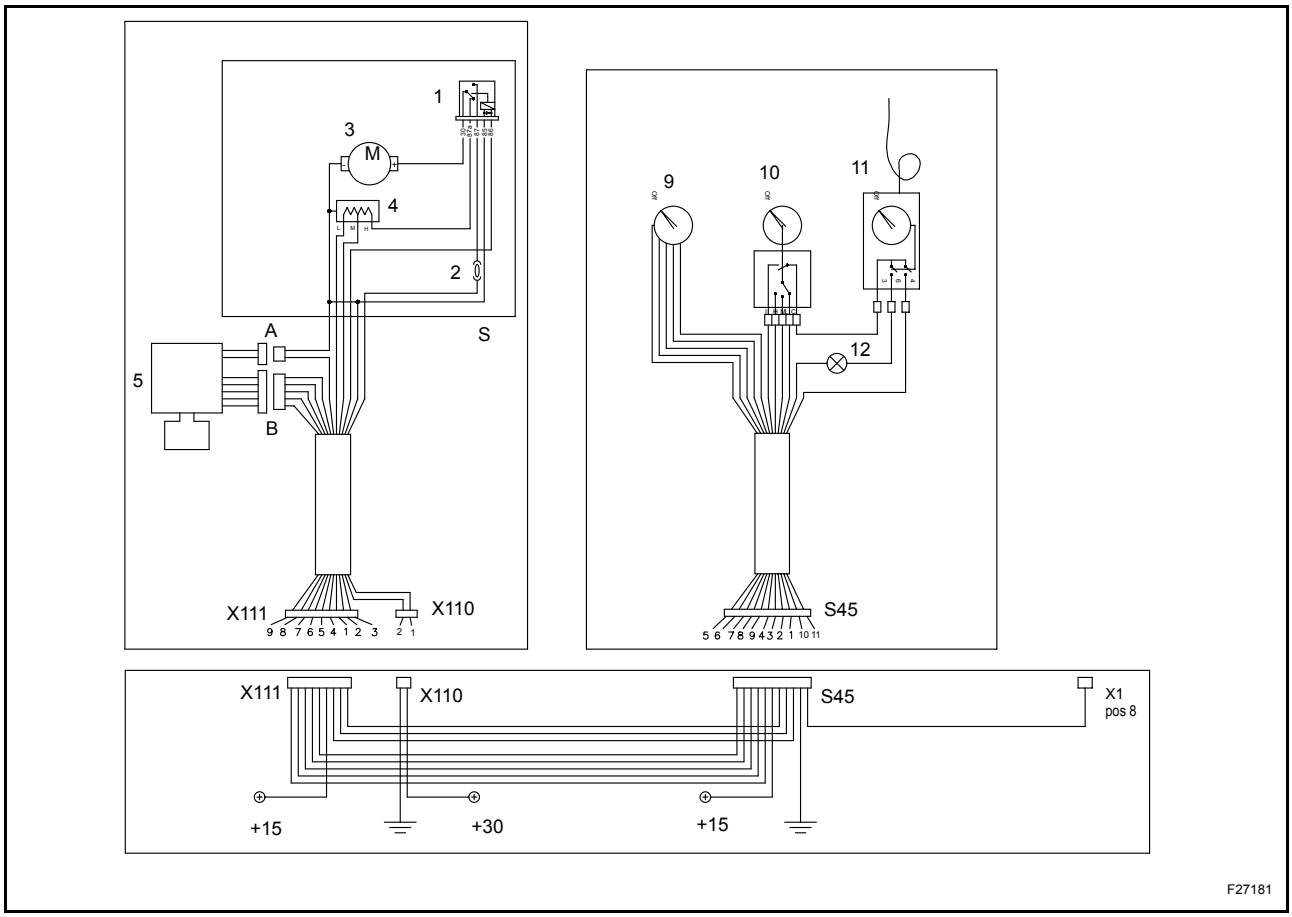
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PIN #	NAME	FUNCTION	WARNING LAMP No.
1	Ignition	10V-16V INPUT	
2	Low oil pressure	Low side switch input	LP1
3	Air filter restriction	Low side switch input	LP2
4	Parking brake	Low side switch input	LP3
5	Alternator	Alternator D+ input	LP4
6	Not used		
7	Crab steer	Low side switch input	LP6
8	Neutral	High side switch input	
9	Seat switch	Low side switch input	
10	A/C system pressure	High side switch input	LP7
11	Not used		
12	Driving lights	High side switch input	LP9
13	Not used		
14	Not used		
15	Engine pre-heat	High side switch input	LP12
16	Not used		
17	Direction	High side switch input	LP14
18	Not used		
19	Tachometer signal	Alternator w input	
20	Fuel level sender	Speed sensor input	LP27
21	Water temperature sender	Speed sensor input	
22	Transmission temperature sender	Speed sensor input	
23	Not used		
24	Driving lights	High side switch input	LP8
25	Brake	High side switch input	LP28
26	Not used		
27	Not used		
28	Not used		
29	Not used		
30	Not used		
31	Transmission oil temperature	Low side switch input	LP23
32	Not used		
33	Front steering	Low side switch input	LP25
34	Crab steering	Low side switch input	LP26
35	Audible alarm	Open collector output	
36	Ground	Ground	

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AIR CONDITIONER SCHEMATIC



S	Evaporator box
1	3rd speed relay
2	Fuse 25 A
3	Ventilated electrical motor
4	1 and 2 speed resistor
5	Electrical cock
X111	9-way connector
X110	2-way power connector

S45	11-way connector
9	Potentiometer
10	Speed switch
11	Temperature switch
12	12 V light
A	2-way waterproof connection
B	5-way waterproof connection

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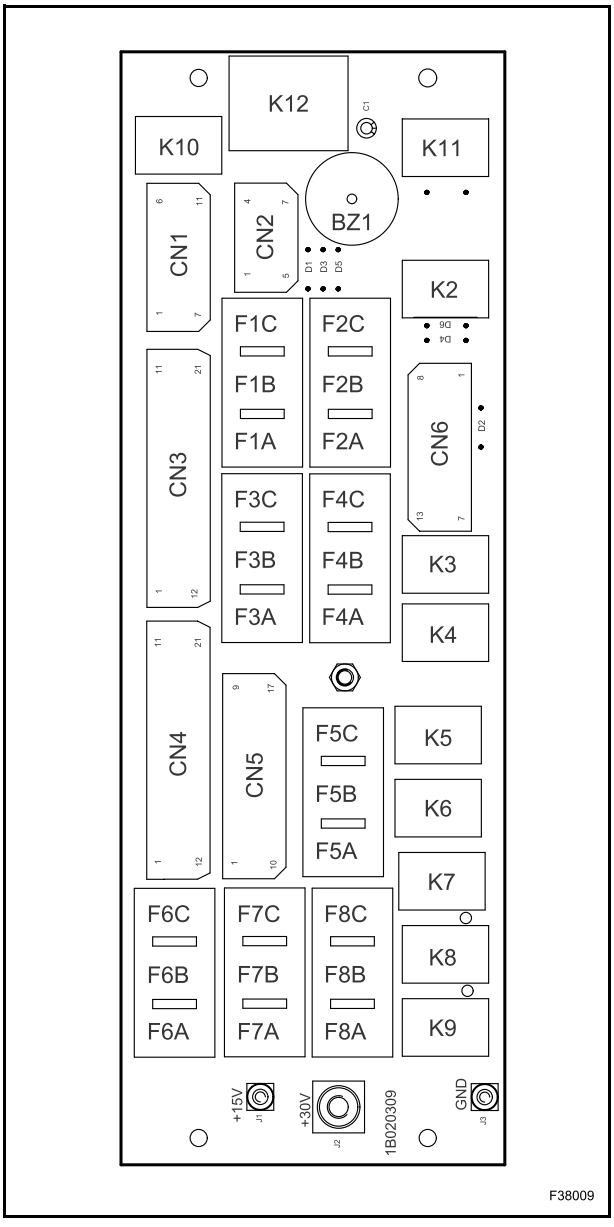
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2.3 ELECTRICAL DIAGRAMS - POWERSHIFT CAB (580SR)

FUSE AND RELAY DESCRIPTION

Fuse No.	Rating	Circuit
F1A	15 A	Rear windshield wiper and rear windshield washer
F1B	7.5 A	Engine stop, (+15) anti-theft device, starter switch key
F1C	10 A	Stop light switch
F2A	15 A	Instrument power supply, switch lamps, brake oil level sensor, pneumo-electric seat, buzzer
F2B	15 A	Air conditioning
F2C	15 A	Pilot control
F3A	3 A	Rear right/front left side light, instrument backlighting
F3B	3 A	Rear left/front right side lights, number plate light
F3C	10 A	Front work light switch, ride control, double delivery
F4A	7.5 A	4WD switch, transmission disconnect button, EGS power supply, differential lock switch
F4B	10 A	Rear hammer button, bucket level solenoid valve + sensor
F4C	10 A	Backhoe attachment lock, backhoe attachment travel lock
F5A	15 A	Inner front work lights
F5B	10 A	Low beams
F5C	15 A	Main beams
F6A	15 A	Rotating beacon
F6B	7.5 A	(+15) hazard warning lights
F6C	7.5 A	Hand hammer
F7A	10 A	(+30) hazard warning lights, horn, (+30) anti-theft device
F7B	10 A	Electrical socket, radio, cab light
F7C	6 A	Front windshield wiper
F8A	15 A	Outer rear work lights
F8B	15 A	Outer front work lights
F8C	15 A	Inner rear work lights

K2	Forward travel relay, parking brake
K3	Starting relay
K4	Bucket level solenoid valve relay
K5	Low and main beam relay
K6	Inner front work light relay
K7	Inner rear work light relay
K8	Outer front work light relay
K9	Outer rear work light relay
K10	Optional
K12	Hazard warning light relay



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COMPONENTS AND CONNECTORS

NAME	DESCRIPTION
BS1	Right speaker (optional)
BS2	Left speaker (optional)
BZ1	Alarm buzzer
EV0	Fuel shut off solenoid valve
EV1	Double delivery solenoid valve (optional)
EV2	Hand hammer control valve (optional)
EV3	Rear hammer solenoid valve (optional)
EV4	Backhoe attachment travel lock solenoid valve
EV5	Backhoe attachment lock solenoid valve (optional)
EV6	Bucket level solenoid valve
EV8	Differential lock solenoid valve
EV11	Ride control solenoid valve (optional)
EV24	Lifting solenoid valve (optional)
EV25	Lifting solenoid valve (optional)
FG1	General fuse 80 A
FG2	A/C fuse 10A
G1	Battery
G2	Alternator
H1	Backhoe attachment lock warning light
H2	Front left light
H3	Front right light
H4	Rear left light
H5	Number plate light
H6	Rear right light
H11	Outer front left work light
H12	Outer front right work light
H13	Outer rear left work light
H14	Outer rear right work light
H15	Rotating beacon
H16	Rotating beacon
H17	Current intake illumination
H18	Cab light
H19	Inner front left work light (optional)
H20	Inner front right work light (optional)
H21	Inner rear left work light (optional)
H22	Inner rear right work light (optional)

NAME	DESCRIPTION
HA1	Reverse buzzer
HA2	Horn
HA3	Optional buzzer
K01	Starting relay
K02	A/C relay
K13	Antitheft unit
K14	Transmission detachment relay
KC	Fuse and relay control unit
M1	Starter motor
M4	Rear windshield wiper motor
M5	Front windshield wiper motor
M6	Rear windshield washer pump
M7	Front windshield washer pump
M9	Blower (optional)
M10	A/C compressor
R2	Engine water temperature sender
R3	Fuel level gauge
R4	Transmission oil high temperature sender
S2	4WD switch
S3	Hand hammer switch (optional)
S4	Double delivery switch (optional)
S5	Ride control switch (optional)
S7	Backhoe attachment travel lock switch
S8	Backhoe attachment lock switch (optional)
S9	Lights switch
S11	Front work light switch
S12	Rear work light switch
S15	Beacon lamp switch
S17	Start switch
S18	Parking brake switch
S20	Engine oil low pressure switch
S21	Air filter blocked switch
S24	Trasmission oil pressure switch
S26	Clutch disconnect button
S28	Bucket sensor
S29	Front horn button
S30	Rear hammer pedal (optional)
S31	Brake oil level sender
S32	Stop light switch
S33	Stop light switch

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NAME	DESCRIPTION
S34	Left cab light switch
S35	Right cab light switch
S36	A/C pressure switch
S41	Light / windshield wiper control lever
S42	Warning switch
S43	Radio (optional)
S44	Pneumo-electric seat (optional)
S45	Blower and air conditioner switch
S46	Current intake
S47	Differential lock switch
S48	EGS manual - Auto switch
S49	Battery master switch
S50	EGS
S52	Solenoid valves lock switch (optional)
S53	Rear windshield washer + wiper switch
S54	Rear horn button (optional)
S68	Cold start temperature switch
ST2	Front instrument cluster
ST3	4x1 bucket control lever
X1	General line - engine line - 18-way connector
X2	“Grid heater” - 6-way connector
X3	Engine stop - 3-way connector
X4	Air filter - 2-way connector
X7	Reverse travel buzzer - 2-way connector
X9	General line - front instrument cluster line - 13-way connector
X10	Solenoid valve line - general line - 29-way connector
X12	General line - upper cab line - 5-way connector
X13	General line - front instrument cluster line - 17-way connector
X14	Anti-theft device - 11-way connector
X15	Start switch - 10-way connector
X16	Optional - 1 way connector
X17	Pneumo-electric seat - 4-way connector
X21	Left light / horn - 7-way connector
X22	Right light - 5-way connector
X23	EGS - 9-way connector
X24	Backhoe attachment travel lock solenoid valve - 2-way connector

NAME	DESCRIPTION
X25	Backhoe attachment lock solenoid valve - 2-way connector
X26	Bucket sensor - 3-way connector
X27	Pilot control audible alarm button - 2-way connector
X28	Clutch disconnect button + differential lock switch - 4-way connector
X29	Bucket level - 2-way connector
X30	Delivery doubling solenoid valve - 2-way connector
X31	Quick coupler solenoid valve - 2-way connector
X32	Rear hammer solenoid valve - 2-way connector
X33	Differential lock solenoid valve - 2-way connector
X34a	Ride control solenoid valve - 2-way connector
X35	Hand hammer solenoid valve - 2-way connector
X36	Rear hammer button - 2-way connector
X37	Rear right light arrangement - 4-way connector
X38	Rear right work light - 4-way connector
X39	Rear windshield wiper - 4-way connector
X40	Rear right work light (optional) - 4-way connector
X41	Blower motor (optional) - 2-way connector
X42	Front direction indicator arrangement - 4-way connector
X43	Beacon lamp - 4-way connector
X44	Front right work light - 4-way connector
X45	Front right work light (optional) - 4-way connector
X46	Rear left work light (optional) - 4-way connector
X47	Rear left work light - 4-way connector
X48	Rear left light arrangement - 4-way connector
X49	Front windshield wiper - 6-way connector
X50	Front left work light (optional) - 4-way connector

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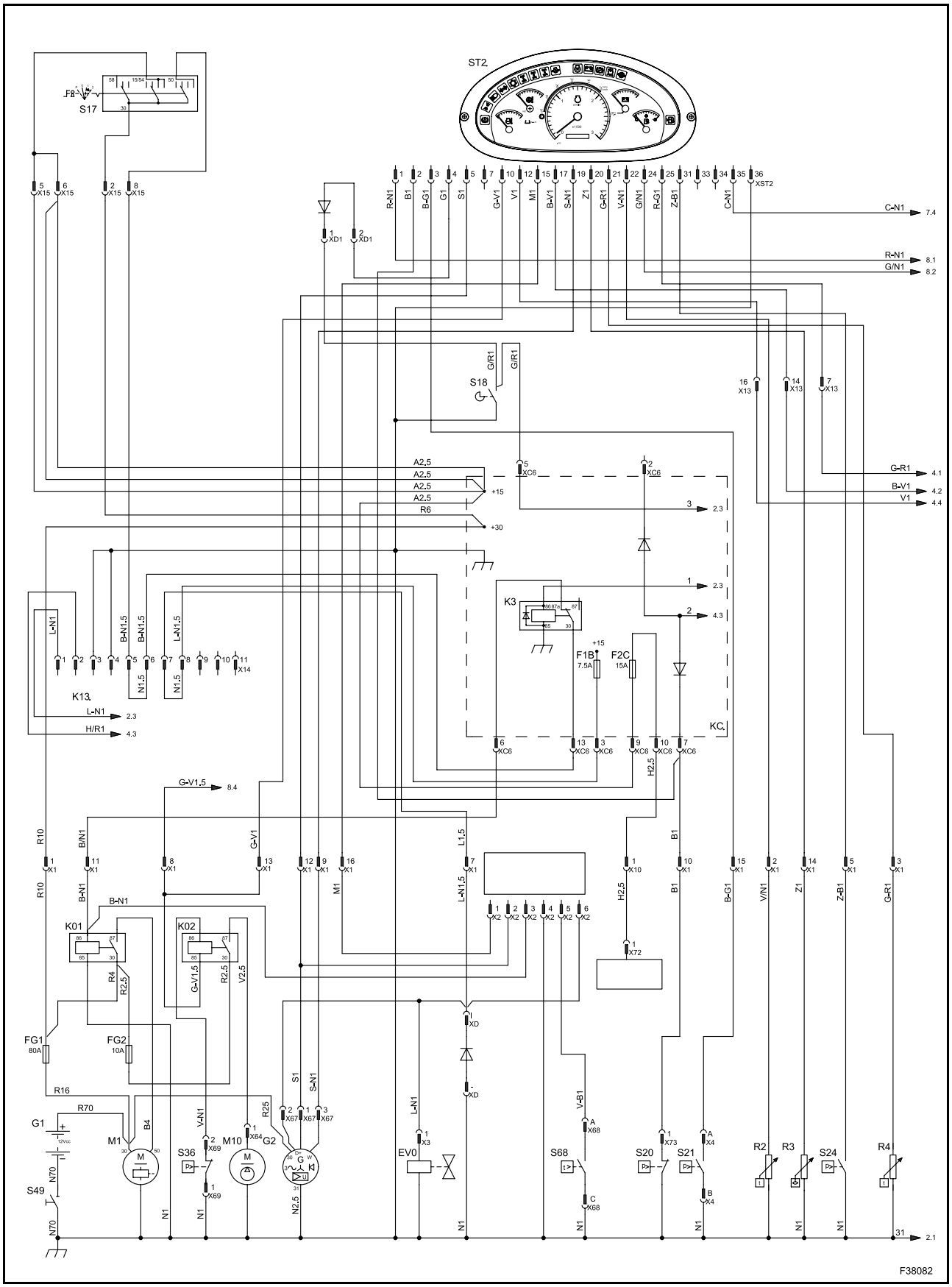
NAME	DESCRIPTION
X51	Front left work light - 4-way connector
X52	Front left direction indicator arrangement - 4-way connector
X53	Radio (brown) - 8-way connector
X54	Radio (black) - 8-way connector
X55	Electrical socket - 2-way connector
X56	Front windshield wiper - 2-way connector
X57	Rear windshield wiper - 2-way connector
X61	Light / windshield wiper control lever - 12-way connector
X63	Number plate light - 12-way connector
X64	Conditioner (optional) - 1-way connector
X67	Alternator - 3-way connector
X70	Front instrument cluster - 12-way connector
X71	Start switch - 10-way connector
X72	Pilot control - 1-way connector
X73	Engine oil low pressure switch - 1-way connector
X80	Beacon lamp - 2-way connector
X81	Beacon lamp - 2-way connector
X82	EGS - 9-way connector
X83	EGS - 19-way connector
X84	Gearshift extension - 13-way connector
X85	Gearshift - 12-way connector
X87	General line - side instrument cluster line - 13-way connector
X88	General line - side instrument cluster line - 9-way connector
X89	Front left light - 6-way connector
X102	Control unit - 3-way connector
X103	Relay - 2-way connector
X104	Valve block switch kit - 1-way connector
X110	Air conditioner - 2-way connector
X111	Air conditioner - 9-way connector
X124	Lifting solenoid valve - 2-way connector
X125	Lifting solenoid valve - 2-way connector
XA	Horn - 2-way connector
XC1	Control unit - 11-way on-board connector
XC2	Control unit - 7-way connector
XC3	Control unit - 21-way connector

NAME	DESCRIPTION
XC4	Control unit - 21-way connector
XC5	Control unit - 17-way connector
XC6	Control unit - 13-way connector
XD	Engine stop diode - 2-way connector
XD1	Parking brake diode - 2-way connector
XST2	Side instrument cluster - 36-way connector
Y12	Proportional solenoid valves

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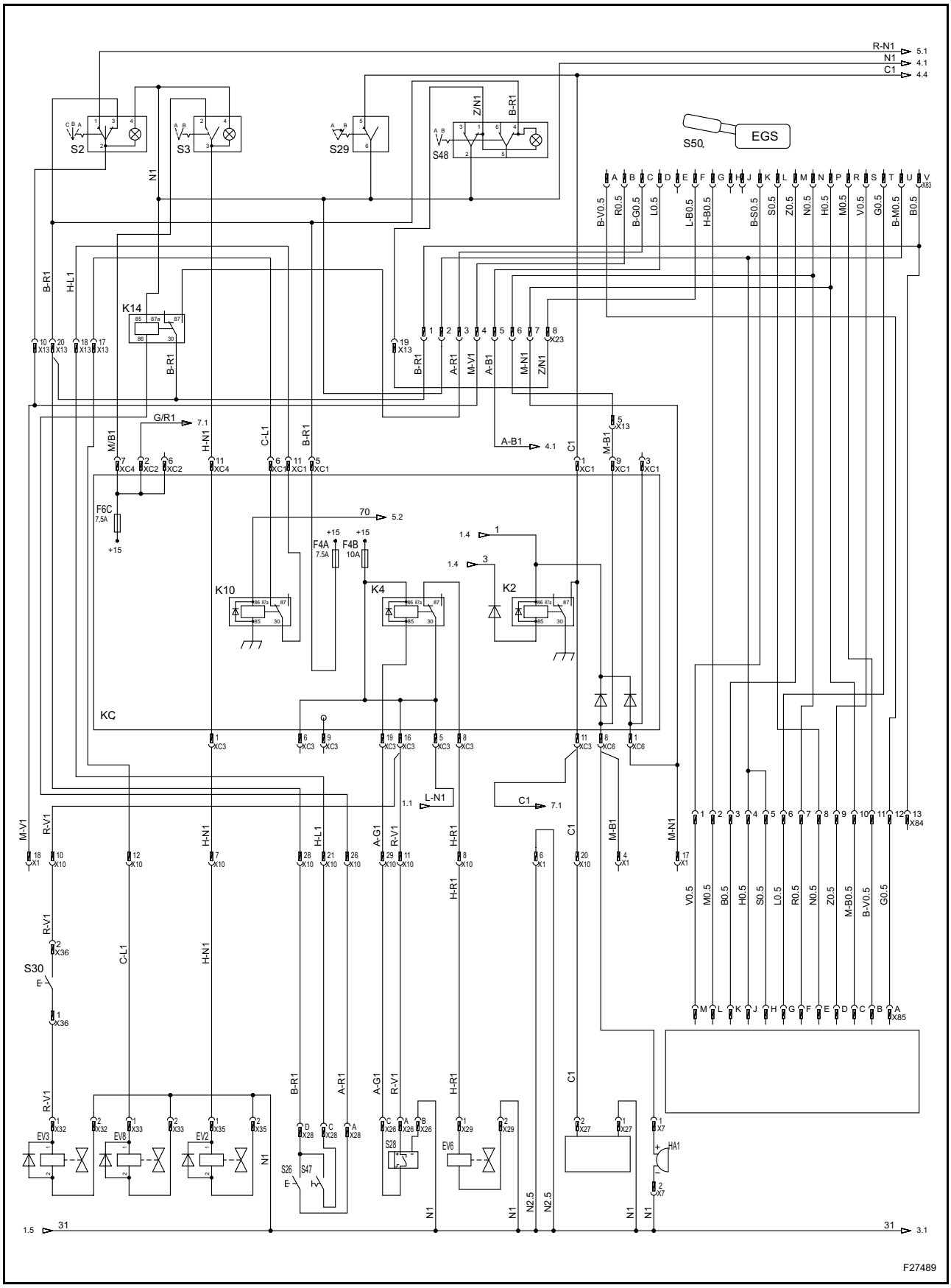
ENGINE LINE DIAGRAM



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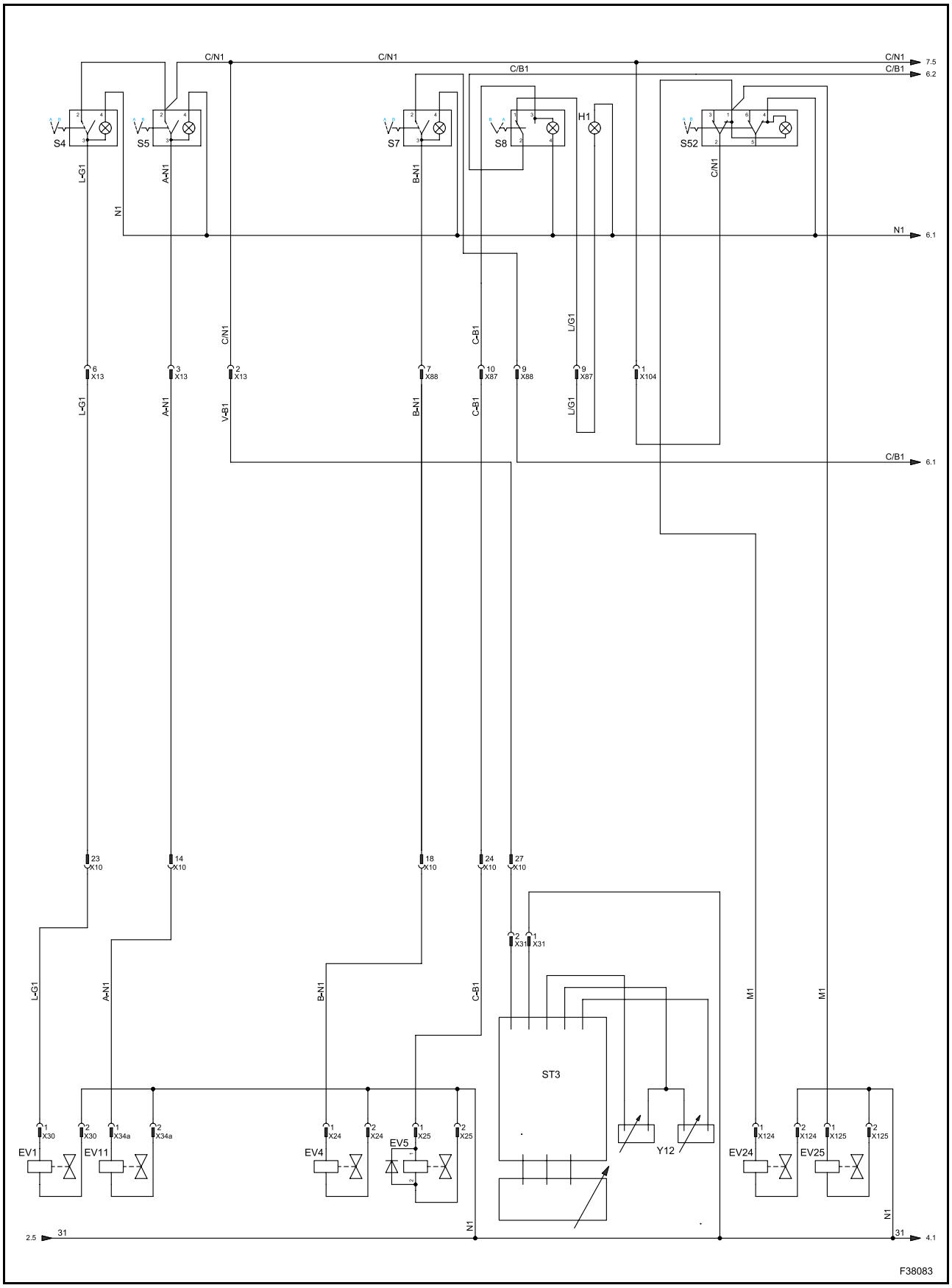
SOLENOID VALVE LINE DIAGRAM



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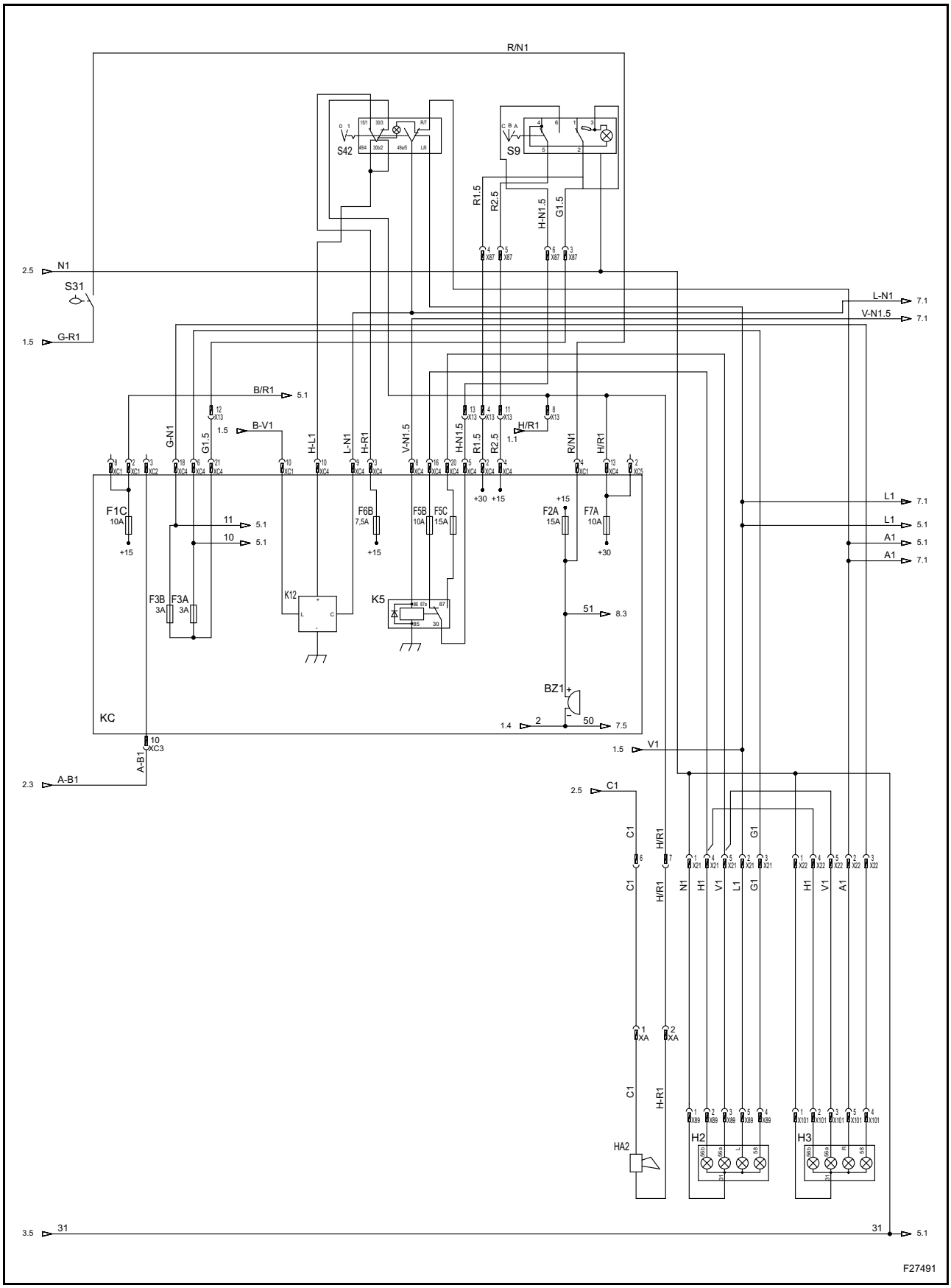
SOLENOID VALVE LINE DIAGRAM



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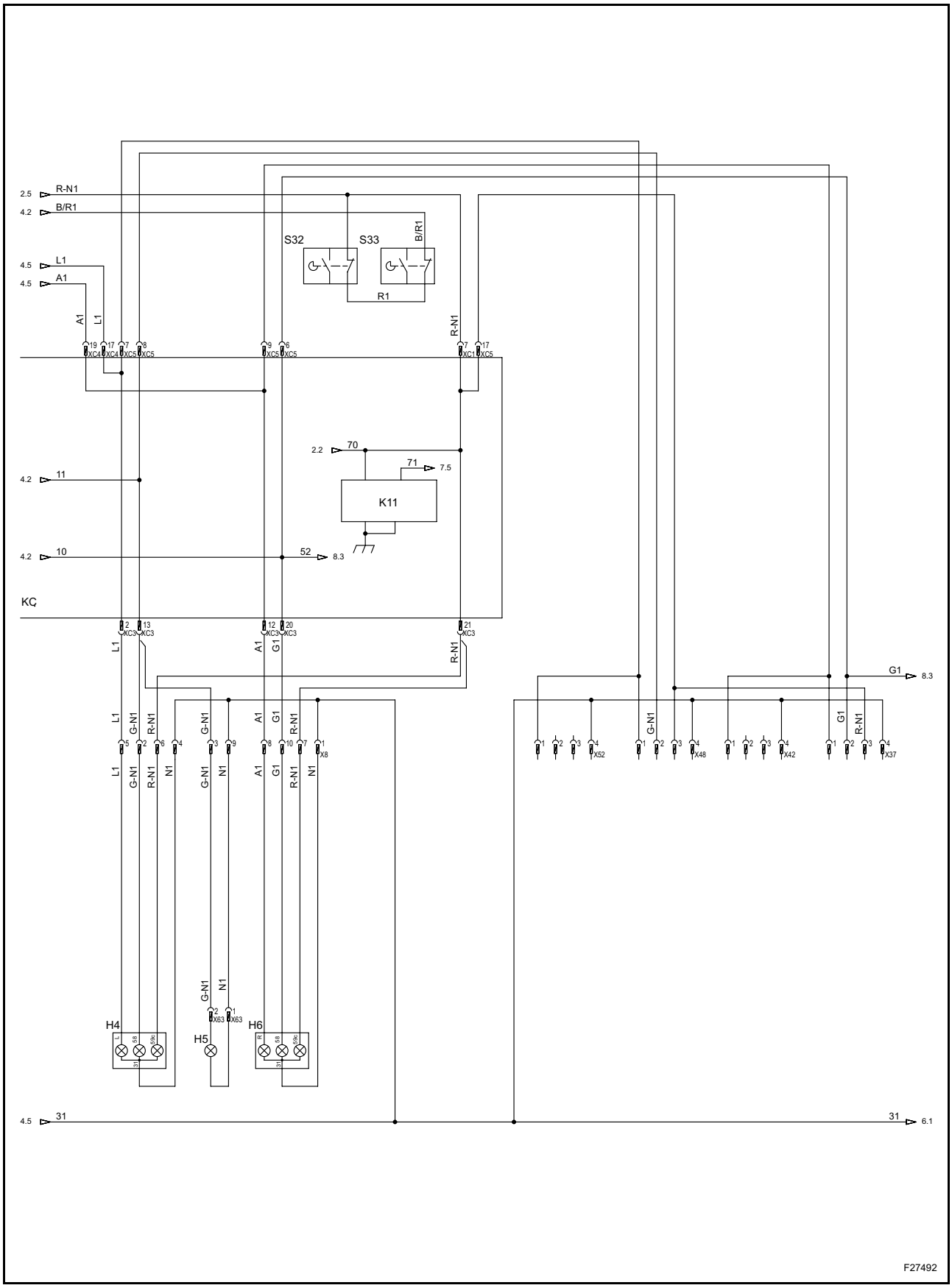
LIGHT LINE DIAGRAM



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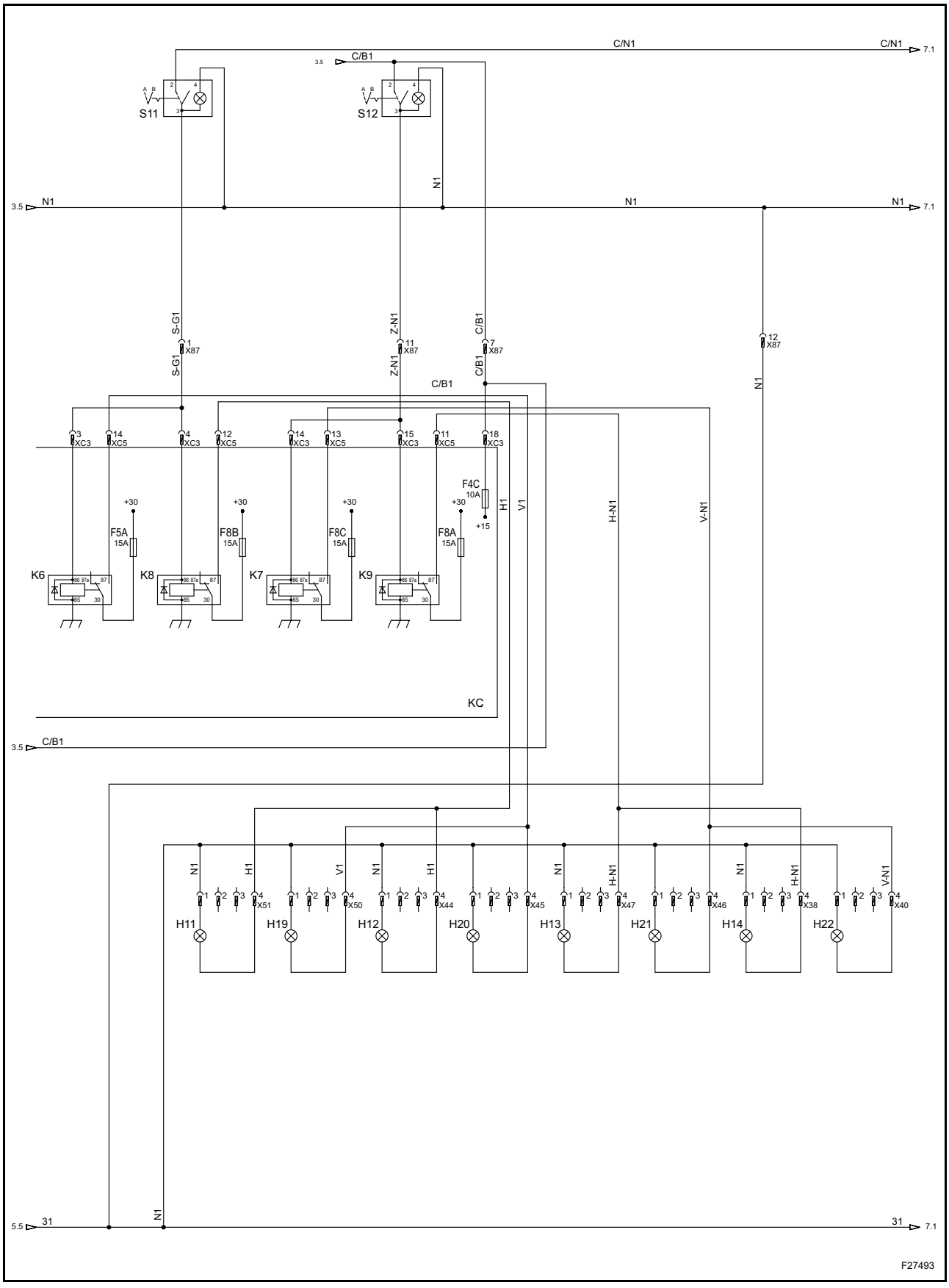
REAR LIGHT LINE DIAGRAM



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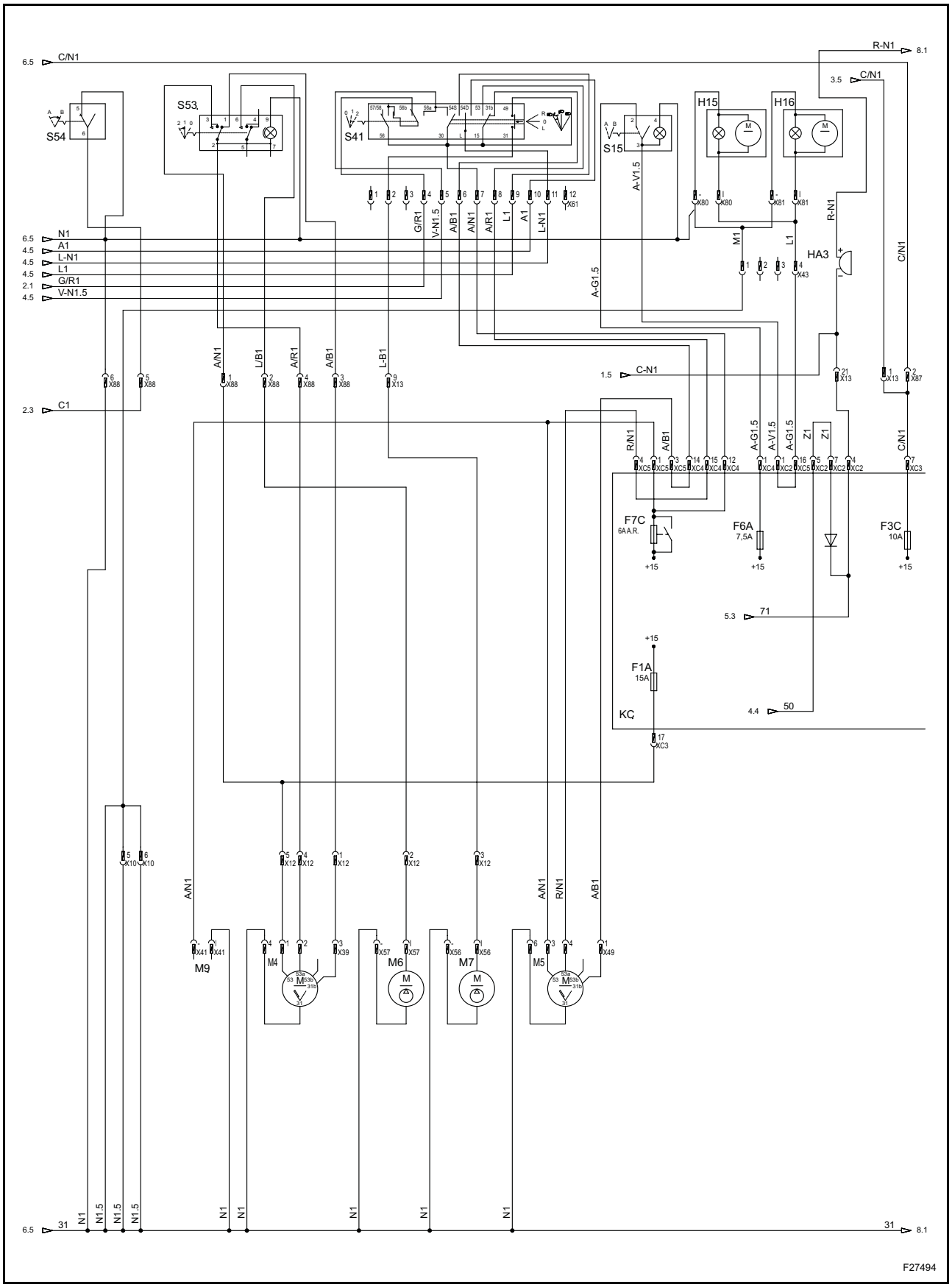
WORK LIGHT LINE DIAGRAM



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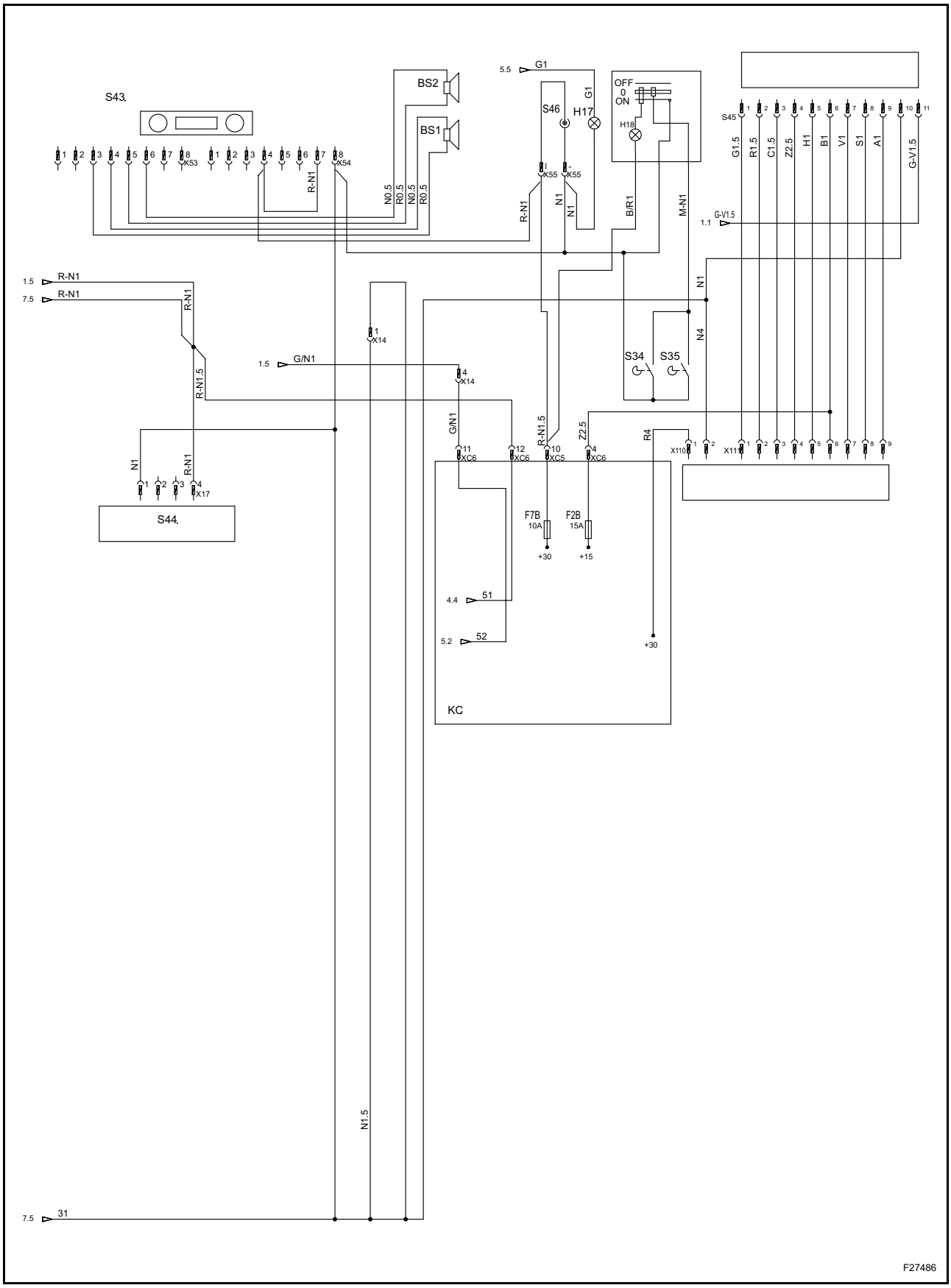
WINDSHIELD WIPER WASHER LINE



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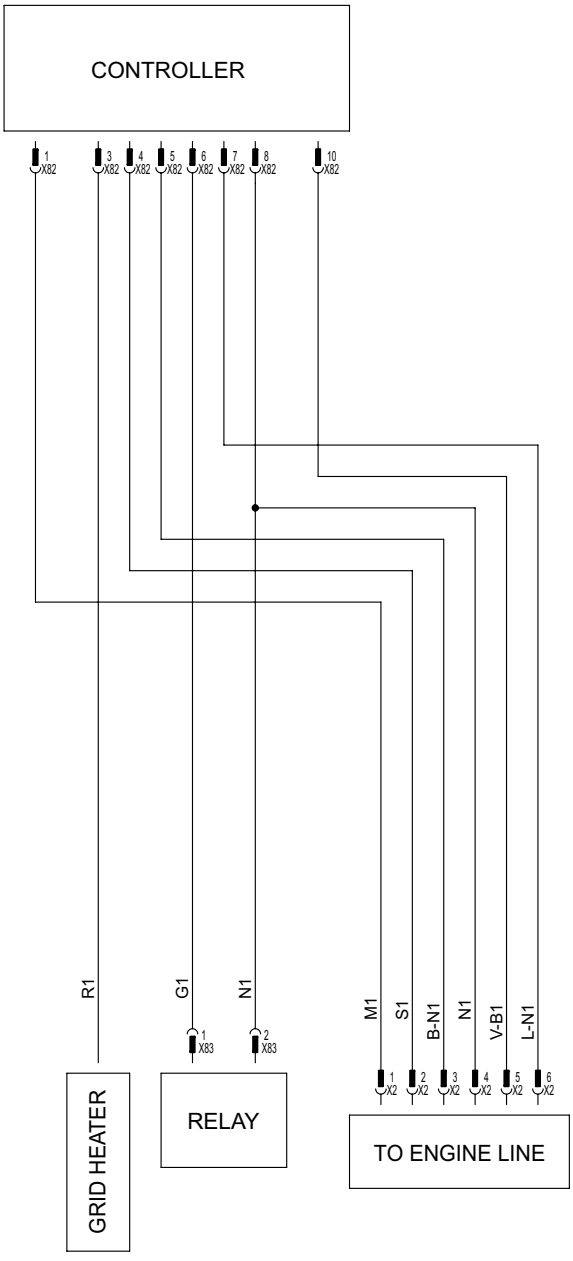
HEATER LINE



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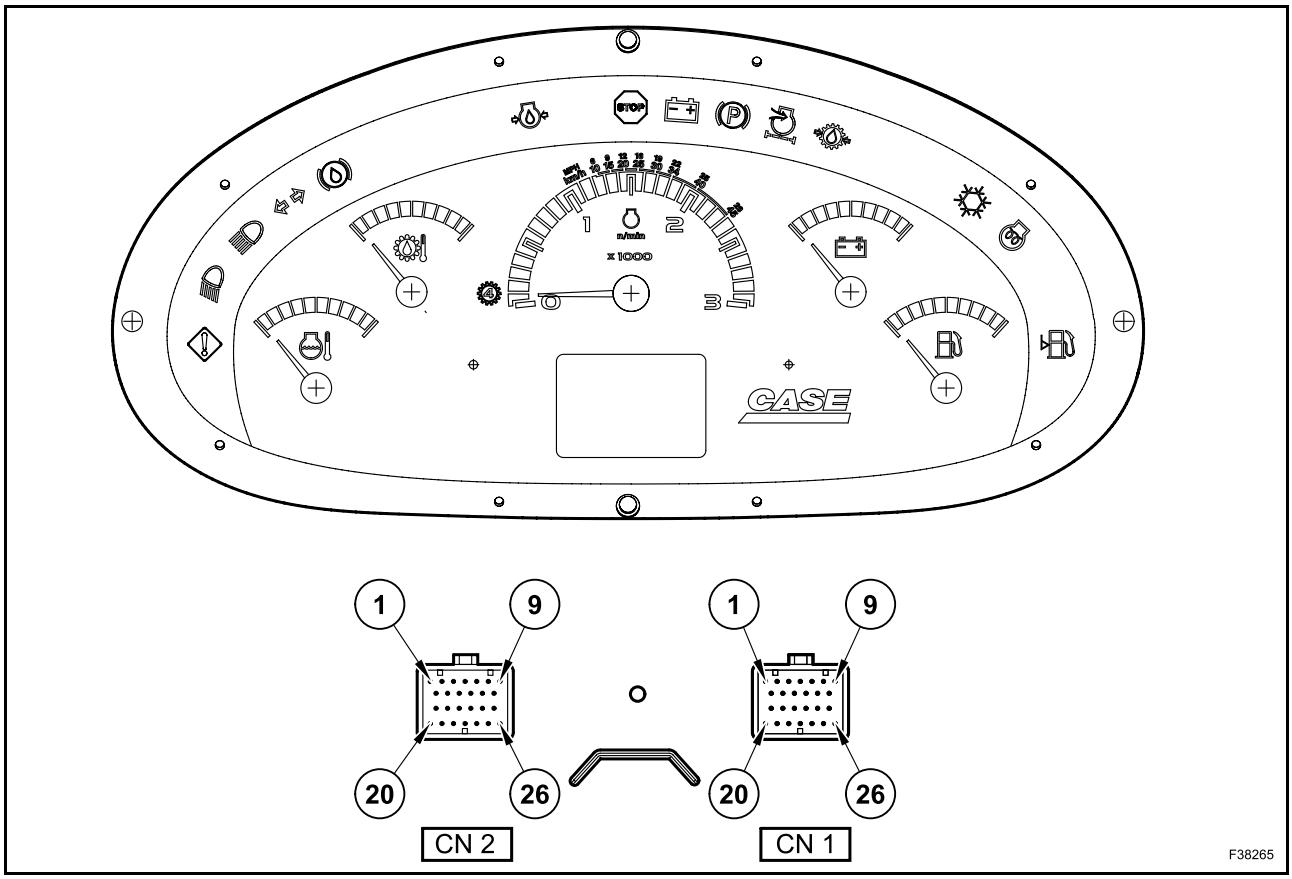
COLD START DIAGRAM



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SIDE INSTRUMENT CLUSTER



Calibrations

Gage type	Input	Reading	Pointer tolerance	Input tolerance	Calibration direction
Speedometer	0 HZ	0 rpm	±3°	N/A	Descending
	307 HZ	1000 rpm	N/A	± 60 rpm	Ascending
	736 HZ	2400 rpm	N/A	± 60 rpm	Ascending
Level fuel	240 OHMS	Empty	+0/-6°	230-240 OHMS (REF)	Descending
	102 OHMS	1/2 Tank	±3° (REF)	98-108 OHMS	Descending
	33 OHMS	Full	+4/-2°	33-42 OHMS	Ascending
Transmission temperature	900 OHMS	Point B	+0/-6°	N/A	Descending
	114 OHMS	106 °C (Red/green line)	±5°	111-117 OHMS (REF)	Ascending
Coolant temperature	700 OHMS	Point A	+0/-5°	N/A	Descending
	95 HMS	106 °C (Red/ green line)	±3°	93-97 OHMS (REF)	Ascending
VOLT	11V	Red/green left line	±3°	10.7-11.3 V (REF)	Descending
	15.9V	Red/green right line	±5°	15.0-15.6 V (REF)	Ascending

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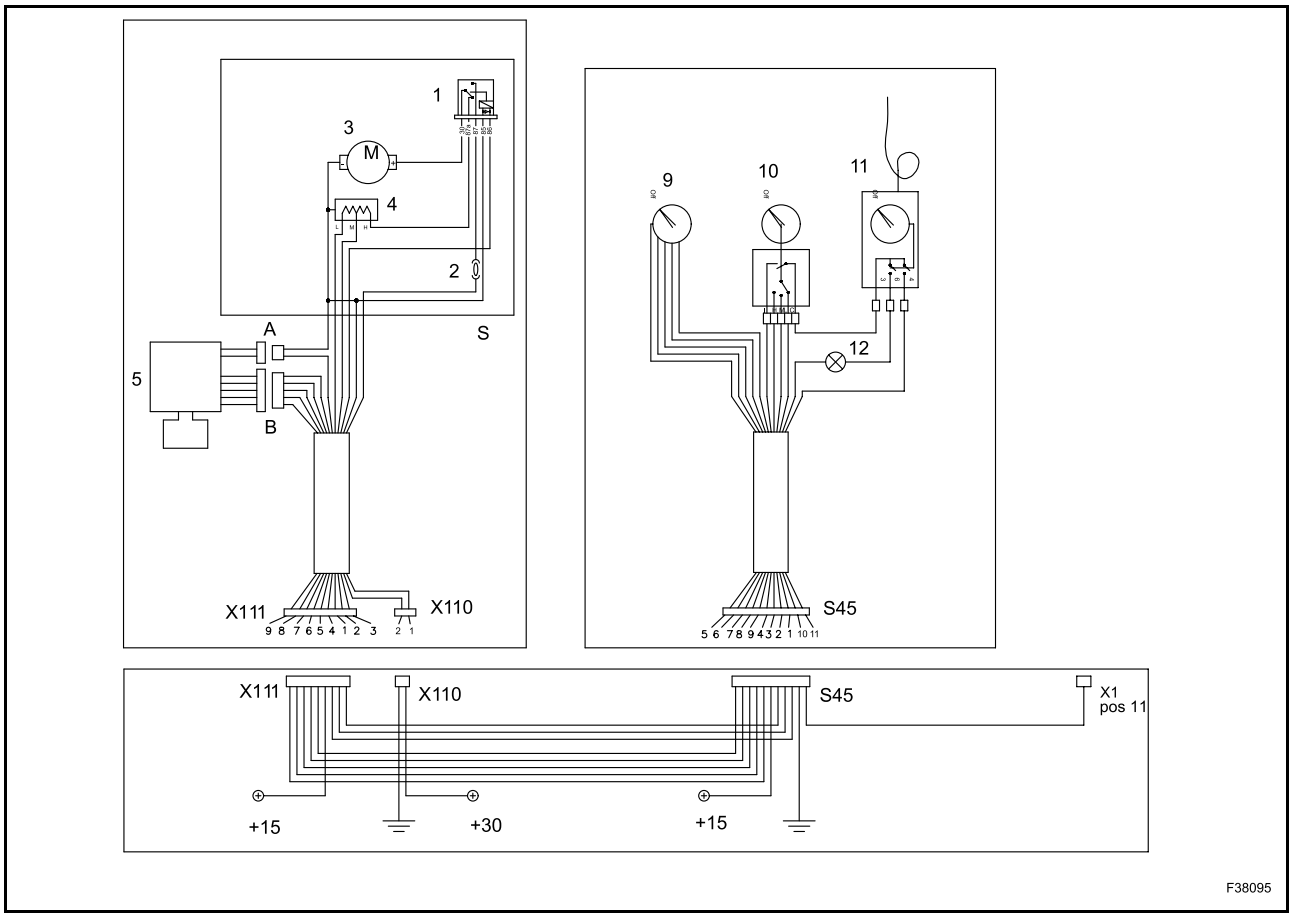
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PIN #	NAME	FUNCTION	WARNING LAMP No.
1	Ignition	10V-16V INPUT	
2	Low oil pressure	Low side switch input	LP1
3	Air filter restriction	Low side switch input	LP2
4	Parking brake	Low side switch input	LP3
5	Alternator	Alternator D+ input	LP4
6	Not used		
7	Crab steer	Low side switch input	LP6
8	Neutral	High side switch input	
9	Seat switch	Low side switch input	
10	A/C system pressure	High side switch input	LP7
11	Not used		
12	Driving lights	High side switch input	LP9
13	Not used		
14	Not used		
15	Engine pre-heat	High side switch input	LP12
16	Not used		
17	Direction	High side switch input	LP14
18	Not used		
19	Tachometer signal	Alternator w input	
20	Fuel level sender	Speed sensor input	LP27
21	Water temperature sender	Speed sensor input	
22	Transmission temperature sender	Speed sensor input	
23	Not used		
24	Driving lights	High side switch input	LP8
25	Brake	High side switch input	LP28
26	Not used		
27	Not used		
28	Not used		
29	Not used		
30	Not used		
31	Transmission oil temperature	Low side switch input	LP23
32	Not used		
33	Front steering	Low side switch input	LP25
34	Crab steering	Low side switch input	LP26
35	Audible alarm	Open collector output	
36	Ground	Ground	

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AIR CONDITIONER SCHEMATIC



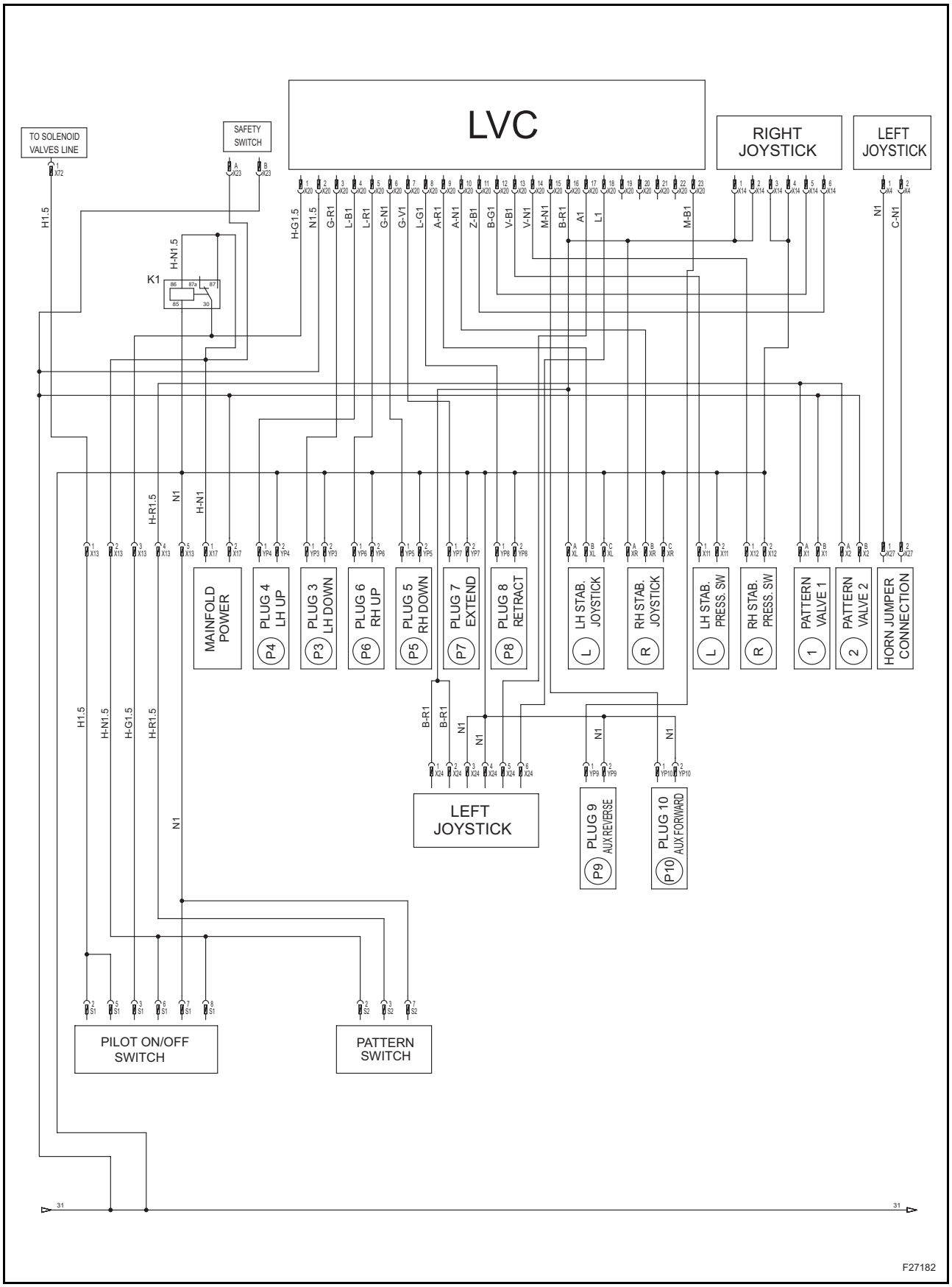
S	Evaporator box
1	3rd speed relay
2	Fuse 25 A
3	Ventilated electrical motor
4	1 and 2 speed resistor
5	Electrical cock
X111	9-way connector
X110	2-way power connector

S45	11-way connector
9	Potentiometer
10	Speed switch
11	Temperature switch
12	12 V light
A	2-way waterproof connection
B	5-way waterproof connection

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PILOT SCHEMATIC



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NAME	DESCRIPTION
K1	Safety relay
S1	Pilot ON/OFF switch - 8-way connector
S2	Gearshift configuration switch - 8-way connector
X1	Valve configuration “1” - 2-way connector
X2	Valve configuration “2” - 2-way connector
X4	Left hydraulic control lever - 2-way connector
X11	Left stabilizer pressure switch - 2-way connector
X12	Right stabilizer pressure switch - 2-way connector
X13	Right towing line - 5-way connector
X14	Right hydraulic control lever - 6-way connector
X17	Manifold power - 2-way connector
X20	Control unit - 23-way connector
X23	Safety switch - 2-way connector
X24	Left stabilizer control lever - 6-way connector
X27	Horn jumper connection - 2-way connector
X72	Pilot control cable - 1-way connector
XL	Left stabilizer control lever - 3-way connector
XR	Right stabilizer control lever - 3-way connector
YP3	Left bottom plug 3 - 2-way connector
YP4	Left top plug 4 - 2-way connector
YP5	Right bottom plug 5 - 2-way connector
YP6	Right top plug 6 - 2-way connector
YP7	Extension plug 7 - 2-way connector
YP8	Retraction plug 8 - 2-way connector
YP9	Reverse travel auxiliary speed plug 9 - 2-way connector
YP10	Auxiliary forward travel plug 10 - 2-way connector

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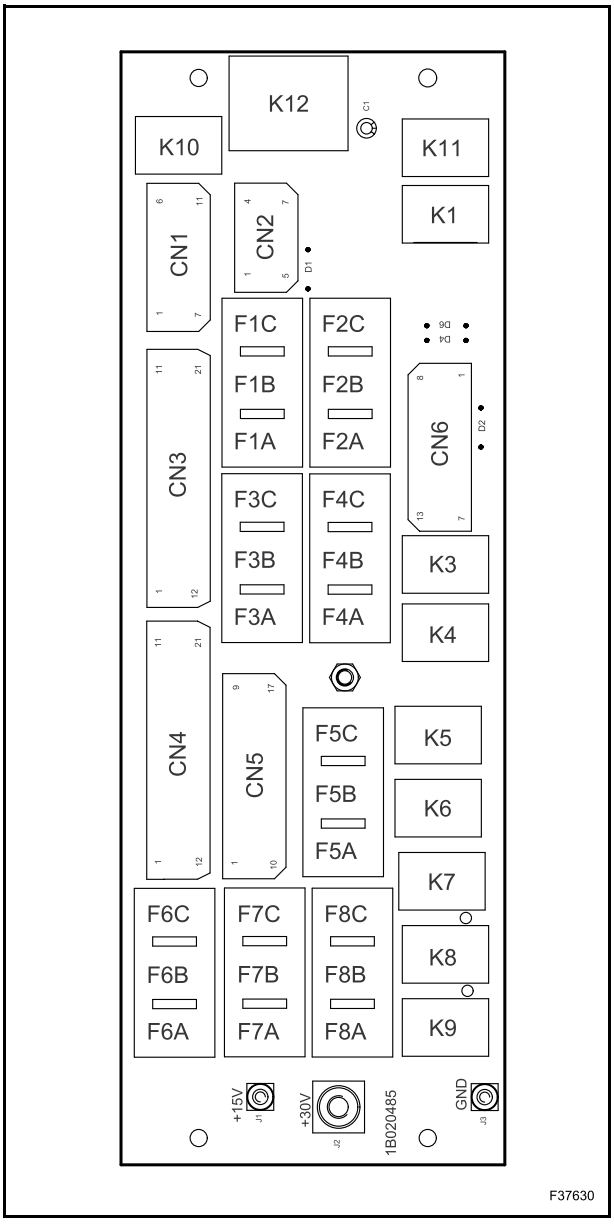
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2.4 ELECTRICAL DIAGRAMS - POWERSHUTTLE CAB (580SR+/590SR)

FUSE AND RELAY DESCRIPTION

Fuse No.	Rating	Function
F1A	15 A	Rear windshield wiper and rear windshield washer
F1B	7.5 A	Engine stop, (+15) anti-theft device, “grid heater”, (+15) ECU power supply, starter switch key
F1C	10 A	Stop light switch
F2A	15 A	Instrument power supply, switch lamps, brake oil level sensor, pneumo-electric seat
F2B	15 A	Air conditioning
F2C	15 A	Pilot control
F3A	3 A	Rear right/front left side light, instrument backlighting
F3B	3 A	Rear left/front right side lights, number plate light
F3C	10 A	Front work light switch, ride control, double delivery
F4A	5 A	Forward travel, reverse travel, reverse buzzer, geashift lever
F4B	10 A	Rear hammer button, bucket level solenoid valve + sensor, clutch disconnect buttons
F4C	10 A	Backhoe attachment lock, backhoe attachment travel lock
F5A	15 A	Inner front work lights
F5B	10 A	Low beams
F5C	15 A	Main beams
F6A	7.5 A	Rotating beacon
F6B	7.5 A	(+15) hazard warning lights
F6C	7.5 A	Hand hammer, 4WD
F7A	10 A	(+30) hazard warning lights, horn
F7B	10 A	Electrical socket, radio, cab light
F7C	6 A	Front windshield wiper
F8A	15 A	Outer rear work lights
F8B	15 A	Outer front work lights
F8C	15 A	Inner rear work lights

K1	Forward-reverse travel gearshift lever relay
K3	Starting relay
K4	Bucket level solenoid valve relay
K5	Low and main beam relay
K6	Inner front work light relay
K7	Inner rear work light relay
K8	Outer front work light relay
K9	Outer rear work light relay
K10	Reverse travel relay
K11	Forward travel relay
K12	Hazard warning light relay



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COMPONENTS AND CONNECTORS

NAME	DESCRIPTION
A1	Right speaker (optional)
A2	Left speaker (optional)
A53	Radio (optional)
A106	Engine control unit
B107	Water in fuel sensor
B4	Air filter pressure switch
B5	Fuel level sender
B24	Accelerator knob
B25	Foot accelerator
B26	Loader bucket sensor
B30	Parking brake
B33	Speed sensor (optional)
B66	Oil temperature switch
B69	A/C pressure switch
B74	Transmission oil pressure switch
B129	Brake oil level sensor
E15	Rotating beacon
E16	Rotating beacon
E17	Warning lamp for intake
E18	Cab light
E26	Control lock warning lamp
E27	Number plate light
E28	Rear left light
E29	Rear right light
E38	Rear left work light
E40	Rear left light (optional)
E44	Front right work light
E45	Front right work light (optional)
E46	Rear left work light (optional)
E47	Rear left work light
E50	Front left work light (optional)
E51	Front left work light
E121	Front left light/audible alarm
E133	Front right light
F1	Main fuse
F2	Control unit fuse
F4	Third speed blower fuse
F5	Water in fuel fuse
F31	Fuse for anti-theft device, diagnostic socket, menu scroll switch, display enter switch, side instrument cluster

NAME	DESCRIPTION
FG4	Fuse A/C
G1	Battery
G67	Alternator
H7	Reverse buzzer
H32	Audible alarm
HA2	Horn
K102	Relay for start signal from the control unit
K103	Start relay
K104	Starter motor relay
K105	A/C relay
M1	Starter motor
M39	Rear windshield wiper motor
M41	Blower motor (optional)
M49	Front pump
M56	Front windshield wiper motor
M57	Rear windshield wiper motor
M64	A/C compressor
S2	4WD switch
S3	Hand hammer switch
S4	Hydraulic speed control switch
S5	Drive switch
S6	Attachment switch
S8	Backhoe attachment travel lock switch
S9	Lights switch
S15	Start switch
S23	Transmission disconnect button
S28	Transmission disconnect button
S34	Left door switch
S35	Right door switch
S36	Rear hammer button (optional)
S42	Warning switch
S130	Windshield wiper/washer switch
S132	Gear switch
S136	Menu scroll switch
S137	Rear work light switch
S138	Rear pump switch
S139	Display enter switch
S140	Backhoe attachment travel lock switch
S141	Front work light switch
S144	Beacon lamp switch

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NAME	DESCRIPTION
SB1	Battery master switch
ST1	Side instrument cluster
ST3	4x1 bucket control lever
Y6	Forward speed solenoid valve
Y7	Reverse travel solenoid valve
Y12	4x1 bucket solenoid valves (optional)
Y24	Backhoe attachment travel lock solenoid valve
Y25	Backhoe attachment travel lock solenoid valve
Y26	Backhoe attachment travel lock solenoid valve
Y27	Backhoe attachment travel lock solenoid valve
Y30	Hydraulic speed control solenoid valve (optional)
Y32	Rear hammer solenoid valve (optional)
Y34	Drive control solenoid valve (optional)
Y35	Hand hammer solenoid valve
X1	Engine line interface - 18-way connector
X2	Preheating relay (optional) - 18-way connector
X4	Air filter sensor - 18-way connector
X5	Fuel level sensor - 2-way connector
X6	Forward gear solenoid valve - 2-way connector
X7	Reverse travel buzzer - 2-way connector
X8	4WD solenoid valve - 2-way connector
X10	General line interface - 31-way connector
X12	General cab line interface - 5-way connector
X13	General line - 17-way connector
X14	Antitheft unit
X17	Seat (optional)
X21	Diagnostic
X25	Foot accelerator
X31	Front quick coupler
X55	Auxiliary 12 V socket
X72	From pilot control cable
X107	Water in fuel
X124	Quick coupler
X128	Optional

NAME	DESCRIPTION
X14	Anti-theft device - 11-way connector
X15.1	Start - connector
X15.6	Start - connector
X17	Optional seat - 4-way connector
X21	Diagnostics - 10-way connector
X22	5-way connector
X23	2-way connector
X24	Accelerator knob - 6-way connector
X25	Accelerator pedal - 6-way connector
X26	Loader attachment sensor - 3-way connector
X27	Number plate light - 2-way connector
X28	Rear left light - 4-way connector
X29	Rear right light - 4-way connector
X30	Speed control solenoid valve - 2-way connector
X32	Horn - 2-way connector
X33	Speedometer sensor - 2-way connector
X34	Drive control - 2-way connector
X35	Hand hammer button - 2-way connector
X36	Rear hammer button - 2-way connector
X37	Rear right light - 4-way connector
X38	Rear right light - 4-way connector
X39	Rear windshield wiper motor - 4-way connector
X40	Rear right light - 4-way connector
X41	Blower motor - 2-way connector
X42	Right direction indicator - 4-way connector
X43	Beacon lamp - 4-way connector
X44	Front left light - 4-way connector
X45	Air conditioning - 11-way connector
X46	Rear left light - 4-way connector
X47	Rear left light - 4-way connector
X48	4-way connector
X49	6-way connector
X50	Front right lights - 4-way connector
X51	Front left ìlights - 4-way connector
X52	Front left direction indicator - 4-way connector
X53	8-way connector
X54	Radio - 8-way connector
X55	2-way connector
X56	Windshield wiper pump - 2-way connector
X57	Windshield wiper pump - 2-way connector

