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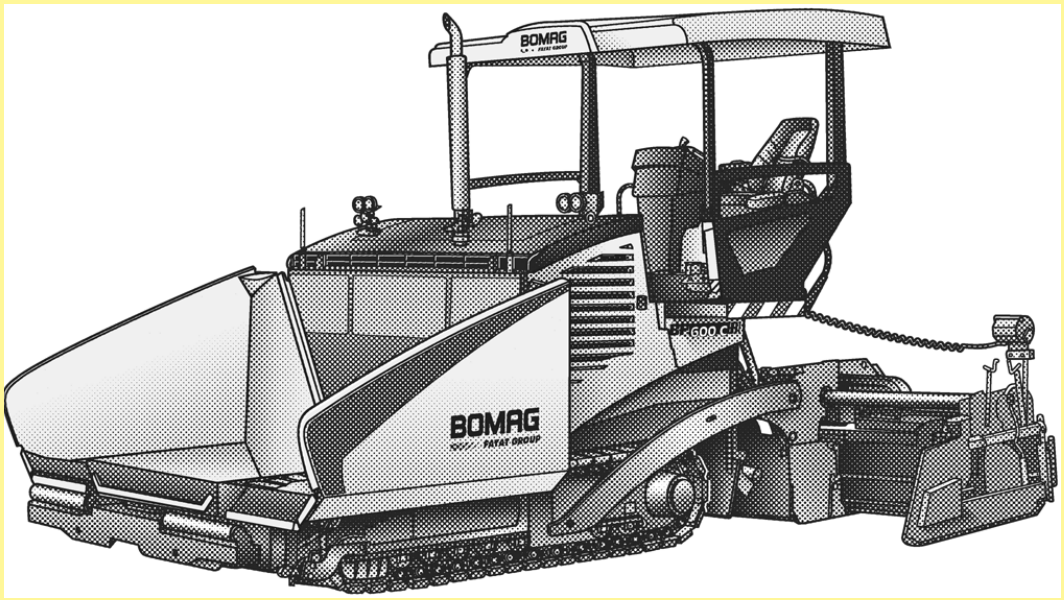
BOMAG
FAYAT GROUP

Service - Manual

BF 600 C - HSE

BF 600 C - HCE

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1 General

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1.1 Introduction

This manual addresses the professionally qualified personnel or the after sales service of BOMAG, and should be of help and assistance in correct and efficient repair and maintenance work.

This manual describes the disassembly, dismantling, assembly, installation and repair of components and assemblies. The repair of components and assemblies is only described as this makes sense under due consideration of working means and spare parts supply.

Documentation

For the BOMAG machines described in this manual the following documentation is additionally available:

1. **Operating and maintenance instructions**
2. **Spare parts catalogue**
3. **Service information**

Use only genuine BOMAG spare parts.

Spare parts needed for repairs can be taken from the spare parts catalogue for the machine.

This manual is not subject of an updating service; for this reason we would like to draw your attention to our additional "Technical Service Bulletins".

In case of a new release all necessary changes will be included.

In the course of technical development we reserve the right for technical modifications without prior notification.

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⚠ Danger

These safety regulations must be read and applied by every person involved in the repair /maintenance of this machine. The applicable accident prevention instructions and the safety regulations in the operating and maintenance instructions must be additionally observed.

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Important notes

These safety regulations must be read and applied by every person involved in the repair /maintenance of this machine. The applicable accident prevention instructions and the safety regulations in the operating and maintenance instructions must be additionally observed.

Repair work shall only performed by appropriately trained personnel or by the after sales service of BOMAG.

Workshop equipment and facilities as well as the use and waste disposal of fuels and lubricants, cleaning agents and solvent as well as gases and chemicals are subject to legal regulations, which are intended to provide a minimum on safety. It is obviously your own responsibility to know and adhere to these regulations.

This manual contains headers like "Note", "Attention", "Danger" and "Environment", which must be strictly complied with in order to inform about and avoid dangers to persons, property and the environment.

i Note

Paragraphs marked like this contain technical information for the optimal economical use of the machine.

⚠ Caution

Paragraphs marked like this highlight possible dangers for machines or parts of the machine.

⚠ Danger

Paragraphs marked like this highlight possible dangers for persons.

Environment

Paragraphs marked like this point out practices for safe and environmental disposal of fuels and lubricants as well as replacement parts.

Observe the regulations for the protection of the environment.

General

- For repair and maintenance work move the machine on a firm base and shut it down.
- Always secure the machine against unintended rolling.
- Secure the engine reliably against unintentional starting.
- Mark a defective machine and a machine under repair by attaching a clearly visible warning label to the dashboard.
- Block the articulated joint with the articulation lock.
- Use protective clothes like hard hat, safety boots and gloves.
- Keep unauthorized persons away from the machine during repair work.
- Tools, lifting gear, lifting tackle, supports and other auxiliary equipment must be fully functional and in safe condition.
- Use only safe and approved lifting gear of sufficient load bearing capacity to remove and install parts or components from and to the machine.
- Do not use easily inflammable or harmful substances, such as gasoline or paint thinners for cleaning.
- Do not smoke or use open fire and avoid sparks when cleaning or repairing a tank.
- When performing welding work strictly comply with the respective welding instructions.

Transport work with cranes and lifting tackle

i Note

Cranes must only be operated by instructed persons who had been trained in handling cranes.

- Follow the operating instructions of the manufacturer when working with cranes.
- Follow the operating instructions of the operator when working with cranes.
- Always comply with the applicable accident prevention instructions when working with cranes and lifting tackle.

Precautions and codes of conduct for welding work

Welding work must only be carried out by properly trained personnel.

⚠ Danger

Electric shock!

Sparks, fire hazard, burning of skin!

Infrared or ultraviolet radiation (arc), flashing of eyes!

Health hazard caused by welding work on highly alloyed work pieces, metal coatings, paint coatings, plastic coatings, oil containing dirt deposits, grease or solvent residues, etc.!

- Check welding equipment and cables for damage before use (also the validity of inspection stickers).
- Ensure good conductivity between ground cable and workpiece, avoid joints and bearings.

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- Start the extraction fan before starting work and guide with the progressing work as required.
- Always isolate the burner when laying it down (remove possible electrode residues).
- Protect cables from being damaged, use cables with insulated couplings.
- Ensure sufficient fire protection, keep a fire extinguisher at hand.
- Welding work in areas where there is a risk of fire or explosion, must only be carried out with welding permission.
- Remove any combustible materials from the welding area or cover such items appropriately.
- Name a fire watch during and after welding work.
- Place welding rod holders and inert gas welding guns only on properly insulated bases.
- Place the inert gas bottles in a safe place and secure them against falling over.
- Use a protective screen or hand shield with welding filter, wear welding gloves and clothes.
- Switch the welding unit off before connecting welding cables.
- Check electrode holders and electric cables at regular intervals.

Behaviour in case of faults

- In case of faults on the welding unit switch of the welding unit immediately and have it repaired by expert personnel.
- In case of failure of the extraction system switch the system off and have it repaired by expert personnel.

Maintenance; waste disposal

- Replace damaged insulating jaws and welding rod holders immediately.
- Replace the welding wire reels only in de-energized state.

What to do in case of accidents; First Aid

- Keep calm.
- Call first air helpers.
- Report the accident.
- In case of an electric accident: Interrupt the power supply and remove the injured person from the electric circuit. If breathing and heart have stopped apply reactivation measures and call for an emergency doctor.

Operation of high-voltage systems

i Note

The rules and statutory regulations valid in the corresponding do apply in addition to the notes given here.

⚠ Caution

The high-voltage system must only be operated and serviced by qualified and authorized personnel.

Before starting operation the operator must check the proper condition of the system.

⚠ Danger

Possibility of injury or even death caused by electric shock:

- **if persons come into contact with live parts,**
- **in case of faulty insulation of live parts,**
- **inadequate, unsuitable insulation,**
- **if melted parts flake off in case of short circuits.**

Old oils

Prolonged and repetitive contact with mineral oils will remove the natural greases from the skin and causes dryness, irritation and dermatitis. Moreover, used engine oils contain potentially hazardous contaminants, which could cause skin cancer. Appropriate skin protection agents and washing facilities must therefore be provided.

- Wear protective clothes and safety gloves, if possible.
- If there is a risk of eye contact you should protect your eyes appropriately, e.g. chemistry goggles or full face visor; a facility suitable for rinsing the eyes should also be available.
- Avoid longer and repetitive contacts with oils. In case of open incisions and injuries seek medical advice immediately.
- Apply protective cream before starting work, so that oil can be easier removed from the skin.
- Wash affected skin areas with water and soap (skin cleansers and nail brushes will help). Lanolin containing agents will replace natural skin oils that were lost.
- Do not use gasoline, kerosene, diesel, thinner or solvents to wash the skin.
- Do not put oil soaked cloths into your pockets.
- Avoid clothes getting soiled by oil.
- Overalls must be washed at regular intervals. Dispose of non-washable clothes environmentally.
- If possible degrease components before handling.

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Environment

It is strictly prohibited to drain off oil into the soil, the sewer system or into natural waters. Old oil must be disposed of according to applicable environmental regulations. If in doubt you should consult your local authorities.

Hydraulics

- Always relieve the pressure in the hydraulic system before disconnecting any lines. Hydraulic oil escaping under pressure can penetrate the skin and cause severe injury.
- Always make sure that all screw fittings have been tightened properly and that hoses and pipes are in mint condition before pressurizing the system again.
- Hydraulic oil leaking out of a small opening can hardly be noticed, therefore please use a piece of cardboard or wood when checking for leaks. When injured by hydraulic oil escaping under pressure consult a physician immediately, as otherwise this may cause severe infections.
- Do not step in front of or behind the drums, wheels or crawler tracks when performing adjustment work in the hydraulic system while the engine is running. Block drums, wheels or crawler tracks with wedges.

Reattach all guards and safety installations after all work has been completed.

Environment

It is strictly prohibited to drain off oil into the soil, the sewer system or into natural waters. Oil oil must be disposed of according to applicable environmental regulations. If in doubt you should consult your local authorities.

Fuels

⚠ Danger

Repair work shall only performed by appropriately trained personnel or by the after sales service of BOMAG.

Follow the valid accident prevention instructions when handling fuels.

The following notes refer to general safety precautions for danger free handling of fuel.

Fuel vapours not only are easily inflammable, but also highly explosive inside closed rooms and toxic; dilution with air creates an easily inflammable mixture. The vapours are heavier than air and therefore sink down to the ground. Inside a workshop they may easily become distributed by draft. Even the smallest portion of spilled fuel is therefore potentially dangerous.

- Fire extinguishers charged with FOAM, CO^2 GAS or POWDER must be available wherever fuel is stored, filled in, drained off, or where work on fuel systems is performed.
- The vehicle battery must always be disconnected, BEFORE work in the fuel system is started. Do not disconnect the battery while working on the fuel system. Sparks could cause explosion of the fuel fumes.
- Wherever fuel is stored, filled, drained off or where work on fuel systems is carried out, all potential ignition sources must be extinguished or removed. Search lights must be fire proof and well protected against possible contact with running out fuel.

Hot fuels

Please apply the following measures before draining of fuel to prepare for repair work:

- Allow the fuel to cool down, to prevent any contact with a hot fluid.
- Vent the system, by removing the filler cap in a well ventilated area. Screw the filler cap back on, until the tank is finally emptied.

Synthetic rubber

Many O-rings, hoses, etc. are made of synthetic material, a so-called fluorocarbon elastomer. Under normal operating conditions this material is safe and does not impose any danger to health.

However, if this material becomes damaged by fire or extreme heat, it may decompose and form highly caustic hydrofluoric acid, which can cause severe burns in contact with skin.

- If the material is in such a state it must only be touched with special protective gloves. The protective gloves must be disposed of according to applicable environmental regulations immediately after use.
- If the material has contacted the skin despite these measures, take off the soiled clothes and seek medical advice immediately. In the meantime cool and wash the affected area of skin over a sufficient time with cold water or lime water.

Poisonous substances

Some of the fluids and substances used are toxic and must under no circumstances be consumed.

Skin contact, especially with open wounds, must be avoided.

These fluids and substances are, amongst others, anti-freeze agents, hydraulic oils, fuels, washing additives, refrigerants, lubricants and various bonding agents.

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Engine

⚠ Danger

Do not work on the fuel system while the engine is running. (Danger to life!)

Once the engine has stopped wait approx. 5 minutes for the system to depressurize. The systems are under high pressure. (Danger to life!)

Keep out of the danger zone during the initial test rung. Danger caused by high pressure in case of leaks. (Danger to life!)

When performing work on the fuel system make sure that the engine cannot be started unintentionally during repair work. (Danger to life!)

- Maintenance and cleaning work on the engine must only be performed with the engine stopped and cooled down. Make sure that the electric system is switched off and sufficiently secured against being switched on again (e.g. pull off ignition key, attach a warning label).
- Observe the accident prevention regulations for electric systems (e.g. -VDE-0100/-0101/-0104/-0105 Electric precautions against dangerous contact voltages).
- Cover all electric components properly before wet cleaning.

Battery

- Always wear goggles and protective clothing to service or clean batteries! Battery acid can cause severe injury by cauterization when coming in contact with skin.
- Work only well ventilated rooms (formation of oxyhydrogen gas).
- Do not lean over the battery while it is under load, being charged or tested (danger of explosion).
- Keep ignition sources away from the battery. Burning cigarettes, flames or sparks can cause explosion of the battery
- Use battery chargers etc. only in strict compliance with the operating instructions.
- After an accident with acid flush the skin with a sufficient amount of water and seek medical advice.
- Do not allow children access to batteries.
- When mixing battery fluid always pour acid into water, never vice-versa.

Special safety regulations

- Use only genuine BOMAG spare parts for repair and maintenance work. Genuine spare parts and original accessories were specially developed, tested and approved for the machine.
- The installation and use of non-genuine spare parts or non-genuine accessories may therefore have an adverse effect on the specific characteristics of the machine and thereby impair the active and/or passive driving safety. The manufacturer explicitly excludes any liability for damage caused by the use of non-original parts or accessories.
- Unauthorized changes to the machine are prohibited for safety reasons.
- Do not perform any cleaning work while the engine is running.
- If tests on the articulated joint need to be performed with the engine running, do not stand in the articulation area of the machine (danger of crushing!).
- If tests must be performed with the engine running do not touch rotating parts of the engine (danger of injury!).
- Always ensure an adequate supply of fresh air when starting in closed rooms. Exhaust gases are highly dangerous!
- Refuel only with the engine shut down. Ensure strict cleanliness and do not spill any fuel.
- Always ensure an adequate supply of fresh air when refuelling in closed rooms.
- Dispose of used filters in accordance with applicable environmental regulations.
- When performing repair and maintenance work collect oils and fuels in suitable containers and dispose of in compliance with applicable environmental regulations.
- Do not heat up oils higher than 160 °C because they may ignite.
- Wipe off spilled or overflown oil using suitable cleaning means and dispose of in accordance with applicable environmental regulations.
- Dispose of old batteries according to applicable environmental regulations.
- There is a danger of scalding when draining off engine or hydraulic oil at operating temperature! Allow engine and hydraulic system to cool down to a sufficient level.
- Do not exceed the max. permissible tire pressure.

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General

- Before removing or disassembling parts, assemblies, components or hoses mark these parts for easier assembly.
- Before assembling and installing parts, assemblies or components oil or grease all movable parts or surfaces as required and in compliance with the compatibility of materials.

Electrics

General

Due to the fast technical development electric and electronic vehicle systems become more intelligent and more comprehensive day by day, and can hardly be dispensed with in hydraulic and mechanical vehicle systems.

Diagnostics according to plan

Well structured trouble shooting procedures can save time and money.

Random tests have revealed that purely electronic components or control units only very rarely are the actual cause of failures:

- In approx. 10 % of the examined cases the problems were caused by control units.
- In approx. 15 % sensors and actuators were the cause of the problems.

By far the highest proportion of all faults could be traced back to wiring and connections (plugs, etc.).

General:

- Before changing any expensive components, such as control units, you should run a systematic trouble shooting session to eliminate any other possible fault sources. Knowledge in basic electrics is required for this purpose. If a fault was diagnosed without having pulled the plug of the control unit or inspected the wiring, this should be done before changing any parts.
- Check for good cable and ground contacts, therefore keep all mechanical transition points between electric conductors (terminals, plugs) free of oxide and dirt, as far as this is possible.
- Always use the machine related wiring diagram for testing. If one or more faults were detected, these should be corrected immediately.
- Do not disconnect or connect battery or generator while the engine is running.
- Do not operate the main battery switch under load.
- Do not use jump leads after the battery has been removed.
- Sensors and electric actuators on control units must never be connected individually or between external power sources for the purpose of testing, but only in connection with the control unit in question.
- It is not permitted to pull plugs off while the voltage supply is switched on (terminal 15 "ON")! Switch the voltage supply "OFF" first and pull out the plug.
- Even with an existing polarity reversal protection incorrect polarity must be strictly avoided. Incorrect polarity can cause damage to control units!

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- Plug-in connectors on control units are only dust and water tight if the mating connector is plugged on! Control units must be protected against spray water, until the mating connector is finally plugged on!
- Unauthorized opening of control electronics (Microcontroller MC), modifications or repairs in the wiring can cause severe malfunctions.
- Do not use any radio equipment or mobile phones in the vehicle cab without a proper aerial or in the vicinity of the control electronics!

Electrics and welding

⚠ Caution

Before starting welding work you should disconnect the negative battery pole or interrupt the electric circuit with the main battery switch, disconnect the generator and pull the plugs off all control units in order to protect the electrical system of the machine.

- Disconnect the minus pole of the battery or interrupt the electric circuit with the main battery switch.
- Isolate the generator and all control units from the electric circuit.
- Always fasten the earth clamp of the welding unit in the immediate vicinity of the welding location.
- When choosing the location for the earth clamp make sure that the welding current will not pass through joints or bearings.

Battery

Rules for the handling of batteries

When removing a battery always disconnect the minus pole before the plus pole. When installing the battery connect the minus pole after the plus pole to avoid short circuits.

Fasten the terminal clamps with a little force as possible.

Always keep battery poles and terminal clams clean to avoid high transition resistances when starting and the related development of heat.

Make sure the battery is properly fastened in the vehicle.

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Generator

Before removing the generator you must disconnect the ground cable from the minus pole of the battery while the ignition is switched off. Do not disconnect the generator while the engine is running, because this may cause extremely high voltage peaks in the vehicle wiring system ("Load Dump"), which could possibly damage control units, radios or other electronic equipment.

When disassembling the battery cable, the B+-nut underneath on the generator side may also be loosened. This nut must in this case be retightened.

When connecting e.g. the battery cable to the terminal of the generator you must make sure that the polarity is correct (generator B+ to the + pole of the battery). Mixing up the polarities by mistake causes short circuit and damage to the rectifier elements - the generator will be out of function.

The generator can only be operated with the battery connected. Under special conditions emergency operation without battery is permitted, the lifetime of the generator is in such cases especially limited.

Plus and minus cables must be disconnected during rapid charging of the battery or electric welding on the vehicle.

When cleaning the generator with a steam or water jet make sure not to direct the steam or water jet directly on or into the generator openings or ball bearings. After cleaning the generator should be operated for about 1 - 2 minutes to remove any deposits of water from the generator.

Starter motor

So-called jump starting (using an additional external battery) without the battery connected is dangerous. When disconnecting the cables from the poles high inductivities (arcs, voltage peaks) may occur and destroy the electrical installation.

For purposes like e.g. purging the fuel systems, starters may be operated for maximum 1 minute without interruption. Then you should wait for at least 30 minutes (cooling down) until trying again. During the 1 minute starting period this process should not be interrupted.

Starter motors must not be cleaned with high pressure steam cleaning equipment.

The contacts on starter terminals 30, 45, 50 must be protected against unintended shorting (jump protection).

When replacing the starter the ring gear on the engine flywheel must be checked for damage and its number of teeth - if necessary replace the ring gear.

Always disconnect the battery before starting assembly work in the starter area of the engine or on the starter itself.

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Hydraulic system

⚠ Caution

Repair work on hydraulic elements shall only performed by appropriately trained personnel or by the after sales service of BOMAG.

Please note

i Note

Cleanliness is of utmost importance. Dirt and other contaminations must strictly be kept out of the system.

- Connections and screw fittings, filler neck covers and their immediate surrounding areas must be cleaned before removal.
- Before loosening hoses, pipe lines etc. relieve all pressure from the system.
- During repair work keep all openings closed with clean plastic plugs and caps.
- Never run pumps, motors and engines without oil or hydraulic oil.
- When cleaning hydraulic components take care not to damage any fine machine surfaces.
- Chemical and rubber soluble cleansing agents may only be used to clean metal parts. Do not let such substances come in contact with rubber parts.
- Rinse of cleaned parts thoroughly, dry them with compressed air and apply anti-corrosion oil immediately. Do not install parts that show traces of corrosion.
- Avoid the formation of rust on fine machined caused by hand sweat.
- Use new O-rings or seal rings for reassembly.
- Use only hydraulic oil as sliding agent when reassembling. Do not use any grease!
- Use only the specified pressure gauges. Risk of damaging the pressure gauges under too high pressure.
- Check the hydraulic oil level before and after the work.
- Fill in only clean oil as specified in the maintenance instructions.
- Check the hydraulic system for leaks, if necessary find and rectify the cause.
- Before taking new hydraulic components into operation fill these with hydraulic oil as specified in the operating and maintenance instructions.
- After changing a hydraulic component thoroughly flush, refill and bleed the complete hydraulic system.
- Perform measurements at operating temperature of the hydraulic oil (approx. 40 ¯C).
- After changing a component perform a high and charge pressure test, if necessary check the speed of the exciter shaft.
- The operating pressure of the exciter shaft to a great extent depends on the base under the vibrating drum. On hard ground place the drums on a suitable base and check the drum pressure. Do not activate the vibration on a hard, concreted base, danger of bearing damage.
- After the completion of all tests perform a test run and then check all connections and fittings for leaks with the engine still stopped and the hydraulic system depressurized.

Before commissioning

- Fill the housings of hydraulic pumps and motors with hydraulic oil. Use only hydraulic oils according to the specification in the maintenance instructions.
- After changing a component flush the hydraulic system as described in the flushing instructions.

Taking into operation

- Bleed the hydraulic circuits.
- Start up the hydraulic system without load.
- Check the hydraulic oil level in the tank, if necessary top up with hydraulic oil as specified in the operating and maintenance instructions or drain oil off into a suitable container.

After taking into operation

- Check fittings and flanges for leaks.
- After each repair check all adjustment data, system pressures, rotational speeds and nominal values in the hydraulic system, adjust if necessary.
- Do not adjust pressure relief valves and control valves to values above their specified values.

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Notes on cleanliness for Common Rail engines

Special requirements with respect to cleanliness in the fuel system do apply for commissioning, maintenance and repair work, particularly for TEIRIII engines with the DEUTZ Common Rail System. Contamination like dirt, welding residues or similar can lead to the failure of individual components and adversely affect engine operation.



Fig. 1

- Spare parts should be left in their original packaging as long as possible and should only be unpacked just before use.
- When parts are unpacked any connections must be closed with suitable plugs or caps, in order to prevent (Fig. 1) contamination of hose connections. If e.g. fuel hoses are connected to one side, while the second side cannot yet be connected, there is a danger of dirt entering into the system. The free connection must in this case also be appropriately closed.

Notes and measures to be applied before starting work in the fuel system

- The fuel system must be closed. Visual examination for leaks / damage in the fuel system.
- Before starting work in the fuel system clean the complete engine and the engine compartment with the system still closed.
- The engine should be dry before work is started in the fuel system.
- Blow drying with compressed air is only permitted while the fuel system is still closed.
- When using steam cleaning equipment cover control unit, cable plugs, all other electrical connections and the generator beforehand and do not expose these items to the direct steam jet.
- Electrical plug connections must be plugged in during jet cleaning.
- Remove loose parts (e.g. paint scales that may have come off during assembly work) with an industrial vacuum cleaner or any means of extraction.
- Vacuum cleaning equipment must generally be used for cleaning when the fuel system is open.
- Perform work on the fuel system only in a clean environment (no dust, no grinding or welding work). Avoid draughts (dust). The workshop floor must be cleaned at regular intervals. No brake or power test stand should be present or operated in the same room.
- Air movements, which could swirl up dust, such as brake repairs or starting of engines, must be strictly avoided.
- For work, such as disassembly and assembly of defective hydraulic components in the Common Rail System, it is strongly recommended to set up a separate workshop area, i.e. an area which is spatially separated from all other areas (general vehicle repairs, brake repairs).
- No general machine tools should be operated in this room.
- Periodic cleaning of this workshop area is obligatory, draughts, ventilation system and heating blowers must be minimized.
- Engine compartment area where dirt particles could come loose, should be covered with new, clean foil.
- Working means and tools must be cleaned before being used for work. Use only tools without damaged chromium coating, or tools without chromium coating.

Notes and measures to be applied during work in the fuel system

- Wear clean working clothes.
- Use only lint-free cleaning cloths for work in the fuel system.
- Remove loose parts (e.g. paint scales that may have come off during assembly work) with an industrial vacuum cleaner or any means of extraction. Vacuum cleaning equipment must generally be used for cleaning when the fuel system is open.
- Working means and tools must be cleaned before being used for work. Use only tools without damaged chromium coating, or tools without chromium coating.

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- Do not use any previously used cleaning or testing fluids for cleaning.
- Compressed air should never be used for cleaning when the fuel system is open.
- Work on disassembled components must only be carried out at a specially furnished work place.
- When disassembling or assembling components you should not use any materials from which particles or fibres could flake off (cardboard, wood, towels).
- Dismantled parts must only be wiped off with clean, lint-free cloths if required. No dirt particles must be wiped into the components.
- Close openings on components and engine immediately with suitable plugs/caps.
- Plugs/caps must only be removed just before the installation.
- Keep plugs/caps in their original packaging, where they are protected against dust and dirt, dispose of after one time use.
- Take new parts out of their original packaging just before installation.
- Disassembled components must be stored in new, sealable bags or – if available – in the packaging material of the new components.
- Always use the original packaging material of the new part to return the disassembled old component.

Notes and measures concerning the workshop area

- For work, such as disassembly and assembly of defective hydraulic components in the Common Rail System, it is strongly recommended to set up a separate workshop area, i.e. an area which is spatially separated from all other areas (general vehicle repairs, brake repairs).
- The workshop floor must be sealed or tiled.
- No welding equipment, grinding machines, general machine tools, brake or power test benches must be operated in this room.
- Periodic cleaning of this workshop area is obligatory, draughts, ventilation system and heating blowers must be minimized.

Notes and measures for work place and tools in the workshop

- A special work place must be set up for work on disassembled components.
- Clean disassembly and assembly tools at regular intervals and keep these in a closed tool cabinet.
- Remove loose parts (e.g. paint scales that may have come off during assembly work) with an industrial vacuum cleaner or any means of extraction.
- Working means and tools must be cleaned before being used for work. Use only tools without damaged chromium coating, or tools without chromium coating.

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Fuel hoses

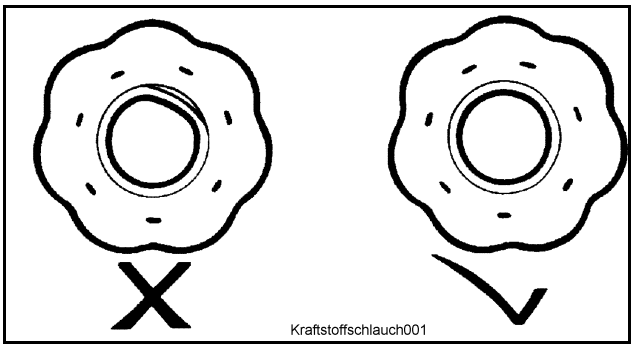


Fig. 2

⚠ Caution

All fuel hoses have two layers of material, a reinforced rubber coating outside and an internal Viton hose. If a fuel hose has come loose one must make absolutely sure that the internal Viton layer has not been separated from the reinforced outer layer. In case of a separation the hose needs to be replaced.

Gaskets and mating surfaces

Leaking sealing faces can mostly be traced back to incorrect assembly of seals and gaskets.

- Before assembling a new seal or gasket make sure that the sealing surface is free of pitting, flutes, corrosion or other damage.
- Inappropriately stored or handled seals (e.g. hanging from hooks or nails) must under no circumstances be used.
- Assemble seals and gaskets only with sealing compound, grease or oil, if this is specifically specified in the repair instructions.
- If necessary remove any old sealing compound before assembling. For this purpose do not use any tools that could damage the sealing surfaces.
- Sealing compound must be applied thin and evenly on the corresponding surfaces; take care that the compound does not enter into oil galleries or blind threaded bores.
- Examine the contact faces for scratches and burrs, remove these with a fine file or an oilstone; take care that no grinding dust and dirt enters into tapped bores or enclosed components.
- Blow out lines, ducts and gaps with compressed air, replace any O-rings and seals that have been dislodged by the compressed air.

Assembly of radial seals

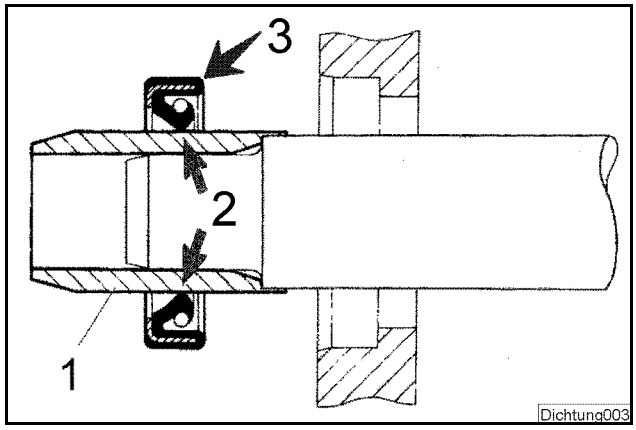


Fig. 3

- Lubricate the sealing lips (2) (Fig. 3) with clean grease; in case of double seals fill the space between the sealing lips with a generous amount of grease.
- Slide the seal over the shaft, with the lip facing towards the fluid to be sealed.

i Note

If possible, use an assembly sleeve (1 (Fig. 3)), ***to protect the lip from being damaged by sharp edges, threads or splines.*** *If no assembly sleeve is avail-*

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able, you should use a plastic tube or adhesive tape to prevent the sealing lip from being damaged.

- Lubricate the outer rim (arrow 3 (Fig. 3)) of the seal and press it flat on the housing seat.

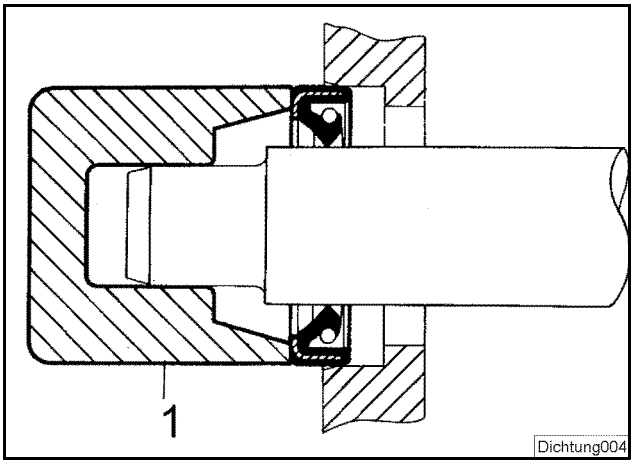


Fig. 4

- Press or knock the seal into the housing, until it is flush with the housing surface.

i Note

*If possible, use a "bell" (1 (Fig. 4)), to make sure **that the seal will not skew.** In some cases it may be advisable to assemble the seal into the housing first, before sliding it over the shaft. Under no circumstances should the full weight of the shaft rest on the seal.*

If you have no proper service tools at hand, use a suitable drift punch with a diameter which is about 0,4 mm smaller than the outer diameter of the seal. Use VERY LIGHT blows with the hammer if no press is available.

Feather keys and keyways

⚠ Caution

Feather keys may only be reused if they are free of damage.

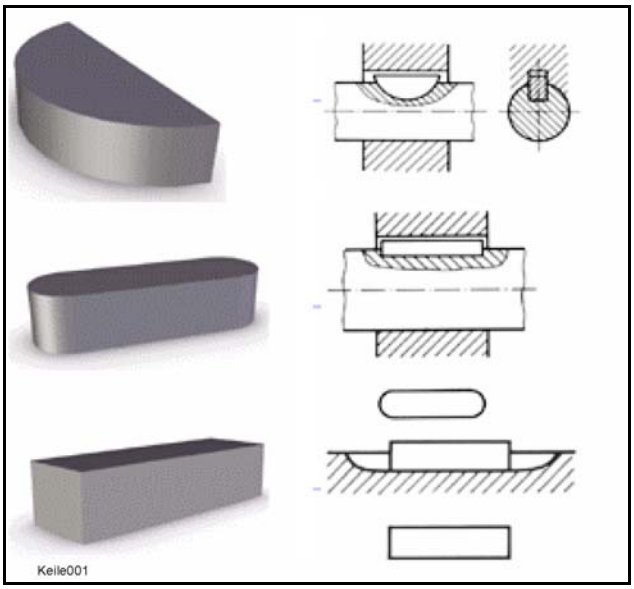


Fig. 5

- Clean and thoroughly examine the feather key.
- Deburr and thoroughly clean the edges of the keyway with a fine file before reassembling.

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Ball and roller bearings

⚠ Caution

Ball and roller bearings may only be reused if they are free of damage and do not show any signs of wear.



Fig. 6

- If a ball or roller bearing of a bearing pair shows defects, both ball or roller bearings need to be replaced.
- Remove any lubricant residues from the ball or roller bearing to be examined by washing it with gasoline or any other appropriate degreasing agent. Ensure strict cleanliness.
- Check balls or rollers, running surfaces, outer faces of outer races and inner faces of inner races for visible damage. Replace the ball or roller bearing if necessary.
- Check the ball or roller bearing for clearance and resistance between the inner and outer races, replace if necessary.
- Lubricate the ball or roller bearing with the recommended type of grease before assembly or reassembly.
- On greased bearings (e.g. wheel bearings) fill the space between ball or roller bearing and outer seal with the recommended type of grease before assembling the seal.
- Check shaft and bearing housing for discolouration or other signs of movement between ball or roller bearing and seats.
- Make sure that shaft and housing are free of burrs before assembling the ball or roller bearing.
- Always mark the individual parts of separable ball or roller bearings (e.g. taper roller bearings) to enable correct reassembling. Never assemble the rollers to an outer race that has already been used, replace the complete ball or roller bearing instead.

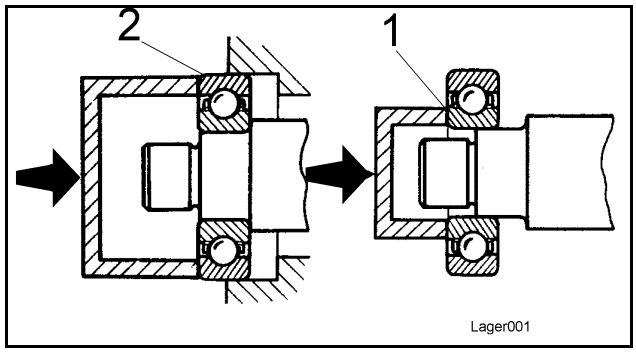


Fig. 7

⚠ Caution

When assembling the ball or roller bearing to the shaft load must only be applied to the inner race 1 (Fig. 7).

When fitting the bearing into the housing load must only be applied to the outer race (2).

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Screws and nuts

Tightening torque

⚠ Caution

Tighten nuts or screws with the tightening torques specified in the following tables of tightening torques. Tightening torques deviating from the ones in the table are specially mentioned in the repair instructions.

Damaged screws must under no circumstances be used any longer. Recutting threads with thread cutters or taps adversely affects the strength and leak tightness of the screw joint. Damaged or corroded thread pitches can cause incorrect torque value readings.

Self-locking nuts must generally be replaced after disassembly.

The use of screws with too high strength can cause damage!

- Nut of a higher strength can generally be used instead of nuts of a lower strength classification.
- When checking or retightening screw joints to the specified tightening torque you should first relieve by a quarter turn and then tighten to the correct torque.
- Before tightening you should lightly oil the thread, in order to ensure low friction movement. **The same applies for self-locking nuts.**
- Make sure that no oil or grease will enter into blind tapped bores. The hydraulic power generated when turning in the screw could cause breakage of the effected part.

Strength classes, metric screws

The strength classes (from 3.6 to 12.9) are specified for all strength classes from a nominal diameter of 5mm. The corresponding identification can be found where allowed for by the shape of the screw.

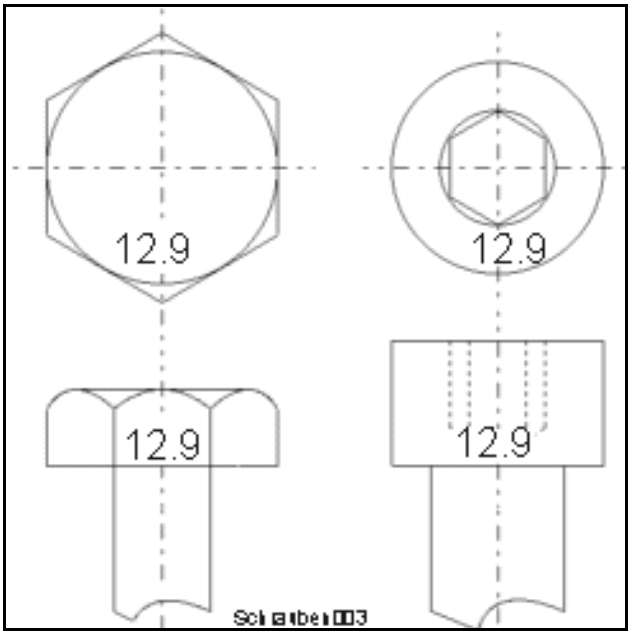


Fig. 8 Identification of screws

Example: A screw is identified with 12.9.

The first number corresponds with 1/100 of the nominal tensile strength (minimum tensile strength) in N/mm^2.

- The nominal tensile strength is 12 X 100 N/mm^2 = 1200 N/mm^2.

The second number specifies 10-times the ration between lower yield point and nominal tensile strength (yield point ratio).

i Note

When exceeding the lower yield point, the material will return to its original shape when being relieved (plastic deformation).

When exceeding the upper yield point the material will not restore its original shape after being relieved.

- The lower tensile strength is 9/10 X 1200 N/mm^2 = 1080 N/mm^2.

i Note

However, these values are by no means identical with the tightening torques, which are to be set on a torque wrench. The corresponding calculation requires a higher effort and, in the end, depends on the materials to be bolted together.

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Strength classes of metric nuts

Nuts are differentiated by three load groups. Each load group has a special designation system for the strength class assigned, so that the load group can be clearly identified.

Nuts for screw joints with full load capability (4, 5, 6, 8, 10, 12)

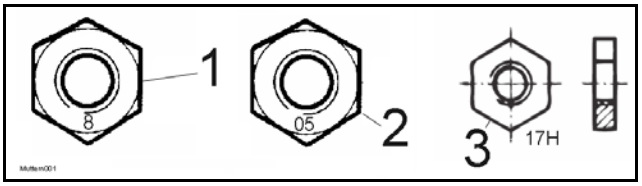


Fig. 9 Identification of nuts

In a connection with a screw, these nuts 1 (Fig. 9) must be able to bear the full pre-load at the yield point.

Nut height above 0.8 d (d = nominal dimension).

Strength class of nut	Strength class of associated screw
4	3.6, 4.6, 4.8
5	3.6, 4.6, 4.8 5.6, 5.8
6	6.8
8	8.8
9	9.8
10	10.8
12	12.8

Nuts for screw joints with limited load factor (04, 05)

The preceding "0" indicates that, due to their low height, nuts 2 (Fig. 9) in this group are only able to withstand the force of a screw to a limited extent.

Nut height below 0,8 d (d = nominal dimension).

Nuts for screw joints without specified load factor (11H, 14H, 17H, 22H)

This standard contains strength classes (hardness classes) for nuts 3 (Fig. 9), for which no load values can be specified, e.g. because of their shape and dimensions, but which can only be classified by their hardness.

Nut height below 0,5 d (d = nominal dimension).

Identification in clock system

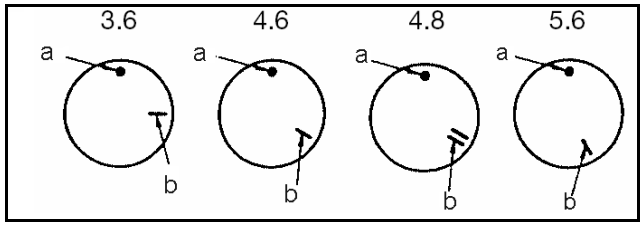


Fig. 10 Identification of nuts in clock system

For small nuts (Fig. 10) the clock system can be used for identification.

- The 12 o'clock position is identified by a dot or the manufacturer's symbol.
- The strength class is identified by a dash (b).

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Identification of UNF-threads

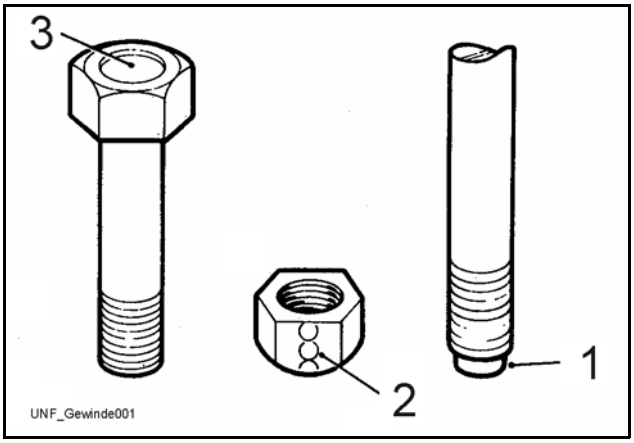


Fig. 11

Screws

The screw head is marked with a stamped in, round cavity 3 (Fig. 11).

Nuts

An uninterrupted series of stamped in circles parallel to the axis of the nut on a hexagon area (2).

Studs and brake rods

At the outmost end a short end of the component is reduced to its core diameter (1).

Cotter pins

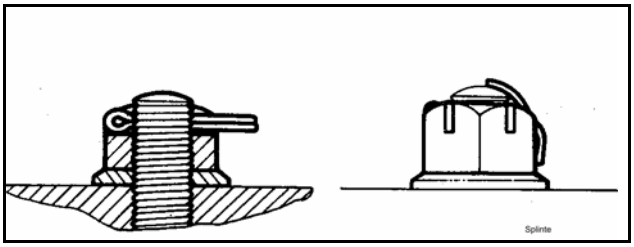


Fig. 12

In places where cotter pins are used, these must be reassembled. Cotter pins must generally be renewed after disassembly.

Cotter pins must be assembled as shown in the illustration, unless specified differently.

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The values specified in the table apply for screws:

- black oiled
- with surface protection A4C
- with surface protection DACROMET

i Note

DACROMET is a surface protection that mainly consists of zinc and aluminium in a chromium oxide matrix. DACROMETIZATION provides excellent corrosion protection for metal surfaces by applying a mineral coating with metallic-silver appearance.

Tightening torques for screws with metric unified thread*

Screw dimension	Tightening torques Nm		
	8.8	10.9	12.9
M4	3	5	5
M5	6	9	10
M6	10	15	18
M8	25	35	45
M10	50	75	83
M12	88	123	147
M14	137	196	235
M16	211	300	358
M18	290	412	490
M20	412	578	696
M22	560	785	942
M24	711	1000	1200
M27	1050	1480	1774
M30	1420	2010	2400

* Coefficient of friction μ tot. = 0,14

Tightening torques for screws with metric unified fine thread*

Screw dimension	Tightening torques Nm		
	8.8	10.9	12.9
M8 x 1	26	37	48
M10 x 1.25	52	76	88
M12 x 1,25	98	137	126
M12 x 1.5	93	127	152
M14 x 1.5	152	216	255
M16 x 1.5	225	318	383
M18 x 1.5	324	466	554
M20 x 1.5	461	628	775
M22 x 1.5	618	863	1058
M24 x 2	780	1098	1294
M27 x2	1147	1578	1920
M30 x 2	1568	2254	2695

* Coefficient of friction μ tot. = 0,14

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Tightening torques for screws treated with anti-seizure paste OKS 240* (copper paste)

Screw dimension	Tightening torques Nm		
	8.8	10.9	12.9
M16	169	240	287
M16 x 1.5	180	255	307
M18	232	330	392
M18 x 1.5	260	373	444
M20	330	463	557
M20 x 1.5	369	502	620
M22	448	628	754
M22 x 1.5	495	691	847
M24	569	800	960
M24 x 2	624	879	1036
M27	840	1184	1520
M27 X 2	918	1263	1536
M30	1136	1608	1920
M30 x 2	1255	1804	2156
3/4“ - 10 UNC	276	388	464
3/4“ - 16 UNC	308	432	520

* Anti-seizure paste (copper paste) is used for the assembly of screw connections, which are exposed to high temperatures and corrosive effects. Prevents seizure and corrosion.

Tightening torques for wheel nuts (fine thread) * **

Thread diameter	Tightening torques Nm
	10.9
M12x1.5	100
M14x1.5	150
M18x1.5	300 - 350
M20x1.5	400 - 500
M22x1.5	500 - 600

* Coefficient of friction μ tot. = 0,14

** These values result in a 90% utilization of the yield point

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The values specified in the table apply for screws:

- black oiled
- with surface protection A4C
- with surface protection DACROMET

i Note

The difference between Withworth and UNF/UNC threads is the fact that UNF and UNC threads have 60° flanks, as the metric ISO-thread, whereas Withworth has a flank of only 55°.

DACROMET is a surface protection that mainly consists of zinc and aluminium in a chromium oxide matrix. DACROMETIZATION provides excellent corrosion protection for metal surfaces by applying a mineral coating with metallic-silver appearance.

Tightening torques for screws with UNC thread, * UNC Unified Coarse Thread Series, American Unified Coarse Thread

Screw dimension	Tightening torques Nm		
	8.8	10.9	12.9
1/4“ - 20	11	15	19
5/16“ - 18	23	32	39
3/8“ - 16	39	55	66
7/16“ - 14	62	87	105
1/2“ - 13	96	135	160
9/16“ - 12	140	200	235
5/8“ - 11	195	275	330
3/4“ - 10	345	485	580
7/8“ - 9	560	770	940
1“ - 8	850	1200	1450
1 1/8“ - 7	1200	1700	2000
1 1/4“ - 7	1700	2400	2900
1 3/8“ - 6	2200	3100	3700
1 1/2“ - 6	3000	4200	5100

* Coefficient of friction μ tot. = 0,14

Tightening torques for screws with UNF thread, * UNF Unified National Fine Thread Series, American Unified Fine Thread

Screw dimension	Tightening torques Nm		
	8.8	10.9	12.9
1/4“ - 28	13	18	22
5/16“ - 24	25	35	42
3/8“ - 24	45	63	76
7/16“ - 20	70	100	120
1/2“ - 20	110	155	185
9/16“ - 18	155	220	260
5/8“ - 18	220	310	370
3/4“ - 16	385	540	650
7/8“ -14	620	870	1050

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Tightening torques for screws with UNF thread, * UNF Unified National Fine Thread Series, American Unified Fine Thread

Screw dimension	Tightening torques Nm		
	8.8	10.9	12.9
1“ - 12	930	1300	1600
1 1/8“ - 12	1350	1900	2300
1 1/4“ - 12	1900	2700	3200
1 3/8“ - 12	2600	3700	4400
1 1/2“ - 12	3300	4600	5600

* Coefficient of friction μ tot. = 0,14

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2 Technical data

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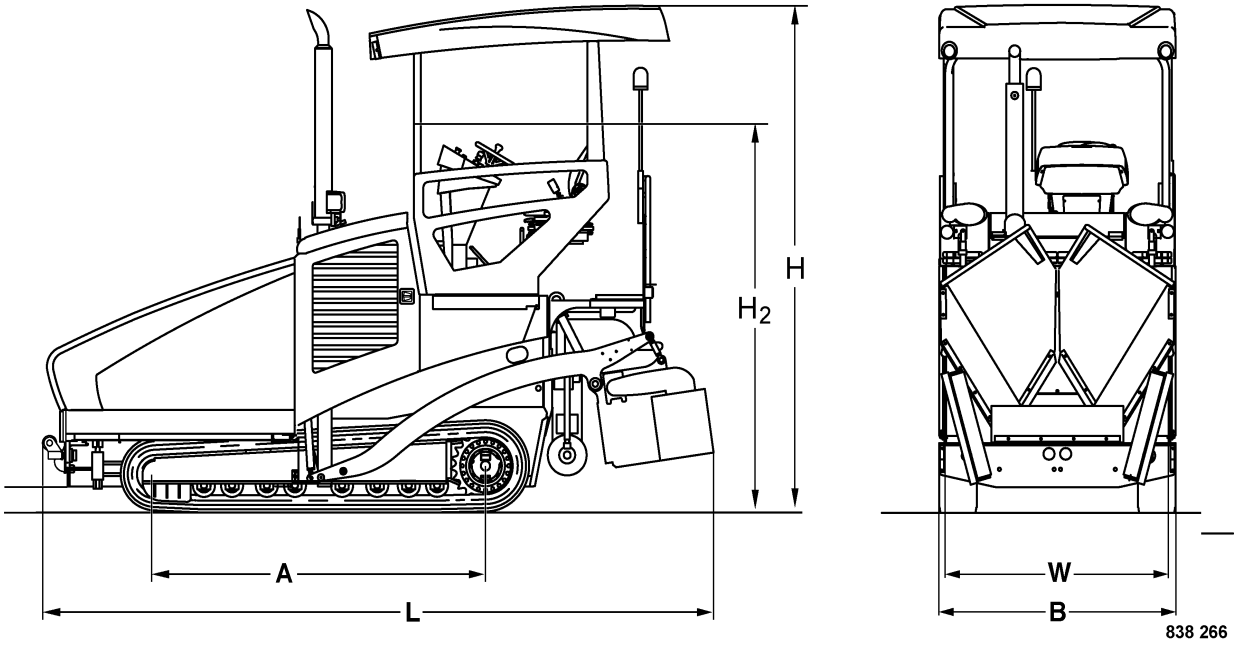


Fig. 13

BF 600 C (HC)	A	B	H	H_2	L	W
Dimensions in mm	2700	2550	3635	2850	5775	2500

Weights

Operating weight (CECE)	kg	16740
Weight of basic screed	kg	3300
Max. operating weight	kg	20100

Travel characteristics

Working speed	m/min	0 - 24
Transport speed	km/h	0 - 4.8
Max perm. inclination (ramp)	°	15

Drive

Engine manufacturer		Deutz
Type		TCD 2013 L04 2V
Cooling		Water
Number of cylinders		4
Rated power ISO 3046	kW	120
Rated speed	min^{-1}	2300

Crawler assembly

Crawler (length x width)	mm	2700 x 300

Hopper

Capacity	m^3	7.1
Width (wings open)	mm	3360
Width (wings closed)	mm	2550
Length	mm	1920
Filling height (middle)	mm	560

Scraper belt / auger

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Quantity		2
Width	mm	440
Rated speed	min^{-1}	18
Individual control		Standard
Reversing operation		Standard

Conveyor auger

Quantity		2
Auger diameter	mm	350
Rated speed	min^{-1}	75
Reversing operation		Standard

Screed

Basic width retracted	mm	2500
Basic width extended	mm	4750
Max. working width	mm	7550
Min. mat width with optional reducing plates	mm	1800
Mat height	mm	300
Smoothing plate depth	mm	400
Smooting plate thickness	mm	12
Heating		electric
Straight crossfalls	%	-2.5 ... +4.5
Tamper frequency	Hz	0 ... 29
Vibration frequency	Hz	20 ... 58

Filling capacities

Fuel (diesel)	l	approx. 215
Engine oil	l	approx. 15
Coolant	l	approx. 20
Hydraulic oil	l	approx. 160

i Note

Subject to technical alterations.

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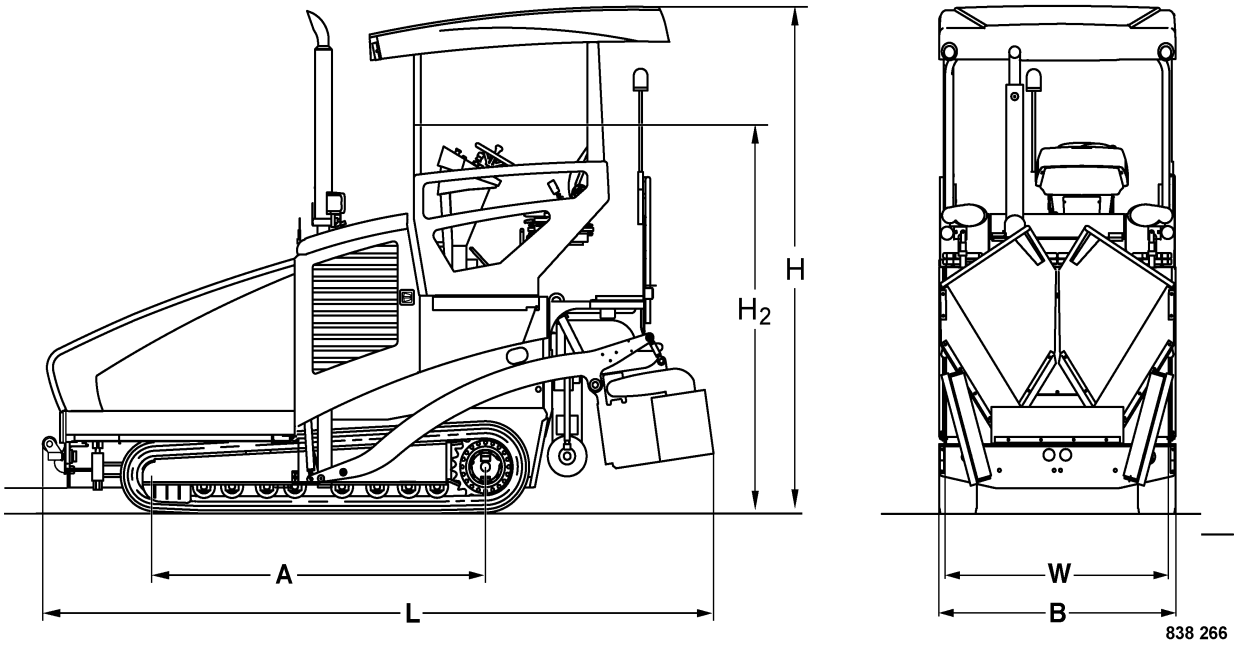


Fig. 14

BF 600 C (HS)	A	B	H	H_2	L	W
Dimensions in mm	2700	2550	3635	2850	5975	2550

Weights		
Operating weight (CECE)	kg	17840
Basic weight of screed	kg	4200
Max. operating weight	kg	20100
Travel characteristics		
Working speed	m/min	0 - 24
Transport speed	km/h	0 - 4.8
Max perm. inclination (ramp)	°	15
Drive		
Engine manufacturer		Deutz
Type		TCD 2013 L04 2V
Cooling		Water
Number of cylinders		4
Rated power ISO 3046	kW	120
Rated speed	min^{-1}	2300
Crawler assembly		
Crawler (length x width)	mm	2700 x 300
Hopper		
Capacity	m^3	7.1
Width (wings open)	mm	3360
Width (wings closed)	mm	2550
Length	mm	1920
Filling height (middle)	mm	560

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Scraper belt / auger		
Quantity		2
Width	mm	440
Rated speed	min^{-1}	18
Individual control		Standard
Reversing operation		Standard
Conveyor auger		
Quantity		2
Auger diameter	mm	350
Rated speed	min^{-1}	75
Reversing operation		Standard
Screed		
Basic width retracted	mm	2550
Basic width extended	mm	5000
Max. working width	mm	7500
Min. mat width with optional reducing plates	mm	1800
Mat height	mm	300
Smoothing plate depth	mm	400
Smooting plate thickness	mm	15
Heating		electric
Straight crossfalls	%	-2.5 ... +2.1
Tamper frequency	Hz	0 ... 29
Vibration frequency	Hz	20 ... 58
Filling capacities		
Fuel (diesel)	l	approx. 215
Engine oil	l	approx. 15
Coolant	l	approx. 20
Hydraulic oil	l	approx. 160

i Note

Subject to technical alterations.

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Additional engine data		
Combustion principle		4-stroke diesel
Low idle speed	rpm	700 - 800
High idle speed	rpm	2200 - 2250
Valve clearance intake	Angle de-gree	90
Valve clearance exhaust	Angle de-gree	150
Specific fuel consumption	g/kWh	222
HYDRAULIC PUMPS		
Travel pump		
Manufacturer		Sauer Danfoss
Type		90R042-KA-57
System		Axial piston - swash plate
Max. displacement	cm^3/rev	42
Max. flow capacity	l/min	176
Maximum pressure	bar	400 - 430
Charge pressure	bar	24 - 26
Pumps for screw drive		
Manufacturer		Sauer Danfoss
Type		PRRR 38/33 S SC47
System		Gear pump
Maximum displacement	cm^3/rev	38
Maximum pressure	bar	190 - 220
Pumps for scraper belt drive		
Manufacturer		Sauer Danfoss
Type		PRRR 38/33 S SC47
System		Gear pump
Maximum displacement	cm^3/rev	38
Maximum pressure	bar	180 - 210
Pump for vibration drive		
Manufacturer		Sauer Danfoss
Type		PRRR 26/26 S SC47
System		Gear pump
Maximum displacement	cm^3/rev	26.2
Maximum pressure (measured on main screed)	bar	105 - 130
Maximum pressure (measured on mobile sections)	bar	90 - 120
Pump for tamper drive		
Manufacturer		Sauer Danfoss
Type		PRRR 26/26 S SC47
System		Gear pump
Maximum displacement	cm^3/rev	26.2
Maximum pressure (measured on main screed)	bar	190 - 220
Maximum pressure (measured on mobile sections)	bar	140 - 170
Service pump		
Manufacturer		Sauer Danfoss

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Type		PRRR 38/33 S SC47
System		Gear pump
Maximum displacement	cm^3/rev	38
Maximum pressure	bar	195 - 205
Test pressure hopper wings	bar	135 - 145
Test pressure screed up	bar	190 - 200
Test pressure screw block up	bar	135 - 145
HYDRAULIC MOTORS		
Travel motors		
Manufacturer		Sauer Danfoss
Type		51C060
Quantity		2
System		Axial piston – swash plate
Max. displacement.	cm^3/rev	60
Tamper motors		
Manufacturer		Sauer Danfoss
Type		SNM2/17 SC02
System		Gear motor
Maximum displacement	cm^3/rev	16.8
Lower test speed (main and mobile screeds)	rpm	200 - 400
Upper test speed (main and mobile screeds)	rpm	1650 - 1850
Vibration motors		
Manufacturer		Sauer Danfoss
Type		BF 8 with HS 500
System		Gear motor
Maximum displacement	cm^3/rev	8.4
Lower test speed (main and mobile screeds)	rpm	400 - 600
Upper test speed (main and mobile screeds)	rpm	3350 - 3650
Auger motors		
Manufacturer		Sauer Danfoss
Type		OMT 500
System		Orbital motor
Max. displacement.	cm^3/rev	500
Test speed	rpm	85 - 91
Scraper belt motor		
Manufacturer		Sauer Danfoss
Type		OMT 400
System		Orbital motor
Max. displacement.	cm^3/rev	400
Test speed	rpm	73 - 77
Fan motor		
Manufacturer		Haldex
Type		WM09
System		Gear motor
Displacement	cm^3/U	14.4

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GEARBOX		
Travel gear		
Manufacturer		Bonfiglioli
Type		710 C3B
System		Planetary gear with integrated brake
Reduction ratio		1:105.7
Quantity		2
Maximum torque	Nm	36000
Maximum input speed	rpm	3500
Brake: Brake torque	Nm	250-600
Brake releasing pressure	bar	10 - 20

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The following noise and vibration data acc. to

- EC Machine Regulation edition 2006/42/EC

- the noise regulation 2000/14/EG, noise protection guideline 2003/10/EC

- Vibration Protection Regulation 2002/44/EC

were determined during conditions typical for this type of equipment and by application of harmonized standards.

During operation these values may vary because of the existing operating conditions.

Noise value

Sound pressure level on the place of the operator:

L_{pA} = 83 dB(A), determined acc. to ISO 11204 and EN 500

Guaranteed sound power level:

L_{WA} = 107 dB(A), determined acc. to ISO 3744 and EN 500

⚠ Danger

Wear your personal noise protection means (ear defenders) before starting operation.

Vibration value

Vibration of the entire body (driver's seat)

The weighted effective acceleration value determined according to ISO 7096 is ≤ 0.5 m/s^2.

Hand-arm vibration values

The weighted effective acceleration value determined according to EN 500/ISO 5349 is ≤ 2.5 m/s^2.

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3 Maintenance

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3.1 General notes on maintenance

When performing maintenance work always comply with the appropriate safety regulations.

Thorough maintenance of the machine guarantees far longer safe functioning of the machine and prolongs the lifetime of important components. The effort needed for this work is only little compared with the problems that may arise when not observing this rule.

The terms right/left correspond with travel direction forward.

- Always clean machine and engine thoroughly before starting maintenance work.
- For maintenance work stand the machine on level ground.
- Always remove the main battery switch for all maintenance work.
- Perform maintenance work only with the engine shut down.
- Relieve hydraulic pressures before working on hydraulic lines.
- Before working on electric parts of the machine disconnect the battery and cover it with insulation material.

Environment

During maintenance work catch all oils and fuels and do not let them seep into the ground or into the sewage system. Dispose of oils and fuels environmentally.

Keep used filters in a separate waste container and dispose of environmentally.

Catch biodegradable oils separately.

Notes on the fuel system

The lifetime of the diesel engine depends to a great extent on the cleanliness of the fuel.

- Keep fuel free of contaminants and water, since this will damage the injection elements of the engine.
- Drums with inside zinc lining are not suitable to store fuel.
- When choosing the storage place for fuel make sure that spilled fuel will not harm the environment.
- Do not let the hose stir up the slurry at the bottom of the drum.
- The fuel drum must rest for a longer period of time before drawing off fuel.
- The rest in the drum is not suitable for the engine and should only be used for cleaning purposes.

Notes on the performance of the engine

On diesel engines both combustion air and fuel injection quantities are thoroughly adapted to each other and determine power, temperature level and exhaust gas quality of the engine.

If your engine has to work permanently in "thin air" (at higher altitudes) and under full load, you should consult the customer service of BOMAG or the customer service of the engine manufacturer.

Notes on the cooling system

Prepare and check coolant with highest care, since otherwise the engine may be damaged by corrosion, cavitation and freezing.

The coolant is prepared by mixing a cooling system protection agent (ethylene glycol) into the coolant.

Mixing with cooling system protection agent is necessary in all climatic zones. It prevents corrosion, lowers the freezing point and raises the boiling point of the coolant.

Notes on the hydraulic system

During maintenance work on the hydraulic system cleanliness is of major importance. Make sure that no dirt or other contaminating substances can enter into the system. Small particles can produce flutes in valves, cause pumps to seize, clog nozzles and pilot bores, thereby making expensive repairs inevitable.

- If, during the daily inspection of the oil level the hydraulic oil level is found to have dropped, check all lines, hoses and components for leaks.
- Seal external leaks immediately. If necessary inform the responsible customer service.
- Do not store drums with hydraulic oil outdoors, or at least under a cover. Water can be drawn in through the bunghole when the weather changes.
- We recommend to use our filling and filtering unit with fine filter to fill the system. This ensures finest filtration of the hydraulic oil, prolongs the lifetime of the hydraulic oil filter and protects the hydraulic system.
- Clean fittings, filler covers and the area around such parts before disassembly to avoid entering of dirt.
- Do not leave the tank opening unnecessarily open, but cover it so that nothing can fall in.

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3.2 Fuels and lubricants

Engine oil

General

Modern diesel engines put high demands on the lubrication oil used. The engine powers that have continuously increased over the past few years lead to higher thermal loads for the lubrication oil. Apart from that, the lubrication oil is additionally loaded by contamination because of the reduced lubrication oil consumption and the prolonged lubrication oil change intervals.

For this reason it is necessary to follow the requirements and recommendations in these operating instructions in order not to reduce the lifetime of the engine.

Engine oils of the same specification can generally be mixed among each other. However, mixing of engine oil should be avoided, because the poorest characteristics of a mixture will always prevail.

The use of additives for lubrication oils is not permitted.

The lubrication oil quality has a considerable influence on the lifetime, performance and thus the economy of the engine. The following is generally valid: the better the lubrication oil quality, the better its properties.

Quality

For use in DEUTZ engines the lubrication oils are classified in DEUTZ Lubrication Oil Quality Classes (DQC).

The following lubrication oils have been approved for the engine described in these operating instructions:

Approved engine oils			
Deutz	ACEA*	API**	DHD
DQC II-05 or DQC II-10	E3-96, E5-02, E7-08, E4-07, E6-04, E9-08	CG-4, CH-4, CI-4, CI-4 Plus, CJ-4	DHD-1
DQC III-05 or DQC III-10	-	-	-
DQC IV-05 or DQC IV-10	-	-	-

* Association des Constructeurs European d'Automobiles
** American Petroleum Institute

The list of approved lubrication oils is also available in the Internet under the following address:

www.deutz.com	
de	SERVICE \ Betriebsstoffe und Additive \ Deutz Quality Class \ DQC-Freigabeliste
en	SERVICE \ Operating Liquids and Additives \ Deutz Quality Class \ DQC Release List

Consult your local service station if in doubt.

- Use winter grade engine oil for winter operation!

Oil viscosity

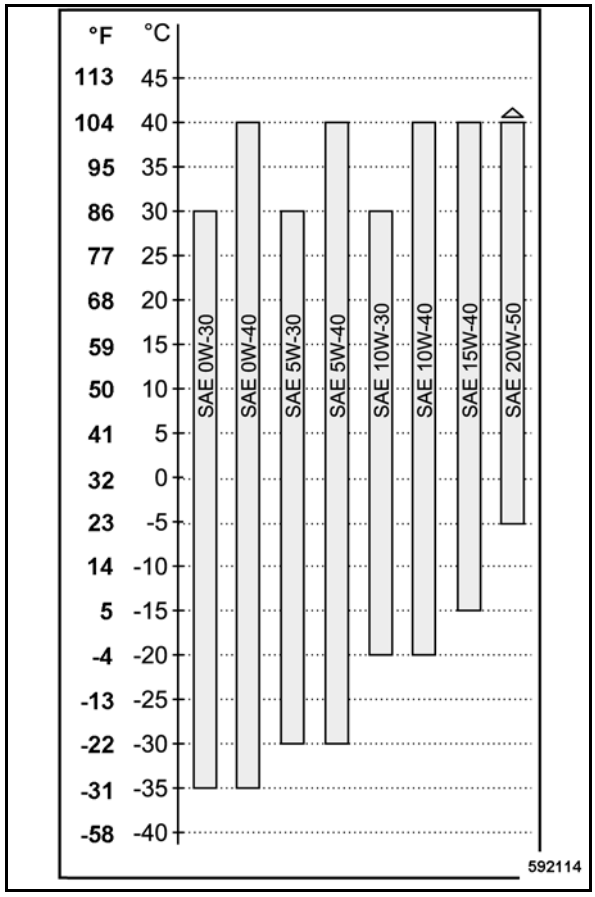


Fig. 15

Since lubrication oil changes its viscosity with the temperature, the ambient temperature at the operating location of the engine is of utmost importance when choosing the viscosity class (SAE-class) .

Multi-purpose oils should generally be used.

Too high viscosity can cause starting difficulties, too low ´viscosity can jeopardize the lubrication effect and result in a high lubrication oil consumption.

Optimal operating conditions can be achieved by using the oil viscosity chart (Fig. 15) as a reference.

At ambient temperatures below -40°C the lubrication oil must be pre-heated (e.g. by parking the machine indoors).

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Oil change intervals

The longest permissible time a lubrication oil should remain in an engine is 1 year. If the following oil change intervals are not reached over a period of 1 year, the oil change should be performed at least once per year, irrespective of the operating hours reached.

DQC II, DQC III, DQC IV: 500 operating hours

⚠ Caution

When using fuels with a sulphur content of more than 0,5% to 1% or under permanent ambient temperatures below -10°C and when using biodegradable diesel fuel the oil change intervals must be halved.

Fuels

You should only use commercially available brand diesel fuel with a sulphur content of less than 0.5% and ensure strict cleanliness when filling in. A higher sulphur content has a negative effect on the oil change intervals.

The fuel level should always be topped up in due time so that the fuel tank is never run dry, as otherwise filter and injection lines need to be bled.

Quality

The following fuel specifications are permitted:

- EN 590
- DIN 51628
- ASTM D975 Grade-No. 1-D and 2-D.
- JIS K 2204 Grade Fuel 1 and Grade Fuel 2 with lubrication properties acc. to EN 590

Winter fuel

For winter operation use only winter diesel fuel, to avoid clogging because of paraffin separation. Diesel fuels suitable for temperatures down to -44 °C are available for Arctic climates. At very low temperatures disturbing paraffin separation can also be expected when using winter diesel fuel.

The admixture of petroleum and the addition of "flow enhancing additives" (fuel additives) is not permitted.

Coolant

For fluid cooled engines the cooling fluid must be prepared by admixing a cooling system protection agent to the fresh water and should be checked within the specified maintenance intervals.

This prevents damage caused by corrosion, cavitation, freezing and overheating.

Water quality

The correct quality of water is highly important when preparing coolant. Clear and clean water within the boundaries of the following analysis values should generally be used.

Analysis values		**ASTM**
pH-value at 20 °C (68 °F)	6.5 - 8.5	D 1293
Chlorine (Cl) (mg/l) (ppm)	max. 100	D 512 D 4327
Sulphate (SO_4 (mg/l) (ppm)	max. 100	D 516
Total hardness ($CaCO_3$) (mmol/l) (mg/l) (ppm)]	 max. 3.56 max. 356	D 1126
corresponds with a content of $CaCO_3$ (mg/l) (ppm)	max. 356	
- German degree (°dH)]	max. 20	
- English degree (°eH)]	max. 25	
- French degree (°fH)]	max. 36.5	

Information concerning the water quality can be obtained from the waterworks.

If the fresh water analysis values are unknown, these must be determined with the help of a water analysis.

If the values of the analysis deviate, the water must be treated accordingly.

- pH-value too low
  Adding of caustic lye of soda or caustic potash solution.
- Water hardness too high:
  Mix with soft, distilled or fully demineralized water
- Chlorides and/or sulphates too high:
  Mix with soft, distilled or fully demineralized water
- Total hardness or carbonate hardness too low:
  Mix with hardened water (harder water is in most cases available in the form of drinking water).

⚠ Caution

Another analysis must be made after the fresh water has been prepared.

Cooling system protection agent

As a protection against frost, corrosion and boiling point anti-freeze agents must be used under any climatic conditions.

Coolant is prepared by adding an ethylene-glycol based anti-freeze agent with corrosion inhibiting properties to the cooling water.

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We therefore highly recommend our BOMAG cooling system protection agent.

If our cooling system protection agent is not available for any important reasons, you may, in exceptional cases, use products that have been approved by the engine manufacturer.

The list of approved cooling system protection agents is also available in the Internet under the following address:

www.deutz.com	
de	SERVICE Betriebsstoffe und Additive DeutzQualityClass DQC-Freigabeliste
en	SERVICE \ Operating Liquids and Additives \ Cooling System Conditioner

Products of the same product group (see Deutz Technical Circular Cooling System Protection Agents) can be mixed with each other.

The BOMAG cooling system protection agent corresponds with product group A.

⚠ Caution

Do not mix different coolants and additives of any other kind.

Before changing the product you must clean the entire cooling system.

Consult your local service station if in doubt.

To ensure proper corrosion protection you must use the cooling system protection agent all year around, whereby the following concentration must not be fallen short of or exceeded.

Mixing ratio		
Cooling system protection agent	**Fresh water**	**Cold protection down to**
min. 35%	65%	-22 °C (-8 °F)
40%	60%	-28 °C (-18 °F)
45%	55%	-35 °C (-31 °F)
max. 50%	50%	-41 °C (-42 °F)

⚠ Caution

A proportion of more than 50% of cooling system protection agent causes a drop in cooling power.

The use of corrosion protection oils as cooling system protection agents is not permitted.

i Note

When working at temperature below -41 °C(-42 °F) you should consult our local service representative.

Environment

Coolant must be disposed of environmentally.

Mineral oil based hydraulic oil

The hydraulic system is operated with hydraulic oil HV 46 (ISO) with a kinematic viscosity of 46 mm^2/s at 40 °C and 8 mm^2/s at 100 °C. For topping up or for oil changes use only high-quality hydraulic oil, type HVLP according to DIN 51524, part 3, or hydraulic oils type HV according to ISO 6743/3. The viscosity index (VI) should be at least 150 (observe information of manufacturer).

Bio-degradable hydraulic oil

The hydraulic system can also be operated with a synthetic ester based biodegradable hydraulic oil.

The biologically quickly degradable hydraulic oil Panolin HLP Synth.46 meets all demands of a mineral oil based hydraulic oil according to DIN 51524.

In hydraulic systems filled with Panolin HLP Synth.46 always use the same oil to top up.

When changing from mineral oil based hydraulic oil to an ester based biologically degradable oil, you should consult the lubrication oil service of the oil manufacturer for details.

⚠ Caution

Check the filter more frequently after this change.

Perform regular oil analyses for content of water and mineral oil.

Replace the hydraulic oil filter element every 500 operating hours.

Gear oil

For the gearboxes use only ,ulti-purpose gear oils ISO VG 220 of API-GL5-class with a minimum viscosity of 20 mm^2/s at 100 °C.

This is a hypoid lubricant of highest quality class for extremely loaded transmissions.

The additives in this oil ensure low wear lubrication under all operating conditions.

Lubrication grease

For lubrication purposes use an EP-high pressure grease, lithium saponified (penetration 2), acc. to DIN 51502 KP 2G.

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3.3 Table of fuels and lubricants

Assembly	Fuel or lubricant		Quantity
	Summer	Winter	Attention Observe the level marks
Motor			
- Engine oil	ACEA: E3-96, E5-02, E7-08, E4-07, E6-08, E9-08 API: CG-4, CH-4, CI-4, CI-4 Plus, CJ-4 SAE 10W-40 (-15 °C to +40 °C) (BOMAG 009 920 06; 20 l) SAE 15W-40 (-5 °C to +40 °C) SAE 5W-40 (-30 °C to +40 °C)		approx. 15 litres
- Fuel	Diesel	Winter diesel fuel	approx. 215 litres
- Coolant	Mixture of water and anti-freeze agent (see "Fuels and Lubricants - Colant")		approx. 20 litres
Hydraulic system	Hydraulic oil (ISO), HLP 46 (BOMAG PN 009 930 09; 20 l) or ester based biodegradable hydraulic oil		approx. 160 litres
Crawler track drive gear	SAE 80W-140, API GL-5 (BOMAG 009 925 07; 20 l)		2 x approx. 3,2 litres
Lubrication points, general	High pressure grease (lithium saponified)		as required

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3.4 Running-in instructions

The following maintenance work must be performed when running in new machines or overhauled engines:

⚠ Caution

Up to approx. 250 operating hours check the engine oil level twice every day.

Depending on the load the engine is subjected to, the oil consumption will drop to the normal level after approx. 100 to 250 operating hours.

After a running-in time of 30 minutes

- Retighten the V-belt

After 50 operating hours

- Track pads for tight fit

After 250 operating hours

- Tighten all bolted connections on air intake, exhaust, oil sump and engine mounts
- Retighten the bolted connections on the machine.
- Change engine oil and oil filter cartridge.
- Track drive wheel hubs, oil change

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3.5 Maintenance table

No.	Maintenance work	Comment	every 10 operating hours, daily	every 250 oper. hours	every 500 oper. hours	every 1000 oper. hours	every 2000 oper. hours	every 6000 oper. hours	as required
5.6	Check the engine oil level	Dipstick mark	X						
5.7	Check the fuel level	Instrument cluster	X						
5.8	Check the hydraulic oil level	Inspection glass	X						
5.9	Check the coolant level	Inspection glass	X						
5.10	Lubricate the machine		X						
5.11	Service the scraper belt			X					
5.12	Service the auger			X					
5.13	Grease the screed extension sliding surface			X					
5.14	Lubricate the machine			X					
5.15	Check the central lubrication system, top up			X					
5.16	Clean the cooling fins on engine and hydraulic oil cooler			X					
5.17	Check the oil level in track drive gear			X					
5.18	Service the battery, check the battery main switch	pole grease		X					
5.19	Checking the condition and tension of the screed heating generator V-belt, tensioning and if necessary replacing the V-belt			X					
5.20	Change engine oil and oil filter cartridge*	min. 1x per year see foot note			X				
5.21	Check, tension, replace the V-belt				X				
5.22	Drain the fuel tank sludge				X				
5.23	Check, adjust tamper bar and floor plates				X				
5.24	Checking track, track drive				X				
5.25	Replace the fuel filter					X			
5.26	Change the fuel filter, bleed the fuel system					X			

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No.	Maintenance work	Comment	every 10 operating hours, daily	every 250 oper. hours	every 500 oper. hours	every 1000 oper. hours	every 2000 oper. hours	every 6000 oper. hours	as required
5.27	Check the engine mounts					X			
5.28	Changing hydraulic oil and hydraulic oil filter**	at least every 2 years see foot note				X			
5.29	Track drive wheel hubs, oil change***	min. 1x per year see foot note				X			
5.30	Hopper, check scrapers and rubber apron					X			
5.31	Check, adjust the valve clearance	Intake = 90° +10 Exhaust = 150° +10					X		
5.32	Replace the coolant	at least every 2 years					X		
5.33	Replace the injection valve	only by authorized service personnel						X	
5.34	Replace the crank case ventilation valve							X	
5.35	Air filter maintenance	min. 1x per year Safety cartridge at least every 2 years							X
5.36	Check, clean the water separator								X
5.37	Replace heating elements of HS screed								X
5.38	Replace heating elements of HC screed								X
5.39	Preparing the machine for a longer rest								X
5.40	Tightening torques								X

* oil change after 250 and 500 operating hours, then every 500 operating hours

** Also in case of repair in the hydraulic system.

*** oil change after 250 and 1000 operating hours, then every 1000 operating hours

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4 Fundamental electrics

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4.1 Understanding wiring diagrams

Electric circuit diagrams are graphic presentations of control logical conditions in the electric system. They do not contain any information on the type of wiring, their purpose is solely the clarification of control logics.

The wiring diagram is indispensable for effective and systematic trouble shooting in the vehicle wiring system. This plan provides the following information:

- Number and type of individual elements in the examined electric circuit, such as plug connectors, fuses, switches, consumers, relays, ...
- The sequence in which current flows through the individual elements in the electric circuit.
- Connections between the examined, faulty electric circuit and other circuits in the vehicle wiring system.
- Pin assignment of plug-and-socket connections.

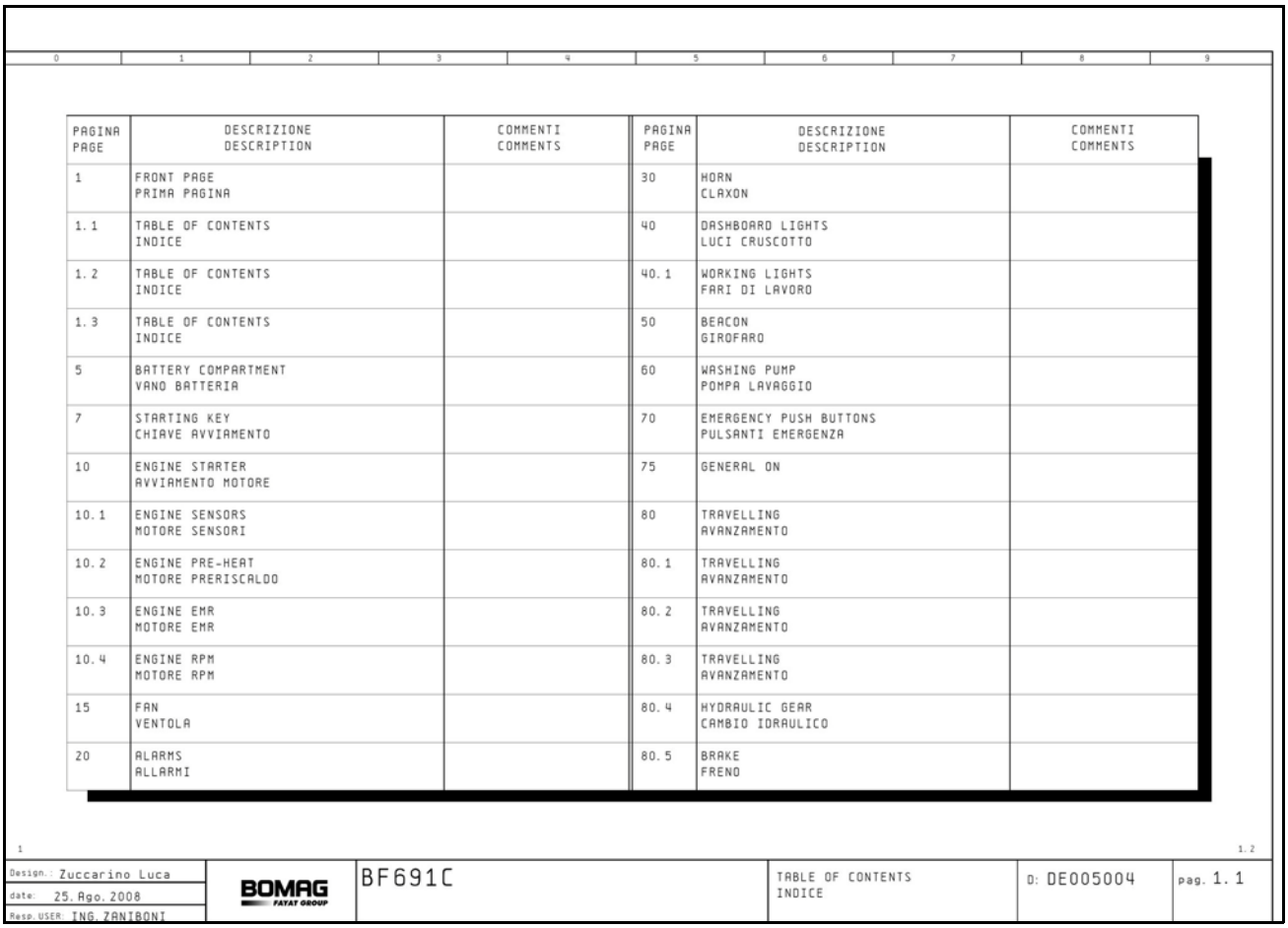
Structure

- Table of contents (Fig. 16)
- Current paths (Fig. 17)
- Function groups (Fig. 18)
- Potential cross references (Fig. 18)
- Relay cross references (Fig. 19)
- List of components (Fig. 20)

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Table of contents (Fig. 16)

The table of contents lists all function groups.



PAGINA PAGE	DESCRIZIONE DESCRIPTION	COMMENTI COMMENTS	PAGINA PAGE	DESCRIZIONE DESCRIPTION	COMMENTI COMMENTS
1	FRONT PAGE PRIMA PAGINA		30	HORN CLAXON	
1.1	TABLE OF CONTENTS INDICE		40	DASHBOARD LIGHTS LUCI CRUSCOTTO	
1.2	TABLE OF CONTENTS INDICE		40.1	WORKING LIGHTS FARI DI LAVORO	
1.3	TABLE OF CONTENTS INDICE		50	BEACON GIROFARO	
5	BATTERY COMPARTMENT VANO BATTERIA		60	WASHING PUMP POMPA LAVAGGIO	
7	STARTING KEY CHIAVE AVVIAMENTO		70	EMERGENCY PUSH BUTTONS PULSANTI EMERGENZA	
10	ENGINE STARTER AVVIAMENTO MOTORE		75	GENERAL ON	
10.1	ENGINE SENSORS MOTORE SENSORI		80	TRAVELLING AVANZAMENTO	
10.2	ENGINE PRE-HEAT MOTORE PRERISCALDO		80.1	TRAVELLING AVANZAMENTO	
10.3	ENGINE EMR MOTORE EMR		80.2	TRAVELLING AVANZAMENTO	
10.4	ENGINE RPM MOTORE RPM		80.3	TRAVELLING AVANZAMENTO	
15	FAN VENTOLA		80.4	HYDRAULIC GEAR CAMBIO IDRAULICO	
20	ALARMS ALLARMI		80.5	BRAKE FRENO	

Fig. 16 Table of contents

Example:

The function group "ENGINE SENSORS/MOTORE SENSORI" can be found on sheet no. 10.1 (PAGINA/ PAGE).

Current paths (Fig. 17)

The pages of a circuit diagram are sub-divided into current paths (Fig. 17) (0 ..... 9).

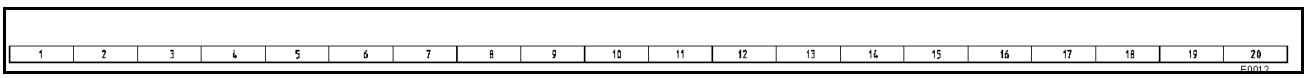


Fig. 17 Current paths

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Function groups

On the individual pages the electric circuits are combined to function groups.

Arrangement of current paths

The individual current paths must be read as follows:

- From top (plus potential) to bottom (minus potential),
- from left to right,
- From function group to function group and
- via cross references for potentials and relays.

Potential cross references (Fig. 18)

Potential cross references serve the purpose of tracking signals, which are transmitted from one function group to another.

Example:

Potential "GEN-ON /80.4.2" on sheet no. 80.3 is continued on sheet no. 80.4 in current path "2" (see arrow).

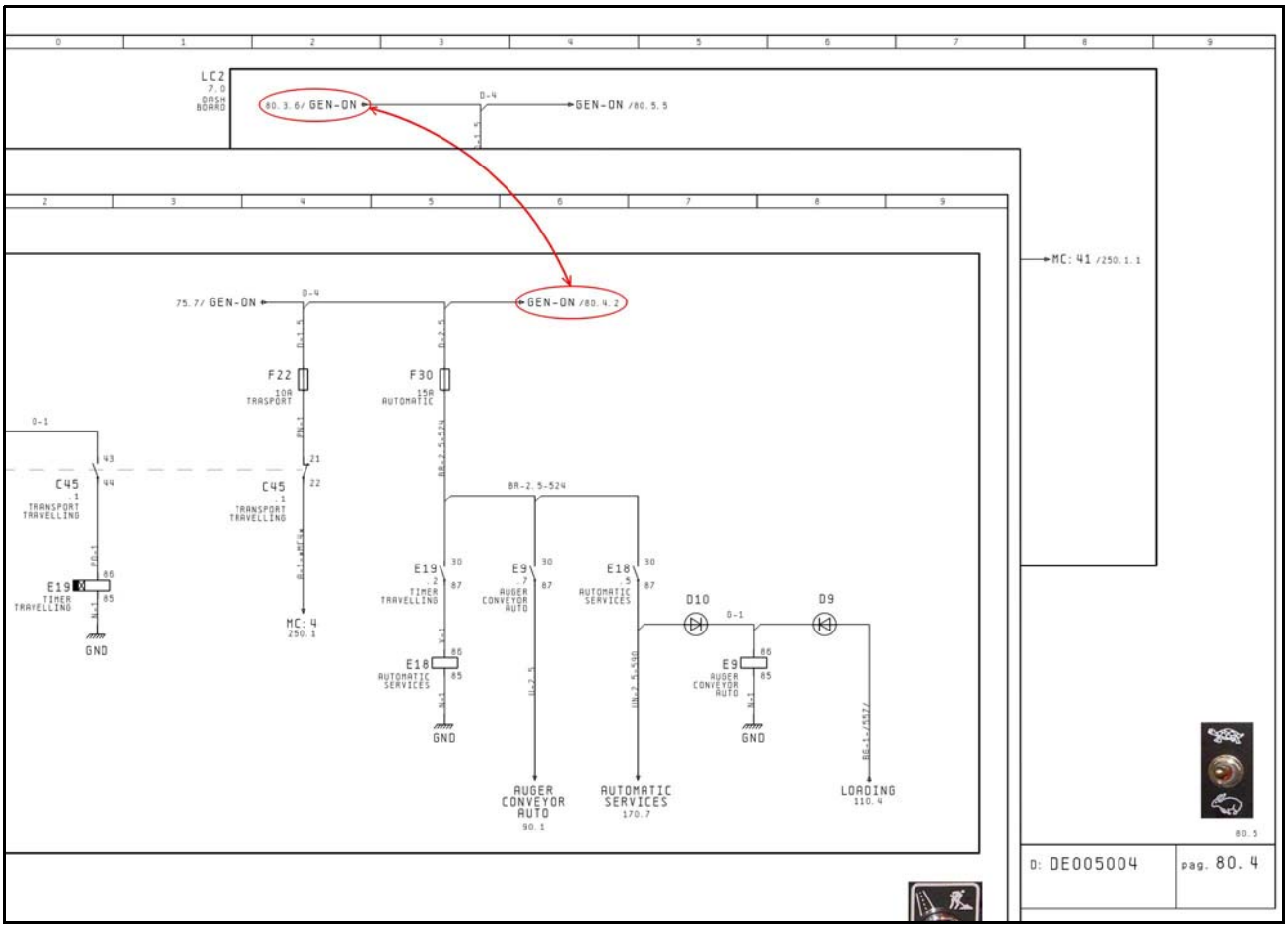


Fig. 18 Potential cross reference

Relay cross references (Fig. 19)

Relay cross references serve the tracking of signals, which need to be tracked for components with outgoing contacts.

Apart from this there is a contact plan under each contactor coil providing information about the contact types of a relay and where these appear in the wiring diagram.

Example:

The coil of relay (E1) is located on page no. 7 in current path "8".

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The contact pictogram under coil (E1) that a normally open contact with terminals 30 and 87 in current path 8 is triggered.

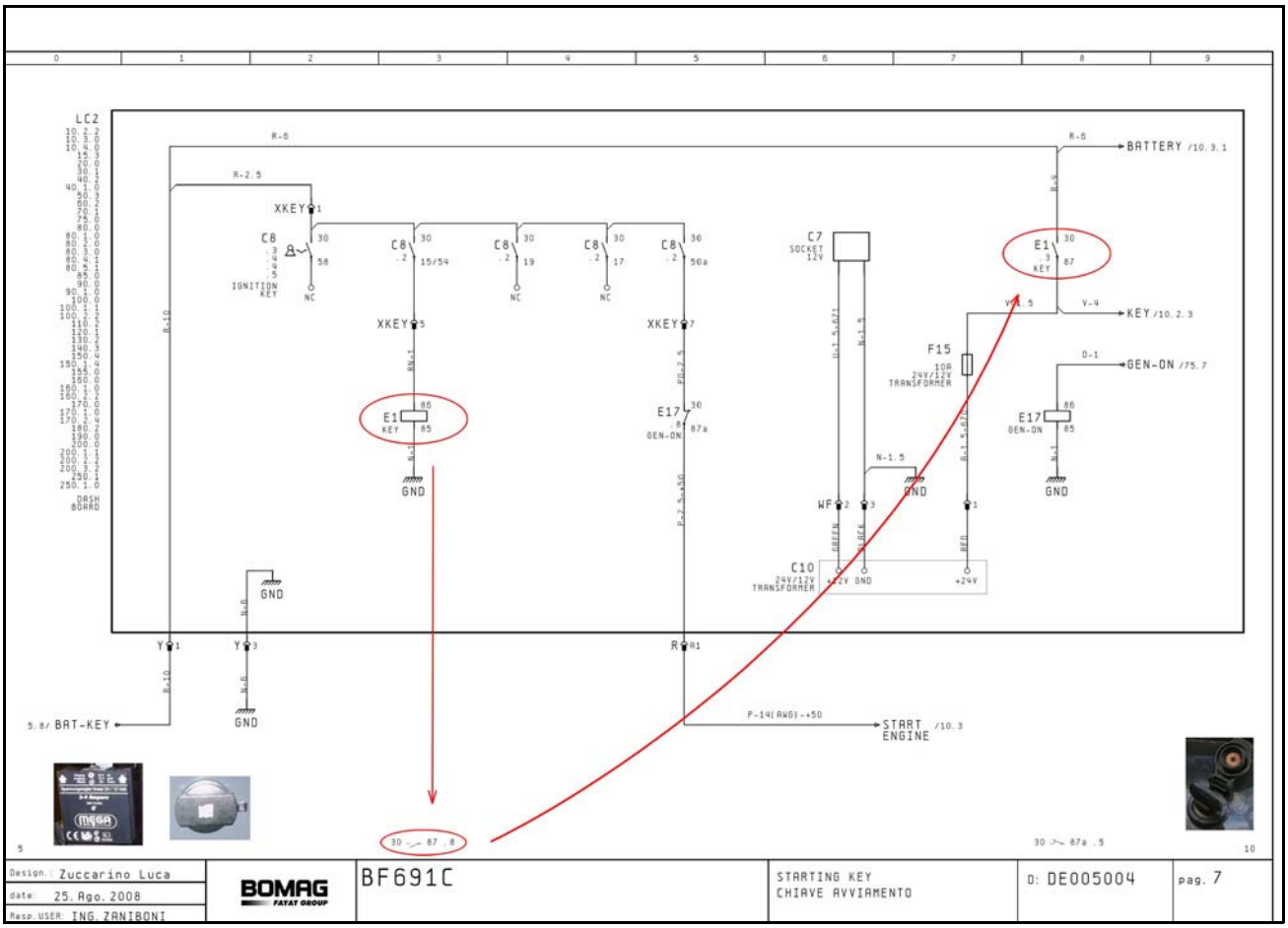
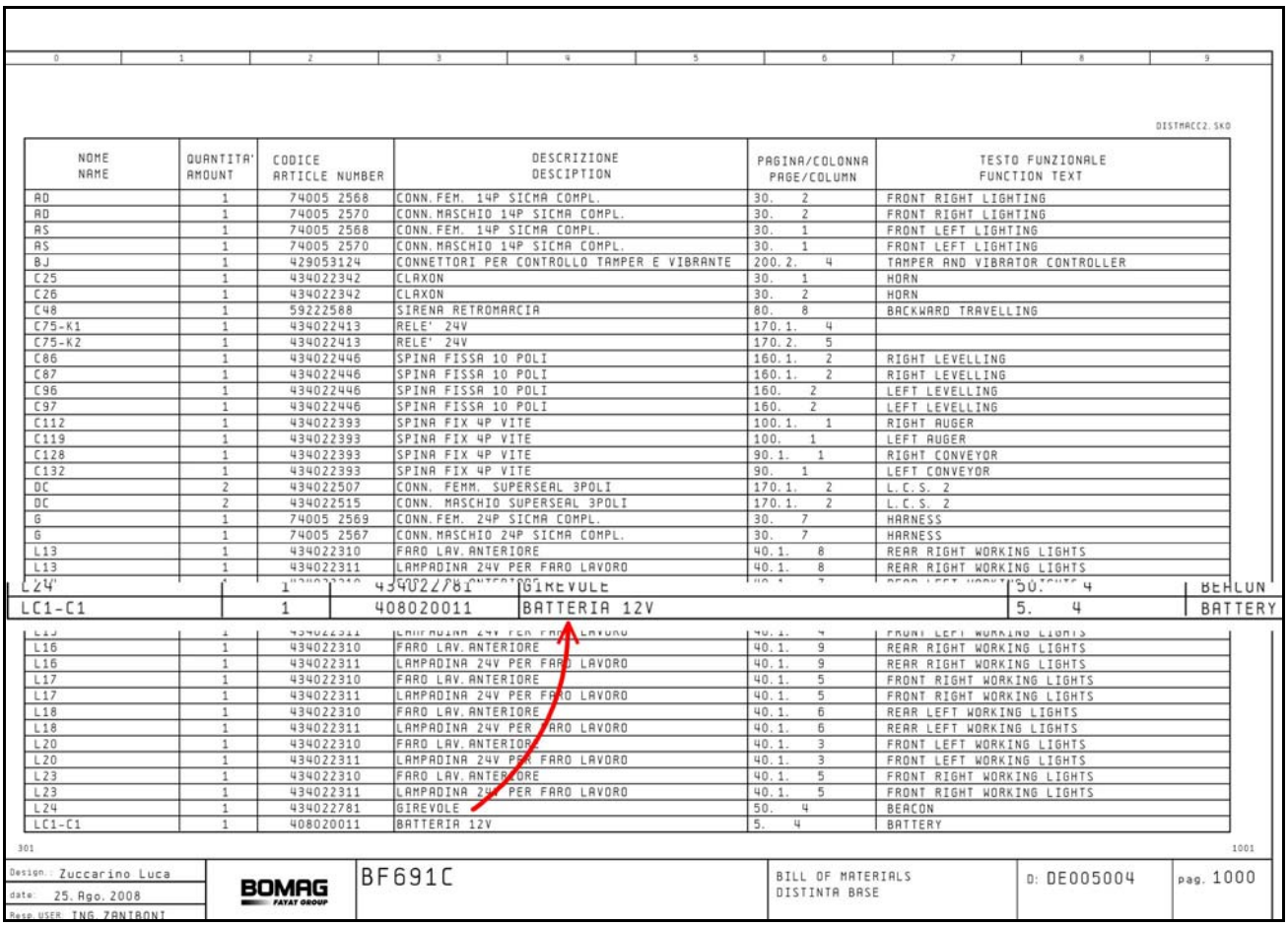


Fig. 19 Relay cross-reference

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List of components (Fig. 20)

This list contains all components used in alphabetical order, related to their component abbreviation (NAME) (AD, AS, BJ,...).



DISTMACC2.SKD

NOME NAME	QUANTITA' AMOUNT	CODICE ARTICLE NUMBER	DESCRIZIONE DESCIPTION	PAGINA/COLONNA PAGE/COLUMN	TESTO FUNZIONALE FUNCTION TEXT
AD	1	74005 2568	CONN.FEM. 14P SICMA COMPL.	30. 2	FRONT RIGHT LIGHTING
AD	1	74005 2570	CONN.MASCHIO 14P SICMA COMPL.	30. 2	FRONT RIGHT LIGHTING
AS	1	74005 2568	CONN.FEM. 14P SICMA COMPL.	30. 1	FRONT LEFT LIGHTING
AS	1	74005 2570	CONN.MASCHIO 14P SICMA COMPL.	30. 1	FRONT LEFT LIGHTING
BJ	1	429053124	CONNETTORI PER CONTROLLO TAMPER E VIBRANTE	200.2. 4	TAMPER AND VIBRATOR CONTROLLER
C25	1	434022342	CLAXON	30. 1	HORN
C26	1	434022342	CLAXON	30. 2	HORN
C48	1	59222588	SIRENA RETROMARCIA	80. 8	BACKWARD TRAVELLING
C75-K1	1	434022413	RELE' 24V	170.1. 4	
C75-K2	1	434022413	RELE' 24V	170.2. 5	
C86	1	434022446	SPINA FISSA 10 POLI	160.1. 2	RIGHT LEVELLING
C87	1	434022446	SPINA FISSA 10 POLI	160.1. 2	RIGHT LEVELLING
C96	1	434022446	SPINA FISSA 10 POLI	160. 2	LEFT LEVELLING
C97	1	434022446	SPINA FISSA 10 POLI	160. 2	LEFT LEVELLING
C112	1	434022393	SPINA FIX 4P VITE	100.1. 1	RIGHT AUGER
C119	1	434022393	SPINA FIX 4P VITE	100. 1	LEFT AUGER
C128	1	434022393	SPINA FIX 4P VITE	90.1. 1	RIGHT CONVEYOR
C132	1	434022393	SPINA FIX 4P VITE	90. 1	LEFT CONVEYOR
DC	2	434022507	CONN. FEMM. SUPERSEAL 3POLI	170.1. 2	L.C.S. 2
DC	2	434022515	CONN. MASCHIO SUPERSEAL 3POLI	170.1. 2	L.C.S. 2
G	1	74005 2569	CONN.FEM. 24P SICMA COMPL.	30. 7	HARNESS
G	1	74005 2567	CONN.MASCHIO 24P SICMA COMPL.	30. 7	HARNESS
L13	1	434022310	FARO LAV.ANTERIORE	40.1. 8	REAR RIGHT WORKING LIGHTS
L13	1	434022311	LAMPADINA 24V PER FARO LAVORO	40.1. 8	REAR RIGHT WORKING LIGHTS
L24	1	434022781	GIREVOLE	50. 4	BEACON
LC1-C1	1	408020011	BATTERIA 12V	5. 4	BATTERY
L16	1	434022310	FARO LAV.ANTERIORE	40.1. 9	REAR RIGHT WORKING LIGHTS
L16	1	434022311	LAMPADINA 24V PER FARO LAVORO	40.1. 9	REAR RIGHT WORKING LIGHTS
L17	1	434022310	FARO LAV.ANTERIORE	40.1. 5	FRONT RIGHT WORKING LIGHTS
L17	1	434022311	LAMPADINA 24V PER FARO LAVORO	40.1. 5	FRONT RIGHT WORKING LIGHTS
L18	1	434022310	FARO LAV.ANTERIORE	40.1. 6	REAR LEFT WORKING LIGHTS
L18	1	434022311	LAMPADINA 24V PER FARO LAVORO	40.1. 6	REAR LEFT WORKING LIGHTS
L20	1	434022310	FARO LAV.ANTERIORE	40.1. 3	FRONT LEFT WORKING LIGHTS
L20	1	434022311	LAMPADINA 24V PER FARO LAVORO	40.1. 3	FRONT LEFT WORKING LIGHTS
L23	1	434022310	FARO LAV.ANTERIORE	40.1. 5	FRONT RIGHT WORKING LIGHTS
L23	1	434022311	LAMPADINA 24V PER FARO LAVORO	40.1. 5	FRONT RIGHT WORKING LIGHTS
L24	1	434022781	GIREVOLE	50. 4	BEACON
LC1-C1	1	408020011	BATTERIA 12V	5. 4	BATTERY

301 1001

Design.: Zuccarino Luca
date: 25. Ago. 2008
Resp.USER: ING. ZANIBONI

BOMAG FAYAT GROUP

BF691C

BILL OF MATERIALS
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D: DE005004

pag. 1000

Fig. 20 List of components

Component cross references

Example:

In the circuit diagram the battery (BATTERIA 12V) "LC1-C1" is located on sheet no. 5 in current path 4.

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4.2 Circuit symbols in the circuit diagram

Circuit symbol

- Circuit symbols are standardized representations for electrical appliances. They serve the purpose of a simplified representation of complete systems, from which, however, the function can be clearly identified. This standardization is in compliance with the globally valid regulations of the IEC (International Electrical Commission). The standardization serves the purpose of global understanding and fault free connection of appliances, especially in automobile repairs. Since the wiring diagram is intended to show only the most essential aspects, the circuit symbol only shows as much of the function, as is needed for easy recognition and for the avoidance of mistakes.

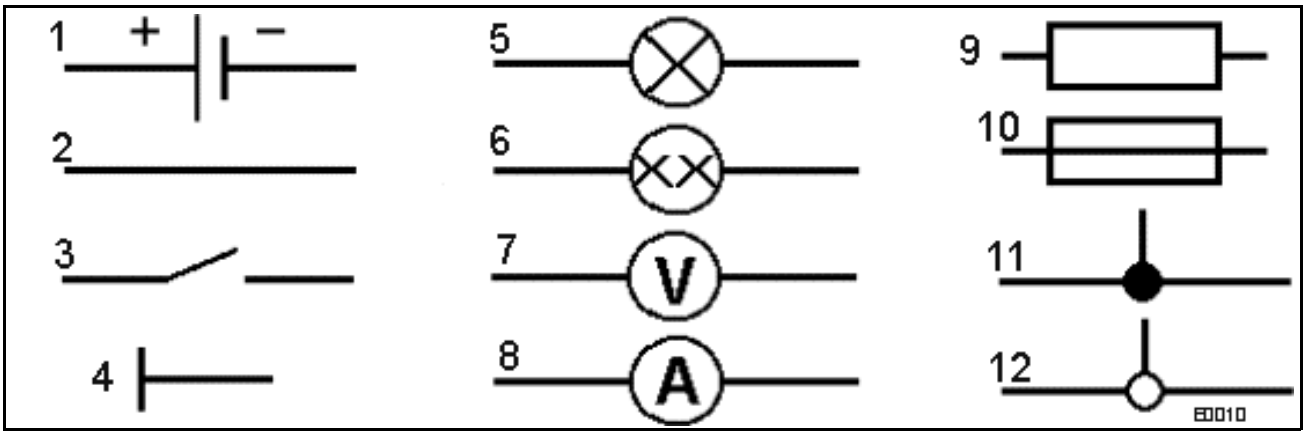


Fig. 1 Example: Circuit symbol

1 Current source
2 Conductor
3 Switch
4 Ground
5 Filament lamp
6 Filament lamp with two luminous elements
7 Voltmeter
8 Amperemeter
9 Resistance
10 Backup
11 Line connection (fixed)
12 Line connection (separable)

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4.3 Battery ground and analog ground

GND, battery ground

The term "ground" (abbreviated GND) describes a conductive body which is normally defined with the potential of "Zero" Volt and represents the reference potential for operating voltages.

The positive pole of the supply voltage (symbol +) and all other electric voltages and electical signals in an electrical circuitry refer to the ground potential.

On motor vehicles and also on motorbikes and bicycles the ground potential is represented by the chassis or the frame. As a conductive part, which covers the entire vehicle, it also serves a return conductor for the vehicle wiring system - the consumers only need to be wired up.

Terminal designation for GND = terminale 31

AGND, analog ground

Apart from the "normal" battery ground there is also the analog ground, which is solely reserved for sensors.

4.4 Processor signals

Signals

Analog signals

Process states are continuous (analog) when they can be mapped by means of a real number, e.g. temperature = 65.5 °C. The sensor converts a continuous process status into an analog signal. If the control unit needs the numerical value of the analog signal, an analog-digital conversion is required.

Analog signals are needed to control, display or monitor limit values. Checking the limit values of physical quantities leads to the binary information: Limit value reached/not reached.

Binary signals

Process states are bivalent (binary) if they have only 2 possible states of truth, such as e.g. button pressed/ not pressed, object present/not present. The two states of truth are mapped by means of defined states of an information carrier, e.g. not-pressed'equals0V,'pressed'equals24V.Thesestate-saredescribedwith{0,1}or{false,true}'

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4.5 Current and voltage

General

If one wants to describe electric current, this can most simply be accomplished by means of a comparison:

One simply compares electric current with water.

Voltage

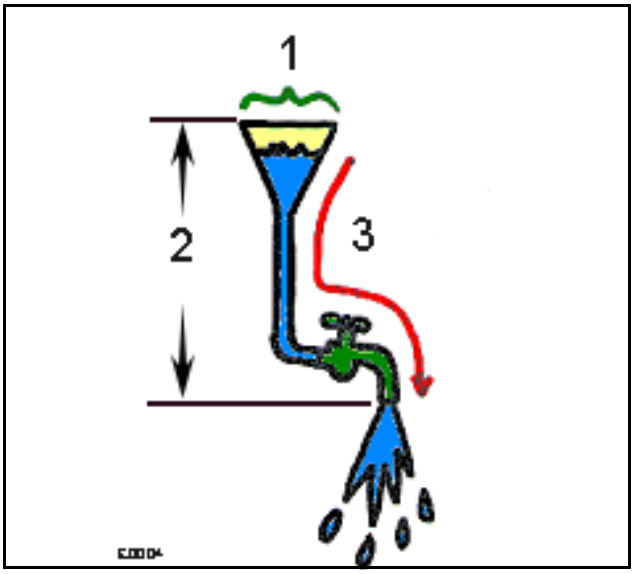


Fig. 1

1 (Fig. 1) Charge

2 Voltage

3 Current

The equalization attempt between different electric charges is referred to as electric voltage.

Voltage sources have two poles of different charge. On the one side we have the plus pole with a lack of electrons, on the opposite side the minus pole with a surplus of electrons. This electric "pressure" is known as electric voltage.

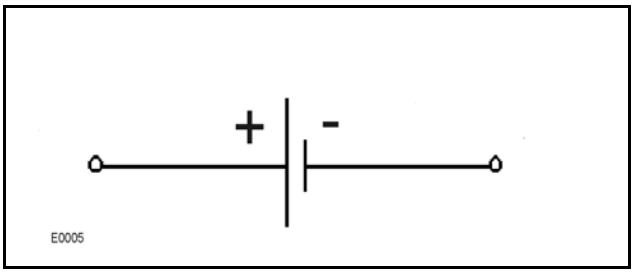


Fig. 2

If there is a connection between these two poles a discharge will take place, resulting in the flow of an electric current.

Plus pole= lack of electrons

Minus pole = excess of electrons

The following statements concerning electric voltage can be made

- electric voltage is the pressure or force applied to free electrons.
- the electric voltage is the cause of electric current
- electric voltage is a result of the equalization attempt of electric charges.

Voltage is measured with a Voltmeter.

Unit, Volt

The electric voltage (U) is measured in Volt (V).

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Current

Electric current generally describes the directed movement of charge carriers.

- The charge carriers may either be electrons or ions.
- Electric current can only flow if there is a sufficient amount of free moving charge carriers.
- The higher the number of electrons flowing through a conductor per second, the higher the amperage.

Current is measured with an ammeter.

Unit, Ampere

The electric amperage (I) is measured in Ampere (A).

The technical flow direction is specified from PLUS to MINUS.

i Note

Current actually flows from minus to plus, because the current flow is made up of negatively charged electrons.

But since this was only discovered after the poles of a current source had already been designated, the assumption that current flows from plus to minus was maintained for historic reasons.

Circuit

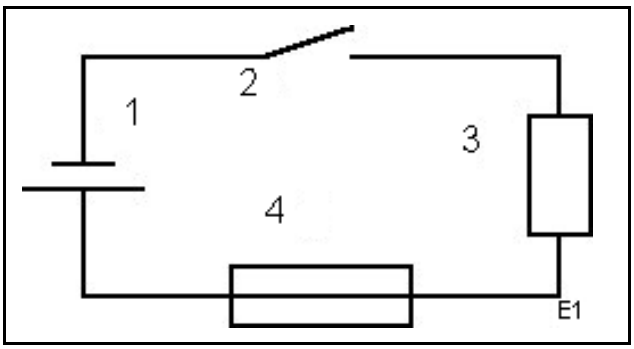


Fig. 3 Circuit

A simple circuit consists of a current source 1 (Fig. 3), a consumer (3) and the connecting wiring.

When the circuit is closed, current can flow.

The circuit can be interrupted or closed with a switch (2).

The system is protected by a fuse (4).

Types of current

Direct current (D.C.)

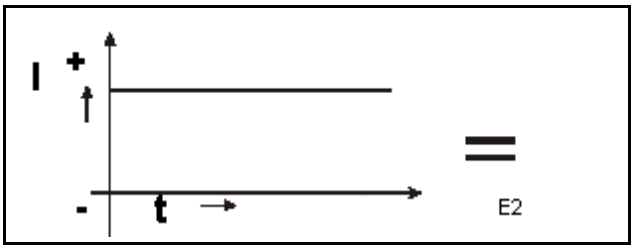


Fig. 1 Direct current (D.C.)

Direct current flows with steady voltage and amperage from the plus to the minus pole.

Pure D.C.-voltages are only delivered by accumulators or batteries.

The voltage in the vehicle wiring system is no pure D.C.-voltage. Even without the generator running, but the consumers switched on, the voltage is not constant, but drops gradually according to the battery charge condition.

The internal resistance of the battery also causes permanent changes in the vehicle voltage, as soon as consumers are switched on or off.

Alternating current (A.C.)

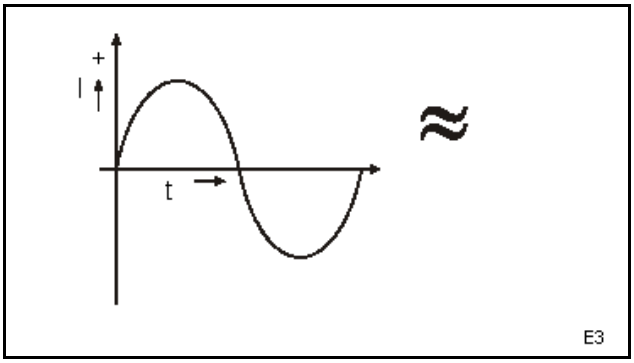


Fig. 2 Alternating current (A.C.)

Alternating current not only changes its direction, but also its amperage.

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4.6 Pulse Width Modulation (PWM)

Pulse width modulation (PWM)

PWM is the abbreviation for Pulse Width Modulation, frequently also referred to as "Pulse Pause Modulation" (PPM). It is used in the field of controls for mobile and robust applications, mainly to control proportional valves (PWM-valves).

The following applies:

- The signal voltage cannot be measured.
- The current can be measured.

⚠ Caution

PWM-solenoid valves must not be interference suppressed with suppressor diodes.

What does a PWM-output do?

Digital outputs normally deliver a fixed output voltage, as soon as they are switched on. The value of the output voltage can in this case not be changed. In contrast to this, PWM-outputs divide the voltage into a quick sequence of many square-wave pulses. The ratio of pulse period "switched on" to pulse period "switched off" determines the effective value of the desired output voltage. One refers to the duty cycle (in percent).

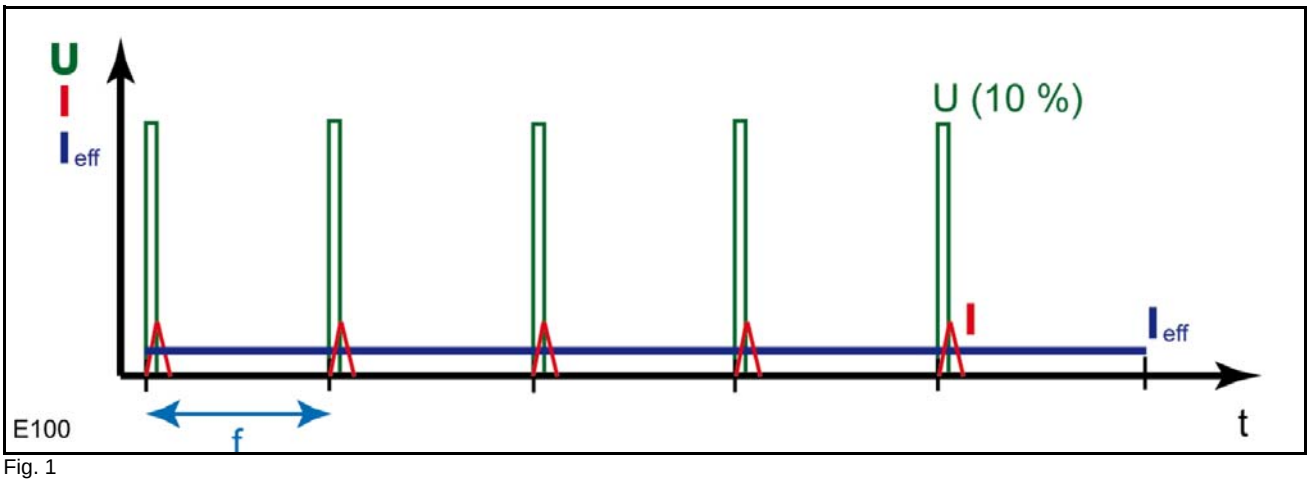


Fig. 1

(Fig. 1)Course of PWM-voltage U and coil current I at 10 % duty cycle The effective coil current Ieff is also 10 %.

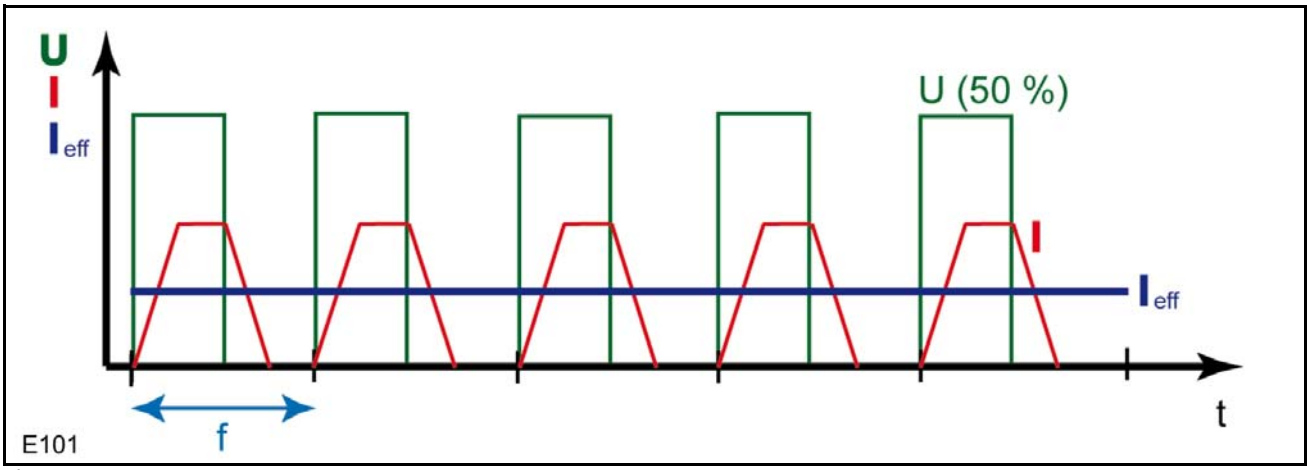


Fig. 1

(Fig. 1) Course of PWM-voltage U and coil current I at 50 % duty cycle The effective coil current Ieff is also 50 %.

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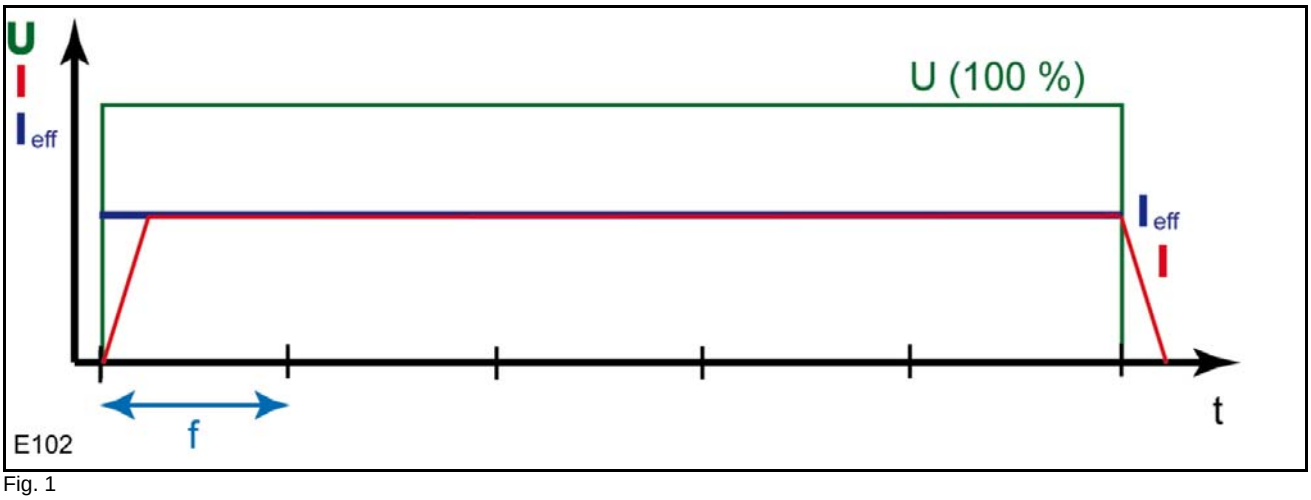


Fig. 1

(Fig. 1) Course of PWM-voltage U and coil current I at 100 % duty cycle The effective coil current Ieff is also 100 %.

What does Dither mean?

When a proportional hydraulic valve is triggered, its spool will not move immediately and at the beginning it will also not move proportionally to the coil current. Due to this "Slip-Stick effect" - a kine of "breakaway torque" - the valve right at the beginning requires a slightly higher current to be able to move the spool out of rest position. The same takes place with any other position change of the valve spool. Especially with very low actuating speeds this effect becomes apparent by jerky movements.

Engineering tackles this problem by subjecting the valve spool to an almost insignificant shuttle movement (the dither). The piston thereby permanently performs a shuttle movement and can therefore not "stick". Even very small position changes now take place without delay, just like a "flying start".

Advantage: The hydraulic cylinder actuated this way can be controlled with a much higher sensitivity.

Disadvantage: With dither the valves becomes noticeably warmer, because the valve spool is permanently in action.

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4.7 Resistance

Resistance and voltage drop

While current flows through a conductor the current flow is more or less inhibited by the conductor, this inhibitation is referred to as Resistance.

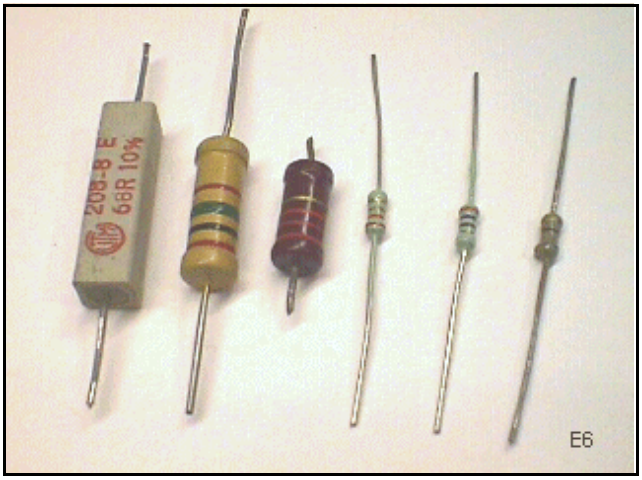


Fig. 1 Various size resistors

Each conductor has its specific resistance, which is characteristic for the corresponding material. A good conductor has a low resistance, a poor conductor has a high resistance.

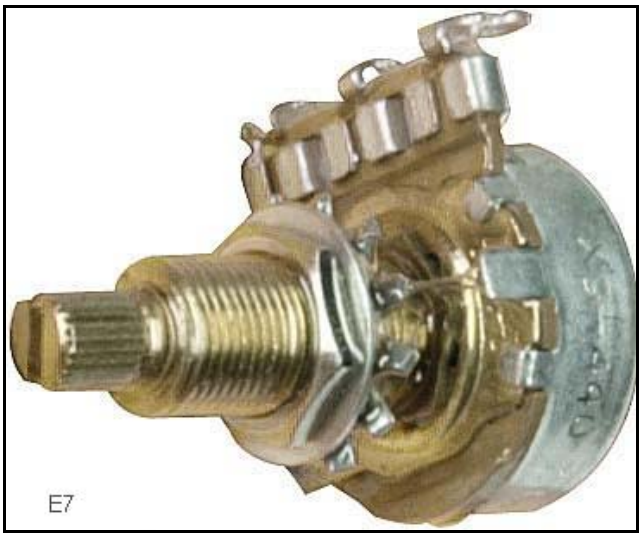


Fig. 2 Potentiometer, infinitely adjustable resistor

The resistance can only be measured with a Multimeter.

Symbol, R

Unit, Ohm Ω

The electric resistance (R) is measured in Ohm Ω.

Rule of thumb:

- The thicker the cable cross-section, the lower the voltage loss.
- The shorter the cable, the better the current.
- The cleaner the contacts, the better the current.
- The quality of the ground cable is of the same importance as the supply line.

Unnecessary resistances

Unnecessary resistances are frequently caused by mechanical connections, even clean ones, but mainly soiled and oxidizes terminals, too thin cables, material with poor conductivity or bent open cable lugs.

Bad

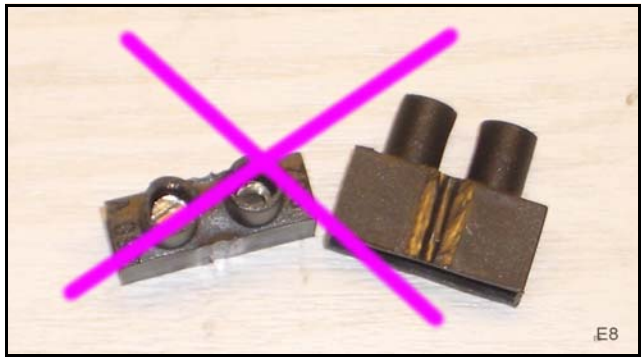


Fig. 1 Screw-type terminals

Copper wires are squashed and thus become faulty.

Better



Fig. 2 Spring clamps

Connecting clamps for flexible conductors

BOMAG No. 057 565 72

Ampacity up to 20 Amp.

Cable cross-section 0.08 to 2.5 qmm

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Fig. 3

In many cases it is better to replace the contact. Soiled or oxidized contacts should be cleaned with Ballistol (Fig. 4) and subsequently wetted with copper paste.

Copper paste is a heat resistant grease, which has been mixed with copper powder. The paste protects electric contacts against oxidation. Copper paste keeps water away.



Fig. 4 Balistol oil

Sometimes the flanks of flat plugs bend open. If these are closed again with the help of pliers the flanks will be excessively strained at the bend and will definitely break sooner or later. It is better to place a small nail under the bottom of the cable lug before bending.

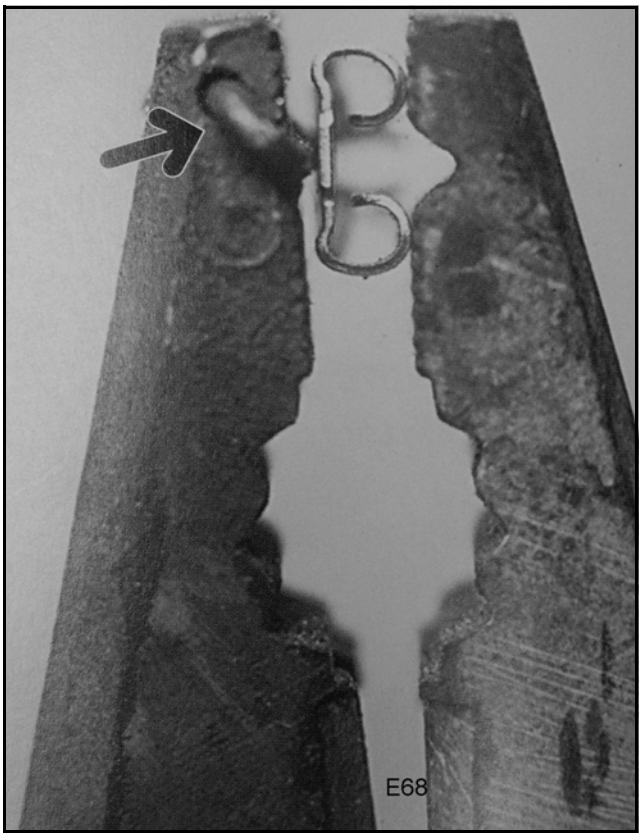


Fig. 5

Hint for practice:

A tool you cannot buy. The pliers were converted, the nail is permanently present.

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4.8 Series / parallel connection

Series connection

In a series circuit the resistors (consumers) are lined up one after the other and the same current (I) passes through each of the consumers However, series connection of consumers is not suitable in practice, as each resistance causes a voltage drop. In the vehicle wiring system all consumers are designed for the same vehicle voltage (e.g. 12 Volt).

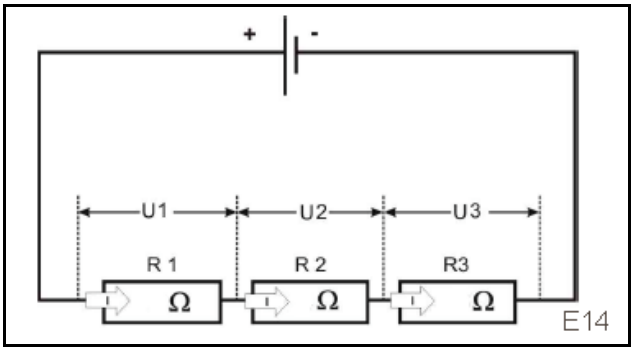


Fig. 1 Series connection

Current

In series connection the current is identical at every point.

Itotal = I1 = I2 = I3

Voltage

The sum of all partial voltages is identical with the total voltage.

Utotal = U1 + U2 + U3

Resistance

The sum of all partial resistances is identical with the total resistance.

Rtotal = R1 + R2 + R3

Series connection of batteries

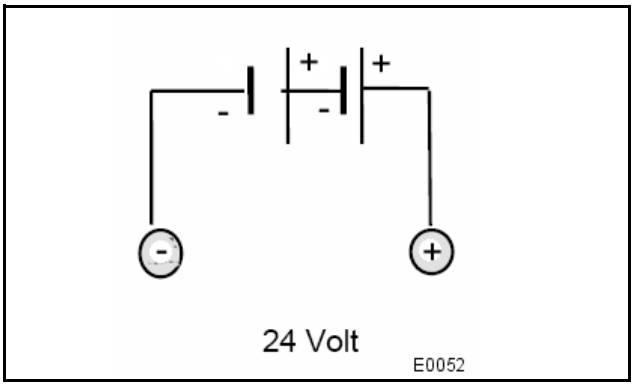


Fig. 2

In order to achieve a vehicle voltage of 24 V two batteries of the same type and capacity must be connected in series mode.

- In series connection the plus pole of the first battery must be connected with the minus pole of the second battery.
- The sum of all individual voltages is applied to the free poles.
- The total capacity (Ah) is identical with the capacity of the individual battery.

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Parallel connection

In parallel connection all resistances (consumers) are connected between feed and return line.

- All resistances (consumers) are supplied with the same voltage.
- Each of the resistances (consumers) draws as much current as required.

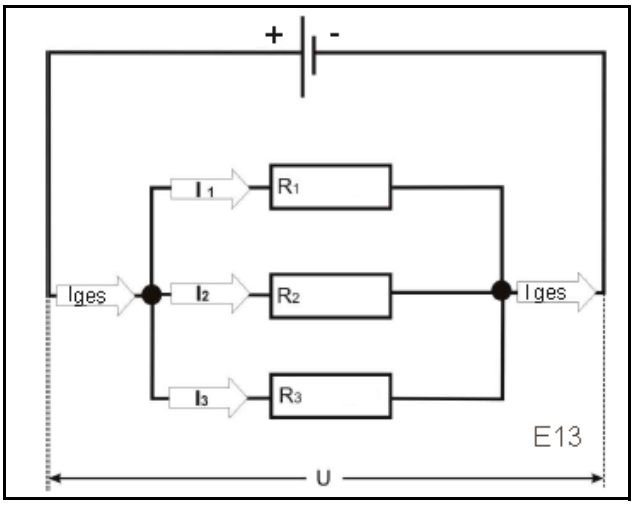


Fig. 3 Parallel connection

Current

The total current is the sum of all currents.

Itotal = I1 + I2 + I3

Voltage

The voltage values are identical at every resistance (consumer).

Utotal = U1 = U2 = U3

Resistance

The total resistance is less than the lowest individual resistance.

Parallel connection of batteries

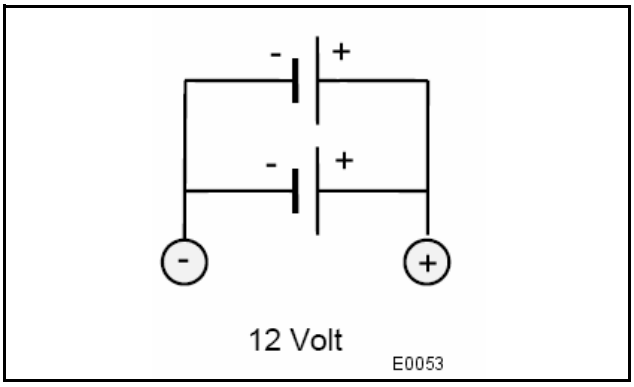


Fig. 4

By connecting 2 batteries of same type and capacity in parallel mode the capacity can be doubled, because the individual capacities add up to the total capacity.

- In parallel connection the plus pole of the first battery is connected with the plus pole of the second battery and the minus pole of the first battery with the minus pole of the second battery.
- Plus and minus poles have the voltage of the single battery applied.
- The total capacity (Ah) is identical with the sum of all battery capacities.

The disadvantage of a parallel connection becomes apparent, by equalizing currents flowing between parallel batteries, if the batteries have different states of charging.

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4.9 Ohm's law

In a closed electric circuit voltage, current and resistance must always be considered in close relation. This relation is represented by Ohm's Law.

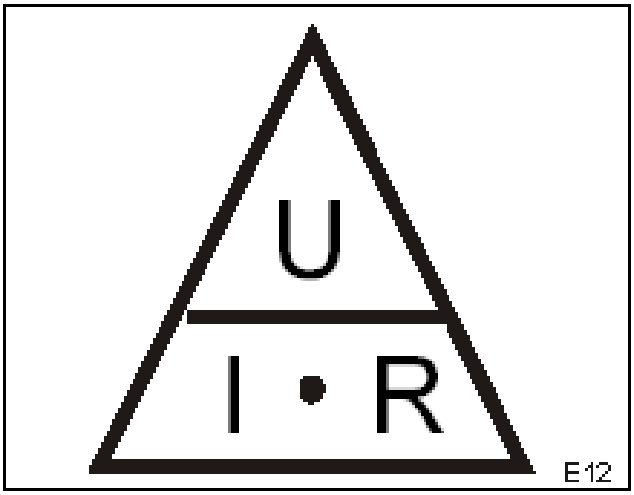


Fig. 1

According to this law a voltage of 1V is required to let 1A (ampere) flow through a conductor with a resistance of 1 (Ohm Ω).

Advice

By means of this triangle the formula can be easily rearranged, the value you are looking form must just be blanked off with a finger.

Voltage U = I multiplied with R

Resistance R = U divided by I

Amperage I = U divided by R

U = Voltage in Volt

I = Current in Ampere

R = Resistance in OHM Ω

4.10 Electrical energy

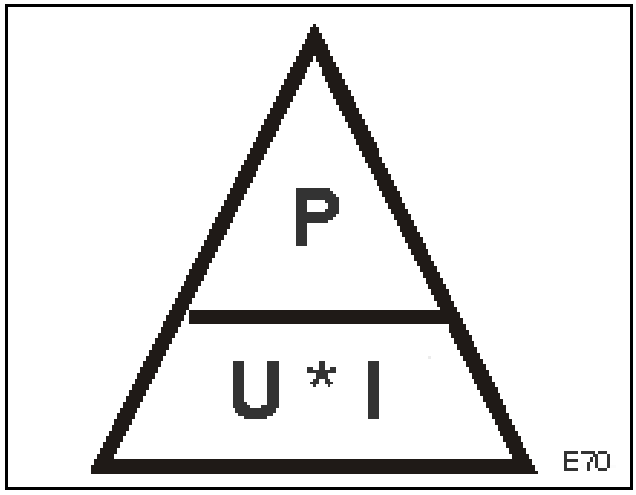


Fig. 1

In a closed electric circuit current and voltage generate energy.

If a current of 1 Ampere flows at a voltage of 1 Volt, energy of 1 Watt is produced.

Advice

By means of this triangle the formula can be easily rearranged, the value you are looking form must just be blanked off with a finger.

Energy P = I multiplied with U

Amperage I = P divided by U

Voltage U = P divided by I

U = Voltage in Volt

I = Current in Ampere

P = Power in Watt

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4.11 Formula diagram

Description:

- Select the desired value from the inner circle.
- Determine the formula variables in the quarter circle
- Calculate

Example:

P = 150 Watt

U = 24 Volt

Sought for = Current in Ampere

I = P : U = 150 W : 24 Volt = 6.25 Ampere

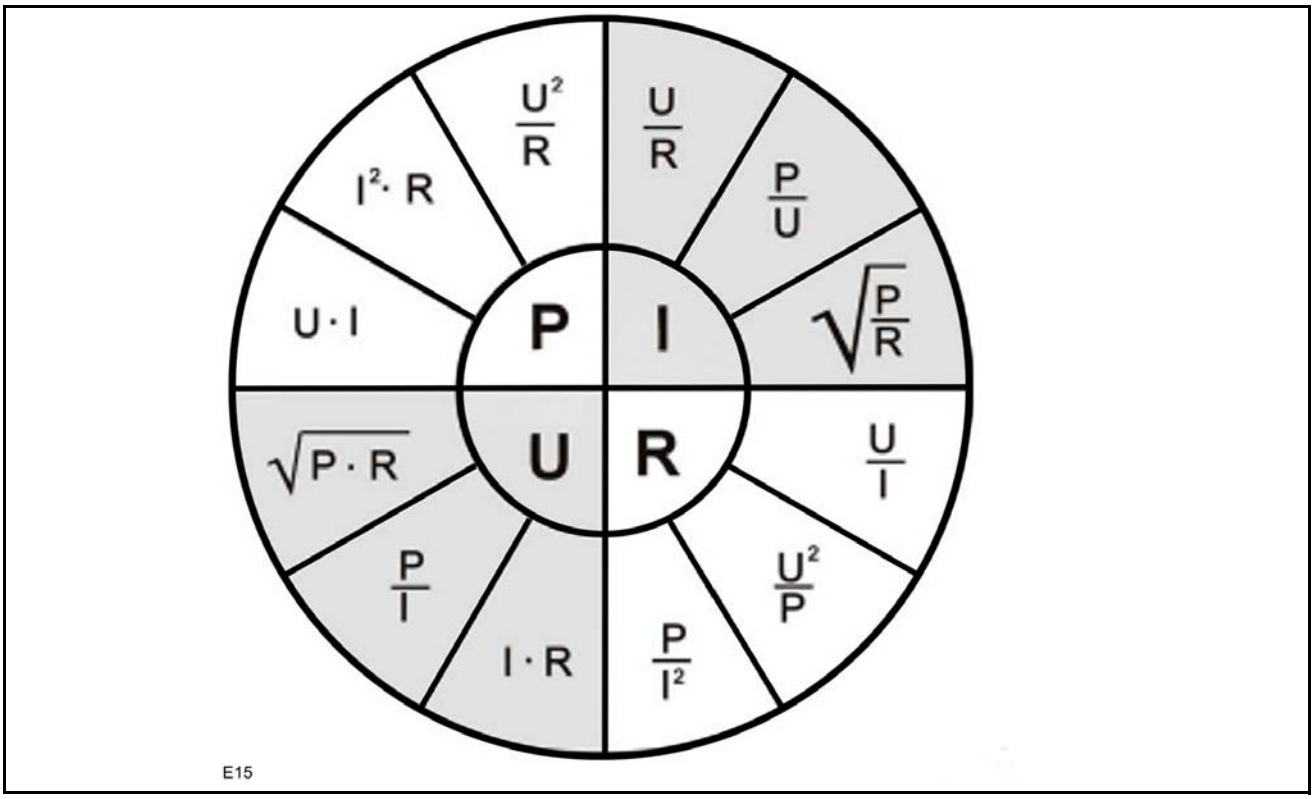


Fig. 1 Formula diagram

Resistance, R Ohm Ω

Voltage, U Volt

Current, I Ampere

Power, P Watt

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4.12 Metrology

Test lamps

Test lamp

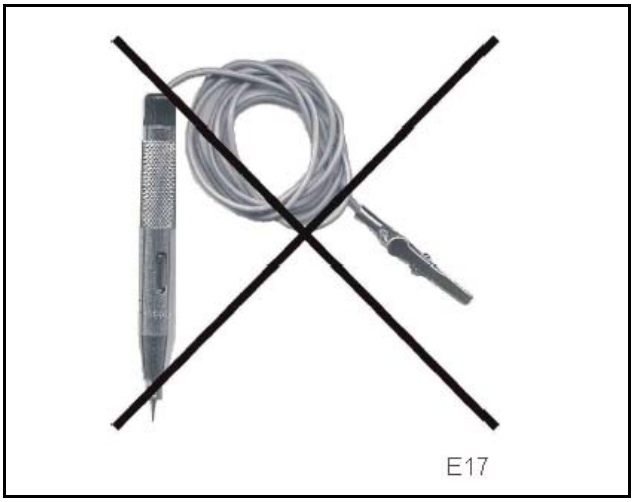


Fig. 1 Test lamp

⚠ Caution

This type of tester must not be used for testing on electronic components. The high power consumption of the test lamp may destroy electronic components in the control units.

Diode test lamp

This instrument is used for simple voltage measurements. The test lamp consists of two test points. The negative measuring cable is connected to ground and the positive measuring cable to the corresponding measuring location.

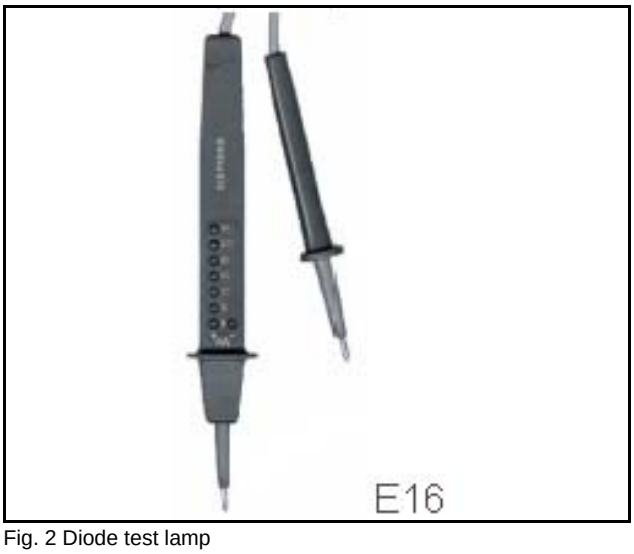


Fig. 2 Diode test lamp

If voltage is present, the corresponding light emitting diode will light up.

Multimeter

This tester is a multimeter and can be used to measure e.g. current, voltage and resistance. Depending on the design it may also be suitable for transistor and frequency.

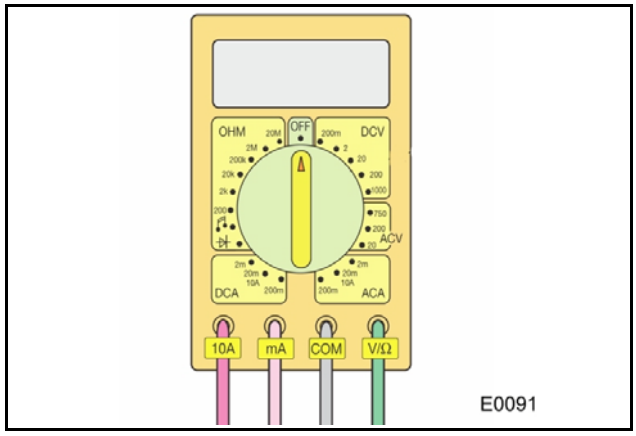


Fig. 1 Multimeter

In order to avoid damage:

- the range selector switch must be correctly set for the corresponding measurement.
- the test cable must be plugged into the correct socket.
- the voltage type (AC/DC) must be set.
- In case of direct voltage the correct polarity must be assured.
- the measuring range should be chosen higher at the beginning of the test.
- In order to avoid any influence on the circuitry to be measured, the internal resistance of the voltage tester should be as high as possible.

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Resistance and continuity measurement with multimeter

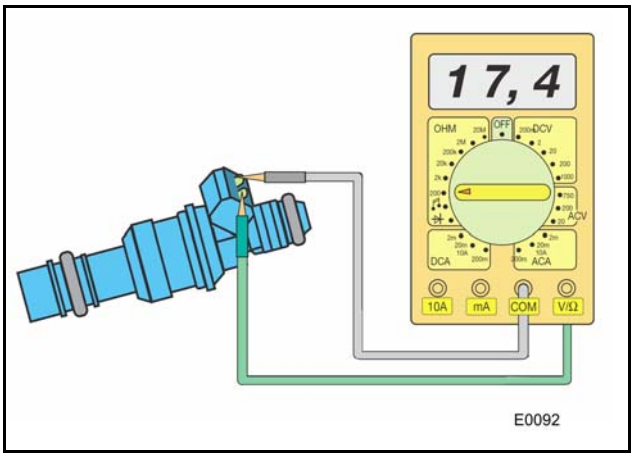


Fig. 2

The continuity tester of the multimeter can be used to measure whether there is a connection between 2 measuring points.

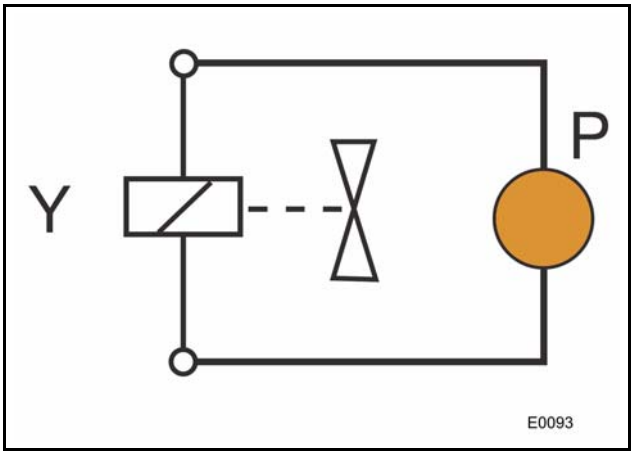


Fig. 3

The following information should be observed when measuring resistance and continuity:

- The component to be measured must not be connected to the power supply during the measurement.
- At least one side of the component to be measured must be disconnected from the circuitry, as otherwise the measuring result may be influenced by parallel components.
- Polarity is of no significance.

Voltage and voltage drop measurement with multimeter

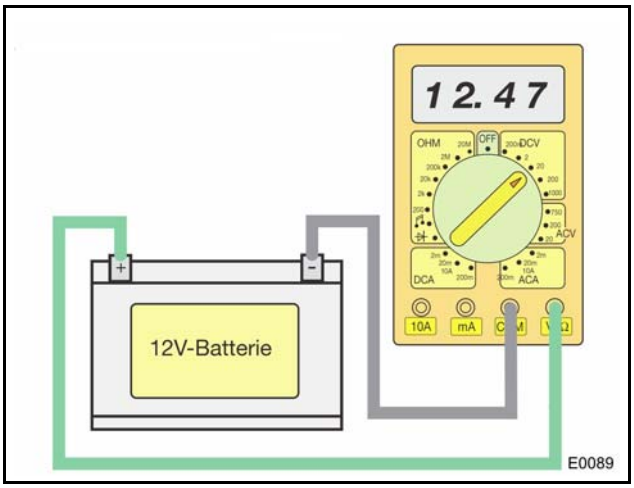


Fig. 4 Measuring voltage

- Measurement at the voltage source measures the currently available Voltage.
- The meter is always connected parallel to consumer, component or power source.

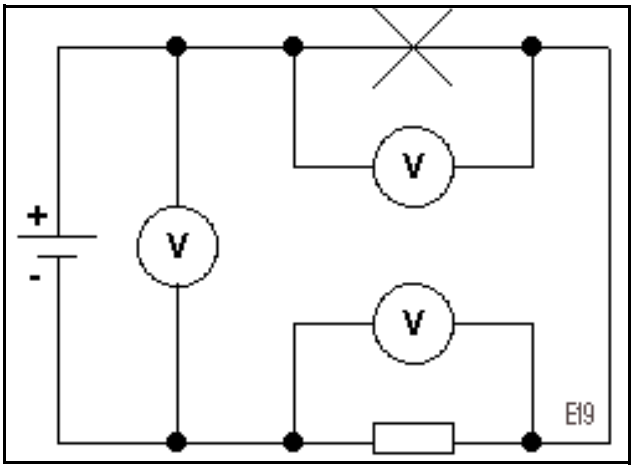


Fig. 5 Voltage measurement

- A measurement at the consumer measures the voltage drop at this component.

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Current measurement with the multimeter

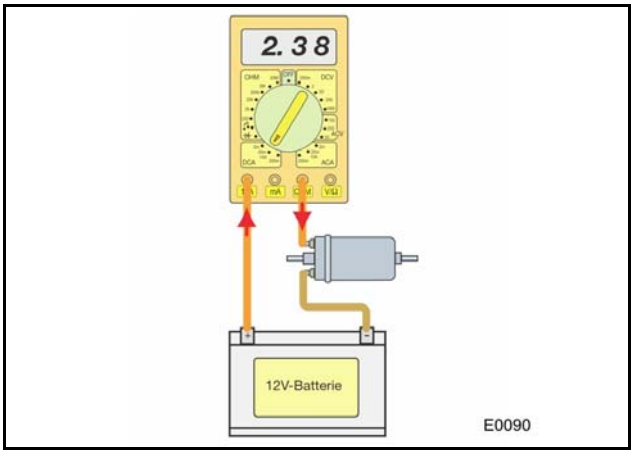


Fig. 6 Measuring current

- The meter is connected in series with the consumer.
- During the measurement the current must be able to flow through the meter, i.e. the electric circuit must be opened.

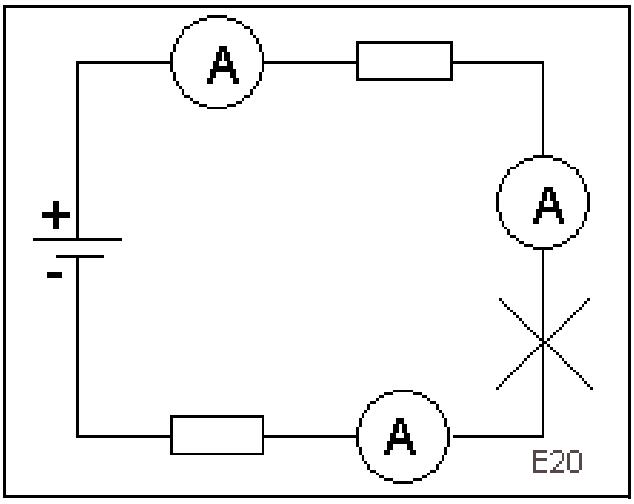


Fig. 7 Current measurement

Advice

If the electric circuit is difficult to access and the internal resistance of the consumer is known, the voltage may also be measured at the consumer.

The current value can then be calculated with the help of Ohm's law.

Clip-on measuring instrument

The clip-on measuring instrument can be used to measure current, voltage and resistance.



Fig. 1 Clip-on measuring instrument

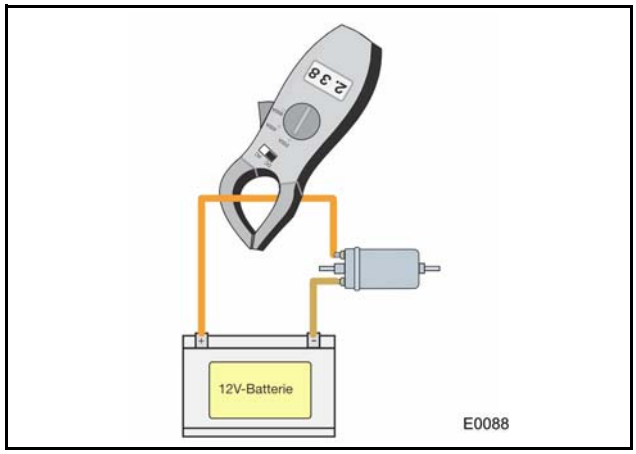


Fig. 2

- For measuring current the individual conductor must be fully enclosed by the measuring tongs, the actual measurement takes place without contact.

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Magnet tester



Fig. 1 Magnet tester

The magnet tester is used to test solenoid valves and magnetic coils.

The test lamp responds to the magnetic fields of A.C-voltage, D.C.-voltage and permanent magnets.

- The component to be tested does not need to be removed.
- The magnetic coil can also be tested under a protective cap.

Power measurement

The electric power of a module within a circuit can be indirectly determined (calculated) by separate measuring of current and voltage.

However, there are also pure power meters with 4 connections available. The power meter has a electrodynamic measuring mechanism. The current circuit must be opened for measuring. Take care when performing power measurements: Voltage or current path may already be overloaded during the measurement, even though the end stop in the meter has not yet been reached.

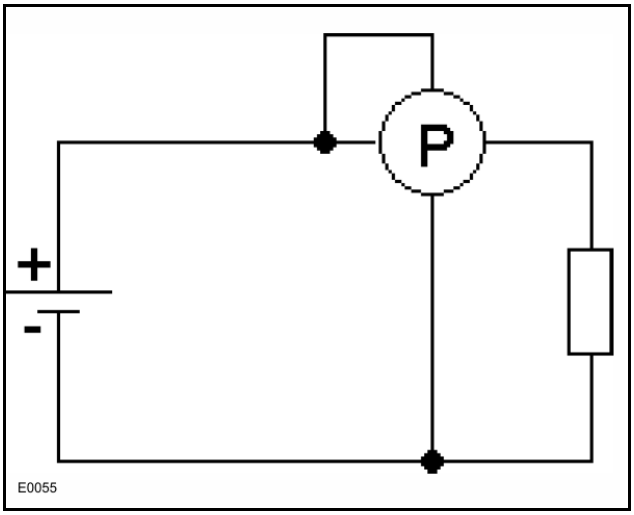


Fig. 2

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4.13 Diodes, relays, fuses

Diodes

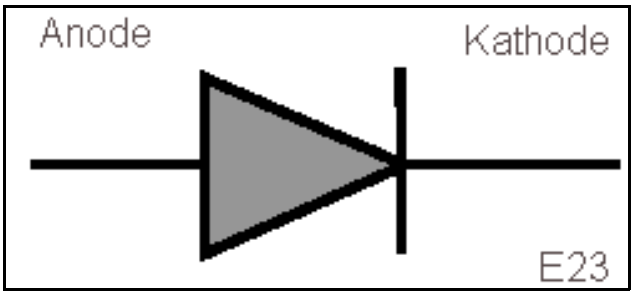


Fig. 1

A diode consists of two different semi-conductors, which are connected by a separating layer. The max. conducting state current must not be exceeded.

Plus-voltage on diode:

- At 0.6 – 0.7 Volt (silicium diode) the diode becomes conductive.

Negative voltage on diode:

- The diode does not allow current to pass through.



Fig. 2 Marking of the cathode

Diodes are used:

- For rectifying A.C. voltage.
- For absorbing voltage peaks (free-wheeling diode).
- For construction of logical circuits.

Diode logics and free-wheeling diode

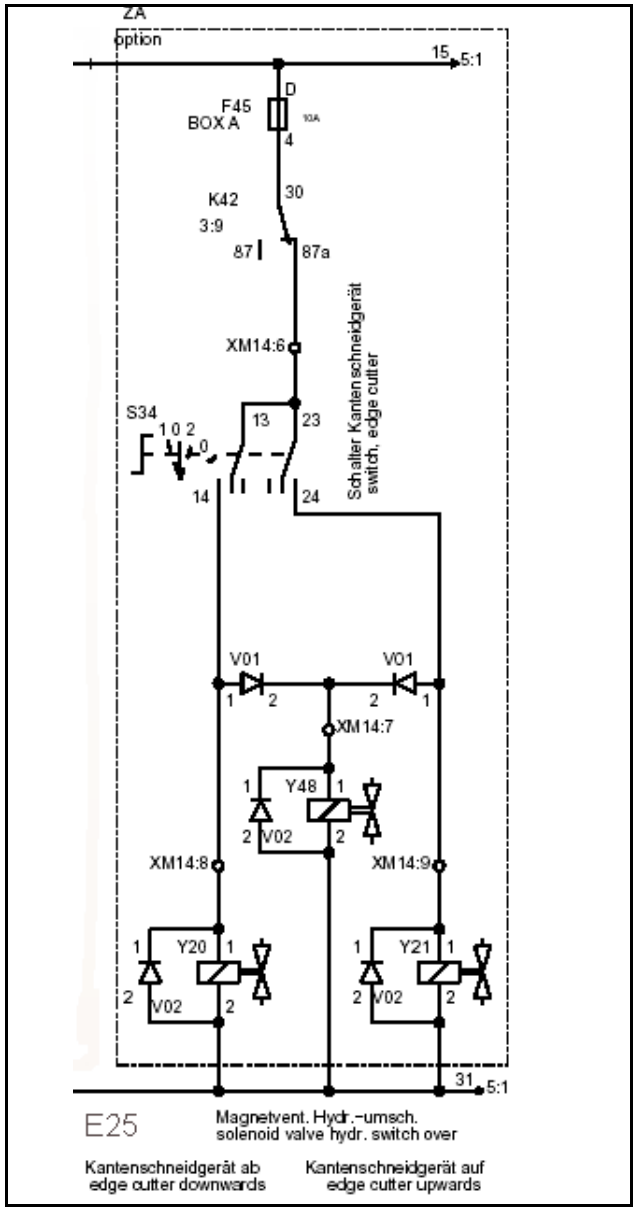


Fig. 3 Diode circuitry

- The solenoid valve Y48 (Fig. 3) is supplied with electric current when switch S34 is switched to position "1" or "2".
- Solenoid valve Y20 is supplied, if the switch is in position "1".
- Solenoid valve Y21 is supplied, if the switch is in position "2".

The three diodes V02 serve as free-wheeling diodes with the function of of eliminating voltage peaks.

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Light emitting diodes

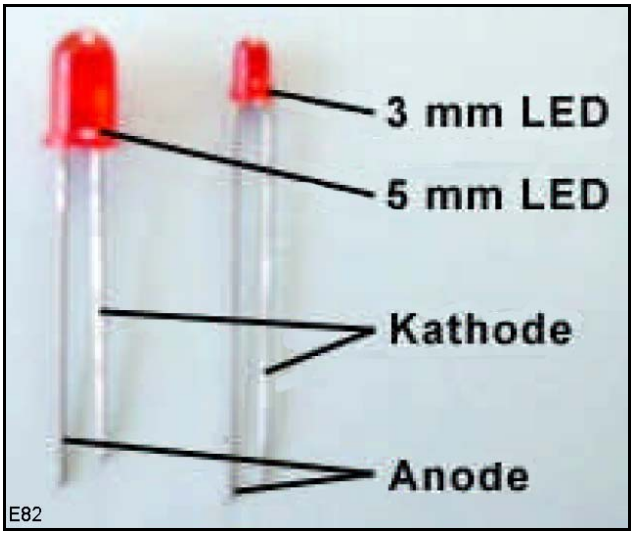


Fig. 4 LED

The light emitting diode, also referred to as LED, is a semi-conductor diode, which generates (emits) light during operation in forward direction. A semi-conductor crystal thereby emits a light signal, which is converged or scattered by the lenticular shape of the head. Light emitting diodes are available in various colours, sizes and shapes. They are for this reason used as signal lamps. This component is constructed of different semi-conductor crystals, depending on its colour. It works like any other semi-conductor diode.

Relays

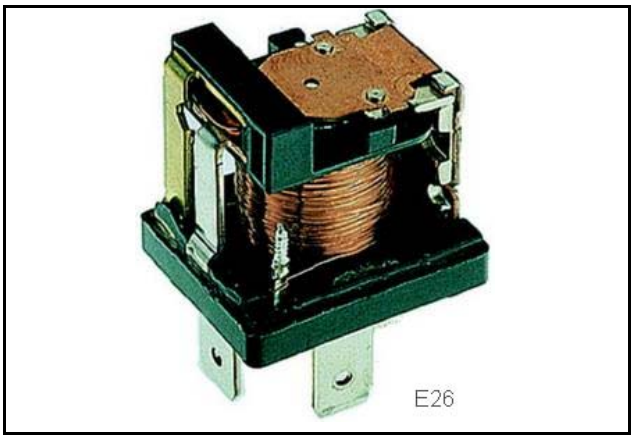


Fig. 1 Relays

Relays are commonly used to realize switching processes.

A free-wheeling diode prevents induction voltage from flowing back from the coil into the vehicle wiring system, which would cause interference with electronic components (control units).

With the possibility of using breaker - maker contacts the effect of an information can be reversed.

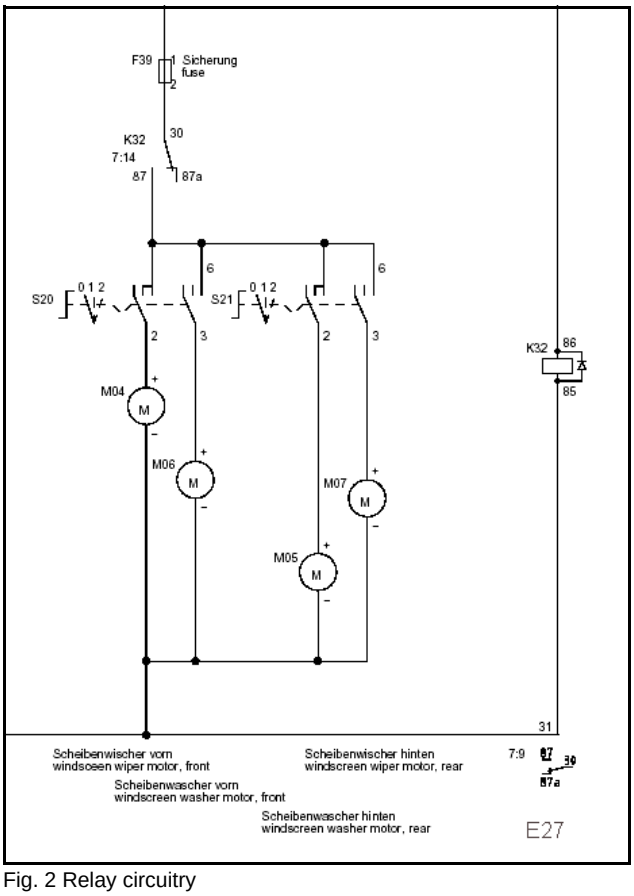


Fig. 2 Relay circuitry

The windscreen wiper and washer motors can only be operated via switches S20 and S21, when relay K32 is supplied with electric current (Fig. 2).

86 = Positive supply for coil

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85 = Ground supply for coil

30 = Supply voltage

87 = Normally open contact

87a= Normally closed contact

Fuses



Fig. 1

Fuses are used to protect lines and equipment against overloads and short circuit. If the fuse is overloaded the fusible wire heats up with increasing current, until it finally melts.

⚠ Caution

Fuses must not be repaired or bridged.

The melting time at 23 °C is:

- approx. 1 hour with 1.5 times the rated current
- approx. 1 minute with 2.5 times the rated current.

A 5 Amp fuse loaded with 1.5 times the rated current (7.5 Amp) will finally melt after approx. 1.5 hours.

Yellow = 5 A

Brown = 7.5 A

White = 8 A

Red = 16 A

Blue = 25 A

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4.14 Inductive proximity switches

General

In all automated sequences the use of sensors as a source of information for the electronic control is indispensable. The sensors deliver the necessary signals about positions, end positions, filling levels or serve as pulse transducers for counting tasks or speed detection. In industrial applications inductive and capacitive proximity switches are today indispensable. Compared with mechanical switches, they offer almost ideal prerequisites: non-contact, wear free operation, high switching frequencies and switching accuracies, as well as high protection against vibration, dust and moisture. Inductive sensors detect all metals without contact, capacitive sensors detect almost all solid and liquid media, such as metal, glass, wood, plastic, water, oil, etc.

Working principle

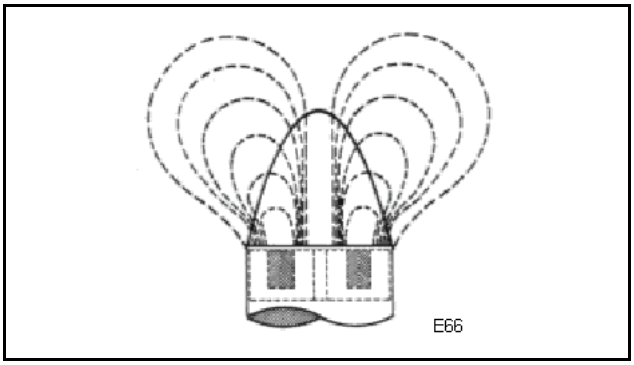


Fig. 2

The working principle is based on the principle of the dampened LC-oscillator. The coil of the oscillation circuit forms a high-frequency magnetic stray field.

This stray field leaks out from the active area of the proximity switch. If metal or non-ferrous metal enters into the response range energy is absorbed. The oscillator is thus dampened and the resulting change in current consumption is evaluated.

PNP circuitry

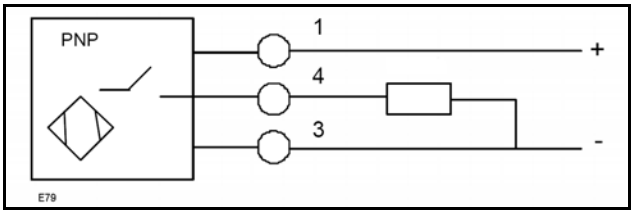


Fig. 3 PNP circuitry

On sensors with PNP-circuitry the output stage contains a PNP-transistor, which switches the load against the positive operating voltage. The load is connected between the output and the negative operating voltage. The switch is designed with a normally open contact, i.e. the contact closes when the initiator comes in "contact" with metal.

NPN circuitry

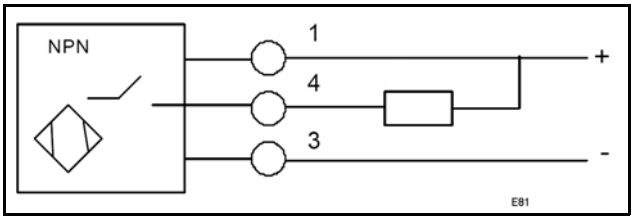


Fig. 4 NPN circuitry

On sensors with NPN-circuitry the output stage contains a NPN-transistor, which switches the load against the negative operating voltage. The load is connected between the output and the positive operating voltage.

Breaking and making contacts

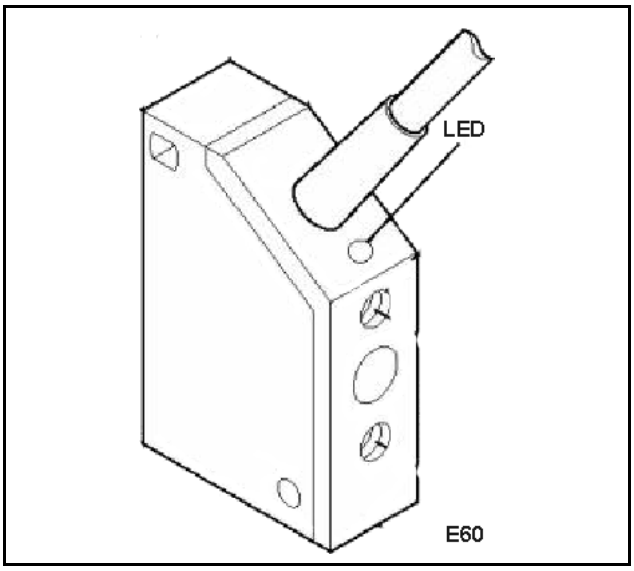


Fig. 5

Proximity switches are used as breaking or making contacts. Depending on the design the switching distances are 2 or 4 mm. The maximum amperage is 300 mA.

The LED (Fig. 5) lights up, when the initiator has detected metal in its stray field.

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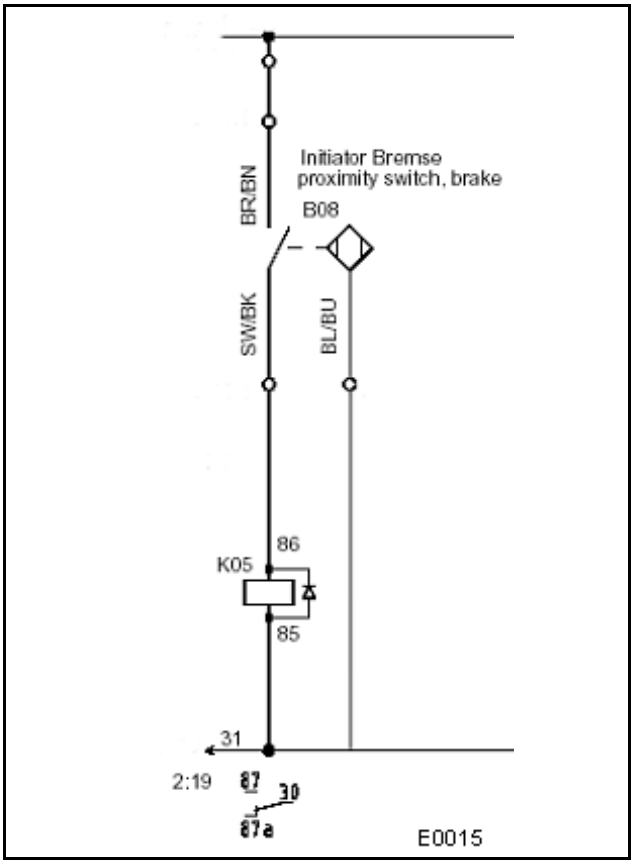


Fig. 6 Circuit diagram, making contact

The circuit diagram (Fig. 6) shows a proximity switch with normally open contact.

Brown = voltage supply

Blue = ground supply

Black = switching output

The initiator switches the relay (K05)

4.15 Plug connectors

Duties and requirements

Electric plug connectors must provide a reliable connection between different system components and thus ensure the safe function of the systems under any operating condition. There design ensures that they will withstand the applied loads throughout the lifetime of the machine.

Examples for these loads are:

- Vibration acceleration
- Temperature fluctuations, high and low temperatures
- Dampness
- Micro movements of the contact with resulting friction corrosion.

These loads may increase the transition resistances of the contacts, up to total interruption. Even the insulation resistances may drop and thus cause short circuits in neighbouring lines. Electric plug connectors must therefore have the following properties:

- Low transition resistances of the conductive parts.
- High insulation strength between conductive parts with different voltage potentials.
- Excellent leak tightness against water and moisture.

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4.16 Magnetic coil plug

Magnetic coil plug with LED and suppressor diode

The plug is equipped with a polarized function display and a suppressor diode as protection against overvoltages.

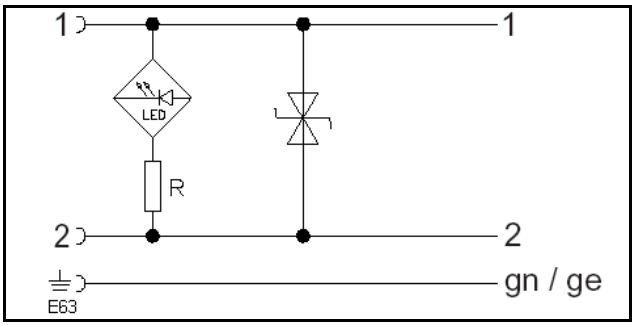


Fig. 7

The plug is reverse polarity protected, it does not matter whether Pin1 or Pin 2 is supplied with current, Pin 3 is not used. The LED lights if voltage is applied to the solenoid valve.

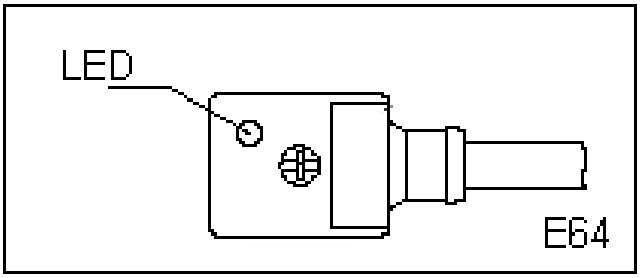


Fig. 8

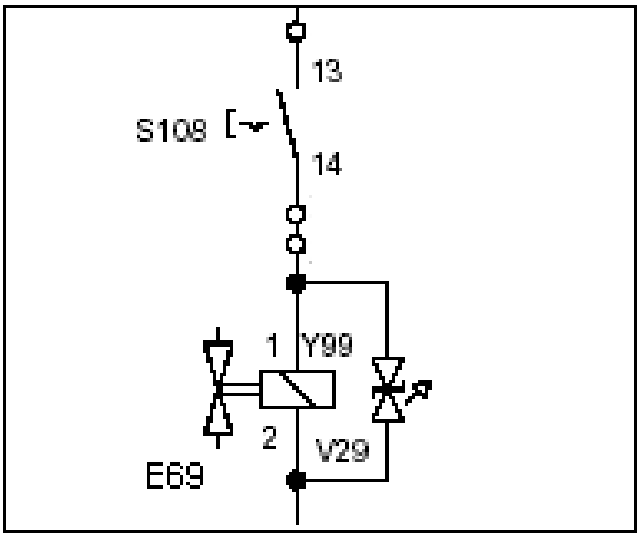


Fig. 9 Switching symbol in circuit diagram

Magnetic coil plug without LED and without supressor diode

The plug has no LED and no suppressor diode as protection against overvoltages.

Assembly of magnetic coil plugs

These instructions are intended to explain the correct installation of the magnetic coil plug. The objective of the instructions is the correct installation of the plug and to avoid malfunctions in the field caused by moisture and any related corrosion damage.



Fig. 10 Solenoid valve plug with pointed cable



Fig. 11

- Connect the plug with the coil connection and press it firmly onto the connecting housing.

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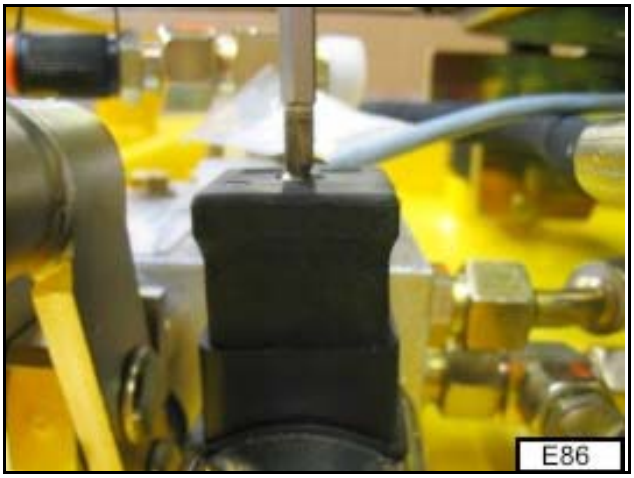


Fig. 12

- Fasten the screw with a suitable screwdriver.



Fig. 13

- Press the plug firmly on again.

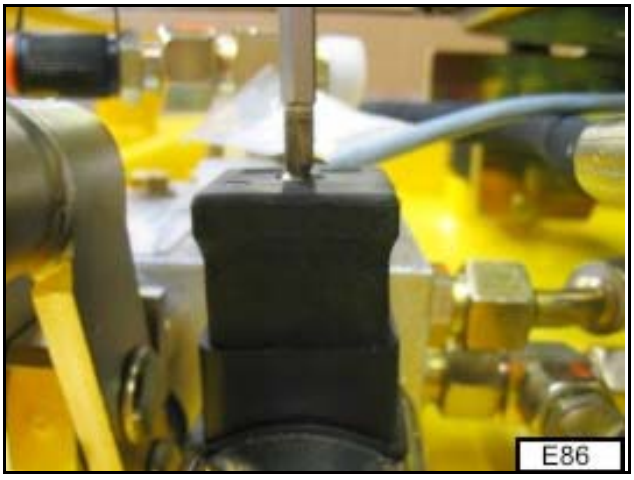


Fig. 14

- Retighten the screw.



Fig. 15

⚠ Caution

There should be no gap between plug and solenoid coil!



Fig. 16 Correctly installed plug without gap

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4.17 Deutsch plug, series DT and DTM

General

Plug connectors DT and DTM have a wedge to hold the pins and sockets in their position. This wedge can be removed and replaced, without having to cut any leads.

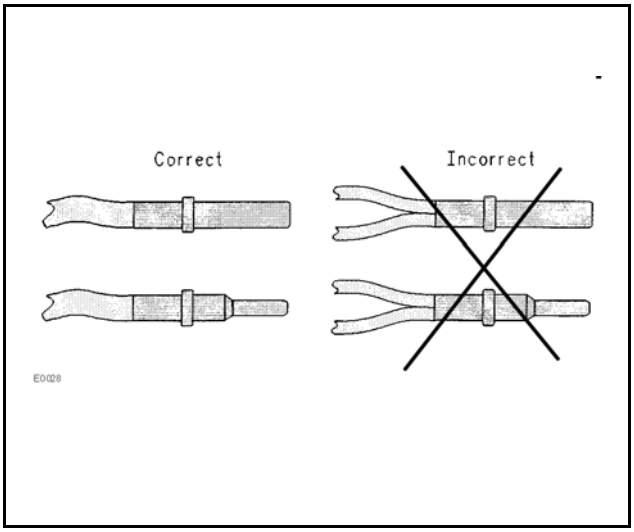


Fig. 17 Crimp connections

⚠ Caution

Do not crimp more than one lead per pin or per socket.

Sockets and pins must not be soldered to leads, they may only be crimped (see special tools for electrics).

When connecting sockets and plugs these must engage with a noticeable click when both halves interlock.

The plug connection should not be separable (without loosening the interlock).

Pulling test

This pulling test ensures that the lead is perfectly crimped and the contact has correctly engaged in the housing.

- Perform a pull test on each lead, each of the terminals and connections must withstand a pulling force of 45 N without any difficulties.

DT Series



Fig. 1 DT plug connection

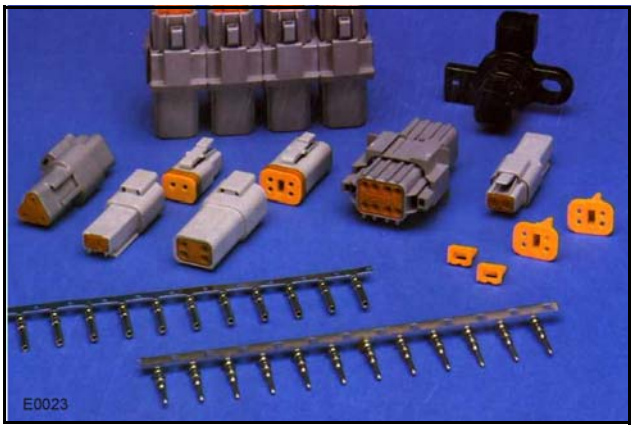


Fig. 2 DT Series

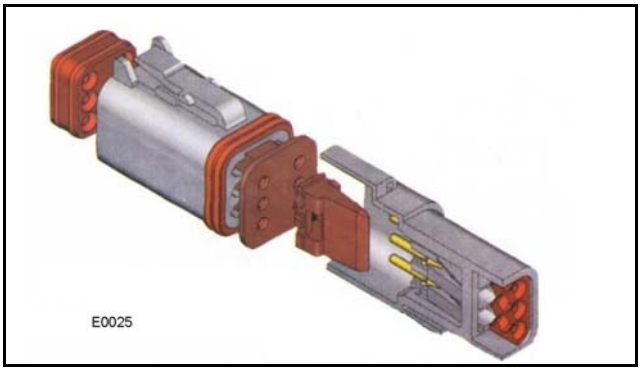


Fig. 3 Sectional drawing

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4.18 Plugs and terminals in spring clamping technology

General

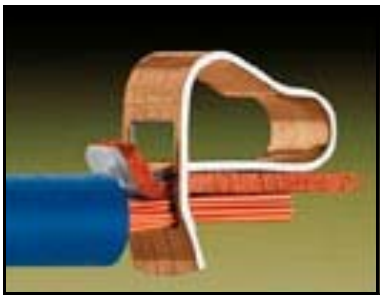


Fig. 1

⚠ Caution

The spring clamp technology is not suitable for extra fine conductors. Extra fine conductors can be easily pulled out of the spring clamp!

Spring clamp technology (Fig. 1) for quick, vibration resistant and maintenance-free connection of all conventional copper conductors (single, multiple or fine stranded) with or without wire and ferrule.

Connecting terminal for quick repairs

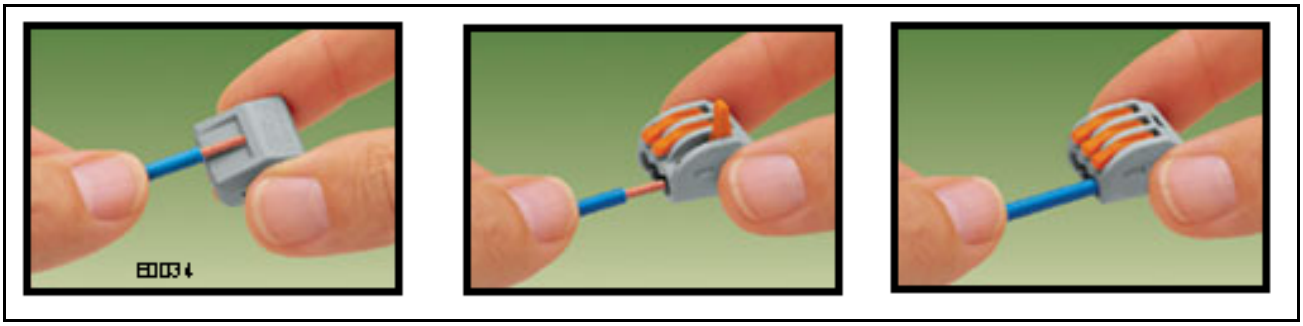


Fig. 2 That's how it works

BOMAG part-no.: 057 565 72

The connecting clamp clamps up to 3 or 5 stripped fine conductors of 0.08 mm^2 to 4 mm^2, single or multiple strand up to 2.5 mm^2. And this even without tools (Fig. 2).

That's how it works

- Strip 9-10 mm of the lead.
- Open the actuating lever and insert the strand.
- Return the actuating lever to initial position.

⚠ Caution

Perform a pull test on each lead, each of the terminals must withstand a pulling force of 45 N without any difficulties.

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Series clamp

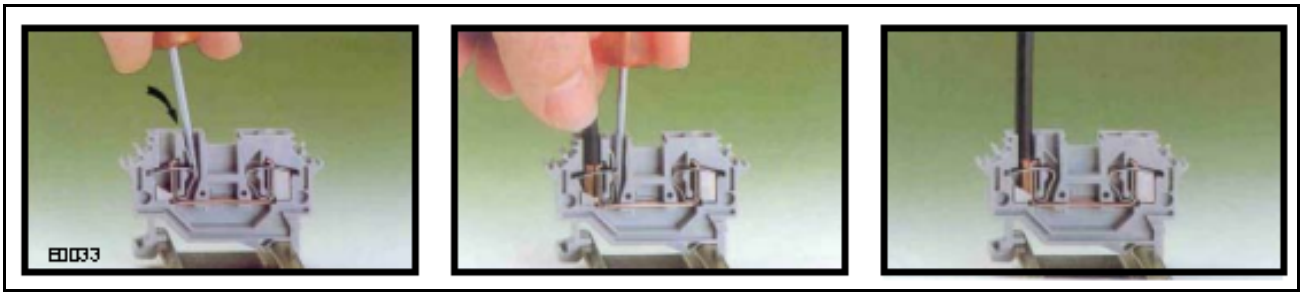


Fig. 3 That's how it works

That's how it works

- Insert a screw driver into the actuating opening until it bottoms.
- Strip 9-10 mm of the lead and insert it into the clamp.
- Pull out the screw driver.

⚠ Caution

Perform a pull test on each lead, each of the terminals must withstand a pulling force of 45 N without any difficulties.

Measuring signals

On these terminal blocks the bridge slot is most suitable for tapping off and measuring signals. Here you may directly insert a 4 mm test adapter (see special tools for electrics) for connecting a measuring lead. This test adapter is standard in the central electrics of heavy equipment machines.

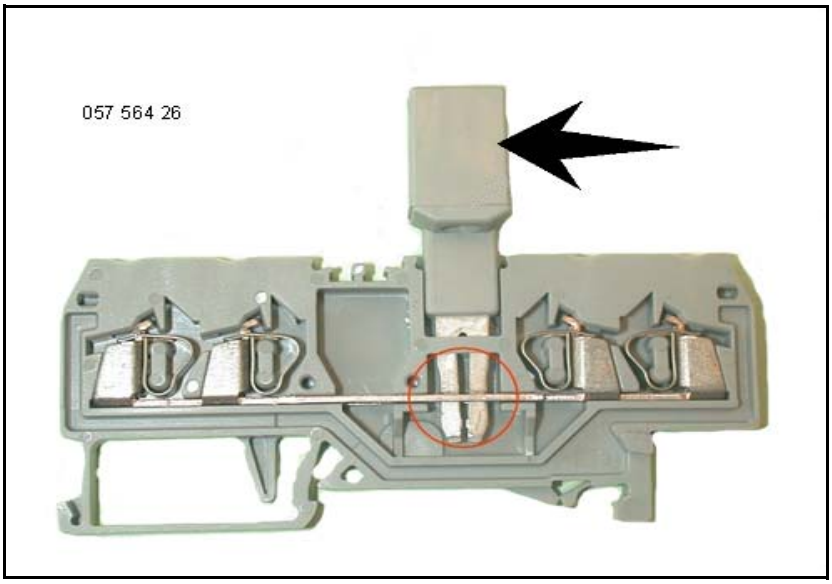


Fig. 4 Test adapter

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X-COM System

The X-COM-SYSTEM, a synthesis of plug connector and series clamp, has grown up to a construction kit for universal system wiring, ever since it was introduced in 1997. All the familiar series clamping functions have thus become pluggable.

X-COM plug clamp

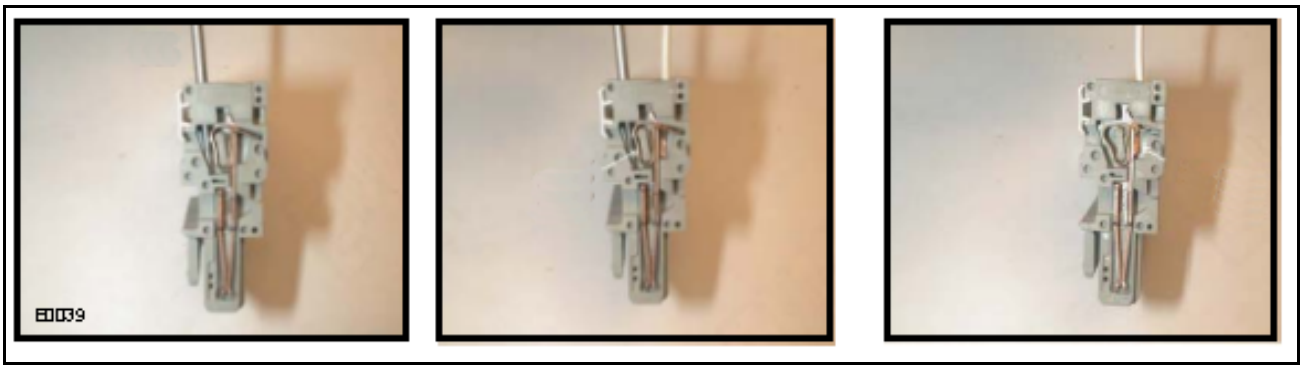


Fig. 5 That's how it works

That's how it works

- Insert a screw driver into the actuating opening until it bottoms.
- Strip 9-10 mm of the lead and insert it into the plug.
- Pull out the screw driver.

⚠ Caution

Perform a pull test on each lead, each of the terminals must withstand a pulling force of 45 N without any difficulties.

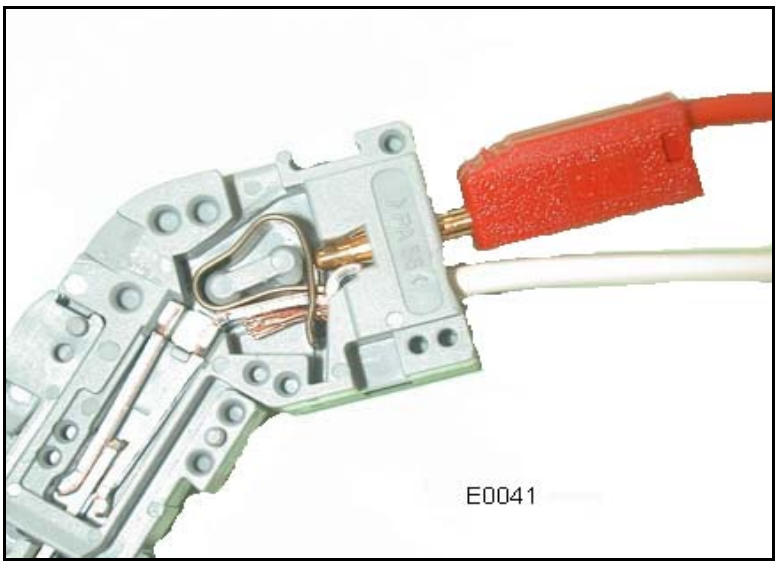


Fig. 6 X-COM plug with measuring cable

- The most reliable measurements on the plug can be made when using the measuring and connecting cable with 2mm plug (see special tools for electrics).

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Measuring signals

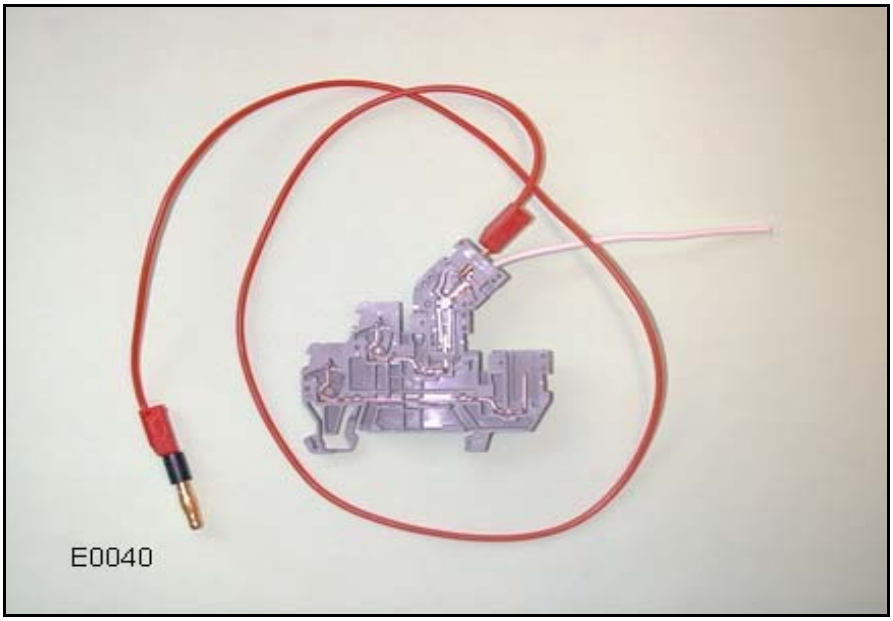


Fig. 7 X-COM plug plugged onto the series clamp

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4.19 Batteries

Battery – accumulator

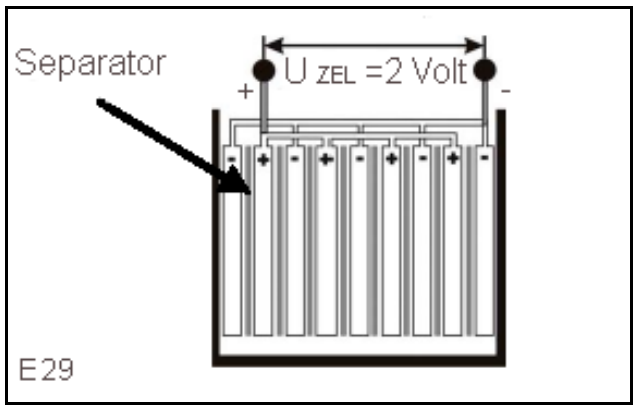


Fig. 1

In vehicles batteries are used to start the engine. The ability to start the engine depends on the charge condition of the batteries.

Lead collectors or accumulators are secondary elements, i.e they can be recharged after discharging electric current.

The basic element of a lead accumulator is the cell. It contains the plate blocks consisting of positive and negative plates. These plates are separated from each other by separators.

All positive plates are arranged parallel to the plus pole, the negative plates parallel to the minus pole of the cells.

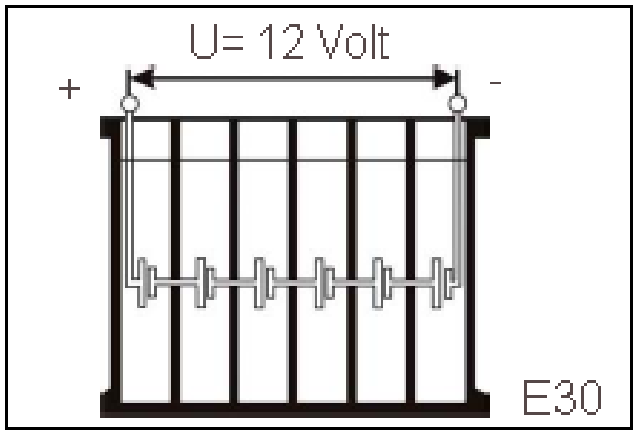


Fig. 2

All cells are filled with a conductive fluid, the electrolyte. For a 12 Volt battery 6 cells are connected in series.

Capacity

is a synonym for the amount of current taken up and discharged by a battery over a specified period of time.

Battery maintenance

i Note

Maintenance free batteries are gaining more and more significance, this freedom from maintenance, however, is only limited to the fact that no water needs to be added.

If the battery is not charged and discharged over a longer period of time, the battery will slowly discharge by itself.

The accumulator may only be discharged down to a final discharging voltage of 10.5 Volt, as otherwise there is a risk of sulphation, i.e. the generated lead sulphate forms increasingly coarser crystals, which will finally not react at all or only very sluggishly during a subsequent charging process.

In the worst case the accumulator can only be disposed of after such an exhaustive discharge.

The following therefore applies for longer downtimes:

- Remove the battery and store it in a cool, dry and frost protected room.
- Check the open circuit voltage on the battery at regular intervals (at least once every month).
- Recharge immediately if the open circuit voltage has dropped to 12.25 Volt (no rapid charging).

i Note

The open circuit voltage of batteries occurs approx. 10 h after the last charging or approx. 1 h after the last discharge.

Battery test in general

- Is the battery leaking? Can traces of impact, shock or compression be found in the leaking area?
- Check for e.g. incorrect fastening, foreign bodies on the battery mounting surface and similar.

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Batteries with screw plugs

Checking the electrolyte level

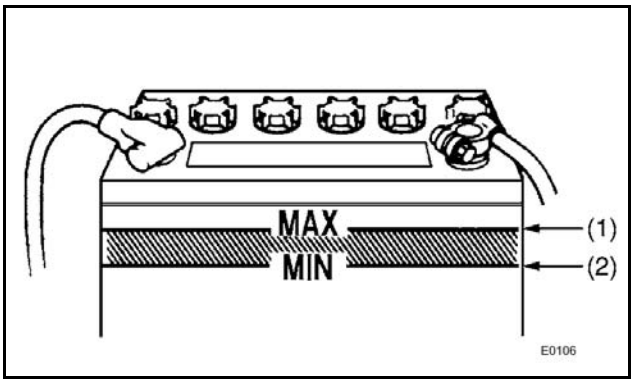


Fig. 3

1 Upper filling level mark

2 Lower filling level mark

- If the electrolyte level only reaches up to the lower filling level mark (2), fill distilled water into the corresponding cells.

Checking the electrolyte density

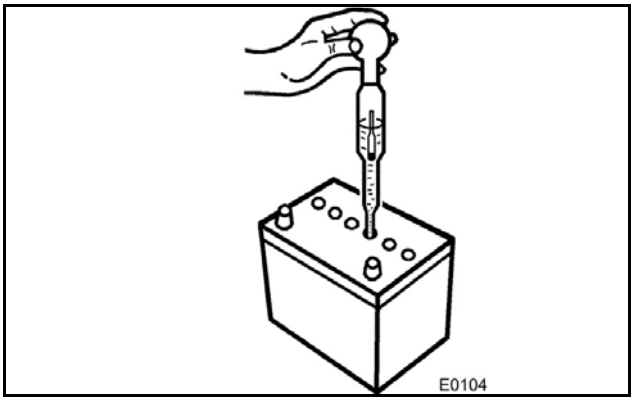


Fig. 4

The cells are filled with diluted sulphuric acid as electrolyte (approx. 25 Vol% sulphuric acid in distilled water), also referred to as accumulator acid, which has a density of 1.285 kg/dm^3 at a temperature of +27° Celsius. This means that one litre of electrolyte has a weight of 1.285 kg. As the cell is being discharged lead sulphate (PbSO4) will form on both electrodes and the electrolyte will increasingly change to water. Since water has a lower specific weight than diluted sulphuric acid, the density of the electrolyte will also drop during the discharge and with a fully discharged cell and a temperature of 27°C it will only be 1.18 kg/dm^3.

With a lead cell the acid density is therefore a measure for the charge condition. This characteristic is used to determine the charge condition of a lead battery. The so-called electrolyte tester (densimeter) is used for this purpose.

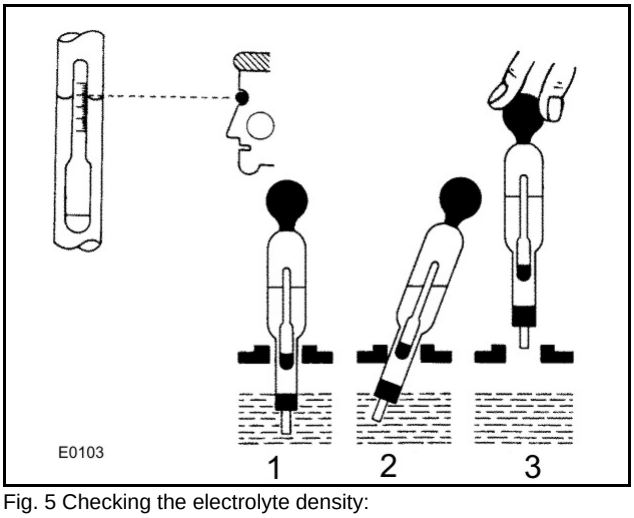


Fig. 5 Checking the electrolyte density:

1) correct

2) poor

3) poor

i Note

(Hold the pipe of the electrolyte tester vertically, without taking it out of the electrolyte.

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Do not draw too much electrolyte into the pipe.

Make sure that the float is not obstructed in its movement and hold the electrolyte tester at eye level.

The electrolyte tester must be read at the highest electrolyte level.

- If the electrolyte temperature deviates from the electrolyte tester calibration temperature, the indicated value for the specific electrolyte weight must be corrected acc. to the formula **(reference)** below.

Reference

The specific weight varies slightly with temperature. To be exact, the specific weight drops by 0.0007 per 1 °C temperature increase (by 0.0004 per 1 °F) and increases by 0,0007 per 1 °C temperature reduction (by 0,0004 per 1 °F) . If e.g. a temperature of 20 °C (68 °F) is used as reference, the indicated value of the specific weight must be corrected acc. to the following formula.

- Specific weight at 20 °C = measuring value + 0,0007 × (electrolyte temperature: 20 °C)
- Specific weight at 68 °F = measuring value + 0,0004 × (electrolyte temperature: 68 °F)

Acid density at 27 °C in kg/dm^3

- 1.25 -1.28, open-circuit voltage approx. 12.7 Volt. Battery is charged.
- 1.20 -1.24, open circuit voltage approx.12.4 to 12.5 Volt, is 50% discharged. Charging is necessary.
- 1.19 and less, open circuit voltage less than 12.3 Volt. Battery is insufficiently charged. The battery needs to be recharged immediately.
- If there is a deviation of the specific weight of more than 0.05 between any of the cells, the battery needs to be replaced.
- If the current consumption during charging is not 1/20 of the nominal capacity (example 100 Ah battery: 100Ah x 1/20 = 5 A) or full recharging of the battery results in a final electrolyte density of only 1.24 kg/dm3 or less, the battery shows normal wear by aging. The battery was insufficient charging or exhaustive discharge.

Testing batteries without screw plugs

On closed batteries the acid density cannot be measured, we therefore recommend testing with the following mobile tester:



Fig. 6 Battery and generator tester

The battery and generator tester comes with an 8-line LC display with background illumination and is able to print out test results via an (optional) integrated thermal printer.

i Note

Before testing clean the poles and ensure good connection between clamps and poles.

The test program calculates the text messages "good" or "replace" on the basis of the charge condition (derived from the battery voltage) and the currently available starting power of the battery. A battery with 45% starting power may thus be rated good and another one with 75% starting power as poor ("replace").

The starting power represents the ratio of detected cold testing current to the entered cold testing current of the battery.

The starting power can exceed 100%.

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Charge condition with hydrometer

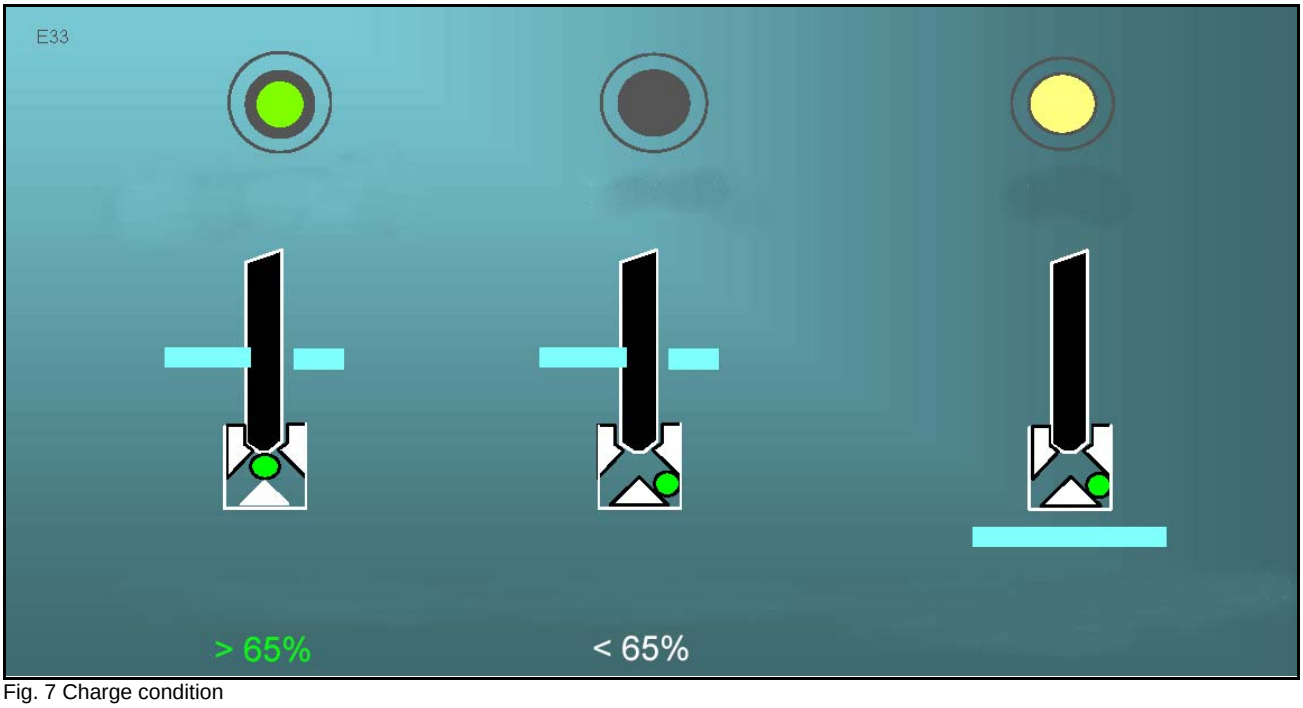


Fig. 7 Charge condition

Green = Charge condition >65%

Dark = Charge condition <65%

Light = Electrolyte level too low

⚠ Danger

Danger of explosion!!! If the electrolyte level is too low, the battery must no longer be charged.

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4.20 Battery maintenance

⚠ Danger

Danger of cauterisation ! Danger of explosion!

When working on the battery do not use open fire, do not smoke!

The battery contains acid. Do not let acid come in contact with skin or clothes!

Wear protective clothing!

Do not lay any tools on the battery!

Environment

Dispose of the old battery environmentally.

i Note

Maintenance free batteries also need care. Maintenance free only means that the fluid level does not need to be checked. Each battery suffers under self-discharge, which may, in not checked occasionally, even cause damage to the battery as a result of exhaustive discharge.

The following therefore applies for the service life:

- Switch off all consumers (e.g. ignition, light, inside light, radio).
- Check open-circuit voltage of the battery at regular intervals. At least once per month.

Reference values: 12.6 V = fully charged; 12.3 V = 50% discharged.

- Recharge the battery immediately after an open-circuit voltage of 12.25 V or less is reached. Do not perform boost charging.

The open-circuit voltage of the battery occurs approx. 10 hours after the last charging process or one hour after the last discharge.

- After each charging process allow the battery to rest for one hour before taking it into service.
- For resting periods of more than one month you should always disconnect the battery. Do not forget to perform regular open-circuit voltage measurements.

⚠ Caution

Exhausted batteries (batteries with formation of sulphate on the plates are not covered under warranty!

- Open the cover.

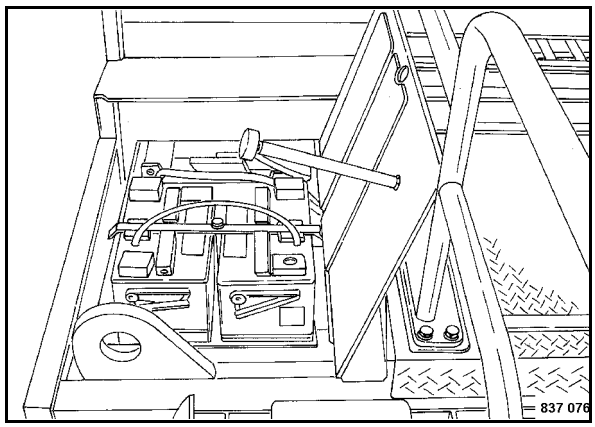


Fig. 8

- Remove the battery (Fig. 8) and clean the battery compartment.
- Clean the outside of the battery.
- Clean battery poles and pole clamps and grease them with pole grease (Vaseline).
- Check the fastening of the battery.
- On serviceable batteries check the acid level, if necessary top up to the filling mark with distilled water.

Charging voltage recommendation

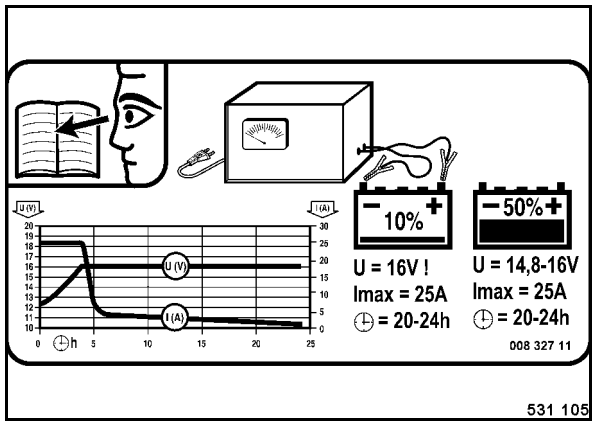


Fig. 9

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4.21 Starting with jump wires

⚠ Caution

When using external starting aid two external batteries (24 V system) are required, one for each onboard battery.

A wrong connection will cause severe damage in the electric system.

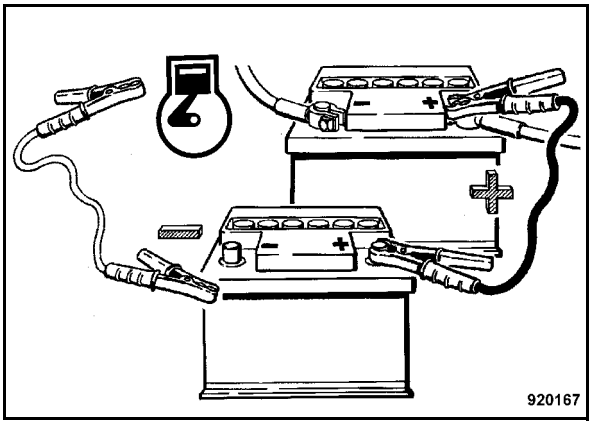


Fig. 10

- First connect the plus poles with the jump lead.
- Then connect the ground cable first to the minus pole of the current supplying auxiliary battery and then to engine or chassis ground, as far away from the battery as possible (Fig. 10).
- Start as described under "Starting the engine".
- Once the engine is running switch on a powerful consumer (working light, etc.).

⚠ Caution

If no powerful consumer is switched on voltage peaks may occur when separating the connecting cables between the batteries, which could damage electrical components.

- After starting disconnect the negative poles (ground cable) first and the positive poles after.
- Switch off the consumer.

4.22 Main battery switch

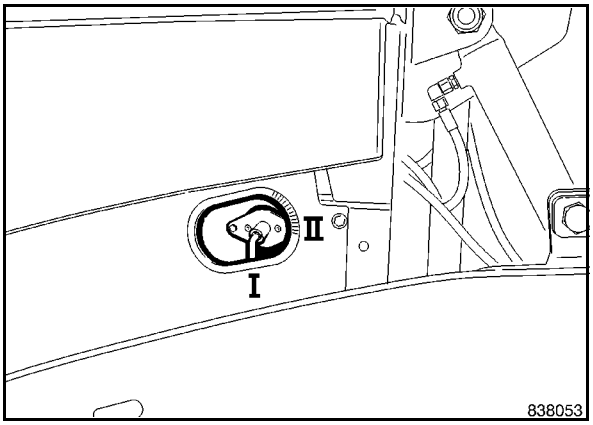


Fig. 11

No. 1 = Main battery switch

Position "I" = Normal position, operation

Position "II" = Separates batteries from the onboard electrics in case of cable fire and fire in the engine compartment as well as protection against unauthorized use.

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Fuses, relays and diodes in the dashboard (Fig. 1)

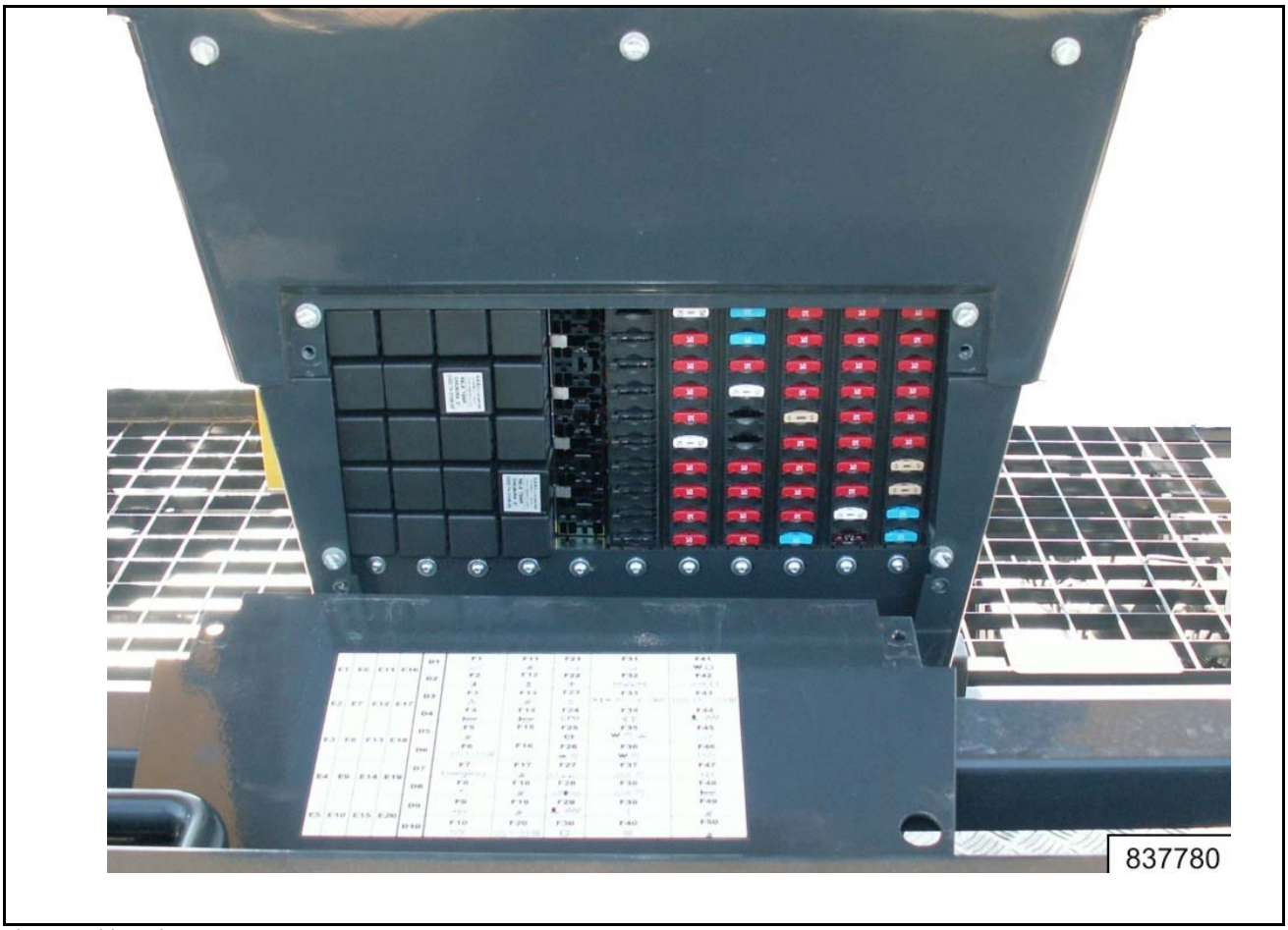


Fig. 1 Dashboard

E1	E6	E11	E16	D1	F1	F11	F21	F31	F41
				D2	F2	F12	F22	F32	F42
E2	E7	E12	E17	D3	F3	F13	F23	F33	F43 LCS,
				D4	F4	F14	F24	F34	F44
E3	E8	E13	E18	D5	F5	F15	F25 CPU	F35	F45
				D6	F6	F16	F26	F36	F46 LCS
E4	E9	E14	E19	D7	F7 Emergency	F17	F27	F37	F47
				D8	F8	F18	F28	F38	F48
E5	E10	E15	E20	D9	F9	F19	F29	F39	F49
				D10	F10 12V	F20	F30	F40	F50

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Fig. 2 BF 600C

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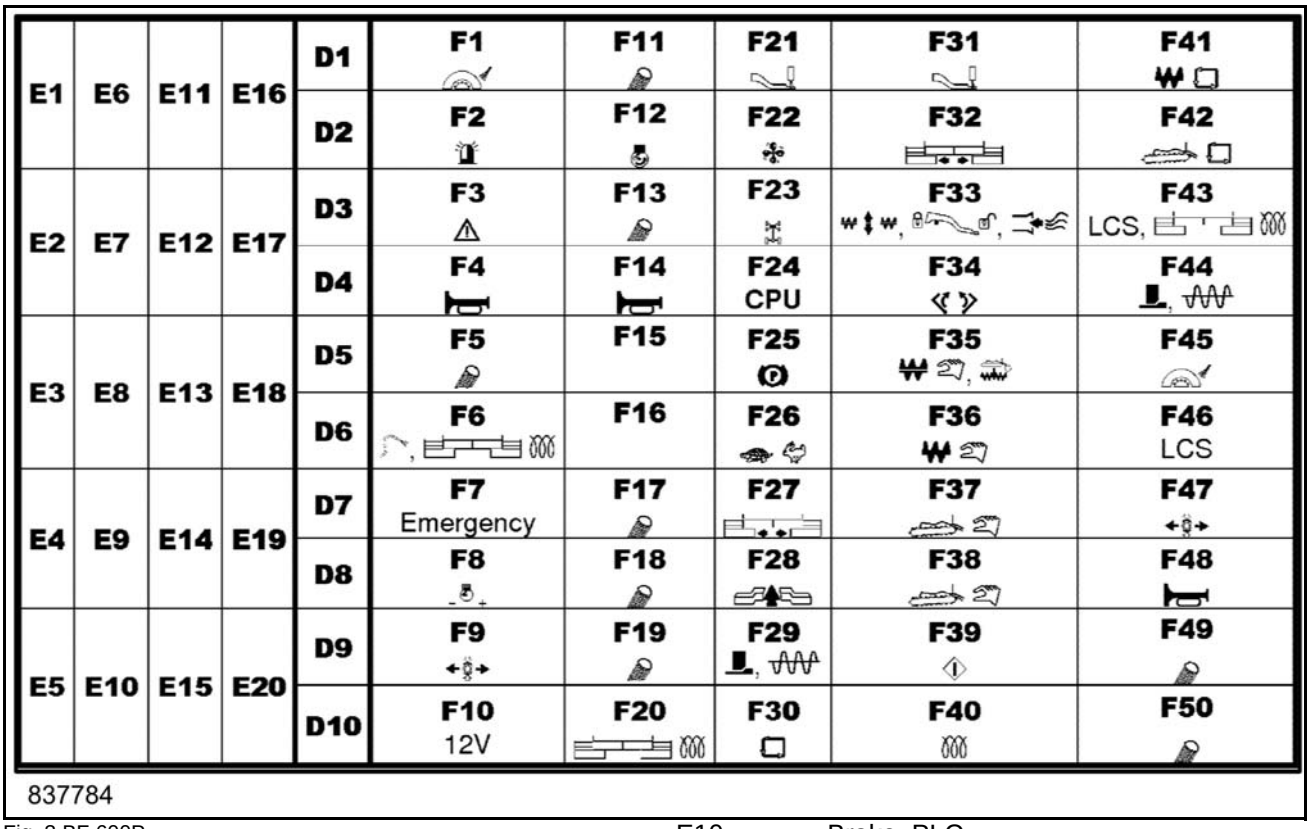


Fig. 3 BF 600P

(D) diodes, (E) relays, (F) fuses

⚠ Danger

Fire hazard!

Do not use fuses with higher ampere ratings and do not bridge fuses.

D1 = Dashboard light
D2 = Dashboard light
D3 = Main switch hydraulics
D4 = Main switch hydraulics
D5 = Warning buzzer
D6 = Display elements
D7 = Automatic functions, travel direction forward
D9 = Loading functions
D10 = Automatic conveyor belt
E1 = Ignition
E2 = Warning buzzer
E3 = Horn
E4 = Rear working light
E5 = Working lights, front
E6 = Emergency stop
E7 = Main switch hydraulics
E8 = EMR
E9 = Automatic screw, conveyor belt
E10 = Brake, PLC
E13 = 2. gear
E14 = L.C.S.
E15 = Screw, right
E16 = Screw, left
E17 = Main switch hydraulics
E18 = Automatic functions, bucket screed extension
E19 = Transport mode
F1 = 25A- Water pump
F2 = 10A- Flashing beacon
F3 = 10A- Pressure switch brake, warning buzzer
F4 = 10A- Horn, lateral operator stand
F5 = 10A- Working lights
F6 = 25A- Washing pump
F7 = 10A- Emergency stop
F8 = 10A- ECO mode
F9 = 10A- Travel, transport mode
F10 = 10A- Voltage converter 24V/12V
F11 = 10A- Fan
F13 = 15A- EMR
F14 = 25A- Warning horn, dashboard
F17 = 15A- Working lights, front
F18 = 15A- Working lights, rear
F19 = 10A- Dashboard illumination

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F20 = 10A- Temperature control, heating
F21 = 10A- Levelling, right
F22 = 10A- Transport mode
F25 = 3A- Brake, PLC
F26 = 10A- 2. gear
F27 = 10A- Screed extension, right
F28 = 10A- Screed up
F29 = 10A- Compaction control display
F30 = 15A- Automatic functions
F31 = 10A- Levelling, left
F32 = 10A- Screed extension, left
F33 = 10A- Screw up/down
F34 = 10A- Hopper wings
F35 = 10A- Screw, right
F36 = 10A- Screw, left
F37 = 10A- Conveyor belt, right
F38 = 10A- Conveyor belt, left
F39 = 25A- Main switch, hydraulics
F40 = 7,5A- Preheating system
F41 = 10A- Screw
F42 = 10A- Conveyor belt
F43 = 10A- L.C.S. Type 2*
F44 = 10A- Tamper, vibration
F45 = 10A- Water spray box
F46 = 10A- L.C.S. Type 1
F47 = 10A- Automatic functions, travel direction forward
F48 = 5A- Travel, reverse

Fuses under operator's stand, left side (battery box) (Fig. 4)

* Optional equipment

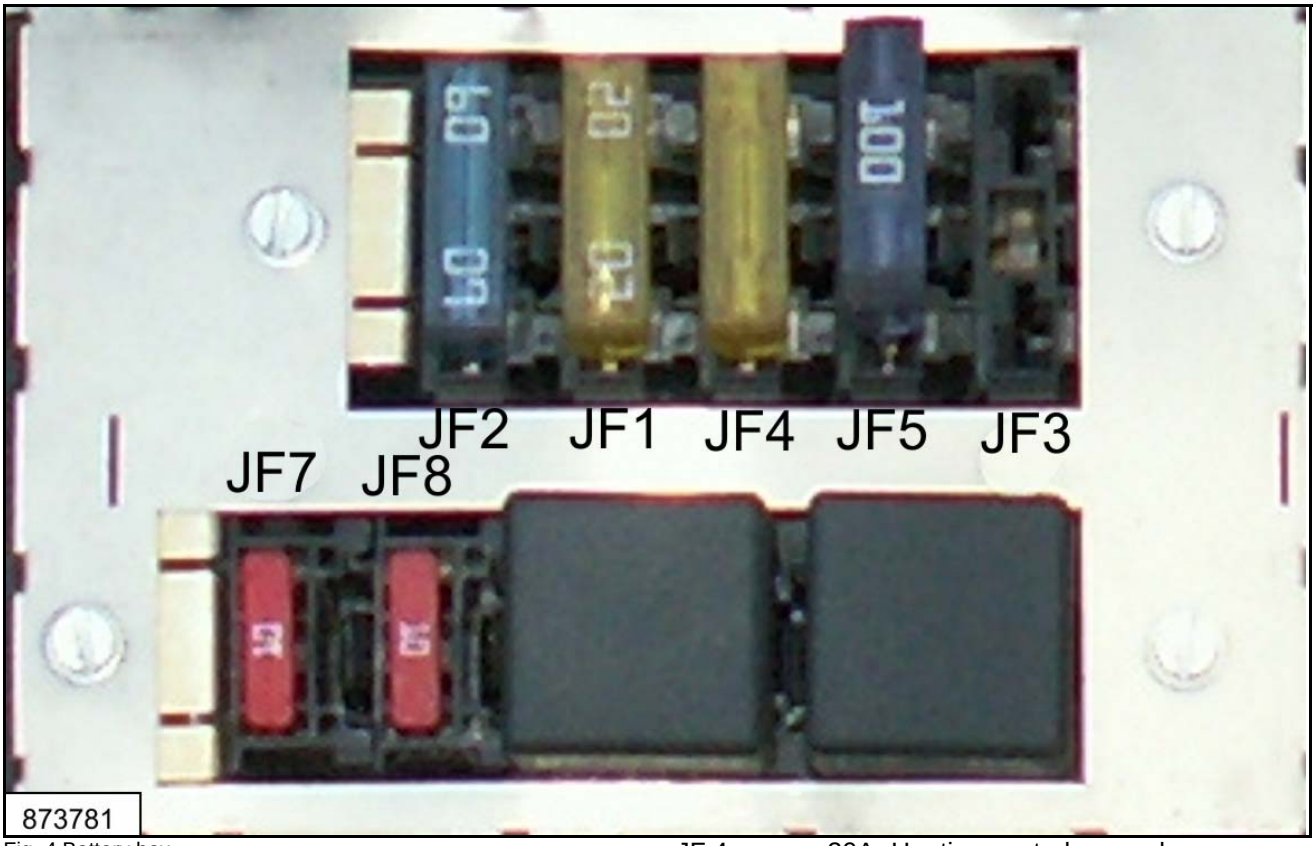


Fig. 4 Battery box

⚠ Danger

Fire hazard!

Do not use fuses with higher ampere ratings and do not bridge fuses.

JF 1 = 20A- Brake, PLC
JF 2 = 60A- General, ignition
JF 3 = 20A- Xenon light**
JF 4 = 20A- Heating control, screed
JF 5 = 100A- Pre-heating system
JF 7 = 15A- Lights, front
JF 8 = 15A- Lights, rear

** Optional equipment

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Control cabinet for electric heater (Fig. 5)

On left side of vehicle.

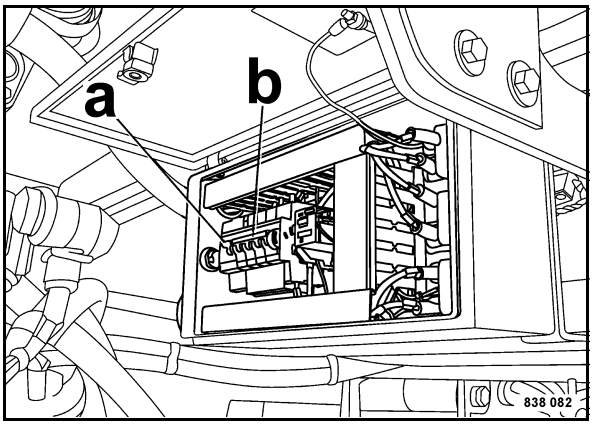


Fig. 5

a = Ground fault circuit interrupter for electric screed heating

b = Fuses for electric screed heating

4.24 Replace heating elements

⚠ Danger

Life hazard!

High voltage 400 Volt

Work on the electric heating system must only be performed by skilled personnel.

i Note

Defective heating elements are indicated by means of LEDs on the terminal box (Fig. 7).

Replacing the heating elements for the base plate

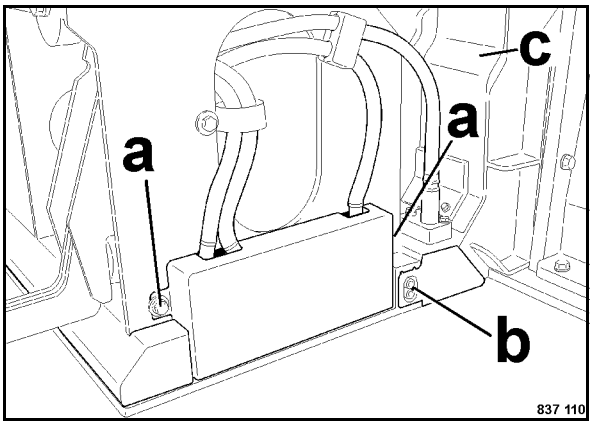


Fig. 6

- Unscrew fastening screws a (Fig. 6) and remove the protection cover.

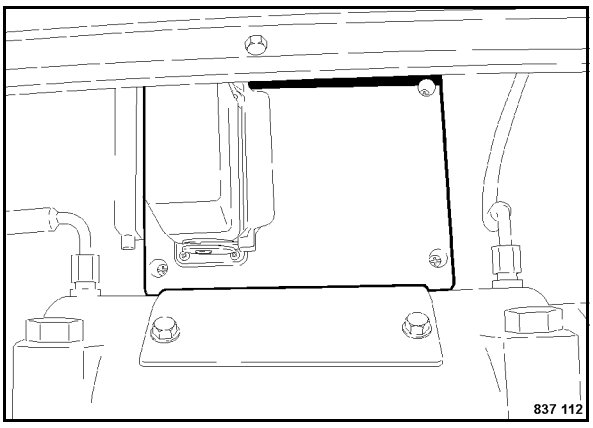


Fig. 7

- Pull the plug off the junction box (Fig. 7) and remove the cover.
- Disconnect the cable for the defective heating element.

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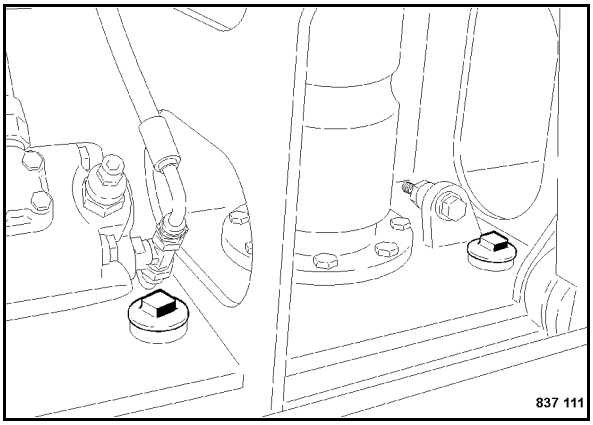


Fig. 8

- Unscrew the plug (Fig. 8) and loosen the clamping screws underneath.
- Pull the heating element out to the side.

⚠ Caution

Do not overtighten the clamping screws for the heating elements, this may damage the heating elements.

- Push in a new heating element, tighten the clamping screw lightly.
- Connect the heating element.
- Close the junction box, screw in the plug and reassemble the guard.

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Replacing the heating element for the tamper

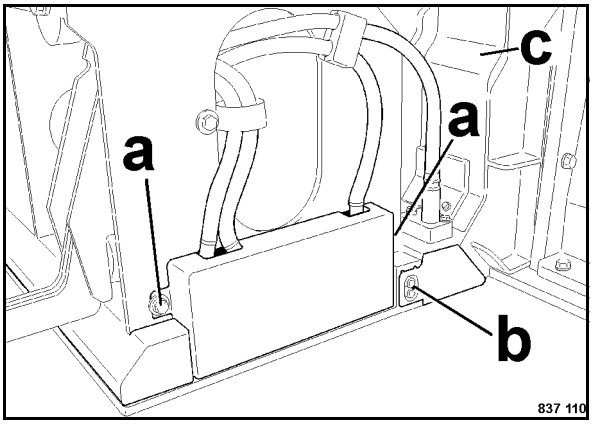


Fig. 9

- Unscrew the fastening screws b (Fig. 9) and take off the holding block.
- Remove the protection plate (c).
- Disconnect the cable inside the terminal box (Fig. 7).

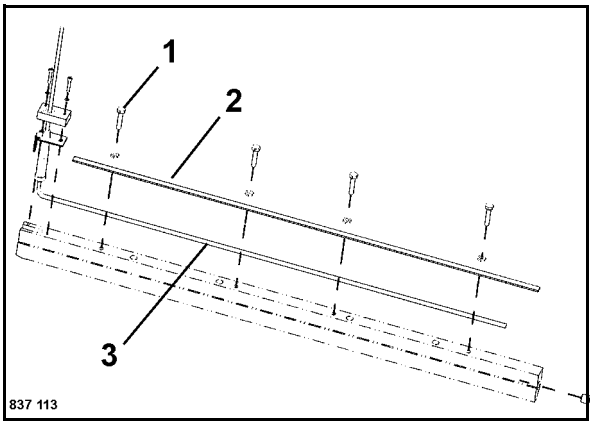


Fig. 10

- Loosen the fastening screws 1 (Fig. 10) for the terminal strip (2) and pull out the heating element.
- Slide in, fasten and connect a new heating element.

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The failure code will repeated all 10 seconds

Failure code number
1 = unique flashing all 10 seconds

Failure code number
8 = 8 flashing all 10 seconds

One flash takes 0,5 seconds

Failure code number
1 = 0,5 seconds flashing and 9,5 seconds with switched off LED.

Failure code number
8 = 8 flashing with 8 x 0,5sec. LED on and 8 x 0,5 sec LED off followed from 2 sec. interruption before the flashing code starts again.



Fig. 1

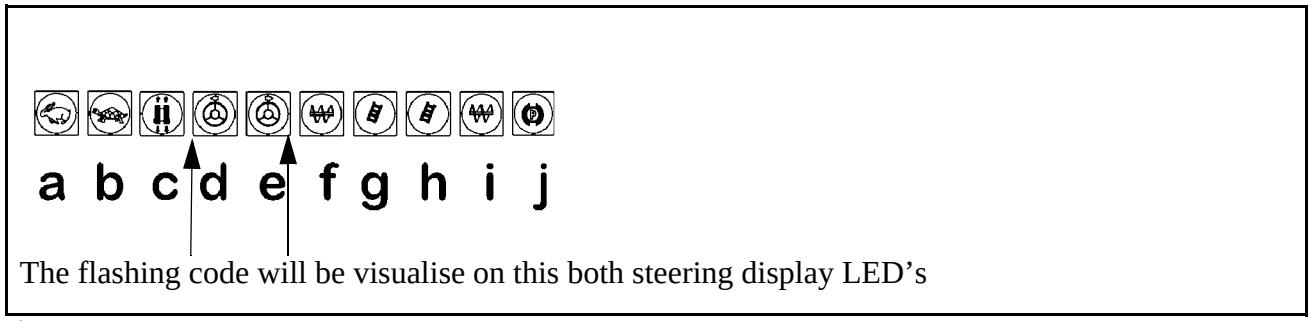


Fig. 2

Amount of flashings	Which kind of failure	which LED is flashing
1	Failure on the speed sensor (motor left)	only left
1	Failure on the speed sensor (motor rigt)	only right
2	Failure on the potentiometer foot pedal	left & right
3	Failure on the potentiometer for the driving speed	left & right
4	Failure on the potentiometer for the steering	left & right
5	Failure on the EDC driving pump left	only left
5	Failure on the EDC driving pump right	only right
6	Failure on the CAN BUS or EMR for the engine	left & right
7	Calibration of the potentiometer for the driving speed	left & right
7	Calibration of the potentiometer for the food pedal	left & right
7	Calibration of the potentiometer for steering	left & right
8	Calibration for the EDC driving pump	left & right

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5 Engine electrics

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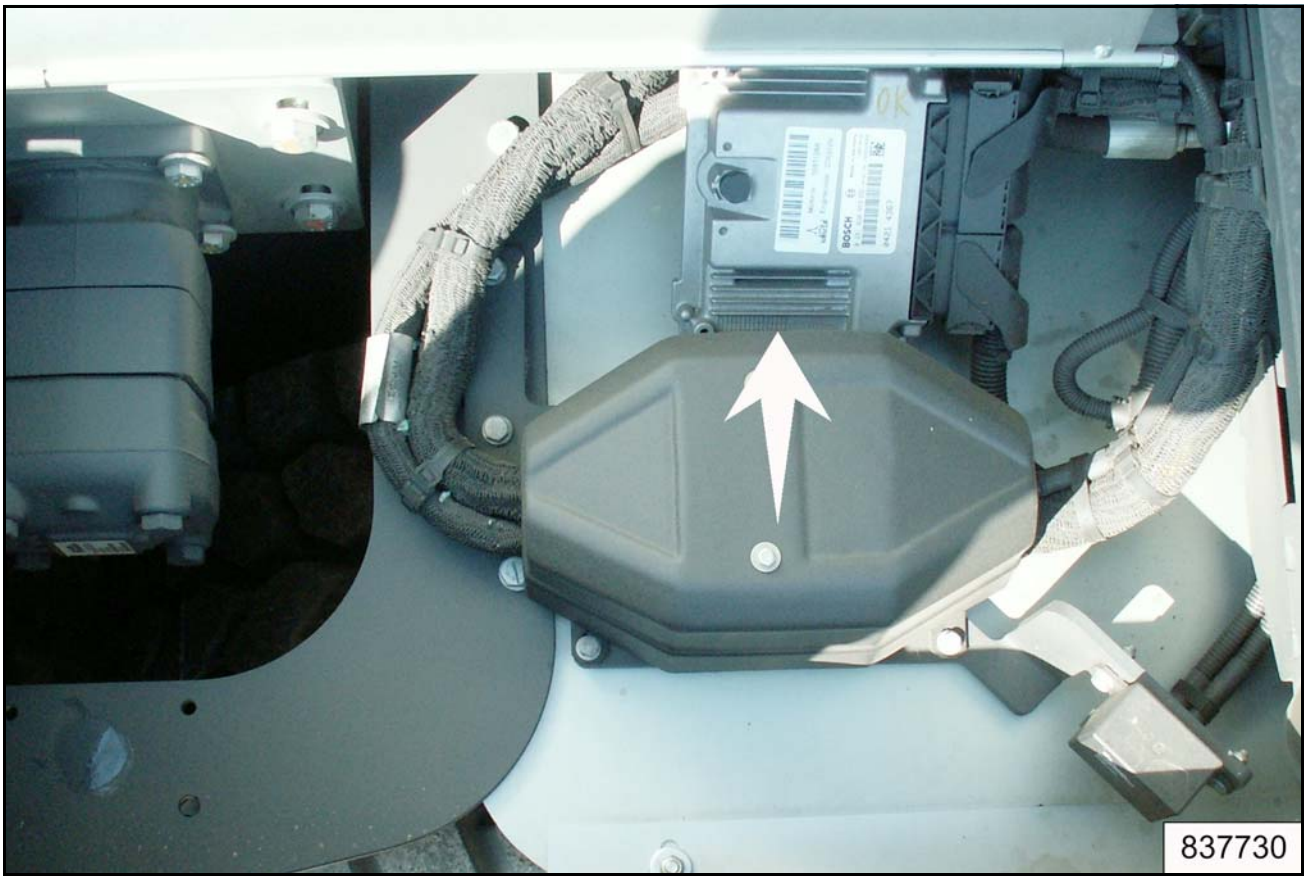


Fig. 1

Installation location under the operator's stand on right hand side.

i Note

Slide the operator's stand to the left and open the floor flap on the right hand side.

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5.2 EMR3 system components

Engine control unit

⚠ Caution

It is not permitted to interchange control units from one manufacturing series or against another engine number. In this case the warranty will become null and void.

Sensors and actuators must not be connected to external power sources for the purpose of testing, but must only be operated on the EMR3. Otherwise components may be permanently damaged.

Pulling off the plug connectors of the control unit while the control unit is working (i.e. with the power supply to terminal 15switched on) is not permitted. Correct procedure: Switch off the electric power supply (normally with the ignition key), wait until the main relay has switched off (with a delay of up to 15 seconds, listen for clicking sound), then pull off the plugs from the control unit.

The engine control unit is the central component of the EMR3-system. It has the function of ensuring optimal performance of the engine with the following goals

- excellent exhaust gas characteristics,
- low fuel consumption,
- smooth running of engine,
- long lifetime of engine,
- efficient servicing

under all operating conditions. For this purpose the engine control unit uses the recorded measuring values and the parameters stored in its data memory to run a number of calculations, which form the basis or all the available functions. The most important functions include:

- exact control of the injection process (among others the number, start and duration of injections),
- idle speed regulation,
- regulation of exhaust gas recirculation,
- optimization of smooth running (by means of injection quantity correction),
- engine monitoring,
- system diagnose.

Replacing the control unit

Each control unit is clearly designated to the engine, in accordance with the respective application. In case of a replacement the control unit therefore needs to be completed with the engine specific data set. When ordering a new control unit you must not only specify the part-number, but also the engine serial number (see sticker on EMR-control unit).

i Note

The Deutz part-number specified on the EMR-control unit is the part number without software specific for the engine. The correct part number can be found in the spare parts catalogue.

Replacing the EMR or DCR components

- On TCD-engines with Common Rail technology the system pressure is so high, that in case of leaks or repair all parts need to be replaced. When replacing sensors or other electric components, the new parts must be calibrated with the EMR control unit. This calibration must be performed with SERDIA (Level IIIa). (see also SERDIA manual).
- Any other EMR components (sensors etc) must under no circumstances be repaired, but must be replaced if they are defective.

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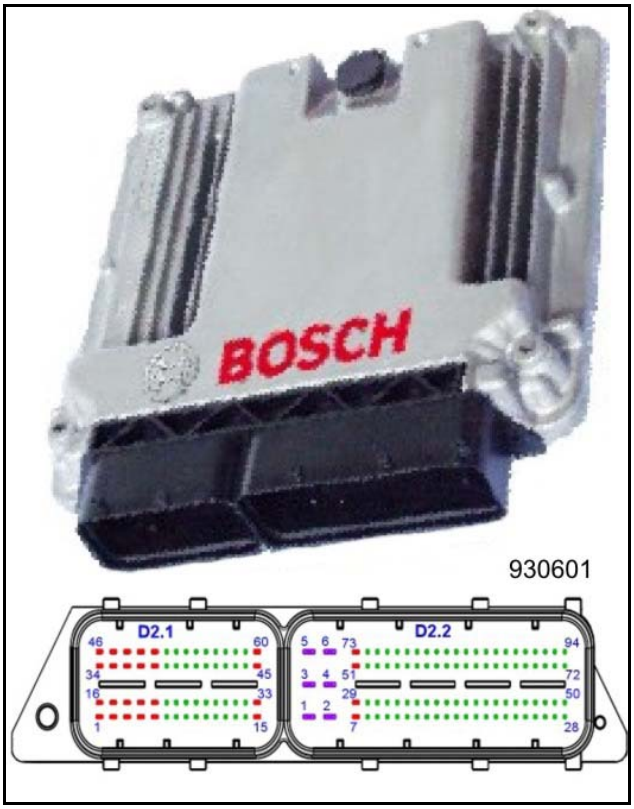


Fig. 2

The EMR3-S (TCD 2012 and TCD 2013) (Fig. 2) engine control unit is fitted with two sockets on the front side of the housing:

- socket D2.1 to connect the engine wiring loom,
- socket D2.2 to connect the vehicle wiring loom.

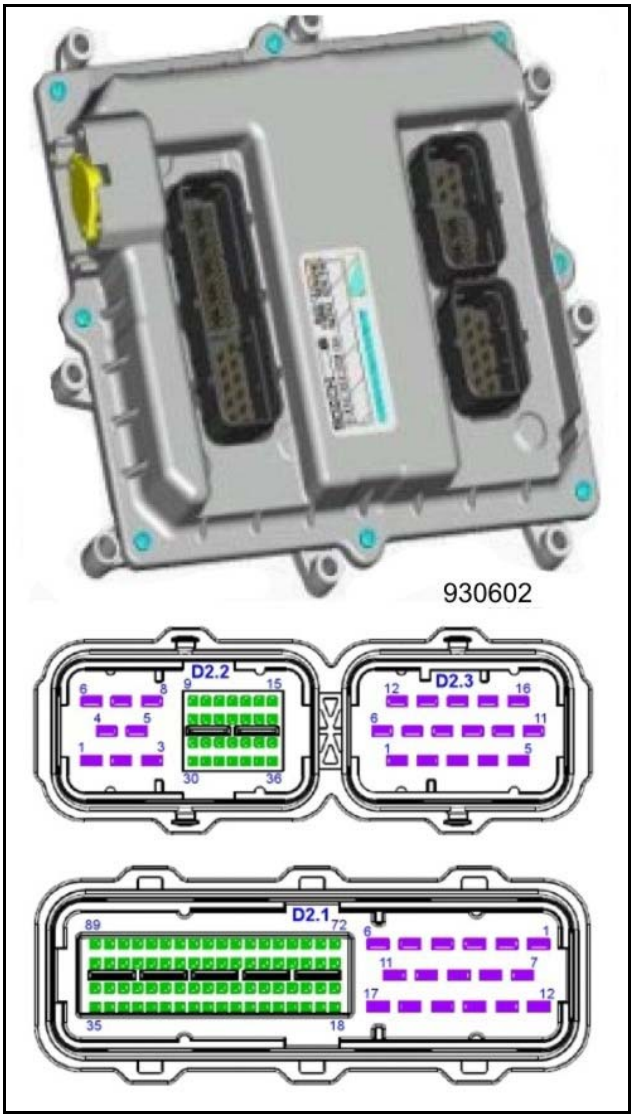


Fig. 3

The EMR3-E (TCD 2015) (Fig. 3) engine control unit is fitted with three sockets on the upper side of the housing:

- socket D2.1 to connect the vehicle wiring loom,
- socket D2.2 to connect the engine wiring loom for sensors and actuators,
- socket D2.3 to connect the engine wiring loom for fuel metering unit and injection valves.

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EMR-3 system in connection with injection system and electrics

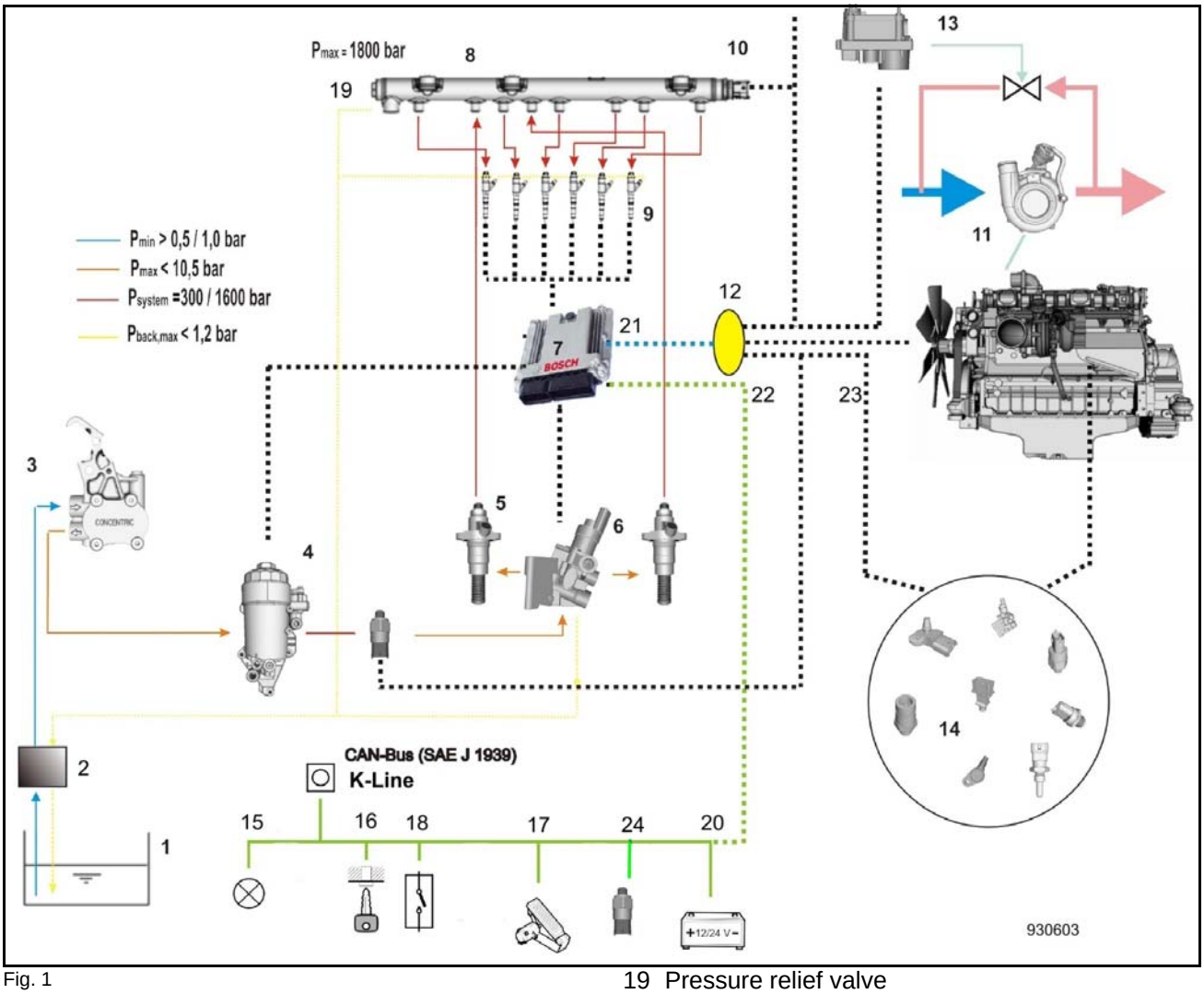


Fig. 1

1 Fuel tank
2 Pre-filter
3 Fuel lift pump
4 Fuel filter
5 High pressure fuel pump
6 Fuel control unit FCU
7 Control unit
8 High pressure accumulator, Rail
9 Injector
10 Rail pressure sensor
11 Exhaust gas turbocharger
12 Engine transfer plug
13 Exhaust gas recirculation, option
14 Engine sensors
15 Diagnostics lamp
16 Ignition switch
17 Pedal
18 Diagnostics button
19 Pressure relief valve
20 Battery terminal 31 and 30
21 Connecting line control unit-engine
22 Wiring loom connecting cable
23 Engine wiring harness
24 Sensor, water in fuel

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Sensors TCD 2012/2013

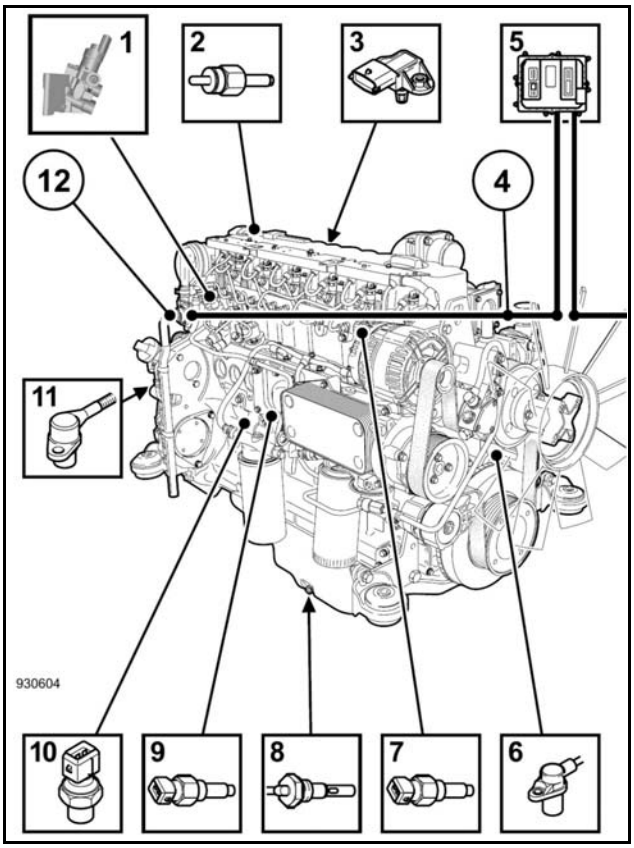


Fig. 1

1 Fuel control unit FCU
2 Coolant temperature sensor
3 Sensor for charge air temperature and charge air pressure
4 Wiring loom connecting cable
5 Engine control unit
6 Crankshaft speed sensor
7 Rail pressure sensor
8 Oil level sensor, option
9 Oil pressure sensor
10 Fuel pressure sensor
11 Camshaft speed sensor
12 Central plug

Sensors TCD 2015

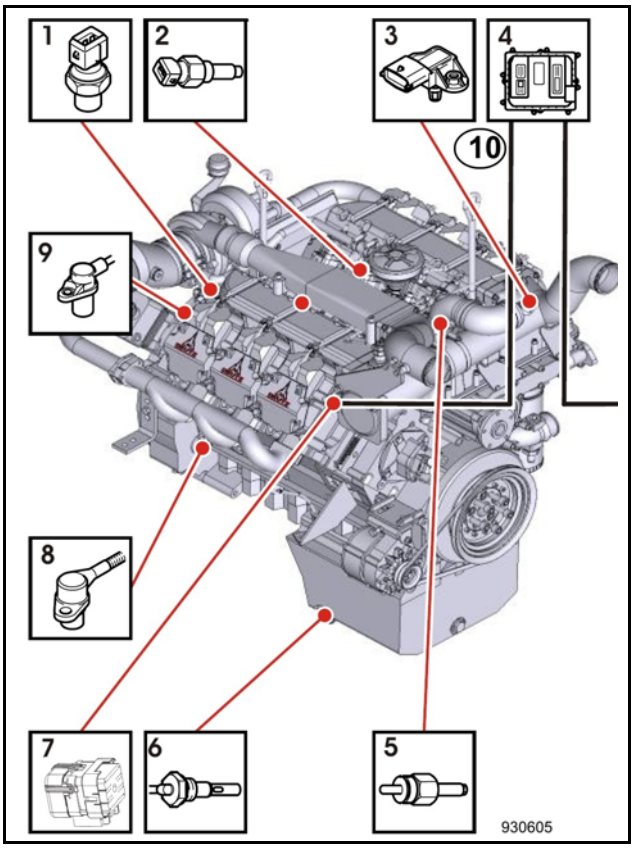


Fig. 1

1 Oil pressure sensor
2 Fuel temperature sensor
3 Sensor for charge air temperature and charge air pressure
4 Engine control unit
5 Coolant temperature sensor
6 Oil level sensor, option
7 Central plug
8 Crankshaft speed sensor
9 Camshaft speed sensor
10 Wiring loom connecting cable

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Shut down the engine.

When shutting down the engine, the ignition switch isolates the electronic system from terminal 15. The injectors are closed immediately, the Rail pressure is discharged in an orderly manner and the counter readings are saved in the non-volatile memory. During this time the system must not be disconnected from terminal 30 ($+U_{batt}$). Once the time has expired the main relay switches off and the control unit is no de-energized..

The main relay serves the purpose of releasing the vehicle energy supply for the EMR3 system.

- The EMR3 engine control unit requires an external main relay (relay K41, in single drum rollers and tandem rollers), (relay E8 in road finishers), see machine related circuit diagram.
- The EMR3-E engine control unit has an internal electronic main relay.

The following applies for both control units: when terminal 15 is no longer connected to battery (+) (i.e. after the ignition has been switched off), the main relay is switched off after approx. 10 seconds.

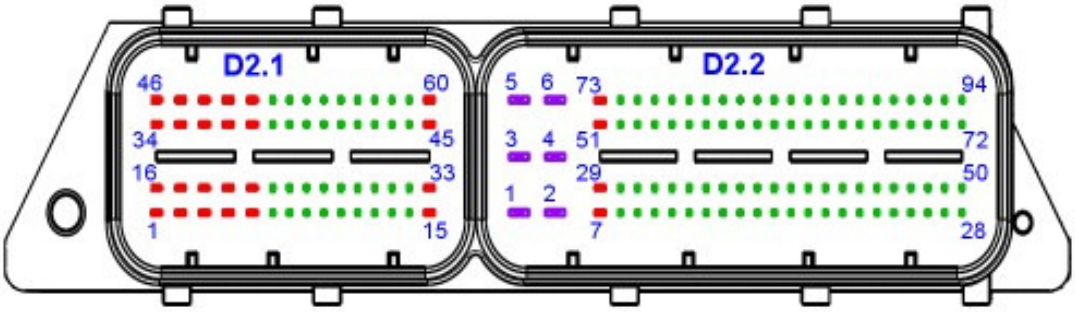
The main relay thereby disconnects the control unit from terminal 30 battery (+), whereby it becomes de-energized.

On the EMR3-S the fault state of the main relay can be examined directly on Pin72, on the EMR3-E on Pin13.

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5.3 Pin assignment of engine control EDC16 / EMR3

Pin assignment



Max. cable cross section: **2,5 mm²**, **1,5mm²**, **0,75 mm²**

Pinout for EMR3-EDC16

Pin	Signal type	Function / components	Remark / Technical data
D2.2.1	power supply (+)	power supply ECUs	U_{Bat} (terminal 30)
D2.2.3	power supply (+)		
D2.2.5	power supply (+)		
D2.2.2	power supply (–)	power supply ECUs	U_{Gnd} (terminal 31)
D2.2.4	power supply (–)		
D2.2.6	power supply (–)		
D2.2.28	signal input, digital	operating signal for ECU	U_{Bat} switched (terminal 15) U > 4,79 V: ECU switched on U < 3,63 V: ECU switched off
D2.2.72	power supply (–), switched	main relay	12V: 140 mA, 120 mH at 1 kHz 24V: 80 mA, 350 mH at 1 kHz
D2.2.9	signal input, analog, with Pulldown-resistance	footpedal (setpoint)1	U_{in}= 0...5 V, R_{down} = 100 kΩ
D2.2.22	power supply (+)	footpedal (setpoint)1	U_{out} = 5 V
D2.2.30	power supply (–)	footpedal (setpoint)1	Intern with U_{Gnd} connected
D2.2.58	signal input, digital, with Pullup-resistance	idle switch footpedal1	external switch to U_{Gnd}, R_{up} = 100 kΩ, U_{low} = 2,1 V, U_{high} = 3,9 V
D2.2.31	signal input, analog, with Pulldown-resistance	handthrottle (setpoint) 2	U_{in} = 0...5 V, R_{down} = 100 kΩ
D2.2.46	power supply (+)	handthrottle (setpoint) 2:	U_{out} = 5 V
D2.2.8	power supply (–)	handthrottle (setpoint) 2:	Intern with U_{Gnd} connected
D2.2.81	signal input, digital, with Pullup-resistance	idle switch footpedal2	external switch to U_{Gnd}, R_{up} = 100 kΩ, U_{low} = 2,1 V, U_{high} = 3,9 V
D2.2.10	power supply (–)	Temperature sensor 2 (optional)	internal with U_{Gnd} connected

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Pin	Signal type	Function / components	Remark / Technical data
D2.2.11	signal input, analog,with Pullup-resistance	Temperature sensor 2 (optional)	U_{in} = 0...5 V, R_{up} = 1,3 kΩ
D2.2.12	power supply (–)	Oil level sensor	internal with U_{Gnd} connected
D2.2.13	signal input, analog,with Pullup-resistance	Oil level sensor	U_{in} = 0...5 V, R_{up} = 1,28 kΩ
D2.2.45	power supply (+)	Oil level sensor	U_{out} = 5 V
D2.2.14	power supply (–)	multiple state switch for speed	internal with U_{Gnd} connected
D2.2.15	signal input, analog,with Pullup-resistance	multiple state switch for speed	U_{in} = 0...5 V, R_{up} = 2,3 kΩ
D2.2.86	power supply (–)	multiple state switch for droop	internal with U_{Gnd} connected
D2.2.89	signal input, analog,with Pullup-resistance	multiple state switch for droop	U_{in} = 0...5 V, R_{up} = 2,3 kΩ
D2.2.17	signal input, digital, with Pulldown-resistance	break switch	external switch to U_{Bat}, R_{down} = 6,8 kΩ, U_{low} = 2,2 V, U_{high} = 3,7 V
D2.2.80	signal input, digital, with Pulldown-resistance	break switch	external switch zu U_{Bat}, R_{down} = 6,8 kΩ, U_{low} = 2,2 V, U_{high} = 3,7 V
D2.2.40	signal input, digital, with Pulldown-resistance	clutch switch	external switch to U_{Bat}, R_{down} = 6,8 kΩ, U_{low} = 2,2 V, U_{high} = 3,7 V
D2.2.54	signal input, digital, with Pulldown-resistance	exhaust gas break switch	external switch to U_{Bat}, R_{down} = 6,8 kΩ, U_{low} = 2,2 V, U_{high} = 3,7 V
D2.2.43	signal input, digital, with Pulldown-resistance	Engine start switch	external switch to U_{Bat}, R_{down} = 6,8 kΩ, U_{low} = 2,2 V, U_{high} = 3,7 V
D2.2.77	signal input, digital, with Pulldown-resistance	intake air differential pressure switch	external switch to U_{Bat}, R_{down} = 6,8 kΩ, U_{low} = 2,2 V, U_{high} = 3,7 V
D2.2.52	signal input, digital,with Pullup-resistance	switch (customer-specific)	external switch to U_{Gnd}, R_{up} = 5 kΩ, U_{low} = 2,2 V, U_{high} = 3,7 V
D2.2.19	signal input, digital,with Pullup-resistance	Override switch	external switch to U_{Gnd}, R_{up} = 5 kΩ, U_{low} = 2,3 V, U_{high} = 3,7 V
D2.2.79	signal input, digital,with Pullup-resistance	coolant level switch	external switch to U_{Gnd}, R_{up} = 6,8 kΩ, U_{low} = 2,2 V, U_{high} = 3,7 V
D2.2.87	signal input, digital,with Pullup-resistance	governor mode switch	external switch to U_{Gnd}, R_{up} = 6,8 kΩ, U_{low} = 2,2 V, U_{high} = 3,7 V
D2.2.57	signal input, digital,with Pullup-resistance	droop switch	external switch to U_{Gnd}, R_{up} = 5 kΩ, U_{low} = 2,2 V, U_{high} = 3,7 V
D2.2.55	power supply (+), switched	diagnosis lamp	0,3 A at 12 V, 4 W at 24 V switch-on current 0,9 A

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Pin	Signal type	Function / components	Remark / Technical data
D2.2.71	power supply (–), switched	Oil alarm lamp	0,3 A at 12 V, 4 W at 24 V switch-on current 0,9 A
D2.2.51	power supply (+), switched	Oil alarm lamp	
D2.2.7	power supply (+), switched	engine running or boost temp lamp	0,3 A at 12 V, 4 W at 24 V switch-on current 0,9 A
D2.2.94	power supply (–), switched	engine running or boost temp lamp	
D2.2.29	power supply (+), switched	Alarm lamp (customer-specific)	$U_{out} = U_{Bat}$, I_{max} = 6 A
D2.2.70	power supply (–), switched	Temperature alarm lamp	0,3 A at 12 V, 4 W at 24 V switch-on current 0,9 A
D2.2.92	power supply (–), switched	heater lamp	0,3 A at 12 V, 4 W at 24 V switch-on current 0,9 A
D2.2.63	power supply (–)	fuel filter water level sensor	internal with U_{Gnd} connected
D2.2.64	signal input, analog,with Pullup-resistance	fuel filter water level sensor	U_{in} = 0...5 V, R_{up} = 120 kΩ
D2.2.76	power supply (–)	Oil Temperature sensor	internal with U_{Gnd} connected
D2.2.66	signal input, analog,with Pullup-resistance	Oil Temperature sensor	U_{in} = 0...5 V, R_{up} = 1,28 kΩ
D2.2.75	signal input, digital,with Pullup-resistance	velocity sensor	external switch to U_{Bat}, R_{up} = 6,8 kΩ, U_{low} = 2,2 V, U_{high} = 3,7 V
D2.2.53	power supply (–)	velocity sensor	internal with U_{Gnd} connected
D2.2.48	signal output, digital (PWM),with Pullup-resistance, minus-switched	engine speed sensor	I_{max} = 50 mA, f_{max} 5kHz, Standard: 60 Impulse/Rotation
D2.2.23	power supply (+)	Fan speed sensor	U_{Out} = 5 V
D2.2.84	signal input, digital,with Pullup-resistance	Fan speed sensor	I_{max} = 20 mA, f_{max} = 1 kHz
D2.2.59	power supply (–)	Fan speed sensor	internal with U_{Gnd} connected
D2.2.73	power supply (+)	Fan control	R > 30 Ω at 24 V R > 10,6 Ω at 12 V L = 15...80 mH switch-on current 1,9 A at 16 V (15 Minutes) f_{max} = 300Hz f_{min} = 15Hz
D2.2.90	power supply (–), switched	Fan control	
D2.2.83	signal input, digital,with Pullup-resistance	PDM-setpoint	external switch to U_{Gnd}, R_{up} = 100 kΩ, U_{low} = 2,1 V, U_{high} = 3,9 V
D2.2.85	power supply (–)	PDM-setpoint	internal with U_{Gnd} connected
D2.2.32	signal input, analog,with Pullup-resistance	Temperature sensor (customer-specific)	U_{in} = 0...5 V, R_{up} = 1,3 kΩ
D2.2.33	power supply (–)	Temperature sensor (customer-specific)	internal with U_{Gnd} connected
D2.2.34	signal input, analog,with Pullup-resistance	exhaust gas Temperature sensor	U_{in} = 0...5 V, R_{up} = 11,05 kΩ
D2.2.35	power supply (–)	exhaust gas Temperature sensor	internal with U_{Gnd} connected
D2.2.26	signal output, digital	PDM-output (customer-specific)	I_{max} = 50 mA, f_{max} = 1 KHz
D2.2.39	power supply (–)	PDM-output (customer-specific)	internal with U_{Gnd} connected
D2.2.27	signal output, digital	PDM-output torque (customer-specific)	I_{max} = 50 mA, f_{max} = 300 Hz
D2.2.74	signal input, digital, with Pulldown-	switch (customer-specific)	external switch to U_{Bat},

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Pin	Signal type	Function / components	Remark / Technical data
	resistance		R_{down} = 6,8 kΩ, U_{low} = 2,2 V, U_{high} = 3,7 V
D2.2.24	power supply (+)	Sensor (customer-specific)	U_{Out} = 5 V
D2.2.36	signal input, analog,with Pullup-resistance	Sensor (customer-specific)	U_{in} = 0...5 V, R_{up} = 680 kΩ
D2.2.37	power supply (–)	Sensor (customer-specific)	internal with U_{Gnd} connected.
D2.2.61	Communication, CAN low	CAN-Bus 2, for customer application	
D2.2.62	Communication, CAN high		
D2.2.60	Communication, CAN low	CAN-Bus 1, for diagnosis tasks	
D2.2.82	Communication, CAN high		
D2.2.25	Communication, K-Line	ISO-9141-Bus	
D2.1.23	power supply (–)	boost pressure sensor	internal with U_{Gnd} connected
D2.1.40	signal input, analog,with Pullup-resistance	boost pressure sensor	U_{in} = 0...5 V, R_{up} = 680 kΩ
D2.1.14	power supply (+)	boost pressure sensor	U_{Out} = 5 V
D2.1.53	signal input, analog,with Pullup-resistance	boost temperature sensor	U_{in} = 0...5 V, R_{up} = 1,28 kΩ
D2.1.20	Shield	Cam shaft speed sensor	internal with U_{Gnd} connected
D2.1.10	signal input (+), digital, with Schmitt-Trigger with Threshold-Application	Cam shaft speed sensor	Inductive sensor, U_{in} = 0,2...80 V ~
D2.1.50	signal input (–), digital, with Schmitt-Trigger with Threshold-Application	Cam shaft speed sensor	
D2.1.41	power supply (–)	coolant Temperature sensor	internal with U_{Gnd} connected
D2.1.58	signal input, analog,with Pullup-resistance	coolant Temperature sensor	U_{in} = 0...5 V, R_{up} = 1,28 kΩ
D2.1.7	Shield	crank shaft speed sensor	internal with U_{Gnd} connected
D2.1.12	signal input (–), digital, with Schmitt-Trigger with Threshold-Application	crank shaft speed sensor	Inductive sensor, U_{in} = 0,2...80 V ~
D2.1.27	signal input (+), digital, with Schmitt-Trigger with Threshold-Application	crank shaft speed sensor	
D2.1.45	power supply (–), switched, with recovery diode to U_{Bat}	exhaust gas break valve control	R > 42 Ω at 24 V R > 14 Ω at 12 V L < 480 mH at 12 V
D2.1.29	power supply (+), switched	exhaust gas break valve control	
D2.1.60	power supply (–), switched	internalal exhaust gas break or EGR	for 12-V-applications: I_{Out} = 1,7 A at V_{bat} = 14,4 V, L = 160 mH, f = 300 Hz, I_{Out} = 3,1 A at V_{bat} = 14,4 V, L = 10 mH, f = 1 Hz, for 24-V-applications: I_{Out} = 0,9 A at V_{bat} = 28,8 V, L = 600 mH, f = 300 Hz, I_{Out} = 1,7 A at V_{bat} = 28,8 V, L = 44 mH, f = 1 Hz
D2.1.49	power supply (–), switched	fuel control unit (FCU, MPROP)	U_{Out} = U_{Bat}, I_{max} = 5 A
D2.1.19	power supply (+)	fuel control unit (FCU, MPROP)	
D2.1.39	power supply (–)	fuel Temperature sensor or crankshaft housing pressure sensor	internal with U_{Gnd} connected
D2.1.52	signal input, analog,with Pullup-resistance	fuel Temperature sensor or crankshaft housing pressure	U_{In} = 0...5 V, R_{up} = 1,28 kΩ

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Pin	Signal type	Function / components	Remark / Technical data
		sensor	
D2.1.59	power supply (–), switched or PWM-Signal	fuel valve flame starting or external EGR	I_{Nenn} = 1,3 A at 24 V L = 0...15 mH at 24 V
D2.1.25	power supply (+)	fuel valve flame starting or external EGR	
D2.1.54	power supply (–)	fuel low pressure sensor	internal with U_{Gnd} connected
D2.1.57	signal input, analog,with Pullup-resistance	fuel low pressure sensor	U_{In} = 0...5 V, R_{up} = 680 kΩ
D2.1.11	power supply (+)	fuel low pressure sensor	U_{Out} = 5 V
D2.1.24	power supply (+)	heater relay	max. 130 mH 2A at 12 V, 1,5A at 24V
D2.1.34	power supply (–), switched	heater relay	
D2.1.21	signal input, digital,with Pullup-resistance	sense for heater relay	external switch depending on Mass, R_{up} = 6,8 kΩ, U_{low} = 2,2 V, U_{high} = 3,7 V
D2.1.51	power supply (–)	Oil pressure sensor	internal with U_{Gnd} connected
D2.1.13	power supply (+)	Oil pressure sensor	U_{Out} = 5 V
D2.1.56	signal input, analog,with Pullup-resistance	Oil pressure sensor	U_{In} = 0...5 V, R_{up} = 6,81 kΩ
D2.1.8	power supply (–)	Rail pressure sensor	internal with U_{Gnd} connected
D2.1.43	signal input, analog,with Pullup-resistance	Rail pressure sensor	U_{In} = 0...5 V, R_{up} = 4,6 kΩ
D2.1.26	power supply (+)	Rail pressure sensor	U_{Out} = 5 V
D2.1.30	power supply (+), switched	Starter relay	L_{max} = 130 mH, I_{max} = 6 A
D2.1.15	power supply (–), switched	Starter relay	
D2.1.35	signal input, digital,with Pullup-resistance	engine stop switch (optional)	R_{up} = 6,8 kΩ, U_{low} = 2,2 V, U_{high} = 3,7 V
D2.1.22	power supply (–)	External EGR (optional)	internal with U_{Gnd} connected
D2.1.28	power supply (+)	crankshaft housing pressure sensor (optional)	U_{Out} = 5 V
D2.1.16	power supply (+)	Injector 1 (Y15.1), 3 (Y15.3) and 5 (Y15.5) = Y15.1/3/5 Bank 1	DCR, 4 and 6 cylinder
D2.1.1	power supply (+)	Injector 2 (Y15.2), 4 (Y15.4) and 6 (Y15.6) = Y15.2/4/6 Bank 2	DCR, 4 and 6 cylinder
D2.1.47	power supply (–)	Injector 1 Y15.1	DCR, 4 and 6 cylinder
D2.1.31	power supply (–)	Injector 2 Y15.2	DCR, 4 and 6 cylinder
D2.1.48	power supply (–)	Injector 3 Y15.3	DCR, 4 and 6 cylinder
D2.1.32	power supply (–)	Injector 4 Y15.4	DCR, 4 and 6 cylinder
D2.1.33	power supply (–)	Injector 5 Y15.5	DCR, 6 cylinder
D2.1.46	power supply (–)	Injector 6 Y15.6	DCR, 6 cylinder

The table above illustrates the maximum assignment of the control unit pins. However, in practice, not all the named pins are actually assigned. Pins which are not listed are generally not used by the EMR3 system. (See circuit diagram)

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5.4 Camshaft speed sensor

Speed sensor

- Inductive sensor
- Determination of TDC
- Limp-home function in case of crankshaft sensor failure



Fig. 2

Disassemble the speed sensor

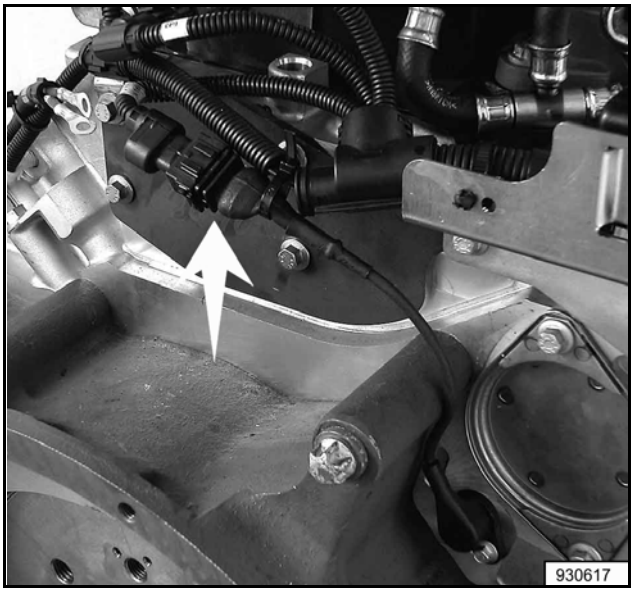


Fig. 3

- Remove the cable strap (Fig. 3).
- Disconnect the cable plug.