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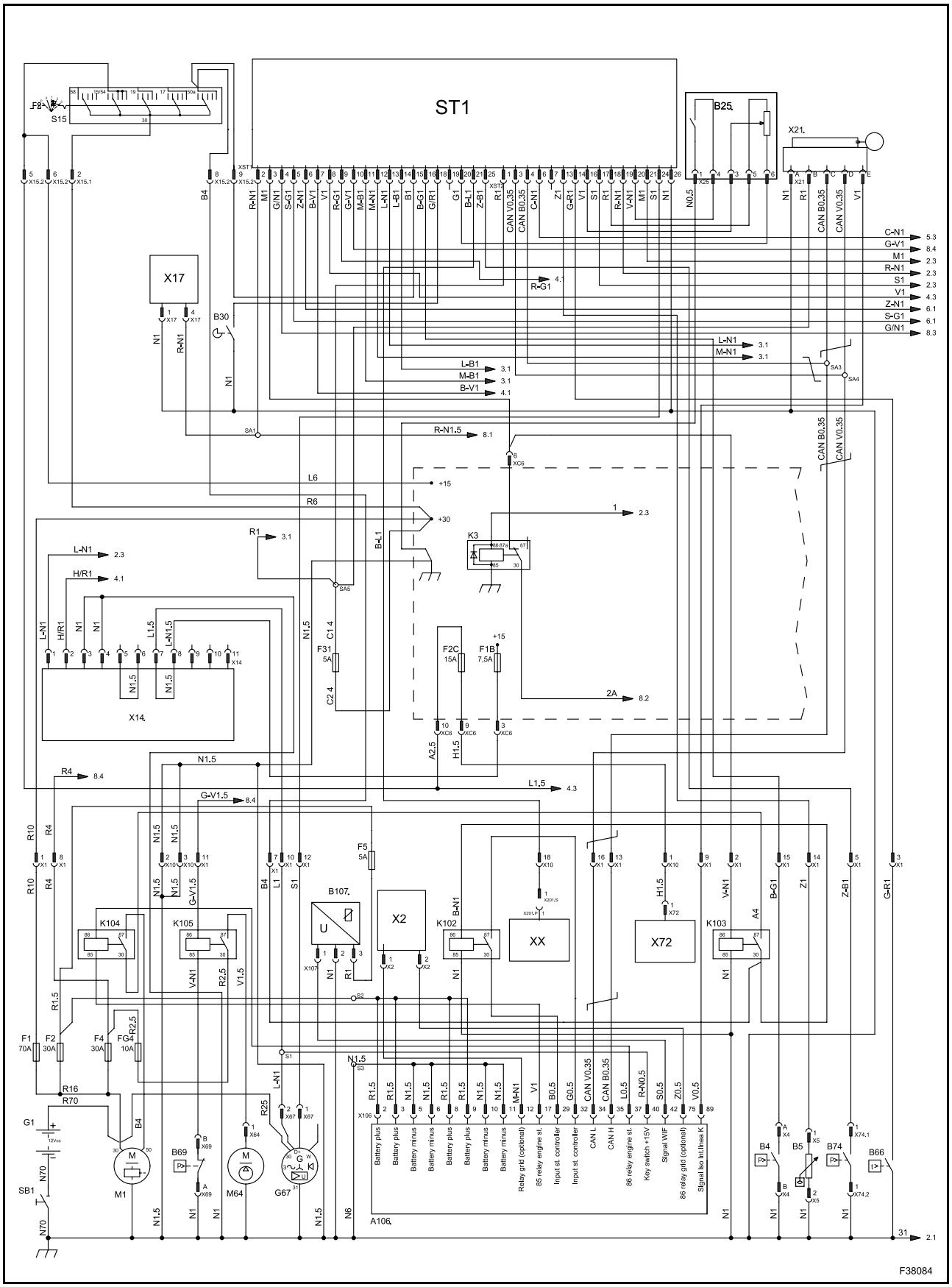
NAME	DESCRIPTION
X58	Left direction indicator - 4-way connector
X64	Air conditioning switch - 1-way connector
X67	Alternator - 3-way connector
X69	Air conditioning pressure switch - 2-way connector
X72	3-way connector
X80	2-way connector
X81	2-way connector
X82	10-way connector
X83	2-way connector
X87	Left general line interface - 13-way connector
X88	Right side general line interface - 17-way connector
X106	Engine control unit - 89-way connector
X107	Water in fuel - 3-way connector
X110	Air conditioning - 3-way connector
X111	Air conditioning - 9-way connector
X130	12-way connector
X132	6-way connector
X144	2-way connector
X201.P	Pilot control - 1-way connector
X201.S	Pilot control - 1-way connector
X202	Backhoe attachment travel solenoid valve - 2-way connector
X203	Backhoe attachment lock solenoid valve - 2-way connector
X204	Horn switch - 2-way connector
X206	Bucket level - 2-way connector
X207	Speed control solenoid valve (optional) - 2-way connector
X208	Loader attachment - 2-way connector
X209	Rear hammer solenoid valve - 2-way connector
X210	Transmissione disconnect - 2-way connector
XC1	Fuse and relay control unit line interface - general line - 11-way connector
XC2	Fuse and relay control unit line interface - general line - 7-way connector
XC3	Fuse and relay control unit line interface - general line - 21-way connector
XC4	Fuse and relay control unit line interface - general line - 21-way connector

NAME	DESCRIPTION
XC5	Fuse and relay control unit line interface - general line - 17-way connector
XC6	Fuse and relay control unit line interface - general line - 13-way connector
XST1	Side instrument cluster - 20-way connector
XST2	Front instrument cluster - 20-way connector
XX	From pilot control cable

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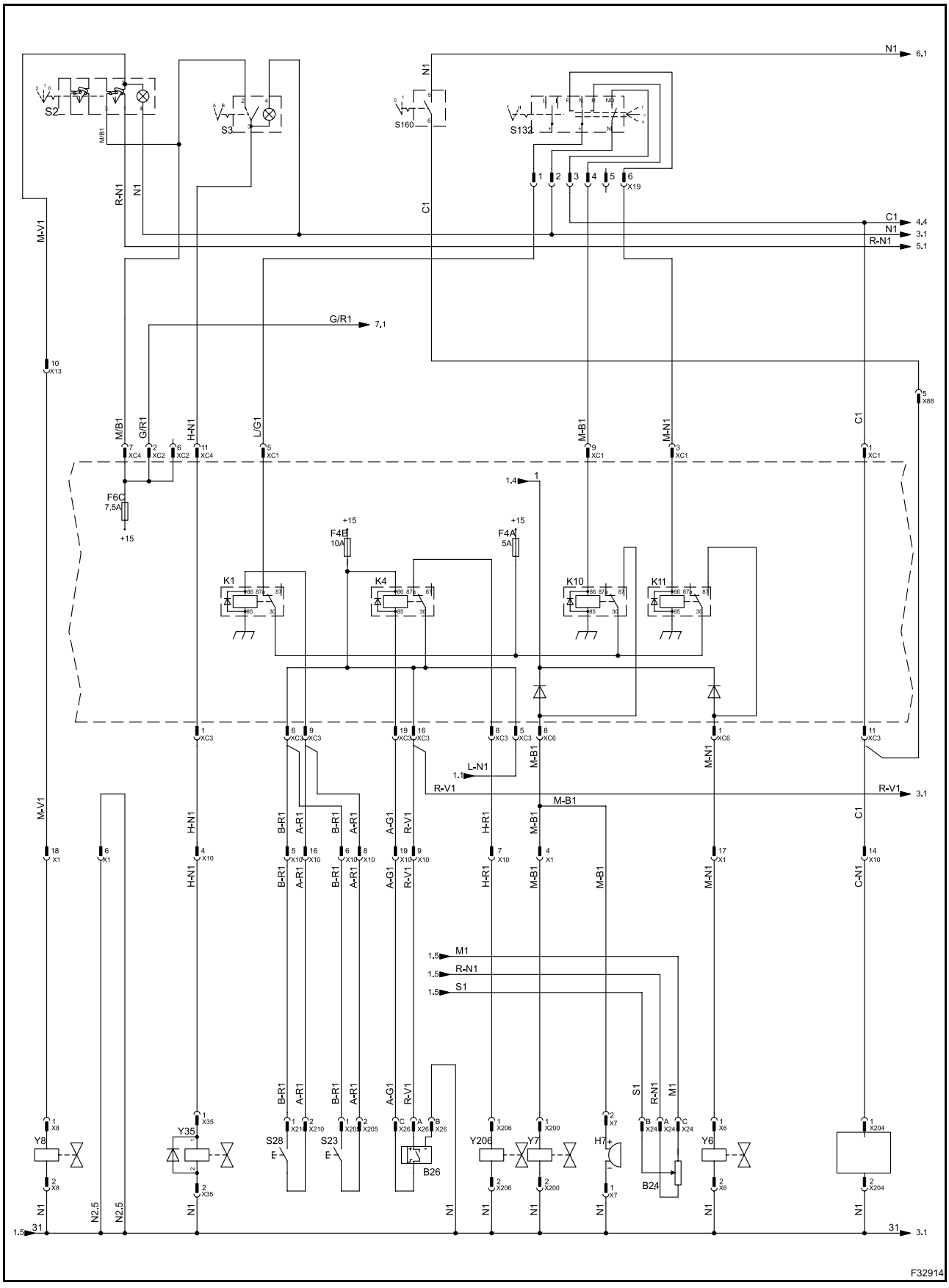
ENGINE LINE DIAGRAM



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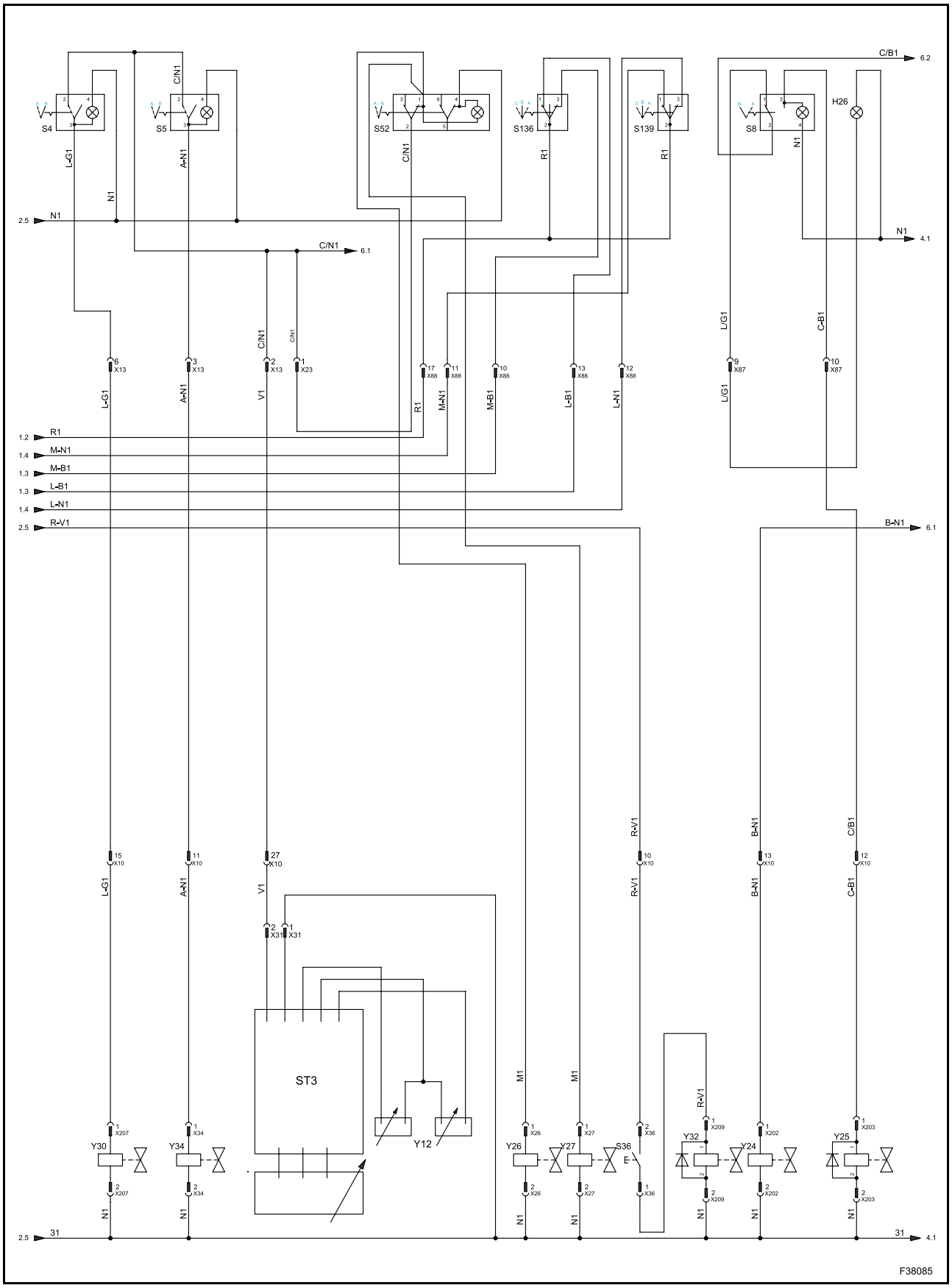
SOLENOID VALVE LINE DIAGRAM



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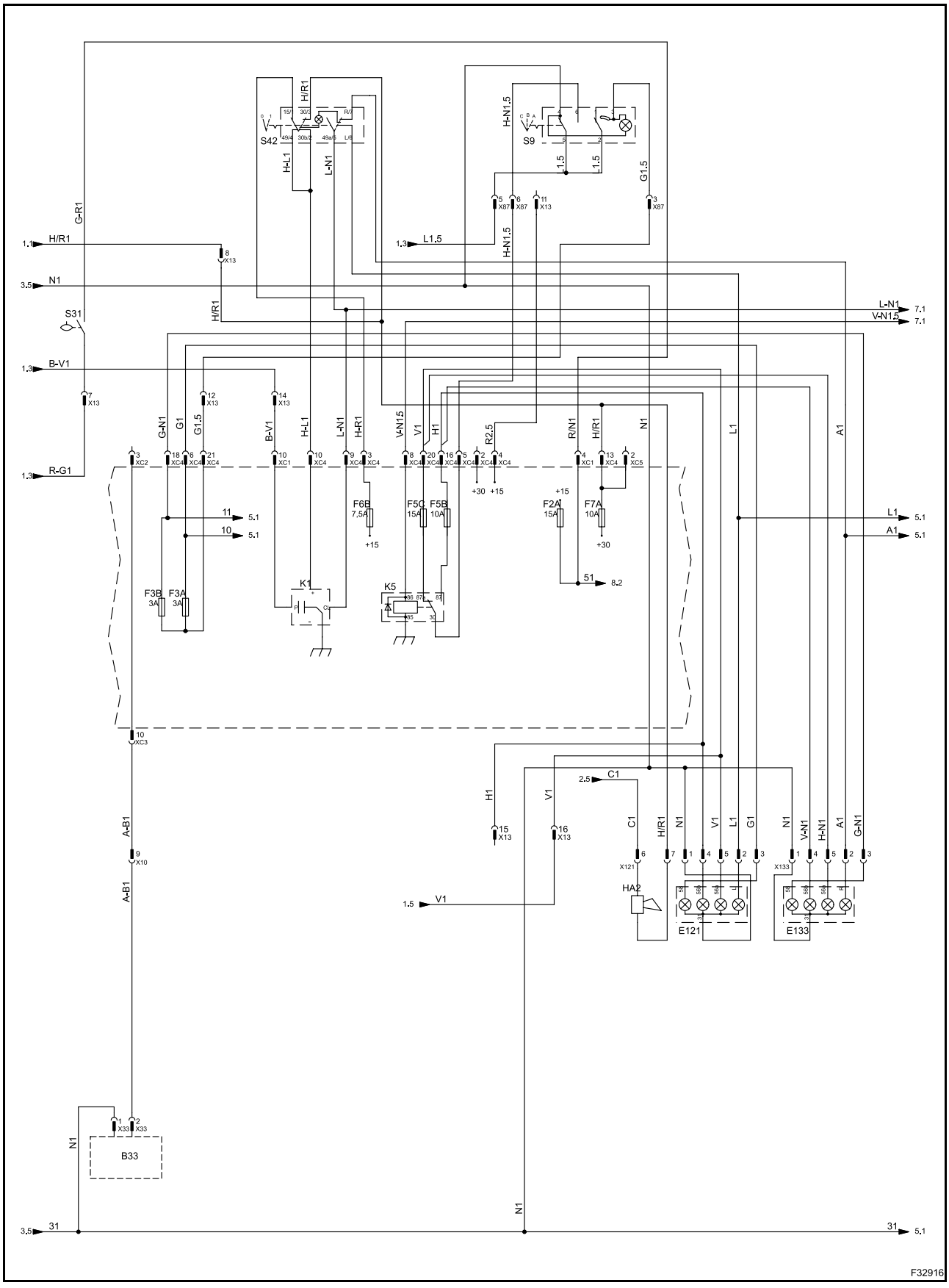
SOLENOID VALVE LINE DIAGRAM



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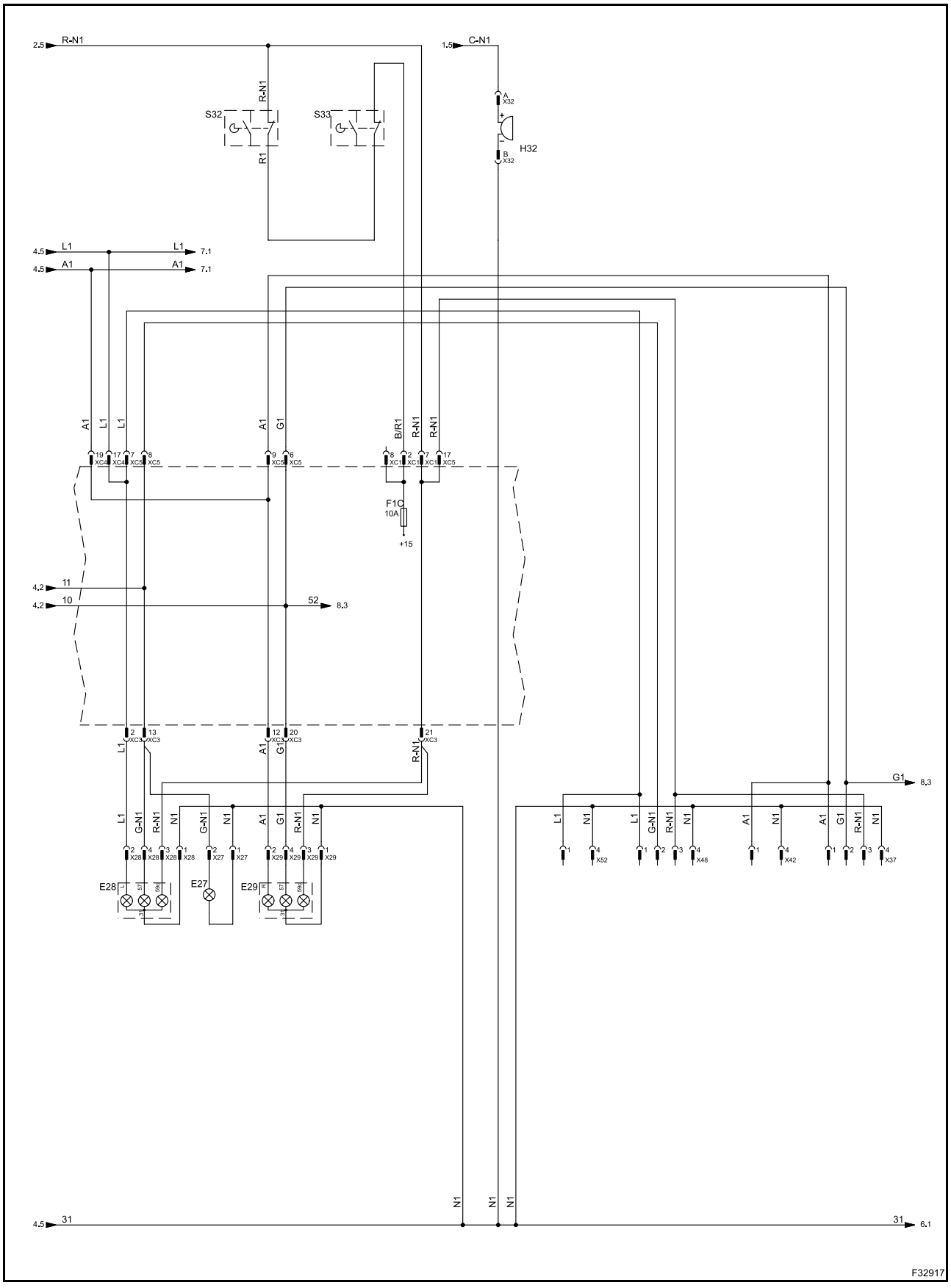
LIGHT LINE DIAGRAM



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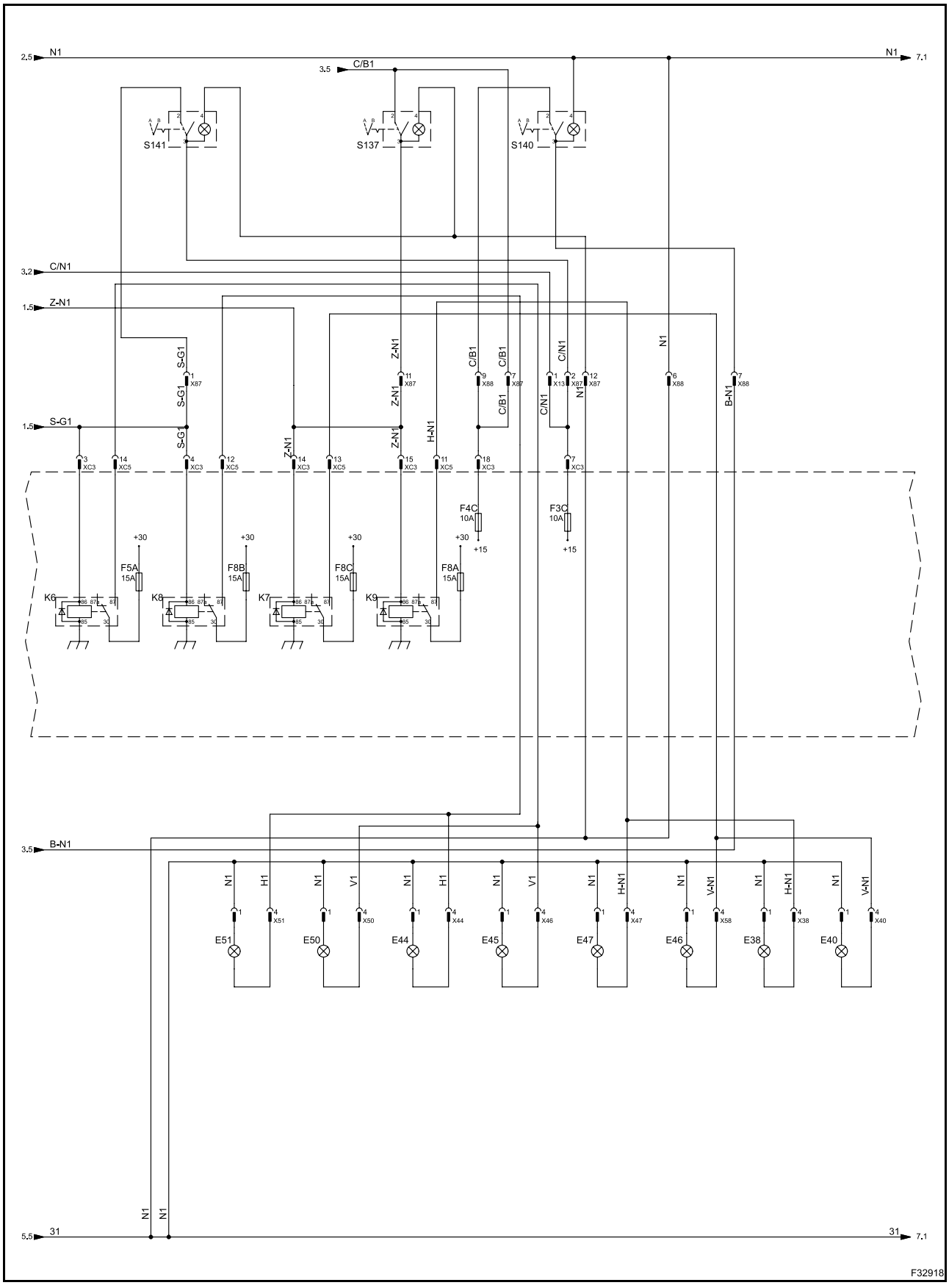
REAR LIGHT LINE DIAGRAM



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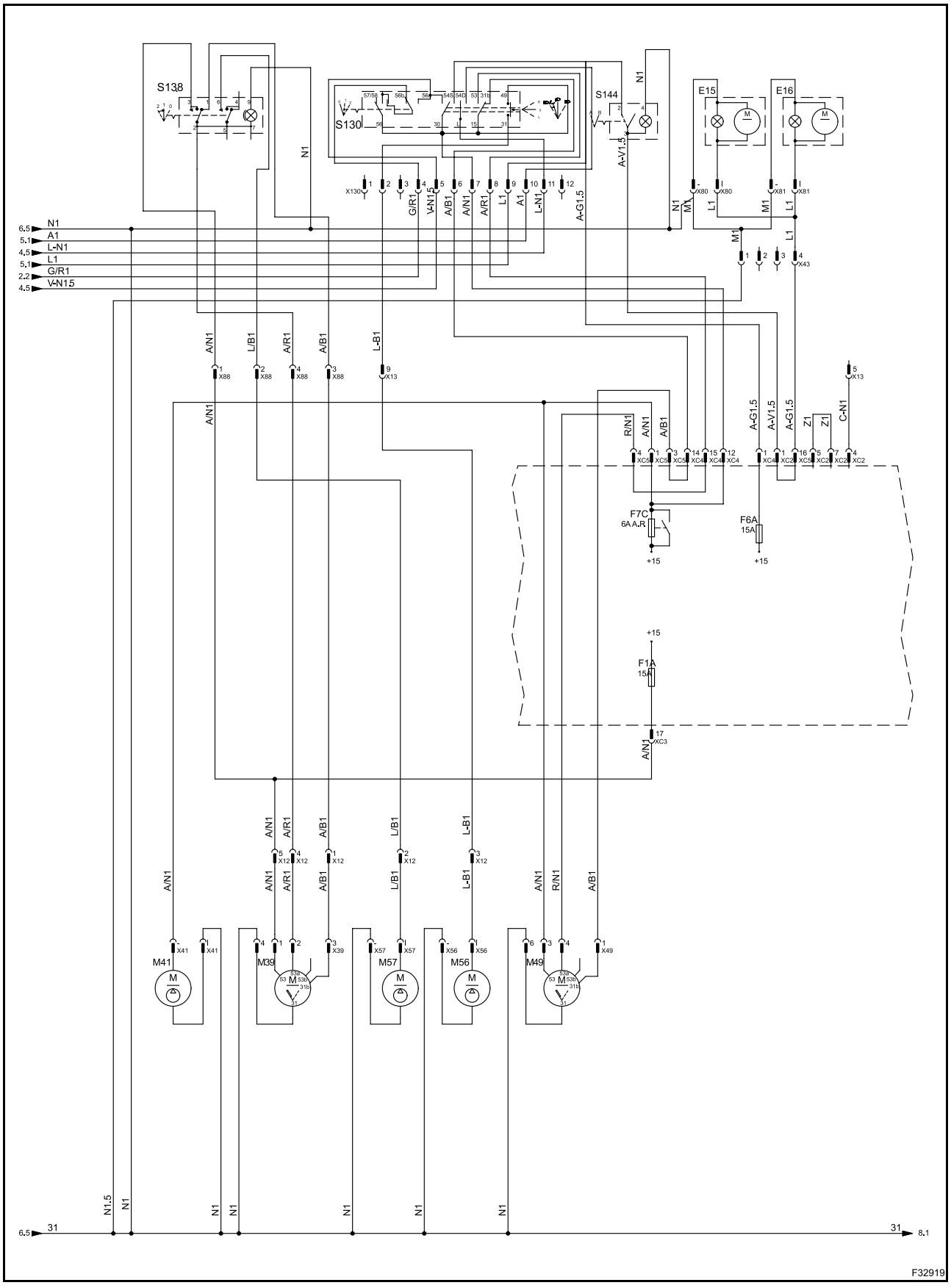
WORK LIGHT LINE DIAGRAM



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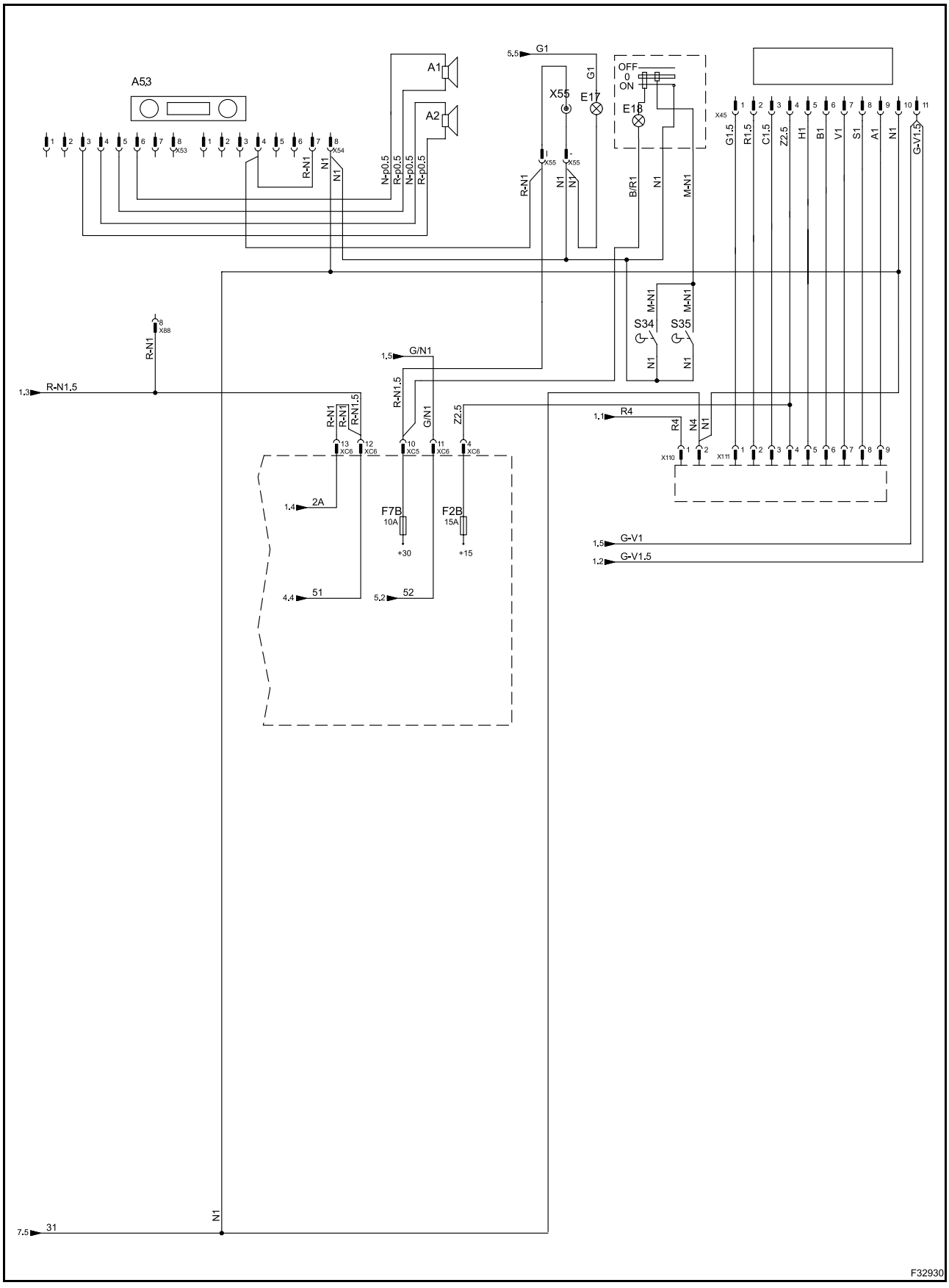
WINDSHIELD WASHER/WIPER LINE DIAGRAM



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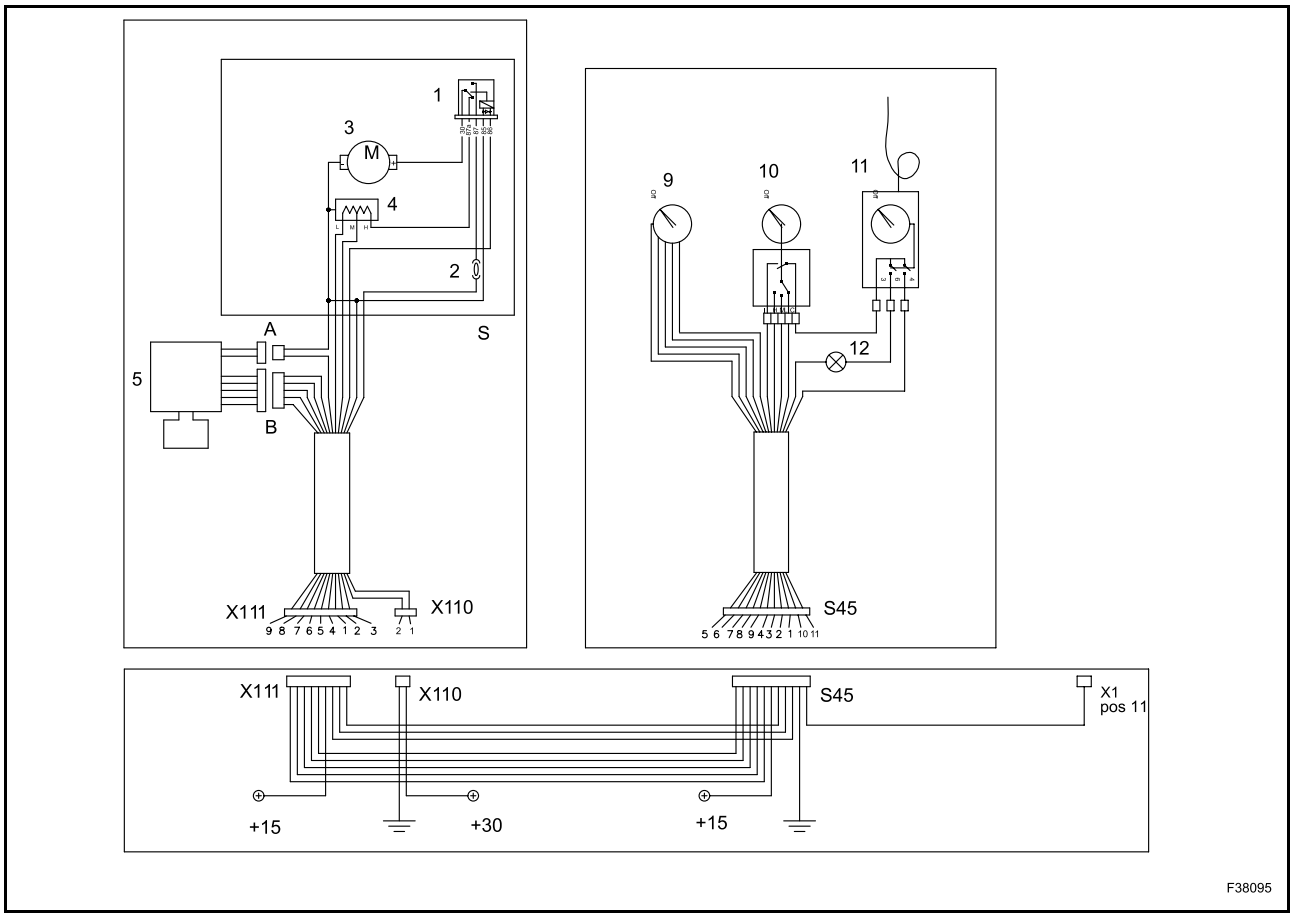
HEATER LINE



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AIR CONDITIONER SCHEMATIC



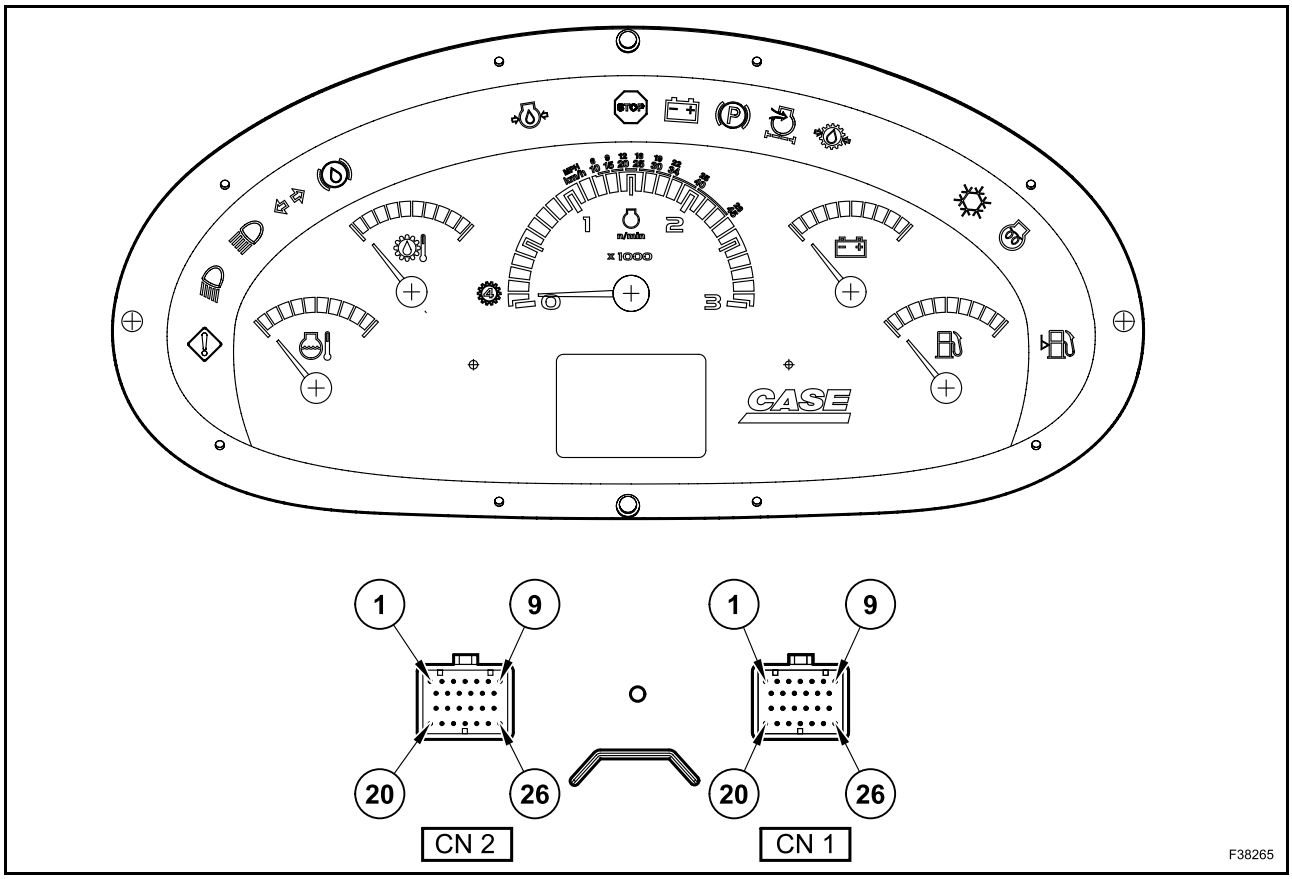
S	Evaporator box
1	3rd speed relay
2	Fuse 25 A
3	Ventilated electrical motor
4	1 and 2 speed resistor
5	Electrical cock
X111	9-way connector
X110	2-way power connector

S45	11-way connector
9	Potentiometer
10	Speed switch
11	Temperature switch
12	12 V light
A	2-way waterproof connection
B	5-way waterproof connection

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SIDE INSTRUMENT CLUSTER



Calibrations

Gage type	Input	Reading	Pointer tolerance	Input tolerance	Calibration direction
Speedometer	0 HZ	0 rpm	±3°	N/A	Descending
	307 HZ	1000 rpm	N/A	± 60 rpm	Ascending
	736 HZ	2400 rpm	N/A	± 60 rpm	Ascending
Level fuel	240 OHMS	Empty	+0/-6°	230-240 OHMS (REF)	Descending
	102 OHMS	1/2 Tank	±3° (REF)	98-108 OHMS	Descending
	33 OHMS	Full	+4/-2°	33-42 OHMS	Ascending
Transmission temperature	900 OHMS	Point B	+0/-6°	N/A	Descending
	114 OHMS	106 °C (Red/green line)	±5°	111-117 OHMS (REF)	Ascending
Coolant temperature	700 OHMS	Point A	+0/-5°	N/A	Descending
	95 HMS	106 °C (Red/green line)	±3°	93-97 OHMS (REF)	Ascending
VOLT	11V	Red/green left line	±3°	10.7-11.3 V (REF)	Descending
	15.9V	Red/green right line	±5°	15.0-15.6 V (REF)	Ascending

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CONNECTORS

CN1		
PIN	**FUNCTION**	**NOTE**
1	Not used	
2	Key on power	Wake up
3	In gear input	Digital input
4	Driving lights	Digital input
5	Front work lights	Digital input
6	Rear work lights	Digital input
7	Not used	
8	Not used	
9	Not used	
10	Air conditioning system pressure	Digital input
11	Display input switch	Digital input
12	Enter input switch	Digital input
13	Up input switch	Digital input
14	Down input switch	Digital input
15	Cranking	Digital input
16	Air filter restriction	Digital input
17	Not used	
18	Parking brake	Digital input
19	Not used	
20	Idle validation switch	Digital input
21	Decelerator button	Digital input
22	Not used	
23	Not used	
24	Not used	
25	Transmission oil pressure	Digital input
26	Not used	

CN2		
PIN	**FUNCTION**	**NOTE**
1	Keep alive power	Need to fuse at 1 ampere without disconnect
2	Not used	
3	Can bus input	Twisted pair, with 120 OHM terminator
4	Can bus input	Twisted pair, with 120 OHM terminator
5	Not used	
6	Audible alarm buzzer	Floyd bell under 80 mA
7	Starter motor interlock	40 OHM relay = 300 mA
8	Not used	
9	Not used	
10	Not used	
11	Not used	
12	Not used	
13	Fuel level gauge	Variable resistance
14	Transmission temperature	Thermistor
15	Not used	
16	Foot accelerator	0.5-4.5 V
17	Accelerator knob	0.5-4.5 V
18	Foot accelerator	Output monitored for diagnostics
19	Accelerator knob	Output monitored for diagnostics
20	Foot accelerator	
21	Accelerator knob	
22	Not used	
23	Not used	
24	Alternator excitation	Low alternator output signals fault
25	Not used	
26	Ground	Digital input

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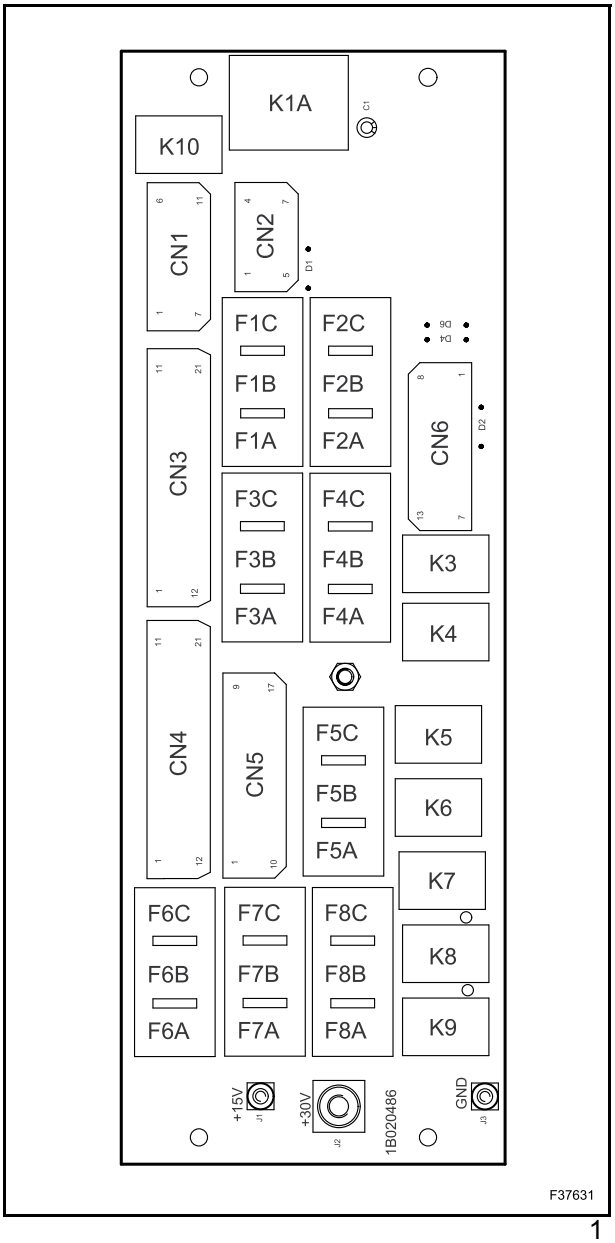
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2.5 ELECTRICAL DIAGRAMS - POWERSHIFT CAB (590SR)

FUSE AND RELAY DESCRIPTION

Fuse No.	Rating	Circuit
F1A	15 A	Rear windshield wiper and rear windshield washer
F1B	7.5 A	Engine stop, (+15) anti-theft device, ECU power supply, starter switch key
F1C	10 A	Stop light switch
F2A	15 A	Instrument power supply, switch lamps, brake oil level sensor, pneumo-electric seat
F2B	15 A	Air conditioning
F2C	15 A	Pilot control
F3A	3 A	Rear right/front left side light, instrument backlighting
F3B	3 A	Rear left/front right side lights, number plate light
F3C	10 A	Front work light switch, ride control, double delivery
F4A	7.5 A	4WD switch, transmission disconnect button, EGS power supply
F4B	10 A	Rear hammer button, bucket level solenoid valve + sensor
F4C	10 A	Backhoe attachment lock, backhoe attachment travel lock
F5A	15 A	Inner front work lights
F5B	10 A	Low beams
F5C	15 A	Main beams
F6A	15 A	Rotating beacon
F6B	7.5 A	(+15) hazard warning lights
F6C	7.5 A	Hand hammer, differential lock
F7A	10 A	(+30) hazard warning lights, horn
F7B	10 A	Electrical socket, radio, cab light
F7C	6 A	Front windshield wiper
F8A	15 A	Outer rear work lights
F8B	15 A	Outer front work lights
F8C	15 A	Inner rear work lights

K1A	Flasher
K3	Starting relay
K4	Bucket level solenoid valve relay
K5	Low and main beam relay
K6	Inner front work light relay
K7	Inner rear work light relay
K8	Outer front work light relay
K9	Outer rear work light relay
K10	Differential lock relay



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COMPONENTS AND CONNECTORS

NAME	DESCRIPTION
A1	Right speaker (optional)
A2	Left speaker (optional)
A23	EGS
A53	Radio (optional)
A106	Engine control unit
A107	Water in fuel sensor
B4	Air filter switch
B5	Fuel level sender
B24	Accelerator knob
B25	Foot accelerator
B26	Loader bucket sensor
B30	Parking brake
B66	Transmission oil temperature switch
B69	A/C pressure switch
B74	Trasmission oil pressure switch
B129	Brake oil level sensor
E15	Rotating beacon
E16	Rotating beacon
E17	Socket light
E18	Cab light
E27	Number plate light
E28	Rear left light
E29	Rear right light
E38	Rear right work light
E40	Rear right work light (optional)
E44	Front right work light
E45	Front right work light (optional)
E46	Rear left work light (optional)
E47	Rear left work light
E50	Front left work light (optional)
E51	Front left work light
E121	Front left light/horn
E133	Front right light
F1	General fuse
F2	Power supply fuse
F4	Third speed blower fuse
F5	Water in fuel fuse
F31	Fuse for anti-theft device, diagnostic socket, menu scroll switch, display enter switch, side instrument cluster

NAME	DESCRIPTION
FG4	Fuse A/C
G1	Battery
G67	Alternator
H7	Reverse buzzer
H32	Audible alarm
HA2	Horn
K14	Transmission relay
K102	Relay for start signal from the control unit
K103	Start relay
K104	Engine start relay
K105	A/C relay
M1	Starter motor
M39	Rear windshield wiper
M41	Blower motor (optional)
M49	Front windshield wiper
M56	Front windshield washer
M57	Rear windshield washer
M64	A/C compressor
S2	4WD switch
S3	Hand hammer switch
S4	Hydraulic speed control switch
S5	Drive switch
S15	Start switch
S23	Differential lock switch
S28	Transmission disconnect button
S29	Front claxon switch
S34	Left door switch
S35	Right door switch
S36	Rear hammer button
S42	Warning switch
S126	Lights switch
S130	Windshield wiper/washer switch
S135	Backhoe attachment travel lock switch
S136	Menu scroll switch
S137	Rear work light switch
S138	Rear pump switch
S139	Display enter switch
S140	Backhoe attachment travel lock switch
S141	Front work light switches
S160	Rear horn switches

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NAME	DESCRIPTION
SB1	Battery master switch
ST1	Side instrument cluster
ST3	4x1 bucket control lever
X1	General engine line interface - 18-way connector
X10	General line interface - 31-way connector
X12	General cab line interface - 5-way connector
X13	General line - 17-way connector
X14	Anti-theft device - 11-way connector
X15.1	Start connector
X15.2	Start connector
X17	Seat (optional) - 4-way connector
X21	Diagnostics - 10-way connector
X22	5-way connector
X23	2-way connector
X24	Accelerator knob - 6-way connector
X25	Accelerator pedal - 6-way connector
X26	Loader attachment sensor - 3-way connector
X27	Number plate light - 2-way connector
X28	Rear left light - 4-way connector
X29	Rear right light - 4-way connector
X30	Speed control solenoid valve - 2-way connector
X32	Horn - 2-way connector
X34	Drive control - 2-way connector
X35	Hand hammer button - 2-way connector
X36	Rear hammer button - 2-way connector
X37	Rear right light - 4-way connector
X38	Rear right light - 4-way connector
X39	Rear windshield wiper motor - 4-way connector
X40	Rear right light - 4-way connector
X41	Blower motor - 2-way connector
X42	Right direction indicator - 4-way connector
X43	Beacon lamp - 4-way connector
X44	Front left light - 4-way connector
X45	Air conditioning - 11-way connector
X46	Rear left light - 4-way connector
X47	Rear left light - 4-way connector
X48	4-way connector

NAME	DESCRIPTION
X49	6-way connector
X50	Front right lights - 4-way connector
X51	Front left ìlights - 4-way connector
X52	Front left direction indicator - 4-way connector
X53	8-way connector
X54	Radio - 8-way connector
X55	2-way connector
X56	Windshield wiper pump - 2-way connector
X57	Windshield wiper pump - 2-way connector
X58	Front right light (optional) - 5-way connector
X64	Air conditioning switch - 1-way connector
X67	Alternator - 3-way connector
X69	Air conditioning pressure switch - 2-way connector
X72	3-way connector
X80	2-way connector
X81	2-way connector
X82	10-way connector
X83	2-way connector
X87	Left general line interface - 13-way connector
X88	Right side general line interface - 17-way connector
X106	Engine control unit - 89-way connector
X107	Water in fuel - 3-way connector
X110	Air conditioning - 3-way connector
X111	Air conditioning - 9-way connector
X124	Quick coupler
X128	Optional
X130	12-way connector
X132	6-way connector
X144	2-way connector
X201.P	Pilot control - 1-way connector
X201.S	Pilot control - 1-way connector
X202	Backhoe attachment travel lock solenoid valve - 2-way connector
X203	Backhoe attachment travel lock solenoid valve - 2-way connector
X204	Horn switch - 2-way connector
X206	Bucket level - 2-way connector

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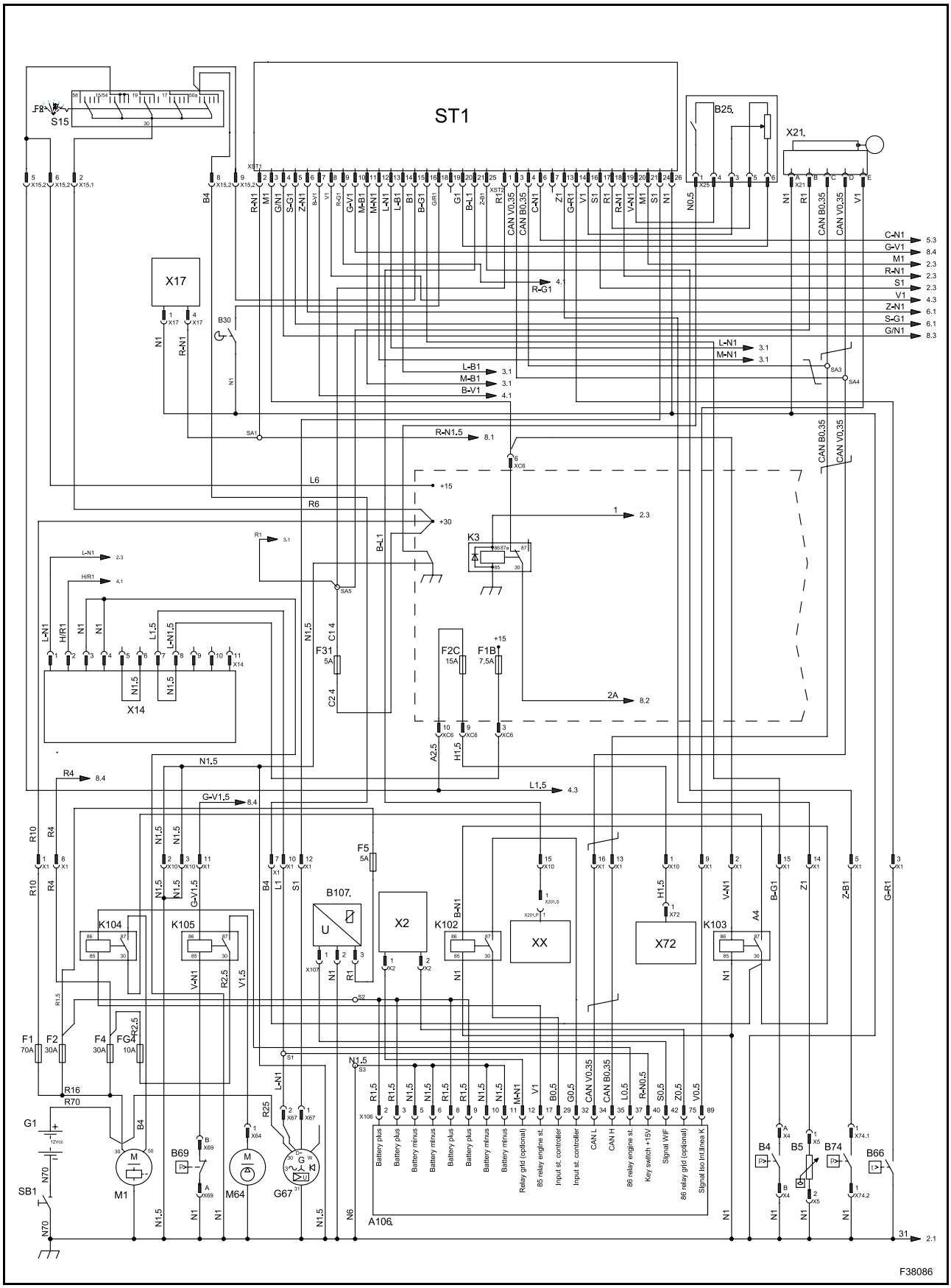
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NAME	DESCRIPTION
X207	Speed control solenoid valve (optional) - 2-way connector
X208	Loader bucket - 2-way connector
X209	Rear hammer solenoid valve - 2-way connector
X210	Transmissione disconnect - 2-way connector
XC1	Fuse and relay control unit line interface - general line - 11-way connector
XC2	Fuse and relay control unit line interface - general line - 7-way connector
XC3	Fuse and relay control unit line interface - general line - 21-way connector
XC4	Fuse and relay control unit line interface - general line - 21-way connector
XC5	Fuse and relay control unit line interface - general line - 17-way connector
XC6	Fuse and relay control unit line interface - general line - 13-way connector
XST1	Side instrument cluster - 20-way connector
XST2	Front instrument cluster - 20-way connector
XX	Pilot control cable
Y8	Differential solenoid valve
Y12	4x1 bucket solenoid valve (optional)
Y24	Backhoe attachment travel lock solenoid valve
Y25	Backhoe attachment travel lock solenoid valve
Y26	Backhoe attachment travel lock solenoid valve
Y27	Backhoe attachment travel lock solenoid valve
Y30	Speed control solenoid valve (optional)
Y32	Rear hammer solenoid valve (optional)
Y34	Drive control solenoid valve (optional)
Y35	Hand hammer solenoid valve

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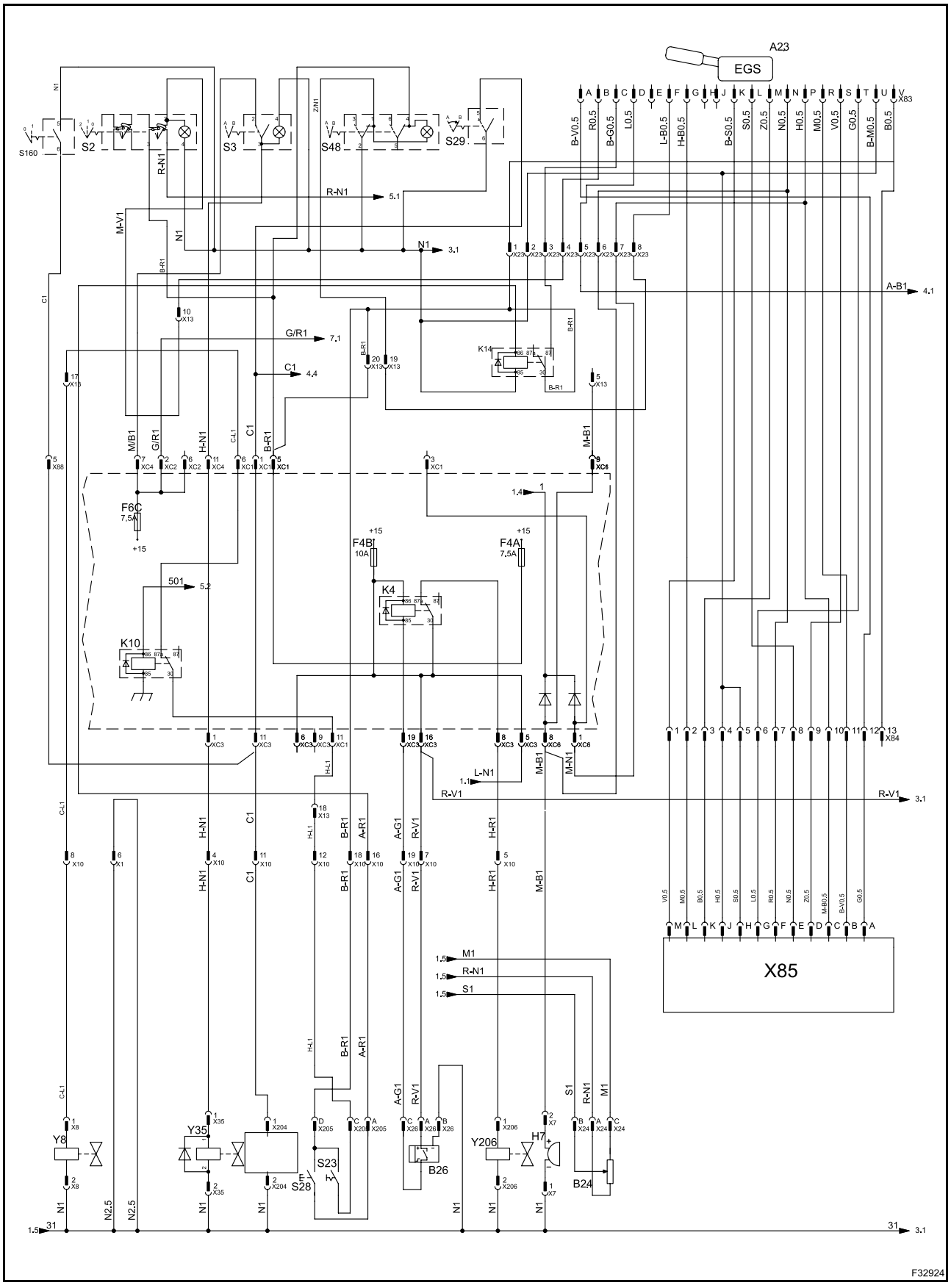
ENGINE LINE DIAGRAM



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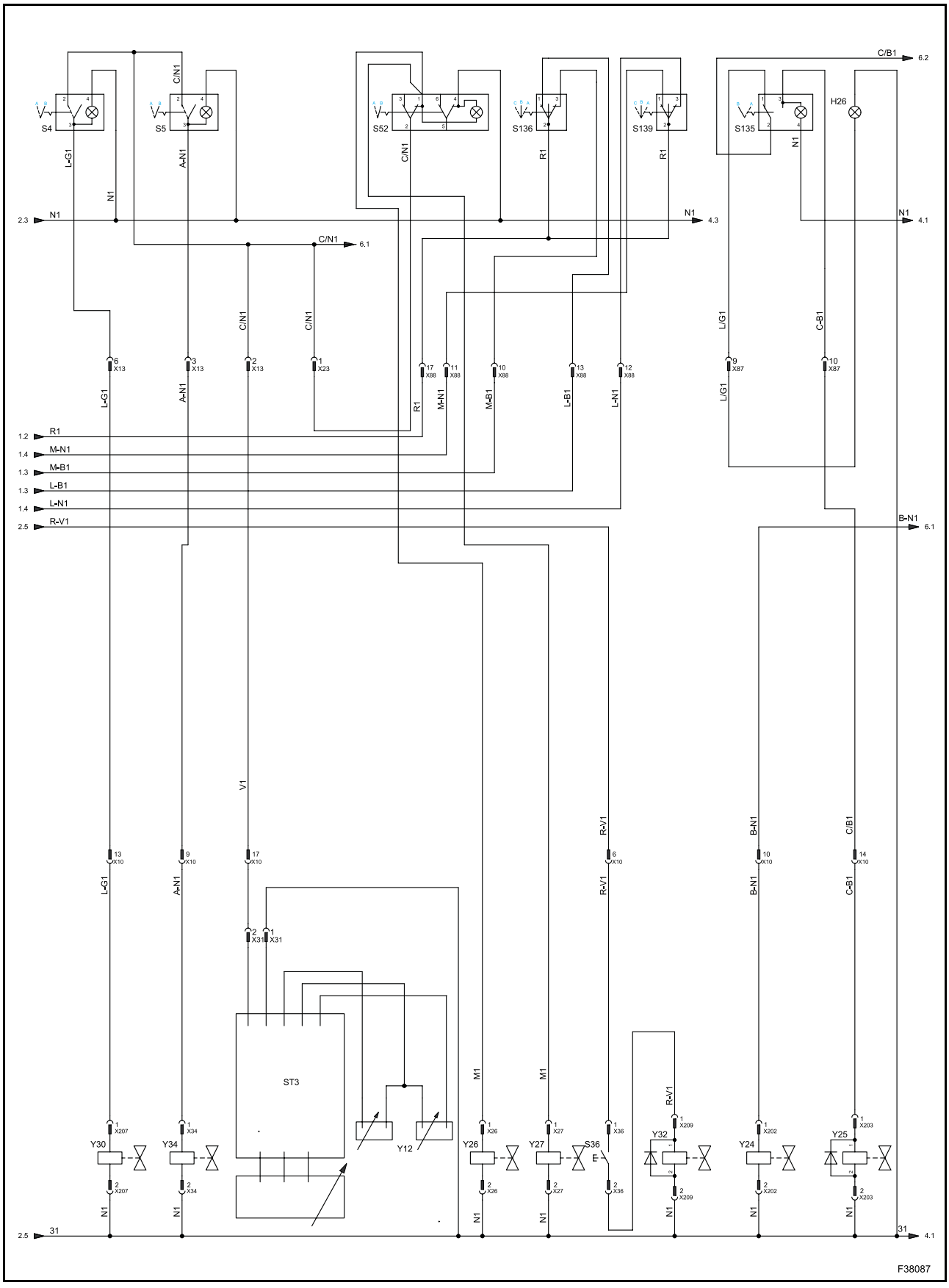
SOLENOID VALVE LINE DIAGRAM



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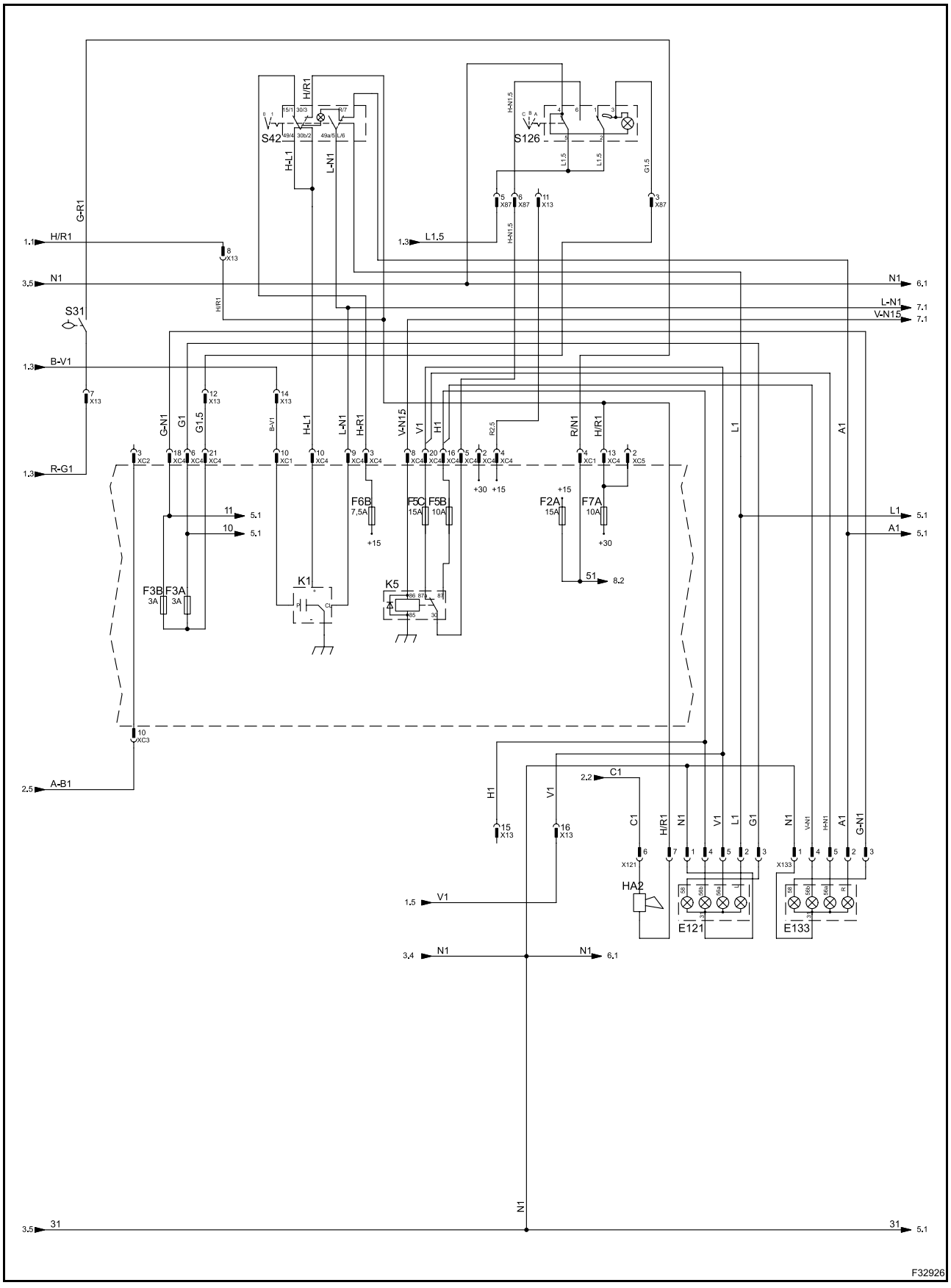
SOLENOID VALVE LINE DIAGRAM



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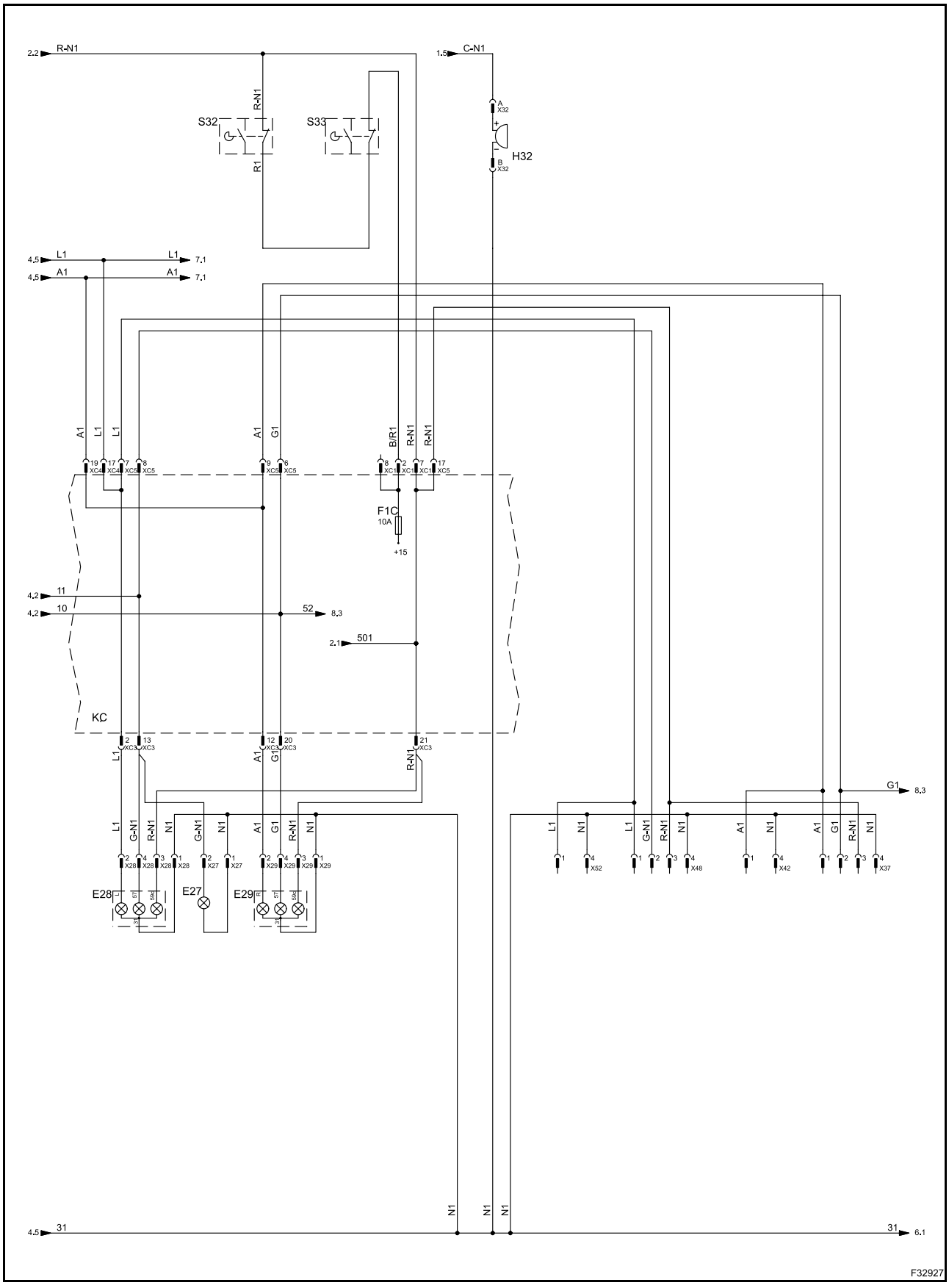
LIGHT LINE DIAGRAM



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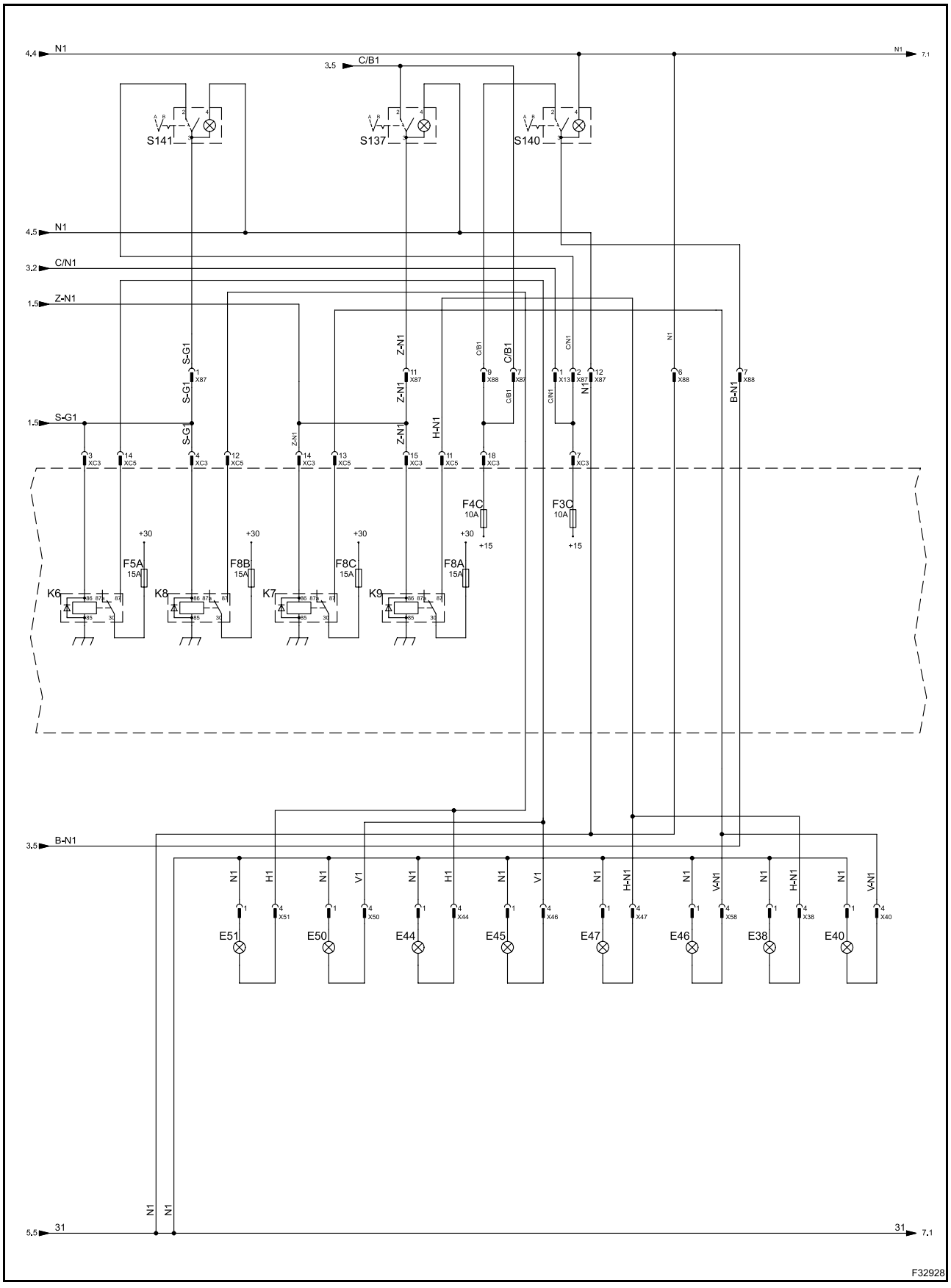
REAR LIGHT LINE DIAGRAM



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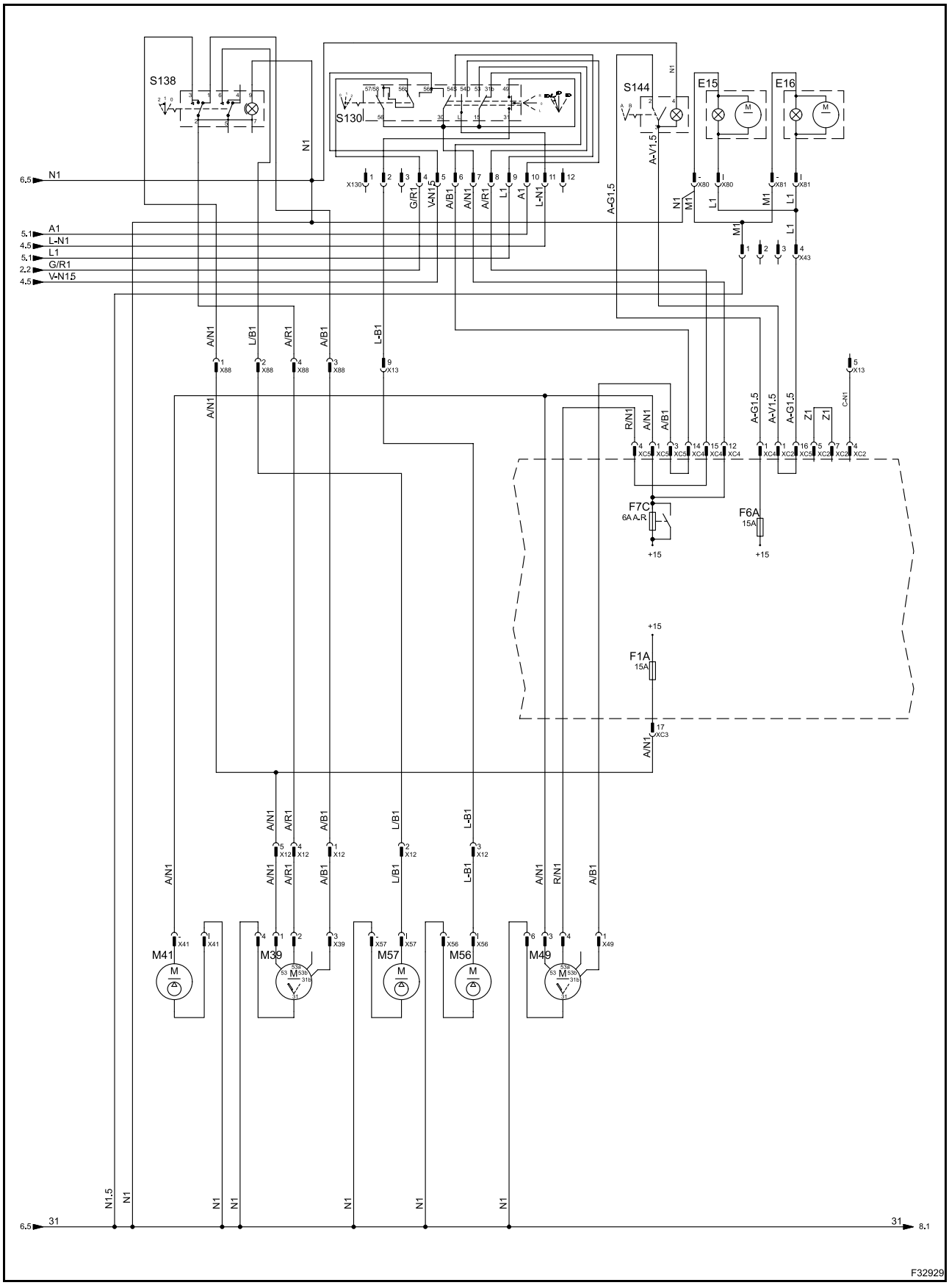
WORK LIGHT LINE DIAGRAM



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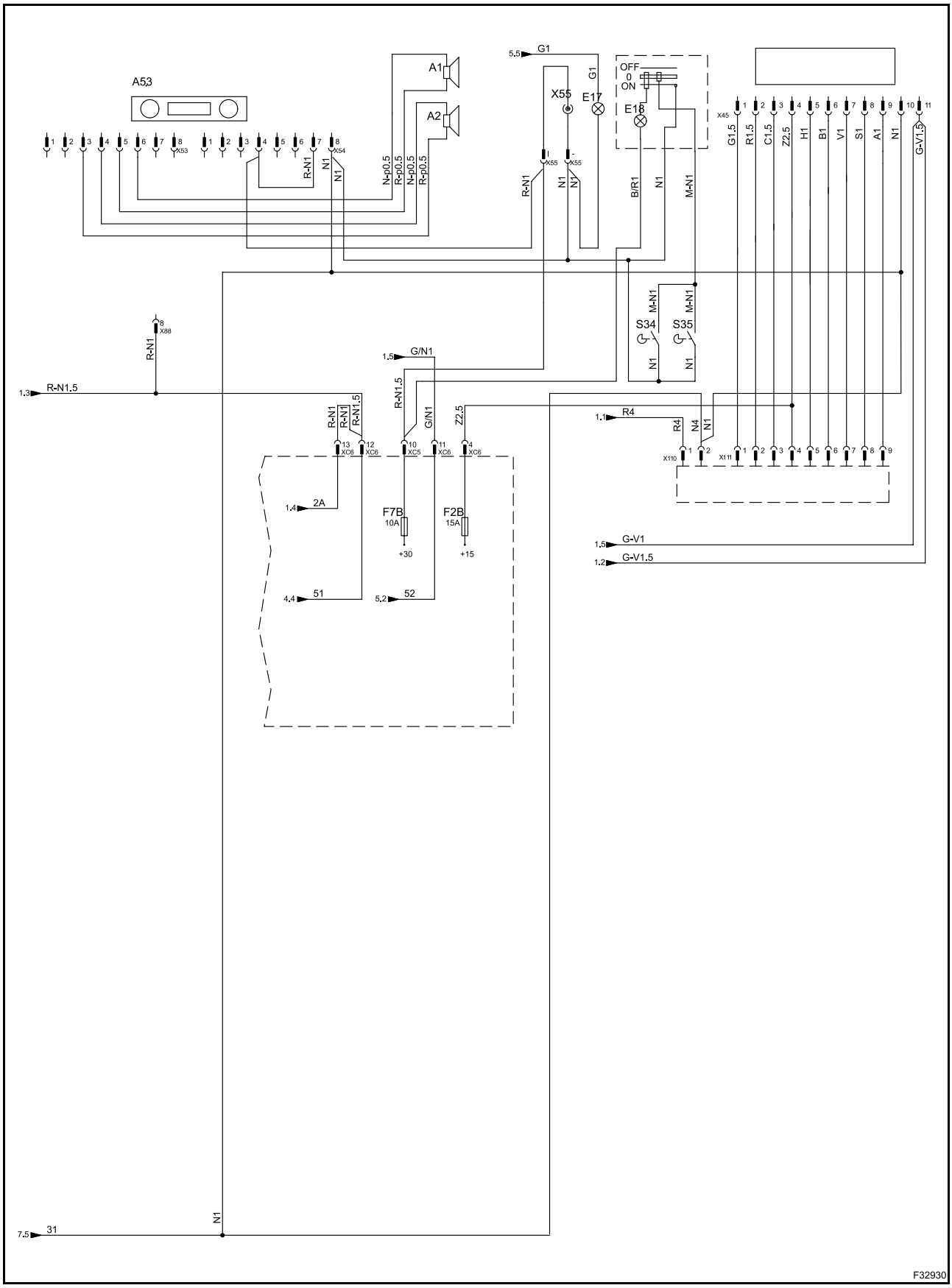
WINDSHIELD WASHER/WIPER LINE DIAGRAM



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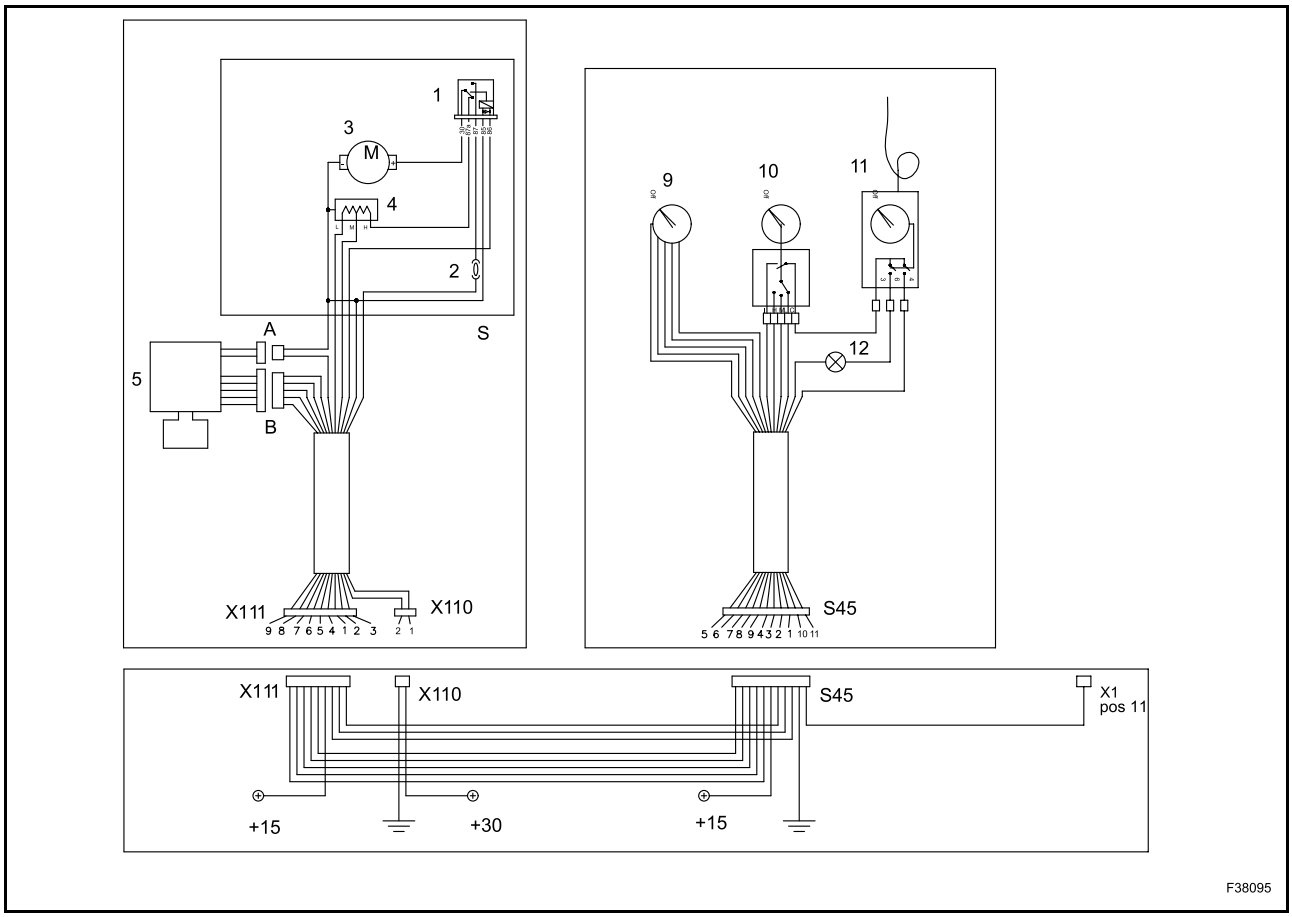
HEATER LINE



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AIR CONDITIONER SCHEMATIC



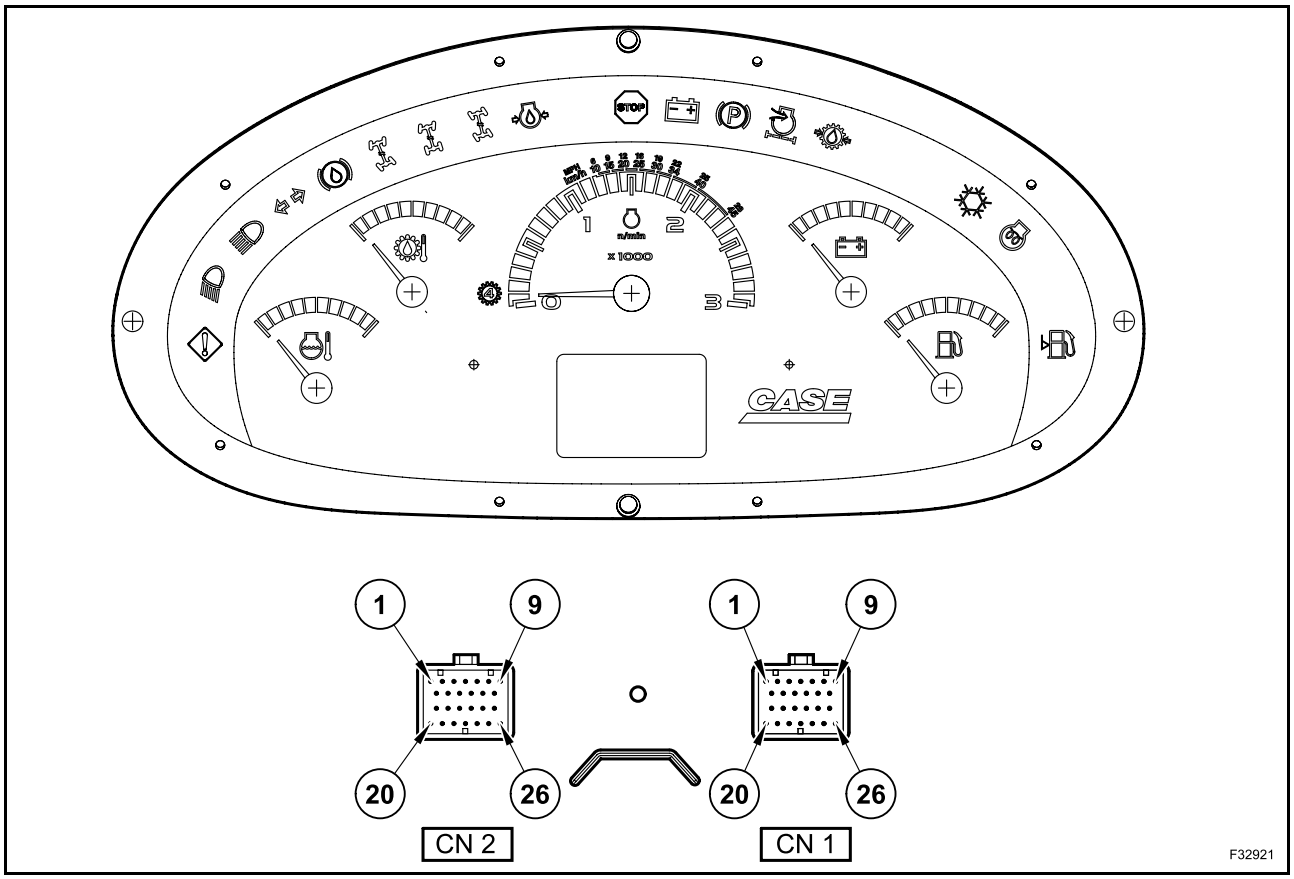
S	Evaporator box
1	3rd speed relay
2	Fuse 25 A
3	Ventilated electrical motor
4	1 and 2 speed resistor
5	Electrical cock
X111	9-way connector
X110	2-way power connector

S45	11-way connector
9	Potentiometer
10	Speed switch
11	Temperature switch
12	12 V light
A	2-way waterproof connection
B	5-way waterproof connection

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SIDE INSTRUMENT CLUSTER



Calibrations

GAGE TYPE	INPUT	READING	TOLERANCE
FUEL LEVEL	320 OHMS	Empty - minimum reading	+0/-2°
	185 OHMS	Right - edge of red band	± 3° (Ref)
	6.5 OHMS	Full - maximum reading	+4/-0°
LOW FUEL LAMP	193 OHMS	ON	± 5 OHMS
	185 OHMS	OFF	± 5 OHMS
TACHOMETER	Can message	0-3000 RPM	± 50 RPM
COOLANT	Can message	Minimum reading 65 °C	± 3° C
	Can message	Left edge of red band 106 °C	± 2° C
	Can message	Maximum reading 112 °C	± 3° C
VOLT	11 V	Right edge of lower red band	± 3° C
	16 V	Edge of upper red band	± 3° C
TRANSMISSION	385 OHMS	Minimum reading 75 °C	± 3° C
	149 OHMS	Left edge of red band 105 °C	± 2° C
	112 OHMS	Maximum reading 115 °C	± 3° C

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CONNECTORS

CN1		
PIN	**FUNCTION**	**NOTE**
1	Not used	
2	Key on power	Wake up
3	In gear input	Digital input
4	Driving lights	Digital input
5	Front work lights	Digital input
6	Rear work lights	Digital input
7	Not used	
8	Not used	
9	Not used	
10	Air conditioning system pressure	Digital input
11	Display input switch	Digital input
12	Enter input switch	Digital input
13	Up input switch	Digital input
14	Down input switch	Digital input
15	Cranking	Digital input
16	Air filter restriction	Digital input
17	Not used	
18	Parking brake	Digital input
19	Not used	
20	Idle validation switch	Digital input
21	Decelerator button	Digital input
22	Not used	
23	Not used	
24	Not used	
25	Transmission oil pressure	Digital input
26	Not used	

CN2		
PIN	**FUNCTION**	**NOTE**
1	Keep alive power	Need to fuse at 1 ampere without disconnect
2	Not used	
3	Can bus input	Twisted pair, with 120 OHM terminator
4	Can bus input	Twisted pair, with 120 OHM terminator
5	Not used	
6	Audible alarm buzzer	Floyd bell under 80 mA
7	Starter motor interlock	40 OHM relay = 300 mA
8	Not used	
9	Not used	
10	Not used	
11	Not used	
12	Not used	
13	Fuel level gauge	Variable resistance
14	Transmission temperature	Thermistor
15	Not used	
16	Foot accelerator	0.5-4.5 V
17	Accelerator knob	0.5-4.5 V
18	Foot accelerator	Output monitored for diagnostics
19	Accelerator knob	Output monitored for diagnostics
20	Foot accelerator	
21	Accelerator knob	
22	Not used	
23	Not used	
24	Alternator excitation	Low alternator output signals fault
25	Not used	
26	Ground	Digital input

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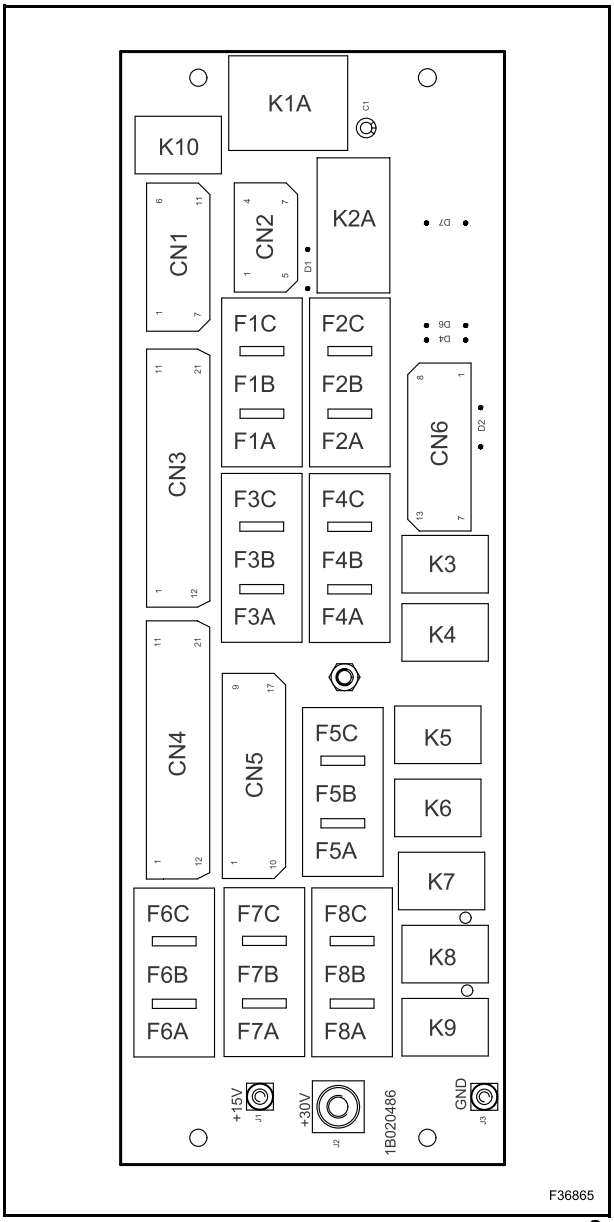
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2.6 ELECTRICAL DIAGRAMS - 4WS POWERSHIFT CAB (695SR)

FUSE AND RELAY DESCRIPTION

Fuse No.	Rating	Function
F1A	15 A	Rear windshield wiper and rear windshield washer
F1B	7.5 A	Engine stop, (+15) anti-theft device, (+15) ECU power supply, starter switch key
F1C	10 A	Steering switch, steering control unit power supply, stop light switch
F2A	15 A	Instrument power supply, switch lamps, brake oil level sensor, pneumo-electric seat, buzzer
F2B	15 A	Air conditioning
F2C	15 A	Pilot control, loader attachment lamp (optional)
F3A	3 A	Rear right/front left side light, instrument backlighting
F3B	3 A	Rear left/front right side lights, number plate light
F3C	10 A	Front work light switch, ride control, double delivery
F4A	7.5 A	4WD switch, transmission disconnect button, EGS power supply
F4B	10 A	Rear hammer button, bucket level solenoid valve + sensor
F4C	10 A	Backhoe attachment lock, backhoe attachment travel lock
F5A	15 A	Inner front work lights
F5B	10 A	Low beams
F5C	15 A	Main beams
F6A	15 A	Rotating beacon
F6B	7.5 A	(+15) hazard warning lights
F6C	7.5 A	Hand hammer
F7A	10 A	(+30) hazard warning lights, horn
F7B	10 A	Electrical socket, radio, cab light
F7C	6 A	Front windshield wiper
F8A	15 A	Outer rear work lights
F8B	15 A	Outer front work lights
F8C	15 A	Inner rear work lights

K1A	Hazard warning lights
K2A	Buzzer
K3	Starting relay
K4	Bucket level solenoid valve relay
K5	Low and main beam relay
K6	Inner front work light relay
K7	Inner rear work light relay
K8	Outer front work light relay
K9	Outer rear work light relay
K10	Optional relay



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COMPONENTS AND CONNECTORS

NAME	DESCRIPTION
A1	Right speaker (optional)
A2	Left speaker (optional)
A23	EGS
A53	Radio (optional)
A106	Engine control unit
B4	Air filter pressure switch
B5	Fuel level sensor
B24	Accelerator knob
B25	Foot accelerator
B26	Bucket sensor
B30	Parking brake
B66	Oil temperature switch
B69	A/C pressure switch
B74	Transmission oil pressure switch
B97	Rear axle sensor
B98	Front axle sensor
B107	Water in fuel sensor
B129	Brake oil level sensor
E15	Rotating beacon
E16	Rotating beacon
E17	Warning lamp for intake
E18	Cab light
E26	Control lock warning lamp
E27	Number plate light
E28	Rear left light
E29	Rear right light
E38	Rear right work light
E40	Rear right work light (optional)
E44	Front right work light
E45	Front right work light (optional)
E46	Rear left work light (optional)
E47	Rear left work light
E50	Front left work light (optional)
E51	Front left work light
E121	Front left light/audible alarm
E133	Front right light
F1	Main fuse
F2	Power supply fuse
F4	Third speed blower fuse
F5	Water in fuel fuse

NAME	DESCRIPTION
F31	Fuse for anti-theft device, diagnostic socket, menu scroll switch, display enter switch, side instrument cluster
FG4	Fuse A/C
G1	Battery
G67	Alternator
H7	Reverse buzzer
H32	Audible alarm
HA2	Horn
K14	Transmission relay
K102	Relay for start signal from the control unit
K103	Start relay
K104	Starter motor relay
K105	A/C relay
KS	Steering unit
M1	Starter motor
M39	Rear windshield wiper motor
M41	Blower motor (optional)
M49	Front pump
M56	Front windshield wiper motor
M57	Rear windshield wiper motor
M64	A/C compressor
S2	4WD switch
S4	Hydraulic speed control switch
S5	Drive switch
S6	Attachment switch
S15	Start switch
S29	Front claxon switch
S32	Stop light switch
S33	Stop light switch
S34	Left door switch
S35	Right door switch
S36	Rear hammer button
S42	Warning switch
S48	EGS switch
S130	Windshield wiper switch
S132	Steering switch
S135	Backhoe attachment travel lock switch
S136	Menu scroll switch
S137	Rear work light switch
S138	Rear pump switch
S139	Display enter switch

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NAME	DESCRIPTION
S140	Backhoe attachment travel lock switch
S141	Front work light switches
S144	Beacon lamp switch
S160	Rear horn switches
S205	Transmission disconnect switch
SB1	Battery master switch
ST1	Side instrument cluster
ST3	4x1 bucket control lever
X1	General engine line interface - 18-way connector
X2	Preheating relay (optional) - 2-way connector
X4	Air filter sensor - 2-way connector
X5	Fuel level sensor - 2-way connector
X6	Forward gear solenoid valve - 2-way connector
X7	Reverse travel buzzer - 2-way connector
X8	Solenoid valve - 2-way connector
X10	General line interface - 31-way connector
X12	General cab line interface - 5-way connector
X13	General line - 17-way connector
X14	Anti-theft device - 11-way connector
X15.1	Start connector
X15.2	Start connector
X17	Seat (optional) - 4-way connector
X21	Diagnostics - 10-way connector
X21	7-way connector
X22	Quick coupler
X23	2-way connector
X24	Knob - 6-way connector
X25	Accelerator pedal - 6-way connector
X26	Backhoe attachment sensor - 3-way connector
X27	Number plate light - 2-way connector
X28	Rear left light - 4-way connector
X29	Rear right light - 4-way connector
X30	Speed control solenoid valve - 2-way connector
X32	Horn - 2-way connector
X34	Drive control - 2-way connector
X35	Hand hammer button - 2-way connector

NAME	DESCRIPTION
X36	Rear hammer button - 2-way connector
X37	Rear right light - 4-way connector
X38	Rear right light - 4-way connector
X39	Rear windshield wiper motor - 4-way connector
X40	Rear right light - 4-way connector
X41	Blower motor - 2-way connector
X42	Right direction indicator - 4-way connector
X43	Beacon lamp - 4-way connector
X44	Front left light - 4-way connector
X45	Air conditioning - 11-way connector
X46	Rear left light - 4-way connector
X47	Rear left light - 4-way connector
X48	4-way connector
X49	6-way connector
X50	Front right lights - 4-way connector
X51	Front left ìlights - 4-way connector
X52	Front left direction indicator - 4-way connector
X52	2-way connector
X53	8-way connector
X54	Radio - 8-way connector
X55	Seat safety switch - 2-way connector
X55	2-way connector
X56	Windshield wiper pump - 2-way connector
X57	Windshield wiper pump - 2-way connector
X58	Left direction indicator - 4-way connector
X64	Air conditioning switch - 1-way connector
X67	Alternator - 3-way connector
X69	Air conditioning pressure switch - 2-way connector
X72	3-way connector
X80	2-way connector
X81	2-way connector
X82	10-way connector
X83	2-way connector
X87	Left general line interface - 13-way connector
X88	Right side general line interface - 17-way connector
X106	Engine control unit - 89-way connector
X107	Water in fuel - 3-way connector

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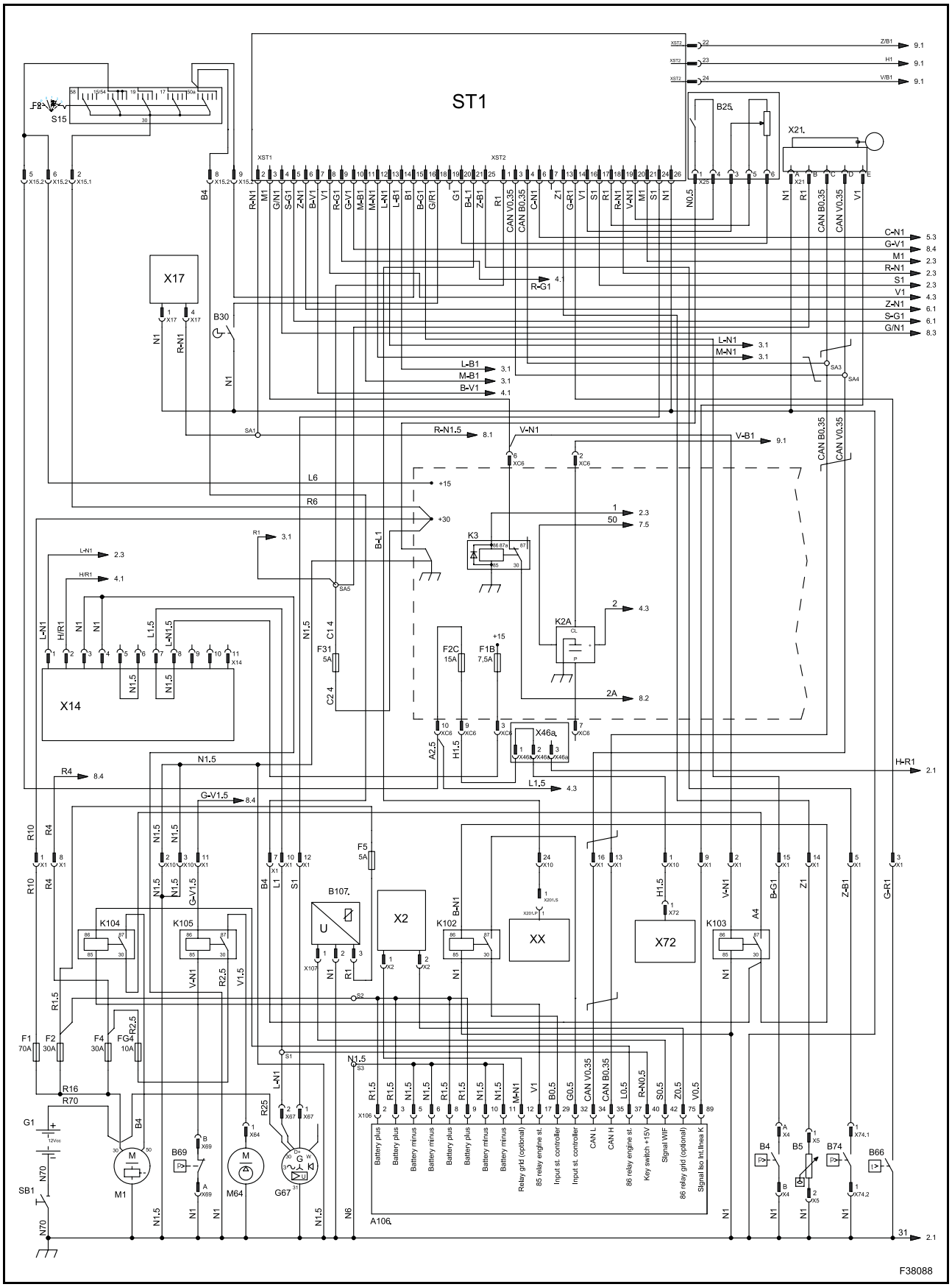
NAME	DESCRIPTION
X110	Air conditioning - 3-way connector
X111	Air conditioning - 9-way connector
X124	Quick coupler
X128	Optional
X130	12-way connector
X132	6-way connector
X144	2-way connector
X202	Backhoe attachment travel lock solenoid valve - 2-way connector
X203	Backhoe attachment travel lock solenoid valve - 2-way connector
X204	Horn switch - 2-way connector
X208	Loader attachment - 2-way connector
XC1	Fuse and relay control unit line interface - general line - 11-way connector
XC2	Fuse and relay control unit line interface - general line - 7-way connector
XC3	Fuse and relay control unit line interface - general line - 21-way connector
XC4	Fuse and relay control unit line interface - general line - 21-way connector
XC5	Fuse and relay control unit line interface - general line - 17-way connector
XC6	Fuse and relay control unit line interface - general line - 13-way connector
XST1	Side instrument cluster - 20-way connector
XST2	Front instrument cluster - 20-way connector
XX	From pilot control cable
Y12	Optional 4x1 bucket solenoid valve
Y24	Backhoe attachment travel lock solenoid valve
Y25	Backhoe attachment travel lock solenoid valve
Y26	Backhoe attachment travel lock solenoid valve
Y27	Backhoe attachment travel lock solenoid valve
Y30	Speed control solenoid valve (optional)
Y32	Rear hammer solenoid valve (optional)
Y34	Drive control solenoid valve (optional)
Y35	Hand hammer solenoid valve
Y91	Steering solenoid valve
Y92	4WS steering solenoid valve
Y93	Crab steering solenoid valve

NAME	DESCRIPTION
Y94	2WS steering solenoid valve
Y206	Bucket level solenoid valve

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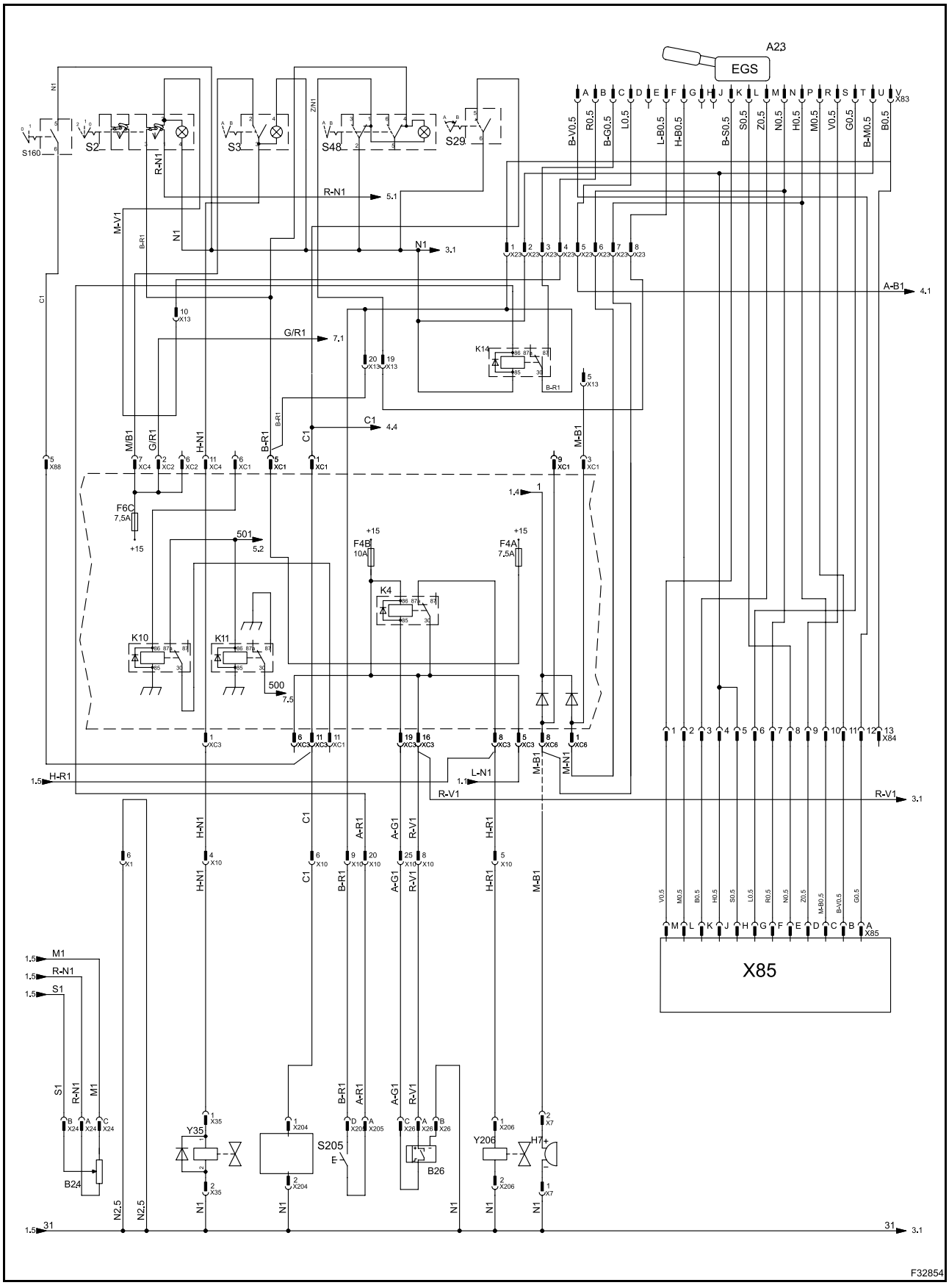
ENGINE LINE DIAGRAM



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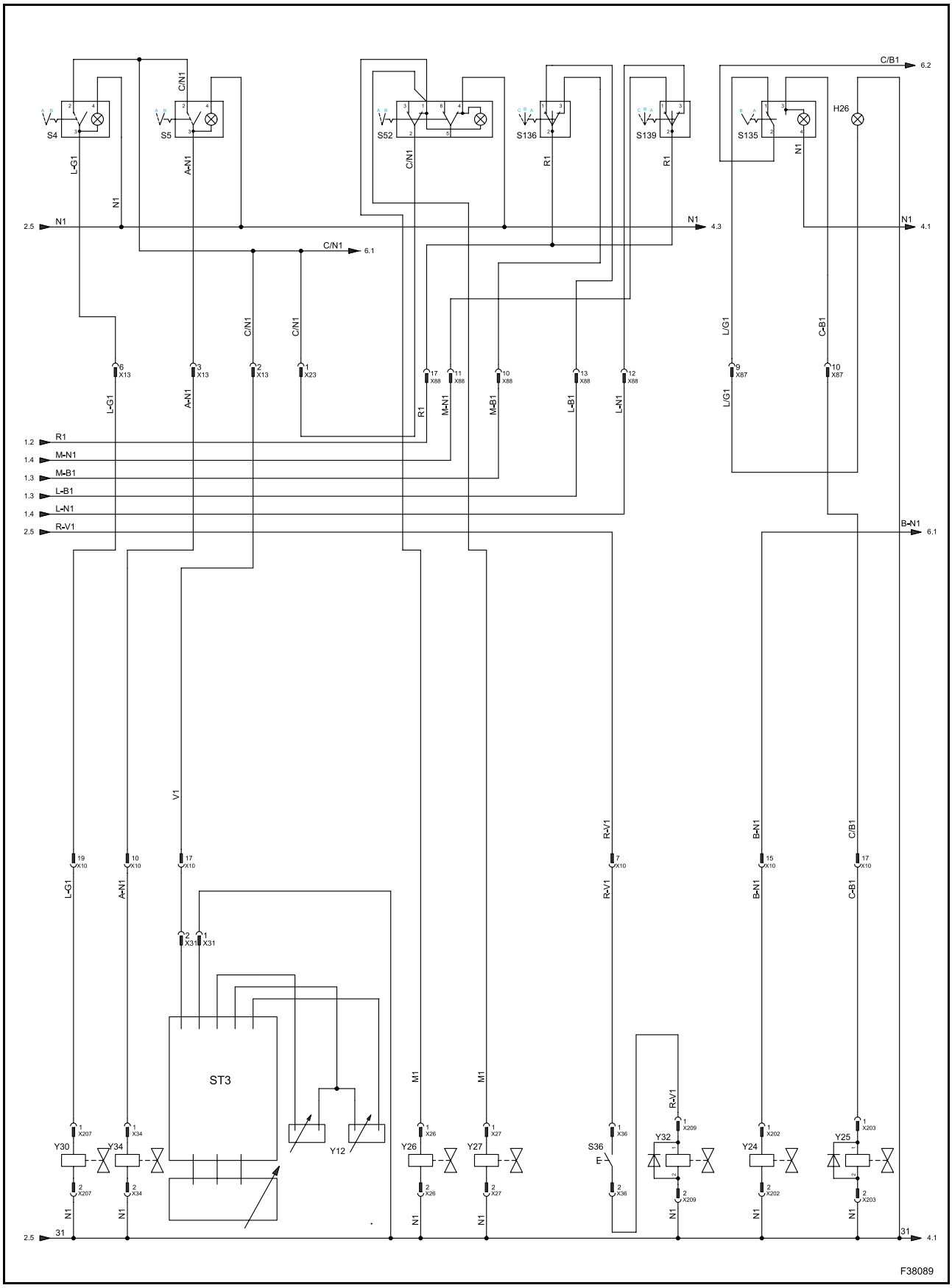
SOLENOID VALVE LINE DIAGRAM



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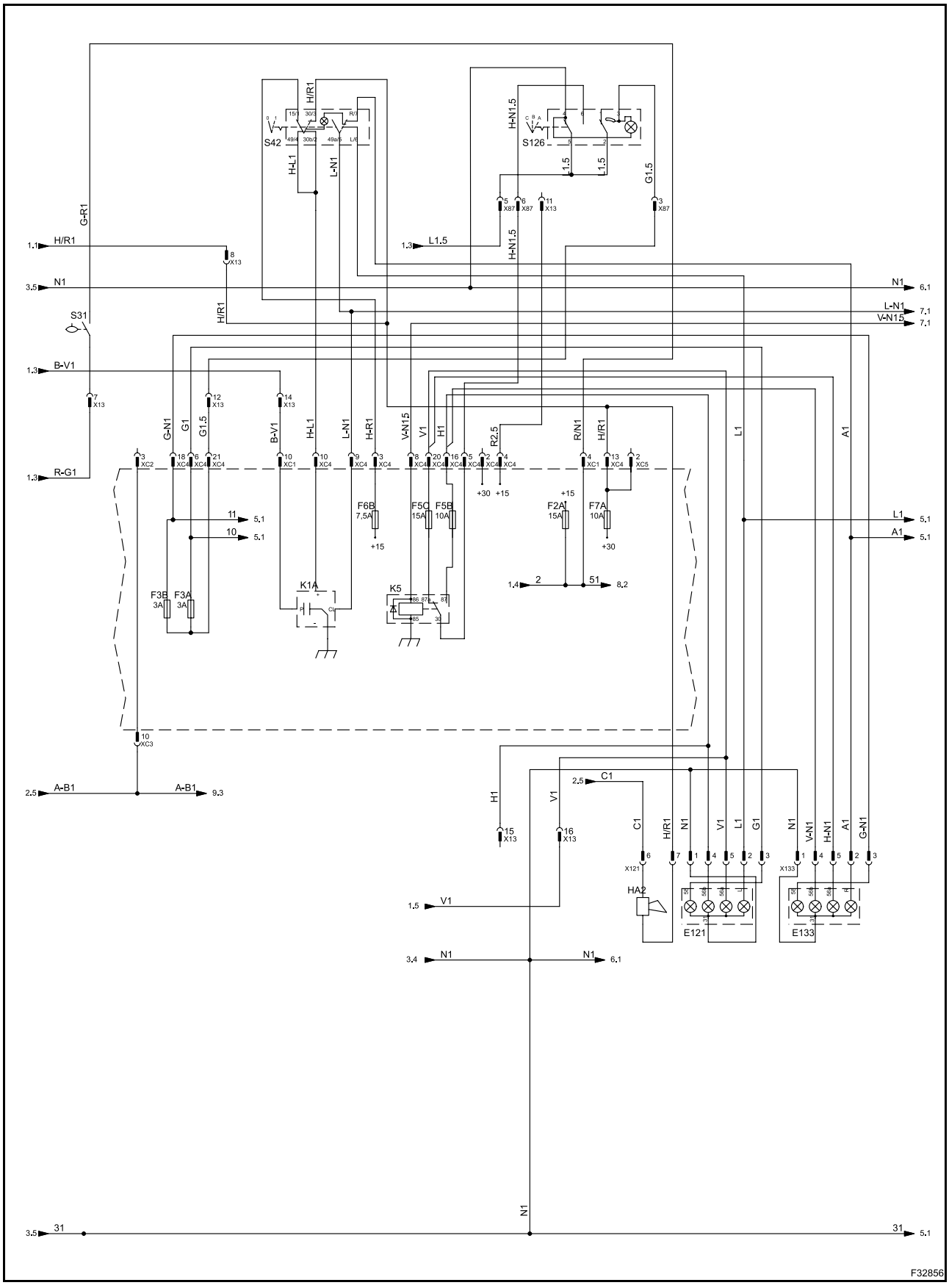
SOLENOID VALVE LINE DIAGRAM



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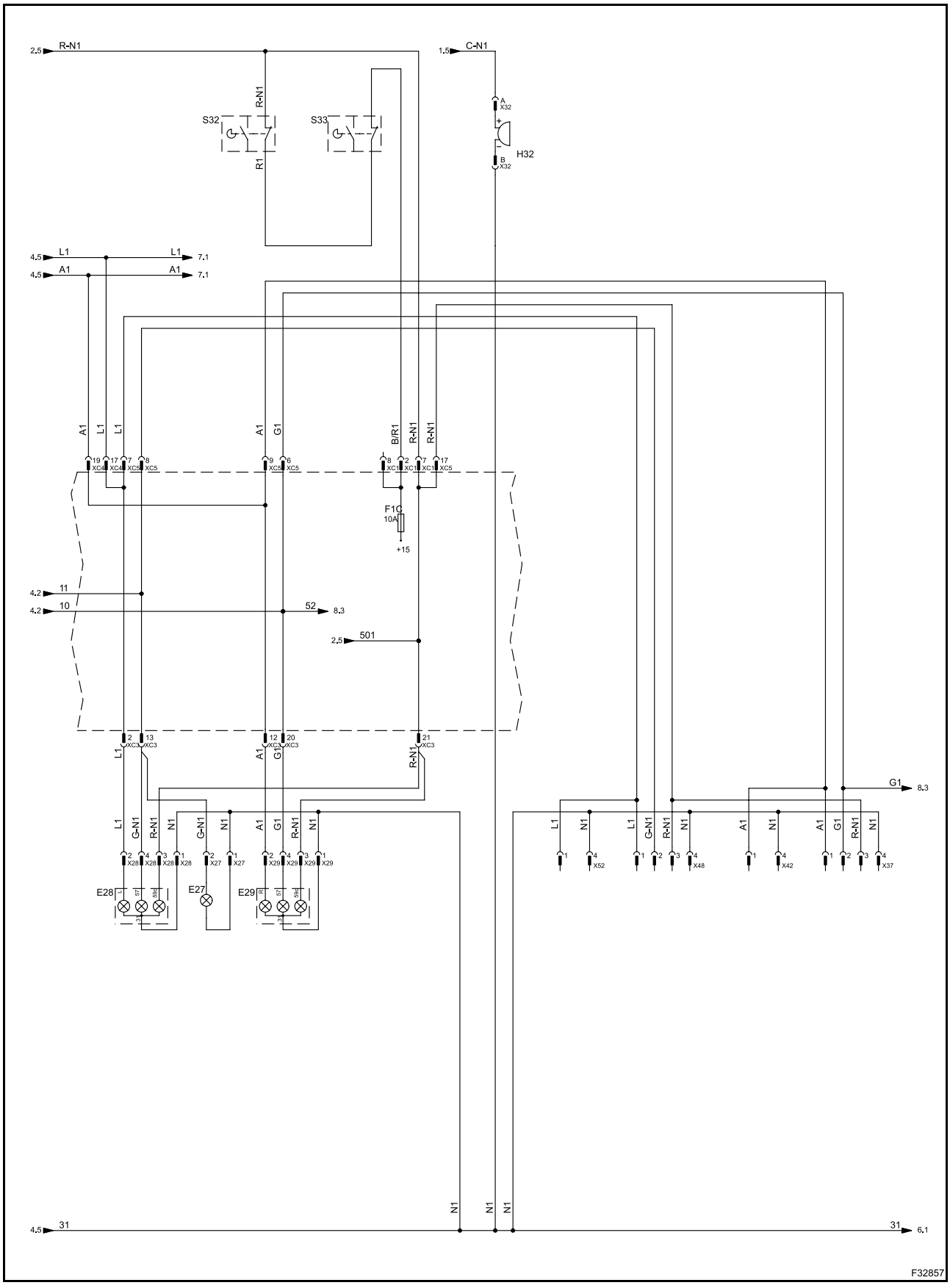
LIGHT LINE DIAGRAM



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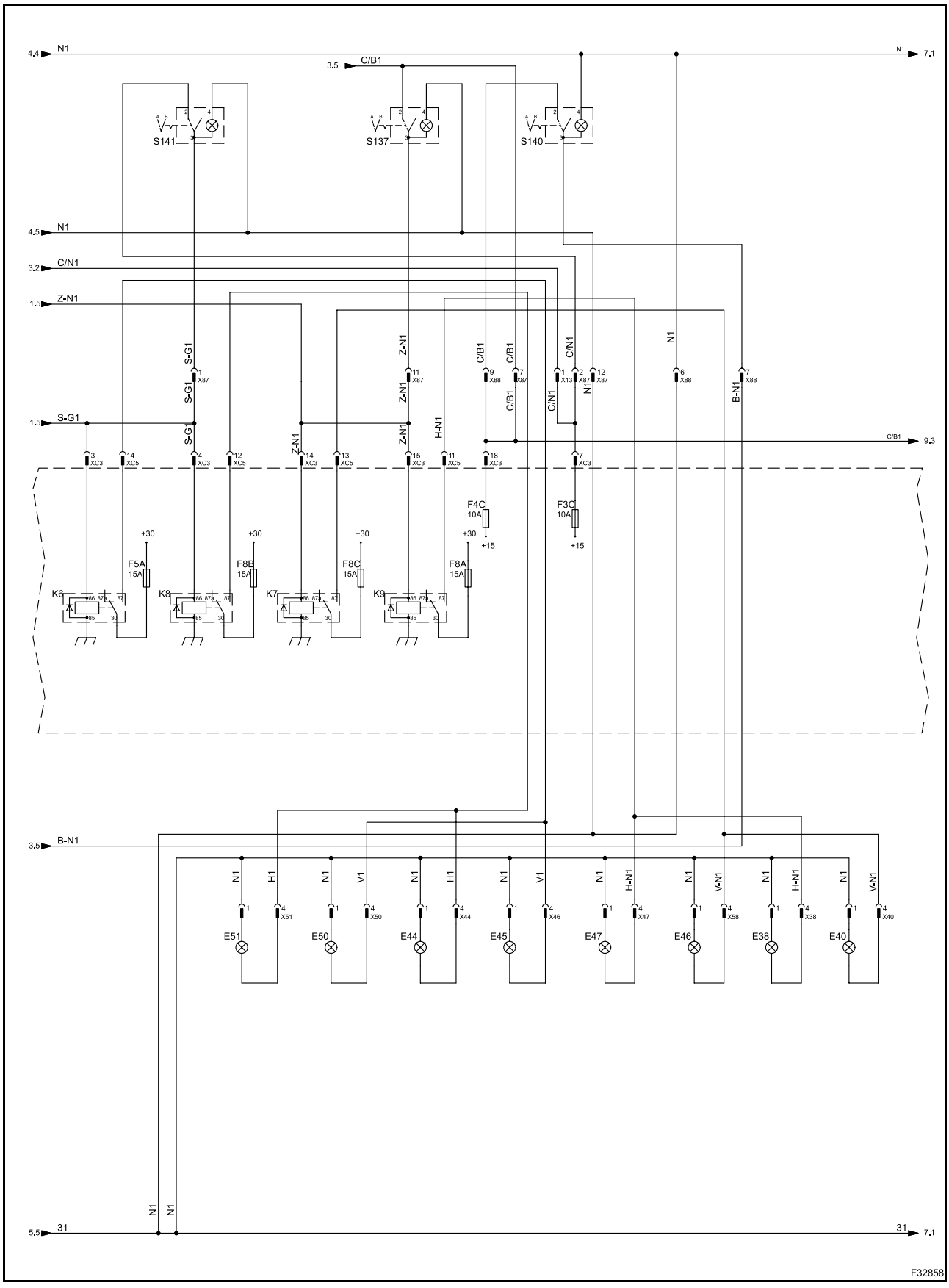
REAR LIGHT LINE DIAGRAM



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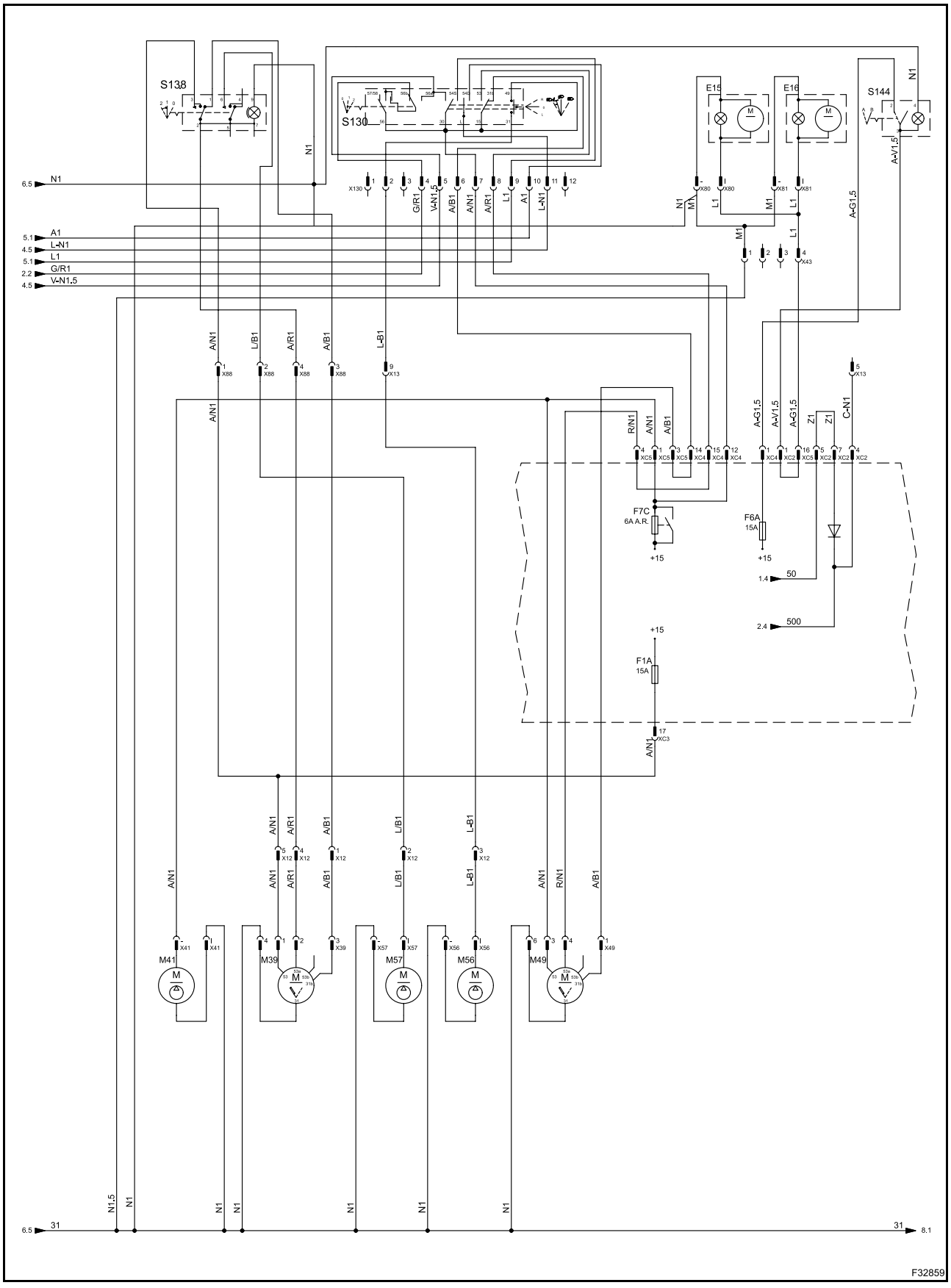
WORK LIGHT LINE DIAGRAM



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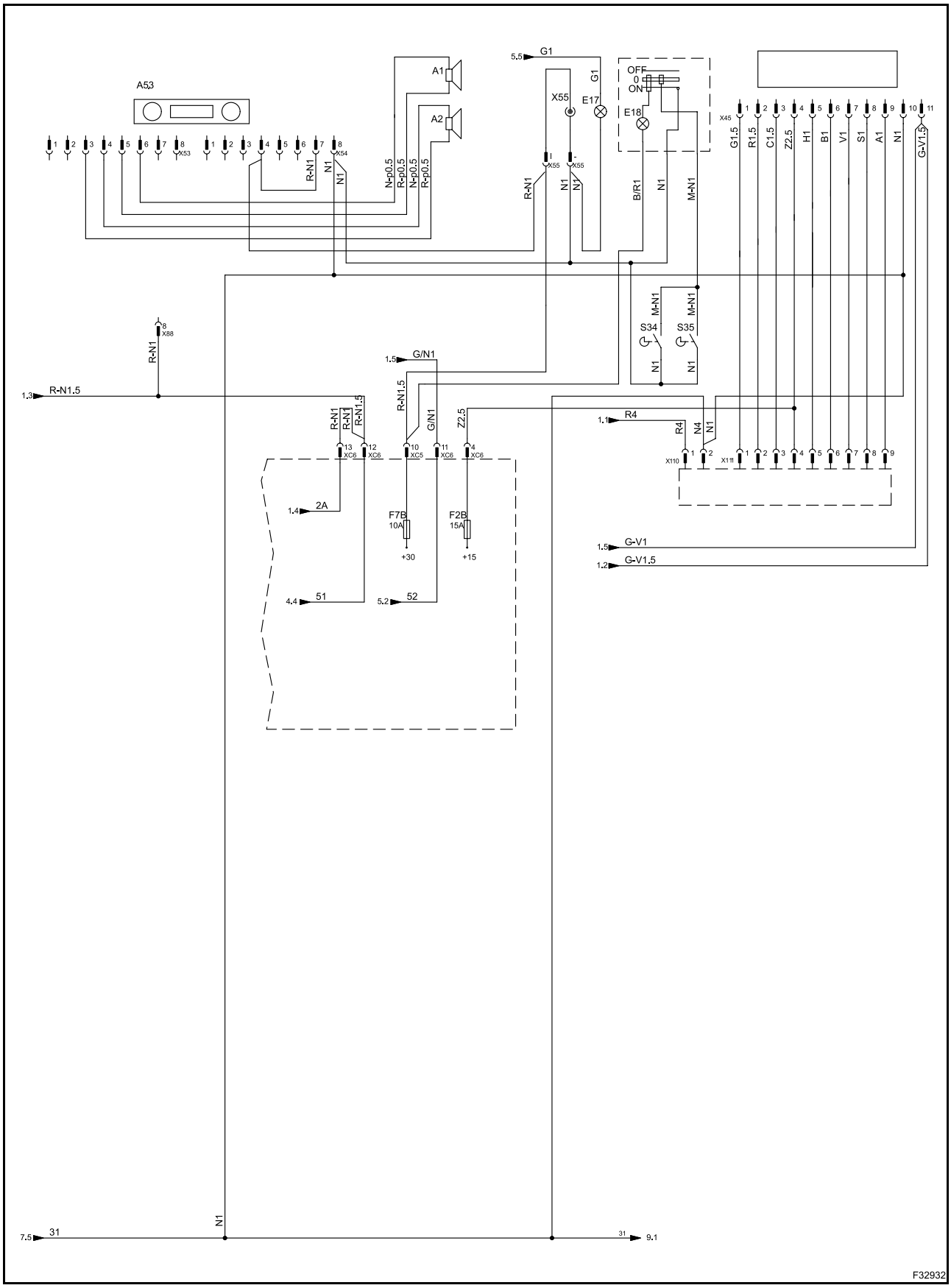
WINDSHIELD WASHER/WIPER LINE DIAGRAM



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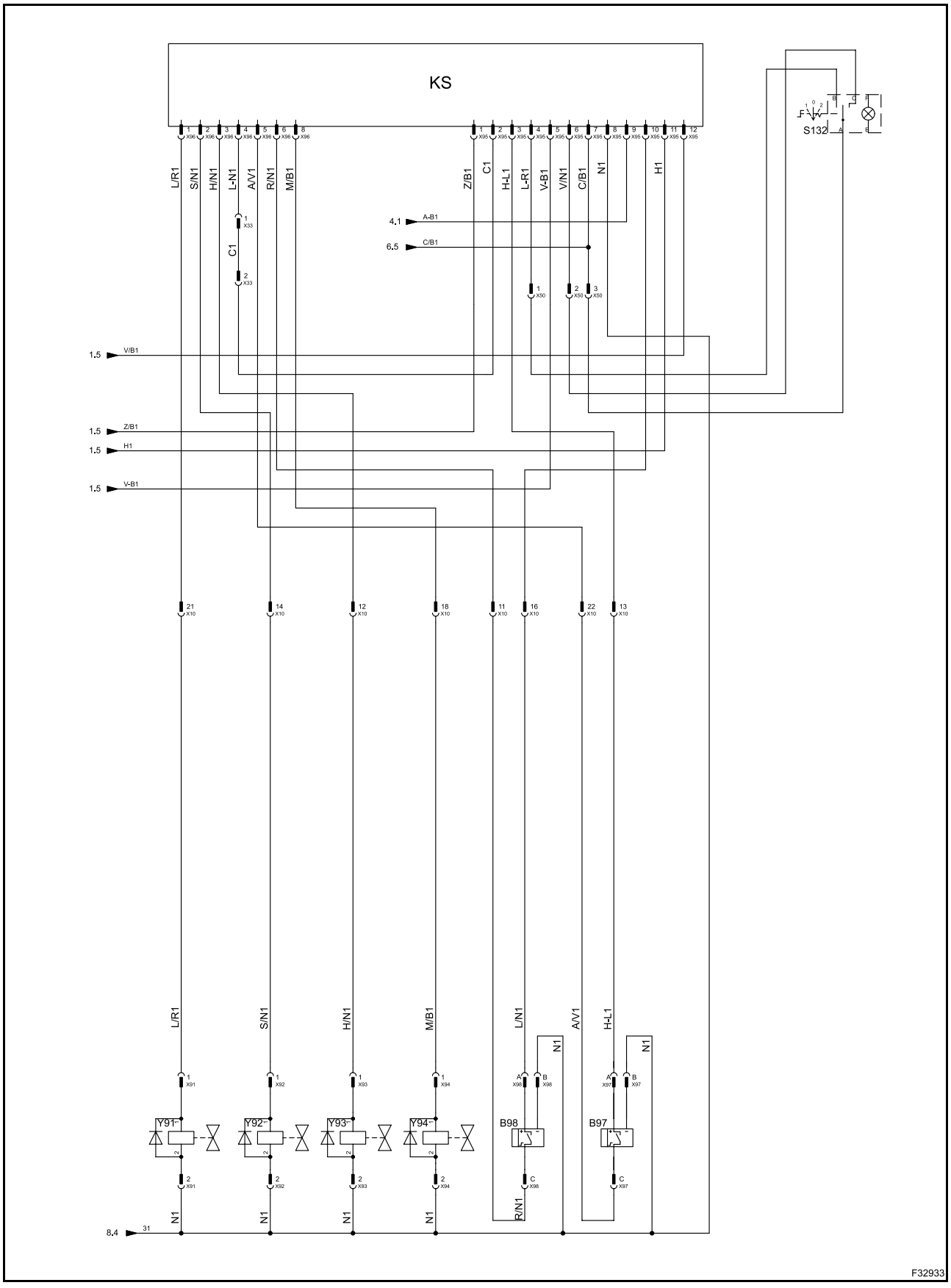
HEATER LINE



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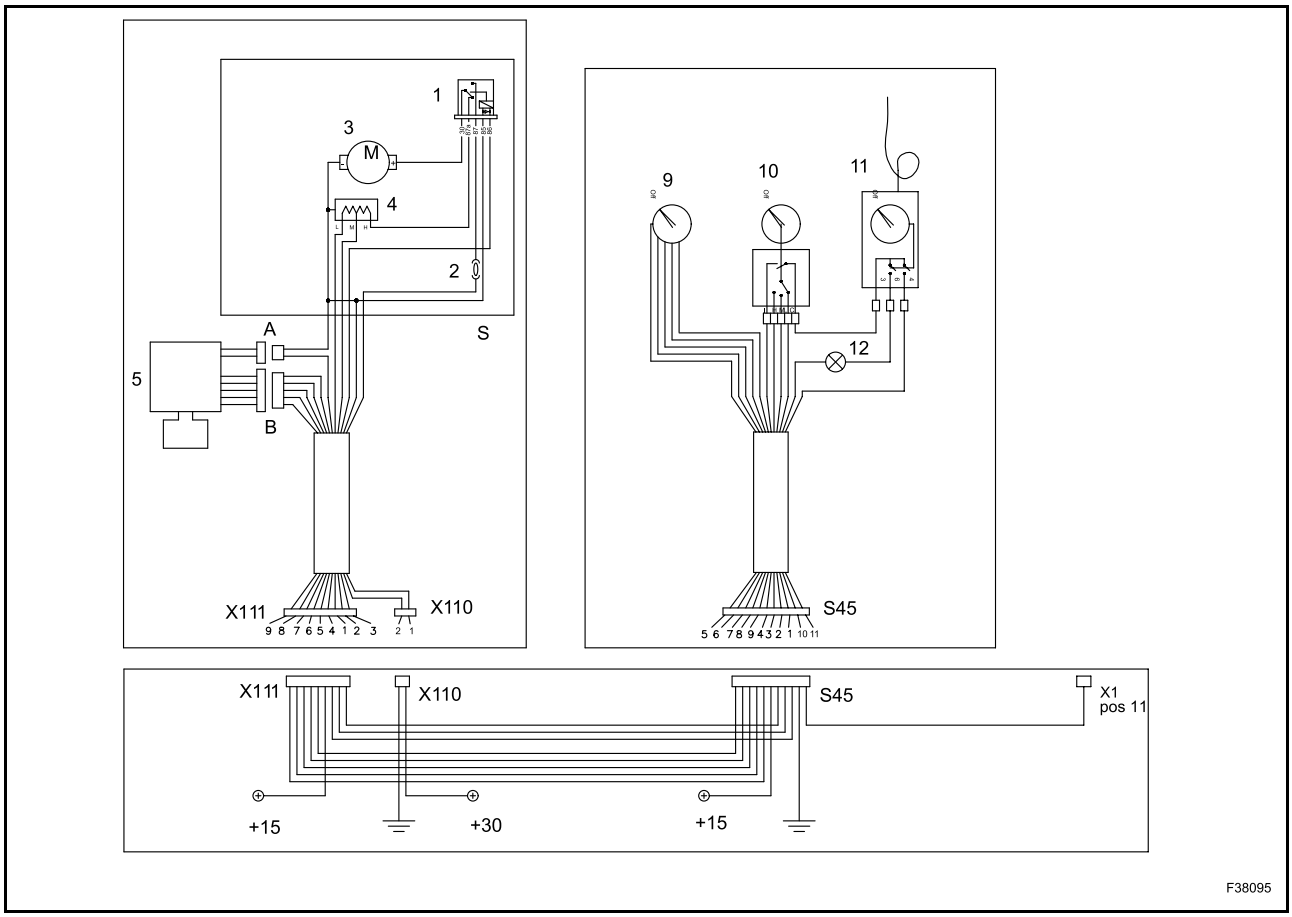
STEERING LINE DIAGRAM



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AIR CONDITIONER SCHEMATIC



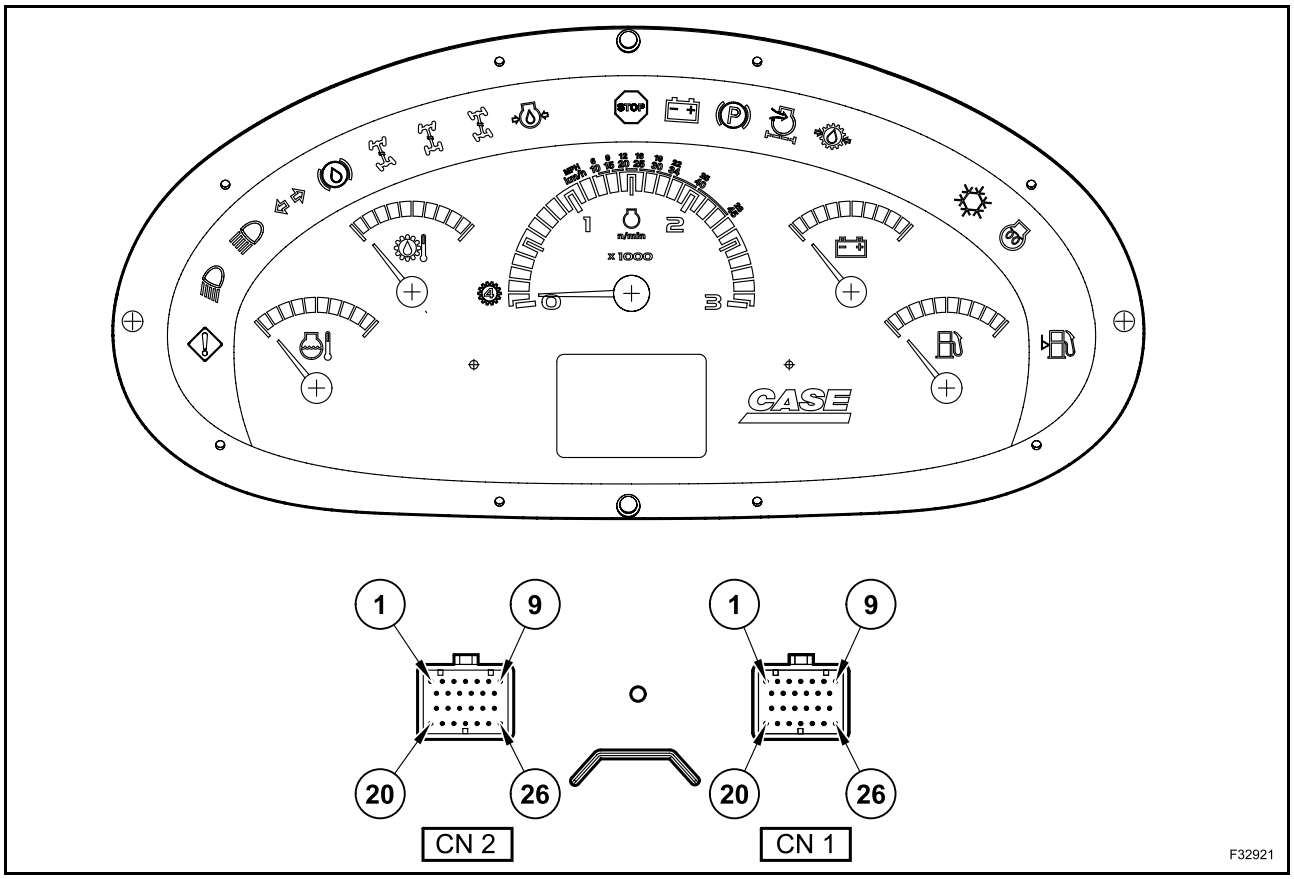
S	Evaporator box
1	3rd speed relay
2	Fuse 25 A
3	Ventilated electrical motor
4	1 and 2 speed resistor
5	Electrical cock
X111	9-way connector
X110	2-way power connector

S45	11-way connector
9	Potentiometer
10	Speed switch
11	Temperature switch
12	12 V light
A	2-way waterproof connection
B	5-way waterproof connection

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SIDE INSTRUMENT CLUSTER



Calibrations

GAGE TYPE	INPUT	READING	TOLERANCE
FUEL LEVEL	320 OHMS	Empty - minimum reading	+0/-2°
	185 OHMS	Right - edge of red band	± 3° (Ref)
	6.5 OHMS	Full - maximum reading	+4/-0°
LOW FUEL LAMP	193 OHMS	ON	± 5 OHMS
	185 OHMS	OFF	± 5 OHMS
TACHOMETER	Can message	0-3000 RPM	± 50 RPM
COOLANT	Can message	Minimum reading 65 °C	± 3° C
	Can message	Left edge of red band 106 °C	± 2° C
	Can message	Maximum reading 112 °C	± 3° C
VOLT	11 V	Right edge of lower red band	± 3° C
	16 V	Edge of upper red band	± 3° C
TRANSMISSION	385 OHMS	Minimum reading 75 °C	± 3° C
	149 OHMS	Left edge of red band 105 °C	± 2° C
	112 OHMS	Maximum reading 115 °C	± 3° C

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CONNECTORS

CN1		
PIN	**FUNCTION**	**NOTE**
1	Not used	
2	Key on power	Wake up
3	In gear input	Digital input
4	Driving lights	Digital input
5	Front work lights	Digital input
6	Rear work lights	Digital input
7	Not used	
8	Not used	
9	Not used	
10	Air conditioning system pressure	Digital input
11	Display input switch	Digital input
12	Enter input switch	Digital input
13	Up input switch	Digital input
14	Down input switch	Digital input
15	Cranking	Digital input
16	Air filter restriction	Digital input
17	Not used	
18	Parking brake	Digital input
19	Not used	
20	Idle validation switch	Digital input
21	Decelerator button	Digital input
22	Not used	
23	Not used	
24	Not used	
25	Transmission oil pressure	Digital input
26	Not used	

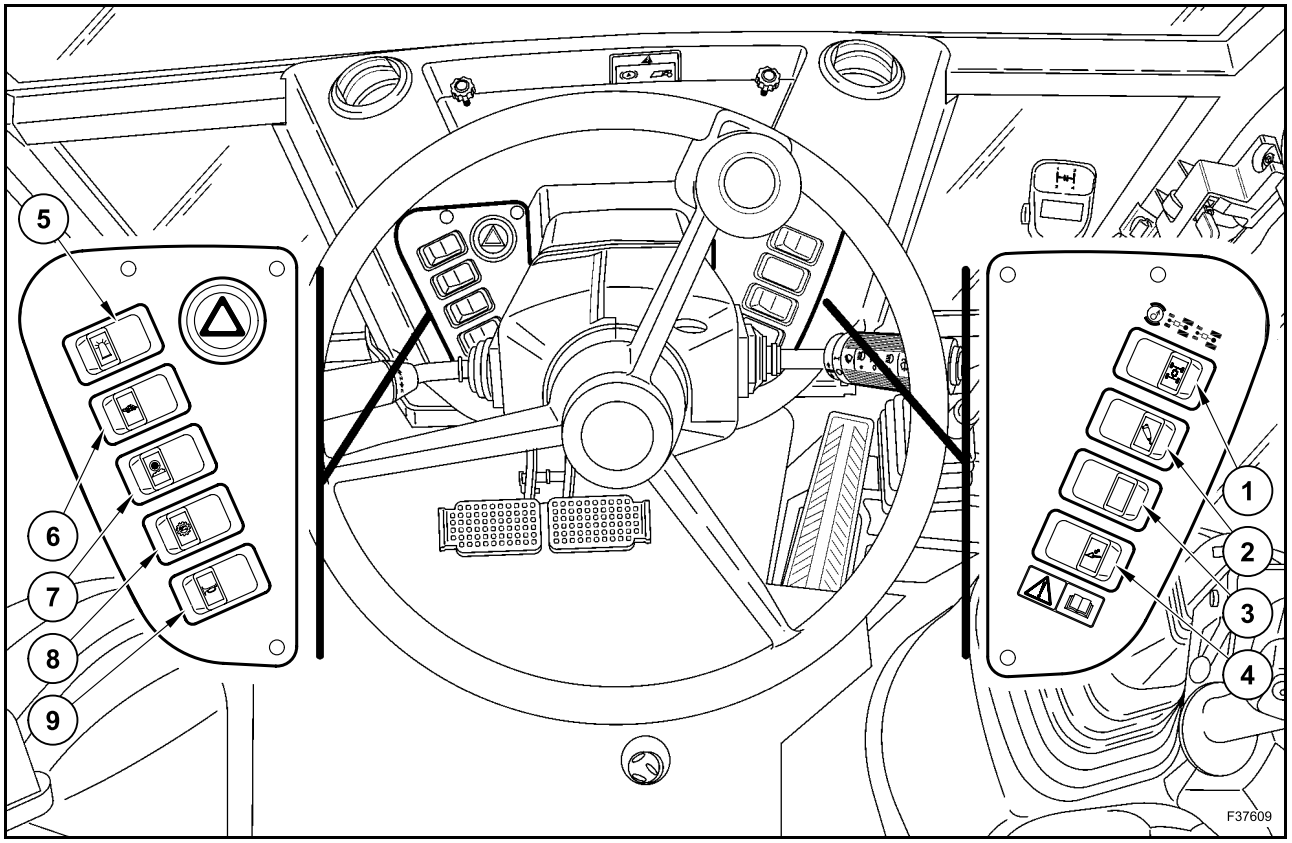
CN2		
PIN	**FUNCTION**	**NOTE**
1	Keep alive power	Need to fuse at 1 ampere without disconnect
2	Not used	
3	Can bus input	Twisted pair, with 120 OHM terminator
4	Can bus input	Twisted pair, with 120 OHM terminator
5	Not used	
6	Audible alarm buzzer	Floyd bell under 80 mA
7	Starter motor interlock	40 OHM relay = 300 mA
8	Not used	
9	Not used	
10	Not used	
11	Not used	
12	Not used	
13	Fuel level gauge	Variable resistance
14	Transmission temperature	Thermistor
15	Not used	
16	Foot accelerator	0.5-4.5 V
17	Accelerator knob	0.5-4.5 V
18	Foot accelerator	Output monitored for diagnostics
19	Accelerator knob	Output monitored for diagnostics
20	Foot accelerator	
21	Accelerator knob	
22	Not used	
23	Not used	
24	Alternator excitation	Low alternator output signals fault
25	Not used	
26	Ground	Digital input

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3. CONTROLS AND INSTRUMENTS

3.1 FRONT CONTROL PANELS (580SR / 590SR)



1

1. 2WD/4WD SWITCH
This switch is used to engage or disengage the four wheel drive.
This switch has three positions:
- First position (by pushing the button on the left):
  rear wheel drive with braking on 4 wheels (lamp off, it turns on when braking).
- Second position (by pushing the button on the right):
  rear wheel drive with braking on rear wheels (lamp off).
- Third position (by pushing again the button on the right):
  4 wheel drive with braking on 4 wheels (lamp on).