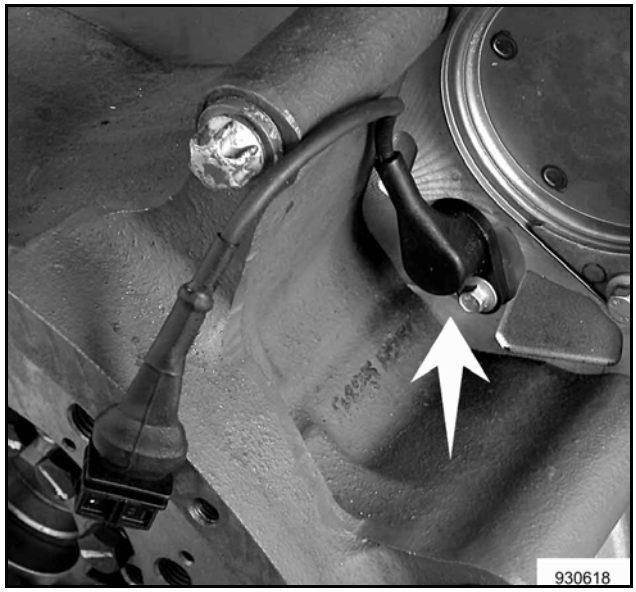


Fig. 4

- Unscrew the screw (Fig. 4).
- Remove the speed sensor.

Assemble the speed sensor

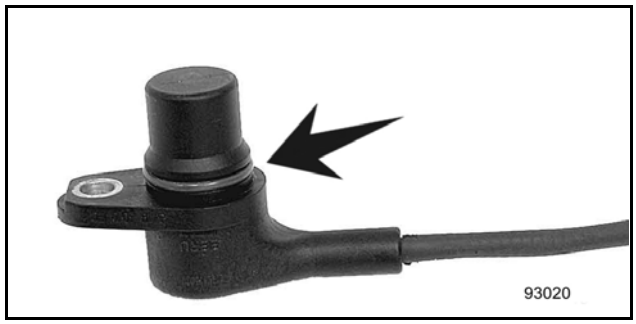


Fig. 5

- Clean the sealing surfaces on speed sensor and wheel housing cover.
- Assemble the new O-ring (Fig. 5) (arrow).
- Cover the O-ring slightly with oil.

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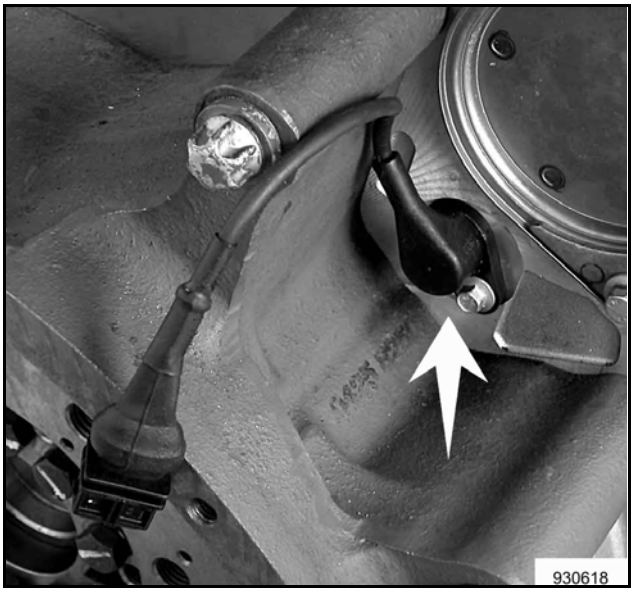


Fig. 6

- Assemble the speed sensor (Fig. 6).
- Tighten the screw.

i Note

Install the screws with screw retention agent.

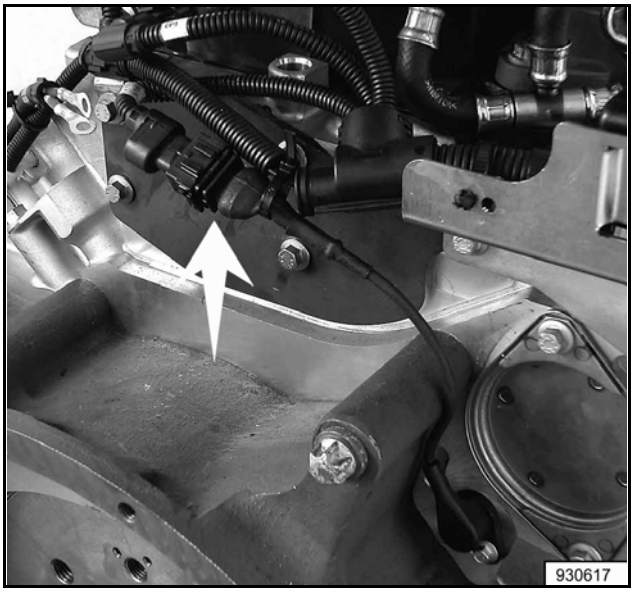


Fig. 7

- Push on the cable plug (Fig. 7).
- Install the cables.
- Fasten the cables with cable straps.

5.5 Crankshaft speed sensor

Speed sensor

- Inductive sensor
- Exact determination of engine speed
- Limp-home function in case of camshaft sensor failure

RPM-meter

The rotary speed is detected by the EMR control and passed on to the multi-function display (Fig. 8) via the CAN-bus connection.

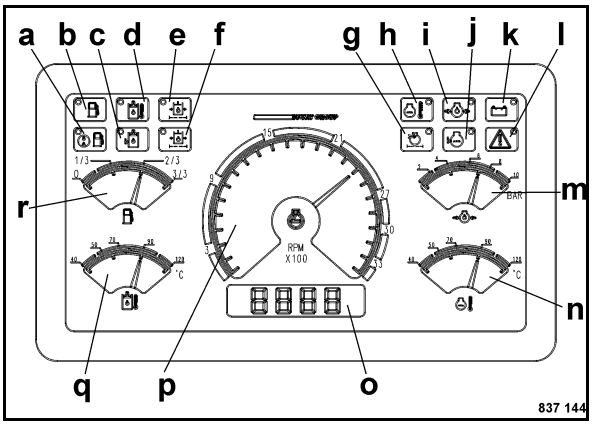


Fig. 8

p = Engine rpm-meter

In case of a fault a fault code is transmitted via the CAN-bus connection to the multi-function display (see chapter "Fault code display engine").

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Disassemble the speed sensor

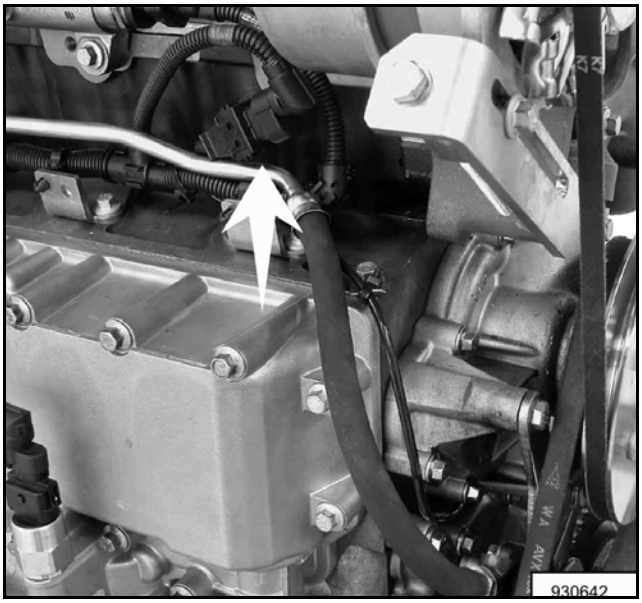


Fig. 9

- Disconnect the cable plug (Fig. 9).

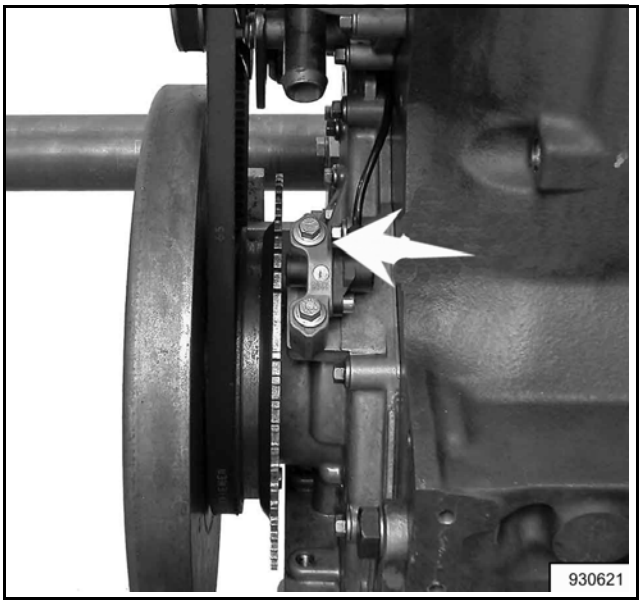


Fig. 10

- Unscrew both screws (Fig. 10).
- Remove the bracket with the speed sensor

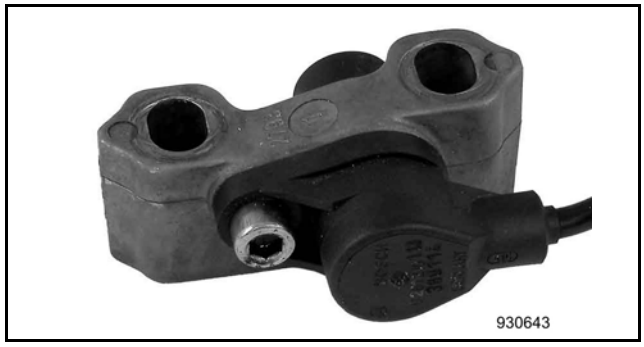


Fig. 11

- Unscrew the screw (Fig. 11).
- Pull the speed sensor out of the bracket

Install the speed sensor

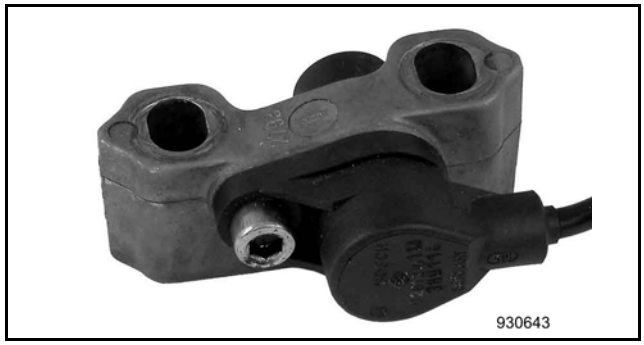


Fig. 12

- Press the speed sensor into the bracket (Fig. 12).

i Note

Clean threads on screw and in bore. Assemble the screws with screw retention agent.

- Tighten the screw with 9 Nm.

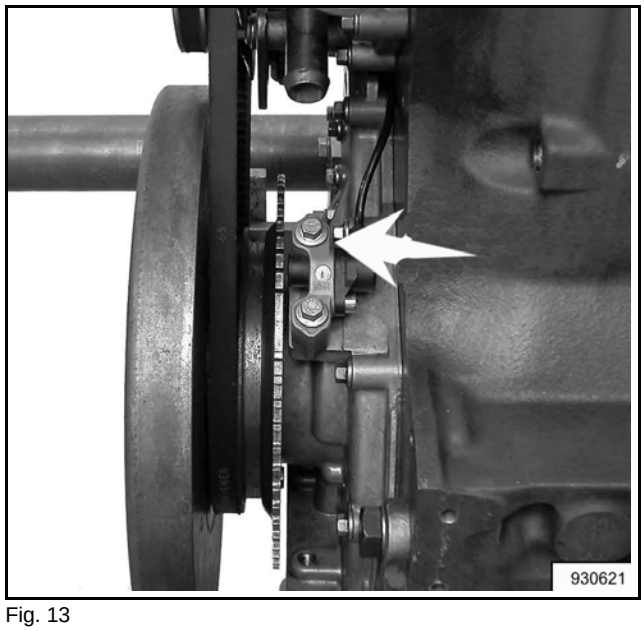


Fig. 13

- Attach the bracket with the speed sensor (Fig. 13).

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i Note

Assemble the screws with screw retention agent and check the gap, adjust if necessary.

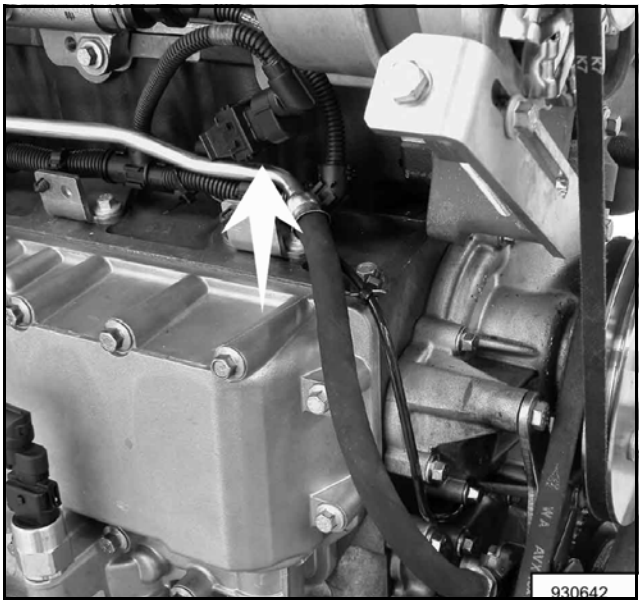


Fig. 14

- Push on the cable plug (Fig. 14).

Check the gap measurement

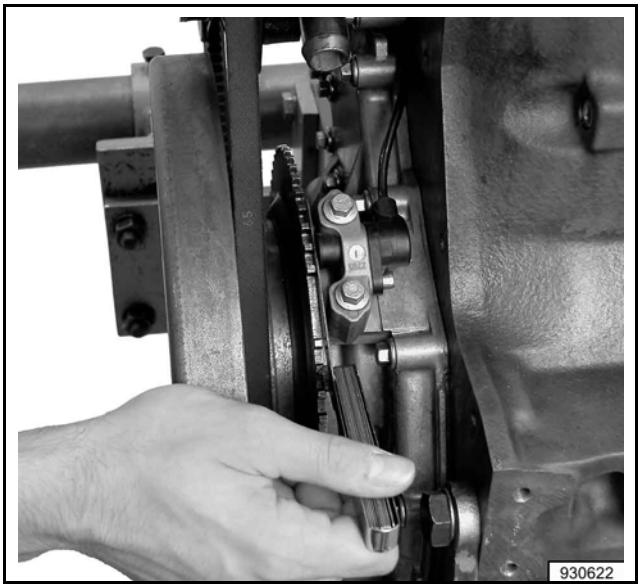


Fig. 15

- Check the gap measurement with a feeler gauge (Fig. 15).

Nominal value: 0,6 $^{\pm 0,1}$mm

i Note

The feeler gauge must fit with only little resistance through the gap between toothed disc and speed sensor (crankshaft).

Adjusting the gap measurement

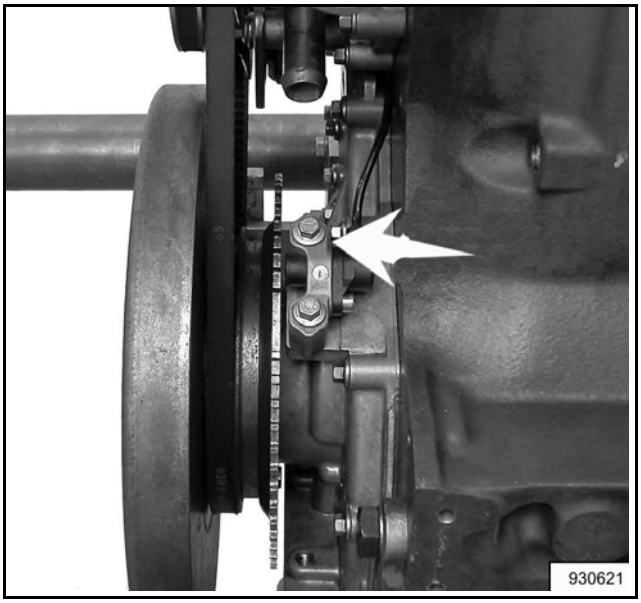


Fig. 16

- Unscrew both screws (Fig. 16).

i Note

Install the screws with screw retention agent.

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⚠ Caution

Observe the different screw lengths.

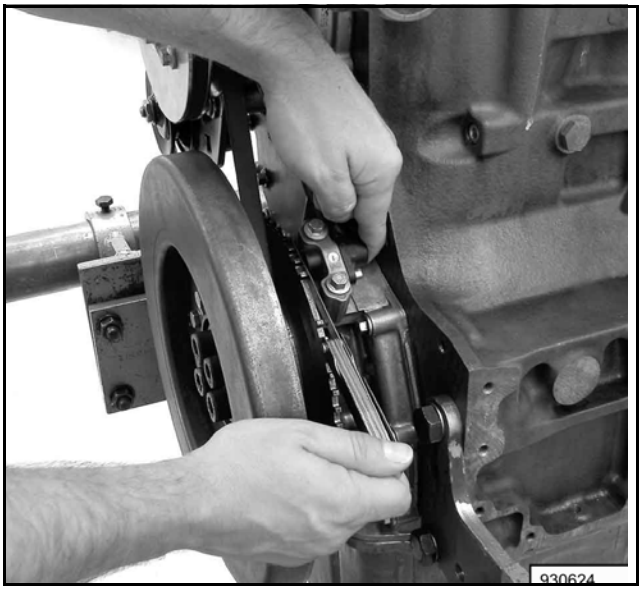


Fig. 17

- Slide the feeler gauge through the gap between toothed disc and speed sensor.
- Press the speed sensor slightly against the feeler gauge and tighten the screws.

i Note

Tightening torque: 20Nm

5.6 Rail pressure sensor

Pressure sensor

- Pressure sensor
- Monitoring the injection pressure



Fig. 18

Disassembling the pressure sensor

⚠ Danger

After shutting down the engine wait another 30 seconds before starting work in the fuel system.

⚠ Caution

Ensure absolute cleanliness when working in the fuel system.

Thoroughly clean the area around the affected component. Dry off wet locations with compressed air.

No foreign objects should enter into the Rail.

Ensure strict cleanliness. Especially on thread and sealing surface of Rail.

Follow the safety regulations and country specific regulations concerning the handling of fuel.

Immediately close all connections and openings with new and clean plugs/caps.

Only remove plugs/caps just before assembling.

Do not touch the contact pins of the Rail pressure sensor with bare hands to avoid electrostatic discharging.

Environment

Catch running out fuel and dispose of environmentally.

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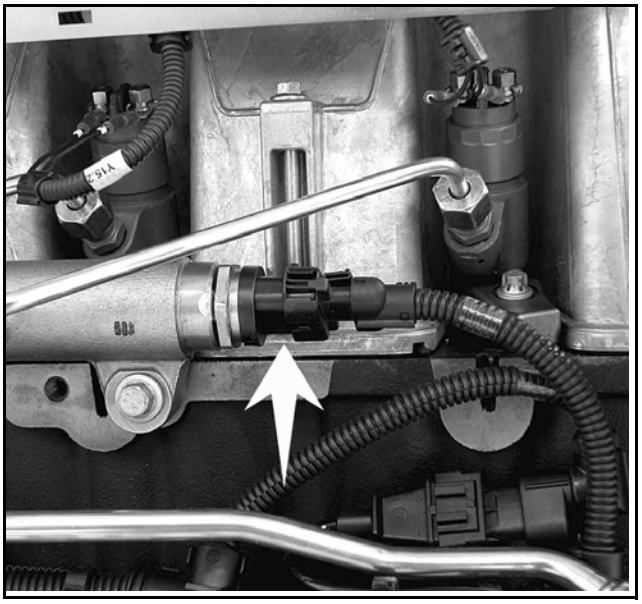


Fig. 19

- Unlock and pull out the cable plug (Fig. 19).
- Unscrew the Rail pressure sensor with a socket spanner.



Fig. 20

- Check thread and sealing edge (arrows) (Fig. 20) on the Rail pressure sensor visually.

Assembling the pressure sensor

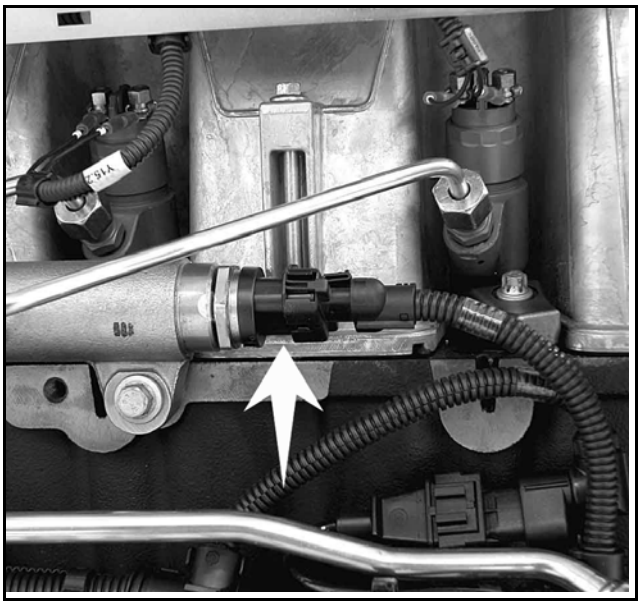


Fig. 21

⚠ Caution

Ensure strict cleanliness. Especially on thread and sealing surface of Rail.

- Slightly grease thread and sealing edge on Rail pressure sensor with assembly grease.
- Turn in and tighten the Rail pressure sensor (2) (Fig. 21).

i Note

Tightening torque: 40 $^{+5}$Nm

- Plug in the cable plug.

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5.7 Fuel pressure sensor

Pressure sensor

- Pressure sensor
- Monitoring the inlet pressure

The fuel low pressure sensor is located after the fuel filter and the pressure is normally between 5 and 7 bar.



Fig. 22

Disassembling the pressure sensor

⚠ Caution

Ensure absolute cleanliness when working in the fuel system.

Thoroughly clean the area around the affected component. Dry off wet locations with compressed air.

Follow the safety regulations and country specific regulations concerning the handling of fuel.

Immediately close all connections and openings with new and clean plugs/caps.

Only remove plugs/caps just before assembling.

Environment

Catch running out fuel and dispose of environmentally.

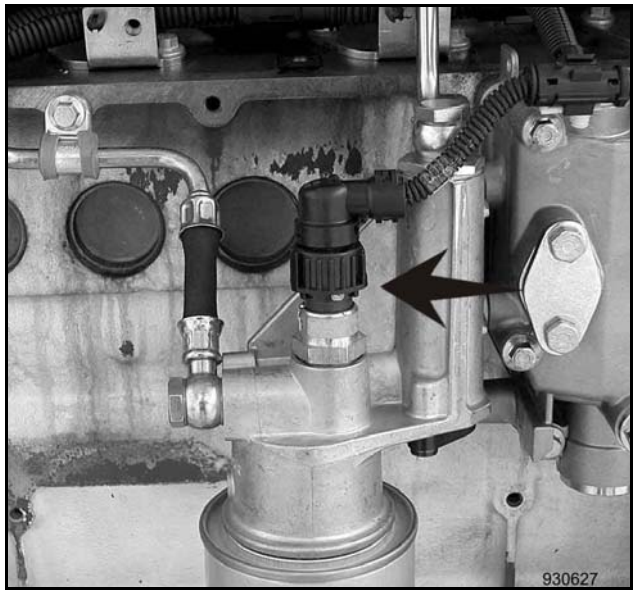


Fig. 23

- Unscrew the locking ring (Fig. 23).
- Pull off the cable plug.
- Unscrew the fuel pressure sensor with a socket spanner.

Installing the pressure sensor

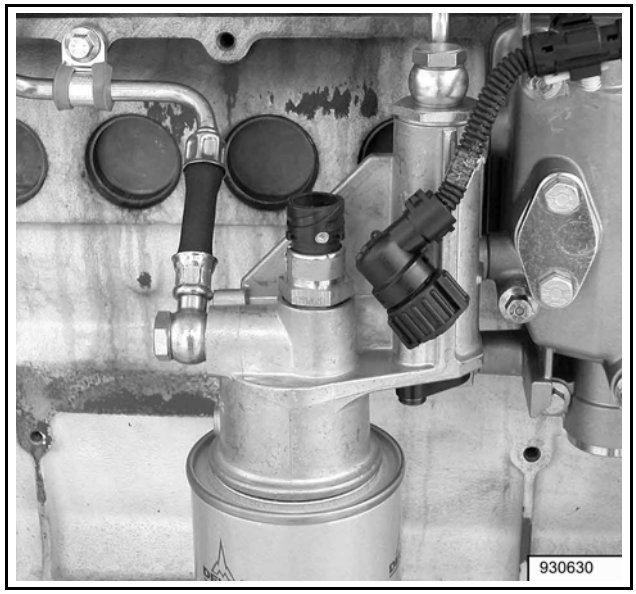


Fig. 24

- Insert the fuel pressure sensor with a new seal ring and tighten (Fig. 24).

i Note

Tightening torque: 30 ± 5 Nm

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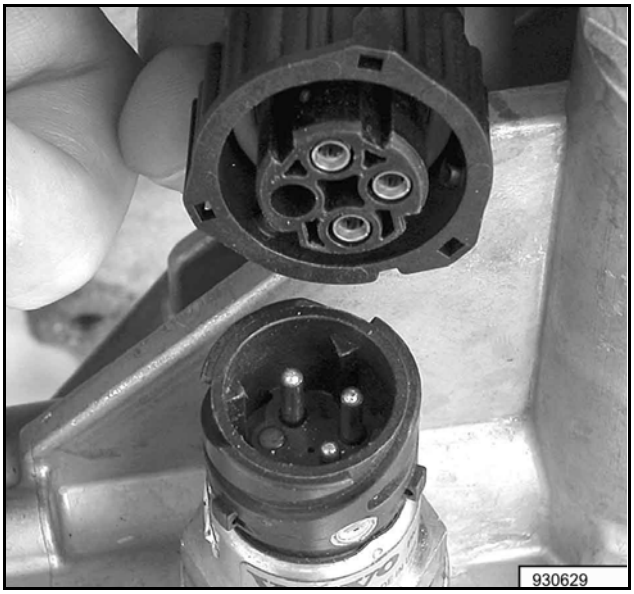


Fig. 25

- Push the cable plug back onto the fuel pressure sensor (Fig. 25).
- Turn in the locking ring until it engages.

i Note

Make sure the contacts are matching.

Spulenkörpered the fuel system with the fuel hand pump on the fuel pre-cleaner.

5.8 Fuel control unit FCU

Fuel control unit (FCU)

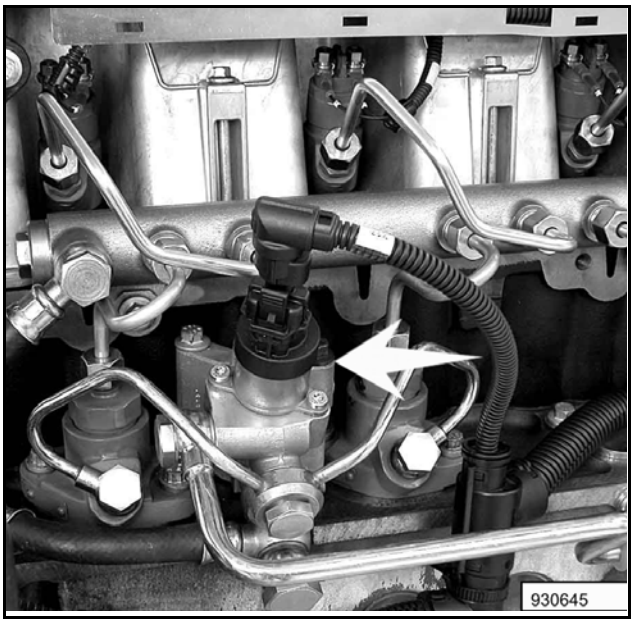


Fig. 26

Function

Here the fuel flowing into the pump elements is metered by an infinitely controllable solenoid valve (also referred to as "fuel control unit").

This valve is mounted to the FCU control block and adapts the fuel quantity supplied to the Rail to the system requirements. The solenoid valve is controlled by a pulse width modulated (PWM) signal. When controlling the valve, the piston is operated by magnetic force. It opens a flow cross-section that corresponds to its position. This quantity regulation reduces the power requirement of the high pressure pump, it will only deliver as much fuel as is needed by the mapped Rail pressure.

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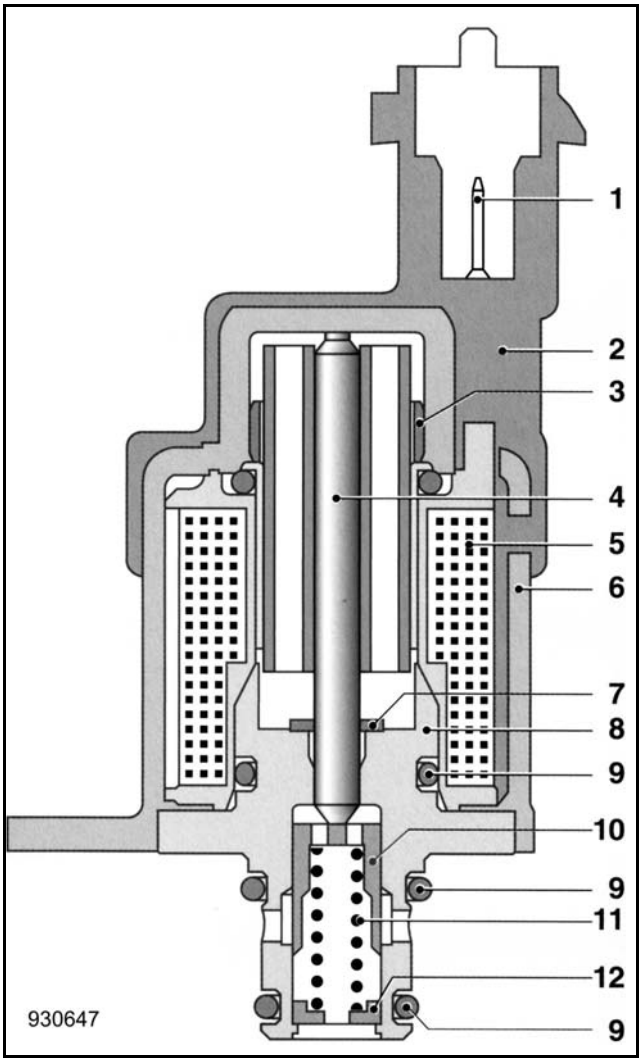


Fig. 27

1 Plug with electric interface
2 Solenoid housing
3 Bearing
4 Anchor with plunger
5 Winding with coil core
6 Bowl
7 Residual air gap disc
8 Magnetic core
9 O-ring
10 Piston with control slots
11 Spring
12 Locking elements

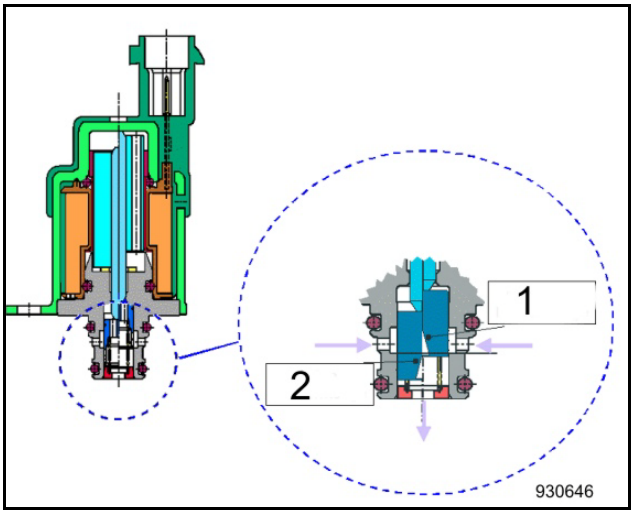


Fig. 28

1 max. flow capacity
2 max. flow capacity

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5.9 Injectors

Injectors

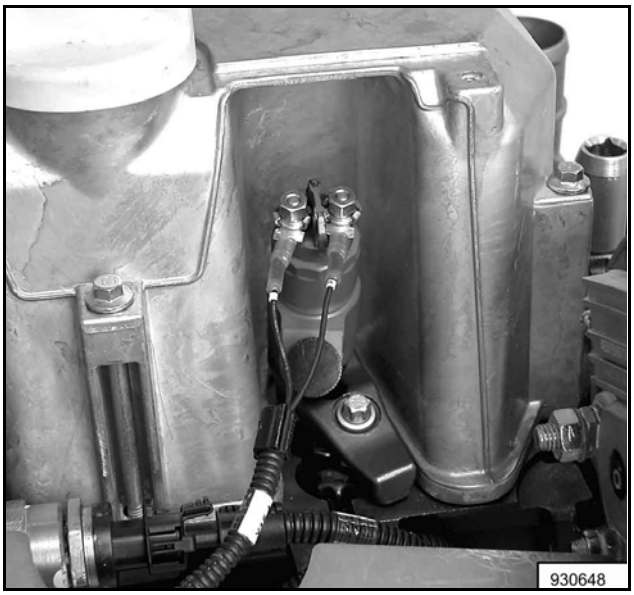


Fig. 29

Function

The injectors are installed in the cylinder head. They have the same functions as nozzöe and nozzle holder in conventional injection systems. The injectors are connected with the pressure accumulator (Rail) by high pressure lines (Fig. 30).

In the injector the beginning and end of injection of the nozzle are determined by a valve. The operating forces for opening and closing the valve are generated by a solenoid. The injectors work with approx. 50 to 70 Volt, instead of the 12 Volt vehicle voltage, which causes undelayed opening of the injectors. This high voltage is generated by capacitors in the control unit. The solenoid valves are then held in position by cycled 12 Volt.

The forces required to open and close the nozzle needle cannot be generated by a solenoid valve on its own. The nozzle needle is therefore indirectly controlled via an hydraulic booster system in the injector (Fig. 31).

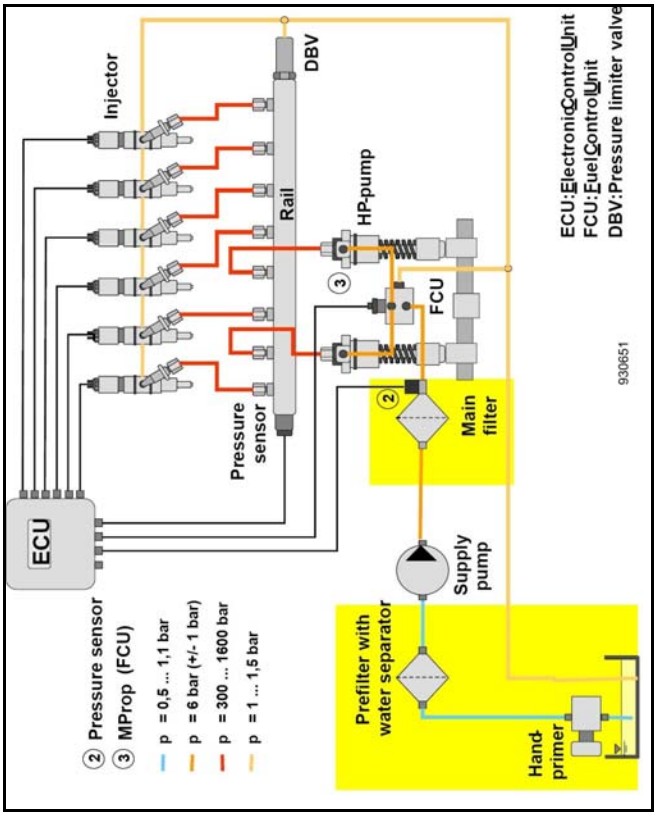


Fig. 30

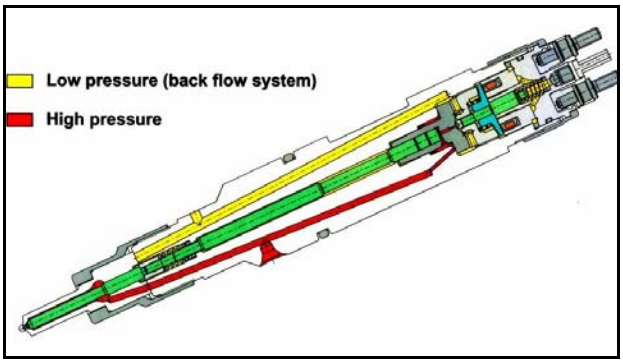


Fig. 31

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5.10 Oil pressure sensor

Pressure sensor

Oil pressure monitoring

The operator is warned if

- the oil pressure falls short of the warning limit and/or
- the power is reduced by the EMR after a pre-warning time, or
- the oil pressure falls short of the shut-down limit and the engine is shut down after a pre-warning time.

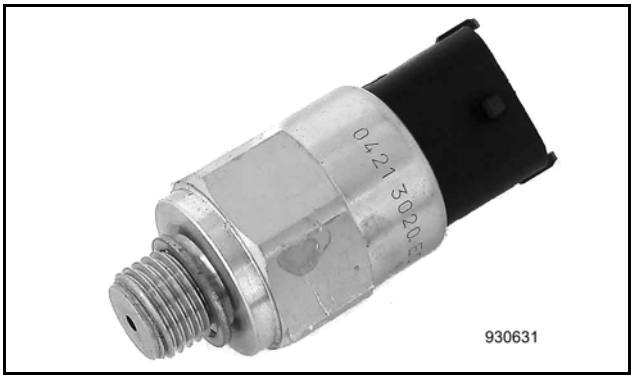


Fig. 32 Oil pressure sensor

In case of a fault a fault code is transmitted via the CAN-bus connection to the multi-function display (see chapter "Fault code display engine").

Disassembling the pressure sensor

⚠ Caution

Ensure absolute cleanliness when working in the lubrication oil system.

Thoroughly clean the area around the affected component. Dry off wet locations with compressed air.

Immediately close all connections and openings with new and clean plugs/caps.

Only remove plugs/caps just before assembling.

Environment

Catch engine oil and dispose of environmentally.

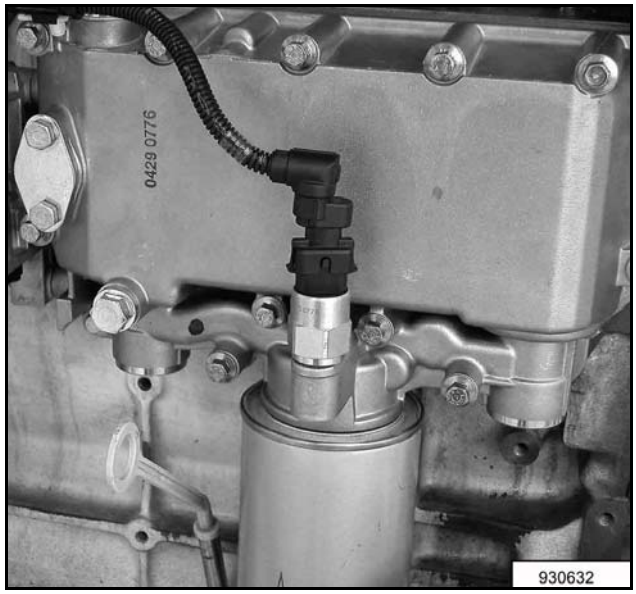


Fig. 33

- Unlock and pull out the cable plug (Fig. 33).
- Unscrew the coolant temperature sensor.

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Installing the pressure sensor

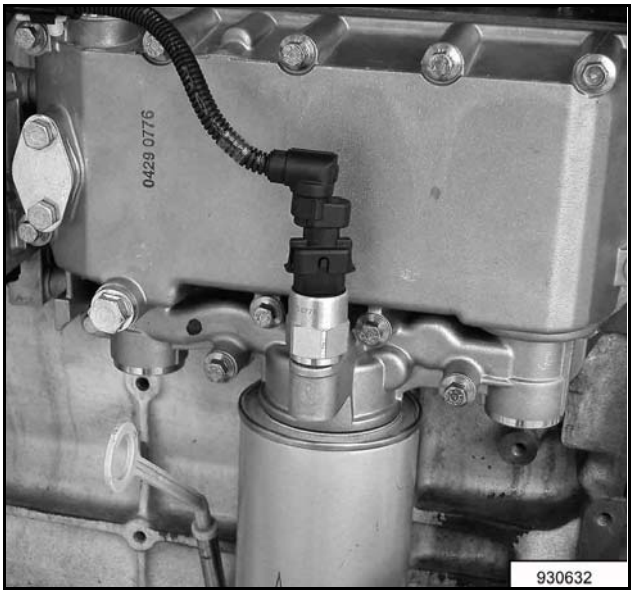


Fig. 34

- Insert the oil pressure sensor with a new seal ring and tighten.

i Note

Tightening torque: 20Nm

5.11 Charge air temperature - charge air pressure sensor

Sensor

Combined charge air pressure / temperature sensor

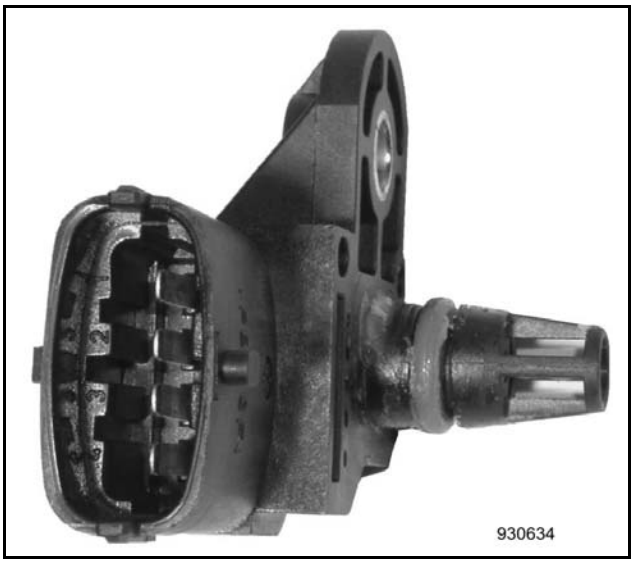


Fig. 35

This sensor unites two functions in one housing. The one function measures the charge air pressure in the and adapts the injection quantity in dependence on the measured pressure. On the other hand the EMR now detects the temperature of the passing air flow. This is used for the smoke limitation.

i Note

With a faulty pressure sensor the engine continues to run with charge pressure simulation.

With a defective temperature sensor the engine also carries on running.

Charge air temperature monitoring

The operator is warned if

- the temperature exceeds the warning limit and/or
- the power is reduced by the EMR 3 after a pre-warning time, or
- the temperature exceeds the shut-down limit and the engine is shut down after a pre-warning time.

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Disassembling the sensor

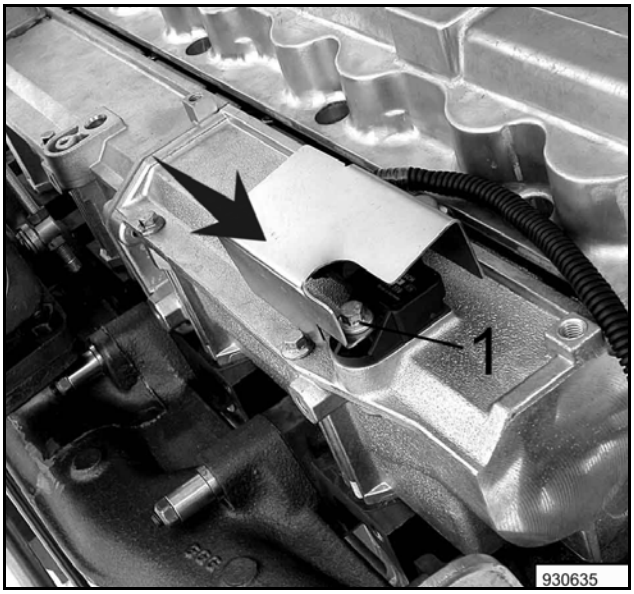


Fig. 36

- Unscrew screw 1 (Fig. 36).
- Remove the cover plate.



Fig. 37

- Unlock and pull out the cable plug (Fig. 37).
- Remove the pressure/temperature sensor.

Installing the sensor

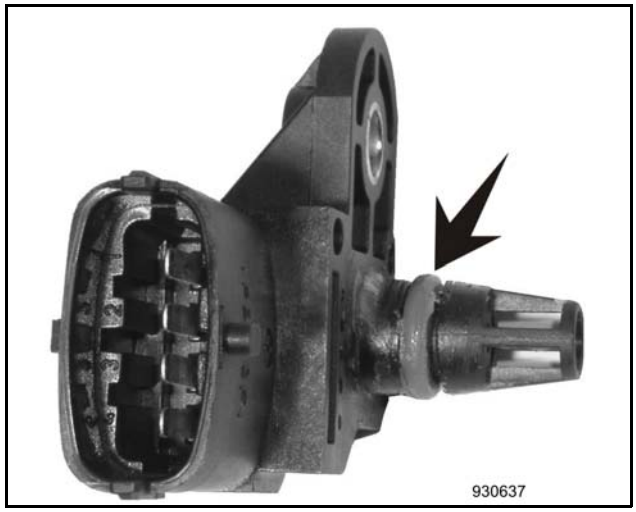


Fig. 38

- Assemble a new O-ring (Fig. 38).
- Slightly cover the O-ring with grease.



Fig. 39

- Carefully insert the pressure/temperature sensor (Fig. 39).
- Plug on the cable plug and engage the lock.

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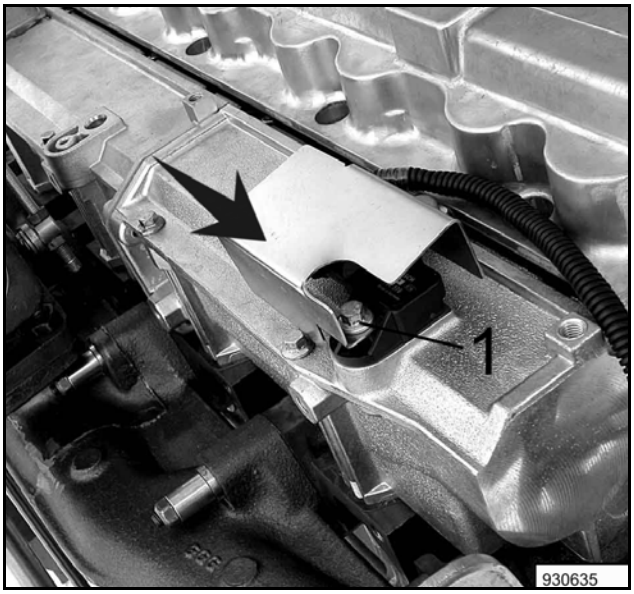


Fig. 40

- Attach the cover platel (Fig. 40).
- Tighten the screw (1).

5.12 EMR coolant temperature sensor

Temperature sensor

The coolant temperature has an effect on the calculated injection quantity and the preheating behaviour of the glow plugs.

Coolant temperature monitoring

The operator is warned if

- the temperature exceeds the warning limit and/or
- the power is reduced by the EMR after a pre-warning time, or
- the temperature exceeds the shut-down limit and the engine is shut down after a pre-warning time.

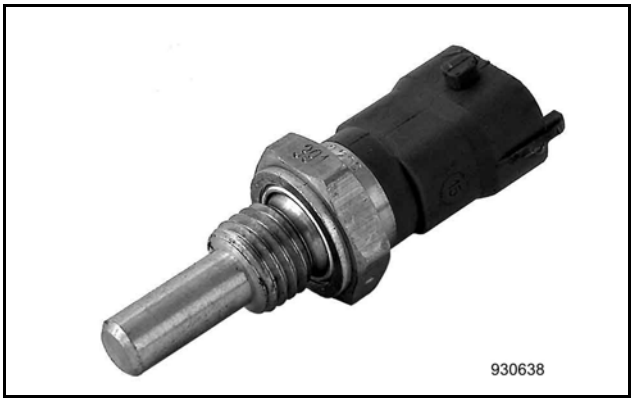


Fig. 41 Coolant temperature sensor

Warning light engine overheating

The coolant temperature is detected by the EMR control. In case of a fault a message is transmitted via the CAN-bus connection to the multi-function display (Fig. 42).

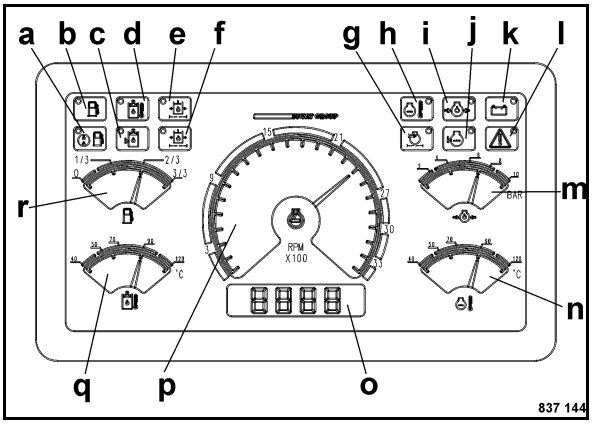


Fig. 42

h = lights if engine overheats. Warning buzzer sounds.

o = Display of operating hours and engine fault codes

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Coolant temperature gauge

n = Gauge, coolant temperature.

Disassembling the temperature sensor

Environment

Catch running out fluids in a suitable vessel and dispose of environmentally.

i Note

Follow the corresponding documentation in the operating instructions to drain and fill the cooling system.



Fig. 43

- Unlock and pull out the cable plug (Fig. 43).

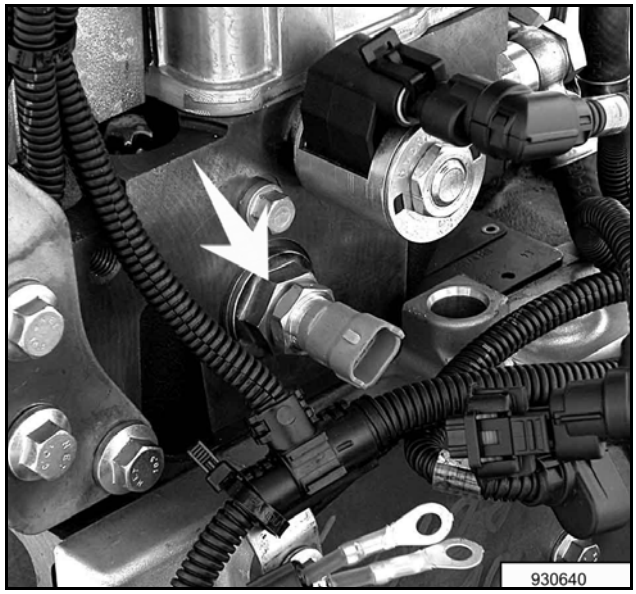


Fig. 44

- Unscrew the coolant temperature sensor (Fig. 44).

i Note

Counter the adapter piece.

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Installing the temperature sensor

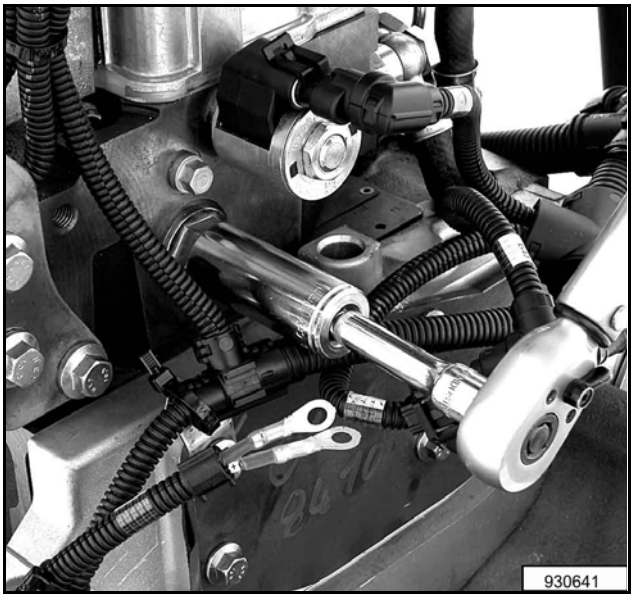


Fig. 45

- Tighten the coolant temperature sensor (Fig. 45).

i Note

Make sure that the seal rings are present .

Tightening torque: $22^{\pm 2}$ Nm.



Fig. 46

- Push on the cable plug (Fig. 46).

5.13 Glow plugs

i Note

The circuitry is shown in the circuit diagram on page 10.2.

The engines are equipped with glow plugs for cold starting as standard. Preheating the glow plugs in the combustion chamber of the diesel engine ensures perfect cold starting and post-heating of the glow plugs has a positive effect on the emissions from the still "cold running" diesel engine (e.g. avoidance of white smoke, noise reduction).

During cold starting the EMR-control switches (Pin24 Ground, Pin34 Plus) (Fig. 48) and the coil of relay JE1 (Fig. 48) is excited. The glow plugs are supplied with battery current via the switch contact of relay (EJ1) and fuse JF5 (Fig. 47).

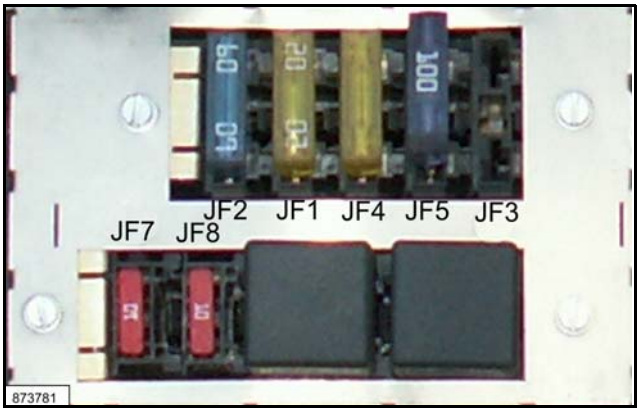


Fig. 47 Fuses in battery compartment

⚠ Danger

Fire hazard!

Do not use fuses with higher ampere ratings and do not bridge fuses.

JF 5 = 100A- Pre-heating system

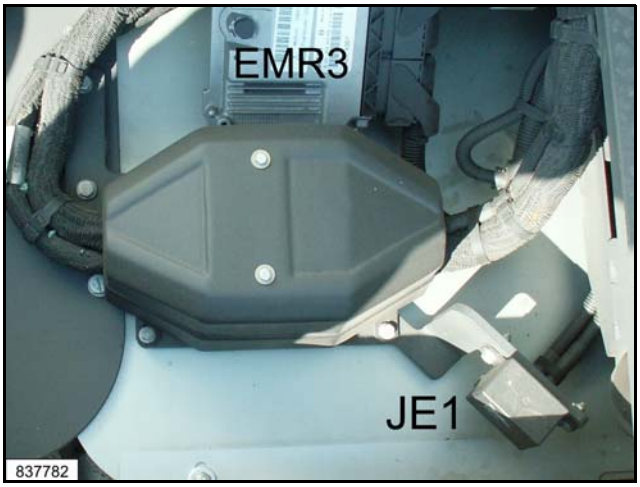


Fig. 48 Relay JE1

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5.14 Sensor, water in fuel, C39

i Note

The circuitry is shown in the circuit diagram on page 10.1.

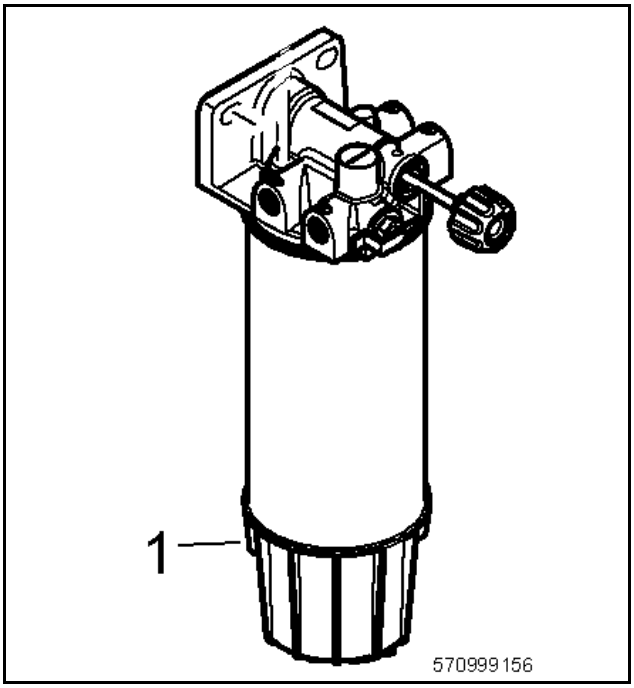


Fig. 1

1 Sensor for water separator

Fault message

The analog sensor is electronically monitored by the EMR-control. In case of a fault a fault code is transmitted via the CAN-bus connection to the multi-function display (see chapter "Fault code display").

5.15 Air filter vacuum switch, C40

i Note

The circuitry is shown in the circuit diagram on page 10.1.

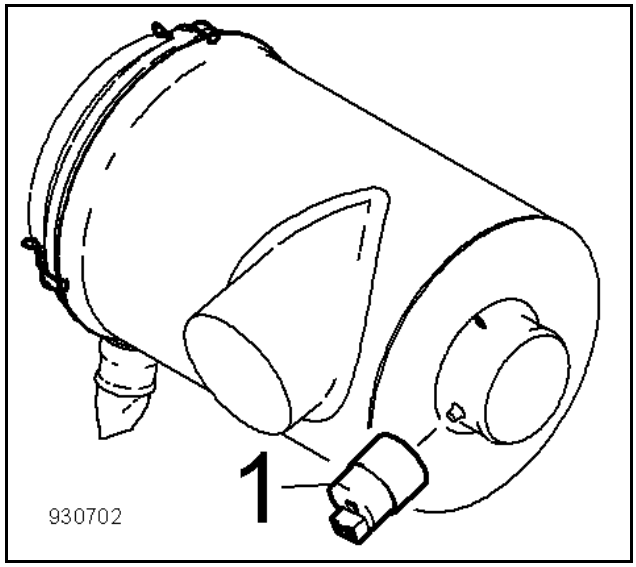


Fig. 1

The vacuum switch operates at a vacuum of > 50 mbar.

Fault message

The switch is electronically monitored by the EMR-control. In case of a fault a fault code is transmitted via the CAN-bus connection to the multi-function display (see chapter "Fault code display").

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5.16 Level probe coolant tank, C38

Note

The circuitry is shown in the circuit diagram on page 10.1.

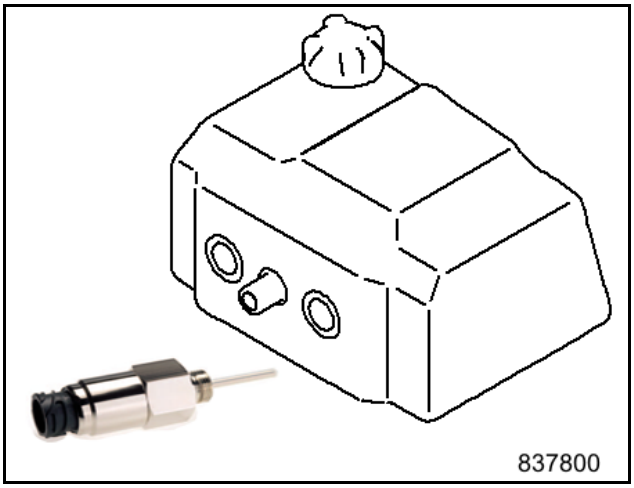


Fig. 1

The level probe works according to the capacitive principle. The capacity change, that is generated when an air surrounded, insulated electrode is submerged in a liquid medium, is detected. This capacity change on the sensor electrode excites an oscillator.

These level probes have a short circuit proof switching output. Since they do not contain any moveable parts, their function can neither be impaired by dirt particles, nor by other influences.

Fault message

The probe is electronically monitored by the EMR-control. In case of a fault a fault code is transmitted via the CAN-bus connection to the multi-function display (see chapter "Fault code display engine").

5.17 Diagnostics interface

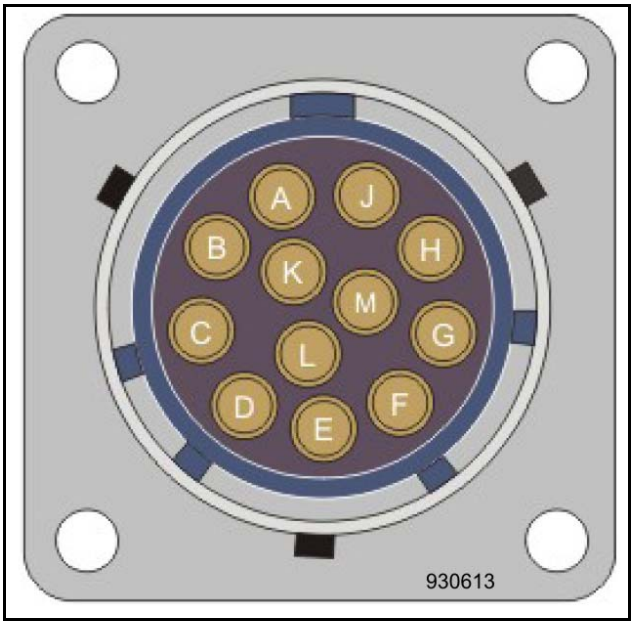


Fig. 1 Diagnostic link

A = Battery plus (+)
B = Battery minus (-)
F = CAN2 low
G = CAN1 low
H = CAN1 high
K = K-Line
M = CAN2 high

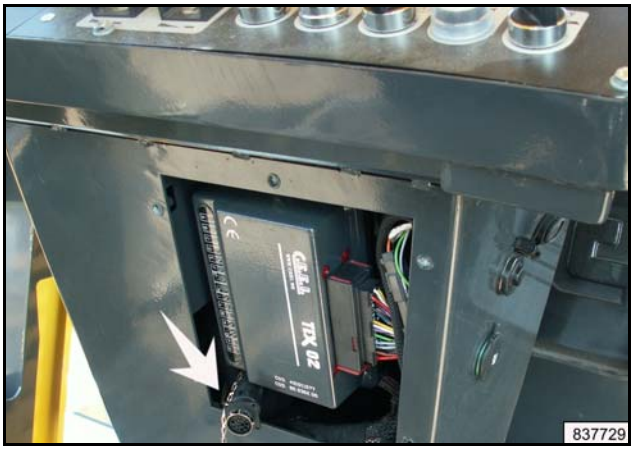


Fig. 2 Diagnostics plug

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SERDIA connection

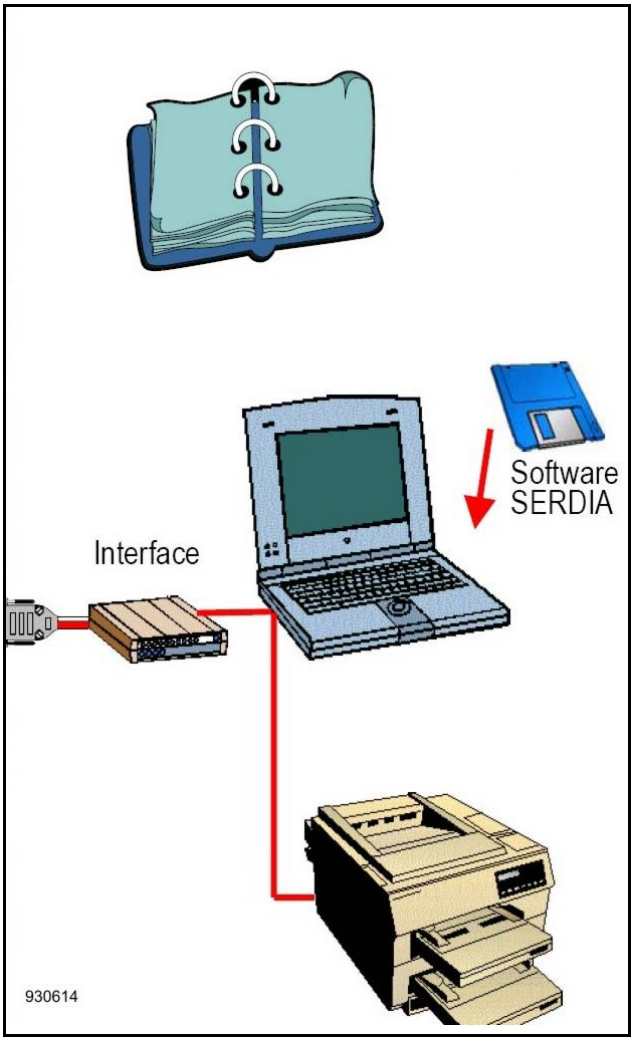


Fig. 3

The KWP-protocol with encrypted dataflow is used via the K-line. For this purpose the PC or laptop (Fig. 3) is connected to the diagnostic interface by means of a special interface cable.

Operation of SERDIA is described in a separate operation manual.

CAN-bus display connection

Operation of the display is described in a separate operation manual.



Fig. 4

Display for EMR control (Fig. 4).

BOMAG part-no.: 057 189 94



Fig. 5

The display is connected to the diagnostic interface by means of a special cable.

Wiring loom for display (Fig. 5)

BOMAG part-no.: 079 900 19

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5.18 Diagnose with CAN-bus

The CAN-bus is used to transfer standard messages of the SAE J 1939.

The display is a compact, robust and integratable modules which enables the user to invoke engine data and to display these in the following formats:

- Analog display
- Digital data
- Multi data (a combination of analog and digital data)
- Alarm messages currently present

The different diagnostic screens enable detailed examination of the engine data flow



Fig. 1

Display for EMR control (Fig. 1).

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5.19 Diagnose with SERDIA

SERDIA

With the diagnostics tool SERDIA and a hardware interface one can read out / delete and save the error log of the control unit.

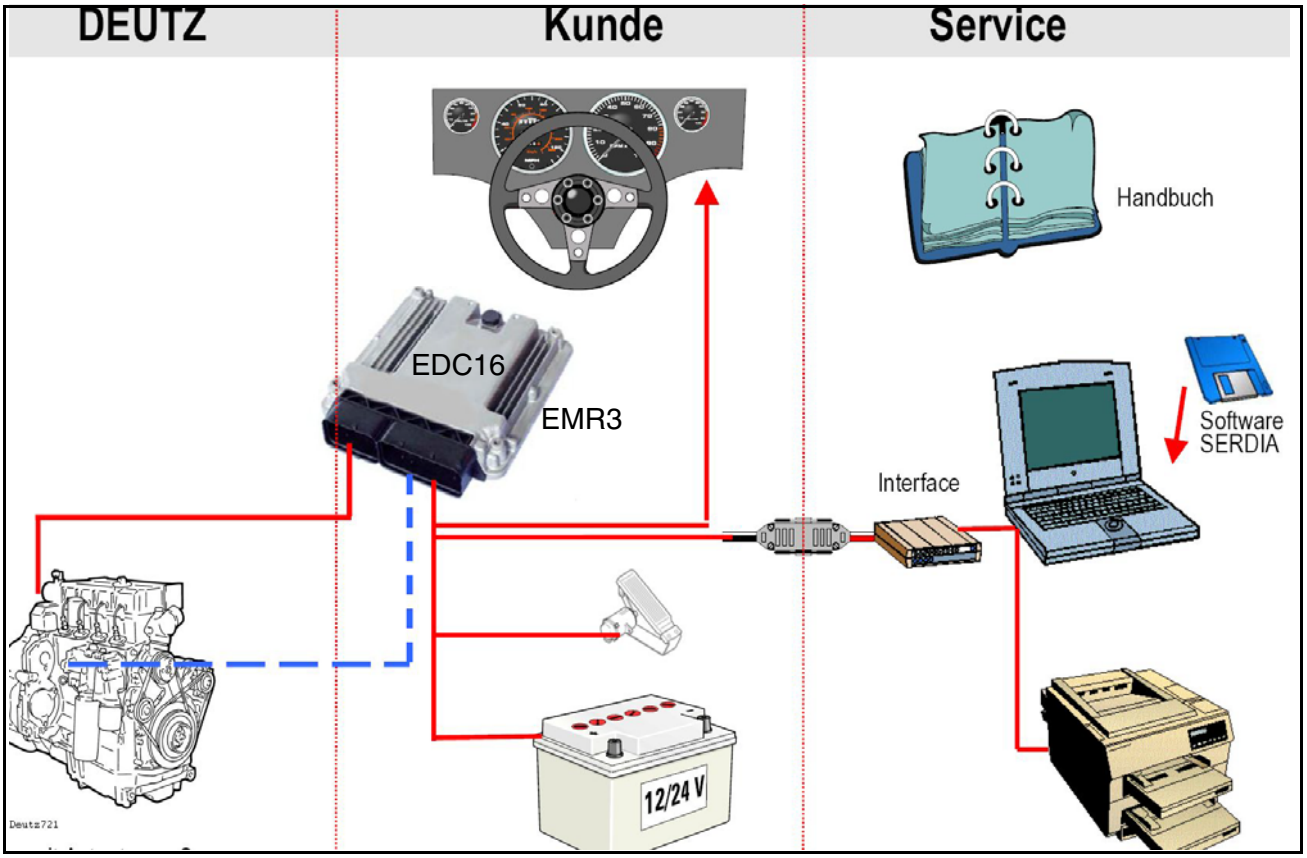


Fig. 1 Service-Software TCD 2012 / 2013

The SERDIA software is first choice for any diagnostics task.

SERDIA is a software program from Deutz which can be used in connection with a laptop computer to perform more detailed fault analyses, especially reading out of the error log.

This displays information on

- Location of fault (e.g. 'coolant temperature sensor')
- Nature of fault (e.g. 'fallen short of bottom limit value', 'sporadic fault')
- Environmental data / operating data (speed and operating hours at the time of the last fault occurrence)
- Number of fault locations and frequency of fault
- Fault status (active – fault present / passive- fault no longer present)
- Fault messages for non-present / rectified faults can be deleted with SERDIA.

Function test

The control outputs can be activated with the engine shut down.

Assignment of inputs/outputs

Display of the current input and output assignment of the EMR-control.

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Representation of measuring values

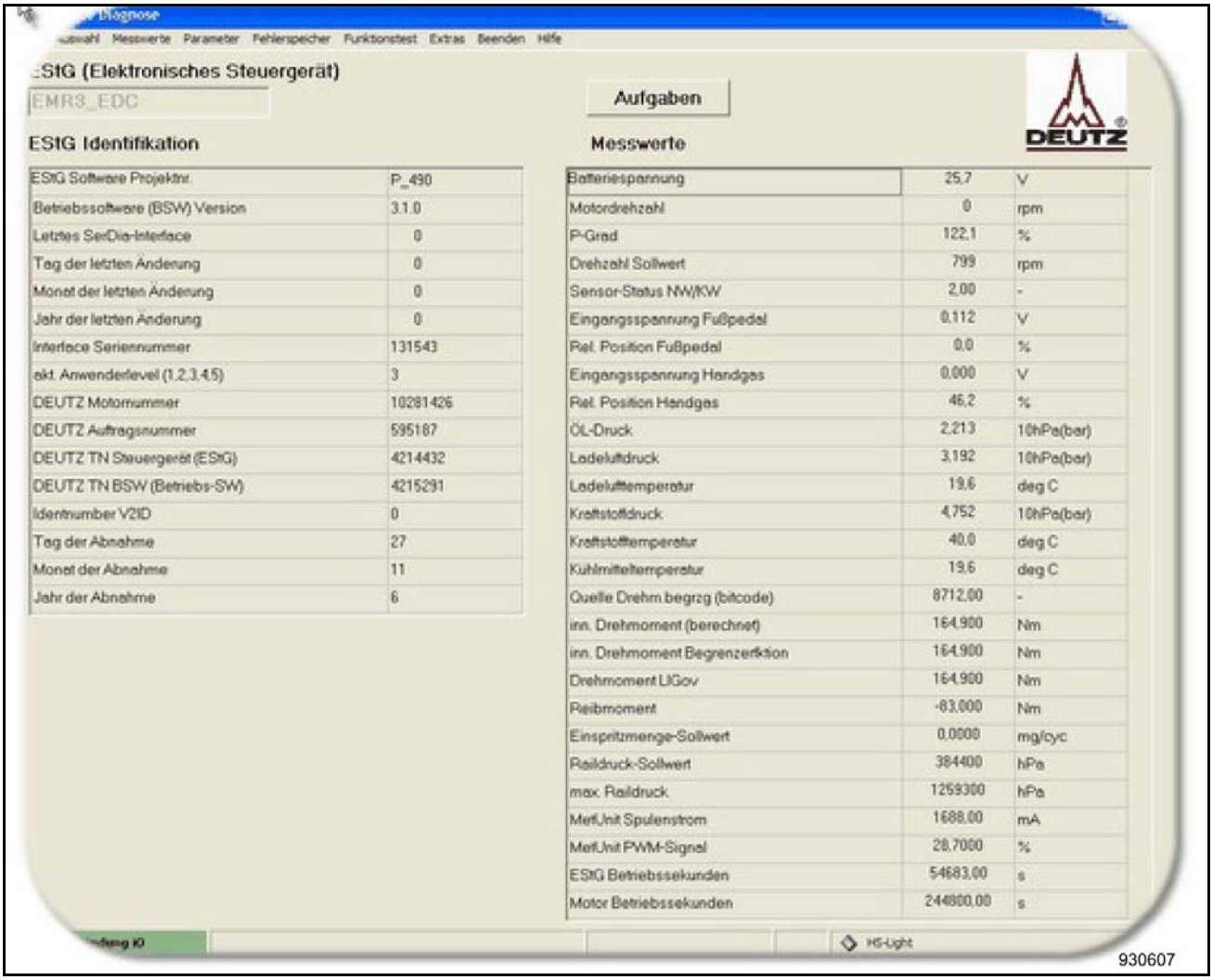


Fig. 2

There is a vast variety of measuring values available for selection which can even be used if no EMR-fault is present (start behaviour, engine sawing, lack of power).

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Representation of fault log

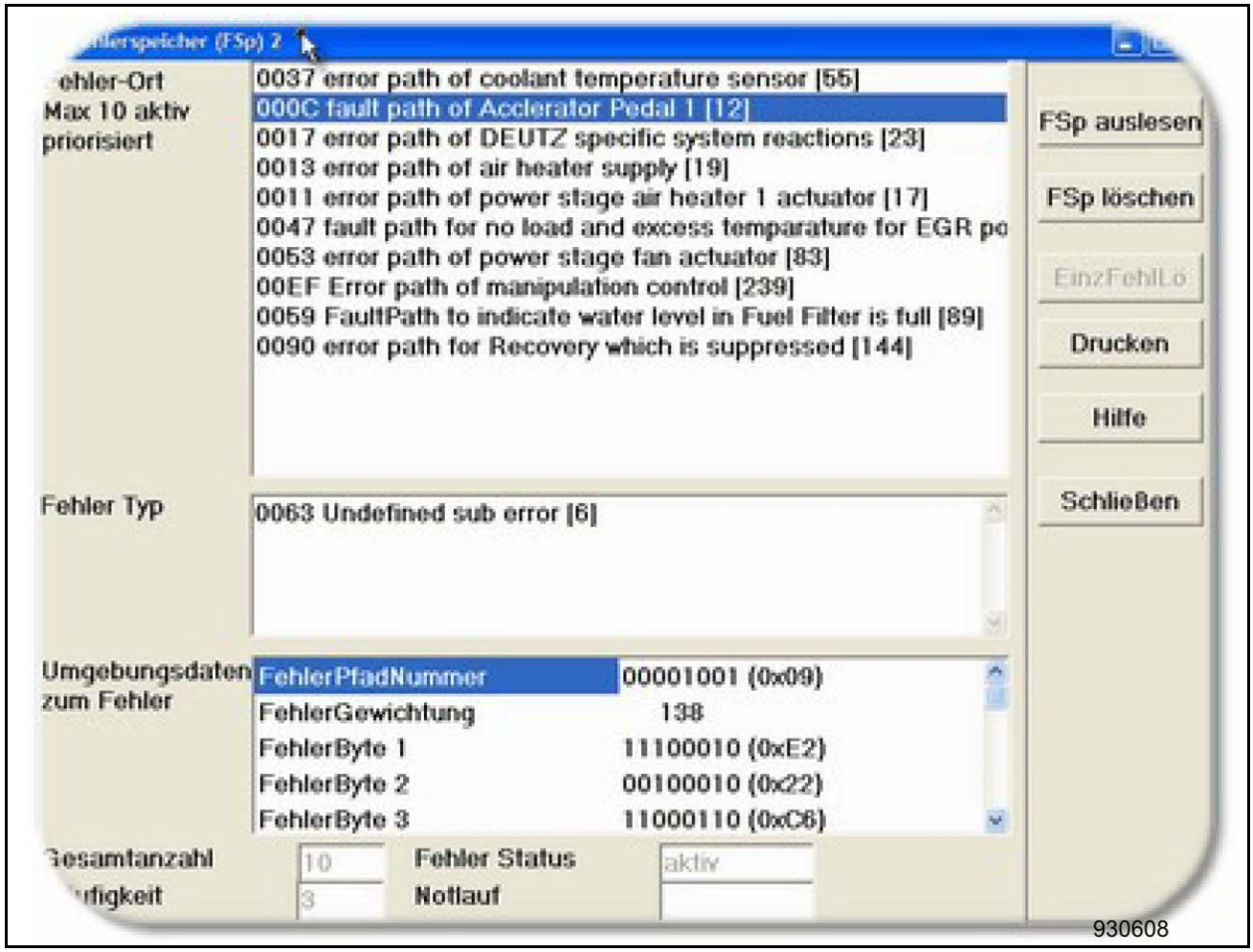


Fig. 3

When looking for the cause of a fault in the EMR3-system examining the fault log of the engine control unit usually provides useful information.

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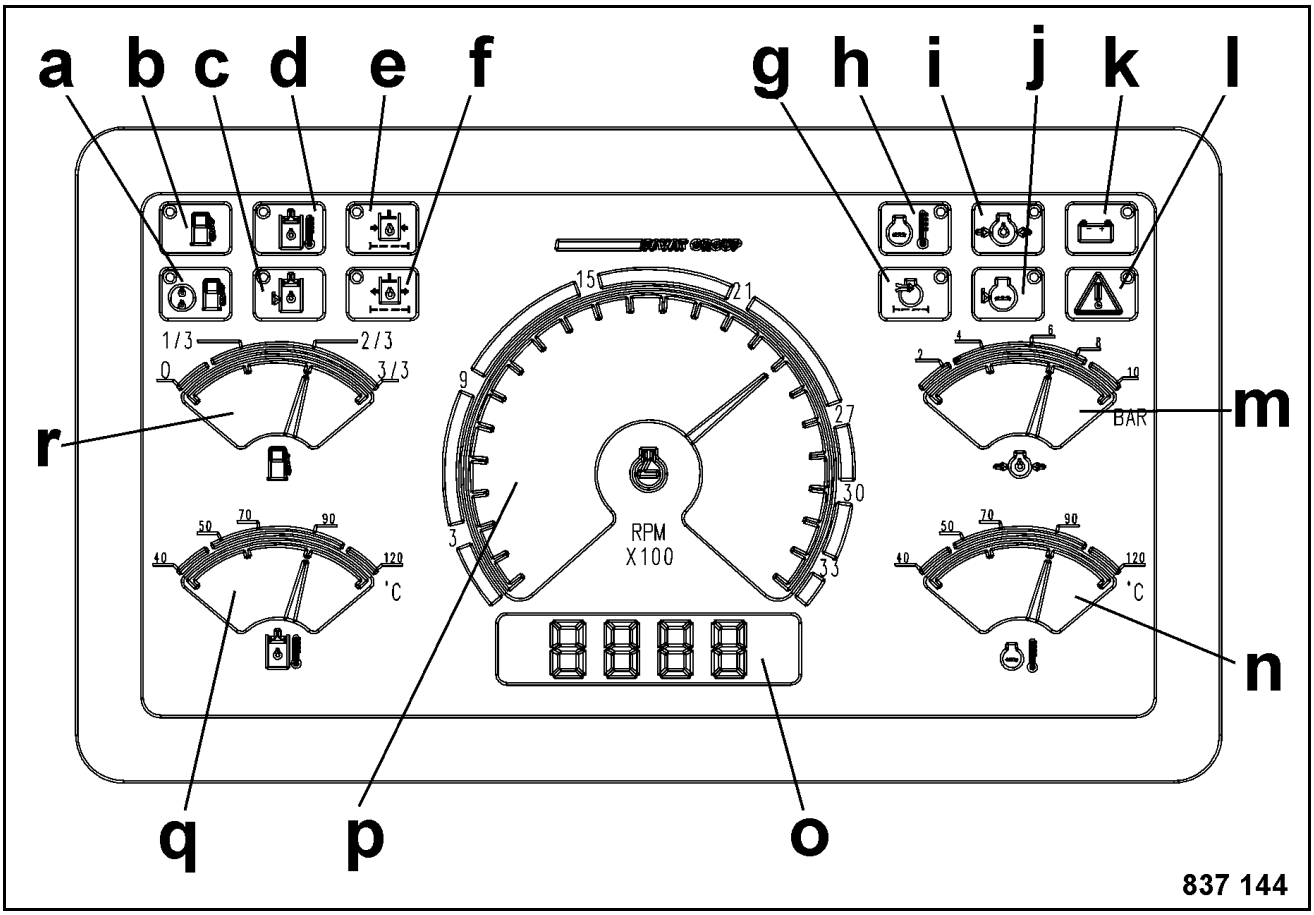


Fig. 1 Display

a = lights, water in fuel filter

g = lights, if the fuel filter is blocked

h = lights if the engine overheats

i = lights if the engine oil pressure is too low

j = lights if the coolant level is too low

k = lights if the battery is not being charged

l = lights in case of a fault

o = Display of operating hours and engine fault codes (hexa-decimal code).

- When the warning buzzer sounds and the fault indicator (l) lights up, read out the hexa-decimal code in the window (o).

i Note

*Hexa-decimal codes are explained in the following fault code list, column "**SPN (hex)**".*

⚠ Caution

A detailed reading out of fault codes for the diesel engine is only possible with Deutz-Serdia

ID	Error code (dec)	Error code (hex)	SPN (dec)	SPN (hex)	FMI	Blink code	Description	Self-curing[1]
AirFltSysReac	11	0B	107	0000006B	1, 11	1-3-6	Air filter: pressure loss above target range with system reaction	yes
APP1	12	0C	91	0000005B	2, 3, 4, 11	2-2-6	Accelerator pedal: cable break or short circuit, implausible compared to signal of idle sensor	no
APPPwm	14	0E	91	0000005B	2, 8	2-2-2	PWM accelerator pedal: bad signal (range or frequency), cable break or short circuit	yes
APPPwmPer	15	0F	91	0000005B	8, 11	2-2-2	PWM accelerator pedal: bad pulse-width repetition rate	yes
APSCD	16	10	108	0000006C	2, 3, 4, 11	2-9-2	ECU internal error: ambient pressure sensor defective	yes
ArHt1	17	11	729	000002D9	3, 4, 5, 11	2-6-3	Air heater relay: cable break or short circuit	yes
ArHt2	18	12	730	000002DA	3, 4, 5, 11	2-6-3	Air heater magnetic valve: cable break or short circuit	yes
ArHtCD_NoLd	19	13	676	000002A4	4, 11	2-6-3	Air heater relay: cable break or wrong connection	no
ArHtCD_RlyErr	20	14	676	000002A4	2, 5, 11	2-6-3	Air heater relay: inoperable during shut-off	no
BattCD	22	16	168	000000A8	0, 1, 11	3-1-8	Battery input (voltage 0-5V): outside target range	yes
BattCDSysReac	23	17	168	000000A8	2, 11	3-1-8	Battery voltage: above target range with system reaction	yes
BIPCyl1	24	18	3561	00000DE9	2	5-3-1	Begin of injection period in cylinder 1: outside target range or missing	yes
BIPCyl2	25	19	3562	00000DEA	2	5-3-2	Begin of injection period in cylinder 2: outside target range or missing	yes
BIPCyl3	26	1A	3563	00000DEB	2	5-3-3	Begin of injection period in cylinder 3: outside target range or missing	yes
BIPCyl4	27	1B	3564	00000DEC	2	5-3-4	Begin of injection period in cylinder 4: outside target range or missing	yes
BIPCyl5	28	1C	3565	00000DED	2	5-3-5	Begin of injection period in cylinder 5: outside target range or missing	yes
BIPCyl6	29	1D	3566	00000DEE	2	5-3-6	Begin of injection period in cylinder 6: outside target range or missing	yes
BIPCyl7	30	1E	3567	00000DEF	2	5-3-7	Begin of injection period in cylinder 7: outside target range or missing	yes
BIPCyl8	31	1F	3568	00000DF0	2	5-3-8	Begin of injection period in cylinder 8: outside target range or missing	yes
BPSCD	32	20	102	00000066	2, 3, 4	2-2-3	Charge air pressure sensor: cable break or short circuit	yes
BPSCDSysReac	33	21	102	00000066	2, 11	2-2-3	Charge air pressure: outside target range	yes
CLSCDSysReac	37	25	111	0000006F	1, 11	2-3-5	Coolant level: outside target range	no
CmbChbMisfire1	38	26	1323	0000052B	11, 12	2-4-1	Misfire detected in cylinder 1	no
CmbChbMisfire2	39	27	1324	0000052C	11, 12	2-4-1	Misfire detected in cylinder 2	no
CmbChbMisfire3	40	28	1325	0000052D	11, 12	2-4-1	Misfire detected in cylinder 3	no
CmbChbMisfire4	41	29	1326	0000052E	11, 12	2-4-1	Misfire detected in cylinder 4	no

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ID	Error code (dec)	Error code (hex)	SPN (dec)	SPN (hex)	FMI	Blink code	Description	Self-curing[1]
CmbChbMisfire5	42	2A	1327	0000052F	11, 12	2-4-1	Misfire detected in cylinder 5	no
CmbChbMisfire6	43	2B	1328	00000530	11, 12	2-4-1	Misfire detected in cylinder 6	no
CmbChbMisfire7	44	2C	1450	000005AA	11, 12	2-4-1	Misfire detected in cylinder 7	no
CmbChbMisfire8	45	2D	1451	000005AB	11, 12	2-4-1	Misfire detected in cylinder 8	no
CmbChbMisfireMul	46	2E	1322	0000052A	11, 12	2-4-1	Misfire detected in multiple cylinders	no
CmbChbSysReac	47	2F	1346	00000542	0, 11	2-4-1	Misfire detected with system reaction	no
CoEngShOffDemIgr	48	30	1109	00000455	2, 11	3-4-1	Shut-off request ignored	no
CRERCD	52	34	1072	00000430	3, 4, 5, 11	5-2-8	Internal engine brake: cable break or short circuit	no
CSLpCD	53	35	1081	00000439	2, 3, 4, 5	3-2-8	Preheating signal lamp: cable break or short circuit	no
CTLpCD	54	36	704	000002C0	11	1-2-3	Coolant temp. warning lamp: cable break or short circuit	no
CTSCD	55	37	110	0000006E	2, 3, 4	2-2-5	Coolant temp. sensor: cable break or short circuit	yes
CTSCDSysReac	56	38	110	0000006E	0, 11	2-3-2	Coolant temp.: outside target range with system reaction	yes
Dummy1CD_Max	57	39	701	000002BD	11	-	Reserve output 1: short circuit to Ubatt	no
Dummy1CD_Min	58	3A	701	000002BD	11	-	Reserve output 1: short circuit to ground	no
Dummy1CD_SigNpl	59	3B	701	000002BD	11	-	Reserve output 1: cable break or ECU internal error	no
Dummy2CD_Max	60	3C	702	000002BE	11	-	Reserve output 2: short circuit to Ubatt	no
Dummy2CD_Min	61	3D	702	000002BE	11	-	Reserve output 2: short circuit to ground	no
Dummy2CD_SigNpl	62	3E	702	000002BE	11	-	Reserve output 2: cable break or ECU internal error	no
EGRCD_Max	69	45	2791	00000AE7	3, 11	4-1-4	EGR actuator (external): short circuit to Ubatt	no
EGRCD_Min	70	46	2791	00000AE7	4, 11	4-1-4	EGR actuator (external): short circuit to ground	no
EGRCD_SigNpl	71	47	2791	00000AE7	2, 5, 11	4-1-5	EGR actuator (external): cable break or ECU internal error	no
EGRCDIntEGR	72	48	2791	00000AE7	2, 3, 4, 5	4-1-6	EGR actuator (internal): cable break or short circuit	no
EngCDTrqCalcOut	74	4A	923	0000039B	2, 3, 4, 5	5-5-5	"Engine Power" output: cable break or short circuit	no
EngMBackUp	75	4B	190	000000BE	11, 12	2-1-2	Running with cam-shaft speed signal only	yes
EngMCaS1	76	4C	190	000000BE	8, 11, 12	2-1-2	Speed signal from cam-shaft: bad or missing	yes
EngMCrS1	77	4D	190	000000BE	8, 11, 12	2-1-2	Speed signal from crank-shaft: bad or missing	yes
EngMOfsCaSCrS	78	4E	190	000000BE	2, 11	2-1-3	Speed signals of crank-shaft and cam-shaft: phase-shifted	no
EngPrtSysReacFOC	79	4F	190	000000BE	0, 11	2-1-4	Engine overspeed with system reaction	no
EngPrtSysReacORC	80	50	190	000000BE	11, 14	2-1-4	Overrun conditions with system reaction	yes

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ID	Error code (dec)	Error code (hex)	SPN (dec)	SPN (hex)	FMI	Blink code	Description	Self-curing[1]
ESLpCD	81	51	703	000002BF	2, 3, 4, 5	1-4-2	Engine operating signal lamp: cable break or ECU internal error	no
ExFlCD	82	52	1074	00000432	3, 4, 5, 11	2-1-9	Engine brake flap actuator: cable break or short circuit	no
FanCD	83	53	975	000003CF	2, 3, 4, 5	2-3-8	Fan actuator: cable break or short circuit	no
FanCDSysReac	86	56	523602	0007FD52	2, 11	2-3-8	Fan speed: above target range with system reaction	yes
FlFCD	87	57	97	00000061	3, 4, 11	2-2-8	Fuel filter / water separator sensor: cable break or short circuit	yes
FlFCD_WtLvl	89	59	97	00000061	11, 12	2-2-8	Water level in fuel filter: above target range	no
FlPSCD	90	5A	94	0000005E	3, 4, 11	2-1-6	Fuel low pressure sensor: cable break or short circuit	yes
FlPSCDSysReac	91	5B	94	0000005E	2, 11	2-1-6	Fuel low pressure: below target range with system reaction	yes
FrmMngDecV1	94	5E	523239	0007FBE7	2, 12	5-2-6	CAN message "DecV1" (pseudo pedal): missing or above target range.	yes
FrmMngFunModCtl	95	5F	523240	0007FBE8	11, 12	5-2-7	CAN message "FunModCtl" (function mode control): missing	yes
FrmMngTOEngPrt	106	6A	523212	0007FBCC	11, 12	3-3-3	CAN message "EngPrt" (engine protection): missing	yes
FrmMngTOPrHtEnCmd	110	6E	523216	0007FBD0	11, 12	3-3-7	CAN message "PrHtEnCmd" (preheat and engine command): missing	yes
FrmMngTORxCCVS	112	70	523218	0007FBD2	11, 12	1-1-1	CAN message "RxCCVS" (cruise control): missing	yes
FrmMngTORxEngTemp	113	71	523604	0007FD54	11, 12	1-1-2	CAN message "RxEngTemp" (enigne temperature): missing	yes
FrmMngTOSwtOut	117	75	523238	0007FBE6	11, 12	1-1-5	CAN message "SwtOut" (switch outputs): missing	yes
FrmMngTOTCO1	118	76	523222	0007FBD6	11, 12	1-1-6	CAN message "TCO1" (speedo signal): missing	yes
FrmMngTOTSC1AE	120	78	523605	0007FD55	11, 12	1-1-8	CAN message "TSC1-AE": missing	no
FrmMngTOTSC1AR	121	79	523606	0007FD56	11, 12	1-1-9	CAN message "TSC1-AR": missing	no
FrmMngTOTSC1DE	122	7A	523607	0007FD57	11, 12	1-1-8	CAN message "TSC1-DE": missing	no
FrmMngTOTSC1DR	123	7B	523608	0007FD58	11, 12	1-1-9	CAN message "TSC1-DR": missing	no
FrmMngTOTSC1PE	124	7C	523609	0007FD59	11, 12	1-1-8	CAN message "TSC1-PE": missing	no
FrmMngTOTSC1TE	125	7D	898	00000382	11, 12	1-1-8	CAN message "TSC1-TE": missing	no
FrmMngTOTSC1TR	126	7E	520	00000208	11, 12	1-1-9	CAN message "TSC1-TR": missing	no
FrmMngTOTSC1VE	127	7F	523610	0007FD5A	11, 12	1-1-8	CAN message "TSC1-VE": missing	no
FrmMngTOTSC1VR	128	80	523611	0007FD5B	11, 12	1-1-9	CAN message "TSC1-VR": missing	no
FrmMngTxTO	131	83	523500	0007FCEC	11, 12	2-7-1	CAN bus: time out of at least one sended message	yes
FTSCD	133	85	174	000000AE	3, 4, 11	2-2-7	Fuel temp. sensor: cable break or short circuit	yes
FTSCDSysReac	134	86	174	000000AE	0, 11	2-3-7	Fuel temp.: above target range with system reaction	yes

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ID	Error code (dec)	Error code (hex)	SPN (dec)	SPN (hex)	FMI	Blink code	Description	Self-curing[1]
GOTSCD	136	88	-	-	2, 3, 4, 11	1-3-3	Customer-specific sensor 1: cable break or short circuit	yes
GOTSCDSysReac	137	89	-	-	2, 11	1-3-3	Customer-specific temp. 1: outside target range with system reaction	yes
HdThrt	138	8A	29	0000001D	2, 3, 4, 11	1-2-6	Hand throttle: cable break or short circuit, implausible compared to signal of idle sensor	no
HOTSCD	139	8B	1638	00000666	3, 4, 11, 12	3-1-4	Customer-specific sensor 2: cable break or short circuit	yes
HOTSCDSysReac	140	8C	1638	00000666	2, 11	3-1-4	Customer-specific temp. 2: outside target range with system reaction	yes
HWEMonCom	141	8D	523617	0007FD61	11, 12	5-5-5	ECU internal error: communication with chip CJ 940 disturbed	no
HWEMonEEPROM	142	8E	630	00000276	11, 12	2-8-1	ECU internal error: EEPROM memory access	no
HWEMonRcyLocked	143	8F	523612	0007FD5C	11, 14	5-5-5	ECU internal hardware monitoring: a recovery occurred which is stored as protected	no
HWEMonRcySuppressed	144	90	523612	0007FD5C	11, 14	5-5-5	ECU internal hardware monitoring: a recovery occurred which is not stored	no
HWEMonRcyVisible	145	91	523612	0007FD5C	11, 14	5-5-5	ECU internal hardware monitoring: a recovery occurred which is visible in the error memory	no
HWEMonUMaxSupply	146	92	523612	0007FD5C	3, 11	5-5-5	ECU internal hardware monitoring: overvoltage	no
HWEMonUMinSupply	147	93	523612	0007FD5C	4, 11	5-5-5	ECU internal hardware monitoring: undervoltage	no
IATSCD	149	95	105	00000069	2, 3, 4, 11	1-2-8	Charge air temp. sensor: cable break or short circuit	yes
IATSCDSysReac	150	96	105	00000069	0, 11	2-3-3	Charge air temp.: above target range with system reaction	yes
InjVlvBnk1A	153	99	523350	0007FC56	3, 4, 11, 13	1-5-1	Injectors of cylinder bank 1: short circuit	no
InjVlvBnk1B	154	9A	523351	0007FC57	5, 13	1-5-1	Injectors of cylinder bank 1: cable break	no
InjVlvBnk2A	155	9B	523352	0007FC58	3, 4, 11, 13	1-5-2	Injectors of cylinder bank 2: short circuit	no
InjVlvBnk2B	156	9C	523353	0007FC59	5, 13	1-5-2	Injectors of cylinder bank 2: cable break	no
InjVlvChipA	157	9D	523354	0007FC5A	2, 3, 12, 14	1-5-3	ECU internal error: injector power stage A	no
InjVlvChipB	158	9E	523355	0007FC5B	12	1-5-3	ECU internal error: injector power stage B	no
InjVlvCyl1A	159	9F	651	0000028B	3, 4, 11, 13	1-5-4	Injector 1: short circuit	no
InjVlvCyl1B	160	A0	651	0000028B	5, 13	1-5-4	Injector 1: cable break	yes
InjVlvCyl2A	161	A1	652	0000028C	3, 4, 11, 13	1-5-5	Injector 2: short circuit	no
InjVlvCyl2B	162	A2	652	0000028C	5, 13	1-5-5	Injector 2: cable break	yes
InjVlvCyl3A	163	A3	653	0000028D	3, 4, 11, 13	1-5-6	Injector 3: short circuit	no
InjVlvCyl3B	164	A4	653	0000028D	5, 13	1-5-6	Injector 3: cable break	yes

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ID	Error code (dec)	Error code (hex)	SPN (dec)	SPN (hex)	FMI	Blink code	Description	Self-curing[1]
InjVlvCyl4A	165	A5	654	0000028E	3, 4, 11, 13	1-6-1	Injector 4: short circuit	no
InjVlvCyl4B	166	A6	654	0000028E	5, 13	1-6-1	Injector 4: cable break	yes
InjVlvCyl5A	167	A7	655	0000028F	3, 4, 11, 13	1-6-2	Injector 5: short circuit	no
InjVlvCyl5B	168	A8	655	0000028F	5, 13	1-6-2	Injector 5: cable break	yes
InjVlvCyl6A	169	A9	656	00000290	3, 4, 11, 13	1-6-3	Injector 6: short circuit	no
InjVlvCyl6B	170	AA	656	00000290	5, 13	1-6-3	Injector 6: cable break	yes
InjVlvCyl7A	171	AB	1419	0000058B	3, 4, 11, 13	1-6-4	Injector 7: short circuit	no
InjVlvCyl7B	172	AC	1419	0000058B	5, 13	1-6-4	Injector 7: cable break	yes
InjVlvCyl8A	173	AD	1420	0000058C	3, 4, 11, 13	1-6-5	Injector 8: short circuit	no
InjVlvCyl8B	174	AE	1420	0000058C	5, 13	1-6-5	Injector 8: cable break	yes
InjVlvErrDet	175	AF	523370	0007FC6A	11, 14	5-5-5	Compression test active: rail-pressure monitoring is going to be disabled	
MeUnCD_ADC	176	B0	523615	0007FD5F	3, 4, 11	1-3-5	Metering unit valve: flow rate outside target range	no
MeUnCDNoLoad	177	B1	523615	0007FD5F	5, 11, 12	1-3-5	Metering unit valve: not connected or output disabled	no
MeUnCDSCBat	178	B2	523615	0007FD5F	11, 12	1-3-5	Metering unit valve: short circuit to Ubatt	no
MeUnCDSCGnd	179	B3	523615	0007FD5F	11, 12	1-3-5	Metering unit valve: short circuit to ground	no
MnRly1_SCB	182	B6	2634	00000A4A	3, 11	1-3-7	Main relay 1: short circuit to Ubatt	no
MnRly1_SCG	183	B7	2634	00000A4A	4, 11	1-3-8	Main relay 1: short circuit to ground	no
Montr	184	B8	523420	0007FC9C	11, 14	1-3-9	ECU internal error: watchdog counter exceeds maximum	no
MRlyCD	186	BA	2634	00000A4A	7, 11, 12	2-6-1	Main relay 2: short circuit to ground or emergency shut-off	no
MRlyCDMnRly2	187	BB	563	00000233	7, 11, 12	2-6-1	Main relay 3: short circuit to ground or emergency shut-off (EDC16 only)	no
MRlyCDMnRly3	188	BC	2634	00000A4A	7, 11, 12	2-6-1	Main relay 3: short circuit to ground or emergency shut-off (EDC7 only)	no
MSSCD1	189	BD	523450	0007FCBA	2, 3, 4, 11	1-4-3	Multi state switch 1: cable break or short circuit, input voltage outside target range	yes
MSSCD2	190	BE	523451	0007FCBB	2, 3, 4, 11	1-4-3	Multi state switch 2: cable break or short circuit, input voltage outside target range	yes
MSSCD3	191	BF	523452	0007FCBC	2, 3, 4, 11	1-4-3	Multi state switch 3: cable break or short circuit, input voltage outside target range	yes
NetMngCANAOff	192	C0	639	0000027F	11, 14	2-7-1	CAN bus A: cable break or short circuit, off-state	yes
NetMngCANBOff	193	C1	1231	000004CF	11, 14	2-7-1	CAN bus B: cable break or short circuit, off-state	yes

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ID	Error code (dec)	Error code (hex)	SPN (dec)	SPN (hex)	FMI	Blink code	Description	Self-curing[1]
NetMngCANCOff	194	C2	1235	000004D3	11, 14	2-7-1	CAN bus C: cable break or short circuit, off-state	yes
OPLpCD	195	C3	705	000002C1	2, 3, 4, 5	1-3-5	Oil pressure warning lamp: cable break or short circuit	no
OPSCD	196	C4	100	00000064	0, 2, 3, 4	2-2-4	Charge air pressure sensor: cable break or short circuit	yes
OPSCD1	197	C5	100	00000064	1, 11	2-3-1	Oil pressure: value implausible low	yes
OPSCDSysReacHi	198	C6	100	00000064	0, 11	2-3-1	Oil pressure: above target range	yes
OPSCDSysReacLo	199	C7	100	00000064	1, 11	2-3-1	Oil pressure: below target range	yes
OSwCD	200	C8	1237	000004D5	2, 11	1-4-5	Override switch hangs	yes
OTSCD	201	C9	175	000000AF	2, 3, 4	1-4-4	Oil temperature sensor: cable break or short circuit	yes
OTSCDSysReac	203	CB	175	000000AF	0, 11	1-4-4	Oil temperature: below target range with system reaction	yes
PRVMon	208	D0	523470	0007FCCE	2, 11, 12, 14	1-4-6	Rail pressure limiting valve: opening failure	no
RailCD	209	D1	157	0000009D	3, 4, 11	1-4-7	Rail pressure sensor: cable break or short circuit	no
RailCDOfsTst	210	D2	157	0000009D	0, 1, 11	1-4-7	Rail pressure sensor: low quality signal (deviation of signal during start or after-run above target range)	yes
RailMeUn0	211	D3	523613	0007FD5D	0, 11	1-3-4	Rail pressure: positive deviation (speed dependent) outside target range	yes
RailMeUn1	212	D4	523613	0007FD5D	0, 11	1-3-4	Rail pressure: positive deviation (flow dependent) outside target range	yes
RailMeUn2	213	D5	523613	0007FD5D	0, 11	1-3-4	Rail pressure: negative deviation (flow dependent) outside target range	yes
RailMeUn3	214	D6	523613	0007FD5D	1, 11	1-3-4	Rail pressure: negative deviation (speed dependent) outside target range	yes
RailMeUn4	215	D7	523613	0007FD5D	0, 11	1-3-4	Rail pressure: above target range	yes
RailMeUn7	216	D8	523613	0007FD5D	2, 11	1-3-4	Rail pressure: implausible (leakage, injector needle blocked in open position, wastage of injectors or high pressure pumps, high pressure pumps defective)	no
SOPTst	218	DA	523490	0007FCE2	3, 4, 11, 12	1-4-9	ECU internal error: redundant shut-off conditions detected	no
SSpMon1	219	DB	1079	00000437	3, 4, 11	2-8-2	ECU internal error: wrong voltage of internal 5V reference source 1	yes
SSpMon2	221	DD	1080	00000438	3, 4, 11	2-8-2	ECU internal error: wrong voltage of internal 5V reference source 2	yes
SSpMon3	222	DE	523601	0007FD51	3, 4, 11	2-8-2	ECU internal error: wrong voltage of internal 5V reference source 3	yes
StrtCDHS	223	DF	677	000002A5	3, 4, 11	5-1-2	Start relay (high side): short circuit	no
StrtCDLS	224	E0	677	000002A5	3, 4, 5, 11	5-1-2	Start relay (low side): cable break or short circuit, disabled by ECU	no

ID	Error code (dec)	Error code (hex)	SPN (dec)	SPN (hex)	FMI	Blink code	Description	Self-curing[1]
SysLamp	225	E1	624	00000270	2, 3, 4, 5	5-1-3	Diagnostic lamp: cable break or short circuit, disabled by ECU	no
T15CD	226	E2	158	0000009E	11, 12	5-1-4	Terminal 15: ignition ON not detected	no
T50CD	227	E3	523550	0007FD1E	11, 12	5-1-5	Terminal 50: engine start switch hangs	no
TPUMon	228	E4	523550	0007FD1E	2, 11	5-5-5	ECU internal error: time processing unit (TPU) defective	no
VSSCD1	232	E8	84	00000054	0, 8, 12, 14	5-2-1	Vehicle speed: above target range, signal missing or implausible	yes
WdCom	235	EB	523600	0007FD50	11, 12	5-5-5	ECU internal error: serial communication interface defective	no

[1] Non-self-curing errors remain active up to the next ECU reset.

Table 2: FMI codes

FMI	Description
0	Data valid but above normal operational range
1	Data valid but below normal operational range
2	Data erratic, intermittent, or incorrect
3	Voltage above normal or shorted high
4	Voltage below normal or shorted low
5	Current below normal or open circuit
6	Current above normal or grounded circuit
7	Mechanical system not responding properly

FMI	Description
8	Abnormal frequency, pulse width,or period
9	Abnormal update rated
10	Abnormal rate of change
11	Failure mode not identifiable
12	Bad intelligent device or component
13	Out of Calibration
14	Special Instructions
15	Reserved

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DTC-List

Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

Deutz-Code / SPN / Fehlername ..... Seite

11 / 107 / AirFltSysReac 3
12 / 91 / APP1 3
14 / 91 / APPPwm 3
15 / 91 / APPPwmPer 4
16 / 108 / APSCD 4
17 / 729 / ArHt1 4
18 / 730 / ArHt2 5
19 / 676 / ArHtCD_NoLd 5
20 / 676 / ArHtCD_RlyErr 5
22 / 168 / BattCD 6
23 / 168 / BattCDSysReac 6
24 / 523561 / BIPCyl1 6
25 / 523562 / BIPCyl2 7
26 / 523563 / BIPCyl3 7
27 / 523564 / BIPCyl4 7
28 / 523565 / BIPCyl5 8
29 / 523566 / BIPCyl6 8
30 / 523567 / BIPCyl7 8
31 / 523568 / BIPCyl8 9
32 / 102 / BPSCD 9
33 / 102 / BPSCDSysReac 9
37 / 111 / CLSCDSysReac 10
38 / 1323 / CmbChbMisfire1 10
39 / 1324 / CmbChbMisfire2 10
40 / 1325 / CmbChbMisfire3 11
41 / 1326 / CmbChbMisfire4 11
42 / 1327 / CmbChbMisfire5 11
43 / 1328 / CmbChbMisfire6 12
44 / 1450 / CmbChbMisfire7 12
45 / 1451 / CmbChbMisfire8 12
46 / 1322 / CmbChbMisfireMul 13
47 / 1346 / CmbChbSysReac 13
48 / 1109 / CoEngShOffDemIgr 13
52 / 1072 / CRERCD 14
53 / 1081 / CSLpCD 14
54 / 704 / CTLpCD 14
55 / 110 / CTSCD 15

Deutz-Code / SPN / Fehlername ..... Seite

56 / 110 / CTSCDSysReac 15
57 / 701 / Dummy1CD_Max 15
58 / 701 / Dummy1CD_Min 16
59 / 701 / Dummy1CD_SigNpl 16
60 / 702 / Dummy2CD_Max 16
61 / 702 / Dummy2CD_Min 17
62 / 702 / Dummy2CD_SigNpl 17
69 / 2791 / EGRCD_Max 17
70 / 2791 / EGRCD_Min 18
71 / 2791 / EGRCD_SigNpl 18
72 / 2791 / EGRCDIntEGR 18
74 / 923 / EngCDTrqCalcOut 19
75 / 190 / EngMBackUp 19
76 / 190 / EngMCaS1 19
77 / 190 / EngMCrS1 20
78 / 190 / EngMOfsCaSCrS 20
79 / 190 / EngPrtSysReacFOC 20
80 / 190 / EngPrtSysReacORC 21
81 / 703 / ESLpCD 21
82 / 1074 / ExFlCD 21
83 / 975 / FanCD 22
85 / 1639 / FanCDEval 22
86 / 523602 / FanCDSysReac 22
87 / 97 / FlFCD 23
89 / 97 / FlFCD_WtLvl 23
90 / 94 / FlPSCD 23
91 / 94 / FlPSCDSysReac 24
94 / 523239 / FrmMngDecV1 24
95 / 523240 / FrmMngFunModCtl 24
106 / 523212 / FrmMngTOEngPrt 25
110 / 523216 / FrmMngTOPrHtEnCmd 25
112 / 523218 / FrmMngTORxCCVS 25
113 / 523604 / FrmMngTORxEngTemp 26
117 / 523238 / FrmMngTOSwtOut 26
118 / 523222 / FrmMngTOTCO1 26
120 / 523605 / FrmMngTOTSC1AE 27
121 / 523606 / FrmMngTOTSC1AR 27

Deutz-Code / SPN / Fehlername ..... Seite

122 / 523607 / FrmMngTOTSC1DE 27
123 / 523608 / FrmMngTOTSC1DR 28
124 / 523609 / FrmMngTOTSC1PE 28
125 / 898 / FrmMngTOTSC1TE 28
126 / 520 / FrmMngTOTSC1TR 29
127 / 523610 / FrmMngTOTSC1VE 29
128 / 523611 / FrmMngTOTSC1VR 29
131 / 523500 / FrmMngTxTO 30
133 / 174 / FTSCD 30
134 / 174 / FTSCDSysReac 30
136 / 523618 / GOTSCD 31
137 / 523619 / GOTSCDSysReac 31
138 / 29 / HdThrt 31
139 / 1638 / HOTSCD 32
140 / 1638 / HOTSCDSysReac 32
141 / 523617 / HWEMonCom 32
142 / 630 / HWEMonEEPROM 33
143 / 523612 / HWEMonRcyLocked 33
144 / 523612 / HWEMonRcySuppressed 33
145 / 523612 / HWEMonRcyVisible 34
146 / 523612 / HWEMonUMaxSupply 34
147 / 523612 / HWEMonUMinSupply 34
149 / 105 / IATSCD 35
150 / 105 / IATSCDSysReac 35
153 / 523350 / InjVlvBnk1A 35
154 / 523351 / InjVlvBnk1B 36
155 / 523352 / InjVlvBnk2A 36
156 / 523353 / InjVlvBnk2B 36
157 / 523354 / InjVlvChipA 37
158 / 523355 / InjVlvChipB 37
159 / 651 / InjVlvCyl1A 37
160 / 651 / InjVlvCyl1B 38
161 / 652 / InjVlvCyl2A 38
162 / 652 / InjVlvCyl2B 38
163 / 653 / InjVlvCyl3A 39
164 / 653 / InjVlvCyl3B 39
165 / 654 / InjVlvCyl4A 39

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referenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
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166 / 654 / InjVlvCyl4B	40
167 / 655 / InjVlvCyl5A	40
168 / 655 / InjVlvCyl5B	40
169 / 656 / InjVlvCyl6A	41
170 / 656 / InjVlvCyl6B	41
171 / 657 / InjVlvCyl7A	41
172 / 657 / InjVlvCyl7B	42
173 / 658 / InjVlvCyl8A	42
174 / 658 / InjVlvCyl8B	42
175 / 523370 / InjVlvErrDet	43
176 / 523615 / MeUnCD_ADC	43
177 / 523615 / MeUnCDNoLoad	43
178 / 523615 / MeUnCDSCBat	44
179 / 523615 / MeUnCDSCGnd	44
182 / 2634 / MnRly1_SCB	44
183 / 2634 / MnRly1_SCG	45
184 / 523420 / Montr	45
186 / 2634 / MRlyCD	45
187 / 563 / MRlyCDMnRly2	46
188 / 2634 / MRlyCDMnRly3	46
189 / 523450 / MSSCD1	46
190 / 523451 / MSSCD2	47
191 / 523452 / MSSCD3	47
192 / 639 / NetMngCANAOff	47
193 / 1231 / NetMngCANBOff	48
194 / 1235 / NetMngCANCOff	48
195 / 705 / OPLpCD	48
196 / 100 / OPSCD	49
197 / 100 / OPSCD1	49
198 / 100 / OPSCDSysReacHi	49
199 / 100 / OPSCDSysReacLo	50
200 / 1237 / OSwCD	50
201 / 175 / OTSCD	50
203 / 175 / OTSCDSysReac	51
208 / 523470 / PRVMon	51
209 / 157 / RailCD	51
210 / 157 / RailCDOfsTst	52

Deutz-Code / SPN / Fehlername	Seite
211 / 523613 / RailMeUn0	52
212 / 523613 / RailMeUn1	52
213 / 523613 / RailMeUn2	53
214 / 523613 / RailMeUn3	53
215 / 523613 / RailMeUn4	53
216 / 523613 / RailMeUn7	54
218 / 523490 / SOPTst	54
219 / 1079 / SSpMon1	54
221 / 1080 / SSpMon2	55
222 / 523601 / SSpMon3	55
223 / 677 / StrtCDHS	55
224 / 677 / StrtCDLS	56
225 / 624 / SysLamp	56
226 / 158 / T15CD	56
227 / 523550 / T50CD	57
228 / 523550 / TPUMon	57
232 / 84 / VSSCD1	57
235 / 523600 / WdCom	58
236 / 523470 / PRVMonSysReac	58
237 / 523006 / APPCDSwtnSel	58
238 / 523007 / FrmMng_TORxEngPress	59
239 / 523008 / MplCtl	59
240 / 98 / OLSCD	59
241 / 98 / OLSCDSysReacHi	60
242 / 107 / ADPSCDAna	60
243 / 98 / OLSCDSysReacLo	60
244 / 523009 / PrvMonWear	61
245 / 523010 / RailMeUn8	61
246 / 523650 / FlSys_FLPFMSysReac	61
247 / 523651 / FlSys_FTSFMSysReac	62
248 / 523652 / FlSys_FlushStateEngineOff	62
249 / 523653 / FlSys_RapeOilHeatEx	62
250 / 523654 / FrmMngDieselLvl	63
251 / 523655 / FrmMngFuelTemp	63
252 / 523656 / FrmMngLowPressureDiesel	63
253 / 523657 / FrmMngRapeOilIn	64
254 / 523658 / FrmMngRapeOilLvl	64

Deutz-Code / SPN / Fehlername	Seite
255 / 523659 / FrmMngRapeOilVlv1	64
256 / 523660 / FrmMngRapeOilVlv2	65
257 / 523661 / FrmMngRapeOilVlv3	65
258 / 523662 / FrmMngRapeOilVlv4	65
259 / 523663 / FrmMngRapeOilVlv5	66
260 / 523664 / FrmMngSTIN1RX	66

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P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

11 / 107 / AirFltSysReac

Error description AIR FILTER COND.
Air filter differential pressure: the pressure difference of the intake air between the filter inlet and outlet calculated by ECU is above the target range and the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 11
BlinkCode (short-long-short): 1 - 3 - 6
SPN: 107
possible FMI:
0: data valid, but above normal working area
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Pressure loss above target range with system reaction, air filter clogged or defective, sensor not working, connection cable demaged

Take actions for error repair
Check airfilter and if necessary clean or renew it, check cabling, check air filter and if necessary replace the filter component, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning or Warning and power reduction
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 2
Measurement @ errortime: actual value

12 / 91 / APP1

Error description THROTTLE 1
Analog accelerator pedal sensor 1 or double accelerator pedal sensor: the voltage measured by ECU is out of the target range or the calculated pedal position is implausible compared with the position of the second pedal

Error codes
DEUTZ-Errorcode: 12
BlinkCode (short-long-short): 2 - 2 - 6
SPN: 91
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Voltage outside target range, signal implausible compared to signal of redundant pedal (analog pedal 1), sensor defective, connection cable demaged

Take actions for error repair
Check cabling, check accelator pedal sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, switching to substitute value correspond to Priority-Chain or Limp Home
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 4
Measurement @ errortime: actual value

14 / 91 / APPPwm

Error description THROTTLE 1
Digital accelerator pedal sensor (PWM): the signal received by ECU is defective or implausible or the pulse-duty factor is out of the target range

Error codes
DEUTZ-Errorcode: 14
BlinkCode (short-long-short): 2 - 2 - 2
SPN: 91
possible FMI:
8: unusual frequency, pulse or period.
8: unusual frequency, pulse or period.
2: data stream is defective
8: unusual frequency, pulse or period.

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Duty cycle outside target range, signal erroneous or implausible (pedal 1), sensor defective, onnection cable demaged

Take actions for error repair
Check cabling, check accelator pedal sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, switching to substitute value correspond to Priority-Chain or Limp Home
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

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referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

15 / 91 / APPPwmPer

Error description THROTTLE 1
digital accelerator pedal sensor (PWM): the frequence of the signal received by ECU is out of the target range

Error codes
DEUTZ-Errorcode: 15
BlinkCode (short-long-short): 2 - 2 - 2
SPN: 91
possible FMI:
8: unusual frequency, pulse or period.
8: unusual frequency, pulse or period.
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Pulse frequency outside target range (pedal 1), sensor defective, connection cable demaged

Take actions for error repair
Check cabling, check accelator pedal sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, switching to substitute value correspond to Priority-Chain or Limp Home
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

16 / 108 / APSCD

Error description BAROMETRIC PRESS.
Ambient air pressure sensor (in ECU): the voltage measured by ECU is out of the target range or the calculated ambient air pressure is implausible compared with the charge air pressure

Error codes
DEUTZ-Errorcode: 16
BlinkCode (short-long-short): 2 - 9 - 2
SPN: 108
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Ambient air pressure sensor defective, ECU defective

Take actions for error repair
Change ECU

other error properties
System reaction: Warning, substitute value (0,85bar)
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: default value

17 / 729 / ArHt1

Error description AIR HEATER RELAY
Air heater relay: the current drain measured by ECU is out of the target range

Error codes
DEUTZ-Errorcode: 17
BlinkCode (short-long-short): 2 - 6 - 3
SPN: 729
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
5: current to low or broken wire
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit at EDC output, relay defective, connection cable demaged

Take actions for error repair
Check cabling, if sensor not working, check relay and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, shutoff output
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 2
Measurement @ errortime: shut off value

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300



18 / 730 / ArHt2

Error description AIR HEATER VALVE
Air heater magnet valve: the current drain measured by ECU is out of the target range

Error codes
DEUTZ-Errorcode: 18
BlinkCode (short-long-short): 2 - 6 - 3
SPN: 730
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
5: current to low or broken wire
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, valve defective, connection cable demaged

Take actions for error repair
Check valve and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 2
Measurement @ errortime: shut off value

19 / 676 / ArHtCD_NoLd

Error description AIR HEATER
Air heater relay: the ECU detects no switching operation at the input of a readback process

Error codes
DEUTZ-Errorcode: 19
BlinkCode (short-long-short): 2 - 6 - 3
SPN: 676
possible FMI:
12. Errormode not identifiable
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Relay energized, but no feedback on sense line, relay defective or wrong wired, preheat component defective, connection cable demaged

Take actions for error repair
Check cabling of preheat component, if relay not working,check relay and if necessary replace it, check preheat component and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 3
Measurement @ errortime: setpoint for output status

20 / 676 / ArHtCD_RlyErr

Error description AIR HEATER
Air heater relay: the ECU detects an implausible signal at the input of a readback process

Error codes
DEUTZ-Errorcode: 20
BlinkCode (short-long-short): 2 - 6 - 3
SPN: 676
possible FMI:
5: current to low or broken wire
2: data stream is defective
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Relay not energized, but working voltage on sense line, relay defective (can not disconnect or switch off), preheat component defective, connection cable demaged

Take actions for error repair
Check cabling of preheat component, if relay not working,check relay and if necessary replace it, check preheat component and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 3
Measurement @ errortime: setpoint for output status

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referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

22 / 168 / BattCD

Error description BATTERY VOLTAGE
Battery voltage: the voltage measured by ECU is out of the target range

Error codes
DEUTZ-Errorcode: 22
BlinkCode (short-long-short): 3 - 1 - 8
SPN: 168
possible FMI:
0: data valid, but above normal working area
1: data valid, but below normal working area
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Voltage below target range, battery defective, too high power supply voltage, too high contact resistance, wiring demaged, energie system overloaded, parametering inaccurate, ECU defective

Take actions for error repair
Check LIMA?, ECU, cabling, contact resistance, safety fuses, too high load in energy system, check battery and if necessary replace it, check battery pole and if necessary clean it, check connection cable and if necessary repair or replace it, check volta

other error properties
System reaction: Warning, substitute value, dependent upon supply voltage (12V, 24V)
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

23 / 168 / BattCDSysReac

Error description BATTERY VOLTAGE
Battery voltage: the voltage measured by ECU is out of the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 23
BlinkCode (short-long-short): 3 - 1 - 8
SPN: 168
possible FMI:
2: data stream is defective
2: data stream is defective
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Above target range with system reaction, too high power supply voltage, parametering inaccurate, ECU defective

Take actions for error repair
Check dataset of calibration of working voltage for application, check LIMA? Check voltage of generator, check the parameters and if necessary correct them, replace ECU

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

24 / 523561 / BIPCyl1

Error description INJECT. PERIOD ZYL.1
Begin of injection of cylinder 1: the ECU can not identify the magnet valve or the injection pump with the measured value of current drain at the begin of the injection

Error codes
DEUTZ-Errorcode: 24
BlinkCode (short-long-short): 5 - 3 - 1
SPN: 523561
possible FMI:
2: data stream is defective
2: data stream is defective
2: data stream is defective
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Value outside target range or missing (cylinder 1), magnet valve or injection pump defective

Take actions for error repair
Check magnetic valve or injection pump and if necessary change them

other error properties
System reaction: No function at the moment/ Allocation check cylinder!
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

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25 / 523562 / BIPCyl2

Error description INJECT. PERIOD ZYL.2
Begin of injection of cylinder 2: the ECU can not identify the magnet valve or the injection pump with the measured value of current drain at the begin of the injection

Error codes
DEUTZ-Errorcode: 25
BlinkCode (short-long-short): 5 - 3 - 2
SPN: 523562
possible FMI:
2: data stream is defective
2: data stream is defective
2: data stream is defective
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Value outside target range or missing (cylinder 2), magnet valve or injection pump defective

Take actions for error repair
Check magnetic valve or injection pump and if necessary change them

other error properties
System reaction: No function at the moment/ Allocation check cylinder!
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

26 / 523563 / BIPCyl3

Error description INJECT. PERIOD ZYL.3
Begin of injection of cylinder 3: the ECU can not identify the magnet valve or the injection pump with the measured value of current drain at the begin of the injection

Error codes
DEUTZ-Errorcode: 26
BlinkCode (short-long-short): 5 - 3 - 3
SPN: 523563
possible FMI:
2: data stream is defective
2: data stream is defective
2: data stream is defective
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Value outside target range or missing (cylinder 3), magnet valve or injection pump defective

Take actions for error repair
Check magnetic valve or injection pump and if necessary change them

other error properties
System reaction: No function at the moment/ Allocation check cylinder!
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

27 / 523564 / BIPCyl4

Error description INJECT. PERIOD ZYL.4
Begin of injection of cylinder 4: the ECU can not identify the magnet valve or the injection pump with the measured value of current drain at the begin of the injection

Error codes
DEUTZ-Errorcode: 27
BlinkCode (short-long-short): 5 - 3 - 4
SPN: 523564
possible FMI:
2: data stream is defective
2: data stream is defective
2: data stream is defective
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Value outside target range or missing (cylinder 4), magnet valve or injection pump defective

Take actions for error repair
d

other error properties
System reaction: No function at the moment/ Allocation check cylinder!
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

28 / 523565 / BIPCyl5

Error description INJECT. PERIOD ZYL.5
Begin of injection of cylinder 5: the ECU can not identify the magnet valve or the injection pump with the measured value of current drain at the begin of the injection

Error codes
DEUTZ-Errorcode: 28
BlinkCode (short-long-short): 5 - 3 - 5
SPN: 523565
possible FMI:
2: data stream is defective
2: data stream is defective
2: data stream is defective
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Value outside target range or missing (cylinder 5), magnet valve or injection pump defective

Take actions for error repair
Check magnetic valve or injection pump and if necessary change them

other error properties
System reaction: No function at the moment/ Allocation check cylinder!
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

29 / 523566 / BIPCyl6

Error description INJECT. PERIOD ZYL.6
Begin of injection of cylinder 6: the ECU can not identify the magnet valve or the injection pump with the measured value of current drain at the begin of the injection

Error codes
DEUTZ-Errorcode: 29
BlinkCode (short-long-short): 5 - 3 - 6
SPN: 523566
possible FMI:
2: data stream is defective
2: data stream is defective
2: data stream is defective
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Value outside target range or missing (cylinder 6), magnet valve or injection pump defective

Take actions for error repair
Check magnetic valve or injection pump and if necessary change them

other error properties
System reaction: No function at the moment/ Allocation check cylinder!
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

30 / 523567 / BIPCyl7

Error description INJECT. PERIOD ZYL.7
Begin of injection of cylinder 7: the ECU can not identify the magnet valve or the injection pump with the measured value of current drain at the begin of the injection

Error codes
DEUTZ-Errorcode: 30
BlinkCode (short-long-short): 5 - 3 - 7
SPN: 523567
possible FMI:
2: data stream is defective
2: data stream is defective
2: data stream is defective
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Value outside target range or missing (cylinder 7), magnet valve or injection pump defective

Take actions for error repair
Check magnetic valve or injection pump and if necessary change them

other error properties
System reaction: No function at the moment/ Allocation check cylinder!
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

31 / 523568 / BIPCyl8

Error description INJECT. PERIOD ZYL.8
Begin of injection of cylinder 8: the ECU can not identify the magnet valve or the injection pump with the measured value of current drain at the begin of the injection

Error codes
DEUTZ-Errorcode: 31
BlinkCode (short-long-short): 5 - 3 - 8
SPN: 523568
possible FMI:
2: data stream is defective
2: data stream is defective
2: data stream is defective
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Value outside target range or missing (cylinder 8), magnet valve or injection pump defective

Take actions for error repair
Check magnetic valve or injection pump and if necessary change them

other error properties
System reaction: No function at the moment/ Allocation check cylinder!
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

32 / 102 / BPSCD

Error description CHARGE AIR PRESS.
Charge air pressure sensor: the measured voltage of sensor by ECU is out of the target range; the calculated charge air pressure is implausible or the received value via CAN is defective

Error codes
DEUTZ-Errorcode: 32
BlinkCode (short-long-short): 2 - 2 - 3
SPN: 102
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
2: data stream is defective
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, sensor defective, onnection cable demaged

Take actions for error repair
Check cabling, if LDF6T sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: default value

33 / 102 / BPSCDSysReac

Error description CHARGE AIR PRESS.
Charge air pressure: the charge air pressure calculated by ECU is above the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 33
BlinkCode (short-long-short): 2 - 2 - 3
SPN: 102
possible FMI:
2: data stream is defective
2: data stream is defective
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light
oder
blinking. Entry in errormemory.

Possible reason for error
Outside target range with system reaction, air system demaged, sensor defective, onnection cable demaged

Take actions for error repair
Check air system, inspect air system and if necessary repair it, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Advice: BPSCD_stSysReacReq
Behaviour error lamp: permanent light
oder
blinking
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

37 / 111 / CLSCDSysReac

Error description ENG COOLANT LEVEL
Coolant level: the coolant level calculated by ECU is underneath the allowed minimum

Error codes
DEUTZ-Errorcode: 37
BlinkCode (short-long-short): 2 - 3 - 5
SPN: 111
possible FMI:
1: data valid, but below normal working area
1: data valid, but below normal working area
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light
oder
blinking. Entry in errormemory.

Possible reason for error
Outside target range with system reaction, cooling system untight, sensor defective, onnection cable demaged

Take actions for error repair
Check coolant level, check cabling, inspect cooling system and if necessary repair it, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Advice: CLSCD_stSysReacReq
Behaviour error lamp: permanent light
oder
blinking
Selfhealing: no
Signal Priority: 3
Measurement @ errortime: actual value

38 / 1323 / CmbChbMisfire1

Error description MISFIRE CYL. 1
Misfire at cylinder 1: the number of the misfire detected by ECU is out of the allowed limit value

Error codes
DEUTZ-Errorcode: 38
BlinkCode (short-long-short): 2 - 4 - 1
SPN: 1323
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Misfire detected (cylinder 1), magnet valve or injection pump defective, fuel system defective, motor engineering demaged

Take actions for error repair
Check magnetic valve or injection pump and if necessary replace them, check fuel system and if necessary repair it, check motor engineering and if necessary repair it

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 0
Measurement @ errortime: actual value

39 / 1324 / CmbChbMisfire2

Error description MISFIRE CYL. 2
Misfire at cylinder 2: the number of the misfire detected by ECU is out of the allowed limit value

Error codes
DEUTZ-Errorcode: 39
BlinkCode (short-long-short): 2 - 4 - 1
SPN: 1324
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Misfire detected (cylinder 2), magnet valve or injection pump defective, fuel system defective, motor engineering demaged

Take actions for error repair
Check magnetic valve or injection pump and if necessary replace them, check fuel system and if necessary repair it, check motor engineering and if necessary repair it

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 0
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

40 / 1325 / CmbChbMisfire3

Error description MISFIRE CYL. 3
Misfire at cylinder 3: the number of the misfire detected by ECU is out of the allowed limit value

Error codes
DEUTZ-Errorcode: 40
BlinkCode (short-long-short): 2 - 4 - 1
SPN: 1325
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Misfire detected (cylinder 3), magnet valve or injection pump defective, fuel system defective, motor engineering demaged

Take actions for error repair
Check magnetic valve or injection pump and if necessary replace them, check fuel system and if necessary repair it, check motor engineering and if necessary repair it

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 0
Measurement @ errortime: actual value

41 / 1326 / CmbChbMisfire4

Error description MISFIRE CYL. 4
Misfire at cylinder 4: the number of the misfire detected by ECU is out of the allowed limit value

Error codes
DEUTZ-Errorcode: 41
BlinkCode (short-long-short): 2 - 4 - 1
SPN: 1326
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Misfire detected (cylinder 4), magnet valve or injection pump defective, fuel system defective, motor engineering demaged

Take actions for error repair
Check magnetic valve or injection pump and if necessary replace them, check fuel system and if necessary repair it, check motor engineering and if necessary repair it

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 0
Measurement @ errortime: actual value

42 / 1327 / CmbChbMisfire5

Error description MISFIRE CYL. 5
Misfire at cylinder 5: the number of the misfire detected by ECU is out of the allowed limit value

Error codes
DEUTZ-Errorcode: 42
BlinkCode (short-long-short): 2 - 4 - 1
SPN: 1327
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Misfire detected (cylinder 5), magnet valve or injection pump defective, fuel system defective, motor engineering demaged

Take actions for error repair
Check magnetic valve or injection pump and if necessary replace them, check fuel system and if necessary repair it, check motor engineering and if necessary repair it

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 0
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

43 / 1328 / CmbChbMisfire6

Error description MISFIRE CYL. 6
Misfire at cylinder 6: the number of the misfire detected by ECU is out of the allowed limit value

Error codes
DEUTZ-Errorcode: 43
BlinkCode (short-long-short): 2 - 4 - 1
SPN: 1328
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Misfire detected (cylinder 6), magnet valve or injection pump defective, fuel system defective, motor engineering demaged

Take actions for error repair
Check magnetic valve or injection pump and if necessary replace them, check fuel system and if necessary repair it, check motor engineering and if necessary repair it

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 0
Measurement @ errortime: actual value

44 / 1450 / CmbChbMisfire7

Error description MISFIRE CYL. 7
Misfire at cylinder 7: the number of the misfire detected by ECU is out of the allowed limit value

Error codes
DEUTZ-Errorcode: 44
BlinkCode (short-long-short): 2 - 4 - 1
SPN: 1450
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Misfire detected (cylinder 7), magnet valve or injection pump defective, fuel system defective, motor engineering demaged

Take actions for error repair
Check magnetic valve or injection pump and if necessary replace them, check fuel system and if necessary repair it, check motor engineering and if necessary repair it

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 0
Measurement @ errortime: actual value

45 / 1451 / CmbChbMisfire8

Error description MISFIRE CYL. 8
Misfire at cylinder 8: the number of the misfire detected by ECU is out of the allowed limit value

Error codes
DEUTZ-Errorcode: 45
BlinkCode (short-long-short): 2 - 4 - 1
SPN: 1451
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Misfire detected (cylinder 8), magnet valve or injection pump defective, fuel system defective, motor engineering demaged

Take actions for error repair
Check magnetic valve or injection pump and if necessary replace them, check fuel system and if necessary repair it, check motor engineering and if necessary repair it

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 0
Measurement @ errortime: actual value

DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

46 / 1322 / CmbChbMisfireMul

Error description MULTIPL. CYL. MISFIRE
Misfire at more cylinders: the number of the misfire detected by ECU is out of the allowed limit value

Error codes
DEUTZ-Errorcode: 46
BlinkCode (short-long-short): 2 - 4 - 1
SPN: 1322
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Misfire detected, magnet valve or injection pump defective, fuel system defective, motor engineering demaged

Take actions for error repair
Check magnetic valve or injection pump and if necessary replace them, check fuel system and if necessary repair it, check motor engineering and if necessary repair it

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 0
Measurement @ errortime: actual value

47 / 1346 / CmbChbSysReac

Error description MISFIRE SYST. REACT
Misfire at more cylinders: the number of the misfire detected by ECU is out of the allowed limit value; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 47
BlinkCode (short-long-short): 2 - 4 - 1
SPN: 1346
possible FMI:
0: data valid, but above normal working area
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Misfire detected with system reaction, magnet valve or injection pump defective, fuel system defective, motor engineering demaged

Take actions for error repair
Check magnetic valve or injection pump and if necessary replace them, check fuel system and if necessary repair it, check motor engineering and if necessary repair it

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 0
Measurement @ errortime: actual value

48 / 1109 / CoEngShOffDemIgr

Error description SHUT OFF REQUEST
Request of engine off: the operator ignors the engine off request within an allowed period.

Error codes
DEUTZ-Errorcode: 48
BlinkCode (short-long-short): 3 - 4 - 1
SPN: 1109
possible FMI:
2: data stream is defective
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Shut-off request ignored by operator

Take actions for error repair
Warranty relevant

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 4
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

52 / 1072 / CRERCD

Error description ENGINE BRAKE INT.
Engine brake actuator (internal): the current drain measured by ECU is out of the target range or the maximum permissble temperature of the ECU component for power supply of the actuator is exceeded.

Error codes
DEUTZ-Errorcode: 52
BlinkCode (short-long-short): 5 - 2 - 8
SPN: 1072
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
5: current to low or broken wire
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
cable break or short circuit, sensor defective, connection cable demaged

Take actions for error repair
Check actuator and if necessary replace it, check connection cable and if necessary repaire or replace it

other error properties
System reaction: Warning, shutoff output, capacity reduction via second topcurve?
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 2
Measurement @ errortime: setpoint for output status

53 / 1081 / CSLpCD

Error description PREHEAT LAMP
Indicator lamp of air heater relay: the current drain measured by ECU is out of the target range or the maximum permissble temperature of the ECU component for power supply of the lamp is exceeded

Error codes
DEUTZ-Errorcode: 53
BlinkCode (short-long-short): 3 - 2 - 8
SPN: 1081
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
5: current to low or broken wire
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, lamp defective, connection cable demaged

Take actions for error repair
Check cabling and load, check lamp and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, shutoff output
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: setpoint for output status

54 / 704 / CTLpCD

Error description TEMP. LAMP
Warning lamp for coolant temperature: the current drain measured by ECU is out of the target range or the maximum temperature of the ECU component for power supply of the lamp is exceeded

Error codes
DEUTZ-Errorcode: 54
BlinkCode (short-long-short): 1 - 2 - 3
SPN: 704
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, lamp defective, connection cable demaged

Take actions for error repair
Check cabling and load, check lamp and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, shutoff output
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: setpoint for output status

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

55 / 110 / CTSCD

Error description ENG COOLANT TEMP.
Coolant temperature sensor: the voltage of the sensor measured by ECU is out of the target range; the coolant temperature calculated by ECU is implausible compared with the oil temperature or the received value via CAN is defective

Error codes
DEUTZ-Errorcode: 55
BlinkCode (short-long-short): 2 - 2 - 5
SPN: 110
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
2: data stream is defective
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, lamp defective, connection cable demaged

Take actions for error repair
Check cabling, sensor defect, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: default value

56 / 110 / CTSCDSysReac

Error description ENG COOLANT TEMP.
Coolant temperature: the coolant temperature calculated by ECU is above the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 56
BlinkCode (short-long-short): 2 - 3 - 2
SPN: 110
possible FMI:
0: data valid, but above normal working area
0: data valid, but above normal working area
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light
oder
blinking. Entry in errormemory.

Possible reason for error
Outside target range with system reaction, cooling system not enough to be filled, clogged or demaged, cooling compressor dropped out, sensor defective, onnection cable demaged

Take actions for error repair
Check cycle cooling system and compressor, inspect cooling system and if necessary repair it, check cooling compressor and if necessary replace it, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Advice: CTSCD_stSysReacReq
Behaviour error lamp: permanent light
oder
blinking
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

57 / 701 / Dummy1CD_Max

Error description RESERVE 2
Reserve output 1: the ECU detects a short circuit to battery

Error codes
DEUTZ-Errorcode: 57
BlinkCode (short-long-short): 1 - 0 - 0
SPN: 701
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Short circuit to Ubatt (output 1), connection cable demaged

Take actions for error repair
Check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, shutoff output
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: shut off value

DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

58 / 701 / Dummy1CD_Min

Error description RESERVE 2
Reserve output 1: the ECU detects a short circuit to ground
Error codes
DEUTZ-Errorcode: 58
BlinkCode (short-long-short): 1 - 0 - 0
SPN: 701
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
Errordetection
Errorlamp shows permanent light. Entry in errormemory.
Possible reason for error
Short circuit to ground (output 1), connection cable demaged
Take actions for error repair
Check connection cable and if necessary repair or replace it
other error properties
System reaction: Warning, shutoff output
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: shut off value

59 / 701 / Dummy1CD_SigNpl

Error description RESERVE 2
Reserve output 1: the ECU detects no load or excess temperature of the ECU component for power supply of the connected components
Error codes
DEUTZ-Errorcode: 59
BlinkCode (short-long-short): 1 - 0 - 0
SPN: 701
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
Errordetection
Errorlamp shows permanent light. Entry in errormemory.
Possible reason for error
Cable break or ECU internal error (output 1), connection cable demaged, connected components defective, parametering of the output inaccurate, ECU defective
Take actions for error repair
Check connection cable and if necessary repair or replace it, check parameters and if necessary correct it, replace ECU
other error properties
System reaction: Warning, shutoff output
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: shut off value

60 / 702 / Dummy2CD_Max

Error description THRUST MODE
Reserve output 2: the ECU detects a short circuit to battery
Error codes
DEUTZ-Errorcode: 60
BlinkCode (short-long-short): 1 - 0 - 0
SPN: 702
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
Errordetection
Errorlamp shows permanent light. Entry in errormemory.
Possible reason for error
Short circuit to Ubatt (output 2), onnection cable demaged
Take actions for error repair
Check connection cable and if necessary repair or replace it
other error properties
System reaction: Warning, shutoff output
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: shut off value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

61 / 702 / Dummy2CD_Min

Error description THRUST MODE
Reserve output 2: the ECU detects a short circuit to ground
Error codes
DEUTZ-Errorcode: 61
BlinkCode (short-long-short): 1 - 0 - 0
SPN: 702
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
Errordetection
Errorlamp shows permanent light. Entry in errormemory.
Possible reason for error
Short circuit to ground (output 2), connection cable demaged
Take actions for error repair
Check connection cable and if necessary repair or replace it
other error properties
System reaction: Warning, shutoff output
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: shut off value

62 / 702 / Dummy2CD_SigNpl

Error description THRUST MODE
Reserve output 2: the ECU detects no load or excess temperature of the ECU component for power supply of the connected components
Error codes
DEUTZ-Errorcode: 62
BlinkCode (short-long-short): 1 - 0 - 0
SPN: 702
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
Errordetection
Errorlamp shows permanent light. Entry in errormemory.
Possible reason for error
Cable break or ECU internal error (output 2), connection cable demaged, connected components defective, parametering of the output inaccurate, ECU defective
Take actions for error repair
Check connection cable and if necessary repair or replace it, check parameters and if necessary correct it, replace ECU
other error properties
System reaction: Warning, shutoff output
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: shut off value

69 / 2791 / EGRCD_Max

Error description EGR ACTUATOR
Actuator of the external EGR valve: the ECU detects a short circuit to battery
Error codes
DEUTZ-Errorcode: 69
BlinkCode (short-long-short): 4 - 1 - 4
SPN: 2791
possible FMI:
3: Voltage to high or short circuit to +Ubatt
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
Errordetection
Errorlamp shows permanent light. Entry in errormemory.
Possible reason for error
Short circuit to Ubatt, connection cable demaged
Take actions for error repair
Check cabling, sensor defect, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it
other error properties
System reaction: Warning, shutoff output, power reduction via second topcurve?
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 3
Measurement @ errortime: shut off value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

70 / 2791 / EGRCD_Min

Error description EGR ACTUATOR
Actuator of the external EGR valve: the ECU detects a short circuit to ground

Error codes
DEUTZ-Errorcode: 70
BlinkCode (short-long-short): 4 - 1 - 4
SPN: 2791
possible FMI:
12. Errormode not identifiable
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Short circuit to ground, connection cable demaged

Take actions for error repair
Check cabling, sensor defect, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, shutoff output, power reduction via second topcurve?
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 3
Measurement @ errortime: shut off value

71 / 2791 / EGRCD_SigNpl

Error description EGR ACTUATOR
Actuator of the external EGR valve: the ECU detects no load or excess temperature of the ECU component for power supply of the connected components

Error codes
DEUTZ-Errorcode: 71
BlinkCode (short-long-short): 4 - 1 - 5
SPN: 2791
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
5: current to low or broken wire
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or excess temperature, sensor defective, connection cable demaged

Take actions for error repair
Check cabling, sensor defect, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, shutoff output, power reduction via second topcurve?
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 3
Measurement @ errortime: shut off value

72 / 2791 / EGRCDIntEGR

Error description EGR ACTUATOR
Actuator of the internal EGR valve: the ECU detects no load or excess temperature of the ECU component for power supply of the actuator

Error codes
DEUTZ-Errorcode: 72
BlinkCode (short-long-short): 4 - 1 - 6
SPN: 2791
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
5: current to low or broken wire
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break, short circuit or excess temperature, sensor defective, connection cable demaged

Take actions for error repair
Check cabling, sensor defect, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, shutoff output, power reduction via second topcurve?
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 3
Measurement @ errortime: shut off value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

74 / 923 / EngCDTrqCalcOut

Error description ENGINE POWER OUT
Output with PWM signal of the engine power: the current drain measured by ECU is out of the target range or the maximum permissible temperature of the ECU component to control the output is exceeded

Error codes
DEUTZ-Errorcode: 74
BlinkCode (short-long-short): 5 - 5 - 5
SPN: 923
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
5: current to low or broken wire
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Engine Power output: cable break or short circuit, output defective, connection cable demaged

Take actions for error repair
Check cabling, sensor defect, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, shutoff output
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: shut off value

75 / 190 / EngMBackUp

Error description ENGINE SPEED
Crankschaft speed sensor: the ECU receives no signal and uses the signal from camschaft speed sensor as alternative to calculate the engine speed

Error codes
DEUTZ-Errorcode: 75
BlinkCode (short-long-short): 2 - 1 - 2
SPN: 190
possible FMI:
12. Errormode not identifiable
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Engine running only with cam-shaft speed signal, transmitter defective, connection cable demaged

Take actions for error repair
Check cabling of crankschaft sensor, check crankschaft sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, calculation of injektion initation point will be incorrect
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: -

76 / 190 / EngMCaS1

Error description ENGINE SPEED
Camschaft speed sensor: the ECU receives no signal or the signal is defective

Error codes
DEUTZ-Errorcode: 76
BlinkCode (short-long-short): 2 - 1 - 2
SPN: 190
possible FMI:
12: Defective component
8: unusual frequency, pulse or period.
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Speed signal from cam-shaft defectiveiv or missing, transmitter defective, connection cable demaged, parametering of the sensor wheel inaccurate

Take actions for error repair
Check cabling, check camschaft sensor and if necessary replace it, check configuration of sensor wheel, check connection cable and if necessary repair or replace it, check parameters and if necessary correct them

other error properties
System reaction: Warning, difficult start
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: 0

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

77 / 190 / EngMCrS1

Error description ENGINE SPEED
Crankschaft speed sensor: the ECU receives no signal or the signal is defective

Error codes
DEUTZ-Errorcode: 77
BlinkCode (short-long-short): 2 - 1 - 2
SPN: 190
possible FMI:
12: Defective component
8: unusual frequency, pulse or period.
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Speed signal from crankshaft defectiveiv or missing, transmitter defective, connection cable demaged, sensor wheel installed inaccurately

Take actions for error repair
Check cabling, check camschaft sensor and if necessary replace it, check configuration of sensor wheel, check connection cable and if necessary repair or replace it, check the position of sensor wheel and if necessary correct it

other error properties
System reaction: Warning, power reduction via second topcurve
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: 0

78 / 190 / EngMOfsCaSCrS

Error description ENGINE SPEED
Speed sensor of crankschaft and camschaft: the received signals are out of phase

Error codes
DEUTZ-Errorcode: 78
BlinkCode (short-long-short): 2 - 1 - 3
SPN: 190
possible FMI:
2: data stream is defective
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Speed signals of crank-shaft and cam-shaft are phase-shifted, sensor wheel installed in wrong position, sensor wrong wired

Take actions for error repair
Check position from crankschaft sensor wheel to camschaft sensor wheel, polarisation crankschaft or camschaft sensor, check position of sensor wheel and if necessary correct it, check cabling and if necessary correct it

other error properties
System reaction: Warning, not possible to start engine
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 4
Measurement @ errortime: -

79 / 190 / EngPrtSysReacFOC

Error description ENGINE SPEED
Engine speed: the engine speed calculated by ECU is above the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 79
BlinkCode (short-long-short): 2 - 1 - 4
SPN: 190
possible FMI:
0: data valid, but above normal working area
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows blinking. Entry in errormemory.

Possible reason for error
Engine overspeed detected with system reaction, maximum engine speed exceeded

Take actions for error repair

other error properties
System reaction:
Behaviour error lamp: blinking
Selfhealing: no
Signal Priority: 5
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

80 / 190 / EngPrtSysReacORC

Error description ENGINE SPEED
Engine speed: under overrun conditions, the engine speed calculated by ECU is above the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 80
BlinkCode (short-long-short): 2 - 1 - 4
SPN: 190
possible FMI:
14: Special Instructions
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Overrun conditions detected with system reaction, maximum engine speed exceeded

Take actions for error repair

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

81 / 703 / ESLpCD

Error description ENG. RUNNING LAMP
Indicator lamp for engine running: the current drain measured by ECU is out of the target range or the maximum permissible temperature of the ECU component for power supply of the lamp is exceeded

Error codes
DEUTZ-Errorcode: 81
BlinkCode (short-long-short): 1 - 4 - 2
SPN: 703
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
5: current to low or broken wire
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or internal ECU error, lamp defective, connection cable demaged

Take actions for error repair
Check cabling and load, check lamp and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, shutoff output
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: shut off value

82 / 1074 / ExFICD

Error description BRAKE FLAP ACTUATOR
Engine brake flap actuator: the current drain measured by ECU is out of the target range or the maximum permissible temperature of the ECU component for power supply of the actuator is exceeded

Error codes
DEUTZ-Errorcode: 82
BlinkCode (short-long-short): 2 - 1 - 9
SPN: 1074
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
5: current to low or broken wire
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Engine brake flap actuator: cable break or short circuit, sensor defective, connection cable demaged

Take actions for error repair
Check cabling, sensor defect, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, shutoff output
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 2
Measurement @ errortime: shut off value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

83 / 975 / FanCD

Error description FAN ACTUATOR
Fan power stage: the current drain measured by ECU is out of the target range or the maximum permissible temperature of the ECU component for power supply of the actuator is exceeded

Error codes
DEUTZ-Errorcode: 83
BlinkCode (short-long-short): 2 - 3 - 8
SPN: 975
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
5: current to low or broken wire
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
cable break or short circuit, sensor defective, connection cable demaged

Take actions for error repair
Check cabling, sensor defect, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, shutoff output
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 2
Measurement @ errortime: Sollwert

85 / 1639 / FanCDEval

Error description
Fan speed sensor: the current drain measured by ECU is out of the target range

Error codes
DEUTZ-Errorcode: 85
BlinkCode (short-long-short): 2 - 3 - 8
SPN: 1639
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Sensor defective, connection cable demaged, fan speed outside the target range

Take actions for error repair
Check sensor and if necessary replace it, check connectionn cable and if necessary repair or replace it, check fan

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 2
Measurement @ errortime: actual value

86 / 523602 / FanCDSysReac

Error description FAN SPEED
Fan speed: the fan speed calculated by ECU is above the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 86
BlinkCode (short-long-short): 2 - 3 - 8
SPN: 523602
possible FMI:
2: data stream is defective
2: data stream is defective
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Above target range with system reaction

Take actions for error repair

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

87 / 97 / FIFCD

Error description WATER IN FUEL
Fuel filter water level sensor: the voltage of sensor measured by ECU is out of the target range

Error codes
DEUTZ-Errorcode: 87
BlinkCode (short-long-short): 2 - 2 - 8
SPN: 97
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
cable break or short circuit, sensor defective, connection cable demaged

Take actions for error repair
Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 1
Measurement @ errortime: default value

89 / 97 / FIFCD_WtLvl

Error description WATER IN FUEL
Water in fuel: the water level calculated by ECU is above the allowed limit value

Error codes
DEUTZ-Errorcode: 89
BlinkCode (short-long-short): 2 - 2 - 8
SPN: 97
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Above target range, excess of maximum permissible water level in fuel filter

Take actions for error repair
flush water seperator

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 3
Measurement @ errortime: actual value

90 / 94 / FIPSCD

Error description FUEL PRE PRESS.
Low fuel pressure sensor: the voltage of sensor measured by ECU is out of the target range

Error codes
DEUTZ-Errorcode: 90
BlinkCode (short-long-short): 2 - 1 - 6
SPN: 94
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
cable break or short circuit, sensor defective, connection cable demaged

Take actions for error repair
Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: default value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

91 / 94 / FlPSCDSysReac

Error description FUEL PRE PRESS.
Low fuel pressure: the low fuel pressure calculated by ECU is underneath the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 91
BlinkCode (short-long-short): 2 - 1 - 6
SPN: 94
possible FMI:
2: data stream is defective
2: data stream is defective
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Below target range with system reaction, interruption in cycling process of low fuel pressure (for example, fuel pump defective), sensor defective, connection cable demaged

Take actions for error repair
Check low fuel pressure loop system, Check fuel pump, inspect fuel system and if necessary repair it, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Advice: FLPSCD_stSysReacReq
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

94 / 523239 / FrmMngDecV1

Error description CAN ERROR DEC-V1
CAN message DecV1 (Pseudo Pedal): the message can not be received by ECU or the received value is above the target range

Error codes
DEUTZ-Errorcode: 94
BlinkCode (short-long-short): 5 - 2 - 6
SPN: 523239
possible FMI:
12: Defective component
12: Defective component
12: Defective component
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing or value above target range (message "DecV1" = pseudo pedal), CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction: Warning, changing to substitute values according to customers configuration.
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 1
Measurement @ errortime: default value

95 / 523240 / FrmMngFunModCtl

Error description CAN ERROR FUNMODCTL
CAN message FunModCtl (Function Mode Control): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 95
BlinkCode (short-long-short): 5 - 2 - 7
SPN: 523240
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing message "FunModCtl" = function mode control, CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction: Warning, changing to substitute values according to customers configuration.
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 1
Measurement @ errortime: default valuee

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

106 / 523212 / FrmMngTOEngPrt

Error description CAN ERROR ENGPRT
CAN message EngPrt (Engine Protection): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 106
BlinkCode (short-long-short): 3 - 3 - 3
SPN: 523212
possible FMI:
12: Defective component
12. Errormode not identifiable
12: Defective component
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing message "EngPrt" = engine protection, CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction: Warning. Hold last value.
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 1
Measurement @ errortime: default value

110 / 523216 / FrmMngTOPrHtEnCmd

Error description CAN ERROR PRHTENCMD
CAN message PrHtEnCmd (Preheat and Engine Command): the message received can not be received by ECU

Error codes
DEUTZ-Errorcode: 110
BlinkCode (short-long-short): 3 - 3 - 7
SPN: 523216
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12: Defective component
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing message "PrHtEnCmd" = preheat and engine command; CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction: Warning, changing to substitute values according to customers configuration.
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 1
Measurement @ errortime: default valuee

112 / 523218 / FrmMngTORxCCVS

Error description CAN ERROR RXCCVS
CAN message RxCCVS (Cruise Control): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 112
BlinkCode (short-long-short): 1 - 1 - 1
SPN: 523218
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12: Defective component
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing message "RxCCVS" = cruise control; CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 1
Measurement @ errortime: default valuee

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

113 / 523604 / FrmMngTORxEngTemp

Error description CAN ERROR RxEngTemp
CAN message RxEngTemp (Engine Temperature): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 113
BlinkCode (short-long-short): 1 - 1 - 2
SPN: 523604
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing message "RxEngTemp" = engine temperature, CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 1
Measurement @ errortime: default value

117 / 523238 / FrmMngTOSwtOut

Error description CAN ERROR SWTOUT
CAN message SwtOut (Switching Output): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 117
BlinkCode (short-long-short): 1 - 1 - 5
SPN: 523238
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing message "SwtOut" = switch outputs, CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 1
Measurement @ errortime: default valuee

118 / 523222 / FrmMngTOTCO1

Error description CAN ERROR TCO1
CAN message "TCO1" (Speedo Signal): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 118
BlinkCode (short-long-short): 1 - 1 - 6
SPN: 523222
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12: Defective component
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing message "TCO1" = speedo signal, CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 1
Measurement @ errortime: default value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

120 / 523605 / FrmMngTOTSC1AE

Error description CAN ERROR TSC1-AE
CAN message TSC1-AE (Torque/Speed Control #1 from Automatic Traction Control to Engine): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 120
BlinkCode (short-long-short): 1 - 1 - 8
SPN: 523605
possible FMI:
12: Defective component
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing message "TSC1-AE", CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction: Warning, changing to substitute values according to priority chain.
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: default value

121 / 523606 / FrmMngTOTSC1AR

Error description CAN ERROR TSC1-AR
CAN message TSC1-AR (Torque/Speed Control #1 from Automatic Traction Control to Retarder): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 121
BlinkCode (short-long-short): 1 - 1 - 9
SPN: 523606
possible FMI:
12: Defective component
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing message "TSC1-AR", CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction: Warning, changing to substitute values according to priority chain.
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: default value

122 / 523607 / FrmMngTOTSC1DE

Error description CAN ERROR TSC1-DE
CAN message TSC1-DE (Torque/Speed Control #1 from Driveline to Engine): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 122
BlinkCode (short-long-short): 1 - 1 - 8
SPN: 523607
possible FMI:
12: Defective component
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing message "TSC1-DE", CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction: Warning, changing to substitute values according to priority chain.
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: default value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

123 / 523608 / FrmMngTOTSC1DR

Error description CAN ERROR TSC1-DR
CAN message TSC1-DR (Torque/Speed Control #1 from Driveline to Retarder): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 123
BlinkCode (short-long-short): 1 - 1 - 9
SPN: 523608
possible FMI:
12: Defective component
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing message "TSC1-DR", CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction: Warning, changing to substitute values according to priority chain.
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: default value

124 / 523609 / FrmMngTOTSC1PE

Error description CAN ERROR TSC1-PE
CAN message TSC1-PE (Torque/Speed Control #1 from Power Take Off to Engine): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 124
BlinkCode (short-long-short): 1 - 1 - 8
SPN: 523609
possible FMI:
12: Defective component
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing message "TSC1-PE", CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction: Warning, changing to substitute values according to priority chain.
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: default value

125 / 898 / FrmMngTOTSC1TE

Error description CAN ERROR TSC1-TE
CAN message TSC1-TE (Torque/Speed Control #1 from Traction Control to Engine): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 125
BlinkCode (short-long-short): 1 - 1 - 8
SPN: 898
possible FMI:
12: Defective component
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing message "TSC1-TE", CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction: Warning, changing to substitute values according to priority chain.
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: default value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

126 / 520 / FrmMngTOTSC1TR

Error description CAN ERROR TSC1-TR
CAN message TSC1-TR (Torque/Speed Control #1 from Traction Control to Retarder): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 126
BlinkCode (short-long-short): 1 - 1 - 9
SPN: 520
possible FMI:
12: Defective component
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing message "TSC1-TR", CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction: Warning, changing to substitute values according to priority chain.
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: default value

127 / 523610 / FrmMngTOTSC1VE

Error description CAN ERROR TSC1-VE
CAN message TSC1-VE (Torque/Speed Control #1 from Vehicle Control to Engine): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 127
BlinkCode (short-long-short): 1 - 1 - 8
SPN: 523610
possible FMI:
12: Defective component
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing message "TSC1-VE", CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction: Warning, changing to substitute values according to priority chain.
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: default value

128 / 523611 / FrmMngTOTSC1VR

Error description CAN ERROR TSC1-VR
CAN message TSC1-VR (Torque/Speed Control #1 from Vehicle Control to Retarder): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 128
BlinkCode (short-long-short): 1 - 1 - 9
SPN: 523611
possible FMI:
12: Defective component
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Missing message "TSC1-VR", CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction: Warning, changing to substitute values according to priority chain.
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: default value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

131 / 523500 / FrmMngTxTO

Error description CAN MESS. TIMEOUT
CAN message: the ECU detects a timeout for one or more posted message

Error codes
DEUTZ-Errorcode: 131
BlinkCode (short-long-short): 2 - 7 - 1
SPN: 523500
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12: Defective component
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Timeout for sent messages

Take actions for error repair

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 1
Measurement @ errortime: -

133 / 174 / FTSCD

Error description FUEL TEMP. SENSOR
Fuel temperature sensor: the voltage measured by ECU is out of the target range

Error codes
DEUTZ-Errorcode: 133
BlinkCode (short-long-short): 2 - 2 - 7
SPN: 174
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Fuel temp. sensor: cable break or short circuit, sendor defective, connection cable demaged

Take actions for error repair
Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: default value

134 / 174 / FTSCDSysReac

Error description FUEL TEMP. SENSOR
Fuel temperature: the fuel temperature calculated by ECU is above the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 134
BlinkCode (short-long-short): 2 - 3 - 7
SPN: 174
possible FMI:
0: data valid, but above normal working area
0: data valid, but above normal working area
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light
oder
blinking. Entry in errormemory.

Possible reason for error
Above target range with system reaction, interruption of fuel loop (for example, rail pressure relief valve defective), sensor defective, connection cable demaged

Take actions for error repair
Check fuel system and if necessary repair it, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Advice: FTSCD_stSysReacReq
Behaviour error lamp: permanent light
oder
blinking
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

136 / 523618 / GOTSCD

Error description CUSTOMER TEMPSENS 1
Customer specific temperature sensor 1: the voltage of sensor measured by ECU is out of the target range or the received value of temperature via CAN is defective

Error codes
DEUTZ-Errorcode: 136
BlinkCode (short-long-short): 1 - 3 - 3
SPN: 523618
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
2: data stream is defective
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit (sensor 1), sensor defective, connection cable demaged, CAN bus wrong cabled, wiring demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Customer specific bugfixing, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it, Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN fun

other error properties
System reaction: Warning, substitute value (customer specific)
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 2
Measurement @ errortime: default value

137 / 523619 / GOTSCDSysReac

Error description
Customer specific temperature 1: the temperature calculated by ECU is above the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 137
BlinkCode (short-long-short): 1 - 3 - 3
SPN: 523619
possible FMI:
2: data stream is defective
2: data stream is defective
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light
oder
blinking. Entry in errormemory.

Possible reason for error
Outside target range with system reaction (temperature 1), dependant on the application

Take actions for error repair
Customer specific bugfixing, denpendant on application

other error properties
System reaction: Advice: GOTSCD_stSysReacReq
Behaviour error lamp: permanent light
oder
blinking
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

138 / 29 / HdThrt

Error description THROTTLE 2
Hand throttle pedal sensor: the voltage measured by ECU is out of the target range or the calculated pedal position is implausible compared with the position of accelerator pedal 1

Error codes
DEUTZ-Errorcode: 138
BlinkCode (short-long-short): 1 - 2 - 6
SPN: 29
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, signal implausible compared to signal of idle sensor, transmitter defective, connection cable demaged

Take actions for error repair
Check cabling, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, changing to substitute values according to priority chain or limp home
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 4
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

139 / 1638 / HOTSCD

Error description CUSTOMER TEMPSENS 2
Customer specific temperature sensor 2: the voltage of sensor measured by ECU is out of the target range or the received value of temperature via CAN is defective

Error codes
DEUTZ-Errorcode: 139
BlinkCode (short-long-short): 3 - 1 - 4
SPN: 1638
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12: Defective component
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit (sensor 2), sensor defective, connection cable demaged, CAN bus wrong cabled, wiring demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Customer specific bugfixing, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it, Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN fun

other error properties
System reaction: Warning, substitute value (customer specific)
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 2
Measurement @ errortime: default value

140 / 1638 / HOTSCDSysReac

Error description CUSTOMER TEMPSENS 2
Customer specific temperature 2: the temperature calculated by ECU is above the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 140
BlinkCode (short-long-short): 3 - 1 - 4
SPN: 1638
possible FMI:
2: data stream is defective
2: data stream is defective
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light
oder
blinking. Entry in errormemory.

Possible reason for error
Outside target range with system reaction (temperature 2), dependant on the application

Take actions for error repair
Customer specific bugfixing, denpendant on application

other error properties
System reaction: Advice: HOTSCD_stSysReacReq
Behaviour error lamp: permanent light
oder
blinking
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

141 / 523617 / HWEMonCom

Error description INTERNAL COMM. ERROR
Internal hardware monitoring: the ECU detects a communication distrubance

Error codes
DEUTZ-Errorcode: 141
BlinkCode (short-long-short): 5 - 5 - 5
SPN: 523617
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Communication with chip CJ 940 disturbed, ECU defective

Take actions for error repair
If cannot delete the error, change ECU

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 4
Measurement @ errortime: -

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

142 / 630 / HWEMonEEPROM

Error description EEPROM MEM. ACCESS
Internal hardware monitoring: the ECU finds an error during the access to ist EEPROM memory or works with an alternative value

Error codes
DEUTZ-Errorcode: 142
BlinkCode (short-long-short): 2 - 8 - 1
SPN: 630
possible FMI:
12. Errormode not identifiable
12: Defective component
12: Defective component
12: Defective component

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Error during EEPROM memory access or EEPROM works with substitute value, programming error, ECU defective

Take actions for error repair
If not programmed, EEPROM is defect --> ECU is defect, reprogram ECU and if necessary replace it

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 4
Measurement @ errortime: -

143 / 523612 / HWEMonRcyLocked

Error description INT. RECOVERY
Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory

Error codes
DEUTZ-Errorcode: 143
BlinkCode (short-long-short): 5 - 5 - 5
SPN: 523612
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
14: Special Instructions

Errordetection
Errorlamp shows blinking. Entry in errormemory.

Possible reason for error
A recovery occurred which is stored as protected

Take actions for error repair
Recoverey occured which is stored as protected
With parameter HWEMon_numRexxxxxxx the recovery nummer and the subsequent position can be identified. See especially SW-Doku _rcy_auto.pdf

other error properties
System reaction: Recovery of ECU
Behaviour error lamp: blinking
Selfhealing: no
Signal Priority: 5
Measurement @ errortime: -

144 / 523612 / HWEMonRcySuppressed

Error description INT. RECOVERY
Internal hardware monitoring: the CPU of the ECU is reset and the cause is logged internally; no item will be created in error memory

Error codes
DEUTZ-Errorcode: 144
BlinkCode (short-long-short): 5 - 5 - 5
SPN: 523612
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
14: Special Instructions

Errordetection
Errorlamp shows blinking. Entry in errormemory.

Possible reason for error
A recovery occurred which is not stored

Take actions for error repair
Recoverey occured which is stored as protected
With parameter HWEMon_numRexxxxxxx the recovery nummer and the subsequent position can be identified. See especially SW-Doku _rcy_auto.pdf

other error properties
System reaction: Warning, shown at error path
Behaviour error lamp: blinking
Selfhealing: no
Signal Priority: 5
Measurement @ errortime: -

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

145 / 523612 / HWEMonRcyVisible

Error description INT. RECOVERY
Internal hardware monitoring: the CPU of the ECU is reset and an item will be created in error memory

Error codes
DEUTZ-Errorcode: 145
BlinkCode (short-long-short): 5 - 5 - 5
SPN: 523612
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
14: Special Instructions

Errordetection
Errorlamp shows blinking. Entry in errormemory.

Possible reason for error
A recovery occurred which is visible in the error memory

Take actions for error repair
Recoverey occured which is stored as protected
With parameter HWEMon_numRexxxxxxx the recovery nummer and the subsequent position can be identified. See especially SW-Doku _rcy_auto.pdf

other error properties
System reaction: Recovery of ECU
Behaviour error lamp: blinking
Selfhealing: no
Signal Priority: 5
Measurement @ errortime: -

146 / 523612 / HWEMonUMaxSupply

Error description INT. RECOVERY
Internal hardware monitoring: the ECU detects an excess of the target range for the power supply of ist communication module

Error codes
DEUTZ-Errorcode: 146
BlinkCode (short-long-short): 5 - 5 - 5
SPN: 523612
possible FMI:
3: Voltage to high or short circuit to +Ubatt
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Overvoltage at CJ940, power supply voltage too high, ECU defective

Take actions for error repair
Check working voltage and if necessary correct it, Check ECU and if necessary replace it

other error properties
System reaction: Power stage shut off
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 4
Measurement @ errortime: -

147 / 523612 / HWEMonUMinSupply

Error description INT. RECOVERY
Internal hardware monitoring: the ECU detects an undershooting of the target range for the power supply of ist communication module

Error codes
DEUTZ-Errorcode: 147
BlinkCode (short-long-short): 5 - 5 - 5
SPN: 523612
possible FMI:
12. Errormode not identifiable
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Undervoltage at CJ940, power supply voltage too low, ECU defective

Take actions for error repair
Check working voltage and if necessary correct it, Check ECU and if necessary replace it

other error properties
System reaction: Power stage shut off
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 4
Measurement @ errortime: -

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300



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149 / 105 / IATSCD

Error description CHARGE AIR TEMP.
Charge air temperature sensor: the voltage of sensor measured by ECU is out of the target range or the received value of temperature via CAN is defective

Error codes
DEUTZ-Errorcode: 149
BlinkCode (short-long-short): 1 - 2 - 8
SPN: 105
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
2: data stream is defective
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, sensor defective, connection cable demaged, CAN bus wrong cabled, wiring demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check cabling, LDF6T-sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it, Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, c

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: default value

150 / 105 / IATSCDSysReac

Error description CHARGE AIR TEMP.
Charge air temperature: die charge air temperature calculated by ECU is above the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 150
BlinkCode (short-long-short): 2 - 3 - 3
SPN: 105
possible FMI:
0: data valid, but above normal working area
0: data valid, but above normal working area
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light
oder
blinking. Entry in errormemory.

Possible reason for error
Above target range with system reaction, air system demaged, sensor defective, connection cable demaged

Take actions for error repair
Check construction of LDF6T , check suction parts, check air system and if necessary repair it, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Advice: IATSCD_stSysReacReq
Behaviour error lamp: permanent light
oder
blinking
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

153 / 523350 / InjVlvBnk1A

Error description INJECTOR BANK A
Injector cylinder bank 1: the current drain measured by ECU is above the target range

Error codes
DEUTZ-Errorcode: 153
BlinkCode (short-long-short): 1 - 5 - 1
SPN: 523350
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
13: out of calibrated range
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Short circuit (cylinder bank 1), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, cylinder shut off
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

https://truckmanualshub.com/

DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

154 / 523351 / InjVlvBnk1B

Error description INJECTOR BANK A
Injector cylinder bank 1: the current drain measured by ECU is underneath the target range

Error codes
DEUTZ-Errorcode: 154
BlinkCode (short-long-short): 1 - 5 - 1
SPN: 523351
possible FMI:
13: out of calibrated range
13: out of calibrated range
5: current to low or broken wire
13: out of calibrated range

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break (cylinder bank 1), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, cylinder shut off
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

155 / 523352 / InjVlvBnk2A

Error description INJECTOR BANK B
Injector cylinder bank 2: the current drain measured by ECU is above the target range

Error codes
DEUTZ-Errorcode: 155
BlinkCode (short-long-short): 1 - 5 - 2
SPN: 523352
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
13: out of calibrated range
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Short circuit (cylinder bank 2), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, cylinder shut off
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

156 / 523353 / InjVlvBnk2B

Error description INJECTOR BANK B
Injector cylinder bank 2: the current drain measured by ECU is underneath the target range

Error codes
DEUTZ-Errorcode: 156
BlinkCode (short-long-short): 1 - 5 - 2
SPN: 523353
possible FMI:
13: out of calibrated range
13: out of calibrated range
5: current to low or broken wire
13: out of calibrated range

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break (cylinder bank 2), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, cylinder shut off
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

157 / 523354 / InjVlvChipA

Error description PWR. INJ. BANK B
Internal hardware monitoring: the ECU detects an error of ist injector high current output

Error codes
DEUTZ-Errorcode: 157
BlinkCode (short-long-short): 1 - 5 - 3
SPN: 523354
possible FMI:
3: Voltage to high or short circuit to +Ubatt
2: data stream is defective
14: Special Instructions
12: Defective component

Errordetection
Errorlamp shows blinking. Entry in errormemory.

Possible reason for error
High power stage Injector A, ECU defective

Take actions for error repair
If error is not removable, change ECU

other error properties
System reaction: Warninig, outputs shut off
Behaviour error lamp: blinking
Selfhealing: no
Signal Priority: 5
Measurement @ errortime: actual value

158 / 523355 / InjVlvChipB

Error description PWR. INJ. BANK B
Internal hardware monitoring: the ECU detects a disturbance in its injector high current output

Error codes
DEUTZ-Errorcode: 158
BlinkCode (short-long-short): 1 - 5 - 3
SPN: 523355
possible FMI:
12: Defective component
12: Defective component
12: Defective component
12: Defective component

Errordetection
Errorlamp shows blinking. Entry in errormemory.

Possible reason for error
High power stage Injector B, ECU defective

Take actions for error repair
If error is not removable, change ECU

other error properties
System reaction: Warninig, outputs shut off
Behaviour error lamp: blinking
Selfhealing: no
Signal Priority: 5
Measurement @ errortime: actual value

159 / 651 / InjVlvCyl1A

Error description INJECTOR 1
Injector 1: the current drain measured by ECU is above the target range

Error codes
DEUTZ-Errorcode: 159
BlinkCode (short-long-short): 1 - 5 - 4
SPN: 651
possible FMI:
3: Voltage to high or short circuit to +Ubatt
13: out of calibrated range
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Short circuit (cylinder 1), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, fuel injection failed, shut off wenn the number of active cylinders below minimum
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

https://truckmanualshub.com/

DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

160 / 651 / InjVlvCyl1B

Error description INJECTOR 1
Injector 1: the current drain measured by ECU is underneath the target range

Error codes
DEUTZ-Errorcode: 160
BlinkCode (short-long-short): 1 - 5 - 4
SPN: 651
possible FMI:
13: out of calibrated range
13: out of calibrated range
5: current to low or broken wire
13: out of calibrated range

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break (cylinder 1), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, fuel injection failed, shut off wenn the number of active cylinders below minimum
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

161 / 652 / InjVlvCyl2A

Error description INJECTOR 2
Injector 2: the current drain measured by ECU is above the target range

Error codes
DEUTZ-Errorcode: 161
BlinkCode (short-long-short): 1 - 5 - 5
SPN: 652
possible FMI:
3: Voltage to high or short circuit to +Ubatt
13: out of calibrated range
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Short circuit (cylinder 2), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, fuel injection failed, shut off wenn the number of active cylinders below minimum
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

162 / 652 / InjVlvCyl2B

Error description INJECTOR 2
Injector 2: the current drain measured by ECU is underneath the target range

Error codes
DEUTZ-Errorcode: 162
BlinkCode (short-long-short): 1 - 5 - 5
SPN: 652
possible FMI:
13: out of calibrated range
13: out of calibrated range
5: current to low or broken wire
13: out of calibrated range

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break (cylinder 2), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, fuel injection failed, shut off wenn the number of active cylinders below minimum
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

163 / 653 / InjVlvCyl3A

Error description INJECTOR 3
Injector 3: the current drain measured by ECU is above the target range

Error codes
DEUTZ-Errorcode: 163
BlinkCode (short-long-short): 1 - 5 - 6
SPN: 653
possible FMI:
3: Voltage to high or short circuit to +Ubatt
13: out of calibrated range
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Short circuit (cylinder 3), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, fuel injection failed, shut off wenn the number of active cylinders below minimum
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

164 / 653 / InjVlvCyl3B

Error description INJECTOR 3
Injector 3: the current drain measured by ECU is underneath the target range

Error codes
DEUTZ-Errorcode: 164
BlinkCode (short-long-short): 1 - 5 - 6
SPN: 653
possible FMI:
13: out of calibrated range
13: out of calibrated range
5: current to low or broken wire
13: out of calibrated range

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break (cylinder 3), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, fuel injection failed, shut off wenn the number of active cylinders below minimum
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

165 / 654 / InjVlvCyl4A

Error description INJECTOR 4
Injector 4: the current drain measured by ECU is above the target range

Error codes
DEUTZ-Errorcode: 165
BlinkCode (short-long-short): 1 - 6 - 1
SPN: 654
possible FMI:
3: Voltage to high or short circuit to +Ubatt
13: out of calibrated range
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Short circuit (cylinder 4), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, fuel injection failed, shut off wenn the number of active cylinders below minimum
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

166 / 654 / InjVlvCyl4B

Error description INJECTOR 4
Injector 4: the current drain measured by ECU is underneath the target range

Error codes
DEUTZ-Errorcode: 166
BlinkCode (short-long-short): 1 - 6 - 1
SPN: 654
possible FMI:
13: out of calibrated range
13: out of calibrated range
5: current to low or broken wire
13: out of calibrated range

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break (cylinder 4), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, fuel injection failed, shut off wenn the number of active cylinders below minimum
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

167 / 655 / InjVlvCyl5A

Error description INJECTOR 5
Injector 5: the current drain measured by ECU is above the target range

Error codes
DEUTZ-Errorcode: 167
BlinkCode (short-long-short): 1 - 6 - 2
SPN: 655
possible FMI:
3: Voltage to high or short circuit to +Ubatt
13: out of calibrated range
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Short circuit (cylinder 5), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, fuel injection failed, shut off wenn the number of active cylinders below minimum
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

168 / 655 / InjVlvCyl5B

Error description INJECTOR 5
Injector 5: the current drain measured by ECU is underneath the target range

Error codes
DEUTZ-Errorcode: 168
BlinkCode (short-long-short): 1 - 6 - 2
SPN: 655
possible FMI:
13: out of calibrated range
13: out of calibrated range
5: current to low or broken wire
13: out of calibrated range

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break (cylinder 5), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, fuel injection failed, shut off wenn the number of active cylinders below minimum
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

169 / 656 / InjVlvCyl6A

Error description INJECTOR 6
Injector 6: the current drain measured by ECU is above the target range

Error codes
DEUTZ-Errorcode: 169
BlinkCode (short-long-short): 1 - 6 - 3
SPN: 656
possible FMI:
3: Voltage to high or short circuit to +Ubatt
13: out of calibrated range
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Short circuit (cylinder 6), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, fuel injection failed, shut off wenn the number of active cylinders below minimum
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

170 / 656 / InjVlvCyl6B

Error description INJECTOR 6
Injector 6: the current drain measured by ECU is underneath the target range

Error codes
DEUTZ-Errorcode: 170
BlinkCode (short-long-short): 1 - 6 - 3
SPN: 656
possible FMI:
13: out of calibrated range
13: out of calibrated range
5: current to low or broken wire
13: out of calibrated range

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break (cylinder 6), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, fuel injection failed, shut off wenn the number of active cylinders below minimum
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

171 / 657 / InjVlvCyl7A

Error description INJECTOR 7
Injector 7: the current drain measured by ECU is above the target range

Error codes
DEUTZ-Errorcode: 171
BlinkCode (short-long-short): 1 - 6 - 4
SPN: 657
possible FMI:
3: Voltage to high or short circuit to +Ubatt
13: out of calibrated range
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Short circuit (cylinder 7), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, fuel injection failed, shut off wenn the number of active cylinders below minimum
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

172 / 657 / InjVlvCyl7B

Error description INJECTOR 7
Injector 7: the current drain measured by ECU is underneath the target range

Error codes
DEUTZ-Errorcode: 172
BlinkCode (short-long-short): 1 - 6 - 4
SPN: 657
possible FMI:
13: out of calibrated range
13: out of calibrated range
5: current to low or broken wire
13: out of calibrated range

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break (cylinder 7), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, fuel injection failed, shut off wenn the number of active cylinders below minimum
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

173 / 658 / InjVlvCyl8A

Error description INJECTOR 8
Injector 8: the current drain measured by ECU is above the target range

Error codes
DEUTZ-Errorcode: 173
BlinkCode (short-long-short): 1 - 6 - 5
SPN: 658
possible FMI:
3: Voltage to high or short circuit to +Ubatt
13: out of calibrated range
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Short circuit (cylinder 8), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, fuel injection failed, shut off wenn the number of active cylinders below minimum
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

174 / 658 / InjVlvCyl8B

Error description INJECTOR 8
Injector 8: the current drain measured by ECU is underneath the target range

Error codes
DEUTZ-Errorcode: 174
BlinkCode (short-long-short): 1 - 6 - 5
SPN: 658
possible FMI:
13: out of calibrated range
13: out of calibrated range
5: current to low or broken wire
13: out of calibrated range

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break (cylinder 8), injector defective, connection cable demaged

Take actions for error repair
Check cabling, check injectors and if necessary replace them, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, fuel injection failed, shut off wenn the number of active cylinders below minimum
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

175 / 523370 / InjVlvErrDet

Error description RAIL PRESS. MON. DISABLED
Rail pressure monitoring: the monitoring of the rail pressure will be deactivated by ECU because of the activation of the function "compression test" by user

Error codes
DEUTZ-Errorcode: 175
BlinkCode (short-long-short): 5 - 5 - 5
SPN: 523370
possible FMI:
14: Special Instructions
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows . Entry in errormemory.

Possible reason for error
Compression test active: rail-pressure monitoring is going to be disabled

Take actions for error repair
not correct

other error properties
System reaction: Rail pressure monitoring disabled
Behaviour error lamp:
Selfhealing: -
Signal Priority: 1
Measurement @ errortime:

176 / 523615 / MeUnCD_ADC

Error description METERING UNIT
Fuel volume flow rate: the fuel volume rate calculated by ECU at outlet of the fuel metering unit is out of the target range

Error codes
DEUTZ-Errorcode: 176
BlinkCode (short-long-short): 1 - 3 - 5
SPN: 523615
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Flow rate outside target range

Take actions for error repair

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 4
Measurement @ errortime: actual value

177 / 523615 / MeUnCDNoLoad

Error description METERING UNIT
Valve at outlet of the fuel metering unit: the ECU detects no load or temperature excess of the ECU component for power supply of the valve

Error codes
DEUTZ-Errorcode: 177
BlinkCode (short-long-short): 1 - 3 - 5
SPN: 523615
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
5: current to low or broken wire
12: Defective component

Errordetection
Errorlamp shows permanent light, 15s before shut off. Entry in errormemory.

Possible reason for error
wiring error or ECU output is switched off because of overtemperature, fuel metering unit defective, connection cable demaged

Take actions for error repair
Check cabling , if necessary check FCU, check fuel metering unit and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, max.extraction of FCU --> open rail pressure relief valve --> shut the engine off in about 5 minutes
Behaviour error lamp: permanent light, 15s before shut off
Selfhealing: no
Signal Priority: 4
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

178 / 523615 / MeUnCDSCBat

Error description METERING UNIT
Valve at outlet of the fuel metering unit: the current drain measured by ECU is above the target range

Error codes
DEUTZ-Errorcode: 178
BlinkCode (short-long-short): 1 - 3 - 5
SPN: 523615
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light, 15s before shut off. Entry in errormemory.

Possible reason for error
Short circuit to Ubatt, fuel metering unit defective, connection cable demaged

Take actions for error repair
Check cabling , if necessary check FCU, check fuel metering unit and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, rail pressure relief valve will open
Behaviour error lamp: permanent light, 15s before shut off
Selfhealing: no
Signal Priority: 4
Measurement @ errortime: actual value

179 / 523615 / MeUnCDSCGnd

Error description METERING UNIT
Valve at outlet of the fuel metering unit: the current drain measured by ECU is above the target range

Error codes
DEUTZ-Errorcode: 179
BlinkCode (short-long-short): 1 - 3 - 5
SPN: 523615
possible FMI:
12. Errormode not identifiable
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light, 15s before shut off. Entry in errormemory.

Possible reason for error
Short circuit to ground, fuel metering unit defective, connection cable demaged

Take actions for error repair
Check cabling , if necessary check FCU, check fuel metering unit and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, rail pressure relief valve will open
Behaviour error lamp: permanent light, 15s before shut off
Selfhealing: no
Signal Priority: 4
Measurement @ errortime: actual value

182 / 2634 / MnRly1_SCB

Error description MAIN RELAY
Main relay 1: the current drains measured by ECU is above the target range

Error codes
DEUTZ-Errorcode: 182
BlinkCode (short-long-short): 1 - 3 - 7
SPN: 2634
possible FMI:
3: Voltage to high or short circuit to +Ubatt
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Short circuit to Ubatt (relay 1), relay defective, connection cable demaged

Take actions for error repair
Check cabling, check ECU, check relay and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, shutoff the outputs MPROP
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 3
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

183 / 2634 / MnRly1_SCG

Error description MAIN RELAY
Main relay 1: the current drains measured by ECU is above the target range

Error codes
DEUTZ-Errorcode: 183
BlinkCode (short-long-short): 1 - 3 - 8
SPN: 2634
possible FMI:
12. Errormode not identifiable
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Short circuit to ground (relay 1), relay defective, connection cable demaged

Take actions for error repair
Check cabling, check ECU, check relay and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, shutoff the outputs MPROP
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 3
Measurement @ errortime: actual value

184 / 523420 / Montr

Error description WATCHDOG COUNTER
Internal hardware monitoring: the ECU detects an disturbance in ist monitoring module (Wachtdog)

Error codes
DEUTZ-Errorcode: 184
BlinkCode (short-long-short): 1 - 3 - 9
SPN: 523420
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
14: Special Instructions

Errordetection
Errorlamp shows blinking. Entry in errormemory.

Possible reason for error
Watchdog counter exceeds maximum, ECU defective

Take actions for error repair
If error is not removable, change ECU

other error properties
System reaction: Recovery of ECU
Behaviour error lamp: blinking
Selfhealing: no
Signal Priority: 5
Measurement @ errortime: -

186 / 2634 / MRlyCD

Error description MAIN RELAY
Main relay: during the switching off, main relay does not switch on within an allowed time

Error codes
DEUTZ-Errorcode: 186
BlinkCode (short-long-short): 2 - 6 - 1
SPN: 2634
possible FMI:
7: Mechanical system not OK
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
EDC16: main relay not open in allowed time or main relay open too early; EDC7: main relay not open in allowed time or short circuit of main relay to ground; EDC16: main relay defective, connection cable demaged; generally: rapid shut-off of the ECU (witho

Take actions for error repair
EDC16: check external main relay, check cabling
EDC7: if error is not removable, change ECU, EDC16: Check main relay and if necessary replace it, check connection cable and if necessary repair or replace it; both: if error is not removable, change ECU

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 3
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

187 / 563 / MRlyCDMnRly2

Error description MAIN RELAY 2
Main relay 2 (in ECU): during the switching off, main relay does not switch on within an allowed time

Error codes
DEUTZ-Errorcode: 187
BlinkCode (short-long-short): 2 - 6 - 1
SPN: 563
possible FMI:
7: Mechanical system not OK
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
rapid shut-off of the ECU (without waiting till the end of the afterrun), ECU defective

Take actions for error repair
If error not removable, change ECU

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 3
Measurement @ errortime: actual value

188 / 2634 / MRlyCDMnRly3

Error description MAIN RELAY
Main relay 3 (in ECU): during the switching off, main relay does not switch on within an allowed time

Error codes
DEUTZ-Errorcode: 188
BlinkCode (short-long-short): 2 - 6 - 1
SPN: 2634
possible FMI:
7: Mechanical system not OK
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Short circuit to ground or emergency shut-off (relay 3 internal), rapid shut-off of the ECU (without waiting till the end of the afterrun), ECU defective

Take actions for error repair
Check cabling, check ECU, if error not removable, change ECU

other error properties
System reaction: Warning, shutoff the outputs MPROP (see BOSCH-Electricity operating plan)
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 3
Measurement @ errortime: actual value

189 / 523450 / MSSCD1

Error description MULTISTATE SWITCH 1
Multi state switch 1: the voltage measured by ECU is out of the target range or the swith setting is not plausible

Error codes
DEUTZ-Errorcode: 189
BlinkCode (short-long-short): 1 - 4 - 3
SPN: 523450
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, input voltage outside target range (switch 1), switch defective, connection cable demaged

Take actions for error repair
Check cabling and sensor, check switch and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 2
Measurement @ errortime: default value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

190 / 523451 / MSSCD2

Error description MULTISTATE SWITCH 2
Multi state switch 2: the voltage measured by ECU is out of the target range or the swith setting is not plausible

Error codes
DEUTZ-Errorcode: 190
BlinkCode (short-long-short): 1 - 4 - 3
SPN: 523451
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, input voltage outside target range (switch 2), switch defective, connection cable demaged

Take actions for error repair
Check cabling and sensor, check switch and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 2
Measurement @ errortime: default value

191 / 523452 / MSSCD3

Error description MULTISTATE SWITCH 3
Multi state switch 3: the voltage measured by ECU is out of the target range or the swith setting is not plausible

Error codes
DEUTZ-Errorcode: 191
BlinkCode (short-long-short): 1 - 4 - 3
SPN: 523452
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, input voltage outside target range (switch 3), switch defective, connection cable demaged

Take actions for error repair
Check cabling and sensor, check switch and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 2
Measurement @ errortime: default value

192 / 639 / NetMngCANAOff

Error description CAN A BUS OFF
CAN bus A: the ECU is not allowed to send messages, because the status "BusOff" is detected

Error codes
DEUTZ-Errorcode: 192
BlinkCode (short-long-short): 2 - 7 - 1
SPN: 639
possible FMI:
14: Special Instructions
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, off-state (CAN bus A), CAN bus deactivated, connection cable demaged

Take actions for error repair
Check cabling of CAN bus and if necessary repair it, check connection cable and if necessary repair or replace it

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 2
Measurement @ errortime:

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

193 / 1231 / NetMngCANBOff

Error description CAN B BUS OFF
CAN bus B: the ECU is not allowed to send messages, because the status "BusOff" is detected

Error codes
DEUTZ-Errorcode: 193
BlinkCode (short-long-short): 2 - 7 - 1
SPN: 1231
possible FMI:
14: Special Instructions
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, off-state (CAN bus B), CAN bus deactivated, connection cable demaged

Take actions for error repair
Check cabling of CAN bus and if necessary repair it, check connection cable and if necessary repair or replace it

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 2
Measurement @ errortime:

194 / 1235 / NetMngCANCOff

Error description CAN C BUS OFF
CAN bus C: the ECU is not allowed to send messages, because the status "BusOff" is detected

Error codes
DEUTZ-Errorcode: 194
BlinkCode (short-long-short): 2 - 7 - 1
SPN: 1235
possible FMI:
14: Special Instructions
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, off-state (CAN bus C), CAN bus deactivated, connection cable demaged

Take actions for error repair
Check cabling of CAN bus and if necessary repair it, check connection cable and if necessary repair or replace it

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 2
Measurement @ errortime:

195 / 705 / OPLpCD

Error description OIL PRESS LAMP
Warning lamp for oil level: the current drain measured by ECU is out of the target range or the maximum temperature of the ECU component for power supply of the lamp is exceeded

Error codes
DEUTZ-Errorcode: 195
BlinkCode (short-long-short): 1 - 3 - 5
SPN: 705
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
5: current to low or broken wire
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, lamp defective, connection cable demaged

Take actions for error repair
Check cabling and load, check lamp and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, shutoff output
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: default value

DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

196 / 100 / OPSCD

Error description ENG OIL PRESS.
Oil pressure sensor: the voltage of sensor measured by ECU is out of the target range or the received value of oil pressure via CAN is implausible (Oil pressure is above the target range with higher oil temperature at the same time)

Error codes
DEUTZ-Errorcode: 196
BlinkCode (short-long-short): 2 - 2 - 4
SPN: 100
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
2: data stream is defective
0: data valid, but above normal working area

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, sensor defective, connection cable demaged, CAN bus wrong cabled, wiring demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it, Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, chec

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: default value

197 / 100 / OPSCD1

Error description ENG OIL PRESS.
Oil pressure: the oil pressure calculated by ECU is implausibly low

Error codes
DEUTZ-Errorcode: 197
BlinkCode (short-long-short): 2 - 3 - 1
SPN: 100
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
1: data valid, but below normal working area

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Oil pressure implausible low, sensor defective, connection cable demaged

Take actions for error repair
Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 2
Measurement @ errortime: actual value

198 / 100 / OPSCDSysReacHi

Error description ENG OIL PRESS.
Oil pressure: the oil pressure calculated by ECU is above the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 198
BlinkCode (short-long-short): 2 - 3 - 1
SPN: 100
possible FMI:
0: data valid, but above normal working area
0: data valid, but above normal working area
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light
oder
blinking. Entry in errormemory.

Possible reason for error
Above target range, oil volume too large, sensor defective, oil pump defective, connection cable demaged

Take actions for error repair
Check oil level and if necessary correct it, check oil pump and if necessary replace it, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Advice: OPSCD_stSysReacReqHi
Behaviour error lamp: permanent light
oder
blinking
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

199 / 100 / OPSCDSysReacLo

Error description ENG OIL PRESS.
Oil pressure: the oil pressure calculated by ECU is underneath the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 199
BlinkCode (short-long-short): 2 - 3 - 1
SPN: 100
possible FMI:
1: data valid, but below normal working area
1: data valid, but below normal working area
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light
oder
blinking. Entry in errormemory.

Possible reason for error
Below target range, oil volume too small, sensor defective, oil pump defective, connection cable demaged

Take actions for error repair
Check oil level and if necessary correct it, check oil pump and if necessary replace it, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Advice: OPSCD_stSysReacReqLo
Behaviour error lamp: permanent light
oder
blinking
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

200 / 1237 / OSwCD

Error description OVERRIDE SWITCH
Bridgeover switch: the ECU receives a permanent signal

Error codes
DEUTZ-Errorcode: 200
BlinkCode (short-long-short): 1 - 4 - 5
SPN: 1237
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Switch is blocked, taster locked, connection cable demaged

Take actions for error repair
Check cabling, if sensor not working, check switch and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 2
Measurement @ errortime: actual value

201 / 175 / OTSCD

Error description OIL TEMP. SENSOR
Oil temperature sensor: the voltage of sensor measured by ECU is out of the target range; the oil temperature calculated by ECU is implausible compared with coolant temperature or the received value via CAN is defective

Error codes
DEUTZ-Errorcode: 201
BlinkCode (short-long-short): 1 - 4 - 4
SPN: 175
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
2: data stream is defective
2: data stream is defective

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, sensor defective, connection cable demaged

Take actions for error repair
Check cabling, if sensor not working, check switch and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: default value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

203 / 175 / OTSCDSysReac

Error description OIL TEMP. SENSOR
Oil temperature: the oil temperature calculated by ECU is above the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 203
BlinkCode (short-long-short): 1 - 4 - 4
SPN: 175
possible FMI:
0: data valid, but above normal working area
0: data valid, but above normal working area
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light
oder
blinking. Entry in errormemory.

Possible reason for error
Above target range with system reaction, oil volume too small, oil loop disturbed, sensor defective, connection cable demaged

Take actions for error repair
Check cycle cooling system and compressor, check oil level and if necessary correct it, check sensor and if necessary replace it, check oil loop and if necessary repair it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Advice: OTSCD_stSysReacReq
Behaviour error lamp: permanent light
oder
blinking
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

208 / 523470 / PRVMon

Error description RAIL PRESS. LIM. VALVE
Rail pressure relief valve: is open, will be forced to open, the forced-open failed

Error codes
DEUTZ-Errorcode: 208
BlinkCode (short-long-short): 1 - 4 - 6
SPN: 523470
possible FMI:
14: Special Instructions
2: data stream is defective
12: Defective component
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light, 15s before shut off. Entry in errormemory.

Possible reason for error
Rail pressure relief valve open or forced open abortive (interpretation of the rail pressure gradient), operating voltage too low, rail pressure sensor defective, fuel metering unit defective, rail pressure relief valve defective, air in fuel system

Take actions for error repair
Check working voltage and if necessary correct it, check rail-pressure sensor and if necessary replace it, check FCU and if necessary replace it, check rail pressure relief valve and if necessary replace it, bleed the fuel-system

other error properties
System reaction: Warning, shut the engine off in about 5 minutes
Behaviour error lamp: permanent light, 15s before shut off
Selfhealing: no
Signal Priority: 4
Measurement @ errortime: actual value

209 / 157 / RailCD

Error description RAIL PRESS. SENSOR
Rail pressure sensor: the voltage of sensor measured by ECU is out of the target range

Error codes
DEUTZ-Errorcode: 209
BlinkCode (short-long-short): 1 - 4 - 7
SPN: 157
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light, 15s before shut off. Entry in errormemory.

Possible reason for error
Cable break or short circuit, sensor defective, connection cable demaged

Take actions for error repair
Check cabling, check rail pressure sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, max.extraction of FCU --> open rail pressure relief valve --> shut the engine off in about 5 minutes
Behaviour error lamp: permanent light, 15s before shut off
Selfhealing: no
Signal Priority: 4
Measurement @ errortime: default value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

210 / 157 / RailCDOfsTst

Error description RAIL PRESS. SENSOR
Rail pressure sensor: the change of the voltage measured by ECU during the engine start or the after-run is out of the target range

Error codes
DEUTZ-Errorcode: 210
BlinkCode (short-long-short): 1 - 4 - 7
SPN: 157
possible FMI:
0: data valid, but above normal working area
1: data valid, but below normal working area
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Deviation of signal during start or after-run above target range, sensor defective

Take actions for error repair
Replace sensor

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 2
Measurement @ errortime: actual value

211 / 523613 / RailMeUn0

Error description RAIL PRESSURE
Rail pressure: the fuel pressure in rail calculated by ECU is above the target range which is dependant on the engine speed

Error codes
DEUTZ-Errorcode: 211
BlinkCode (short-long-short): 1 - 3 - 4
SPN: 523613
possible FMI:
0: data valid, but above normal working area
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light
oder
blinking. Entry in errormemory.

Possible reason for error
1) Leakage in high pressure system (external) ,
2) Leakage at rail pressure relief valve (internal),
3) Needle clampt in open position,
4) Abrasion at injector,
5) Abrasion at high pressure pump,
6) Too low primary pressure on low pressure side, sensor d

Take actions for error repair
(A) Check for leakage
(B) Chek fuel-primary pressure
(C) Change components, check sensor and if necessary replace it, check fuel system and if necessary repair it

other error properties
System reaction: Warning or Warning and power reduction
Behaviour error lamp: permanent light
oder
blinking
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

212 / 523613 / RailMeUn1

Error description RAIL PRESSURE
Rail pressure: the fuel pressure in rail calculated by ECU is above the target range which is dependant on the volume flow rate

Error codes
DEUTZ-Errorcode: 212
BlinkCode (short-long-short): 1 - 3 - 4
SPN: 523613
possible FMI:
0: data valid, but above normal working area
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light
oder
blinking. Entry in errormemory.

Possible reason for error
1) Leakage in high pressure system (external) ,
2) Leakage at rail pressure relief valve (internal),
3) Needle clampt in open position,
4) Abrasion at injector,
5) Abrasion at high pressure pump,
6) Too low primary pressure on low pressure side, sensor d

Take actions for error repair
(A) Check for leakage
(B) Chek fuel-primary pressure
(C) Change components, check sensor and if necessary replace it, check fuel system and if necessary repair it

other error properties
System reaction: Warning or Warning and power reduction
Behaviour error lamp: permanent light
oder
blinking
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

213 / 523613 / RailMeUn2

Error description RAIL PRESSURE
Rail pressure: the fuel pressure in rail calculated by ECU is underneath the target range which is dependant on the engine speed

Error codes
DEUTZ-Errorcode: 213
BlinkCode (short-long-short): 1 - 3 - 4
SPN: 523613
possible FMI:
0: data valid, but above normal working area
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light
oder
blinking. Entry in errormemory.

Possible reason for error
1) No power supply in FCU,
2) ZME clamped in open position,
3) Too high pressure nach Nullförderdrossel (FCU),
4) Nullförderdrossel clogged,
5) Too high primary pressure on low pressure side, sensor defective, fuel system disturbed

Take actions for error repair
(A) Check return-pressure FCU
(B) Check flow-pressure
(C) Change FCU, check sensor and if necessary replace it, check fuel system and if necessary repair it

other error properties
System reaction: Warning or Warning and power reduction
Behaviour error lamp: permanent light
oder
blinking
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

214 / 523613 / RailMeUn3

Error description RAIL PRESSURE
Rail pressure: the fuel pressure in rail calculated by ECU is underneath the target range which is dependant on the volume flow rate

Error codes
DEUTZ-Errorcode: 214
BlinkCode (short-long-short): 1 - 3 - 4
SPN: 523613
possible FMI:
1: data valid, but below normal working area
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light
oder
blinking. Entry in errormemory.

Possible reason for error
1) Leakage in high pressure system (external) ,
2) Leakage at rail pressure relief valve (internal),
3) Needle clampt in open position,
4) Abrasion at injector,
5) Abrasion at high pressure pump,
6) Too low primary pressure on low pressure side, sensor d

Take actions for error repair
(A) Check for leakage
(B) Chek fuel-primary pressure
(C) Change components, check sensor and if necessary replace it, check fuel system and if necessary repair it

other error properties
System reaction: Warning or Warning and power reduction
Behaviour error lamp: permanent light
oder
blinking
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

215 / 523613 / RailMeUn4

Error description RAIL PRESSURE
Rail pressure: the fuel pressure in rail calculated by ECU is above the absolute target range

Error codes
DEUTZ-Errorcode: 215
BlinkCode (short-long-short): 1 - 3 - 4
SPN: 523613
possible FMI:
0: data valid, but above normal working area
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light
oder
blinking. Entry in errormemory.

Possible reason for error
1) No power supply in FCU,
2) ZME clamped in open position,
3) Too high pressure nach Nullförderdrossel (FCU),
4) Nullförderdrossel clogged,
5) Too high primary pressure on low pressure side, sensor defective, fuel system disturbed

Take actions for error repair
(A) Check return-pressure FCU
(B) Check flow-pressure
(C) Change FCU, check sensor and if necessary replace it, check fuel system and if necessary repair it

other error properties
System reaction: Warning or Warning and power reduction
Behaviour error lamp: permanent light
oder
blinking
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

216 / 523613 / RailMeUn7

Error description RAIL PRESSURE
Rail pressure: the fuel pressure in rail calculated by ECU is implausible compared with the setpoint setting of the fuel metering unit

Error codes
DEUTZ-Errorcode: 216
BlinkCode (short-long-short): 1 - 3 - 4
SPN: 523613
possible FMI:
2: data stream is defective
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light
oder
blinking. Entry in errormemory.

Possible reason for error
1) Leakage in high pressure system (external) ,
2) Leakage at rail pressure relief valve (internal),
3) Needle clampt in open position,
4) Abrasion at injector,
5) Abrasion at high pressure pump,
6) Too low primary pressure on low pressure side, sensor d

Take actions for error repair
(A) Check for leakage
(B) Chek fuel-primary pressure
(C) Change components, check sensor and if necessary replace it, check fuel system and if necessary repair it

other error properties
System reaction: Warning or Warning and power reduction
Behaviour error lamp: permanent light
oder
blinking
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

218 / 523490 / SOPTst

Error description REDUNDANT SHUT OFF DET.
Internal hardware monitoring: the ECU finds an disturbance in the redundant switch off path through a test during the ramp up phase

Error codes
DEUTZ-Errorcode: 218
BlinkCode (short-long-short): 1 - 4 - 9
SPN: 523490
possible FMI:
12. Errormode not identifiable
12: Defective component
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Test of redundant shut-off paths

Take actions for error repair
Could be triggered by over/undervoltage or external Watchdog

other error properties
System reaction: Test will only be executed with ECU Initialisation. Warning, dependent upon application.
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 4
Measurement @ errortime: -

219 / 1079 / SSpMon1

Error description 5V SUPPLY 1 FAIL.
Internal hardware monitoring: the ECU detects a deviation of the target range of the power supply voltage of sensor 1

Error codes
DEUTZ-Errorcode: 219
BlinkCode (short-long-short): 2 - 8 - 2
SPN: 1079
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
5V sensor supply voltage 1 outside target range, operating voltage too high or to low, connection cable demaged, ECU defective

Take actions for error repair
If error not removable, change ECU, check cabling of external components, check working voltage and if necessary correct it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

221 / 1080 / SSpMon2

Error description 5V SUPPLY 2 FAIL.
Internal hardware monitoring: the ECU detects a deviation of the target range of the power supply voltage of sensor 2

Error codes
DEUTZ-Errorcode: 221
BlinkCode (short-long-short): 2 - 8 - 2
SPN: 1080
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
5V sensor supply voltage 2 outside target range, operating voltage too high or to low, connection cable demaged, ECU defective

Take actions for error repair
If error not removable, change ECU, check cabling of external components, check working voltage and if necessary correct it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

222 / 523601 / SSpMon3

Error description 5V SUPPLY 3 FAIL.
Internal hardware monitoring: the ECU detects a deviation of the target range of the power supply voltage of sensor 3

Error codes
DEUTZ-Errorcode: 222
BlinkCode (short-long-short): 2 - 8 - 2
SPN: 523601
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Wrong voltage of internal 5V reference source 3, operating voltage too high or too low, connection cable demaged, ECU defective

Take actions for error repair
If error not removable, change ECU, check cabling of external components, check working voltage and if necessary correct it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: actual value

223 / 677 / StrtCDHS

Error description START RELAY
Start relay (high side power stage): the current drain measured by ECU is above the target range

Error codes
DEUTZ-Errorcode: 223
BlinkCode (short-long-short): 5 - 1 - 2
SPN: 677
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Start relay (high side): short circuit, relay defective, conncection cable defective

Take actions for error repair
Check cabling and start relay and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, shutoff output
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: default value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

224 / 677 / StrtCDLS

Error description START RELAY
start relay (low side power stage): the current drain measured by ECU is out of the target range

Error codes
DEUTZ-Errorcode: 224
BlinkCode (short-long-short): 5 - 1 - 2
SPN: 677
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
5: current to low or broken wire
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Start relay (low side): cable break or short circuit, disabled by ECU, relay defective, connection cable demaged

Take actions for error repair
Check cabling and start relay and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, shutoff output
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: default value

225 / 624 / SysLamp

Error description DIAGNOSTIC LAMP
Error lamp (diagnositic lamp): the current drain measured by ECU is out of the target range or the maximum permissble temperature of the ECU component for power supply of the lamp is exceeded

Error codes
DEUTZ-Errorcode: 225
BlinkCode (short-long-short): 5 - 1 - 3
SPN: 624
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
5: current to low or broken wire
2: data stream is defective

Errordetection
Errorlamp shows -. Entry in errormemory.

Possible reason for error
Cable break or short circuit, disabled by ECU, lamp defective, connection cable demaged

Take actions for error repair
Check cabling and load, check lamp and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: only error memory item
Behaviour error lamp: -
Selfhealing: no
Signal Priority: 2
Measurement @ errortime: setpoint Diagnosticlamp

226 / 158 / T15CD

Error description TERMINAL 15
Terminal 15: ECU receives no signal

Error codes
DEUTZ-Errorcode: 226
BlinkCode (short-long-short): 5 - 1 - 4
SPN: 158
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12: Defective component
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Ignition ON not detected, ignition switch defective, connection cable demaged

Take actions for error repair
Check cabling, if sensor not working, check ignition switch and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, engine can not start
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 2
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

227 / 523550 / T50CD

Error description TERMINAL 50
Terminal 50: ECU receives a permanent signal
Error codes
DEUTZ-Errorcode: 227
BlinkCode (short-long-short): 5 - 1 - 5
SPN: 523550
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
Errordetection
Errorlamp shows permanent light. Entry in errormemory.
Possible reason for error
Engine start switch stuck, start switch clamped, connection cable demaged
Take actions for error repair
Check cabling, if sensor not working, check start switch and if necessary replace it, check connection cable and if necessary repair or replace it
other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 1
Measurement @ errortime: actual value

228 / 523550 / TPUMon

Error description TERMINAL 50
Internal hardware monitoring: ECU detects a deviation between the signal of time module and the system time
Error codes
DEUTZ-Errorcode: 228
BlinkCode (short-long-short): 5 - 5 - 5
SPN: 523550
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
2: data stream is defective
Errordetection
Errorlamp shows blinking. Entry in errormemory.
Possible reason for error
Time processing unit (TPU) defective, ECU defective
Take actions for error repair
If error not removable, change ECU
other error properties
System reaction: Recovery of ECU
Behaviour error lamp: blinking
Selfhealing: no
Signal Priority: 5
Measurement @ errortime: -

232 / 84 / VSSCD1

Error description VEHICLE SPEED
Vehicle speed: over the maximum, signal invalid or implausible compared with the injection quantity and the engine speed, offset factors unlearned
Error codes
DEUTZ-Errorcode: 232
BlinkCode (short-long-short): 5 - 2 - 1
SPN: 84
possible FMI:
0: data valid, but above normal working area
12: Defective component
8: unusual frequency, pulse or period.
14: Special Instructions
Errordetection
Errorlamp shows permanent light. Entry in errormemory.
Possible reason for error
Speed above target range, signal invalid or implausible compared to injection volume and engine speed, distance factor not learned, sensor defective, connection cable demaged
Take actions for error repair
Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it
other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: default value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

235 / 523600 / WdCom

Error description SERIAL INTERFACE DEF.
Internal hardware monitoring: the ECU detects a disturbance in internal communication

Error codes
DEUTZ-Errorcode: 235
BlinkCode (short-long-short): 5 - 5 - 5
SPN: 523600
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable
12: Defective component

Errordetection
Errorlamp shows blinking. Entry in errormemory.

Possible reason for error
Communication disturbed, ECU defective

Take actions for error repair
If error not to removable, change ECU

other error properties
System reaction: Recovery of ECU
Behaviour error lamp: blinking
Selfhealing: no
Signal Priority: 5
Measurement @ errortime: -

236 / 523470 / PRVMonSysReac

Error description RAIL PRESS. LIM. VALVE
Rail pressure relief valve: is open, will be forced to open, the forced-open failed; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 236
BlinkCode (short-long-short): 1 - 4 - 6
SPN: 523470
possible FMI:
12: Defective component
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light, 15s before shut off. Entry in errormemory.

Possible reason for error
Rail pressure relief valve open or forced open abortive (interpretation of the rail pressure gradient), power supply voltage too low, rail pressure sensor defective, fuel metering unit defective, rail pressure relief valve defective, air in fuel system

Take actions for error repair
Check working voltage and if necessary correct it, check rail-pressure sensor and if necessary replace it, check FCU and if necessary replace it, check rail pressure relief valve and if necessary replace it, bleed the fuel-system

other error properties
System reaction: Warning, shut the engine off in about 5 minutes
Behaviour error lamp: permanent light, 15s before shut off
Selfhealing: no
Signal Priority: 4
Measurement @ errortime: actual value

237 / 523006 / APPCDSwtnSel

Error description CONTR. MODE SWITCH
Controller mode switch: the signal received by ECU is defective or implausible.

Error codes
DEUTZ-Errorcode: 237
BlinkCode (short-long-short): 2 - 4 - 2
SPN: 523006
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
2: data stream is defective
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break, signal implausible, switch defective, connection cable demaged

Take actions for error repair
Check switch and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 2
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

238 / 523007 / FrmMng_TORxEngPress

Error description CAN ERROR RxEngPress.

Error codes

DEUTZ-Errorcode: 238
BlinkCode (short-long-short): 2 - 1 - 5
SPN: 523007
possible FMI:
12: Defective component
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection

Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error

Take actions for error repair

other error properties

System reaction:
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 1
Measurement @ errortime: default value

239 / 523008 / MpICtl

Error description MANIPULATION CONTROL

Data monitoring: the torque curve does not match the specification

Error codes

DEUTZ-Errorcode: 239
BlinkCode (short-long-short): 4 - 2 - 4
SPN: 523008
possible FMI:
1: data valid, but below normal working area
2: data stream is defective
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection

Errorlamp shows . Entry in errormemory.

Possible reason for error

Manipulation of Topcurve detected, data manipulation, too slow changed curve

Take actions for error repair

other error properties

System reaction:
Behaviour error lamp:
Selfhealing: -
Signal Priority: 3
Measurement @ errortime:

240 / 98 / OLSCD

Error description OIL LEVEL SWITCH

Oil level sensor: the voltage of sensor measured by ECU is out of the target range or the received value of oil level via CAN is defective or the signal value is implausible

Error codes

DEUTZ-Errorcode: 240
BlinkCode (short-long-short): 2 - 1 - 1
SPN: 98
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
2: data stream is defective
2: data stream is defective

Errordetection

Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error

Voltage outside target range, CAN signal error, signal implausible, sensor defective, connection cable demaged, CAN bus wrong cabled, wiring demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair

Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it, Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, chec

other error properties

System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: default value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

241 / 98 / OLSCDSysReacHi

Error description OIL LEVEL SWITCH
Oil level: the oil level calculated by ECU is above the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 241
BlinkCode (short-long-short): 2 - 5 - 1
SPN: 98
possible FMI:
0: data valid, but above normal working area
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Oil level too high with system reaction, oil volume too large, sensor defective, connection cable demaged, CAN data error

Take actions for error repair
Check oil level and if necessary correct it, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Advice: OLSCD_stSysReacReq
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

242 / 107 / ADPSCDAna

Error description AIR FILTER COND.
Air filter differential pressure sensor: the voltage of sensor measured by ECU is out of the target range

Error codes
DEUTZ-Errorcode: 242
BlinkCode (short-long-short): 1 - 3 - 6
SPN: 107
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Voltage outside target range, sensor defective, connection cable demaged

Take actions for error repair
Check cable harness, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: default value

243 / 98 / OLSCDSysReacLo

Error description OIL LEVEL SWITCH
Oil level: the oil level calculated by ECU is underneath the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 243
BlinkCode (short-long-short): 2 - 5 - 2
SPN: 98
possible FMI:
1: data valid, but below normal working area
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Oil level too low with system reaction, oil volume too small, sensor defective, connection cable demaged, CAN data error

Take actions for error repair
Check oil level and if necessary correct it, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Advice: OLSCD_stSysReacReq
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: actual value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

244 / 523009 / PrvMonWear

Error description REPL. RAIL PRESS. VALVE
Rail pressure relief valve: is open more frequently or for a longer time than what the technical specification allows

Error codes
DEUTZ-Errorcode: 244
BlinkCode (short-long-short): 2 - 5 - 3
SPN: 523009
possible FMI:
9: Abnormal update rated
10: Abnormal rate of change
14: Special Instructions
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Rail pressure relief valve open more frequently than the technical specification allowed, rail pressure relief valve open longer than the technical specification allowed, rail pressure relief valve defective

Take actions for error repair
Change rail pressure relief valve and remove the error through Serdia command

other error properties
System reaction: permanent error message, unerasable by "Clear EM"
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 3
Measurement @ errortime: actual value

245 / 523010 / RailMeUn8

Error description LEAKAGE DETECTION
Wenn the engine is in idle running, the metering unit compares its output and rail pressure with the default value (Parameter) and calculates a correction factor-it calibrates itself then

Error codes
DEUTZ-Errorcode: 245
BlinkCode (short-long-short): 2 - 5 - 4
SPN: 523010
possible FMI:
0: data valid, but above normal working area
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error

Take actions for error repair

other error properties
System reaction:
Behaviour error lamp: permanent light
Selfhealing: no
Signal Priority: 3
Measurement @ errortime: actual value

246 / 523650 / FlSys_FLPFMSysReac

Error description
Low fuel pressure Diesel: the low fuel pressure calculated by ECU is underneath the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 246
BlinkCode (short-long-short): 5 - 4 - 1
SPN: 523650
possible FMI:
2: data stream is defective
2: data stream is defective
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Diesel fuel pressure below target range with system reaction, interruption in cycling process of low fuel pressure (for example, fuel pump defective), sensor defective, connection cable demaged

Take actions for error repair
Check Diesel low fuel pressure loop system, Check electrical fuel pump, inspect fuel system and if necessary repair it, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 4
Measurement @ errortime: default value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

247 / 523651 / FlSys_FTSFMSysReac

Error description
Rape Oil Fuel temperature: the fuel temperature calculated by ECU is above the target range; the ECU activates a system reaction

Error codes
DEUTZ-Errorcode: 247
BlinkCode (short-long-short): 5 - 4 - 2
SPN: 523651
possible FMI:
2: data stream is defective
2: data stream is defective
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Rape oil fuel temperature above target range with system reaction, interruption of rape oil fuel loop (for example, heat exchanger not working properly), sensor defective, connection cable demaged

Take actions for error repair
Check rape oil fuel system as well as heat exchanger and heat exchanger valve, if necessary repair it, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning and switchover to Diesel operation mode
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: default value

248 / 523652 / FlSys_FlushStateEngineOff

Error description
Engine shut off without flushing or flushing was not already completed. ECU stores every shutoff with uncompleted or missing flushing process

Error codes
DEUTZ-Errorcode: 248
BlinkCode (short-long-short): 5 - 4 - 3
SPN: 523652
possible FMI:
2: data stream is defective
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Engine shut off without flushing of the fuel system in Diesel operation mode, Shutoff before flushing in Diesel operation mode was finished

Take actions for error repair
Awaiting complete flushing of the fuel system everytime before engine shut off

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: -

249 / 523653 / FlSys_RapeOilHeatEx

Error description RAPEOILSYSTEM
Awaited temperatur rise with opened heat exchanger valve did not occur. Error in fuel heating system.

Error codes
DEUTZ-Errorcode: 249
BlinkCode (short-long-short): 5 - 4 - 4
SPN: 523653
possible FMI:
2: data stream is defective
12. Errormode not identifiable
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Fuel heating system (heat exchanger) not working correctly

Take actions for error repair
Check Heat exchanger and heat exchanger valve, check cooling system going to the heat exchanger, check rape oil system going to the heat exchanger

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: -

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

250 / 523654 / FrmMngDieselLvl

Error description RAPEOILSYSTEM
Status DieselLvl (Diesel tank level): the voltage of the sensor measured by ECU is out of the target range

Error codes
DEUTZ-Errorcode: 250
BlinkCode (short-long-short): 5 - 4 - 5
SPN: 523654
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, sensor defective, connection cable demaged

Take actions for error repair
Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: default value

251 / 523655 / FrmMngFuelTemp

Error description RAPEOILSYSTEM
Status FuelTemp (Fuel Temperature): the voltage of the sensor measured by ECU is out of the target range

Error codes
DEUTZ-Errorcode: 251
BlinkCode (short-long-short): 5 - 4 - 6
SPN: 523655
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, lamp defective, connection cable demaged

Take actions for error repair
Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: default value

252 / 523656 / FrmMngLowPressureDiesel

Error description RAPEOILSYSTEM
Status LowPressureDiesel (Low fuel pressure diesel): the voltage of the sensor measured by ECU is out of the target range

Error codes
DEUTZ-Errorcode: 252
BlinkCode (short-long-short): 5 - 4 - 7
SPN: 523656
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, lamp defective, connection cable demaged

Take actions for error repair
Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: default value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

253 / 523657 / FrmMngRapeOilIn

Error description RAPEOILSYSTEM
CAN messageRapeOilIn (Rape oil input): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 253
BlinkCode (short-long-short): 5 - 6 - 1
SPN: 523657
possible FMI:
12: Defective component
12. Errormode not identifiable
12: Defective component
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction: Warning, substitute values
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: default value

254 / 523658 / FrmMngRapeOilLvl

Error description RAPEOILSYSTEM
Status RapeOilLvl (Rape oil tank level): the voltage of the sensor measured by ECU is out of the target range

Error codes
DEUTZ-Errorcode: 254
BlinkCode (short-long-short): 5 - 6 - 2
SPN: 523658
possible FMI:
3: Voltage to high or short circuit to +Ubatt
4: Voltage to low or short circuit to -Ubatt
12. Errormode not identifiable
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, lamp defective, connection cable demaged

Take actions for error repair
Check cabling, if sensor not working, check sensor and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning, substitute value
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: default value

255 / 523659 / FrmMngRapeOilVlv1

Error description RAPEOILSYSTEM
Status RapeOilVlv1 (Valve 1): the current drain measured by ECU is out of the target range or the maximum permissible temperature of the ECU component is exceeded

Error codes
DEUTZ-Errorcode: 255
BlinkCode (short-long-short): 5 - 6 - 3
SPN: 523659
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12: Defective component
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, valve defective, connection cable demaged

Take actions for error repair
Check cabling, if valve not working, check valve and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning and switchover to Diesel operation mode
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: default value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

256 / 523660 / FrmMngRapeOilVlv2

Error description RAPEOILSYSTEM
Status RapeOilVlv2 (Valve 2): the current drain measured by ECU is out of the target range or the maximum permissible temperature of the ECU component is exceeded

Error codes
DEUTZ-Errorcode: 256
BlinkCode (short-long-short): 5 - 6 - 4
SPN: 523660
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12: Defective component
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, valve defective, connection cable demaged

Take actions for error repair
Check cabling, if valve not working, check valve and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning and switchover to Diesel operation mode
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: default value

257 / 523661 / FrmMngRapeOilVlv3

Error description RAPEOILSYSTEM
Status RapeOilVlv3 (Valve 3): the current drain measured by ECU is out of the target range or the maximum permissible temperature of the ECU component is exceeded

Error codes
DEUTZ-Errorcode: 257
BlinkCode (short-long-short): 5 - 6 - 5
SPN: 523661
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12: Defective component
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, valve defective, connection cable demaged

Take actions for error repair
Check cabling, if valve not working, check valve and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning and switchover to Diesel operation mode
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: default value

258 / 523662 / FrmMngRapeOilVlv4

Error description RAPEOILSYSTEM
Status RapeOilVlv4 (Valve 4): the current drain measured by ECU is out of the target range or the maximum permissible temperature of the ECU component is exceeded

Error codes
DEUTZ-Errorcode: 258
BlinkCode (short-long-short): 5 - 6 - 6
SPN: 523662
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12: Defective component
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, valve defective, connection cable demaged

Take actions for error repair
Check cabling, if valve not working, check valve and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: default value

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DTC-List
Diagnosis- and Errorcodes

referrenced ECU-Software
P490_: 220, 310, 501
P491_: 220, 310, 400, 501
P492_: 213
P513_: 214, 300

259 / 523663 / FrmMngRapeOilVlv5

Error description RAPEOILSYSTEM
Status RapeOilVlv5 (Valve 5): the current drain measured by ECU is out of the target range or the maximum permissible temperature of the ECU component is exceeded

Error codes
DEUTZ-Errorcode: 259
BlinkCode (short-long-short): 5 - 6 - 7
SPN: 523663
possible FMI:
12. Errormode not identifiable
12. Errormode not identifiable
12: Defective component
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
Cable break or short circuit, valve defective, connection cable demaged

Take actions for error repair
Check cabling, if valve not working, check valve and if necessary replace it, check connection cable and if necessary repair or replace it

other error properties
System reaction: Warning
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: default value

260 / 523664 / FrmMngSTIN1RX

Error description RAPEOILSYSTEM
CAN message STIN1 (State Inputs 1): the message can not be received by ECU

Error codes
DEUTZ-Errorcode: 260
BlinkCode (short-long-short): 5 - 6 - 8
SPN: 523664
possible FMI:
12: Defective component
12. Errormode not identifiable
12: Defective component
12. Errormode not identifiable

Errordetection
Errorlamp shows permanent light. Entry in errormemory.

Possible reason for error
CAN bus wrong cabled, wiring is demaged, receiver (sender of the message) work inaccurately, parametering inaccurate

Take actions for error repair
Check CAN Bus cabling (Bus sheduling, polarity, short circuit, power interrupt), test protocol of receiver, check CAN functional range

other error properties
System reaction: Warning, substitute values
Behaviour error lamp: permanent light
Selfhealing: yes
Signal Priority: 3
Measurement @ errortime: default value

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5.22 Generator

General

The generator should be of light weight, have a high rate of efficiency and supply all consumers in the vehicle with electric current at a steady voltage already at idling speed.

Terminal designations

- B61, L = charge control
- B+, B = battery plus, also with the designation "30"
- B- = battery minus, also with the designation "31"
- D+ = dynamo plus corresponds with terminal "61" and "L"
- D- = dynamo minus (this designation is only found on D.C. generators or A.C. generators with regulator removed)
- DF = dynamo field (this designation is only found on D.C. generators or A.C. generators with regulator removed). Note: The designation DF is also found on older alternators with externally arranged regulator on the connection of the exciting coil to the regulator or on the regulator itself
- DF1 = dynamo field 1
- DF2 = dynamo field 2
- IG = "15" ignition switch

Three-phase generator

The AC-generator first of all produces AC-voltage / AC-current.

Why does AC-current need to be rectified?

There are a few components for which can either be operated with alternating current or direct current, because they work independently from the current flow direction.

This includes :

- Incandescent lamps
- Fluorescent lamps
- Glow lamps
- Electric heating elements.

There are also a few components that could be operated either with alternating current, direct current or three-phase current, if the components were designed accordingly.

This includes :

- Electric motors
- Relays.

Finally, a variety of important components solely require direct current. These will under no circumstances work with alternating or three-phase current.

This includes :

- Accumulators
- Control units
- All electronics
- Communication equipment.

Design and function

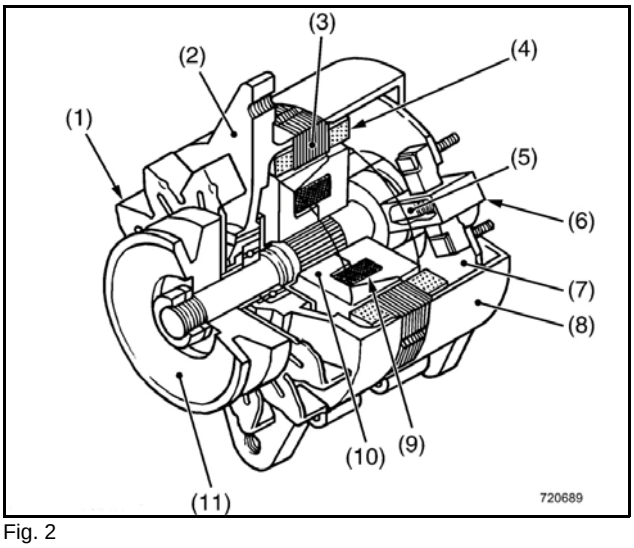


Fig. 2

1 Fan
2 Holding plate
3 Stator core
4 Stator winding
5 Brush

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6 Brush holder
7 Rectifier
8 Bearing cover
9 Rotor winding
10Rotor
11V-belt pulley



Fig. 3 Rotor with claw poles

In the generator the armature windings are located inside the stationary stator (Fig. 4), whereas the exciter winding is arranged on the internally revolving rotor (Fig. 3).



Fig. 4 Stator

The three stator windings (Fig. 4) are electrically offset to each other by 120°. The excitation of the magnetic field requires direct current, which is fed to the rotor via two carbon brushes and slip rings.

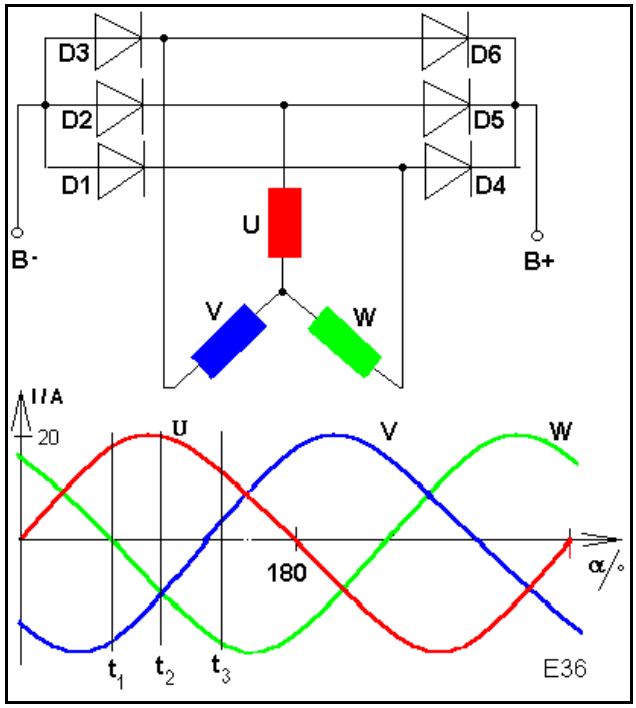


Fig. 5 3-phase current

The wiring diagram (Fig. 5) shows the 3 windings in Y-connection and the 6 associated rectifier diodes (D1 to D6).

The diodes D1, D2, D3 are also referred to as minus diodes, because they have B- as common connection (minus plate). The other diodes are the plus diodes.

The rectifier diodes have the effect that the negative half-wave is suppressed and only the positive section of the wave is allowed to pass, resulting in a pulsating D.C. voltage.

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Charge control light

The charge control light has two duties:

- Indication of the correct generator function
- External excitation of the generator during the starting phase

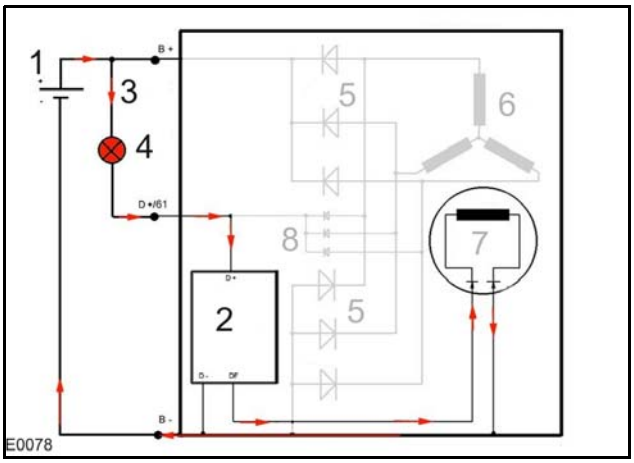


Fig. 6 plus controlled charging regulator

(Fig. 6) shows the current flow with the ignition switched on, engine stopped.

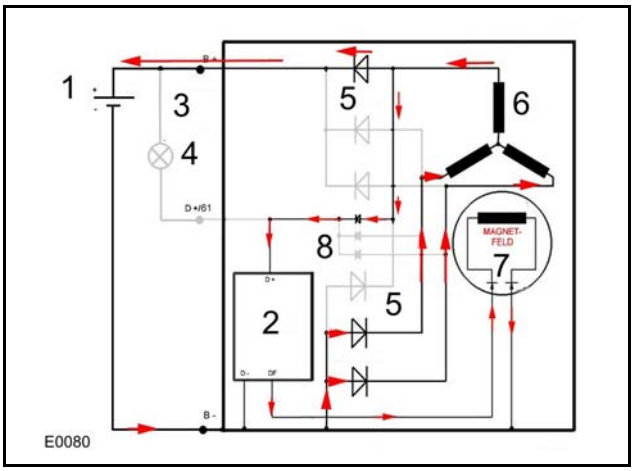


Fig. 7 plus controlled charging regulator

(Fig. 7) shows the current flow with the ignition switched on, engine running.

1 Battery

2 Charge controller

3 Ignition switch

4 Charge control light

5 Rectifier

6 Rotor

7 Sliprings / carbon brush

8 Auxiliary rectifier

Normally the charge control light lights with the engine stopped and the ignition switched on and goes out at low engine speed, but at the latest after a single, short-term increase in engine speed from idle speed, because there is no longer a voltage difference on the lamp.

Any other behaviour would indicate a defect on the generator (rectifier, carbon brushes, regulator) or a defect on the lamp, presumed the on-board battery is not discharged.

A far more important function of the lamp is the transition and provision of field current. At standstill there is no magnetic field in the de-energized generator. Since this is necessary for the generation of electric current, the rotor must be supplied with current, so that a weak field can build up.

The current flows from the ignition switch via the charge control light through the generator winding against ground (terminal 31) and is limited to approx. 300 mA by the light bulb (4 W) (without the lamp the current flow would be 2 to 5 A). While the rotor is rotating current is induced into the stator winding, whereby a small part (2–5 A, depending on speed) flows through the charge regulator into the field winding of the rotor and the major part flows to the output terminals (B+), where it can be tapped as useful current. If the charge control light is defective or no battery is available or the battery is discharged, external excitation is no longer possible at standstill and no voltage will be generated, even when the generator is running.

With used, older generators a weak permanent magnetic field may have developed over the lifetime, which does even exist when no voltage is applied. This type of machines can even start without charge control light and produce current during operation. However, this is an unintended effect and you should not presume that a generator without charge control light or external excitation can be started up.

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Charge controller

The charge controller has the following functions

- To regulate the voltage generated by the generator
- To protect against overloads caused by too high output current
- Protection against reverse current

If the output voltage or the output current of the generator exceeds the determined maximum values, the field current and thus the electric power is reduced.

Electronic charge regulator

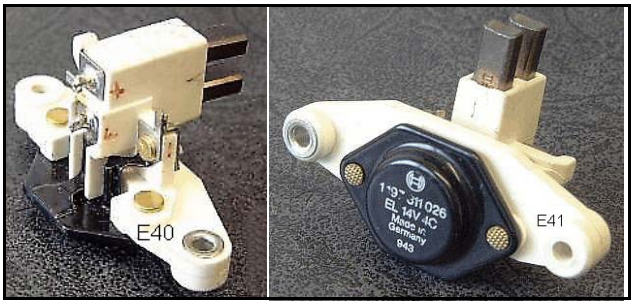


Fig. 8

In AC-generators the electrically generated exciter field of the generator rotor is influenced by an attached electronic charge regulator. Together with the holder for the carbon brushes this regulator forms a unit, which transfers the field current to the sliprings of the rotor.

The regulator compares the rectified actual current of the generator with the a stable reference voltage in the regulator and matches the strength of the exciter field (field current) by increasing or reducing the current flow (PWM, switching controller) in such a way, that the actual voltage of the generator remains constant, irrespective of load and speed. The generator voltage is thereby regulated, the generator current, however, is not measured, but limited by the construction dependent internal resistance of the stator coils or thermal monitoring.

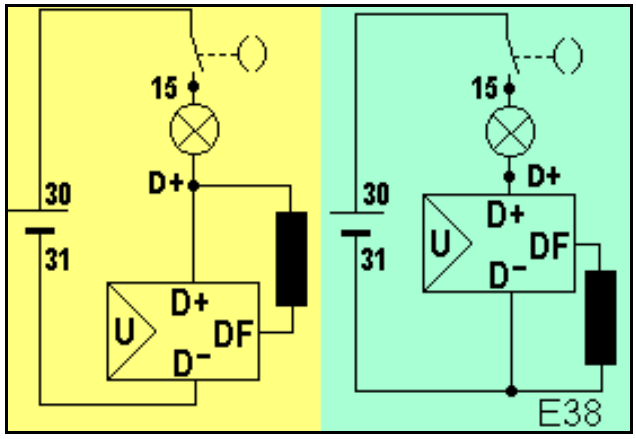


Fig. 9 plus controlled regulator

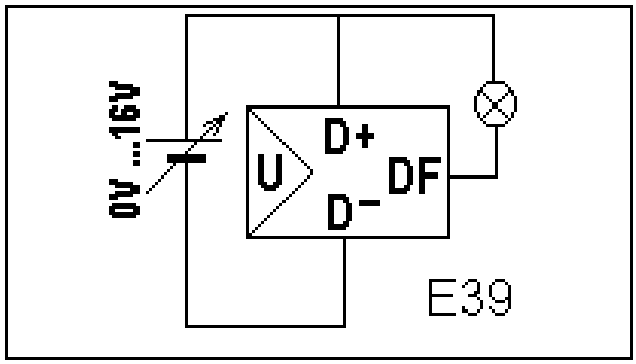


Fig. 10 minus controlled regulator

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Checking the generator

First one must check whether the generator is actually defective.

- This can be easily found out by checking whether the charge control light in the dashboard lights up. If the light does not go out, even at higher speeds, there must be a defect on the generator, the regulator, the wiring or the V-belt.
- When the engine is at rest, the charge control light must light up. If not, the lamp may probably be defective. Defects on generator or wiring are obviously also possible.

The following points allow to contain faults in the voltage supply within certain limits.

- Cable connections on the generator OK?
- V-belt OK?
- Generator ground (engine ground) OK?
- Pre-excitation from vehicle electronics OK?

Only if all criteria mentioned above are OK, the fault must be in the generator itself. In this case it must be replaced or the following trouble shooting procedure must be performed.

Checking the pre-exciter circuit, D+ generator

The most common reason for a 3-phase alternator not charging is a too low pre-excitation current. The pre-excitation current through connection D+ depends on the connected consumer (resistance), e.g. charge control light or relay of a MD+ engine control.

The pre-excitation current should be approx. 250 mA at 12 Volt. This corresponds with a 3 Watt light bulb or an equivalent combination of light bulb + resistance or an LED + resistance.

The total resistance of the disconnected dead supply line D+ max. should not exceed 48 Ohm.

In case of faults like

- charge control light stays on
- no voltage increase, e.g. from 12 V to 14 V

one should check that the correct resistance is assured.

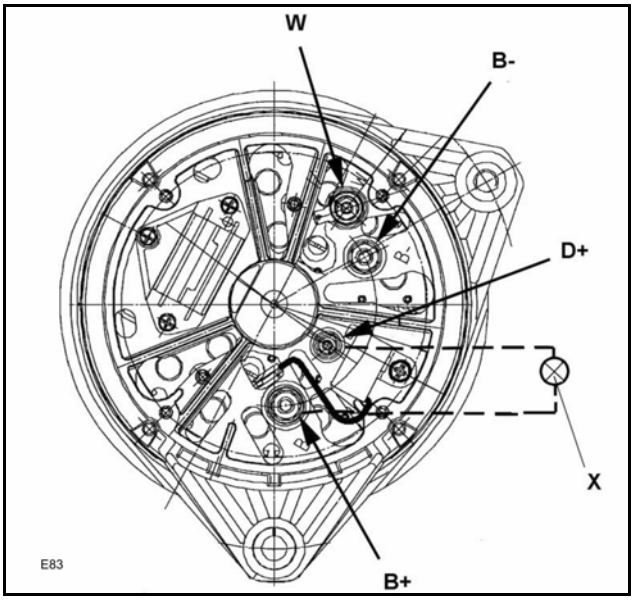


Fig. 11 Connections on the three-phase alternator (exemplary design)

If the charge control light or LED stays on when the engine is running, you should proceed as follows:

- Temporarily bridge connections D+ and B+ on the three-phase alternator (Fig. 11). The bridging must be made using an insulated cable with a cross-section of approx. 1.0 mm, which is stripped for approx. 5 mm on either end. This cable must be fitted with a consumer (X), e.g. a light bulb of 21 W, 12 V, in case of a 12 V system.

If this measure does not clear the fault, the alternator must be defective.

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Measuring the charge current

- All plug-and-socket connectors must be free of corrosion and intermittent contact.
- The generator ground connection must be OK.
- During the measurement switch on as many consumers as possible.

1 Attach the clip-on ammeter around the B+ line.

2 Gradually increase the engine speed.

3 The generator current must be at least as high as the total current of all switched on consumers.

Checking the rotor

i Note

The rotor coils can only be measured in disassembled state.

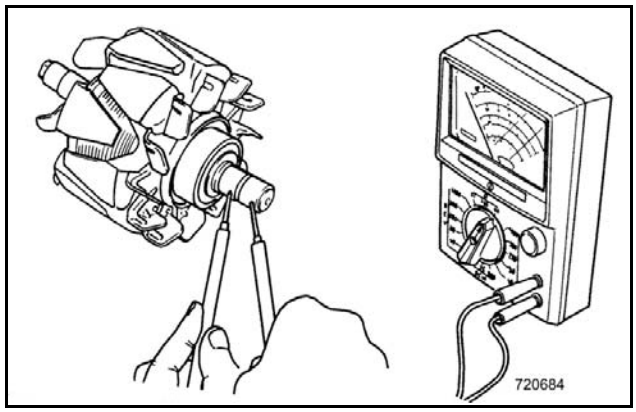


Fig. 12

- Measure the resistance between the sliprings.
- If the resistance does not comply with the factory specification, replace the rotor.
- Use the resistance range of the continuity tester to check the continuity between slipring and core.
- Replace the rotor if no infinite value is indicated.

i Note

Factory specification for resistance: 2.8 to 5 OHM.

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Checking the stator

i Note

The stator coils can only be measured in disassembled state.

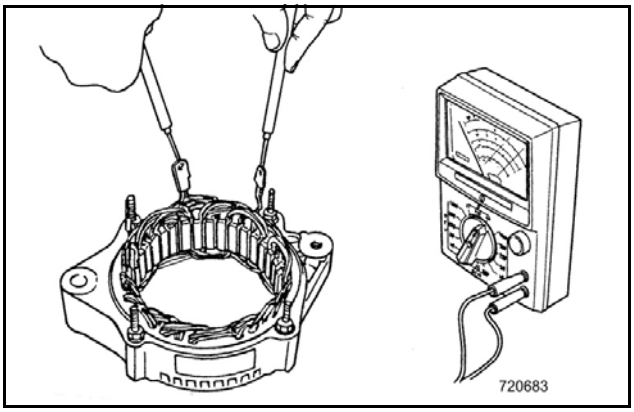


Fig. 13

- Use the resistance range of the continuity tester to measure the resistance between the individual lines of the stator winding.
- If the measuring value does not comply with the factory specification, replace the stator.
- Use the resistance range of the continuity tester to check the continuity between the individual stator windings and the core.
- Replace the stator if no infinite value is indicated.

i Note

Factory specification for resistance: Less than 1 OHM.

Checking the bearings

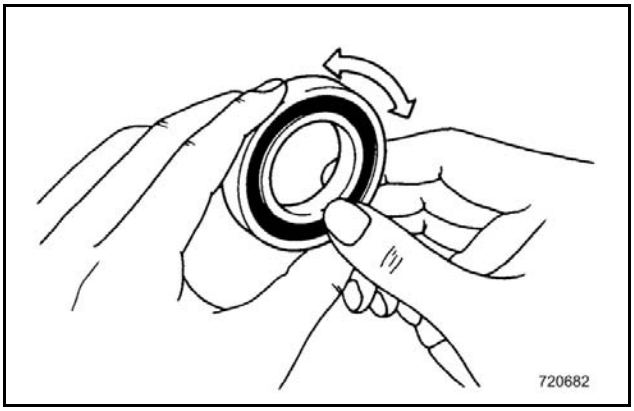


Fig. 14

- Check whether the bearing rotates without obstruction.
- Replace the bearing if it does not rotate properly.

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Checking the regulator voltage with the generator tester

The battery and generator tester comes with an 8-line LC display with background illumination and is able to print out test results via an (optional) thermal printer.



Fig. 15

The generator test assesses the regulator voltage and the ripple factor of the generator voltage.

- All plug-and-socket connectors must be free of corrosion and intermittent contact.
- The generator ground connection must be OK.
- The battery should be in good condition – the idle voltage of the battery should be at least 12.6 Volt.
- If possible switch off all consumers.
- Perform the measurement at raised engine speed.

Checking the regulator voltage with the multimeter

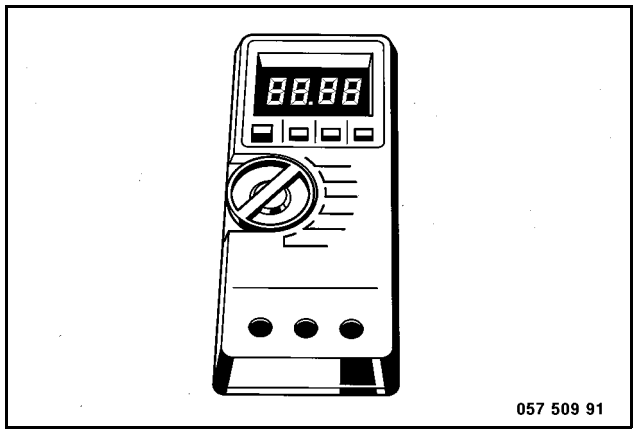


Fig. 16

- All plug-and-socket connectors must be free of corrosion and intermittent contact.
- The generator ground connection must be OK.
- The battery should be in good condition – the idle voltage of the battery should be at least 12.6 Volt.
- If possible switch off all consumers.
- Perform the measurement at raised engine speed.
- The voltage (B+) should adjust itself at 13 to 14 Volt.

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Checking the regulator in disassembled state

On a **Bosch generator** unscrew two fastening screws for the regulator and lift the regulator off. For this work the generator does not need to be removed.

The **Delco-Remy generator** needs to be removed and partly dismantled, if the regulator needs to be disassembled. Unscrew the housing screws to do so. Pull rotor with drive bearing and V-belt pulley out of the stator. Unscrew the ends of the stator winding from the diode carrier and separate the stator from the collector ring bearing. Disassemble exciter diodes and brush holders and remove also the regulator.

i Note

When testing the regulator one should be aware that there are 2 different types of regulators:

- If the carbon brush is not connected to ground the regulator is a so-called minus controlled regulator. The exciter winding is positioned between D+ and DF, the regulator therefore regulates the exciter winding on the ground side. The other carbon brush is connected with the cathodes of the exciter diodes, terminal D+. This leaves one further terminal, this is DF.

D+ (vehicle wiring system)

D- (ground contact, mostly located on one of the fastening screws)

DF (Dynamo Field)

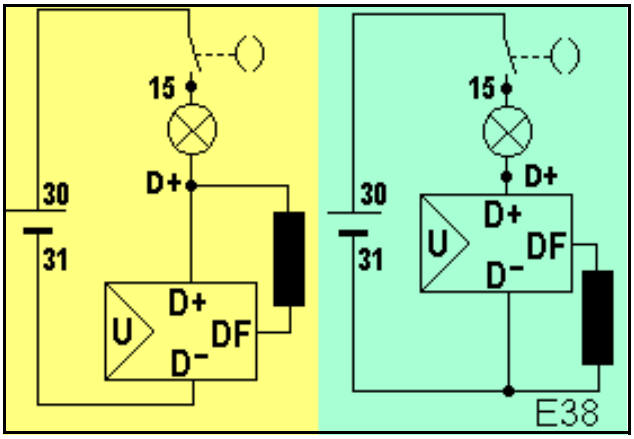


Fig. 17

- If the carbon brush is connected to ground the regulator is a so-called plus controlled regulator. The exciter winding is positioned between DF and D-, the regulator therefore regulates the exciter winding on the plus side. The other carbon brush is then connected with terminal DF. This leaves one further terminal, this is D+.

The basic function of a disassembled regulator can be easily tested with a 12V lamp and an adjustable D.C. power supply unit (0V ... 20V).

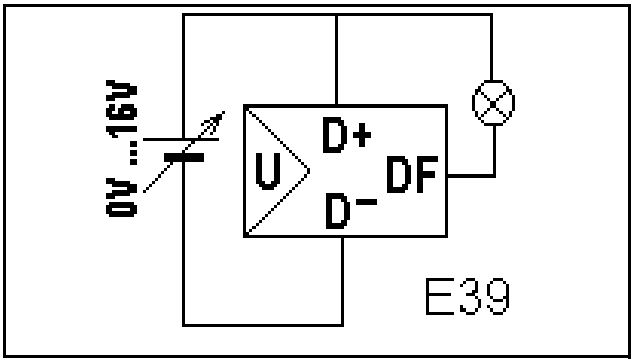


Fig. 18

E.g minus controlled regulator

One connects the regulator (Fig. 18) with D+ and D- to the power source, as shown in the illustration, and the lamp to both carbon brushes, instead of the exciter winding. When slowly increasing the voltage the lamp will first become brighter, because the regulator allows all lamp current (= exciter current) to flow at voltage values up to 14.4V. Once the regulator voltage is reached, the regulator switches the lamp current off. When returning the voltage back below the control voltage, the regulator will switch the lamp back on.

With this test the major difficulty is the problem to remove the regulator an identify terminals D+, DF and D-.

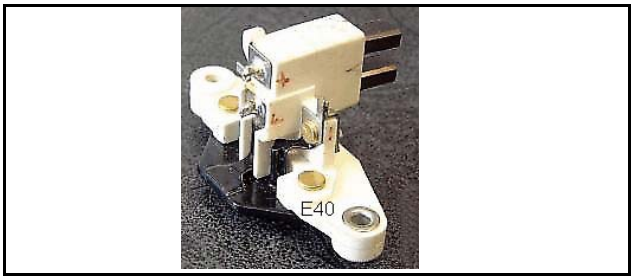


Fig. 19



Fig. 20

The illustrations (Fig. 19) and (Fig. 20) show two different regulator types.

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Replacing carbon brushes

- On a **Bosch generator** unscrew two fastening screws for the regulator and lift the regulator off. Pull out the carbon brushes from underneath. Their minimum length is **5 mm**, shorter carbon brushes need to be replaced, unsolder both connection litz wires. Solder the litz wires of the new carbon brushes, insert these and fasten the regulator again. For this work the generator does not need to be removed.
- For replacing the carbon brushes in the **Delco-Remy generator** the generator needs to be disassembled and partly dismantled. The carbon brush holder is located inside the collector ring bearing.

5.23 Electric starter

General

Combustion engines need to be started by means of a special device, because they are not able to start by themselves. Considerable resistances caused by compression and friction must thereby be overcome.

The starter converts the electric energy stored in the battery into mechanical energy. The starter can only generate its power when a battery with appropriate capacity is available.

Duties of the starter:

- to accelerate the combustion engine to start speed with lowest possible current consumption.
- establish the gear connection between starter and combustion engine.
- to maintain this connection.
- to switch on the starter current.

After starting the engine:

- to return the starter pinion to initial position.
- to switch off the starter current.

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Directly acting electric starter

This shows the design of this starter. It consists of a starter motor and a magnetic switch.

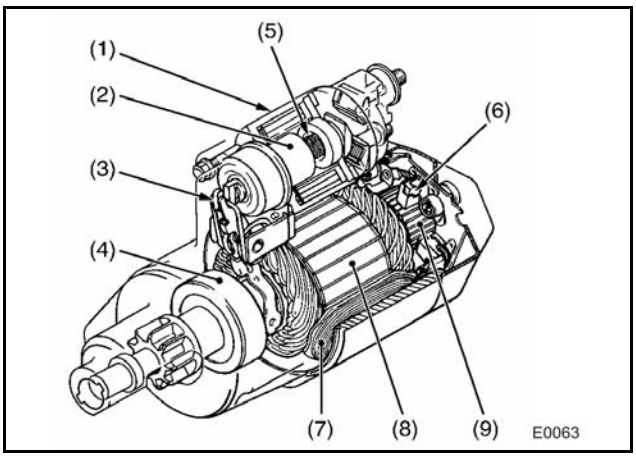


Fig. 21

1 Magnetic switch
2 Armature
3 Actuating lever
4 Freewheeling clutch
5 Resetting spring
6 Brush
7 Exciting winding
8 Armature
9 Collector

Ignition switch in position "START"

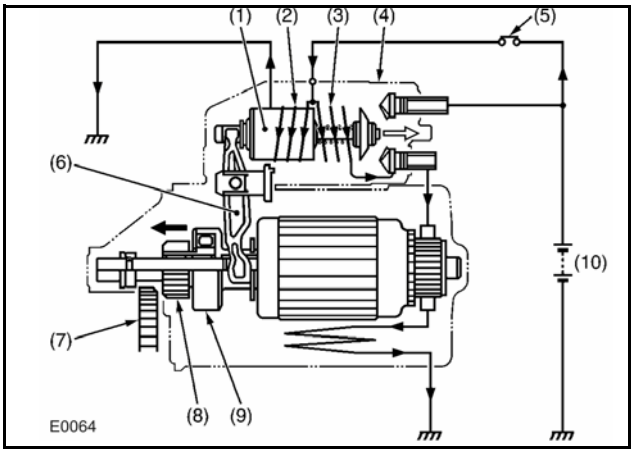


Fig. 22 Magnetic switch open

With the ignition switch (5) in "START" position current flows from the battery (10) through the holding winding (2) and the pick-up winding (3).

The armature (1) is magnetically picked up and forces the pinion (8) with the actuating lever (6) to engage with the ring gear (7).

1 Armature
2 Holding winding
3 Pick-up winding
4 Magnetic switch
5 Ignition switch
6 Actuating lever
7 Ring gear
8 Pinion
9 Freewheeling clutch
10(Battery

Pinion meshes with the ring gear

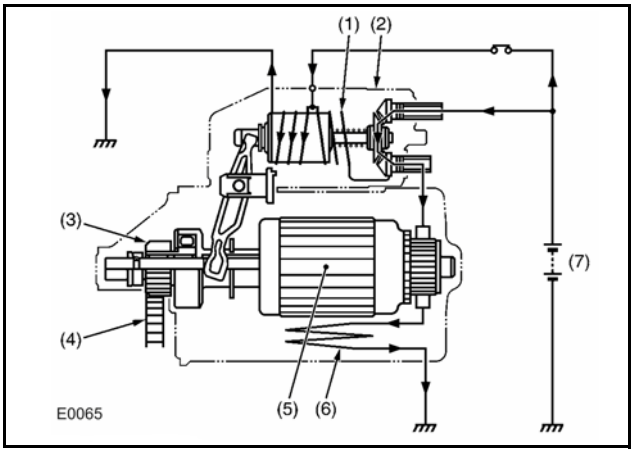


Fig. 23 Magnetic switch closed

When the pinion (3) meshes with the flywheel mounted ring gear (4) and the magnetic switch (2) is closed, a strong current flows from the battery (7) directly into the exciting winding (6) and the armature winding, but not into the pick-up winding.

This causes the armature (5) to rotate with high speed and drives the pinion, which in turn drives the ring gear (4) with a speed of 200 to 300 rpm.

1 Pick-up winding
2 Magnetic switch
3 Pinion
4 Ring gear
5 Armature
6 Exciting winding
7 Battery

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Engine running

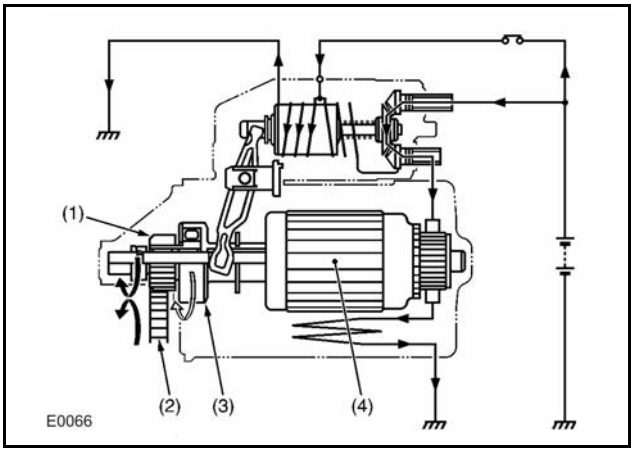


Fig. 24

Once the engine is running and drives the pinion (1) via the ring gear (2), the freewheeling clutch (3) will open and prevent the armature (4) from being driven by the engine.

1 Pinion

2 (Ring gear

3 Freewheeling clutch

4 Armature

Ignition switch released

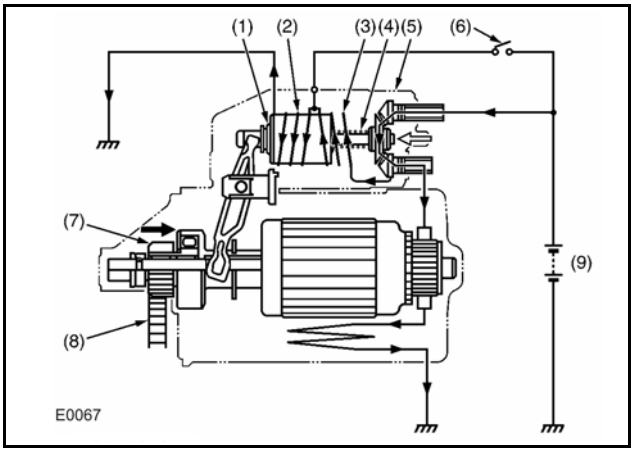


Fig. 25

When releasing the ignition switch (6) it will return from position "START" to "ON" and interrupt the starter current circuit. Current will now flow from the battery (9) through the contact plate in the pick-up winding (3) and the holding winding (2). Since both coils generate opposed magnetic fields, the magnetic field will collapse and the resetting spring (4) takes the armature (1) back to its initial position.

This opens the current circuit on the contact plate and the pinion (7) is pulled back from the ring gear (8) and stops.