NOTE: when the 4WD switch is in OFF position and the two brake pedals are pressed at the same time, the 4 wheel drive is engaged automatically (at speeds higher than 3 km/h) to ensure braking on the 4 wheels; it disengages when the brake pedals are released.

2. HAND-HELD AUXILIARY HYDRAULIC ATTACHMENT SWITCH (Optional)
This switch has two positions:
- The first position is OFF.
- The second position is ON and enables the auxiliary hydraulic attachments.

3. OPTIONAL ATTACHMENT SWITCH

4. LOADER ATTACHMENT LOCKING SWITCH (Optional)
When operated, this switch is for preventing any movement of the loader attachment during travel.

5. ROTATING BEACON SWITCH
This switch is used to turn the rotating beacon on or off.

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6. HYDRAULIC SPEED CONTROL SWITCH (If fitted)
   This switch enables an increase in the moving speed of the loader and backhoe attachment.
7. “GLIDE RIDE” SWITCH (Optional)
   The “glide ride” system control improves the machine comfort during travel, regardless of the type of terrain and with the loader bucket full or empty. It reduces forward and rearward pitching when moving to the rear or forwards and when carrying loads, at the same time increasing productivity and operator comfort. It also reduces impact forces to the machine during operation. Do not use this system while operating the loader attachment.

⚠ WARNING ⚠

Never operate the “glide ride” system control when the loader arm and loader bucket are maintaining the front of the machine raised off the ground. The machine could fall and cause serious or fatal injury.

8. MANUAL MODE SELECTION SWITCH (Powershift transmission)
   In situations where manual gearshifting (up or downshift) is required, the automatic gearshift of the powershift transmission can be overridden by means of this switch.

NOTE: changing gears up or down must always be done using the powershift transmission lever.

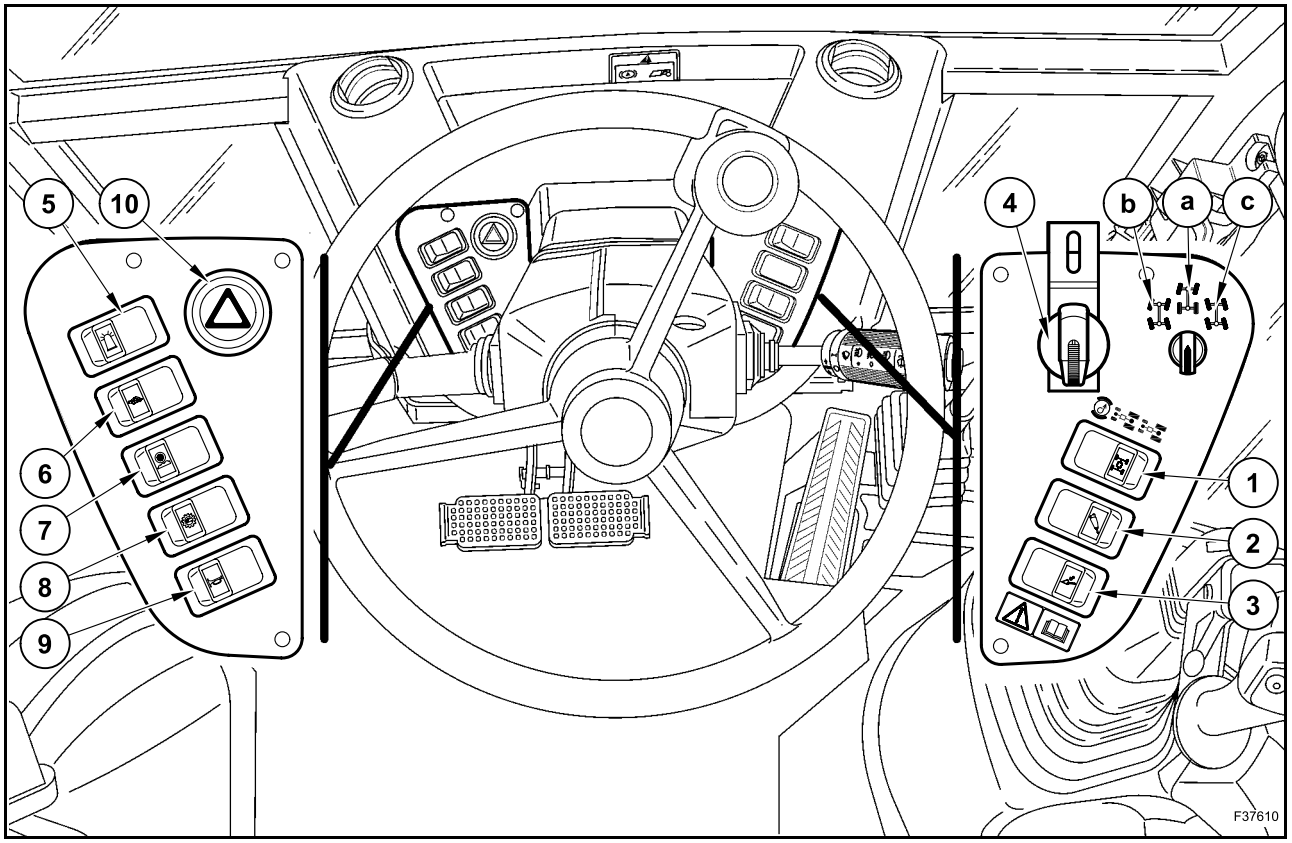
When the manual mode is no longer required, place the switch back to the OFF position to return to automatic gearshifting.

9. HORN BUTTON
   (Powershift transmission)
   This hold-down switch operates the warning horn.
10. HAZARD LIGHT SWITCH
    Press the control down to locked position. The direction indicators and the control will flash simultaneously.
    Press the control down again to turn off the direction indicators and the indicator lamp.

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3.2 FRONT CONTROL PANELS (695SR)



2

1. 2WD/4WD SWITCH
This switch is used to engage or disengage the four wheel drive.
This switch has three positions:
- First position (by pushing the button on the left):
  rear wheel drive with braking on 4 wheels (lamp off, it turns on when braking).
- Second position (by pushing the button on the right):
  rear wheel drive with braking on rear wheels (lamp off).
- Third position (by pushing again the button on the right):
  4 wheel drive with braking on 4 wheels (lamp on).

NOTE: when the 4WD switch is in OFF position and the two brake pedals are pressed at the same time, the 4 wheel drive is engaged automatically (at speeds higher than 3 km/h) to ensure braking on the 4 wheels; it disengages when the brake pedals are released.

2. HAND-HELD AUXILIARY HYDRAULIC ATTACHMENT SWITCH (Optional)
This switch has two positions:
- The first position is OFF.
- The second position is ON and enables the auxiliary hydraulic attachments.

3. LOADER ATTACHMENT LOCKING SWITCH (Optional)
When operated, this switch is for preventing any movement of the loader attachment during travel.

4. STEER MODE SWITCH
This switch has a locking cover and is used to select “Road”, “4 wheel steer” or “Crab steer”.
This switch has three positions:
- Position (a) = Road
- Position (b) = 4 wheel steer
- Position (c) = Crab steer

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IMPORTANT: before undertaking any road travel, select “Road” mode and fold back the cover to lock the switch in this position.

5. ROTATING BEACON SWITCH
   This switch is used to turn the rotating beacon on or off.
6. HYDRAULIC SPEED CONTROL SWITCH (If fitted)
   This switch enables an increase in the moving speed of the loader and backhoe attachment.
7. “GLIDE RIDE” SWITCH (Optional)
   The “glide ride” system control improves the machine comfort during travel, regardless of the type of terrain and with the loader bucket full or empty. It reduces forward and rearward pitching when moving to the rear or forwards and when carrying loads, at the same time increasing productivity and operator comfort. It also reduces impact forces to the machine during operation. Do not use this system while operating the loader attachment.

⚠ WARNING ⚠

Never operate the “glide ride” system control when the loader arm and loader bucket are maintaining the front of the machine raised off the ground. The machine could fall and cause serious or fatal injury.

8. MANUAL MODE SELECTION SWITCH (Powershift transmission)
   In situations where manual gearshifting (up or downshift) is required, the automatic gearshift of the powershift transmission can be overridden by means of this switch.

NOTE: changing gears up or down must always be done using the powershift transmission lever.

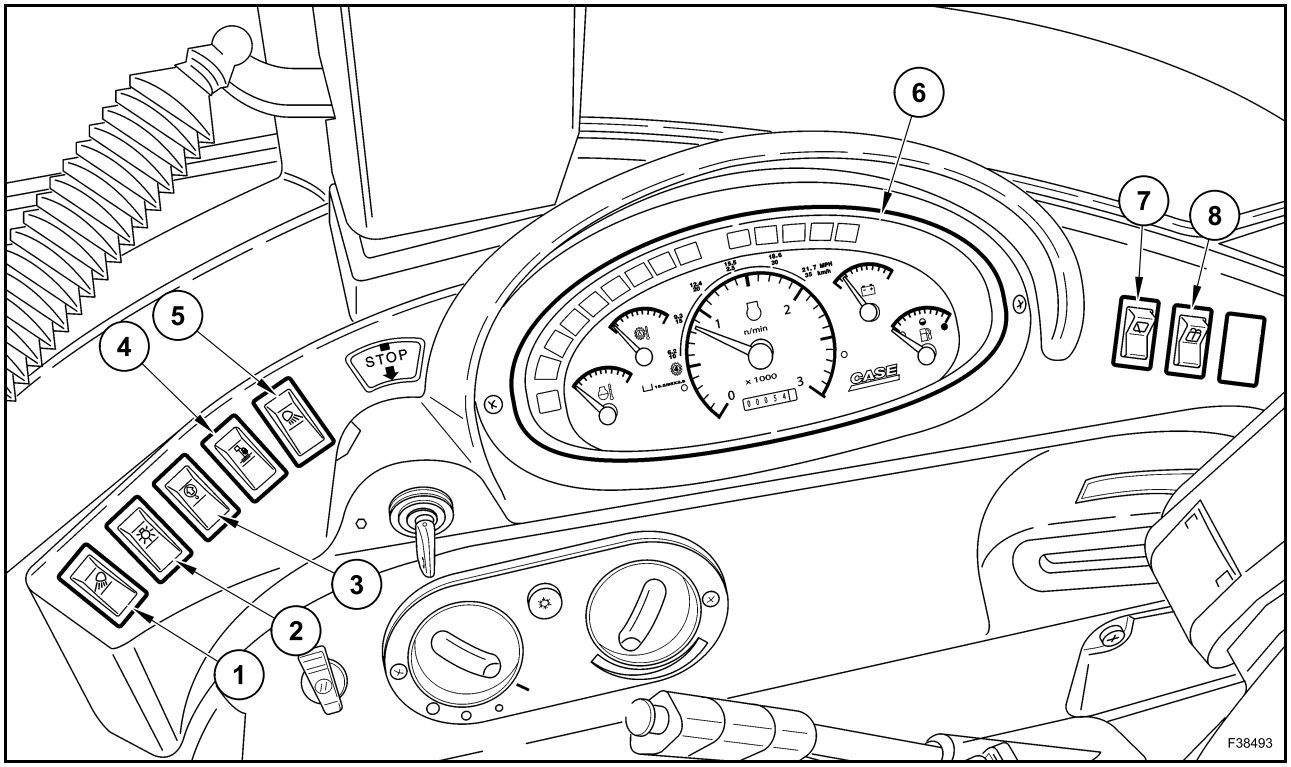
When the manual mode is no longer required, place the switch back to the OFF position to return to automatic gearshifting.

9. HORN BUTTON
   (Powershift transmission)
   This hold-down switch operates the warning horn.
10. HAZARD LIGHT SWITCH
    Press the control down to locked position. The direction indicators and the control will flash simultaneously.
    Press the control down again to turn off the direction indicators and the indicator lamp.

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3.3 SIDE INSTRUMENT CLUSTER PANEL (580SR)



3

1. FRONT WORK LIGHT SWITCH
This switch has three positions:
- The first position is OFF.
- Second position, the two front external work lights turn on.
- Third position, the two front internal work lights turn on.
The light switch turns on only in the second and third position.

2. LIGHT SWITCH
This switch has three positions:
- The first position is OFF.
- The second position powers the gauge cluster, the parking lights, with heading indicator lamp and the rear red lateral lights.
- The third position enables the main beams and the indicator lamp of the main beams.

3. ROLL-OVER PROTECTION SWITCH (Optional)
This switch is used to engage or disengage the roll-over protection device. When the operator is about to start working with the backhoe attachment in conditions which could cause the machine to roll over, he/she must activate the roll-over protection device by pressing the switch (ON position and lamp turned on).
In this condition, the audible alarm will sound by means of the buzzer when the pressure switch, installed on the backhoe attachment boom cylinder, detects a pressure exceeding the following values:
2WS = 116 bar (17 psi)
4WS = 126.5 bar (18 psi)

4. BACKHOE ATTACHMENT SIDESHIFT CARRIAGE LOCKING / UNLOCKING SWITCH (Sideshift version)
The switch is used to lock or unlock the backhoe attachment sideshift carriage to allow sideshifting.

5. REAR WORK LIGHT SWITCH
This switch has three positions:
- The first position is OFF, the rear lights are off.
- Second position, the two rear external work lights turn on.
- Third position, the two rear internal work lights turn on.

The light switch turns on only in the second and third position.

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NOTE: never use the work lights during road travel.

6. SIDE INSTRUMENT CLUSTER

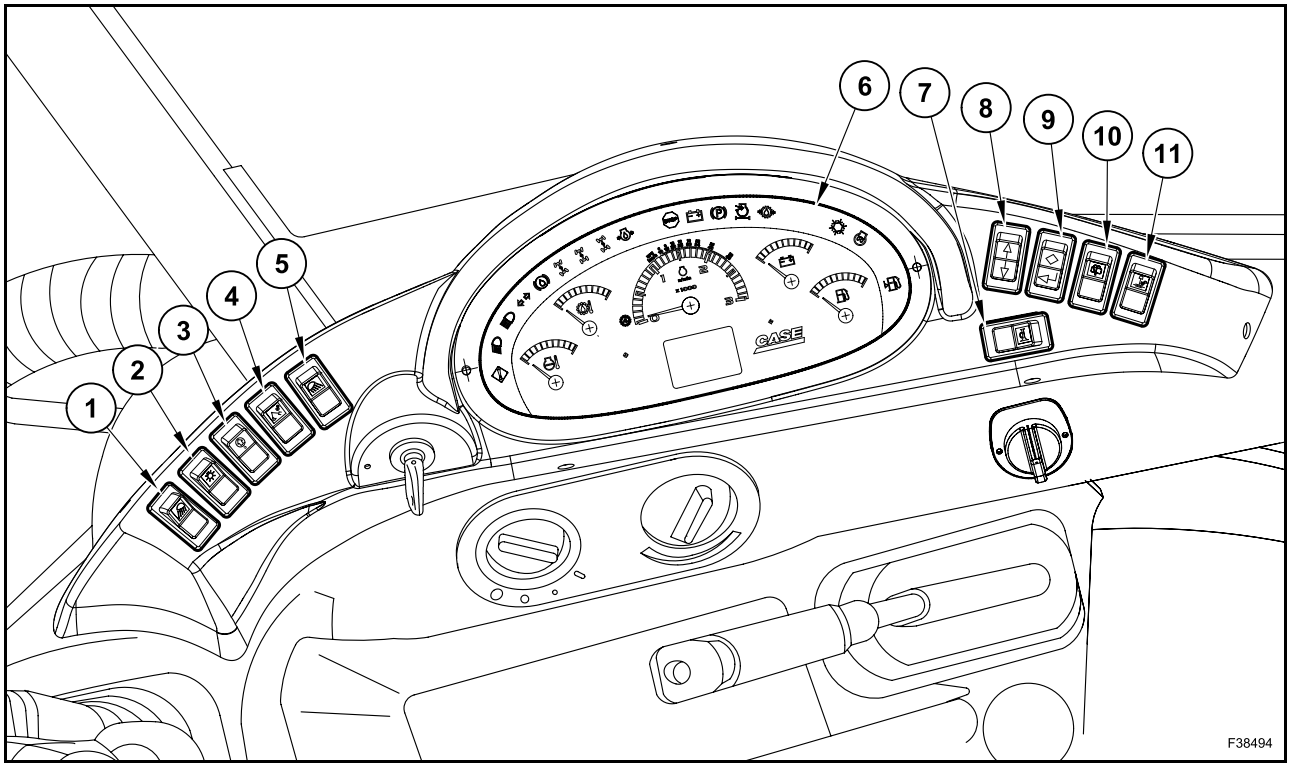
7. REAR WINDSHIELD WIPER SWITCH
When this switch is pressed, the windshield wiper is activated and will continue operating until the switch is returned to the OFF position.

8. REAR WINDSHIELD WASHER SWITCH
The windshield washer will operate when this switch is pressed and held down.
When the switch is released, the windshield washer ceases to operate.

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3.4 SIDE INSTRUMENT CLUSTER PANEL (580SR+ / 590SR / 695SR)



4

1. FRONT WORK LIGHT SWITCH
This switch has three positions:
- The first position is OFF.
- Second position, the two front external work lights turn on.
- Third position, the two front internal work lights turn on.
The light switch turns on only in the second and third position.

2. LIGHT SWITCH
This switch has three positions:
- The first position is OFF.
- The second position powers the gauge cluster, the parking lights, with heading indicator lamp and the rear red lateral lights.
- The third position enables the main beams and the indicator lamp of the main beams.

3. ROLL-OVER PROTECTION SWITCH (Optional)
This switch is used to engage or disengage the roll-over protection device. When the operator is about to start working with the backhoe attachment in conditions which could cause the machine to roll over, he/she must activate the roll-over protection device by pressing the switch (ON position and lamp turned on).
In this condition, the audible alarm will sound by means of the buzzer when the pressure switch, installed on the backhoe attachment boom cylinder, detects a pressure exceeding the following values:
2WS = 116 bar (17 psi)
4WS = 126.5 bar (18 psi)

4. BACKHOE ATTACHMENT LOCKING SWITCH (Optional)
The switch is used to lock or unlock the backhoe attachment locking plate in preparation for road travel.

5. REAR WORK LIGHT SWITCH
This switch has three positions:
- The first position is OFF, the rear lights are off.
- Second position, the two rear external work lights turn on.
- Third position, the two rear internal work lights turn on.

The light switch turns on only in the second and third position.

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NOTE: never use the work lights during road travel.

6. SIDE INSTRUMENT CLUSTER

7. HORN BUTTON
(Powershift transmission)
This hold-down switch operates the warning horn.

8. UP/DOWN SWITCH
By means of this control, it is possible to scroll through the menu or data options shown on the diagnostic display.

9. MENU ENTER SWITCH
By means of this control it is possible to display and confirm the menu options shown on the display.

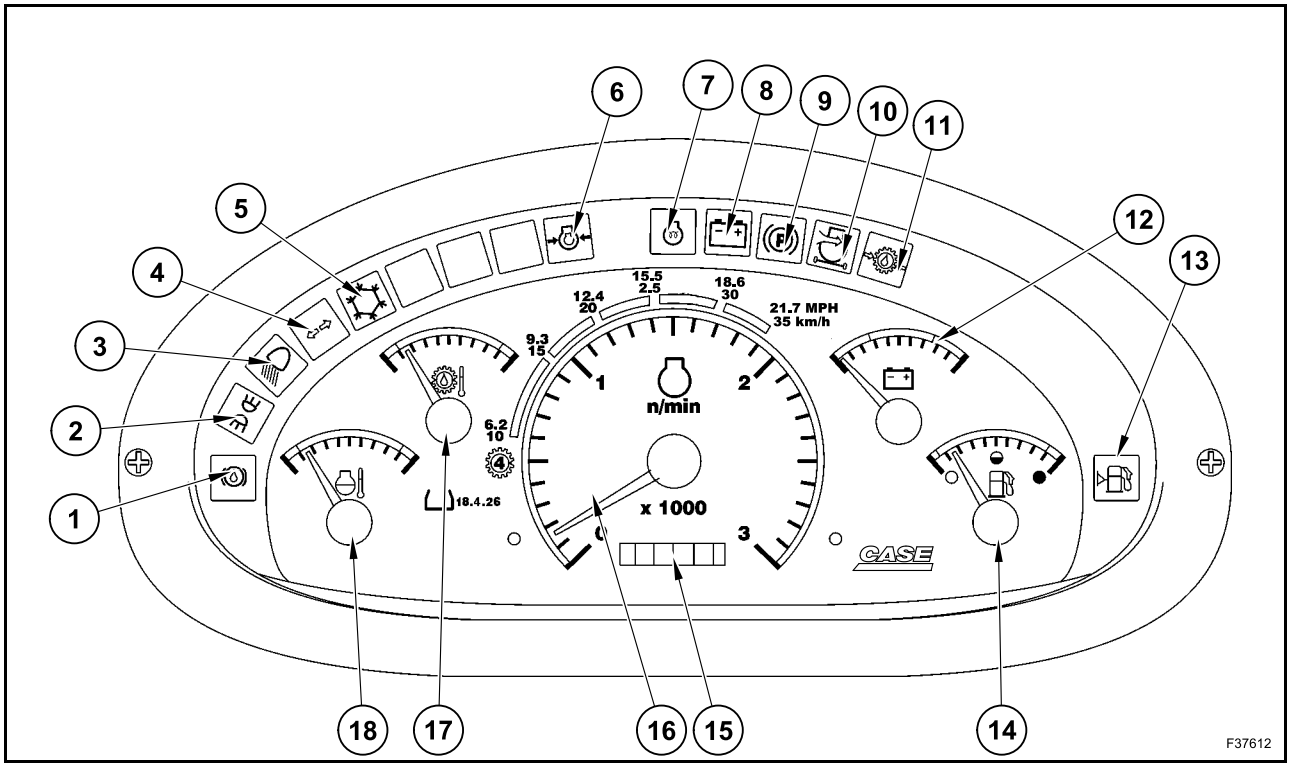
10. REAR WINDSHIELD WIPER AND WASHER SWITCH
When this switch is pressed, the windshield wiper is activated and will continue operating until the switch is returned to the OFF position.
The windshield washer is operated by further pressing and holding the switch.
When the switch is released, the washer stops and the wiper starts operating again.

11. BACKHOE ATTACHMENT SIDESHIFT CARRIAGE LOCKING / UNLOCKING SWITCH (Sideshift version)
The switch is used to lock or unlock the backhoe attachment sideshift carriage to allow sideshifting.

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3.5 SIDE INSTRUMENT CLUSTER (580SR)



5

1. BRAKE LIQUID LEVEL WARNING LAMP
   This lamp turns on and the audible warning device sounds when the brake liquid is at minimum level.
2. SIDE LIGHT AND LOW BEAM INDICATOR LAMP
   This indicator lamp turns on when the side lights or the low beams are on.
3. MAIN BEAM INDICATOR LAMP
   This indicator lamp turns on when the main beams are on.
4. DIRECTION INDICATOR LAMP
   This lamp turns on when the direction indicators are working.
5. AIR CONDITIONER INDICATOR LAMP (Optional)
   This lamp turns on when the air conditioner is working.
6. ENGINE OIL PRESSURE WARNING LAMP
   This warning lamp turns on and the audible warning device sounds when the engine oil pressure is too low.
   If the lamp turns on while the machine is working, move the machine to a safe place, immediately stop the engine, remove the starter switch key and find the cause of the problem.
7. “GRID HEATER” INDICATOR LAMP (If fitted)
   If the machine is equipped with a “grid heater”, wait for the indicator lamp to turn off before starting the engine.
8. BATTERY CHARGE WARNING LAMP
   This warning lamp turns on when the alternator/fan belt is broken or when the alternator is not charging the battery.
   If the lamp turns on while the machine is working, move the machine to a safe place, immediately stop the engine, remove the starter switch key and find the cause of the problem.

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9. PARKING BRAKE INDICATOR LAMP
This indicator lamp turns on when the parking brake lever is in the raised position (wheels braked).

10. AIR FILTER RESTRICTION WARNING LAMP
This warning lamp turns on when the air filter element needs to be cleaned or replaced.

11. TRANSMISSION OIL PRESSURE WARNING LAMP
This lamp turns on and the audible alarm sounds when the transmission oil pressure is too low. If the lamp turns on while the machine is working, move the machine to a safe place, immediately stop the engine, remove the starter switch key and find the cause of the problem.

12. BATTERY CHARGE GAUGE
This indicator shows the state of charge of the battery. At normal charge the needle should be in the grey area. If the needle is in the left red area, this shows that the battery charge is insufficient or that the alternator is not charging the battery. If the needle is in the right red area, this indicates excessive battery charge which may cause damage to the battery.

13. LOW FUEL LEVEL WARNING LAMP
This warning lamp turns on when the fuel level is low. You have approximately an hour to fill the fuel tank.

NOTE: when the starter switch key is in the ON position, lamps (6), (8), (9), (10) and (11) turn on for three seconds. After this time, only lamps (9), (8) and (11) remain alight. If one or more do not turn on, the bulbs must be replaced.

---

14. FUEL LEVEL GAUGE
This gauge shows the quantity of fuel in the fuel tank.

15. HOURMETER
The hourmeter shows the number of hours and tenths of hours the engine has been functioning. It also makes it possible to determine when servicing operations are due.

16. TACHOMETER
The tachometer shows the engine speed in revolutions per minute.
The figures indicated must be multiplied by 100. Each intermediate mark shows a value of 100 rpm.
We recommend not to reach the red line.
The tachometer shows travel speed in kilometres per hour (km/h) and miles per hour (mph).
Road speed in 4th gear with 18.4-26 tyres.

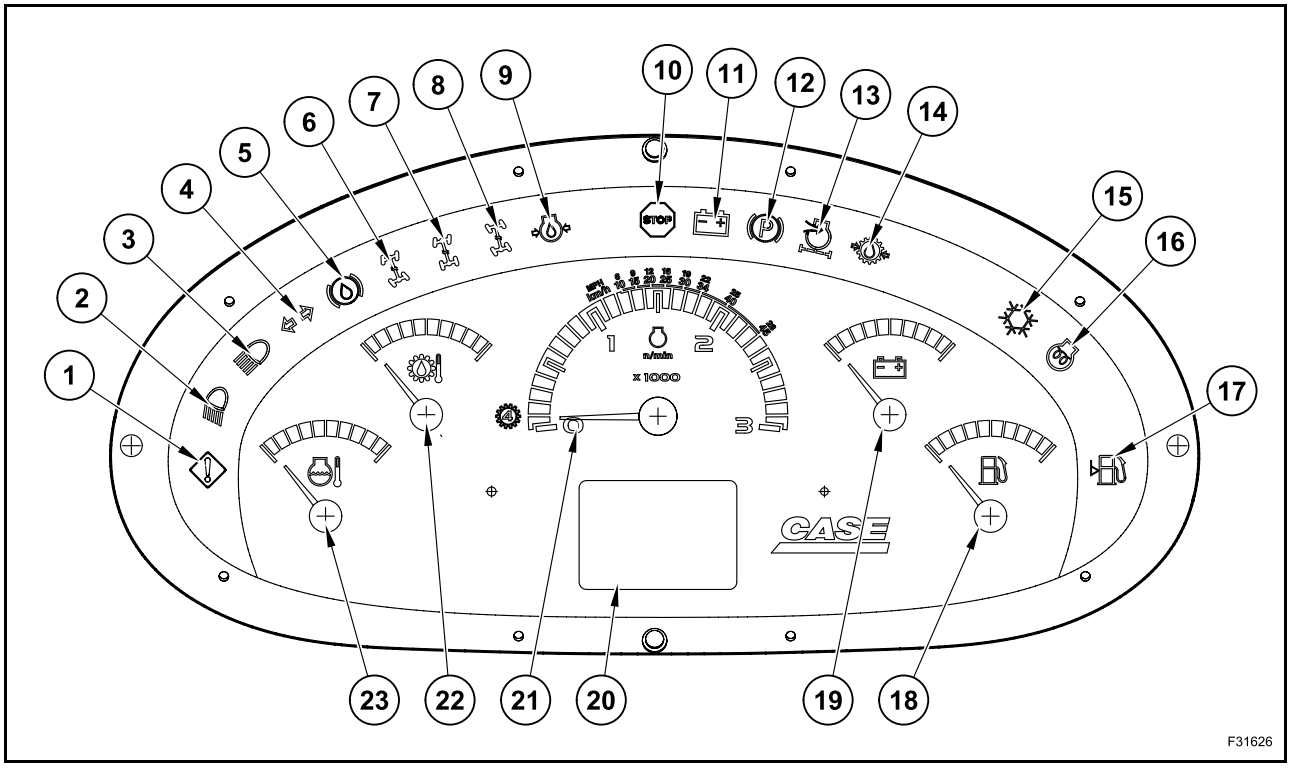
17. TRANSMISSION OIL TEMPERATURE WARNING LAMP
This indicator shows the transmission oil temperature. When the temperature is normal, the needle is in the grey area. If the needle is in the red area, change down to a lower gear. If the needle still remains in the red area, stop the machine travel, place the gearshift lever and the direction-of-travel control lever in the neutral position and leave the engine running at 1000 rpm. If this operation does not enable the oil temperature to be reduced, check the gearbox oil level and make sure that the radiator and oil cooler are perfectly clean.

18. ENGINE COOLANT TEMPERATURE GAUGE
This indicator shows the temperature of the engine coolant solution. When the temperature is normal, the needle is in the grey area. If the needle is in the red area, the audible warning sounds. Move the machine to a safe place, immediately stop the engine, remove the starter switch key and check the coolant level. Make sure that the radiator and oil cooler are perfectly clean and that all the thermostats function correctly.

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3.6 SIDE INSTRUMENT CLUSTER (580SR+ / 590SR / 695SR)



6

1. CAUTION MASTER LAMP
   This lamp signals a not critical caution.
   When this caution is active, it is necessary to change the operating mode, plan a down time to carry out maintenance or, if the fault continues, consult your dealer.
   This warning lamp turns on at the same time of lamps (5), (9), (11), (13), (14) and (16) that indicates a fault on the machine.
2. SIDE LIGHT AND LOW BEAM INDICATOR LAMP
   This indicator lamp turns on when the side lights or the low beams are on.
3. MAIN BEAM INDICATOR LAMP
   This indicator lamp turns on when the main beams are on.
4. DIRECTION INDICATOR LAMP
   This lamp turns on when the direction indicators are working.
5. BRAKE LIQUID LEVEL WARNING LAMP
   This lamp turns on and the audible warning device sounds when the brake liquid is at minimum level.
6. “FOUR WHEEL STEER” (4WS) STEER INDICATOR LAMP
   This lamp turns on when 4 wheel steer mode is selected and phased.
7. “ROAD” (4WS) STEER INDICATOR LAMP
   This lamp turns on when 2 wheel steer mode is selected and phased.
8. “CRAB” (4WS) STEER INDICATOR LAMP
   This lamp turns on when crab steer mode is selected and phased.

NOTE: if the three lamps turn on at once, this means there is a problem with the electrical circuit. Consult your Dealer.

---

9. ENGINE OIL PRESSURE WARNING LAMP
   This warning lamp turns on and the audible warning device sounds when the engine oil pressure is too low. If the lamp turns on while the machine is working, move the machine to a safe place, immediately stop the engine, remove the starter switch key and find the cause of the problem.

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10. STOP MASTER LAMP
The stop master lamp signals a critical caution. When this lamp turns on, stop the machine immediately and shut off the engine.
If this is not the case, the machine can get damaged or accidents may occur.

11. BATTERY CHARGE WARNING LAMP
This warning lamp turns on when the alternator/ fan belt is broken or when the alternator is not charging the battery. If the lamp turns on while the machine is working, move the machine to a safe place, immediately stop the engine, remove the starter switch key and find the cause of the problem.

12. PARKING BRAKE INDICATOR LAMP
This indicator lamp turns on when the parking brake lever is in the raised position (wheels braked).

13. AIR FILTER RESTRICTION WARNING LAMP
This warning lamp turns on when the air filter element needs to be cleaned or replaced.

14. TRANSMISSION OIL PRESSURE WARNING LAMP
This lamp turns on and the audible alarm sounds when the transmission oil pressure is too low. If the lamp turns on while the machine is working, move the machine to a safe place, immediately stop the engine, remove the starter switch key and find the cause of the problem.

15. AIR CONDITIONER INDICATOR LAMP (Optional)
This lamp turns on when the air conditioner is working.

16. “GRID HEATER” INDICATOR LAMP (If fitted)
If the machine is equipped with a “grid heater”, wait for the indicator lamp to turn off before starting the engine.

17. LOW FUEL LEVEL WARNING LAMP
This warning lamp turns on when the fuel level is low. You have approximately an hour to fill the fuel tank.

NOTE: when the starter switch key is in the ON position, all lamps turn on and the instrument buzzer sounds for 5 seconds. Afterwards, the lamps turn off and only lamp (9) remains on. The gauges (18) and (19) set to position.

---

18. FUEL LEVEL GAUGE
This gauge shows the quantity of fuel in the fuel tank.

19. BATTERY CHARGE GAUGE
This indicator shows the state of charge of the battery. At normal charge the needle should be in the grey area. If the needle is in the left red area, this shows that the battery charge is insufficient or that the alternator is not charging the battery. If the needle is in the right red area, this indicates excessive battery charge which may cause damage to the battery.

20. DIAGNOSTIC DISPLAY
By means of this display it is possible to visualize the various data of diagnostics. The service hours are also indicated.

21. TACHOMETER
The tachometer shows the engine speed in revolutions per minute.
The figures indicated must be multiplied by 100. Each intermediate mark shows a value of 100 rpm.
We recommend not to reach the red line.

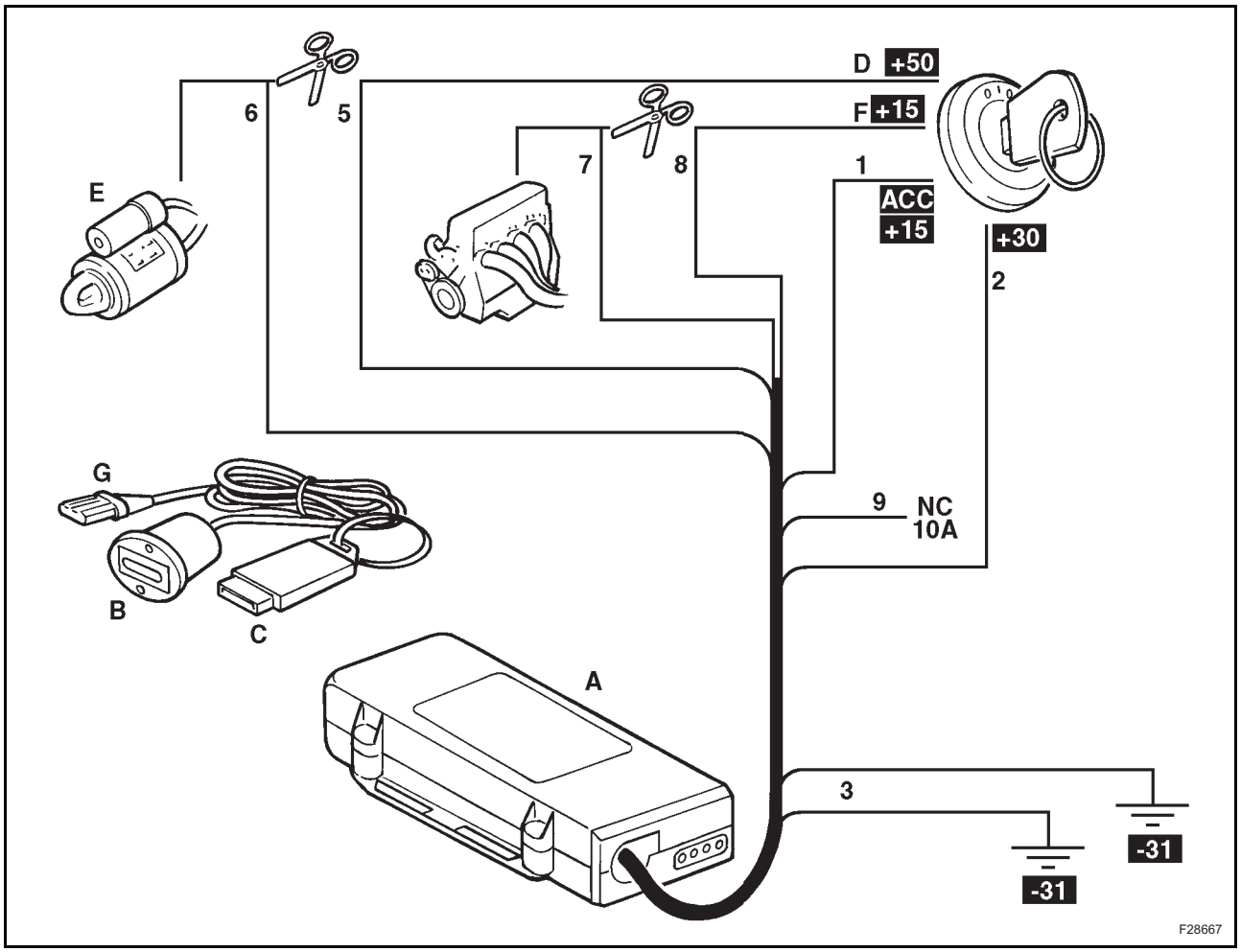
22. TRANSMISSION OIL TEMPERATURE WARNING LAMP
This indicator shows the transmission oil temperature. When the temperature is normal, the needle is in the grey area. If the needle is in the red area, change down to a lower gear. If the needle still remains in the red area, stop the machine travel, place the gearshift lever and the direction-of-travel control lever in the neutral position and leave the engine running at 1000 rpm. If this operation does not enable the oil temperature to be reduced, check the gearbox oil level and make sure that the radiator and oil cooler are perfectly clean.

23. ENGINE COOLANT TEMPERATURE GAUGE
This indicator shows the temperature of the engine coolant solution. When the temperature is normal, the needle is in the grey area. If the needle is in the red area, the audible warning sounds. Move the machine to a safe place, immediately stop the engine, remove the starter switch key and check the coolant level. Make sure that the radiator and oil cooler are perfectly clean and that all the thermostats function correctly.

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3.7 IMMOBILISER CIRCUIT



A. M38 Immobiliser
B. Electronic key socket with LED
C. 2 piece electronic key
D. + 50 to ignition
E. Starter motor
F. + 15 key positive
G. Electronic key

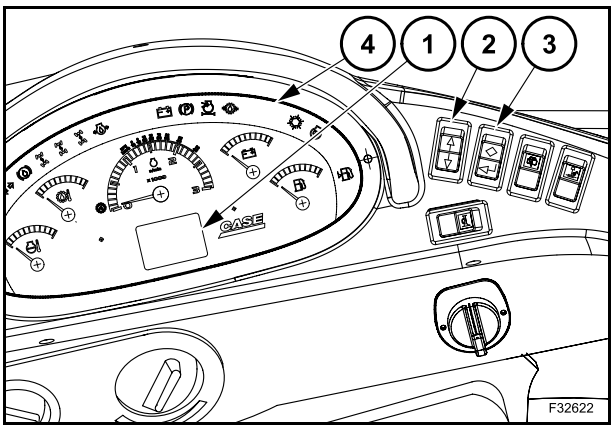
Wire No.	Function	Connection
1	(+15) Key positive	Connected to the + 12 V full ignition supply
2	(+30) Permanent + 12 V power supply	Connected to the wire from the battery positive
3	(-31) Negative power supply	Connected to the vehicle negative at two independent points
5 - 6	Immobilization relay No. 2	Connected in line with the wire controlling the starter motor relay/solenoid - Minimum 500 mA maximum 10 A capacity
7 - 8 - 9	Immobilization relay No. 1	Connect in line with the wire controlling the ignition or fuel circuit - Minimum 500 mA maximum 10 A capacity

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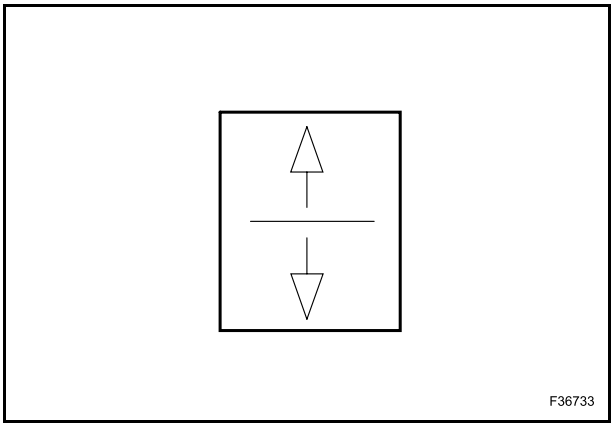
4. DIAGNOSTIC DISPLAY (580SR+ / 590SR / 695SR)

The diagnostics display (1) is located in the middle of the side instrument panel (4).
The switches used to enter diagnostics are following:

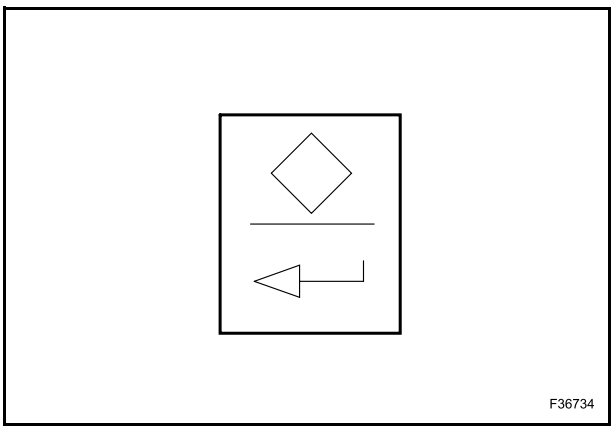


• UP/DOWN SWITCH (2)
Use this UP/DOWN switch to scroll through the menus.

NOTE: push the arrow at start up to display engine rpms on the display.



• DISPLAY ENTER SWITCH (3)
Use this switch to select and confirm a service menu.
The Diamond icon, or top portion of the switch, is used to select displays.
The 90° arrow icon or bottom portion of the switch, is used to enter selected choices.



Features adjustable during setup:

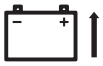
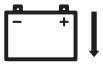
- backlighting dimming and contrast control,
- maintenance/service interval customization;
- storage of error codes;
- “grid heater” presence:
  it is possible to select or deselect the “grid heater” option;
- low temperature idle speed setting:
  when the engine coolant temperature is below 10 °C, the unit will change from a normal low idle to a low temperature idle which can be adjusted between 975 and 1500 rpm. The default setting is 1000 rpm;
- high idle speed setting (2500 rpm maximum).

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4.1 SYMBOLS

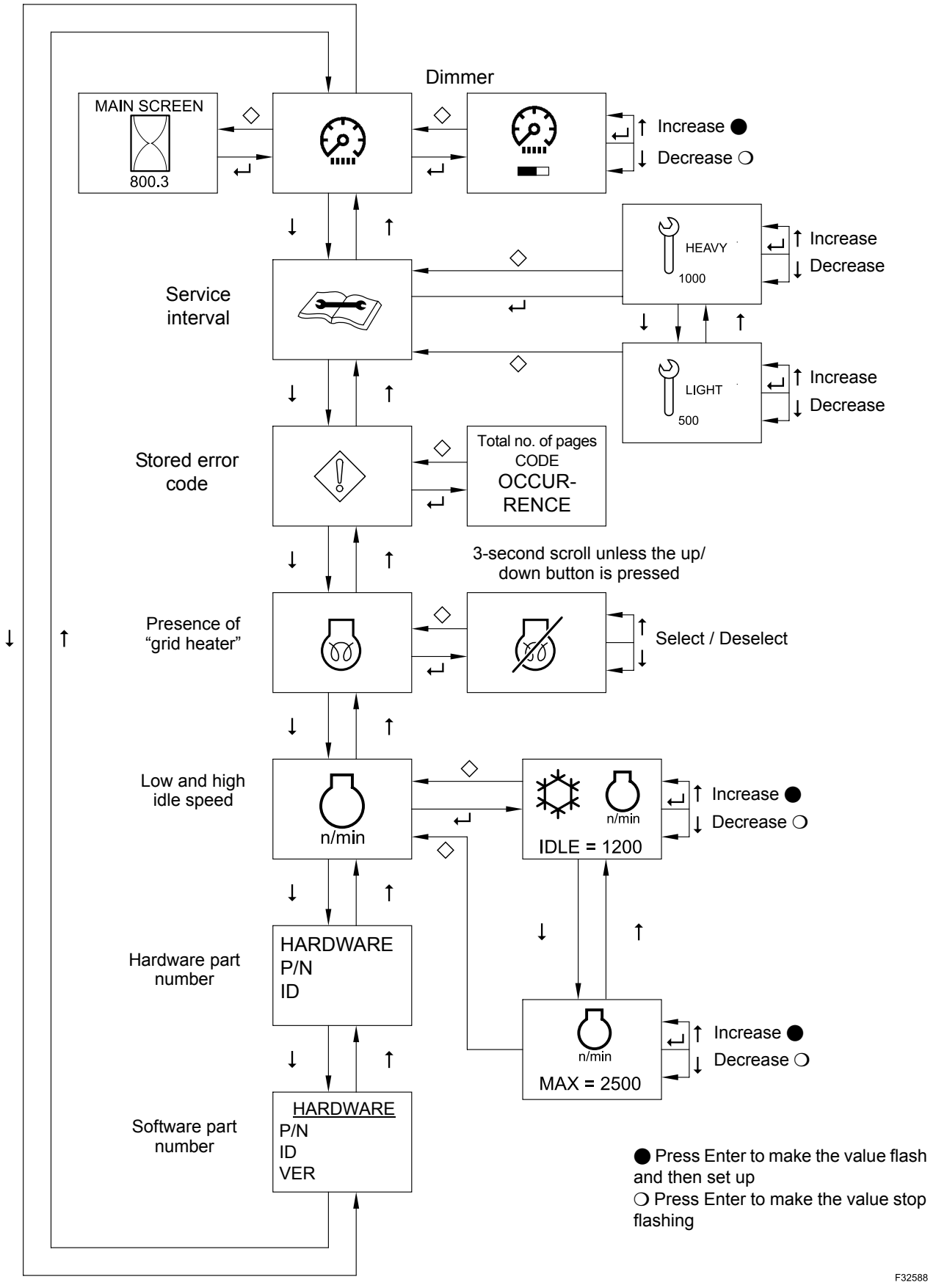
	Work hours
	Maintenance
	Maintenance heavy (hours)
	Maintenance light (hours)
	Stored error code
	“Grid heater”
	Engine speed
	Engine area of fault
	Engine intake air filter blocked
	Charge air temperature too high
	Engine coolant level too low
	Engine coolant too high
	Engine oil pressure too low
	Brake fluid level too low
	Parking brake engaged
N	Put the shuttle lever into neutral position

	Hydraulic oil filter blocked
	Transmission oil pressure too high
	Battery charging failure
	Contaminated fuel
	Malfunction
	Back-light dimming
	Battery voltage too high
	Battery voltage too low

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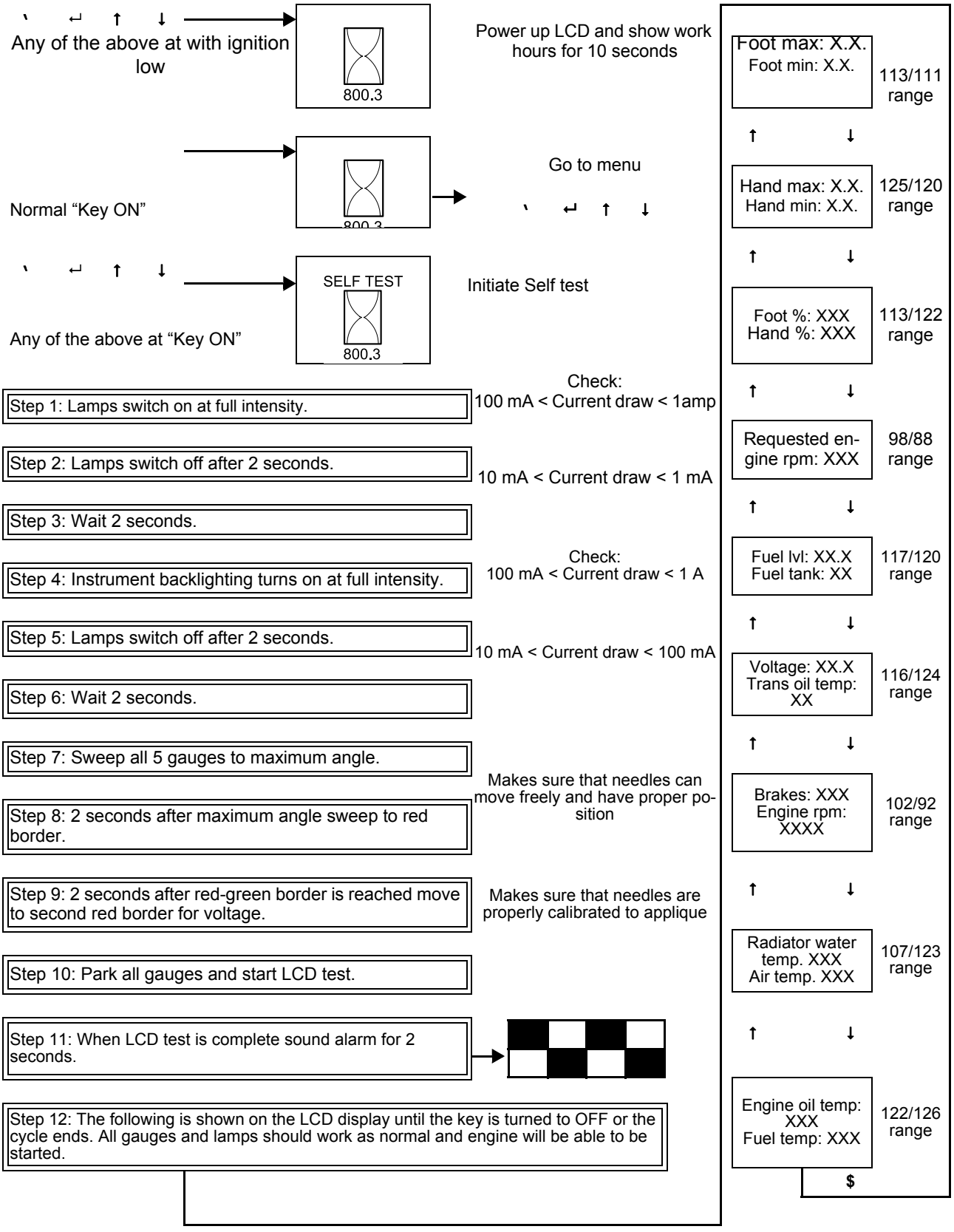
4.2 SETUP MENU



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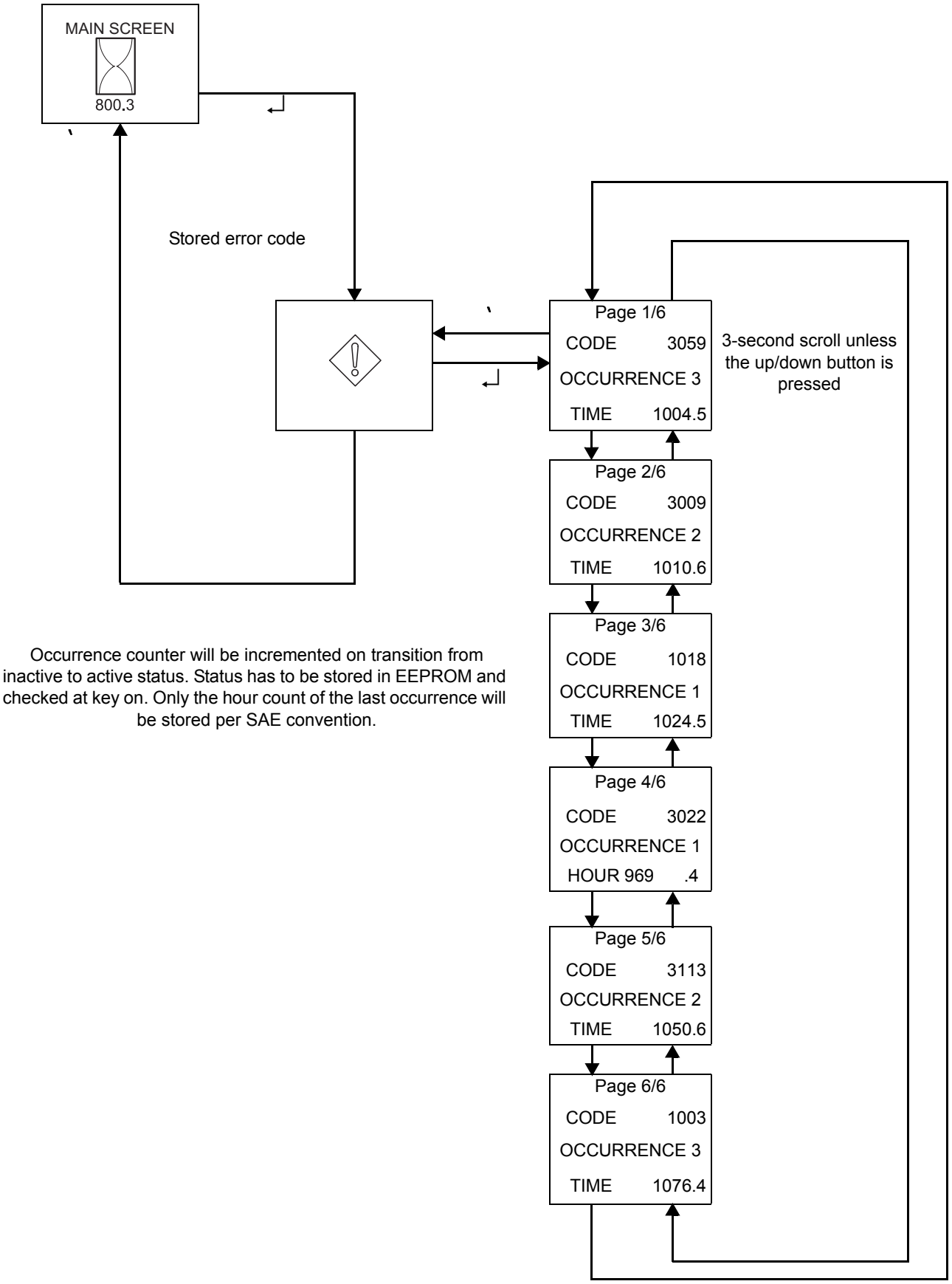
4.3 PROCEDURE ABOUT SELF TEST



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4.4 ON BOARD ERROR CODE RETRIEVAL



Occurrence counter will be incremented on transition from inactive to active status. Status has to be stored in EEPROM and checked at key on. Only the hour count of the last occurrence will be stored per SAE convention.

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4.5 BACKLIGHTING AND DIMMING

A proper and uniform backlighting for matrix, gauge pointer and symbols shall be provided.

Separate backlighting electronics shall be provided for matrix and symbols-gauge pointers. The backlighting will be achieved by LEDs and dimming shall be provided through the setup menu selections.

The backlighting shall go at its maximum level when the front, rear and driving lights are off.
The gauges backlighting dimming is switched on when the cluster sees a HIGH level on front work lights, rear work lights or driving lights for more then 100 ms.
The lamps intensity is decreased when side lights are activated. The 2 different luminance levels are defined as 100% during daytime use and 50% when backlighting is active.

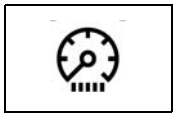
The display intensity of luminance will be 6 cd/m2 (not dimmed). The maximum available luminance spread will be 30%. To avoid dark zones the maximum difference of intensity of luminance between closed points is 15%. Note that the matrix backlighting may go to 0 by customer selection. The lamps and the audible alarm will warn the customer of an alarm condition occurring.

DIMMING LAW
The dimming adjustment is done through the setup menu, it can be used in single. In single step mode, the luminance level go from min to max value in 10 steps.

The luminance levels of display and gauges always varies in parallel.
The cluster switches between day and night luminance levels using the work and driving light status, and is able to manage the display and gauges independently using the same law and customer setting. Only the night settings can be adjusted since the day setting of the display is 100% intensity.

During dimming setup the matrix shows the dimming symbol together with the percentage of luminance: its value varies using a step of 10%. The dimming symbol appears when the proper menu is selected and stays on the matrix for at least 2 seconds.

The dot matrix visualization will be as follows:



The default value is 80% and the may go to zero if set by the customer.

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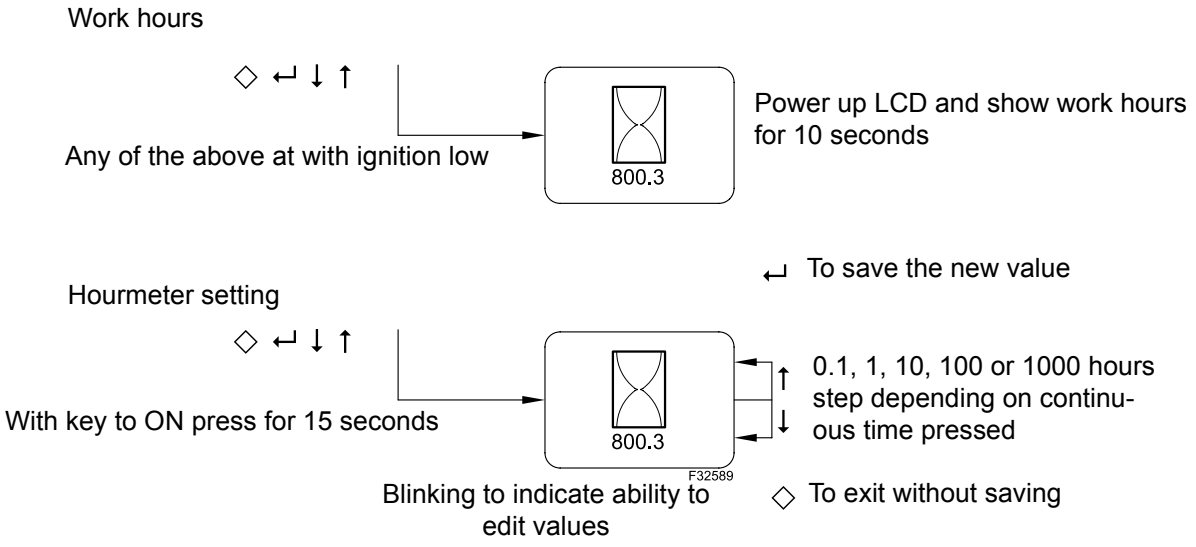
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4.6 WORK HOURS

In order to allow service or the customer to view vehicle hours of operation, it will not be necessary to have the key. By pressing the enter/display/up/down switch, with the key-off, the cluster must wake up and display hours for 10 seconds.
The hourmeter increments when the engine is running (rpm> 600). The hours are visualized starting from 0.0 until 210,554,060.7 using a step of 6 minutes. In case of battery disconnection, the cluster can lose 0.1 hour or 6 minutes max.

WORK HOURS SETTING
In order to allow service to install a new Vehicle Control Module (VCM) on an old vehicle, it is possible to increase (no decrease will be allowed) the hour to the same setting as the original.
To modify the hourmeter value, execute the following procedure:
- select the hourmeter function on the display;
- press and hold depressed for 15 seconds “arrow UP” and “display” until the value shown on display starts to blink (1 Hz, duty 50%);
- once in the adjustment mode the meaning of the arrow UP switch is “increase hourmeter value”, and the meaning of arrow DOWN switch is “decrease hourmeter value”. Single switch pressure will increase or decrease the value of one unit (6 min). Continuous switch pressure will increase or decrease the value continuously (1 every 300 milliseconds): when the value reaches a multiple of 10, the increment/decrement rate is 10 units every 300 ms; when the value reaches a multiple of 100, the rate is 100 units every 300 ms; when the value reaches a multiple of 1000, the rate is 1000 units every 300 ms.

During continuous setting the value stops flashing. Once the operator has reached the desired value press and hold down the arrow UP and display switches for 15 seconds to end setting procedure. It is not possible to set a value lower than the current one, and the procedure can be repeated three times in the cluster life.



Value may only increase for the hourmeter. While setting the value it can be decreased due to operator overshoot, but the value can not be stored if it is below the current stored value. Pressing DISPLAY will exit without saving. ENTER must be pressed to store the modified value in protected memory.

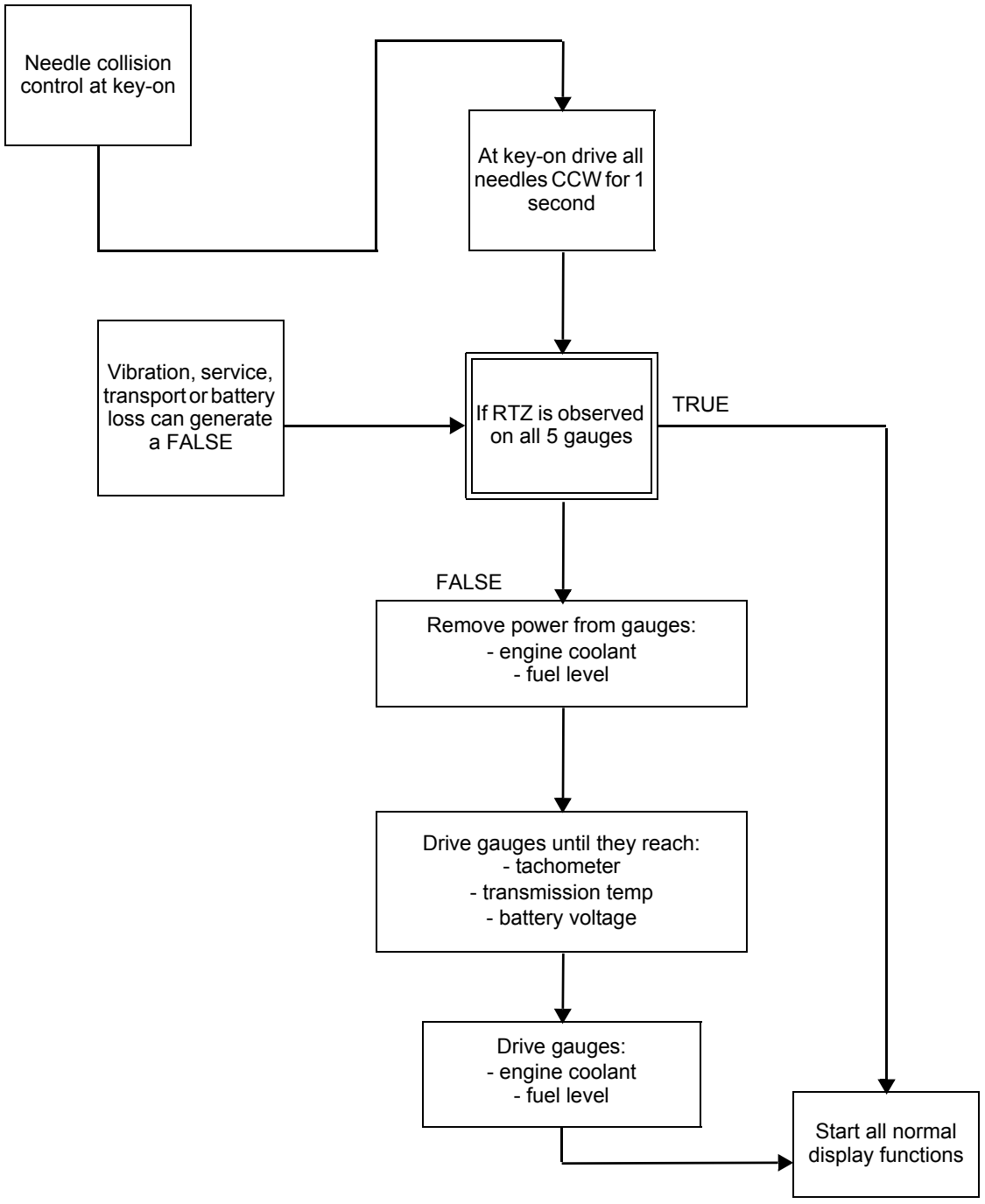
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4.7 FUNCTIONAL DESCRIPTION

Auto wake up at every 600 ms for sensing a change in ENTER, DISPLAY, UP or DOWN switch status will be provided. Upon sensing of one of those inputs transition, the cluster has to wake up.
As a general rule, during cranking, all warnings activation and all gauges movements have to be frozen unless we detect an error on the cranking line.

With the key OFF, all indicators must be set to the parking position. The parking position is hard to obtain with the internal stops of the stepper motor. With the key ON, follow the procedure below.



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TACHOMETER - ENGINE SPEED GAUGE

The tachometer accuracy should be less than or equal ± 50 rpm. The above-specified tolerances must be respected in all operating ranges (temperature, voltage, etc.). A stepper motor will drive the tachometer. Needle calibration has never to be lost for any external condition.
The message to be used is EEC1.

EEC1 message	Gauge position
0000	0 rpm
0001 => FFFD	According to the value
Green field	0 - 2500 rpm
Red field	2500 - 3000 rpm
FFFF	0 rpm

The behavior of the gauge in case of faulty sensor will be to return to the parked position. Since this signal is a function of the engine controller the appropriate warning lamp and lamp will be illuminated. During cranking, the needle movement shall be frozen in order to inhibit any spurious movement of it.

ENGINE COOLANT TEMPERATURE GAUGE

A stepper motor will drive coolant temperature gauge. The gauge accuracy should be less than or equal 3%. Needle calibration has never to be lost for any external condition.

Gauge	Temperature
Gauge indication range	+65 to +112 °C
Green field	+65 to +106 °C
Red field	+106 to +112 °C

The message to be used is engine temperature.

Engine temperature message	Gauge position
00 => FD	According to the logic above
FE	Minimum value
FF	Minimum value

An audible alarm must sound when the engine temperature exceeds 106 °C.
If the sender is disconnected, the instrument must go to 65 °C. Once the sensor is connected again, the instrument must return to the correct position. Both the movements have to be uniform.
The behavior of the gauge in case of faulty sensor will be to return to the parked position. Since this signal is a function of the engine controller the appropriate warning lamp and lamp will be illuminated. During cranking, the needle movement shall be frozen in order to inhibit any spurious movement of it.

VOLTMETER GAUGE

The voltmeter will indicate the voltage of the vehicle electrical system. This gauge will have three operating ranges: two reds and one green. One red range will indicate low voltage. The other red will indicate high voltage. The green range will indicate normal operating voltage.

- The bottom of the scale is 9 V.
- Low voltage range 11 V or less. The pointer will be ±3° of the bold centerline indicating 11 V.
- The normal operating range will vary between 11 and 16 V.
- High voltage range 16 V or more. The pointer will be ±3° of the bold centerline indicating 16 V.
- The top of the scale will be 18 V.

A stepper motor will drive the voltmeter gauge. The gauge accuracy should be less than or equal 3%. Needle calibration has never to be lost for any external condition. Loss of voltmeter sensor will be the loss of the internal VCM A/D converter.
During cranking, the needle movement shall be frozen in order to inhibit any spurious movement of it.
A/D accuracy is specified as ± 180 mV during self test operation.

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TRANSMISSION OIL TEMPERATURE GAUGE

The oil temp gauge indicates transmission oil temperature from 75 °C to 115 °C.
This gauge is broken up into two ranges, green and red. The green zone is 75 °C to 106 °C.
The red zone is from 105 °C to 115.5 °C.
This gauge will be connected to a sensor that will provide a specific resistance to correlate to a specific oil temperature.

Gauge	Temperature
Gauge indication range	+75 to +115 °C
Green field	+75 to +105 °C
Red field	+105 to +115 °C

- 5 V = 75 °C.
  The CL of the pointer will be ±2 angular degrees of the centerline of the tick mark that indicates this temperature.
- 2.6 V = 93.3 °C.
  The CL of the pointer will be ±3 angular degrees of the centerline of the tick mark that indicates this temperature.
- 2.05 V = 115.5 °C.
  The CL of the pointer will be ±2 angular degrees of the centerline of the tick mark that indicates this temperature.

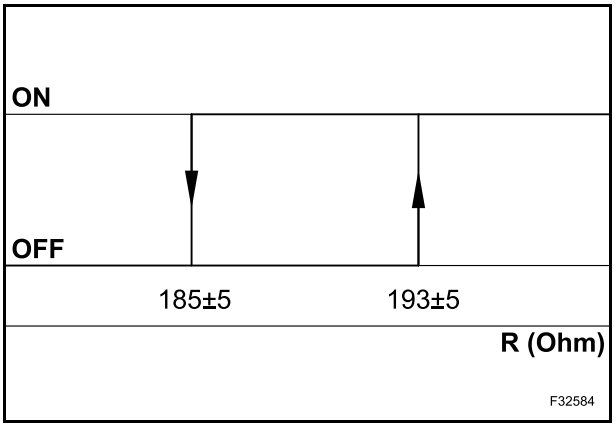
The same range of temperature is used for powershift and powershuttle transmissions. The gauge will move 9 angular degrees at key-on in the clockwise position to replicate the current production cluster behavior. This is necessary due to the cool temperatures present when the unit is working in backhoe position. In case the sender is disconnected, the gauge has to go down to home position. Reconnecting the sensor will make the error code inactive and the gauge has to return to the correct position. Both the movements have to be uniform.
A stepper motor will drive the transmission oil temperature gauge. The gauge accuracy should be less than or equal ± 2%. Needle calibration has never to be lost for any external condition. During cranking, the needle movement shall be frozen in order to inhibit any spurious movement of it.

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FUEL LEVEL GAUGE

When a certain low fuel level is reached, the relevant “low fuel” lamp will be lit according to the following logic. The filtering of the data read is obtained with a hysteresis on the resistance value joined to a delay time of 2 seconds.
Ohmic parameter threshold and delay time value must be kept in NVM. Lamp activation depends on values used for needle movement; this means that at key-on the low fuel level warning is active if the cluster sees a resistance value greater the table below.



Resistance values used are as follows:
The fuel level gauge will indicate the fuel level of the vehicle tank. The gauge dial will be divided into two ranges: red and green. The red range will indicate a low fuel zone. The green range will indicate a non-low fuel zone. This gauge will be connected to a sensor that will provide specific a resistance to correlate to a specific fuel tank level.

Tank size	Empty value (X)	Red-green border (Y)	Full (Z) value	Fuel level indicated
133 l	320 ohms	186 ohms	6.5 ohms	30% with 18 angular degrees of gauge motion

- X = empty. The centerline (CL) of the pointer will be +0/-2 angular degrees of the centerline of this empty mark.
- Y = Red - Green threshold. The CL of the pointer will be +/-3 angular degrees of the centerline of this 1/2 mark.
- Z = full. The CL of the pointer will be +4/-0 angular degrees of the centerline of this full mark.

In case the sender is disconnected, the gauge has to go down in empty position. Reconnecting the sensor the gauge has to return to the correct position. Both the movements have to be uniform.
A stepper motor will drive fuel level gauge. The gauge accuracy should be less than or equal ± 2%.
Needle calibration has never to be lost for any external condition. During cranking, the needle movement shall be frozen in order to inhibit any spurious movement of it.

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4.8 WARNING SYSTEM

The diagnostic has to inform the operator regarding all the operating conditions of the loader backhoe which are out of range. These conditions are different from each other:

- Warnings
- Error codes
- Faults on the system
- Action Required

1. We can define warnings as all those situations that could be dangerous for the loader backhoe or for the operator. The diagnostic will turn the display Red or as well as activate the buzzer; the display will show an icon symbol that identifies the occurring problem.
2. There are conditions in which the diagnostic detects one of its sensors out of order: in this case it will generate an error code. According to the severity of the failure, it will control the relevant warning lamp and the audible alarm: the display will display the appropriate Icon together with the error code number.
3. If it is necessary to inform the operator that he/she has done an incorrect maneuver, or that he/she must perform a special operation (Required action), the diagnostics will display an icon again or will activate the relevant audible alarm.

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ALARM ACTIVATION

Non Critical	A failure is present but the operator can continue his work: the purpose is to warn him regarding the presence of the fault. This will be a 1 second beep every 30 seconds.
Critical	A serious fault that can affect either the safety of the operator or the damage of the loader backhoe is present: the operator shall stop the loader backhoe. This will be a continuous alarm.
Action Required	The system is asking for a certain maneuver from the operator in order to return to the normal functionality. This will be a continuous alarm.
Safety	The system purpose is to warn the operator regarding the presence of a dangerous situation for his safety. This will be a continuous alarm.
General Sound	There are some condition in which there is the need of an activation of the audible alarm. This is a one second beep to draw the operator's attention to the instrument cluster.

Whenever an audible alarm activation is related to an icon visualization, this icon should remain displayed at least for 4 seconds in order to give the possibility to the operator to understand the cause of the alarm activation.
When many warnings with different priority occur, the audible alarm is related to the higher priority warning.
When a warning activates with an audible alarm different from the current one, the corresponding icon must be displayed simultaneously.
If a warning lamp dedicated to a function is associated to the activation cause of the audible alarm, the warning lamp will activate together with the audible alarm.

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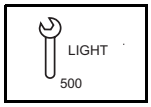
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4.9 MAINTENANCE

Two different kinds of maintenance will be available:
- light maintenance;
- heavy maintenance.

LIGHT MAINTENANCE

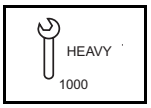
From 2 hours before the set value, display on the display the “light maintenance symbol” at every key on for one second after cranking; after this, the last selected icon will be visualized on the display. The hours shown will be the hours when light maintenance is required, not the standard hours displayed by the hourmeter.



Amber-coloured lighting

HEAVY MAINTENANCE

From 10 hours before the set value, display on the display the “heavy maintenance symbol” at every key on and should last for one second after cranking. After cranking after this, the last selected icon will be visualized on the display. The hours shown will be the hours when light maintenance is required, not the standard hours displayed by the hourmeter.

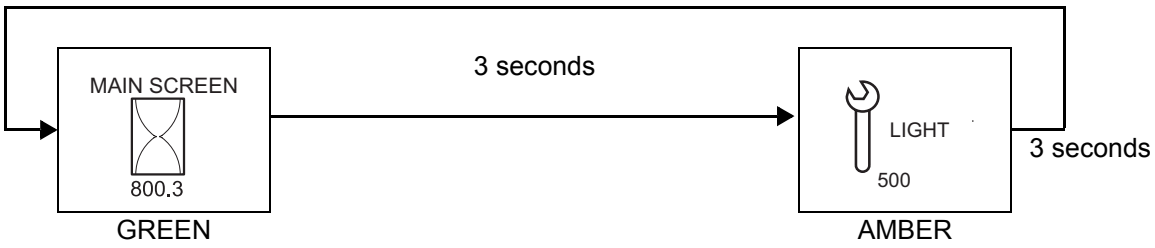


Amber-coloured lighting

NOTE: the symbols will show up as follows once the set value is reached, and the customer clears the feature with a key cycle.

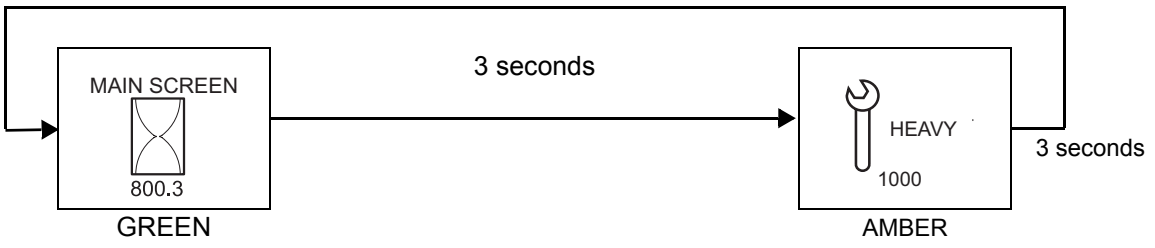
DISPLAY FUNCTION

When the hourmeter reaches the light service interval



Audible alarm for 1 second when displaying either service interval for the first time

When the hourmeter reaches the heavy service interval



Audible alarm for 1 second when displaying either service interval for the first time

Since heavy maintenance contains light maintenance the following will be shown:
500 - Light
1000 - Heavy
1500 - Light
2000 - Heavy
The service indicator message will be cleared with a single key cycle

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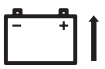
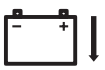
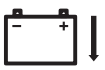
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4.10 WARNING MESSAGES

Function	Lamp	Alarm	Lamp	Display lamp	Condition	DTC	SA	Description	Priority	Color
Engine coolant too high	STOP	Continuous			Coolant above 112 °C for 5 seconds	1002	VCM	Coolant temperature signal - Above normal	1	Red
Engine oil pressure too low	STOP	Continuous			Pressure < 26 bar 500> rpm	3028	ECU	Oil pressure sensor - pressure too low	1	Red
Transmission oil pressure too low	STOP	Continuous			Switch closed to ground for 25 seconds	1008	VCM	The engine must be running with switch closed for 25 seconds	1	Red
Malfunction	STOP	Continuous			5 seconds without message	1051	ECU	Timeout of message	1	Red
Malfunction	STOP	Continuous			25 seconds without message	1053	ECU	Timeout of message	1	Red
Malfunction	STOP	Continuous			5 seconds without message	1054	VCM	Timeout of message engine temperature	1	Red
Malfunction	STOP	Continuous			5 seconds without message	1055	VCM	Timeout of message inlet/ exhaust	1	Red
Malfunction	STOP	Continuous			5 seconds without message	1056	VCM	Timeout of message engine fluid	1	Red
Malfunction	STOP	Continuous			5 seconds without message	1057	VCM	Timeout of message vehicle electrical	1	Red
Malfunction	STOP	Continuous			5 seconds without message	1059	VCM	Timeout of message display	1	Red
Transmission oil temperature too high	STOP	Continuous			Transmission oil above 115 °C for 5 seconds	1009	VCM	Transmission oil temperature limit reached	1	Red

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Function	Lamp	Alarm	Lamp	Display lamp	Condition	DTC	SA	Description	Priority	Color
General display message		Continuous			DTC's 3000 - 3366			Only display with display request	1	Red
One touch idle active						N/A	VCM		1	Red
Parking brake engaged		Continuous, if vehicle is in gear			Switch closed to ground	N/A	VCM	This prevents damaging the parking brake	2	Red
Brake temperature too high		Continuous			Sender temperature over 152 °C for 5 seconds	1006	VCM	Warns customer before brake fade	2	Red
Brake fluid level low		Continuous			Switch closed to Vbat for 5 seconds	1007	VCM		2	Red
Engine oil pressure too high		Continuous			Pressure depends on speed	3032	ECU		2	Red
Battery charge voltage too high		Continuous				3051	ECU	Battery voltage too high	2	Red
Battery charge voltage too high		Continuous			Supply source above 16 V for 5 seconds	1014	VCM	Supply battery voltage above 16 V	2	Red
Battery charge voltage too low		Continuous				3052	ECU	Battery voltage too low	2	Red
Battery charge voltage too low		Continuous			Supply source below 11 V for 5 seconds	1015	VCM	Supply battery voltage below 11 V	2	Red
Alternator unable to charge		Continuous			Alternator L+ terminal under 1.5 V for 5 seconds	1050	VCM	Alternator unable to charge	2	Red
Foot accelerator signal out of range		One second alarm every 30 seconds			IVS not changing state in 300 ms	1010	VCM	Foot accelerator sensor - not plausible	2	Amber

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Function	Lamp	Alarm	Lamp	Display lamp	Condition	DTC	SA	Description	Priority	Color
Foot accelerator signal out of range		One second alarm every 30 seconds			Accelerator above 4.75 V for 5 seconds	1011	VCM	Foot accelerator sensor -signal above range	2	Amber
Foot accelerator signal out of range		One second alarm every 30 seconds			Accelerator under 0.25 V for 5 seconds	1012	VCM	Foot accelerator sensor -signal below range	2	Amber
Foot accelerator signal out of range		One second alarm every 30 seconds				1013	VCM	Foot accelerator sensor -no signal	2	Amber
Foot accelerator signal out of range		One second alarm every 30 seconds			Accelerator above 9 V for 5 seconds	1029	VCM	Foot accelerator sensor - shorted high to Vbat	2	Amber
Foot accelerator signal out of range		One second alarm every 30 seconds			Accelerator under 0.5 V for 5 seconds	1030	VCM	Foot accelerator sensor - shorted low to Vbat	2	Amber
Foot accelerator 5 V supply		One second alarm every 30 seconds			Accelerator above 5.1 V for 5 seconds	1023	VCM	Foot accelerator supply voltage too high	2	Amber
Foot accelerator 5 V supply		One second alarm every 30 seconds			Accelerator under 4.9 V for 5 seconds	1024	VCM	Foot accelerator supply voltage too low	2	Amber
Foot accelerator 5 V supply		One second alarm every 30 seconds			Accelerator above 9 V for 5 seconds	1025	VCM	Foot accelerator supply shorted high to Vbat	2	Amber
Foot accelerator 5 V supply		One second alarm every 30 seconds			Accelerator under 0.5 V for 5 seconds	1026	VCM	Foot accelerator supply shorted low to ground	2	Amber

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Function	Lamp	Alarm	Lamp	Display lamp	Condition	DTC	SA	Description	Priority	Color
Hand accelerator signal out of range		One second alarm every 30 seconds			Accelerator above 4.75 V for 5 seconds	1035	VCM	Hand accelerator sensor -signal above range	2	Amber
Hand accelerator signal out of range		One second alarm every 30 seconds			Accelerator under 0.25 V for 5 seconds	1036	VCM	Hand accelerator sensor -signal above range	2	Amber
Hand accelerator signal out of range		One second alarm every 30 seconds				1037	VCM	Hand accelerator sensor - no signal	2	Amber
Hand accelerator signal out of range		One second alarm every 30 seconds			Accelerator above 9 V for 5 seconds	1038	VCM	Hand accelerator sensor - shorted high to Vbat	2	Amber
Hand accelerator signal out of range		One second alarm every 30 seconds			Accelerator under 0.5 V for 5 seconds	1039	VCM	Hand accelerator sensor - shorted low to ground	2	Amber
Hand accelerator 5 V supply		One second alarm every 30 seconds			Accelerator above 5.1 V for 5 seconds	1031	VCM	Hand accelerator supply voltage too high	2	Amber
Hand accelerator 5 V supply		One second alarm every 30 seconds			Accelerator under 4.9 V for 5 seconds	1032	VCM	Hand accelerator supply voltage too low	2	Amber
Hand accelerator 5 V supply		One second alarm every 30 seconds			Accelerator above 9 V for 5 seconds	1033	VCM	Hand accelerator supply shorted high	2	Amber
Hand accelerator 5 V supply		One second alarm every 30 seconds			Accelerator under 0.5 V for 5 seconds	1034	VCM	Hand accelerator supply shorted low	2	Amber

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Function	Lamp	Alarm	Lamp	Display lamp	Condition	DTC	SA	Description	Priority	Color
Seat not in driving position		Continuous		N	Switch closed to ground with vehicle in gear and no park brake	N/A	VCM	This must have a debounce time of less then 500 ms	2	Amber
Boost air temperature too high		One second alarm every 30 seconds			Boost temperature over 88 °C for 5 seconds	1018	VCM	Engine over operating boost air temperature	3	Amber
Engine coolant too high		One second alarm every 30 seconds			Coolant above 106 °C for 5 seconds	1019	VCM	Engine over operating coolant temperature		Amber
Engine coolant too high		One second alarm every 30 seconds				3007	ECU	Coolant temperature signal source high	3	Amber
Transmission oil above 105 °C		One second alarm every 30 seconds			Coolant above 105 °C for 5 seconds	1020	VCM	Transmission over operating temperature	3	Amber
Fuel temperature too high		One second alarm every 30 seconds			Fuel over 82 °C for 5 seconds	1021	VCM	Fuel over operating temperature	3	Amber
Fuel temperature too high		One second alarm every 30 seconds				3015	ECU	Fuel temperature signal source high	3	Amber
Fuel temperature too high		One second alarm every 30 seconds				3016	ECU	Fuel temperature signal no signal	3	Amber
Air filter restriction		One second alarm every 30 seconds			Switch closed to ground for 5 seconds	1001	VCM	Air filter threshold	4	Red

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Function	Lamp	Alarm	Lamp	Display lamp	Condition	DTC	SA	Description	Priority	Color
Air conditioning not functional		One second alarm every 30 seconds			Switch closed to Vbat for 5 seconds	1003	VCM	Air conditioning system pressure	4	Amber
Hydraulic filter restriction		One second alarm every 30 seconds			Switch closed to ground for 5 seconds	1004	VCM	Hydraulic filter threshold	4	Red
Fuel contaminated with water		One second alarm every 30 seconds			Display message	1022	VCM		4	Amber
Fuel level sensor		One second alarm every 30 seconds			Fuel sender above 9 V for 5 seconds	1043	VCM	Fuel sender shorted high - park gauge	4	Amber
Fuel level sensor		One second alarm every 30 seconds			Fuel sender below 0.5 V for 5 seconds	1044	VCM	Fuel sender shorted low - park gauge	4	Amber
Fuel level sensor		One second alarm every 30 seconds			Input is switched battery for 5 seconds	1045	VCM	Fuel sender open circuit - park gauge	4	Amber
Transmission temperature sensor		One second alarm every 30 seconds			Transmission temperature sender above 9 V for 5 seconds	1046	VCM	Transmission temperature sender shorted high	4	Amber
Transmission temperature sensor		One second alarm every 30 seconds			Transmission temperature sender below 0.5 V for 5 seconds	1047	VCM	Transmission temperature sender shorted low	4	Amber
Transmission temperature sensor		One second alarm every 30 seconds			Input is switched battery for 5 seconds	1048	VCM	Transmission temperature open circuit	4	Amber

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Function	Lamp	Alarm	Lamp	Display lamp	Condition	DTC	SA	Description	Priority	Color
Brake temperature sensor		One second alarm every 30 seconds			Sender over 1000 ohms for 5 seconds	1049	VCM	Brake temperature sender out of range	4	Amber
General display message		One second alarm			DTC's 3000 - 3366		VCM	Only display with display request	4	Amber
Low fuel warning		One second alarm					VCM	Low fuel - must stay on for remaining key cycle	5	Amber

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5. STARTING SYSTEM

5.1 DESCRIPTION AND OPERATION

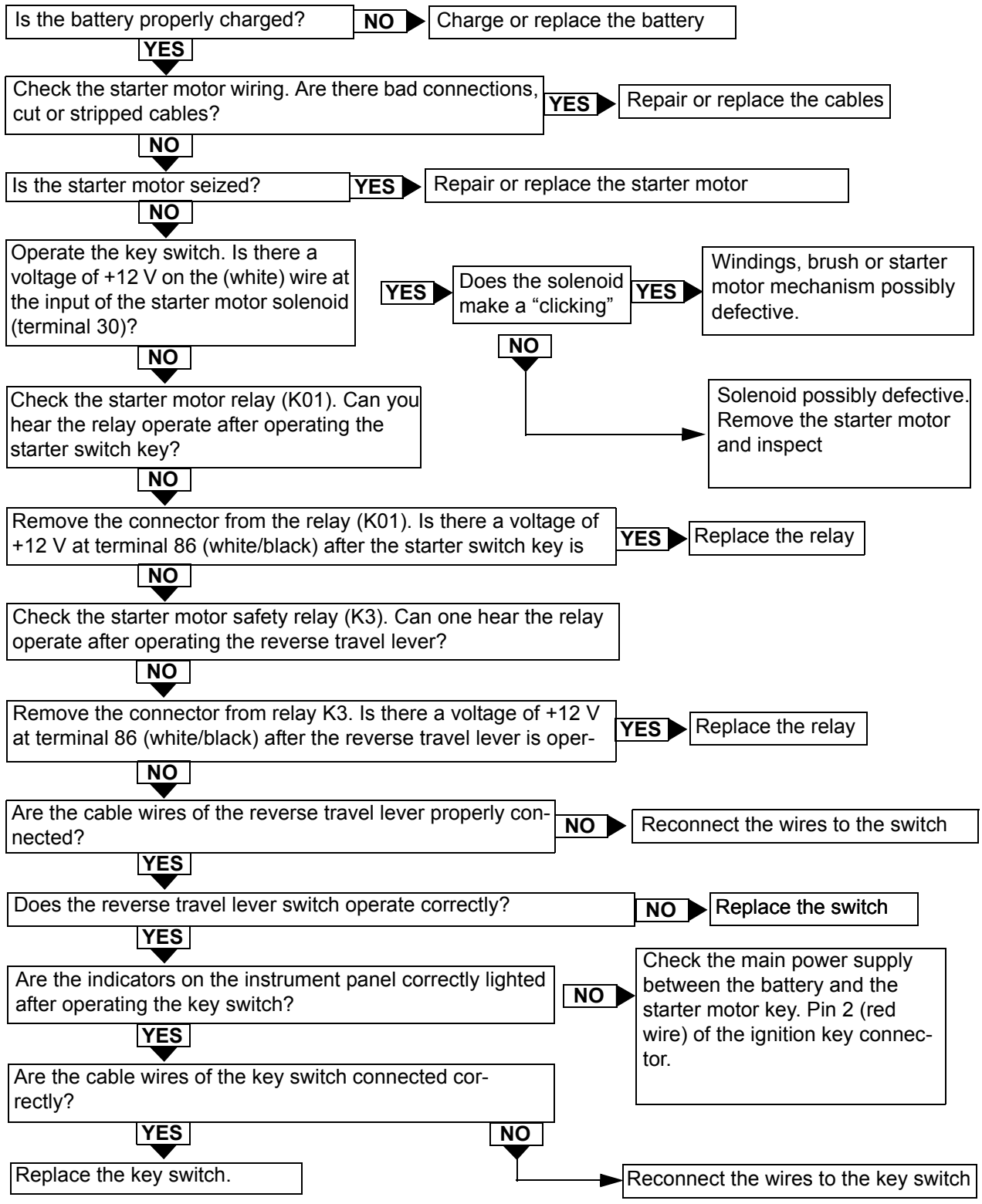
The system includes a key switch, a reinforcedwiring, a starter motor and a relay-solenoid valve assembly.
This is a starter motor with built-in solenoid and positive engagement drive system.
When the key switch is operated with the forward and reverse travel lever in the neutral position, the solenoid windings are energized and cause the mobile core to be drawn inside the solenoid.
This movement causes the drive pinion to mesh with the ring gear on the engine flywheel. When the ring gear and the drive pinion are engaged, the mobile core of the solenoid closes a series of contacts enabling the battery to power the field coils directly and provide the entire power to the starter motor.
The starter motor contains only a single set of contacts and a mobile core, which closes the contacts completely, even if the teeth of the drive pinion and the gear are not aligned. In this case, a spring is compressed and forces the complete engagement of the pinion as soon as the starter motor starts rotating.
Once the ignition is turned off, the solenoid and the starter motor are de-energized. The solenoid’s recoil spring causes the drive pinion to be uncoupled and the contacts of the solenoid to reopen.

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5.2 FAULT FINDING

The motor does not start when the starter switch key is operated and the transmission is in the neutral position.



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CHECKING THE STARTER MOTOR CIRCUIT

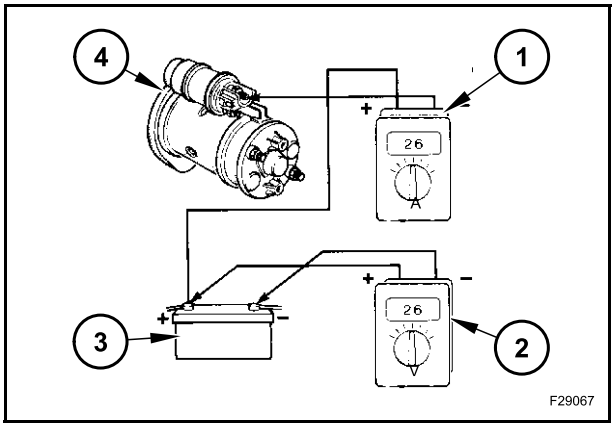
To troubleshoot the starter motor circuit rapidly and easily, it is recommended that a battery-starter motor testing device (quick discharge) be used, which includes a 0-20 V voltmeter and a 0-500 A ammeter to detect problems in the starter motor circuit.
Use a testing device in accordance with the manufacturer's instructions. If a testing device of the type indicated is not available, use a standard 0-20 V voltmeter and a 0-500 A ammeter to check the operation of the starter motor on the vehicle.
Before testing:

- Check that the battery is properly charged.
- Check the state of the starter motor circuit, by making sure that no wire is cut or stripped and that the connections are not loose.
- Check that the motor is not seized.

Current draw of the starter motor circuit:

1. Disconnect the ground cable (negative) from the battery (3).
2. Disconnect the positive cable from the battery on the solenoid of the starter motor. Connect the positive cable of the ammeter (1) to the positive terminal of the battery and the negative cable to the input terminal of the solenoid.
3. Reconnect the ground cable (negative) of the battery to the negative terminal of the battery.
4. Connect the positive cable of the voltmeter (2) to the positive terminal of the battery and the negative cable of the voltmeter to the negative terminal of the battery.
5. Disconnect the injection pump fuel inlet cut-off wire from the solenoid.
6. Start the motor and observe the values indicated by the voltmeter and ammeter. The voltage must remain steady at around 12 V with a current draw of 250 to 300 A.

- If the current draw is within the indicated range, the starter motor (4) is operating correctly. If the voltage reduces during the test, refer to the "Resistance of the starter motor circuit" section below.
- If the current draw is higher than the specified range, check the circuit as indicated below. If tests of the starter motor circuit have proved satisfactory, the starter motor is defective and must be removed in order to identify the source of the problem.
- If the current draw is less than the specified range, the starter motor is defective and must be removed in order to identify the source of the problem.



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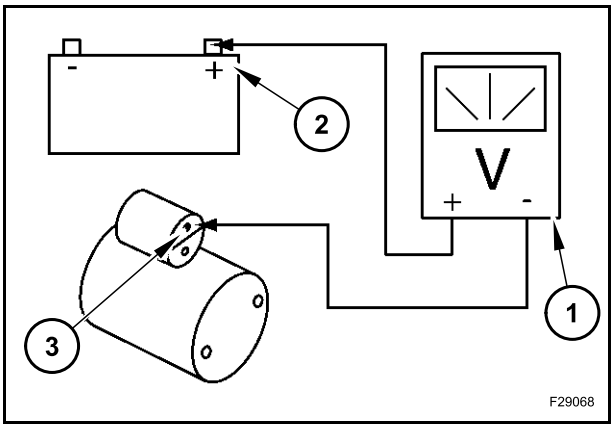
RESISTANCE OF THE STARTER MOTOR CIRCUIT
(Voltage lowering)

If the current draw is excessive, check the circuit by noting down the voltage lowers at various components of the circuit.

IMPORTANT: disconnect the injection pump fuel inlet cut-off wire from the solenoid.

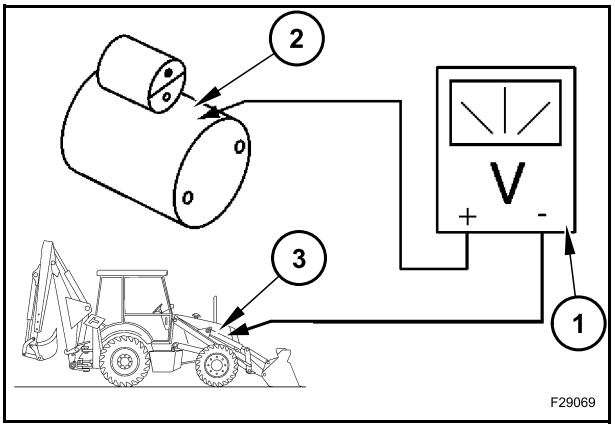
Positive cable of the battery:

1. Connect the positive cable of the voltmeter (1) to the positive terminal of the battery (2).
2. Connect the negative cable of the voltmeter (1) to the battery terminal of the starter motor solenoid valve (3).
3. Start the starter motor and observe the reading on the voltmeter. If the voltage drop exceeds 0.2 V, check and retighten the cable connections. Check the voltage again. If it is still excessive, replace the cable.



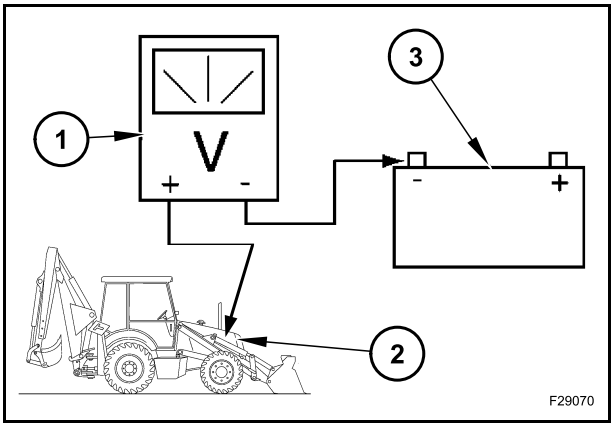
Starter motor connections to ground

1. Connect the positive cable of the voltmeter (1) to the body of the starter motor (2).
2. Connect the negative cable of the voltmeter (1) to the motor block (3).
3. Start the starter motor and observe the reading on the voltmeter. If the voltage drop exceeds 0.2 V, check and retighten the cable connections, check the ground connections between the starter motor clamp and the undercarriage.



Ground cable of the battery:

1. Connect the positive cable of the voltmeter (1) to the motor block (2).
2. Connect the negative cable of the voltmeter (1) to the negative terminal of the battery (3).
3. Start the starter motor and observe the reading on the voltmeter. If the voltage drop exceeds 0.2 V, check and retighten the ground cable connections. Check the voltage again. If it is still excessive, replace the ground cable.



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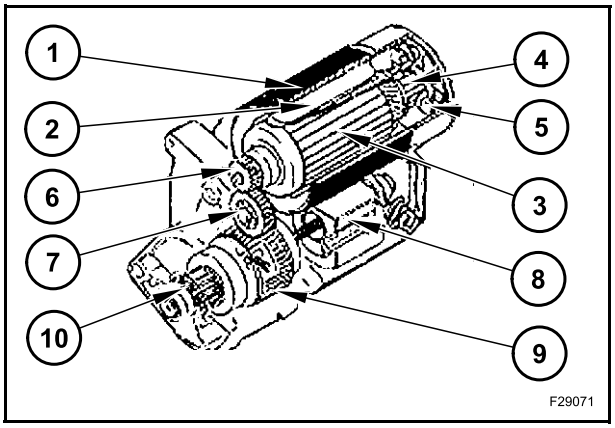
5.3 STARTER MOTOR

SPECIFICATIONS

Manufacturer	Denso
Voltage	12 V
Rated power	2.7 kW
Starting system	Positive
Operating time	30 s
Direction of rotation	Clockwise seen from the pinion side
Weight	8.4 kg
Maximum consumption without load at 11 V and 3000 rpm minimum	200 A maximum
Maximum consumption with a torque of 19.6 Nm at 8 V and 1130 rpm minimum	600 A maximum
Maximum consumption when shimming at 3 V with a torque of 39.2 Nm minimum	1400 A maximum

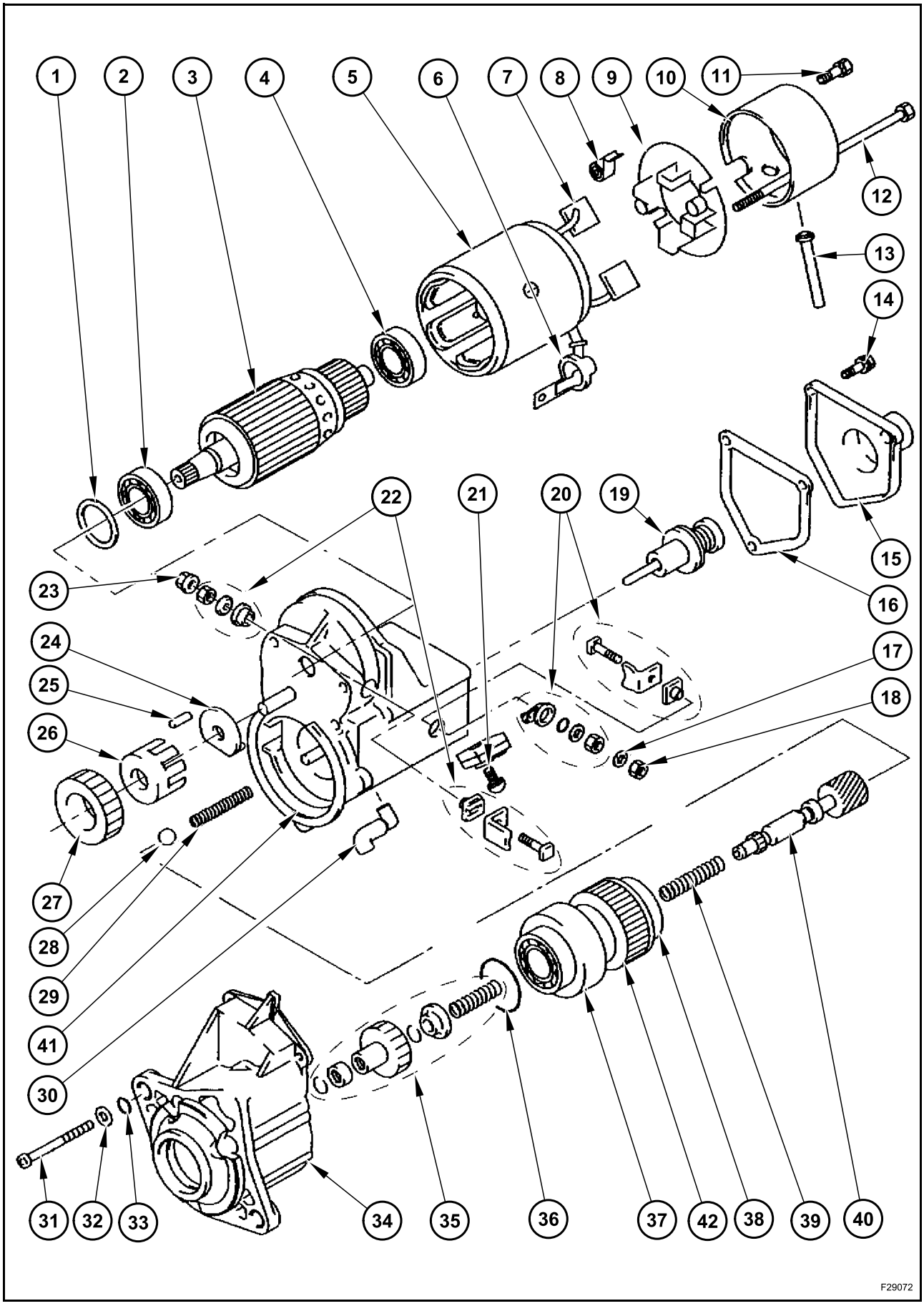
MAIN COMPONENTS

1. Motor
2. Induction coils
3. Armature
4. Commutator
5. Brush assembly
6. Pinion gear
7. Intermediate pinion
8. Solenoid
9. Clutch
10. Drive pinion



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1. Shim
2. Bearing
3. Armature
4. Bearing
5. Coils housing
6. Protection
7. Brush spring
8. Brush assembly
9. Disc
10. Cover
11. Screw
12. Screw
13. Drain
14. Screw
15. Protection
16. Gasket
17. Washer
18. Nut
19. Rod
20. Connection assembly
21. Screw
22. Connection assembly
23. Nut
24. Ring
25. Roller
26. Cage
27. Pinion
28. Ball
29. Spring
30. Drain
31. Screw
32. Washer
33. O-ring
34. Flange
35. Pinion, rings and spring assembly
36. O-ring
37. Bearing
38. Bearing
39. Spring
40. Shaft
41. Body
42. Clutch assembly

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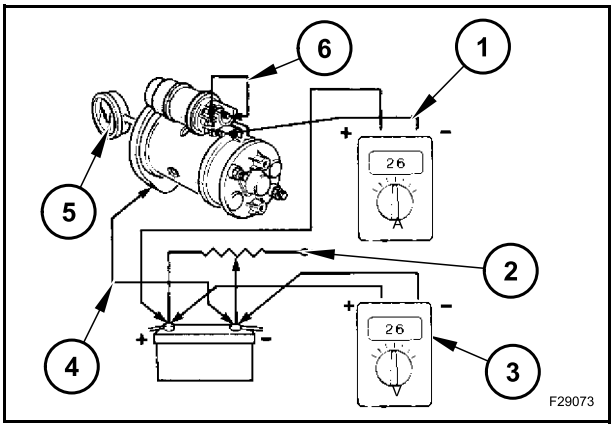
REMOVING AND INSTALLING THE STARTER MOTOR

- Disconnect the ground cable (negative) from the battery.
- Remove the rear protection cover and disconnect all cables connected to the starter motor.
- Remove the three retaining screws of the starter motor and remove the starter motor.
- To install the starter motor again, proceed in the reverse order to that of removal.

TEST BENCH CHECK

Checking the starter motor without load

NOTE: before carrying out the test, check that the battery is fully charged then obtain a battery-starter motor testing device (quick discharge) and a carbon cell (variable load resistance).



- Lock the starter motor in a vice with soft jaws.
- Connect the negative cable (4) of the battery to the mounting flange of the starter motor.
- Connect a short cable (6) between the solenoid battery wire and the terminals of the solenoid switch.
- Connect the positive cable of the voltmeter (3) to the positive terminal of the battery and the negative cable to the negative terminal of the battery, the positive cable of the ammeter (1) to the positive terminal of the battery and the negative terminal the solenoid valve battery or to the starter motor clamp.
- Install a tachometer (5) at the end of the armature shaft. Activate the starter motor by adjusting the carbon cell (2) to obtain a voltage of 11 V. When the armature is rotating at 3000 rpm, the maximum current draw must not exceed 200 A.
- If the starter motor does not operate in these conditions, check that the field coils are not grounded, that the armature is not rubbing and that its shaft is not deformed.

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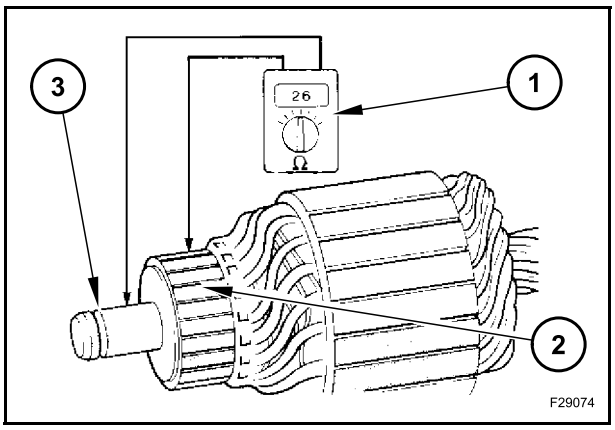
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Armature

- The surface of the commutator must be clean and without traces of burns. If necessary, remove traces of burns using fine sandpaper. Do not use emery cloth. Then, clean the commutator with a cloth soaked in gasoline.
- After rectifying the commutator, polish it with fine sandpaper, then wipe it with a cloth soaked in gasoline.

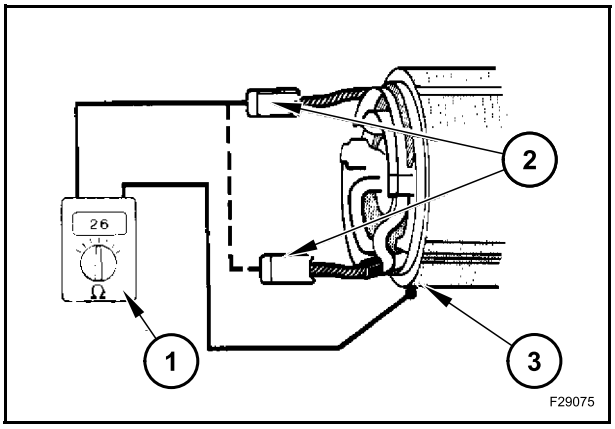
NOTE: make sure not to graze the metal of the commutator during rectification of insulating notches.

- The resistance of the armature insulation may be checked by connecting an ohmmeter (1) between the blades of the commutator (2) and the armature shaft (3). The resistance must be infinite (no continuity).
- To check that the armature is not short-circuited, a special device for armatures must be used. The other solution is to replace the armature.
- If the circumference of the armature has come into contact with the starter pole shoes, the bearings of the armature are probably excessively worn out. First check that the starter pole shoes have been tightened and that the armature rotates without any concentric defect. If necessary, replace the armature bearings.



Field coils

- To check the resistance of the field coil insulation, connect an ohmmeter (1) between the brushes of each induction coil (2) and a clean unpainted area of the body (3). The resistance must be infinite (no continuity).
- To check the continuity of the field coils, connect an ohmmeter between the brushes of each induction coil and the main supply terminal (the thickest braided wire). The resistance must be equal to 1 MW.
- If the field coils are defective, the entire assembly consisting of the body and the field coils must be replaced.



Drive pinion

- The drive pinion must only rotate clockwise. If the pinion is seized or turns in both directions or if its teeth are damaged, change the complete drive assembly.

NOTE: if the teeth of the drive pinion are damaged, also check the teeth of the engine flywheel ring gear.

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FAULT FINDING

PROBLEM	CAUSE	CORRECTION
The starter motor does not run (the magnetic switch makes no operating noise)	Poor battery specific gravity and level Poor ignition switch circuit connection or contact Malfunction of the coil or of the magnetic switch pull-in piston.	Inspect the battery. Replace the wiring harness and the ignition switch. Replace the magnetic switch.
The starter motor does not run (the magnetic switch makes an operating noise)	Poor battery specific gravity and level Poor start-up circuit contact Poor magnetic switch contact Motor assembly malfunction (e.g. layer short, brush wear)	Inspect the battery. Repair the wiring harness. Replace the magnetic switch. Repair or replace the motor assembly.
The starter motor runs too slowly	Poor magnetic switch contact Motor assembly malfunction (e.g. layer short, brush wear)	Replace the magnetic switch. Repair or replace the motor assembly.
The starter motor running cannot crank the engine	Pinion gear does not engage with ring gear Clutch sliding	Repair or replace the clutch and the control lever. Replace the clutch.
Anomalous noise	Abnormal bushing wear Wear on pinion gear or ring gear tooth tips Poor pinion gear sliding	Replace the bushing. Replace the clutch and the ring gear. Lubricate or replace the clutch.
Pinion gear springing out Field coil loss Magnetic switch coil burnt, etc.	Poor ignition switch return Pinion gear disengagement fault caused by a coil short circuit in the magnetic switch.	Replace the ignition switch. Replace the magnetic switch.

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6. ALTERNATOR

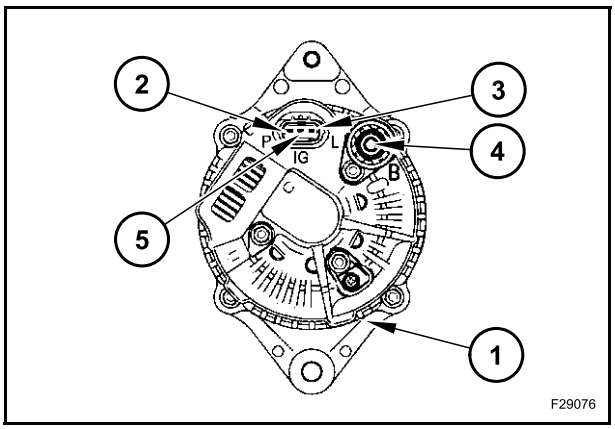
6.1 SPECIFICATIONS

Manufacturer	Denso
Rated voltage	12 V
Polarity	Negative terminal grounded
Current	90 A
Minimum charging speed	1400 rpm
Maximum speed	9000 rpm
Operating temperature	-30 °C to 90 °C
Direction of rotation	Clockwise seen from the pulley side
Regulated voltage at 5000 rpm with 10 A at 25 °C	14.2 - 14.8 V
Maximum load that can be applied at terminal L	12 V, 3.4 W x 6

6.2 DESCRIPTION AND OPERATION

The alternator, installed on the motor, on the front RH side of the vehicle, is driven by the crankshaft pulley with the help of a belt. The alternator contains built-in regulators.

Current draw of the starter motor circuit:
When the ignition key is turned, a current of low intensity is sent by the battery to the field winding of the rotor (terminal IG).
At this stage, the indicator lamp (terminal L) turns on and the rotor is partially magnetized.
When the motor starts and the partially magnetized rotor rotates inside the stator, a three-phase alternating current is generated (terminal B+). A constant portion of this current is transformed into a direct current by three excitation diodes installed in the rectifier.
The direct current is sent as reinforcement through the field winding of the rotor.
Using this method an increase in the magnetic field of the rotor is obtained, as well as a rapid rise in the voltage and current generated at the output.
The luminosity of the indicator lamp decreases when the voltage generated at the output is increasing (terminal L). The indicator lamp goes out when the voltage at terminal “L” is equal to that of the battery.
The voltage continues to increase up to the value predefined by the regulator.
In case the alternator belt is broken, the voltage does not accumulate in the alternator and the load indicator lamp remains lighted to indicate the problem.

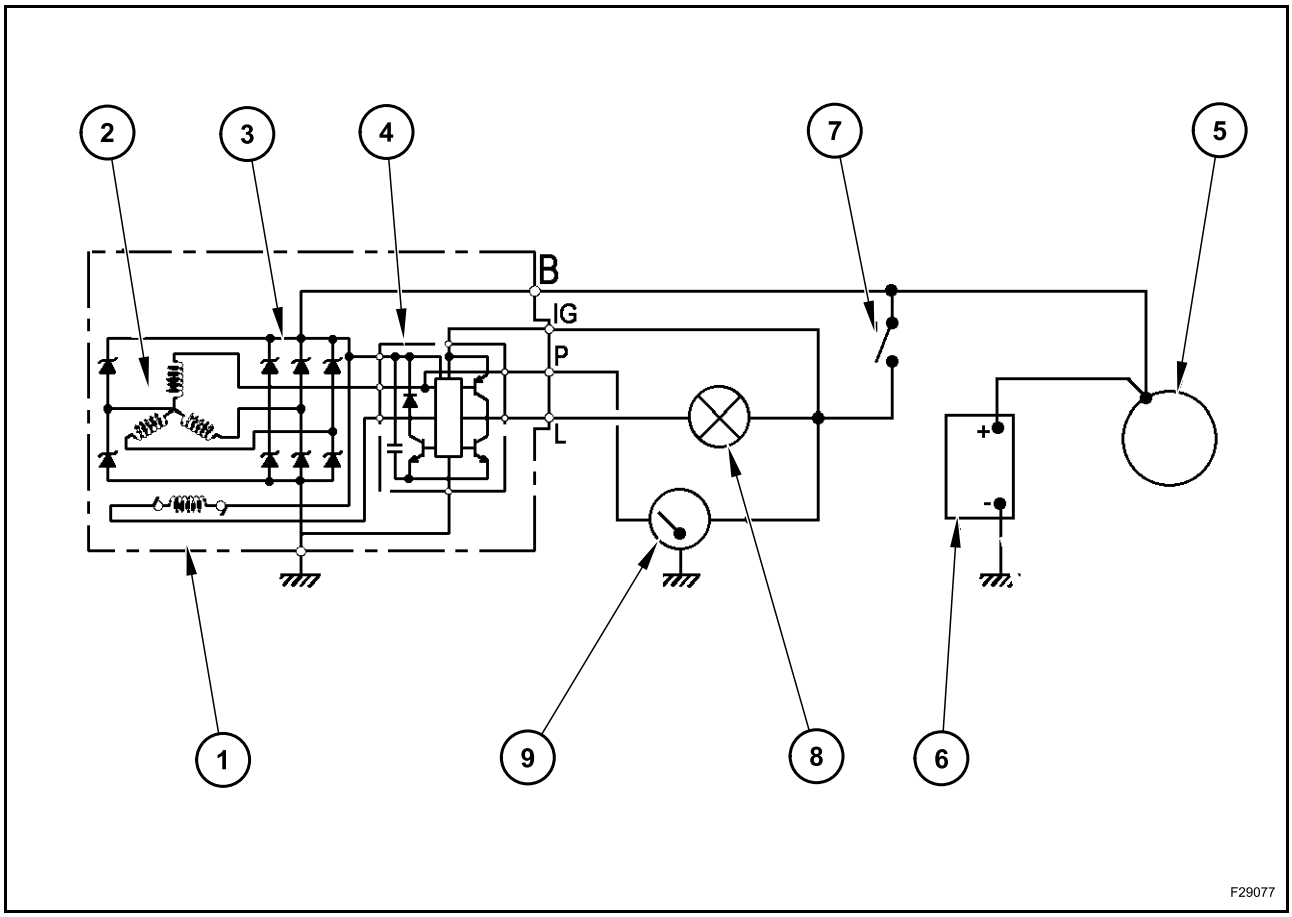


1. Ground connection
2. Terminal P: motor tachometer
3. Terminal L: charge indicator
4. Terminal B+: charge +12 V
5. Terminal IG: +12 V after ignition (10 A fuse)

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DIAGRAM OF THE CHARGING CIRCUIT

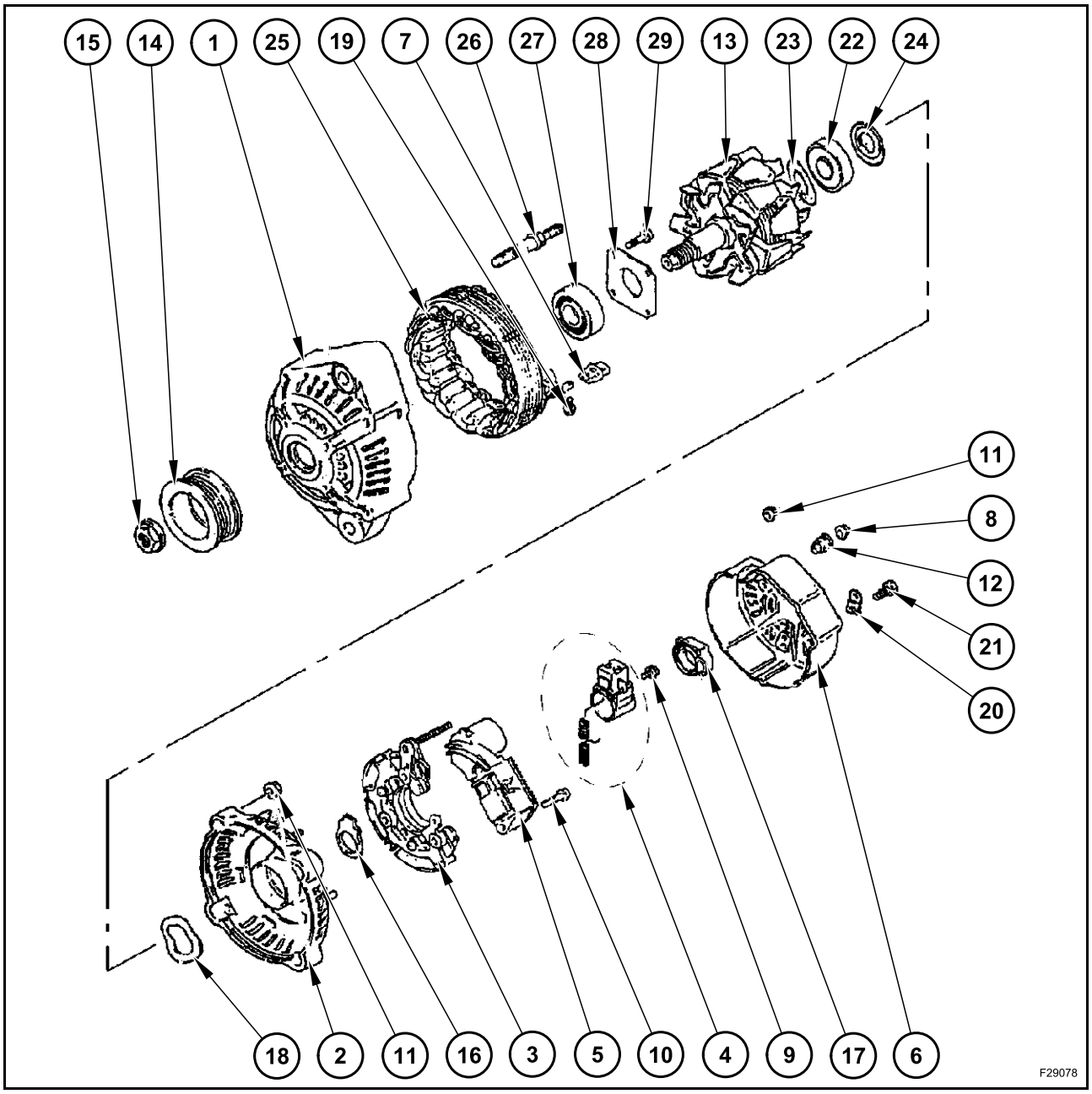


1. Alternator
2. Output winding of the rotor
3. Rectifier
4. Regulator
5. Starter motor
6. Battery
7. Key switch
8. Charge indicator
9. Speedometer

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6.3 COMPONENTS



1. Front housing
2. Rear housing
3. Rectifier
4. Brush holder
5. Regulator
6. Rear protective
7. Insulation ring
8. Insulation ring
9. Screw
10. Screw
11. Nut
12. Nut
13. Rotor
14. Pulley
15. Pulley nut
16. Sealing ring
17. Sealing ring
18. Washer
19. Screw
20. Electrical terminal
21. Screw
22. Bearing
23. Flange
24. Flange
25. Stator
26. Stud screw
27. Bearing
28. Plate
29. Screw

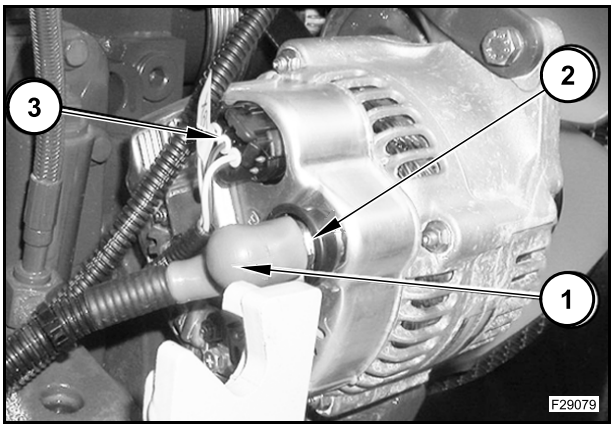
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6.4 REMOVAL

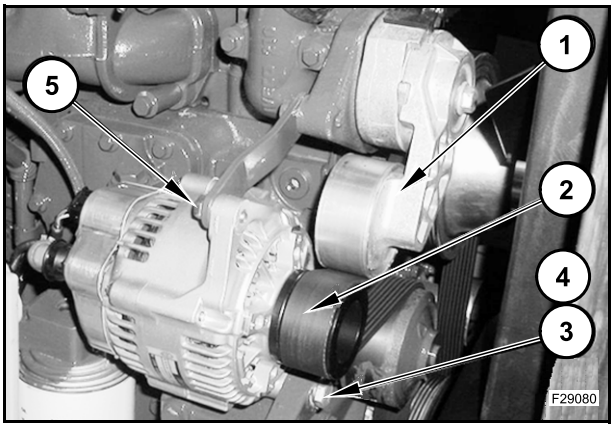
Electrical disconnections of the alternator

1. Disconnect the negative cable from the battery.
2. Disconnect the battery cable (1) from terminal B+ (2).
3. Disconnect the connector (3).



Removing the alternator

1. Free the tension roller (1) using a suitable wrench, then remove the belt (2).
2. Remove the screw (3) and the nut (4).
3. Remove the bolt (5).
4. Remove the alternator.



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6.5 PRELIMINARY CHECK AND TESTS

To prevent damage to components of the alternator charging circuit, the following precautions must be taken during maintenance:

- NEVER connect or disconnect a charging circuit connection, including the battery, when the motor is running.
- NEVER dead short to ground any component of the charging circuit.
- ALWAYS disconnect the ground cable from the battery (negative) to recharge the battery on the vehicle using a battery charger.
- ALWAYS respect the polarity when connecting the battery on the vehicle or when connecting an auxiliary starter battery to the motor.

IMPORTANT: connect the positive cable to the positive terminal and the negative cable to the negative terminal.

PRELIMINARY CHECKS

Before undertaking an electrical inspection, check the charging circuit and the electrical circuit carefully. Check the state of cables and the tightening of connections.

Checking the battery

Check each cell of the battery with a hydrometer. The battery must be charged at least 70% and be in good condition.

Checking the drive belt

Check that the belt and the pulley of the alternator are clean, without any trace of oil and grease and that they are in good condition.

Checking the indicator lamp

Turn the ignition key and check that the charge indicator is well lit.
If it is not fully lighted, check its bulb. If the bulb is OK, check the alternator wire connections as described in the “Preliminary tests” section below.
If the indicator lamp is lighted, start the motor and run it at a speed that is higher than the idling speed. The indicator lamp must turn off.
If the indicator lamp does not turn off, turn off the motor and disconnect the ground cable L. If the indicator lamp goes out, an alternator component is defective. Follow the instructions given in the “Checking the alternator components” section below.
If the indicator lamp stays lighted, look for a dead short to ground between the terminal “L” cable and the indicator lamp.

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PRELIMINARY TESTS

The preliminary tests may be carried out without removing the charging circuit components, these tests help check the following items:

- Connections of the alternator cables
- Charging current and regulated voltage of the alternator
- Voltage lowers in the alternator charging circuit
- Maximum flow of the alternator

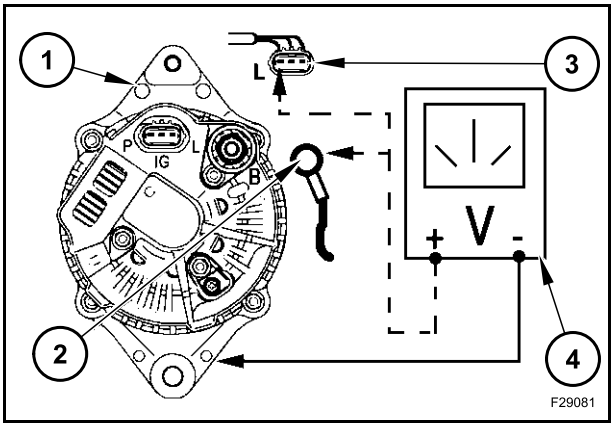
Required devices:

- Voltmeter (0-30 V, moving coil)
- Millivoltmeter (0-1 V)
- Ammeter (0-110 A, moving coil)
- Variable resistance of 1.5 Ohm, 110 A

NOTE: most testing instruments sold in shops group together several measurement functions in a single device. Use these devices in accordance with the manufacturer's instructions.

CHECKING THE CONNECTIONS OF THE ALTERNATOR CABLES

- Disconnect the battery.
- Disconnect the terminals B+ (2) and L (3) from the alternator.
- Reconnect the battery and turn the ignition key without starting the motor. Connect a voltmeter (4) between each terminal (B+ or L) and the ground (1). The voltmeter must show the battery voltage.
- If there is no battery voltage, the external cable has a continuity fault; in this case, check the entire circuit and carry out the necessary repairs.
- Connect the terminal L indicator lamp wire to the ground. The indicator lamp should turn on.
- Disconnect the battery and reconnect the cables to the alternator.



NOTE: if the indicator lamp does not turn on after having reconnected the alternator, the regulator of the alternator or the rotor circuits is defective. Make sure that terminal L is clean, then check the components of the alternator as indicated in this chapter.

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CHECKING THE CHARGING CURRENT AND THE REGULATED VOLTAGE

- Make sure that all electrical components are powered off and that the ignition is turned off (key on “off”).
- Disconnect the negative terminal from the battery and disconnect terminal B+ (4) from the alternator.
- Connect an ammeter (1) between the disconnected cable (3) and terminal B+ of the alternator.
- Connect a voltmeter (2) between terminal B+ of the alternator and the ground.
- Reconnect the battery. Start the motor and run it at a speed of 2000 rpm. Observe the values shown on the ammeter and the voltmeter.

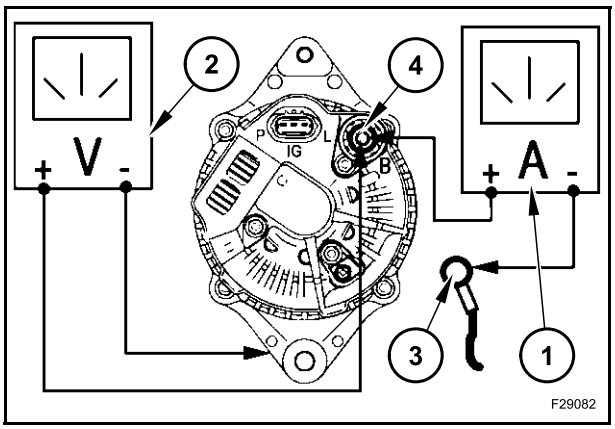
The voltage shown on the voltmeter should at first be too high and then should stabilize between 14.2-14.8 V when the value on the ammeter lowers below 10 A.

If the voltmeter stabilizes at a voltage greater than 14.8 V, the regulator of the alternator needs to be replaced.

On the other hand, if the voltmeter stabilizes below 14.2 V, a component of the alternator is defective or the resistance in the external connections of the charging circuit is too high.

If the ammeter indicates zero amps, an alternator component is defective.

Turn off the motor and carry out the operations described in the “Checking the alternator components”.



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CHECK THE VOLTAGE LOWERINGS IN THE CHARGING CIRCUIT

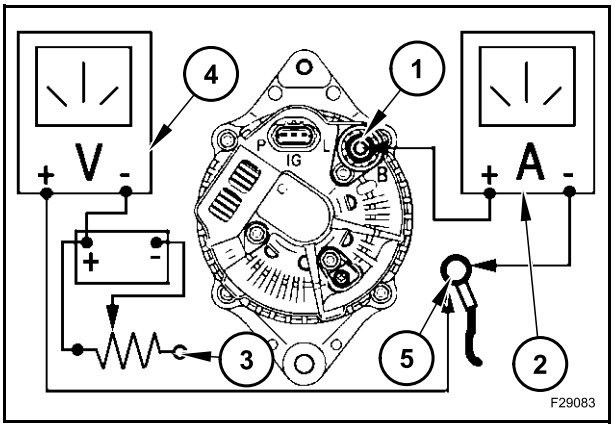
Voltage drop on insulated side

Check that the ignition is turned off (key on “off”).

- Disconnect the negative cable from the battery and disconnect cable B+ (1) from the alternator.
- Connect a millivoltmeter (4) between the positive terminal of the battery and cable B+ (5) (positive side on cable).
- Connect an ammeter (2) between terminal B+ of the alternator and cable B+ (negative side on cable).
- Reconnect the negative cable of the battery and connect a variable resistance (3) between the battery terminals by adjusting the cursor to the minimum current draw (maximum resistance).
- Start the motor and increase its speed to 2000 rpm.
- Gradually reduce the resistance until the ammeter shows 90 A.
- Observe the millivoltmeter, which must not indicate a value that is greater than 400 millivolts.

If the value exceeds 400 millivolts, the resistance of the external circuit is too high. If the output value of the alternator is not sufficient and the millivoltmeter indicates a value that is less than 400 millivolts, an alternator component is defective. Carry out the operations described in the “Checking the alternator components”.

- Stop the engine.



Voltage lower on ground side

- Check that the ignition is turned off (key on “off”).
- Check the same circuit as the one in the previous test, but by connecting the millivoltmeter (4) between the negative terminal of the battery and the alternator body (negative side on body).

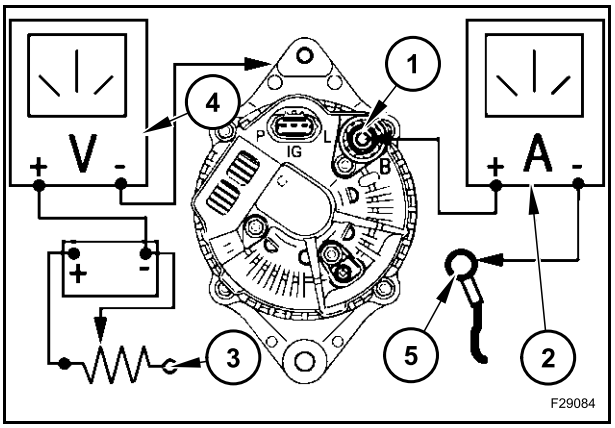
IMPORTANT: make sure that the variable resistance (3) is in the minimum current draw position (maximum resistance).

- Start the motor and increase its speed to 2000 rpm.
- Gradually reduce the resistance until the ammeter (2) shows 90 A.
- Observe the millivoltmeter, which must not indicate a value that is greater than 200 millivolts.

If the value exceeds 200 millivolts, the resistance of the external circuit is too high.

If the output value of the alternator is not sufficient and the millivoltmeter indicates a value that is less than 200 millivolts, an alternator component is defective. Carry out the operations described in the “Checking the alternator components”.

- Stop the engine.



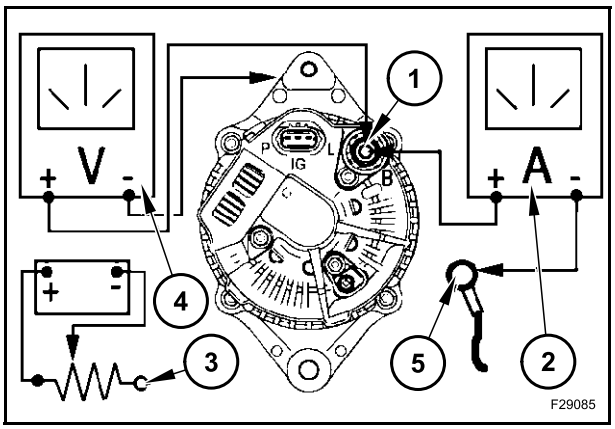
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CHECKING THE MAXIMUM OUTPUT OF THE ALTERNATOR

- Check that the ignition is turned off (key on “off”).
- Disconnect the negative cable from the battery and disconnect cable B+ (5) from the alternator.
- Connect an ammeter (2) between terminal B+ (1) of the alternator and the disconnected cable B+ (negative side towards the cable).
- Connect a voltmeter (4) between terminal B+ of the alternator and the ground.
- Reconnect the battery, start the motor and increase its speed to 2000 rpm.
- Gradually reduce the resistance (3) until the ammeter shows 90 A.
- Observe the voltmeter, which must not indicate a value that is less than 14.2 V.

If the value lowers below 14.2 V, an alternator component is defective.
Carry out the operations described in the “Checking the alternator components”.



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CHECKING THE ALTERNATOR COMPONENTS

Checking of components must be done only if the PRELIMINARY TESTS reveal an alternator defect which relates to the following components:

- Regulator
- Continuity of the rotor field winding
- Brushes, springs and slip rings

NOTE: these checks may be carried out without removing the alternator from the vehicle.
The alternator must be removed to check the other components of the alternator.
Refer to the “Removal” section in this chapter.

IMPORTANT: before disconnecting the cables from the alternator, make sure that the ignition is turned off (key on “off”) and the negative cable of the battery is disconnected.

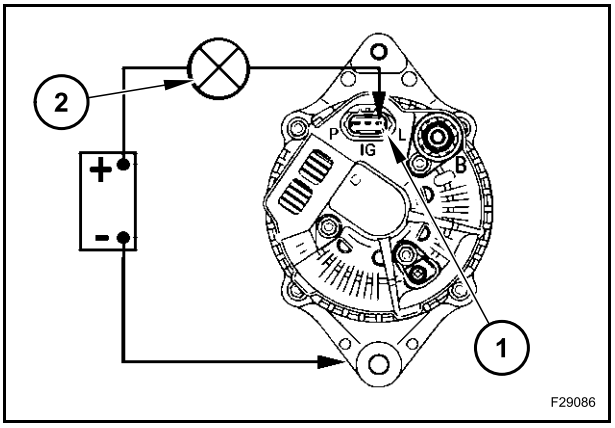
Required devices:

- 12 V battery
- Multimeter
- 2.2 W test lamp

CHECKING THE REGULATOR AND THE FIELD CIRCUIT OF THE REGULATOR

- Disconnect all cables from the alternator.
- Connect a 12 V battery and a 2.2 W test lamp (2) in series between terminal L (1) and the alternator body (negative side on body).
- The test lamp must turn on.

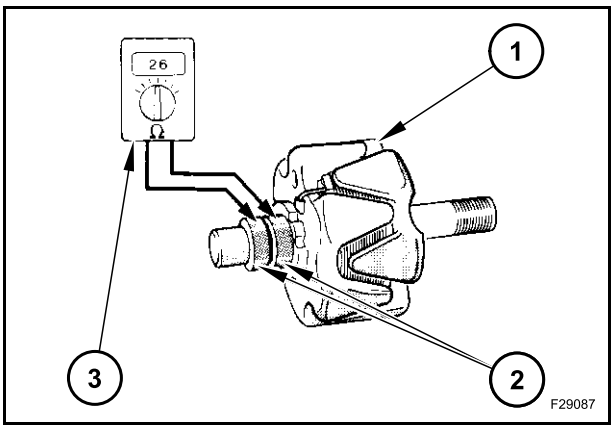
If the lamp does not turn on, the rotor circuit is defective. Check the brushes, the slip rings and the continuity of the rotor field windings.
If the inspection reveals that these components are in good condition, the defect may be due to the regulator.



CHECKING THE CONTINUITY OF THE ROTOR FIELD WINDING

- Remove the regulator with the brush holder.
- Connect an ohmmeter (3) between the two slip rings (2). The resistance must be 2.6 ohms at 20 °C.

If the resistance is not correct, replace the rotor (1) as described in the “Removal” section below.



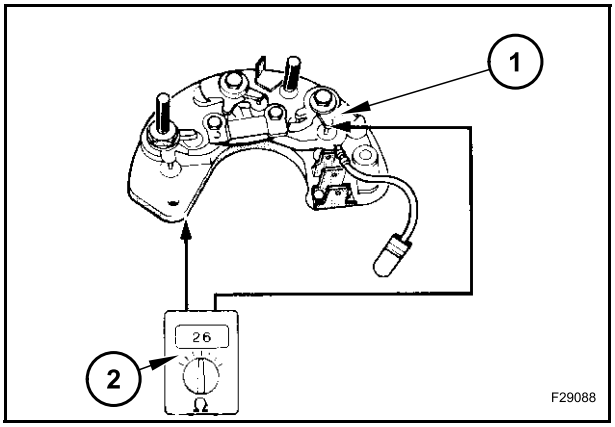
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RECTIFIER - CHECKING THE POSITIVE / NEGATIVE DIODES

Check each of the six diodes separately by proceeding as follows:

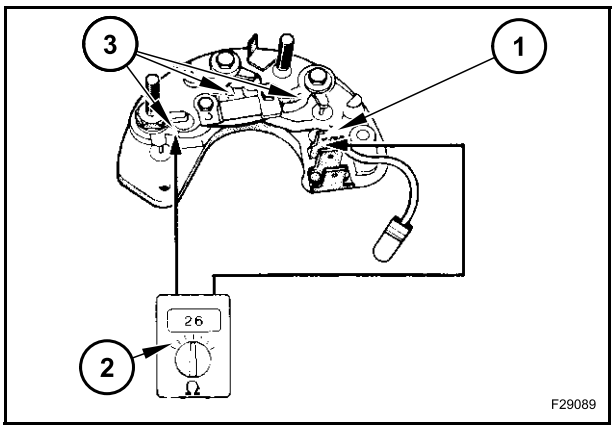
- Connect a multimeter (2) in series with one of the diodes. Place one wire of the multimeter on the connecting pin (1) of the diode and the other wire on the plate where the diode is installed.
- Note down the value of the resistance indicated by the multimeter. Reverse the wires of the multimeter.
- The multimeter should indicate infinite resistance (open circuit) only during the first half of the test. If this check reveals that a diode is defective, replace the entire rectifier.



RECTIFIER - CHECKING THE EXCITATION DIODES

Check each excitation diode separately by proceeding as follows:

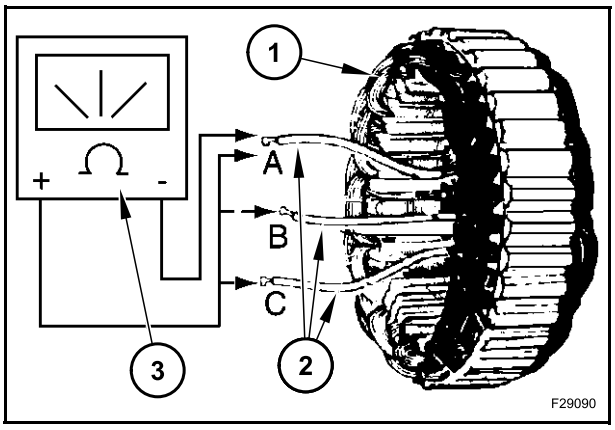
- Connect a multimeter (2) in series on the excitation diode module. Place the negative wire on terminal L (1) and the other wire on the connection of each excitation diode (3).
- Note down the value of the resistance indicated by the multimeter. Reverse the wires of the multimeter.
- The multimeter should indicate infinite resistance (open circuit) only during the first half of the test. If this check reveals that a diode is defective, replace the entire rectifier.



STATOR - CHECKING THE CONTINUITY OF THE WINDING

Check each excitation diode separately by proceeding as follows:

- Connect the wires of the ohmmeter (3) between wires A, B and C (2). The resistance between each of the wires must be low (0.1 W). If the resistance is greater than this value, it indicates a possible break in the winding, i.e. an open circuit. A lower value (0.0. for example) indicates a short circuit in the winding. If the result of this check is not satisfactory, replace the stator (1) and its casing.

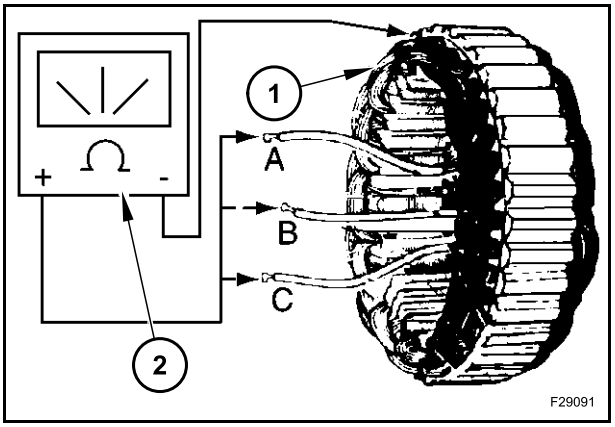


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STATOR -CHECKING THE INSULATION

- Check the insulation of each winding with respect to the alternator casing. There must not be any continuity between the winding and the casing. If the ohmmeter (2) indicates any value other than an open circuit, replace the entire stator (1).



CHECKING THE ROTOR

Before checking the rotor components, inspect the slip rings to make sure that they are in good condition.

- Check that the slip rings are clean and smooth. If necessary, clean them with a cloth soaked in gasoline. If the slip rings are burnt, scrape them with very fine sandpaper (do not use emery cloth) and wipe them.

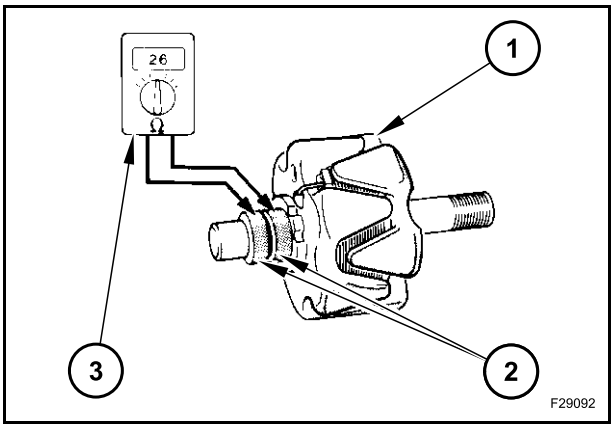
NOTE: make sure that the sandpaper is sufficiently fine in order to obtain a perfect finish of the slip ring surfaces and avoid premature wear of the brushes.

- If the slip rings are excessively worn, replace the rotor.

ROTOR - CHECKING THE CONTINUITY OF THE FIELD WINDING

- Connect an ohmmeter (3) between the two slip rings (2). The resistance must be 2.6 ohms at 20 °C.

If the resistance is incorrect, replace the rotor (1).

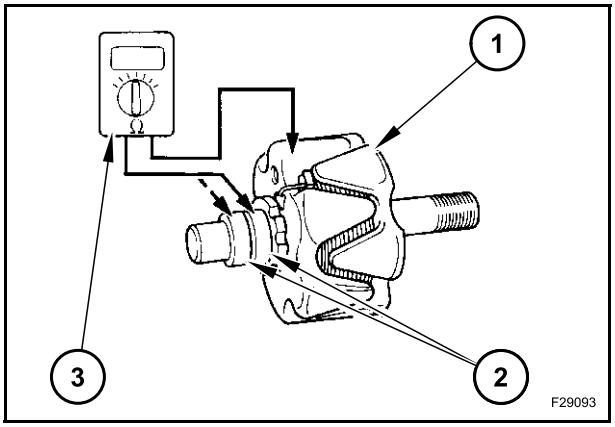


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ROTOR - CHECKING THE INSULATION OF THE FIELD WINDING

- Using an ohmmeter (3), measure the resistance between each slip ring (2) and the rotor terminals (1). The resistance should always be infinite. If a resistance is not infinite, replace the rotor.



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6.6 FAULT FINDING

PROBLEM	CAUSE	CORRECTION
Not recharged	Recharge circuit interrupted (warning lamp, fuse, connector, etc.).	Check the connections of the recharge circuit, clean and tighten the alternator and battery terminals.
	Voltage regulator inefficient	Replace the part.
	Rotor winding cut out	Replace the part.
	Worn brushes	Replace the part.
Recharge insufficient	Slackened fan belt	Supply the correct voltage.
	Voltage regulator faulty	Replace the part.
	Excessive wear of rotor rings or brushes	Replace the part.
	Short-circuited diodes	Replace the part.
	Stator windings or rotor winding short-circuited	Replace the part.
Excessive recharge	Loose circuit connections	Check the connections of battery terminals, starter motor terminals and alternator.
	Voltage regulator inefficient	Replace the part.
	Ground connection faulty	Check connections for leaks.

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7. BATTERY

For the loader backhoe models two different kinds of installation are provided:
- with one battery.
- with two batteries (for cold climates).

7.1 SPECIFICATIONS

Single battery

Voltage:	12 V
Capacity (20 h):	95 Ah
Discharge current:	900 A
Weight with electrolyte:	25 kg

Double battery

Voltage:	12 V
Capacity (20 h):	60 Ah
Discharge current:	600 A
Weight with electrolyte:	17 kg

7.2 DESCRIPTION AND OPERATION

All models feature one or two 12 volt, negative ground, “maintenance free” lead calcium (Pb-Ca) type battery, of six cell construction.

IMPORTANT: “Maintenance Free” means that under normal charging conditions the battery does not lose water from the electrolyte. Conditions that may cause water loss include prolonged charging above 14.4 volts where gassing occurs as it approaches full charge. This can be caused by a faulty charging system or boost/recovery charging equipment.

The battery has four major functions:
- To provide a source of current for starting, lighting and instrumentation.
- To help control the voltage in the electrical system.
- To furnish current when the electrical demands exceed the alternator output.
- To support quiescent loads from radio and micro processor memory.

The battery is constructed in such a manner that each cell contains positive and negative plates placed alternatively next to each other. Each positive plate is separated from a negative plate by a non conducting porous envelope separator. If any of the positive plates should make contact with negative plates within a cell, the cell will short circuit and suffer irreparable damage. All of the positive plates are welded to a bus-bar, forming a positive terminal and all of the negative plates are welded to a similar bus-bar forming a negative terminal.

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Each positive plate is composed of a lead grid with lead peroxide pasted into the grid openings.
The negative plates are composed of a lead grid with spongy lead pasted into the grid openings.
The plates are submerged in a liquid electrolyte solution of diluted sulphuric acid.

7.3 BATTERY REPLACEMENT

Use the ignition switch key to open the battery box and then remove the tool box.

⚠ WARNING

A spark or flame can cause the electrolyte in a battery to explode. To prevent any risk of explosion, observe the following instructions:

- Place the battery master switch key in the OFF position (disconnected).
- When disconnecting the battery cables, always disconnect the negative cable (-) first.
- When reconnecting the battery cables, always connect the negative (-) cable last.
- Never short-circuit the battery terminals with metal objects.
- Do not weld, grind or smoke near a battery.

⚠ WARNING

Batteries produce explosive gases. Keep away any flame, spark or cigarettes. Always provide good ventilation when charging a battery or using a battery in an enclosed space. Always protect your eyes when working near a battery.

⚠ WARNING

Before carrying out any welding on the machine or repair work on the electrical circuit, disconnect the battery and disconnect the B+ and D+ wires on the alternator. When reconnecting, check the wire markings.

⚠ WARNING

Always store batteries in a safe place, out of the reach of children.

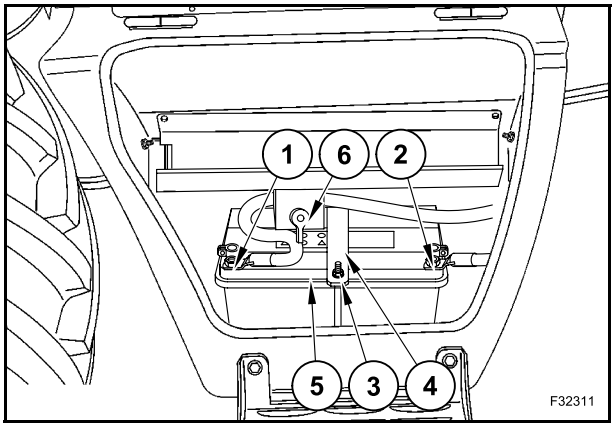
⚠ WARNING

Never touch the battery terminals with your hands. This can induce a state of electrolysis and impair the main organs of the body.

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- Remove the battery master switch support (6) without disconnect the battery cables.
- Remove the terminal covers and disconnect the cables, first from the negative terminal (1) then the positive terminal (2).
- Remove the nuts and washers (3), the clamping bar (4) and the brackets (5) and remove the old battery.
- Install the new battery.
- Install the brackets (5), the clamping bar (4) and the washers and nuts (3).
- Clean the cables and the connecting terminals and coat them with grease.
- Connect the cables, first to the positive terminal (2), then the negative terminal (1) and install the terminal covers.
- Remove the battery master switch support (6).



⚠ WARNING

Never reverse the battery terminals. Connect the positive cable to the positive terminal (+) and the negative cable to the negative terminal (-).

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7.4 MAINTENANCE

SPECIFIC GRAVITY

The specific gravity of the battery electrolyte indicates the state of charge.
Fully charged the specific gravity of the electrolyte is 1.280 minimum at 25 °C.
Alternatively the approximate state of charge can be measured by using an accurate digital volt meter (+/ -0.01 V) as follows:
Less than ..... 10.5 V Battery unserviceable*
Less than ..... 11.8 V Battery discharged
Less than ..... 12.3 V Battery 1/2 charged
Better than ..... 12.6 V Battery fully charged
* See note under tests for possible recovery of a mildly sulphated battery.

Battery voltage to be taken with the battery unloaded and:

A. After the battery has rested unloaded for at least 4 hours.

B. If the vehicle has recently run or battery has recently been charged, switch on headlamps for 2 minutes.

When a battery discharges, sulphuric acid in the electrolyte combines chemically with the plates and this action lowers the specific gravity of the solution. A battery hydrometer will determine the specific gravity of the electrolyte in a cell and the amount of unused sulphuric acid in the solution is a measure of the degree of charge of that cell.
The lower the temperature at which a battery is required to operate, the more necessary it is that the battery is maintained in a fully charged condition. For example, a battery with a low specific gravity of 1.225 at 27 °C will operate the starting motor at warm ambient temperatures, but may not be able to do it at low temperatures due to a lower battery efficiency.
Table shows the effect of temperature on the efficiency of a typical battery.

Temperature	Efficiency of a fully charged battery temperature
25.0 °C	100%
-4.5 °C	82%
-24.0 °C	64%
-27.5 °C	58%
-31.0 °C	50%
-34.5 °C	40%
-37.5 °C	33%

Maximum battery life will be obtained if the correct care and periodic inspection is given. It is important that output capacity should not be exceeded by constant and excessive overloading and that charging requirements are maintained.