1 Armature

2 Holding winding

3 Pick-up winding

4 Resetting spring

5 Magnetic switch

6 Ignition switch

7 Pinion

8 Ring gear

9 Battery

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Magnetic switch

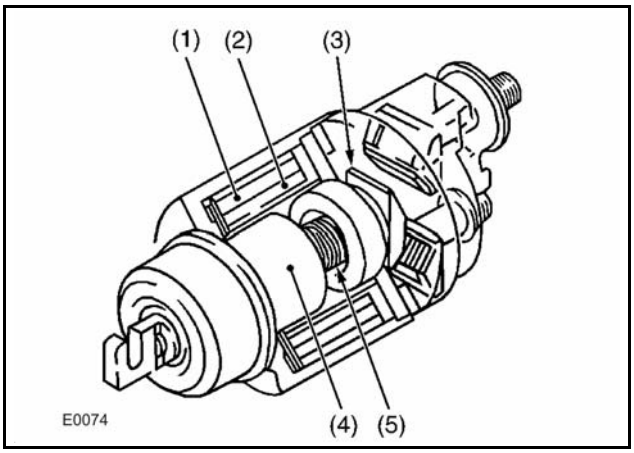


Fig. 26 Direct acting electric motor

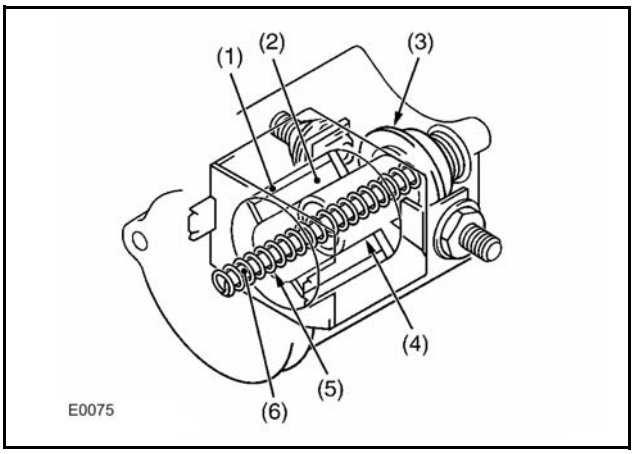


Fig. 27 Geared motor

Armature (4), contact plate (3) and armature guide (6) form a closed unit. When the ignition switch is turned to "START", the armature is picked up and causes the pinion of the clutch to disengage.

This causes the pinion and the ring gear to mesh, while the contact plate establishes a connection between the contacts, which enable the main current to flow into the armature. Once the ignition switch is opened, the resetting spring (5) will pull the armature back to initial position.

1 Holding winding

2 Pick-up winding

3 Contact plate

4 Armature

5 Resetting spring

6 Armature guide

Freewheeling clutch

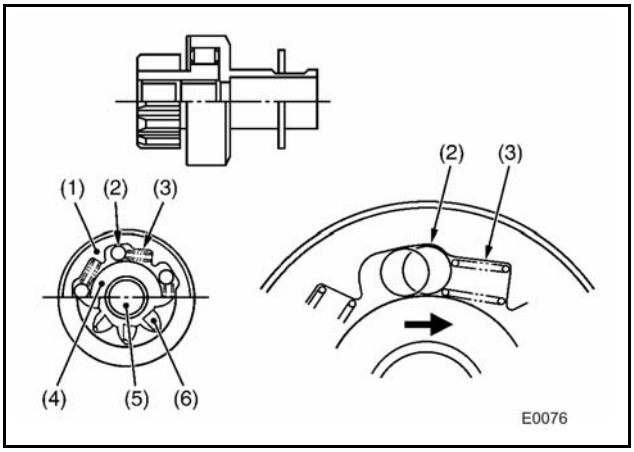


Fig. 28 Freewheeling clutch

The freewheeling clutch is designed in such a way, that the flow of force is automatically interrupted if the pinion (5) of the clutch rotates faster than the freewheeling ring (1) at higher engine speeds.

This makes sure that the armature will only drive the ring gear, but can never be driven by the engine.

1 Freewheeling ring

2 Roller

3 Roller spring

4 Splined shaft

5 Pinion

6 Pinion

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Trouble shooting "Starter"

i Note

The most frequent fault is definitely a fully discharged battery.

If the starter rotates too slowly, either the brushes are partly worn off, or parts of the exciter or armature winding is shorted. In some cases oxidized electric contacts or a soiled ground connection causing extremely high voltage losses in the overall starter system are the cause of problems.

If the starter only emits a clicking sound,- either the magnetic switch is defect / soiled (dismantle and clean))- the main contacts on the magnetic switch are worn off / soiled (scrape off carefully with a file and clean)- the starter motor is defective / soiled (remove armature and clean), cover cleaned, moveable parts with grease.

Frequently a jammed return mechanism is the reason for a starter failure.

Occasionally worn contacts are found on the magnetic return switch

Defects on the actual starter motor including pinion and carbon brushes are very rare.

With a trouble shooting chart the faults in the starter system can be narrowed down. The starter system can only work when many conditions are fulfilled at the same time.

- Immobilizer deactivated?
- Ignition switch OK?
- Travel lever in correct position?
- Emergency stop not actuated?
- Battery sufficiently charged?
- Battery poles OK?
- Main battery fuse OK?
- Main battery switch closed?
- Main starter cable (terminal 30) OK?
- Starter control cable (terminal 50) OK, voltage drop?
- Ground cable OK?
- Switching of magnetic switches OK?

The sequence of these tests is generally of no significance. It mainly depends on:

- the experience of the specialist
- the failure probability of the component to be tested and the testing effort for the respective part.

Only if all criteria mentioned above are OK, the fault must be in the starter itself. In this case it can be repaired or replaced.

Testing and measuring the starter

Function control with the starter removed

⚠ Caution

Fasten the starter to make sure that it will not come loose during the test.

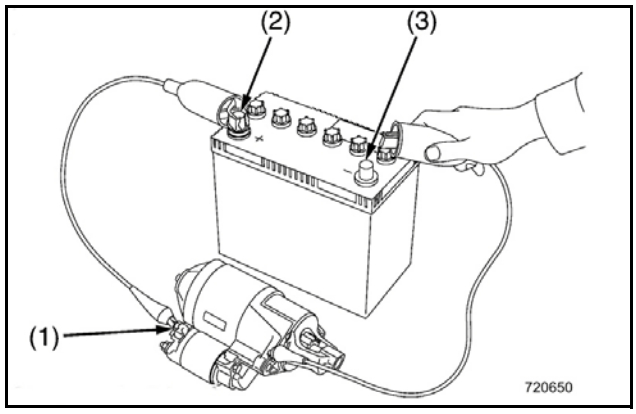


Fig. 29

- Connect a jumper lead between start terminal (1) and battery plus (2).
- Connect a jumper cable instantaneously between starter housing and battery minus (3).

i Note

If the motor does not start, the starter is defective. Repair or replace the starter.

Checking the magnetic switch

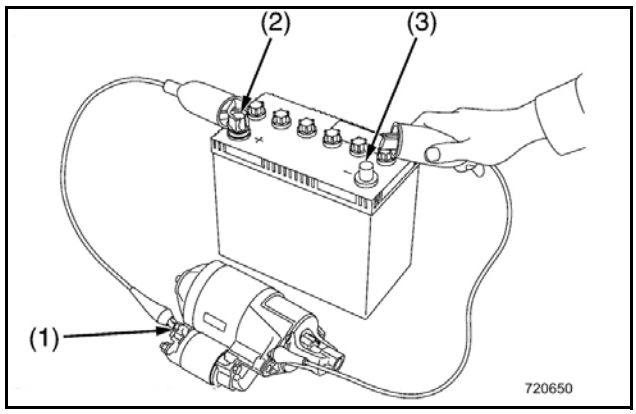


Fig. 30

- Connect a jumper lead between start terminal (1) and battery plus (2).
- Connect a jumper cable instantaneously between starter housing and battery minus (3).

i Note

If the pinion does not disengage, the magnetic switch is defective. Repair or replace the starter.

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Continuity test for the magnetic switch

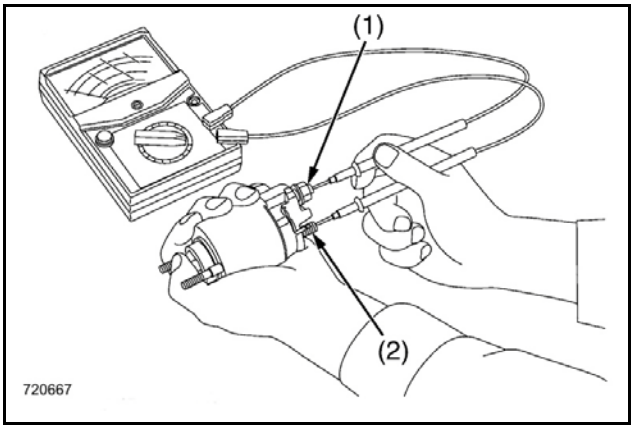


Fig. 31

- Use a continuity tester to check for continuity between terminal (1) and terminal (29 while holding the pin depressed.
- Replace the magnetic switch if no continuity is detected.

Removing and assembling the starter

Removing the starter

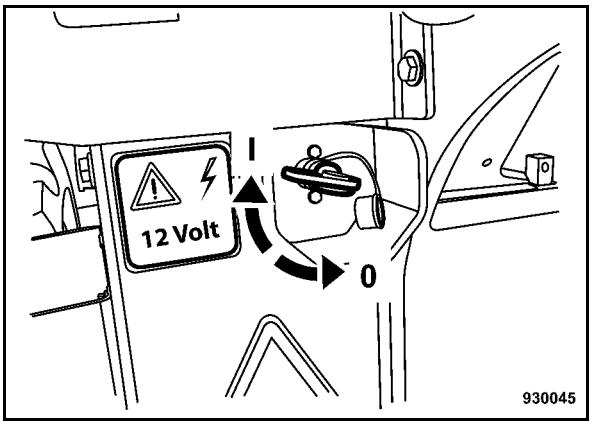


Fig. 32

- Switch the main battery switch to position "0" (Fig. 32).

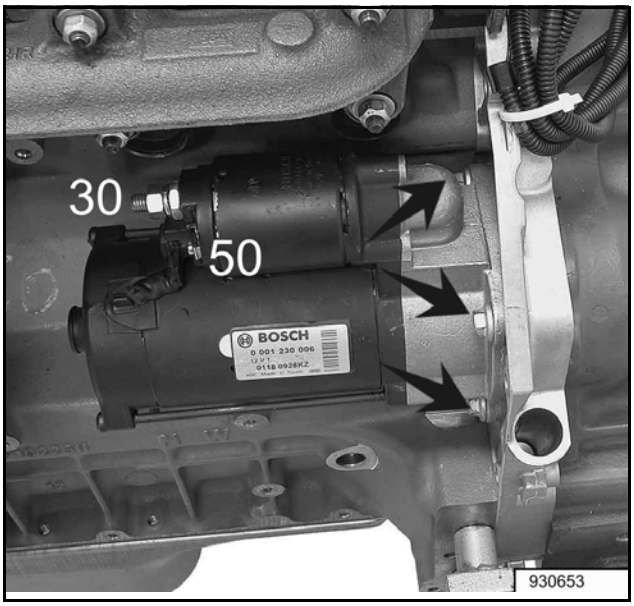


Fig. 33

- Disconnect the cable connections (terminal 30 and 50).
- Unscrew the screws (arrows) (Fig. 33).
- Take off the starter.

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Assembling the starter

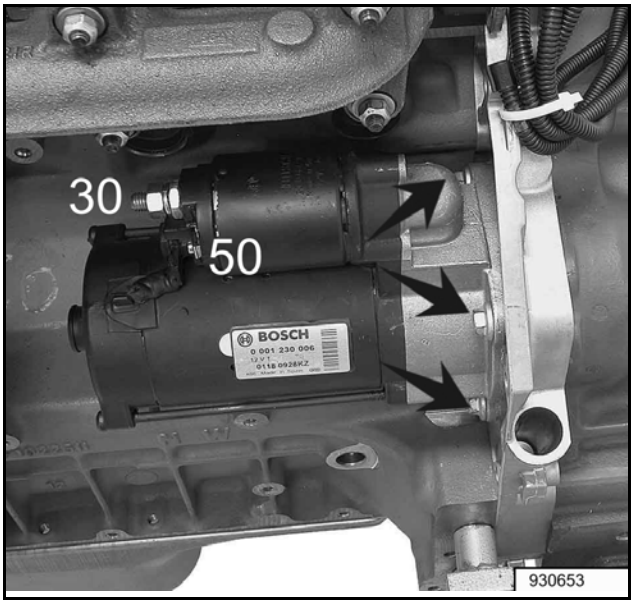


Fig. 34

- Insert the starter.
- Tighten the screws (arrows) (Fig. 34), tightening torque 60 Nm.
- Connect the cables (terminal 30 and 50).

⚠ Caution

Please comply with the following tightening torques when tightening the cable connections, in order to avoid damage to the starter terminals or other components.

Terminal 30, $24^{\pm 4}$ Nm

Terminal 50, 1 - 1,3 Nm

To tightly tightened nuts can cause damage to starter components (e.g. cracks in the cover of the magnetic switch). Moisture entering into the starter can cause short circuit - or even cable fire.

Insufficiently tightened nuts can cause cable connections to come loose and thus short circuit - or even cable fire.

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6 Engine

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6.1 Diesel engine

The road finishers of type BF600 are powered by a 4-cylinder Deutz diesel engine type TCD 2013.

The engines are water cooled in-line engines with EMR3 electronics.

The engines are mainly designed in two-valve technology with turbo charging and intercooler. They are highly compact and come with a Deutz-Common-Rail injection system, called DCR in short.

All engines are designed with exhaust gas recirculation and thus reach emission values complying with EPA/ COM/ Tier/ stage lll

These engines are characterized by the following positive features:

- compact design
- low noise level
- almost vibration free operation
- low fuel consumption
- low exhaust emission EPA/COM III
- high power density
- good access to all service points.
- high reliability
- low running costs,
- long lifetime

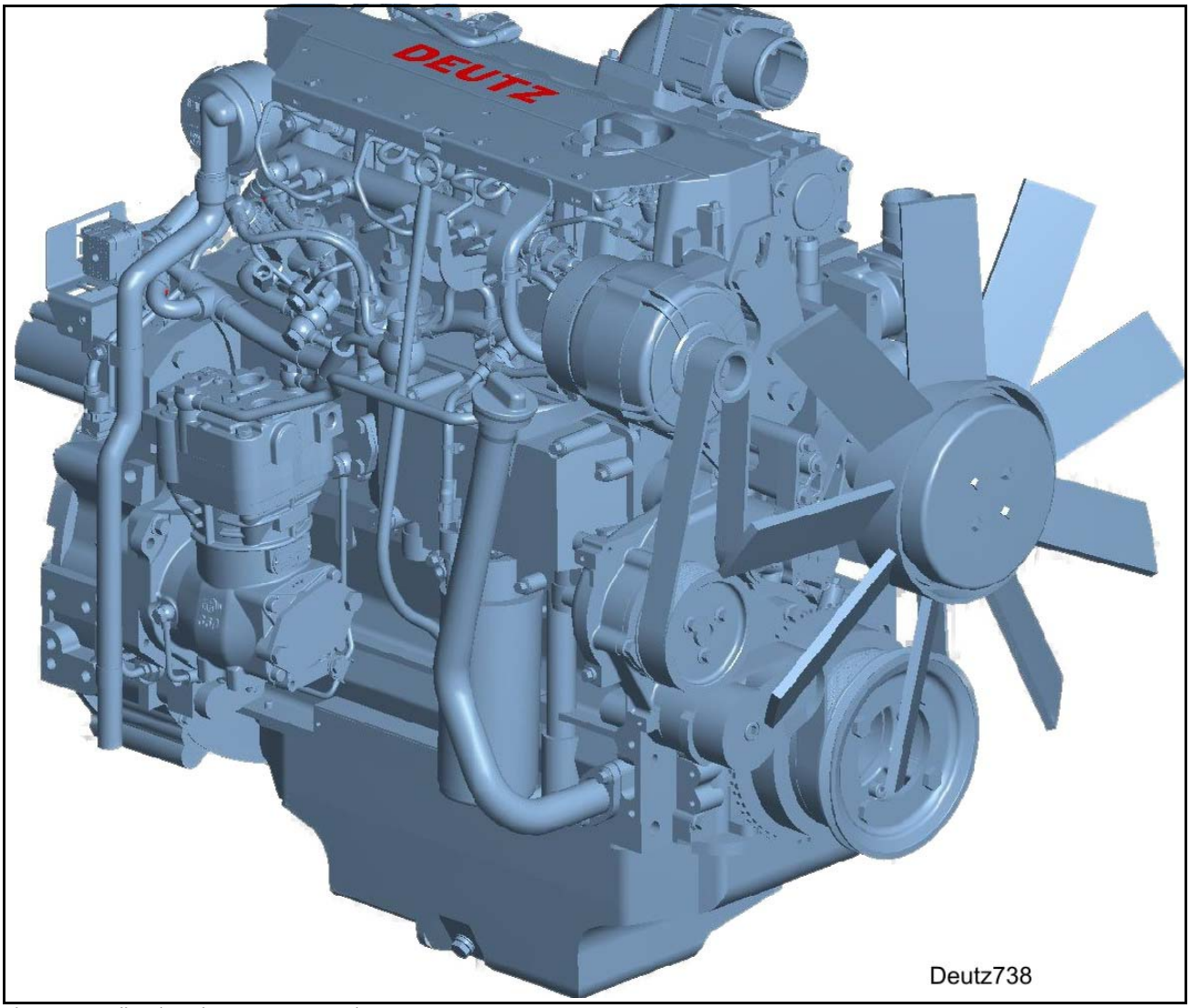


Fig. 1 Deutz diesel engine TCD 2012 and 2013

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6.2 Engine description TCD 2013, 4 and 6 cylinder

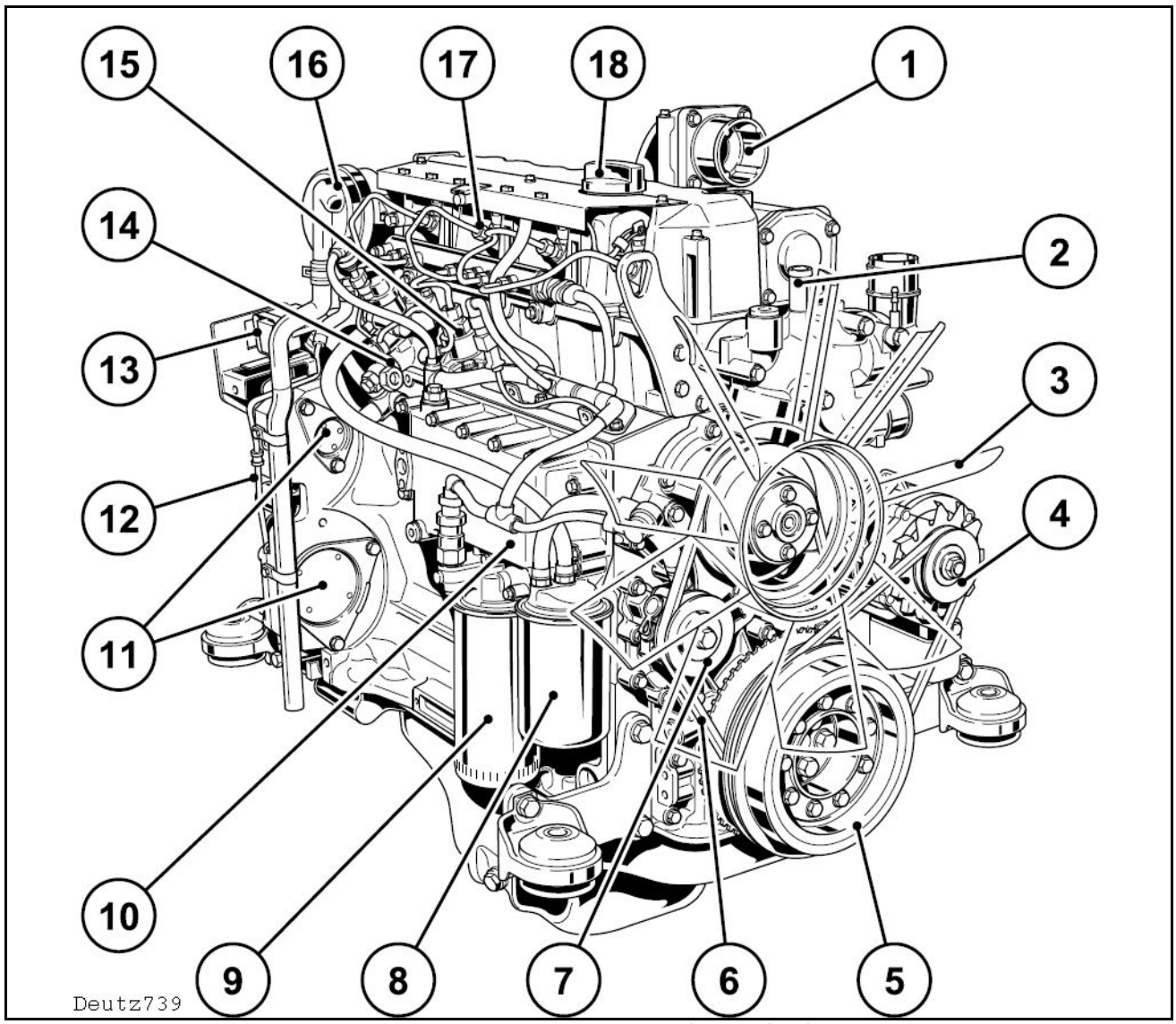


Fig. 1 Deutz diesel engine TCD 2013 L04 2V, right hand side

1 Combustion air inlet (possibility to install a heating flange, optionally)
2 Connection cabin heater ort compensation line
3 Fan
4 Generator
5 Belt pulley on crankshaft
6 V-belt
7 Fuel lift pump drive
8 Fuel filter
9 Replaceable lubrication oil filter
10 Lubrication oil cooler
11 Possible installation of hydraulic pump or compressor (optional)
12 Lubrication oil return line crankcase ventilation
13 Central plug (for engine control)
14 Fuel control unit
15 High pressure pump
16 Crankcase ventilation valve
17 Injector
18 Lubrication oil filling neck

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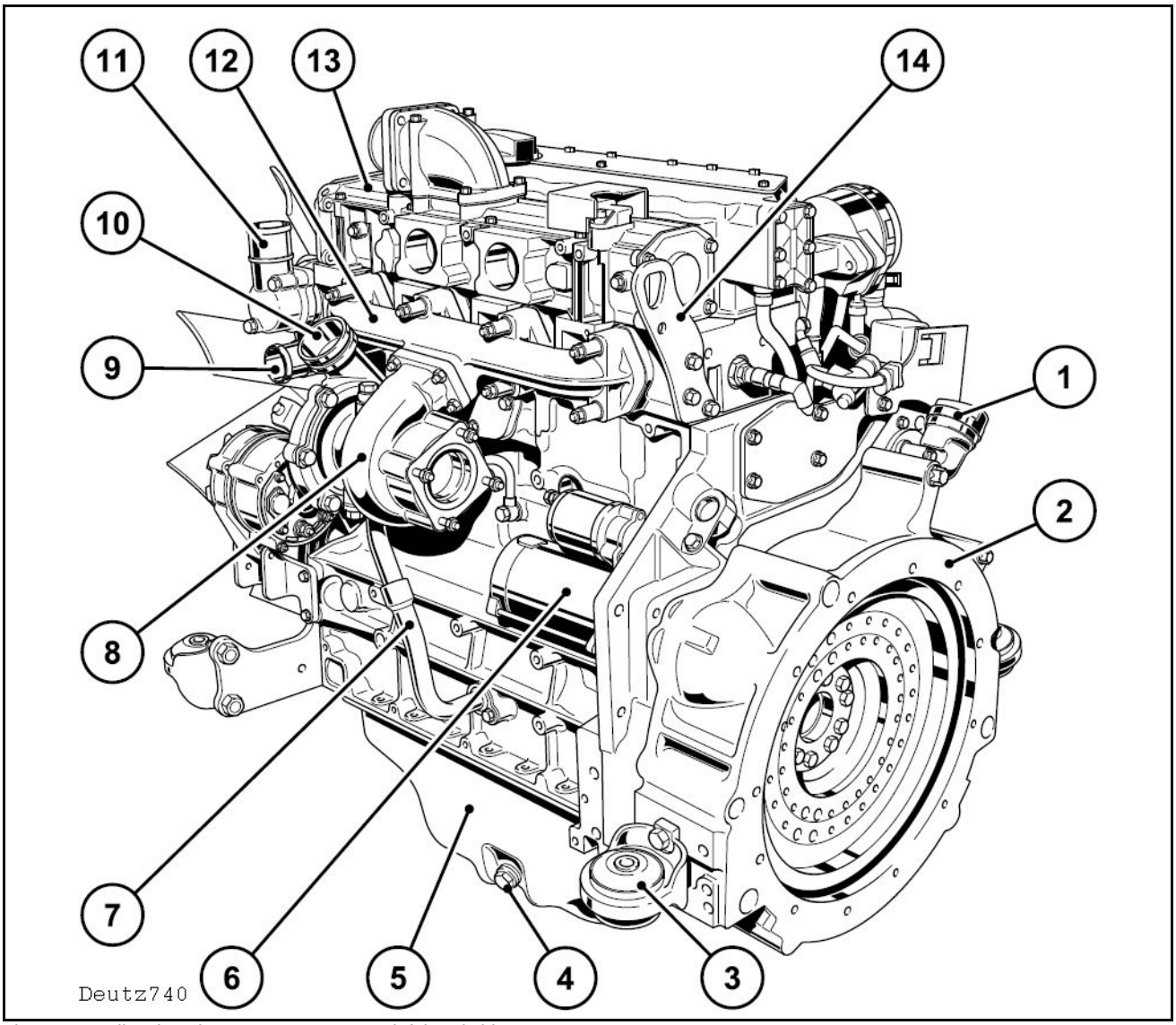


Fig. 2 Deutz diesel engine TCD 2013 L04 V2, left hand side

1 Lubrication oil filling neck (optional)
2 Transmission connection (SAE)
3 Engine mounts
4 Lubrication oil drain plug
5 Lubrication oil sump
6 Starter motor
7 Lubrication oil return line from exhaust gas turbo charger
8 Exhaust turbo charger
9 Coolant inlet
10 Charge air connection to intercooler
11 Coolant outlet
12 Exhaust manifold
13 Charge air line
14 Transport device

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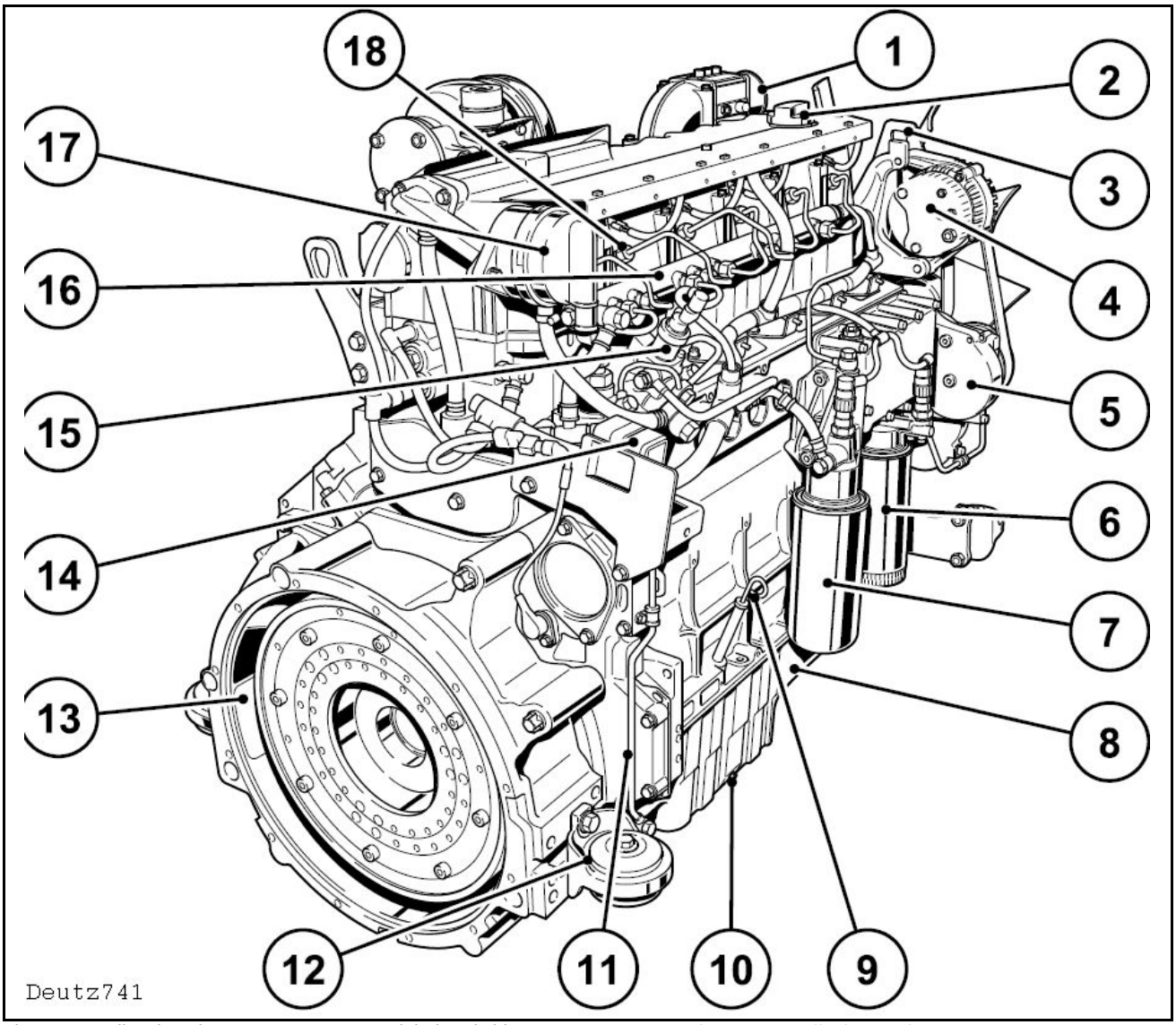


Fig. 3 Deutz diesel engine TCD 2013 L06 2V, right hand side

1 Combustion air inlet
2 Lubrication oil filling neck
3 Transport device
4 Fan hub
5 Generator
6 Replaceable lubrication oil filter
7 Fuel filter
8 Lubrication oil sump
9 Oil dipstick
10 Lubrication oil drain plug
11 Oil return line crankcase ventilation
12 Engine mounts
13 Transmission connection (SAE)
14 Central plug (for engine control)
15 High pressure pump
16 Rail
17 Crankcase ventilation valve
18 Injector

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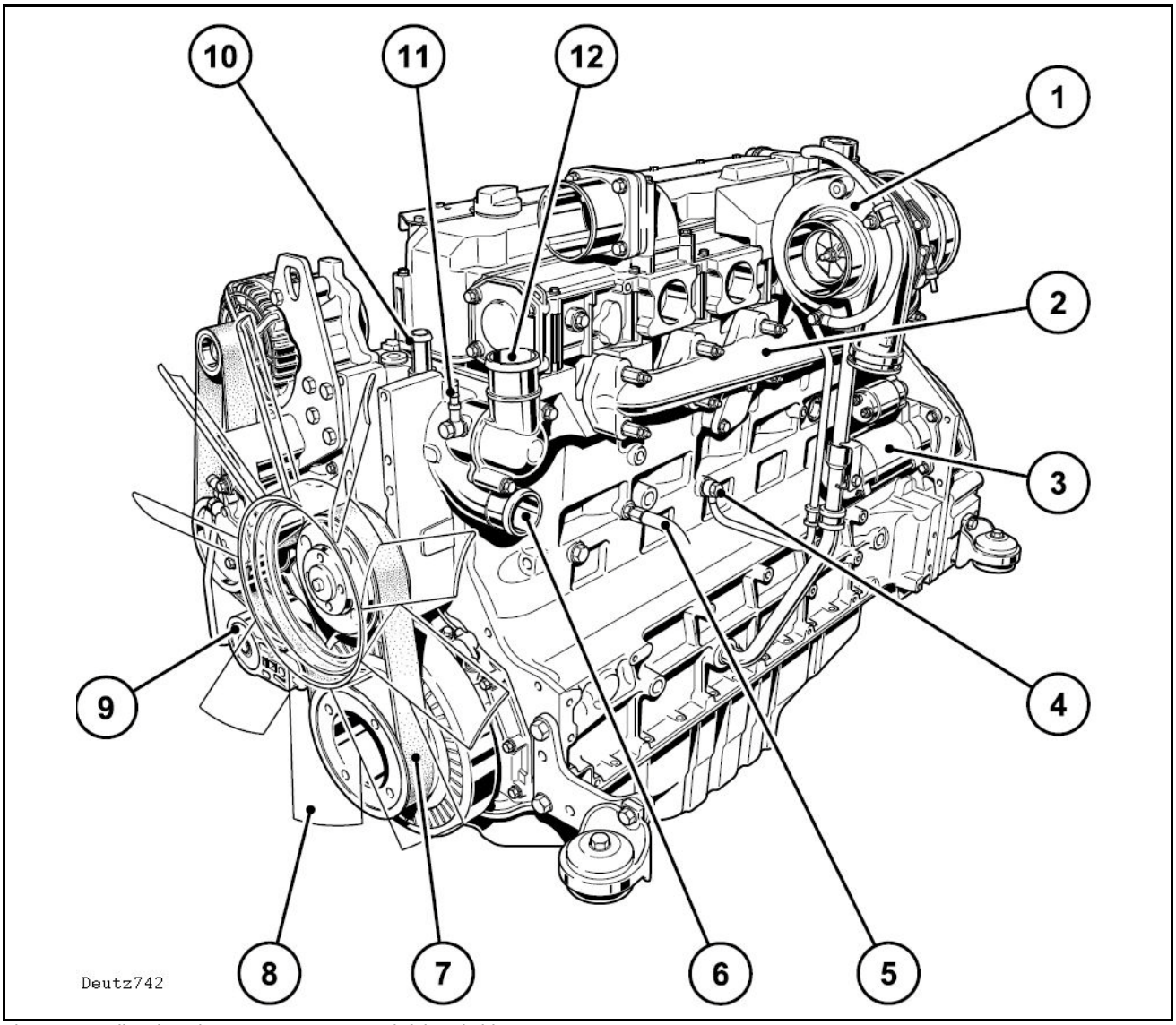


Fig. 4 Deutz diesel engine TCD 2013 L06 2V, left hand side

1 Exhaust turbo charger
2 Exhaust manifold
3 Starter motor
4 Lubrication oil flow to exhaust turbo charger
5 Coolant drain plug
6 Coolant inlet
7 Ribbed V-belt
8 Fan hub
9 Idler pulley
10 Connection cabin heater ort compensation line
11 Ventilation line to compensation tank
12 Coolant line from engine to radiator

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6.3 Lubrication oil circuit TCD 2012 / 2013

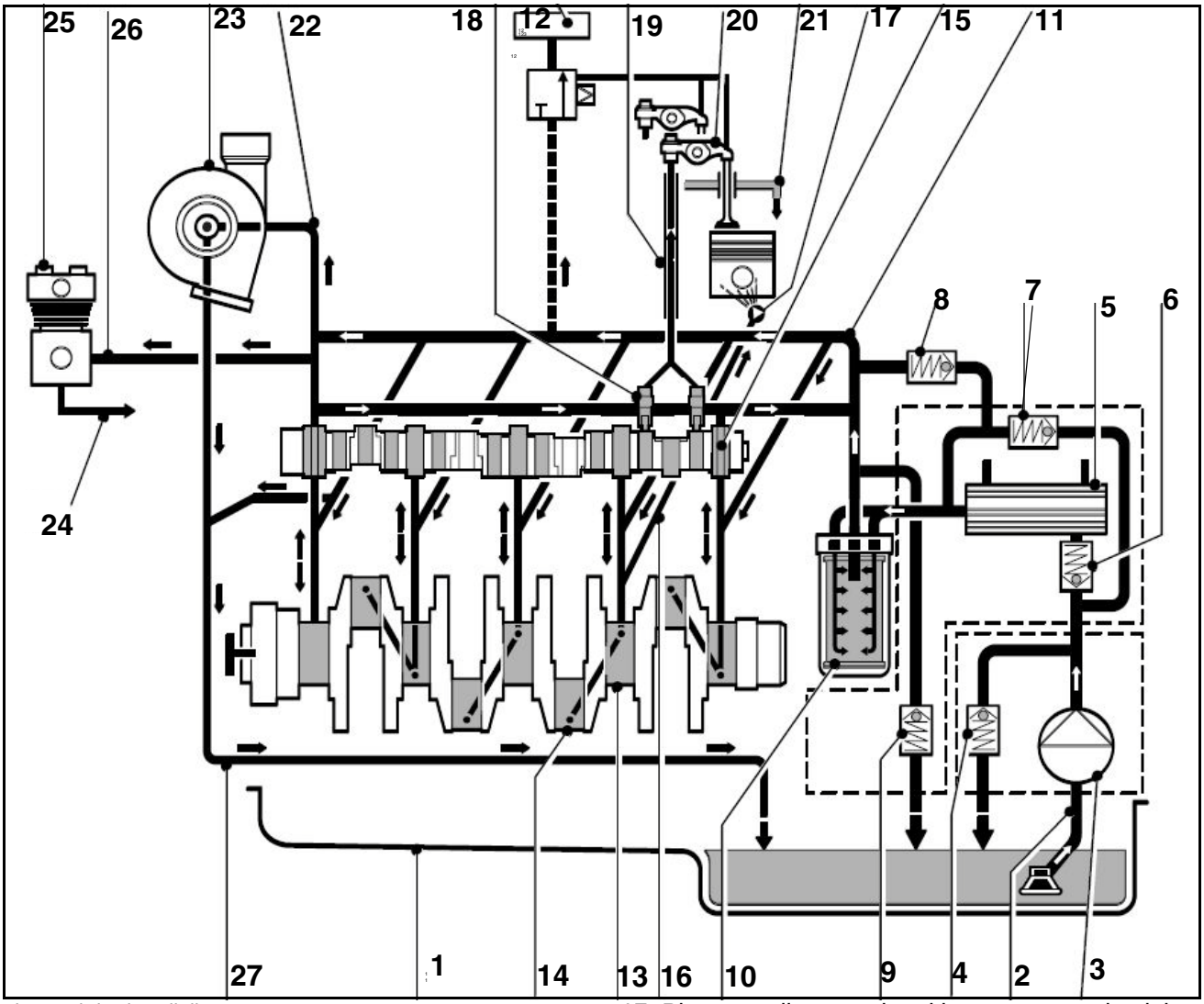


Fig. 1 Lubrication oil diagram

1 Lubrication oil sump
2 Lubrication oil suction pipe
3 Lubrication oil pump
4 Pressure relief valve
5 Lubrication oil cooler
6 Return flow check valve (only on 2012)
7 By-pass valve
8 By-pass valve lubrication oil filter
9 Pressure control valve
10 Replaceable lubrication oil filter
11 Main lubrication oil lines
12 Internally switched exhaust gas recirculation
13 Crankshaft bearings
14 Conrod bearings
15 Camshaft bearings
16 Line to spray nozzle
17 Piston cooling nozzle with pressure maintaining valve
18 Plunger with rocker arm pulse lubrication
19 Push rod, lubrication oil supply for rocker arm lubrication
20 Rocker arm
21 Return line to lubrication oil sump
22 Lubrication oil flow to exhaust turbo charger
23 Exhaust turbo charger
24 Return line from compressor / hydraulic pump to crankcase
25 Compressor or hydraulic pump
26 Lubrication oil line to crankshaft and camshaft, compressor / hydraulic pump
27 Return flow from exhaust turbo charger

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6.4 Coolant circuit TCD 2012 / 2013

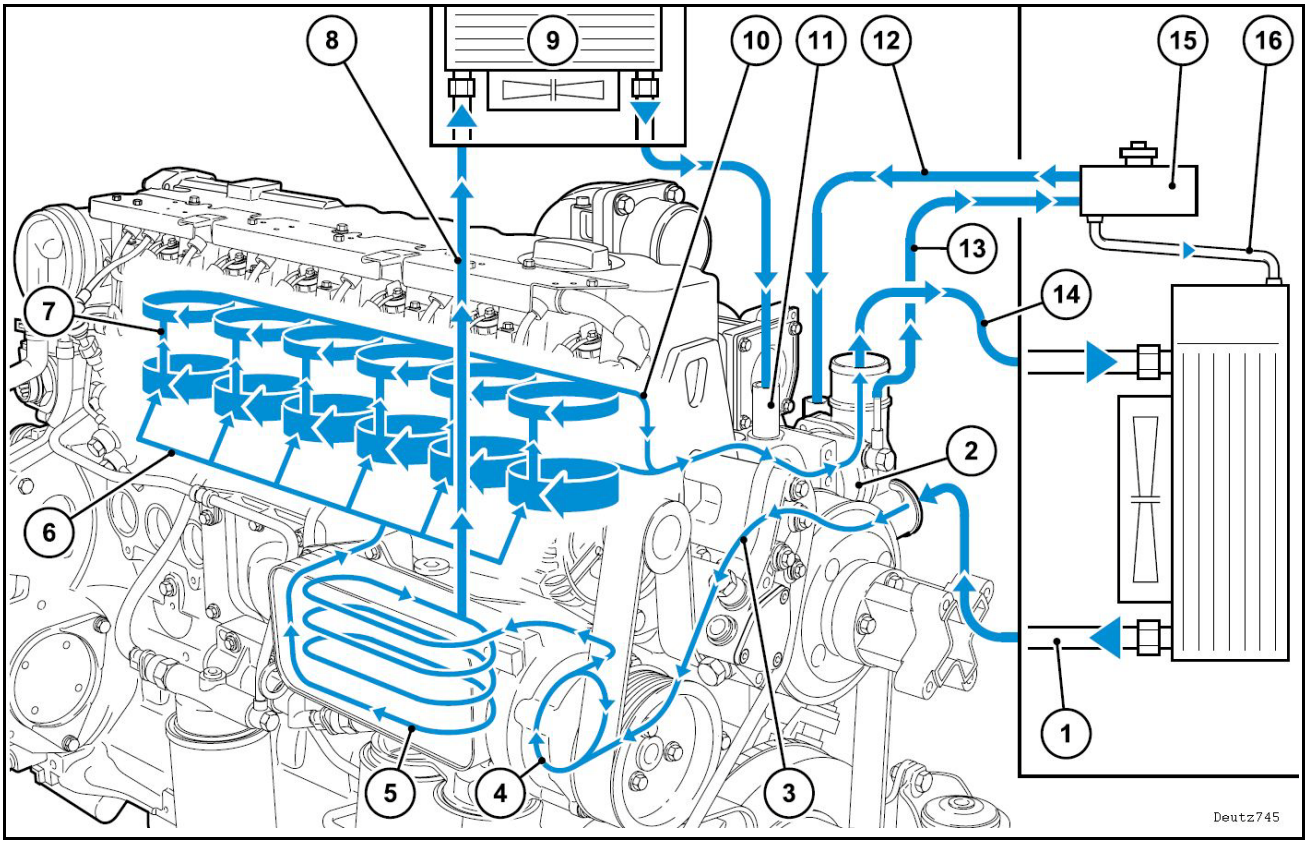


Fig. 1 Fuel diagram

1 Coolant outlet on radiator
2 Thermostat
3 Coolant - supply to water pump
4 Coolant pump
5 Lubrication oil cooler
6 Cylinder cooling
7 Cylinder liner / head cooling
8 Coolant flow to heater
9 Cabin heater (optional)
10 Coolant to thermostat
11 Connection for cabin heater
12 Compensation line
13 Ventilation line to compensation tank
14 Coolant outlet to radiator
15 Compensation tank
16 Compensation line to heat exchanger

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6.5 Fuel system TCD 2012 / 2013

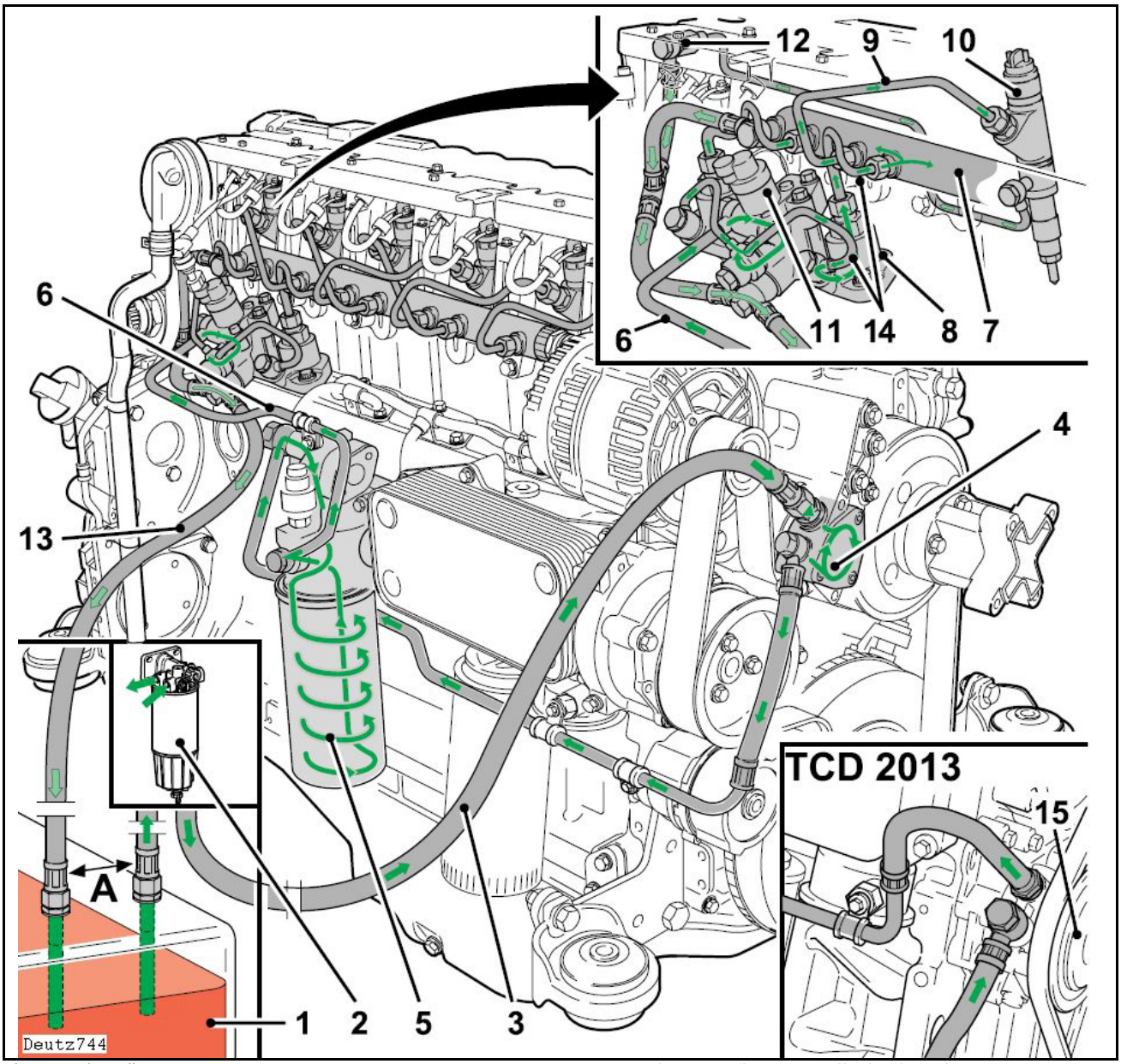


Fig. 1 Coolant diagram

1 Fuel tank A= minimum distance 500 mm
2 Fuel pre-filter with pre-pressure pumping possibility to fill the low pressure section (provided by customer)
3 Line to fuel lift pump
4 Fuel lift pump
5 Fuel filter
6 Fuel supply line to fuel control unit
7 Rail
8 High pressure pump
9 Fuel supply line to injector
10 Injector
11 FCU (Fuel Control Unit)
12 Fuel return flow on cylinder head
13 Fuel return line to fuel tank
14 Fuel lines from fuel control unit to high pressure pumps and Rail
15 Fuel lift pump 2013

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Fuel pre-cleaner

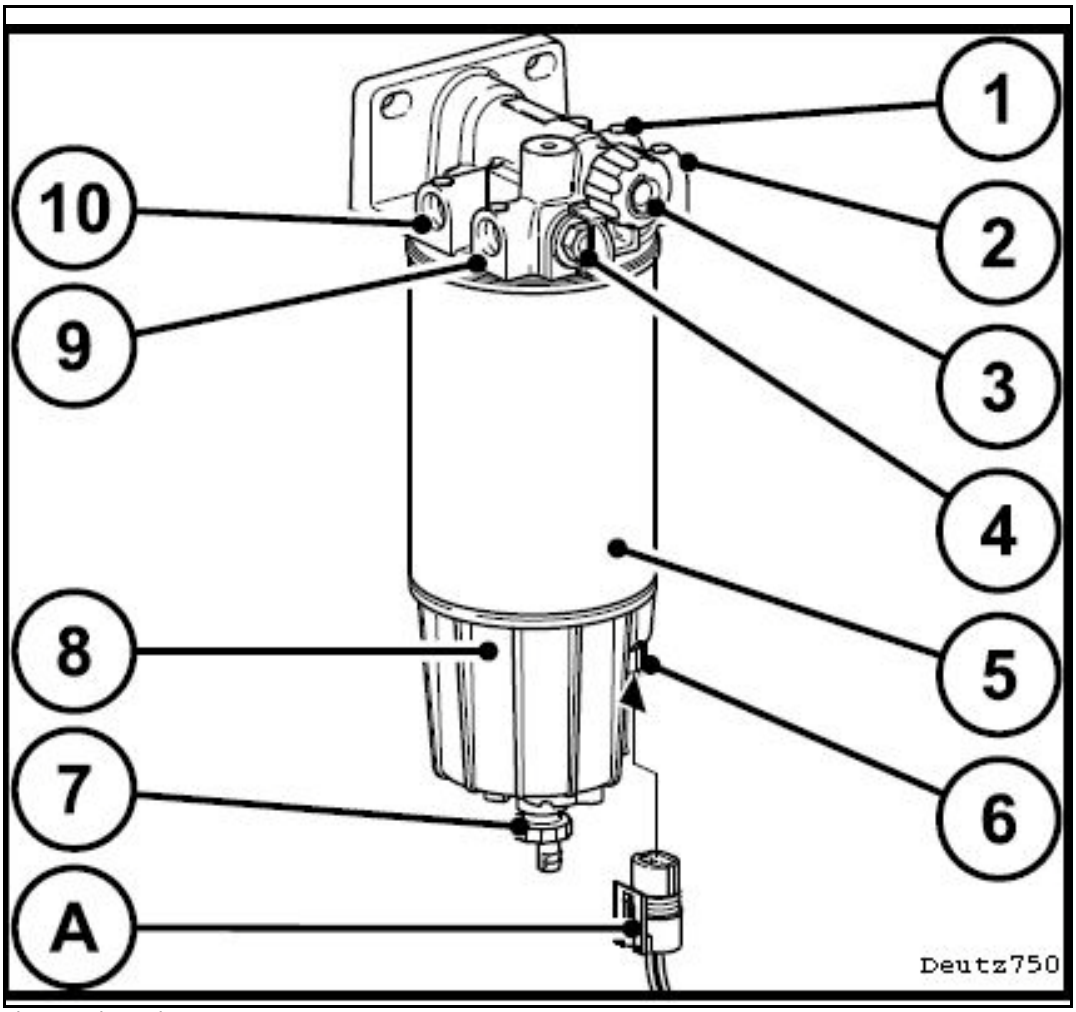


Fig. 2 Fuel pre-cleaner

1 Fuel supply to pump
2 Fuel return flow from FCU (Fuel Control Unit)
3 Manual fuel pump with bayonet lock to lock and unlock
4 Thermostat valve with shut-down lever
5 Filter cartridge
6 Possibility to connect an electric water level sensor
7 Drain tap
8 Water collecting bowl
9 Fuel inlet from fuel tank
10 Fuel return flow to fuel tank
A Electric water level sensor

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6.6 Deutz Common Rail (DCR) injection system for TCD 2012 / 2013

The diesel engines type TCD 2012 and 2013 are equipped with a "Deutz Common Rail" injection system, DCR in short.

The English term "Common Rail" indicates that the system is based on a common Rail. It describes the use of a common high pressure fuel line with corresponding branches to supply all cylinders with fuel.

The "Common Rail" injection is an injection system for combustion engines, in which a high pressure pump pressurizes the fuel to a high pressure level. The pressurized fuel fills a piping system, which is permanently under pressure while the engine is running.

The general idea is the total isolation of the pressure generation from the actual injection process. An injection solely controlled by mapping is only possible under this condition. Injection timing and injection quantity are controlled by the engine electronics. The electric signals control an electrically operated valve per cylinder, which is integrated in the injection nozzle. The short distances between valve and injection nozzle result in short pressure rise times, which has a positive effect on the combustion process and its control. Various types of injection van be realized, e.g. pre-injection, main injection and post-injection. These are freely controllable, in dependence on the control unit.

The electric control is accomplished by the electronic control unit (EDC16) with EMR3, in dependence on the operating parameters. The system is capable of providing a wide range of limp-home functions, should any of the sensors fail. This ensures a reliable and safe completion of travel and work.

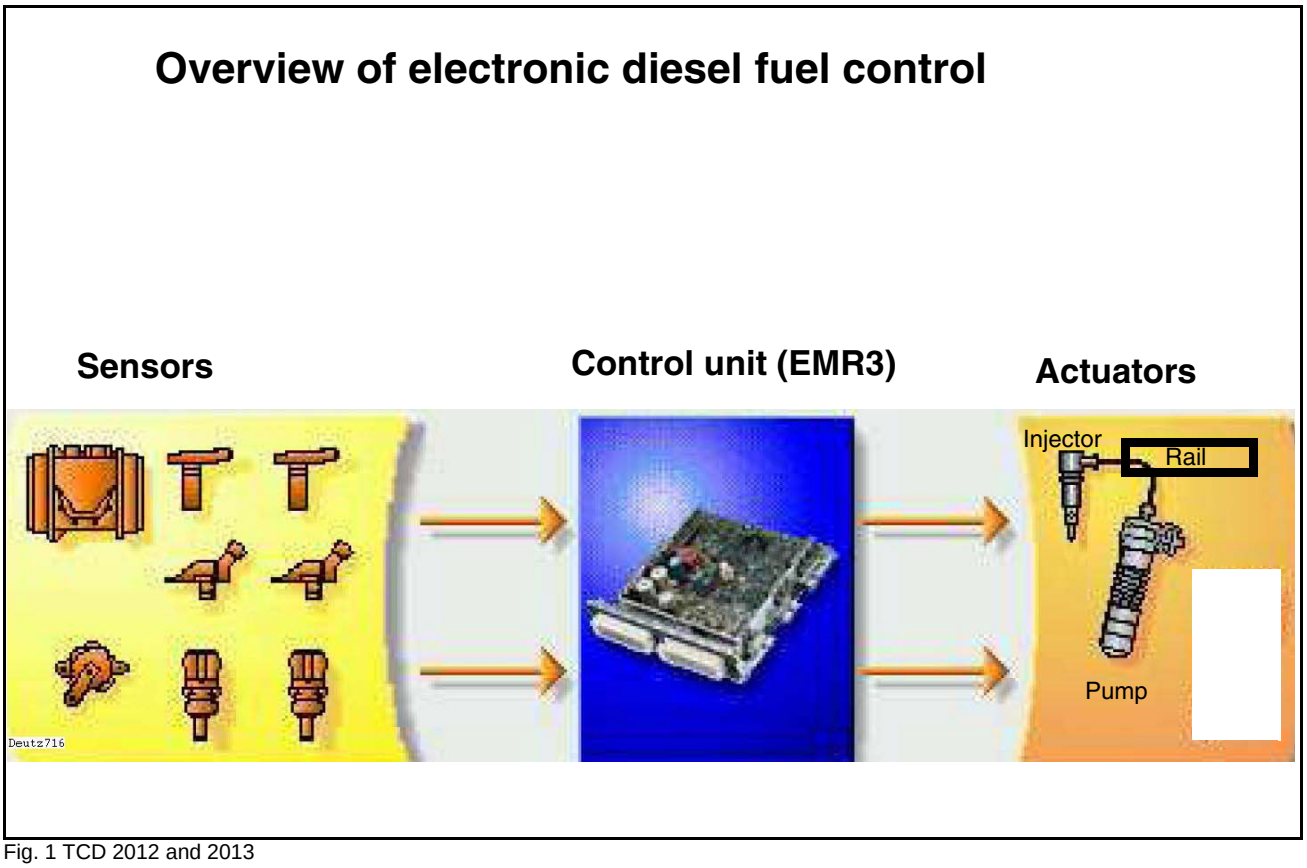


Fig. 1 TCD 2012 and 2013

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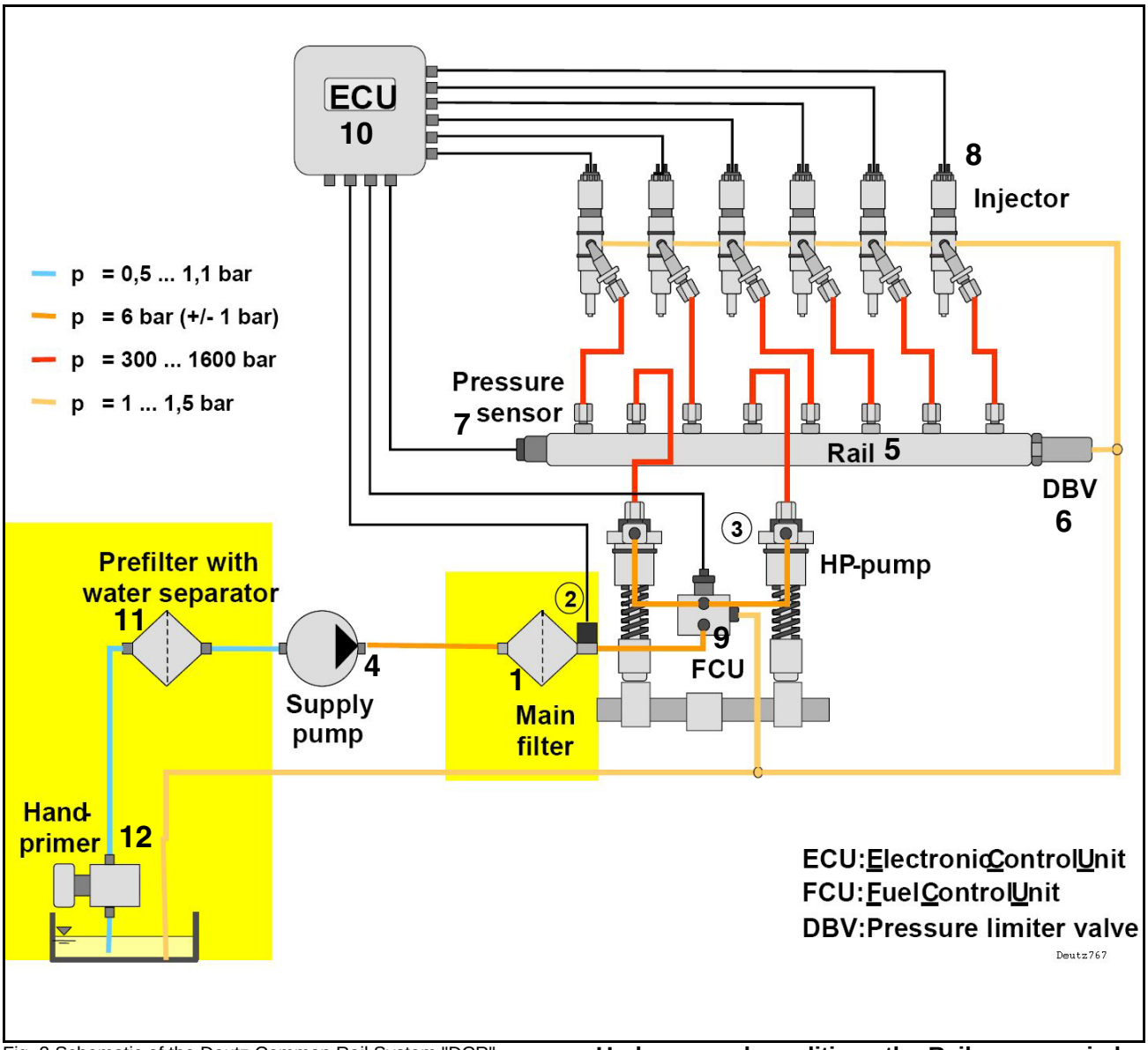


Fig. 2 Schematic of the Deutz Common Rail System "DCR"

1 Fuel filter high pressure
2 Fuel low pressure sensor (5-7bar)
3 High pressure pumps
4 Fuel lift pump
5 Rail (high pressure pipe up to 1600 bar)
6 PRV (max. Rail pressure limitation 1600bar)
7 Rail pressure sensor
8 Injectors
9 FCU Fuel Control Unit
10 Engine control EDC16 - EMR3
11 Fuel pre-filter with water separator
12 Hand pump

Under normal conditions the Rail pressure is between 300 and 1350 bar

The PRV is set to 1600 bar

If the PRV is defective or always open, the pressure in the Rail will only build up to max. 700 bar.

The Rail pressure must be at least 1.5 bar to start the diesel engine

The fuel low pressure sensor is located after the fuel filter and the pressure is normally between 5 and 7 bar.

The solenoid valve of the Fuel Control Unit (FCU) is dead, open towards the tank.

The voltage applied to the injectors is normally approx. 40 V.

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FCU Fuel Control Unit

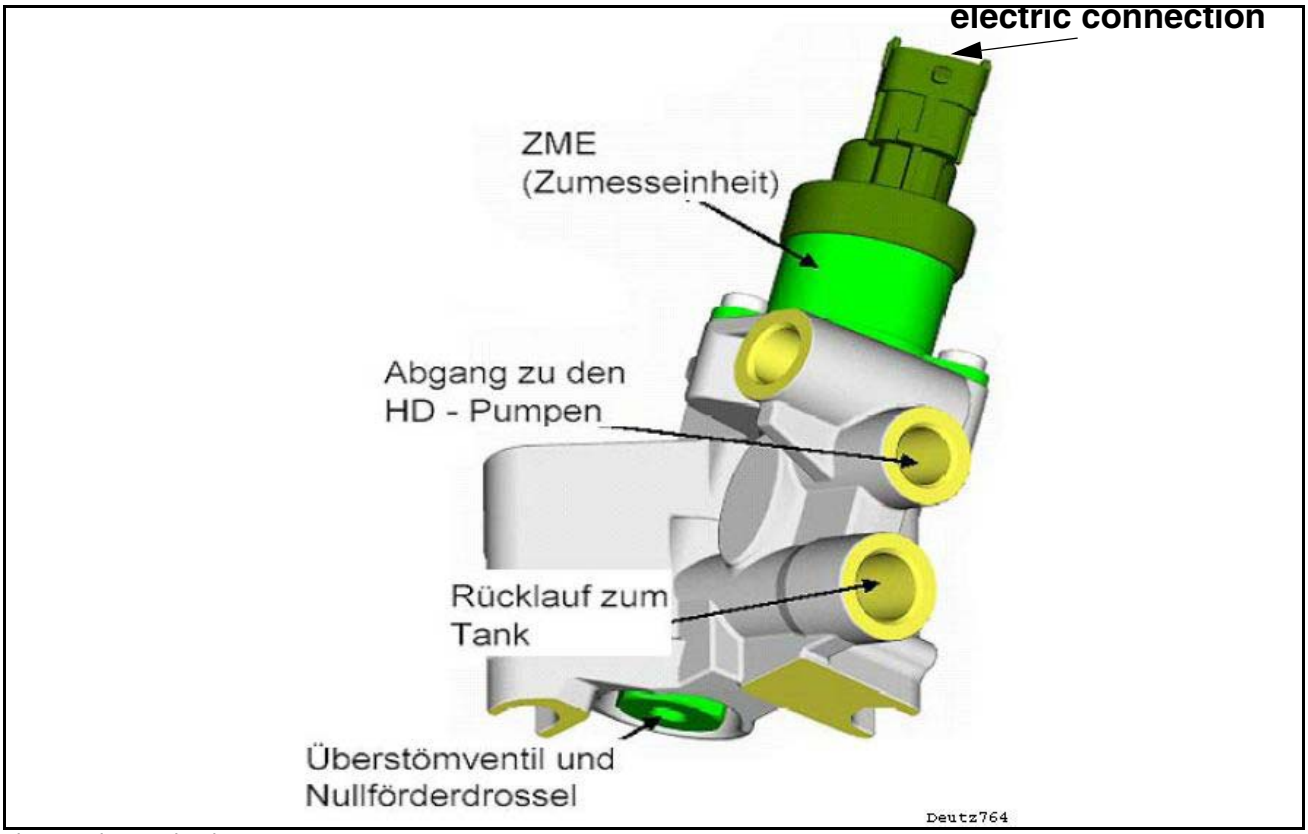


Fig. 3 Fuel Control Unit FCU

Two high pressure pumps

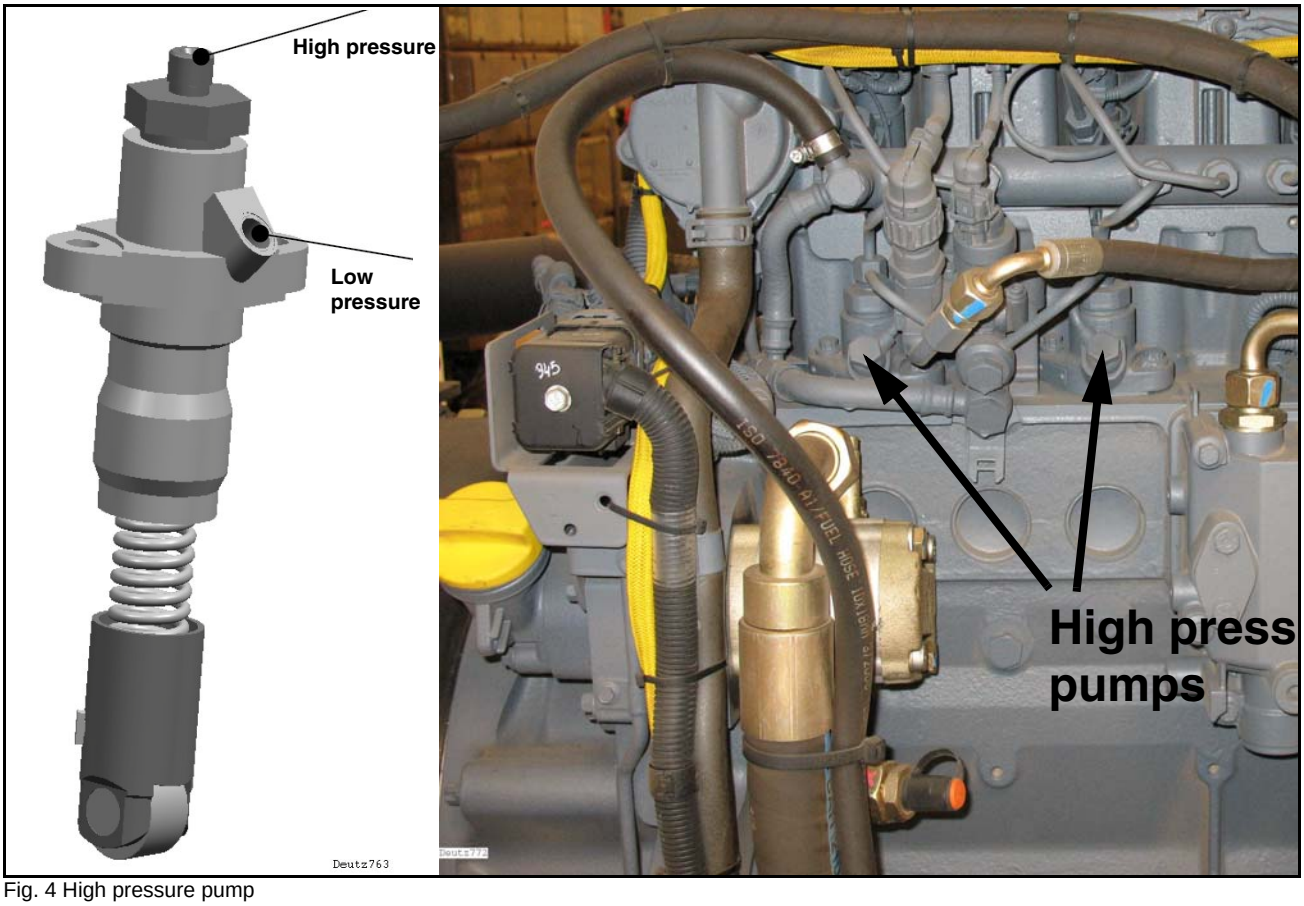


Fig. 4 High pressure pump

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Injector)

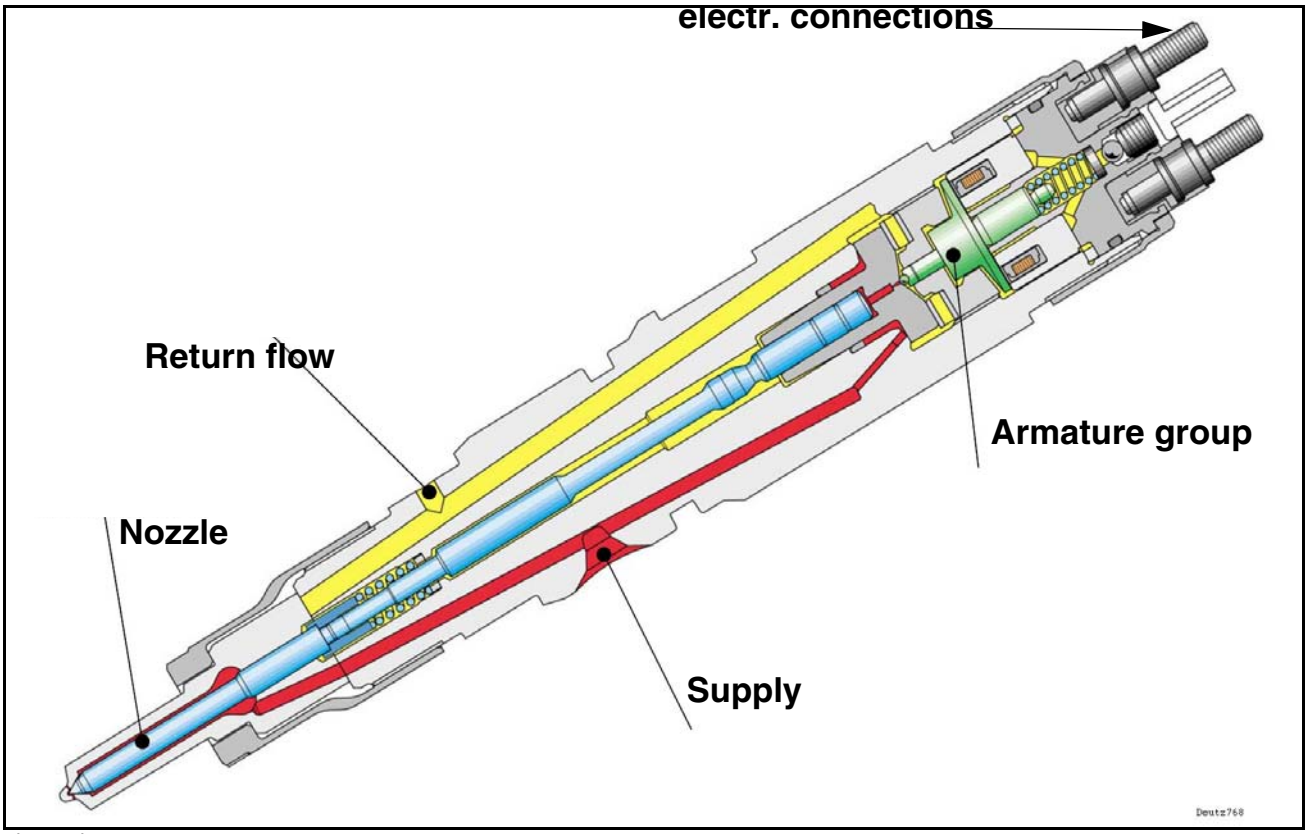


Fig. 5 Injector

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6.7 Exhaust gas recirculation TCD 2012 / 2013

In order to be able to meet the exhaust gas standards EC and stage/Tier3, all engines are designed with exhaust gas recirculation.

On 4-cylinder 2-valve engines TCD 2012/2013 the exhaust gas recirculation has been realized internally through the intake valves, on 6-cylinder 2-valve engines through the exhaust valves. For this purpose the camshaft has been manufactured with an additional cam for short-term opening of the intake valve or exhaust valve respectively.

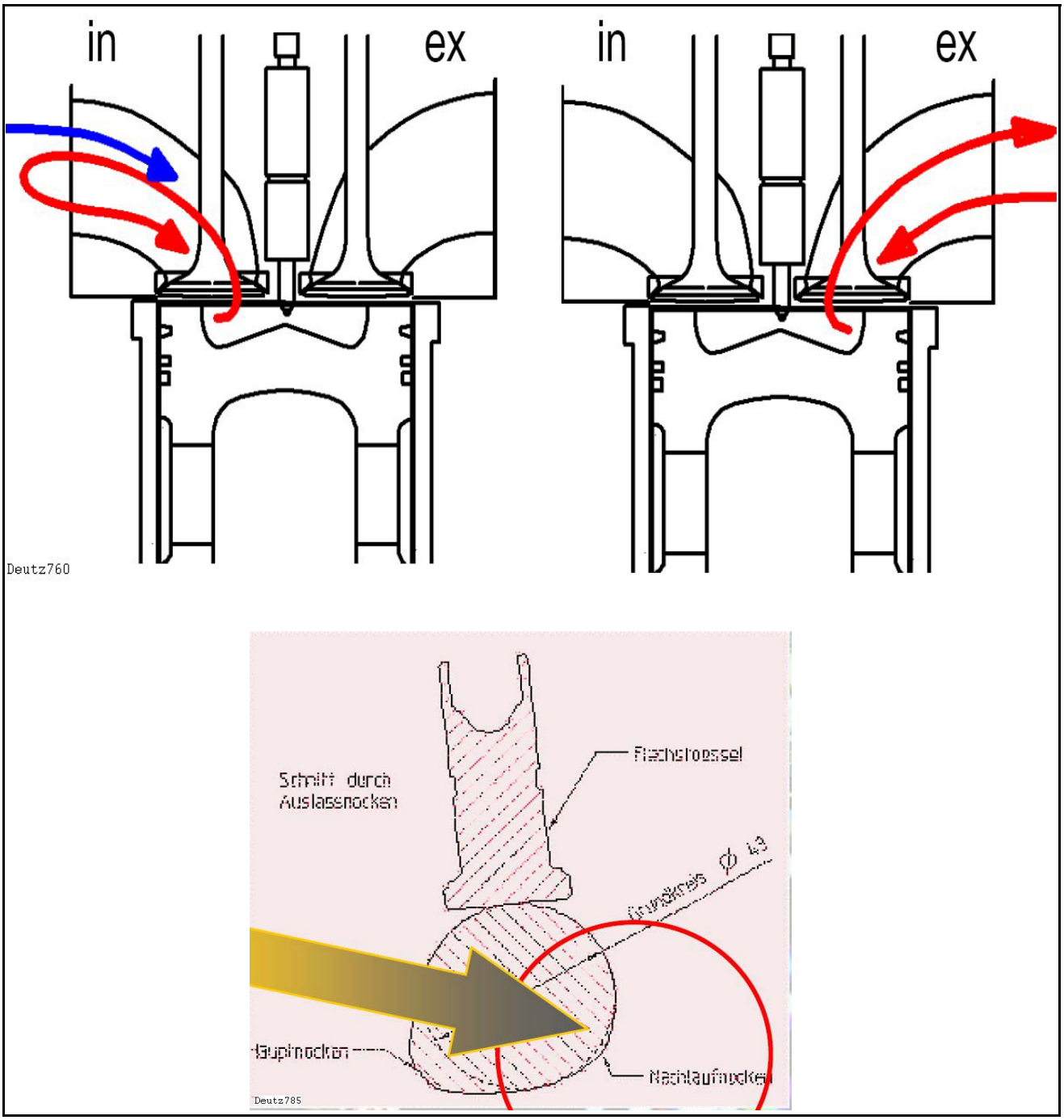


Fig. 1 Exhaust/intake valve control TCD 2012 / 2013

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6.8 Wastegate - charge pressure controller on TCD-engines

The Wastegate is a exhaust gas bypass valve and is located on or in the exhaust turbocharger

The Wastegate (exhaust gas bypass valve) is used to control the charge pressure

The charge pressure control takes place by means of a charge pressure triggered pressure valve in connection with the exhaust gas bypass valve. Depending on this bypass valve hot exhaust gases flow past the exhaust gas turbine into the exhaust without the available energy being utilized

The bypass valve is normally closed

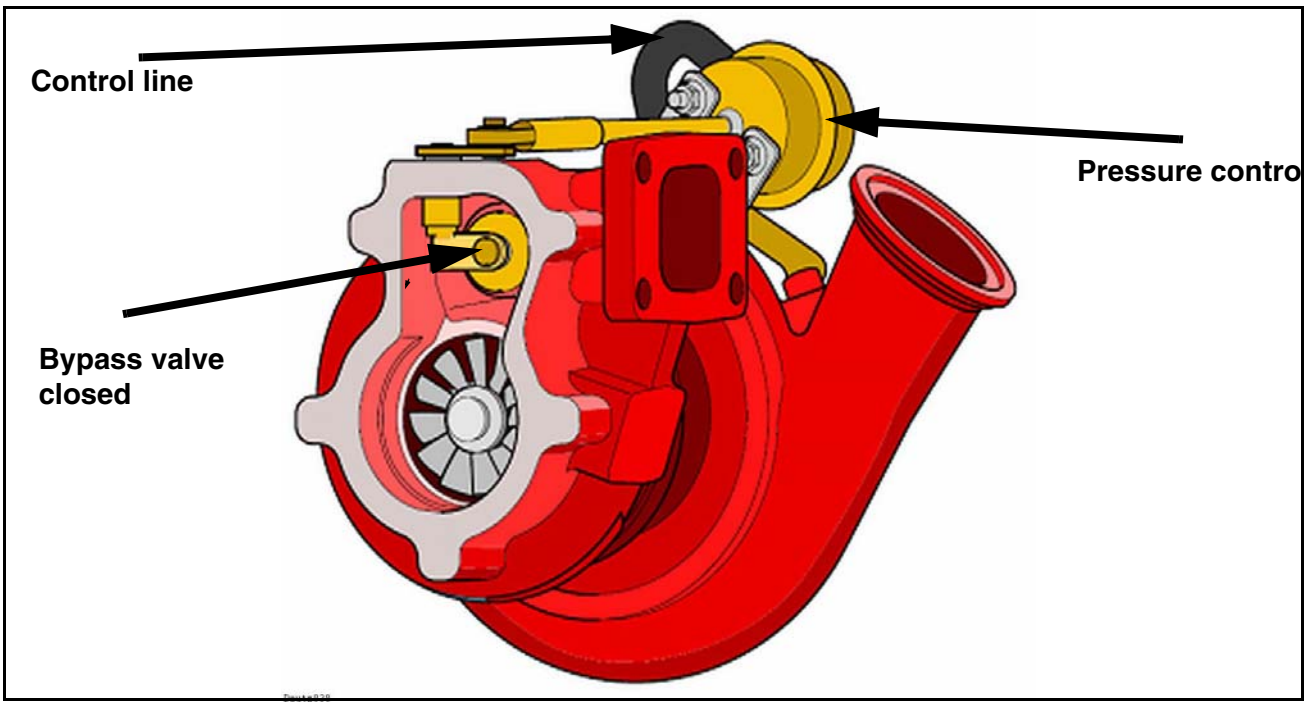


Fig. 1 Exhaust gas turbocharger with Wastegate

Wastegate active, charge pressure control, i.e. bypass valve open

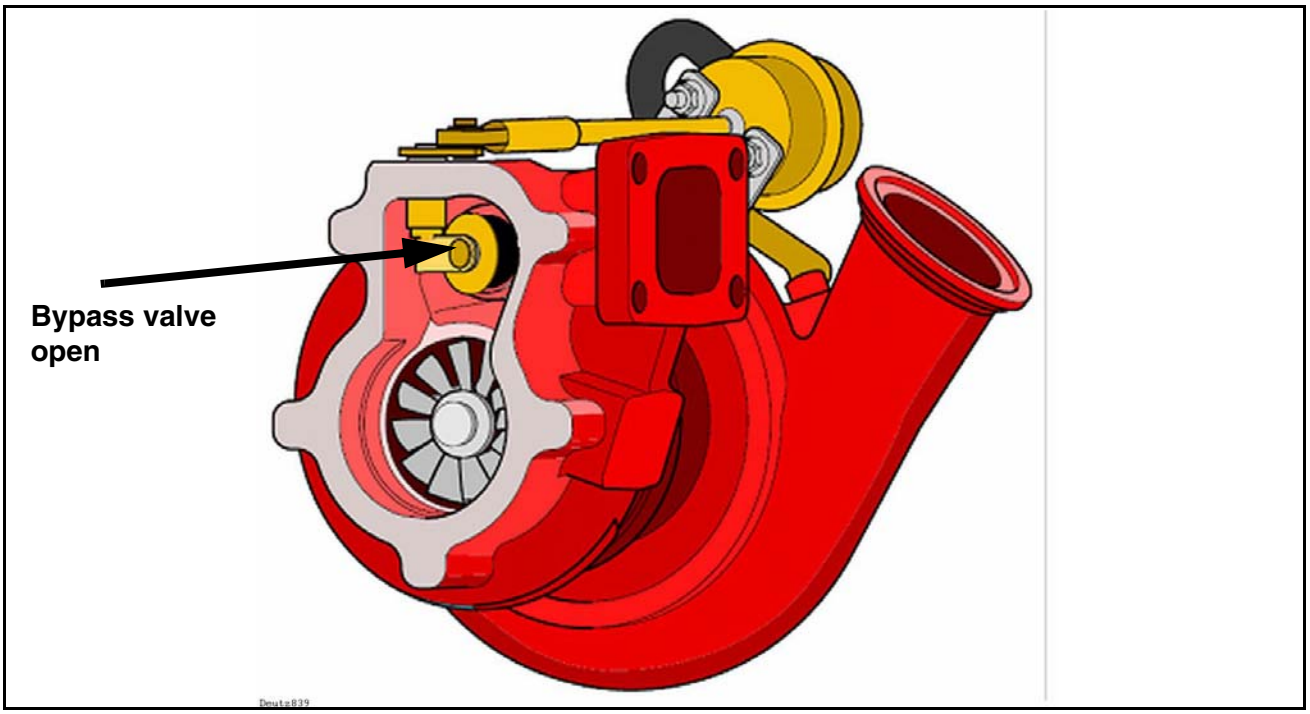


Fig. 1 Exhaust gas turbocharger with Wastegate

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Wastegate on TCD 2013

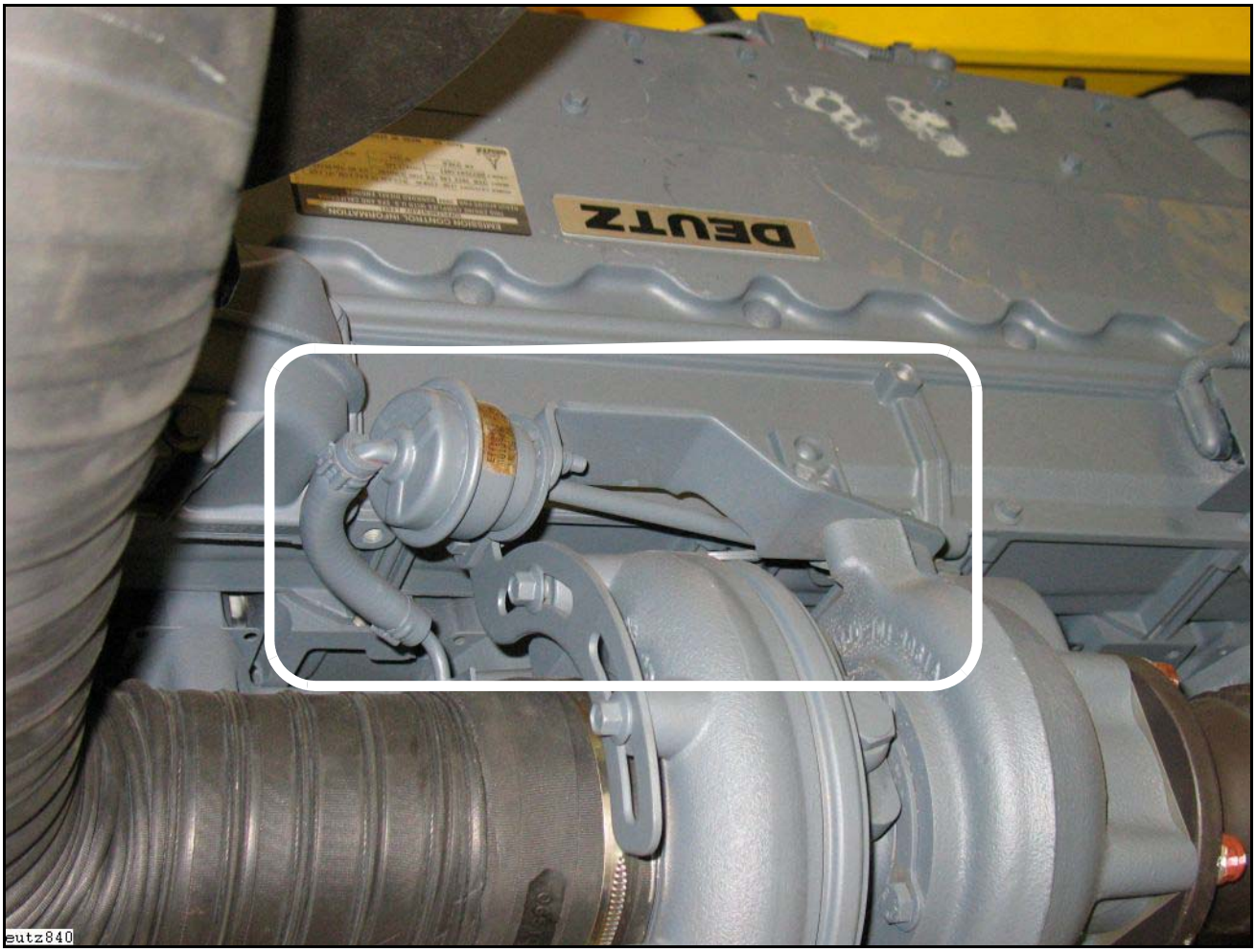


Fig. 2 Exhaust gas turbocharger with Wastegate

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6.9 Engine problems

Fault	Possible cause	Remedy
Engine does not start or starts poorly	Temperature below starting limit	Check
	Oil level too low	Fill up lubrication oil
	Lubrication oil level too high	Check the lubrication oil level, drain off if necessary
	Lubrication oil cooler defective	Check
	Exhaust gas counter pressure too high	Check
	V-belt/ribbed V-belt (fuel pump in belt drive)	check, whether torn or loose
	Engine oil with wrong SAE viscosity class	Change the lubrication oil
	Fuel quality not as specified in the operating instructions	Change the fuel
	Air in the fuel system	Bleed the fuel system
	Battery defective or not charged	Check the battery
	Cable to starter loose or oxidized	Check cable connection
	Starter defective or pinion does not engage	Check starter
Engine does not start and diagnostic lamp flashing	Engine electronics prevent starting	Check fault by fault code, repair as necessary
Engine starts, but runs irregularly or misfires	V-belt/ribbed V-belt (fuel pump in belt drive)	check, whether torn or loose
	Incorrect valve clearance	Adjust
	Injector defective	Replace
	Injection valve defective	Check / replace the injection valve
	Glow plug defective	Replace
	Air in the fuel system	Bleed the fuel system
	Fuel pre-cleaner soiled	Clean/replace
	Fuel quality not as specified in the operating instructions	Change the fuel
	Injection line leaking	Check the injection line
Speed changes are possible and diagnostic lamp lights	Engine electronics detected a system fault and activates a substitute speed	Check fault by fault code, repair as necessary

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Fault	Possible cause	Remedy
Engine overheating, temperature warning system responds	Bleeding line clogged	Clean ventilation line
	Injector defective	Replace
	Coolant heat exchanger soiled	Clean
	Coolant pump defective (V-belt torn or loose)	check, whether torn or loose
	Lack of coolant	Fill up
	Charge air pipe leaking	Check the charge air pipe
	V-belt/ribbed V-belt (fuel pump in belt drive)	check, whether torn or loose
	Lubrication oil filter soiled	Replace
	Lubrication oil level too low	Fill up lubrication oil
	Lubrication oil level too high	Check the lubrication oil level, drain off if necessary
	Air filter clogged / exhaust turbocharger defective	Check/replace
	Fan defective / V-belt torn or loose	Check fan / V-belt, replace if necessary
	Short circuit of heat in cooling system	Check the cooling system
	Resistance in cooling system too high / flow quantity too low	Check the cooling system
Engine has to low or no oil pressure	Lubrication oil level too low	Fill up lubrication oil
	Engine oil with wrong SAE viscosity class	Change the lubrication oil
Insufficient engine power	Engine oil level too high	Drain the engine oil down to the top dipstick mark
	Fuel quality not as specified in the operating instructions	Change the fuel
	Air filter clogged / exhaust turbocharger defective	Check/replace
	Charge air pipe leaking	Check the charge air pipe
	Intercooler soiled	Clean
	Injection line leaking	Check the injection line
	Injector defective	Replace
	Injection valve defective	Check the injection valve
Insufficient engine power and diagnostic lamp lights	Engine electronics reduces the power	Check fault by fault code, repair as necessary
Engine does not work with all cylinders	Injection line leaking	Check the injection line
	Injection valve defective	Check / replace the injection valve

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Fault	Possible cause	Remedy
Engine has excessive oil consumption	Lubrication oil level too high	Check the lubrication oil level, drain off if necessary
Blue engine exhaust smoke	Lubrication oil level too high	Check the lubrication oil level, drain off if necessary
White engine exhaust smoke	Temperature below starting limit	Check
	Fuel quality not as specified in the operating instructions	Change the fuel
	Injection valve defective	Check/replace
Black engine exhaust smoke	Air filter clogged / exhaust turbocharger defective	Check/replace
	Charge air pipe leaking	Check charge air line
	Injection valve defective	Check / replace the injection valve
	Injector defective	Replace

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6.10 Check the engine oil level

⚠ Danger

Danger of injury!

Support the engine hood for all maintenance and repair work.

⚠ Caution

The machine must be in horizontal position.

If the engine is warm, shut it down and check the oil level after five minutes.

With a cold engine the oil level can be checked immediately.

For quality of oil refer to the "table of fuels and lubricants".

- Open the engine hood.

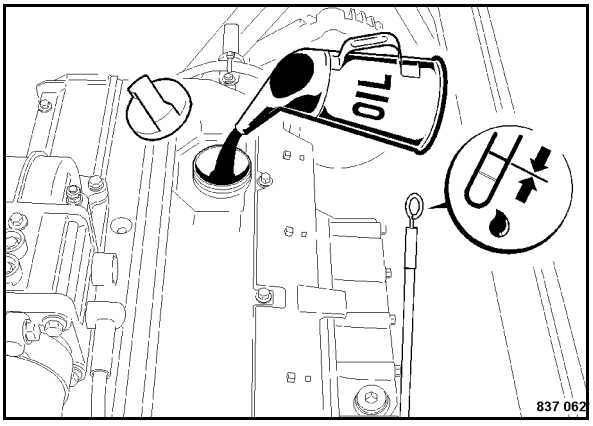


Fig. 3

- Pull the dipstick (Fig. 3) out, wipe it off with a lint-free, clean cloth and reinsert it until it bottoms.
- Pull the dipstick back out.
- The oil level must always be between the "MIN"- and "MAX"-marks. If the oil level is too low, top up oil to the "MAX" mark immediately.

6.11 Changing engine oil and oil filter cartridge

⚠ Danger

Danger of scalding!

When draining off hot oil.

By hot oil when unscrewing the engine oil filter.

⚠ Caution

Drain the oil only when the engine is warm.

For quality and quantity of oil refer to the "table of fuels and lubricants".

Environment

Catch running out oil and dispose of environmentally together with the oil filter cartridge.

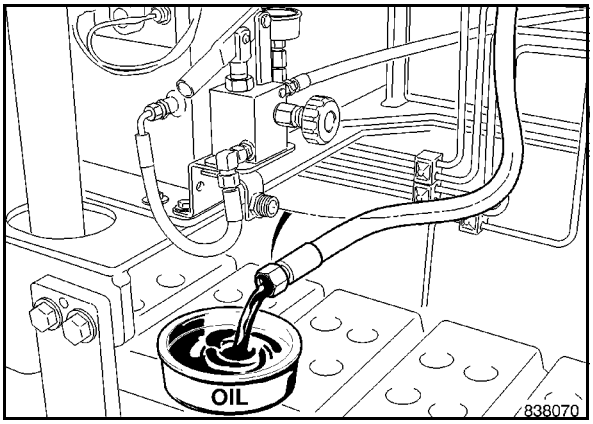


Fig. 4

- Unscrew the drain hose (Fig. 4) and catch running out oil.
- Fasten the drain hose again in place.

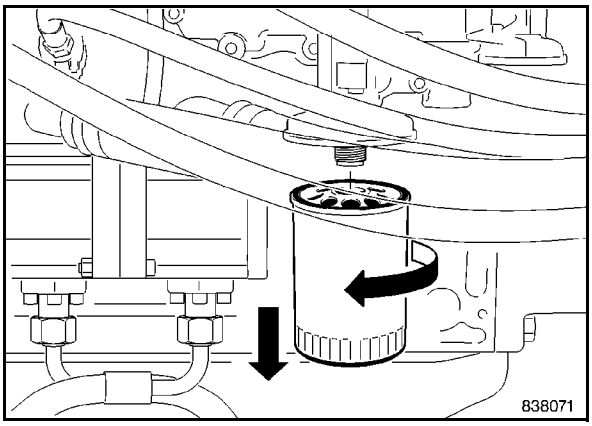


Fig. 5

- Thoroughly clean the outside of the filter cartridge (Fig. 5).
- Unscrew the filter cartridge using an appropriate filter wrench.

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- Clean the sealing face on the filter carrier from any dirt.
- Slightly oil the rubber seal on the new filter cartridge.

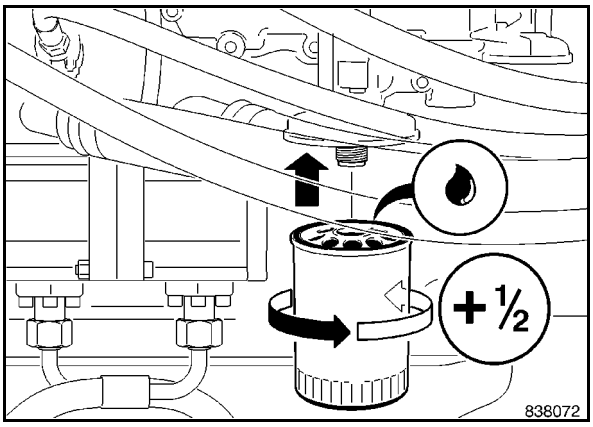


Fig. 6

- Turn the new filter cartridge (Fig. 6) on by hand, until the seal contacts.
- Tighten the filter element for another half turn.

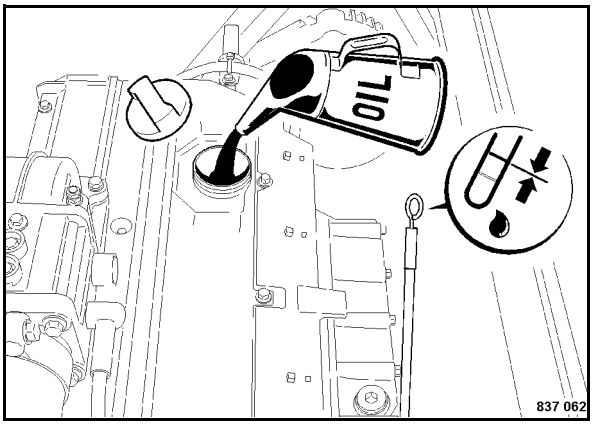


Fig. 7

- Fill in new engine oil (Fig. 7).
- Tighten the oil filler cap properly.
- After a short test run check the oil level on the dipstick . The oil level should reach the MAX-mark, top up oil if necessary.
- Check filter cartridge and drain hose for leaks.

6.12 Replace the fuel filter cartridges.

⚠ Danger

Fire hazard!

When working on the fuel system do not use open fire, do not smoke and do not spill any fuel.

⚠ Danger

Health hazard!

Do not inhale any fuel fumes.

⚠ Caution

Ensure strict cleanliness! Thoroughly clean the area around the fuel filters.

After work on the fuel system bleed the system, perform a test run and check for leaks.

Additional bleeding of the fuel system by a 5 minute test run in idle speed or low load is mandatory.

Environment

Any fuel must be caught and disposed of in an environmentally friendly manner.

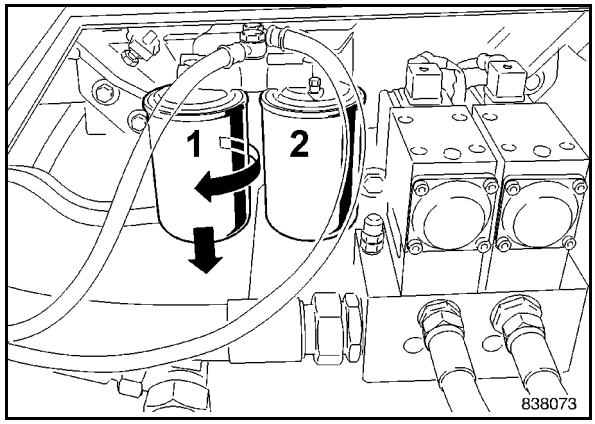


Fig. 8

- Loosen both fuel filters (Fig. 8) using a suitable filter wrench and screw it off.
- Clean the sealing face on the filter carriers from any dirt.

⚠ Caution

Filter cartridges must never be filled beforehand.

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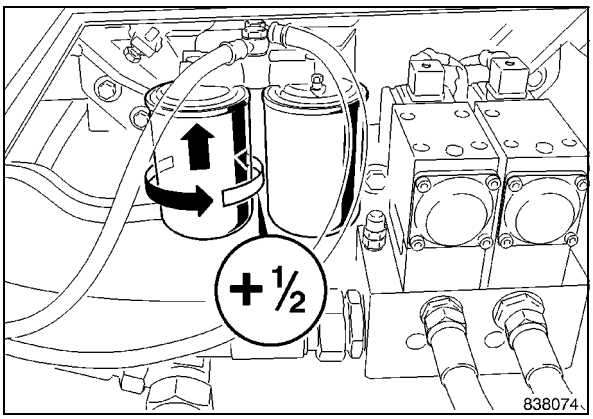


Fig. 9

- Slightly oil the rubber seal on the new filter cartridges (Fig. 9).
- Turn the new filter cartridges on by hand, until the seal contacts.
- Then tighten hand-tight.
- Always bleed the fuel system after changing the fuel pre-filter cartridge (see next chapter).
- Check for leaks after a short test run.

6.13 Changing the fuel filter, bleeding the fuel system

⚠ Danger

Fire hazard!

When working on the fuel system do not use open fire, do not smoke and do not spill any fuel.

⚠ Danger

Health hazard!

Do not inhale any fuel fumes.

⚠ Caution

Ensure strict cleanliness! Thoroughly clean the area around the fuel filters.

After work on the fuel system bleed the system, perform a test run and check for leaks.

Additional bleeding of the fuel system by a 5 minute test run in idle speed or low load is mandatory.

Environment

Any fuel must be caught and disposed of in an environmentally friendly manner.

Replace the fuel filter cartridge

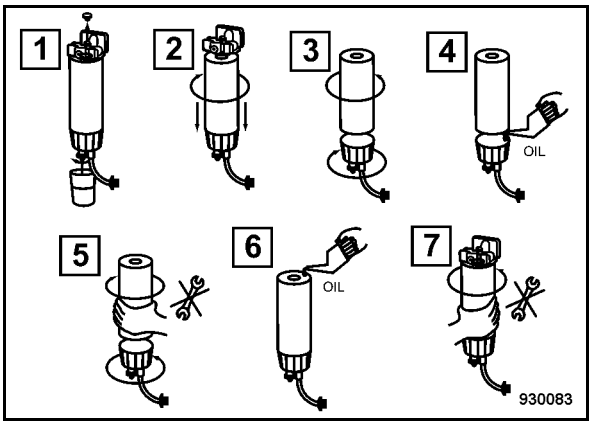


Fig. 10

- Tighten the cable on the water separator (Fig. 10).
- (1) Loosen the bleeding screw and drain off fuel from the bleeding screw.
- (2) Loosen and unscrew the fuel pre-filter cartridge using an appropriate filter wrench.
- (3) Unscrew the water separator from the filter cartridge.
- (4) Apply a thin coat of oil to the rubber seal of the water separator.

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- (5) Turn the water separator on by hand, until the seal contacts, then tighten hand-tight.
- (6) Apply a thin coat of oil to the rubber seal of the filter element (5).
- (7) Turn the filter cartridge on by hand, until the seal contacts, then tighten hand-tight.
- Plug the water sensor cable back on.

Bleed the fuel system

i Note

Air in the fuel system causes irregular running of the engine, a drop in engine power, stalls the engine and makes starting impossible.

Therefore bleed the fuel system after changing the fuel pre-filter or working on the fuel system.

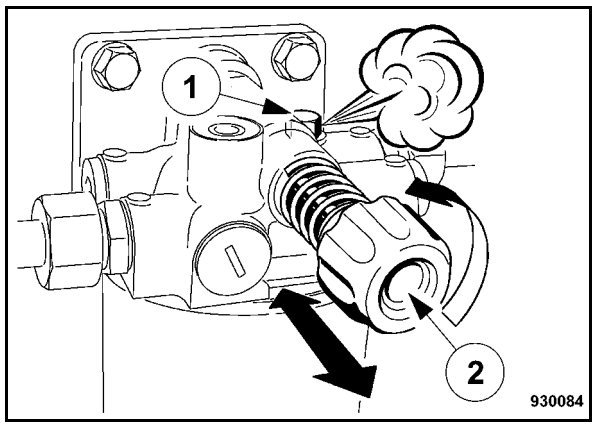


Fig. 11

- Slacken the bleeding screw (1) (Fig. 11) on the fuel pre-filter for 2 to 3 turns.
- Unlock the bayonet lock of the fuel hand pump by pressing it down and turning it anti-clockwise.
- Operate the fuel hand pump (2) manually, until fuel flows out of the loosened bleeding screw without air bubbles.
- Then tighten the bleeding screw while pumping.

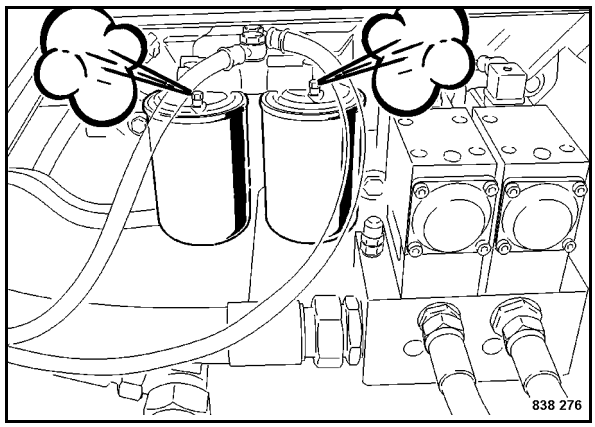


Fig. 12

- Slacken the bleeding screws (Fig. 12) on the fuel pre-filters for a few turns.
- Operate the fuel hand pump (2) (Fig. 11) manually, until fuel flows out of the loosened bleeding screws without air bubbles.
- Then tighten the bleeding screws while pumping.
- Lock the bayonet lock of the fuel hand pump by pressing it down and turning it clockwise.
- Start the engine and run it 5 minutes with idle speed.

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6.14 Check, clean the water separator

⚠ Danger

Fire hazard!

When working on the fuel system do not use open fire, do not smoke.

Environment

Any fuel must be caught and disposed of in an environmentally friendly manner.

i Note

The service intervals for the water separator depend on the water content in the fuel and can therefore not be determined precisely. After taking the engine into operation you should check the filter bowl initially every day, later as required, for signs of water.

If a too high quantity is drained off, the filter needs to be bled, see section "Replacing the fuel pre-cleaner cartridge".

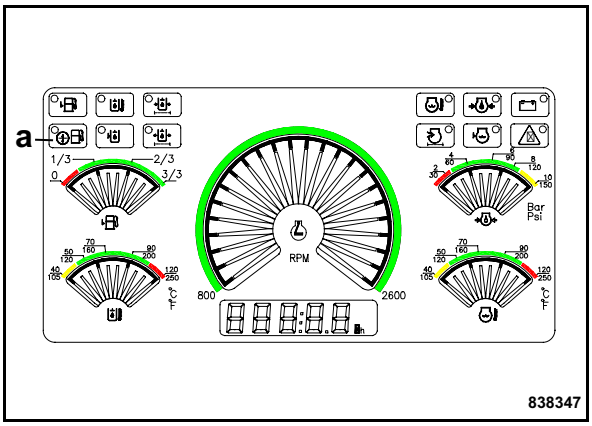


Fig. 13

- If the "water in fuel" warning lamp (d) (Fig. 13) lights up when starting or during operation, drain the water from the pre-filter immediately.

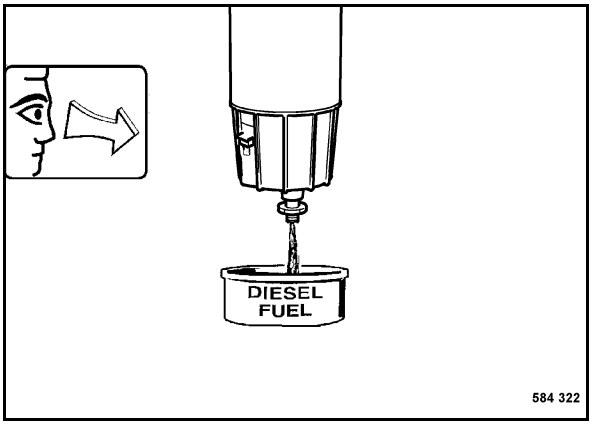


Fig. 14

- Slacken the drain plug (Fig. 14) for a few turns and catch running out fuel / water.
- Turn the plug tightly back in. Check for leaks, if necessary use a new seal ring.

i Note

Once the water separator is empty the warning lamp for water in fuel must go out.

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6.15 Check the coolant level

⚠ Danger

Danger of scalding!

Fill up coolant only when the engine is cold.

⚠ Caution

If, during the daily inspection the coolant level is found to have dropped, check all lines, hoses and engine for leaks.

Do not use radiator sealant to seal leaks.

For quality and quantity of coolant refer to the "table of fuels and lubricants".

- Open the engine flap and secure it.

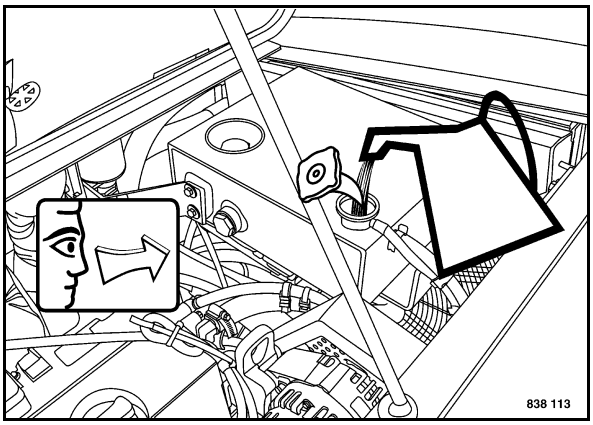


Fig. 15

- Check the coolant level in the compensation tank (Fig. 15).
- Top up coolant, if necessary.
- To top up unscrew the filler cap and fill in coolant up to the MAX-mark.

6.16 Replacing the coolant

⚠ Danger

Danger of scalding!

Change the coolant only when the engine is cold.

⚠ Caution

Do not start the engine after draining off the coolant.

In case of lubrication oil entering into the cooling system or a suspicious turbidity caused by corrosion residues or other suspended matter, the coolant must be drained off and the complete cooling system needs to be cleaned. Lubrication oil can damage the sealing materials used in the engine.

When changing the coolant without any signs of contamination, cleaning of the cooling system is not necessary.

⚠ Caution

For quality and quantity of coolant refer to the "table of fuels and lubricants".

Do not mix different coolants and additives, see section "Fuels and Lubricants - Coolant".

Environment

Catch coolant and dispose of environmentally.

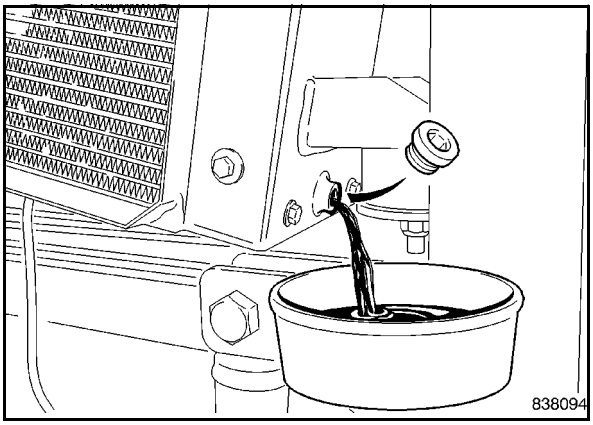


Fig. 16

- Unscrew the plug (Fig. 16), let the coolant run out and catch it.
- Screw the plug back in once all coolant has run out.
- Check the condition of the coolant.

⚠ Caution

Thoroughly flush the cooling system if the coolant is contaminated by corrosion residues or other suspended matter.

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If lubrication oil has entered you must add a cleansing agent in order to remove any residues from the system. Follow the instructions of the manufacturer. If in doubt consult your local service station or the engine manufacturer.

- Remove the thermostat.
- Fill in clean water.
- Start the diesel engine and run it warm to operating temperature.
- Allow the engine to cool down to approx. 50 °C.
- Drain all water off.
- Repeat the flushing process twice using a cleansing agent with clear water.
- Screw the plug back in once all coolant has run out.
- Reinstall the thermostat .

⚠ Caution

The anti-freeze concentration (additive) must be at least 35 Vol% and maximum 45 Vol%.

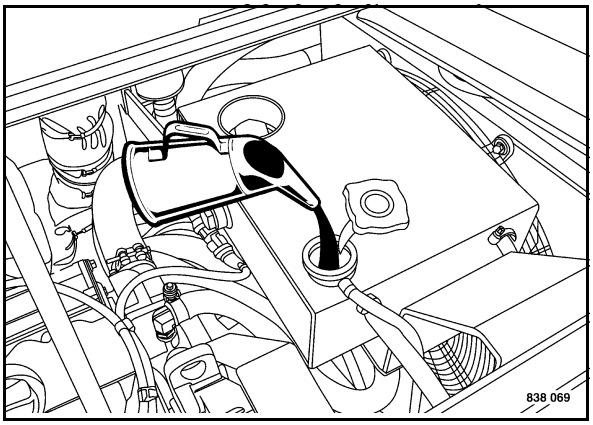


Fig. 17

- Open the radiator cap (Fig. 17) and fill in coolant.
- Screw the cover back on again.
- Start the diesel engine and run it warm to operating temperature.
- Let the engine cool down and check the coolant level again, top up if necessary.

6.17 Air filter maintenance

⚠ Caution

Do not start the engine after having removed the air filter.

If necessary, the air filter may be cleaned up to six times. After one year at the latest it must be replaced together with the safety element.

Cleaning does not make sense if the air filter element is covered with a sooty deposit.

Do not use gasoline or hot fluids to clean the filter element.

After cleaning the air filter must be inspected for damage using a torch.

Do not continue to use a damaged air filter element. If in doubt use a new air filter.

If the air filter is damaged, the safety element must be replaced as well.

The safety element must not be cleaned.

i Note

We generally recommend to renew the air filter. A new filter element is far less expensive than a possible engine damage.

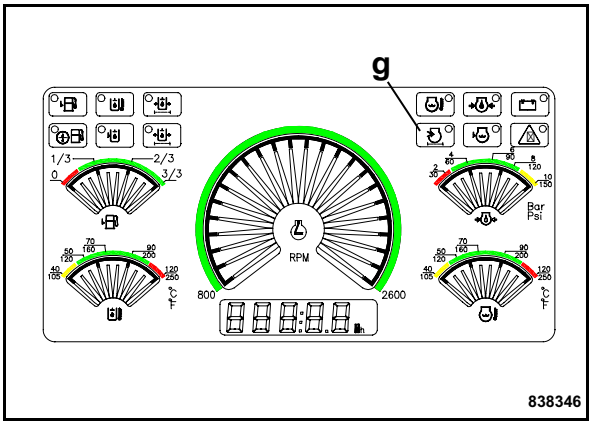


Fig. 18

Maintenance of the air filter is due when the air filter warning lamp (g) (Fig. 18) lights up, but at the latest after one year.

i Note

Once the air filter warning lamp lights up, work may be continued until the end of the day.

- Open the engine hood completely and secure it.

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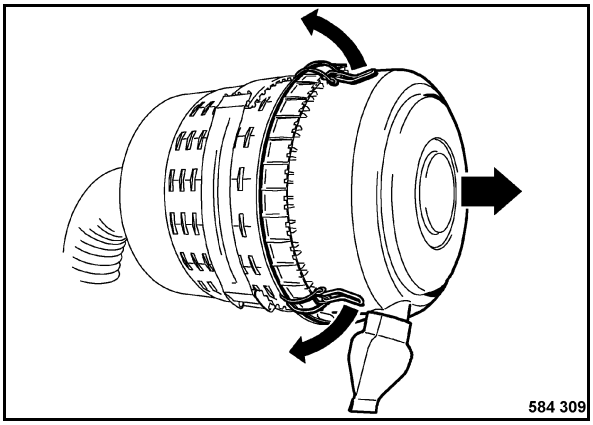


Fig. 19

- Loosen both locking hooks (Fig. 19) on the housing cover and take the cover off.

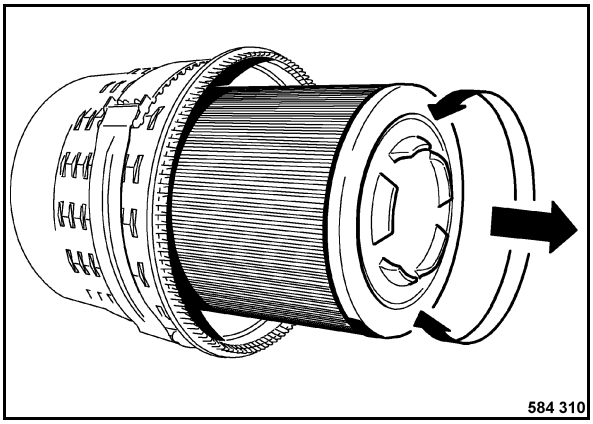


Fig. 20

- Pull out the main filter element (Fig. 20) with light turning movements.

The safety cartridge remains in the housing.

⚠ Danger

Danger of injury!

Wear protective clothing (goggles, gloves).

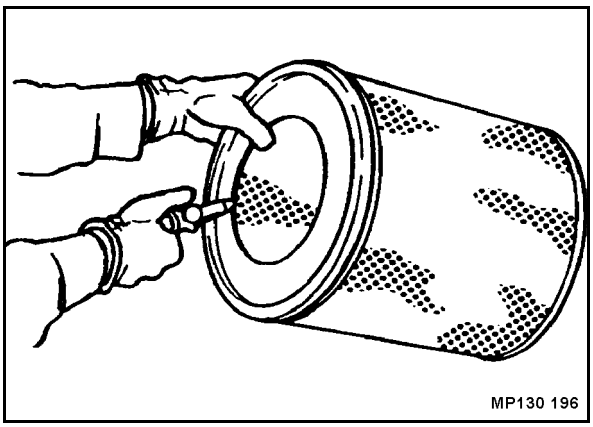


Fig. 21

- Blow the air filter out from inside to outside with dry compressed air (max. 5 bar (70 psi)) (Fig. 21), until all dust has been removed.

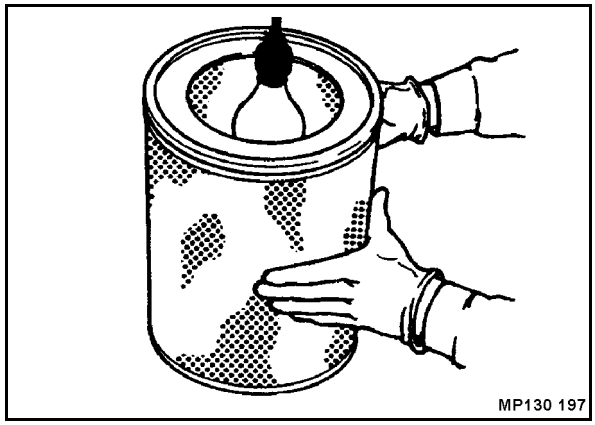


Fig. 22

- Examine the air filter with a torch for cracks and holes in the paper bellows (Fig. 22).
- In case of damage replace the air filter and the safety element.

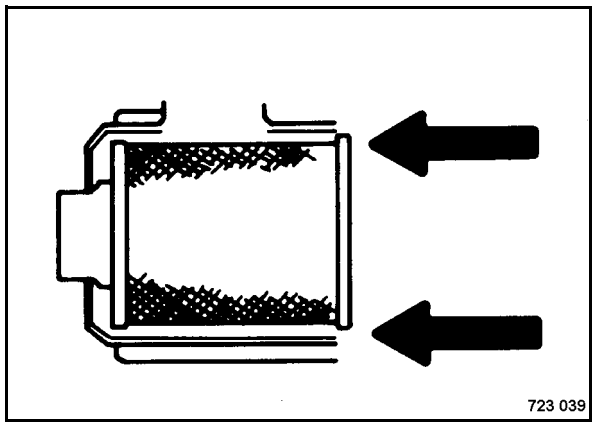


Fig. 23

- Slide the air filter carefully into the housing (Fig. 23).

⚠ Caution

The dust discharge valve must point vertically downwards.

Make sure that the cover locks engage correctly.

- Reassemble the housing cover.

Replacing the safety element

⚠ Caution

The safety element must not be cleaned and should not be used again after it has been removed.

The safety element must be replaced:

- **if the air filter is damaged.**
- **at the latest after 1 year.**
- **if the air filter warning lamp comes on again after the air filter has been cleaned.**

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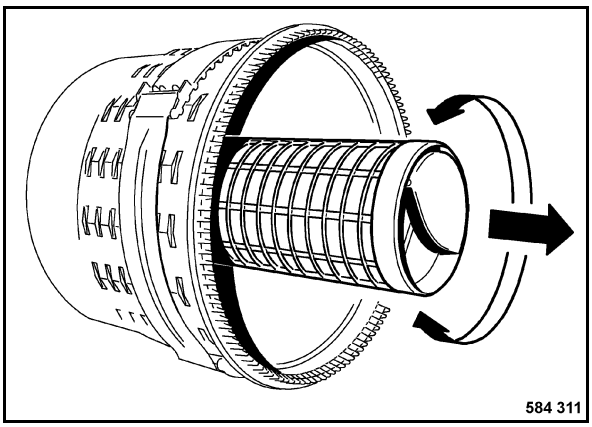


Fig. 24

- Remove the housing cover and pull the air filter off.
- Pull the safety element (Fig. 24) out by slight turning movements.
- Push in a new safety filter element.
- Reassemble air filter and housing cover.

6.18 Adjust the valve clearance

⚠ Caution

We recommend to have this work carried out by trained personnel or our after sales service.

Before checking the valve clearance let the engine cool down for at least 30 minutes. The engine oil temperature must be less than 80 °C.

- Remove the valve covers.
- Turn the crankshaft with the cranking device until the valves are overlapping.

i Note

Firing order 1-3-4-2

Overlapping of valves: Exhaust valve not yet closed, intake valve starts to open.

Valves	Cylinder			
overlapping	1	3	4	2
adjustment	4	2	1	3

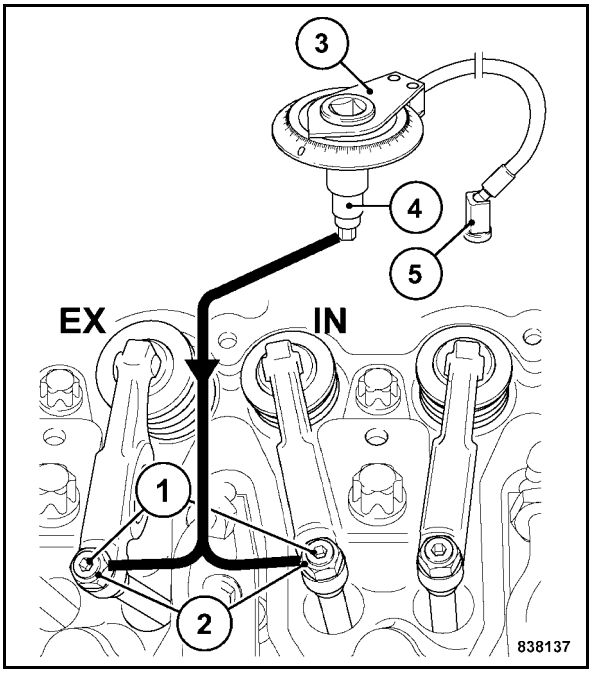


Fig. 25

- Loosen the counter nut (1) (Fig. 25).
- Attach the rotation angle disc (3) and the spanner socket (4) to the valve clearance adjustment screw (2).
- Fix the magnet (5) of the rotation angle disc.

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- Turn the rotation angle disc clockwise against the stop (rocker arm no clearance) and set the scale to zero.
- Turn the rotation angle disc counter-clockwise, until the specified angle is reached.

Intake valve = 90° +10°

Exhaust valve = 150° +10°

- Hold the rotation angle disc tight, so that it does not turn, and tighten counter nut (1).

Tightening torque: 20 Nm

- Repeat this adjustment procedure an all other cylinders, after cranking the crankshaft accordingly.
- Install the cylinder head cover with a new gasket.

Tightening torque: 13 Nm

- After a short test run check the engine for leaks.

6.19 Adjusting the control piston play

⚠ Caution

This work must be performed after adjusting the valve clearance.

- Crank the engine, until the valves on cylinder 1 overlap.
- The cylinders to be adjusted can be taken from the section "Adjustment Schematic".

Adjusting the control piston play

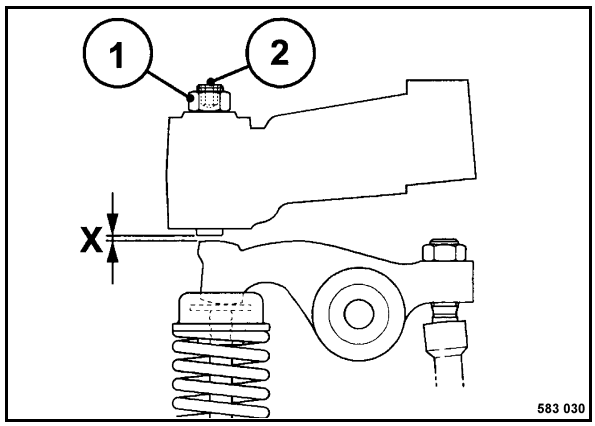


Fig. 26

- Loosen counter nut 1 (Fig. 26).

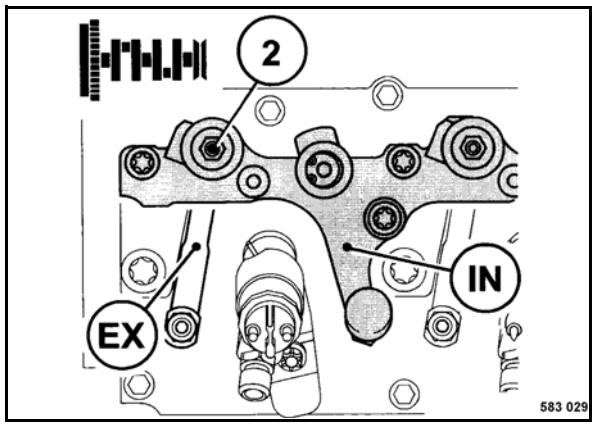


Fig. 27

- Plug rotation angle disc and socket onto the set-screw 2 (Fig. 27).
- Fix the magnet of the rotation angle disc.
- Turn the rotation angle disc clockwise against the stop (rocker arm no clearance) and set the scale to zero.
- Turn the rotation angle disc anti-clockwise, until the specified angle is reached.

https://truckmanualshub.com/

- Hold the rotation angle disc tight, so that it does not turn, and tighten counter nut 1 (Fig. 26).
- Repeat this adjustmennt procedure on each control piston according to the crankshaft position.
- Assemble the cylinder head cover with a new gasket.

Adjustment schematic

- Firing order 1-3-4-2

Valves	Cylinder			
overlapping	1	3	4	2
adjustment	4	2	1	3

Overlapping of valves:

Exhaust valve not yet closed,

intake valve starts to open.

⚠ Caution

With the intake valve opened, the exhaust valve will temporarily open for about 2 mm.

This is no valve overlap condition!

6.20 Clean the cooling fins on engine and hydraulic oil cooler

⚠ Danger

Danger of injury!

Perform cleaning work only after the engine has cooled down and with the engine stopped.

⚠ Caution

Do not damage any cooling fins on the cooler core when cleaning.

i Note

Dirt on fan blades and oil cooler reduce the cooling effect. Dirt deposits in these areas are substantially supported by oil and fuel on these surfaces. For this reason you should always seal any oil or fuel leaks in the vicinity of the cooling fan or the oil cooler and clean the cooling surfaces after.

Cleaning with compressed air

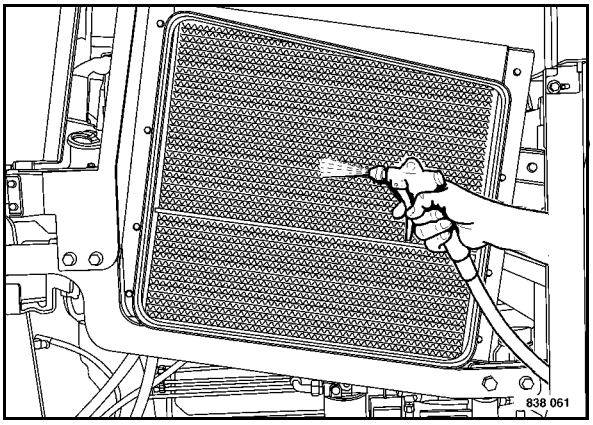


Fig. 28

i Note

Start to blow out from the exhaust side.

- Blow radiator and hydraulic oil cooler (Fig. 28) out with compressed air.

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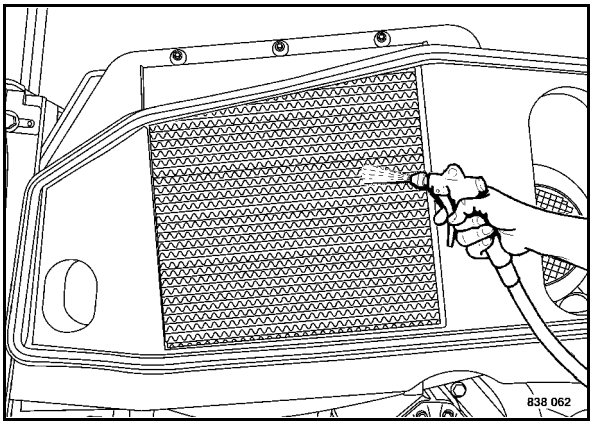


Fig. 29

i Note

Start to blow out from the exhaust side.

- Blow the intercooler (Fig. 29) out with compressed air.

Cleaning with cold cleansing agent

⚠ Caution

Protect electrical equipment such as generator, regulator and starter against the direct water jet.

- Spray the engine with a suitable cleansing agent, e.g. cold cleanser, let it soak in for a while and spray it off with a strong water jet.
- Run the engine warm for a while to avoid corrosion.

6.21 Check the engine mounts

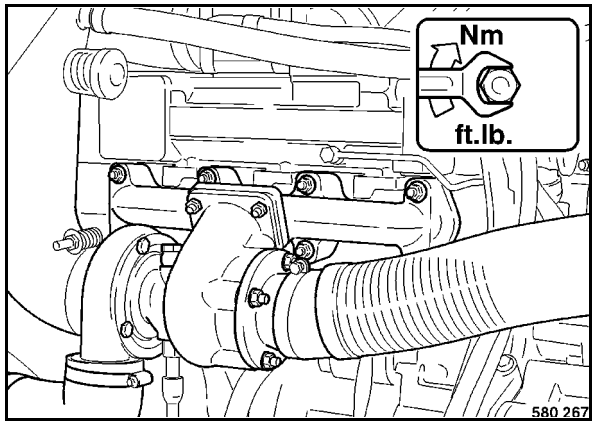


Fig. 30

- Tighten fastenings of intake and exhaust manifolds (Fig. 30) on the cylinder heads.
- Check sockets and clamps between air filter, exhaust turbocharger and charge air line as well as the lubrication air line for tight fit and leaks.
- Retighten the fastening screws for oil sump and engine mounts.

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6.22 Replace the crank case ventilation valve

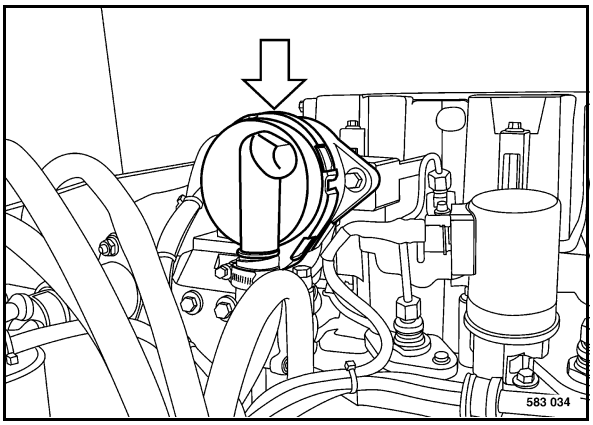


Fig. 31

- Replace the crank case ventilation valve (Fig. 31).

6.23 Electronic injector test EMR

i Note

This work must only be performed by authorized service personnel.

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6.24 Engine conservation

If the engine is to be shut down for a longer period of time (e.g. over winter), please consult the service department of the engine manufacturer for further details.

6.25 Checking the condition and tension of the screed heating generator V-belt, tensioning and if necessary replacing the V-belt

⚠ Danger

Danger of injury!

Work on the V-belt must only be performed with the engine shut down.

⚠ Caution

A frequency meter is required to check the belt tension.

Checking the toothed belt

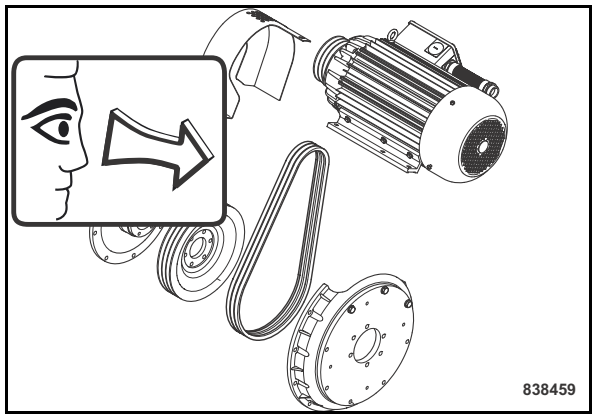


Fig. 32

- Inspect the entire circumference of the V-belt (Fig. 32) visually for damage and cracks. Replace damaged or cracked V-belts.
- Check the belt tension with a frequency meter.

Nominal values:

Tension of new V-belts: 117 - 121 Hz

Tension of toothed belt in use: 110 - 115 Hz

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Tensioning the toothed belt

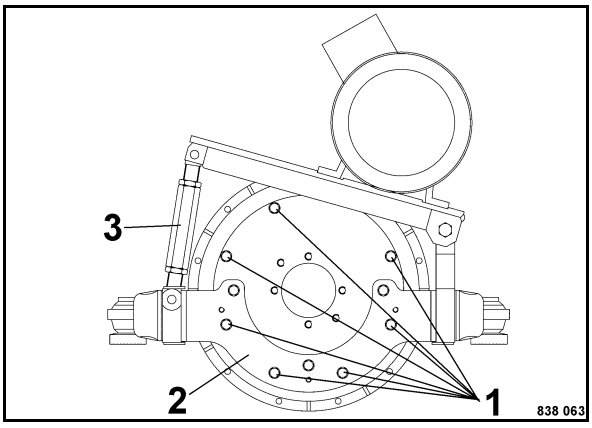


Fig. 33

- Loosen the counter nut on spindle (3) (Fig. 33).
- Turn the spindle, until the correct belt tension has been adjusted.
- Tighten the counter nut.

Replacing the toothed belt

- Loosen the counter nut on spindle (3) (Fig. 33).
- Turn spindle (3) to lower the generator carrier.
- Unscrew the fastening screws (1) from the pump flange.
- Loosen the clamping screws of the bracket (2) on both sides.
- Pull the pump flange away from the engine case to a distance of approx. 50-60 mm.
- Take the old V-belt off.
- Fit the new V-belt to the V-belt pulleys.
- Carefully reassemble pump flange and bracket and tighten the fastening screws with the specified torque.
- Tighten the V-belt.

⚠ Caution

Check the V-belt tension after a running time of 30 minutes.

6.26 Check, tension, replace the V-belt

⚠ Danger

Danger of accident!

Perform this work only with the engine shut down!

Check the V-belt

- Remove the guard.

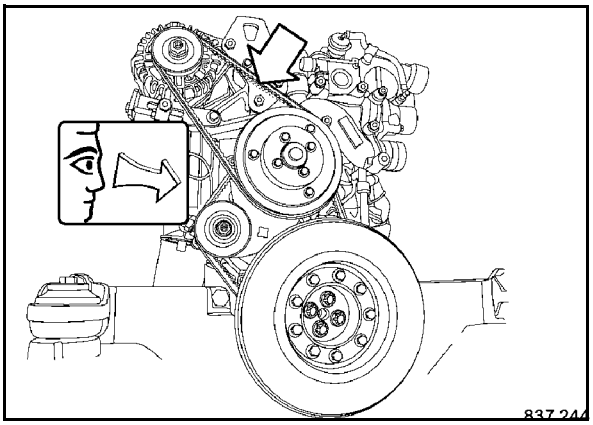


Fig. 34

- Check the entire circumference of the V-belts (Fig. 34) for damage and cracks. Replace damaged or cracked V-belts.
- Check with thumb pressure whether the V-belt can be depressed more than 10 to 15 mm between the V-belt pulleys, retighten if necessary.

Tensioning the generator V-belt

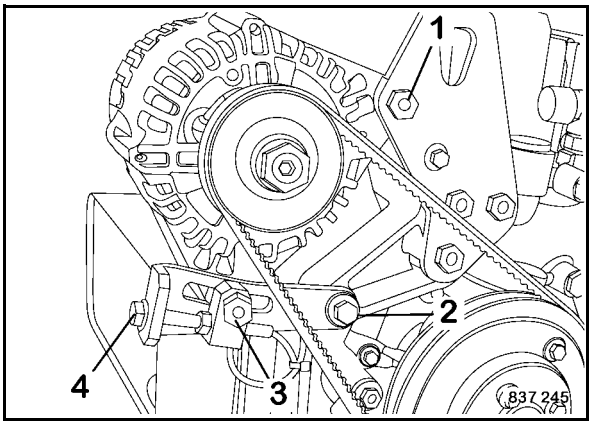


Fig. 35

- Slightly slacken fastening screws 1, 2 and 3(Fig. 35).
- Turn the tensioning screw (4), until the correct V-belt tension is achieved.
- Retighten all fastening screws.

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Replacing the generator V-belt

- Slightly slacken the fastening screws 1, 2 and 3.
- Screw in the tensioning screw (4).
- Take the old V-belt off.
- Fit the new V-belt to the V-belt pulleys.
- Tension the V-belt as previously described.

⚠ Caution

Check the V-belt tension after a running time of 30 minutes.

Tightening the V-belt, coolant/fuel pump

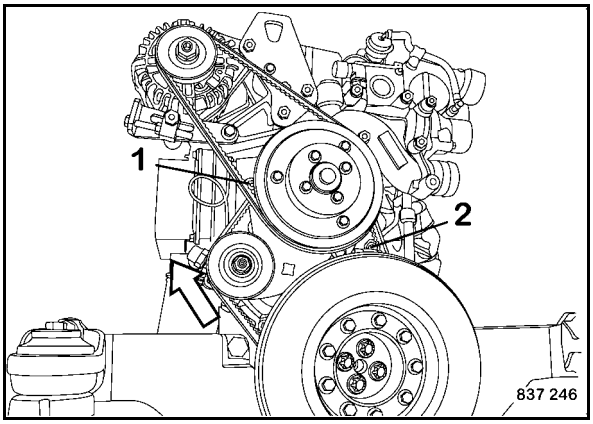


Fig. 36

- Slacken the fastening screws 1 and 2(Fig. 36) slightly.
- Press the idler pulley in direction of arrow, until the correct V-belt tension is reached.
- Retighten all fastening screws.

Replacing the V-belt, coolant/fuel pump

- Take of the fan generator V-belt, see following section.
- Slightly slacken fastening screws 1 and 2.
- Press the idler pulley in opposite direction to the arrow completely against the engine.
- Take the old V-belt off.
- Fit the new V-belt to the V-belt pulleys.
- Tension the V-belt as previously described.
- Reassemble the generator V-belt.

⚠ Caution

Check the V-belt tension after a running time of 30 minutes.

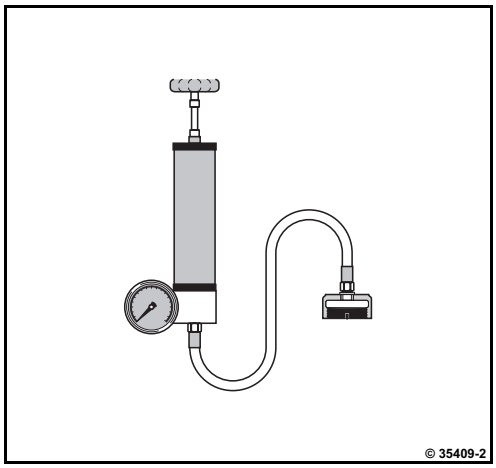
https://truckmanualshub.com/

6.27 Special tools, Deutz engine (TCD 2013 2V)

TCD 2013 2V — Standard tools

8002
Pressure pump
Checking cooling system for leak-tightness

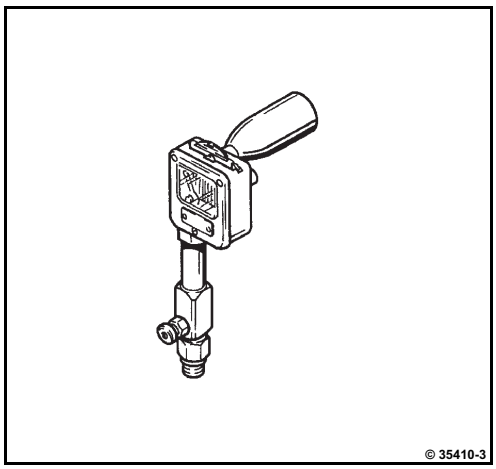
057 250 66



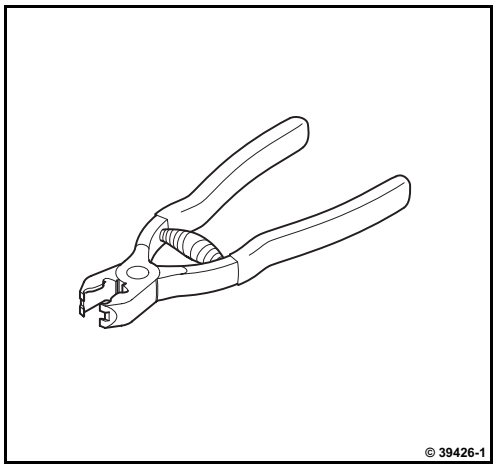
8005
Compression pressure tester
for diesel engines
10 - 40 bar

057 250 67





8011
Hose clip pliers
e. g. fuel return pipe

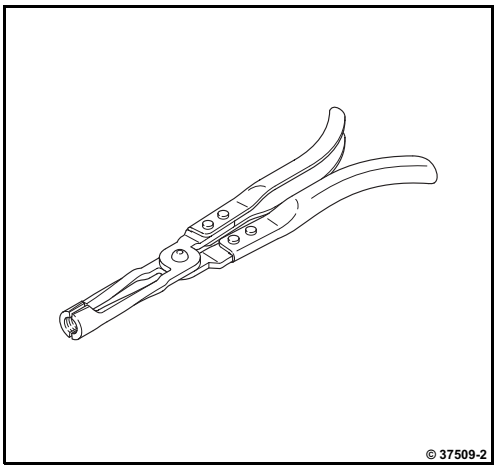


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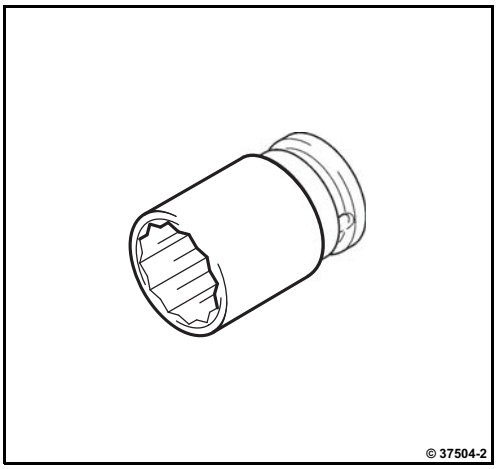
Standard tools TCD 2013 2V

8024
Assembly pliers
Removing valve stem gaskets

057 250 68



8035
Socket wrench insert
reinforced, size 22
removing and installing main bearing



8113
Socket wrench insert
Torx - E 14

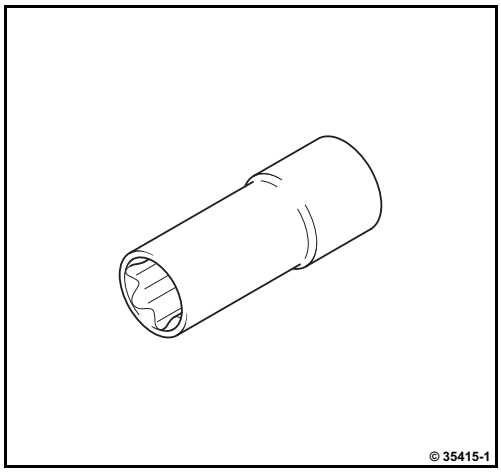
057 250 69



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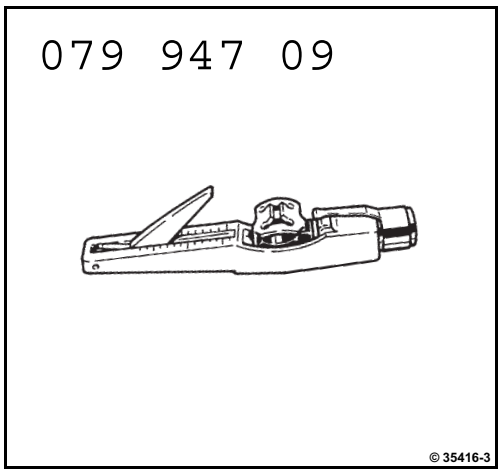
TCD 2013 2V — Standard tools

8114
Socket wrench insert
Torx - E 20



8115
V-belt tension measuring device
150 to 600 N
for checking the V-belt tension

079 947 09



8189
Torx tool set
Contents of case:
- Double-ended ring spanner E6/E8
- Double-ended ring spanner E10/E12
Socket wrench insert E8 and E10 (1/4 inch)
- Socket wrench insert E10 and E12 (3/8 inch)
- Socket wrench insert E18 (1/2 inch)

079 947 01



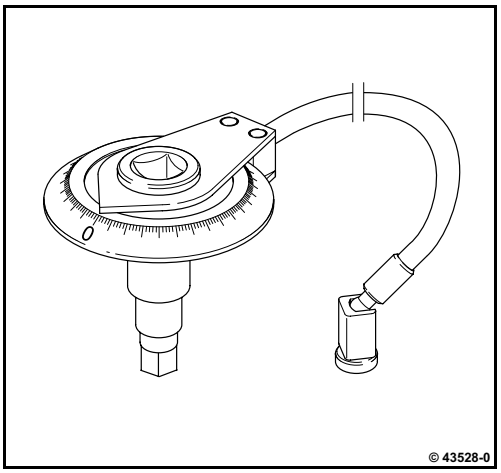
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Standard tools

TCD 2013 2V

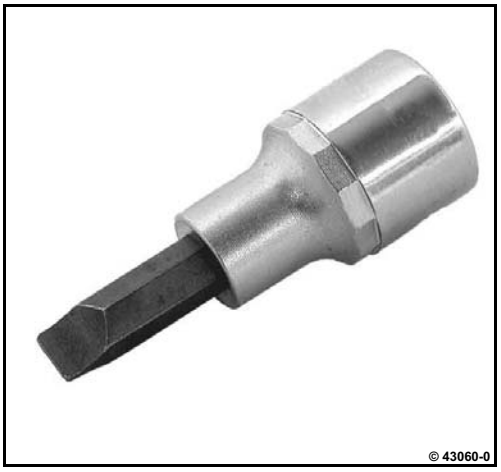
8190
Rotation angle disc
with magnet
Setting valve clearance

057 250 72



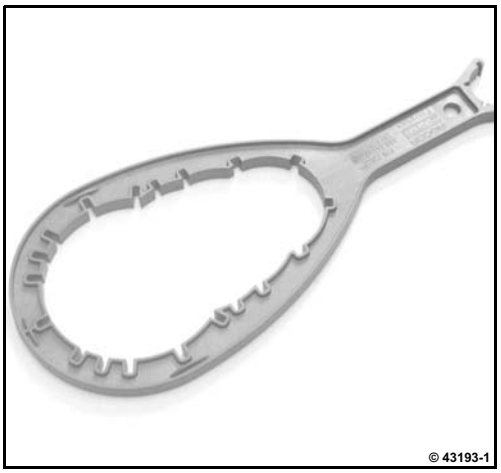
8191
Screwdriver insert
for slotted screw
Valve clearance setting

057 250 74



8192
Bowl wrench
Fuel pre-filter (type: Racor)

057 250 73

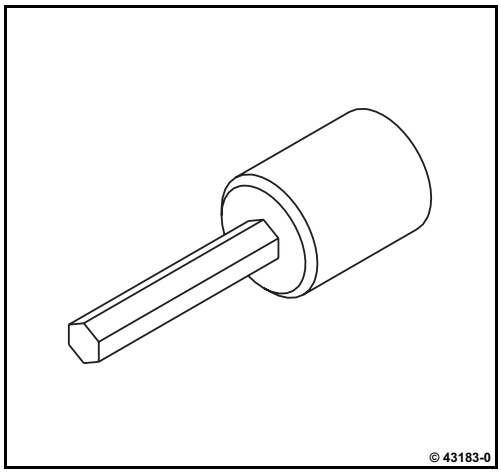


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TCD 2013 2V — Standard tools

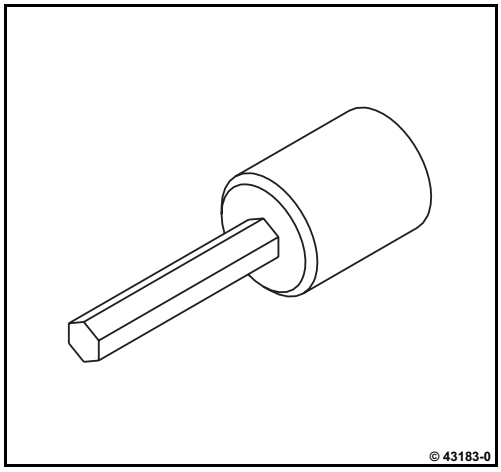
8193
Screwdriver insert
with pressed in hexagonal pin (5 mm),
1/2 inch, long version
(in conjunction with rotation angle disc 8190)

057 250 59

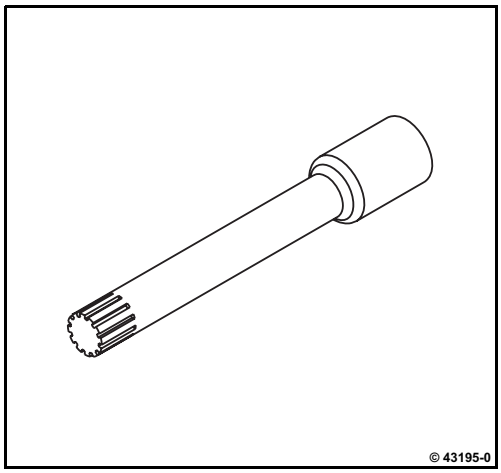


8194
Screwdriver insert
with hexagon socket (size 4 mm),
1/2 inch, long version
(in conjunction with rotation angle disc 8190)

057 250 75



8195
Multi-toothed screwdriver set
260 mm long
remove and install air compressor



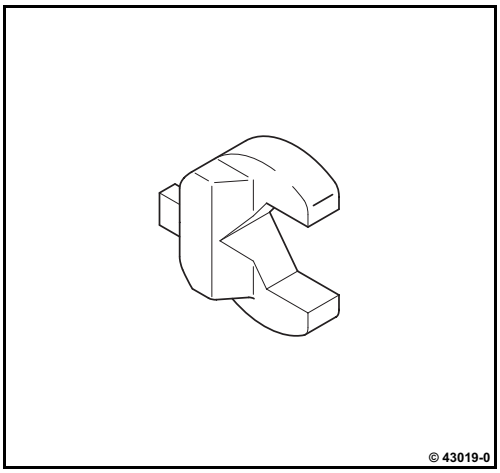
https://truckmanualshub.com/

Standard tools

TCD 2013 2V

8196
Open end wrench adapter
Size 13,
for torque wrench
Tightening of lock nut of the valve clearance setting screw

057 250 71



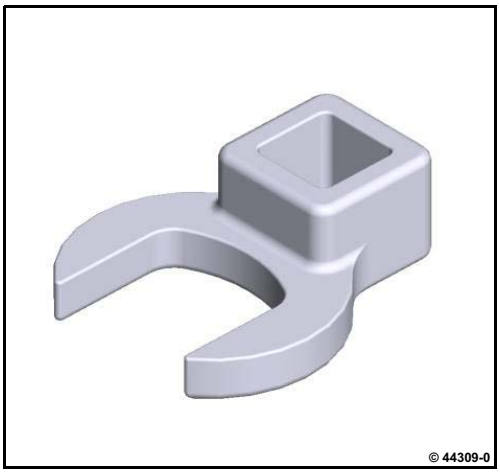
8198
Pricker
Removing rotary shaft lip seal

057 250 76



8199
Crowfoot wrench
Size 15
3/4 inch
(in connection with rotation angle disc 8190)

057 250 77

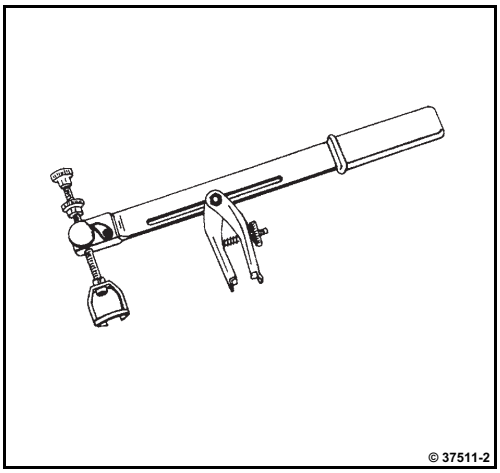


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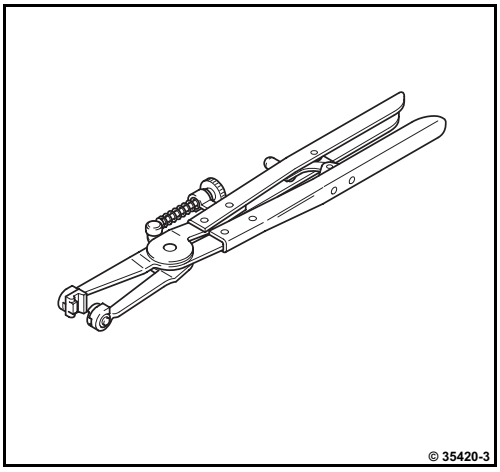
TCD 2013 2V — Standard tools

9017
Assembly lever
Example: Removing and installing the valves

057 250 78



9090
Spring band pliers
320 mm
tighten spring band clamp



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DEUTZ

TCD 2013 2V — Special tools

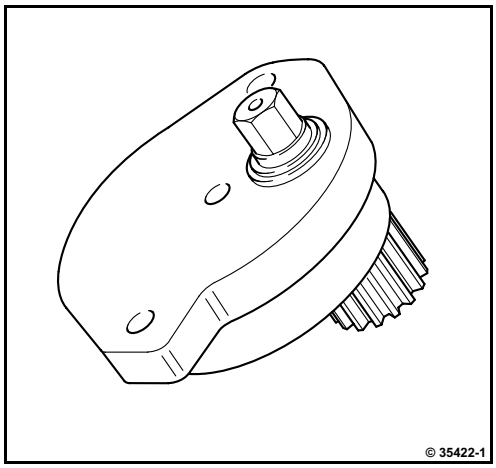
100 190
Connector
(in conjunction with compression pressure tester 8005)

057 250 79



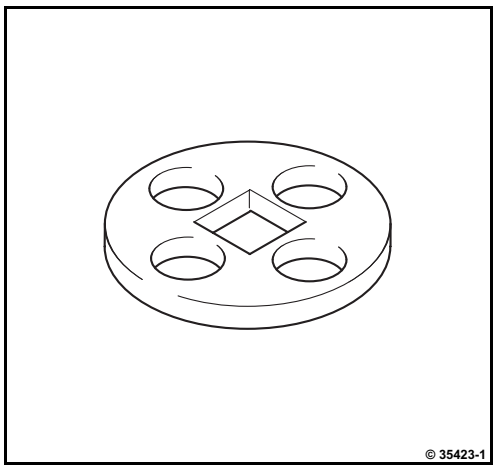
100 320
Turning gear
flywheel side

057 250 80



100 330
Turning gear
V-belt pulley
Turning crankshaft on torsional vibration damper

079 947 19

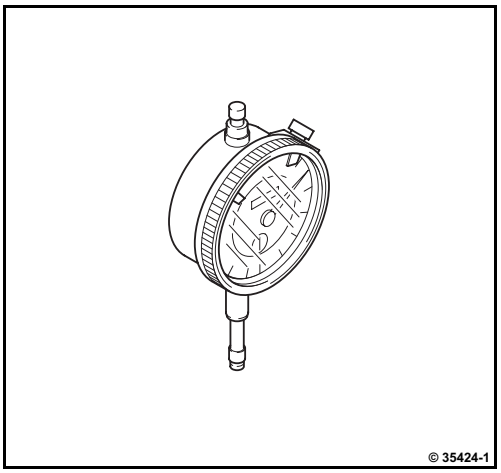


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Special tools TCD 2013 2V

100 400
Dial gauge with fixing wheel
Measuring range 0 - 10 mm / 0.01 mm

057 250 81



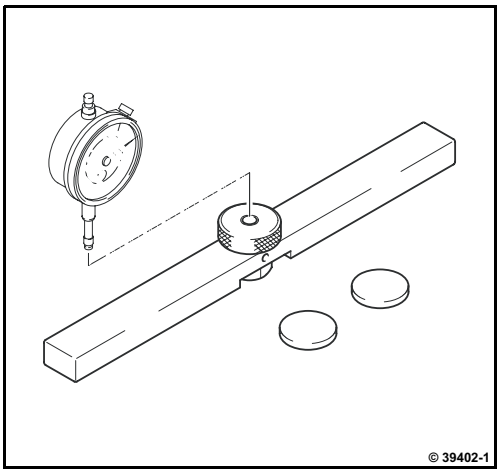
100 410
Digital gauge
Measuring range 0 - 30 mm / 0.01 mm

057 250 82



100 750
Measuring device
Measuring bar with two shims
(in conjunction with 100400 and 100410)
Checking valve lag dimension
Checking piston projection

057 250 83



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103 050
Socket wrench insert
Size 15
for valve clearance setting with removed exhaust return module
(in connection with 8190)

057 250 84



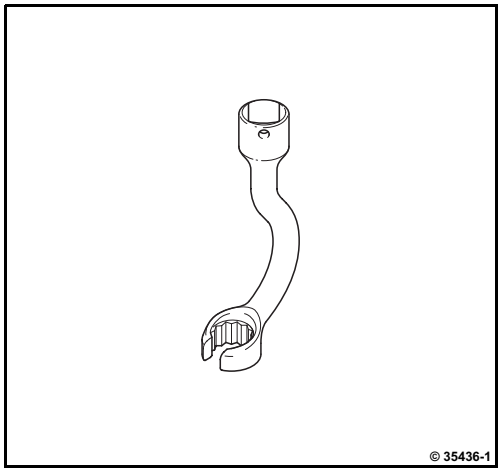
103 220
Special pliers
for removing the roller tappet

057 250 85



110 500
Special wrench
Size 17
Removing and installing high-pressure lines

057 250 86



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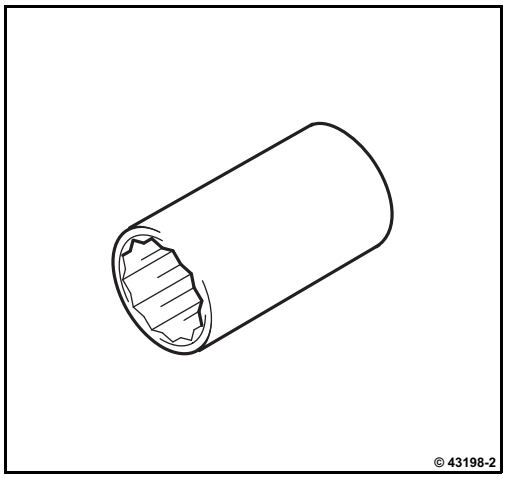
Special tools TCD 2013 2V

110 640
Lever tool
Remove injector



110 700
Socket wrench insert
long
Installing and removing pressure sensors
(rail pressure, oil pressure, fuel pressure)

057 250 87



110 900
Assembly case
Case for O-rings, complete with:
Disassembly tool 110 901 and three assembly sleeves with guide:
- High pressure pump (Ø 36), 110 902
- Injector, 2V motor (Ø 16), 110 903
- Injector, 4V motor (Ø 23), 110 904

Removing and installing O-rings

057 250 88



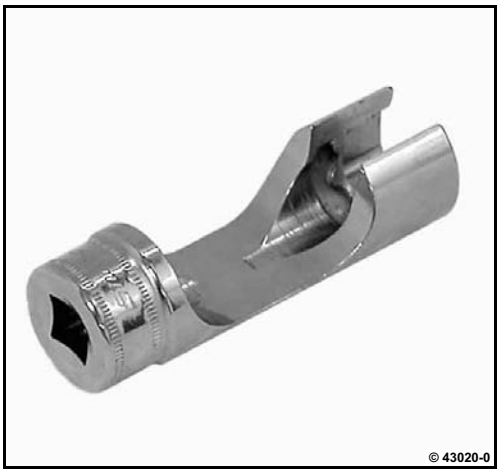
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DEUTZ

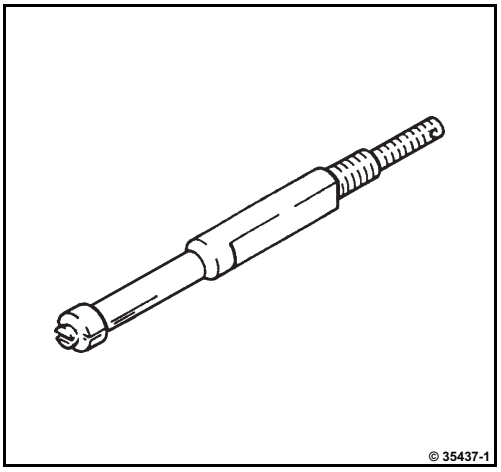
TCD 2013 2V — Special tools

120 430
Assembly tool
Removing and installing the glow plugs

057 250 89

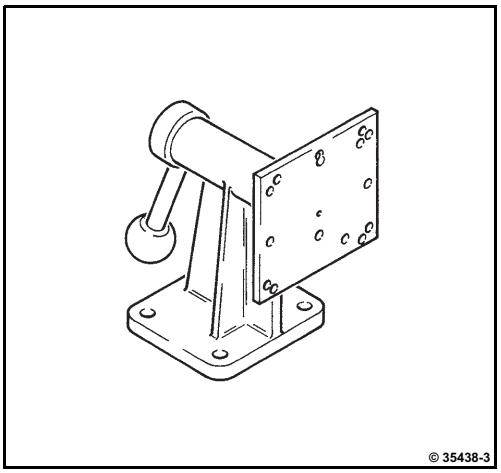


120 680
Puller
(in conjunction with slide hammer 150 800)
Removing fixed injector sealing ring



120 900
Support bracket
pivoting
Clamping cylinder head

057 250 90

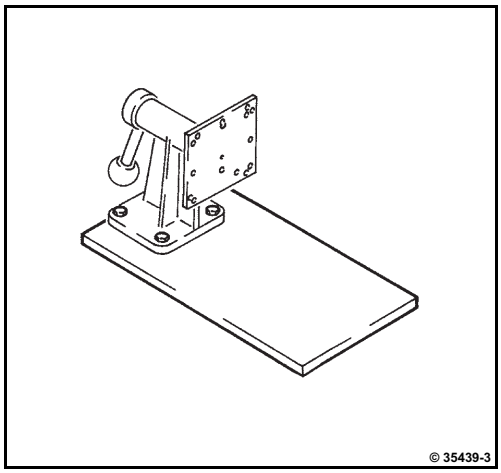


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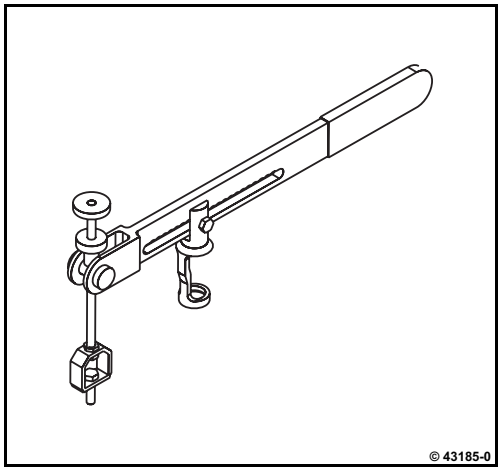
Special tools TCD 2013 2V

120 910
Base plate
(in conjunction with support bracket 120 900 if support bracket is not screwed tightly)

057 250 91

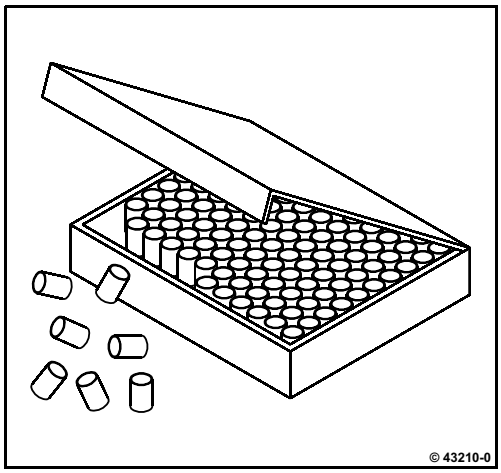


121 330
Assembly lever
Removing and installing the valves



121 420
Assembly sleeves
Set of assembly sleeves for valve stem gasket

057 250 93



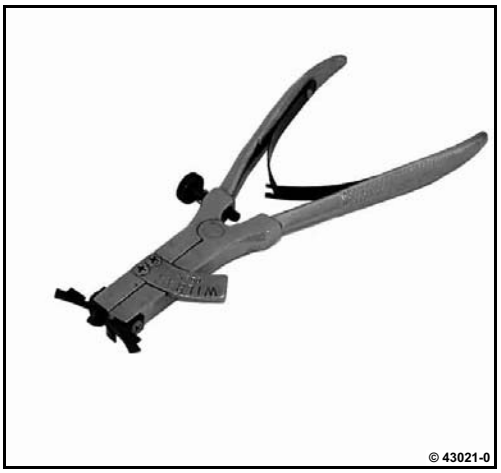
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DEUTZ

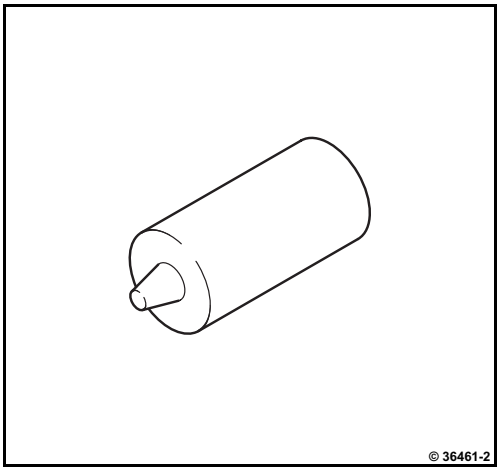
TCD 2013 2V — Special tools

130 300
Universal piston ring pliers
Removing and installing the piston rings

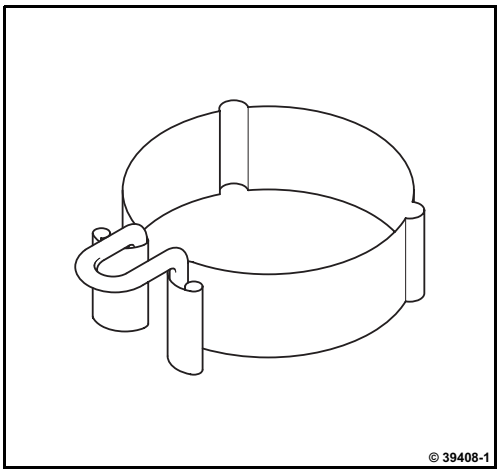
057 250 94



130 420
Trapezoidal groove wear gauge
Piston diameter 108 mm



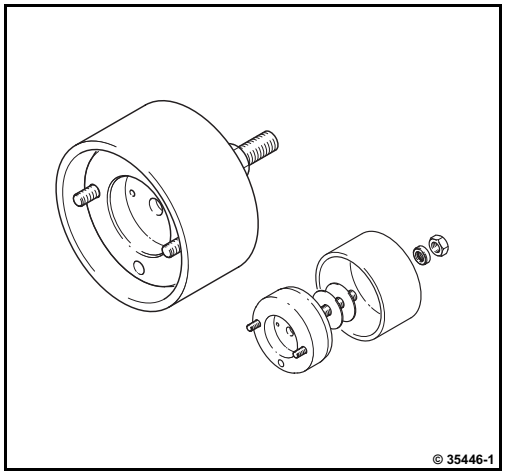
130 640
Piston ring compressor
Piston diameter 108 mm



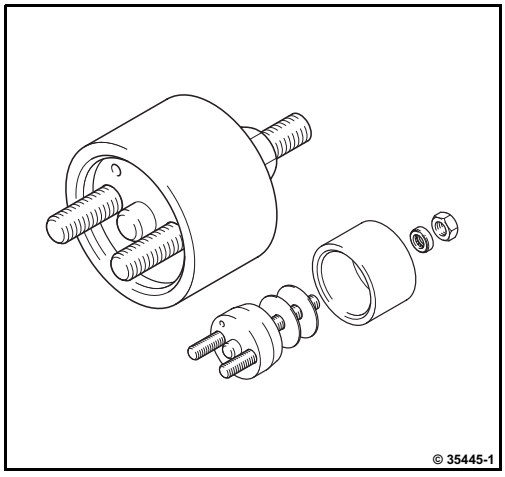
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Special tools TCD 2013 2V

142 810
Assembly tool
Installing crankshaft sealing ring
(flywheel side)



142 820
Assembly tool
Installing crankshaft sealing ring
(opposite side to flywheel)



150 170
Puller, universal
Comprising traverse, support and threaded rod
(in conjunction with disc 150 171)
Removing cylinder liner

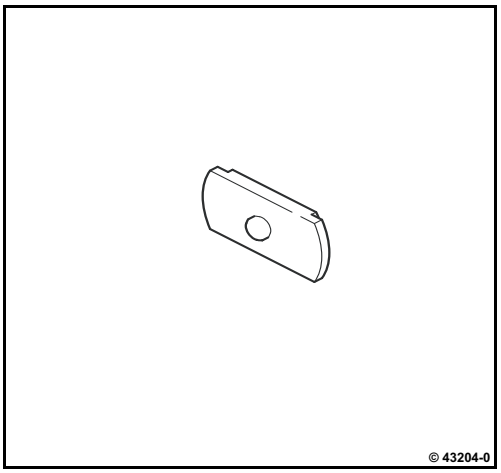


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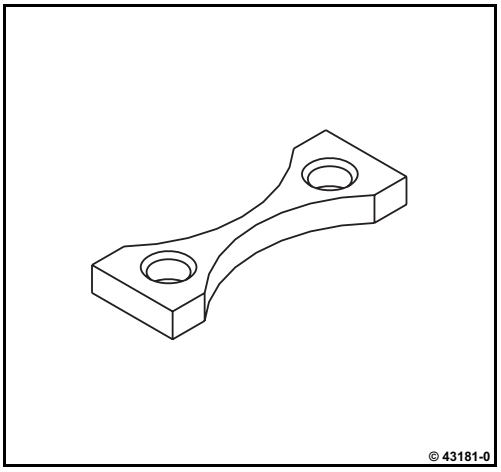
DEUTZ

TCD 2013 2V — Special tools

150 171
Plate
(in conjunction with puller 150 170)
for liner diameter: 108 mm
Removing cylinder liner



150 180
Liner holder
(Set comprises 7 holders)
Turning crankshaft with cylinder head removed



150 190
Assembly lever
Lever with bolts
(in conjunction with disc 150 191)
Installing cylinder liner



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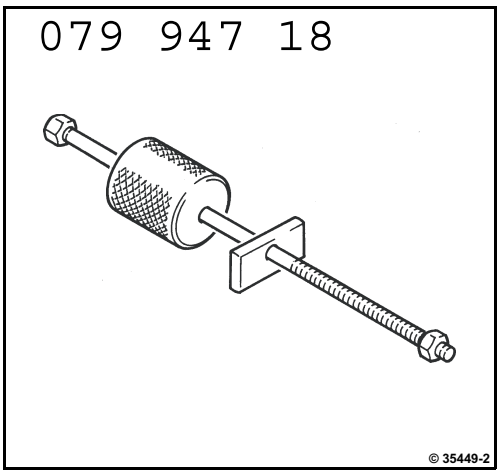
Special tools TCD 2013 2V

150 191
Washer
(in conjunction with assembly tool 150 190)
for liner diameter: 108 mm
Installing cylinder liner



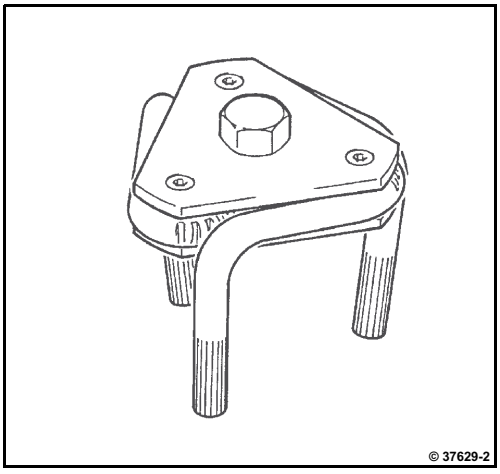
150 800
Slide hammer
(in conjunction with puller 120 680)
Removing injector sealing ring

079 947 18



170 050
Special wrench
Unscrewing the filter cartridges

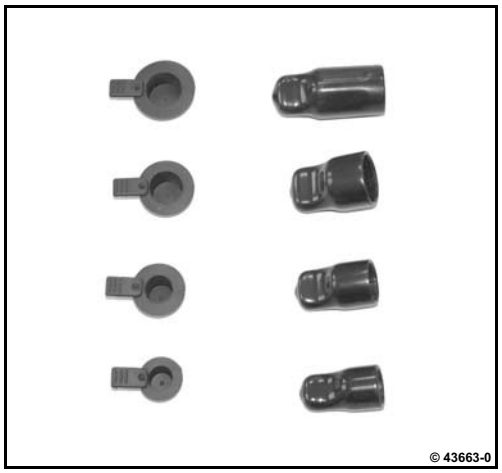
079 947 28



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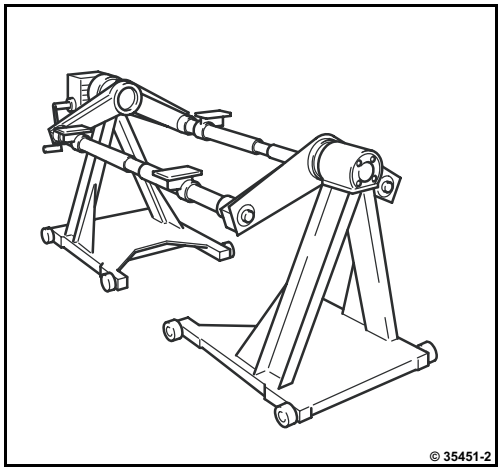
170 160
Stoppers/caps
1 set of differently-sized stoppers and caps
Sealing openings on the fuel system

079 947 29



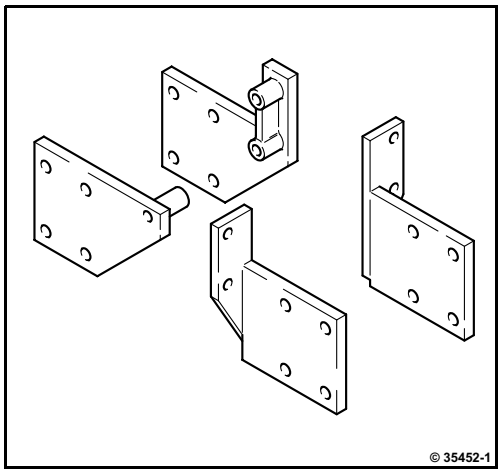
6066
Assembly block
Engine clamping, double-sided

079 947 30



6066/158
Clamping bracket
consisting of:
1 holder 6066/158-1 rear right,
1 holder 6066/158-2 rear left,
1 holder 6066/158-3 front right,
1 holder 6066/158-4 front left
(in connection with assembly block 6066)
Clamping of the engine, double-sided

079 947 31



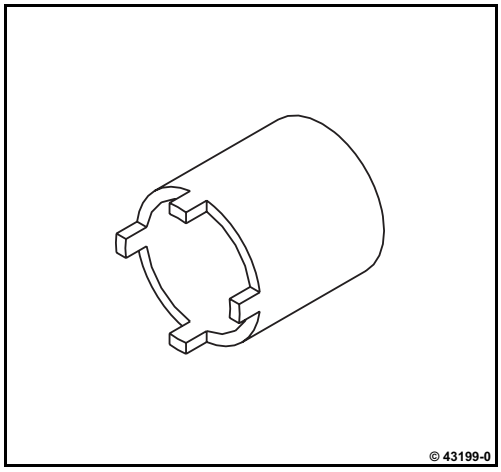
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Special tools TCD 2013 2V

6068
Engine lifting device
Version for commercial vehicles with worm gear, ultimate load (2t), 3-point suspension, spindle clamp, traverse, chains and hooks



6692
Slotted nut wrench
Cable plug



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7 Hydraulics

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7.1 Hydraulic circuit

Open circuit

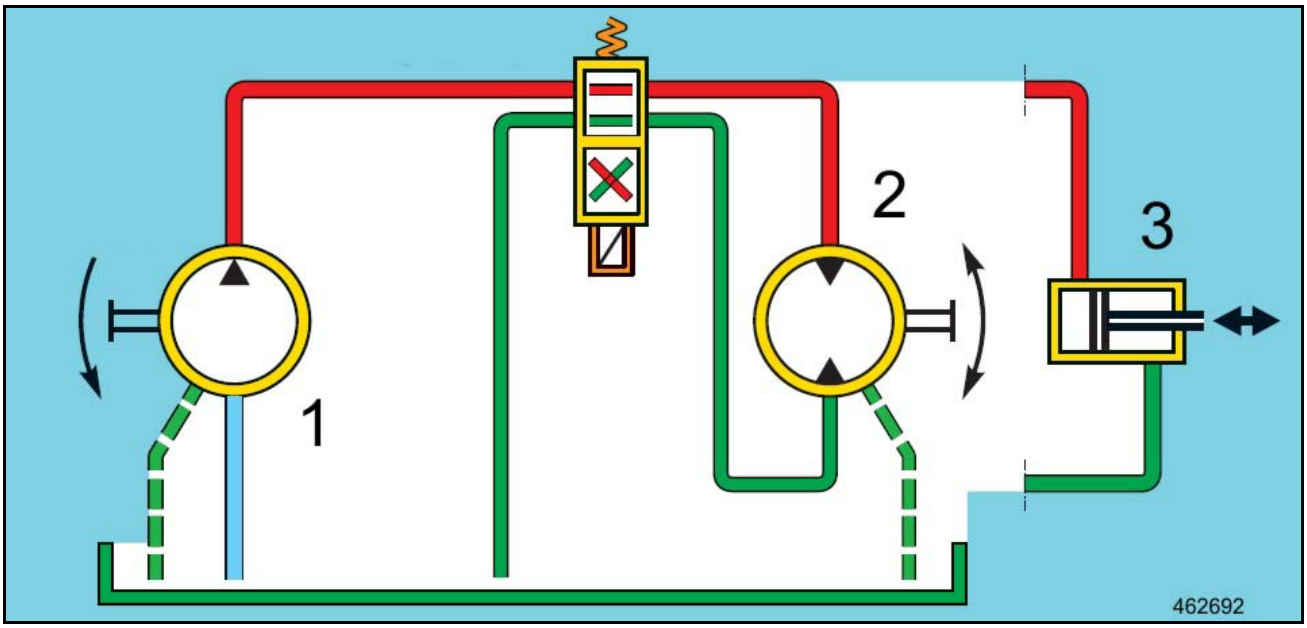


Fig. 1 Open circuit

Open in this case means that the suction line of a **pump**) (Fig. 1) normally is situated below the fluid level, the surface of which is in open contact with atmospheric pressure. Reliable equalization of pressure between the air in the hydraulic oil tank and the ambient air ensures problem free suction of the pump.

In an open circuit the hydraulic fluid is fed to the **consumer** (2 or 3) and also returned to the tank through way valves.

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Closed circuit

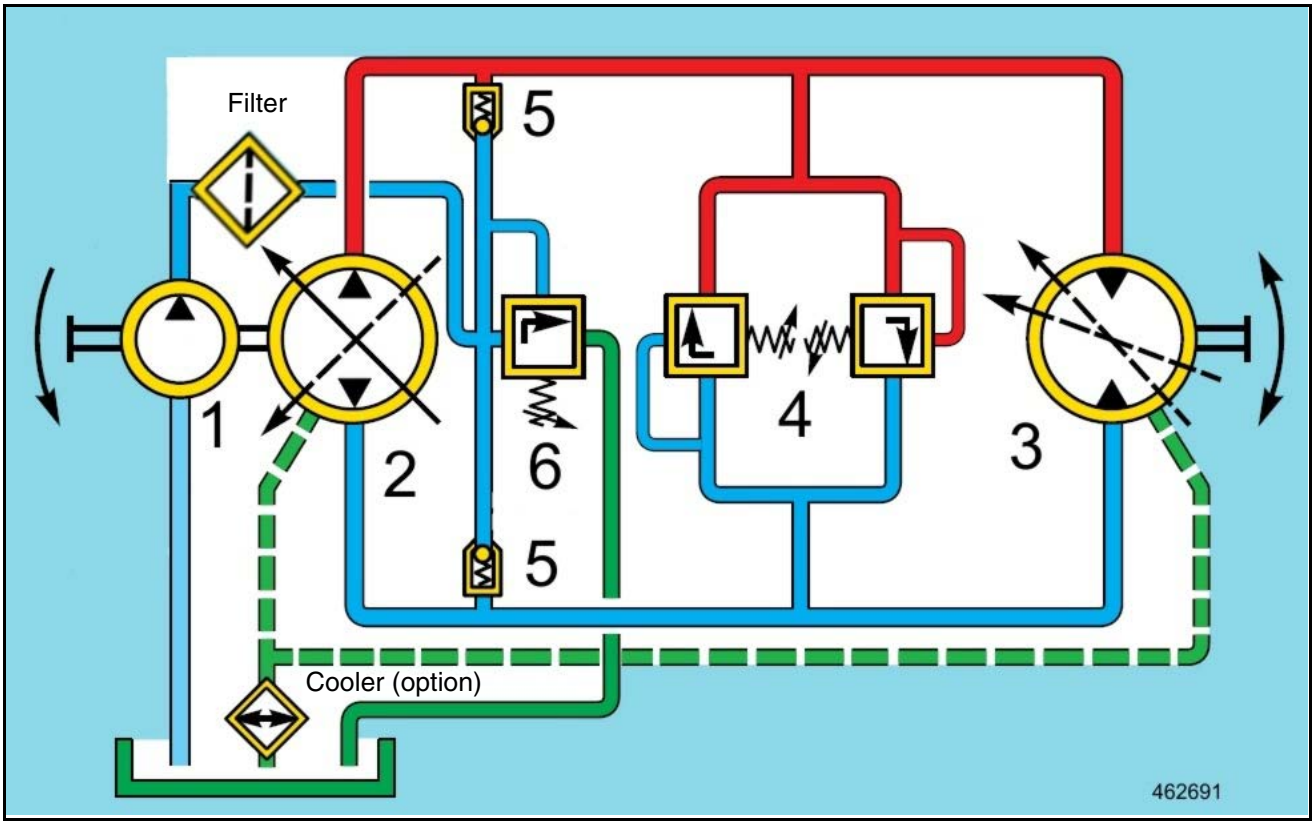


Fig. 2 Closed circuit

One talks about a closed hydraulic system, when the hydraulic oil flows from the **consumer** (3) (Fig. 2) directly back to the **pump** (2).

The closed circuit consists of a high and a low pressure side, depending on the load direction (take-off moment on the consumer).

The high pressure side is protected by **pressure relief valves** (4), which release oil into the low pressure side. The medium remains in the circuit.

Only the permanent leakage on pump and motor needs to be replenished. This is accomplished by a **charge pump** (1), which permanently delivers a sufficient amount of fluid (charge capacity) through a **check valve** (5) into the low pressure side of the closed circuit. Any excess oil delivered by the charge pump, which works in an open circuit, runs through a **charge pressure relief valve** (6) back into the tank. Charging the low pressure side enables the **pump** (2) to work with higher operating data.

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Travel system

On the machine described in this documentation the travel system works with a closed hydraulic circuit, i.e. the hydraulic oil remains in the pressure lines and circulates permanently between travel pump and travel motor.

The system is driven by a diesel engine, the output of which is transferred to the attached pumps (e.g. travel pumps and gear pumps)(Fig. 3).

The most essential components of the travel system are:

- the two travel pumps with integrated safety elements
- the travel motors with integrated safety elements
- the gear pump to release the brake and to tension the crawler tracks
- the brake releasing valve
- the travel gears with integrated brakes

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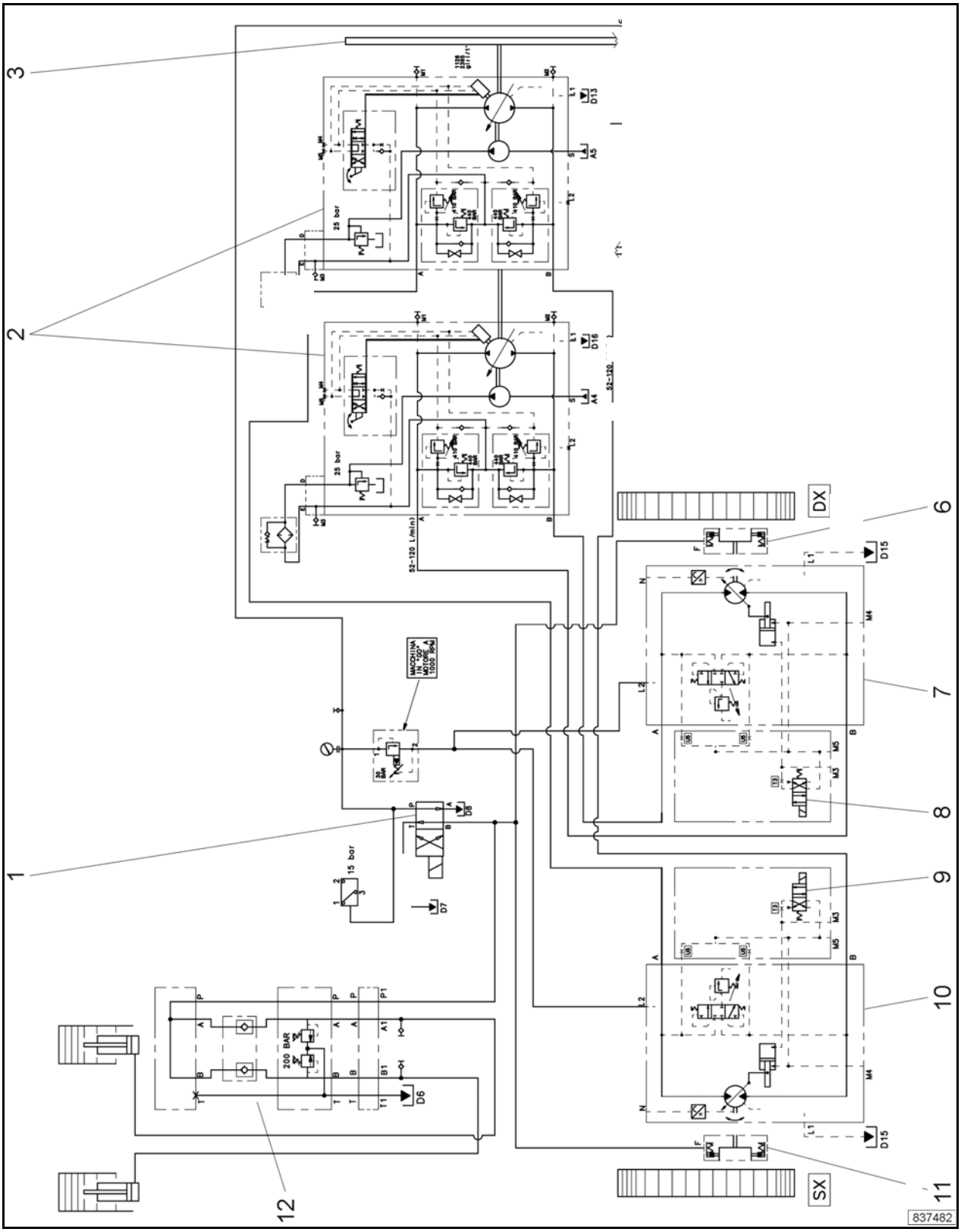


Fig. 3 Travel drive - excerpt from hydraulic diagram

1	Brake releasing valve	7	Travel motor, right
2	Travel pumps	8	Electric-hydraulic two-point control, travel motor right
3	Diesel engine	9	Electric-hydraulic two-point control, travel motor left
4		10	Travel motor, left
5		11	Travel gear, left
6	Travel gear, right	12	Valve block crawler track tensioning

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The travel pumps, which are linked to a tandem unit, have the function of supplying the complete travel drive with hydraulic oil.

The hydraulic oil is filtered by a charge pressure filter, which is fitted with an electric blockage monitoring facility and is hydraulically installed directly after the charge pumps for the charge oil circuit. The charge circuit also supplies the closed circuits with cool and filtered hydraulic oil to compensate for leakage and flushing quantities.

The gear pump at the auxiliary output of the engine is used for the brake releasing valve to release the hydraulically released spring accumulator multi-disc brakes and for the valve block for tensioning the crawler tracks.

The two travel motors are both flanged to a travel gear and can be switched between a fast speed range (low torque) and a slow speed range (high torque). Moreover, the travel motors are each hydraulically connected with an independently controllable travel pump and can thereby initiate travel movements and direction changes.

Brake circuit and valve block for crawler track tensioning

When the travel/working speed is returned towards neutral position or the travel direction is changed, the displacement of both or one travel pump is adjusted towards zero accordingly and the machine is hydraulically braked.

To avoid creeping movements of the machine, the machine is additionally equipped with spring accumulator multi-disc parking brakes in the travel gears. These close in neutral position of the travel lever and when the machine is stopped.

The spring accumulator multi-disc parking brake and the valve block for tensioning the crawler tracks are controlled via an electrically actuated 4/2-way solenoid valve (see section "Brake circuit"). In de-energized state the hydraulic oil supply from the gear pump to the brake pistons and to the valve block for crawler track tensioning is interrupted, so that the oil flows through the 4/2-way solenoid valve directly back into the hydraulic oil tank.
With the 4/2--way solenoid valve operated the spring accumulator multi-disc parking brake is released yb the applied hydraulic pressure and travel movements are possible. The hydraulic oil (brake releasing pressure) is also guided to the valve block for crawler track tensioning, which ensures automatic tensioning of the crawler track, while the integrated shock valves protect the hydraulic system against overloads.

Travel pumps

Both rotor pumps are linked to a tandem unit.

Two swash plate operated axial piston pumps with variable displacement from Sauer Danfoss, type 90R42-KA57 serve as travel pumps.

The pumps are equipped with all control and safety elements needed for operation in a closed hydraulic circuit. These are:

- the charge pump with charge pressure filter and charge pressure relief valve
- the servo control with electric control via a 4/3-way proportional valve
- the variable displacement pump with control cylinder
- the multi-function valves

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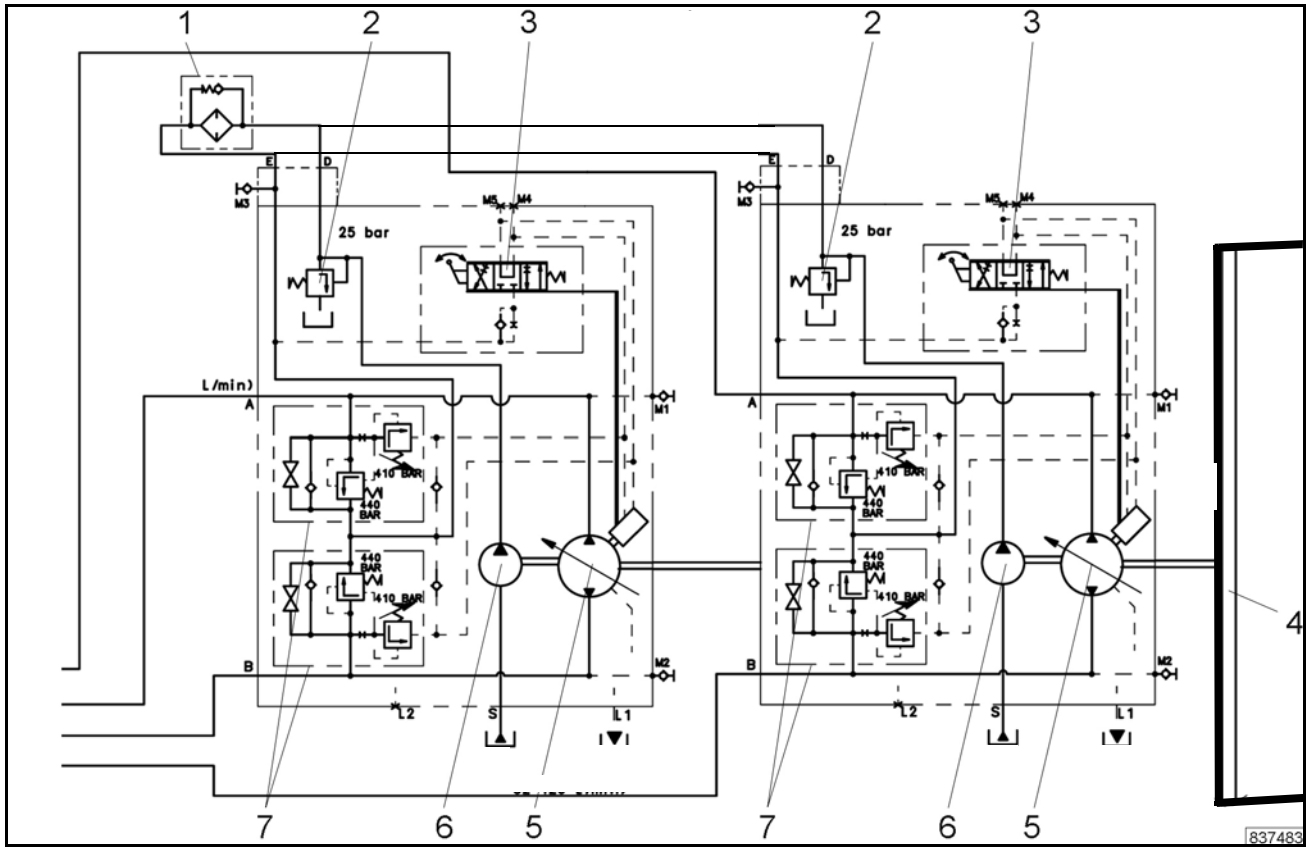


Fig. 4 Travel pumps - excerpt from hydraulic diagram

1	Charge pressure filter	5	Variable displacement pump
2	Charge pressure relief valve	6	Charge pump
3	Servo control (4/3-way proportional valve)	7	Multi-function valves
4	Diesel engine		

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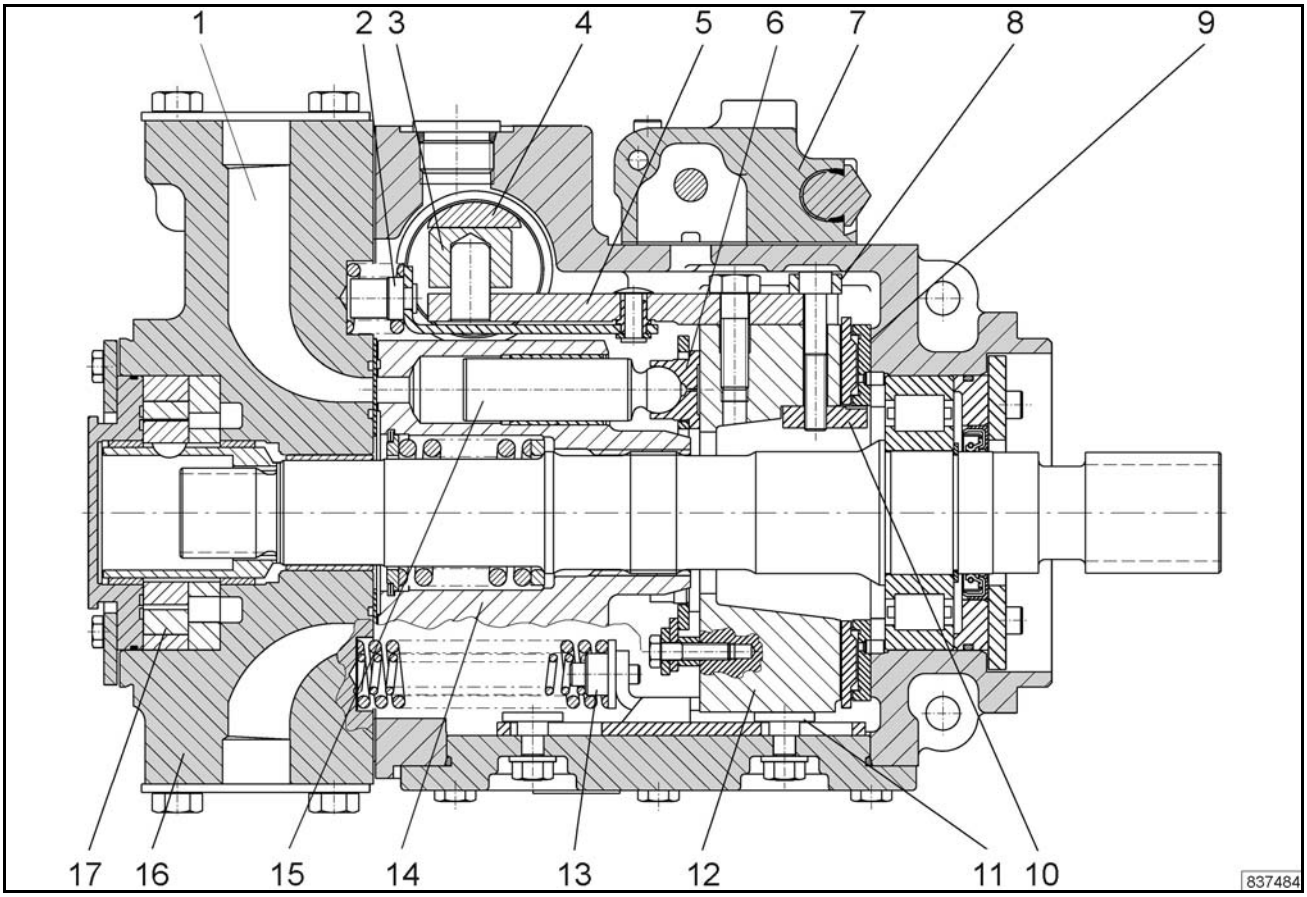


Fig. 5 Sectional view of travel pump (vertical)

1	High pressure port	10	Lateral swash plate guidance
2	Swashing lever hold-down	11	Lateral swash plate guidance
3	Sliding block	12	Swash plate
4	Control piston	13	Swash plate reset
5	Swashing lever	14	Cylinder block
6	Slipper pad	15	Working pistons
7	Servo valve (4/3-way proportional valve)	16	End housing
8	Recirculation	17	Charge pump
9	Swash plate bearing		

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Travel pump control unit

The travel pump control unit is an integral part of the pump housing and consists mainly of:

- the electro-hydraulic servo valve (7) (Fig. 5) or (1) (Fig. 6) with 4/3-proportional solenoid valve
- the swashing lever (5)(Fig. 5)
- the control piston (4)
- the swash plate (12)
- the swash plate bearing (9)
- the swash plate reset (13)

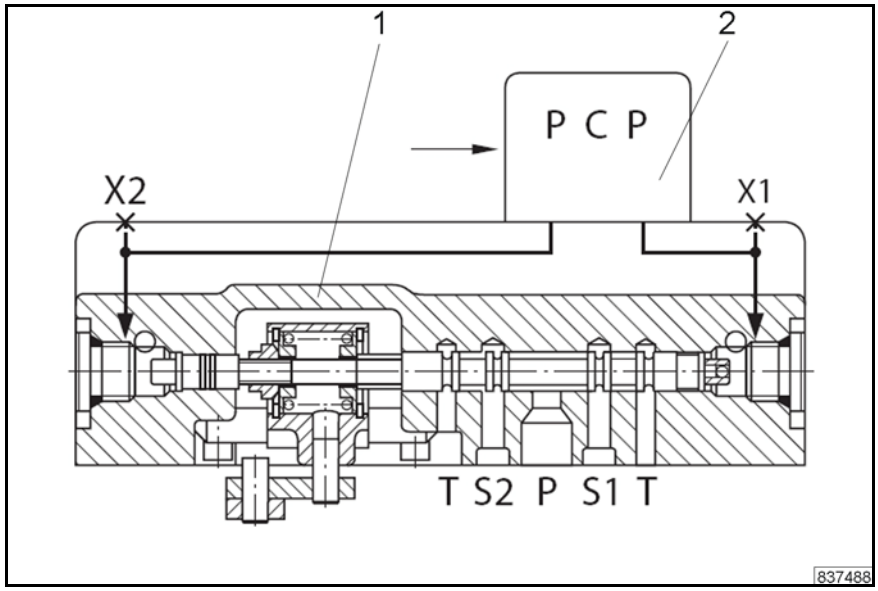


Fig. 6 Cross-sectional drawing of travel pump control

1	Servo valve (4/3-way proportional valve)	2	Pilot control valve

Function and design

The pilot valve (2) (Fig. 6) of the travel pump converts the electric input signal of the travel control into a hydraulic signal and thus controls the servo valve (4/3-way proportional valve) (1) accordingly. The servo valve opens or closes the charge circuit to one side of the double-acting control piston (4) (Fig. 5), which then moves due to the pressure application on one side.

The resulting displacement of the swash plate (12) (Fig. 5) or (5) (Fig. 7) triggers the movement of the working pistons (15) (Fig. 5) or (3) (Fig. 7) inside the cylinder block (14) (Fig. 5) or (2) (Fig. 7). During this axial movements hydraulic oil is drawn in from the low pressure side through the valve plate, pressurized by the upwards movement of the piston inside the closed cylinder and discharged into the high pressure side through the high pressure port (1) (Fig. 5) to the travel motors.

Once the control piston has reached the position that is determined by the input signal, the travel pump displacement will remain at a constant level. If the input signal is changed, e.g. by reversing the travel direction, the control elements will be repositioned through the neutral position, whereby the flow direction of the hydraulic oil will change.

The hydraulic oil from the opposite control chamber flows directly back into the hydraulic oil tank, together with the leakage oil.

Since the travel pump control is spring centred, the swash plate will automatically return to neutral position when the engine is shut down or in case of a pressure drop in the charge circuit.

As a measure to prevent metal to metal contact between the slipper pads (6) (Fig. 5) or (4) (Fig. 7) and the swash plate, all working pistons are bored through their entire length. The hydraulic oil flowing through these bore holes generates a hydrostatically balanced field on which the slipper pads can glide without having metal to metal contact with the swash plate.

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When operating the travel lever pressure builds up in the hydraulic lines between travel pump outlet and travel motor inlet, which is dependent on the load applied to the travel motors. This pressure keeps the boost check valve inside the multi-function valve (1) or (8) (Fig. 7) in closed position.

In order to be able to operate and control the travel system at all, the travel pump is equipped with a pump shaft driven charge pump (17) (Fig. 5) or (10) (Fig. 7). The hydraulic oil supplied by the charge pump serves the positive pressure supply of the travel circuit, the control of the travel pump, the supply of cool and filtered hydraulic oil and the compensation of leakages and flushing quantities. Due to the system design these leakages and flushing quantities can be replenished in the low pressure side of the closed hydraulic system, through the boost check valve, which is part of the multi-function valve.

The multi-function valve limits possibly occurring extreme pressure peaks to the setting of the valve. When these valves react, hydraulic oil flows out of the high pressure side and re-enters into the low pressure side.
Since the cross-sections of these valves are very small and the hydraulic oil enters the low pressure side already inside the travel pump, the system would very quickly overheat if the pressure in the system would be permanently relieved via the multi-function valves. For this reason the travel pump is equipped with an additional pressure override valve, which cuts off the control oil flow to the control piston. This regulates the displacement of the travel pump to the value determined by the pressure override.
If the pressure drops again, the pressure override valve will open and the travel pump can swash back to the previously chosen position. This design prevents overheating of the multi-function valves and thus of the entire hydraulic system as well as overloading of the engine.

The bypass function in the multi-function valve enables free circulation of the hydraulic oil, which may be needed when having to tow the machine. Opening of the bypass valve thereby causes a closed hydraulic circuit which bypasses the travel pump, but directly connects both pressure lines.

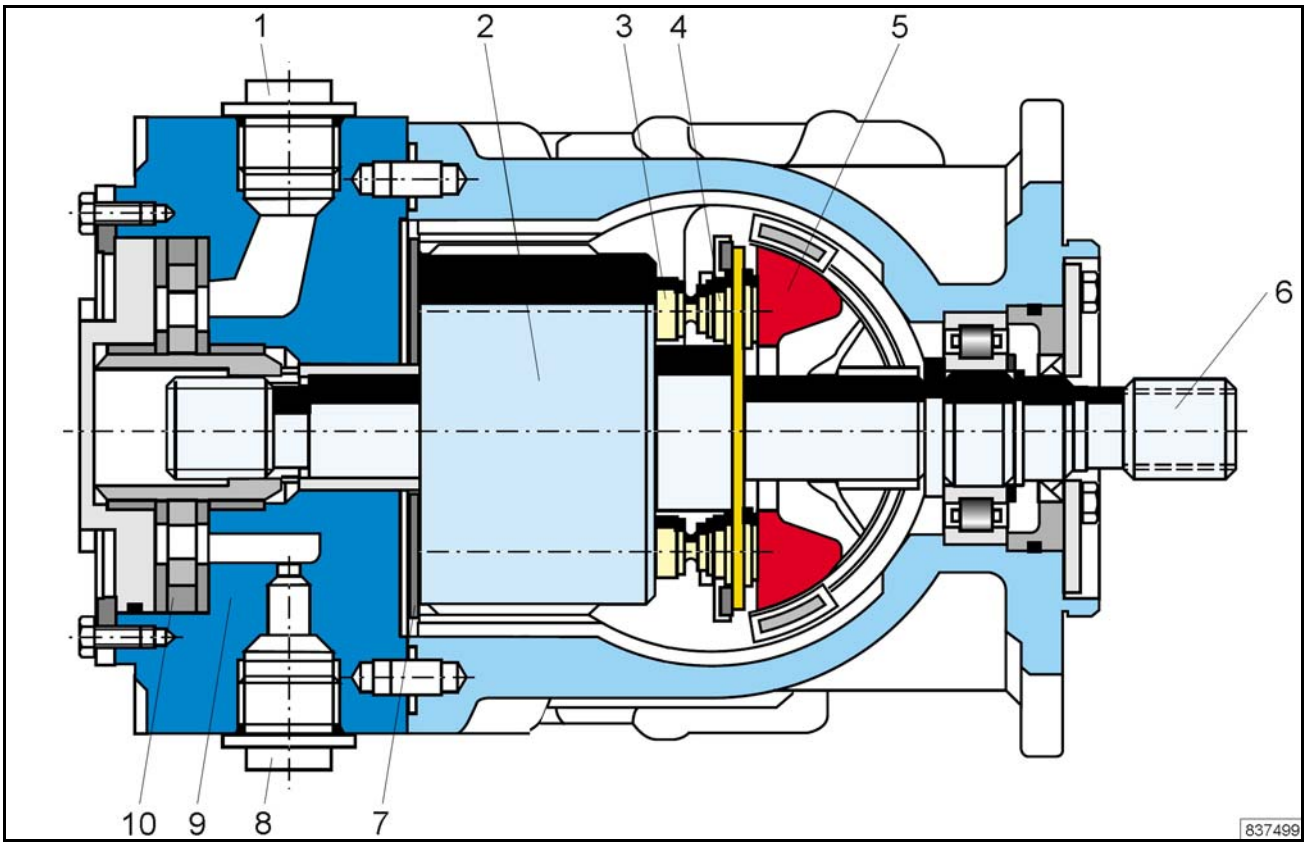


Fig. 7 Sectional view of travel pump (horizontal)

1	Multi-function valve	6	Drive shaft
2	Cylinder block	7	Valve plate
3	Working pistons	8	Multi-function valve
4	Slipper pad	9	End housing
5	Swash plate	10	Charge pump

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Charge pump

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The charge pump (1) (Fig. 8), which is integrated in the travel pump housing, is a fixed displacement pump, which delivers the same amount of hydraulic oil with each revolution.

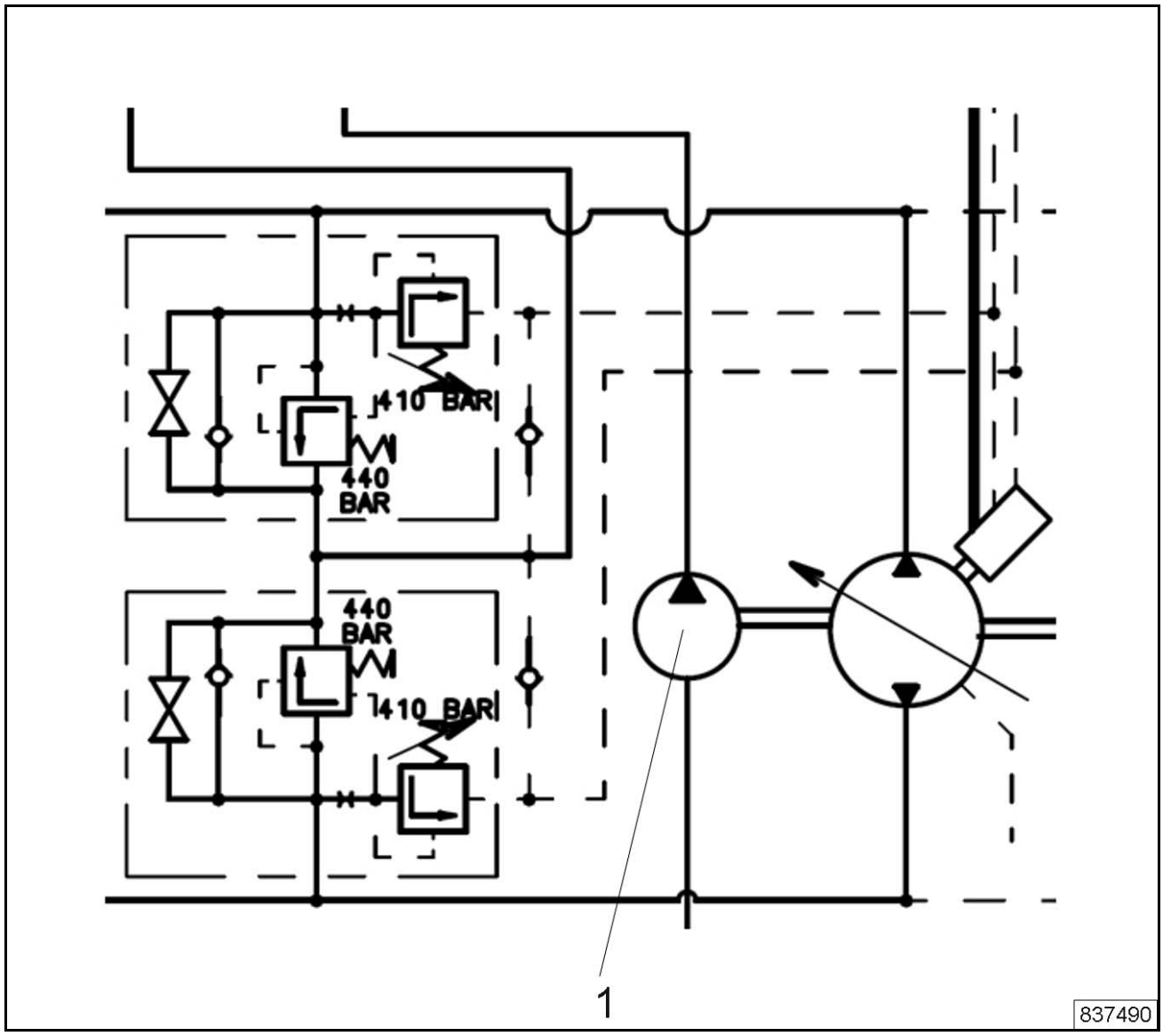


Fig. 8 Charge pump - excerpt from hydraulic diagram

1	Charge pump, integrated in travel pump

The drive is accomplished by the engine driven pump shaft of the corresponding travel pump.

The charge pump supplies the servo control on the variable displacement pump with the necessary amount of hydraulic oil via the charge pressure relief valve (see section "Charge pressure relief valve") and the charge pressure filter (see section "Charge pressure filter).
Due to the arrangement of the multi-function valves and their boost check valves (see section "Multi-function valves") the travel circuit is also supplied with cool and filtered hydraulic oil.

The boost check valves open towards the low pressure side and alloow hydraulic oil to flow from the charge circuit into the closed hydraulic circuit in order to compensate for leakages and flushing quanities and to reduce the hydraulic oil temperature.

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Charge pressure relief valve

The charge pressure relief valve (1) (Fig. 9) is a fixed, direct acting pressure relief valve.

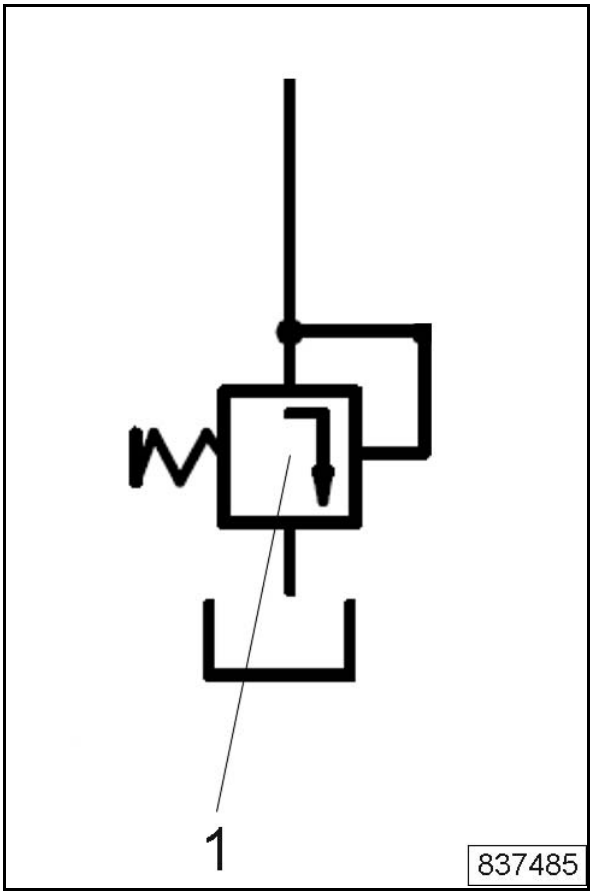


Fig. 9 Charge pressure relief valve - excerpt from hydraulic diagram

1	Charge pressure relief valve

The charge pressure relief valve has the function of limiting the supplied oil flow to the pressure value set by the valve and to return excess oil to the hydraulic oil tank.

In order to enable the compensation of leak oil and flushing quantities in the closed hydraulic circuit, the hydraulic pressure in the low pressure side is identical with the charge pressure.

Charge pressure filter

The charge pressure filter (1) (Fig. 10) is mounted to the engine. The filter has the function of filtering the pumped charge oil.

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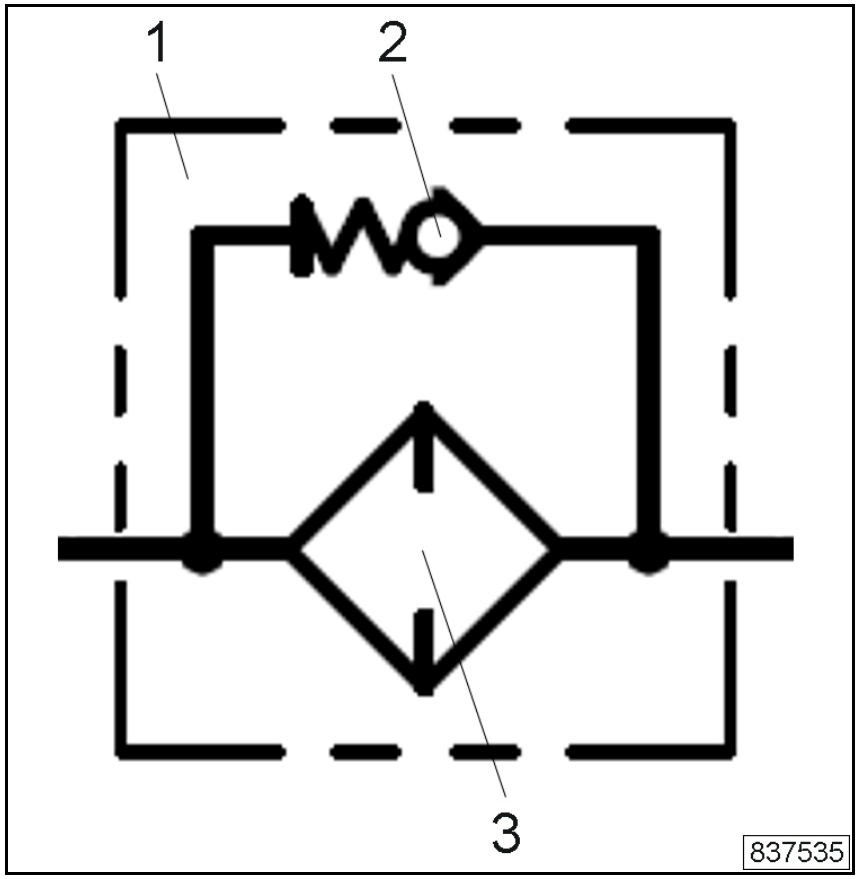


Fig. 10 Charge pressure filter - excerpt from hydraulic diagram

1	Charge pressure filter	3	Filter element
2	Bypass valve		

Function and design

The charge pressure filter is installed in the hydraulic circuit directly after the pump.

For safety reasons the filter is equipped with a bypass valve (2), so that the machine functions can be maintained with unfiltered charge oil, if the filter is blocked. In this case the higher charge pressure will act againstb the spring force of the bypass valve and thus open the bypass line around the filter element (3).

The condition of the charge pressure filter is electrically monitored by a sensor on the filter housing. In case of a blockage the indicating and control elements on the driver's stand will indicate that the charge pressure filter needs to be inspected and replaced.

Multi-function valve

The travel pump is secured by two multi-function valves (1) (Fig. 11). Each multi-function valve has an integrated no-stroke pressure controller (2), a high pressure relief valve (3), a boost check valve (4) and a bypass function (5).

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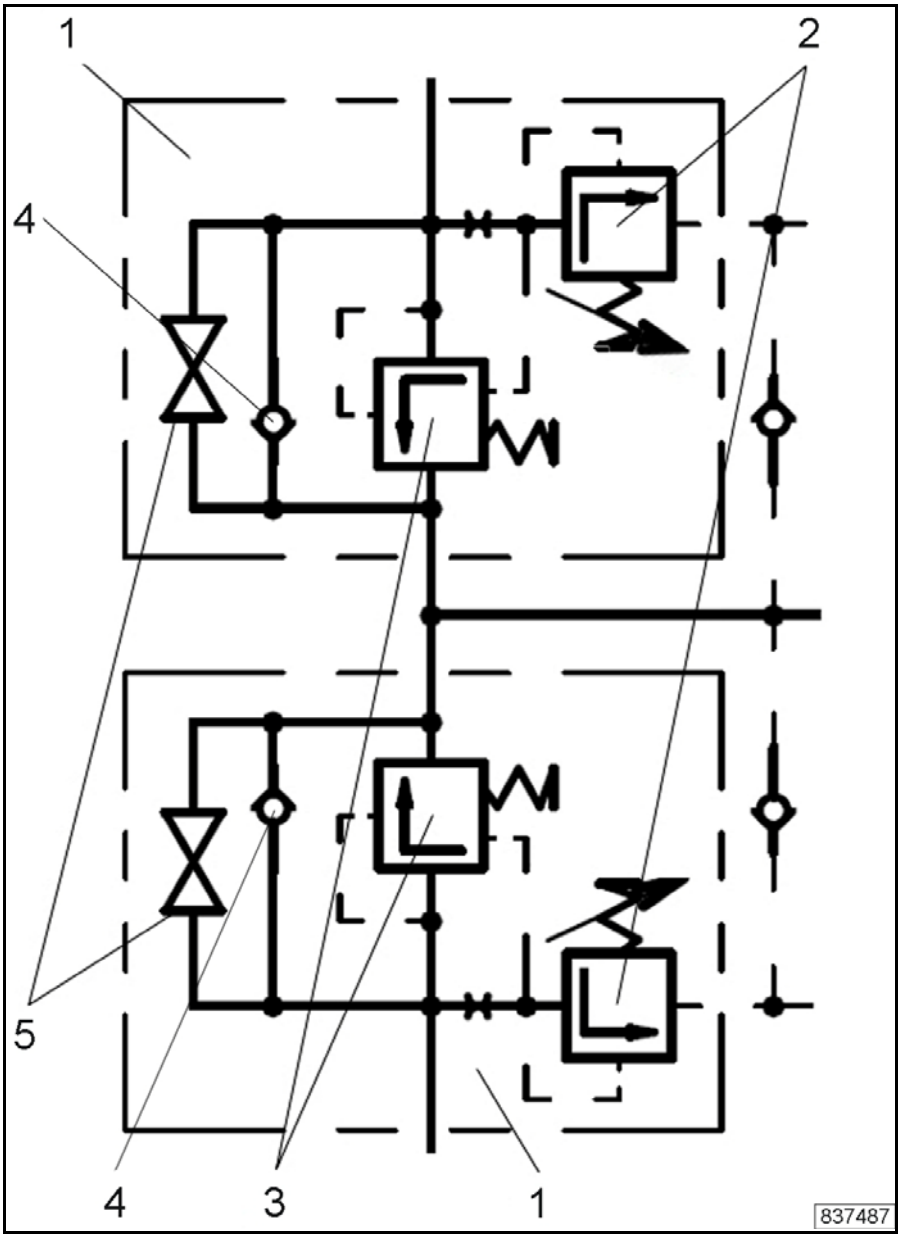


Fig. 11 Multi-function valve - excerpt from hydraulic diagram

1	Multi-function valve	4	Boost check valve
2	No-stroke pressure controller	5	Bypass
3	High pressure relief valve		

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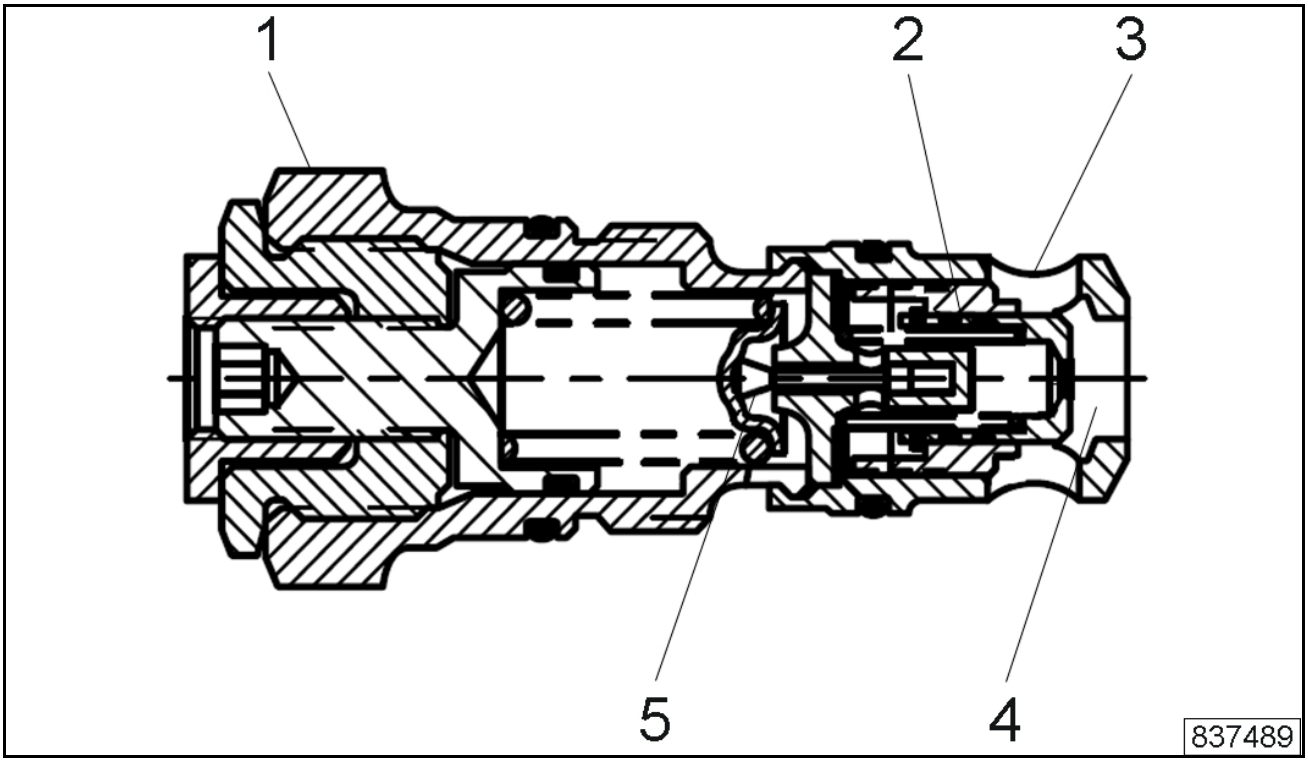


Fig. 12 Cross-sectional view of multi-function valve

1	Multi-function valve	4	Bypass valve
2	High pressure relief valve	5	No-stroke pressure control valve
3	Boost check valve		

Function and design

Once the maximum system pressure in the travel circuit set on the multi-function valve (1) (Fig. 12) is reached, the no-stroke pressure control valve (5) overrides the signal of the flow volume control and thus limits the system pressure by swashing the swash plate back (see section "Travel pumps").
In case of an exceptionally quick pressure increase in the travel system the integrated high pressure relief valve (2) will limit the system pressure immediately by opening the high pressure side towards the low pressure side of the travel circuit. Cutting off the hydraulic pressure this way, protects the hydraulic system against overpressure.

The boost check valve (3) in the low pressure side serves the purpose of compensating for leak oil and flushing quantities in the travel circuit. The boost check valve is able to open from the charge circuit to the low pressure side, because the hydraulic pressures in low pressure side and in charge circuit are almost identical, and allows hydraulic oil to flow into the closed travel circuit.

The bypass valve (4) in the multi-function valve enables free circulation of the hydraulic oil, which may be needed when having to tow the machine. By opening the bypass valve both pressure lines are directly connected, so that the hydraulic oil flow bypasses the travel pump and only circulates to the consumer.

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Travel motors

Unit of travel motor and travel gear

The travel motors (6) and (11) (Fig. 13)) are variable displacement axial piston motors from Sauer Danfoss, type 51C60, which are each flange-mounted to a travel gear.

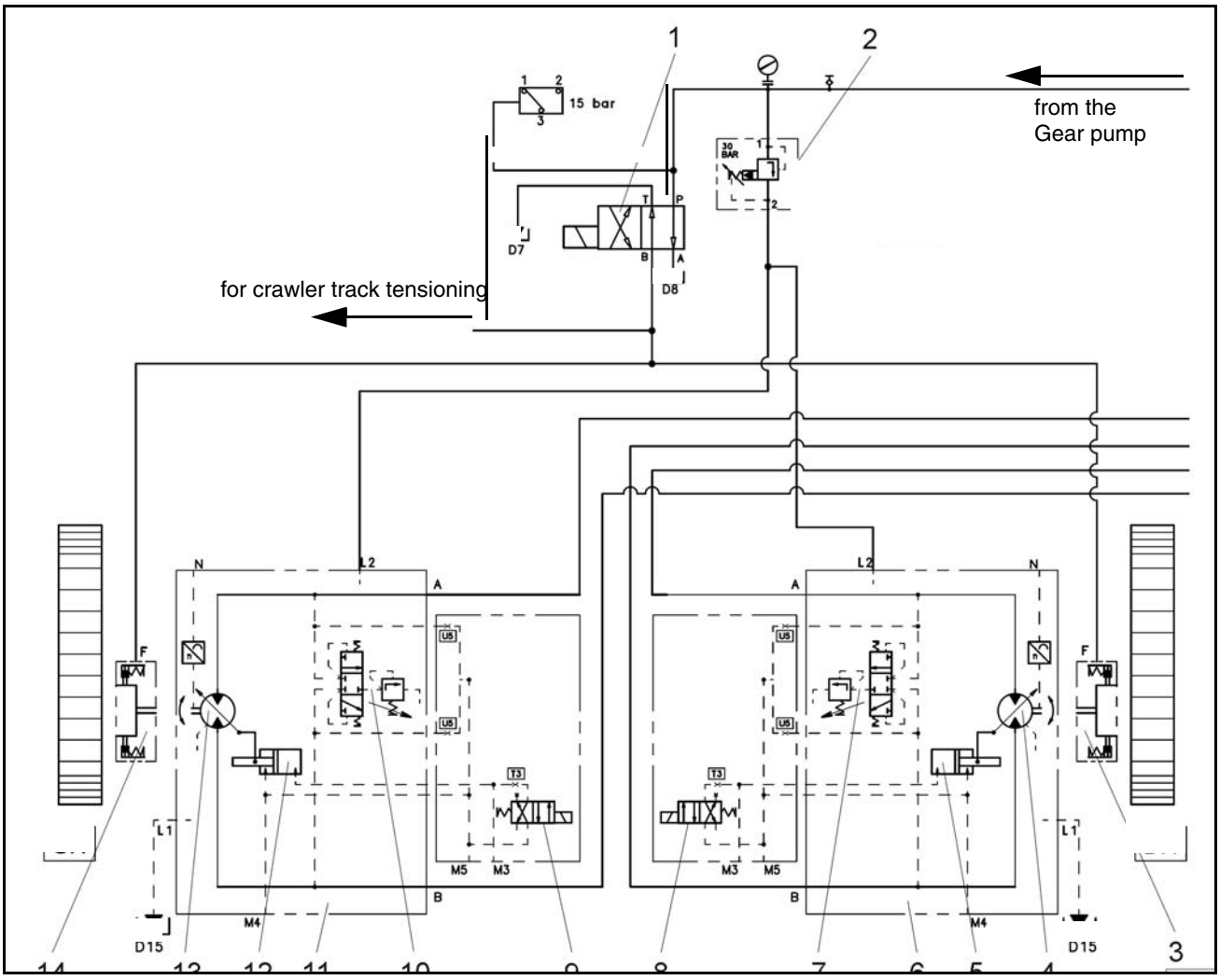


Fig. 13 Travel motors - excerpt from hydraulic diagram

1	Brake releasing valve	8	Electric-hydraulic two-point control, right
2	Pressure relief valve	9	Electric-hydraulic two-point control, left
3	Travel gear, right	10	Charge pressure relief valve, left
4	Variable displacement motor, right	11	Travel motor, left
5	Control piston, right	12	Control piston, left
6	Travel motor, right	13	Variable displacement motor, left
7	Charge pressure relief valve, right	14	Travel gear, left

Function and design

The travel motor is connected with the corresponding travel pump via the high pressure ports A and B. Hydraulic oil flows under high pressure through the adjustable valve segment (2) (Fig. 14) and the bearing plate (3) to the back of the working pistons (10). These are moving away from dead centre position. The inflowing hydraulic oil moves the working piston in the cylinder block (14) towards the upper dead centre and thus converts the stoke movement (axial movement) into a rotary movement of the drive shaft (8).

Since the angle of the cylinder block to the drive shaft can be changed via the electric hydraulic two-point control (8) or (9) to two different positions, the piston strokes of the working pistons are of different length, depending on the angle:

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- With a large angle (as shown in (Fig. 14)) the maximum stroke length of the working pistons results in max. displacement, which in turn results in a slow rotary speed but with a high torque.
- With a smaller angle the motor works with a shorter stroke length (min. displacement), which in turn results in a fast rotary speed but with a low torque.

Once the respective working piston (4) has reached its lower dead centre, the slot in the valve plate takes it over to the low pressure side . The pressurized working pistons on the high pressure side now move this particular working piston back to its top dead centre. This stroke pumps the hydraulic oil out of the cylinder room back to the travel pump.

The synchronizing shaft (5) ensures uniform rotation of output shaft and cylinder block. The ball joints of the working pistons run in a pivot bearing. It is press-fitted into the outer drive shaft, which is running in two taper roller bearings (7) in the housing.

The flushing pressure relief valve (12) flushes hydraulic oil out of the low pressure side into the motor housing to cool the high pressure circuit and to remove contaminants from the circuit. The flushing pressure relief valve limits the flushing pressure to 16 bar, so that it does not fall below the charge pressure of 16 bar.

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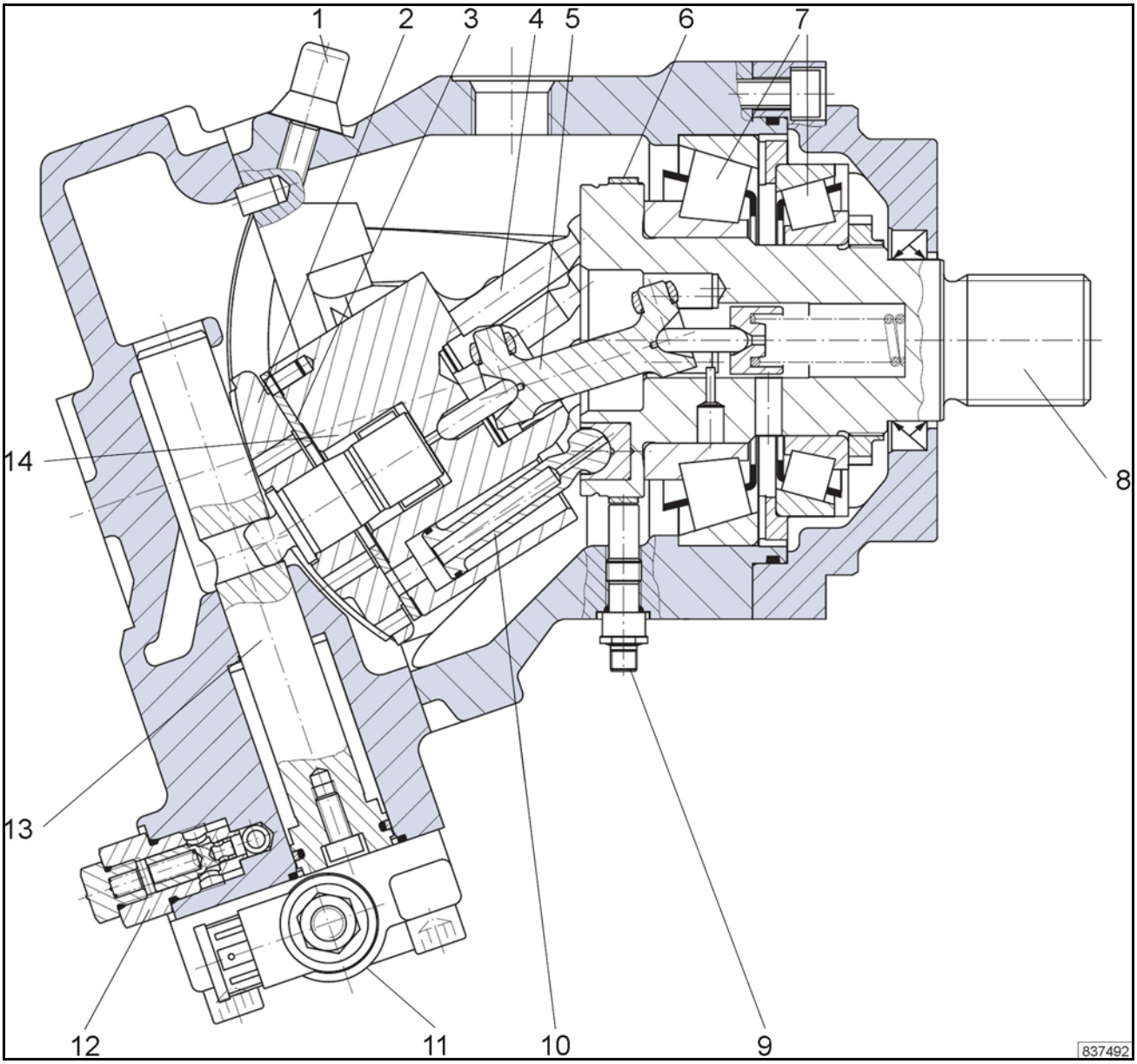


Fig. 14 Sectional view of travel motor

1	Setting of swashing angle	8	Output shaft
2	Valve segment	9	RPM-sensor
3	Bearing plate	10	Working piston (moving towards the top dead centre)
4	Working piston (moving towards the bottom dead centre)	11	Electric-hydraulic two-point control
5	Synchronizing joint	12	Flushing pressure relief valve
6	Magnetic ring for rotary speed detection	13	Control piston
7	Taper roller bearing	14	Cylinder block

Flushing pressure relief valve

The flushing pressure relief valve (1) (Fig. 15) is integrated in the housing of the travel motor. It has the function of flushing a certain quantity of oil out of the low pressure side, if the pressure increases in one of the two sides of the closed travel circuit.

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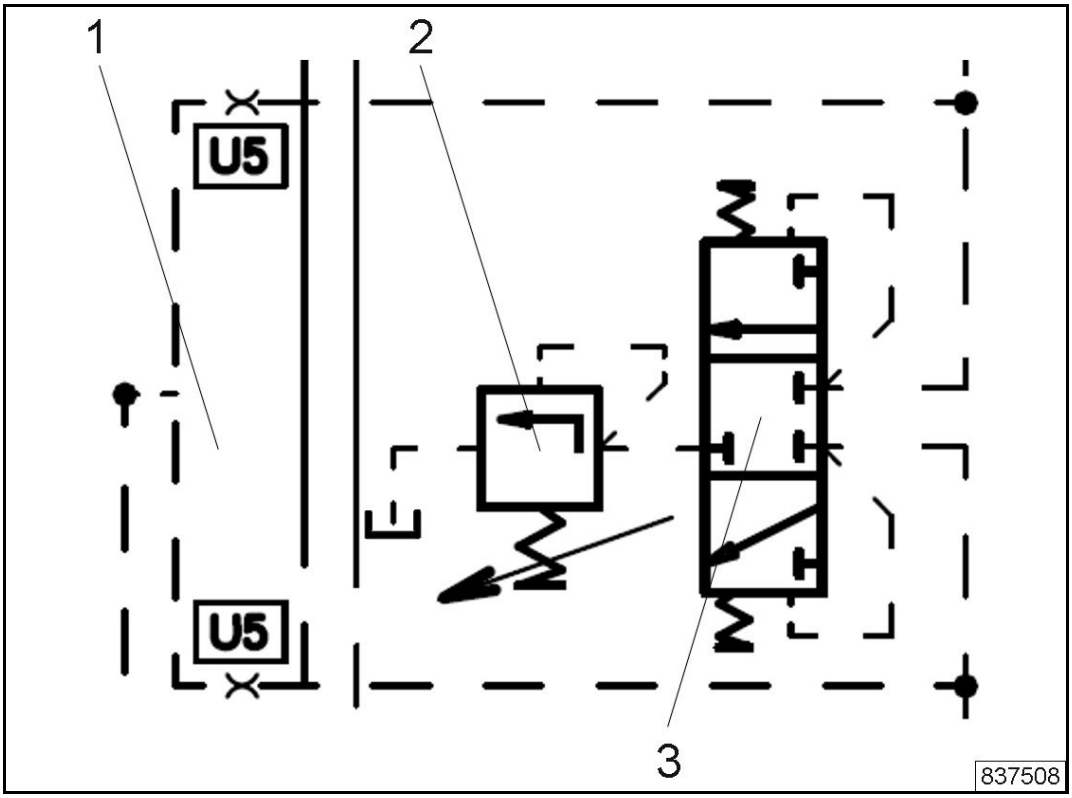


Fig. 15 Flushing pressure relief valve - excerpt from hydraulic diagram

1	Flushing pressure relief valve	3	3/3-way valve (spring centred)
2	Pressure relief valve		

Function and design

The pressure differential between high and low pressure side operates the flushing pressure relief valve (1) (Fig. 16). The increasing hydraulic oil pressure presses the 3/3-way valve (3) (Fig. 15) out of neutral against the neutral setting spring and thereby opens the low pressure side.
Hydraulic oil now flows out of the low pressure side through a pressure relief valve (2) back to the tank. The oil quantity flushed out of the closed hydraulic circuit is immediately replaced by oil entering from the charge circuit through the corresponding boost check valve.

In this way the closed travel circuit is permanently supplied with cool and filtered oil and the temperature household of the hydraulic system is maintained at a permissible level.

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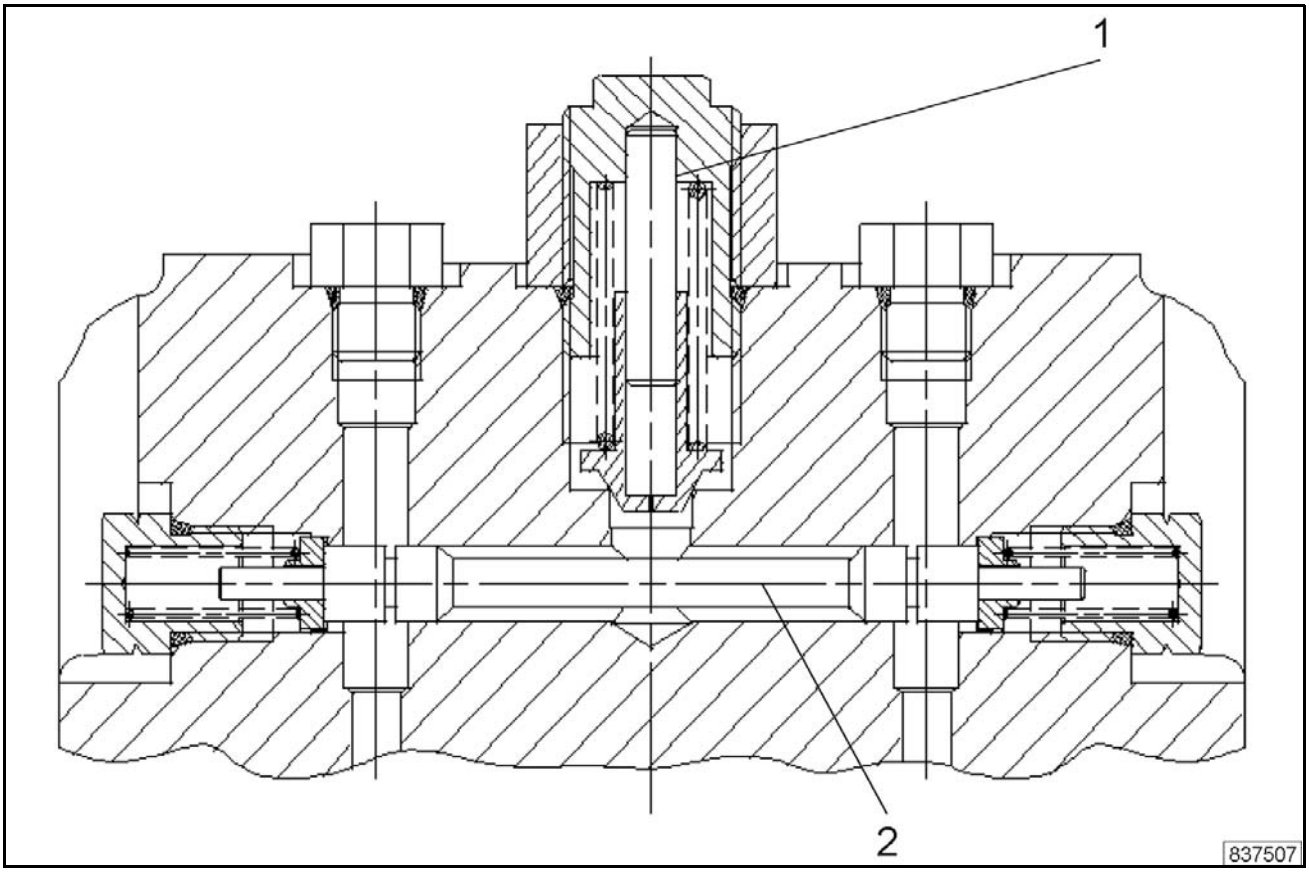


Fig. 16 Flushing pressure relief valve - cross-sectional drawing

1	Flushing pressure relief valve	2	Flushing spool

Travel gear

The travel gears are planetary gears for mobile equipment made by Bonfiglioli, type 707 C3B, which are each driven by a flange mounted travel motor.

Function and design

The housing side of the travel gear is rigidly connected with the crawler track drive via a flange. The travel motor is also flanged to the travel gear and meshes directly with the drive shaft.

The drive shaft carries an additional hydraulically released spring accumulator multi-disc parking brake. When the brake releasing valve is operated, pressure is applied to the brake. This hydraulic oil pressure works against the discs of the parking brake and releases the drive shaft for travel movements. Once the brake releasing valve returns to non-operated state, the brake will close again. Travel movements caused by the travel motors or undesired creeping of the machine are not possible.

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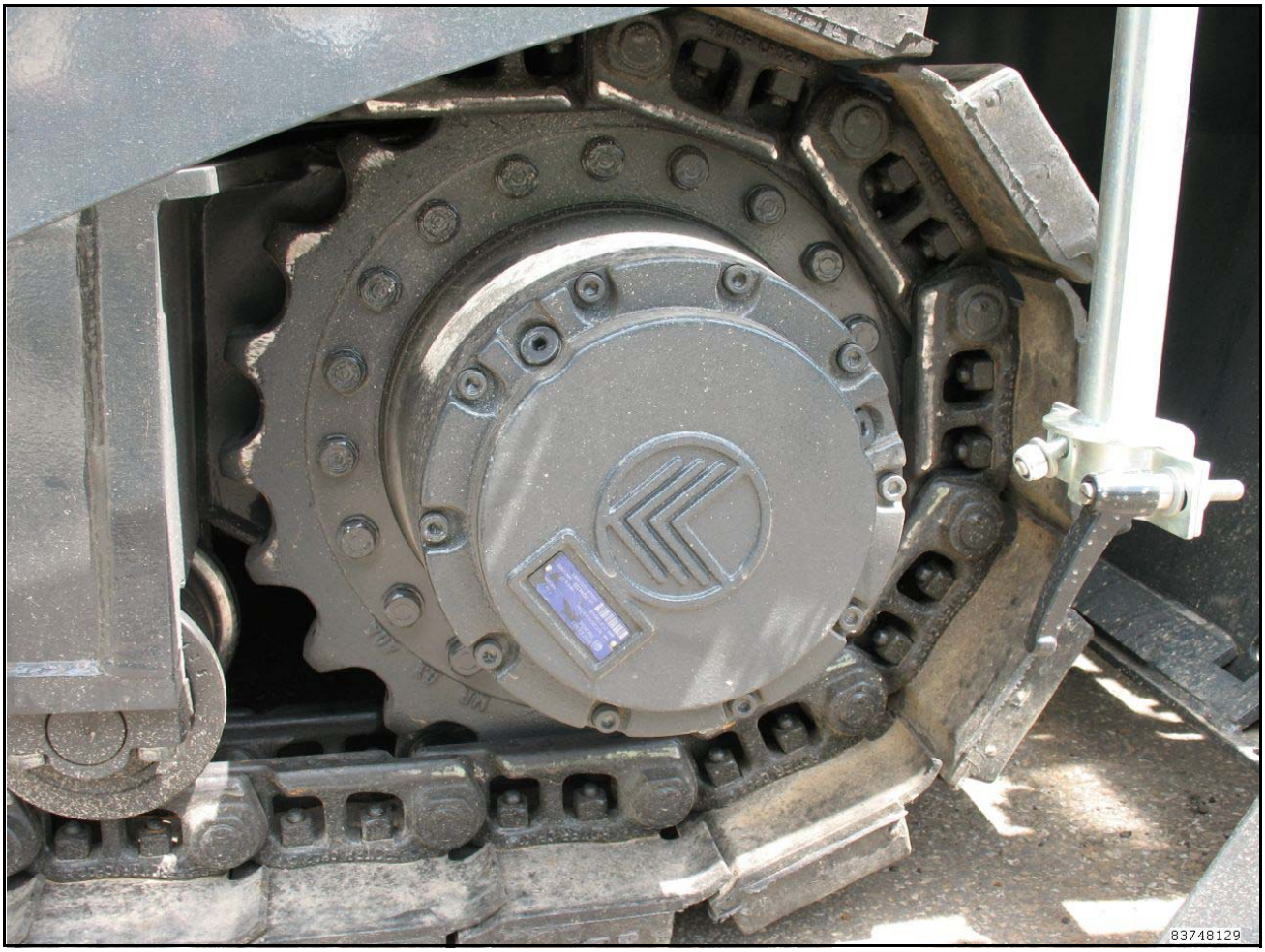


Fig. 17 Travel gear, left hand side

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Brake circuit

The brake circuit (Fig. 18) mainly consists of a brake releasing valve (1) and parallel connected pressure relief valve (3). The latter controls the function of the spring pressure contgrolled multi-disc parking brake.

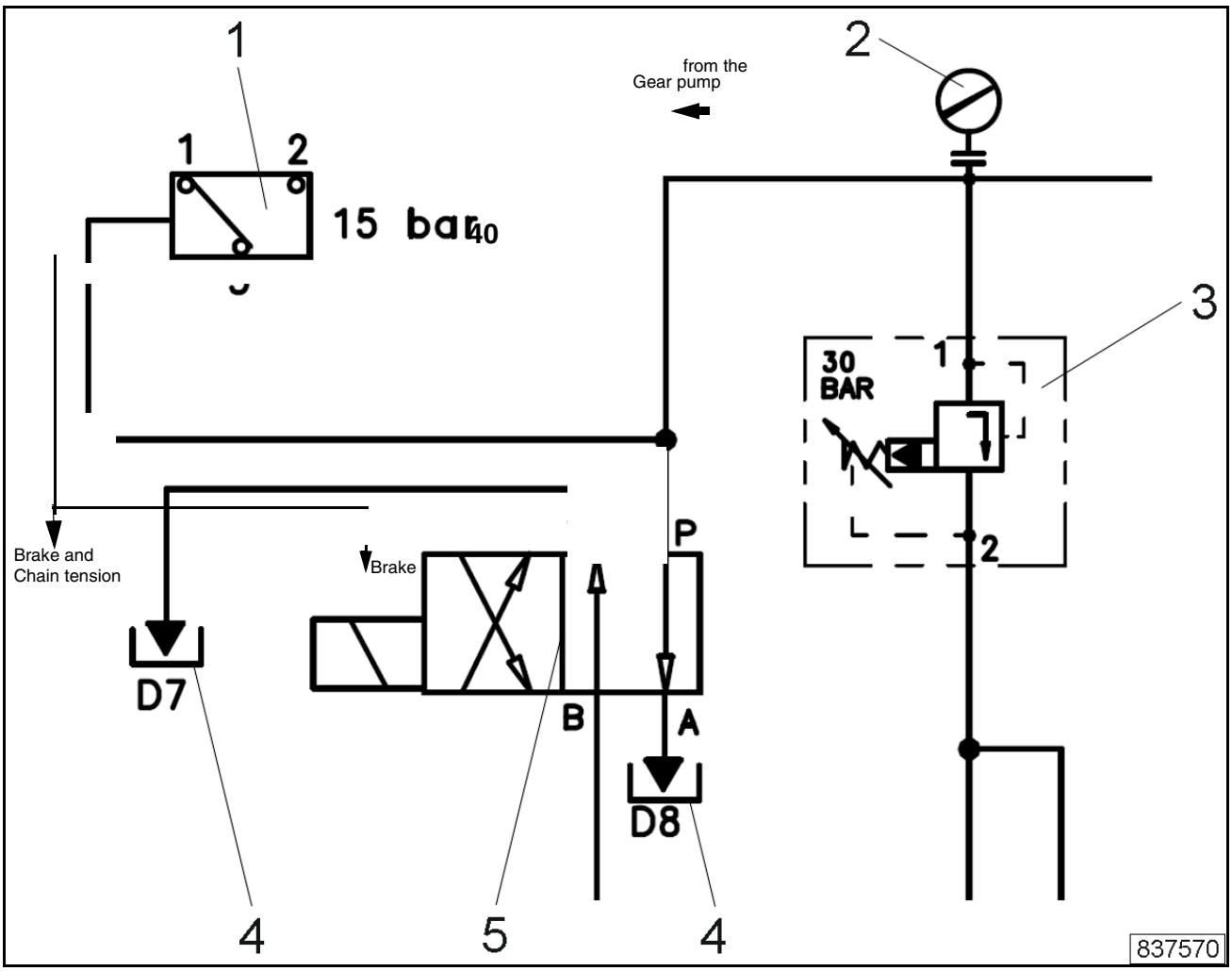


Fig. 18 Brake circuit - excerpt from hydraulic diagram

1	Pressure switch	4	Hydraulic oil tank
2	Pressure gauge	5	Brake releasing valve (4/2-way solenoid valve)
3	Pressure relief valve		

Function and design

With the brake releasing valve (5) **not operated** and when shutting down the engine, the parking brakes are automatically closed by the spring pressure working on the brake discs. The machine is not able to drive or even creep. In this case the hydraulic oil supplied by the scraper chain pump is guided through the brake releasing valve back to the hydraulic oil tank (4), together with the hydraulic oil from the spring accumulator multi-disc brakes.

With the brake releasing valve **operated**, the spring force in the parking brake is overridden by the hydraulic oil pressure. The brake discs are forced apart and the drive shaft is released for travel movements. The pressure relief valve (3) limits the hydraulic oil pressure by discharging excess hydraulic oil through the travel motor housing back into the hydraulic oil tank when the adjusted value is exceeded. This makes sure that both the entire brake system and the connected hydraulic system for track tensioning are limited to a certain hydraulic pressure.

The pressure switch (1) is located inside the brake releasing valve and is operated by hydraulic oil pressure. The switch (1) passes the corresponding switching state on to the vehicle control in form of an electric signal.

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Brake valve and solenoid valve for crawler tracks

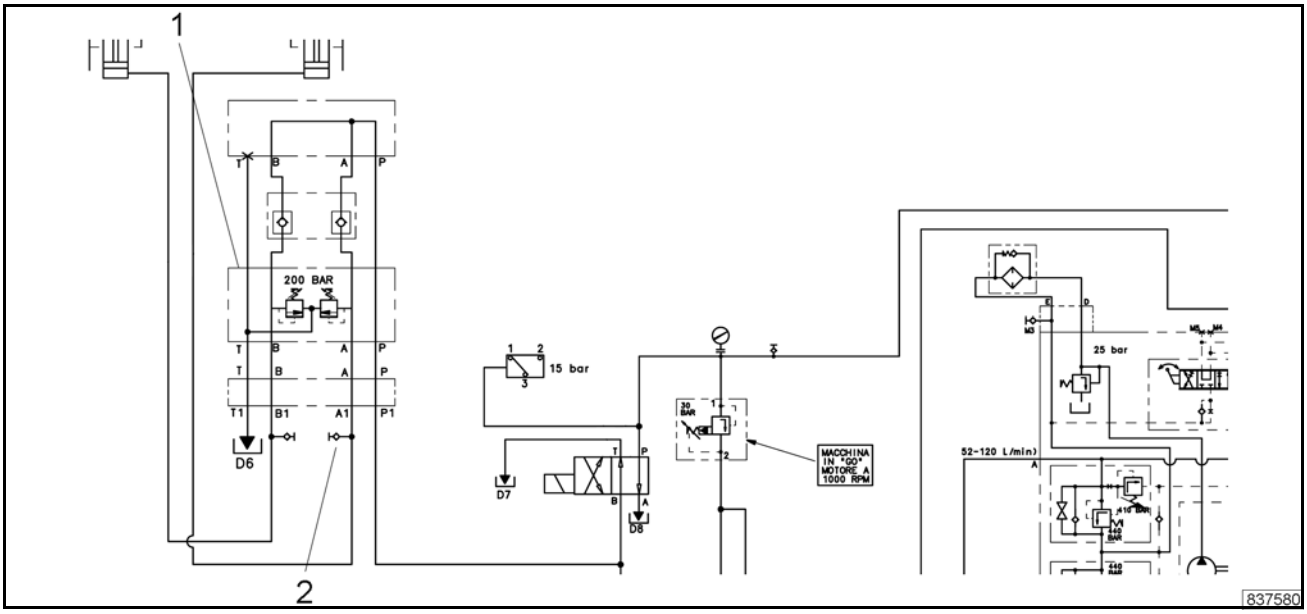


Fig. 19 Detail from hydraulic diagram

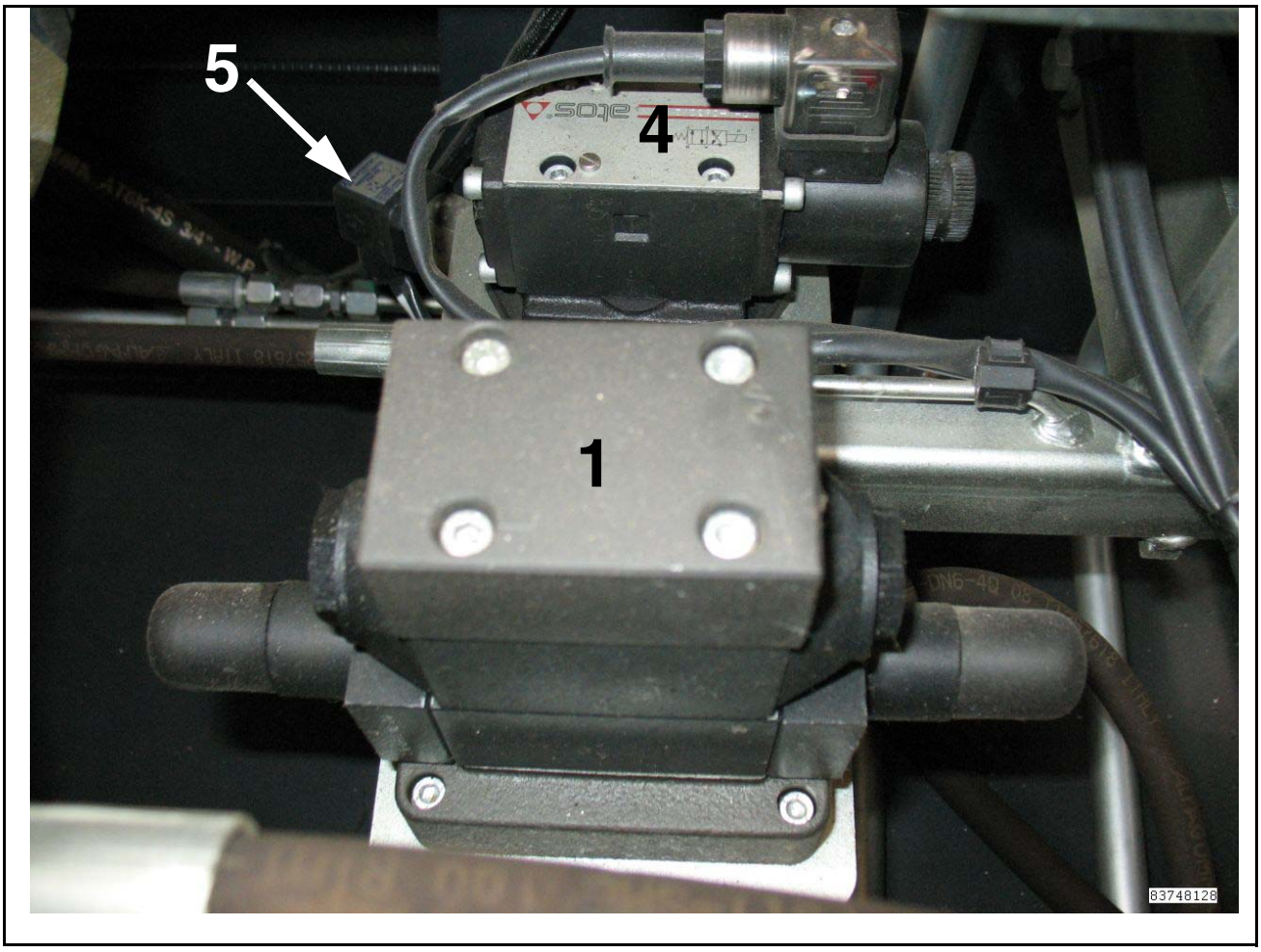


Fig. 20 Brake valve and solenoid valve for crawler tracks

1	Valve block for crawler tracks	4	Brake valve
2	Pressure test port, crawler track right	5	Pressure switch

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Brake pressure gauge

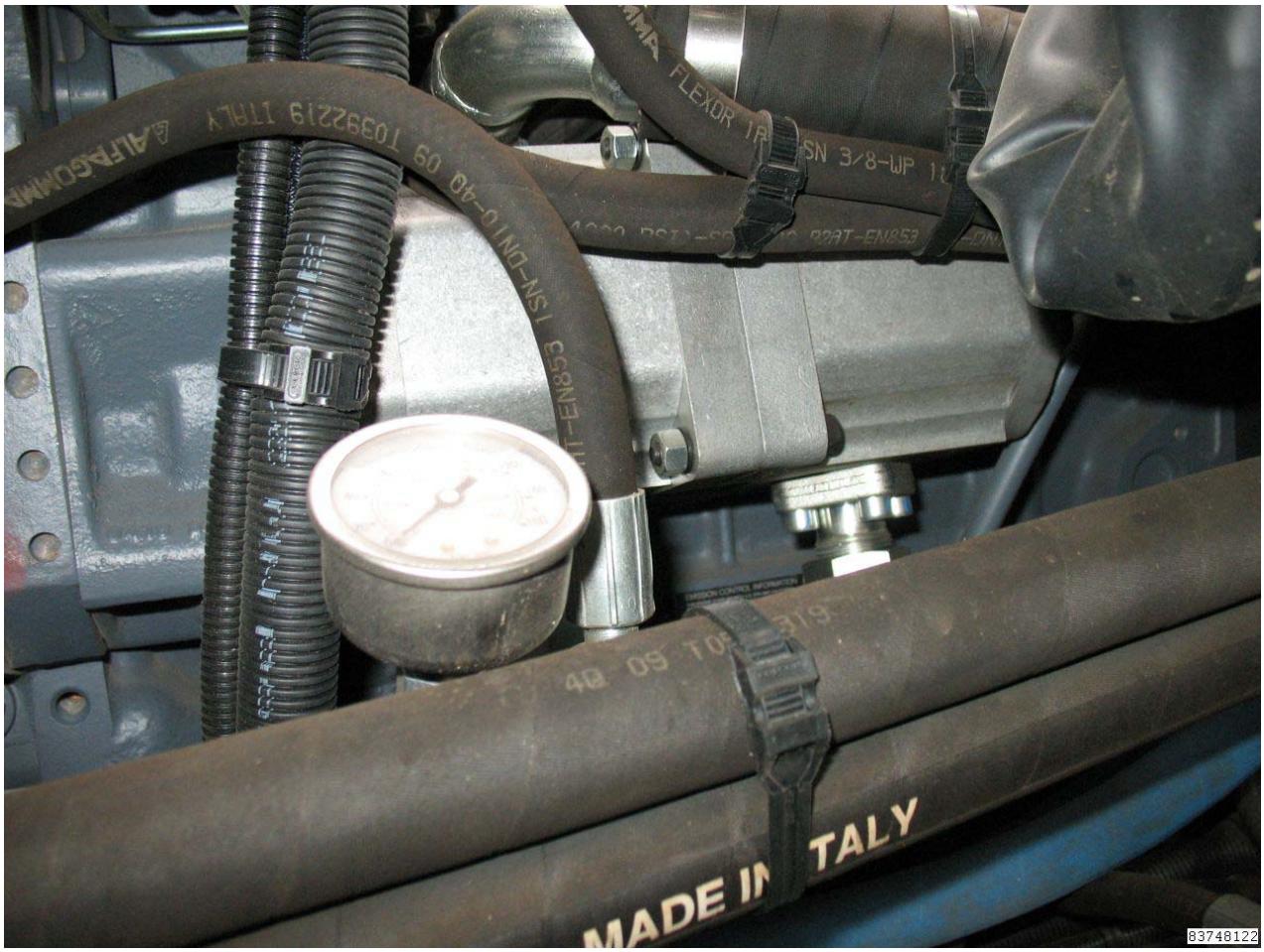


Fig. 21 Pressure gauge

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Valve block crawler track tensioning

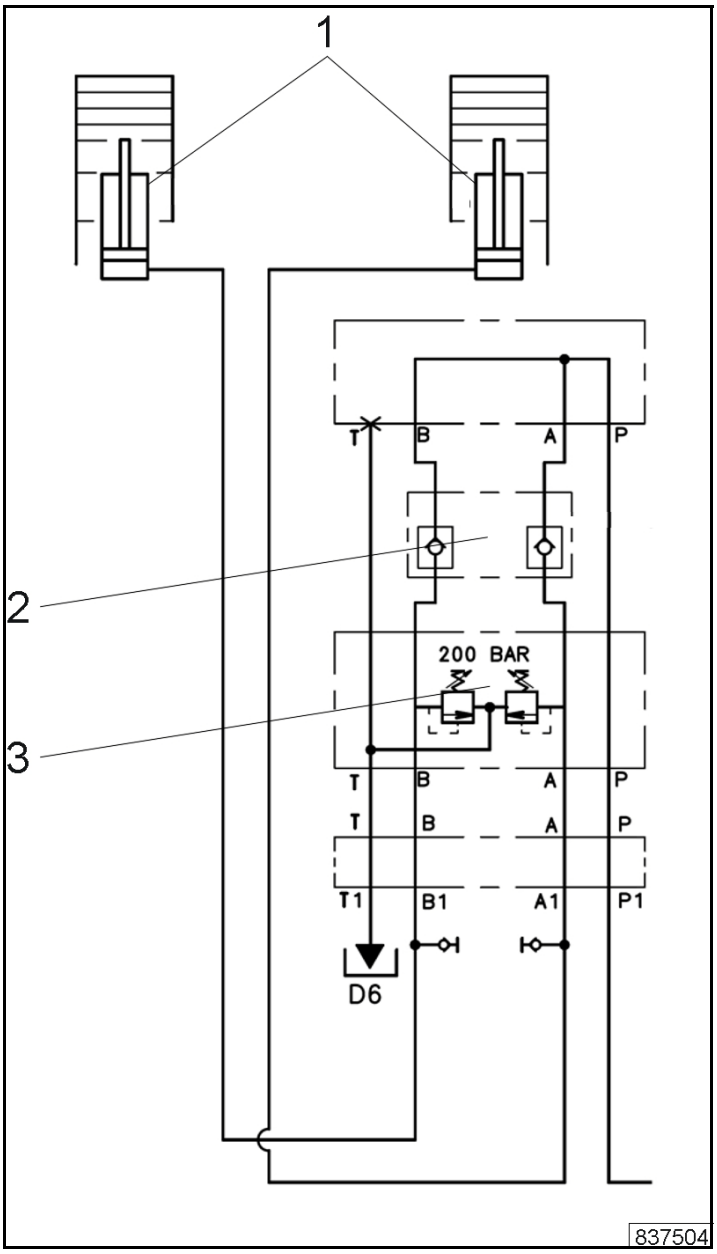


Fig. 22 Valve block crawler track tensioning - excerpt from hydraulic diagram

1	Tensioning cylinder
2	Check valves
3	Pressure relief valves

Function and design

The valve block for "Crawler track tensioning" is controlled via the brake releasing valve. Only the operation of the brake releasing valve supplies the valve block with hydraulic oil.