MAINTENANCE

⚠ WARNING
Battery electrolyte causes severe burns. The battery contains sulphuric acid. Avoid any contact with the skin, eyes or clothing.
Antidote:
EXTERNAL: rinse well with water, removing any soiled clothing.
INTERNAL: avoid vomiting. Drink water to rinse your mouth. Consult a doctor.
EYES: rinse abundantly with water for 15 minutes and consult a doctor.

Battery terminal tightness check ... Every 250 hours
Electrolyte level inspection..... Every 1000 hours

When servicing a battery the following steps should be observed:

- Maintain the electrolyte to the recommended level of 6 mm above the plates. If this is not observed the acid will reach a high concentration that will damage the separators and impair the performance of the plates.
- Use only distilled or de-mineralized water, do not overfill and never use tap water or water from a rain barrel or other source.
- Always keep the battery at least 75% charged otherwise the plates will become sulphated and loss of efficiency will result with possible damage from freezing at low temperatures.
- Avoid overcharging the battery as excessive charging will create high internal heat that will cause plate grid deterioration and produce water loss.
- When fast charging ensure the battery temperature does not exceed 50 °C.
- Do not add sulphuric acid to a cell unless the electrolyte has been lost through spilling. Before replenishing ensure the solution is at the correct specific gravity. A slow charge is the only method to be employed to fully charge a battery. A high rate charger can be used to quickly boost the battery capacity but this must be followed by a slow charge rate to bring the battery to full capacity.

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DRY CHARGED

- Remove the battery cell vent plugs.
- Fill each cell to the recommended level with electrolyte of 1.260 specific gravity.

Dry charged batteries must be prepared for service as follows:

NOTE: the electrolyte must be diluted sulphuric acid preferably at a temperature of 21 - 32 °C.

- After filling, allow the battery to stand for 15 minutes then re-check the electrolyte level and top up if necessary.
- Charge the battery for 4 hours at a rate of 5-8 amperes and check that all cells are gassing freely.
- Install the battery cell vent plugs.

CHARGING THE BATTERY

Before charging a battery:

- Thoroughly clean the battery casing and cell covers with dilute ammonia or hot water and clean the terminals.
- Check the level of the electrolyte in each cell and, if below plates, add distilled water to bring above plate level.

NORMAL (TOP-UP) CHARGING

- With a slow charger use a rate of 3 to 6 amperes for the time necessary to bring the battery to full charge. This may take 36 hours or more if the battery is heavily discharged. A severely sulphated battery might not accept a charge. When the battery is fully charged the cells will gas freely and the specific gravity will remain constant. Remove the charger after three consecutive hydrometer readings taken at hourly intervals indicate that the specific gravity has stopped rising.
- When using a fast or high rate of charge carefully follow the manufacturers instructions. High rate charging raises the temperature of the electrolyte and unless the charger is equipped with an automatic time or temperature device, the electrolyte temperature could exceed 50 °C, which may cause violent battery gassing and damage to internal components.
- Re-check the level of electrolyte in each cell and add distilled water as necessary.

⚠ WARNING

When a battery is being charged an explosive gas is produced. Do not smoke or use an exposed flame when checking the electrolyte level and ensure the charger is switched off before connecting or disconnecting to avoid sparks which could ignite the gas.

RECHARGING DEEPLY DISCHARGED

The recommended method to recharge a maintenance free Pb-Ca battery is to use a constant voltage charger. For deeply discharged batteries a 48 hours charging period at 16 volts is recommended, with current limitation, (47.5 A for 95 Ah).
This system is self regulating: high current is delivered at the beginning (when battery voltage is low), lower and lower current is then absorbed when battery reaches full charge (and its voltage is high).
If only constant current chargers are available it is recommended to use the current levels and times. The figures are intended for deeply discharged batteries. If the battery is only 50% discharged use one half of the time listed (slow charge programs). For other states of discharge reduce proportionally the time of charge. Whenever possible use the slowest charge program to increase the battery's life.
If when charging the battery, violent gassing or spewing of electrolyte occurs, or the battery case feels hot (50 °C or greater), reduce or temporarily halt charging to avoid damaging the battery.

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7.5 TESTS

Before commencing battery tests check the battery for clogged vents, corrosion, raised vent plugs or a cracked case.
Test equipment required:
• Hydrometer.
• Battery starter tester (High rate discharge tester).
• Thermometer.
• Battery Charger.

SPECIFIC GRAVITY

This test will determine the state of battery charge.

1. With the float in the vertical position take the reading.
2. Adjust the hydrometer reading for electrolyte temperature variations by subtracting 4 points (0.004 specific gravity) for every 5.5 °C below the temperature at which the hydrometer is calibrated and by adding 4 points (0.004 specific gravity) for every 5.5 °C above this temperature.

The following examples are calculated using a hydrometer calibrated at 30 °C.

Example 1:
Temperature below 30 °C
Electrolyte temperature.....19 °C
Hydrometer reading 1.270
Subtract (11.0 / 5.5) x 0.004 .....0.008
Corrected specific gravity.....1,262

Example 2:
Temperature above 30 °C
Electrolyte temperature.....40 °C
Hydrometer reading 1.220
Add (10.0 / 5.5) x 0.004 .....0.007
Corrected specific gravity.....1.227

3. Use the following table to determine the state of charge.

State of Charge	Corrected specific gravity @ 15 °C	Corrected specific gravity @ 25 °C	Average battery voltage
100%	1.295	1.287	2.76
75%	1.253	1.246	12.52
50%	1.217	1.210	12.30
25%	1.177	1.170	12.06
Discharged	1.137	1.130	11.84

NOTE: specific gravity should not vary more than 0.025 points between cells.

4. If the specific gravity is 1.280 or more the battery is fully charged and in good operating condition.
5. Should the corrected specific gravity be below 1.280, charge the battery and inspect the charging system to determine the cause of the low battery charge.

NOTE: if distilled water has recently been added the battery should be recharged for a short period otherwise accurate hydrometer readings will not be obtained.

If the battery has been charged under static conditions, denser electrolyte will accumulate at the bottom of the cells. The battery should be shaken periodically to mix the electrolyte, this will improve the charge rate and provide a more accurate hydrometer reading when tested.

PERFORMANCE TEST

The performance test is to determine if the battery has adequate capacity to turn the engine. The voltage reading obtained is used to determine the battery condition. Prior to testing, ensure the electrolyte level is correct and the open circuit voltage is 12.5 V or more.
The battery may be tested on or off the loader backhoe.

1. Set the current control switch of the battery starter tester (high rate discharge tester) to the “off” position and the voltage selector switch equal to, or slightly higher than, the rated battery voltage. Connect the tester positive leads to the battery positive terminal and the negative leads to the negative battery terminal.
2. Turn the current control knob until the ammeter reading is half the CCA rating of the battery and take the voltage reading.

• If the reading is 9.6 volts or more after 15 seconds, the battery has an acceptable output capacity and will readily accept a normal charge.
• If however the reading is below 9.6 volts, the battery is considered unsatisfactory for service and should be test charged as described below.

⚠ CAUTION
Do not leave the high discharge load on the battery for periods longer than 15 seconds.

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TEST CHARGING

This test is designed only for batteries that have failed the previous capacity test.

1. Attach the battery starter (high rate discharge tester) positive leads to the battery positive terminal and the negative leads to the battery negative terminal.
2. Connect the battery charger positive lead to the battery positive terminal and the negative lead to the battery negative terminal.
3. Turn the charger timer past a “3 minutes” charge indication and then back to the “3 minutes” mark.
4. Set the charging rate as close as possible to 40 amperes.
5. After 3 minutes at this fast charge take the voltmeter reading.

- If the total voltage is over 15.5 volts the battery is unsatisfactory and is probably sulphated or worn out and should be replaced.

NOTE: a mildly sulphated battery can be recovered by using a multiple battery type charger, with an open circuit upper voltage limit of 50 V.
Owing to the high resistance of a sulphated battery, it will primarily require a high voltage setting to overcome the resistance of the sulphation initially there may be no visible acceptance of the charge. After a few minutes of inactivity a small charge will be apparent, followed by a rapid increase in the charge rate. The charge rate must not exceed 14.0 amperes or the electrolyte temperature 50 °C.
When the ampere rate is stable, reset the volts until the charge ampere rate is a steady 5 A.
Continue at this rate until the electrolyte specific gravity stops rising at approximately 1.275 - 1.280 at 20 °C, this can take up to 48 hours of charging. Stand the battery for 24 hours and then conduct the capacity test detailed previously.

- If the total voltage is under 15.5 volts, test the specific gravity of each cell and re-charge the battery to the following scale:

Specific Gravity	Fast charge up to:
1.150 or less	60 minutes
1.151 to 1.175	45 minutes
1.176 to 1.200	30 minutes
1.201 to 1.225	15 minutes
	(Slow charge only)

NOTE: when battery problems are experienced the fan belt tension and the complete charging system should be checked.

COMMON CAUSES OF BATTERY FAILURES

- Internal open circuit.
- Internal short circuit.
- Loss of electrolyte.
- Separation of active materials from grids.
- Accumulation of sulphate crystals too large to disperse.

These failures are normally caused by the following:

- Failure of inter cell components.
- Excessive crystal growth may puncture the separators and cause short circuits.
- Excessive over charging (charging system malfunction, boost/recovery techniques with high voltage, operation in very high temperatures).
- Freezing of electrolyte. A fully charged battery does not freeze until -65 °C. A 50% charged battery freezes between -17 °C and -27 °C. Fully discharged electrolyte freezes at -3 °C to -11°C. Excessively high boost charging and gassing will also cause separation of active materials from the grids. Separation destroys the chemical function of the battery.
- Crystal growth occurs whenever batteries are left discharged. High temperatures and extended discharged periods increase this condition.

At room temperature after one week the battery is unlikely to recover on the vehicle.
Recharge will require a higher constant voltage.
After 3 weeks the battery will have suffered permanent degradation and the procedure detailed previously for charging a “Deeply Discharged” battery should be followed.
When fully charged, batteries have a long shelf life.
The lead calcium type battery self discharges at 3% per month. This means that it will take 16 months to lower to 50% charged. On the loader backhoe the quiescent load is about 50 mA. To predict rundown on a static vehicle this should be added as approximately 8 Ah per week.
It is worth stressing that when cranking, if a battery starts to fade, it is beneficial to stop and allow two minutes for the battery to recover. The recovery time should be increased as the temperature decreases.

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7.6 CONNECTING A BOOSTER BATTERY

⚠ WARNING

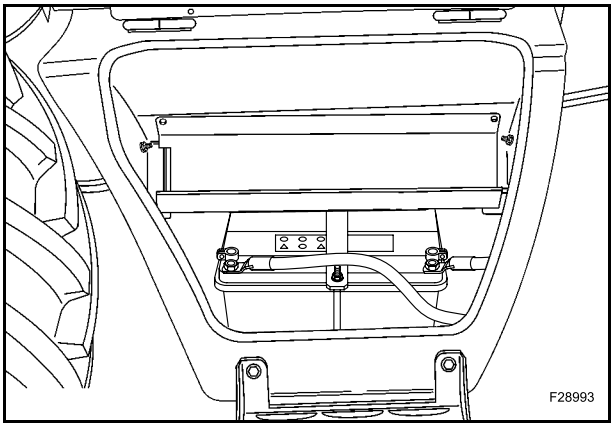
When the electrolyte of a battery is frozen, it can explode if you attempt to charge the battery or if you try to start the engine using a booster battery. Always keep the battery charged to prevent the electrolyte freezing.

⚠ WARNING

Connecting jumper cables wrongly or short-circuiting battery terminals can cause an accident. Connect the jumper cables following the instructions in this manual.

IMPORTANT: make sure that the voltage of the booster batteries is the same as that of the machine circuit (12 V).

- Open the battery box and then remove the tool box.
- Remove the terminal covers.
- Connect the positive (+) jumper cable to the positive (+) terminal of the machine's battery.
- Connect the negative (-) jumper cable to one of the fastening screws (1) of tank.
- Start the engine
- First disconnect the negative (-) jumper cable, then disconnect the positive (+) jumper cable from the booster battery.
- Install the terminal covers.
- Install the tool box and close the battery box.

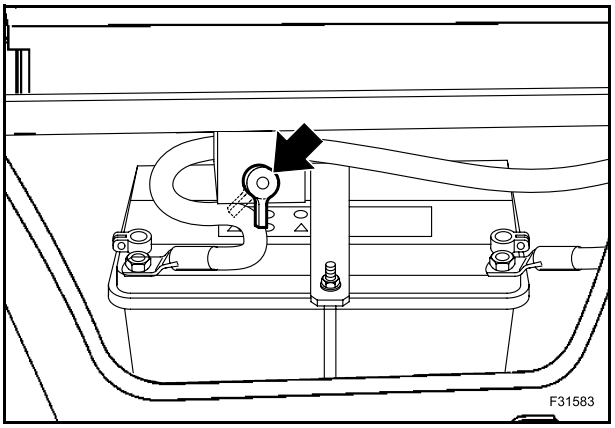


7.7 BATTERY MASTER SWITCH

The battery master switch is located into battery compartment and is used to disconnect the electrical system completely from the battery.
When the battery master switch has an inclination of 45°, the system is disconnected.
When the battery master switch is in horizontal position, the system is connected.

⚠ WARNING

The battery master switch must be switched off at the end of each working day, for machine service or for any operations on the electrical system. It acts as an anti-theft device when the cab doors and windows are locked.



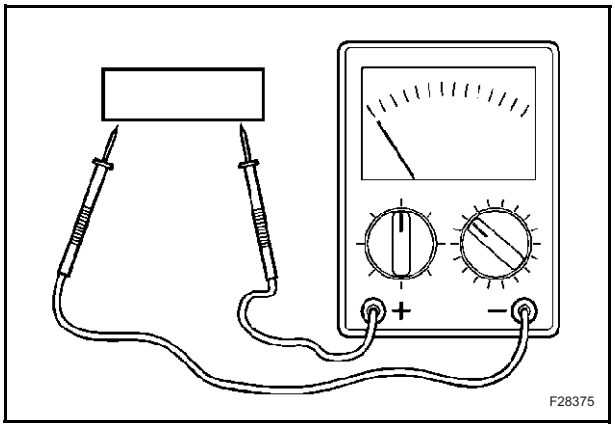
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8. COMPONENT TESTING

8.1 GENERAL INTRODUCTION

No special tools are required to remove or replace electrical components.
Refer to the appropriate section of this Service Manual for overhaul procedures regarding the starter motor and the alternator.
Fault finding of electrical systems should be carried out in a logical and methodical fashion. A few minutes spent understanding the system and analysing the symptoms can save considerable time.
An essential piece of equipment for checking electrical systems is a good quality multimeter with a high impedance which can measure voltage, current and resistance.



NOTE: labelling of connectors prior to disassembly will greatly assist when reconnecting any harness.

Where it is necessary to clean the multiple connectors, a contact spray should be used.

IMPORTANT: DO NOT use a cleaner that contains trichloroethylene which will dissolve the plastic connectors.

The wiring harnesses contain wires which are colour coded for identification.
Each harness can be removed and replaced, but certain precautions must be observed:

- Disconnect or isolate the battery, negative terminal first, prior to disconnection or removal of any wiring harness.
- Prior to removal, note the harness routing, clamping positions and terminal connections.
- On replacement, be sure that the harness routing is not in contact with sharp edges, the exhaust system or moving parts.
- Check connections for wire colour matching.
- Use a light coating of di-electrical grease on the connector pins to prevent corrosion.
- Be sure that all connectors are fully engaged and no conductor is exposed.
- Tape back unused connectors.
- Be sure that ground connections are clean with metal-to-metal contact. Use toothed lock washers for good ground connections.
- Be sure that fuses are of the specified rating.
- Check the system amperage before applying power to the wiring.
- Check polarity of the battery before connecting power to the harness.
- When it is necessary to remove or partially disconnect a wiring harness, label each connector before removal from its mating instrument.

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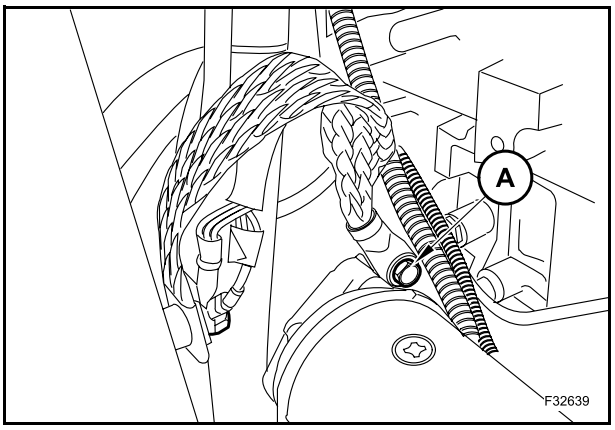
8.2 COMPONENT TESTING

In general with the key start on there should be 12 V found at the component connections.
Where 12 V is not present check fuses, relays and wiring for breaks.

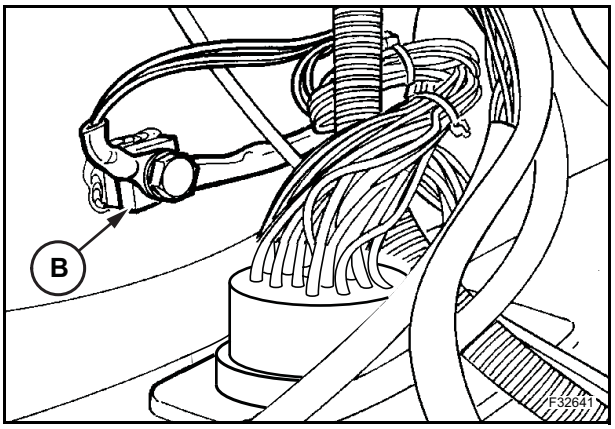
8.3 GROUND POINTS

NOTE: always ensure the ground points are clean and functional. A poor ground will cause the electrics to fail.

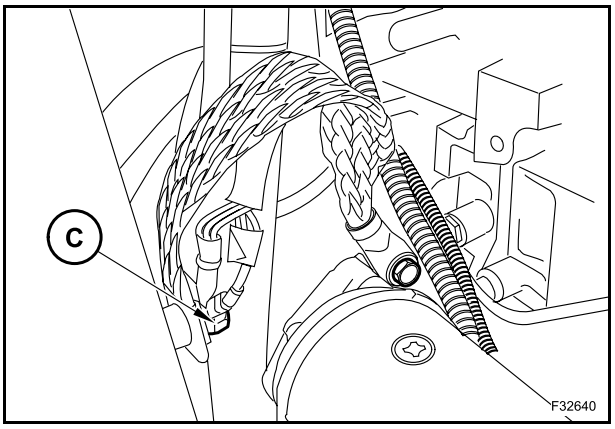
Ground point A - Starter motor (engine harness)
Ground point A is also linked to ground point B.



Ground point B - Right hand console (front console harness)
This is also linked to ground points A, C, and D.



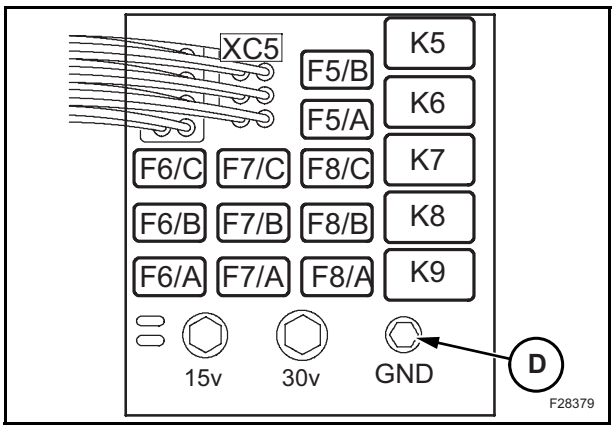
Ground point C - Rear of chassis (Chassis harness)
This is also linked to ground point E.



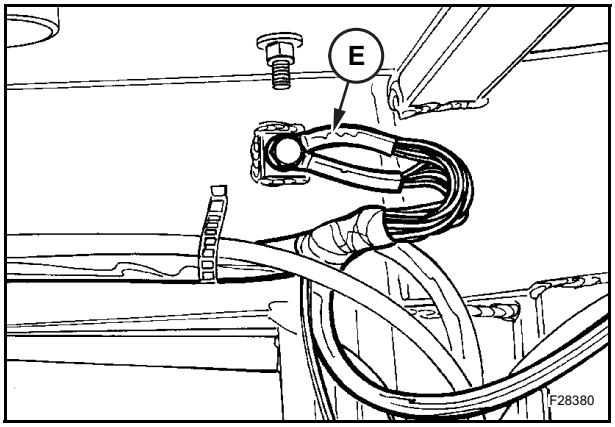
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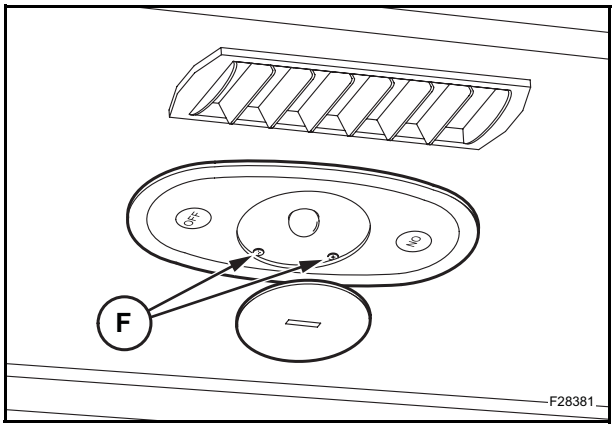
Ground point D - Fuse board
This is also a back-up ground point for Location E.



Ground point E - Top right hand B pillar (roof harness)



Ground point F - Operator'seat light



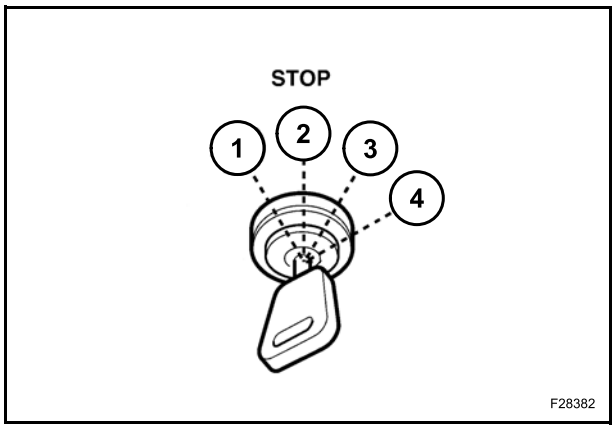
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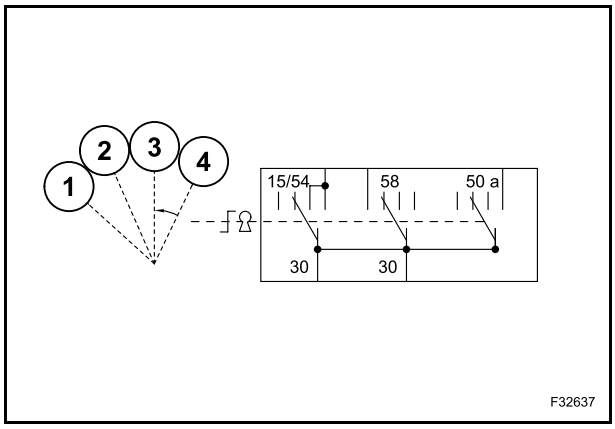
8.4 STARTER SWITCH KEY AND STOP SWITCH

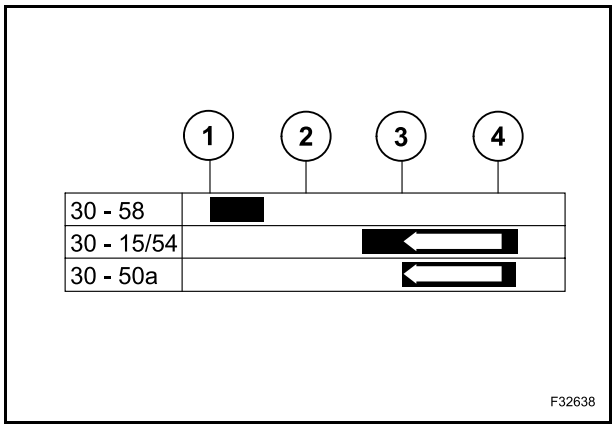
NOTE: when the starter switch key/stop switch is turned to ON, the audible alarm sounds until the engine is started or the key is returned to the initial position.

Starter switch key
1. Not used
2. Off
3. Ignition ON
4. Cranking



CONTACTS	MAXIMUM CURRENT 12 V	MAXIMUM CURRENT 24 V	TIME
30-58	8 A	4 A	•
30-15/54	35 A	17.5A	•
30-50a	70 A 18 A	40 A 5 A	1 min



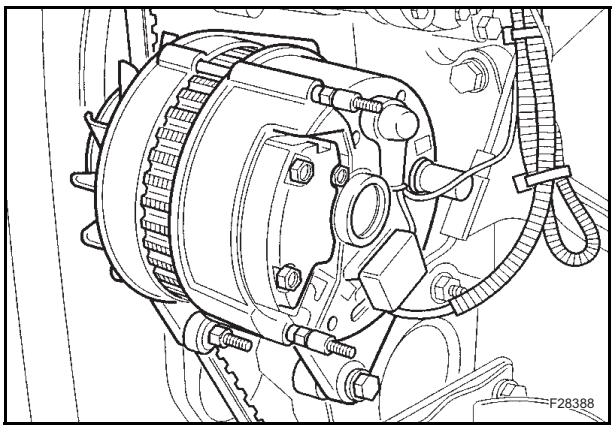


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8.5 ALTERNATOR

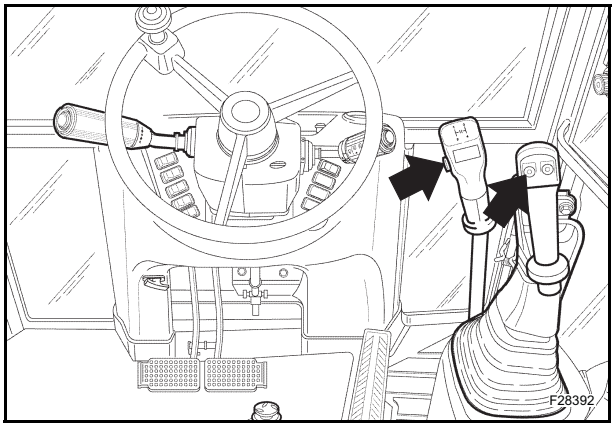
This sends a square wave signal, the frequency of which varies between 142.52 855 Hz (480 - 3060 rpm) to the instrument panel.
With the engine running, the warning light should turn off. If not, disconnect the wire connected to the terminal D+ (pink wire).
When D+ is not connected and the warning light goes out, there is a fault with the alternator. If it does not turn off, then check the bulb and the wiring loom.



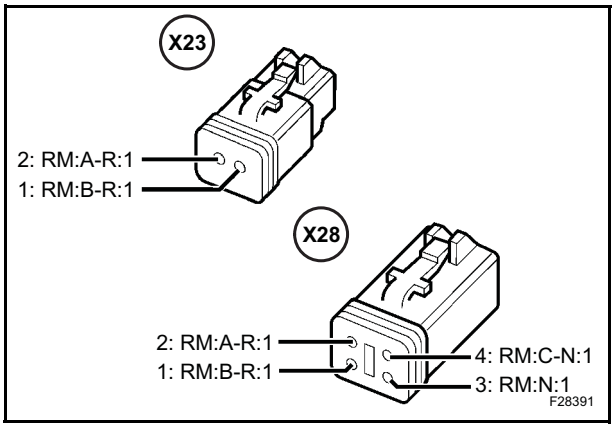
8.6 TRANSMISSIONS

POWERSHUTTLE DISCONNECT - X23/X28

Energizes the transmission dump solenoid at 12 V.



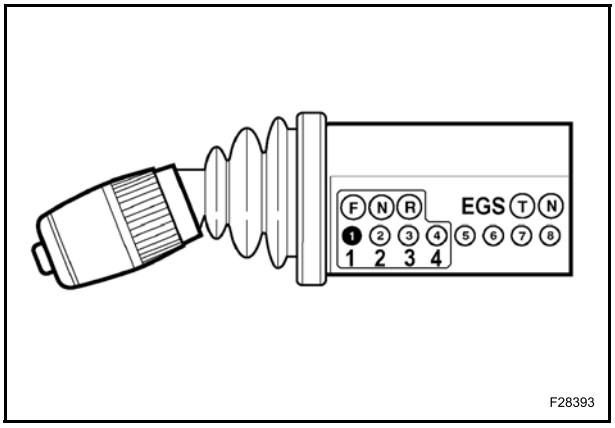
Test procedure
Continuity should be found between pin 1 and pin 2 when switch is operated.



POWERSHIFT EGS CONNECTOR

The EGS receives input from the FWD Switch, brakes, switches, transmission disconnect switch, temperature sensor and speed sensor. The EGS also sends signals to the transmission control valve. For input and output tests to check correct operation of the EGS, refer to Section 21.

Test Procedure
Test procedure of the speed sensor refer to the next page.

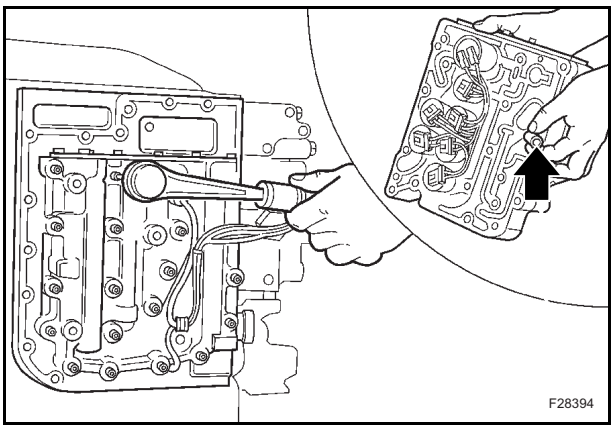


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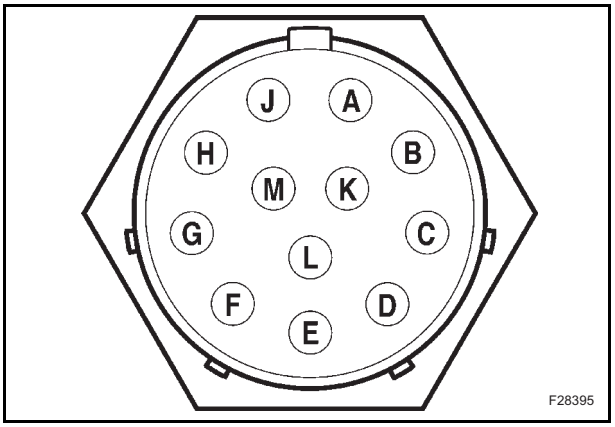
POWERSHIFT CONTROL UNIT

The control unit receives the signals switching ON or OFF the solenoids and allowing the desired gears to be selected. A variable current solenoid receives a reducing signal from the EGS controlling modulator. The control unit is equipped with a combined temperature and speed sensor which sends signals back to the EGS.



Test Procedure

Test between pin indicated in the left hand column and either pin H or M as detailed in the table below.



DESCRIPTION		
Pin No.	H	M
A	27.5 Ω	-
B	27.5 Ω	-
C	27.5 Ω	-
D	27.5 Ω	-
E	27.5 Ω	-
F	27.5 Ω	-
G	-	14 Ω
K	-	31 Ω

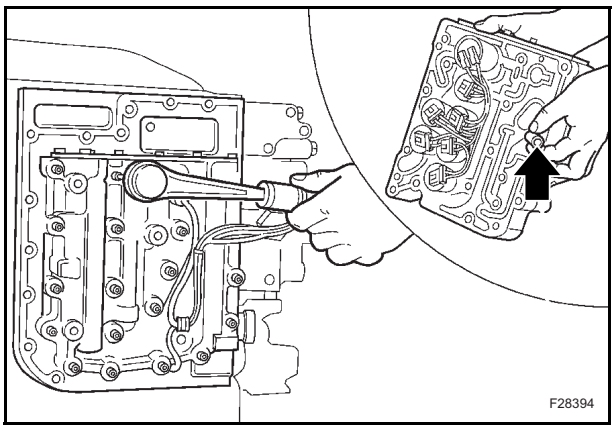
* A Speed sensor plus output 24
B Forward Lo/Hi solenoid
C Forward/neutral solenoid
D Range 1/2 solenoid
E FWD solenoid
F Reverse neutral solenoid
G Direction modulation solenoid
K Range modulation solenoid
L Transmission temperature out ground
M Control valve common plus

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POWERSHIFT SPEED SENSOR TEST

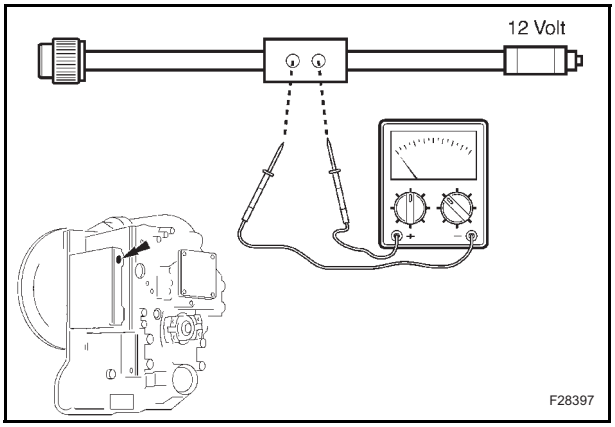
Disconnect from control valve and fit the 12 pin connector from special tool.
Connect the power socket to the 12 V socket.
Install the probes from a multimeter into the tool. Raise the unit off the ground and observe voltage (V1). Turn the rear wheel which in turn rotates the transmission output shaft, observe the second voltage (V2).



Test procedure

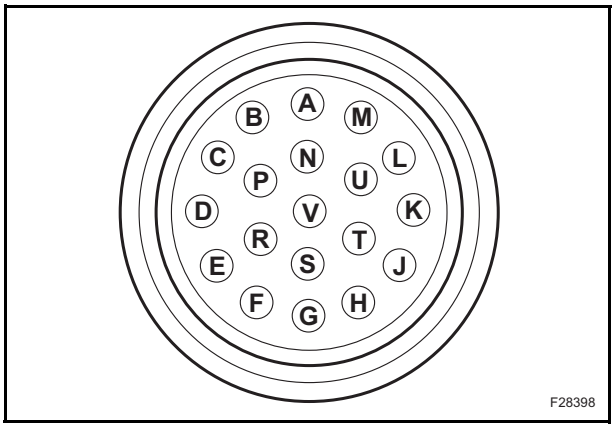
Pin No.	V1	V2
A	0.6 - 0.8	1.3 - 1.5

The special tool connects to pin A speed sensor plus output, and pin J speed sensor/temperature sensor ground.



Description

A Speed sensor +
B FWD request
C Disconnect request input
D Speedometer output
E Diagnostics link input
F Analogue Input 1
G Analogue Input 0
H -
J -
K PWM solenoid supply
L Solenoid 3
M PWM 1
N Range solenoid 27
P Forward solenoid
R Solenoid 2
S Solenoid 1
T VCS
U Ground
V Battery +

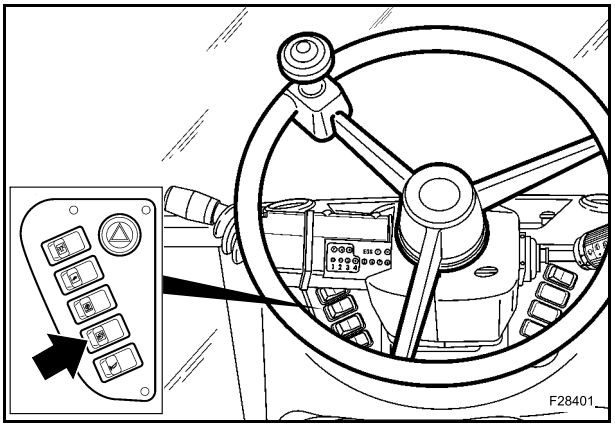


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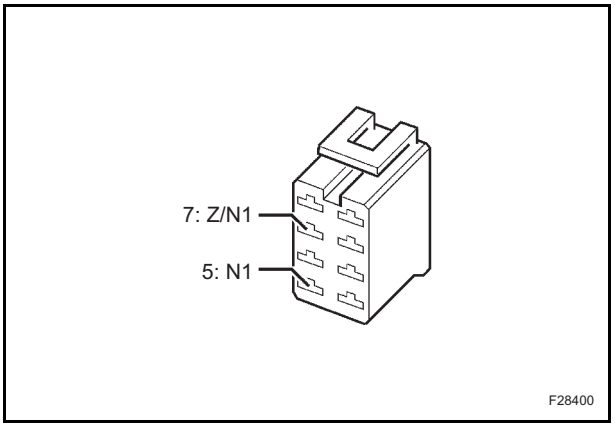
POWERSHIFT EGS OVERRIDE

In situations where a “MANUAL” gearshift (up or downshift) is required, the powershift transmission auto change can be overridden by selection of this console-mounted switch.



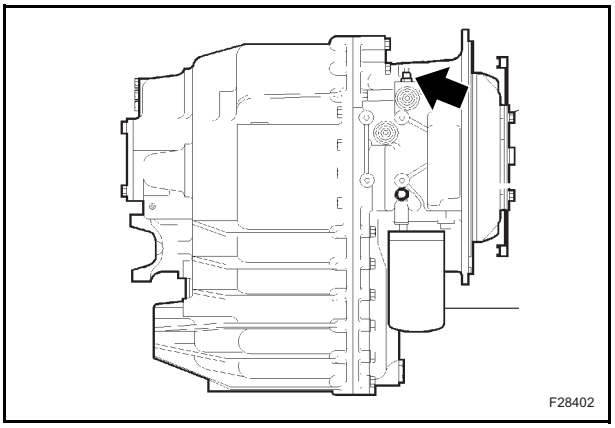
Test procedure

Continuity should be found between pin 1 and pin 2 when switch is operated.



OIL PRESSURE SWITCH - POWERSHIFT

Energized at 12 V if the transmission pressure is to low, the warning lamp will flash.

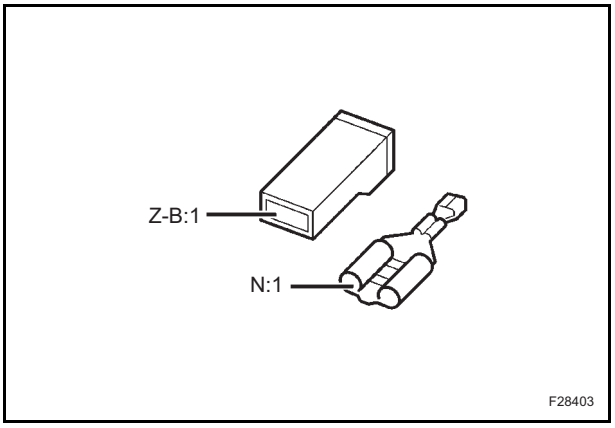


Test procedure

The voltage measured between pin 1 and pin 2 should be 12 V.

With Transmission oil pressure continuity should be found.

Pin No.	Sender	Resistance
1	12 V	with low pressure 0.3 Ω

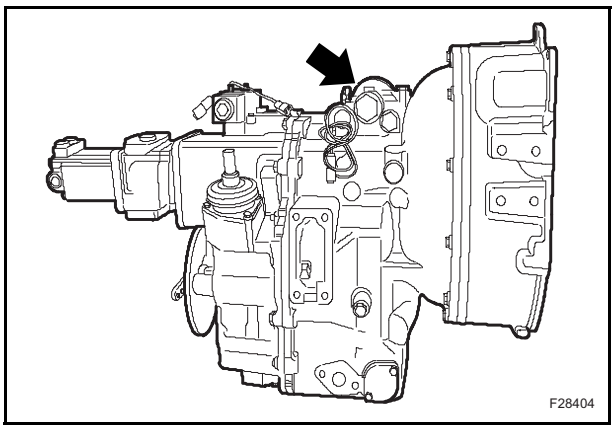


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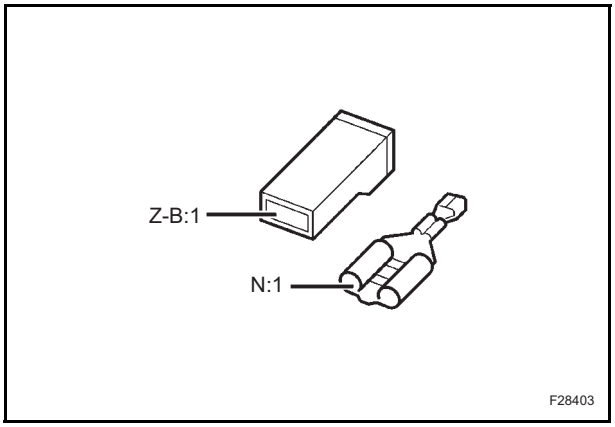
OIL PRESSURE SWITCH - POWERSHUTTLE

If the transmission pressure is to low, the warning lamp to flash.



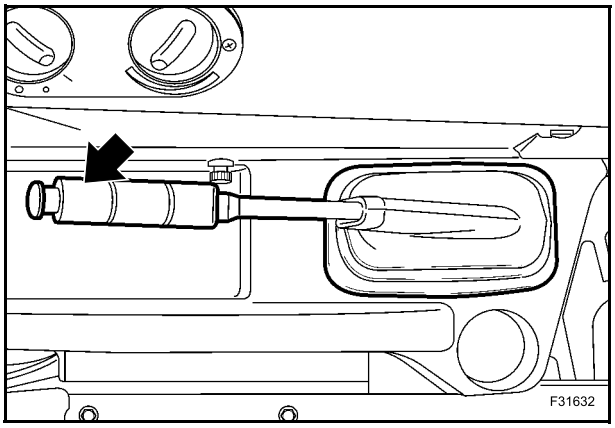
Test procedure
The voltage measured between pin 1 and pin 2 should be 12 V.
With Transmission oil pressure continuity should be found.

Pin No.	Sender	Resistance
1	12 V	with low pressure 0.3 Ω



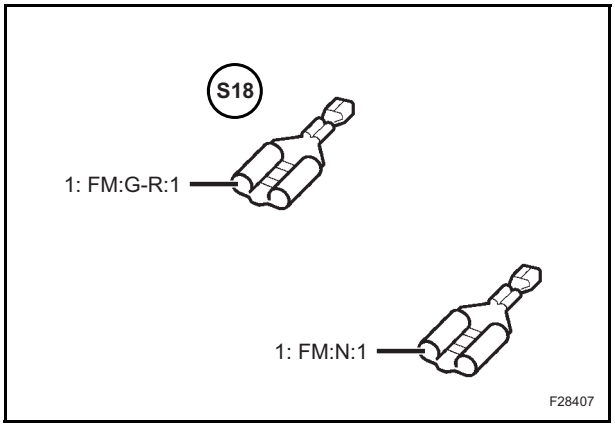
8.7 PARKING BRAKE SWITCH

When the parking brake is engaged, the switch is deactivated and the warning lamp turns on.
An audible alarm sounds if the parking brake is operated with the gearshift lever engaged.



Test procedure
Brake engaged:
switch closed warning light illuminated.

Brake disengaged:
switch open warning light off.



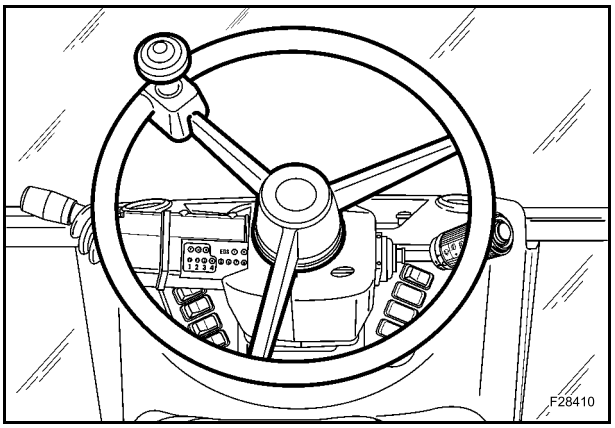
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8.8 CAB

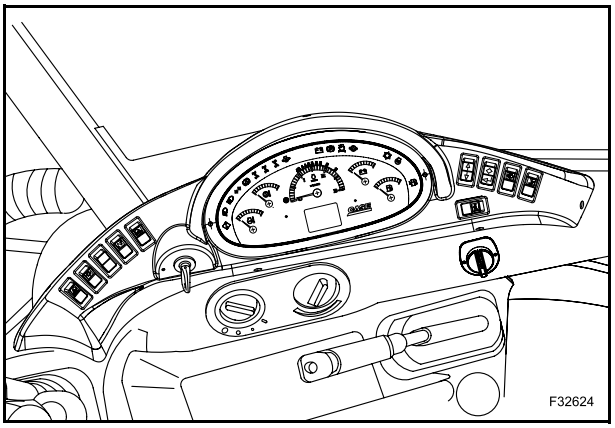
FRONT INSTRUMENT

The front instrument cluster receives signals from the brake oil level sender, the transmission speed sensor, the light switch and the indicator switch.
Behind the instrument there are connectors attached to the vehicle wiring.
These connectors and functions are listed on the following pages.



SIDE INSTRUMENT CLUSTER

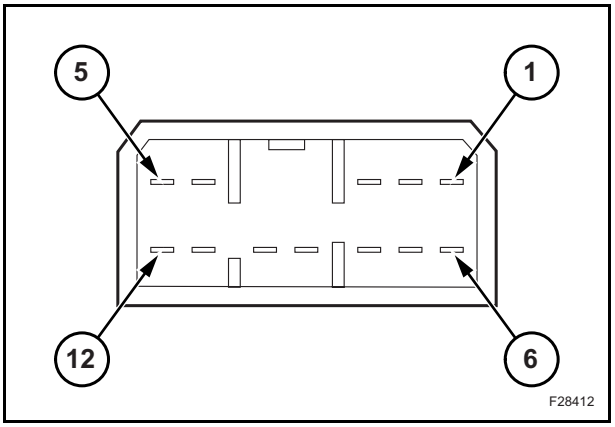
Receives signal from sensors to display, hours, engine RPM, oil pressure, fuel level and signals to warning and indicator lights.



FRONT INSTRUMENT CLUSTER CONNECTOR - AMPERE 070 12-WAY POWERSHUTTLE

Pin functions and test procedure
Listed below are the pin numbers, warning lights, and gauges.

1. Starter switch key 12 V
2. Ground:
   check continuity
3. Tachometer:
   Signal from W output of the alternator
4. Dipped beam:
   green warning light illuminates at 12 V with multi function light switch on
5. Main beams - Blue warning light illuminates at 12 V with multi function switch on
6. 12 V and instrument backlighting
7. Not used
8. Not used
9. Not used
10. Not used
11. Direction indicators:
    green warning light illuminates at 12 V with light switch on
12. Brake oil level:
    red warning light when the input is connected to ground with Ignition on 12 V



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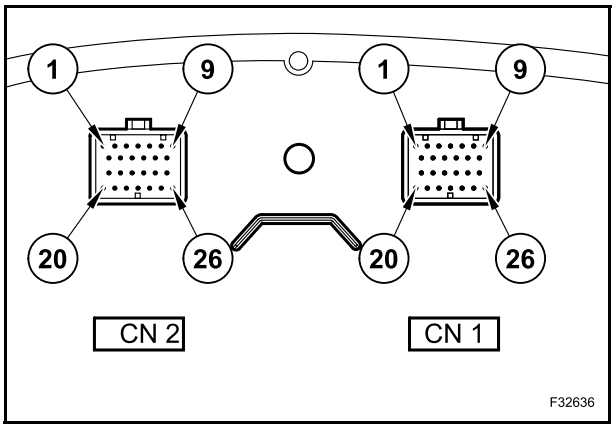
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SIDE INSTRUMENT CLUSTER

Calibrations

GAGE TYPE	INPUT	READING	TOLERANCE
FUEL LEVEL	320 OHMS	Empty - minimum reading	+0/-2°
	185 OHMS	Right - edge of red band	± 3° (Ref)
	6.5 OHMS	Full - maximum reading	+4/-0°
LOW FUEL LAMP	208 OHMS	ON	± 5 OHMS
	200 OHMS	OFF	± 5 OHMS
TACHOMETER	Can message	0-3000 RPM	± 50 RPM
COOLANT TEMPERATURE	Can message	Minimum reading (65 °C)	± 3 °C
	Can message	Left edge of red band (106 °C)	± 2 °C
	Can message	Maximum reading (112 °C)	± 3 °C
VOLT	11 V	Right edge of lower red band	± 3 °C
	16 V	Left edge of upper red band	± 3 °C
TRANSMISSION TEMPERATURE	358 OHMS	Minimum reading (75 °C)	± 3 °C
	149 OHMS	Left edge of red band (105 °C)	± 2 °C
	112 OHMS	Maximum reading (115 °C)	± 3 °C

Connectors



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CN1

PIN	FUNCTION	NOTE
1	Not used	
2	Key on power	Wake up
3	In gear input	Digital input
4	Driving lights	Digital input
5	Front work lights	Digital input
6	Rear work lights	Digital input
7	Turn signals	Digital input
8	Main beams	Digital input
9	Brake fluid level low	Digital input
10	Air conditioning system pressure	Digital input
11	Display input switch	Digital input
12	Enter input switch	Digital input
13	Up input switch	Digital input
14	Down input switch	Digital input
15	Cranking	Digital input
16	Air filter restriction	Digital input
17	Not used	
18	Parking brake	Digital input
19	Not used	
20	Idle validation switch	Digital input
21	Decelerator button	Digital input
22	Crab steering	Digital input
23	Road steering	Digital input
24	Turn steering	Digital input
25	Transmission oil pressure	Digital input
26	Not used	

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CN2

PIN	FUNCTION	NOTE
1	Keep alive power	Need to fuse at 1 ampere without disconnect
2	Not used	
3	Can bus input	Twisted pair, with 120 OHM terminator
4	Can bus input	Twisted pair, with 120 OHM terminator
5	Not used	
6	Audible alarm buzzer	Floyd bell under 80 mA
7	Starter motor interlock	40 OHM relay = 300 mA
8	Not used	
9	Not used	
10	Not used	
11	Not used	
12	Not used	
13	Fuel level gauge	Variable resistance
14	Transmission temperature	Thermistor
15	Not used	
16	Foot accelerator	0.5 - 4.5 V
17	Accelerator knob	0.5 - 4.5 V
18	Foot accelerator	Output monitored for diagnostics
19	Accelerator knob	Output monitored for diagnostics
20	Foot accelerator	
21	Accelerator knob	
22	Not used	
23	Not used	
24	Alternator excitation	Low alternator output signals fault
25	Not used	
26	Ground	Digital input

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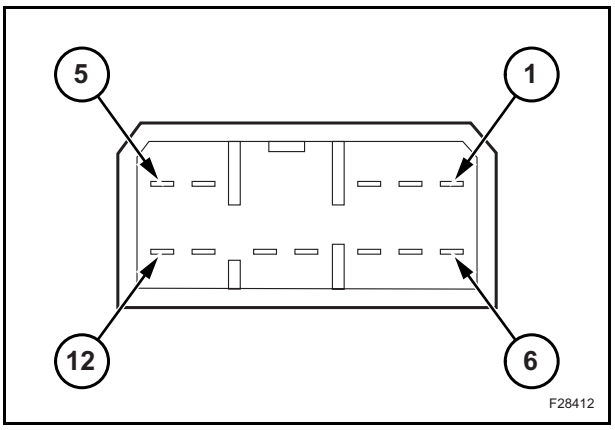
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FRONT INSTRUMENT CLUSTER CONNECTOR - AMPERE 070 12-WAY POWERSHIFT

Pin functions and test procedure

Listed below are the pin numbers, warning lights, and gauges.

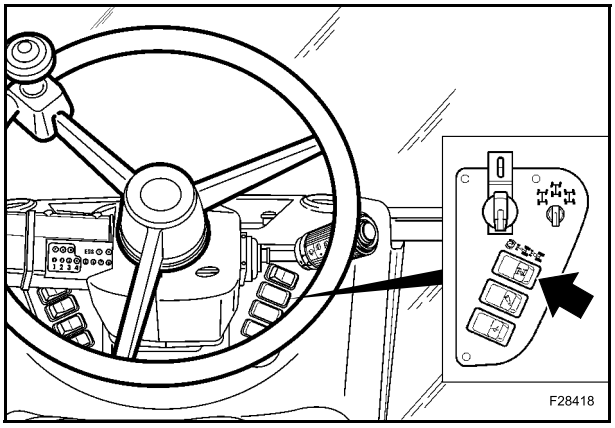
1. Starter switch key 12 V
2. Ground:
   check continuity
3. Tachometer:
   signal from W output of the alternator
4. Dipped beam:
   green warning light illuminates at 12 V with multi function light switch on
5. Main beams - Blue warning light illuminates at 12 V with multi function switch on
6. 12 V and instrument backlighting
7. Not used
8. 4WS - Green warning light four wheel input. With Ignition ON and 4WS selected 0.5 V should be indicated.
   With 2WS or crab steer selected, 0 V should be indicated.
9. Crab steer - Green warning light
10. 2WS - Green warning light 2WS input. With Ignition ON and 2WS selected 1.5 V should be indicated.
    With 4WS or crab steer selected, 12 V should be indicated.
11. Direction indicators:
    green warning light illuminates at 12 V with light switch on
12. Brake oil level:
    red warning light when the input is connected to ground with ignition on 12 V



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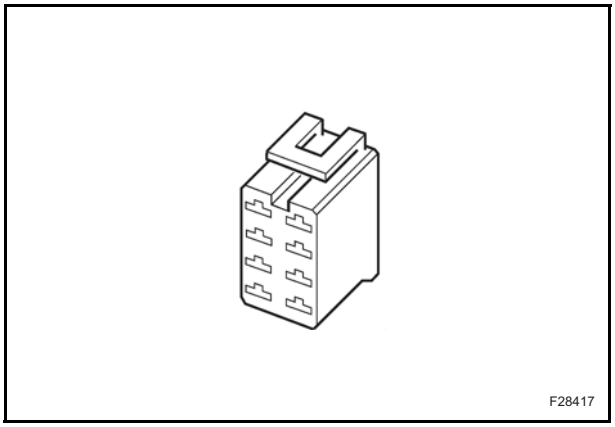
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8.9 4WD SWITCH



Test procedure

Continuity		
Switch OFF	**Position 1**	**Position 2**
From pin 7 to pin 5	From pin 5 to pin 3	From pin 1 to pin 3
From pin 6 to pin 8	From pin 4 to pin 6	From pin 2 to pin 4

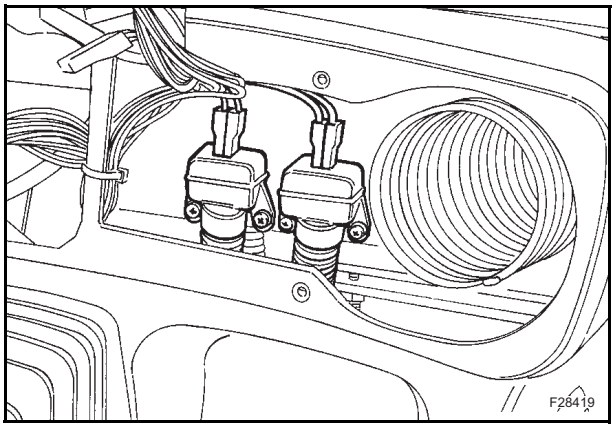


Voltage:
Ignition ON: Pin 3 = 12 V
Pin 6 = 9 V

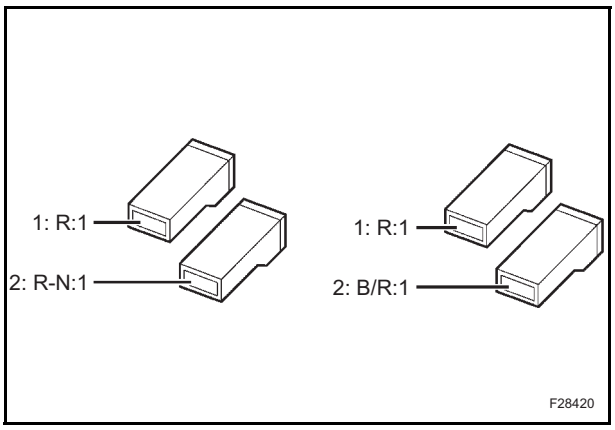
8.10 BRAKE PEDAL SWITCHES

Test Procedure

Continuity:
Brakes not applied: no continuity.
Brakes applied: continuity, between the two centre pins of each switch.
Both brake pedals must be applied to allow 12 V to relay.



Voltage:
Left switch:
White / red wire 12 V continuous with ignition ON
Red wire 12 V pedal depressed
0 V pedal released
Right switch:
Red wire 12 V pedal depressed
0 V pedal released
Red - Black wire 12 V pedal depressed
0 V pedal released

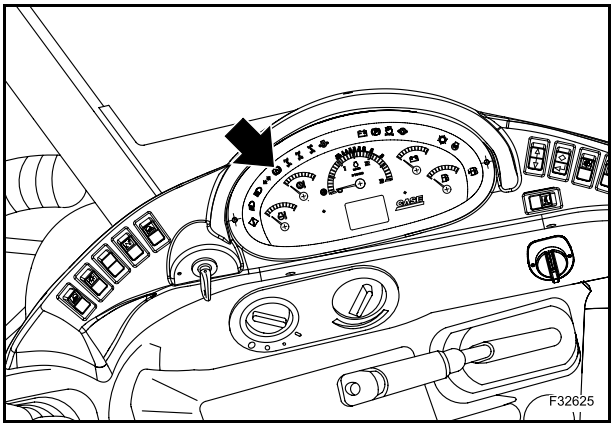


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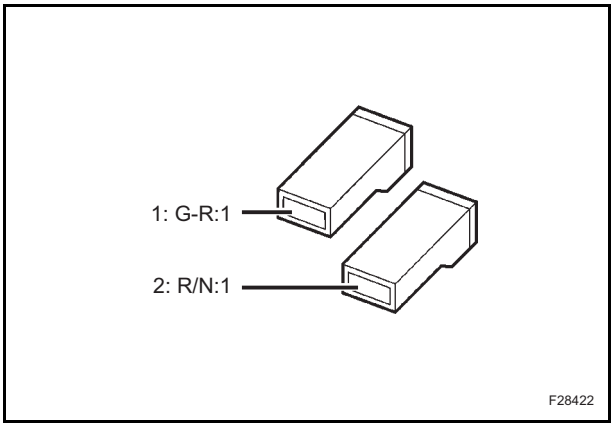
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8.11 BRAKE OIL LEVEL WARNING LAMP

When the warning lamp is turned on due to a low oil level, it sends a signal to the instrument cluster to illuminate the relevant warning lamp.

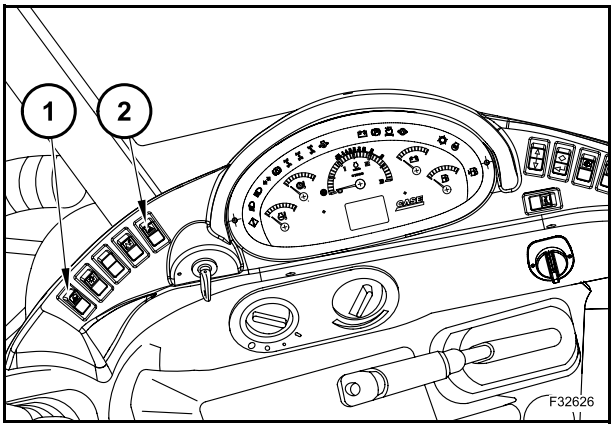


Test procedure:
Continuity:
With the fluid level correct there should be no continuity through the switch. Continuity should be seen when the level is low or the test button pushed.
Voltage:
With the Ignition ON there should be 12 V at the Red/Black terminal.

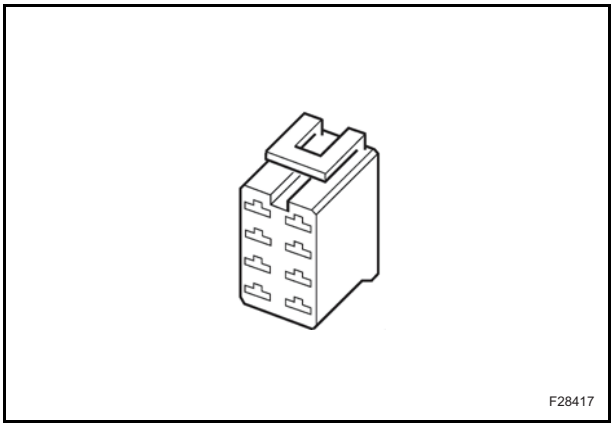


8.12 FRONT WORK LAMP SWITCH (1) - REAR WORK LAMP SWITCH (2) MAIN LIGHT SWITCH

There must be 12 V at the switch only after the main light switch and the starter switch key have been activated.



Test procedure
(Switch Off)
Continuity should not be found between any pins.
(Switch On)
Continuity should be found between pins 1 and 3 and 2 and 8.

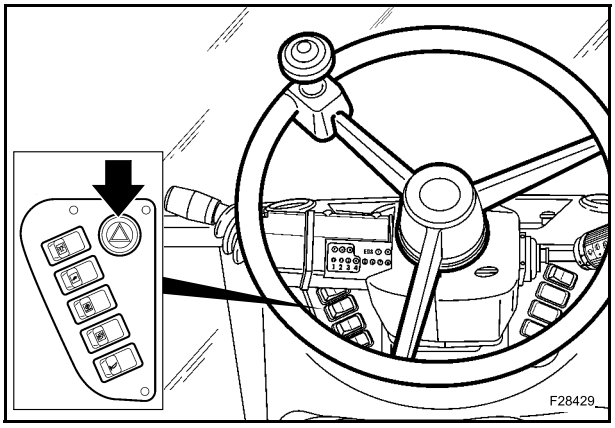


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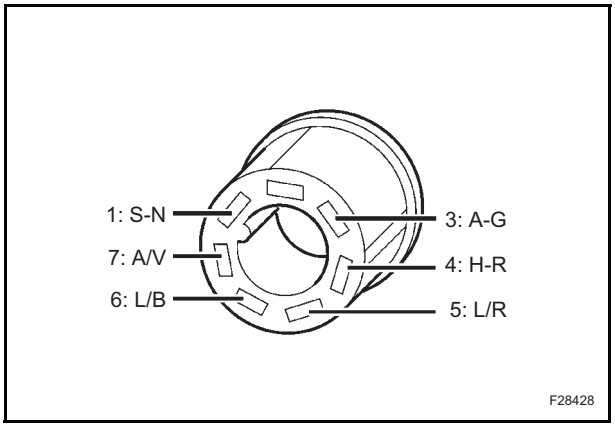
8.13 HAZARD SWITCH

12 V should be found at this switch at all times regardless of key start position.



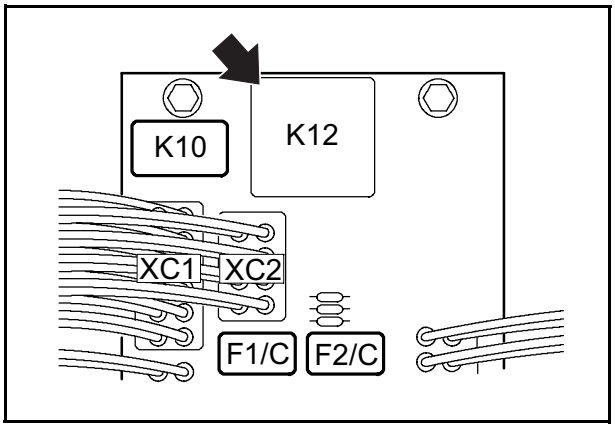
Test procedure

Pin No.	Switch OFF	Switch ON
1	to pin 4	-
3	-	to pins 5/6/7
4	to pin 1	-
5	-	to pins 2/3/6/7
6	-	to pins 2/3/5/7
7	-	to pins 2/3/5



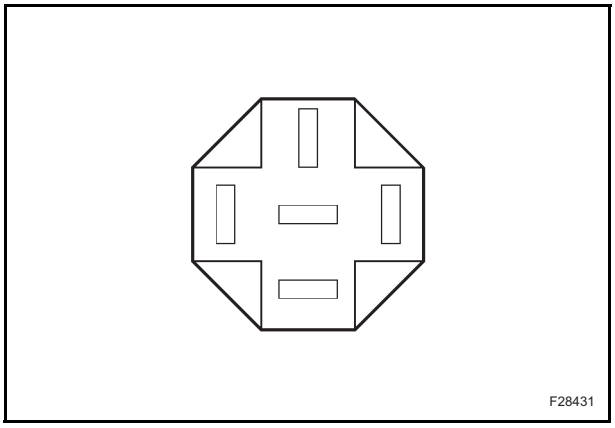
8.14 HAZARD WARNING LIGHT RELAY

Operational at all times in conjunction with the hazard switch.



Continuity

Pin No.	Hazard / Indicator	
	Switch OFF	Switch ON
CL	12 V	12 V
+	-	12 V - 0 V - 12 V - 0 V
31	-	12 V - 0 V - 12 V - 0 V
PR	-	-



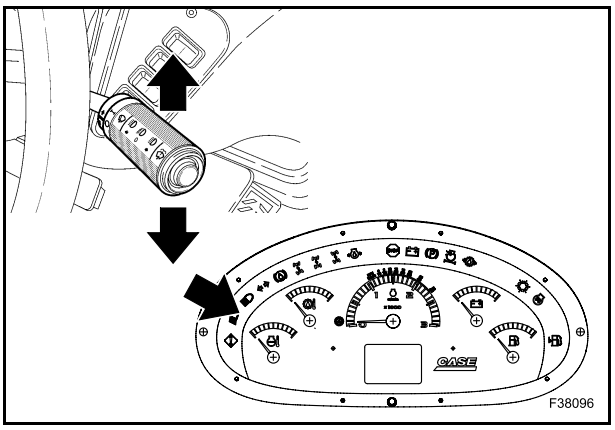
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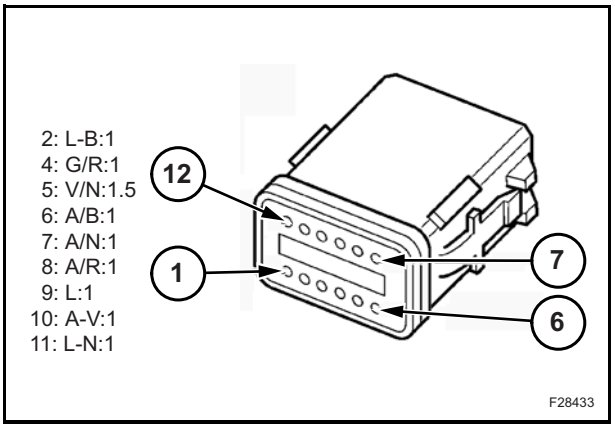
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8.15 MULTI FUNCTION SWITCH

Switch Continuity

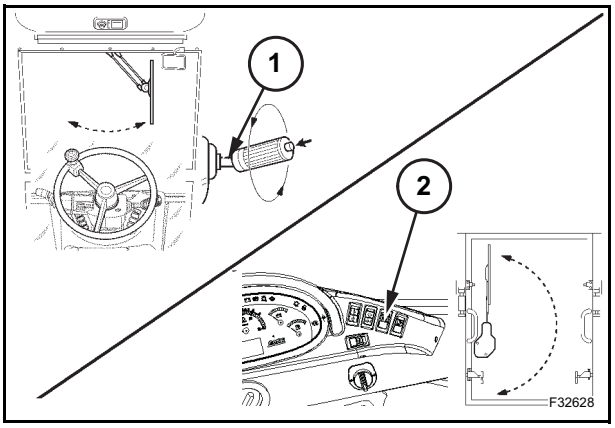
Pin No.	All switches OFF	Wind-shield washer	Indicator		Beam		Wiper seal
			Left	Right	Low	High	On
1							
2		pin 7					
3						pin 4	
4					pin 5	pin 3	
5					pin 4		
6	pin 8						
7		pin 2					pin 8
8	pin 6						pin 7
9			pin 11				
10				pin 11			
11			pin 9	pin 10			
12							





8.16 FRONT WINDSHIELD WIPER MOTOR (1) - REAR WINDSHIELD WIPER MOTOR (2)

Energized at key start at 12 V.



Test procedure

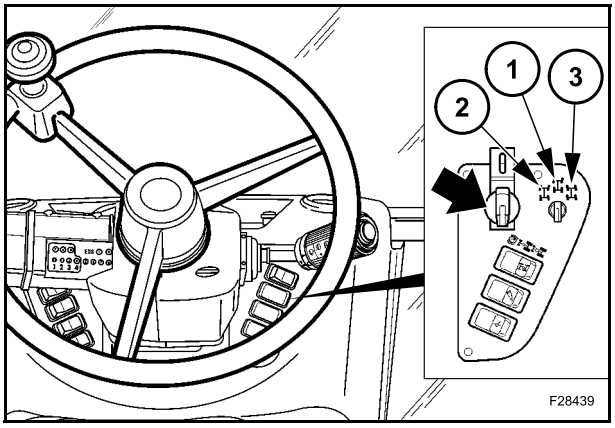
Pin No.	Continuity	Continuity
1	pin 3	pin 5 2 Ω
3	pin 5 2 Ω	-

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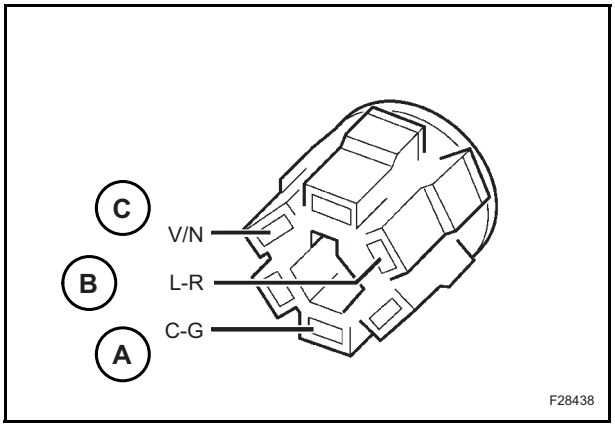
8.17 4WS - STEERING SELECTOR SWITCH

At key start 12 V should be found at the switch and is directed to the steering sensors when a switch selection is made.



Test procedure
With ignition ON

Pin	2WS	4WS	CRAB
A	12 V	12 V	12 V
B	-	-	12 V
C	-	12 V	-

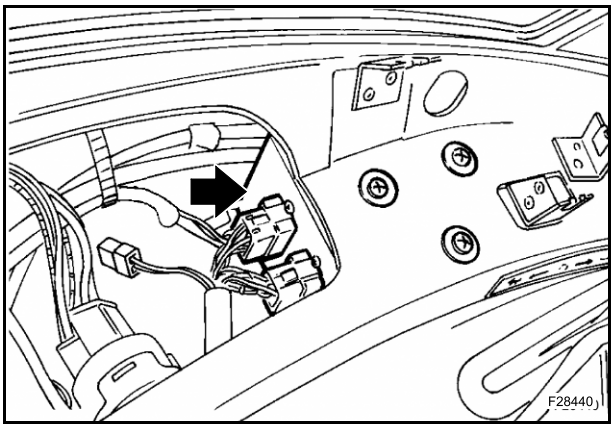


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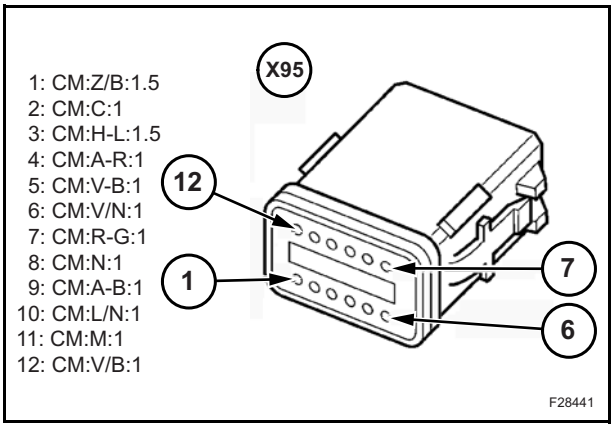
8.18 STEERING CONTROL UNIT

The steering control unit controls the different steering functions that can be selected from the switch S47.
When changing steering mode, the light for the current mode is extinguished and the light for the new mode starts to flash. When movement of the steering wheel is detected, the light for the new mode remains steady.



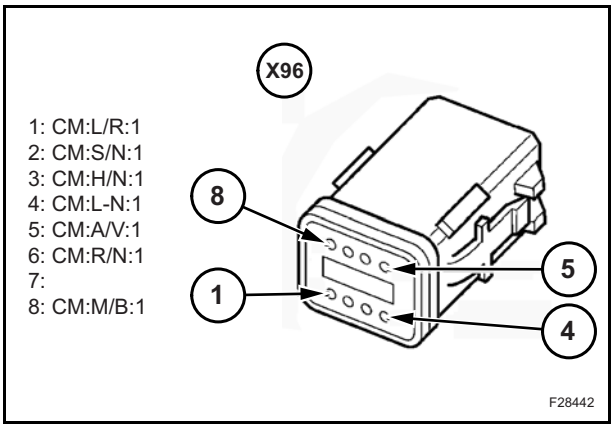
Connector pin out description
12 pin connector -X95:

Pin	Function	Signal
1	Crab steering warning light	-
2	Buzzer configuration	-
3	Front alignment sensor input	+12
4	Crab steering control	+12
5	Buzzer output	-
6	Rod iron steering control	+12
7	Control unit supply	+12
8	Ground	-
9	Speed sensor input	-
10	Rear alignment sensor input	+12
11	2WS warning light	-
12	4WS warning light	-



8 pin connector -X96:

Pin	Function	Signal
1	EV2A output	+12
2	EV2B output	+12
3	EV3A output	+12
4	Ground	-
5	Front sensor supply output	+12
6	Rear sensor supply output	+12
7	Available optional output	+12
8	EV3B output	+12



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Solenoid valve operation
Crab/4WS > 2WS
When the rear axle sensor detects alignment of its axis, the control unit de-energizes the active steering solenoid valves and activates the solenoid valves for 2WS.
2WS > Crab/4WS
When the rear axle sensor detects bridge alignment, all the solenoid valves for 2WS are de-activated and the solenoid valves for the selected mode are energized.
Crab > 4WS and 4WS > Crab
When the rear axle sensor detects alignment the 2WS temporarily activates (energizing the corresponding solenoid valves) until, after overcoming the condition of rear bridge alignment, the desired steering type activates when, by reversing the steering swing direction, the rear axle sensor detects alignment.

Solenoid valve failure
The operation condition of any solenoid valve output is tested each time the selected steering requires its supply. Even when only one solenoid valve output is short circuited or open, the control unit provides to cut the supply to all the solenoid valves by means of the self protection (the control unit is locked) and to signal this condition (short - or open - circuit) by means of the three warning lights relative to steering flashing at the same time. Once the solenoid valve causing the failure has been de-energized or the correct operation has been reset.

Buzzer operation
Buzzer operation depends on setting of pin 2 of the 12 way connector:
- Pin 2 not connected (North America only). If 12 km/h is exceeded in crab mode, the buzzer sounds.
- Pin 2 grounded (Outside of N/America). If 12 km/h is exceeded in crab or 4WS mode, the buzzer sounds.

Buzzer operation is intermittent, 250 ms on and 250 ms off.
The control unit is set at 9 km/h; steering mode change is not possible when this speed is exceeded.

Solenoid valve output

Solenoid	2WS	4WS	CRAB
EVA2			X
EVA3		X	X
EVB2	X	X	
EVB3	X		

Speed pulses
Speed pulses are drawn from EGS-CLARK control unit. Output reference values of clark transmission are:
- 7 Hz for 1 km Æ
- 14 Hz for 2 km Æ
- 35 Hz for 5 km Æ

values in V -8 and +8.
The speed calculation has been determined with a tyre having a circumference of 4.165 m.

Steering type storage
The steering type is stored in a non-volatile memory each time the machine is turned off. This information is therefore stored for an indefinite time even with the supply cut off.