The pressure relief valves (3) (Fig. 22) in combination with the tensioning cylinders (1) keep up the tension of the crawler tracks with a constant pressure level. This enables automatic self-adjustment.

Shock relief

The two check valves (2) prevent any pressure increase in the hydraulic oil circuit caused by external influences (e.g. driving against an obstruction). Hydraulic oil is not forced back into the hydraulic circuit, but relieved through the two pressure relief valves (3) into the hydraulic oil tank. Moreover, the two check valves (2) also make sure that the track tension is maintained, even when the machine is shut down.

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Test and adjustment points

Travel pump, tandem unit with gear pump on through-drive side

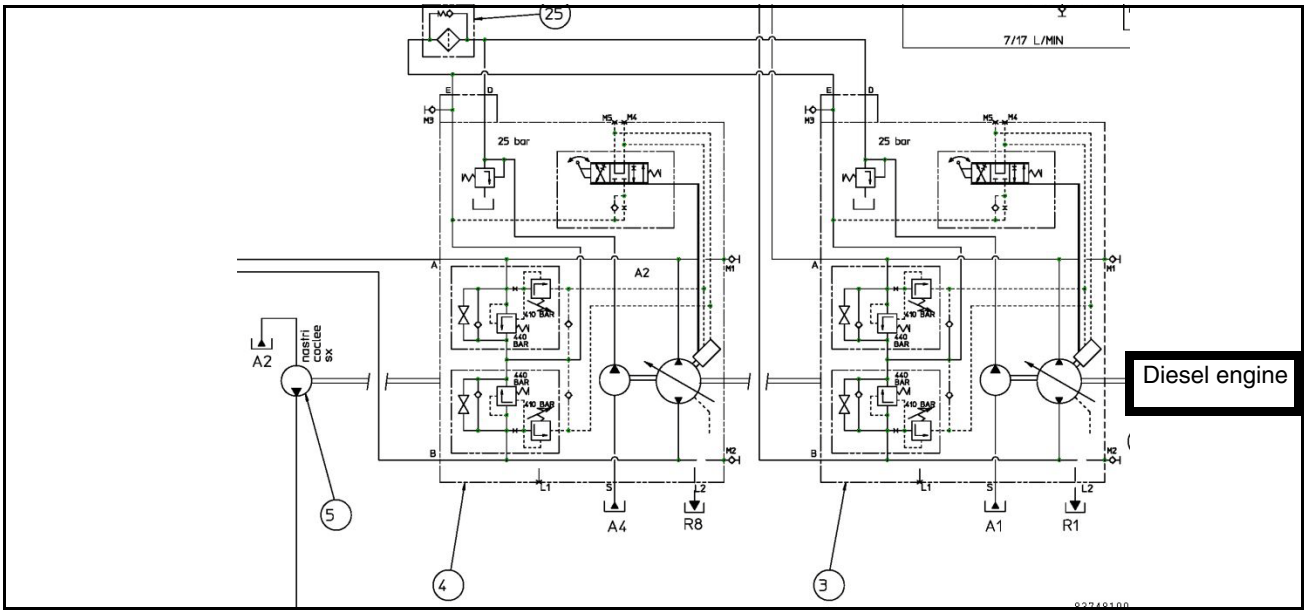


Fig. 23 Travel pump, excerpt from hydraulic diagram

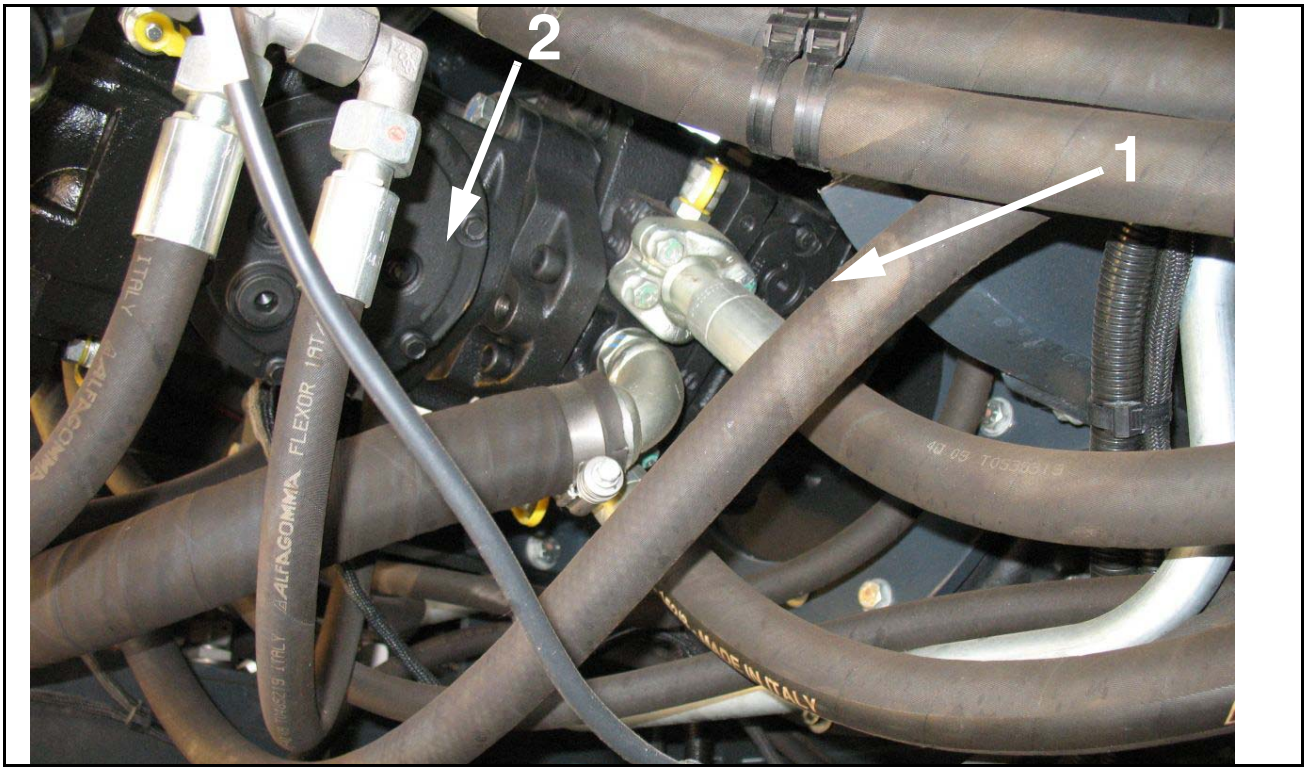


Fig. 24 Travel pump, tandem pump bottom view

Pos	Designation	Position in hydraulic diagram	Position in wiring diagram	Measuring values and switching points
1	Travel pumps for right hand travel drive	3		
2	Travel pumps for left hand travel drive	4		

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Pressure test ports, travel pump for travel drive right hand side

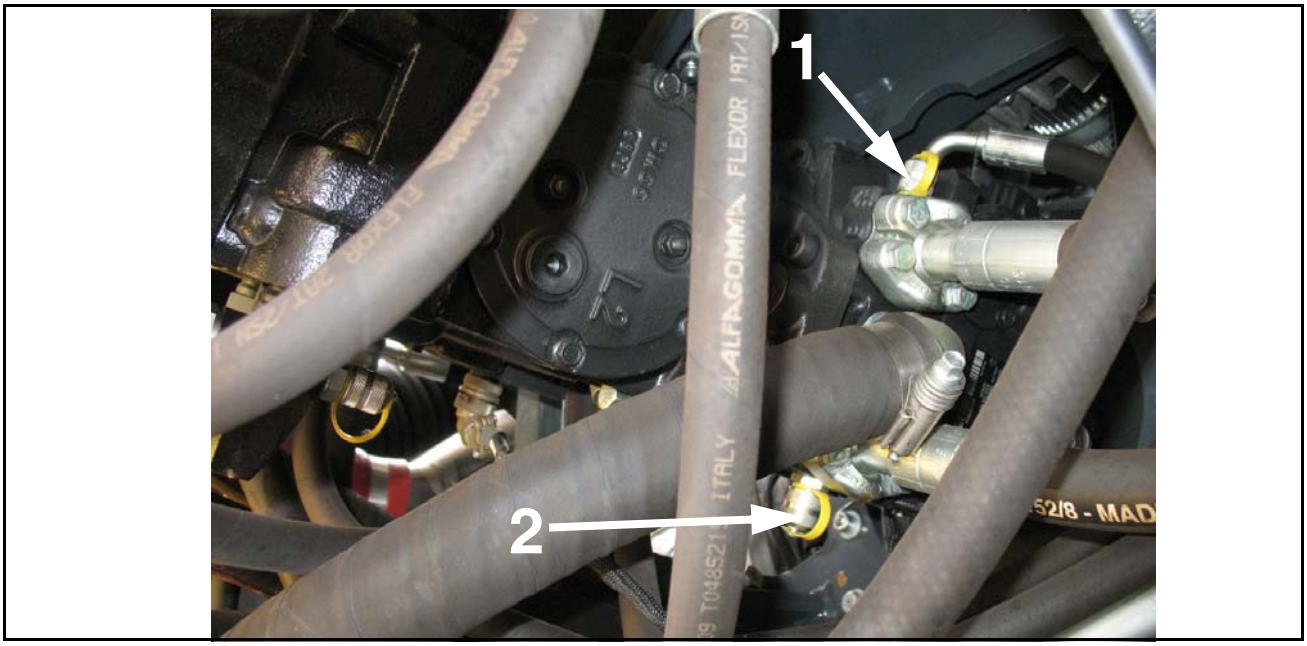


Fig. 25 Pressure test port high pressure, travel pump for travel lever right hand side

Pressure test ports, travel pump for travel lever left hand side

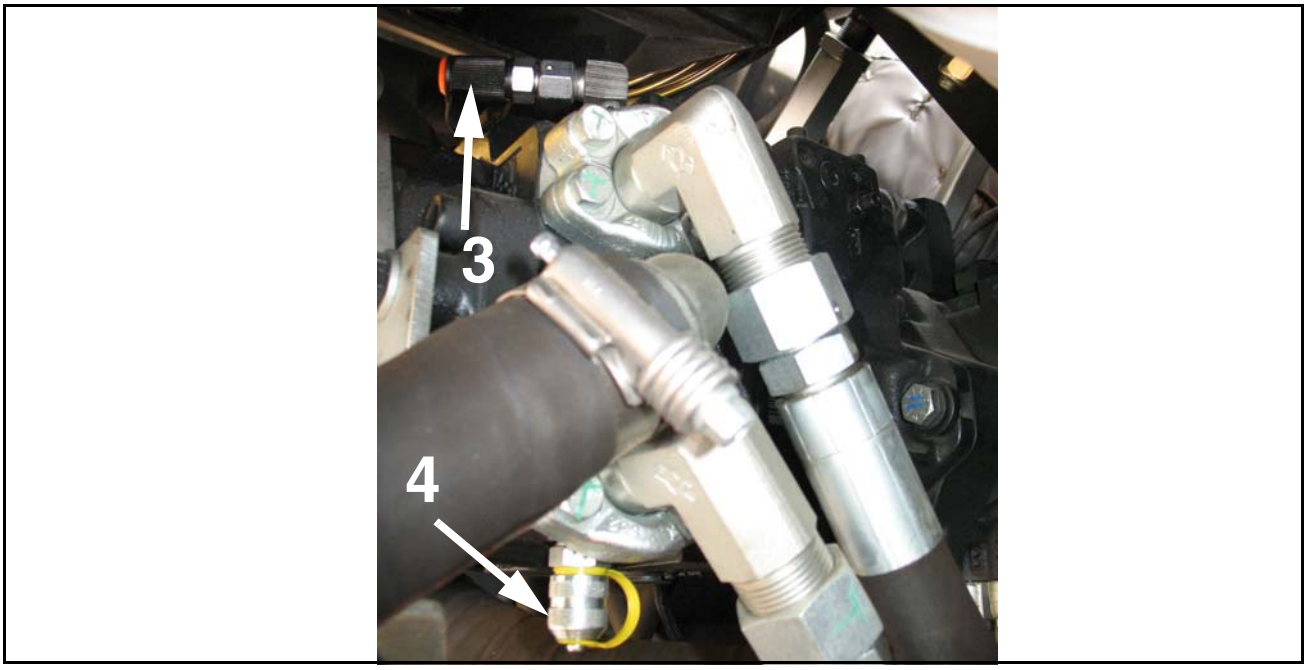


Fig. 26 Pressure test port high pressure, travel pump for travel drive left hand side

Pos	Designation	Position in hydraulic diagram	Position in wiring diagram	Measuring values and switching points
1	Pressure test port, high pressure - right hand side, forward-reverse	3- M1		Pressure override 410bar, HP 440bar
2	Pressure test port, high pressure - right hand side, forward-reverse	3- M2		Pressure override 410bar, HP 440bar
3	Pressure test port, high pressure - left hand side, forward-reverse	4- M1		Pressure override 410bar, HP 440bar
4	Pressure test port, high pressure - left hand side, forward-reverse	4- M2		Pressure override 410bar, HP 440bar

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Charge pressure test port on travel pump

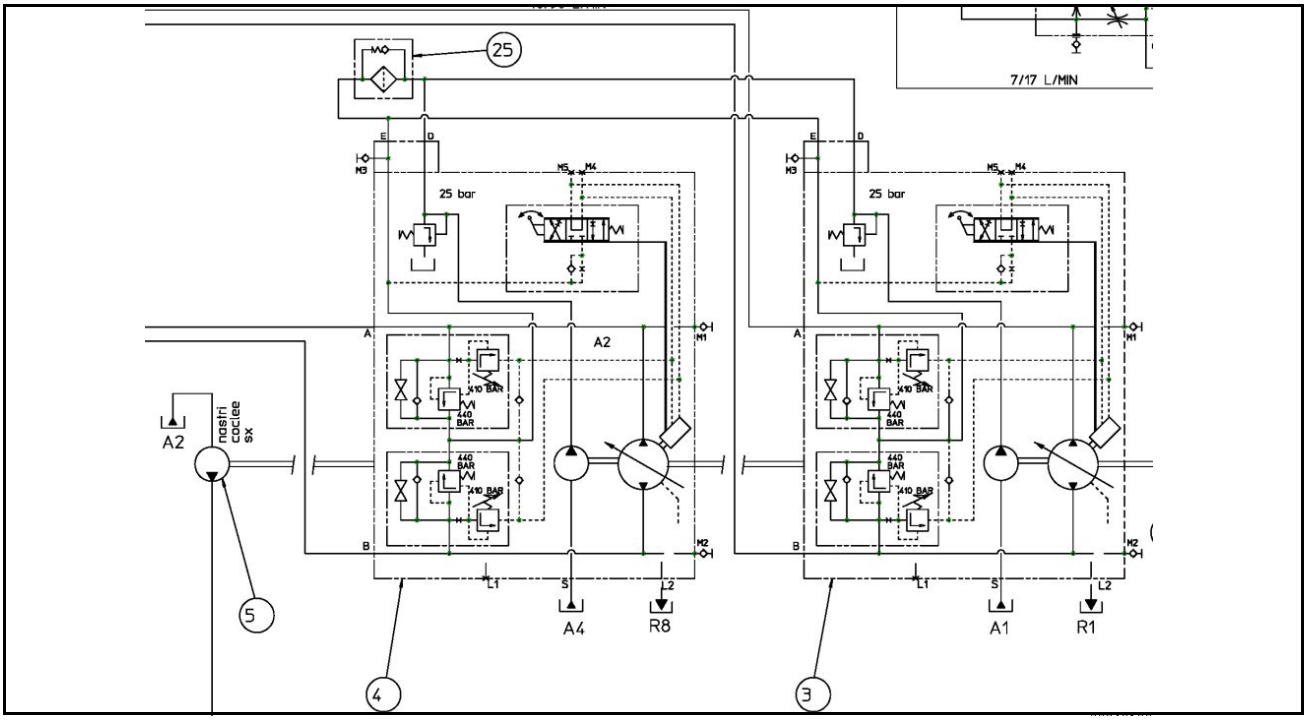


Fig. 27 Travel pump, excerpt from hydraulic diagram

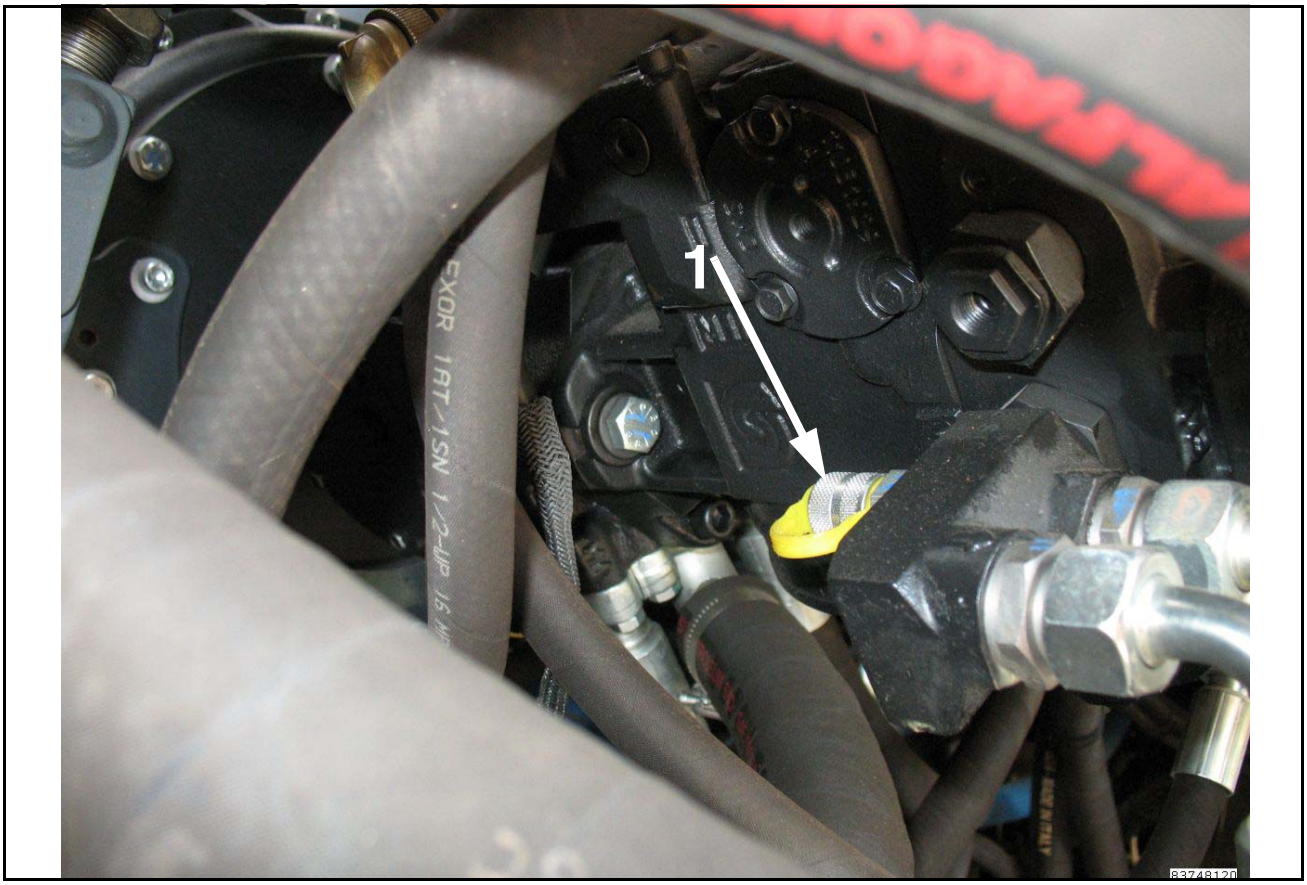


Fig. 28 Charge pressure test port on travel pump

Pos	Designation	Position in hydraulic diagram	Position in wiring diagram	Measuring values and switching points
1	Pressure test port, charge pressure	4- M3		25 bar

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Travel pump control control, proportional valve

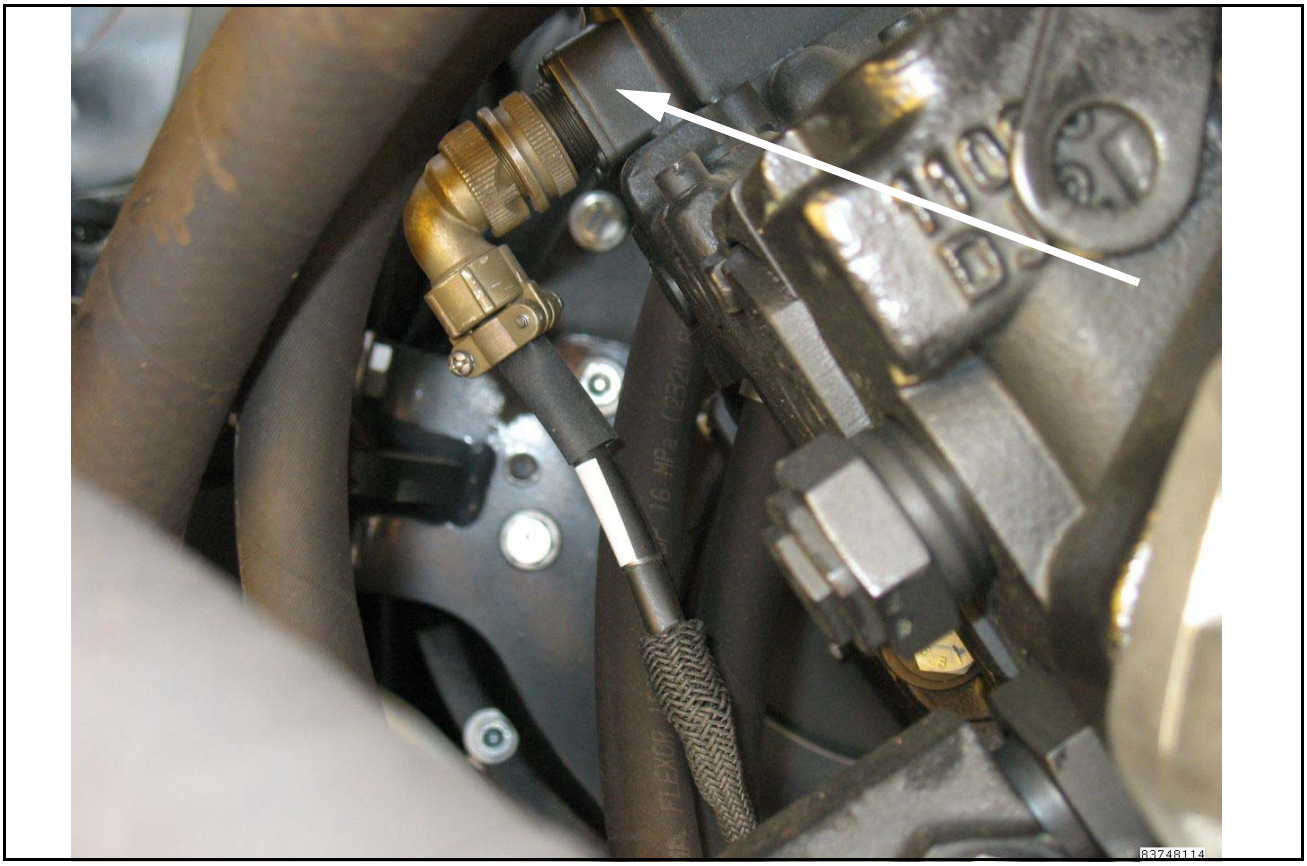


Fig. 29 Proportional control

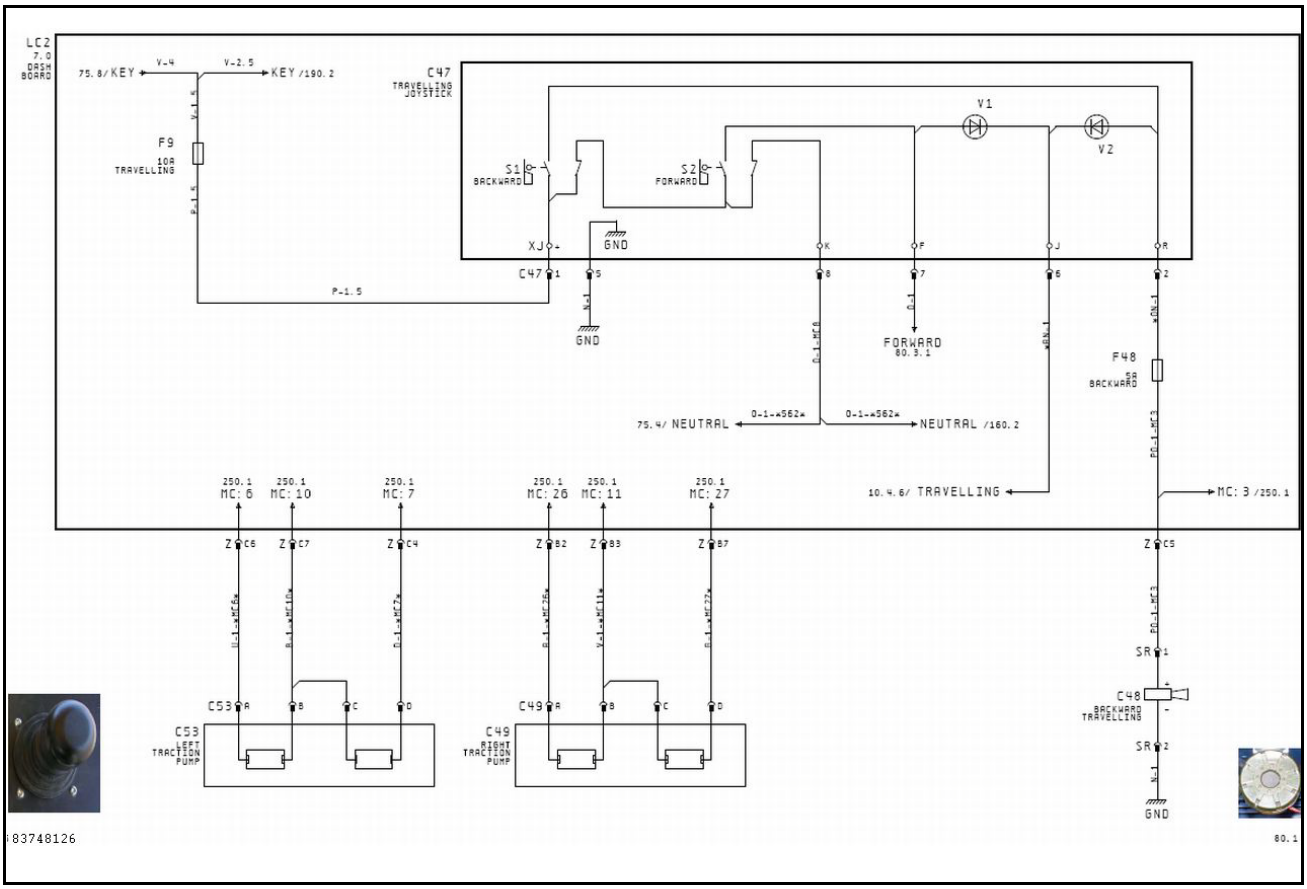


Fig. 30 Travel drive - excerpt from wiring diagram

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Charge pressure filter and travel pump

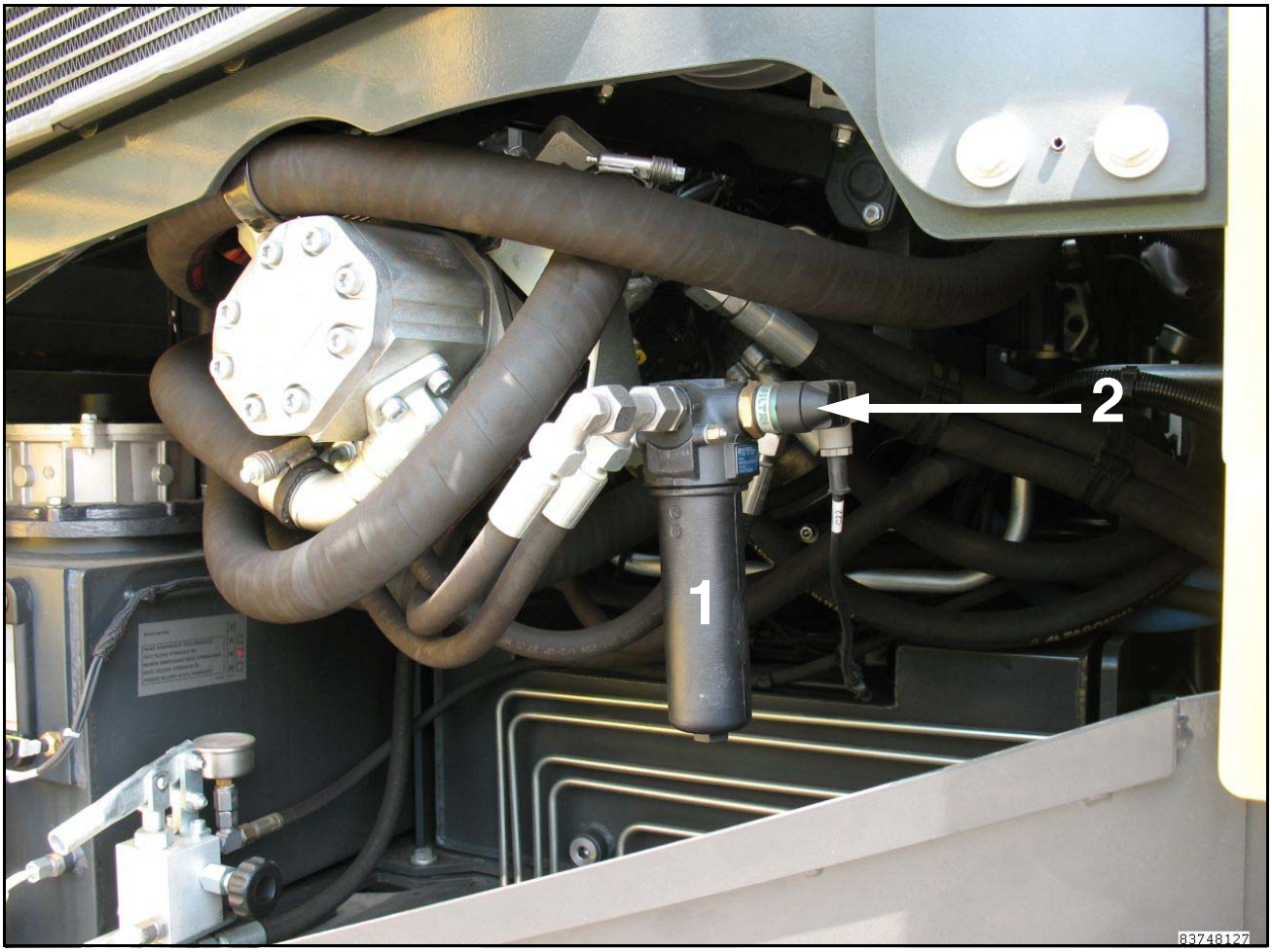


Fig. 31 Pressure test port M_2 - excerpt from hydraulic diagram

Pos	Designation	Position in hydraulic diagram	Position in wiring diagram	Measuring values and switching points
1	Cahreg pressure filter	25		
2	Different.pressure switch - charge pressure filter	25	C15, C22, Page 20	

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Pressure gauge for brake releasing valve

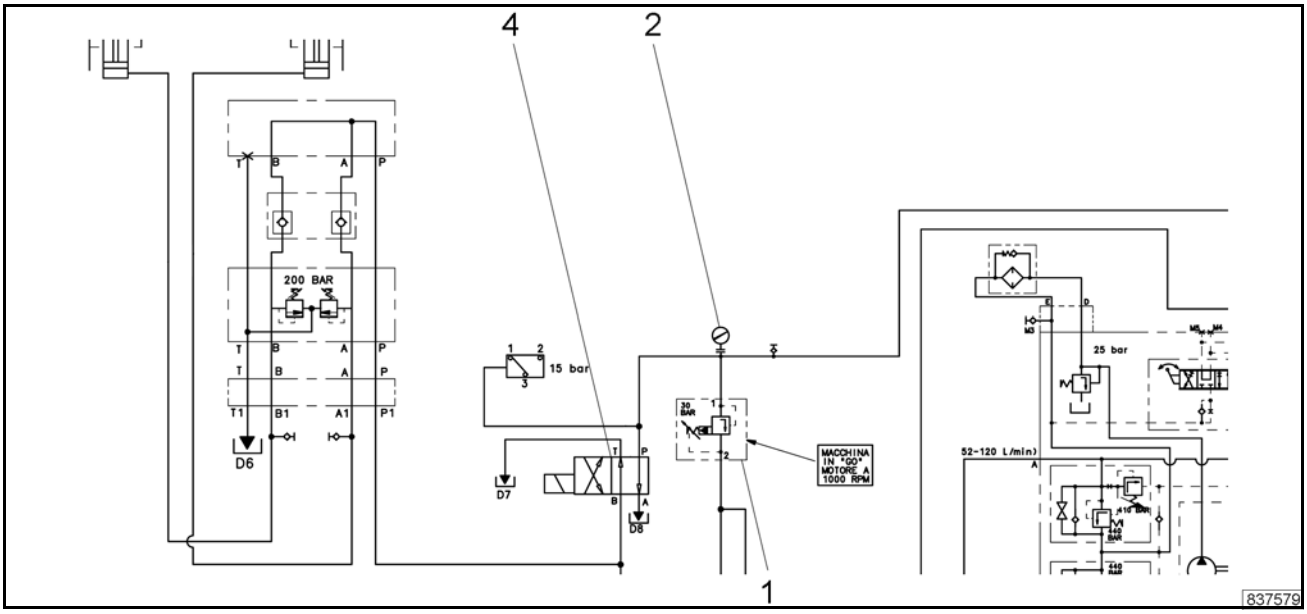


Fig. 32 Pressure gauge for brake releasing valve - excerpt from hydraulic diagram

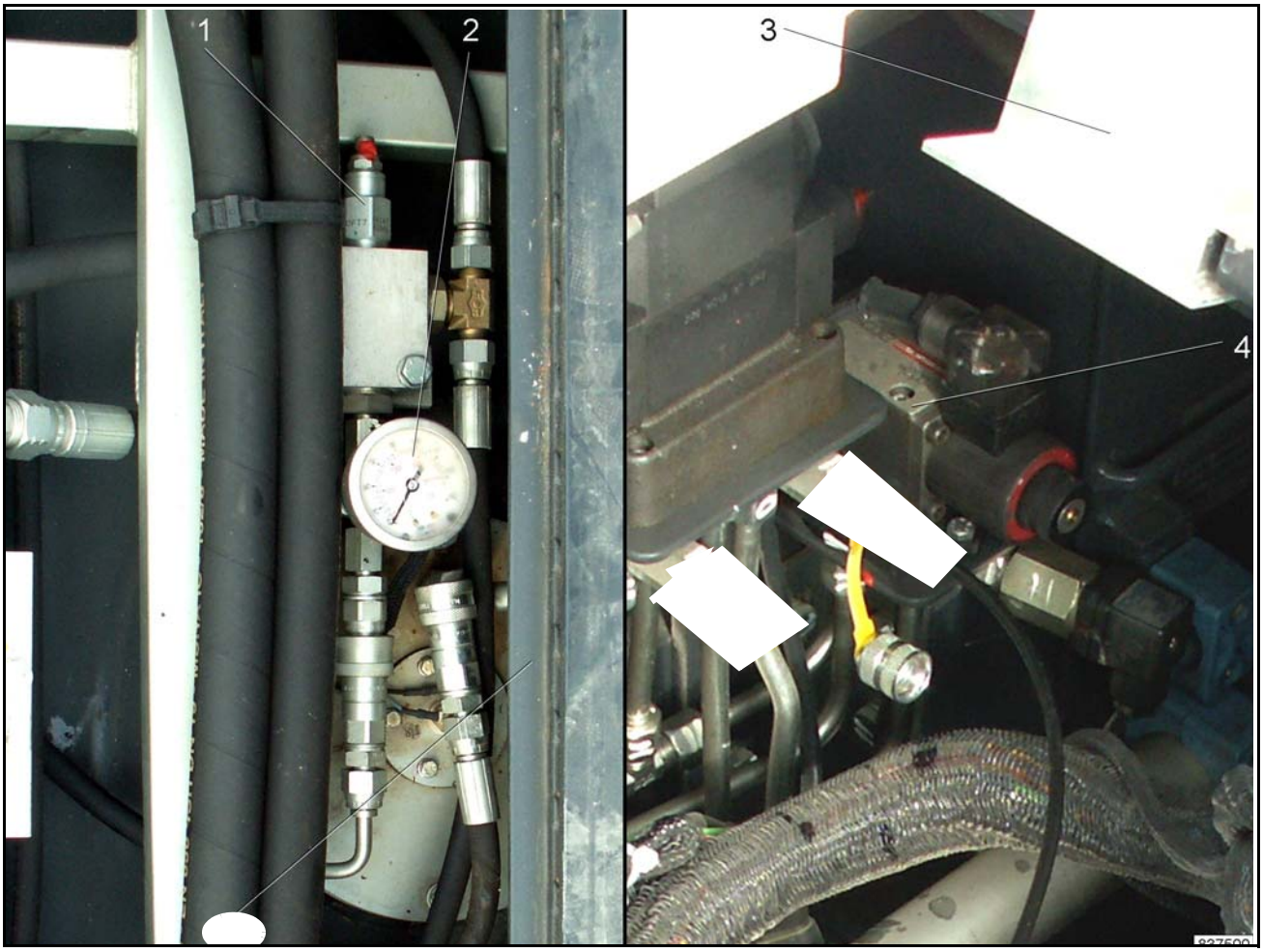


Fig. 33 Pressure gauge - brake releasing valve

1	Pressure relief valve	4	4/2-way solenoid brake valve
2	Brake pressure gauge (160 bar)High pressure gauge (160 bar)	3	Floor flap, operator's stand

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Valve block for crawler tracks

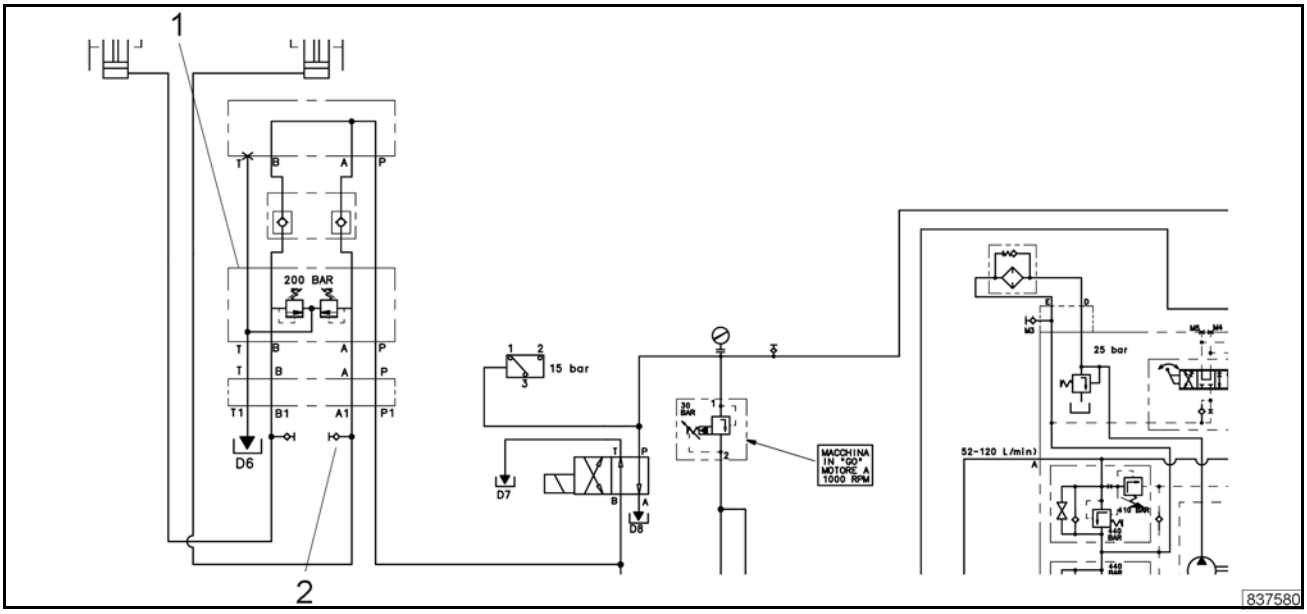


Fig. 34 Detail from hydraulic diagram

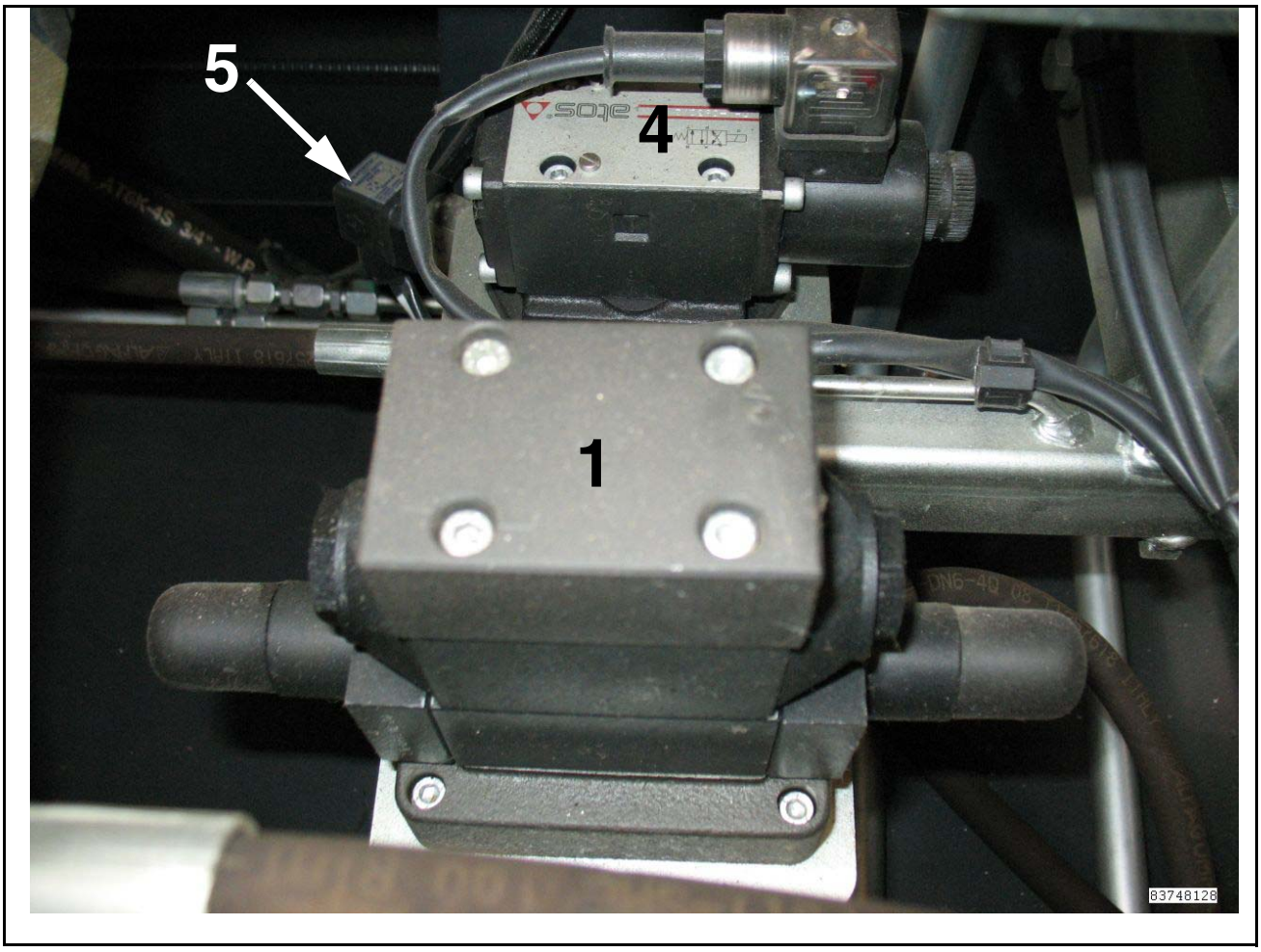


Fig. 35 Valve block for crawler tracks

1	Valve block for crawler tracks	4	Brake valve
2	Pressure test port, crawler track right	5	Pressure switch

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Brake pressure gauge

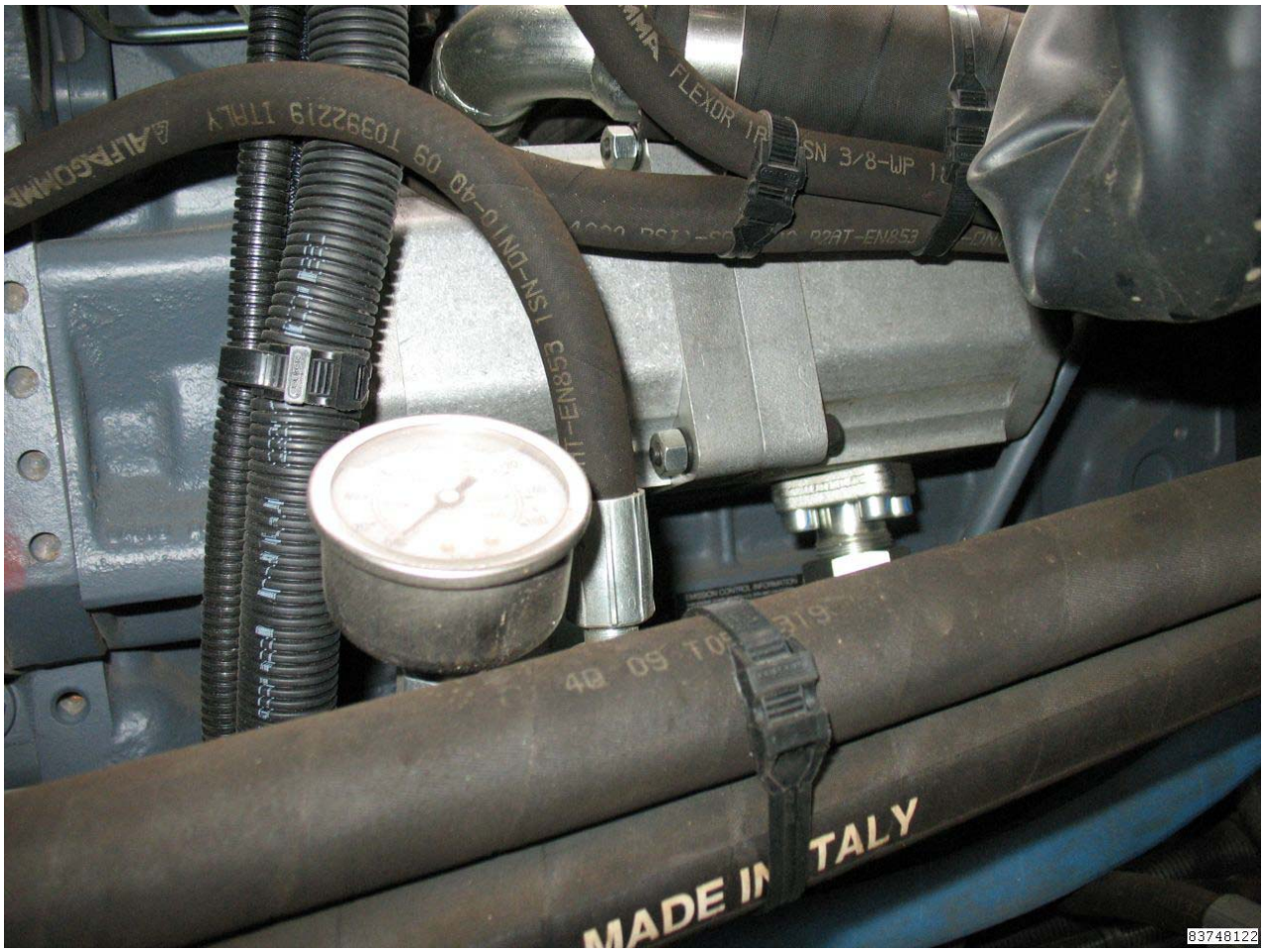


Fig. 36 Pressure gauge

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Adjustment points on travel pumps

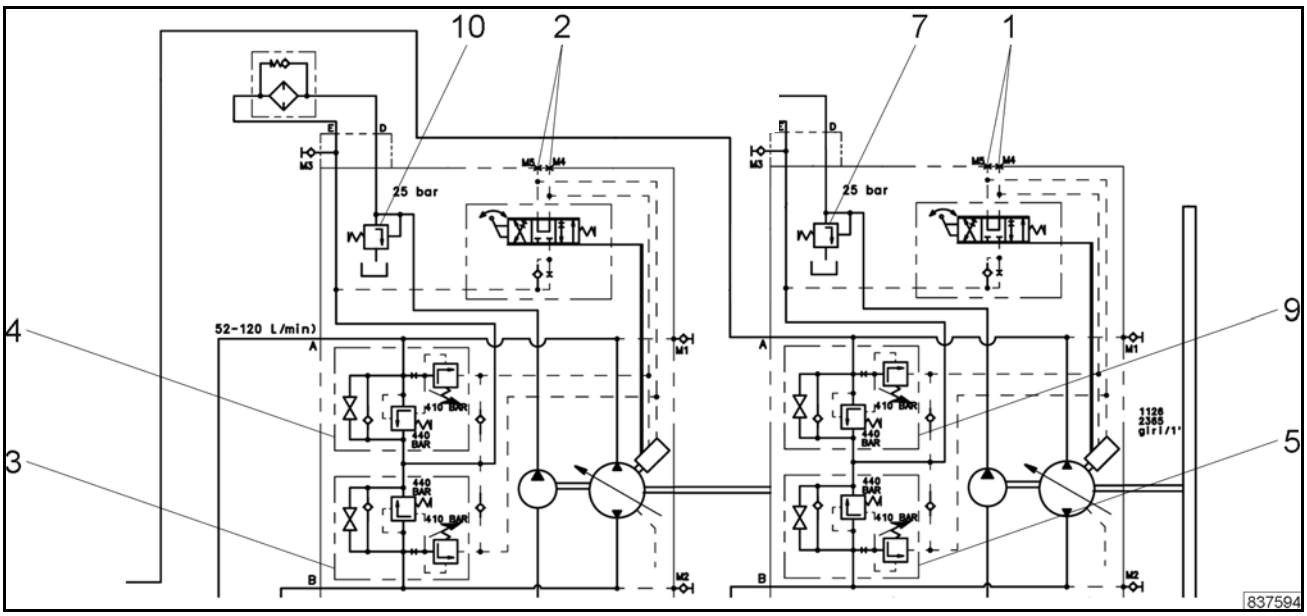


Fig. 37 Adjustment points on travel pumps - excerpt from hydraulic diagram

1	Pressure test port for control pressure (M4 and M5), travel pump right	6	Adjusting screw for mechanical neutral position of travel pump, right
2	Pressure test port for control pressure (M4 and M5), travel pump left	7	Charge pressure relief valve, travel pump right
3	Multifunction valve (B), travel pump, left	8	Adjusting screw for mechanical neutral position of travel pump, left
4	Multifunction valve (A), travel pump, left	9	Multifunction valve (A), travel pump, right
5	Multifunction valve (B), travel pump, right	10	Charge pressure relief valve, travel pump left

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Actuator drive

The actuator drive is an open hydraulic circuit. This means that the hydraulic oil is drawn out of the hydraulic oil tank by the gear pump (10), delivered to the consumers and finally directed back through the hydraulic oil cooler to the hydraulic oil tank.

The most essential components are (Fig. 38):

- the gear pump (10)
- the service block (12)
- the levelling block (14)
- the load control system (L.S.C.) (1)
- the straight crossfalls adjustment (13)*
- screed up/down (2)
- the tow point adjustment for screed right (3) and left (4)
- the hopper wing adjustment right (6) and left (5)
- the screed lock (7)
- the screw height adjustment (8)

* Option

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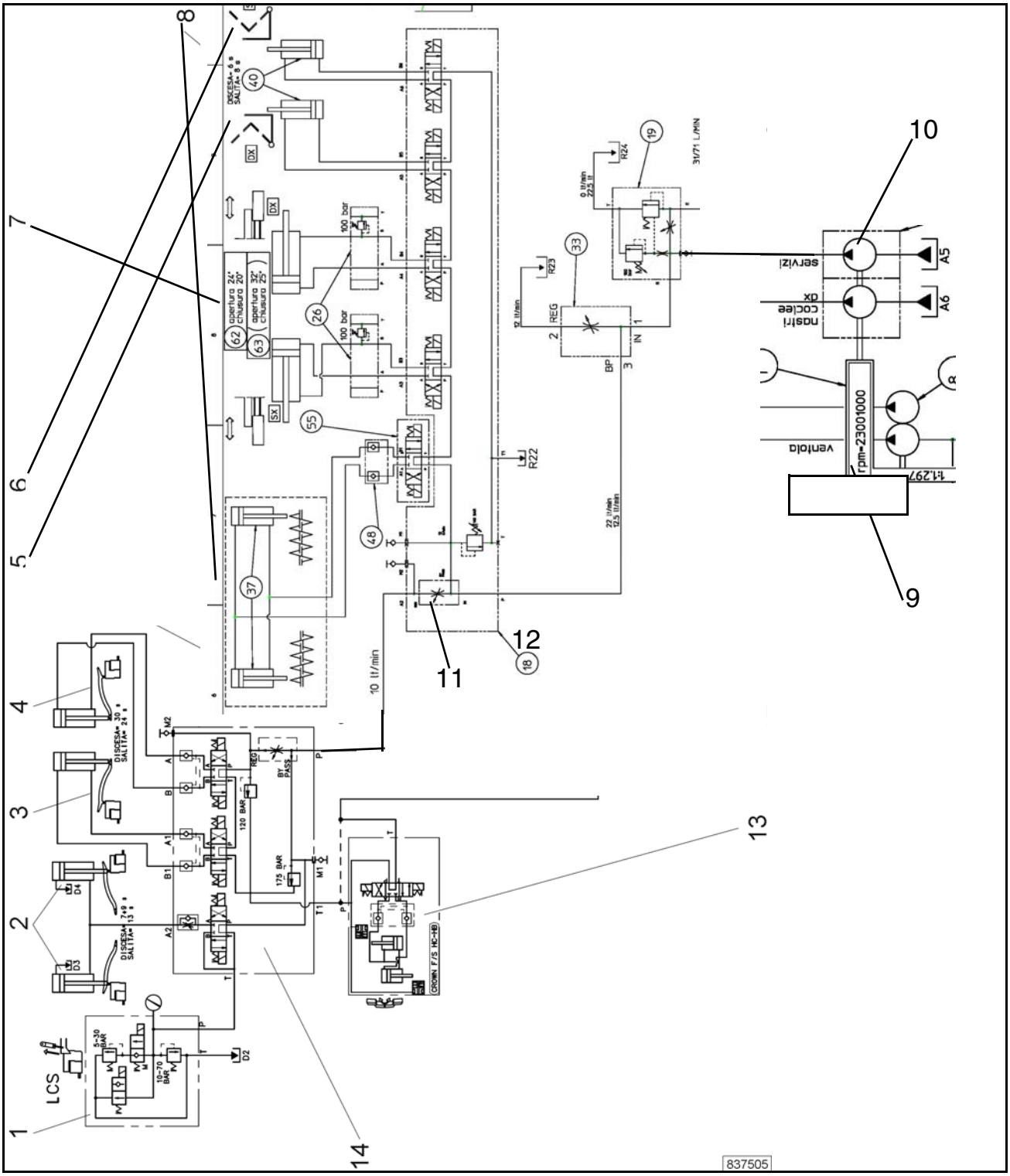


Fig. 38 Actuation - excerpt from hydraulic diagram

1	Load control system (L.S.C.)	8	Screw height adjustment
2	Screed up/down	9	Diesel engine
3	Tow point adjustment screed right	10	Gear pump
4	Tow point adjustment screed left	11	Volume flow distribution
5	Hopper wing adjustment, left	12	Service block
6	Hopper wing adjustment, right	13	Straight crossfalls adjustment*
7	Screed interlock	14	Levelling block

* Option

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The outer gear pump serves the hydraulic oil supply for the actuator circuit with service and levelling blocks.

A flow divider at the inlet of the service block divides the volume flow and thus enables parallel operation of service and levelling block.

A pressure relief valve with fixed setting protects the service block against overpressure.

The functions:

- of the the hopper wings, right and left
- of the screed lock
- of the screw height adjustment

can each be electrically controlled via a 4/3-way solenoid valve. Both the screed interlock and the screw height adjustment are equipped with an additional locking valve in the hydraulic supply and return lines, whereby the screed and the screws can be held in fixed position.

A flow divider integrated in the levelling block divides the flow volume:

- the load control system (L.S.C.)
- Screed up/down
- tow point adjustment right and left
- straight crossfalls adjustment

.

The functions for:

- screed up/down
- tow point adjustment, right and left
- straight crossfalls adjustment

can each be electrically controlled via a 4/3-way solenoid valve. To be able to hold the set position for height and tow point adjustment as well as crown adjustment, the supply and return lines are equipped with unlockable locking valves.

Lifting/lowering the screed, load control system (L.C.S.)

Lifting/lowering the screed is accomplished by two hydraulic cylinders at the rear ends of both tow arms. The L.C.S. enables the these control cylinders to lift/lower or release the screed.

This combination enables floating operation when paving asphalt, with the machine stopped during asphalt application as well as relieving or locking the screed to avoid flatness faults caused by uncontrolled lowering.

The tow point adjustment for the screed is accomplished by two independently adjustable adjusting cylinders mounted to the front ends of both side arms. These adjusting cylinders control the floating behaviour of the screed or the thickness of the paved material.

Service block

Control with solenoid valves in an open circuit

The service block (18) (Fig. 39) is a valve block made up of five 4/3-way solenoid valves in series connection in an open hydraulic circuit..

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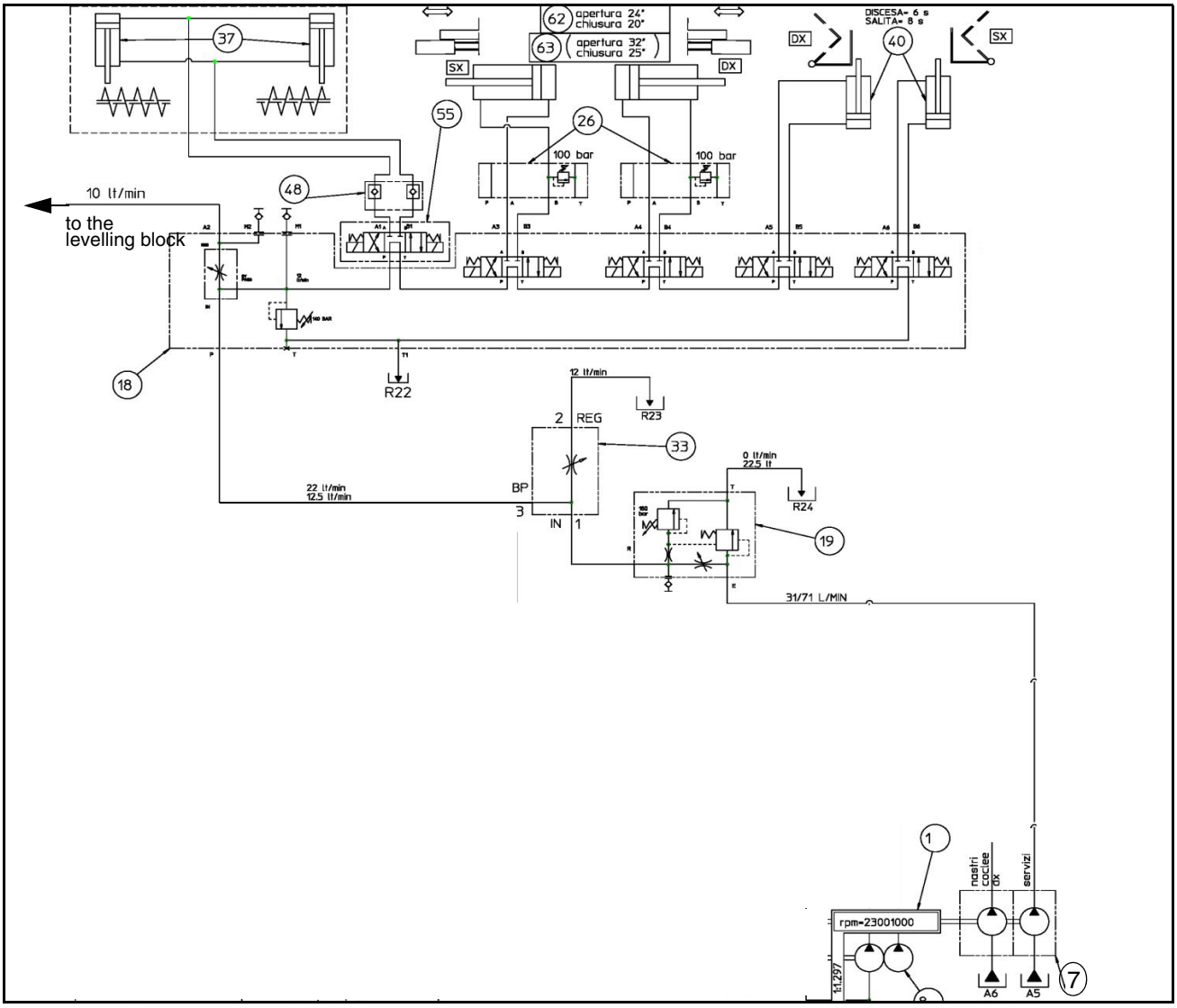


Fig. 39 Service block - excerpt from hydraulic diagram

1	Diesel engine	48	Check valves, unlockable (locking block)
7	Gear pump	18	Service block
37	Adjusting cylinders for screw height adjustment	19 and 33	Volume flow and pressure relief valve
40	Adjusting cylinder hopper wall adjustment, right and left	26	Pressure relief valve, retraction of screed
55	4/3-way solenoid valve, adjusting cylinder for screw height adjustment	62 and 63	Screed adjustment, extension/retraction

Function and design

The service block is hydraulically installed between gear pump and the downstream levelling block. The consumers are the adjusting cylinders for hopper side wall adjustment (40), the screed control (62 and 63) and the screw height adjustment (55).

Solenoid valve

Function and design

The solenoid valves mounted on the service block are 4/3-way valves. They control the start, the end and the direction of the volume flow to the connected consumers. The valves mainly consist of: (Fig. 40)

- the housing (2)
- the solenoids (5)

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- the control piston (3)
- the resetting springs (6)

If **not operated** the control piston (3) is retained in middle or initial position by the resetting springs and thus blocks both the high and low pressure lines.

In **operated condition** the solenoid (5) moves the plunger (1) to the control piston, pushes it out of its resting position to the corresponding end position. The flow direction is released and the the oil volume flows into the adjusting cylinder and adjusts the related component.

Once the magnet is de-energized the resetting springs return the control piston back to its resting position, whereby the volume flow is interrupted and the adjusting cylinder remains in its last position.

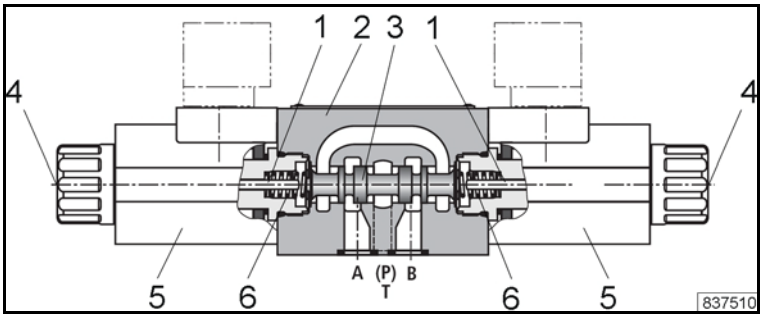


Fig. 40 4/3-way solenoid valve - sectional view

1	Plunger	4	Emergency control facility
2	Housing	5	Magnet
3	Control piston	6	Resetting spring

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Test and adjustment points

Service block

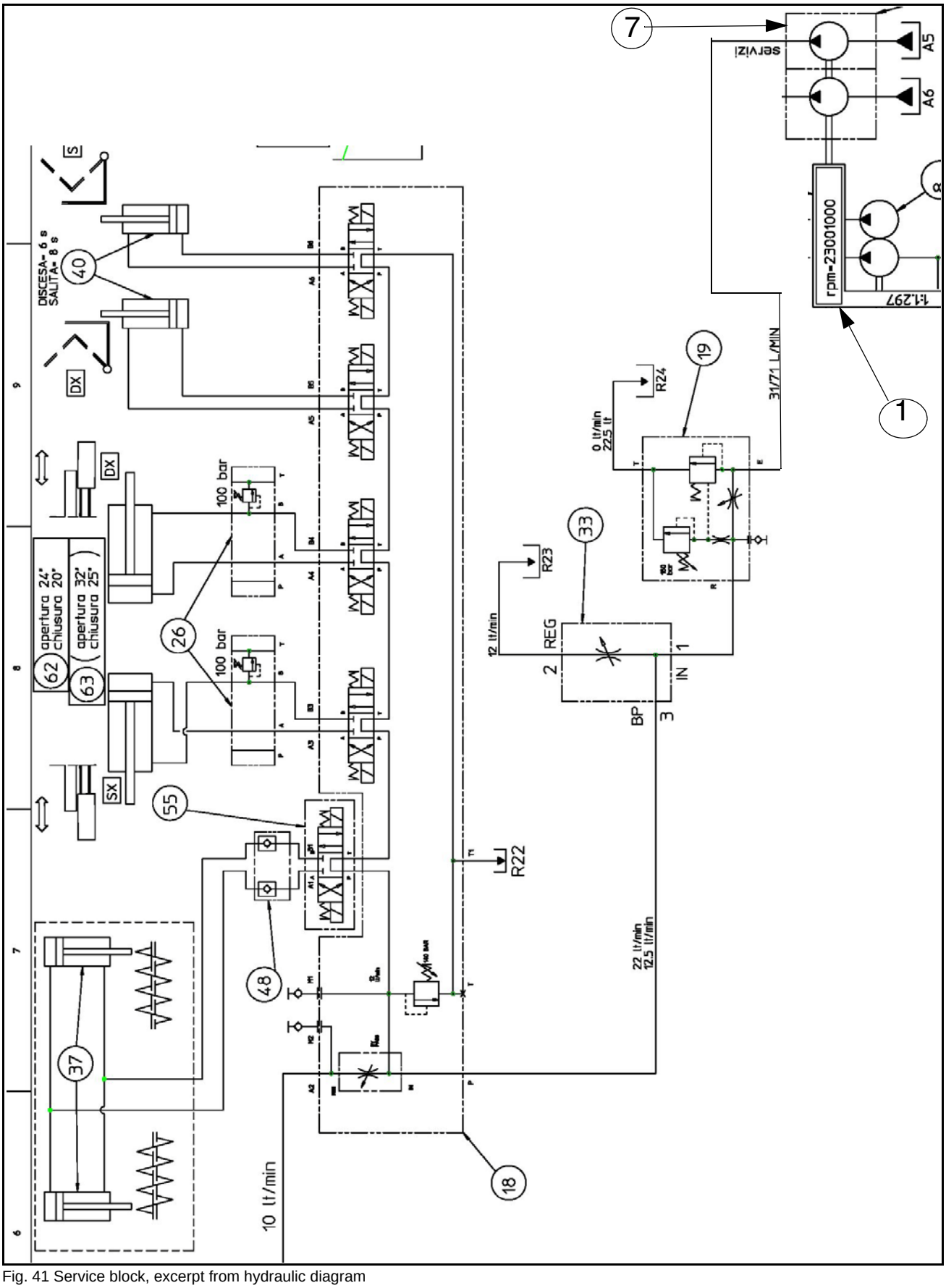


Fig. 41 Service block, excerpt from hydraulic diagram

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Pump for service block (7)

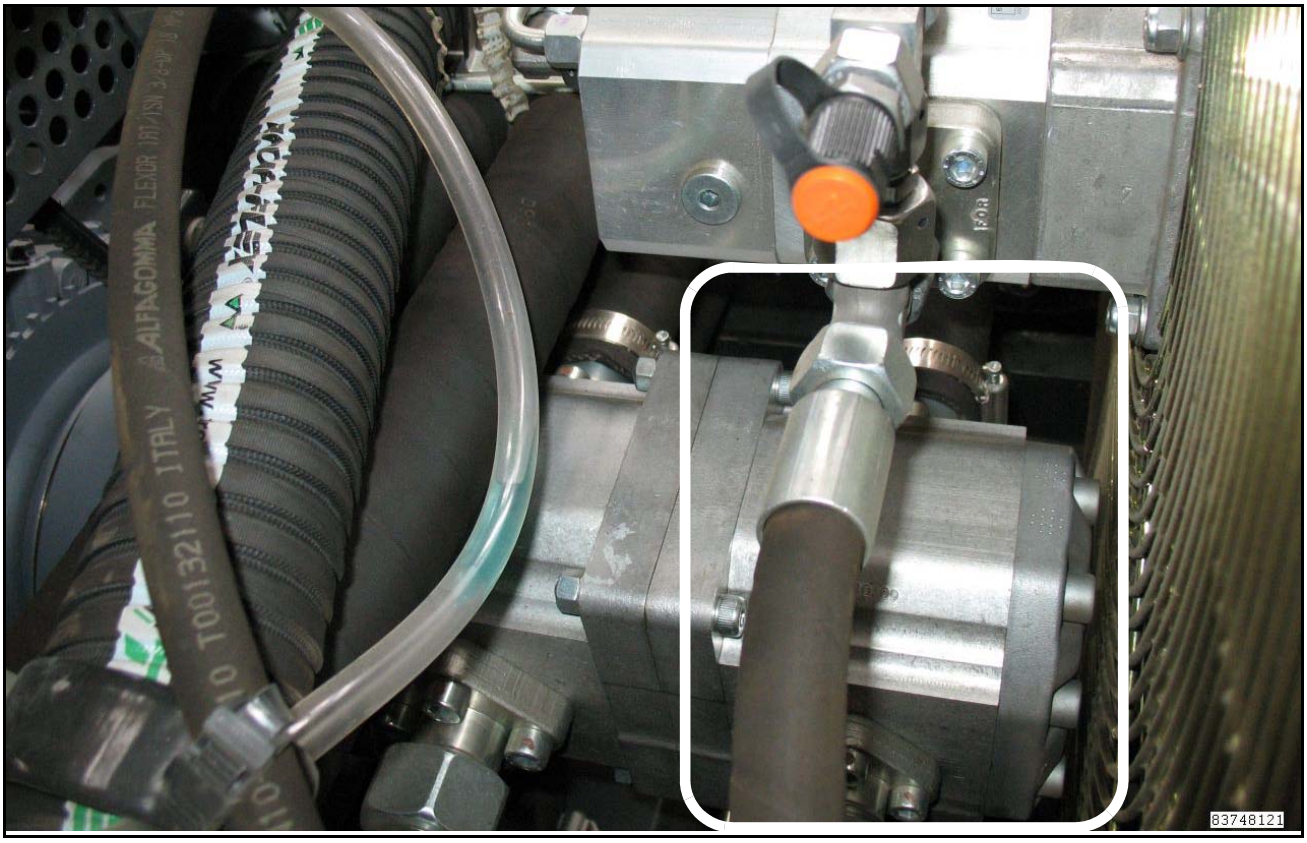


Fig. 42 Tandem gear pump, in hydraulic diagram no.: 7

Service block (18)

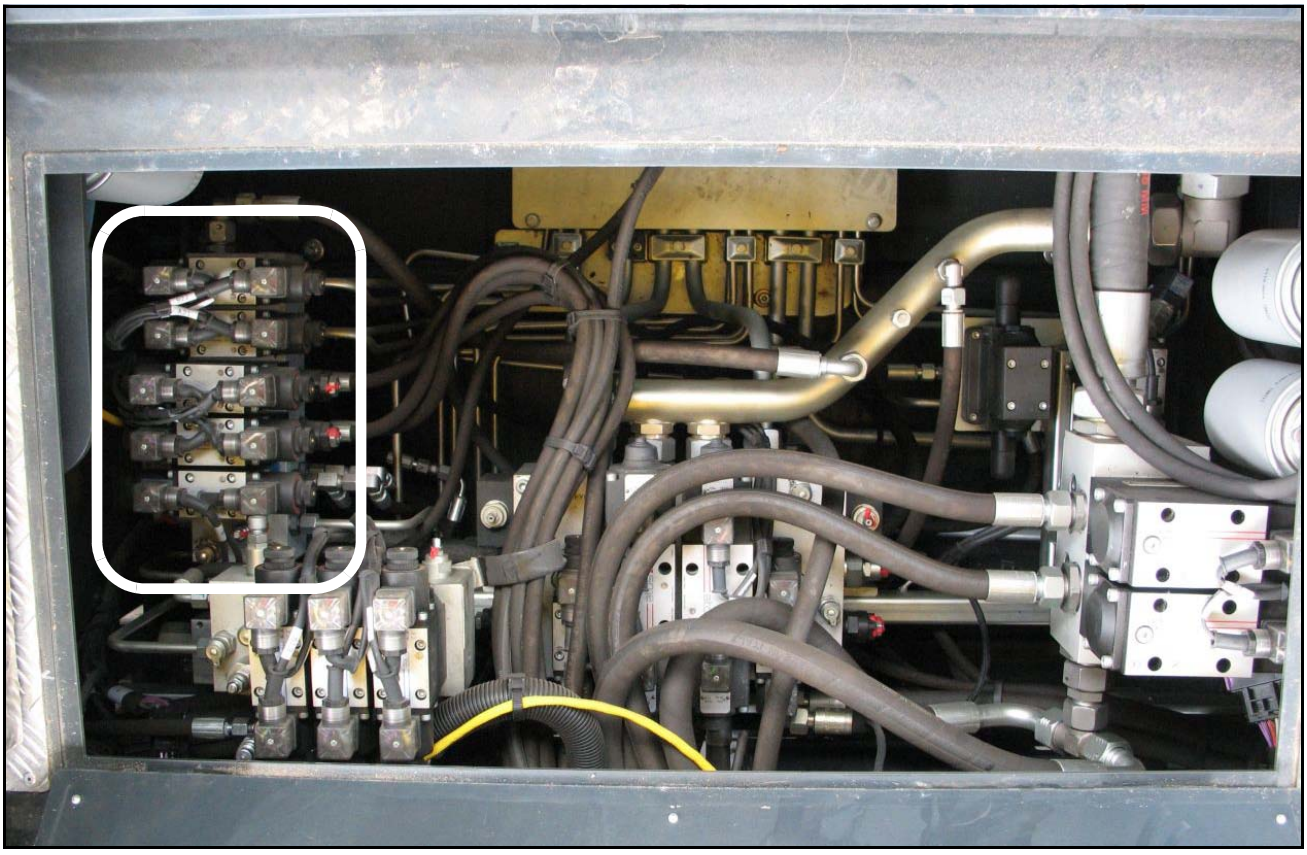


Fig. 43 Valves underneath the floor plate

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Service block

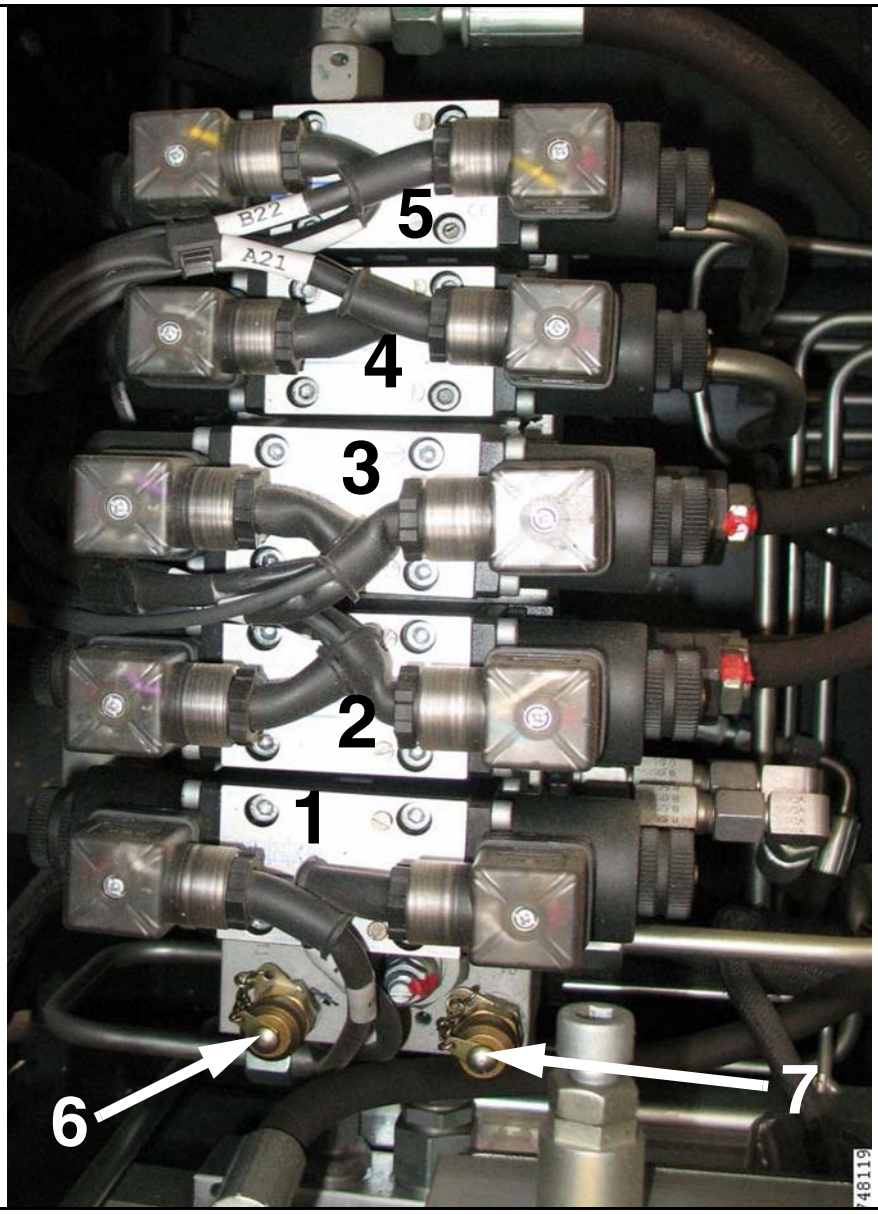


Fig. 44 Service block

Pos	Designation	Position in hydraulic diagram	Position in wiring diagram	Measuring values and switching points
1	Solenoid valve, conveyor screws, up/down	18 / 55	A19 / B19, Page 100.2	0 / 24 V
2	Solenoid valve, screed extend/retract left	18	A16 / B16, Page 150	0 / 24 V
3	Solenoid valve, screed extend/retract right	18	B14 / A14, Page 150.1	0 / 24 V
4	Solenoid valve, hopper open/close right	18	A2 / B21, Page 120	0 / 24 V
5	Solenoid valve, hopper open/close left	18	A22 / B22, Page 120	0 / 24 V
6	Pressure test port, pressure service block	18 / M1		Pressure relief valve 140 bar
7	Pressure test port, screed up	18 / M2		Pressure relief valve 180 bar

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Levelling block

Valve block

The levelling block (2) (Fig. 45) is a valve block made up of three 4/3-way solenoid valves.

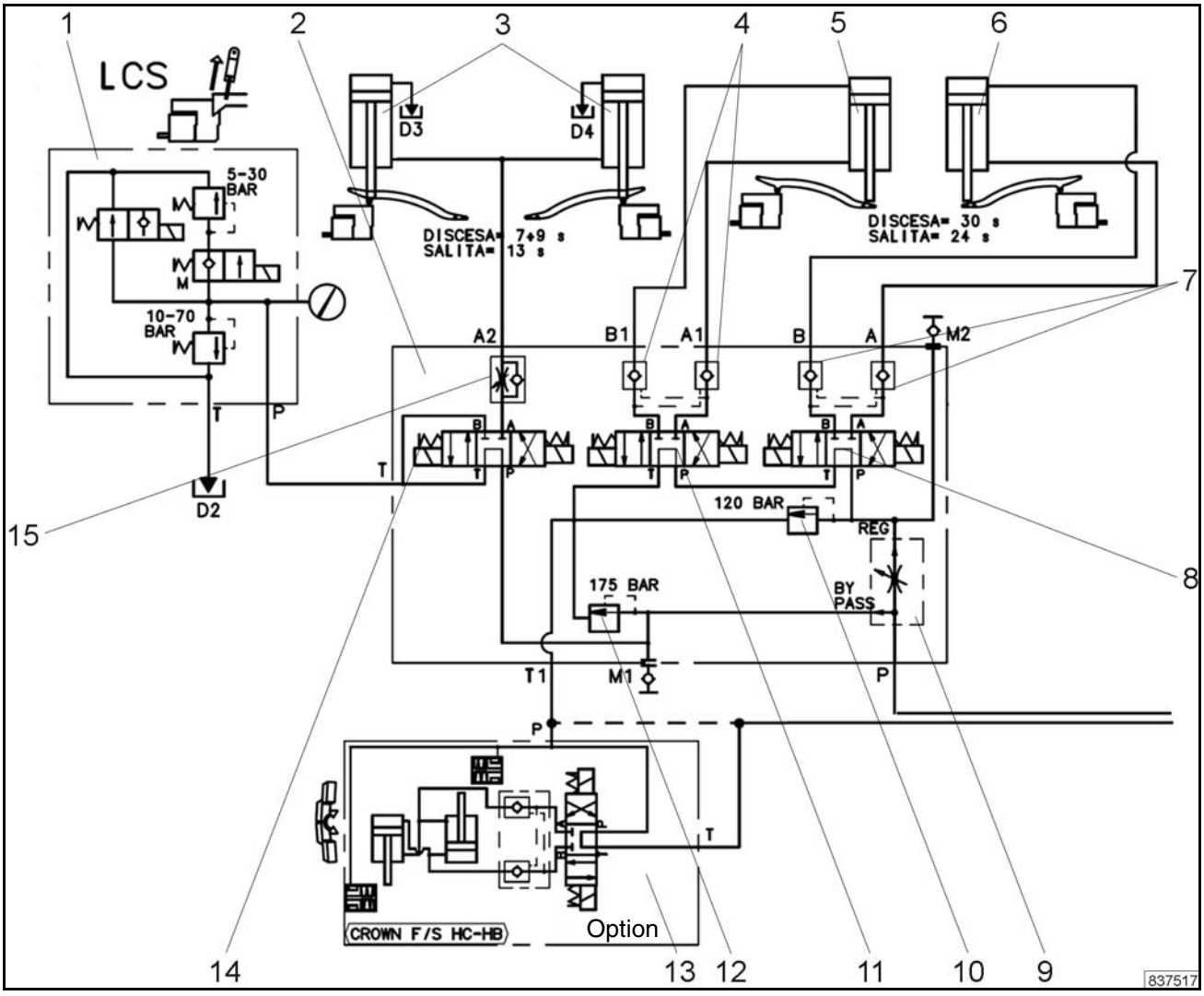


Fig. 45 Levelling block - excerpt from hydraulic diagram

1	Load control system (L.S.C.)	9	Flow divider
2	Levelling block	10	Pressure relief valve tow point adjustment
3	Adjusting cylinder for screed height	11	4/3-way solenoid valve, adjusting cylinder tow point left
4	Check valves, adjusting cylinder tow point left	12	Pressure relief valve screed up/down
5	Adjusting cylinder tow point, left	13	Crown adjustment*
6	Adjusting cylinder tow point, right	14	4/3-way solenoid valve, adjusting cylinder screed height
7	Check valves, adjusting cylinder tow point, right	15	One-way restrictor
8	4/3-way solenoid valve, adjusting cylinder tow point, right		

* Option

Function and design

The levelling block is hydraulically arranged between service block and the consumers connected in series. The consumers are:

- the L.C.S. (1)
- the adjusting cylinders for scree up/down (3)

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- the adjusting cylinders for two point adjustment (5) and (6)
- the straight crossfalls adjustment (13)

The high and low pressure lines of the service block are internally connected and combined as central ports.

The solenoid valves (8), (11) and (14) mounted on the levelling block are 4/3-way valves. They control the start, the end and the direction of the volume flow to the connected consumers. The valves mainly consist of (Fig. 46):

- the housing (2)
- the solenoids (5)
- the control piston (3)
- the resetting springs (6)

If **not operated** the control piston (3) is retained in middle or initial position by the resetting springs and thus blocks both the high and low pressure lines.

In **operated condition** the solenoid (5) moves the plunger (1) to the control piston, pushes it out of its resting position to the corresponding end position. The flow direction is released and the the oil volume flows into the adjusting cylinder and adjusts the related component.

Once the magnet is de-energized the resetting springs return the control piston back to its resting position, whereby the volume flow is interrupted and the adjusting cylinder remains in its last position.

Levelling

Levelling of the screed takes place via the flow divider (9) (Fig. 45), which is arranged upstream of the solenoid valves. It divides the flows for:

- screed up/down
- screed tow point adjustment
- L.C.S.
- straight crossfalls adjustment

to enable simultaneous adjustment.

Two pressure relief valves (10) and (12) are installed in the high pressure lines of the service block, downstream from the flow divider. These cut off the hydraulic oil pressure at the value set by the valve by opening a connection to the charge circuit of the conveyor screw pump. Depending on the operating status of the crown adjusting valve (13) the cut-off hydraulic oil is returned into the charge circuit of the conveyor screw pump, or it is further used for crown adjustment.

Straight crossfalls adjustment

If the straight crossfalls adjustment is operated:

- the two cylinders are pressurized
- the multi-disc brakes of the straight crossfalls adjustment are opened (this enables the straight crossfalls adjustment)

Load control system screed (L.S.C.)

The L.C.S. has the function to lift the screed slightly off the paving material, when the finisher is stopped during work. This prevents the screed from leaving a mark in the material. In general the screed is switched from “Floating position” to “Slightly raised and held position” while the finisher is stopped.

The L.C.S. consists of two solenoid valves, each with a downstream pressure relief valve. The pressure reduction of one of these pressure relief valves in "floating position" a pressure level is built up in the adjusting cylinder for screed up/down, which fully compensates the basic weight of the screed.

The adjusting cylinders for screed up/down are equipped with a one-way restrictor (15) integrated in the high pressure line of the 4/3-way solenoid valve. The throttle restricts the hydraulic oil flow to a pre-set volume, to accommodate sensitive adjustment of the screed. The check valve has the function of permanently holding the current position.

The 4/3-way solenoid valve of the screed tow point adjustment is additionally equipped with unlockable locking valves (4 and 7) in high and low pressure lines. With this the adjusting cylinders for tow point can be permanently held in position.

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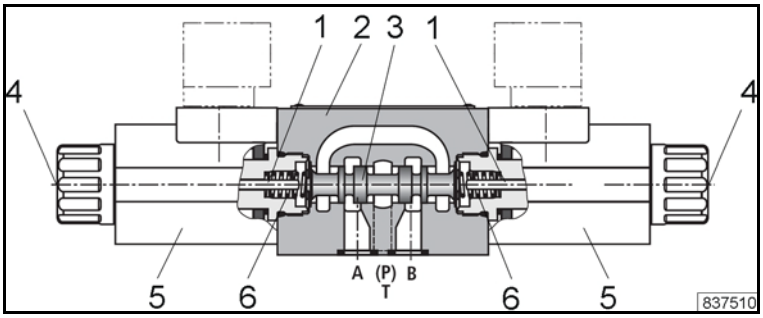


Fig. 46 4/3-way solenoid valve - sectional view

1	Plunger	4	Emergency control facility
2	Housing	5	Magnet
3	Control piston	6	Resetting spring

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Test and adjustment points

Levelling block

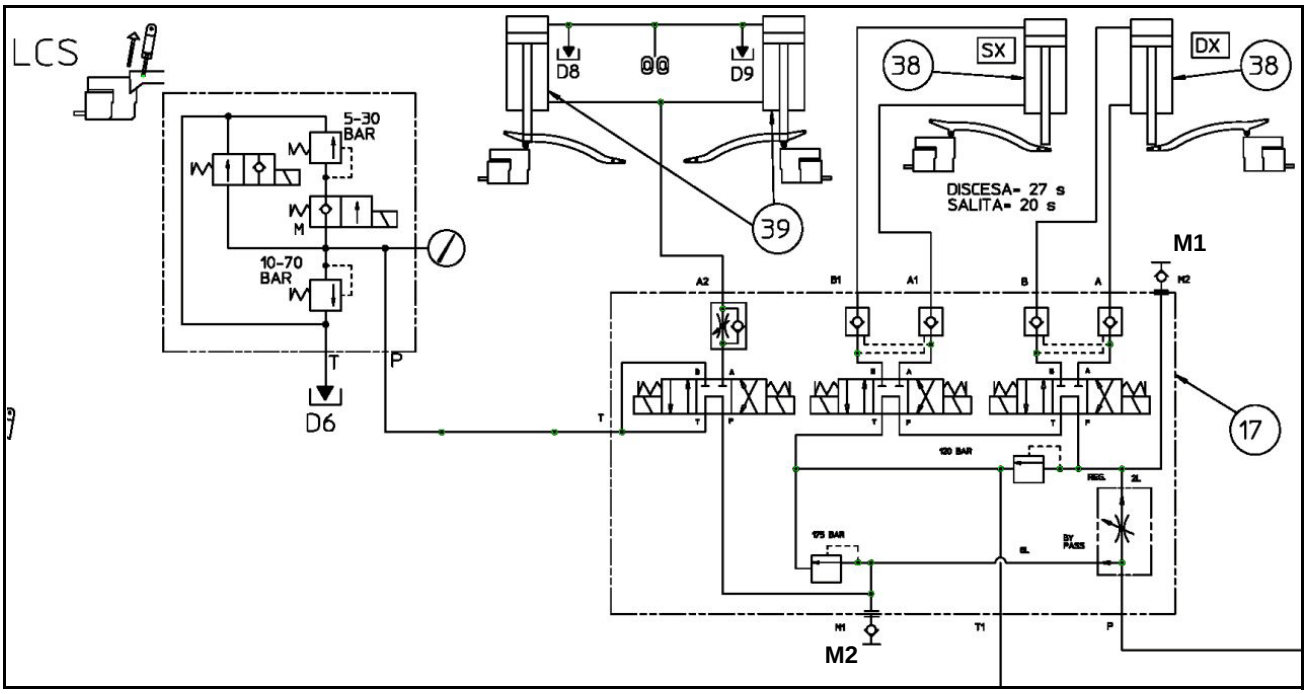


Fig. 47 Levelling block - excerpt from hydraulic diagram

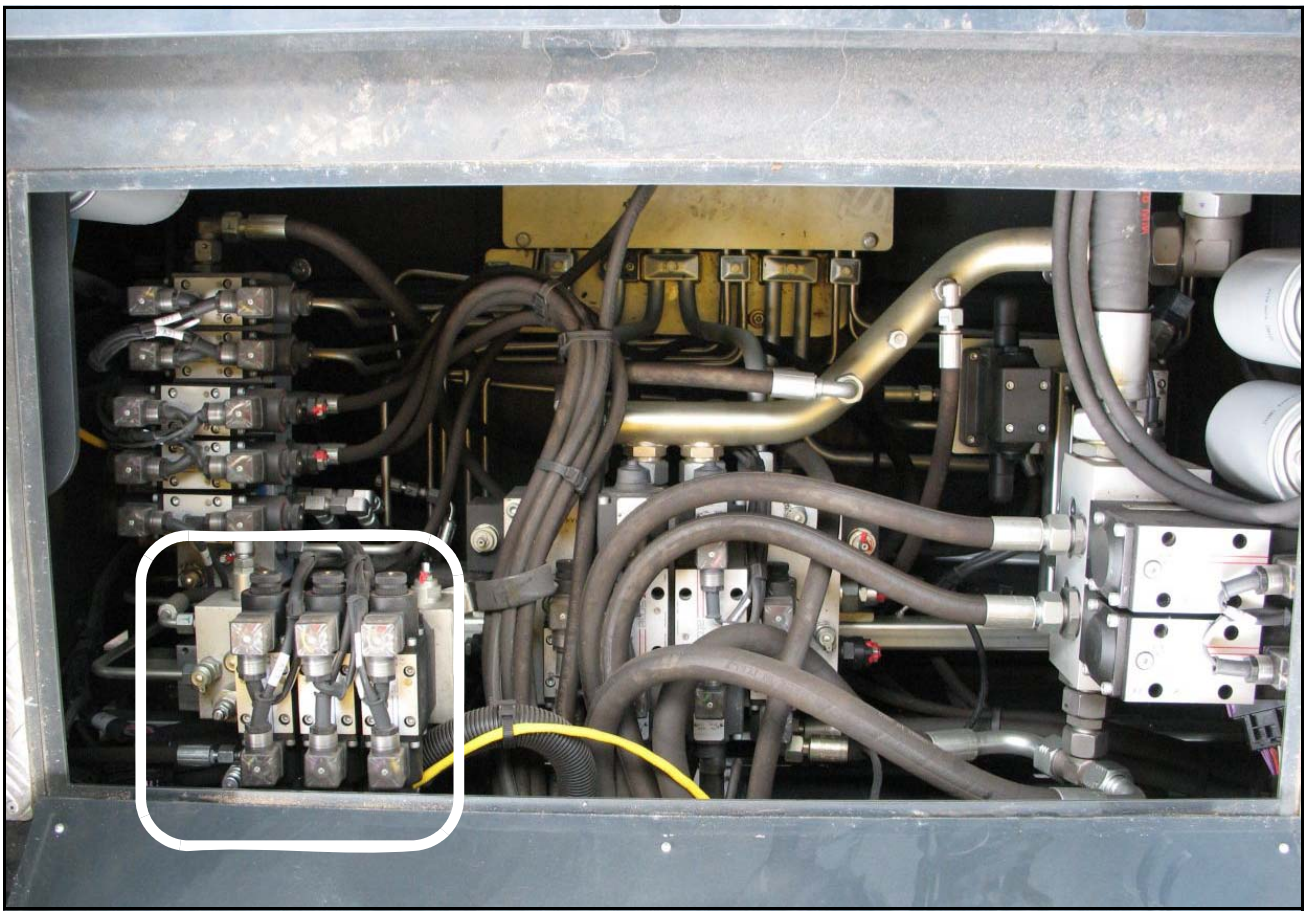


Fig. 48 Valves underneath the floor plate

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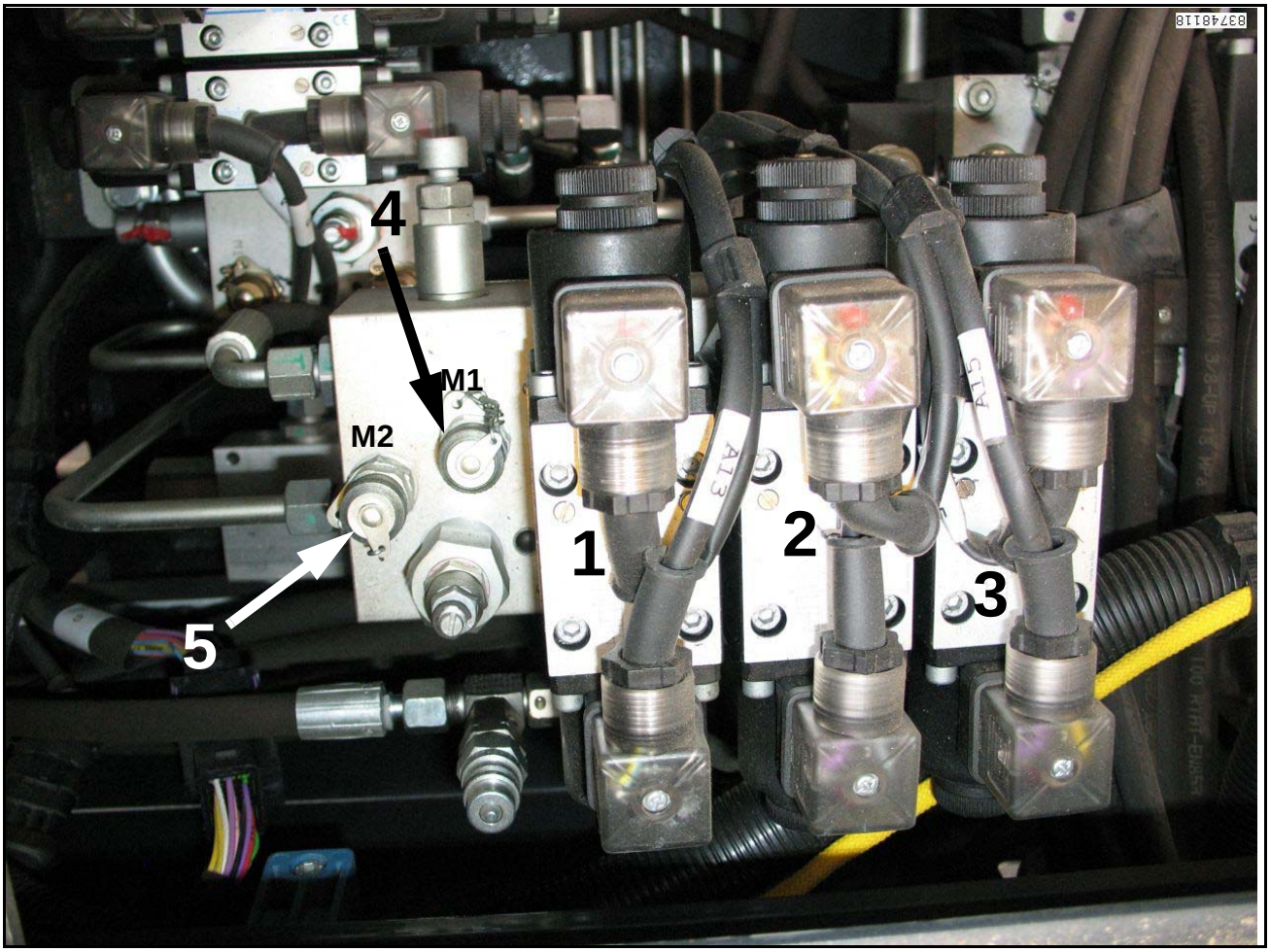


Fig. 49 Levelling block

Pos	Designation	Position in hydraulic diagram	Position in wiring diagram	Measuring values and switching points
1	Solenoid valve, screed height adjustment, up/down	17 / 39	A13 / B13, Page 170	0 / 24 V
2	Solenoid valve, screed draw point adjustment left, up/down	17 / 38	A17 / B17, Page 150	0 / 24 V
3	Solenoid valve, screed draw point adjustment right, up/down	17 / 38	B15 / A15, Page 160.1	0 / 24 V
4	Pressure test port, screed height adjustment	17 / M1		Pressure relief valve 175 bar
5	Pressure test port, draw point adjustment	17 / M2		Pressure relief valve 120 bar

External gear pumps

External gear pumps mainly consist of the friction bearing mounted gear pair and the housing with front and rear covers. The drive shaft, which is sealed with a radial seal, protrudes from the front cover. The bearing forces are absorbed by friction bearings. These have been designed for high pressures and have excellent antifriction properties - particularly at low speeds. The gears have 12 teeth each. This keeps flow pulses and noise emissions at a low level.

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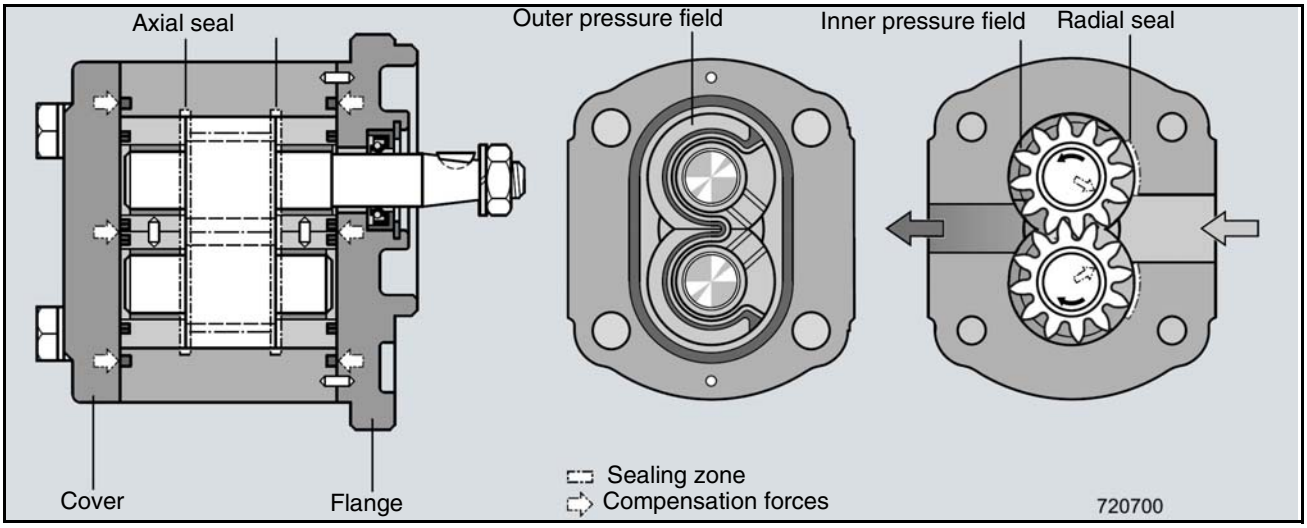


Fig. 50 Axial compensation of gear pump

Internal sealing of the pressure chambers is achieved by flow volume dependent forces. This results in an excellent rate of efficiency. On the rear side the moveable bearing bushings are pressurized and thus tightly pressed against the gears. The pressurized pressure fields are thereby limited by special seals. Sealing around the circumference of the gears to the housing is assured by small gaps, which appears between gears and housing in dependence on the pressure.

Function

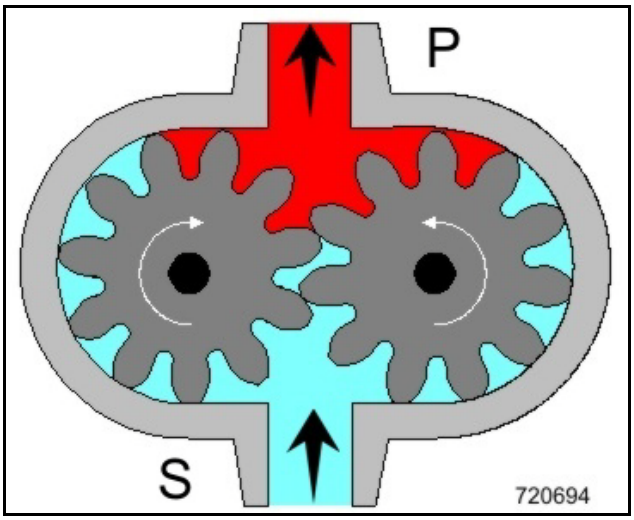


Fig. 51

The increasing volume caused by a tooth exiting a tooth gap results in a vacuum in the suction chamber. The pressure fluid is transported into the pressure chamber. There the meshing of teeth and tooth gaps displaces the pressure fluid into the upper supply line.

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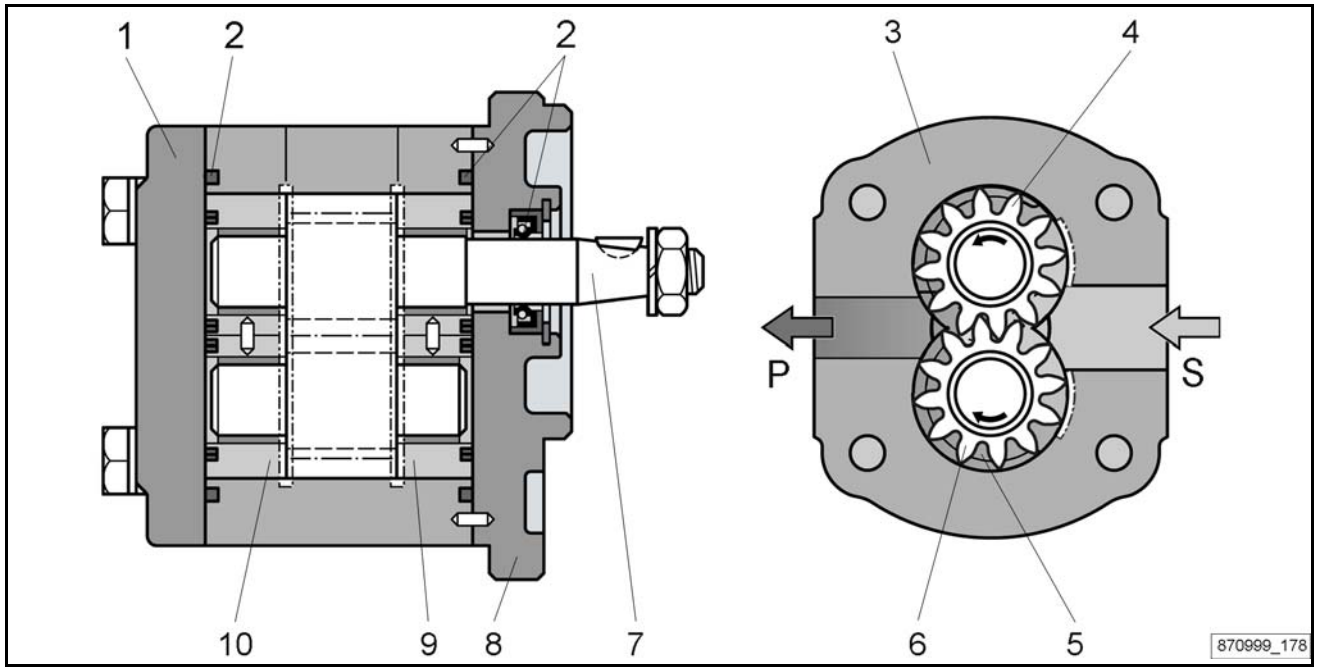


Fig. 52

1	Cover	6	Gear (driven)
2	Seals and gaskets	7	Shaft
3	Housing	8	Flange
4	Gear (driving)	9	Bearing plate
5	Displacement chamber	10	Bearing plate

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Scraper chain and conveyor screw drive

The scraper chain and conveyor screw drive has been designed as an open hydraulic circuit.

The most essential components are (Fig. 53):

- the gear pumps (5) and (7)
- the valve block (14)
- the hydraulic motors for scraper chain right/left (43)
- the hydraulic motors for conveyor screw right/left (44)

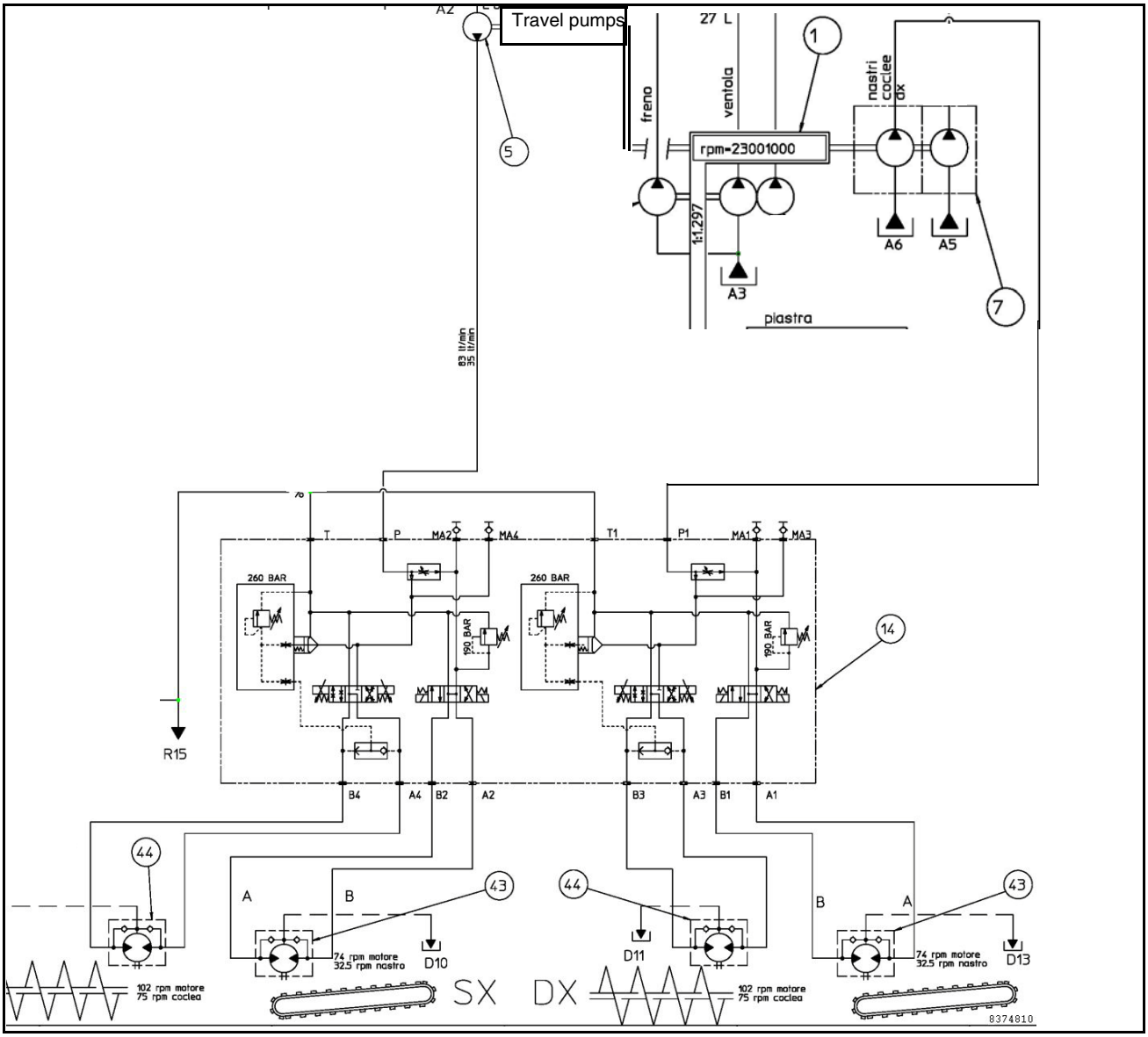


Fig. 53 Scraper chain and conveyor screw drive - excerpt from hydraulic diagram

1	Diesel engine	14	Valve block, scraper chain and conveyor screw
5	Gear pump, scraper chain and conveyor screw, right hand side	43	Scraper chain motor, right and left
7	Gear pump, scraper chain and conveyor screw, left hand side	44	Scraper chain motor, right and left

The hydraulic pumps for scraper chain and conveyor screw drive supply the hydraulic motors with hydraulic oil via the valve block (14).

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The hydraulic oil for the conveyor screw motors is supplied through a separately controllable 4/3-way proportional valve in the valve block. It enables individual speeds of right or left hand motor. With the proportional valve not actuated the pumped hydraulic oil is discharged through a pressure maintaining valve. With the proportional valve open, this pressure maintaining valve is closed by the increasing pressure in the pilot line, so that the full hydraulic oil volume is available for driving the motors.

An adjustable pressure relief valve protects the valve block against overpressure.

For the scraper belt drive control valves are used instead of proportional valves.

Valve arrangement

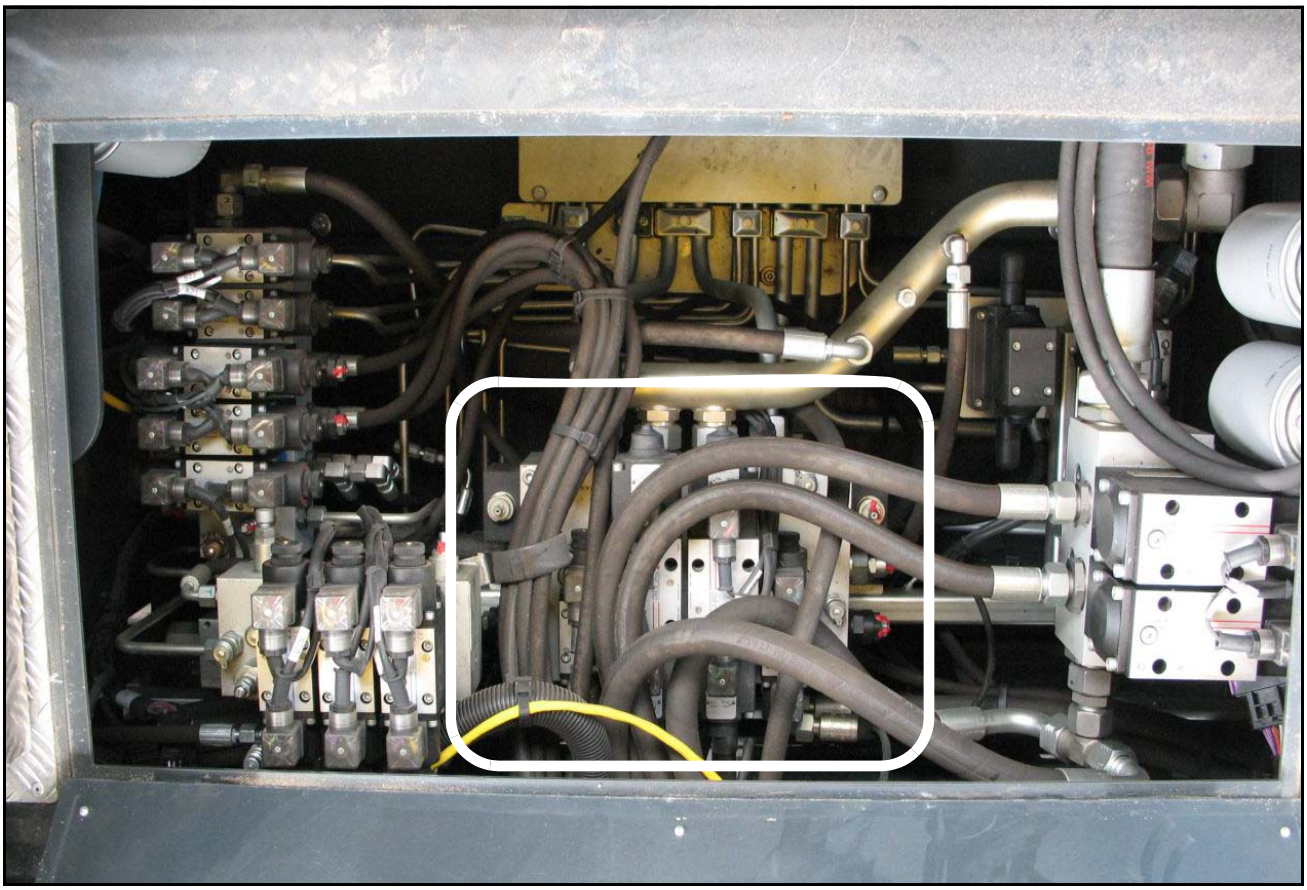


Fig. 54 Valves underneath the floor plate

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Valve block for scraper chain and conveyor screw

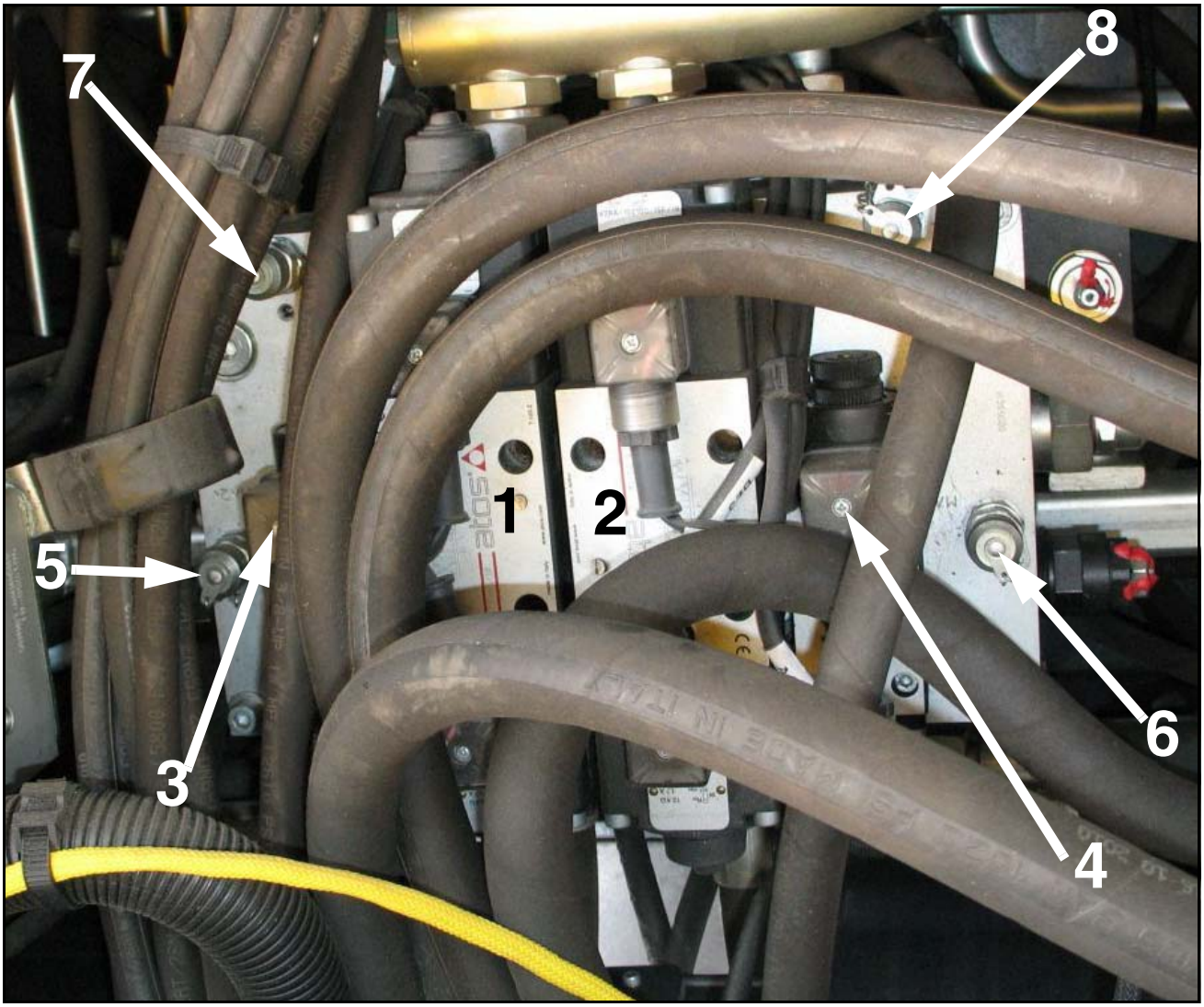


Fig. 55 Valve block

Pos	Designation	Position in hydraulic diagram	Position in wiring diagram	Measuring values and switching points
1	Proportional valve, conveyor screw left	14	A/B 24, page 100	Prop.
2	Proportional valve, conveyor screw right	14	A/B 23, page 100.1	Prop.
3	Solenoid valve, scraper chain left	14	A/B 26, page 90	0 /24 V
4	Solenoid valve, scraper chain right	14	A/B 25, page 90.1	0 /24 V
5	Pressure test port, conveyor screw left	14 / MA4	A/B 24,	PRV, 260 bar
6	Pressure test port, conveyor screw right	14 / MA1	A/B 23,	PRV, 260 bar
7	Pressure test port, scraper chain left	14 / MA2	A/B 26,	PRV, 190 bar
8	Pressure test port, scraper chain right	14 / MA3	A/B 25,	PRV, 190 bar

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Gear pumps assigned for left and right hand sides

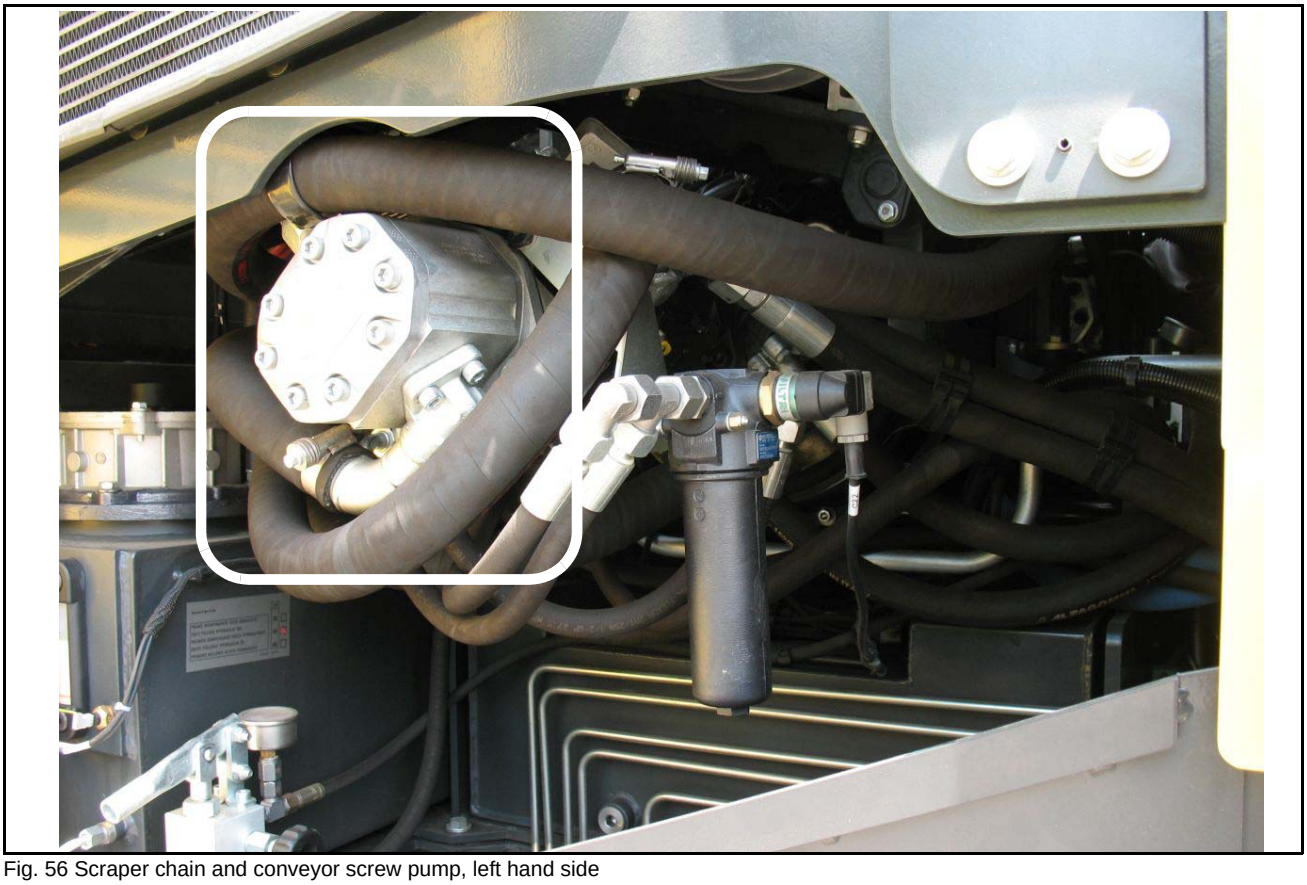


Fig. 56 Scraper chain and conveyor screw pump, left hand side

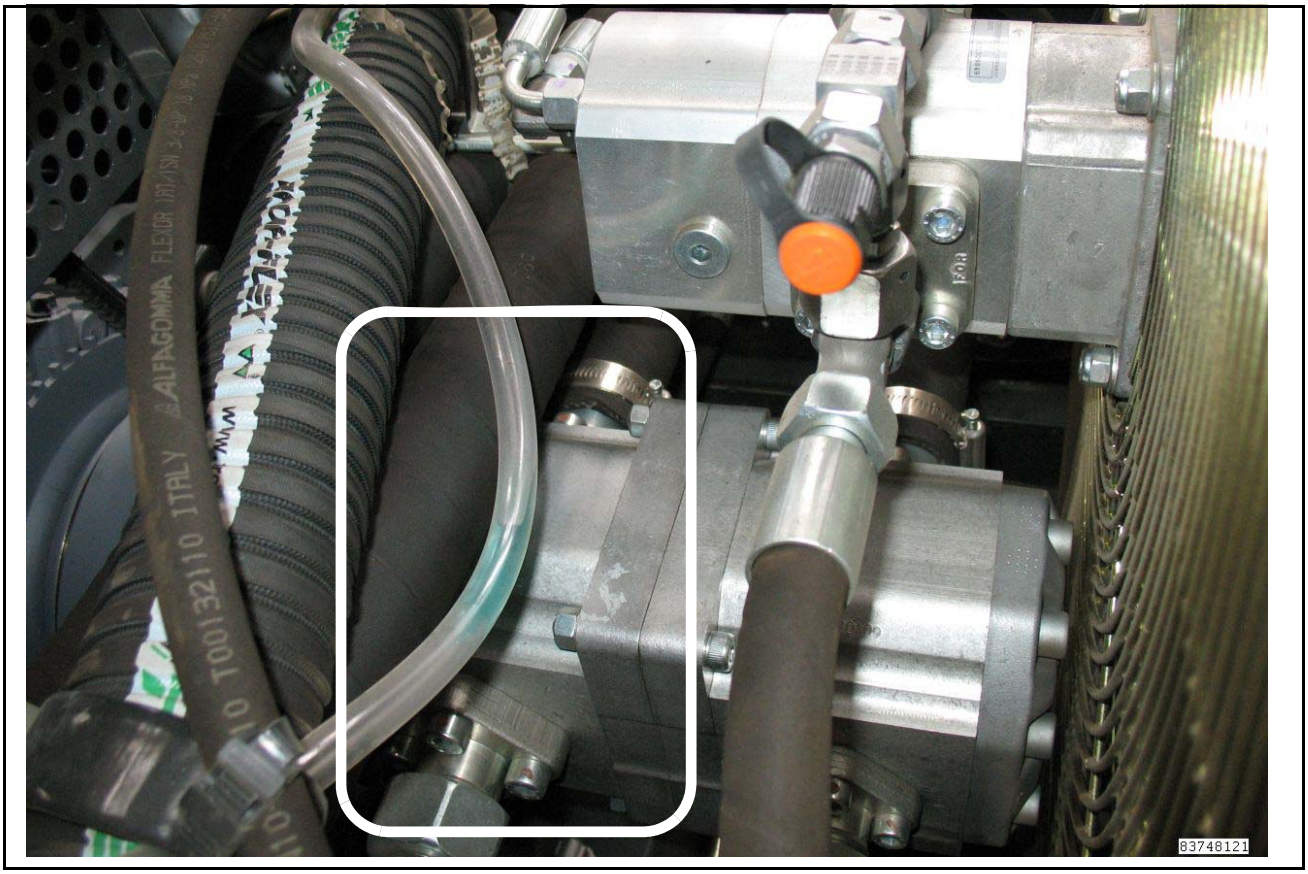


Fig. 57 Scraper chain and conveyor screw pump, right hand side

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Scraper chain motors

The scraper chain motors (1) (Fig. 58) drive the scraper chain by means of a drive chain.

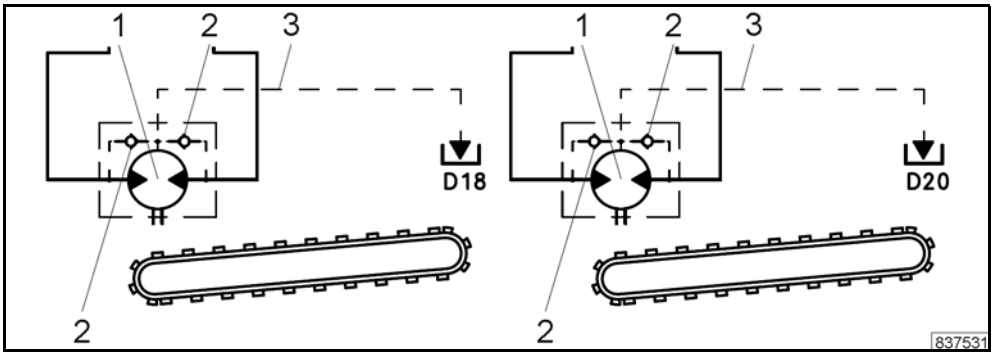


Fig. 58 Scraper chain motors - excerpt from hydraulic diagram

1	Scraper chain motor with reduction gear	3	Leakage line
2	Check valve		

Orbital motor

Function and design

An orbital motor (Fig. 59) is a housing with an internal gear, which consists of a fixed ring gear with internal gearing (- displacement ring (1)) and a rotor (3).

The pressure applied to the working chambers (4) controlled by a distributor valve (7), sets the rotor (3) into motion. This working movement is executed by a complete filling and emptying of the working chambers (2) in a sequence determined by the distributor valve (7).

The drive of the distributor valve (7) is synchronous to the output torque applied by the rotor (3) to the universal shaft and the stub shaft.

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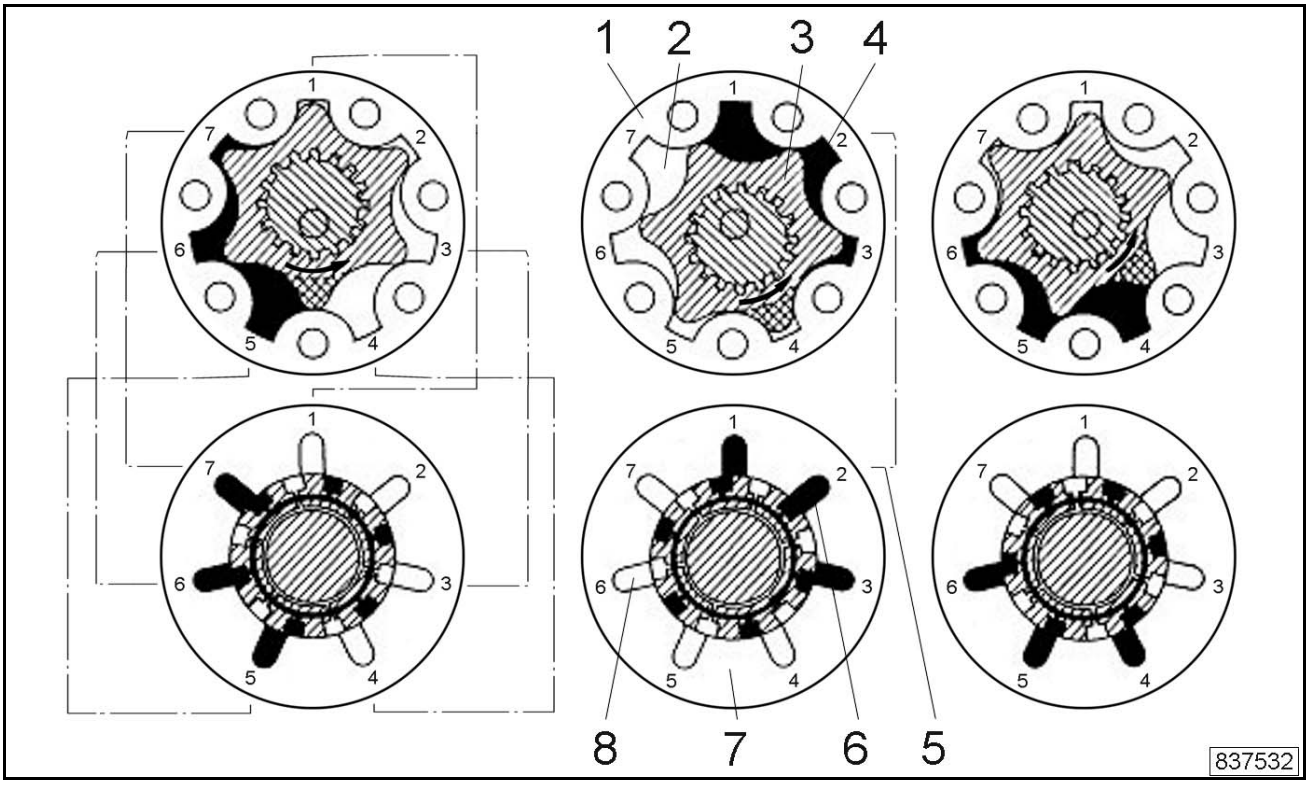


Fig. 59 Operational principle (pressurizing of working chamber - control slot)

1	Displacement ring	5	Pressurizing of working chamber - control slot
2	Working chamber (low pressure side)	6	Control slot (high pressure side)
3	Rotor	7	Distributor valve (plate valve)
4	Working chamber (high pressure side)	8	Control slot (low pressure side)

Due to the 3-chamber design of the orbital motor, high pressure has no direct connection to the inside of the housing or the radial seal, which enables operation with very high return flow pressures.

The orbital motor is equipped with two additional check valves, which make sure that the pressure acting on the radial seal does not exceed the pressure in the low pressure line.

Due to the movement of the drive shaft in the housing no seals can be fitted at the shaft outlet, so that the leak oil from the orbital motor flows into the reduction gear, from where it is returned to the hydraulic oil tank.

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Test and adjustment points

Scraper chain motors

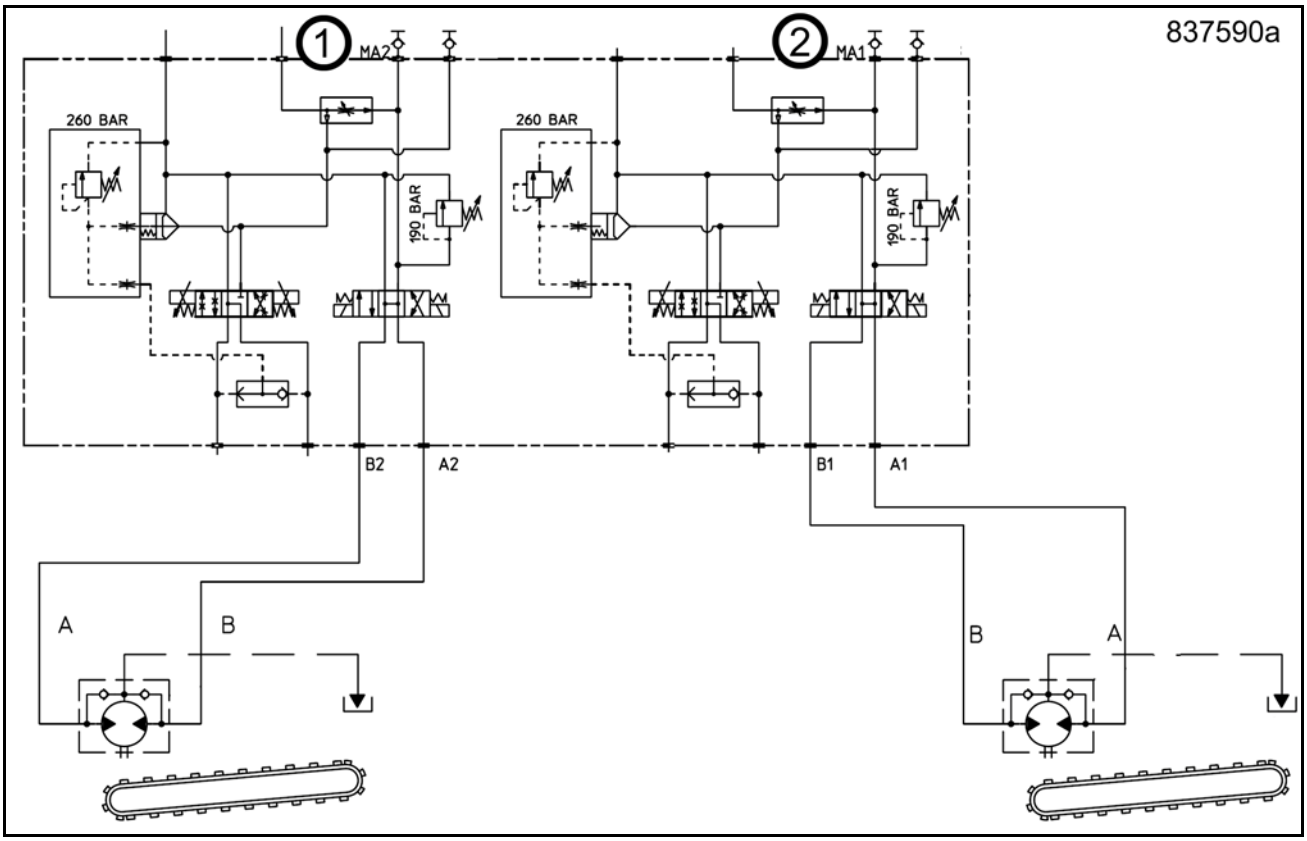


Fig. 60 Detail from hydraulic diagram

1	Pressure test port (MA2) scraper chain motor left
2	Pressure test port (MA1) scraper chain motor right

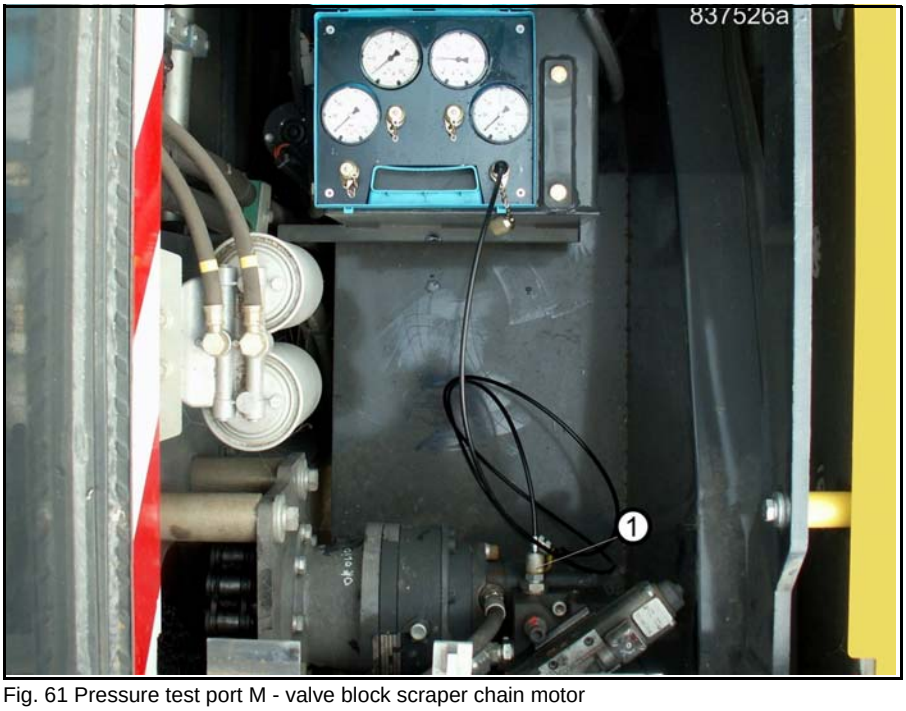


Fig. 61 Pressure test port M - valve block scraper chain motor

1	Pressure test port scraper chain motor left (right accordingly)

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Conveyor screw motor

The conveyor screw motors (1) (Fig. 62) drive the conveyor screw by means of a drive chain.

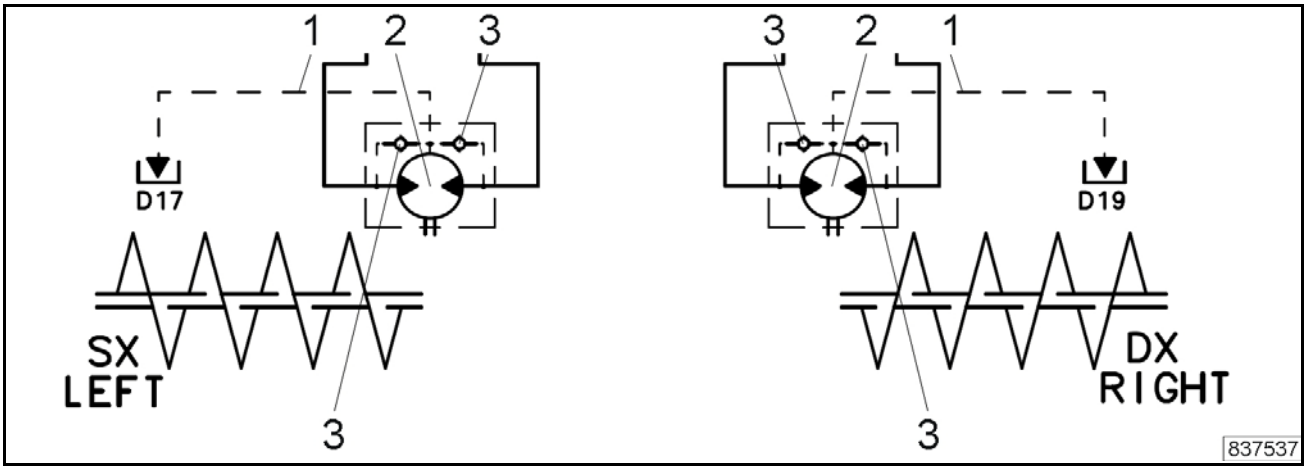


Fig. 62 Conveyor screw motor - excerpt from hydraulic diagram

1	Leakage line	3	Check valve
2	Conveyor screw motor with reduction gear;		

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3-way flow divider (pressure compensated)

The flow divider (6) (Fig. 63) is located between the variable displacement pump and the adjustment drive.

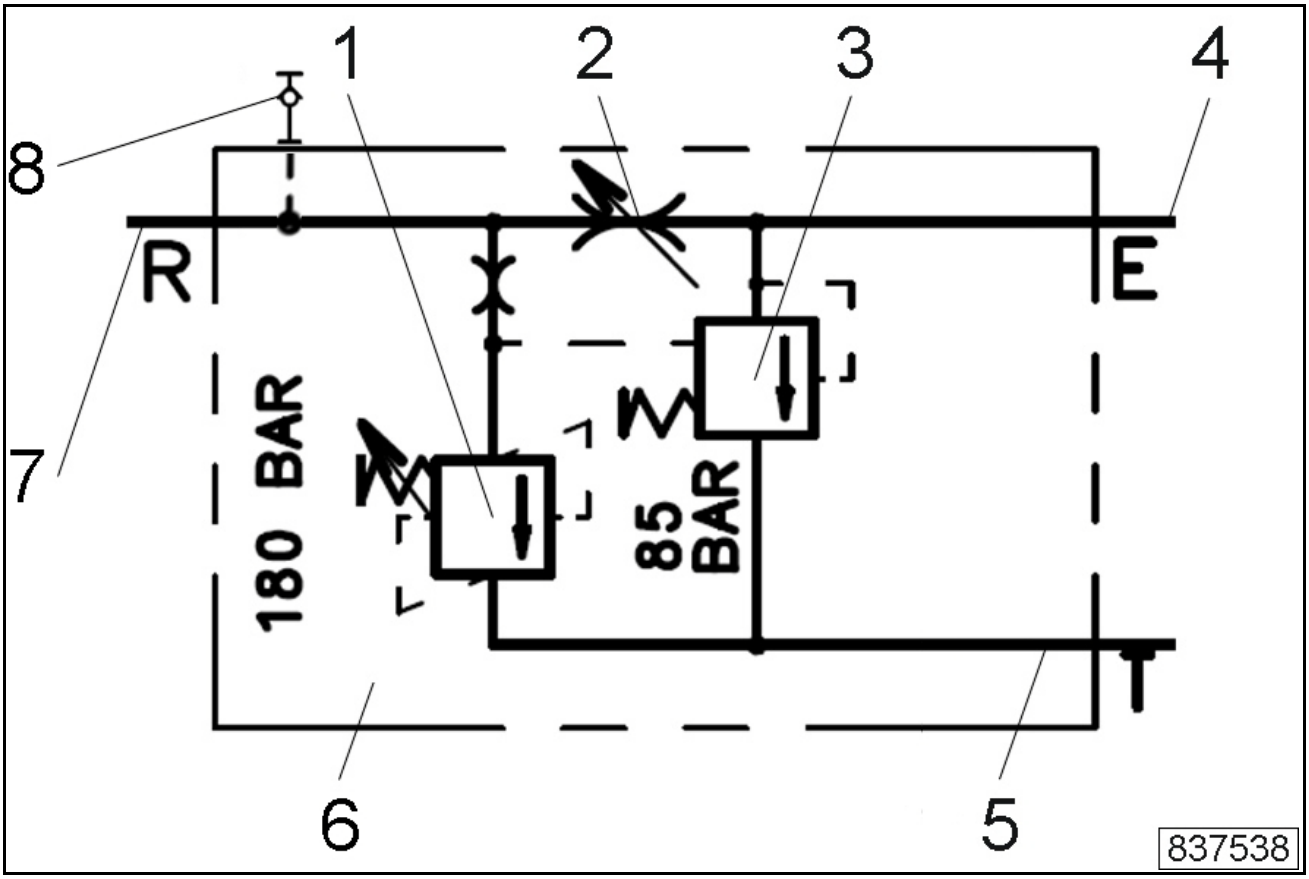


Fig. 63 3-way flow divider (pressure compensated) - section from hydraulic diagram

1	Pressure relief valve	5	Bypass
2	Control valve, adjustable	6	Flow divider
3	Bypass (pressure relief valve)	7	Main flow
4	Supply	8	Pressure test port

Function and design

The flow divider (6) divides the hydraulic oil flow in the supply line (4) into the main flow and the bypass flow.

The flow volume needed for the main flow (7) is generated by the control valve (2). The thus generated main flow is directed to the adjusting drive and supplies this drive with hydraulic oil.

The excess part of the available flow volume in the supply is discharged through the "bypass" (pressure relief valve) into the bypass flow (5). It serves as charge oil supply for the conveyor screw pump.

A pressure relief valve (1) downstream of the control valve (2) protects the main flow to the adjusting drive against pressure peaks. If the pressure of the main flow rises above the setting of the pressure relief valve (1), the "bypass" (pressure relief valve) (3) is closed through the pilot line and the pressure relief valve (1) opens to the by pass. The hydraulic pressure of the main flow is thereby limited to the max. pressure set by the pressure relief valve.

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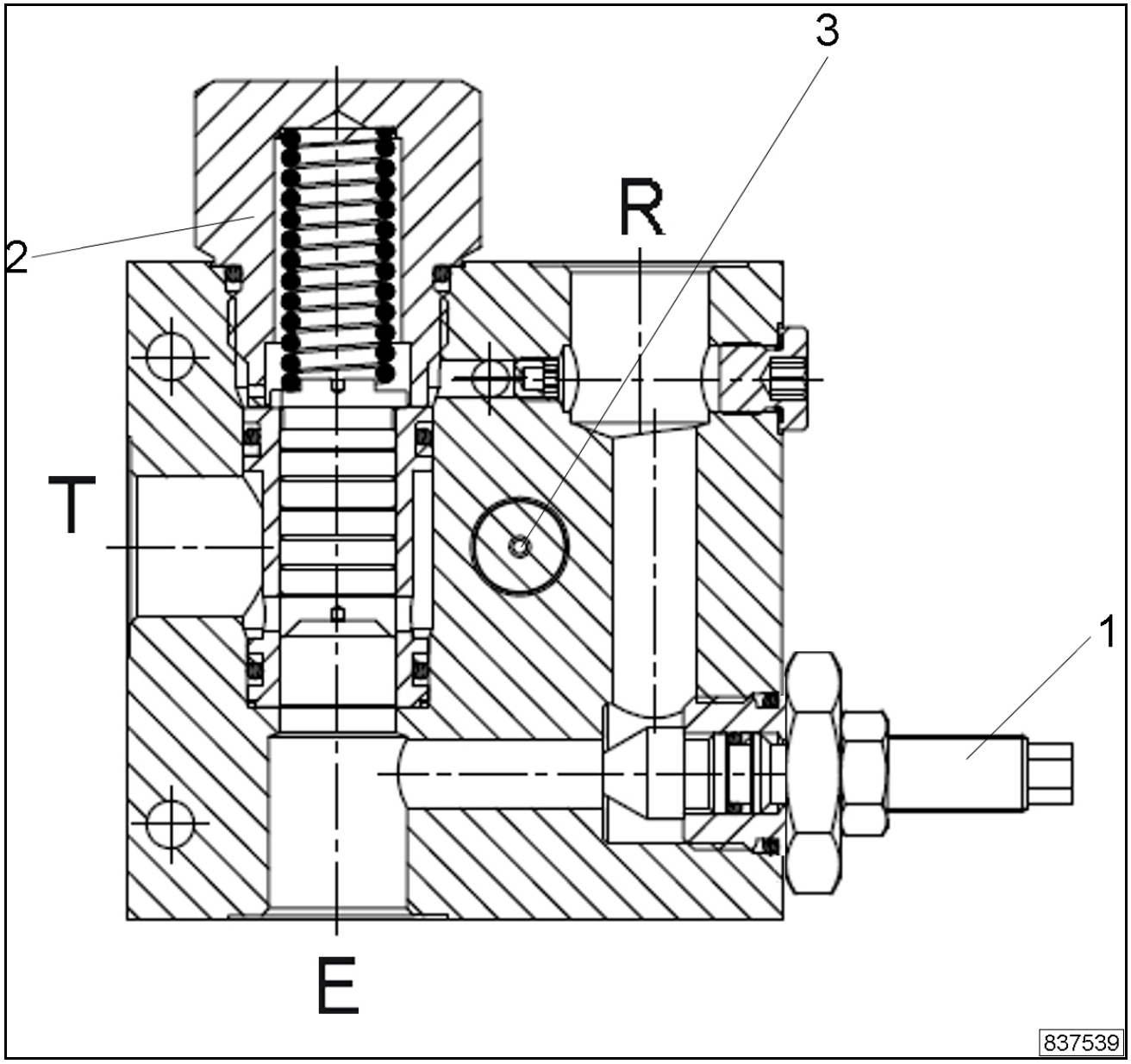


Fig. 64 Sectional view 3-way flow divider (pressure compensated)

1	Control valve, adjustable	3	Pressure relief valve
2	Bypass (pressure relief valve)		

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Outer gear motors non-reversible

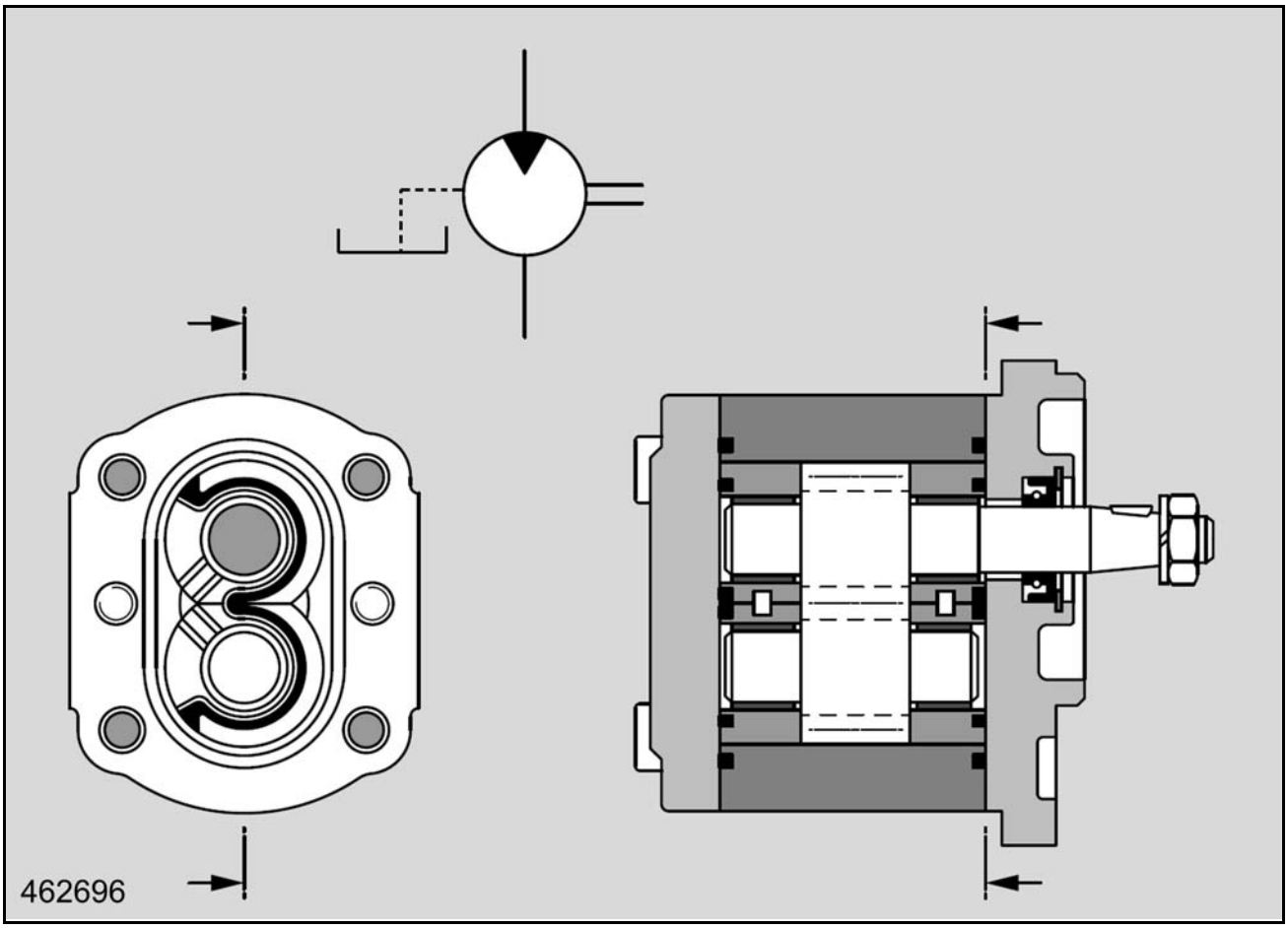


Fig. 65 Gear motor

In their design gear motors are quite similar to gear pumps. The only difference is the slightly different axial pressure field. The pressure fluid flowing into the gear motor works on the gears. It generates a torque, which is then transferred by the output shaft.

External gear motors for one sense of rotation are of asymmetrical design, i.e. high and low pressure sides are predetermined. Reversing operation is not possible. The arising leak oil is internally fed to the outlet. The pressure load in the outlet is limited because of the radial seal.

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Vibration and tamper drive

The vibration and tamper drive has been designed as an open hydraulic circuit.

The most essential components are (Fig. 66):

- the vibration pump (4)
- the tamper pump (5)
- the valve block for vibration drive (1)
- the vibration motors of the main screed (10) and (13)
- the vibration motors of the mobile screeds (9) and (14)
- the valve block for tamper drive (2)
- the tamper motors of the main screed (11) and (12)
- the tamper motors of the mobile screeds (8) and (15)

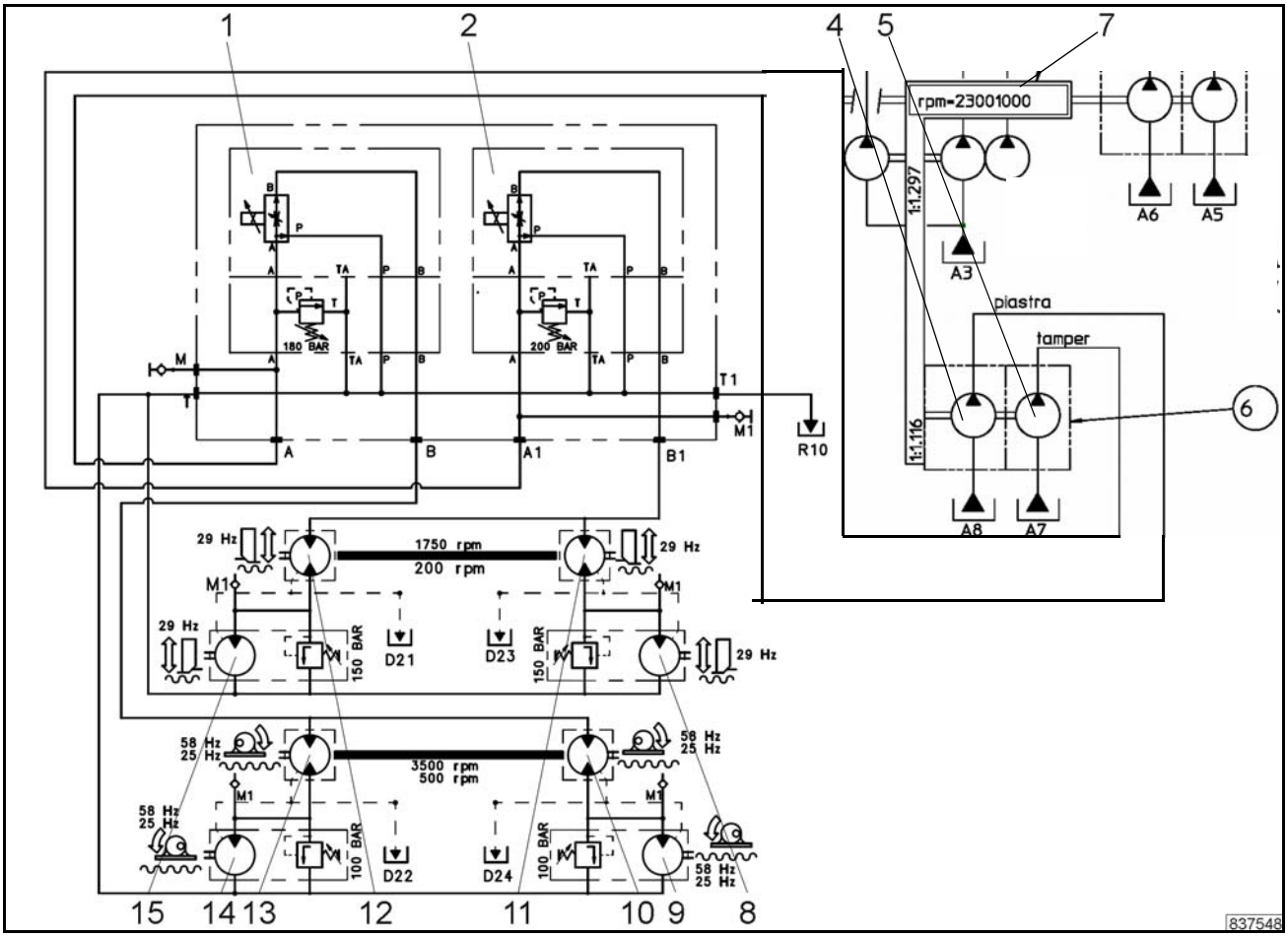


Fig. 66 Vibration and tamper drive - excerpt from hydraulic diagram

1	Valve block for vibration drive	9	Vibration motor, mobile screed right
2	Valve block for tamper operation	10	Vibration motor main screed, right
3		11	Tamper motor, main screed right
4	Vibration pump	12	Tamper motor, main screed left
5	Tamper pump	13	Vibration motor main screed, left
6	Tandem pump	14	Vibration motor, mobile screed left
7	Diesel engine	15	Tamper motor, mobile screed left
8	Tamper motor, mobile screed right		

The vibration (4) and tamper pumps (5) are joined together to a tandem gear pump (6) and are driven by the auxiliary output of the diesel engine (7). The vibration (4) and tamper pumps (5) supply the corresponding hydraulic circuits for vibration and tamping with a constant oil flow.

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This hydraulic oil supply runs through separate valve blocks for vibration drive (1) and tamper drive (2). Both valve blocks are equipped with a pressure relief valve and a 3-way flow divider. The flow divider is proportionally adjustable and thus enables an individually adjustable frequency of the vibration and tamper motors.

The tamper motors drive a drive shaft, which is connected with the corresponding tamper plate by eccentrically mounted connecting rods. Due to this eccentric mounting, the tamper bars perform a up and down movement. This has the purpose of pre-compacting the paved material. The tamper motors of main and mobile screeds are connected by prop-shafts. This makes sure that the tamper bars work exactly synchronously and that no erratic behaviour or a compensation of amplitudes will occur.

The vibration motors each engage directly into a flanged on exciter housing with exciter shaft (eccentric shaft). The eccentric arrangement of the weight of the exciter shaft causes a radial vibration, which works directly on the screed plates. The generated vibration of the screed plates serves the compaction and levelling of the paved material. The tamper motors of main and mobile screeds are connected by prop-shafts. This makes sure that the tamper bars work exactly synchronously and that no erratic behaviour or a compensation of amplitudes will occur.

Valve blocks

The two valve blocks (1) and (6) (Fig. 67) consist each of a pressure relief valve and a proprtionally adjustable 3-way flow divider.

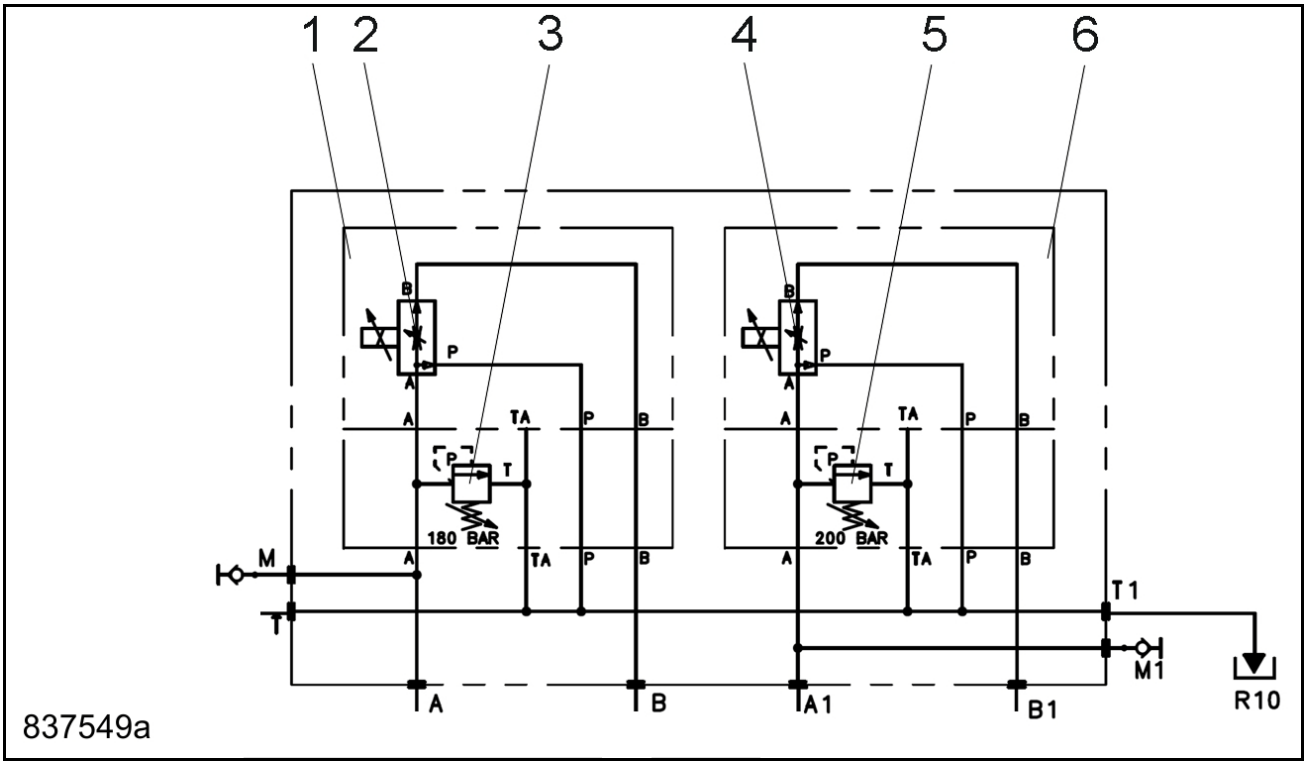


Fig. 67 Valve blocks - excerpt from hydraulic diagram

1	Valve block for vibration	5	Pressure relief valve
2	3-way flow divider, proportionally adjustable	6	Valve block for tamping
3	Pressure relief valve		
4	3-way flow divider, proportionally adjustable		

Function and design

The corresponding valve block is hydraulically installed between the pumps and the motors for the main or mobile screeds.

The high and low pressure lines of the valve block are internally connected and combined as central ports.

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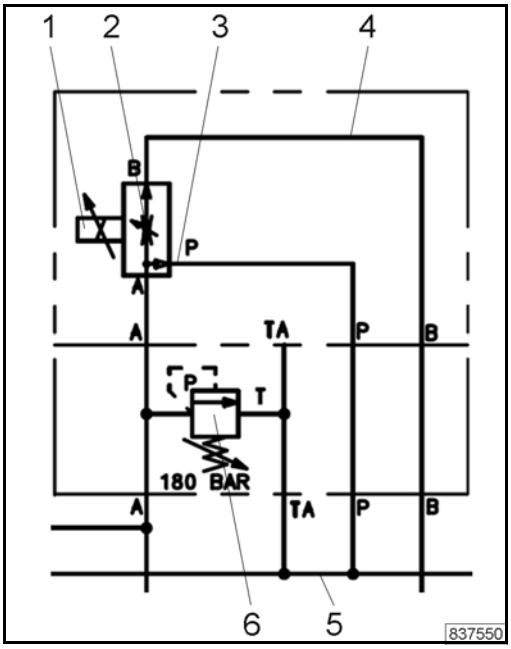


Fig. 68 3-way flow divider - excerpt from hydraulic diagram

1	Proportional solenoid	4	High pressure line
2	Throttle, adjustable	5	Low pressure line
3	Bypass	6	High pressure relief valve

The directly controlled pressure relief valve (PRV) (6) (Fig. 68) integrated in the high pressure line limits the hydraulic oil pressure for the motors to the value set by the valve (6). The PRV (6) opens the hydraulic circuit via port “T” to the low pressure side, so that the excess pressure is relieved. Port “T” on the PRV (6) is connected with the low pressure line (5). It returns to the hydraulic oil tank.

The oil volume flowing in through port "A" is subsequently regulated by the adjustable throttle (2) (controlled by the proportional solenoid (2)) of the flow divider, or completely returned to the hydraulic oil tank via the bypass "P" (3). Due to this regulation the motors (for tamper and vibration) can be operated within a fixed frequency range, or they can be completely isolated from the hydraulic circuit (no vibration or tamper operation).

Vibration and tamper motors

The vibration and tamper motors on main screed and both mobile screeds are gear motors.

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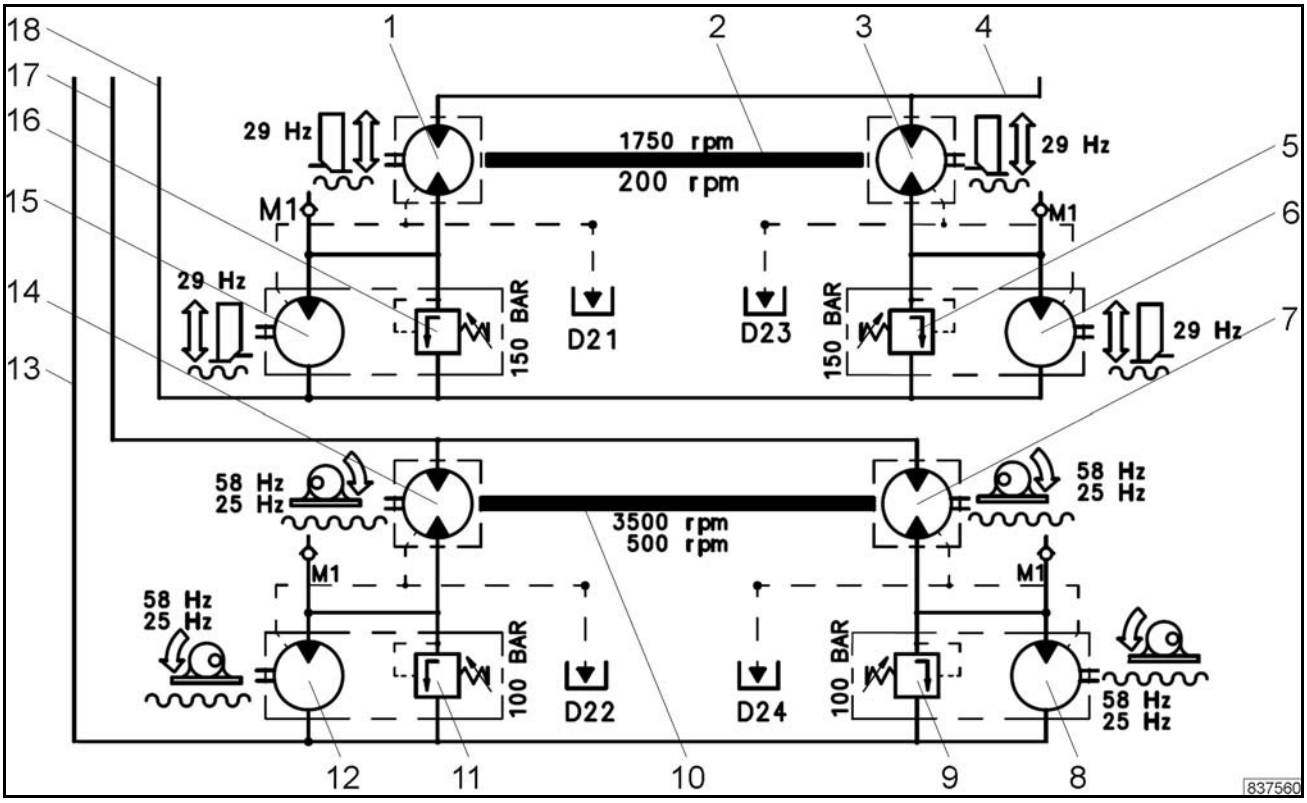


Fig. 69 Vibration and tamper motors - excerpt from hydraulic diagram

1	Tamper motor left, main screed	10	Universal shaft, vibration motors
2	Universal shaft, tamper motors	11	Pressure relief valve, vibration motors left
3	Tamper motor right, main screed	12	Vibration motor left, mobile screed
4	High pressure line, tamper motors	13	Low pressure line, vibration motors
5	Pressure relief valve, tamper motor right	14	Vibration motor left, main screed
6	Tamper motor right, mobile screed	15	Tamper motor left, mobile screed
7	Vibration motor right, main screed	16	Pressure relief valve, tamper motor left
8	Vibration motor right, mobile screed	17	High pressure line, vibration motors
9	Pressure relief valve, vibration motor right	18	Low pressure line, tamper motors

Vibration motors

The vibration motors (7), (8), (12) and (14) (Fig. 69) sare tightly attached to the screeds via the exciter unit. The vibration motors of the main screed are connected by a universal shaft (10). This makes sure that the tamper bars work exactly synchronously and that no erratic behaviour or a compensation of amplitudes will occur.

Tamper motors

The tamper motors drive a drive shaft, which is connected with the corresponding tamper plate by eccentrically mounted connecting rods. Due to this eccentric mounting, the tamper bars perform a up and down movement. This has the purpose of pre-compacting the paved material. The tamper motors of the main screed are connected by a universal shaft. This makes sure that the tamper bars work exactly synchronously and that no erratic behaviour or a compensation of amplitudes will occur.

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Outer gear motors non-reversible

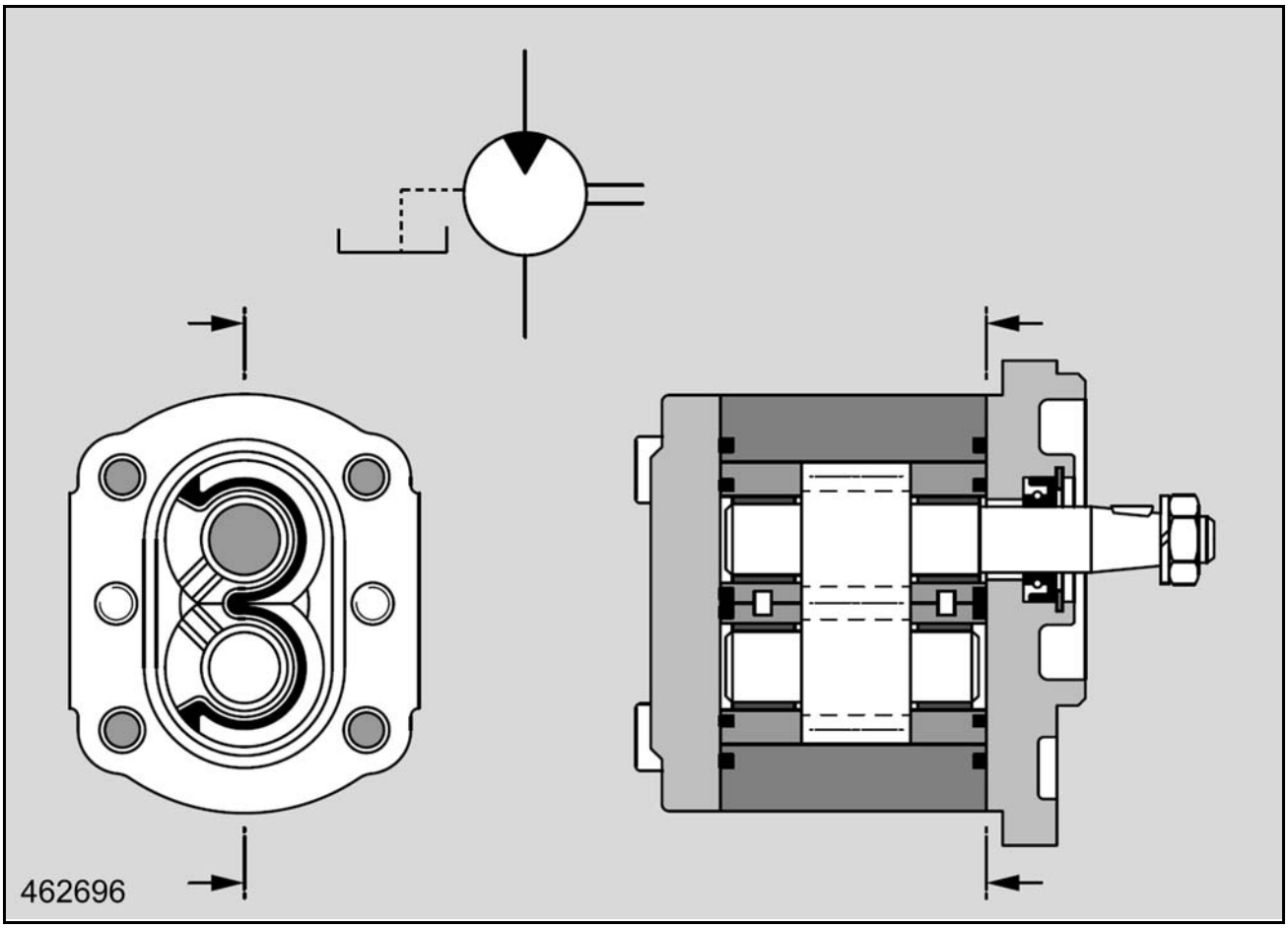


Fig. 70 Gear motor

In their design gear motors are quite similar to gear pumps. The only difference is the slightly different axial pressure field. The pressure fluid flowing into the gear motor works on the gears. It generates a torque, which is then transferred by the output shaft.

External gear motors for one sense of rotation are of asymmetrical design, i.e. high and low pressure sides are predetermined. Reversing operation is not possible. The arising leak oil is internally fed to the outlet. The pressure load in the outlet is limited because of the radial seal.

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Test and adjustment points

Valve block vibration and tamper operation

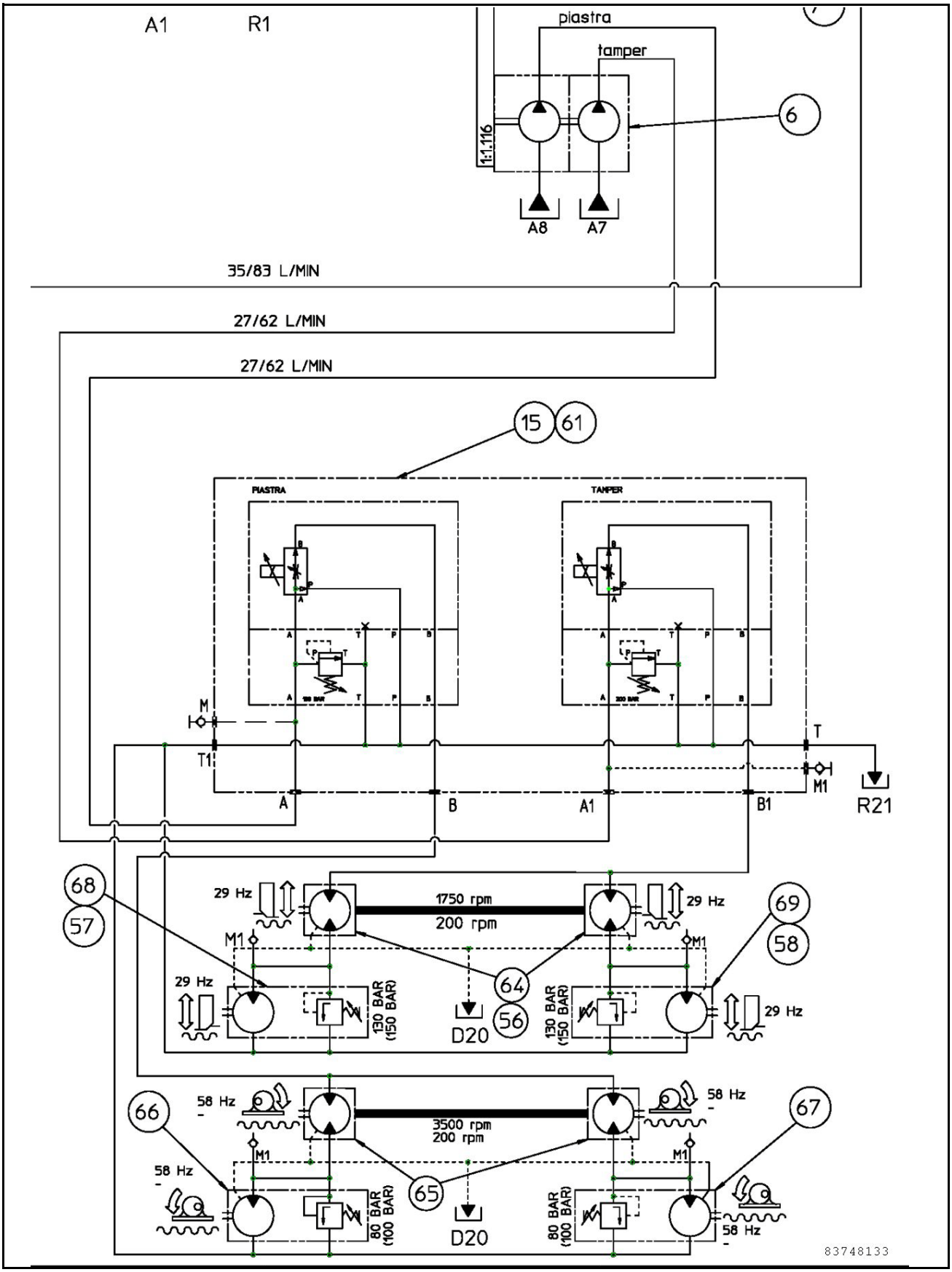


Fig. 71 Vibration and tamper operation - excerpt from hydraulic diagram

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Valve block vibration and tamper

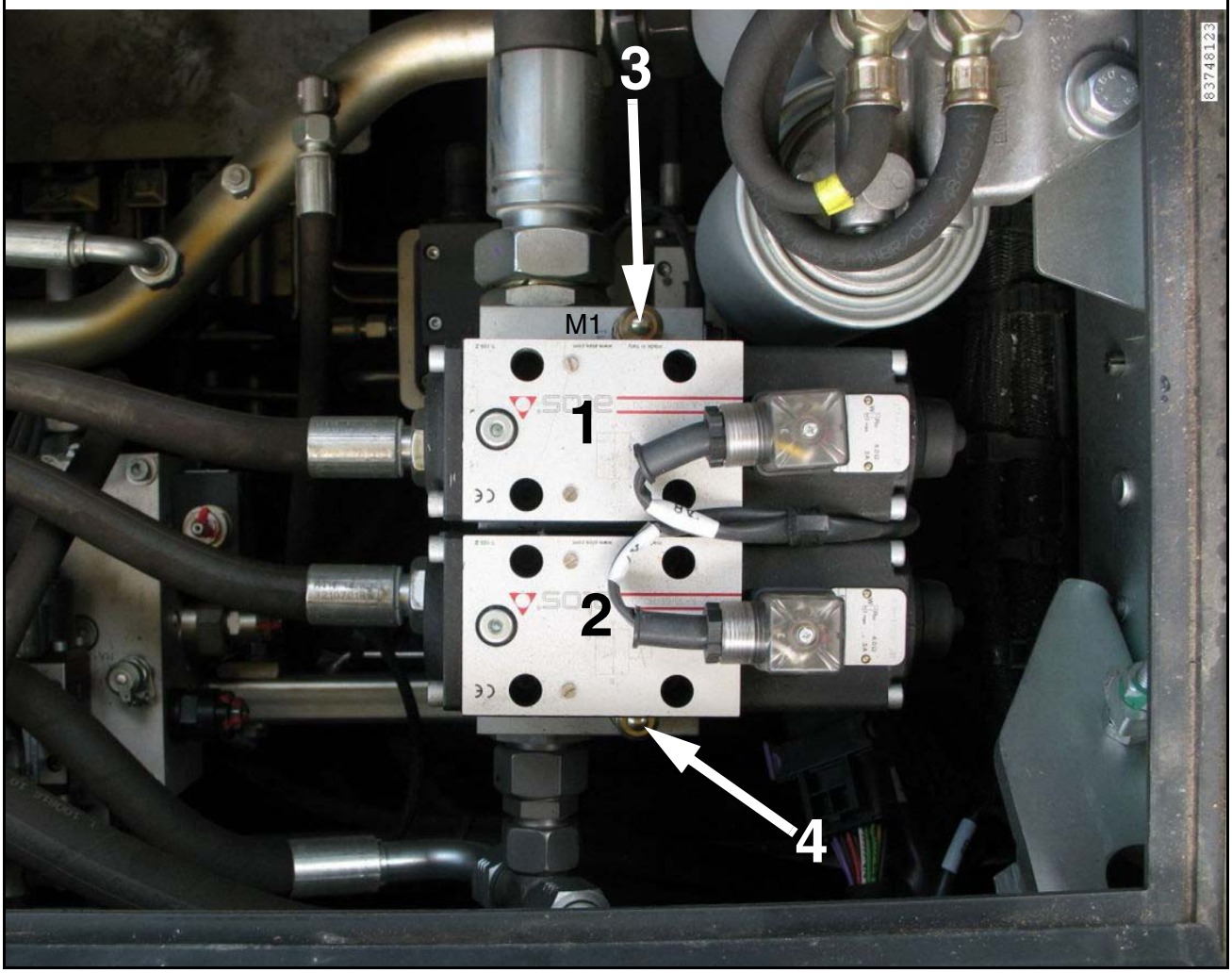


Fig. 72 Valve block, vibration and tamper

Pos	Designation	Position in hydraulic diagram	Position in wiring diagram	Measuring values and switching points
1	Proportional valve, tamper	15	A8, Page 200	Prop.
2	Proportional valve, vibration	15	A7, Page 200	Prop.
3	Pressure test port, tamper	15 / M1		Pressure relief valve 200 bar
4	Pressure test port, vibration	15 / M		Pressure relief valve 180 bar

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Pressure test port M_1 - vibration motor main screed, right

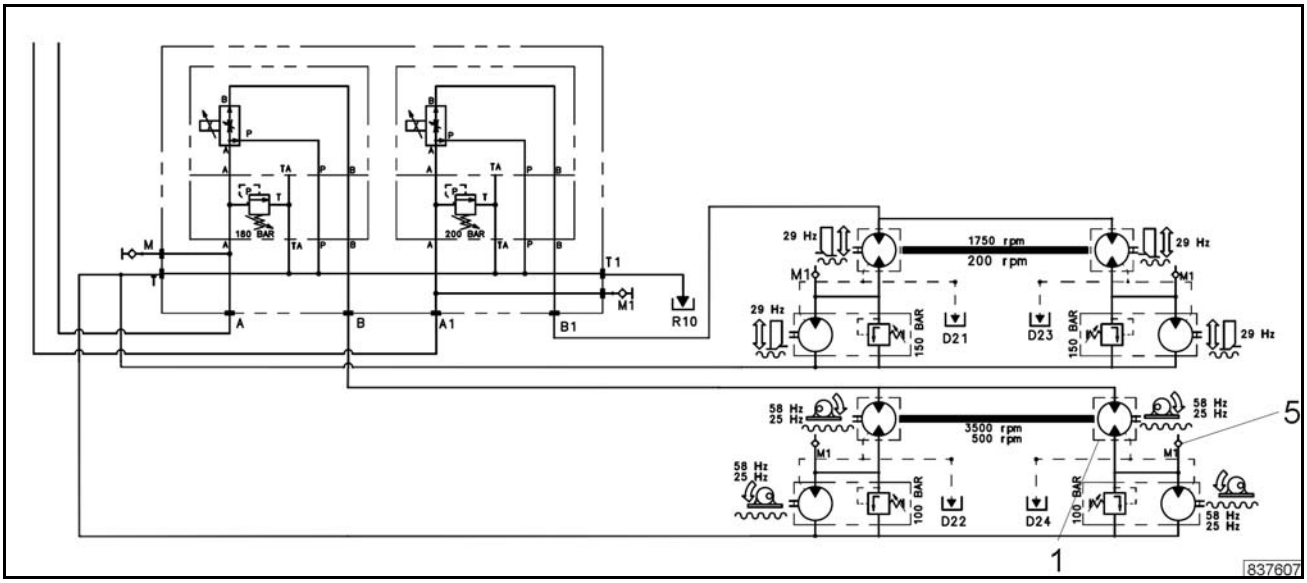


Fig. 73 Pressure test port M_1 - excerpt from hydraulic diagram

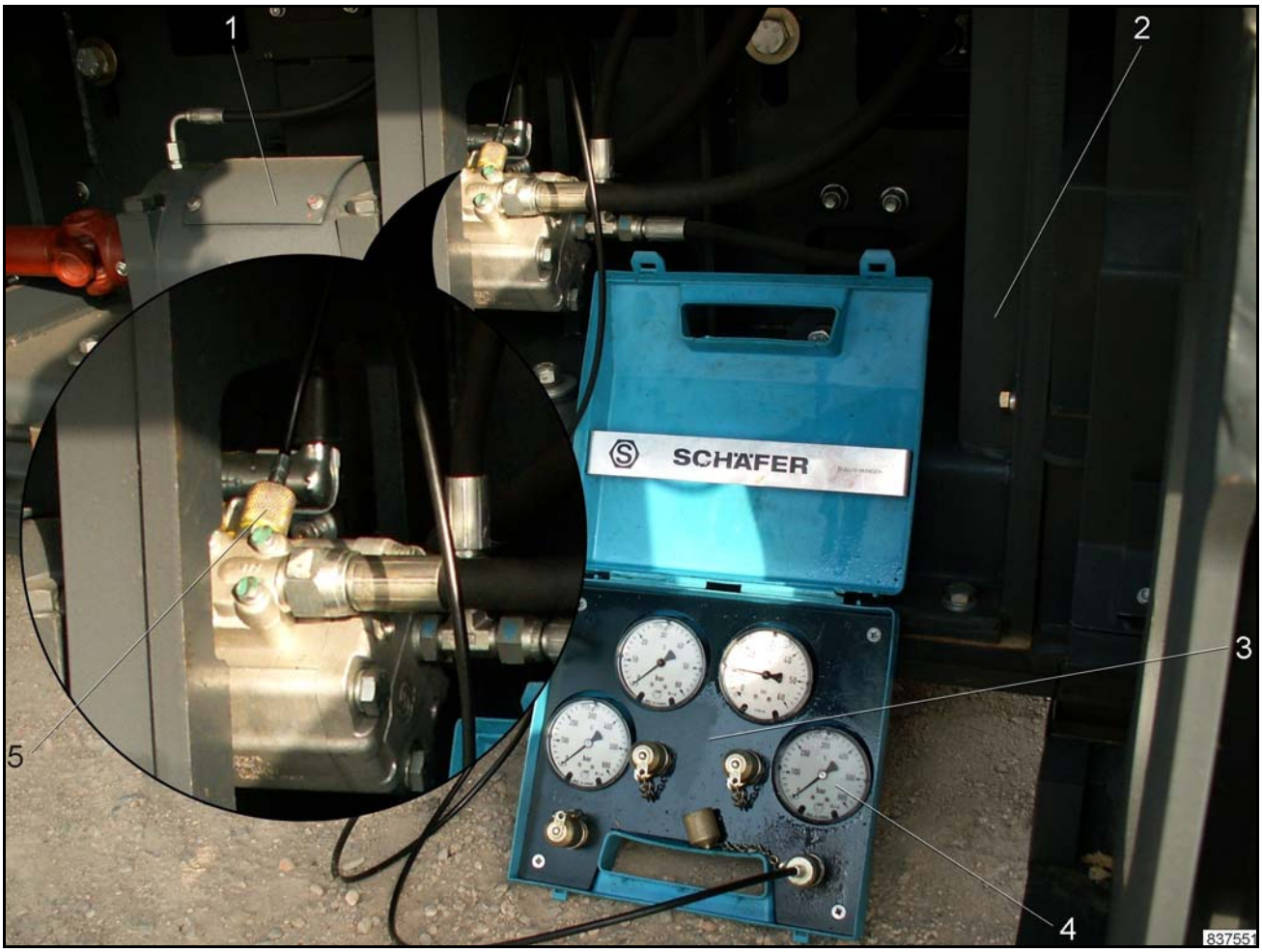


Fig. 74 Pressure test port M_1 - vibration motor main screed, right

1	Vibration motor main screed, right	4	High pressure gauge (600 bar)
2	Main screed, right	5	Pressure test port M_1
3	Hydraulic test case **[BOMAG Part-No.: 079 930 01]**		

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Pressure test port M_1 - vibration motor main screed, left

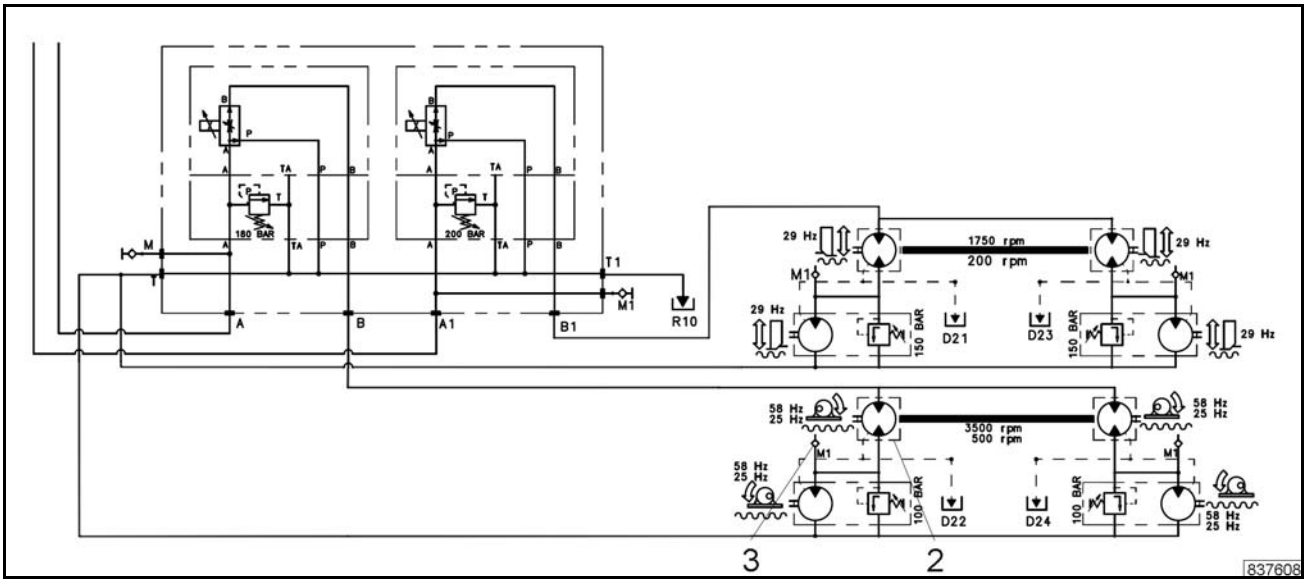


Fig. 75 Pressure test port M_1 - excerpt from hydraulic diagram

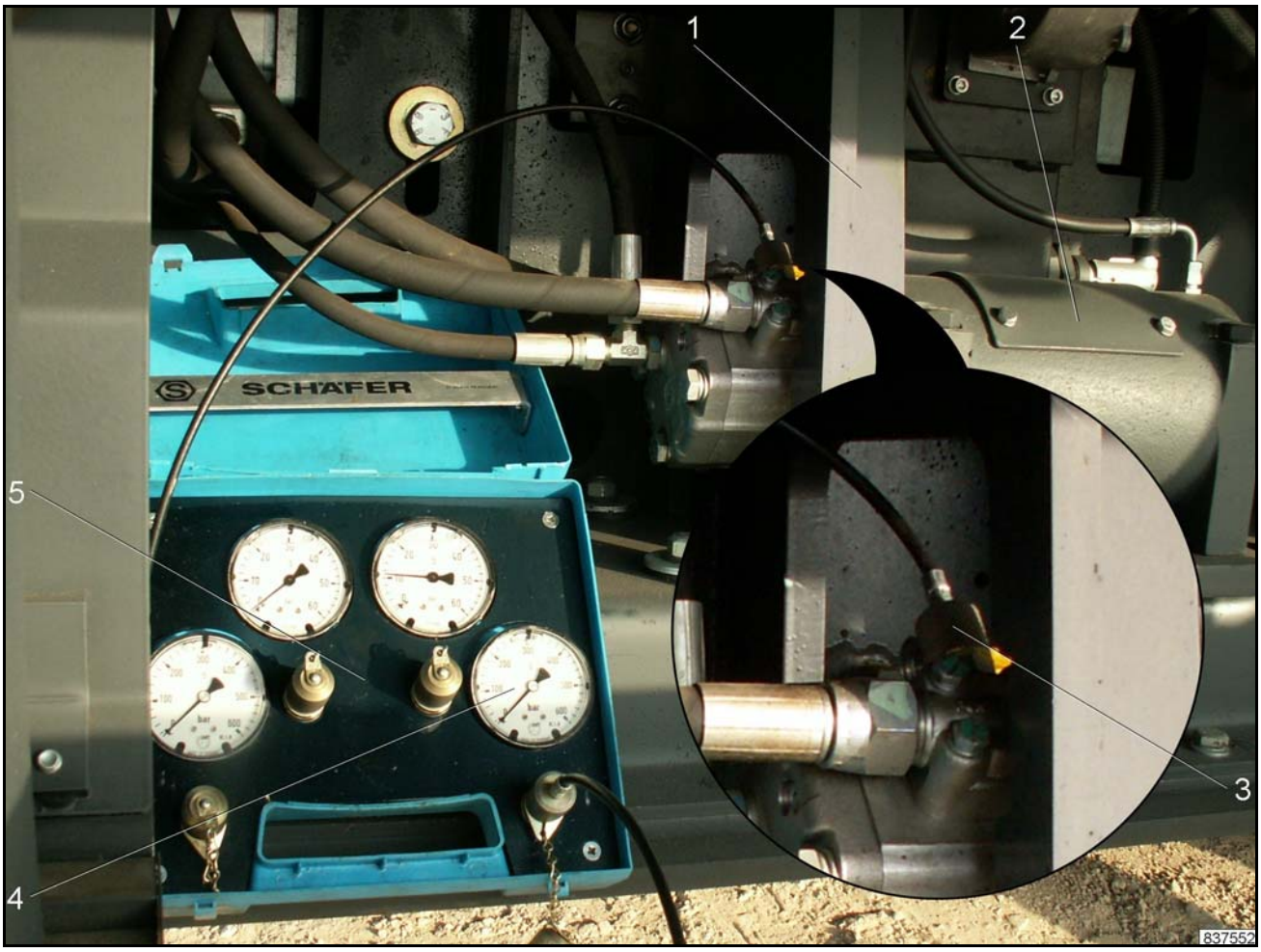


Fig. 76 Pressure test port M_1 - vibration motor main screed, left

1	Main screed, left	4	High pressure gauge (600 bar)
2	Vibration motor main screed, left	5	Hydraulic test case **[BOMAG Part-No.: 079 930 01]**
3	Pressure test port M_1		

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Pressure test port M_1 - tamper motor mobile screed, right

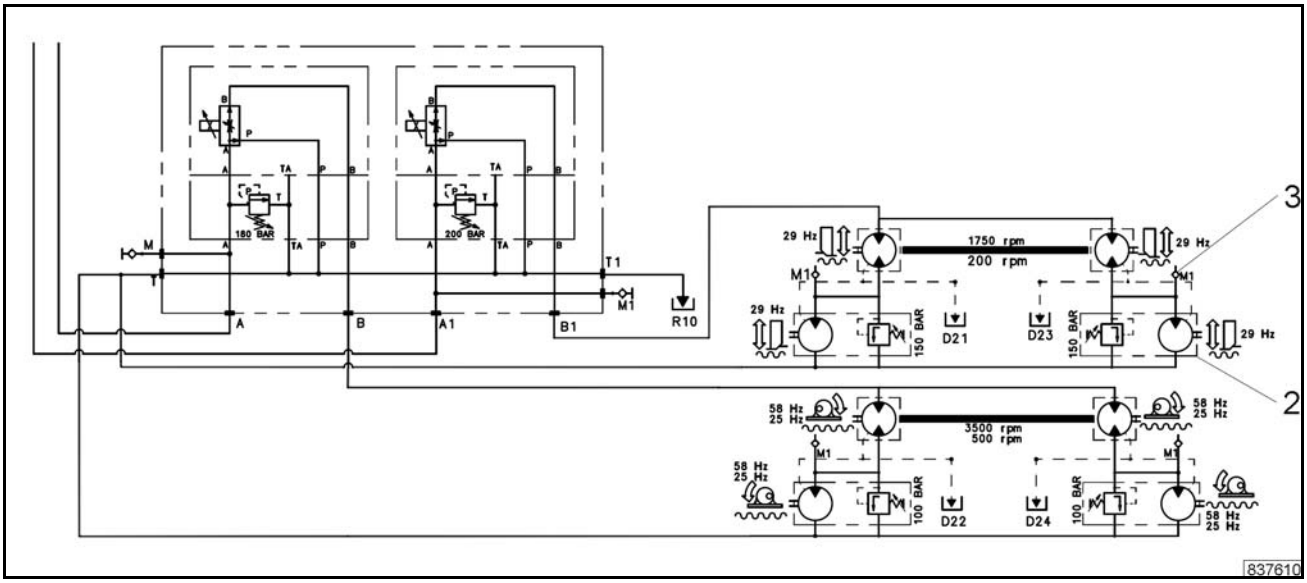


Fig. 77 Pressure test port M_1 - excerpt from hydraulic diagram

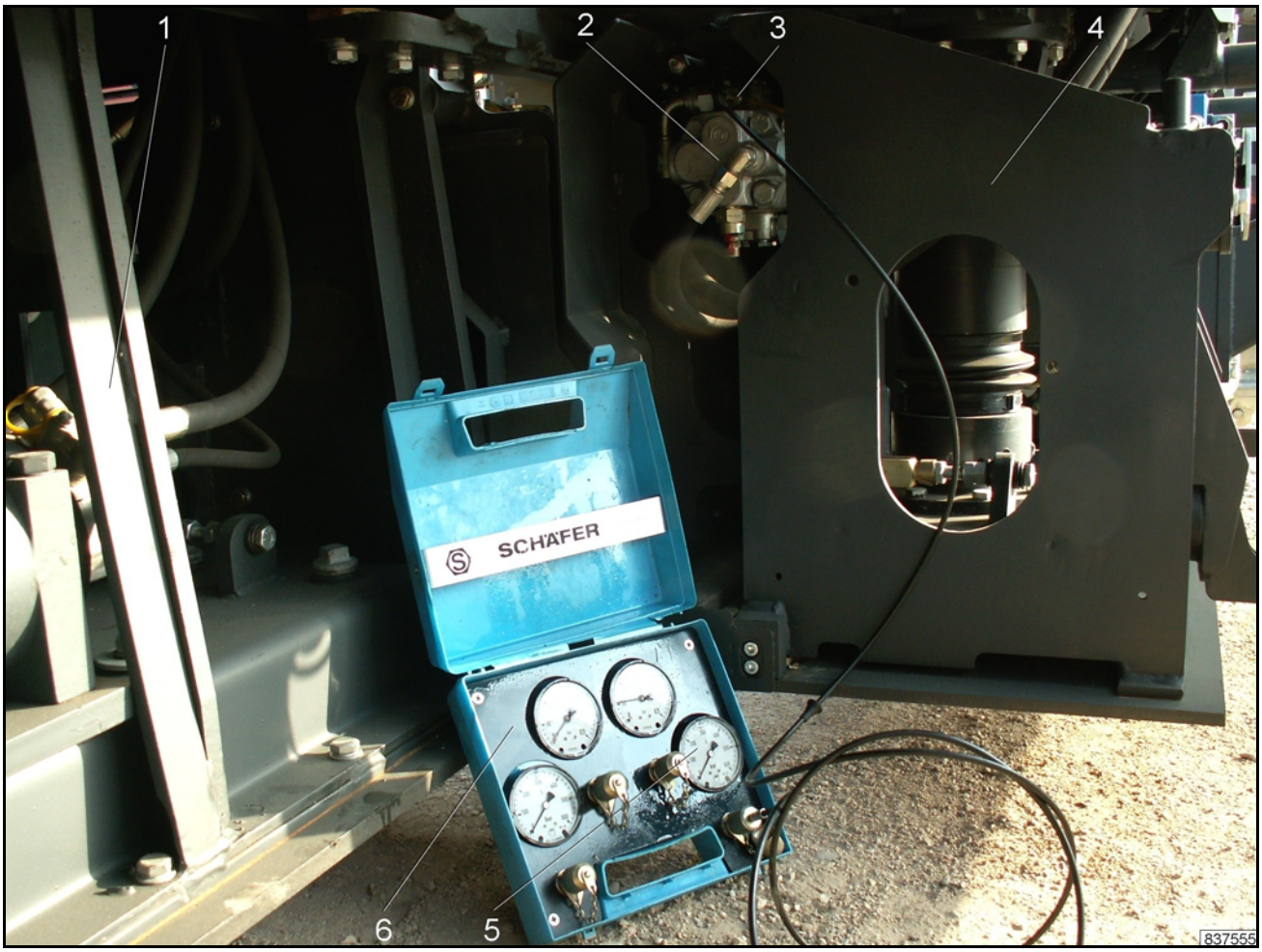


Fig. 78 Pressure test port M_1 - tamper motor mobile screed, right

1	Main screed	4	Mobile screed, right
2	Tamper motor right, mobile screed	5	High pressure gauge (600 bar)
3	Pressure test port M_1	6	Hydraulic test case **[BOMAG Part-No.: 079 930 01]**

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Pressure test port M_1 - tamper motor mobile screed, left

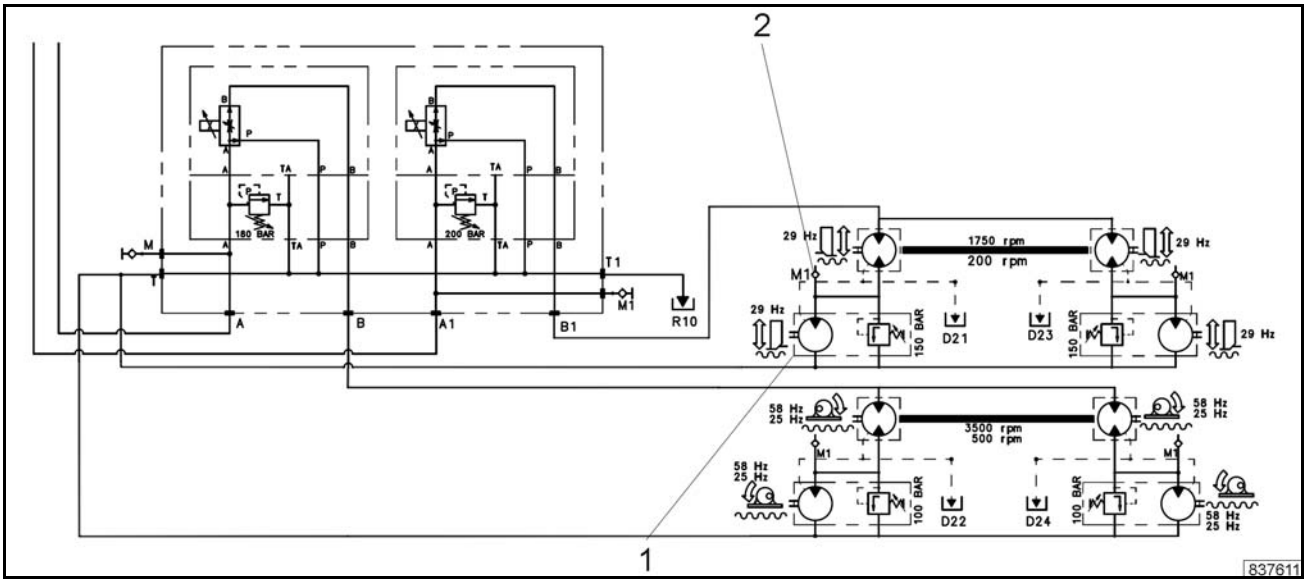


Fig. 79 Pressure test port M_1 - excerpt from hydraulic diagram

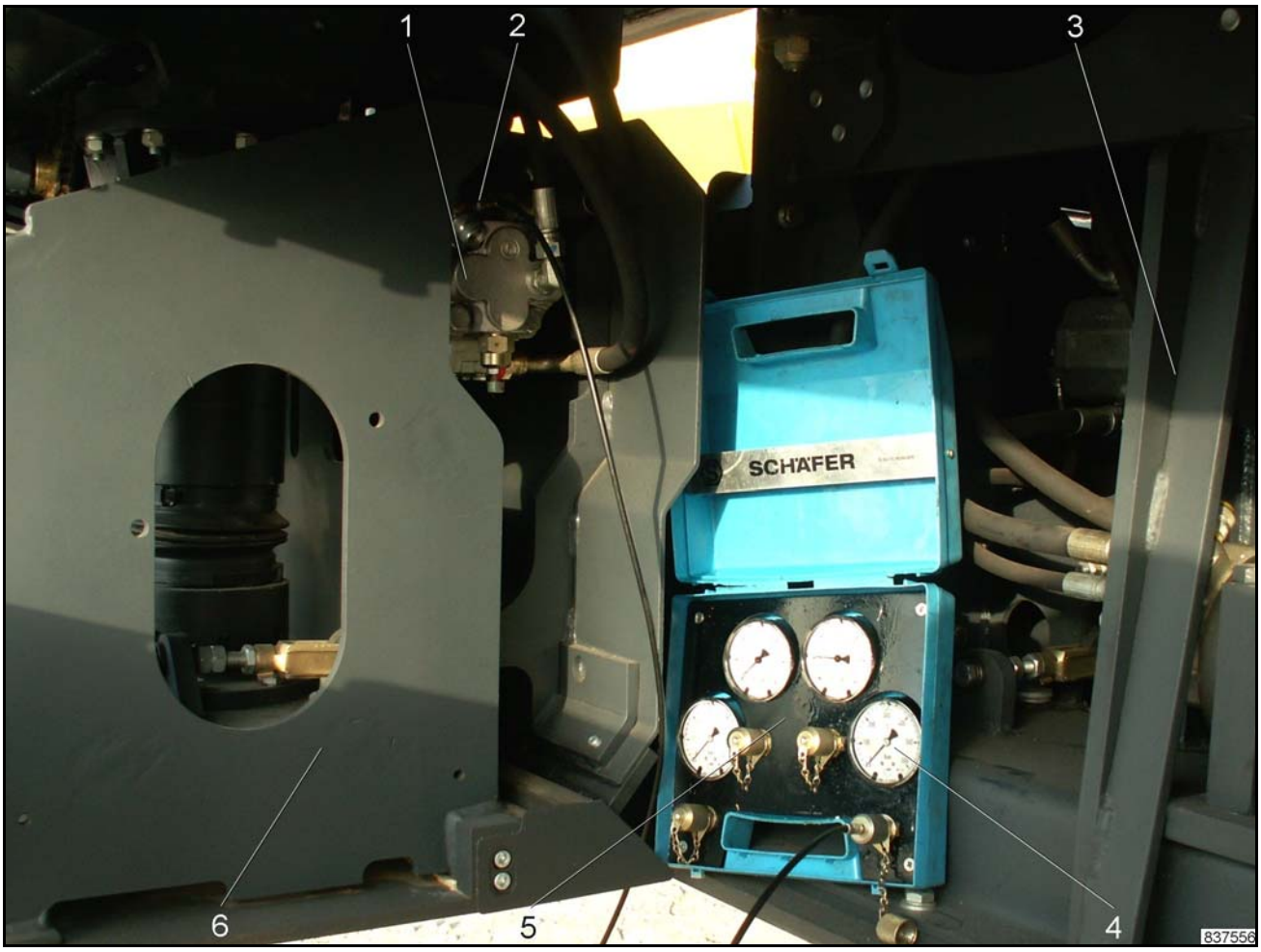


Fig. 80 Pressure test port M_1 - tamper motor mobile screed, left

1	Tamper motor mobile screed, left	4	High pressure gauge (600 bar)
2	Pressure test port M_1	5	Hydraulic test case **[BOMAG Part-No.: 079 930 01]**
3	Main screed	6	Mobile screed, left

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Adjustment points valve blocks vibration and tamping

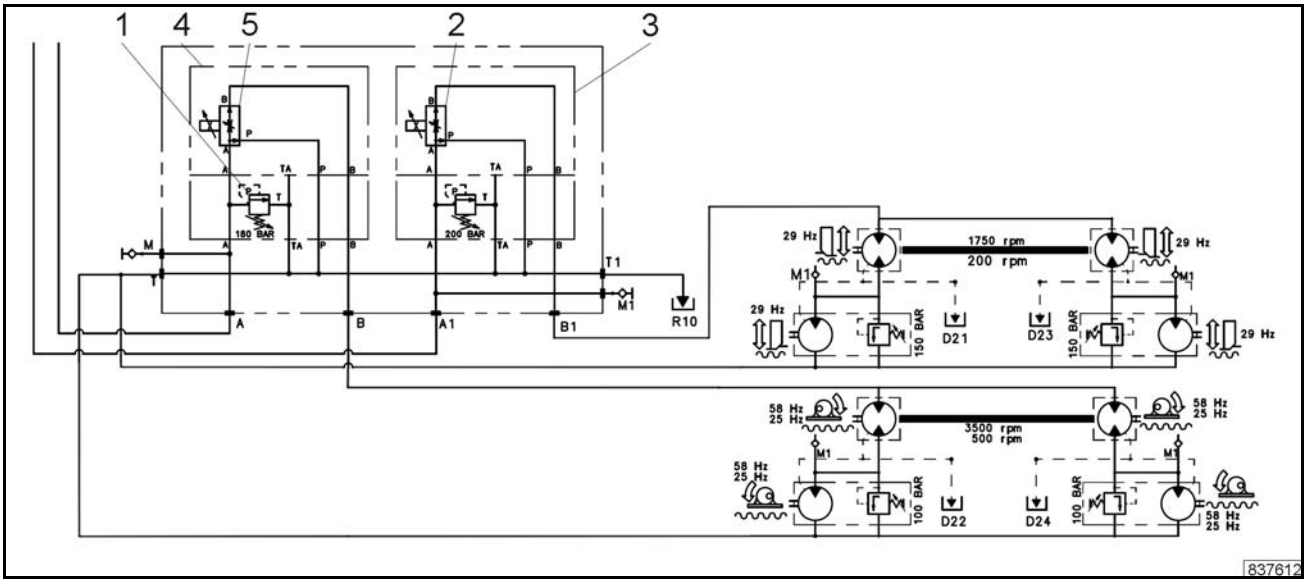


Fig. 81 Adjustment points: Valve block vibration and valve block tamping - excerpt from hydraulic diagram

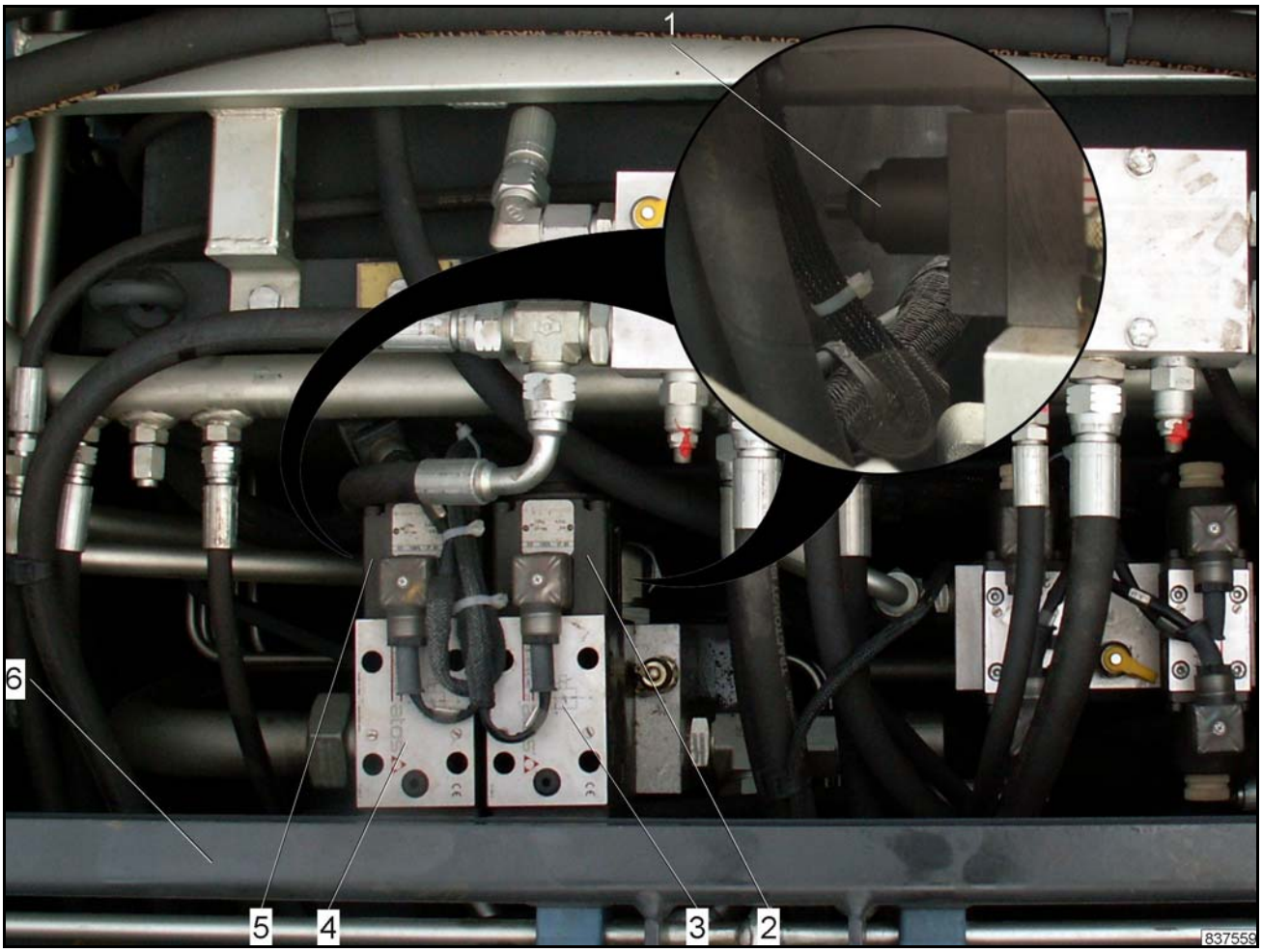


Fig. 82 Adjustment points valve block vibration and valve block tamping

1	Pressure relief valve vibration (shown) and tamping (not shown)	4	Valve block for vibration
2	Solenoid valve tamping (control symbol no.: A8)	5	Solenoid valve vibration (control symbol no.: A7)
3	Valve block for tamping	6	Opening, maintenance flap driver's stand

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Adjustment point for vibration drive mobile screed, right

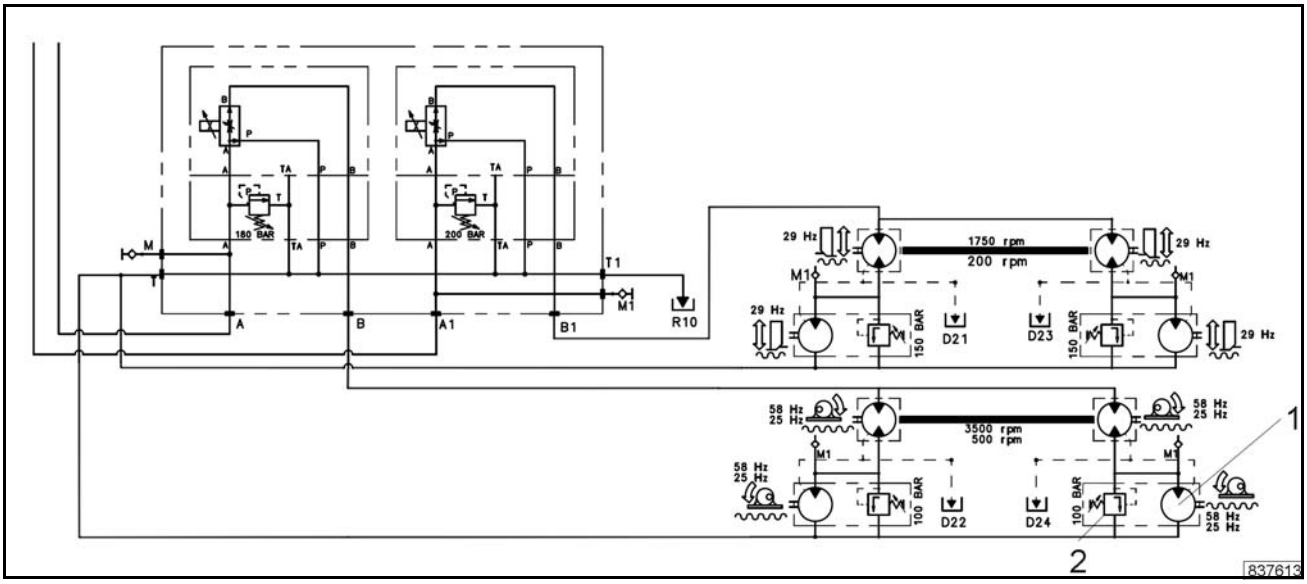


Fig. 83 Adjustment point for vibration drive mobile screed, right - excerpt from hydraulic diagram

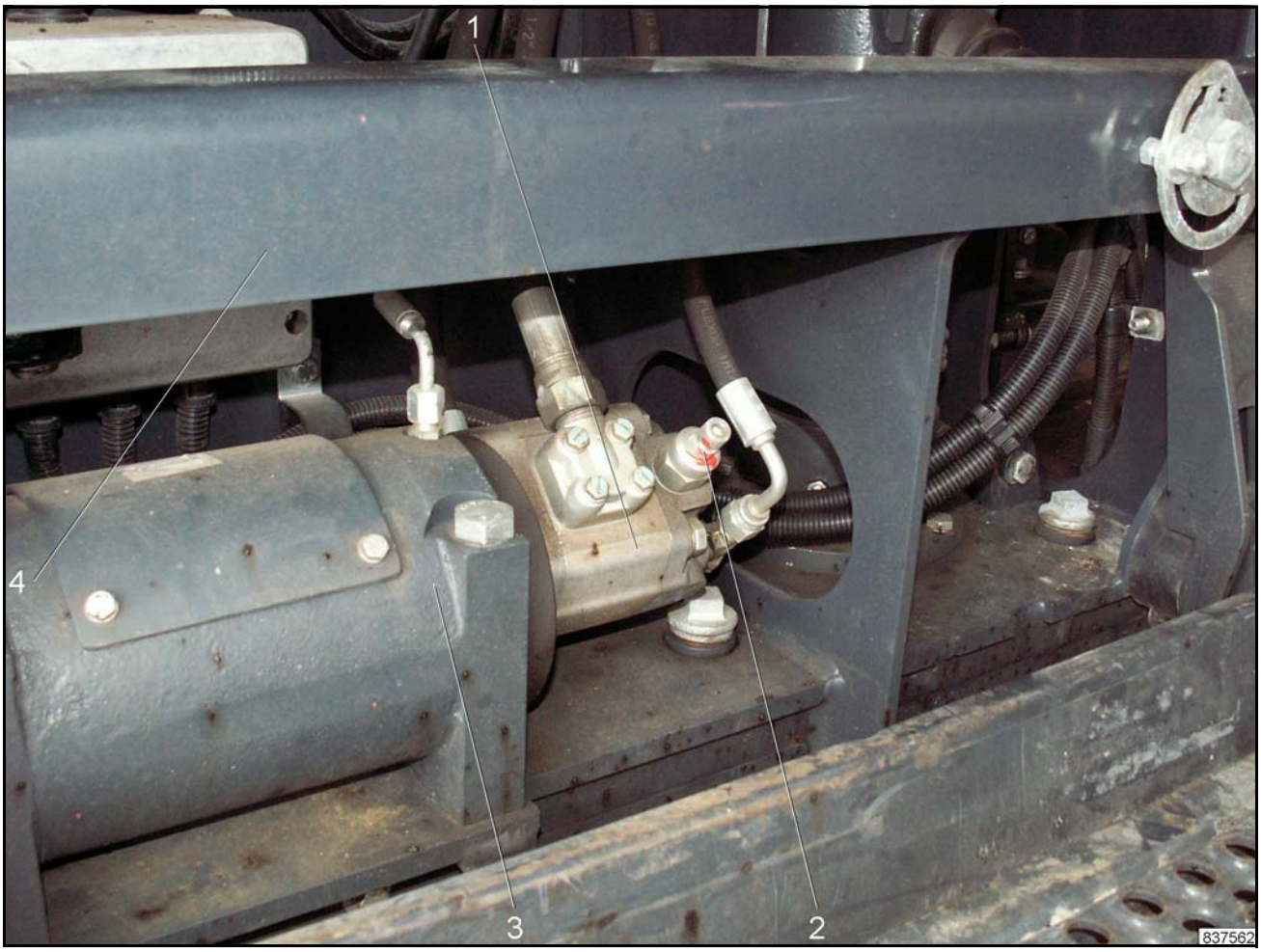


Fig. 84 Adjustment point for vibration drive mobile screed, right

1	Vibration motor, mobile screed right	3	Exciter housing
2	Pressure relief valve	4	Mobile screed, right

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Adjustment point for vibration drive mobile screed, left

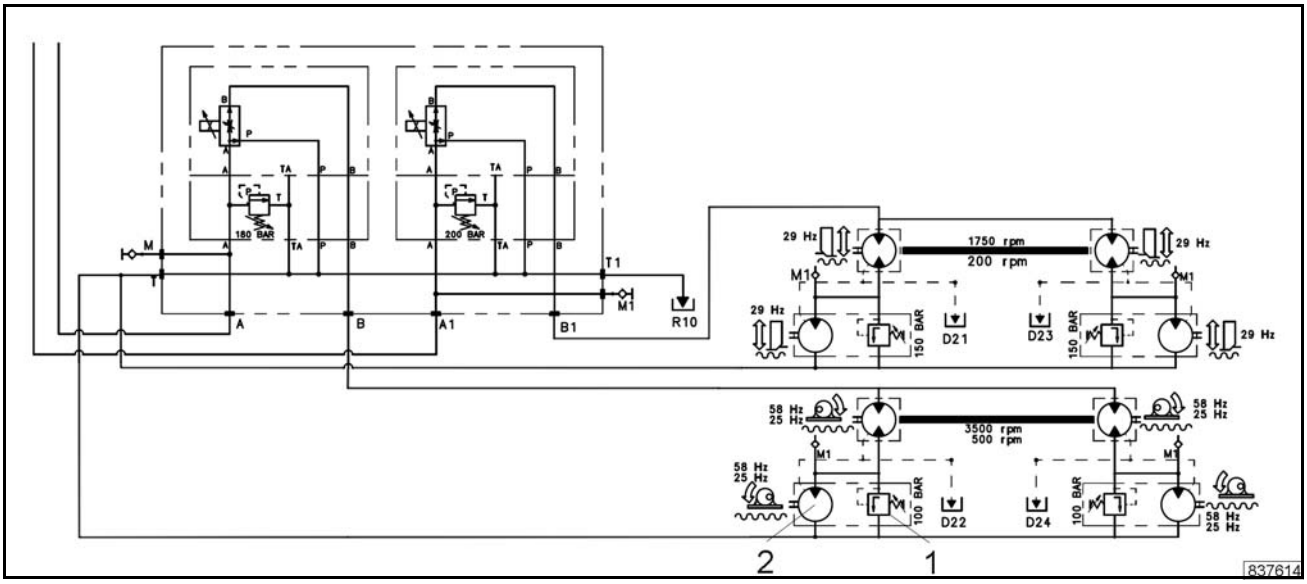


Fig. 85 Adjustment point for vibration drive mobile screed, left - excerpt from hydraulic diagram

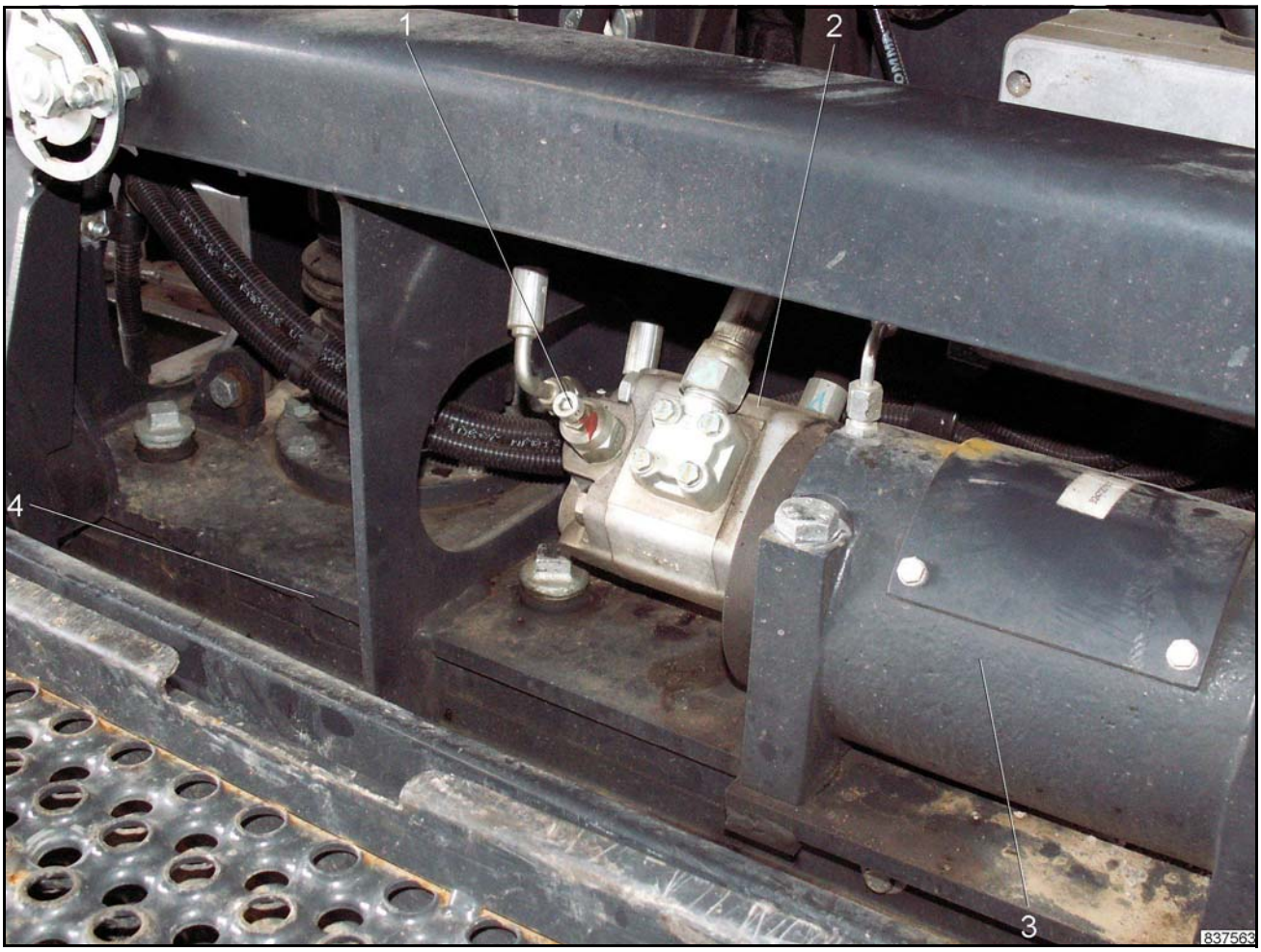


Fig. 86 Adjustment point for vibration drive mobile screed, left

1	Pressure relief valve	3	Exciter housing
2	Vibration motor	4	Mobile screed, left

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Adjustment point for tamper drive mobile screed, right

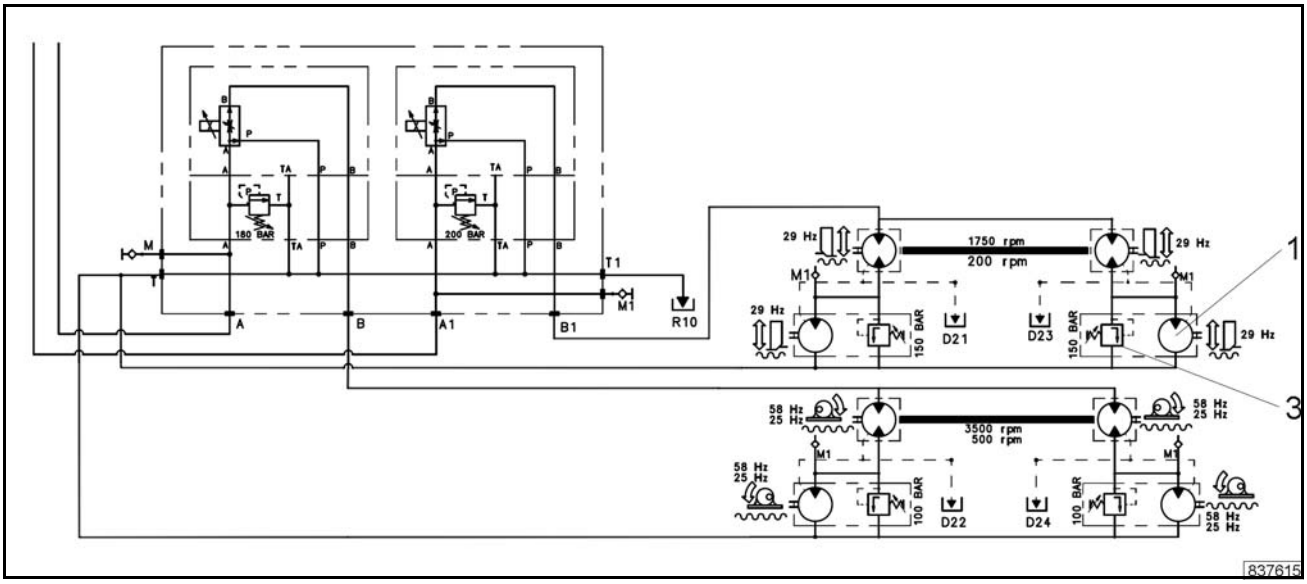


Fig. 87 Adjustment point for tamper drive mobile screed, right - excerpt from hydraulic diagram

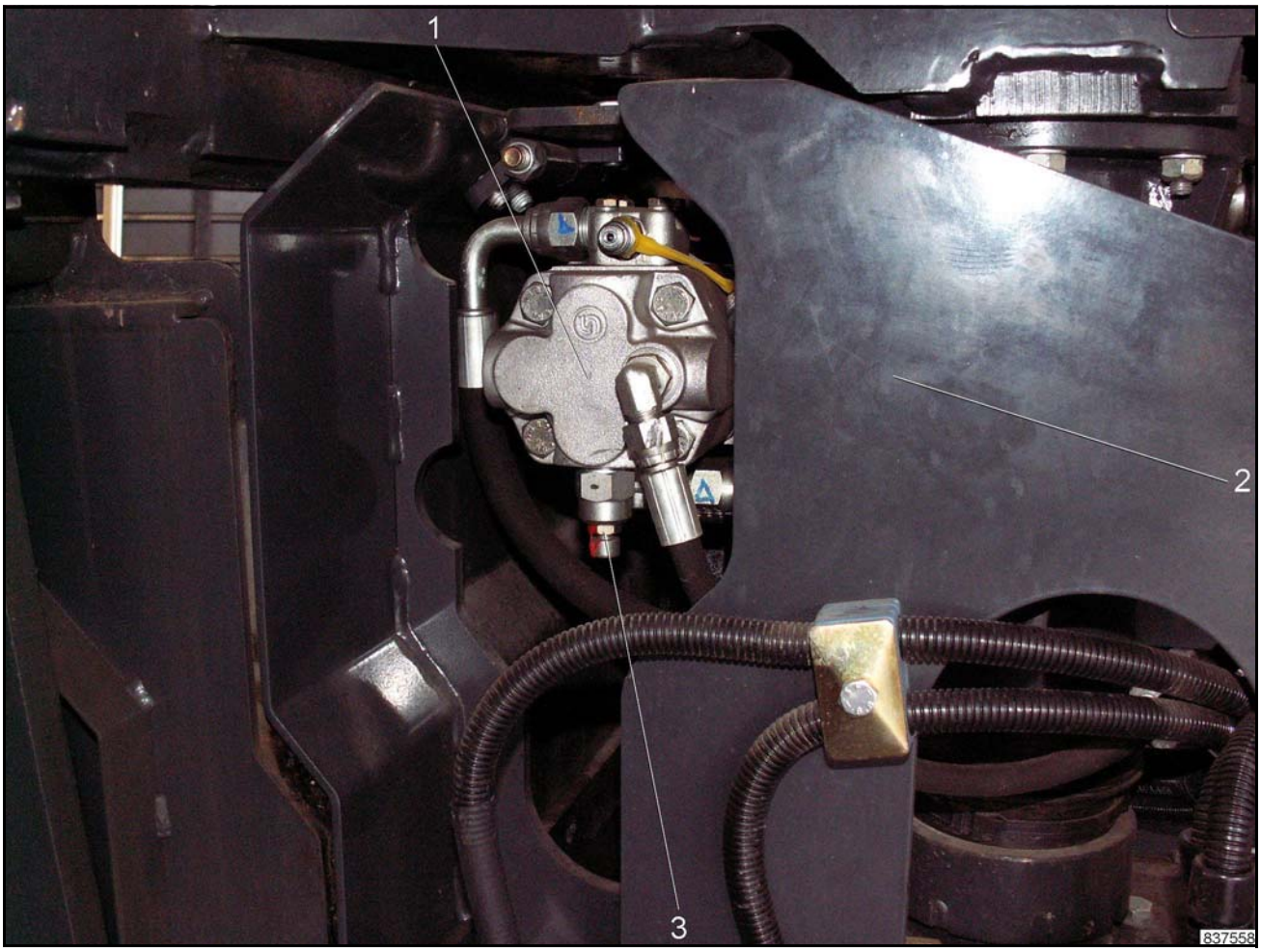


Fig. 88 Adjustment point for tamper drive mobile screed, right

1	Tamper motor, mobile screed right	3	Pressure relief valve
2	Mobile screed, right		

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Adjustment point for tamper drive mobile screed, left

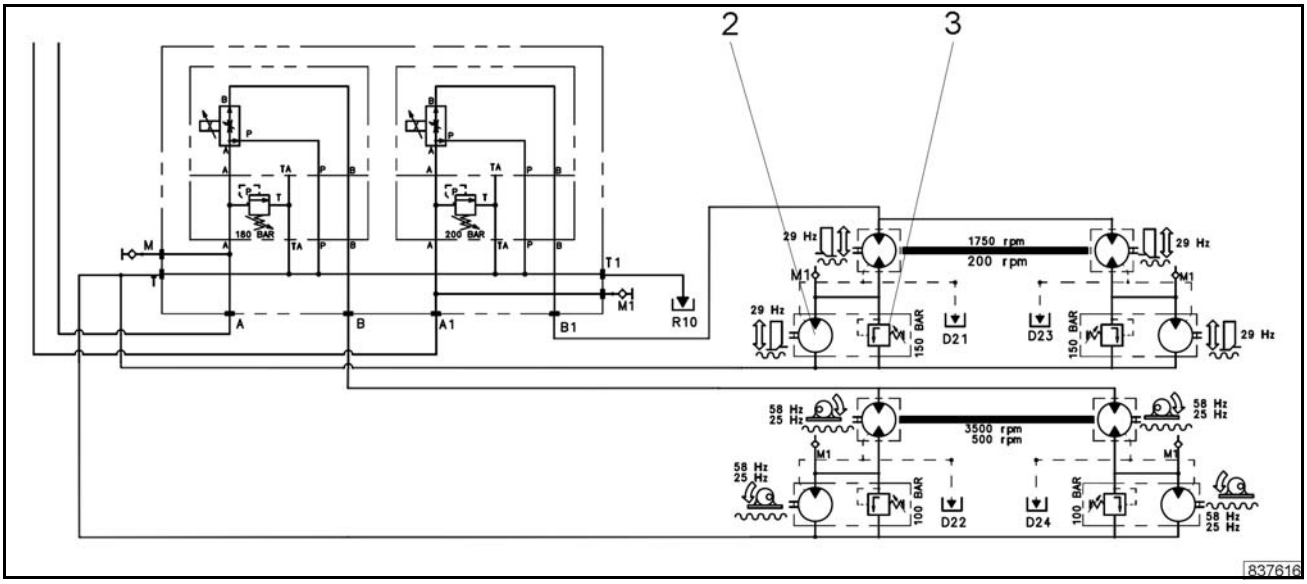


Fig. 89 Adjustment point for tamper drive mobile screed, left - excerpt from hydraulic diagram

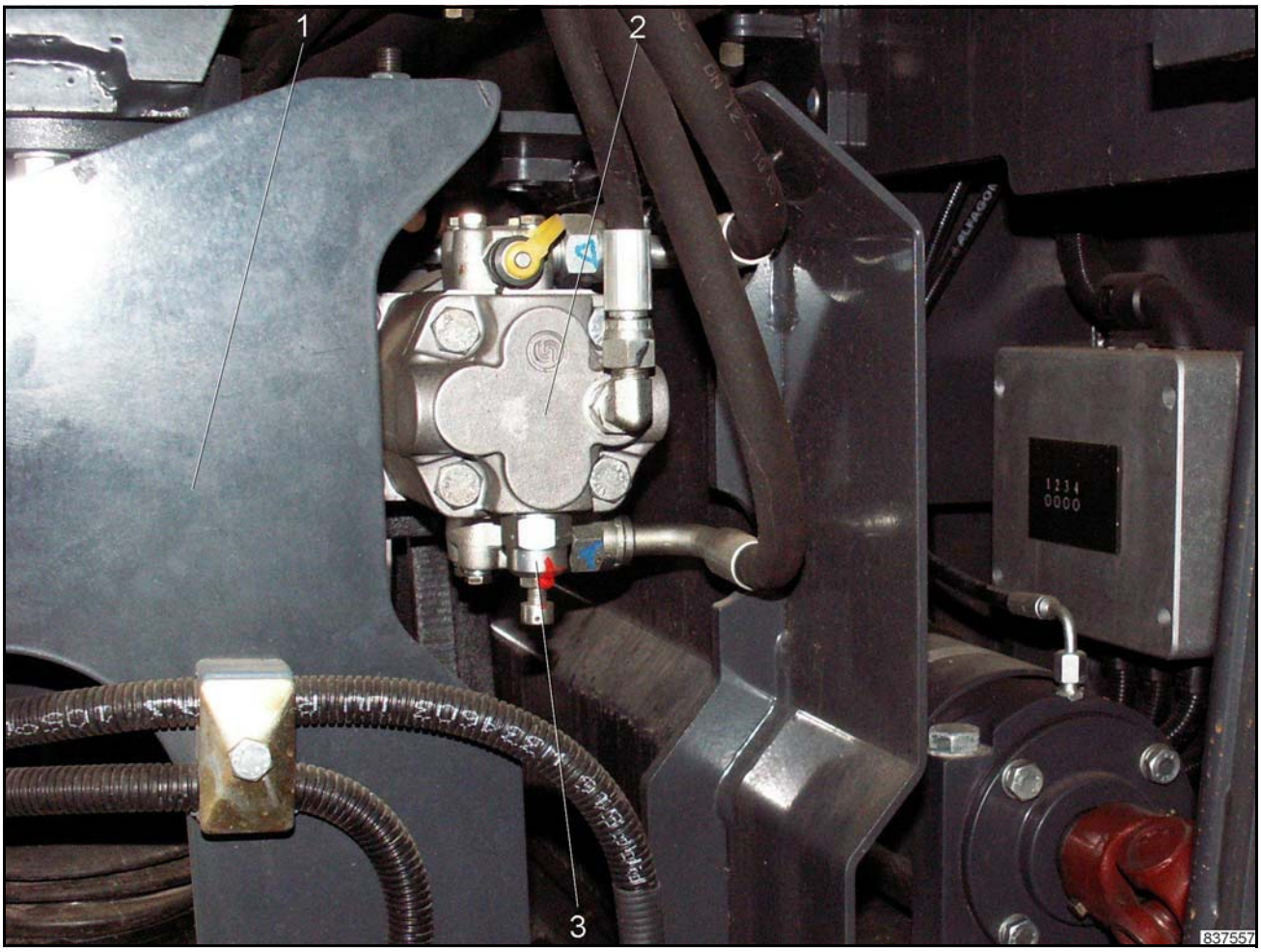


Fig. 90 Adjustment point for tamper drive mobile screed, left

1	Mobile screed, left	3	Pressure relief valve
2	Tamper motor, mobile screed left		

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Fan drive

The fan drive has been designed as an open hydraulic circuit.

The most essential components are (Fig. 91):

- the tandem pump (1)
- the fan motors (2) and (3)
- the check valve (4)
- the temperature switches (5) and (6)
- the control valve (7)

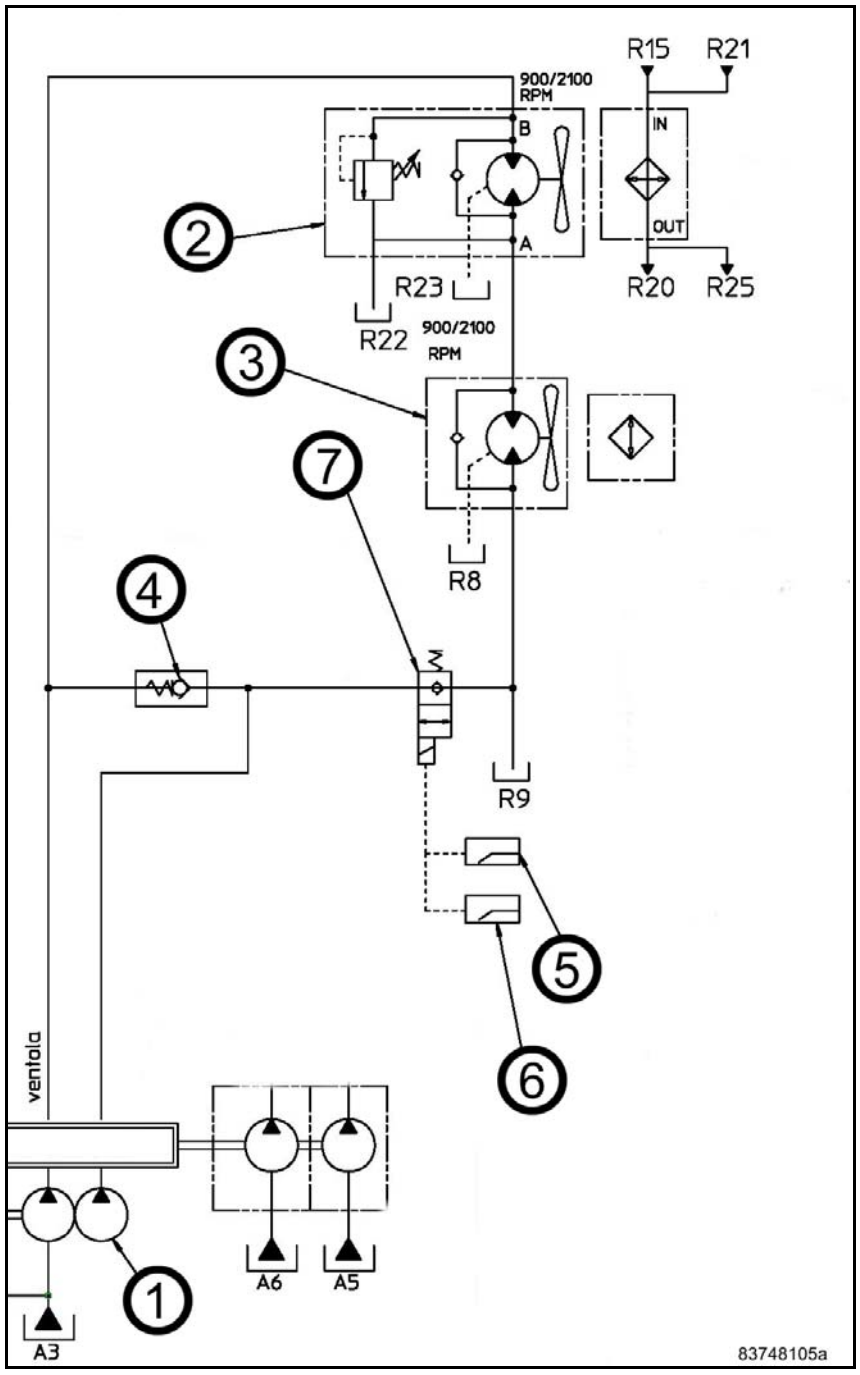


Fig. 91 Fan drive - excerpt from hydraulic diagram

1	Tandem gear pump	5	Coolant temperature switch
2	Fan motor - combination cooler	6	Temperature switch hydraulic oil
3	Fan motor - intercooler	7	Control valve
4	Check valve		

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Function and design

The engine driven tandem pump (1) supplies the fan circuit with hydraulic oil. The fan motors (2) and (3) are connected in series and therefore always run at the same time.

In cold condition the control valve (7) is energized and thus open. **Only** the oil from the first pump flows to the fan motors (2) and (3), the oil from the second pump flows through the control valve (7) directly back inton the hydraulic oil tank. The resulting fan speeds are approx. 900 rpm.

If one of the temperature switches (5) or (6) responds (coolant at about 90 °C, hydraaulic oil approx. 60 °C), the control valve (7) is de-energized (i.e. closed) and the second pump delivers oil through the check valve (4) also into the fan circuit. The resulting fan speeds are approx. 2100 rpm.

A pressure relief valve in the fan motor housing (2) protects the entire fan drive against overpressure, by limiting the hydraulic pressure to the value set by the valve.

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Test and adjustment points

Fan circuit

Components

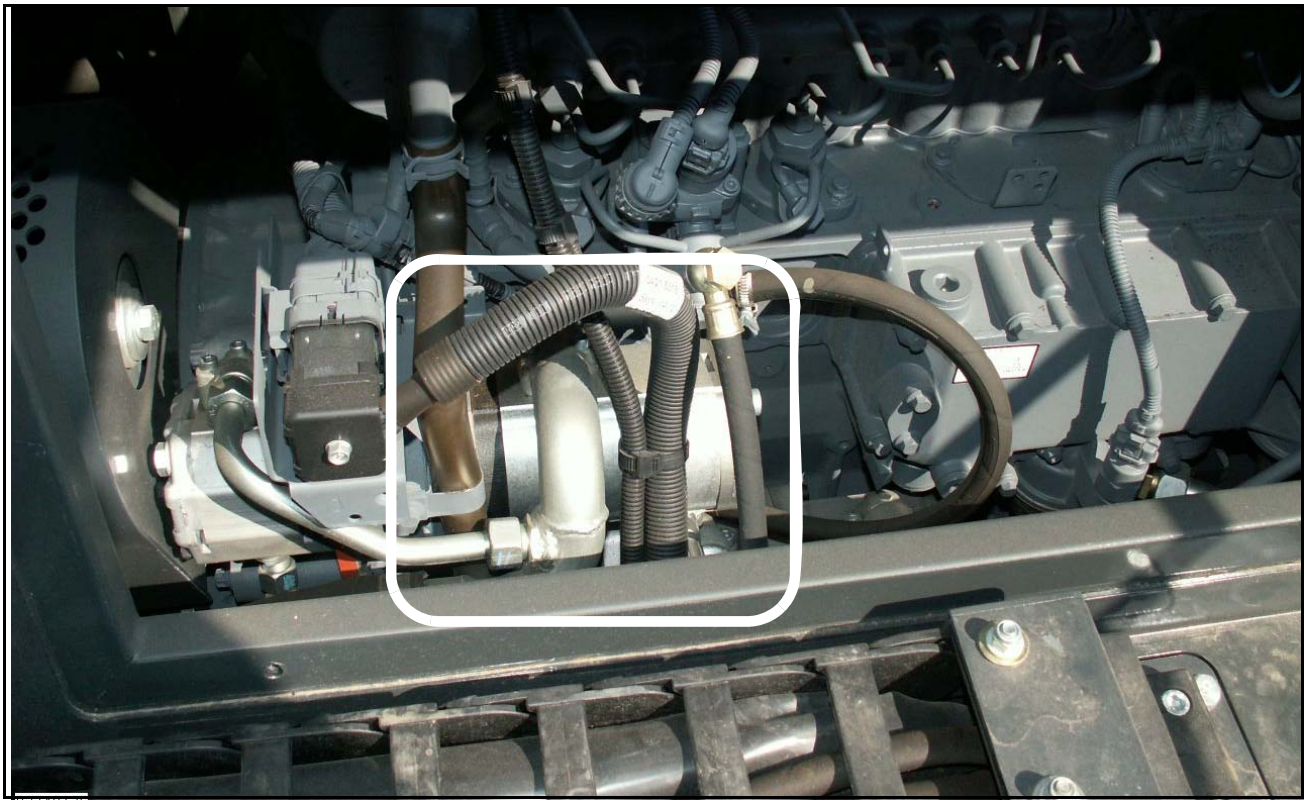


Fig. 92 Tandem gear pump



Fig. 93 Fan motor fr intercooler

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Test port for fan pressure

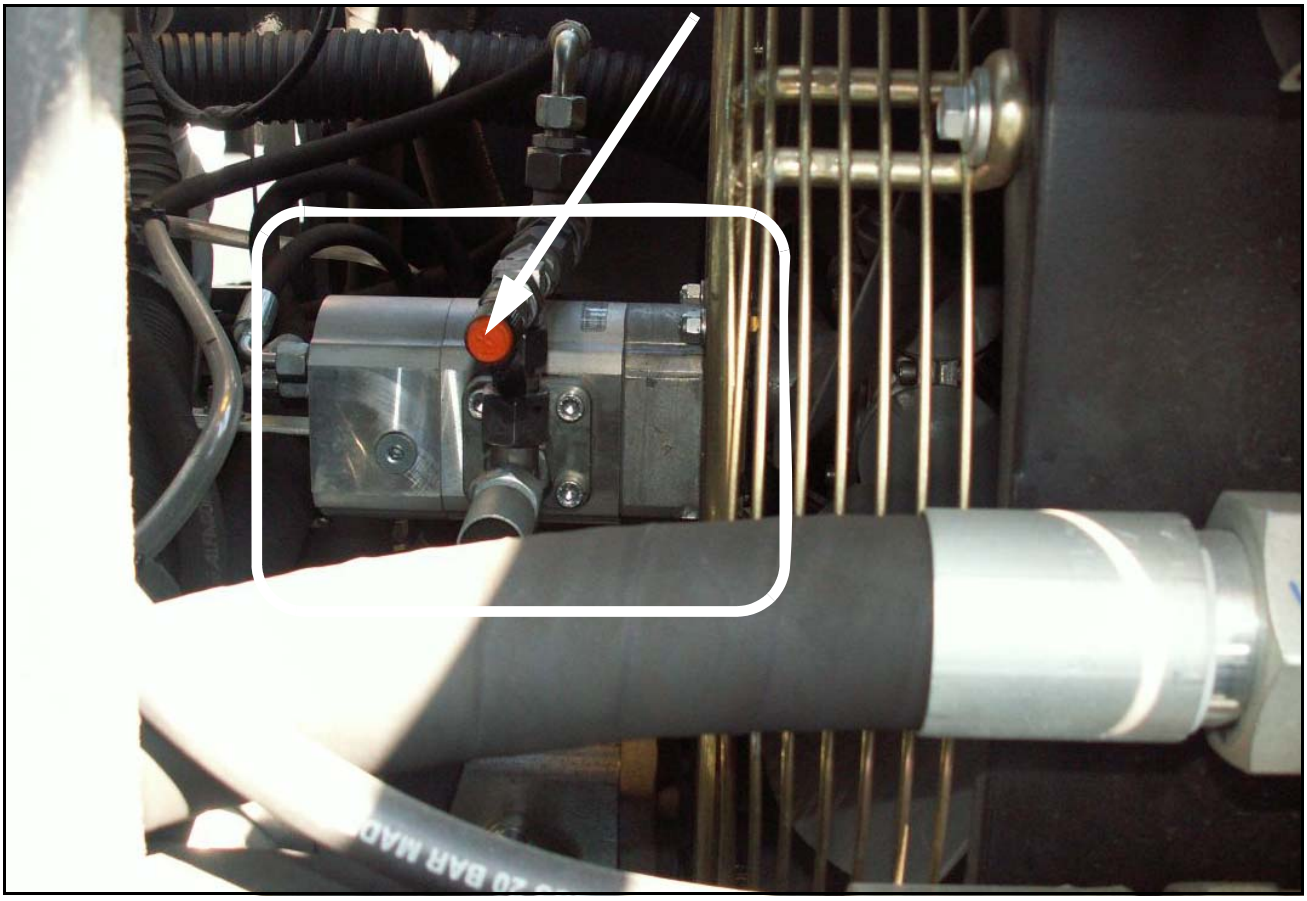


Fig. 94 Fan motor for combined coolant/hydraulic oil cooler

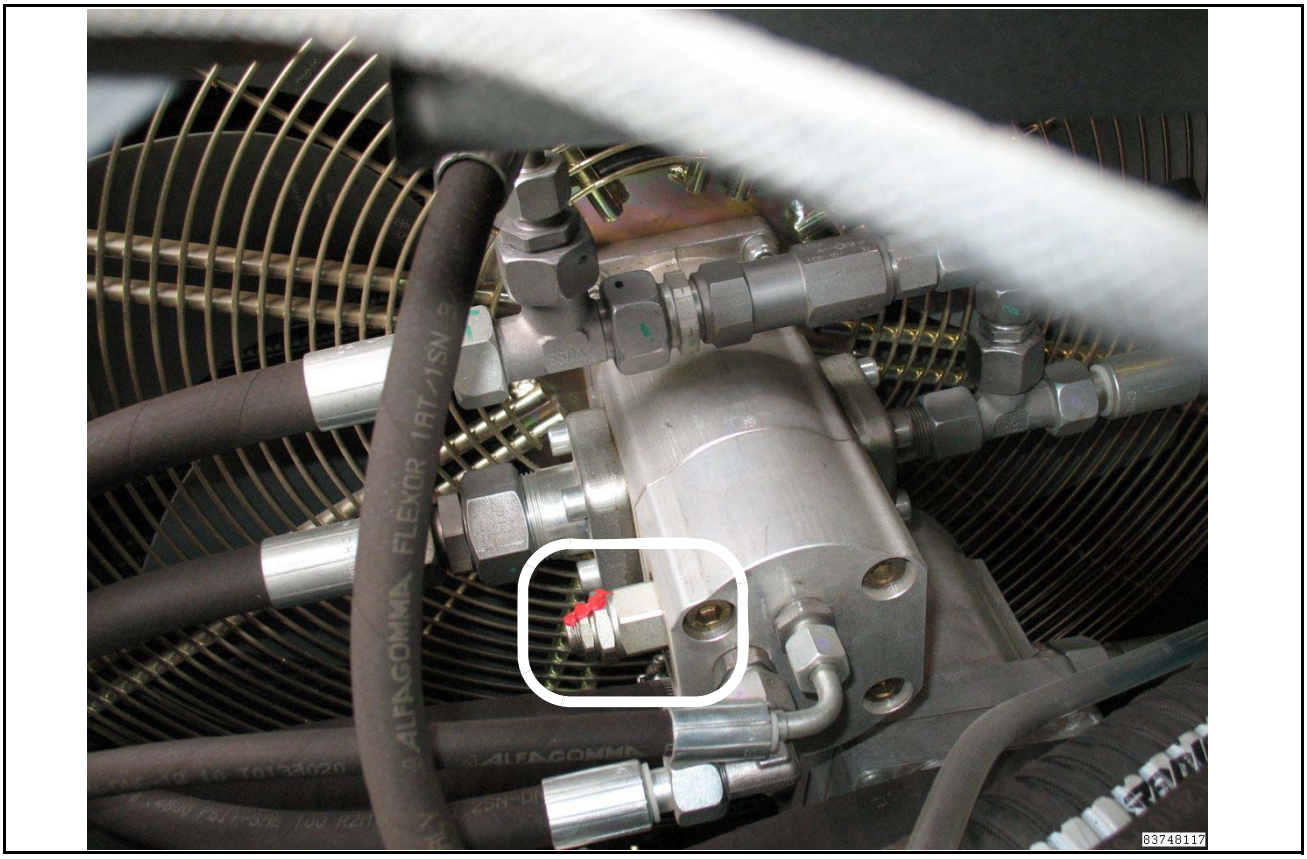


Fig. 95 PRV fan circuit on fan motor for combined coolant/hydraulic oil cooler

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Control valve (29) and check valve (27)

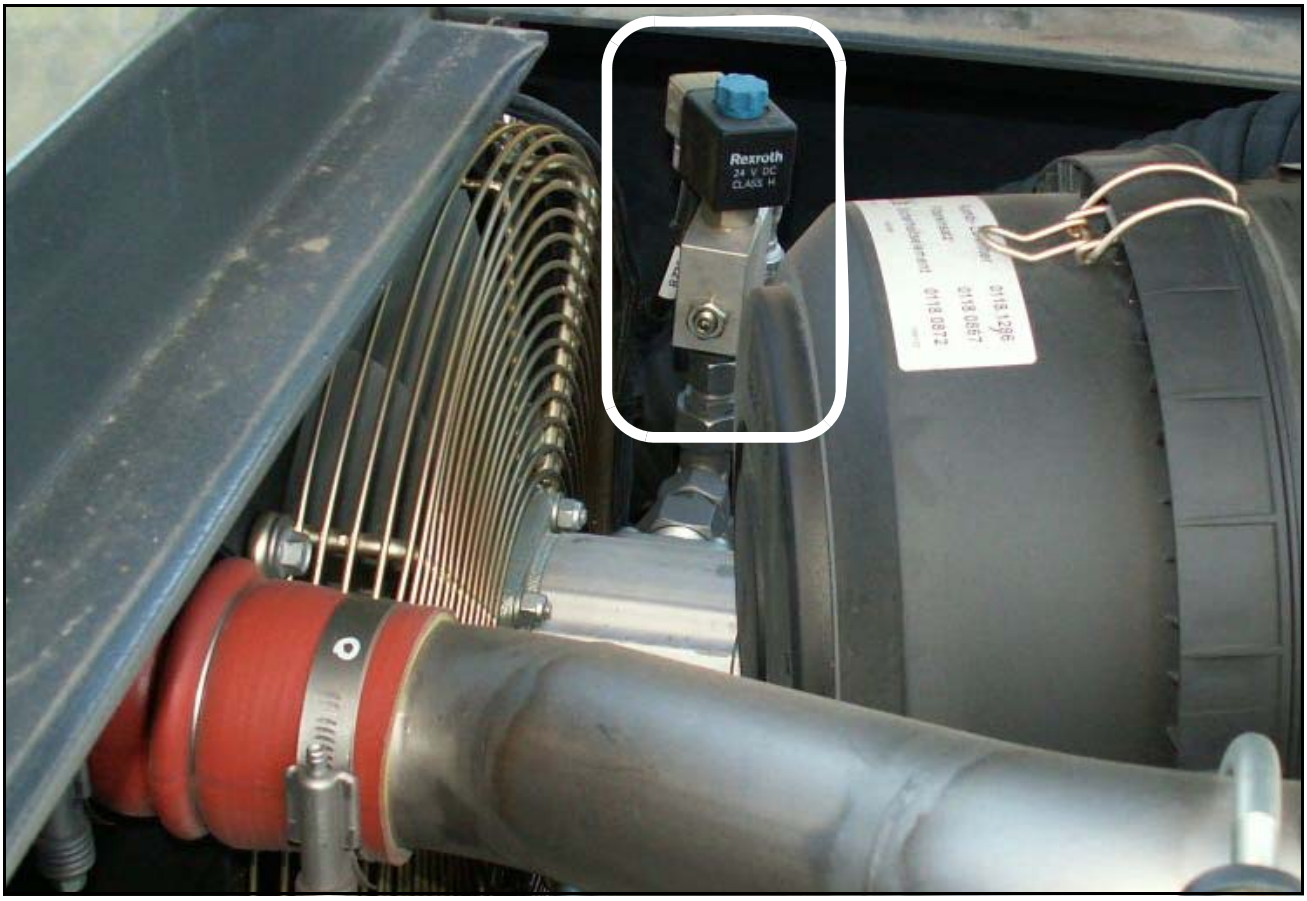


Fig. 96 Control valve

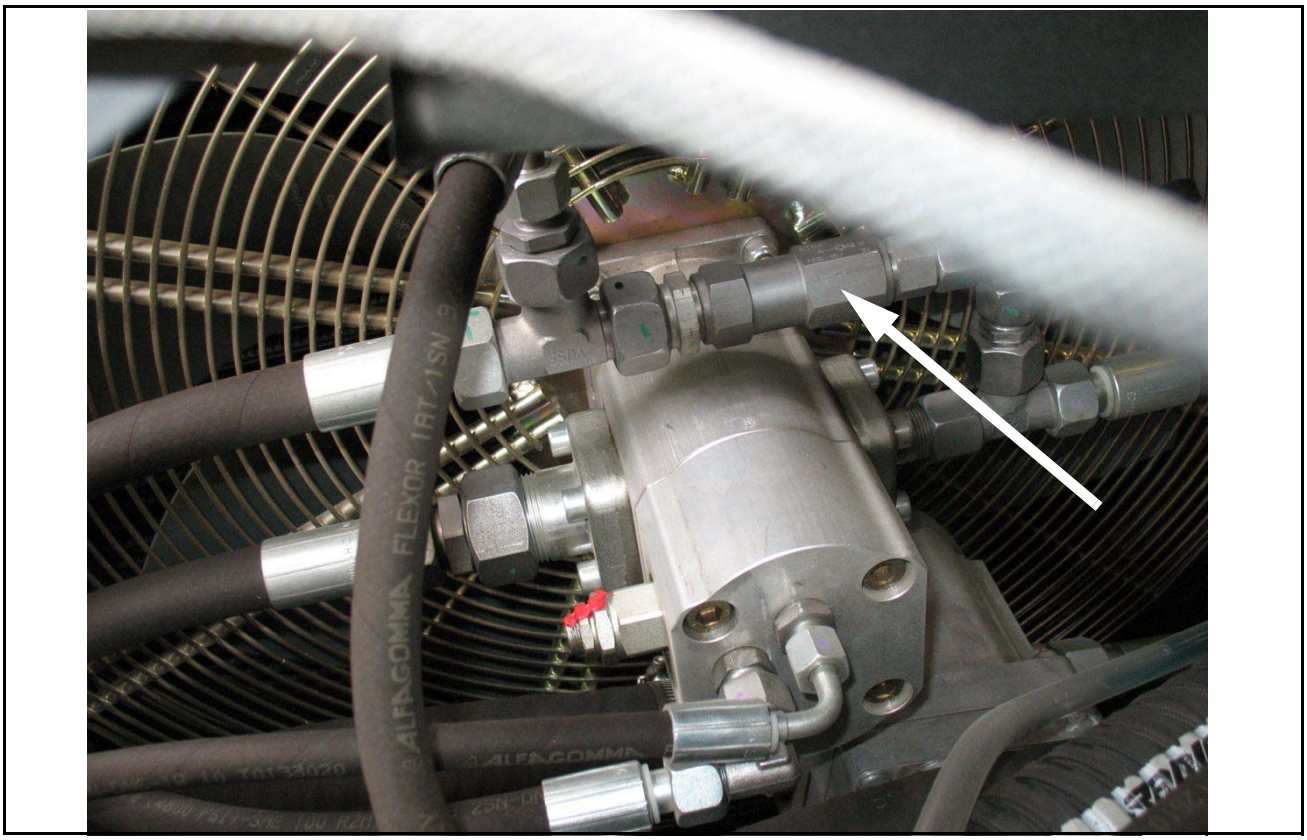


Fig. 97 Check valve

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Temperature switch

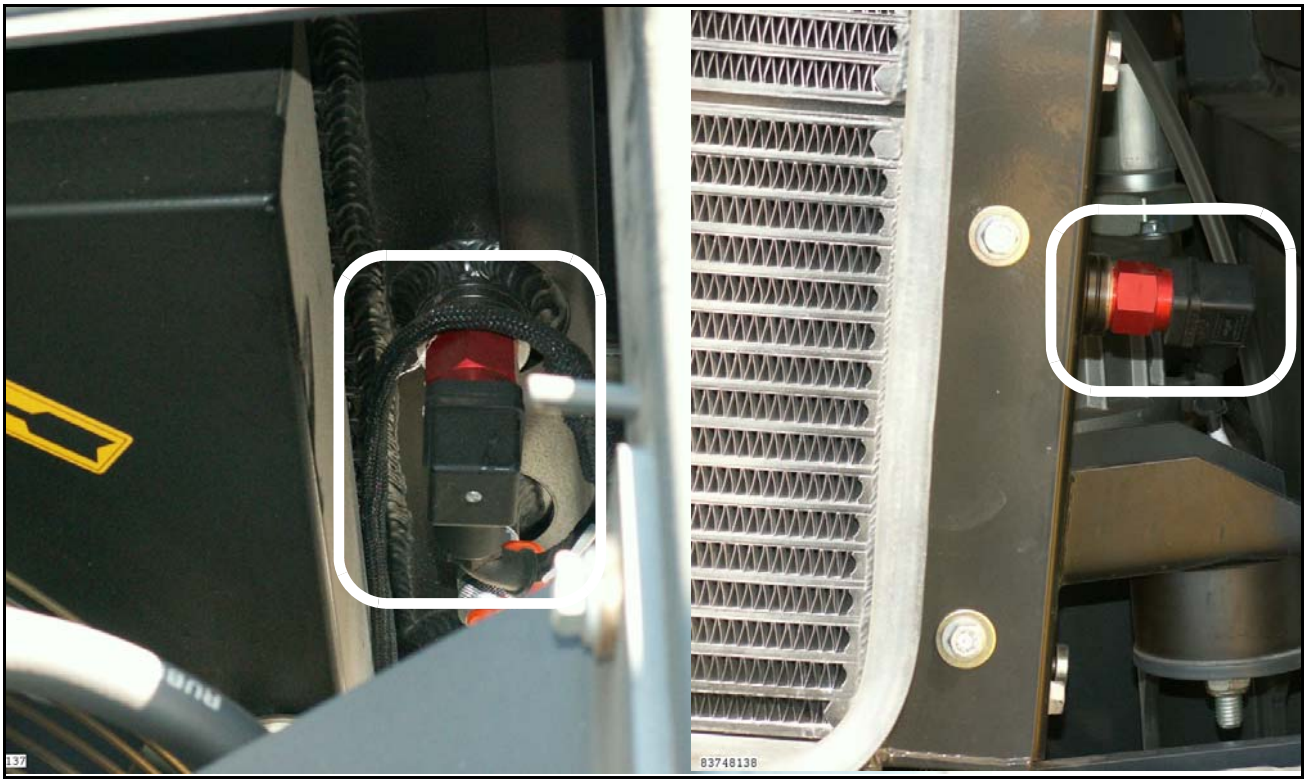


Fig. 98 Temperature switch on coolers

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8 Tests and adjustments

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8.1 Checking and adjusting the vibration

⚠ Caution

Perform measurements at operating temperature of the hydraulic oil (40 °C).

Special tools

Hydraulic test case **[BOMAG Part-No.: 079 930 01]**

Pressure test vibration drive, mobile screed right and left

1. Raise and lock the screed (Fig. 1).
2. Fully extend right and left hand mobile screeds.
3. Shut down the engine.

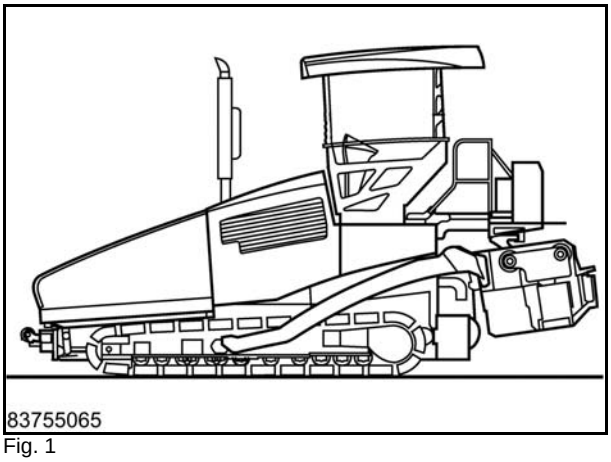


Fig. 1

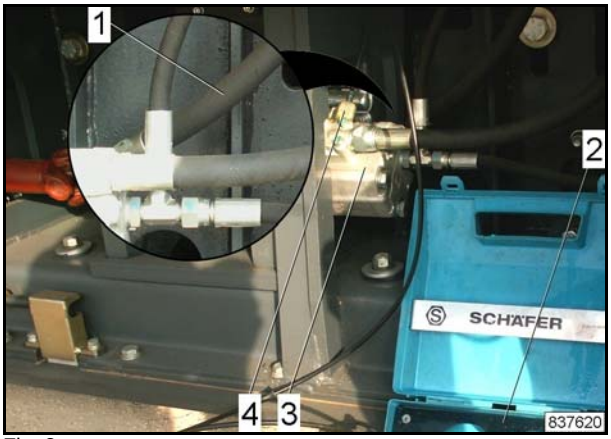


Fig. 2

⚠ Danger

Danger of injury!

Before connecting the pressure gauge make sure that the engine has been shut down!

i Note

Perform the following work steps also on the vibration motor, mobile screed left.

4. Disconnect the hydraulic line (1) from the right vibration motor, main screed (3) and close the hydraulic line/port with plugs.
5. Connect a high pressure gauge (600 bar) (2) to pressure test port M_1 (4/(Fig. 2)) on the vibration motor, main screed.
6. Start the engine, set switch (Fig. 3) to position "MAX".

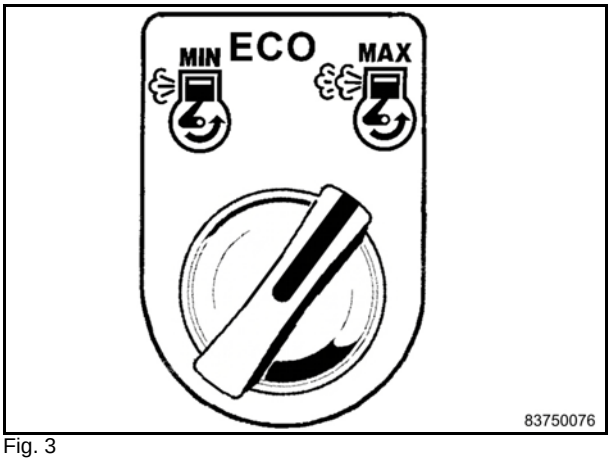


Fig. 3

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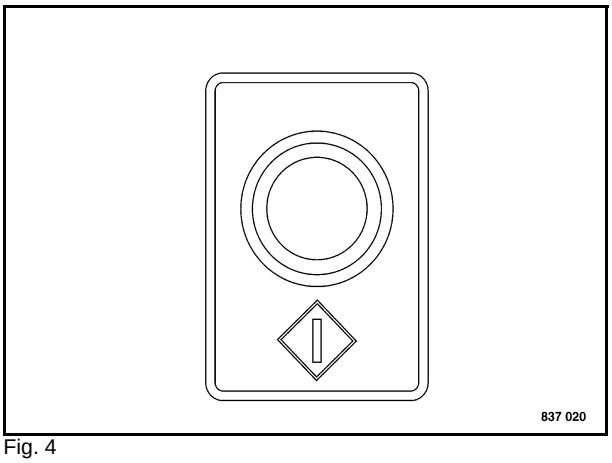


Fig. 4

7. Activate the hydraulic system (Fig. 4).

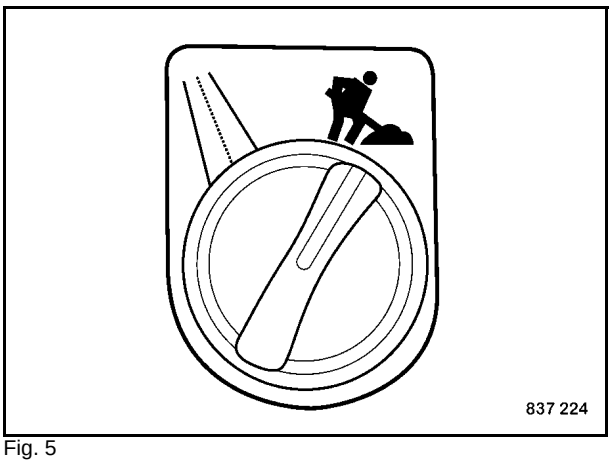


Fig. 5

8. Select "Work"-mode (Fig. 5).

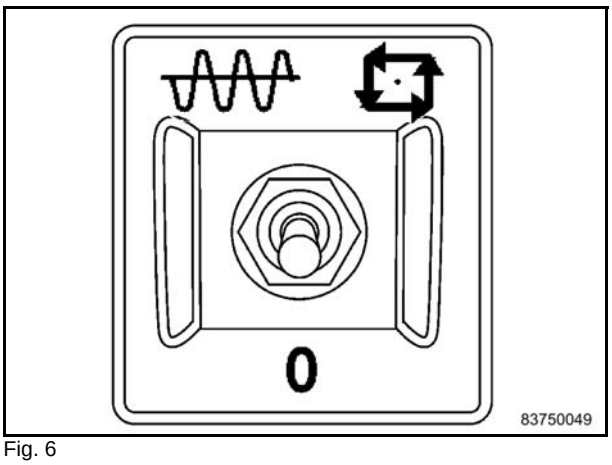


Fig. 6

⚠ Caution

Run the following pressure test only for max. 5 seconds.

9. Switch the vibration on (Fig. 6).

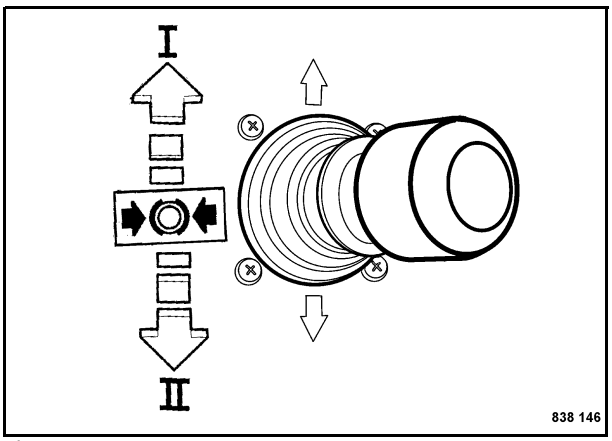


Fig. 7

10. Shift the travel lever to "forward" position (Fig. 7).
11. Read the hydraulic oil pressure in the pressure gauge (Fig. 8).
12. Shift the travel lever to "Neutral" position.

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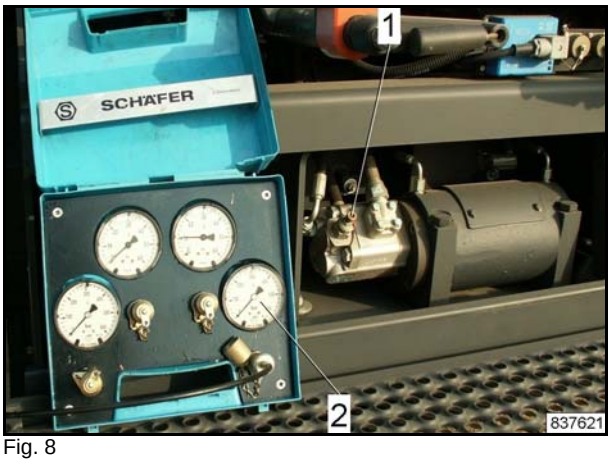


Fig. 8

13. Read the hydraulic pressure on the high pressure gauge (600 bar) (2) (Fig. 8).

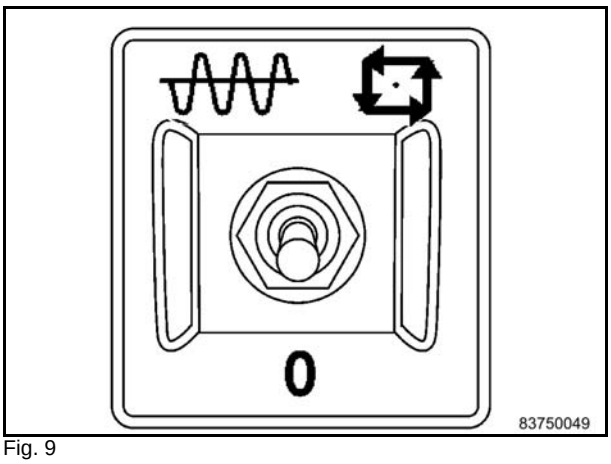


Fig. 9

14. Switch the vibration off (Fig. 9).

Nominal value

See chapter "Technical Data".

i Note

If the nominal pressure relief value is not reached, adjust the pressure relief valve (1) (Fig. 8) accordingly.

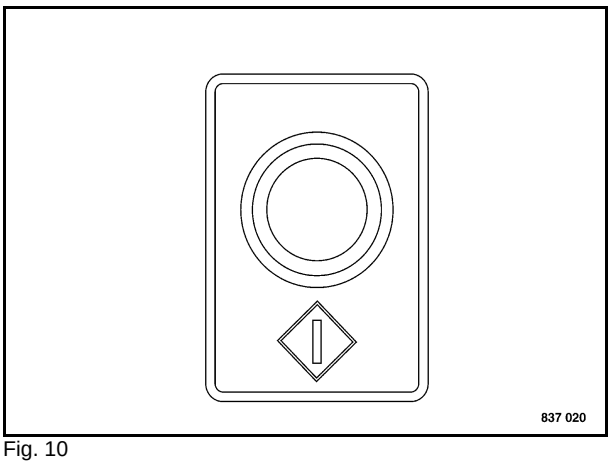


Fig. 10

15. Deactivate the hydraulic system (Fig. 10).

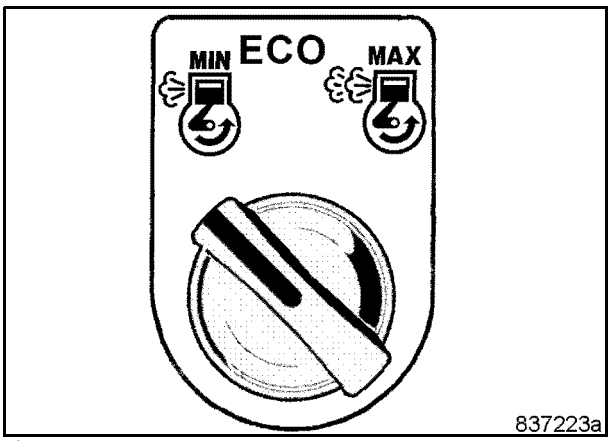


Fig. 11

16. Turn the switch (Fig. 11) to position "MIN", shut down the engine.

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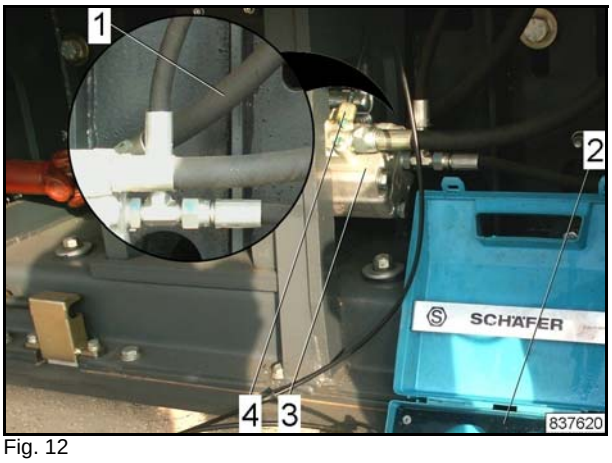


Fig. 12

⚠ Danger

Danger of injury!

Before disconnecting the pressure gauge make sure that the engine has been shut down!

17. Disconnect the high pressure gauge (600 bar) from test port M_1 (4) on the right vibration motor for the main screed (3).
18. Unscrew the plugs and connect the hydraulic line (1) (Fig. 12) to the right hand vibration motor for the main screed.

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8.2 Checking and adjusting the tamping process

⚠ Caution

Perform measurements at operating temperature of the hydraulic oil (40 °C).

Special tools

Hydraulic test case **[BOMAG Part-No.: 079 930 01]**

Pressure test tamper drive, mobile screed right and left

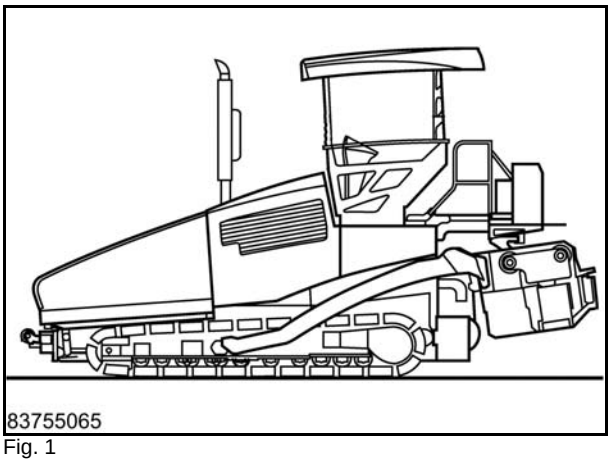


Fig. 1

1. Raise and lock the screed (Fig. 1).
2. Fully extend right and left hand screeds.
3. Shut down the engine.

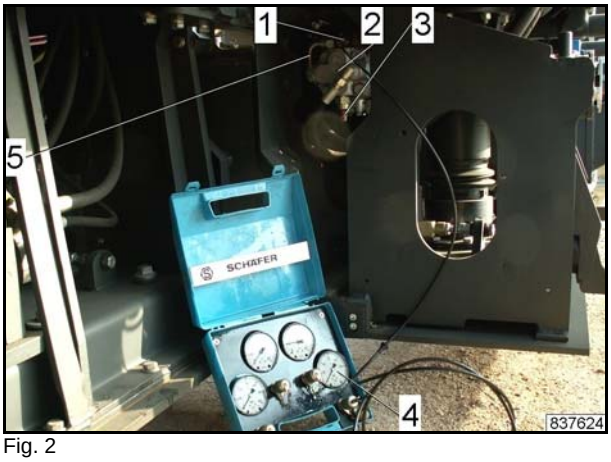


Fig. 2

⚠ Danger

Danger of injury!

Before connecting the pressure gauge make sure that the engine has been shut down!

i Note

Perform the following work steps also on the tamper motor, mobile screed left.

4. Disconnect the hydraulic line (5) (Fig. 2) from the tamper motor for the right mobile screed (2) and close the hydraulic line/port with a plugs.
5. Connect a high pressure gauge (600 bar) (4) to pressure test port M_1 (1) on the tamper motor for right mobile screed.

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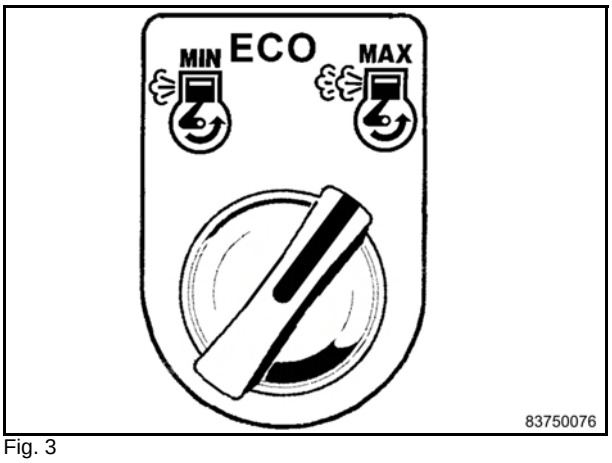


Fig. 3

6. Start the engine, set switch (Fig. 3) to position "MAX".

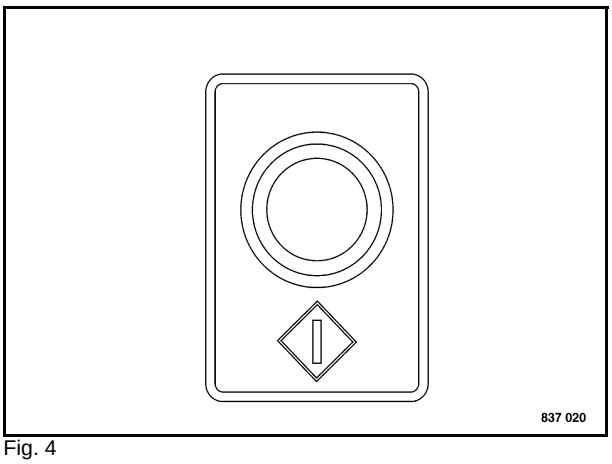


Fig. 4

7. Activate the hydraulic system (Fig. 4).

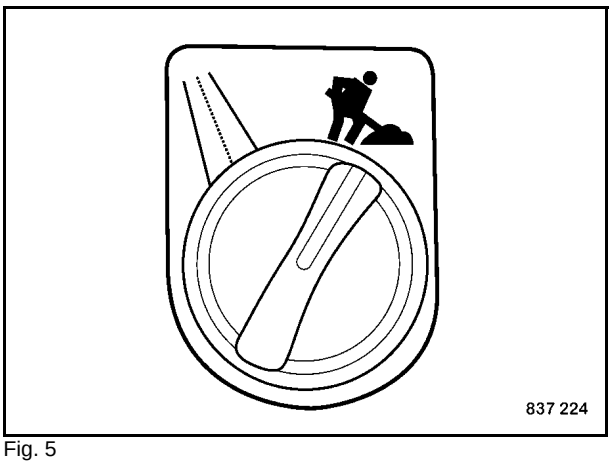


Fig. 5

8. Select "Work"-mode (Fig. 5).

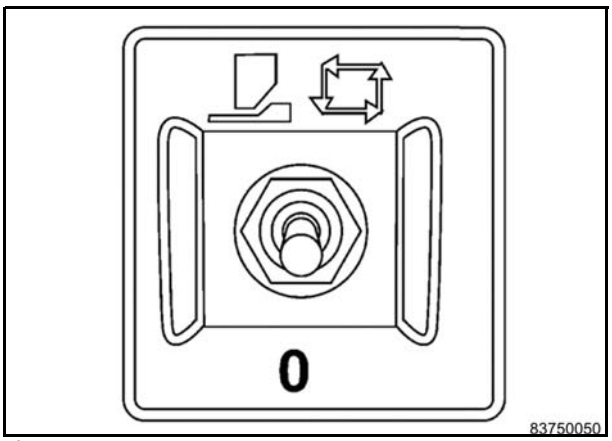


Fig. 6

⚠ Caution

Run the following pressure test only for max. 5 seconds.

9. Switch on the tamper (Fig. 6).

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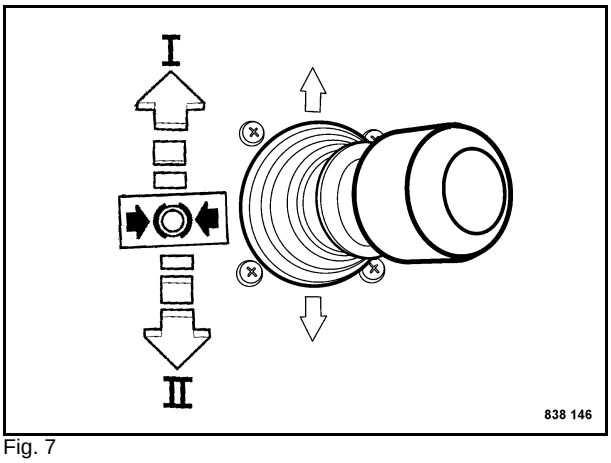


Fig. 7

10. Shift the travel lever to "forward" position (Fig. 7).
11. Read the pressure in the pressure gauge (4) (Fig. 8).
12. Shift the travel lever to "Neutral" position .

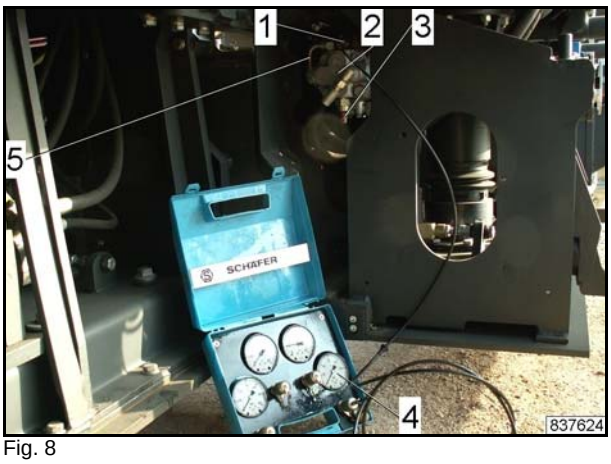


Fig. 8

13. High pressure gauge (600 bar) (4) (Fig. 8).

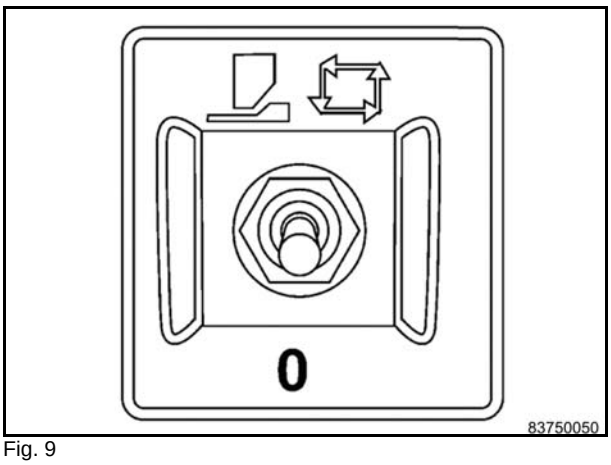


Fig. 9

14. Switch of the tamper (Fig. 9).

    Nominal value

    See chapter "Technical Data".

    i Note

    If the nominal pressure relief value is not reached, adjust the pressure relief valve (3) (Fig. 8) accordingly.

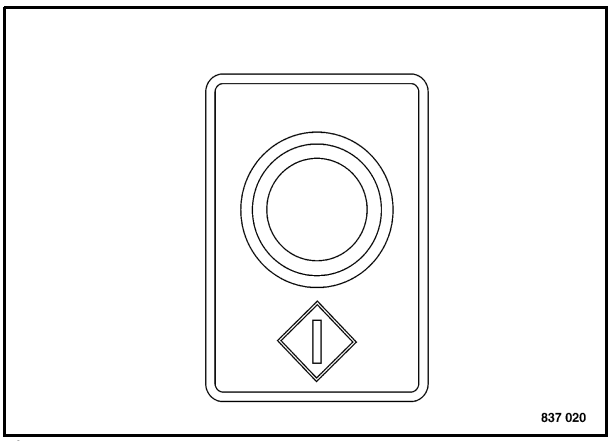


Fig. 10

15. Deactivate the hydraulic system (Fig. 10).

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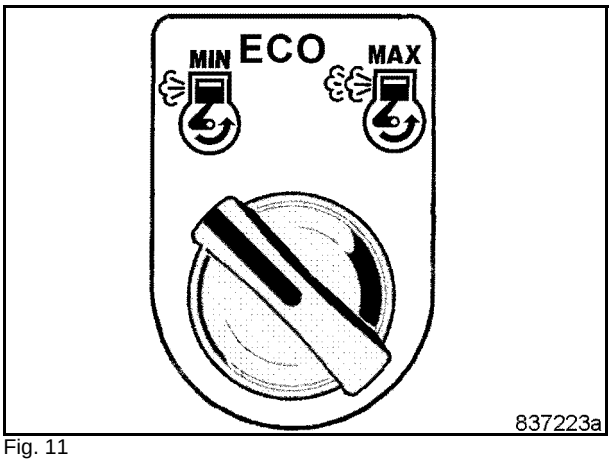


Fig. 11

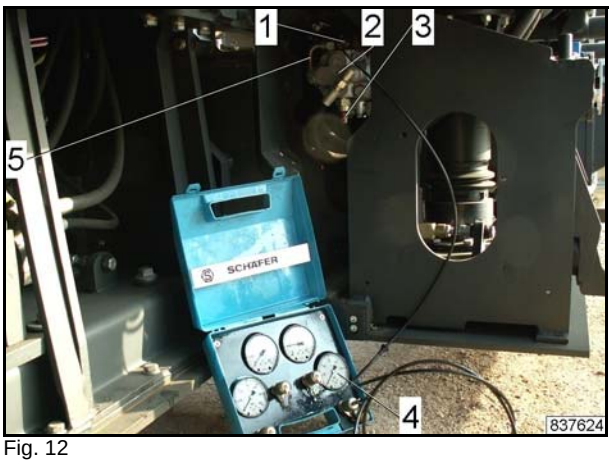


Fig. 12

16. Turn the switch (Fig. 11) to position "MIN", shut down the engine.

⚠ Danger

Danger of injury!

Before disconnecting the pressure gauge make sure that the engine has been shut down!

17. Disconnect the high pressure gauge (600 bar) (4) from pressure test port M_1 (1) on the tamper motor for right mobile screed (2) (Fig. 12).
18. Unscrew the plugs and connect the hydraulic line (5/) to the tamper motor for the right hand mobile screed.

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8.3 Checking/adjusting the mobile screed

⚠ Caution

Perform measurements at operating temperature of the hydraulic oil (40 °C).

Time measurement for extension and retraction of mobile screeds

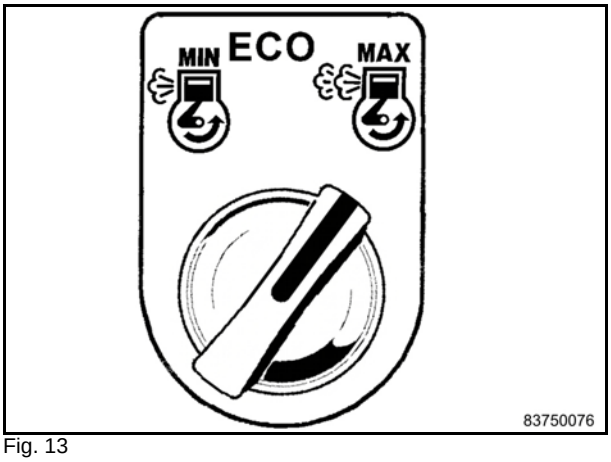


Fig. 13

1. Start the engine and set the switch to position "MAX" (Fig. 13).

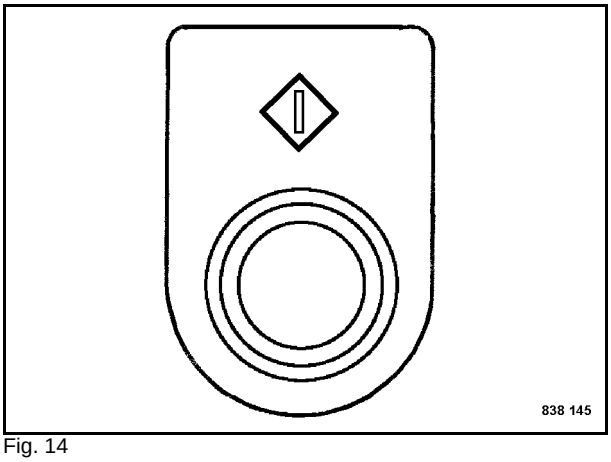


Fig. 14

2. Activate the hydraulic system (Fig. 14).

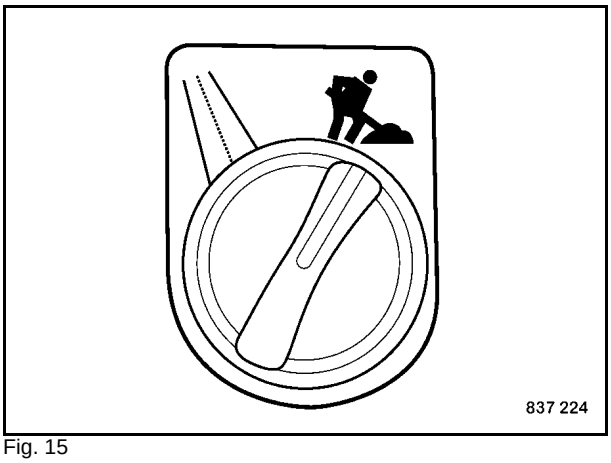


Fig. 15

3. Select "Work"-mode (Fig. 15).

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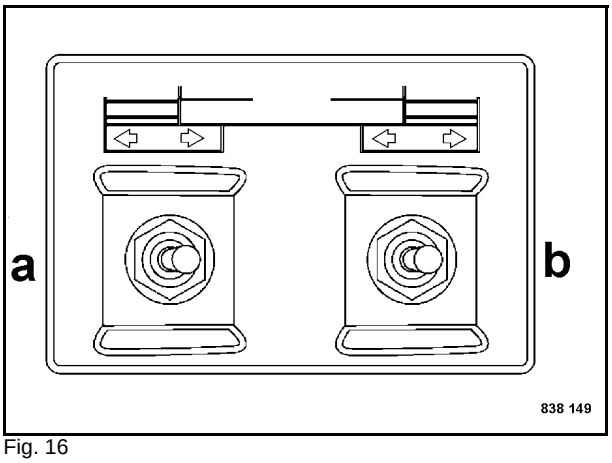


Fig. 16

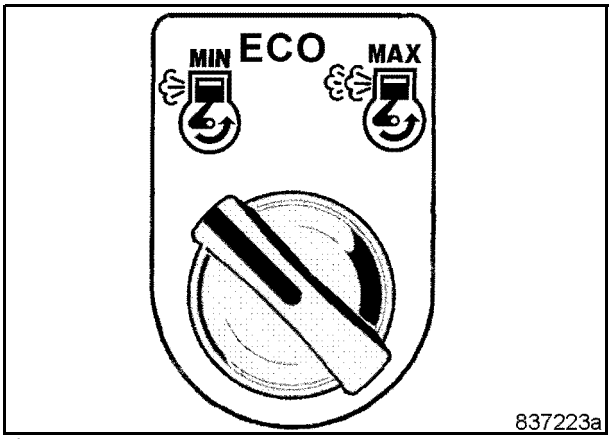


Fig. 17

4. If necessary retract the mobile screed completely (Fig. 16).
5. Fully **extend** the mobile screed and measure the required time.

   Nominal value

   19 - 25 seconds (HCG/HCE-screed)

   29 - 35 seconds (HSE-screed)
6. Fully **retract** the mobile screed and measure the required time.

   Nominal value

   13 - 19 seconds (HCG/HCE-screed)

   22 - 28 seconds (HSE-screed)
7. Turn the switch to position "MIN" and shut down the engine (Fig. 17).

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8.4 Checking/adjusting the hopper wings

⚠ Caution

Perform measurements at operating temperature of the hydraulic oil (40 °C).

Testing the hopper wing movement time

1. Start the engine and set the switch to position "MAX" (Fig. 18).

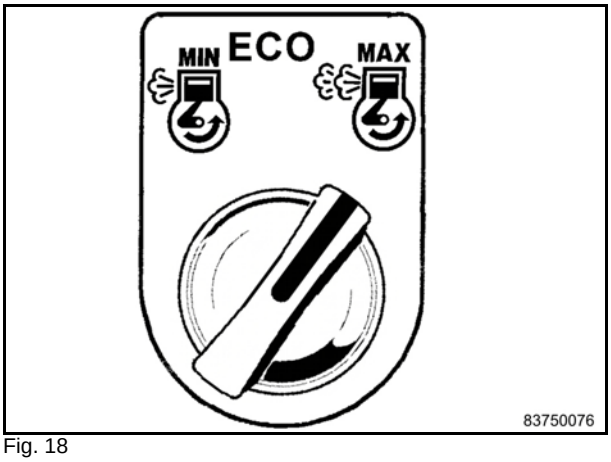


Fig. 18

2. Activate the hydraulic system (Fig. 19).

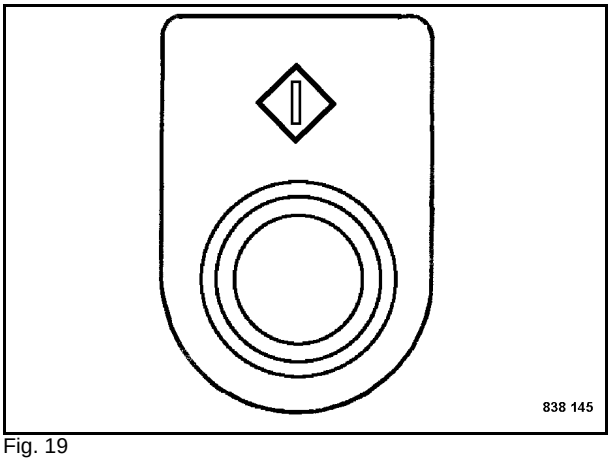


Fig. 19

3. Select "Work"-mode (Fig. 20).

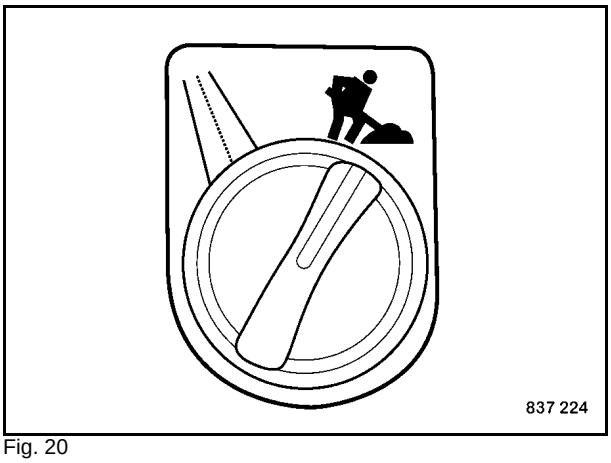


Fig. 20

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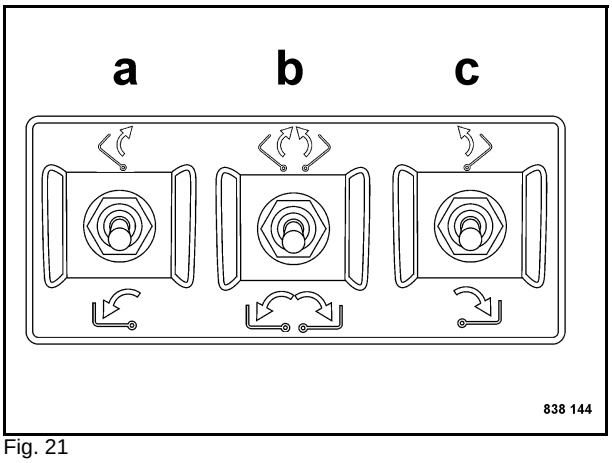


Fig. 21

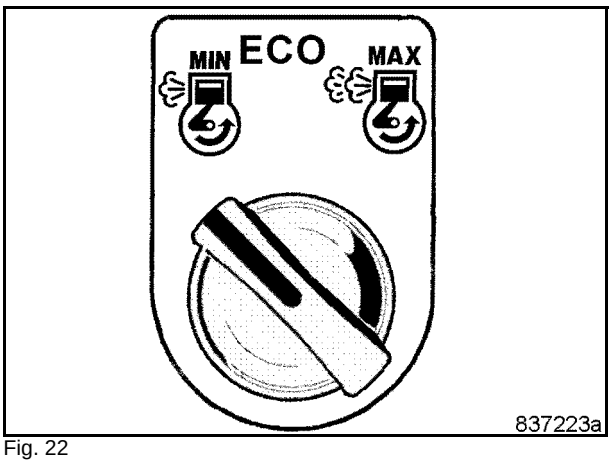


Fig. 22

4. If necessary open the hopper wings completely (Fig. 21).
5. **Close** the hopper wing completely and measure the required time.

   Nominal value

   8 - 9 seconds
6. **Open** the hopper wing completely and measure the required time.

   Nominal value

   5 - 7 seconds

7. Turn the switch to position "MIN" and shut down the engine (Fig. 22).

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8.5 Checking & adjusting the time for screed levelling

⚠ Caution

Perform measurements at operating temperature of the hydraulic oil (40 °C).

Time measurement screed levelling

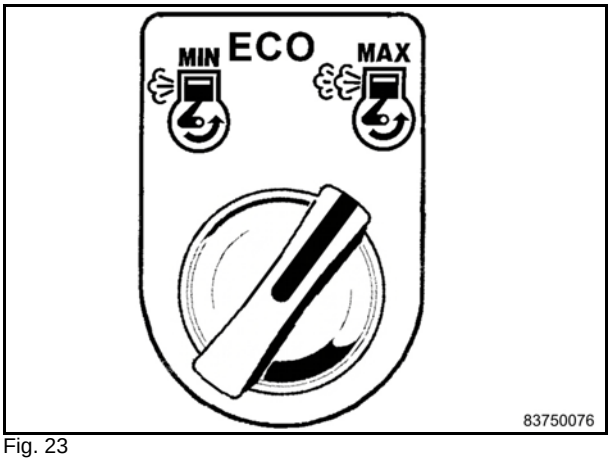


Fig. 23

1. Start the engine and set the switch to position "MAX" (Fig. 23).

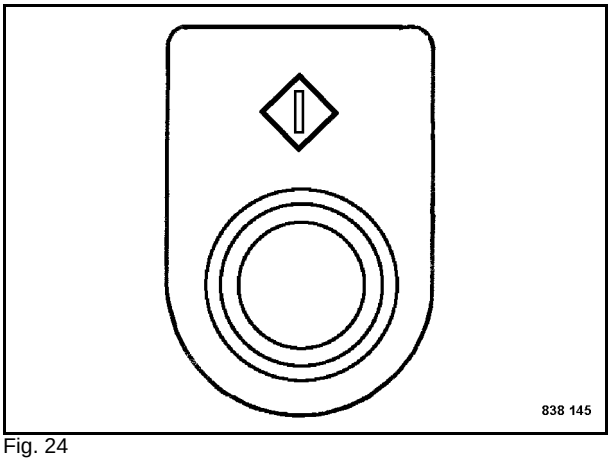


Fig. 24

2. Activate the hydraulic system (Fig. 24).

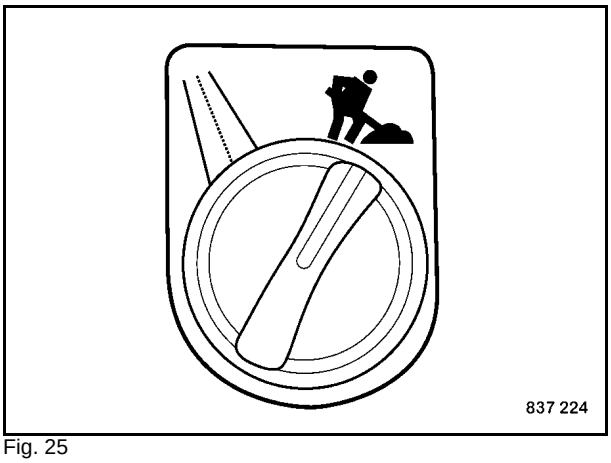


Fig. 25

3. Select "Work"-mode (Fig. 25).

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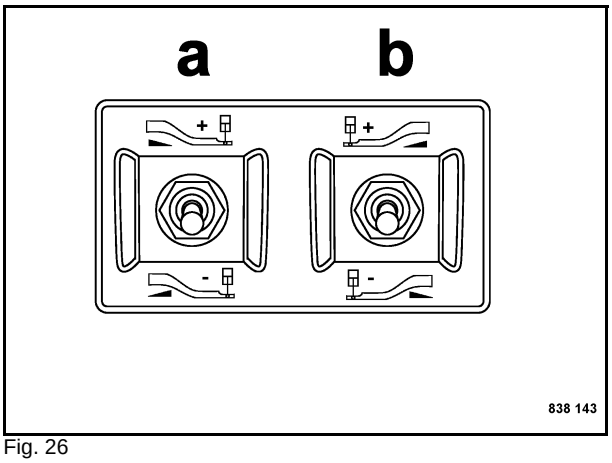


Fig. 26

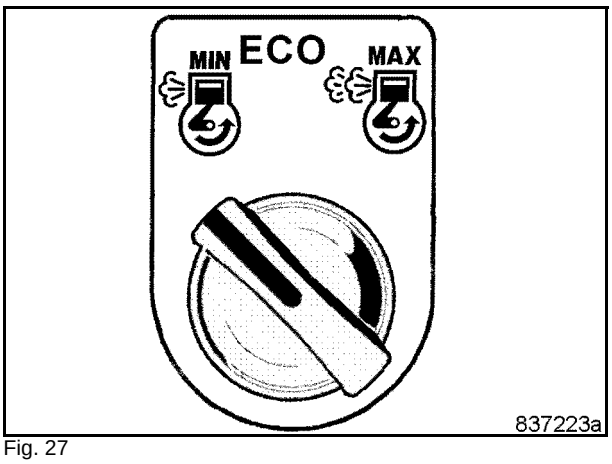


Fig. 27

4. If necessary lower the drawing arms completely (Fig. 26).
5. **Lift** the drawing arms completely and measure the required time.

   Nominal value

   5 - 7 seconds
6. **Lower** the drawing arms completely and measure the required time.

   Nominal value

   7 - 9 seconds

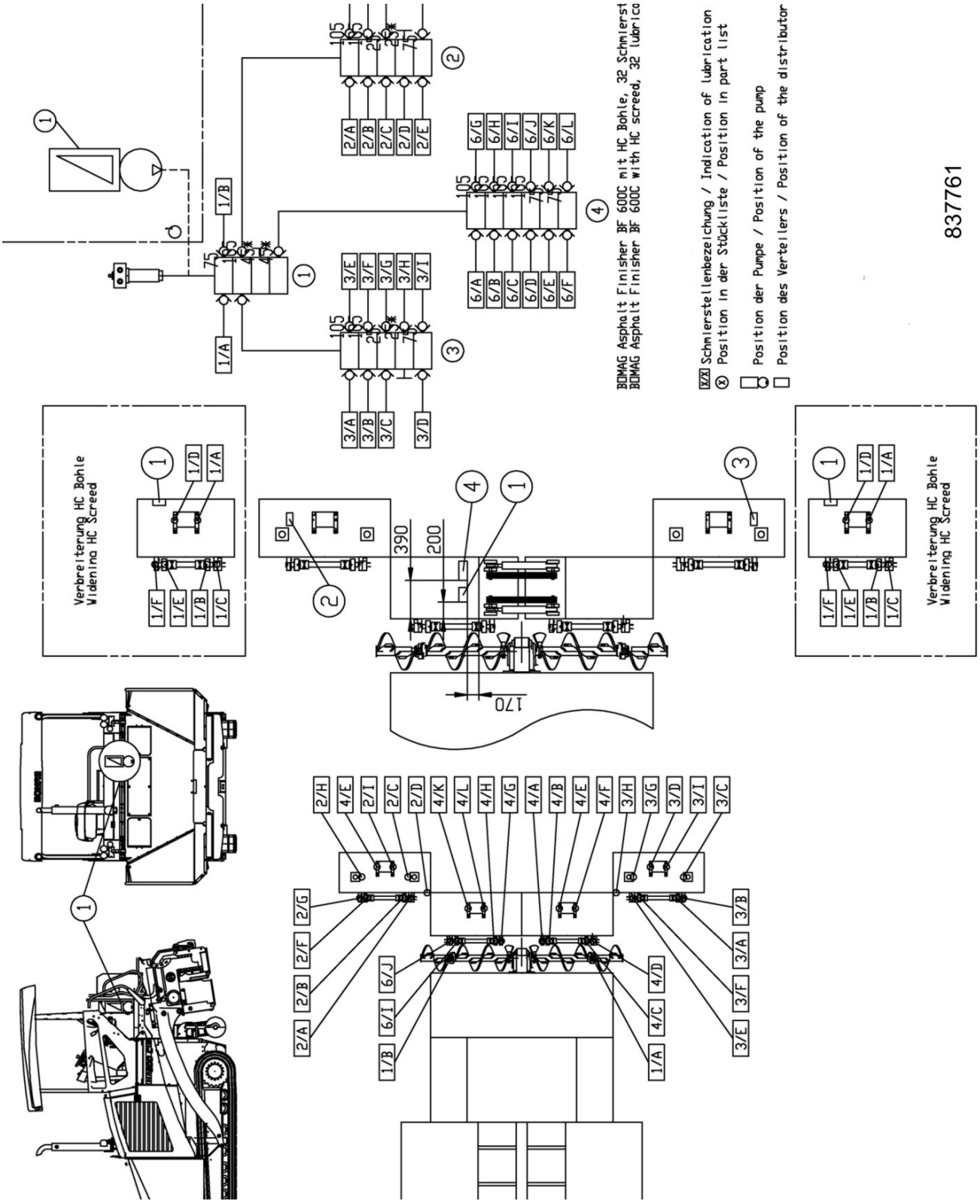
7. Turn the switch to position "MIN" and shut down the engine (Fig. 27).

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9 Central lubrication system

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After a running-in phase of 100 hours and after inspection of all lubrication points the lubrication intervals can be extended or reduced, as required.

⚠ Caution

The cycle time must not be changed.

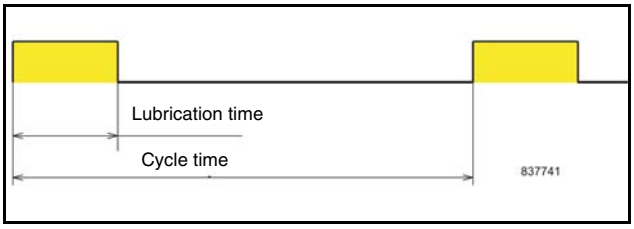


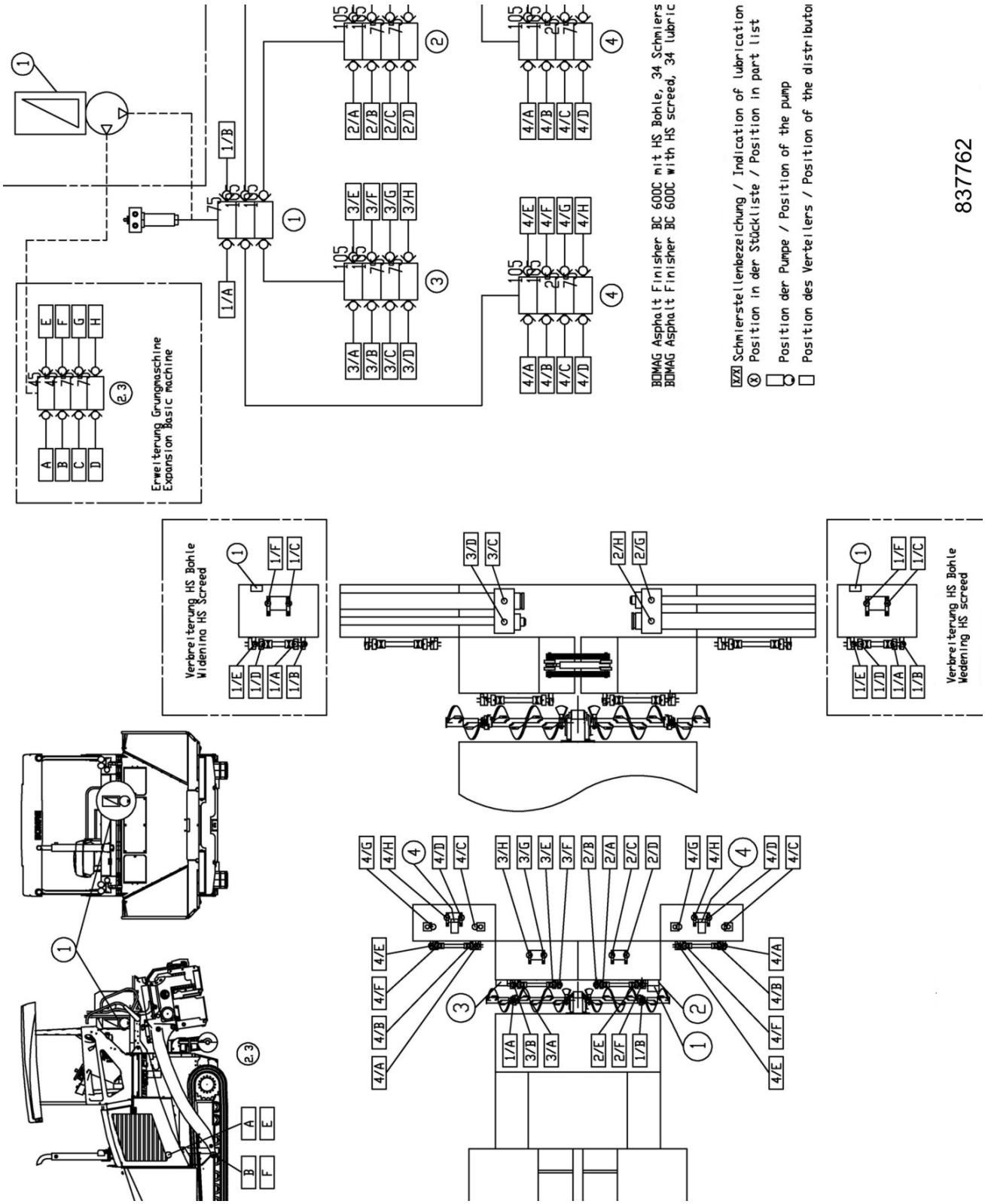
Fig. 28

Pump revolutions:= 60

Cycle time = 0.5 hours

Grease = lithium saponified multi-purpose grease, NLGI3

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After a running-in phase of 100 hours and after inspection of all lubrication points the lubrication intervals can be extended or reduced, as required.

⚠ Caution

The cycle time must not be changed.

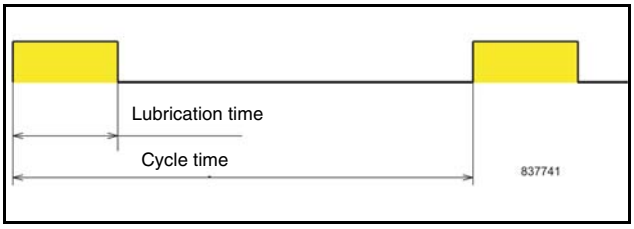


Fig. 29

Pump revolutions:= 60

Cycle time = 0.5 hours

Grease = lithium saponified multi-purpose grease, NLGI3

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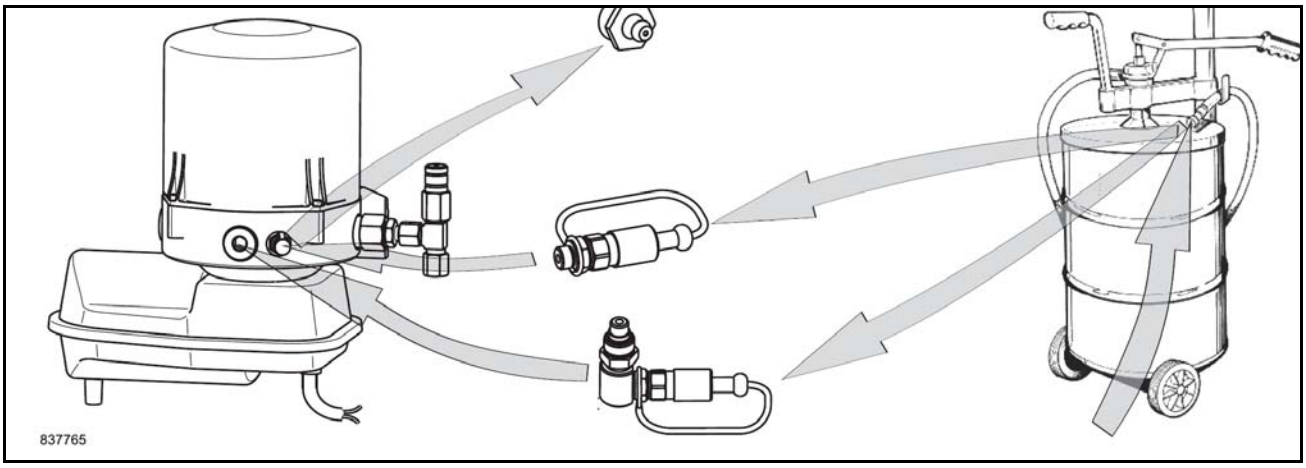


Fig. 1 Filler coupling

(Fig. 1) Through filler coupling.

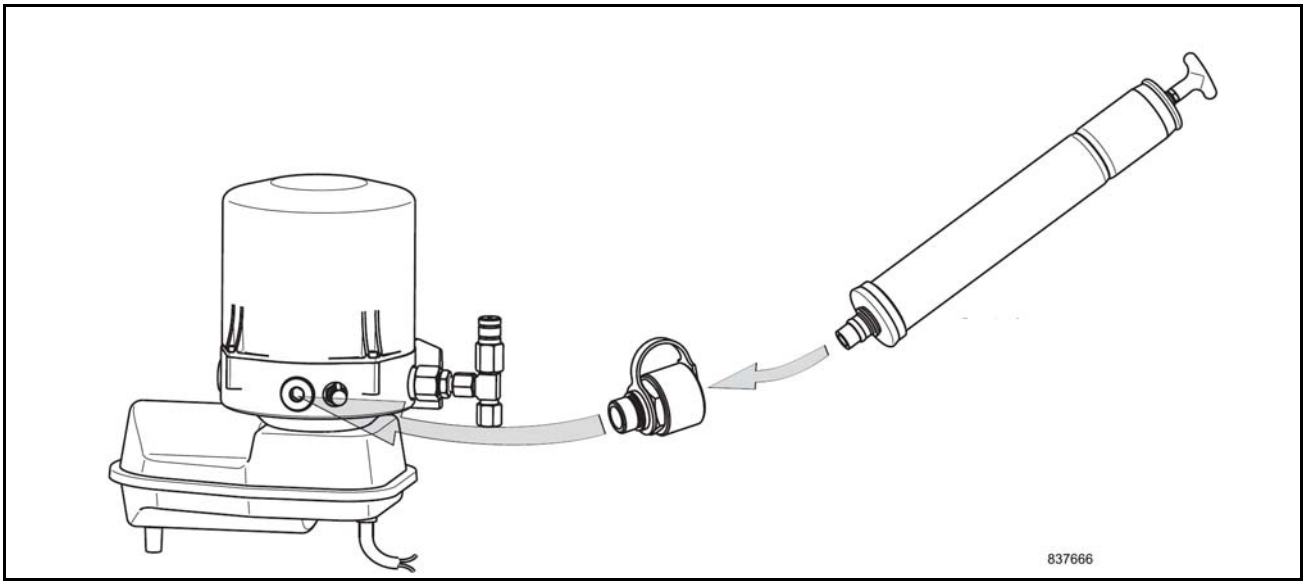


Fig. 2 Grease gun

(Fig. 2) With grease gun

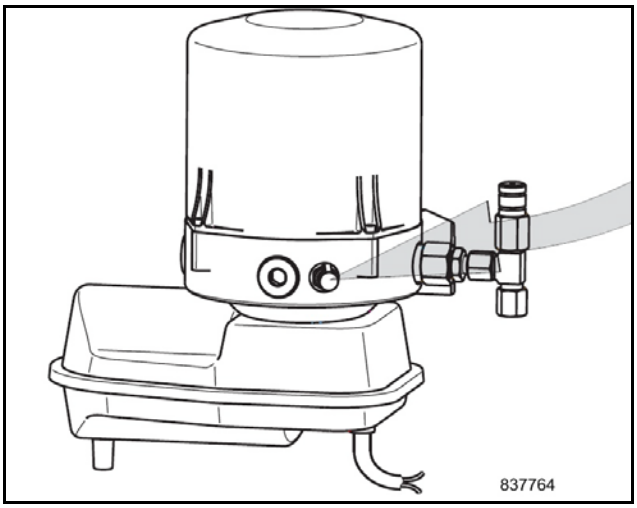


Fig. 3 Grease nipple

(Fig. 3) Through grease nipple with hand-operated or pneumatic grease gun

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9.4 Electric pump

Electric pump EP-1

The central lubrication grease pump is electrically driven. With a working pressure of max. 280 bar (setting of high pressure relief valve) this pump is suitable for pumping conventional greases up to NLGI-Kl. 2.

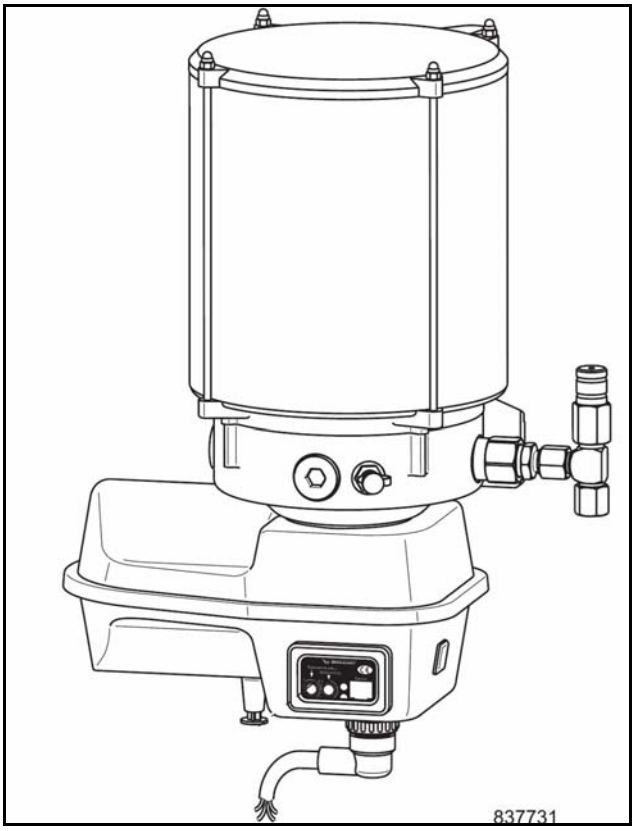


Fig. 4 EP-1 with 4 kg container and integrated electronic control

Technical dada

Motor:

Operating voltage= 12/24 V DC

Rated speed = 15 rpm

Power consumption
at idle speed = 0.4 A

Power consumption
at full load speed= 1.1 A

Fuse = 3 A

Pump:

Max. operating pressure = 280 bar

Permissible operating temperature = -35°C to +80°C

Container capacity= 1.9 kg, 2.5 kg, 4 kg or 8 kg

Rotation of agitator =counter-clockwise

Installation position= Container vertically upright

Protection class= IP5K9K acc. to DIN 40050

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Working principle

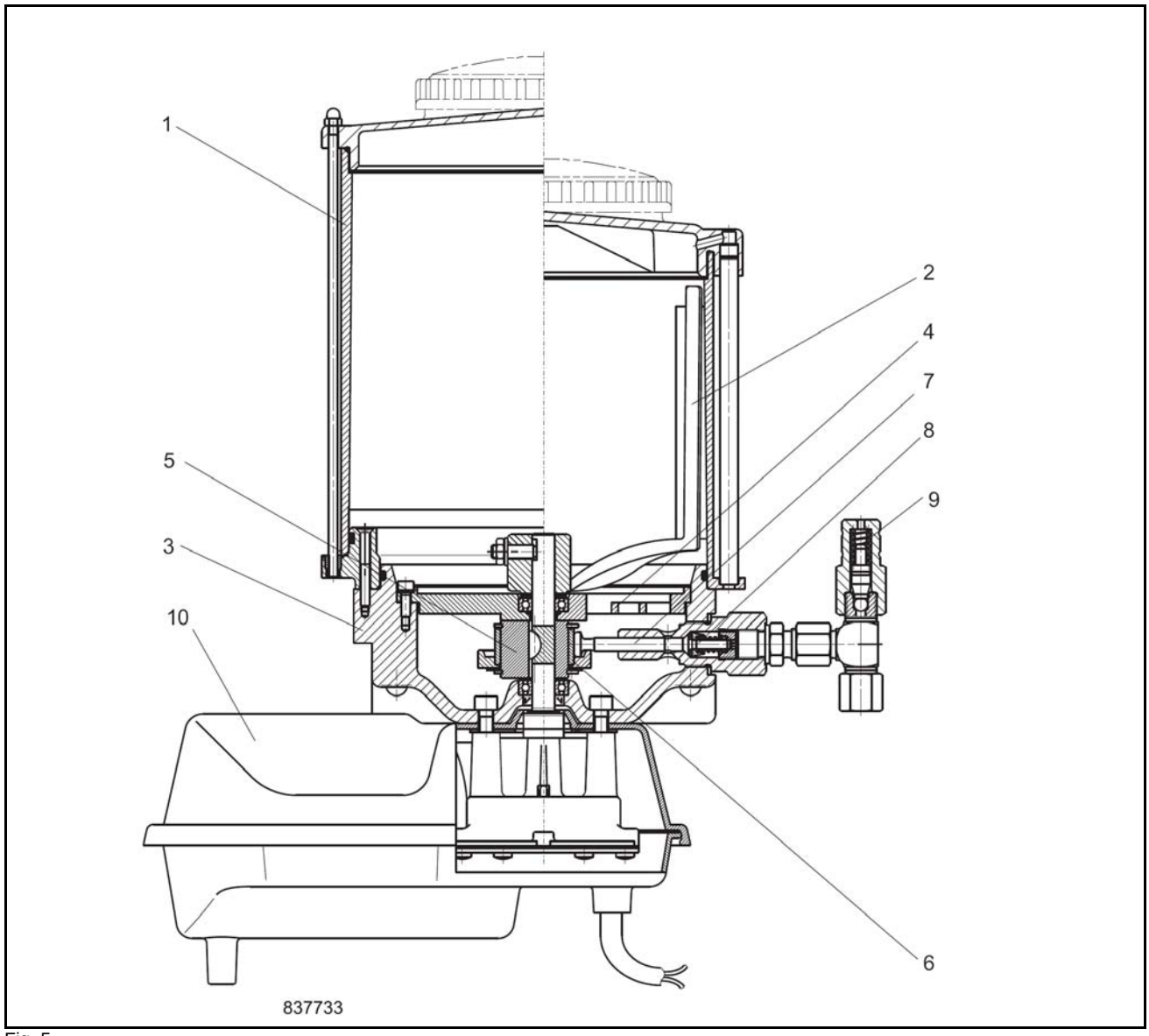


Fig. 5

A DC-motor 10 (Fig. 5) continuously drives the eccentric (5) with thrust ring (6). This eccentricity causes the suction and pressure stroke of the pump piston (7), whereby the integrated check valve (8) prevents the pumped medium from being sucked back in from the main line.

The agitator (2) forces the lubricant out of the provision container (1) through a screen plate (4 to the suction area in the pump housing (3), whereby air bubbles are eliminated A scraper on the agitator (2) enables visual inspection of the still available grease quantity inside the transparent provision container (1).

The pressure relief valve (9) is factory set to 280 bar.

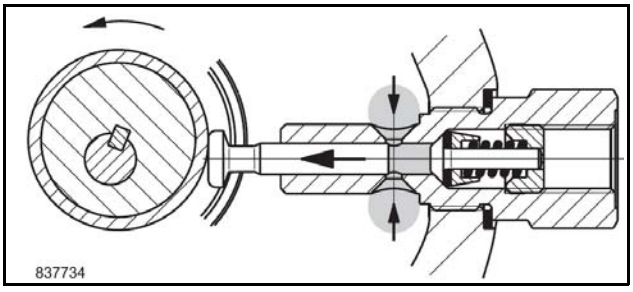


Fig. 6 Pump element drawing in grease

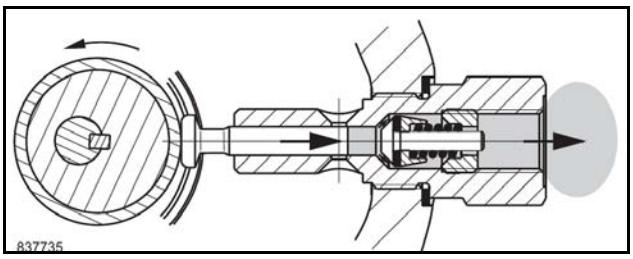


Fig. 7 Pump element pumping

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Pump element PE-120V

Max. flow capacity

- Pump element factory set to full stroke
- max. flow capacity 0.12 cm with full stroke
- Reduction of 0.013 cm per detent = 1/2 revolution

Flow capacity regulation:

- Unscrew the plug 2 (Fig. 8)) with an Allen key (SW 5)
- The setscrew (3) is then regulated with a screwdriver
- Turning clockwise reduces the flow capacity
- Turn anti-clockwise increases the flow capacity
- Max. stroke of setscrew is 2.4 mm = 6 detents.
- 1 turn of the setscrew is 0.8 mm = 2 detents
- Tighten the plug (2) with the seal ring.

Technical data:

Max. flow capacity= 0.04 to 0.12 cm^3 / stroke

Flow capacity regulation	=	6 detents per 1/2 turn
Reduction	=	0.013 cm^3 per detent
Piston return	=	forced

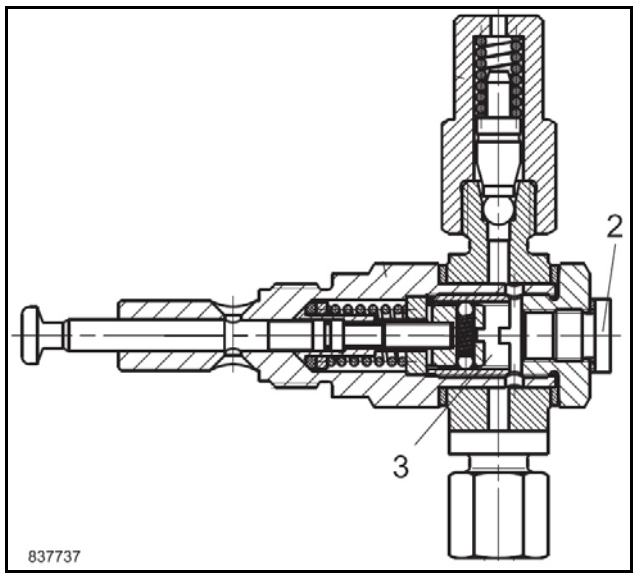


Fig. 8

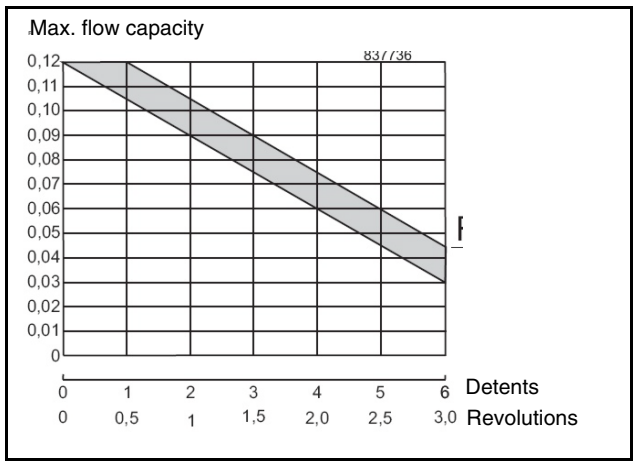


Fig. 9

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Installation of pump element

- Installation and removal only with the pump stopped.
- Assembly of the pump element with the piston (4) partly pulled out, insert upwards under a slanted angle into the housing bore (Fig. 10)).
- Once the piston head touches the pressing ring - move the element to horizontal position (Fig. 11).
- The piston head must run in the groove of the guide ring.
- Tighten the pump element.
- Disassemble in reverse order.

i Note

When disassembling the pump element make sure that the piston (4) does not remain in the pump housing.

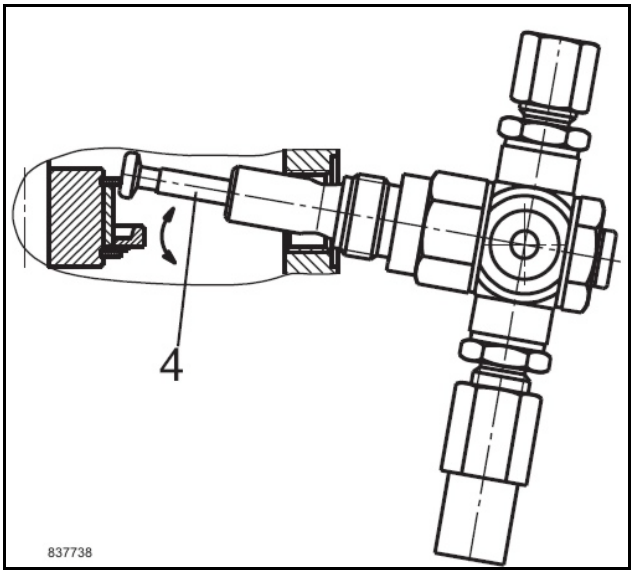


Fig. 10

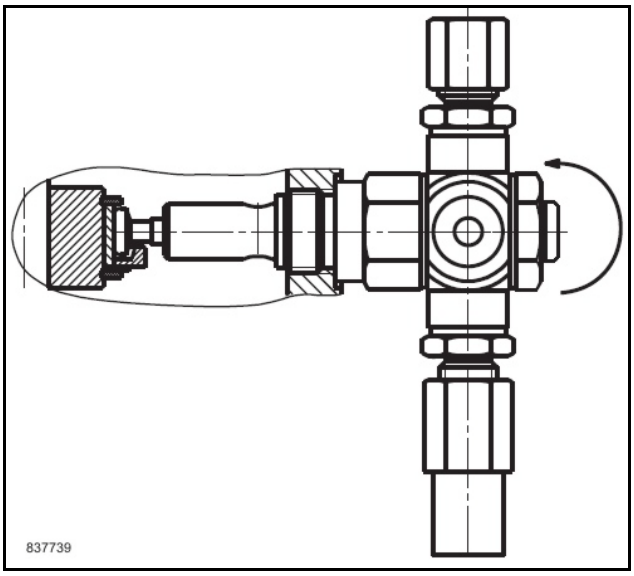


Fig. 11

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9.5 Integrated electronic control

The control unit is equipped with a data memory which logs the following values:

- Control type
- Version of control serial number
- Manufacturing date
- Type of operation (time or speed control)
- Settings (setting ranges).

Functional sequence

After switching on the ignition the green and red LEDs light up for 1.5 seconds to indicate readiness for operation (switch-on control), irrespective of the set program.

Each initial connection of the control triggers a lubrication process, the green LED 2 (Fig. 12) in the control bowl light during the entire lubrication process.

The integrated electronic control unit BEKA-troniX1 is equipped with a data log. This, among other, serves the purpose of logging expired times. If the ignition is interrupted during a lubrication process or within a pause period, this time is stopped and logged. After switching the ignition back on the still remaining lubrication or pause times are read out of the log and the function will be resumed at exactly the point where it was interrupted.

With the ignition switched on intermediate lubrication can be triggered at any time by pressing the push button (1) on the side of the motor housing, this function also serve the purpose of function testing. The pump in this case immediately starts a lubrication cycle, the accumulated or logged lubrication or cycle time is reset and starts anew.

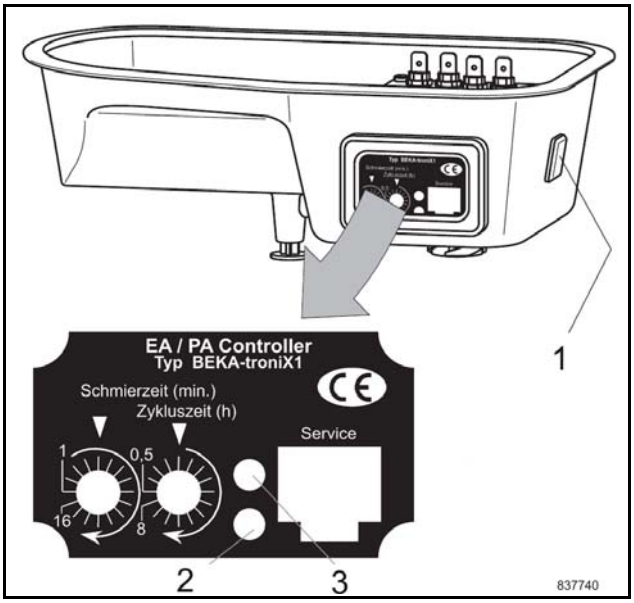


Fig. 12

1 Push button to trigger intermediate lubrication

2 Green LED to indicate function

3 Red LED to indicate faults

Technical data:

Supply voltage = 10 to 60 V DC

Current load max.= 6.0 A

Fuse (not contained in the unit) = 6.3 A

Output for signal lamp = 0.4 A

Temperature range= -35°C to +75°C

Protection class= IP 65

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Modes of operation

A) Timer control

With time dependent control of a central lubrication system both the cycle time and the lubrication time can be adjusted. Cycle time means the time span between beginning of a lubrication process to the beginning of the next lubrication process.

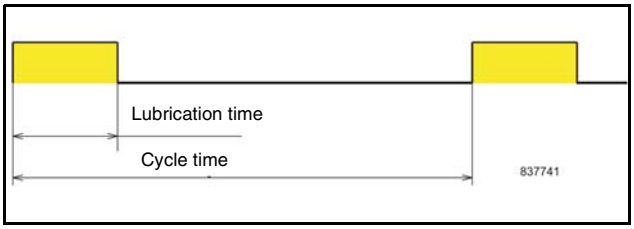


Fig. 13

B) RPM-control

With the integrated electronic control unit one can, e.g. in case of speed fluctuations caused by low temperatures or high torques, also determine the lubrication period on the basis of the number of revolutions of the pump motor.

A sliding contact connects the pump motor with the control. Each pump revolution sends a signal to the control, which in turn counts the number of arriving signals.

If no signals are received from the pump motor over an adjustable monitoring time (standard 30 sec.) after the beginning of the lubrication process, the control will indicate a fault.

The red LED in the inspection window in the bottom motor shell of the pump or an externally installed signal lamp (option) will start to flash.

Setting parameters

The cycle or lubrication times can be set with the help of maintained-contact switches in the inspection window of the control.



Fig. 14

For setting the time disassemble the red frame from the motor protection housing of the pump using a flat screwdriver (Fig. 14), loosen four cross-recessed screws and remove the transparent protection cover.

The cycle or lubrication time can be set with a flat screwdriver.

⚠ Caution

The cycle time must not be changed.

In case of improper closing of the cover water will seep into the control and cause damage. In this case any warranty will become null and void.

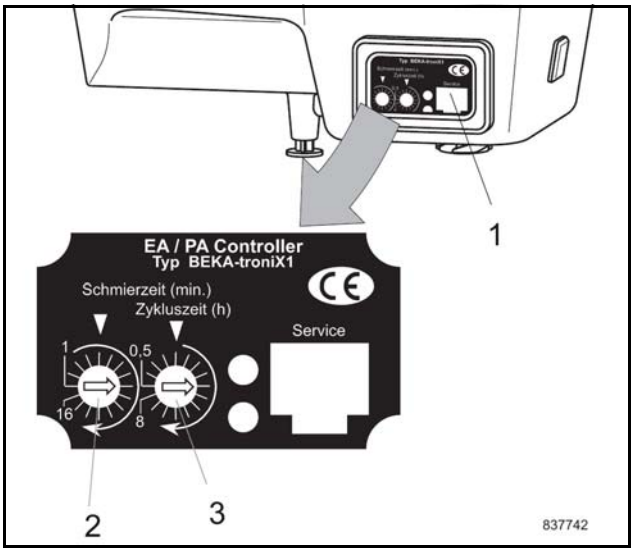


Fig. 15

1 Connection of system diagnose

2 Maintained-contact switch to set the lubrication time

3 Maintained-contact switch to set the cycle time

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Lubrication times:

1 to 16 min. (16 contacts for 1 min. each)

2 to 32 min. (16 contacts for 2 min. each)

2 to 32 sec. (16 contacts for 2 sec. each)

Cycle times:

0.5 to 8 h (16 contacts for 0.5 h each)

2 to 32 min. (16 contacts for 2 min. each)

2 to 32 h (16 contacts for 2 h each)

Pump revolutions:

1 to 16 revolutions (16 contacts for 1 revolution each)

10 to 160 revolutions (16 contacts for 10 revolution each)

170 to 320 revolutions (16 contacts for 10 revolution each)

Summary of signal displays

Two control LEDs (green/red) in the inspection window of the motor shell show the functions of the pump, whereby the red LED always indicates a fault in the program sequence.

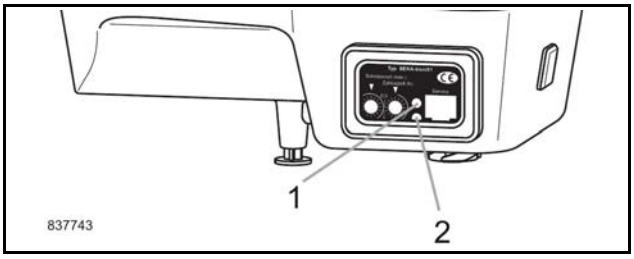


Fig. 1 Indication of functional readiness

1 Red LED to indicate faults

2 Green LED to indicate function

a) Functional readiness



Fig. 2 Indication of functional readiness

b) Lubrication active

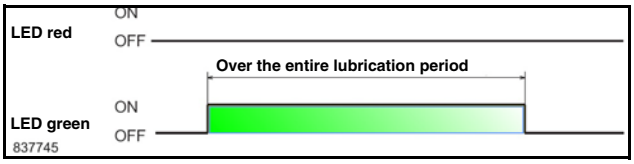


Fig. 3 Lubrication sequence

c) Rotary speed fault

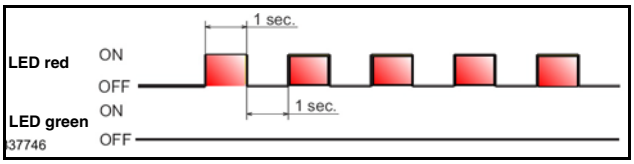


Fig. 4 Rotary speed fault on pump motor

d) Fault CPU/memory

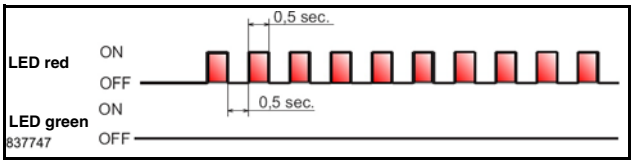


Fig. 5 Fault CPU/memory

e) Test lubrication (permanent lubrication)

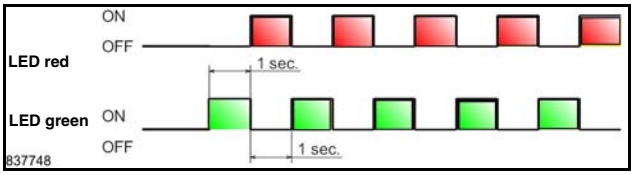


Fig. 6 Test lubrication

i Note

In order to be able to trigger permanent lubrication for service purposes in "Timer controlled" mode, the lubrication time must be set to a value that is higher than the cycle time.

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Terminal diagram

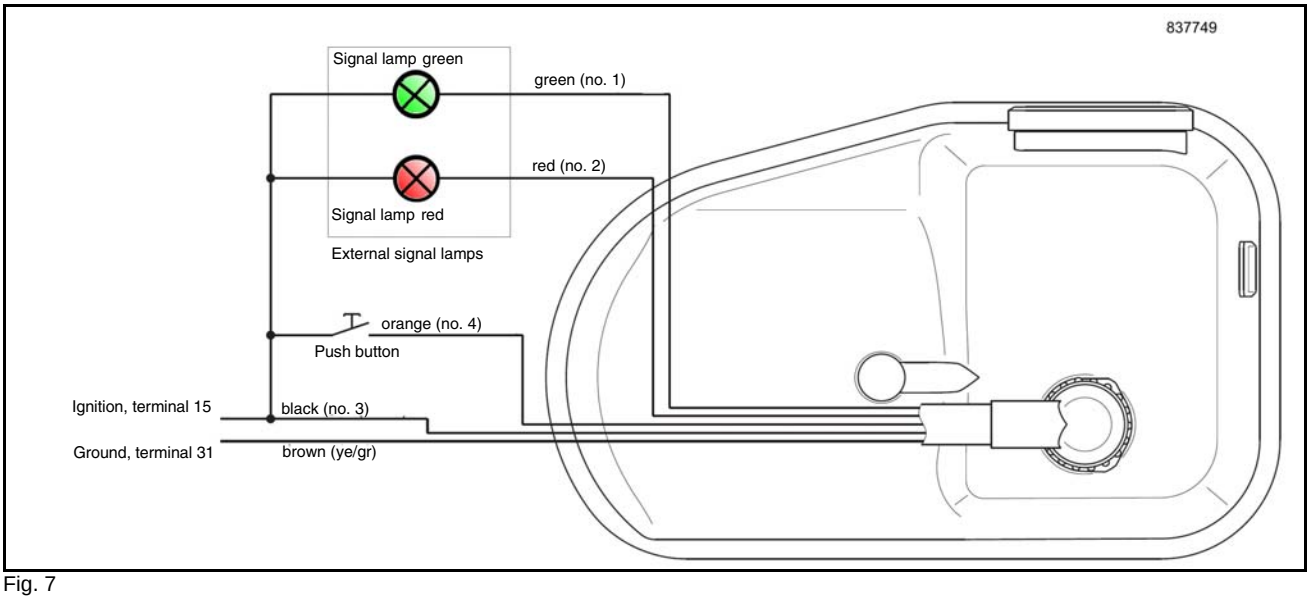


Fig. 7

i Note

(No. ...) = Cable no. for mono-colour cable

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9.6 Progressive distributor

The progressive distributor can be employed as main or a secondary distributor.

Progressive piston distributors are distributor units with a hydraulic sequence control the pistons of which are controlled by the fed lubricant in such a way that the lubricant is forced successively to the individual outlets. In case of disturbances in the sequence of lubricant flow, e.g. blockage of lubrication lines or lubrication points, the distributors will block. This blockage is used as an aid to monitor the distributors. With automatic pumps, such as e.g. the electric pump EP-1, the lubricant emerges from the pressure relief valve.

The progressive distributors are manufactured in a variable disc design. This has the advantage that the distributor can be extended or shortened, depending on the number of lubrication points. This disc design also provides the possibility to customize individual distributor discs with different displacements per piston stroke to one overall progressive distributor.

The different displacements per piston stroke are achieved by different piston diameters.

For correct functioning a progressive distributor requires at least three pistons, i.e. at lest three pumping elements.

Technical data:

Operating pressure at inlet = max. 300 bar

Temperature range= -35°C to + 80°C

Number of elements = Min. 3 piston elements, Max. 12 piston elements

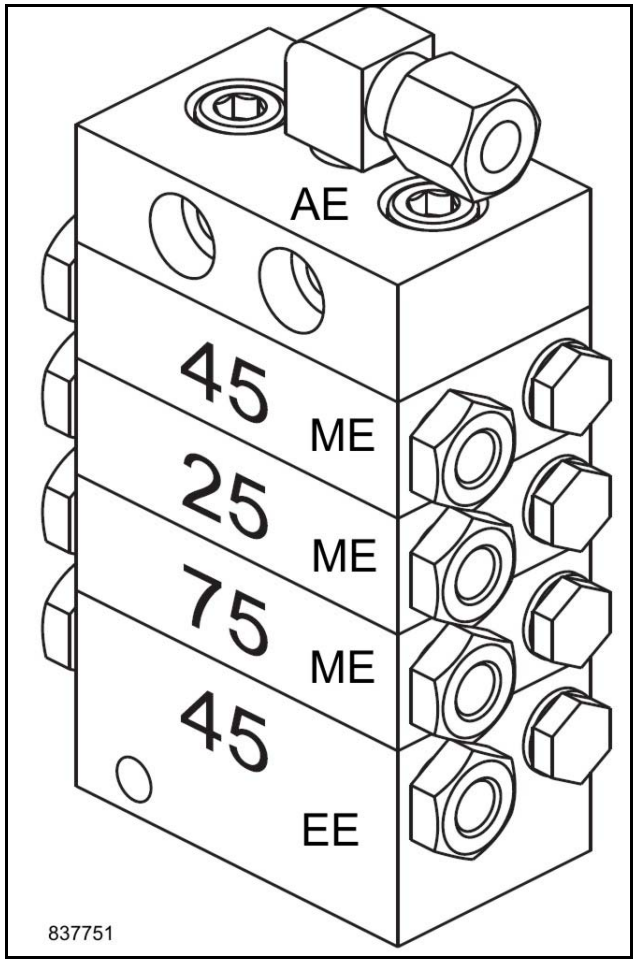


Fig. 8 Example: 4 piston elements and 8 outlets

In detail the progressive distributor consists of a start element (without piston), a middle element ME and an end element EE, which are held together as distributor blocks by tie rods (socket head cap screws) with serrated washers. The individual elements are sealed by O-rings.

Element designation	Max. flow capacity		Piston
	per outlet	per element	∅
MX- F25	25 mm^3	50 mm^3	3 mm
MX- F45	45 mm^3	90 mm^3	4 mm
MX- F75	75 mm^3	150 mm^3	5 mm
MX- F105	105 mm^3	210 mm^3	6 mm

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Description of function

Lubricant flows into the distributor inlet port through all distributor discs to piston I (Fig. 1). Piston (I) is displaced to the left and the lubricant from the left pressure chamber of the pumping piston is pressed to outlet 1 (Fig. 2).

Then the metering pistons (II) and (III) are displaced in succession and lubricant is delivered to outlets 2 and 3. After displacing piston (III) lubricant is delivered to the left side of pumping piston (I) (Fig. 3) and displaced out of the right pressure chamber of the pumping piston to outlet 4.

Then the metering pistons (II) and (III) are displaced in succession and lubricant is pressed to outlets 5 and 6.

After the displacement of pumping piston (III) the lubricant is once again guided to the right side of the pumping piston (Fig. 1) and a new cycle of the progressive piston distributor is started. The function described above is repeated, as long as the progressive distributor is supplied with grease.

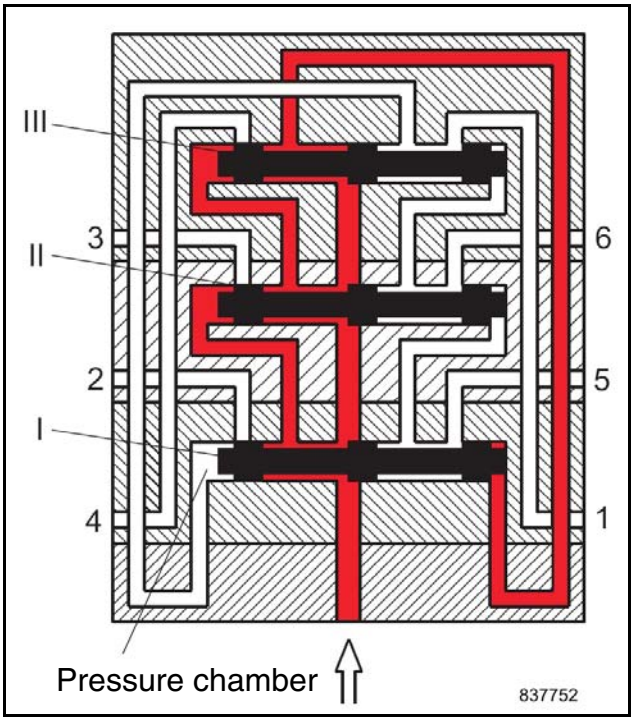


Fig. 1

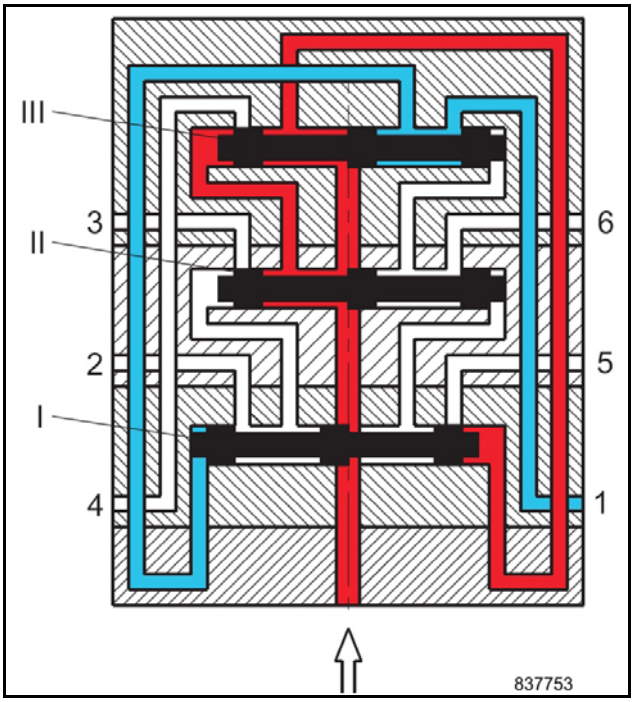


Fig. 2

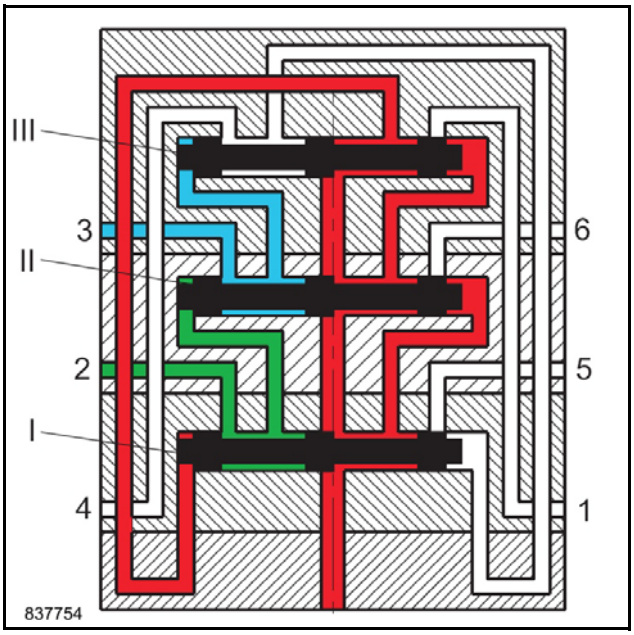


Fig. 3

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Connection of 2 outlets

For large lubrication points it may be necessary to join two or more outlets on the progressive distributor together.

The individual discs of the progressive distributor have two outlets.

When connecting two outlets on the progressive distributor, both outlets of one disc are joined together. For this purpose the sealing screw, which separates both sides, is removed and a plug is screwed into the side to be closed. The metered quantity of the closed side no emerges from the other side, i.e. the metered quantity on the open side is doubled.

2 outlets per distributor element (Fig. 4)

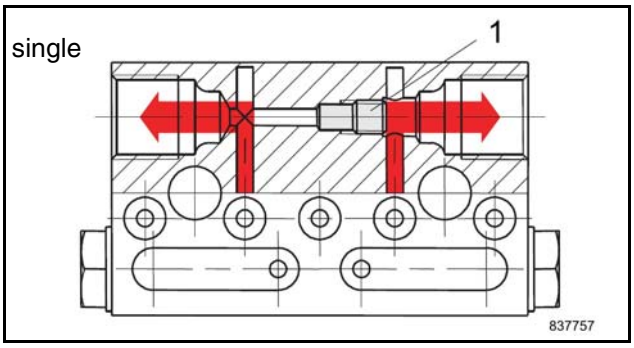


Fig. 4 2 outlets

1 Sealing screw

1 outlet per distributor element (Fig. 5)

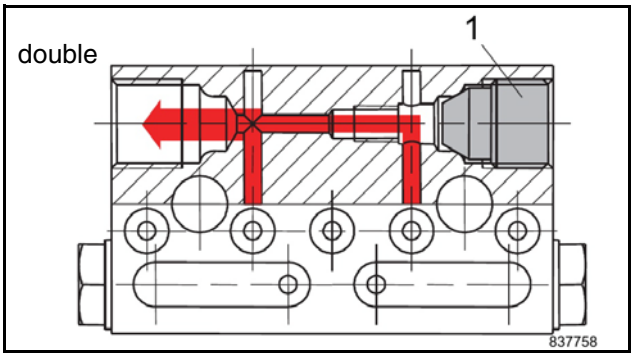


Fig. 5 1 outlet

1 Plug

For connecting outlets, plugs are required.

Connection of several outlets

Connection of outlets with bridging pipes without outlet

Should the total metering quantity exceed the capacity of the outlets connected in one disc of the progressive distributor, e.g. for extremely big lubrication points or for main distributors, there is a possibility to join the outlets of several distributor discs with bridging pipes (Fig. 6).

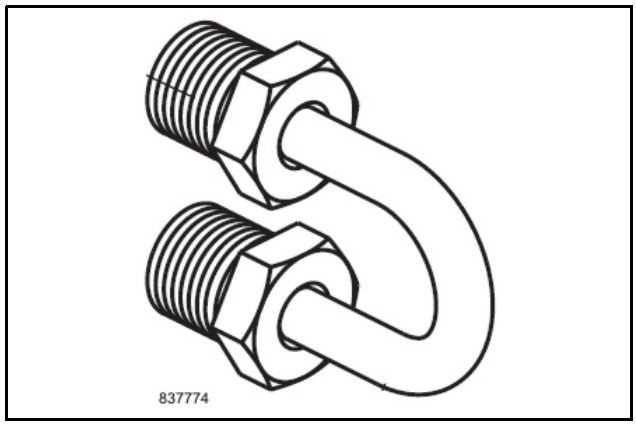


Fig. 6 Bridging pipe

3 outlets joined together (Fig. 7)

In this case two distributor discs are connected with a bridging pipe or a distributor bridge without outlet, as described hereunder. Depending on the element from which the sealing screw 1 (Fig. 7) had been removed, three outlets are joined together this way. The metered quantities of the closed outlets then emerge from one common outlet.

The metered quantity is calculated on the basis of the metering parameters for all joined piston sides.

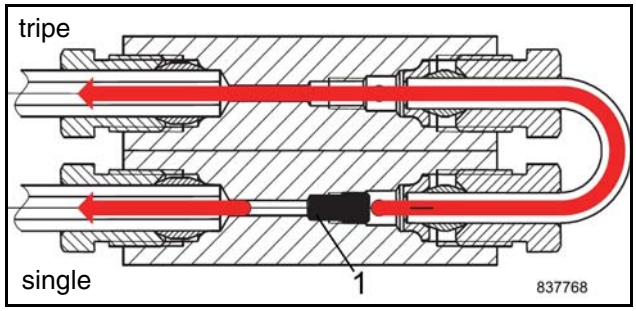


Fig. 7 3 outlets

1 Sealing screw

4 outlets joined together (Fig. 8)

With the help of a bridging pipe or a distributor bridge without outlet you can even join four outlets. For this purpose the sealing screws must be removed from both distributor discs and one of the two outlets opposite the bridging pipe or the distributor bridge must be closed with a plug.

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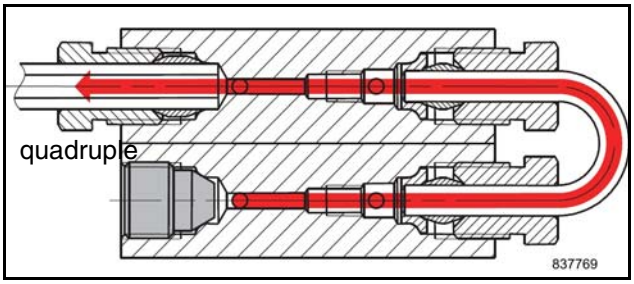


Fig. 8 4 outlets

Distributor bridge without outlet

Distributor bridge without check valve (Fig. 9)

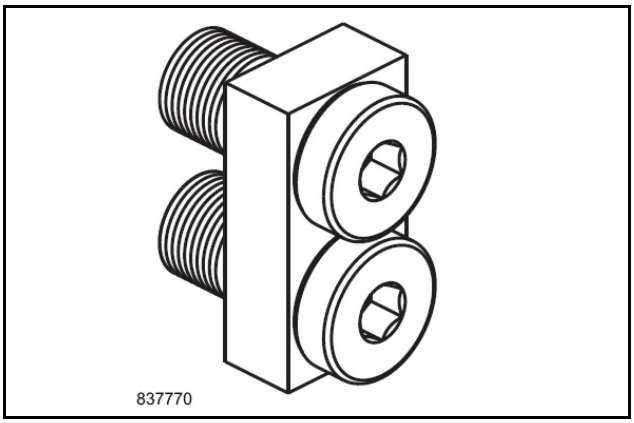


Fig. 9 without check valve

Distributor bridge with integrated check valve

In order to ensure proper functioning of a progressive distributor with three delivering elements but only two outlets (Fig. 10), you must use a distributor bridge without outlet, but with integrated check valve (Fig. 11).

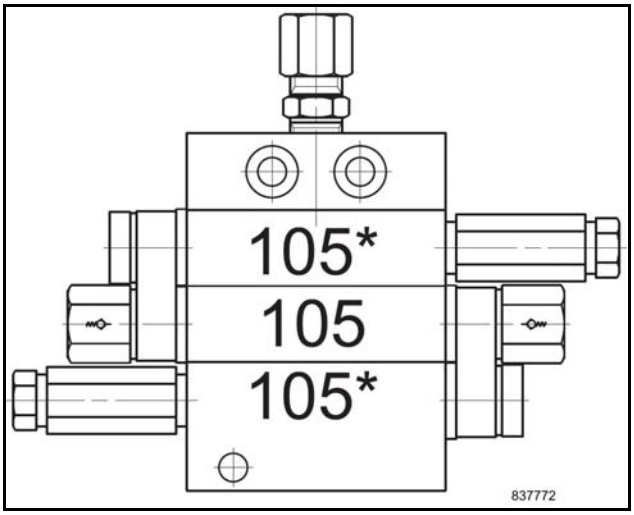


Fig. 10

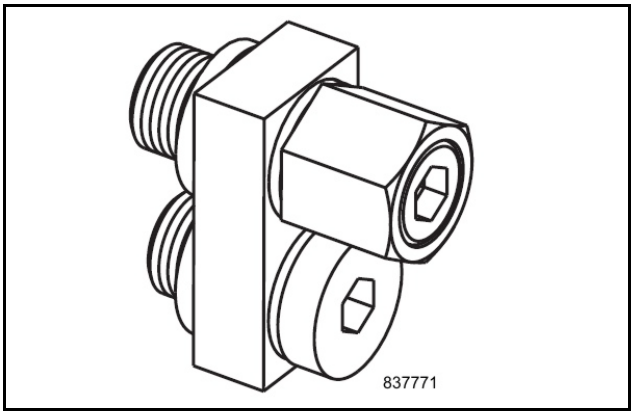


Fig. 11 with check valve

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Connection of outlets with distributor bridges with outlet

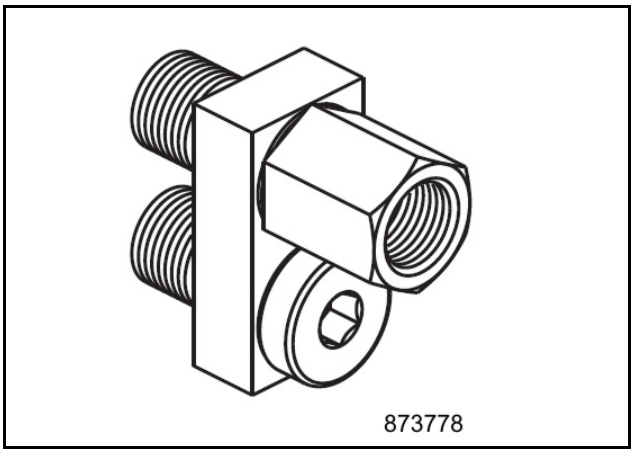


Fig. 12 Distributor bridge with outlet

2 outlets joined together (Fig. 13)

If two outlets (on different, adjacent distributor discs) are to be joined together, the sealing screws must not be unscrewed from any of the affected distributor discs. The delivery from both outlets in this case emerges from the outlet on the distributor bridge.

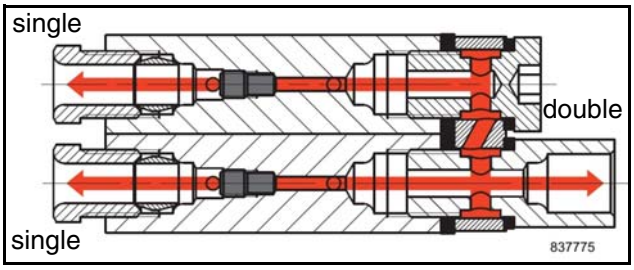


Fig. 13 2 outlets

3 outlets joined together (Fig. 14)

If three outlets are to be joined together, the sealing screw must be unscrewed from one of the two affected distributor discs and a plug must be screwed into the free outlet on this distributor disc. The delivery from all three outlets in this case emerges from the outlet in the distributor disc.

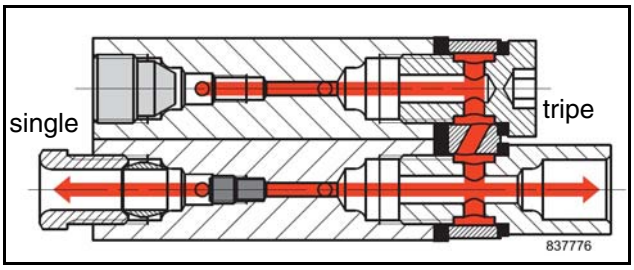


Fig. 14 3 outlets

4 outlets joined together (Fig. 15)

If four outlets are to be joined together, the sealing screws must be unscrewed from both distributor discs the plugs must be screwed into the outlets opposite the distribuitor bridge. The delivery from all four outlets in this case emerges from the outlet in the distributor disc.

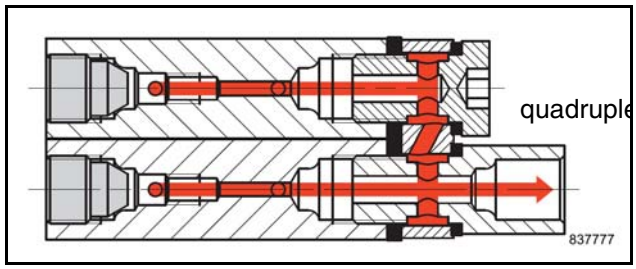


Fig. 15 4 outlets

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Check valves

The check valves are used in combination with high pressure hoses, e.g. on lubrication points with high counter pressure or in main distributors.

There are two versions of check valves available, on which the pipe socket is screwed in.

Check valve for main distributor (Fig. 16)

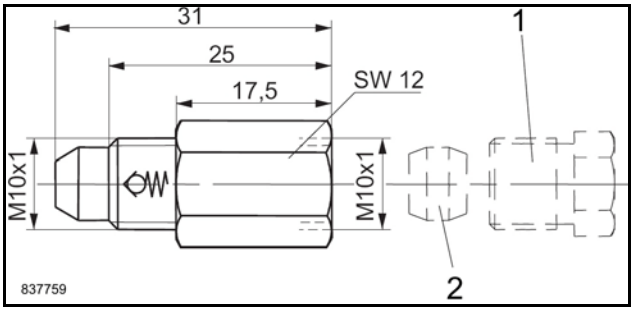


Fig. 16

1 Cap screw

2 Duplex ring

Check valve for secondary distributor (Fig. 17)

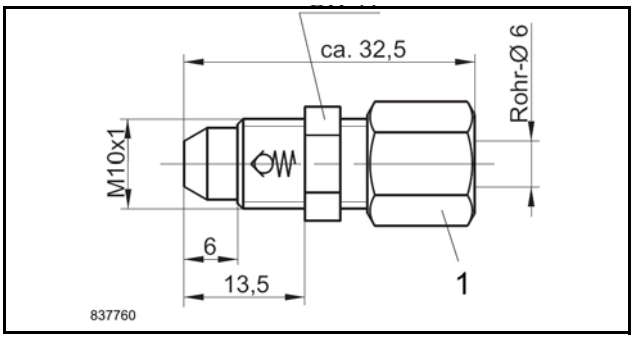


Fig. 17

1 Cap nut and cutting ring

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9.7 Fault - Cause - Remedy

Fault	Cause	Remedy
Pump does not work	Integrated electronic control defective	Replace the lower part of the motor protection housing
	Electric line interrupted	Replace the electric line
	Pump defective	Replace the pump
Pump works, but does not deliver	Air cushion in pumping piston	Vent the pump
	Min. filling level fallen short of	Fill up the provision container
	Pump element defective	Replace the pump element
No grease collar at the lubrication points	Pump does not work	See "Pump does not work"
	Pause time too long or lubrication period too short	Reduce pause time or extend lubrication time
	System blocked	See "Grease emerging from pressure relief valve"
No grease collars at various lubrication points	Supply line to secondary distributor burst or leaking	Replace the line
	Screw fittings leaking	Retighten or replace screw fitting
No grease collar on one lubrication point	Corresponding grease line burst or leaking	Replace the line
	Screw fitting leaking	Retighten or replace screw fitting
Pump speed too low	High system pressure or low ambient temperature	Check system / bearing point No damage (perform 1 or 2 intermediate lubrication cycles)
Grease emerging from pressure relief valve	System pressure too high	Check system
	Progressive distributor blocked	Replace the distributor
	System blocked	Repair blocked / seized bearing points
	Valve spring defective	Replace the pressure relief valve
LED-display	The LED of the control flashes or is permanently on	See "Summary of signal displays"

Cause for a blockage in the system

- A crushed or blocked lubricant line
- A bearing overfilled with lubricant or blocked
- An unsuitable lubricant for central lubrication systems
- A blocked distributor outlet
- A blocked distributor

Indication of a blockage

- Grease emerging from pressure relief valve

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Identify the location of the blockage

⚠ Caution

All repair work must be carried out with utmost cleanliness.

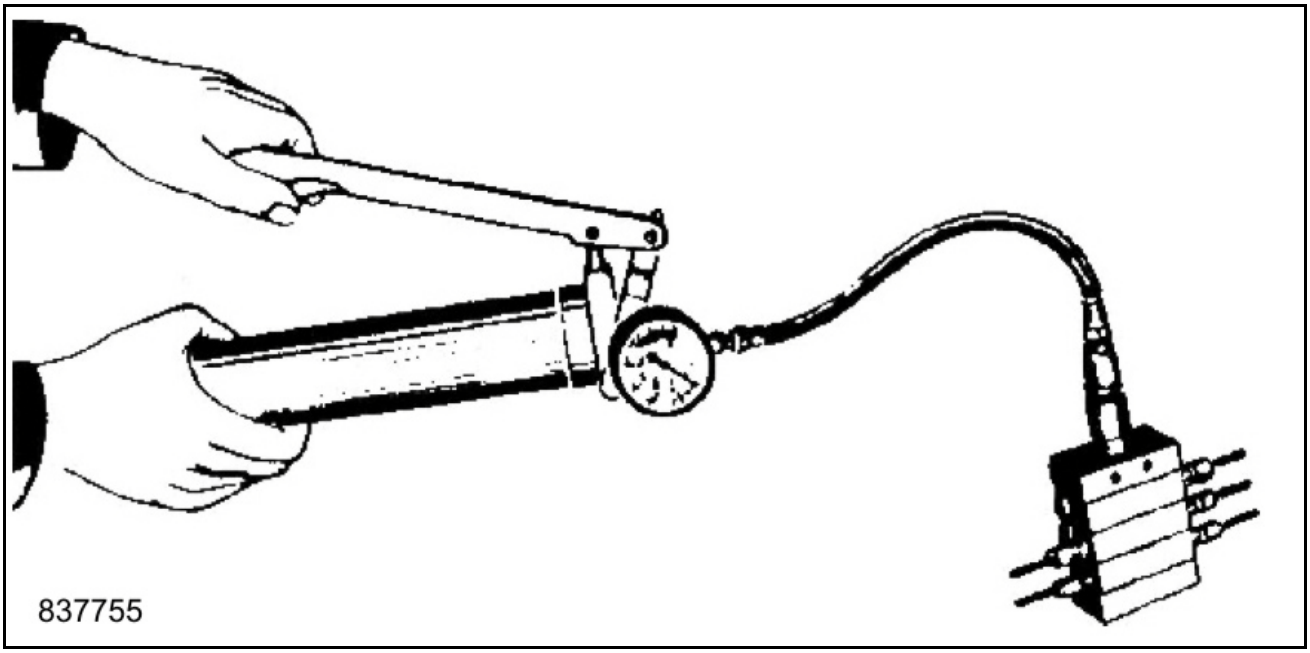


Fig. 18

- 1.) Unscrew the main line from the main distributor, operate the pump and check whether lubricant is delivered properly.
- 2.) Unscrew the cap screws on the distributor one after the other and operate the pump each time a cap screw is removed. The line (cap screw) at which the pressure drops, is the blocked line or lubrication point.
- 3.) Follow the same principle when checking the associated secondary distributor all the way to the lubrication point.

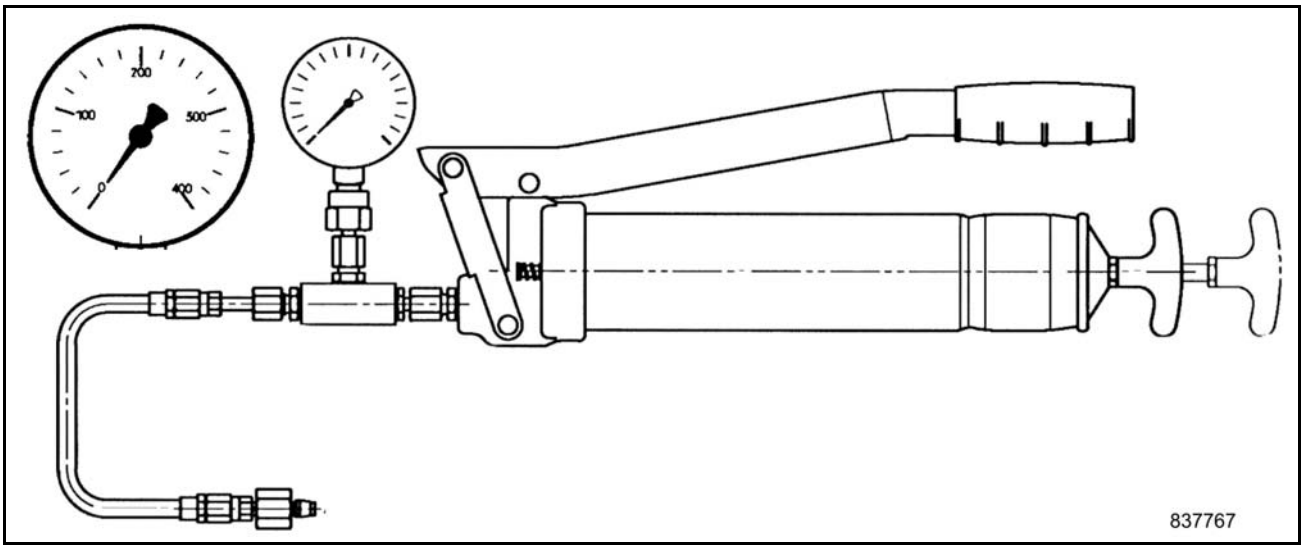


Fig. 19 KIT to check central lubrication systems

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Repair of a blocked distributor

⚠ Caution

All repair work must be carried out with utmost cleanliness.

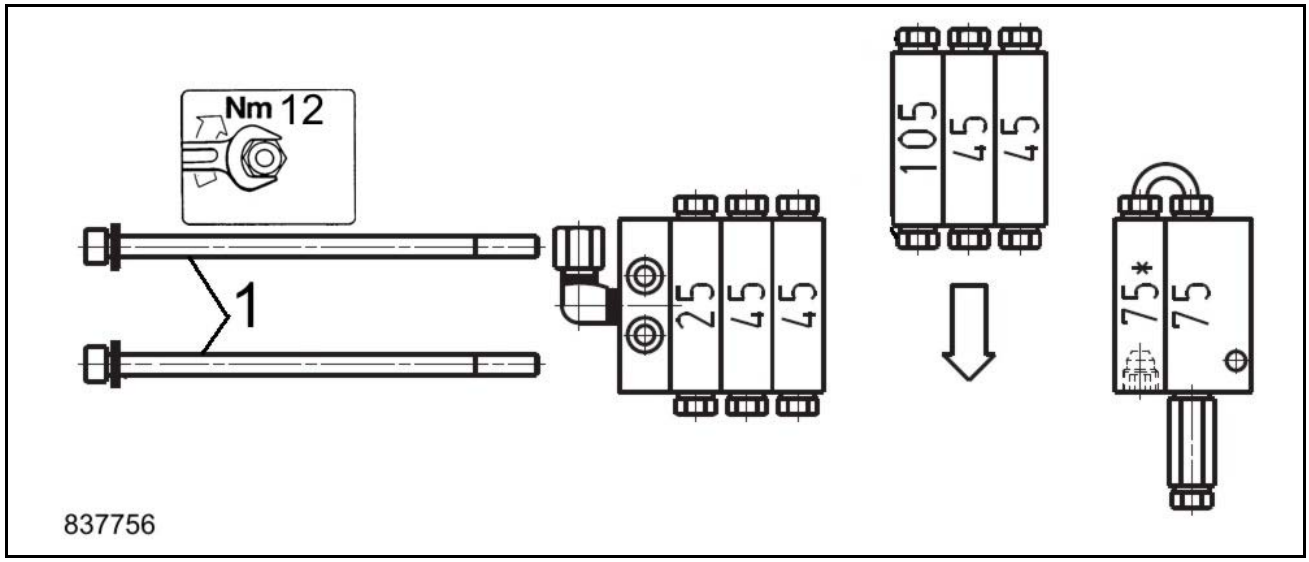


Fig. 20 Example

Remove the distributor from the system. .

- Note the sequence of distributor discs.
- Remove the draw bars 1(Fig. 20)
- Take off the distributor disc(s).

⚠ Caution

Pistons are not exchangeable among each other .

If piston and bores in the distributor disc show deposits of hardened grease, these deposits must be removed by washing or blowing out. The bores in the distributor disc must be free of grease residues.

i Note

Grease getting hard indicates that the grease is not suitable for central lubrication systems.

- Unscrew the plugs from the piston bores (2) and slide the pistons from side to side (do not push out).
- Screw the plugs back in.
- Check the next distributor disc, until the blocked piston is found.
- the piston of the blocked distributor disc out and check the bore in the distributor disc and the surface of the piston for scratches and damage.

⚠ Caution

In case of severe damage replace the distributor disc.

- Once all distributor discs have been checked reassemble the distributor in the recorded sequence.
- To prevent jamming of the pistons tighten the draw bars with 12 Nm.
- Check function of the distributor.

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10 Suppliers documentation

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10.1 Travel pump

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Genuine Parts

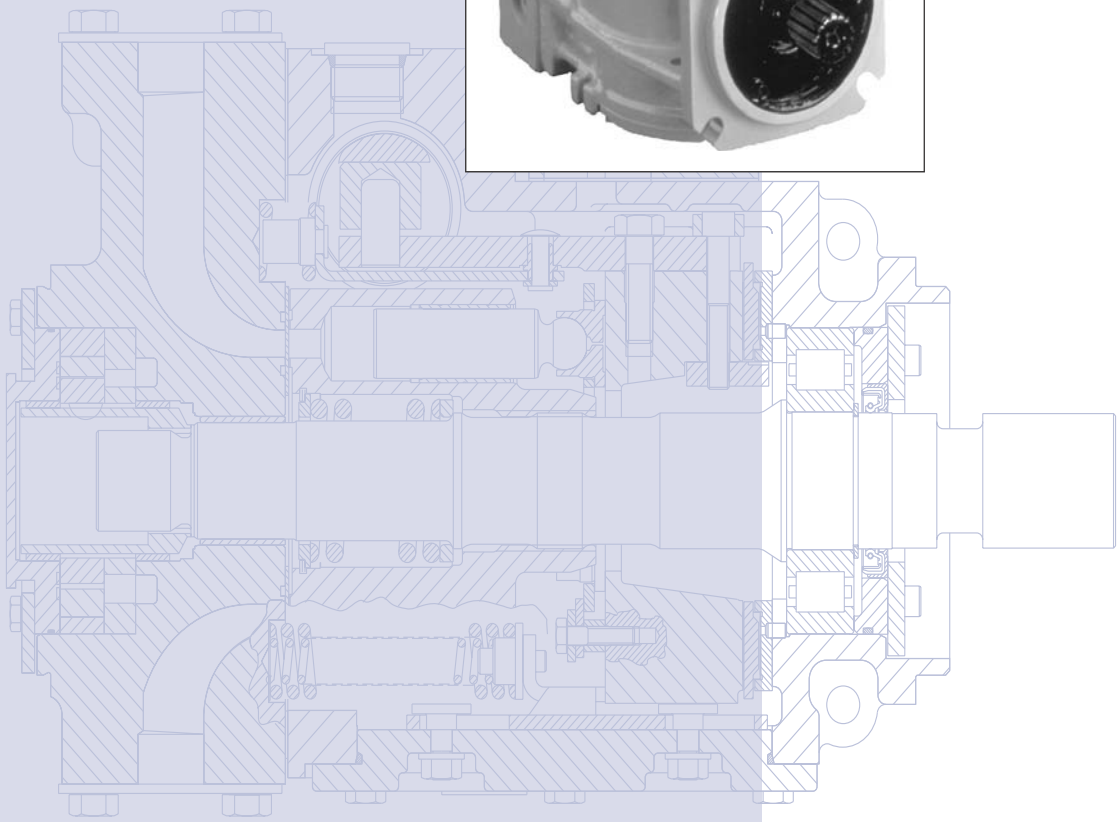
Series 90 Pumps

Service Manual









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Series 90 Axial Piston Closed Circuit Pumps Service Manual
Revisions

HISTORY OF REVISIONS

Table of Revisions

Date	Page	Changed	Rev.
April 2008	70	Torque for G45, G50, G52, G54, B70, B72, B82, B83 changed to 40 Nm [30 lbf•ft]	AB
September 2007	-	First printing - replaces BLN-9947	AA

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Front cover illustrations: F000539, F300856, F101411

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OVERVIEW

This manual includes information for the installation, maintenance, and minor repair of Series 90 axial piston closed circuit pumps. It includes a description of the unit and its individual components, troubleshooting information, and minor repair procedures.

Performing minor repairs requires you remove the unit from the vehicle/machine. Thoroughly clean the unit before beginning maintenance or repair activities. Since dirt and contamination are the greatest enemies of any type of hydraulic equipment, follow cleanliness requirements strictly. This is especially important when changing the system filter and when removing hoses or plumbing.

A worldwide network of Sauer-Danfoss Global Service Partners (GSPs) is available for major repairs. Sauer-Danfoss trains GSPs and certifies their facilities on a regular basis. You can locate your nearest ASC using the distributor locator at www.sauer-danfoss.com. Click on the *Sales and Service* link.

WARRANTY

Performing installation, maintenance, and minor repairs according to the procedures in this manual will not affect your warranty. Major repairs requiring the removal of a unit's rear or side cover voids the warranty unless done by a Sauer-Danfoss Authorized Service Center.

GENERAL INSTRUCTIONS

Follow these general procedures when repairing Series 90 variable displacement closed circuit pumps.

Remove the unit

Prior to performing major repairs, remove the unit from the vehicle/machine. Chock the wheels on the vehicle or lock the mechanism to inhibit movement. Be aware that hydraulic fluid may be under high pressure and/or hot. Inspect the outside of the pump and fittings for damage. Cap hoses after removal to prevent contamination.

Keep it clean

Cleanliness is a primary means of assuring satisfactory pump life, on either new or repaired units. Clean the outside of the pump thoroughly before disassembly. Take care to avoid contamination of the system ports. Cleaning parts by using a clean solvent wash and air drying is usually adequate.

As with any precision equipment, keep all parts free of foreign materials and chemicals. Protect all exposed sealing surfaces and open cavities from damage and foreign material. If left unattended, cover the pump with a protective layer of plastic.

Replace all O-rings and gaskets

Use new O-rings and gaskets during reassembly. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly.

Secure the unit

For repair, place the unit in a stable position with the shaft pointing downward. It will be necessary to secure the pump while removing and torquing end covers, controls, and valves.

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SAFETY PRECAUTIONS

Always consider safety precautions before beginning a service procedure. Protect yourself and others from injury. Take the following general precautions whenever servicing a hydraulic system.

Unintended machine movement

⚠ Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

Flammable cleaning solvents

⚠ Warning

Some cleaning solvents are flammable. To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

Fluid under pressure

⚠ Warning

Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury and/or infection. This fluid may also be hot enough to cause burns. Use caution when dealing with hydraulic fluid under pressure. Relieve pressure in the system before removing hoses, fittings, gauges, or components. Never use your hand or any other body part to check for leaks in a pressurized line. Seek medical attention immediately if you are cut by hydraulic fluid.

Personal safety

⚠ Warning

Protect yourself from injury. Use proper safety equipment, including safety glasses, at all times.

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SYMBOLS USED IN SAUER-DANFOSS LITERATURE

- WARNING may result in injury
- CAUTION may result in damage to product or property
- Reusable part
- Non-reusable part, use a new part
- Non-removable item
- Option – either part may exist
- Superseded – parts are not interchangeable
- Measurement required
- Flatness specification
- Parallelism specification
- External hex head
- Internal hex head
- Torx head
- O-ring boss port
- Tip, helpful suggestion
- Lubricate with clean hydraulic fluid
- Apply grease/petroleum jelly
- Apply locking compound
- Inspect for wear or damage
- Clean area or part
- Be careful not to scratch or damage
- Note correct orientation
- Mark orientation for reinstallation
- Torque specification
- Press in – press fit
- Pull out with tool – press fit
- Cover splines with installation sleeve
- Pressure measurement/gauge location or specification

The symbols above appear in the illustrations and text of this manual. They are intended to communicate helpful information at the point where it is most useful to the reader. In most instances, the appearance of the symbol itself denotes its meaning. The legend above defines each symbol and explains its purpose.

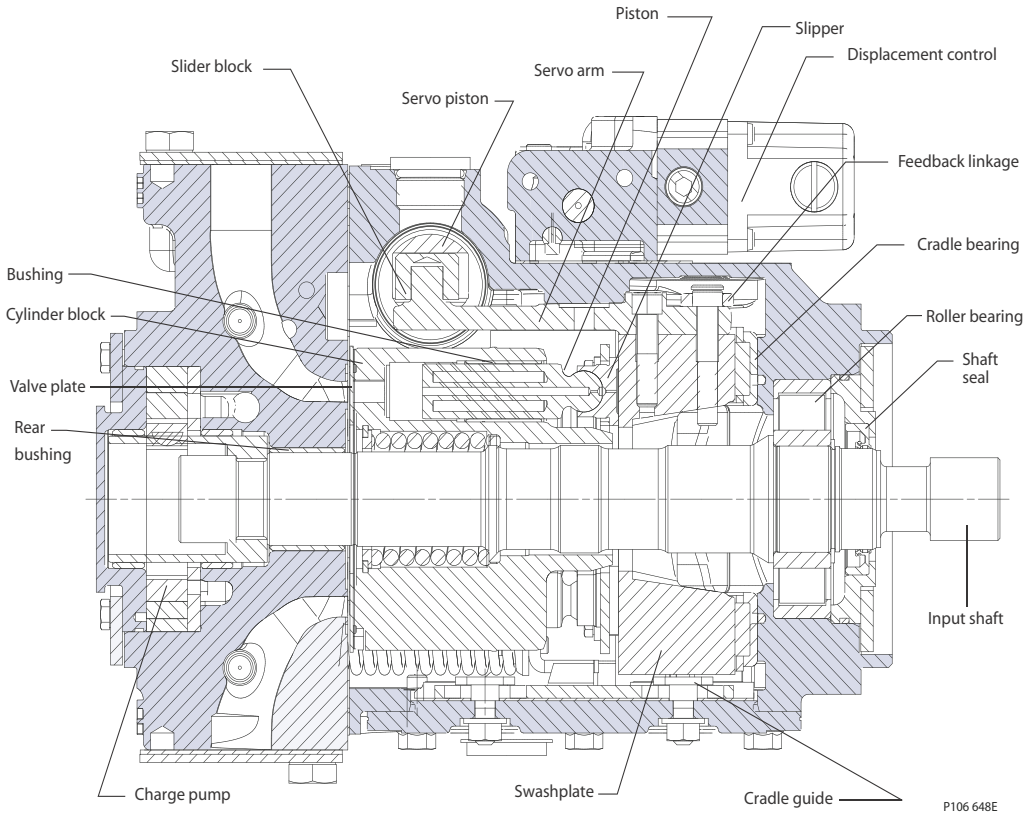
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DESIGN

Sauer-Danfoss Series 90 closed circuit piston pumps convert input torque into hydraulic power. The input shaft transmits rotational force to the cylinder block. Bearings support the input shaft at the front and rear of the pump. The shaft is splined into the cylinder block. A lip-seal at the front end of the pump prevents leakage where the shaft exits the pump housing. The spinning cylinder block contains nine reciprocating pistons. A ball joint at one end connects each piston to a brass slipper. Fixed-clearance hold-down brackets keep the slippers in contact with the swashplate. The reciprocating movement of the pistons occurs as the slippers slide against the inclined swashplate during rotation. The valve plate connects one half of the cylinder block to low pressure and the other half to high pressure. As each piston cycles in and out of its bore, fluid is drawn from the inlet and displaced to the outlet thereby imparting hydraulic power into the system. A small amount of fluid flows from the cylinder block/valve plate and slipper/swashplate interfaces for lubrication and cooling. Case drain ports return this fluid to the reservoir.

The angle of the swashplate controls the volume of fluid displaced into the system. The servo piston forces the swashplate into an inclined position. The pump control, acting on input from the operator, by modulating pressure balance across the servo piston, sets displacement in the system circuit.

Cross section



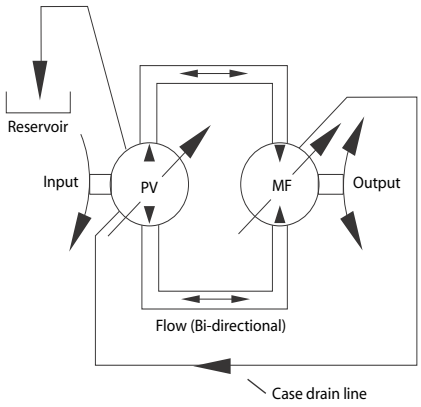
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THE SYSTEM CIRCUIT

The basic closed circuit

Hydraulic lines connect the main ports of the pump to the main ports of the motor. Fluid flows in either direction from the pump to the motor then back to the pump in this closed circuit. Either of the hydraulic lines can be under high pressure. In pumping mode the position of the pump swashplate determines which line is high pressure as well as the direction of fluid flow.

Basic closed circuit diagram

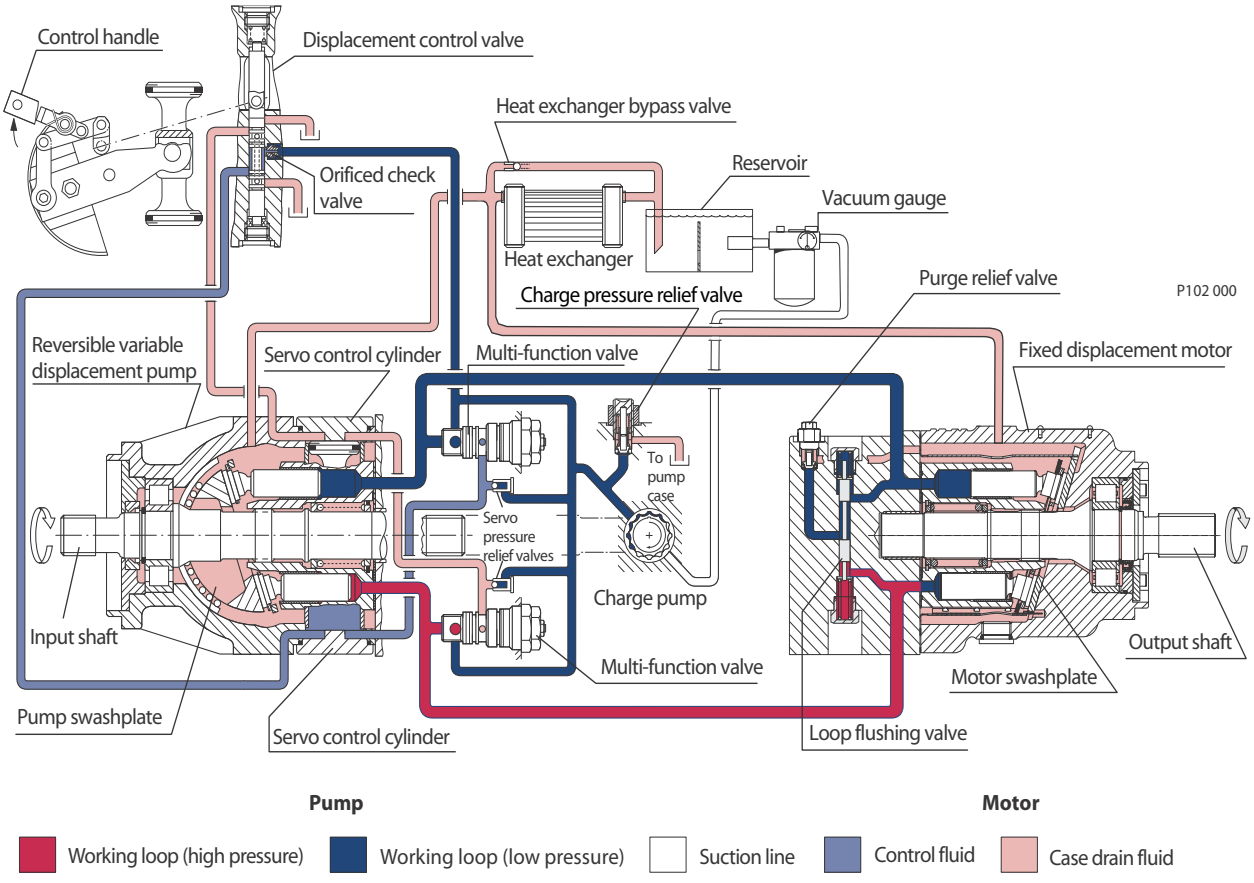


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Case drain and heat exchanger

The pump and motor require case drain lines to remove hot fluid from the system. The topmost port drains the motor to ensure the case remains full of fluid. Fluid routes through the lower drain port on the pump and out the topmost port to the reservoir. A heat exchanger, with a bypass valve, cools the case drain fluid before it returns to the reservoir.

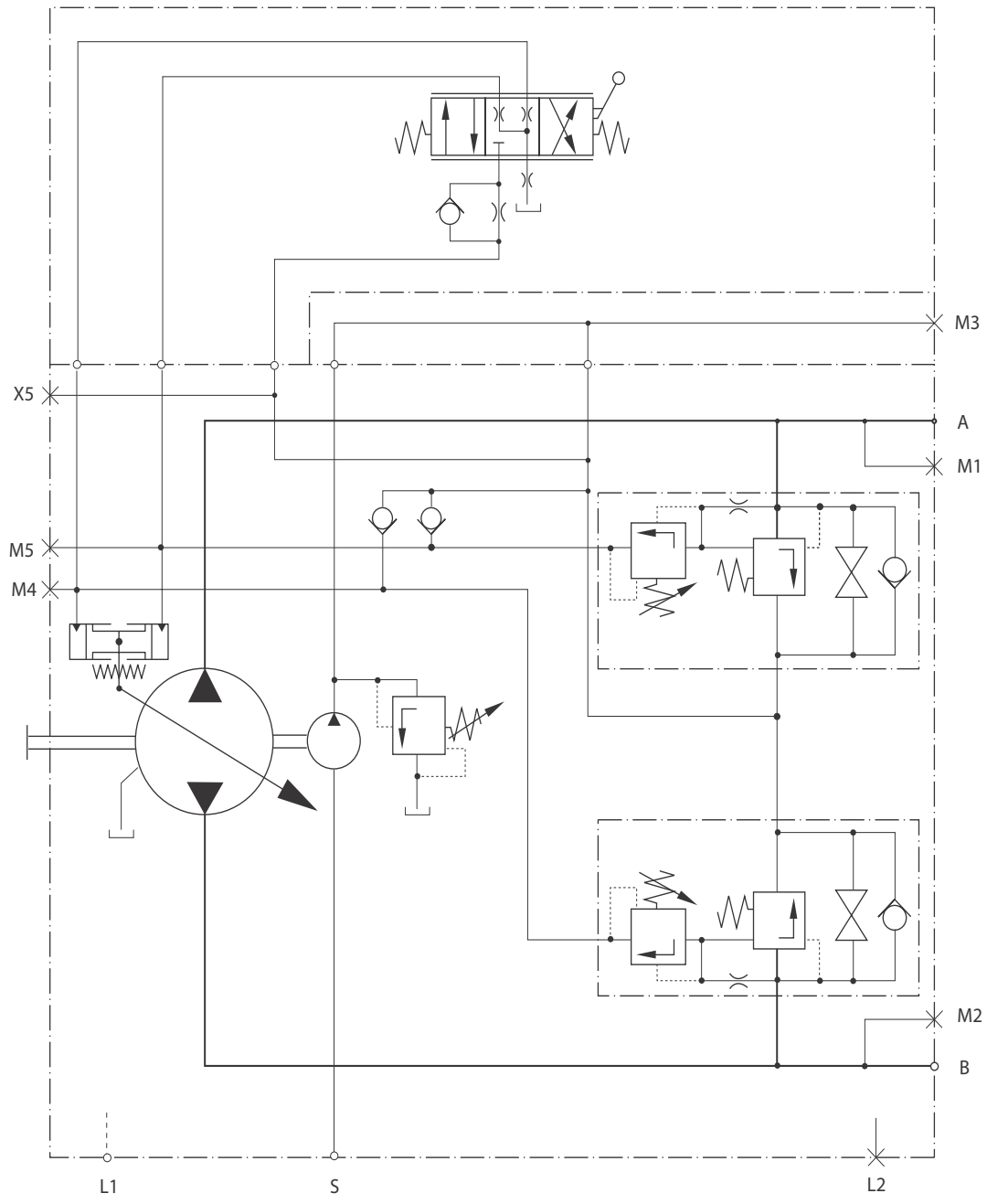
System circuit diagram



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THE SYSTEM CIRCUIT (continued)

Pump schematic



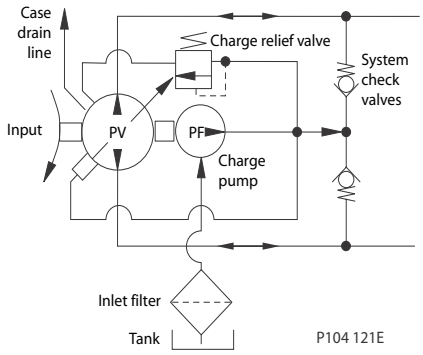
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CHARGE PUMP

The charge pump is necessary to supply cool fluid to the system, to maintain positive pressure in the main system loop, to provide pressure to operate the control system, and to make up for internal leakage. Charge pressure must be at its specified pressure under all conditions to prevent damage to the transmission.
The charge pump is a fixed-displacement, gerotor type pump driven off the main pump shaft. The charge relief valve limits charge pressure.

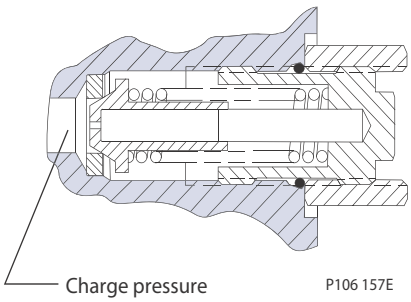
Pump charge system



CHARGE RELIEF VALVE

The charge relief valve on the pump maintains charge pressure at a designated level. A direct-acting poppet valve relieves fluid when charge pressure reaches a certain level. This level is nominally set referencing case pressure at 1500 rpm. This nominal setting assumes the pump is in neutral (zero flow). In forward or reverse, charge pressure is lower. The pump model code specifies the charge relief valve setting.

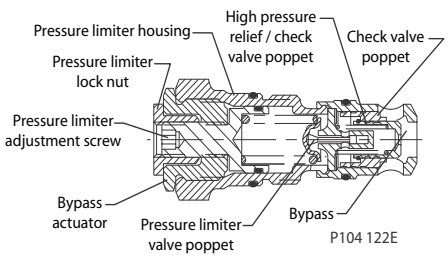
Charge pressure relief valve



MULTI-FUNCTION VALVES

The multi-function valve incorporates the system check valve, the pressure limiter valve, the high pressure relief valve, and the bypass valve in a replaceable cartridge. These functions are described separately. There are two multi-function valve cartridges in each Series 90 pump to handle functions in either direction. See corresponding sections for adjustments and repairs.

Multi-function valve



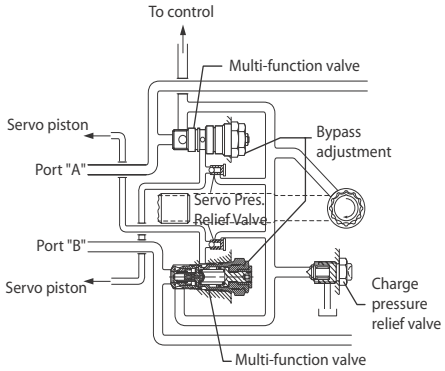
Some multi-function valves do not include a pressure limiter valve

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PRESSURE LIMITER AND HIGH PRESSURE RELIEF VALVES

Series 90 pumps have a sequenced pressure limiting system and high pressure relief valves. When the system pressure reaches the preset, the pressure limiter system rapidly de-strokes the pump to limit system pressure. For unusually rapid load application, the high pressure relief valve immediately limits system pressure by cross-porting system flow. The pressure limiter valve acts as the pilot for the high pressure relief valve spool. The high pressure relief valve is sequenced to operate at approximately 35 bar (500 psi) above the level that initiates the pressure limiter valve.

Circuit diagram showing pressure control mechanism



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For some applications, such as dual path vehicles, the pressure limiter function may be defeated so that only the high pressure relief valve function remains.

SYSTEM CHECK VALVES

The system check valves allow pressurized flow from the charge pump to enter the low pressure side of the loop. This is needed as the pump generally loses system pressure due to lubrication/cooling flow and other factors. Since the pump operates in either direction, the system uses two check valves to direct the charge supply into the low pressure lines. The system check valves are part of the multi-function valve assembly.

BYPASS VALVES

You can operate the bypass valves to move the vehicle or mechanical function when the pump is not running. Manually resetting the valve position opens the valve. The bypass valves are built into the multi-function valves.

SPEED SENSORS

An optional speed sensor can provide unit speed information. The sensor reads a magnetic ring on the unit's cylinder block. See the corresponding section to locate, install, and adjust the speed sensor.

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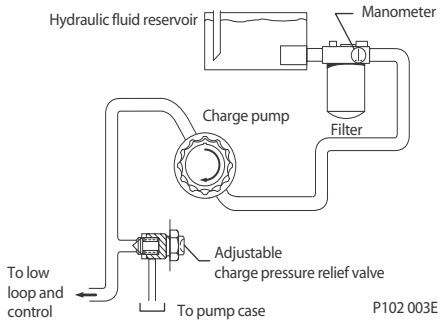
FILTRATION OPTIONS

Series 90 pumps may have either suction or charge pressure filtration to filter the fluid entering the circuit.

Suction filtration – option S

The suction filter is in the circuit between the reservoir and the inlet to the charge pump, as shown below. The use of a filter contamination monitor is recommended.

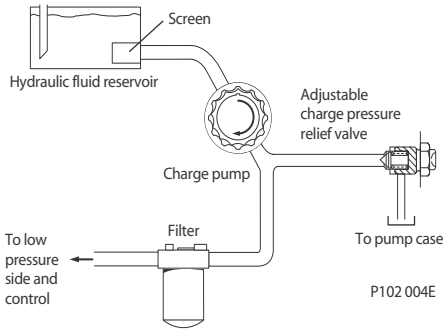
Suction filtration



Charge pressure filtration – option R, T, P, and L

The pressure filter can be mounted on the pump or remotely for ease of servicing. You will typically find a 100-125 µm mesh screen, in the reservoir or the charge inlet. This system requires a filter capable of withstanding charge pressure (reference to atmosphere - add case pressure).

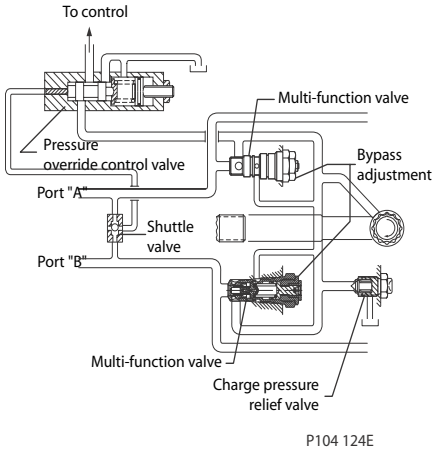
Charge pressure filtration



PRESSURE OVERRIDE (POR) – 180 FRAME SIZE ONLY

The Pressure OverRide valve (POR) modulates control pressure to maintain a pump displacement which produces a system pressure level less than or equal to the POR setting. For unusually rapid load application, the high pressure relief valve function of the multi-function valves is available to also limit the pressure level.

POR-Valve (180 frame size only)



The pressure override consists of a three-way normally open valve which operates in series with the pump displacement control. Control supply pressure normally ports through the POR valve to the displacement control valve. If the system demands a pressure above the override setting, the POR valve overrides the control by reducing the pressure to the displacement control. As the control pressure reduces, the internal forces rotating the swashplate overcome the force of the servo pistons and decreases the pump's displacement.

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MANUAL DISPLACEMENT CONTROL (MDC)

The manual displacement control converts a mechanical input signal to a hydraulic signal using a spring-centered four-way servo valve. This valve ports hydraulic pressure to either side of a dual-acting servo piston. The servo piston rotates the cradle swashplate through an angular rotation of ±17°, varying the pump's displacement from full in one direction to full in the opposite direction. The angular position of the pump swashplate is proportional to the rotation of the control input shaft.

NON-LINEAR MDC

The non-linear manual displacement control operates in the same manner except that it is designed so the change in the angular position of the pump swashplate progressively increases as the control input shaft is rotated toward its maximum displacement position.

SOLENOID OVERRIDE VALVE FOR MDC

A solenoid override valve option is available for the MDC. This safety feature returns the swashplate to zero displacement. It is available in normally open (activate to allow) or normally closed (activate to disallow) options..

NEUTRAL START SWITCH (NSS)

The neutral start switch is an optional feature available with the MDC. When connected properly with the vehicle's electrical system, the neutral start switch ensures that the prime mover can start only when the control is in neutral position.

HYDRAULIC DISPLACEMENT CONTROL (HDC)

The hydraulic displacement control uses a hydraulic input signal to operate a spring-centered four-way servo valve. This valve ports hydraulic pressure to either side of a dual-acting servo piston. The servo piston rotates the cradle swashplate through an angular rotation of ±17°, thus varying the pump's displacement from full displacement in one direction to full displacement in the opposite direction. The angular position of the pump swashplate is proportional to input pressure.

ELECTRIC DISPLACEMENT CONTROL (EDC)

The electric displacement control uses a Pressure Control Pilot (PCP) valve to modulate pressure balance across the spring-centered four-way servo valve. The PCP valve converts a DC electrical input signal to a hydraulic signal. The servo valve ports hydraulic pressure to either side of a dual-acting servo piston. The servo piston rotates the swashplate through an angular rotation of ±17°, varying the pump's displacement. The angular position of the swashplate is proportional to the EDC input.

AUTOMOTIVE CONTROL (FBA II B)

The automotive control allows the operator to drive a vehicle similar to an automobile with an automatic transmission. The automotive control includes a three-position electric control to provide direction control.

3-POSITION (FNR) ELECTRIC CONTROL

This control utilizes a 12 or 24 Vdc electrically operated spool valve to port pressure to either side of the pump servo piston. Energizing one of the solenoids causes the pump to go to its maximum displacement in the corresponding direction. All functions of the three-position (FNR) electric control are preset at the factory

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OVERVIEW

This section defines the operating parameters and limitations for Series 90 pumps with regard to input speeds and pressures. For actual parameters, refer to the operating parameters for each displacement.

INPUT SPEED

Minimum speed is the lowest input speed recommended during engine idle condition. Operating below minimum speed limits the pump's ability to maintain adequate flow for lubrication and power transmission.

Continuous speed is the highest input speed recommended at full power condition. Operating at or below this speed should yield satisfactory product life.

Maximum speed is the highest operating speed permitted. Exceeding maximum speed reduces product life and can cause loss of hydrostatic power and braking capacity. Never exceed the maximum speed limit under any operating conditions.

When determining speed limits for a particular application see Sauer-Danfoss publication **BLN-9884** *Pressure and speed limits*.

⚠ Warning

Unintended vehicle or machine movement hazard

Exceeding maximum speed may cause a loss of hydrostatic drive line power and braking capacity. You must provide a braking system, redundant to the hydrostatic transmission, sufficient to stop and hold the vehicle or machine in the event of hydrostatic drive power loss.

SYSTEM PRESSURE

System pressure is the differential pressure between system ports A and B. It is the dominant operating variable affecting hydraulic unit life. High system pressure, which results from high load, reduces expected life. System pressure must remain at or below continuous pressure during normal operation to achieve expected life.

Continuous pressure is the average, regularly occurring operating pressure. Operating at or below this pressure should yield satisfactory product life.

Maximum pressure is the highest intermittent pressure allowed. Maximum machine load should never exceed this pressure. For all applications, the load should move below this pressure.

All pressure limits are differential pressures referenced to low loop (charge) pressure. Subtract low loop pressure from gauge readings to compute the differential.

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CHARGE PRESSURE

An internal charge relief valve regulates charge pressure. The charge pump supplies the control with pressure to operate the swashplate and to maintain a minimum pressure in the low side of the transmission loop.

Minimum charge pressure is the lowest pressure allowed to maintain a safe working condition in the low side of the loop. Minimum control pressure requirements are a function of speed, pressure, and swashplate angle, and may be higher than the minimum charge pressure shown in the operating parameters table.

Maximum charge pressure is the highest charge pressure allowed by the charge relief adjustment, and provides normal component life. You can use elevated charge pressure as a secondary means to reduce the swashplate response time.

The charge pressure setting in the order code is the set pressure of the charge relief valve with the pump in neutral, operating at 1800 min^{-1} (rpm), and with a fluid viscosity of 32 mm^2/sec (150 SUS). The charge pressure setting is referenced to case pressure. Charge pressure is the differential pressure above case pressure.

CHARGE INLET PRESSURE

At normal operating temperature charge inlet pressure must not fall below **rated charge inlet pressure**.

Minimum charge inlet pressure is only allowed at cold start conditions. In some applications it may be necessary to warm up the fluid by running the engine at limited speed until the system fluid temperature reaches an acceptable level.

CASE PRESSURE

Under normal operating conditions, do not exceed the **rated case pressure**. During cold start, maintain the case pressure below maximum intermittent case pressure.

Caution

Possible component damage or leakage

Operation with case pressure in excess of stated limits may damage seals, gaskets, and/or housings, causing external leakage. Performance may also be affected since charge and system pressure are additive to case pressure.

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TEMPERATURE AND VISCOSITY

Temperature

The high temperature limits apply at the hottest point in the transmission loop, which is normally the motor case drain. Maintain system temperature below the quoted **rated temperature**.

Never exceed the **maximum intermittent temperature**.

Cold oil will generally not affect the durability of the transmission components, but it may affect the ability of oil to flow and transmit power; therefore temperatures should remain 16 °C [30 °F] above the pour point of the hydraulic fluid.
The **minimum temperature** relates to the physical properties of component materials. Size heat exchangers to keep the fluid within these limits. Test heat exchangers to verify that these temperature limits are not exceeded.

Viscosity

For maximum efficiency and bearing life, ensure the fluid viscosity remains in the **recommended range**.

Minimum viscosity should be encountered only during brief occasions of maximum ambient temperature and severe duty cycle operation.

Maximum viscosity should be encountered only at cold start.

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FLUID AND FILTER RECOMMENDATIONS

To ensure optimum pump life, perform regular maintenance of the fluid and filter. Contaminated fluid is the main cause of unit failure. Maintain fluid cleanliness when servicing.

Check the reservoir daily for proper fluid level, the presence of water, and rancid fluid odor. Fluid contaminated by water may appear cloudy or milky or free water may settle in the bottom of the reservoir. Rancid odor indicates the fluid has been exposed to excessive heat. Change the fluid immediately if these conditions occur. Correct the problem immediately.

Inspect vehicle for leaks daily.

Change the fluid and filter per the vehicle/machine manufacturer's recommendations or at the intervals shown in the table. Change fluid after first 500 hours.

Fluid and filter change interval

Reservoir type	Max oil change interval
Sealed	2000 hours
Breather	500 hours

Caution

High temperatures and pressures result in accelerated fluid aging. Change fluid more frequently if operating under extreme conditions.

Change the fluid more frequently if it becomes contaminated with foreign matter (dirt, water, grease, etc.) or if the fluid is subjected to temperature levels greater than the recommended maximum.

Dispose of used hydraulic fluid properly. Never reuse hydraulic fluid.

Change filters whenever the fluid is changed or when the filter indicator indicates a filter change. Replace all fluid lost during filter change.

For detailed filtration information, see Sauer-Danfoss publication **520L0463** *Fluids and Filtration*. For information on biodegradable fluids see Sauer-Danfoss publication **520L0465** *Biodegradable Hydraulic Fluids*.

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OVERVIEW

Specifications and operating parameters for pumps appear here for reference.

FEATURES AND OPTIONS

Model	Series 90 Pumps
Mount	SAE B, SAE C and E (SAE J 744)
Pump type	Axial piston type
Rotation	Bidirectional
Installation position	Discretionary: Housing must always be filled with hydraulic fluid. Do not install with control on bottom.
Input shafts	Splined
Control options	MDC (with options), EDC, HDC, FNR

OPERATING PARAMETERS

Parameter		Unit	Pressure
System pressure	Rated	bar [psi]	420 [6000]
	Maximum		480 [7000]
	Minimum low loop		10 [150]
Charge pressure	Minimum	bar [psi]	10 [150]
	Maximum		35 [508]
Charge inlet pressure	Rated	bar (absolute) [in Hg vacuum]	0.7 [9]
	Minimum (cold start)		0.2 [24]
Case pressure	Rated	bar [psi]	3.0 [40]
	Maximum		5.0 [75]

Parameter	Unit	Frame size						
		042	055	075	100	130	180	250
Displacement (maximum)	**cm³** [in³]	42 [2.56]	55 [3.35]	75 [4.57]	100 [6.10]	130 [7.93]	180 [10.98]	250 [15.25]
Minimum speed	**min^{-1}** (rpm)	500	500	500	500	500	500	500
Rated speed	**min^{-1}** (rpm)	4200	3900	3600	3300	3100	2600	2300
Maximum speed	**min^{-1}** (rpm)	4600	4250	3950	3650	3400	2850	2500
Maximum attainable speed at maximum displacement	**min^{-1}** (rpm)	5000	4700	4300	4000	3700	3150	3750
Theoretical torque at maximum displacement	**N•m/bar** [lbf•in/1000 psi]	0.67 [380]	0.88 [530]	1.19 [730]	1.59 [870]	2.07 [1260]	2.87 [1750]	3.97 [2433]
Weight (base unit only)	**kg** [lb]	34 [75]	40 [88]	49 [108]	68 [150]	88 [195]	136 [300]	154 [340]

FLUID SPECIFICATIONS

Ratings and data are based on operation with premium petroleum-based hydraulic fluids containing oxidation and foam inhibitors.

Parameter	Unit	Minimum	Continuous	Maximum
Viscosity	mm²/sec (cSt) [SUS]	7 [47]	12-60 [66-278]	1600 [7500]
Temperature	°C [°F]	-40 [-40]	104 [220]	115 [240]
Cleanliness		ISO 4406 Class 22/18/13 or better		
Filtration efficiency	suction filtration	β_{35-44}=75 ($\beta_{10}\geq$2)		
	charge filtration	β_{15-20}=75 ($\beta_{10}\geq$10)		

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Initial start-up procedure

GENERAL

Follow this procedure when starting-up a new pump installation or when restarting an installation in which the pump was removed.

⚠ Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

Prior to installing the pump, inspect for shipping damage.

START-UP PROCEDURE

1. Ensure that the hydraulic fluid and system components (reservoir, hoses, valves, fittings, and heat exchanger) are clean and free of contamination.

2. Install new system filter element(s) if necessary. Check that inlet line fittings are properly tightened and there are no air leaks.

3. Install the pump. Install a 50 bar [1000 psi] gauge in the charge pressure gauge port M3.

4. Fill the housing by adding filtered fluid in the upper case drain port. Open the case plug in the top of the control to assist with air bleed.

5. Fill the reservoir with hydraulic fluid of the recommended type and viscosity. Use a 10-micron filler filter. Fill inlet line from reservoir to pump.

6. Disconnect the pump control input signal.

After start-up the fluid level in the reservoir may drop due to filling of the system components. Check the level in the reservoir to maintain a full fluid level throughout the start-up procedure.

Caution

Damage to hydraulic components may occur from failure to maintain fluid supply.

7. Use a common method to disable the engine to prevent the engine from starting. Crank the starter for several seconds. Do not to exceed the engine manufacturer's recommendation. Wait 30 seconds and then crank the engine a second time. This operation helps remove air from the system lines. Refill the reservoir to recommended full fluid level.

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START-UP PROCEDURE (continued)

8. When charge pressure reaches 3.5 bar [50 psi], enable and start engine. Let the engine run for a minimum of 30 seconds at low idle to allow the air to work itself out of the system. Check for leaks at all line connections and listen for cavitation. Check for proper fluid level in reservoir.

Caution

Air entrapment in fluid under high pressure may damage hydraulic components.

Caution

Do not run at maximum pressure until system is free of air and fluid has been thoroughly filtered.

9. When adequate charge pressure is established (as shown in model code), increase engine speed to normal operating rpm to further purge residual air from the system.

10. Shut off the engine. Connect the pump control signal. Start the engine, checking to be certain the pump remains in neutral. Run the engine at normal operating speed and carefully check for forward and reverse control operation.

11. Continue to cycle between forward and reverse for at least five minutes to bleed all air and flush system contaminants out of loop.

Normal charge pressure fluctuation may occur during forward and reverse operation.

12. Check that the reservoir is full. Remove charge pressure gauge. The pump is now ready for operation.

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REQUIRED TOOLS

You can perform the service procedures described in this manual using common mechanic's tools. Special tools, if required are shown. Use calibrated pressure gauges to ensure accuracy. Use snubbers to protect pressure gauges.

PORT LOCATIONS AND GAUGE INSTALLATION

The following sections list the ports for each type of hydraulic unit. The fitting size and recommended pressure gauge are also specified.

The following table and drawings show the port locations and gauge sizes needed.

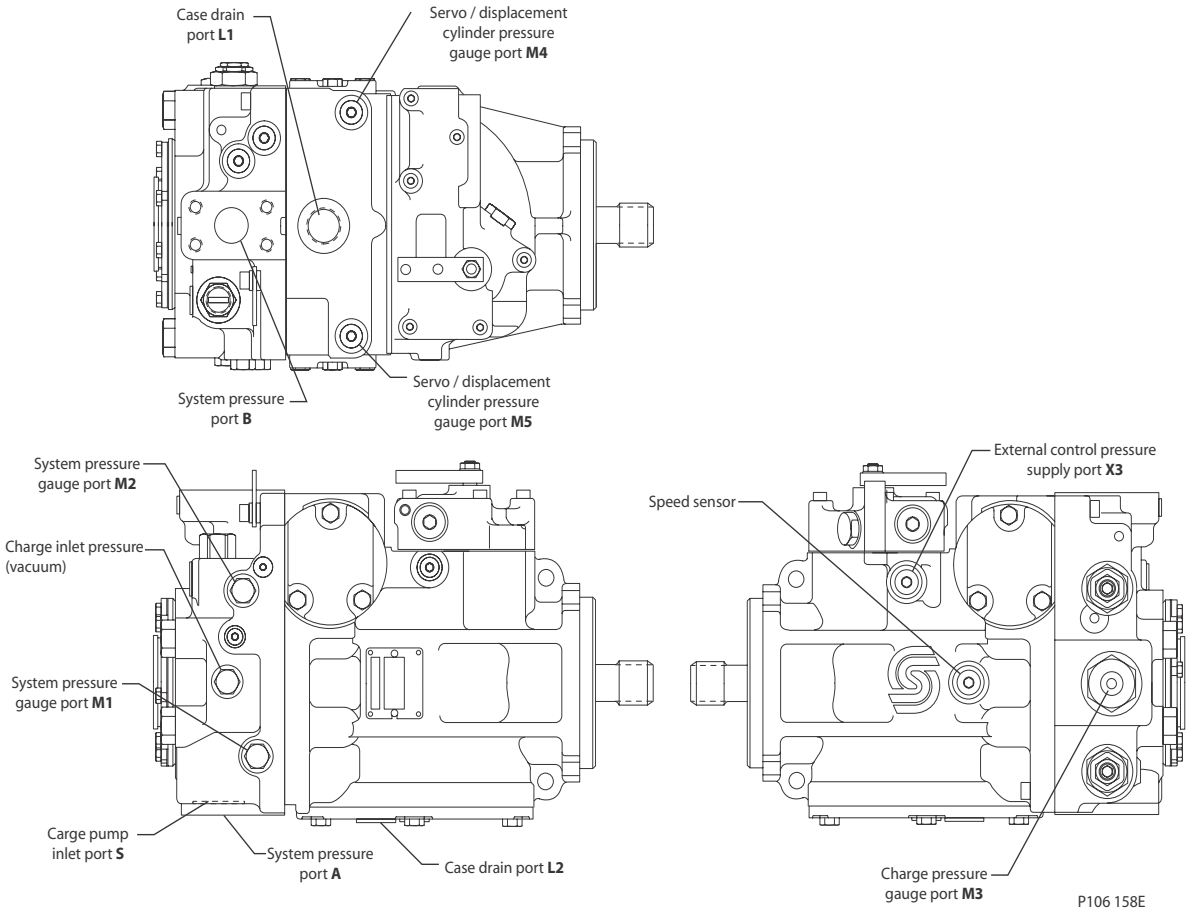
Port information

Port identifier	Pressure obtained	Gauge size	Port size	
M1, M2	System pressure	1000 bar [10 000 psi]	9/16-18	
M3 (M6)	Charge pressure	50 bar [1000 psi]	9/16-18	
M4, M5	Servo pressure	50 bar [1000 psi]	9/16-18	
L1, L2	Case pressure	10 bar [100 psi]	030-042	7/8-14
			055-100	1-1/16-12
			130	1-5/16-12
			180-250	1-5/8-12
X1, X2	HDC/EDC control pressure	50 bar [1000 psi]	7/16-20 or 9/16-18	
X3	External control pressure	50 bar [1000 psi]	9/16-18	
S	Charge pump inlet	Vacuum gauge, Tee into inlet line	030-042	1-1/16-12
			055-075	1-5/16-12
			100-180	1-5/8-12
			250	1-1/2 SAE-split flange

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PORT LOCATIONS AND GAUGE INSTALLATION (continued)

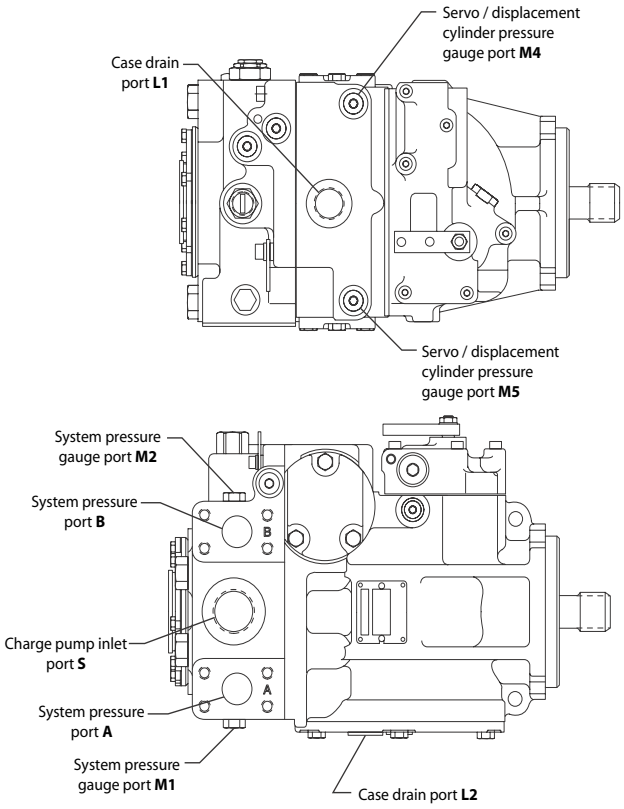
Pump with side port end cap and manual displacement control



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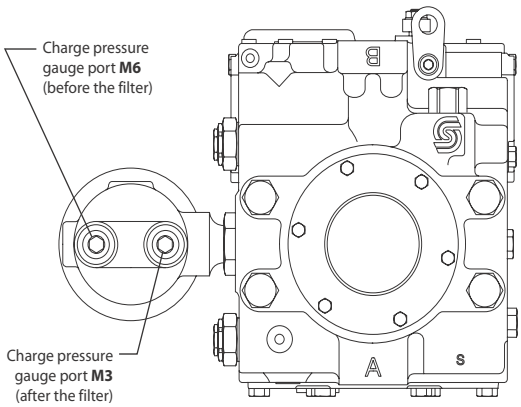
PORT LOCATIONS AND GAUGE INSTALLATION (continued)

Pump with twin port end cap and manual displacement control

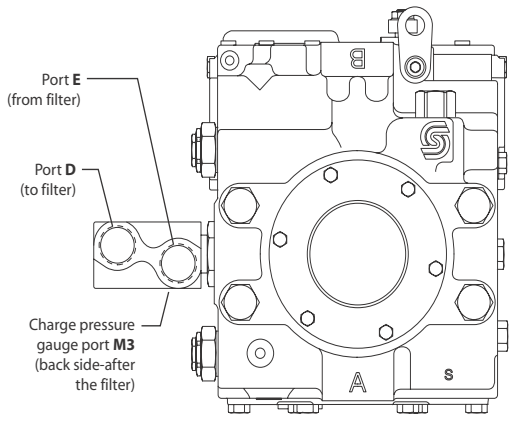


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Pump with side port end cap and remote pressure filtration



Pump with side port end cap and integral pressure filtration



P106 163E

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OVERVIEW

This section provides general steps to follow if certain undesirable system conditions occur. Follow the steps in a section until you solve the problem. Some of the items are system specific. For areas covered in this manual, we reference the section. Always observe the safety precautions listed in the *Introduction* section (page 6) and those relating to your specific equipment.

NEUTRAL DIFFICULT OR IMPOSSIBLE TO FIND

Item	Description	Action
Input to pump control	Input to control module is operating improperly.	Check control input and repair or replace as necessary.
Pump displacement control	Control linages are not secure, control orifices are blocked.	Adjust, repair, or replace control module as necessary.
Multifunction valve	Multifunction valve is leaking.	Swap multifunction valves. If system changes direction, replace defective valve.

SYSTEM OPERATING HOT

Item	Description	Action
Oil level in reservoir	Insufficient hydraulic fluid will not meet cooling demands of system.	Fill reservoir to proper level.
Heat exchanger	Heat exchanger is not sufficiently cooling the system.	Check air flow and input air temperature for heat exchanger. Clean, repair, or replace heat exchanger.
Charge pressure	Low charge pressure will overwork system.	Measure charge pressure. Inspect and adjust or replace charge relief valve, or repair leaky charge pump.
Charge pump inlet vacuum	High inlet vacuum will overwork system. A dirty filter will increase the inlet vacuum. Inadequate line size will restrict flow.	Check charge inlet vacuum. If high, inspect inlet filter and replace as necessary. Check for adequate line size, length or other restrictions.
System relief pressure settings	If the system relief settings are too low, the relief valves will be overworked.	Verify settings of pressure limiters and high pressure relief valves and adjust or replace multi-function valves as necessary.
For internal leakage in motor	Leakage will reduce low side system pressure and overwork the system.	Monitor motor case flow without loop flushing in the circuit (use defeat spool). If flow is excessive, replace motor.
System pressure	High system pressure will overheat system.	Measure system pressure. If pressure is high, reduce loads.

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TRANSMISSION OPERATES NORMALLY IN ONE DIRECTION ONLY

Item	Description	Action
Input to pump control	Input to control module is operating improperly.	Check control input and repair or replace as necessary.
Pump displacement control	Control linkages are not secure, control orifices are blocked.	Repair or replace control module as necessary.
System pressure limiters, high pressure relief valves, or system check valves	Interchanging the multi-function valves will show if the problem is related to the valve functions contained in the multi-function valves.	Interchange multi-function valves. If the problem changes direction, repair or replace the valve on the side that does not operate.
Charge pressure	If charge pressure decays in one direction, the loop flushing valve may be sticking in one direction.	Measure charge pressure in forward and reverse. If pressure decays in one direction, inspect and repair the motor loop flushing valve.

SYSTEM WILL NOT OPERATE IN EITHER DIRECTION

Item	Description	Action
Oil level in reservoir	Insufficient hydraulic fluid to supply system loop	Fill reservoir to proper level.
Input to pump control	Input to control module is operating improperly	Check control input and repair replace as necessary.
Pump displacement control	Control linkage is not secure, control orifices are blocked, etc.	Repair or replace control module as necessary.
Bypass valve(s) open	If bypass valve(s) are open, the system loop will be depressurized.	Close bypass valves. Replace multi-function valve if defective.
Charge pressure with pump in neutral	Low charge pressure is insufficient to recharge system loop.	Measure charge pressure with the pump in neutral. If pressure is low, go to *Pump charge relief valve*; otherwise continue with *Charge pressure with pump in stroke.*
Charge pressure with pump in stroke	Low charge pressure with the pump in stroke indicates a motor charge relief valve or system pressure relief valve may be improperly set.	Measure charge pressure with pump in stroke. If pressure is low, adjust or replace motor charge relief valve, otherwise go to *Charge pumps.*
Pump charge relief valve	A pump charge relief valve that is leaky or set too low will depressurize the system.	Adjust or replace pump charge relief valve as necessary.
Charge pump inlet filter	A clogged filter will under supply system loop.	Inspect filter and replace if necessary.
Charge pumps	A malfunctioning charge pump will provide insufficient charge flow.	Repair or replace the charge pump.
Pump displacement control	Control linkages are not secure, control orifices are blocked.	Repair or replace control module as necessary.
System pressure	Low system pressure will not provide power necessary to move load.	Measure system pressure. Continue to next step.
System multi-function valves	Defective multi-function valves will cause system to pressure to be low.	Repair or replace multi-function valve(s).

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LOW MOTOR OUTPUT TORQUE

Item	Description	Action
System pressure at motor	Low system pressure at the motor will reduce torque	Measure system pressure at motor. If pressure limiter setting is low, increase setting.
Variable motor stuck at minimum displacement	Minimum motor displacement yields low output torque.	Check control supply pressure or repair displacement control. Check motor control orifices.
Internal leakage	Internal leakage will reduce system pressure.	Check for leaking O-rings, gaskets and other fittings. Repair unit as required, or replace leaking unit.

IMPROPER MOTOR OUTPUT SPEED

Item	Description	Action
Oil level in reservoir	Insufficient hydraulic fluid will reduce motor speed.	Fill oil to proper level.
Pump output flow	Incorrect outflow will affect output speed. Incorrect output flow indicates the swashplate is out of position.	Measure pump output and check for proper pump speed. Ensure the pump is in full stroke.
Variable motor displacement control	If variable motor displacement control is not functioning correctly, variable motor swashplate may be in wrong position.	See if variable motor displacement control is responding. If not, repair or replace control.
Internal leakage	Internal leakage will reduce system pressure.	Check for leaking O-rings, gaskets, and other fittings. Repair unit as required, or replace leaky unit.

SYSTEM NOISE OR VIBRATION

Item	Description	Action
Oil in reservoir	Insufficient hydraulic fluid will lead to cavitation.	Fill reservoir to proper level.
Air in system	Air bubbles will lead to cavitation.	Look for foam in reservoir. Check for leaks on inlet side system loop and repair. Afterwards, let reservoir settle until foam dissipates. Run system at low speed to move system fluid to reservoir. Repeat.
Pump inlet vacuum	High inlet vacuum causes noise. A dirty filter will increase the inlet vacuum.	Inspect and replace filter as necessary. Check for proper suction line size.
Shaft couplings	A loose shaft coupling will cause excessive noise.	Replace loose shaft coupling or replace pump or motor.
Shaft alignment	Misaligned shafts cause noise.	Align shafts.

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SYSTEM RESPONSE IS SLUGGISH

Item	Description	Action
Oil level in reservoir	Insufficient hydraulic fluid causes sluggish response.	Fill reservoir to proper level.
Multi-function valves pressure settings	Incorrect pressure settings affects system reaction time.	Adjust or replace multi-function valves.
Pump inlet vacuum	High pump inlet vacuum reduces system pressure.	Measure charge inlet vacuum. If high, replace inlet filter.
Prime mover speed	Low engine speed reduces system performance.	Adjust engine speed.
Charge and control pressures	Incorrect charge or control pressures affects system performance.	Measure charge and control pressures and correct if necessary.
System internal leakage	Internal leakage reduces system pressure.	Check for leakage in O-rings, gaskets, and other fittings.

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STANDARD PROCEDURES, INSPECTIONS, AND ADJUSTMENTS

Before working on the pump, clean the outside of the pump.

Caution

Contamination can damage internal components and void your warranty. Take precautions to ensure system cleanliness when removing and reinstalling system lines.

1. With the prime mover off, thoroughly clean the outside of the pump.
2. If removing the pump, tag each hydraulic line connected to the pump. If hydraulic lines are disconnected, plug each open port with a clean plug, to ensure that dirt and contamination do not get into the pump.
3. Ensure the surrounding areas are clean and free of contaminants.
4. Inspect the system for contamination.
5. Visually inspect the hydraulic fluid for signs of system contamination, fluid discoloration, foam in the fluid, sludge, or small metal particles.
6. If there are signs of contamination in the hydraulic fluid, replace all filters, drain and flush the hydraulic system, and fill with the correct filtered hydraulic fluid.
7. Flush the lines before replacing the hydraulic fluid.

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ADJUSTMENTS

This section offers instruction on inspection and adjustment of pump components. Read through the entire related section before beginning a service activity. Refer to *Pressure measurements*, pages 23, 24 and 25, for location of gauge ports and suggested gauge sizes.

CHARGE PRESSURE RELIEF VALVE ADJUSTMENT

⚠ Warning

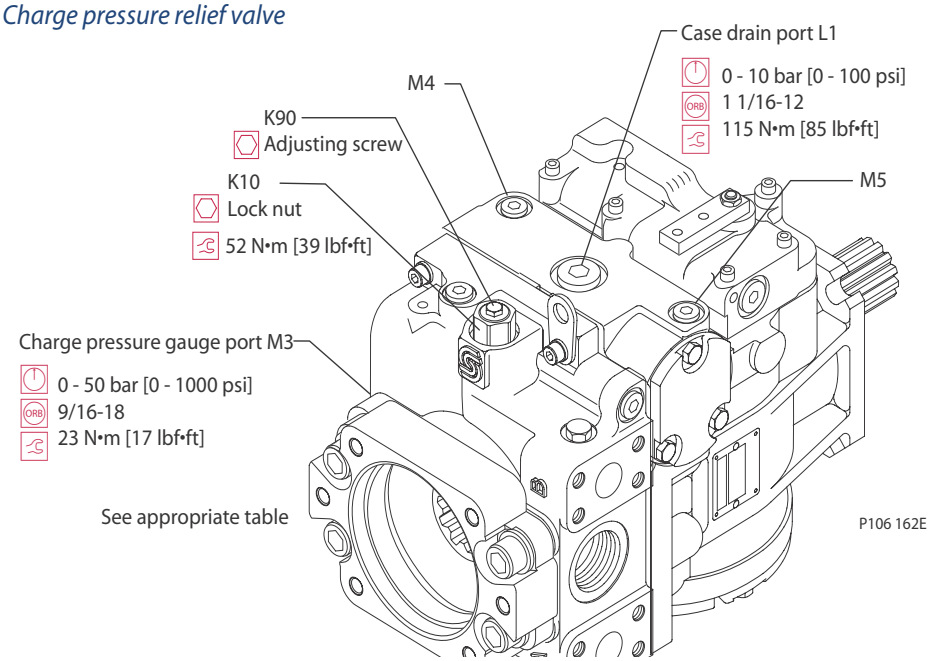
The following procedure may require the vehicle/machine to be disabled (wheels raised off the ground, work function disconnected, etc.) in order to prevent injury to the technician and bystanders. Take necessary safety precautions before moving the vehicle/machine.

The following procedure explains how to check and adjust the charge pressure relief valve.

1. Install a 50 bar [1000 psi] pressure gauge in the pump charge pressure gauge port (M3). Install a 10 bar [100 psi] gauge to measure case pressure (tee into L1 or L2 or use servo gauge port M4 or M5). Operate the system with the pump in neutral (zero displacement) when measuring pump charge pressure.

2. The table shows the acceptable pump charge pressure range for some charge relief valve settings. These pressures assume 1500 min^{-1} (rpm) and a reservoir temperature of 50°C [120°F], and are referenced to case pressure.

Charge pressure relief valve



Listed pressures assume a pump speed of 1500 min^{-1} (rpm). At higher pump input speeds (with higher charge flows) the charge pressure will rise over the rated setting.

Charge pressure ranges

Model code	Measured charge pressure*
20	18.1 – 21.7 bar [262 –315 psi]
24	22.0 – 26.9 bar [319 – 390 psi]
28	25.8 – 30.7 bar [37.4 – 44.5 psi]

* This is the actual charge pressure port gauge reading minus the case pressure port gauge reading.

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CHARGE PRESSURE RELIEF VALVE ADJUSTMENT (continued)

3. Earlier production Series 90 pumps have a shim adjustable charge pressure relief valve. Shim kits are available from Sauer-Danfoss. Remove the plug using a 1in hex wrench and exchange shims behind the spring to adjust charge pressure. Torque plug to 68 N•m [50 lbf•ft].

4. Later production Series 90 pumps have an external screw-adjustable charge pressure relief valve. Loosen locknut (K10) and turn the adjusting screw (K90) using a screwdriver or 1/2 in. hex wrench to adjust charge pressure setting.

Lock nut wrench size

Frame size	Wrench size
030 – 100	1-1/16 inch
130 – 250	1-5/8 inch

5. Clockwise rotation of the plug increases the setting and counterclockwise rotation decreases the setting (at a rate of approximately 3.9 bar [50 psi] per turn). Torque lock nut to 52 N•m [39 lbf•ft].

6. Once you achieve the desired charge pressure setting, remove the gauges and plug the ports.

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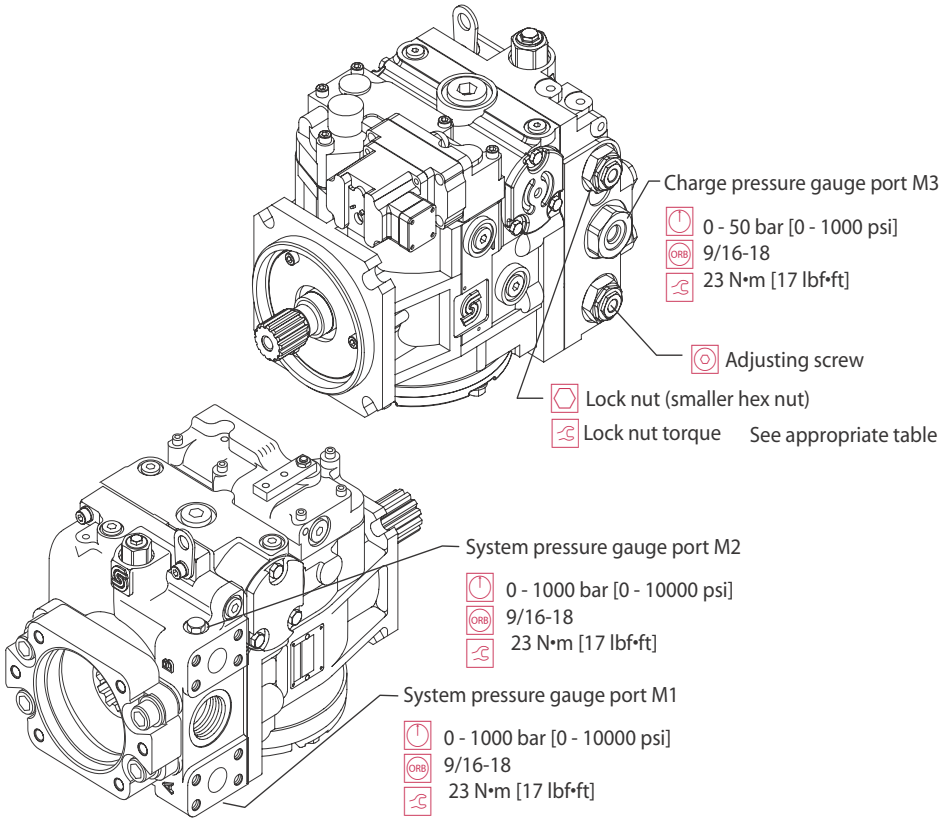
MULTI-FUNCTION VALVE PRESSURE ADJUSTMENT

You accomplish adjustment of the pressure limiter setting and the high pressure relief valve (HPRV) setting simultaneously. The HPRV setting is automatically set approximately 35 bar [500 psi] above the pressure limiter setting.

⚠ Warning
Take necessary precautions that the motor shaft remains stationary during the adjustment procedure.

Lock the motor output shaft by locking the vehicle's brakes or rigidly fixing the work function so it cannot rotate or cap the system ports. ⚠

Multi-function valve adjustment



1. Install two 1000 bar (or 10 000 psi) pressure gauges in the high pressure gauge ports (M1 and M2). Install a 50 bar (or 1000 psi) pressure gauge in the pump charge pressure gauge port (M3).
2. Start the prime mover and operate at normal speed.
3. Loosen locking nut.
4. Insert an internal hex wrench into the pressure adjusting screw.

A plastic dust plug is installed in the adjusting screw.

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MULTI-FUNCTION VALVE PRESSURE ADJUSTMENT (continued)

5. The model code shows the factory preset pressure limiter setting. It is referenced to charge pressure, so the pressure limiter setting is the difference between the high and low pressure sides of the system loop. Activate or move the control input so that pressure increases in the high pressure side of the closed circuit to the pressure limiter pressure setting. The pressure limiter setting is reached when the pressure stops increasing and remains steady at a given pressure level (as shown on the gauges).

6. Return the pump to its neutral (zero flow) position and adjust the pressure limiter setting by rotating the pressure adjusting screw with an internal hex wrench.

   Clockwise rotation of the pressure adjustment screw increases the pressure setting, and counterclockwise rotation decreases the pressure setting. Each complete rotation of the pressure adjusting screw changes the pressure as shown in the following table.

Pressure limiter adjustment data

Frame size	Lock nut wrench size and torque	Adjusting screw size	Approximate pressure change per revolution of adjusting screw
early 042-100	10 mm 3 N•m [26 lbf•in]	3 mm	80 bar [1157 psi]
030-100	19 mm 20 N•m [15 lbf•ft]	5 mm	90 bar [1300 psi]
early 130	13 mm 20 N•m [15 lbf•ft]	4 mm	80 bar [1157 psi]
130-250	24 mm 40 N•m [30 lbf•ft]	8 mm	80 bar [1157 psi]

7. To verify the actual pressure setting, actuate or move the control input so that the pump again develops pressure in the high pressure circuit to the newly adjusted pressure limiter pressure setting: then read the high pressure gauge. Allow the pump to return to its neutral position. The pressure in the high pressure circuit should return to the charge pressure setting.

8. While holding the pressure adjusting screw stationary, tighten the pressure adjusting screw lock nut. Torque as shown in the table.

Do not overtorque.

9. Shut down the prime mover, remove the gauges and install the gauge port plugs. Replace the plastic dust plugs (if used).

Use the same procedure for setting the pressure limit of the other multi-function valve. Move or activate the control input signal in the opposite direction so that high pressure develops in the opposite side of the closed circuit.

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ENGAGING THE BYPASS FUNCTION

The multi-function valve cartridges perform the bypass function. Shut down the prime mover when engaging the bypass function. Open both the bypass valves to engage the bypass function.

Caution

Damage to the pump and motor can result from rotating these components without charge flow for lubrication. Bypass valves are intended for moving a machine or vehicle for very short distances at very slow speeds. They are not tow valves.

1. loosen the bypass actuator three turns. Refer to table for wrench size.

Do not rotate more than 3-1/2 revolutions, as additional rotation will permit external leakage.

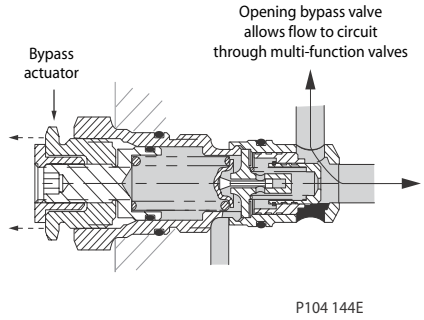
2. For units with an MDC-type control, prior to moving the vehicle or otherwise causing the motor shaft to turn, move the control handle of the manual displacement control on the pump to the maximum full forward position. Hold the handle in this position during bypass valve operation.

3. To close the bypass valve, tighten the bypass actuator. See table provided for proper torque.

Bypass actuator wrench size

Frame size	Wrench size
newer 030 – 100	1-1/16 inch
130 – 250	1-3/8 inch

Multi-Function Valve with Bypass Function Engaged



Bypass actuator torque

Frame size	Torque
newer 030 – 100	41 N•m [30 lbf•ft]
130 – 250	100 N•m [75 lbf•ft]

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PRESSURE OVERRIDE (POR) VALVE PRESSURE ADJUSTMENT (OPTION FOR 180 FRAME SIZE)

⚠ Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

Pressure override valve operation is explained in the *Operation section* (page 14).

1. Install two 1000 bar [10 000 psi] pressure gauges in the high pressure gauge ports (M1 and M2). Install a 50 bar [1000 psi] pressure gauge in the pump charge pressure gauge port (M3).

2. Start the prime mover and operate at normal speed.

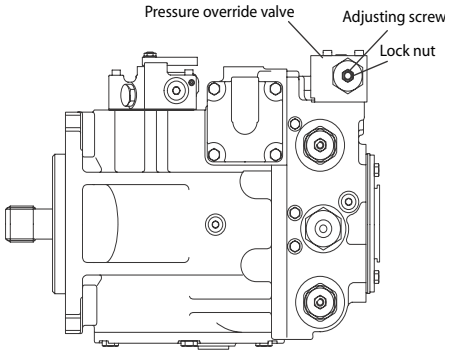
3. With the pump operating at approximately 20% displacement, load the work function and note the pressure as the POR valve operates (pump displacement reduces to zero).

4. Adjust the pressure override setting by loosening the lock nut with a 9/16 inch hex wrench and turning the adjustment screw with a 3/16 inch internal hex wrench. Set the POR setting to at least 50 bar [750 psi] below the high pressure relief valve setting of the multi-function valves.

5. Torque the lock nut to 43 N•m [32 lbf•ft].

6. Shut down the prime mover and remove the gauges and install the gauge port plugs.

Pressure override valve for 180 frame size



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DISPLACEMENT LIMITER ADJUSTMENT

You can limit the maximum displacement in either direction.

1. Loosen the lock nut (F212) while holding the adjusting screw (F213) steady.

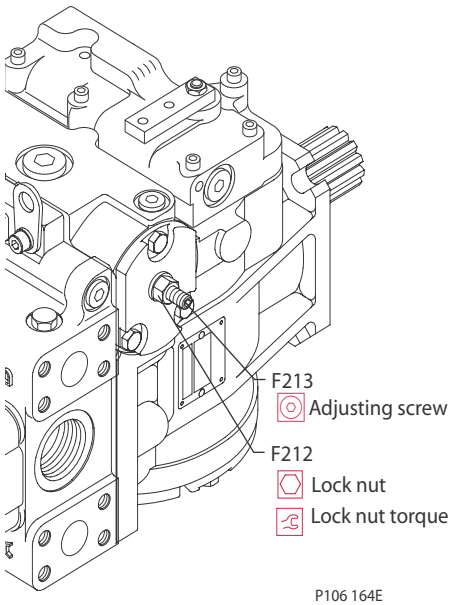
2. Rotate the adjusting screw some amount (using information in the following table). ! Rotating the adjusting screw clockwise decreases the maximum displacement of the pump while rotating the adjusting screw counterclockwise increases the maximum displacement.

3 One turn of the adjusting screw changes the maximum displacement as shown in table below

3. After establishing the desired maximum displacement setting, torque the lock nut to the torque shown in table below.

! Caution
Take care in adjusting displacement limiters to avoid undesirable flow or speed conditions. Re-torque lock nut (F212) after every adjustment to prevent an unexpected change in operating conditions and to prevent external leakage during unit operation.

Displacement limiter adjustment



Frame size	Lock nut wrench size and torque	Adjusting screw size	Approximate displacement change per revolution of adjusting screw
030	13 mm 24 N•m [18 lbf•ft]	4 mm	2.8 cm³/(rev) [0.17 in³/rev]
042	13 mm 24 N•m [18 lbf•ft]	4 mm	3.5 cm³/(rev) [0.21 in³/rev]
055	13 mm 24 N•m [18 lbf•ft]	4 mm	4.2 cm³/rev [0.26 in³/rev]
075	13 mm 24 N•m [18 lbf•ft]	4 mm	5.1 cm³/rev [0.31 in³/rev]
100	13 mm 24 N•m [18 lbf•ft]	4 mm	6.2 cm³/rev [0.38 in³/rev]
130	17 mm 48 N•m [35 lbf•ft]	5 mm	8.8 cm³/rev [0.53 in³/rev]
180	19 mm 125 N•m [92 lbf•ft]	6 mm	12.5 cm³/rev [0.76 in³/rev]
250	19 mm 125 N•m [92 lbf•ft]	6 mm	17.3 cm³/rev [1.06 in³/rev]

STANDARD MANUAL DISPLACEMENT CONTROL (MDC) ADJUSTMENT

There are no adjustable elements in the manual displacement control. Centering springs and washers on each end of the control spool hold it in its neutral position. Since there is no centering spring on the control input shaft, the shaft automatically assumes the appropriate position when the control is installed on the pump.

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NON-LINEAR MANUAL DISPLACEMENT CONTROL (MDC)

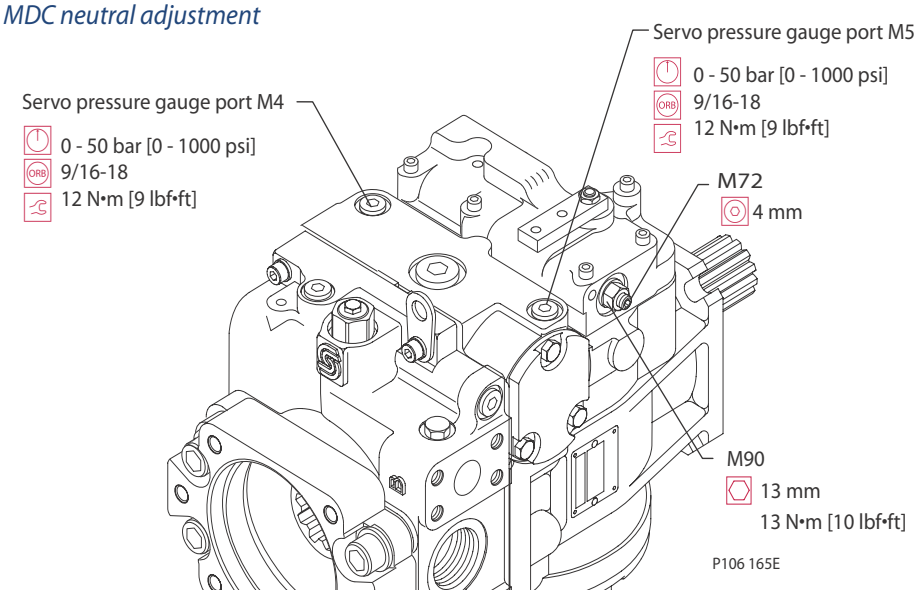
A centering spring, located on the control input shaft, locates the control shaft in its neutral position. A bias spring on the control spool maintains a force on the spool and the control linkage to eliminate free-play in the linkage.

Neutral adjustment is the only adjustment that can be made on the nonlinear manual displacement control. All other functions are preset at the factory. Perform neutral adjustment on a test stand or on the vehicle/machine with the prime mover operating.

⚠ Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

MDC neutral adjustment



1. Install a 50 bar [1000 psi] gauge in each of the two servo cylinder gauge ports (M4 and M5). Disconnect the external control linkage from the control handle and make certain the control shaft is in its neutral position. Start the prime mover and operate at normal speed.

2. Loosen the lock nut (M90) on the neutral adjusting screw (M72) with a 13 mm hex wrench.

3. Using a 4 mm internal hex wrench, rotate the neutral adjusting screw clockwise until the pressure increases on one of the pressure gauges. Note the angular position of the wrench. Then rotate the adjusting screw counterclockwise until the pressure increases by an equal amount on the other gauge. Note the angular position of the wrench.

4. Rotate the adjusting screw clockwise half the distance between the locations noted above. The gauges should read the same pressure, indicating that the control is in its neutral position.

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NON-LINEAR MANUAL DISPLACEMENT CONTROL (MDC) (continued)

5. Hold the adjusting screw stationary and tighten the lock nut to 13.5 N•m [10 lbf•ft]. Do not overtorque the nut.

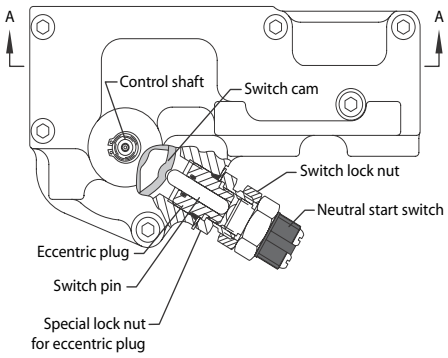
6. Once the neutral position is set, stop the prime mover, remove the gauges, and install the gauge port plugs. Reconnect the external control linkage.

MDC NEUTRAL START SWITCH (NSS) ADJUSTMENTS

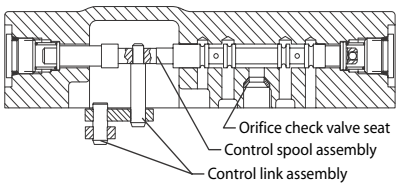
The Neutral Start Switch (NSS) provides a means to prevent the system prime mover from starting while the pump control handle is in-stroke. When the control input shaft is in its neutral position, the switch pin engages a slot on the eccentric cam attached to the control shaft. This allows the spring loaded NSS to close, completing the electrical starting circuit for the prime mover. When the control input shaft is not in its neutral position, the eccentric cam opens the NSS switch.

The neutral start switch is threaded into the special lock nut for the eccentric plug. Turning the NSS clockwise (CW) moves the NSS closer to the switch cam on the control shaft, and narrows the NSS deadband. Turning the NSS counterclockwise (CCW) moves the NSS farther from the switch cam on the control shaft, widening the NSS deadband. The switch pin is located in an eccentric plug which is turned to move the center of the NSS deadband.

MDC with neutral start switch



View at section A-A



View A-A P104 146E

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MDC NEUTRAL START SWITCH (NSS) ADJUSTMENTS (continued)

Adjust the Neutral Start Switch to meet the following three requirements:

i. The distance you can move the control handle without opening the NSS is the **NSS deadband**. The distance you can move the control handle without moving the control spool enough to port hydraulic fluid to the pump displacement control cylinders is the **control deadband**. These deadbands must be concentric.

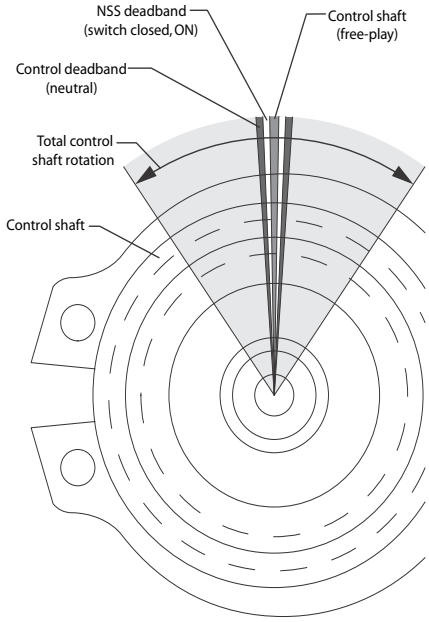
   Since you cannot adjust the position of the control deadband, you must adjust the position of the NSS deadband to match it.

ii. The NSS deadband must be wide enough so the NSS will not open within the loose area of control handle movement caused by normal operating clearances in the control linkage (control shaft free-play).

   By setting the NSS to open outside this area, the control spool springs or control shaft centering spring can always return the handle to neutral and re-close the NSS.

iii. The NSS deadband must be narrow enough so the NSS will open before the unit builds 7 bar [100 psi] differential system pressure in either direction.

Neutral start switch adjustment requirements



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MDC NEUTRAL START SWITCH (NSS) ADJUSTMENTS (continued)

Neutral start switch eccentric plug adjustment (condition i)

Center the NSS deadband and the control deadband in relation to each other. Since you cannot adjust the position of the control deadband, you must adjust the position of the NSS deadband to match it. The switch pin is located in an eccentric plug which you turn to move the center of the NSS deadband. Ensure the MDC is installed on the pump and in its neutral position when adjusting the neutral start switch eccentric plug. The accompanying drawing provides dimensions for an eccentric plug adjustment tool.

1. Hold the switch and eccentric plug from turning and use a 1-1/8 inch wrench to loosen the lock nut. Remove the neutral start switch. ⚠

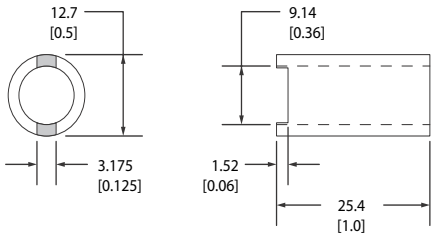
2. Note the slots on the eccentric plug for the adjustment tool. Hold the eccentric plug in place with the adjustment tool, and loosen the lock nut with a 1-1/8 inch wrench.

3. Position the eccentric plug so the switch pin is offset toward the control mounting surface. This will provide the best contact between the pin and the cam on the control shaft.

⚠ Warning

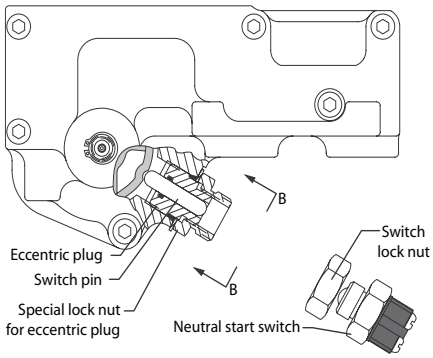
Do not start the prime mover while the neutral start switch is removed from the control. Case pressure will force the pin out of the eccentric plug, causing oil loss.

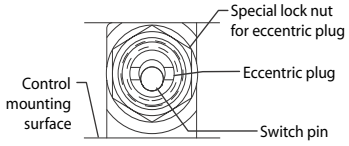
Eccentric plug adjustment tool



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NSS with eccentric plug





View B-B
(switch and lock nut removed)

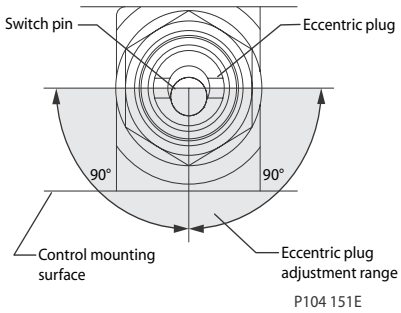
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MDC NEUTRAL START SWITCH (NSS) ADJUSTMENTS (continued)

4. Hold the control shaft in its neutral position (in the center of the control shaft free-play area). Locate the switch pin in the slot of the switch cam by turning the eccentric plug while checking the pin position (depth) in the plug. When the pin engages the cam slot, the pin will be at its maximum depth in the plug. Hand tighten the plug lock nut to hold the eccentric plug in position.

Eccentric plug adjustment



5. Turn the control shaft an equal amount in either direction from neutral. The switch pin should move out of the eccentric plug an equal distance when the control shaft is turned. Turn the eccentric plug to center the switch pin with the cam slot. Only a small amount of adjustment in either direction is needed to center the pin.

6. While holding the eccentric plug in place, tighten the eccentric plug lock nut to 27 N•m [20 lbf•ft]. Reinstall and adjust the switch as outlined in the previous section.

The eccentric plug normally requires between 5-1/2 and 6-1/2 turns to install into the control housing.

Caution

Do not turn the eccentric plug into or out of the housing beyond specifications.

7. Once the switch is correctly adjusted, hold the switch in place and tighten the lock nut to 27 N•m [20 lbf•ft] torque.

NSS deadband adjustment (conditions ii & iii)

The NSS deadband must be wide enough so the NSS will not open within the control shaft free-play area, and it must be narrow enough so the NSS will open before the unit builds 7 bar (100 psi) differential system pressure in either direction.

1. Install two 1000 bar [10 000 psi] pressure gauges in the system pressure gauge ports M1 and M2.

2. Using two 1-1/8 inch wrenches, hold the neutral start switch from turning and loosen the lock nut.

3. Disconnect the external control linkage and make certain the control shaft is in its neutral position.

4. Attach a continuity checker to the terminals of the switch. With the control shaft in its neutral position, turn the switch clockwise (CW) until the switch opens, then turn the switch counterclockwise (CCW) until it closes. Turn the switch counterclockwise (CCW) an additional 1/4 turn (90°) after the switch closes.

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MDC NEUTRAL START SWITCH (NSS) ADJUSTMENTS (continued)

5. Hold the switch in place and tighten the lock nut to 27 N•m (20 lbf•ft) torque.

6. With the continuity checker attached to the switch, rotate the control handle (or the control shaft) in each direction to assure the switch opens when the control is not in the neutral position.

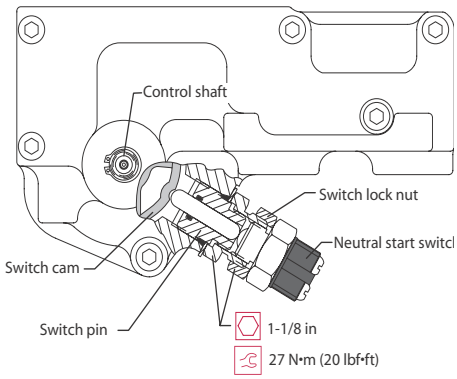
7. If the switch closes in neutral and satisfactorily opens in each direction, proceed to check the switch with the prime mover running. The switch must open before the unit builds 7 bar [100 psi] differential system pressure in either direction.

   If the switch opens after the unit builds system pressure in either direction, loosen the switch lock nut and turn the switch clockwise (CW) 1/12 turn (30°). Tighten the switch lock nut and recheck the switch operation. Repeat this procedure if necessary.

8. If the switch does not open with an equal movement of the control handle in each direction, turn off prime mover, remove the pressure gauges, and continue with the next section.

9. If neutral start switch operation is satisfactory, turn off the prime mover, remove the pressure gauges, and reconnect the external control linkage.

Neutral start switch



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CHECKING SWITCH CONTINUITY

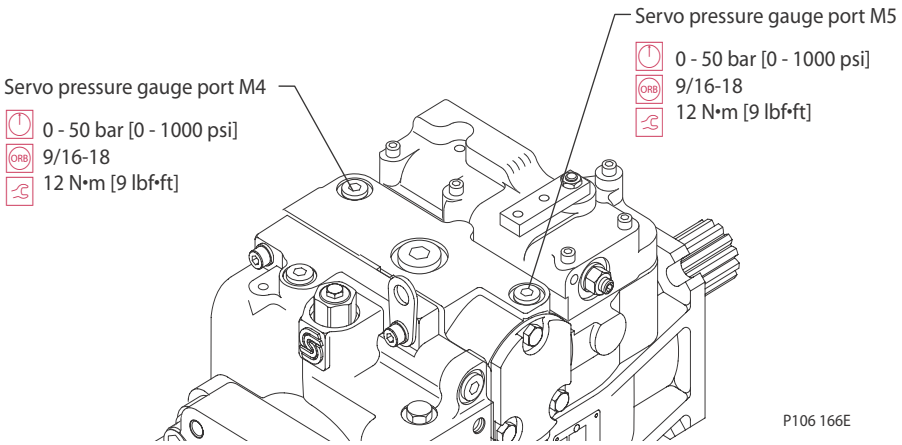
⚠ Warning

The following procedure may require the vehicle/machine to be disabled (wheels raised off the ground, work function disconnected, etc.) while performing the procedure in order to prevent injury to the technician and bystanders. Take necessary safety precautions before moving the vehicle/machine.

Recheck switch continuity to determine whether additional adjustment of the eccentric plug is necessary. ⚠

1. Install a 50 bar [1000 psi] gauge in each of the two servo cylinder gauge ports (M4 and M5). Attach a continuity checker to the terminals of the neutral start switch.

Checking switch continuity



2. Energize the starter circuit, and start the prime mover.

3. While operating at normal speed and with the pump in its neutral (zero flow) position, note the pressure reading on the gauges. Note this reading as the base pressure.

4. Slowly move the control handle in one direction while observing the pressure gauges and the continuity checker. The switch must open before the pressure on either gauge increases more than 1 bar [14.5 psi] from the base pressure obtained at neutral.

5. Slowly move the control handle in the opposite direction. Again, The switch must open before the gauge pressure increases more than 1 bar [14.5 psi] from base pressure.

6. Verify continuity again when the control is returned to neutral.

7. If the switch does not open at base pressure plus 0 to 1 bar [0 to 14.5 psi] in either direction, stop the prime mover and readjust the eccentric plug as described in the previous section. If the pressure difference is equal in each direction but greater than 1 bar [14.5 psi], loosen the switch lock nut and turn the switch clockwise 1/12 turn (30°) to increase the sensitivity. Retighten the lock nut and recheck pressure differences and continuity.

8. After verifying proper control and switch operation, stop the prime mover. Remove the continuity checker and pressure gauges. Reinstall the servo pressure port plugs and reconnect the electrical leads from the machine starter circuit to the NSS. Install and adjust, the external control linkage if necessary.

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HYDRAULIC DISPLACEMENT CONTROL (HDC) AND ELECTRIC DISPLACEMENT CONTROL (EDC) ADJUSTMENT

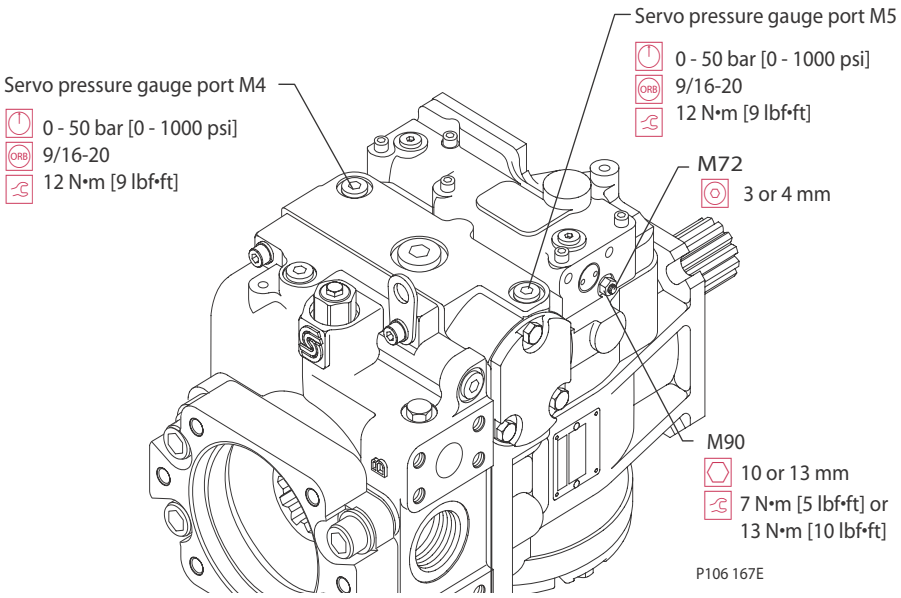
⚠ Warning

The following procedure may require the vehicle/machine to be disabled (wheels raised off the ground, work function disconnected, etc.) while performing the procedure in order to prevent injury to the technician and bystanders. Take necessary safety precautions before moving the vehicle/machine.

The neutral adjustment is the only adjustment that can be made on hydraulic and electric displacement controls. All other functions are preset at the factory.

Make this adjustment on a test stand or on the vehicle/machine with the prime mover operating. ⚠

HDC and EDC neutral adjustment



1. Install a 50 bar [1000 psi] gauge in each of the two displacement control cylinder gauge ports (M4 and M5). Disconnect the external control input (hydraulic or electronic) from the control. Start the prime mover and operate at normal speed.

2. Loosen the lock nut (M90) with a 10 mm or 13 mm hex wrench.

3. Using a 3 mm or 4 mm internal hex wrench, rotate the adjusting screw (M72) clockwise until the pressure increases in one of the pressure gauges. Note the angular position of the wrench. Rotate the neutral adjusting screw counterclockwise until the pressure increases by an equal amount on the other gauge. Again note the angular position of the wrench.

4. Rotate the adjusting screw clockwise half the distance between the locations noted above. The gauges should read the same pressure (case pressure), indicating that the control is in its neutral position.

5. Hold the neutral adjusting screw stationary. Tighten the neutral adjusting screw lock nut to 7 N•m [62 lbf•in] for the 6 mm screw or 13.5 N•m [120 lbf•in] for the 8 mm screw. Do not overtorque the nut.

6. Once the neutral position is set, stop the prime mover, remove the gauges, and install the gauge port plugs. Reconnect the external control input.

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SPEED SENSOR ADJUSTMENT

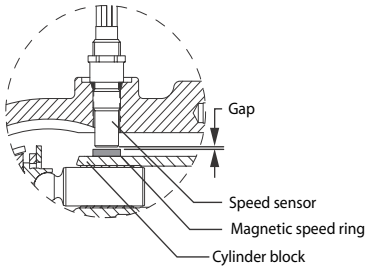
When installing or adjusting the speed sensor on a pump, it must be set at a specific distance from the speed ring on the unit's cylinder. To locate the position of the speed sensor on the unit or description see the corresponding section.

1. Loosen the sensor lock nut with an 11/16 inch hex wrench.
2. Turn the sensor clockwise (CW) by hand until it contacts the speed ring.
3. Turn the sensor counterclockwise (CCW) 1/2 turn (180°) to establish the nominal gap of 0.71 mm [0.028 inch].
4. Then turn the sensor clockwise (CW) until the wrench flats on sensor body are positioned at a 22° angle to the pump shaft center line.

Most open-end wrenches have a 22° handle offset.

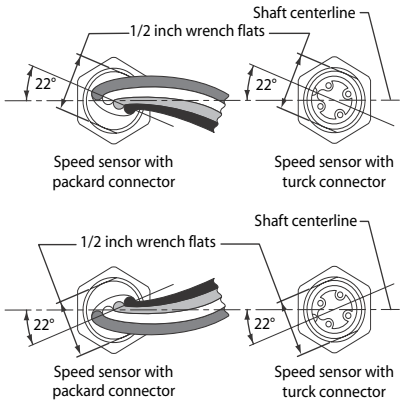
5. The final sensor position should be between 1/2 (180°) and 1/4 turn (90°) counterclockwise (CCW) from the point where the sensor contacts the speed ring.
6. Hold sensor in position with a 1/2 inch hex wrench while tightening the lock nut to 13 N•m [10 lbf•ft].

Cross section view of speed sensor in variable pump



P104 152E

Positioning speed sensor relative to pump shaft



P104 155E

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STANDARD PROCEDURES

Removing the pump

Before working on the pump, clean the outside of the pump. If the pump has an auxiliary pump attached, remove both pumps as a single unit. Tag and cap all hydraulic lines as they are disconnected and plug all open ports to ensure that contamination does not enter the system.

Caution

Contamination can damage internal components and void your warranty. Take precautions to ensure system cleanliness when removing and reinstalling system lines

Disassembly

1. With the prime mover off, thoroughly clean the outside of the pump.
2. Tag, cap, and disconnect each hydraulic line connected to the pump. As hydraulic lines are disconnected, plug each open port, to ensure that dirt and contamination do not enter the system.
3. Remove the pump and its auxiliary pump (if applicable) as a single unit.

Inspection

4. Ensure the work surface and surrounding area are clean and free of contaminants.
5. Inspect the system for contamination.
6. Look at the hydraulic fluid for signs of system contamination, fluid discoloration, foam, sludge, or small metal particles.

Reassembly

7. Before replacing the pump on the machine, replace all filters and drain and fill the hydraulic system with the correct hydraulic fluid.
8. Flush the lines before replacing the hydraulic fluid.

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SHAFT SEAL AND SHAFT REPLACEMENT

You can replace the shaft and seal without major disassembly of the unit. Clean pump and surrounding area thoroughly. Disconnect and remove the pump from the unit, and clean it thoroughly before starting repairs. Mark all connections for later reassembly.

Shaft removal

1. Position the pump with the shaft facing up.

If the unit is positioned horizontally, or moved or jarred while the shaft is out, the cylinder block could move out of place, making shaft installation difficult.

2. Remove the three or four screws (L70) holding the retainer plate (L60) and seal carrier (L30) to the housing, using a 10 mm hex wrench (042 unit), a 5 mm internal hex wrench (055 through 100 units), or a 6 mm internal hex wrench (130 through 250 units). Remove the retainer plate.

Certain earlier production units use a one piece retainer plate and seal carrier.

3. After removing the screws, the spring force on the shaft may move the seal carrier out of its bore by approximately 5 mm [1/4 inch]. If the seal carrier does not move from its bore, pry it from its bore and/or lightly tap the end of the shaft with a soft mallet.

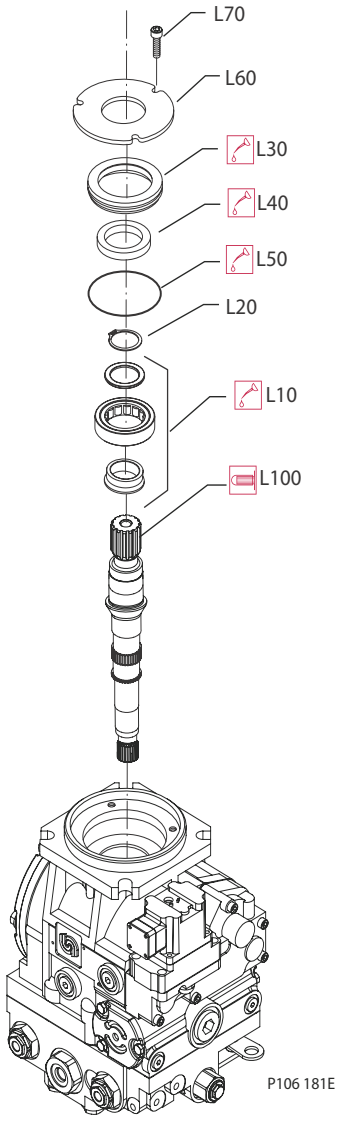
4. Remove the O-ring (L50) from the seal carrier and discard.

5. Place seal carrier and seal in an arbor press and press out the seal (L40).

6. Remove shaft (L100) and roller bearing assembly (L10) from pump. You can transfer the bearing assembly to the new shaft.

7. Using snap-ring pliers, remove the retaining ring (L20) that secures the roller bearing assembly. Remove the roller bearing assembly.

Shaft assembly



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SHAFT SEAL AND SHAFT REPLACEMENT (continued)

Inspection

8. Inspect the seal carrier, the new seal and the O-ring for any damage or nicks.

9. Inspect the shaft and bearing for rust, wear, or contamination. Spin the bearing in your hand feeling for roughness. Replace if necessary.

Reassembly

10. Using the arbor press, press the new seal (L40) into seal carrier (L30). Be careful not to damage the seal.

If the shaft is not being replaced proceed to step 12.

11. Place roller bearing assembly on new shaft and secure with the retaining ring.

12. Install an installation sleeve or wrap spline or keyed end of shaft with plastic film to prevent damage to the sealing lip on the seal during installation.

13. Lubricate and install a new O-ring (L50) on the seal carrier. Lubricate the seal with clean petroleum jelly.

14. Assemble the seal carrier and seal over the shaft and into the housing bore. Install the retainer plate (if used).

15. Install the screws and torque to the appropriate value in the table to the right.

Torque the screws in a sequenced pattern then recheck.

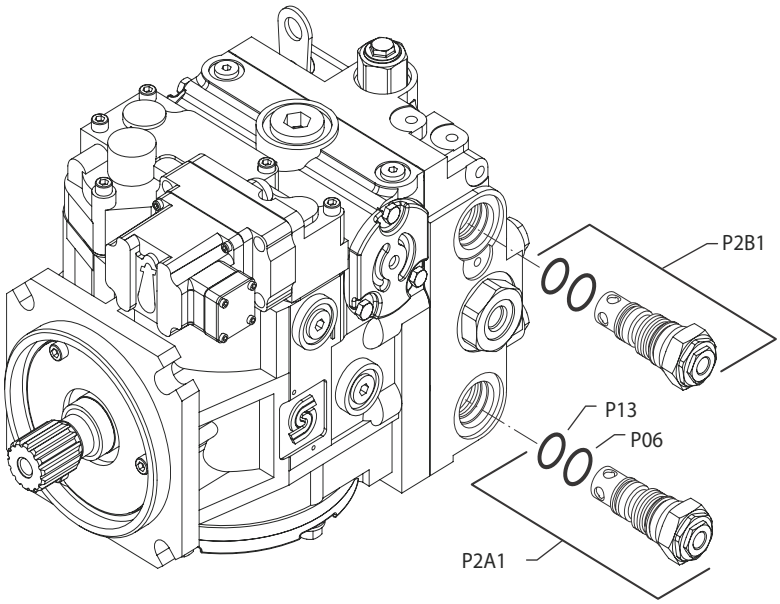
Shaft retainer screw torque

Frame size	Torque
030 – 042	12 N•m [9 lbf•ft]
055 – 100	16 N•m [12 lbf•ft]
130 – 250	32 N•m [24 lbf•ft]

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MULTI-FUNCTION VALVE CARTRIDGES

Multi-function valve removal / installation



P106 180E

Older multifunction valves (pre 1988) contain different components. See *multifunction valves - Pre 1988*, (page 52) for disassembly instructions.

Removal

1. Remove multi-function valves (P2A1 and P2B1) using hex wrench listed in table.

Multi-function valve wrench size

Frame size	Wrench size
030 – 100	1-1/4 inch
130 – 250	1-5/8 inch

2. Remove and discard O-rings (P13 and P06).

3. Relieve spring pressure by removing bypass actuator (P03), using a 1-1/16 wrench. To retain pressure setting, do not separate adjusting screw (P01), and locknut (P04) from bypass actuator (P03).

4. Remove and discard O-ring (P02).

Multi-function valves are sold as complete units only. You may purchase O-rings separately.

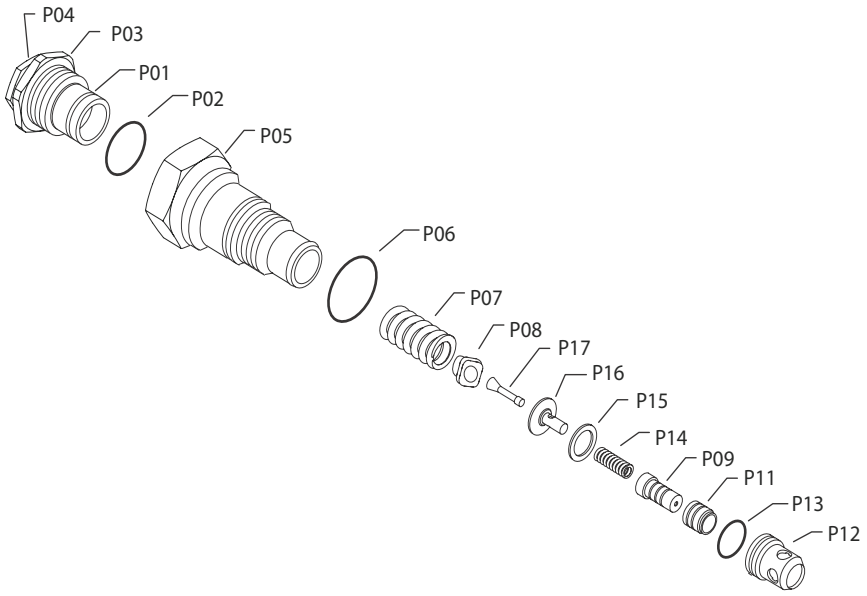
5. The poppet seat section is pressed over a lip. Place the cartridge in a vise and pry the poppet seat (P12) off with an appropriate tool. Maintain sufficient control to prevent the internal components from flying loose. Do not damage parts during disassembly.

6. Remove internal parts (P07, P08, P17, P16, P15, P14, P09, and P11).

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MULTI-FUNCTION VALVE CARTRIDGES (continued)

Multi-function valve



E101 531E

Inspection

7. Clean and inspect all disassembled parts.

Reassembly

8. Lubricate and install internal components (P07, P08, P17, P16, P15, P14, P09, P11, and P12).

9. Place the cartridge in a vise and press on the poppet seat (P12).

10. Lubricate and install new O-rings (P02, P06, P13).

11. Install bypass actuator (P03) with pressure limiter valve (P01). Torque to 40 N•m [30 lbf•ft]

Caution

If pressure limiter (P01) was removed from bypass actuator (P03), adjust pressure limiter to model code specifications.

Caution

Do not overtorque the multi-function valve cartridges

12. Install cartridges and torque as shown in the table.

Multi-function valve torque

Frame size	Torque
030 – 100	89 N•m [66 lbf•ft]
130 – 250	210 N•m [155 lbf•ft]

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MULTI-FUNCTION VALVE CARTRIDGES - PRE 1988

Removal

1. Remove multi-function valves using hex wrench listed in table.

Multi-function valve wrench size

Frame size	Wrench size
030 – 100	1-1/4 inch
130 – 250	1-5/8 inch

2. Remove and discard O-rings (P03 and P06).

3. It is not necessary to remove the bypass function (P14) except for cleaning. Wrench size is 1-1/16.

Multi-function valves are sold as complete units only. O-rings may be purchased separately.

4. To retain pressure setting, do not disassemble bypass function (P14).

5. Remove retaining ring (P22) with a snap ring pliers.

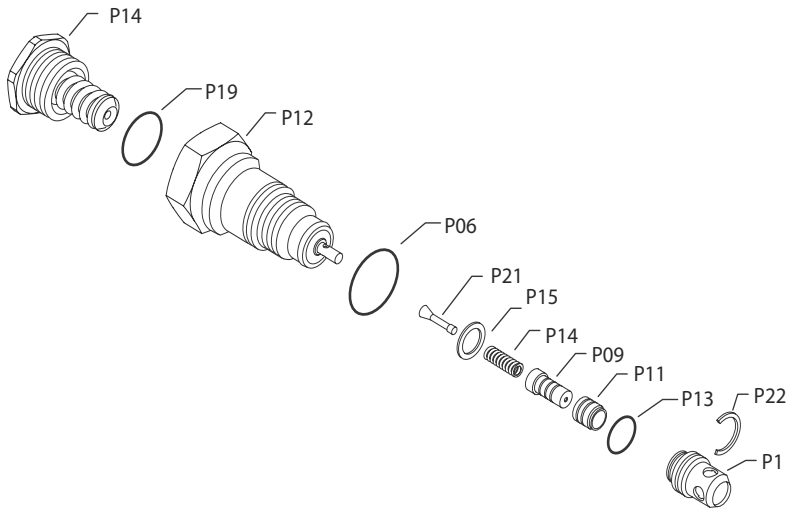
6. Remove poppet seat (P12).

7. Remove internal parts (P21, P15, (P14, P09, and P11).

Inspection

8. Clean and inspect all disassembled parts.

Multi-function valve - pre 1988



E101 532E

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MULTI-FUNCTION VALVE CARTRIDGES - PRE 1988 (continued)

Reassembly

9. Lubricate and install internal components (P01, P11, P09, P14, P15, and P21).
10. Install poppet seat (P1).
11. Install retaining ring (P22).
12. If previously removed, lubricate and install O-ring (P19).
13. If previously removed, reassemble and install bypass actuator (P14). Torque to 40 N•m [30 lbf•ft].
14. Lubricate and install new O-rings (P06, P13).

Caution

If pressure limiter was removed from bypass actuator (P14), adjust pressure limiter to model code specifications.

Caution

Do not overtorque the multi-function valve cartridges

15. Install cartridges and torque as shown in the table below.

Multi-function valve torque

Frame size	Torque
030 – 100	89 N•m [66 lbf•ft]
130 – 250	210 N•m [155 lbf•ft]

PRESSURE OVERRIDE VALVE (OPTION FOR 180 FRAME SIZE)

Removal

1. Remove the four screws attaching the pressure override valve to the pump end cap with a 5 mm internal hex wrench. Remove and discard the O-rings.

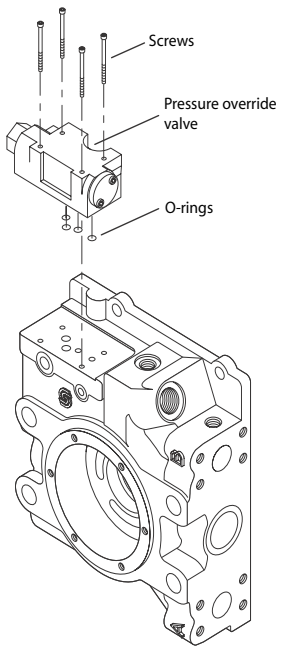
Inspection

2. Clean and inspect valve for damage to parts.

Reassembly

3. Install new O-rings. Install the valve onto the pump end cap and torque the screws to 16 N•m [12 lbf•ft].

Pressure override valve components



E101 079E

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CHARGE PRESSURE RELIEF VALVE

The charge pressure relief valve is shim adjustable (early models) or screw adjustable (late models). Screw adjustable charge relief valve is shown.

Removal

1. Remove the shim adjustable charge relief valve plug with a 1 inch hex wrench.

   Before removing the screw adjustable relief valve plug, mark the plug (K90), lock nut (K10), and housing to approximately maintain the original adjustment when assembling. Remove the screw adjustable charge relief valve plug by loosening the lock nut with a hex wrench corresponding to the table.

   Unscrew the plug using a large screwdriver or 1/2 inch hex wrench. Remove and discard the O-ring (K50).

2. Remove the spring (K70) and relief valve poppet (K80).

Lock nut wrench size

Frame size	Wrench size
030 – 100	1-1/16 inch
130 – 250	1-5/8 inch

Inspection

3. Inspect the poppet (K80) and mating seat in the endcap for damage or foreign material.

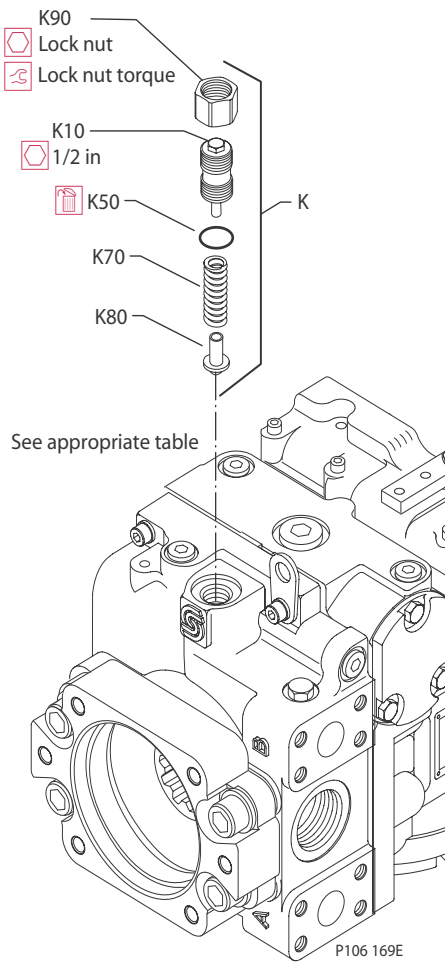
   When inspecting shim adjustable valves, do not alter the shims or interchange parts.

Reassembly

4. Install the poppet (K80) and spring (K70). For shim adjustable valves, install the shims and plug, torque to 68 N•m [50 lbf•ft]. For screw adjustable valves, install the plug with its lock nut, aligning the marks made at disassembly, and torque the lock nut to 52 N•m [38 lbf•ft].

   Check the charge pressure and adjust, if necessary. Refer to *Charge pressure adjustments* (page 31).

Charge pressure relief valve



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AUXILIARY PAD

Removal

1. Remove the four end cap screws (J80). Remove and discard special washers (J70).

Caution

On earlier production frame size 75 pumps with twin ports, secure the end cap to the pump housing with a clamp to avoid gasket damage.

Aux. pad screw wrench size

Frame size	Wrench sizes
030 – early 042	8 mm internal hex
late 042	10 mm internal hex
055	19 mm hex
075 – 100	24 mm hex
100 – 130	14 mm internal hex
180 –250	17 mm internal hex

2. Remove the auxiliary pad (J60) and discard the O-rings (J50 and J90).

Inspection

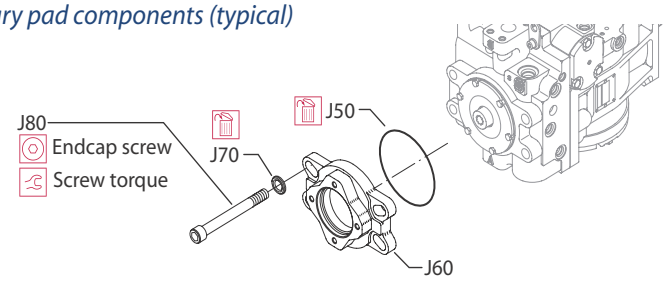
3. Inspect the auxiliary pad for damage and replace if necessary.

4. Take care to assure the surfaces are clean and free of any foreign material or paint prior to installing the auxiliary pad.

Caution

Do not allow the force of the cylinder block spring and swashplate leveler springs to separate the end cap from the pump housing. Gasket damage and external leakage may result.

Auxiliary pad components (typical)



See appropriate table for wrench size and torque

E101 084E

Inspection

5. Inspect the auxiliary pad components for wear or damage and replace if any is found.

6. Take care to ensure the surfaces are clean and free of any foreign material or paint prior to installing the auxiliary pad.

Reassembly

7. Lubricate and install O-ring (J50) on end cap pilot.

8. Install the auxiliary mounting pad (J60) on rear of endcap.

End cap screw torque

Frame size	Torque
030	58 N•m [43 lbf•ft]
042	75 N•m [55 lbf•ft]
055	122 N•m [90 lbf•ft]
075 – 130	298 N•m [220 lbf•ft]
180 – 250	580 N•m [429 lbf•ft]

Torque endcap screws in a criss-cross pattern

9. Install four large screws (J80) and new washers (J70) through the mounting pad and end cap into the housing. Torque per the accompanying table.

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CHARGE PUMP

The following procedure shows how to remove and install a charge pump.

Removal

1. For pumps with an auxiliary mounting pad, refer to the *Auxiliary Pad* instructions (page 55).

Caution

On earlier production frame size 75 pumps with twin ports, secure the endcap to the pump housing with a clamp to avoid gasket damage.

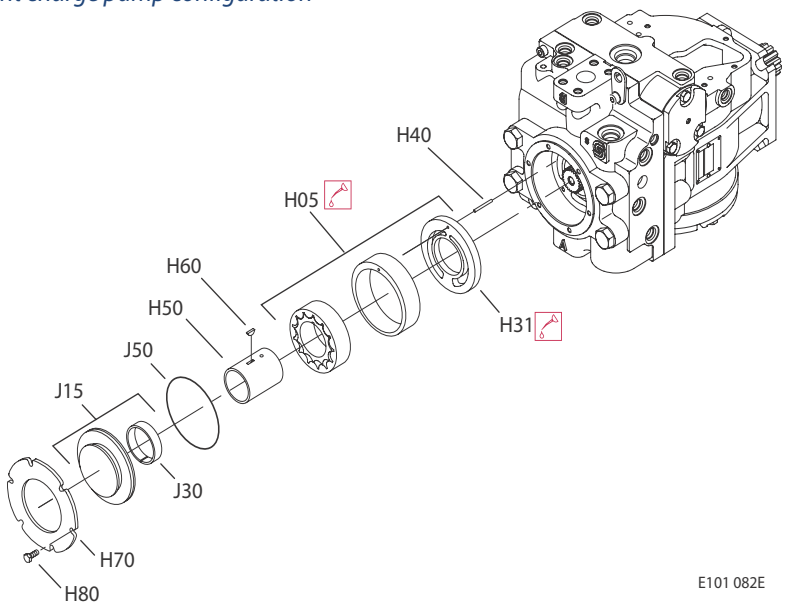
2. Remove the six screws (H80) holding the charge pump cover retainer (H70).

3. Remove the retainer (H70) and the charge pump cover (J15). Remove and discard O-ring (J50). Note the orientation of the gerotor assembly (H05).

Retainer screw wrench size

Frame size	Wrench size
030 – 100	10 mm
130 – 250	13 mm

Current charge pump configuration



Refer to appropriate *Sauer-Danfoss Series 90 service parts manual* for earlier charge pump configurations.

4. Remove the charge pump coupling (H50) and charge pump drive key (H60).

5. Remove the charge pump gerotor assembly (H05).

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CHARGE PUMP (continued)

6. Remove the alignment pin (H40).

7. Remove the inner port plate (H31).

Inspection

Inspect all parts for abnormal wear or damage and replace if necessary.

If installing a different displacement charge pump, the gerotor assembly, gerotor outer eccentric ring, and inner port plate (early and late production pumps) or outer spacer plate(s) (intermediate production pumps) must be replaced together. If different thickness port plates are used in an early production charge pump assembly, the thicker plate is the inner port plate (installed next to the pump end cap).

Different production charge pump assemblies include a different quantity / type of port plates and spacer plates.

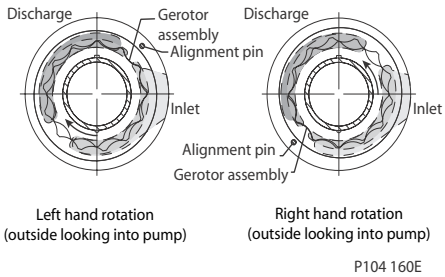
Reassembly

Be sure to install the charge pump in the proper orientation. If unsure of charge pump rotation, refer to the model code.

The orientation of the gerotor assembly outer eccentric ring and the location of the alignment pin in the end cap determine the charge pump rotation..

Do not mix charge pump parts from different production periods. Always install as a complete assembly.

Orienting alignment pin



8. Install the inner port plate (H31) and the gerotor assembly outer ring.

9. Install the alignment pin (H40) to properly orient the port plates and outer eccentric ring for corresponding pump rotation.

10. Prior to installation, lubricate the I.D., O.D., and side faces of the gerotor assembly.

11. Install the gerotor assembly (H05).

12. Install the outer port plate (early production and intermediate production pumps only).

13. Install the spacer plate, if present (intermediate production pumps).

14. Install the charge pump drive key (H60) into the charge pump coupling (H50) and retain with petroleum jelly.

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CHARGE PUMP (continued)

Intermediate production 75 cm³ and 100 cm³ pumps use the same charge pump coupling. Two keyways are provided in the coupling for the charge pumps used in these units. The rear keyway (with identifier groove) is used in 75 cm³ pumps. The front keyway (closest to the internally splined end of the shaft) is used in 100 cm³ pumps.

8. Install the charge pump coupling. The internally splined end of the coupling must engage the main pump shaft.

The outside diameter of the internally splined end of some early production charge pump couplings were chamfered. Early production end caps may not be machined to accept a non-chamfered coupling. Always use a chamfered charge pump coupling in pumps with the early endcap.

9. For pumps with an auxiliary mounting pad, install the auxiliary drive coupling.

10. For pumps with no auxiliary pad, install a new O-ring (J50) onto charge pump cover. (If an auxiliary pad is installed, an O-ring is not used on the cover.)

11. Carefully remove the alignment pin from the charge pump parts. Install the pin in its hole in the charge pump cover (J15) (see previous page for correct orientation) and retain with petroleum jelly. Install the cover (with alignment pin) into the end cap and aligned charge pump parts. (Take care not to damage the cover O-ring, if used.)

Caution

In order to avoid loss of charge pressure in pumps with an auxiliary mounting pad, always install the charge pump cover with the pad drain hole located on the same side of the end cap as the charge inlet port. Refer to the section *"Auxiliary Pad Installation"* for details.

12. Install the charge pump cover retainer (H70) and the six internal hex screws (H80). Torque the screws per the table at the right..

Retainer screw torque

Frame size	Torque
030 – 100	16 N•m [11.85 lbf•ft]
130 – 250	32.5 N•m [24 lbf•ft]

13. For pumps with auxiliary mounting pads, install the O-ring and auxiliary mounting pad adaptor onto the end cap. Refer to the corresponding section for instructions on auxiliary pad installation.

ADDING AN AUXILIARY PAD TO A PUMP PREVIOUSLY WITHOUT ONE

1. If installing an auxiliary pad kit on a pump that was previously without one, carefully remove the alignment pin from the charge pump parts.

2. Install the pin in its hole in the new charge pump cover (with hole for the auxiliary coupling) and retain with petroleum jelly.

3. Install the new charge pump cover with alignment pin into the end cap and the aligned charge pump parts.

4. Lubricate and install O-ring. Install auxiliary pad. Refer to previous sections, *Auxiliary pad*, page 55, and *Charge pump*, page 56, for instructions.

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INTEGRAL CHARGE PRESSURE FILTER REPLACEMENT

Removal

1. Remove the filter canister (N40) from the filter head (N10) as described on the canister.

Lock nut wrench size and torque

Frame size	Wrench size	Torque
030 – 042	1-3/8 inch	70 N•m [52 lbf•ft]
055 – 130	1-5/8 inch	122 N•m [90 lbf•ft]
180 – 250	1-5/8 inch	156 N•m [115 lbf•ft]

2. Hold the filter head in place and loosen the lock nut (N20) using the wrench size corresponding to pump frame size.

3. Rotate the filter head counterclockwise to remove it from the housing. Remove and discard the O-ring (N15).

4. Remove the hydraulic tube (N25) from its bore in the endcap.

Inspection

5. Inspect the filter head and lock nut sealing surfaces. If you find any nicks or scratches, replace the damaged components.

Reassembly

6. Install the hydraulic tube (N25) into it's bore in the endcap. Install the filter head (N10) into the port using a new O-ring (N15). The hydraulic tube should go in with low force.

7. After rotating the filter head clockwise so that the threads engage with the threads in the endcap, continue to rotate it clockwise between 6 and 7 revolutions. Position head as desired. !

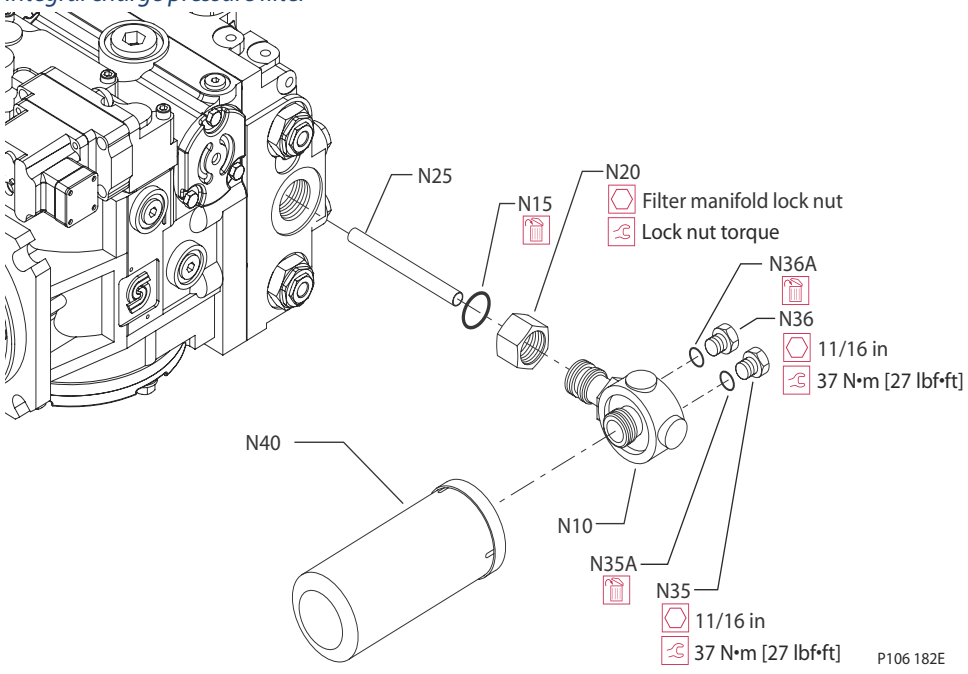
8. While holding the filter head in the desired position, tighten the swivel lock nut (N20) and torque as shown in table.

9. Install a new filter canister (N40) per the instructions on the filter canister.

! Caution

Failure to install the filter manifold or filter head to a sufficient depth in the end cap will result in insufficient engagement of the tube in the end cap bore. This may allow unfiltered oil to bypass the filter and enter the charge system.

Integral charge pressure filter



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PUMP CONTROL COVER PLATE

Removal

1. Thoroughly clean external surfaces prior to removal of cover plate.

2. Using a 5 mm internal hex wrench, remove the six cover plate mounting screws (M90). Remove the cover plate (M1) and gasket (M11) from housing. Discard the gasket.

Caution

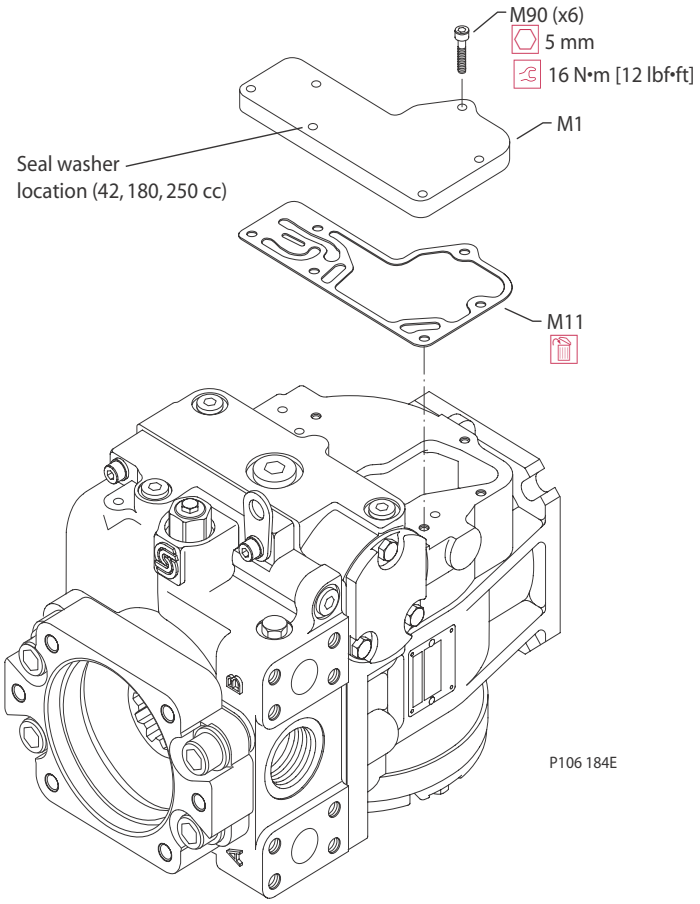
Protect exposed surfaces and cavities from damage and foreign material.

Reassembly

3. Install a new gasket on the housing. Install the cover plate and install the screws. Torque the screws to 16 N•m [12 lbf•ft].

Install a sealing washer under the head of any mounting screws that are installed into through holes in the housing.

Pump controls cover plate

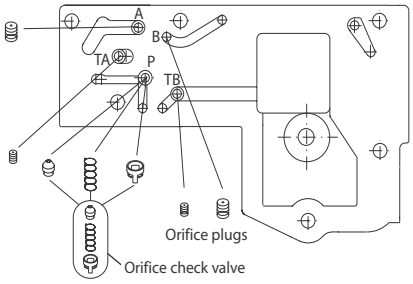


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DISPLACEMENT CONTROL ORIFICES

1. Remove the control assembly as described in the instructions for the specific displacement control.
2. Orifice plugs may be located in the control assembly, at the pump housing face. Remove the orifice plugs one at a time (to avoid mixing them up) with a 4 mm internal hex wrench. Note the location of each plug, do not interchange plugs. Clean, reinstall, and torque the orifice plugs to 3 N•m [2.2 lbf•ft].

Underside of an HDC/EDC module showing orifice locations



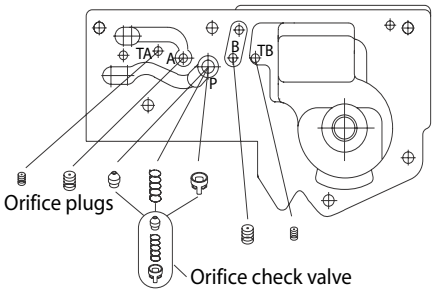
E101 085E

3. Assemble the control onto the pump. Refer to the instructions for the specific control.

DISPLACEMENT CONTROL ORIFICE CHECK VALVE

1. Remove the control assembly as described in the instructions for the specific displacement control.
2. The orifice check valve is located in the control assembly, at the surface of the pump housing face. Remove the spring retainer and spring from the orifice check valve cavity and then remove the orifice check valve.

Underside of an MDC module showing orifice locations



E101 086E

3. Clean and install the orifice check valve in the cavity and then install the spring and spring retainer to hold the orifice check valve in position.
4. Assemble the control onto the pump. Refer to the instructions for the specific control.

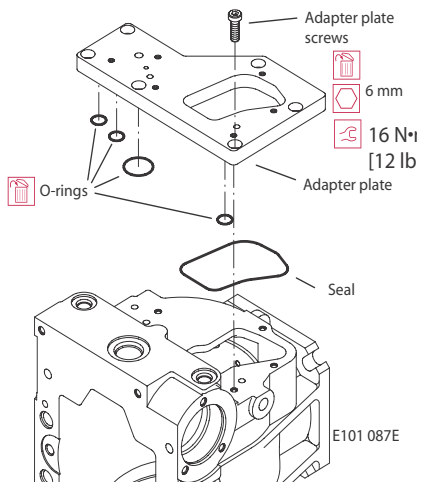
DISPLACEMENT CONTROL ADAPTER PLATE (EARLY PRODUCTION 130 PUMPS ONLY)

Do not remove the adapter plate unless leakage is evident. The mounting screws with sealing compound are difficult to remove.

The screws fastening the control adapter plate to the housing have sealing compound on the threads. You may remove them with a 6 mm internal hex wrench if necessary. Remove and discard the O-rings and seals.

When installing the adapter plate, replace screws (with sealing compound), and ensure the new O-rings and seal are in the proper position. Torque the screws to 32 N•m [24 lbf•ft].

Displacement control adapter plate (early production 130 cm³ pumps only)



E101 087E

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MANUAL DISPLACEMENT CONTROL (MDC)

Removal

1. Thoroughly clean external surfaces prior to removal of control.

2. Using a 5 mm internal hex wrench, remove the six control mounting screws (M90). Remove the control (M1) (with orifice check valve (T40) and spring (T30)) and control gasket (M11) from the housing. Discard the gasket.

If necessary, remove the control handle (M70) by removing the locking nut (M72) and washer (M71).

Caution

Protect exposed surfaces and cavities from damage and foreign material.

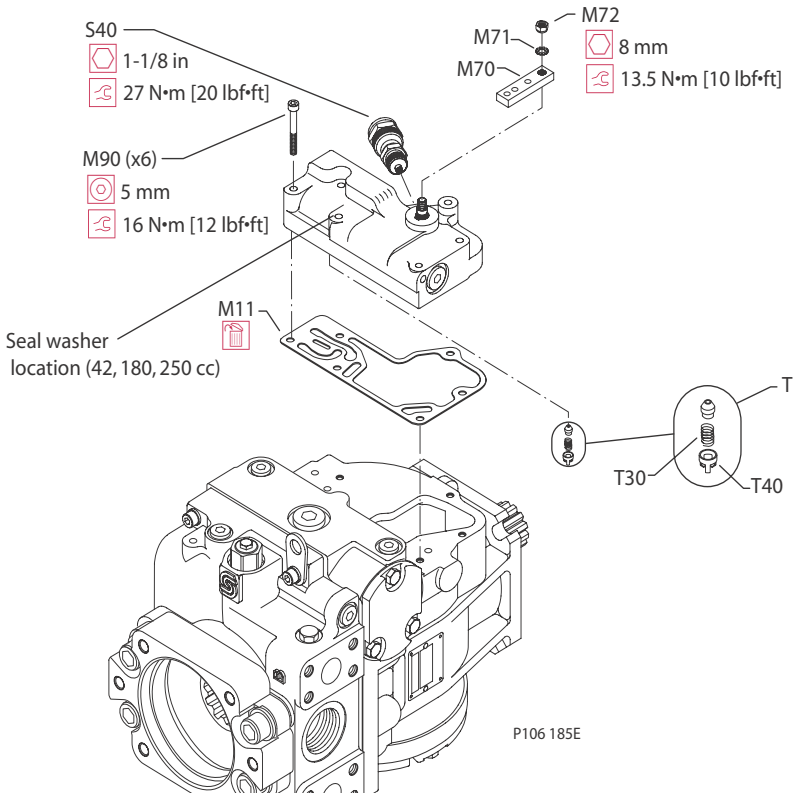
Reassembly

3. Install a new gasket (M11). Inspect control to assure that the control orifice check valve and spring are in their proper position in the control.

4. Install the control. Engage the pin on the control linkage into the mating hole in the link attached to the swashplate.

5. With the control in position, move control lever both directions to check proper engagement of control linkage pin. If properly assembled, lever will return to center. If lever does not return to center, remove the control and repeat the above procedure.

MDC removal/installation



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MANUAL DISPLACEMENT CONTROL (MDC) (continued)

If removed, install the control handle (M70) and locking nut (M72) with washer (M71). Hold the position of the handle and torque the locking nut to 13.5 N•m [10 lbf•ft] using an 8mm hex wrench.

6. Align the control gasket and install the screws. Torque the screws to 16 N•m [12 lbf•ft].

Install a sealing washer under the head of mounting screws that are installed into through holes in the housing.

Warning
The neutral start switch neutral must be readjusted after reassembling the MDC module.

7. If the control is equipped with a neutral start switch, refer to *MDC Neutral start switch adjustment* instructions page 41.

SOLENOID OVERRIDE VALVE FOR MDC

Removal

1. Thoroughly clean external surfaces prior to removal of valve.

2. Remove the solenoid from the valve by removing the nut with a 3/4 inch hex wrench. Remove the solenoid valve (M76) from the manifold (M75) with a 7/8 inch hex wrench.

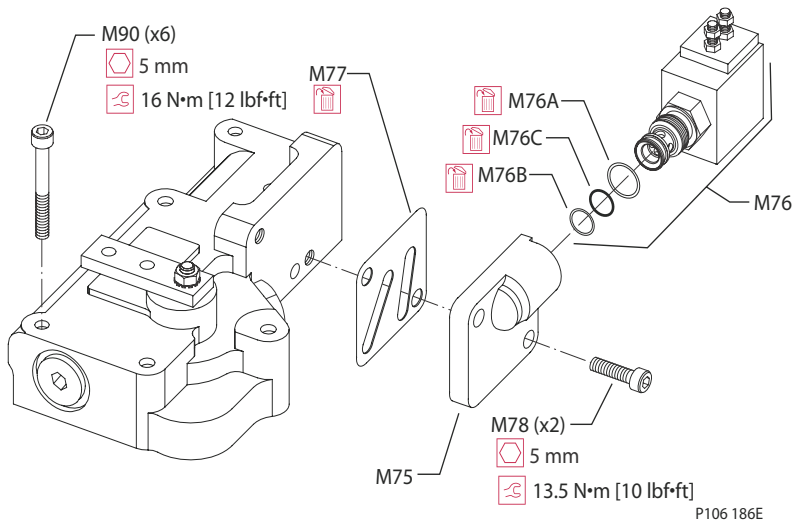
3. Using a 5 mm internal hex wrench, remove the two screws (M78) and remove solenoid manifold (M75) from housing. Remove and discard the gasket (M77).

Reassembly

4. Torque valve (M76) to 24 N•m [17.7 lbf•ft]. Torque solenoid nut to 6 N•m [4.5 lbf•ft]. Do not overtorque the solenoid nut.

5. Install a new gasket on the control housing. Install the manifold onto the control housing, align the gasket, and install the screws. Torque the screws to 13.5 N•m [10 lbf•ft].

Solenoid override valve removal/installation



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SOLENOID OVERRIDE VALVE FOR MDC WITH PRESSURE RELEASED BRAKE

Removal

1. Thoroughly clean external surfaces prior to removal of valve.

2. Using a 4 mm internal hex wrench, remove the four solenoid valve mounting screws (M92). Remove the solenoid valve (M9) (with O-rings) from the adapter plate. Discard the O-rings.

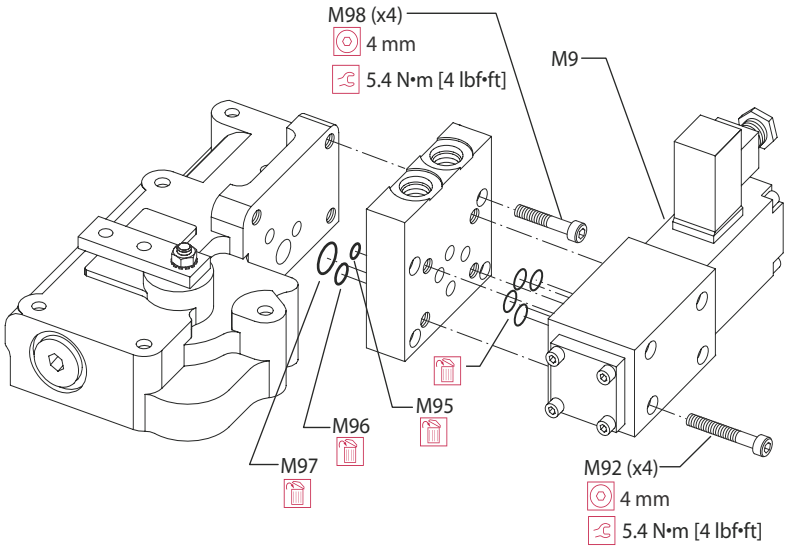
3. Using a 4 mm internal hex wrench, remove the four adapter plate mounting screws (M98). Remove the adapter plate and O-rings (M95, M96, and M97) from the control housing. Discard the O-rings.

Reassembly

4. Using petroleum jelly to retain them, install new O-rings (M96, M96, M97) on the adapter plate. Place the adapter plate into position and install the screws (M98). Torque the screws to 5.4 N•m [4 lbf•ft].

5. Using petroleum jelly to retain them, install new O-rings onto the solenoid valve assembly (M9) and install the solenoid valve onto the adapter plate. Install the screws (M92) and torque to 5.4 N•m [4 lbf•ft].

Solenoid override valve removal/installation



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HYDRAULIC AND ELECTRIC DISPLACEMENT CONTROLS

Removal

1. Thoroughly clean external surfaces prior to removal of control.

2. Using a 5 mm internal hex wrench, remove the six control mounting screws (M90). Remove the control (M1) (with orifice check valve (T40) and spring (T30)) and control gasket (M11) from housing. Discard the gasket.

Caution

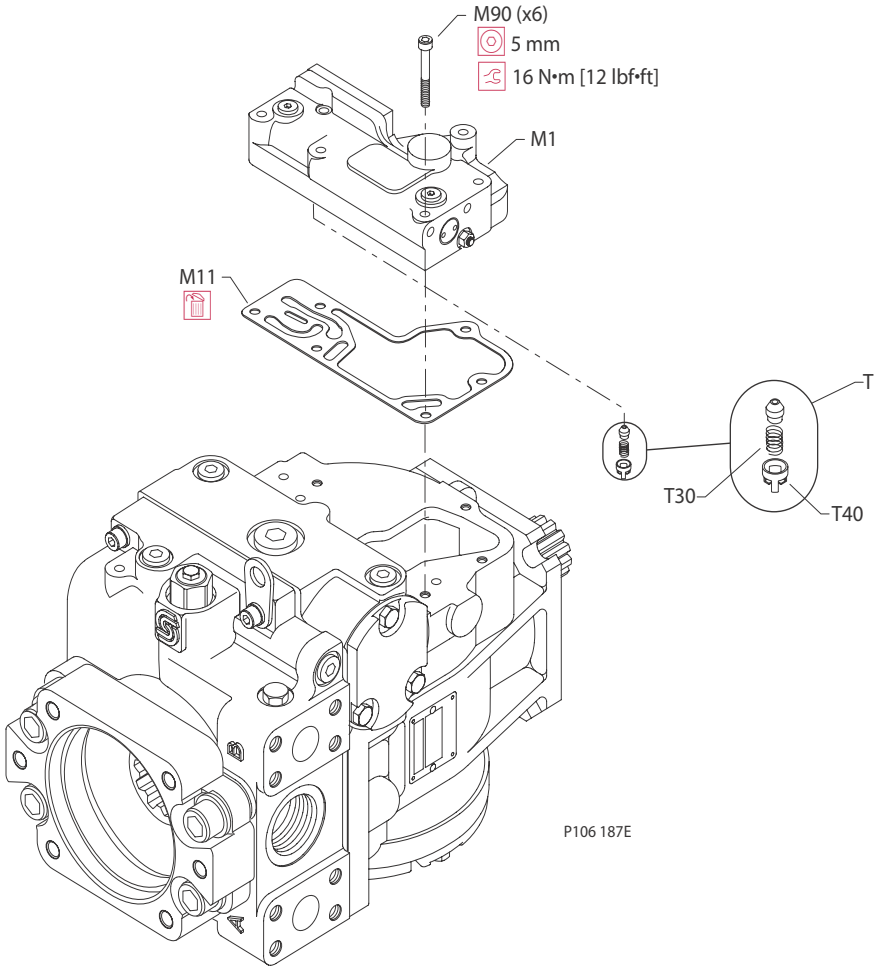
Protect exposed surfaces and cavities from damage and foreign material.

Reassembly

3. Install a new gasket (M11). Verify the control orifice check valve and spring (T) are in their proper position in the control.

4. Position the control on the housing. Insert the control linkage pin into the swashplate link.

Hydraulic/Electric displacement control



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5. With the control in position, move control assembly left and right to check engagement of pin in the link. Proper engagement is indicated by an increasing resistance as the control is moved away from center position. Non-engagement of pin is indicated by lack of spring force. In case of non-engagement, remove control and repeat the above procedure.

6. Align the control gasket and install the screws. Torque the screws to 16 N•m [12 lbf•ft].

Install a sealing washer under the head of any mounting screws that are installed into through holes in the housing.

PRESSURE CONTROL PILOT (PCP) FOR ELECTRIC DISPLACEMENT

Removal

1. Thoroughly clean external surfaces of control.

2. Using a 4 mm internal hex wrench, remove the four screws (M98) and remove the PCP (M9).

Inspection

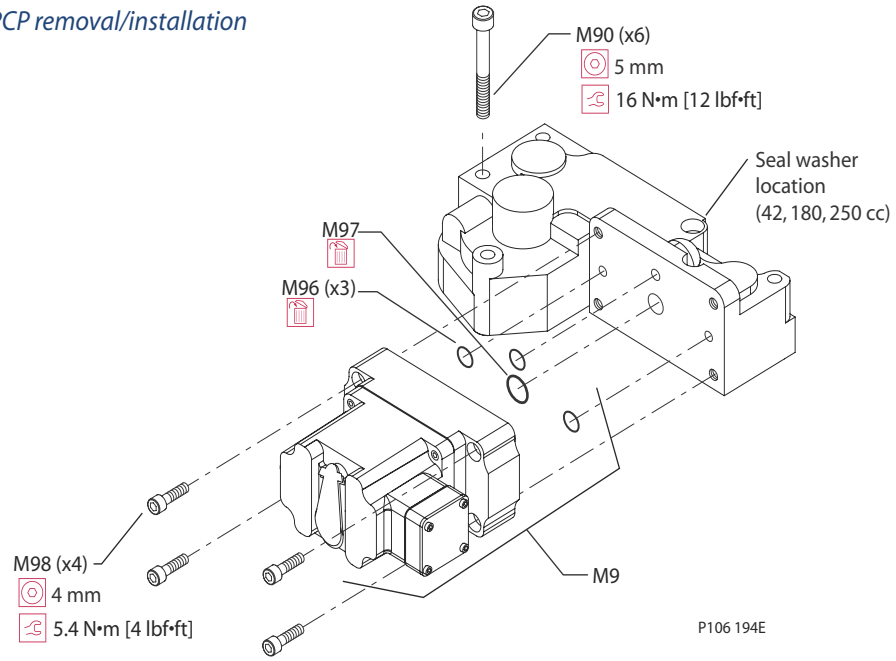
3. Check surfaces for nicks or damage. Clean internal screens.

Reassembly

4. Install new O-rings (M96 and M97) in PCP Housing. Place PCP against EDC housing and install the screws (M98). Torque to 5.4 N•m [4 lbf•ft].

Do not remove black plastic cover from the aluminum plate. This is not a serviceable item and will void the product warranty.

PCP removal/installation



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3-POSITION (FNR) ELECTRIC CONTROL

Removal

1. Thoroughly clean external surfaces prior to removal of control.

2. Using a 4 mm internal hex wrench, remove the four solenoid valve mounting screws (W702). Remove the solenoid valve (W701) (with O-rings (W701A) and orifice) from the adapter plate.

3. Using a 5 mm internal hex wrench, remove the six adapter plate mounting screws (M90). Remove the adapter plate and gasket (M11) from the housing. Discard the gasket. !

! Caution
Protect exposed surfaces and cavities from damage and foreign material.

Inspection

4. Inspect the orifice installed between the valve and adapter plate. This orifice *must* be installed in the case drain passage for proper pressure limiter operation.

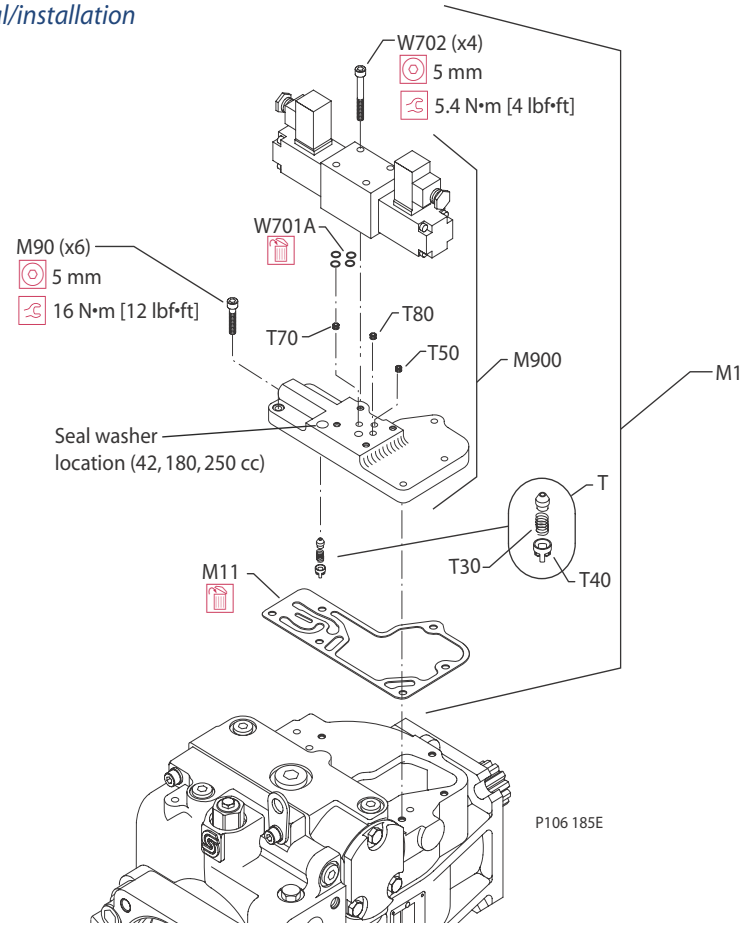
Reassembly

5. Install a new gasket (M11) on the housing. Place the adapter plate into position and install the screws (M90). ! Torque the screws to 16 N•m [12 lbf•ft].

6. Install new O-rings (W701A) and the orifice onto the solenoid valve assembly and install the solenoid valve onto the adapter plate. Install screws (W702). Torque to 5.4 N•m [4 lbf•ft].

Install a sealing washer under the head of any mounting screws that are installed into through holes in the housing.

FNR removal/installation

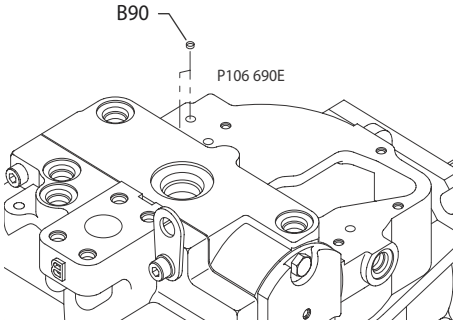


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DISPLACEMENT CONTROL FILTER SCREENS

If the pump is equipped with control filter screens in the pump housing (late production), press them into position (with the rounded edge of the filter screens facing the control) until they are flush to 2.0 mm [0.08 inch] below the surface of the housing.

Filter screen installation



SPEED SENSOR

Removal

1. Loosen the lock nut using a 11/16 in hex wrench.

2. Unscrew the speed sensor (B83) from the pump housing. Remove and discard the O-ring (B83A).

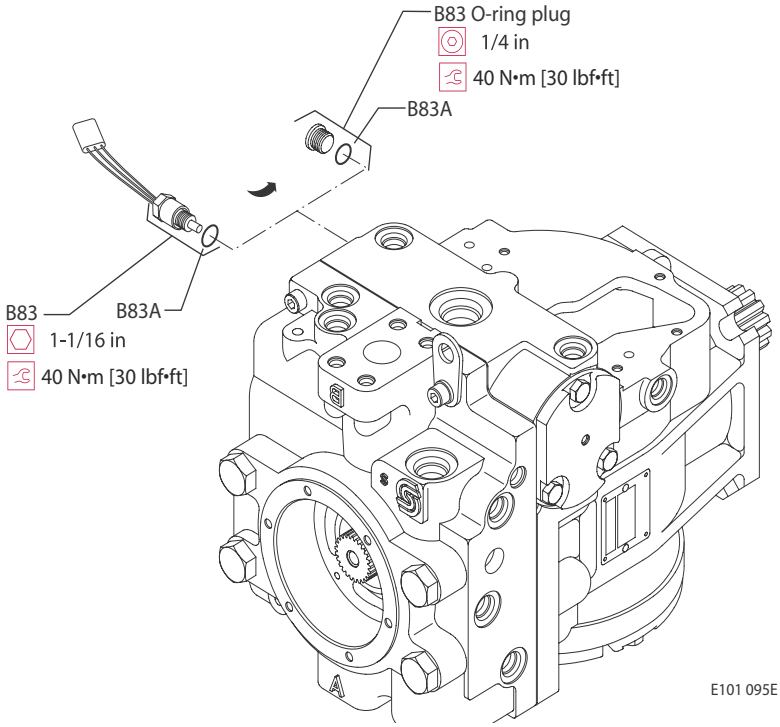
Reassembly

3. Install a new O-ring before reinstalling the sensor.

4. Reinstall the speed sensor (with lock nut and O-ring) into the housing. Adjust the gap between the sensor and the magnetic speed ring as instructed in *Speed sensor adjustment* (page 46) and torque the sensor lock nut to 13 N•m [10 lbf•ft].

5. If a speed sensor is not installed, use a 1/4 in internal hex wrench to torque the housing plug (B83) to 40 N•m [30 lbf•ft].

Typical location of speed sensor



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FASTENER SIZE AND TORQUE CHART

Item	Fastener	Frame size	Wrench size	Torque
B83	Speed sensor lock nut	030-250	1-1/16 in hex	13.5 N•m [10 lbf•ft]
E60	Side cover screw Blind holes	030-042	10 mm hex	13.5 N•m [10 lbf•ft]
		055-100	13 mm hex	32 N•m [24 lbf•ft]
		130-250	17 mm hex	50 N•m [37 lbf•ft]
E60	Side cover screw Thru holes	030-042	10 mm hex	10.4 N•m [7.7 lbf•ft]
		055-100	13 mm hex	32 N•m [24 lbf•ft]
		130-250	17 mm hex	64 N•m [47 lbf•ft]
F111/ F211	Servo cylinder screw	030-055	8 mm hex	13.5 N•m [10 lbf•ft]
		075-250	10 mm hex	32.5 N•m [24 lbf•ft]
G90/ G97	End cap screw	030-042	5 mm internal hex	13.5 N•m [10 lbf•ft]
		055-100	6 mm internal hex	32.4 N•m [24 lbf•ft]
		130	10 mm hex	38 N•m [28 lbf•ft]
		180-250	10 mm hex	110 N•m [81 lbf•ft]
H80	Charge pump retaining screw	030-100	10 mm hex	16 N•m [11.85 lbf•ft]
		130-250	13 mm hex	32 N•m [24 lbf•ft]
J80	End cap screw	030	8 mm internal hex	58 N•m [43 lbf•ft]
		early 042	8 mm internal hex	75 N•m [55 lbf•ft]
		late 042	10 mm internal hex	75 N•m [55 lbf•ft]
		055	19 mm hex	122 N•m [90 lbf•ft]
		075-100	24 mm hex	298 N•m [220 lbf•ft]
		100-130	14 mm internal hex	298 N•m [220 lbf•ft]
		180-250	17 mm internal hex	580 N•m [429 lbf•ft]
K10	Charge pressure valve plug	030-250	1/2 in hex	NA
K90	Charge pressure lock nut	030-100	1-1/16 in hex	52 N•m [38 lbf•ft]
		130-250	1-5/8 in hex	52 N•m [38 lbf•ft]
L70	Shaft retaining screw	030-042	10 mm hex	12 N•m [9 lbf•ft]
		055-100	5 mm internal hex	16 N•m [12 lbf•ft]
		130-250	6 mm internal hex	32 N•m [24 lbf•ft]
M72	MDC handle nut	030-250	8 mm	13.5 N•m [10 lbf•ft]
M78	De-stroke valve manifold screw	030-250	5 mm internal hex	13.5 N•m [10 lbf•ft]
M85	Eccentric plug lock nut	030-250	1-1/8 in hex	27 N•m [20 lbf•ft]
M88	Neutral start switch lock nut	030-250	1-1/8 in hex	27 N•m [20 lbf•ft]
M90	Control mounting screw	030-250	5 mm internal hex	16 N•m [12 lbf•ft]
M92	Solenoid valve mounting screw	030-250	4 mm internal hex	5.4 N•m [4 lbf•ft]
M98	PCP mounting screw	030-250	4 mm internal hex	5.4 N•m [4 lbf•ft]
N10	Filter reducer assembly	030-042	1-1/4 in hex	70 N•m [52 lbf•ft]
		055-130	1-1/2 in hex	122 N•m [90 lbf•ft]
		180-250	1-1/2 in hex	156 N•m [115 lbf•ft]
N37	Filter plug assembly	030-250	1/4 in internal hex	27 N•m [20 lbf•ft]
P2B1/ P2A1	Multi-function valve	030-100	1-1/4 in hex	89 N•m [66 lbf•ft]
		130-250	1-5/8 in hex	210 N•m [155 lbf•ft]

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PLUG SIZE AND TORQUE CHART

If any plugs or fittings are removed from the pump during servicing,install and torque as indicated in the accompanying table.

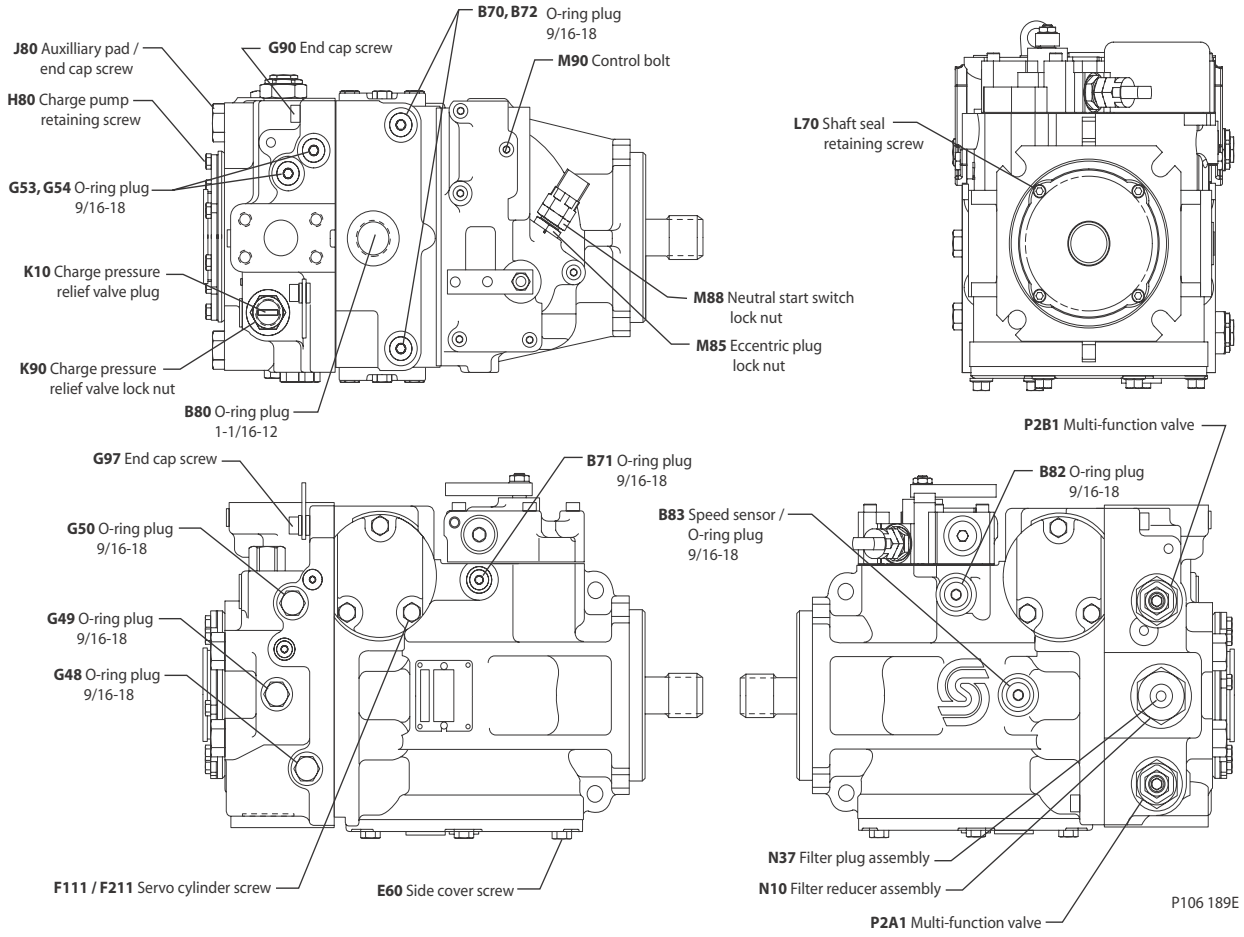
Always install new O-rings before reinstalling the plugs or fittings.

Caution
Torque plugs or fittings installed into aluminum housings to the lower values specified for internal hex plugs of the same size.

Item	O-ring plug	Wrench size	Torque
B70, B72	9/16-18	3/16 internal hex wrench	40 N•m [30 lbf•ft]
B71	9/16-18	3/16 internal hex wrench	12 N•m [9 lbf•ft]
B80	1-1/16-12	9/16 internal hex wrench	115 N•m [85 lbf•ft]
B82, B83	9/16-18	1/4 internal hex wrench	40 N•m [30 lbf•ft]
G18	7/16-20	3/16 internal hex wrench	12 N•m [9 lbf•ft]
G45-G50	9/16-18	11/16 inch hex wrench	40 N•m [30 lbf•ft]
G52-G54	9/16-18	1/4 internal hex wrench	23 N•m [17 lbf•ft]
H90 (not shown)	1-5/16-12	5/8 internal hex wrench	129 N•m [95 lbf•ft]
N35, N36 (not shown)	9/16-18	11/16 inch hex wrench	37 N•m [27 lbf•ft]
N37	9/16-18	1/4 internal hex wrench	40 N•m [30 lbf•ft]

FASTENERS AND PLUGS

Fastener and plug locations



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Notes

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Local address:

Sauer-Danfoss (US) Company
2800 East 13th Street
Ames, IA 50010, USA
Phone: +1 515 239-6000
Fax: +1 515 239-6618

Sauer-Danfoss ApS
DK-6430 Nordborg, Denmark
Phone: +45 7488 4444
Fax: +45 7488 4400

Sauer-Danfoss GmbH & Co. OHG
Postfach 2460, D-24531 Neumünster
Krokamp 35, D-24539 Neumünster, Germany
Phone: +49 4321 871-0
Fax: +49 4321 871 122

Sauer-Danfoss-Daikin LTD
Sannomiya Grand Bldg. 8F
2-2-21 Isogami-dori, Chuo-ku
Kobe, Hyogo 651-0086, Japan
Phone: +81 78 231 5001
Fax: +81 78 231 5004

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SAUER DANFOSS

Genuine Parts

Series 90 Pumps

Repair Instructions







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Series 90 Pumps
Repair Instructions
Revisions

Genuine Parts

HISTORY OF REVISIONS

Table of Revisions

Date	Page	Changed	Rev.
April 2008	79	Torque for G45, G50, G52, G54, B70, B72, B82, B83 changed to 40 Nm [30 lbf•ft]	AB
Dec 2007	-	First printing	AA

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Front cover illustrations: F000539, F300856, F101 411

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Genuine Parts

OVERVIEW

This manual details major repair procedures for Series 90 pumps. These include the complete disassembly, inspection, and reassembly of the unit. Where rework of worn or damaged components is possible, specifications appear to ensure these parts meet factory tolerances. Only Sauer-Danfoss Global Service Partners (GSPs) are authorized to perform major repairs. Sauer-Danfoss trains Global Service Partners and certifies their facilities on a regular basis.

Warning

Use of components that do not comply with rework specifications may result in loss of performance, which may constitute a safety hazard. Do not reuse components that don't comply to given specifications: replace with genuine Sauer-Danfoss service parts.

Minor repair procedures, adjustments, and troubleshooting information appear in the *Series 90 Pumps Service Manual*, **520L0818**. Minor repairs include service operations you can perform without removing the unit's endcap. Removal of the endcap voids your warranty.

GENERAL INSTRUCTIONS

Follow these general procedures when repairing Series 90 pumps.

Remove the unit

Prior to performing major repairs, remove the unit from the vehicle/machine. Chock the wheels on the vehicle or lock the mechanism to inhibit movement. Be aware that hydraulic fluid may be under high pressure and/or hot. Inspect the outside of the pump and fittings for damage. Cap hoses and plug ports after removal to prevent contamination.

Keep it clean

Cleanliness is a primary means of assuring satisfactory pump life, on either new or repaired units. Clean the outside of the pump thoroughly before disassembly. Take care to avoid contamination of the system ports. Cleaning parts in a clean solvent wash and air drying is usually adequate.

As with any precision equipment, keep all parts free of foreign materials and chemicals. Protect all exposed sealing surfaces and open cavities from damage and foreign material. If left unattended, cover the pump with a protective layer of plastic.

Lubricate moving parts

During assembly, coat all moving parts with clean hydraulic fluid. This assures that these parts are lubricated during start-up.

Replace all O-rings and gaskets

Sauer-Danfoss recommends that you replace all O-rings, seals and gaskets. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly.

Secure the unit

For major repair, place the unit in a stable position with the shaft pointing downward. It is necessary to secure the pump while removing and torquing the endcap bolts.

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SAFETY PRECAUTIONS

Always consider safety precautions before beginning a service procedure. Protect yourself and others from injury. Take the following general precautions whenever servicing a hydraulic system.

Unintended machine movement

⚠ Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

Flammable cleaning solvents

⚠ Warning

Some cleaning solvents are flammable. To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

Fluid under pressure

⚠ Warning

Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury and/or infection. This fluid may also be hot enough to cause burns. Use caution when dealing with hydraulic fluid under pressure. Relieve pressure in the system before removing hoses, fittings, gauges, or components. Never use your hand or any other body part to check for leaks in a pressurized line. Seek medical attention immediately if you are cut by hydraulic fluid.

Personal safety

⚠ Warning

Protect yourself from injury. Use proper safety equipment, including safety glasses, at all times.

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Genuine Parts

SYMBOLS USED IN SAUER-DANFOSS LITERATURE

- WARNING may result in injury
- CAUTION may result in damage to product or property
- Reusable part
- Non-reusable part, use a new part
- Non-removable item
- Option – either part may exist
- Superseded – parts are not interchangeable
- Measurement required
- Flatness specification
- Parallelism specification
- External hex head
- Internal hex head
- Torx head
- O-ring boss port
- Tip, helpful suggestion
- Lubricate with hydraulic fluid
- Apply grease/petroleum jelly
- Apply locking compound
- Inspect for wear or damage
- Clean area or part
- Be careful not to scratch or damage
- Note correct orientation
- Mark orientation for reinstallation
- Torque specification
- Press in – press fit
- Pull out with tool – press fit
- Cover splines with installation sleeve
- Pressure measurement/gauge location or specification

The symbols above appear in the illustrations and text of this manual. They are intended to communicate helpful information at the point where it is most useful to the reader. In most instances, the appearance of the symbol itself denotes its meaning. The legend above defines each symbol and explains its purpose.

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SHAFT

Shaft and bearing

1. Position pump with the shaft pointing up.

Number of screws and wrench size varies by model.

2. Remove the three or four screws (L70) holding the retainer plate (L60) and seal carrier (L30) to the housing, using a 10 mm hex wrench (042 unit), a 5 mm internal hex wrench (055 through 100 units), or a 6 mm internal hex wrench (130 through 250 units). Remove the retainer plate.

3. Pry the seal carrier (L30) from its bore. You may tap lightly on the end of the shaft with a soft mallet to facilitate removal.

4. Remove the O-ring (L50) from the seal carrier and discard.

5. Place seal carrier in an arbor press and press out the seal (L40). Discard seal.

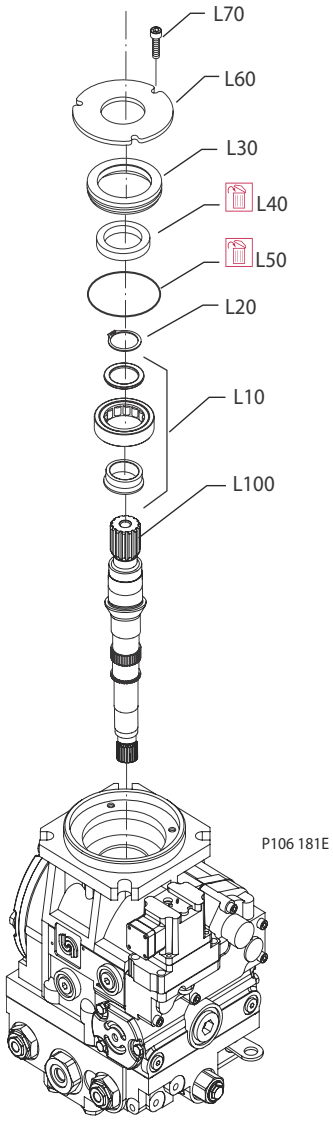
6. Lift the shaft and bearing assembly out of the pump.

7. Remove the snap ring (L20).

8. Remove the bearing washer and roller assembly (L10).

9. Press the inner bearing race off the shaft (L100).

Removing the shaft and bearing assembly

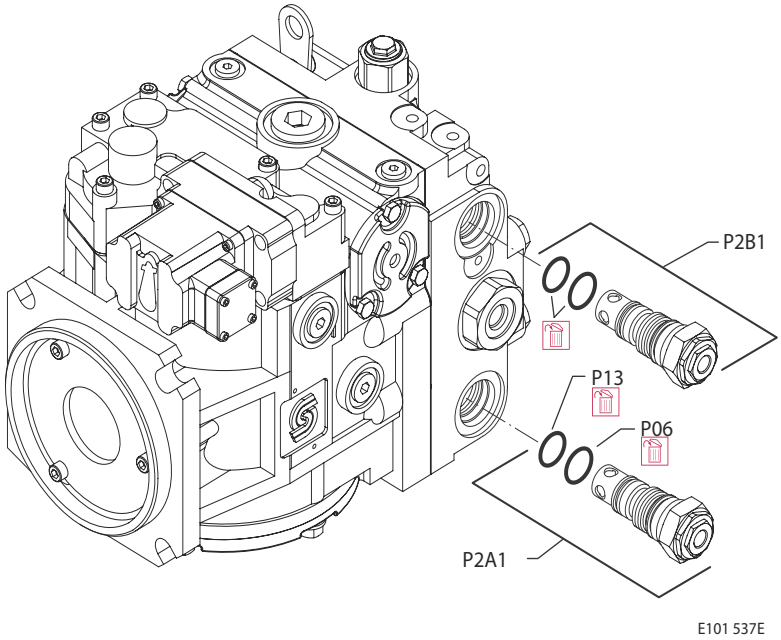


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MULTI-FUNCTION VALVE CARTRIDGES

Older multifunction valves (pre 1988) contain different components. See *multifunction valves - Pre 1988*, (page 10) for disassembly instructions.

Multi-function valve removal



E101 537E

Removal

Remove multi-function valves (P2A1 and P2B1) using hex wrench listed in table.

Multi-function valve wrench size

Frame size	Wrench size
030 – 100	1-1/4 inch
130 – 250	1-5/8 inch

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Genuine Parts

MULTI-FUNCTION VALVE CARTRIDGE (continued)

Disassembly

1. Remove and discard O-rings (P13 and P06).

2. Relieve spring pressure by removing bypass actuator (P03), using a 1-1/16 wrench. To retain pressure setting, do not separate adjusting screw (P01), and locknut (P04) from bypass actuator (P03).

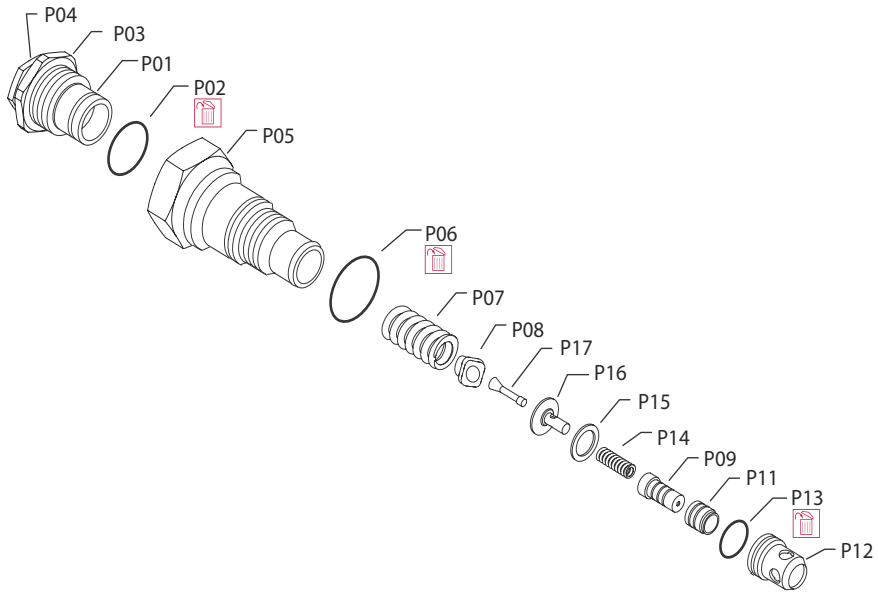
3. Remove and discard O-ring (P02).

Multi-function valves are sold as complete units only. You may purchase O-rings separately.

4. The poppet seat section is pressed over a lip. Place the cartridge in a vise and pry the poppet seat (P12) off with an appropriate tool. Maintain sufficient control to prevent the internal components from flying loose. Do not damage parts during disassembly.

5. Remove internal parts (P07, P08, P17, P16, P15, P14, P09, and P11).

Multi-function valve



E101 531E

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MULTI-FUNCTION VALVE CARTRIDGES - PRE 1988

Removal

Remove multi-function valves using hex wrench listed in table.

Multi-function valve wrench size

Frame size	Wrench size
030 – 100	1-1/4 inch
130 – 250	1-5/8 inch

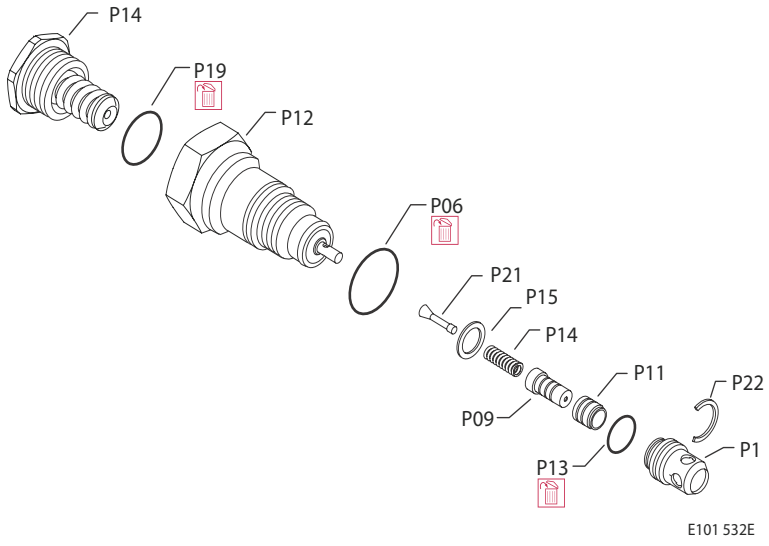
Disassembly

1. Remove and discard O-rings (P03 and P06).
2. It is not necessary to remove the bypass actuator (P14) except for cleaning. Wrench size is 1-1/16.

Multi-function valves are sold as complete units only. O-rings may be purchased separately.

3. To retain pressure setting, do not disassemble bypass actuator (P14).
4. Remove retaining ring (P22) with a snap ring pliers.
5. Remove poppet seat (P1).
6. Remove internal parts (P21, P15, P14, P09, and P11).

Multi-function valve - pre 1988



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CHARGE PRESSURE RELIEF VALVE

The charge pressure relief valve is shim adjustable (early models) or screw adjustable (late models). Screw adjustable charge relief valve is shown.

Removal

1. Remove the shim adjustable charge relief valve plug with a 1 inch hex wrench. Retain shims.

   Before removing the screw adjustable relief valve plug, mark the plug (K10), lock nut (K90), and housing to approximately maintain the original adjustment when assembling. Remove the screw adjustable charge relief valve plug by loosening the lock nut with a hex wrench corresponding to the table.

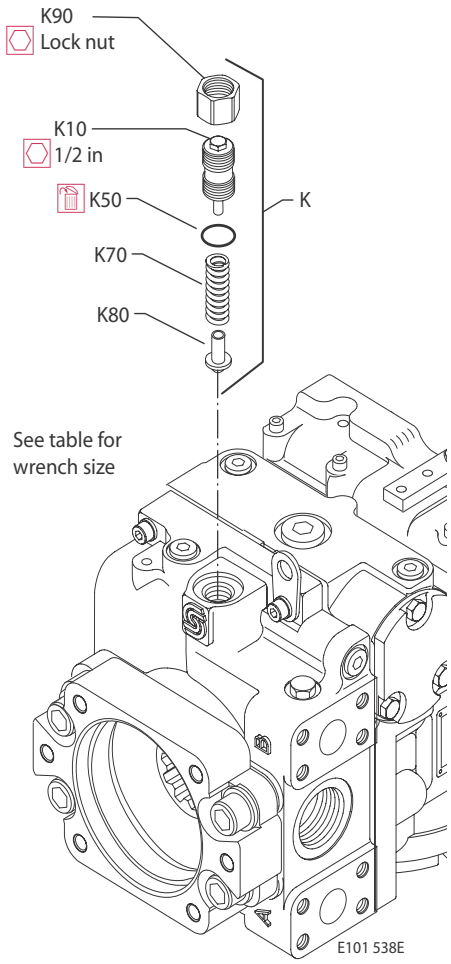
   Unscrew the plug using a large screwdriver or 1/2 inch hex wrench. Remove and discard the O-ring (K50).

2. Remove the spring (K70) and relief valve poppet (K80).

Lock nut wrench size

Frame size	Wrench size
030 – 100	1-1/16 inch
130 – 250	1-5/8 inch

Charge pressure relief valve



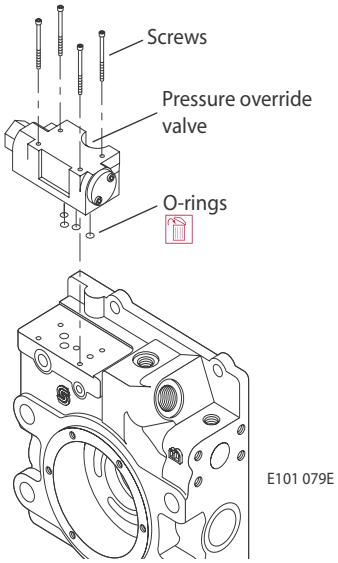
PRESSURE OVERRIDE VALVE (OPTION FOR 180 FRAME SIZE)

Removal

1. Remove four screws attaching the pressure override valve to the end cap with a 5 mm internal hex wrench.

2. Remove and discard the O-rings.

Pressure override valve components



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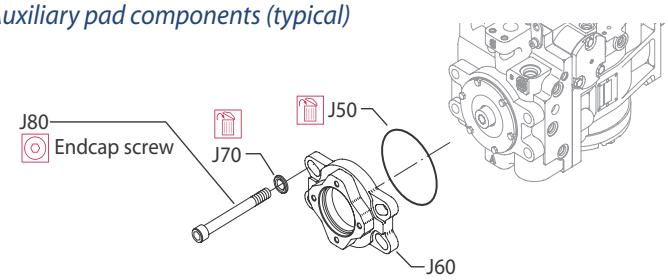
AUXILIARY PAD

Removal

1. Remove four end cap screws (J80). Remove and discard seal washers (J70).

2. Remove the auxiliary pad (J60) and discard the O-ring (J50).

Auxiliary pad components (typical)



See table for wrench size and torque

E101 084E

Auxiliary pad screw wrench size

Frame size	Wrench sizes
030 – early 042	8 mm internal hex
late 042	10 mm internal hex
055	19 mm hex
075 – 100	24 mm hex
100 – 130	14 mm internal hex
180 –250	17 mm internal hex

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CHARGE PUMP

Removal

1. For pumps with an auxiliary mounting pad, refer to the *Auxiliary Pad* instructions (page 13).

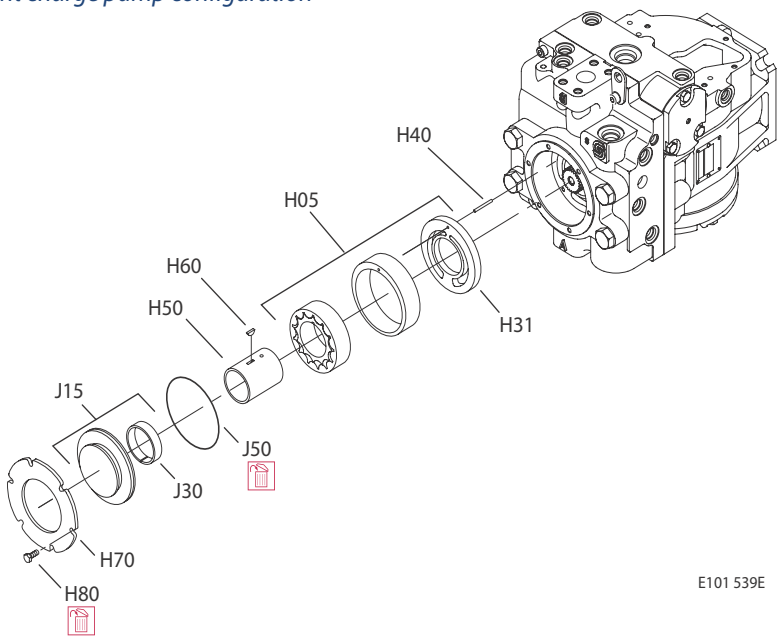
2. Remove and discard six screws (H80) from the charge pump cover retainer (H70).

3. Remove retainer (H70) and the charge pump cover (J15). Remove and discard O-ring (J50). Note the orientation of the gerotor assembly (H05).

Retainer screw wrench size

Frame size	Wrench size
030 – 100	10 mm
130 – 250	13 mm

Current charge pump configuration



Refer to appropriate *Sauer-Danfoss Series 90 service parts manual* for earlier charge pump configurations.

4. Remove charge pump coupling (H50) and charge pump drive key (H60).

5. Remove the charge pump gerotor assembly (H05).

6. Remove the alignment pin (H40).

7. Remove the valve plate (H31).

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INTEGRAL CHARGE PRESSURE FILTER REPLACEMENT

Removal

1. Remove filter canister (N40) from the filter head (N10) as described on the canister.

Lock nut wrench size and torque

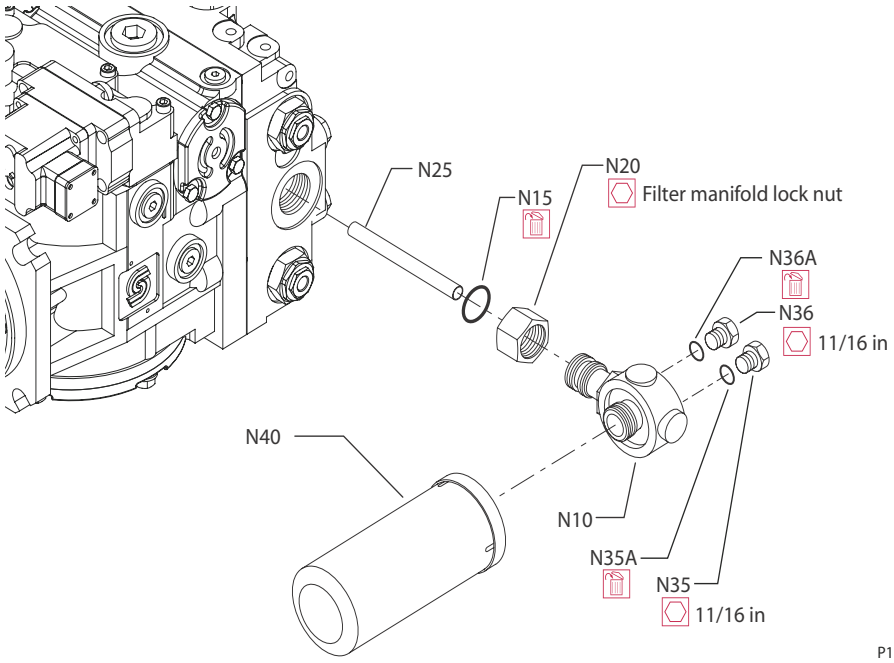
Frame size	Wrench size	Torque
030 – 042	1-3/8 inch	70 N•m [52 lbf•ft]
055 – 130	1-5/8 inch	122 N•m [90 lbf•ft]
180 – 250	1-5/8 inch	156 N•m [115 lbf•ft]

2. Hold filter head in place and loosen the lock nut (N20) using the wrench size in the table.

3. Rotate filter head counterclockwise to remove it from the housing. Remove and discard the O-ring (N15).

4. Remove hydraulic tube (N25) from its bore in the endcap.

Integral charge pressure filter



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PUMP CONTROL COVER PLATE

Removal

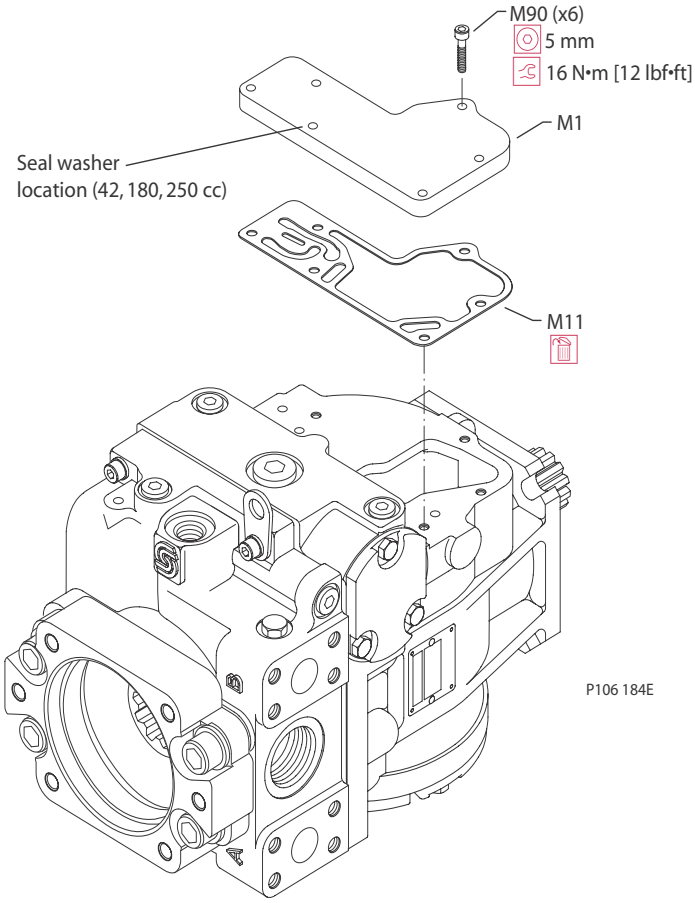
1. Thoroughly clean external surfaces prior to removing cover plate.

2. Using a 5 mm internal hex wrench, remove six cover plate mounting screws (M90). Remove the cover plate (M1) and gasket (M11) from housing. Discard the gasket.

Caution

Protect exposed surfaces and cavities from damage and foreign material.

Pump controls cover plate



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MANUAL DISPLACEMENT CONTROL (MDC)

Removal

1. Thoroughly clean external surfaces prior to removing control.

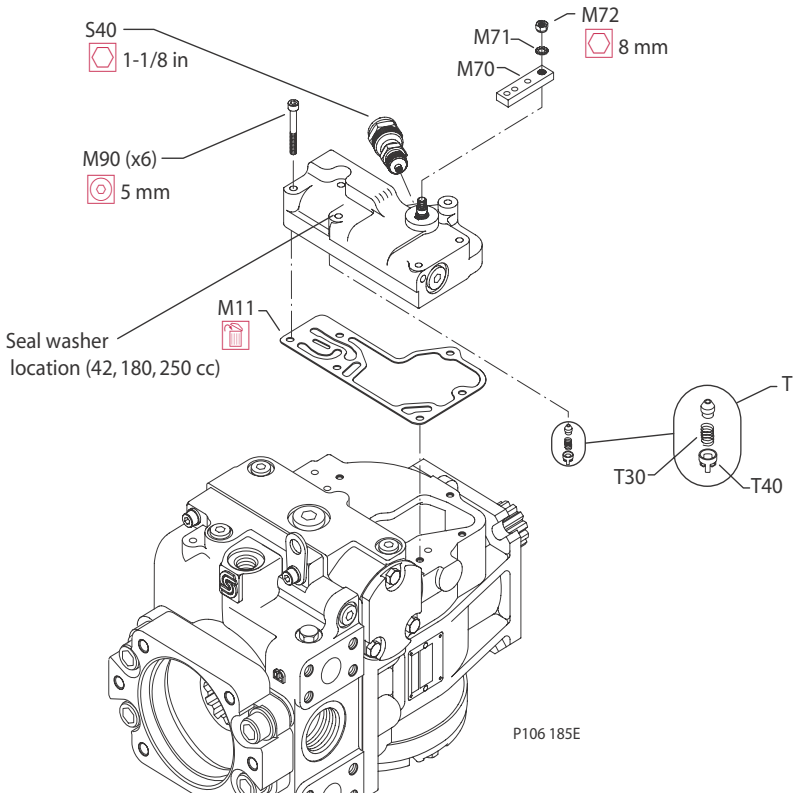
2. Using a 5 mm internal hex wrench, remove six control mounting screws (M90). Remove the control (M1) (with orifice check valve (T40) and spring (T30)) and control gasket (M11) from the housing. Discard the gasket.

If necessary, remove the control handle (M70) by removing the locking nut (M72) and washer (M71).

Caution

Protect exposed surfaces and cavities from damage and foreign material.

MDC removal/installation



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SOLENOID OVERRIDE VALVE FOR MDC

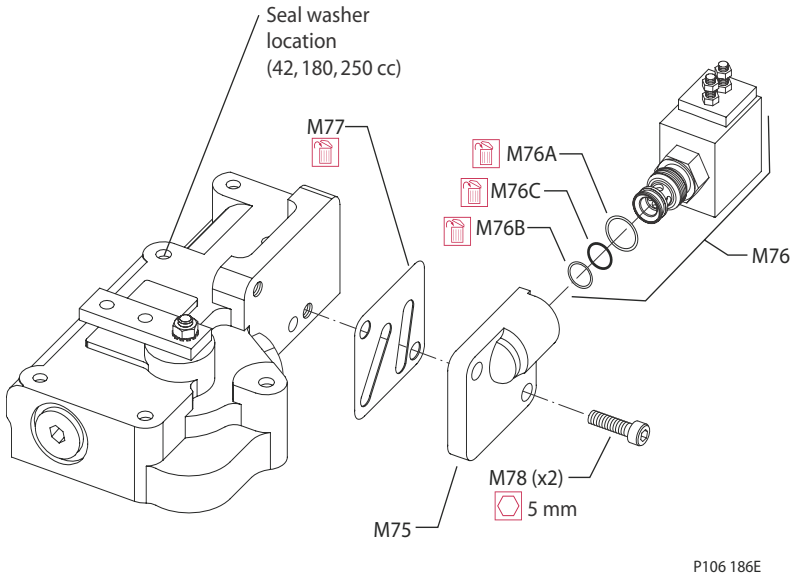
Removal

1. Thoroughly clean external surfaces prior to removing valve.

2. Remove the solenoid from the valve by removing the coil-nut with a 3/4 inch hex wrench. Remove the solenoid valve (M76) from the manifold (M75) with a 7/8 inch hex wrench. Remove the O-rings (M76A, B) and backup ring (M76C); discard.

3. Using a 5 mm internal hex wrench, remove two screws (M78) and remove solenoid manifold (M75) from housing. Remove and discard the gasket (M77).

Solenoid override valve removal/installation



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SOLENOID OVERRIDE VALVE FOR MDC WITH PRESSURE RELEASED BRAKE

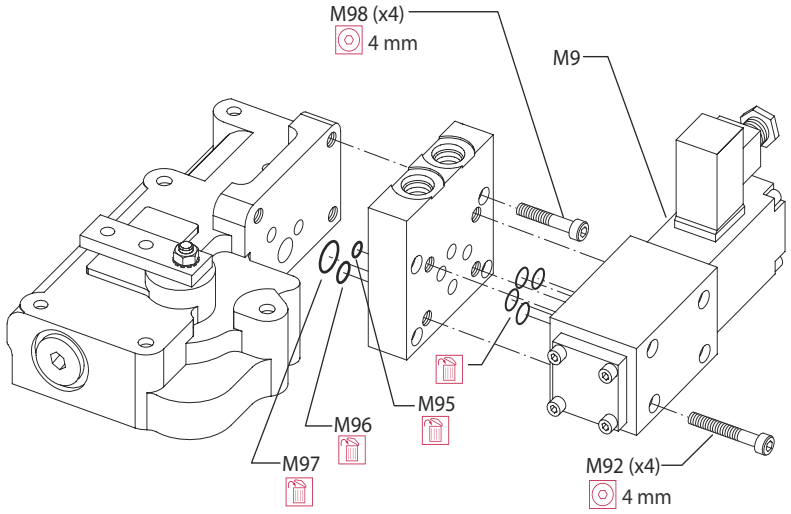
Removal

1. Thoroughly clean external surfaces prior to removing valve.

2. Using a 4 mm internal hex wrench, remove the four solenoid valve mounting screws (M92). Remove the solenoid valve (M9) (with O-rings) from the adapter plate. Discard the O-rings.

3. Using a 4 mm internal hex wrench, remove the four adapter plate mounting screws (M98). Remove the adapter plate and O-rings (M95, M96, and M97) from the control housing. Discard the O-rings.

Solenoid override valve removal/installation



P106 192E

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HYDRAULIC AND ELECTRIC DISPLACEMENT CONTROLS

Removal

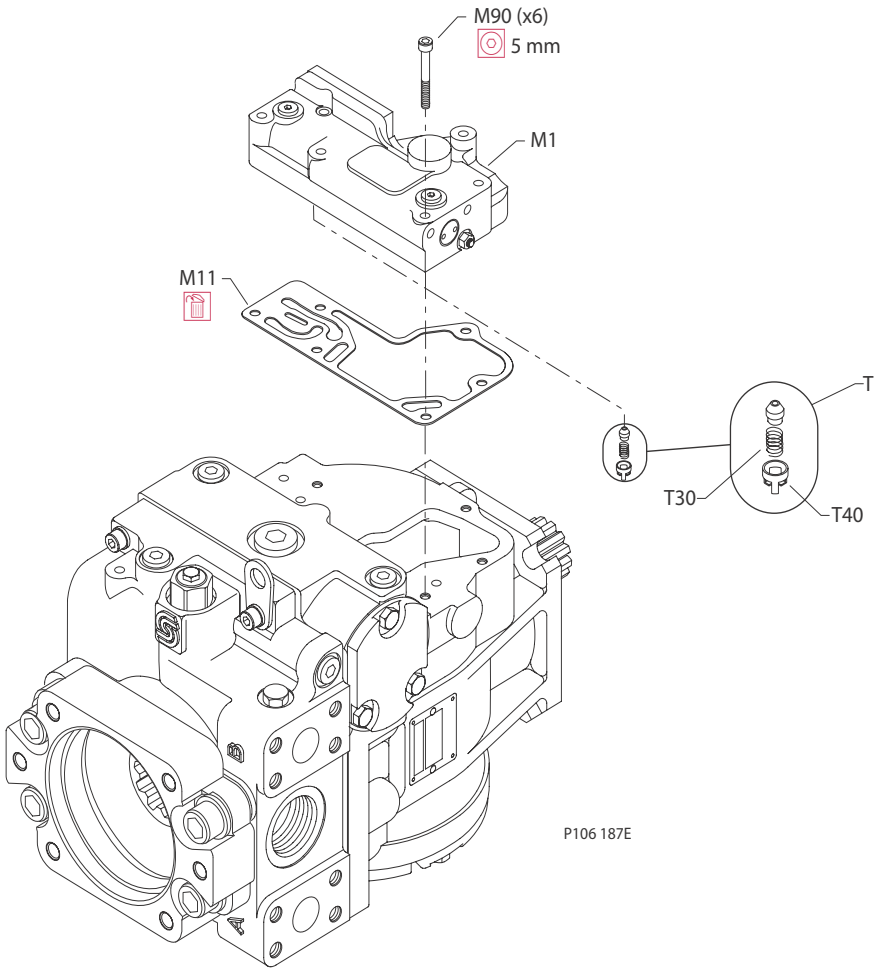
1. Thoroughly clean external surfaces prior to removing control.

2. Using a 5 mm internal hex wrench, remove six control mounting screws (M90). Discard seal washer if present. Remove control (M1) with orifice check valve (T40) and spring (T30) and control gasket (M11) from housing. Discard the gasket.

Caution

Protect exposed surfaces and cavities from damage and foreign material.

Hydraulic/Electric displacement control



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PRESSURE CONTROL PILOT (PCP) FOR ELECTRIC DISPLACEMENT CONTROL (EDC)

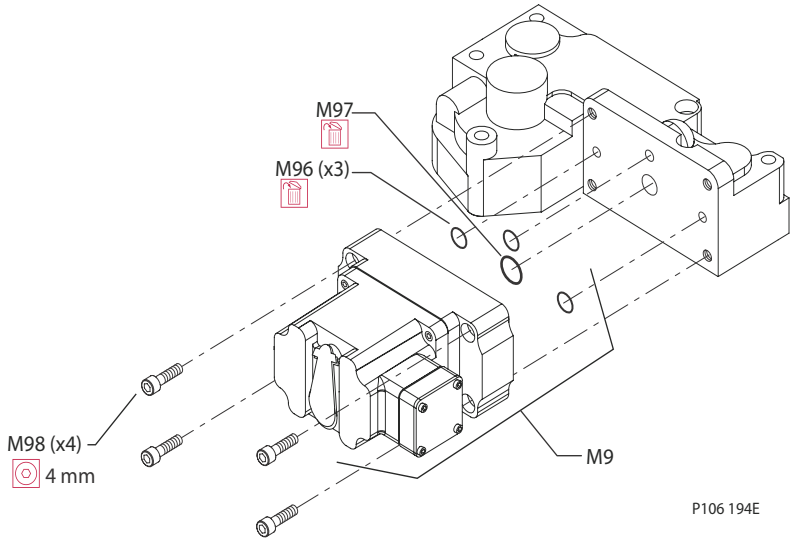
Do not disassemble the PCP (M9). It is available only as a complete unit.

Removal

1. Thoroughly clean external surfaces of control.

2. Using a 4 mm internal hex wrench, remove four screws (M98) and remove the PCP (M9). Remove and discard the O-rings (M97, M96)

PCP removal/installation



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3-POSITION (FNR) ELECTRIC CONTROL

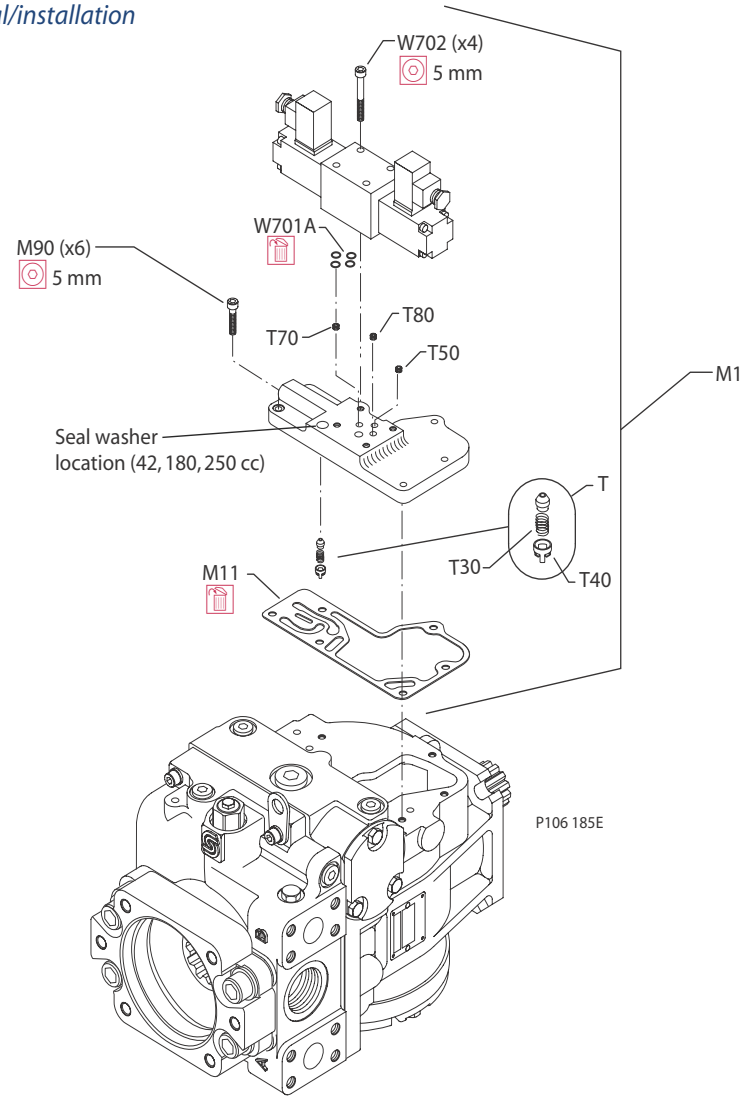
Removal

1. Thoroughly clean external surfaces prior to removal of control.
2. Using a 4 mm internal hex wrench, remove four solenoid valve mounting screws (W702). Remove the solenoid valve (W701), with O-rings (W701A) and orifice, from the adapter plate.
3. Using a 5 mm internal hex wrench, remove the six adapter plate mounting screws (M90). Remove the adapter plate and gasket (M11) from the housing. Discard the gasket. !
4. If necessary, remove and clean the three orifices (T50, T70, T80) using a 2.5mm internal hex wrench and a 4mm internal hex wrench.

! Caution
Protect exposed surfaces and cavities from damage and foreign material.

Do not disassemble the FNR control. It is available as a complete unit only.

FNR removal/installation

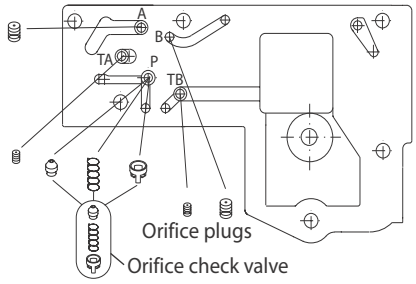


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DISPLACEMENT CONTROL ORIFICES (EDC/HDC CONTROL)

1. Remove the control assembly as described in the instructions for the specific displacement control.
2. You may find orifice plugs in the control assembly, at the pump housing face. To avoid mixing them up, remove, clean, and replace orifice plugs individually. Use a 4mm internal hex wrench to remove the plugs. Note the location of each plug, do not interchange plugs. Clean, reinstall, and torque the orifice plugs to 3 N•m [2.2 lbf•ft].

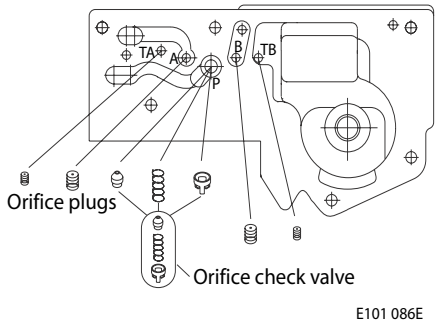
Underside of an HDC/EDC module showing orifice locations



DISPLACEMENT CONTROL ORIFICE CHECK VALVE (MDC CONTROL)

1. Remove the control assembly as described in the instructions for the specific displacement control.
2. The orifice check valve is in the control assembly, at the surface of the pump housing face. Remove the spring retainer and spring from the orifice check valve cavity and then remove the orifice check valve.
3. Clean and install the orifice check valve in the cavity and then install the spring and spring retainer to hold the orifice check valve in position.

Underside of an MDC module showing orifice locations

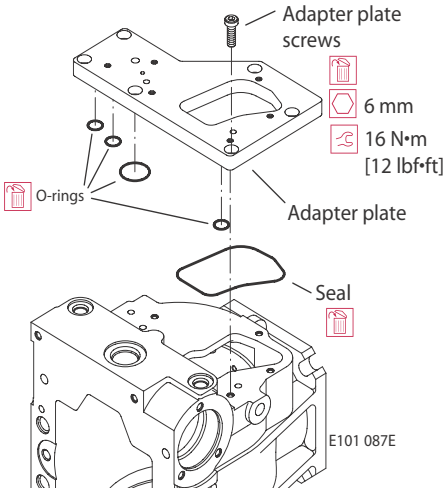


DISPLACEMENT CONTROL ADAPTER PLATE (EARLY PRODUCTION 130 PUMPS ONLY)

Do not remove the adapter plate unless leakage is evident. The mounting screws with sealing compound are difficult to remove.

The screws fastening the control adapter plate to the housing have sealing compound on the threads. You may remove them with a 6 mm internal hex wrench if necessary. Remove and discard the O-rings and seals.

Displacement control adapter plate (early production 130 cm³ pumps only)

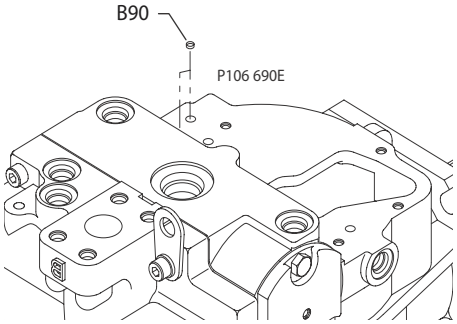


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DISPLACEMENT CONTROL FILTER SCREENS

If you remove the screens, replace with new screens. Press them into position with the rounded edge of the screen facing the control, until they are flush to 2.0 mm [0.08 inch] below the surface of the housing.

Filter screen installation



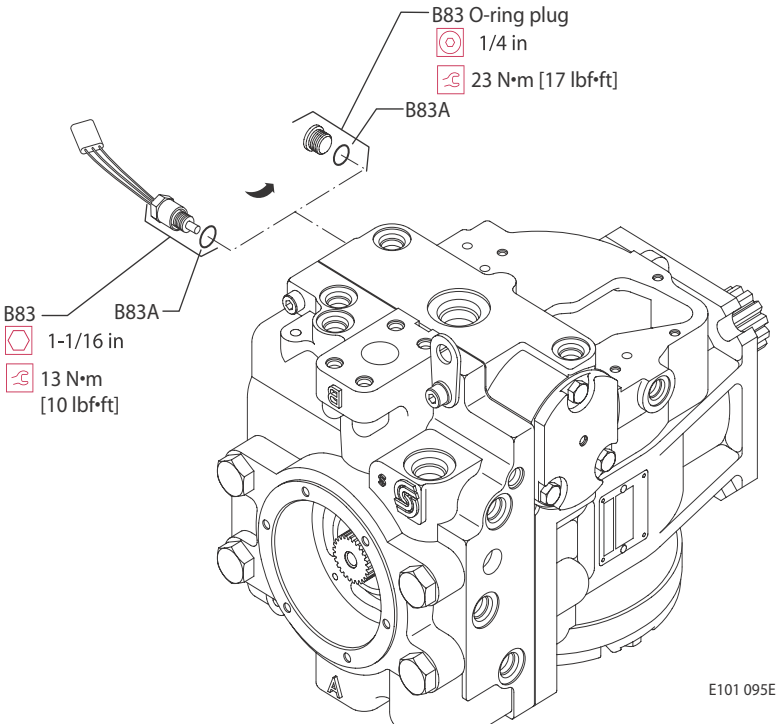
SPEED SENSOR

Removal

1. Loosen the lock nut using an 11/16 in hex wrench.

2. Unscrew speed sensor (B83) from the pump housing. Remove and discard the O-ring (B83A).

Typical location of speed sensor



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SERVO RELIEF VALVES

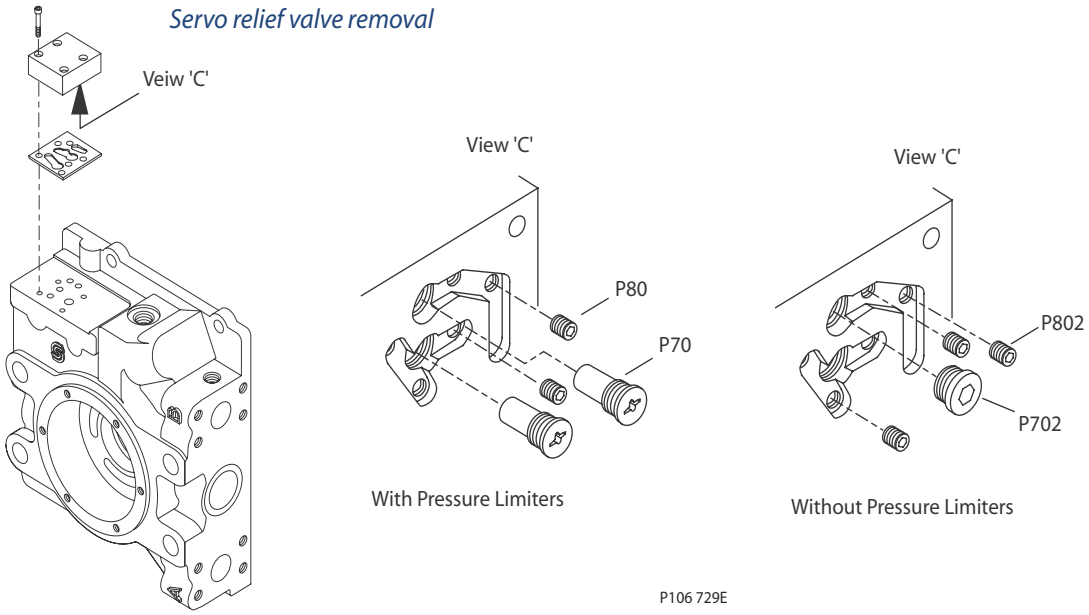
Certain frame size pumps with twin port end caps may have the servo relief valves and rotation plugs in a removable rotation block.

1. Using a 5 mm internal hex wrench, remove the rotation block screws.
2. Remove the block.
3. Remove the gasket.

Some pumps have a pressure-limiter function.

4. Remove the servo relief valves from the end cap (or rotation block). Use a screwdriver.

Servo relief valve removal



Servo relief passage plugs

Some pumps have pressure limiter valves and/or relief valves.

1. Note the position of the rotation pipe plugs.
2. Using a 3/16 inch internal hex wrench, remove the servo relief passage plug(s) from the end cap or rotation block.
3. Using a 1/8 inch internal hex wrench remove the pipe plugs from the end cap or rotation block.
4. Clean passages with a suitable solvent.

See the illustrations on the following pages for proper plug and valve locations on various pumps.

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Genuine Parts

SERVO RELIEF VALVES (continued)

Installing servo relief valves

1. Install servo relief valves or relief valve passage plugs into the end cap or rotation block.

2. Install servo relief valves in the end cap or rotation block of pumps with pressure limiter functions or relief valves.

3. Install the rotation pipe plugs into the end cap or rotation block. ⚠

⚠ Warning

Make sure the pressure limiter logic plugs are in the correct ports for pump rotation. Uncontrollable machine movement results from improper plug installation. Verify correct pressure limiter function. Test the pump before installing in machine. Also, test it before releasing the machine from repair.

4. Torque the servo relief valves or relief valve passage plugs to 12.2 N•m [9.0 lbf•ft].

5. Torque the rotation pipe plugs to 5.4 N•m [4 lbf•ft].

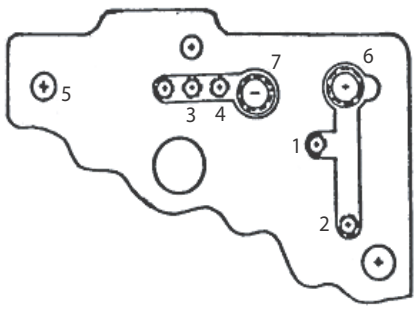
6. Install rotation block, gasket, and screws, if used.

7. Torque the rotation block screws to 16.3 N•m [12.0 lbf•ft].

Specifications

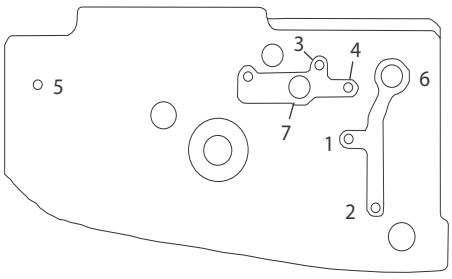
Pressure limiter		Pump rotation	Holes with pipe plugs	Holes with servo relief valves	Holes with O-ring plugs	Open holes
Port A	Port B					
Yes	Yes	Right (CW)	1, 3	6, 7	None	2, 4, 5
Yes	Yes	Left (CCW)	2, 4	6, 7	None	1, 3, 5
No	No	Either	1, 2, 5	None	6	3, 4, 7
Yes	No	Right (CW)	1, 3, 5	6	None	2, 4, 7
Yes	No	Left (CCW)	2, 4, 5	6	None	1, 3, 7
Yes	Yes	Right (CW) with automotive control	1, 3	None	6, 7	2, 4, 5
Yes	Yes	Left (CCW) with automotive control	2, 4	None	6, 7	1, 3, 5

030 twin ported end cap (early units)



P104 189

030 Twin ported end cap

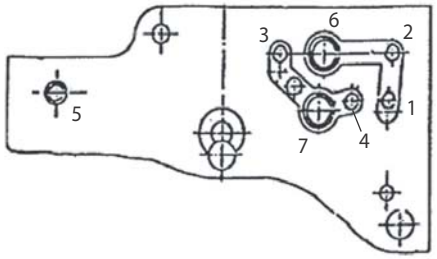


P104 190

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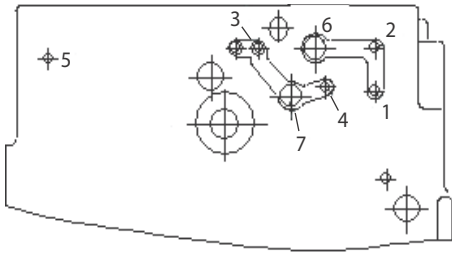
SERVO RELIEF VALVES (continued)

042 twin ported end cap (early units)



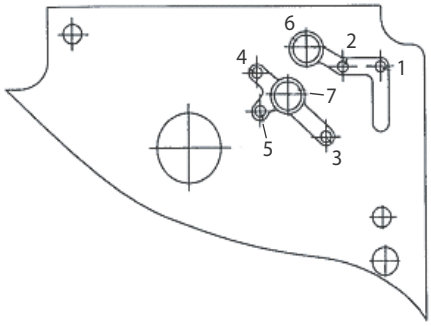
P104 191

042 twin ported end cap



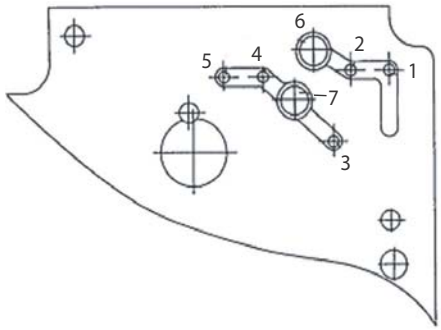
P104 192

055 side ported end cap



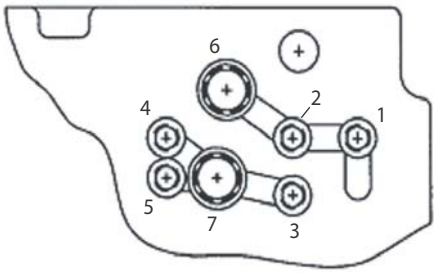
P104 193

055 twin ported end cap



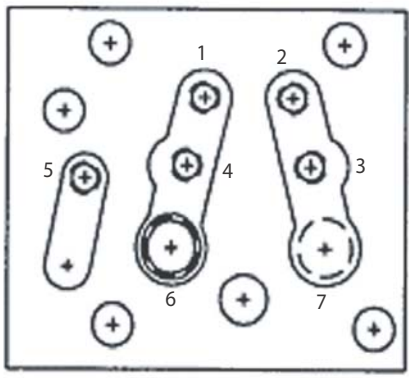
P104 194

075 side and twin ported end cap



P104 195

075 twin ported end cap rotation block

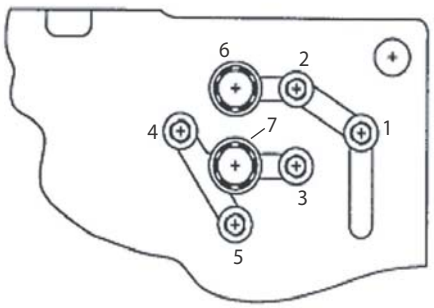


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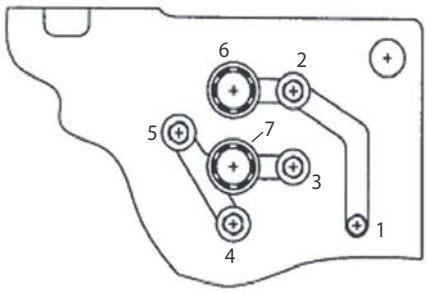
SERVO RELIEF VALVES (continued)

100 side ported end cap



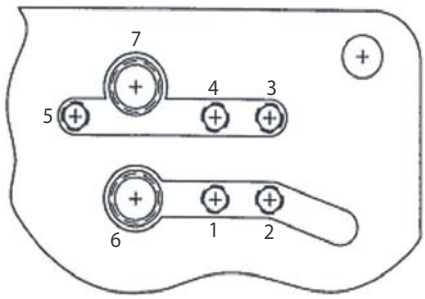
P104 197

100 twin ported end cap



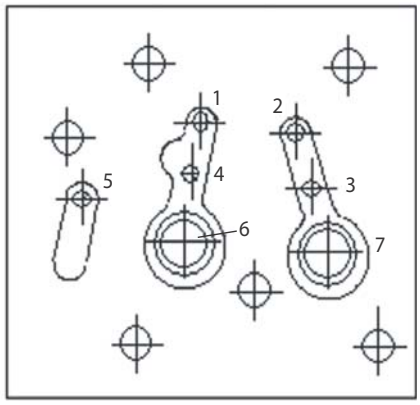
P104 198

130 twin ported end cap



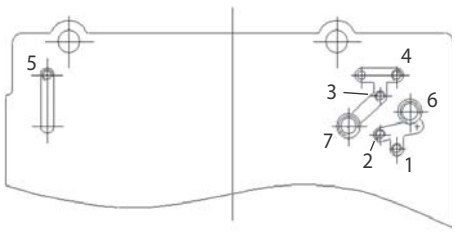
P104 199

180 twin ported end cap rotation block



P104 200

250 twin port end cap



P104 201

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ENDCAP

1. Place the pump on the work surface with endcap (G04) facing up.

Number of screws and wrench size varies by model.

2. Using a 5 or 6 mm internal hex wrench, or a 10 mm hex wrench remove the 2 or 3 screws (G90/G97) fastening the end cap to the pump housing.

The screw (G97) retains a spacer (G93), a lifting bracket (G94), and a washer (G95).

3. Remove screws (J80) if present. Refer to the table: *Screw removal* for wrench sizes.

4. Remove end cap (G04) from housing.

(J80) Screw removal

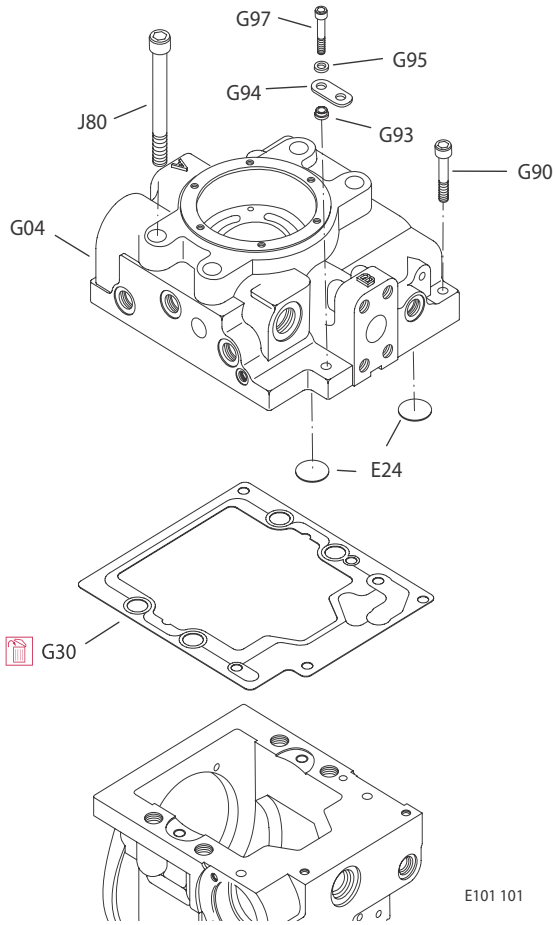
Pump size	Wrench size
042 cc	8 mm internal hex
055 cc	19 mm hex
075 cc and 100 cc	24 mm hex
130 cc	14 mm internal hex
180 cc and 250 cc	17 mm internal hex

The alignment pins and valve plate will usually remain with the housing.

5. Remove and discard end cap gasket (G30).

6. Remove the hardened shims (E24) from the end cap pockets.

Removing the end cap and gasket



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VALVEPLATE

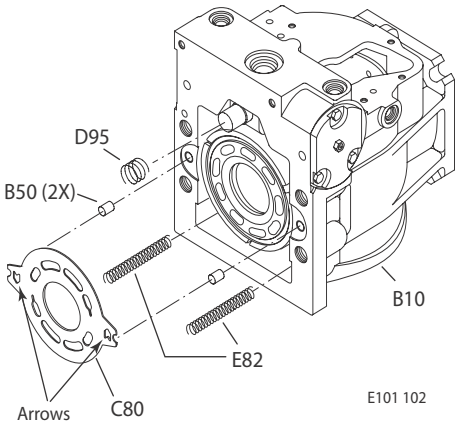
Valveplate and springs

1. Remove valve plate (C80), noting direction of arrows on valve plate.
2. Remove the long springs (E82) from the swashplate leveler.

Some units have dual swashplate leveler springs (an inner spring nested inside each of the standard springs).

3. Remove the short swashplate hold down spring (D095 if present).
4. Remove the two alignment pins (B50).

Removing internal parts



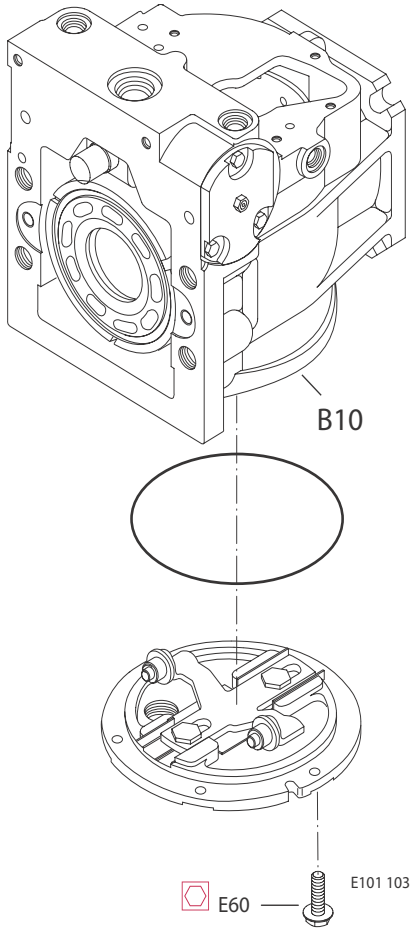
SIDECOVER

1. Mark the orientation of the side cover (E10) to the housing.
2. Straighten the locking tabs (used on earlier production units).
3. Remove the 6 side cover screws (E60). Refer to table below for wrench sizes.
4. Remove side cover assembly from pump housing.

Side cover screw removal

Pump size	Wrench size
042 cc	10 mm hex
055 cc through 100 cc	13 mm hex
130 cc through 250 cc	17 mm hex

Removing the side cover



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SIDECOVER DISASSEMBLY

Side cover components

1. Remove spacer washers (if used) on the leveler spring seats (E22).

Some units with dual swashplate leveler springs have spacer washers on the leveler spring seats.

2. Remove spring seats (E22) from swashplate leveler (E20).

Some levelers do not have removable spring seats.

3. Remove the sealing nuts (E40) and guide posts (E30) holding the leveler (E20) to the side cover (E10). Refer to table below for wrench sizes.

Sealing nut removal

Pump size	Wrench sizes
030 cc and 042 cc	17 mm open end 10 mm hex
055 cc through 100 cc	3/4 inch open end 13 mm hex
130 cc through 250 cc	24 mm open end 17 mm hex

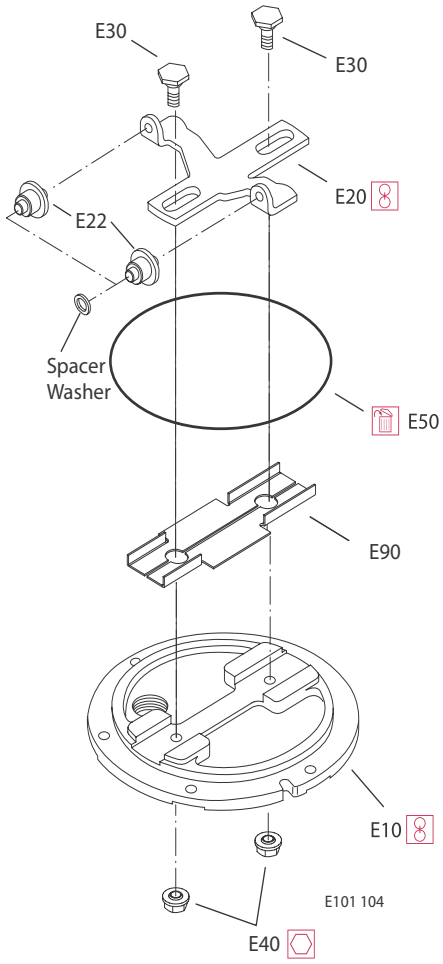
4. Note the orientations of the leveler (E20) and side cover (E10).

5. Remove leveler (E20) from side cover (E10).

6. Remove the insert assembly (E90).

7. Remove and discard side cover O-ring (E50).

Leveler disassembly

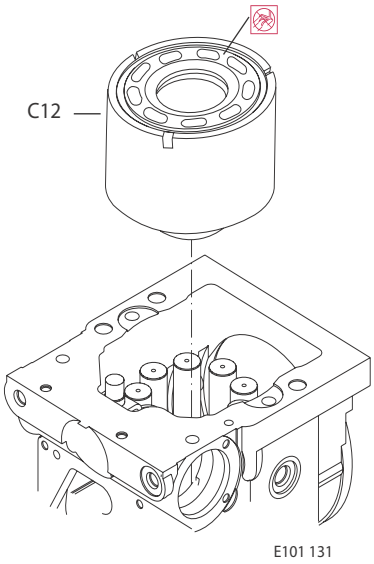


CYLINDER BLOCK

Remove the cylinder block (C12) from the housing.

The swashplate and piston assembly remains in the housing. ! Take care to prevent pistons from being scratched while the cylinder block is out of the housing. The pistons are not selectively fitted, however units with high hourly usage may develop wear patterns. Number the pistons and bores for re-assembly if they are to be reused.

Cylinder block removal



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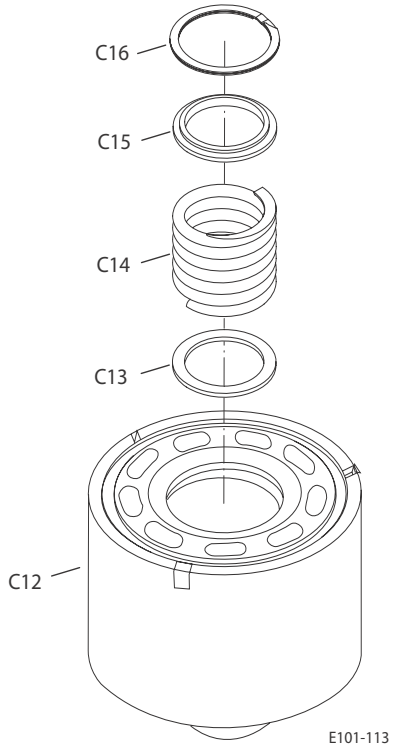
CYLINDER BLOCK

Most repairs do not require block spring removal. Perform this procedure only if you suspect problems with the block spring.

⚠ Warning
Risk of personal injury: Compressing the block spring requires 350 to 400 N [80 to 90 lbf]. Use a press sufficient to maintain this force with reasonable effort. Ensure the spring is secure before attempting to remove the spiral retaining ring. Release the pressure slowly after the retaining ring is removed.

1. Using a press, apply pressure on the block spring washer (C15) to compress the block spring (C14). Compress the spring enough to safely remove the spiral retaining ring (C16). While maintaining pressure, unwind the spiral retaining ring. Carefully release the pressure and remove the outer block spring washer, block spring, and inner block spring washer (C13) from the cylinder block. ⚠

Cylinder block disassembly



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SERVO CYLINDERS

1. Mark the servo cylinders (F110/F210) and housing (B10). This helps to identify each servo cylinder (F110/F210) with its respective side of the housing (B10).

Number of screws and wrench size varies by model.

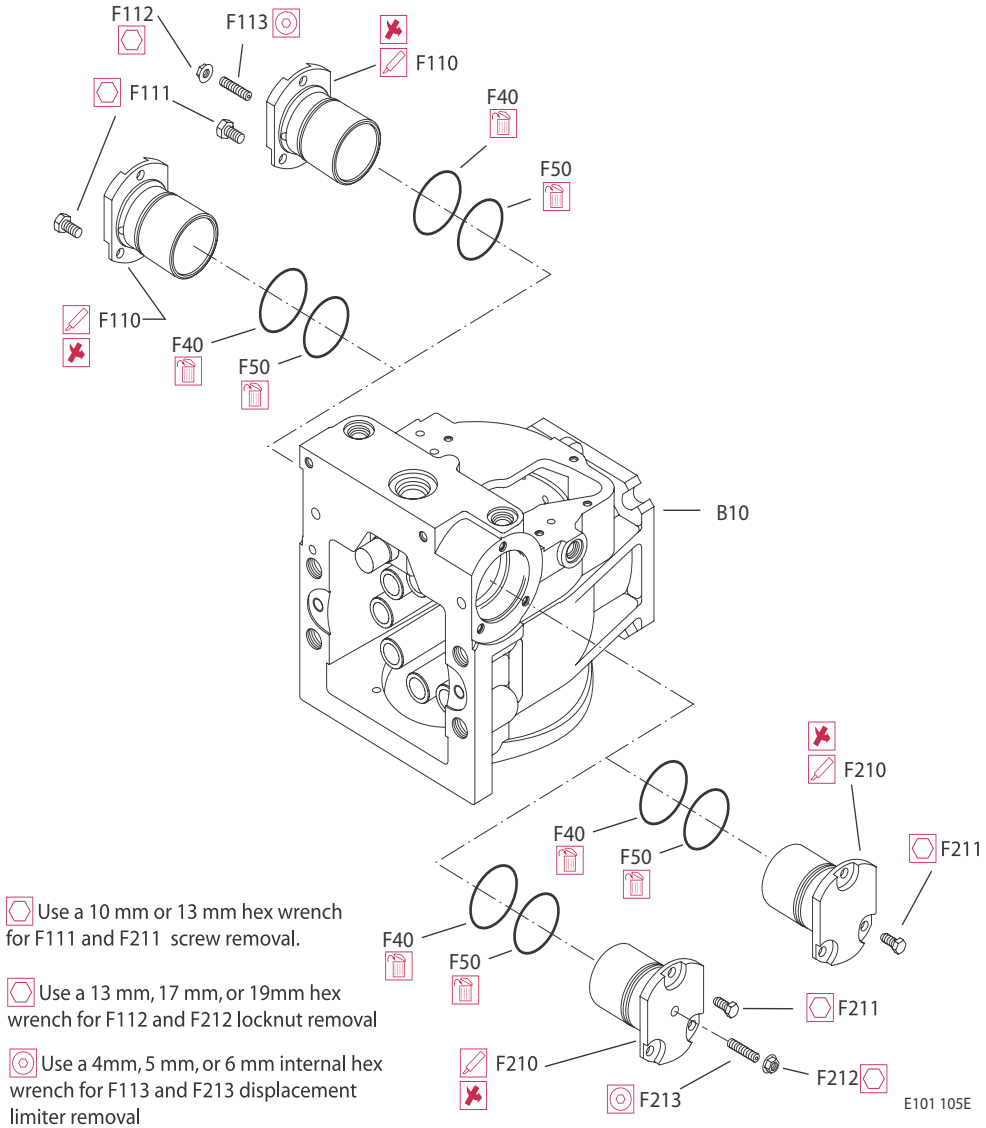
2. Using a 10 mm or 13 mm hex wrench, remove the 3 or 4 screws (F111/F211) retaining each servo cylinder (F110/F210) to the housing (B10).

3 a. For early production units, carefully pry each cylinder (F110/F210) from the housing (B10) by using a screwdriver in the notches in the cylinder.

b. For later production units, install an 8 mm or 10 mm screw in the threaded hole in the center of each cylinder (F110/F210), and pull the cylinders from the housing (B10).

The servo piston will remain in the housing. For later production units with displacement limiters, remove the nut (F112/F212) and limiter screw (F113/F213) from each servo cylinder (F110/F210) and install an 8 mm or 10 mm screw in its place as a puller screw.

Servo cylinder removal



Use a 10 mm or 13 mm hex wrench for F111 and F211 screw removal.

Use a 13 mm, 17 mm, or 19mm hex wrench for F112 and F212 locknut removal

Use a 4mm, 5 mm, or 6 mm internal hex wrench for F113 and F213 displacement limiter removal

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SWASHPLATE

042 cm³ displacement pumps use a screw as the link pin. Remove it with a 3 mm internal hex wrench if necessary.

1. Remove the swashplate bearing cage link pin (D85) from the housing through the control opening.
2. Remove the bearing cage locator link (D80) from the swashplate through the control opening.

180 cc and 250 cc pumps have 2 screw-type link pins. One is at the control opening. The other is at the side cover opening.

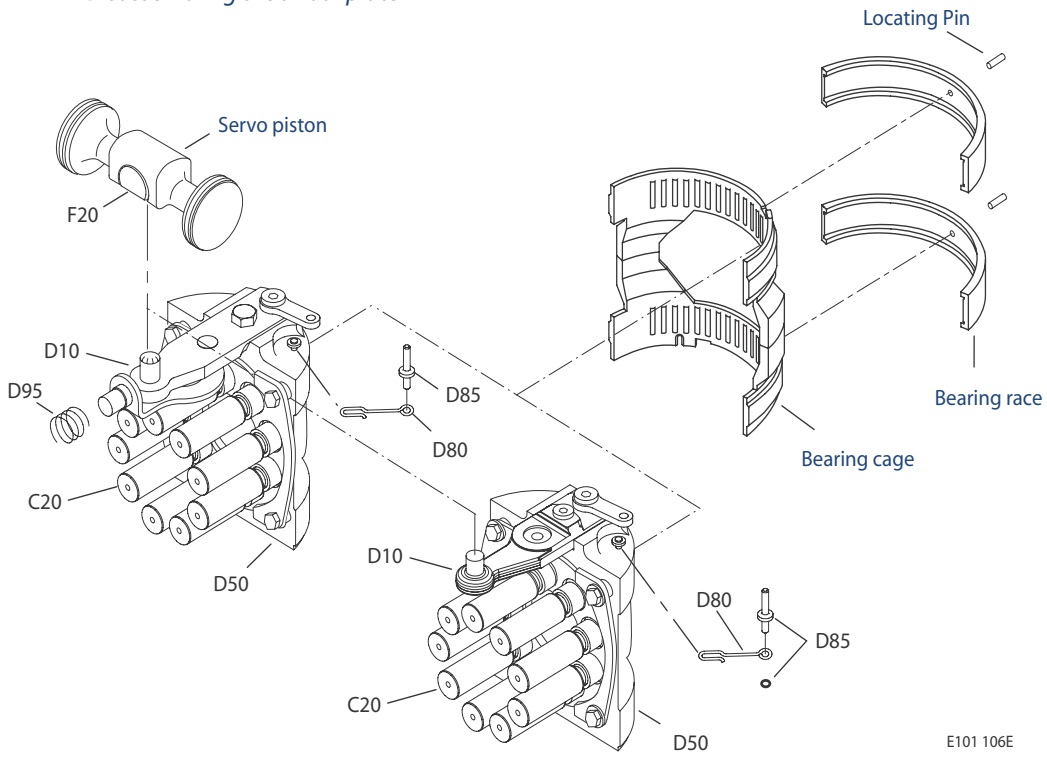
3. Remove the swashplate (D50) and piston assembly (C20) through the housing side cover opening.

Units with an automotive control have a threaded hole in one end of the servo piston. This is for the centering assist spring assembly. For these units, note the orientation of the servo piston in the housing.

4. Disengage the servo arm (D10) from the slider block (F20) in the servo piston as you remove the assembly.
5. Remove the servo piston and slider block (F20) from housing.
6. Remove the cradle bearing cage and races with locating pins.

The bearing race locating pins are a loose fit.

Disassembling the swashplate

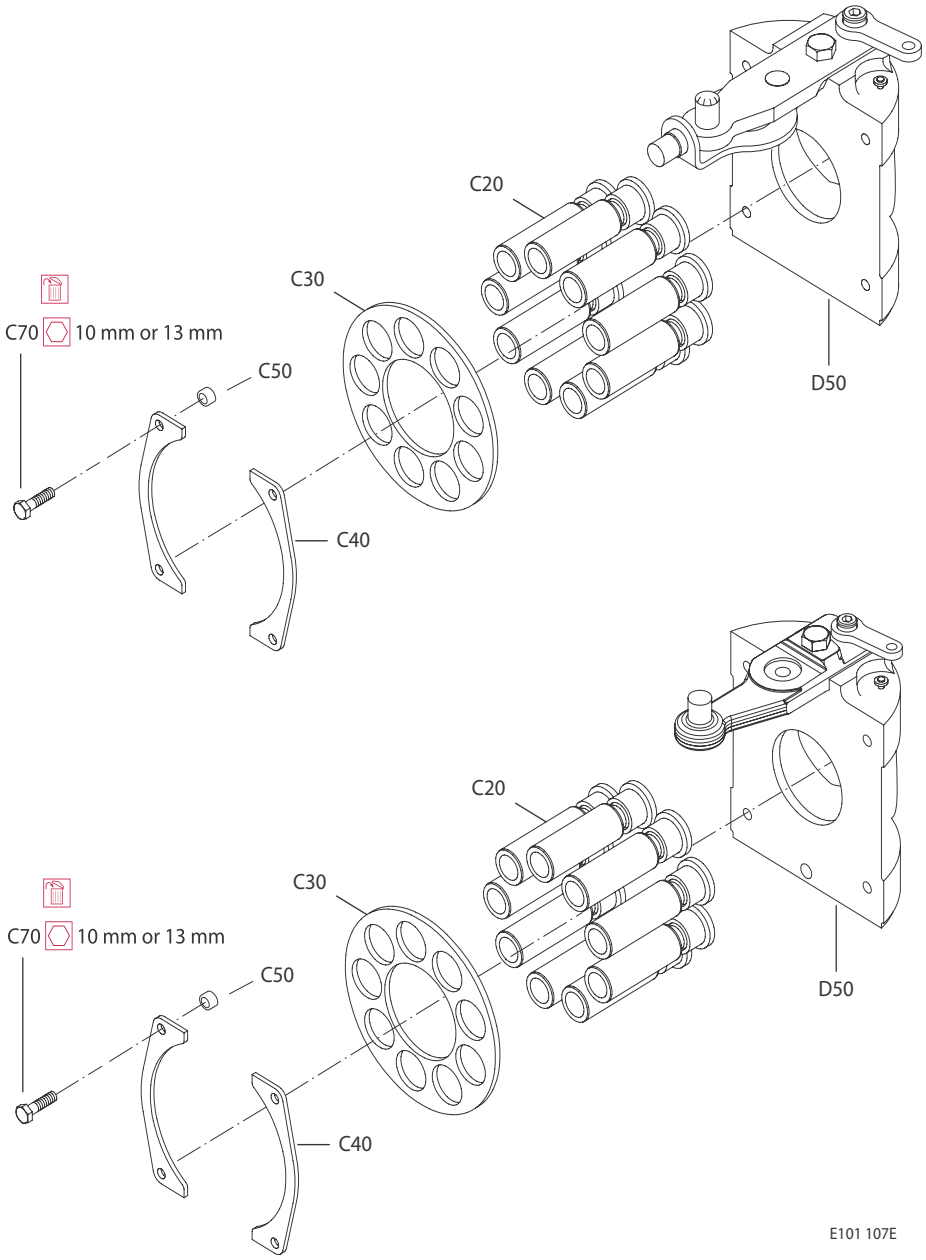


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PISTON ASSEMBLY

1. Using a 10 mm or 13 mm hex wrench remove the 4 screws (C70) and spacers (C50) holding the two slipper guide hold down bearings (C40) to the swashplate (D50).
2. Discard screws (C70). Replace with new screws when pump is assembled.
3. Remove the hold down bearings (C40) and spacers (C50).
4. Remove the slipper guide (C30) and pistons (C20) from the swashplate (D50).
5. Remove the piston assemblies (C20) from the slipper guide (C30).

Removing the piston/slipper assembly



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SWASHPLATE

1. Remove guide (D60) and feedback link (M14) by removing special locking screw (D65). Discard locking screw. See table *Swashplate components* below for wrench sizes.

2. Remove servo arm (D10) from swashplate (D50) by removing locking screw (D55). Discard locking screw. See table *Swashplate components* below for wrench sizes.

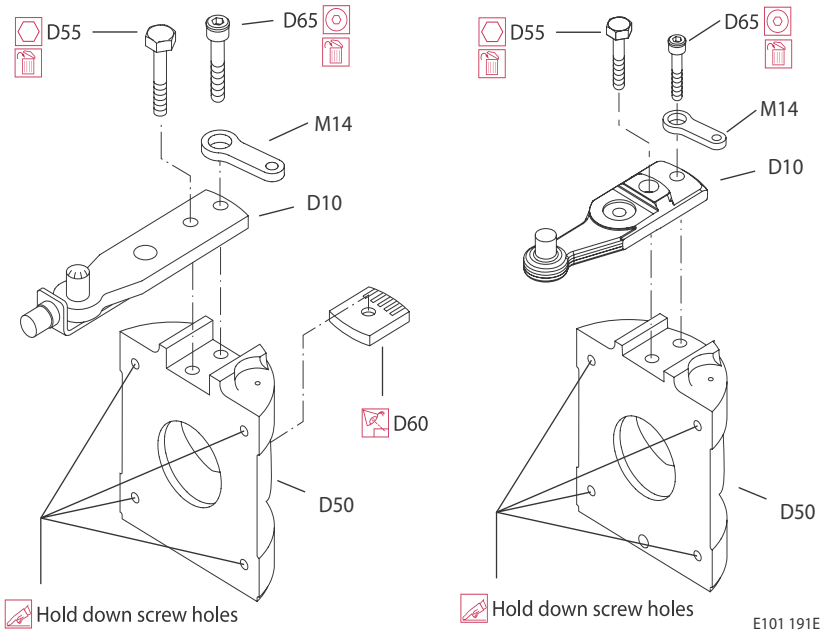
3. Clean the threaded holes for the hold down screws in swashplate (D50) of all old locking compound. Use a M6 X 20 or M8 X 25 thread tap for this procedure.

4. Clean the threaded holes for the locking screws (D55, D65) in swashplate (D50) of all old locking compound. Use a thread tap, given in the table below, for this procedure.

Swashplate components

Pump size	D55 wrench size	D55 thread size	D65 wrench size	D65 thread size
030 cc and 042 cc	13 mm hex	M8 - 32	5 mm internal hex	M6 -25
055 cc and 075 cc	13 mm hex	M8 - 35	6 mm internal hex	M8 - 45
100 cc and 130 cc	17 mm hex	M10 - 35	6 mm internal hex	M8 - 45
180 cc and 250 cc	19 mm hex	M12 - 40	8 mm internal hex	M12 - 70

Removing the swashplate guide and servo arm



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OVERVIEW

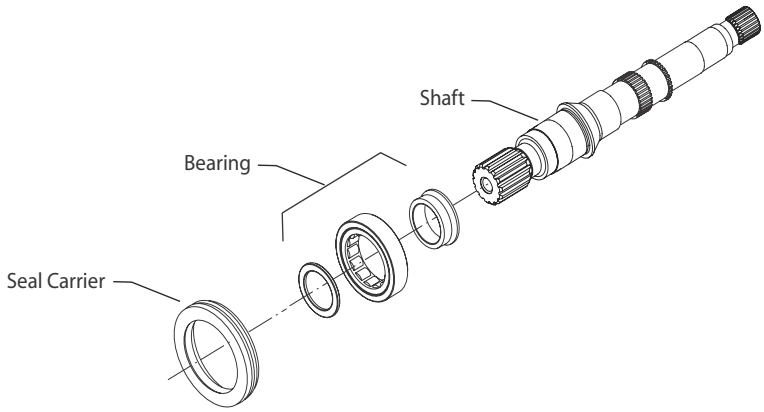
Clean all parts in a suitable solvent. Replace: O-rings, gaskets, shaft seal. Inspect all parts for damage, nicks, or unusual wear patterns. Replace all parts with unusual or excessive wear or discoloration , which indicates excessive heat.

SHAFT ASSEMBLY

Inspection

Inspect the seal carrier for any damage or nicks. Inspect the shaft and bearing for rust, wear, or contamination. Spin the bearing in your hand feeling for roughness. Replace if necessary

Shaft assembly



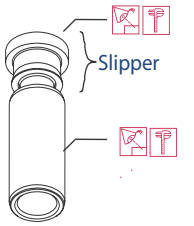
E101 541E

PISTONS AND SLIPPERS

Inspect the pistons for damage and discoloration. Discolored pistons may indicate excessive heat; do not reuse.

Inspect the running surface of the slippers. Replace any piston assemblies with scored or rounded slipper edges. Measure the slipper foot thickness. Replace any piston assemblies with worn slippers. Check the slipper axial end-play. Replace any piston assemblies with excessive end-play. Refer to Rework Specifications 520L1033 for component rework guidelines.

Inspect pistons



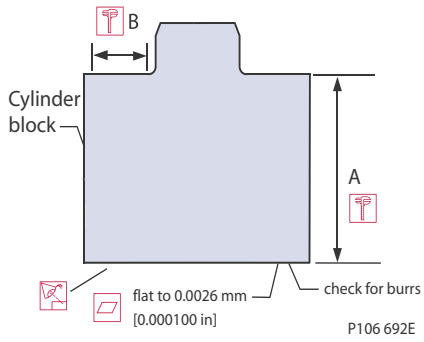
P104 109E

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CYLINDER BLOCK

Examine the running face of the cylinder block. The surface should be smooth and free of nicks and burrs. Remove any burrs. Ensure that no scratches or grooves exist; these may drastically reduce output flow and life of pump. Refer to Rework Specifications 520L1033 for component rework guidelines.

Inspect cylinder block



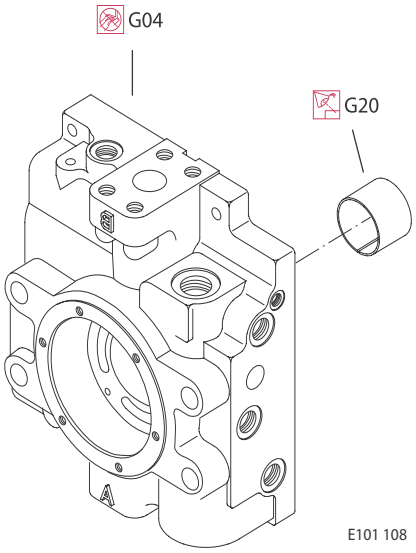
ENDCAP JOURNAL BEARING

⚠ Warning
Do not damage the valve plate surface of the end cap when removing the bearing.

Inspect the endcap valve plate and sealing surfaces for nicks and scratches. Check surface flatness. Refer to Rework Specifications 520L1033 for component rework guidelines. If any of the base metal is visible through the plastic bearing material, replace the end cap journal bearing (G20).Use a suitable puller to remove the bearing. ⚠ Press the journal bearing into the end cap (G04) using a press pin. Make sure bearing is flush to 0.51 mm [0.020 inches] below the valve plate surface of the end cap (G04).

Replace endcap If journal bearing spins in the endcap.

End cap and journal bearing



VALVEPLATE

Inspect valve plate for wear and scratches. Scratches deep enough for you to feel with your fingernail or a pencil-tip are not acceptable. Do not attempt to rework Series 90 valve plates, replace if damaged.

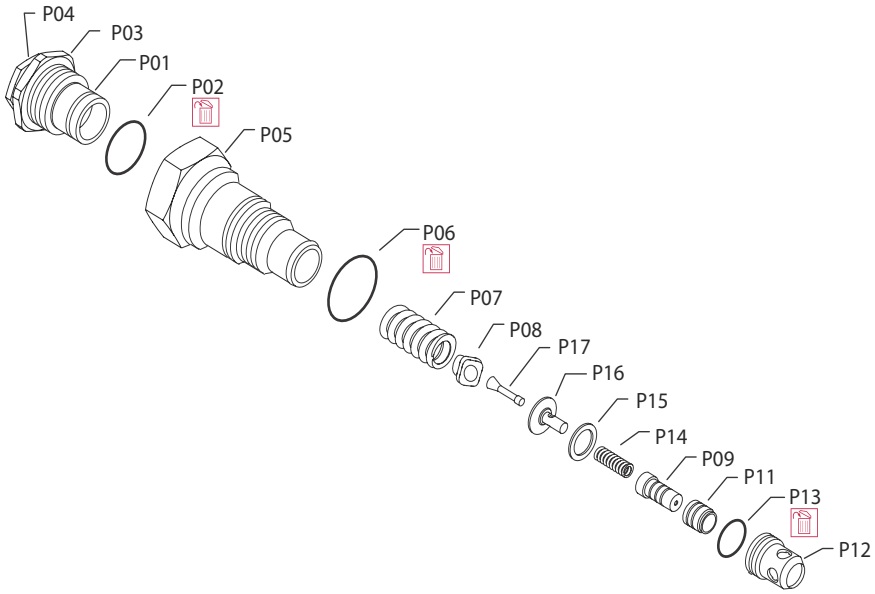
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MULTI-FUNCTION VALVE CARTRIDGES

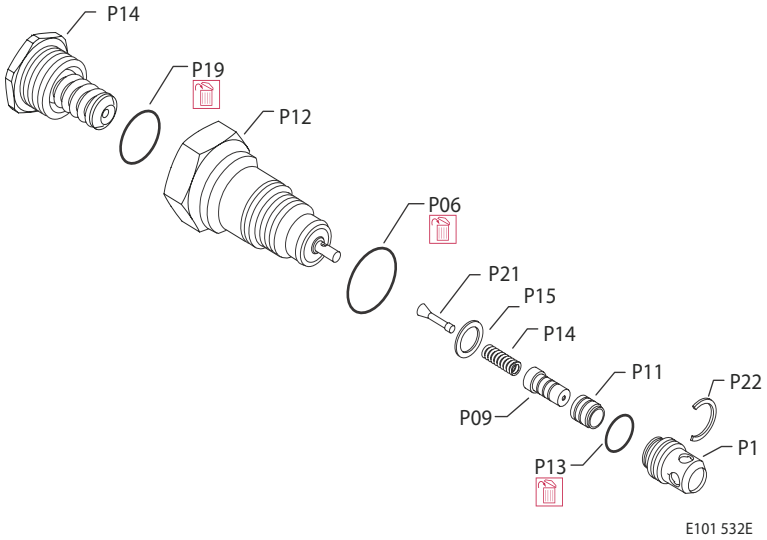
Inspection

Clean and inspect all parts. Cartridge is available as complete unit only. O-rings are available separately.

Multi-function valve



Multi-function valve - pre 1988



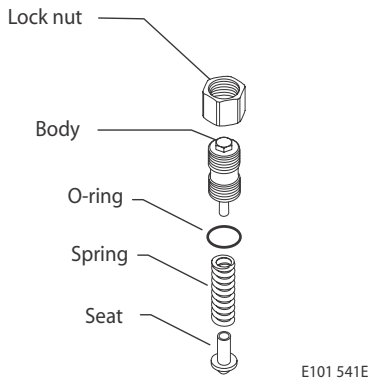
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CHARGE PRESSURE RELIEF VALVE

Inspection

Inspect the poppet (K80) and mating seat in the endcap for damage or foreign material. When inspecting shim adjustable valves, do not alter the shims or interchange parts.

Charge pressure relief valve

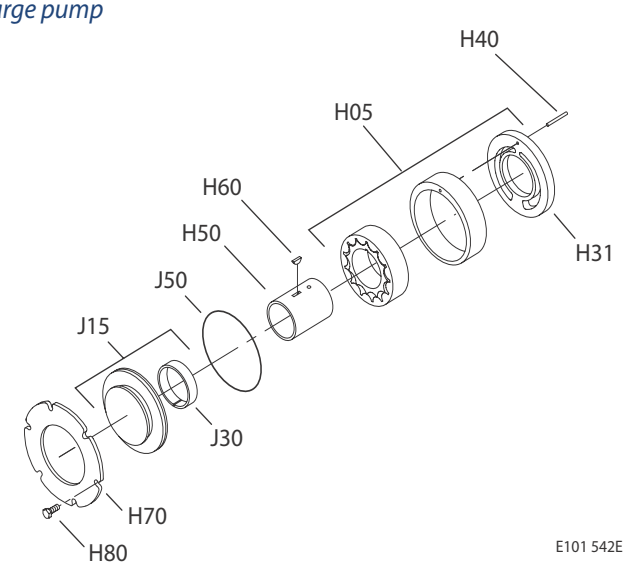


CHARGE PUMP

Inspection

Inspect all parts for wear or damage and replace if necessary. Check gerotor assembly and valve plate for pitting from cavitation.

Charge pump



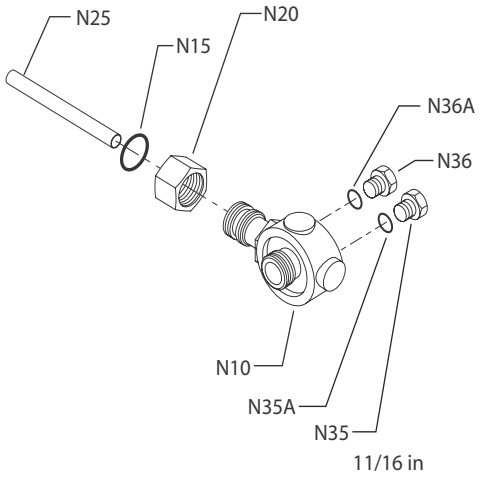
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INTEGRAL CHARGE PRESSURE FILTER

Inspection

Inspect the filter head and lock nut sealing surfaces. If you find any nicks or scratches, replace damaged components.

Integral charge pressure filter manifold



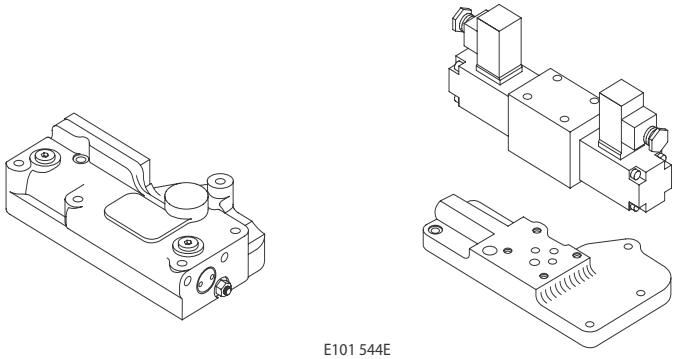
E101 543E

HYDRAULIC AND ELECTRIC DISPLACEMENT CONTROLS

Inspection

Inspect machined surfaces on control and pump for nicks and scratches. Replace control if you find damage to machined surfaces.

Hydraulic/Electric displacement controls



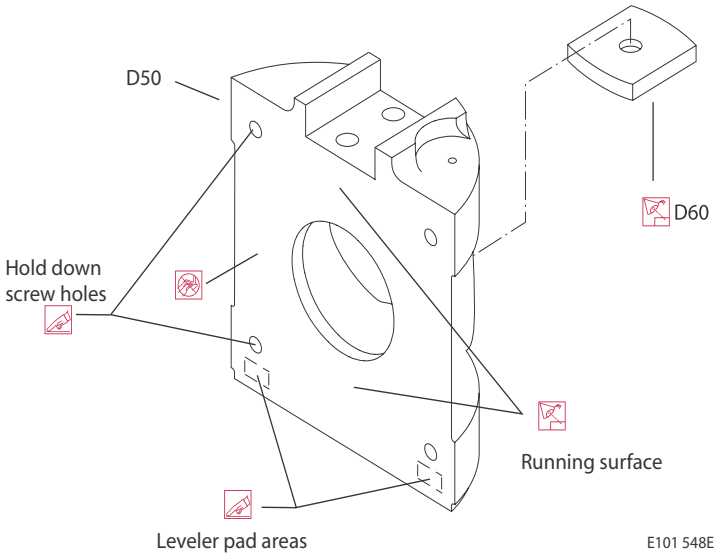
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SWASHPLATE

Inspect running surface for wear or scratches. Inspect hold down screw holes for damage. If screw holes are damaged, replace swashplate. Inspect for wear in leveler pad areas, excessive wear may affect pump neutral. If you find damage, replace swashplate. Inspect swashplate guide (D60) for wear. Replace if necessary. Refer to Rework Specifications 520L1033 for component rework guidelines.

Swashplate and guide inspection

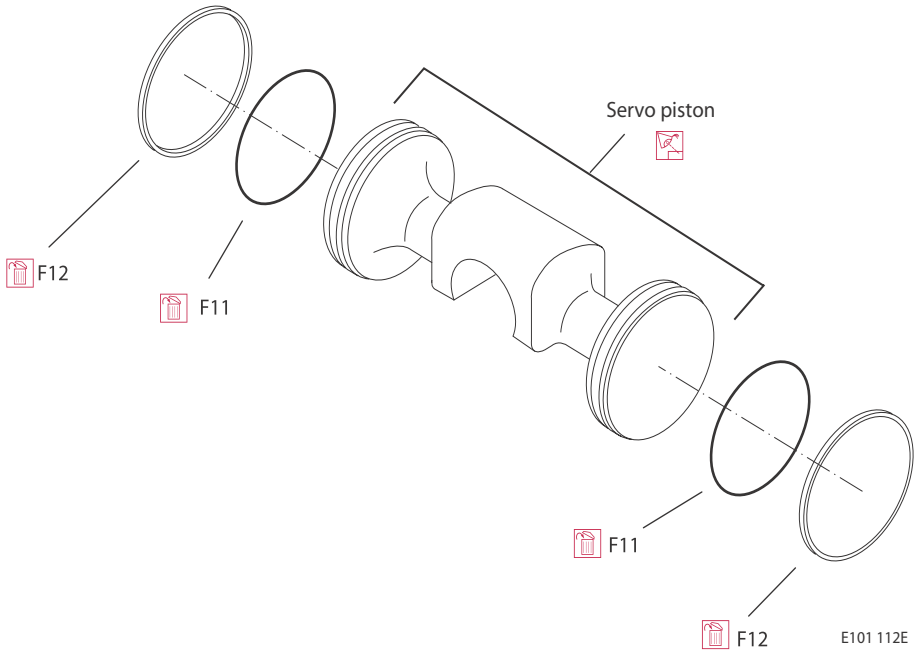


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SERVO PISTON

Inspect the servo piston for wear. Remove and discard seal rings (F12) and expander O-rings (F11). Replace servo piston if necessary. Replace O-rings and seal rings before reassembly.

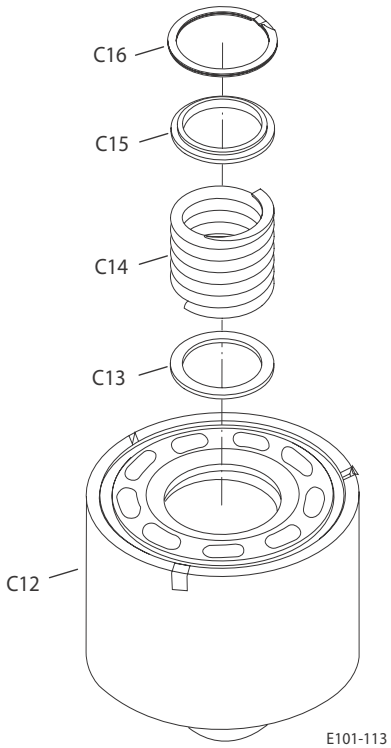
Servo piston inspection



CYLINDER BLOCK

Visually inspect the cylinder block, spring, and washers for indications of wear or damage. Replace if wear, cracks or other damage is present.

Cylinder block inspection



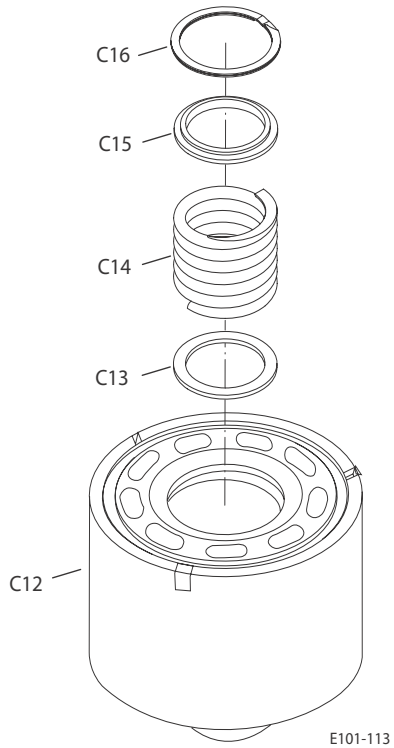
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CYLINDER BLOCK

Warning
Risk of personal injury: Compressing the block spring requires 350 to 400 N [80 to 90 lbf]. Use a press sufficient to maintain this force with reasonable effort. Ensure the spring is secure before attempting to remove the spiral retaining ring. Release the pressure slowly after the retaining ring is removed.

1. Coat all parts with clean hydraulic fluid prior to reassembly.
2. Install the inner block spring washer (C13), block spring (C14), and outer washer (C15) into the cylinder block. Using a press, compress the block spring enough to expose the retaining ring groove. Wind the spiral retaining ring (C16) into the groove in the cylinder block. ⚠
3. Release pressure on spring. Visually check that spiral retaining ring is properly positioned in its groove.

Cylinder block assembly

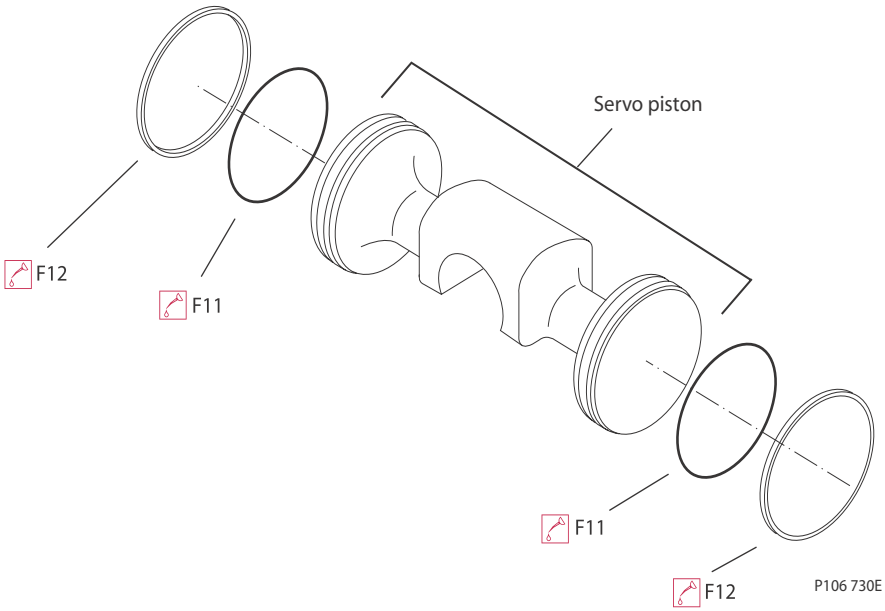


SERVO PISTON RINGS

Caution
Do not stretch the seal rings any more than necessary during installation.

1. Install new expander O-rings (F11) into the seal grooves in the servo piston. Install the seal rings (F12) in the grooves, over the expander O-rings (F11). ❗
2. Allow the assembly to set for at least 5 minutes. This allows the seal rings (F12) to return to their original, unstretched size.

Servo piston assembly



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SERVO ARM

1. Install the servo arm (D10).

Align press fit design servo arms with the swashplate's slot and threaded holes while installing. Press completely into the swashplate slot.

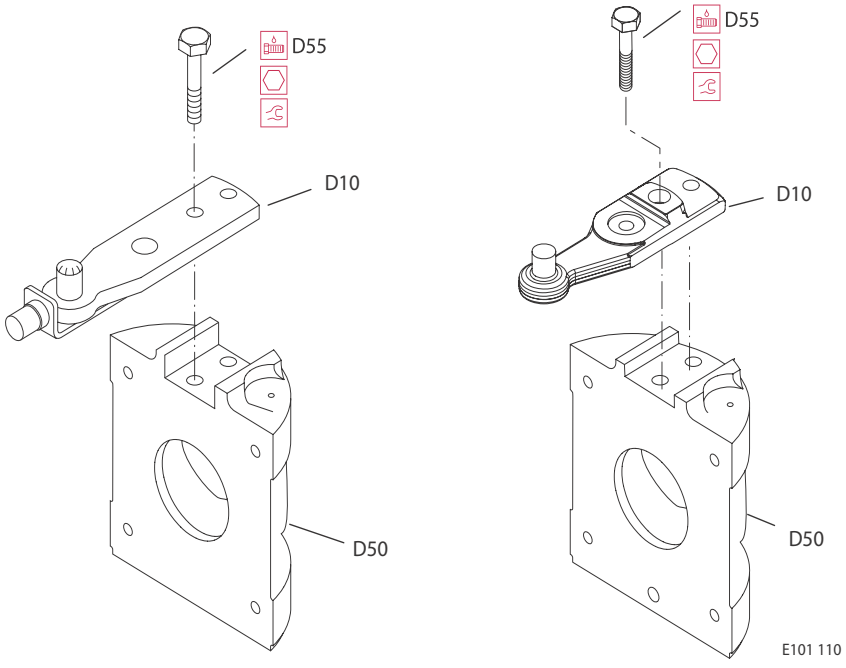
2. Install new locking screw (D55), with pre-applied locking compound, into swashplate.

3. Torque locking screw (D55). See table below for wrench sizes and torques.

Servo arm specifications

Pump size	Wrench size (for D55)	Torque N•m [lbf•ft]
030 cc through 075 cc	13 mm hex	32.5 [24.0]
100 cc	17 mm hex	42.0 [31.0]
130 cc	17 mm hex	63.7 [47.0]
180 cc, 250 cc	19 mm hex	110 [81.0]

Servo arm installation



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SWASHPLATE GUIDE

1. Assemble the swashplate guide (D60) and feedback link (M14) to the swashplate. Install new locking screw (D65), with pre-applied locking compound, using an internal hex wrench.

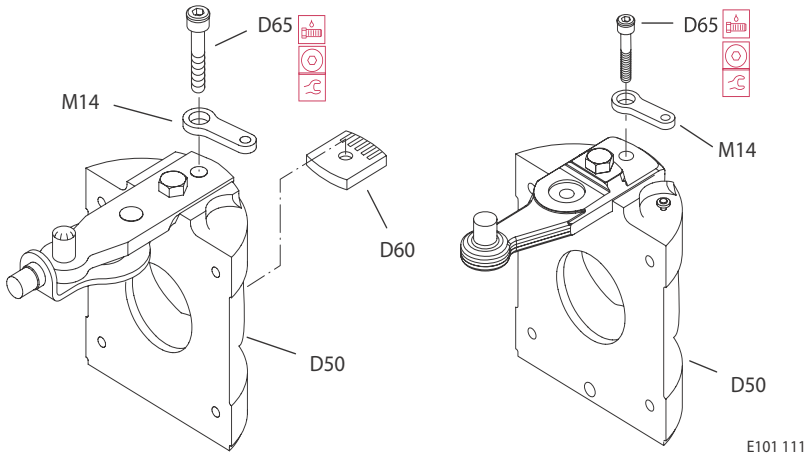
2. Torque the screw to specifications in the table below.

When installing the guide onto the 100 cc swashplate, hold the straight sides of the guide perpendicular to the slipper surface of the swashplate (D50) while tightening screw.

Special locking screw specifications

Pump size	D65 wrench sizes	Torque N•m [lbf•ft]
030 cc and 042 cc	5 mm internal hex	13.5 [10.0]
055 cc through 100 cc	6 mm internal hex	32.5 [24.0]
130 cc	8 mm internal hex	54.2 [40.0]
180 cc and 250 cc	8 mm internal hex	92.1 [68.0]

Attaching swashplate guide



Roll pin and flat washer

Install the headed roll pin (D75) and flat washer (D70) if removed. For proper distance H between the washer (D70) and the side of the swashplate follow the tables *Roll pin specifications (A)* and *(B)* below.

Roll pin specifications (A)

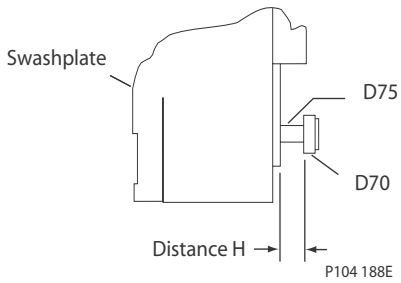
Pump frame size	Distance, H: + 0.1, -0.25 mm [+ 0.003, - 0.010 inches]
030 cc	2.50 mm [0.100 inches] (no washer)

Roll pin specifications (B)

Pump frame size	Distance, H: ± 0.25 mm [± 0.010 inches]
042 cc	3.60 mm [0.140 inches]
055 cc through 100 cc	6.10 mm [0.240 inches]
130 cc	5.59 mm [0.220 inches]
180 cc and 250 cc	7.2, [0.28]* 9.2, [0.36]**

* Pin at side cover position.
** Pin at control position.

Pin and washer positions



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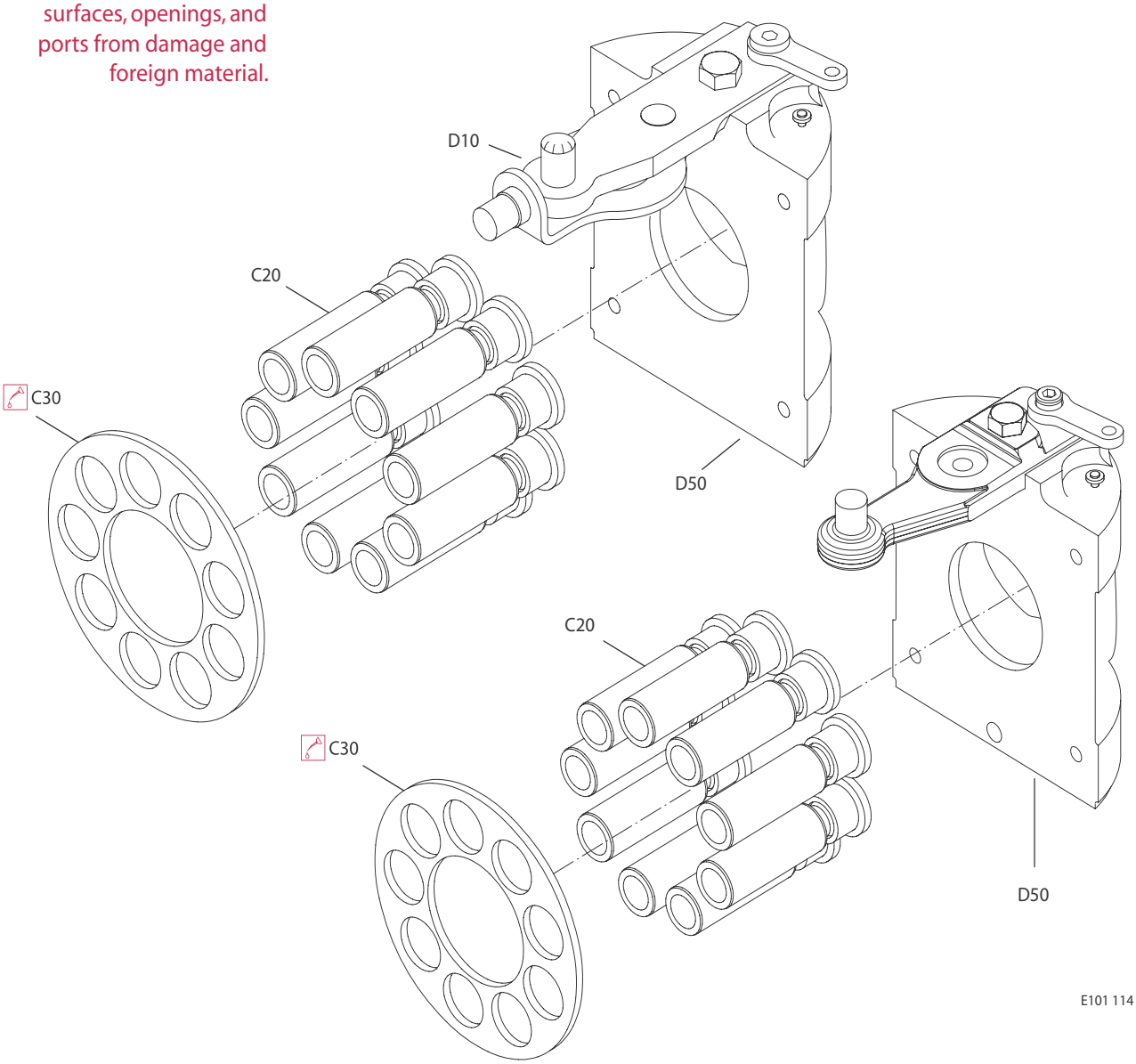
PISTON ASSEMBLY

Caution
Most parts have critical, high tolerance surfaces. Take care not to damage these surfaces during assembly. Protect exposed surfaces, openings, and ports from damage and foreign material.

Piston assembly

1. Assemble the piston assemblies (C20) into the slipper guide (C30).
2. Lubricate the slipper and swashplate running surfaces.
3. Center the pistons (C20) and guide (C30) on the swashplate.

Piston assembly



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PISTON ASSEMBLY (continued)

Fixed-clearance hold-down bearing

Some early production pumps use a spring-loaded hold-down mechanism. Service parts for the spring-loaded hold-down mechanism are no longer available. The fixed-clearance hold-down bearing must be installed if hold-down parts require replacement on these early pumps. Refer to the appropriate *Service Parts Manual* for more information.

Assemble one-half of the fixed-clearance slipper guide hold-down bearings (C40):

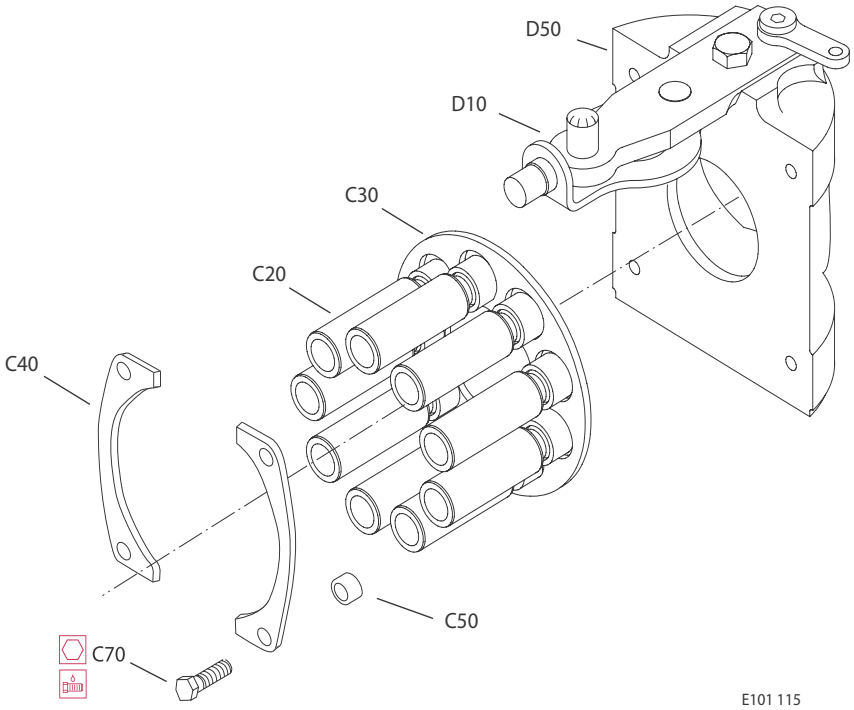
1. Position 2 spacers (C50) over the threaded holes in the swashplate (D50).
2. Install one slipper guide hold down bearing (C40) and spacers (C50). !
3. Install 2 new screws (C70) through the slipper guide hold down bearing (C40), and spacers (C50). !

! Caution
Position the split between the C40 slipper guide bearing plates in line with the D10 swashplate arm. Locate the bearing surface of the C40 bearing plates next to the C30 slipper guide.

! Caution
Always use new screws with proper locking compound.

4. Start the screws (C70) into the swashplate (D50) do not torque.
5. Position slipper guide with pistons under first hold down bearing.
6. Assemble second slipper guide hold down bearing with screws and spacers onto the swashplate. Start the screws; do not torque..
7. Lubricate slipper guide and hold down bearings.

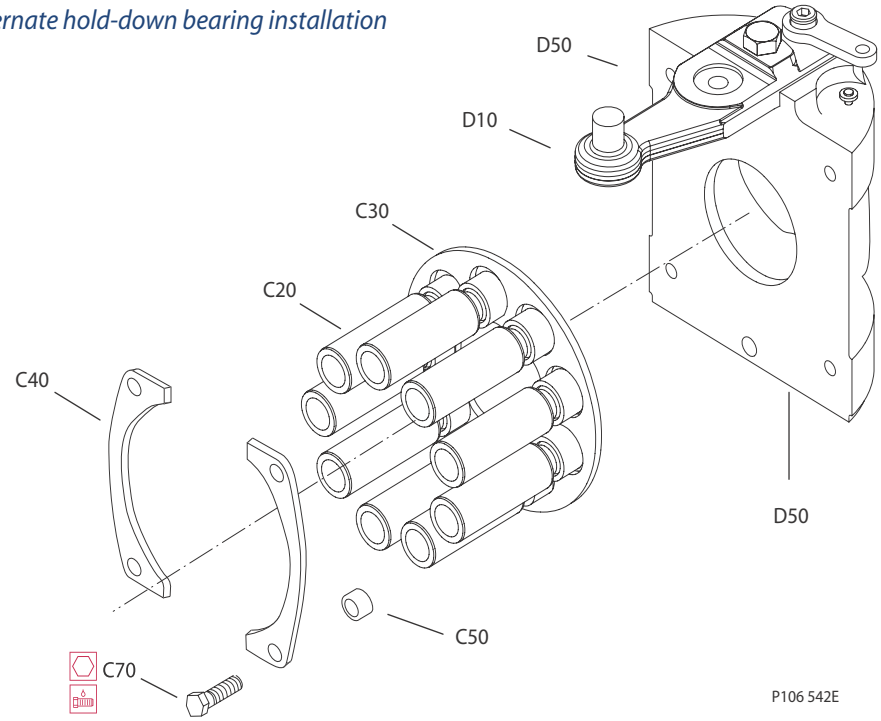
Hold-down bearing installation



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PISTON ASSEMBLY (continued)

Alternate hold-down bearing installation



8. Torque the slipper guide hold-down screws (C70) to the specifications in *Torque settings*.

Torque settings

Pump size	Torque N•m [lbf•ft]
030 cc through 100 cc	13.5 [10.0]
130 cc through 250 cc	32.5 [24.0]

Ensure the slipper guide (C30) and piston slippers (C20) slide freely on the swashplate after all bolts are torqued.

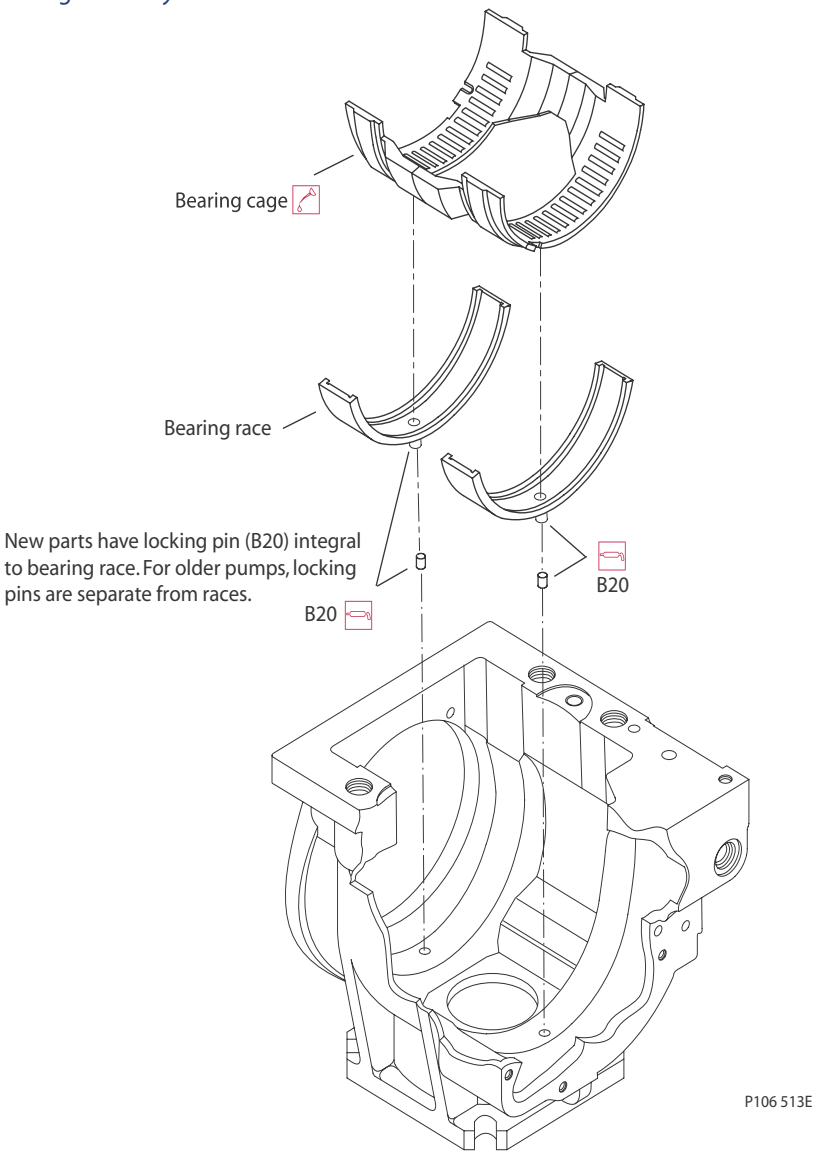
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BEARING CAGE

New parts have locking pin (B20) integral to bearing race. For older pumps, locking pins are separate from races. The locating pins, assure proper assembly.
Retain the races in position with petroleum jelly.

1. Install the bearing races into the housing, positioning the races on the locating pins (B20).
2. Assemble and lubricate the bearing cage.
3. Install the bearing cage on the bearing races.

Bearing assembly



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HOUSING

Refer to the illustration, *Housing installations,* next page for the next 9 steps.

1. Position the servo piston (F10) in the housing.

For units with an automotive control, the servo piston has a threaded hole on its machined end. Put this end on the side of the housing where the centering assist spring sleeve is located..

2. Lubricate and install the bronze slider block (F20) onto the servo piston.
3. Carefully lower the swashplate assembly into the housing through the end cap opening. Protect the pistons from being scratched.
4. Hold the swashplate assembly approximately 12 mm [½ inch] above the cradle bearings.
5. Position the feedback link (D14) in the control opening.
6. Lower the swashplate assembly onto the cradle bearings.

Caution
Be sure to assemble the correct servo cylinder on each side of the housing.

7. Position the servo piston on the slider block (F20). The parts should slide freely.
8. Lubricate inside the servo cylinders. Hold the servo piston in place and install the servo cylinders.

For units with an automotive control, there is a special servo cylinder on the centering assist spring side of the housing.

9. If previously removed, install new screens (B60). Use proper installation tool.

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HOUSING (continued)

Servo cylinder screws

1. Install the servo cylinders (F110) completely into the housing bores.

Number of screws and wrench sizes vary by model.

Caution
If the servo cylinders are not seated completely into the bores, tightening of the screws can damage the O-rings.

2. Install the 3 or 4 screws (F111/F211) in each servo cylinder !.
3. Torque to specifications in *Servo cylinder screw torques*.

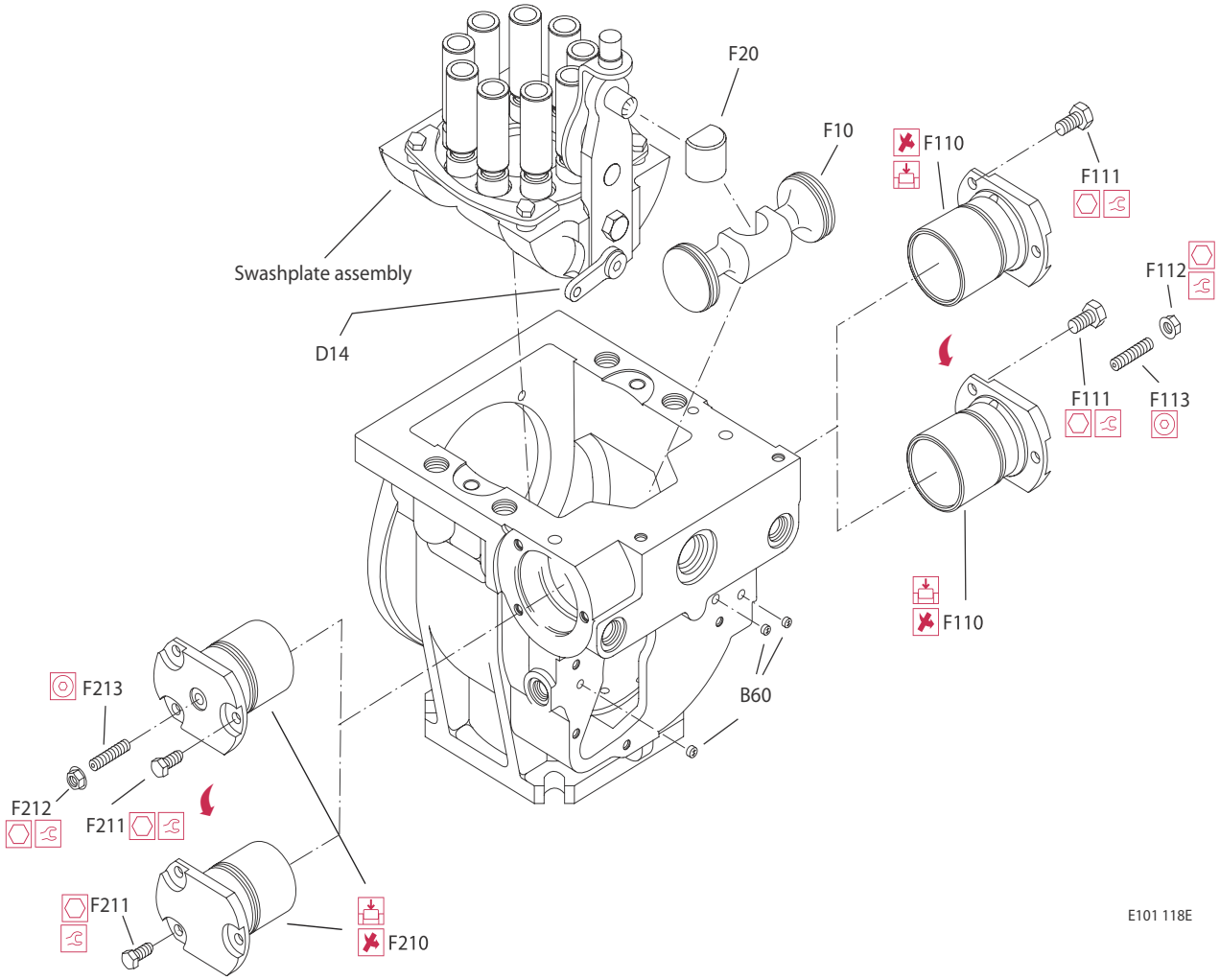
For units with an automotive control install the servo cylinder screws on to the housing's centering assist spring side.

4. If previously removed, replace screens (B60) with new screens.

Servo cylinder screw torques

Pump size	F111/F211 N•m [lbf•ft]
030 cc	13.5 [10.0]
042 cc	13.5 [10.0]
055 cc	13.5 [10.0]
075 cc	32.5 [24.0]
100 cc	32.5 [24.0]
130 cc	32.5 [24.0]
180 cc and 250 cc	32.5 [24.0]

Housing installations



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HOUSING (continued)

Displacement limiter.

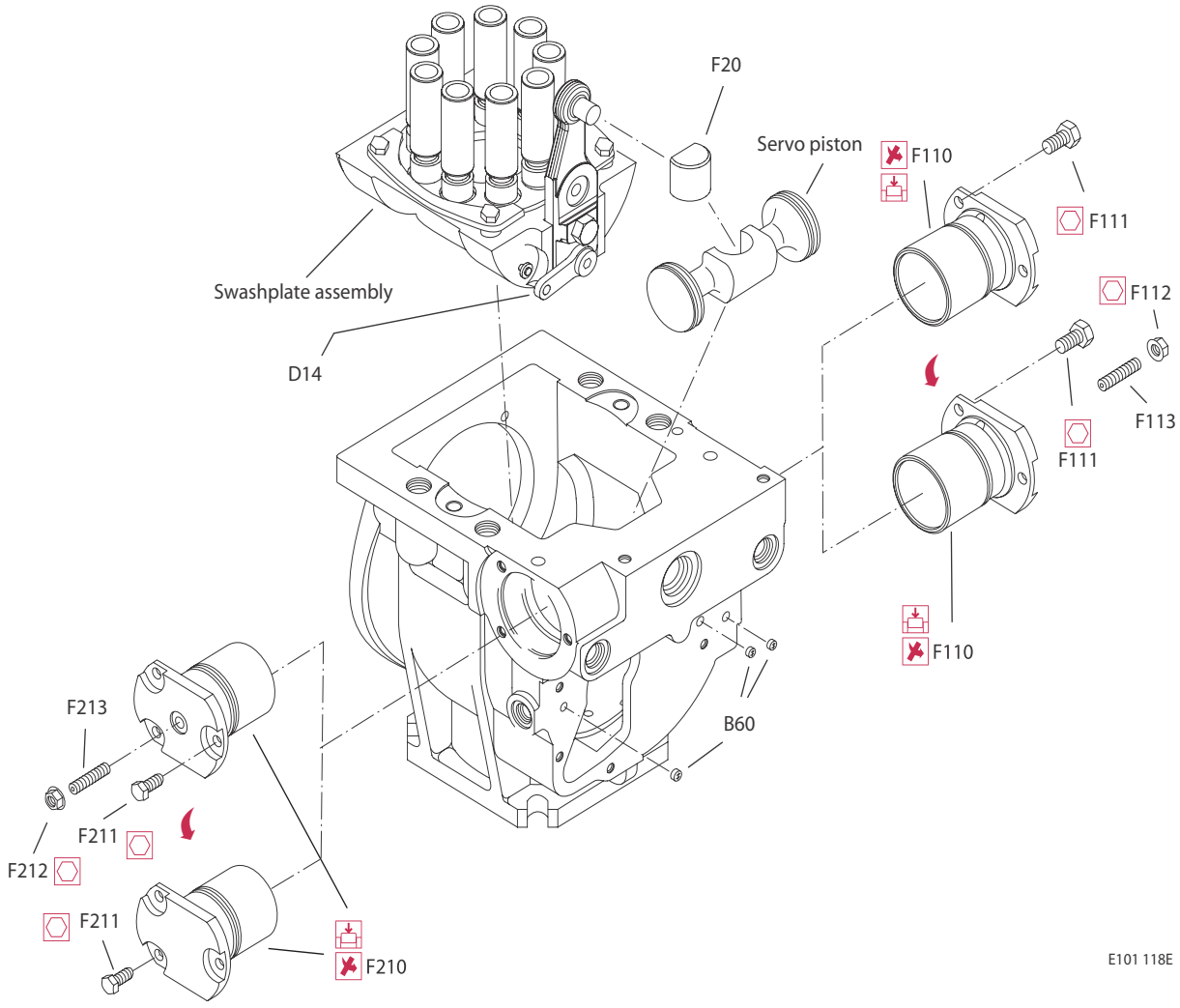
1. Install displacment limiters (F113, F213) into servo cylinders to location marked durring disassembly. Wrench sizes are shown in table below.

2. Install new seal lock nuts (F112 F212) onto displacement limiters. Torque seal lock nuts while holding displacement limiter. Wrench sizes and torque values are shown in table below. Refer to the *Series 90 Pumps Service Manual* **520L0818** for displacement limiter adjustment information.

Displacment limiter and seal lock nut wrench sizes and torques

Pump size	F113 F213 wrench size	F112/F212 wrench	F112/F212 Torque N•m [lbf•ft]
030 cc - 100 cc	4 mm	13 mm	24.4 [18.0]
130 cc	5 mm	17 mm	47.4 [35.0]
180 cc and 250 cc	6 mm	19 mm	125 [92.0]

Housing installations



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BEARING CAGE LOCATOR LINK

1. Align the swashplate's bearing cage slot with the headed spring pin. Align with the housing's pin hole. See illustration *Locator link position* for correct orientation.
2. Hook the cage locator link (D80) over the spring pin, between the washer and the swashplate.
3. Rotate the link (D80) into the bearing cage slot.

030 frame size pumps do not have a washer on the spring pin.

4. Align the locator link (D80) hole with the housing hole.
5. Install the link pin (D85) through the locator link (D80) and into the housing.

042, 180, and 250 pumps use a flat head screw as the link pin. Steps 6 and 7 refer to these pumps.

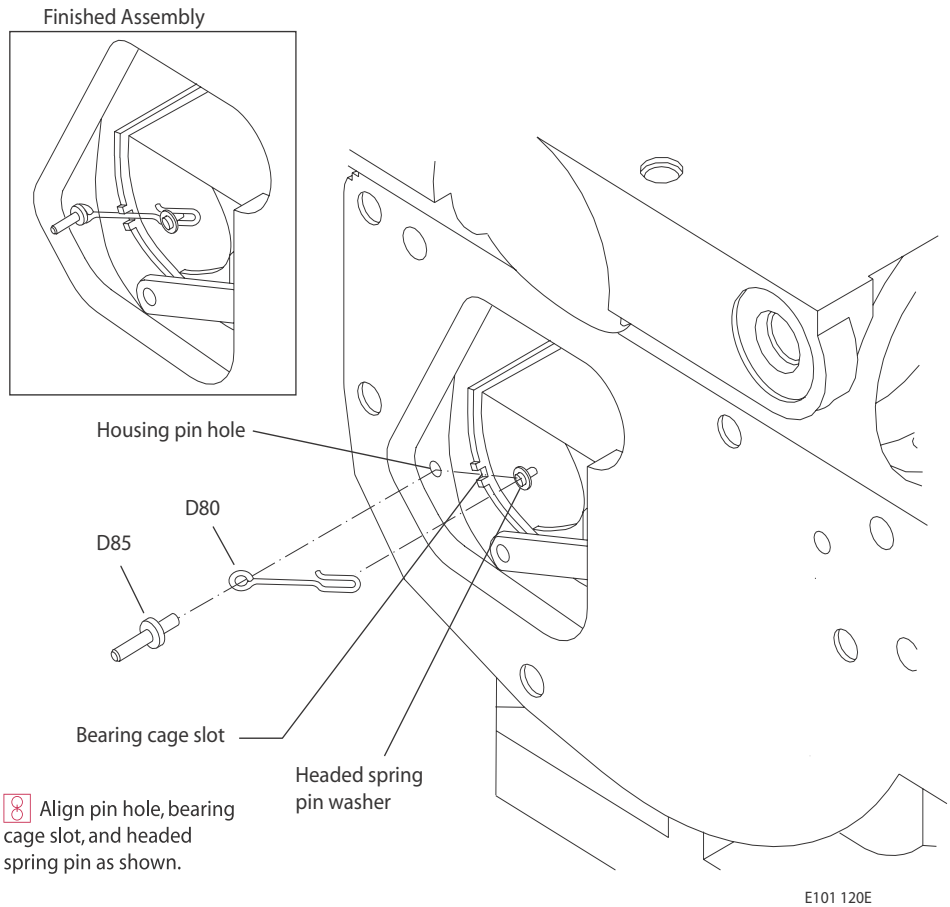
Caution
Always use a new screw with proper locking compound.

6. Install a new screw (with locking compound) through the locator link (D80) and into the housing.

Caution
Do NOT torque this screw against the D80 locator link. The link must rotate freely.

7. Tighten the screw into the housing. Do this until the head of the screw is at a height of 4.52 to 4.78 mm [0.178 to 0.188 inches] from the pump housing's machined surface.

Locator link position



Align pin hole, bearing cage slot, and headed spring pin as shown.

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VERIFY PROPER ASSEMBLY

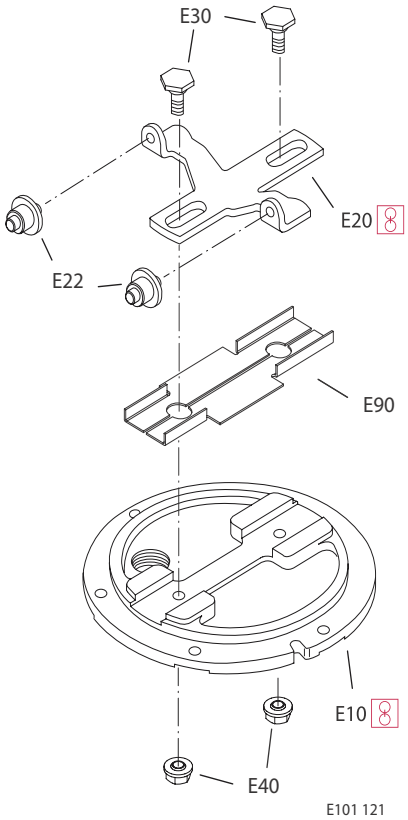
1. Push the swashplate assembly toward the control side of the housing until the swashplate guide contacts the bearing race.
2. Check for clearance between the servo arm and the slider block.
3. Ensure swashplate assembly moves freely on bearings.
4. Rotate swashplate on bearings to check for control link movement and proper locator link position.

SWASHPLATE LEVELER

1. Place inserts (E90) onto side cover (E10).
2. Position the swashplate leveler (E20) on the side cover inserts (E90).
3. Note the orientation of the leveler (E20) and the side cover (E10).
4. Install the 2 guide posts (E30) and sealing nuts (E40). See *Guide post/sealing nut installation* table for wrench sizes and torque specifications.
5. Install the leveler spring seats (E22), if necessary.

Some pumps do not have removable swashplate leveler spring seats (E22).

Attach leveler to side cover



Guide post/sealing nut installation

Pump size	Wrench sizes	Torque N•m [lbf•ft]
030 cc and 042 cc	17 mm open end 10 mm hex	9.1 [6.7]
055 cc through 100 cc	3/4 inch open end 13 mm hex	23.1 [17.0]
130 cc through 250 cc	24 mm open end 17 mm hex	44.7 [33.0]

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INSTALLING LEVELER AND SIDE COVER

1. Lubricate and install a new side cover O-ring (E50).
2. Install the side cover assembly. ❗
3. Install 2 side cover screws (E60), without locking compound, at 9 o'clock and 3 o'clock locations. Tighten only to half torque.

❗ Caution
Slide swashplate leveler (E20) toward the case drain port. This allows the leveler (E20) to clear the side of the swashplate during side cover installation.

This holds the E10 cover while checking the zero angle position of the swashplate.

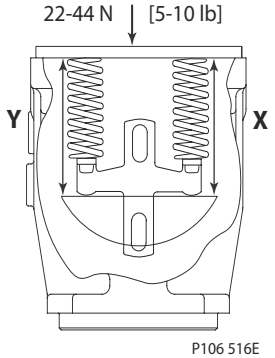
Setting leveler - neutral position

1. If reusing original parts, rotate the side cover (E10) to align the marks on the cover and housing (added during disassembly). If using new swashplate leveler parts, alignment marks may not be accurate.
2. Apply a force of 22 to 44 N [5 to 10 lbf] to the swashplate leveler (E20). This ensures both arms are in contact with the swashplate. Clamp a flat plat onto the pump housing as shown in *Leveling swashplate* drawing below.
3. Ensure the swashplate is on its bearings.
4. Measure with a depth micrometer to find the distance from the end cap face of the housing to the outer edge of the swashplate surface.
5. Take a second measurement at a point 180° from the first point of measurement (at the opposite edge of swashplate surface). ⚠

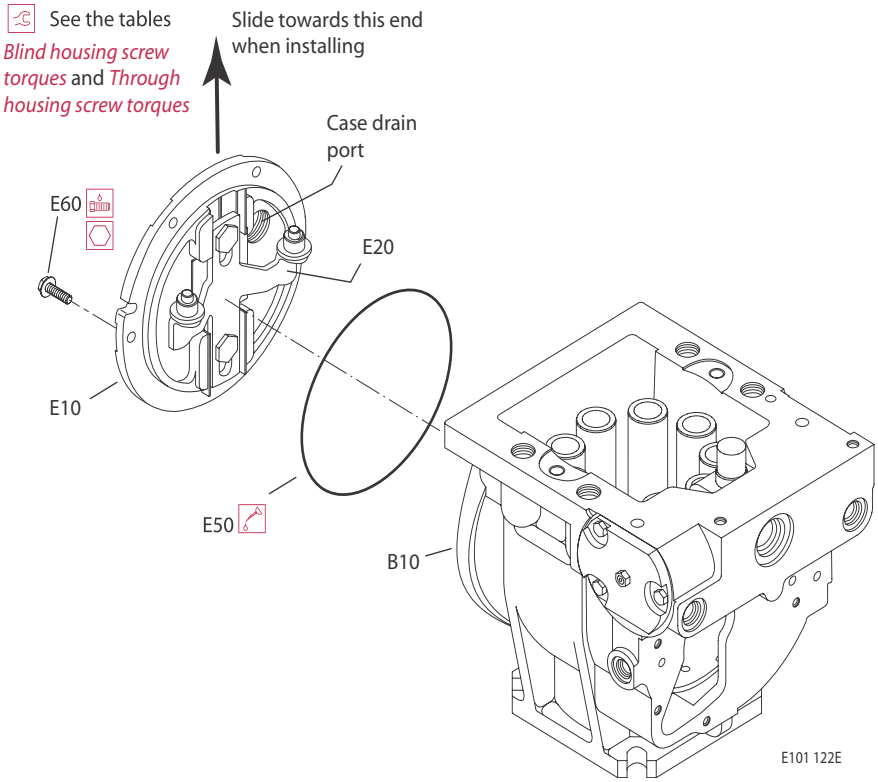
⚠ Warning
These measurements must not vary by more than 0.025 mm [0.001 inches].

X and Y are measurements from the top of the swashplate to the end of the housing Difference between X and Y must be less than 0.025 mm [0.001 in]

Leveling swashplate



Side cover and O-ring installations



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INSTALLING LEVELER AND SIDE COVER (continued)

Positioning the side cover

1. Rotate the side cover (E10), which will also rotate the leveler and swashplate, until the measured depth on each side of the swashplate is within 0.025 mm [0.001 in].

2. Install the 4 remaining screws (E60) with pre-applied locking compound.

3. Torque these screws to the specifications in *Blind housing screw torques* and *Through housing screw torques.*

4. Replace the 2 screws (E60) used initially to hold the side cover on while setting neutral with new screws that have locking compound.

5. Torque these screws to the specifications in *Blind housing screw torques.*

Warning
These measurements must not vary by more than 0.025 mm [0.001 inches].

Through housing screw torques

Pump size	Torque N•m [lbf•ft]
030 cc and 042 cc	10.4 [7.7]
055 cc through 100 cc	32.5 [24.0]
130 cc through 250 cc	50.1 [37.0]

Blind housing screw torques

Pump size	Torque N•m [lbf•ft]
030 cc and 042 cc	13.5 [10.0]
055 cc through 100 cc	32.5 [24.0]
130 cc through 250 cc	63.7 [47.0]

CYLINDER BLOCK INSTALLATION

1. Position pistons using a twisting motion so that they all lean in a clockwise direction.

2. Set cylinder block (C12) onto pistons so each block bore sits on top of a piston.

3. Prevent the pistons/slippers from turning by carefully placing a screwdriver between the slipper retainer and swashplate. Do not scratch swashplate or slippers.

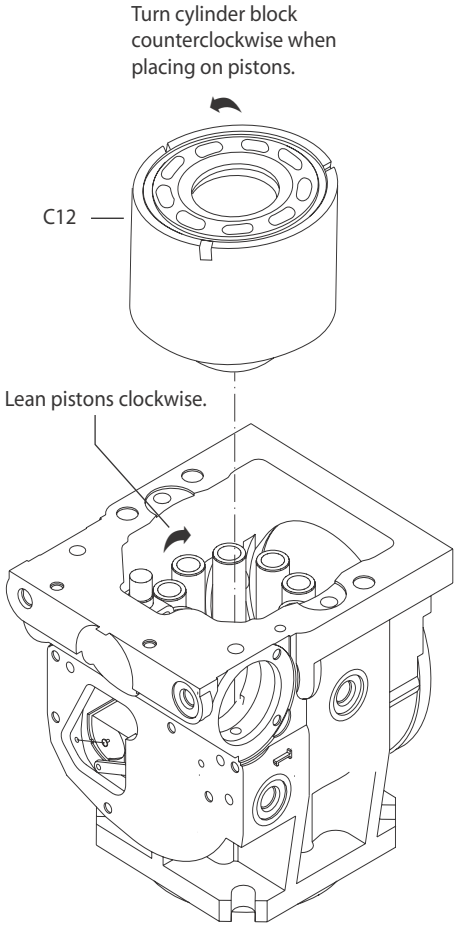
4. Turn the cylinder block counterclockwise.

This makes the pistons stand up straight and fit into the block bores.

5. Lower the block onto the pistons.

6. Relubricate piston bores and cylinder block.

Installing cylinder block



E101 130E

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END CAP INSTALLATION

Preparing for end cap installation

1. Install the end cap alignment pins (B50) into the housing.
2. Lubricate the running surface of the cylinder block.
3. Install the valve plate (C80) on the alignment pins.
4. Note the direction of the arrow cut-outs in the valve plate.

When viewing from the end cap side of valve plate, the arrows must point in the opposite direction of pump rotation. For example, a right hand (clockwise) rotation pump must have the arrows pointing in the counterclockwise direction.

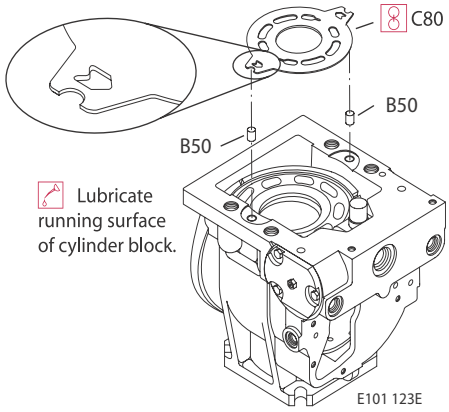
5. Install the 2 long springs (E80), with inner springs, (if used) on the swashplate leveler spring seats.
6. If used, install the short spring (D95) on the servo arm bracket.

Some models are built with an alternate servo arm which does not require spring (D95).

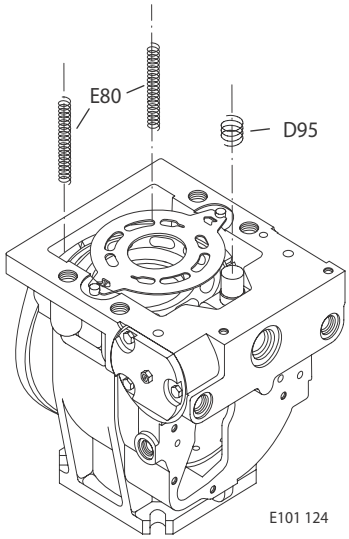
7. Place new end cap gasket (G30) on the housing in the orientation shown, (located by the alignment pins). !

! Caution
Do not bend or damage the end cap gasket during installation.

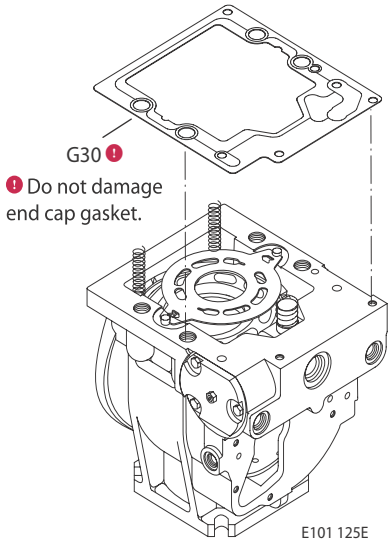
Installing the valve plate



Installing the springs



Installing the gasket



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END CAP INSTALLATION (continued)

End cap parts

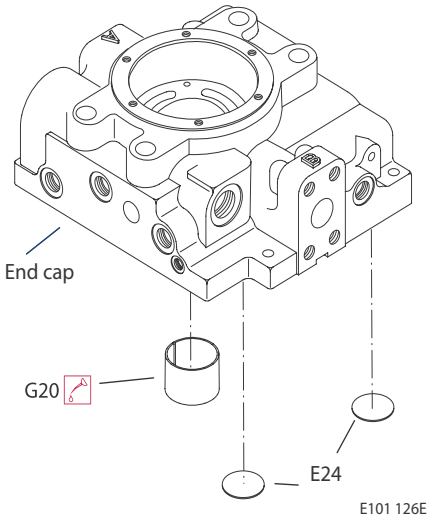
1. Lubricate the end cap journal bearing (G20). Press bearing into housing if necessary.

2. Install the hardened shims (E24) in the end cap pockets for the swashplate leveler springs.

Retain the shims using petroleum jelly.

The shim pockets are different depth in endcap.

Installations into end cap



End cap installation

1. Lower the end cap onto housing while positioning the springs in their end cap pockets.

2. Install the 4 large end cap screws (J80).

3. Tighten the large end cap screws (J80) evenly. See *Large end cap screw torques*.

When properly installed, the end cap engages the alignment pins. The springs hold the end cap 3 to 8 mm [1/8 to 1/4 inch] away from the housing.

Number of screws and wrench size varies by model.

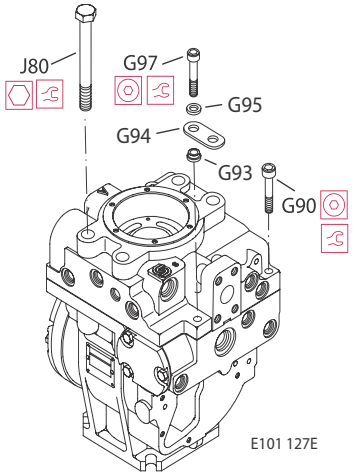
4. Install the 2 or 3 smaller screws (G90/G97) holding the end cap to the housing.

There is a lifting bracket (G94), spacer (G93), and washer (G95) on the end cap screw (G97).

5. Torque the 6 mm internal hex screws (G90, G97) to 13.5 N•m [10 lbf•ft].

6. Torque the 8 mm internal hex screws (G90, G97) to 38 N•m [28 lbf•ft].

Fastening end cap to housing



Torque 6 mm internal hex screws to 13.5 Nm [10.0 lbf•ft]

Torque 8 mm internal hex screws to 38.0 Nm [28.0 lbf•ft]

See *Large endcap screw torques* for appropriate J80 torque values.

Large end cap screw torques

Pump size	Torque N•m [lbf•ft]
030 cc	58.3 [43.0]
042 cc	74.5 [55.0]
055 cc	122 [90]
075 cc	298 [220]
100 cc	298 [220]
130 cc	298 [220]
180 cc and 250 cc	581 [429]

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SPEED SENSOR

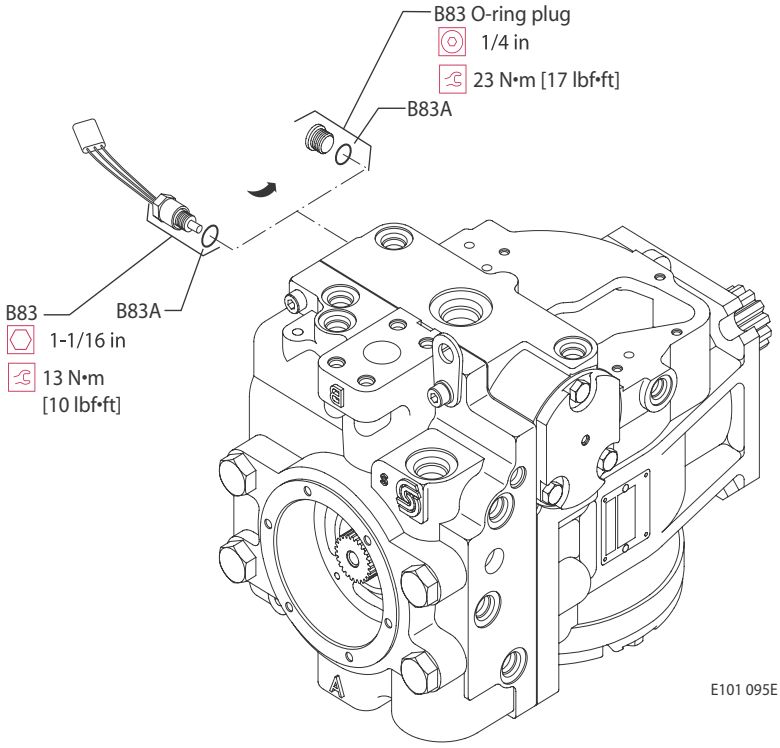
Assembly

1. Install a new O-ring (B83A) onto the sensor (B83).

2. Using an 11/16 wrench, install the speed sensor (with lock nut and O-ring) into the housing. Adjust the gap between the sensor and the magnetic speed ring as instructed in *Speed sensor adjustment* in *Series 90 Pumps Service Manual* **520L0818**. After adjustment, torque the sensor lock nut to 13 N•m [10 lbf•ft].

3. If a speed sensor is not installed, use a 1/4 in internal hex wrench to torque the housing plug (B83) to 23 N•m [17 lbf•ft].

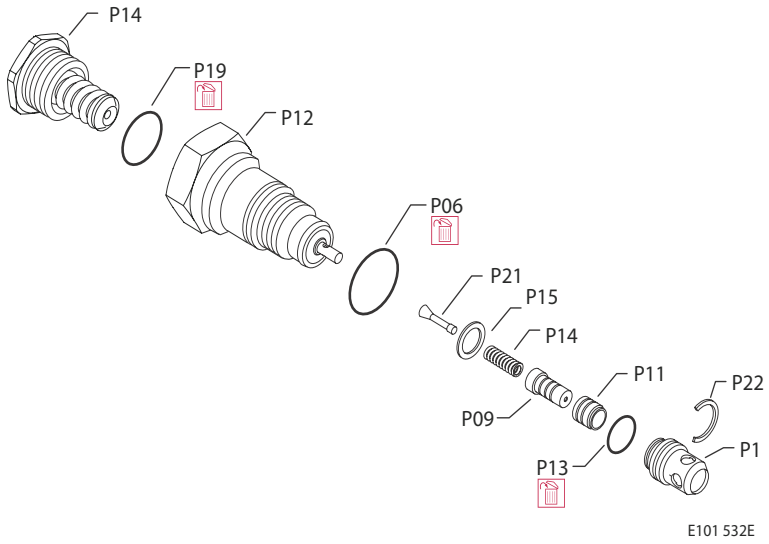
Speed sensor



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MULTI-FUNCTION VALVE CARTRIDGES - PRE 1988

Multi-function valve - pre 1988



Assembly

1. Lubricate and install internal components (P01, P11, P09, P14, P15, and P21).
2. Install poppet seat (P1).
3. Install retaining ring (P22).
4. Lubricate and install O-ring (P19).
5. If previously removed, reassemble and install bypass actuator (P14). Torque to 40 N•m [30 lbf•ft].
6. Lubricate and install new O-rings (P06, P13).

Caution

If pressure limiter was removed from bypass actuator (P14), adjust pressure limiter to model code specifications.

7. Install cartridges and torque as shown in the table below.

Multi-function valve wrench size

Frame size	Wrench size
030 – 100	1-1/4 inch
130 – 250	1-5/8 inch

Multi-function valve torque

Frame size	Torque
030 – 100	89 N•m [66 lbf•ft]
130 – 250	210 N•m [155 lbf•ft]

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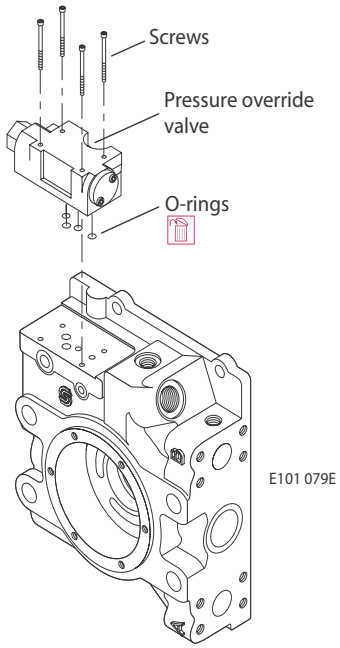
PRESSURE OVERRIDE VALVE (OPTION FOR 180 FRAME SIZE)

Assembly

1 Install new O-rings.

2. Install the valve onto the pump end cap and torque the screws to 16 N•m [12 lbf•ft].

Pressure override valve components



CHARGE PRESSURE RELIEF VALVE

Assembly

1. Install the poppet (K80) and spring (K70).

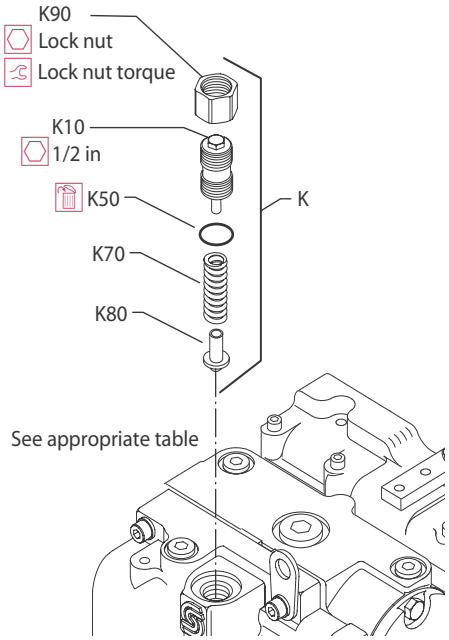
2. For shim adjustable valves, install the shims and plug, torque to 68 N•m [50 lbf•ft]. For screw adjustable valves, install the plug with its lock nut, aligning the marks made at disassembly, and torque the lock nut to 52 N•m [38 lbf•ft].

3. Check the charge pressure and adjust, if necessary.

Lock nut wrench size

Frame size	Wrench size
030 – 100	1-1/16 inch
130 – 250	1-5/8 inch

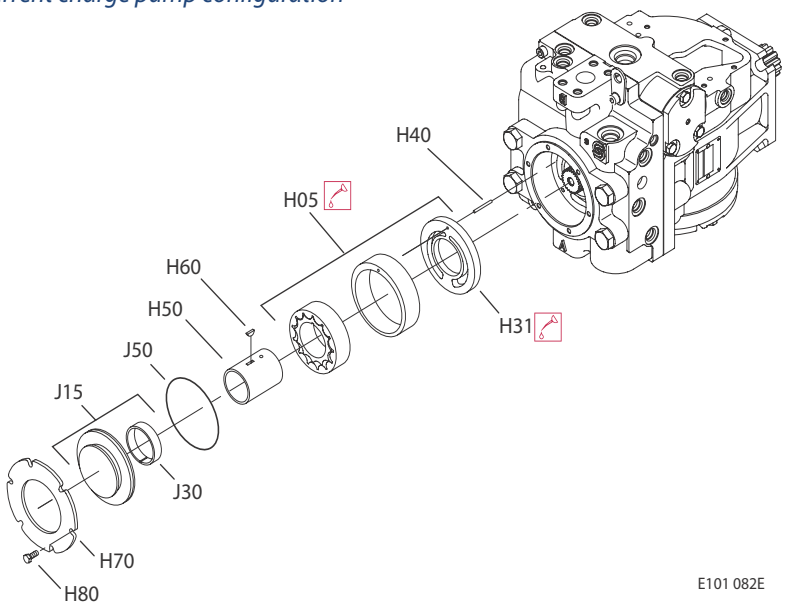
Charge pressure relief valve



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CHARGE PUMP

Current charge pump configuration



Retainer screw wrench size

Frame size	Wrench size
030 – 100	10 mm
130 – 250	13 mm

Assembly

Be sure to install the charge pump in the proper orientation. If unsure of charge pump rotation, refer to the model code.

The orientation of the gerotor assembly outer eccentric ring and the location of the alignment pin in the end cap determine the charge pump rotation. Do not mix charge pump parts from different production periods. Always install as a complete assembly.

1. Install the valve plate (H31) and the gerotor assembly outer ring.
2. Install the alignment pin (H40) to properly orient the valve plate and outer eccentric ring for corresponding pump rotation.
3. Prior to installation, lubricate the I.D., O.D., and side faces of the gerotor assembly.
4. Install the gerotor assembly (H05).
5. Install the outer plate (early production and intermediate production pumps only, not shown).

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Genuine Parts

CHARGE PUMP (continued)

Intermediate production 75 cm³ and 100 cm³ pumps use the same charge pump coupling. Two keyways are provided in the coupling for the charge pumps used in these units. The rear keyway (with identifier groove) is used in 75 cm³ pumps. The front keyway (closest to the internally splined end of the shaft) is used in 100 cm³ pumps.

6. Install the charge pump coupling. The internally splined end of the coupling must engage the main pump shaft. For pumps with an auxiliary mounting pad, install the auxiliary drive coupling instead.

The outside diameter of the internally splined end of some early production charge pump couplings was chamfered. Early production end caps may not be machined to accept a non-chamfered coupling. Always use a chamfered charge pump coupling in pumps with the early endcap.

7. For pumps with no auxiliary pad, install a new O-ring (J50) onto charge pump cover. (If an auxiliary pad is installed, an O-ring is not used on the cover.)

8. Carefully remove the alignment pin from the charge pump parts. Install the pin in its hole in the charge pump cover (J15) (see previous page for correct orientation) and retain with petroleum jelly. Install the cover (with alignment pin) into the end cap and aligned charge pump parts. (Take care not to damage the cover O-ring, if used.)

Caution

In order to avoid loss of charge pressure in pumps with an auxiliary mounting pad, always install the charge pump cover so the pad drain hole is located on the same side of the end cap as the charge inlet port.

9. Install the charge pump cover retainer (H70) and the six internal hex screws (H80). Torque the screws per the table at the right..

Retainer screw torque

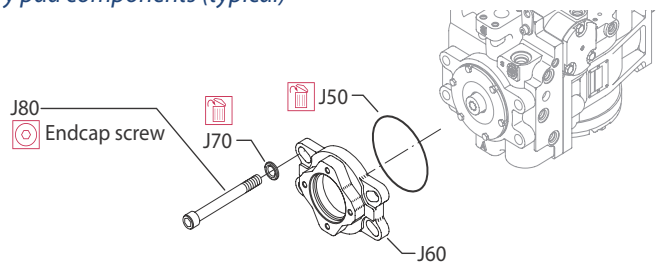
Frame size	Torque
030 – 100	16 N•m [11.85 lbf•ft]
130 – 250	32.5 N•m [24 lbf•ft]

10. For pumps with auxiliary mounting pads, install the O-ring and auxiliary mounting pad adaptor onto the end cap.

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AUXILIARY PAD

Auxiliary pad components (typical)



See table for wrench size and torque

E101 084E

Assembly

1. Lubricate and install O-ring (J50) on end cap pilot.
2. Install the auxiliary mounting pad (J60) on rear of endcap.

Torque aux pad screws in a criss-cross pattern

3. Install four large screws (J80) and new washers (J70) through the mounting pad and end cap into the housing. Torque per the accompanying table.

Aux. pad screw wrench size

Frame size	Wrench sizes
030 – early 042	8 mm internal hex
late 042	10 mm internal hex
055	19 mm hex
075 – 100	24 mm hex
100 – 130	14 mm internal hex
180 –250	17 mm internal hex

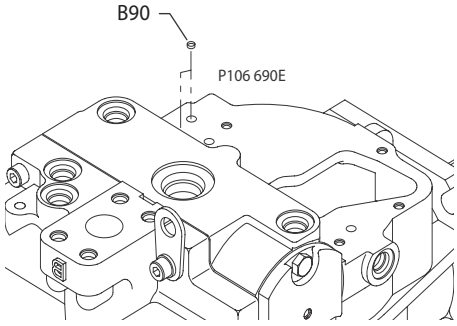
Aux pad screw torque

Frame size	Torque
030	58 N•m [43 lbf•ft]
042	75 N•m [55 lbf•ft]
055	122 N•m [90 lbf•ft]
075 – 130	298 N•m [220 lbf•ft]
180 – 250	580 N•m [429 lbf•ft]

DISPLACEMENT CONTROL FILTER SCREENS

If the pump is equipped with control filter screens in the pump housing (late production), press them into position (with the rounded edge of the filter screens facing the control) until they are flush to 2.0 mm [0.08 inch] below the surface of the housing.

Filter screen installation



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INTEGRAL CHARGE PRESSURE FILTER REPLACEMENT

Caution

Failure to install the filter manifold or filter head to a sufficient depth in the end cap will result in insufficient engagement of the tube in the end cap bore. This may allow unfiltered oil to bypass the filter and enter the charge system.

Assembly

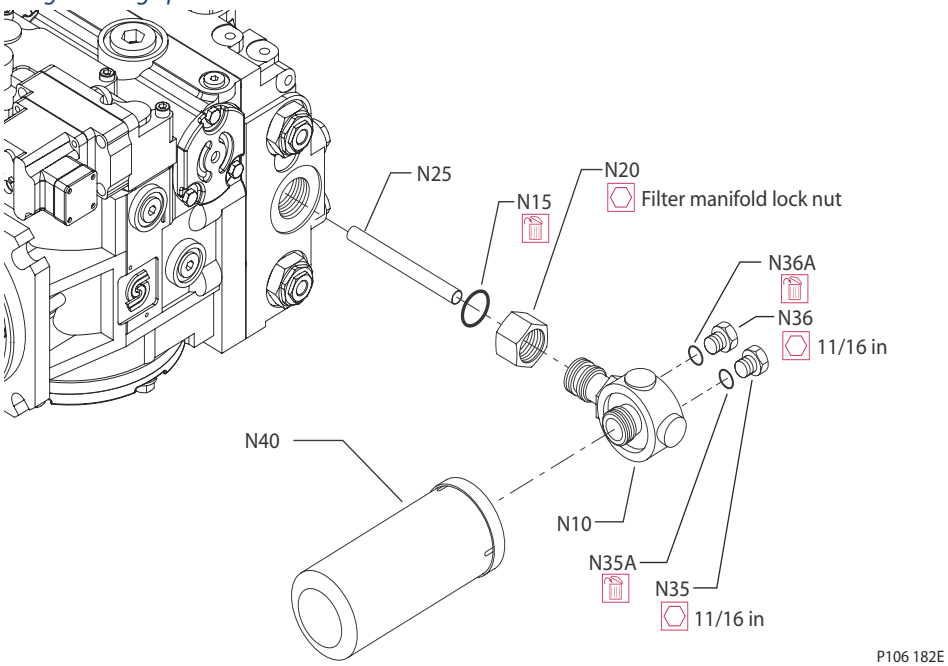
1. Install the hydraulic tube (N25) into it's bore in the endcap. Install the filter head (N10) into the port using a new O-ring (N15). The hydraulic tube should go in with low force.

2. After rotating the filter head clockwise so that the threads engage with the threads in the endcap, continue to rotate it clockwise between 6 and 7 revolutions. Position head as desired.

3. While holding the filter head in the desired position, tighten the swivel lock nut (N20) and torque as shown in table.

4. Install a new filter canister (N40) per the instructions on the filter canister.

Integral charge pressure filter



Lock nut wrench size and torque

Frame size	Wrench size	Torque
030 – 042	1-3/8 inch	70 N•m [52 lbf•ft]
055 – 130	1-5/8 inch	122 N•m [90 lbf•ft]
180 – 250	1-5/8 inch	156 N•m [115 lbf•ft]

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PUMP CONTROL COVER PLATE

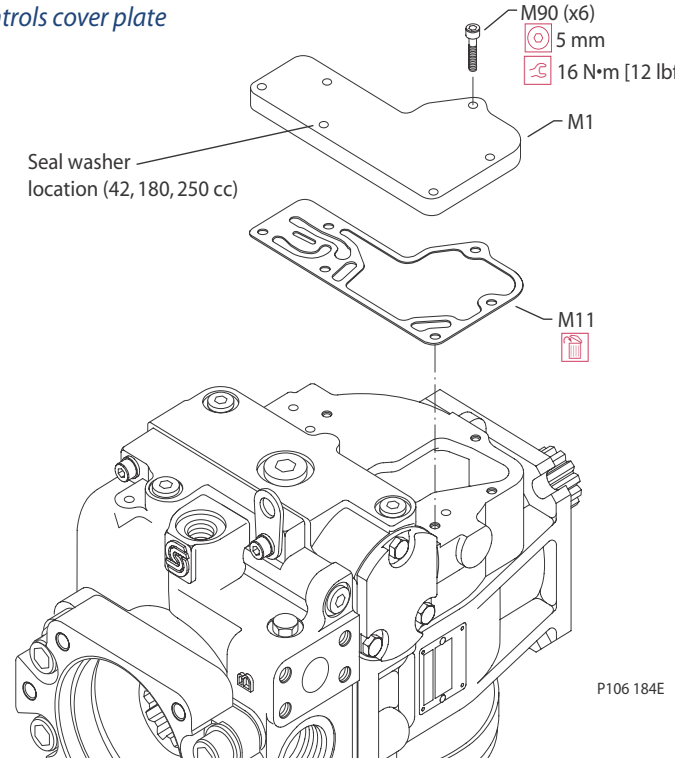
Assembly

1. Install a new gasket on the housing. Install the cover plate.

2. Install screws (M90) using a 5 mm internal hex wrench. Torque the screws to 16 N•m [12 lbf•ft].

Install a sealing washer under the head of any mounting screws that are installed into through holes in the housing.

Pump controls cover plate



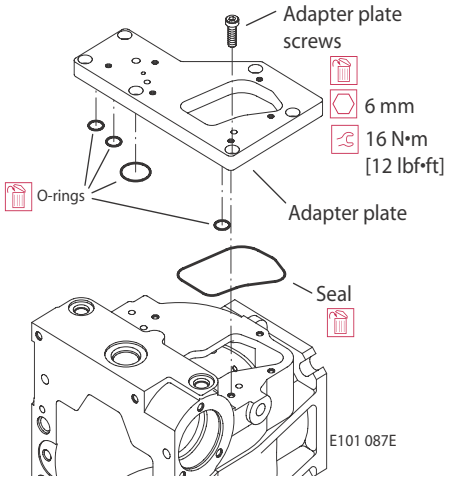
DISPLACEMENT CONTROL ADAPTER PLATE (EARLY PRODUCTION 130 PUMPS ONLY)

1. Install new O-rings using petroleum jelly to retain them.

2. Install adapter plate.

3. Install screws using a 6 mm internal hex wrench. Torque to 32 N•m [24 lbf•ft].

Displacement control adapter plate (early production 130 cm³ pumps only)



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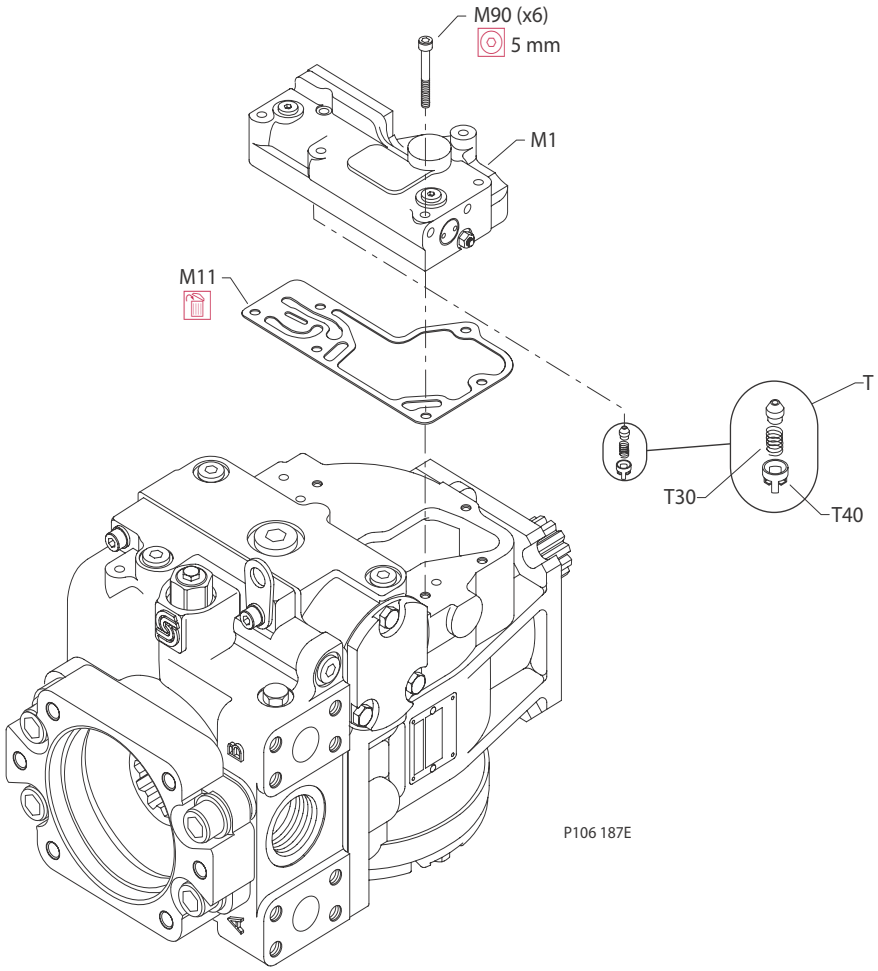
HYDRAULIC AND ELECTRIC DISPLACEMENT CONTROLS

Assembly

1. Install a new gasket (M11). Verify the control orifice check valve and spring (T) are in their proper position in the control.

2. Position the control (M1) on the housing. Insert the control linkage pin into the swashplate link.

Hydraulic/Electric displacement control



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MANUAL DISPLACEMENT CONTROL (MDC)

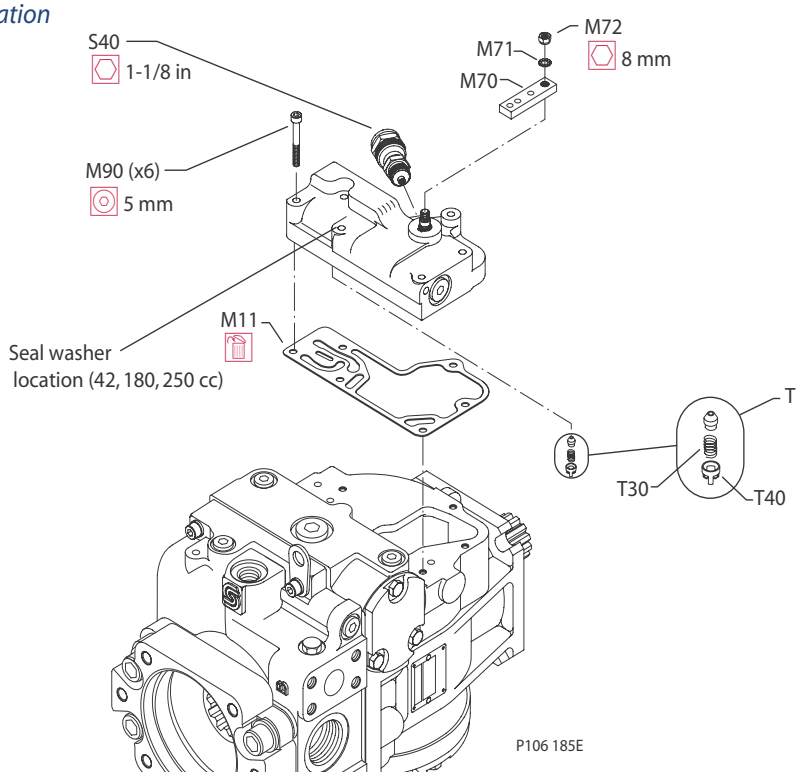
Assembly

1. Install a new gasket (M11). Inspect control to assure that the control orifice check valve and spring are in their proper position in the control.

2. Install the control. Engage the pin on the control linkage into the mating hole in the link attached to the swashplate.

3. If removed, install the control handle (M70) and locking nut (M72) with washer (M71). Hold the position of the handle and torque the locking nut to 13.5 N•m [10 lbf•ft] using an 8mm hex wrench.

MDC installation



4. With the control in position, move control lever both directions to check proper engagement of control linkage pin. If properly assembled, lever will return to center. If lever does not return to center, remove the control and repeat the above procedure.

5. Align the control gasket and install the screws. Torque the screws to 16 N•m [12 lbf•ft].

⚠ Warning

Risk of improper machine start-up. If equipped with Neutral Start Switch (NSS), perform NSS adjustment procedure in service

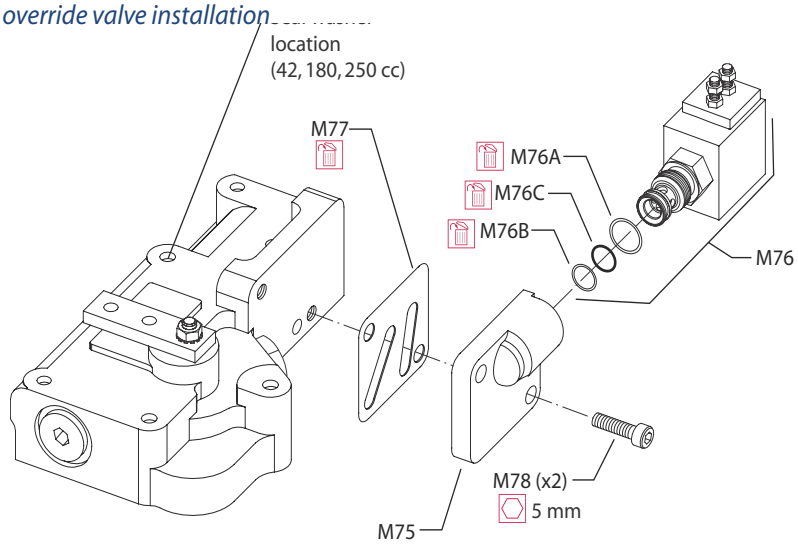
Install a sealing washer under the head of mounting screws in the location shown

6. If the control is equipped with a neutral start switch, refer to *MDC Neutral start switch adjustment* instructions in the *Series 90 Pumps Service Manual* **520L0818**..

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SOLENOID OVERRIDE VALVE FOR MDC

Solenoid override valve installation



Assembly

1. Install a new gasket (M77) on the control housing. Install the manifold (M75) onto the control housing, align the gasket, and install the screws (M78). Torque the screws to 13.5 N•m [10 lbf•ft].

2. Using a 17 mm wrench, torque valve (M76) to 24 N•m [17.7 lbf•ft]. If solenoid was removed, torque solenoid nut to 6 N•m [4.5 lbf•ft]. Do not overtorque the solenoid nut.

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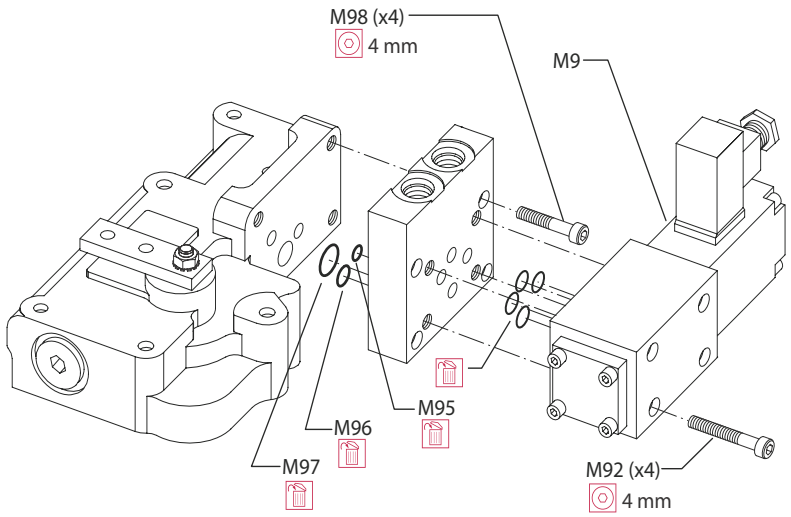
SOLENOID OVERRIDE VALVE FOR MDC WITH PRESSURE RELEASED BRAKE

Assembly

1. Using petroleum jelly to retain them, install new O-rings (M95, M96, M97) on the adapter plate. Place the adapter plate into position and using a 4 mm internal hex, install the screws (M98). Torque the screws to 5.4 N•m [4 lbf•ft].

2. Using petroleum jelly to retain them, install new O-rings onto the solenoid valve assembly (M9) and install the solenoid valve onto the adapter plate. Using a 4 mm internal hex ,install the screws (M92) and torque to 5.4 N•m [4 lbf•ft].

Solenoid override valve installation



P106 192E

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PRESSURE CONTROL PILOT (PCP) FOR ELECTRIC DISPLACEMENT CONTROL (EDC)

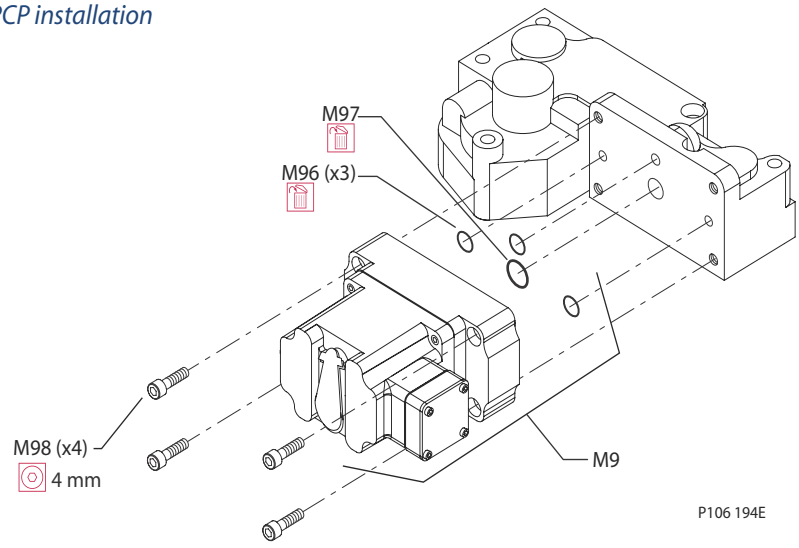
Assembly

1. Using petroleum jelly to retain them, install new O-rings (M96 and M97) in PCP Housing.

2. Place PCP against EDC housing and using a 4 mm internal hex, install the screws (M98). Torque to 5.4 N•m [4 lbf•ft].

Do not remove black plastic cover from the aluminum plate. This is not a serviceable item and removal voids the product warranty.

PCP installation



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3-POSITION (FNR) ELECTRIC CONTROL

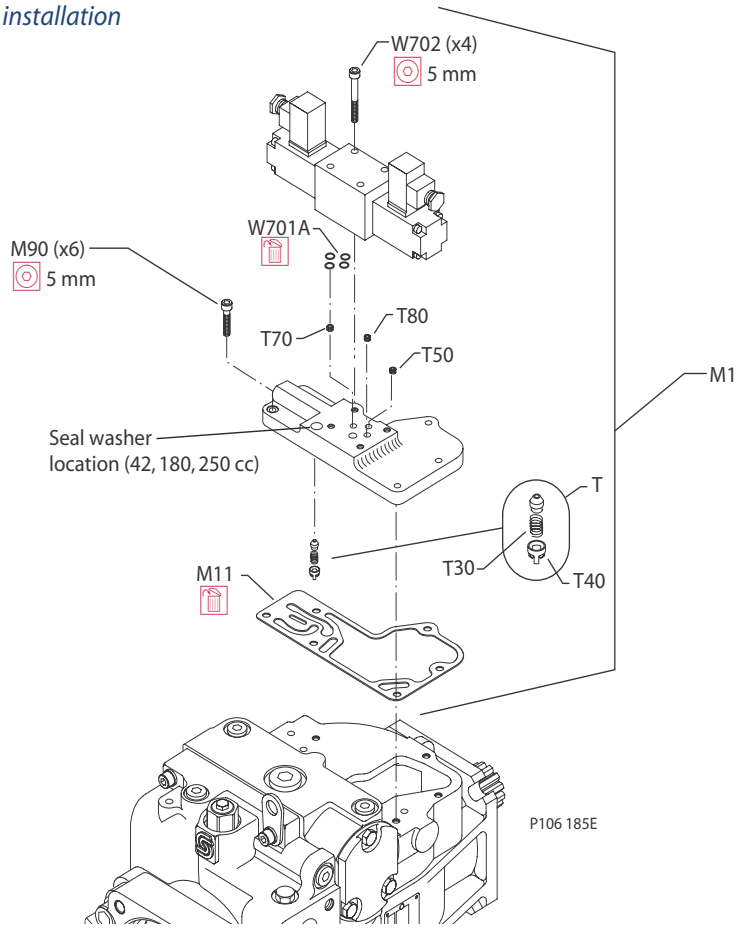
Assembly

1. Install a new gasket (M11) on the housing. Place the adapter plate into position and using a 5 mm internal hex, install the screws (M90). Install a sealing washer under the head of mounting screws that are installed into through holes in the housing. Torque the screws to 16 N•m [12 lbf•ft].

2. Install orifices (T70 and T80) into adapter plate using a 0.8, 0.9, 1.0, 1.2, or 1.5 mm internal hex wrench. Install orifice (T50) into adapter plate using a 0.8, 1.0, or 1.2 mm internal hex wrench. Torque M5 threads to 3.69 N•m [5 lbs•lft], M6 threads to 6 N•m [4.43 lbs•lft], and M8 threads to 8 N•m [5.9 lbs•lft].

3. Using petroleum jelly to retain them, install new O-rings (W701A) onto the solenoid valve assembly and install the solenoid valve onto the adapter plate. Using a 5 mm internal hex, install screws (W702). Torque to 5.4 N•m [4 lbf•ft].

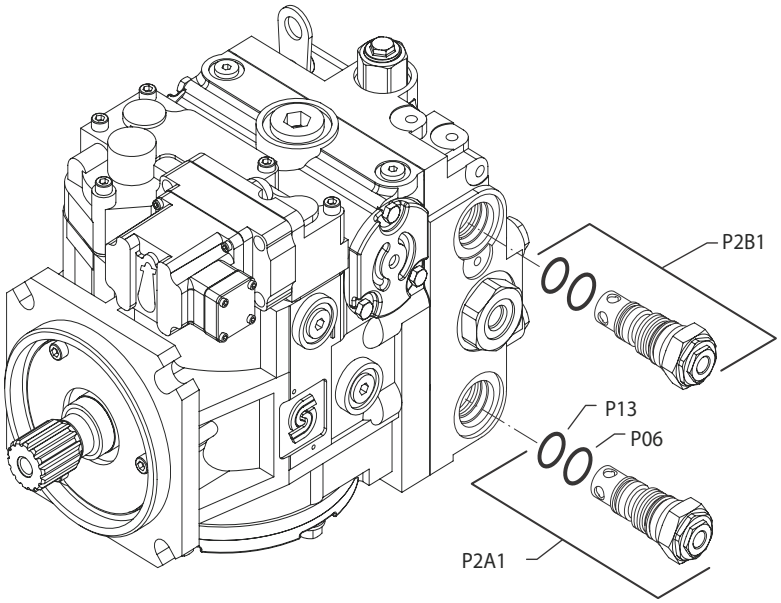
FNR installation



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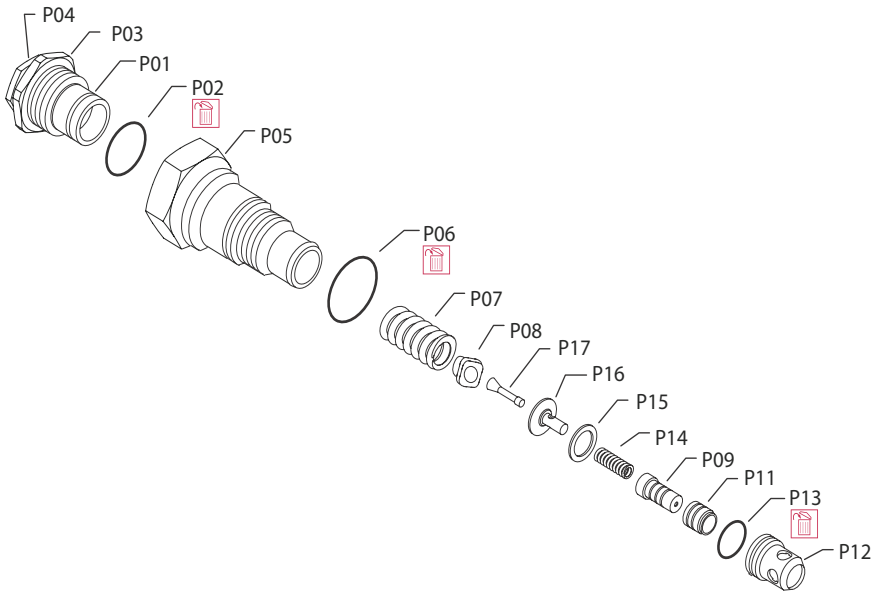
MULTI-FUNCTION VALVE CARTRIDGES

Multi-function valve installation



P106 180E

Multi-function valve



E101 531E

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Assembly

1. Lubricate and install internal components (P07, P08, P17, P16, P15, P14, P09, P11, and P12).

2. Place the cartridge in a vise and press on the poppet seat (P12).

3. Lubricate and install new O-rings (P02, P06, P13).

4. Install bypass actuator (P03) with pressure limiter valve (P01). Torque to 40 N•m [30 lbf•ft]

Caution

If pressure limiter (P01) was removed from bypass actuator (P03), adjust pressure limiter to model code specifications.

Caution

Do not overtorque the multi-function valve cartridges

5. Install cartridges and torque as shown in the table.

Multi-function valve wrench size

Frame size	Wrench size
030 – 100	1-1/4 inch
130 – 250	1-5/8 inch

Multi-function valve torque

Frame size	Torque
030 – 100	89 N•m [66 lbf•ft]
130 – 250	210 N•m [155 lbf•ft]

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INSTALLING SHAFT AND BEARING

Shaft and bearing installation

1. Position the pump on its end cap.
2. Press the roller bearing (L10) onto the input shaft (L1). For units with a 3-piece bearing, press the inner race onto the shaft, then install the outer race/cage assembly and special washer.
3. Using suitable retaining-ring pliers, install the bearing retaining ring (L20).

Caution

Do not damage the sealing surface in the housing during shaft/bearing installation.

4. Lubricate and install shaft and bearing assembly through front of housing, aligning the shaft spline with the cylinder block spline. If pump is equipped with auxiliary pad, align charge pump shaft with auxiliary pad coupling.
5. Continue to lower the shaft into the unit while aligning the end of the shaft with end cap journal bearing.

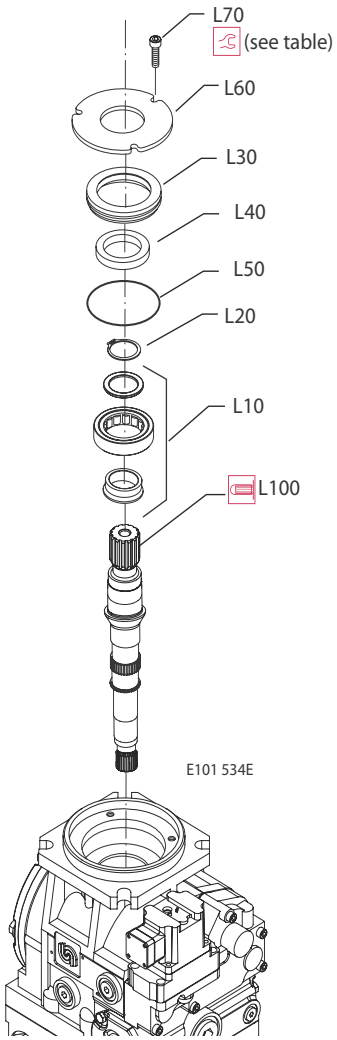
If necessary, coat the outside diameter of the seal lightly with a sealant (such as Loctite™ High Performance Sealant #59231) prior to installation. This aids in preventing leaks caused by damage to the seal bore in the seal carrier.

6. Lubricate and press seal (L40), in carrier (L30).
7. Lubricate and install O-ring (L50) in carrier (L30).
8. Lubricate and press seal carrier into its bore in the housing.
9. Install retainer plate (L60), and bolts (L70). Wrench sizes and torque values for retainer plate bolts are shown in table below.

L70 wrench sizes and torques

Pump size	Wrench size	Torque N•m [lbf•ft]
042 cc	10 mm hex	12 N•m [9 lbf•ft]
055 - 100 cc	5 mm internal hex	16 N•m [12 lbf•ft]
130 - 250 cc	6 mm internal hex	32 N•m [24 lbf•ft]

Installing the shaft and bearing assembly



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FINAL ASSEMBLY AND TESTING

Final assembly and testing procedures

Rotate the pump shaft with a torque wrench to assure correct assembly. The table *Torque to turn shaft at 0° (with seal assembly installed) shows* torques necessary to turn the shaft (after break-away).

Torque to turn shaft at 0° (with seal assembly installed)

Pump size	Minimum torque N•m [lbf•ft]	Maximum torque N•m [lbf•ft]
030 cc	2.7 [2.0]	10.2 [7.5]
042 cc	3.5 [2.6]	10.5 [7.7]
055 cc	5.4 [4.0]	12.2 [9.0]
075 cc	6.8 [5.0]	13.6 [10.0]
100 cc	10.2 [7.5]	17.6 [13.0]
130 cc	12.2 [9.0]	21 [15.5]
180 cc	17.0 [12.5]	33.9 [25.0]
250 cc	23.0 [17.0]	44.9 [33.1]

⚠ Warning

Test the pump before putting it into service. Verify correct pressure limiter and control function. Improper function of these systems can result in uncontrollable movement of the vehicle/machine.

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FASTENER SIZE AND TORQUE CHART

Item	Fastener	Frame size	Wrench size	Torque
B83	Speed sensor lock nut	030-250	1-1/16 in hex	13.5 N•m [10 lbf•ft]
E60	Side cover screw Blind holes	030-042	10 mm hex	13.5 N•m [10 lbf•ft]
		055-100	13 mm hex	32 N•m [24 lbf•ft]
		130-250	17 mm hex	50 N•m [37 lbf•ft]
E60	Side cover screw Thru holes	030-042	10 mm hex	10.4 N•m [7.7 lbf•ft]
		055-100	13 mm hex	32 N•m [24 lbf•ft]
		130-250	17 mm hex	64 N•m [47 lbf•ft]
F111/ F211	Servo cylinder screw	030-055	8 mm hex	13.5 N•m [10 lbf•ft]
		075-250	10 mm hex	32.5 N•m [24 lbf•ft]
G90/ G97	End cap screw	030-042	5 mm internal hex	13.5 N•m [10 lbf•ft]
		055-100	6 mm internal hex	32.4 N•m [24 lbf•ft]
		130	10 mm hex	38 N•m [28 lbf•ft]
		180-250	10 mm hex	110 N•m [81 lbf•ft]
H80	Charge pump retaining screw	030-100	10 mm hex	16 N•m [11.85 lbf•ft]
		130-250	13 mm hex	32 N•m [24 lbf•ft]
J80	End cap screw	030	8 mm internal hex	58 N•m [43 lbf•ft]
		early 042	8 mm internal hex	75 N•m [55 lbf•ft]
		late 042	10 mm internal hex	75 N•m [55 lbf•ft]
		055	19 mm hex	122 N•m [90 lbf•ft]
		075-100	24 mm hex	298 N•m [220 lbf•ft]
		100-130	14 mm internal hex	298 N•m [220 lbf•ft]
		180-250	17 mm internal hex	580 N•m [429 lbf•ft]
K10	Charge pressure valve plug	030-250	1/2 in hex	NA
K90	Charge pressure lock nut	030-100	1-1/16 in hex	52 N•m [38 lbf•ft]
		130-250	1-5/8 in hex	52 N•m [38 lbf•ft]
L70	Shaft retaining screw	030-042	10 mm hex	12 N•m [9 lbf•ft]
		055-100	5 mm internal hex	16 N•m [12 lbf•ft]
		130-250	6 mm internal hex	32 N•m [24 lbf•ft]
M72	MDC handle nut	030-250	8 mm	13.5 N•m [10 lbf•ft]
M78	De-stroke valve manifold screw	030-250	5 mm internal hex	13.5 N•m [10 lbf•ft]
M85	Eccentric plug lock nut	030-250	1-1/8 in hex	27 N•m [20 lbf•ft]
M88	Neutral start switch lock nut	030-250	1-1/8 in hex	27 N•m [20 lbf•ft]
M90	Control mounting screw	030-250	5 mm internal hex	16 N•m [12 lbf•ft]
M92	Solenoid valve mounting screw	030-250	4 mm internal hex	5.4 N•m [4 lbf•ft]
M98	PCP mounting screw	030-250	4 mm internal hex	5.4 N•m [4 lbf•ft]
N10	Filter reducer assembly	030-042	1-1/4 in hex	70 N•m [52 lbf•ft]
		055-130	1-1/2 in hex	122 N•m [90 lbf•ft]
		180-250	1-1/2 in hex	156 N•m [115 lbf•ft]
N37	Filter plug assembly	030-250	1/4 in internal hex	27 N•m [20 lbf•ft]
P2B1/ P2A1	Multi-function valve	030-100	1-1/4 in hex	89 N•m [66 lbf•ft]
		130-250	1-5/8 in hex	210 N•m [155 lbf•ft]

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PLUG SIZE AND TORQUE CHART

If any plugs or fittings are removed from the pump during servicing,install and torque as indicated in the accompanying table.

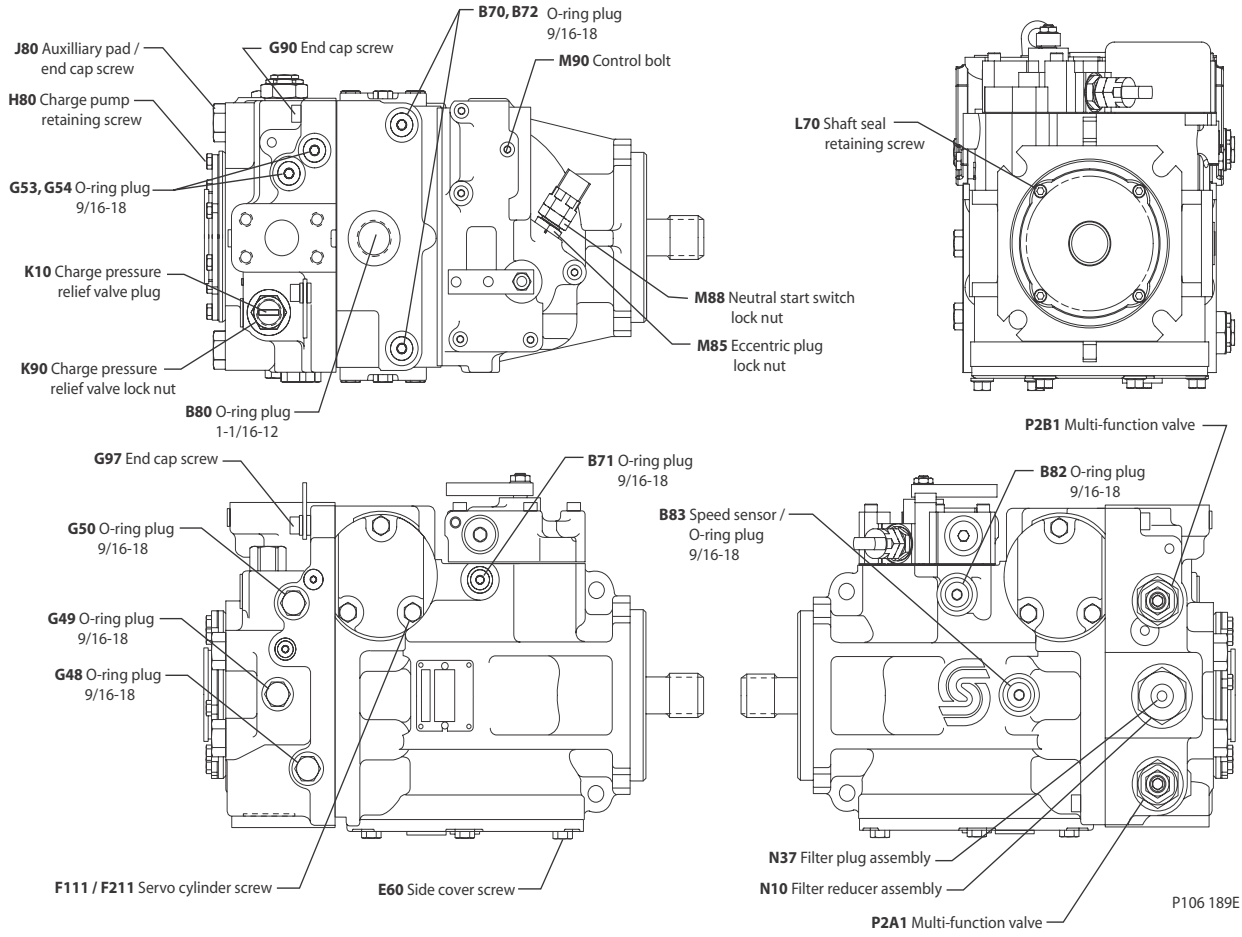
Always install new O-rings before reinstalling the plugs or fittings.

Caution
Torque plugs or fittings installed into aluminum housings to the lower values specified for internal hex plugs of the same size.

Item	O-ring plug	Wrench size	Torque
B70, B72	9/16-18	3/16 internal hex wrench	40 N•m [30 lbf•ft]
B71	9/16-18	3/16 internal hex wrench	12 N•m [9 lbf•ft]
B80	1-1/16-12	9/16 internal hex wrench	115 N•m [85 lbf•ft]
B82, B83	9/16-18	1/4 internal hex wrench	40 N•m [30 lbf•ft]
G18	7/16-20	3/16 internal hex wrench	12 N•m [9 lbf•ft]
G45-G50	9/16-18	11/16 inch hex wrench	40 N•m [27 lbf•ft]
G52-G54	9/16-18	1/4 internal hex wrench	40 N•m [30 lbf•ft]
H90 (not shown)	1-5/16-12	5/8 internal hex wrench	129 N•m [95 lbf•ft]
N35, N36 (not shown)	9/16-18	11/16 inch hex wrench	37 N•m [27 lbf•ft]
N37	9/16-18	1/4 internal hex wrench	23 N•m [17 lbf•ft]

FASTENERS AND PLUGS

Fastener and plug locations



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OUR PRODUCTS

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Local address:

Sauer-Danfoss (US) Company
2800 East 13th Street
Ames, IA 50010, USA
Phone: +1 515 239-6000
Fax: +1 515 239-6618

Sauer-Danfoss ApS
DK-6430 Nordborg, Denmark
Phone: +45 7488 4444
Fax: +45 7488 4400

Sauer-Danfoss GmbH & Co. OHG
Postfach 2460, D-24531 Neumünster
Krokamp 35, D-24539 Neumünster, Germany
Phone: +49 4321 871-0
Fax: +49 4321 871 122

Sauer-Danfoss-Daikin LTD
Sannomiya Grand Bldg. 8F
2-2-21 Isogami-dori, Chuo-ku
Kobe, Hyogo 651-0086, Japan
Phone: +81 78 231 5001
Fax: +81 78 231 5004

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10.2 Travel motor

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Genuine Parts

Series 51 and 51-1 Bent Axis Motors

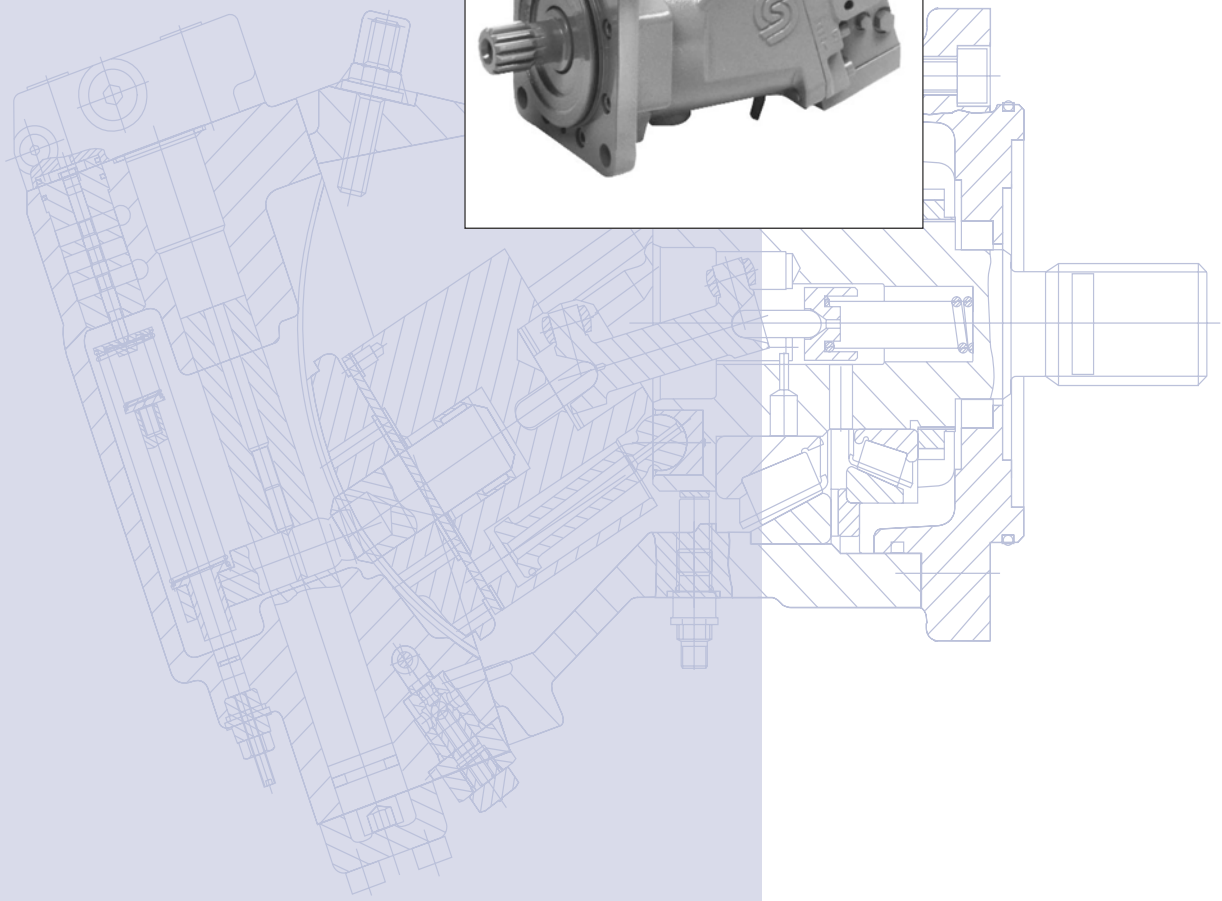
Service Manual











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Series 51 and 51-1 Motors
Service Manual
Revisions

HISTORY OF REVISIONS

Table of Revisions

Date	Page	Changed	Rev.
November 2009	14	correction to defeated loop flushing information	AE
November 2009	19	11009442 is correct number for Series 51 two position controls manual	AD
April 2009	5	remove list of manuals	AC
February 2009	34	Frame size 60 - Minimum displacement range to 36 ccm	AB
December 2007	-	First edition	AA

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Series 51 and 51-1 Motors Service Manual

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Genuine Parts

OVERVIEW

The complete service and repair information for Series 51 and Series 51-1 motors is in a modular format. Service information modules are available for the basic motor components, for each family of motor controls, and for major repair procedures. Each module contains information on the function, adjustment, and repair of each group of components or controls. The repair instructions module focuses on major repair procedures.

Functional description, technical specifications, adjustment procedures, minor repair procedures, and exploded view common parts drawings for the basic Series 51 and Series 51-1 motor components comprise this manual. It discusses those minor repairs you can perform without removing the motor's end cap. These repairs will not affect the unit's warranty.

Major repairs require removing the motor's end cap. This manual does not describe them. Only Sauer-Danfoss Authorized Service Centers and / or original equipment manufacturers trained by Sauer-Danfoss should perform these repairs.

Major repairs performed by persons other than a Sauer-Danfoss Authorized Service Center or trained OEM personnel may void the unit's warranty

For information on control types see pages, 18-20.

ORDERING REPLACEMENT PARTS AND SERVICE

Order genuine Sauer-Danfoss replacement parts to ensure the best performance. For *lists of available service parts and service kits for Series 51 units*, see **520L0765** through **520L0770**.

Sauer-Danfoss provides a complete repair and parts service for all products. Contact any Sauer-Danfoss Authorized Service Center for details. Check our web site at http://www.sauer-danfoss.com to see a list of Sauer-Danfoss Authorized Service Center locations.

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SAFETY PRECAUTIONS

Always consider safety precautions before beginning a service procedure. Protect yourself and others from injury. Take the following general precautions whenever servicing a hydraulic system.

Unintended machine movement

⚠ Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

Flammable cleaning solvents

⚠ Warning

Some cleaning solvents are flammable. To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

Fluid under pressure

⚠ Warning

Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury and/or infection. This fluid may also be hot enough to cause burns. Use caution when dealing with hydraulic fluid under pressure. Relieve pressure in the system before removing hoses, fittings, gauges, or components. Never use your hand or any other body part to check for leaks in a pressurized line. Seek medical attention immediately if you are cut by hydraulic fluid.

Personal safety

⚠ Warning

Protect yourself from injury. Use proper safety equipment, including safety glasses, at all times.

Hazardous material

⚠ Warning

Hydraulic fluid contains hazardous material. Avoid prolonged contact with hydraulic fluid. Always dispose of used hydraulic fluid acm³ording to state, and federal environmental regulations.

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Genuine Parts

SYMBOLS USED IN SAUER-DANFOSS LITERATURE

- WARNING may result in injury
- CAUTION may result in damage to product or property
- Reusable part
- Non-reusable part, use a new part
- Non-removable item
- Option – either part may exist
- Superseded – parts are not interchangeable
- Measurement required
- Flatness specification
- Parallelism specification
- External hex head
- Internal hex head
- Torx head
- O-ring boss port
- Tip, helpful suggestion
- Lubricate with hydraulic fluid
- Apply grease/petroleum jelly
- Apply locking compound
- Inspect for wear or damage
- Clean area or part
- Be careful not to scratch or damage
- Note correct orientation
- Mark orientation for reinstallation
- Torque specification
- Press in – press fit
- Pull out with tool – press fit
- Cover splines with installation sleeve
- Pressure measurement/gauge location or specification

The symbols above appear in the illustrations and text of this manual. They are intended to communicate helpful information at the point where it is most useful to the reader. In most instances, the appearance of the symbol itself denotes its meaning. The legend above defines each symbol and explains its purpose.

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GENERAL INSTRUCTIONS

Keep it clean

You can complete many repairs or adjustments without removing the unit from the machine, *if* the unit is accessible and you can thoroughly clean it before beginning any procedures.

Cleanliness is a primary means of assuring satisfactory motor life on either new or repaired units. *Clean the outside of the motor thoroughly before disassembly.* Take care to avoid contamination of the system ports. Cleaning parts with a clean solvent wash and air drying is usually adequate.

As with any precision equipment, keep all parts free of foreign materials and chemicals. Protect all exposed sealing surfaces and open cavities from damage and foreign material. Cap all hoses after removal, and plug all open ports. Cover any unattended parts with a protective layer of plastic.

Inspect for system contamination

Inspect the motor for signs of system contamination. If you find contamination, fully disassemble, clean and inspect all components of the motor.

Replace the O-rings and gaskets

Replace all O-rings and gaskets. Discard them only after you make certain that you have the correct replacement parts. Lightly lubricate all O-rings with clean petroleum jelly before assembly.

Lubricate all moving parts

During reassembly, coat all moving parts with a film of clean hydraulic oil. This helps lubricate the surfaces during start-up.

For fluid quality requirements, refer to **520L0463** *Hydraulic Fluids and Lubricants, Technical Information*.

Torque procedure

During reassembly, cross torque all retaining screws to the given value. Do not overtorque.

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VARIABLE DISPLACEMENT MOTORS

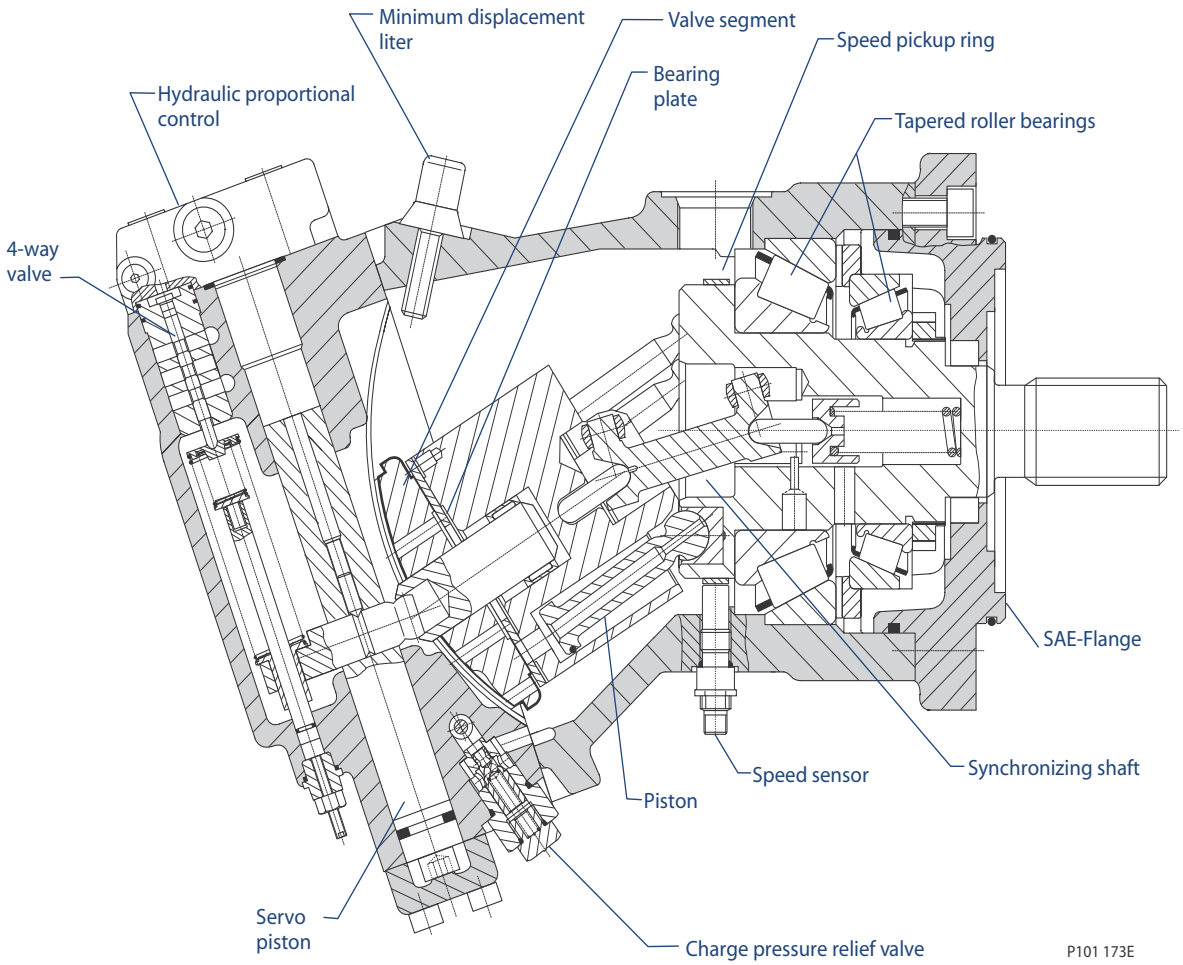
Series 51 and Series 51-1 variable displacement motors feature a bent-axis rotating group that provides high starting torque and high speed. The ball end of each piston runs in a bushing pressed into the drive shaft. This permits the transfer of hydraulic power directly into rotary motion at the drive shaft. The pressure balanced spherical piston rings maintain contact with the cylinder block bores providing high volumetric efficiency and low friction. A constant velocity joint (synchronizing shaft) keeps the rotation of the cylinder block synchronized with the motor output shaft.

A servo piston changes the angle of the rotating group and varys the displacement of the motor. Decreasing displacement increases speed. Increasing displacement decreases speed.

Several hydraulic and electrohydraulic controls are available.

The 4-way spool valve shifts the servo supply pressure to change the motor displacement. The servo supply pressure can be external or internal.

Series 51 motor cross section



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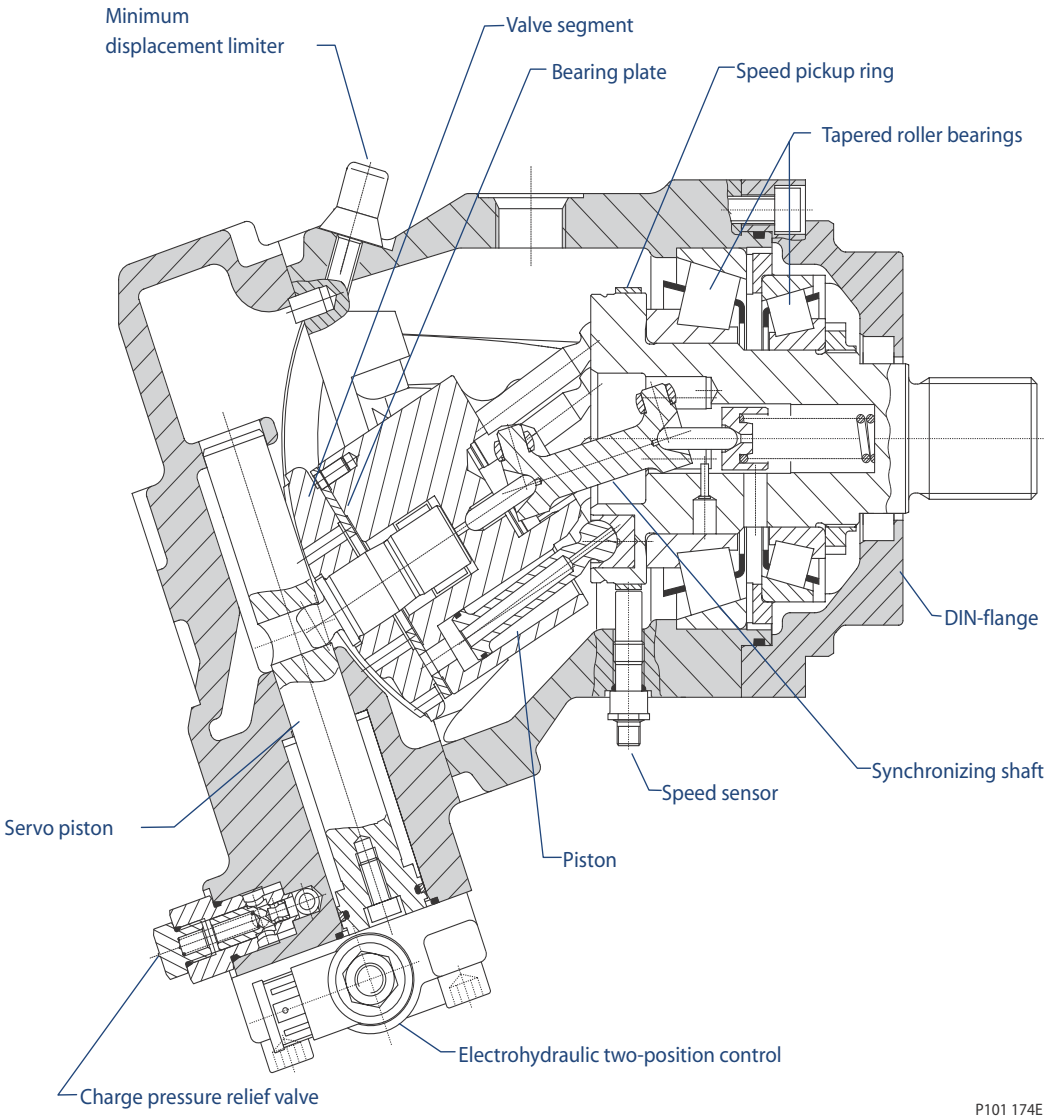
SERIES 51-1 MOTORS

Series 51-1 motors feature simplified end cap and control components. The servo piston in the Series 51-1 has a differential area of 2 to 1. The connecting joint is designed to decrease the overall length of the motor.

The Series 51-1 control feeds servo pressure directly to the servo piston. Low system loop pressure for two-position controls, and high system loop pressure for pressure compensating controls actuates the servo piston.

Rotating hardware and housing components are common between Series 51 and Series 51-1.

Series 51-1 motor cross section

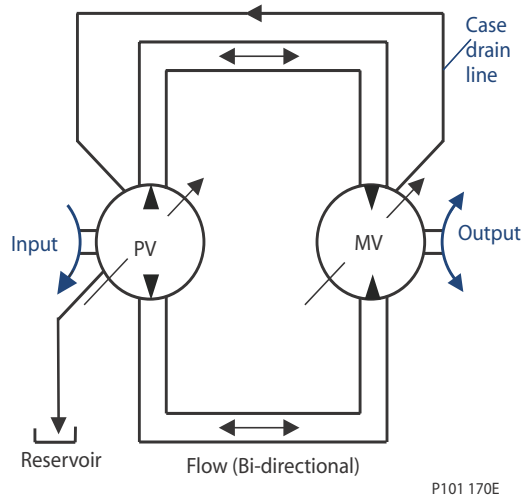


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CLOSED CIRCUIT

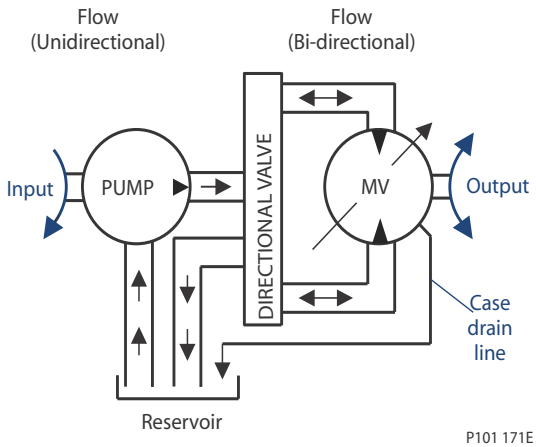
In a closed circuit, hydraulic lines connect the main ports of the pump to the main ports of the motor. Fluid flows in either direction from the pump to the motor and back to the pump. Either of the hydraulic lines can be under high pressure.



The direction and speed of the fluid flow (and motor output shaft rotation) depends on the position of the pump swash plate. The pump flow and motor displacement determines motor output shaft speed. The machine load determines the system pressure.

OPEN CIRCUIT

A hydraulic line connects the outlet port of the pump to a directional valve in an open circuit. The main ports of the motor connect to the working ports of this valve. When the directional valve is actuated, fluid flows first from the pump to the valve. The directional valve then directs the fluid to the motor in either direction.



The direction of fluid flow (and motor output shaft rotation) depends on the position of the directional valve. The motor output speed depends on (1) pump output volume, (2) the restriction of the valve opening and (3) motor displacement. The machine load determines the system pressure. The directional valve routes fluid returning from the motor to the reservoir. Additional components may be necessary to provide dynamic breaking and to deal with overrunning loads.

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SHAFTS

Many shaft configurations are available on Series 51 and Series 51-1 motors. These tables show shafts that may be on each motor flange configuration.

Series 51-1 shaft options

Frame size			60		80		110	
Order code	Shaft description	Flange	SAE	Cart/ DIN	SAE	Cart/ DIN	SAE	Cart/ DIN
S1	14-tooth, 12/24 pitch		STD	—	STD	—	—	—
C6	21-tooth, 16/32 pitch		OPT	—	—	—	—	—
C7	23-tooth, 16/32 pitch		—	—	OPT	—	—	—
C8	27-tooth, 16/32 pitch		—	—	—	—	—	—
F1	13-tooth, 8/16 pitch		—	—	—	—	STD	—
D1	W30x2x30x14x9g per DIN 5480		—	STD	—	—	OPT	
D2	W30x2x30x16x9g per DIN 5480		—	OPT	—	STD	—	—
D3	W35x2x30x18x9g per DIN 5480		—	—	—	OPT	—	STD
D4	W45x2x30x21x9g per DIN 5480		—	—	—	—	—	OPT

Series 51 shaft options

Frame size			80		110		160		250
Order code	Shaft description	Flange	SAE	Cart/ DIN	SAE	Cart/ DIN	SAE	Cart/ DIN	SAE
S1	14-tooth, 12/24 pitch		STD	—	—	—	—	—	—
C7	23-tooth, 16/32 pitch		OPT	—	—	—	—	—	—
C8	27-tooth, 16/32 pitch		—	—	OPT	—	OPT	—	—
F1	13-tooth, 8/16 pitch		—	—	STD	—	STD	—	—
F2	15-tooth, 8/16-pitch		—	—	—	—	—	—	STD
D2	W35x2x30x16x9g per DIN 5480		—	STD	—	—	—	—	—
D3	W40x2x30x18x9g per DIN 5480		—	OPT	—	—	—	—	—
D4	W45x2x30x21x9g per DIN 5480		—	—	—	STD	—	—	—
D5	W50x2x30x24x9g per DIN 5480		—	—	—	—	—	STD	—

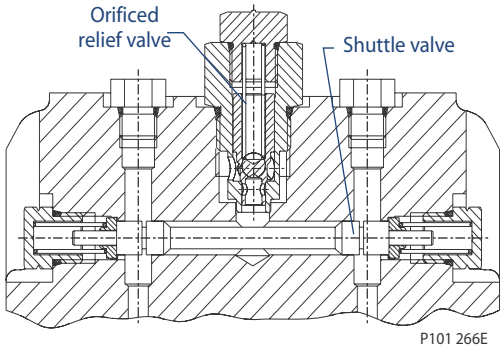
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LOOP FLUSHING

Series 51 and 51-1 motors are designed to accommodate a loop flushing function. Installations that require additional fluid removal from the main hydraulic circuit because of transmission cooling requirements use a loop flushing function. The loop flushing function consists of a shuttle valve and a poppet style relief valve or an orificed relief valve cartridge.

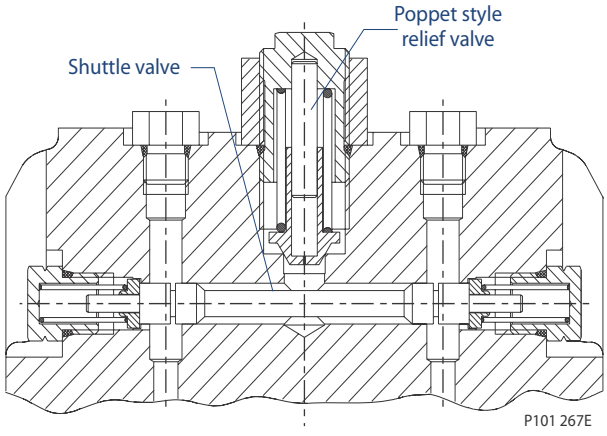
The **shuttle valve** acts as a resolver, directing fluid only from the low pressure side of the loop to the motor relief valve. The shuttle valve is spring centered to the closed position to prevent high pressure fluid loss from the circuit when reversing directions.

Loop flushing cross-section showing orificed relief valve



The **poppet style relief valve** regulates the charge pressure level in the system circuit when there is a pressure differential in the main loop. When you use this valve, the pressure setting of the motor must be less than the pump's charge pressure setting. The pressure setting of this valve is critical to achieving the proper loop flushing flow rate.

Loop flushing cross-section showing poppet style relief valve

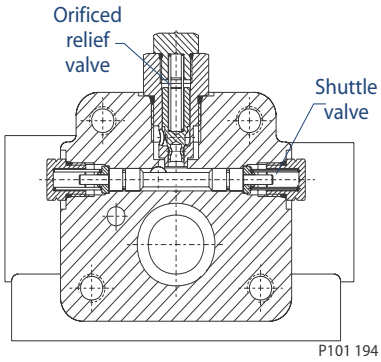


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LOOP FLUSHING (continued)

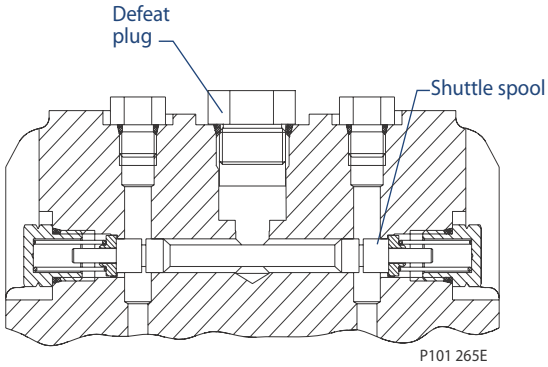
The **orificed relief cartridge** controls flushing flow under most conditions. A combination of orifice size and charge pressure will produce a specific flushing flow. You may exchange the orificed relief cartridge for one with a different flow rating.

Loop flushing cross-section showing defeated relief valve



A plug is installed in the relief valve cavity to defeat the loop flushing function.

Defeated loop flushing

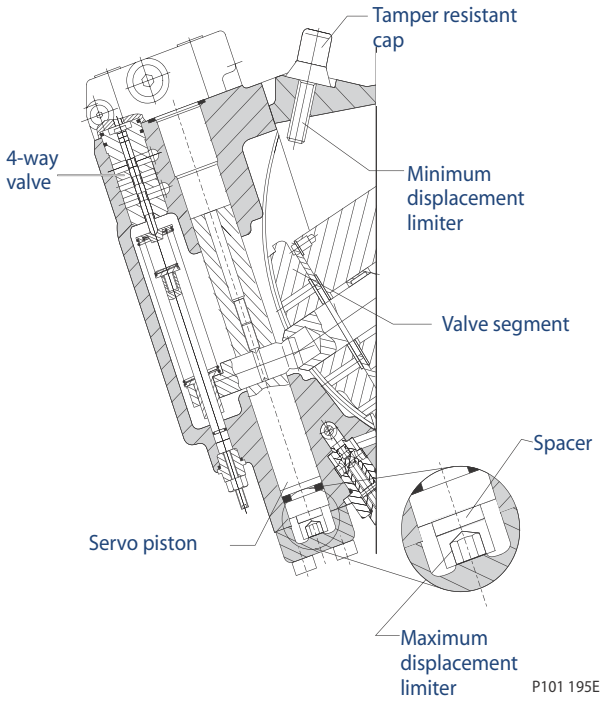


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DISPLACEMENT LIMITERS

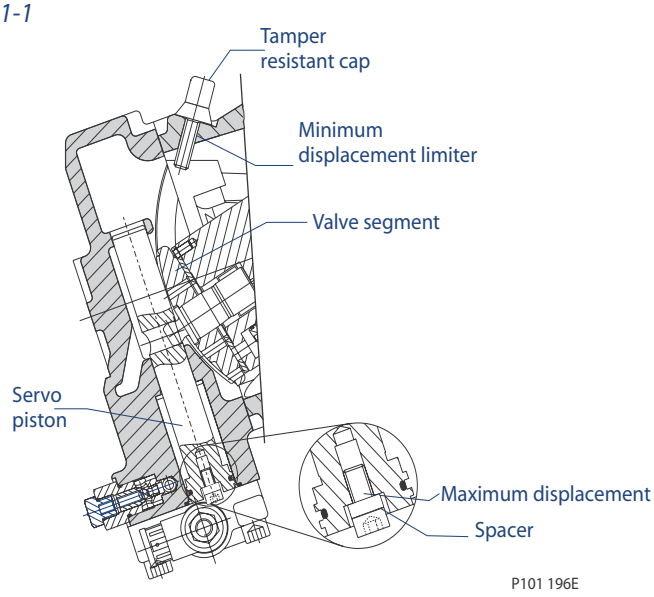
Series 51 and Series 51-1 motors incorporate mechanical displacement limiters. You can set a specific displacement range by limiting the travel of the valve segment/rotating group.

Displacement limiters Series 51



The **maximum displacement** of the motor is set by a screw and spacers installed on the end of the servo piston. The **minimum displacement** of the motor is set by an adjustable stop in the motor housing.

Displacement limiters Series 51-1



See *Adjustments,* pages 33-36, for available setting ranges.

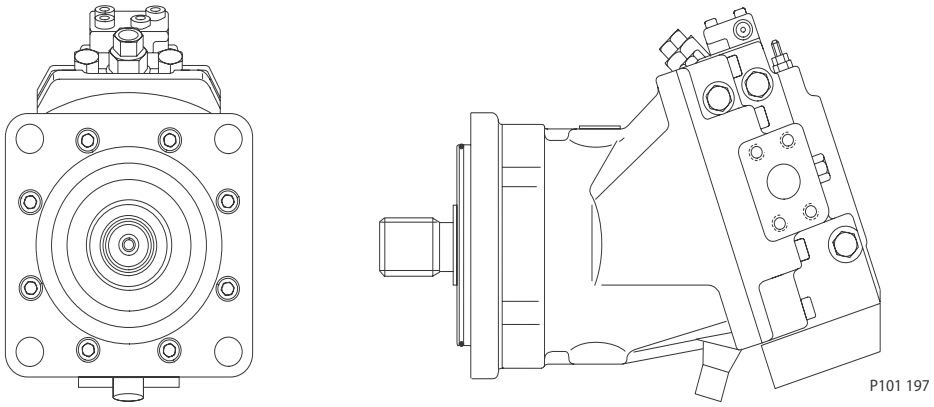
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MOUNTING CONFIGURATIONS

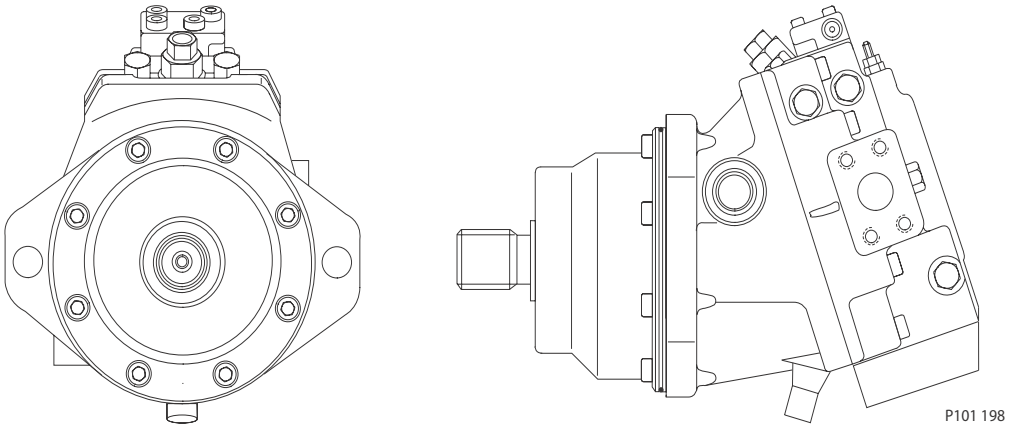
Series 51 and Series 51-1 motors are available in three mounting configurations. They are designated by the letters V, C, or D following the number 51 in the model code. The designations represent:

- V = SAE C, D, or E mounting flange
- C = Cartridge style mounting
- D = DIN ISO 3019/2 mounting flange

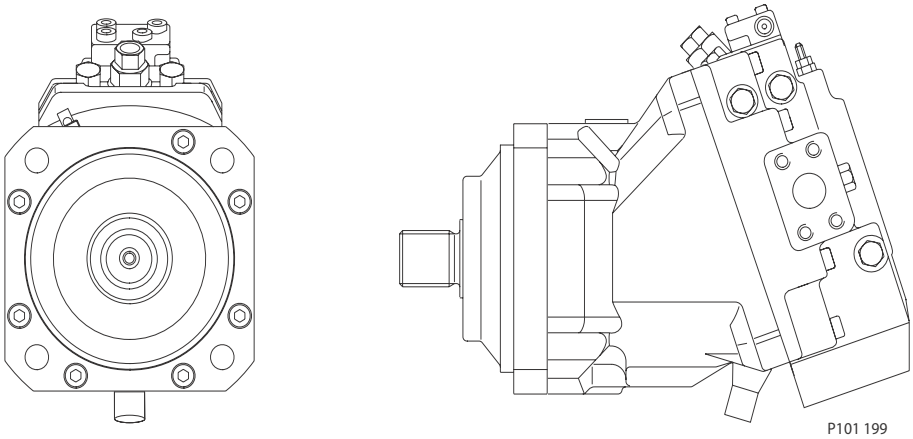
SAE configuration



Cartridge configuration



DIN configuration

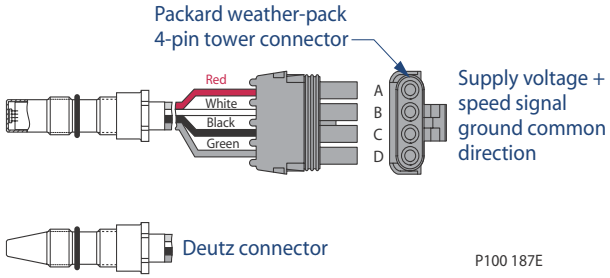


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SPEED SENSORS

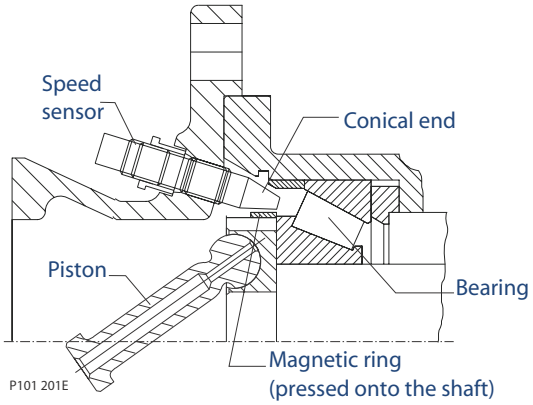
Series 51 and Series 51-1 motors are available with an optional speed sensor for direct measurement of motor output speed. The sensor may also be used to sense the direction of motor rotation.

Speed sensor with Packard connector



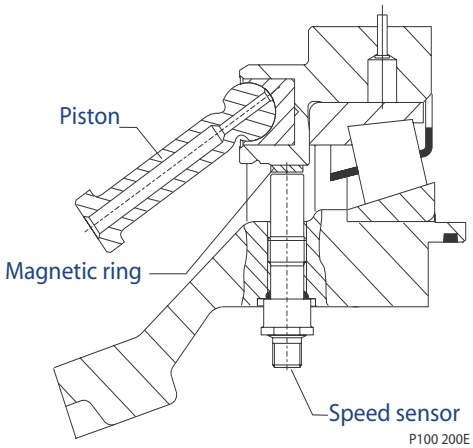
A special magnetic speed ring is pressed on to the outside diameter of the shaft. A Hall effect sensor is installed in the motor housing. The sensor acm³epts supply voltage and outputs a digital pulse signal in response to the speed of the ring.

Speed sensor location cartridge motors



The output changes its high/low state as the north and south poles of the permanently magnetized speed ring pass by the face of the sensor. The digital signal is generated at frequencies suitable for microprocessor-based controls.

Speed sensor location SAE / DIN flange motors



The SAE and DIN flange motors use a flat end speed sensor. Cartridge flange motors use a conical end speed sensor.

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CONTROLS

Overview

There are three basic categories of controls available for Series 51 and Series 51-1:

- Two-position controls
- Pressure -compensator controls
- Proportional controls (Series 51 only)

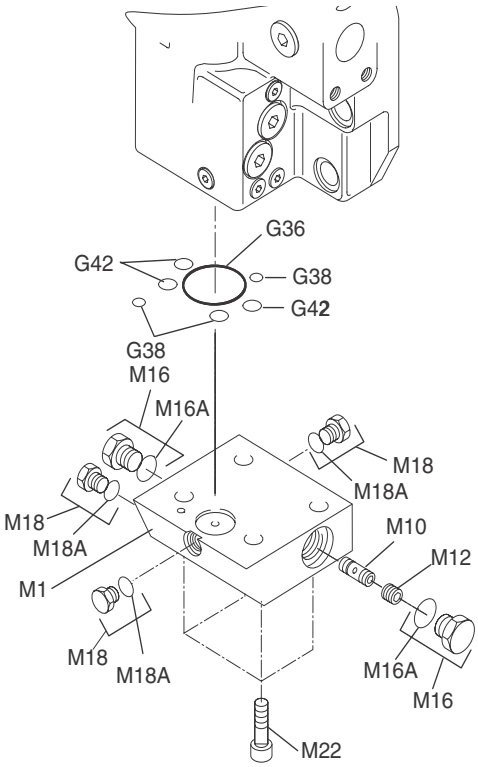
TWO-POSITION CONTROLS

Two-position controls shift the motor to only two discrete positions:

- maximum displacement
- minimum displacement.

Control input may be either by hydraulic or electrical signal. To change motor displacement, the control routes pilot pressure to one end of the servo piston while draining the other. Series 51-1 controls may direct pilot pressure to both ends of the servo simultaneously, allowing the differential area of the piston to stroke the motor to minimum angle.

Two-position control



Some two-position controls are available with a **P**ressure **C**ompensator **O**ver**R**ide (**PCOR**) feature.

The PCOR feature allows normal 2-position control while causing the motor to increase displacement when system pressure reaches a set level due to load. The pressure compensator portion of the control overrides the minimum displacement position commanded by the control input signal. PCOR controls are available with brake pressure defeat to prevent the pressure compensator from operating during dynamic braking.

Complete functional description, maintenance, and repair procedures for 2-position controls are covered in detail in these supplements to this manual:

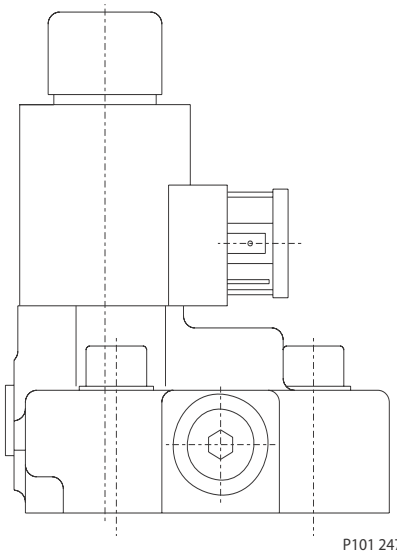
- 11009442 *Series 51 Hydraulic and Electrohydraulic Two-position Controls*
  Types: N2, HZ, E1-E2, F1-F2, G1-G2, S1

- 11009443 *Series 51-1 Controls Service Instructions*
  Types: N1, E1-E2-E7, B1-B2-B7, T1, T2, T7, TA, TH

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PRESSURE-COMPENSATOR CONTROLS

Pressure compensator (PC) controls allow the motor to match its displacement to the system load. Usually this means that the motor defaults to minimum displacement while allowing the motor to increase displacement when system pressure reaches a set level due to load. This permits the motor to regulate system pressure by modulating the displacement angle of the rotating group. As displacement increases, so does available torque, while output speed decreases and system pressure remains nearly constant at the PC setting.



P101 247E

PC controls are available with a **B**rake **P**ressure **D**efeat (**BPD**) feature. The BPD feature defeats the operation of the PC during dynamic breaking (when the motor is running as a pump).

A shuttle spool upstream of the PC valve directs only acm³eleration system pressure to the PC. During dynamic deceleration the dynamic breaking pressure is blocked from the PC. The motor remains at minimum displacement, limiting rapid and uncontrolled pressures or engine over-speeding while the vehicle/machine is slowing down. Hydraulic or electric actuation is available. PC on one system-pressure side is also an option.

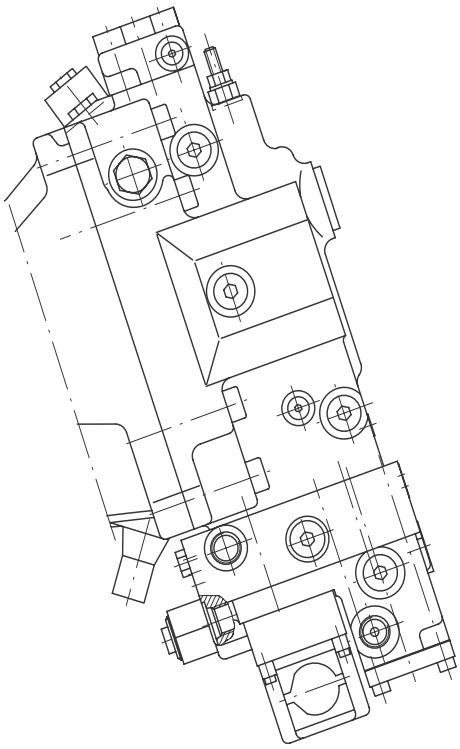
Complete functional description, maintenance, and repair procedures for pressure-compensator controls are covered in detail in the supplement to this manual:

- 11009442 *Series 51 Two Position Controls Service Manual*
  Types: T1, T2, TH, TA, PC, PD

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PROPORTIONAL CONTROLS

Proportional control



P001826

Proportional controls allow the motor to operate in an infinitely variable displacement position based on a hydraulic or electrical input signal.

Proportional controls are available on Series 51 motors. Series 51-1 motors are two-position only. Proportional controls are also available with a PCOR feature.

The PCOR feature allows normal proportional control while causing the motor to increase displacement when system pressure reaches a set level due to load. The pressure compensator portion of the control *overrides* any position less than maximum as commanded by the control input signal.

PCOR controls are available with BPD to prevent the pressure compensator from operating during dynamic braking. Supplements to this manual detail functional description, maintenance, and repair procedures for proportional controls. Supplements include:

- 11009446 *Series 51 Single Input Hydraulic Proportional Controls*
  Types: HZ, HA, HB, HE, HS, H1/H2, J1, J3, J4, K1/K2
- 11009447 *Series 51 Dual Input Hydraulic Proportional Controls*
  Types: HP, HC, JA
- 11009448 *Series 51 Electrohydraulic Proportional Controls*
  Types: EP, EQ, ER, ES, L1-L2, L7, A7, D7, D8

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Genuine Parts

GENERAL SPECIFICATIONS

Most specifications for Series 51 and 51-1 motors are listed on these pages. For definitions of the various specifications, see **520L0440** *Series 51 Technical Information Manual*.

Not all hardware options are available for all configurations. Consult the *Series 51 Model Code Supplement* or *price book* for more information.

Basic requirements

- Motor type Axial piston motor with variable displacement bent-axis design
- Direction of rotation Clockwise and counter-clockwise (bi-directional)
- Installation position Discretionary (the housing must always be filled with hydraulic fluid)
- Other system requirements Independent braking system, circuit overpressure protection, suitable reservoir

Technical data includes dimension and frame size for displacement, case and system pressure, speed, and torque. These tables illustrate each facet.

TECHNICAL DATA

			Frame size				
Dimension			**60**	**80**	**110**	**160**	**250**
Maximum displacement	Vg_{max}	cm^3 $[in^3]$	60 [3.66]	80.7 [4.92]	109.9 [6.71]	160.9 [9.82]	250 [15.26]
Minimum displacement	Vg_{min}	cm^3 $[in^3]$	12 [0.73]	16.1 [0.98]	22 [1.34]	32.2 [1.96]	50 [3.05]
Rated flow	Q	l/min [gal/min]	216 [57]	250 [66]	308 [81]	402 [106]	550 [145]
Maximum corner power	P corner max.	kW [hp]	336 [450]	403 [540]	492 [660]	644 [864]	850 [1140]
Weight with control Hz	m	kg lb	28 [62]	32 [71]	44 [97]	56 [123]	86 [190
Mass moment of inertia of the internal rotating parts		$kg•m^2$ $slug•ft^2$	0.0046 [0.1092]	0.0071 [0.1685]	0.0128 [0.3037]	0.0234 [0.5553]	0.048 [1.158]
Type of mounting	Four (4) bolt flange, SAE or DIN flange configuration Two (2) bolt flange cartridge motor configuration						
Pipe connections	Main pressure ports: SAE flange Remaining ports: SAE straight-thread O-ring boss						
Controls	Two-position, proportional (Series 51), hydraulic or electric, pressure compensator, w/wo override, w/wo brake pressure defeat						
Displacement limiter	All Series 51 motors incorporate mechanical minimum and maximum displacement limiters						
Shaft configuration	Splined ANSI or DIN shaft						

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TECHNICAL DATA (continued)

Case pressure

	bar	psi
Rated pressure	3	44
Maximum pressure (cold start)	5	73
Minimum pressure	1	15

System pressure range

	bar	psi
Maximum delta pressure	480	7000
Minimum low pressure side	10	145

Speed limits

Speed	min^{-1} [rpm]	Frame size				
		060	080	110	160	250
Rated speed	at maximum displacement	3,600	3,100	2,800	2,500	2,200
	at minimum displacement	5,600	5,000	4,500	4,000	3,400
Maximum speed[1]	at maximum displacement	4,400	4,000	3,600	3,200	2,700
	at minimum displacement	7,000	6,250	5,600	5,000	4,250

[1]Contact your Sauer-Danfoss representative for maximum speed at displacements between maximum and minimum displacement.

Theoretical torque

Displacement condition		Frame size				
		060	080	110	160	250
at maximum displacement	N•m/bar	0.95	1.28	1.75	2.56	3.98
	[lbf•in/1000 psi]	583	784	1067	1563	2428
at minimum displacement	N•m/bar	0.19	0.26	0.35	0.51	0.80
	[lbf•in/1000 psi]	117	156	214	313	486

FLUID SPECIFICATIONS

Temperature range[1]

Calefaction	°C	°F
Intermittent (cold start)	- 40	- 40
Continuous	104	220
Intermittent	115	240

[1]At the hottest point, usually the case drain port.

Viscosity

	mm^2/s	SUS
Minimum (intermittent)	7	47
Recommended operating range	12-60	70-278
Maximum (cold start)	1,600	7,500

Fluid cleanliness

Cleanliness level and β_x-ratio	
Required fluid cleanliness level	ISO 4406 Class 18/13
Recommended β_x-ratio for suction filtration	$B_{35\text{-}45}$=75 ($B_{10}\geq 2$)
Recommended β_x-ratio for charge pressure filtration	$B_{15\text{-}20}$=75 ($B_{10}\geq 10$)
Recommended inlet screen size for charge pressure filtration	100 µm - 125 µm

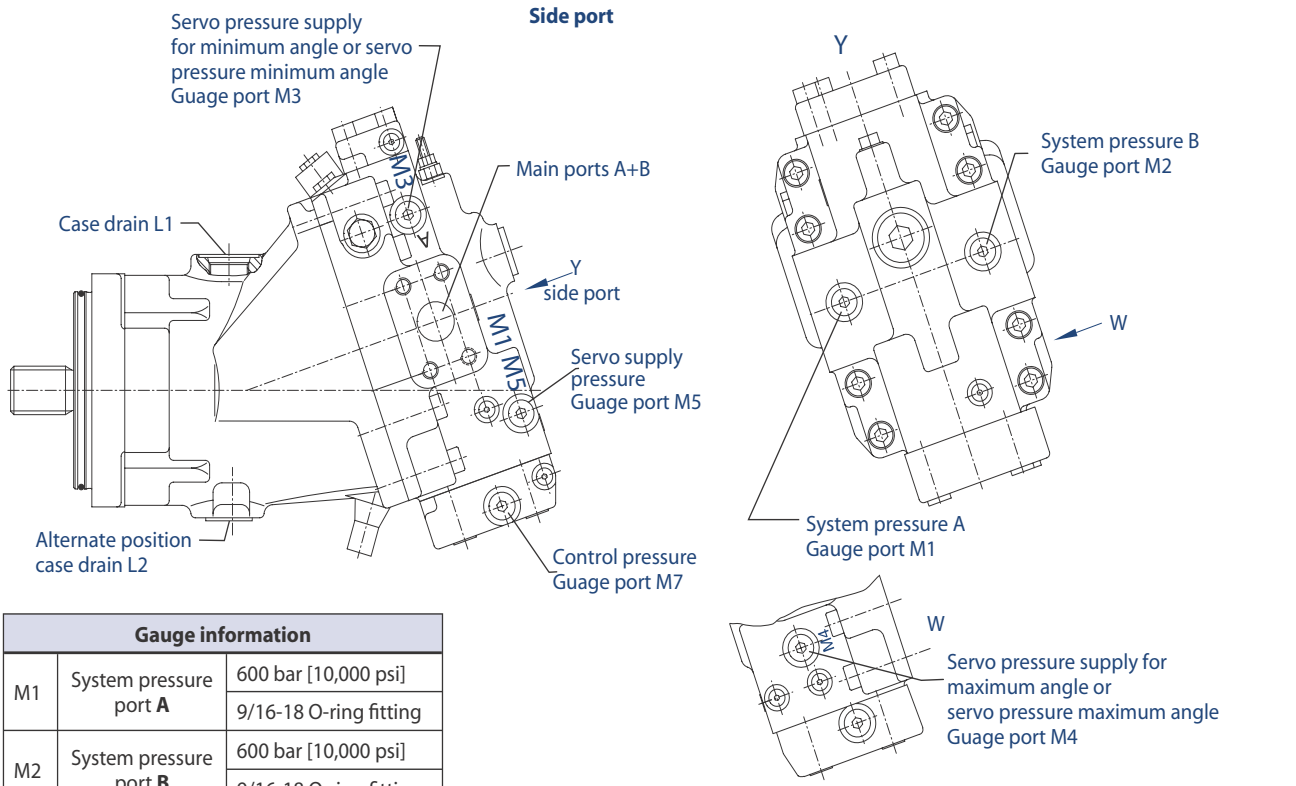
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REQUIRED TOOLS

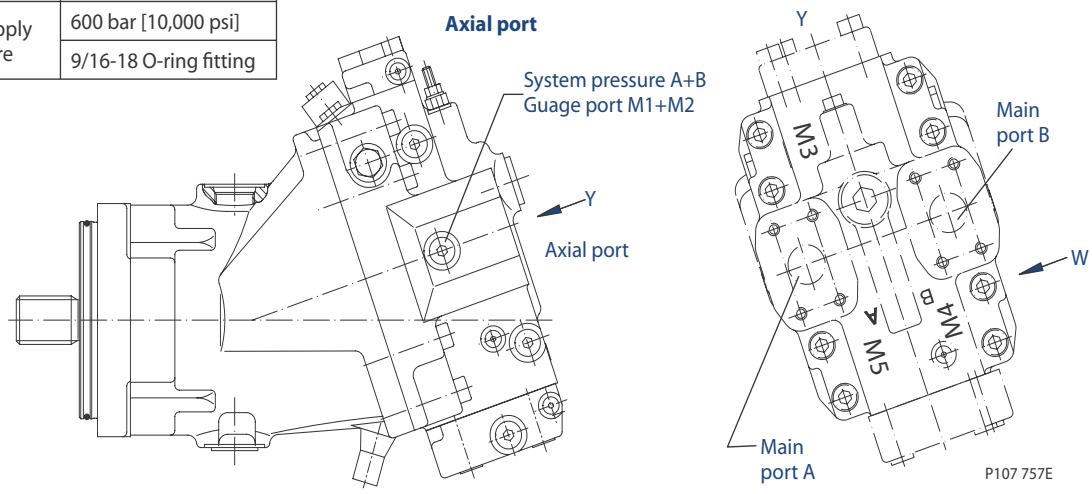
You can perform service procedures described in this manual using common mechanic's hand tools. Special tools, if required, are shown. Calibrate pressure gauges frequently to ensure acm³uracy. Use snubbers to protect pressure gauges.

PORT LOCATIONS AND GAUGE INSTALLATION

Series 51 motors



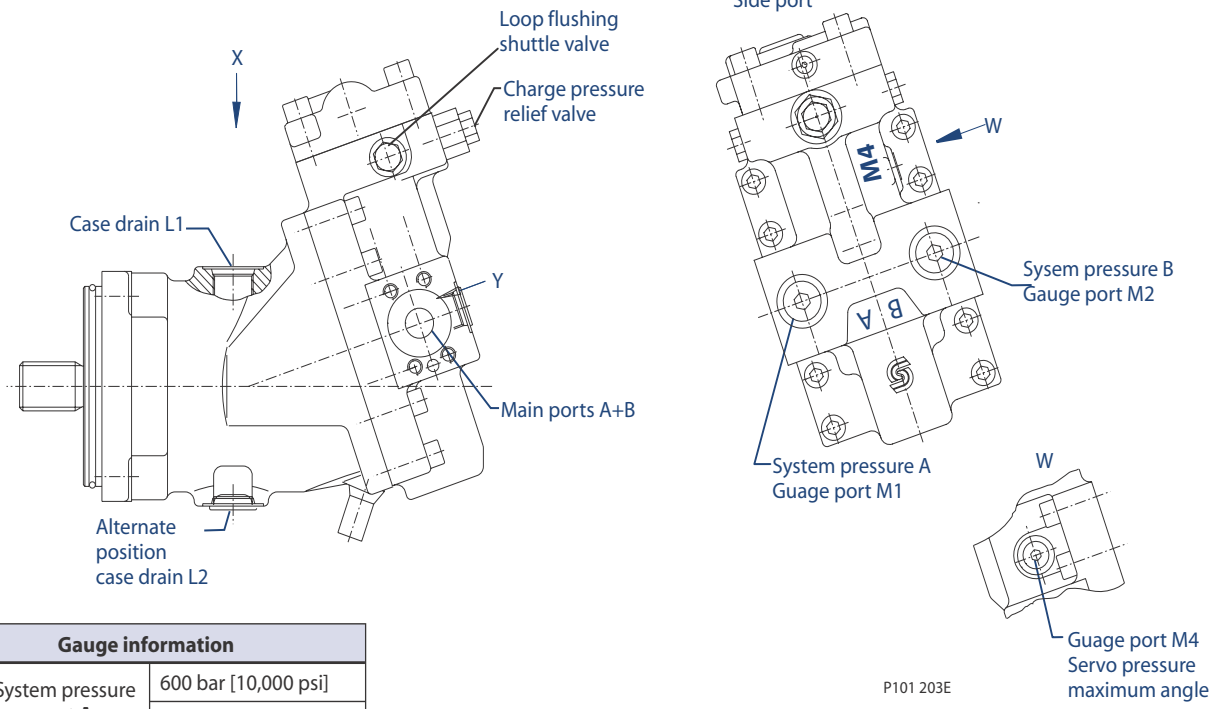
Gauge information		
M1	System pressure port **A**	600 bar [10,000 psi]
		9/16-18 O-ring fitting
M2	System pressure port **B**	600 bar [10,000 psi]
		9/16-18 O-ring fitting
M3	Servo pressure minimum angle	600 bar [10,000 psi]
		9/16-18 O-ring fitting
M4	Servo supply pressure maximum angle	600 bar [10,000 psi]
		9/16-18 O-ring fitting
M5	Servo supply pressure	600 bar [10,000 psi]
		9/16-18 O-ring fitting



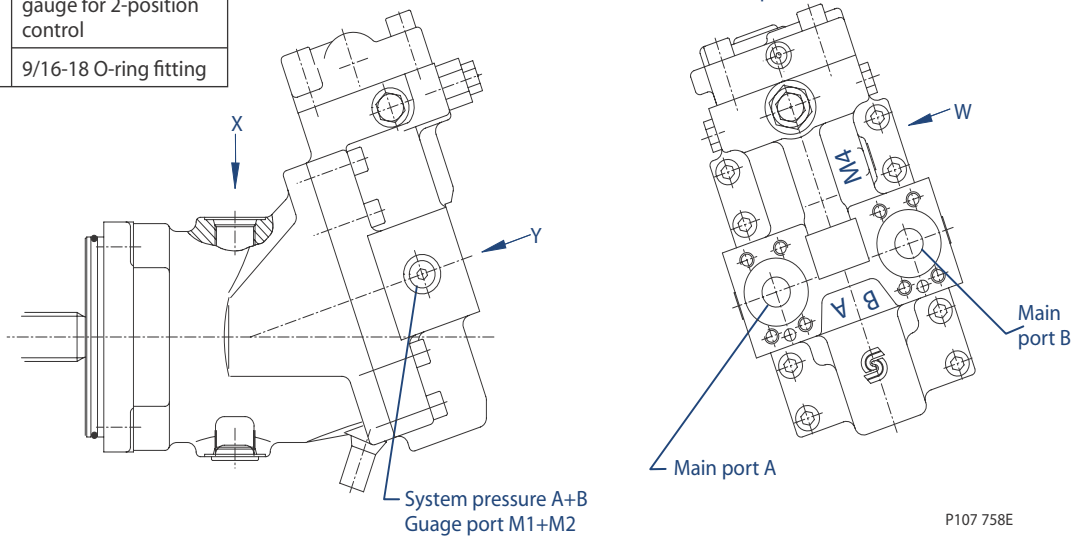
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PORT LOCATIONS AND GAUGE INSTALLATION (continued)

Series 51-1 motors



Gauge information		
M1	System pressure port **A**	600 bar [10,000 psi]
		9/16-18 O-ring fitting
M2	System pressure port **B**	600 bar [10,000 psi]
		9/16-18 O-ring fitting
M3	Servo pressure minimum angle (on control)	600 bar [10,000 psi] 60 bar [500 psi] gauge for 2-position control
		9/16-18 O-ring fitting
M4	Servo supply pressure maximum angle	600 bar [10,000 psi] 60 bar [500 psi] gauge for 2-position control
		9/16-18 O-ring fitting



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FLUID AND FILTER RECOMMENDATIONS

To ensure optimum life, perform regular maintenance of the fluid and filter. Contaminated fluid is the main cause of unit failure. Take care to maintain fluid cleanliness when servicing. Inspect vehicle for leaks daily.

Check the reservoir daily for proper fluid level, the presence of water, and rancid fluid odor. Fluid contaminated by water may appear cloudy or milky or free water may settle in the bottom of the reservoir. Rancid odor indicates excessive heat. Change the fluid immediately if these conditions ocm³ur. Correct the problem immediately.

Change the fluid and filter per the vehicle/machine manufacturer's recommendations or at these intervals: First fluid change recommended at 500 hours.

Fluid and filter change interval

Reservoir type	Max. oil change interval
Sealed	2000 hours
Breather	500 hours

High temperatures and pressures result in acm³elerated fluid aging. More frequent fluid changes may be required.

Change the fluid more frequently if it becomes contaminated with foreign matter (dirt, water, grease, etc.) or if the fluid is subjected to temperature levels greater that the recommended maximum. Dispose of used hydraulic fluid properly. Never reuse hydraulic fluid.

Change filters whenever the fluid is changed or when the filter indicator shows that it is necessary to change the filter. Replace all fluid lost during filter change.

Hazardous material

⚠ Warning

Hydraulic fluid contains hazardous material. Avoid contact with hydraulic fluid. Always dispose of used hydraulic fluid acm³ording to state, and federal environmental regulations.

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PROCEDURE

Always follow this procedure when starting-up a new Series 51 or Series 51-1 installation or when restarting an installation in which either the pump or motor has been removed.

⚠ WARNING
This service procedure may require disabling the vehicle / machine (raising the wheels off the ground, disconnecting work function, and so forth) while performing, to prevent injury to the technician and bystanders. Take the necessary safety precautions.

1. Before installing the motor and/or pump, inspect the units for damage incurred during shipping and handling.
2. Make certain all system components (reservoir, hoses, valves, fittings, heat exchanger, and so forth) are clean before filling with fluid.
3. Fill the reservoir with recommended hydraulic fluid. Filter using a 10 micron (nominal, no bypass) filter into the reservoir. Using contaminated fluid may damage components which may result in unexpected vehicle/machine movement.
4. Fill the inlet line leading from the reservoir to the pump.
5. Check inlet line for properly tightened fittings
6. Make sure the inlet line is free of restrictions and air leaks.
7. Fill the motor and/or pump housing with clean hydraulic fluid before start up. Fill by pouring filtered oil into the upper case drain port.

! Caution
Never start the prime mover unless the motor and pump are **filled completely** with clean hydraulic fluid.

8. Install a 0-60 bar [0-1000 psi] pressure gauge in the charge pressure gauge port of the pump to monitor the charge pressure during start-up.
9. Disconnect any external control input signal (linkage for MDC, hydraulic lines for HDC, or electrical connections for EDC) from the pump control until after initial start-up. This ensures that the pump remains in its neutral position.
10. Use a common method to disable the prime mover. Jog (slowly rotate) prime mover until charge pressure starts to rise.

⚠ WARNING
Do not start the prime mover unless the pump is in neutral position (swash plate at 0° angle). Take necessary precautions to prevent machine movement in case pump is actuated in stroke during initial start-up.

11. Enable prime mover. Start the prime mover and run at the lowest possible speed until charge pressure is established.

If necessary, bleed excess air from the high pressure lines through the high pressure system gauge port.

12. Once charge pressure is established, increase speed to normal operating speed.

Charge pressure should be as indicated in the pump model code. If charge pressure is low, shut down and determine cause. See: *Troubleshooting*, pages 28-30.

! Caution
Low charge pressure may affect the operators ability to control the machine.

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PROCEDURE (continued)

13. Shut down the prime mover.
14. Connect the external control input signal.
15. Reconnect the machine function if disconnected earlier.
16. Start the prime mover, checking to ensure the pump remains in neutral.
17. Check for forward and reverse machine operation, with the prime mover at normal operating speed.

Charge pressure may decrease slightly during forward or reverse operation.

18. Continue to cycle slowly between forward and reverse for at least five minutes.
19. Shut down prime mover.
20. Remove gauges.
21. Plug the gauge ports.
22. Check reservoir level.
23. Add filtered fluid to the reservoir, if needed.

The motor / transmission is now ready for operation.

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SLUGGISH SYSTEM

Check		Cause	Corrective action
1.	Control orifices	Blocked or restricted orifice will cause sluggish response. Orifices installed to the wrong locations will cause PCOR control to be sluggish.	Remove, inspect and clean all orifices. Ensure the appropriate orifices are installed.
2.	Threshold setting (proportional controls)	Inappropriately high threshold setting will shift the motor at the wrong time.	Check threshold setting. Adjust if necessary.
3.	Control spool or piston	A sticky 4-way spool or control piston will cause sluggish response.	Clean and inspect the 4-way valve spool and control piston. Replace if necessary.
4.	Pressure compensator setting	Inappropriately low pressure compensating setting will shift motor to maximum displacement at lower pressure	Check pressure compensator setting. Adjust if necessary.
5.	Control input signal	An improper or erratic input signal to the control may cause sluggish response.	Check input signal or electric current and correct if necessary.
6.	Charge pressure	Inappropriately low pressure setting at loop flushing relief valve may cause improper supply pressure to motor control.	Measure change pressure in forward and reverse. Adjust loop flushing relief valve if necessary.
7.	System pressure	Inappropriately low system pressure setting may cause sluggish response.	Measure system pressure. Adjust pump pressure limiter or system relief valve if necessary.
8.	Internal leakage	Excessive leakage will cause lower charge pressure and affect performance.	Install loop flushing defeat option and monitor case flow. If case flow is excessive, motor may require major repair. Contact your Sauer-Danfoss service provider.

SYSTEM OPERATING HOT

Check		Cause	Corrective action
1.	Oil level	Insufficient hydraulic fluid will cause overheating.	Fill reservoir to proper level.
2.	Heat exchanger	Blocked heat exchanger or low air flow will not sufficiently cool the system.	Check temperature upstream and downstream of heat exchanger. Clean, repair, or replace heat exchanger if necessary.
3.	Loop flushing charge pressure	Inappropriately high loop flushing relief valve setting will reduce or prevent loop flushing flow. Improper orifice size will not give proper flow for cooling purposes.	Monitor case drain flow. If low, adjust loop flushing relief valve setting or replace with orificed type relief.
4.	System pressure	If system relief valve settings are too low, excess heat will be generated.	Adjust system relief valve settings.
5.	Air in system	Entrained air generates heat under pressure and causes cavitation	Look for foam or bubbles in reservoir. Check for leaks on inlet side of charge pump.
6.	Internal leakage	Excessive internal leakage will overheat the system.	Install loop flushing defeat option and monitor case flow. If case flow is excessive, motor may require major repair. Contact your Sauer-Danfoss service provider.

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EXCESSIVE NOISE OR VIBRATION

Check		Cause	Corrective action
1.	Oil level in reservoir	Insufficient hydraulic fluid will cause cavitation.	Fill reservoir to proper level.
2.	Air in system	Air bubbles may lead to cavitation.	Look for foam or bubbles in reservoir. Check for leaks on inlet side of charge pump.
3.	Shaft coupling	Loose shaft coupling creates excess noise.	Replace loose shaft coupling. Replace or repair motor if shaft splines are worn excessively.
4.	Shaft alignment	Misaligned shafts create excessive noise and damage motor.	Correct shaft misalignment.

MOTOR OPERATES NORMALLY IN ONE DIRECTION ONLY

Check		Cause	Corrective action
1.	Charge pressure	If charge pressure is low in one direction, the loop flushing shuttle spool may be sticking to one side.	Measure charge pressure in forward and reverse. If pressure drops in one direction, inspect and repair loop flushing shuttle spool.
2.	Motor control	If control shifts motor to minimum displacement in one direction, motor may not have enough torque to operate.	Measure maximum and minimum servo pressures to check control operation. Repair control or correct input signal if necessary.
3.	Pressure compensator control	If pressure compensator operates in one direction only, the motor will stay at minimum displacement in the other direction	Check brake pressure defeat spool. It may be sticking or receiving an improper signal. Repair spool or correct input signal.

IMPROPER OUTPUT SPEED

Check		Cause	Corrective action
1.	Oil level in reservoir	Insufficient hydraulic fluid will reduce system efficiency.	Fill reservoir to proper level.
2.	Threshold setting	Improper threshold setting will cause motor to have wrong displacement for given signal.	Check threshold setting. Refer to control service manual for adjustment procedure.
3.	Pressure compensator setting	Improper pressure compensator setting shifts motor displacement at wrong pressure.	Check pressure compensator setting. Adjust if necessary.
4.	Control spool or piston	Pressure compensator piston or spool sticking holds motor at wrong displacement.	Check pressure compensator piston or spool. Repair or replace if needed.
5.	Control orifices	Blocked or restricted orifice causes motor to shift improperly.	Remove, inspect, and clean all orifices.
6.	Control piston	Sticky control piston causes motor to shift improperly.	Check control piston for proper operation. Repair if necessary.
7.	Control input signal	Improper input signal causes motor to shift improperly.	Correct control input signal.
8.	Internal leakage	Excess internal leakage causes lower charge pressure and affects system performance including output speed.	Install loop flushing defeat option and monitor case flow. If case flow is excessive, motor may require major repair. Contact your Sauer-Danfoss Service Provider.

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LOW OUTPUT TORQUE

Check		Cause	Corrective action
1.	System pressure	Low system pressure at motor reduces output torque.	Measure system pressure at the motor. If the pressure limiter or relief valve setting is low, increase setting to the proper level.
2.	Charge pressure	Low loop flushing relief valve setting may cause improper supply pressure to motor control.	Measure charge pressure in forward and reverse. Adjust loop flushing relief valve setting if necessary.
3.	Pressure compensator setting	High pressure compensator setting causes improper motor displacement for torque required.	Check and adjust pressure compensator setting.
4.	Control orifices	Blocked or restricted orifice causes motor to shift improperly.	Remove, inspect and clean all orifices.
5.	Pressure compensator piston or spool	Sticking pressure compensator piston or spool causes control to hold motor at minimum displacement.	Remove and inspect control spool and sensing piston. Repair or replace if necessary.
6.	Control spool or piston	Sticking 4-way spool or control piston causes motor to shift improperly.	Remove and inspect 4-way spool and control piston. Repair or replace if necessary.
7.	Two position solenoid	Two position control not shifting motor to maximum displacement.	Inspect solenoid valve for bent stem or bad coil. Repair or replace if necessary.
8.	Control input signal	Improper control input signal causes motor to stay at minimum displacement.	Correct control input signal.
9.	Threshold setting	Improper threshold setting causes improper motor displacement for torque required.	Check and adjust threshold setting.
10.	Internal leakage	Excess internal leakage causes charge pressure to decay, reducing output torque.	Install loop flushing defeat option and monitor case flow. If case flow is excessive, motor may require major repair. Contact your Sauer-Danfoss Service Provider.

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Genuine Parts

OVERVIEW

Adjust components of the Series 51 and Series 51-1 motors per following procedures (where necessary, refer to *Pressure Measurement*, pages 23-24, for gauge port locations and sizes):

Charge pressure relief valve

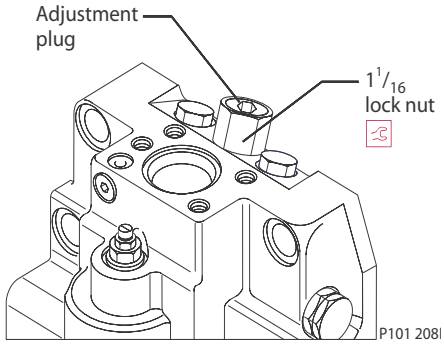
Set the charge pressure relief valve to the model order code specifications. In most applications, the motor charge relief valve is set 2 to 4 bar [29 to 58 psi] *below the setting of the pump charge relief valve* (measured with the pump in its neutral or zero-angle position). This setting assumes a reservoir temperature of 50° C [122° F]. Charge pressure is referenced (additive) to case pressure.

⚠ WARNING
This service procedure may require disabling the vehicle / machine (raising the wheels off the ground, disconnecting the work function, and so forth) while performing, in order to prevent injury to the technician and bystanders. Take the necessary safety precautions

Measuring charge pressure

1. Install a 0 to 60 bar [0 to 1000 psi] pressure gauge in port M1 or M2 (use which ever is at *low* loop pressure).
2. Install a 0 to 60 bar [0 to 1000 psi] gauge in port L1 or L2 to measure case pressure.
3. Operate the system with the prime mover at normal operating speed and the pump at half stroke (forward or reverse).

Series 51 charge pressure relief valve



Older Series 51 and Series 51-1 motors may be equipped with an external screw adjustable charge pressure relief valve (not shown).

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OVERVIEW (continued)

⚠ WARNING
Incorrect charge pressure settings may result in the inability to build required system pressure and / or inadequate loop flushing flows. You must maintain the correct charge pressure under all operation conditions to maintain pump performance

Adjusting charge pressure

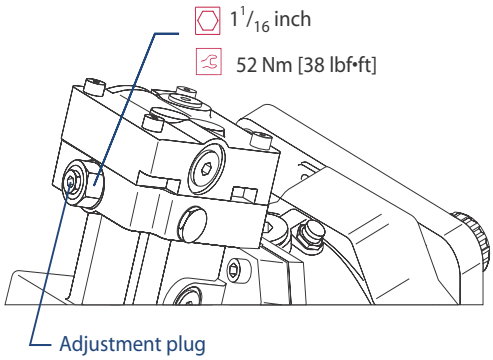
1. Loosen the lock nut using a $1^{1}/_{16}$ hex wrench.
2. Turn the adjustment plug with a large screwdriver or 13mm hex wrench.

Clockwise rotation of the plug increases the setting, and counterclockwise rotation decreases the setting. The charge pressure setting will be reduced or increased at a rate of approximately 3.4 bar [50 psi] per turn.

3. After adjusting the plug, torque the locknut to 52 N•m [38 lbf•ft]. Do not overtorque
4. Remove the gauges.
5. Reinstall the port plugs.

Motors with loop flushing defeated, or equipped with an orificed charge pressure relief valve (see *charge relief valve, orificed style* on page 44) do not require adjustment.

Series 51-1 charge pressure relief valve



P101 209E

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MINIMUM DISPLACEMENT LIMITER

The factory sets minimum displacement. A tamper-resistant cap covers the adjustment screw.

Caution

To avoid unexpected changes in operating conditions and to prevent external leakage, torque the lock nut (Y20) after *every* adjustment.

Detect changes in motor displacement by providing a constant flow of fluid to the motor, while maintaining the motor at minimum displacement and monitoring the motor output shaft speed. An increase in displacement will result in a decrease in shaft speed, while a decrease in displacement will result in an increase in shaft speed.

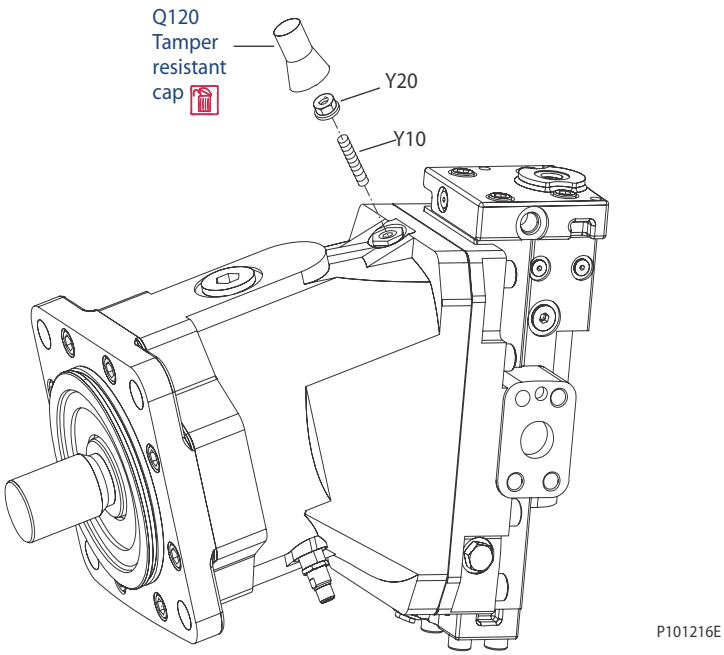
WARNING
Adjustment of the minimum displacement limiter can result in undesirable or unsafe speed conditions. Consult with the Original Equipment Manufacturer or your Sauer-Danfoss representative before changing the minimum displacement setting. After adjustment, verify minimum displacement setting by using an appropriate test apparatus.

Adjusting minimum displacement

1. Remove the tamper resistant cap (Q120) from the adjusting screw (Y10). Removing the tamper resistant cap destroys the locking device.

2. Discard the cap (Q120) after comparing it with a new one to make sure the new one fits.

Minimum displacement limiter



3. Hold adjusting screw (Y10) using a 5 mm or 6 mm internal hex wrench.

4. Loosen the sealing lock nut (Y20), using a :
   - 17 mm hex wrench for 060cm³ and 080cm³ frame size motors

   or
   - 19 mm hex wrench for 110cm³, 160cm³, and 250cm³ frame size motors.

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MINIMUM DISPLACEMENT LIMITER (continued)

5. Turn the adjustment screw (Y10) for the desired displacement (following the table) with a:
   - 5 mm hex wrench for 060cm³ and 080cm³ frame size motors

   or
   - 6 mm hex wrench for 110cm³, 160cm³, and 250cm³ frame size motors.

Rotating the adjustment screw clockwise increases the minimum displacement of the motor; rotating the adjustment screw counterclockwise decreases it.

The minimum displacement setting changes (see chart) for each full revolution of the adjustment screw. Major changes in minimum displacement setting may require a different size adjustment screw.

Adjustment screw and displacement

Frame size	Minimum displacement range cm³ [in³]	Screw size and length mm [in]	Approximate change in minimum displacement per revolution of adjusting screw cm³/rev [in³/rev]
60	12 - 29 [.73 - 1.77]	M10 x 65 [2.56]	1.5 [.09]
	30 - 36 [1.83 - 2.20]	M10 x 80 [3.15]	
80	16- 35 [.98 - 2.14]	M10 x 65 [2.56]	2.1 [1.3]
	36 - 54 [2.20 - 3.20]	M10 x 80 [3.15]	
110	22 - 46 [1.34 - 2.81]	M12 x 70 [2.76]	3.1 [.19]
	47 - 74 [2.878 - 4.52]	M12 x 80 [3.15]	
160	32 - 72 [1.95 - 4.39]	M12 x 75 [2.95]	4.0 [.24]
	73 - 107 [4.45 - 6.53]	M12 x 90 [3.54]	
250	50 - 90 [3.05 - 5.49]	M12 x 75 [2.95]	6.2 [.38]
	91 - 130 [5.55 - 7.93]	M12 x 90 [3.54]	
	131 - 167 [7.99 - 10.19]	M12 x 100 [3.94]	

! Caution: Do not overtorque locknut

6. After adjustment, torque the lock nut on the adjustment screw to:
   - 51 N•m [38 lbf•ft] for 060cm³ and 080cm³ motors

   or
   - 86 N•m [63 lbf•ft] for 110cm³, 160cm³, and 250cm³ motors.

7. Install a new tamper-resistant cap.

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MAXIMUM DISPLACEMENT LIMITER

Limit the maximum displacement by setting the stroke of the servo piston. A stop screw and spacer is on the servo piston to limit the maximum displacement of the motor to less than 100%. Spacers are available in 5% increments.

⚠ WARNING
Adjusting the maximum displacement limiter can result in undesirable or unsafe speed conditions. Consult with the Original Equipment Manufacturer or your Sauer-Danfoss representative before changing the maximum displacement setting.

Limit the displacement by using spacers on the displacement stop screw. When changing the maximum displacement, you may need a different length screw to accommodate the alternate spacers.

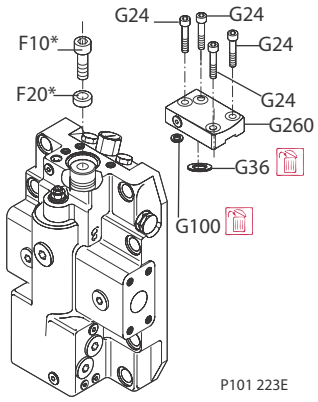
Detect changes in motor displacement by providing a constant flow of fluid to the motor, while maintaining the motor at maximum displacement and monitoring the motor output shaft speed.

An increase in displacement results in a decrease in shaft speed. A decrease in displacement results in an increase in shaft speed.

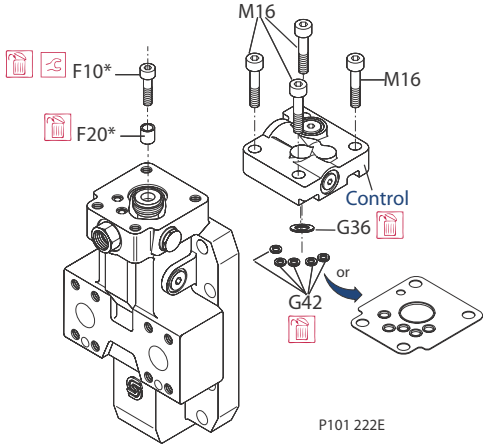
Series 51 motors

1. Remove the 4 screws (G24) retaining the servo cover (G260) using:
   - an 8mm hex wrench (060cm³, 080cm³, 110cm³, and 160cm³ motors),
   or:
   - a 10 mm hex wrench (250cm³ motors).
2. Remove the servo cover (G260) and O-rings (G36) and (G100).
3. Remove the displacement limiter screw (F10) and spacer (F20)(if used) with a 10 mm hex wrench for 60cm³, 80 cm³, 110 cm³, 160 cm³ and 250 cm³ motors.
4. Save original spacer, replacing each with the appropriate spacer and screw to achieve the desired maximum displacement. (See the *chart on the next page*).

Series 51 Maximum displacement limiter



Series 51-1 Maximum displacement limiter



Series 51-1 motors

1. Remove the 4 screws (M16) retaining the control assembly using an 8 mm hex wrench.
2. Remove the control assembly.
3. Remove interface (G36) and O-rings (G42) or seal plate.
4. Add appropriate spacer (F20) and screw to achieve the desired displacement (see *chart below*).

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MAXIMUM DISPLACEMENT LIMITER (continued)

Using a longer spacer decreases the maximum displacement. Using a shorter spacer increases maximum displacement.

5. Torque displacement limiter screw (F10) to:
   - 46 N•m [34 lbf•ft] for the 80cm³ and 110cm³ motors.
   - 23 N•m [17 lbf•ft] for the 60 cm³ motor.

Caution

Do not overtorque screws.

Maximum displacement screw (F10) and spacer (F20)

% of full disp.	F10=screw F20=spacer	60 cm³	80cm³	110cm³	160cm³	250cm³
100	F10N	M8 x 20	M10 x 20	M10 x 20	M10 x 20	M10 x 20
95	F10A	F8 x 25	M10 x 25	M10 x 25	M10 x 25	M10 x 25
	F20A	3.5mm	4.0mm	4.0mm	4.5mm	5.0mm
90	F10B	M8 x 25	M10 x 25	M10 x 30	M10 x 30	M10 x 30
	F20B	6.5mm	7.5mm	8.0mm	9.0mm	10mm
85	F10C	M8 x 30	M10 x 30	M10 x 30	M10 x 35	M10 x 35
	F20C	9.5mm	11mm	11.5mm	13mm	15mm
80	F10D	M8 x 30	M10 x 35	M10 x 35	M10 x40	M10 x 40
	F20D	12.5mm	14.5mm	15mm	17mm	20mm
75	F10E	M8 x 35	M10 x 40	M10 x 40	M10 x 40	M10 x 45
	F20E	15.5mm	18mm	18.5mm	21mm	24.5mm
70	F10F	M8 x 40	M10 x 40	M10 x 40	M10 x 45	M10 x 50
	F20F	18.5mm	21mm	22mm	25mm	29mm
65	F10G	M8 x 40	M10 x 45	M10 x 45	M10 x 50	M10 x 55
	F20G	21.5mm	24.5mm	25.5mm	29mm	33.5mm

6. Replace all O-rings or seal plate. Do not discard any O-ring until you are certain that you have the correct replacement.

7. Install the Series 51 minimum angle servo cover or Series 51-1 control.

8. Install the servo cover (G24) or control screws (M16).

9. Torque the servo cover control screws (M16) to:
   - 78 N•m [58 lbf•ft] for 060cm³, 080cm³, 110cm³ and 160cm³ motors using an 8mm hex wrench.
   - 110 N•m [81 lbf•ft] for 250cm³ motor using a 10mm hex wrench.

Caution

Do not overtorque screws

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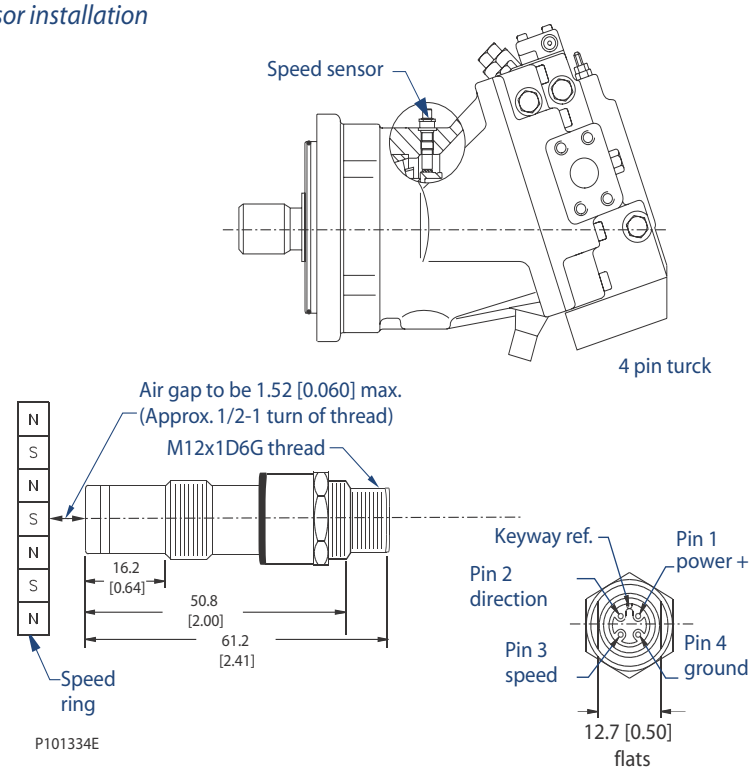
SPEED SENSOR INSTALLATION AND ADJUSTMENT

DIN and SAE flange units

1. Loosen locknut.

Keep all old parts until you receive and inventory new parts.

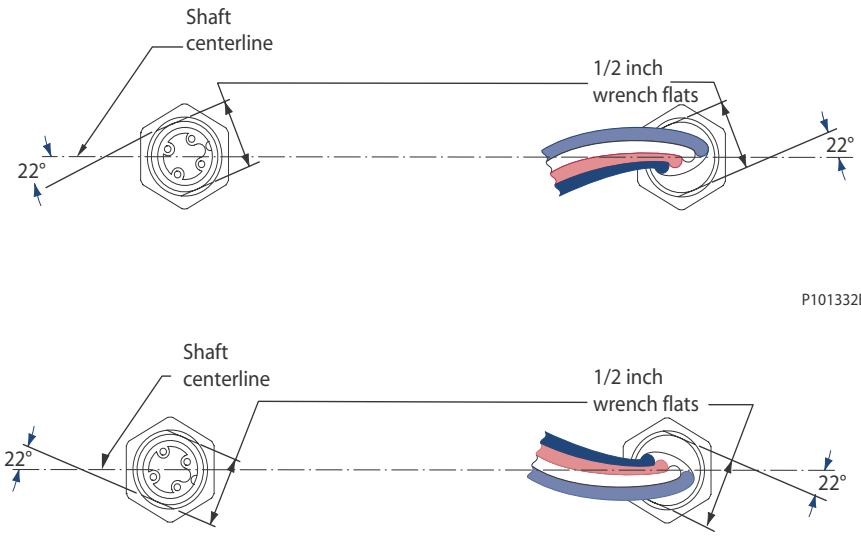
Speed sensor installation



2. Push the O-ring toward connector end of sensor unit so that the O-ring does not contact motor housing during step 3.

Speed sensor with Turck connector

Speed sensor with Packard connector



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INSTALLATION AND ADJUSTMENT (continued)

3. Thread sensor (CW) into motor housing by hand until bottom end touches the speed ring.

4. Back out (CCW) 1/2 turn.

5. Continue backing out until the flats are 22° either side of the motor shaft center line (20° to 30° is acm³eptable).

6. Hold sensor with a 1/2 inch wrench, torque the locknut using an 11/16 inch wrench to 13 N•m [10 lbf•ft].

Caution
Do not overtorque locknut.

Cartridge units

1. Loosen locknut.

2. Push O-ring toward connector end of sensor unit so that the O-ring does not contact motor housing during step 3.

3. Thread sensor (CW) into motor housing by hand until bottom end touches the speed ring.

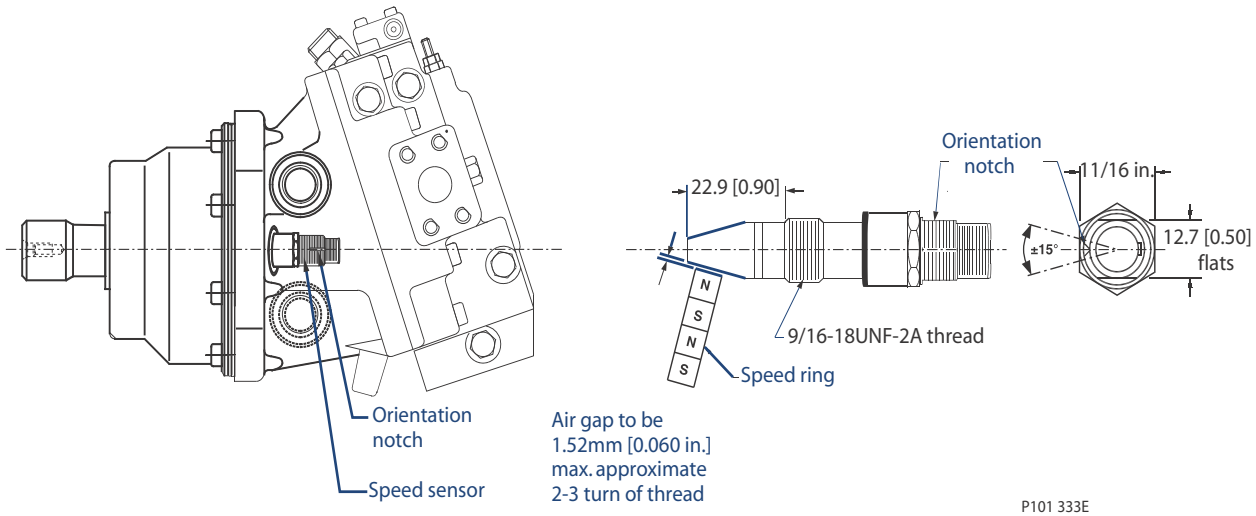
4. Back out (CCW) 2 turns.

5. Turn in or out (whichever is closest) until the orientation notch is 180° away from housing.

6. Hold sensor with a 1/2 inch wrench, torque the locknut using an 11/16 inch wrench to 13 N•m [10 lbf•ft].

Caution
Do not overtorque locknut.

Cartridge model speed sensor



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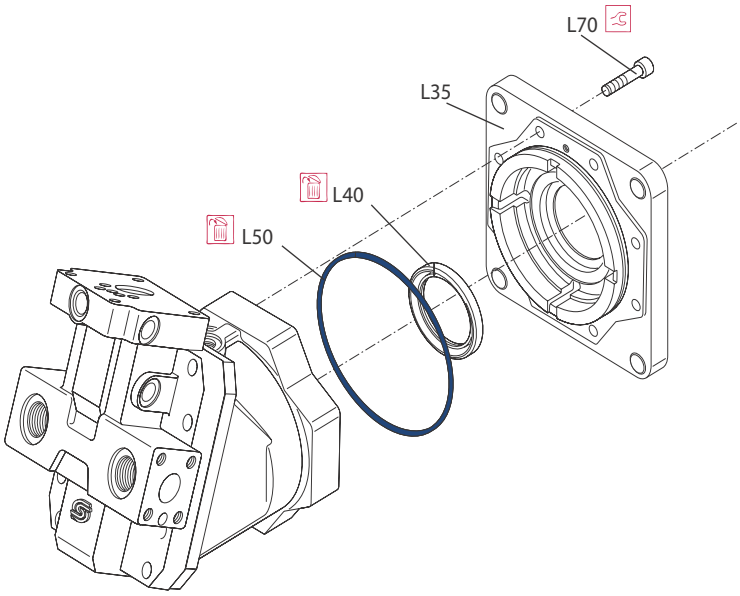
SHAFT SEAL REPLACEMENT

SAE and DIN flanged motors

Disassembly

1. Thoroughly clean all external surfaces before disassembly.

Internal parts of the shaft seal



P101224

2. Remove the 8 screws (L70) retaining the flange to the motor housing using a:
   - 8mm hex wrench for 60cm³ and 80cm³ motors.
   - 10mm hex wrench for 110cm³ and 160cm³ motors.
   - 12mm hex wrench for 250cm³ motors.

3. Remove the flange (L35) from the motor housing, using an appropriate puller.

4. Press out the shaft seal (L40) from the flange front side.

Inspection

1. Inspect the shaft seal cavity in the flange.

2. Inspect the sealing area on the shaft for wear.

Reassembly

1. Orient the new shaft seal (L40) with the cupped side facing towards the motor shaft bearings.

2. Press the shaft seal (L40) into the flange from the rear side. Press until the shaft seal bottoms out in the cavity.

3. Remove the O-ring (L50).

4. Discard the O-ring after making certain that you have a correct replacement.

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SHAFT SEAL REPLACEMENT (continued)

5. Lubricate with petroleum jelly and install new O-ring (L050) to the groove in the flange.

6. Install the flange (L35) to the housing, using a seal protection sleeve on the shaft.

7. Install the 8 socket head capscrews (L70).

8. Tighten the 8 socket head capscrews (L70) slowly in a crisscross pattern until the flange is pulled fully down onto the housing.

9. Torque the capscrews using a crisscross pattern to:
   - 37 N•m [27.3 lbf•ft] for 60cm³ and 80cm³ motors, using an 8 mm wrench.
   - 63 N•m [46.5 lbf•ft] for 110cm³ motors, using a 10 mm wrench.
   - 110 N•m [81.1 lbf•ft] for 160cm³ motors, using a 10 mm wrench.
   - 174 N•m [128.4 lbf•ft] for 250 cm³ motors, using a 12 mm wrench.

Caution

Do not overtorque capscrews

10. Remove the shaft protection sleeve.

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SHAFT SEAL REPLACEMENT (continued)

Cartridge flanged motors

Disassembly

1. Thoroughly clean all external surfaces before disassembly.
2. Remove the seal carrier snap ring (L80) from the motor housing, using appropriate snap ring pliers.
3. Carefully pull the seal carrier (L75) from the housing.

Caution

Do not damage the housing bore or shaft.

4. Remove the O-ring (L50C) from the housing bore.
5. Discard the O-ring (L50C) after inspecting the new one to make certain that it fits.
6. Carefully press the shaft seal (L40) from the seal carrier.
7. Discard the shaft seal (L40) from the seal carrier (L75) after making certain that the new one fits.

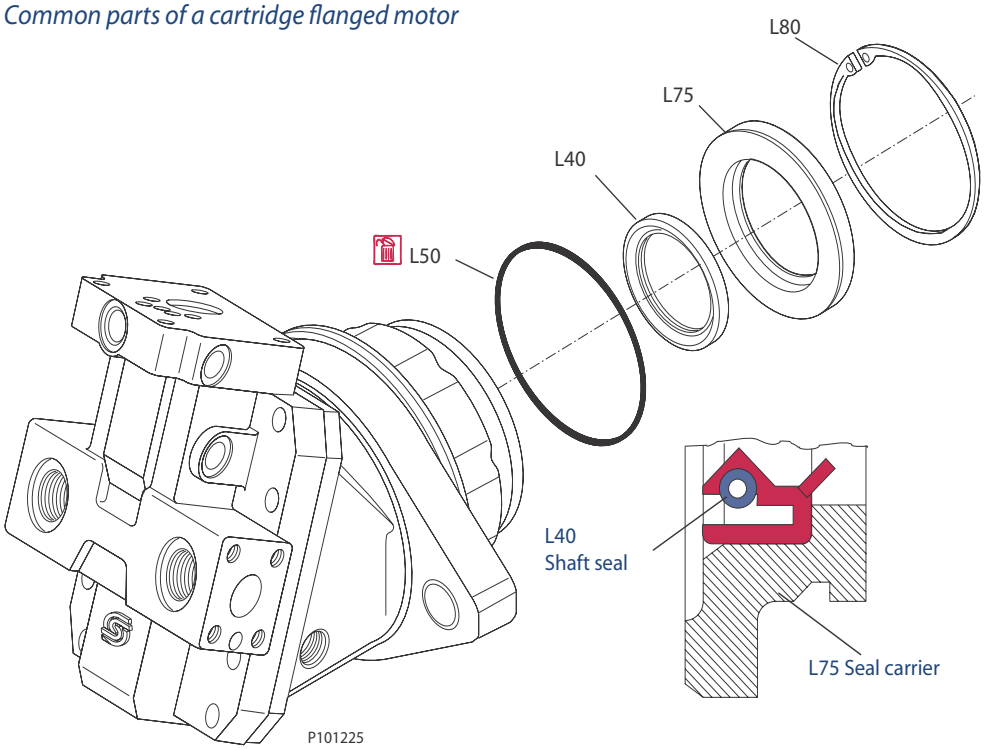
Caution

Do not damage the seal carrier during removal.

Inspection

1. Inspect the seal carrier (L75) and housing bore for damage.
2. Inspect the sealing area on the shaft for wear.

Common parts of a cartridge flanged motor



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SHAFT SEAL REPLACEMENT (continued)

Reassembl;y

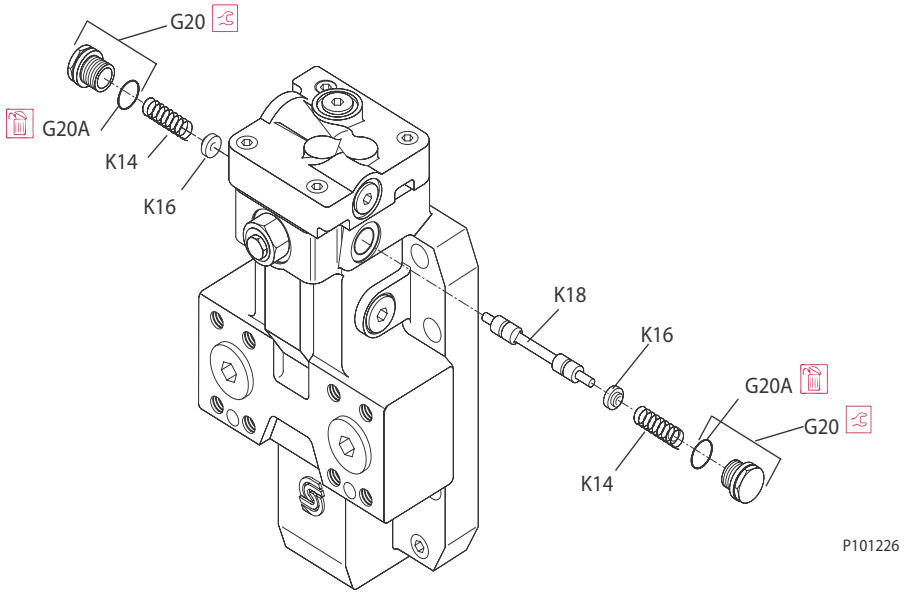
1. Orient the new shaft seal (L40) so the cupped side faces inward.
2. Press new shaft seal (L40) into the seal carrier (L75).
3. Press until the shaft seal bottoms out in the cavity.
4. Using petroleum jelly to lubricate, install new O-ring (L50) to the groove in the housing bore.
5. Using a seal protection sleeve on the shaft, push the seal carrier (L75) into the housing bore until it clears the snap ring groove.
6. Install snap ring (L80) into the grove in the housing bore, using the appropriate snap ring pliers.
7. Remove the shaft seal protection sleeve.

LOOP FLUSHING SHUTTLE VALVE

Disassembly

1. Thoroughly clean all external surfaces before disassembly.
2. Using an 11/16 inch hex wrench, remove the two hex plugs (G20) from the endcap.
3. Remove the O-rings (G20A) from the hex plugs.

Common parts of loop flushing shuttle valve



Legend for G20

use an 11/16 inch wrench
41 N•m [30 lbf•ft]

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LOOP FLUSHING SHUTTLE VALVE (continued)

4. Discard the O-rings (G20A) after inspecting the new ones to make certain they fit.
5. Remove the springs (K14) and seats (K16) or spring / seat assembly from the cavity.
6. Remove the spool (K18) from the cavity.

Inspection

1. Inspect the spool (K18) and cavity for wear or damage.
2. Clean the spool and cavity.

Reassembly

1. Aafter making certain that you have the exact replacement parts, replace parts as necessary.
2. Install the spring seat (K16) or spring/seat assembly to one end of the spool.
3. Lubricate the spool with clean hydraulic oil.
4. Slide the lubricated spool into the cavity.
5. Install the other spring seat (K14) or spring/seat assembly to the spool from the opposite end.
6. Install new O-rings (G20A) to the hex plugs (G20).
7. Place the K14 springs in to the hex plugs.
8. Install the hex plugs.
9. Torque the hex plugs to 41 N•m [30 lbf•ft] using an 11/16 hex wrench.

Caution

Do not overtorque hex plugs

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CHARGE RELIEF VALVE

Overview

You may use one of two charge relief valves on Series 51 and Series 51-1 motors: either poppet or orificed. Alternatively, a defeat plug may block the charge relief valve cavity.

Poppet style (older production)

Disassembly

1. Thoroughly clean all external surfaces before disassembly.
2. Loosen the locknut (K90) using a $1^{1}/_{16}$ hex wrench.
3. Unscrew the adjustment screw (K10) from the cavity in the endcap, using a standard screwdriver, or a 13mm wrench.
4. Remove the O-ring (K50) from the adjustment screw.
5. Discard the O-ring (K50) after inspecting the new one to make certain that it fits.
6. Remove the spring (K70) and poppet (K80) from the cavity.

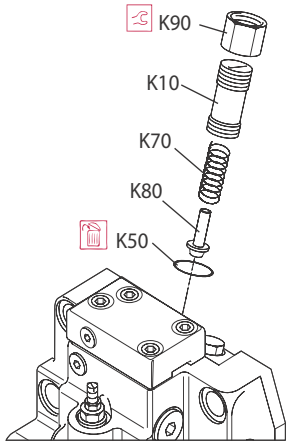
Inspection

1. Inspect the parts and cavity for wear or damage.
2. Clean the cavity.

Reassembly

1. Replace any damaged or worn part, making certain that you have the exact replacement parts before discarding the worn parts.
2. Install the poppet (K80) to the cavity.
3. Install the spring (K70) to the poppet.
4. Install a new O-ring (K50) to the adjustment screw (K10).
5. Install the adjustment screw in the cavity.
6. Hand tighten the locknut (K90).
7. Check and adjust the charge relief valve to the proper setting.

Poppet charge relief valve



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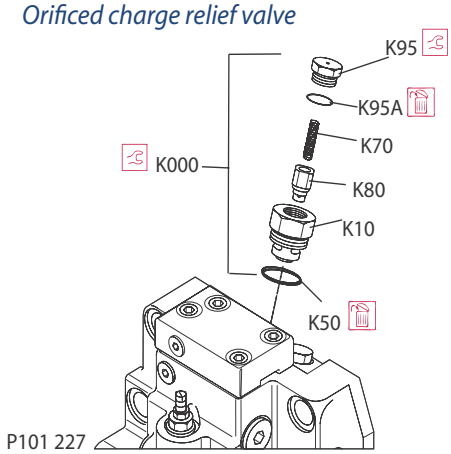
CHARGE RELIEF VALVE (continued)

Orificed style

Disassembly

1. Thoroughly clean all external surfaces before disassembly.
2. Remove cartridge (K000) from the cavity in the endcap using a 1 inch hex wrench.
3. Remove O-ring (K50) from the cartridge.
4. Discard O-ring after inspecting the new one to make certain that it fits.
5. Disassemble cartridge (K000) using 1 inch and 11/16 inch hex wrenches.
6. Remove plug (K95).
7. Remove O-ring (K95A).
8. Discard the O-ring after inspecting the new one to make certain that it fits.
9. Remove spring (K70).
10. Remove poppet (K80).

Orificed charge relief valve



Inspection

1. Inspect the cavity and parts for wear or damage.
2. Clean the cavity and parts.

Reassembly

1. Replace parts as necessary after inspecting the new one to make certain that each fits.
2. Discard replaced parts.
3. Install O-rings (K50) (K95A) to plugs (K10) (K95).
4. Reassemble the cartridge.
5. Torque plug (K95) to 37 N•m [27 lbf•ft] using an 11/16 hex wrench.
6. Install cartridge into the cavity.
7. Torque cartridge to 52 N•m [38 lbf•ft] using a 1 inch hex wrench.

Caution

Do not overtorque cartridge

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CHARGE RELIEF VALVE (continued)

Defeat plug

Disassembly

1. Thoroughly clean all external surfaces before disassembly.
2. Remove plug (K90) from the cavity in the endcap using a 1 inch wrench.
3. Remove O-ring (K90A) from the plug.
4. Discard O-ring (K90A) after inspecting the new one to make certain that it fits.

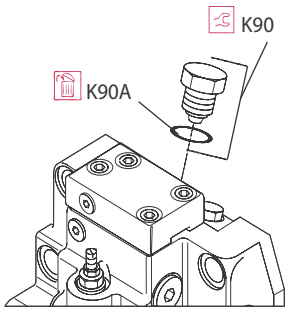
Inspection

1. Clean and inspect the cavity.
2. Inspect the plug (K90).
3. Clean or replace the plug if necessary.

Reassembly

1. Install a new O-ring to the plug.
2. Install the plug into the cavity.
3. Torque plug (K90) to 40 N•m [30 lbf•ft] using a 1 inch wrench.

Defeat plug



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Caution

Do not overtorque plug

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MAXIMUM ANGLE STOP - SERIES 51 MOTORS

Disassembly

1. Thoroughly clean all external surfaces before disassembly.

2. Remove the 4 screws (G24) retaining the minimum angle servo cover to the endcap using
   - an 8 mm hex wrench for 60cm³, 80cm³, 110cm³ and 160cm³ motors.
   - a 10 mm hex wrench for 250cm³ motor.

3. Remove the O-rings (G100 and G36).

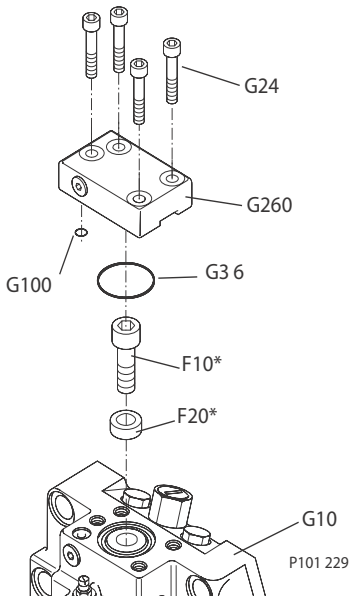
4. Discard the O-rings after inspecting the new ones to make certain that they fit.

5. Remove the maximum angle stop screw (F10) from the servo piston end using:
   - an 8mm internal hex wrench for 60cm³ motors.
   - a 10mm internal hex wrench for 80cm³, 110cm³, 160cm³ and 250cm³ motors.

6. If equipped, remove the spacer (F20) from the servo piston end.

Inspection

Inspect all parts for wear or damage. Replace worn or damaged parts.



Legend

for G24
use an 8 mm internal hex wrench
78 N•m [58 lbf•ft] for 80 cm³, 110 cm³, 160 cm³ motors

for G24
use a 10 mm internal hex wrench
110 N•m [81 lbf•ft] for 250 cm³ motors

for F10
use an 8 mm internal hex wrench
23 N•m [17 lbf•ft] for 60 cm³ motors

for F10
use a 10 mm internal hex wrench
46 N•m [34 lbf•ft] for 80 cm³, 110 cm³, 160 cm³, 250 cm³ motors

Reassembly

1. Install the stop screw and spacer (if so equipped) to the servo piston end.

2. Torque the stop screw (F10) to:
   - 23 N•m [17 lbf•ft] for a 60 cm³ motor using an 8 mm internal hex wrench
   - 46 N•m [34 lbf•ft] for 80 cm³, 110 cm³, 160 cm³, and 250 cm³ motors using a 10mm internal hex wrench.

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MAXIMUM ANGLE STOP - SERIES 51 MOTORS (continued)

3. Using petroleum jelly to retain them, install a new O-ring G100 and G36) to the end cap.

2. Install servo cover to (G260) the endcap.

3. Install the 4 screws (items G24).

4. Torque the 4 screws (G24) to:
   - 78 N•m [58 lbf•ft] for 60cm³, 80cm³, 110cm³ and 160cm³ motors using an 8 mm internal hex wrench.
   - 110 N•m [81 lbf•ft] for 250cm³ motors using a 10mm internal hex wrench.

Caution

Do not overtorque screws

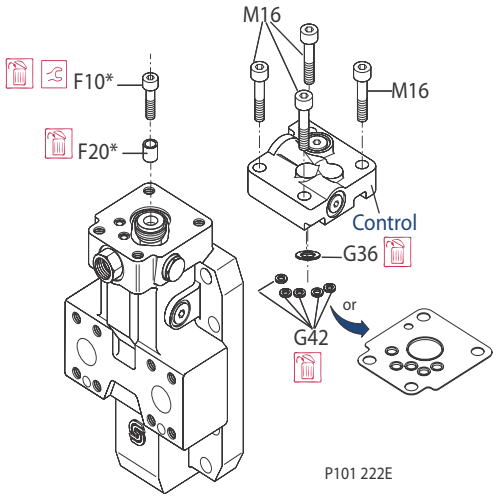
MAXIMUM ANGLE STOP - SERIES 51-1 MOTORS

Disassembly

1. Remove the 4 screws (M16) retaining the control assembly using an 8mm internal hex wrench.

2. Remove the control assembly.

Series 51-1 maximum displacement limiter



Legend

F10
using an 8mm internal hex wrench
23 N•m [17 lbf•ft] for 60 cm³ motors

F10
using a 10mm internal hex wrench
46 N•m [34 lbf•ft] for 80cm³ and 110cm³ motors

F10
using a 8 mm internal hex wrench
78 N•m [58 lbf•ft] for 60cm³, 80cm³ and 110cm³ motors

3. Remove interface (G36) and O-rings (G42) or seal plate.

4. Remove the screw (F10) and spacer (F20), if present, using:
   - an 8mm internal hex wrench for 60cm³ motors and
   - a 10mm internal hex wrench for 80cm³ and 110cm³ motors.

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MAXIMUM ANGLE STOP - SERIES 51-1 MOTORS (continued)

Inspection

Inspect for any contaminants.

Reassembly

5. Clean the endcap and servo piston area.

6. Replace the screw (F10) and spacer (F20) if they were present.

7. Torque displacement limiter screw (F10) to:
   - 46 N•m [34 lbf•ft] for the 80 cm³ and 110 cm³ motors using a 10 mm hex wrench.
   - 23 N•m [17 lbf•ft] for the 60 cm³ motor using an 8 mm hex wrench.

Caution
Do not overtorque screw

8. Replace all O-rings.

9. Discard all previously used O-rings. Do not discard any O-rings until you are certain that you have the correct replacement.

10. Install the control.

11. Install the control screws (G24).

12. Torque the control screws (M16) to 78 N•m [58 lbf•ft] using an 8mm hex wrench.

Caution
Do not overtorque screw

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MINIMUM ANGLE ADJUSTMENT SCREW

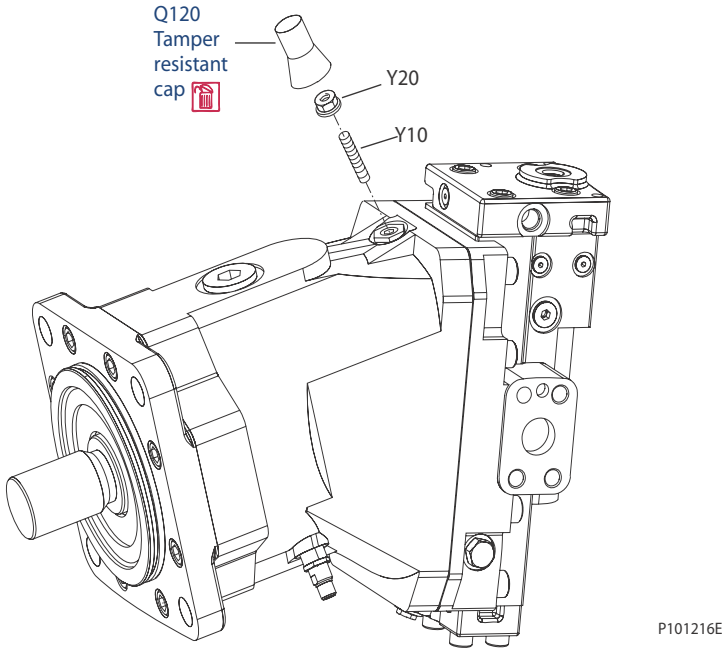
Disassembly

1. Thoroughly clean all external surfaces before disassembly.
2. Remove the tamper resistant cap (Q120) covering the adjustment screw.
3. Discard the cap. Removing the cap destroys the locking device.

⚠ WARNING
Improper adjustment of the minimum displacement limiter can result in undesirable or unsafe speed conditions. Consult with the original equipment manufacturer or your Sauer-Danfoss representative before changing the minimum displacement setting. After adjustment, verify the minimum displacement setting by testing: using an appropriate test apparatus.

4. Measure the length of the screw (Y10) to assure correct reinstallation.

Minimum displacement limiter



5. Loosen the locknut (Y20) on the minimum angle adjustment screw using:
   - a 17 mm hex wrench for 60 cm³ and 80 cm³ motors

   or:
   - 19 mm hex wrench for 110 cm³, 160 cm³ and 250 cm³ motors.
6. Remove the adjustment screw (Y10):
   - using a 5 mm hex wrench for 60 cm³ and 80 cm³ frame size motors

   or:
   - 6 mm hex wrench for 110 cm³, 160 cm³ and 250 cm³ motors.

Inspection

Inspect the adjustment screw.

Reassembly

1. Install the adjustment screw to the motor housing.
2. Turn the adjustment screw the appropriate number of revolutions to set the approximate displacement limit or proper length.

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MINIMUM ANGLE ADJUSTMENT SCREW (continued)

3. Check the minimum displacement and reset as required.

4. Verify minimum displacement setting by testing either on an appropriate test apparatus, or in the vehicle.

See *Adjustments,* on pages 33-34.

5. While holding the adjustment screw, torque the seal locknut (Y20) to:
   - 51 N•m [38 lbf•ft] for 60 cm³ and 80 cm³ motors using a 17 mm hex wrench.

   or:
   - 86 N•m [63 lbf•ft] for 110 cm³, 160 cm³ and 250 cm³ motors using a 19 mm hex wrench.

Caution

Do not overtorque locknut

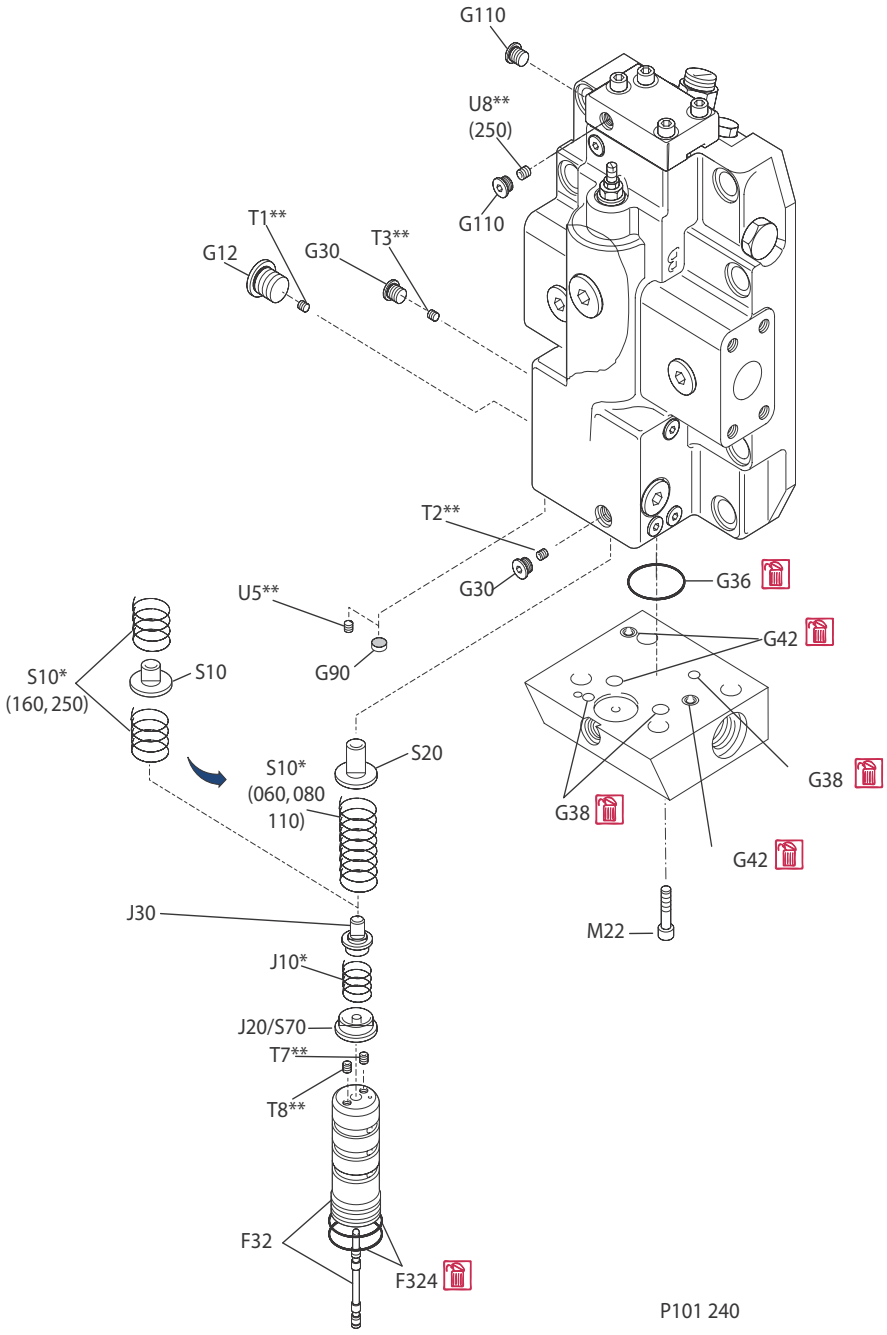
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4-WAY VALVE AND THRESHOLD SPRINGS

4-way valve disassembly

1. Remove screws (M22) from the control using:
   - 10 mm hex wrench for 60 cm³, 80 cm³, 110 cm³ motors
   - 12 mm hex wrench for 160 cm³ and 250 cm³ motors.

4-way valve and threshold springs expanded view



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4-WAY VALVE AND THRESHOLD SPRINGS (continued)

2. Remove the control valve from the endcap.
3. Remove the interface O-rings (G36, G38 and G42) or seal plate.
4. Discard the O-rings only after making certain you have the correct replacements.
5. Remove the plugs (G12 and G30) covering orifices T1, T2, and T3 using a:
   - ¼ inch hex wrench for G12 plugs
   - $^1/_8$ inch hex wrench for G30 plugs.
6. Remove the O-rings (G12A and G30A) from plugs.
7. Discard the O-rings after inspecting the new one to make certain that it fits.
8. Remove the orifices (T1, T2, and T3) using a 3 mm hex wrench.
9. Tag to each orifice, recording its location for reassembly.
10. Remove the four-way spool (F32) from the 4-way valve sleeve.

Inspection

Inspect all parts for wear or damage. Replace worn or damaged parts.

Reassembly

1. Install a 4 mm screw into one of the threaded holes in the sleeve.
2. Use the screw to pull the sleeve out of the cavity.
3. Remove the O-rings (F324) from the sleeve (F32).
4. Discard the O-rings (F324) after inspecting the new ones to make certain that they fit.
5. Remove orifices (T7 and T8) from the sleeve (F32) using a 2.5 mm internal hex wrench.

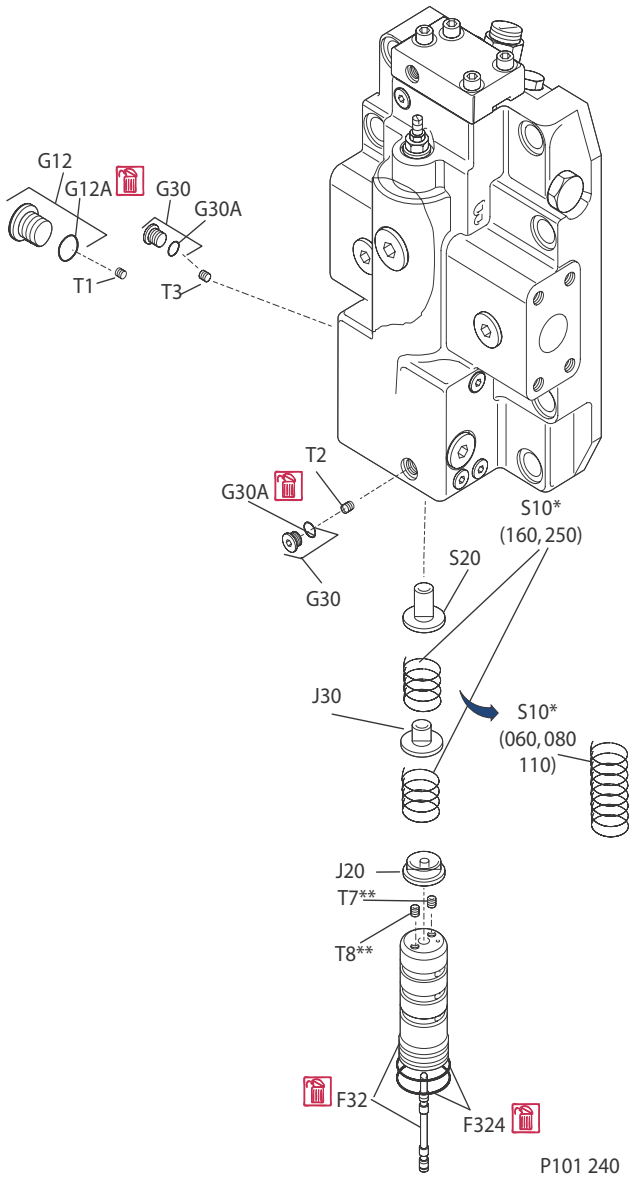
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4-WAY VALVE AND THRESHOLD SPRINGS (continued)

Threshold adjustment screw and springs disassembly

1. Remove threshold spring guide (J20) from the cavity.
2. Remove the threshold spring(s) (S10).
3. Remove the threshold spring guide (J30).

Threshold springs



4. If present, remove the ramp spring(s) (S10).

There are 2 ramp springs and intermediate spring guides in 160cm³ and 250cm³ motors.

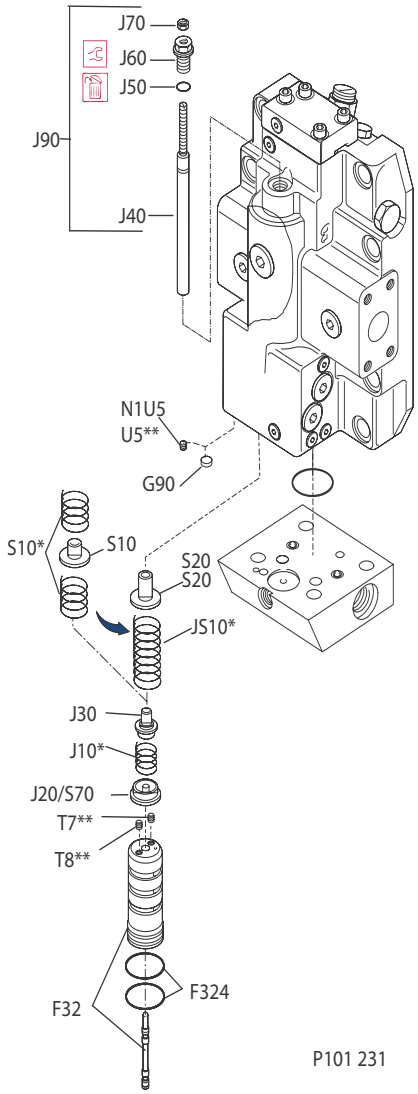
5. Remove the intermediate ramp spring guide (S10), if present. Remove the other spring, if present.
6. Remove the bottom spring guide (S20).

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4-WAY VALVE AND THRESHOLD SPRINGS (continued)

7. Turn the motor over to access the threshold adjustment screw (J90).
8. Loosen locknut (J70).
9. Loosen the mounting sleeve (J60) holding the threshold adjustment screw (J40) using a 13 mm wrench.
10. Unscrew the threshold adjustment screw assembly.
11. Remove the O-ring (J50) from threshold adjustment screw.
12. Discard the O-ring after inspecting the new one to make certain that it fits.

Adjustment screws and springs
Exploded view — common parts



P101 231

Inspection

1. Clean all parts.
2. Inspect all parts.
3. Replace any part, as necessary, discarding old or worn parts only after making certain you have the correct replacement(s).

Reassembly

1. Install new O-ring (J50) on threshold adjustment screw.
2. Install the mounting sleeve (J60) with the threshold adjustment screw.

Slide screw (J40) through the hole in the feedback fork.

3. Torque the mounting sleeve to 32 N•m [23 lbf•ft] using a 13 mm wrench.
4. Turn the motor over to access the 4-way valve cavity.
5. Using a magnetic probe, carefully install the ramp spring guide (S20) (if present) into the cavity.

Slide guide (S20) into the end of the threshold adjusting screw.

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4-WAY VALVE AND THRESHOLD SPRINGS (continued)

6. Install the ramp spring (S10) into the cavity, sitting it properly on the spring guide (S20). Install the intermediate spring guide and second ramp spring (S10) into the 160cm³ and 250cm³ units.

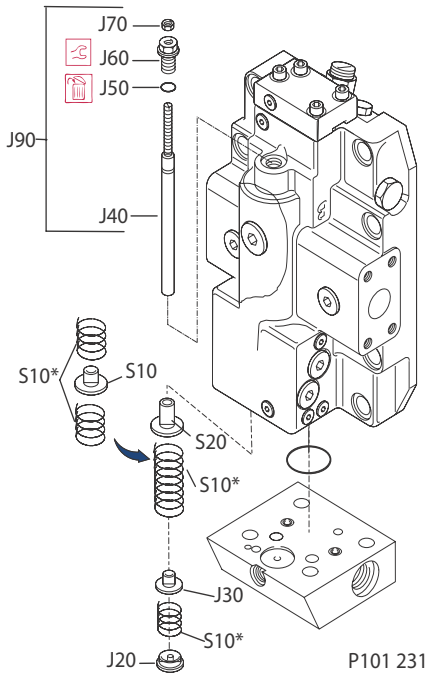
7. Carefully install the threshold spring guide (J30) on to the end of the threshold adjusting screw (J40) using a magnetic probe.

The guide must sit in the hole in the threshold adjusting screw (J40).

8. Install the threshold spring (J10) on to the spring guide (J30).

9 Install the remaining spring guide (J20) on to the end of the ramp threshold spring (S10) using a magnetic probe.

Ramp spring guide location



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4-WAY VALVE AND THRESHOLD SPRINGS (continued)

Assembling the 4-way valve

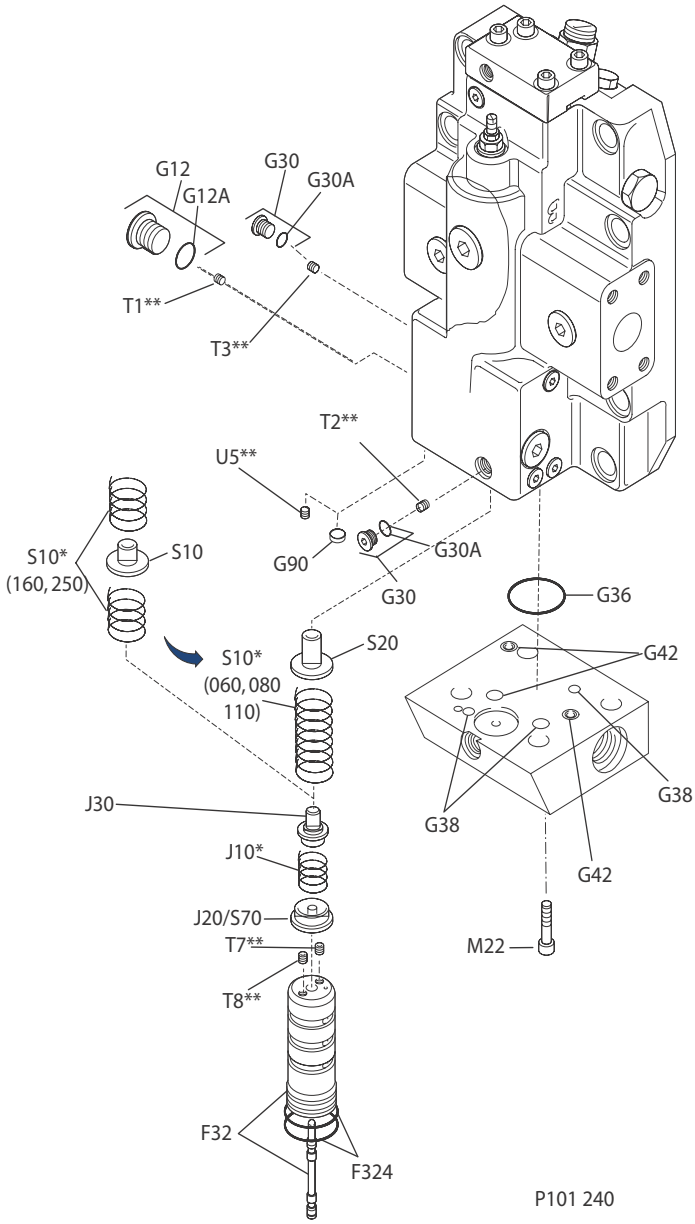
Using the diagram of orientation that you prepared when disassembling, reassemble the 4-way valve accordingly, putting the parts in the marked places on the 4-way valve, in that order:

1. Install orifices (T7 and T8) in appropriate cavities in the 4-way valve sleeve using a 2.5mm hex wrench.

Caution
Do not overtorque orifices

2. Torque the orifices to 4 N•m [2.95 lbf•ft].

Assembly orientation



Legend for T7/T8

use a 2.5 mm hex wrench
for 60 cm³, 80 cm³, 110 cm³, 160 cm³, 250 cm³ motors
4 N•m [2.95 lbf•ft]

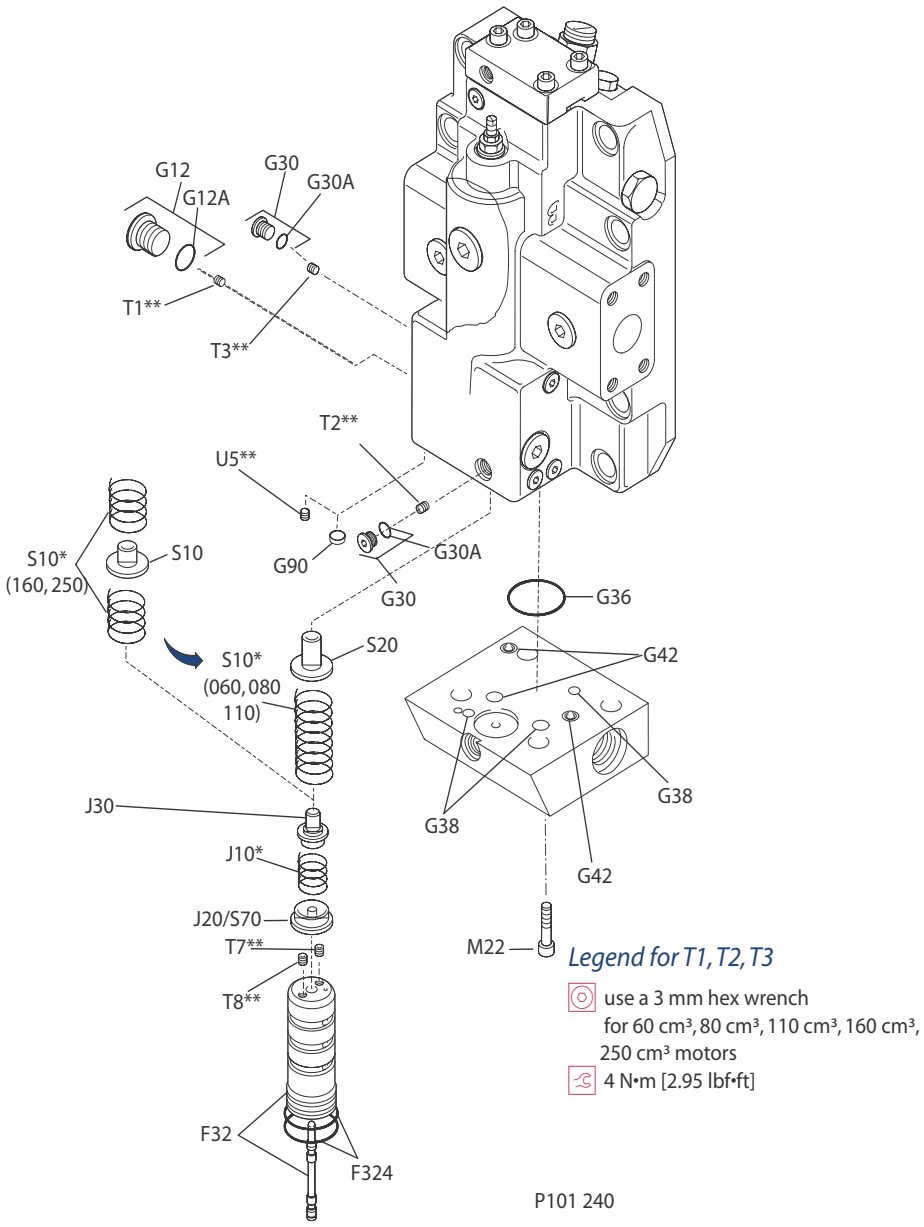
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4-WAY VALVE AND THRESHOLD SPRINGS (continued)

Assembling the 4-way valve (continued)

3. Install new O-rings (F324) on to the 4-way valve sleeve (F32).
4. Lubricate the sleeve and O-rings with clean hydraulic oil.

Assembly orientation



5. Push the sleeve (F32) into the cavity.
6. Lubricate the 4-way spool with clean hydraulic oil.
7. Install the 4-way spool in the cavity of the sleeve.
8. Install orifices (T1, T2, and T3) in the appropriate cavities.

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4-WAY VALVE AND THRESHOLD SPRINGS (continued)

Assembling the 4-way valve (continued)

9. Torque the (T1, T2, and T3) orifices to 4 N•m [2.95 lbf•ft] using a 3 mm hex wrench.
10. Install new rings (G12A and G30A) on the cavity plugs (G12 and G30).
11. Install the cavity plugs in the orifice cavities.
12. Torque the cavity plugs (G12) to 37 N•m [27 lbf•ft] using a ¼-inch hex wrench.
13. Torque the cavity plugs (G30) to 6 N•m [4 lbf•ft] using a 1/8-inch wrench.
14. Using petroleum jelly to retain it, install a new interface O-ring (G42).
15. Using petroleum jelly to retain them, install new interface O-rings (G38 and G36).
16. Install the motor control and/or multifunction block.
17. Install the screws (M22).
18. Torque the screws:
    - 78 N•m [57.6 lbf•ft] using a 10 mm internal hex wrench for 60 cm³, 80 cm³, 110 cm³ motors.
    - 110 N•m [81 lbf•ft] using a 12 mm internal hex wrench for 160 cm³ and 250 cm³ motors.

Caution

Do not overtorque screws.

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Local address:

Sauer-Danfoss (US) Company
2800 East 13th Street
Ames, IA 50010, USA
Phone: +1 515 239-6000
Fax: +1 515 239-6618

Sauer-Danfoss GmbH & Co. OHG
Postfach 2460, D-24531 Neumünster
Krokamp 35, D-24539 Neumünster, Germany
Phone: +49 4321 871-0
Fax: +49 4321 871 122

Sauer-Danfoss ApS
DK-6430 Nordborg, Denmark
Phone: +45 7488 4444
Fax: +45 7488 4400

Sauer-Danfoss-Daikin LTD
Shin-Osaka TERASAKI 3rd Bldg.6F
1-5-28 Nishimiyahara, Yodogawa-ku,
Osaka 532-0004, Japan
Phone: +81 6 6395 6066
Fax: +81 6 6395 8585

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SAUER DANFOSS

Genuine Parts

Series 51 and 51-1 Bent Axis Motors

Repair Instructions









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Series 51 and 51-1 Bent Axis Motors
Repair Instructions
Revisions

HISTORY OF REVISIONS

Table of Revisions

Date	Page	Changed	Rev.
January 2008	-	First edition	AA

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Series 51 and 51-1 Bent Axis Motors
Repair Instructions
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Series 51 and 51-1 Bent Axis Motors Repair Instructions
Introduction

Genuine Parts

OVERVIEW

This manual details repair procedures for Series 51 bent axis motors. These include the complete disassembly, inspection, and reassembly of the unit. Where rework of worn or damaged components is possible, specifications are given to ensure these parts meet factory tolerances. Only Sauer-Danfoss Global Service Partners may perform major repairs. Sauer-Danfoss trains Global Service Partners to perform major repairs and certifies their facilities on a regular basis.

Warning

Use of components that do not comply with rework specifications may result in loss of performance, which may constitute a safety hazard. Do not reuse components that don't comply to given specifications: replace with genuine Sauer-Danfoss service parts.

Minor repair procedures, adjustments, and troubleshooting information are given in the *Series 51 and 51-1 Service Manual*, **11008567**. Minor repairs include service operations you can perform without removing the unit's endcap. Removal of the endcap voids your warranty.

GENERAL INSTRUCTIONS

Follow these general procedures when repairing Series 51 bent axis variable displacement closed circuit motors.

Remove the unit

Prior to performing major repairs, remove the unit from the vehicle/machine. Chock the wheels on the vehicle or lock the mechanism to inhibit movement. Be aware that hydraulic fluid may be under high pressure and/or hot. Inspect the outside of the pump and fittings for damage. Cap hoses after removal to prevent contamination.

Keep it clean

Cleanliness is a primary means of assuring satisfactory pump life on either new or repaired units. Clean the outside of the pump thoroughly before disassembly. Take care to avoid contamination of the system ports. Cleaning parts with a clean solvent wash and air drying is usually adequate.

As with any precision equipment, you must keep all parts free of foreign materials and chemicals. Protect all exposed sealing surfaces and open cavities from damage and foreign material. If left unattended, cover the pump with a protective layer of plastic.

Lubricate moving parts

During assembly, coat all moving parts with clean hydraulic oil. This assures that these parts are lubricated during start-up.

Replace all O-rings and gaskets

Sauer-Danfoss recommends you replace all O-rings, gaskets, and seals. Lubricate O-rings with clean petroleum jelly prior to assembly. Grease must be soluble in hydraulic fluid.

Secure the unit

For major repair, place the unit in a stable position with the shaft pointing downward. Secure the pump while removing and torquing the endcap bolts.

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SAFETY PRECAUTIONS

Always consider safety precautions before beginning a service procedure. Protect yourself and others from injury. Take the following general precautions whenever servicing a hydraulic system.

Unintended machine movement

⚠ Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

Flammable cleaning solvents

⚠ Warning

Some cleaning solvents are flammable. To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

Fluid under pressure

⚠ Warning

Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury and/or infection. This fluid may also be hot enough to cause burns. Use caution when dealing with hydraulic fluid under pressure. Relieve pressure in the system before removing hoses, fittings, gauges, or components. Never use your hand or any other body part to check for leaks in a pressurized line. Seek medical attention immediately if you are cut by hydraulic fluid.

Personal safety

⚠ Warning

Protect yourself from injury. Use proper safety equipment, including safety glasses, at all times.

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Genuine Parts

SYMBOLS USED IN SAUER-DANFOSS LITERATURE

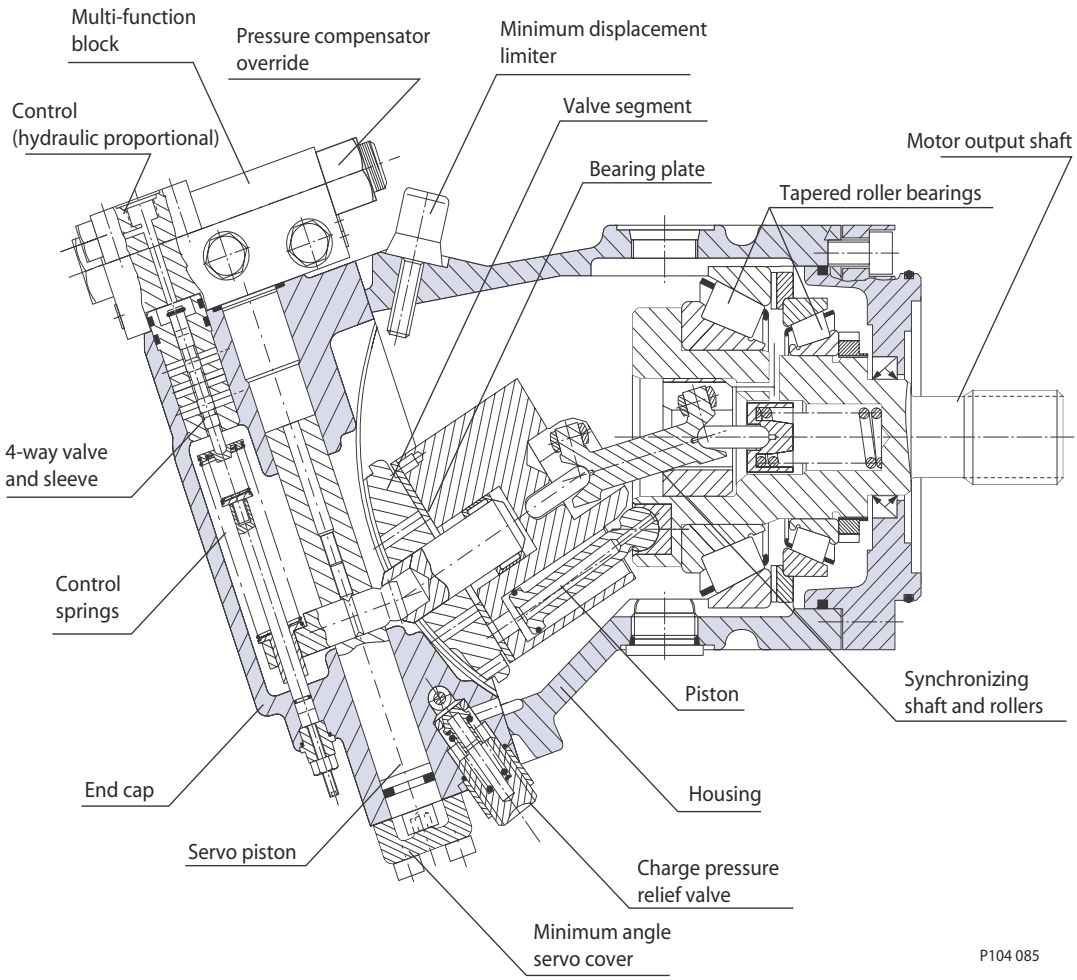
- WARNING may result in injury
- CAUTION may result in damage to product or property
- Reusable part
- Non-reusable part, use a new part
- Non-removable item
- Option – either part may exist
- Superseded – parts are not interchangeable
- Measurement required
- Flatness specification
- Parallelism specification
- External hex head
- Internal hex head
- Torx head
- O-ring boss port
- Tip, helpful suggestion
- Lubricate with hydraulic fluid
- Apply grease / petroleum jelly
- Apply locking compound
- Inspect for wear or damage
- Clean area or part
- Be careful not to scratch or damage
- Note correct orientation
- Mark orientation for reinstallation
- Torque specification
- Press in – press fit
- Pull out with tool – press fit
- Cover splines with installation sleeve
- Pressure measurement / gauge location or specification

The symbols above appear in the illustrations and text of this manual. They are intended to communicate helpful information at the point where it is most useful to the reader. In most instances, the appearance of the symbol itself denotes its meaning. The legend above defines each symbol and explains its purpose.

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SECTION DIAGRAM

Series 51 bent axis variable motor



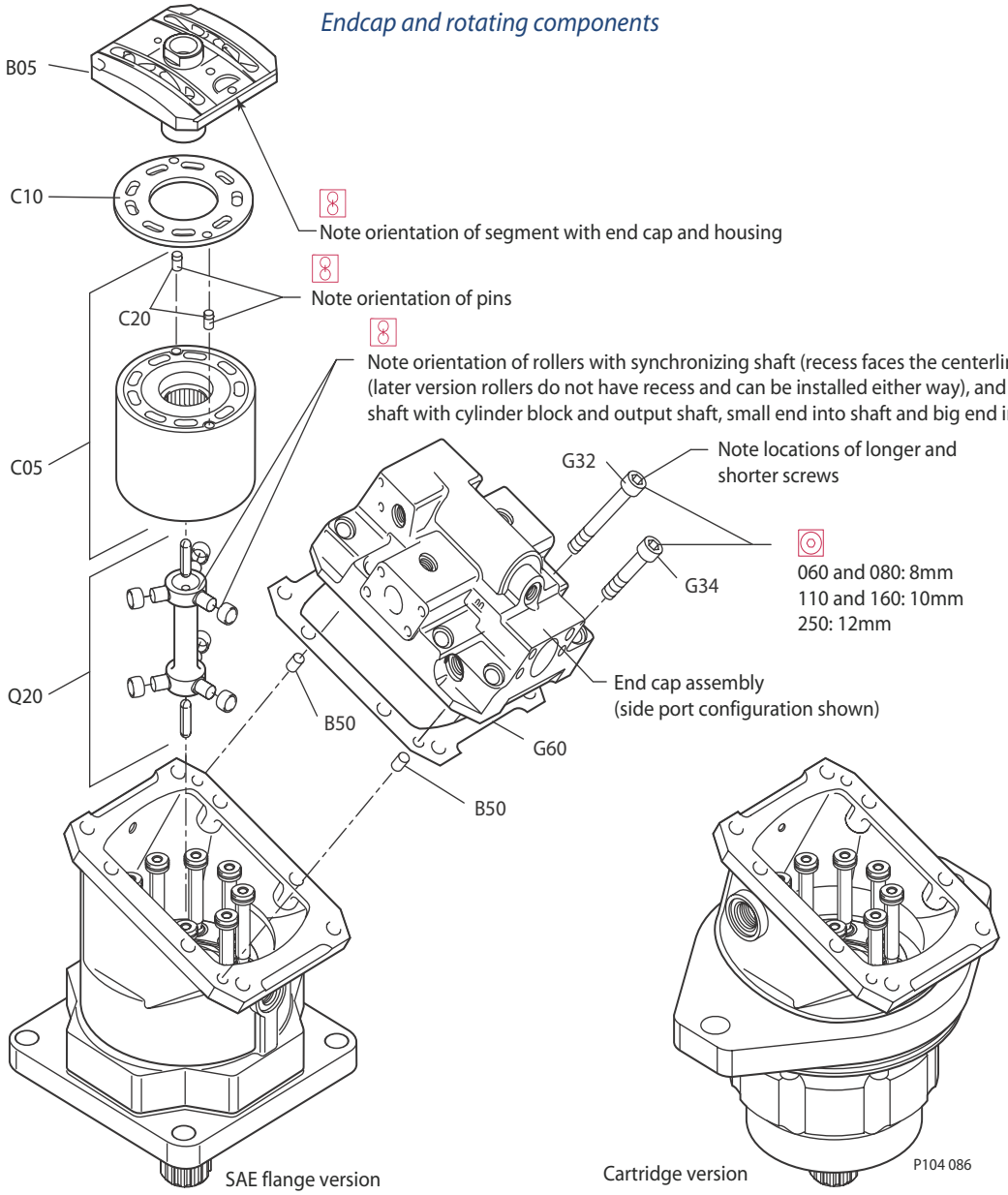
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ENDCAP

Following procedures in the *Series 51 and 51-1 Service Manual*, **11008567**: Remove the control and multi-function block (if installed). Remove the 4-way valve spool and sleeve (if installed). Remove the threshold springs and guides. Remove the control springs (if installed). Remove the ramp springs and guides (if installed). Remove the minimum angle servo cover from the motor. Remove the loop-flushing valve and charge relief valve.

1. Remove the screws (G32 and G34) retaining the end cap assembly to the motor housing.
2. Remove the end cap assembly.
3. Remove the gasket (G60); discard.
4. Remove the alignment pins (B50).

Endcap and rotating components

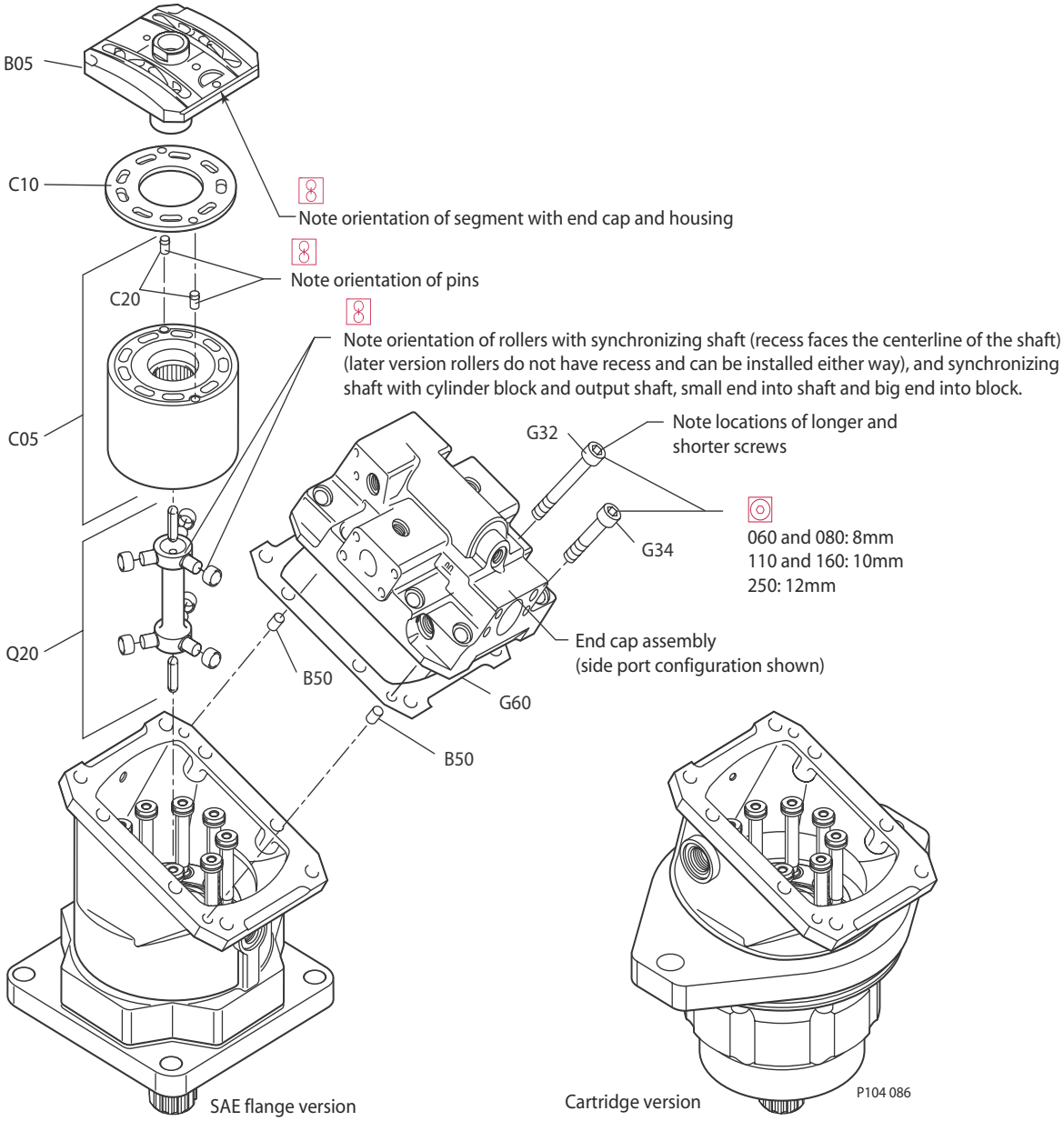


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ROTATING COMPONENTS

1. Remove the valve segment (B05) and set aside.
2. Remove the bearing plate (C10) and alignment pins (C20).
3. Remove the cylinder block (C05) and set aside. Be careful not to scratch the running surface of the block.
4. Remove the synchronizing shaft assembly (C20) with rollers and pins.

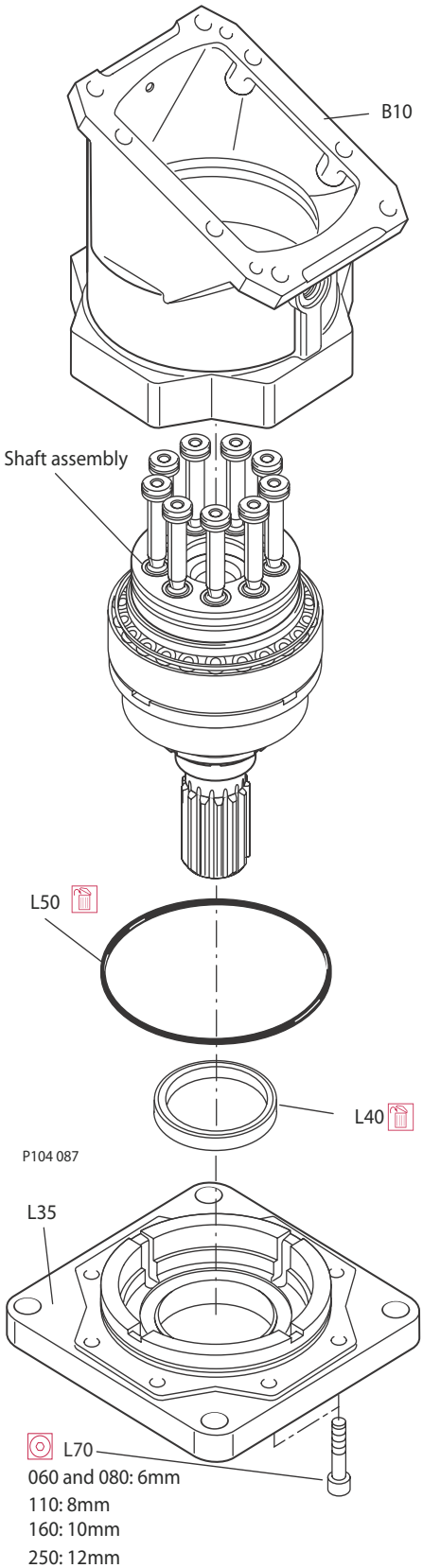
Endcap and rotating components



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SHAFT REMOVAL (SAE OR DIN)

Shaft assembly SAE or DIN flange version



1. Remove screws (L70) retaining the mounting flange (L35) to the main housing (B10).
2. Remove the mounting flange using a suitable puller.
3. Remove the O-ring (L50); discard.
4. Remove the shaft seal (L40) from the flange; discard.
5. Press shaft assembly out of main housing, taking care not to damage the shaft and speed sensor ring (if installed).

Caution

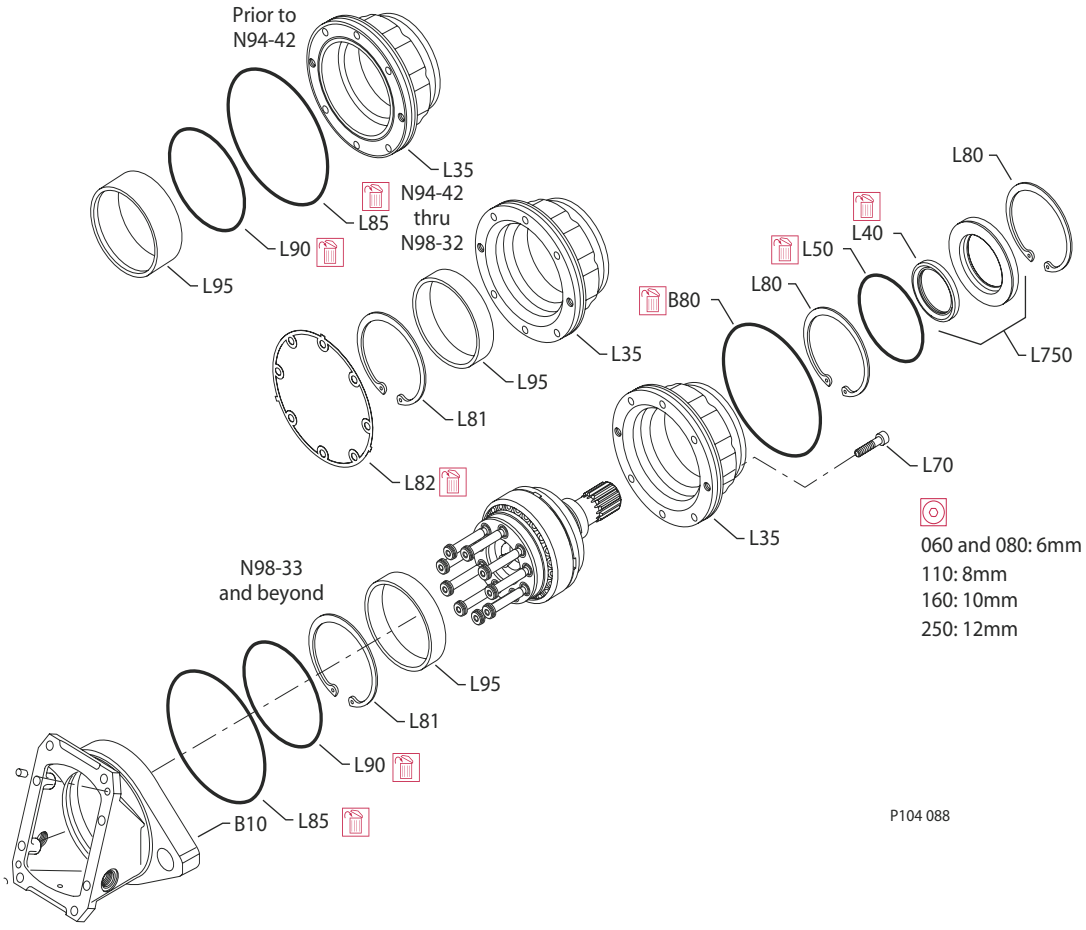
Do not damage piston sockets.

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SHAFT REMOVAL (CARTRIDGE)

1. Remove retaining ring (L80).
2. Remove seal carrier (L750).
3. Remove shaft seal (L40); discard.
4. Remove retaining ring (L80) for the shaft seal carrier (L750) from the bearing housing (L35).
5. Remove the screws (L70) retaining the bearing housing (L35) to the main housing (B10).
6. Separate the bearing housing from the main housing (B10).
7. Remove the retaining ring (L81) if present.
8. Remove spacer ring (L95).
9. Remove O-rings (L85 and L90, or gasket L82); discard.
10. Press shaft assembly out of bearing housing, taking care to not damage the shaft, piston sockets, and speed sensor ring (if installed).

Shaft assembly, cartridge version



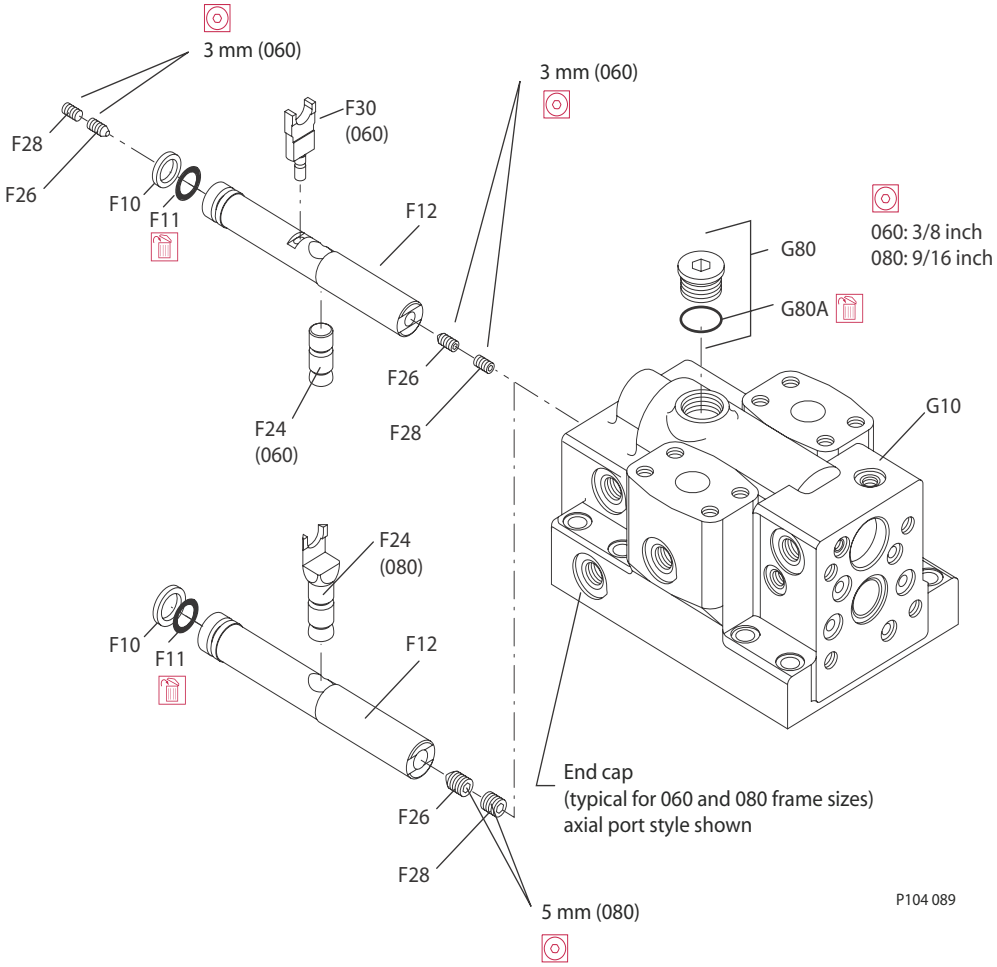
https://truckmanualshub.com/

ENDCAP DISASSEMBLY

060 frame

1. Remove end cap plug (G80). Remove O-ring (G80A) from plug; discard.
2. Remove lock screws (F28) from servo piston (F12).
3. Remove cone-point set screws (F26) from servo piston.
4. Remove feedback fork (F30) through the hole in the end cap.
5. Remove the setting lug (F24) from inside of end cap.

End cap components



080 frame

1. Remove end cap plug (G80).
2. Remove lock screw (F28).
3. Remove cone-point set screw (F26).
4. Remove feedback fork / setting lug (F24) through hole in end cap.

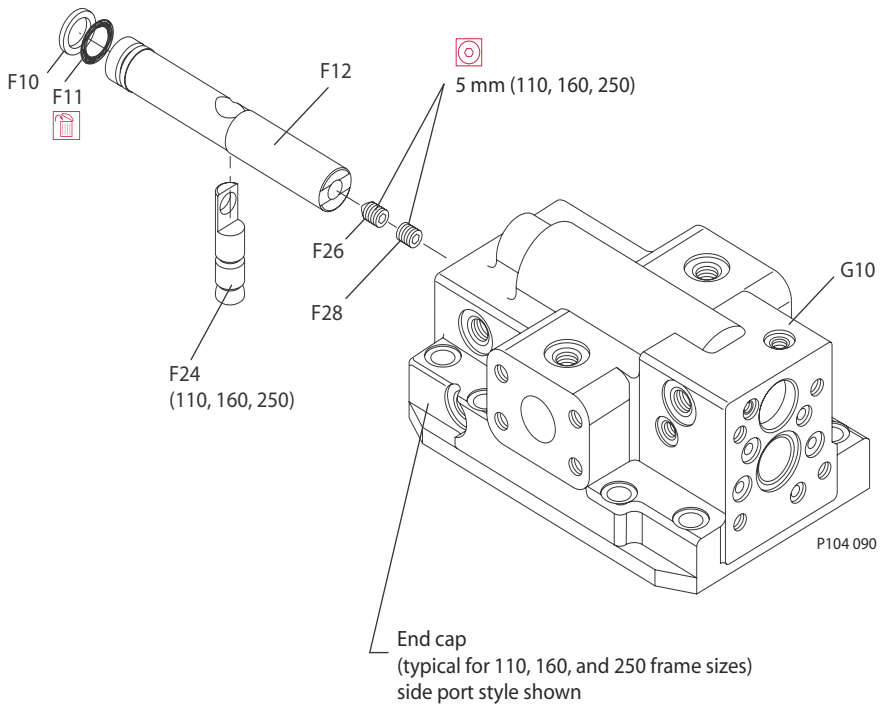
https://truckmanualshub.com/

ENDCAP DISASSEMBLY (continued)

110 - 250 frame

1. Remove lock screw (F28).
2. Remove cone-point set screw (F26).
3. Remove feedback fork / setting lug (F24) from inside of end cap.

Disassembling the end cap



All frame sizes

1. Remove servo piston (F12) from end cap (F10) glide ring end first.
2. Inspect glide ring (F10) for damage or wear.
3. Remove glide ring (F10) from servo piston if you need to replace it.
4. Remove O-ring (F11) from servo piston; discard.
5. Inspect servo piston bore in end cap for damage or wear.

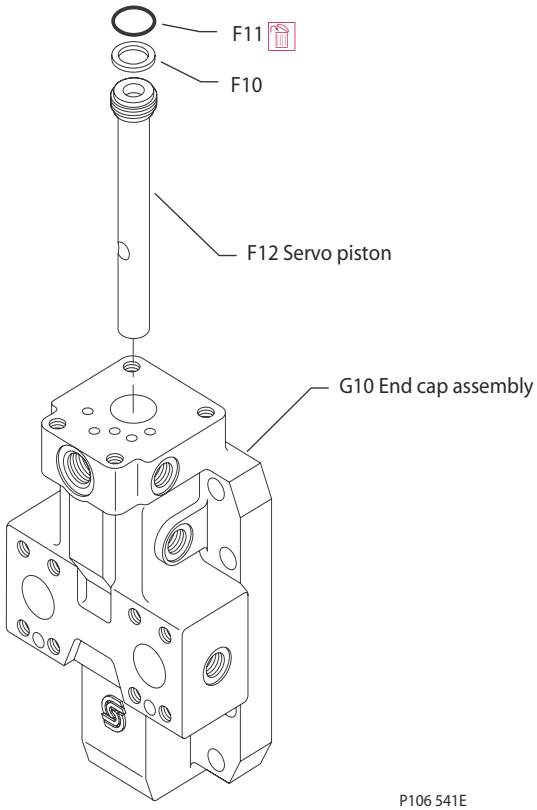
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ENDCAP DISASSEMBLY (continued)

51-1 Endcap

1. Remove servo piston (F12) from end cap (G10) glide ring end first.
2. Inspect glide ring (F10) for damage or wear.
3. Remove glide ring (F10) from servo piston if you need to replace it.
4. Remove O-ring (F11) from servo piston; discard.
5. Inspect servo piston bore in end cap for damage or wear.

Disassembling the end cap



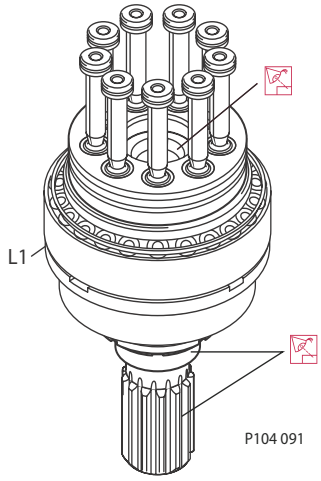
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SHAFT ASSEMBLY

Caution
The optional magnetic speed sensor ring is pressed onto a machined surface of the shaft. Take care not to damage the sensor ring..

1. Check the seal area of the shaft (L1) for damage or wear.
2. Check the output splines for damage or wear.
3. Inspect synchronizing shaft raceways for wear.
4. Inspect shaft bearings for wear and roughness.
5. Check that the bearing retaining nut is firmly staked to the output shaft, and that no noticeable looseness is present in the bearings.

Shaft assembly



6. Check the piston assemblies (L84) for damage or wear.

Bearings and pistons are not individually serviceable. Replace the entire shaft assembly if any components are damaged or worn.

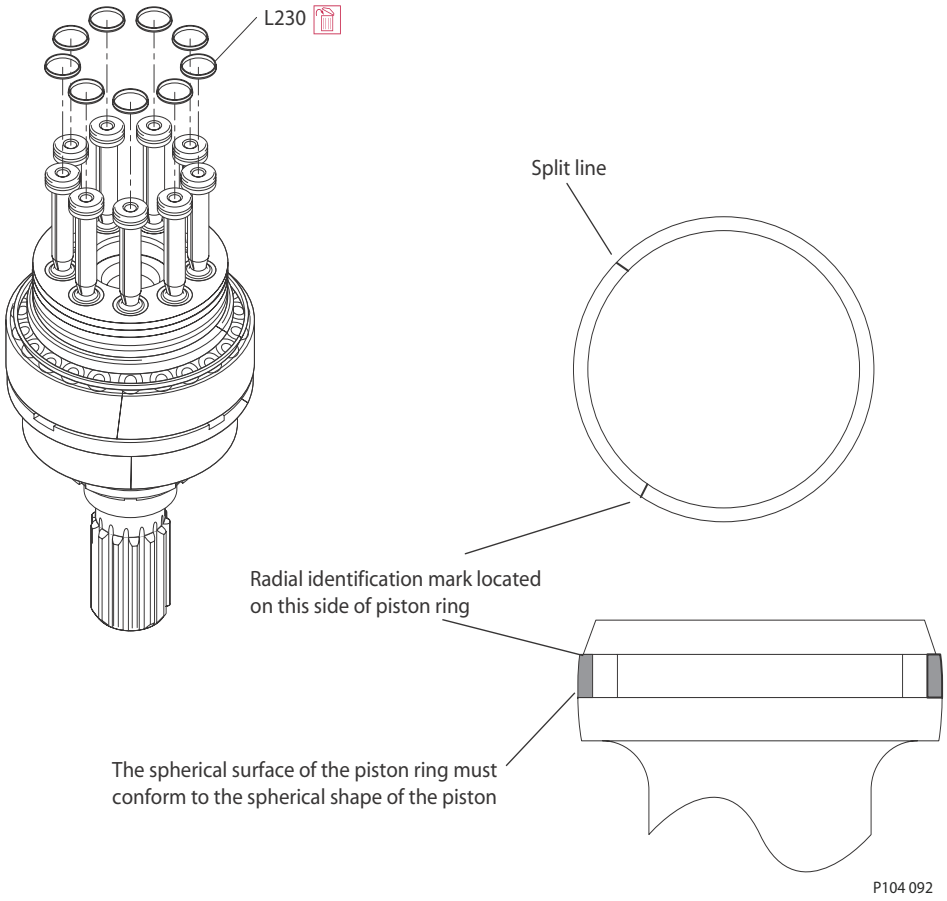
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PISTON RINGS

1. Use a small pair of retaining ring pliers to spread and remove the piston rings (L230) from the pistons. Discard the rings.

2. Install new piston rings (L230). Ensure the spherical surface conforms to the shape of the piston. A radial identification mark appears on the outer side of the piston rings. Do not let the ends of each piston ring overlap each other.

Spherical piston rings

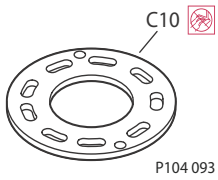


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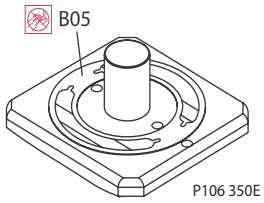
BEARING PLATE, VALVE SEGMENT, AND CYLINDER BLOCK

1. Inspect the bronze surface of the bearing plate (C10) for damage and excessive wear. Sealing surface must be free from scratches and nicks. The locating pin holes must not be worn. Replace if necessary.

Bearing plate



Valve segment

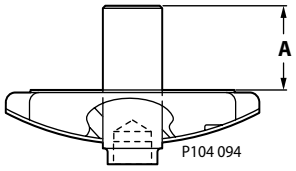


2. Inspect the valve segment (B05) for damage or wear on the sealing surfaces.

3. Inspect the spindle for wear.

4. Ensure the spindle is located correctly in the valve segment by measuring distance **A**. If this dimension is not within the range shown in the table, it indicates that the spindle has moved in the valve segment. Replace it.

Valve segment



Spindle location distance

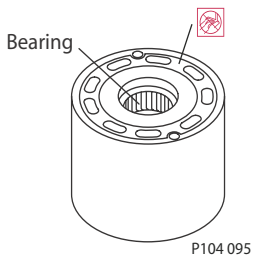
Frame size	**Distance A** mm [in]
060	27.5 ± .4 [1.08 ± 0.02]
080	32 ± .4 [1.25 ± 0.02]
110	34 ± .4 [1.34 ± 0.02]
160	38.9 ± .4 [1.49 ± 0.02]
250	44.2 ± .4 [1.74 ± 0.02]

Do not lap the valve segment to remove scratches. The hard treated surface is thin and lapping may remove this surface. Removing the spindle loosens its tight press fit and allows it to move.

5. Inspect cylinder block assembly for wear or damage. If bearing is worn or damaged, replace the complete block assembly. The bearing is not available as a separate part.

   The piston bores must be smooth. The bearing plate surface must be free from scratches or nicks. The holes for the bearing plate locating pins must be free from wear. The races for the synchronizing shaft rollers must also be free from wear.

Cylinder block bearing



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ENDCAP ASSEMBLY

All frame sizes

1. Carefully install a new O-ring (F11) and glide ring (F10) on the servo piston (F12).
2. Lubricate the glide ring.
3. Install the servo piston into the end cap (G10).

The end of the servo piston with the glide ring is opposite the multi-function block/ control mounting surface of the end cap.

060 frame

1. Install the setting lug (F24) into the servo piston (F12) from inside of end cap.
2. Using a 3 mm internal hex wrench, install the cone-point set screw (F26) so that its point enters the groove in the setting lug and torque to 5 N•m [44 lbf•in].
3. Install the lock screw (F28).
4. Using a 3 mm hex wrench torque the lock screw (F28) to 7 N•m [62 lbf•in].
5. Install the feedback fork (F30) into the servo piston through the hole in the end cap.

The contact pads on the fork must face toward the multi-function block/control end of the end cap.

6. Using a 3mm internal hex wrench, install the other cone-point set screw (F26) so that its point enters the groove in the feedback fork (F30). Do not tighten the set screw yet. See page 21 for final assembly instructions.
7. Lubricate and install a new O-ring (G80A) on the end cap plug (G80). Install the plug.
8. Using a 3/8 in. internal hex wrench, torque the end cap plug to 40 N•m [29.5 lbf•ft].

080 frame

1. Install feedback fork / setting lug (F24) into the servo piston through the hole in the end cap.

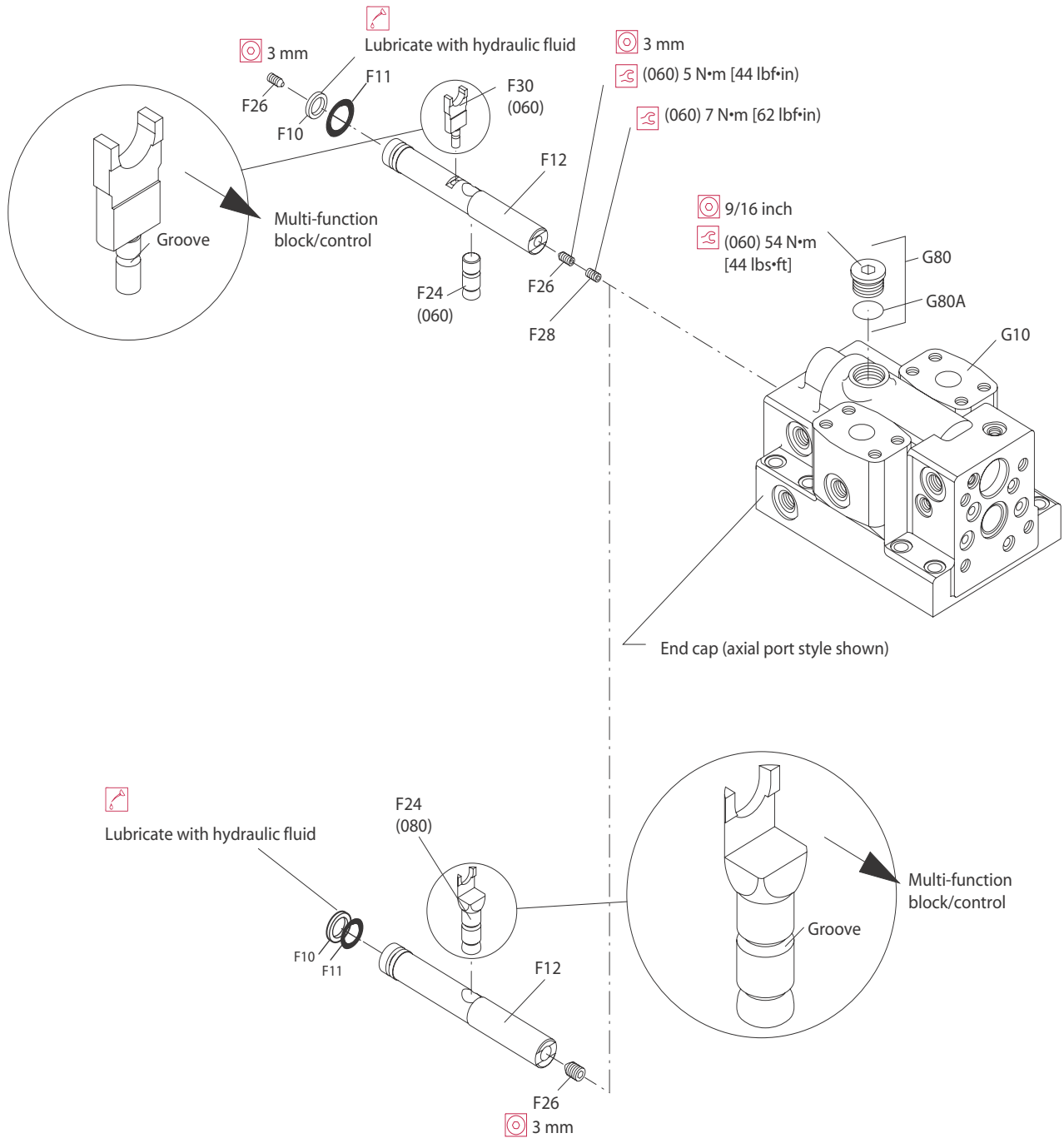
The offset of the fork must be facing away from the multi-function block / control end of the end cap.

2. Install the cone-point set screw (F26) so that its point enters the groove in the feedback fork (F30) / setting lug (F24). Do not tighten the set screw yet. See page 21 for final assembly instructions.
3. Install the end cap plug (G80).
4. Using a 9/16 in. internal hex wrench torque the end cap plug (G80) to 40 N•m [29.5 lbf•ft].

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ENDCAP ASSEMBLY (continued)

Setting lugs



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ENDCAP ASSEMBLY (continued)

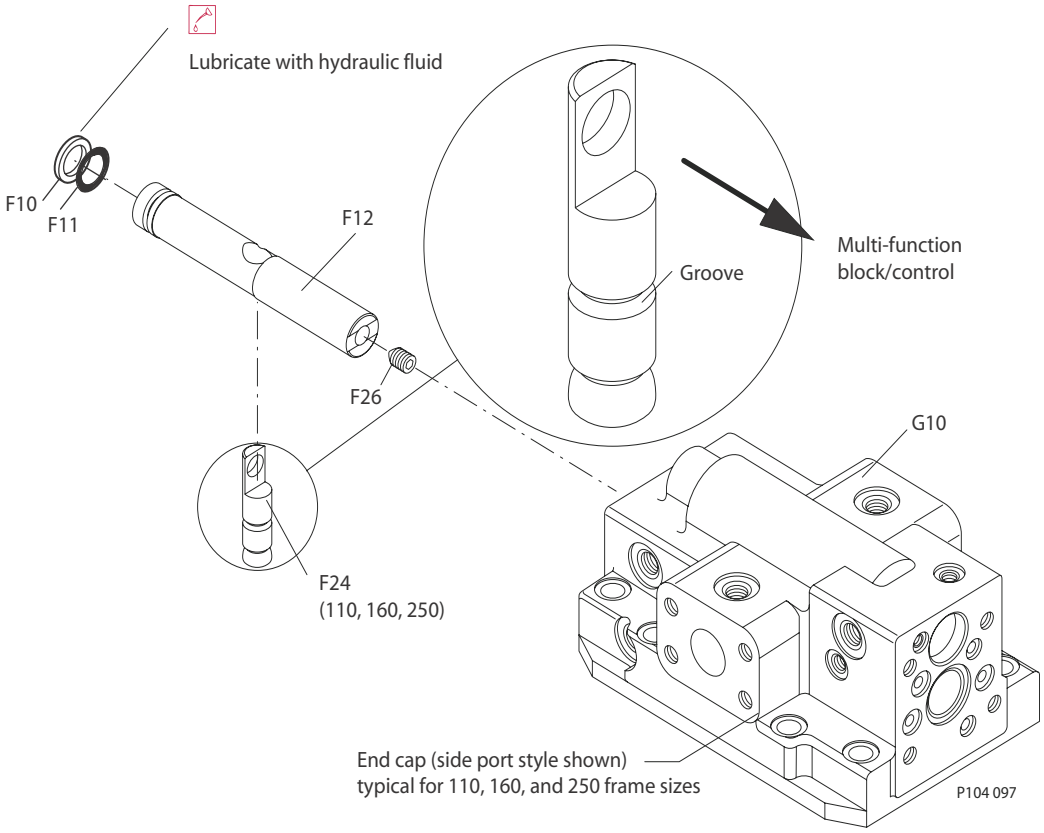
110-250 frames

1. Install feedback fork (F24) / setting lug into the servo piston from inside of the endcap.

The offset of the fork must be away from the multi-function block / control end of the end cap.

2. Install the cone-point set screw (F26) so that its point enters the groove in the feedback fork (F24) / setting lug. Do not tighten the set screw yet. See page 21 for final assembly instructions.

Cone-point screw and feedback fork



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ENDCAP ASSEMBLY (continued)

All frame sizes

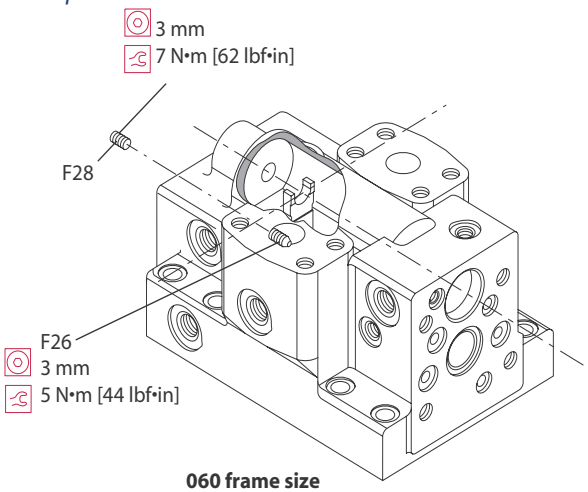
1. Position feedback fork (F30) (060 cc) or feedback fork/setting lug (080 cc - 250 cc) perpendicular to the setting piston for proper control spring operation.

2. Insert a 26.9 mm [1.06 in] diameter rod, with the end machined perpendicular to its axis, into the valve sleeve bore in the end cap. Align the fork while tightening the cone-point set screw (F26).

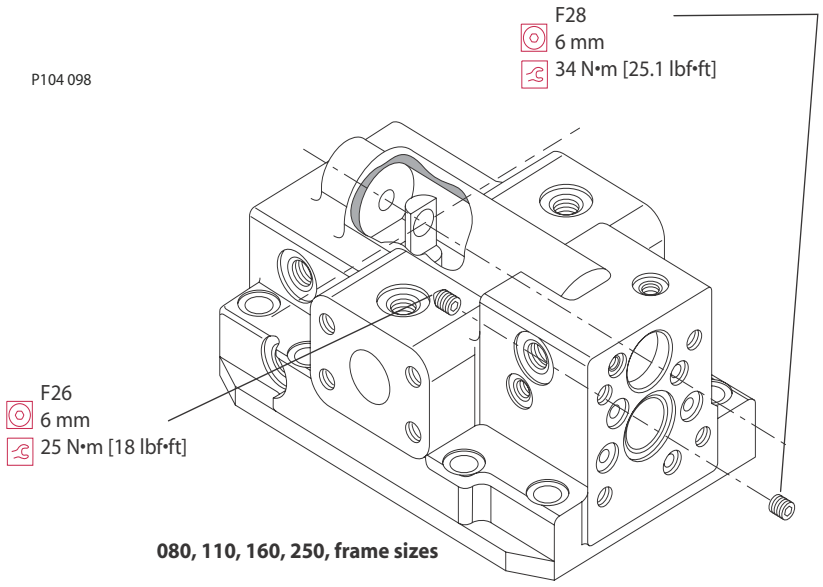
3. Using a 3 or 5 mm internal hex wrench, torque the cone-point set screw to 5 N•m [44 lbf•in].

4. Install and torque the lock screw (F28) to
   - 7 N•m [62 lbf•in] using a 3 mm internal hex wrench for a 60 cc motor
   - 34 N•m [25 lbf•ft] using a 5 mm internal hex wrench for the 80 cc through 250 cc motors

Cone-point set screws



060 frame size



080, 110, 160, 250, frame sizes

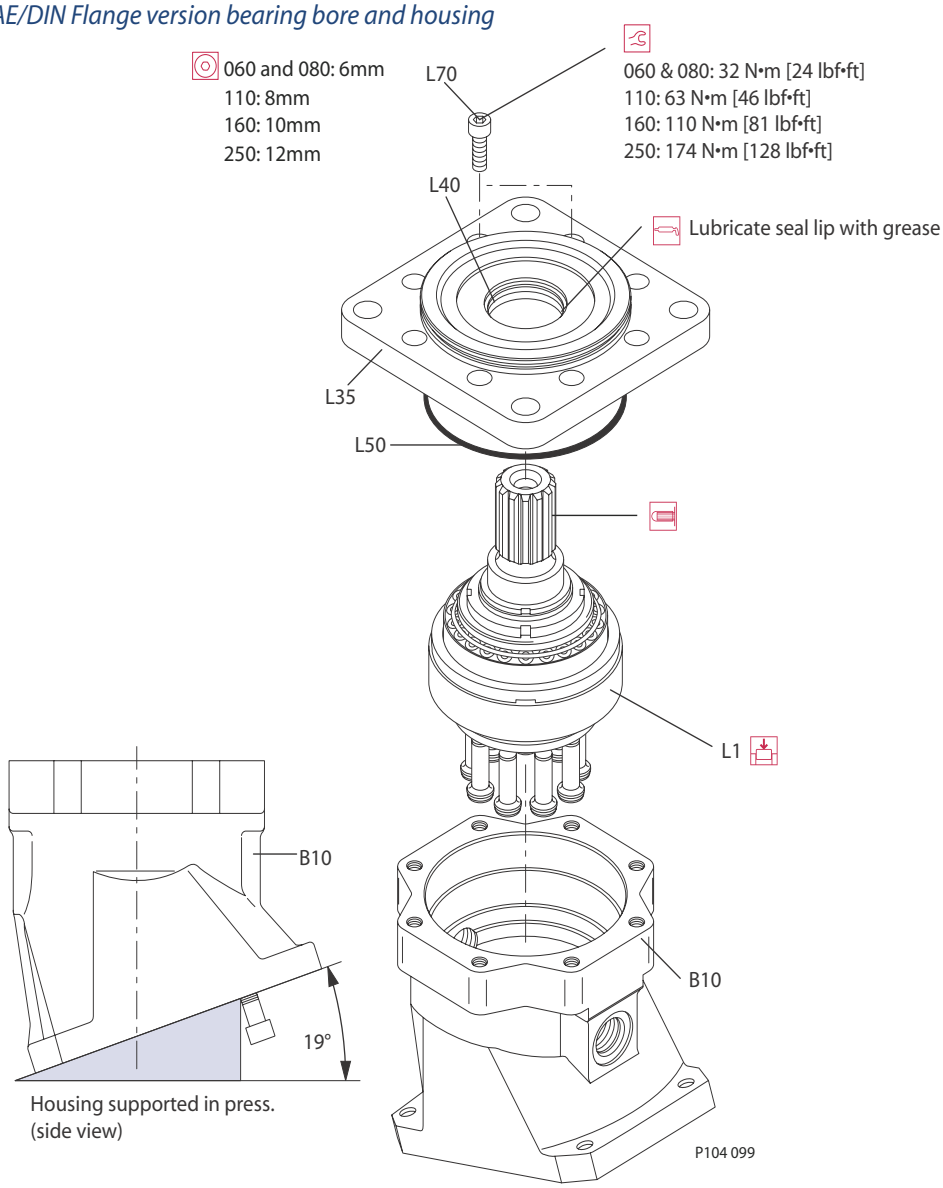
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SHAFT AND MOUNTING FLANGE ASSEMBLY

SAE/DIN flange

1. Support the main housing (B10) so the bearing bore is vertical.
2. Press shaft assembly (L1) into main housing.
3. Install new O-ring (L50) on mounting flange (L35).
4. Install new seal (L40) in flange.
5. Cover the shaft splines with an installation sleeve to protect the seal during assembly. Install flange assembly (L35).
6. Install screws (L70).
7. Torque screws (L70) to value shown in the diagram.

SAE/DIN Flange version bearing bore and housing



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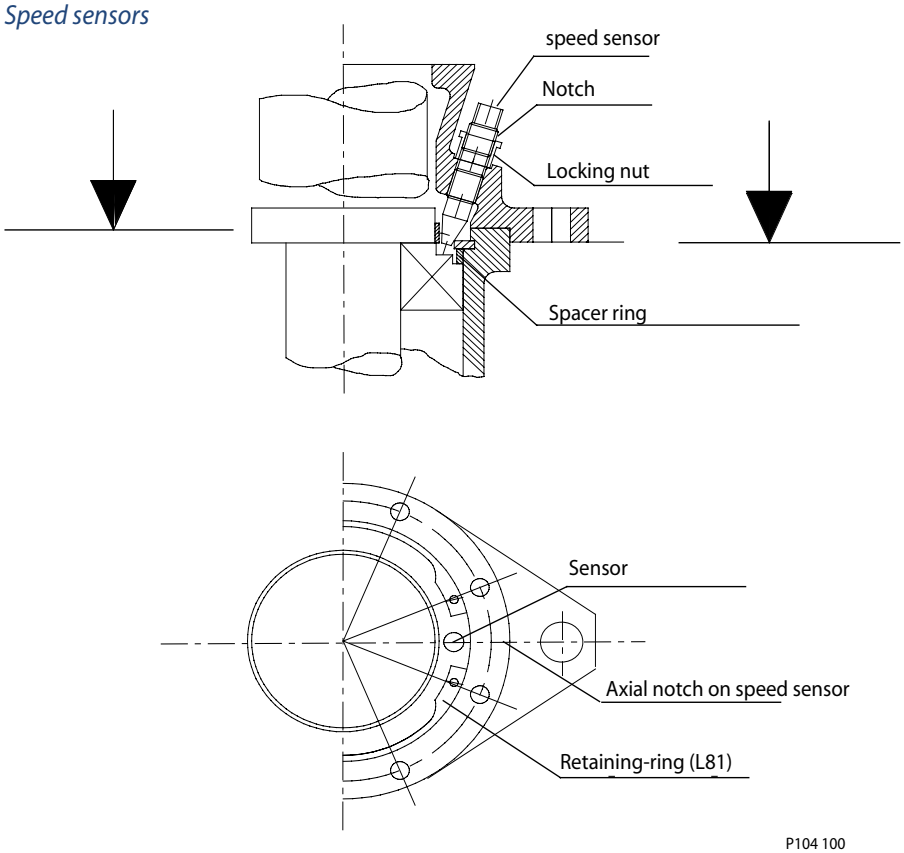
SHAFT AND MOUNTING FLANGE ASSEMBLY (continued)

Cartridge flange

1. Install the inner retaining ring (L80) for the shaft seal carrier in the bearing housing.
2. Press shaft assembly into bearing housing (L35).
3. Install spacer ring (L95). !
4. Install the end of the spacer with the larger inside diameter next to the inner shaft bearing cup.
5. Install retaining ring (L81).
6. Align ends of the retaining ring between the two bolt holes to allow clearance for speed sensor.

! Caution
Do not damage the piston sockets or shaft seal surface.

Speed sensors

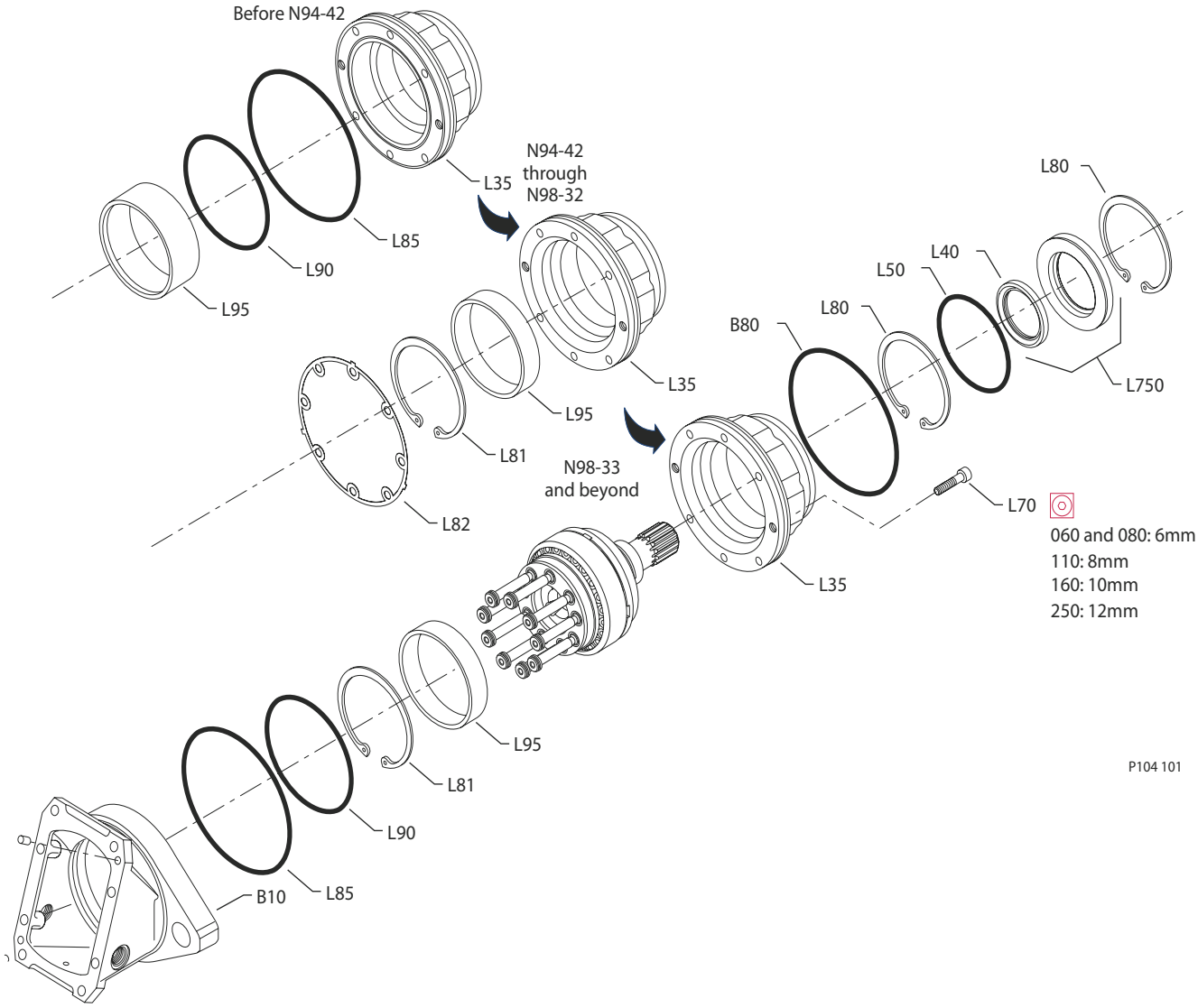


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SHAFT AND MOUNTING FLANGE ASSEMBLY (continued)

7. Install O-rings (L85) and (L90) or gasket (L82).
8. Install main housing (B10). Ensure snap ring (L81) ends align with speed sensor port.
9. Install screws (L70).
10. Torque screws:
    - 32 N•m [24 lbf•ft] for 60 cc and 80 cc
    - 63 N•m [46 lbf•ft] for 110 cc
    - 110 N•m [81 lbf•ft] for 160 cc

Cartridge version bearing bore and housing



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CYLINDER BLOCK AND SYNCHRONIZING SHAFT

Synchronizing shaft and rollers

1. Using petroleum jelly to retain it, install the first synchronizing shaft support pin (C40) into the recess in the cylinder block.

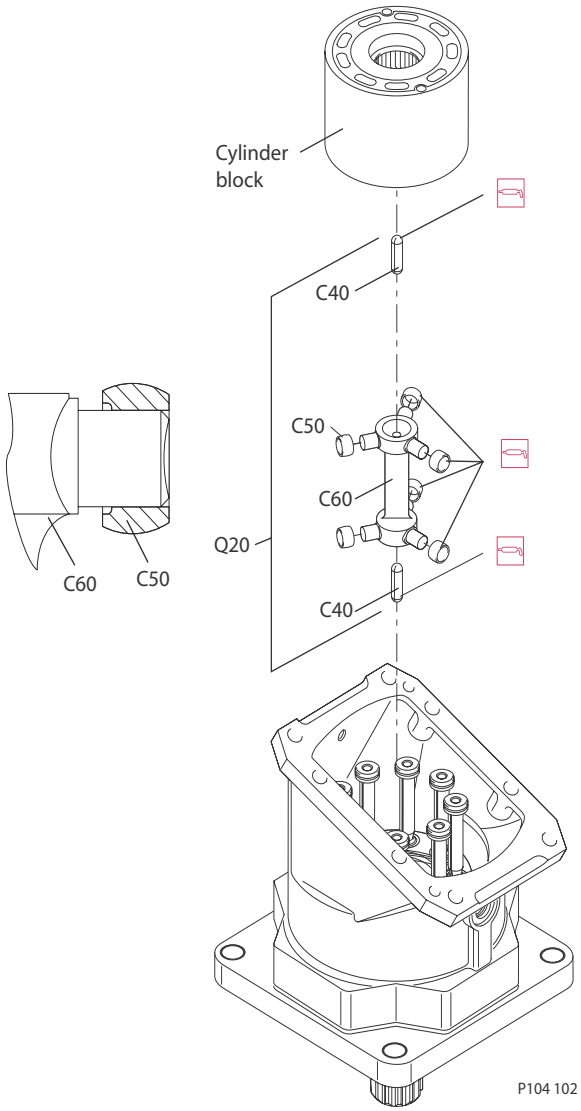
2. Using petroleum jelly to retain them, install the synchronizing shaft rollers (C50) on the journals of the synchronizing shaft (C60).

3. Position the recess on each roller to face the center line of the synchronizing shaft.

Motors built after serial number N01-39-XXXXX have symmetrical rollers.
See service bulletin *SB-2001-015*.

4. Position each roller with its outside edge flush with the end of the synchronizing shaft journal.

Cylinder block and sync-shaft



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MOTOR ASSEMBLY (continued)

Synchronizing shaft and rollers (continued)

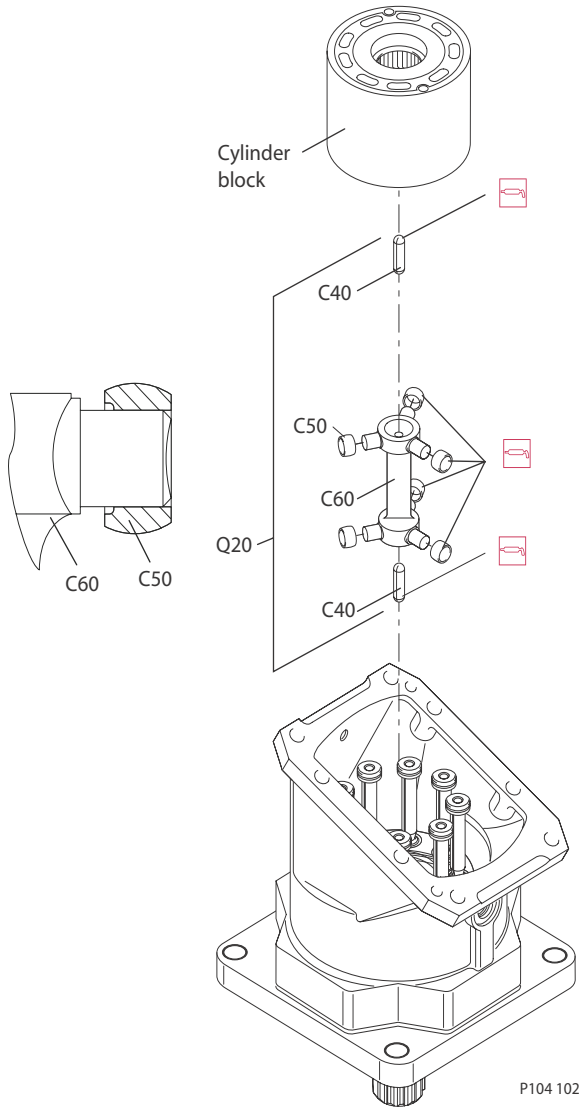
5. Install the second C40 synchronizing shaft support pin into the motor shaft assembly.

6. Install the synchronizing shaft and rollers into the motor shaft.

The cylinder block end of the shaft is a larger diameter than the motor shaft end on all frame sizes. The rollers must enter the races in the motor shaft and the recess in the end of the synchronizing shaft must engage the support pin.

7. Tip and rotate the synchronizing shaft in all directions to check for binding. The synchronizing shaft rollers must move freely in the races in the motor shaft.

Cylinder block and sync-shaft



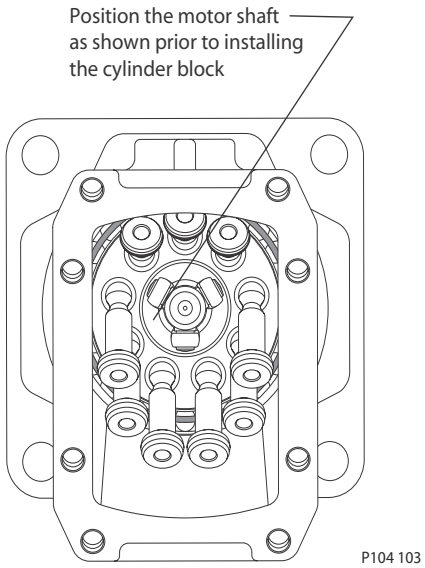
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CYLINDER BLOCK AND SYNCHRONIZING SHAFT (continued)

Cylinder block

1. Lubricate the pistons and sync-shaft and rollers with clean hydraulic oil and rotate the shaft to the position shown in the illustration.

Pistons



(Cylinder block not installed)

2. Tip the 3 pistons closest to the minimum angle stop out, toward the housing.
3. Tip the 6 remaining pistons forward toward the lowest part of the end cap mounting surface.
4. Tip the synchronizing shaft forward toward the lowest part of the end cap mounting surface.
5. Position the cylinder block so one synchronizing shaft roller raceway is aligned between two pistons.
6. Install the cylinder block and its support pin (C40) on to the pistons and synchronizing shaft.

The synchronizing shaft rollers (C50) enter their races in the block, while each piston enters its corresponding bore in the block.

7. Insert a brass rod through the cylinder block kidneys to guide the pistons into position.
8. Start with the four (4) pistons closest to the lowest part of the end cap mounting surface.
9. After the 4 pistons enter their bores, tilt the cylinder block so the synchronizing shaft rollers (C50) enter their races in the cylinder block and the next two pistons enter their bore.

The support pin (C40) enters its recess in the synchronizing shaft (C60).

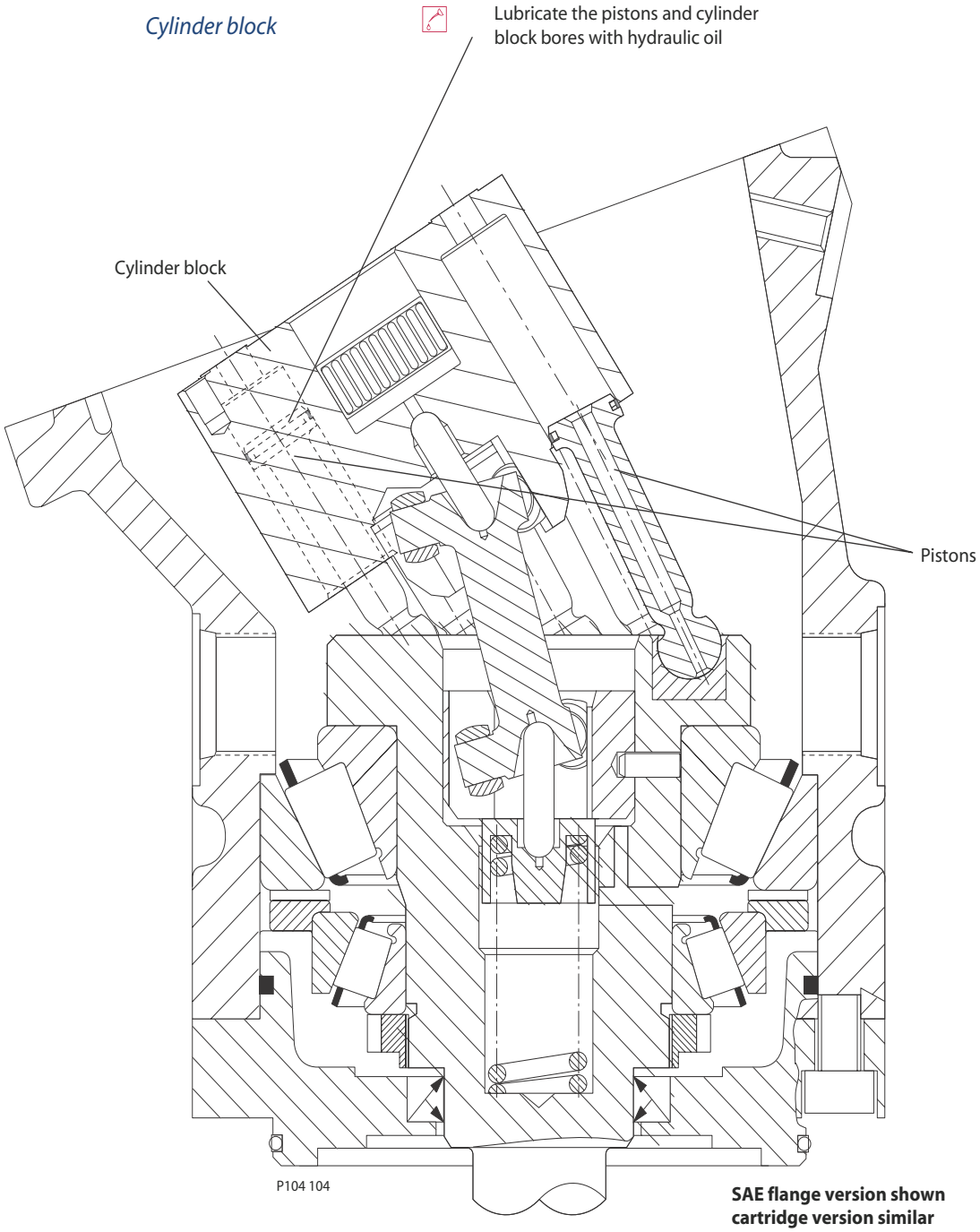
10. Lift the cylinder block slightly.
11. Guide the remaining 3 pistons into their bores.
12. After the last piston is in position, check the position of the rollers closest to the minimum angle stop.
13. Maintain an inward force on the cylinder block.
14. Carefully push it toward the highest part of the end cap mounting surface.

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CYLINDER BLOCK AND SYNCHRONIZING SHAFT (continued)

15. Check that all of the synchronizing shaft rollers are in position.

If the cylinder block is properly installed, there will be very little rotational free-play between the cylinder block and the motor shaft.



SAE flange version shown cartridge version similar

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BEARING PLATE AND VALVE SEGMENT

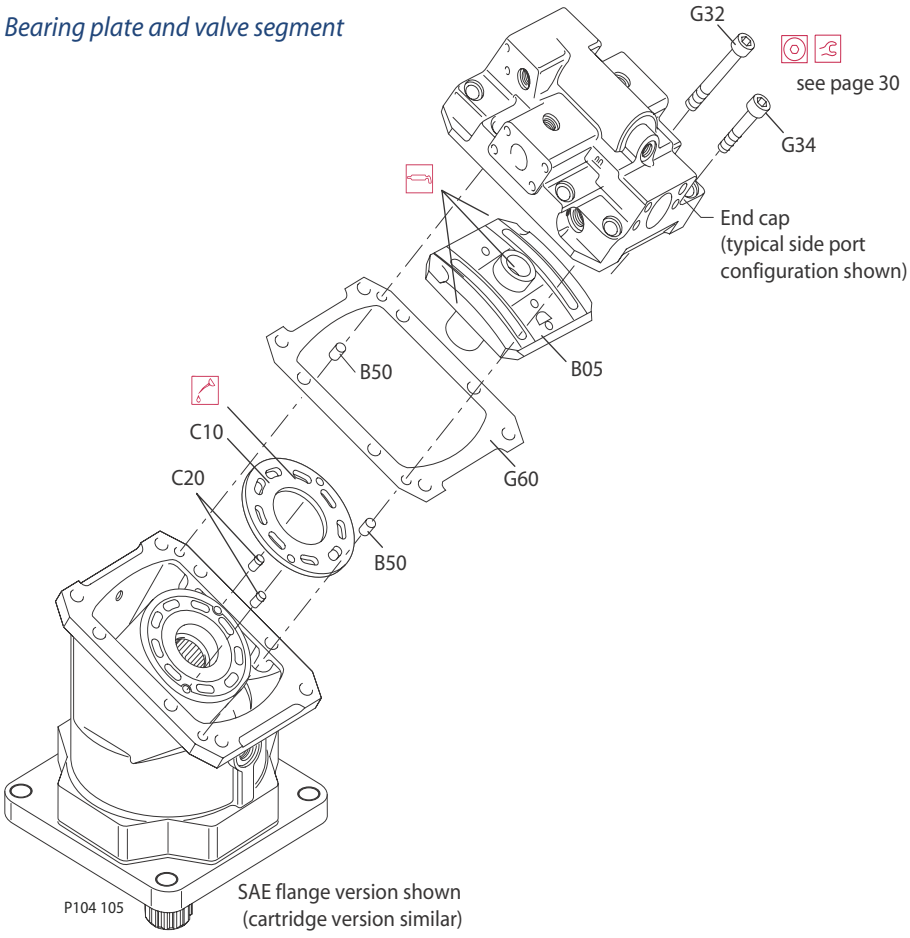
Bearing plate

1. Install the bearing plate locating pins (C20) into the cylinder block.
2. Install the longer end of each shouldered pin into the block.
3. Install the bearing plate (C10) on the cylinder block, with steel side facing the block.
4. Lubricate the bronze side of the plate with hydraulic oil.
5. Install the end cap alignment pins (B50). Install a new gasket (G60).
6. Locate the cylinder block in the approximate center of the housing opening.

Tip the housing until the endcap mounting surface is level to help keep the block centered. Do not allow pistons or synchronizing shaft rollers to fall out of position

7. Using petroleum jelly, install the valve segment (B05) into the end cap so the segment spindle engages the setting lug in the servo piston.
8. Orient the valve segment so the hole at the edge is aligned with the loop-flushing valve drain hole in the end cap.
9. Locate the valve segment and servo piston in the approximate center of their travel.

Bearing plate and valve segment



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ENDCAP INSTALLATION

Caution
Do not allow the pistons or synchronizing shaft rollers to fall out of position.

1. Rotate the motor shaft and check for play between the shaft and cylinder block. Any play indicates that the synchronizing shaft rollers are not installed correctly.
2. Install the end cap assembly and valve segment so the spindle engages the bearing in the cylinder block.
3. Install screws (G32) and (G34) to retain the end cap assembly to the motor.

Install the screws in their proper locations to ensure adequate thread engagement. The internal spring (in the motor shaft) will hold the end cap away from the housing a short distance.

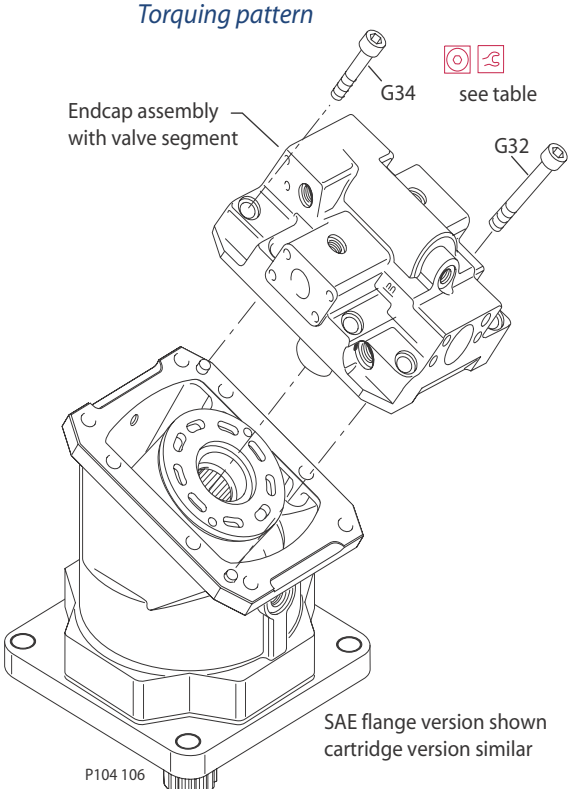
Caution
Do not force the end cap into position on the housing. If necessary, reassemble the components to ensure proper alignment.

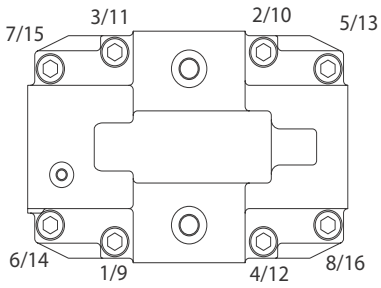
4. Tighten the screws by hand in a double-X pattern while rotating the motor shaft to ensure proper positioning of the synchronizing shaft rollers.
5. When the end cap is in position, torque the screws in a double-X pattern as shown in the table:
6. Recheck the end cap screw torque.
7. Reinstall the minimum angle servo cover, control springs (if used), 4-way valve spool and sleeve (if used), and control and multifunction block (if used). Refer to *Series 51 and 51-1 Service Manual*, **11008567** for instructions.

Endcap screw torque

Frame size	Wrench size	Torque N•m [lbf•ft]
060	8 mm	66 [49]
080	8 mm	78 [58]
110	10 mm	115 [85]
160	10 mm	135 [100
250	12 mm	213 [157]

Torquing pattern





Double-X pattern torquing sequence
(110 frame size with side port end cap shown)

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ENDCAP INSTALLATION (continued)

Following procedures in the *Series 51 and 51-1 Service Manual*, **11008567**: Install the control and multi-function block (if installed). Install the 4-way valve spool and sleeve (if installed). Install the threshold springs and guides. Install the control springs (if installed). Install the ramp springs and guides (if installed). Install the minimum angle servo cover from the motor. Install the loop-flushing valve and charge relief valve.

After assembly, test and adjust the motor as necessary before placing the unit back in service. Refer to *Series 51 and 51-1 Service Manual*, **11008567** for adjustment procedures.

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Local address:

Sauer-Danfoss (US) Company
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Fax: +1 515 239-6618

Sauer-Danfoss ApS
DK-6430 Nordborg, DeN•mark
Phone: +45 7488 4444
Fax: +45 7488 4400

Sauer-Danfoss GmbH & Co. OHG
Postfach 2460, D-24531 Neumünster
Krokamp 35, D-24539 Neumünster, Germany
Phone: +49 4321 871-0
Fax: +49 4321 871 122

Sauer-Danfoss-Daikin LTD
Sannomiya Grand Bldg. 8F
2-2-21 Isogami-dori, Chuo-ku
Kobe, Hyogo 651-0086, Japan
Phone: +81 78 231 5001
Fax: +81 78 231 5004

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10.3 Conveyor screws - scraper belt motor

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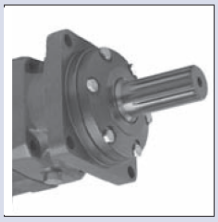
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SAUER DANFOSS

OMT series 2

Orbital Motors

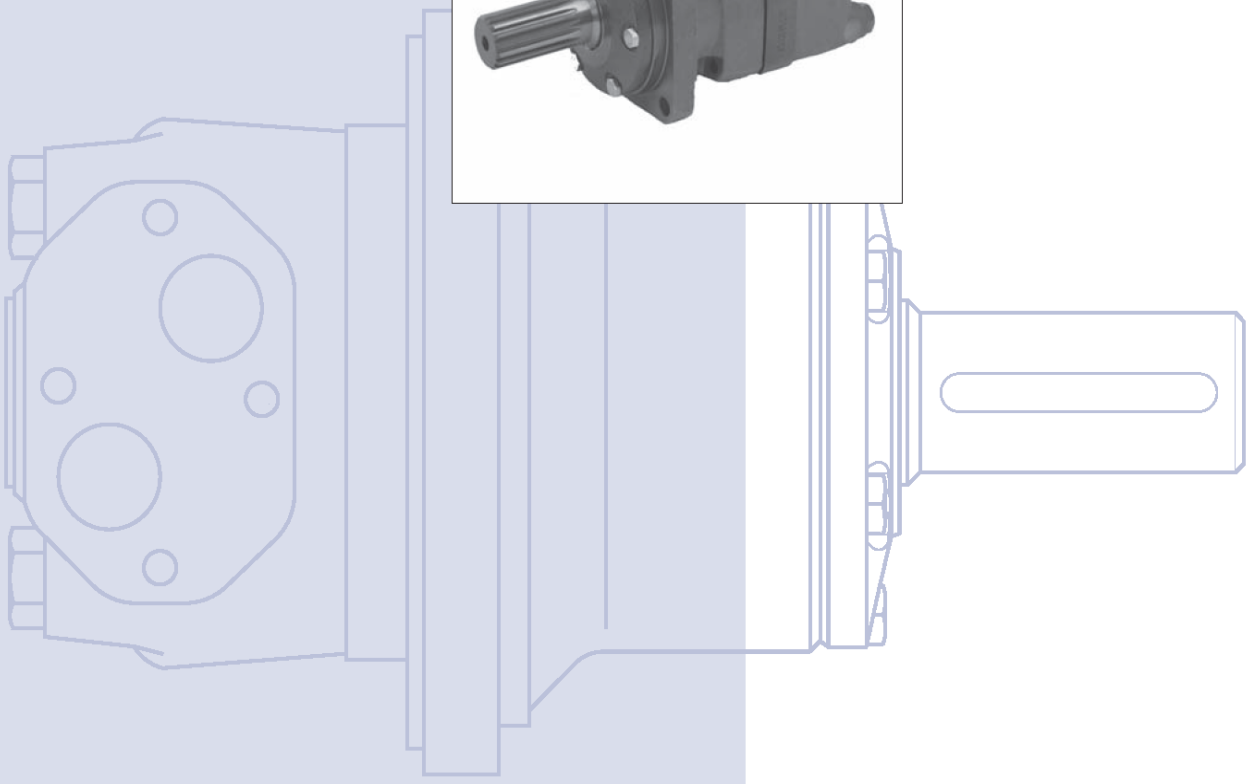
Service and Parts Manual











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OMT Orbital motor
Service and parts manual
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OMT Orbital motor
Service and parts manual
Contents

SPECIAL VERSIONS

The list of spare parts cannot be used when ordering parts for special OMT versions. In this respect, please contact the sales organisation for Sauer-Danfoss.

COST-FREE REPAIRS

We would point out that cost-free repairs as mentioned in Sauer-Danfoss General Conditions of Sale, are carried out only at Sauer-Danfoss Nordborg or at service shops authorised by Sauer-Danfoss.

COMMENTS

a) Only OMT series 2:
After week 41.97 the guide pin has a new location. When repairing motors manufacturing before week 41.97 it will therefore be necessary to replace end cover, balance plate, tightening pin and spring washer.

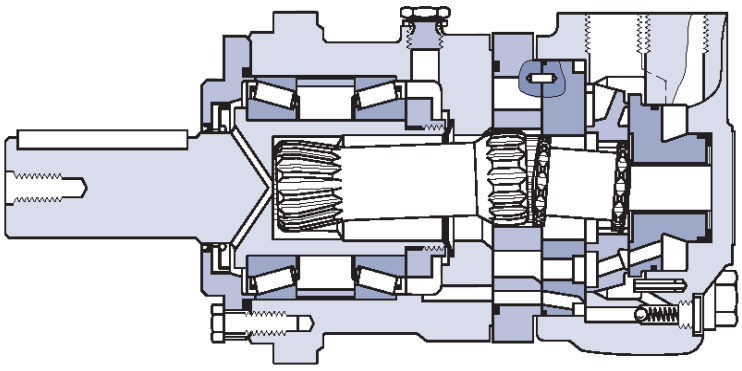
SERIES MARKING

The series number is altering when parts in the motor are changed.
The OMT series marking follows its date marking: XXX-2, XXX-2.1

MODIFICATION BY CHANGE OF SERIES

From OMT series 2 to series 2.1:
New shaft bearings introduced.
Shaft incl. bearings, bearing housing and front cover modified accordingly.

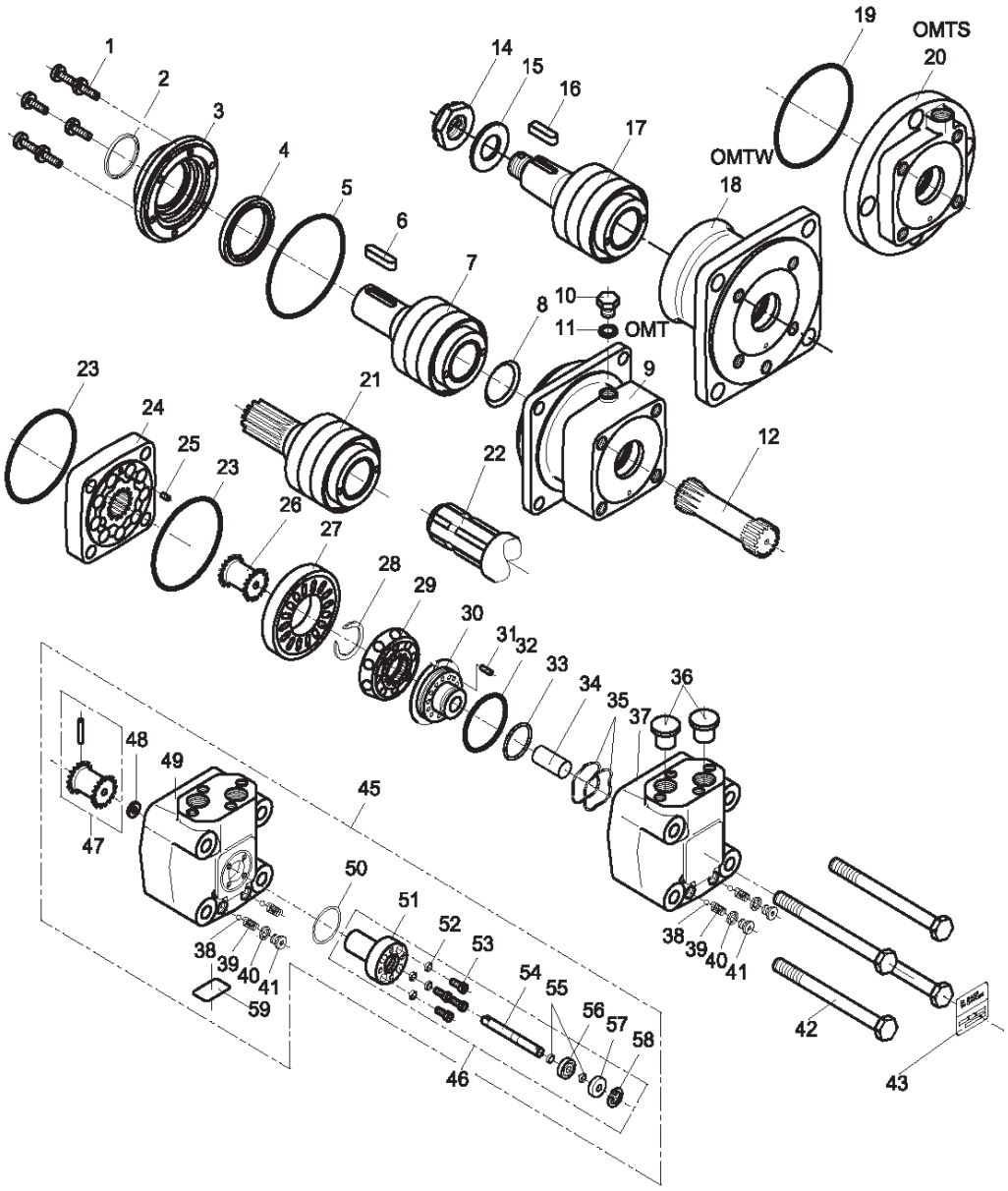
OMT SERIES 2



151-1776.10

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EXPLODED VIEW OMT SERIES 2



151-1333.11

Tightening torque:

Item 1	22 - 26 N·m [194 - 230 lbf·in]
Item 10:	30 - 60 N·m [265 - 531 lbf·in]
Item 41:	10 - 15 N·m [88 - 132 lbf·in]
Item 42:	135 - 145 N·m [1195 - 1283 lbf·in]
Item 53:	4 - 6 N·m [35 - 53 lbf·in]

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SPARE PARTS LIST

Item	Spare parts		Stock per 100 motors** Number per motor Code No.		
1	Screw	M8; l = 25 mm [0.98 in]		6	25
2	Dust seal ring	45 • 52 • 4 mm [1.77 • 2.05 • 0.16 in]		1	*
3	Front cover	OMT series 2.1		1	3
		OMT series 2		1	3
4	Shaft seal	45 • 65 • 7 mm [1.77 • 2.16 • 0.27 in] NBR		1	*
		45 • 65 • 7 mm [1.77 • 2.16 • 0.27 in] FPM		1	*
5	O-ring	90 • 2 mm [3.54 • 0.08 in]		1	*
6	Parallel key				
		Metric: 12 • 8 • 70 mm		1	5
		SAE: 3/8 • 3/8 • 2 1/4 in, BS 46		1	5
7	Cylindrical shaft				
	Metric: ∅40 mm OMT/OMTW incl. bearings and parallel key series 2.1			1	2
	∅40 mm OMT/OMTW incl. bearings and parallel key series 2			1	2
	SAE: ∅1 1/2 in OMT/OMTW incl. bearings and parallel key series 2.1			1	2
	∅1 1/2 in OMT/OMTW incl. bearings and parallel key series 2			1	2
8	Conical seal ring			1	*
9	Bearing housing	Metric: OMT series 2.1		1	2
		OMT series 2		1	2
		SAE: OMT series 2.1		1	2
		OMT series 2		1	2
10	Drain plug				
		Metric: 1/4 BSP.F steel		1	5
		SAE: 9/16 - 18 UNF, incl O-ring		1	5
11	Washer, metric version only 17.5 • 13.5 • 1.5 mm [0.69 • 0.53 • 0.06 in]			1	5
12	Cardan shaft				
	OMT/OMTW/OMTS 160	l = 104 mm [4.09 in]		1	3
	OMT/OMTW/OMTS 200	l = 108 mm [4.25 in]		1	3
	OMT/OMTW/OMTS 250	l = 114 mm [4.48 in]		1	3
	OMT/OMTW/OMTS 315	l = 124 mm [4.88 in]		1	3
	OMT/OMTW/OMTS 400	l = 134.5 mm [5.30 in]		1	3
	OMT/OMTW/OMTS 500	l = 148.5 mm [5.85 in]		1	3
14	Castellated nut	Metric: M 30 • 2 mm		1	5
		SAE: 1 1/4 - 18 UNEF		1	5
15	Washer, metric version only	31 • 56 • 4 mm [1.22 • 2.20 • 1.56 in]		1	5
16	Parallel key	Metric: 12 • 8 • 28 mm		1	5
		SAE: 7/16 • 7/16 • 1 1/4 in, BS 46		1	5
17	Tapered shaft				
	Metric: ∅45 mm OMT/OMTW	series 2.1		1	2
	incl. bearings and item 14, 15, 16	series 2			
	SAE: ∅1 3/4 in OMT/OMTW	series 2.1		1	2
	incl. bearings and items 14, 16	series 2			
18	Bearing housing	Metric: OMTW series 2.1		1	2
		OMTW series 2		1	2
		SAE: OMTW series 2.1		1	2
		OMTW series 2		1	2
19	O-ring OMTS	125 • 3 mm [4.92 • 0.12 in] NBR		1	*
20	Mounting flange OMTS	Metric:		1	2
		SAE:		1	2

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SPARE PARTS LIST

Item	Spare parts		Code No.	Stock per 100 motors** Number per motor	
21	Splined shaft				
	Metric:	∅38.1 mm incl. bearings series 2.1		1	2
		∅38.1 mm incl. bearings series 2		1	2
	SAE:	∅1 1/2 in incl. bearings series 2.1		1	2
		∅1 1/2 in incl. bearings series 2		1	2
22	P.t.o. shaft				
	Metric:	incl. bearings series 2.1		1	2
	SAE:	incl. bearings series 2		1	2
23	O-ring	96 • 3 mm [3.77 • 0.12 in] NBR		2	*
24	Gearwheel set				
	OMT/OMTW/OMTS 160	W = 20 mm [0.79 in]		1	5
	OMT/OMTW/OMTS 200	W = 25 mm [0.10 in]		1	5
	OMT/OMTW/OMTS 250	W = 31 mm [1.22 in]		1	5
	OMT/OMTW/OMTS 315	W = 40 mm [1.57 in]		1	5
	OMT/OMTW/OMTS 400	W = 51 mm [2.00 in]		1	5
	OMT/OMTW/OMTS 500	W = 65 mm [2.56 in]		1	5
25	Guide pin	∅4, l = 10 mm [0.39 in]		1	5
26	Valve drive			1	5
27	Channel plate			1	5
28	Stop ring for OMTS 315, 400 and 500			1	5
29	Disc valve			1	5
30	Balance plate	a)		1	5
31	Guide pin	∅5, l = 14 mm [0.55 in] a)		1	5
32	O-ring				
		63 • 2 mm, NBR [2.48 • 0.08 in]		1	*
		60 • 2 mm, FPM [2.36 • 0.08 in]		1	*
33	O-ring				
		40 • 2 mm, NBR [1.57 • 0.08 in]		1	*
		40 • 2 mm, FPM [1.57 • 0.08 in]		1	*
34	Spacer			1	2
35	Spring washer	33 • 39.1 • 0.5 mm [1.30 • 1.54 • 0.02 in] a)		2	10
36	Seal plug (plastic)	Metric		2	25
		SAE		2	25
37	Valve housing	Metric a)		1	2
		SAE a)		1	2
38	Ball	∅1/4 in		2	5
39	Spring			2	5
40	Washer	13.9 • 10.2 • 1 mm [0.54 • 0.40 • 0.04 in]		2	5
41	Plug	1/8 BSP.F		2	5
42	Screw M14				
	OMT/OMTW/OMTS 160/200	l = 120 mm [4.72 in]		4	12
	OMT/OMTW/OMTS 250	l = 130 mm [5.12 in]		4	12
	OMT/OMTW/OMTS 315	l = 140 mm [5.51 in]		4	12
	OMT/OMTW/OMTS 400	l = 150 mm [5.90 in]		4	12
	OMT/OMTW/OMTS 500	l = 160 mm [6.30 in]		4	12
43	Name plate (aluminium)	OMT/OMTW/OMTS		1	15
	Name plate (brass)			1	15
45	Valve housing with tacho connection and valve drive, metric version only a)			1	2

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SPARE PARTS LIST

Item	Spare parts		Code No.	Stock per 100 motors** Number per motor	
46	Tacho connection			1	3
47	Valve drive incl. guide pin			1	2
48	Spacer ring			1	2
49	Tacho valve housing	a)		1	1
50	O-ring	40 • 2 mm, NBR [1.57 • 0.08 in]		1	10
51	Tacho bearing housing	a)		1	1
52	Washer	5.6 • 8.5 • 1 mm [0.22 • 0.33 • 0.04 in]		4	16
53	Screw M5	l = 15 mm [0.59 in]		4	16
54	Tacho drive shaft			1	1
55	Retaining ring	6.0 • 0.7 DIN 6799		2	10
56	Bearing	8 • 22 • 7 mm [0.31 • 0.87 • 0.27 in]		1	2
57	Shaft seal	8 • 22 • 6.5 mm [0.31 • 0.87 • 0.25 in]		1	5
58	Retaining ring	22 • 1 DIN 472		1	2
59	Name plate (aluminium) for OMT/OMTW/OMTS with tacho connection			1	15
A	Set of seals NBR	OMT, OMTW item 2, 4, 5, 8, 23, 32 and 33		1	10
B	Set of seals FPM	OMT, OMTW, OMTS item 4, 32 and 33		1	10
C	Set of seals NBR	OMT, OMTW, OMTS item 8, 19, 23, 32 and 33		1	10
D	Set of seals NBR	OMTS item 8 and 19		1	10

NBR: (Buna N, Perbunan), FPM (Viton)

* Contained in spare parts bag A, B, C or D
** The number of spare parts to be held in stock for each 100 motors being in service in your district.

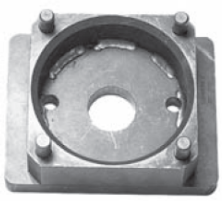
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SPECIAL TOOLS

A



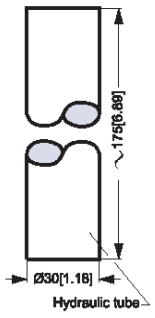
B



C

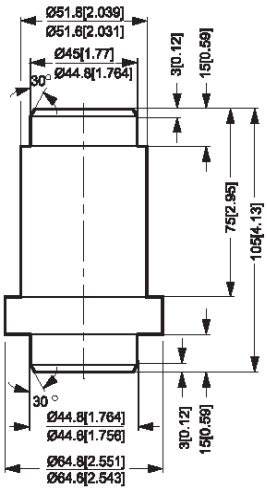


D

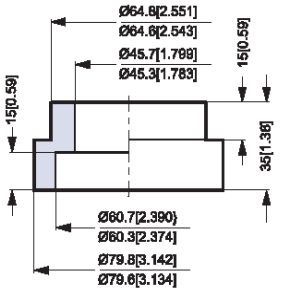


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E

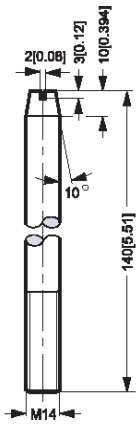


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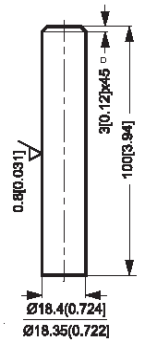
151-1341.10

F



151-1339.10

G



151-1338.10

A: Main holding tool SJ 151-9000-1
B: Holding tool for OMT and OMTS. Code number: SJ 151B9000-1
C : Holding tool for OMTW. Code number: SJ 151B9000-2
D: Mandrel for output shaft removal
E: Mandrel and backstop for fitting shaft seal
F: Two guide bolts
G : Mandrel to remove balance plate

D, E, F and G cannot be bought from Sauer-Danfoss

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DISMANTLING

Item	Part to remove	Comments
6 or 16	Parallel key	Cylindrical or tapered shafts
8 *	Conical seal ring	
10, 11	Drain plug and washer	
36	Seal plugs (2off)	Place the motor in holding tool.
41	Plugs (2 off) Series 2 only	Use 5 mm Allan head spanner
40	Washer (2 off)	
39	Springs (2 off)	Tilt motor, springs and balls come out.
38	Ball (2 off)	
42	Screw (4 off)	Use 22 mm socket spanner.
37	Valve housing	Lift off carefully as a unit, holding your fingers under the channel plate (Item no. 27).
23	O-ring	
27	Channel plate	
28	Stop ring	Only on OMTS 315, 400 an 500
29	Disc valve	
34	Spacer	
30	Balance plate	Fill in oil into the spacer hole and use the ø18.4 mm [0.72 in] mandrel as a piston to press up the balance plate.
31	Guide pin	
32	O-ring	
33	O-ring	
35	Spring washer (2 off)	
26	Valve drive	
25	Guide pin	Series 2 only
24	Gearwheel set	Hold fingers under the gearwheel set to prevent the parts from dropping out.
23	O-ring	
12	Cardan shaft	
8	Conical seal ring	Not on OMTS, is already removed.
1**)	Screw (6 off)	Unscrew with 13 mm socket spanner
3 **)	Front cover	
5 **)	O-ring	
2 **)	Dust seal ring	Item no. 2 and 4 to be knocked out by means af the special mandrel ("E" on page 8).
4 **)	Shaft seal	
7,17 **) 21, 22	Shaft incl. bearings	Press out the shaft/bearing assembly using a hydraulic press (pressing force max. 2500 N) using the special mandrel ("D" on page 8) Shaft/bearing assembly should not be dismantled!

* OMTS only
**) OMTS except

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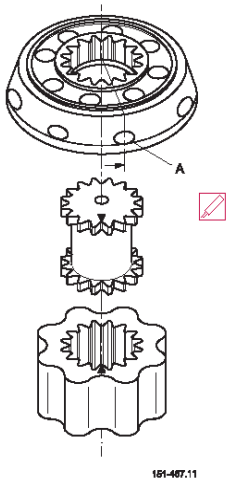
DISMANTLING OF TACHO CONNECTION

Item	Part to remove	Comments
53	Screw (4 off)	
46	Tacho connection	Remove from tacho valve housing
50	O-ring	
48	Spacer ring	
58	Retaining ring	Loosen tacho shaft package (by tapping lightly at the end of the shaft) and extract the package from tacho housing.
57	Shaft seal	
55	Retaining ring (2 off)	
56	Bearing	

After dismantling, clean all parts in low aromatic kerosene.
Examine the parts and exchange them if necessary.
Immidiately before assembly, lubricate each part with hydraulic oil and grease rubber parts with vaseline

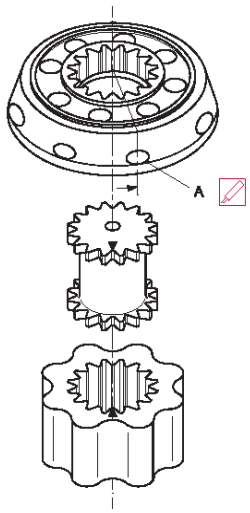
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ASSEMBLING

Item	Part to assemble	Comments
8 *)	Conical seal ring	Fit into recess in bearing housing, placed in the holding tool.
7, 17 **) 21 or 22	Shaft incl. bearings	Check the depth of the bore for the bearings at the bearing housing. OMT series 2.1: 59.5 mm [2.34 in] OMT series 2: 60.5 mm [2.38 in] Width of the bearing package outer rings. OMT series 2.1: 56 mm [2.20 in] OMT series 2: 58 mm [2.28 in] Use the hydraulic press. (max. 2500 N [550 lbf]) Always press on the bearing outer ring.
4 **)	Shaft seal	Knock into position in the front cover, using the assembly mandrel. Grease with vaseline.
2 **)	Dust seal ring	Use assembly mandrel, plastic hammer and support (to prevent the shaft seal from being knocked out). Grease with vaseline.
5 **)	O-ring	Grease with vaseline.
3 **)	Cover	Hight of the bearing support: OMT series 2.1: 3.5 mm [1.14 in] OMT series 2: 2.5 mm [0.10 in]
1 **)	Screw (6 off)	Use a 13 mm socket spanner. Tighten to 22 - 26 N·m [195 - 230 lbf·in] Turn the motor upside down. Fill up splines area in the shaft with oil. Mount 2 off guide bolts
12	Cardan shaft	If visible difference in splines length: Longest splines to be mounted in the output shaft.
23	O-ring	Grease with vaseline.
24	Gearwheel set 	Hold fingers under the gearwheel set to prevent parts falling out. Hole 6 mm [0.24 in] to be aligned with hole in the bearing housing. Mark the wheel of the gearwheel set at the point where the tip of a spline tooth is opposite the bottom of a tooth in the external rotor teeth (see drawing).

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ASSEMBLING

Item	Part to assemble	Comments
26	Valve drive 	Mark the bottom of a spline tooth on the valve drive. Line up the mark on rotor and valve drive. Applies to motors with tacho connection: Pin on valve drive must point upwards
23	O-ring	Grease with vaseline. Mount in channel plate groove.
25	Guide pin	
27	Channel plate	
29	Disc valve	Align mark on valve drive with a hole in the outer rim. (A on drawing). Turn disc valve counter clockwise until splines in the two parts engage.
35	Spring washer (2 off)	Place into valve housing.
32, 33	O-ring	Fit the two O-rings (greased with vaseline) in the balance plate grooves.
31	Guide pin	
30	Balance plate	Mount in valve housing.
34	Spacer	Grease with vaseline to prevent the spacer from dropping out.
37	Valve housing	Mount unit on the rest of the motor. Ports should face in the same direction as the drain port.
42	Screw (4 off)	Lubricate threads and cross tighten screws to 135 - 145 N·m [1195 - 1283 lbf·in].
38	Ball (2 off)	
39	Spring (2 off)	
40	Washer (2 off)	
41	Plug (2 off)	Tighten to 10 - 15 N·m [90 - 130 lbf·in]
6 or 16	Parallel key	Secure with plastic ring or tape.
10, 11	Drain plug and washer	Fill motor with oil before plugging. Tighten to 30 - 60 N·m [270 - 530 lbf·in].
8 *)	Conical seal ring	Grease with vaseline to keep in place
36	Seal plug (2 off)	

*) OMTS only

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Assembling of tacho connection

ASSEMBLING OF TACHO CONNECTION

The tacho connection must be reassembled in reverse order in relation to the procedure described under "disassembling the tache connection".
4 screws (pos. 53) to be tightened to 4 - 6 N·m [35.5 - 53 lbf·in].

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Notes

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Notes

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SAUER DANFOSS

OUR PRODUCTS

- Hydrostatic transmissions
- Hydraulic power steering
- Electric power steering
- Electrohydraulic power steering
- Closed and open circuit axial piston pumps and motors
- Gear pumps and motors
- Bent axis motors
- Orbital motors
- Transit mixer drives
- Planetary compact gears
- Proportional valves
- Directional spool valves
- Cartridge valves
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- Hydrostatic transaxles
- Integrated systems
- Fan drive systems
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- Electric motors and inverters
- Digital electronics and software
- Joysticks and control handles
- Displays
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Sauer-Danfoss (US) Company
2800 East 13th Street
Ames, IA 50010, USA
Phone: +1 515 239-6000, Fax: +1 515 239 6618

Sauer-Danfoss (Neumünster) GmbH & Co. OHG
Postfach 2460, D-24531 Neumünster
Krokamp 35, D-24539 Neumünster, Germany
Phone: +49 4321 871-0, Fax: +49 4321 871 122

Sauer-Danfoss (Nordborg) A/S
DK-6430 Nordborg, Denmark
Phone: +45 7488 4444, Fax: +45 7488 4400

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10.4 Travel gear

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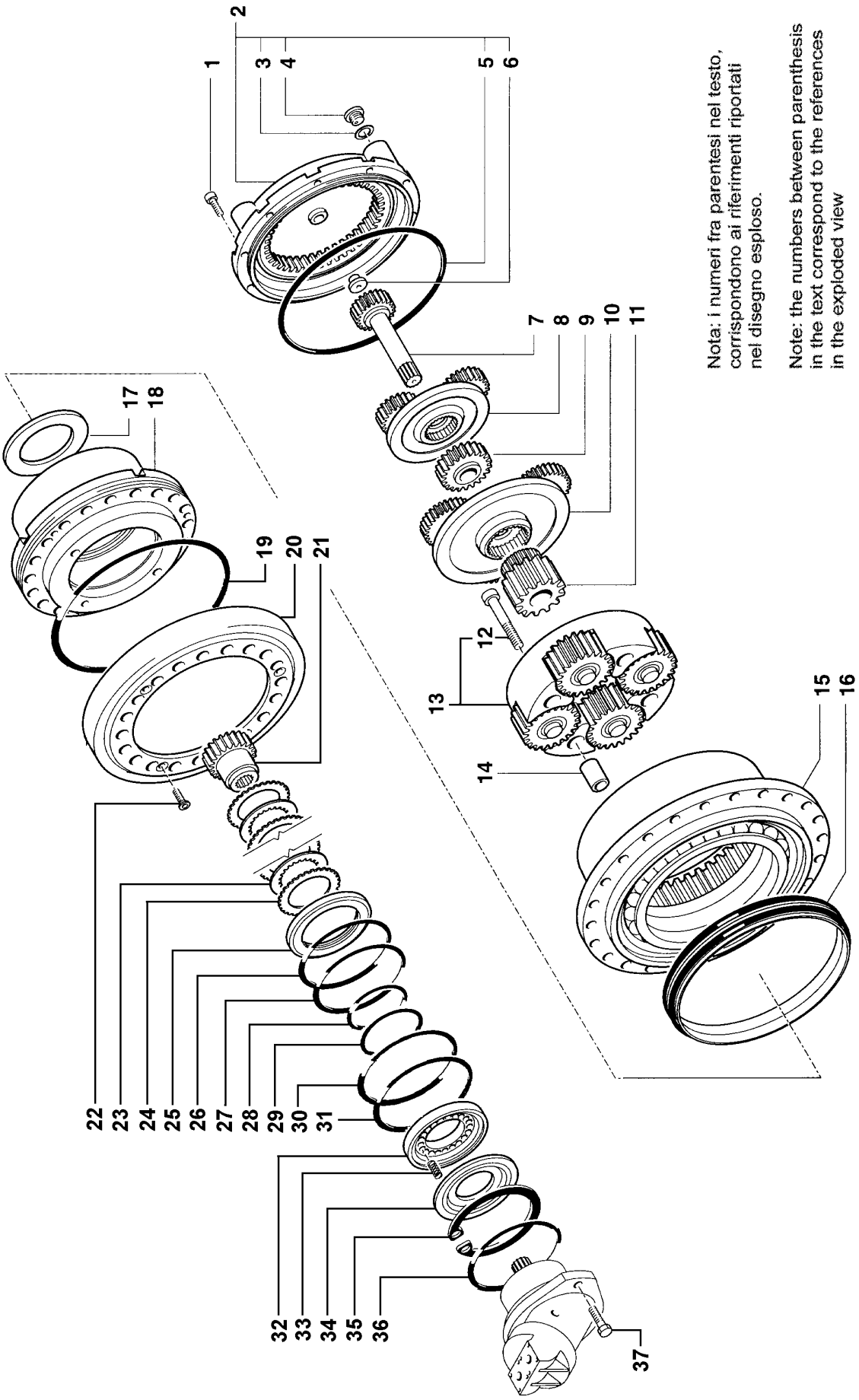
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Disegno esploso riduttore - Gearbox exploded view

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1.0 INFORMAZIONI GENERALI

1.1 SCOPO DEL MANUALE

Questo manuale è stato realizzato dal costruttore per fornire le informazioni necessarie a coloro che sono autorizzati ad interagire con il prodotto: dai progettisti, agli installatori, manutentori e riparatori.

Oltre ad adottare le regole della buona tecnica di costruzione, le informazioni devono essere lette attentamente ed applicate in modo rigoroso.

La non osservanza di dette informazioni può essere causa di rischi per la salute e la sicurezza delle persone e danni economici.

Anche se le descrizioni non corrispondono esattamente al prodotto in Vs possesso, ciò non pregiudica la loro validità.

1.2 INFORMAZIONI SULLA SICUREZZA

Leggere attentamente le istruzioni riportate in questo manuale e eventualmente quelle applicate direttamente sul prodotto, in particolare rispettare quelle riguardanti la sicurezza.

Il personale che effettua qualsiasi tipo di intervento in tutto l'arco di vita del prodotto, deve possedere precise competenze tecniche, particolari capacità ed esperienze acquisite e riconosciute nel settore specifico. La mancanza di questi requisiti può causare danni alla si-curezza e alla salute delle persone.

Eseguire la movimentazione del prodotto rispettando le informazioni riportate in questo manuale oppure applicate direttamente sull'imballo (se presenti).

Utilizzare il prodotto solo per gli usi previsti dal fabbricante. L'impiego del prodotto per usi impropri può recare rischi per la sicurezza e la salute delle persone e danni economici, nonchè il decadere della garanzia da parte del costruttore.

Mantenere il prodotto in condizioni di massima effi-cienza effettuando le operazioni di manutenzione pro-grammata previste dal costruttore. Una buona manutenzione consentirà di ottenere le migliori presta-zioni, una più lunga durata di esercizio e un manteni-mento costante dei requisiti di sicurezza.

Per eseguire interventi di manutenzione in zone non facilmente accessibili o pericolose, predisporre ade-guate condizioni di sicurezza per sé stessi e per gli altri rispondenti alle leggi vigenti in materia di sicurezza sul lavoro.

Sostituire i particolari usurati utilizzando i ricambi originali. Usare gli oli e i grassi consigliati dal costruttore. Tutto questo potrà assicurare la funzionalità del pro-dotto ed un livello di "sicurezza accettabile".

1.0 GENERAL INFORMATION

1.1 MANUAL AIM

This manual has been devised by the manufacturer to give necessary information to those authorised to work on this product for example the design engineers, in-stallers, repair and maintenance technicians.

Besides helping one understand the rules of good manufacturing techniques used, the information given must be read attentively and strictly put into action.

Failure to observe this information may lead to health and safety risks to persons as well as economic loss.

Even though the descriptions may not correspond ex-actly to the product in possession, this does not have any bearing on their validity.

1.2 INFORMATION ON SAFETY

Carefully read the instructions given in this instruction manual as well as the ones attached to the product and make sure to follow the information concerning safety.

Personnel, which perform any type of work on the product during its life span, must possess precise tech-nical qualifications as well as recognised skills and ex-perience gained in the specific sector. Failure to do so may lead to health and safety risks to persons.

It is recommended that when handling the product attention is paid to the information given in this manual or simply follow the instructions given on the packaging (if present).

Utilise the product only for the use specified by the manufacturer. Improper use of the product could lead to health and safety risks to persons as well as economic loss and furthermore will invalidate the guarantee given by the manufacturer.

Keep the product in perfect working order by following the scheduled maintenance procedure set out by the manufacturer. Good maintenance will ensure the best performances, a longer period of operation and a con-stant safeguard towards security requirements.

To undertake maintenance procedures in areas which are hard to reach or otherwise dangerous it is important to follow adequate safety conditions for one self and for others in compliance with the rules and regulations that govern safety in the workplace.

When replacing worn parts, use original spare parts. Use oils and greases recommended by the manufac-turer. Doing this, will ensure that the product works properly and that the safety level is "acceptable".

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2.0 TARGHETTA IDENTIFICATIVA

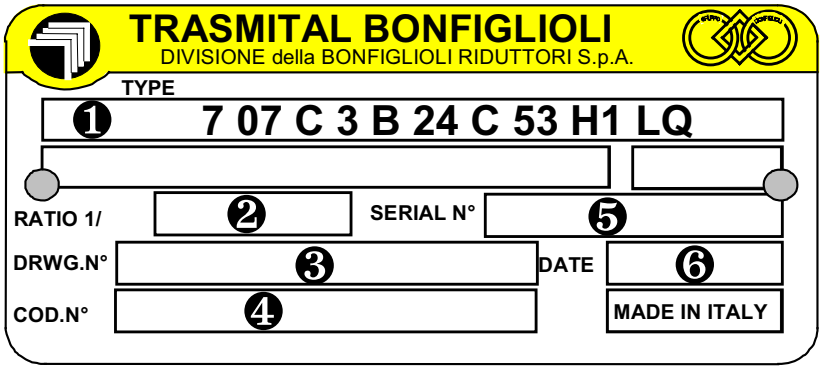
I dati per l'identificazione del prodotto sono riportati in una targhetta applicata su di esso.

Nel caso di un motoriduttore vi sono due targhette; una riporta i dati del riduttore, l'altra quelli del motore idraulico. L'illustrazione evidenzia la disposizione dei dati.

2.0 *NAME PLATE*

The data to identify the product are shown on the identification plate attached to it.

The gearmotor has two plates, one gives data on the gearbox and the other data on the hydraulic motor. The following illustration shows how the data is set out.



Ref.	Dati / Data	Descrizione / Description	Note / Notes
❶	**TYPE**	Designazione riduttore / Gearbox Designation	**7 07 C 3 B 24 C 53 H1 LQ**
❷	**RATIO 1:**	Rapporto di riduzione / Reduction ratio	**1:53**
❸	**DRWG.N°**	Disegno di installazione / Installation drawing	**5.613.108.2**
❹	**COD.N°**	Codice Prodotto / Product code	**2T261300732**
❺	**SERIAL N°**	N° di serie prodotto / Product serial number	
❻	**DATE**	Data di costruzione / Manufacturing date	

Attenzione **La targhetta deve essere sempre conservata leggibile in tutti gli elementi in essa contenuti**. Usare i dati identificativi (almeno il numero di serie) per i rapporti con il costruttore, come per esempio: richiesta di ricambi, informazioni, assistenza.
La completa e costante osservanza delle indicazioni contenute nel presente manuale tecnico garantisce la migliore economia di esercizio ed una piu' lunga durata di funzionamento del riduttore.
La documentazione fotografica ed i disegni sono forniti a scopo esplicativo, in modo da descrivere esaurientemente le operazioni da eseguire sul riduttore. Anche se il riduttore in vostro possesso si discostasse in parte dalle illustrazioni contenute in questo manuale tecnico, le caratteristiche e la sequenza delle operazioni descritte sono sempre garantite.

Warning ***The informations stamped on the name plate must always be readable.*** *Use the identification data (at least serial number) for spare part enquiries, information and service, etc.*
A strict and consistent compliance with the specifications of this technical manual ensure the minimum operating costs and a longer unit life.
Photographic documentation and drawings are supplied for educational purposes, so as to safely and properly carry out maintenance operations.
Minor deviations from pictures of this manual may appear on the actual gearbox. However, these discrepancies are not relevant to the main parameters, or maintenance functions.

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3.0 NOTE

3.1 CONDIZIONI DI FORNITURA

I riduttori vengono forniti dalla **TRASMITAL BONFIGLIOLI** nelle seguenti condizioni standard:

- Già predisposti per essere installati nella posizione di montaggio come definito in fase di ordine:
- Le parti interne, per garantirne l'integrità, sono preventivamente lubrificate con un velo d'olio usato per il collaudo finale del riduttore e compatibile con gli olii raccomandati (Tab.1). **Non viene eseguito il riempimento dell'olio lubrificante (come segnalato da cartellino).**
- Verniciati con una vernice di fondo antiossidante all'acqua di colore grigio, sopra verniciabile. Le superfici di accoppiamento non sono verniciate. La verniciatura finale è a cura del cliente.
- Collaudati.
- Appositamente imballati.

Informazioni **Al ricevimento del prodotto, accertarsi che corrisponda alle specifiche di acquisto e che non presenti danni o anomalie. Per qualsiasi inconveniente rivolgersi direttamente alla rete di vendita del costruttore.**

3.2 TRASPORTO

Durante il trasporto è norma trattare i riduttori come merce delicata per evitare danni.
Durante i trasporti interni dei riduttori senza imballo, evitare che questi prendano urti per non danneggiare le parti delicate.

3.3 STOCCAGGIO

Per il corretto stoccaggio del prodotto, osservare le seguenti raccomandazioni:

- Escludere aree all'aperto, zone esposte alle intemperie o con eccessiva umidità.
- Interporre sempre tra il pavimento ed i prodotti, pianali lignei o di altra natura, atti ad impedire il diretto contatto col suolo.
- Per periodi di stoccaggio superiori ai 60 giorni, le superfici interessate agli accoppiamenti quali flange, alberi e giunti, devono essere protette con idoneo prodotto antiossidante **(SHELL ENSIS FLUID SDC od equivalente)**.

Per periodi di stoccaggio previsti superiori ai 6 mesi, i prodotti devono essere oggetto delle seguenti attività:

- Ricoprire le parti lavorate esterne e quelle di accoppiamento con grasso atto ad evitare ossidazioni.
- Posizionare i riduttori con il tappo di sfiato nella posizione più alta e riempirli di olio.

I riduttori, prima del loro utilizzo, dovranno essere riempiti con la corretta quantità e tipo di lubrificante previsto.

3.0 NOTES

3.1 DELIVERY CONDITIONS

*Gearboxes are supplied by **TRASMITAL BONFIGLIOLI** at the following standard conditions:*

- *Ready for installation in the mounting position specified when ordering.*
- *To guarantee their reliability, the internal parts are properly lubricated with a layer of oil, the same as the one used in the final test of the gearbox and compatible with the recommended oils (section 5.1). **Lubricating oil has not been added (as shown on the card).***
- *Externally painted with an antioxidant grey-coloured water paint suitable for finish painting. Machined surfaces are not painted. Finish coat to be applied by the customer.*
- *100% factory tested.*
- *Suitably packed.*

Information ***When the product arrives, ensure that it meets the information contained in the purchase agreement and that there are no damages or irregularities. If there are any problems contact the manufacturers' sales network directly.***

3.2 TRANSPORT

We recommend that the box containing gearboxes is handled carefully in order to avoid damages during transport. When removing gearboxes from their packaging, extra caution should be taken to avoid impacts, which may damage sensitive parts.

3.3 STORAGE

Observe the following instructions to ensure correct storage of delivered products:

- *Do not store outdoors, in areas exposed to weather or with excessive humidity.*
- *Always place boards of wood or other material between floor and products, to avoid direct contact with the floor.*
- *For storage periods of over 60 days, all machined surfaces such as flanges, shafts and couplings must be protected with a suitable anti-oxidation product **(SHELL ENSIS FLUID SDC or equivalent product)**.*

The following measures must be taken for products which expected storage period exceeds 6 months:

- *Cover outer machined parts and mating parts with grease to avoid oxidation.*
- *Position the gearboxes with the breather plug up and fill them with oil.*

Before use, the gearboxes should be filled with the proper amount of lubricant of the recommended type.

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3.4 SOLLEVAMENTO E MOVIMENTAZIONE

Se la movimentazione avviene quando il prodotto è imballato, è sufficiente attenersi alle indicazioni applicate direttamente sull'imballo e/o comunque utilizzando i normali mezzi di sollevamento.

Attenzione **Considerando che la massa e la forma del prodotto non ne consentono lo spostamento a mano, in particolari movimentazioni (es: installazione), è necessario utilizzare accessori che consentono di garantire la sicurezza delle persone ed evitare danni al prodotto.**

Informazioni **Non togliere in nessun caso il coperchio in plastica delle porte di alimentazione del motore idraulico, in modo da evitare l'introduzione accidentale di corpi estranei, sino al momento del collegamento dei tubi flessibili.**

3.4 LIFTING AND HANDLING

If the handling occurs when the product is still packaged, simply follow the instructions given on the packaging and/or use normal hoisting means.

Warning ***Considering that the size and form of the product do not allow manual shifting, in particular handlings, (e.g. installation) it is necessary to use accessories that guarantee human safety and which also avoid damages to the product.***

Information ***Under no circumstance remove the plastic lid from the power supply ports of the hydraulic motor; this will help avoid the accidental introduction of foreign bodies into the motor, until the hoses are assembled.***

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4.0 INSTALLAZIONE

4.1 INSTALLAZIONE DEL MOTORE IDRAULICO

Assicurarsi che le superfici di accoppiamento ed il centraggio dove va inserito il motore idraulico siano pulite ed esenti da bave.

Informazioni **Prima di montare il motore idraulico, verificare, con un calibro per interni, il corretto assemblaggio del riduttore controllando la quota assiale indicata nello schema in basso:**

Quota assiale = 93,2-94,0 mm.

Montare la guarnizione O-ring (36), fornita con il riduttore, nella propria sede nel motore idraulico ed assemblare quest'ultimo al riduttore facendo attenzione a non danneggiare la guarnizione precedentemente montata.
Serrare le n°2 viti TE M16x40, classe di resistenza 8.8 (37), con una chiave dinamometrica alla coppia di 215 Nm.

4.2 INSTALLAZIONE DEL RIDUTTORE SULLA MACCHINA

a) Pulire le zone di accoppiamento da protettivi o vernice ed installare il riduttore sul sottocarro.

b) Fissare il riduttore al telaio con n°20 viti M20 classe minima di resistenza 8.8, serrate con una chiave dinamometrica alla coppia di 415 Nm.

c) Pulire la zona di accoppiamento alla ruota motrice. Per il fissaggio della ruota usare n°20 viti M16 classe di resistenza 8.8, serrate con una chiave dinamometrica alla coppia di 215 Nm.

4.0 INSTALLATION

4.1 HYDRAULIC MOTOR INSTALLATION.

The mating areas and the pilot diameter of the gearbox where the motor is to be mounted must be clean and without burrs.

Informazioni ***Before assembling the hydraulic motor, verify by a depth slide gauge the correct assembly of the unit checking the axial distance as shown in the scheme below:***

Axial dimension = 93,2-94,0 mm.

Fit the O-ring (36), supplied with the gearbox, in its seat in the hydraulic motor, and assemble it to the gearbox being careful not to damage the seal already fitted.

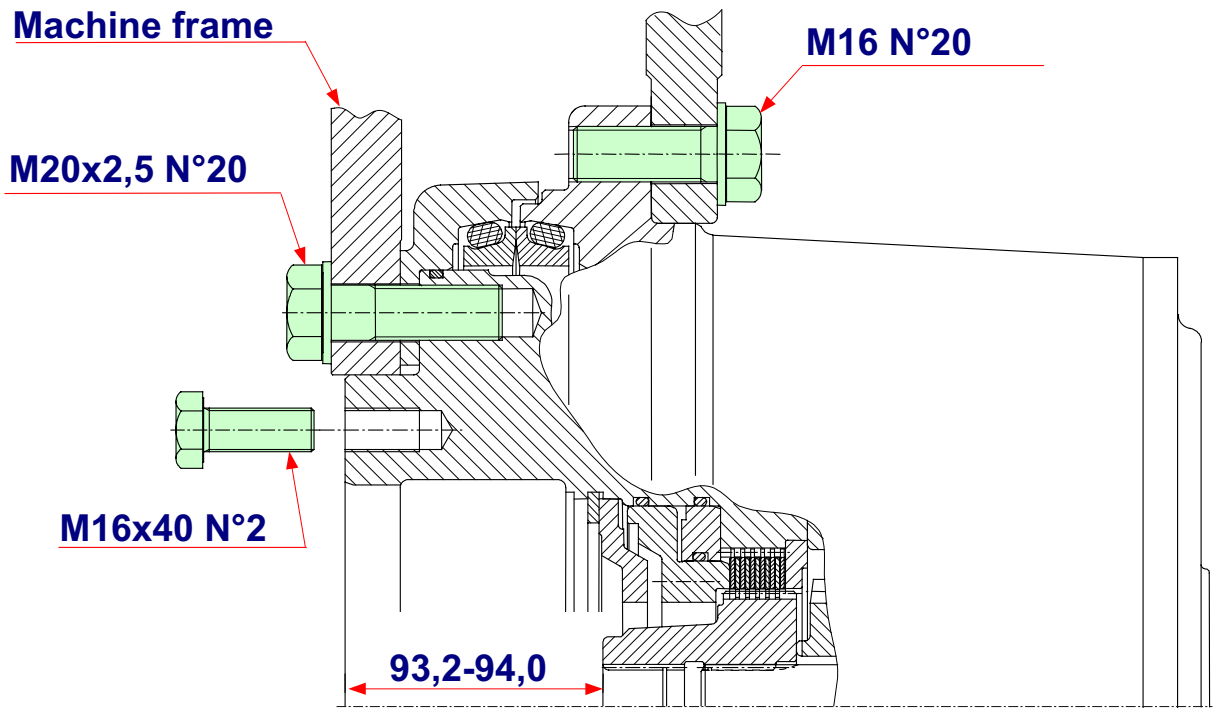
Tighten the nos.2 hexagonal head screws M16x40, grade 8.8 (37), by a torque wrench at 215 Nm torque.

4.2 INSTALLATION OF THE GEARBOX TO THE MACHINE

a) Clean the mating surfaces from oils or paint and fit the gearbox to the undercarriage.

b) Fix the gearbox to the frame with nos.20 screws M20 minimum grade 8.8, tightened by a torque wrench at 415 Nm torque.

c) Clean the area which mates to the driven wheel. To fit the sprocket use nos.20 screws M16, grade 8.8, tightened by a torque wrench at 215 Nm torque.



Schema di installazione – Installation scheme

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4.3 COLLEGAMENTO DEL FRENO

Il riduttore e' provvisto di un freno negativo a dischi multipli di sicurezza a comando idraulico (freno di stazionamento).
Per l'apertura del freno collegare il tubo di comando al foro filettato situato sul mozzo flangiato (filettatura 1/4"G - BSP 19 filetti per pollice)

4.3 CONNECTION OF THE BRAKE PIPE

The gearbox is supplied with a safety negative multidisc brake hydraulically driven (parking brake).

For brake releasing, connect the oil pipe to the threaded hole placed on the flanged hub (1/4"G - BSP thread, 19 T.P.I).

DATI TECNICI FRENO / *BRAKE TECHNICAL DATA*		
N° dischi acciaio / *Nos. of steel discs*	*[qty.]*	**5**
N° dischi sinterizzati / *Nos. of sintered discs*	*[qty.]*	**6**
N° molle / Nos. *of springs*	*[qty.]*	**18**
Pressione minima di completa apertura / *minimum brake release pressure*	*(bar)*	**14±10%**
Pressione massima di comando freno / *Maximum operating pressure brake*	*(bar)*	**50**
Coppia frenante / *Braking torque*	*(Nm)*	**400±10%**

5.0 LUBRIFICAZIONE

5.1 LUBRIFICAZIONE RIDUTTORE

La lubrificazione è separata fra motore e riduttore.
La lubrificazione del riduttore e' a sbattimento in bagno d'olio.

L'olio consigliato e' del tipo per trasmissioni ad ingranaggi, con viscosita' **SAE 80W/90 oppure SAE 85W/140** con caratteristiche **EP** rispondente a: **MIL-L-2105 C & API GL 5**, secondo le indicazioni di Tab.1

Informazioni **Durante l'esercizio e solo per brevi momenti l'olio può raggiungere, ma non superare, la temperatura di 85-90°C intermittente.**

5.0 LUBRICATION

5.1 GEARBOX LUBRICATION

The motor and the gearbox have separate lubrication. The gearbox is lubricated by oil splashing.

*The recommended type of oil is **SAE 80W/90 or SAE 85W/140** with **EP** features complying with **MIL-L-2105 C & API GL5**, according to Tab.1*

Information** **During operation the oil temperature must not exceed 85-90°C intermittent.

Elenco olii consigliati a Norme SAE 80W/90 e SAE 85W/140 con caratteristiche API GL5 Lubricant oils suggested according SAE 80W/90 and SAE 85W/140 API GL5 grade			
Temperatura ambiente Ambient temperature Viscosità olio / Oil viscosity		**-10°C / +30°C SAE 80W/90**	**+20°C / +45°C SAE 85W/140**
Produttori / Manufacturers		**Tipo olio / Oil Brand**	
	SHELL	**SPIRAX HD**	**SPIRAX HD**
	AGIP	ROTRA MP	ROTRA MP
	ARAL	GETRIEBEOL HYP	GETRIEBEOL HYP
	BP-MACH	HYPOGEAR EP	HYPOGEAR EP
	CASTROL	HYPOY	HYPOY
	CHEVRON	UNIVERSAL GEAR LUBRICANTE	UNIVERSAL GEAR LUBRICANTE
	ELF	TRANSELF B	TRANSELF B
	ESSO	GEAR OIL GX PONTONIC MP	GEAR OIL GX PONTONIC MP
	I.P.	PONTIAX HD	PONTIAX HD
	MOBIL	MOBILUBE HD	MOBILUBE HD
	TOTAL	TRASMISSION TM	TRASMISSION TM

Tab.1 Elenco olii consigliati / Lubricant oils suggested

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5.2 RIEMPIMENTO OLIO

Attenzione **Il riduttore viene fornito privo di olio ma predisposto con tappi di carico, scarico e livello. Prima della messa in funzione occorre fare il riempimento.**

1. Con l'asse del riduttore in orizzontale, ruotare il corpo riduttore fino a che il tappo (2) si trovi sull'asse orizzontale del coperchio.
2. Svitare i tappi (1-2)
3. Riempire dal foro superiore (1) fino a che l'olio lubrificante (caratteristiche indicate in Tab.1) non fuoriesca dal foro (2).
4. Avvitare i tappi (1-2) e mettere in funzione il riduttore; attendere qualche istante, poi verificare nuovamente il livello dell'olio.
5. Aggiungere olio lubrificante se necessario.

Quantita' olio indicativa = 2,5 litri ±10%.

5.2 OIL FILLING

Warning ***The gearbox is supplied without oil; anyway it has filling, draining and oil level plugs. Before putting the gearbox into operation, it is necessary to fill it with oil.***

1. *Check that the gearbox axis is horizontal. Rotate the gearbox housing until the plug (2) is on the horizontal axis of the cover.*
2. *Unscrew the two plugs (1-2).*
3. *Fill from the upper hole (1) until the lubricant oil (characteristics given in Tab.1) flows out from the hole (2).*
4. *Tighten the filling oil plug (1-2) and let the gearbox run. After a few minutes, stop and check the oil level.*
5. *If necessary, refill with lubricant oil.*

Approximate oil capacity = 2,5 liters ±10%.

5.3 SCARICO E SOSTITUZIONE OLIO

1. Con l'asse del riduttore in orizzontale, ruotare il corpo riduttore fino a che il tappo (2) si trovi in basso sull'asse verticale del coperchio.
2. Svitare i tappi (1-2) e fare defluire l'olio; per agevolare l'operazione di scarico e' bene operare con olio caldo.
3. Effettuare il riempimento dell'olio seguendo le modalità predefinite (vedi paragrafo 5.2).

Attenzione **Si raccomanda di non miscelare olii a base minerale con olii a base sintetica e viceversa.**

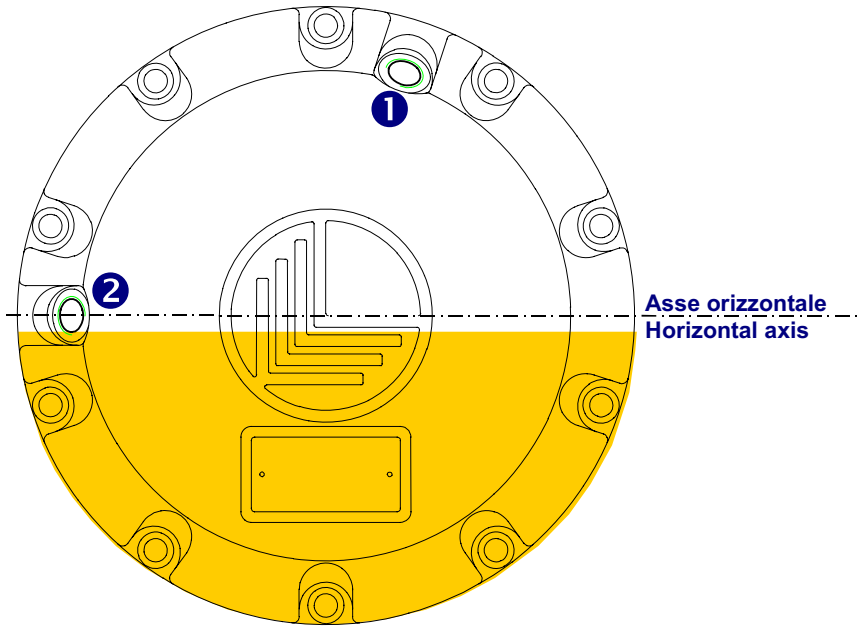
Attenzione **Non disperdere l' olio nell' ambiente ma smaltirlo rispettando le leggi vigenti in materia.**

5.3 OIL DRAINING AND REPLACEMENT

1. *Check that the gearbox axis is horizontal. Rotate the gearbox housing until the plug (2) is on the bottom of the vertical axis of the cover.*
2. *Unscrew the plugs (1-2) and let the oil flow; in order to facilitate the draining must be oil still warm.*
3. *Proceed with the oil fill-up following the procedures given (see Section 5.2).*

Warning ***Never mix mineral oils with synthetic oils and vice versa.***

Warning ***Do not dispose of the oil in the natural environment but be careful to eliminate it in compliance with the relative rules and regulations that govern locally.***



Schema di carico, scarico e livello olio - Filling, draining and oil level scheme

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6.0 MESSA IN ESERCIZIO

In questa prima fase, si raccomanda di adottare alcune precauzioni come di seguito indicato:

1. Avviare il motoriduttore dopo aver riempito il corpo del motore con olio idraulico fino al foro di drenaggio. Eliminare eventuale aria residua dal circuito idraulico e aggiungere olio se necessario.

Informazioni **La presenza di aria residua nel circuito idraulico si manifesta con la presenza di schiuma nel serbatoio e causa un funzionamento a strappi del motore ed un eccessiva rumorosità del motore e delle valvole.**

2. Avviare il motoriduttore a bassa velocità ed incrementare gradualmente, dopo avere verificato che il funzionamento sia corretto, in assenza di rumore e vibrazioni.

Informazioni **Non arrivare alla massima pressione sino a quando tutto l'impianto non sia stato filtrato per l'eliminazione di eventuali particelle di impurità.**

Durante il rodaggio eseguire le operazioni di seguito indicate:

3. Controllare che il numero dei giri ed il senso di rotazione siano corretti.
4. Controllare che il funzionamento sia regolare ed in assenza di rumore eccessivo e vibrazioni.
5. Controllare che la temperatura dell'olio non superi i 90°.
6. Controllare che non vi siano altri problemi.

Al termine di questo primo rodaggio eseguire le operazioni di seguito indicate.

6. Controllare che non vi siano perdite olio. In caso contrario provvedere alla loro eliminazione
7. Controllare il livello dell'olio lubrificante del motoriduttore
8. Durante il primo avviamento, causa l'eventuale presenza di aria, l'apertura del freno potrebbe risultare ritardata. Ripetere alcune volte il comando di apertura e chiusura del freno.
9. Controllare che non vi siano altri problemi.

6.0 *START UP*

In this first stage it is advised to follow the measures Given below.

1. *Start the gearmotor after having filled the motor housing with hydraulic oil up to drain hole. Add more oil if necessary, after having eliminated any residual air that may have been in the hydraulic circuit.*

Information ***The presence of residual air in the hydraulic circuit will manifest itself with the presence of foam in the tank and will lead to a jerking of the motor as well as excessive noise coming from the motor and the valves.***

2. *Start the gearmotor at a low speed and gradually increase it after having verified that it is functioning correctly without any noises or vibrations.*

Information ***Do not reach maximum pressure unless the entire system has been filtered to eliminate any particles of dirt that may be present.***

During the running-in stage follow the steps given below.

3. *Check the correct revolution and direction of rotation.*
4. *Make sure that the functioning is regular and without any excessive noises and vibrations.*
5. *Make sure that the oil temperature does not exceed 90°.*
6. *Make sure there are no other problems in general.*

After having terminated this first running-in follow the steps given below.

6. *Check that there are no oil leakages. If present, proceed to remove them.*
7. *Check the level of lubricating oil in the gearmotor*
8. *It could happen that due to the presence of air, during the first start up, the opening action of the brake could be slowed down. It is advised to repeat the opening and closing function of the brake.*
9. *Check that there are no other problems in general.*

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7.0 MANUTENZIONE

In caso di normale funzionamento il motoriduttore non necessita di alcuna manutenzione ad eccezione del controllo e cambio olio. Sono necessari interventi di assistenza solo in seguito ad anomalie di funzionamento.

Eseguire i controlli ed attività secondo la tabella seguente:

7.0 *MAINTENANCE*

Under normal operating circumstances, no routine maintenance is required, except routine oil checks and oil changes. As recommended in this manual, unusual operating characteristics, such as noise or overheat, should indicate further investigation.

For a proper maintenance of the gearbox, the following checks and operations have to be done.

Controllo / *Inspection*	**Frequenza / *Frequency***	**Azione / *Action***
Serraggio viti *Tightening screws*	Dopo le prime 50 ore di lavoro del riduttore *After the first 50 operating hours of the gearbox*	Verificare serraggio viti *Screws tightening torque check*
Livello olio *Oil level*	Ogni 100 ore di lavoro del riduttore *Every 100 operating hours of the gearbox*	Aggiungere olio *Refill oil*
Primo cambio olio *1st oil change*	A 150 ore di lavoro del riduttore *At 150 operating hours of the gearbox*	Sostituire olio *Oil replacement*
Cambi olio successivi *Next oil change*	Ogni 1000 ore di lavoro del riduttore o 1 volta l'anno *Every 1000 operating hours or at least one a year*	Sostituire olio *Oil replacement*

Informazioni **In caso di manutenzioni importanti e complesse, fare riferimento ai Disegni Esplosi e Liste Ricambi fornibili su richiesta ed alle prescrizioni contenute nel presente manuale tecnico.**

Se sono necessarie istruzioni supplementari o se dovessero nascere problemi particolari, non esitate a contattare il distributore o direttamente il nostro servizio tecnico.

Information ***In case of important and complex maintenance operations, make reference to The Spare Part Lists Exploded View which can be supplied under request or the suggestions of this manual.***

Do not hesitate to contatct the gearbox distributor or manufacturer if further instructions are necessary or in case of particular problems.

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8.0 SMONTAGGIO

Per le prime verifiche degli ingranaggi, del freno e del motore idraulico, è possibile intervenire senza smontare la ruota e il riduttore dalla macchina.

Per dare inizio alla fase di smontaggio, fare defluire completamente l'olio lubrificante dal riduttore secondo quanto descritto al paragrafo 5.3. Svitare e sfilare le 2 viti TE M16x40 (37), classe di resistenza 8.8 e togliere il motore idraulico e la guarnizione O-ring (36).

8.0 DISASSEMBLY

Initial inspection of the gears, of the brake and of the hydraulic motor, can be made without disassembling the wheel and the gearbox from the machine.

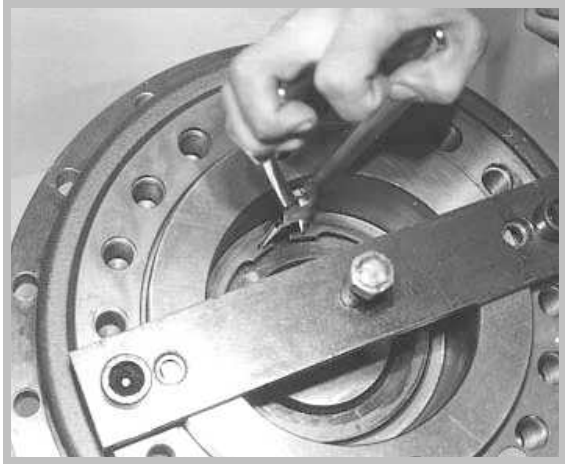
Before wheel drive disassembling, make sure that the oil is discharged according to instructions specified in section 5.3. Unscrew and remove the 2 hexagonal head screws M16x40 (37), grade 8.8, and remove the hydraulic motor and the O-ring seal (36).



1.

Montare l'attrezzatura **(AT709C.03)** sul mozzo (18) ed agire sulla vite fino a contrastare la forza delle molle (33).

*Install the equipment **(AT709C.03)** on the flanged hub (18) and turn the screw until it contrasts the force of the spring (33).*



2.

Con l'ausilio di pinze sfilare l'anello elastico (35) e smontare l'attrezzatura.

Using pliers remove the circlip (35) and take away the equipment.



3.

Sfilare il disco spingimolle (34).

Remove springs retainer (34).

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8.0 SMONTAGGIO

8.0 DISASSEMBLY



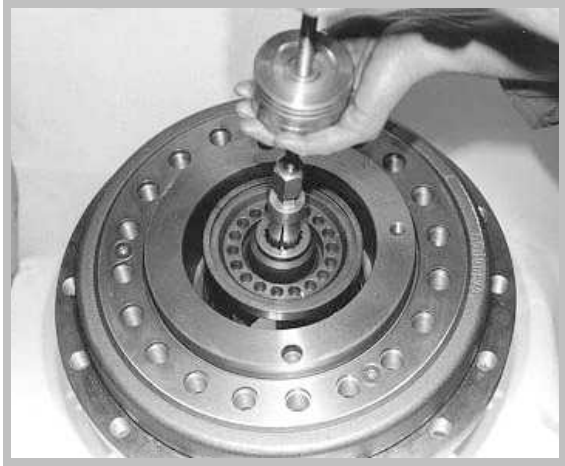
4.

Sfilare le molle (33) dalle proprie sedi nel pistone freno (32).

Informazioni Contrassegnare la posizione delle molle allo scopo di avere un riferimento per il rimontaggio.

Remove the springs (33) from their seats in the brake piston (32).

Information *Mark the position of the springs as a reference for the reassembling step.*



5.

Inserire un estrattore per interni nel foro dell'albero freno (21), espandere l'estremità inferiore dell'estrattore nello scarico interno dell'albero freno e sfilare contemporaneamente quest'ultimo e il pistone freno (32).

Insert an inside puller into the hole of the brake shaft (21), expand the lower end of the puller into the internal release of the brake shaft and remove contemporary it and the brake piston (32).



6.

Sfilare il distanziale (25).

Remove the spacer (25).



7.

Togliere le guarnizioni O-ring (27-28) e gli anelli antiestrusione (26-29) dalle proprie sedi nel distanziale (25).

Remove the O-Ring seals (27-28) and the backup rings (26-29) from their seat in the spacer (25).

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8.0 SMONTAGGIO

8.0 DISASSEMBLY



8.

Sfilare il pacco dei dischi freno (23-24).

Remove brake discs pack (23-24).



9.

Togliere la guarnizione O-ring (30) e l'anello antiestrusione (31) dalle proprie sedi situate nel mozzo flangiato (18).

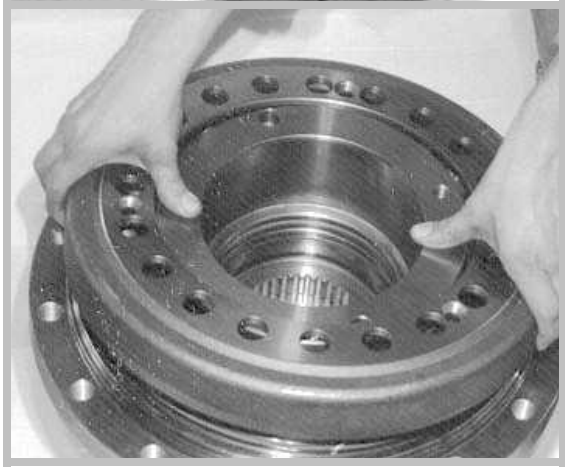
Remove the O-ring seal (30) and the backup ring (31) from their seats in the flanged hub (18).



10.

Svitare le n°3 viti TSPEI M10x25 (22), classe di resistenza 10.9, che fissano l'anello ritegno (20) al mozzo flangiato (18).

Unscrew the nos.3 flathead screws M10x25 (22) grade 10.9, which fix the cover (20) to the flanged hub (18).



11.

Sfilare l'anello ritegno (20).

Remove the cover (20).

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8.0 SMONTAGGIO

8.0 DISASSEMBLY



12.

Togliere la guarnizione O-ring (19) dalla propria sede nel mozzo flangiato (18).

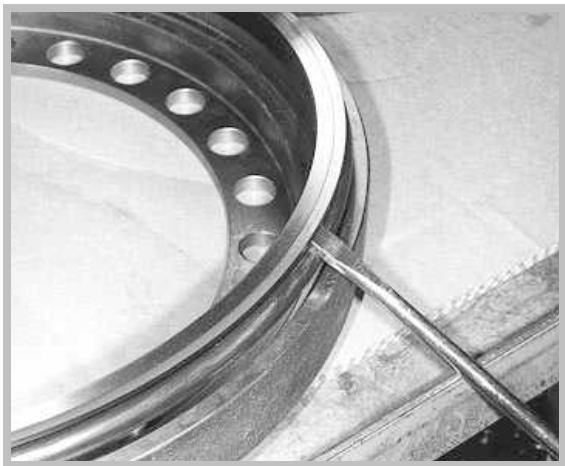
Remove the O-ring seal (19) from its seat in flanged hub (18).

8.1 CONTROLLO TENUTA FRONTALE

Informazioni Puo' essere necessario in caso di perdite olio, dover provvedere al controllo ed alla eventuale sostituzione della tenuta frontale (16), cioe' di entrambi gli anelli metallici e delle guarnizioni O-rings.

8.1 LIFETIME SEAL CHECK

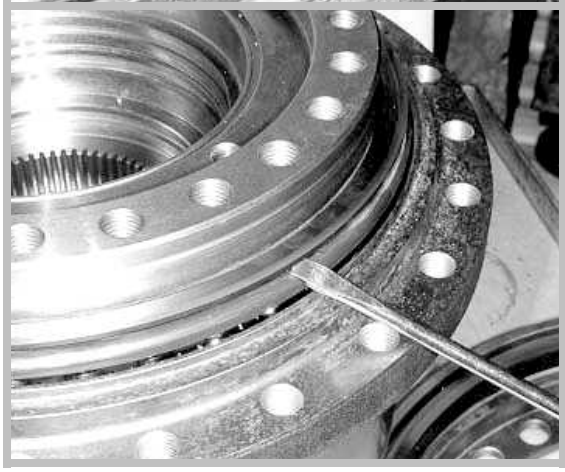
Information *In case of oil leakages, it might be necessary to check and eventually replace the lifetime seal (16), which means both the steel rings and the O-rings.*



13.

Con l'aiuto di un cacciavite smontare la 1°semitenuta frontale (16) dall'anello di ritegno (20).

Use a screwdriver to remove the 1st half-seal (16) from the cover (20).



14.

Con l'aiuto di un cacciavite smontare la 2°semitenuta frontale (16) dal mozzo flangiato (18).

Use a screwdriver to remove the 2nd half-seal (16) from the flanged hub (18).

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8.0 SMONTAGGIO

8.0 *DISASSEMBLY*



15.

Capovolgere il riduttore e svitare le n°10 viti TCEI M10x25 (1), classe di resistenza 12.9, che fissano il coperchio di chiusura (2) al corpo riduttore (15) con chiave esagonale maschio.

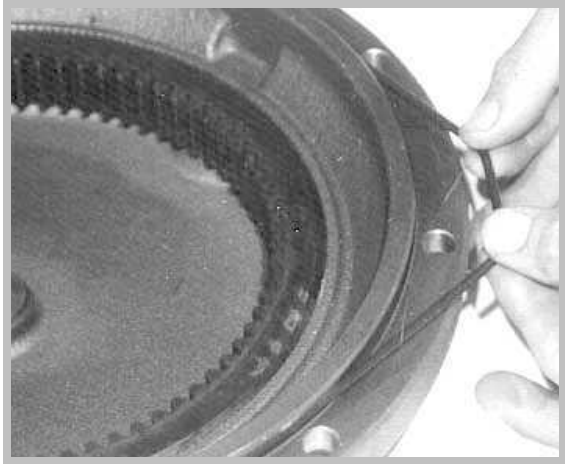
Turn the gearbox upside down and unscrew the nos.10 socket head screws M10x25 (1) grade 12.9, which fix the end cover (2) to the gearbox housing (15) by using a male hex head wrench.



16.

Sfilare il coperchio di chiusura (2) con l'ausilio di n°2 viti M18x1,5 avvitate nei fori dei tappi olio.

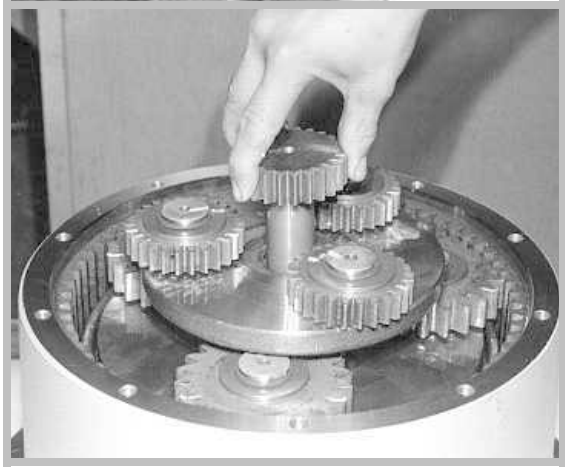
Remove the end cover (2) by using nos.2 screw M18x1,5 screwed to the oil plugs holes.



17.

Togliere la guarnizione O-ring (5) dal coperchio di chiusura (2).

Remove the O-ring seal (5) from the end cover (2).



18.

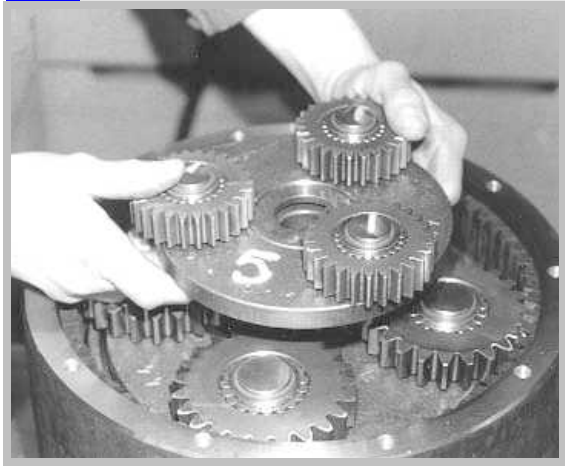
Sfilare il solare di 1°riduzione (7).

Take out 1st stage sun gear (7).

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8.0 SMONTAGGIO

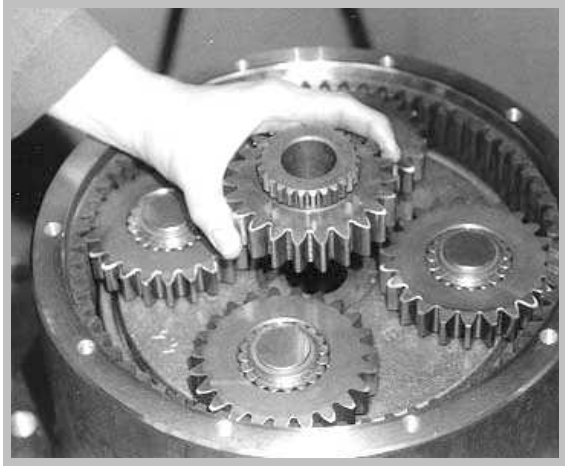
8.0 *DISASSEMBLY*



19.

Estrarre la 1°riduzione (8).

Remove the 1st reduction assembly (8).



20.

Sfilare il solare di 2°riduzione (9).

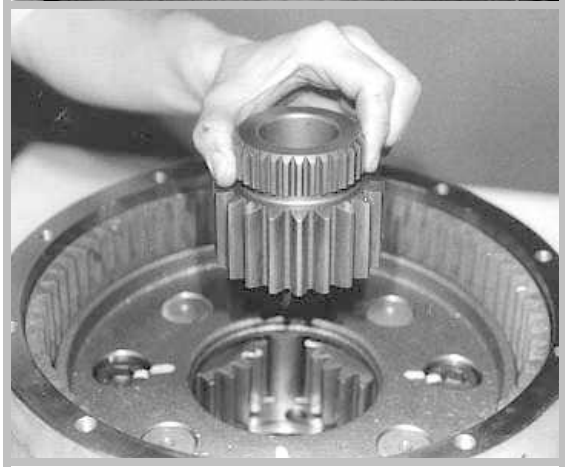
Remove the 2nd stage sun gear (9).



21.

Estrarre la 2°riduzione (10).

Remove the 2nd reduction assembly (10).



22.

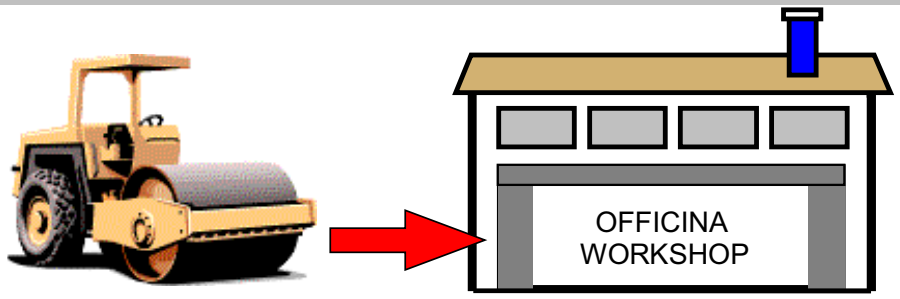
Sfilare il solare di 3°riduzione (11).

Remove the 3rd stage sun gear (11).

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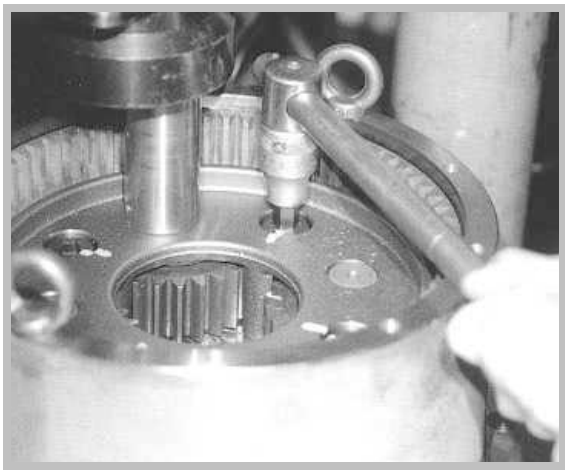
8.0 SMONTAGGIO

8.0 *DISASSEMBLY*



Informazioni **Per proseguire nello smontaggio del riduttore, occorre a questo punto smontarlo dalla macchina e recarsi in una officina opportunamente attrezzata.**

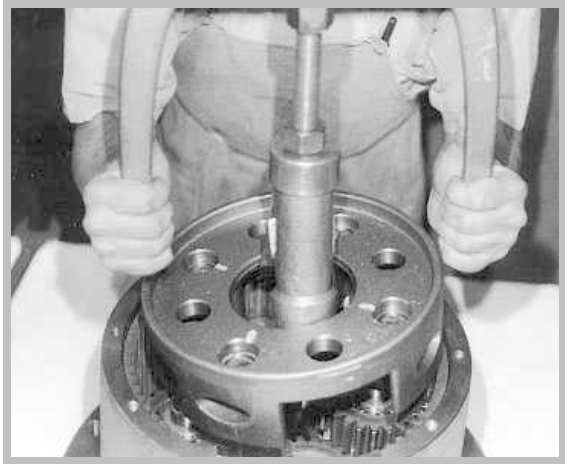
Information ***In order to proceed with the gearbox disassembly, it is now necessary to remove it from the machine and bring it to a properly equipped workshop.***



23.

Svitare le n°4 viti TCEI M16x100 (12), classe di resistenza 10.9, che fissano la 3°riduzione (13) al mozzo flangiato (18) con chiave esagonale maschio.

Unscrew the nos.4 socket head screws M16x100 (12), grade 10.9, which fix the 3rd reduction assembly (13) to the flanged hub (18), by using a male hex head wrench.



24.

Servendosi di un estrattore, sfilare il portaplanetario di 3° riduzione (13) dal mozzo flangiato (18).

By using a puller, remove the 3rd reduction planet carrier (13) from the flanged hub (18).



25.

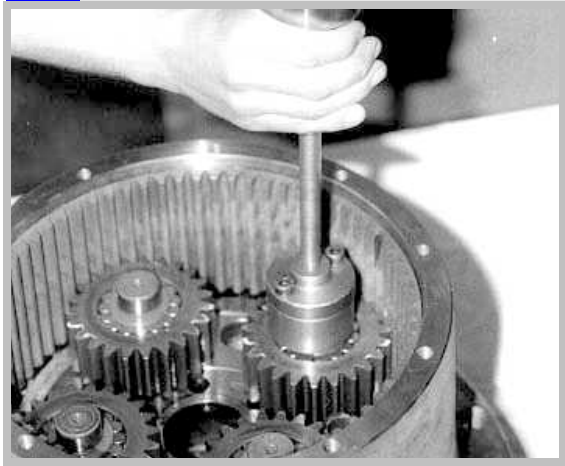
Utilizzando l'attrezzatura **(ATZ.05.006)**, sfilare le n°4 boccole (14) dal mozzo flangiato (18) o dal portaplanetari di 3°riduzione (13).

*Using the equipment **(ATZ.05.006)**, remove the nos.4 bushes (14) from the flanged hub (18) or from the 3rd reduction planet carrier (13).*

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8.0 SMONTAGGIO

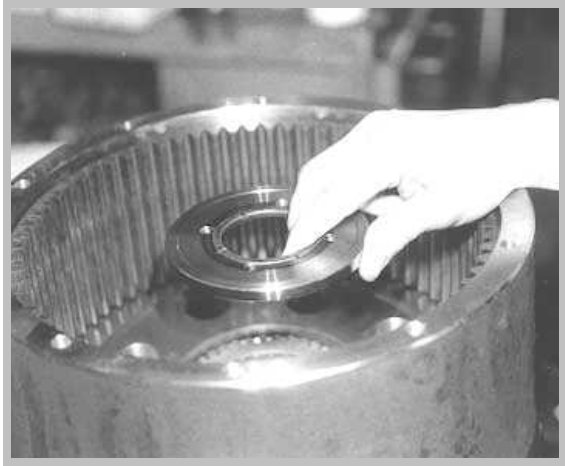
8.0 DISASSEMBLY



26.

Utilizzando l'attrezzatura **(ATZ.05.006)**, sfilare i n°4 gruppi planetari di 3°riduzione (13).

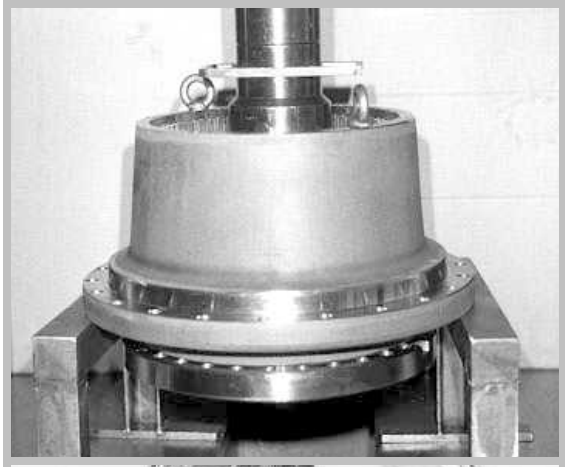
*By using the equipment **(ATZ.05.006)** remove the nos.4 planet assemblies of the 3rd reduction (13).*



27.

Sfilare l'anello spingidischi (17) dal mozzo flangiato (18).

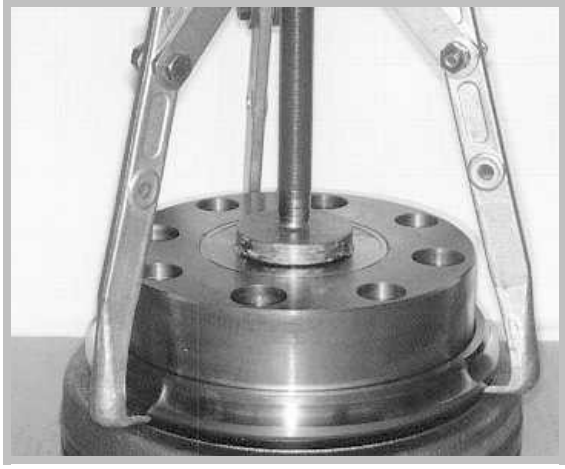
Remove the discs retainer (17) from the flanged hub (18).



28.

Sollevare il corpo riduttore (15) posizionandolo su 2 distanziali. Servendosi di una pressa e di un tampone metallico, sfilare il mozzo flangiato (18) dal corpo riduttore (15) facendo attenzione all'eventuale caduta delle sfere.

Lift the gearbox housing (15) positioning it on 2 spacers. By using a press and a metal stopper, remove the flanged hub (18) from the gearbox housing (15) paying attention to the eventual falling down of the main bearing's balls.



29.

Servendosi di un estrattore, sfilare l'anello interno del cuscinetto rimasto sul mozzo flangiato (18).

Use a puller to remove the bearing inner race remaining on the flanged hub (18).

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8.0 SMONTAGGIO

8.0 *DISASSEMBLY*

Informazioni **Lo smontaggio del riduttore termina con quest'ultima operazione: tutti i particolari sono ora a disposizione per le verifiche necessarie.**

Information ***The gearbox disassembly ends with the above operation. All the parts are now available for the necessary inspections.***

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9.0 RIMONTAGGIO

9.1 NOTE IMPORTANTI PRIMA DEL RIMONTAGGIO

Quando si procede al rimontaggio del riduttore occorre attenersi ad alcune regole fondamentali:

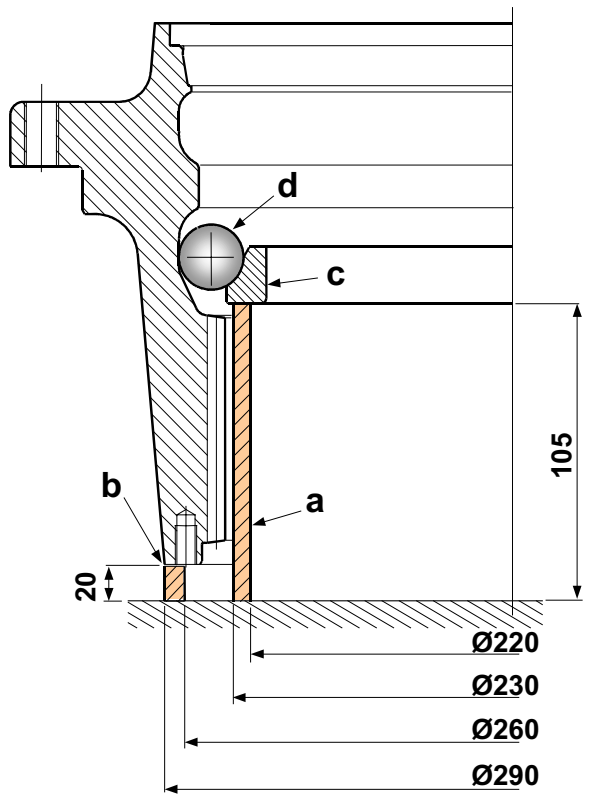
1. Nel caso di ingranaggi danneggiati, esempio un planetario, non sostituire il singolo ingranaggio ma tutta la riduzione.
2. **Sostituire sempre le guarnizioni O-ring ed gli anelli di tenuta interessati alla parte da rimontare** dopo aver pulito con attenzione le sedi di montaggio ed aver aggiunto un film di grasso sulle sedi stesse e sulle guarnizioni per facilitarne il montaggio.
3. **sostituire sempre le parti che risultano danneggiate o usurate, con ricambi originali.**

9.0 REASSEMBLY

9.1 IMPORTANT NOTES BEFORE REASSEMBLY

When proceeding with the gearbox reassembly, it is necessary to follow the rules listed below:

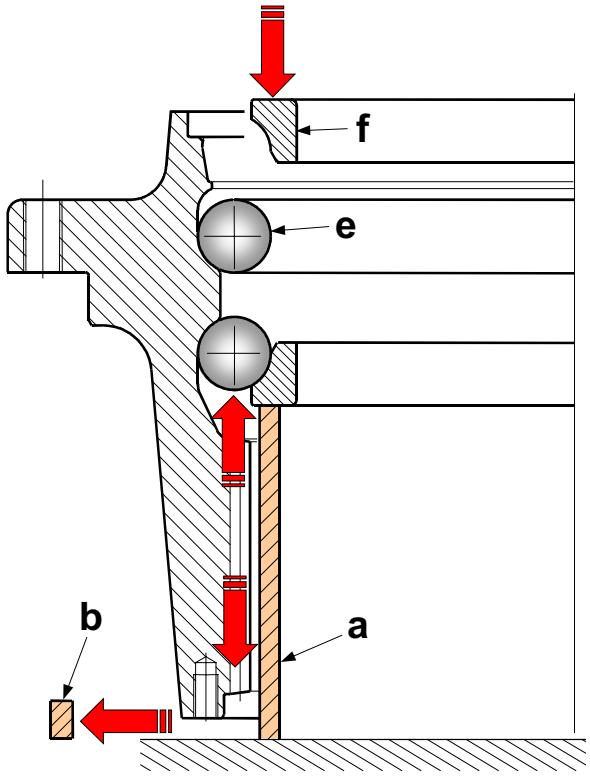
1. *In case of damaged gears, for example a planet, do not replace the single gear, but the whole reduction stage.*
2. ***Replace always the O-rings and seal rings of the part to be reassembled** after having carefully cleaned the seats and having buttered some grease on the seats themselves and on the O-rings to make easier the reassembly.*
3. ***always replace all the components that seems to be damaged or with excessive wear, with original spare parts.***



30.

Montare sul corpo riduttore (15) il giro di sfere inferiore (d), sostenendo l'anello interno (c) tramite i distanziali (a-b).

Fit the lower ball row (d), into the gearbox housing (15) holding the inner raceway (c) with spacers (a-b).



31.

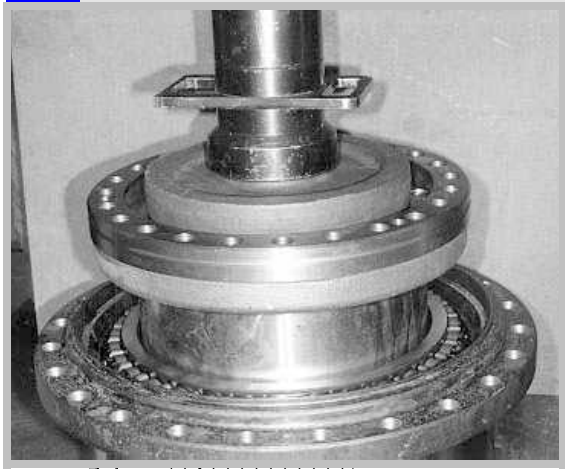
Sfilare il distanziale (b).
Montare il giro di sfere superiore (e).
Inserire l'anello interno del cuscinetto (f).

Remove the spacer (b).
Drop the upper ball row (e)
Assemble the inner raceway (f).

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9.0 RIMONTAGGIO

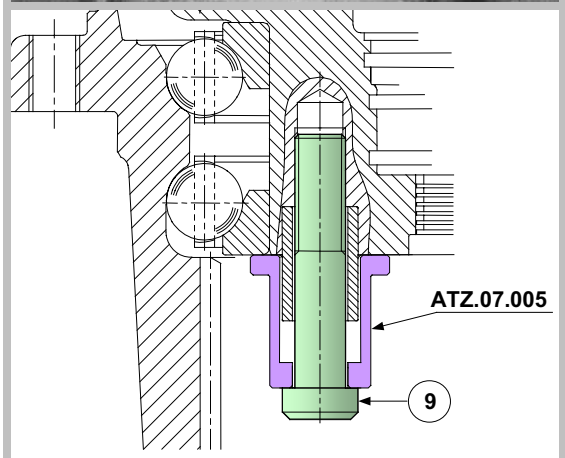
9.0 *REASSEMBLY*



32.

Supportare il corpo riduttore (15) con il distanziale “a” (vedi schema precedente).
Posizionare il mozzo flangiato (18) all'interno del corpo riduttore (15) e servendosi di una pressa e di un tampone metallico, spingere quest’ultimo in battuta fino ad ottenere il completo assemblaggio del gruppo.

Support the gearbox housing (15) by using the spacer “a” (shown in the sketch above)
Place the flanged hub (18) inside the gearbox housing (15) and by using a press and a metallic stopper, push it against the shoulder until assembly of the unit is complete.



33.

Avvitare la boccola di sicurezza **(ATZ.07.005)** in uno dei quattro fori filettati M16 presenti nel mozzo flangiato (18) usando la vite TCEI M16x100 (12), classe di resistenza 10.9 e capovolgere l'unità mozzo flangiato-corpo riduttore (18-15).
Al termine dell'operazione su indicata, smontare la boccola di sicurezza.

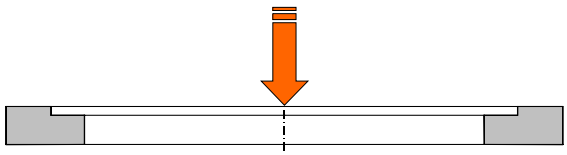
*Screw the safety bush **(ATZ.07.005)** in one of the four holes M16 in the flanged hub (18) by using the socket head screw M16x100 (12), grade 10.9 and turn the gearbox housing flanged hub group (15-18) upside down.*
At the end of above step disassemble the safety bush.



34.

Montare correttamente l'anello spingi-dischi (17) nel mozzo flangiato (18).

Assemble correctly the discs retainer (17) in the flanged hub (18).





35.

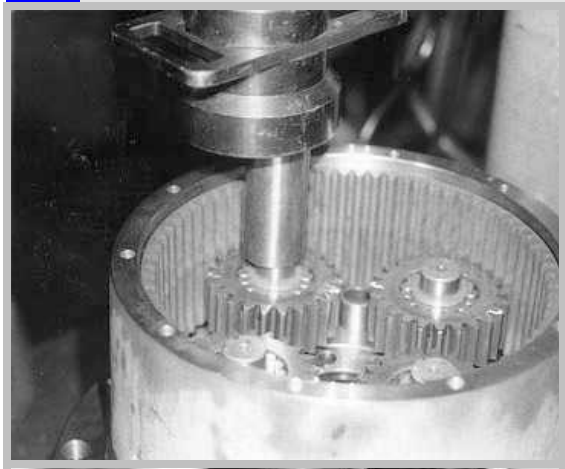
Posizionare le n°4 boccole (14) nelle proprie sedi nel mozzo flangiato (18) e con la pressa spingerle in battuta fino ad ottenere il completo assemblaggio.

Place the nos.4 bushes (14) into their seats on the flanged hub (18) and by using a press, push them against the shoulder inside their seats until assembling is complete.

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9.0 RIMONTAGGIO

9.0 *REASSEMBLY*



36.

Posizionare i n°4 gruppi planetari di 3°riduzione (13) nelle proprie sedi nel mozzo flangiato (18), e con una pressa spingerli in battuta fino ad ottenere il completo assemblaggio.

Place the nos.4 planet assemblies of the 3rd reduction (13) into their seats on the flanged hub (18), and use a press to push them against the shoulder until assembling is complete.



37.

Posizionare il portaplanetari di 3°riduzione (13) sul mozzo flangiato (18), e con la pressa spingere quest'ultimo in battuta fino ad ottenere il completo assemblaggio.

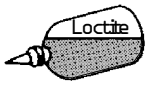
Place the 3rd reduction planet carrier (13) on the flanged hub (18) and by using a press push it against the shoulder until assembling is complete.

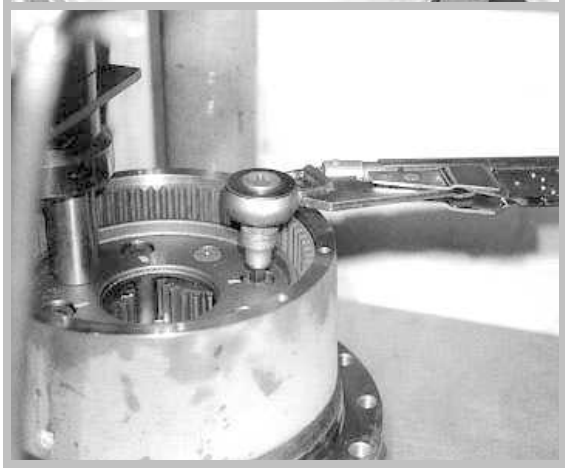


38.

Applicare **LOCTITE 243** sulle n°4 viti TCEI M16x100 (12), classe di resistenza 10.9, ed inserirle nei rispettivi fori nel mozzo flangiato (18).

*Apply **LOCTITE 243** on the nos.4 socket head screws M16x100 (12), grade 10.9, and insert them in the thread holes in the flanged hub (18).*





39.

Serrare le n°4 viti TCEI M16x100 (12), classe di resistenza 10.9 con chiave dinamometrica esagonale maschio alla coppia di 290 Nm.

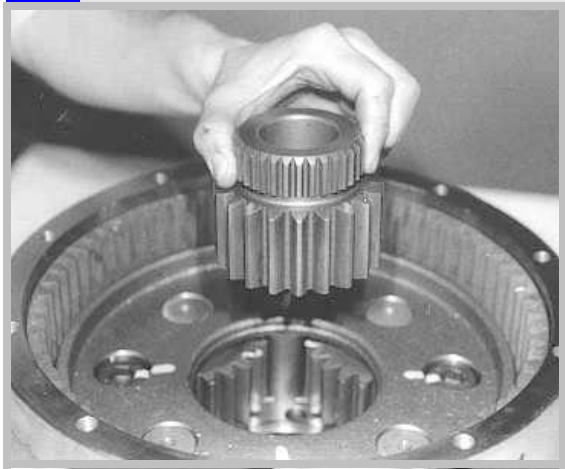
Tighten the nos.4 socket head screws M16x100 (12), grade 10.9, by a male hex head torque wrench at 290 Nm torque.



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9.0 RIMONTAGGIO

9.0 *REASSEMBLY*



40.

Inserire il solare di 3°riduzione (11).

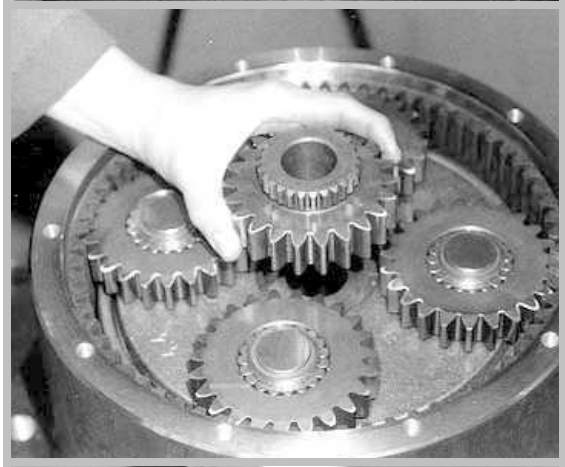
Insert the 3rd stage sun gear (11).



41.

Montare la 2° riduzione (10).

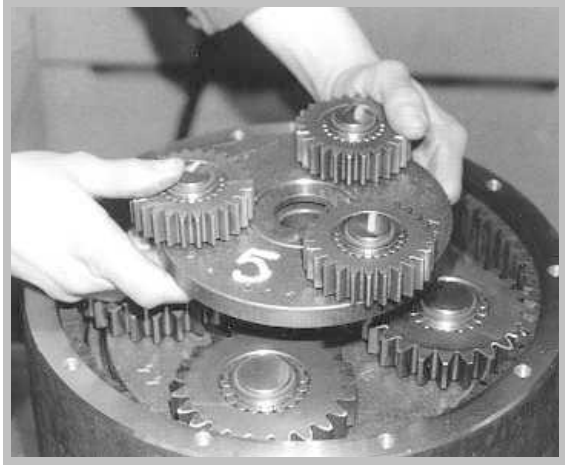
Assemble the 2nd reduction assembly (10).



42.

Inserire il solare di 2°riduzione (9).

Insert the 2nd stage sun gear (9).



43.

Montare la 1° riduzione (8).

Assemble the 1st reduction assembly (8).

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9.0 RIMONTAGGIO

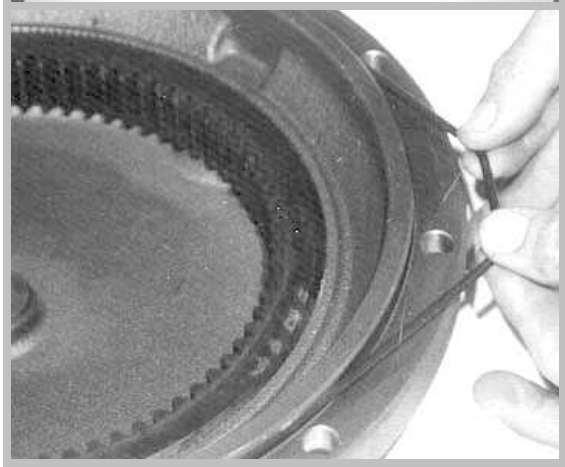
9.0 *REASSEMBLY*



44.

Inserire il solare di 1°riduzione (7).

Insert the 1st stage sun gear (7).



45.

Montare la guarnizione O-ring (5) nella propria sede nel coperchio di chiusura (2).

Assemble the O-ring seal (5) into its seat in the end cover (2).



46.

Fissare il coperchio di chiusura (2) al corpo riduttore (15) con n°10 viti TCEI M10x25 (1), classe di resistenza 12.9, serrate con una chiave dinamometrica alla coppia di 75 Nm.

Fix the cover (2) to the gearbox housing (15) by using nos.10 socket head screws M10x25 (1) grade 12.9, tightened by a torque wrench at 75 Nm torque.





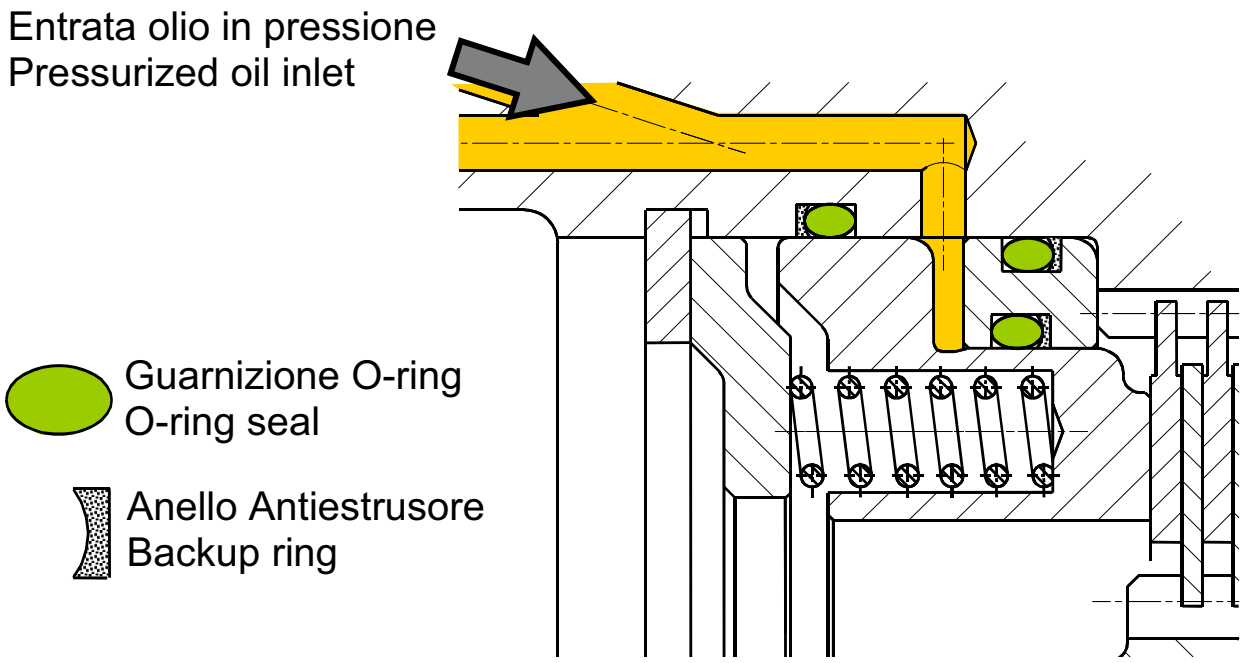
47.

Capovologere il riduttore e assemblare le guarnizioni O-ring (30) e l'anello antiestrusione (31) come descritto nello schema seguente.

Turn the gearbox upside down and assemble the O-ring seal (30) and the backup ring (31) as shown in the following scheme.

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9.0 RIMONTAGGIO — 9.0 *REASSEMBLY*



Schema di montaggio guarnizioni freno - Brake seals installation scheme

Informazioni

Inserire nella sede un anello O-ring e un anello antiestrusione in modo che quest'ultimo si trovi a valle dell'anello O-ring rispetto all'olio in pressione.

Information

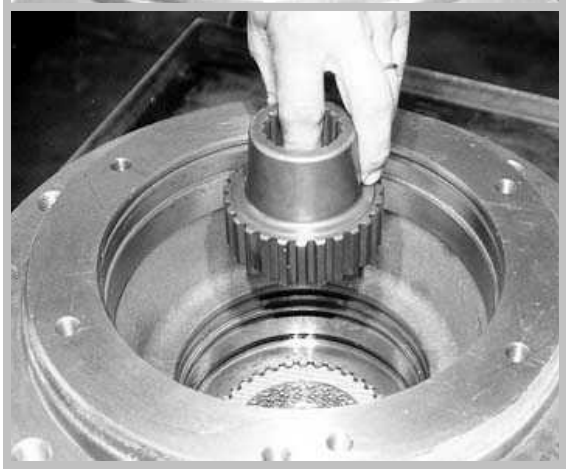
An O-ring and a backup ring must be fitted in the seat paying attention that the backup ring must always be beyond the O-ring seal against the oil flow.



48.

Montare un pacco nuovo di dischi freno secondo il seguente ordine:
inserire per primo un disco in bronzo sinterizzato (24) a dentatura esterna. Inserire successivamente un disco in acciaio (23) a dentatura interna. Ripetere l'operazione sino ad ottenere una successione di n°6 dischi in bronzo sinterizzato e n°5 in acciaio.

Assemble a new brake discs package according to the following order: firstly insert an external toothed sintered bronze disc (24). Then insert, an internal toothed steel disc (23). Repete the operation untill reaching the number of 6 sintered bronze and 5 steel discs.



49.

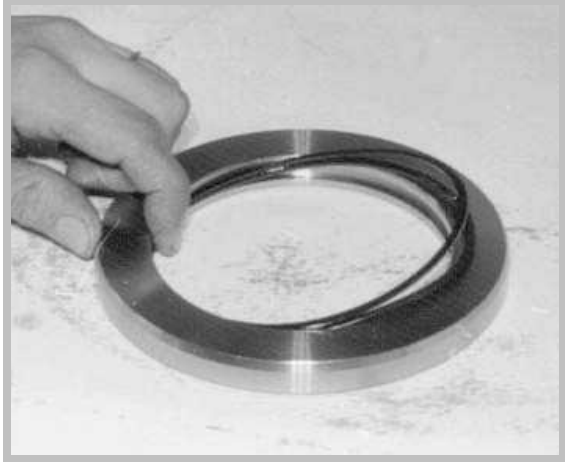
Montare l'albero freno (21).

Assemble the brake shaft (21).

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9.0 RIMONTAGGIO

9.0 *REASSEMBLY*



50.

Montare le guarnizioni O-ring (27-28) e gli anelli antiestrusione (26-29) nelle proprie sedi nel distanziale (25).

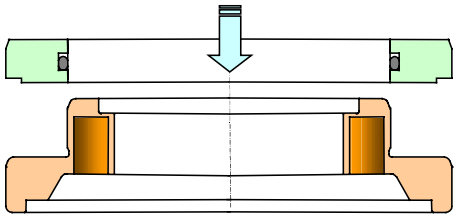
Fit the O-ring seals (27-28) and the backup rings (26-29) into their seats in the spacer (25).



51.

Assemblare il distanziale (25) al pistone freno (32), facendo attenzione a non danneggiare le guarnizioni precedentemente montate.

Assemble the spacer (25) to the brake piston (32), paying attention not to damage the seals already fitted.





52.

Inserire il gruppo pistone freno-distanziale pistone (32-25) all' interno del mozzo flangiato (18), facendo attenzione a non danneggiare le guarnizioni precedentemente montate.

Insert the brake piston-spacer group (32-25) inside the flanged hub (18), paying attention not to damage the seals already fitted.



53.

Informazioni Inserire le molle (33) nel proprio alloggiamento rispettando le posizioni contrassegnate in precedenza.

Information *Insert the springs (33) in their seats respecting the markings set out previously.*

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9.0 RIMONTAGGIO

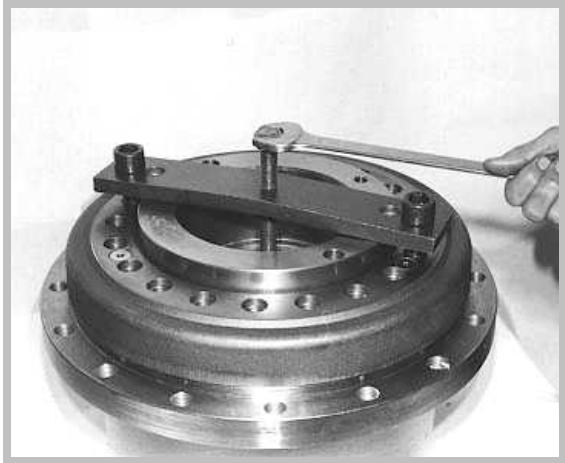
9.0 *REASSEMBLY*



54.

Inserire il disco spingimolla (34).

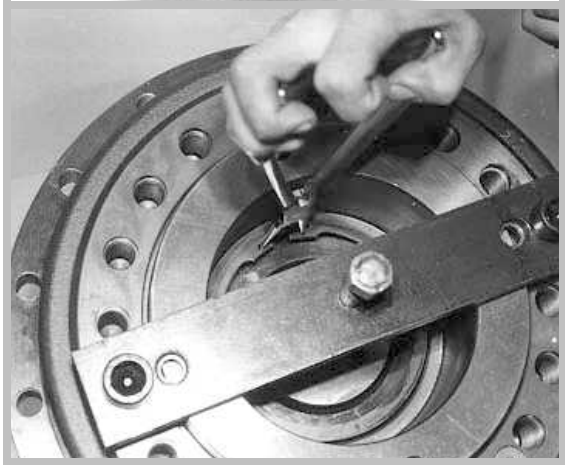
Assemble the spring retainer disc (34).



55.

Montare l'attrezzatura **(AT.709C03)** sul mozzo flangiato (18) ed agire sulla vite fino a contrastare la forza delle molle.

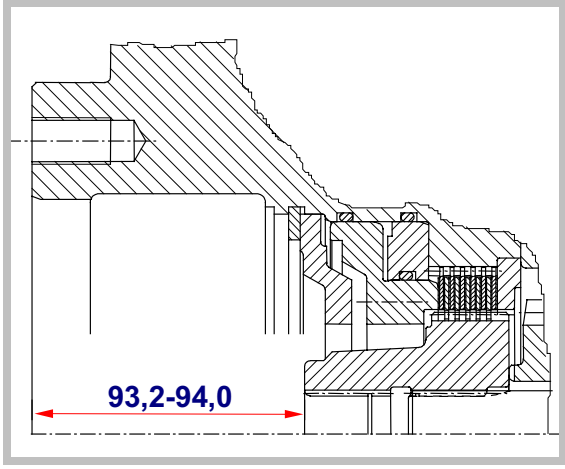
*Put the equipment **(AT.709C03)** in the flanged hub (18) and turn the screw until it contrasts the force of the spring.*



56.

Con l'aiuto di pinze, montare l'anello elastico (35) nella propria sede.

Using pliers, assemble the circlip (35) into its seat.



57.

Attenzione Prima di montare il motore idraulico, verificare, con un calibro per interni, il corretto assemblaggio del riduttore controllando la quota assiale indicata nel disegno a fianco.

Warning *Before assembling the hydraulic motor, verify by a depth slide gauge the correct assembly of the unit checking the axial distance as shown in the scheme.*

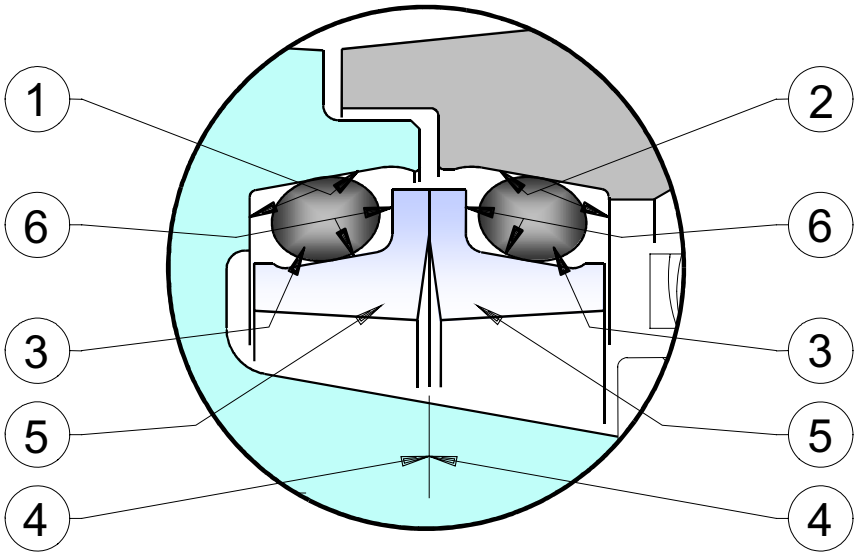
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9.0 RIMONTAGGIO

9.2 ISTRUZIONI PER IL MONTAGGIO DELLA TENUTA FRONTALE

9.0 *REASSEMBLY*

9.2 *INSTRUCTIONS FOR THE INSTALLATION OF THE LIFETIME SEAL.*



Particolare di tenuta frontale - Lifetime seal detail

Preparazione della tenuta frontale

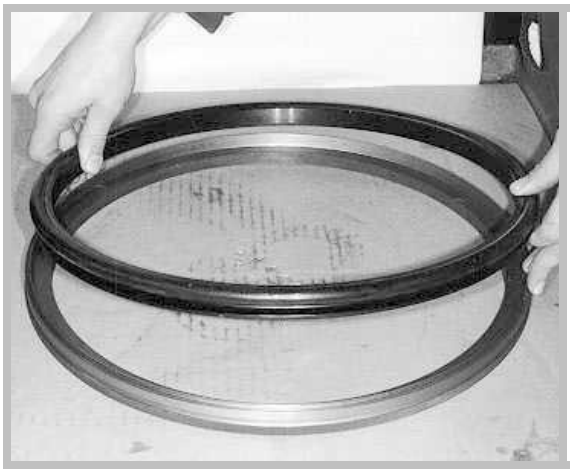
Per ottenere una perfetta tenuta, e' necessario procedere al montaggio degli anelli nel seguente modo:

1. Effettuare una accurata pulizia degli alloggiamenti "1" e "2" facendo uso, se necessario, di spazzole metalliche o solventi (le superfici a contatto con gli anelli di gomma "3" devono essere perfettamente pulite ed asciutte).
2. Assicurarsi che le superfici di tenuta "4" degli anelli "5" siano esenti da qualsiasi rigatura, ammaccatura o corpi estranei e che le superfici "6" degli stessi anelli siano perfettamente pulite ed asciutte.
3. Togliere dalle superfici lappate "4" degli anelli "5" ogni traccia di polvere o impronte digitali e umettarle poi con un leggero strato di olio, avendo cura di non ungere le rimanenti parti.

Makeready of the lifetime seal

To follow these instructions at the time of fitting, in order to obtain the correct seal:

1. *Carefully clean the seats "1" and "2" using, if necessary, metal brushes or solvent (surfaces in contact with or "3" must be perfectly clean and dry).*
2. *Make sure that sealing surfaces "4" of metal rings "5" are free from scratches, dinges or foreign substances; metal ring surfaces must be perfectly clean and dry.*
3. *Carefully clean the lapped surface "4" of metal rings "5" and remove dust or fingerprints. Then lubrificate them with a thin oil film, taking care not to oil the other components.*



58.

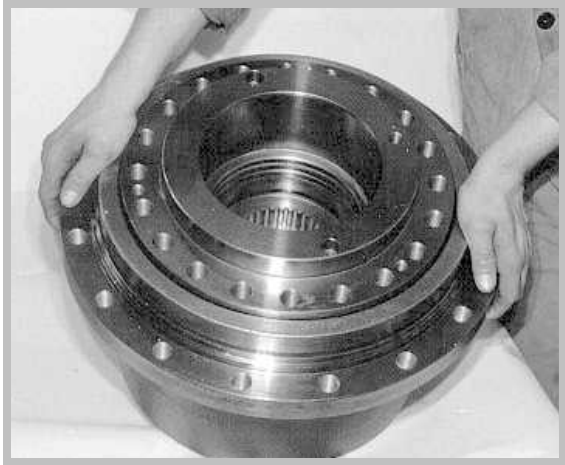
Montare una semitenuta frontale (16) sull' attrezzo **(ATZ.04.003)**.

*Assemble an half seal (16) on the tool **(ATZ.04.003)**.*

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9.0 RIMONTAGGIO

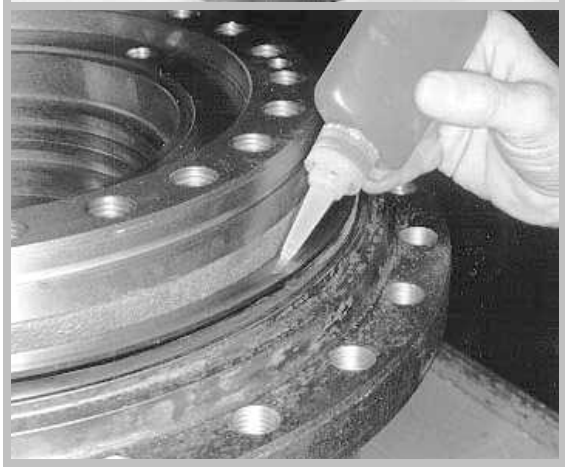
9.0 *REASSEMBLY*



59.

Eseguire il montaggio della 1° semitenuta frontale (16) sul mozzo flangiato (18).

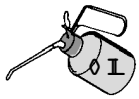
Assemble the 1st half seal (16) on the flanged hub (18).

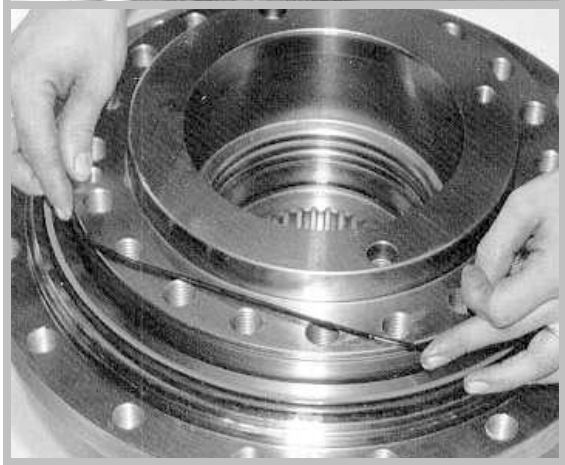


60.

Pulire le parti metalliche della tenuta frontale (16) da eventuali residui o polvere, e applicare sulla loro superficie un leggero strato di olio.

Clean carefully the metallic faces of the lifetime seal (16), and lube them with a thin oil film.





61.

Montare la guarnizione O-ring (19) nella propria sede nel mozzo flangiato (18).

Assemble the O-ring (19) in its seat in the flanged hub (18).



62.

Montare, sempre con lo stesso attrezzo **(ATZ.04.003)**, la semitenuta frontale (16) sull'anello ritegno (20).
Pulire le parti metalliche delle semitenute frontali da eventuali residui o polvere.

Assemble, by using the same tool **(ATZ.04.003)**, *the half seal (16) on the cover (20).*
Clean carefully the metal faces of the half-seals.

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9.0 RIMONTAGGIO

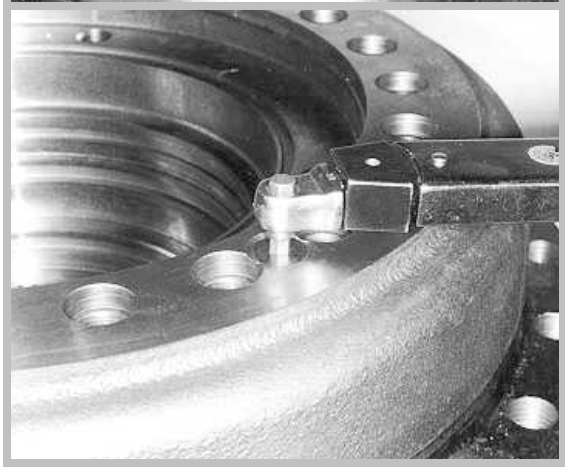
9.0 *REASSEMBLY*



63.

Montare l'anello di ritegno (20) sul mozzo flangiato (18).

Assemble the cover (20) on the flanged hub (18).



64.

Fissare l'anello ritegno (20) al mozzo flangiato (18) con n°3 viti TSPEI M10x25 (22), classe di resistenza 10.9, serrate con chiave dinamometrica esagonale maschio alla coppia di 50 Nm.

Fix the cover (20) to the flanged hub (18) by using nos.3 flathead screws M10x25 (22) grade 10.9, tightened by a male hex head torque wrench at 50 Nm torque.



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9.0 RIMONTAGGIO

9.3 CONTROLLO FRENO

Qualora si sia eseguito un intervento sul freno, è necessario controllare che non ci siano perdite di olio.

Procedere come segue:

1. Collegare al foro comando freno un manometro e la relativa valvola di comando afflusso olio
2. Aprire la valvola di comando afflusso olio e sbloccare il freno, raggiungendo la pressione di **150 bar**
3. Chiudere la valvola di comando afflusso olio e mantenere la pressione nel freno per un periodo **di 3 minuti**.
4. Verificare con il manometro che la pressione rimanga costante.

Attenzione Se la pressione diminuisce significa che il rimontaggio non è stato eseguito in modo corretto; oppure che le guarnizioni del freno non fanno tenuta: in tal caso si dovrà procedere alla loro sostituzione.

9.0 REASSEMBLY

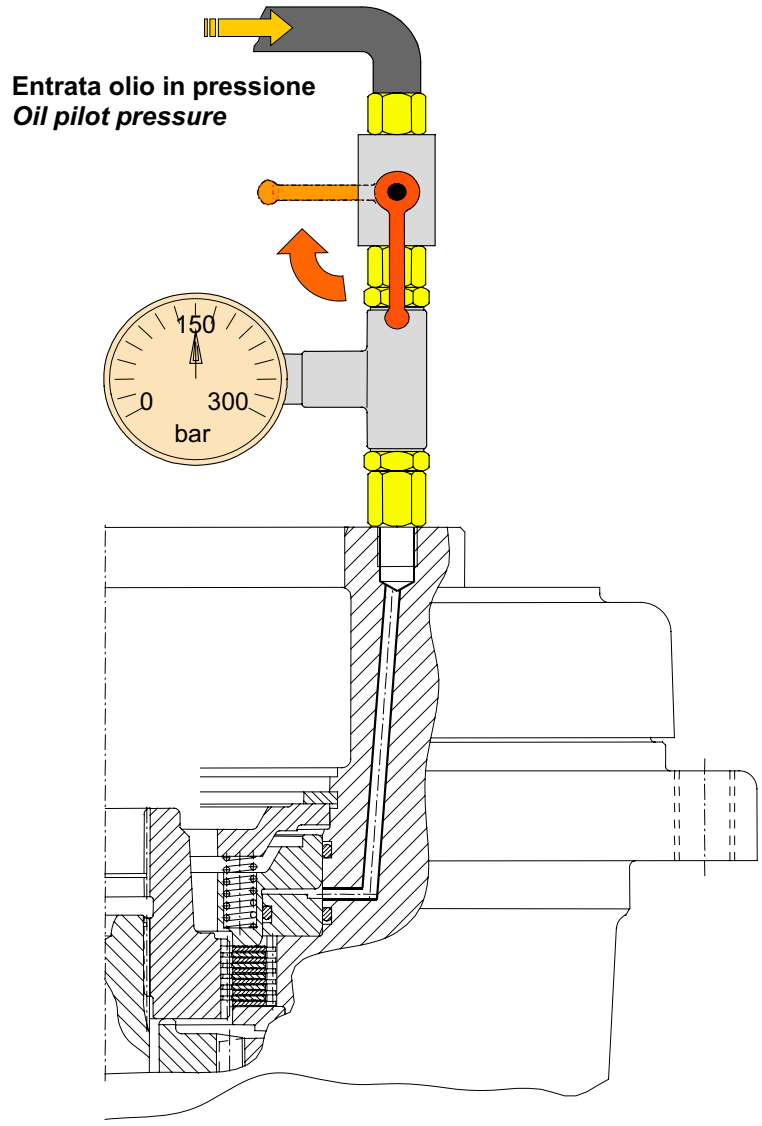
9.3 BRAKE CHECK

If the brake has been disassembled then a check of the brake function is needed before putting it into operation.

Proceed as follow:

1. *Connect the pressure pilot line with the manometer to the brake release port. The flow valve is closed.*
2. *Open the flow valve and release the brake with the pilot pressure of **150 bar***
3. *Close the flow valve and keep the brake released **3 minutes** long.*
4. *Check that no pressure drop has occured*

Warning *If the pressure drops down, the gearbox reassembly is not correct, or the seals are damaged: in this case the seals have to be repalced.*



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9.0 RIMONTAGGIO

Informazioni Al termine delle operazioni rimontare il motore idraulico completo della sua guarnizione O-ring (36), fissandolo al riduttore con n°2 viti TE M16x40 (37), classe di resistenza 8.8, serrate ad una coppia di 215 Nm.

Effettuare il riempimento olio come illustrato al paragrafo 5.2

9.0 *REASSEMBLY*

Information *After having reassembled the gearbox, fit the hydraulic motor, being careful to include the O-ring (36), with nos.2 hexagonal head fixing screws M16x40 (37), grade 8.8, tightened at 215 Nm torque.*

Fill the gearbox with the lubricant oil as shown in section 5.2.



10.0 DISEGNI ATTREZZATURE

I disegni costruttivi delle attrezzature speciali utilizzate per le fasi di smontaggio e rimontaggio del riduttore sono riportati di seguito:

AT709C.03 Attrezzo smontaggio-rimontaggio freno

ATZ.05.006: Estrattore smontaggio riduzione

ATZ.07.005: Boccola di sicurezza

ATZ.04.003: Anello montaggio tenuta frontale

AT707C.08: Schema montaggio kit corpo

AT707C.06: Ricambio kit corpo

AT707C.09: Tubo per montaggio kit corpo

AT707C.07: Attrezzo per montaggio kit corpo

10.0 *FIXTURE DRAWINGS*

Special drawings of the tools used in the disassembly and reassembly steps of the gearbox are shown below:

AT709C.03: *Tool for brake disassembly-reassembly*

ATZ.05.006: *Puller for reduction disassembly*

ATZ.07.005: *Safety bush*

ATZ.04.003: *Tool for lifetime seal assembly*

AT707C.08: *Scheme for kit housing assembly*

AT707C.06: *Kit housing spare part*

AT707C.09: *Tube for kit housing assembly*

AT707C.07: *Tool for kit housing assembly*

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INSERIMENTI-MODIFICHE

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ADDITIONS-MODIFICATIONS

		Par.	*Rev.*	*Date*

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11 Circuit diagrams

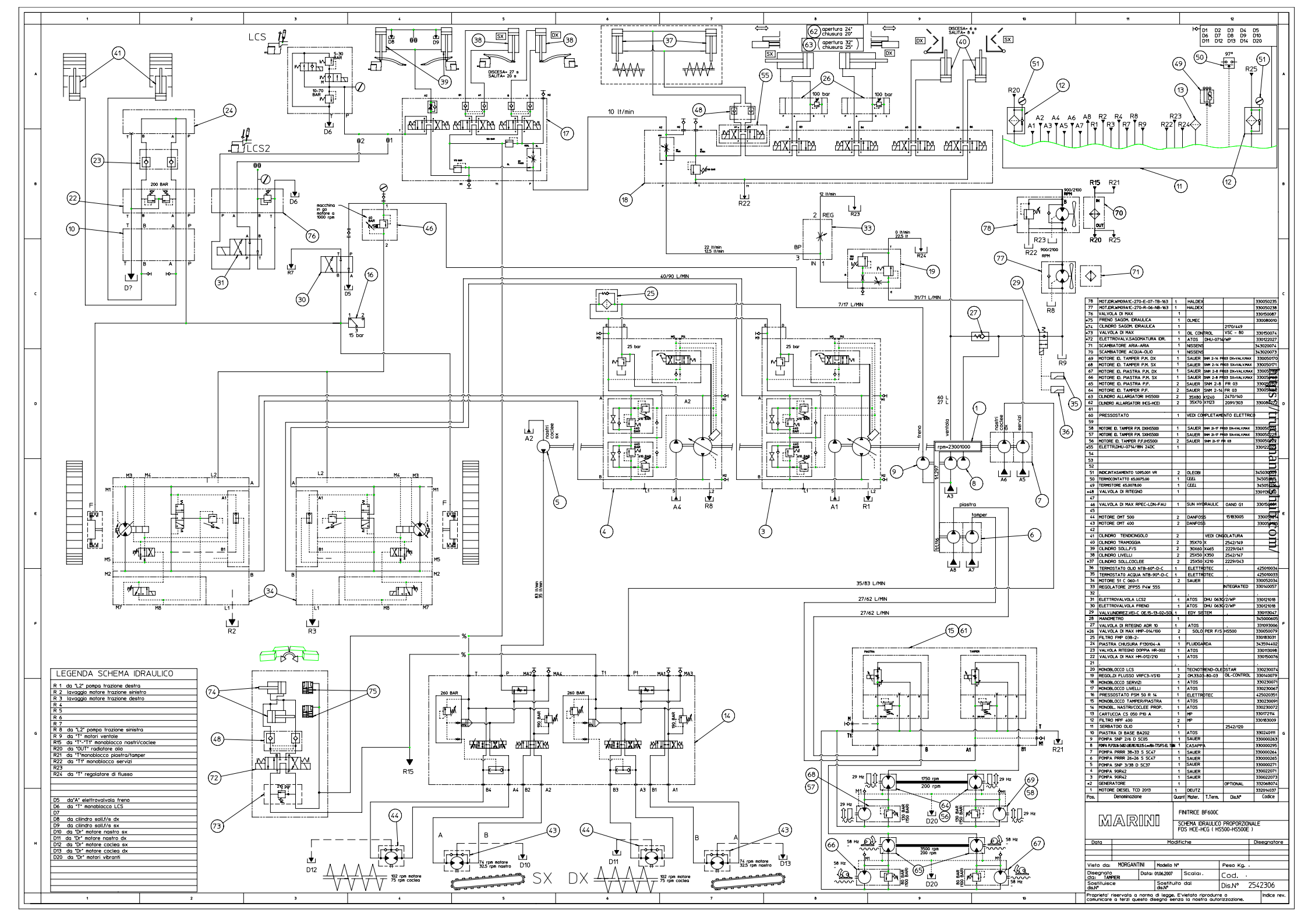
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11.1 Hydraulic diagram 2542306

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Pos.	Denominazione	Quant	Mater.	T.Term.	Dis.N°	Codice
78	MOT.IDR.WM09A1C-270-E-07-TB-163	1	HALDEX			330050235
77	MOT.IDR.WM09A1C-270-R-06-NB-163	1	HALDEX			330050238
76	VALVOLA DI MAX	1				330150087
*75	FRENO SAGOM. IDRAULICA	1	OLMEC			330080010
*74	CILINDRO SAGOM. IDRAULICA	1			2170/449	
*73	VALVOLA DI MAX	1	OIL CONTROL		VSC - 80	330150074
*72	ELETTROVALV.SAGOMATURA IDR.	1	ATOS	DHU-0714/WP		330122027
71	SCAMBIATORE ARIA-ARIA	1	NISSENS			343020074
70	SCAMBIATORE ACQUA-OLIO	1	NISSENS			343020073
69	MOTORE ID. TAMPER P.M. DX	1	SAUER	SNM 2-14 FR03 DX+VALV.MAX		330050170
68	MOTORE ID. TAMPER P.M. SX	1	SAUER	SNM 2-14 FR03 SX+VALV.MAX		330050171
67	MOTORE ID. PIASTRA P.M. DX	1	SAUER	SNM 2-8 FR03 DX+VALV.MAX		330050168
66	MOTORE ID. PIASTRA P.M. SX	1	SAUER	SNM 2-8 FR03 SX+VALV.MAX		330050169
65	MOTORE ID. PIASTRA P.F.	2	SAUER	SNM 2-8	FR 03	330050157
64	MOTORE ID. TAMPER P.F.	2	SAUER	SNM 2-14	FR 03	330050162
63	CILINDRO ALLARGATORI (HS500)	2	35X80	X1240	2470/140	
62	CILINDRO ALLARGATORI (HCG-HCE)	2	35X70	X1123	2091/303	330080272
61						
60	PRESSOSTATO	1	VEDI COMPLETAMENTO ELETTRICO			
59						
58	MOTORE ID. TAMPER P.M. DX(HS500)	1	SAUER	SNM 2i-17 FR03 DX+VALV.MAX		330050224
57	MOTORE ID. TAMPER P.M. SX(HS500)	1	SAUER	SNM 2i-17 FR03 SX+VALV.MAX		330050223
56	MOTORE ID. TAMPER P.F.(HS500)	2	SAUER	SNM 2i-17 FR 03		330050222
*55	ELETTR.DHU-0714/18N 24DC	1				330122027
54						
53						
52						
51	INDIC.INTASAMENTO 1.095.001 VR	2	OLEOBI			345030009
50	TERMOCONTATTO 65.0075.00	1	C.E.E.I.			345051215
49	TERMISTORE 65.0078.00	1	C.E.E.I.			345051216
*48	VALVOLA DI RITEGNO	1				330113030
47						
46	VALVOLA DI MAX RPEC-LDN-FAU	1	SUN HYDRAULIC		OANO G1	330150081
45						
44	MOTORE OMT 500	2	DANFOSS		151B3005	330050214
43	MOTORE OMT 400	2	DANFOSS			330050125
42						
41	CILINDRO TENDICINGOLO	2		VEDI CINGOLATURA		
40	CILINDRO TRAMOGGIA	2	35X70	X	2542/149	
39	CILINDRO SOLL.F/S	2	30X60	X465	2229/041	
38	CILINDRO LIVELLI	2	25X50	X350	2542/147	
*37	CILINDRO SOLL.COCLEE	2	25X50	X210	2229/043	
36	TERMOSTATO OLIO NTB-60°-D-C	1	ELETTROTEC		.	425010034
35	TERMOSTATO ACQUA NTB-90°-D-C	1	ELETTROTEC		.	425010033
34	MOTORE 51 C 060-1	2	SAUER			330052034
33	REGOLATORE 2FP55 P4W 55S				INTEGRATED	330140057
32	.	.	.		.	.
31	ELETTROVALVOLA LCS2	1	ATOS	DHU 0630/2/WP		330121018
30	ELETTROVALVOLA FRENO	1	ATOS	DHU 0630/2/WP		330121018
29	VALV.UNIDIREZ.VEI-C OE.15-13-02+SOL	1	EDY SISTEM		.	330113047
28	MANOMETRO	1				345000605
27	VALVOLA DI RITEGNO ADR 10	1	ATOS		.	331093006
*26	VALVOLA DI MAX HMP-014/100	2	SOLO PER F/S		HS500	330050079
25	FILTRO FMP 038-2-	1				330183031
24	PIASTRA CHIUSURA F130104-A	1	FLUIDGARDA			343594402
23	VALVOLA RITEGNO DOPPIA HR-002	1	ATOS			330113098
22	VALVOLA DI MAX HM-012/210	1	ATOS			330150076
21	.	.	.		.	.
20	MONOBLOCCO LCS	1	TECNOTREND-OLEOSTAR			330230074
19	REGOL.DI FLUSSO VRFC3-VS10	2	OM.33.03-80-03		OIL-CONTROL	330140079
18	MONOBLOCCO SERVIZI	1	ATOS			330230071
17	MONOBLOCCO LIVELLI	1	ATOS			330230067
16	PRESSOSTATO PSM 50 R 14	1	ELETTROTEC			425020351
15	MONOBLOCCO TAMPER/PIASTRA	1	ATOS			330230091
14	MONOBL. NASTRI/COCLEE PROP.	1	ATOS			330230072
13	CARTUCCIA CS 050 P10 A	1	MP			330172114
12	FILTRO MPF 400	2	MP			330183009
11	SERBATOIO OLIO	1			2542/120	
10	PIASTRA DI BASE BA202	1	ATOS			330240111
9	POMPA SNP 2/6 D SC05	1	SAUER			330000263
8	POMPA PLP20.16-54B2-LBE/BC/10.3.15-L**/BA-T7S/FS-EL TWIN	1	CASAPPA			330000295
7	POMPA PRRR 38+33 S SC47	1	SAUER			330000264
6	POMPA PRRR 26+26 S SC47	1	SAUER			330000265
5	POMPA SNP 3/38 D SC37	1	SAUER			330000271
4	POMPA 90R42	1	SAUER			330022071
3	POMPA 90R42	1	SAUER			330022073
*2	GENERATORE	1			OPTIONAL	332068074
1	MOTORE DIESEL TCD 2013	1	DEUTZ			332014037



LEGENDA SCHEMA IDRAULICO

R 1	da "L2" pompa trazione destra
R 2	lavaggio motore trazione sinistra
R 3	lavaggio motore trazione destra
R 4	
R 5	
R 6	
R 7	
R 8	da "L2" pompa trazione sinistra
R 9	da "T" motori ventole
R15	da "T"-"T1" monoblocco nastri/coclee
R20	da "OUT" radiatore olio
R21	da "T"monoblocco piastra/tamper
R22	da "T1" monoblocco servizi
R23	
R24	da "T" regolatore di flusso
D5	da"A" elettrovalvola freno
D6	da "T" manoblocco LCS
D7	
D8	da cilindro soll.t/s dx
D9	da cilindro soll.t/s sx
D10	da "Dr" motore nastro sx
D11	da "Dr" motore nastro dx
D12	da "Dr" motore coclea sx
D13	da "Dr" motore coclea dx
D20	da "Dr" motori vibranti

Pos.	Denominazione	Quant	Mater.	T.Tem.	Dis.N°	Codice
78	MOT.IDR.MM09A1C-270-E-07-TB-163	1	HALDEX			330050235
77	MOT.IDR.MM09A1C-270-R-06-NB-163	1	HALDEX			330050238
76	VALVOLA DI MAX	1				330150087
*75	FRENO SAGOM. IDRAULICA	1	OLMEC			330080010
*74	CILINDRO SAGOM. IDRAULICA	1			2170/449	
*73	VALVOLA DI MAX	1	OIL CONTROL		VSC - 80	330150074
*72	ELETTROVALV.SAGOMATURA IDR.	1	ATOS	DHU-0714	WP	330122027
71	SCAMBIATORE ARIA--ARIA	1	NISSENS			343020074
70	SCAMBIATORE ACQUA-OLIO	1	NISSENS			343020073
69	MOTORE ID. TAMPER P.M. DX	1	SAUER	SNM 2-1/4 FR03	DX+VALV.MAX	330050170
68	MOTORE ID. TAMPER P.M. SX	1	SAUER	SNM 2-1/4 FR03	SX+VALV.MAX	330050171
67	MOTORE ID. PIASTRA P.M. DX	1	SAUER	SNM 2-8 FR03	DX+VALV.MAX	330052169
66	MOTORE ID. PIASTRA P.M. SX	1	SAUER	SNM 2-8 FR03	SX+VALV.MAX	330052169
65	MOTORE ID. PIASTRA P.F.	2	SAUER	SNM 2-8	FR 03	330052167
64	MOTORE ID. TAMPER P.F.	2	SAUER	SNM 2-1/4	FR 03	330052168
63	CILINDRO ALLARGATORI IHS500	2	35X80	X1240	2470/140	
62	CILINDRO ALLARGATORI IHG-HCEI	2	35X70	X1123	2091/303	330080275
61						
60	PRESSOSTATO	1	VEDI COMPLETAMENTO ELETTRICO			
59						
58	MOTORE ID. TAMPER P.M. DXIHS500	1	SAUER	SNM 2-1/7 FR03	DX+VALV.MAX	330050224
57	MOTORE ID. TAMPER P.M. SXIHS500	1	SAUER	SNM 2-1/7 FR03	SX+VALV.MAX	330050224
56	MOTORE ID. TAMPER P.F.IHS500	2	SAUER	SNM 2-1/7 FR 03		330050224
*55	ELETTR.DHU-0714/BN 24DC	1				330122027
54						
53						
52						
51	INDICNITASAMENTO 1095.001 VR	2	OLEOBI			345030079
50	TERMOCONTATTO 65.0075.00	1	CEEL			345052145
49	TERMISTORE 65.0078.00	1	CEEL			345052214
*48	VALVOLA DI RITEGNO	1				330134200
47						
46	VALVOLA DI MAX RPEC-LDN-FAU	1	SUN HYDRAULIC		OANO G1	330150087
45						
44	MOTORE OMT 500	2	DANFOSS		151B3005	330050144
43	MOTORE OMT 400	2	DANFOSS			330050145
42						
41	CILINDRO TENDICINGOLO	2		VEDI CINGOLATURA		
40	CILINDRO TRAMOGGIA	2	35X70	X	2542/149	
39	CILINDRO SOLL.F/S	2	30X60	X465	2229/041	
38	CILINDRO LIVELLI	2	25X50	X350	2542/147	
*37	CILINDRO SOLL.COCLEE	2	25X50	X210	2229/043	
36	TERMOSTATO OLIO NTB-60*-D-C	1	ELETTROTEC		.	425010034
35	TERMOSTATO ACQUA NTB-90*-D-C	1	ELETTROTEC		.	425010033
34	MOTORE 51 C 060-1	2	SAUER			330052034
33	REGOLATORE 2FP55 P4W 55S	1			INTEGRATED	330140057
32		.	.		.	.
31	ELETTROVALVOLA LCS2	1	ATOS	DHU 0630	/2/WP	330121018
30	ELETTROVALVOLA FRENO	1	ATOS	DHU 0630	/2/WP	330121018
29	VALV.UNIDIREZ.VEI-C OE.15-13-02-SOL	1	EDY SISTEM		.	330113047
28	MANOMETRO	1				345000605
27	VALVOLA DI RITEGNO ADR 10	1	ATOS		.	331093006
*26	VALVOLA DI MAX HMP-014/100	2	SOLO PER F/S		HS500	330050079
25	FILTRO FMP 038-2-	1				330183031
24	PIASTRA CHIUSURA FI30104-A	1	FLUIDGARDA			343594402
23	VALVOLA RITEGNO DOPPIA HR-002	1	ATOS			330113098
22	VALVOLA DI MAX HM-012/210	1	ATOS			330150076
21	.	.	.			.
20	MONOBLOCCO LCS	1	TECNOTREND-OLEOSTAR			330230074
19	REGOLDI FLUSSO VRFC3-VS10	2	OM.13.03-.80-.03		OIL-CONTROL	330140079
18	MONOBLOCCO SERVIZI	1	ATOS			330230071
17	MONOBLOCCO LIVELLI	1	ATOS			330230067
16	PRESSOSTATO PSM 50 R 14	1	ELETTROTEC			425020351
15	MONOBLOCCO TAMPER/PIASTRA	1	ATOS			330230091
14	MONOBL. NASTRI/COCLEE PROP.	1	ATOS			330230072
13	CARTUCCIA CS 050 P10 A	1	MP			330172114
12	FILTRO MPF 400	2	MP			330183009
11	SERBATOIO OLIO	1			2542/120	
10	PIASTRA DI BASE BA202	1	ATOS			330240111
9	POMPA SNP 2/6 D SC05	1	SAUER			330000263
8	POMPA PVP16-5452-UEUB/RJ15-LnnBA-TTSP5-E-TBN	1	CASAPPA			330000295
7	POMPA PRRR 38+33 S SC47	1	SAUER			330000264
6	POMPA PRRR 26+26 S SC47	1	SAUER			330000265
5	POMPA SNP 3/38 D SC37	1	SAUER			330000271
4	POMPA 90R42	1	SAUER			330022071
3	POMPA 90R42	1	SAUER			330022073
*2	GENERATORE	1			OPTIONAL	332060874
1	MOTORE DIESEL TCD 2013	1	DEUTZ			332014037

MARINI

FINITRICE BF600C

SCHEMA IDRAULICO PROPORZIONALE
FDS HCE-HCG (HS500-HS500E)

Data	Modifiche	Disegnatore

Visto da: MORGANTINI	Modello N°		Peso Kg. -
Disegnato da: TAMPERI	Data: 01.06.2007	Scala: -	Cod. -
Sostituisce dis.N°	Sostituito dal dis.N°		Dis.N° 2542306

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Indice rev.

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11.2 Wiring diagram DE006010

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BOMAG
FAYAT GROUP

Industriegebiet Hellerwald
D-56154 Boppard

BF600C

DEUTZ TIER3

ELECTRIC DRAWING

REV 04

Drawing: DE006010
Created: 28. Lug. 2011
Last update: 07. Mar. 2012

Total Pages: 63

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1.2	TABLE OF CONTENTS INDICE		40.1	WORKING LIGHTS FARI DI LAVORO	
1.3	TABLE OF CONTENTS INDICE		45	ROOF TETTOIA	
5	BATTERY COMPARTMENT VANO BATTERIA		50	BEACON GIROFARO	
7	STARTING KEY CHIAVE AVVIAMENTO		60	WASHING PUMP POMPA LAVAGGIO	
10	ENGINE STARTER AVVIAMENTO MOTORE		70	EMERGENCY PUSH BUTTONS PULSANTI EMERGENZA	
10.1	ENGINE SENSORS MOTORE SENSORI		75	GENERAL ON	
10.2	ENGINE PRE-HEAT MOTORE PRERISCALDO		80	TRAVELLING AVANZAMENTO	
10.3	ENGINE EMR MOTORE EMR		80.1	TRAVELLING AVANZAMENTO	
10.4	ENGINE RPM MOTORE RPM		80.2	TRAVELLING AVANZAMENTO	
15	FAN VENTOLA		80.3	TRAVELLING AVANZAMENTO	
20	ALARMS ALLARMI		80.4	HYDRAULIC GEAR CAMBIO IDRAULICO	

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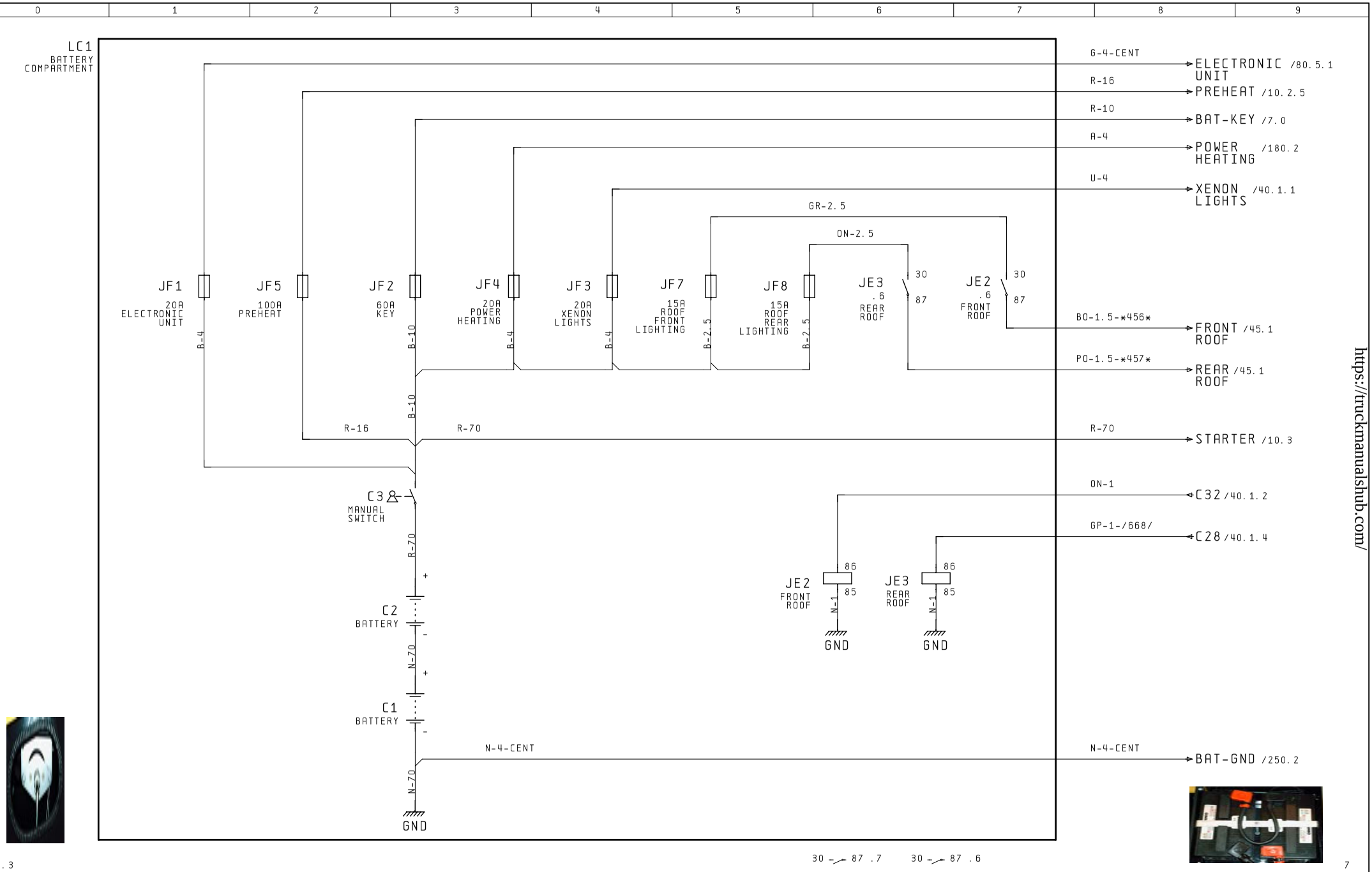
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110	LOADING MATERIAL CARICAMENTO MATERIALE		180	SCREED HEATING RISCALDAMENTO FERRO DA STIRO	
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130	SAFETY LOCK BOLTS CATENACCI DI SICUREZZA		200	TAMPER AND VIBRATOR TAMPER E VIBRANTE	
140	FUME EXHAUSTER ASPIRATORE FUMI		200.1	TAMPER AND VIBRATOR TAMPER E VIBRANTE	
150	LEFT SCREED EXTENSION ALLARGATORE SINISTRO		200.2	TAMPER AND VIBRATOR TAMPER E VIBRANTE	
150.1	RIGHT SCREED EXTENSION ALLARGATORE DESTRO		200.3	TAMPER AND VIBRATOR TAMPER E VIBRANTE	

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250.1	ELECTRONIC UNIT CENTRALINA				
301	COLORS COLORI				
1000	BILL OF MATERIALS DISTINTA BASE				
1001	BILL OF MATERIALS DISTINTA BASE				
1002	BILL OF MATERIALS DISTINTA BASE				
1003	BILL OF MATERIALS DISTINTA BASE				
1004	BILL OF MATERIALS DISTINTA BASE				
1005	BILL OF MATERIALS DISTINTA BASE				
1006	BILL OF MATERIALS DISTINTA BASE				

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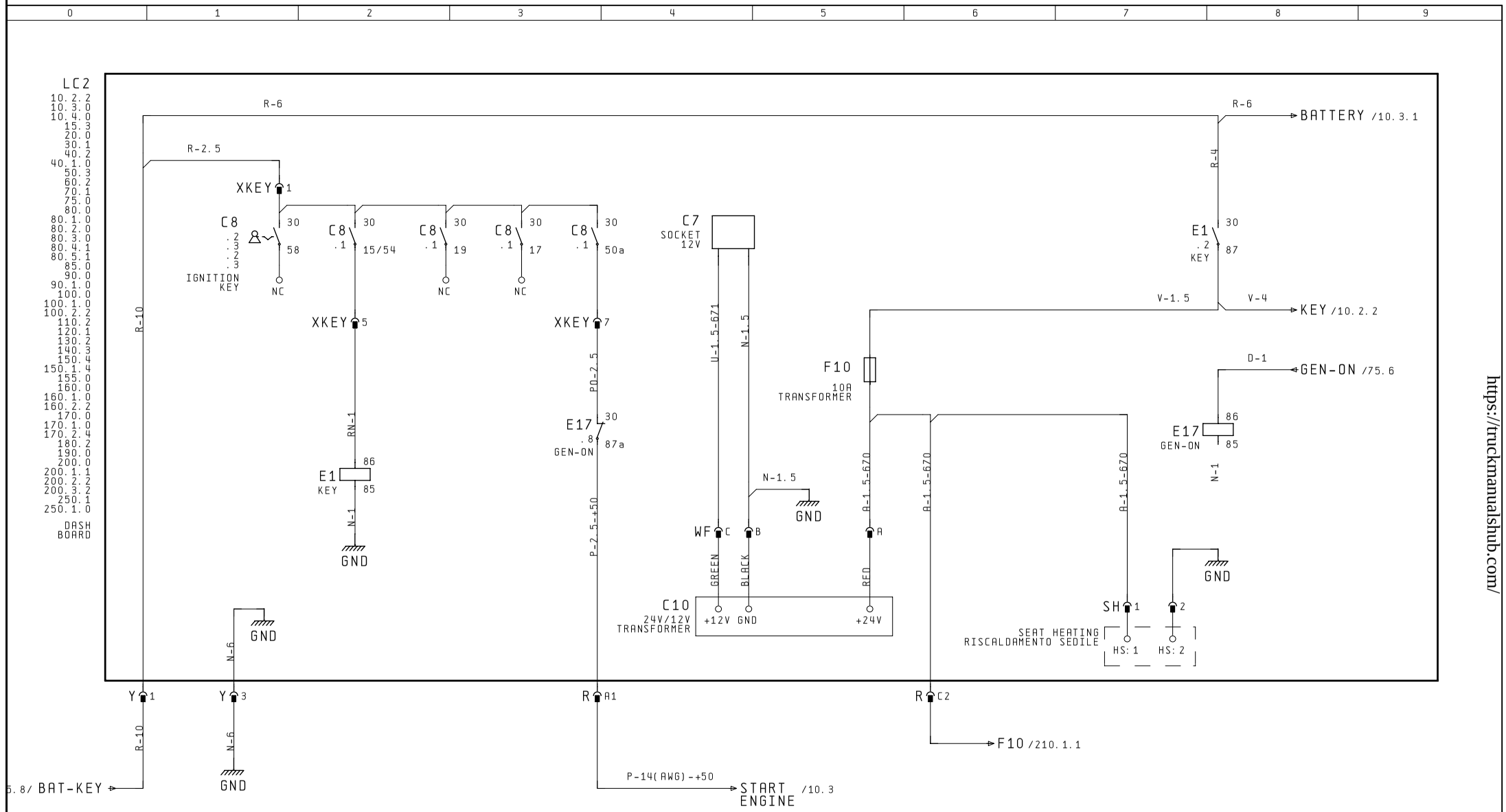


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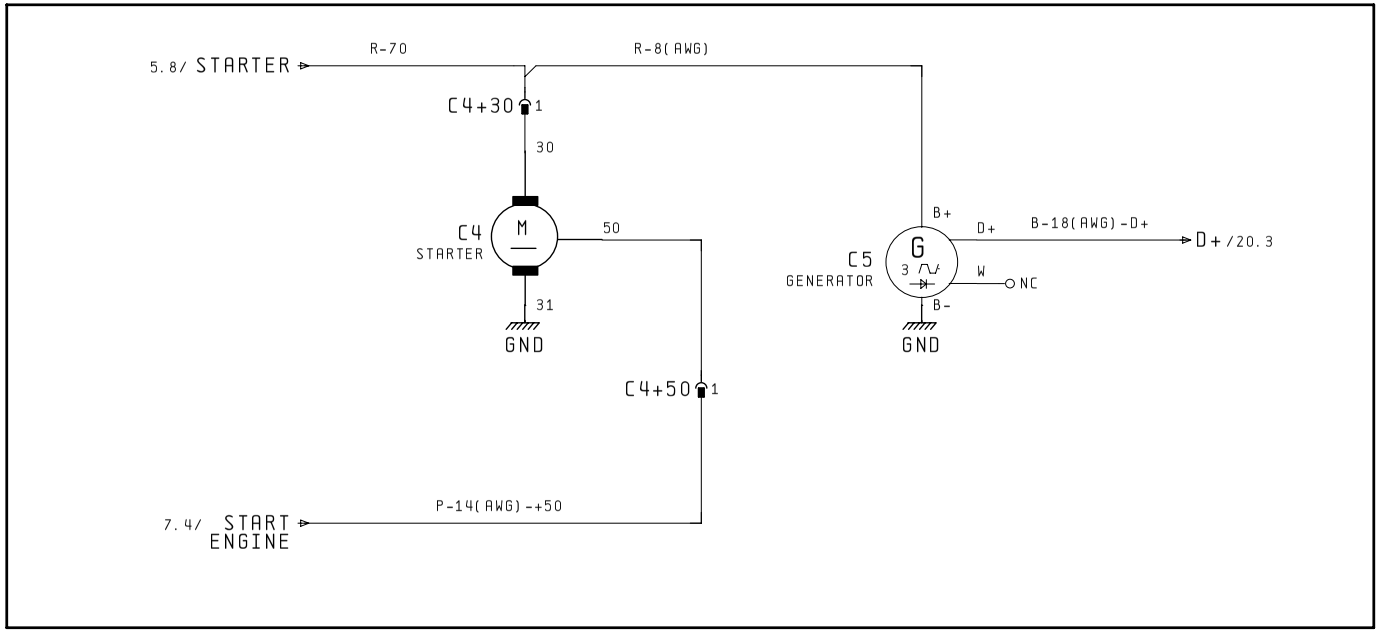






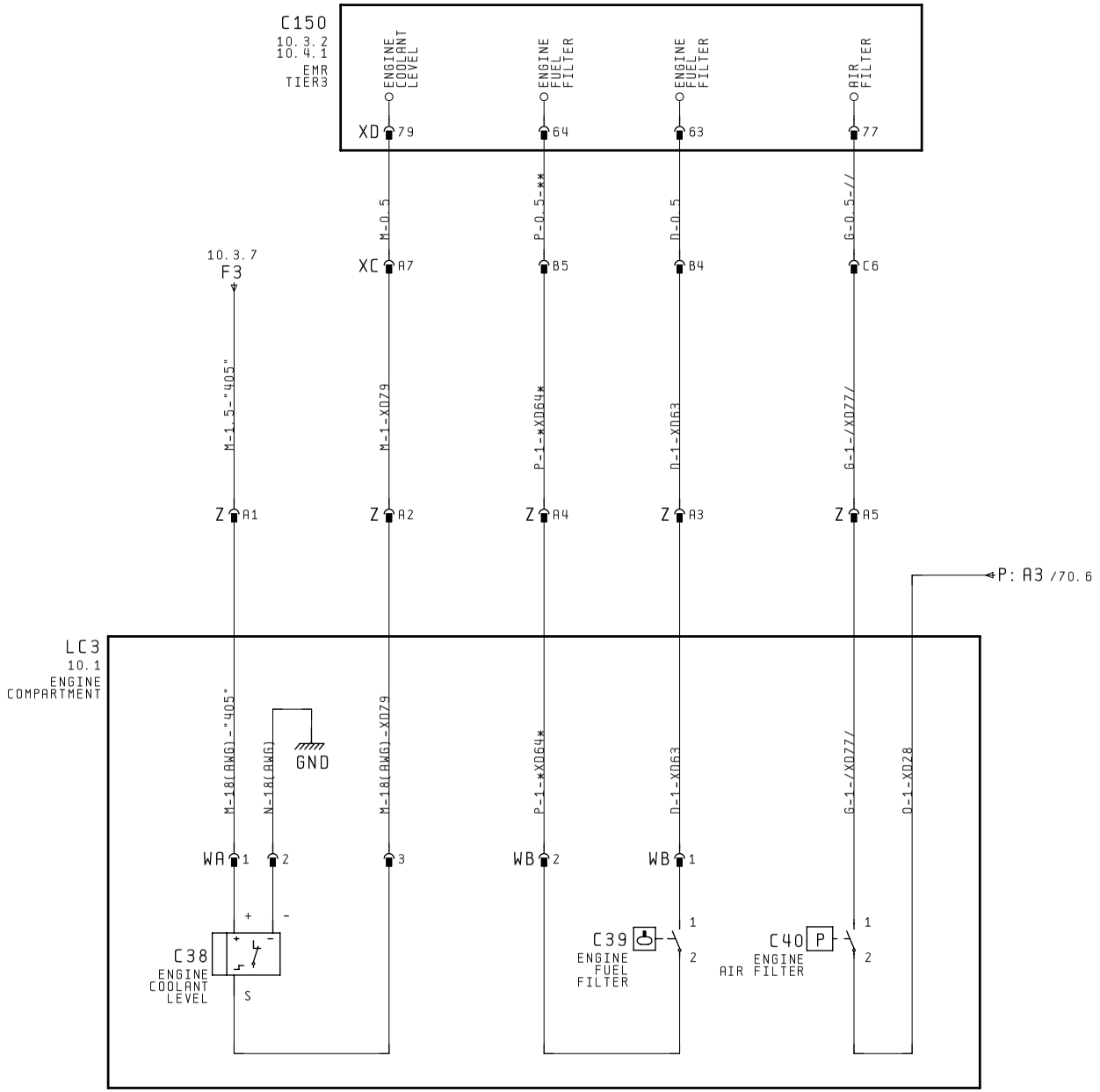
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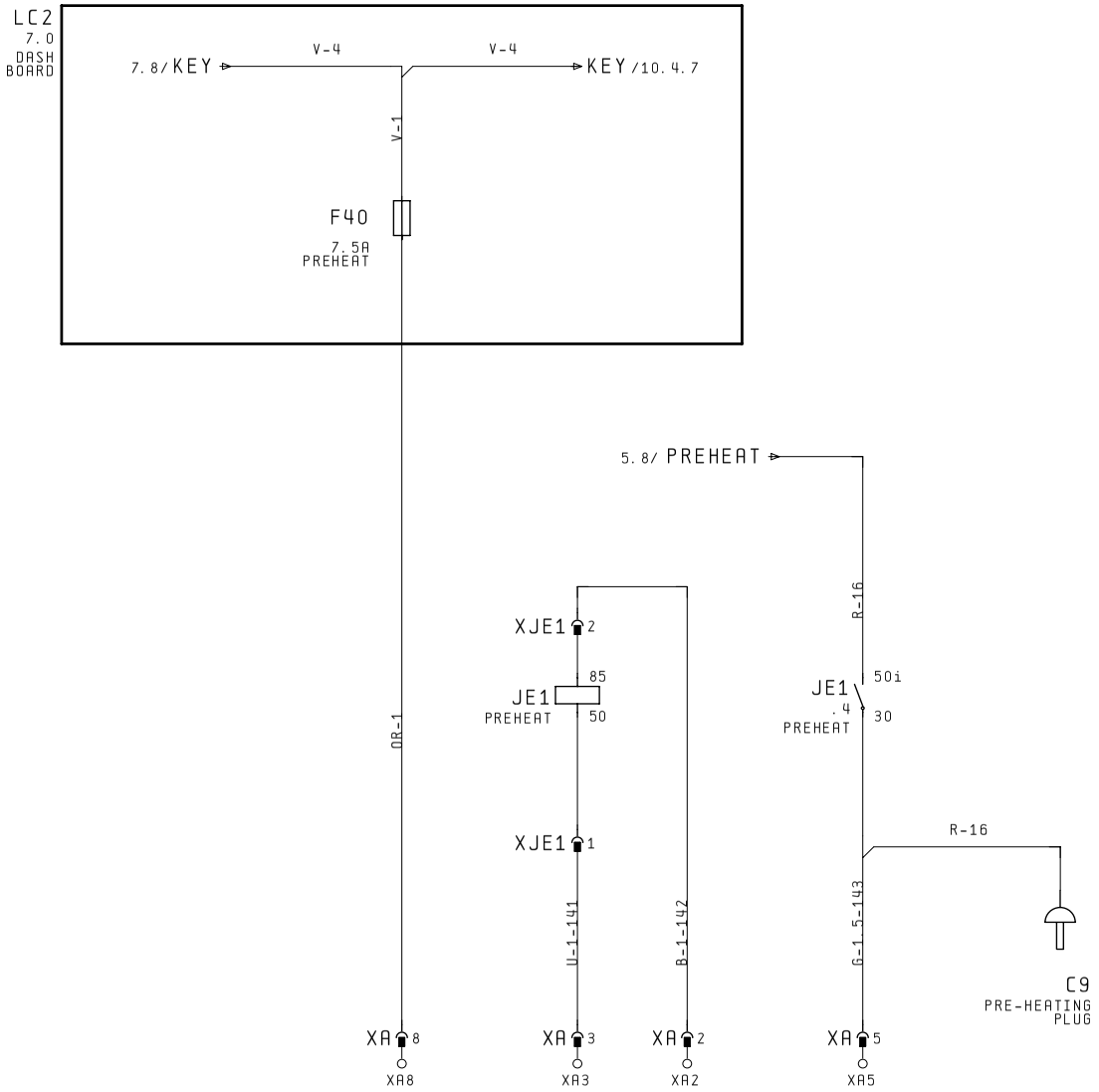
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LC2
7.0
DASH
BOARD

DIAGNOSTIC

7.8/ BATTERY → R-6 → BATTERY /30.1

R-2.5

F13
10A
POWER
EMR

P-2.5

P-2.5

E8
POWER
EMR
85
86

E8
.1
POWER
EMR
30
87

R-2.5-XD1

XD: 28 /70.4

XE
E NC
D NC
CANL G
CANH H
DIAGNOSTIC K
CANH2 M
CANL2 F
GND B
C NC
J NC
L NC
+VCC A

N-1
GND

M-1-"405"
M-1.5-"405"
M-1-"405"
10.1.3/F3
F3 /20.1

P-1-XD62
CAN H2 /20.7

U-1-XD61
CAN L2 /20.8

TWISTED
TWISTED
TWISTED
TWISTED

GND

A-1-XD72
R-1-XD1
R-1-XD3
R-1-XD5
O-1-XD28
N-1
N-1
N-1
R-1-XD60
G-1-XD82
V-1-XD25
P-1-XD62
U-1-XD61

XC
A2
A1
B1
C1
A3
A8
B8
C8
A4
A5
A6
B2
B3

A-0.5
R-1
R-0.5
R-0.5
O-0.5
N-1
N-1
N-1
B-0.5
G-0.5
V-0.5
P-0.5
U-0.5

C150
10.1.3
EMR
TIER3

XD
72 GND
1 POWER
3 POWER
5 POWER
28 +VCC KEY
2 GND
4 GND
6 GND
60 CANL
82 CANH
25 DIAGNOSTIC
62 CANH2
61 CANL2



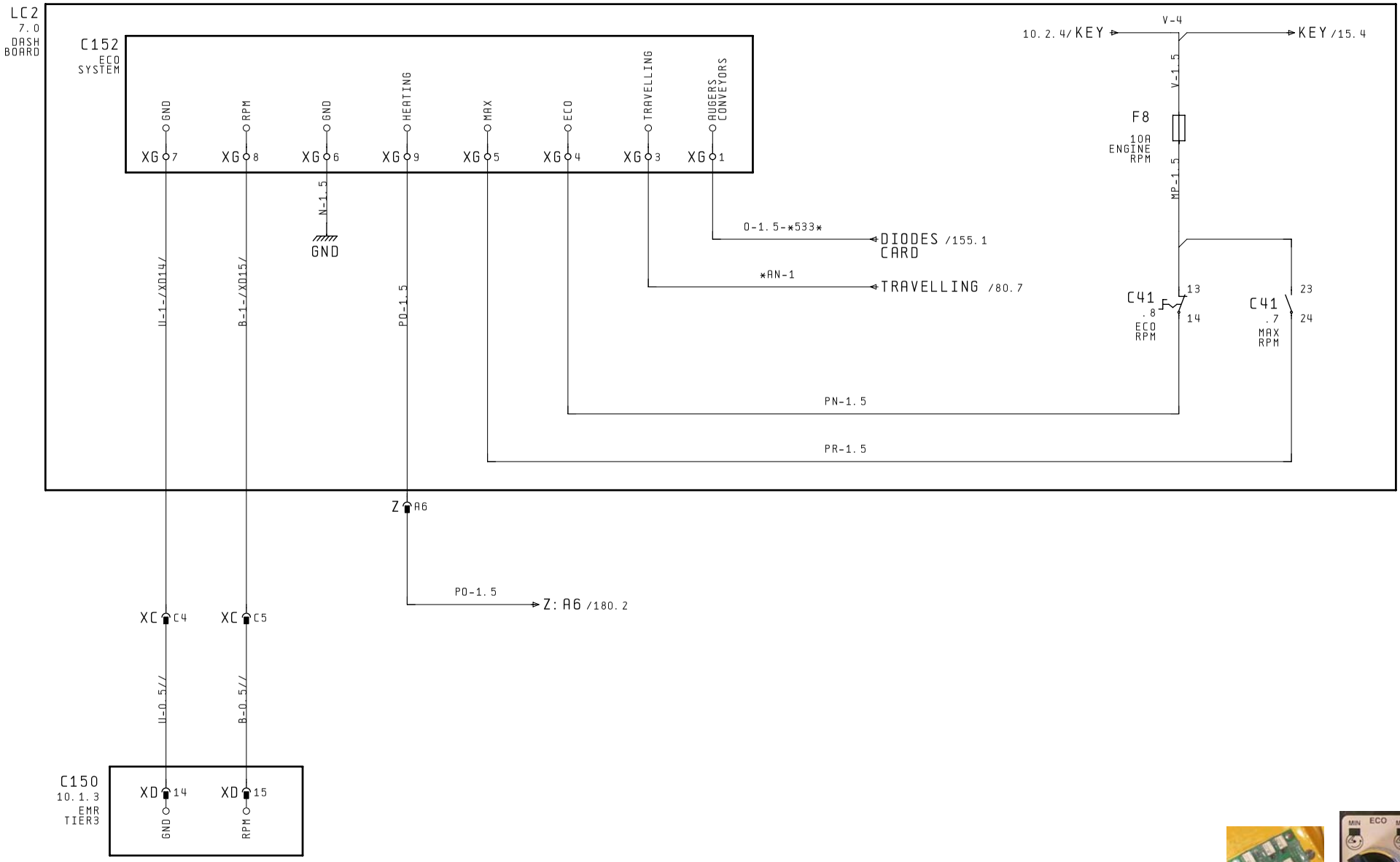
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10.2

10.4

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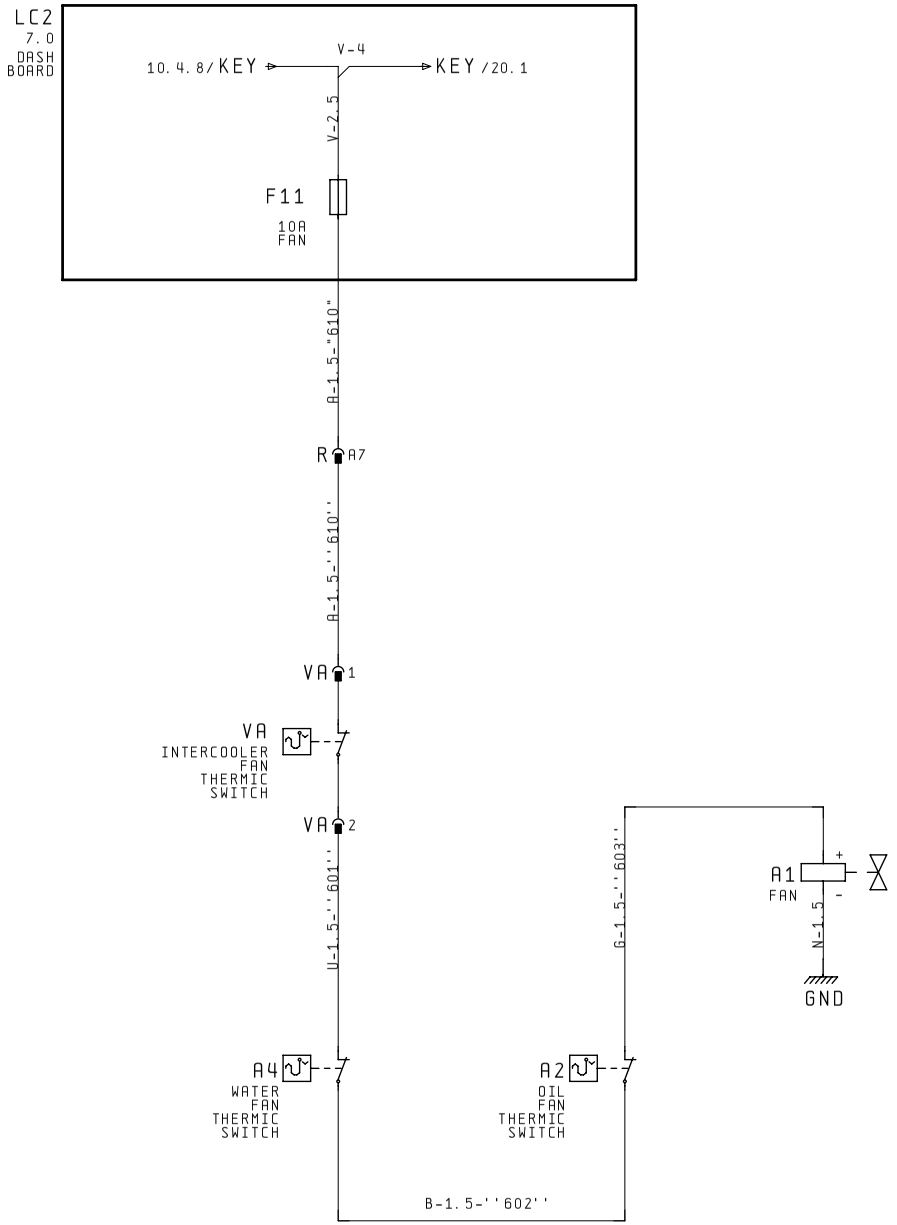






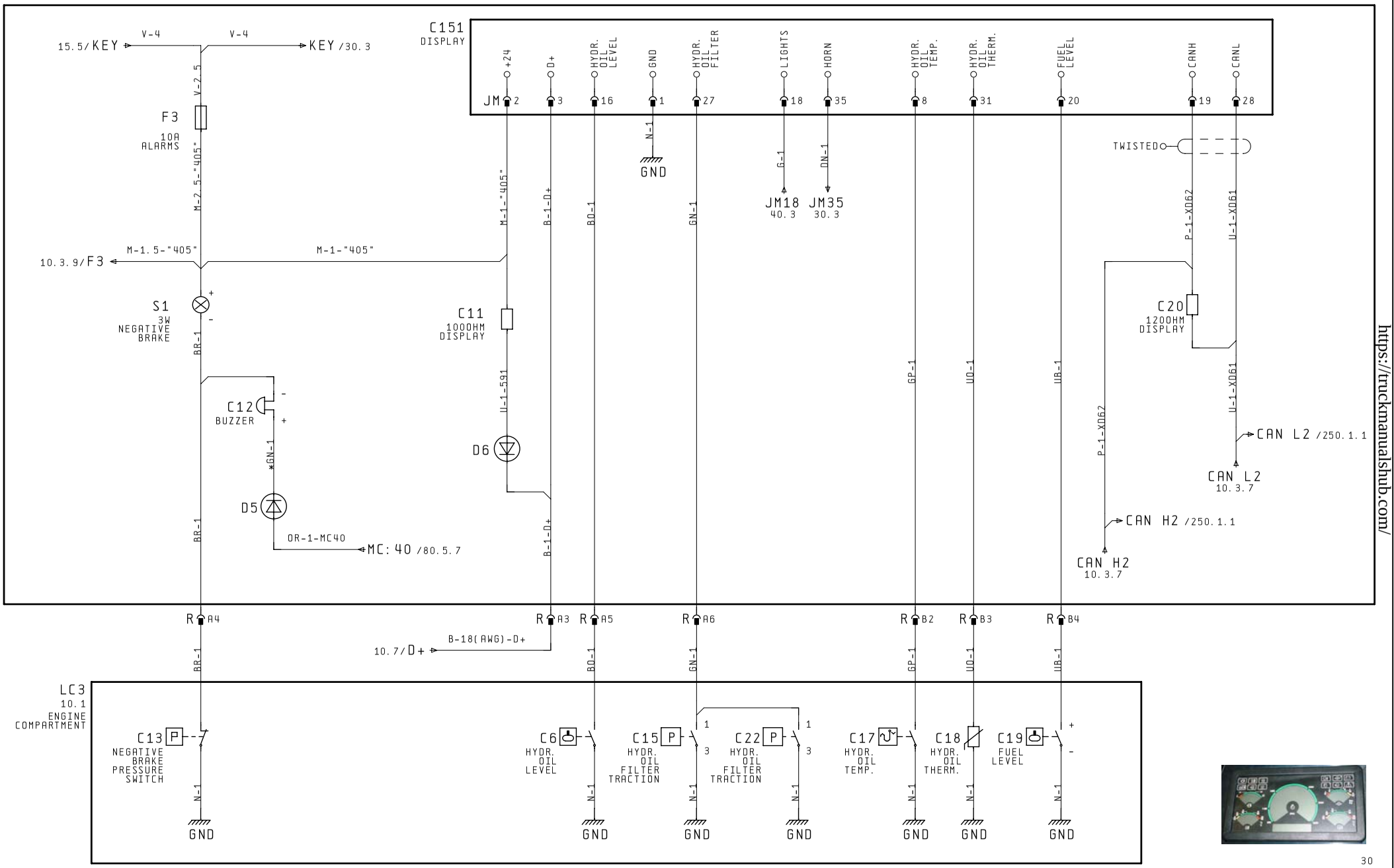
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Design.: Zuccarino Luca date: 28. Lug. 2011 Resp. USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	ENGINE RPM MOTORE RPM	D: DE006010	pag. 10.4



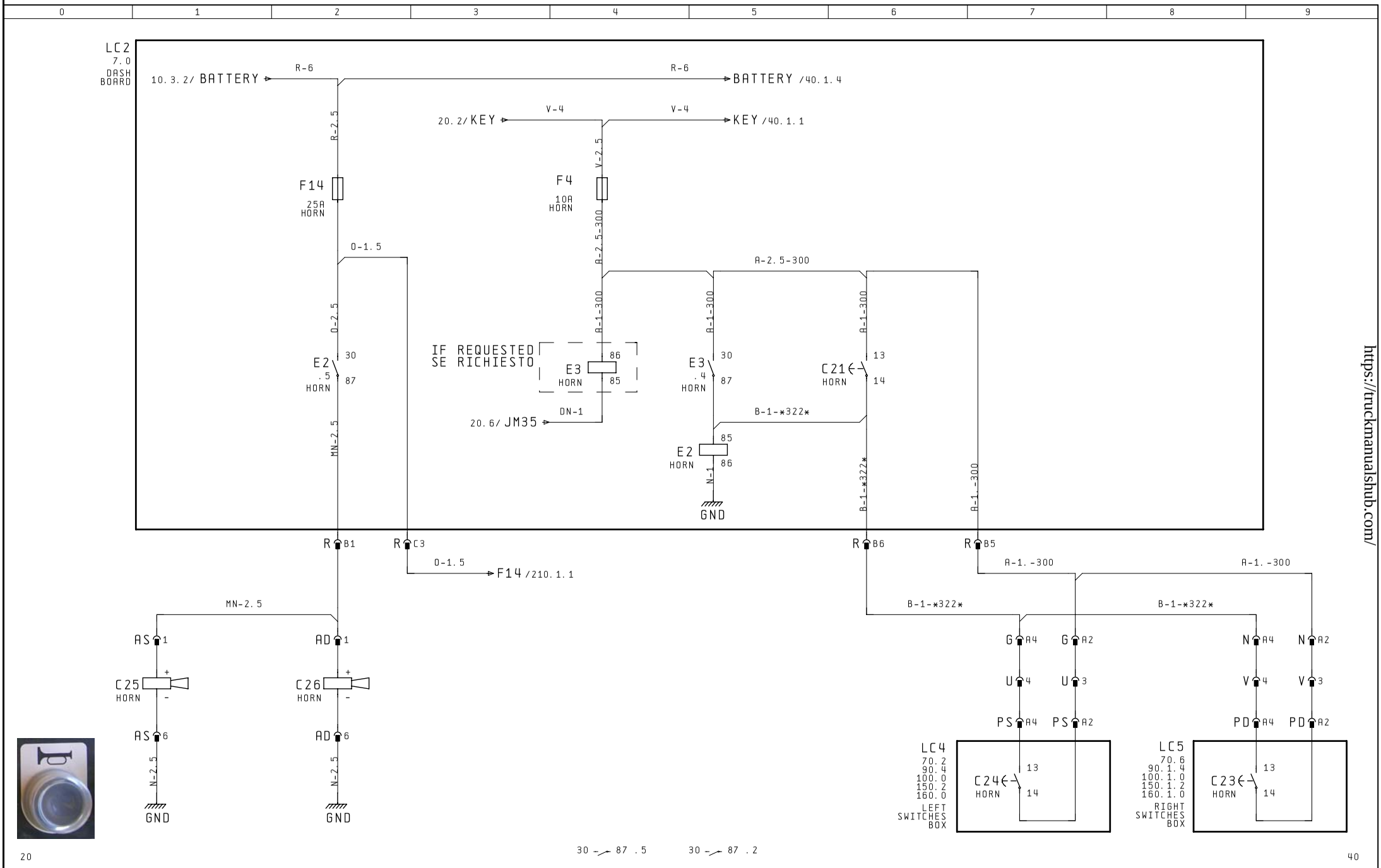
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Design.: Zuccarino Luca date: 28.Lug.2011 Resp.USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	FAN VENTOLA	D: DE006010	pag. 15



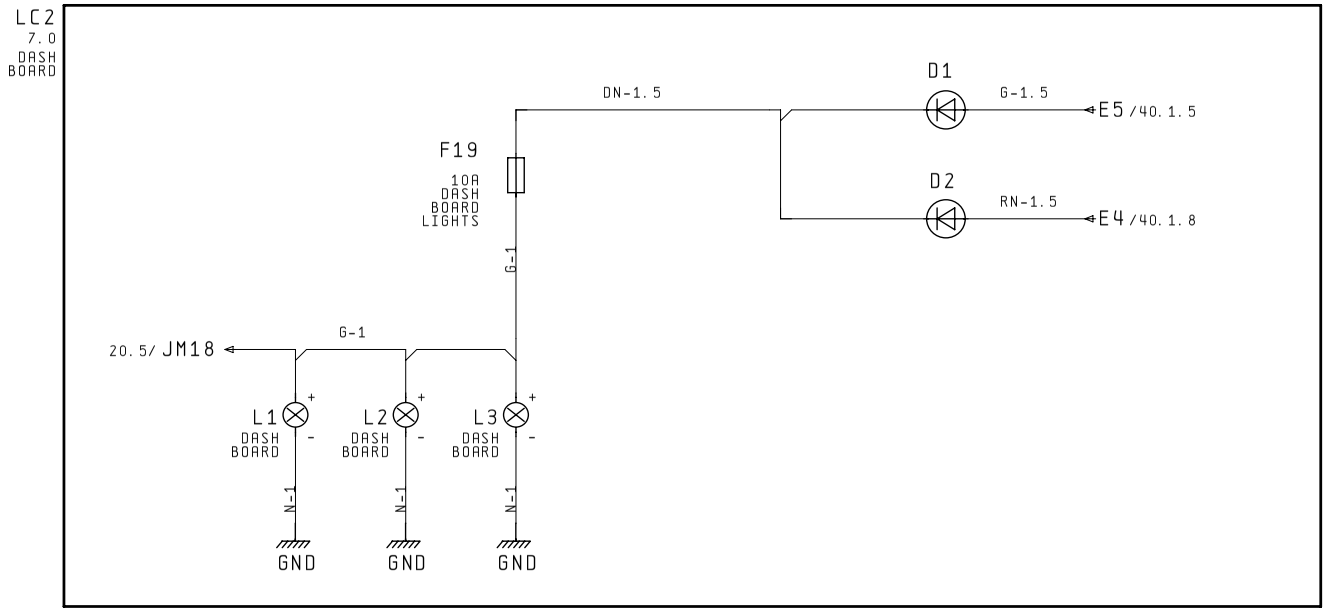
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Design.: Zuccarino Luca date: 28. Lug. 2011 Resp. USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	HORN CLAXON	D: DE006010	pag. 30

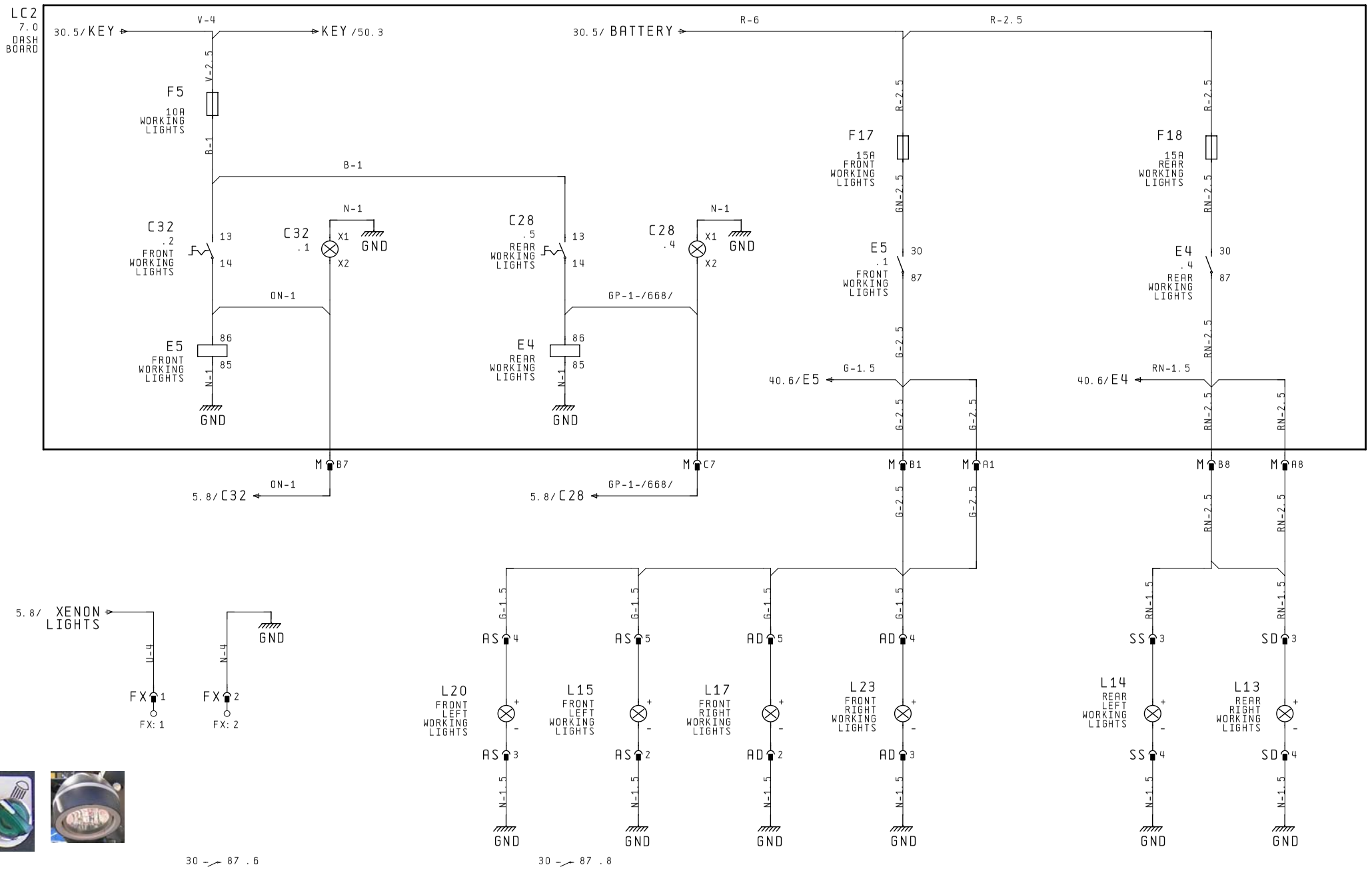


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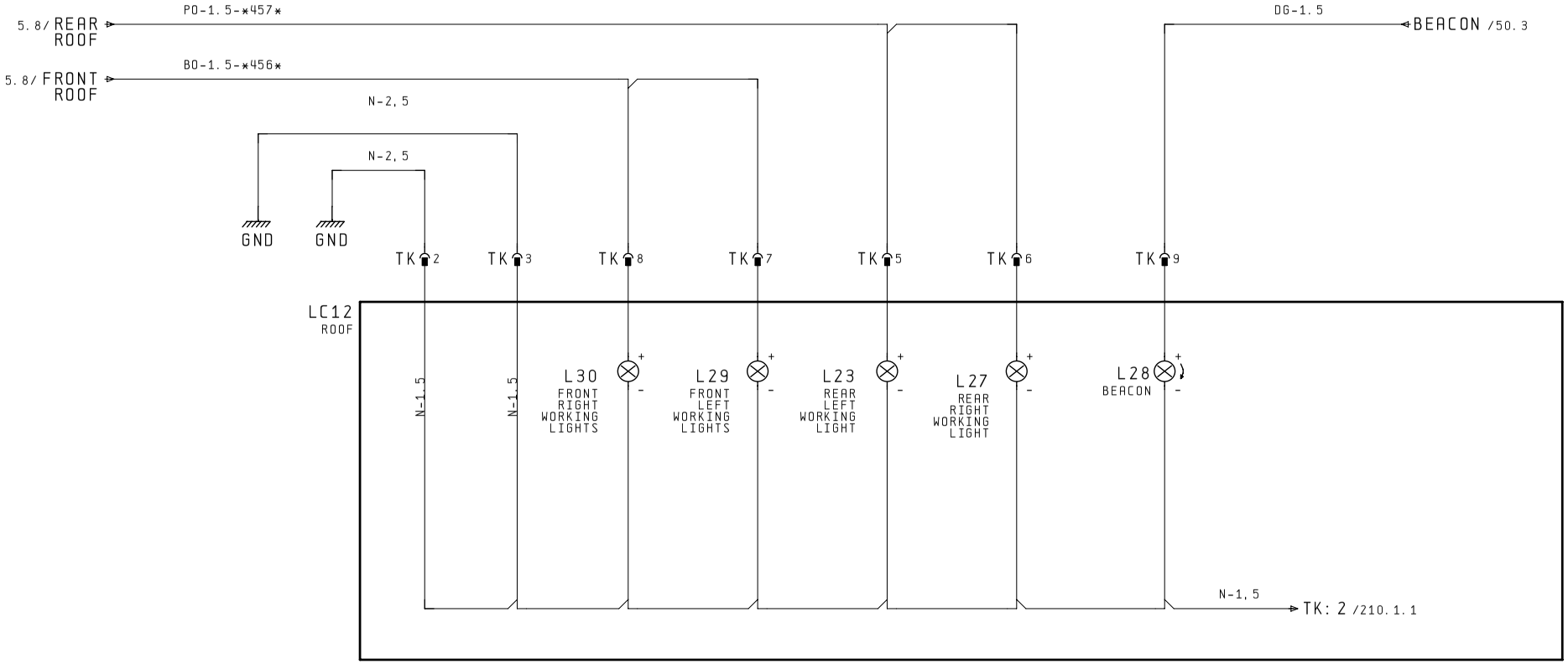


Design.: Zuccarino Luca date: 28.Lug.2011 Resp.USER: ING.ZANIBONI	BOMAG FAYAT GROUP	BF600C	DASHBOARD LIGHTS LUCI CRUSCOTTO	D: DE006010	pag. 40



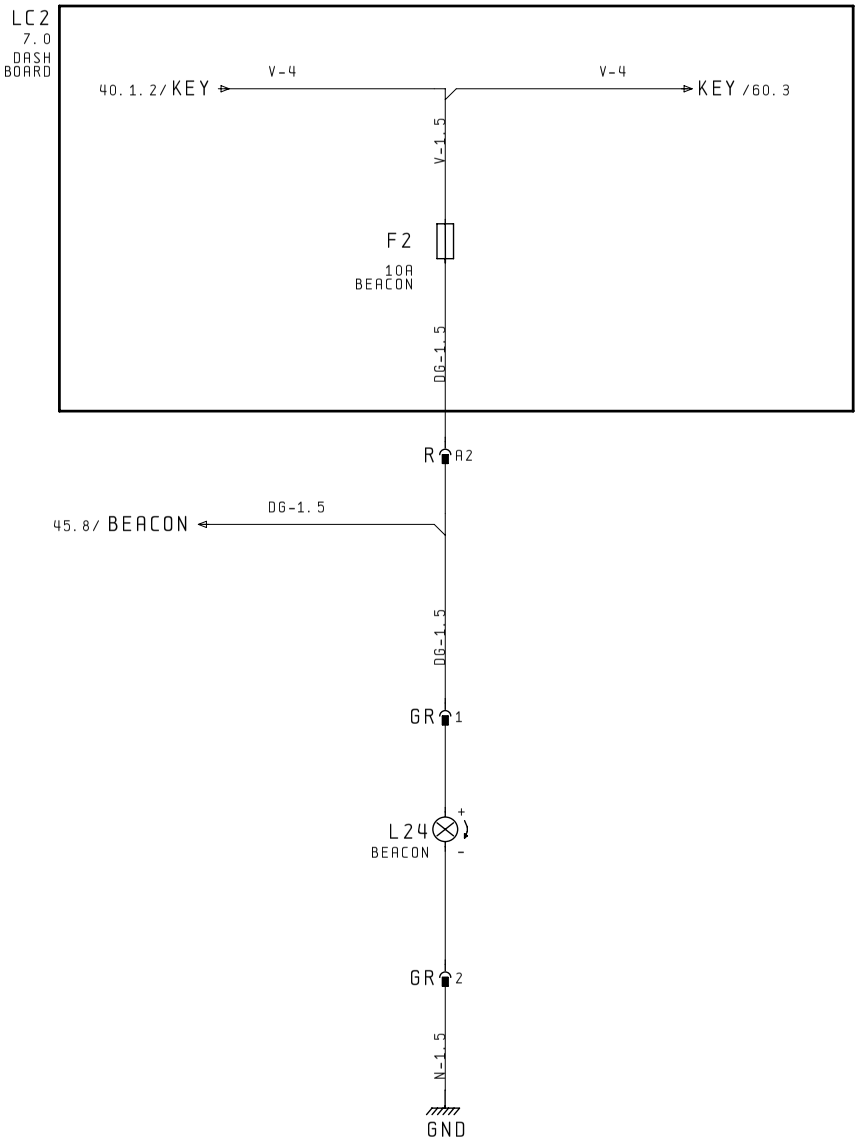
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Design.: Zuccarino Luca date: 28. Lug. 2011 Resp. USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	WORKING LIGHTS FARI DI LAVORO	D: DE006010	pag. 40. 1





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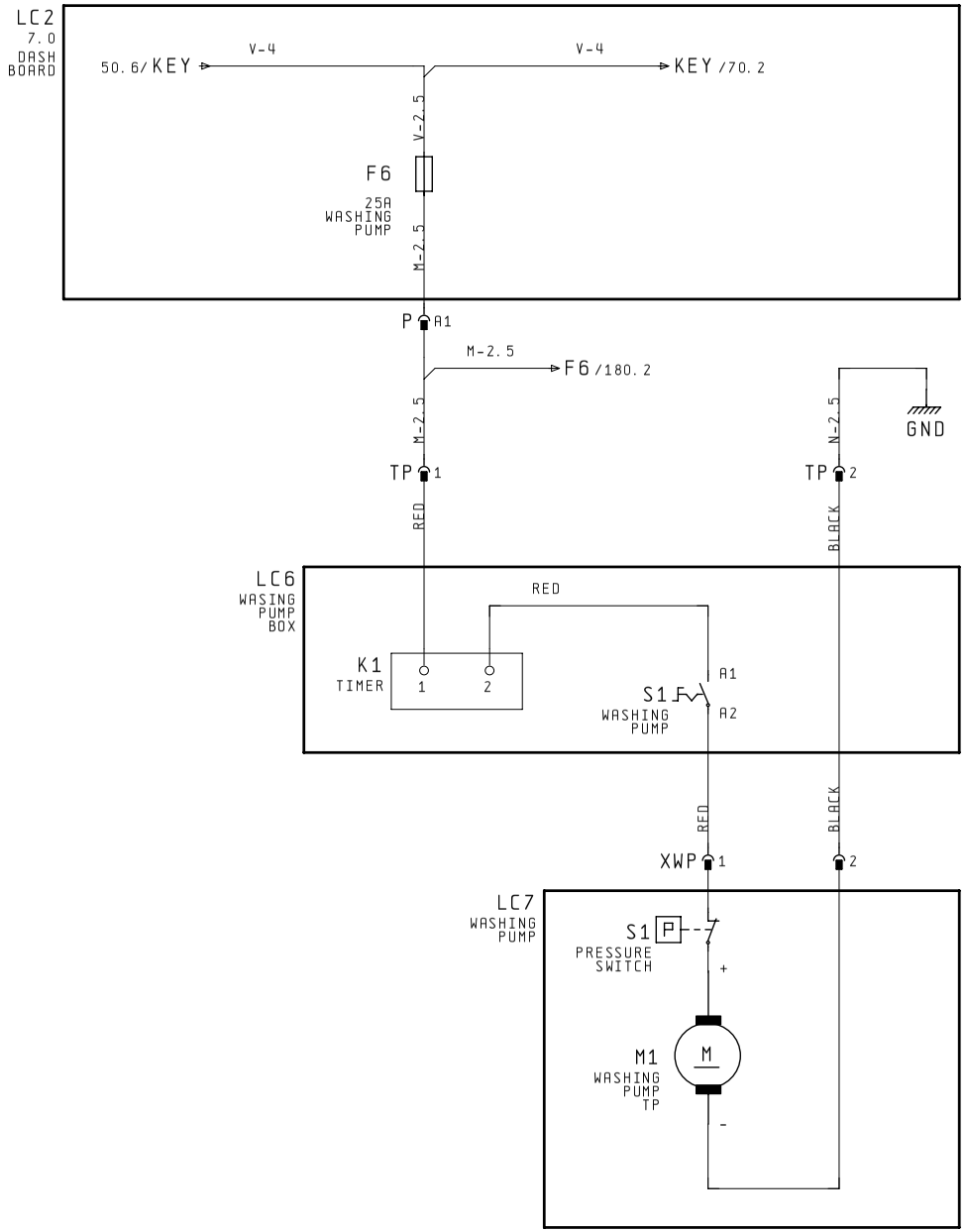


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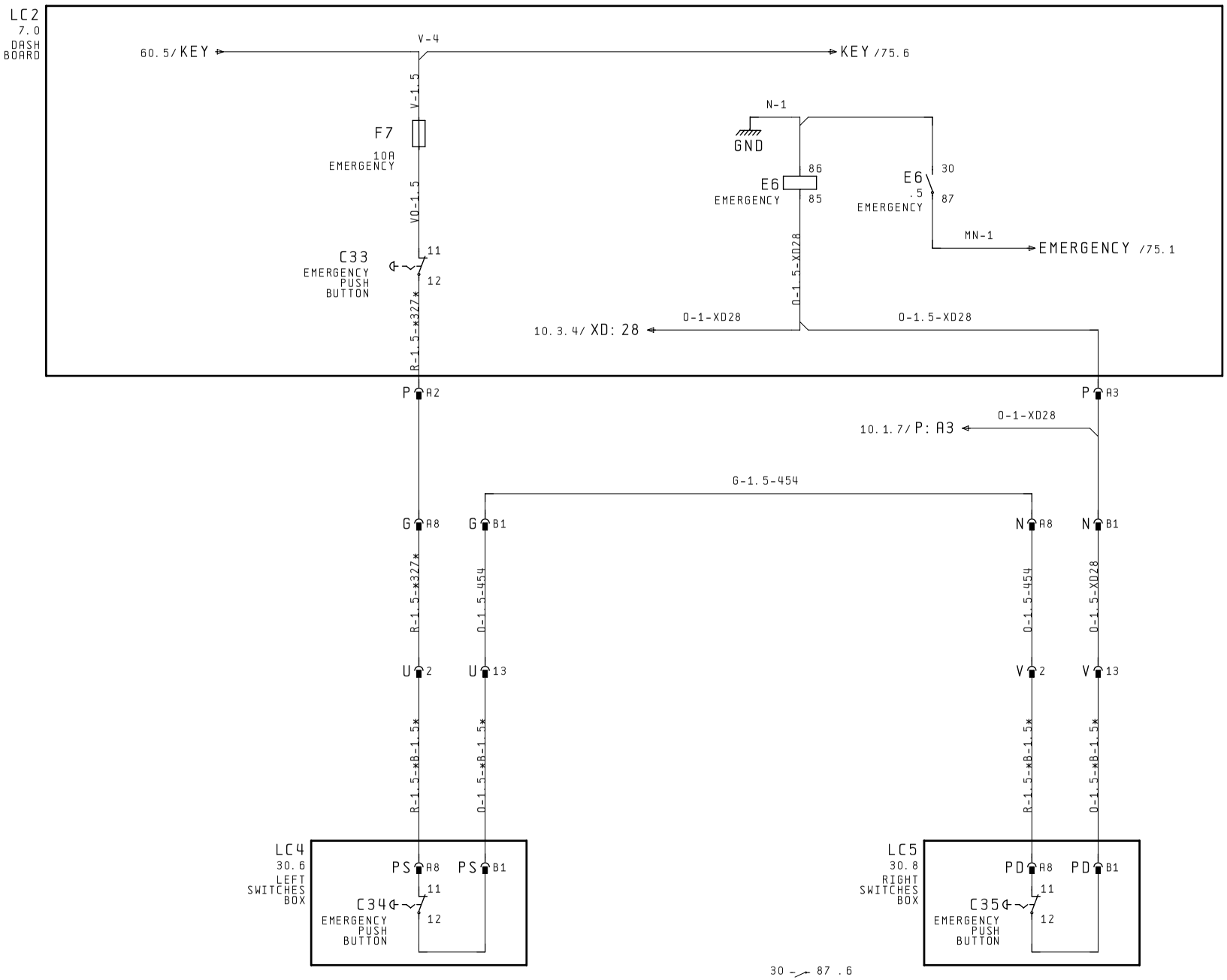
Design.: Zuccarino Luca date: 28.Lug.2011 Resp.USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	BEACON GIROFARO	D: DE006010	pag. 50





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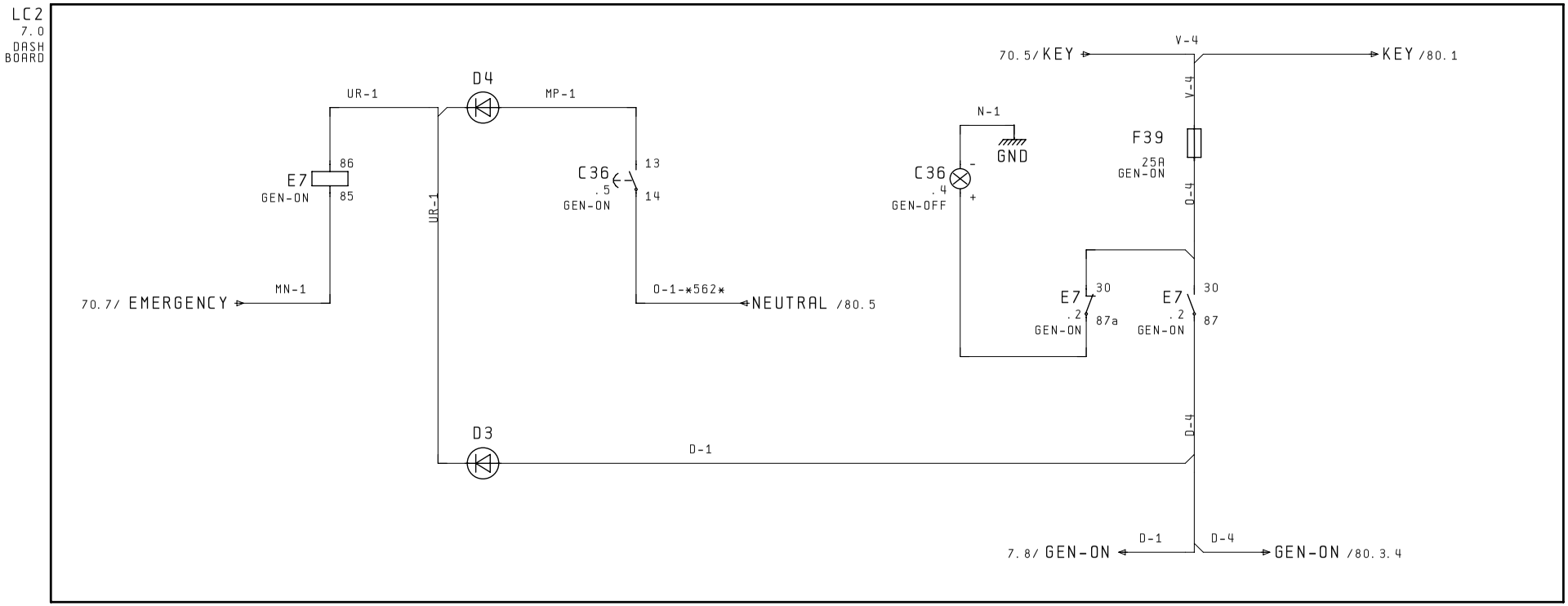
Design.: Zuccarino Luca date: 28.Lug.2011 Resp.USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	WASHING PUMP POMPA LAVAGGIO	D: DE006010	pag. 60





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Design.: Zuccarino Luca date: 28. Lug. 2011 Resp. USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	EMERGENCY PUSH BUTTONS PULSANTI EMERGENZA	D: DE006010	pag. 70





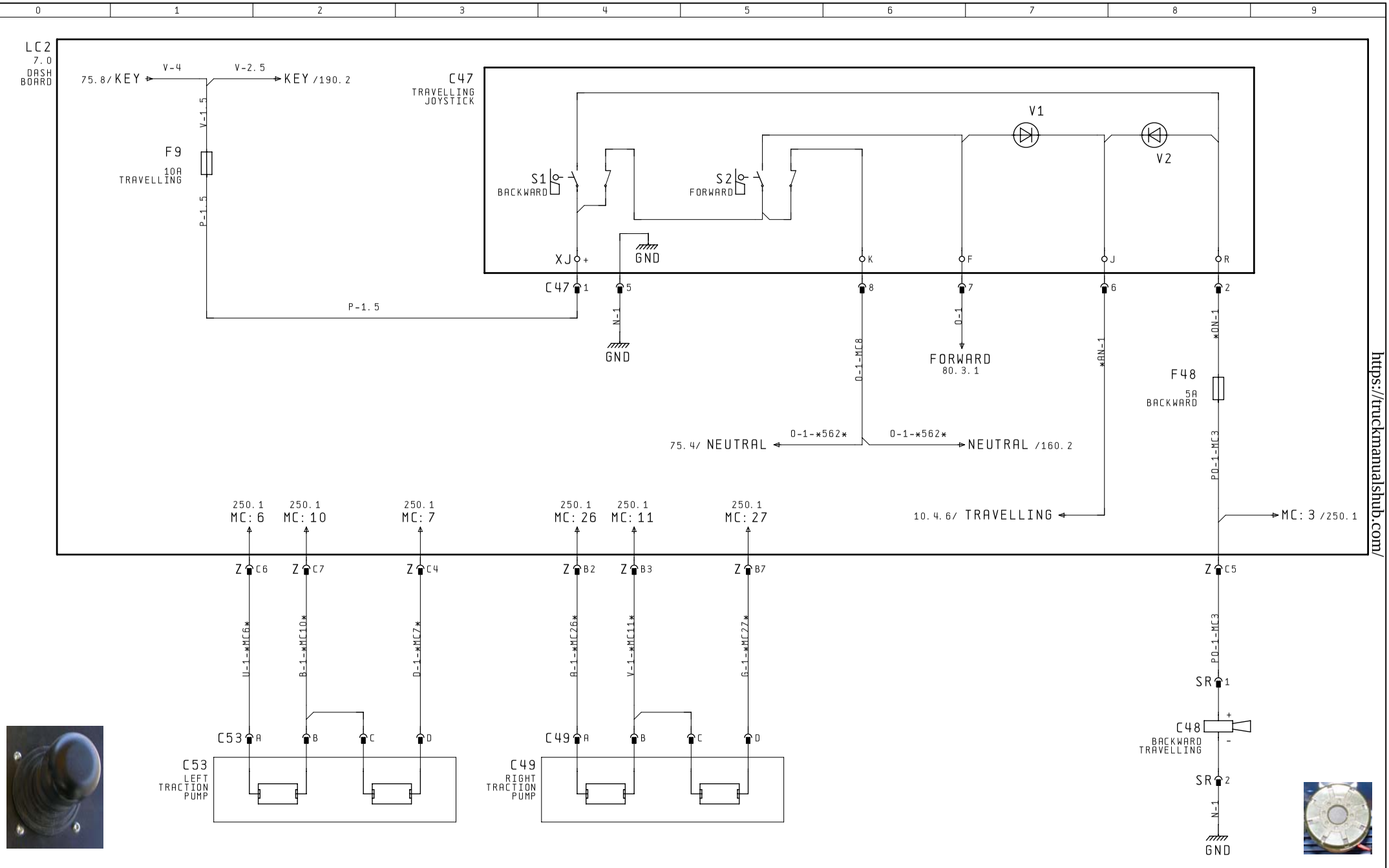
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Design.: Zuccarino Luca date: 28. Lug. 2011 Resp. USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	GENERAL ON	D: DE006010	pag. 75

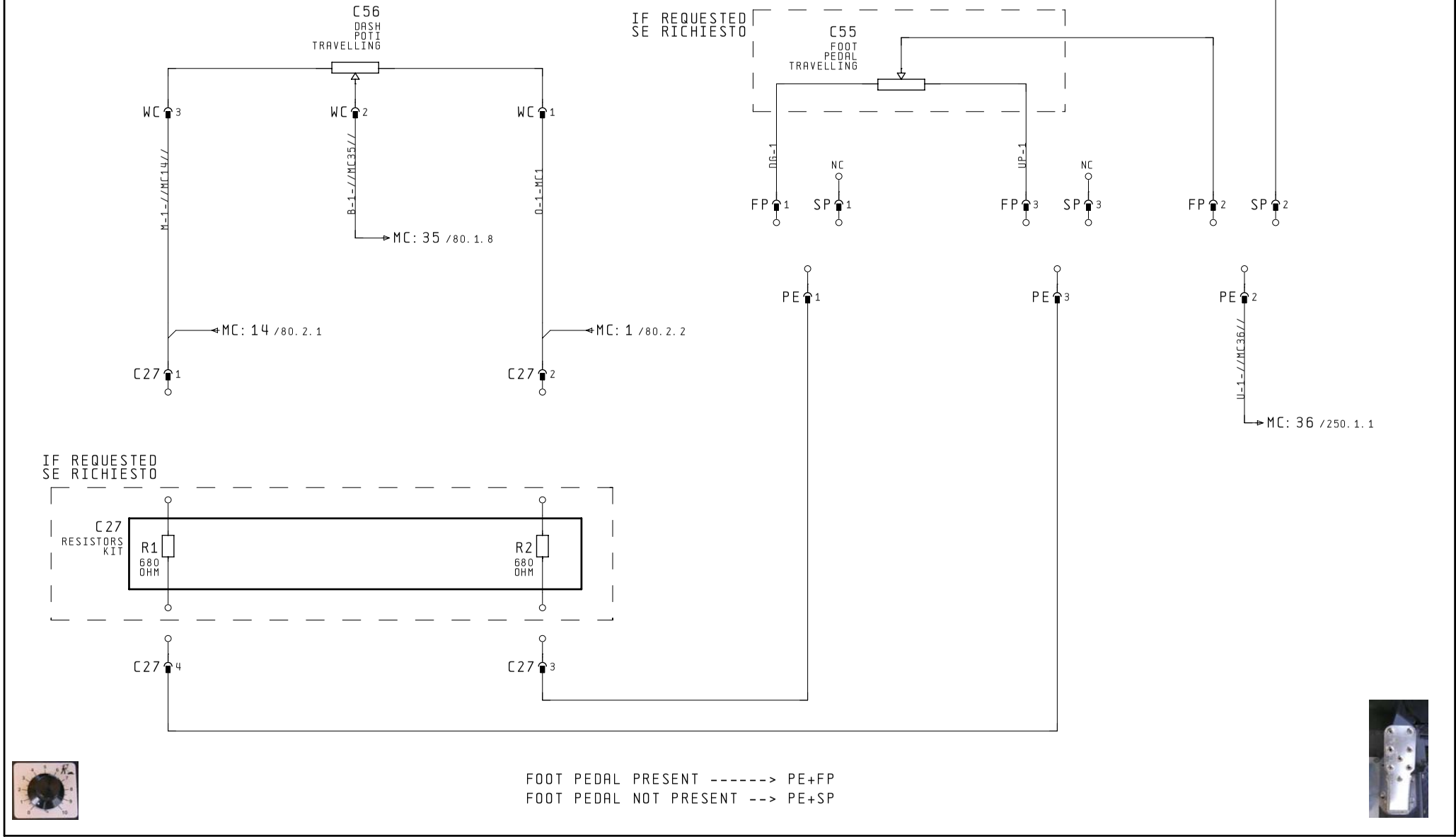


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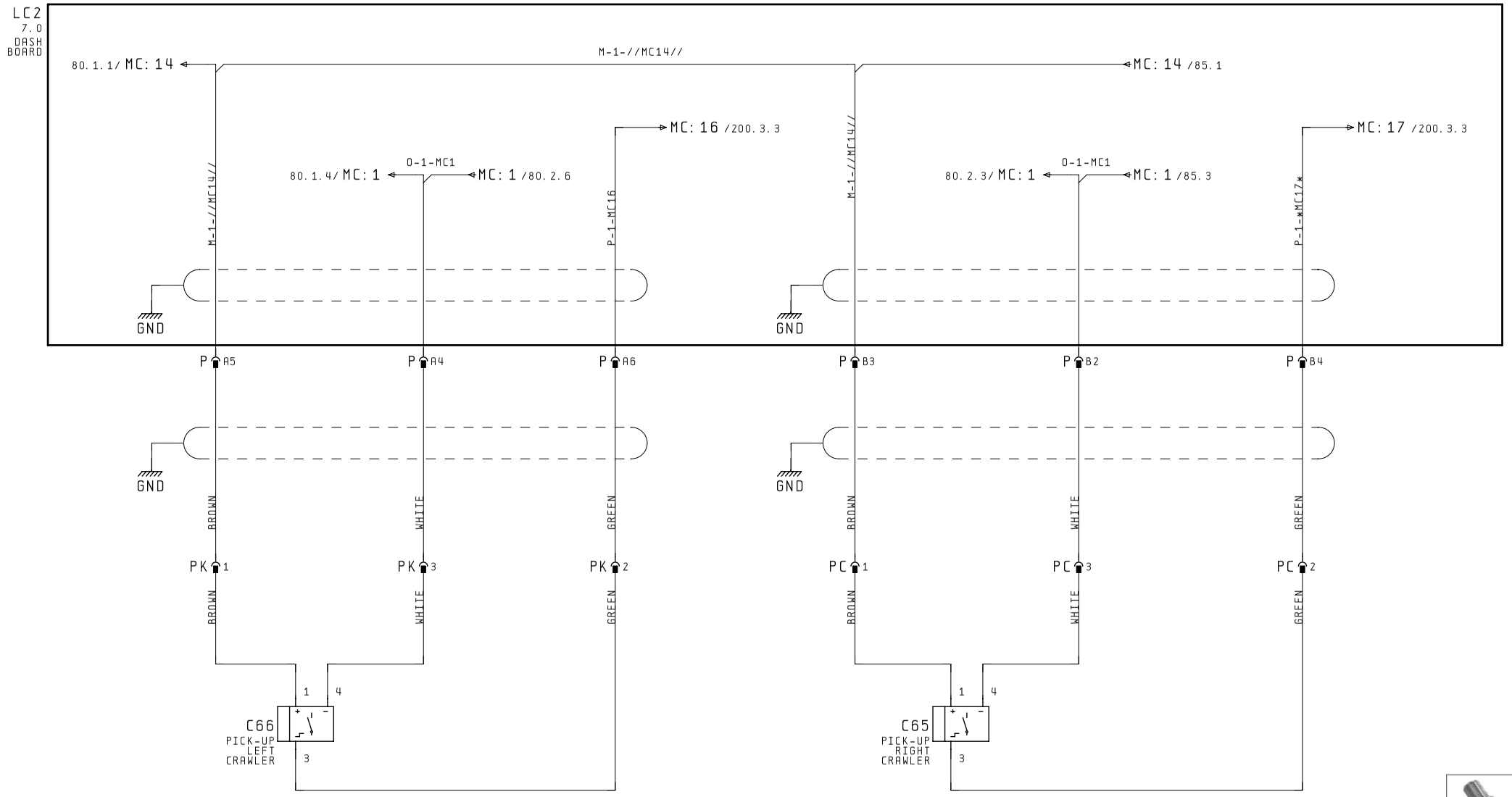
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Design.: Zuccarino Luca date: 28. Lug. 2011 Resp. USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	TRAVELLING AVANZAMENTO	D: DE006010	pag. 80

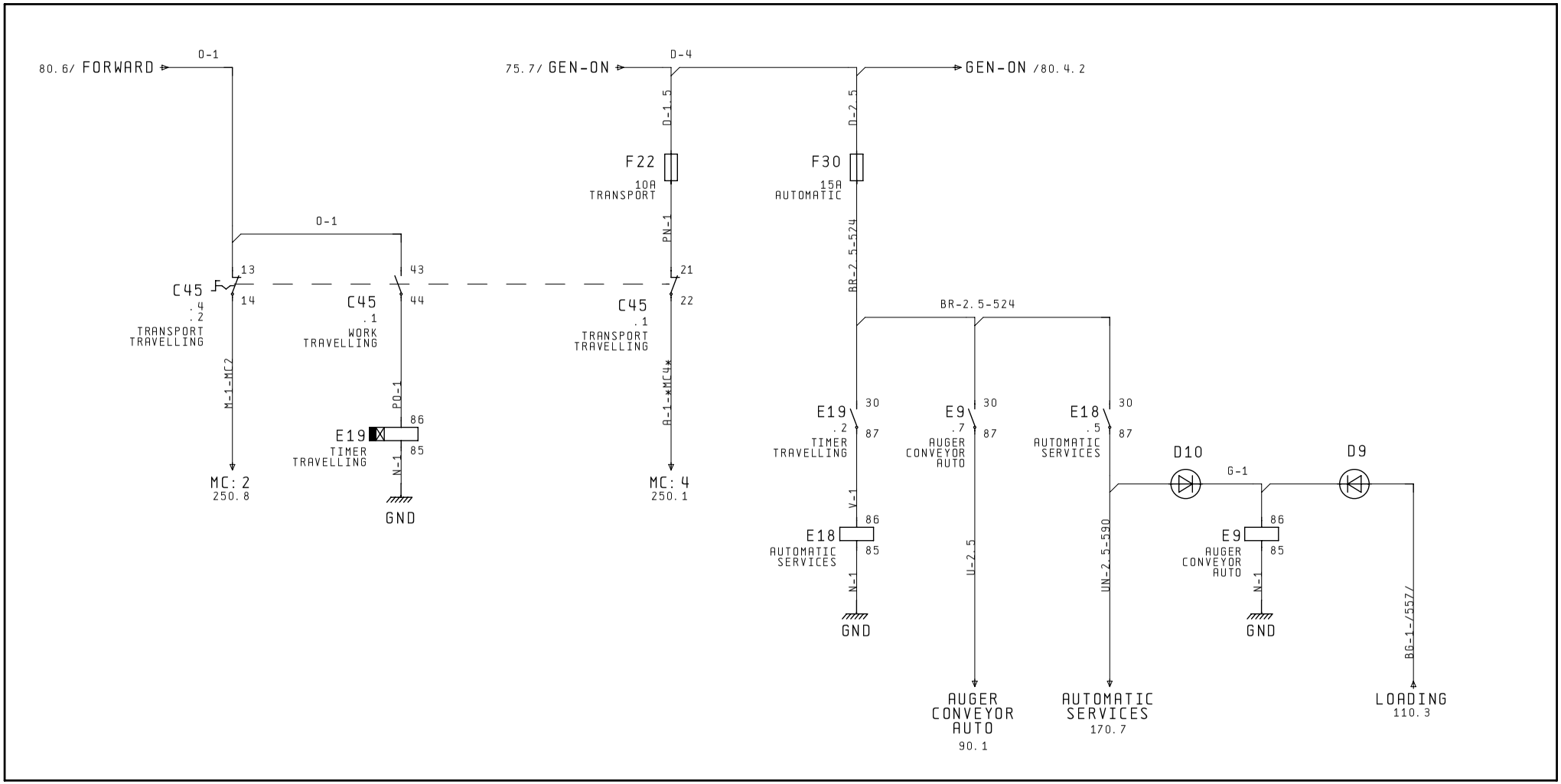


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Design.: Zuccarino Luca date: 28.Lug.2011 Resp.USER: ING.ZANIBONI	BOMAG FAYAT GROUP	BF600C	TRAVELLING AVANZAMENTO	D: DE006010	pag. 80.1



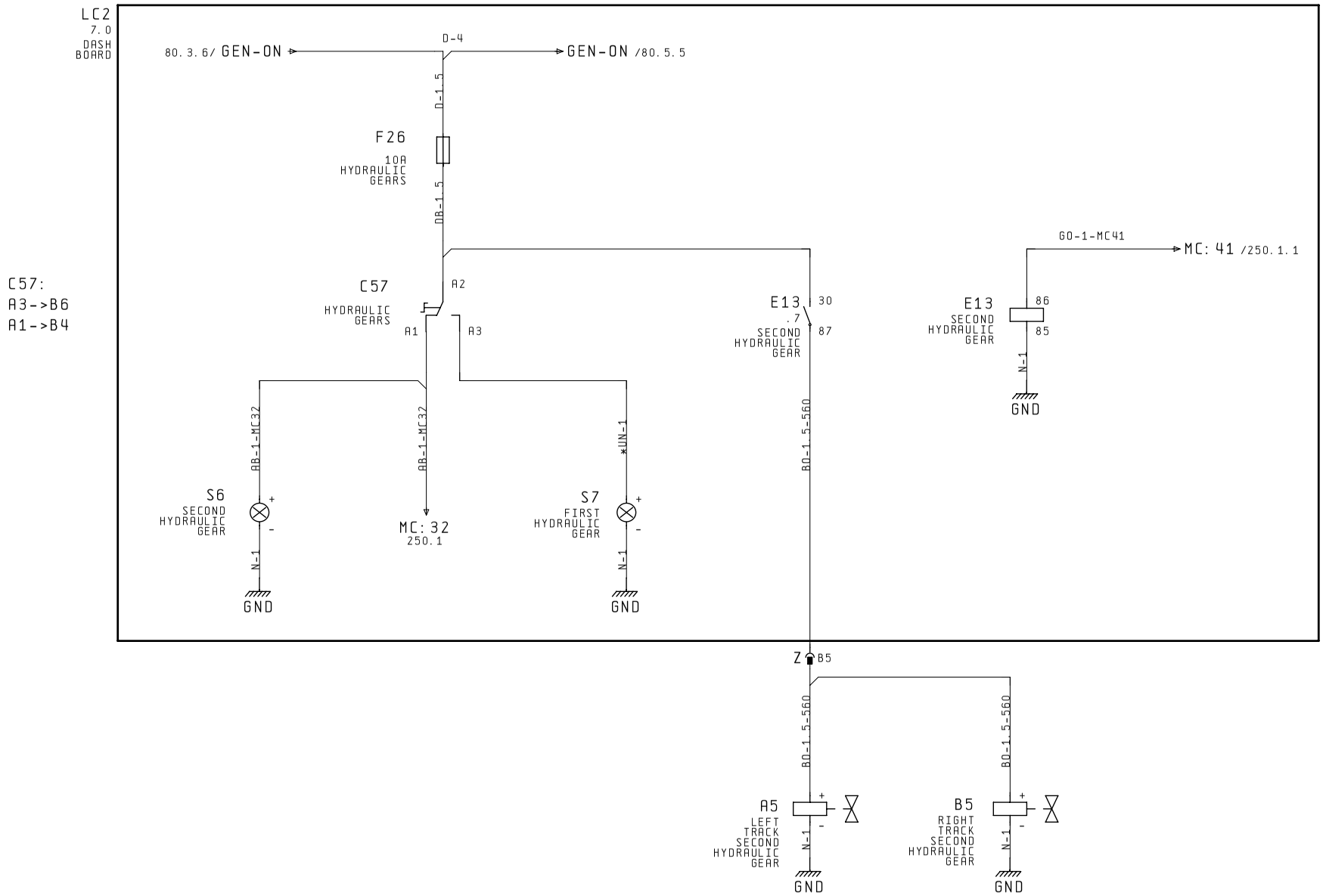
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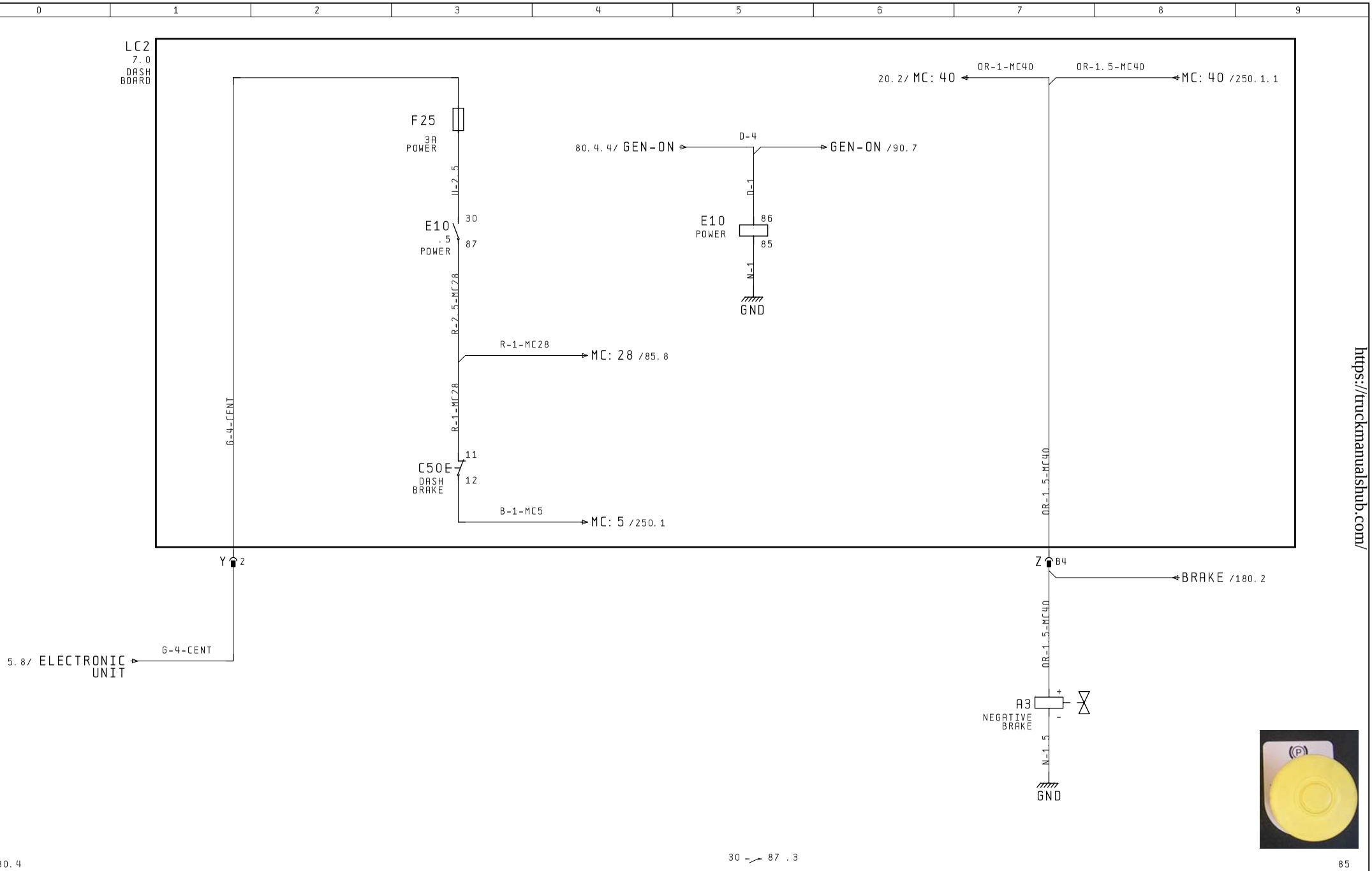


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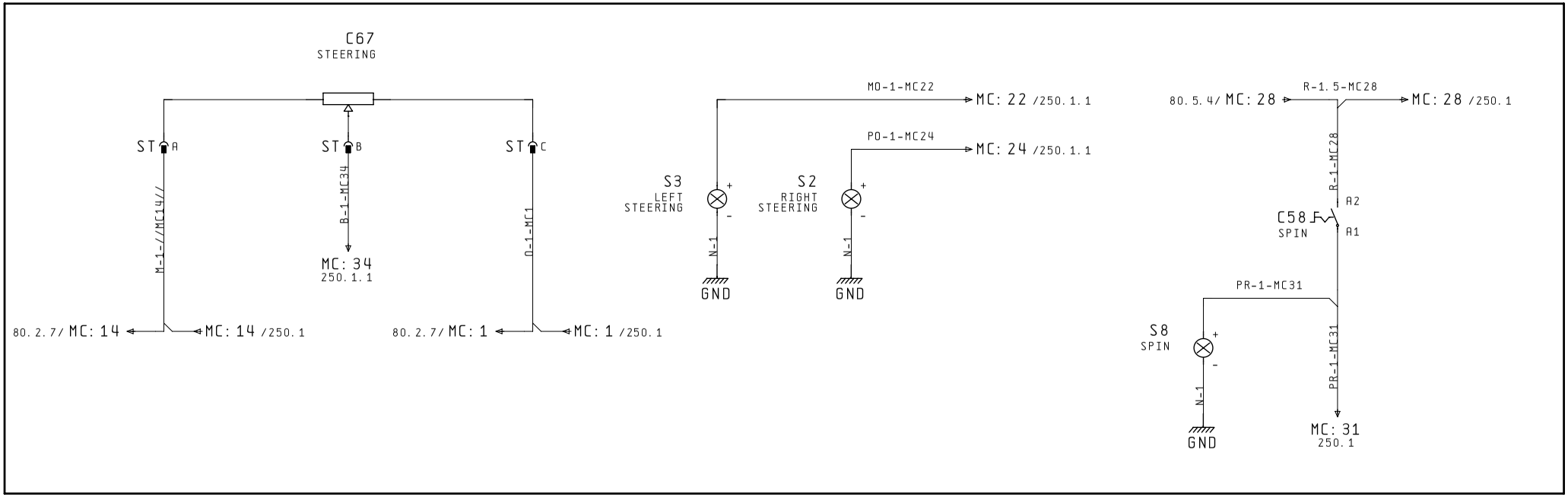
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Design.: Zuccarino Luca date: 28. Lug. 2011 Resp. USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	BRAKE FRENO	D: DE006010	pag. 80.5

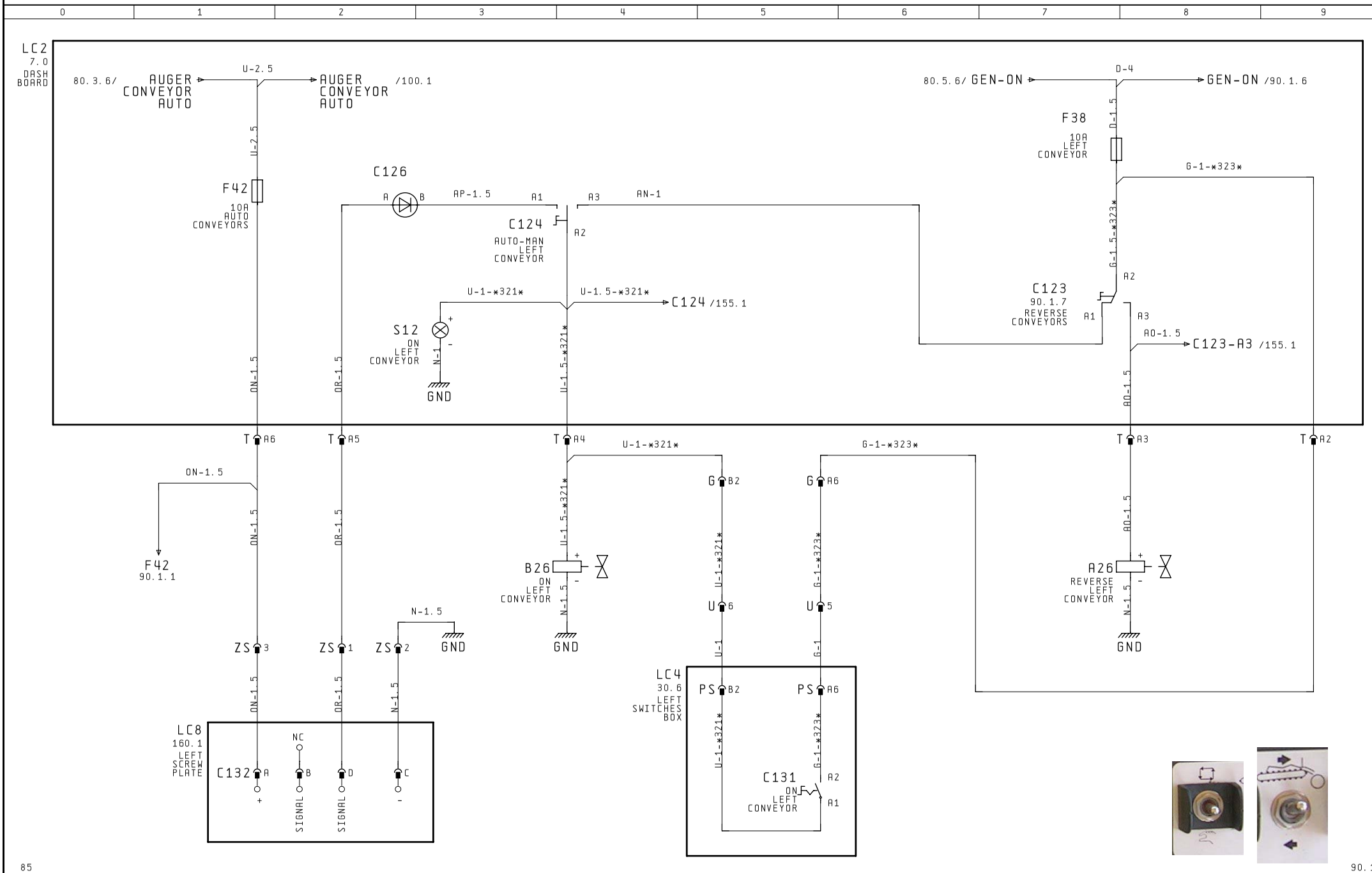


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Design.: Zuccarino Luca date: 28.Lug.2011 Resp.USER: ING.ZANIBONI	BOMAG FAYAT GROUP	BF600C	STEERING STERZATURA	D: DE006010	pag. 85

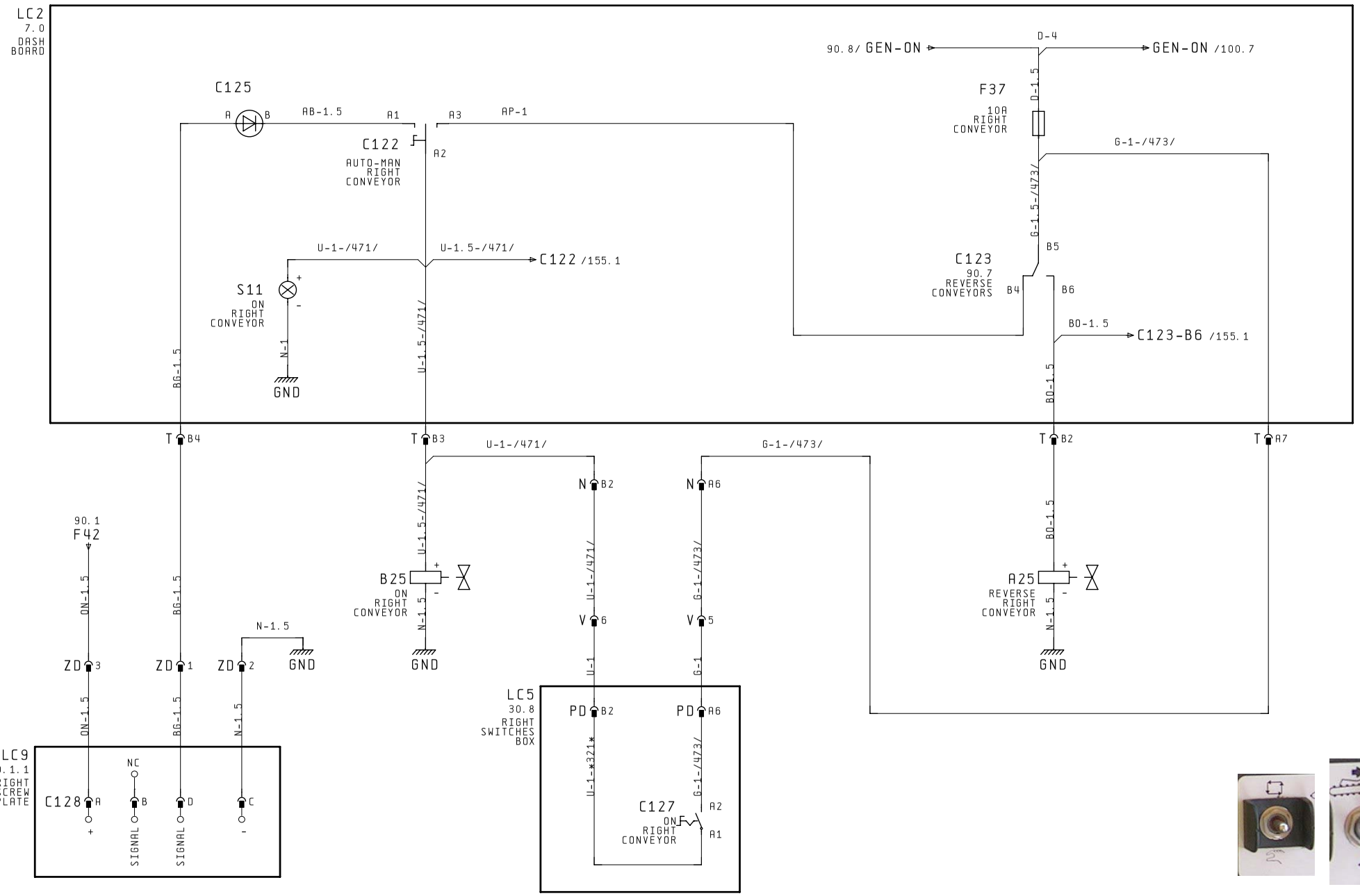


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85

90.1

Design.: Zuccarino Luca date: 28.Lug.2011 Resp.USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	LEFT CONVEYOR NASTRO SINISTRO	D: DE006010	pag. 90

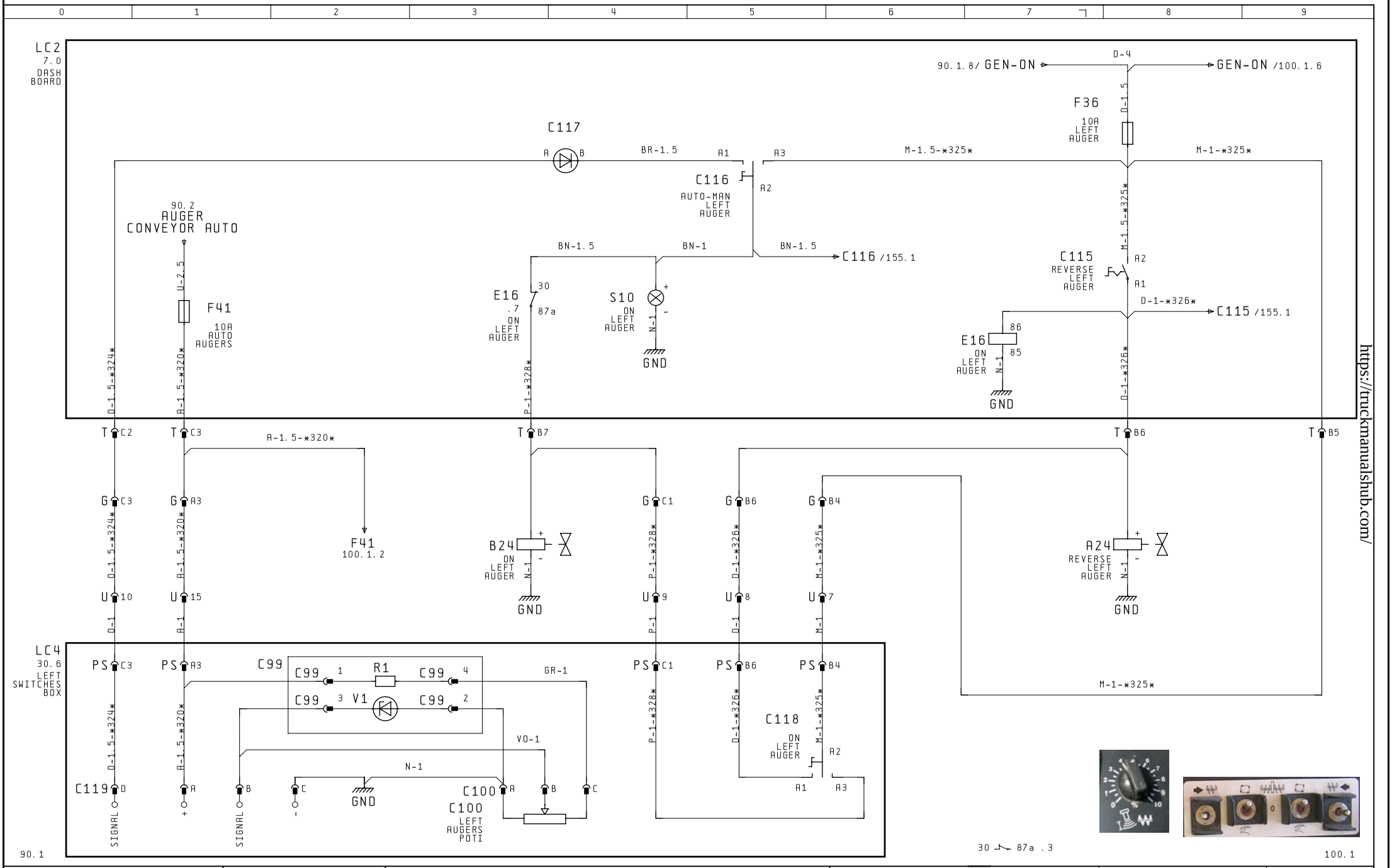




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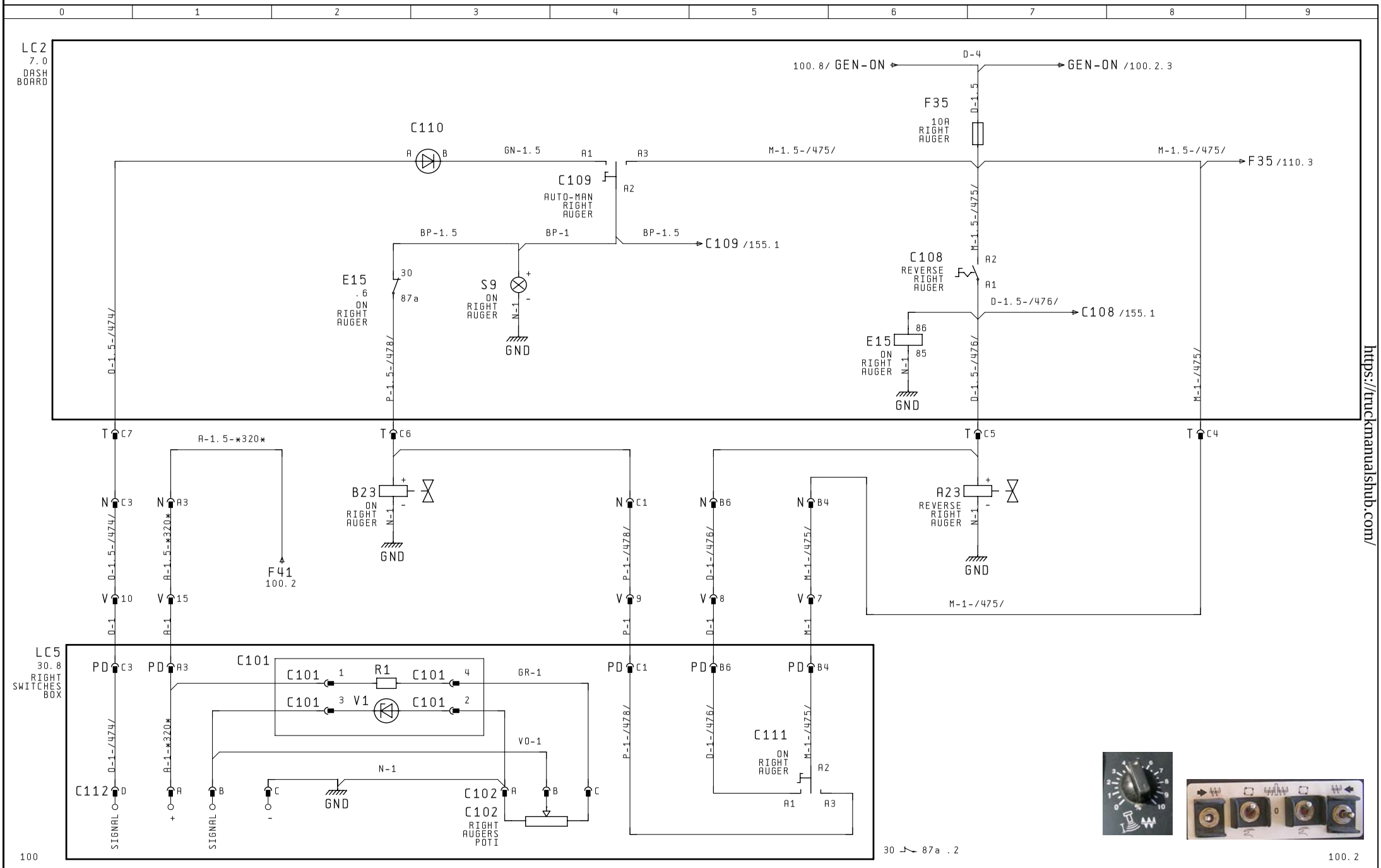
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Design.: Zuccarino Luca date: 28. Lug. 2011 Resp. USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	RIGHT CONVEYOR NASTRO DESTRO	D: DE006010	pag. 90.1



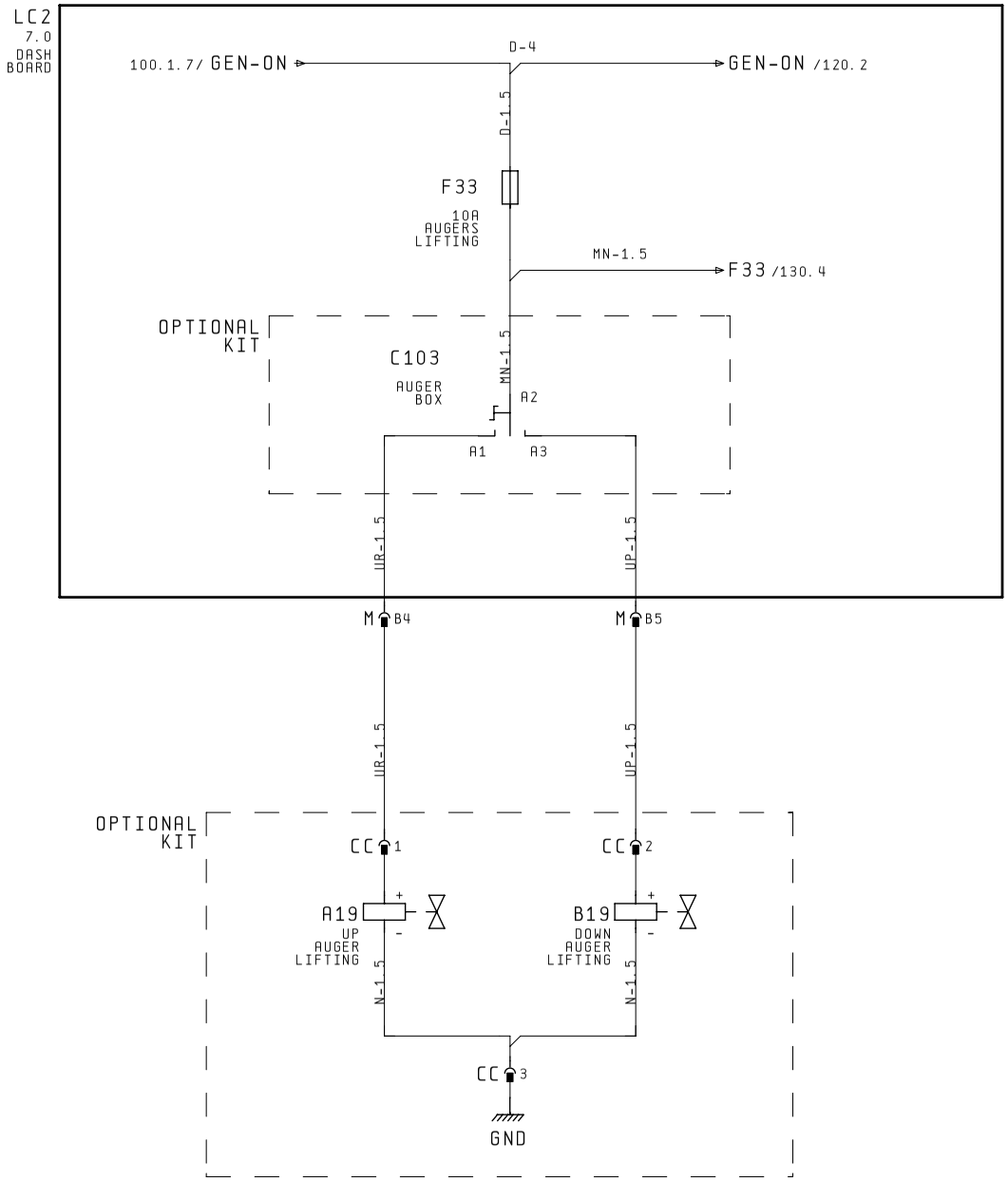
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Design.: Zuccarino Luca date: 28. Lug. 2011 Resp. USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	LEFT AUGER COCLEA SINISTRA	D: DE006010	pag. 100



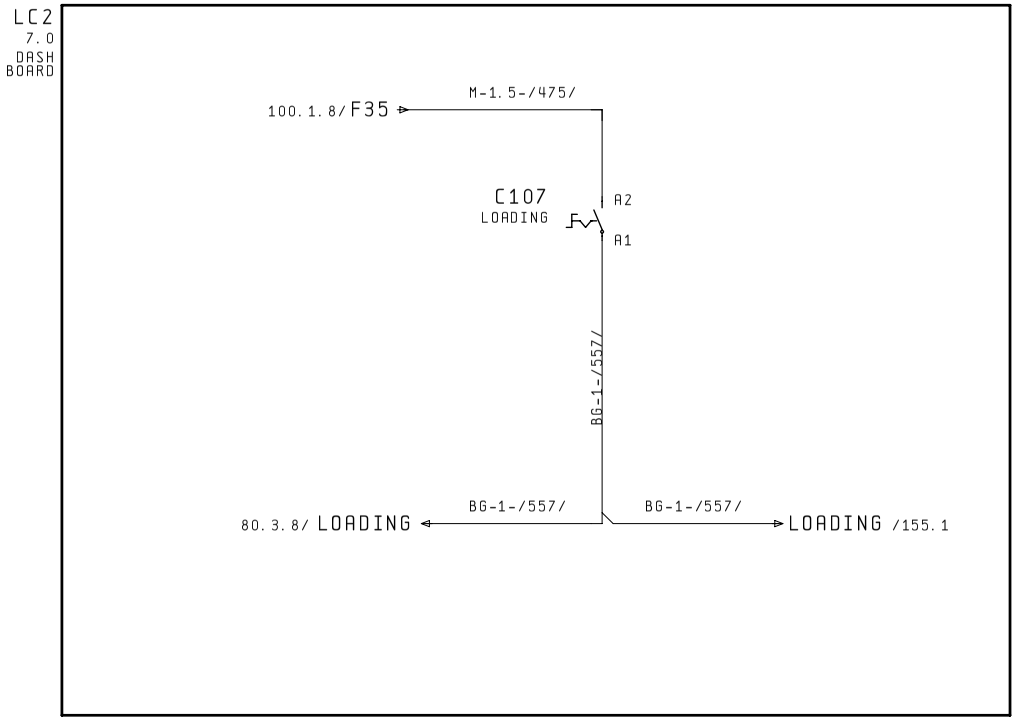
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Design.: Zuccarino Luca date: 28. Lug. 2011 Resp. USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	RIGHT AUGER COCLEA DESTRA	D: DE006010	pag. 100. 1



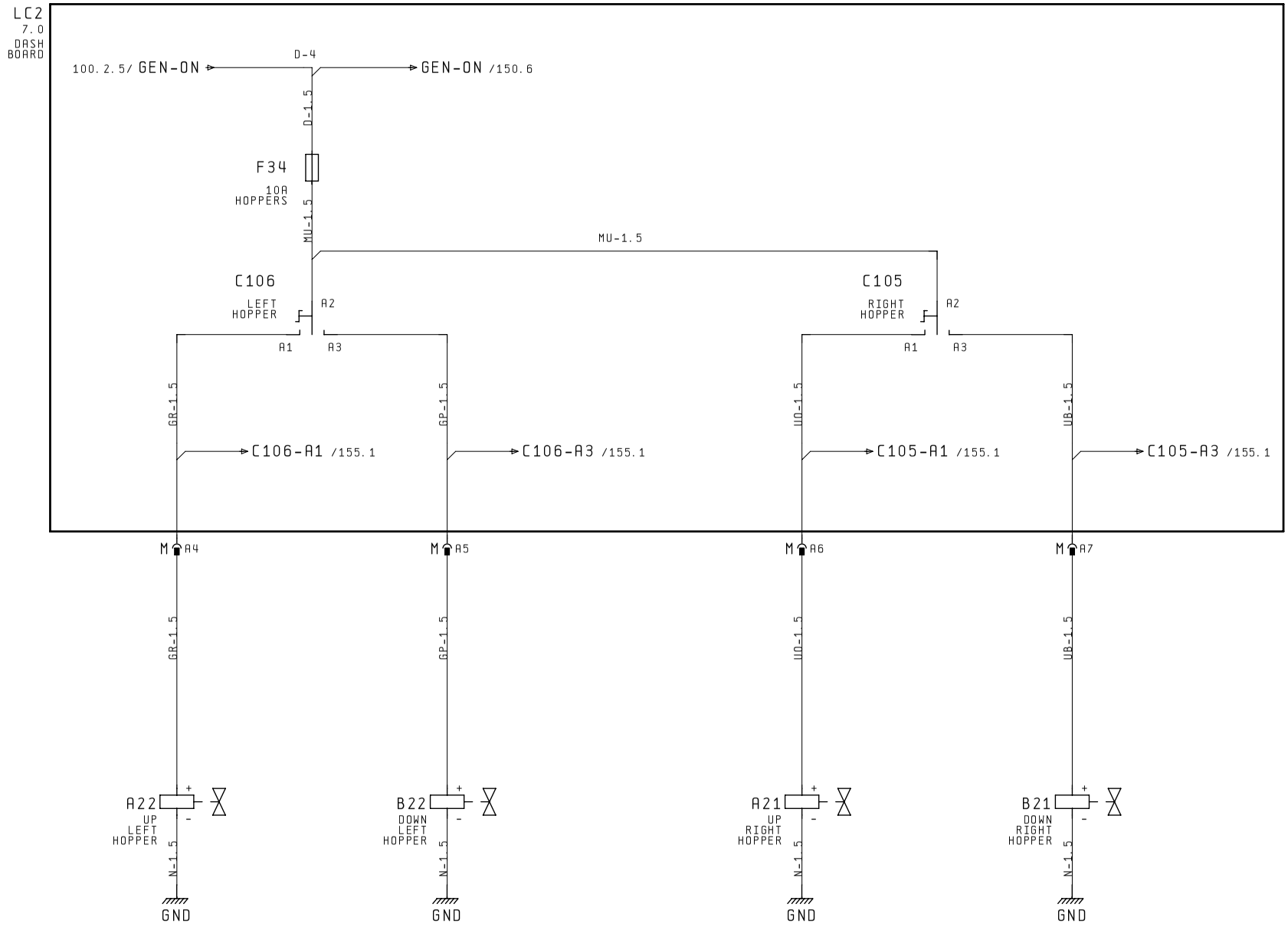


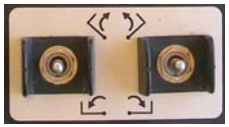
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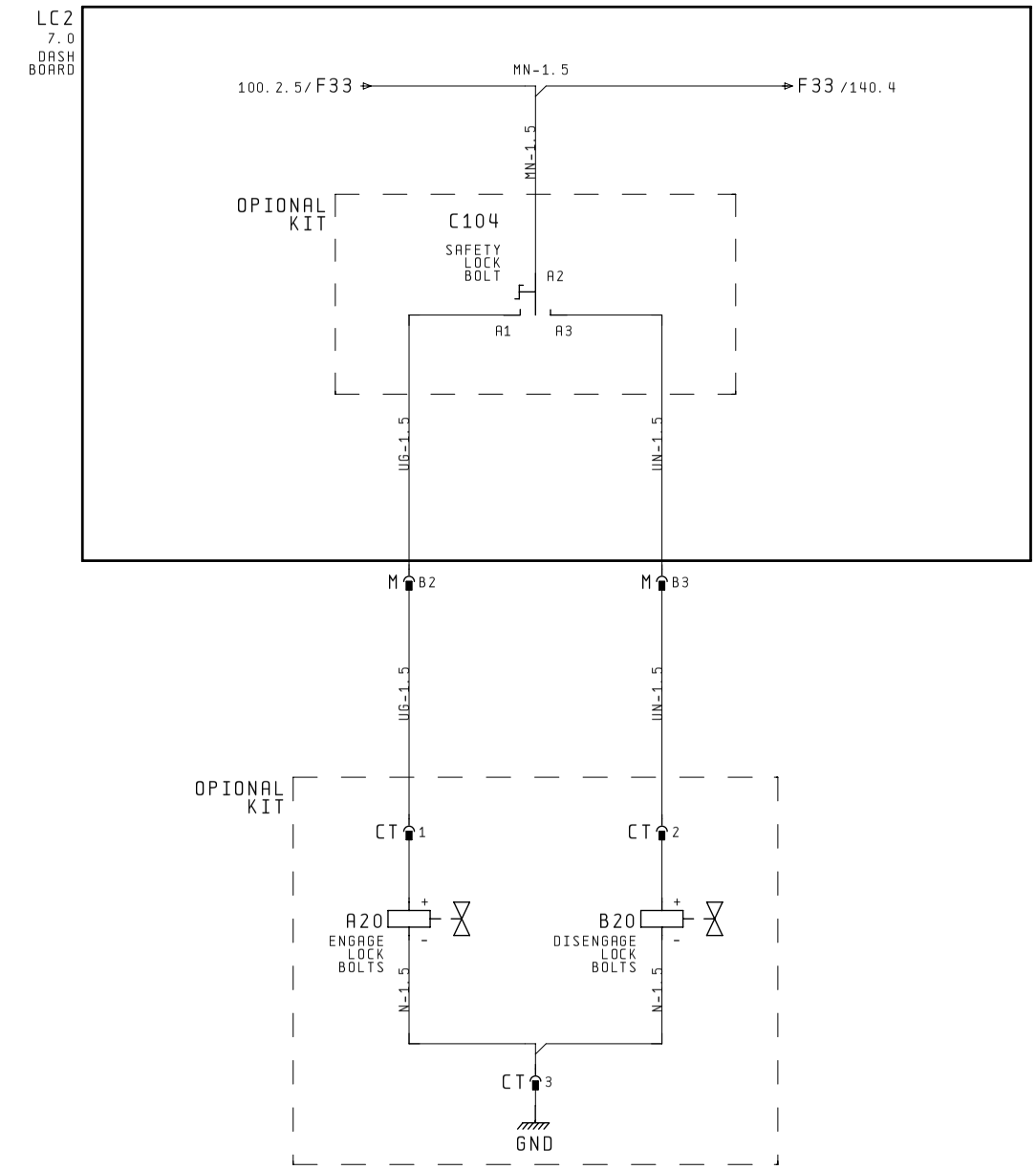




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110 130

Design.: Zuccarino Luca date: 28. Lug. 2011 Resp. USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	HOPPERS TRAMOGGE	D: DE006010	pag. 120

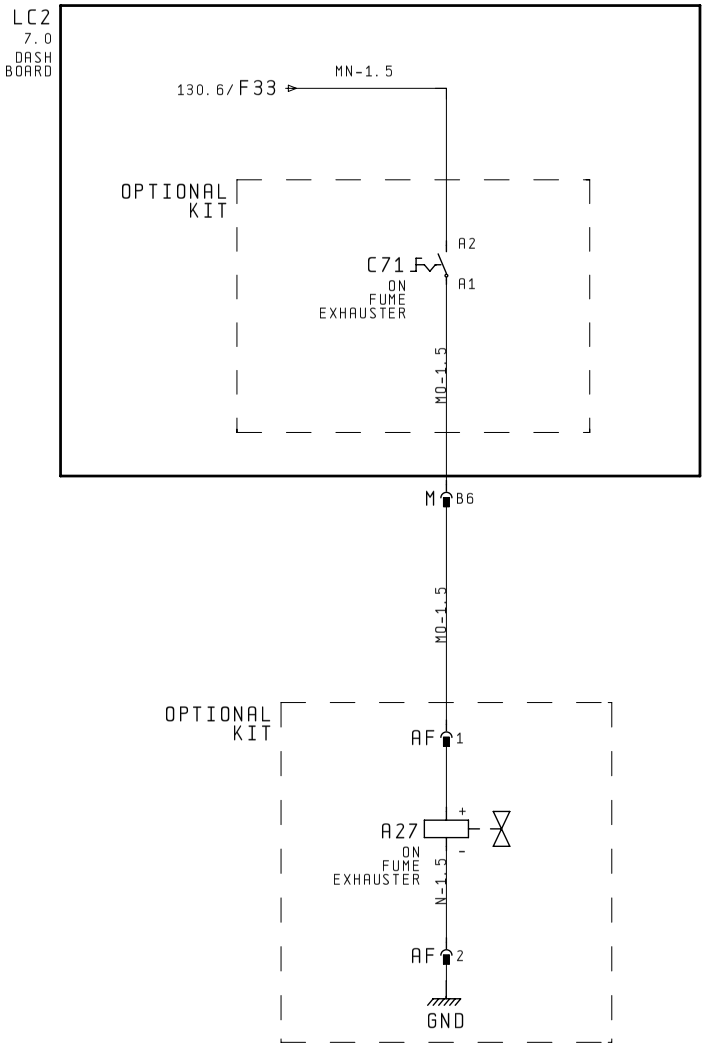




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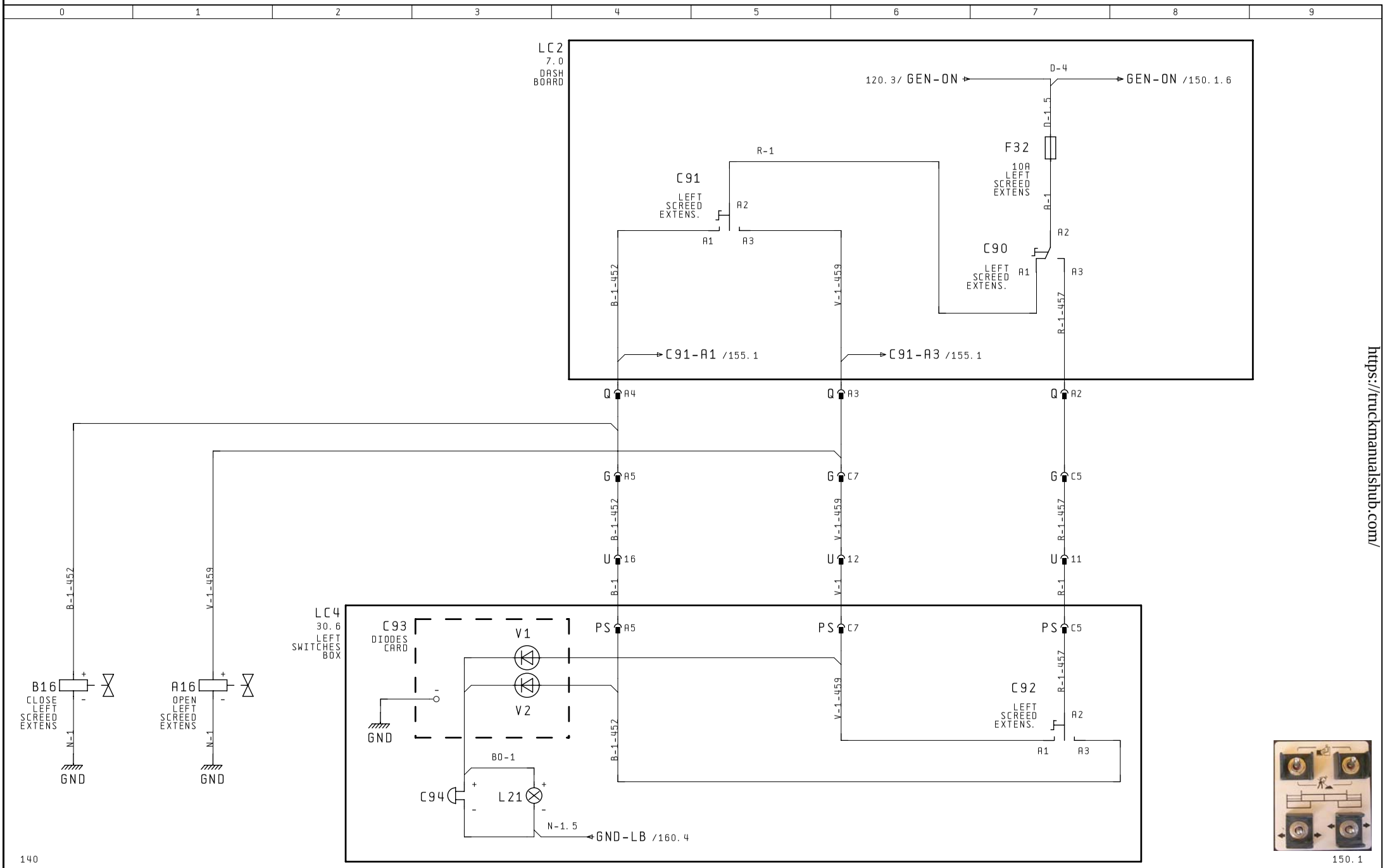
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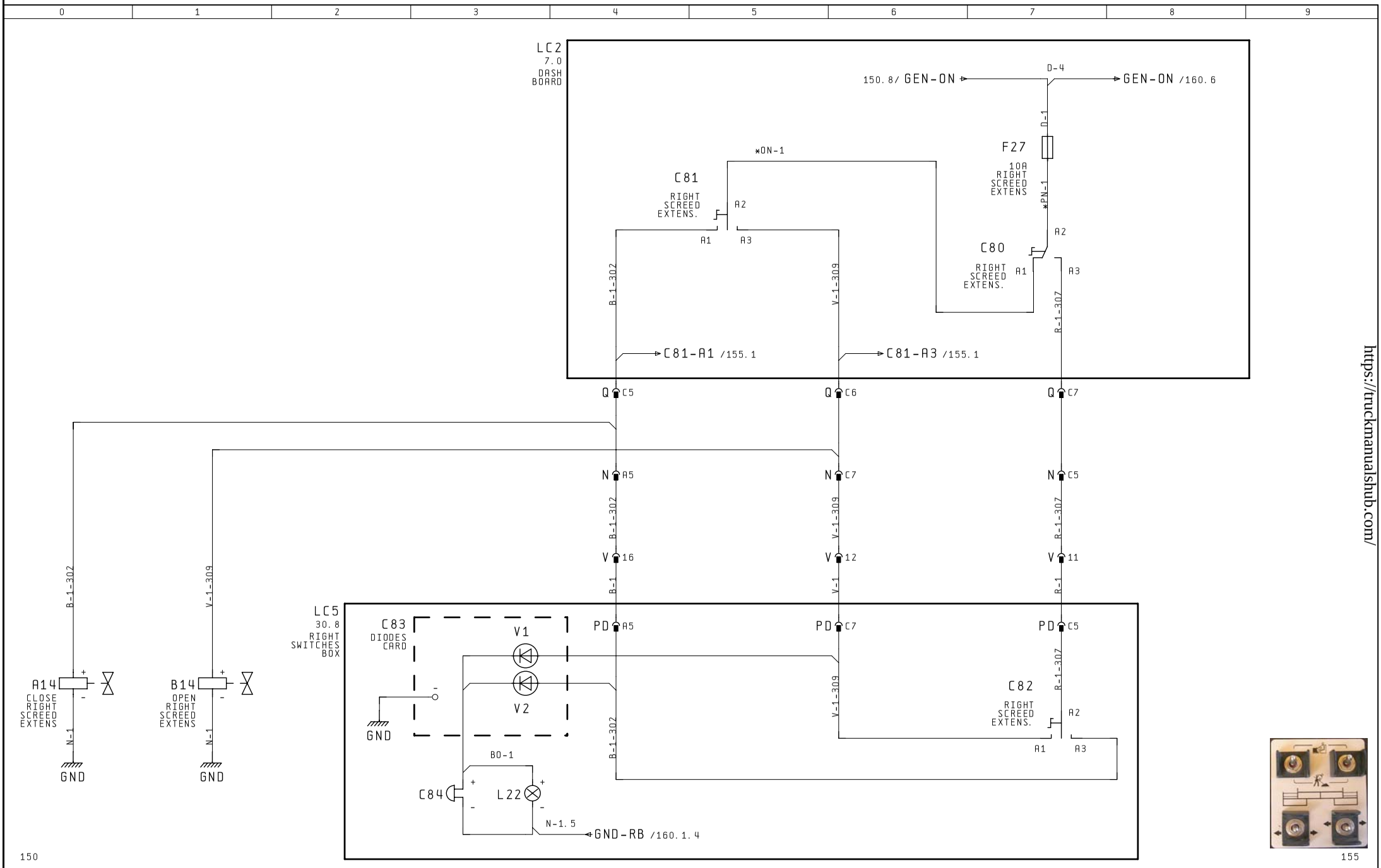


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Design.: Zuccarino Luca date: 28.Lug.2011 Resp.USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	LEFT SCREED EXTENSION ALLARGATORE SINISTRO	D: DE006010	pag. 150



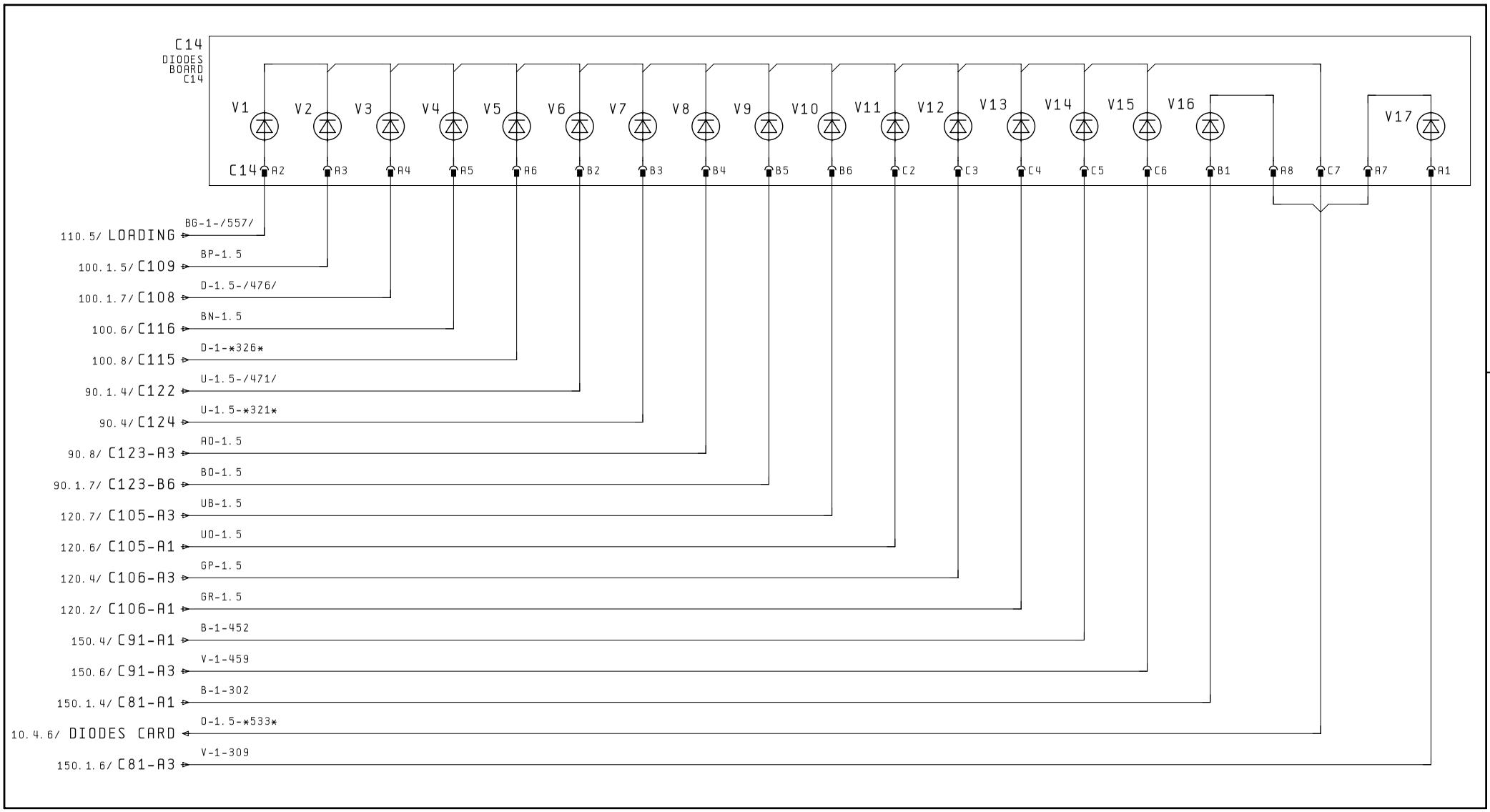
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155

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Design.: Zuccarino Luca date: 28. Lug. 2011 Resp. USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	RIGHT SCREED EXTENSION ALLARGATORE DESTRO	D: DE006010	pag. 150. 1

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7.0
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BOARD



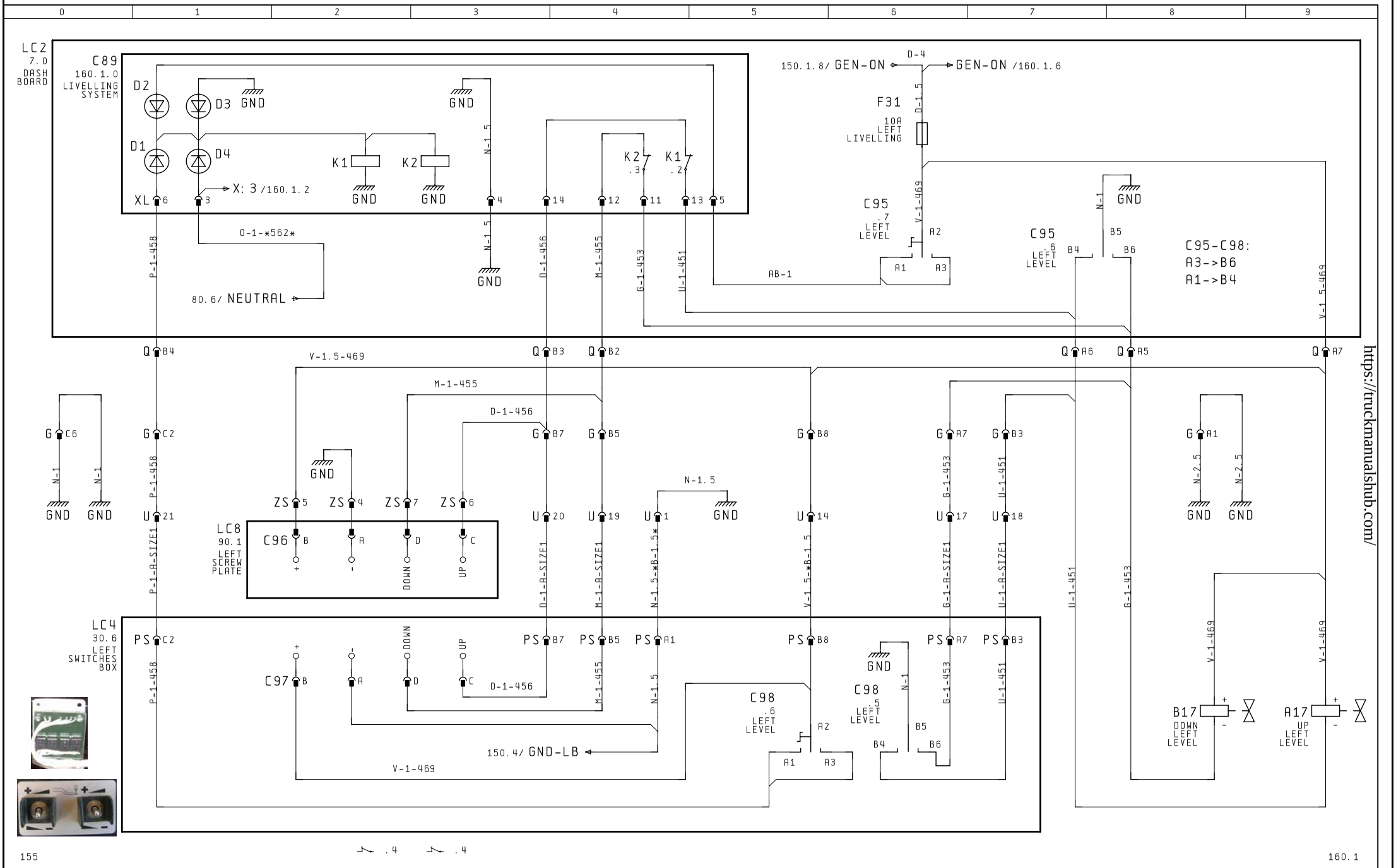


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Design.: Zuccarino Luca date: 28.Lug.2011 Resp.USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	DIODES CARD SCHEDA DIODI	D: DE006010	pag. 155

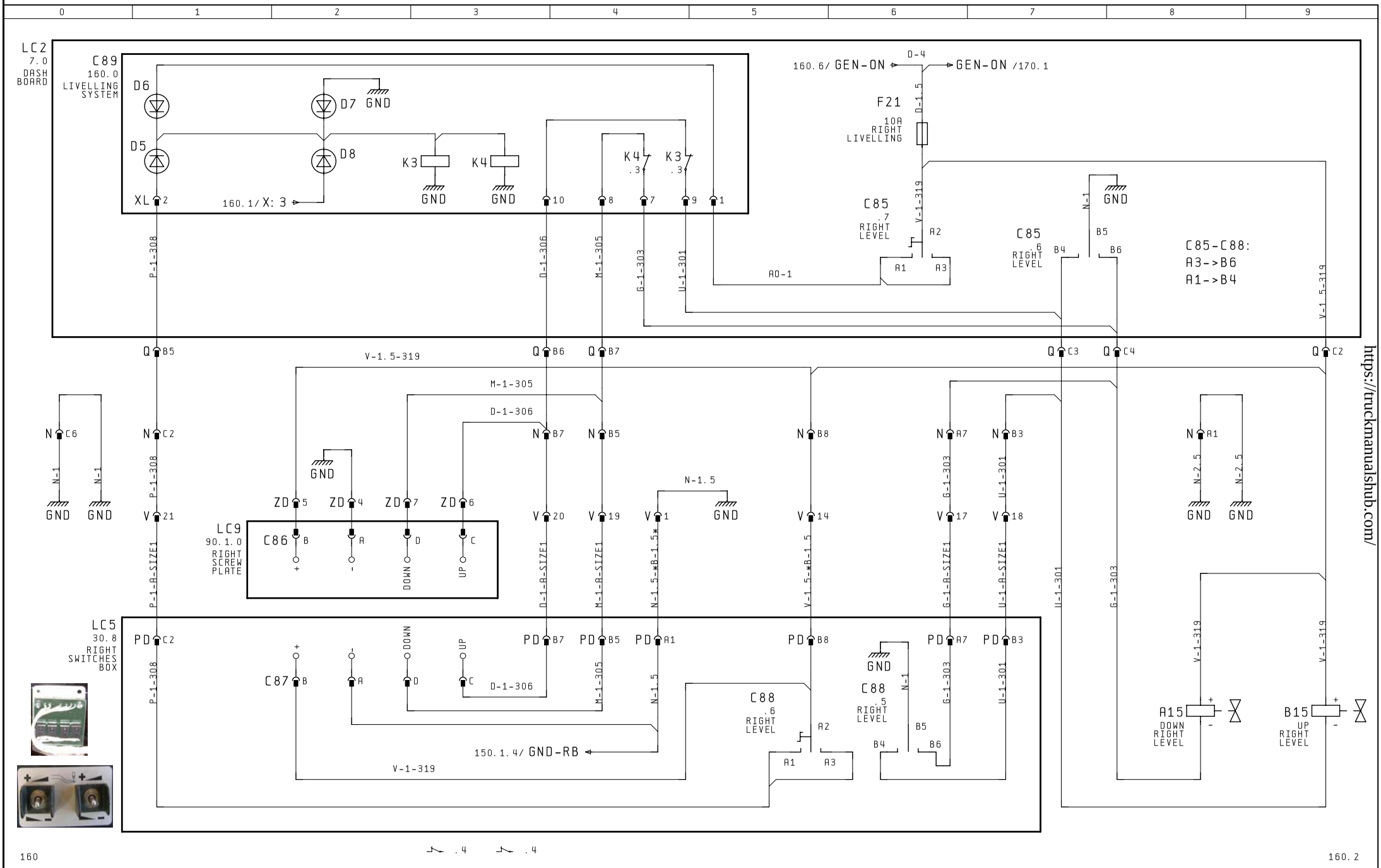


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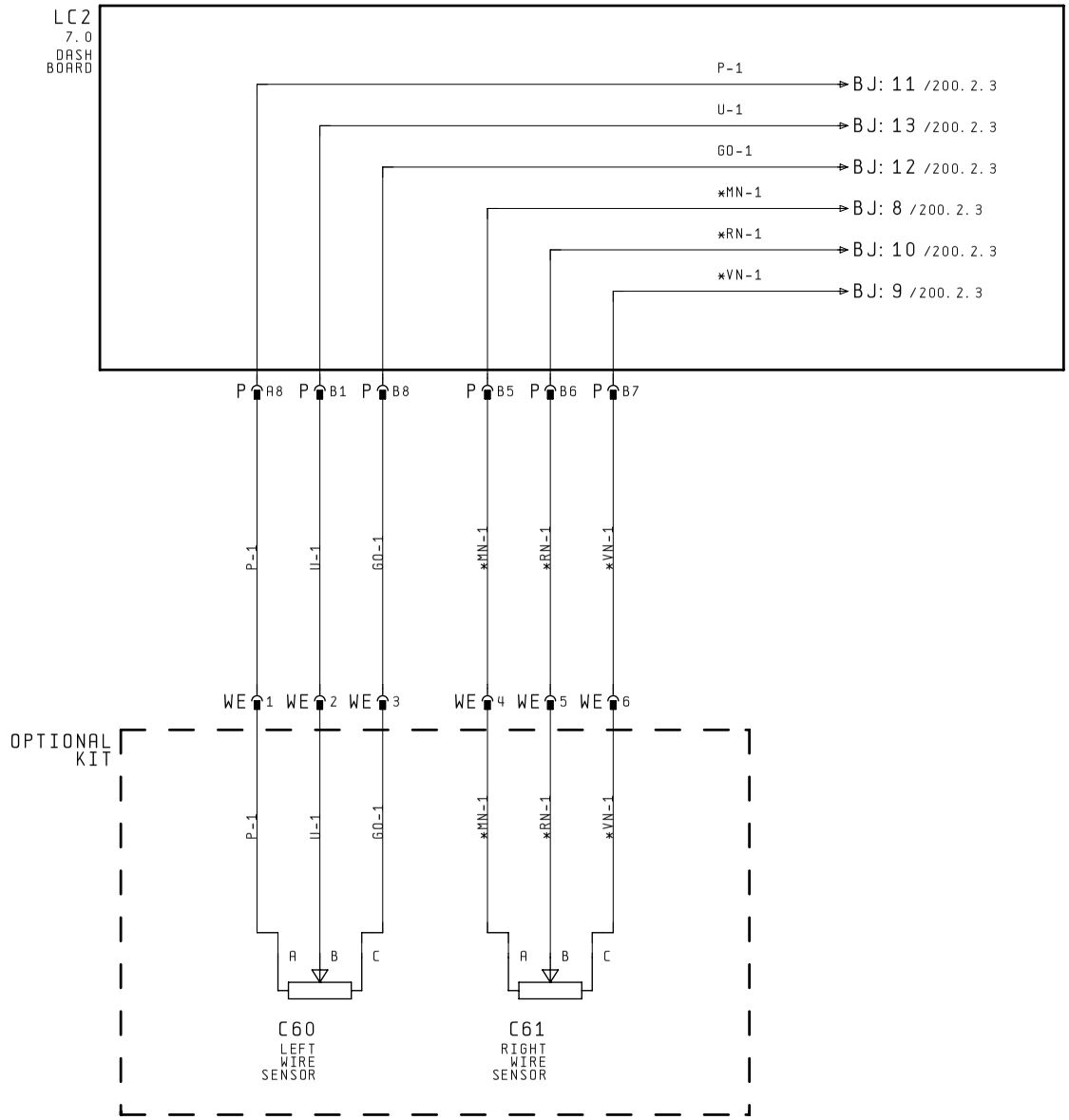
Design.: Zuccarino Luca date: 28. Lug. 2011 Resp. USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	LEFT LEVELLING LIVELLO SINISTRO	D: DE006010	pag. 160

https://truckmanualshub.com/

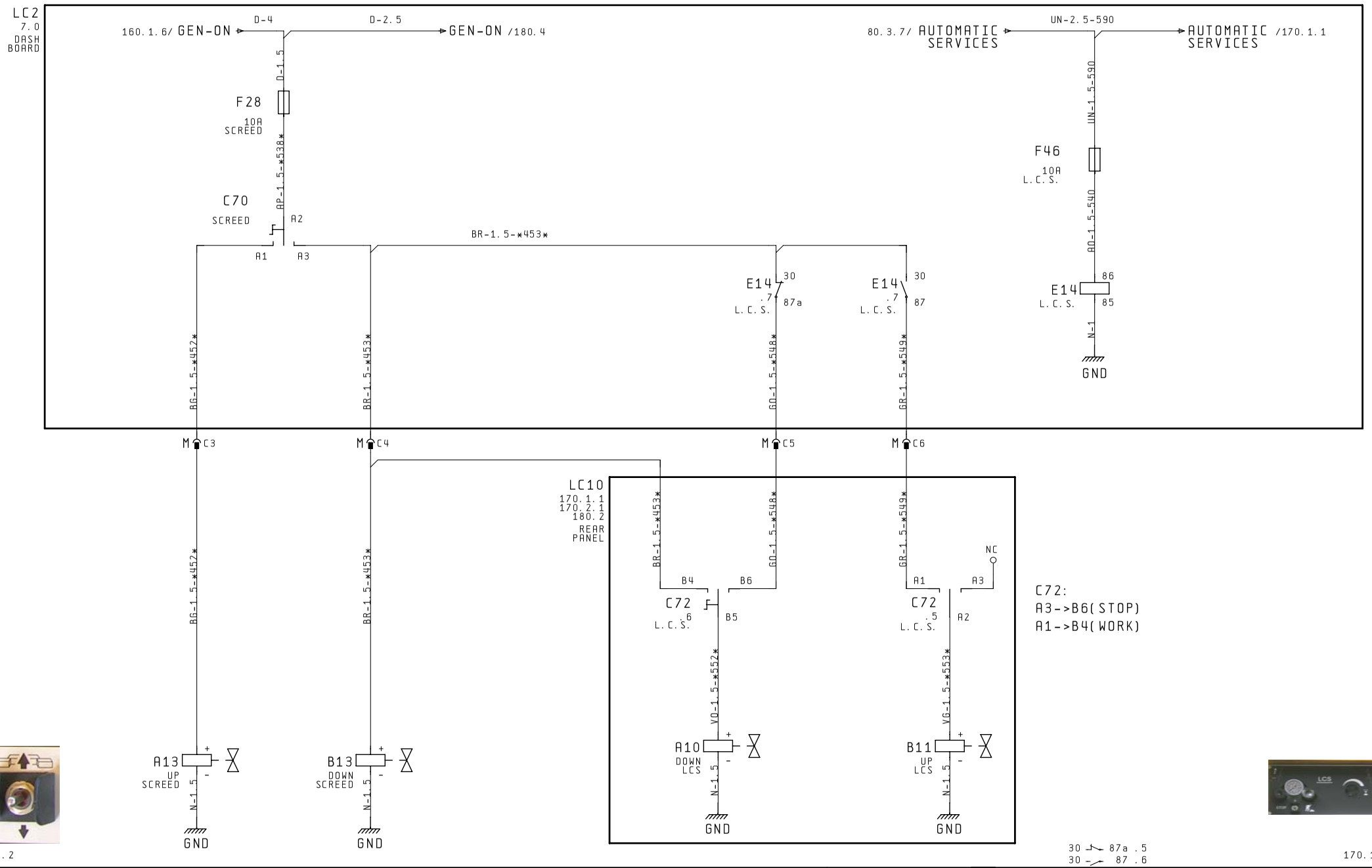


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Design.: Zuccarino Luca date: 28. Lug. 2011 Resp. USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	RIGHT LEVELLING LIVELLO DESTRO	D: DE006010	pag. 160. 1

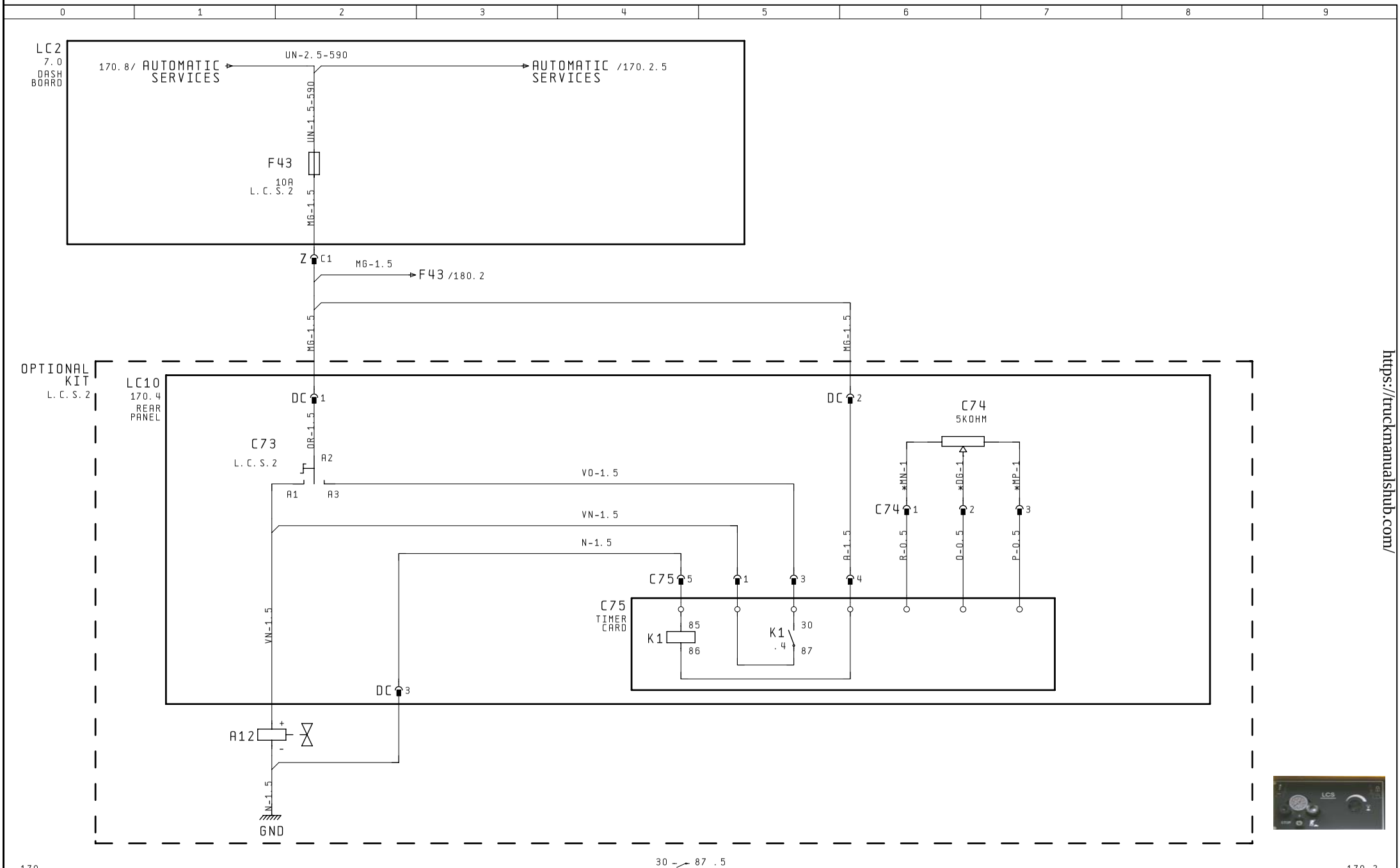


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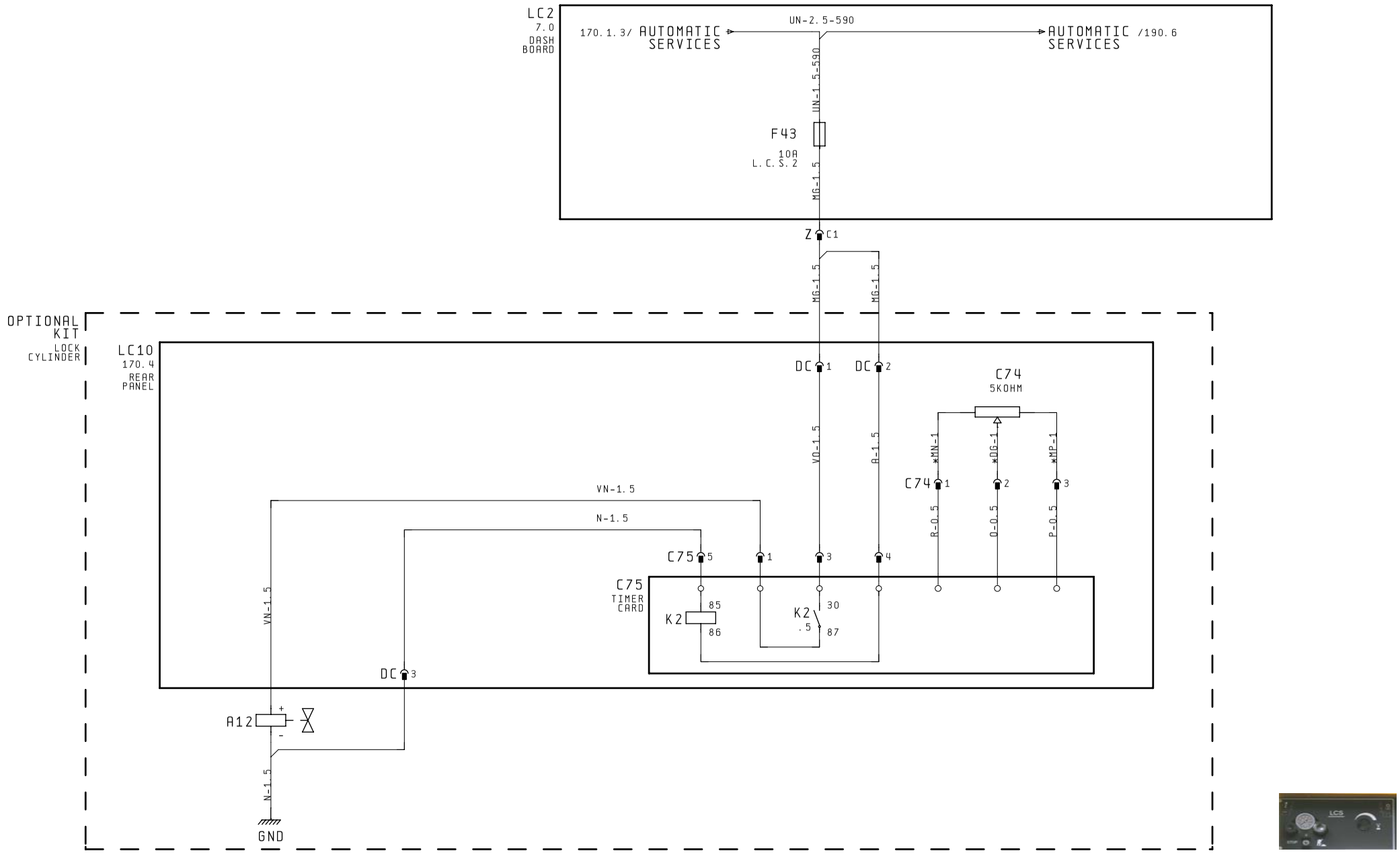
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Design.: Zuccarino Luca date: 28.Lug.2011 Resp.USER: ING.ZANIBONI	BOMAG FAYAT GROUP	BF600C	SCREED LIFTING SOLLEVAMENTO FERRO DA STIRO	D: DE006010	pag. 170

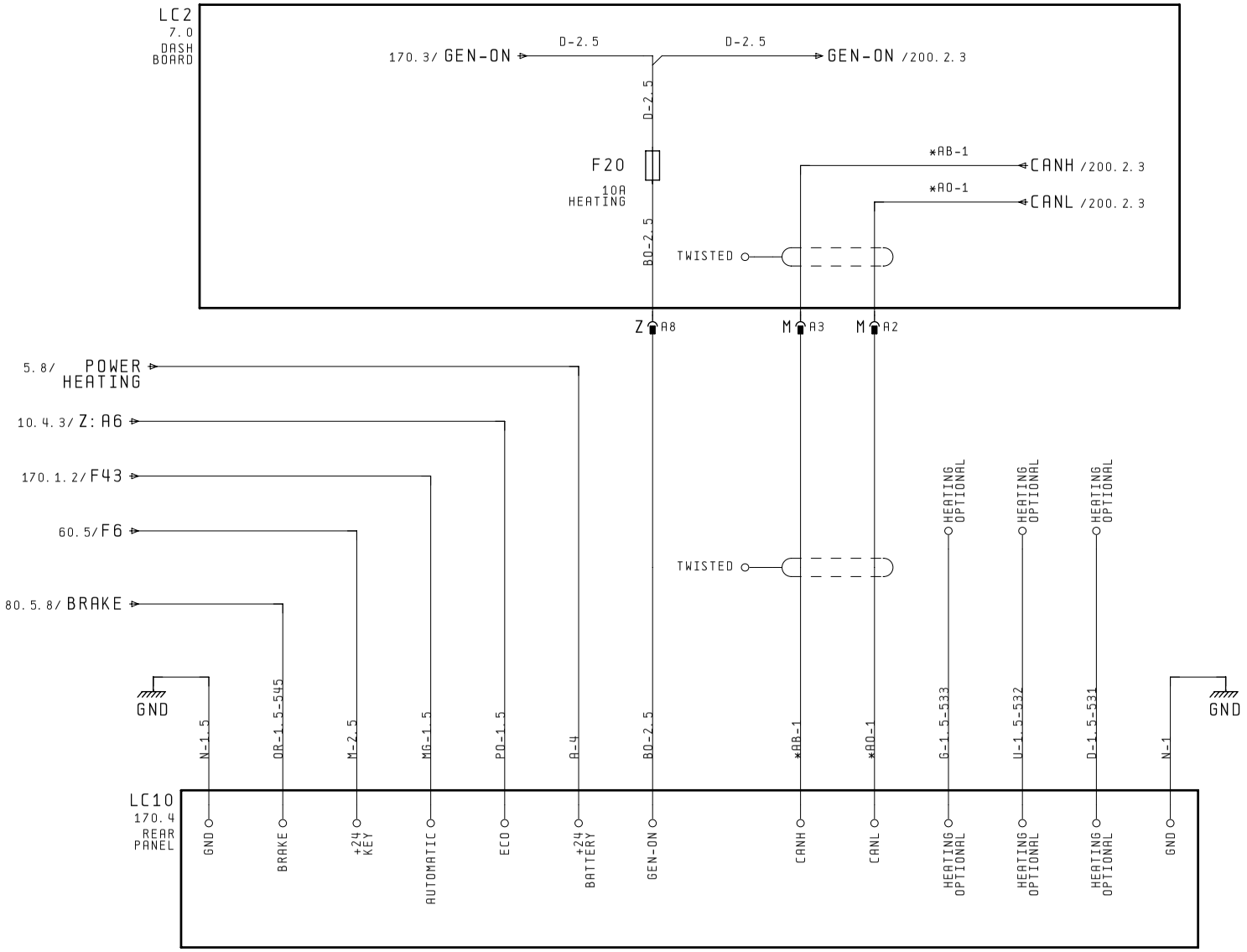


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Design.: Zuccarino Luca date: 28.Lug.2011 Resp.USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	SCREED LIFTING SOLLEVAMENTO FERRO DA STIRO	D: DE006010	pag. 170.1



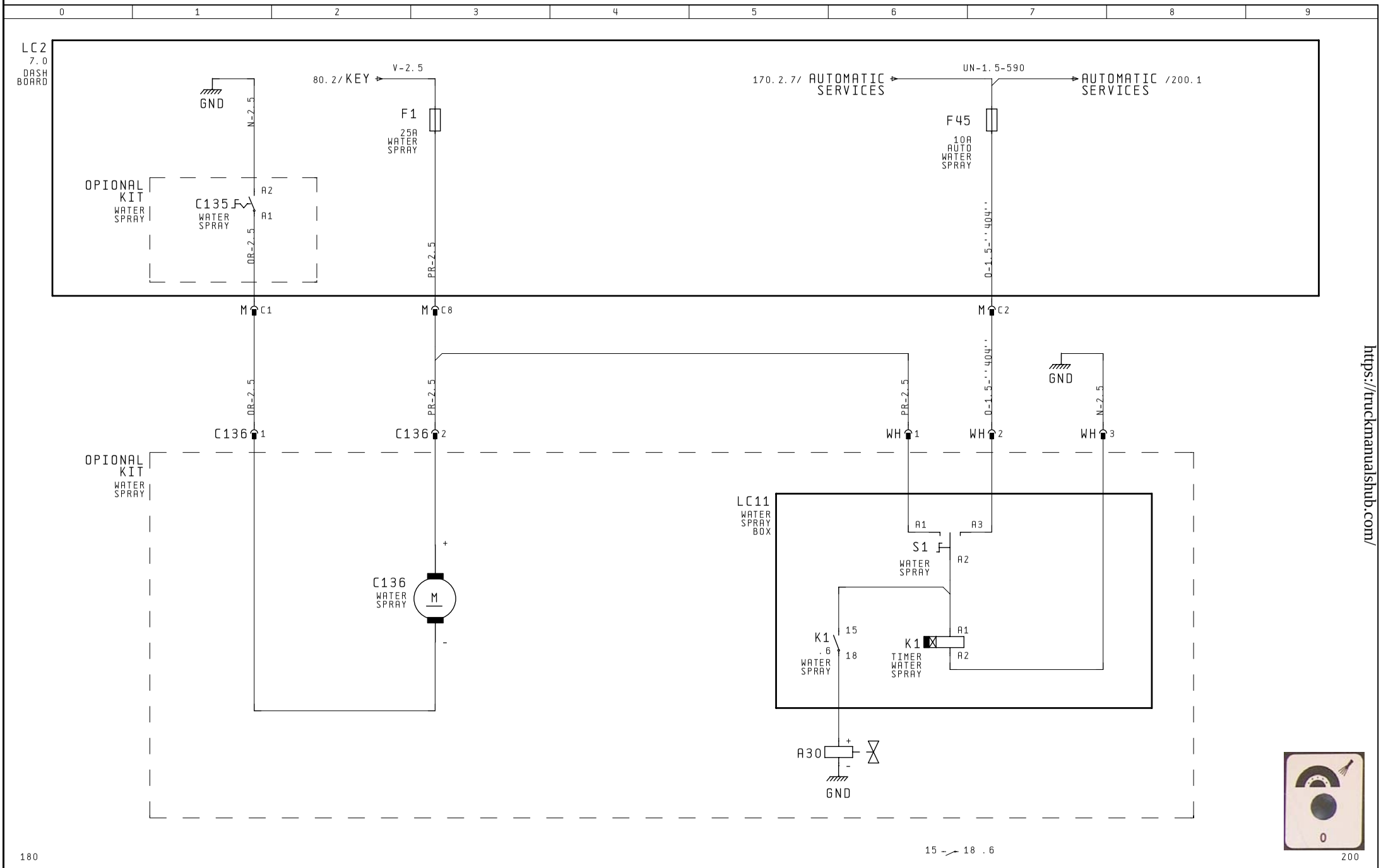
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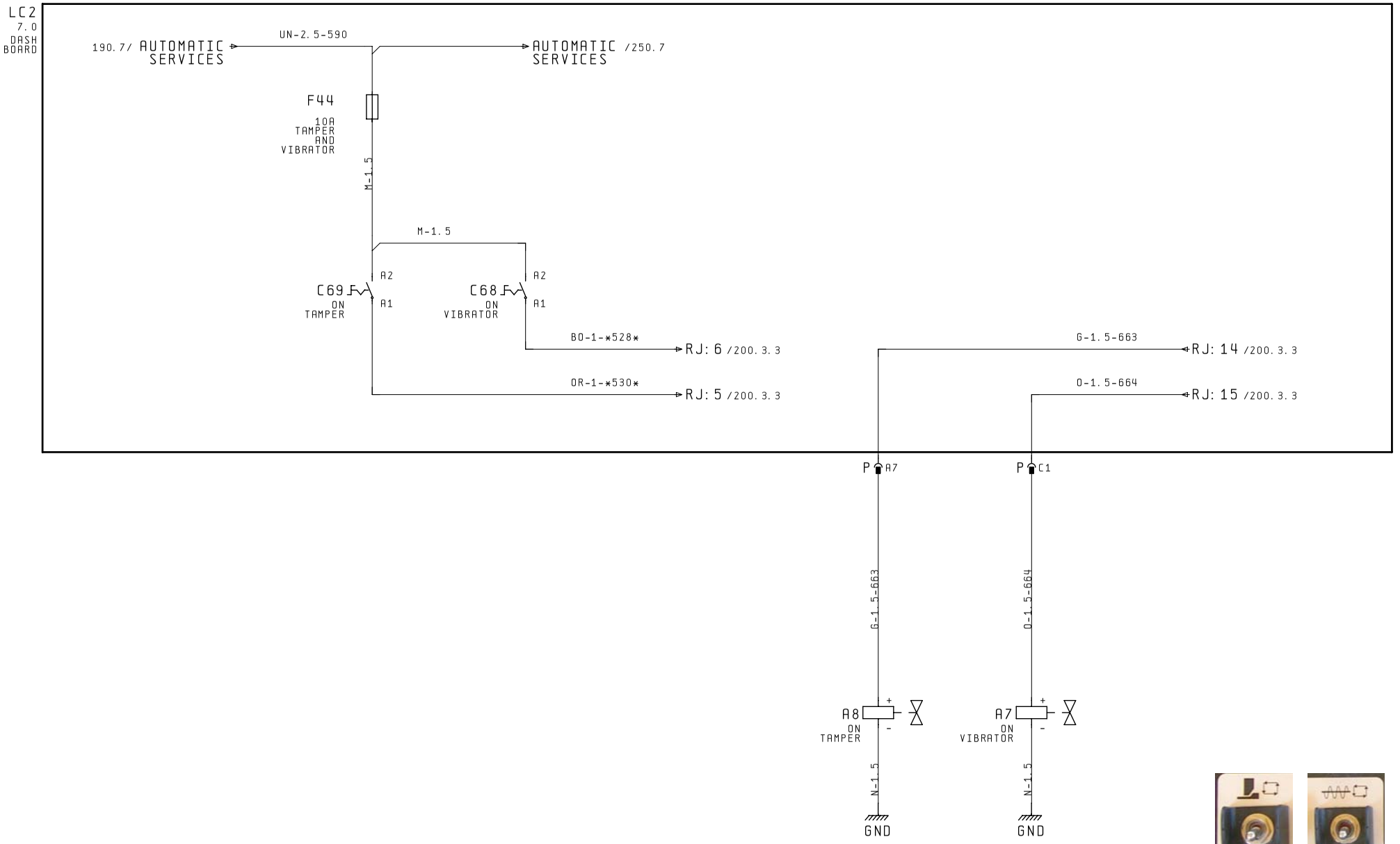
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Design.: Zuccarino Luca date: 28.Lug.2011 Resp.USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	SCREED HEATING RISCALDAMENTO FERRO DA STIRO	D: DE006010	pag. 180



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Design.: Zuccarino Luca date: 28. Lug. 2011 Resp. USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	WATER SPRAYING SPRUZZATURA ACQUA	D: DE006010	pag. 190

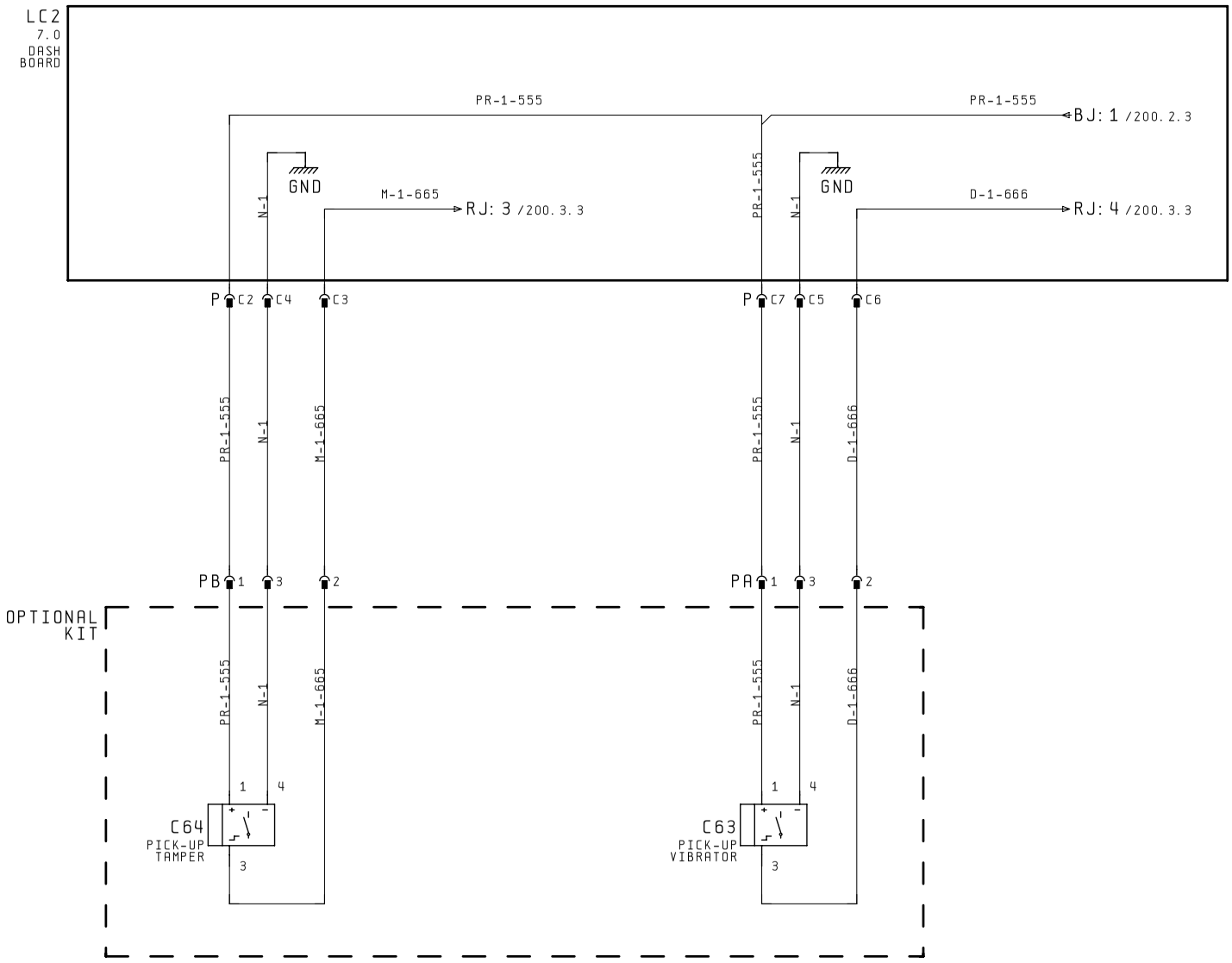






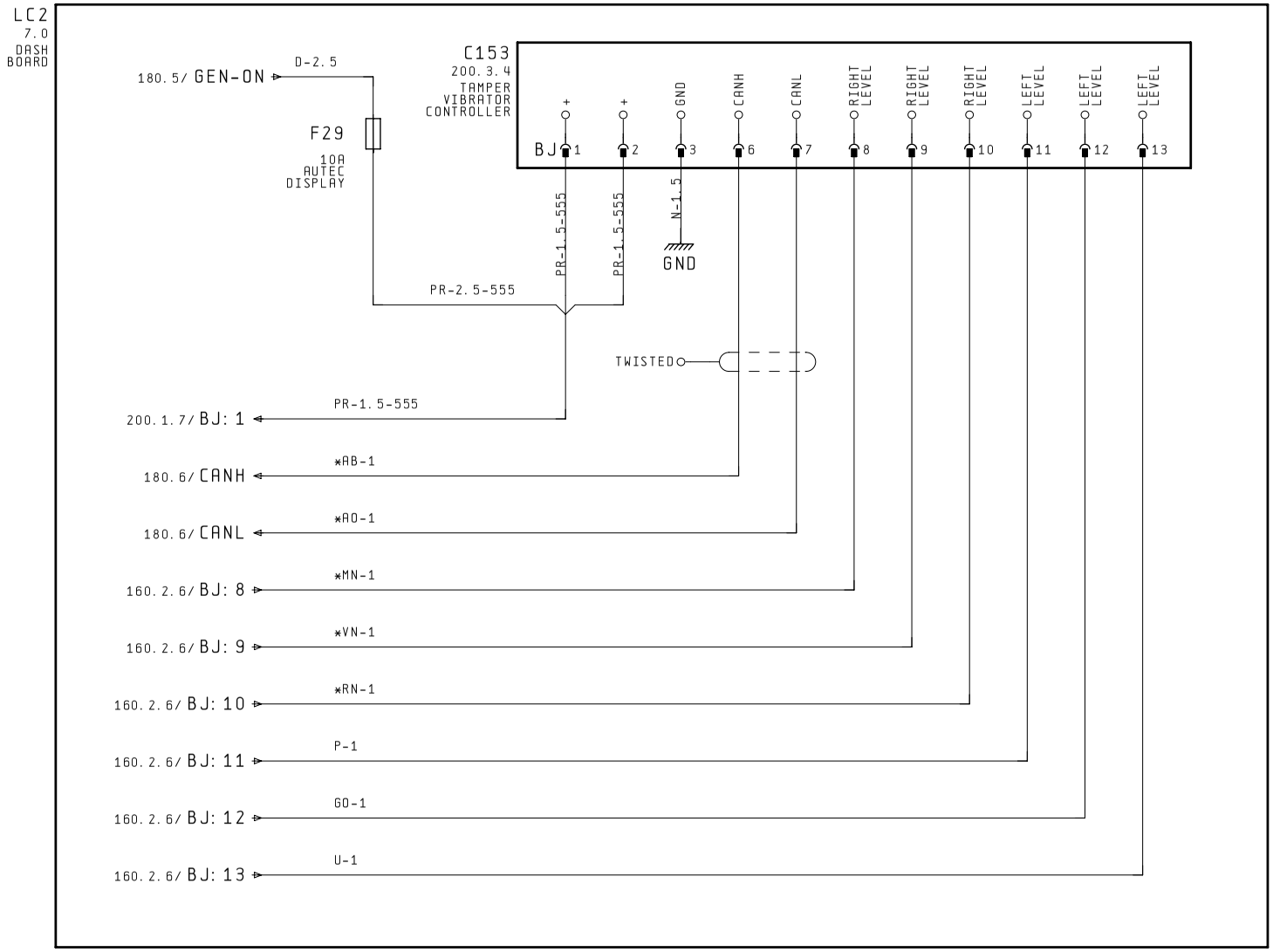
https://truckmanualshub.com/

Design.: Zuccarino Luca date: 28.Lug.2011 Resp.USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	TAMPER AND VIBRATOR TAMPER E VIBRANTE	D: DE006010	pag. 200



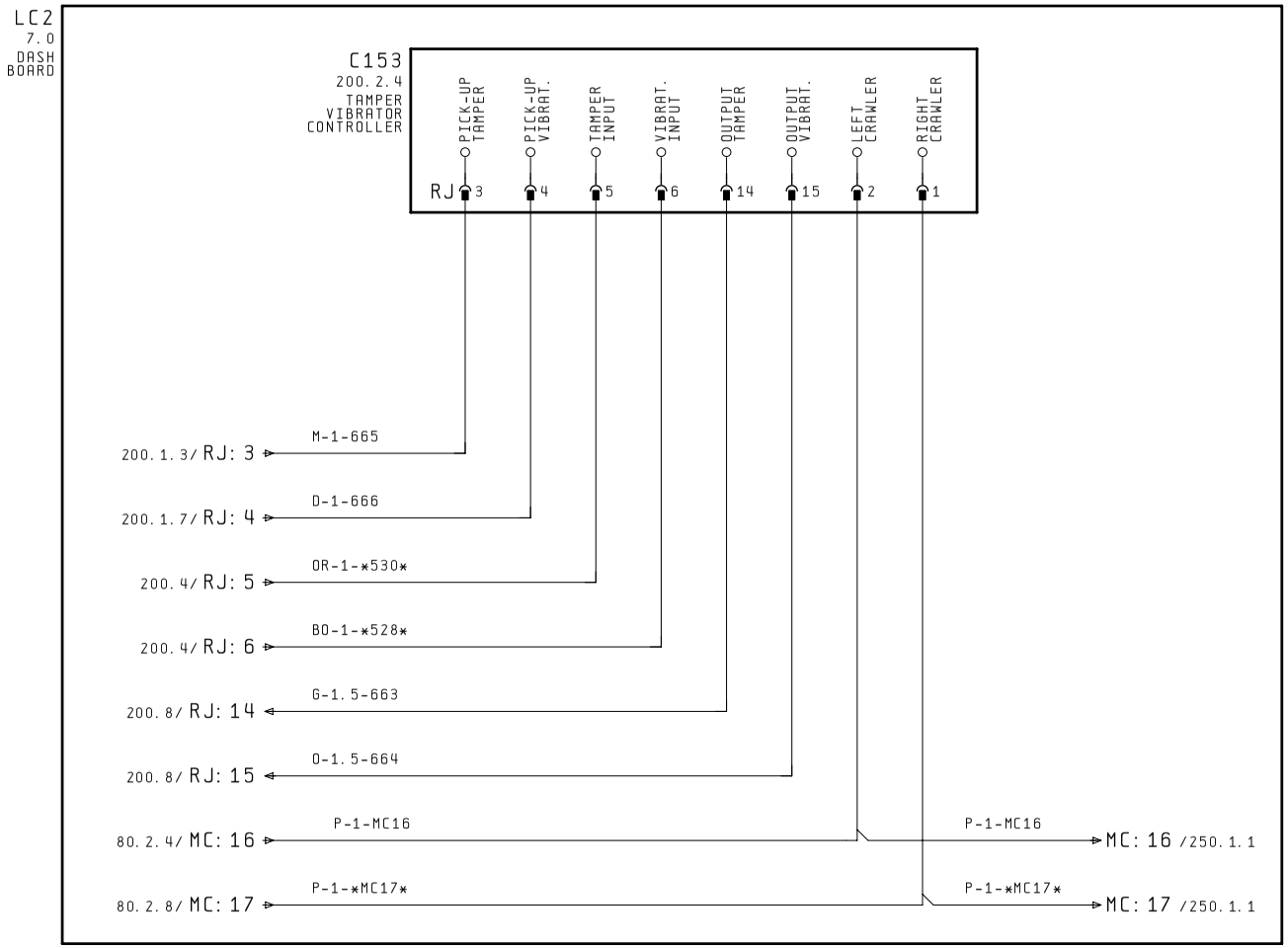
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Design.: Zuccarino Luca date: 28. Lug. 2011 Resp. USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	TAMPER AND VIBRATOR TAMPER E VIBRANTE	D: DE006010	pag. 200. 1



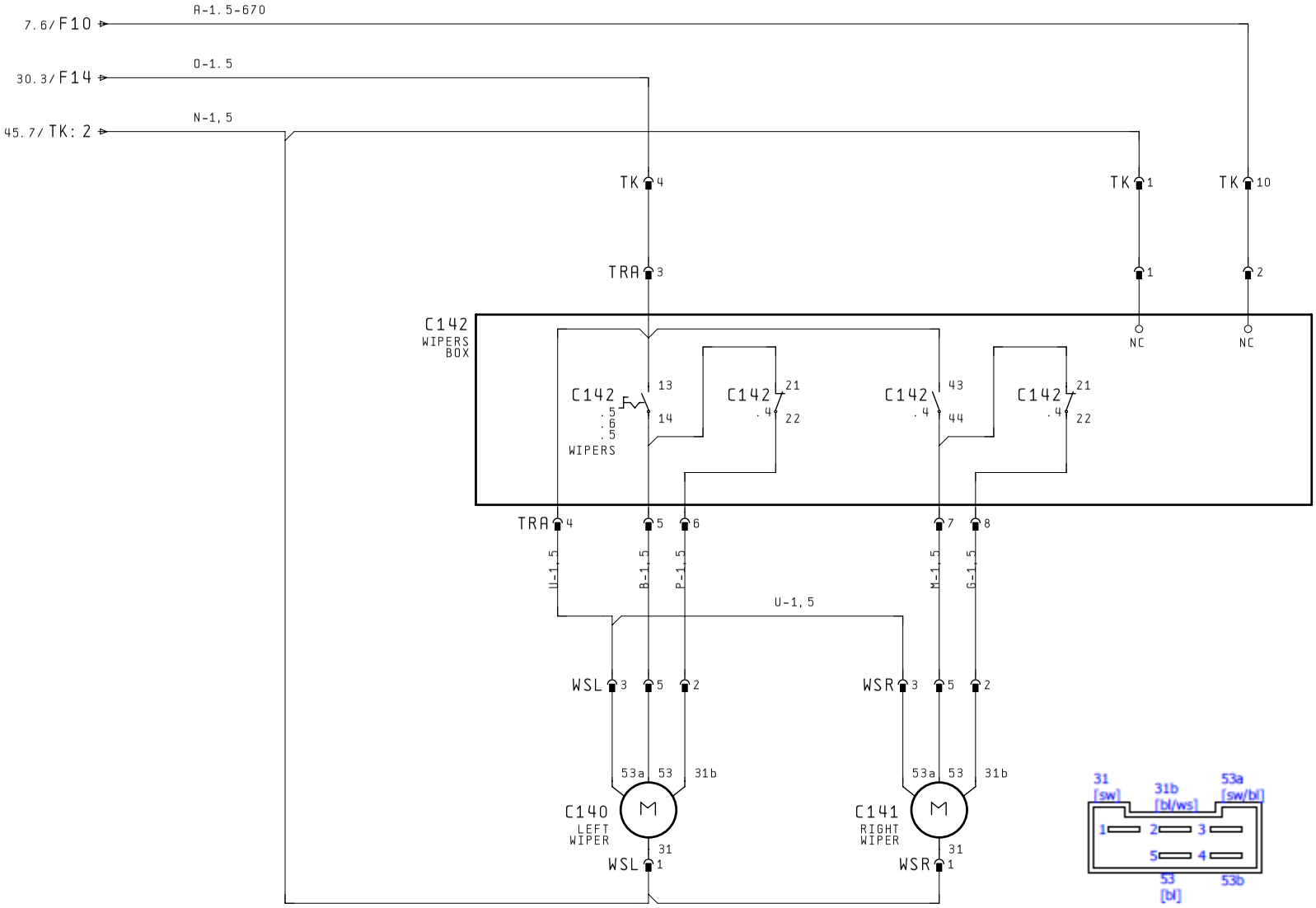


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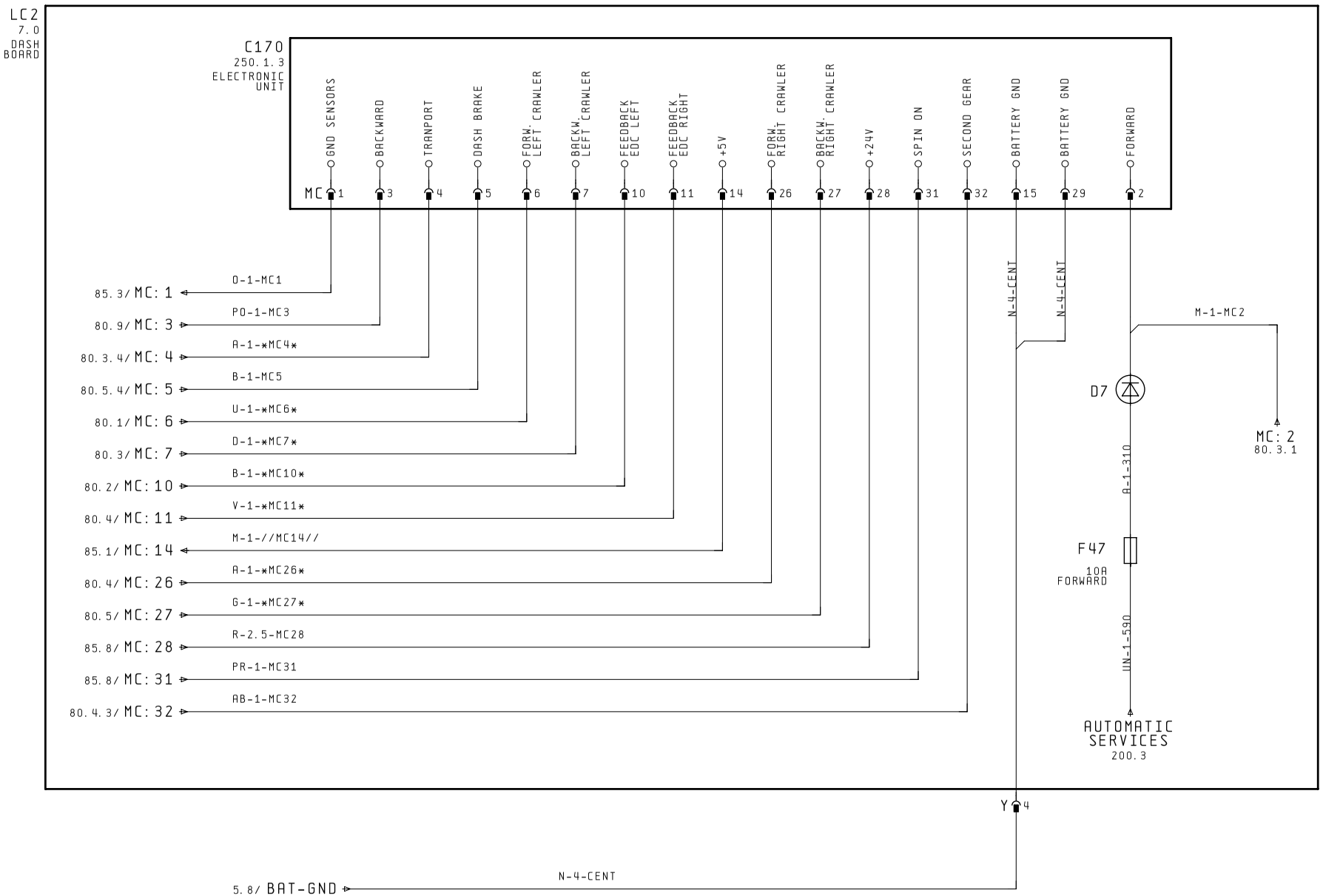




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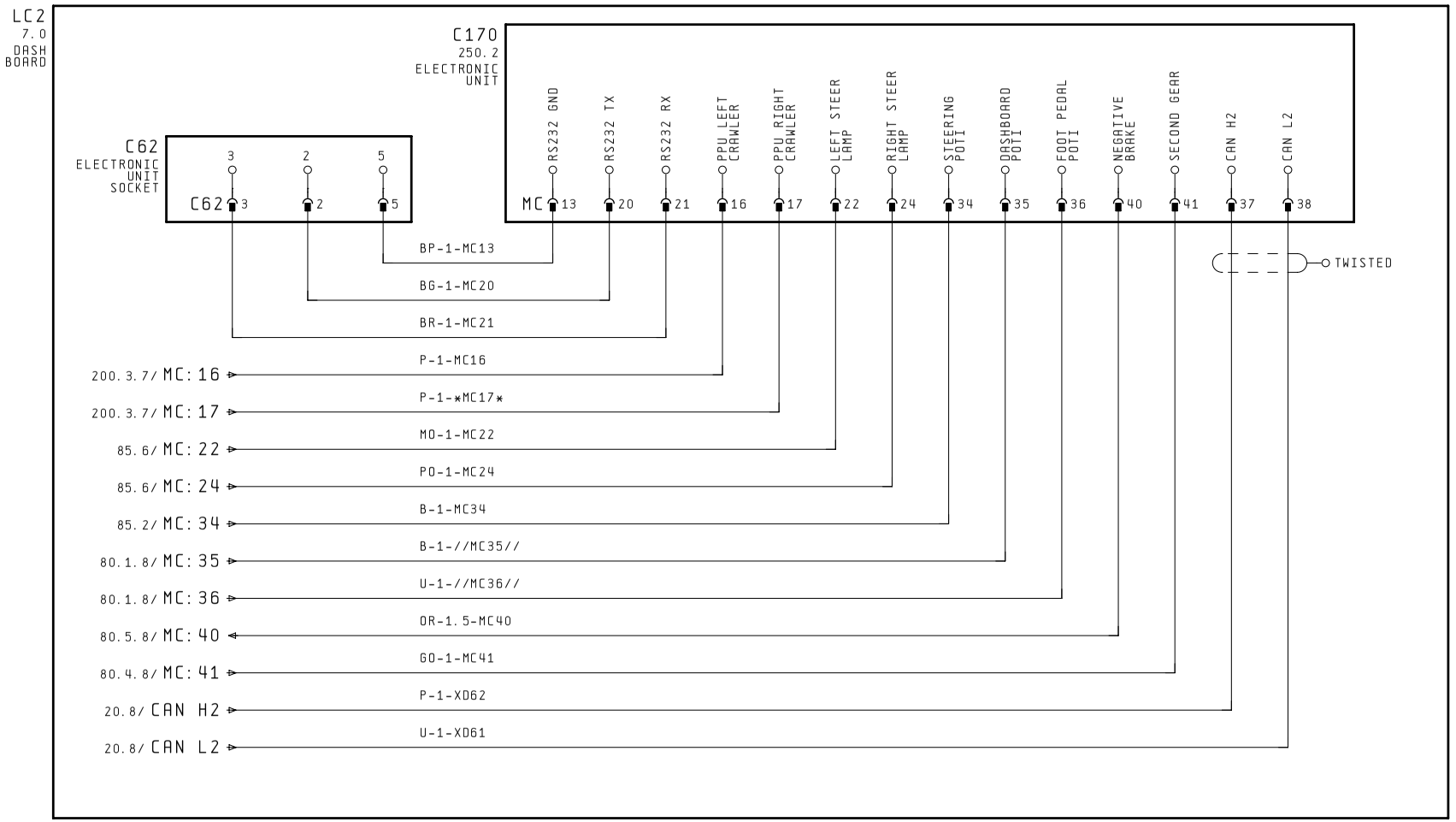
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Design.: Zuccarino Luca date: 28.Lug.2011 Resp.USER: ING. ZANIBONI	BOMAG FAYAT GROUP	BF600C	ELECTRONIC UNIT CENTRALINA	D: DE006010	pag. 250





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A=ORANGE/ARANCIONE
B=BLUE/BLU
O=WHITE/BIANCO
G=YELLOW/GIALLO
U=GREY/GRIGIO
M=BROWN/MARRONE
N=BLACK/NERO
D=PINK/ROSA
R=RED/ROSSO
P=GREEN/VERDE
V=VIOLET/VIOLA

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DISTMACC3.SKO

NOME NAME	QUANTITA' AMOUNT	PAGINA/COLONNA PAGE/COLUMN	TESTO FUNZIONALE FUNCTION TEXT
AD	1	30. 2	FRONT RIGHT LIGHTING
AD	1	30. 2	FRONT RIGHT LIGHTING
AS	1	30. 1	FRONT LEFT LIGHTING
AS	1	30. 1	FRONT LEFT LIGHTING
BJ	1	200. 2. 4	TAMPER AND VIBRATOR CONTROLLER
C25	1	30. 1	HORN
C26	1	30. 2	HORN
C48	1	80. 8	BACKWARD TRAVELLING
C75-K1	1	170. 1. 4	
C75-K2	1	170. 2. 5	
C86	1	160. 1. 2	RIGHT LEVELLING
C87	1	160. 1. 2	RIGHT LEVELLING
C96	1	160. 2	LEFT LEVELLING
C97	1	160. 2	LEFT LEVELLING
C112	1	100. 1. 0	RIGHT AUGER
C119	1	100. 0	LEFT AUGER
C128	1	90. 1. 1	RIGHT CONVEYOR
C132	1	90. 1	LEFT CONVEYOR
DC	2	170. 1. 2	L.C.S. 2
DC	2	170. 1. 2	L.C.S. 2
FP	1	80. 1. 5	FOOT PEDAL TRAVELLING
FP	1	80. 1. 5	FOOT PEDAL TRAVELLING
G	1	30. 7	HARNESS
G	1	30. 7	HARNESS
L24	1	50. 4	BEACON
LC1-C1	1	5. 3	BATTERY
LC1-C2	1	5. 3	BATTERY
LC1-C3	1	5. 3	MANUAL SWITCH
LC1-JE2	1	5. 6	FRONT ROOF
LC1-JE3	1	5. 6	REAR ROOF
LC1-JF1	1	5. 1	ELECTRONIC UNIT
LC1-JF2	1	5. 3	KEY
LC1-JF3	1	5. 4	XENON LIGHTS
LC1-JF4	1	5. 3	POWER HEATING
LC1-JF5	1	5. 2	PREHEAT
LC1-JF7	1	5. 5	ROOF FRONT LIGHTING
LC1-JF8	1	5. 5	ROOF REAR LIGHTING
LC2-C7	1	7. 4	SOCKET 12V
LC2-C8	1	7. 1	IGNITION KEY
LC2-C8	1	7. 1	IGNITION KEY

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NOME NAME	QUANTITA' AMOUNT	PAGINA/COLONNA PAGE/COLUMN	TESTO FUNZIONALE FUNCTION TEXT
LC2-C10	1	7. 4	TRANSFORMER
LC2-C11	1	20. 3	DISPLAY
LC2-C12	1	20. 2	BUZZER
LC2-C14	1	155. 1	DIODES BOARD
LC2-C20	1	20. 8	DISPLAY
LC2-C21	1	30. 6	HORN
LC2-C27	1	80.1. 1	RESISTORS KIT
LC2-C28	1	40.1. 4	REAR WORKING LIGHTS
LC2-C32	1	40.1. 1	FRONT WORKING LIGHTS
LC2-C33	1	70. 3	EMERGENCY PUSH BUTTON
LC2-C36	1	75. 4	GEN-ON
LC2-C41	1	10.4. 7	RPM
LC2-C45	1	80.3. 1	TRAVELLING
LC2-C47	1	80. 3	TRAVELLING JOYSTICK
LC2-C50	1	80.5. 3	DASH BRAKE
LC2-C55	1	80.1. 6	FOOT PEDAL TRAVELLING
LC2-C56	1	80.1. 2	DASH POTI TRAVELLING
LC2-C57	1	80.4. 3	HYDRAULIC GEARS
LC2-C58	1	85. 8	SPIN
LC2-C67	1	85. 2	STEERING
LC2-C68	1	200. 3	VIBRATOR
LC2-C69	1	200. 2	TAMPER
LC2-C70	1	170. 2	SCREED
LC2-C71	1	140. 5	FUME EXHAUSTER
LC2-C80	1	150.1. 7	SCREED EXTENS.
LC2-C81	1	150.1. 5	SCREED EXTENS.
LC2-C85	1	160.1. 6	RIGHT LEVEL
LC2-C89	1	160. 0	LIVELLING SYSTEM
LC2-C90	1	150. 7	SCREED EXTENS.
LC2-C91	1	150. 5	SCREED EXTENS.
LC2-C95	1	160. 6	LEFT LEVEL
LC2-C103	1	100.2. 4	AUGER BOX
LC2-C104	1	130. 4	SAFETY LOCK BOLT
LC2-C105	1	120. 6	HOPPER
LC2-C106	1	120. 2	HOPPER
LC2-C107	1	110. 4	LOADING
LC2-C108	1	100.1. 7	RIGHT AUGER
LC2-C109	1	100.1. 4	RIGHT AUGER
LC2-C110	1	100.1. 3	
LC2-C115	1	100. 8	LEFT AUGER

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NOME NAME	QUANTITA' AMOUNT	PAGINA/COLONNA PAGE/COLUMN	TESTO FUNZIONALE FUNCTION TEXT
LC2-C116	1	100. 5	LEFT AUGER
LC2-C117	1	100. 4	
LC2-C122	1	90.1. 3	RIGHT CONVEYOR
LC2-C123	1	90. 7	CONVEYORS
LC2-C124	1	90. 3	LEFT CONVEYOR
LC2-C125	1	90.1. 2	
LC2-C126	1	90. 2	
LC2-C135	1	190. 1	WATER SPRAY
LC2-C151	1	20. 3	DISPLAY
LC2-C152	1	10.4. 1	ECO SYSTEM
LC2-C153	1	200.2. 4	TAMPER VIBRATOR CONTROLLER
LC2-C170	1	250. 2	ELECTRONIC UNIT
LC2-D1	1	40. 6	
LC2-D2	1	40. 6	
LC2-D3	1	75. 3	
LC2-D4	1	75. 3	
LC2-D5	1	20. 2	
LC2-D6	1	20. 3	
LC2-D7	1	250. 7	
LC2-D9	1	80.3. 8	
LC2-D10	1	80.3. 7	
LC2-E1	1	7. 2	KEY
LC2-E2	1	30. 5	HORN
LC2-E3	1	30. 4	HORN
LC2-E4	1	40.1. 4	REAR WORKING LIGHTS
LC2-E5	1	40.1. 1	FRONT WORKING LIGHTS
LC2-E6	1	70. 5	EMERGENCY
LC2-E7	1	75. 2	GEN-ON
LC2-E8	1	10.3. 1	POWER EMR
LC2-E9	1	80.3. 7	AUGER CONVEYOR AUTO
LC2-E10	1	80.5. 5	POWER
LC2-E13	1	80.4. 7	HYDRAULIC GEAR
LC2-E14	1	170. 7	L.C.S.
LC2-E15	1	100.1. 6	RIGHT AUGER
LC2-E16	1	100. 7	LEFT AUGER
LC2-E17	1	7. 8	GEN-ON
LC2-E18	1	80.3. 5	AUTOMATIC SERVICES
LC2-E19	1	80.3. 2	TRAVELLING
LC2-F1	1	190. 3	WATER SPRAY
LC2-F2	1	50. 4	BEACON

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NOME NAME	QUANTITA' AMOUNT	PAGINA/COLONNA PAGE/COLUMN	TESTO FUNZIONALE FUNCTION TEXT
LC2-F3	1	20. 1	ALARMS
LC2-F4	1	30. 4	HORN
LC2-F5	1	40.1. 1	WORKING LIGHTS
LC2-F6	1	60. 4	WASHING PUMP
LC2-F7	1	70. 3	EMERGENCY
LC2-F8	1	10.4. 7	ENGINE RPM
LC2-F9	1	80. 1	TRAVELLING
LC2-F10	1	7. 5	TRANSFORMER
LC2-F11	1	15. 4	FAN
LC2-F13	1	10.3. 1	POWER EMR
LC2-F14	1	30. 2	HORN
LC2-F17	1	40.1. 6	FRONT WORKING LIGHTS
LC2-F18	1	40.1. 8	REAR WORKING LIGHTS
LC2-F19	1	40. 4	DASH BOARD LIGHTS
LC2-F20	1	180. 4	HEATING
LC2-F21	1	160.1. 6	RIGHT LIVELLING
LC2-F22	1	80.3. 4	TRANSPORT
LC2-F25	1	80.5. 3	POWER
LC2-F26	1	80.4. 3	HYDRAULIC GEARS
LC2-F27	1	150.1. 7	RIGHT SCREED EXTENS
LC2-F28	1	170. 2	SCREED
LC2-F29	1	200.2. 3	AUTEC DISPLAY
LC2-F30	1	80.3. 5	AUTOMATIC
LC2-F31	1	160. 6	LEFT LIVELLING
LC2-F32	1	150. 7	LEFT SCREED EXTENS
LC2-F33	1	100.2. 4	AUGERS LIFTING
LC2-F34	1	120. 2	HOPPERS
LC2-F35	1	100.1. 7	RIGHT AUGER
LC2-F36	1	100. 8	LEFT AUGER
LC2-F37	1	90.1. 7	RIGHT CONVEYOR
LC2-F38	1	90. 7	LEFT CONVEYOR
LC2-F39	1	75. 7	GEN-ON
LC2-F40	1	10.2. 3	PREHEAT
LC2-F41	1	100. 1	AUGERS
LC2-F42	1	90. 1	CONVEYORS
LC2-F43	1	170.1. 2	L.C.S.2
LC2-F43	1	170.2. 5	L.C.S.2
LC2-F44	1	200. 2	TAMPER AND VIBRATOR
LC2-F45	1	190. 7	WATER SPRAY
LC2-F46	1	170. 7	L.C.S.

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NOME NAME	QUANTITA' AMOUNT	PAGINA/COLONNA PAGE/COLUMN	TESTO FUNZIONALE FUNCTION TEXT
LC2-F47	1	250. 7	FORWARD
LC2-F48	1	80. 8	BACKWARD
LC2-L1	1	40. 3	DASH BOARD
LC2-L2	1	40. 3	DASH BOARD
LC2-L3	1	40. 4	DASH BOARD
LC2-S1	1	20. 1	NEGATIVE BRAKE
LC2-S1	1	20. 1	NEGATIVE BRAKE
LC2-S2	1	85. 5	RIGHT STEERING
LC2-S2	1	85. 5	RIGHT STEERING
LC2-S3	1	85. 4	LEFT STEERING
LC2-S3	1	85. 4	LEFT STEERING
LC2-S6	1	80.4. 2	HYDRAULIC GEAR
LC2-S6	1	80.4. 2	HYDRAULIC GEAR
LC2-S7	1	80.4. 4	HYDRAULIC GEAR
LC2-S7	1	80.4. 4	HYDRAULIC GEAR
LC2-S8	1	85. 7	SPIN
LC2-S8	1	85. 7	SPIN
LC2-S9	1	100.1. 3	RIGHT AUGER
LC2-S9	1	100.1. 3	RIGHT AUGER
LC2-S10	1	100. 4	LEFT AUGER
LC2-S10	1	100. 4	LEFT AUGER
LC2-S11	1	90.1. 2	RIGHT CONVEYOR
LC2-S11	1	90.1. 2	RIGHT CONVEYOR
LC2-S12	1	90. 3	LEFT CONVEYOR
LC2-S12	1	90. 3	LEFT CONVEYOR
LC3-C17	1	20. 6	HYDR. OIL TEMP.
LC3-C18	1	20. 7	HYDR. OIL THERM.
LC3-C19	1	20. 7	FUEL LEVEL
LC3-C38	1	10.1. 3	ENGINE COOLANT LEVEL
LC3-C38	1	10.1. 3	ENGINE COOLANT LEVEL
LC4-C24	1	30. 7	HORN
LC4-C34	1	70. 3	EMERGENCY PUSH BUTTON
LC4-C92	1	150. 7	SCREED EXTENS.
LC4-C93	1	150. 3	DIODES CARD
LC4-C94	1	150. 3	
LC4-C98	1	160. 5	LEFT LEVEL
LC4-C99	1	100. 2	
LC4-C100	1	100. 3	LEFT AUGERS POTI
LC4-C118	1	100. 5	LEFT AUGER
LC4-C131	1	90. 5	LEFT CONVEYOR

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NOME NAME	QUANTITA' AMOUNT	PAGINA/COLONNA PAGE/COLUMN	TESTO FUNZIONALE FUNCTION TEXT
LC4-L21	1	150. 3	
LC4-L21	1	150. 3	
LC5-C23	1	30. 9	HORN
LC5-C35	1	70. 7	EMERGENCY PUSH BUTTON
LC5-C82	1	150.1. 7	SCREED EXTENS.
LC5-C83	1	150.1. 3	DIODES CARD
LC5-C84	1	150.1. 3	
LC5-C88	1	160.1. 5	RIGHT LEVEL
LC5-C101	1	100.1. 2	
LC5-C102	1	100.1. 3	RIGHT AUGERS POTI
LC5-C111	1	100.1. 5	RIGHT AUGER
LC5-C127	1	90.1. 5	RIGHT CONVEYOR
LC5-L22	1	150.1. 3	
LC5-L22	1	150.1. 3	
LC10-C72	1	170. 5	L.C.S.
LC10-C73	1	170.1. 2	L.C.S.2
LC12-L28	1	45. 6	BEACON
N	1	30. 9	HARNESS
N	1	30. 9	HARNESS
OPIONALKIT	1	190. 1	WATER SPRAY
OPTIONALKIT	1	170.1. 0	L.C.S.2
OPTIONALKIT	1	170.2. 0	LOCK CYLINDER
P	1	60. 4	HARNESS
P	1	60. 4	HARNESS
PA	1	200.1. 5	PICK-UP VIBRATOR
PA	1	200.1. 5	PICK-UP VIBRATOR
PB	1	200.1. 2	PICK-UP TAMPER
PB	1	200.1. 2	PICK-UP TAMPER
PC	1	80.2. 5	PICK-UP RIGHT CRAWLER
PC	1	80.2. 5	PICK-UP RIGHT CRAWLER
PE	1	80.1. 5	FOOT PEDAL TRAVELLING
PE	1	80.1. 5	FOOT PEDAL TRAVELLING
PK	1	80.2. 1	PICK-UP LEFT CRAWLER
PK	1	80.2. 1	PICK-UP LEFT CRAWLER
Q	2	150. 4	HARNESS
Q	2	150. 4	HARNESS
R	3	7. 3	HARNESS
R	3	7. 3	HARNESS
RJ	1	200.3. 4	TAMPER AND VIBRATOR CONTROLLER
SP	2	80.1. 5	FOOT PEDAL TRAVELLING

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NOME NAME	QUANTITA' AMOUNT	PAGINA/COLONNA PAGE/COLUMN	TESTO FUNZIONALE FUNCTION TEXT
SP	2	80.1. 5	FOOT PEDAL TRAVELLING
T	1	90. 1	HARNESS
T	1	90. 1	HARNESS
VA	1	15. 4	FAN
VA	1	15. 4	FAN
WA	1	10.1. 3	ENGINE COOLANT LEVEL
WA	1	10.1. 3	ENGINE COOLANT LEVEL
WB	1	10.1. 4	ENGINE FUEL FILTER
WB	1	10.1. 4	ENGINE FUEL FILTER
WE	1	160.2. 3	LEVELLING WIRE SENSORS
WE	1	160.2. 3	LEVELLING WIRE SENSORS
WH	1	190. 6	WATER SPRAYING
WH	1	190. 6	WATER SPRAYING
XC	1	10.1. 4	EMR
XC	1	10.1. 4	EMR
XJE1	1	10.2. 4	PRE-HEAT
XKEY	1	7. 1	STARTING KEY
XKEY	1	7. 1	STARTING KEY
Z	1	10.1. 3	HARNESS
Z	1	10.1. 3	HARNESS

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Head Office/Hauptsitz
BOMAG
Hellerwald
D-56154 Boppard
Germany
Telefon: +49 6742 100-0
Fax: +49 6742 3090
E-Mail: info@bomag.com

BOMAG
FAYAT GROUP

BOMAG
Niederlassung Berlin
Gewerbestraße 3
15366 Hoppegarten
GERMANY
Tel.: +49 3342 369410
Fax: +49 3342 369436
e-mail: nlberlin@bomag.com.de

BOMAG
Niederlassung Boppard
Hellerwald
56154 Boppard
GERMANY
Tel.: +49 6742 100360
Fax: +49 6742 100392
e-mail: nlboppard@bomag.com

BOMAG
Niederlassung Chemnitz
Querstraße 6
09247 Chemnitz
GERMANY
Tel.: +49 3722 51590
Fax: +49 3722 515951
e-mail: nlchemnitz@bomag.com

BOMAG
Niederlassung Hannover
Dieselstraße 44
30827 Garbsen-Berenbostel
GERMANY
Tel.: +49 5131 70060
e-mail: nlhannover@bomag.de

BOMAG
Niederlassung München
Otto-Hahn-Ring 3
85301 Schweitenkirchen
GERMANY
Tel.: +49 8444 91840
e-mail: nlmuenchen@bomag.de

BOMAG
Niederlassung Stuttgart
Uferstraße 22
73630 Remshalden-Grunbach
GERMANY
Tel.: +49 7151 986293
e-mail: nlstuttgart@bomag.de

BOMAG (China) Construction
Machinery Co. , Ltd
No. 2808, west Huancheng Road,
Shanghai Comprehensive Industrial
Zone Fengxian Shanghai 201401
CHINA
Tel.: +86 21 3365 5566
Fax: +86 21 3365 5508
e-mail: china@bomag.com

BOMAG France S.A.S.
2, avenue du Général de Gaulle
91170 VIRY-CHATILLON
FRANCE

Tel.: +33 1 69578600
Fax: +33 1 69962660
e-mail: france@bomag.com

BOMAG (GREAT BRITAIN), LTD
Sheldon Way, Larkfield
Aylesford
Kent ME20 6SE
GREAT BRITAIN

Tel.: +44 1622 716611
Fax: +44 1622 710233
e-mail: gb@bomag.com

BOMAG Italia Srl.
Via Roma 50
48011 Alfonsine
ITALY
Tel.: +39 0544 864235
Fax: +39 0544 864367
e-mail: italy@bomag.com

BOMAG (CANADA), INC.
3455 Semenyk Court
Missisauga, Ontario
CANADA
Tel.: +1 905 361 9961
Fax: +1 905 361 9962
e-mail: canada@bomag.com

BOMAG Maschinenhandelsgesellschaft
m.b.H.
Porschestraße 9
1230 Wien
Tel.: +43 1 69040-0
Fax: +43 1 69040-20
e-mail: austria@bomag.com

FAYAT BOMAG Polska Sp. z.o.o.
Ul. Szyszkowa 52
02-285 Warzawa
POLAND

Tel.: +48 22 4820400
Fax: +48 22 4820401
e-mail: poland@bomag.com

FAYAT BOMAG Rus OOO
Klyazma block, h 1-g
141400 Khimki, Moscow region, RF
RUSSIA

Tel.: +7 (495) 2879290
Fax: +7 (495) 2879291
e-mail: russia@bomag.com

BOMAG GmbH, Singapore
300, Beach Road
The Concourse, , 18-06
Singapore 199555
SINGAPORE
Tel.: +65 294 1277
Fax: +65 294 1377
e-mail: singapore@bomag.com

BOMA Equipment Hong Kong LTD
Room 1003, 10/F Charm Centre
700, Castle Peak Road
Kowloon,
HONG KONG
Tel.: +852 2721 6363
Fax: +852 2721 3212
e-mail: bomahk@bomag.com

BOMAG Americas, Inc.
2000 Kentville Road
Kewanee, Illinois 61443
U.S.A.

Tel.: +1 309 8533571
Fax: +1 309 8520350
e-mail: usa@bomag.com

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