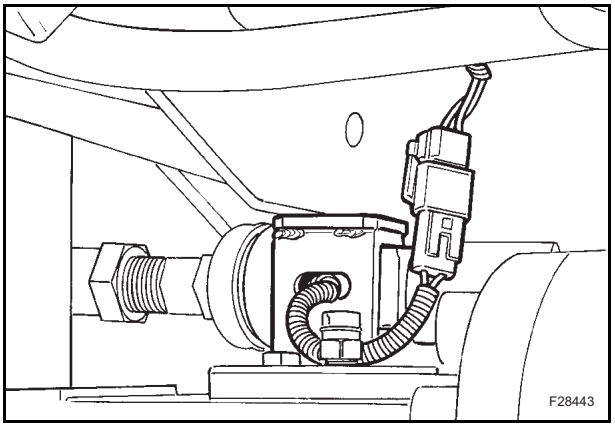
Start-up and axle recovery
The control units are supplied with a storage of the last steering selected at two wheels. With this steering type selected, it is always possible to recover the axle alignment; “short-circuit” the sensor or front and rear axles, supply the machine (with the switch in 2 wheel position) and select the type of 4WS enabling the bridge alignment.

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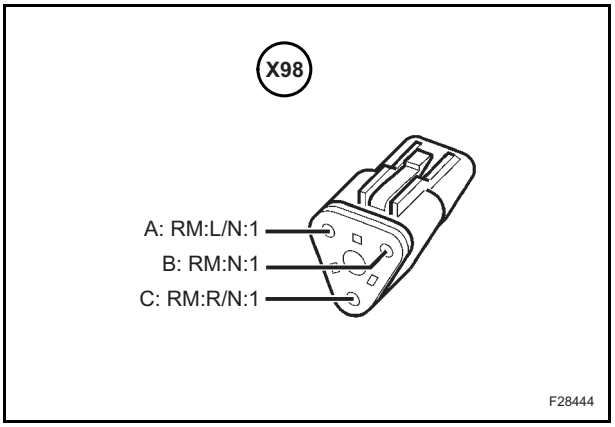
8.19 4WS REAR AXLE STEERING SENSOR

At key start 12 V should be found at the switch and is directed to the steering sensor when the switch selection is made.



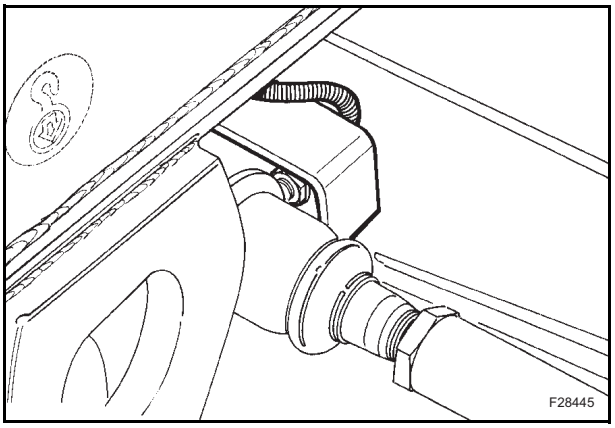
X98

Pin	2WS	4WS	CRAB
A	12 V	12 V	12 V
B	-	-	-
C	-	-	-



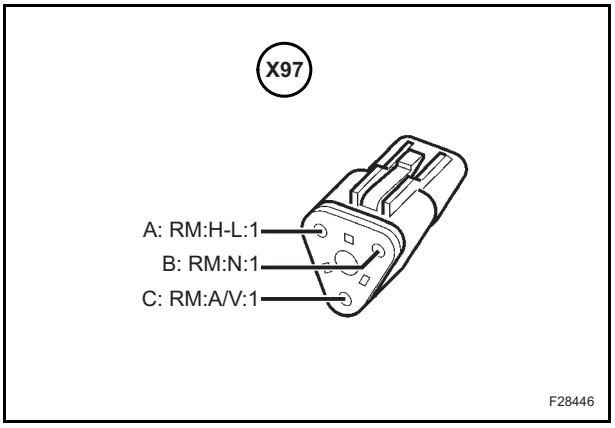
8.20 4WS FRONT AXLE STEERING SENSOR

At key start 12 V should be found at the switch and is directed to the steering sensor when a switch selection is made.



X97

Pin	2WS	4WS	CRAB
A	12 V	12 V	12 V
B	-	-	-
C	-	-	-

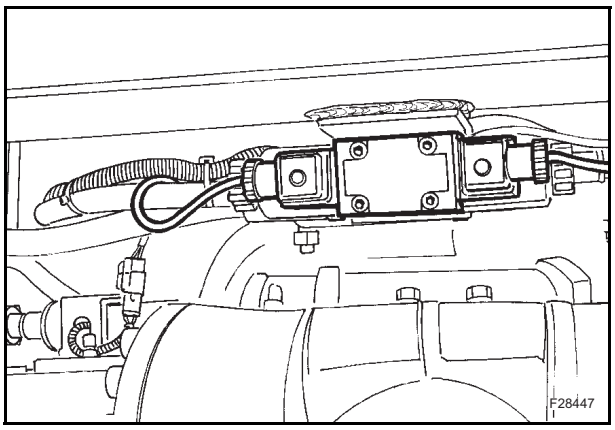


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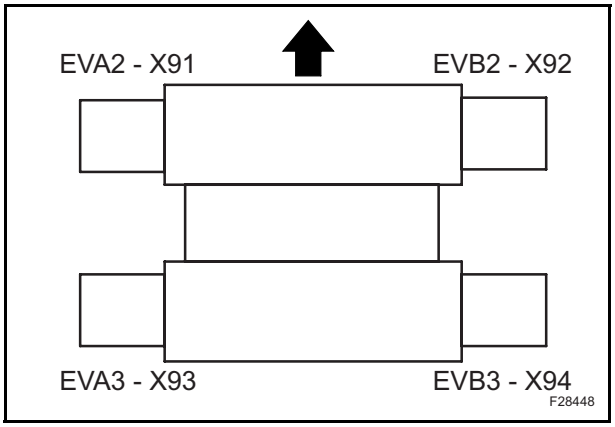
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8.21 STEERING SOLENOID VALVE

Energized at 12 V but governed by the steering processor.

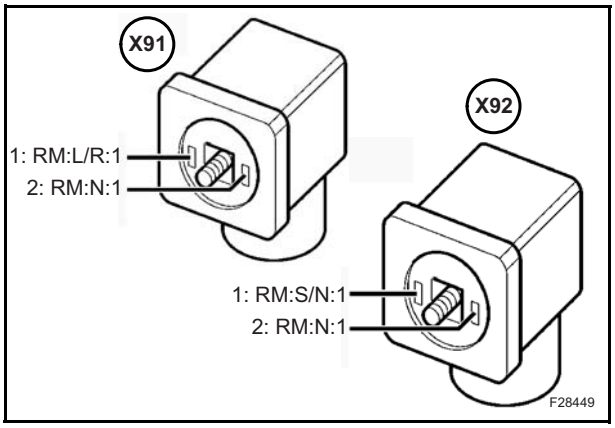


Solenoid valve connections, viewed from the top. Arrow denotes front of loader backhoe.

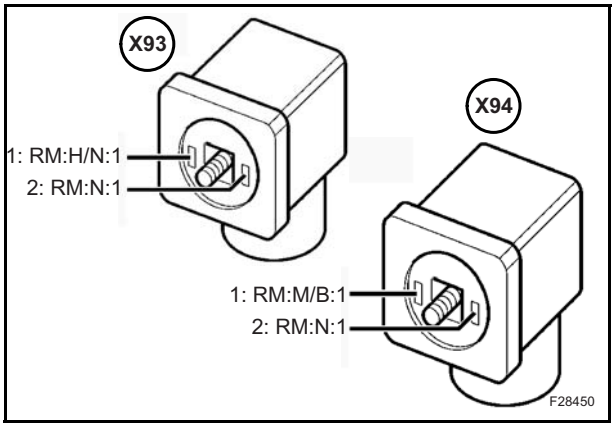


Solenoid	2WS	4WS	CRAB
EVA2	0 V	0 V	12 V
EVA3	0 V	12 V	12 V
EVB2	12 V	12 V	0 V
EVB3	12 V	0 V	0 V

Pin No.	Solenoid	Resistance
1	0 V	5.0 Ω



Pin No.	Solenoid	Resistance
1	0 V	5,0 Ω

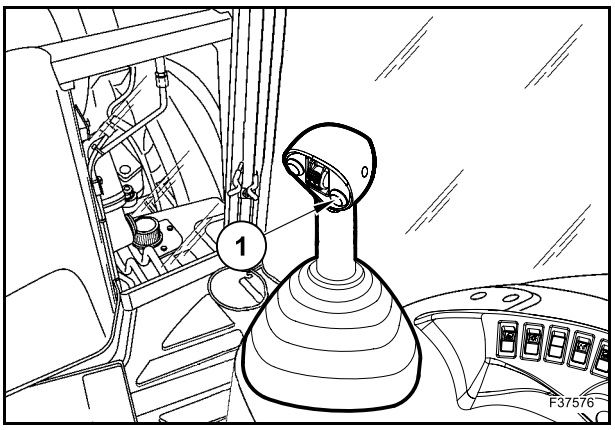


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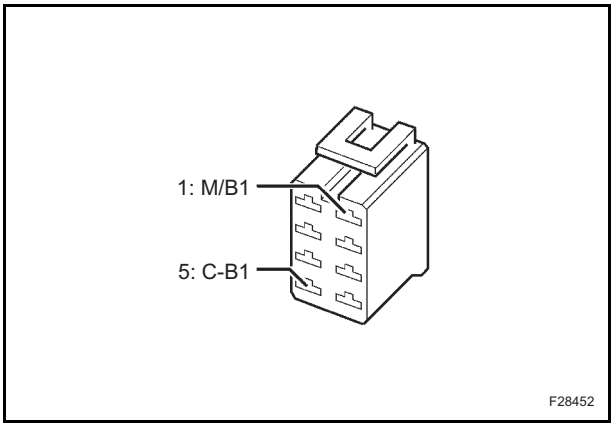
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8.22 DIFFERENTIAL LOCK SWITCH (1)

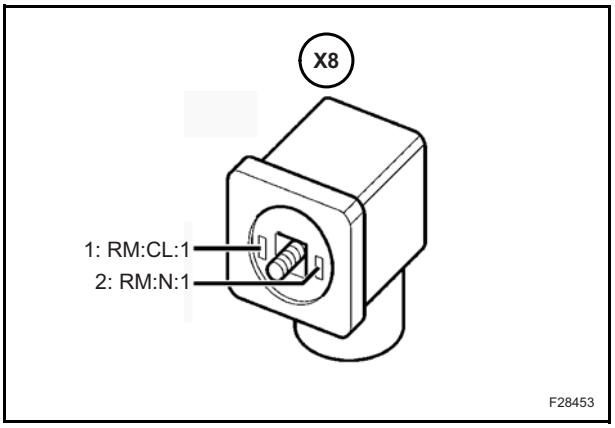
At key start the spring loaded switch has 12 V and when operated energizes the differential solenoid valve.



Test procedure
(Switch Off)
Continuity should not be found between any pins (Switch On).
Continuity shoud be found between pins 1 and 5.



Pin No.	Solenoid	Resistance
1	0 V	5.0 Ω



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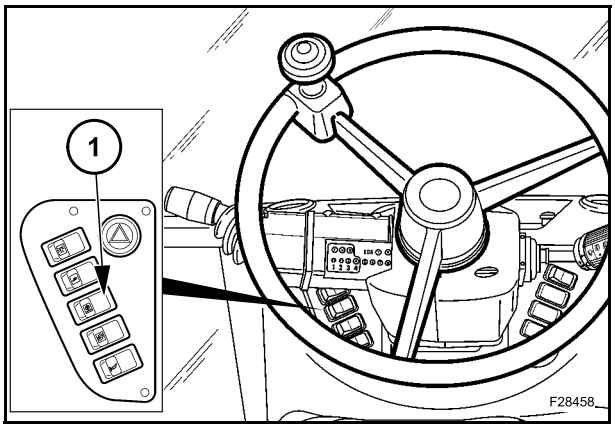
8.23 LOADER

"GLIDE RIDE" (1)

Designed to reduce loader attachment oscillations when travelling with empty bucket.

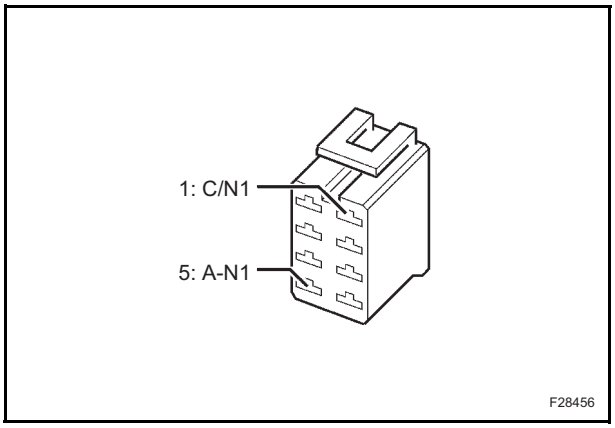
⚠ WARNING

If the machine is raised using the loader bucket do not operate the glide switch ensure it is switched OFF.



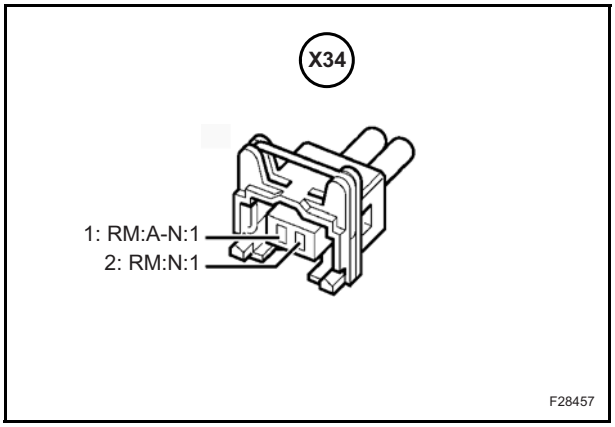
Test procedure

(Switch Off)
Continuity should not be found between any pins.
(Switch On)
Continuity shoud be found between pins 1 and 5.



EV11

Pin No.	Solenoid	Resistance
EV11	0 V	5.0 Ω

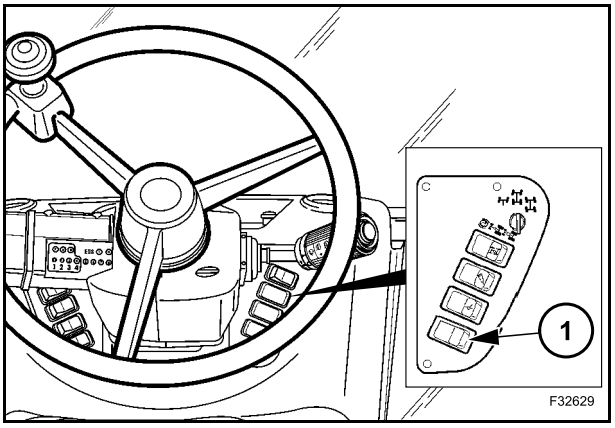


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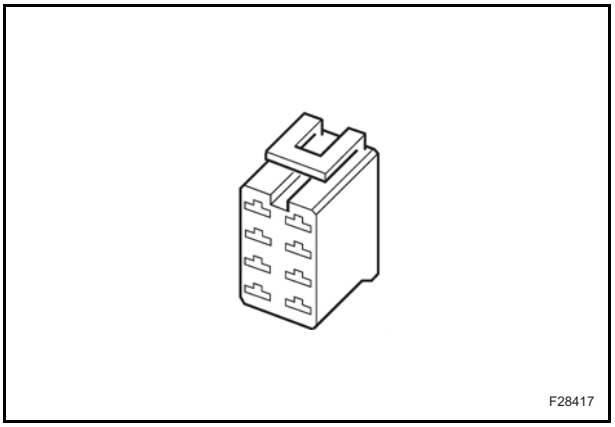
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LOADER ATTACHMENT LOCK (1)

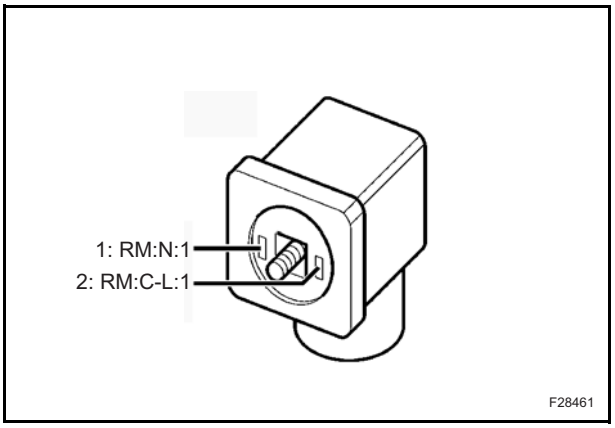
The loader attachment lock, when actuated, is designed to prevent movement of the loader attachment during road travel.



Continuity should be found between pin 1 and 3.



Pin No.	Solenoid	Resistance
1	0 V	5.0 Ω

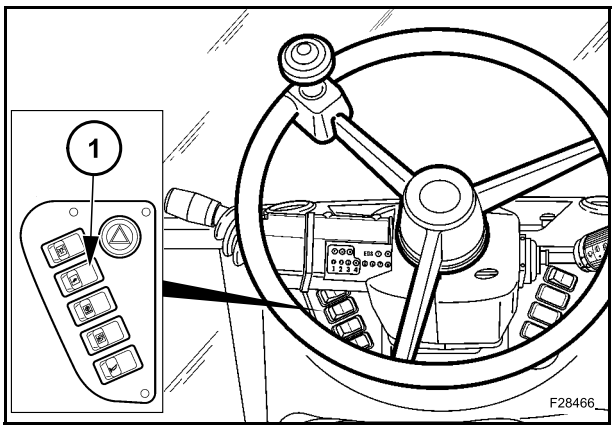


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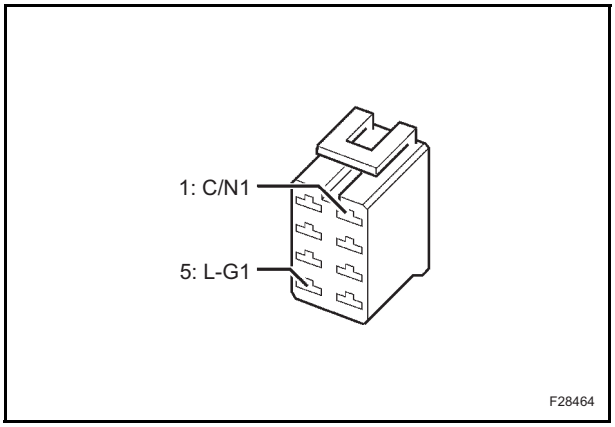
HYDRAULIC SPEED CONTROL (1)

It enables an increase of the moving speed of the loader attachment.

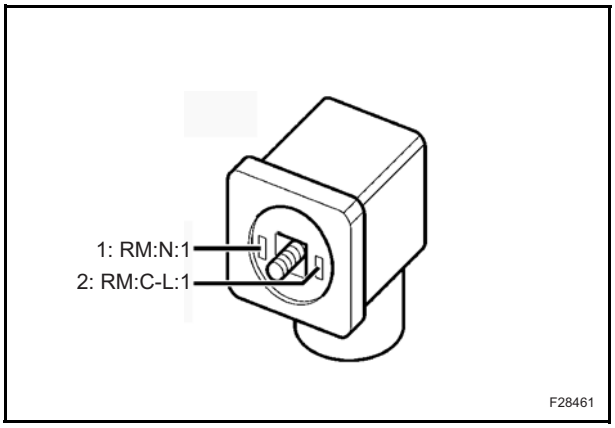


Test procedure

(Switch Off)
Continuity should not be found between any pins.
(Switch On)
Continuity shoud be found between pins 1 and 5.



Pin No.	Solenoid	Resistance
1	0 V	5.0 Ω



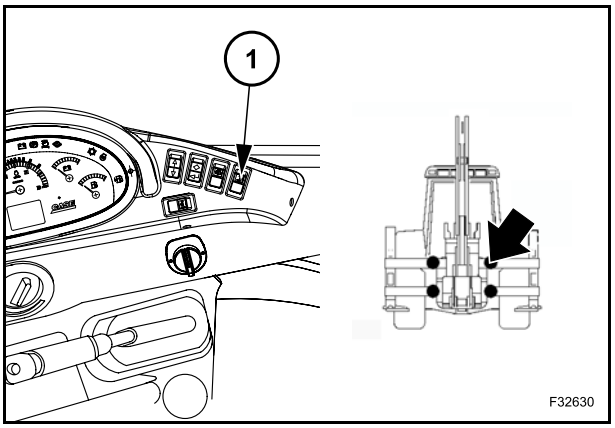
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8.24 BACKHOE

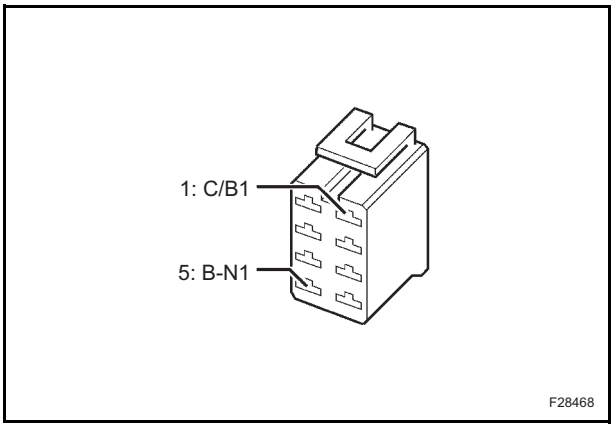
BACKHOE ATTACHMENT TRAVEL LOCK SWITCH

At start-up, the switch must have 12 V to disengage / engage the backhoe attachment travel lock cylinders.

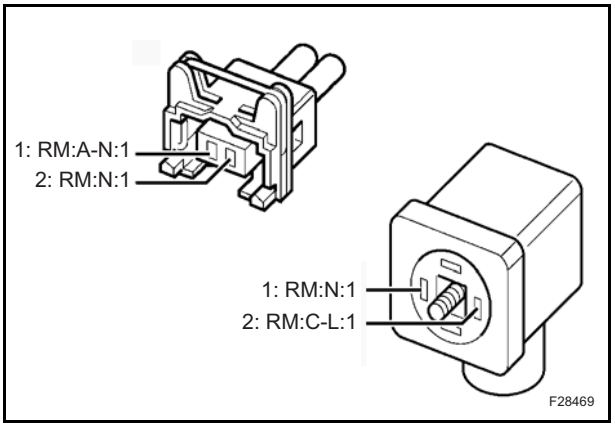


Test procedure

(Switch Off)
Continuity should not be found between any pins (Switch On).
Continuity shoud be found between pins 1 and 5.



Pin No.	Solenoid	Resistance
1	12 V	9.7 Ω

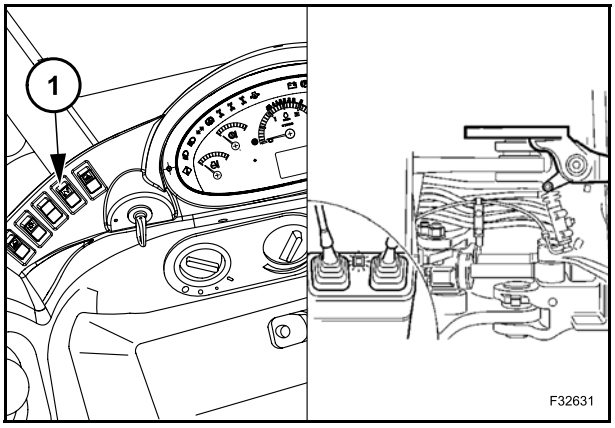


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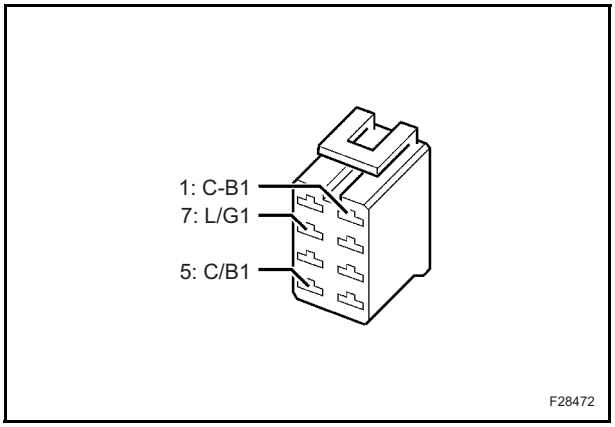
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BACKHOE ATTACHMENT LOCK SWITCH (1)

At start-up, the switch must have 12 V for the operation of the backhoe attachment lock.

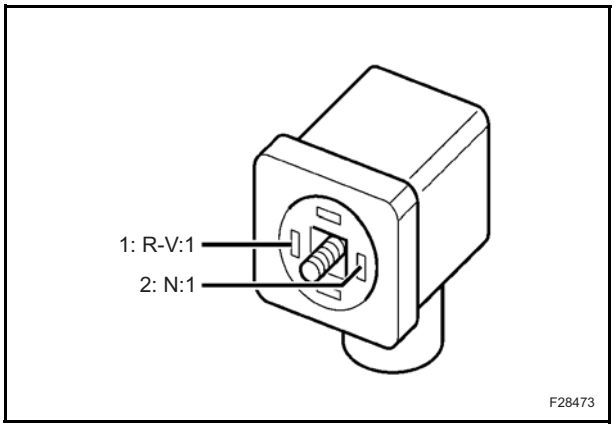


Test procedure
(Switch Off) - X25
Continuity shoud be found between pins 1 and 5.
(Switch On)
Continuity shoud be found between pins 5 and 7.



EV5

Pin No.	Solenoid	Resistance
1	12 V	7.5 Ω

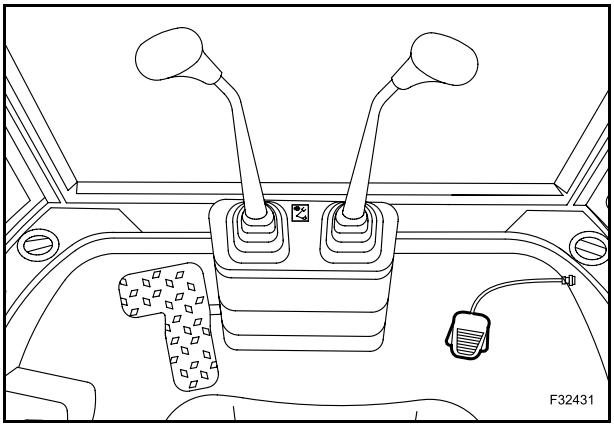


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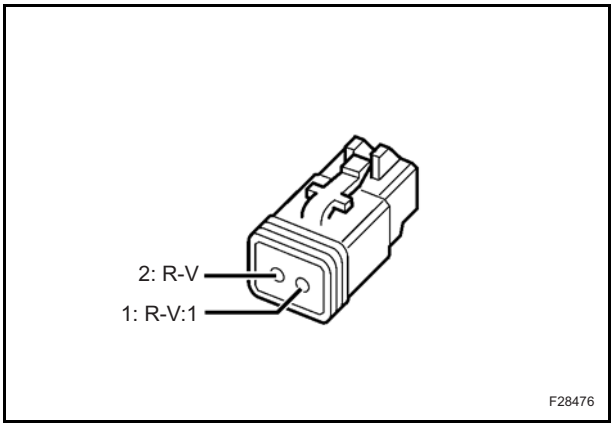
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HYDRAULIC HAMMER CONTROL PEDAL

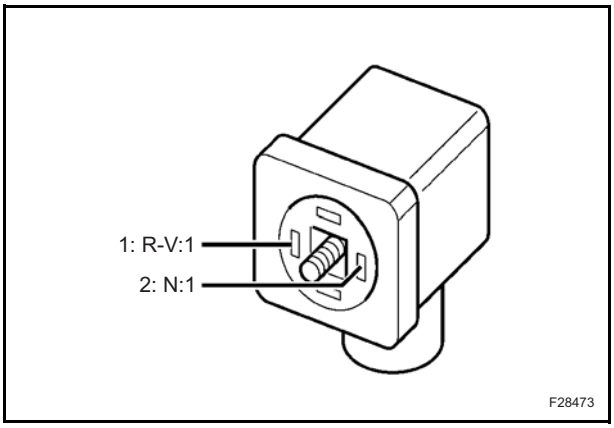
At start-up, the pedal must have 12 V for the operation of the hammer.



When the switch is operated, there must be 12 V at pin 2.



Pin No.	Solenoid	Resistance
1	12 V	7.5 Ω

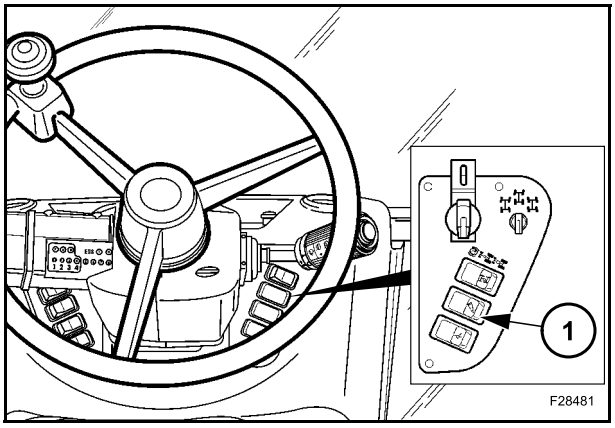


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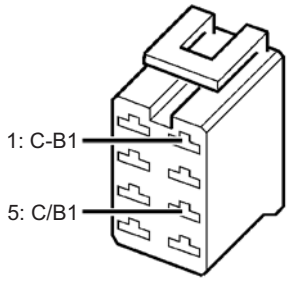
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HAND HAMMER SWITCH (1)

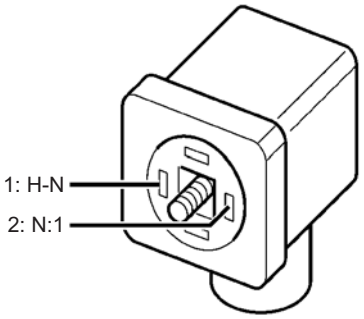
At start-up, the switch must have 12 V for the operation of the hand hammer.



When the switch is operated, there must be 12 V at pin 1.



Pin No.	Solenoid	Resistance
1	12 V	7.5 Ω

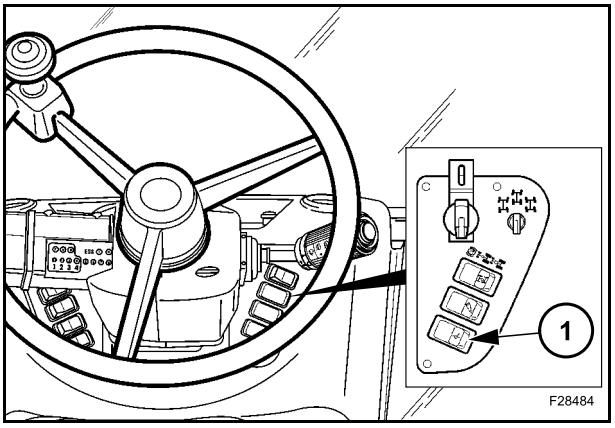


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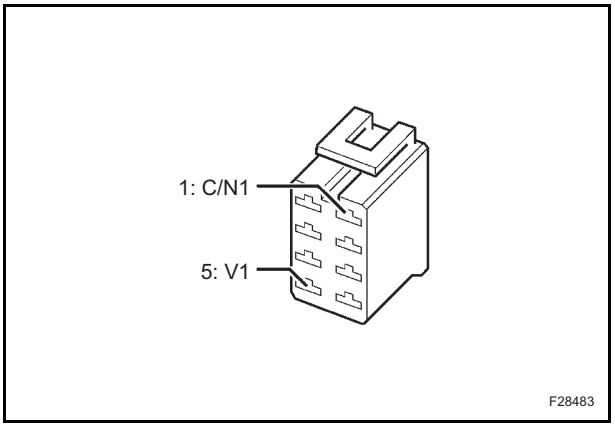
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ATTACHMENT SWITCH (1)

At start-up, the switch must have 12 V.

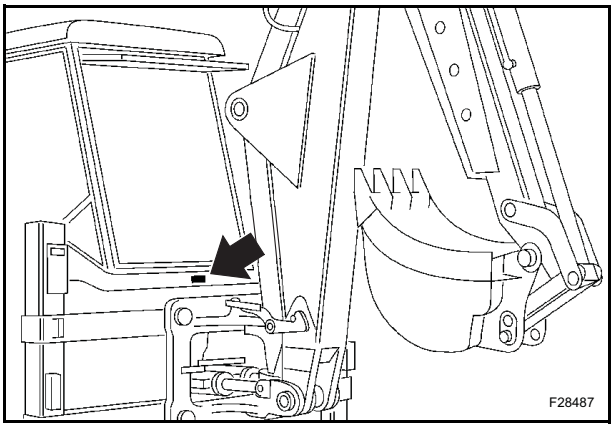


When the switch is operated, there must be 12 V at pin 5.

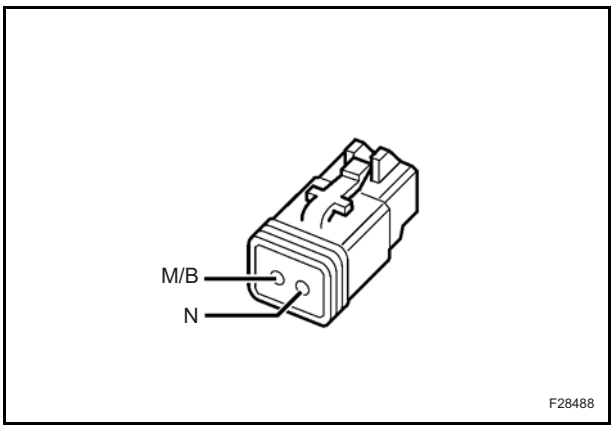


REVERSING BUZZER

Activated by 12 V at key start when reverse gear is selected.



With reverse travel selected, there must be 12 V at pin connector.
Resistance of the buzzer 162 Ω.

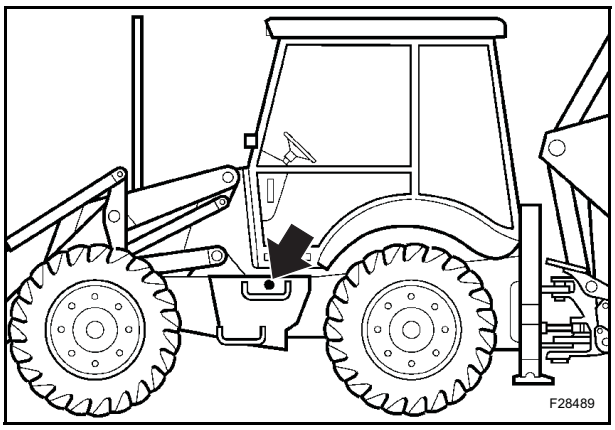


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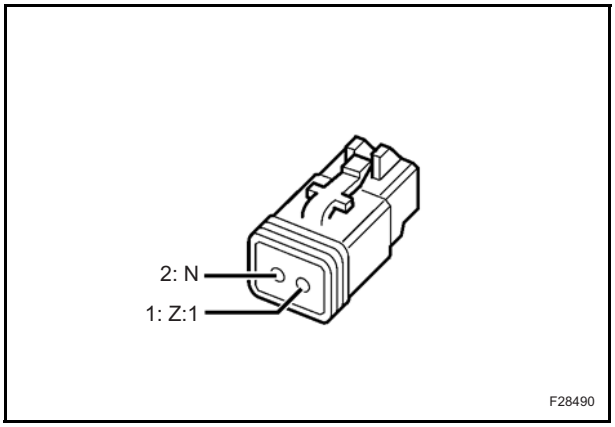
FUEL LEVEL GAUGE

The gauge indicating the fuel level is located in the side instrument cluster.



Test procedure
Approximate resistance:

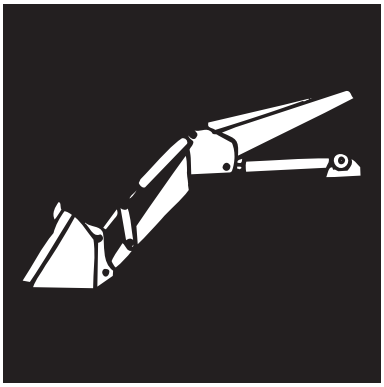
Gauge indication	Sensor resistance
Full	9 Ω
Half	129 Ω
Empty	333 Ω



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580SR
580SR+
590SR
695SR



SECTION 82 - LOADER

1. LOADER ATTACHMENT CONTROLS 3
1.1 LOADER ATTACHMENT OPERATION 3
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3. LOADER ATTACHMENT SAFETY STRUT 7
4. LOADER BUCKET REMOVAL 8
5. LOADER REMOVAL 11

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1. LOADER ATTACHMENT CONTROLS

WITH STANDARD LOADER BUCKET

Located on the right of the steering wheel, this nine position lever operates all the loader attachment controls. The speed of movement of each control depends on the angle to which the lever is tilted. In the intermediate position, two movements can be obtained simultaneously.

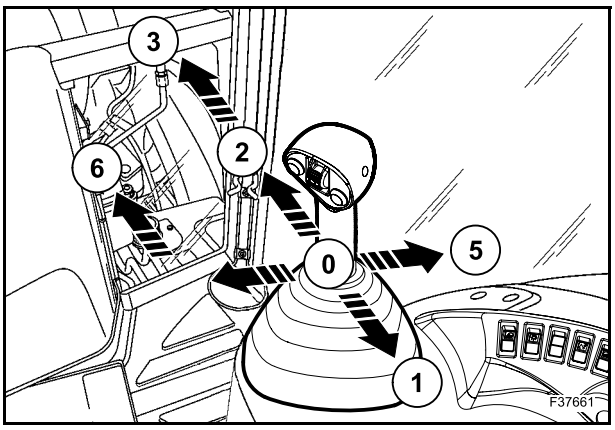
WITH 4x1 LOADER BUCKET

The function of the lever is identical to that of the machine fitted with the standard loader bucket, with the addition of the clam control.

1.1 LOADER ATTACHMENT OPERATION

NEUTRAL AND HOLD

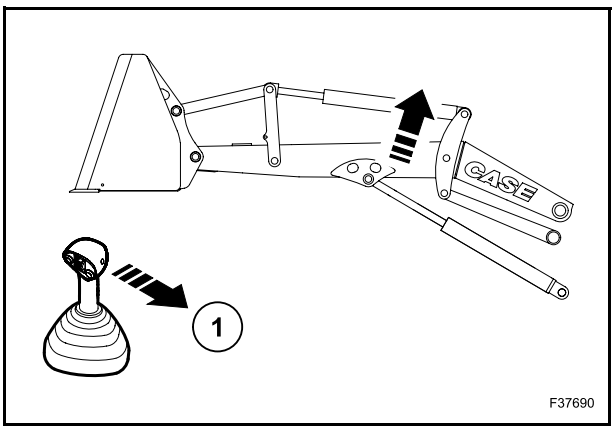
With the lever in the neutral/hold position (0), the attachment movement can be stopped. As soon as the lever is released, it automatically returns to the neutral position (0) and the attachment remains in the position where it was when movement stopped.



1

RAISING THE LOADER ATTACHMENT

With the lever in position (1), the attachment rises.



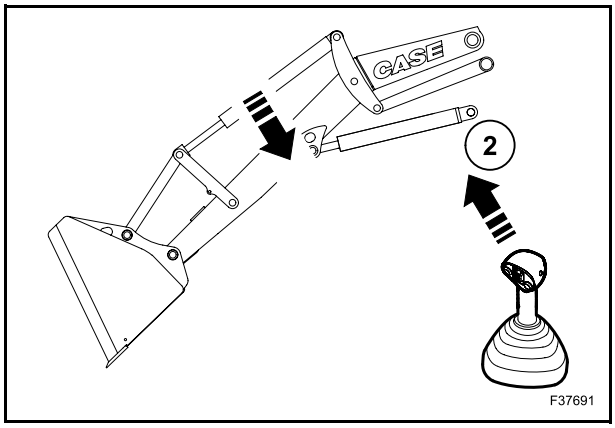
2

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LOWERING THE LOADER ATTACHMENT

With the lever in position (2), the attachment lowers.

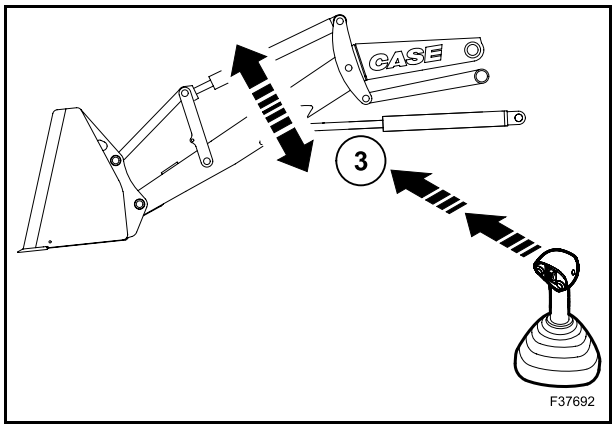


3

LOADER BUCKET FLOAT CONTROL

With the lever in position (3), the bucket follows the contours of the ground without it being necessary to operate the lever.

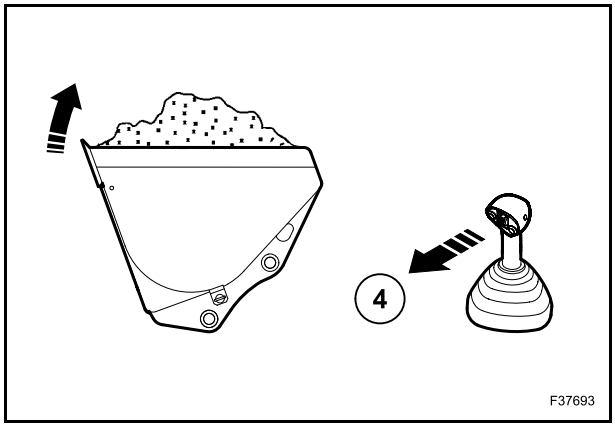
NOTE: in this position the lever does not automatically return to neutral when it is released. It is necessary to move it manually.



4

FILLING THE LOADER BUCKET

With the lever in position (4), the bucket rolls back (fills).



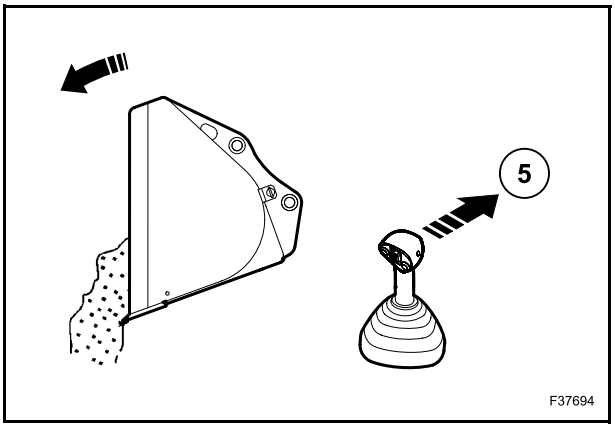
5

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DUMPING THE LOADER BUCKET

With the lever in position (5), the bucket rolls forward (dumps).

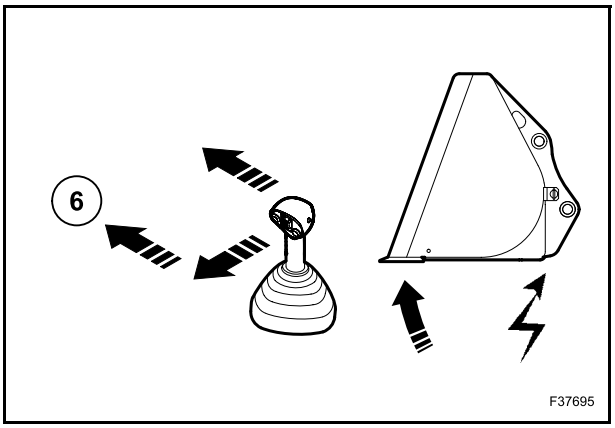


6

AUTOMATIC RETURN TO LOADER BUCKET FILLING

With the lever in position (6), the attachment lowers and, simultaneously, the bucket places itself to the digging position.

NOTE: it is possible to adjust the tilt angle for bucket filling.

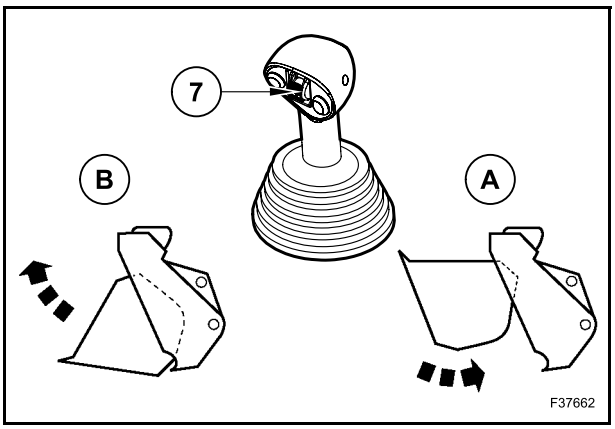


7

1.2 4x1 LOADER BUCKET CLAM CONTROL (If fitted)

This control operates the opening and closing of the 4x1 loader bucket clam.
This control is proportional:

When releasing the roller (7), it automatically returns to the initial position (neutral) and the bucket remains in the position where it was when movement stopped.
It is possible to lock the roller into detent by moving the roller to the full forward (raised) position. To release the detent, press on the lower portion of the roller as your return it to the neutral position.
When shifting the roller (7) forward: the loader bucket clam closes (A).
When shifting the control (7) backward: the loader bucket clam opens (B).



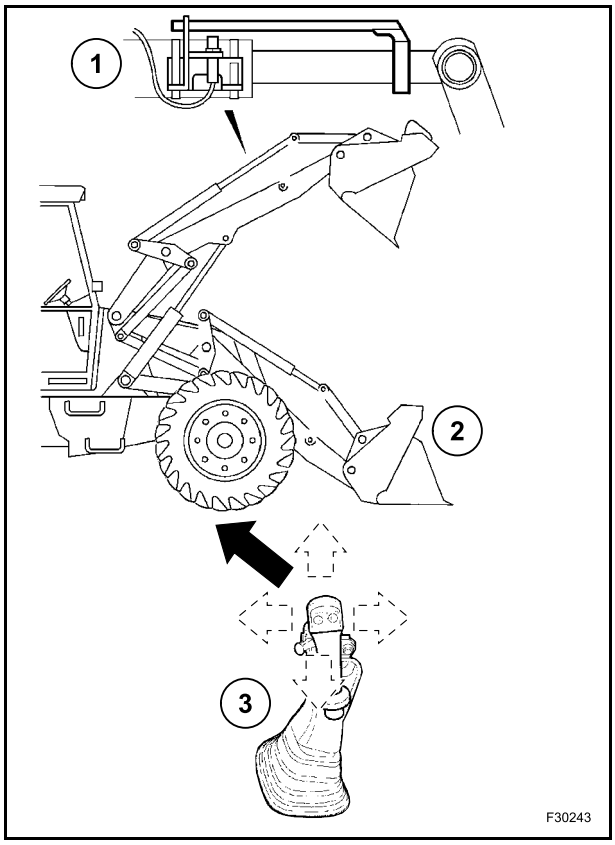
8

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2. LOADER BUCKET SELF LEVELING

The self-levelling linkage mounted on the right hand loader arm and chassis automatically controls the angle of the loader bucket during the raising cycle of the lift arms to maintain a constant bucket level. There is no self-levelling during lowering.
Return to dig is an electrically activated feature which enables the operator to automatically return the bucket to a level digging position for a further work cycle with one simple movement of the loader control lever (3).
Whenever the bucket is rolled forward to dump, the return to dig system is activated, and the solenoid valve on the bucket spool is energized.
When the loader bucket control lever (3) is moved diagonally left to the return to dig position (2) the electromagnet will hold the bucket spool in the roll back position until the bucket is in the level digging position at which time the indicator on the rod of the bucket self-levelling linkage will pass in front of the sensor which de-energises the electromagnet on the bucket spool enabling the spool to return to the neutral position.

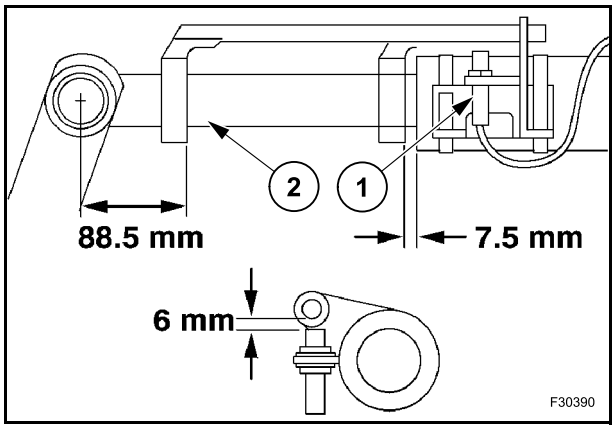


RETURN TO DIG SENSOR ADJUSTMENT

The return to dig system consists of an electromagnet mounted on the loader bucket control valve spool, a sensor (1) mounted on top of the loader arm and a pointer attached to the tube of the bucket self-levelling linkage.

- Place the bucket on the ground in the preferred digging position.
- Check the dimensions of 88.5 mm and 7.5 mm are maintained as shown.
- Ensure the face of the sensor (1) is 6 mm from rod (2).

As a visual aid for the operator, while seated in the cab, the pointer mounted on the loader arm can be seen to align with the pointer on return to dig linkage, when the loader arms are lowered and the bucket is in the level digging position.



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3. LOADER ATTACHMENT SAFETY STRUT

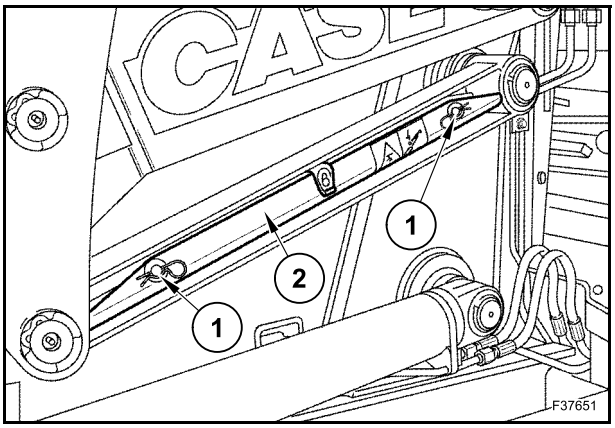
Located on the left-hand side of the loader attachment, this safety strut enables the loader attachment to be locked in the raised position in case of defects in the system.

LOCKED POSITION

Completely raise the loader attachment. Stop the engine and remove the starter switch key.

Remove the split pins (1) and the safety strut (2) from the arm. Put the split pins back in place.

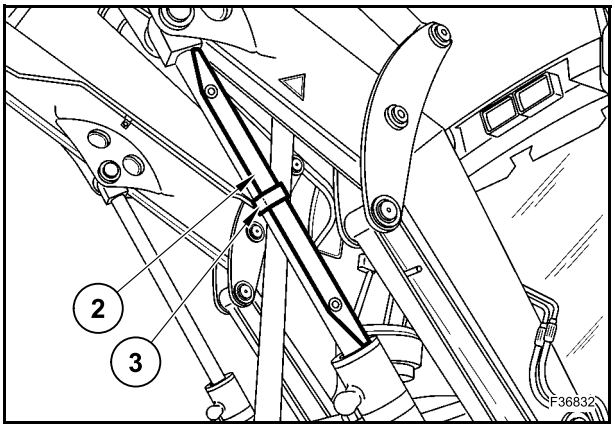
Place the strut (2) on the cylinder rod and fasten it by means of the fastening flip (3).



9

UNLOCKED POSITION

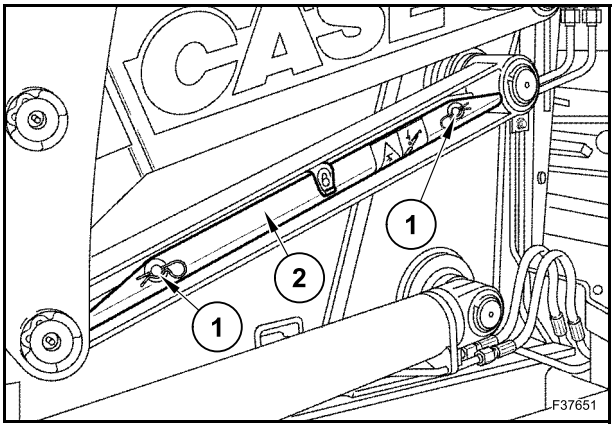
Remove the flip (3) and the strut (2) from the cylinder rod.



10

Install the safety strut (2) on the loader arm by means of the split pins (1).

Start the engine and lower the loader attachment.



11

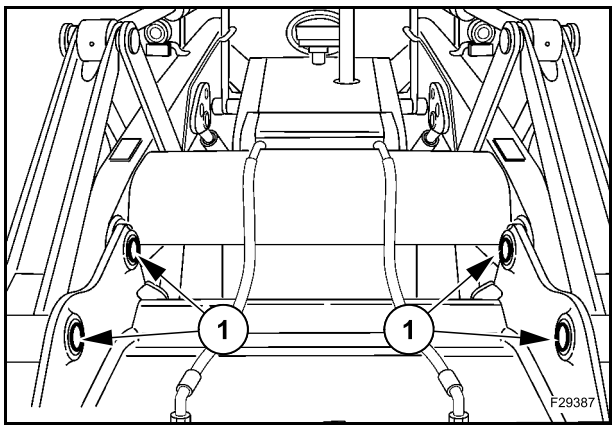
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4. LOADER BUCKET REMOVAL

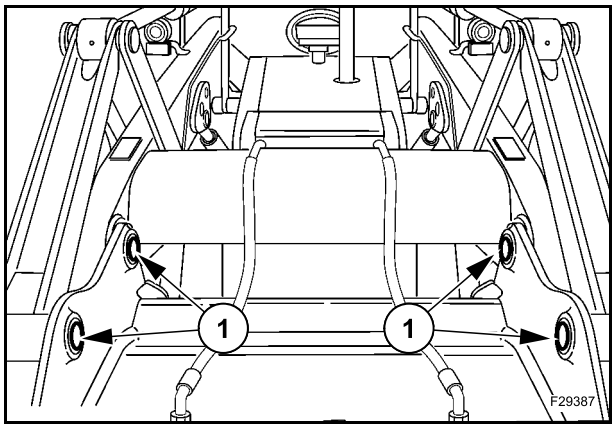
REMOVAL

Park the machine on flat surface.
Lower the bucket to the ground in dump position (tilted completely forward).
Stop the engine and remove the starter switch key.
If the machine is fitted with a 4x1 bucket, release the pressure from the bucket system.
Remove the snap rings and retaining pins and then drive out the linkage pins (1).
(4x1 bucket) disconnect and plug the hydraulic supply lines.
Start the engine
Operate the attachment controls so as to release the bucket.
Reverse the machine from the bucket.



INSTALLATION

Make sure all bushings are completely clean.
Remove any dirt or foreign matter, if necessary.
Start the engine
Use the attachment controls to engage the attachment between the bucket lugs.
Install the arm/bucket linkage pins (1) and then install the retaining pins and snap rings.
Use the bucket controls to align the connecting rod holes with the bucket lugs.
Stop the engine and remove the starter switch key.
(4x1 bucket) release the pressure from the bucket system.
Install the connecting rod/bucket linkage pins (1) and then install the retaining pins and snap rings.
(4x1 bucket) remove the plugs and reconnect the hydraulic supply lines.



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4.1 LOADER BUCKET WITH FORKS (Optional)

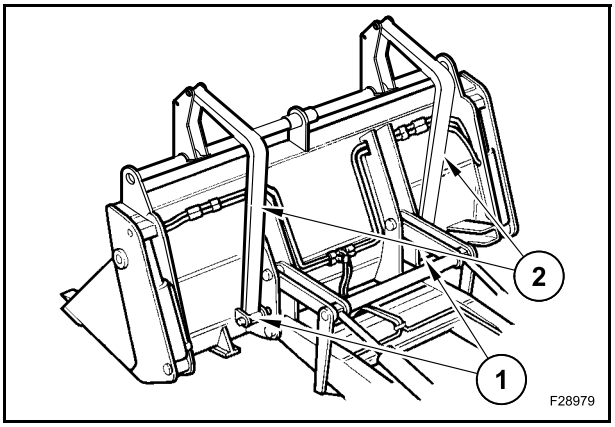
⚠ WARNING ⚠

The forks are heavy, so use great care when swinging them into their working and stowage position.

INSTALL FORKS IN WORKING POSITION

Move the bucket to a level and firm ground. Stop the engine and remove the starter switch key. Raise the parking brake lever.
Remove the retained pin and the pin (1).
Lower the fork (2) manually and carefully until it is laying in position against the bucket cutting edge.

IMPORTANT: the forks must be laying against the cutting edge of the bucket, and never against bucket teeth.

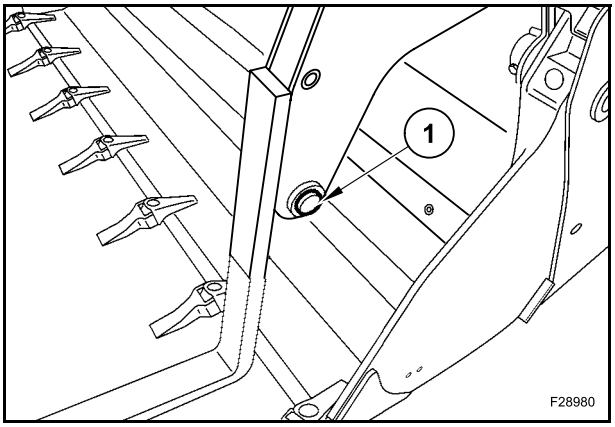


12

Install the pin (1) and the safety pin.
Repeat the same operations for the other fork.
Slide the forks until they are suitably spaced for the intended job.

IMPORTANT: the two forks must be positioned at the same distance from the centre of the bucket.

IMPORTANT: never use the forks to lift the machine.



13

⚠ WARNING ⚠

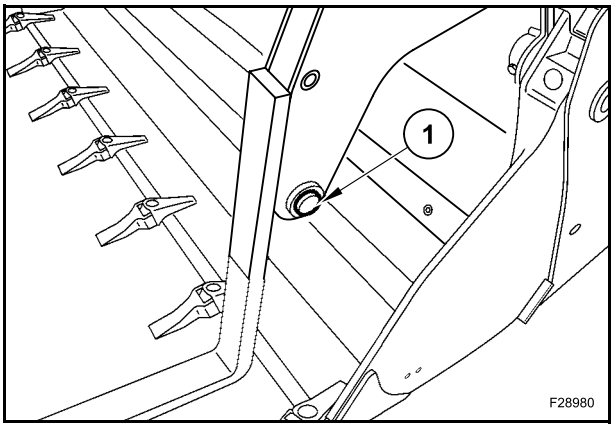
When using the forks with a 4x1 bucket, never attempt to use the bucket jaw opening function.

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INSTALL THE FORKS IN REST POSITION

Rest the loader bucket on a level and firm ground.
Stop the engine and remove the starter switch key.
Disengage the parking brake lever.
Remove the retained pin and the pin (1).
Tilt the fork (2) manually and carefully until it is rearwards into transport position.



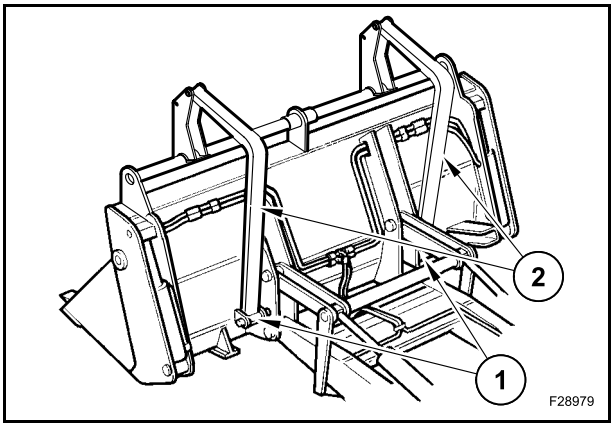
14

Reinstall the pin (1) and the safety pin into their housing.

NOTE: if necessary, slide the fork to the side to bring it into its housing.

Repeat the same operations for the other fork.

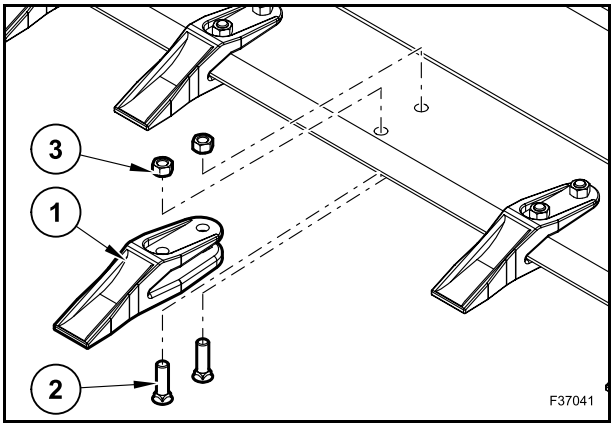
IMPORTANT: the forks must be securely retained in their proper storage position using the pins and split pins provided for this purpose. If forks are not correctly secured, they can cause serious injury.



15

4.2 REPLACING LOADER BUCKET TEETH

Move the machine to a level and firm ground.
Position the loader bucket so that the bucket teeth can be replaced.
Place the direction-of-travel lever and gearshift lever in neutral position.
Immobilize the machine by means of the parking brake.
Stop the engine and remove the starter switch key.
Loosen and remove the screws (2) with the nuts (3).
Extract the tooth (1).
Clean the area around the tooth.
Assemble the new tooth (1).
Screw in and tighten the screws (2) with the nuts (3).



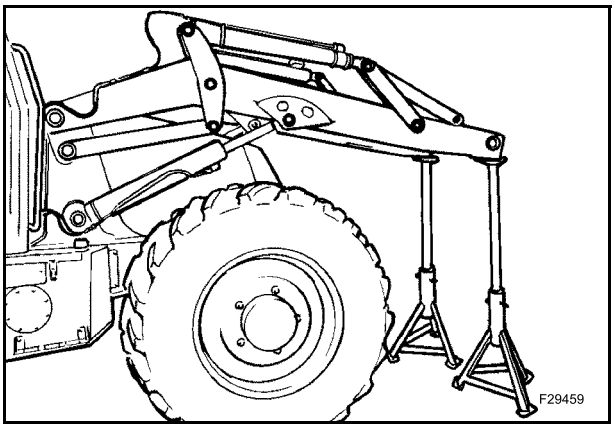
16

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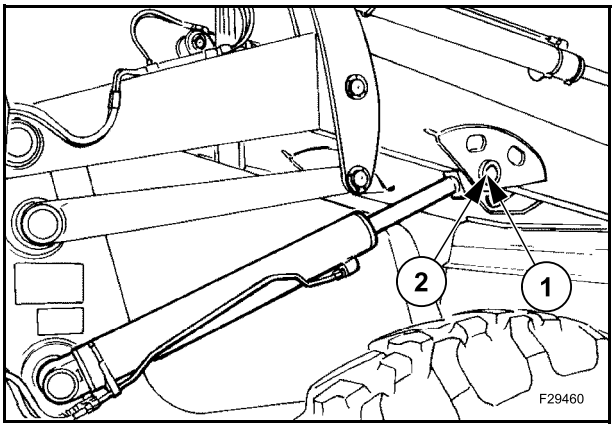
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5. LOADER REMOVAL

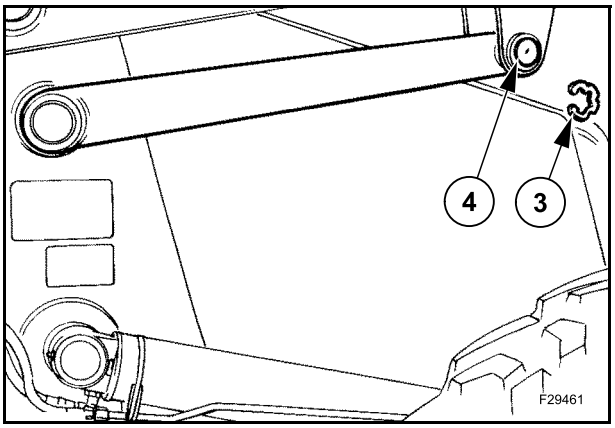
Remove the loader bucket (see procedure described previously).
Fully retract bucket cylinders and raise arm until lift cylinder pivots can be seen above engine guard. Place a suitable stand under the end of the arm to take the weight.
Switch off the engine and relieve hydraulic pressure.



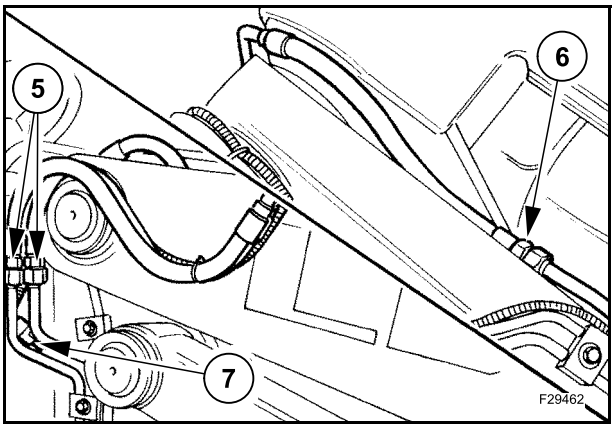
Remove the safety rings (2) and the pins and then drive out the pins (1). Lower the lift cylinders carefully onto the chassis.



Remove the snap rings (3) and drive out the pins (4). Lower the arms onto the lift cylinders.



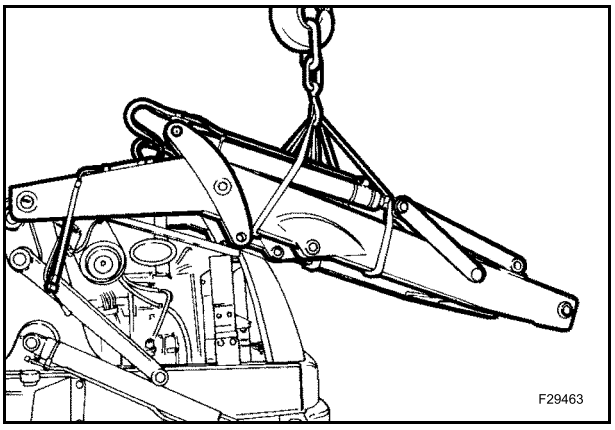
Disconnect and cap the lift cylinder hoses (5) at the top of the loader arm on each side of the machine and disconnect the return to dig sensor cable (7) on the right hand side. If the 4x1 bucket is fitted disconnect and cap hose (6) on each side of the loader.



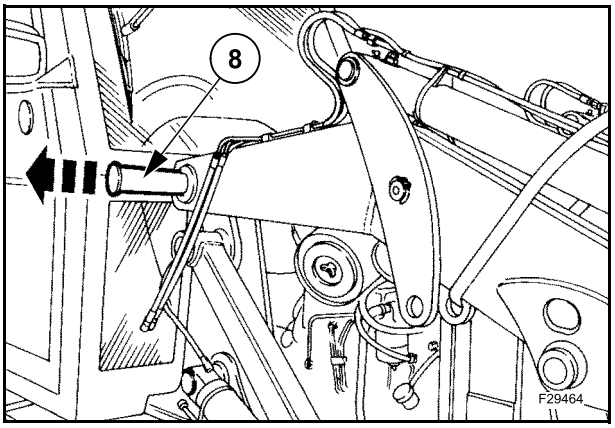
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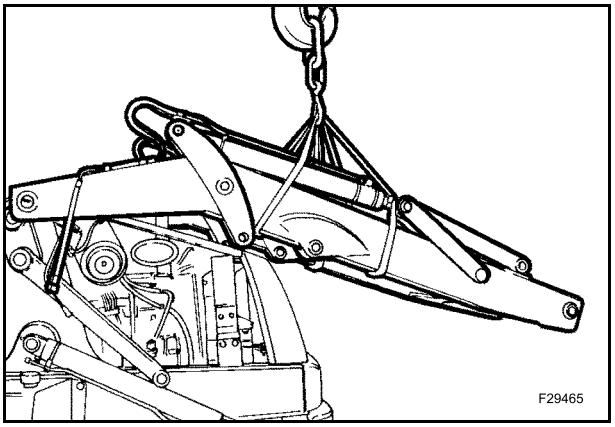
Support loader using a suitable sling.



Remove the safety ring and pins and then pull out the pin (8).



Remove the loader from the machine.



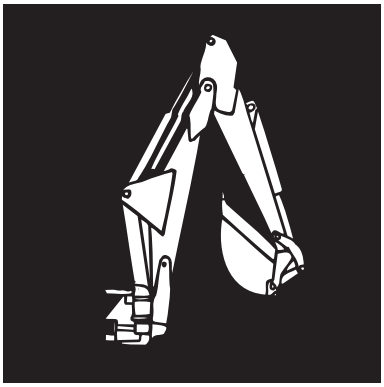
INSTALLATION

Installation is removal procedure in reverse.

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580SR
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590SR
695SR



SECTION 84 - BACKHOE

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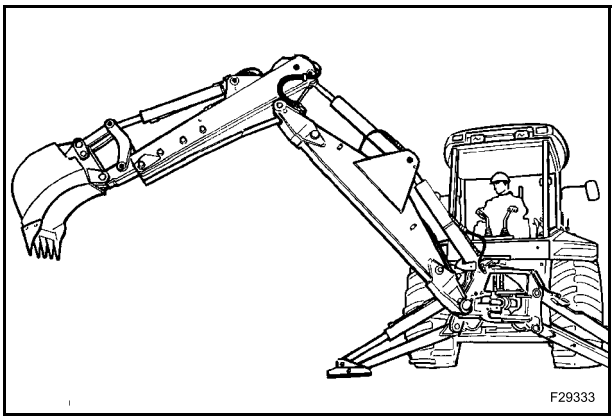
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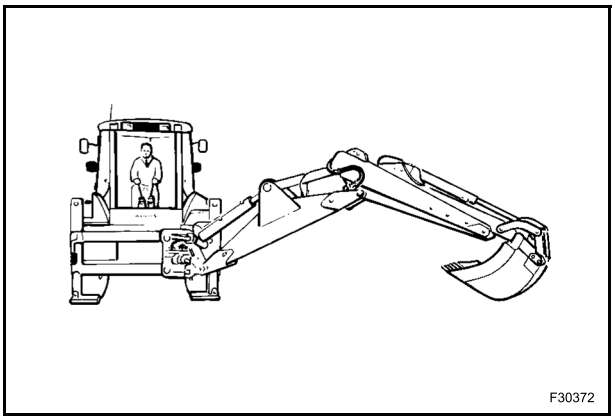
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1. DESCRIPTION AND OPERATION

Loader backhoes are available with center pivot or sideshift backhoe attachment.
On center pivot machines the backhoe pivots on a fixed central point at the rear of the machine.
Independently operated stabilizers are attached to the base of the chassis and pivot about an arc to raise or lower each side of the machine.

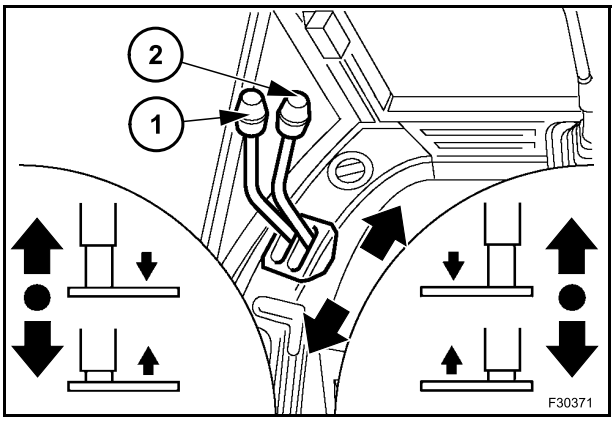


On sideshift machines the backhoe is attached to a carriage hydraulically clamped to the machine frame. This allows the operator to reposition the carriage on the frame and to adjust the position of the backhoe attachment to suit the operating conditions.
The machine is raised using two vertical stabilisers attached to each side of the machine.

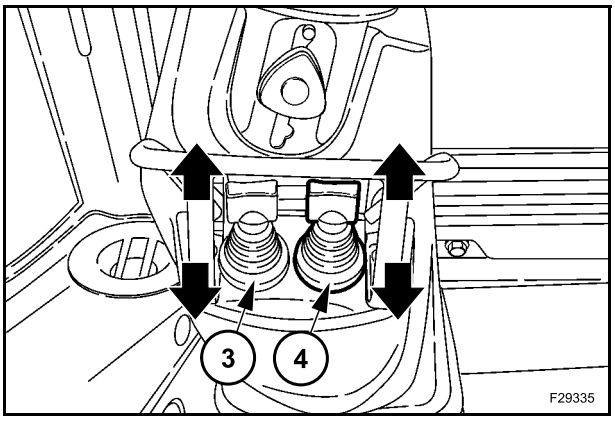


Each stabilizer is independently operated using:

- levers (1) and (2) on loader backhoe control models mechanical;



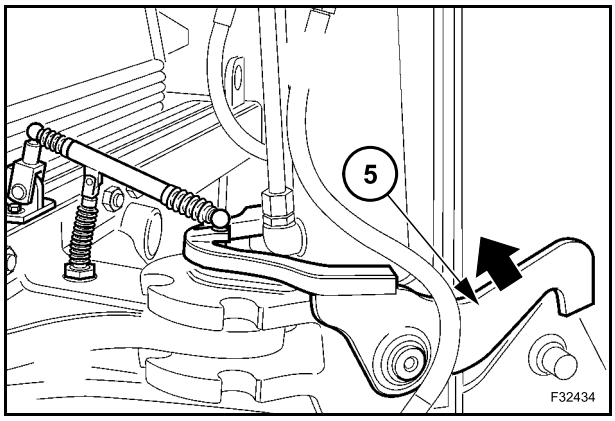
- control levers (3) and (4) on loader backhoe pilot control models.



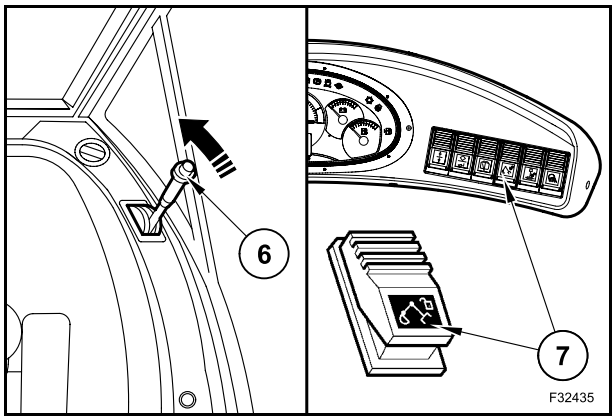
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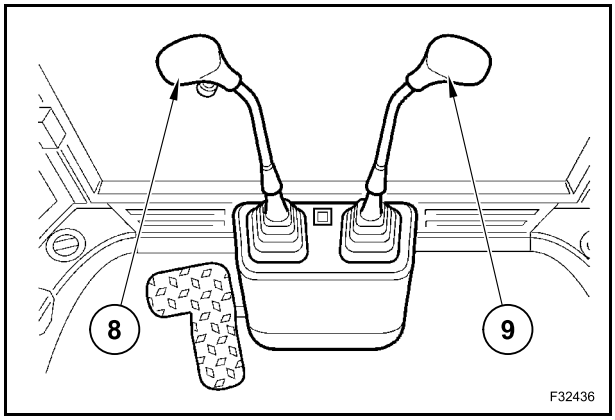
The backhoe attachment is locked in position during transport using a hydraulically and mechanically operated lock (5).



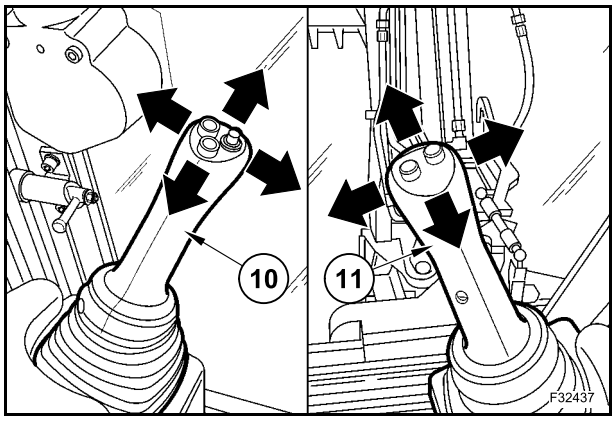
The lock is operated by the lever (6) or the switch (7).



The backhoe on the mechanical control models is controlled using two main control levers.
Three types of control pattern for two levers (8) and (9) systems are available as shown on the following pages. A four levers dealer installed system is also available as a Dealer installed accessory.



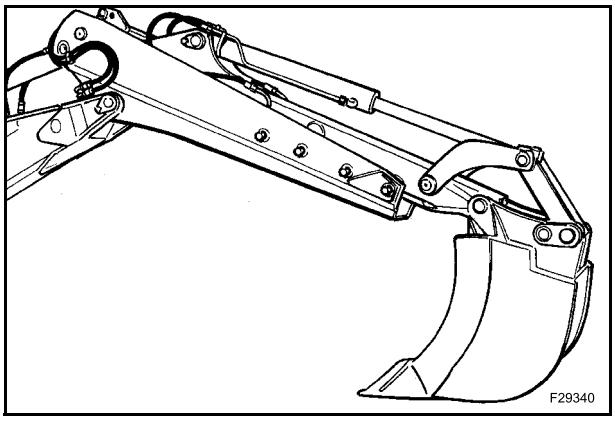
The backhoe on the hydraulic control models is controlled using two rear hydraulic control levers (10) and (11).



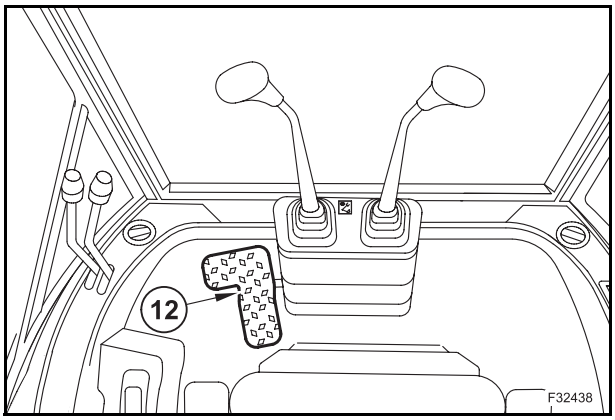
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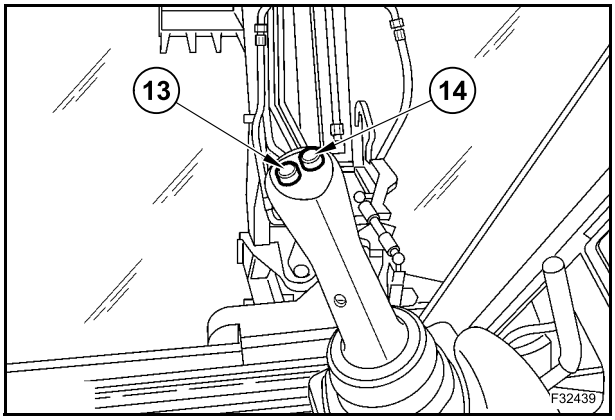
Machines may be fitted with an optional telescopic dipper which can be operated simultaneously with other boom, dipper and bucket movements.



The telescopic dipper on the manually controlled models is controlled by a pedal (12) located in the rear part of the cab.



The telescopic dipper on pilot control modes, is controlled using the two buttons (13) and (14) on the left hydraulic control lever.



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2. BACKHOE ATTACHMENT MECHANICAL CONTROLS VERSION

Three backhoe attachment control configurations exist:
• standard configuration;
• ISO configuration;
• cross-pattern configuration;
• four-lever pattern.
The operating pattern of the control levers is different.

STANDARD CONFIGURATION

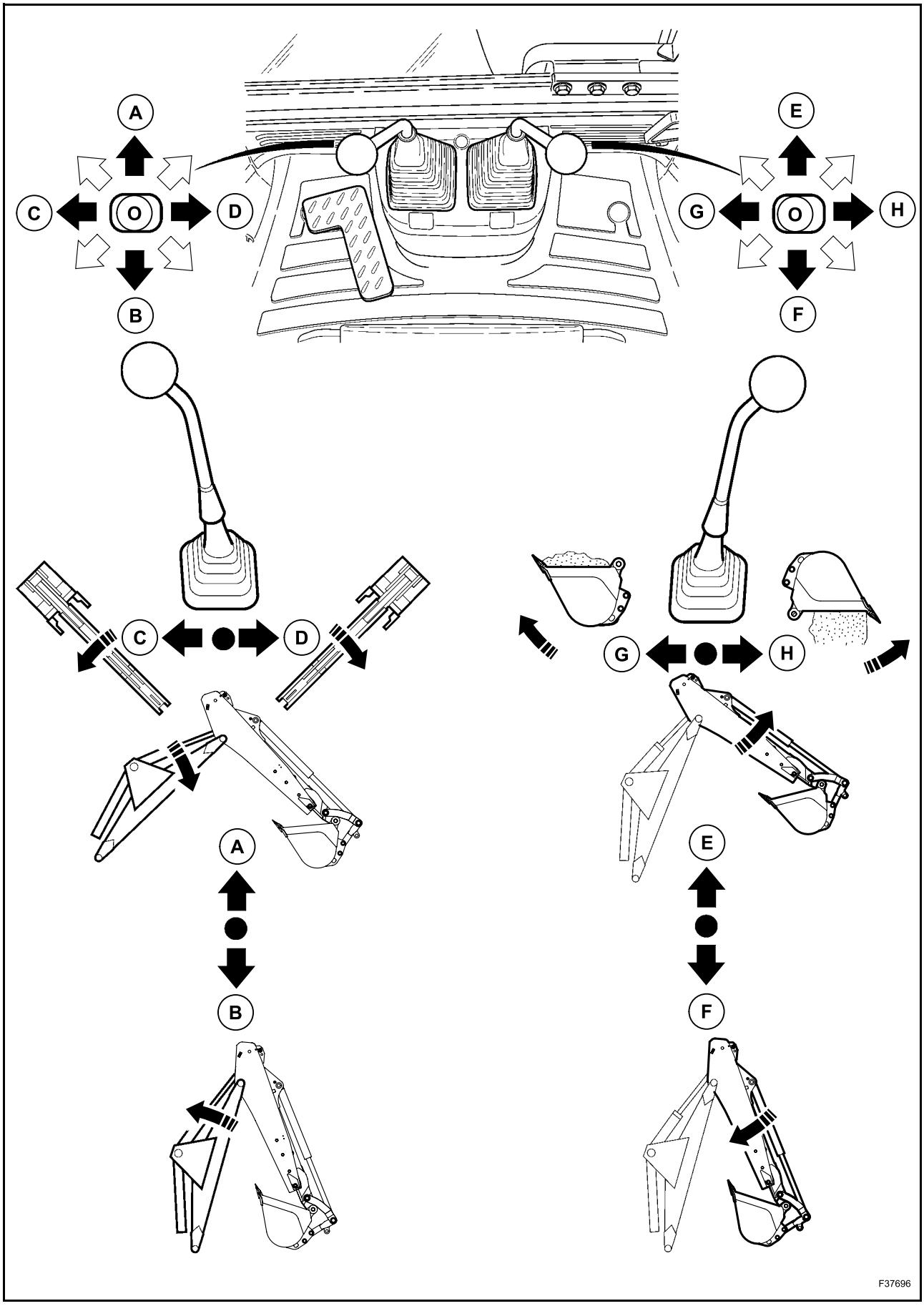
Backhoe boom and backhoe attachment swing left-hand control lever
This lever has five positions:
Position (0): neutral/hold. This position enables the attachment movement to be stopped. As soon as the lever is released, it automatically returns to the neutral position (0) and the attachment remains in the position where it was when movement stopped.
Position (A): the boom lowers.
Position (B): the boom rises.
Position (C): the backhoe attachment swings to the left.
Position (D): the backhoe attachment swings to the right.

Backhoe dipper and backhoe bucket right-hand control lever

This lever has five positions:
Position (0): neutral/hold. This position enables the attachment movement to be stopped. As soon as the lever is released, it automatically returns to the neutral position (0) and the attachment remains in the position where it was when movement stopped.
Position (E): the backhoe dipper extends.
Position (F): the backhoe dipper retracts.
Position (G): the backhoe bucket closes.
Position (H): the backhoe bucket opens.

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ISO CONFIGURATION

Lever for backhoe dipper and backhoe attachment swing

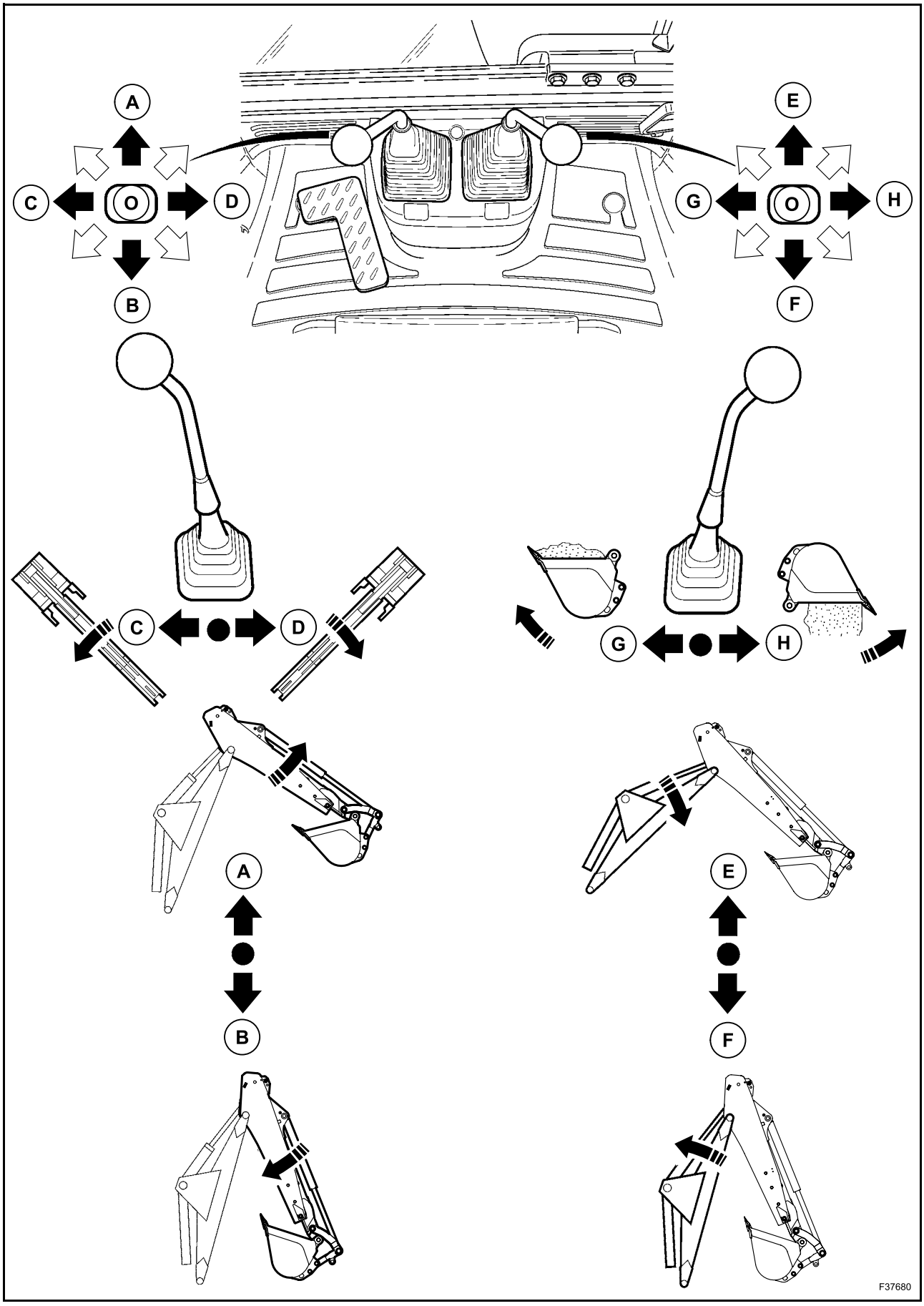
This lever has five positions:
Position (0): neutral/hold. This position enables the attachment movement to be stopped. As soon as the lever is released, it automatically returns to the neutral position (0) and the attachment remains in the position where it was when movement stopped.
Position (A): the backhoe dipper extends.
Position (B): the backhoe dipper retracts.
Position (C): the backhoe attachment swings to the left.
Position (D): the backhoe attachment swings to the right.

Backhoe boom and backhoe bucket right-hand control lever

This lever has five positions:
Position (0): neutral/hold. This position enables the attachment movement to be stopped. As soon as the lever is released, it automatically returns to the neutral position (0) and the attachment remains in the position where it was when movement stopped.
Position (E): the boom lowers.
Position (F): the boom rises.
Position (G): the backhoe bucket closes.
Position (H): the backhoe bucket opens.

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CROSS-PATTERN CONFIGURATION

Backhoe boom and backhoe attachment swing left-hand control lever

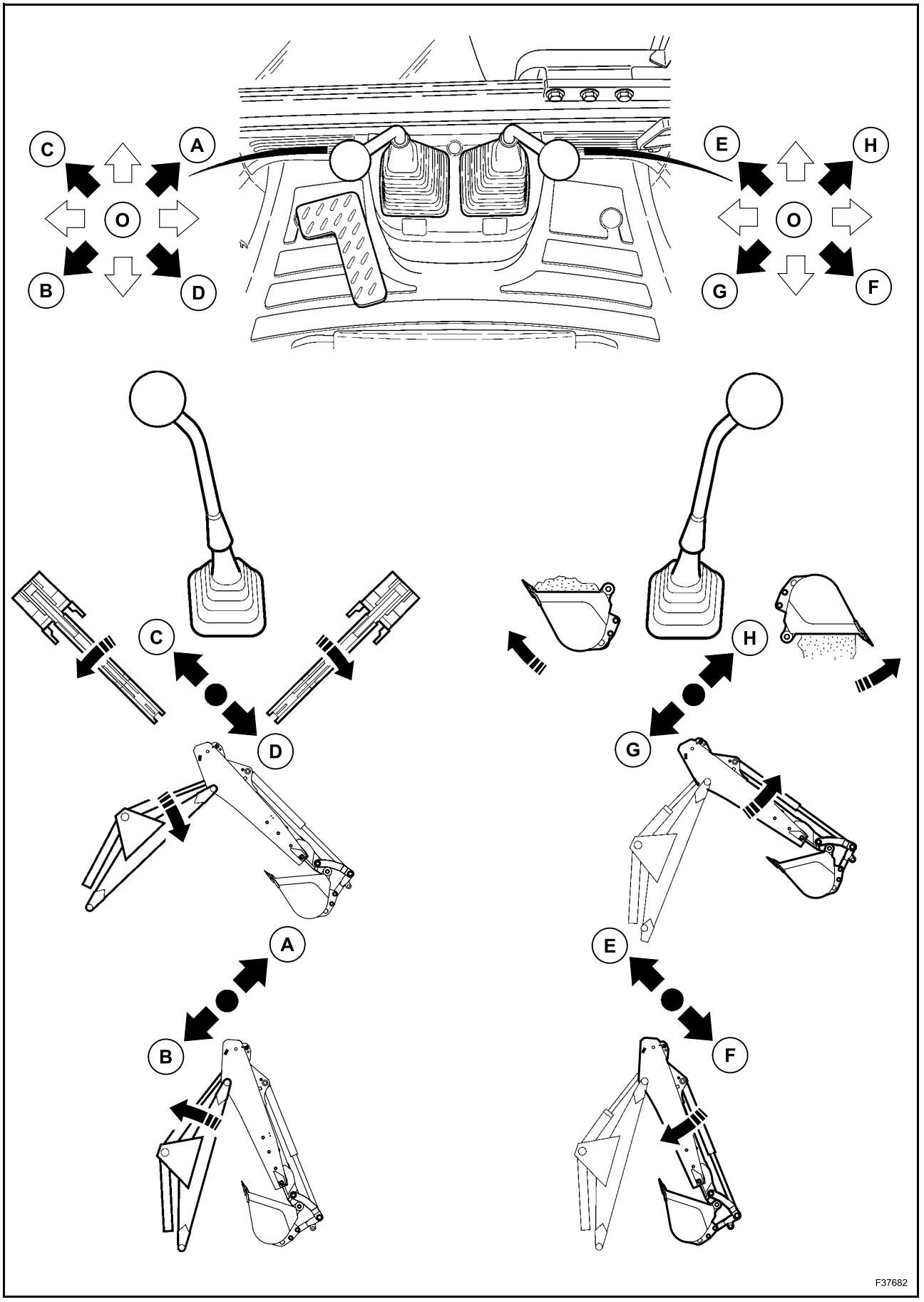
This lever has five positions:
Position (0): neutral/hold. This position enables the attachment movement to be stopped. As soon as the lever is released, it automatically returns to the neutral position (0) and the attachment remains in the position where it was when movement stopped.
Position (A): the boom lowers.
Position (B): the boom rises.
Position (C): the backhoe attachment swings to the left.
Position (D): the backhoe attachment swings to the right.

Backhoe dipper and backhoe bucket right-hand control lever

This lever has five positions:
Position (0): neutral/hold. This position enables the attachment movement to be stopped. As soon as the lever is released, it automatically returns to the neutral position (0) and the attachment remains in the position where it was when movement stopped.
Position (E): the backhoe dipper extends.
Position (F): the backhoe dipper retracts.
Position (G): the backhoe bucket closes.
Position (H): the backhoe bucket opens.

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Four-lever pattern configuration

Lever (1) for dipper

This lever has three positions:

Position (0): neutral/hold. This position enables the attachment movement to be stopped. As soon as the lever is released, it automatically returns to the neutral position (0) and the attachment remains in the position where it was when movement stopped.
Position (A): the backhoe dipper extends.
Position (B): the backhoe dipper retracts.

Lever (2) for boom

This lever has three positions:
Position (0): neutral/hold. This position enables the attachment movement to be stopped. As soon as the lever is released, it automatically returns to the neutral position (0) and the attachment remains in the position where it was when movement stopped.
Position (C): the boom rises.
Position (D): the boom lowers.

Lever (3) for backhoe bucket

This lever has three positions:

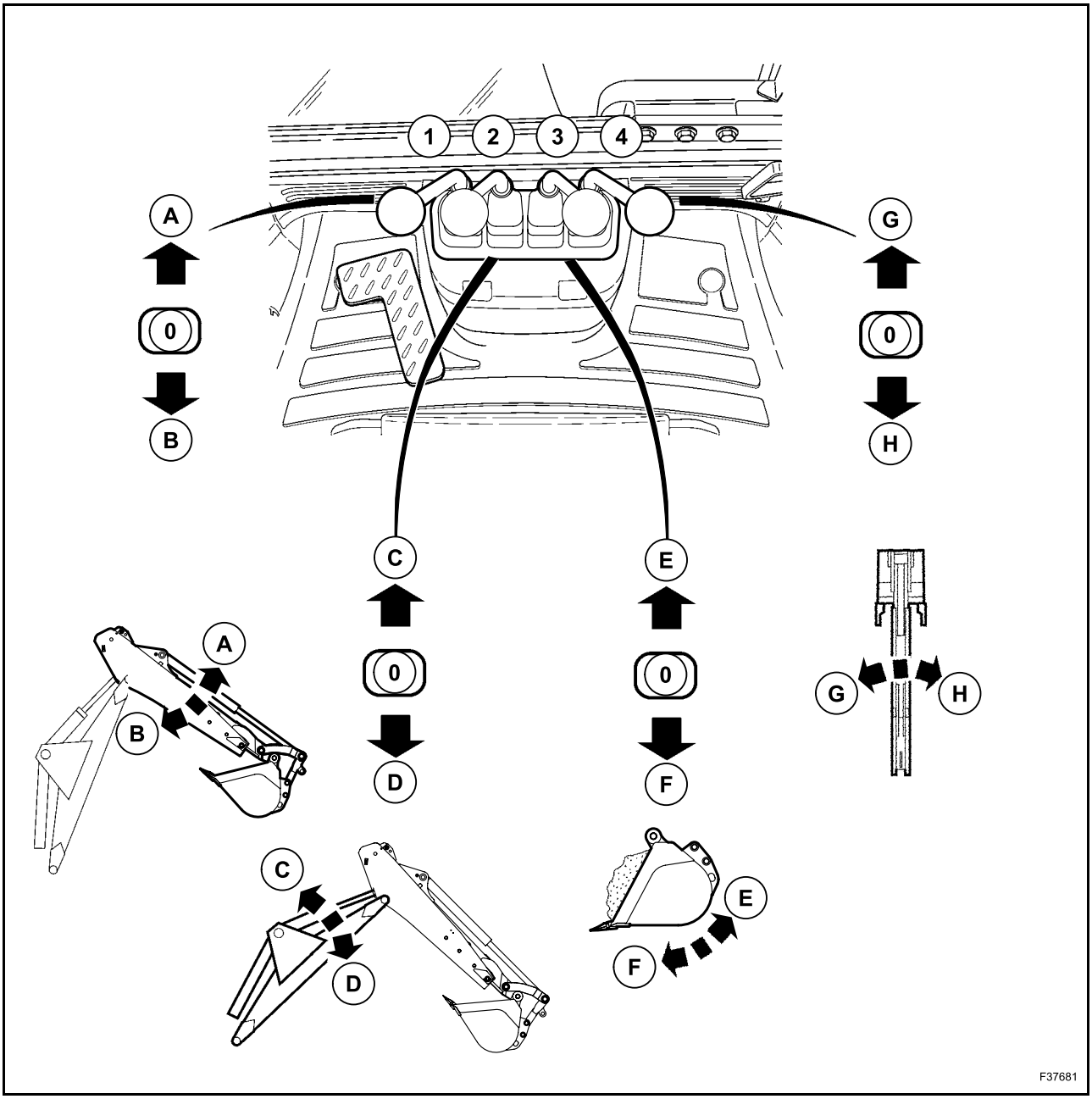
Position (0): neutral/hold. This position enables the attachment movement to be stopped. As soon as the lever is released, it automatically returns to the neutral position (0) and the attachment remains in the position where it was when movement stopped.
Position (E): the backhoe bucket closes.
Position (F): the backhoe bucket opens.

Lever (4) for backhoe attachment swing

This lever has three positions:
Position (0): neutral/hold. This position enables the attachment movement to be stopped. As soon as the lever is released, it automatically returns to the neutral position (0) and the attachment remains in the position where it was when movement stopped.
Position (G): the backhoe attachment swings to the right.
Position (H): the backhoe attachment swings to the left.

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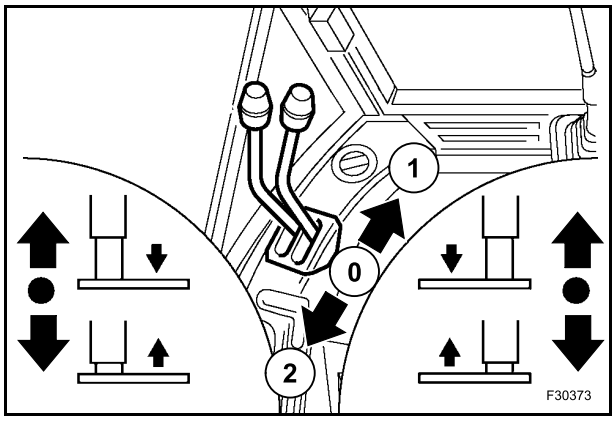
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STABILIZER MECHANICAL CONTROLS

Left-hand stabilizer left-hand control lever

This lever has three positions:
Position (0): neutral. This position stops the movement of the left-hand stabilizer. As soon as the lever is released, it automatically returns to the neutral position (0) and the left-hand stabilizer stops raising or lowering.
Position (1): the left-hand stabilizer lowers.
Position (2): the left-hand stabilizer rises.



Right-hand stabilizer right-hand control lever

This lever has three positions:
Position (0): neutral. This position stops the movement of the right-hand stabilizer. As soon as the lever is released, it automatically returns to the neutral position (0) and the right-hand stabilizer stops raising or lowering.
Position (1): the right-hand stabilizer lowers.
Position (2): the right-hand stabilizer rises.

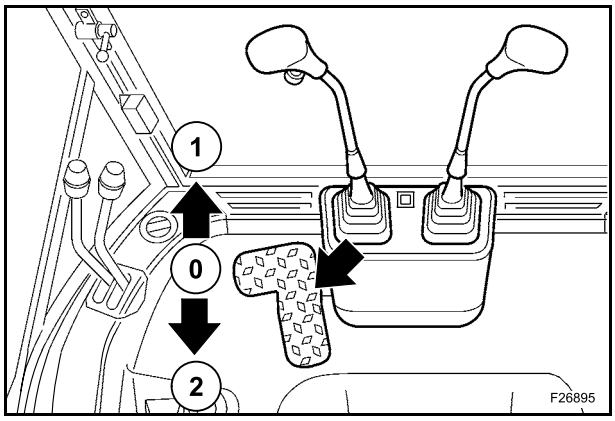
NOTE: to raise or lower the stabilizers at the same time, operate the two levers simultaneously.

TELESCOPIC DIPPER MECHANICAL CONTROL PEDAL

This pedal has three positions:
Position (0): neutral. This position enables the movement of the telescopic dipper to be stopped.

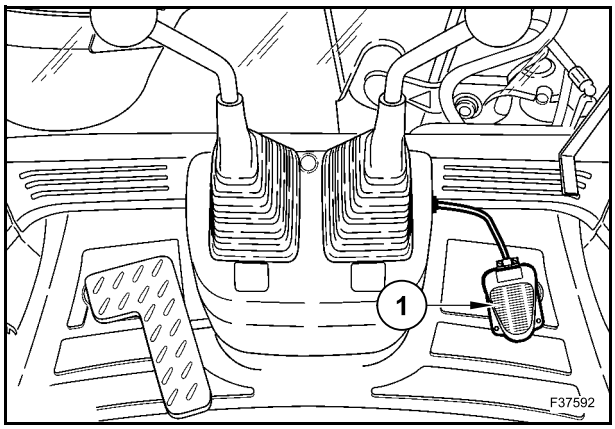
NOTE: the pedal automatically returns to this position as soon as it is released.

Position (1): the telescopic dipper extends.
Position (2): the telescopic dipper retracts.



AUXILIARY ATTACHMENT CONTROL PEDAL (Optional)

This pedal (1) is located to the right of the backhoe attachment controls and is used for operating auxiliary attachment, such as a hydraulic hammer.



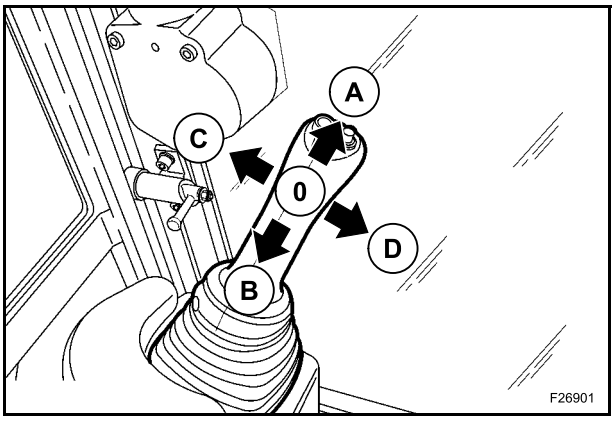
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3. BACKHOE ATTACHMENT HYDRAULIC CONTROLS

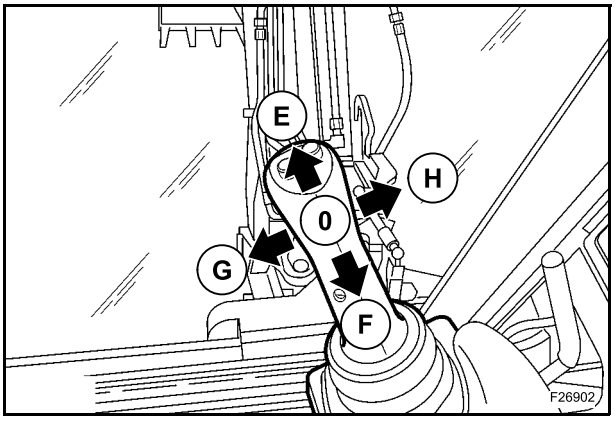
BACKHOE CONTROLS

Backhoe boom and backhoe attachment swing left-hand hydraulic control lever



This control lever has five positions:
Position (0): neutral/hold. This position enables the attachment movement to be stopped. As soon as released, it automatically returns to the neutral position (0) and the attachment remains in the position where it was when movement stopped.
Position (A): the boom lowers.
Position (B): the boom rises.
Position (C): the backhoe attachment swings to the left.
Position (D): the backhoe attachment swings to the right.

Backhoe dipper and backhoe bucket right-hand control lever

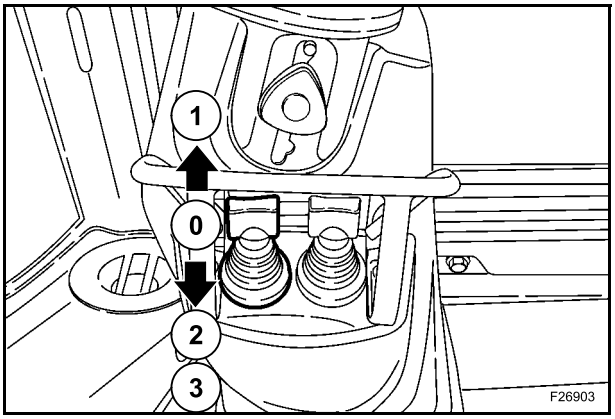


This control lever has five positions:
Position (0): neutral/hold. This position enables the attachment movement to be stopped. As soon as released, it automatically returns to the neutral position (0) and the attachment remains in the position where it was when movement stopped.
Position (E): the backhoe dipper extends.
Position (F): the backhoe dipper retracts.
Position (G): the backhoe bucket closes.
Position (H): the backhoe bucket opens.

STABILIZER CONTROLS

These controls are located on the left-hand hydraulic control lever and may be operated independently or simultaneously.

Left-hand control lever for left-hand stabilizer



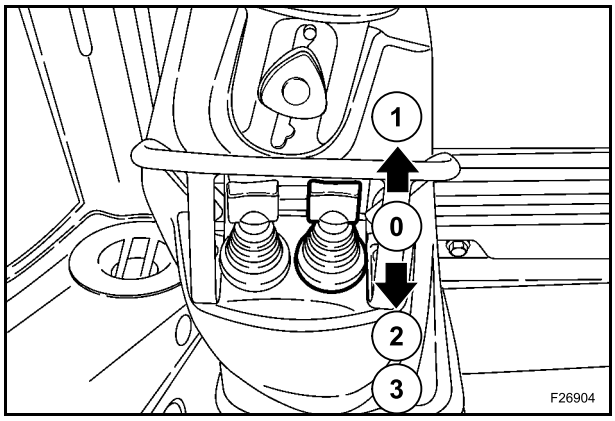
This lever has four positions:
Position (0): neutral. This position stops the movement of the left-hand stabilizer. As soon as the lever is released from positions (1) or (2), it automatically returns to the neutral position (0) and the left-hand stabilizer stops raising or lowering.
When held in position (1): the left-hand stabilizer lowers.
When held in position (2): the left-hand stabilizer rises.
Position (3): stabilizer auto-up feature.

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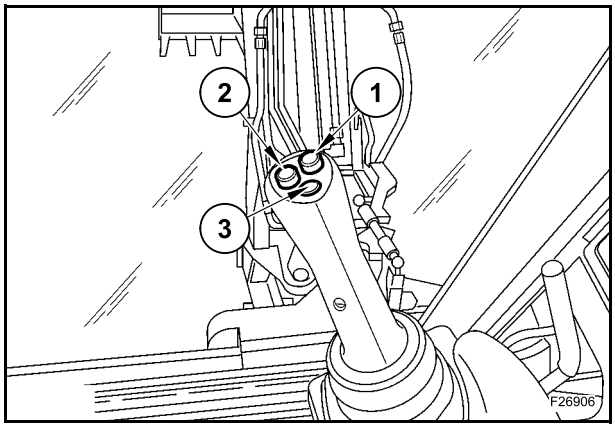
Right-hand lever for right-hand stabilizer

This lever has four positions:
Position (0): neutral. This position stops the movement of the right-hand stabilizer. As soon as the lever is released from positions (1) or (2), it automatically returns to the neutral position (0) and the right-hand stabilizer stops raising or lowering.
When held in position (1): the right-hand stabilizer lowers.
When held in position (2): the right-hand stabilizer rises.
Position (3): stabilizer auto-up feature.



TELESCOPIC DIPPER CONTROLS

Press and hold down the right-hand button (1) to extend the telescopic dipper. As soon as the button is released the dipper stops and remains in the position it occupied when the button was released.
Press and hold down the left-hand button (2) to retract the telescopic dipper. As soon as the button is released the dipper stops and remains in the position it occupied when the button was released.
By pressing button (3), it is possible to set the engine rpm to idle run disabling accelerator handle and accelerator pedal. By pressing again button (3) the engine rpm are restored and the accelerator handle and accelerator pedal as well.
Before using these controls, make sure the telescopic dipper is mechanically unlocked.



2

NOTE: operating the backhoe attachment control levers and these controls simultaneously will enable numerous possibilities of progressive functioning.

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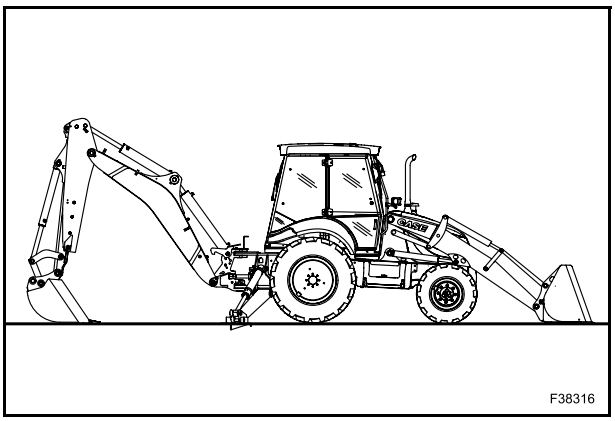
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4. REMOVAL AND INSTALLATION

4.1 CENTER PIVOT BACKHOE ATTACHMENT DISASSEMBLY

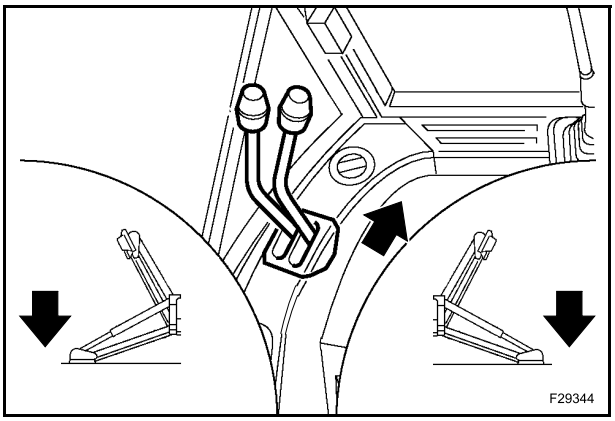
Park the machine on a flat surface and position the backhoe on the ground.

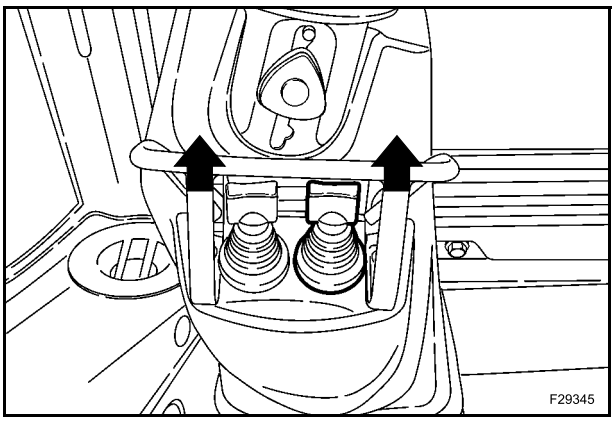
⚠ WARNING
Always support the structural members so that they will be stable and safe to work around.



Lower stabilizers sufficiently and however ensure that the rear tyres are in contact with the ground to remove the weight from the rear wheels.

IMPORTANT: the rear wheels must remain in contact with the ground.

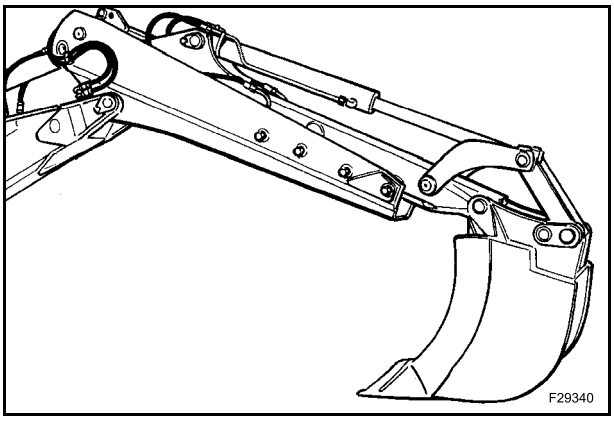




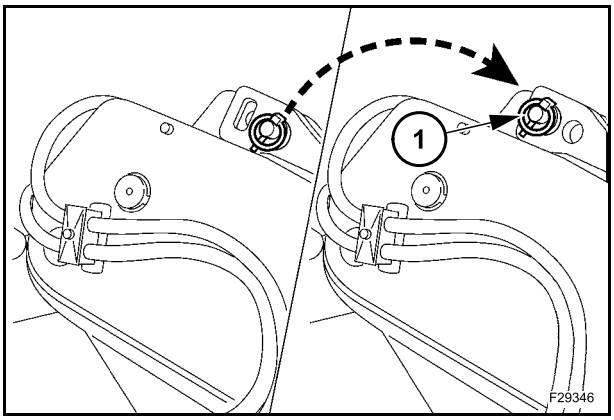
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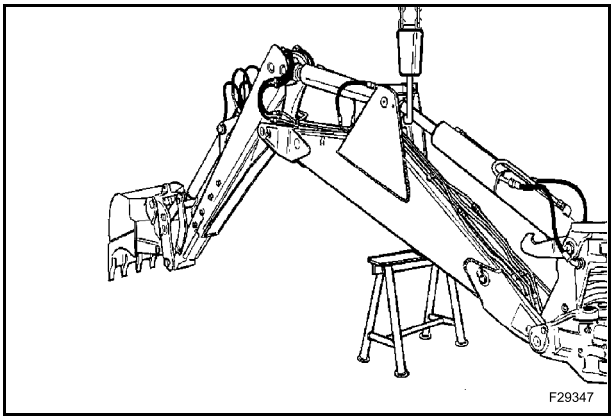
Fully retract telescopic dipper, where fitted.



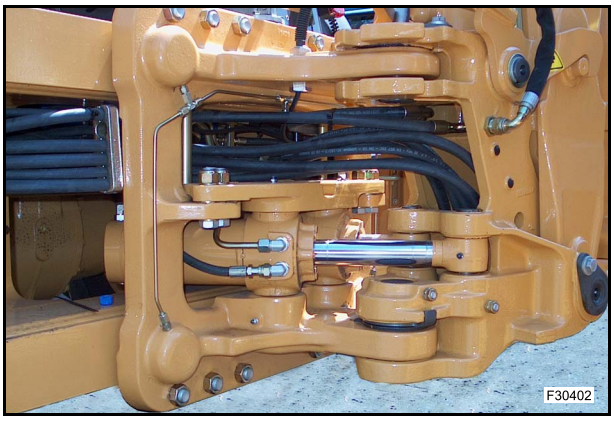
On machines fitted with telescopic dipper install locking pin in transport hole (1).



Fully retract dipper cylinder and lower boom until bucket is firmly resting on the ground.
Support the backhoe using suitable stand and hoist capable of carrying 1500 Kg.
Turn off engine, then move backhoe control levers through all operating positions to relieve pressure in the system.
Re-check that backhoe elements are fully supported.



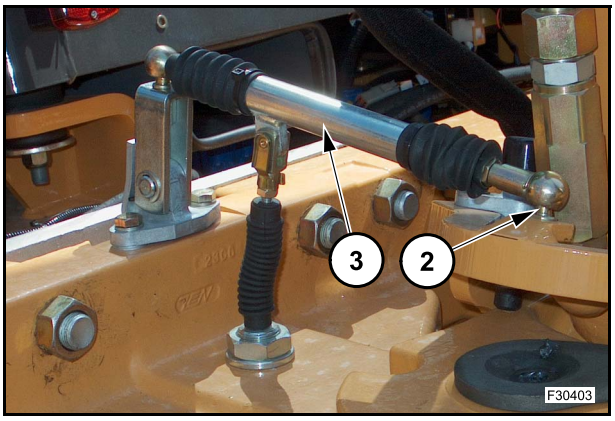
Disconnect all hoses that travel through the swing bracket reach the backhoe.



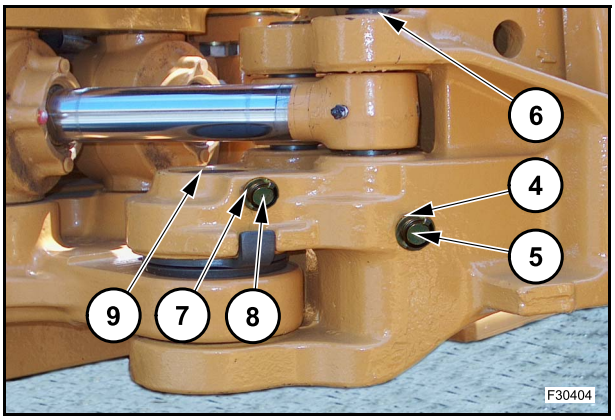
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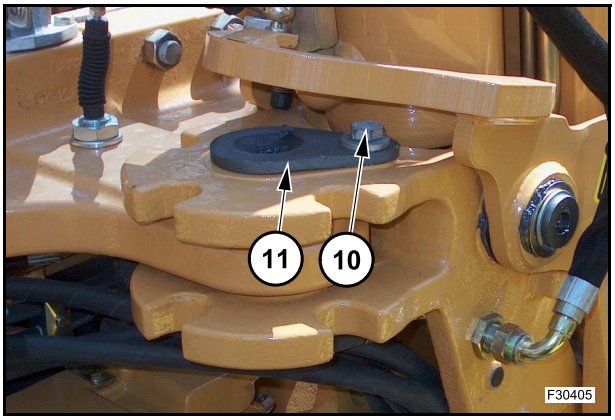
Unscrew and remove the nut (2) to disconnect the backhoe lock (3).



Remove the snap ring (4), slide out the pin (5) and with an hammer remove the pin (6) of the swing cylinder.
Repeat the operation with both swing cylinders. Remove the snap ring (7).
Slide out the pin (8) and by means of an hammer remove the lower pin (9) from swing bracket.



Unscrew the screw (10).
Remove the upper pin (11) of the swing support.



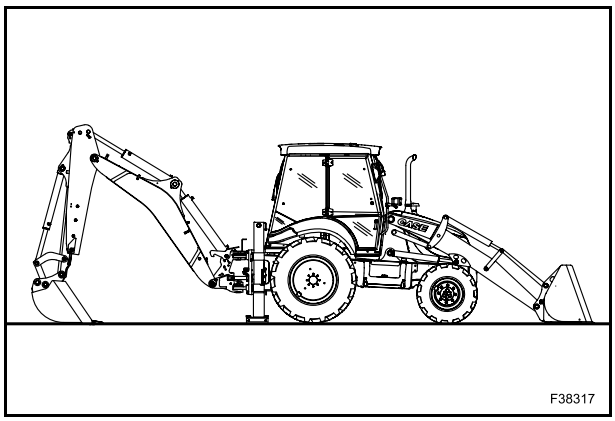
Now it is possible to remove the backhoe assembly.

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4.2 BACKHOE ATTACHMENT DISASSEMBLY - SIDESHIFT

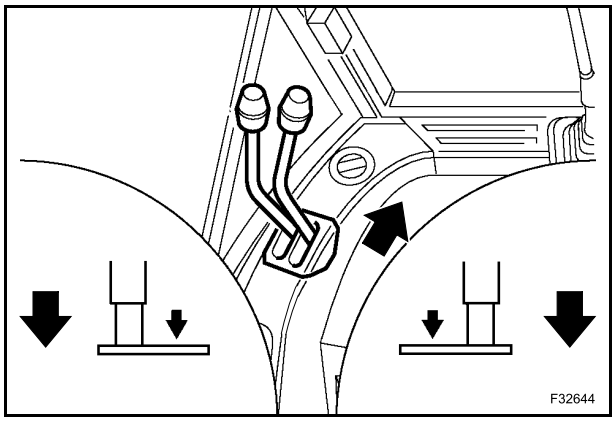
Park the machine on a flat surface and position the backhoe on the ground.



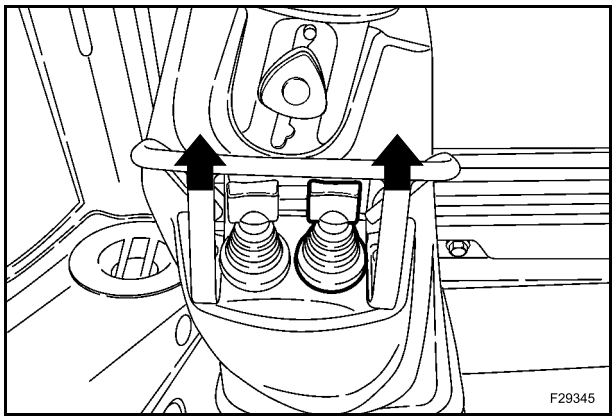
⚠ WARNING

Always support the structural members so that they will be stable and safe to work around.

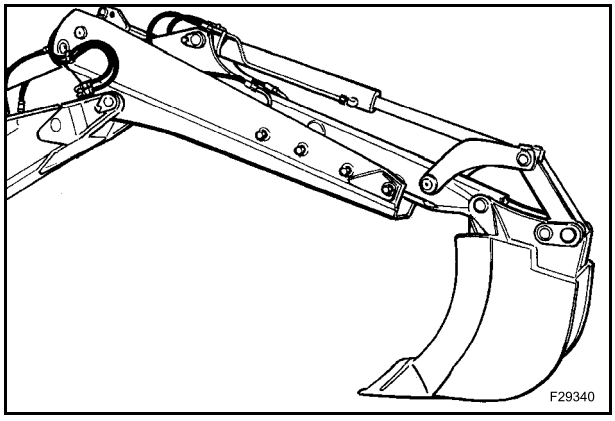
Lower stabilizers sufficiently and however ensure that the rear tyres are in contact with the ground to remove the weight from the rear wheels.



IMPORTANT: the rear wheels must remain in contact with the ground.



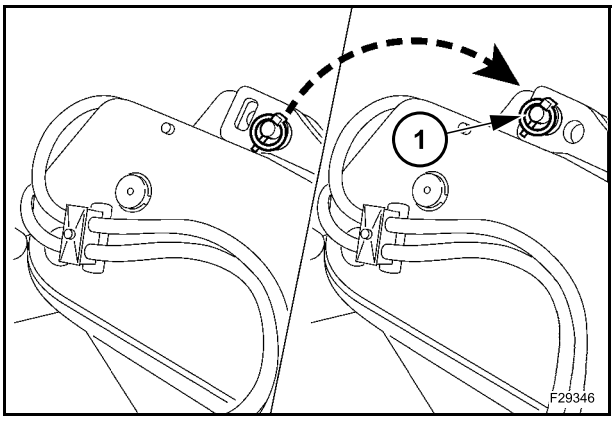
Fully retract telescopic dipper, where fitted.



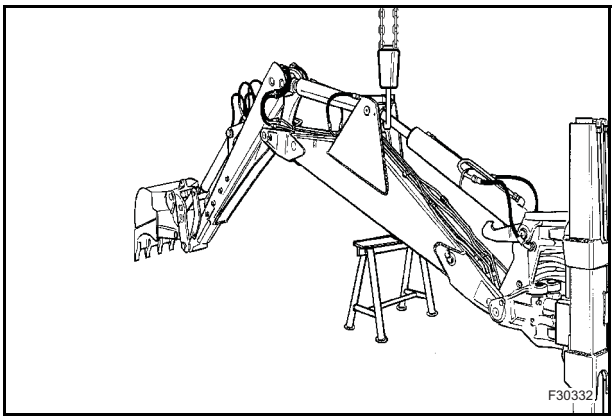
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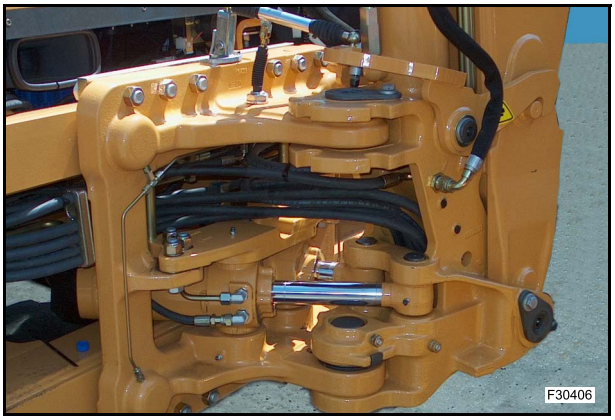
On machines fitted with telescopic dipper install locking pin in transport hole (1).



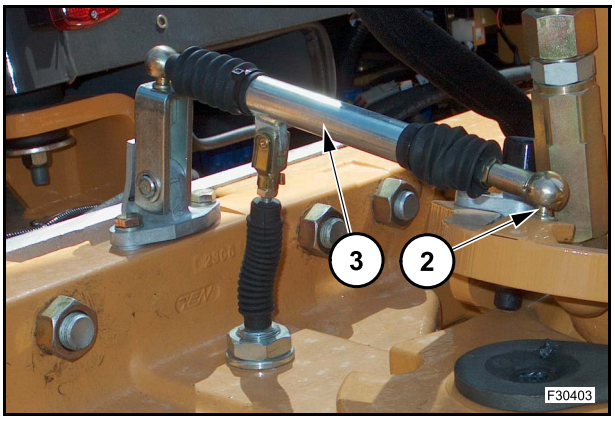
Fully retract dipper cylinder and lower boom until bucket is firmly resting on the ground.
Support the backhoe using suitable stand and hoist capable of carrying 1500 Kg.
Turn off engine, then move backhoe control levers through all operating positions to relieve pressure in the system.
Re-check that backhoe elements are fully supported.



Disconnect all hoses that travel through the swing bracket reach the backhoe.



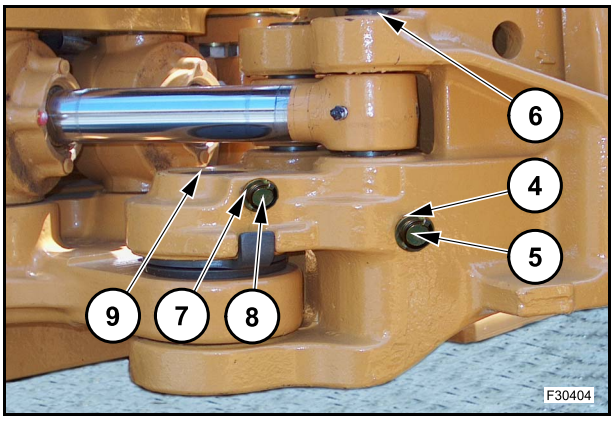
Unscrew and remove the nut (2) to disconnect the backhoe lock (3).



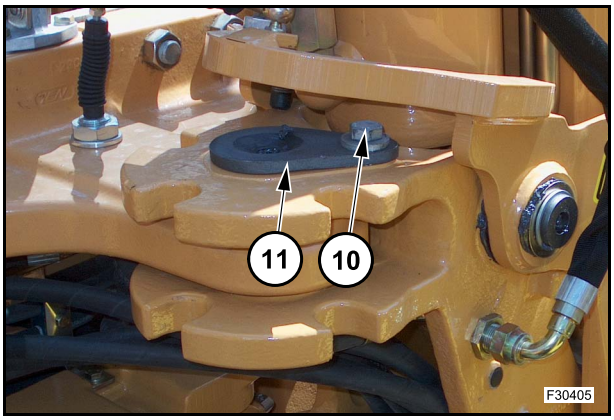
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Remove the snap ring (4), slide out the pin (5) and with an hammer remove the pin (6) of the swing cylinder.
Repeat the operation with both swing cylinders. Remove the snap ring (7).
Slide out the pin (8) and with an hammer remove the lower pin (9) from the swing support.



Unscrew the screw (10).
Remove the upper pin (11) of the swing support.



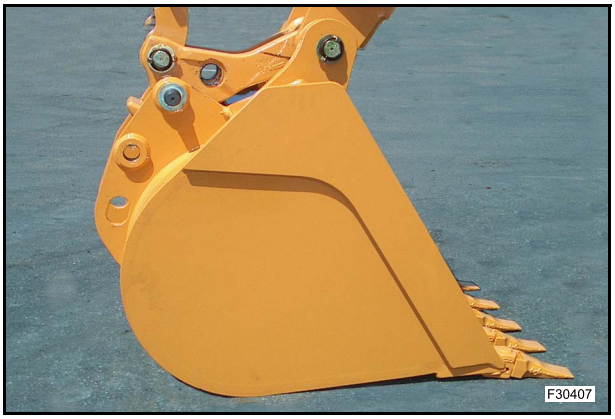
Now it is possible to remove the backhoe assembly.

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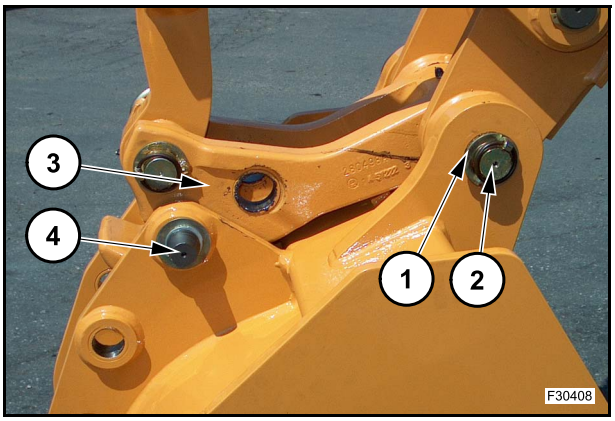
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4.3 BACKHOE BUCKET REMOVAL

Park the machine on a flat surface.
Lower the stabilizers until they are resting on the ground.
Place the bucket on the ground.
Stop the engine and remove the starter switch key.



Remove the safety pin (1).
Slide out the pin (2).
Start the engine
Move the arm so that the hook (3) can get released from the bucket pin (4).
Remove the backhoe bucket.

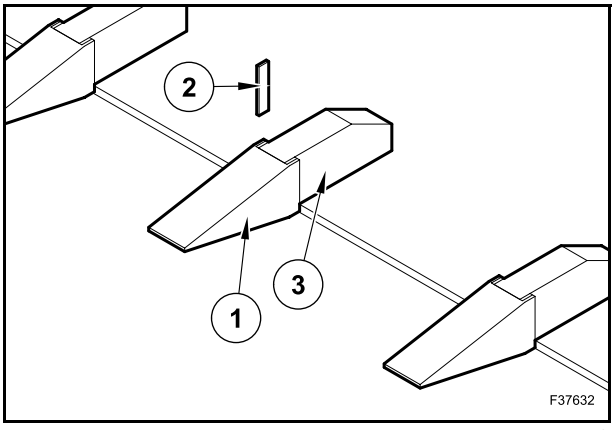


4.4 BUCKET TEETH REPLACEMENT

Move the machine to a level and firm ground.
Position the backhoe bucket so that the bucket teeth can be replaced.
Place the direction-of-travel lever and gearshift lever in neutral position.
Immobilize the machine by means of the parking brake.
Stop the engine and remove the starter switch key.

⚠ WARNING ⚠

Nobody must be in the trajectory of the tooth holder and of the tooth to be removed.
During tooth removal, both the tooth holder and the tooth could be unexpectedly projected, thus hitting persons standing in their trajectory or nearby.
Projected metal chips could hit persons and cause injury.



Remove the tooth holder (2) using a hammer and a chisel.
Remove the tooth (1) from the tooth holder (3).
Clean the inside of the tooth holder, removing any dirt or rust.
Insert a new tooth (1) into the tooth holder (3).
Lock the new tooth by installing the tooth holder (2).

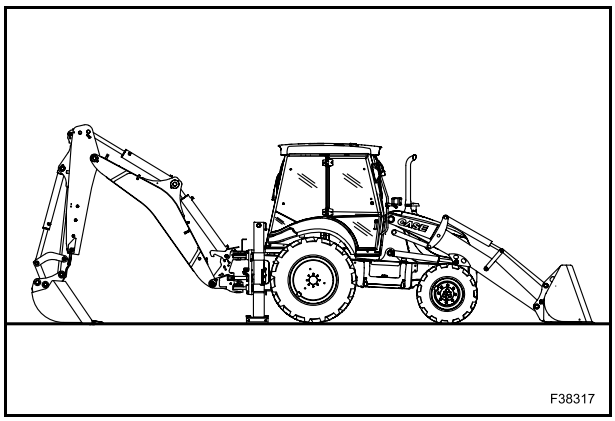
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4.5 DIPPER REMOVE

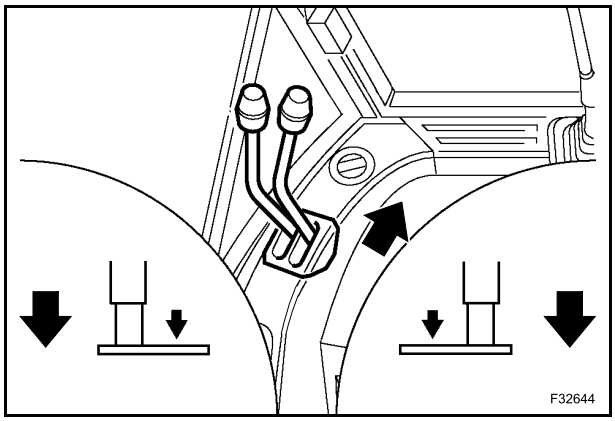
Park the machine on a level, firm surface and position the backhoe on the ground.

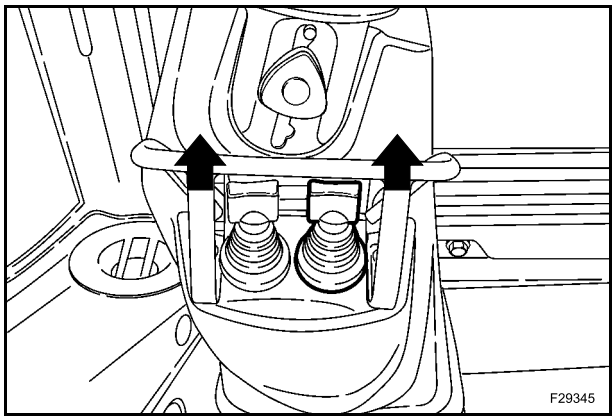
⚠ WARNING
Always support the structural members so that they will be stable and safe to work around.



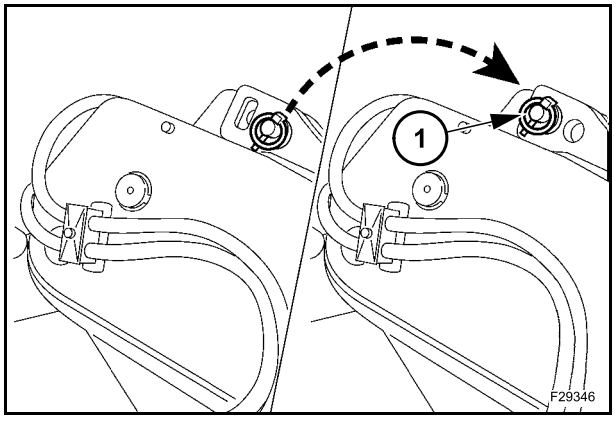
Lower stabilizers sufficiently to remove the weight from the rear wheels.

IMPORTANT: the rear wheels must remain in contact with the ground.





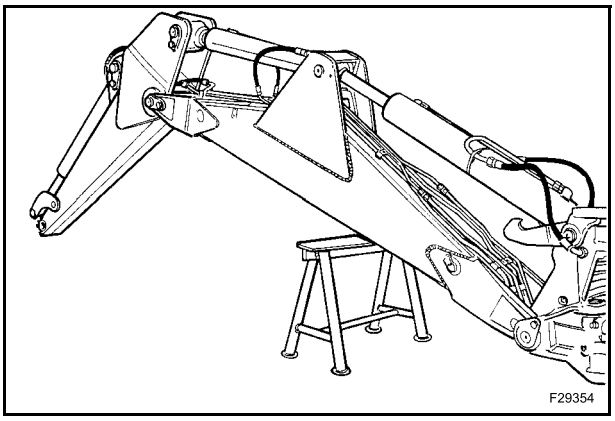
Install the locking pin in transport hole (1) [on machines fitted with telescopic dipper].



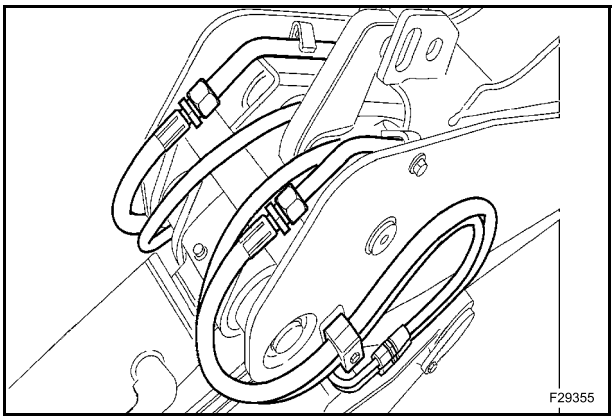
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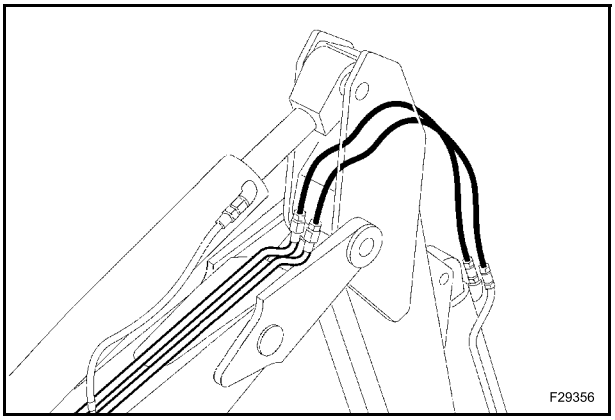
Lower the backhoe to the ground and support using a suitable stand.
Turn off engine, then move backhoe control levers through all operating positions to relieve pressure in the system.



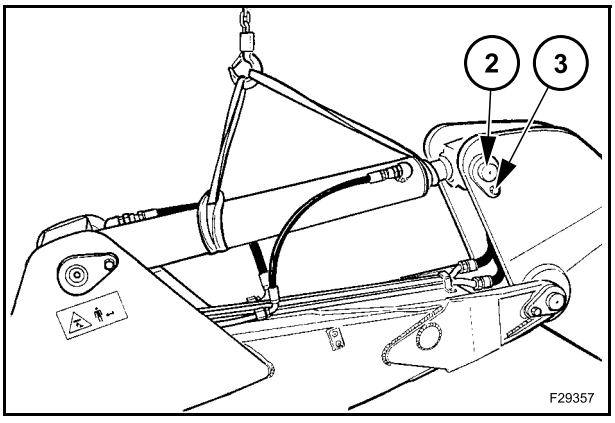
Disconnect the hoses to the dipper cylinders:
• Telescopic dipper hoses.



• Standard dipper hose.



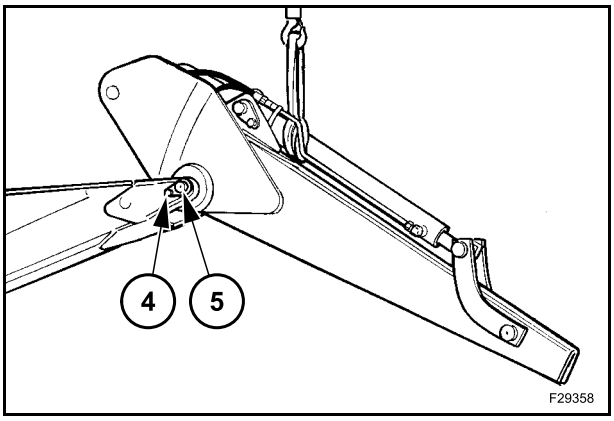
Support the dipper cylinder, unscrew and remove the screw (2), slide out the pin (3).
Lower cylinder onto boom. Use suitable cylinder supports to ensure weight of cylinder does not damage hydraulic tubes attached to the dipper.



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Support the dipper using suitable hoist. Unscrew and remove the screw (4), slide out the pin (5) and carefully lower dipper to the ground.



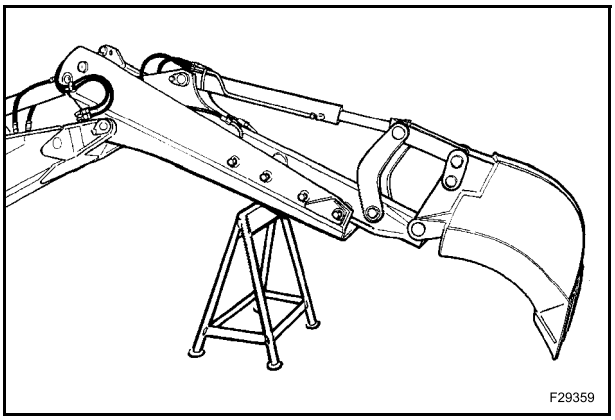
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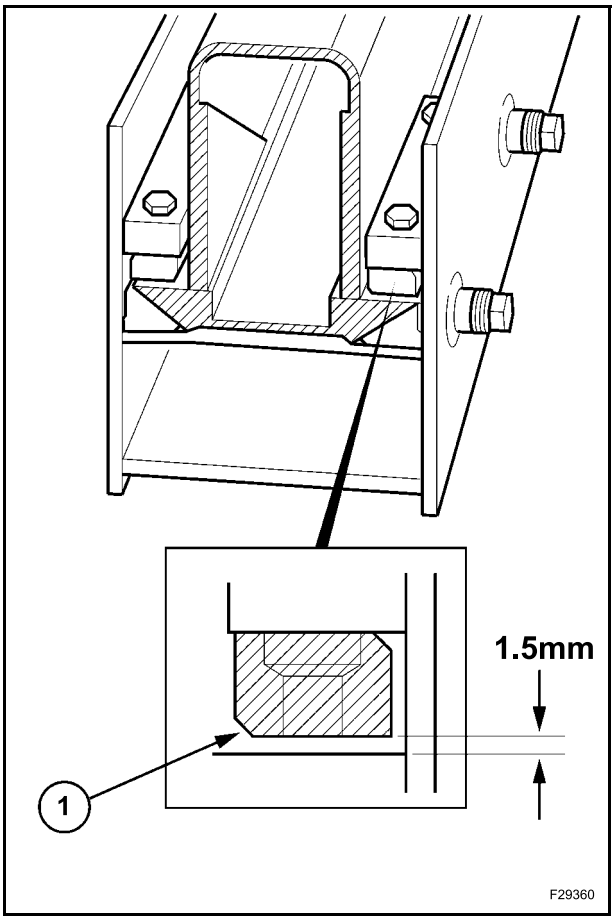
5. TELESCOPIC DIPPER REVISION

INSPECTION OF GUIDE PADS

Park the machine on level ground and retract the telescopic dipper.
Position the dipper on a suitable stand with the bucket raised from the ground.
Clean the area around the pads.



Inspect each upper guide pad and if the chamfered edge (1) on the corner of the pads is no longer visible the pads have worn beyond their limit and must be replaced.
If pads do not require replacement visually check if the gap between the inner part of the dipper and upper guide pad is greater than 1.5 mm.
If the gap is greater than 1.5 mm the guide pads must be adjusted.

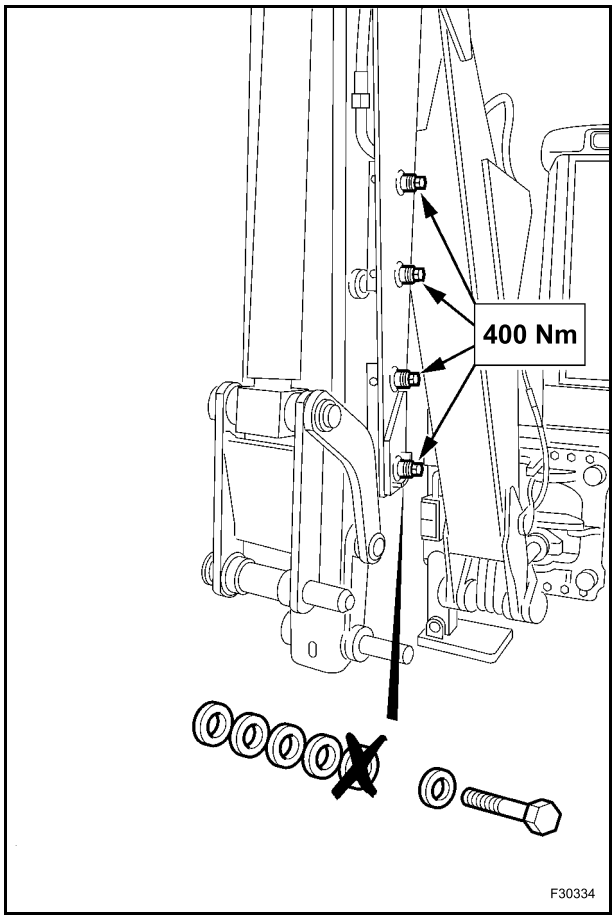


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ADJUSTMENT OF GUIDE PADS

Position the dipper in the vertical position.
Count the number of shims behind the adjusting screws on the left and right hand sides of the dipper to determine which side has the most shims.
Remove one shim from behind an adjusting screw on the side of the dipper which contains the most shims.
Refit the screw and tighten to a torque of 350 - 400 Nm. Do NOT over torque the bolt.
Repeat the procedure for the remaining three screws on the same side of the dipper.
Recheck the gap.
If the gap remains greater than 1.5 mm remove a shim from behind each of the adjusting screws on the opposite side of the dipper.
After performing an adjustment apply a coat of Dry Moly-coat grease to the slide rails of the dipper.



NOTE: when all shims have been removed the guide pads must be replaced.

REPLACEMENT OF GUIDE PADS

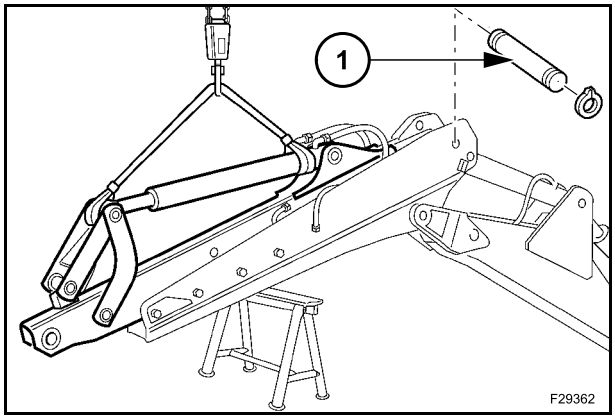
To replace the guide pads it is necessary to separate the inner and outer parts of the telescopic dipper using either of the following procedures which are dependent on workshop facilities.

Procedure No. 1

Park the machine on level ground and lower loader bucket.
Lower stabilizers sufficiently to remove the weight from the rear wheels.

IMPORTANT: the rear wheels must remain in contact with the ground.

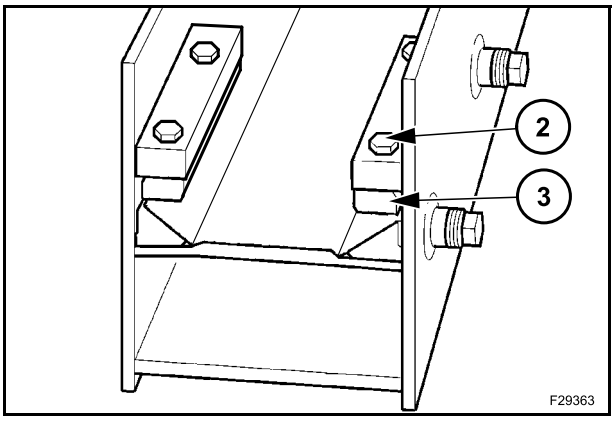
Position the dipper on a suitable stand.
Attach hoist to inner part of the dipper.
Disconnect the hose connections to the bucket and the telescopic dipper cylinders.
Remove telescopic dipper cylinder pin (1) and separate inner and outer parts of telescopic dipper.



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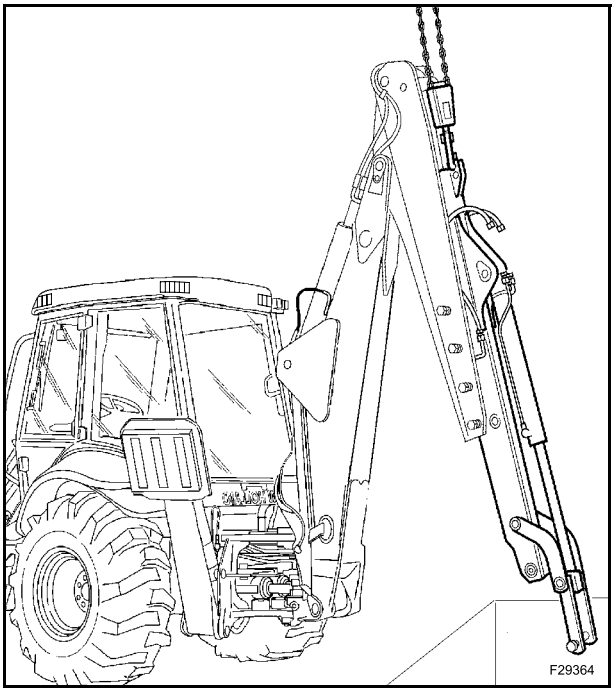
Unscrew and remove the screws (2).
Remove the guide pads (3). Install new guide pads and apply some thread sealant No. 82995773 to the retaining screws. Tighten to a torque of 29 - 31 Nm. Do not over tighten or damage to the threaded inserts may occur.



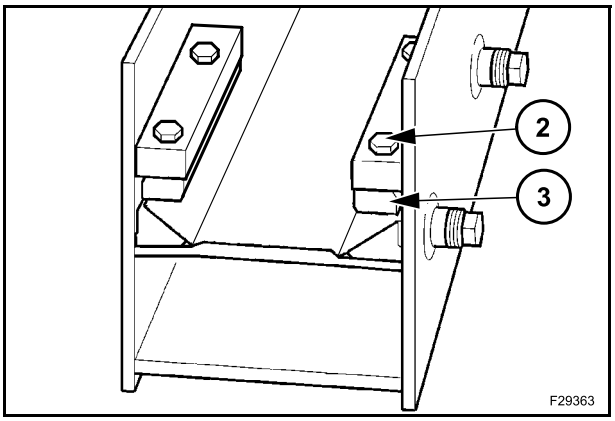
Re-assemble inner and outer parts of telescopic dipper.
Place 5 shims beneath the heads of each adjusting screw.
Adjust guide pads as described previously.

Procedure No. 2

This procedure requires the use of a loading dock or service pit.
Park the machine with backhoe positioned over loading dock or service pit.
Place the loader bucket on the ground and lower stabilizers sufficiently to remove the weight from the rear wheels.
Attach suitable hoist to top of inner section of dipper and position boom so that dipper is hanging vertically.
Disconnect the hose connections to the bucket and the telescopic dipper cylinders.
Remove the telescopic dipper cylinder retaining pin.
Slowly lower hoist allowing inner and outer parts of telescopic dipper to separate.



Unscrew and remove the screws (2).
Remove the guide pads (3). Install new guide pads and apply thread sealant to the retaining screws. Tighten to a torque of 29 - 31 Nm. Do not over tighten or damage to the threaded inserts may occur.
Position new lower guide pads in the outer part of the telescopic dipper.



Re-assemble inner and outer parts of telescopic dipper.
Place 5 shims beneath the heads of each adjusting screw.
Adjust guide pads as described previously.

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NOTES: