



Technical Publication

Diesel Engine
12V 4000

Maintenance Manual
MR20101/00E

Sold & Serviced By Detroit Diesel

Technical Publication

Diesel Engine
12V 4000 G

Maintenance Manual
MR20101/00E

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Printed in Germany

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Le manuel devra être observé en vue d'éviter des incidents ou des endommagements pendant le service. Aussi recommandons-nous à l'exploitant de le mettre à la disposition du personnel chargé de l'entretien et de la conduite.

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Il manuale va consultato per evitare anomalie o guasti durante il servizio, per cui va messo a disposizione dall'utente al personale addetto alla manutenzione e alla condotta.

Con riserva di modifiche.

Amendment Service!

Amendments to this publication will be sent to you in the form of Amendment Sets as and when they are issued provided that you complete and return the receipt section on the reverse of this page.

MR20101/00E	Postcard MTU Friedrichshafen GmbH Department SCT 88040 Friedrichshafen GERMANY
Maintenance Manual	
12 V 4000 G	



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A001 Important information

This manual is intended for use by technical personnel responsible for the maintenance and servicing of the MTU 4000 series **diesel engine**

This handbook contains descriptions of the following:

- scheduled service operations under maintenance echelons W6
- non-scheduled service operations on the individual assemblies

REMAN assemblies

The following assemblies are available only in the replacement procedure:

- Cylinder head
- High-pressure pump
- Injector
- Coolant pump
- MDEC
- Exhaust turbocharger
- Intercooler
- Vibration damper
- Starter
- Alternator (generator)
- Fuel delivery pump
- Engine short block

Only removal and installation is explained.

Structure of this handbook

This manual is divided into 3 main sections:

- Section A General
- Section B Work schedules
- Section C Task description

Section C is further subdivided into main function groups (MFG) and function groups (FG). The structure is oriented toward the logical structure of the parts lists and Spare Parts Catalogues.

Each function group (FG) consists of no more than nine parts:

- C.011.0501 Overview drawing
- C.011.0502 Special tools
- C.011.0504 Before-removal operations
- C.011.0505 Removal
- C.011.0506 Disassembly
- C.011.0508 Inspection and repair
- C.011.0510 Assembly
- C.011.0511 Installation
- C.011.0512 After-installation operations

Systematic searches for specific information and rapid orientation in the manual are supported by:

- The contents sheet, which cross-references the tables of contents of the individual groups.
- An alphabetical subject index in Section A provides direct access to the individual Groups.
- The Group Summary at the start of Section C lists the individual main function groups.

Requirements for maintenance tasks

If the maintenance work is carried out by the customer, the following must be ensured:

- All safety regulations are observed
- Use of trained and qualified personnel
- Suitable workshop equipment with general tools
- Suitable test equipment
- Approved special tools

General Assembly Instructions

- **Component cleanliness:**
Areas of all components that come into contact with oil, fuel, coolant and combustion air must be clean.
- Components requiring "special cleanliness" (e.g. oil and fuel-carrying parts) must be cleaned with suitable cleaning procedures before assembly, checked for particular cleanliness and treated accordingly.
- Component packaging must only be removed immediately before installation.
- Elastomer components (e.g. rubber and similar) must not be washed with diesel fuel, solvent or cold cleaners.
 - Parts dirtied with oil and fuel must be cleaned immediately. The parts should be wiped with a dry cloth.
 - Elastomer components such as engine mounts, damping elements, couplings and V-belts must not be painted. They can only be installed after painting the engine or must be covered before painting work is carried out.
- Radial-lip shaft seals treated by the manufacturer with oil show as a result definite signs of swelling when delivered. They must therefore be cleaned (not washed) only with an abrasion-proof paper cloth before installation.
- The surfaces of parts that slide against each other must be lubricated with SAE 30 engine oil when installed, unless otherwise specified.
- O-rings and surfaces moving against them during installation (bores and shafts) must be coated with petroleum jelly, unless otherwise specified.
When installing O-rings with counterrings in coolant pumps, always follow the installation instructions.
- After installing O-rings in shaft grooves, in order to remedy twists caused by installation, pass a rounded marking tool under the O-ring in the direction of the circumference if the O-ring diameter is sufficiently large. Make sure that the O-ring is not damaged.
- Before installing shaft seals
 - On the shaft, the sealing lip of the shaft seal must be coated with petroleum jelly and the shaft running surface with thin-film lubricant or SAE 30 engine oil.
 - In the support bore, the outer surface of metal outer jackets – unless otherwise specified in the drawing – must be coated with surface sealant.
In the case of an elastomer outer jacket or combined metal/elastomer outer jacket, the outer surface must be coated with denaturated ethanol.
-  This symbol applies to radial-lip shaft seals and its significance depends on its position.
The arrow indicates the position of the sealing lip.
- Sealing paste must be used to fix the position of flat gaskets. Sealing paste is to be thinly applied in spots on the flat gaskets or mating faces. Immediately after application of the sealing paste, the flat gaskets must be fitted to the component and then (no more than 20 minutes later) the seal components screwed together.
Oil, multi-purpose grease or other materials must not be used to fix the position.
- Before installing antifriction bearings, lightly lubricate the bearing seats.
Only remove the bearings from their original packaging immediately before installation so they do not get dirty.
Do not remove the corrosion inhibitor from the bearings in original packaging.
Use petroleum spirit or acid-free kerosene to clean the antifriction bearings.
After cleaning, relubricate the bearings with engine oil.
 - During assembly, do not apply (axial) forces to antifriction elements and do not hit the bearing rings with a hammer (use assembly aids).
 - Do not use an open flame to heat bearing inner races.
 - The temperature should be between 80 °C and 100 °C and must never exceed 120 °C.
 - Deep-freezing for friction bearing installation is not permissible (risk of cracking, rusting through condensate).
- Dry bearings must not be oiled.
- When installing gears, the splines must be lubricated with SAE 30 engine oil.

- All support and mating surfaces of components (e.g. mating surfaces for centring devices, flange and sealing surfaces, joint surfaces of press fits) must be clean, polished or provided with the specified surface protection and free from warping and damage. Corrosion inhibitors (e.g. oil, grease) must be removed from support and mating surfaces.
- After parts are joined which are installed by means of cooling using liquid nitrogen, all condensate must be removed and the parts coated with SAE 30 engine oil.
- Sensors must be coated with long-life lubricant before installation in the immersion sleeves.
- Cable connections with cutting ring threaded connections must be installed in a vice and tightened, the thread first being coated with thin-film lubricant.
- If components are to be marked by etching, after the etching is completed the solution must be removed by means of neutralization agent. The affected parts must then be preserved with SAE 30 engine oil.
- Components used in hot part areas (e.g. V-clamps, bellows, plug-in pipes) must be coated at the support and mating surfaces with assembly paste, unless otherwise specified.
- The assembly surfaces of screws, nuts, washers and of parts to be tensioned must be clean and polished or provided with the specified surface protection and free from warping and damage. Corrosion inhibitors (e.g. oil, grease) must be removed. Threads and screw heads must be coated with lubricant before assembly as per tightening specifications.
- Unless otherwise specified, engine oil (SAE 30) must be used as lubricant, and assembly paste in the area of hot parts.
- Threaded connections without tightening specifications
For threaded connections without tightening specifications, the tightening procedure can be selected as required, i.e. mechanical tightening with screwdriver or normal manual tightening with an open-end wrench or box wrench is possible. In the event of mechanical tightening, the tightening torque must be taken from the general tightening specifications according to thread size and property class.
- Threaded connections with tightening specifications
 - Torque tightening
The screw connections must be tightened by hand with a torque wrench or angle-of-rotation torque wrench. The specified tightening torques must be set at the torque wrench without consideration of the specified tolerance. When using an angle-of-rotation torque wrench, the torque indicated must be within the torque specification limit value. Proceed in a similar manner with torsionally protected threaded connections. These instructions apply also to testing torque.
 - Note:** If no tolerance for tightening torque is stated, the tightening tolerance is +10% of specified torque.
 - Angle-of-rotation tightening
The additional angles of rotation specified in the tightening specifications must be achieved and may be exceeded within the specified tolerance.
If no tightening tolerance is specified, the following tolerances must be observed:
+5° for additional angle of rotation less than/equal to 90°
+10° for additional angle of rotation greater than 90°
Before angle-of-rotation tightening, each screw head must be colour-marked so that after tightening it is possible to check that the angle of rotation is correct (exception: colour-marking is not necessary in the case of a self-monitoring NC screwdriver).
 - Tightening to elongation
Tightening must be carried out in accordance with tightening specifications taking the tightening tolerance into consideration.

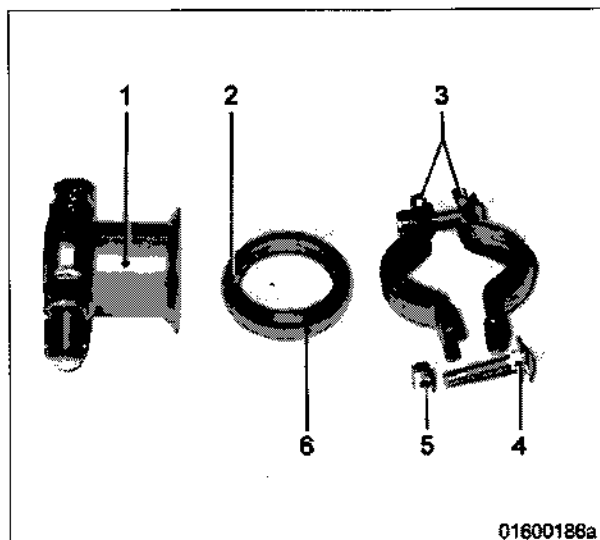
Information on installation of Flexmaster pipe connection

To improve adhesion between the sealing ring and pipe, as well as prevent loosening of the sealing ring, both pipe ends are to be thoroughly degreased to at least the insertion depth. Remove paint from the area near the sealing ring.

The cut edges on the pipe must be deburred.

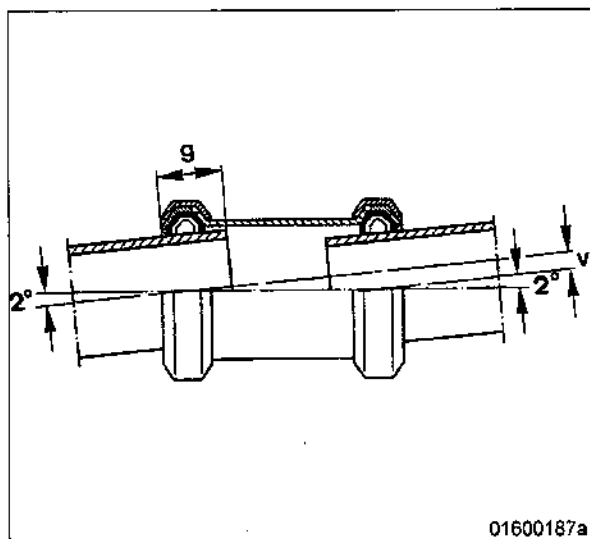
Otherwise leaks may arise during installation or in operation.

Note: When installing sealing rings, no oil, grease, graphite or other lubricants must be used.



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- 1 Sleeve
- 2 Sealing ring
- 3 Clamps
- 4 Screw
- 5 Self-locking nut
- 6 Seal carrier

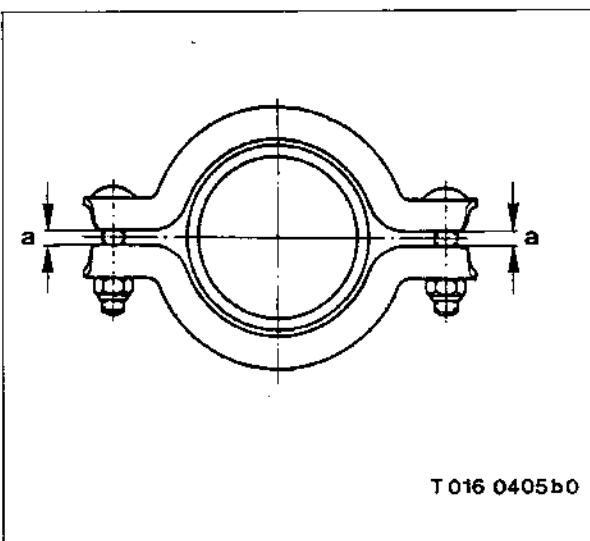


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In event of alignment offset (v) of pipes to be connected, pipe ends of the sleeve must not touch.

The permissible non-alignment is determined by the immersion depth of the pipe ends (g) and the permissible angle of $\pm 2^\circ$.

The depth of insertion (g) must be marked beforehand for a well centred fit.



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The clamp halves are placed over seal carrier and sleeve and tightened with screws and self-locking nuts until dimension "a" is achieved.

Note: Replace deformed clamping-ring halves.
Clamps must not be fully tightened.
Replace self-locking nuts after loosening and retightening several times.

Dimension "a" for pipe outer diameters:

from 12 mm to 26.9 mm min. 2 mm max. 5 mm
from 28 mm to 60.3 mm min. 4 mm max. 8 mm
from 63.5 mm to 127 mm min. 8 mm max. 12 mm

A002 Hazards in the work area

These Safety Instructions must be read and followed by any persons operating, carrying out maintenance or repairs on the machinery plant.

General safety and accident prevention regulations

- In addition to the instructions given in this publication, general safety and accident prevention regulations and laws must be taken into consideration; these may vary from country to country.
- This MTU engine is a state-of-the-art product and conforms with all the applicable specifications and regulations. Nevertheless, persons and property may be at risk in the event of:
 - Incorrect use
 - Operation, maintenance and repair carried out by untrained personnel
 - Modifications or conversions
 - Noncompliance with the Safety Instructions

Correct use

- The engine is to be used solely for the purpose stated in the contract. Any other use is considered improper use. The manufacturer will accept no liability for any resultant damage. The responsibility is borne by the user alone.
- Correct use also includes observation of the Operating Instructions and Maintenance Manual and compliance with maintenance and repair instructions.

Personnel requirements

- Work on the engine must be carried out only by reliable personnel. The specified legal minimum age must be respected.
- Only fully-trained or qualified personnel must be employed. Responsibilities of the operating, maintenance and repair personnel must be specified.

Modifications or conversions

- Modifications made by the customer to the engine may affect safety. No modifications or conversions must be carried out without prior consent from MTU.
- No liability will be accepted for damage resulting from unauthorised modifications.

Organisational measures

- This manual must be made available to maintenance and repair personnel.
- The personnel must be instructed on engine operation and repair by means of the Maintenance Manual, and in particular the safety instructions must be explained. This is especially important for personnel who work on the engine only on an occasional basis.

Note: *This copy is only subject to the Amendment Service if the acknowledgement of receipt card has been returned to MTU. This also applies to in-house use by MTU personnel.*

Spare parts

- Spare parts must at least satisfy the requirements specified by the manufacturer. This is guaranteed when original components are used.

Working clothes and protective equipment

- Always wear protective shoes when working on plant.
- Select appropriate protective goggles for the work to be carried out. Always wear protective goggles when working with mallets, cutting tools, drift punches and similar tools.
- Work clothing must be tight-fitting so that it does not catch on rotating or projecting parts. Do not wear jewellery (e.g. rings, chains, etc.).

Welding operations

- Never use the engine as an earth connection. – (This prevents the welding current passing through the engine and causing scorching or burning at bearings, sliding surfaces and tooth flanks, which can lead to pitting or other material damage)
- Welding operations on the engine or mounted units are not permitted.
- Never place the welding cable across or near wiring harnesses of MTU plants. (The welding current could be induced in the cable harnesses which could possibly damage the electrical plant)
- The ground terminal of the welding unit must be connected to the welding point at a distance no greater than 60 cm.
- If welding must be carried out on components (e.g. exhaust pipe), these components must be removed from the engine beforehand.
- At the MTU electronics system, it is not necessary to remove the connector and connections to carry out welding operations if the master switch of the power supply is switched from "On" to "Off" and the cable has been disconnected from the negative and positive poles on the battery.
- During welding operations, always wear welding gloves, headgear/goggles, protective aprons and other suitable protective clothing.

Transport

- Lift the engine only with the lifting eyes provided.
- Use only the transportation and lifting equipment approved by MTU.
- Take into consideration engine centre of gravity.
- The engine must only be transported in installation position.
- In event of special packaging with aluminium foil, attach engine to lifting eyes of bearing pedestal or transport with forklift truck.
- Before transporting the engine, the crankshaft transportation locking device and engine mount locking device must be installed.

Engine operation

- When the engine is running, ear protectors must always be worn in the engine room.
- The engine room must be well ventilated.
- To avoid injuries caused by falling, leaked or spilt engine oil and coolant must be cleaned up immediately or absorbed with appropriate bonding agents.
- Exhaust gases from combustion engines are poisonous and injurious to health if inhaled. If inhaled, they can result in a risk to health. The exhaust pipework must be leak-free and must discharge the gases to atmosphere.
- During engine operation, do not touch battery terminals, generator terminals or cables. Inadequate protection of electrical components can lead to electric shocks and serious injuries.
- If engine is running, never release coolant, oil, fuel, compressed air or hydraulic lines.

Maintenance and repair

- Compliance with maintenance specifications is an important safety factor.
- Unless expressly permitted, no maintenance or repair work must be carried out with the engine running. The engine must be secured against inadvertent starting and the battery disconnected. Attach sign "Do not operate" in operating area or to control equipment. Persons not involved must keep clear.
- Never attempt to rectify faults or carry out repairs if you do not have the necessary experience or special tools required. Maintenance work must only be carried out by authorised, qualified personnel.
- Use only tools in perfect condition.
- Do not work on engines or components which are only held by lifting equipment or crane. Always support these components on suitable frames or stands before beginning any maintenance or repair work.

- Before barring the engine, make sure that nobody is standing in the danger zone. After working on the engine, check that all guards have been reinstalled and that all tools and loose components have been removed from the engine.
- Fluids emerging under high-pressure can penetrate clothing and skin and may cause serious injury. Before starting work, relieve pressure in systems and H.P. lines which are to be opened.
- Never bend a fuel line and do not install bent lines. Keep fuel injection lines and connections clean. Always seal connections with caps or covers if a line is removed or opened.
- During maintenance or repair work, do not hit fuel lines with wrenches or other tools. To tighten connections when installing lines, use the correct tightening torque and ensure that all retainers and dampers are installed correctly.
- Ensure that all fuel injection lines and compressed oil lines have sufficient play to avoid contact with other components. Do not place fuel or oil lines near hot components.
- The H.P. lines for hydraulic installation and removal are tested with 3800 bar.
- Do not attempt to bend or apply force to lines.
- In order to avoid burning, take special care when handling hot components on products just taken out of use and when working with hot liquids in pipelines, pipes and chambers.
- Until the engine has cooled, the breather cap must not be opened. Release the breather cap and allow pressure to escape, before cap removal.
- Take special care when removing ventilation or plugs from engine. In order to avoid being sprayed with highly-pressurised liquids, hold a cloth over the screw or plug. There is increased danger if the engine has only recently been shut down as the liquids can still be hot.
- Take special care when draining hot fluids – Risk of injury! Drain the fluids into a suitable container and wipe up any spillages.
- When changing engine oil or working on the fuel system, ensure that the engine room is adequately ventilated.
- When working high on the engine, always use suitable ladders and work platforms. Make sure components are placed on stable surfaces.
- To avoid damaging your back when lifting components weighing 25 kg (50 lb.) or more, use lifting gear or request aid from other workers. Ensure that all chains, hooks, slings, etc. are in good condition, are sufficiently strong and that hooks are correctly positioned. Lifting eyes must not be unevenly loaded.
- When operating electrical equipment, certain components of this equipment are live.
- Noncompliance with warning notices could result in serious physical injury or damage to property.
- Work must be carried out only by qualified personnel. Prior to working on electrical equipment, switch off live units.
- Gases released from the battery are explosive. Avoid sparks and naked flames. Do not allow battery acids to come into contact with skin or clothing. Wear protective goggles. Do not place tools on the battery. Before connecting the cable to the battery, check battery polarity. Battery pole reversal may lead to injury through the sudden discharge of acid or bursting of the battery body.
- Do not damage wiring during removal work and when reinstalling wiring and ensure that during operation it is not damaged by contact with sharp objects, by rubbing against another component or by a hot surface. Never connect wiring to a line which carries liquid.
- On completion of the maintenance and repair work, any cables which have become loose must be correctly secured.
- Always tighten connectors with connector pliers.
- If cables are present at mechanical components and there is a risk of wear, the cables must be retained in cable clamps.
- For this purpose, no cable straps must be used as, during maintenance and/or repair work, the straps can be removed but not installed a second time.

- Check security of all plug-in connections.
- It is not sufficient to tighten the connections by hand with a bayonet union. There is the risk of the lock not engaging properly and the connector coming loose during engine operation. Therefore pliers must be used for turning the bayonet union nut in clockwise direction.

Fire prevention

- Rectify any fuel or oil leaks immediately; even splashes of oil or fuel on hot components can cause fires – therefore always keep the engine in a clean condition. Do not leave oil-soaked cloths on the engine. Do not store combustible fluids near the engine. Do not allow dirt or foreign matter to accumulate near the engine, as this constitutes a fire hazard.
- Welding work must not be carried out on pipes and components containing oil. Before welding, clean with a noncombustible fluid.
- Never mix petrol/gasoline with diesel fuel. If petrol/gasoline is added to diesel fuel, there is increased risk of fire.
- When starting the engine with a foreign power source, connect the ground lead last and remove it first. To avoid sparks in the vicinity of the battery, connect the ground lead from the foreign power source to the ground lead of the engine or to the ground terminal of the starter.
- Always keep a fire extinguisher at hand and learn how to operate it.

Noise

- Hearing may be impaired at workplaces where the sound pressure level is in excess of 85 dB(A).
- Wear earplugs or earmuffs!

Environmental protection

- Dispose of used fluids and lubricants and filters in accordance with local regulations.
- Manipulation of the injection or control system can influence the engine performance and exhaust emissions. As a result, compliance with environmental regulations may no longer be guaranteed.

Skin complaints

- Barrier creams issued for prophylactic use are not suitable for treatment of skin complaints. Seek medical advice on skin rashes of any type, even if symptoms are very slight.

Warning signs

- Before putting the engine into service and before working on the engine, read and follow all warning signs. Do not paint on warning signs. Replace illegible signs.

Auxiliary materials

- Use only fluids and lubricants that have been tested and approved by MTU.
- Fluids and lubricants must be kept in properly designated containers. When using fluids, lubricants and other chemical substances, follow the safety instructions applicable to the product. Take special care when using hot and caustic materials. When using inflammable materials, avoid all sparks and do not smoke.

Lead

- When working with lead or pastes that contain lead, take care that the body does not absorb even tiny amounts of lead (from air-borne lead dust, smoke, dirty hands).
- Adopt suitable measures to avoid the formation of lead dust!
- Switch on extraction system!
- Wash hands before consuming food or beverages!

Chlorinated hydrocarbons

- When working with chlorinated hydrocarbons (e.g. perchlorethylene, trichlorethane) or other cold cleaners which contain declared hazardous substances, health-endangering substances may be inhaled.
- Switch on ventilation and extraction systems!
- Observe fire-prevention regulations!
- No smoking and no consumption of alcoholic beverages!
- Do not permit substances to enter the waste-water system!

Acids and alkalis

- When working with acids and alkalis, wear protective goggles or face mask, gloves and protective clothing.
- Immediately remove clothing wetted by acids and alkalis!
- Rinse injuries with plenty of clean water!
- Rinse eyes immediately with water from rinsing bottle or clean mains water!

Painting

- When painting in other than spray booths equipped with extractors, ensure good ventilation. Make sure that adjacent work areas are not affected.
- Always wear a mask providing protection against paint and solvent vapours!
- Observe all fire-prevention regulations!
- No smoking!
- No naked flame!

Liquid oxygen

- Liquid oxygen is highly flammable.
- Liquid oxygen should only be stored in small quantities and in regulation containers (without fixed seals)! Do not bring into contact with parts of the body (hands); causes cold burns and severe frostbite.
- No smoking, no naked flame (risk of explosion)! Oxygen enrichment in the air causes flash combustion.
- Do not store combustible substances (e.g. oils and greases) within 5 m of the working area!
- Under no circumstances wear oily or greasy clothing!
- Do not allow vapours to penetrate clothing! Oxygen enrichment in fabric can cause working clothes to ignite suddenly!
- After working with liquid oxygen, do not smoke until clothing is free of vapours!
- Take great care to avoid impact and shock when working with liquid oxygen!

Liquid nitrogen

- Store liquid nitrogen only in small quantities and always in regulation containers without fixed covers.
- Do not allow liquid nitrogen to come into contact with parts of body (eyes, hands). Liquid nitrogen causes cold burns and severe frostbite.
- Wear protective clothing (including gloves and closed shoes) and protective goggles!
- Ensure good ventilation (suffocation if nitrogen enrichment in inhaled air reaches 88%)
- Avoid all knocks and jars to the containers, fixtures or workpieces.

Compressed air

- Compressed air is air which has been compressed at excess pressure and is stored in tanks from which it can then be extracted.
- The compressed air pressure can be read off at the pressure indicator (pressure gauge); the pressure vessels and compressed air lines must also be at this pressure.
- High pressure is harmful to the human body, especially if applied suddenly.
- When working with compressed air, safety precautions must be constantly observed:
- Pay special attention to the pressure level in the compressed air network and pressure vessel!

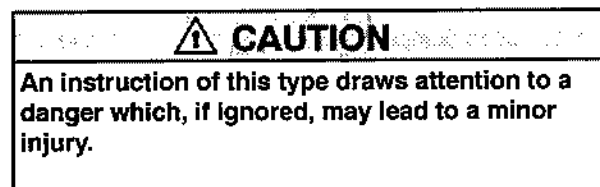
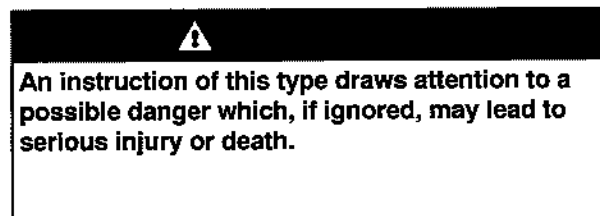
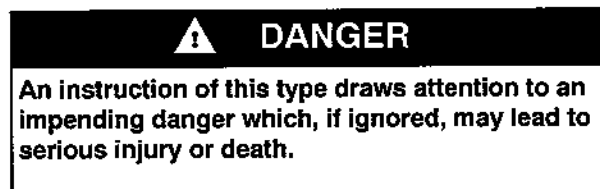
- Connecting devices and equipment must either be designed for this pressure or, if the permitted pressure for the connecting elements is lower than the pressure required, a pressure reducing valve and safety valve (set to permitted pressure) must form an intermediate connection. Hose coupling and connections must be securely attached!
- Always wear protective goggles when blowing off tools or extracting chips!
- The snout of the air nozzle is provided with a protective disc (e.g. rubber disc), which prevents air-borne particles being reflected and thereby prevents damage to the eyes.
- First shut off compressed air lines before compressed air equipment is disconnected from the supply line or before equipment or tool is to be replaced!
- Unauthorised use of compressed air, e.g. forcing flammable liquids (danger class A1, A11 and B) out of containers, results in a risk of explosion!
- Forcing compressed air into thin-walled containers (e.g. containers made of tin, plastic and glass) for drying purposes or to check for leaks results in a risk of explosion.
- Removing dirt on soiled clothes while still worn can result in a Risk of injury!
Even compressed air at low pressure penetrates clothing and, if the jet is directed at the back, the air can enter the anal cavity and fatally rupture the intestines!

Used oil

- Used oil may contain health-threatening combustion residues.
- Rub barrier cream into hands!
- Clean hands thoroughly after contact with used oil!

Warning notices

- Section "C" of this Publication contains especially emphasised safety instructions in accordance with the American standard ANSI Z535, which begin with one of the following signal words according to the degree of danger.
- Take extreme care in these situations!
- Read and become acquainted with all warning notices and symbols before operating or repairing this product!
- Inform operating and maintenance personnel on all Safety Instructions!



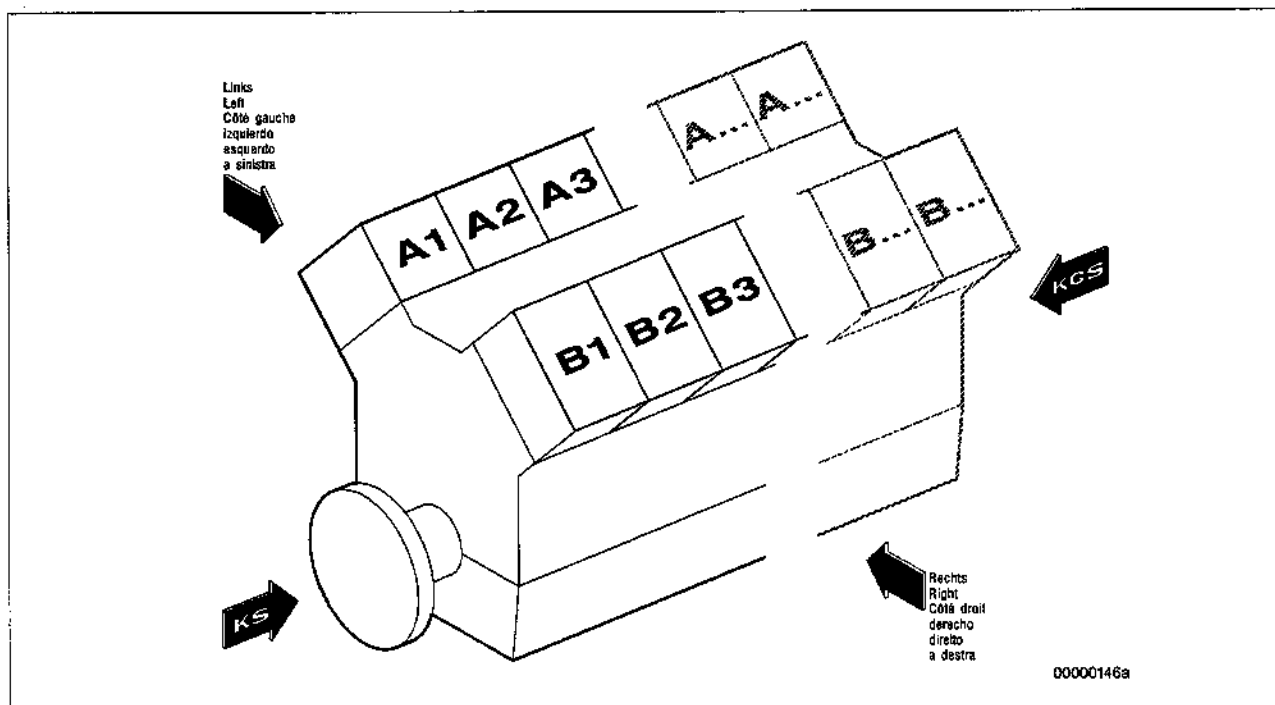
A003 Designation of engine sides and cylinders

Engine sides are always designated as viewed from the driving end.

Cylinders are designated (to DIN ISO 1204) A on the left engine side and B on the right engine side.

The cylinders of each bank are numbered in consecutive order, beginning at No. 1 at the driving end.

The consecutive numbering of other components, too, always begins with No. 1 at the driving end of the engine.



Designations and Abbreviations

Driving end = KS

Free end = KGS

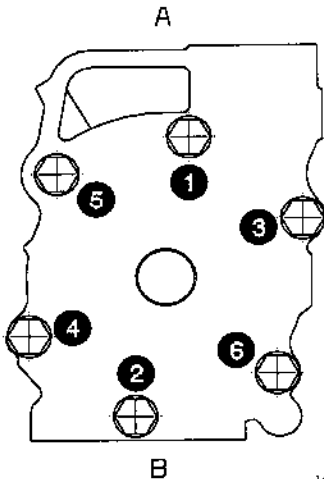
Left side

Right side

Top end

Bottom end

A004 Torque specification for screws and nuts

Designation	Tightening Specification	Lubricant	See
Running gear			
Hex screws on vibration damper flange	500 Nm + 50 Nm	Engine oil	C 035.05
Hex screws on seal carrier, free end	74 Nm + 7 Nm	Engine oil	C 035.05
Hex screws on graduated disc	21 Nm + 2 Nm	Engine oil	C 032.20
Cylinder head			
Hex screws for cylinder head Nominal length: 283.3 mm Nominal length: 333.3 mm engine lifting eye Tightening sequence of screws: 1, 2, 3, 4, 5, 6 – Fit: Pretightening torque: Additional angle of rotation: Checking torque:	approx. 25 Nm 180 Nm + 10 Nm 180° + 10° 450 Nm	Engine oil	C 042.05
Cylinder head tightening diagram  K 041 4003 b0			
Valve gear			
Hex screw for camshaft gear on camshaft	100 Nm + 10 Nm	Engine oil	C 052.05
Locknut (a/f 19) on adjusting screw for valve bridge	35 Nm + 5 Nm	Engine oil	C 055.05
Locknut on adjusting screw for rocker arm outlet	90 Nm + 9 Nm	Engine oil	C 055.05
Locknut on adjusting screw for rocker arm inlet	90 Nm + 9 Nm	Engine oil	C 055.05
Hex screws for rocker shaft support Max. shaft length: 180.8 mm – Tightening torque:	250 Nm + 25 Nm	Engine oil	C 055.05
Hex screw: Cylinder head cover	42 Nm	Engine oil	C 055.10

Designation	Tightening Specification	Lubricant	See
Fuel system - high-pressure			
Nuts for H.P. line on injector and on flow limiting valve	120 Nm + 12 Nm	Engine oil	C 077.05
Nuts for H.P. line on H.P. pump and on H.P. accumulator	100 Nm + 10 Nm	Engine oil	C 077.05
H.P. accumulator on crankcase	57 Nm + 6 Nm	Engine oil	C 077.05
H.P. sensor for H.P. pump	30 Nm to 40 Nm	Engine oil	C 073.05
Thrust screw for H.P. accumulator seal	550 Nm + 55 Nm	Engine oil	C 077.05
Socket-head screws for pressure relief valve in thrust screw	15 Nm + 2 Nm	Engine oil	C 077.05
Hex screw for hold-down clamp at injector	100 Nm + 10 Nm	Engine oil	C 075.05
Temperature transmitter on H.P. pump	30 Nm to 40 Nm	Engine oil	C 075.05
Exhaust system			
Hex screws, exhaust distribution housing/exhaust line M12 X 60	70 Nm + 7 Nm	Ultra-Therm MTU or Molykote P37	C 143.05
Lube oil system			
Nut for cooler insert	100 Nm	Engine oil	C 183.15
Lube oil pressure transmitter	24 to 27 Nm	Engine oil	C 183.05
Lube oil temperature transmitter	24 to 27 Nm	Engine oil	C 183.05
Crankcase pressure transmitter	24 to 27 Nm	Engine oil	C 183.05
Oil spray nozzle	21 Nm + 2 Nm	Engine oil	C 184.10
Generator			
Nut for belt pulley	360 to 400 Nm	Engine oil	C 213.05
Mounting/support			
Hex screws: Engine carrier on foundation	74 Nm + 7 Nm	Engine oil	C 231.10
Hex screw: Damping mount on engine carrier	190 Nm + 19 Nm	Engine oil	C 231.10
Hex screws: Engine carrier on crankcase	500 Nm + 50 Nm	Engine oil	C 231.10
Hex screws: Engine support on flywheel housing	180 Nm + 18 Nm	Engine oil	C 231.10
Hex screws for engine support on equipment carrier	74 Nm + 7 Nm	Engine oil	C 231.10

Tightening specification for set screw and stud connections to works standard MTN 5008

This works standard applies to set screws subjected to little dynamic load as per MMN 384, DIN 912, EN 24014 (DIN 931-1), EN 24017 (DIN 933), EN 28765 (DIN 960), EN 28676 (DIN 961), DIN 6912 and to studs as per DIN 833, DIN 835, DIN 836, DIN 938, DIN 939 and associated nuts.

They do not apply to heat-proof screws in the hot component area.

Tightening torques MA are for screws of strength class 8.8 (bright surface, phosphate coating or galvanised) and 10.9 (bright surface or with phosphate coating).

The values in the table are based on a friction coefficient $\mu_{tot} = 0.125$. Precondition: Thread and mating faces of screws and nuts must be coated in engine oil prior to assembly.

An assembly tolerance of + 10% of the table values is permitted for unavoidable deviations of the tightening torque from the table value during the tightening process – e.g. resulting from inaccurate readings and overtightening during assembly.

When tightening mechanically, the permitted assembly tolerance is + 15 %.

Tightening torques = MA

Thread	Manual-tightened		Machine-tightened	
	8.8 MA (Nm)	10.9 MA (Nm)	8.8 MA (Nm)	10.9 MA (Nm)
M 6	9	12	8	11
M 8	21	31	20	28
M 8 x 1	23	32	21	30
M 10	42	60	40	57
M 10 x 1.25	45	63	42	60
M 12	74	100	70	92
M 12 x 1.25	80	110	75	105
M 12 x 1.5	76	105	72	100
M 14	115	160	110	150
M14 x 1.5	125	180	120	170
M 16	180	250	170	235
M16 x 1.5	190	270	180	255
M 18	250	350	240	330
M18 x 1.5	280	400	270	380
M 20	350	500	330	475
M 20 x 1.5	390	550	350	520
M 22	480	680	450	650
M 22 x 1.5	520	730	490	700
M 24	600	850	570	810
M 24 x 1.5	680	950	640	900
M 24 x 2	660	900	620	850
M 27	900	1250	850	1175
M 27 x 2	960	1350	900	1275
M 30	1200	1700	1100	1600
M 30 x 2	1350	1900	1250	1800

Tightening torques for stress bolt connections prescribed in standard MTN 5007

This standard applies to stress pin bolts and stress bolts which are subjected to static and dynamic load of strength class 10.9 and the associated nuts.

Shaft and transition dimensions as to MMN 209 standard and material and machining to MMN 389 standard (bright surface or with phosphate coating).

The values in the table are based on a friction coefficient $\mu_{tot} = 0.125$. Precondition: Thread and mating faces of screws and nuts must be coated in engine oil prior to assembly.

When tightening manually (defined tightening), an assembly tolerance of + 10 % of the table values is permitted for unavoidable deviations of the tightening torque from the table value during the tightening process – e.g. resulting from inaccurate readings and overtightening during assembly.

The values in the tables are for manual tightening with torque wrench.

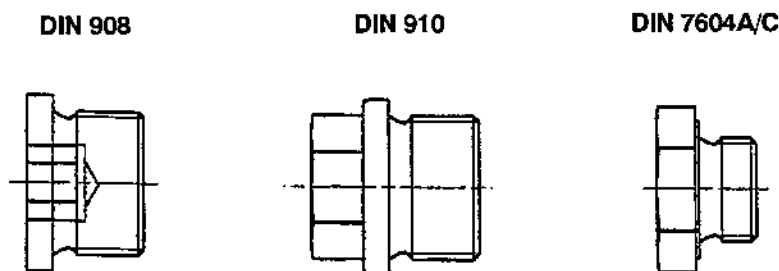
Tightening torques = MA

Thread	Without torsion protection MA (Nm)	With torsion protection* MA (Nm)
M 6	9	12
M 8	21	28
M 8 x 1	24	30
M 10	42	55
M 10 x 1.25	46	60
M 12	75	93
M 12 x 1.5	78	99
M 14	120	150
M 14 x 1.5	135	160
M 16	180	225
M 16 x 1.5	200	245
M 18	250	315
M 18 x 1.5	300	360
M 20	350	450
M 20 x 1.5	430	495
M 22	500	620
M 22 x 1.5	560	675
M 24	640	790
M 24 x 2	700	850
M 27	900	1170
M 27 x 2	1000	1230
M 30	1250	1575

*Protect shank against torsion when tightening.

Tightening torques for plugs prescribed in standard MTN 5183-1

This standard applies to plugs as per DIN 908, DIN 910 and DIN 7604 with screwed plug DIN 3852, model A (sealed by sealing ring DIN 7603-Cu).



Tightening torques M_A are given for plugs made of steel (St) with surface protected by a phosphate coating and oiled or galvanised.

Thread and mating faces beneath heads must be coated in engine oil prior to assembly.

An assembly tolerance of + 10% of the table values is permitted for unavoidable deviations of the tightening torque from the table value during the tightening process – e.g. resulting from inaccurate readings and overtightening during assembly.

Tightening torques = M_A

Tightening torques for plugs DIN 908, DIN 910 and DIN 7604A (with short screwed plug)

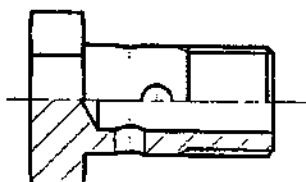
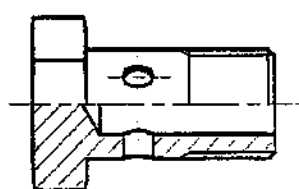
Thread	inserted in	
	Steel /gray cast iron M_A (Nm)	Al-alloy M_A (Nm)
M 10 x 1	15	15
M 12 x 1.5	35	25
M 14 x 1.5	35	25
M 16 x 1.5	40	30
M 18 x 1.5	50	35
M 20 x 1.5	55	45
M 22 x 1.5	60	50
M 24 x 1.5	70	60
M 26 x 1.5	80	70
M 27 x 2	80	70
M 30 x 1.5	100	90
M 30 x 2	95	85
M 33 x 2	120	110
M 36 x 1.5	130	115
M 38 x 1.5	140	120
M 42 x 1.5	150	130
M 45 x 1.5	160	140
M 48 x 1.5	170	145
M 52 x 1.5	180	150
M 56 x 2	190	160
M 64 x 2	205	175

Tightening torques for plugs as per DIN 7604C (with long screwed plug)

Thread	inserted in	
	Steel /gray cast iron M_A (Nm)	Al-alloy M_A (Nm)
M 8 x 1	10	10
M 22 x 1.5	80	65
M 26 x 1.5	105	90
M 30 x 1.5	130	130
M 38 x 1.5	140	120
M 45 x 1.5	160	140

Tightening torques for banjo screws as per MTN 5183-2 standard

This standard applies to banjo screws as per MMN 223 and N 15011 sealed with sealing ring DIN 7603-Cu

MMN 223 (4 flow holes)**N 15011 (3 flow holes)**

Tightening torques M_A are given for banjo screws made of steel (St) with surface protected by a phosphate coating and oiled or galvanised and consisting of copper/aluminium alloys.

Thread and mating faces beneath heads must be coated in engine oil prior to assembly.

An assembly tolerance of + 10% of the table values is permitted for unavoidable deviations of the tightening torque from the table value during the tightening process – e.g. resulting from inaccurate readings and overtightening during assembly.

Tightening torques = M_A

Tightening torques for banjo screws made of steel

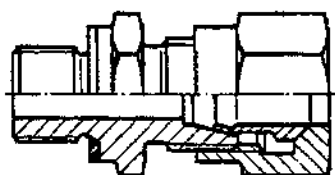
Thread	inserted in steel/gray cast iron/Al-alloy M_A (Nm)
M 8 x 1	10
M 10 x 1	15
M 12 x 1.5	20
M 14 x 1.5	25
M 16 x 1.5	25
M 18 x 1.5	30
M 22 x 1.5	60
M 26 x 1.5	90
M 30 x 1.5	130
M 38 x 1.5	140
M 45 x 1.5	160

Tightening torques for banjo screws made of copper-aluminium alloys

Thread	inserted in steel/gray cast iron/Al-alloy M_A (Nm)
M 10 x 1	15
M 16 x 1.5	30

Tightening torques for male connector as per MTN 5183-3 standard

This standard applies to male connectors DIN 2353, row L with screwed plug DIN 3852, model A
(Sealed by sealing ring DIN 7603-Cu)

DIN 2353, model C

Tightening torques M_A are given for male connectors made of steel (St) with surface protected by a phosphate coating and oiled or galvanised.

Thread and mating faces beneath heads must be coated in engine oil prior to assembly.

An assembly tolerance of + 10% of the table values is permitted for unavoidable deviations of the tightening torque from the table value during the tightening process – e.g. resulting from inaccurate readings and overtightening during assembly.

Tightening torques = M_A

Thread	inserted in Steel /gray cast iron M_A (Nm)
M 10 x 1	10
M 12 x 1.5	20
M 14 x 1.5	40
M 16 x 1.5	50
M 18 x 1.5	60
M 22 x 1.5	70
M 26 x 1.5	100
M 32 x 2	160
M 42 x 2	260
M 48 x 2	320

A005 Settings

Firing order

12V: A1 – B2 – A5 – B4 – A3 – B1 – A6 – B5 – A2 – B3 – A4 – B6

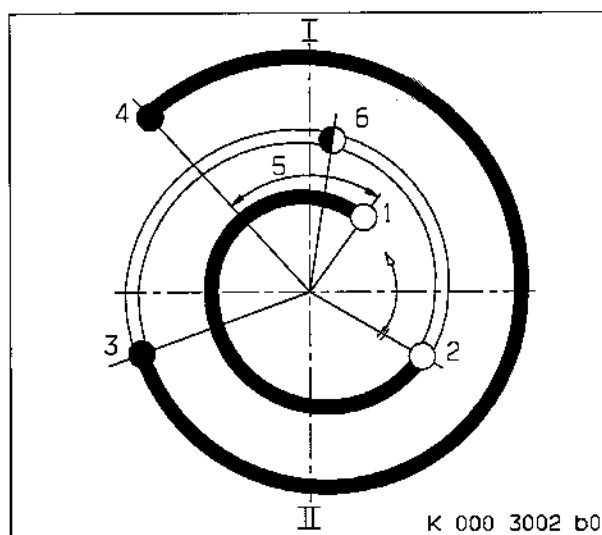
Direction of rotation as viewed from driving end

Crankshaft	counterclockwise
Camshaft	clockwise
H.P. fuel pump	counterclockwise
Oil pump	counterclockwise
Engine coolant pump	counterclockwise
Charge Air Coolant Pump	counterclockwise
Air-conditioner compressor	counterclockwise

Valve clearance, engine cold (20 °C)

Inlet	0.20 mm
Exhaust	0.50 mm

Valve timing, valve clearance adjusted



	° Crank angle
1 Inlet valve opens	42.6° before TDC
2 Inlet valve closes	66.6° after BDC
3 Exhaust valve opens	57.6° before BDC
4 Exhaust valve closes	30.4° after TDC
5 Overlap	73°
6 Start of delivery	Map based

I	Top dead centre (TDC)
II	Bottom dead centre (BDC)

Cam and valve lift for camshaft adjustment

	Inlet	Exhaust
Cam lift at TDC	1.43 mm	1.43 mm
Valve lift at TDC (zero valve clearance)	2.00 mm	2.00 mm

A007 Conversion tables**Length** SI unit: mOther permitted units: μm , mm, km

Unit A	multiplied by factor	=	Unit B
in	25.40	=	mm
ft	0.3048	=	m
yd	0.9144	=	m
stat. mile	1.609	=	km
yd	3	=	ft
yd	36	=	in

Unit B	multiplied by factor	=	Unit A
mm	0.03937	=	in
m	3.281	=	ft
km	0.6215	=	stat. mile

Area SI unit: m^2 Other permitted units: mm^2 , a (Ar) = 100 m^2 , ha

Unit A	multiplied by factor	=	Unit B
in^2 (sq in)	645.16	=	mm^2
ft^2 (sq ft)	0.0929	=	m^2
yd^2 (sq yd)	0.8361	=	m^2
stat. mile ²	2.5889	=	km^2

Unit B	multiplied by factor	=	Unit A
mm^2	0.00155	=	in^2 (sq in)
m^2	10.7643	=	ft^2 (sq ft)
m^2	1.1960	=	yd^2 (sq yd)
km^2	0.3863	=	stat. mile ²

Volume SI unit: m^3 Other permitted units: l, mm^3 , cm^3 , dm^3

Unit A	multiplied by factor	=	Unit B
in^3 (cu in)	16387	=	mm^3
ft^3 (cu ft)	0.02832	=	m^3
yd^3 (cu yd)	0.7646	=	m^3
gallon (US)	3.787	=	dm^3
gallon (brit.)	4.546	=	dm^3

Unit B	multiplied by factor	=	Unit A
cm^3	0.06102	=	in^3 (cu in)
m^3	35.31	=	ft^3 (cu ft)
dm^3	0.2642	=	gallon (US)
dm^3	0.22	=	gallon (brit.)

Speed

SI unit: m/s

Other permitted units: km/h

Unit A	multiplied by factor	=	Unit B
ft/s	0.3048	=	m/s
stat. mile/h (mph)	1.609	=	km/h
knot (brit.)	1.852	=	km/h

Unit B	multiplied by factor	=	Unit A
m/s	3.281	=	ft/s
km/h	0.6215	=	stat. mile/h (mph)
km/h	0.54	=	knot (brit.)

Mass

SI unit: kg

Other permitted units: mg, g, t

Unit A	multiplied by factor	=	Unit B
lb	0.4536	=	kg
oz	28.35	=	g
ton	1.016	=	t

Unit B	multiplied by factor	=	Unit A
g	0.03527	=	oz
kg	2.205	=	lb
t	0.9843	=	ton

Force SI unit: N

Other permitted units: mN, kN, MN

Unit A	multiplied by factor	=	Unit B
lb	0.4536	=	kp
lb	4.4483	=	N

Unit B	multiplied by factor	=	Unit A
kp	2.205	=	lb
N	0.101972	=	kp
kp	9.80665	=	N

Pressure

SI unit: Pa

Other permitted units: bar, mbar, μ bar; 1 bar = 10^5 Pa

Unit A	multiplied by factor	=	Unit B
lb/sq in (psi)	703.1	=	kp/m ² (mm WS)
lb/sq in (psi)	0.06895	=	bar
lb/sq ft	47.883	=	Pa
in QS	0.03386	=	bar
in QS	345.3	=	kp/m ²

Unit B	multiplied by factor	=	Unit A
atm	760	=	mm QS
atm	1.0133	=	bar
atm	10332	=	kp/m ² (mm WS)
atm	1.0332	=	kp/cm ² (at)
atm	14.696	=	lb/sq in
bar	14.503	=	lb/sq in

Density SI unit: kg/m³Other permitted units: g/cm³, kg/dm³, kg/l

Unit A	multiplied by factor	=	Unit B
lb s ² /ft ⁴	515.4	=	kg/m ³

Unit B	multiplied by factor	=	Unit A
kg/m ³	0.00194	=	lb s ² /ft ⁴

Torque

SI unit: Nm

Unit A	multiplied by factor	=	Unit B
ft lb	1.3563	=	Nm

Unit B	multiplied by factor	=	Unit A
Nm	0.7373	=	ft lb

Mass moment, 2nd grade SI unit: kg m²

Unit A	multiplied by factor	=	Unit B
ft lb s ²	1.3563	=	kg m ²

Unit B	multiplied by factor	=	Unit A
kg m ²	0.7373	=	ft lb s ²

Energy SI unit: J
Other permitted units: kJ, kWh

Unit A	multiplied by factor	=	Unit B
ft lb	1.356	=	J
kcal	4186.8	=	J
BTU	1055	=	J
CHU	1899	=	J

Unit B	multiplied by factor	=	Unit A
J	0.7376	=	ft lb
J	0.0002389	=	kcal
J	0.0009479	=	BTU
J	0.00052656	=	CHU

Power SI unit: W; 1 W = 1 J/s = 1 Nm/s
Other permitted units: kW, kJ/h

Unit A	multiplied by factor	=	Unit B
PS	0.7355	=	kW
HP	0.7457	=	kW
BTU/s	1.055	=	kW
kcal/h	1.163	=	W
HP	550	=	ft lb/s

Unit B	multiplied by factor	=	Unit A
kW	1.36	=	PS
kW	1.341	=	HP
kW	0.9479	=	BTU/s
W	0.8598	=	kcal/h
ft lb/s	0.0018	=	HP

Temperature SI unit: K
Other permitted units: °C; 1 °C = 273.15 K, °F = $\frac{9}{5}$ °C + 32

	Celsius	Kelvin	Fahrenheit	Réaumur
x °C	—	= x + 273.15 K	= $\frac{9}{5}$ x + 32 °F	= $(\frac{4}{5} x)$ °R
x K	= x - 273.15 °C	—	= $\frac{9}{5} (x - 273.15) + 32$ °F	= $\frac{4}{5} (x - 273.15)$ °R
x °F	= $\frac{5}{9} (x - 32)$ °C	= $\frac{5}{9} (x - 32) + 273.15$ K	—	= $\frac{4}{9} (x - 32)$ °R
x °R	= $\frac{5}{4} x$ °C	= $(\frac{5}{4} x) + 273.15$ K	= $(\frac{9}{4} x) + 32$ °F	—

Specific fuel consumption

Unit A	multiplied by factor	=	Unit B
mile/gal (US)	0.4251	=	km/l
gal/mile (US)	2.3527	=	l/km

Unit B	multiplied by factor	=	Unit A
km/l	2.3527	=	mile/gal (US)
l/km	0.4251	=	gal/mile (US)

A008 Publication summary**Other applicable Customer Service documents:**

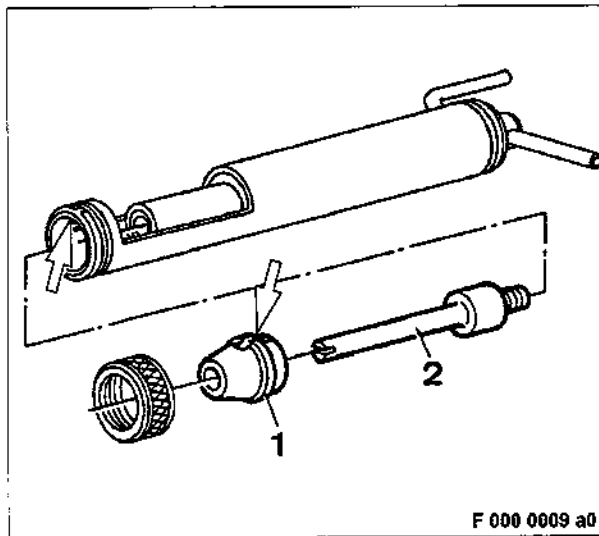
– Operating Instructions	M0 15 ...
– Fluids and Lubricants Specification	A00 1061
– Tools List	M0 04 029
– Tolerance and Wear Limits List	M0 70 040
– Test Procedure	A 060 643
Instructions for use for auxiliary materials, protective measures	

Further data, in particular operational data, can be obtained from the MTU Engine Acceptance Test Record for the individual engine concerned.

A009 Repairing Threaded Bores with Threaded Inserts (Heli-Coil)

Data

Thread	Core hole bore-dia. (max./min.)	Twist drill dia.
M 6	<u>6.31</u> 6.04	6.1–6.2–6.25
M 8	<u>8.35</u> 8.04	8.1–8.2–8.25–8.3
M 8 x 1	<u>8.32</u> 8.04	8.1–8.2–8.25–8.3
M10	<u>10.40</u> 10.05	10.25
M12	<u>12.50</u> 12.05	12.25–12.5
M 12 x 1.5	<u>12.43</u> 12.05	12.25
M14	<u>14.53</u> 14.06	14.25–14.5
M 14 x 1.5	<u>14.43</u> 14.05	14.25
M 15 x 2	<u>15.30</u> 15.20	15.25
M16	<u>16.53</u> 16.06	16.25–16.5
M16 x 1.5	<u>16.43</u> 16.05	16.25
M24 x 1.5	<u>24.43</u> 24.05	24.25
M26 x 1.5	<u>26.43</u> 26.05	26.25
M30 x 1.5	<u>30.43</u> 30.05	30.25



Repairing

If necessary, remove thread insert with suitable removal tool from bore (left).

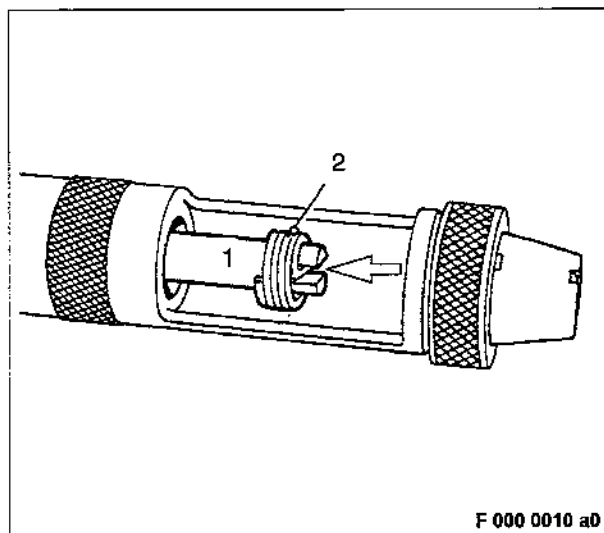
Bore core hole with suitable twist drill – see table.

Cut thread with special tapped bore.

Note: Do not countersink bore!

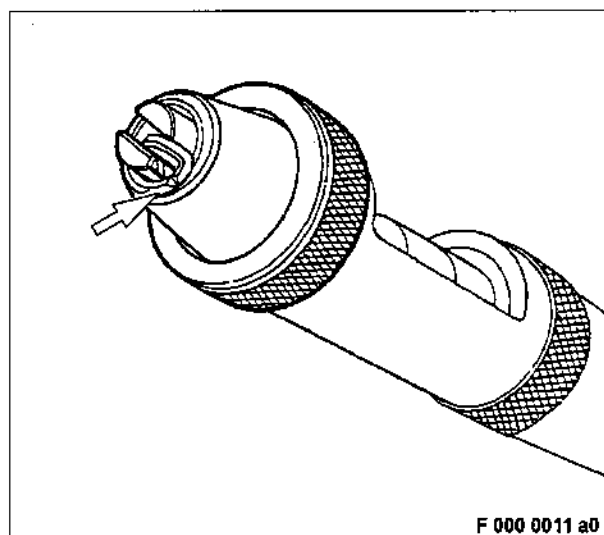
Mount spindle (2) and snout (1) corresponding with thread.

Groove on snout must be aligned with markings on installation tool (arrows).

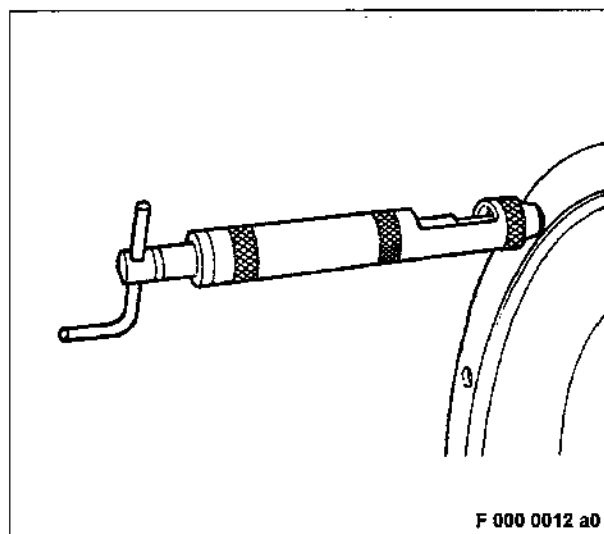


Insert thread insert (2) into spindle (1) in installation tool.

Driver journal of thread insert must be in groove (arrow).



Use spindle to turn thread insert through snout until it is flush at front (arrow).



Mount installation tool on threaded hole and install thread insert without applying pressure to spindle.

Note: Insert thread insert 1/2 to 1 1/2 turns deeper than threaded bore surface.

Use bolt shearer to remove driver journal to M 14. In event of threaded inserts over M 14, move driver journal up and down with pointed pliers and remove.

A080 Abbreviations

°C	Grad Celsius
ATL	Abgasturbolader (Exhaust turbocharger)
ECS	Engine Control System, MTU-Motormanagementsystem
ECU	Engine Control Unit, MTU-Motorregler
ISO	International Organization for Standardisation
KGS	Freie Seite (Kraftgegenseite) (Free end)
KS	Antriebsseite (Kraftseite) (Driving end)
KW	Kurbelwelle (Crankshaft)
LLK	Ladeluftkühler (Intercooler)
M _A	Tightening torques
MDEC	MTU Diesel Engine Control
MTU	Motoren- und Turbinen-Union
NW	Nockenwelle (Camshaft)
UT	Unterer Totpunkt (Bottom dead centre)
OT	Obere Totpunkt (Top dead centre)

A090 Keyword index**A**

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Air intake / air supply	C 120
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Air supply to cylinders	C 124.05

C

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Charge air coolant pump	C 203.05
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Crankcase	C 011.05
Crankcase and externally mounted components	C 010
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Crankcase ventilation	C 018.10a
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Cylinder head cover	C 055.10
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Cylinder liner	C 013.05

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End housing, driving and free end	C 016.30
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Engine coolant pump	C 202.05
Engine disassembly	B 005
Engine installation and operation	B 007
Engine mount	C 231.10
Engine oil heat exchanger	C 183.15
Engine removal	B 003

Engine run-in	B 006
Exhaust pipework after cylinder head	C 141.10
Exhaust system	C 140
Exhaust turbocharger	C 100
Exhaust turbocharger	C 101.01

F

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Fuel pump	C 081.10
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Fuel system - high-pressure	C 070

G

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High-pressure pump	C 073.05

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Injector	C 075.05
Intercooler	C 111.05
Intercooler	C 110

K

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L

Leak-off fuel line	C 086.05
Lifting attachments for engine and running gear	C 015.05
Lube oil pump with drive	C 181.05
Lube oil system	C 180

M

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O

Oil filter	C 183.05
Oil pan	C 014.05
Oil return lines for exhaust turbocharger	C 185.25
Oil supply lines for turbocharger	C 185.10
Oil system in crankcase	C 184.10

P

Power supply, engine side	C 210
Pressure testing coolant chamber	C 200.08
PTO, driving end	C 032.05
PTO, free end	C 035.05
Publication summary	A 008

R

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S

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T

Torque specification for screws and nuts	004 A
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V

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W

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B002	W5 Maintenance Operations	B – 2
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B004	Engine assembly	B – 5
B005	Engine disassembly	B – 7
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B007	Engine Installation and operation	B – 11

B001 Checking engine condition before a major overhaul

Before the engine is removed, a brief test should be conducted to assist in evaluating its condition and running behaviour. Deviations from the Engine Acceptance Test Record Data found during the test run provide valuable information for subsequent overhaul services.

Operations to be performed	See
Perform operations preparatory to starting the engine	Operating Instructions
Start engine	Operating Instructions
Carry out engine warm-up procedure	Operating Instructions
Test engine at highest possible power	–
Check engine speed, temperatures and pressures where gauges are installed	–
Check operating states with fault recorder, assess discrepancies	Operating Instructions
Check running noises; these should be restricted to normal operating sounds	–
During test run, visually inspect engine and external lines for leaks	Operating Instructions
Check for water emerging from intercooler drain lines and check for obstructions	Operating Instructions
Check exhaust gas colour	Operating Instructions
Operate engine with adjustable zero-power speed	–
Connect fuel line connections for leaks	–
Remove cylinder head cover	C 055.10
Check valve gear lubrication (visual inspection)	–
Extract engine oil sample	Operating Instructions
Analyze engine oil sample (spot test, water content, dilution with fuel)	MTU Test Kit
Extract coolant sample	Operating Instructions
Analyze coolant sample	MTU Test Kit
Check function of monitoring system and ECU.	Operating Instructions
Shut down engine	Operating Instructions
Only if installed: Reduce the coolant level in the expansion tank and check the level switch response (coolant level monitoring)	Operating Instructions
Drain coolant	Operating Instructions
Drain charge air coolant	Operating Instructions
Fill system with cleaning solution	Special Publication
Start engine	Operating Instructions
Flush cooling system	–
Flush charge air cooling system	–
Shut down engine	Operating Instructions
Check engine (endoscopic examination)	Operating Instructions

B002 W5 Maintenance Operations

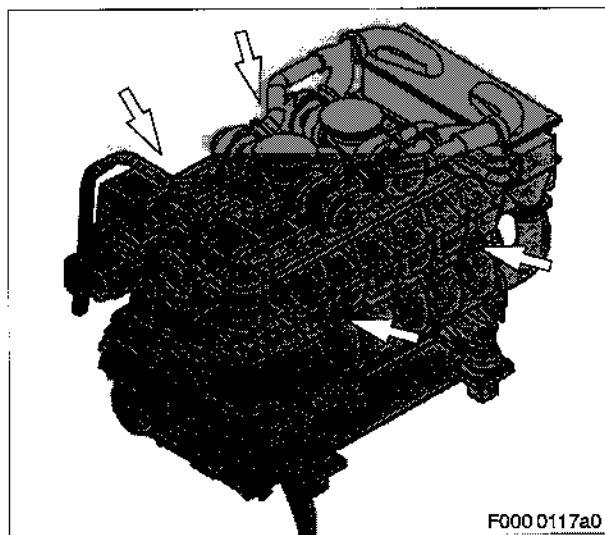
Note: The following table is based on maintenance schedule MO...../.
When carrying out maintenance work, always use the valid maintenance schedule corresponding to the affected engine.

Operations to be performed	See
Disable engine start	Operating Instructions
Wash plant, without using chemical cleaning agents	Operating Instructions
Drain engine coolant and flush coolant systems	Operating Instructions
Drain engine oil	Operating Instructions
Replace engine oil filter	Operating Instructions
Replace fuel duplex filter easy-change filter	Operating Instructions
Clean fuel prefilter or replace filter elements	Operating Instructions
Clean air filter, replace if necessary.	Operating Instructions
Check function of contamination indicator and reset if necessary	Operating Instructions
Overhaul engine coolant preheating system	–
Replace exhaust turbocharger	C 101.01
Intake air system, remove lines, clean, replace gaskets	–
Drain exhaust system, check security of securing screws	Operating Instructions
Remove and replace intercooler (low-temperature circuit)	C 111.05
Engine coolant cooler (high-temperature circuit), clean and check for leaks	–
Clean charge air coolant cooler (low-temperature circuit), check for leaks	–
Check coolant thermostat (high-temperature circuit), replace if necessary	C 206.05.08
Check coolant thermostat (low-temperature circuit), replace if necessary	C 206.05.08
Replace engine coolant pump (high-temperature circuit)	C 202.05.06
Replace charge air coolant pump	C 203.05.08
Check condition of engine control system and wiring and check for security	–
Check starter, wiring and connections for corrosion and loose connections, check wiring	–
Replace H.P. fuel pump and H.P. sensor	C 073.05.05
Remove and check valve gear, rocker arms and valve bridges	C 055.05.05
Check rocker arms, rollers, pushrod seat and rocker arm bearings for wear	
Remove and replace cylinder heads	C 041.05.05
Valve gear, prelubricate	–
Remove and replace vibration damper	C 035.05.05
Clean centrifugal oil filter	Operating Instructions
Check bearing, replace if necessary	C 183.10.05
Replace sealing sleeve	Operating Instructions
Remove oil heat exchanger, clean and check for leaks, replace O-rings	C 183.15.05
Crankcase breather, replace oil separator	C 018.10
Check starter	C 172.05.08
Engine mount, check security	Operating Instructions
Check condition of resilient mounts	Operating Instructions
Check buffer clearance	Operating Instructions
ECU, wiring, check security and condition	Operating Instructions

Operations to be performed	See
Check function of monitoring units	Operating Instructions
Check battery charge state, electrolyte specific gravity and level	Operating Instructions
Reinstall/mount parts that were removed after they have been assembled according to the engine assembly sequence	B 005
Fill oil system with engine oil Fill engine coolant, vent coolant system Carry out before-operation services	Operating Instructions Operating Instructions Operating Instructions
Switch on monitoring system	Operating Instructions
Carry out lamp test	–
Open fuel supply	Operating Instructions
Preheat engine	Operating Instructions
Start engine Perform checks with engine running as for initial operation	Operating Instructions Operating Instructions
Engine test run, check speed, pressures, and temperatures Check running noises	Operating Instructions
Check engine and external pipework for leaks	Operating Instructions
Check turbocharger and exhaust connections for leaks; check oil supply and return lines for leaks	Operating Instructions
Check exhaust gas colour	Operating Instructions
Check intake air system for leaks	Operating Instructions
Shut down engine	Operating Instructions
Check engine oil level	Operating Instructions
Check engine coolant level	Operating Instructions
Charge air coolant, check level	Operating Instructions

B003 Engine removal

Operations to be performed	See
Shut off fuel supply	Operating Instructions
Drain oil with engine warm if possible	Operating Instructions
Examine oil sludge for metallic residues	Operating Instructions
Drain engine coolant when temperature of coolant is below 60 °C	Operating Instructions
Drain charge air coolant	Operating Instructions
Wash plant, without using chemical cleaning agents	—
Disconnect all connections	—
Install non-fibrous plugs and blanking plates to seal all open connections	—
Release engine securing screws	—
Remove engine and place on stands	—
Using a lifting device, attach engine only on lifting eyes provided as shown in installation drawing, taking centre of gravity and transportation specifications into consideration.	—

**Engine weight:**

(with standard accessories installed without coupling)

12 V 4000 – approx. 5650 kg

Note: Raise engine only by means of the lifting eyes shown (arrows).

B004 Engine assembly

Before beginning complete engine disassembly, it is advisable to take photographs of the engine from all sides or to record all components installed on the engine in writing.

The sequence of the required operations in the following list corresponds to the order in which actual disassembly is to be carried out.

The individual tasks are described in detail in the Groups listed in the right-hand column.

Operations to be performed	See
Place engine in assembly dolly	—
Mark and disconnect electric cables	—
Remove crankcase vent line	C 018.10
Remove crankcase breather	C 018.10
Remove oil supply lines for turbochargers	C 185.10
Remove oil return lines for turbochargers	C 185.25
Remove intake air system from turbocharger to intercooler	C 125.05
Remove Y-pipe from exhaust outlet housing	C 141.10
Remove exhaust turbocharger	C 101.01
Remove coolant vent lines	C 202.65
Remove charge air coolant lines (low temperature)	C 203.25
Remove intercooler	C 111.05
Remove coolant lines (high temperature)	C 202.10
Remove exhaust manifolds	C 141.10
Remove coolant lines (high temperature)	C 202.10/C 202.20
Remove fan drive	C 221.05
Remove engine carrier, free end (gear case)	C 231.05
Remove vibration damper	C 035.05
Remove centrifugal filter	C 183.10
Remove oil heat exchanger	C 183.15
Remove coolant distribution housing and thermostat	C 206.05
Remove oil filter	C 183.05
Remove V-belt	C 213.05
Remove generator	C 213.05
Disconnect air supply to cylinders	C 124.05
Remove fuel filter	C 083.05
Remove fuel lines (low pressure)	C 083.05
Remove fuel pump (low pressure)	C 081.10
Remove leak-off fuel lines	C 086.05
Remove injection lines with H.P. accumulator	C 077.05
Remove H.P. pump	C 073.05
Remove wiring harness	C 507.10
Remove Engine Control Unit ECU	C 508.10
Remove cylinder head covers	C 055.10
Remove fuel injectors	C 075.05
Remove coupling	Special Publication

Operations to be performed	See
Remove drive flange, seal carrier and graduated disc	C 032.10
Remove flywheel housing	C 016.30
Remove drive flange (free end) from crankshaft	C 035.10
Remove graduated disc	C 032.10
Remove seal carrier (free end)	C 035.05
Remove charge air coolant pump (low temperature)	C 203.05
Remove coolant pump (high-temperature)	C 202.05
Remove starter	C 172.05
Remove valve gear	C 055.05
Remove pushrods	C 054.10
Remove cylinder heads	C 041.05
Remove auxiliary PTO	C 259.05
Remove oil dipstick and oil filler neck	C 011.05
Remove oil pan	C 014.05
Remove suction basket and oil drain valve from the oil pan	C 014.05
Remove lube oil pump and valves	C 181.05
Remove main oil gallery	C 011.05
Remove oil supply and oil spray nozzles	C 184.10
Remove crankcase from assembly dolly	C 011.05.11

B005 Engine disassembly

The sequence in which the following required procedures are listed corresponds to the order in which actual assembly is performed.

The individual tasks are described in detail in the Groups listed in the right-hand column.

Operations to be performed	See
Install crankcase in assembly dolly	C 011.05.05
Install oil spray nozzle	C 184.10
Install flywheel housing	C 016.05
Install valve drive	C 055.05
Install flange on oil pan	C 014.05
Install suction basket in oil pan	C 014.05
Install oil pan	C 014.05
Remove crankcase from assembly dolly	C 011.05
Install oil dipstick and oil filler neck	C 011.05
Install cylinder heads	C 041.05
Install pushrods	C 054.10
Install valve gear	C 055.05
Install main oil gallery	C 011.05
Install starter	C 172.05
Install H.P. pump	C 073.05
Install fuel injector	C 075.05
Install fuel pump (low pressure)	C 081.05
Install injection lines with H.P. accumulator	C 077.05
Install wiring harness	C 507.10
Install Engine Control Unit ECU	C 508.10
Install fuel filter	C 083.05
Install intercooler	C 111.05
Install charge air manifolds	C 124.05
Install oil heat exchanger	C 183.15
Install centrifugal filter	C 183.10
Install oil filter	C 183.05
Install coolant pump (high-temperature)	C 202.10
Install coolant distribution housing and thermostat	C 206.05
Install coolant lines (high-temperature)	C 202.10
Install exhaust manifold	C 141.10
Install turbocharger	C 101.01
Install oil supply lines for turbochargers	C 185.10
Install oil return lines for turbochargers	C 185.25
Install Y-pipe at exhaust outlet housing	C 141.10
Install crankcase breather	C 018.25
Install crankcase vent line	C 018.10
Install coolant lines (high-temperature)	C 202.10/C 202.20

Operations to be performed	See
Install charge air coolant pump (low-temperature)	C 203.05
Install charge air coolant lines (low-temperature)	C 203.25
Install generator	C 213.05
Install V-belt	C 213.05
Install seal carrier (free end)	C 035.05
Install drive flange (free end) on crankshaft	C 035.05
Install vibration damper	C 035.05
Install engine mount, free end (gear case)	C 231.05
Install graduated disc, seal carrier (driving end) with drive flange	C 032.10
Install coupling	see Special Publication

B006 Engine run-in

After installing the replacement component "engine short block", an engine run-in must be carried out in accordance with the respective run-in program.

Conscientious running is of critical importance as regards the durability and operational reliability of the engine.

Use a brake or alternator to absorb the power generated in the braking run.

Power must be transmitted from the engine to the brake by means of a resilient coupling.

Settings

Set fuel and intake air temperatures before engine in accordance with the temperatures stated for the engine in the MTU Engine Acceptance Test Record.

The engine coolant temperature depends on the operating range of the coolant thermostat.

Fuel temperature depends on the volume of the service tank insofar as there is no fuel-cooling device on the test stand.

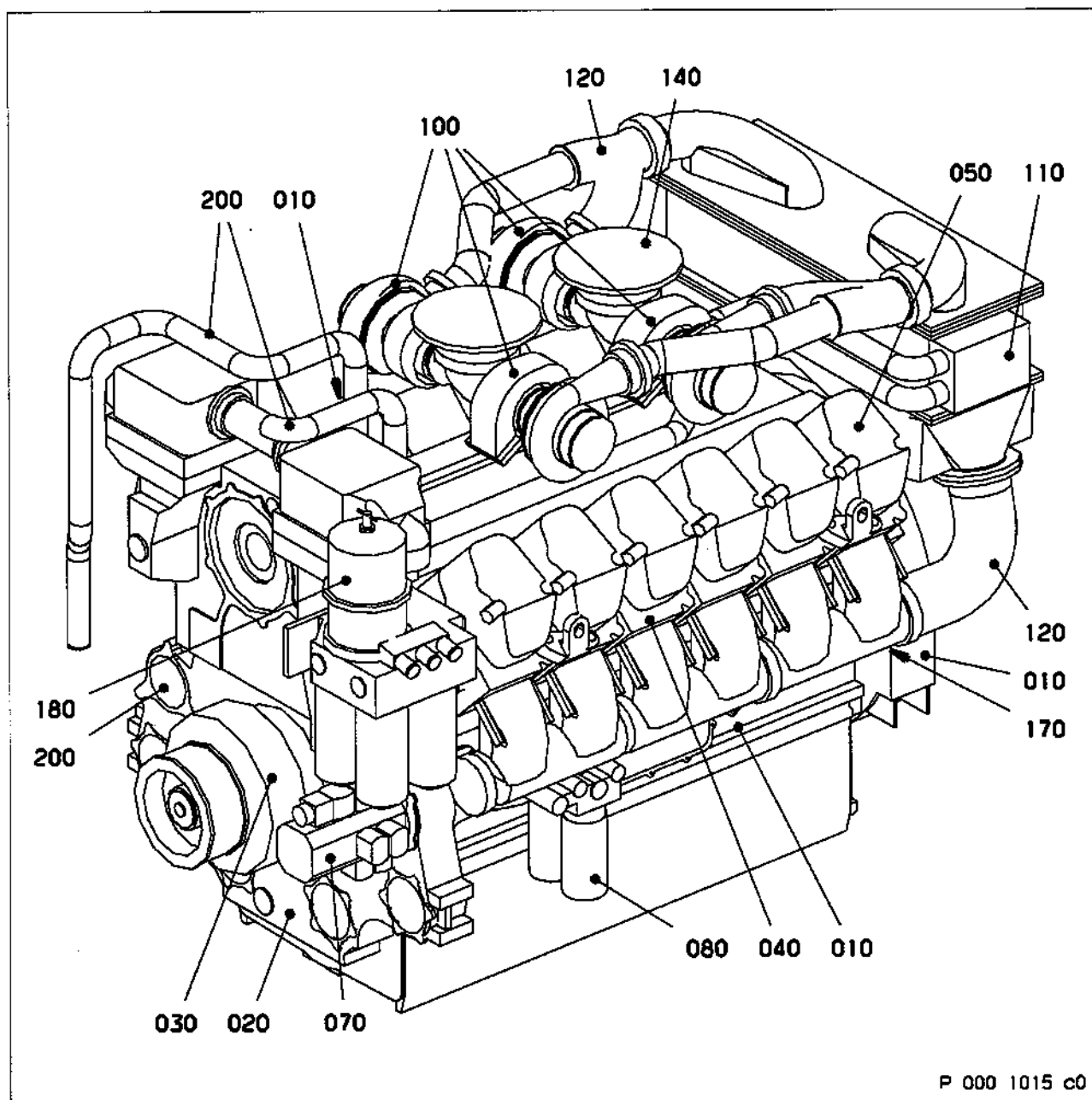
Record readings for power, fuel, lube oil, coolant, charge air and control air at each test point (time, speed and effective power) of the run-in schedule and enter readings under "Engine Run-in" in "MTU Diesel Engine Factory Test" record.

Operations to be performed	See
Install engine on test stand	—
Connect engine to brake or alternator	—
Connect air intake, exhaust, engine coolant and fuel lines	—
Connect measuring sensor and measuring lines to the corresponding measuring points to record the measured values for fuel, lube oil, engine coolant, supercharging and exhaust which were noted in the MTU Engine Acceptance Test Record.	MTU Engine Acceptance Test Record
Connect dialogue unit to ECU	—
Fill expansion tank with coolant and 2% corrosion inhibitor oil up to max. mark	Operating Instructions
Vent coolant lines until bubble-free coolant emerges	Operating Instructions
Check that fuel in service or supply tank is to specification	MTU Fluid and Lubricants Specification
Fill oil system up to max. mark with fresh oil	Operating Instructions
Prelubricate valve gear with oil	Operating Instructions
Check operation of emergency shutdown system	—
Preheat engine coolant	Operating Instructions
Prelubricate engine oil system (external pump)	—
Start engine via ECU	Operating Instructions
Shut down engine after approx. 1 min no-load operation and carry out following operations: — Check oil level, top up with oil if necessary. — Remove valve gear cover, check valve gear lubrication.	— Operating Instructions Operating Instructions
Start engine, check idling speed	—
Check engine running noises	Operating Instructions
Carry out engine warm-up procedure	Operating Instructions
Check for leaks at coolant, oil and fuel lines, crankcase seals, air system and exhaust lines	Operating Instructions
Run in engine and record measurements in accordance with running-in schedule	B 006
Compare test data with those recorded in MTU Acceptance Test Record Check and make a note of fuel density	MTU Engine Acceptance Test Record
Check exhaust gas colour	—

Operations to be performed	See
Enter barometric reading and relative humidity in record	MTU Engine Acceptance Test Record
Check engine for abnormal noises and for leaks	—
Check function of monitoring units	—
After running in, run down engine and switch off	Operating Instructions
Oil filter – cut open one filter and check residues	Operating Instructions
Check oil level and prepare engine for oil-consumption measurement	—
Carry out acceptance test in accordance with MTU Engine Acceptance Test Record	B 006
Enter operational data in engine acceptance test record provided	MTU Engine Acceptance Test Record
Compare test data with those recorded in MTU Engine Acceptance Test Record	MTU Engine Acceptance Test Record
Carry out governor test	—
After completing acceptance test, run down engine and switch off	Operating Instructions
Carry out oil-consumption test	Operating Instructions
Start engine	—
Go through the governor curve (DBR) in accordance with the MTU Engine Acceptance Test Record	MTU Engine Acceptance Test Record
Set the specified service power rating as per MTU Engine Acceptance Test Record	MTU Engine Acceptance Test Record
Shut down engine and carry out six start attempts	—
Carry out engine preservation run	Operating Instructions
Shut down engine and disable engine start	—
Drain engine oil and coolant	Operating Instructions
Adopt suitable protective measures if engine is scheduled for marine transport	—
Disconnect exhaust, engine coolant and fuel lines Disconnect valve gear from MDEC	—
Remove measuring sensor and measuring lines from engine and seal measuring points	—
Remove engine from test stand	—
Prepare engine for paint spraying and spray with protective paint	—

B007 Engine installation and operation

Operations to be performed	See
Open all connections, remove cover and rubber plugs	—
Attach engine only on suspension brackets provided as shown in installation drawing, taking centre of gravity and transportation specifications into consideration, and install in plant.	—
Join connections for engine coolant, fuel, engine monitoring as appropriate	—
Fill engine coolant system	Operating Instructions
Fill charge air coolant system	Operating Instructions
Fill oil system with engine oil	Operating Instructions
Align engine	—
Prepare engine for operation	Operating Instructions
Preheat engine	Operating Instructions
Start engine	Operating Instructions
Perform checks while engine is running	Operating Instructions
Carry out test run	—
Measure intake air depression	Operating Instructions
Measure exhaust backpressure	Operating Instructions
Shut down engine	Operating Instructions
Perform after-shutdown services	Operating Instructions
If the plant is to be taken out of service for an extended period, carry out external preservation, disable engine start, seal air inlet and exhaust outlet. (Note: An engine preservation run was carried out after the test stand run.)	Operating Instructions

C000 Group Summary

010 Crankcase and externally mounted components
 020 Gear train **
 030 Running gear **
 040 Cylinder head **
 050 Valve gear
 070 Fuel injection system (high-pressure)
 080 Fuel system (low-pressure)
 100 Exhaust turbocharger **
 110 Intercooler
 * not shown

120 Air intake / air supply
 140 Exhaust system
 170 Starting system
 180 Lube oil system
 200 Coolant system
 210 Power supply, engine side*
 230 Mounting/support *
 250 PTO systems, driving and free end (couplings)*
 500 Electrical equipment*
 ** Exchange components (REMAN)

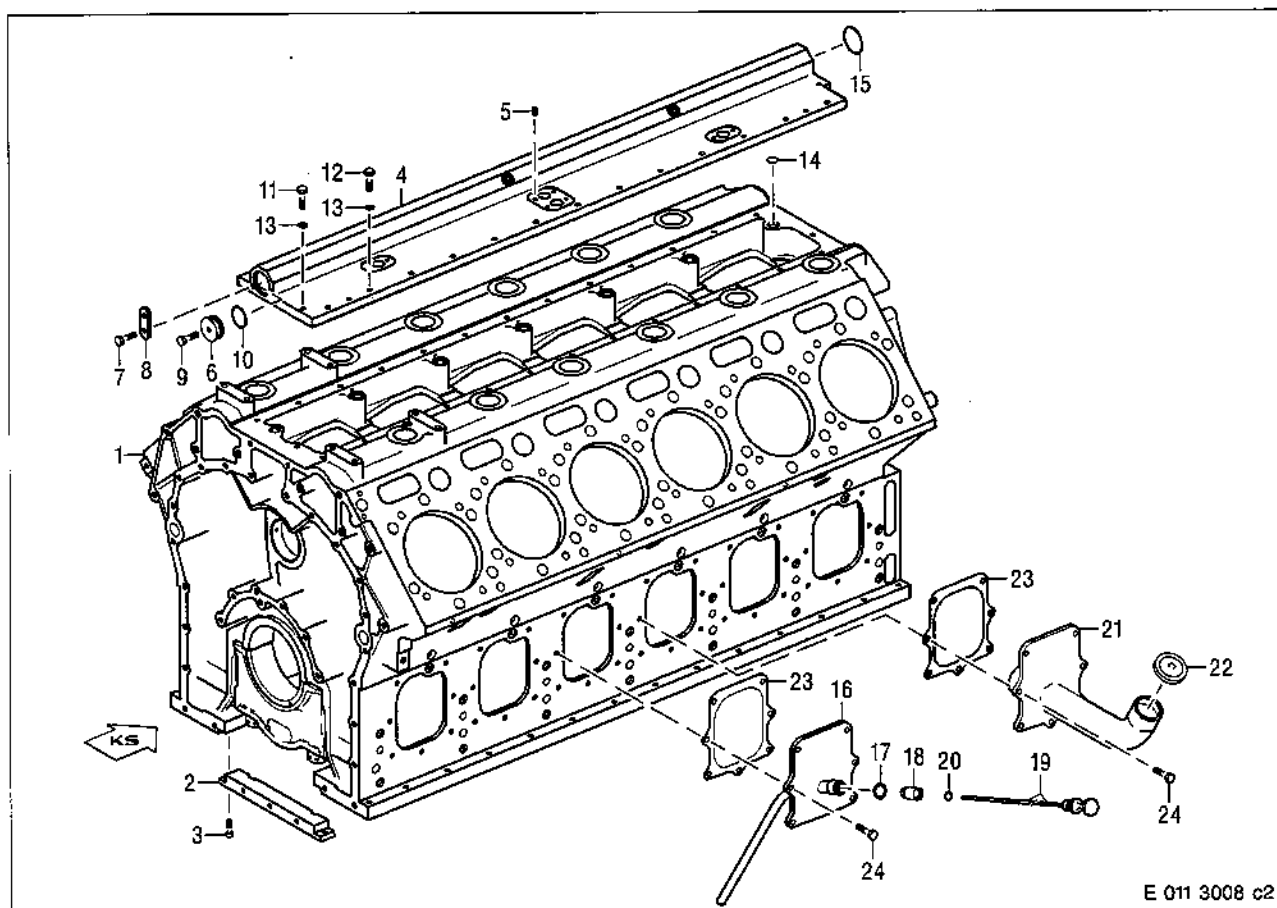
C010	Crankcase and externally mounted components	C – 3
C011.05	Crankcase	C – 3
C011.05.01	Overview drawings	C – 3
C011.05.02	Special tools	C – 5
C011.05.04	Before-removal operations	C – 5
C011.05.05	Removal	C – 5
C011.05.08	Inspection and repair	C – 5
C011.05.11	Installation	C – 6
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C014.05	Oil pan	C – 9
C014.05.01	Overview drawing, grey cast iron	C – 9
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C014.05.08	Inspection and repair	C – 12
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C018.10.01	Overview drawing, driving end	C – 29
C018.10.04	Before-removal operations	C – 30
C018.10.05	Removal	C – 30
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C018.10.11	Installation	C – 33
C018.10.12	After-installation operations	C – 37
C018.10a	Crankcase ventilation	C – 39
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C018.10.04a	Before-removal operations	C – 40
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C018.10.11a	Installation	C – 44
C018.10.12 a	After-installation operations	C – 47

C010 Crankcase and externally mounted components

C011.05 Crankcase

C011.05.01 Overview drawings

Cover (main oil gallery), guide tube, oil filler neck,

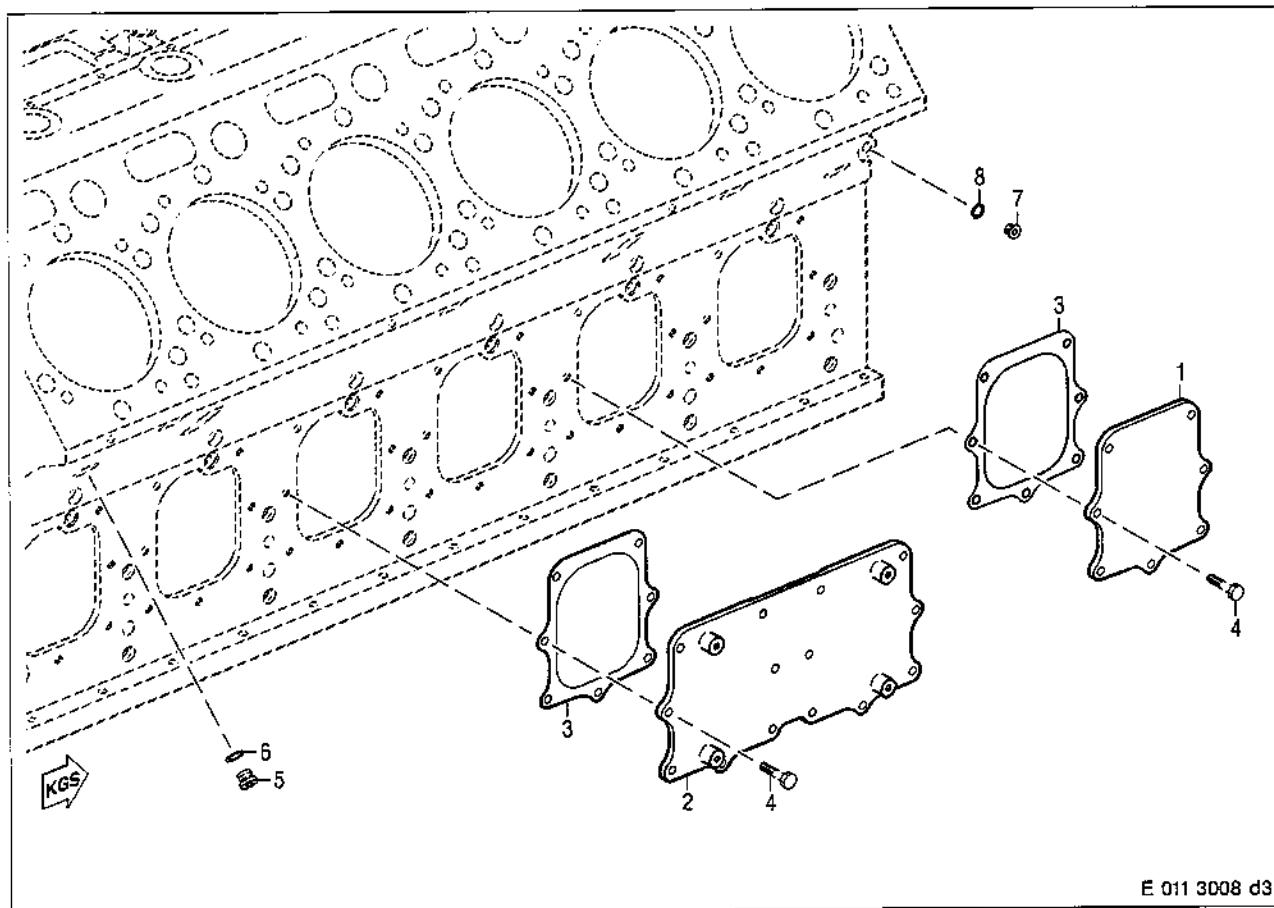


- 1 Crankcase
- 2 Block
- 3 Cylinder head screw
- 4 Cover
- 5 Stud
- 6 Blanking plug
- 7 Hex screw
- 8 Link
- 9 Hex screw
- 10 O-ring
- 11 Hex screw
- 12 Hex screw

- 13 Washer
- 14 O-ring
- 15 O-ring
- 16 Guide tube
- 17 Sealing ring
- 18 Union
- 19 Oil dipstick
- 20 O-ring
- 21 Oil filler neck
- 22 Cover
- 23 Gasket
- 24 Hex screw

- * Tightening sequence starting from driving end:
 1. Pretighten all socket-head screws on left side and then on right side
 2. Fully tighten all socket-head screws on left side and then on right side
- ** Newly installed studs must be pre-stretched prior to initial tightening

Inspection port cover



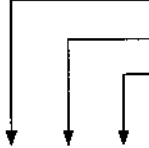
- 1 Inspection port cover
- 2 Inspection port cover
- 3 Gasket
- 4 Hex screw

- 5 Plug
- 6 Sealing ring
- 7 Plug
- 8 Sealing ring

C011.05.02 Special tools

Designation	Use/dimension	Number
• Stop plate	Aligning oil gallery with crankcase	1

C011.05.04 Before-removal operations

For the following tasks, a distinction must be made as to whether:   The engine is to be completely disassembled  The engine is to be removed but not disassembled  The engine is to remain installed			
Measure			See
x	–	–	Engine removal → B 003
x	–	–	Perform operations as per Disassembly Plan → B 004

C011.05.05 Removal**Remove oil filler neck, cover (main oil gallery), guide tube, inspection port cover**

Remove cover, guide tube, oil filler neck and inspection port cover as shown in the overview drawing, see C 011.05.01.

Remove blanking plugs, gaskets, sealing rings and O-rings.

Remove O-ring from blanking plug.

C011.05.08 Inspection and repair

Clean all components, check mating faces, sealing faces and fits; rub down with an oilstone or emery cloth as necessary.

Oil filler neck

		CAUTION
		Compressed air is highly pressurized. Risk of injury! If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask. Pressure must not exceed 3.0 bar.

Clean oil filler neck with cold cleaner and blow clear with compressed air.

Visually inspect component for damage and defects; replace if necessary.

Check condition of threads; machine or replace components as necessary.

Replace sealing rings.

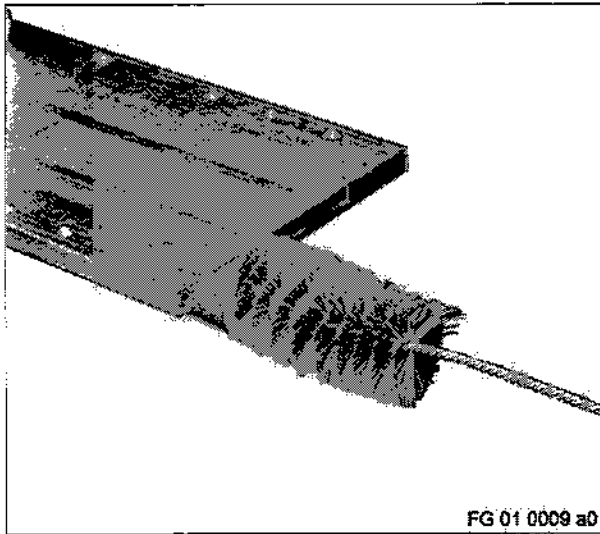
Oil dipstick

Visually inspect for damage and defects; replace if necessary.

Check that the oil dipstick is secure in the guide tube.

When replacing dipstick, make sure you use correct version. Part number is stamped on grip.

Replace O-ring.



Cover (main oil gallery)

Remove old sealant from mating surfaces and check for wear and damage; machine if necessary.

Thoroughly clean oil bores, use a bristle brush if necessary.

Note: Never use a wire brush!

CAUTION

Compressed air is highly pressurized.
Risk of injury!
If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask.
Pressure must not exceed 3.0 bar.

After cleaning, flush oilways (under pressure if possible) and blow clear with dry compressed air.

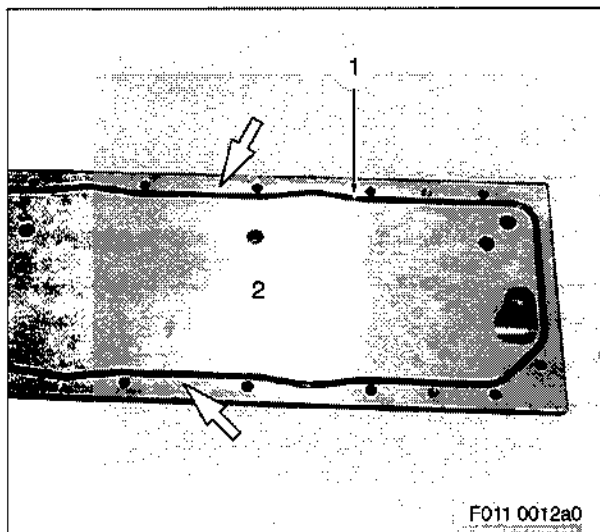
Use a plastic plug or suitable adhesive tape to prevent each bore from getting dirty until the crankcase has been assembled.

C011.05.11 Installation

Note: Prior to installation, remove all blanking plugs and covers. Make sure parts are perfectly clean.

Installing inspection port cover with oil filler neck and oil dipstick

Install and tighten inspection port cover as per overview drawing – see C 011.05.01.



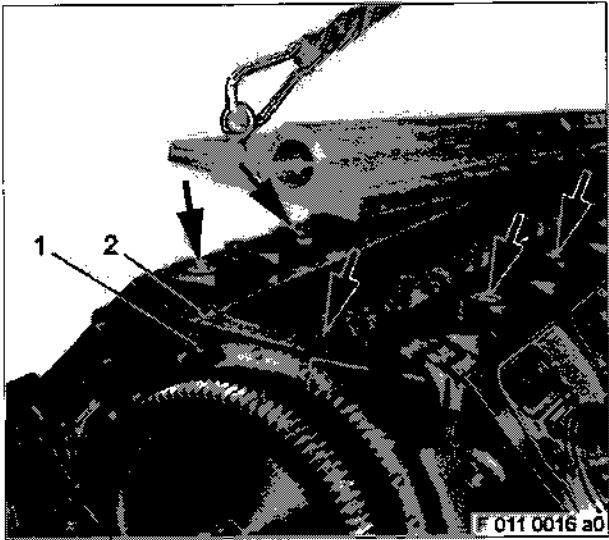
Installing cover (main oil gallery)

Make sure that oil chambers and oilways are perfectly clean.

Complete cover as per Overview drawing – see C 011.05.01.

Clean and degrease mating faces on crankcase and cover (2) (arrows).

Insert new O-ring (1) in groove on cover.



Coat mating face (2) on crankcase with surface sealant (Loctite 5910).

Insert new O-rings (arrows) in oil transfer bores on crankcase.

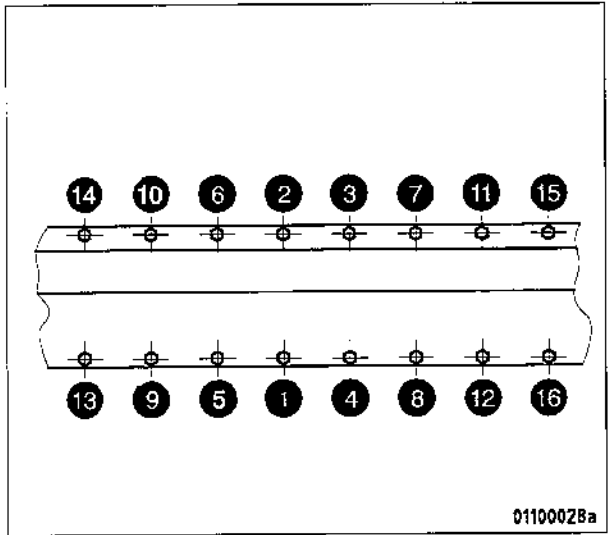
Insert assembly pins in the crankcase at two diagonally opposite corner points.

Screw in suitable lifting eyes.

Using the lifting appliance, fit the cap onto the assembly pins and slowly lower onto the crankcase support surface.

Install stop plate on face (1) of crankcase.

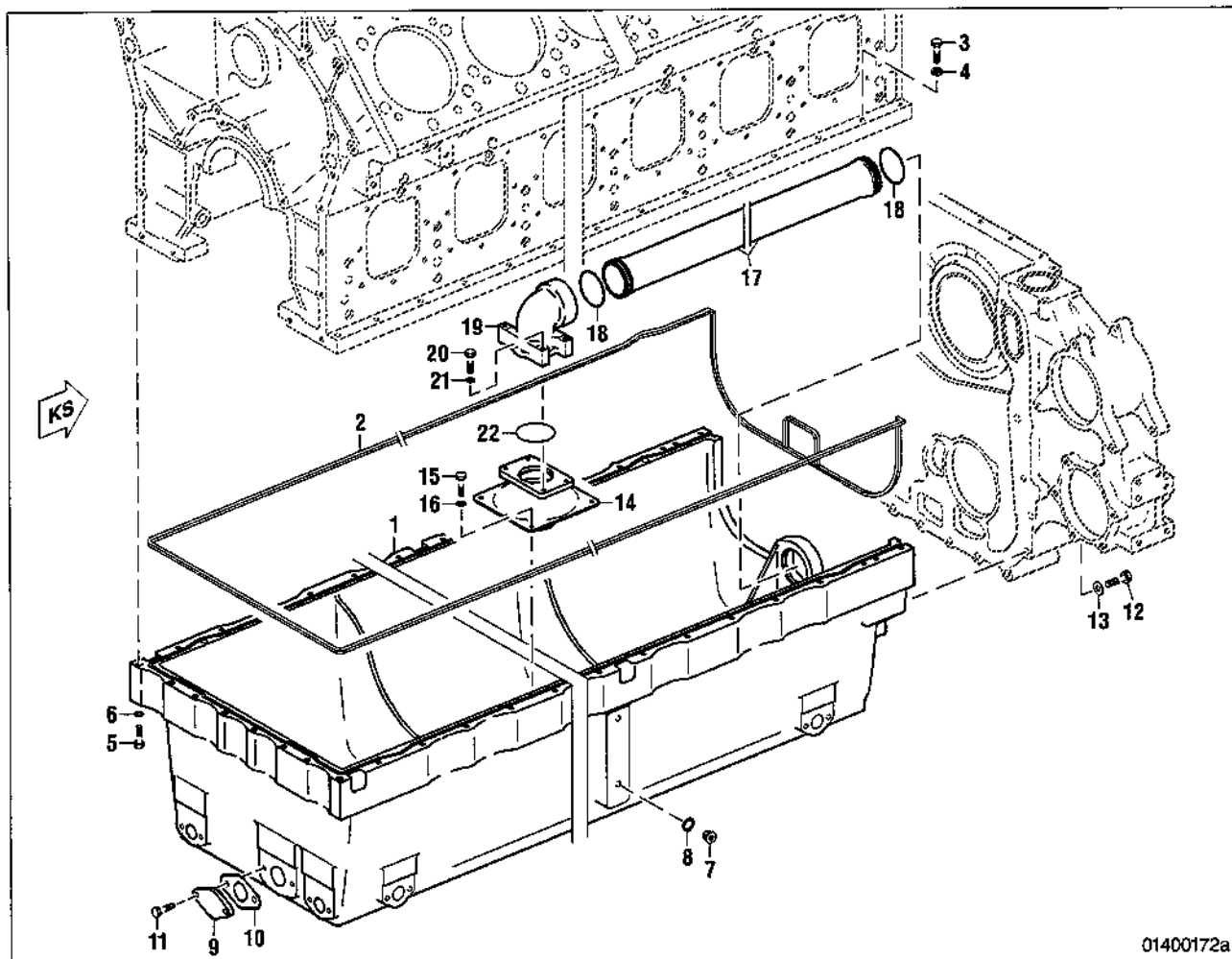
Align cover with stop plate.



Tighten hex screws as per adjacent tightening diagram.

C011.05.12 Before-removal operations

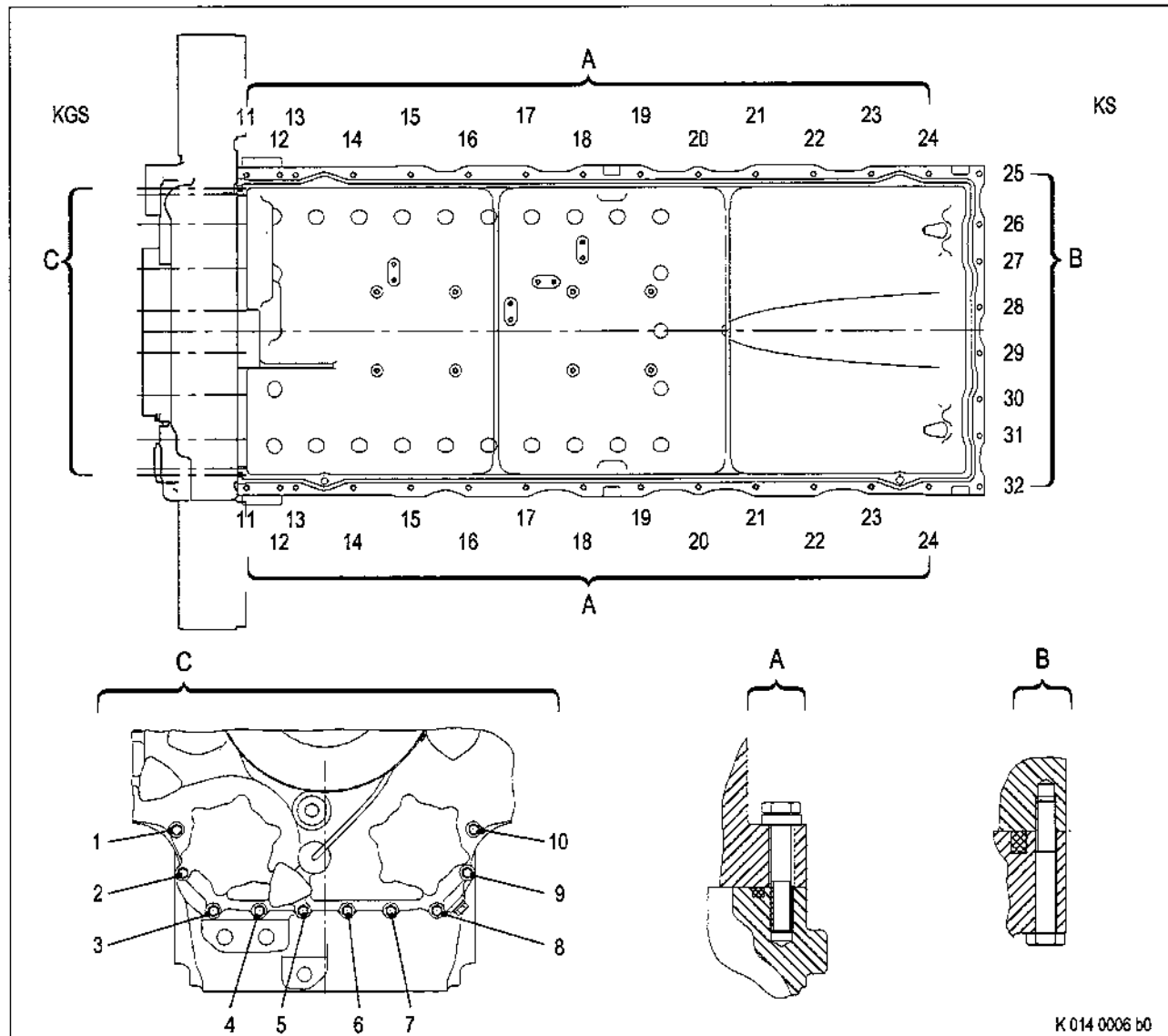
			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	—	—	Perform operations as per Assembly Plan	→ B 005
x	—	—	Install engine	→ B 007

C014.05 Oil pan**C014.05.01 Overview drawing, grey cast iron**

01400172a

- | | |
|------------------|-------------------------------|
| 1 Oil pan | 12 Hex screw |
| 2 Rubber profile | 13 Washer |
| 3 Hex screw | 14 Suction basket |
| 4 Washer | 15 Hex screw |
| 5 Hex screw | 16 Washer |
| 6 Washer | 17 Plug-in pipe (intake pipe) |
| 7 Plug | 18 O-ring |
| 8 Sealing ring | 19 Connector |
| 9 Flange | 20 Hex screw |
| 10 Gasket | 21 Washer |
| 11 Hex screw | |

Tightening diagram, oil pan (cast steel)

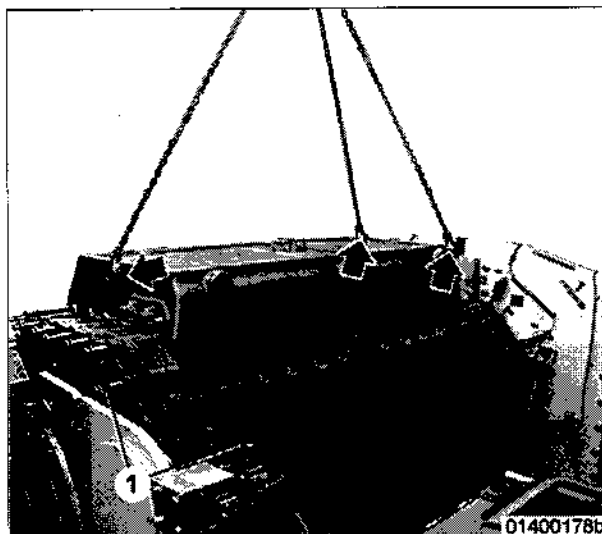


Lubricant = Engine oil

1. Tighten four hex screws by hand at the corner points of the oil pan (11 and 24) diagonally and evenly so that the rubber profile settles.
2. Insert hex screws (1 to 10) through equipment carrier and tighten. Tightening torque: 60 Nm
3. Release hex screws (1 to 10) and then retighten. Tightening torque: 30 Nm
4. Tighten four hex screws by hand at the corner points of the oil pan (11 and 24) diagonally and evenly to the respective specified final tightening torque. Tightening torque: 42 + 4 Nm
5. Tighten eight hex screws at the front face of the oil pan, driving end, (25 to 32).
Tightening torque: 42 + 4 Nm
6. Tighten hex screws (11 to 24) to the respective specified final torque.
Tightening torque: 42 + 4 Nm
7. Tighten hex screws (1 to 10) to the respective specified final torque.
Tightening torque: 74 + 7 Nm

C014.05.04 Before-removal operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Remove engine	→ B 003
x	–	–	Perform operations as per Disassembly Plan	→ B 004
–	–	x	Disable engine start	→ Operating Instructions
–	–	x	Drain engine coolant (as required)	→ Operating Instructions
–	–	x	Drain or draw off engine oil	→ Operating Instructions
–	x	x	Remove gear case	→ C 024.05.05
–	x	x	Remove fuel delivery pump (as required)	→ C 081.05.05
–	x	x	Release or remove oil filler neck	→ C 011.05.05
–	x	x	Remove engine mounts, free and driving ends	→ C 231.05.05

C014.05.05 Removal**Remove oil pan**

Install engine in assembly dolly and turn by 180°.

Remove all hex screws for oil pan (1).

Unscrew plugs at the drain points of the oil pan and insert three suitable eyebolts (arrow) in the oil pan.

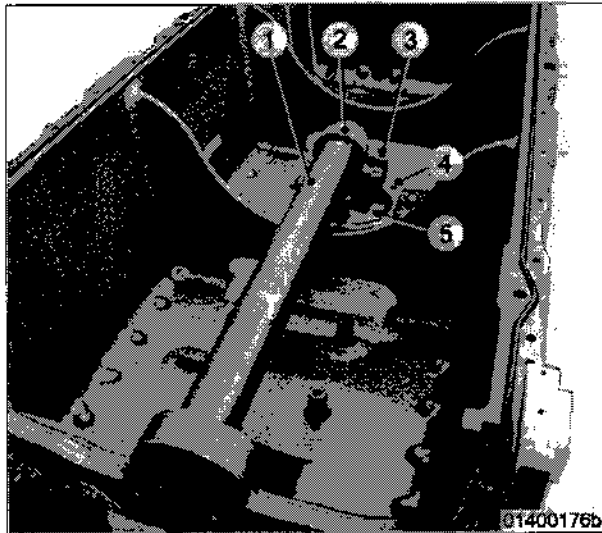


**Suspended load.
Risk of injury!
Only use lifting device provided by manufacturer and observe lifting instructions.
Never stand beneath a suspended load.**

Carefully raise oil pan with lifting ropes and crane and lower onto suitable support.

Remove eyebolts and remove flange from the front face.

Remove rubber profile.



Removing suction basket

Unscrew and remove hex screws (3) and (4) with washers, remove suction basket (5) with connector (2) and intake pipe (1) from oil pan.

Remove O-rings.

C014.05.08 Inspection and repair

Note: Make sure parts are perfectly clean.

Clean oil pan and carefully remove any remaining detergent.

Check oil pan and attachments for cracks using surface crack-testing method with red penetrant dye and repair as necessary.

Replace component if cracks are found.

If oil pan must be reconditioned, contact MTU.

Check mating face of oil pan with crankcase for surface irregularities.

In event of irregularities over 0.2 mm, recondition mating face.

Check all mating and sealing faces and the rubber profile support groove; rub down with emery cloth or an oilstone as necessary.

Check all parts for wear and damage; replace components as necessary.

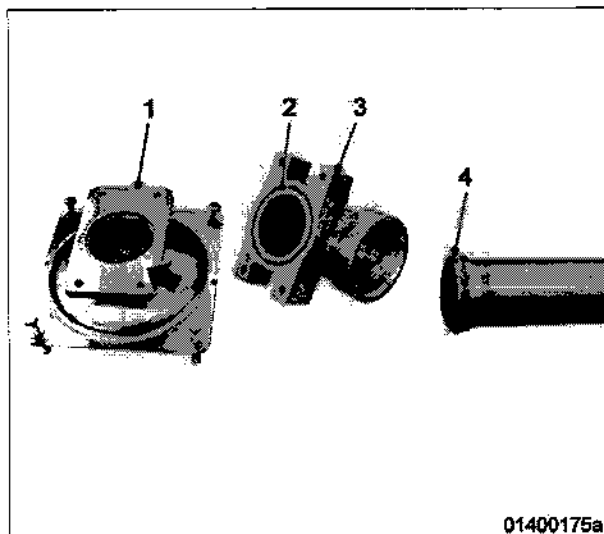
Check condition of threads in tapped bores; replace threaded inserts if necessary.

Check suction basket for contamination and damage; replace the suction basket if the mesh grill is found to be damaged (pierced).

Replace gaskets, sealing rings and rubber profile.

C014.05.11 Installation

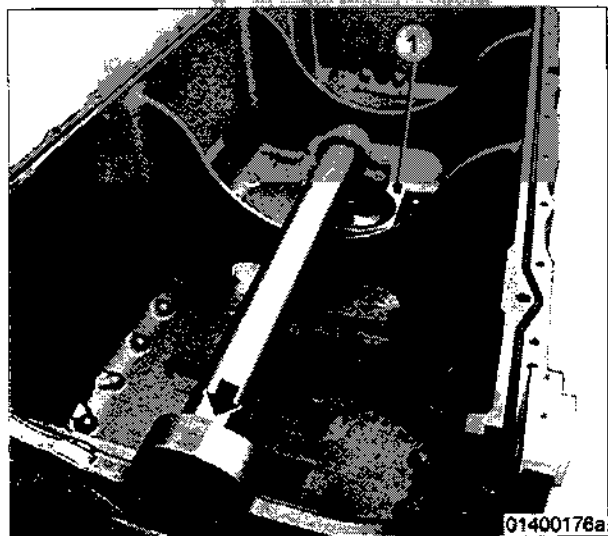
Note: Always make sure that all components are perfectly clean.

**Installing suction basket**

Insert O-rings (2) and (4) into groove on connector (3) or fit on intake pipe and coat with petroleum jelly.

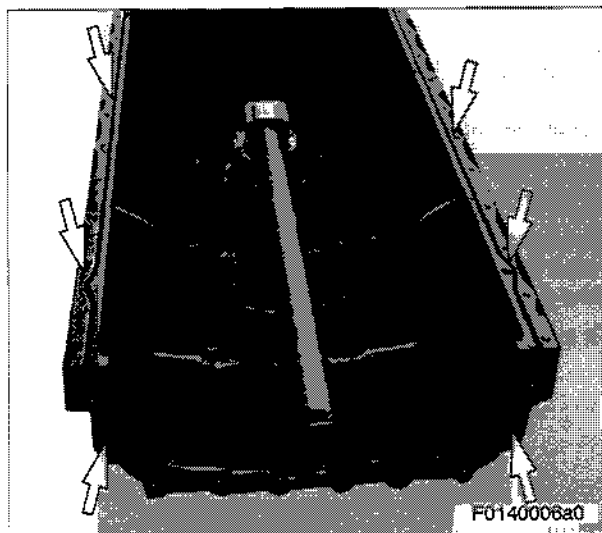
Clean mating face (arrow) on suction basket (1) and install connector on suction basket – see also Overview drawing C014.05.01.

Fit intake pipe in connector.



Press suction basket with connector and intake pipe into oil pan (arrow).

Install hex screws (1) with washers and tighten.

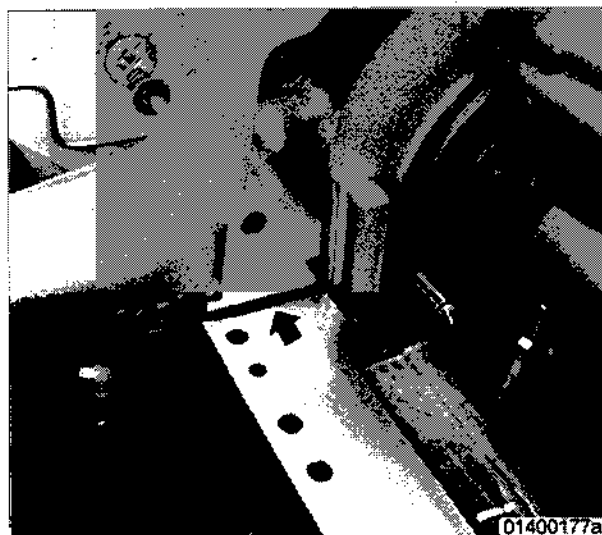


Installing oil pan

Note: Make sure parts are perfectly clean.

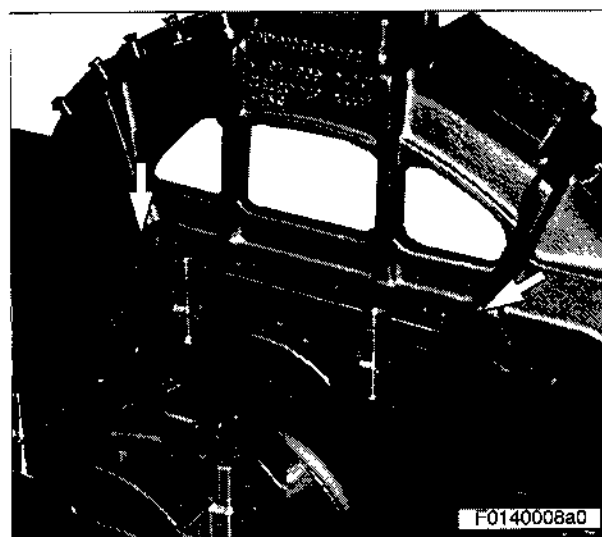
Clean and degrease mating faces on oil pan, on crankcase and on equipment carrier with Loctite cleaning agent.

Insert rubber profile carefully in oil pan groove (see arrow) and coat with petroleum jelly.



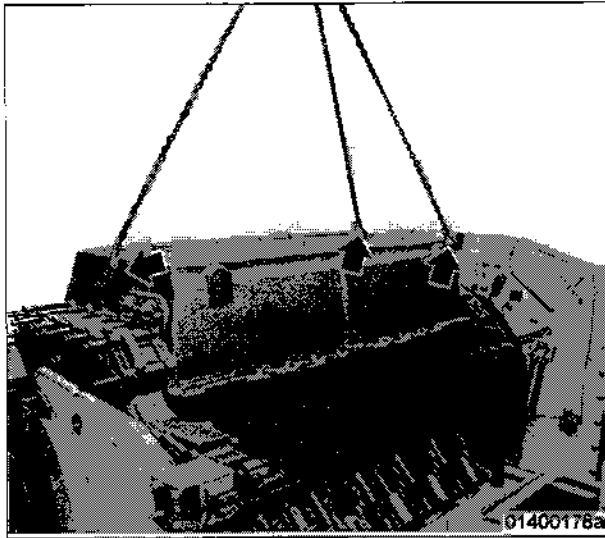
Coat parting line of equipment carrier/crankcase with surface sealant Loctite 5910 on both sides of equipment carrier (arrow); apply a bead of approx. 5 mm.

Note: Apply surface sealant immediately before installing oil pan.
Surface sealant must not start to dry.



Coat parting line/crankcase with surface sealant 5910 (arrow); apply a bead of approx. 5 mm.

Note: Apply surface sealant 5910 (black) directly before assembly to the oil pan.
Surface sealant must not be allowed to dry.



Coat flange surface on equipment carrier with Loctite 518 (red).

Wipe off excess Loctite (red) from free flange surfaces with lint-free cloth, or clean with Loctite cleaner.

Suspended load.

Risk of injury!

Only use lifting device provided by manufacturer and observe lifting instructions.

Never stand beneath a suspended load.

Insert three suitable eyebolts into oil pan bores for blanking plugs.

Using the lifting ropes and crane, lift the oil pan and carefully place on the mating face of the crankcase. (Align oil pan bores with crankcase bores).

Screw in eyebolts as per tightening diagram (see C 014.05.01) and tighten.

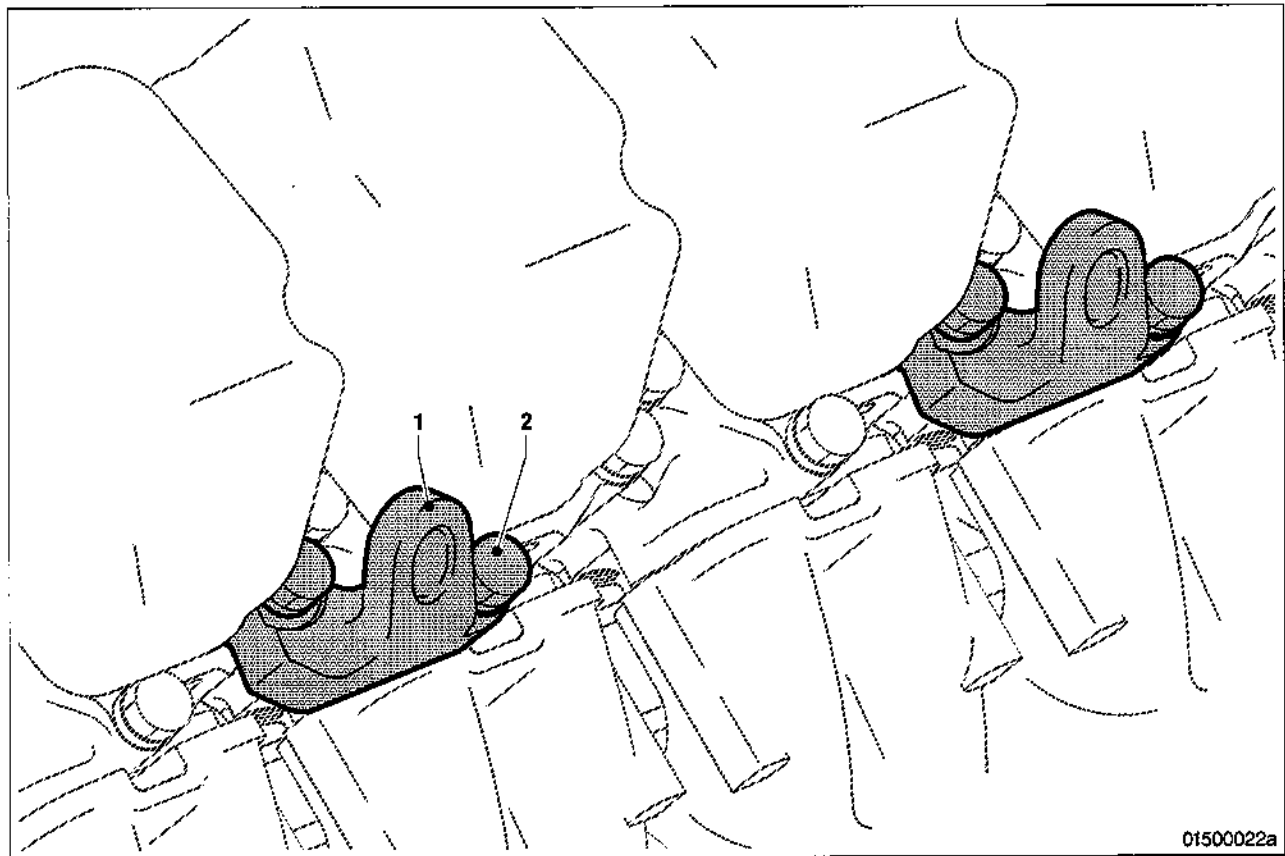
Screw on cover as per Overview drawing – see C 014.05.01.

C014.05.12 After-installation operations

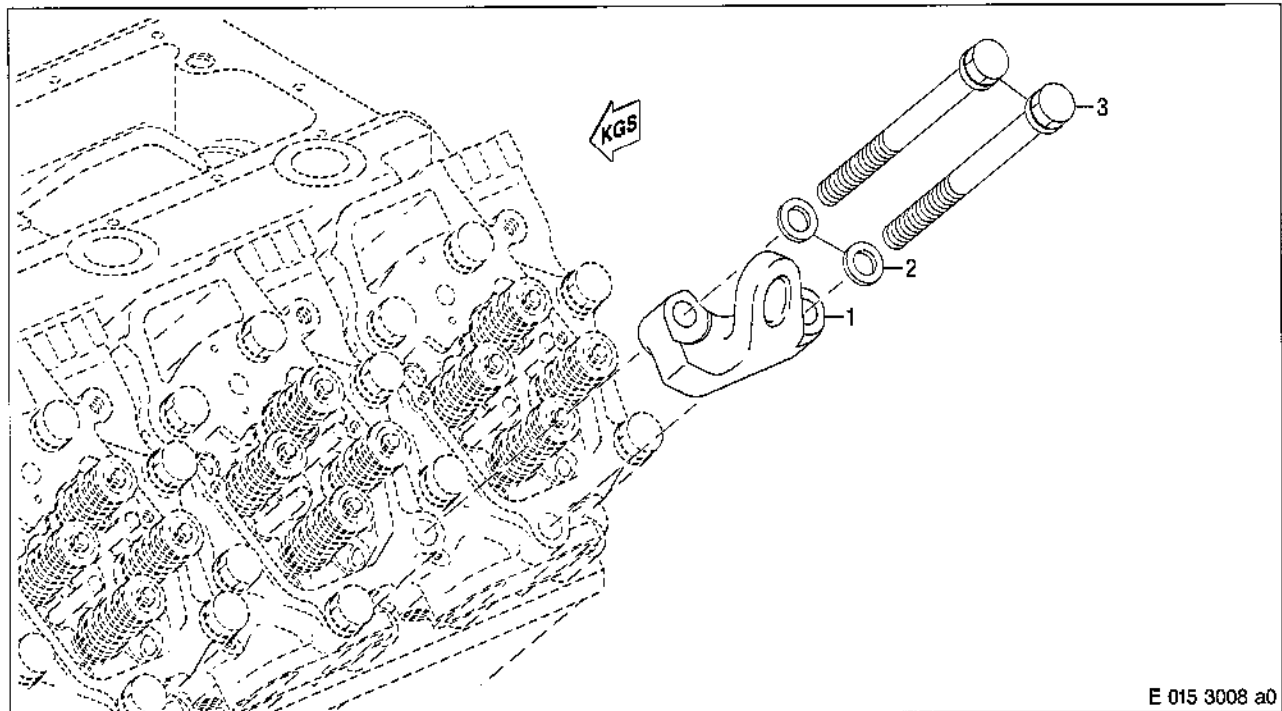
For the following tasks, a distinction must be made as to whether:

- The engine is to be completely disassembled
- The engine is to be removed but not disassembled
- The engine is to remain installed

			Measure	See
x	-	-	Perform operations as per Assembly Plan	→ B 005
x	-	-	Install engine	→ B 007
-	x	x	Assembly in reverse sequence to disassembly	→ C 014.05.04
-	-	x	Fill oil system with engine oil	→ Operating Instructions
-	-	x	Fill engine coolant system	→ Operating Instructions
-	-	x	Release engine start	→ Operating Instructions

C015.05 Lifting attachments for engine and running gear**C015.05.01 Overview drawing**

Engine lifting device



- 1 Lifting eye
- 2 Thrust washer
- 3 Cylinder head screw

C015.05.04 Before-removal operations

For the following tasks, a distinction must be made as to whether:				
The engine is to be completely disassembled				
The engine is to be removed but not disassembled				
The engine is to remain installed				
↓	↓	↓	Measure	See
x	—	—	Remove engine	→ B 003
x	—	—	Perform operations as per Disassembly Plan	→ B 004
—	—	x	Disable engine start	→ Operating Instructions

C015.05.05 Removal

Removing engine lifting attachments

Remove cylinder head screws for lifting eye – see Overview drawing C 015.05.01.

Remove cylinder head screws, thrust washer and lifting eye.

C015.05.08 Inspection and repair

Clean all components and visually inspect for damage and defects; repair as necessary.

Using the magnetic crack-testing method with fluorescent powder, check lifting eye for cracks; replace with original spare part if cracks are detected.

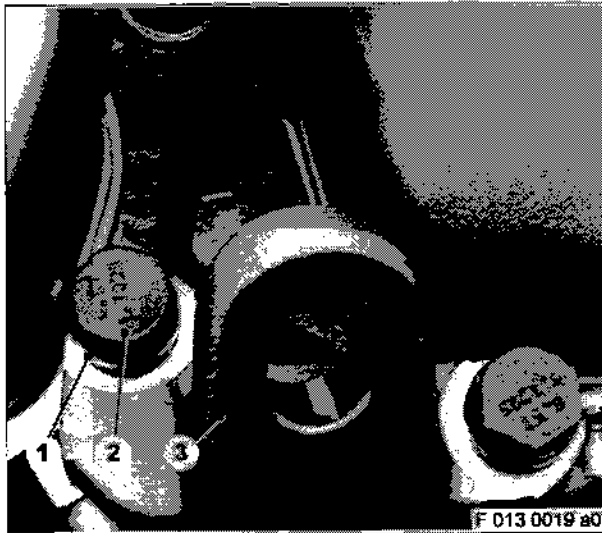
Note: Alignment work or repair welding is not permitted at the lifting eye!

Check condition of mating faces and/or screw-down surfaces; rub down with oilstone if necessary.

Check thread in cylinder head for ease of movement; rechase as necessary.

Check thread and screw head mating face of cylinder head screws, replace if necessary.

C015.05.11 Installation



Installing engine lifting attachment

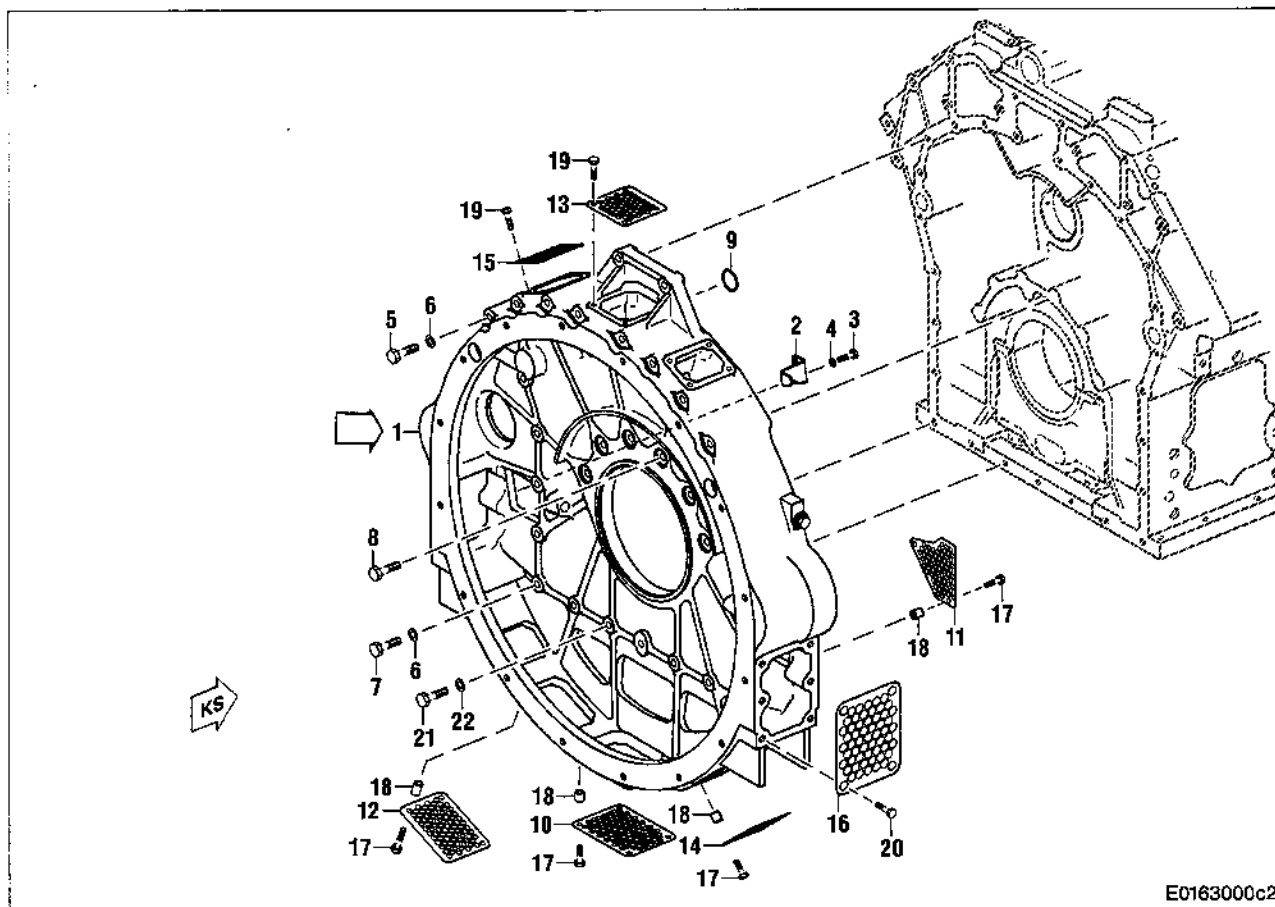
Place lifting eye (3) on cylinder head edges and align to the bores for the cylinder head screws.

Screw in cylinder head screw (2) with thrust washer (1) and tighten as per tightening specifications – see C 041.05.01.

Note: If only the cylinder head screws at the lifting eye were released, then it is sufficient to tighten **both** of these cylinder head screws to torque / additional angle of rotation in accordance with C 41.05.01.

C015.05.12 After-installation operations

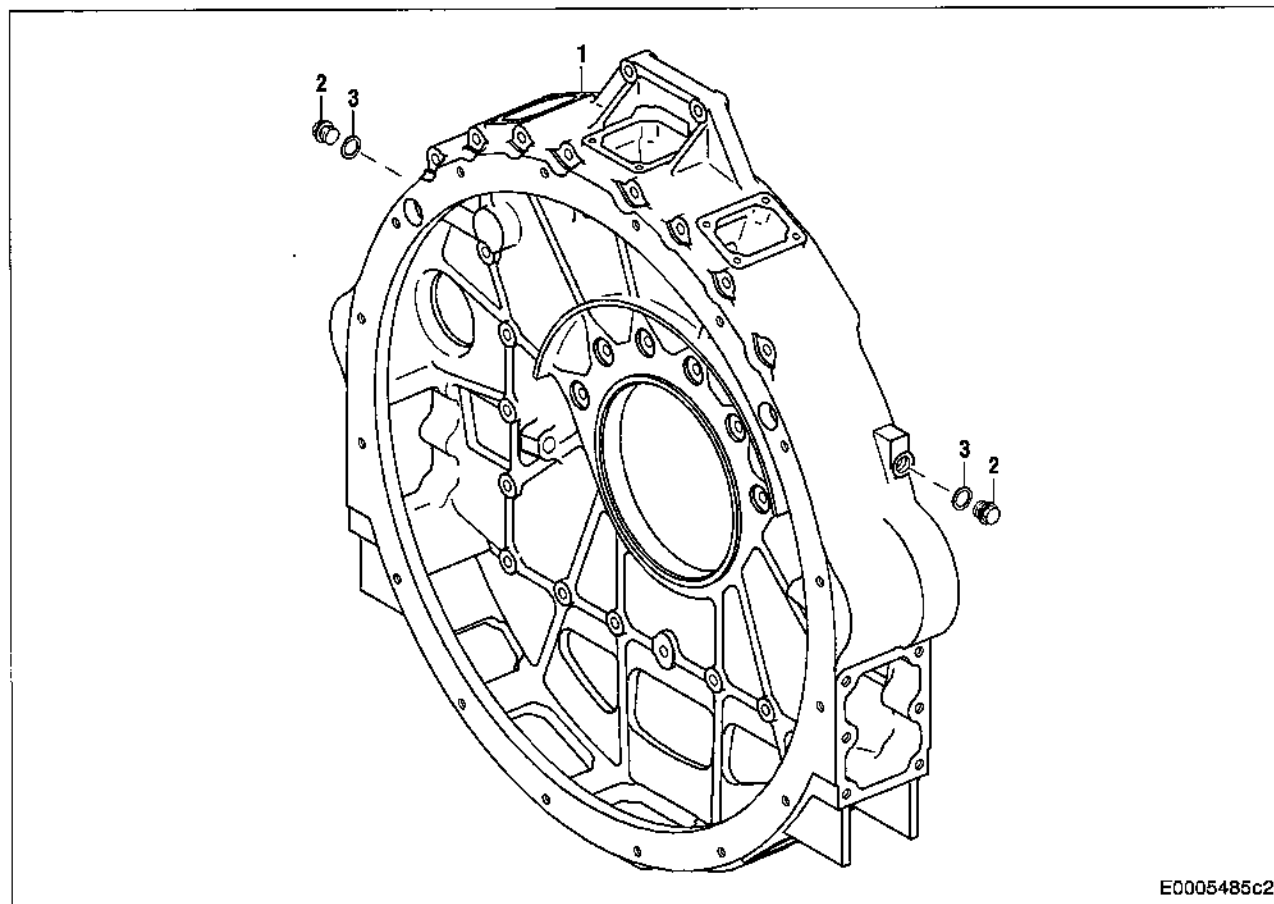
For the following tasks, a distinction must be made as to whether:			
The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed			
Measure			See
x	–	–	Perform operations as per Assembly Plan → B 005
x	–	–	Install engine → B 007
–	–	x	Release engine start → Operating Instructions

C016.30 End housing, driving and free end**C016.30.01 Overview drawing****Flywheel housing with attachments**

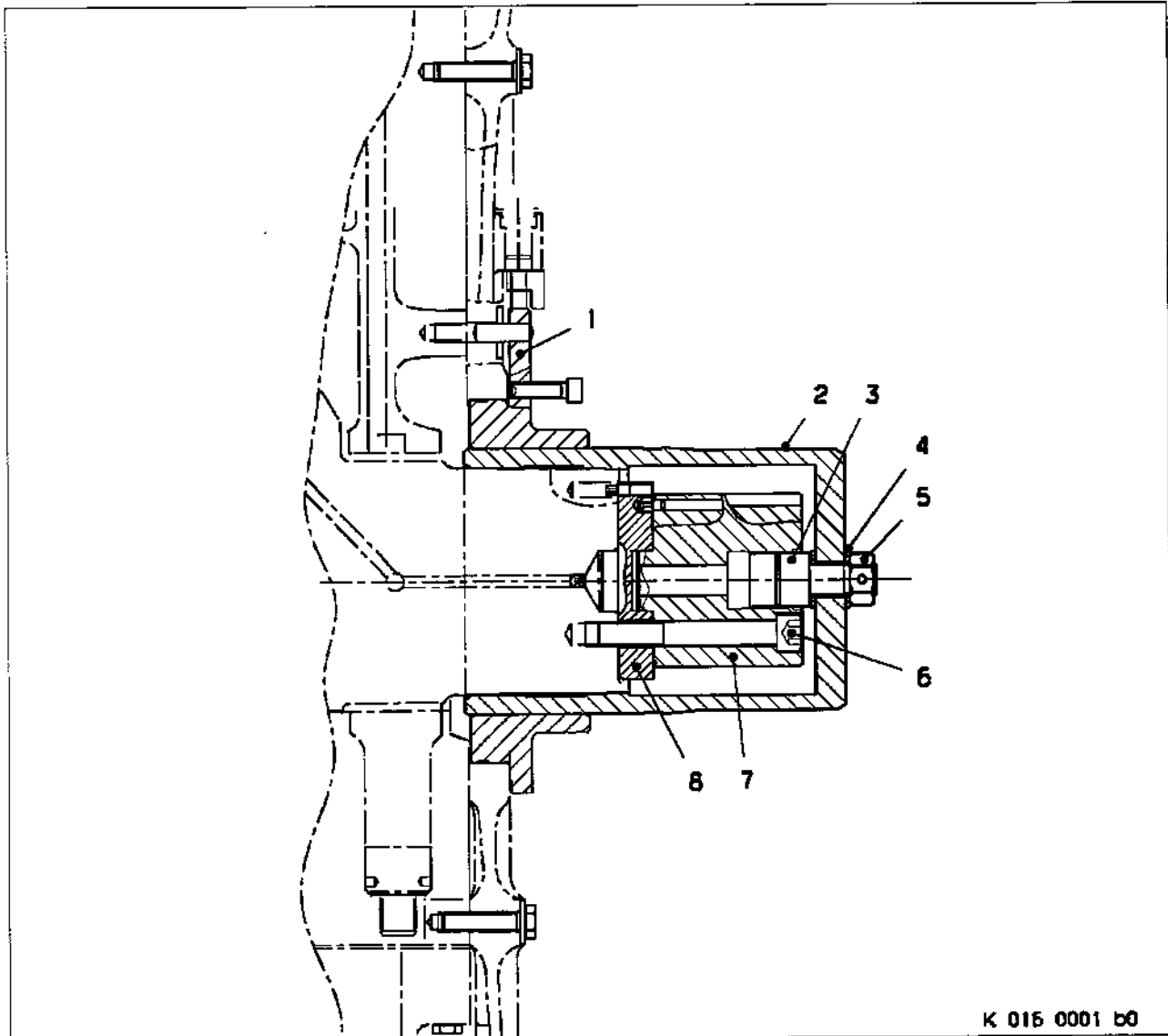
E0163000c2

- | | |
|-------------------------|---------------------|
| 1 Flywheel housing | 12 Protective plate |
| 2 Dead-centre indicator | 13 Protective plate |
| 3 Hex screw | 14 Protective plate |
| 4 Washer | 15 End cover |
| 5 Plug | 16 Protective plate |
| 6 Spring washer | 17 Hex screw |
| 7 Hex screw | 18 Spacer bush |
| 8 Hex screw | 19 Hex screw |
| 9 O-ring | 20 Hex screw |
| 10 End cover | 21 Hex screw |
| 11 Protective plate | 22 Spring washer |

Flywheel housing



- 1 Flywheel housing
- 2 Plug
- 3 Sealing ring

Guide bush layout for installation / removal of flywheel housing

- 1 Support
- 2 Guide bush
- 3 Guide
- 4 Washer

- 5 Nut
- 6 Socket-head screw
- 7 Flange
- 8 Flange

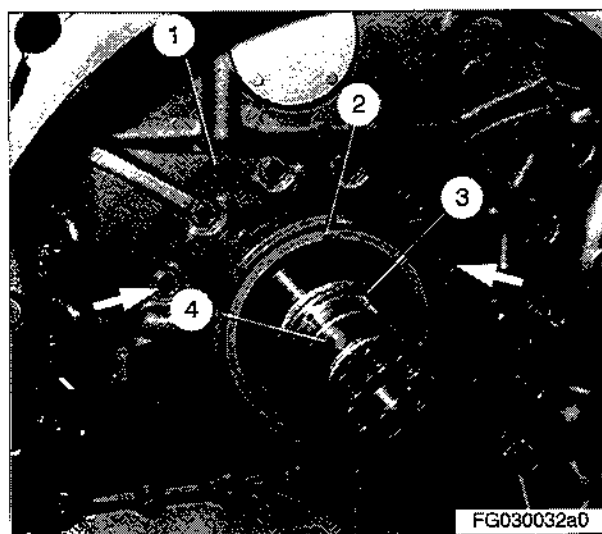
C016.30.02 Special tools

Designation	Use/dimension	Number
• Guide bush	for flywheel housing (short)	1
– Support		1
– Flange		1
– Flange		1
– Socket-head screw	M 16 x 120	6
• Support bracket	for flywheel housing, short and long	1

C011.05.04 Before-removal operations

For the following tasks, a distinction must be made as to whether: → The engine is to be completely disassembled → The engine is to be removed but not disassembled → The engine is to remain installed			
Measure			See
x	–	–	Engine removal → B 003
x	–	–	Perform operations as per Disassembly Plan → B 004
–	–	x	Disable engine start → Operating Instructions
–	–	x	Drain engine coolant (high temperature) → Operating Instructions
–	–	x	Drain charge air coolant (low temperature) → Operating Instructions
–	–	x	Install appropriate charge air manifold → C 124.05.05
x	x	x	Remove starter, right side → C 172.05.05
x	x	x	Remove intercooler → C 111.05.05
x	x	x	Remove flywheel with graduated disc → C 032.20.05

C016.30.05 Removal



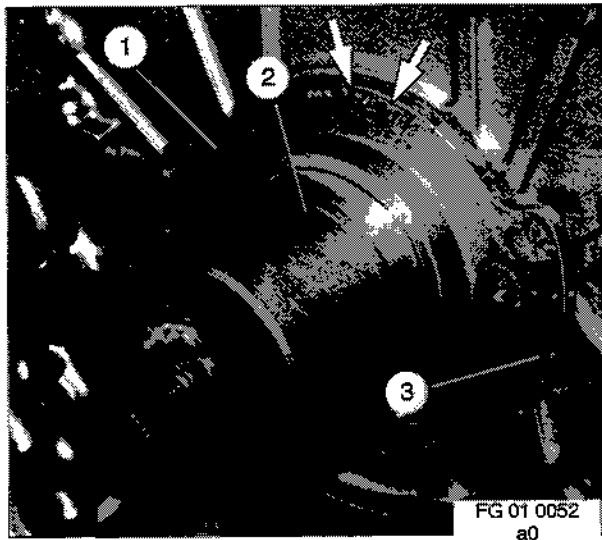
Removing flywheel housing

Note: The engine is turned 180°, i.e. oil pan side is at the top.
Do not damage flywheel housing and crankshaft.

Use a suitable extractor to withdraw radial-lip shaft seal (2) out of flywheel housing (1).

Mount flanges (3 and 4) on crankshaft end.

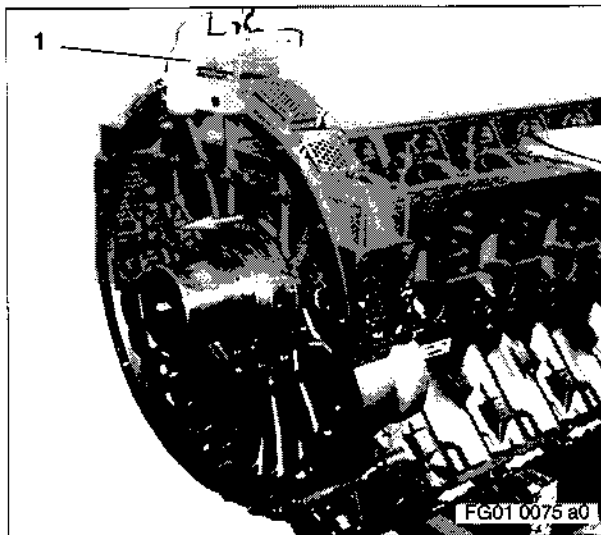
Unscrew the two hex screws marked with an arrow in the flywheel housing inner circle.



Push support (1) onto guide bush (2).

Insert the positioning mandrels (3) of the support in the bores of the hex screws that were previously released and press the support against the flywheel housing as far as it will go.

Note: The marking "TOP – Oben" (arrows) on the front of the guide bush must always face up, independently of the crankcase position.



 WARNING
Suspended load. Risk of injury! Only use lifting device provided by manufacturer and observe lifting instructions. Never stand beneath a suspended load.

Screw lifting appliance (1) to flywheel housing and, using a lightly tensioned rope, hang onto crane.

Unscrew all of the hex screws that secure the flywheel housing to the crankcase (see overview drawing C 016.30.01).

Remove flywheel housing (in direction of arrow) from crankcase.

C016.30.06 Disassembly

Removing dead-centre indicator, end cover and guard plates

Remove dead-centre indicator, end cover and guard plates as per overview drawing – see C 021.05.01.

C016.30.08 Inspection and repair

Clean all components and visually inspect for damage and defects; repair as necessary.

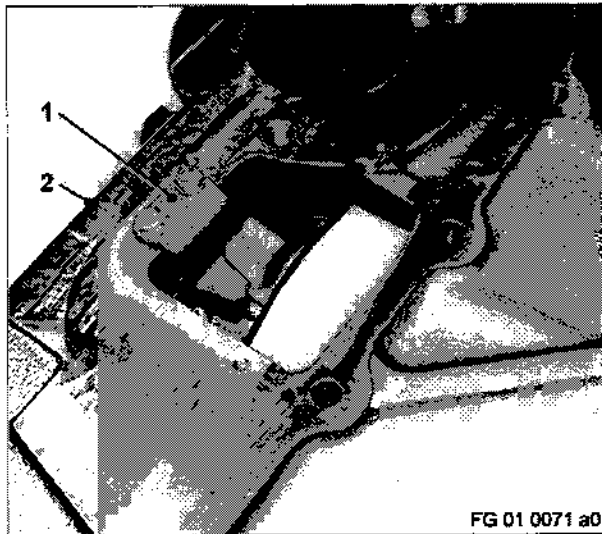
Check dead-centre indicator for damage. Do not straighten dead-centre indicator if it is damaged or bent but replace with a new part.

Check condition of mating faces and/or screw-down surfaces; rub down with oilstone if necessary.

Check condition of threads; rechase threads or replace component if necessary.

Replace O-rings and sealing rings at every assembly.

C016.30.10 Assembly

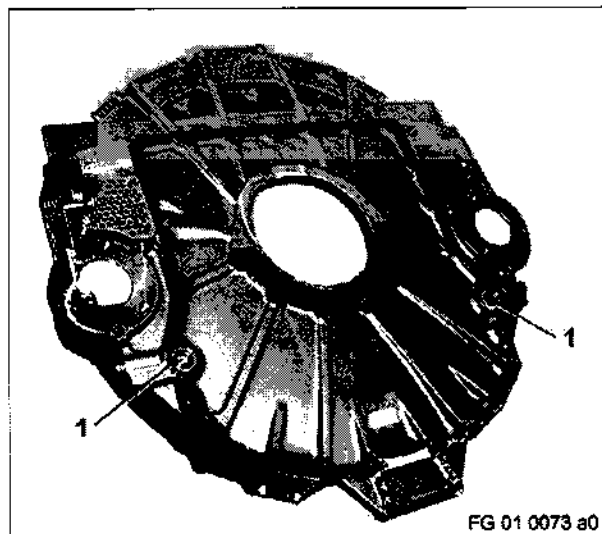


Installing dead-centre indicator, end cover and guard plates

Fit dead-centre indicator (1) to flywheel housing (2).

Remove end cover and guard plates as per overview drawing – see C 016.30.01.

C016.30.11 Installation

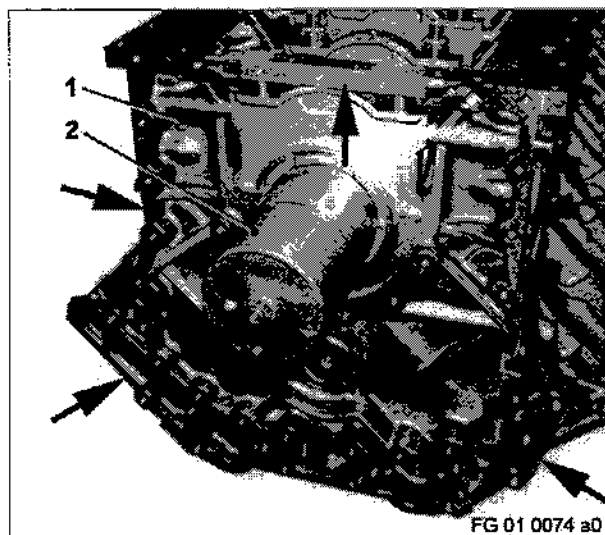


Installing flywheel housing

Clean and degrease sealing surfaces between flywheel housing and crankcase.

Coat sealing surface evenly and smoothly with surface sealant Loctite 518.

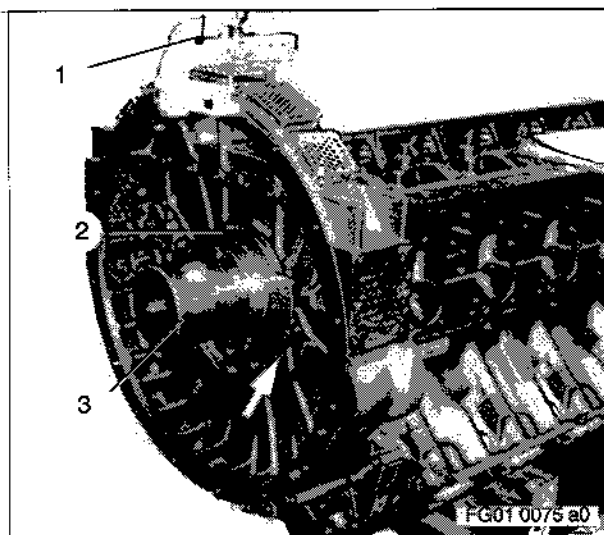
Coat O-rings (1) with petroleum jelly and insert into bores.



Note: In the picture, the engine is turned 180°, i.e. oil pan side is at the top.

Clean and degrease sealing surfaces (arrows) on crankcase.

Screw guide bush (2) onto flange at crankshaft end.



Suspended load.
Risk of injury!
Only use lifting device provided by manufacturer and observe lifting instructions.
Never stand beneath a suspended load.

Install support (2) on the flywheel housing.

Suspend flywheel housing from crane with lifting gear (1).

Install flywheel housing with support on guide bush (3) and push in direction of crankcase up to stop.

Note: Note that screws differ in length.

Screw in hex screws for flywheel housing hand-tight (see overview drawing, C 016.30.01).

Tighten two opposing hex screws in the inner circle (arrow) of the flywheel housing to specified torque.

Remove support from flywheel housing.

Fit remaining hex screws.

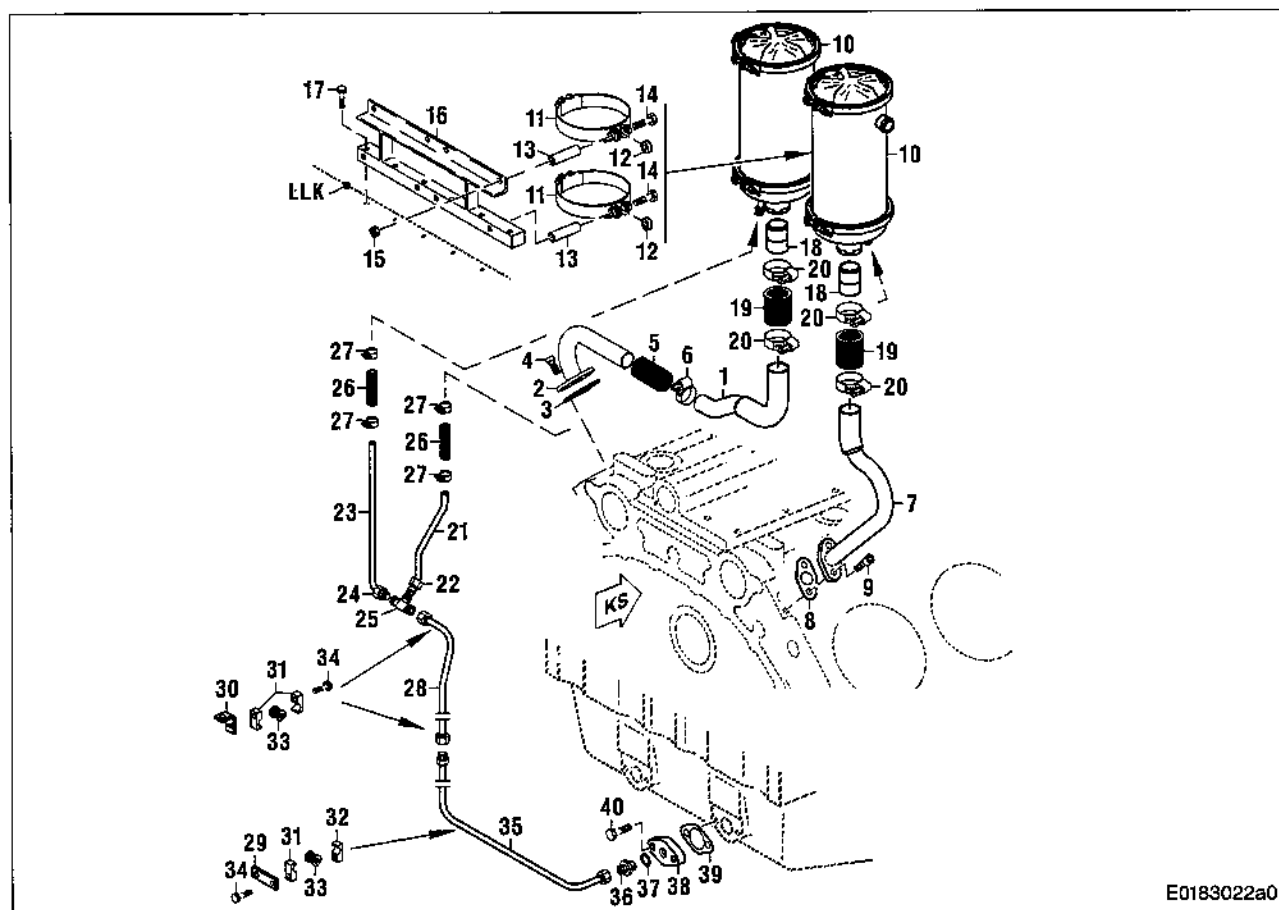
Tighten all hex screws for securing flywheel housing and crankcase (see overview drawing, C 016.30.01) to specified torque.

Note: First tighten hex screws in inner circle of flywheel, then tighten screws in outer circle of flywheel housing. Proceed clockwise.

Install radial-lip shaft seal in flywheel housing – see C 032.05.10.

C016.30.12 After-installation operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	x	x	Assembly in reverse sequence to disassembly	→ C 016.30.04
–	–	x	Fill charge air coolant system	→ Operating Instructions
–	–	x	Release engine start	→ Operating Instructions

C018.10 Crankcase ventilation**C018.10.01 Overview drawing, driving end**

E0183022a0

- | | | |
|------------------------|------------------|--------------------|
| 1 Pipeline | 15 Hex nut | 29 Bracket |
| 2 Pipeline | 16 Bracket | 30 Bracket |
| 3 Gasket | 17 Hex screw | 31 Pipe clamp half |
| 4 Socket-head screw | 18 Guide sleeve | 32 Pipe clamp half |
| 5 Rubber sleeve | 19 Rubber sleeve | 33 Grommet |
| 6 Clamp | 20 Clamp | 34 Hex screw |
| 7 Pipeline | 21 Pipeline | 35 Pipeline |
| 8 Gasket | 22 Nut | 36 Reduction union |
| 9 Hexagon socket screw | 23 Pipeline | 37 Sealing ring |
| 10 Oil separator | 24 Nut | 38 Flange |
| 11 Clamp | 25 T-piece | 39 Gasket |
| 12 Washer | 26 Rubber sleeve | 40 Hex screw |
| 13 Spacer bushing | 27 Clamp | |
| 14 Hex screw | 28 Pipeline | |

Tightening torque: 20 Nm + 2 Nm

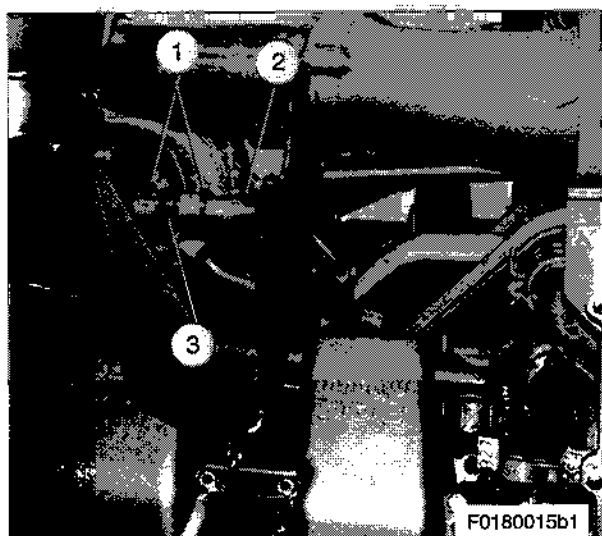
C018.10.04 Before-removal operations

For the following tasks, a distinction must be made as to whether:

- The engine is to be completely disassembled
- The engine is to be removed but not disassembled
- The engine is to remain installed

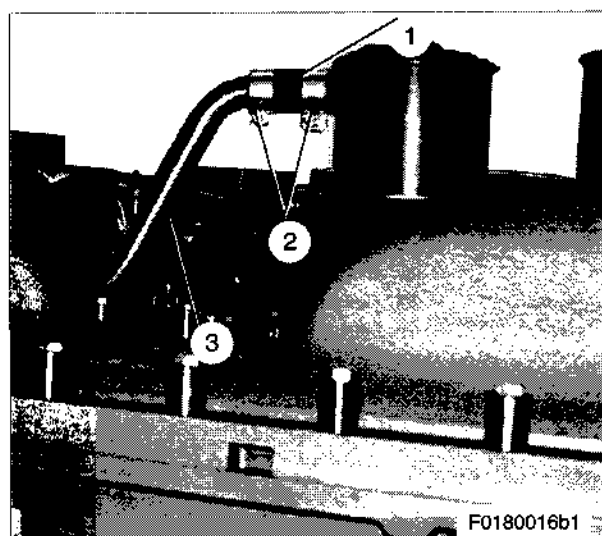
Measure				See
x	—	—	Remove engine	→ B 003
x	—	—	Perform operations as per Disassembly Plan	→ B 004
—	—	x	Disable engine start	→ Operating Instructions

C018.10.05 Removal



Release clamps (1) and fit rubber sleeve (3) over remaining pipe end (2).

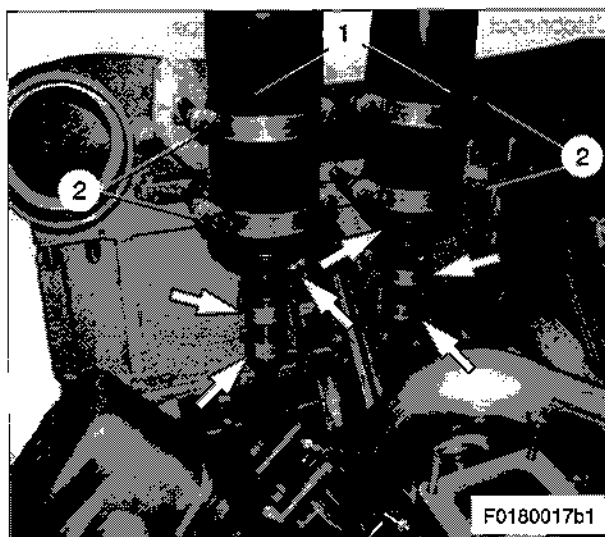
Note: Dismantling refers to engine side, left and right.



Release clamps (2) and fit rubber sleeve (1) over remaining pipe end (3).

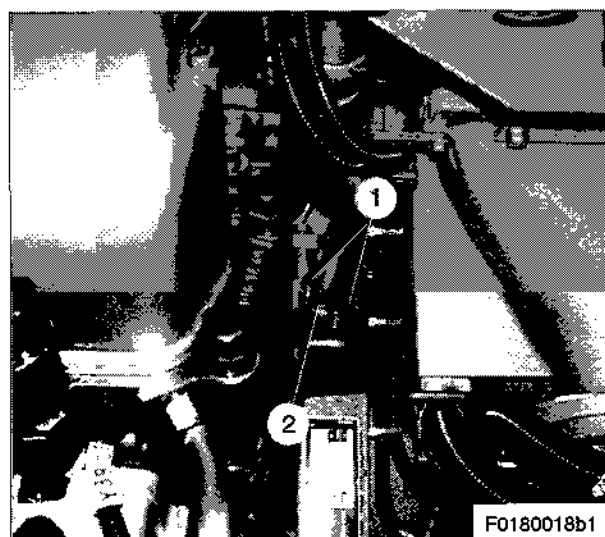
Remove piping system.

Note: Dismantling refers to engine side, left and right.



Release clamps (arrow) and fit rubber sleeves over remaining pipe.

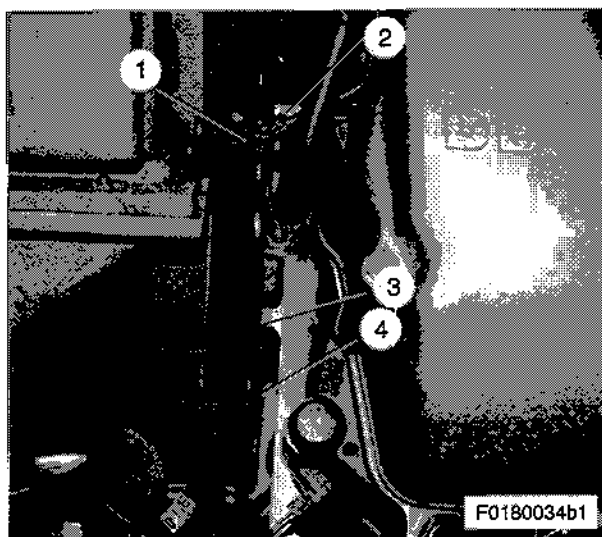
Unscrew hex screws (2), remove clamps with oil separator (1) and spacer sleeves.



Unscrew hex sockets (1) and remove piping system (2), left engine side.

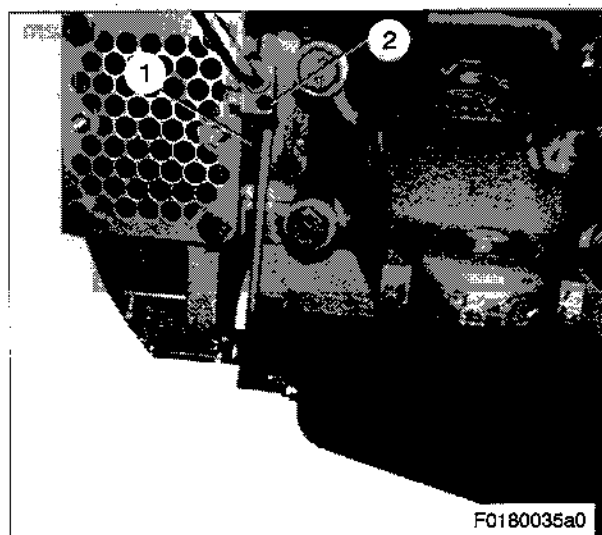


Unscrew hex sockets (1) and remove piping system, right engine side.

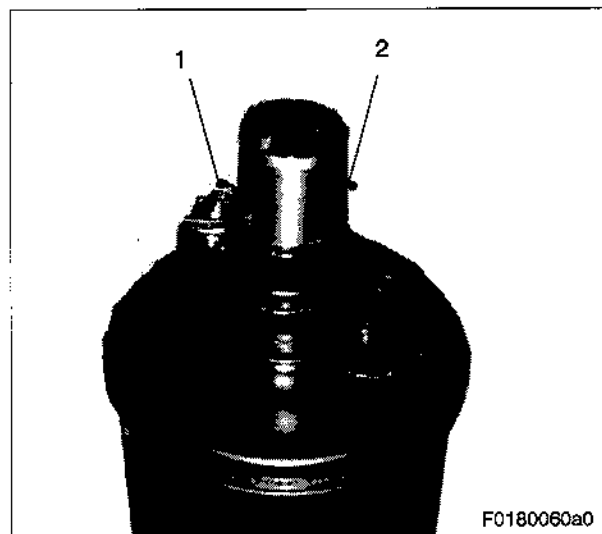


Disconnect piping system (2) at T-piece.

Remove pipe clamp halves (1), disconnect line (3) at partition area (4) and remove.



Remove pipe clamp halves (2), disconnect line (1) at partition area to oil pan and remove.



Unscrew hex screw (1), withdraw sleeve (2) from oil separator and remove.

Note: Sleeve is not included in scope of delivery of new oil separator.

Note: After removal, seal all connections with suitable plugs.

C018.10.08 Inspection and repair

Note: Make sure that air-carrying components are perfectly clean.

Clean all components.

Replace oil separator.

Dispose of parts in accordance with local regulations.

Visually inspect components for damage and wear; replace components as necessary.

Check sealing and mating faces for damage and defects; rub down with an oilstone or replace parts if necessary.

Check pipes for damage, repair if necessary. Check for leaks in water bath, using compressed air which contains corrosion inhibitor.

**WARNING**

Compressed air is highly pressurized.

Risk of injury! Pressure must not exceed 0.5 bar.

Always wear protective clothing, protective gloves and protective goggles/safety mask.

Air test pressure: 0.5 bar

Water temperature min. 30° C, max. 40° C.

**WARNING**

Hydrochloric acid is extremely caustic. Risk of injury and suffocation!

Do not allow hydrochloric acid to come into contact with eyes, clothing or skin.

– do not inhale.

Always wear protective clothing, protective gloves and protective goggles/safety mask.

Ventilate working area well.

After welding or hot-bending pipework, allow pipework to cool slowly and then pickle with a hydrochloric acid solution (9 parts water and 1 part hydrochloric).

Pickling period up to 2 hours depending on layer of scale or rust.

**CAUTION**

Compressed air is highly pressurized. Risk of injury!

If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask. Pressure must not exceed 3.0 bar.

After pickling, wash lines with hot water and blow dry with compressed air.

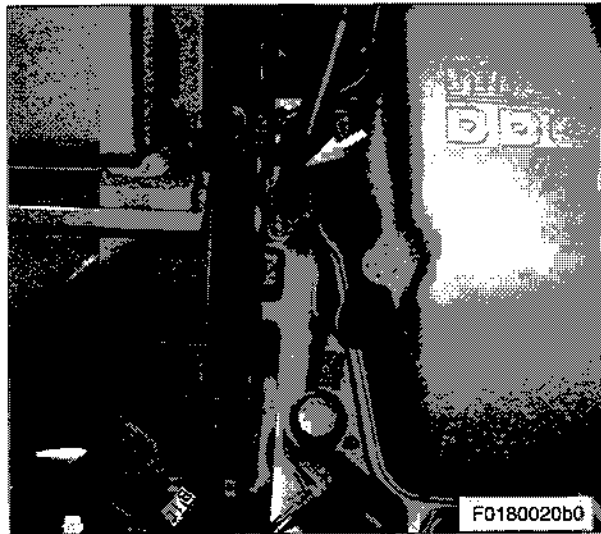
Preserve lines in oil bath and allow to drip dry.

Check condition of threads; rechase threads if necessary or replace threaded inserts if necessary.

Replace gaskets and O-rings.

C018.10.11 Installation

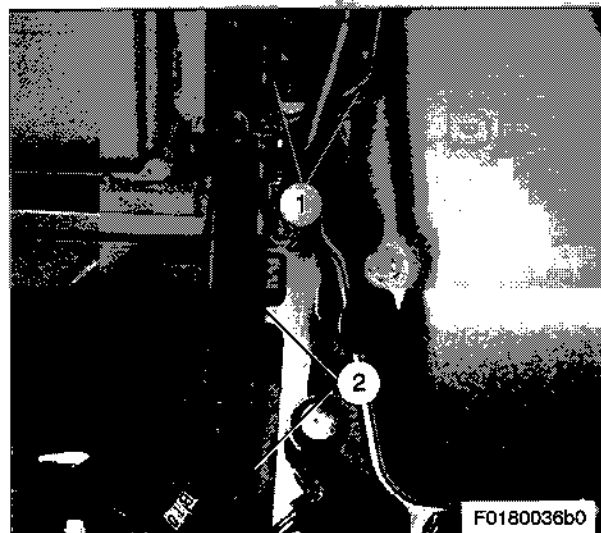
Note: Prior to installation, remove all blanking plugs and ensure oil-carrying components are perfectly clean. Install all pipes tension-free.



Engine side, right

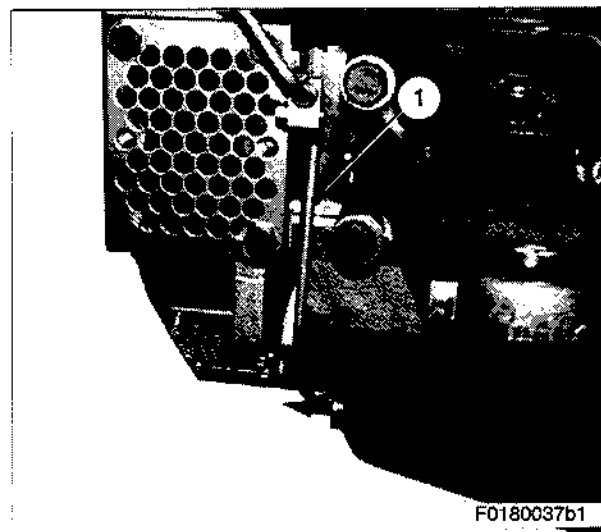
Fit pipe (arrow) with new gasket, see Overview drawing C 018.05.01.

Slide rubber sleeves over pipe end and loosely fit clamps over rubber sleeve.

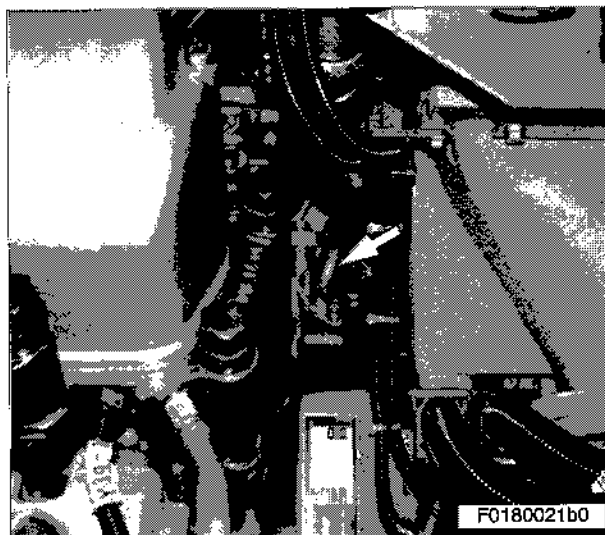


Ensure pipes (1) and (2) are free of tension when installed. Mount pipe clamp halves with rubber grommet and hex screw.

Tighten nuts on piping system.

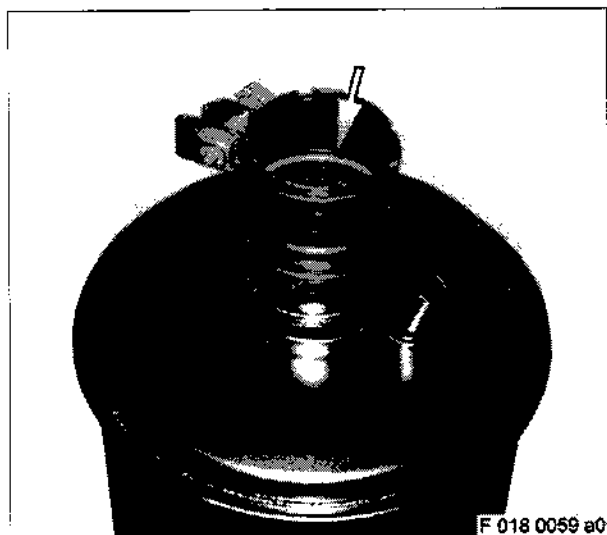


Ensure pipework (1) is free of tension when installed. Mount pipe clamp halves with rubber grommet and hex screw. Tighten nuts on piping system. Hold reduction union firmly in position.

**Engine side, left**

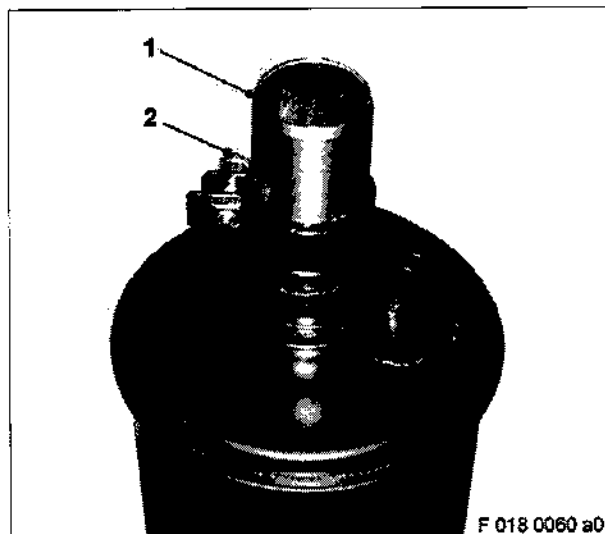
Fit pipe (arrow) with new gasket, see Overview drawing C 018.05.01.

Slide rubber sleeves over pipe end and loosely fit clamps over rubber sleeve.

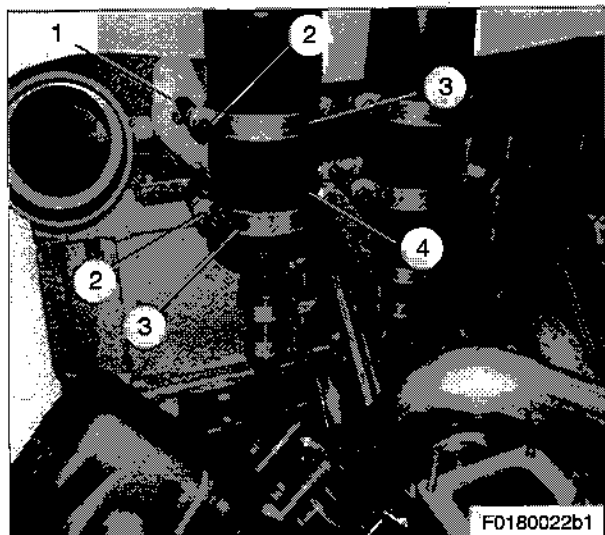


Coat O-ring (arrow) with denaturated ethanol. Insert sleeve, see next illustration.

Note: Denaturated ethanol acts as an anti-friction coating during fitting.

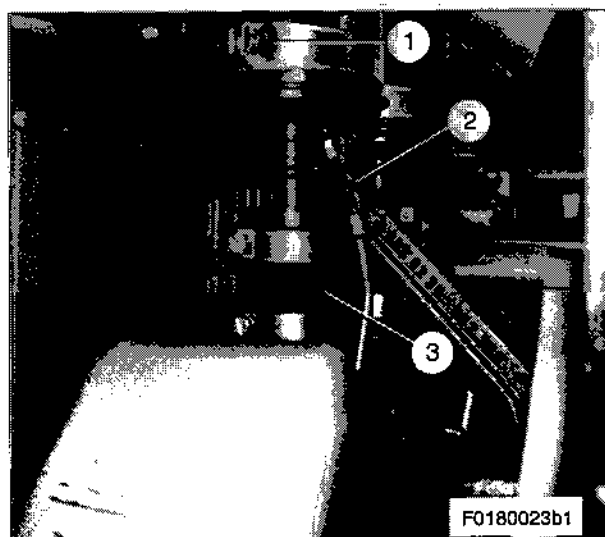


Insert sleeve (1) and tighten with hex screw (2).



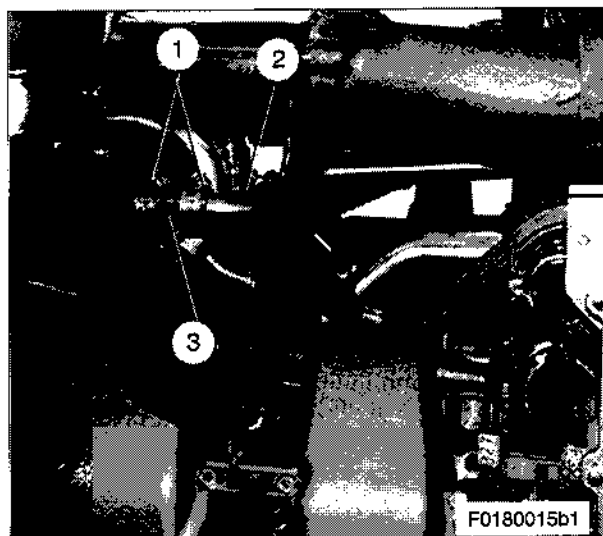
Mount clamps (3) with spacer sleeves (1) and hex screws (2) on intercooler retainer but do not fully tighten.

Mount oil separator (4) and align, see overview drawing C 018.05.01.



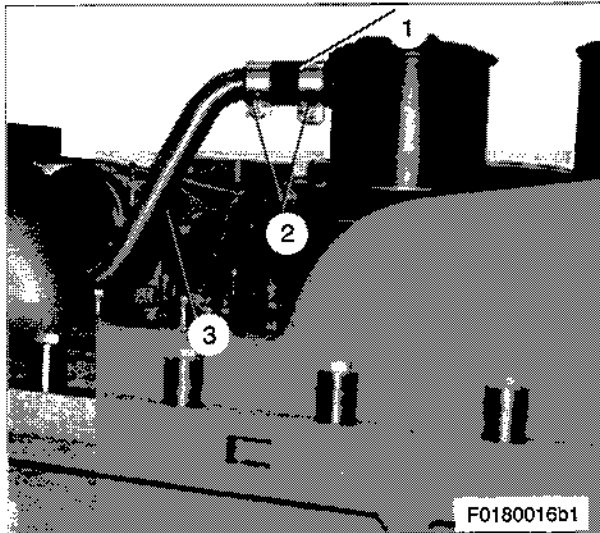
Fit rubber sleeves (2) and (3) over the pipe ends and tighten using suitable pipe clamps, see overview drawing C 018.05.01.

Tighten hex screws (1) as shown in overview drawing C 018.05.01 – to specified tightening torque.



Mount rubber sleeve (3) with clamps (1).

Note: Installation refers to engine side, left and right.
Ensure that pipe (2) is installed free of tension.



Mount rubber sleeve (1) with clamps (2).

Note: Installation refers to engine side, left and right.
Ensure that pipe (3) is installed free of tension.

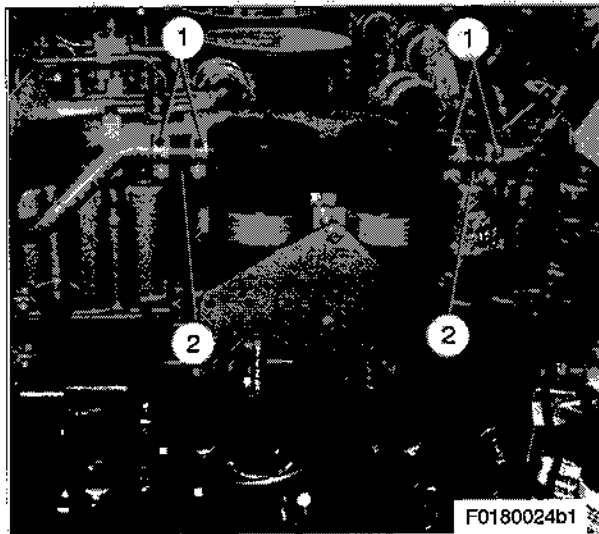
C018.10.12 After-installation operations

For the following tasks, a distinction must be made as to whether:			
↓ ↓ ↓ The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed			
Measure			See
x	–	–	Perform operations as per Assembly Plan → B 005
x	–	–	Install engine → B 007
–	–	x	Release engine start → Operating Instructions

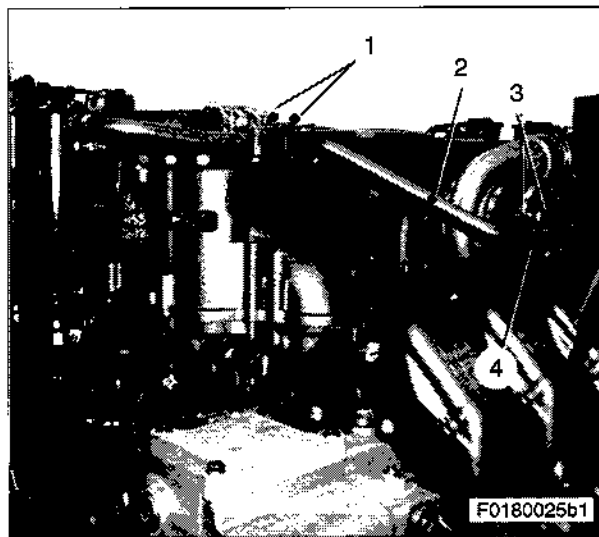
C018.10.04a Before-removal operations

For the following tasks, a distinction must be made as to whether:				
The engine is to be completely disassembled				
The engine is to be removed but not disassembled				
The engine is to remain installed				
↓	↓	↓	Measure	See
x	—	—	Remove engine	→ B 003
x	—	—	Perform operations as per Disassembly Plan	→ B 004
—	—	x	Disable engine start	→ Operating Instructions

C018.10.05 a Removal

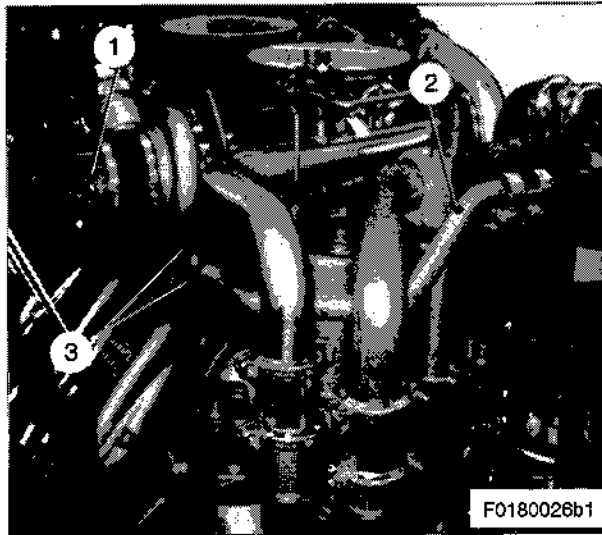


Release clamps (1) and fit rubber sleeves (2) over remaining pipe end.



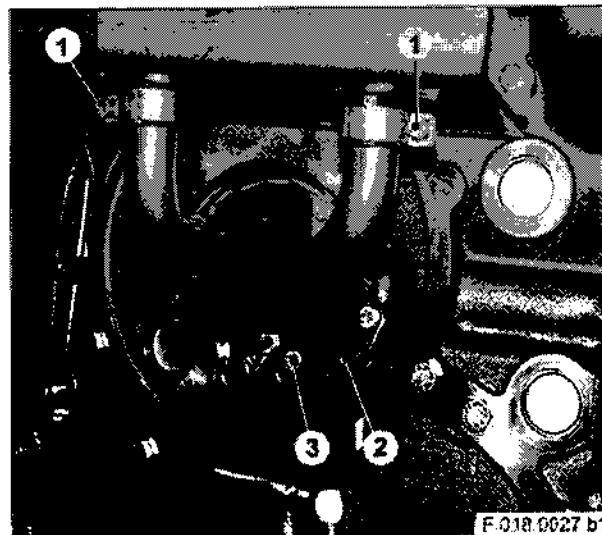
Unscrew hex screws (1), remove pipe clamp halves, release clamps (3) and fit rubber sleeve (4) over the remaining pipe end.

Remove pipe (2) from left engine side.



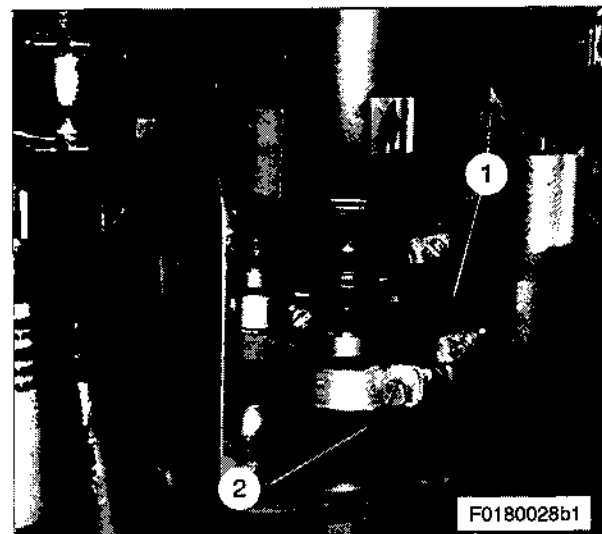
Unscrew hex screws (3), remove pipe clamp halves, release two clamps (1) and fit rubber sleeve over the remaining pipe end.

Remove pipe (2) from right engine side.

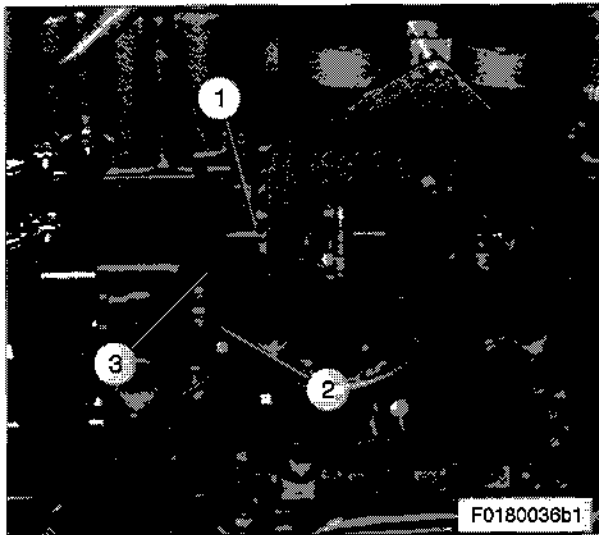


Release hex screws (1) from clamps.

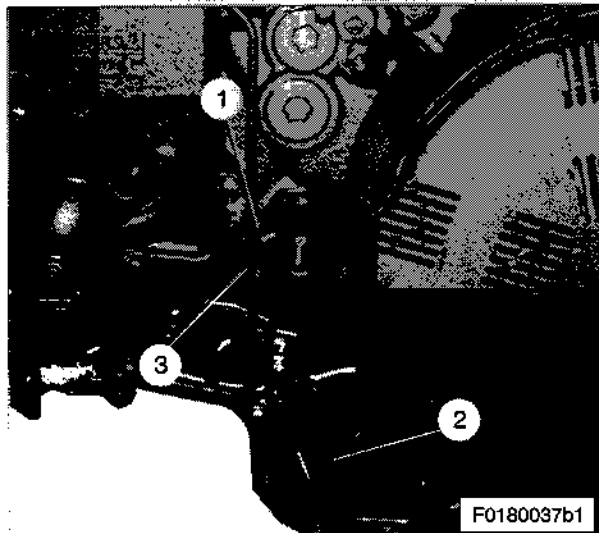
Unscrew hex screws (3) from pipe retainer (2), press off pipe retainer to remove.



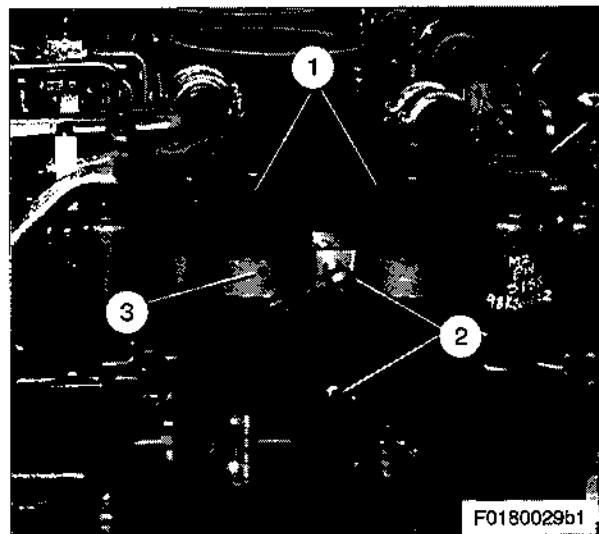
Release clamp(s) from rubber sleeve(s) (1) and (2). Fit rubber sleeve(s) over remaining pipe(s).



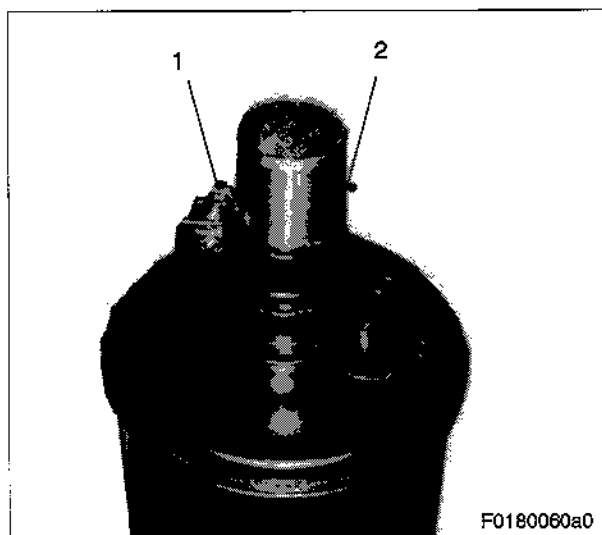
Remove pipe clamp halves (2) and separate pipe (3) from nut (1).



Remove pipe clamp halves (1) and separate pipe (3) from nut (1).



Unscrew hex screws (2), remove clamps (3) with oil separator (1) and spacer sleeves.



Unscrew hex screw (1), withdraw sleeve (2) from oil separator and remove.

Note: Sleeve is not included in scope of delivery of new oil separator.

Note: After removing lines, seal all open connections by installing suitable plugs.

C018.10.08 a Inspection and repair

Note: Make sure that air-carrying components are perfectly clean.

Clean all components.

Replace oil separator.

Dispose of parts in accordance with local regulations.

Visually inspect components for damage and wear; replace components as necessary.

Check sealing and mating faces for damage and defects; rub down with an oilstone or replace parts if necessary.

Check pipes for damage, repair if necessary. Check for leaks in water bath, using compressed air which contains corrosion inhibitor.



Compressed air is highly pressurized.

Risk of injury! Pressure must not exceed 0.5 bar.

Always wear protective clothing, protective gloves and protective goggles/safety mask.

Air test pressure: 0.5 bar

Water temperature min. 30° C, max. 40° C.



Hydrochloric acid is extremely caustic. Risk of injury and suffocation!

Do not allow hydrochloric acid to come into contact with eyes, clothing or skin.

– do not inhale.

Always wear protective clothing, protective gloves and protective goggles/safety mask.

Ventilate working area well.

After welding or hot-bending pipework, allow pipework to cool slowly and then pickle with a hydrochloric acid solution (9 parts water and 1 part hydrochloric).

Pickling period up to 2 hours depending on layer of scale or rust.



CAUTION

Compressed air is highly pressurized. Risk of injury!
If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask. Pressure must not exceed 3.0 bar.

After pickling, wash lines with hot water and blow dry with compressed air.

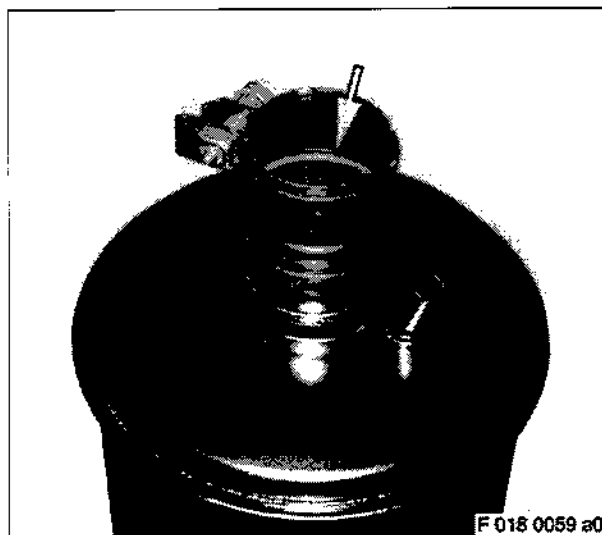
Preserve lines in oil bath and allow to drip dry.

Check condition of threads; rechase threads if necessary or replace threaded inserts if necessary.

Replace gaskets and O-rings.

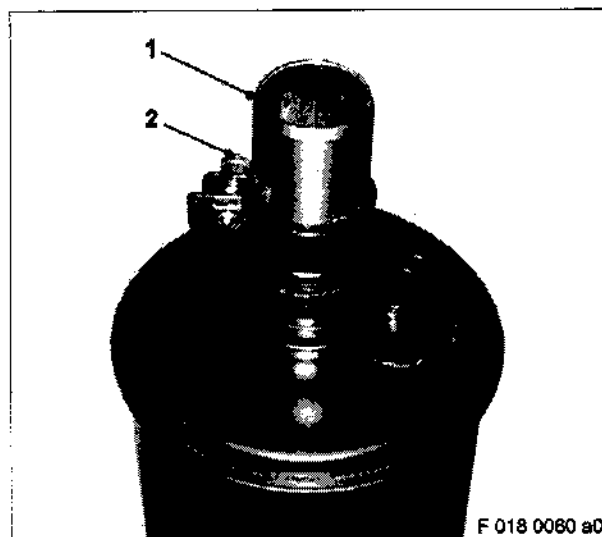
C018.10.11a Installation

Note: Prior to installation, remove all plugs and ensure they are perfectly clean.
Install all pipes tension-free.

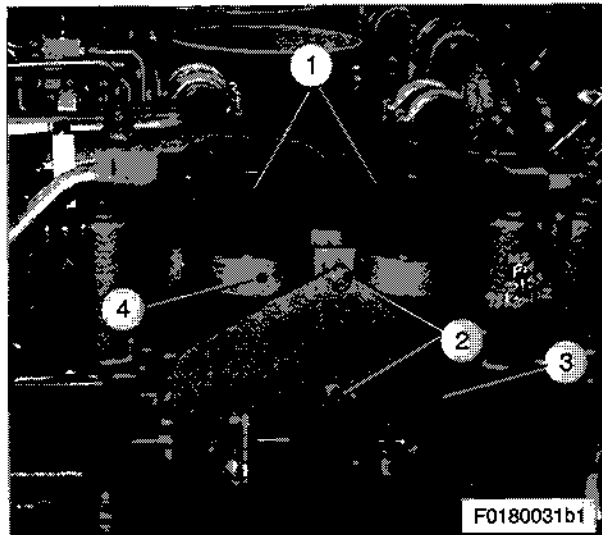


Coat O-ring (arrow) with denaturated ethanol. Insert sleeve, see next illustration.

Note: Denaturated ethanol acts as an anti-friction coating during fitting.

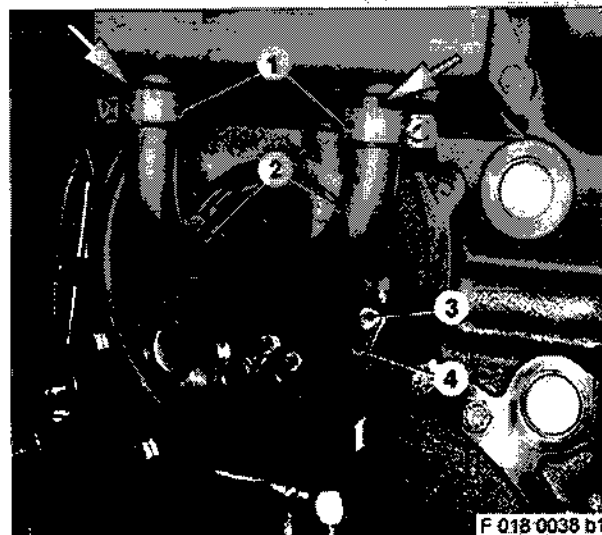


Insert sleeve (1) and tighten with hex screw (2).



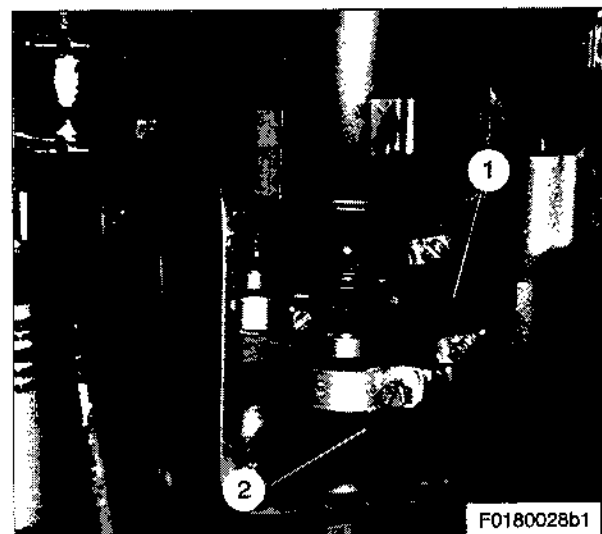
Mount clamps (4) with spacer sleeves (arrow) and hex screws (2) on retainer (3) do not fully tighten.

Mount oil separator (1) and align, see Overview drawing C 018.05.01.a.

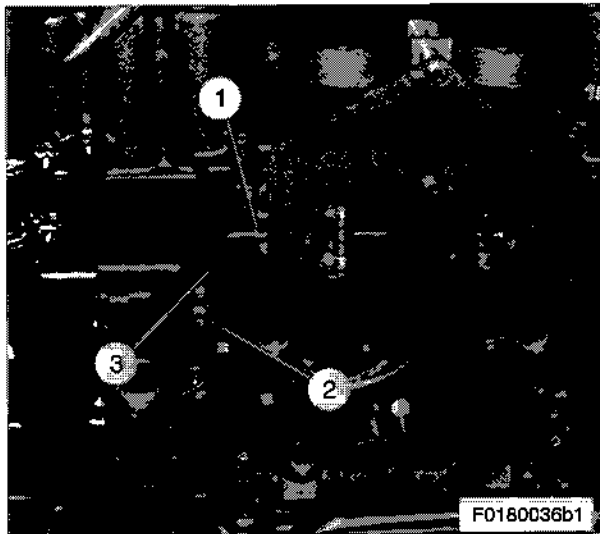


Check mounting surface, clean if necessary.

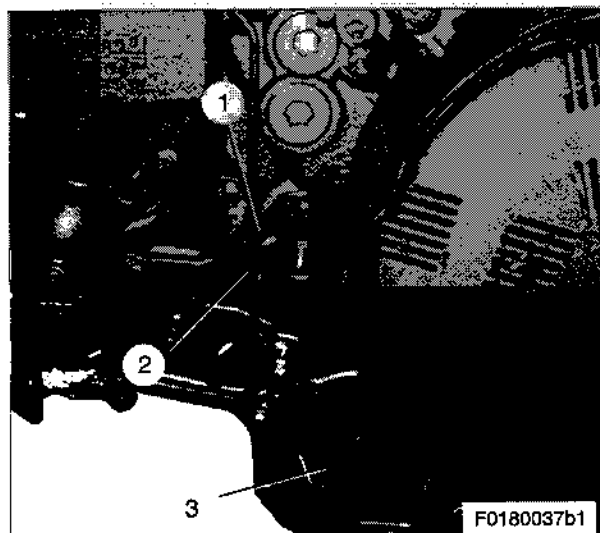
Coat mounting surface of pipe retainer (4) with Loctite 5910 and fit pipe retainer with hex screws (3) on coolant distribution housing. Fit rubber sleeve(s) (arrow) over the pipe(s) (2) and mount with clamp(s) (1).



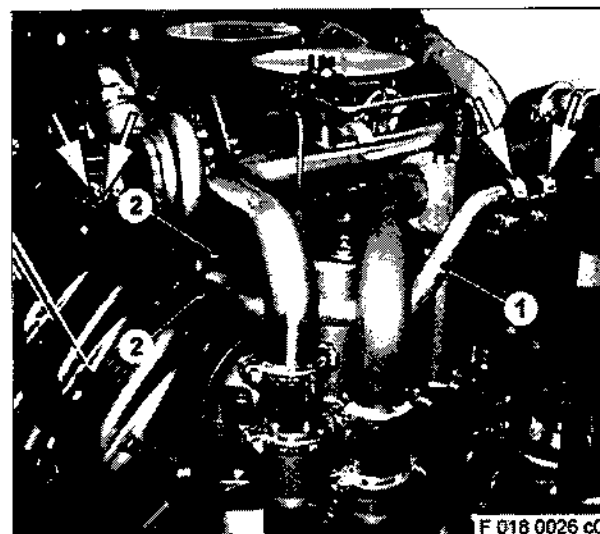
Fit rubber sleeves (1) and (2) over the respective joining sockets and secure with clamps, see Overview drawing C 018.05.01 a.



Mount pipe (3) with pipe clamp halves (2) and pipe loosely at the partition area (1).



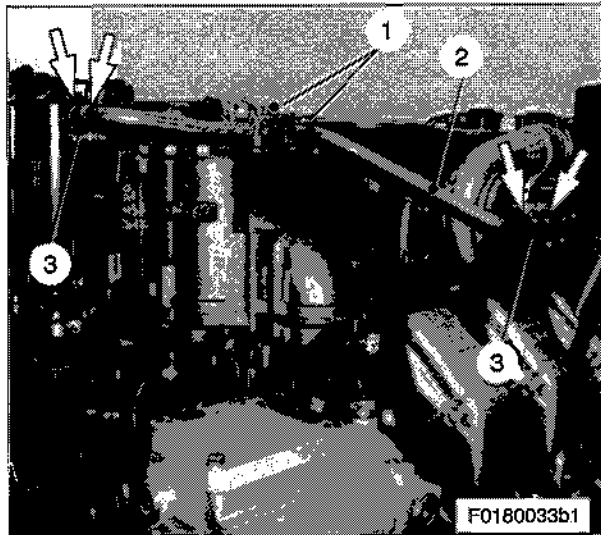
Mount pipe (2) with pipe clamp halves (1) on equipment carrier.
Tighten nut (3), hold reduction union firmly in position – see Overview drawing C 018.10.01a.
Tighten nut and pipe clamp halves, pipe (2) at separations.



Engine side, right

Align pipe (1) and mount pipe clamp halves (2) but do not yet tighten.
Fit rubber sleeves over the pipe ends.

Mount clamps (arrow) and tighten pipe clamp halves with hex screws on heat exchanger housing.

**Engine side, left**

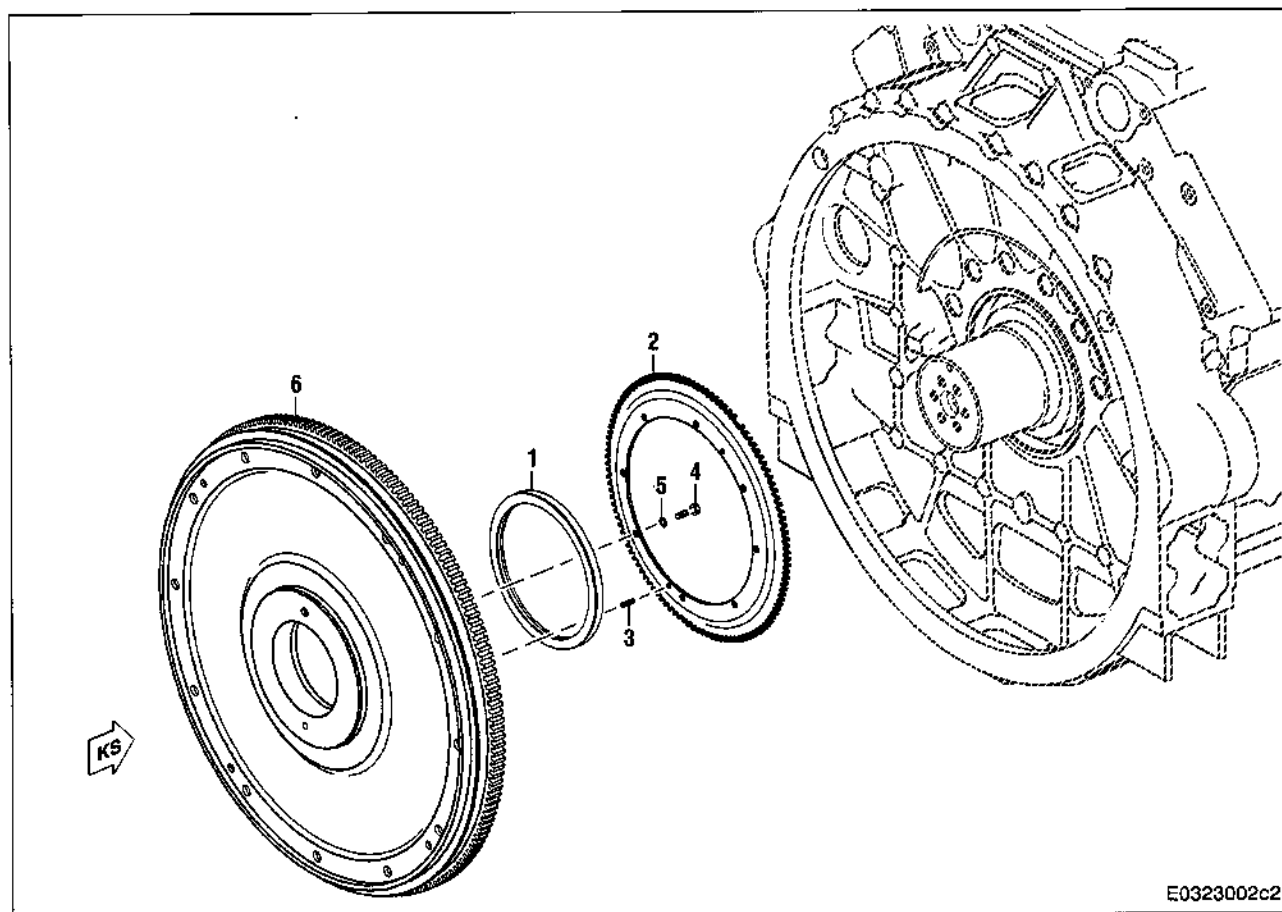
Align pipe (2) and mount pipe clamp halves (1).
Fit rubber sleeves over the pipe ends.

Mount clamps (arrow) and tighten pipe clamp halves
with hex screws on heat exchanger housing.

C018.10.12 a After-installation operations

For the following tasks, a distinction must be made as to whether:			
The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed			
Measure			See
x	–	–	Perform operations as per Assembly Plan
x	–	–	Install engine
–	–	x	Release engine start
			→ B 005
			→ B 007
			→ Operating Instructions

C030	Running gear	C – 1
C032.05	PTO, driving end	C – 1
C 032.05.01	Overview drawing	C – 1
C032.05.02	Special tools	C – 4
C032.05.04	Before-removal operations	C – 4
C032.05.05	Removal	C – 4
C032.05.06	Disassembly	C – 7
C032.05.08	Inspection and repair	C – 7
C032.05.10	Assembly	C – 8
C032.05.11	Installation	C – 9
C032.05.12	After-installation operations	C – 13
C035.05	PTO, free end	C – 15
C035.05.01	Overview drawing	C – 15
C035.05.02	Special tools	C – 18
C035.05.04	Before-removal operations	C – 18
C035.05.05	Removal	C – 18
C 035.05.06	Disassembly	C – 21
C035.05.11	Installation	C – 21
C035.05.12	After-installation operations	C – 24

C030 Running gear**C032.05 PTO, driving end****C 032.05.01 Overview drawing**

1 Radial-lip shaft seal

2 Graduated disc

3 Spring pin

4 Hex screw

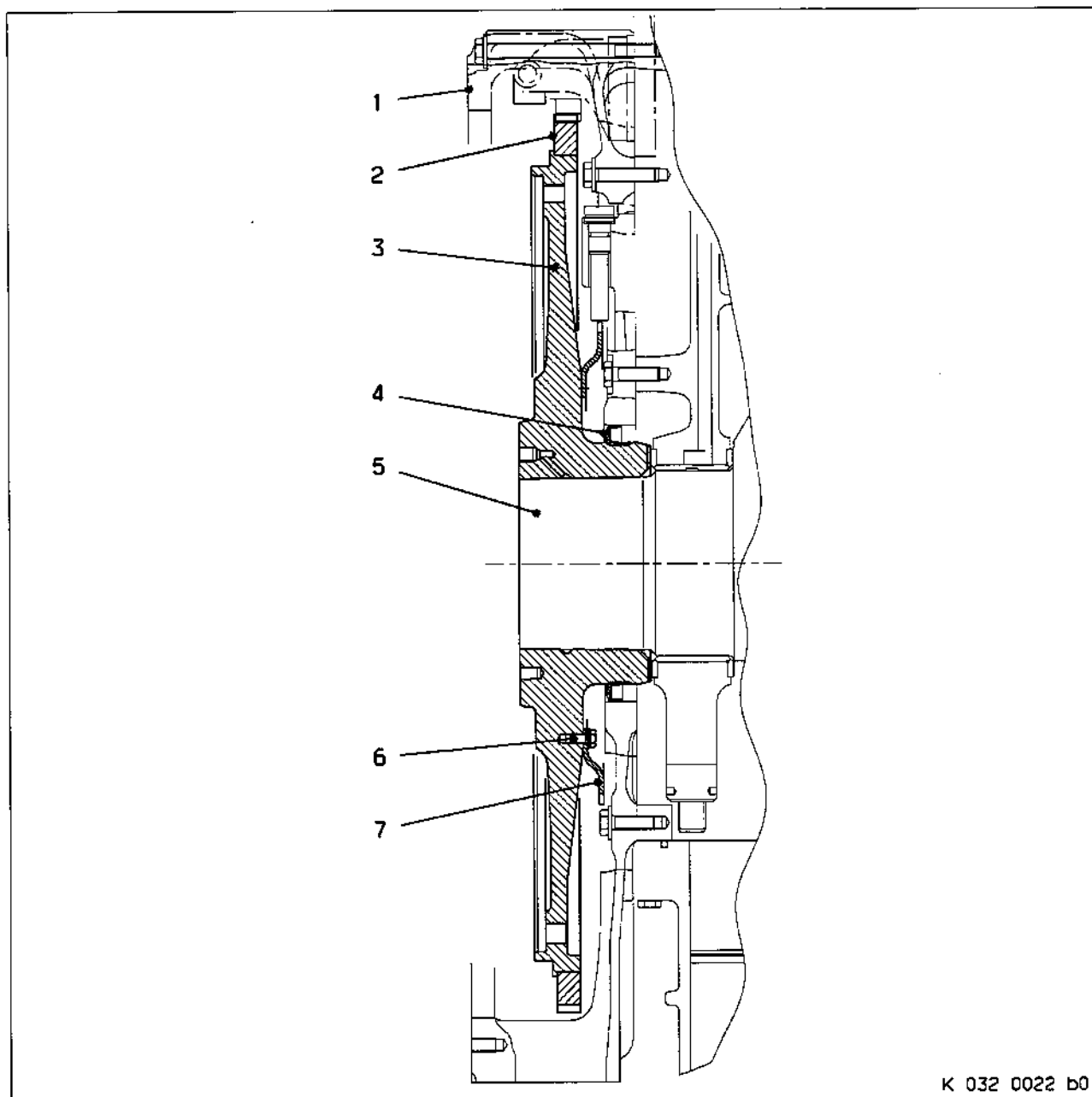
Lubricant: Engine oil

Tightening torque: 21 Nm + 2 Nm

5 Washer

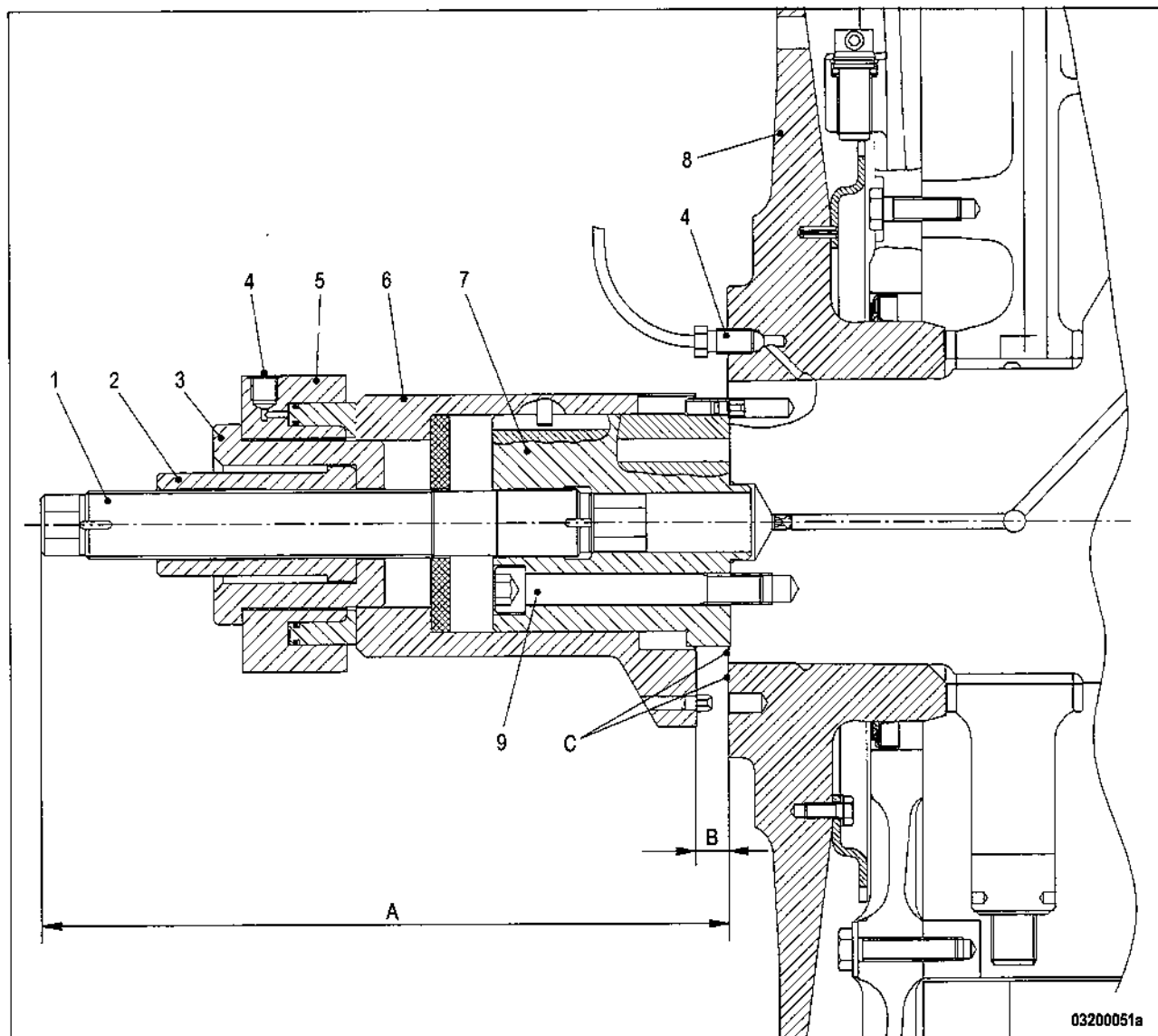
6 Flywheel

PTO with flywheel



- 1 Flywheel housing
- 2 Flywheel ring gear
- 3 Flywheel
- 4 Radial-lip shaft seal

- 5 Crankshaft
- 6 Hex screw
Lubricant: Engine oil
Tightening torque: 21 Nm + 2 Nm
- 7 Graduated disc

Layout for installation/removal tool for flywheel

- 1 Draw spindle
- 2 Hex nut M36
- 3 Support
- 4 Connection for H.P. fuel line
- 5 Hydraulic nut (press)

- 6 Pressure bush
- 7 Flange
- 8 Flywheel
- 9 Screw

Reference dimension

A = 362 mm

Push-on dimension

B = 17 mm to 13.7 mm

Reference surface

C = press-fitted flush

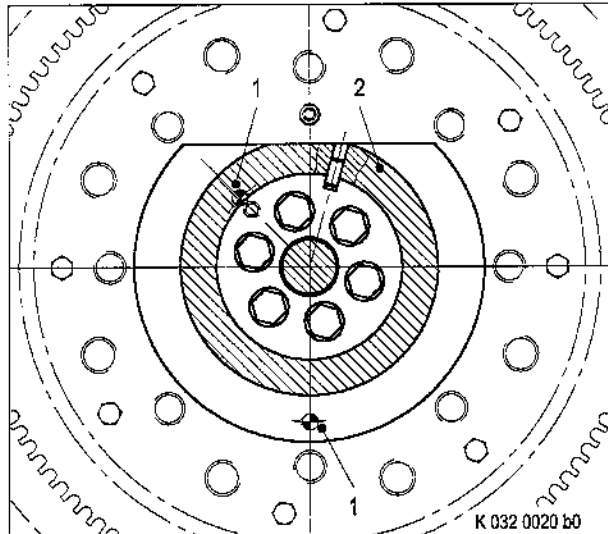
C032.05.02 Special tools

Designation	Use/dimension	Number
• Installation/removal tool	for flywheel	1
• Tool kit (hydraulic hand pump)	for 0 – 3500 bar	1
• SKF hand pump	for 0 – 1000 bar	1
• Press-fitting tool	for radial-lip shaft seal	1
• Assembly sleeve	for flywheel	1

C032.05.04 Before-removal operations

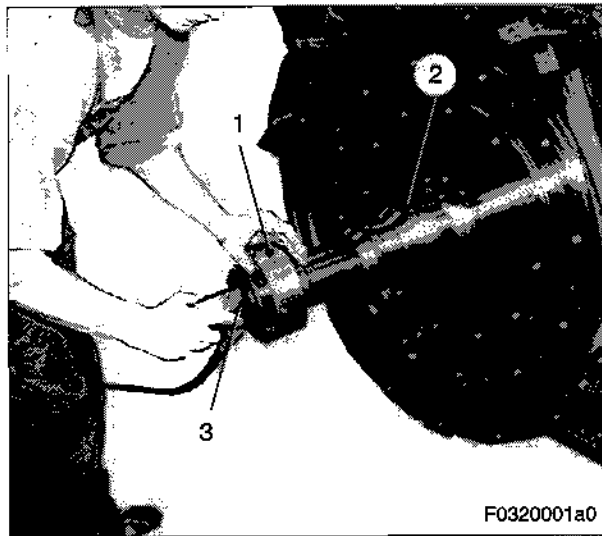
For the following tasks, a distinction must be made as to whether:			
The engine is to be completely disassembled			
The engine is to be removed but not disassembled			
The engine is to remain installed			
		Measure	See
x	–	Remove engine	→ B 003
x	–	Perform operations as per Disassembly Plan	→ B 004
–	–	x Disable engine start	→ Operating Instructions
–	x	x Separate engine from gearbox or alternator	→ –

C032.05.05 Removal



Install flange with hex screws – see Overview drawing C 032.05 Arrangement, hydraulic installation and removal – on crankshaft journal, driving end.

Rotate crankshaft so that locating element (1) of pressure bush (2) engages in flywheel.



Equipment which is faulty, installed incorrectly or not in accordance with specifications may become loose or drop off and cause serious injury.

Risk of knocks or crushing!

Liquids emerging under high-pressure can lead to serious injury!

Hydraulic installation/removal must be carried out only by qualified personnel. Only use specified and tested equipment.

The specified expansion and push-on pressure must not be exceeded.

During the installation/removal procedure, make sure that nobody is standing in the danger area. Do not attempt to bend or exert force on H.P. lines.

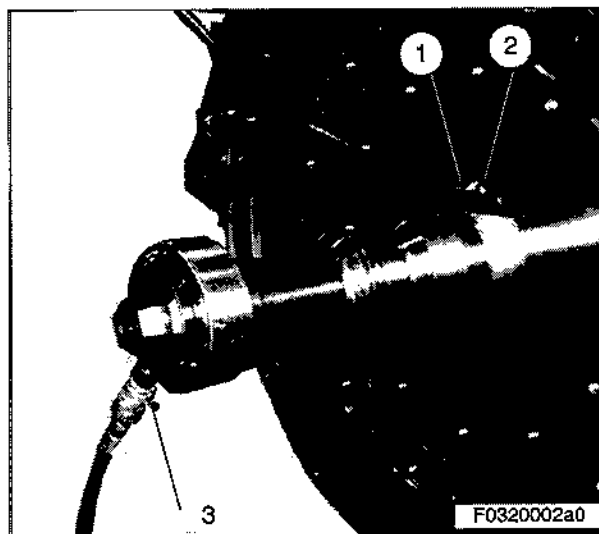
Always wear protective gloves and protective goggles/safety mask.

For arrangement of installation/removal tool, see Overview drawing C 032.05.01.

Screw draw spindle into crankshaft.

For reference dimension (A), see Overview drawing C 032.05.01, Measuring end face of draw spindle to end face of spacer.

Mount pressure sleeve (2) and hydraulic nut (press) (1) over draw spindle and install nut (3).



Remove plug from expansion bore in flywheel.

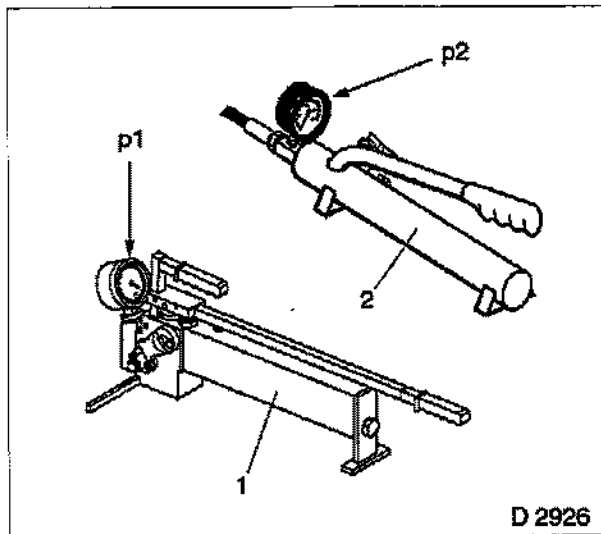
Screw connector (2) into flywheel and connect H.P. line (1).

Connect H.P. line (3) of Lukas hand pump to hydraulic press.

Fully tighten nut then back off nut distance equal to push-on dimension.

Push-on dimension – see Overview drawing 032.05.01.

Note: When fitting the nut up to the stop, the hydraulic press must be at its initial position (0 stroke).



Fill hydraulic hand pumps with SAE 10 engine oil.
Prime pumps and lines until oil escaping is free of bubbles.

Tighten high-pressure line.

Actuate SKF hand pump (2) for hydraulic press and move press with minimum pressure (p2) (pressure starts to rise) until it contacts with hub.

Note: The hydraulic nut (press) acts as a buffer, stopping the flywheel as it slips off its taper seat.

Operate hydraulic hand pump (1) for expanding the flywheel taper until expansion pressure is half the permitted maximum (p1).

Maintain this pressure for approx. 5 minutes.

Maximum expansion pressure p_{max} , is stamped on driver flange.

Increase expansion pressure in stages of $0.1 \times p_{max}$, waiting approx. 2 minutes between increases, until flywheel is released from crankshaft.

Do not exceed maximum permissible expansion pressure p_{max} .

Operate pump to maintain constant expansion pressure.

An increase in pressure (p2) at the hydraulic press indicates that the flywheel is released from tapered seat.

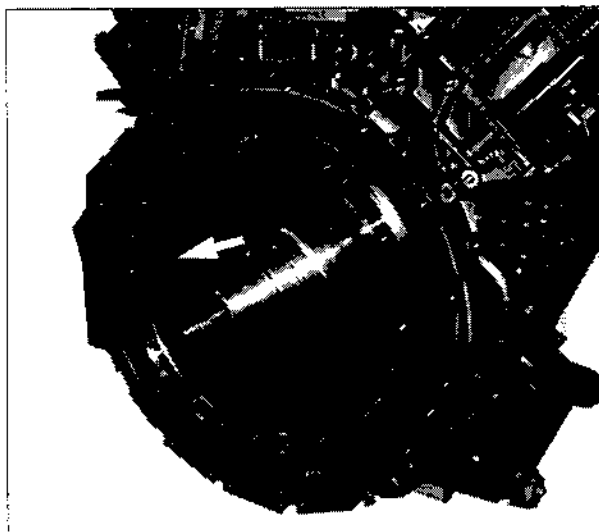
Gradually relieve pressure in hydraulic press while steadily operating pump for expansion fluid.

Relieve pressure in hydraulic hand pumps.

Insert eyebolt into flywheel and attach to rope and crane.

Remove high-pressure line and reducer.

Remove nut, hydraulic press and pressure sleeve.



Suspended load.

Risk of injury!

Only use lifting device provided by manufacturer and observe lifting instructions.

Never stand beneath a suspended load.

Remove flywheel via forcing thread.

Slightly tension flywheel with crane and rope sling. Using crane and rope sling, lift flywheel via the pressure bush out of flywheel housing.

C032.05.06 Disassembly**Removing radial-lip shaft seal from flywheel housing**

Use a suitable extractor to withdraw radial-lip shaft seal out of flywheel housing.

Note: Do not damage flywheel housing and crankshaft.

Removing graduated disc

Note: Remove measuring wheel only if necessary (e.g. if damaged).

Remove graduated disc as per Overview drawing – see C 032.05.01.

Withdraw spring pin from flywheel.

C032.05.08 Inspection and repair

Clean all components.

Using the magnetic crack-testing method with fluorescent magnetic powder, check flywheel with ring gear for cracks.

Replace flywheel if cracks are found.

Check mating faces on flywheel for evenness, wear, scoring and indentations; recondition if necessary.

Renew flywheel if scoring and indentations are greater than the maximum permissible material removal – see Tolerance and Wear Limits List.

Check all sealing, mating and bearing faces on flywheel for wear, scoring and indentations.

Remove minor wear, indentations and scoring by rubbing down with emery cloth or an oilstone; replace flywheel if necessary.

Check taper surfaces of flywheel for scoring and damage.

Remove minor scoring and damage by polishing with emery cloth.

Check taper 1:50 with taper gauge.

Replace flywheel if taper bore is oversized.

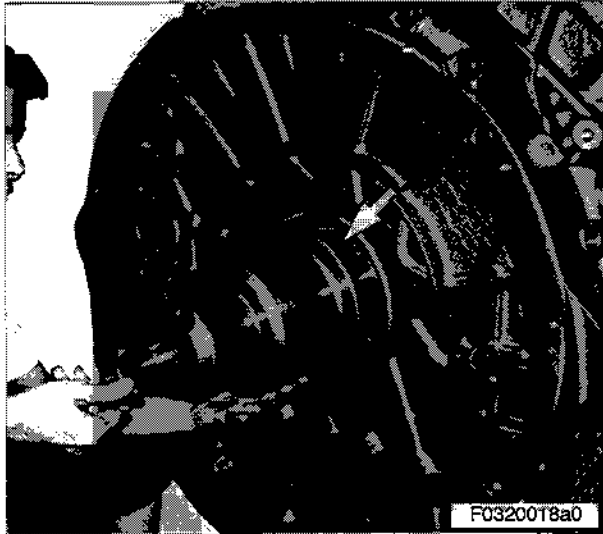
Check thread of expansion bore; rechase if necessary.

Check ring gear for wear, replace if necessary.

Remove slight burrs and chipping from teeth by grinding or filing.

Replace spring pin and O-rings at every installation.

C032.05.10 Assembly



Installing radial-lip shaft seal into flywheel housing

**Heavy object.
Risk of injury!
Use suitable tools and lifting equipment.**

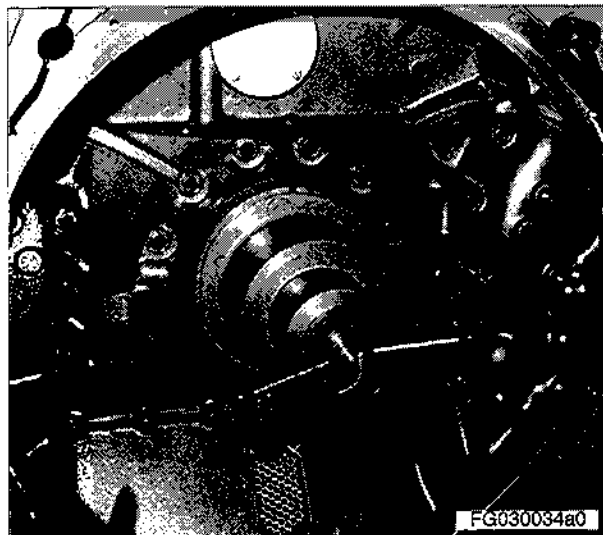
Note: The press-fitting tool for the radial-lip shaft can only be used when the flywheel housing is installed. Installation of flywheel housing – see Section C 016.30.

Install flange with spacer on face of crankshaft – see Overview drawing C 032.05.01.

Fit radial-lip shaft seal, with sealing lip facing outwards, on press-fitting tool.

Coat sealing face (arrow) of radial-lip oil seal with denaturated ethanol.

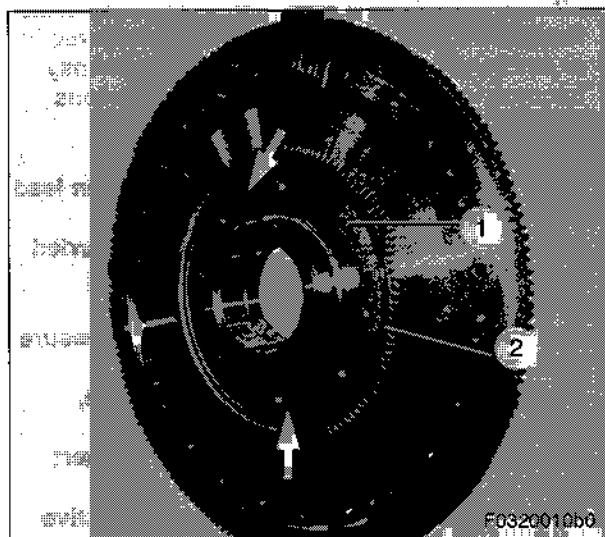
Note: Denaturated ethanol acts as lubricant for press-fitting.



Clean and degrease support bore for radial-lip oil seal in flywheel housing.

Use pressure spindle to install radial-lip shaft seal flush in flywheel housing.

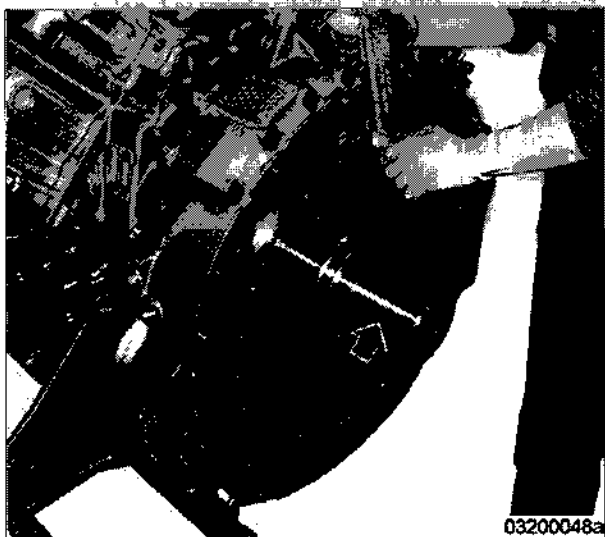
Remove pressure spindle with flange from crankshaft.

C032.05.11 Installation**Assembling flywheel**

Install graduated disc (2) with hex screws (1) on flywheel, but do not tighten.

Drive spring pins (arrow) into flywheel.

Tighten hex screws in diagonally opposite sequence to specified torque – see C 032.05.01.



WARNING

Suspended load.
Risk of injury!
 Only use lifting device provided by manufacturer and observe lifting instructions.
 Never stand beneath a suspended load.

Clean and degrease taper surface on crankshaft and flywheel (2).

Coat running surface of flywheel for radial-lip shaft seal with thin-film lubricant.

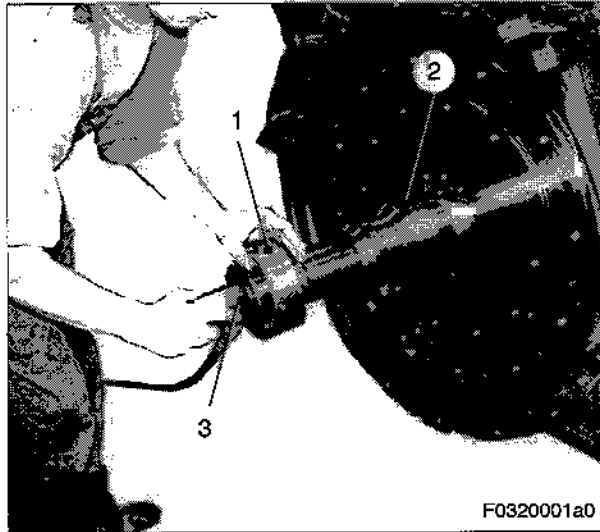
Coat lip of radial-lip oil seal with petroleum jelly.

Install guide sleeve (arrow).

Using the crane and ropes, insert the flywheel over the guide sleeve into the flywheel housing.

Note: Take care not to damage radial seal lip.

Remove guide sleeve (arrow).



Equipment which is faulty, installed incorrectly or not in accordance with specifications may become loose or drop off and cause serious injury.

Risk of knocks or crushing!

Liquids emerging under high-pressure can lead to serious injury!

Hydraulic installation/removal must be carried out only by qualified personnel. Only use specified and tested equipment.

The specified expansion and push-on pressure must not be exceeded.

During the installation/removal procedure, make sure that nobody is standing in the danger area. Do not attempt to bend or exert force on H.P. lines.

Always wear protective gloves and protective goggles/safety mask.

For arrangement of installation/removal tool, see Overview drawing C 032.05.01.

Screw draw spindle into crankshaft.

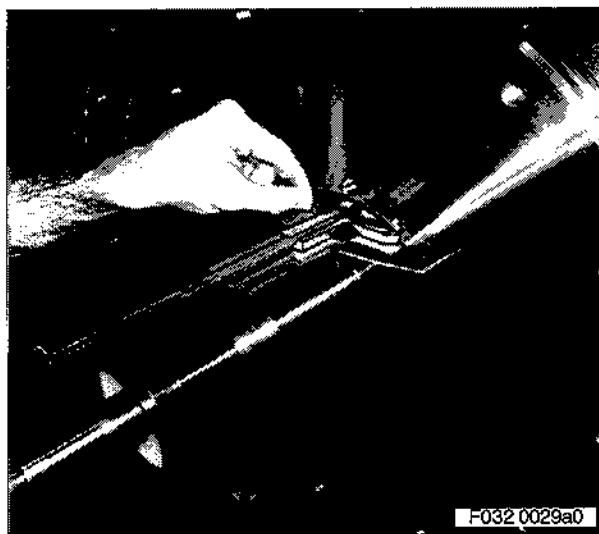
For reference dimension (A), see Overview drawing C 032.05.01, Measuring end face of draw spindle to end face of spacer.

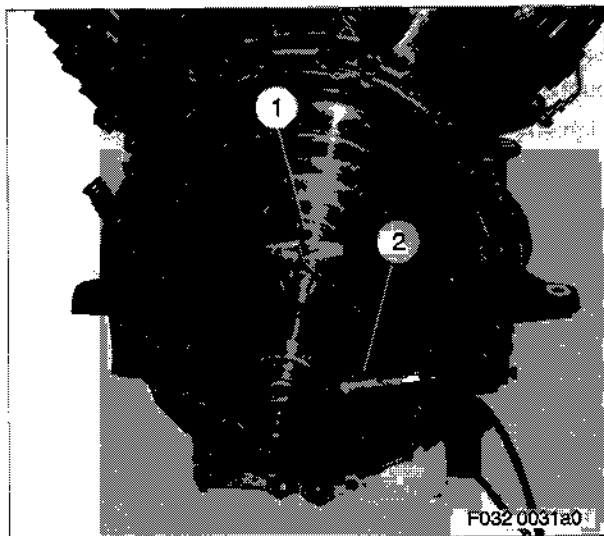
Mount pressure sleeve (2) and hydraulic nut (press) (1) over draw spindle and install nut (3).

Calculate push-on distance by measuring distance from end face of spacer to end face of flywheel with depth gauge.

If calculated distance is less than push-on distance a, check dimensional accuracy of taper.

Push-on dimension "a" is stamped on flywheel.





Equipment which is faulty, installed incorrectly or not in accordance with specifications may become loose or drop off and cause serious injury.

Risk of knocks or crushing!

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Hydraulic installation/removal must be carried out only by qualified personnel. Only use specified and tested equipment.

The specified expansion and push-on pressure must not be exceeded.

During the installation/removal procedure, make sure that nobody is standing in the danger area. Do not attempt to bend or exert force on H.P. lines.

Always wear protective gloves and protective goggles/safety mask.

Note: Pressure bush with centring pin (see Overview drawing C 032.05.01) centres drive flange and specifies installation position.

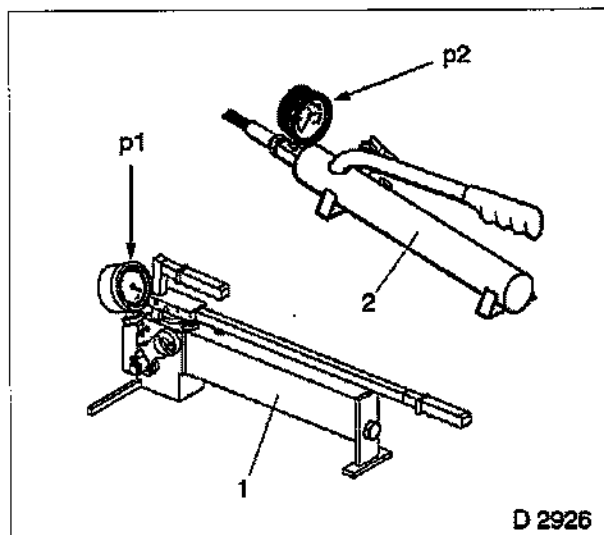
Connect H.P. line (1).

Connect H.P. line (2) of Lukas hand pump to hydraulic nut (press).

Fully tighten nut then back off nut distance equal to push-on dimension.

For push-on dimension B and expansion pressure, see information on face of flywheel.

Note: Before tightening nut (press), make sure that hydraulic press is in initial position (0 stroke).



Fill hydraulic hand pumps with SAE 10 engine oil.

Prime pumps and lines until oil escaping is free of bubbles.

Tighten high-pressure line.

Before installing, coat taper faces with expansion fluid by operating hydraulic hand pump (1) until expansion fluid emerges at both sides of hub.

Operate Lukas hand pump (2) for hydraulic nut (press) and, by applying minimum pressure, seat press against flywheel.

Operate pump for expansion fluid until no further increase in expansion pressure (p1) is possible, then increase force-on pressure (p2) by operating force-on pump.

Repeat this process until crankshaft gear is seated on flywheel.

Select force-on pressure such as to seat shaft in approx. 5 steps.

During installation, do not allow the expansion pressure to exceed the maximum permissible expansion pressure p_{max} .

p_{max} see information stamped on flywheel.

The installation procedure has concluded when the pressure bush is at the stop on the crankshaft.

Note: Rapid pressure rise (P2)

Open valve screw in hydraulic oil pump to relieve expansion pressure.

Maintain maximum force-on pressure for 60 minutes, to ensure that the expansion fluid is expelled from the joint and static friction can build up between the fixed components.

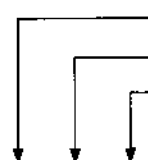
Unscrew H.P. lines.

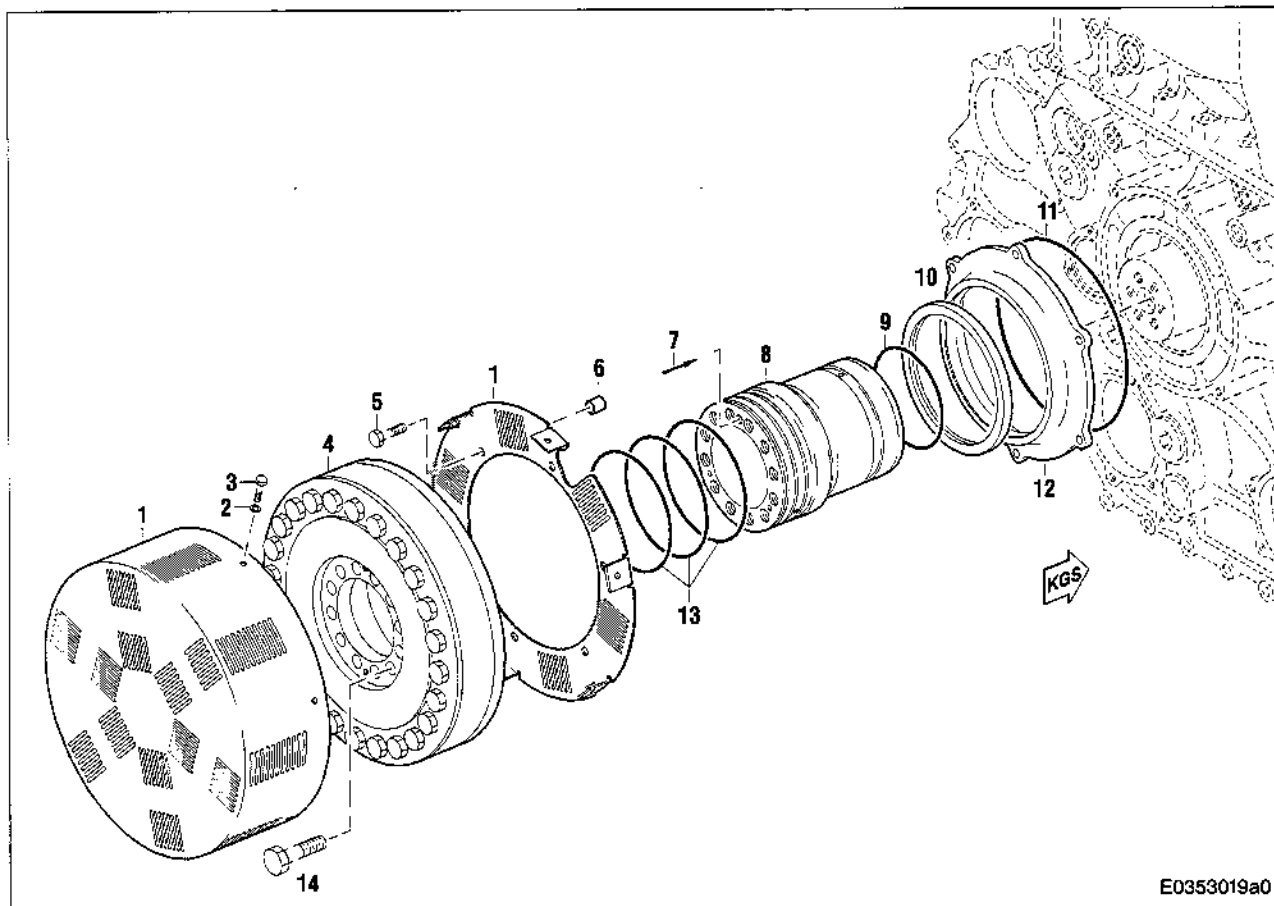
Allow specified retention time to elapse and remove nut, hydraulic nut (press), pressure sleeve and draw spindle.

Note: Do not subject press fitting to operating load for at least 8 hours.

After the retention time, remove oil from the expansion bore, screw in threaded pin and tighten to specified torque – see Overview drawing C 032.05.01.

C032.05.12 After-Installation operations

For the following tasks, a distinction must be made as to whether:				
				
The engine is to be completely disassembled				
The engine is to be removed but not disassembled				
The engine is to remain installed				
Measure			See	
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	–	x	Connect engine with gearbox/alternator	→ –
–	–	x	Release engine start	→ Operating Instructions

C035.05 PTO, free end**C035.05.01 Overview drawing**

1 Protective plate

2 Washer

3 Hex screw

4 Vibration damper

5 Hex screw

Lubricant: Engine oil
Tightening torque: 74 Nm + 7 Nm

6 Spacer sleeve

7 Sealing plug

8 Drive flange

9 O-ring

10 Radial-lip shaft seal

11 O-ring

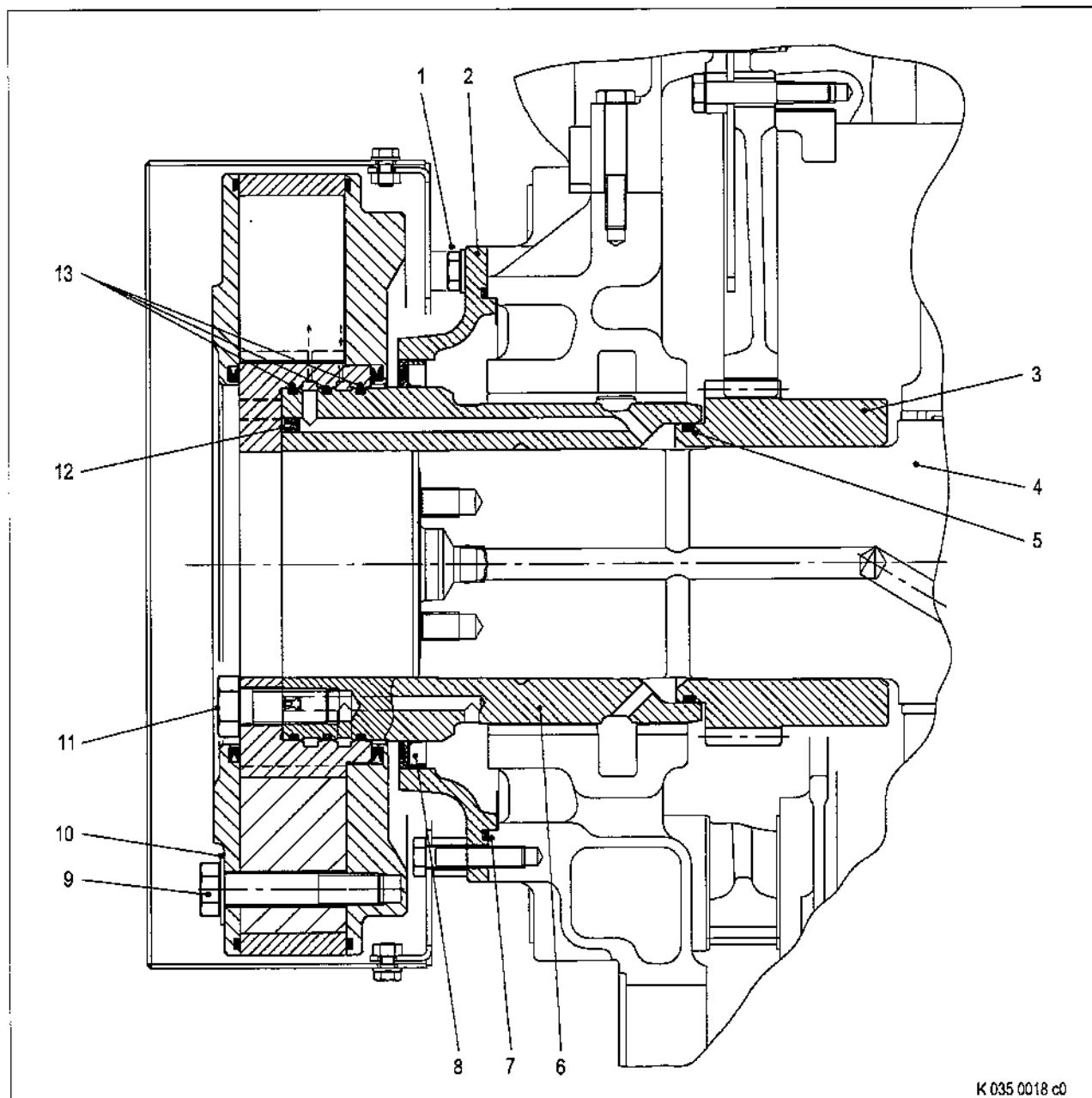
12 Seal carrier, free end

13 O-rings

14 Hex screw

Lubricant: Engine oil
Tightening torque: 500 Nm +50 Nm

PTO with vibration damper

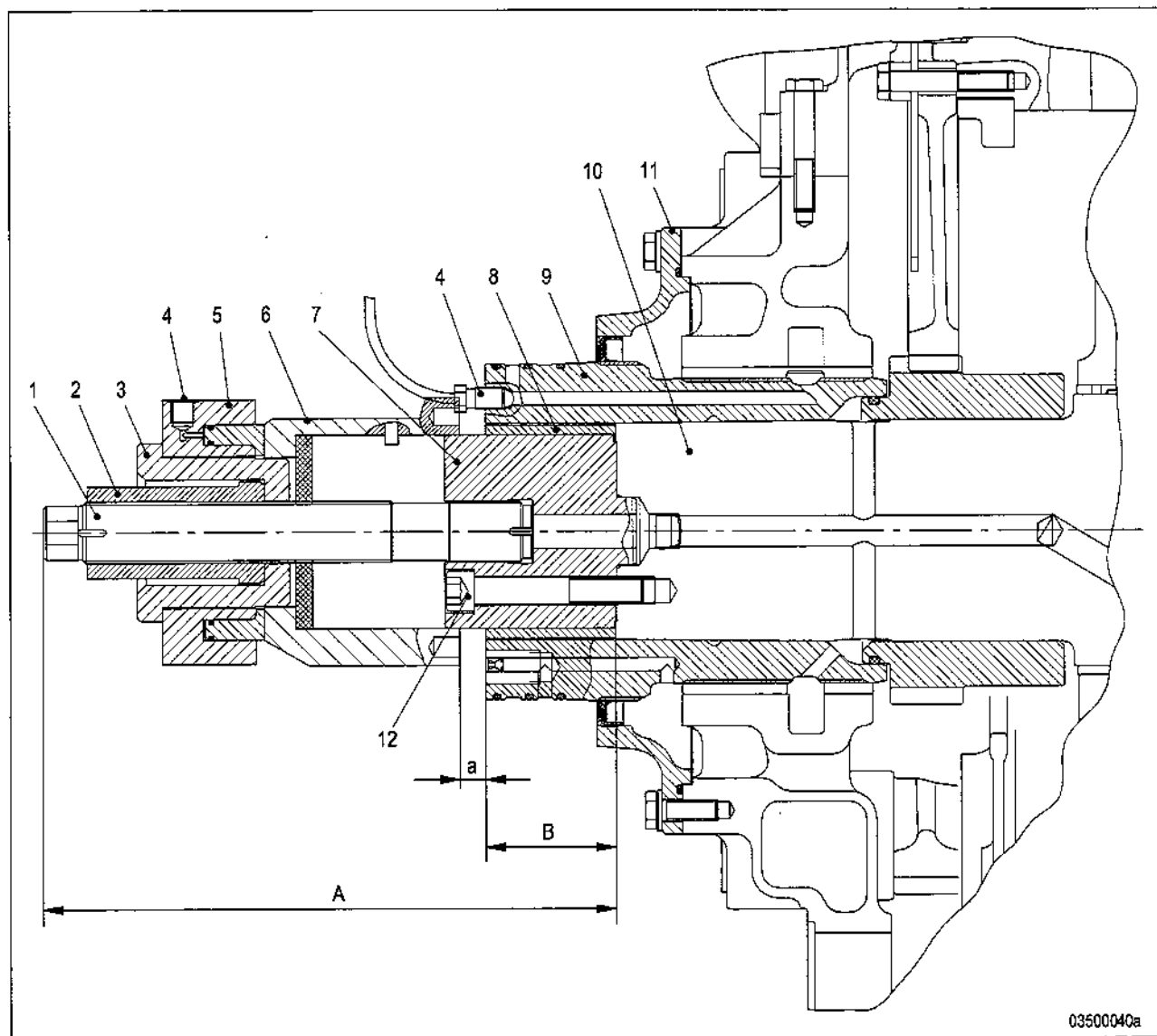


K 035 0018 c0

- 1 Hex screws
Lubricant: Engine oil
Tightening torque: 74 Nm + 7 Nm
- 2 Seal carrier
- 3 Crankshaft gear
- 4 Crankshaft
- 5 O-ring
- 6 Drive flange
- 7 O-ring
- 8 Radial-tip shaft seal

- 9 Hex screw
- 10 Washer
- 11 Hex screw
Lubricant: Engine oil
Tightening torque: 500 Nm +50 Nm
- 12 Sealing plug
- 13 O-rings

Arrangement of drive flange installation/removal tool



- | | |
|---------------------------------|----------------------|
| 1 Draw spindle | 7 Flange |
| 2 Hex nut | 8 Spacer bush |
| 3 Support | 9 Drive flange |
| 4 Connection for H.P. fuel line | 10 Crankshaft |
| 5 Hydraulic nut (press) | 11 Seal carrier |
| 6 Pressure bush | 12 Socket-head screw |

Reference dimension
Push-on dimension
Push-on distance

A = 339 mm
B = from 76.95 mm to 77.05 mm
a = 15.5 mm

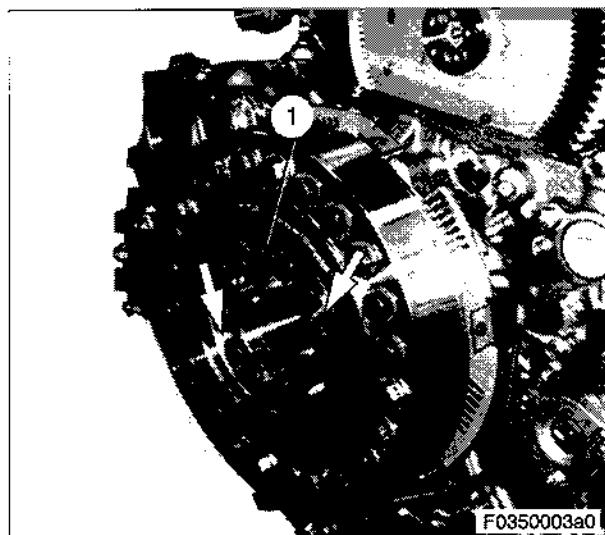
C035.05.02 Special tools

Designation	Use/dimension	Number
• Installation/removal tool	for drive flange	1
• Hydraulic set	for main bearing screws	1
– Hand pump 3000 HT		1
• Adjusting mandrel	for vibration damper	2
• Support bracket	for vibration damper	1
• Retaining device	for flywheel	1

C035.05.04 Before-removal operations

For the following tasks, a distinction must be made as to whether: → The engine is to be completely disassembled → The engine is to be removed but not disassembled → The engine is to remain installed			
Measure			See
x	–	–	Remove engine → B 003
x	–	–	Perform operations as per Disassembly Plan → B 004
–	–	x	Disable engine start → Operating Instructions

C035.05.05 Removal



Removing vibration damper

Remove guard plate – see Overview drawing C 035.05.01.

Lock flywheel on flywheel housing with positioning fixture.

Remove hex screws (1), one screw is left for securing purposes.

Screw in two adjusting mandrels in opposite threaded bores of drive flange.

Remove remaining hex screw.

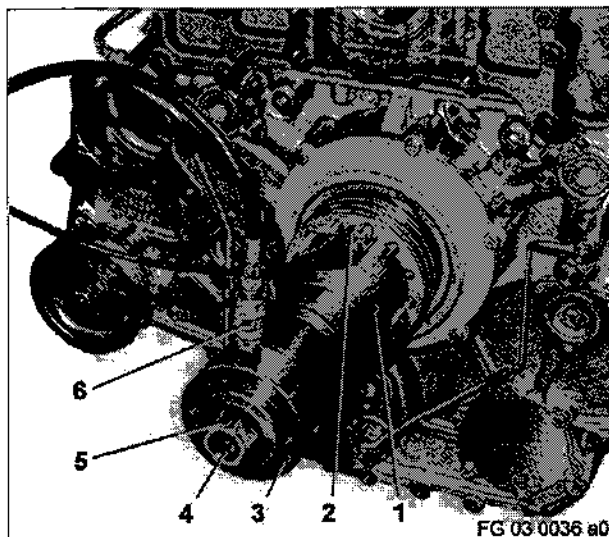
Remove vibration damper with two jackscrews (ar-



**Heavy object.
Risk of injury!
Use suitable tools and lifting equipment.**

Attach vibration damper with support bracket to rope and crane and remove.

Unscrew adjusting mandrels and remove.



Removing drive flange



Equipment which is faulty, installed incorrectly or not in accordance with specifications may become loose or drop off and cause serious injury.

Risk of knocks or crushing!

Liquids emerging under high-pressure can lead to serious injury!

Hydraulic installation/removal must be carried out only by qualified personnel. Only use specified and tested equipment.

The specified expansion and push-on pressure must not be exceeded.

During the installation/removal procedure, make sure that nobody is standing in the danger area. Do not attempt to bend or exert force on H.P. lines.

Always wear protective gloves and protective goggles/safety mask.

Remove seals from expansion bore in driver flange.

Screw draw spindle (4) into crankshaft.

Check reference dimension A of draw spindle – see Overview drawing C 035.05.01.

Mount pressure sleeve (1) and hydraulic press (3) over spindle and install nut (5).

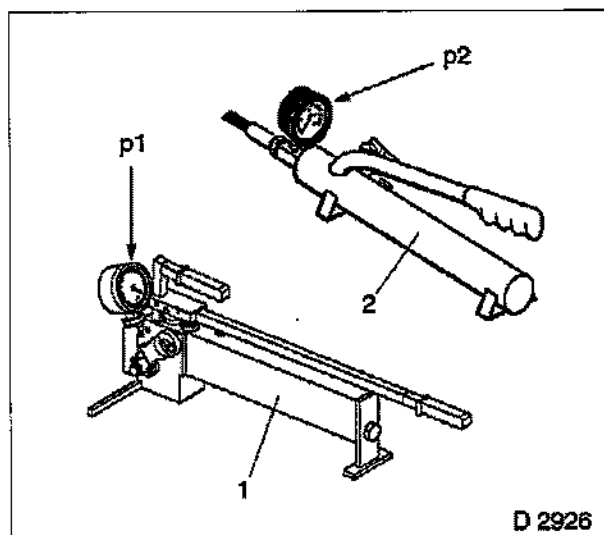
Screw connector (2) into drive flange and connect H.P. line.

Connect H.P. line (6) of Lukas hand pump to hydraulic press.

Fully tighten nut then back off nut distance equal to push-on dimension.

Force-on distance a is stamped on driver flange.

Hinwels: When fitting the nut up to the stop, the hydraulic press must be at its initial position (0 stroke).



Fill hydraulic hand pumps with SAE 10 engine oil.

Prime pumps and lines until oil escaping is free of bubbles.

Tighten high-pressure line.

Operate Lukas hand pump (2) for hydraulic press and, by applying minimum pressure (p2) (start of pressure increase), seat press against driver flange.

Hinweis: The hydraulic press acts as a buffer, stopping the driver flange as it slips off its tapered seat, and ensures safety when the driver flange is released.

Operate hydraulic hand pump (1) for expanding the driver flange taper until expansion pressure is half the permitted maximum (p1).

Maintain this pressure for approx. 5 minutes.

Maximum expansion pressure p_{max} , is stamped on driver flange.

Increase expansion pressure in stages by $0.1 \cdot p_{max}$, holding for approx. 2 minutes between each stage, until drive flange is released from crankshaft.

Do not exceed maximum permissible expansion pressure p_{max} .

Operate pump to maintain constant expansion pressure.

An increase in pressure (p2) in the hydraulic press indicates that driver flange is released from taper seat.

Gradually relieve pressure in hydraulic press while steadily operating pump for expansion fluid.

Relieve pressure in hydraulic hand pumps.

Disconnect high-pressure line.

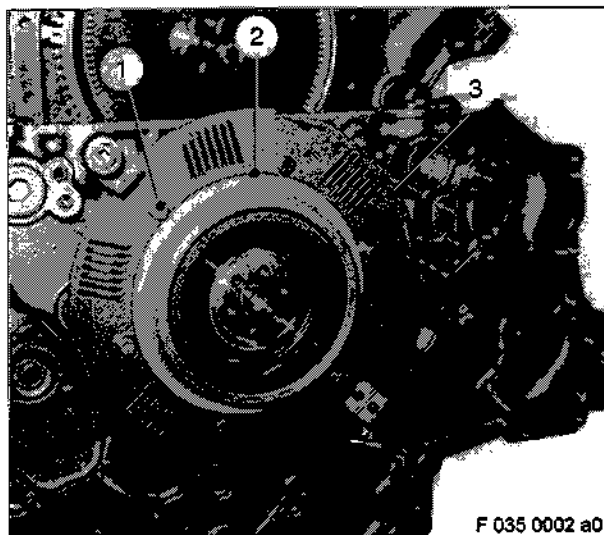
Remove nut, hydraulic press, pressure sleeve, and draw spindle.

Unscrew reducer.



**Heavy object.
Risk of injury!
Use suitable tools and lifting equipment.**

Remove driver flange from crankshaft.

**Removing seal carrier**

Remove hex screws (1) together with washers.

Remove guard plate (3).

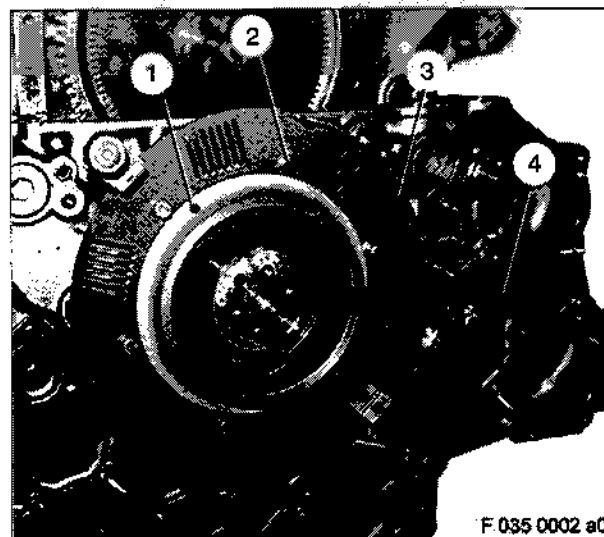
Press seal carrier (2) from fit and remove.

Hinweis: The radial-lip shaft seal can only be replaced after removal of the driver flange. If the assembly sequence is not followed, the sealing ring will be damaged or destroyed.

C 035.05.06 Disassembly

Disassembly of the vibration damper is not planned.

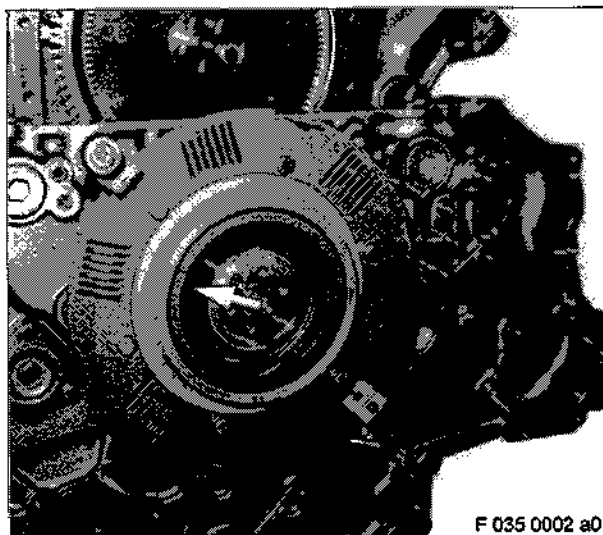
The vibration damper is an exchangeable component and can be obtained in the exchange procedure.

C035.05.11 Installation**Installing seal carrier**

Coat O-ring with petroleum jelly and insert in groove in seal carrier (1).

Press-fit seal carrier in equipment carrier (4), ensuring it is exactly flush.

Install guard plate (3) and tighten hex screws (2) with washers diagonally to specified tightening torque – see Overview drawing C 035.05.01.



Installing drive flange



Equipment which is faulty, installed incorrectly or not in accordance with specifications may become loose or drop off and cause serious injury.

Risk of knocks or crushing!

Liquids emerging under high-pressure can lead to serious injury!

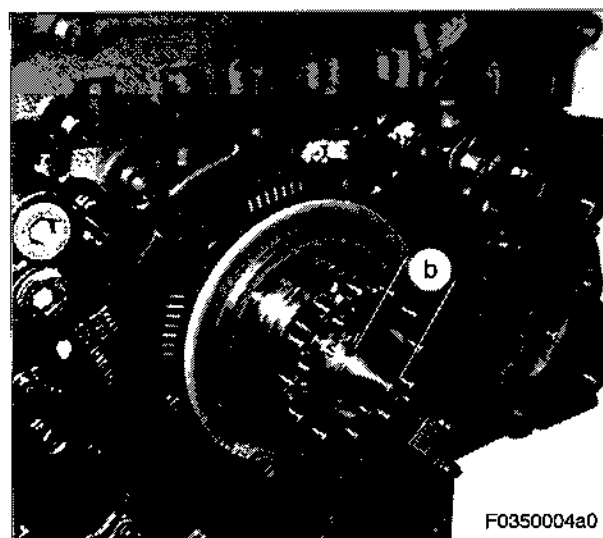
Hydraulic installation/removal must be carried out only by qualified personnel. Only use specified and tested equipment.

The specified expansion and push-on pressure must not be exceeded.

During the installation/removal procedure, make sure that nobody is standing in the danger area. Do not attempt to bend or exert force on H.P. lines.

Always wear protective gloves and protective goggles/safety mask.

Coat O-ring with petroleum jelly and fit on crankshaft gear (arrow) – see also Overview drawing C 035.05.01



Clean and degrease tapers of crankshaft and vibration damper.

Coat running surface of crankshaft bearing and drive flange with oil.

Coat lip of radial-lip oil seal with petroleum jelly.



Heavy object.

Risk of injury!

Use suitable tools and lifting equipment.

Mount driver flange on crankshaft taper.

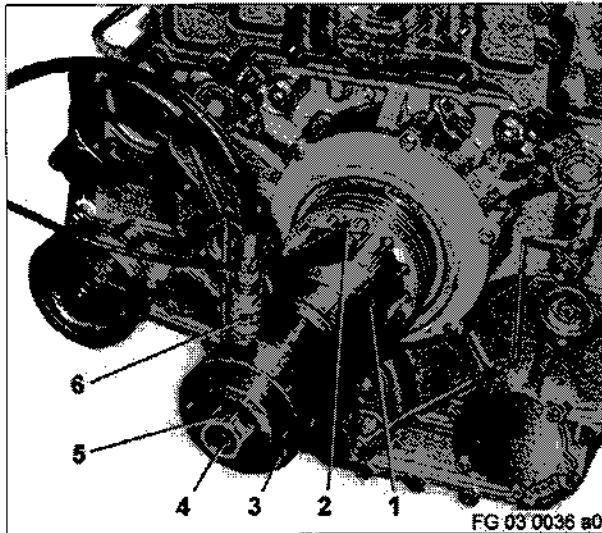
To calculate force-on distance, measure distance from end face of crankshaft to end face of drive flange using depth gauge. Make a note of this figure.

Calculate difference (=push-on distance) between measured dimension and push-on dimension B – see C 035.05.01.

Push-on dimension B = distance from face of crankshaft to face of drive flange after hydraulic installation.

Force-on distance a is stamped on drive flange.

If calculated distance is less than push-on distance a, check dimensional accuracy of taper.



Screw draw spindle (4) into crankshaft.

Check reference dimension A – see C 035.05.01.

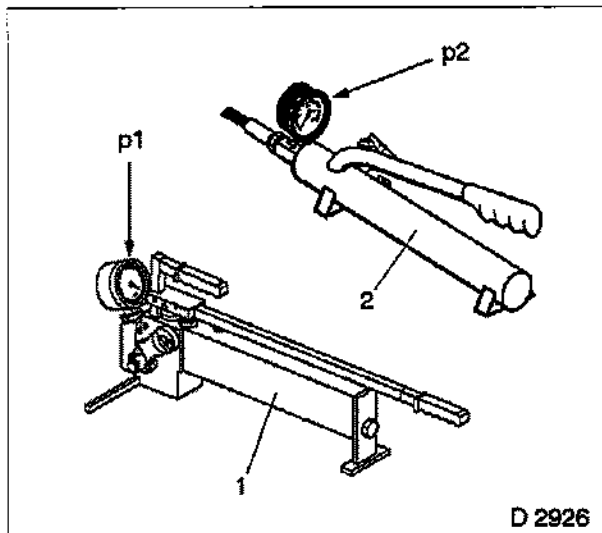
Mount pressure sleeve (1) and hydraulic press (3) over spindle.

Install nut (5) and hand-tighten.

Hinweis: When fitting the nut up to the stop, the hydraulic press must be at its initial position (0 stroke).

Screw connector (2) into drive flange and connect H.P. line.

Connect H.P. line (6) of Lukas hand pump to hydraulic press.



Fill hydraulic hand pumps with SAE 10 engine oil.

Prime pumps and lines until oil escaping is free of bubbles.

Tighten high-pressure line.

Before press-fitting, coat taper faces with expansion fluid; operate hydraulic hand pump (1) until expansion fluid escapes at drive flange end.

Operate Lukas hand pump (2) for hydraulic press and, by applying minimum pressure, seat press against driver flange.

Operate pump for expansion fluid until no further increase in expansion pressure (p1) is possible, then increase force-on pressure (p2) by operating force-on pump.

Repeat this process until driver flange is correctly seated.

Select force-on pressure such as to seat shaft in approx. 5 steps.

During installation, do not allow the expansion pressure to exceed the maximum permissible expansion pressure P_{max} .

P_{max} see specification on drive flange.

The installation procedure has concluded when the pressure bush is at the stop on the crankshaft.

Hinweis: Rapid pressure rise (P2)

Open valve screw in hydraulic oil pump to relieve expansion pressure.

Maintain maximum force-on pressure for 60 minutes, to ensure that the expansion fluid is expelled from the joint and static friction can build up between the fixed components.

Disconnect high-pressure line.

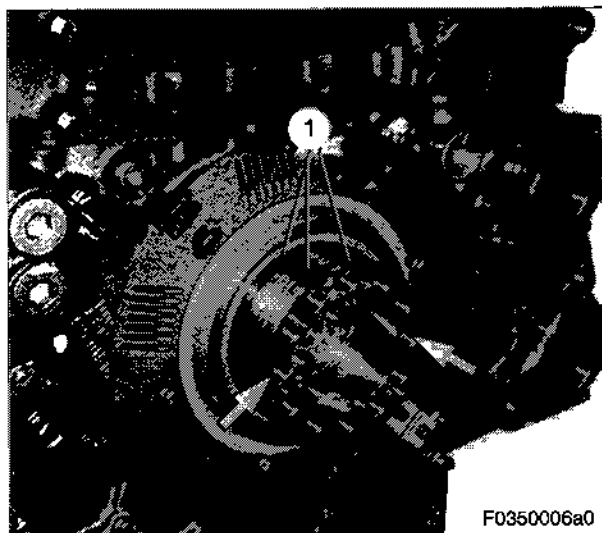
Allow specified retention time to elapse and remove nut, hydraulic press, pressure sleeve and draw spindle.

Hinweis: Do not subject press fitting to operating load for at least 8 hours.

Check push-on dimension B – see C 035.05.01, crankshaft end face to driver flange end face.

If push-on dimension is not achieved, hydraulically remove drive flange and determine the cause

Remove oil from expansion bore in driver flange, screw in and tighten plug.

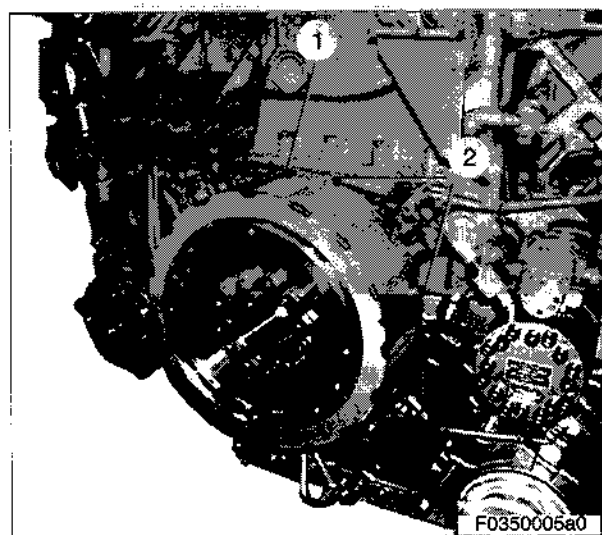


Installing vibration damper

Hinweis: Make sure parts are perfectly clean.

Screw in two adjusting mandrels in opposite threaded bores (arrows) of drive flange.

Coat O-rings (1) with petroleum jelly and fit on driver flange.



Coat vibration damper felt with Molykote 111.

⚠ WARNING

**Heavy object.
Risk of injury!
Use suitable tools and lifting equipment.**

Attach vibration damper with support bracket to rope and crane and install over adjusting mandrels.

Fit hex screws and tighten diagonally and evenly.

Remove adjusting mandrels and lifting device.

Lock flywheel on flywheel housing with positioning fixture.

Tighten hex screws in diagonally opposite sequence to specified torque – see C 035.05.01.

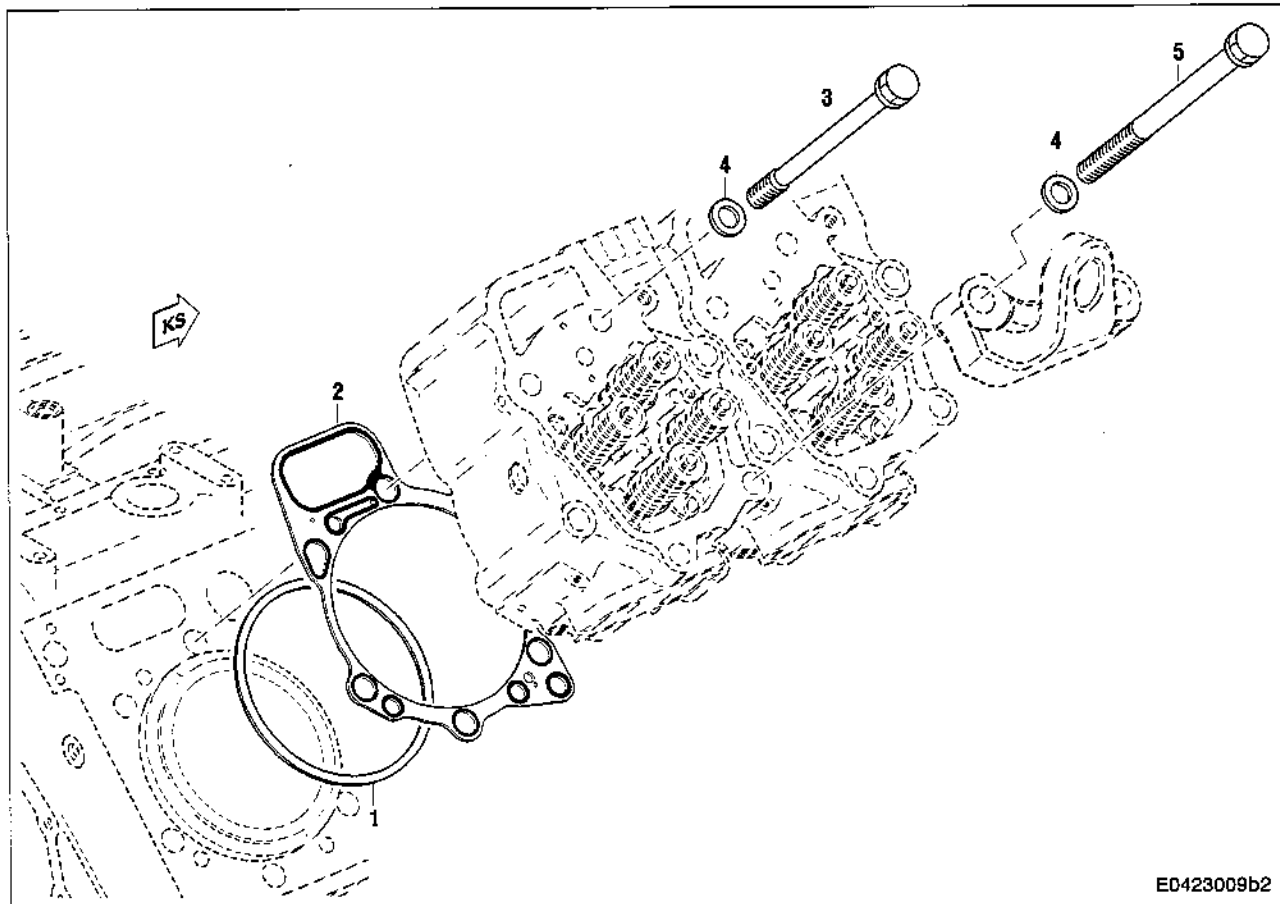
Note: Remove positioning fixture.

Install guard plate (1) with hex screws (2) and washers as per Overview drawing.

C035.05.12 After-installation operations

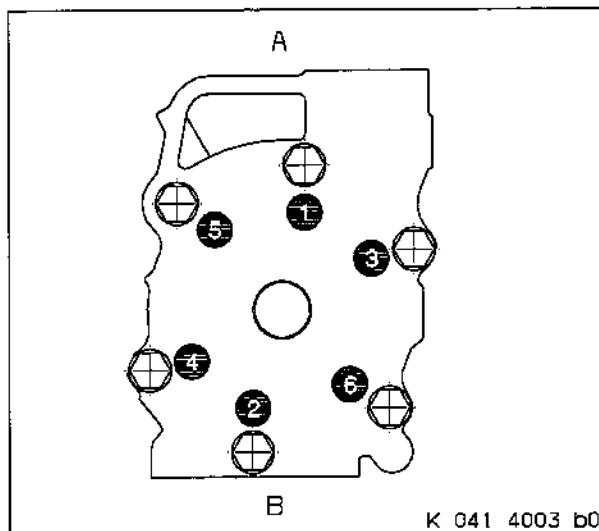
			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	–	x	Release engine start	→ Operating Instructions

C040	Cylinder head with fixtures	C – 1
C041.05	Cylinder head	C – 1
C041.05.01	Overview drawing	C – 1
C041.05.02	Special tools	C – 2
C041.05.04	Before-removal operations	C – 2
C041.05.05	Removal	C – 3
C041.05.06	Disassembly	C – 4
C041.05.11	Installation	C – 5
C041.05.12	After-installation operations	C – 7

C040 Cylinder head with fixtures**C041.05 Cylinder head****C041.05.01 Overview drawing**

- 1 Sealing ring
- 2 Gasket
- 3 Cylinder head screw

- 4 Thrust washer
- 5 Cylinder head screw

**Cylinder head tightening diagram**

Lubricant: Engine oil

- 1. Fitting screws: approx. 25 Nm
- 2. Tightening screws: 180 Nm + 10 Nm
- 3. Additional angle of rotation: $180^\circ + 10^\circ$
- 4. Checking torque: 450 Nm

Tighten screws at every respective stage in the following sequence: 1, 2, 3, 4, 5, 6

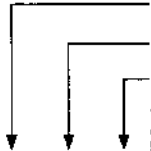
A = Exhaust side

B = Inlet side

C041.05.02 Special tools

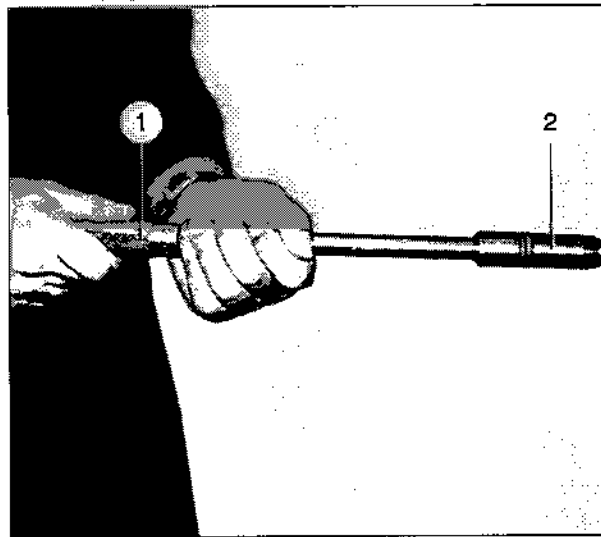
Designation	Use/dimension	Number
Blanking plug	for oil duct at cylinder head screw bore	1
– Installation/removal tool.	for blanking plug	1
Support bracket	for cylinder head in installation position	1
Angle of rot. tightening tool (power amplifier)	Tighten for cylinder head screws	1
Alignment tool	for cylinder heads, 8V/12V/16V engine	1
Adjusting mandrel	for cylinder head	2

C041.05.04 Before-removal operations

For the following tasks, a distinction must be made as to whether:				
				
The engine is to be completely disassembled				
The engine is to be removed but not disassembled				
The engine is to remain installed				
			Measure	See
x	-	-	Remove engine	→ B 003
x	-	-	Perform operations as per Disassembly Plan	→ B 004
-	-	x	Disable engine start	→ Operating Instructions
-	-	x	Drain engine coolant	→ Operating Instructions
-	x	x	Remove air filter (if necessary)	→ -
-	x	x	Remove Y-pipe from exhaust	→ C 141.10.05
-	x	x	Remove exhaust turbocharger	→ C 101.01.05
-	x	x	Remove exhaust manifolds	→ C 141.10.05
-	x	x	Remove rocker arm brackets	→ C 055.05.05
-	x	x	Remove push rods	→ C 055.05.05
-	x	x	Remove valve bridges	→ C 055.05.05
-	x	x	Disconnect and remove electric cable at injector	→ C 507.10.05
-	x	x	Remove fuel injector	→ C 075.05.05
-	x	x	Remove charge air manifolds	→ C 124.05.05
-	x	x	Remove H.P. line between cylinder head and H.P. accumulator	→ C 077.05.05
-	x	x	Disconnect fuel return lines	→ C 086.05.05

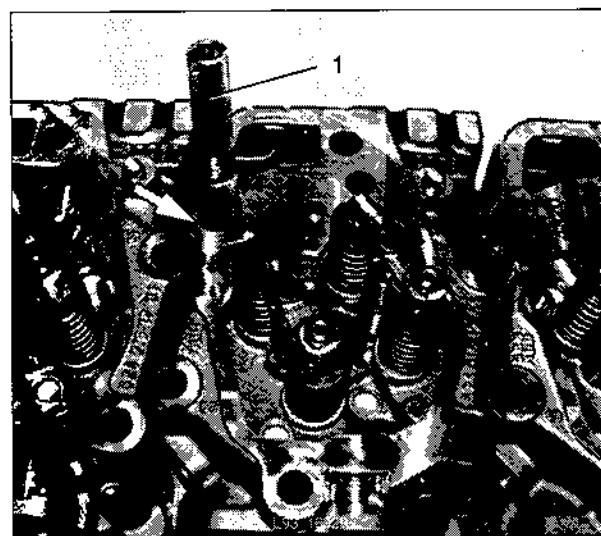
C041.05.05 Removal**Removing cylinder head**

Using a large ratchet or power assist (2), remove hex screws (1) evenly.



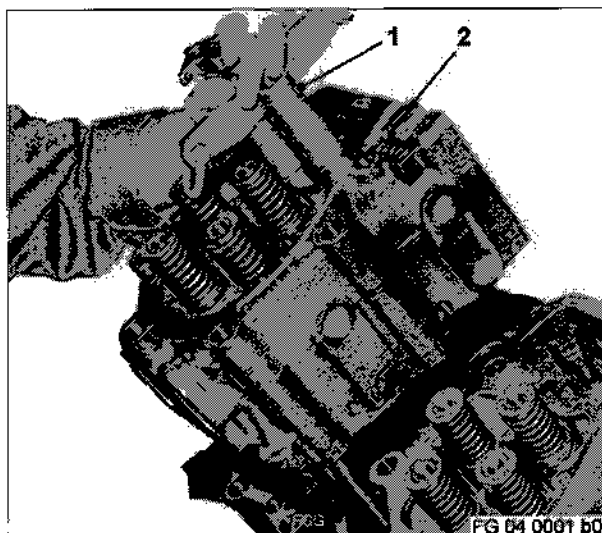
Before removing cylinder head, seal oil supply line to valve gear in crankcase as follows:

Fit blanking plugs (2) on installation/removal tool and lock slightly in position with the retaining grip (1).



Screw blanking plugs with installation/removal tool (1) into oil supply line (arrow) in crankcase (10 o'clock position) and spread.

Unscrew installation/removal tool from blanking plug and remove.



CAUTION

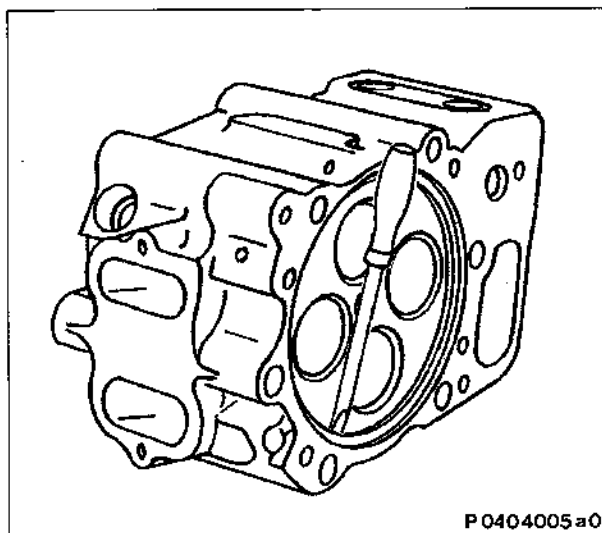
**Components have sharp edges.
Risk of injury!
Handle components only when wearing protective gloves.**

Using the lifting device (1), lift the cylinder head (2) out of the crankcase and place it on a suitable base.

Note: With injector installed, place cylinder head to the side. Injector protrudes at bottom of cylinder head.

Remove cylinder head gasket from crankcase mating face.

Remove blanking plug from oil supply bore for valve gear.

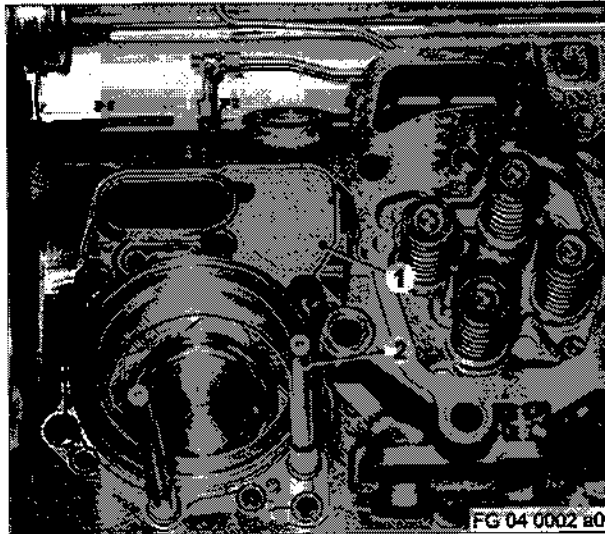


Using a screwdriver, carefully lever sealing ring (1) out of cylinder head lower section.

C041.05.06 Disassembly

Disassembly of cylinder head is not planned.

The cylinder head is a replacement part and available in the replacement programme.

C041.05.11 Installation**Installing cylinder head**

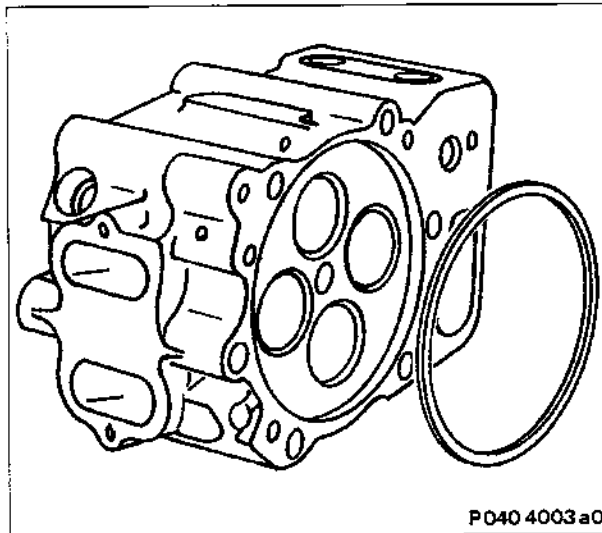
Note: Prior to installation, remove all plugs and ensure oil bores are perfectly clean.

Check that cylinder head mating face and crankcase partition surface are in perfect condition. Wipe and clean as necessary.

Note: Always use new cylinder head gaskets.

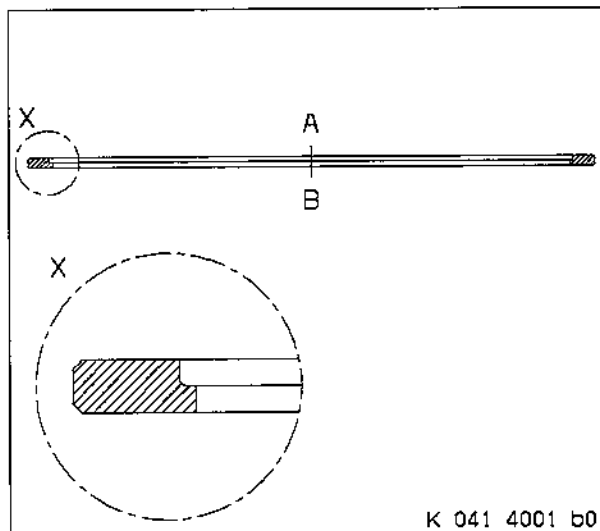
Fit cylinder head gasket (1).

Install adjusting mandrel (2) for positioning cylinder head gasket and cylinder head in crankcase.



To improve clamping effect of sealing ring in cylinder head, tap sealing ring with a plastic mallet to produce a slight oval shape.

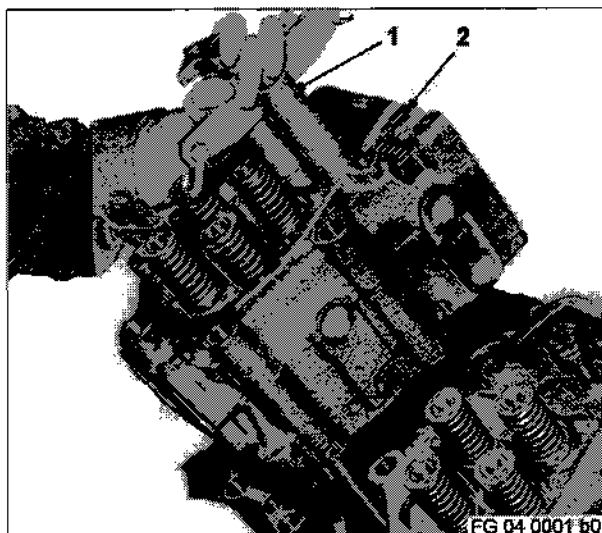
Insert sealing ring in groove on combustion chamber side of cylinder head.



Ensure that sealing ring is fitted correctly:

A = Cylinder head side

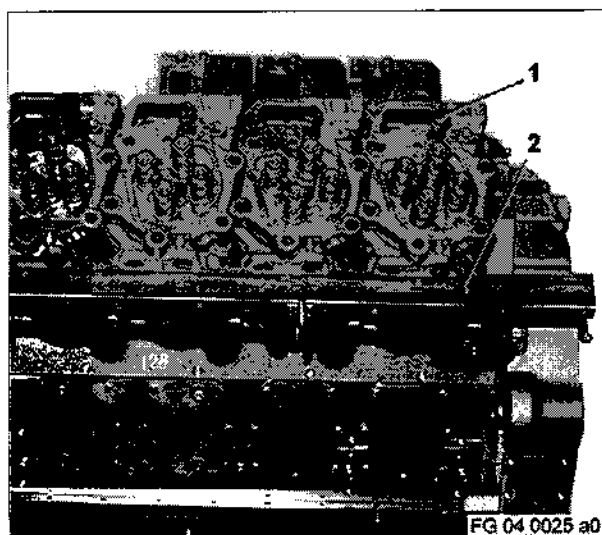
B = Piston side



CAUTION

Components have sharp edges.
Risk of injury!
Handle components only when wearing protective gloves.

Using lifting equipment (1), install cylinder head (2) on crankcase.



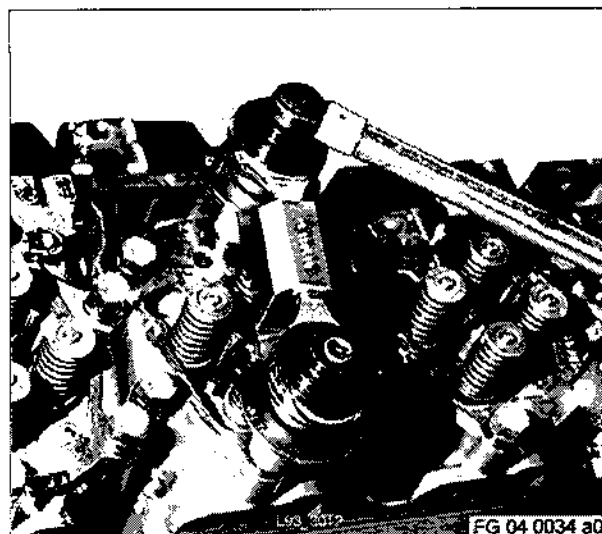
Coat thread, head and shaft of cylinder head screws (1) with engine oil.

Ensure correct allocation of cylinder head screws (engine lifting eye), see Overview drawing C 041.05.01.

Install cylinder head screws with thrust washers manually in crankcase.

Fit alignment tool (2) on inlets of cylinder heads and tighten.

Note: Carry out cylinder head alignment carefully, otherwise deformation and cracks may result in exhaust and intake pipework.



Tighten cylinder head screws in steps to specified pretightening torque in accordance with the tightening sequence, see Overview drawing C 041.05.01.

Mark screw heads.

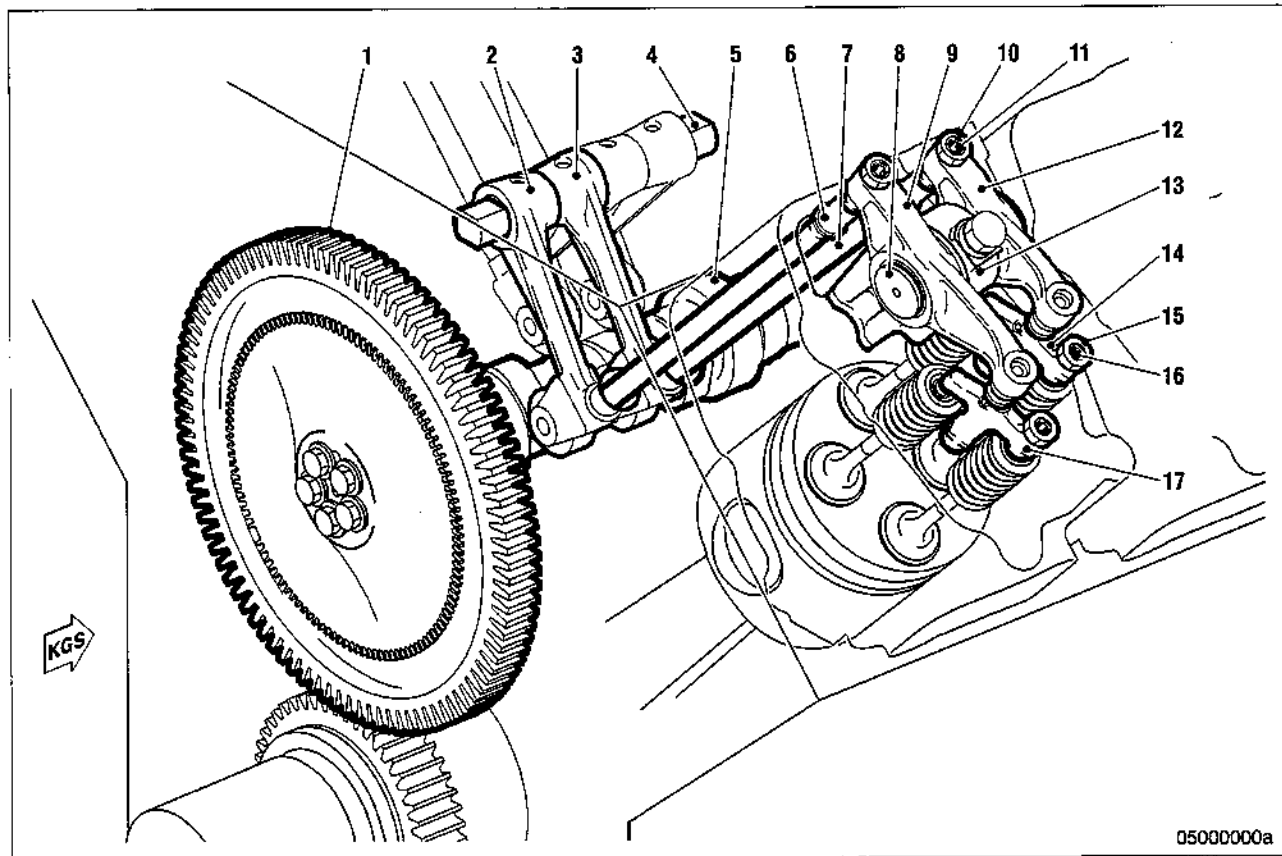
Using a large ratchet or power amplifier, tighten cylinder head screws to angle of rotation in specified sequence as per tightening specifications.

Remove alignment tool.

C041.05.12 After-installation operations

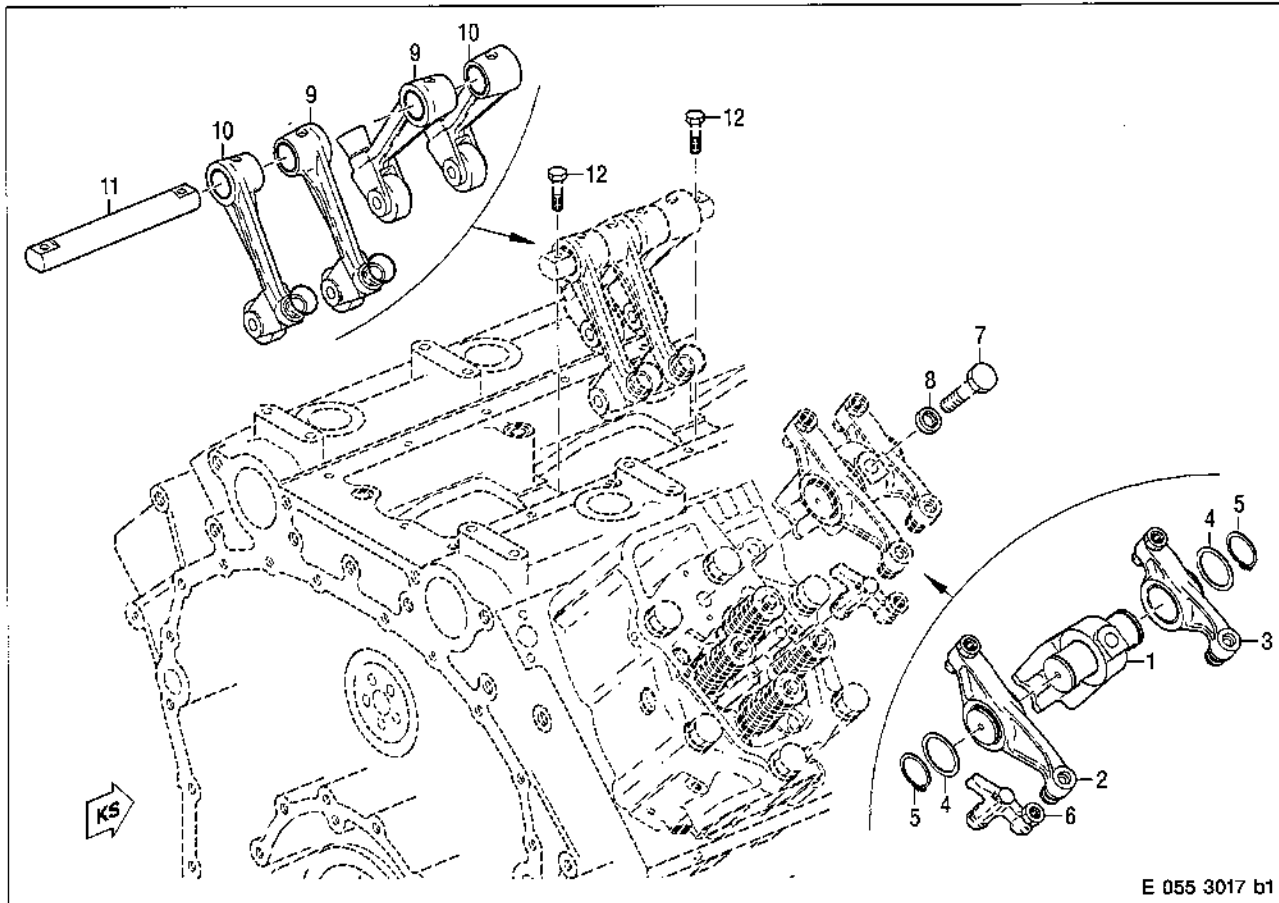
			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	—	—	Perform operations as per Assembly Plan	→ B 005
x	—	—	Install engine	→ B 007
—	x	x	Assembly in reverse sequence to disassembly	→ C 041.05.04
—	x	x	Adjust valve clearance	→ C 055.05.11
—	—	x	Fill engine coolant system	→ Operating Instructions
—	—	x	Release engine start	→ Operating Instructions
—	—	x	Fill fuel system	→ Operating Instructions

C050	Valve gear	C – 1
C055.05	Valve drive	C – 3
C055.05.01	Overview drawing	C – 3
C055.05.02	Special tools	C – 6
C055.05.04	Before-removal operations	C – 7
C055.05.05	Removal	C – 7
C055.05.06	Disassembly	C – 8
C055.05.08	Inspection and repair	C – 10
C055.05.10	Assembly	C – 12
C055.05.11	Installation	C – 14
C055.05.12	After-installation operations	C – 18
C055.10	Cylinder head cover	C – 19
C055.10.01	Overview drawing	C – 19
C055.10.04	Before-removal operations	C – 19
C055.10.05	Removal	C – 20
C055.10.08	Inspection and repair	C – 20
C055.10.11	Installation	C – 20
C055.10.12	After-installation operations	C – 21

C050**Valve gear**

- 1 Camshaft gear
- 2 Rocker arm, inlet
- 3 Rocker arm, exhaust
- 4 Rocker shaft
- 5 Camshaft
- 6 Pushrod, inlet
- 7 Pushrod, exhaust
- 8 Axle
- 9 Rocker arm, inlet

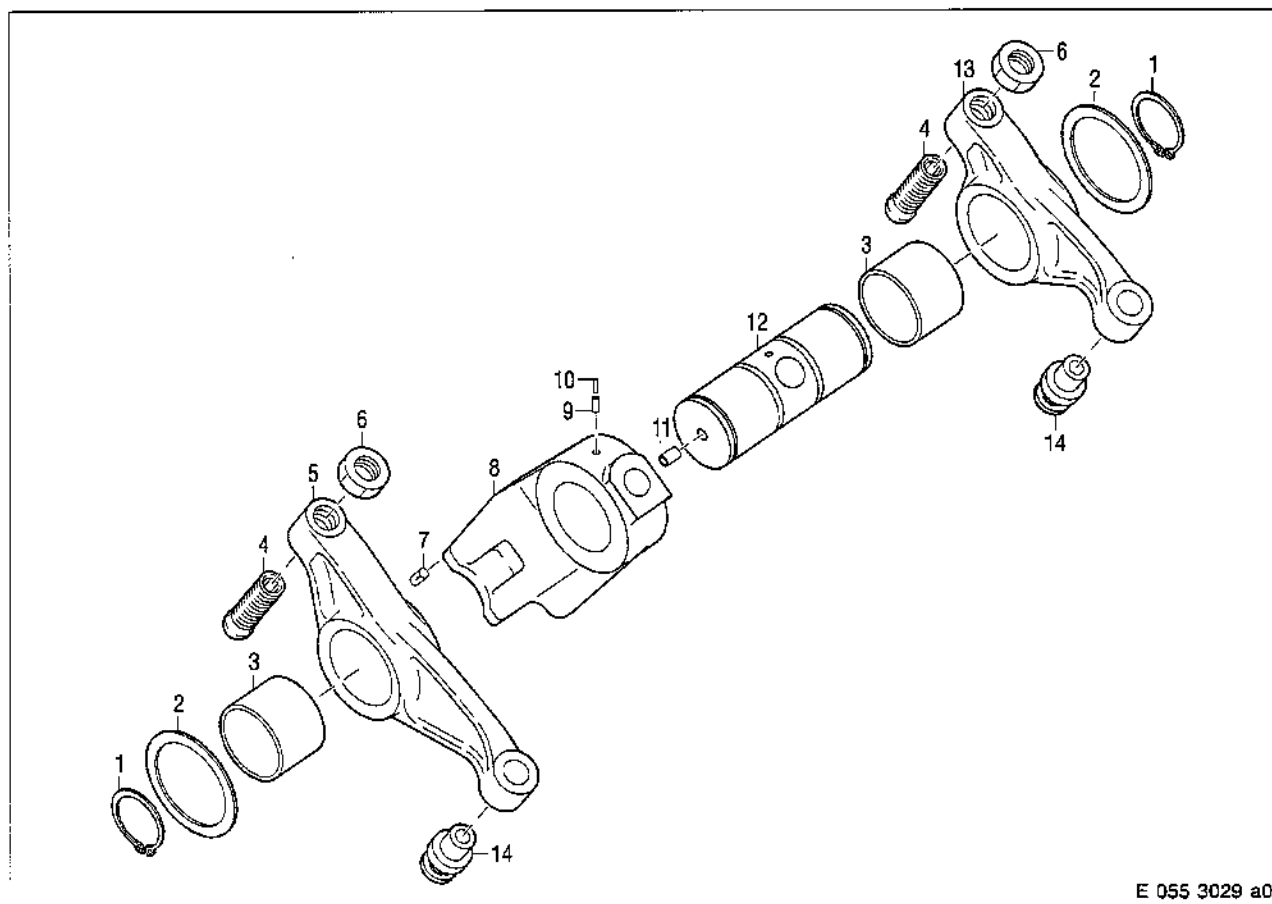
- 10 Hex nut
- 11 Adjusting screw
- 12 Rocker arm, exhaust
- 13 Bearing pedestal
- 14 Valve bridge, exhaust
- 15 Hex nut
- 16 Adjusting screw
- 17 Valve bridge, inlet

C055.05 Valve drive**C055.05.01 Overview drawing****Rocker arm assembly**

E 055 3017 b1

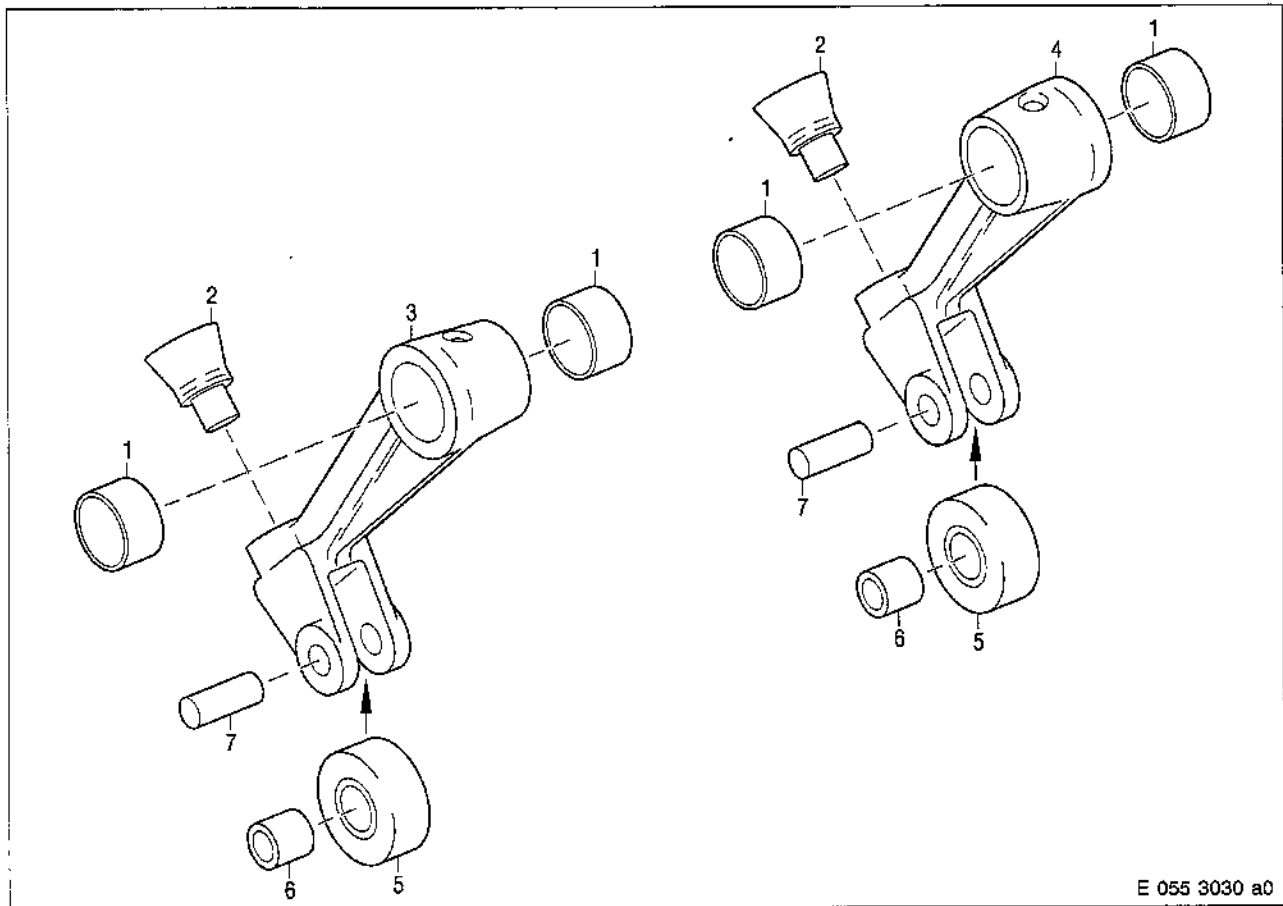
- | | |
|-----------------------|-----------------------|
| 1 Bearing pedestal | 8 Washer |
| 2 Rocker arm, inlet | 9 Rocker arm, exhaust |
| 3 Rocker arm, exhaust | 10 Rocker arm, inlet |
| 4 Adjusting shim | 11 Rocker shaft |
| 5 Snap ring | 12 Hex screw |
| 6 Valve bridge | |
| 7 Hex screw | |
- Lubricant: Engine oil
Tightening torque: 250 Nm + 25 Nm

Rocker shaft support



E 055 3029 a0

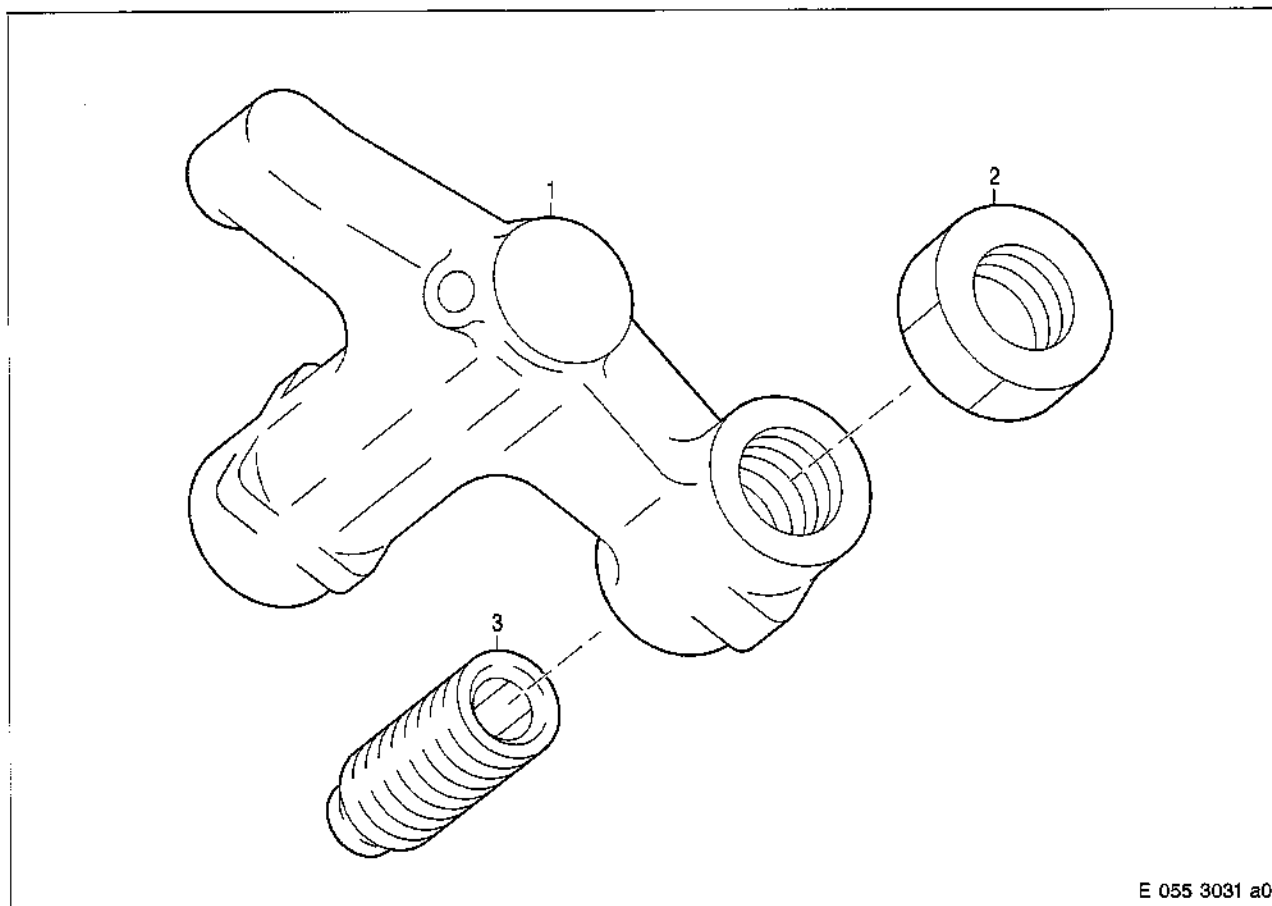
- | | |
|---------------------------------|------------------------|
| 1 Snap ring | 7 Grooved pin |
| 2 Adjusting shim | 8 Bearing pedestal |
| 3 Bush | 9 Spring pin |
| 4 Adjusting screw | 10 Spring pin |
| 5 Rocker arm, inlet | 11 Sealing plug |
| 6 Nut | 12 Axle |
| Lubricant: Engine oil | 13 Rocker arm, exhaust |
| Tightening torque: 90 Nm + 9 Nm | 14 Thrust pad |

Rocker arm

- 1 Bush
- 2 Ball socket
- 3 Rocker arm, exhaust
- 4 Rocker arm, inlet

- 5 Roller
- 6 Bush
- 7 Pin

Valve bridge



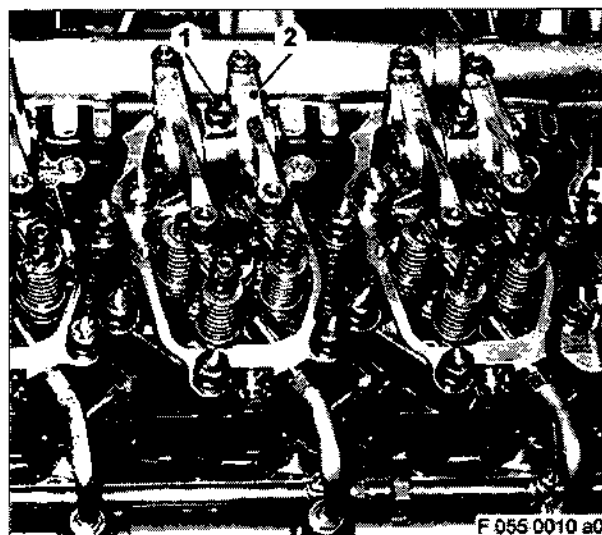
- 1 Valve bridge
- 2 Nut, 19 A/F
Lubricant: Engine oil
Tightening torque: 35 Nm + 5 Nm
- 3 Adjusting screw M 12

C055.05.02 Special tools

Designation	Use/dimension	Number
• Feeler gauge	0.5 – 1.0 mm	1
• Barring tool	Free end	1
– Pointer for barring tool	for barring tool	1
– Timing disc, free end	Set TDC-A1	1

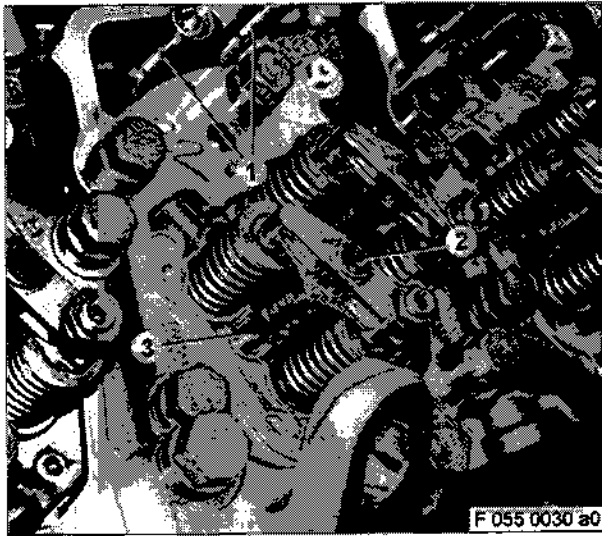
C055.05.04 Before-removal operations

			For the following tasks, a distinction must be made as to whether:	
			↓ ↓ ↓ The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed	
			Measure	See
x	-	-	Remove engine	→ B 003
x	-	-	Perform operations as per Disassembly Plan	→ B 004
-	-	x	Disable engine start	→ Operating Instructions
-	-	x	Drain engine coolant (high temperature)	→ Operating Instructions
-	-	x	Drain charge air coolant (low temperature)	→ Operating Instructions
-	x	x	Remove Y-pipe from exhaust outlet housing	→ C 141.10.05
-	x	x	Remove oil supply lines for turbochargers	→ C 185.10.05
-	x	x	Remove oil return lines for turbochargers	→ C 185.25.05
-	x	x	Remove air pipework from exhaust turbocharger to intercooler*	→ C 125.05.05
-	x	x	Remove coolant lines (high temperature)*	→ C 202.10.05
-	x	x	Remove exhaust turbocharger*	→ C 101.01.05
-	x	x	Remove charge air coolant vent lines (low temperature)	→ C 202.55.05
-	x	x	Remove engine coolant vent lines (high temperature)	→ C 202.65.05
-	x	x	Remove crankcase ventilation*	→ C 018.10.05
-	x	x	Remove charge air coolant line (low temperature)*	→ C 203.25.05
-	x	x	Remove main oil gallery*	→ C 011.05.05
-	x	x	Remove cylinder head cover(s)	→ C 055.10.05

C055.05.05 Removal**Removing rocker arm assembly**

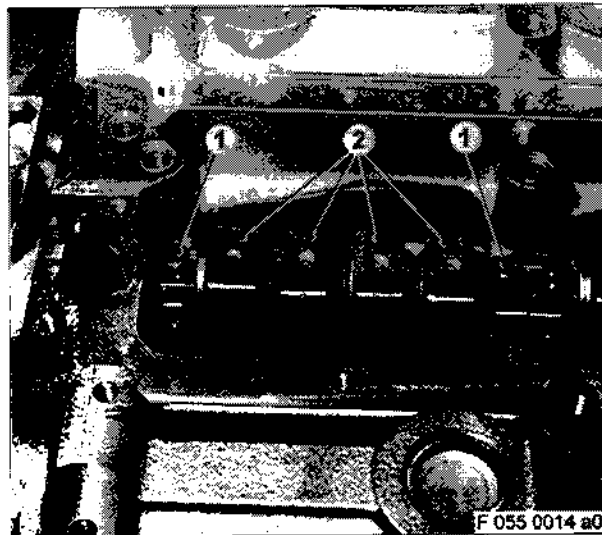
Remove hex screw (1) and remove rocker shaft support (2) from cylinder head, paying attention to grooved pin fit.

When raising rocker shaft support, ensure that a pushrod (suction effect, pushrod seat) is not lifted as well.



Mark valve bridges (2) and remove from sliding pins (3).

Mark pushrods (1) and remove.

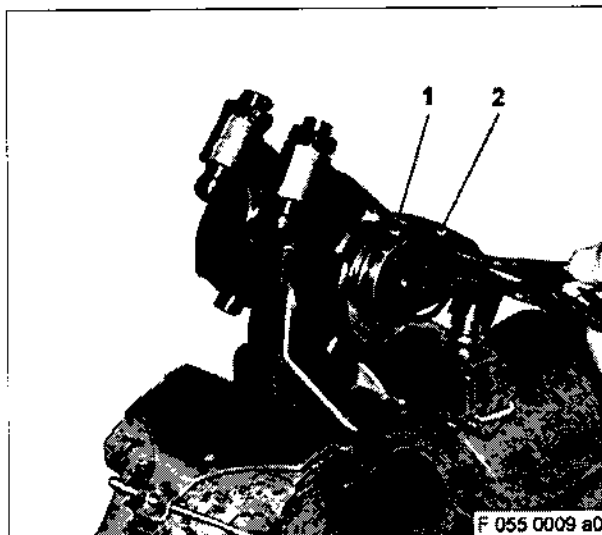


Removing rocker arm

Remove hex screws (1).

Remove rocker shaft with rocker arm (2) from crank-case.

C055.05.06 Disassembly



Disassembling rocker arm assembly

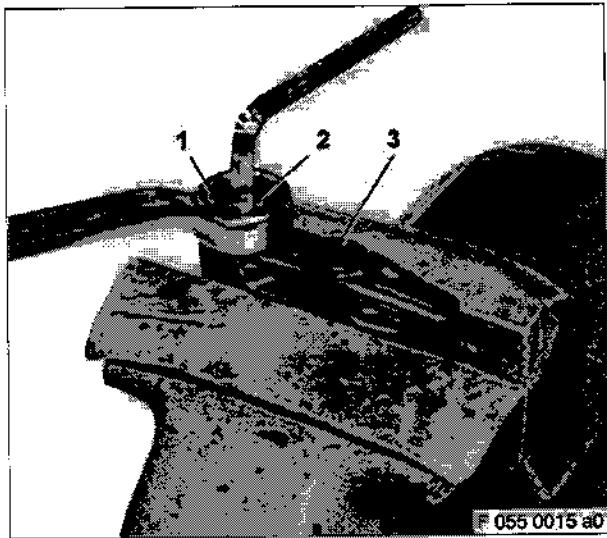
Clamp shaft support in vice with aluminium jaws.

Using snap ring pliers, remove snap ring (2) from shaft.

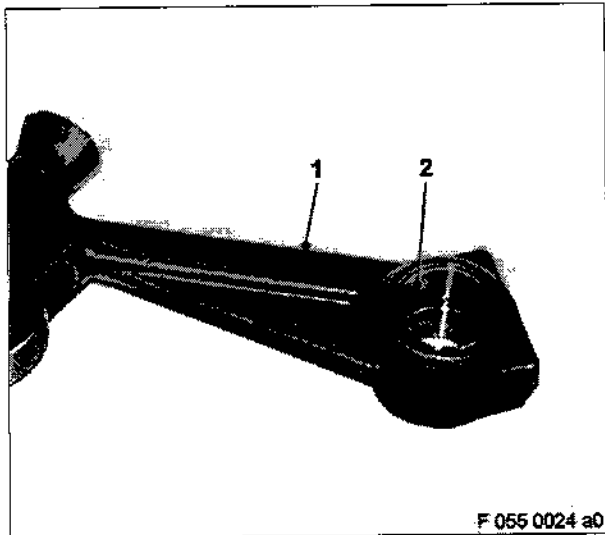
Remove washer (1).

Remove rocker arm from axle.

Remove nut and adjusting screw.



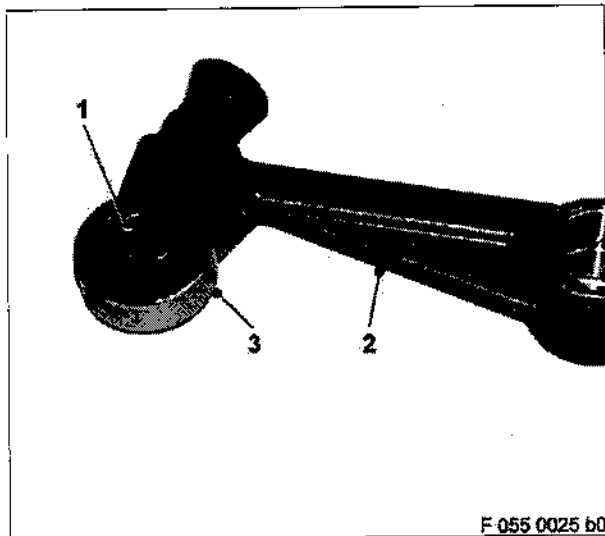
Clamp valve bridge (3) in vice with aluminium jaws.
Release nut (1) and remove adjusting screw (2).



Removing rocker arm bush

Note: Remove rocker arm bush only if necessary (e.g. wear) – see C 055.05.08.

Use mandrel and hydraulic press to remove rocker arm bush (2) from rocker arm (1).



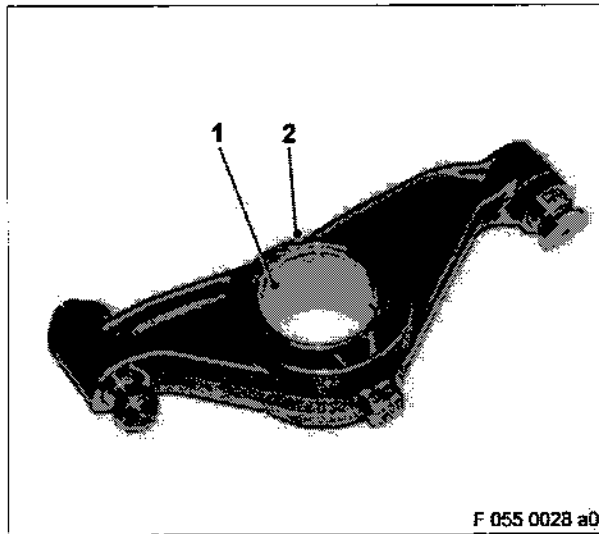
Removing pin and roller

Note: Remove pin and roller only if necessary – see C 055.05.08.

To remove pin, place rocker arm between two prisms so that both sides of pin bore have sufficient support.

Use mandrel to remove pin (1) from rocker arm (2).

Remove roller (3) from fit.



Removing rocker arm bush

Note: Remove rocker arm bush only if necessary – see C 055.05.08.

Use mandrel and hydraulic press to remove rocker arm bush (1) from rocker arm (2).

C055.05.08 Inspection and repair

Clean all components.

Using the magnetic crack-testing method with fluorescent magnetic powder, check rocker shaft support and axles, rocker arms, valve bridges, rocker shaft, roller, pins, pushrods, hex screws and adjusting screws for cracks.

Replace cracked parts.

Check running surfaces of axles, rollers, valve bridges and rocker arms for wear, indentations and scoring.

Remove scoring and indentations by polishing with emery cloth; replace components as necessary.

Check snap rings and washers for damage and wear; replace components as necessary.

Check condition of mating faces on rocker shaft support; burnish with oilstone if necessary.

Check condition of axle snap ring grooves; replace rocker shaft support as necessary.

The ball element within the swivel angle, at least 10°, must not jam and must move freely.

Check screws, nuts and adjusting screws for wear and damage; replace component if necessary.

Check threads of nuts, adjusting screws and hex screws for ease of movement; replace component as necessary.

Check threaded bores in rocker arms and valve bridges for ease of movement; remachine if necessary.

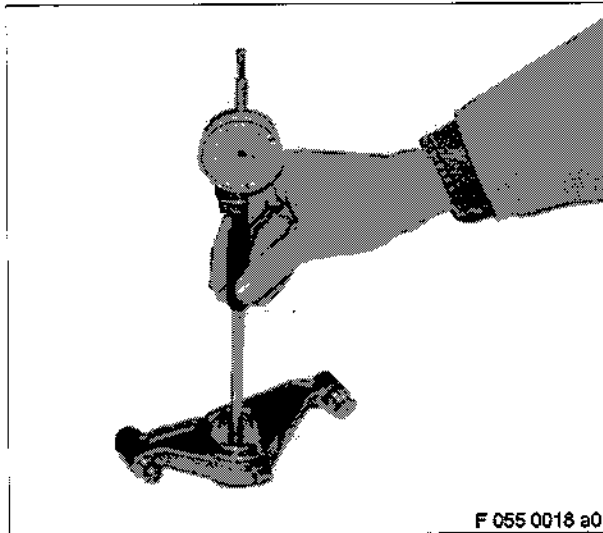
Measure register bores in valve bridges with bore gauge.

Check pushrod seat and ball socket of pushrod for wear; replace pushrod if necessary.

Check concentricity of pushrod; replace push rod if necessary.

Check sliding pins in cylinder head for wear and protrusion (A) – see C 041.05.08.

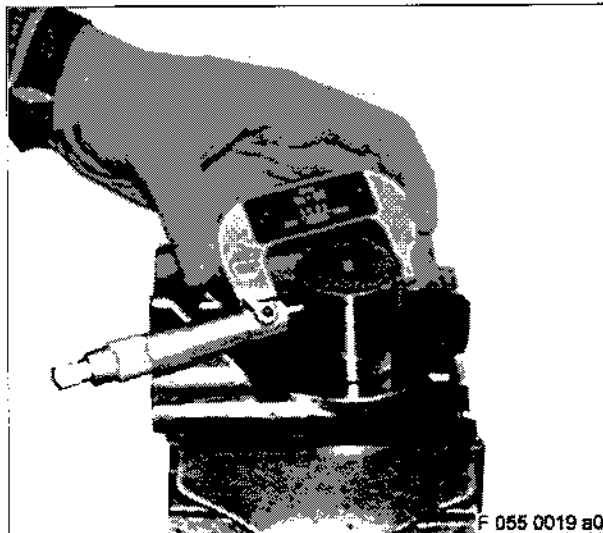
Replace gaskets and sealing washers during W6 overhaul.

**Measuring diameter of bush bore in rocker arm**

Adjust bore gauge to basic size of bush bore and measure diameter of bore.

For specified dimensions, see Tolerance and Wear Limits List.

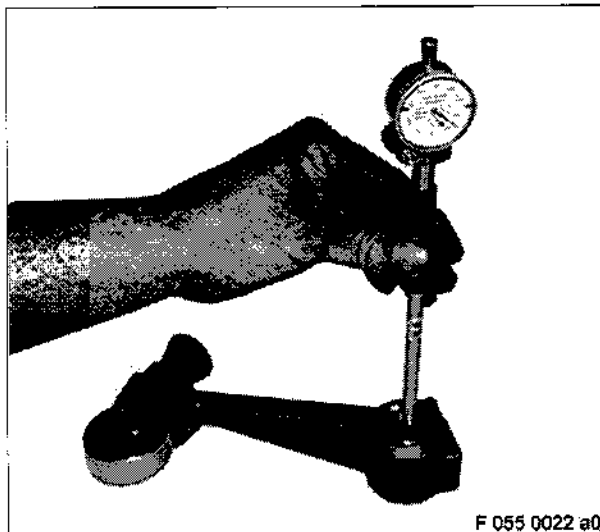
If permissible values are exceeded, replace bearing bush.

**Measuring diameter of bearing pedestal axles**

Using micrometer, measure outside diameters of bearings.

For permissible values, see Tolerance and Wear Limits List.

If measurements are below limit values, replace rocker shaft support.

**Measuring diameter of bush bore in rocker arm**

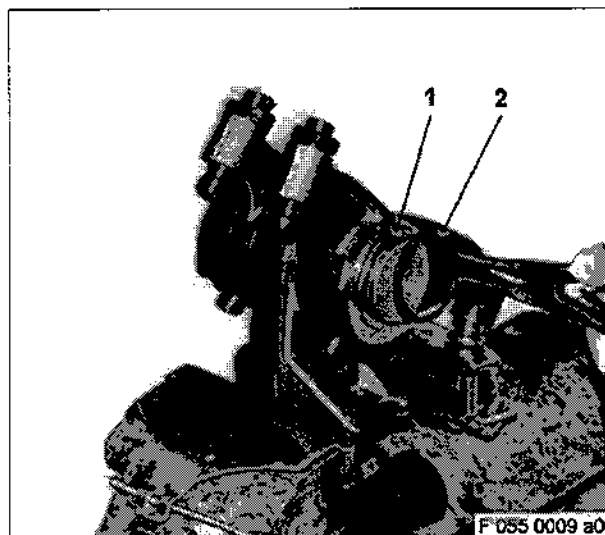
Adjust bore gauge to basic size of bush bore and measure diameter of bore.

For permissible values, see Tolerance and Wear Limits List.

If permissible values are exceeded, replace bearing bush.

C055.05.10 Assembly

Note: Make sure parts are perfectly clean.



Assembling rocker arm assembly

Clamp rocker shaft support in vice with aluminium jaws.

Fit adjusting screw and nut in rocker arm, but do not tighten!

Coat axles on rocker shaft support and bushes of rocker arm with engine oil.

Fit rocker arm on axle.

CAUTION

Snap ring pretension

Risk of injury!

Use suitable snap ring pliers. Always wear protective goggles/safety mask.

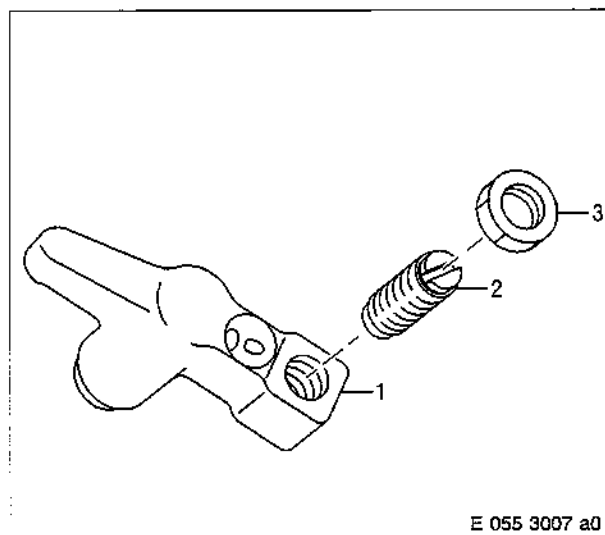
Fit washer (1) and secure with snap ring (2).

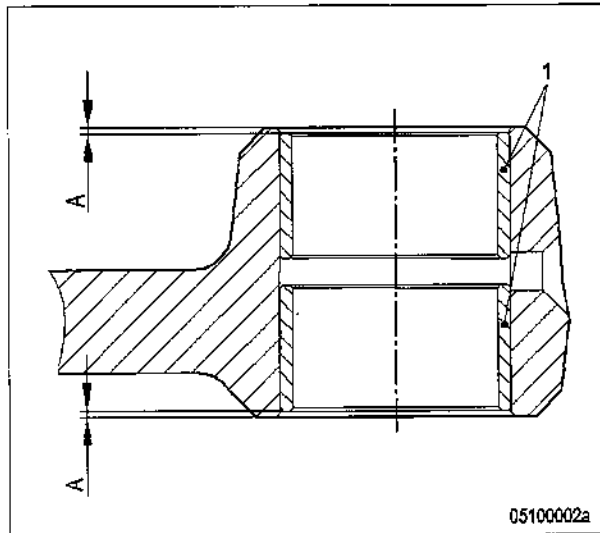
Make sure that snap ring is correctly seated.

Check minimum axial clearance of rocker arm.

Insert adjusting screw (2) into valve bridge (1).

Attach nut (3) to adjusting screw; do not tighten!

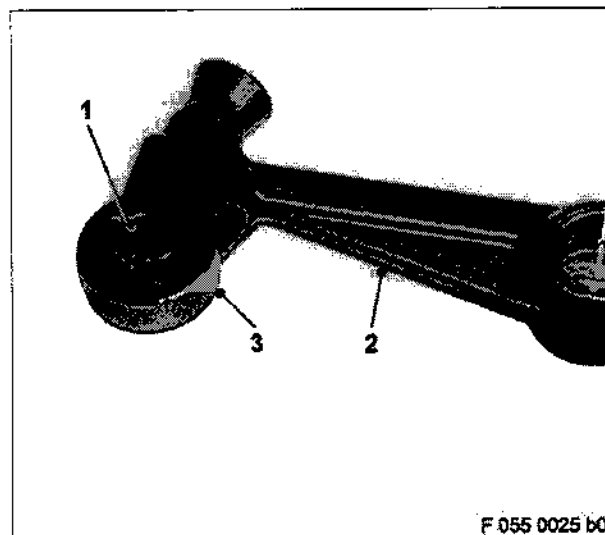


**Assembling rocker arm****CAUTION**

Nitrogen is liquid at $-200\text{ }^{\circ}\text{C}$ (-328F). Danger of freezing and suffocation!
 Do not allow liquid nitrogen to come into contact with parts of body (eyes, hands).
 Wear protective clothing (including gloves and closed shoes) and goggles.
 Ventilate working area well.

Chill bushes (1) in liquid nitrogen and press into rocker arm on both sides, observing remaining distance (A).

$A = 0.5\text{ mm} \pm 0.5\text{ mm}$



Heat rocker arm to approx. $130\text{ }^{\circ}\text{C}$ to $150\text{ }^{\circ}\text{C}$.

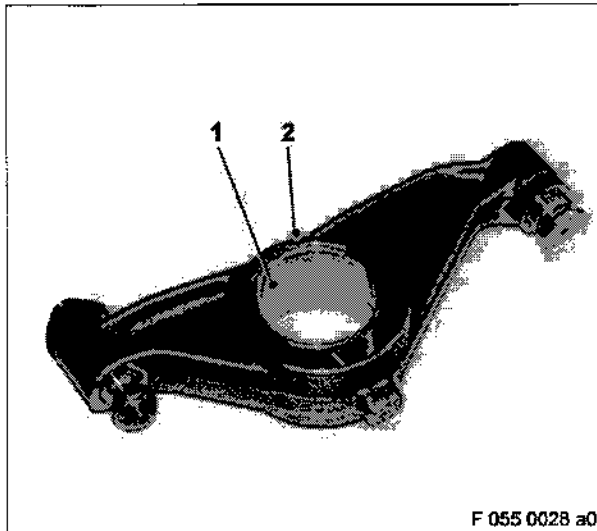
CAUTION

Component is hot.
 Risk of injury!
 Handle components only when wearing protective gloves.

Insert roller (3) in rocker arm.

Chill pin (1) in liquid nitrogen and insert by hand flush in rocker arm (1).

Note: Subsequent press fitting is not permitted.



Assembling rocker arm

Chill bush (1) in liquid nitrogen.

CAUTION

Nitrogen is liquid at -200°C (-328°F). Danger of freezing and suffocation!
Do not allow liquid nitrogen to come into contact with parts of body (eyes, hands).
Wear protective clothing (including gloves and closed shoes) and goggles.
Ventilate working area well.

Heat rocker arm to max. 150°C .

CAUTION

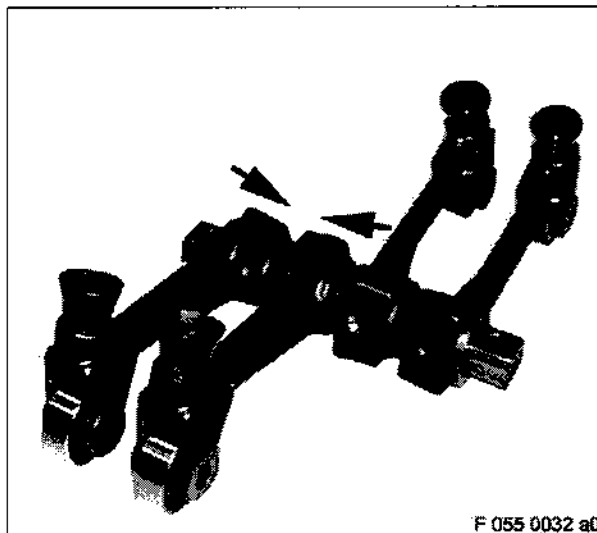
Component is hot.
Risk of injury!
Handle components only when wearing protective gloves.

Insert bush (2) so that it is flush.

Projection is not permissible on both sides.

C055.05.11 Installation

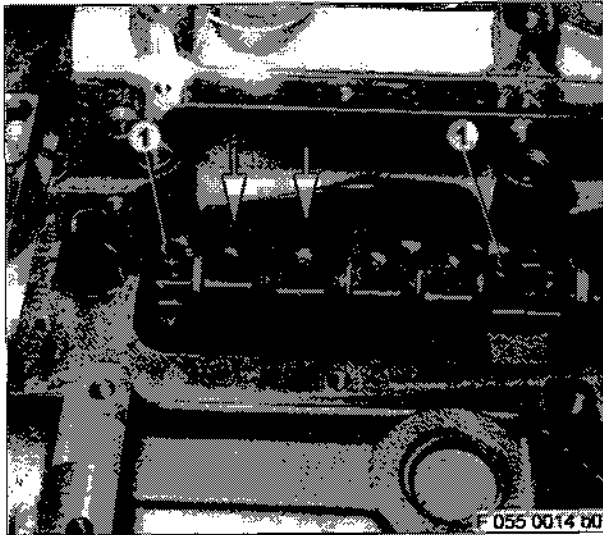
Note: Make sure parts are perfectly clean.



Installing rocker arm

Coat axle and bushes of rocker arm with engine oil.

Fit exhaust and inlet rocker arms on rocker shaft, ensuring they are correctly positioned (arrows).



Coat rollers and camshaft bushings with engine oil.
Match rocker arms to left and right cylinder banks and carefully insert into camshaft chamber.

Note: Correct installation position (arrow) can be seen in this illustration.

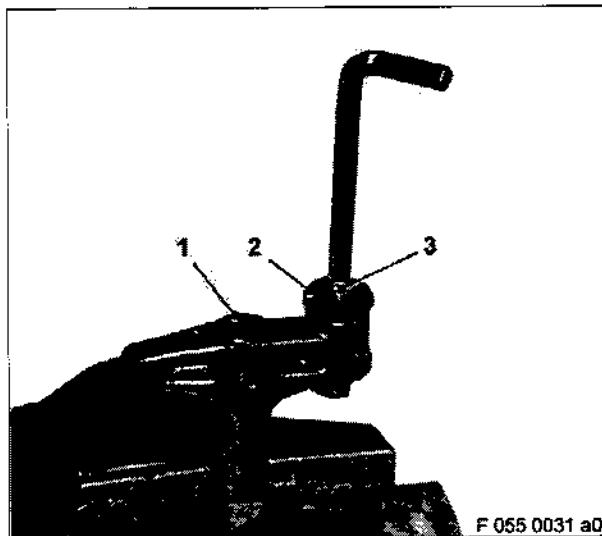
Insert hex screws (1) and tighten.



Install pushrods

Coat pushrod seats and ball sockets (arrows) of pushrods with engine oil.

Insert pushrods through cylinder head into pushrod seats of rocker arms.

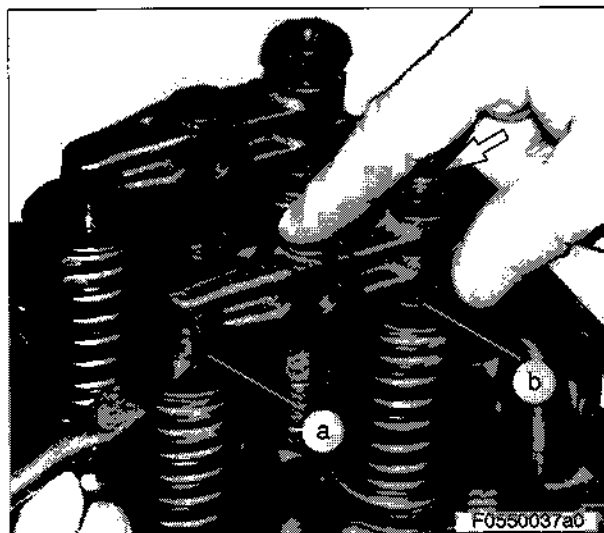


Adjusting and installing valve bridges

Measure projection of sliding pins with respect to cylinder head – see C 041.05.08.

Coat register bore of valve bridge with engine oil.

Secure valve bridge (1) in vice with aluminium jaws, release locknut (2) and back off adjusting screw (3) by approx. 3 revolutions.



Fit valve bridge(s) in accordance with marking (installation location) on sliding pin in cylinder head.

Adjusting screw (arrow) faces charge air manifold.

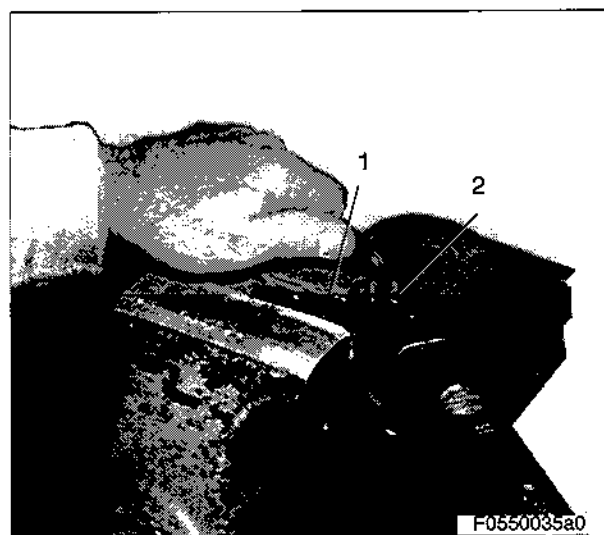
Press valve bridge downwards and hold.

The valve bridge must be in contact with the valve shaft (A), if necessary back of adjusting screw.

Use Allen key to insert adjusting screw with valve bridge pressed until adjusting screw just contacts valve stem (B); valve bridge must not move upwards.

Hold adjusting screw firmly with Allen key and tighten locknut by hand.

Remove valve bridge from cylinder head.



Clamp valve bridge (1) in vice with aluminium jaws.

Tighten locknut to specified tightening torque – see C 055.05.01.

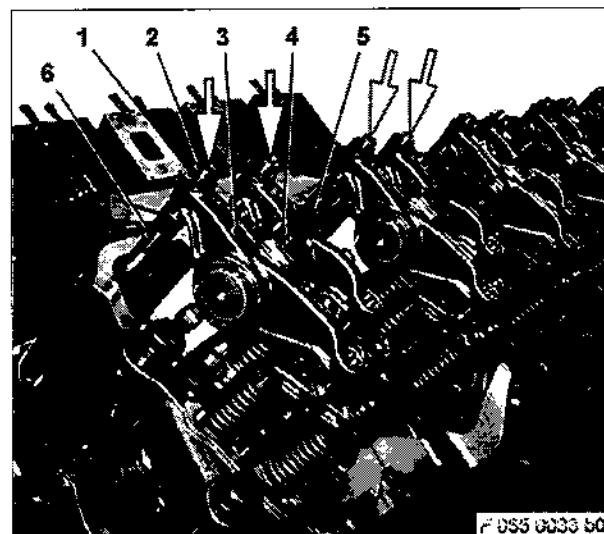
Fit valve bridge in accordance with marking (installation location) on corresponding sliding pin in cylinder head.

Check valve bridge adjustment as follows:

1. Insert feeler gauge (0.05 mm) between valve bridge and valve stem (see illustration above); when the valve bridge is pressed, the feeler gauge must jam or be drawn through with resistance.

2. Insert feeler gauge (0.05 mm) between valve bridge and opposing valve stem and check resistance.

The valve bridge is correctly adjusted if the feeler gauge jams when the valve bridge is pressed or can be drawn through with resistance.



Installing rocker arm assembly

Bar crankshaft to bring appropriate piston of cylinder to firing TDC.

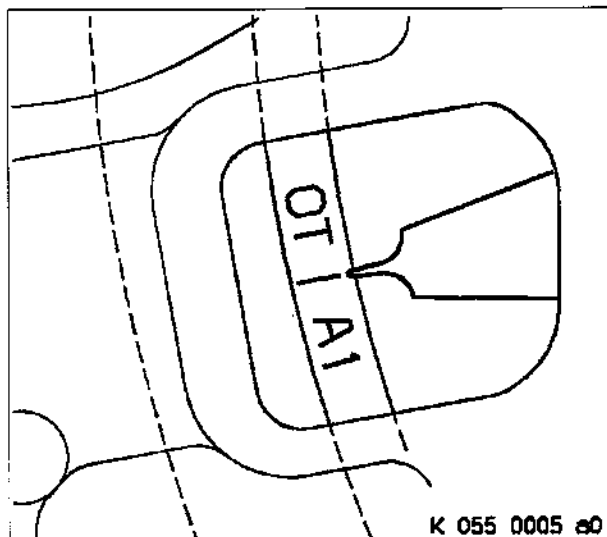
Release nuts (1) of adjusting screws (2) on rocker arm (3) and back off adjusting screw.

Fit rocker shaft support on cylinder head and check fit of grooved pins.

Check position of ball joints in pushrods (6).

Install hex screw (5) with washer (4) in cylinder head and tighten to specified tightening torque – see Overview drawing C 055.55.01.

Note: Fill adjusting screws (arrow) with engine oil.



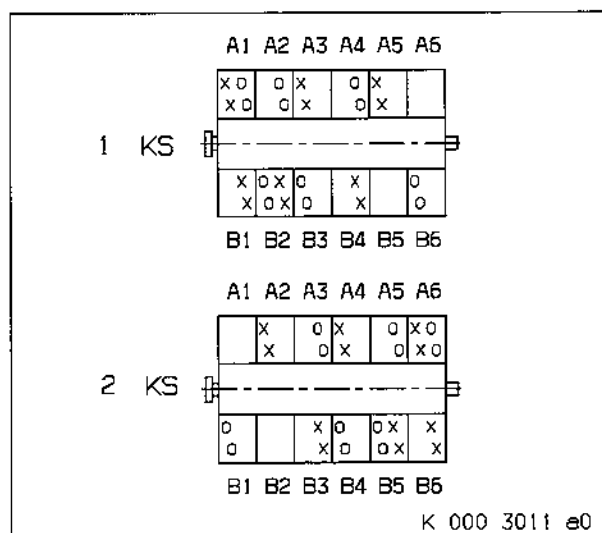
Adjusting valve clearance with two cranks-haft positions

Note: Valve bridges are adjusted!

Turn crankshaft with barring tool in normal direction of engine rotation until OT-A1 mark on starter ring gear and dead-centre indicator are aligned.

If rocker arms on cylinder A1 are unloaded, the piston is in firing TDC.

If rocker arms on cylinder A1 are loaded, the piston is in overlap TDC.



Set valve clearances at initial TDC crankshaft position in accordance with the adjacent valve clearance setting diagrams.

Procedure for setting – see next illustration.

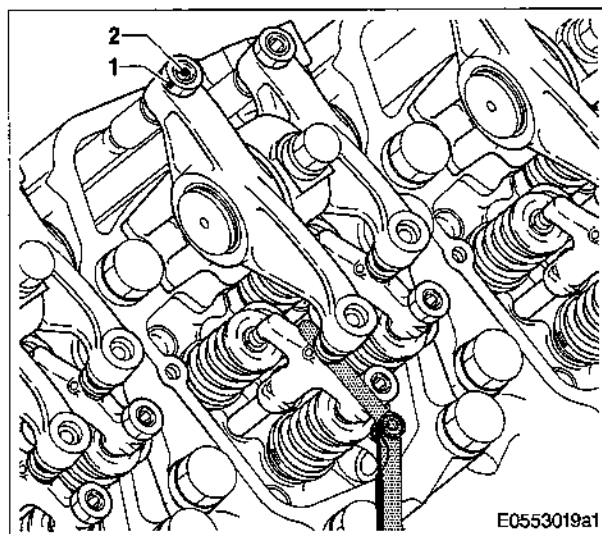
Rotate crankshaft a further 360° (to second TDC crankshaft position) and set remaining valve clearances in accordance with valve clearance setting diagram.

1 = Firing TDC at cylinder A1

2 = Overlap TDC at cylinder A1

X = Exhaust valve.

O = Inlet valve.



Note: Inlet valves: Long rocker arm
exhaust valves: Short rocker arm

Release locknut (1) and back off adjusting screw (2) slightly with Allen key.

For specified valve clearance – see A 004.

Insert feeler gauge between valve bridge and rocker arm.

Set adjusting screw so that the feeler gauge can just be pulled through when locknut is tightened.

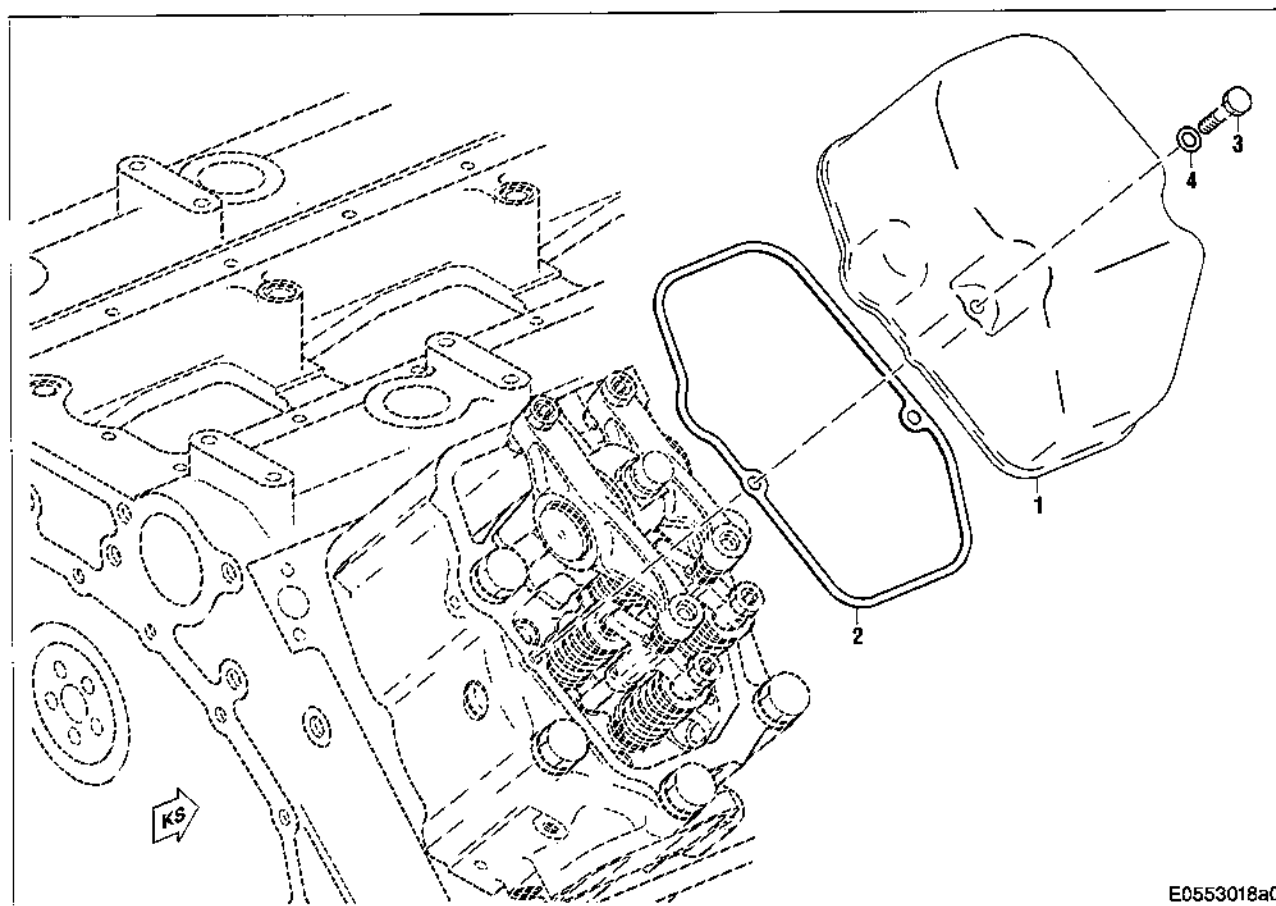
Tighten locknut to specified tightening torque – see C 055.05.01; when doing this, hold adjusting screw in position with an Allen key.

Recheck valve clearance after locking nut.

Remove engine barring tool.

C055.05.12 After-installation operations

For the following tasks, a distinction must be made as to whether:			
Measure			See
x	–	–	Perform operations as per Assembly Plan → B 005
x	–	–	Install engine → B 007
–	–	x	Assembly in reverse sequence to disassembly → C 055.05.04
–	–	x	Release engine start → Operating Instructions

C055.10 Cylinder head cover**C055.10.01 Overview drawing**

1 Cylinder head cover

2 Gasket

3 Hex screw

Lubricant: Engine oil

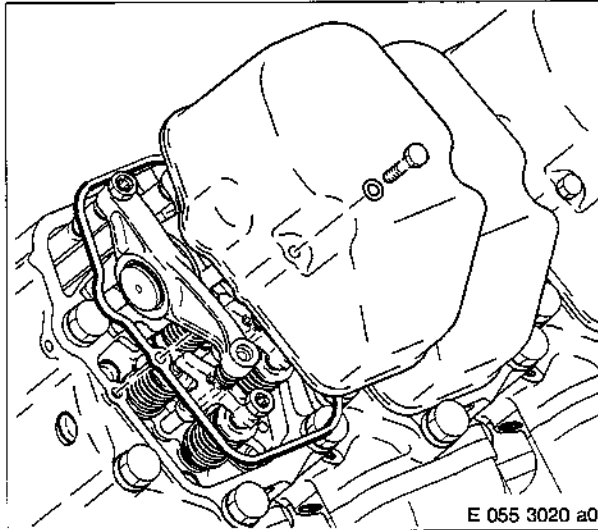
Tightening torque: 42 Nm

4 Washer

C055.10.04 Before-removal operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	-	-	Remove engine	→ B 003
x	-	-	Perform operations as per Disassembly Plan	→ B 004
-	-	x	Disable engine start	→ Operating Instructions

C055.10.05 Removal



Remove cylinder head cover

Remove hex screws.

Remove cylinder head cover and gasket.

C055.10.08 Inspection and repair



CAUTION

Compressed air is air pressurised by overpressure. If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask. Compressed air must not be directed at the body.

The pressure must not exceed 3.0 bar (40 lb/in²).

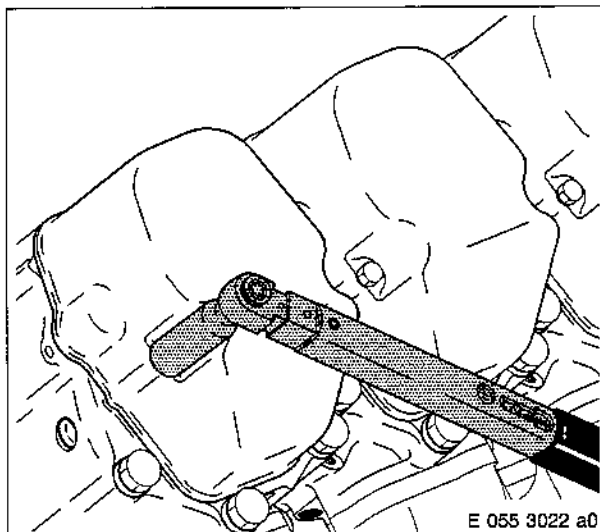
Clean cylinder head cover with cleaner, blow out with compressed air and make sure it is perfectly clean.

Make visible inspection of cylinder head cover for wear and damage paying particular attention to the mating and sealing surfaces; rub down with emery cloth or an oilstone or replace cylinder head cover as necessary.

Clean hex screws and check condition, check thread for ease of movement; replace hex screw if necessary.

Replace gasket during W6 maintenance.

C055.10.11 Installation



Installing cylinder head cover

Note: Make sure parts are perfectly clean.

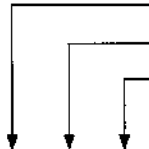
Check mounting surface, clean if necessary.

Insert gasket into cylinder head cover.

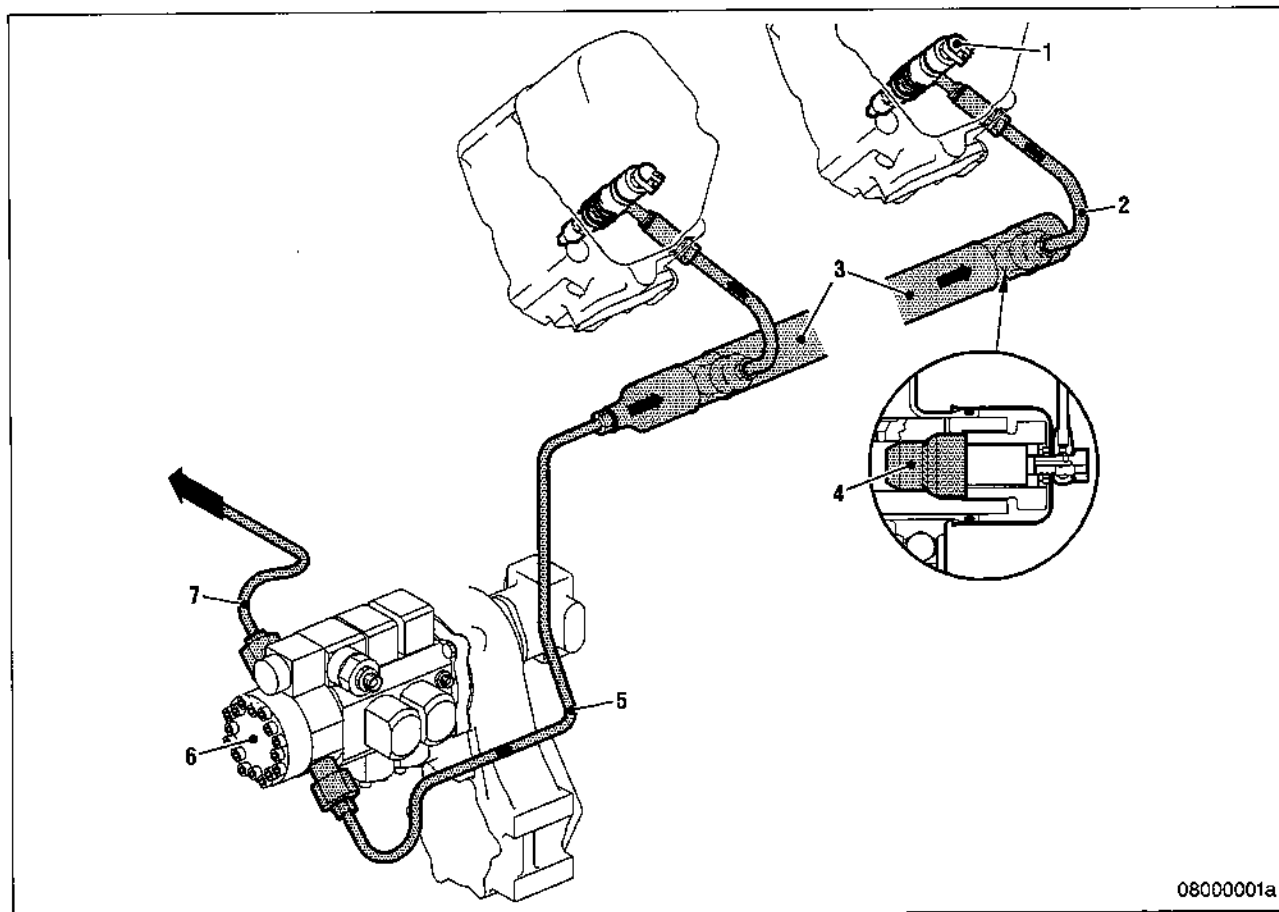
Place cylinder head cover on cylinder head as per Overview drawing – Arrangement of cylinder head covers.

Tighten hex screws and washers to specified tightening torque – see Overview drawing C 055.10.01.

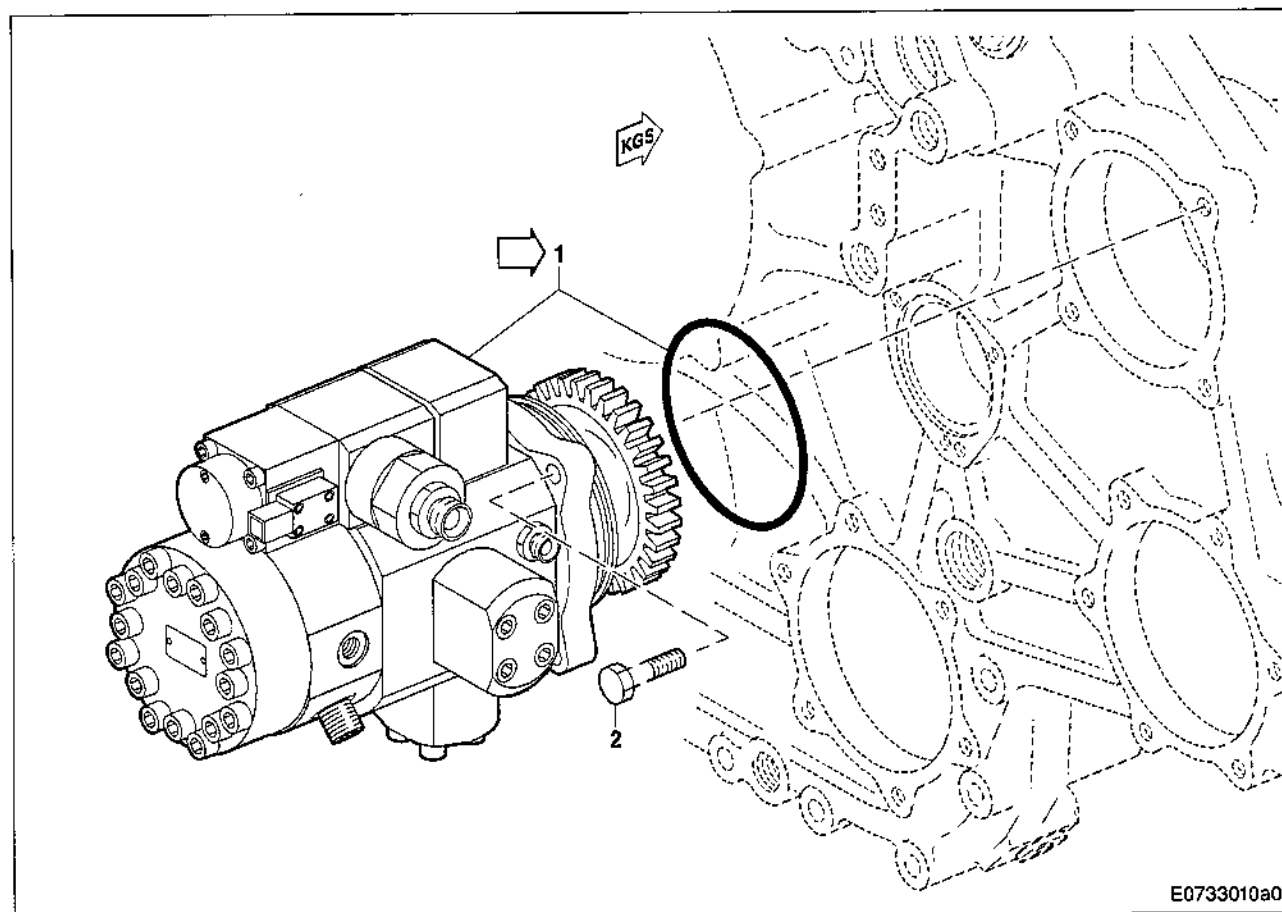
C055.10.12 After-installation operations

			For the following tasks, a distinction must be made as to whether:
			
			The engine is to be completely disassembled
			The engine is to be removed but not disassembled
			The engine is to remain installed
			Measure
			See
x	–	–	Perform operations as per Assembly Plan → B 005
x	–	–	Install engine → B 007
–	–	x	Release engine start → Operating Instructions

C070	Fuel system - high-pressure	C – 1
C073.05	High-pressure pump	C – 3
C073.05.01	Overview drawing	C – 3
C073.05.02	Special tools	C – 4
C073.05.04	Before-removal operations	C – 4
C073.05.05	Removal	C – 5
C073.05.06	Disassembly	C – 6
C073.05.08	Inspection and repair	C – 6
C073.05.11	Installation	C – 6
C073.05.12	After-installation operations	C – 8
C075.05	Injector	C – 9
C075.05.01	Overview drawing	C – 9
C075.05.02	Special tools	C – 9
C075.05.04	Before-removal operations	C – 9
C075.05.05	Removal	C – 10
C075.05.06	Disassembly	C – 12
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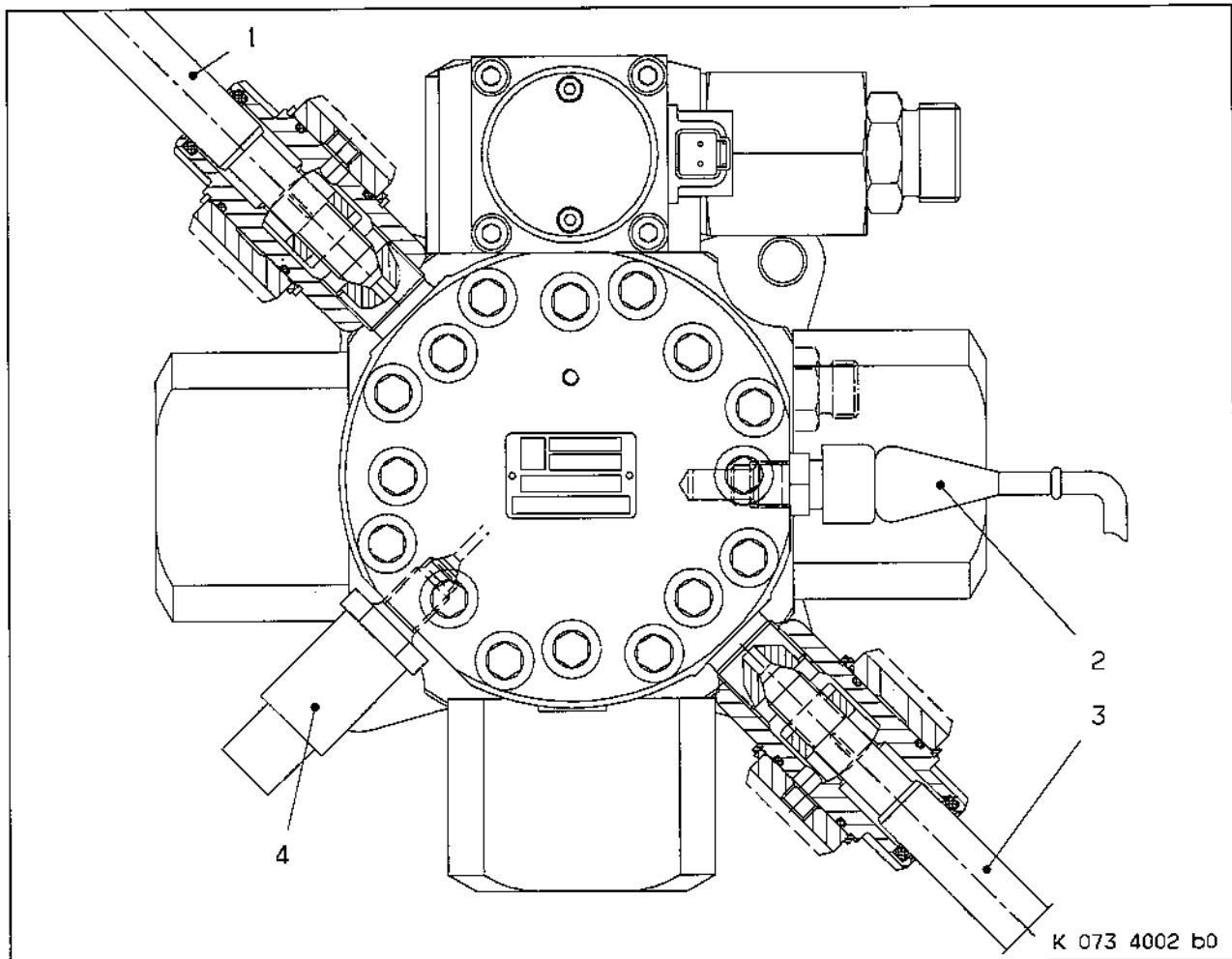
C070 Fuel system - high-pressure

- 1 Injector
- 2 H.P. line
- 3 H.P. accumulator
- 4 Pressure relief valve
- 5 H.P. line, left engine side
- 6 High-pressure pump
- 7 H.P. line, right engine side

C073.05 High-pressure pump**C073.05.01 Overview drawing**

- 1 High-pressure pump
- 2 Hex screw

High-pressure pump



- 1 H.P. line to right engine side
- 2 Temperature sensor
- 3 H.P. line to left engine side
- 4 High-pressure sensor

C073.05.02 Special tools

Designation	Use/dimension	Number
• Support bracket	for high-pressure pump	1
• Hydraulic filling unit	For H.P. and L.P. fuel system	1

C073.05.04 Before-removal operations

For the following tasks, a distinction must be made as to whether:			
	The engine is to be completely disassembled		
	The engine is to be removed but not disassembled		
	The engine is to remain installed		
Measure	See		
x - -	Remove engine	→ B 003	
x - -	Perform operations as per Disassembly Plan	→ B 004	

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
–	–	x	Disable engine start	→ Operating Instructions
–	x	x	Remove low-pressure fuel pump	→ C 081.10
–	x	x	Remove fuel lines (low-pressure)	→ C 086.05
–	x	x	Remove fuel lines (high-pressure)	→ C 077.05
–	x	x	Remove high-pressure sensor	→ C 500
–	x	x	Remove temperature transmitter	→ C 500

C073.05.05 Removal


WARNING

Fuels and fuel mists are flammable and poisonous. Risk of fire, explosions and poisoning! When using fuel: – do not use naked flame, – no electric sparks, – do not smoke, – do not spill fuel – do not inhale. Always wear protective gloves and protective goggles/safety mask. Ventilate working area well.

Removing H.P. pump



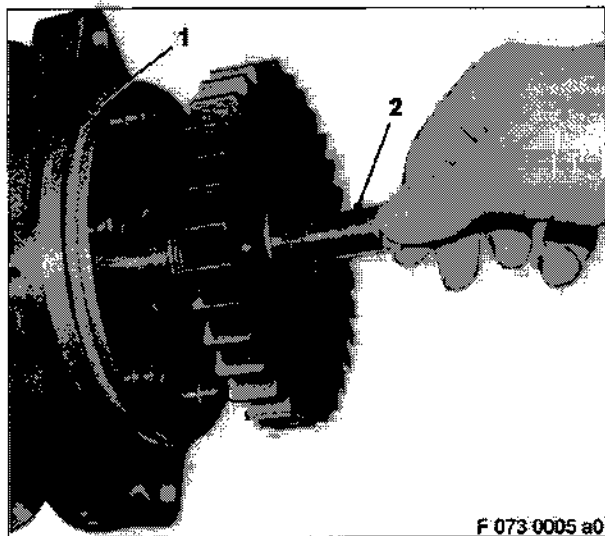
Heavy object. Risk of injury!
Use suitable tools and lifting equipment.

Attach H.P. pump with support bracket to crane.

Remove hex screws for high-pressure pump.

Release high-pressure raw water pump from equipment carrier and remove.

Cover opening in gear case.



Remove O-ring (1).

Note: Remove intermediate element only if necessary (e.g. if damaged). Intermediate element has been installed with thread-locking agent and must be heated to approx. 130°C before removal.

Remove intermediate element (2)

Note: Replacement high-pressure pumps are delivered without intermediate element.

C073.05.06 Disassembly

No provision is made for disassembling the high-pressure pump.

The H.P. pump is a replacement part and available in the replacement programme.

C073.05.08 Inspection and repair

Check high-pressure pump in a specialist workshop or at Manufacturer's; have repaired if necessary.

Clean hex screws and check condition.

Make sure threads are in perfect condition; replace hex screw as necessary.

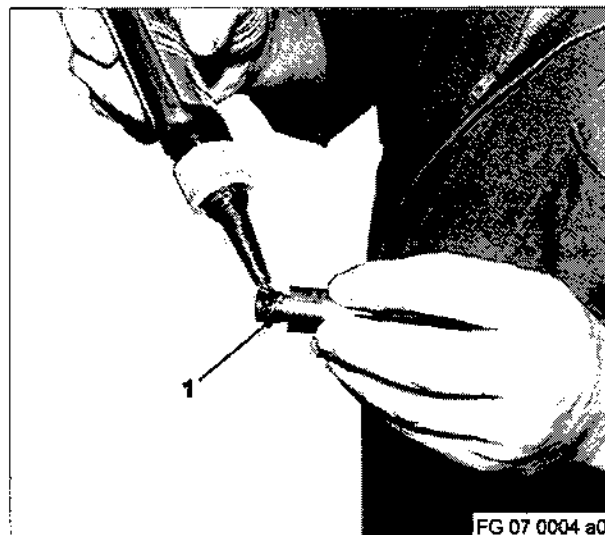
Check connection thread on high-pressure pump for perfect condition and ease of movement.

Check drive gear.

Check condition of wiring; replace if necessary.

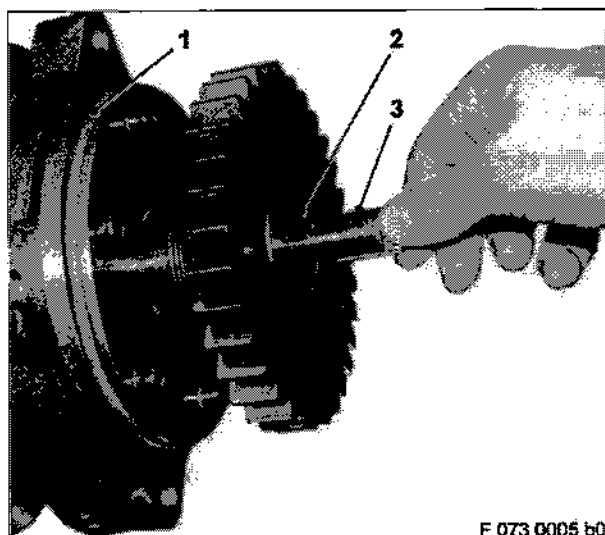
Replace O-ring after each removal.

C073.05.11 Installation



Installing H.P. pump

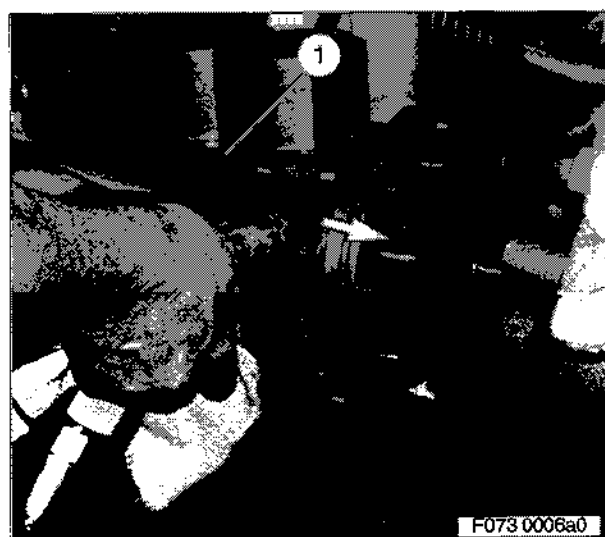
Coat thread of driver (1) with Loctite 270 thread-locking agent.



Screw driver (3) into pump shaft (2).

Note: Final strength of thread-locking agent at 20 °C after 12 hours.

Coat O-ring (1) with petroleum jelly and insert into groove on high-pressure pump.



Clean and check sealing surface in support bore of equipment carrier.

Note: Before installing the high-pressure pump, the low-pressure pump with plug-in coupling must first be removed, as perfect insertion of the driver (high-pressure pump) in the plug-in coupling is not guaranteed.



**Heavy object.
Risk of injury!
Use suitable tools and lifting equipment.**

Attach H.P. pump (1) with support bracket to crane and carefully move into assembly bore.

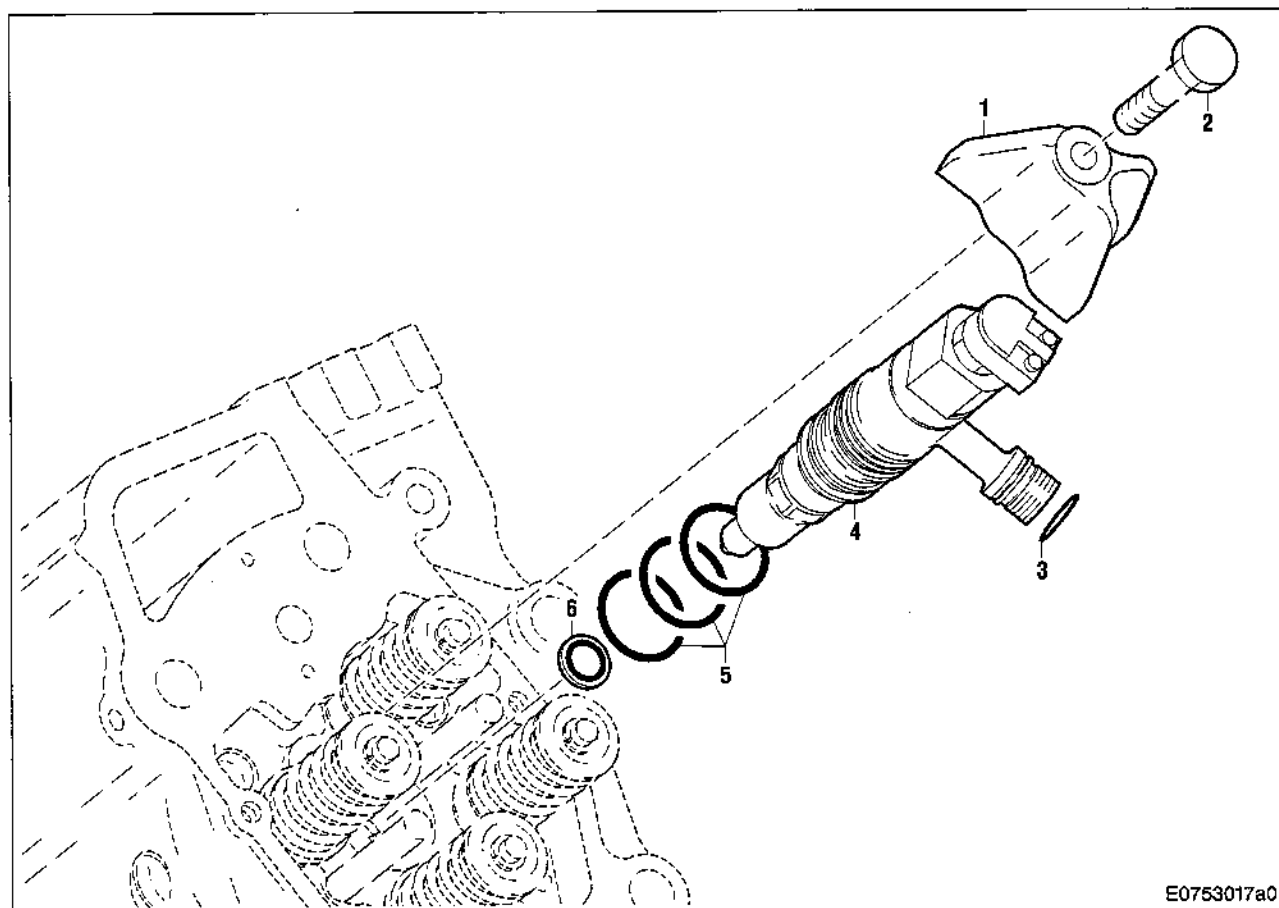
Install hex screws for high-pressure pump and tighten uniformly.

C073.05.12 After-installation operations

A distinction must be made as to whether:

- 1 — The engine was completely disassembled
- 2 — The engine is removed but was not disassembled
- 3 — The engine is installed

1	2	3	Operations	See
x	—	—	Perform operations as per Assembly Plan	B 005
x	—	—	Install engine	B 007
—	x	x	Assembly in reverse sequence to disassembly	C 073.05.04
—	x	x	Fill fuel system	Operating Instructions
—	—	x	Release engine start	Operating Instructions

C075.05 Injector**C075.05.01 Overview drawing**

1 Hold-down clamp

2 Hex screw

Lubricant: Engine oil
 Pretightening torque: 5 Nm + 5 Nm
 Tightening torque: 100 Nm + 10 Nm

3 O-ring

4 Injector

5 O-ring

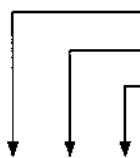
6 Sealing ring

C075.05.02 Special tools

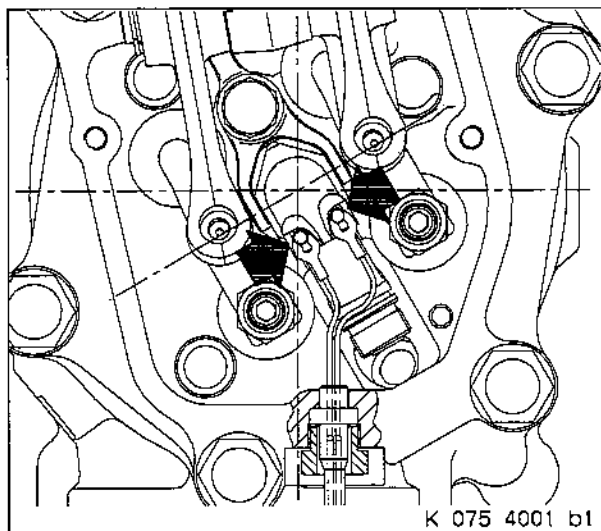
Designation	Use/dimension	Number
• Tools from the W4 tool kit		1
• Torque wrench	M3 screws for cable connection	1

C075.05.04 Before-removal operations

For the following tasks, a distinction must be made as to whether:		
The engine is to be completely disassembled		
The engine is to be removed but not disassembled		
The engine is to remain installed		
	Measure	See
x	Remove engine	→ B 003
x	Perform operations as per Disassembly Plan	→ B 004

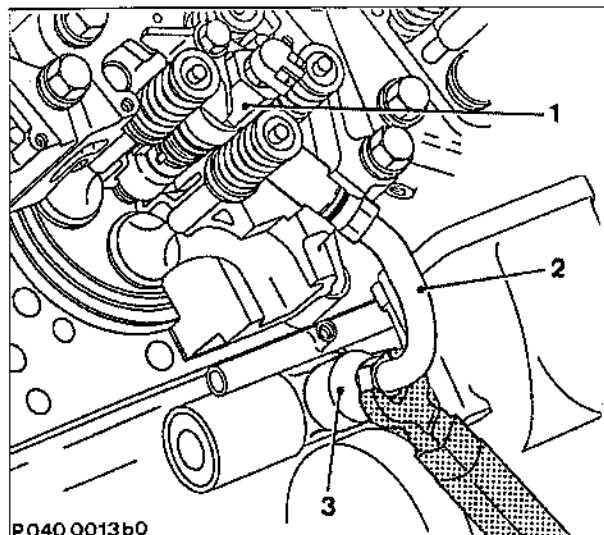
For the following tasks, a distinction must be made as to whether: 				
			Measure	See
-	-	x	Disable engine start	→ Operating Instructions
-	x	x	Remove cylinder head cover	→ C 055.10

C075.05.05 Removal

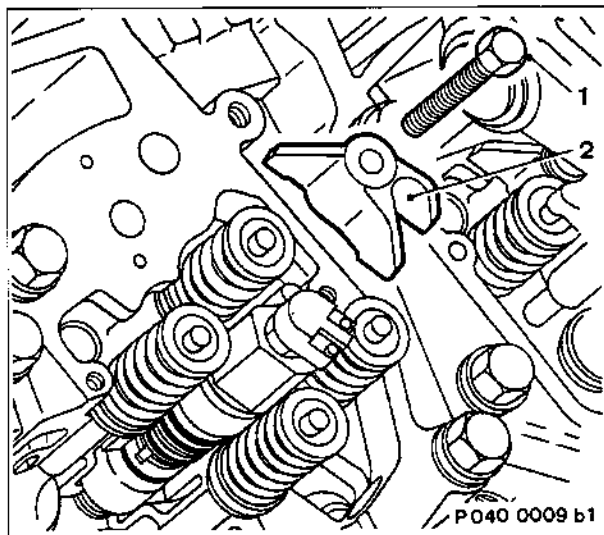


Removing fuel injector

Release cable terminal union on injector and remove cable terminals.



Unscrew H.P. line (2) from injector (1) and limiting valve (3) – see also C 077.05.



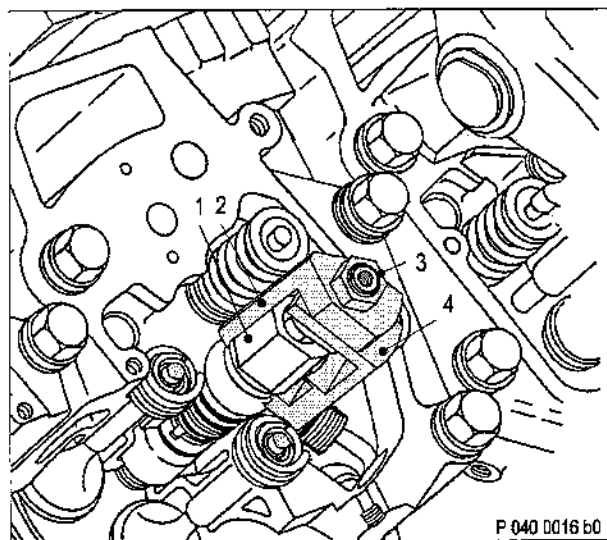
**Fuels and fuel mists are flammable and poisonous.
Risk of fire, explosions and poisoning!**
When using fuel:

- No open flame
- No electric sparks
- Do not smoke
- Do not spill fuel
- Do not inhale

Always wear protective gloves and protective goggles/safety mask. Ventilate working area well.

Note: Ensure that no fuel enters the cylinder chamber.

Remove screw (1) on hold-down clamp (2) and remove hold-down clamp.

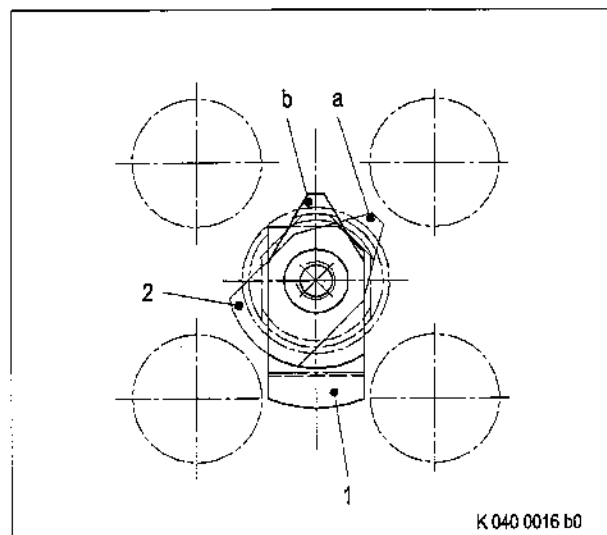


Note: The removal tool for the injector consists of two components.

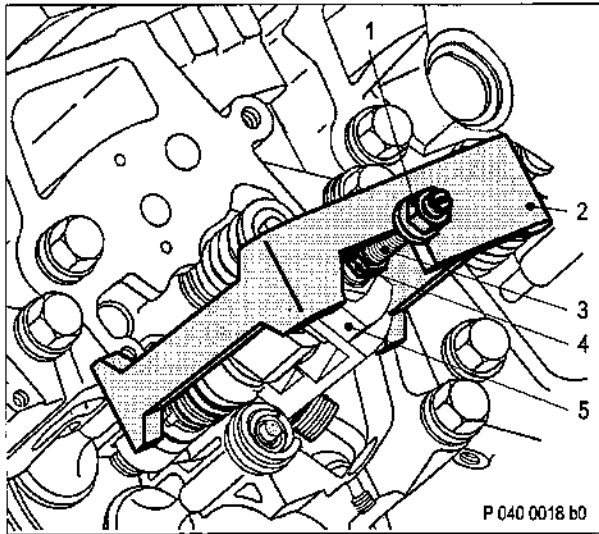
Place removal sleeve (4) on injector (1).

Fit locking sleeve (2) over removal sleeve and rotate to correct position – see next illustration.

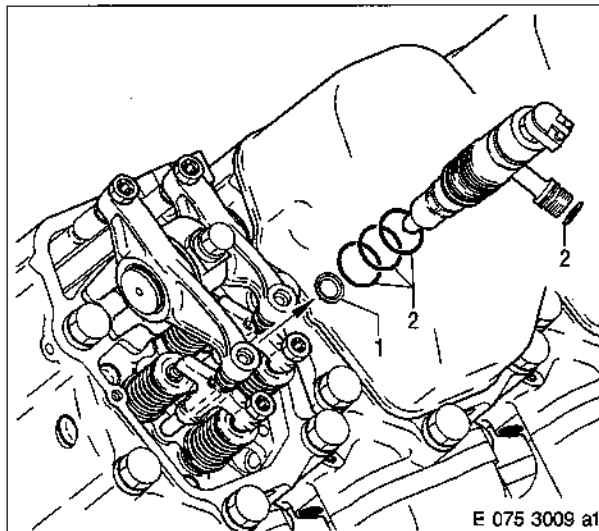
Secure locking sleeve with hex nut (3).



Rotate locking sleeve (2) from position "a" to position "b" over the removal sleeve (1).



Mount removal bracket (2) on cylinder head.
Insert threaded rod (3) in extractor sleeve (5) and lock with hex nut (4).
Remove injector by turning nut (1) to the right.
Remove special tool.
Remove injector manually.



Remove O-ring (2) from injector.
Remove sealing ring (CE-ring) (1) from injector or use wire hook to remove from cylinder head.

Note: After removing injector, make sure no CE support ring remains in bore for injector in cylinder head.

Cover all connections and installation bores or seal with suitable plugs.

C075.05.06 Disassembly

Injector must not be disassembled.

The injector is a replacement part and available in the replacement programme.

C075.05.07 Inspection and repair

Clean all components.

Check injector visually on outside for damage and defects.

In event of wear or other defects, the injector must be replaced.

Using the magnetic crack-testing method with fluorescent magnetic powder, check hex screw and clamping element for cracks; replace components as necessary.

Check mating faces of hold-down clamp; rub down with emery cloth or an oilstone or replace components as necessary.

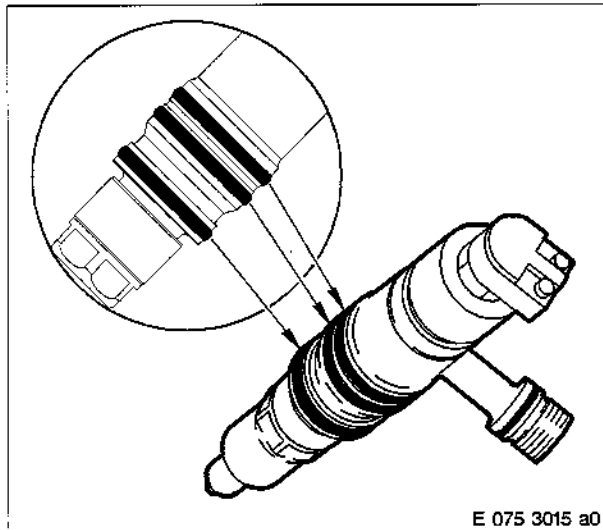
Check mating face of injector (in cylinder head), replace component if necessary.

Check cable connections for damage.

Check sealing cone of injector for damage and wear; replace component if necessary.

Check thread on hex screw and injector for ease of movement. Replace part if necessary.

Replace CE rings and O-rings at every assembly.

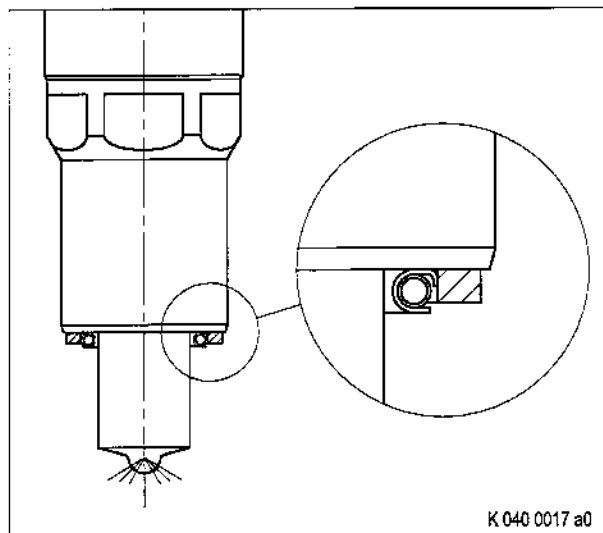
C075.05.11 Installation**Installing fuel injector**

Note: Make sure fuel-carrying components are perfectly clean. Prior to installation, remove all blanking plug and/or covers.

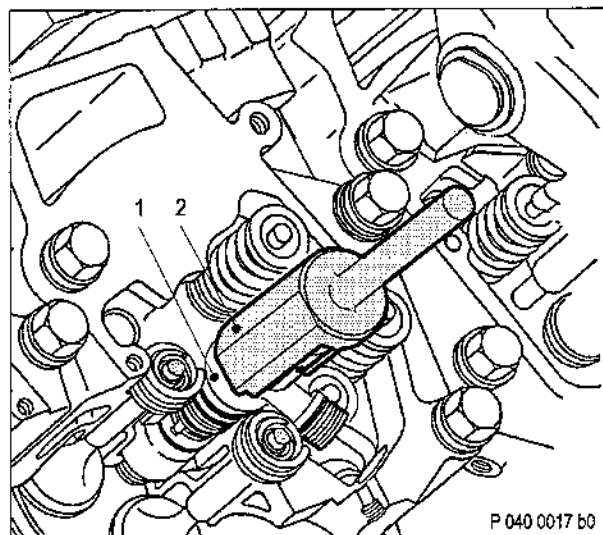
Coat O-rings with petroleum jelly and fit on injector. Affix sealing ring with grease on mating face of injector.

Note: Ensure that sealing ring is correctly fitted, see next illustration.

Check sealing surface on cylinder head and nozzle holder; clean if necessary.

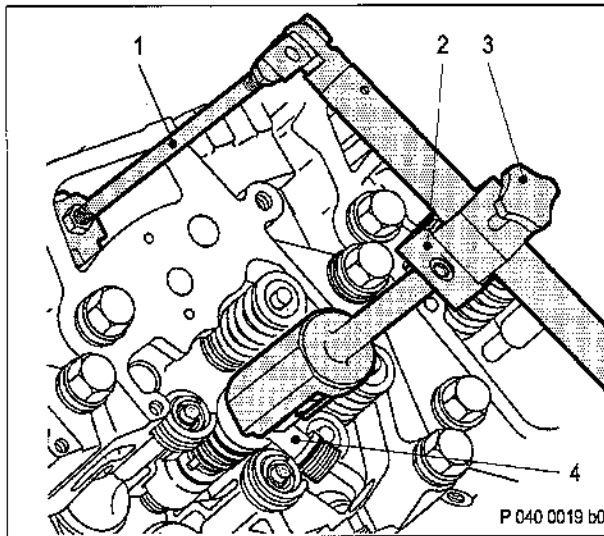


Fit sealing ring on injector so that level contact surface faces injector.



Insert injector (1) into cylinder head, ensuring that H.P. line connection is correctly aligned.

Fit installation sleeve (2).

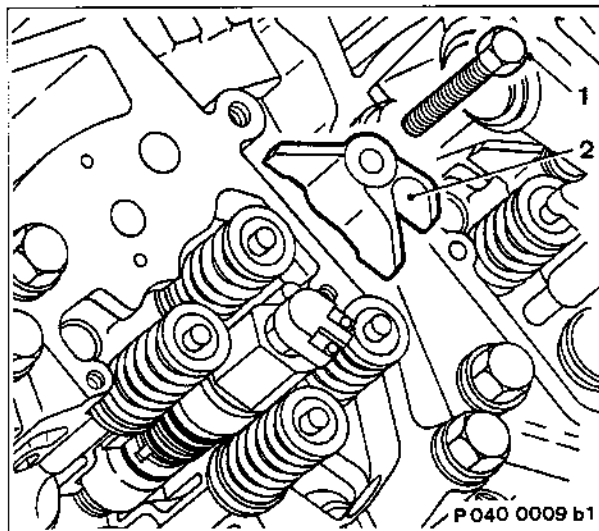


Lock retaining device (1) of press-fitting tool between pushrods.

Release palm grip (3) and move pressure section (2) to correct position for installation sleeve.

Lock palm grip and press injector (4) with press-fitting tool into cylinder head.

Remove installation tool.

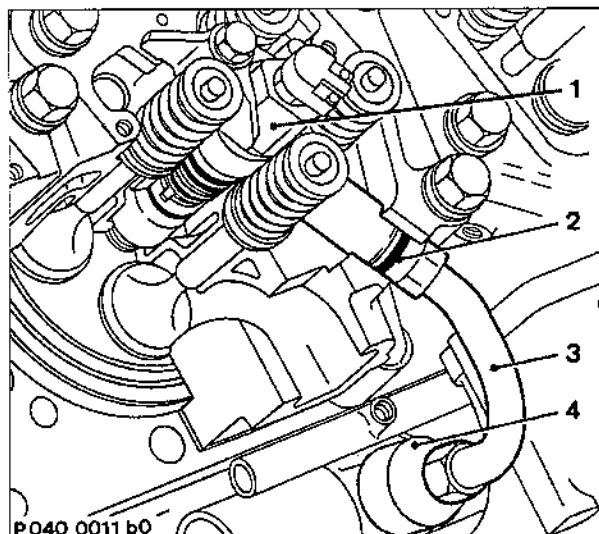


Mount hold-down clamp (2), ensuring it is correctly positioned, and pretighten hex screw (1) (see Overview drawing C 075.05.01); injector must still be rotatable.

To ensure smooth assembly on injector, the following procedure should be used for **Reman cylinder heads** in conjunction with **new CE rings**:

- 1 Tighten hex screws (1) to 100 Nm +10 Nm and then release.
- 2 Pretighten hex screw, see Overview drawing C 075.05.01; injector must still be rotatable.

Note: Hex screw of hold-down clamp is not fully tightened until H.P. line is fitted.



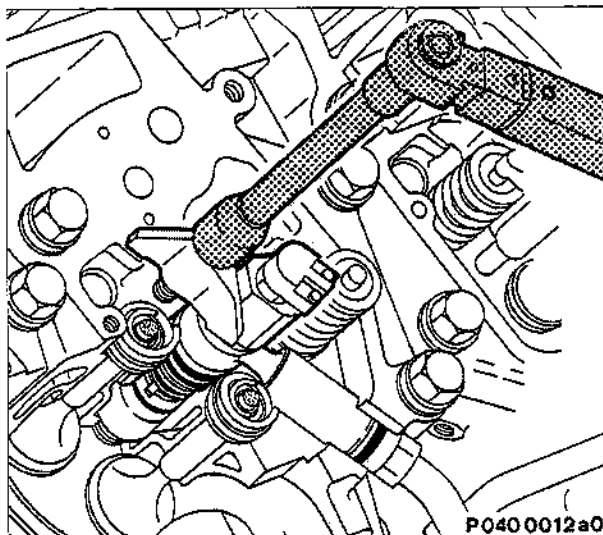
Note: Do not bend the H.P. line and pay attention to installation position.

Retighten thrust rings at both ends of line with face spanner – see C 077.05.10.

Coat O-rings with petroleum jelly and insert in grooves on union nuts (2) and (4).

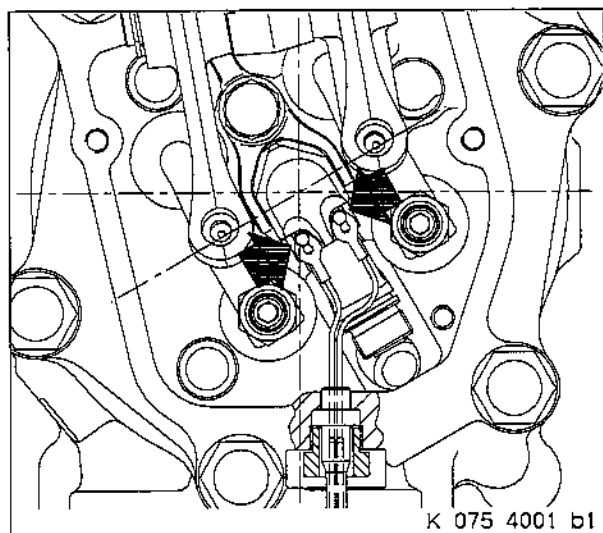
Install H.P. line on injector (1) and on limiting valve.

Fit H.P. by hand and pretighten to 10 Nm.



Tighten hex screw of hold-down clamp to tightening torque – see Overview drawing C 075.05.01.

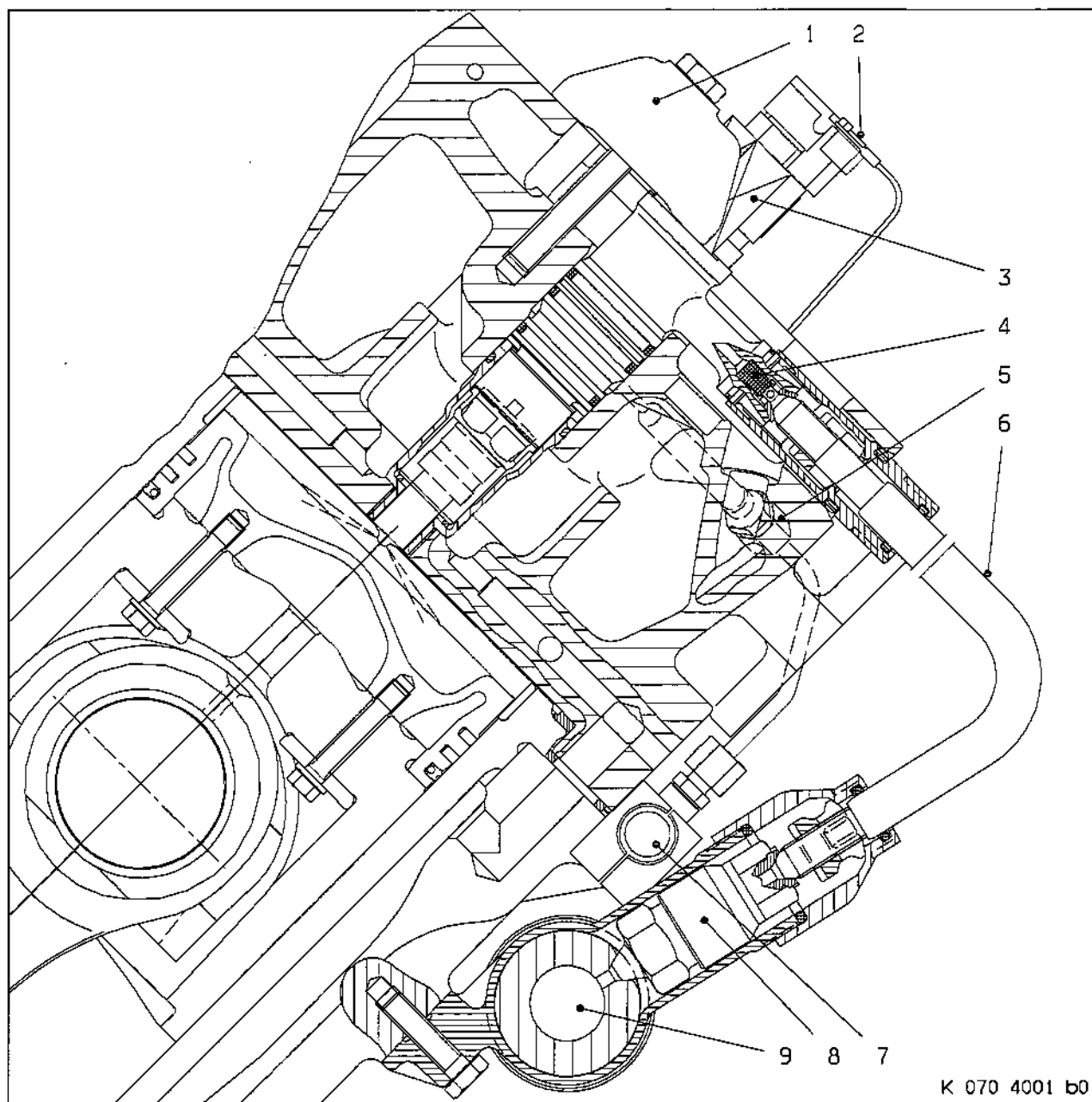
Install threaded union of H.P. line on injector (1) and on connector for limiting valve (2) – for tightening torque, see Overview drawing C 077.05.01.



Push cable terminals under screws on injector and tighten to specified tightening torque, see Overview drawing C 077.05.01.

C075.05.12 After-installation operations

			For the following tasks, a distinction must be made as to whether:	
			→ → →	The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	x	x	Assembly in reverse sequence to disassembly	→ 075.05.04
–	–	x	Release engine start	→ Operating Instructions

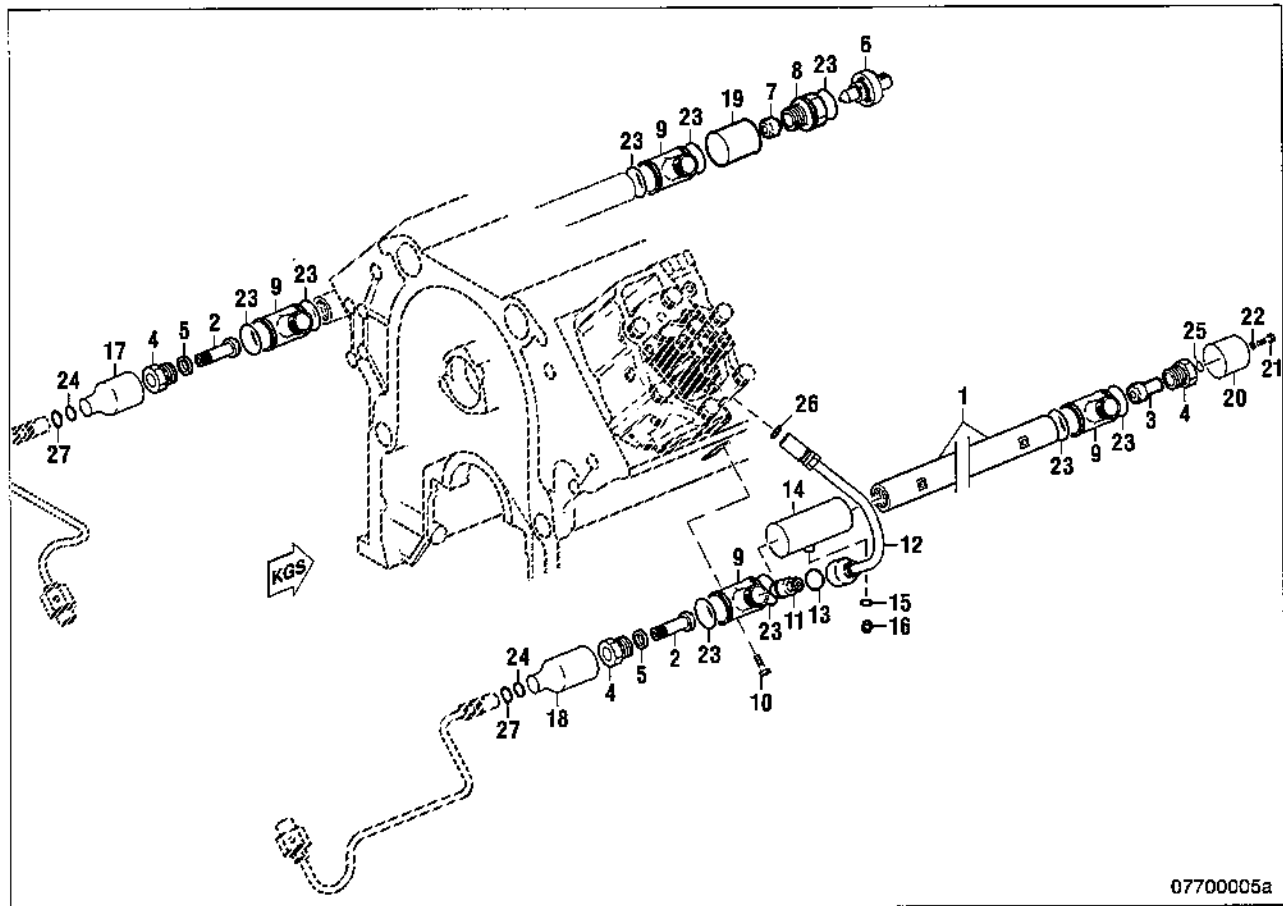
C077.05 Injection Line / High-Pressure Line**C077.05.01 Overview drawing**

K 070 4001 b0

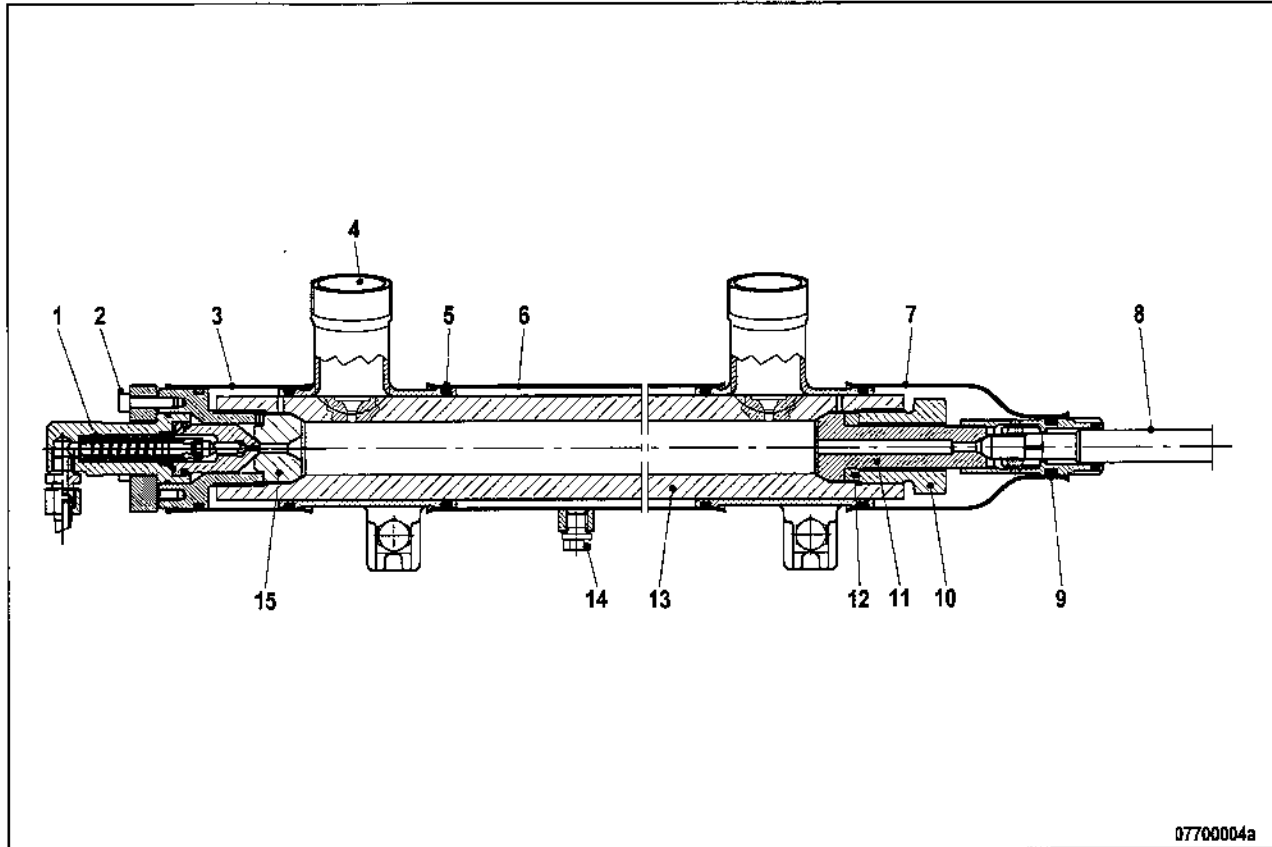
- 1 Hold-down clamp
- 2 Cable connection
Tightening torque: 1 Nm
- 3 Injector
- 4 Filter head
- 5 Fuel return line

- 6 H.P. line
- 7 Fuel collecting line
- 8 Limiting valve
- 9 H.P. accumulator

H.P. accumulator (version with pressure relief valve 1550 bar)



- | | |
|-----------------------------------|-----------------|
| 1 H.P. accumulator | 13 O-ring |
| 2 Thrust pad | 14 Plug-in pipe |
| 3 Thrust pad | 15 Sealing ring |
| 4 Thrust screw | 16 Plug |
| Lubricant: Engine oil | 17 Plug-in pipe |
| Tightening torque: 550 Nm + 50 Nm | 18 Plug-in pipe |
| 5 Washer | 19 Plug-in pipe |
| 6 Pressure relief valve | 20 Plug-in pipe |
| 7 Adapter | 21 Hex screw |
| 8 Thrust screw | 22 Washer |
| Lubricant: Engine oil | 23 O-ring |
| Tightening torque: 550 Nm + 50 Nm | 24 O-ring |
| 9 Connector | 25 O-ring |
| 10 Hex screw | 26 O-ring |
| Lubricant: Engine oil | 27 Snap ring |
| Tightening torque: 57 Nm + 6 Nm | |
| 11 Limiting valve | |
| 12 H.P. line | |
| Lubricant: Engine oil | |
| Tightening torque: 120 Nm + 10 Nm | |

H.P. accumulator, right engine side (version with pressure relief valve 1550 bar)

1 Pressure relief valve

2 Socket-head screw

Lubricant: Engine oil
Tightening torque: 15 Nm + 2 Nm

3 Plug-in pipe

4 Connector for H.P. line

5 O-ring

6 Plug-in pipe

7 Plug-in pipe

8 H.P. line

9 O-ring

10 Thrust screw

Lubricant: Engine oil
Tightening torque: 550 Nm + 50 Nm

11 Thrust pad

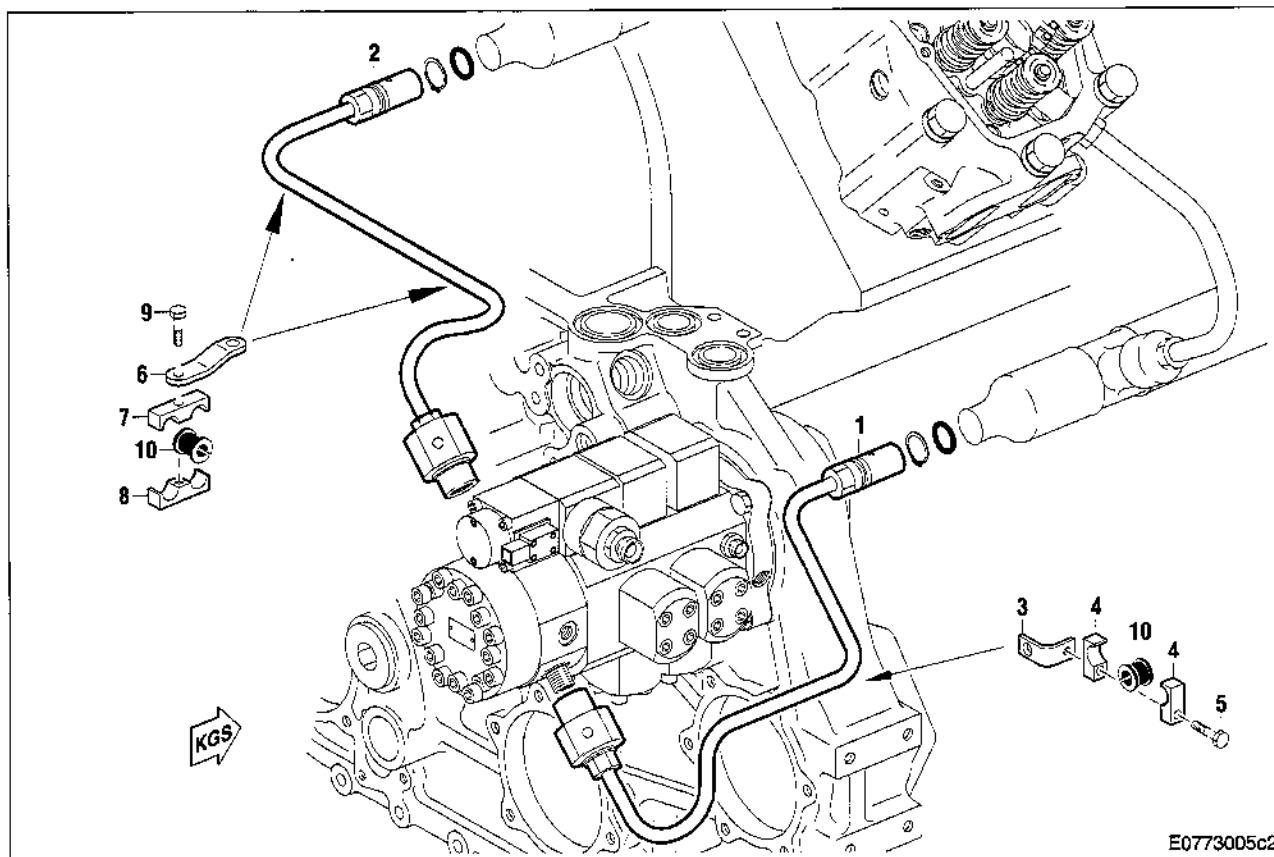
12 Washer

13 H.P. accumulator

14 Plug

15 Thrust pad

H.P. line



- 1 H.P. line, left side
Lubricant: Engine oil
Tightening torque: 100 Nm + 10 Nm
- 2 H.P. line, right side
Lubricant: Engine oil
Tightening torque: 100 Nm + 10 Nm
- 3 Bracket
- 4 Pipe clamp half

- 5 Hex screw
- 6 Bracket
- 7 Pipe clamp half
- 8 Pipe clamp half
- 9 Hex screw
- 10 Grommet

C077.05.02 Special tools

Designation	Use/dimension	Number
• Mount retaining device	for H.P. accumulator	1
• Alignment tool	for H.P. accumulator	2
• Tools from the W4 tool kit		1
• Hydraulic filling unit	for H.P. and L.P. fuel system	1

C077.05.04 Before-removal operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Remove engine	→ B 003
x	–	–	Perform operations as per Disassembly Plan	→ B 004
–	–	x	Disable engine start	→ Operating Instructions
–	x	x	Remove charge air manifolds	→ C 123.05

C075.05.05 Removal**Removing H.P. lines between H.P. pump and H.P. accumulator**

Note: Before removing H.P. lines, it is advisable to photograph the mounted lines or attach metal tags to the lines so that they can be reinstalled in their original positions.

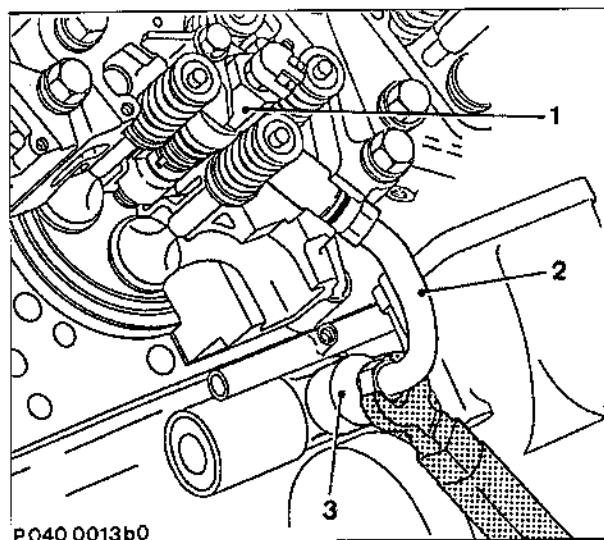

WARNING

Fuels and fuel mists are flammable and poisonous. Risk of fire, explosions and poisoning! When using fuel: – do not use naked flame, – no electric sparks, – do not smoke, – do not spill fuel – do not inhale. Always wear protective gloves and protective goggles/safety mask. Ventilate working area well.

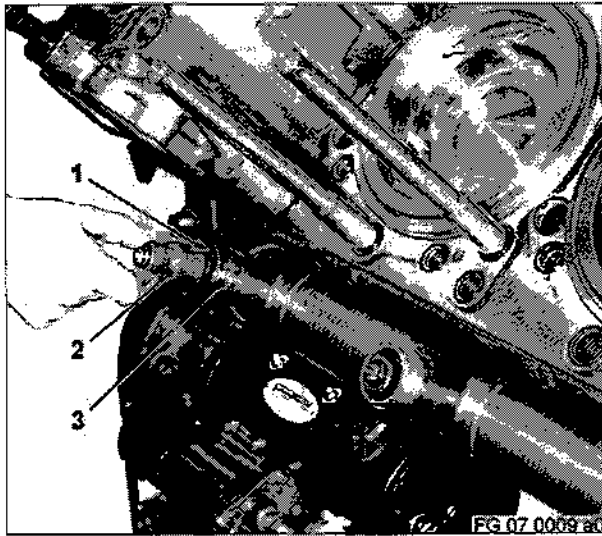
Release H.P. line threaded connections and catch fuel emerging in a suitable container.

Remove H.P. fuel lines between H.P. pump and H.P. accumulator – see C 077.05.01.

After removing H.P. lines, seal all open connections by installing suitable plugs.

**Removing H.P. lines**

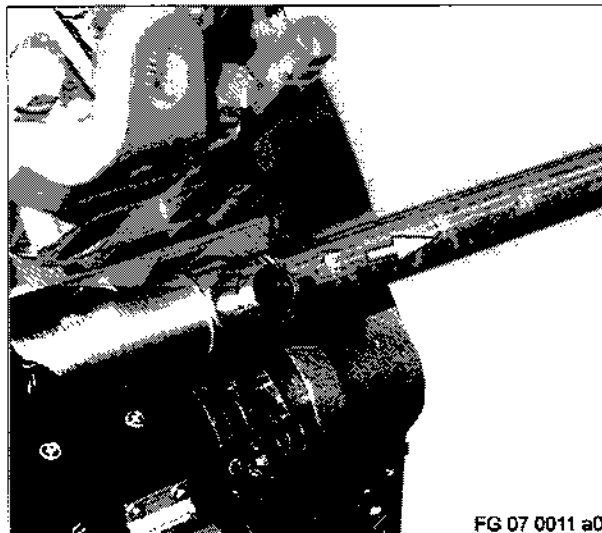
Unscrew and remove H.P. line (2) from injector (1) and limiting valve (3).



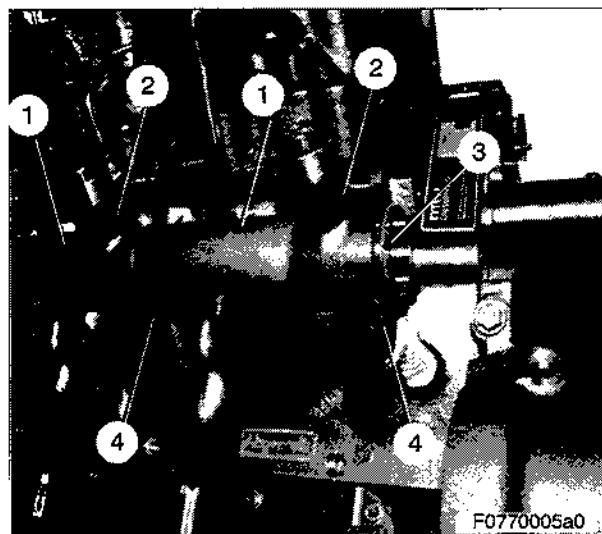
Removing H.P. accumulator

Remove limiting valve (2) from connector (3).

Remove fuel return lines and plug-in pipe end pieces (1) or pressure relief valve as per Overview drawing (see C 077.05.01) from H.P. accumulator.

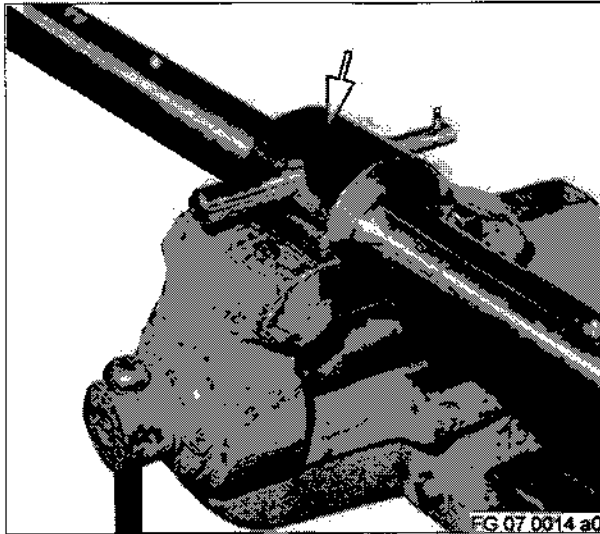


Carefully remove H.P. accumulator from connectors and plug-in pipes.

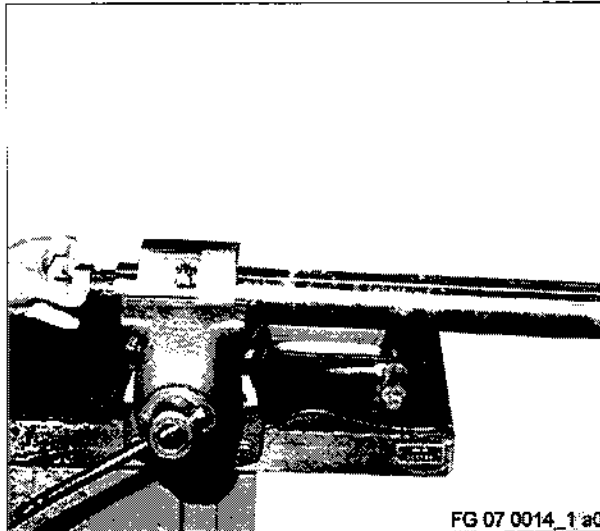


Release connector (2), hex screws (4) and remove with plug-in pipe (1) from crankcase.

Remove O-ring (3) from connections.

C077.05.06 Disassembly**Disassembling H.P. accumulator**

Use retaining device (arrow) to clamp H.P. accumulator in vice.



Remove thrust screws.

Remove thrust pad and pressure relief valve.

C075.05.07 Inspection and repair

Clean all components.

Check thread of hex screws for damage; replace screws if necessary.

Check condition of threads of H.P. lines and connectors for ease of movement; replace components as necessary.

Check sealing cones of thrust pads and pressure relief valve for damage and wear, and replace as necessary.

Check sealing taper of H.P. accumulator for damage and wear; replace component if necessary.

Using the magnetic crack-testing method with fluorescent magnetic powder, check H.P. accumulator for cracks; replace component if necessary.

Check H.P. lines, plug-in pipes and fuel return line for damage and wear; replace components as necessary.

After damage to the ceramic bearing of the high-pressure pump, flush the H.P. lines and check that they are particularly clean; see also Section C 083.05.07 Fuel filter.

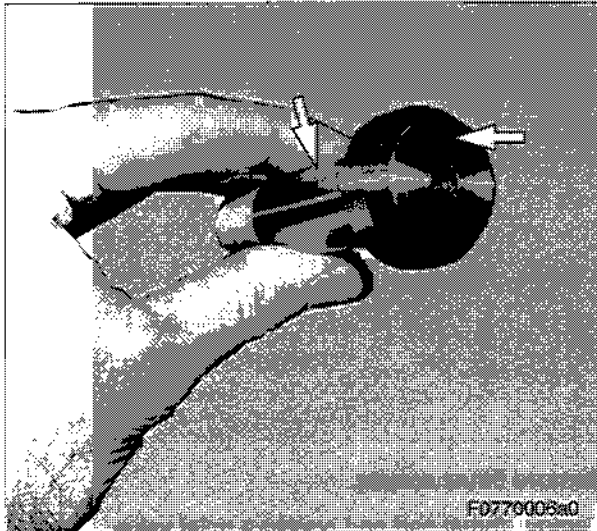
For checking limiting valves and pressure relief valves, see Manufacturer's Documentation.

Consult MTU service for further information..

Check that H.P. lines and H.P. accumulator are perfectly clean.

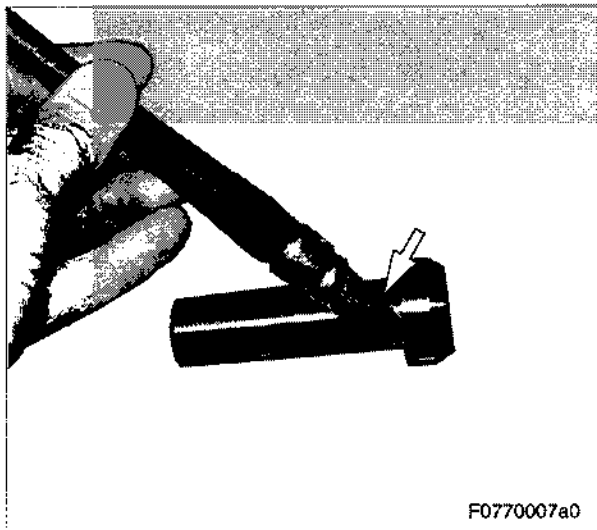
Note: Do not bend the H.P. line!
Replace O-rings and sealing rings at every assembly.

C075.05.10 Assembly

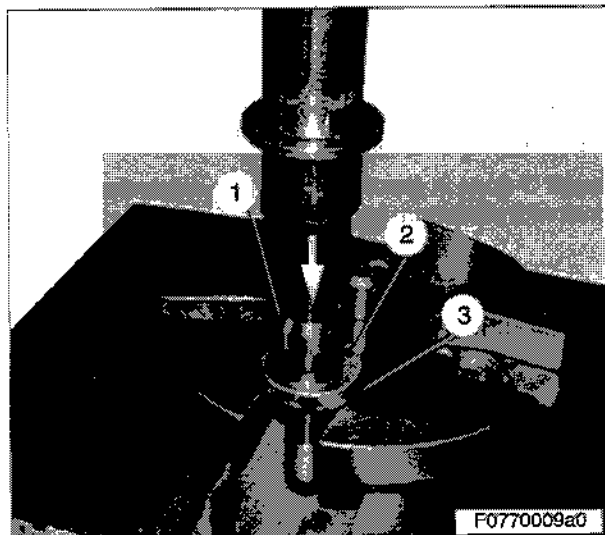


Assembling H.P. accumulator

Note: Make sure parts are perfectly clean.
Clean and degrease surfaces (arrows) of thrust pad.

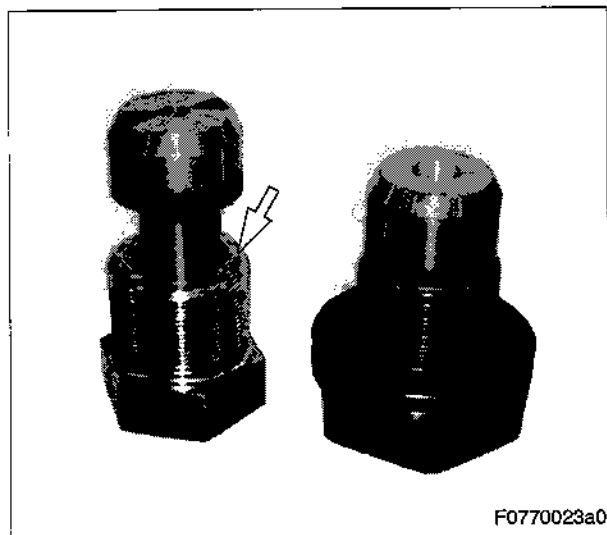


Coat surface (arrow) with oil.



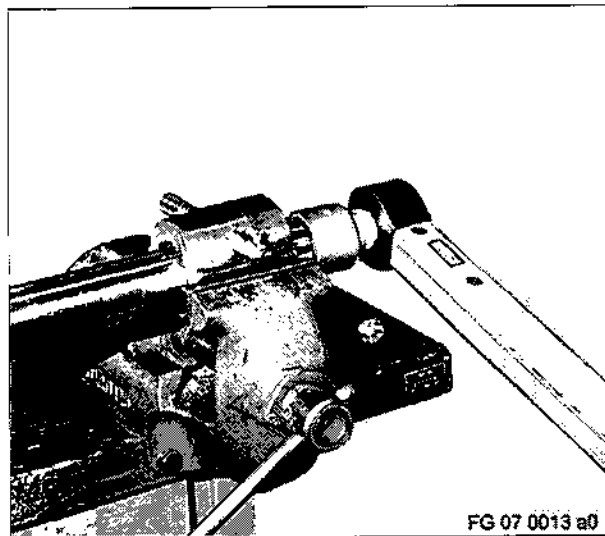
Press-fit washer (2) on thrust pad (1), ensuring there is no gap.

Note: Protect washer with disc (3) against damage.



Coat thread and pressure surface (arrows) of thrust screws with engine oil.

Join thrust screw to preassembled thrust pad.



Use retaining device to clamp H.P. accumulator in vice.

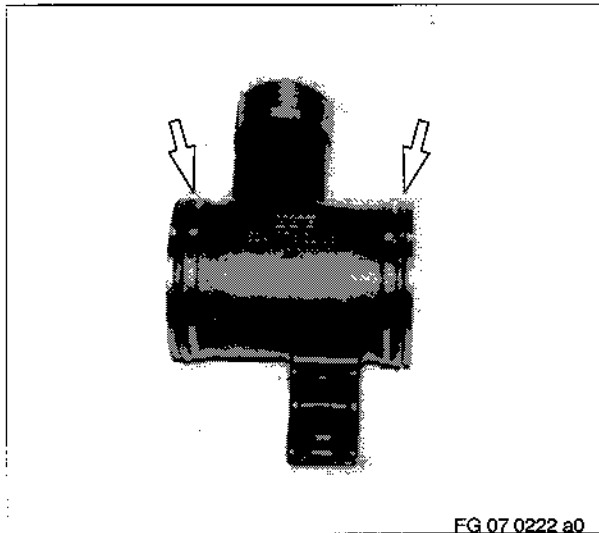
Insert prepared thrust pad with thrust screw in support bore and tighten to specified tightening torque – see C 077.05.01.

Insert pressure relief valve in opposite support bore of H.P. accumulator.

Insert thrust screw and tighten to specified torque.

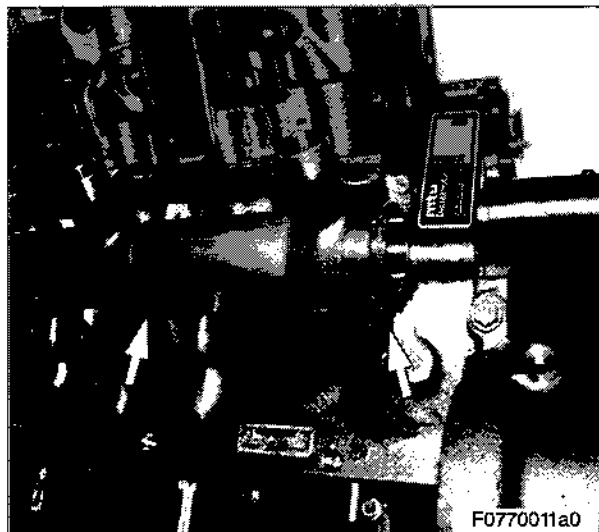
C075.05.11 Installation

Note: Make sure fuel-carrying components are perfectly clean.
Prior to installation, remove all blanking plug and/or covers.



Installing H.P. accumulator

Insert O-rings in grooves (arrow) on connector and coat with petroleum jelly.

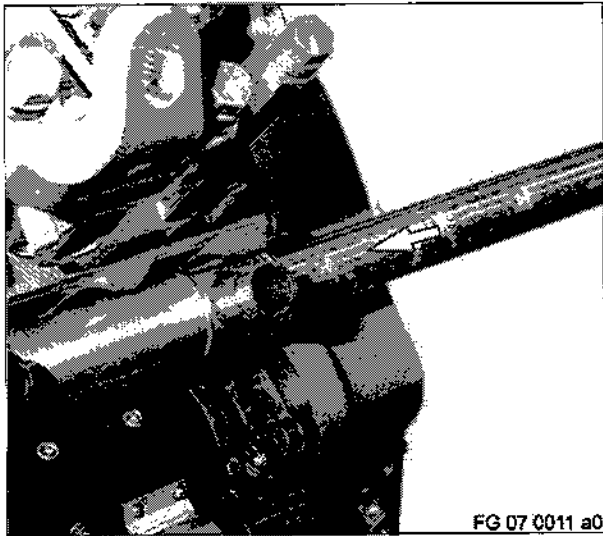


Fit connectors and plug-in pipes together in alternating sequence.

Fit plug-in pipes over O-rings of connectors.

Note: Make sure mating face of connector is correctly positioned with regard to crankcase, corresponding to left or right engine side.

Fit hex screws (arrow) to secure connectors on crankcase and tighten to 5 Nm to 10 Nm.



Carefully insert H.P. accumulator in preassembled connector and plug-in pipe assembly.

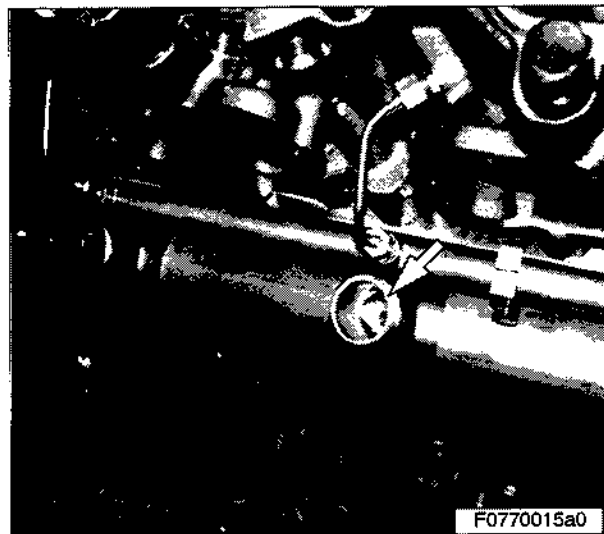
Note: Ensure that H.P. accumulator is correctly positioned.



Insert alignment tools in tightened connectors (first and last connector of respective engine side).

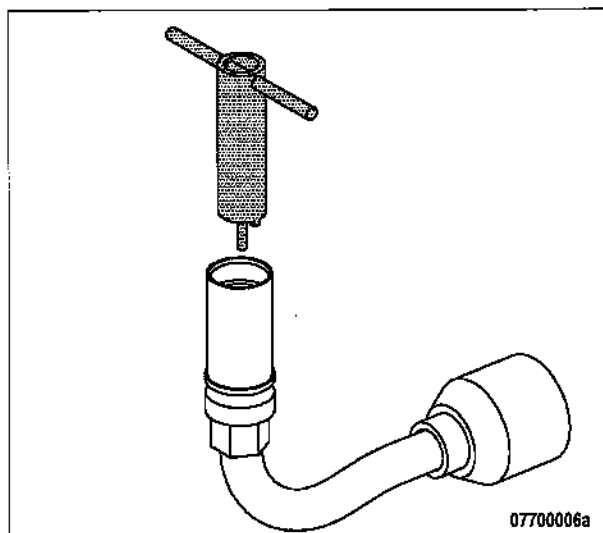
Align H.P. accumulator until alignment tool taper is centred in bore of H.P. accumulator.

Tighten alignment tools to 20 Nm + 2 Nm.



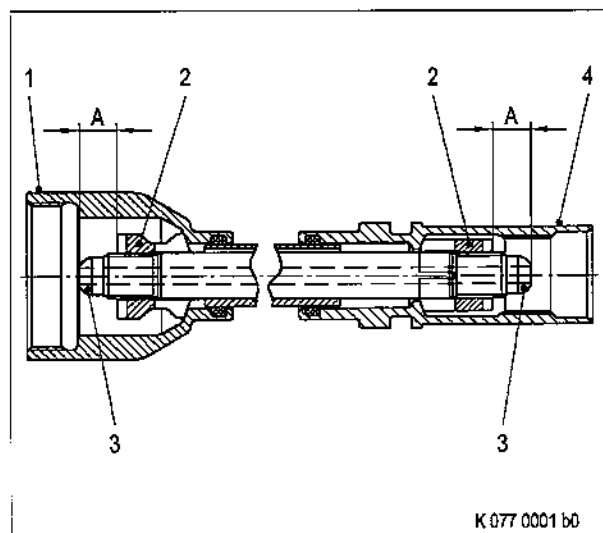
Insert limiting valves into free outlets (arrow) of connectors.

Note: Remove alignment tools only after injection lines have been installed.



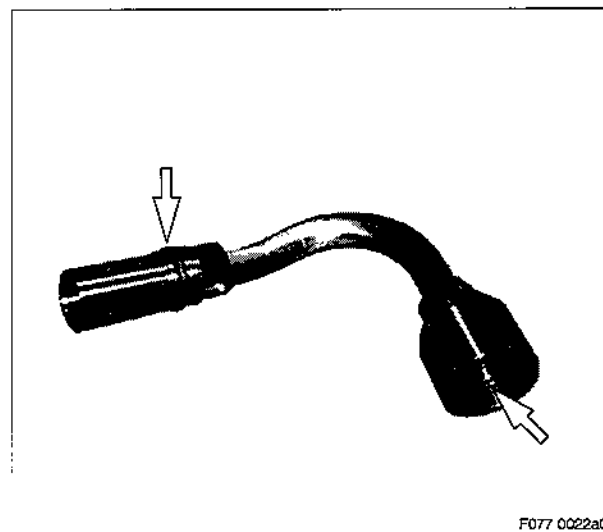
Installing H.P. lines

Check thrust rings at both ends of line for security with face spanner (10 Nm).

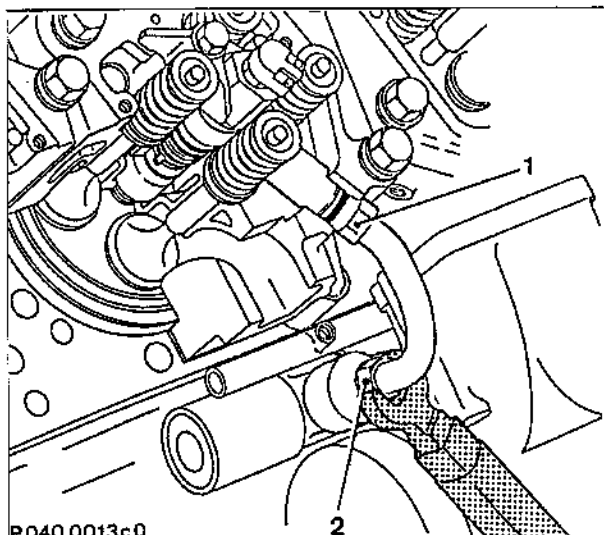


Measure distance (A) from end of line to thrust ring.

A = 11.7 mm.



Insert O-rings (arrows) in grooves.



Note: If injectors are removed, procedure as in Section C 075.05 11.

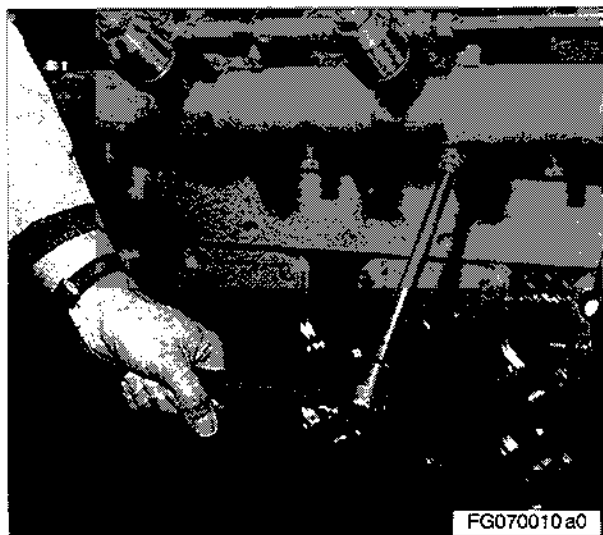
Install H.P. line on injector and on limiting valve.

Pretighten union nuts (1) and (2) to 5 Nm to 10 Nm.

Note: If necessary, for further tension-free assembly, release hex screws for connectors – see next illustration.

Tighten union nuts to specified tightening torque – see Overview drawing C 077.05.01.

Remove alignment tools for H.P. accumulator and other H.P. lines as described.



Tighten hex screws for connectors to crankcase to specified tightening torque – see Overview drawing C 077.05.01.

Tightening sequence: From centre outwards.

Complete H.P. accumulator and connect to return lines – see Overview drawing C 077.05.01.

Installing H.P. lines between H.P. pump and H.P. accumulator

Note: Before installation, remove all blanking plugs.



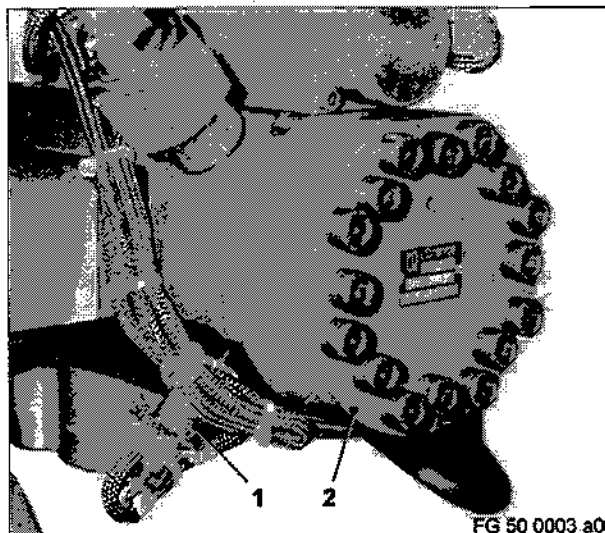
CAUTION

Compressed air is air pressurised by overpressure. If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask. Compressed air must not be directed at the body.

The pressure must not exceed 3.0 bar (40 lb/in²).

Blow out H.P. lines with compressed air and make sure they are perfectly clean.

Install H.P. lines with securing elements in accordance with Overview drawing (see C 081.05.01), or install tension-free as shown in the photo or as per markings.



Leak-checking COMMON Rail System

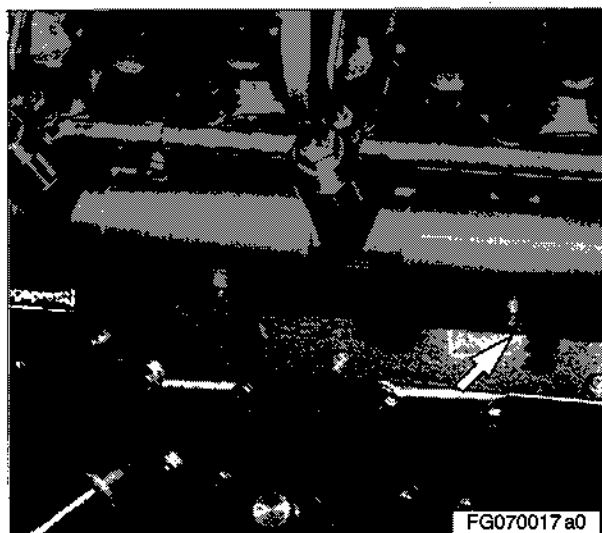
Remove pressure sensor (1) from high-pressure pump (2).



**Compressed air is highly pressurized.
Risk of injury!
Test pressure must not be exceeded.
Always wear protective clothing, protective
gloves and protective goggles/safety mask.**

Install H.P. line and apply pressure to system.

Test pressure = 3 bar



Remove control screws (arrow) from H.P. accumulator.

Check all threaded connections in system for leaks.

Remove H.P. inspection line.

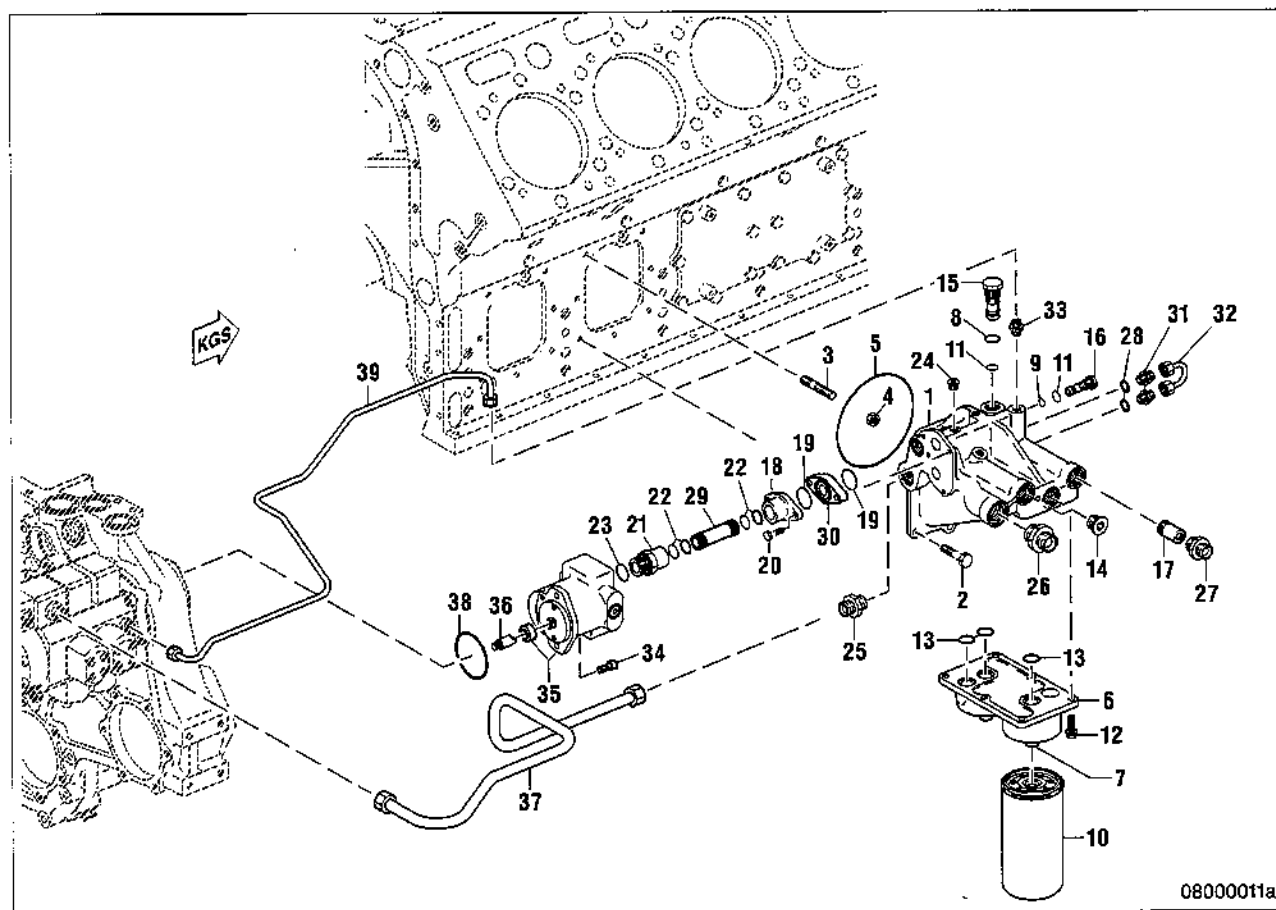
Install high-pressure sensor – see C 507.00.

Fit checking screws.

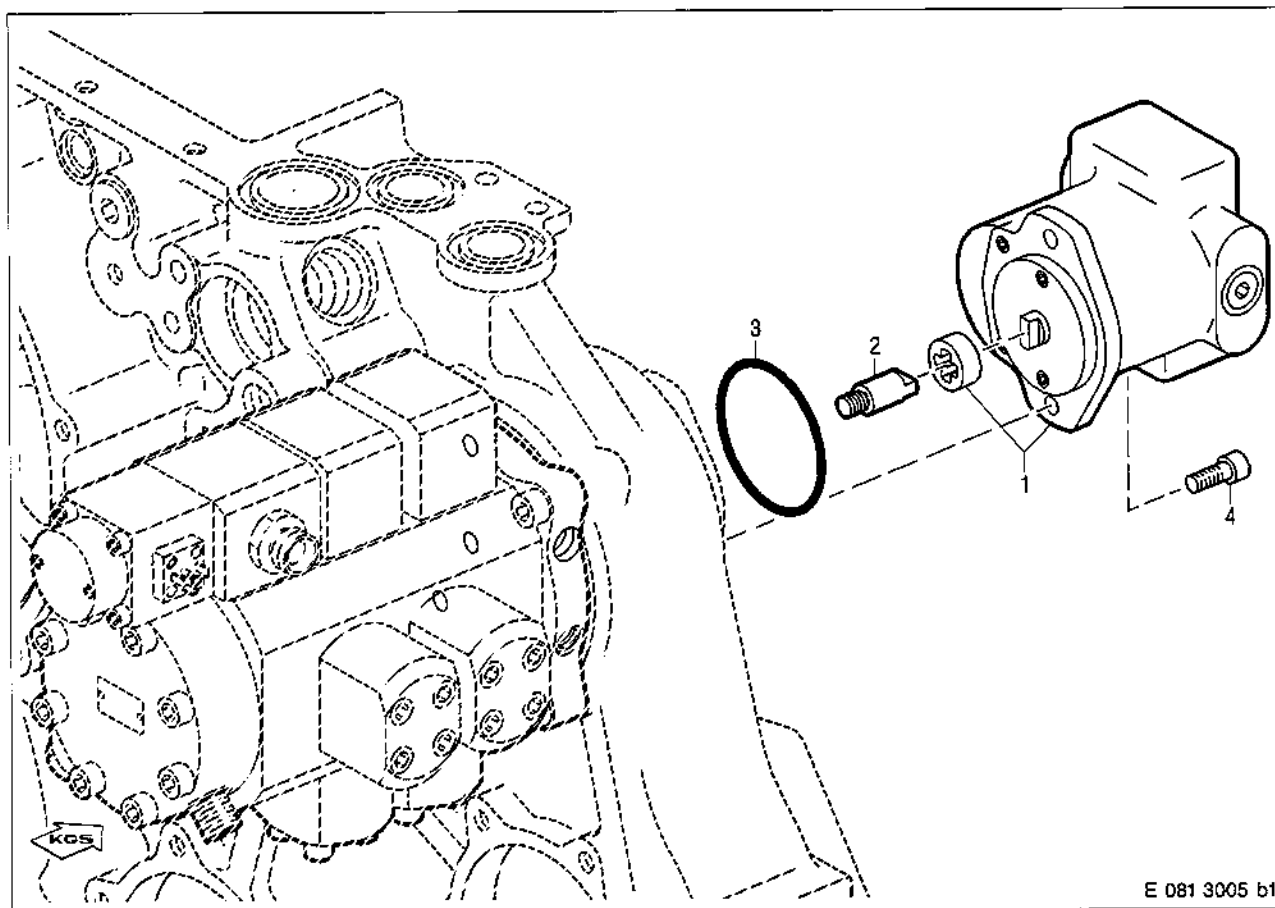
C077.05.12 After-installation operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	–	x	Assembly in reverse sequence to disassembly	→ C 077.05.04
–	–	x	Fill fuel system	→ Operating Instructions
–	–	x	Release engine start	→ Operating Instructions

C080	Fuel System (Low-Pressure)	C – 1
C081.10	Fuel Pump	C – 3
C081.10.01	Overview drawing	C – 3
C081.10.04	Before-removal operations	C – 4
C081.10.05	Removal	C – 4
C081.05.06	Disassembly	C – 4
C081.05.08	Inspection and repair	C – 5
C081.10.11	Installation	C – 5
C081.05.12	After-installation operations	C – 6
C083.05	Fuel Filter	C – 7
C083.05.01	Overview drawing	C – 7
C083.05.02	Special tools	C – 8
C083.05.04	Before-removal operations	C – 9
C083.05.05	Removal	C – 9
C083.05.06	Disassembly	C – 9
C083.05.08	Inspection and repair	C – 9
C083.05.10	Assembly	C – 11
C083.05.11	Installation	C – 11
C031.05.12	After-installation operations	C – 12
C086.05	Leak-off fuel line	C – 13
C086.05.01	Overview drawing	C – 13
C086.05.04	Before-removal operations	C – 14
C086.05.05	Removal	C – 14
C086.05.08	Inspection and repair	C – 14
C086.05.11	Installation	C – 15
C086.05.12	After-installation operations	C – 15

C080 Fuel System (Low-Pressure)

- | | | | |
|----------------------------|-------------------------------|------------------|---|
| 1 Fuel distributor housing | 11 O-ring | 21 Union | 31 Union |
| 2 Hex screw | 12 Hex screw | 22 O-ring | 32 Fuel line |
| 3 Stud | 13 O-ring | 23 O-ring | 33 Union |
| 4 Nut | 14 Blanking plug | 24 Blanking plug | 34 Socket-head screw |
| 5 O-ring | 15 Pressure maintaining valve | 25 Union | 35 Fuel delivery pump with coupling element |
| 6 Filter head | 16 Valve (1.7 bar) | 26 Union | 36 Intermediate element |
| 7 Bracket | 17 Valve | 27 Union | 37 Fuel line |
| 8 O-ring | 18 Flange | 28 O-ring | 38 O-ring |
| 9 O-ring | 19 O-ring | 29 Plug-in pipe | 39 Fuel return line |
| 10 Filter head | 20 Hex screw | 30 Flange | |

C081.10 Fuel Pump**C081.10.01 Overview drawing**

- 1 Fuel delivery pump
with coupling element
- 2 Intermediate element
- 3 O-ring
- 4 Socket-head screw

C081.10.04 Before-removal operations

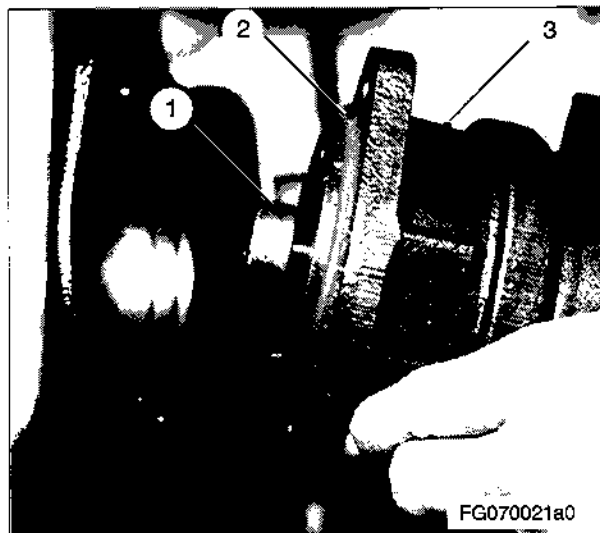
			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Remove engine	→ B 003
x	–	–	Perform operations as per Disassembly Plan	→ B 004
–	–	x	Disable engine start	→ Operating Instructions
–	x	x	Remove charge air manifold	→ C 124.05.05
–	x	x	Remove fuel supply line	→ C 086.05.05
–	x	x	Remove plug-in pipes	→ C 083.05.05

C081.10.05 Removal



WARNING

Fuels are combustible. Risk of fire! When working on the fuel system:
 – do not use naked flame – no electric sparks – do not smoke – do not spill fuel.



Remove fuel delivery pump

Remove socket-head screws for fuel delivery pump.
 Pull fuel delivery pump (3) from its seat and remove.
 Remove coupling element (1) from drive shaft of fuel delivery pump.
 Remove O-ring (2).

C081.05.06 Disassembly

Fuel delivery pump must not be disassembled.

In event of wear or other defects, the fuel delivery pump must be replaced.

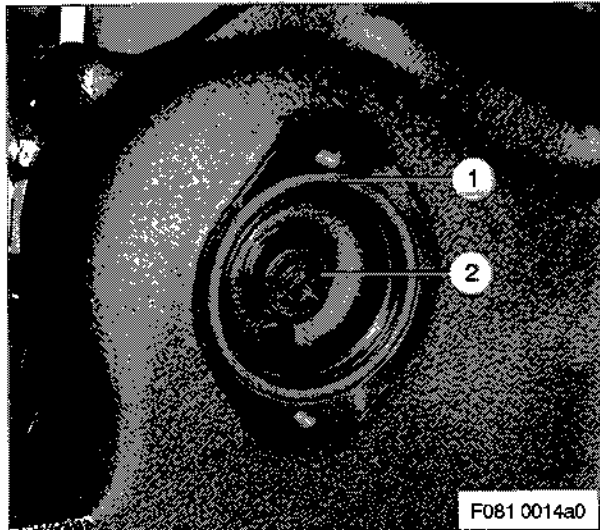
C081.05.08 Inspection and repair

Check fuel delivery pump externally for damage and condition.

Check securing screws for condition and thread for ease of movement; replace screws if necessary.

Check coupling element for wear and damage, replace component if necessary.

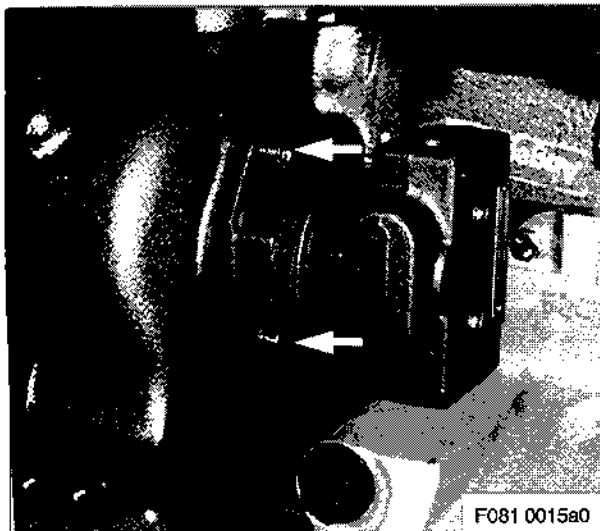
Check pump shaft driver for wear; rub down with an emery cloth or oilstone, replace delivery pump if necessary.

C081.10.11 Installation**Installing fuel delivery pump**

Note: Make sure that oil-carrying and fuel-carrying components are perfectly clean.

Insert O-ring (1) in equipment carrier.

Mount coupling piece (2) on H.P. pump driver.



Align driver of fuel delivery pump driver to coupling element.

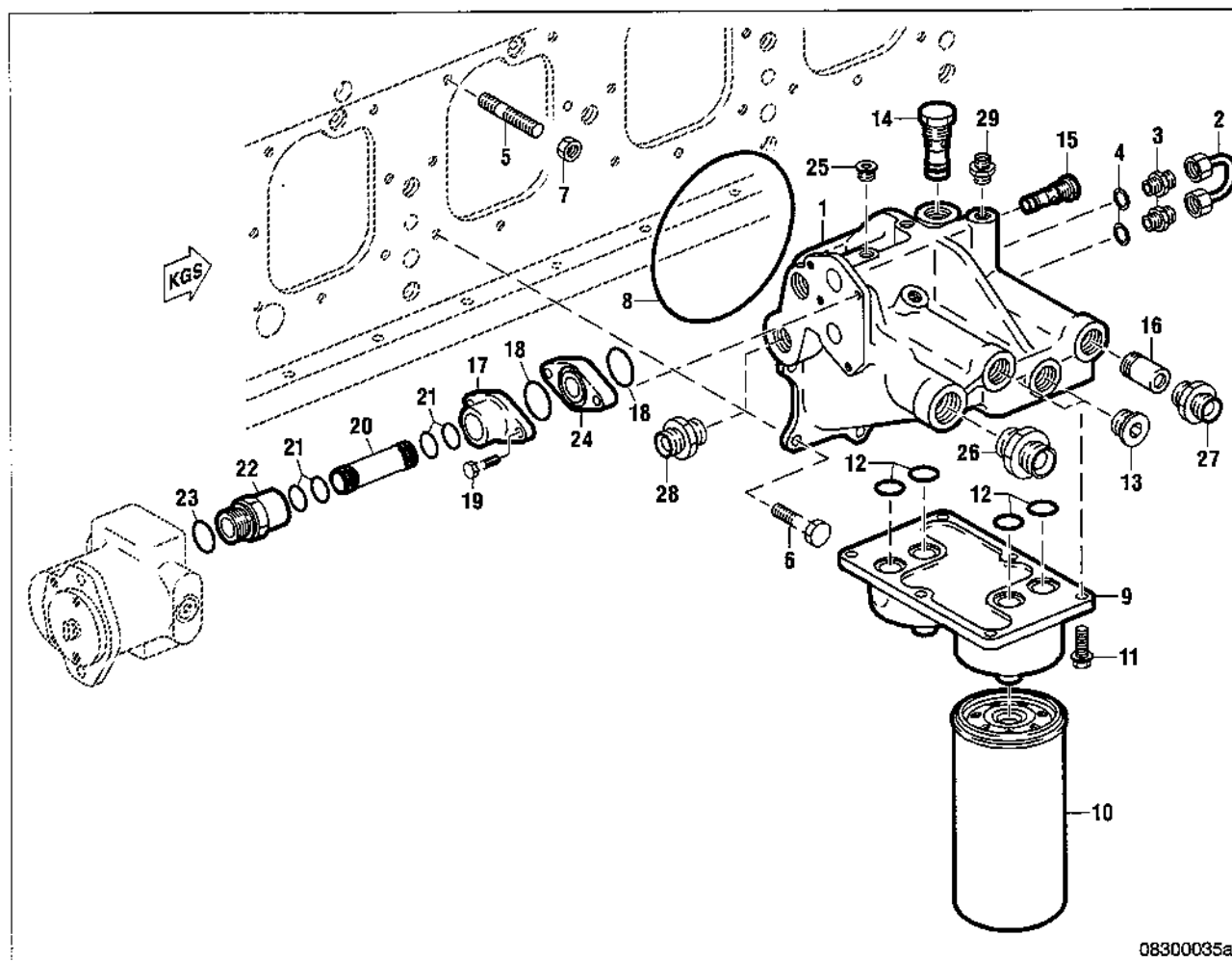
Install fuel delivery pump in equipment carrier, making sure driver is correctly positioned on coupling element.

Note: If the pump does not move in as far as the stop, withdraw the pump again and check the position of the driver with regard to the coupling element.

Tighten fuel delivery pump with socket-head screws (arrows).

C081.05.12 After-installation operations

For the following tasks, a distinction must be made as to whether:				
				The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	x	x	Assembly in reverse sequence to disassembly	→ C 081.10.04
–	–	x	Fill fuel system	→ Operating Instructions
–	–	x	Release engine start	→ Operating Instructions

C083.05 Fuel Filter**C083.05.01 Overview drawing**

1 Fuel distribution housing

2 Fuel line

3 Adapter

4 Sealing ring

5 Stud M 10

6 Hex screw

7 Nut

8 O-ring

9 Filter head

10 Filter cartridge

11 Screw

12 O-ring

13 Blanking plug

14 Pressure maintaining valve (2 bar)

15 Valve (1.7 bar)

16 Valve

17 Flange

18 O-ring

19 Hex screw

20 Plug-in pipe

21 O-ring

22 Union

23 O-ring

24 Flange

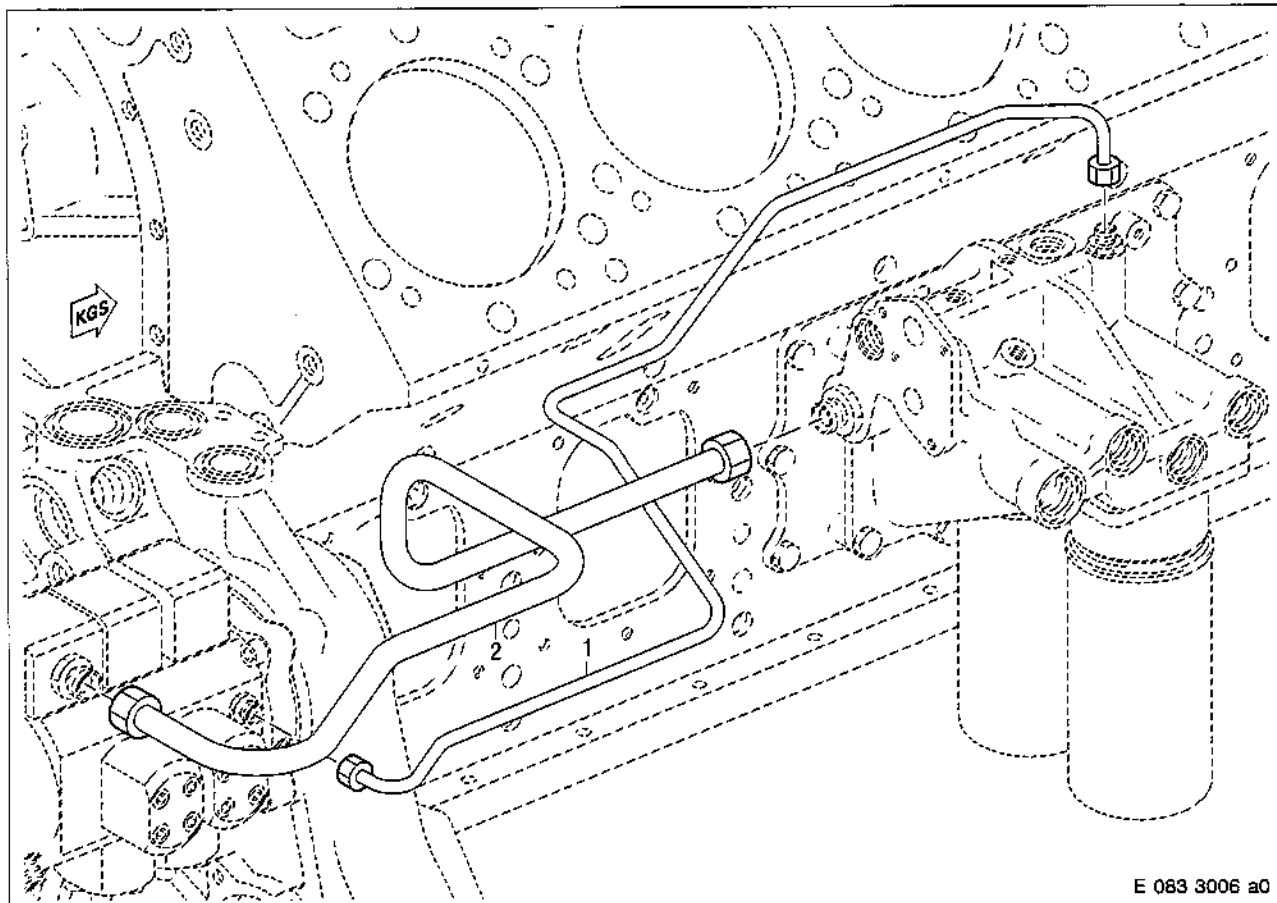
25 Blanking plug

26 Union

27 Union

28 Union

29 Union



E 083 3006 a0

- 1 Fuel line
- 2 Fuel return line

C083.05.02 Special tools

Designation	Use/dimension	Number
• Oil filter wrench	also for fuel filter	1

C083.05.04 Before-removal operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Remove engine	→ B 003
x	–	–	Perform operations as per Disassembly Plan	→ B 004
–	–	x	Disable engine start	→ Operating Instructions
–	x	x	Remove charge air manifold	→ C 124.05.05
–	x	x	Remove fuel supply line	→ C 086.05.05

C083.05.05 Removal


WARNING

Fuels are combustible. Risk of fire! When working on the fuel system:
 – do not use naked flame – no electric sparks – do not smoke – do not spill fuel.

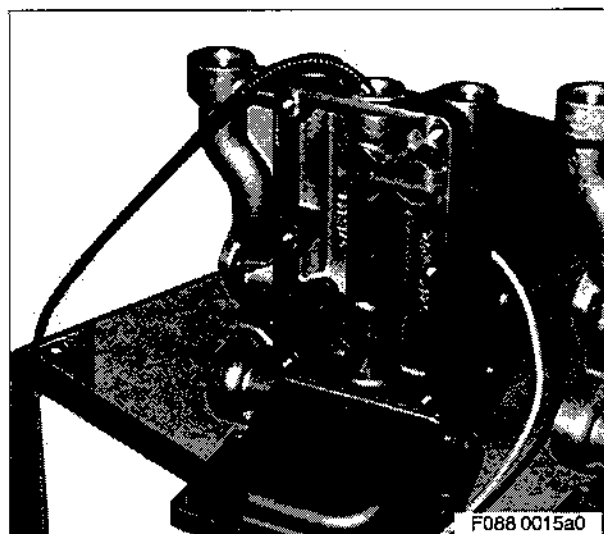
Remove fuel filter with oil filter wrench and dispose of in accordance with local regulations.

Remove plug-in pipes and flanges as shown in Overview drawing – see C083.05.01.

Remove fuel distribution housing as shown in Overview drawing – see C083.05.01.

C083.05.06 Disassembly

Disassemble filter head and distribution housing as shown in Overview drawing – see C 083.05.01.

C083.05.08 Inspection and repair**Filter head and distribution housing**

Examine all channels with cold light and check for contamination.

Clean channels with nylon brush and fuel.

Valves

Visually inspect valves for damage; replace if necessary.

Check valves for leaks and correct opening pressure; if leaks are found or opening pressure is incorrect, replace valves.

Note: Make sure fuel-carrying components are perfectly clean.

Clean fuel lines, flanges and valves with cleaner, check for damage (visual inspection) and replace if necessary.

	CAUTION
Compressed air is air pressurised by overpressure. If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask. Compressed air must not be directed at the body. The pressure must not exceed 3.0 bar (40 lb/in²).	

Blow lines through with compressed air and make sure they are perfectly clean.

Check fuel lines with air under water for leakages; replace if leaks are found.

	CAUTION
Compressed air is air which has been compressed under pressure. Test fluid is hot. Risk of injury! Pressure must not exceed 0.5 bar (7.25 lb/in²). Always wear protective clothing, protective gloves and protective goggles/safety mask.	

Water temperature min. 30° C, max. 40° C.

Note: The component must likewise reach this temperature.

Test pressure: 0.5 bar

Check threads of union nuts and single-ended unions for ease of movement; recondition or replace part as required.

Check condition of studs in crankcase (see Overview drawing C083.05.01) and thread for ease of movement; replace studs if necessary.

Check sealing and mating faces for damage and defects; rub down with an oilstone if necessary.

Replace components with damaged or indented sealing tapers.

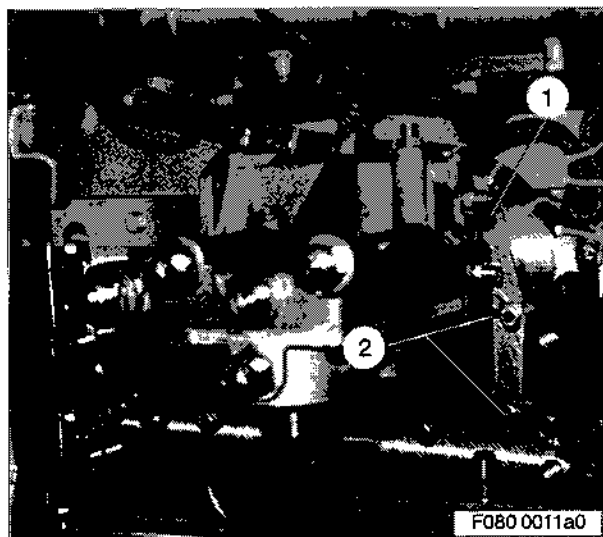
Replace gaskets and O-rings.

C083.05.10 Assembly

Note: Make sure fuel-carrying components are perfectly clean.
Coat O-rings with petroleum jelly and place in filter bowl.
When installing the valve (16) (see Overview drawing C 083.05.01), pay attention to direction of flow.
Assemble filter head and distribution housing as shown in Overview drawing – see C 083.05.01.

C083.05.11 Installation

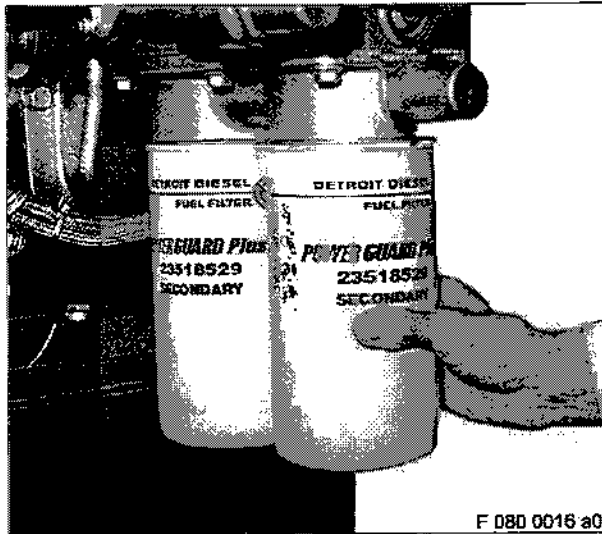
Note: Make sure fuel-carrying components are perfectly clean.



Coat O-ring with petroleum jelly and insert in distributor housing.
Fit fuel distribution housing on studs on crankcase.
Fit nuts (1).
Screw in hex screws (2).
Install nuts and hex screws and tighten.

Assemble plug-in pipes and flanges as shown in Overview drawing – see C083.05.01.

Note: Fit O-rings on plug-in pipes or in annular grooves of flanges and coat with petroleum jelly.



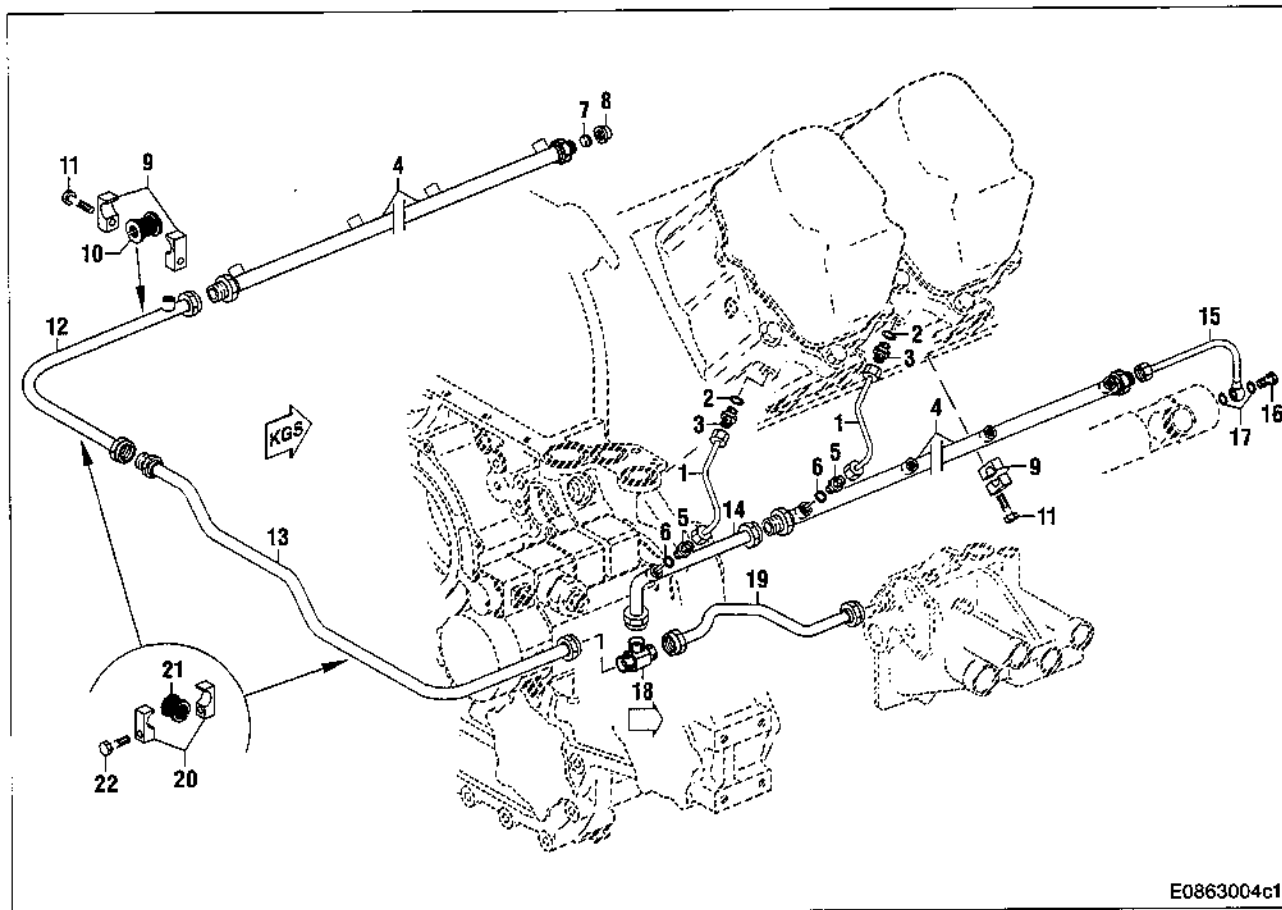
Coat sealing ring (filter) with fuel.

Install fuel filter and tighten manually.

Note: Do not use any tool to attach filter element!

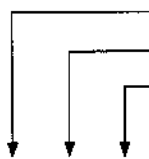
C031.05.12 After-installation operations

For the following tasks, a distinction must be made as to whether:			
↓ ↓ ↓ The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed			
Measure			See
x	–	–	Perform operations as per Assembly Plan → B 005
x	–	–	Install engine → B 007
–	x	x	Install fuel supply line → C 086.05.11
–	x	x	Install charge air manifold → C 124.05.11
–	–	x	Release engine start → Operating Instructions
–	–	x	Vent fuel system → Operating Instructions

C086.05 Leak-off fuel line**C086.05.01 Overview drawing**

- | | |
|------------------------|---------------------|
| 1 Fuel return line | 12 Fuel return line |
| 2 Sealing ring | 13 Fuel return line |
| 3 Union | 14 Fuel return line |
| 4 Fuel collecting line | 15 Fuel return line |
| 5 Union | 16 Banjo screw |
| 6 Sealing ring | 17 Sealing ring |
| 7 Sealing cone | 18 T-piece |
| 8 Sealing nut | 19 Fuel return line |
| 9 Pipe clamp half | 20 Pipe clamp half |
| 10 Grommet | 21 Grommet |
| 11 Hex screw | 22 Hex screw |

C086.05.04 Before-removal operations

For the following tasks, a distinction must be made as to whether: 				
			Measure	See
x	–	–	Remove engine	→ B 003
x	–	–	Perform operations as per Disassembly Plan	→ B 004
–	–	x	Disable engine start	→ Operating Instructions
–	x	x	Remove charge air manifold (as required)	→ C 124.10

C086.05.05 Removal

Disconnecting leak-off fuel lines

Note: Before removing fuel lines, it is advisable to take photographs of the lines on the engine or to mark the fuel lines with metal tabs to facilitate reinstallation.



Fuels and fuel mists are flammable and poisonous. Risk of fire, explosions and poisoning! When using fuel: – do not use naked flame, – no electric sparks, – do not smoke, – do not spill fuel – do not inhale. Always wear protective gloves and protective goggles/safety mask. Ventilate working area well.

Release banjo screws on fuel lines and catch fuel emerging.

Remove fuel line in accordance with Overview drawing – see C 086.05.01.

Remove sealing rings.

After removing lines, seal all open connections by installing suitable plugs.

C086.05.08 Inspection and repair

Clean fuel lines with cleaner. Check condition of lines and inspect for damage; replace lines if necessary.


CAUTION

Compressed air is air pressurised by overpressure. If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask. Compressed air must not be directed at the body.

The pressure must not exceed 3.0 bar (40 lb/in²).

Blow lines through with compressed air and make sure they are perfectly clean.

Check fuel lines with air under water for leakages; replace if leaks are found.



Compressed air is air which has been compressed under pressure. Test fluid is hot. Risk of injury! Pressure must not exceed 0.5 bar (7.25 lb/in²). Always wear protective clothing, protective gloves and protective goggles/safety mask.

Water temperature min. 30° C, max. 40° C.

Note: The component must likewise reach this temperature.

Test pressure: 0.5 bar

Check threads of union nuts and single-ended unions for ease of movement; recondition or replace part as required.

Check fuel line fixtures for damage and wear; replace components as necessary.

Replace sealing rings as part of every assembly.

Replace grommets as part of every W6 overhaul.

C086.05.11 Installation

Connecting leak-off fuel lines

Note: Before installation, remove all blanking plugs.

 CAUTION
Compressed air is air pressurised by overpressure. If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask. Compressed air must not be directed at the body. The pressure must not exceed 3.0 bar (40 lb/in²).

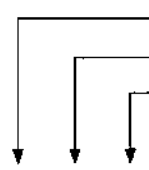
Blow out leak-off fuel lines with compressed air and make sure they are perfectly clean.

Ensure fuel bores and sealing surfaces on cylinder heads are perfectly clean; clean if necessary.

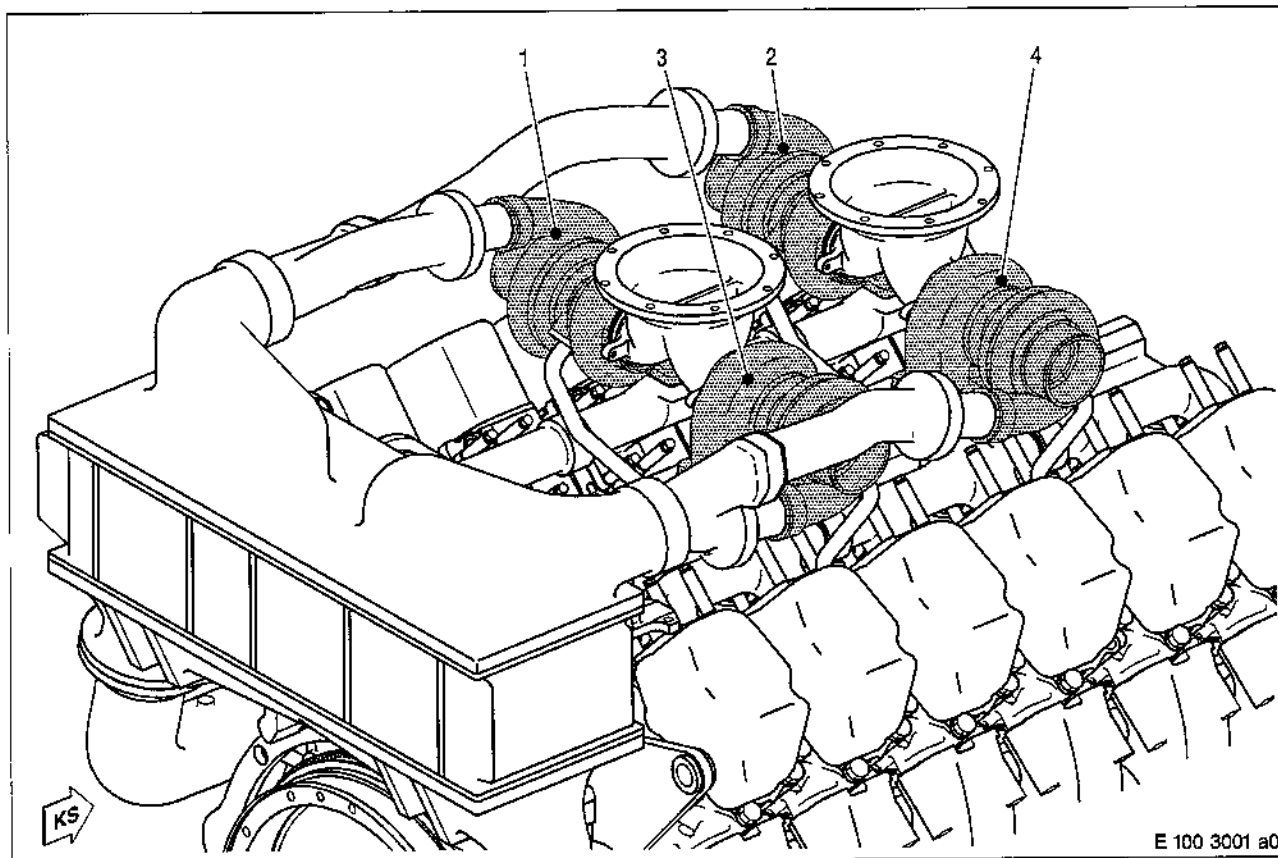
Install leak-off fuel lines with securing elements in accordance with Overview drawing (see C 086.05.01) or as per the photos or markings, ensuring they are free of tension.

Note: After engine start, visually inspect fuel system for leaks.

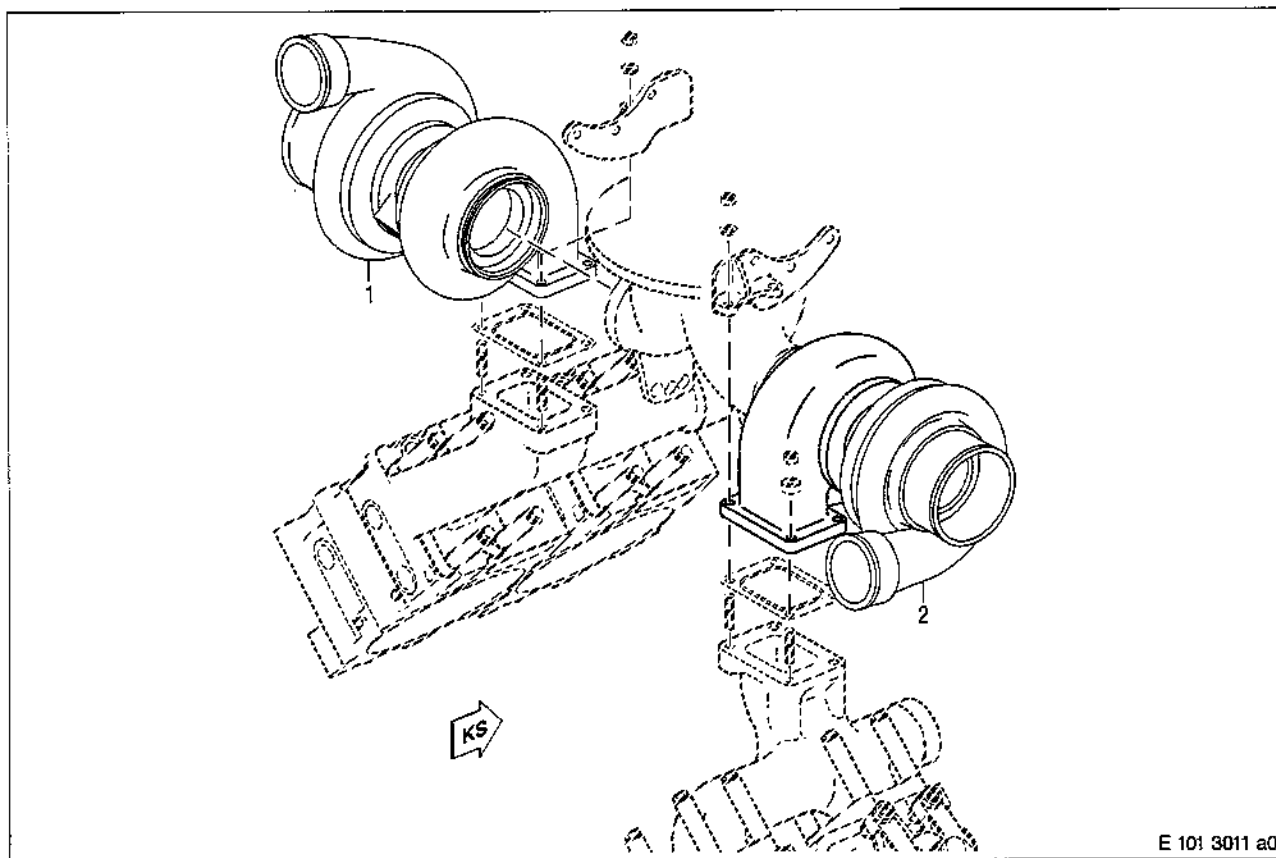
C086.05.12 After-installation operations

For the following tasks, a distinction must be made as to whether:  The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed				
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	x	x	Assembly in reverse sequence to disassembly	→ C 086.05.04
–	–	x	Release engine start	→ Operating Instructions

C100	Exhaust turbocharger	C – 1
C101.01	Exhaust turbocharger	C – 3
C101.01.01	Overview drawing	C – 3
C101.01.02	Special tools	C – 3
C101.01.04	Before-removal operations	C – 4
C101.01.05	Removal	C – 4
C101.01.06	Disassembly	C – 5
C101.01.08	Inspection and repair	C – 5
C101.01.10	Assembly	C – 5
C101.01.11	Installation	C – 6
C101.01.12	After-installation operations	C – 7

C100 Exhaust turbocharger

- 1 Exhaust turbocharger, front left
- 2 Exhaust turbocharger, rear left
- 3 Exhaust turbocharger, front right
- 4 Exhaust turbocharger, rear right

C101.01 Exhaust turbocharger**C101.01.01 Overview drawing**

- 1 Exhaust turbocharger, left (2 x)
- 2 Exhaust turbocharger, right (2 x)

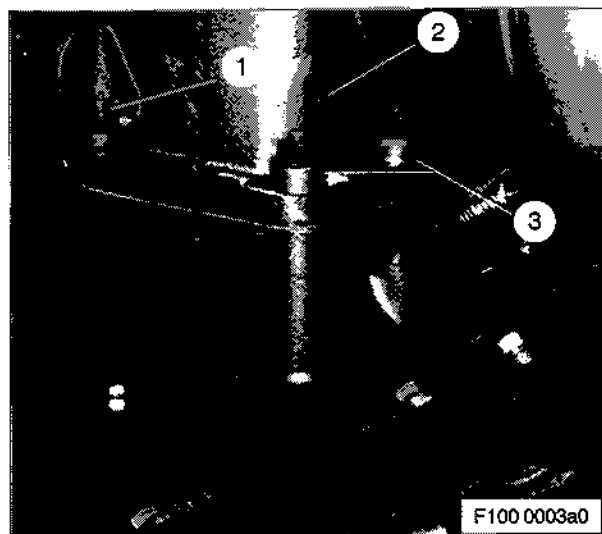
C101.01.02 Special tools

Designation	Use/dimension	Number
• Support bracket	for 2 exhaust turbochargers with Y-pipe (G00 engines)	1

C101.01.04 Before-removal operations

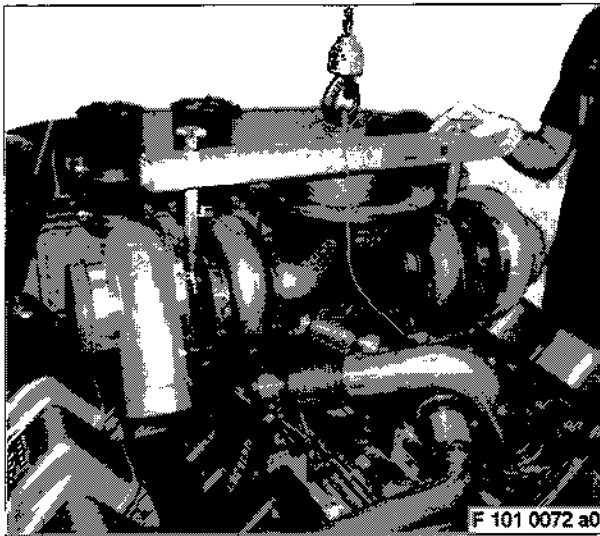
			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	-	-	Remove engine	→ B 003
x	-	-	Perform operations as per Disassembly Plan	→ B 004
-	-	x	Disable engine start	→ Operating Instructions
-	x	x	Remove air system before exhaust turbocharger	→ -
-	x	x	Remove exhaust system after Y-pipe	→ -
-	x	x	Remove intermediate element of charge air manifold on exhaust turbocharger	→ C 125.05
-	x	x	Remove oil supply lines for turbochargers	→ C 185.10
-	x	x	Remove oil return lines for turbochargers	→ C 185.25

C101.01.05 Removal



Unscrew hex nuts (1) on flange of exhaust turbocharger (2), left and right engine side.

Remove spacer bushes (3).



**Heavy object.
Risk of injury!
Use suitable tools and lifting equipment.**

Install support bracket on left and right of exhaust distribution housing. Use crane to carefully lift entire assembly, including Y-pipe, from studs.

Support bracket on this picture corresponds to workshop fittings.

Note: When lifting turbocharger, secure Y-pipe to prevent it slipping out of turbocharger.

Remove gasket from exhaust line.

Remove carrier.

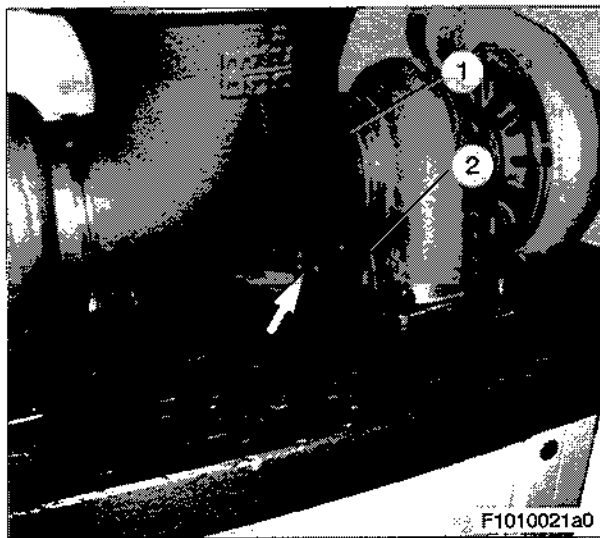
Note: Secure Y-pipe against twisting in the exhaust turbocharger.

Release nut (arrow), unscrew washer and hex screw from Y-pipe (1) and bracket (2).

Remove brackets and both turbochargers from Y-pipe.

Remove both turbochargers from Y-pipe.

Remove piston rings from Y-pipe.



C101.01.06 Disassembly

Disassembly of the turbocharger is not planned.

The turbocharger is an exchangeable component and can be obtained in the exchange procedure.

C101.01.08 Inspection and repair

Testing and repairing the turbocharger is not planned.

The exhaust turbocharger is a replacement component.

Clean Y-pipe and visually inspect for damage and defects; replace as necessary.

Using the surface crack-testing method with fluorescent penetrant dye, check Y-pipe for cracks.

Check all sealing and seating faces for damage and surface irregularities; rub down with an oilstone or emery cloth as necessary.

Check thread of studs for ease of movement; replace studs as necessary.

Always replace nuts securing exhaust turbocharger, sealing rings and gaskets.

C101.01.10 Assembly

See remarks under C 101.01.06.

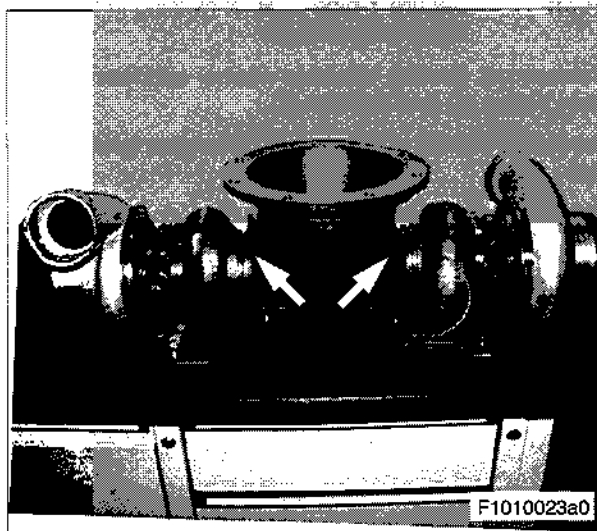
C101.01.11 Installation



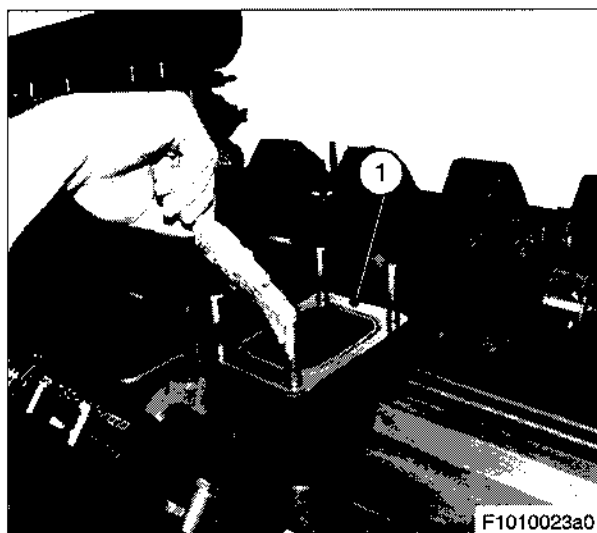
Installing turbocharger

Insert piston ring in groove (arrow) provided on Y-pipe.

Coat piston ring outer surface with Ultratherm assembly paste.



Insert end unions (arrow) of Y-pipe on turbine side into exhaust turbocharger.

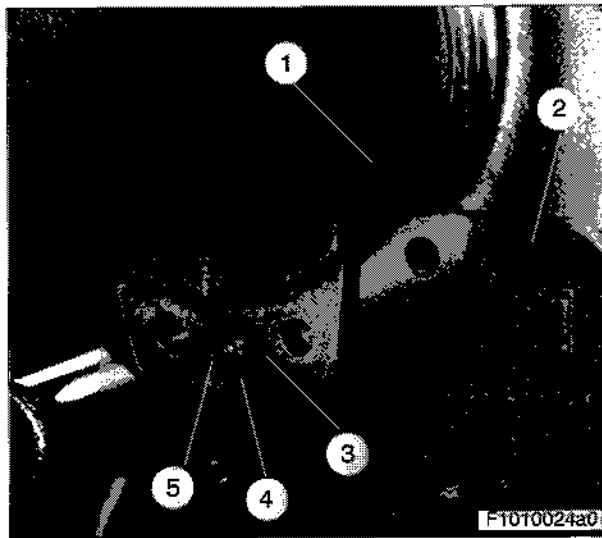


Fit gasket (1) and coat studs with Ultratherm assembly paste.



**Heavy object.
Risk of injury!
Use suitable tools and lifting equipment.**

Install support bracket on left and right of exhaust distribution housing. Attach four chains and carefully lift entire assembly, including Y-pipe, and place on appropriate point of installation.

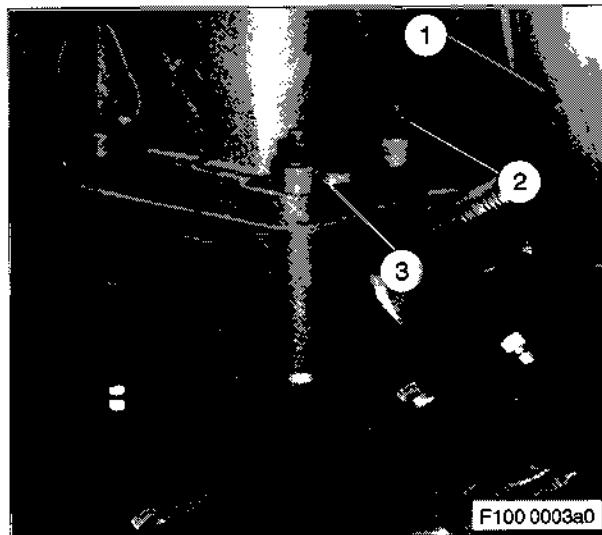


Bolt bracket (2) and Y-pipe (1) together with hex screw (5), washer (3) and nut (4).

- Tightening torque: 40 Nm

Note: Secure Y-pipe to prevent slipping.

Note: Join retainers on Y-pipe and bracket at central bores. Final alignment of Y-pipe with exhaust pipework can be carried out in installed condition.



⚠ WARNING

**Heavy object.
Risk of injury!
Use suitable tools and lifting equipment.**

Fit spacer bushes (3).

Tighten exhaust turbocharger (1) diagonally and evenly with hex nuts (2).

- Tightening torque: 40 Nm

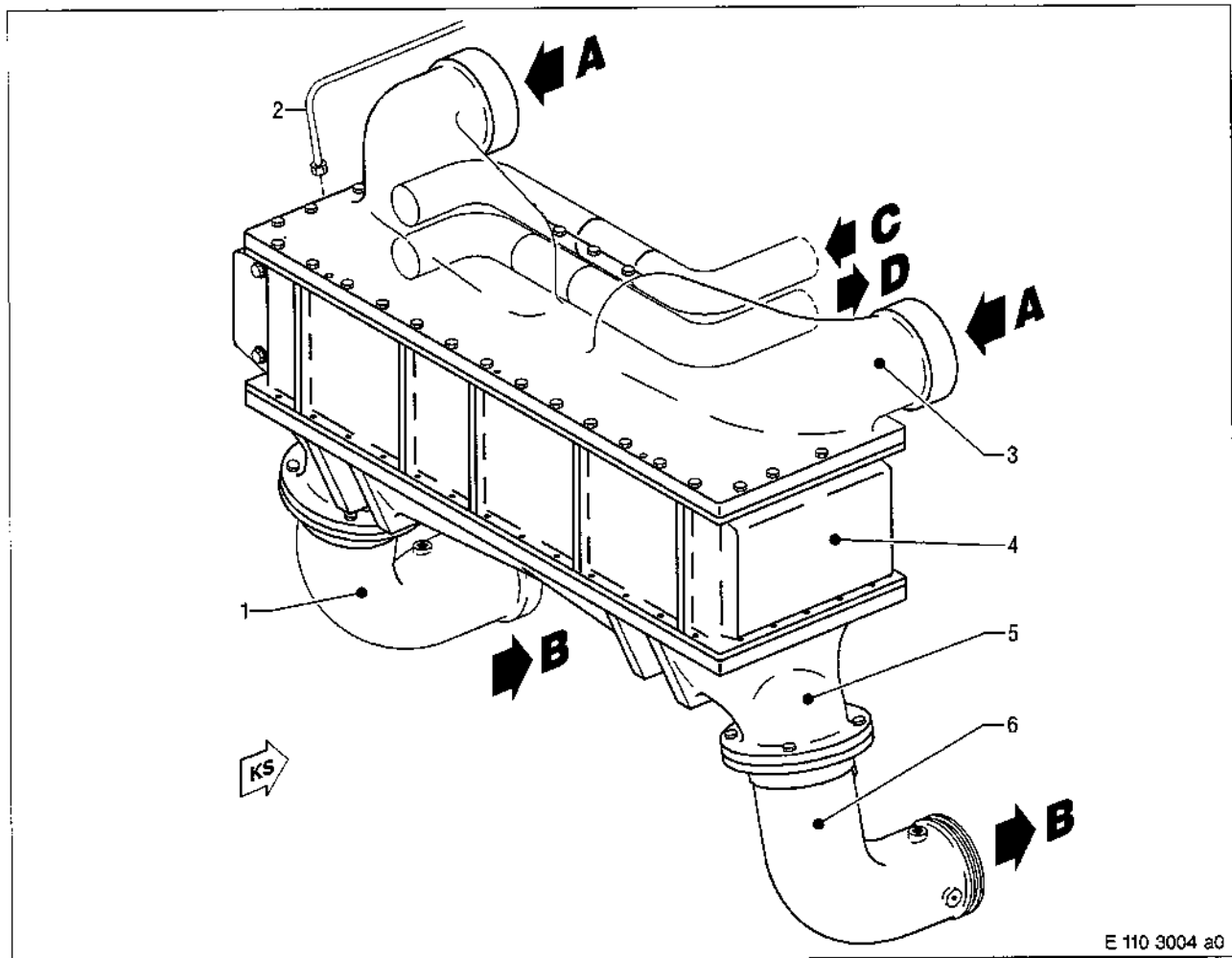
Install support brackets on left and right of turbocharger and align entire assembly.

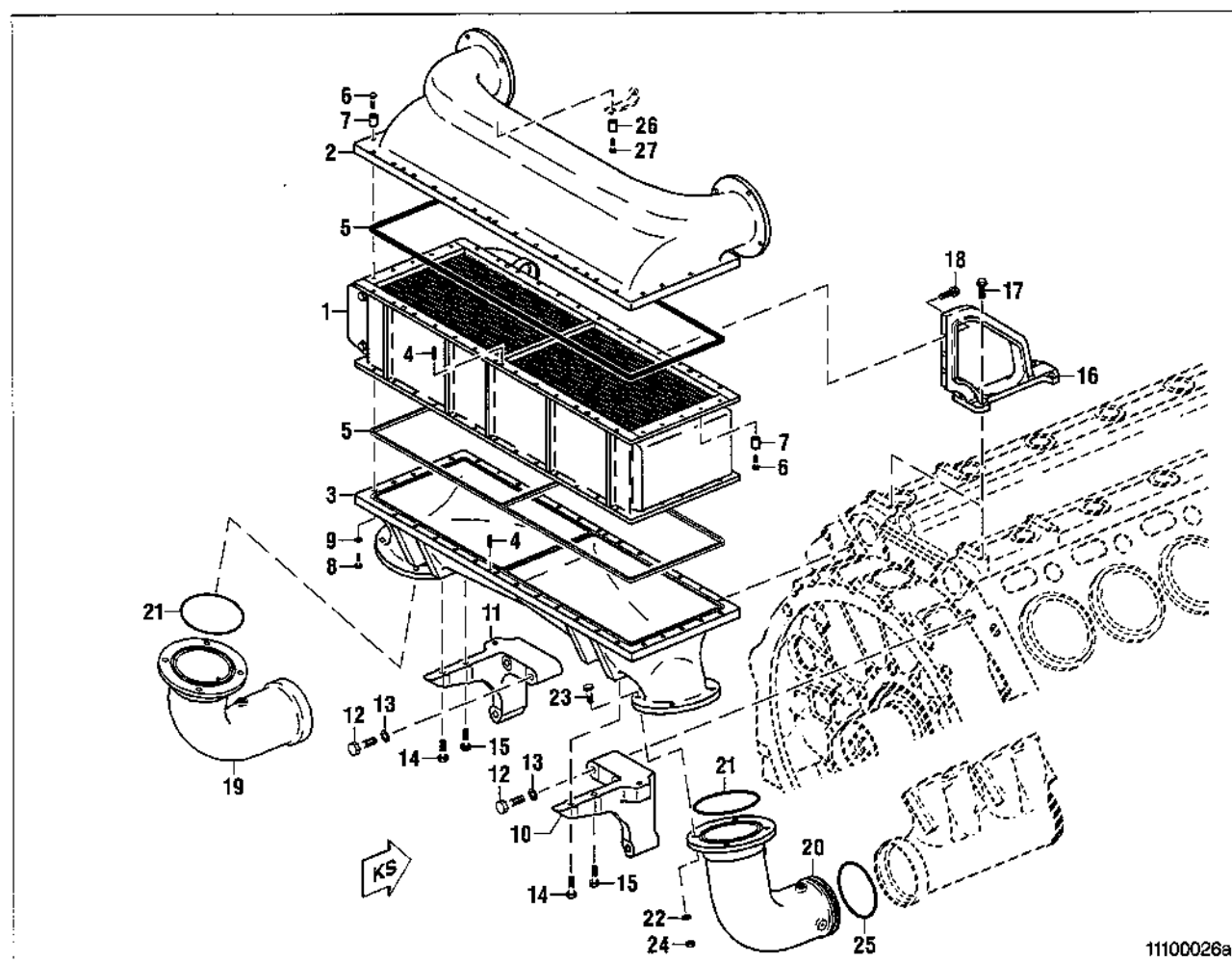
C101.01.12 After-installation operations

A distinction must be made as to whether:

For the following tasks, a distinction must be made as to whether:			
The engine is to be completely disassembled			
The engine is to be removed but not disassembled			
The engine is to remain installed			
			Measure
			See
x	–	–	Perform operations as per Assembly Plan
x	–	–	Install engine
–	x	x	Assembly in reverse sequence to disassembly
–	–	x	Release engine start
			→ B 005
			→ B 007
			→ C 101.01.04
			→ Operating Instructions

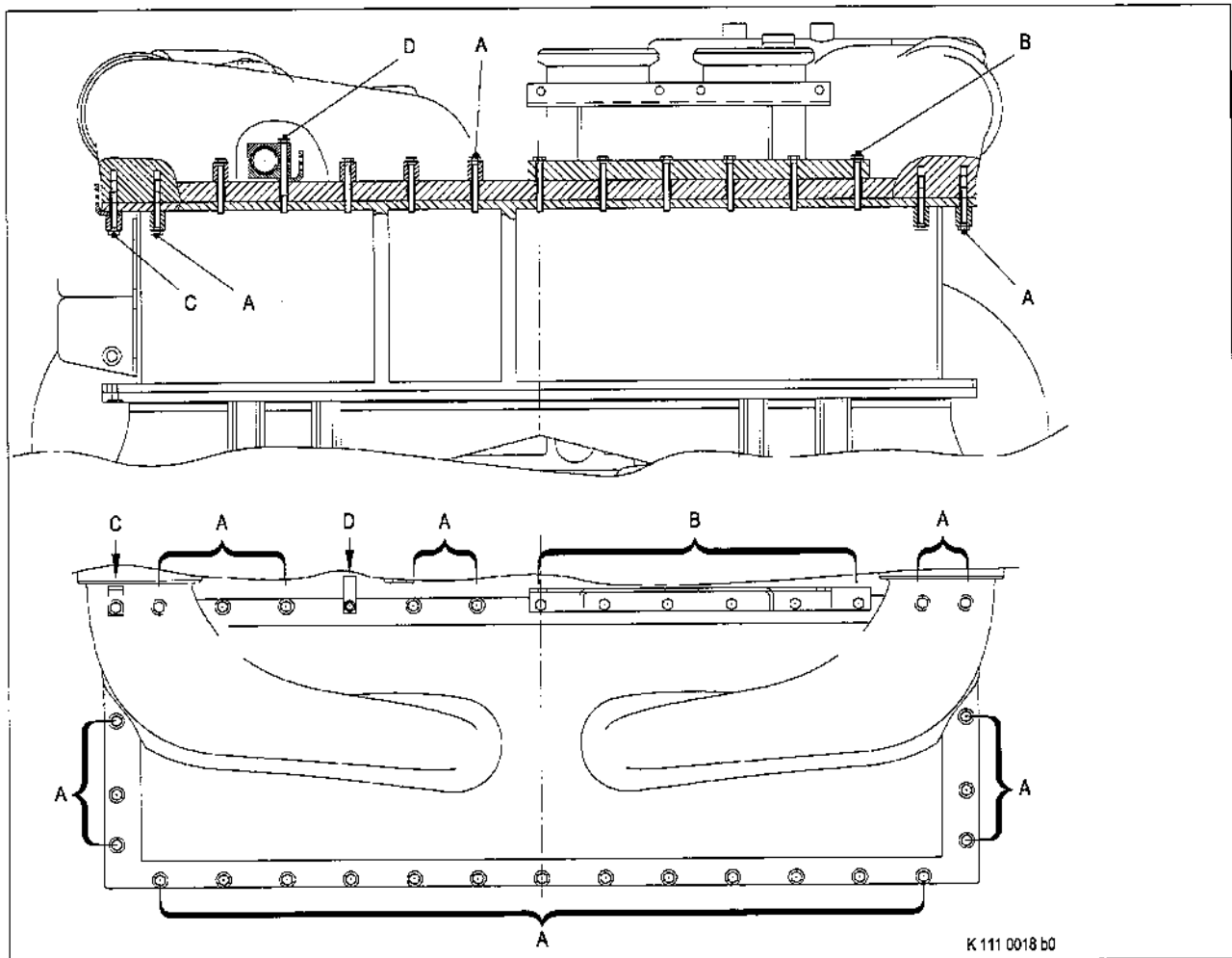
C110	Charge air cooling	C – 1
C111.05	Intercooler	C – 3
C111.05.01	Overview drawing	C – 3
C111.05.04	Before-removal operations	C – 5
C111.05.05	Removal	C – 5
C111.05.06	Disassembly	C – 6
C111.05.08	Inspection and repair	C – 6
C111.05.10	Assembly	C – 7
C111.05.11	Installation	C – 8
C111.05.12	After-installation operations	C – 9

C110 Charge air cooling

C111.05 Intercooler**C111.05.01 Overview drawing**

11100026a

- | | | | |
|------------------------------|-------------------|--------------|------------------|
| 1 Intercooler | 8 Hex screw | 15 Hex screw | 22 Washer |
| 2 Connecting housing, top | 9 Washer | 16 Bracket | 23 Hex screw |
| 3 Connecting housing, bottom | 10 Bracket, right | 17 Hex screw | 24 Nut M12 |
| 4 Dowel pin | 11 Bracket, left | 18 Hex screw | 25 O-ring |
| 5 O-ring | 12 Hex screw | 19 Elbow | 26 Spacer sleeve |
| 6 Hex screw | 13 Washer | 20 Elbow | 27 Hex screw |
| 7 Spacer sleeve | 14 Hex screw | 21 O-ring | |



A Hex screw
Lubricant: Engine oil
Tightening torque: 21 Nm + 2 Nm

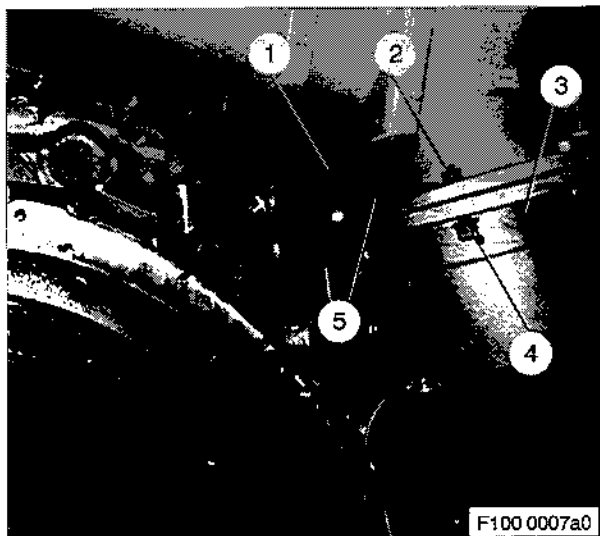
B Hex screw
Lubricant: Engine oil
Tightening torque: 21 Nm + 2 Nm

C Hex screw
Lubricant: Engine oil
Tightening torque: 21 Nm + 2 Nm

D Hex screw
Lubricant: Engine oil
Tightening torque: 21 Nm + 2 Nm

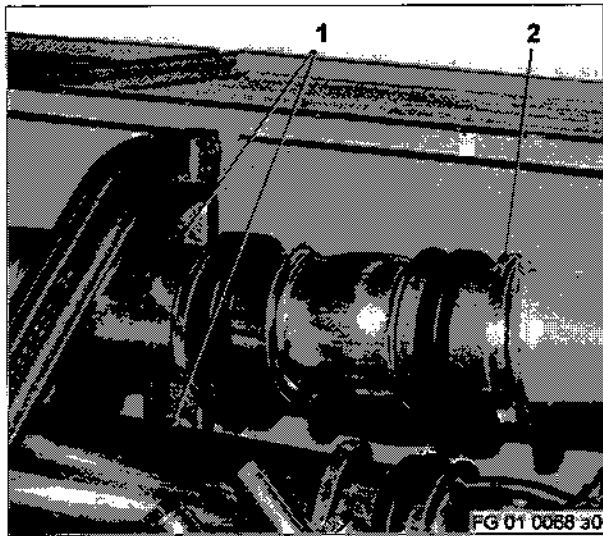
C111.05.04 Before-removal operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Remove engine	→ B 003
x	–	–	Perform operations as per Disassembly Plan	→ B 004
–	–	x	Disable engine start	→ Operating Instructions
–	–	x	Remove monitoring system	→ C 500.05.04
–	–	x	Remove charge air manifolds	→ C 125.05.04
–	–	x	Remove coolant vent line	→ C 206.05.04
–	–	x	Drain engine coolant	→ Operating Instructions
–	x	x	Remove coolant lines	→ C 202.15.04

C111.05.05 Removal**Removing intercooler**

Remove hex screws (5) from bracket (1).

Unscrew nuts (2) from elbow (3) and remove hex screws (4).



Release pipe clamps (2) from coolant inlet and outlet.

Remove pipes for coolant inlet and outlet.

Remove securing screws (1) between intercooler and bracket.

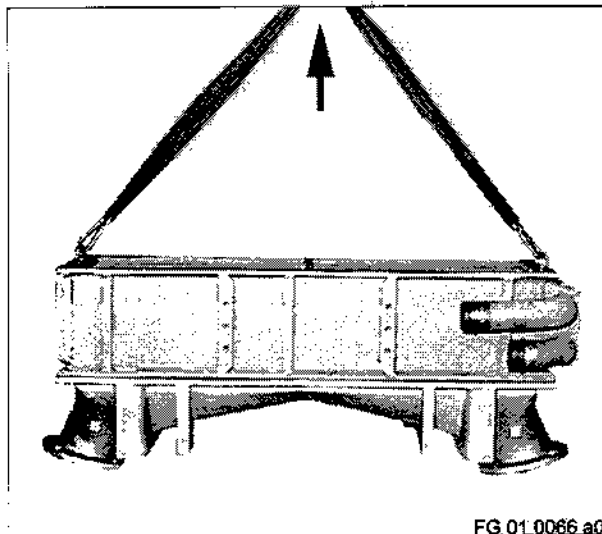
**Warning**

**Heavy object.
Risk of injury!
Use suitable tools and lifting equipment.**

Attach intercooler to crane with rope and carefully raise from engine.

Note: After removing intercooler, seal all connections on engine with suitable plugs and covers.

C111.05.06 Disassembly



Unscrew hex screws between intercooler and connecting housing, top.

Lift off connecting housing.

Unscrew hex screws between connecting housing, bottom, and intercooler.

Remove intercooler from connecting housing, bottom.

Remove rubber profile from connecting housings.

Note: Protect intercooler (in particular the cooling fins) from mechanical damage (e.g. jolts, etc.), e.g. by covering cooling fins with firm cardboard.

C111.05.08 Inspection and repair

The intercooler is an exchangeable component and can be obtained in the exchange procedure.

Clean all components and visually inspect for damage and defects; replace as necessary.

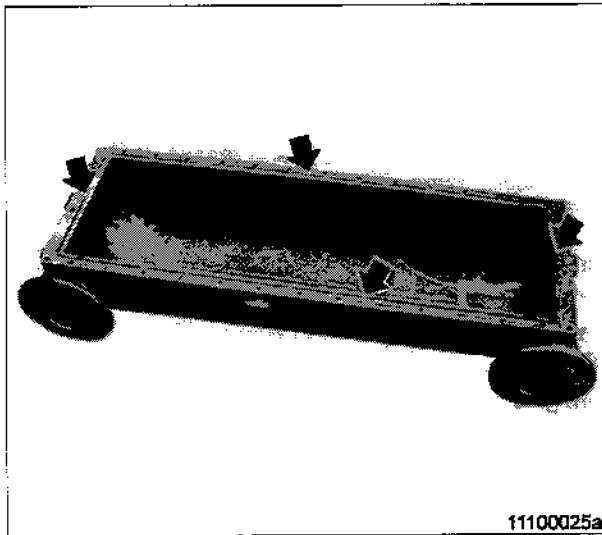
Check connecting housing for cracks using surface crack-testing method with red penetrant dye.

If cracks are detected, replace part.

Clean all sealing, contact and mating faces off remaining particles of seal and check for damage and unevenness; if necessary, smooth with oilstone or emery cloth.

Check thread in connecting housing for ease of movement; recondition as necessary.

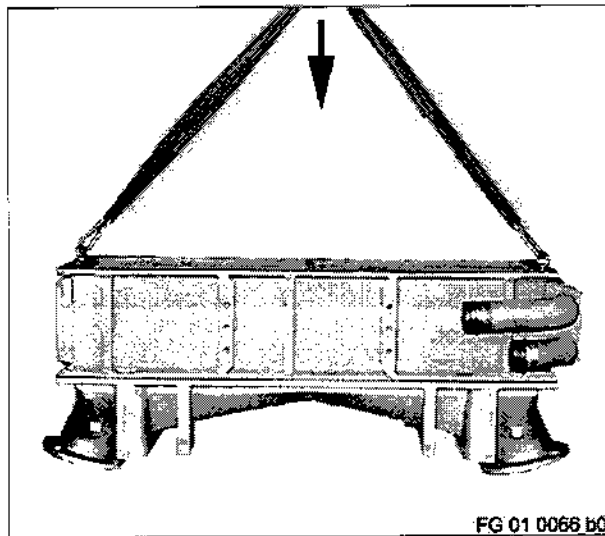
Replace sealing rings and gaskets.

C111.05.10 Assembly**Preparing connecting housing**

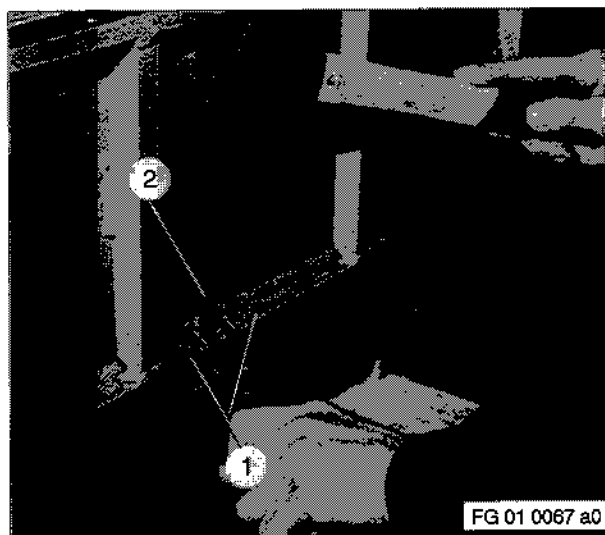
Insert O-ring in groove (arrow) on upper connecting box.

Insert rubber profile in groove on lower connecting box.

Note: Insert dry rubber profile.
Insert T-shaped profile with wide side into groove.

**Installing intercooler on lower connecting box**

Using rope and crane, carefully place intercooler on lower connecting housing.



Screw in hand-tight the two hex screws (1) in centre of front and rear of intercooler (i.e. immediately to left and right of bore for guide pin (2)).

Drive guide pin into bore provided.

Starting in centre on both front and rear of intercooler, secure four hex screws from centre in both directions, tightening in several stages to specified tightening torque. Then tighten all other hex screws in sequence to tightening torque.

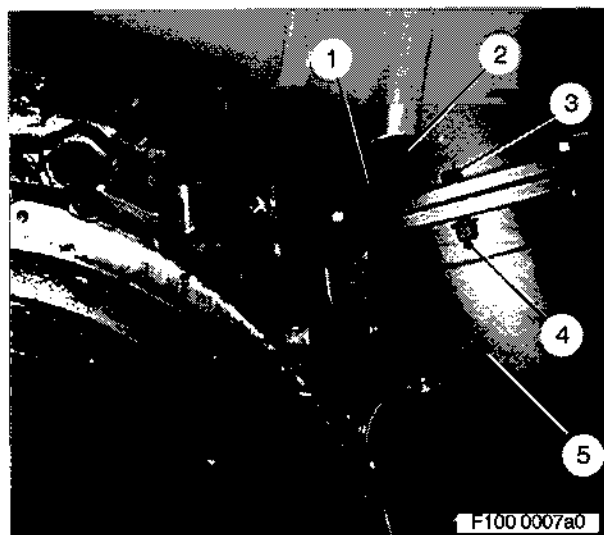
Installing upper connecting box on intercooler

Mount upper connecting box on intercooler. Insert hex screws with spacer sleeves (observe positioning of spacer sleeves) all around and tighten to specified torque, see C 111.05.01.

Proceed as for installing lower connecting box.

C111.05.11 Installation

Note: Prior to installation, remove all blanking plugs and seals and ensure air-carrying lines are perfectly clean.



Install intercooler

Coat O-ring with petroleum jelly and fit on elbow flange.

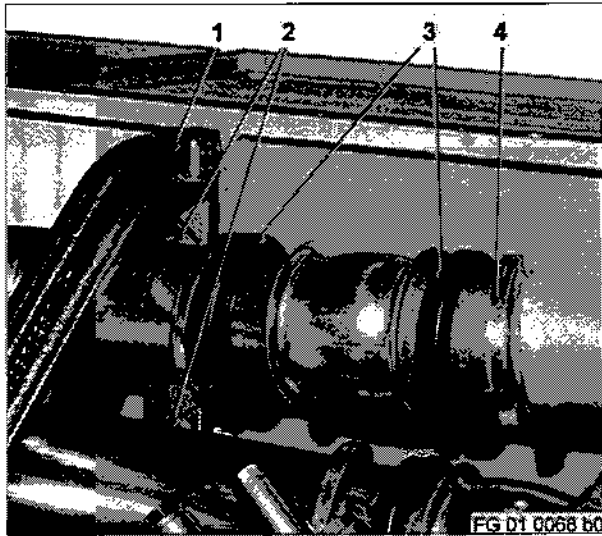


**Heavy object.
Risk of injury!
Use suitable tools and lifting equipment.**

Attach intercooler to crane with rope and place on engine.

Screw hex screws (1) in bracket (2).

Secure elbow (5) with hex screws (3) and nuts (4) on intercooler.



Install securing screws (2) between intercooler (1) and bracket.

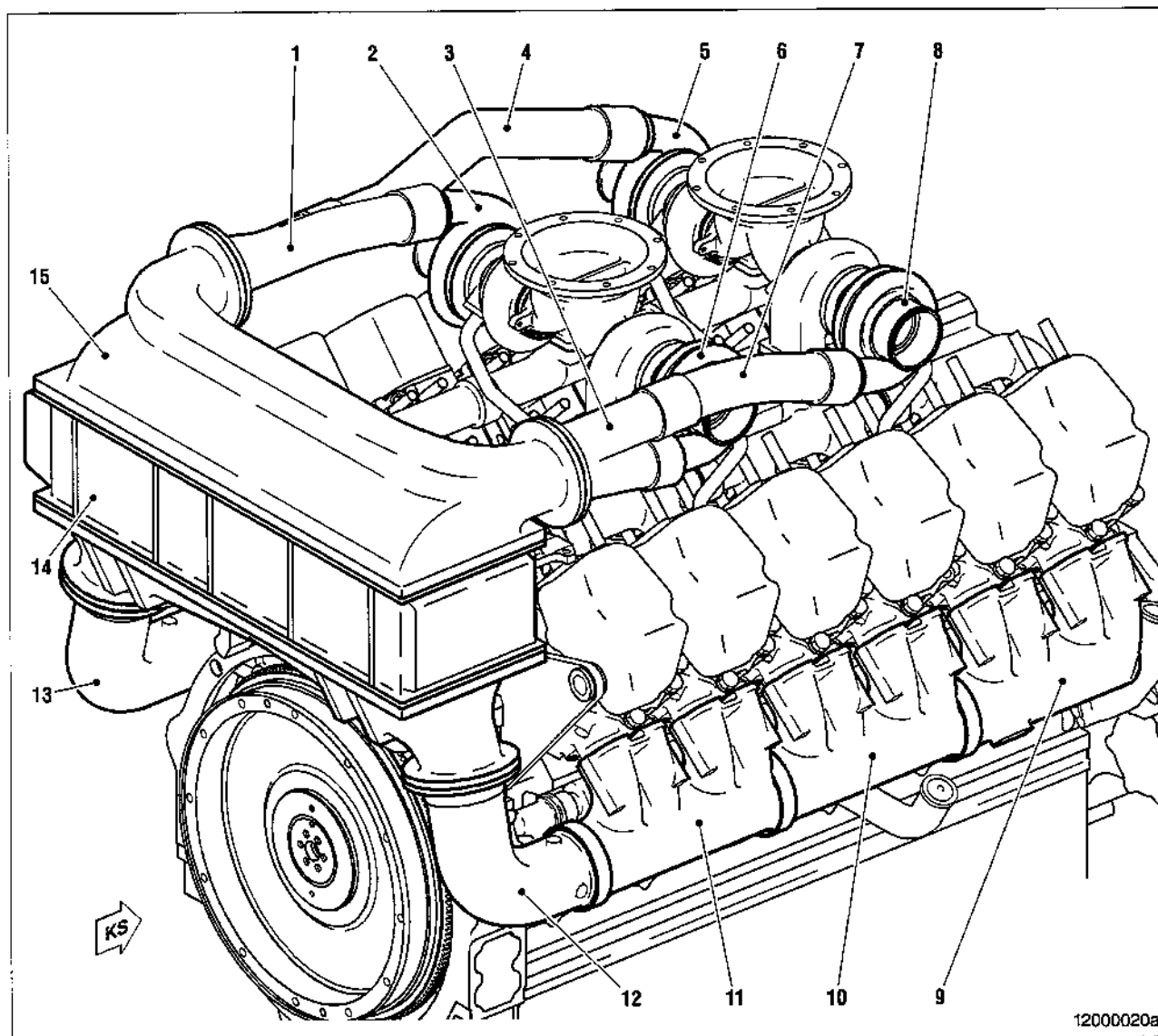
Fit seal (3).

Secure thrust pad (4) for coolant inlet and outlet with appropriate V-clamps.

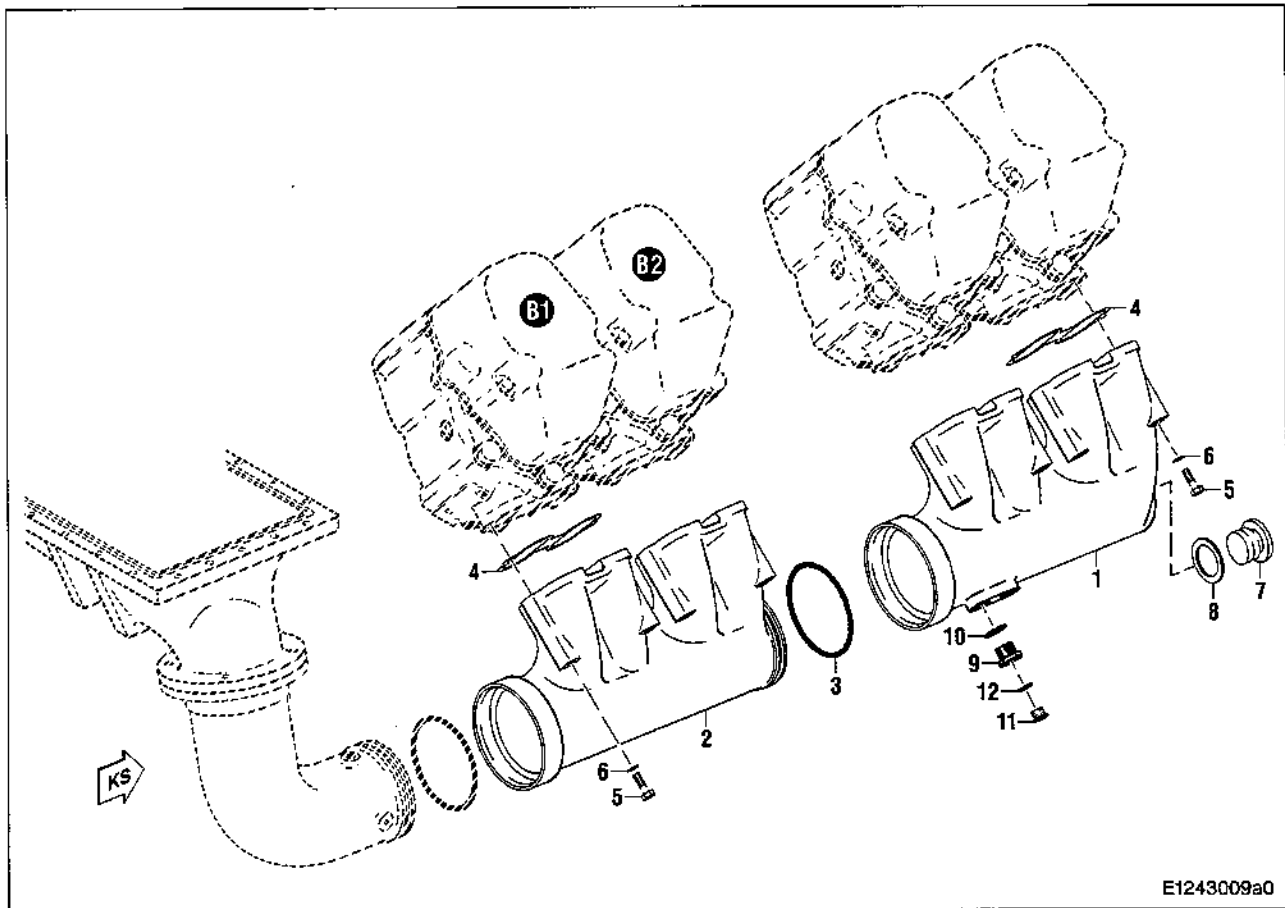
C111.05.12 After-installation operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	-	-	Perform operations as per Assembly Plan	→ B 005
x	-	-	Install engine	→ B 007
-	x	x	Install charge air manifolds	→ C 125.05.11
-	-	x	Install coolant vent lines	→ C 206.05.11
-	-	x	Install monitoring system	→ C 500.05
-	-	x	Fill engine coolant system	→ Operating Instructions
-	-	x	Fill charge air coolant system	→ Operating Instructions
-	-	x	Release engine start	→ Operating Instructions

C120	Air intake / air supply	C – 1
C124.05	Air supply to cylinders	C – 3
C124.05.01	Overview drawing	C – 3
C124.05.04	Before-removal operations	C – 4
C124.05.05	Removal	C – 4
C124.05.08	Inspection and repair	C – 4
C124.05.11	Installation	C – 5
C124.05.12	After-installation operations	C – 5
C125.05	Air supply system from turbocharger to intercooler	C – 7
C125.05.01	Overview drawing	C – 7
C125.05.04	Before-removal operations	C – 7
C125.05.05	Removal	C – 8
C125.05.08	Inspection and repair	C – 8
C125.05.11	Installation	C – 8
C125.05.12	After-installation operations	C – 8

C120 Air intake / air supply

- | | |
|--|------------------------|
| 1 Connection elbow, left side | 9 Charge air manifold |
| 2 Exhaust turbocharger, left side (front) | 10 Charge air manifold |
| 3 Connection elbow, right side | 11 Charge air manifold |
| 4 Charge air manifold, left side | 12 Elbow, right side |
| 5 Exhaust turbocharger, left side (rear) | 13 Elbow, left side |
| 6 Exhaust turbocharger, right side (front) | 14 Intercooler |
| 7 Charge air manifold, right side | 15 Connecting housing |
| 8 Exhaust turbocharger, right side (rear) | |

C124.05 Air supply to cylinders**C124.05.01 Overview drawing**

- 1 Charge air manifold
- 2 Charge air manifold
- 3 O-ring
- 4 Gasket
- 5 Hex screw
- 6 Washer

- 7 Plug
- 8 Sealing ring
- 9 Threaded bush
- 10 Sealing ring
- 11 Blanking plug
- 12 Sealing ring

C124.05.04 Before-removal operations

For the following tasks, a distinction must be made as to whether:				
The engine is to be completely disassembled				
The engine is to be removed but not disassembled				
The engine is to remain installed				
			Measure	See
x	–	–	Remove engine	→ B 003
x	–	–	Perform operations as per Disassembly Plan	→ B 004
–	–	x	Disable engine start	→ Operating Instructions

C124.05.05 Removal

Removing charge air manifold

Note: Removal starts from the free end.

Remove charge air manifold as per Overview drawing C 124.05.01.

Remove gaskets and O-rings.

After removal, seal all apertures with suitable plugs or covers.

C124.05.08 Inspection and repair

Clean all air-carrying components with cleaning agent.

Pressure-test charge air manifold for leaks with air in water bath.



Compressed air is air which has been compressed under pressure. Risk of injury! Pressure must not exceed 0.5 bar (7.25 lb/in²). Always wear protective clothing, protective gloves and protective goggles/safety mask.

Air pressure = 0.5 bar

Replace blanking plugs if necessary (e.g. if leaking) or reseal.

Check charge air manifold for cracks using surface crack-testing method with red penetrant dye as necessary.

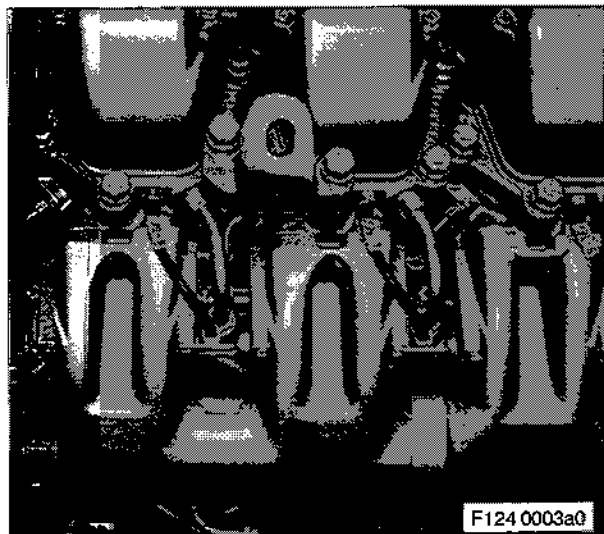
Replace charge air manifold in event of cracks.

Check sealing and mating faces for surface irregularities and damage; rub down with an oilstone if necessary.

Check condition of threads; rechase threads if necessary or replace threaded inserts if necessary.

Check hex screws for damage and wear; replace as necessary.

Replace sealing rings, O-rings and gaskets at every assembly.

C124.05.11 Installation**Installing charge air manifold**

Note: Prior to installation, remove all plugs and seals and ensure air-carrying lines are perfectly clean.

Fit O-rings on elbow and charge air manifold, see Overview drawing C 124.05.01.

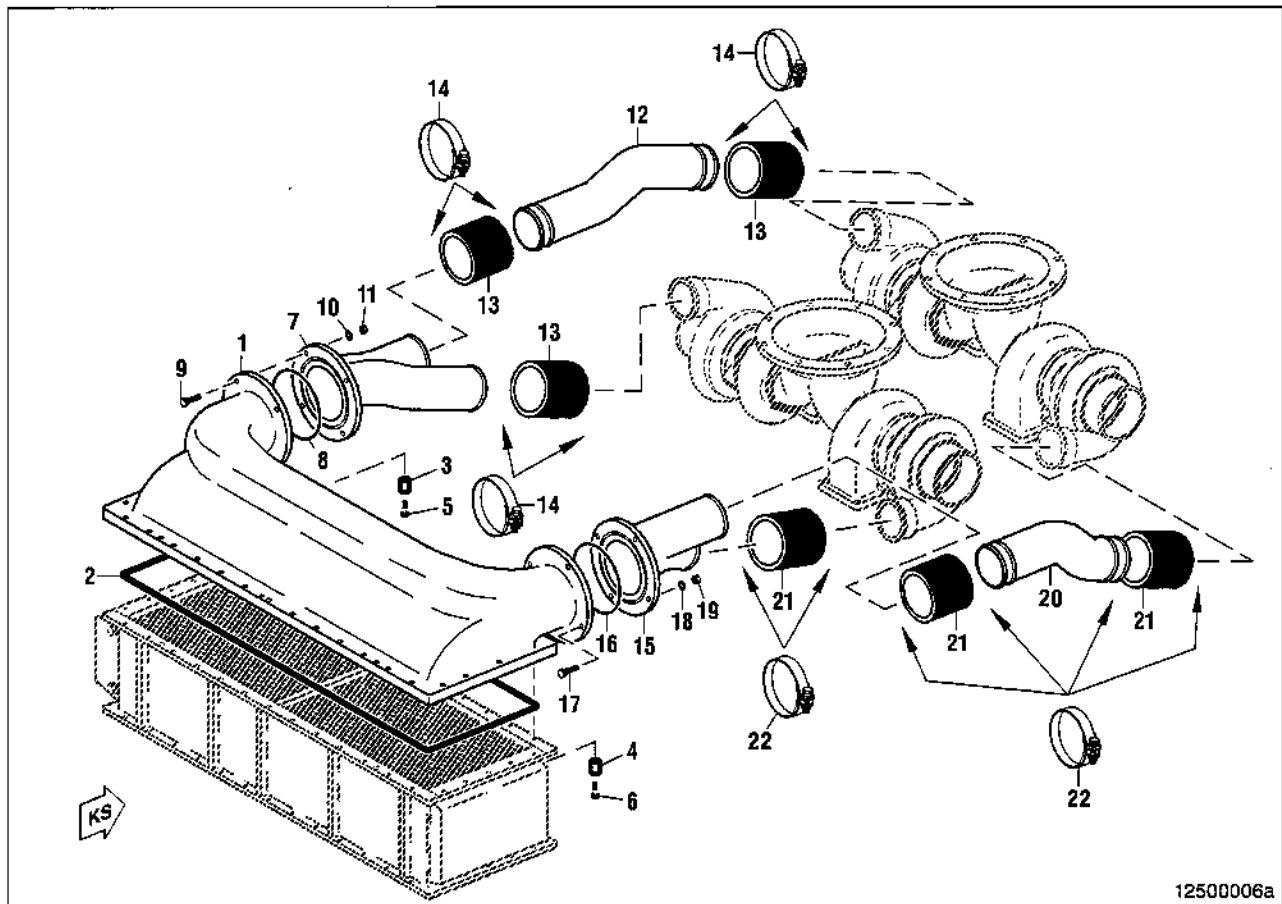
Coat gaskets with petroleum jelly and place on charge air manifold sealing surface.

Note: Installation starts from the driving end. Before tightening hex screws, check that gasket is correctly positioned.

Install charge air manifold as per illustration.

C124.05.12 After-installation operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	—	—	Perform operations as per Assembly Plan	→ B 005
x	—	—	Install engine	→ B 007
—	—	x	Release engine start	→ Operating Instructions

C125.05 Air supply system from turbocharger to intercooler**C125.05.01 Overview drawing**

- | | | |
|----------------------|-----------------------------------|------------------------------------|
| 1 Connecting housing | 9 Hex screw | 17 Hex screw |
| 2 O-ring | 10 Washer | 18 Washer |
| 3 Spacer sleeve | 11 Hex nut | 19 Hex nut |
| 4 Spacer sleeve | 12 Charge air manifold, left side | 20 Charge air manifold, right side |
| 5 Hex screw | 13 Rubber sleeve | 21 Rubber sleeve |
| 6 Hex screw | 14 Clamp | 22 Clamp |
| 7 Connection elbow | 15 Connection elbow | |
| 8 O-ring | 16 O-ring | |

C125.05.04 Before-removal operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	-	-	Remove engine	→ B 003
x	-	-	Perform operations as per Disassembly Plan	→ B 004
-	-	x	Disable engine start	→ Operating Instructions

C125.05.05 Removal

Removing charge air manifold

Remove charge air manifolds as per Overview drawing – see C 125.05.01.

Remove O-rings.

After removal, seal all apertures with suitable plugs or covers.

C125.05.08 Inspection and repair

Clean all air-carrying components with cleaning agent.

Pressure-test charge air manifold for leaks with air in water bath.



WARNING

Compressed air is air which has been compressed under pressure. Risk of injury! Pressure must not exceed 0.5 bar (7.25 lb/in²). Always wear protective clothing, protective gloves and protective goggles/safety mask.

Air pressure = 0.5 bar

Check charge air manifold for cracks using surface crack-testing method with red penetrant dye as necessary.

Replace charge air manifold in event of cracks.

Check sealing and mating faces for surface irregularities and damage; rub down with an oilstone if necessary.

Visually check retaining plates and brackets for cracks; replace components as necessary.

Check condition of threads; rechase threads if necessary or replace threaded inserts if necessary.

Check clamps for condition and screws for ease of movement; replace if necessary.

Check hex screws for damage and wear; replace as necessary.

Replace sealing rings, O-rings and gaskets at every assembly.

Replace rubber sleeves and clamps during W6 overhaul.

C125.05.11 Installation

Installing charge air manifold

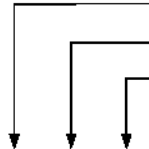
Note: Prior to installation, remove all plugs and seals and ensure air-carrying lines are perfectly clean.

Insert O-ring in annular groove of connecting housing and coat with petroleum jelly.

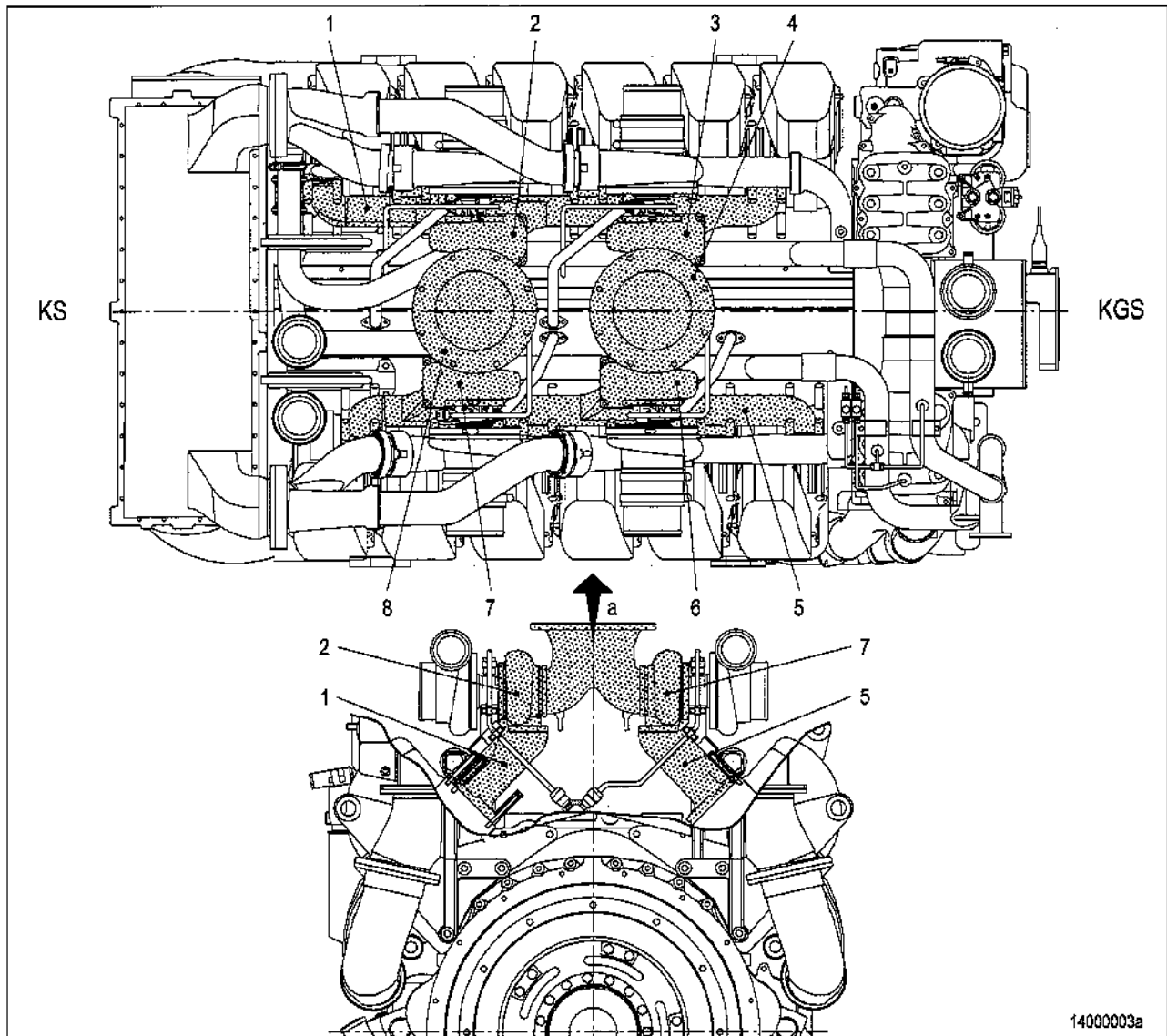
Install connection elbow as per Overview drawing (see C 125.05.01) on connecting housing.

Coat rubber sleeves, connection elbows and charge air manifolds with denaturated ethanol and install as per Overview drawing (see C 125.05.01).

C125.05.12 After-installation operations

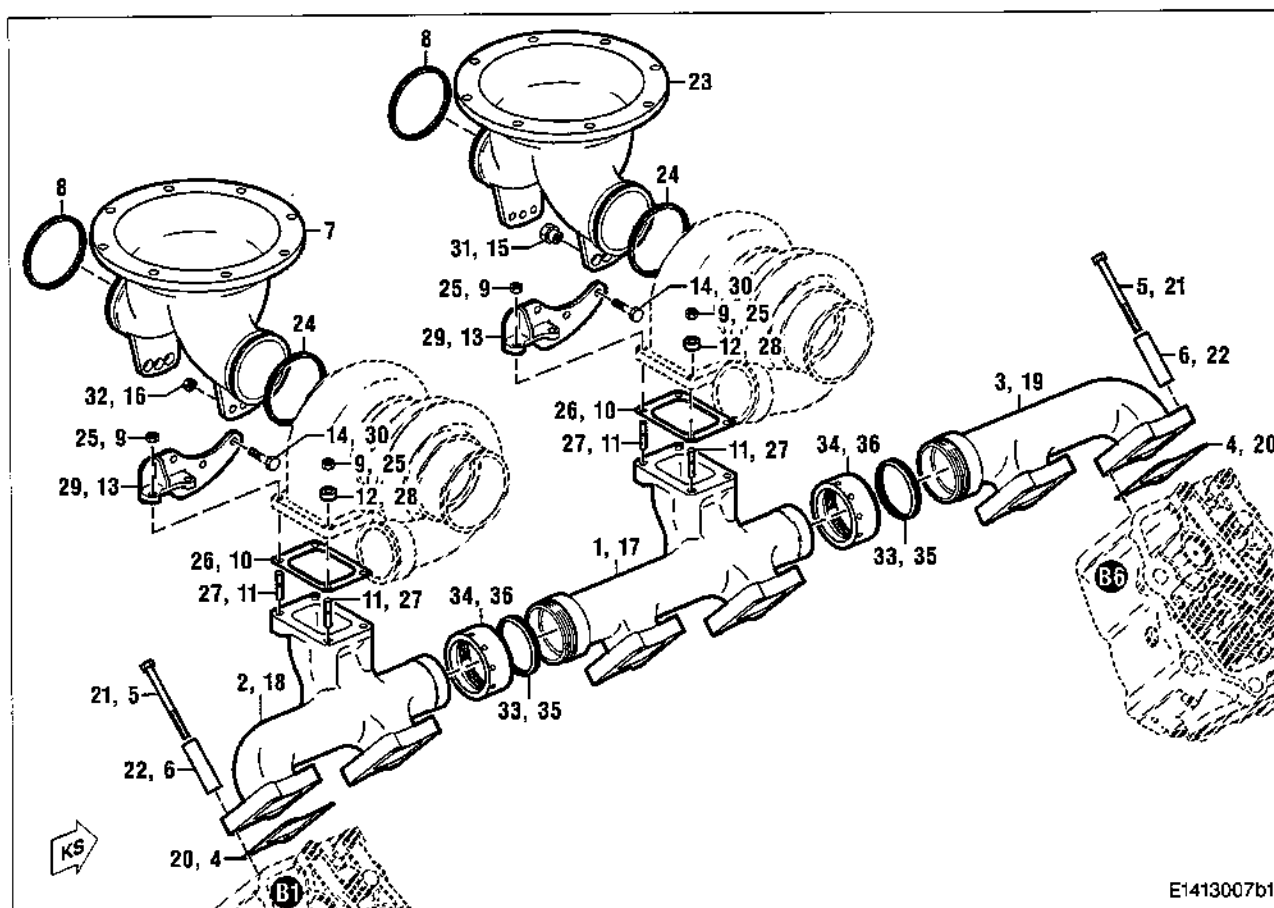
			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	–	x	Release engine start	→ Operating Instructions

C140	Exhaust system	C – 1
C141.10	Exhaust pipework after cylinder head	C – 3
C141.10.01	Overview drawing	C – 3
C141.10.02	Special tools	C – 4
C141.10.04	Before-removal operations	C – 4
C141.10.05	Removal	C – 4
C141.10.06	Disassembly	C – 5
C141.10.08	Inspection and repair	C – 5
C141.10.10	Assembly	C – 6
C141.10.11	Installation	C – 7
C141.10.12	After-installation operations	C – 9

C140 Exhaust system

- 1 Exhaust manifold, left
- 2 Exhaust turbocharger, left, driving end
- 3 Exhaust turbocharger, left, free end
- 4 Y-pipe, free end

- 5 Exhaust manifold, right
- 6 Exhaust turbocharger, right, free end
- 7 Exhaust turbocharger, right, driving end
- 8 Y-pipe, driving end

C141.10 Exhaust pipework after cylinder head**C141.10.01 Overview drawing**

- | | | |
|---------------------------|---------------------------|-------------------|
| 1 Exhaust line | 13 Bracket | 25 Hex nut |
| 2 Exhaust line | 14 Hex screw | 26 Gasket |
| 3 Exhaust line | 15 Washer | 27 Stud |
| 4 Gasket | 16 Nut | 28 Spacing washer |
| 5 Screw | 17 Exhaust line | 29 Bracket |
| Lubricant: Assembly paste | 18 Exhaust line | 30 Hex screw |
| Tightening torque: 70 Nm | 19 Exhaust line | 31 Washer |
| 6 Spacer sleeve | 20 Gasket | 32 Nut |
| 7 Y-pipe | 21 Hex screw | 33 Sealing ring |
| 8 Piston ring | Lubricant: Assembly paste | 34 Union nut |
| 9 Hex nut | Tightening torque: 70 Nm | 35 Sealing ring |
| 10 Gasket | 22 Spacer sleeve | 36 Union nut |
| 11 Stud | 23 Y-pipe | |
| 12 Spacer washer | 24 Piston ring | |

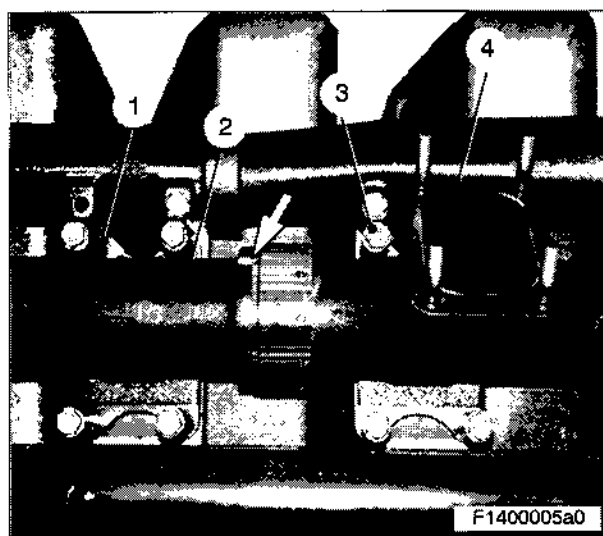
C141.10.02 Special tools

Designation	Use/dimension	Number
• Joint C-wrench	90–155 mm	1
• Torque wrench		1

C141.10.04 Before-removal operations

For the following tasks, a distinction must be made as to whether: → The engine is to be completely disassembled → The engine is to be removed but not disassembled → The engine is to remain installed			Measure	See
			x – – Remove engine	→ B 003
			x – – Perform operations as per Disassembly Plan	→ B 004
			– – x Disable engine start	→ Operating Instructions
–	x	x	Remove air system before exhaust turbocharger	→ –
–	x	x	Remove exhaust system after Y-pipe	→ –
–	x	x	Remove intermediate element of charge air manifold on exhaust turbocharger	→ C 124.05
–	x	x	Remove oil supply lines for turbochargers	→ C 185.10
–	x	x	Remove oil return lines for turbochargers	→ C 185.25
–	x	x	Remove exhaust turbocharger	→ C 101.05
–	x	x	Remove Y-pipe with bracket	→ C 101.01.05

C141.10.05 Removal



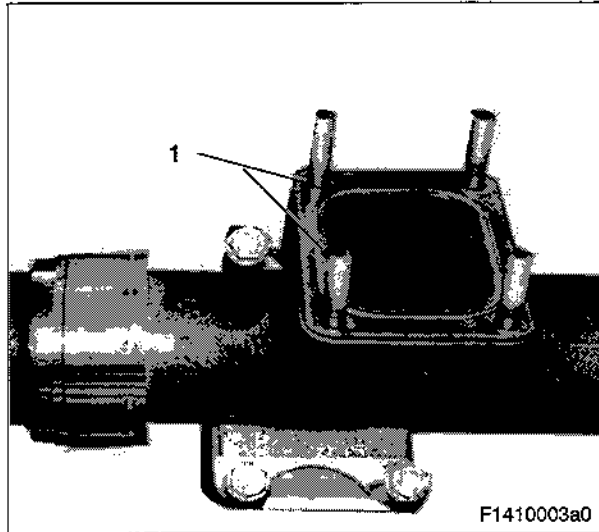
Remove gasket (4).

Release peening (arrow) and unscrew union nut with an articulated C-wrench.

Remove all hex screws (3) securing exhaust lines (2) and spacer sleeves (1).

Remove exhaust pipework from engine.

Note: Provide suitable protective covers for openings, cylinder head exhaust outlet.

C141.10.06 Disassembly**Removing studs**

Note: Remove studs (1) from exhaust line only if necessary.

Fit hex nut on stud and lock with second hex nut.

Place box wrench on locked hex nut and unscrew stud.

 CAUTION

Component is hot.

Risk of injury!

Handle components only when wearing protective gloves.

Note: If stud cannot be released with box wrench, slightly heat stud in area of thread. Ensure that only under the colour is heated.

C141.10.08 Inspection and repair

Clean all components and visually inspect for damage and defects; replace as necessary.

**CAUTION**

When using these chemical substances, it is essential to observe the manufacturer's instructions for use, safety instructions and waste disposal specifications.

Place exhaust elbow and exhaust pipes in a container containing decarbonizer.

Duration of exhaust manifold immersion in cleaning bath depends on thickness of deposit layer.

After cleaning with carbon-deposit remover, rinse components in water until no further residues are washed off.

If deposits are stubborn, use synthetic shot-blasting pellets (nominal size 16 to 20) to help cleaning.

Using the surface crack-testing method with red penetrant dye, check exhaust lines for cracks; replace component if cracks are found.

Check exhaust lines for warping; replace line in event of warping.

Check sealing and mating faces; rub down with emery cloth or an oilstone or replace components as necessary.

Check stud thread for damage and ease of movement; rechase as necessary.

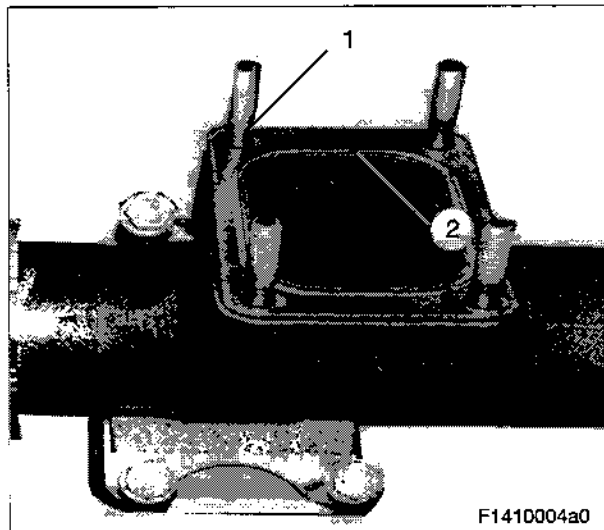
Replace gaskets, studs and nuts.

Remove sealing ring from exhaust manifold and check surface for damage; smooth with emery cloth as necessary.

Check threads of union nuts or replace part as required.

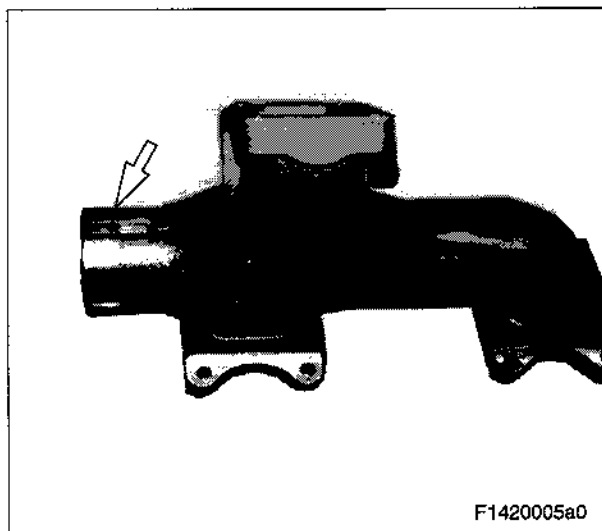
Exhaust manifold, recondition threads if necessary.

C141.10.10 Assembly

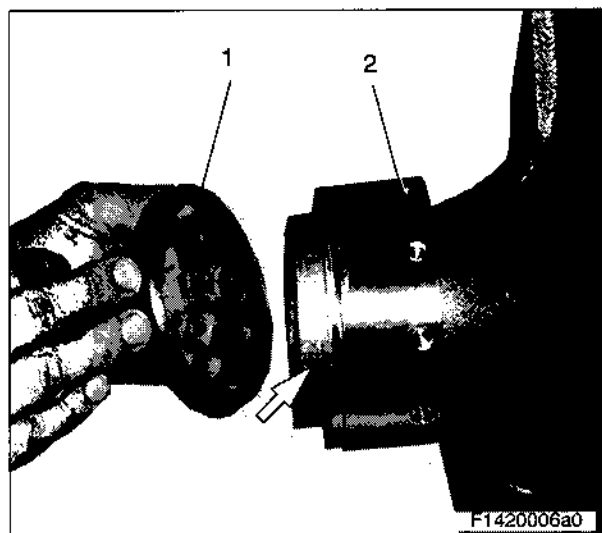


Installing stud

Insert dry stud (1) in flange of exhaust line (2) and tighten to stop by means of locked hex nut.



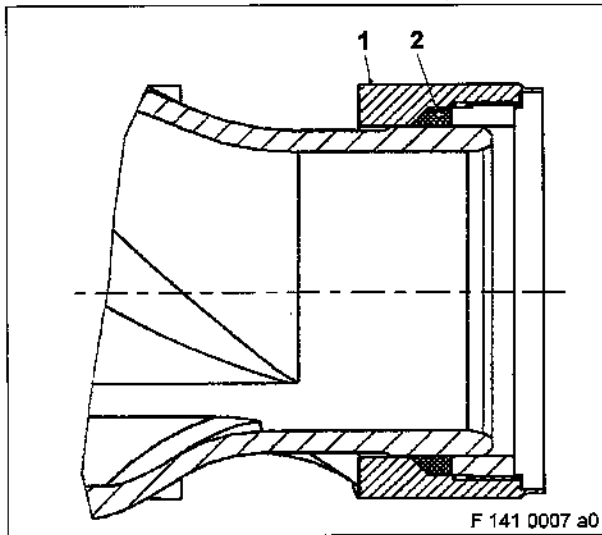
Before installing union nut and sealing ring, clean and degrease sealing surface (arrow).



Preassemble exhaust line with union nut (2) and sealing ring (1). Do not yet tighten connection.

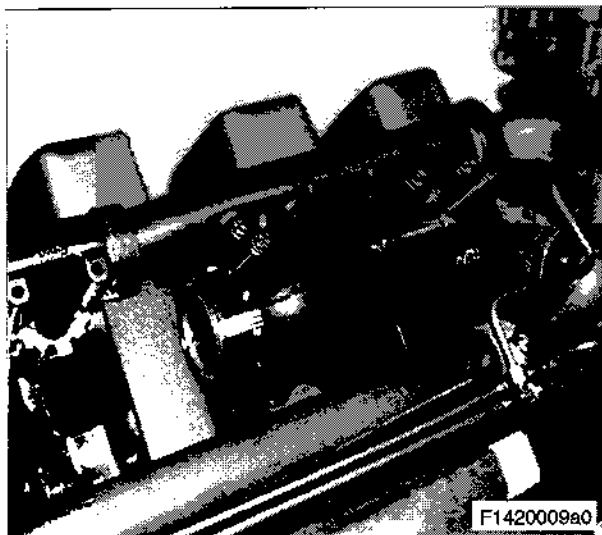
Refer to next illustration for a more comprehensible presentation.

Coat thread of union nuts and bolt-on face (arrow) with assembly paste Ultratherm.



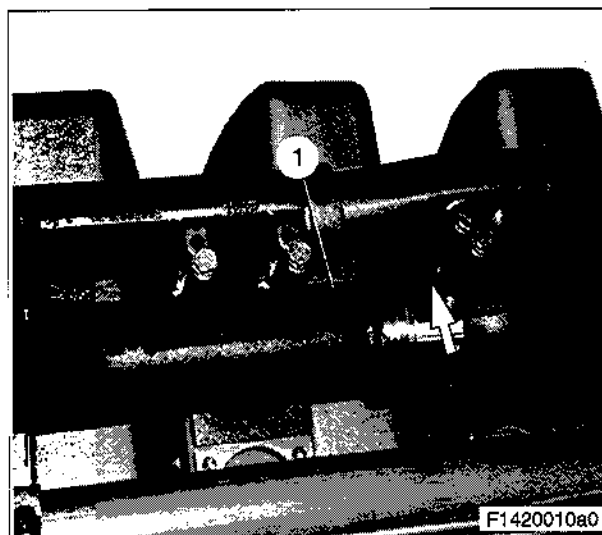
When assembling exhaust manifold, ensure that union nut (1) and sealing ring (2) are installed in correct positions.

C141.10.11 Installation



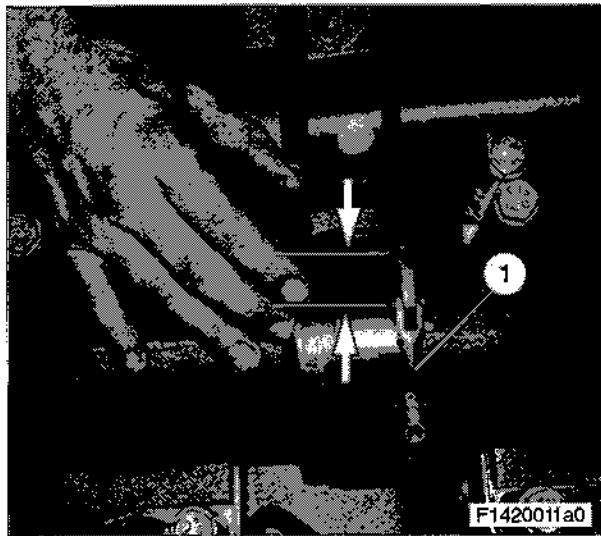
Clean and degrease bolt-on surfaces of cylinder heads and exhaust line.

Install exhaust lines with gaskets as per Overview drawing (see C 141.05.01) on cylinder heads, but do not tighten.



Coat thread of union nuts and bolt-on face of exhaust manifold with assembly paste Ultratherm.

Tighten union nut by hand (arrow) against exhaust manifold (1).

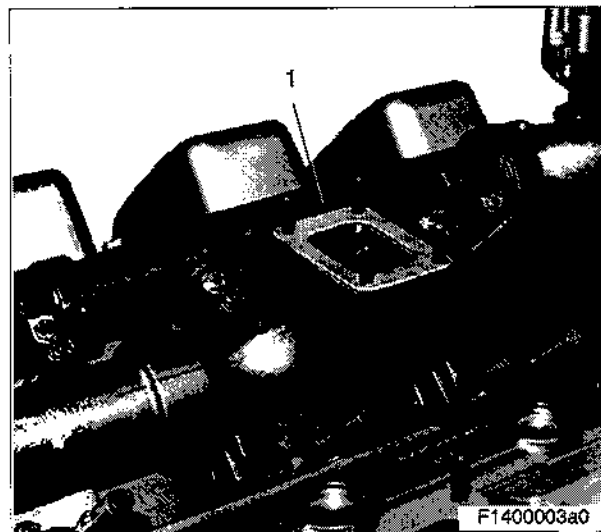


Turn union nut further with joint C-wrench (1) by 35 mm (arrows), corresponds to 40° at circumference.



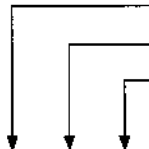
Tighten all hex screws (1) diagonally and evenly to specified tightening torque – see C 141.10.01.

Secure union nuts against turning by means of peening, observe specified groove (arrow) in exhaust manifold.

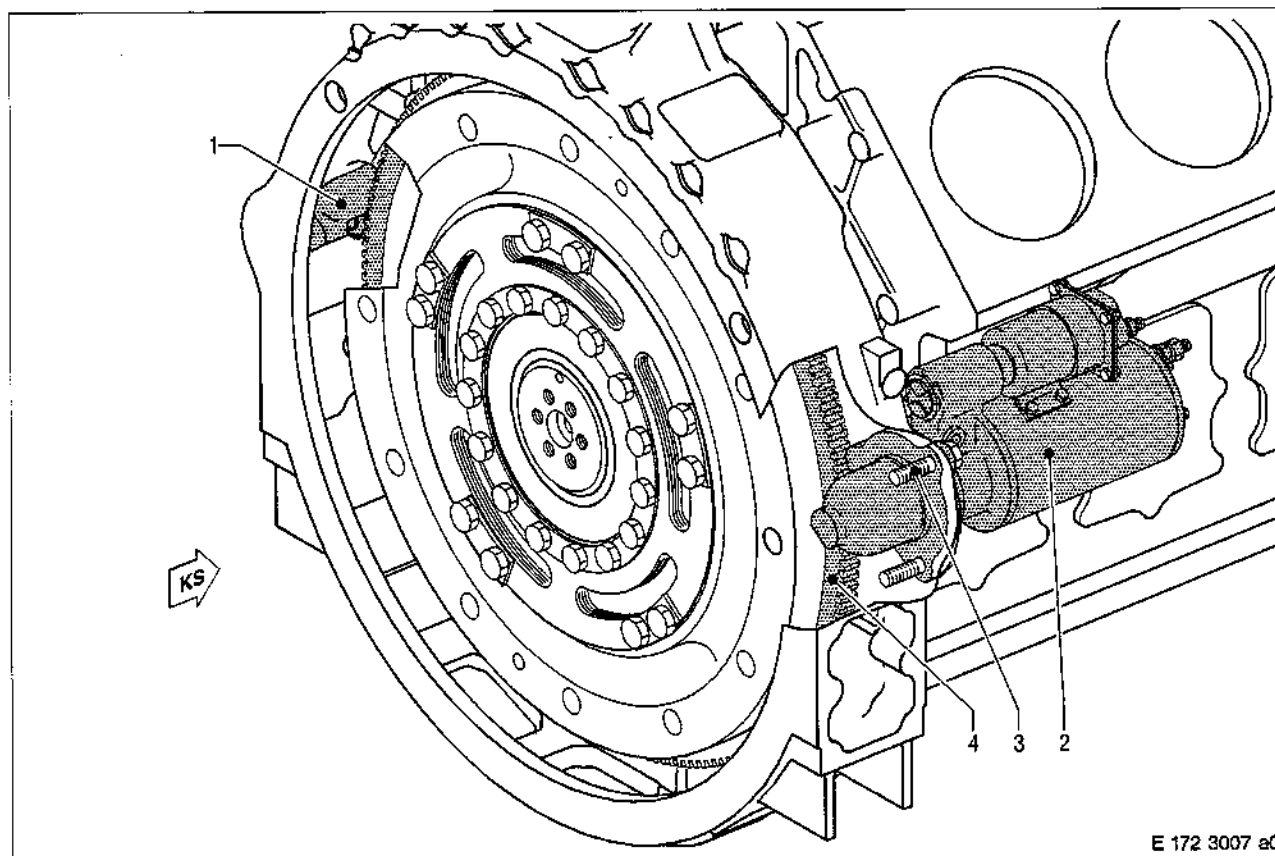


Fit dry gasket (1) on turbocharger flange.

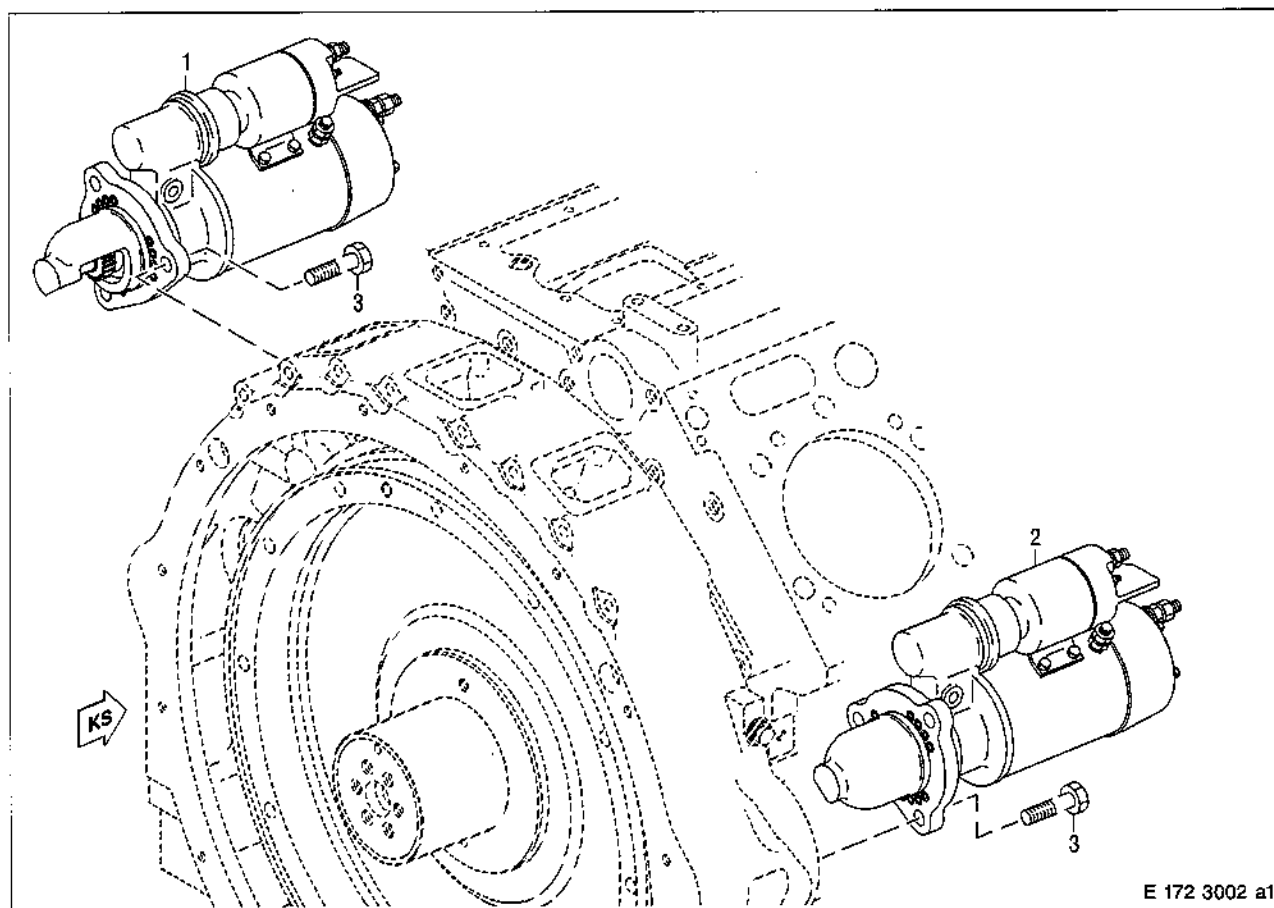
C141.10.12 After-installation operations

For the following tasks, a distinction must be made as to whether:  The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed				
			Measure	See
x	—	—	Perform operations as per Assembly Plan	→ B 005
x	—	—	Install engine	→ B 007
—	—	x	Install exhaust turbocharger with Y-pipe	→ C 101.01.11
—	x	x	Install oil supply lines for turbochargers	→ C 185.10.11
—	x	x	Install oil return lines for turbochargers	→ C 185.25.11
—	x	x	Install intermediate element of charge air manifold on exhaust turbocharger	→ C 124.05.11
—	x	x	Install exhaust pipework after Y-pipe	→ —
—	x	x	Install air system before exhaust turbocharger	→ —
—	—	x	Release engine start	→ Operating Instructions

C170	Starting system	C – 1
C172.05	Starter	C – 3
C172.05.01	Overview drawing of starter	C – 3
C172.05.02	Special tools	C – 4
C172.05.04	Before-removal operations	C – 5
C172.05.05	Removal	C – 5
C172.05.06	Disassembly	C – 5
C172.05.08	Inspection and repair	C – 5
C172.05.10	Assembly	C – 5
C172.05.11	Installation	C – 6
C172.05.12	After-installation operations	C – 6

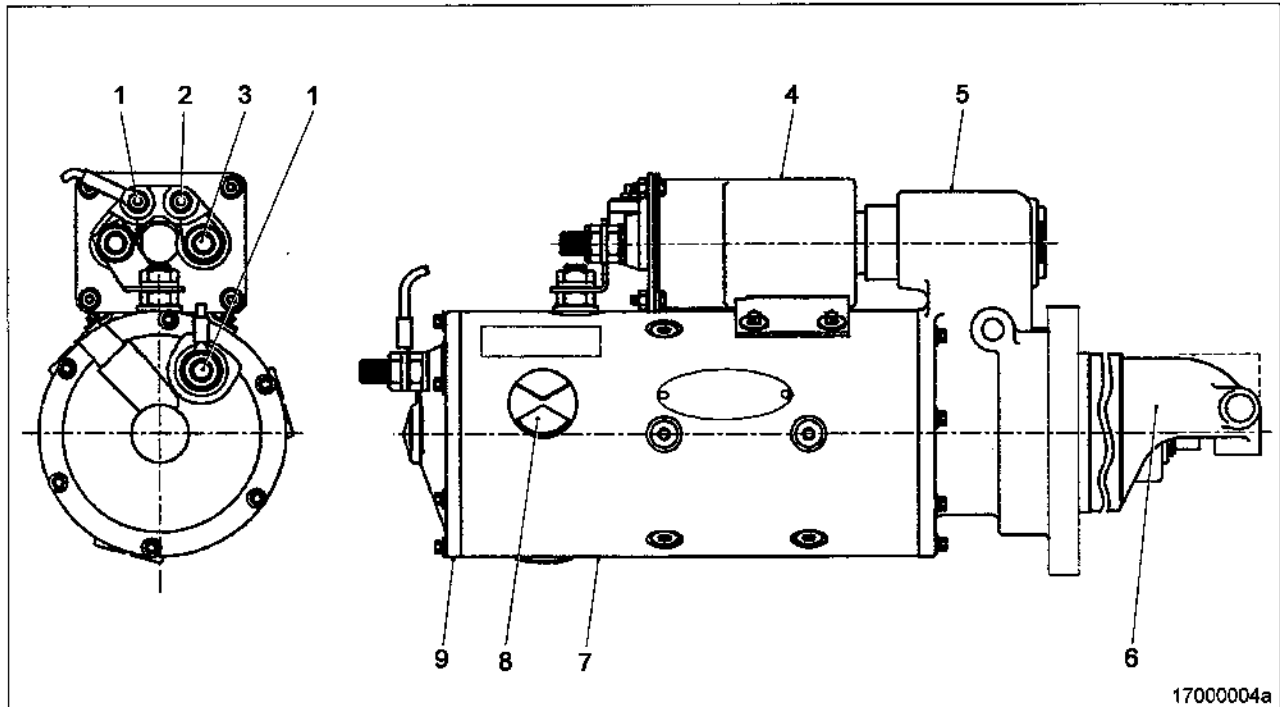
C170 Starting system

- 1 Starter, left
- 2 Starter, right
- 3 Hex socket screw
- 4 Ring gear

C172.05 Starter**C172.05.01 Overview drawing of starter**

- 1 Starter, left
- 2 Starter, right
- 3 Hex socket screw

Overview drawing of starter



- 1 Terminal 31
- 2 Terminal 50
- 3 Terminal 30
- 4 Engagement relay
- 5 Housing for engagement lever

- 6 Driver housing
- 7 Stator housing
- 8 Inspection port cover for inspecting carbon brushes
- 9 Commutator cover

C172.05.02 Special tools

Designation	Use/dimension	Number
• Tools from the W4 tool kit		1

C172.05.04 Before-removal operations

For the following tasks, a distinction must be made as to whether: → The engine is to be completely disassembled → The engine is to be removed but not disassembled → The engine is to remain installed				
			Measure	See
x	–	–	Remove engine	→ B 003
x	–	–	Perform operations as per Disassembly Plan	→ B 004
–	–	x	Disable engine start	→ Operating Instructions
–	–	x	Remove charge air manifold if necessary	→ C 124.05

C172.05.05 Removal**Remove starter**

Note: Before removal, ensure that the negative battery pole is disconnected!

Mark cable at starter if necessary and remove.


WARNING

Heavy object. Risk of injury!
Use suitable tools and lifting equipment.

Note: Secure starter to prevent it falling out.

Remove socket-head screws for starter as per Overview drawing – see C 172.05.01.

Pull starter from its seat and remove.

C172.05.06 Disassembly

See Manufacturer's Documentation.

C172.05.08 Inspection and repair

If required, send starter to authorised dealer. Consult MTU service for further information.

Clean starter externally and check for damage and check condition.

Note: During cleaning operations, ensure that no moisture can penetrate inner parts of solenoid switch. If moisture penetrates solenoid switch it results in corrosion and circuit breaks.

Check tooth flanks of pinion for wear, indentations and chipping; if necessary recondition or replace starter.

Check mating face on flywheel housing for wear, smooth with emery cloth or oilstone as necessary.

Check condition of threads; re chase threads if necessary.

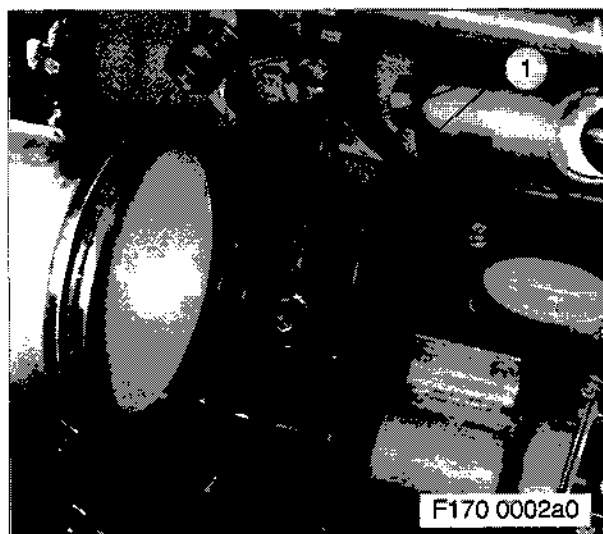
Check screws for condition and thread for ease of movement; replace screws if necessary.

C172.05.10 Assembly

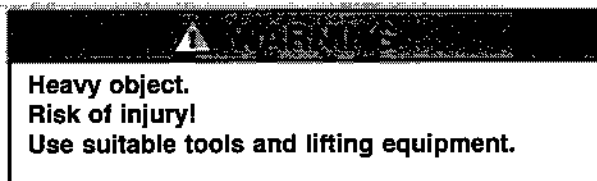
See Manufacturer's Documentation.

C172.05.11 Installation

Note: Prior to installing starter, coat starter pinion with long-lasting lubricant grease.

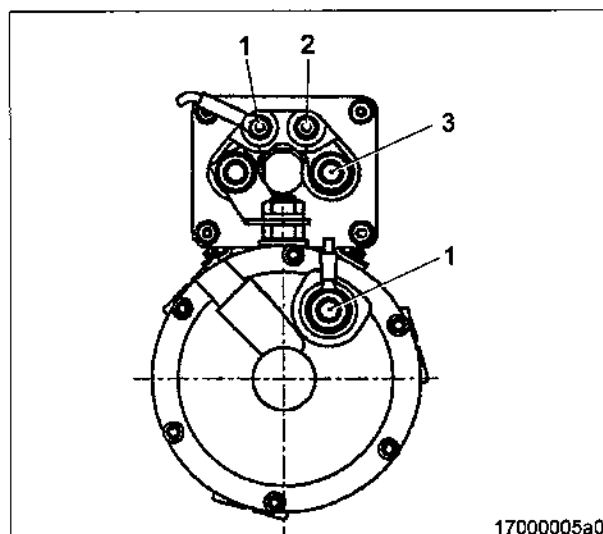


Install starter



Insert starter in fit in flywheel housing and align bores in starter flange to support bores.

Screw in socket-head screws (1) and tighten.



Connecting electric starter

Connect lines to starter, ensuring that lines are correctly laid.

Terminal 31 (1): Earth wire

Terminal 50 (2): Control line

Terminal 30 (3): Plus line

Connect battery ground strap.

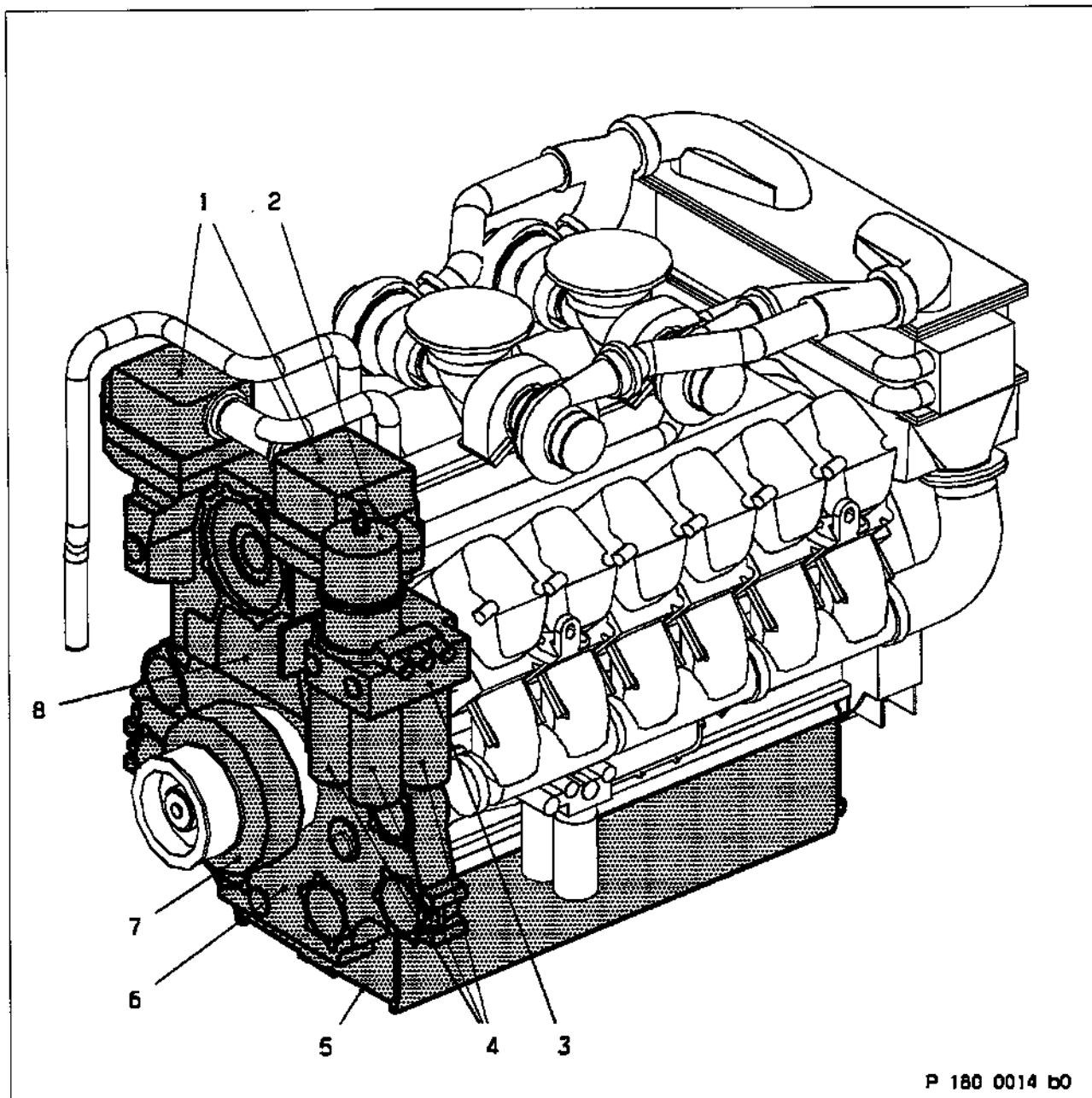
Note: When connecting to ground, ensure that the electric circuit is correctly poled (plus or minus).
Check starter direction of rotation.

C172.05.12 After-installation operations

For the following tasks, a distinction must be made as to whether:			
The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed			
		Measure	See
x	-	-	Perform operations as per Assembly Plan
x	-	-	Install engine
-	-	x	Release engine start
-	-	x	Release engine start
			→ B 005
			→ B 007
			→ C 124.05
			→ Operating Instructions

C180	Lube oil system	C-1
C181.05	Lube oil pump with drive	C-3
C181.05.01	Overview drawing	C-3
C181.05.02	Special tools	C-4
C181.05.04	Before-removal operations	C-4
C181.05.05	Removal	C-4
C181.05.06	Disassembly	C-5
C181.05.08	Inspection and repair	C-5
C181.05.11	Installation	C-6
C181.05.12	After-installation operations	C-7
C183.05	Oil filter	C-9
C183.05.01	Overview drawing	C-9
C183.05.02	Special tools	C-10
C183.05.04	Before-removal operations	C-10
C183.05.05	Removal	C-10
C183.05.08	Inspection and repair	C-11
C183.05.11	Installation	C-12
C183.05.12	After-installation operations	C-13
C183.10	Centrifugal oil filter	C-15
C183.10.01	Overview drawing	C-15
C183.05.04	Before-removal operations	C-19
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C183.10.06	Disassembly	C-19
C183.10.08	Inspection and repair	C-21
C183.10.10	Assembly	C-22
C183.10.11	Installation	C-25
C183.05.12	After-installation operations	C-25
C183.15	Engine oil heat exchanger	C-27
C183.15.01	Overview drawing	C-27
C183.15.04	Before-removal operations	C-28
C183.15.05	Removal	C-28
C183.15.08	Inspection and repair	C-29
C183.15.11	Installation	C-32
C183.15.12	After-installation operations	C-34
C184.10	Oil system in crankcase	C-35
C184.10.01	Overview drawing	C-35
C184.10.02	Special tools	C-37
C184.10.04	Before-removal operations	C-37
C184.10.05	Removal	C-37
C184.10.08	Inspection and repair	C-38
C184.10.11	Installation	C-39
C184.10.12	After-installation operations	C-39
C185.10	Oil supply lines for turbocharger	C-41
C185.10.01	Overview drawing	C-41
C185.10.02	Special tools	C-41
C185.10.04	Before-removal operations	C-42
C185.10.05	Removal	C-42

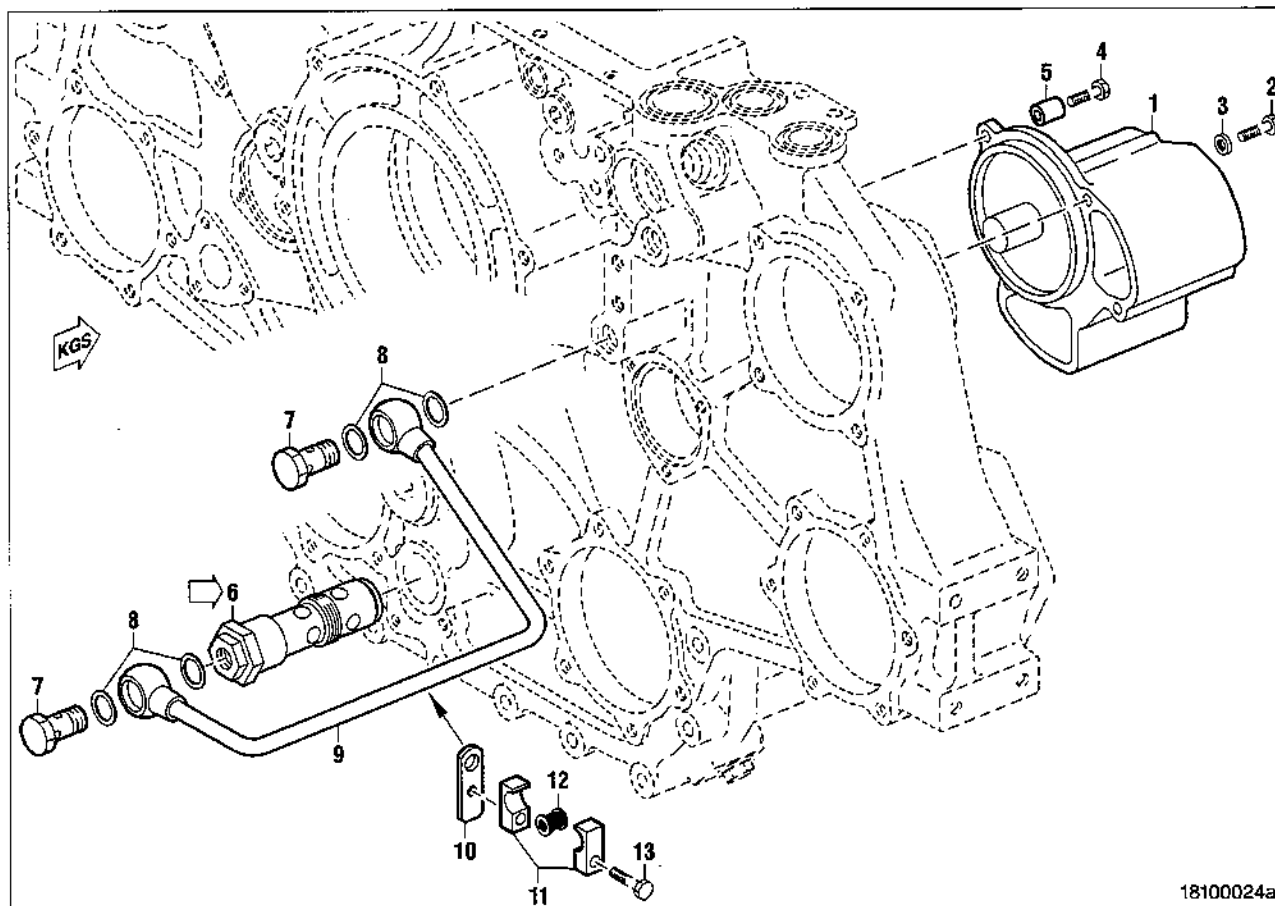
C185.10.08	Inspection and repair	C – 43
C185.10.11	Installation	C – 43
C185.10.12	After-installation operations	C – 44
C185.25	Oil return lines for exhaust turbocharger	C – 45
C185.25.01	Overview drawing	C – 45
C185.25.04	Before-removal operations	C – 46
C185.25.05	Removal	C – 46
C185.25.08	Inspection and repair	C – 46
C185.25.11	Installation	C – 47
C185.25.12	After-installation operations	C – 47

C180 Lube oil system

P 180 0014 b0

- 1 Oil cooling (oil heat exchanger)
- 2 Centrifugal oil filter
- 3 Mounting bracket (centrifugal oil filter)
- 4 Oil filter

- 5 Crankcase bottom section (oil pan)
- 6 Equipment carrier with oil pump and valves
- 7 Vibration damper
- 8 Coolant distribution housing with oil pipework

C181.05 Lube oil pump with drive**C181.05.01 Overview drawing**

18100024a

- | | | |
|----------------------------------|--|--------------------|
| 1 Oil pump | | 7 Banjo screw |
| 2 Hex screw | | 8 Sealing ring |
| Lubricant: Engine oil | | 9 Oil line |
| Tightening torque: 60 Nm + 7 Nm | | 10 Bracket |
| 3 Washer | | 11 Pipe clamp half |
| 4 Hex screw | | 12 Grommet |
| Lubricant: Engine oil | | 13 Hex screw |
| Tightening torque: 60 Nm + 7 Nm | | |
| 5 Spacer sleeve | | |
| 6 Pressure reduction valve | | |
| Lubricant: Engine oil | | |
| Tightening torque: 60 Nm + 20 Nm | | |

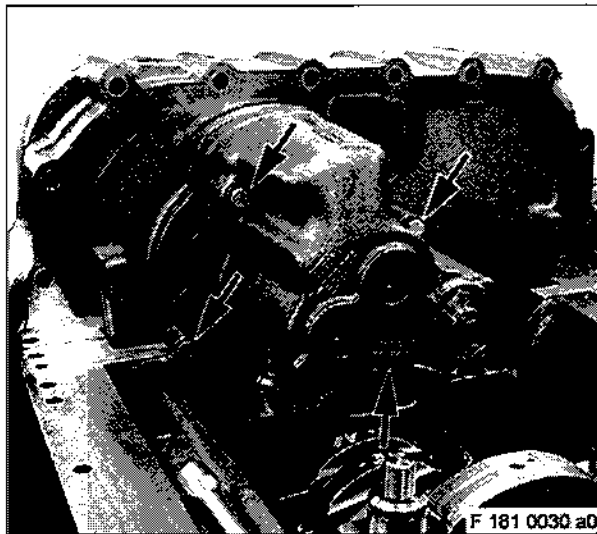
C181.05.02 Special tools

Designation	Use/dimension	Number
• Support bracket	for oil pump	1

C181.05.04 Before-removal operations

For the following tasks, a distinction must be made as to whether: → The engine is to be completely disassembled → The engine is to be removed but not disassembled → The engine is to remain installed				
			Measure	See
x	–	–	Remove engine	→ B 003
x	–	–	Perform operations as per Disassembly Plan	→ B 004
–	–	x	Disable engine start	→ Operating Instructions
–	–	x	Drain or draw off engine oil	→ Operating Instructions
–	x	x	Remove oil pan	→ C 014.05
–	x	x	Remove engine mounts	→ C 231.05

C181.05.05 Removal



Removing oil pump with safety valve

Note: Illustration does not show engine in installation position.

Remove hex screws (arrows) for oil pump.



**Heavy object.
Risk of injury!
Use suitable tools and lifting equipment.**

Mount support bracket on oil pump and, using a lightly tensioned rope, hang onto crane.

Remove oil pump from equipment carrier.

Removing oil line and pressure reduction valve

Remove oil line from equipment carrier, see Overview drawing C 181.05.01.

Remove pressure reduction valve from equipment carrier.

Remove sealing rings.

Seal connections with suitable plugs.

Protect oil line from damage.

C181.05.06 Disassembly**Disassembling lube oil pump**

The lube oil pump must not be disassembled.

C181.05.08 Inspection and repair**Oil line**

	CAUTION
Compressed air is air pressurised by overpressure. If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask. Compressed air must not be directed at the body. The pressure must not exceed 3.0 bar (40 lb/in²).	

Clean oil line with cold cleaner and blow clear with compressed air.

Visually inspect components for condition and damage; recondition as necessary or replace.

Machine defective sealing face and check for surface irregularities with ink-check plate.

Check condition of threads; replace components as necessary.

Replace gaskets

Oil pump with safety valve

Have lube oil pump checked and, if necessary, repaired by manufacturer.

Visually inspect outside of lube oil pump for damage and defects.

Check tooth flanks of gears for wear, indentations and chipping; if necessary recondition or replace lube oil pump.

Check pressure relief valve opening pressure of 15 bar.

Test medium: Engine oil SAE 30

Medium temperature: from 90 °C to 100 °C

If values are above or below opening pressure, replace pressure relief valve.

Check securing screws for condition and thread for ease of movement; replace screws if necessary.

Pressure reduction valve

Visually inspect pressure reduction valve for damage; replace if necessary.

Check pressure reduction valve opening pressure.

Operation: The valve limits the oil flow so that a constant pressure of 5.5 ± 1 bar is maintained at the last main bearing.

Medium temperature: from 90 °C to 100 °C

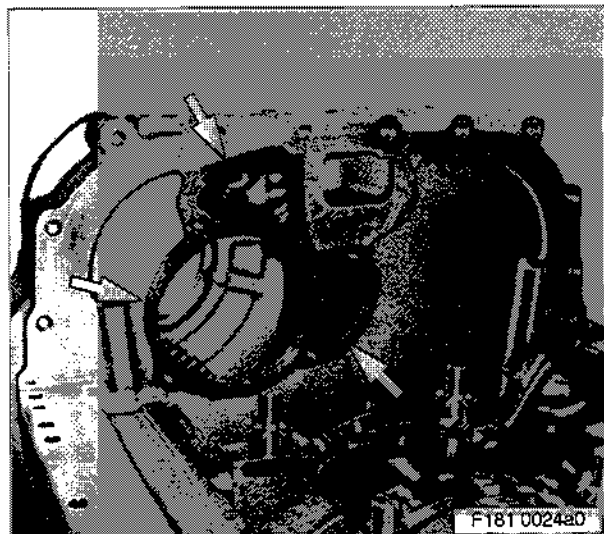
Design pressure at

n/min n/max of oil pump: 1.5 bar / 7 bar

If opening pressure is exceeded or not reached, replace pressure reduction valve.

C181.05.11 Installation

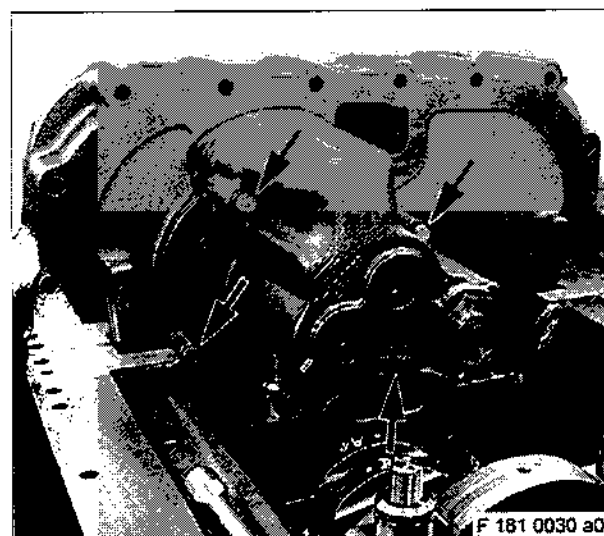
Note: When performing any tasks ensure that components are perfectly clean!



Installing oil pump with safety valve

Degrease and dry mating face on oil pump.

Using a spatula/roller, coat sealing surface (arrows) of equipment carrier with surface sealant Loctite 518.

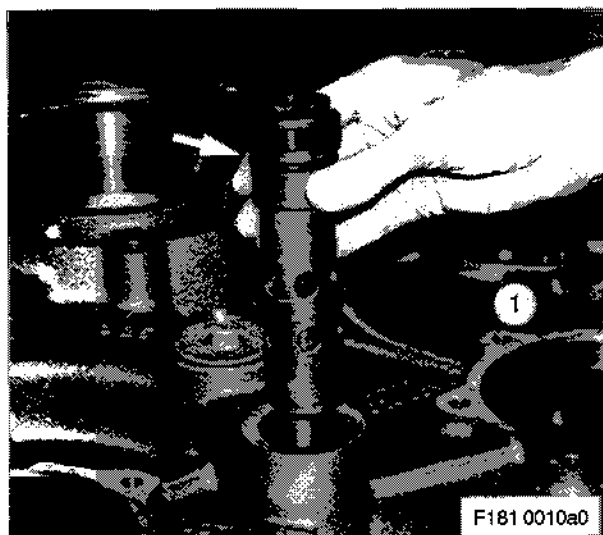


Attach oil pump with support bracket to crane.

Insert oil pump into equipment carrier, making sure gears engage correctly.

Screw in hex screws (arrow) for oil pump and tighten diagonally and evenly to specified tightening torque – see Overview drawing C 181.05.01.

Note: Observe identification marking (10.9) on screw head and note different screw lengths.



Installing pressure reduction valve

Coat O-ring with petroleum jelly and insert into groove (arrow) on pressure reduction valve.

Insert pressure reduction valve in equipment carrier (1) and tighten to specified tightening torque, see Overview drawing C 181.05.01.

Installing oil line

Note: Before installation, remove all blanking plugs.

 CAUTION
Compressed air is air pressurised by overpressure. If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask. Compressed air must not be directed at the body. The pressure must not exceed 3.0 bar (40 lb/in²).

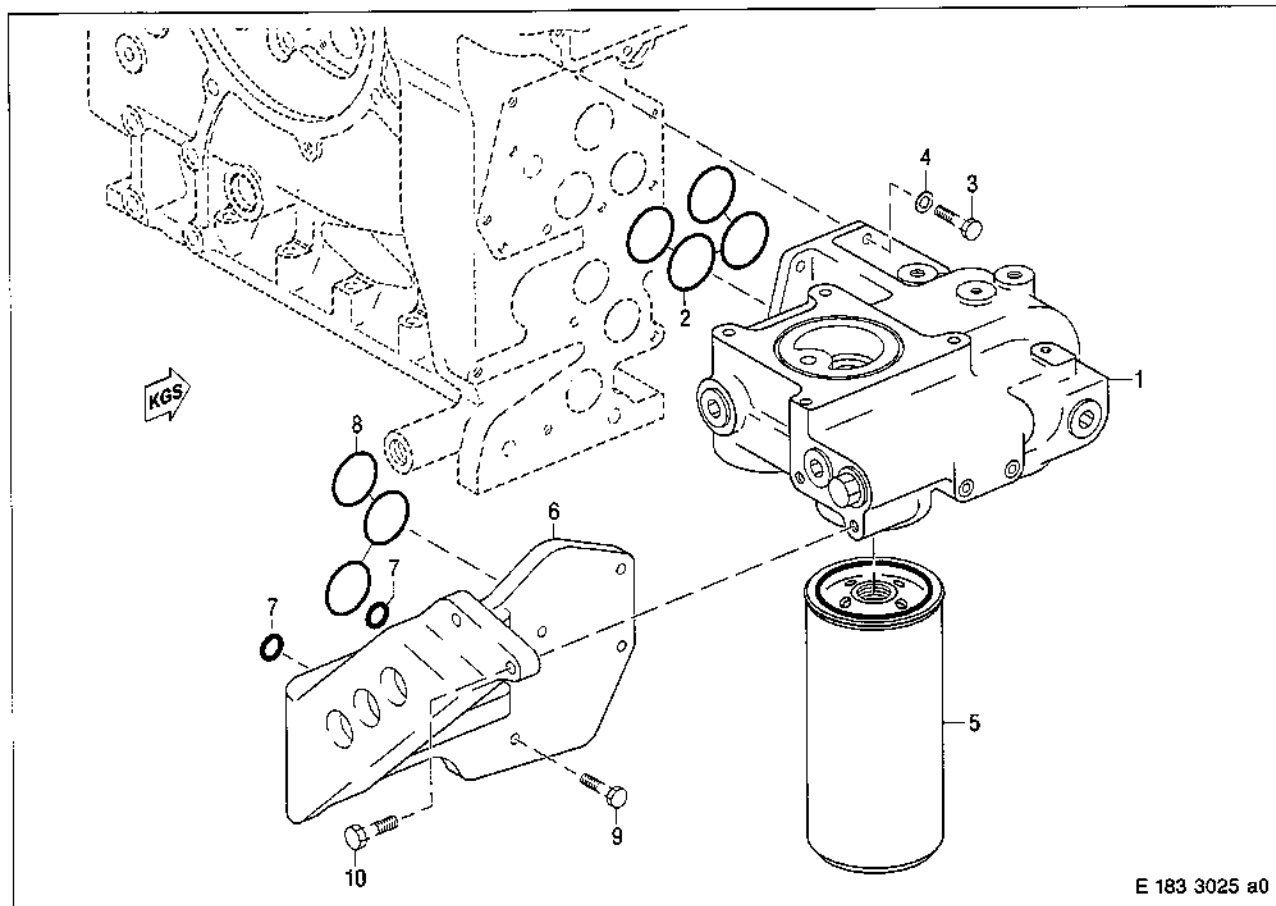
Blow out oil line with compressed air and ensure that it is perfectly clean.

Mount oil line with fastening elements free of tension as shown in Overview drawing C 181.05.01.

Note: After engine start, visually inspect oil line for leaks.

C181.05.12 After-installation operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	x	x	Assembly in reverse sequence to disassembly	→ C 101.01.04
–	–	x	Fill oil system with engine oil	→ Operating Instructions
–	–	x	Release engine start	→ Operating Instructions

C183.05 Oil filter**C183.05.01 Overview drawing**

- 1 Mounting bracket
- 2 Sealing ring
- 3 Hex screw
- 4 Washer
- 5 Oil filter

- 6 Bracket
- 7 O-ring
- 8 Sealing ring
- 9 Hex screw
- 10 Hex screw

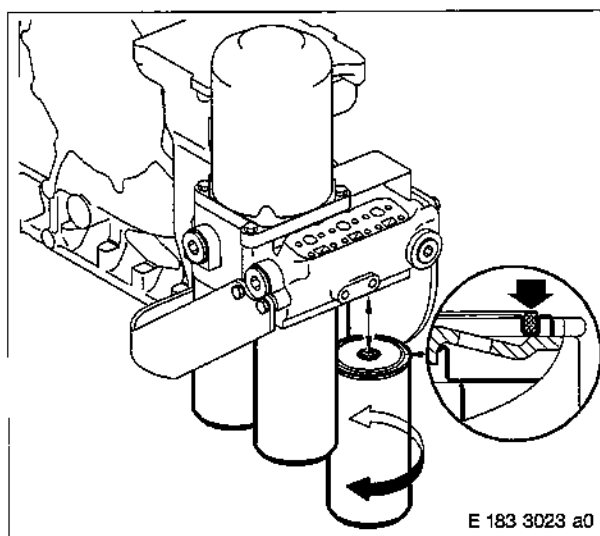
C183.05.02 Special tools

Designation	Use/dimension	Number
• Oil filter wrench	(also for fuel filter)	1

C183.05.04 Before-removal operations

For the following tasks, a distinction must be made as to whether: → The engine is to be completely disassembled → The engine is to be removed but not disassembled → The engine is to remain installed			
Measure			See
x	–	–	Remove engine → B 003
x	–	–	Perform operations as per Disassembly Plan → B 004
–	–	x	Disable engine start → Operating Instructions
–	–	x	Drain engine coolant → Operating Instructions
–	x	x	Drain engine oil from centrifugal oil filter → Operating Instructions
–	x	x	Remove pressure transmitter and temperature transmitter → C 507.10

C183.05.05 Removal



Remove oil filter

Remove oil filter with oil filter wrench and dispose of in accordance with local specifications.

Drain oil residue from oil filter into a container.

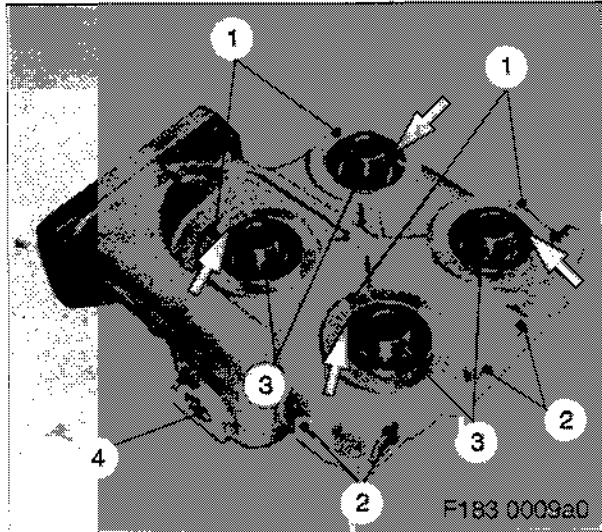
Removing oil filter housing



Heavy object. Risk of injury!
Use suitable tools and lifting equipment.

Remove oil filter housing as shown in Overview drawing C 183.05.01.

After removing all connections and openings, seal with suitable plugs.

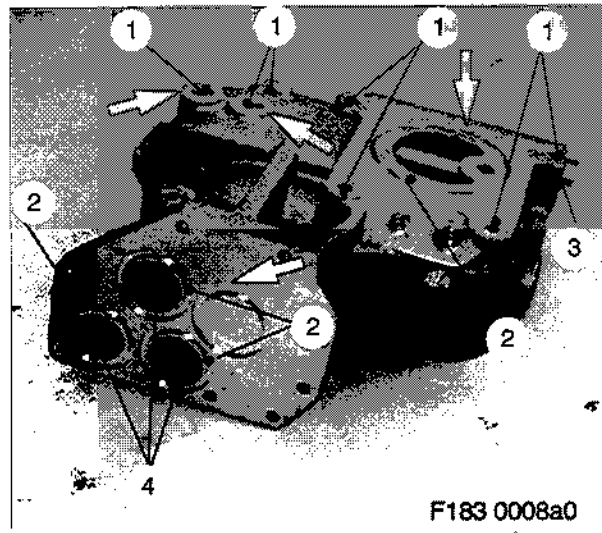
C183.05.08 Inspection and repair

Clean mounting bracket.

Check all sealing, mating and sliding surfaces for wear, scoring and indentations.

Check in particular:

- threaded plugs (3)
- threaded bores (2)
- plane surface (1)
- inner surface, mounting bracket (arrow)
- threaded union (4)



Check components for damage; machine or replace as necessary.

Check all sealing, mating and sliding surfaces for wear, scoring and indentations.

Check in particular:

- threaded bores (1)
- plane surface (arrow)
- inner face (4)
- seating surface of O-rings (2)

Unscrew threaded union (3) and remove pressure limiting valve.

Clean components thoroughly.

If piston jams slightly, recondition by relapping.

Check opening pressure (2.5 bar).

If opening pressure does not correspond to specified value, disassemble valve and readjust by fitting appropriate adjusting shims until correct value is achieved.

Remove minor wear, scoring and indentations by rubbing down with oilstone or emery paper; replace components as necessary.

Check thread for ease of movement; recut as necessary or replace component with thread insert – see Section A 009.

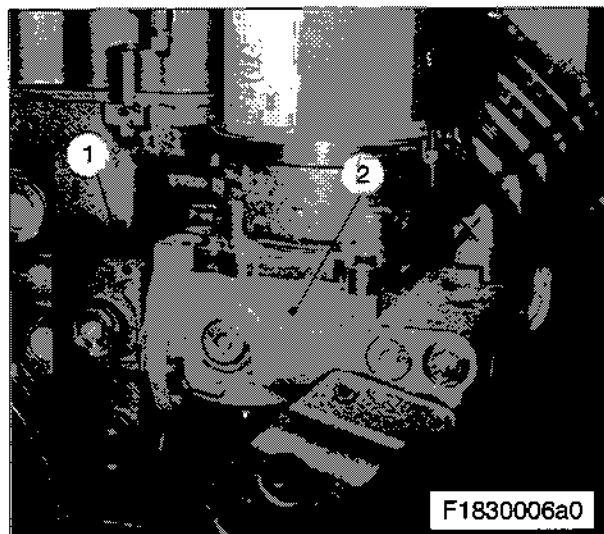
Replace blanking plugs and plugs if necessary (e.g. if leaking) .

Replace hose line as part of every W6 overhaul.

Replace gaskets, sealing rings, gasket and O-rings.

Make sure that oil chambers and oilways are perfectly clean.

C183.05.11 Installation



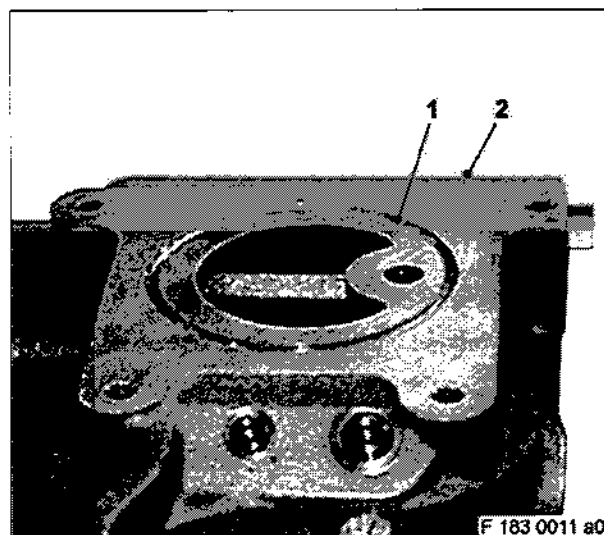
Installing mounting bracket

Note: Prior to installation, remove all blanking plugs and covers.

Make sure that oil chambers and oilways are perfectly clean.

Before installation coat sealing rings and O-rings with petroleum jelly and fit as per Overview drawing C 183.10.01.

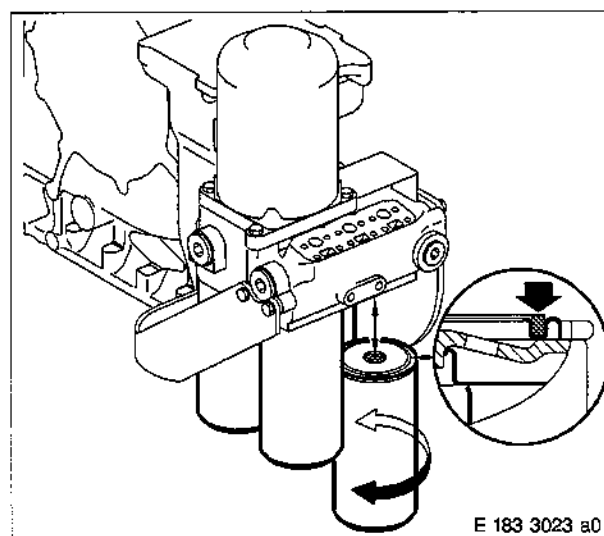
Install mounting bracket (2) with washers and hex screws on coolant distribution housing (1).



Install centrifugal filter

Coat sealing ring with petroleum jelly and insert into groove (1) of mounting bracket (2).

Install centrifugal oil filter as per Overview drawing – see C 183.05.01.



Install oil filter

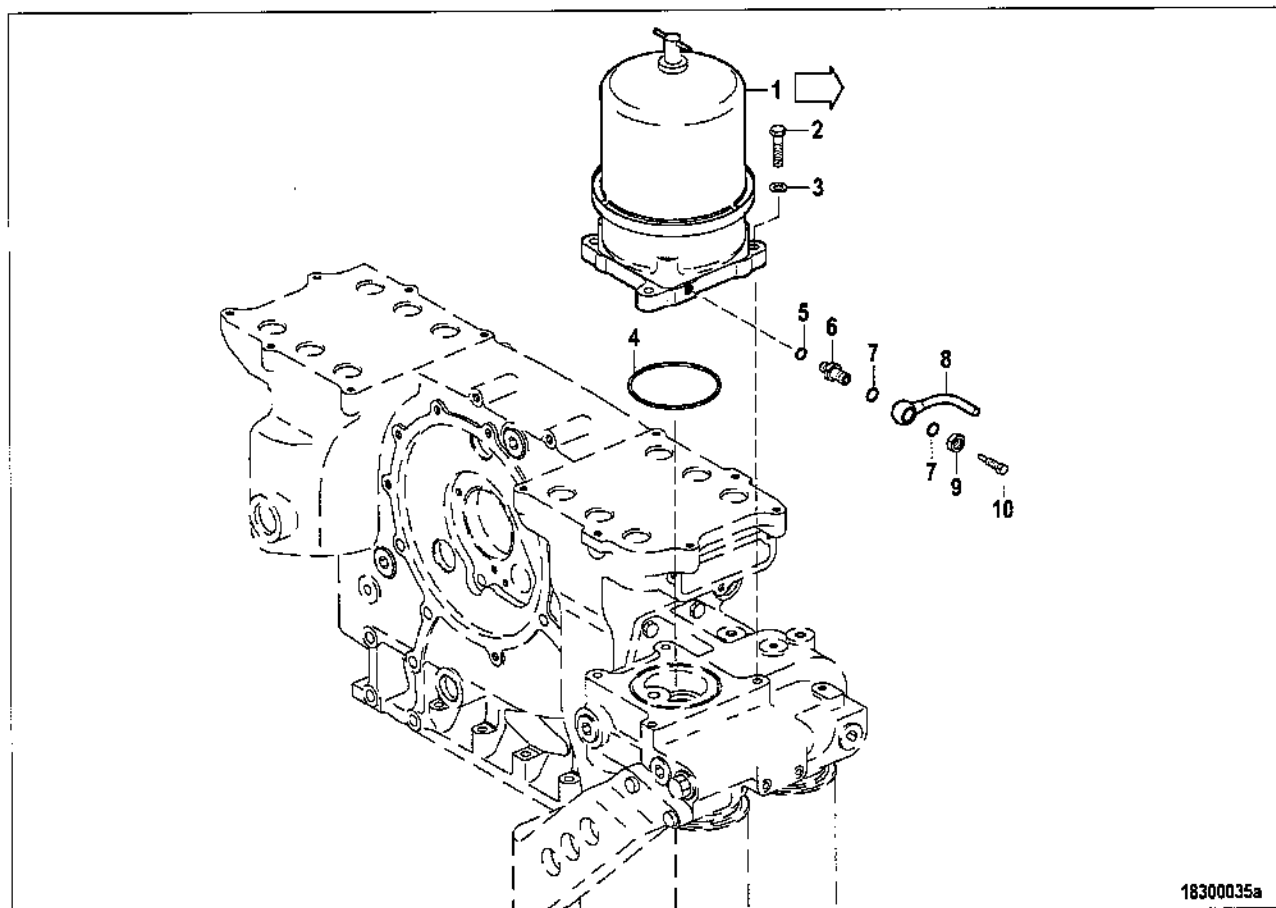
Check sealing ring of new oil filter cartridge, clean as necessary and coat with oil.

Install new oil filter cartridges and tighten manually.

Note: After engine start, visually inspect oil filters for leaks.

C183.05.12 After-installation operations

			For the following tasks, a distinction must be made as to whether:	
			↓ ↓ ↓ The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed	
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	x	x	Assembly in reverse sequence to disassembly	→ C 183.05.04
			Fill engine oil as necessary	→
			Fill engine coolant system	→ Operating Instructions
–	–	x	Release engine start	→ Operating Instructions

C183.10 Centrifugal oil filter**C183.10.01 Overview drawing**

18300035a

1 Centrifugal oil filter

2 Hex screw

3 Washer

4 O-ring

5 Sealing ring

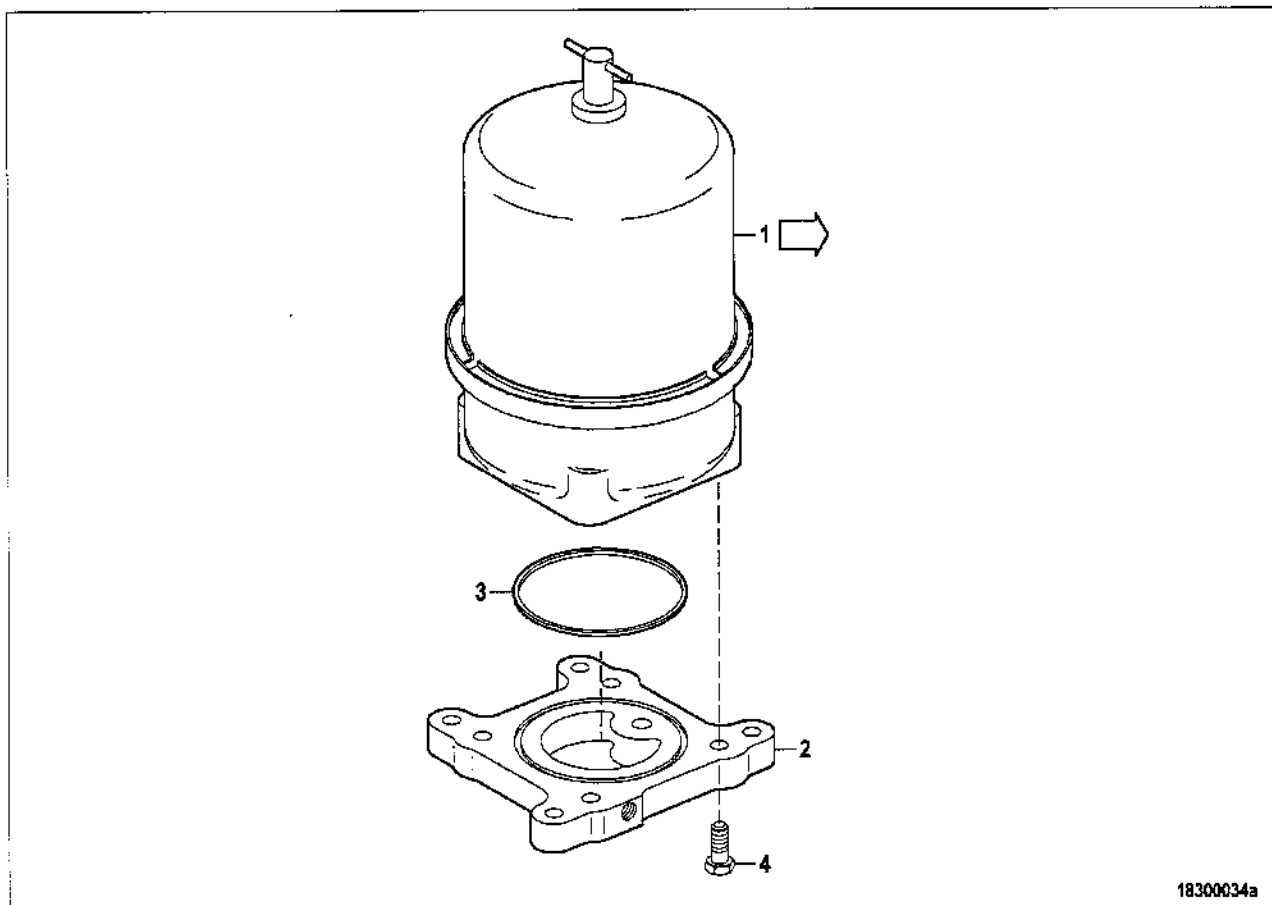
6 Adapter

7 Sealing ring

8 Oil line

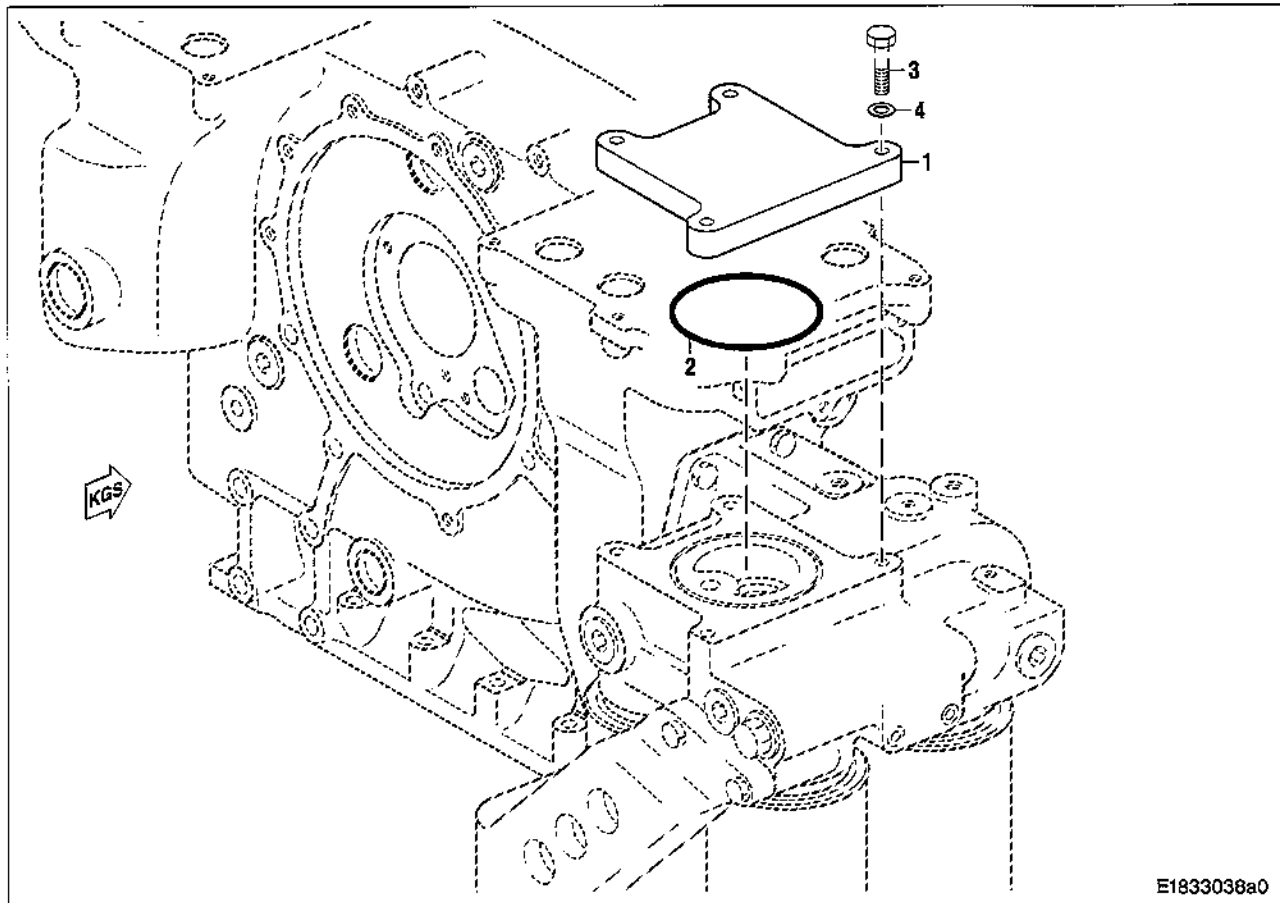
9 Hex nut

10 Screw



- 1 Centrifugal oil filter
- 2 Flange

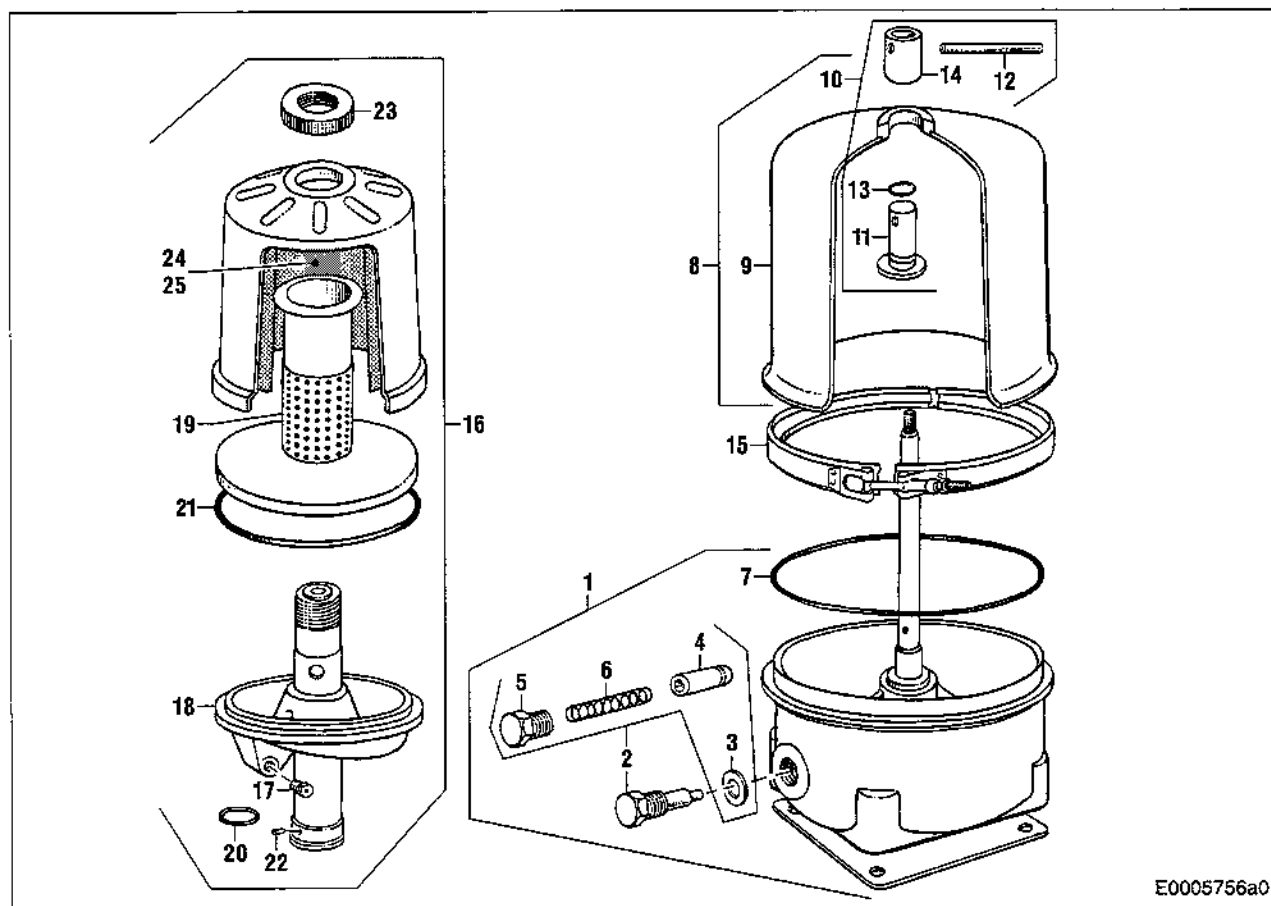
- 3 Sealing ring
- 4 Hex screw



- 1 Cover
- 2 Sealing ring

- 3 Hex screw
- 4 Washer

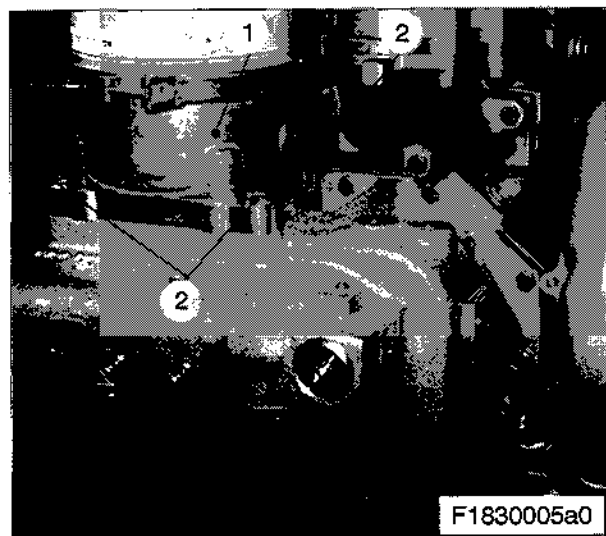
Centrifugal oil filter



- | | | |
|----------------------|----------------|------------------------------|
| 1 Housing | 10 Cover screw | 18 Substructure with bearing |
| 2 Valve | 11 Screw | 19 Standpipe |
| 3 Sealing ring | 12 Pin | 20 Snap ring |
| 4 Valve plunger | 13 O-ring | 21 O-ring |
| 5 Plug | 14 Drain screw | 22 Pin |
| 6 Compression spring | 15 Clamp | 23 Knurled nut |
| 7 O-ring | 16 Rotor unit | 24 Sleeve |
| 8 Safety cover | 17 Nozzle | 25 Reinforcing plate |
| 9 Cover | | |

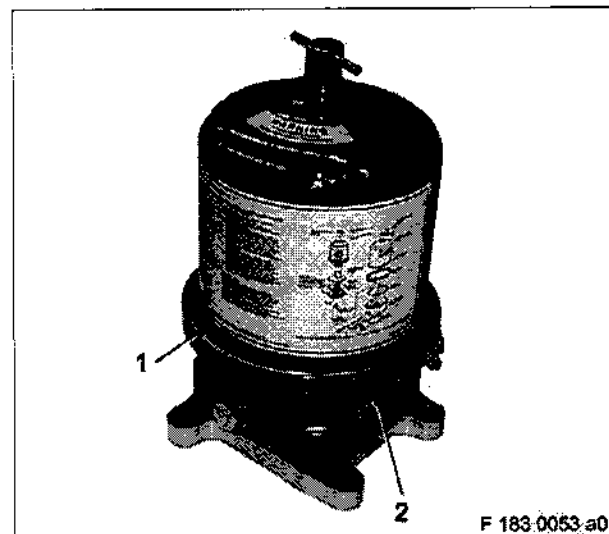
C183.05.04 Before-removal operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Remove engine	→ B 003
x	–	–	Perform operations as per Disassembly Plan	→ B 004
–	–	x	Disable engine start	→ Operating Instructions
–	x	x	Drain engine oil from centrifugal oil filter	→ Operating Instructions

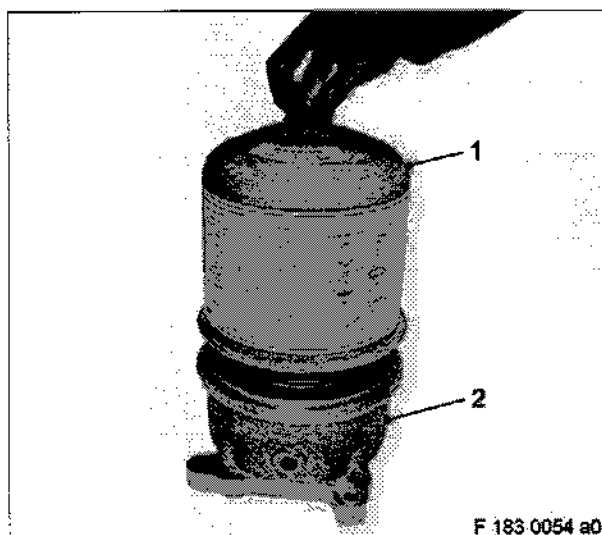
C183.05.05 Removal**Remove centrifugal filter**

Remove hex screws (2) for centrifugal oil filter (1) and remove centrifugal oil filter from mounting bracket.

Cover installation bore or seal with a suitable plug.

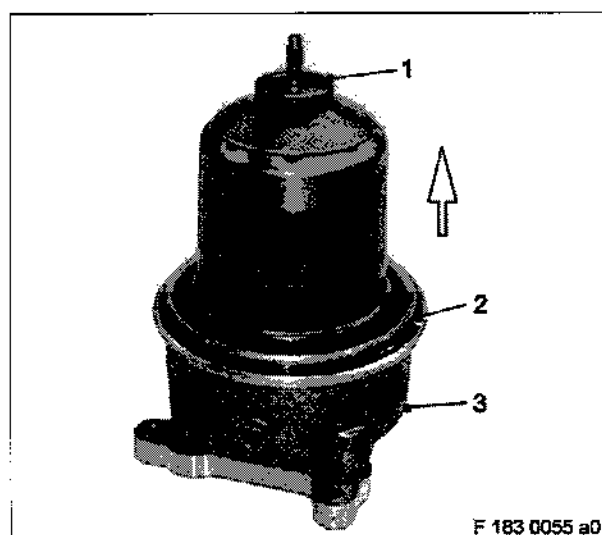
C183.10.06 Disassembly**Disassembling centrifugal oil filter**

Release toggle (2) and remove V-clamp (1).



Release cover screw.

Remove centrifugal filter cover (1) from housing substructure (2).



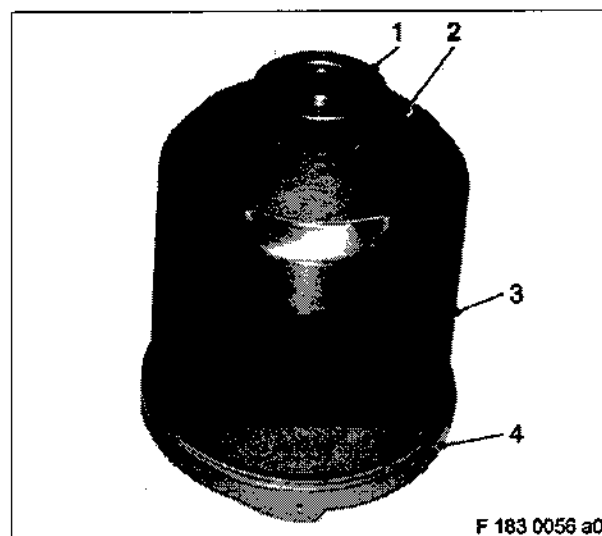
Make sure that rotor unit has been completely drained.

Remove rotor unit (1) carefully from housing (3).

Remove O-ring (2).

Note: Take care not to damage bearings and shaft.

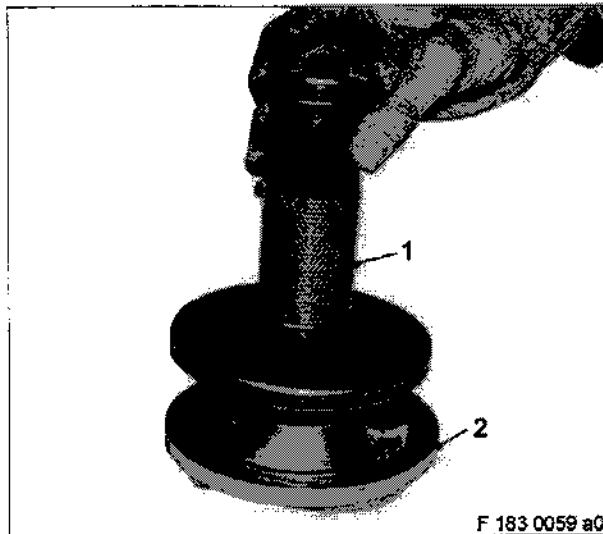
Remove flange from housing and take out sealing ring.



The rotor must never be clamped in a vice.

Release knurled nut (1) and remove rotor hood (3) with cover plate (2) from rotor substructure (4).

Note: Take care not to interchange rotors belonging to different centrifugal filters because rotor hood and substructure are aligned to one another during manufacture.



Remove standpipe (1) from rotor substructure (2).

Remove blanking plug, compression spring and valve plunger, see Overview drawing C 183.10.01.

C183.10.08 Inspection and repair

Use a wooden spatula or similar instrument to remove contaminant deposits from the inside surface of the rotor cap.

Rinse rotor parts and dry. Failure to do this could result in an imbalance, which would lead to increased wear of the shaft bearings.

Check housing and substructure with bearing for cracks using surface crack-testing method with red penetrant dye; replace components if cracks are found.

Remove surface irregularities from sealing and mating faces by rubbing down with an oilstone or emery cloth.

Check rotor bearing journal for wear, smooth with emery cloth as required, replace rotor if necessary.

Note: Rotor substructure and hood must only be installed and replaced as a set since they were manufactured as a complete unit.

Using a brass wire, check that jets of nozzles are perfectly clean and unobstructed.

Check bearing running surfaces on the shaft for wear, rub down with emery cloth if required; if damaged or worn, the entire housing substructure with shaft must be replaced.

Check piston (4) and spring (6) for wear (minimum pressure supply), see Overview drawing C 183.10.01; replace housing substructure if necessary.



CAUTION

Compressed air is highly pressurized. Risk of injury!

If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask. Pressure must not exceed 3.0 bar.

Blow out standpipe and nozzle with compressed air and, if required, clean with brass brush; replace parts if necessary.

Replace O-rings, sealing rings and insertion sleeves at every assembly.

Check bearing clearance

Set dial gauge via the dial gauge stylus to zero and measure clearance at the outer edge of the rotor, top and bottom.

- measure clearance
- rotate rotor 90° and repeat measurement
- place dial gauge once again at 90° at previous measuring point and measure

– rotate rotor 90° and repeat measurement

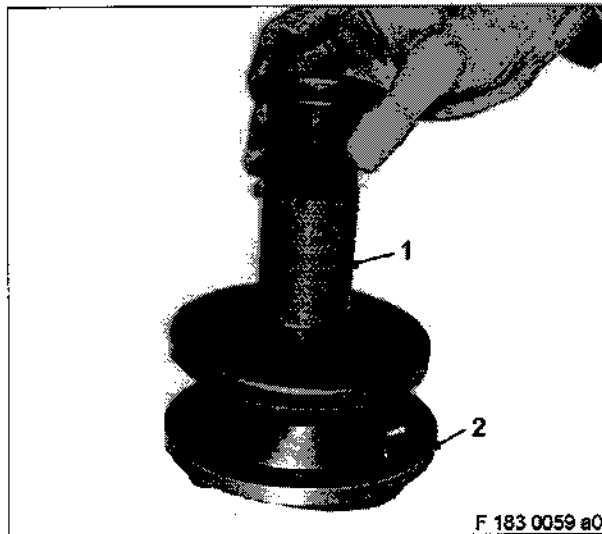
The highest read-off dimension equals the bearing clearance.

Max. clearance new dimension upper bearing 0.08 mm, lower bearing 0.06 mm.

If clearance of upper bearing is greater than 0.25 mm, lower bearing 0.2 mm, replace complete unit of rotor substructure and rotor hood as a pair only.

– Diameter of upper bearing running surface of shaft	14.98 mm
– Diameter of lower bearing running surface of shaft	21.63 mm
– ID of upper bearing	15.06 mm
– ID of lower bearing	21.69 mm

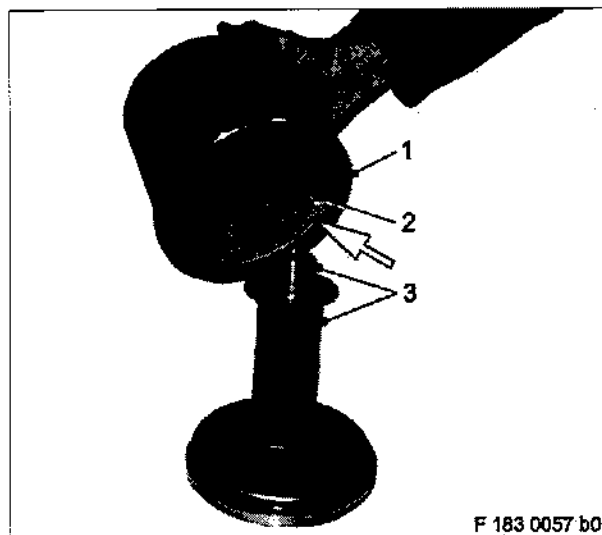
C183.10.10 Assembly



Assembling centrifugal oil filter

Note: Ensure that all components are perfectly clean.

Mount standpipe (1) on rotor substructure (2).



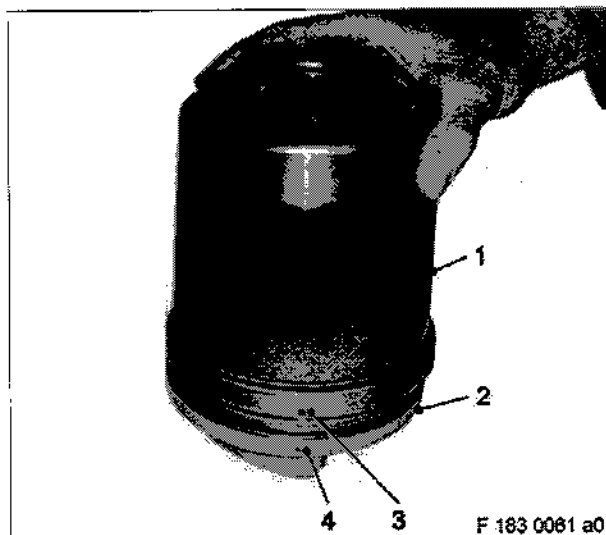
Insert new insert sleeve (2) into rotor hood (1).

Coat O-ring (arrow) with petroleum jelly and insert into groove on rotor hood.

Mount rotor hood and insert sleeve carefully onto rotor substructure.

Slot on rotor hood must be in alignment with pin on rotor substructure, see following illustration.

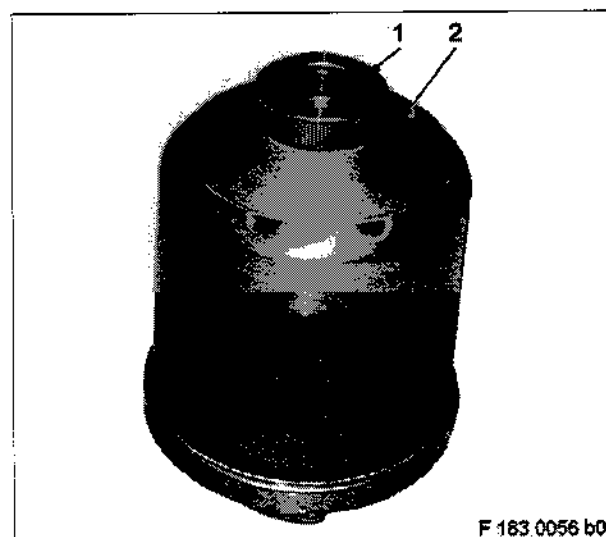
Rotor hood and substructure are aligned to one another.



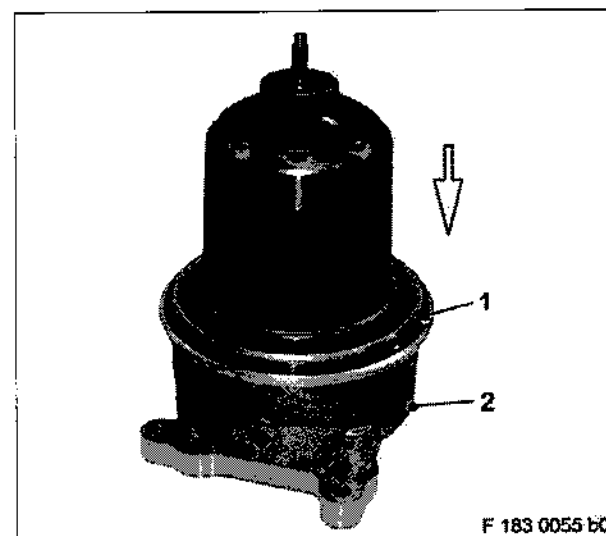
Mount rotor hood (1).

Note: Slot (3) on rotor hood must be in alignment with pin (4) on rotor substructure (2).

Rotor hood and substructure are aligned to one another.



Mount cover plate (2) and tighten knurled nut (1) by hand.



Insert sealing ring in flange, see Overview drawing C 183.10.01.

Mount flange with hex screw on housing (2), ensuring it is correctly positioned.

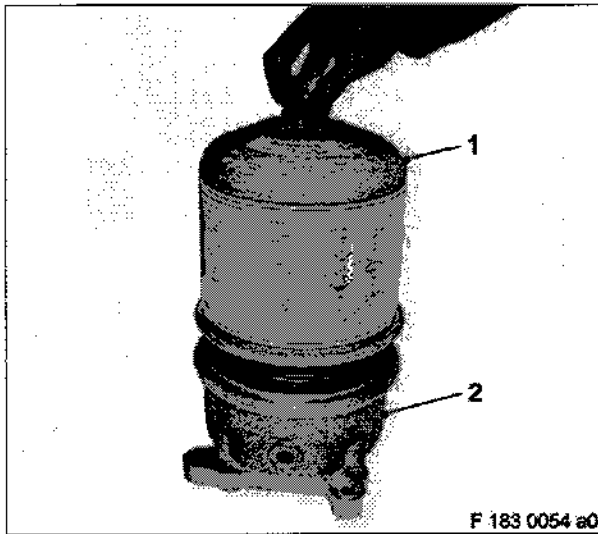
Coat shaft with engine oil.

Insert rotor unit carefully into rotor substructure.

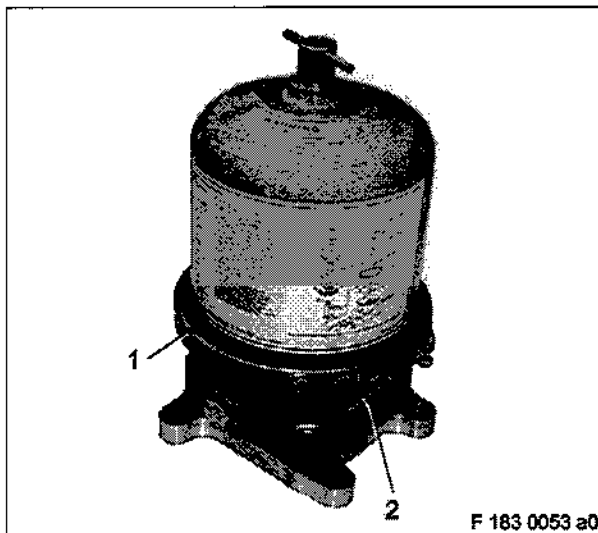
Note: Take care not to damage bearings and shaft.

Check that rotor rotates freely.

Coat O-ring (1) with petroleum jelly and insert in groove on rotor substructure.



Place centrifugal filter cover (1) carefully onto housing substructure (2) and tighten cover screw.



Fit V-clamp (1) and tighten nut (1) with toggle.
Check cover screw once again for security.

C183.10.11 Installation

Note: Prior to installation, remove all blanking plug and/or covers.

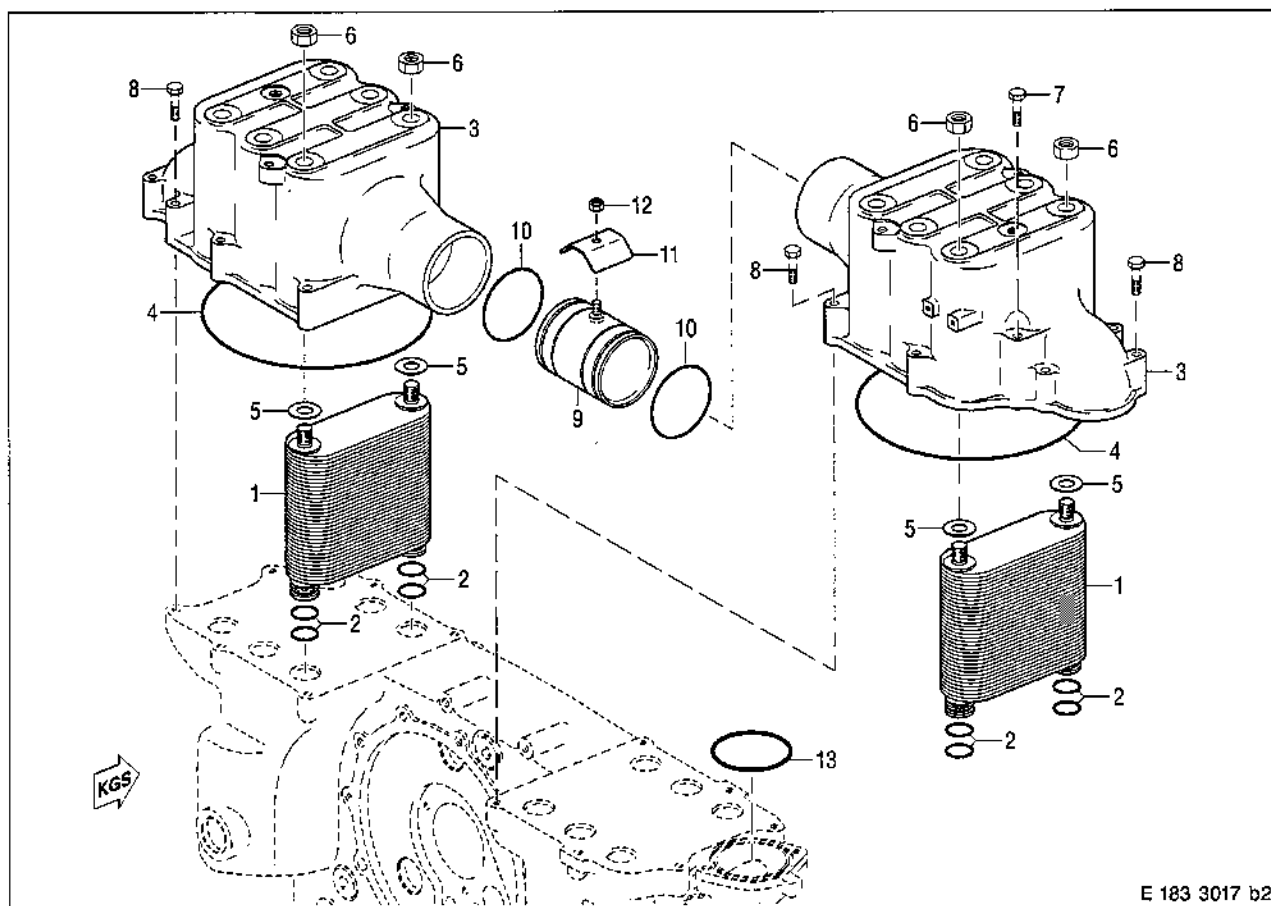
Make sure sealing surfaces, oil chambers and oilways are particularly clean, clean as required.

Installation is carried out in reverse sequence.

For installation of centrifugal oil filter, see C 183.10.01.

C183.05.12 After-installation operations

For the following tasks, a distinction must be made as to whether:			
↓ ↓ ↓ ↓ The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed			
Measure			See
x	–	–	Perform operations as per Assembly Plan → B 005
x	–	–	Install engine → B 007
–	x	x	Fill engine oil as necessary → –
–	–	x	Release engine start → Operating Instructions

C183.15 Engine oil heat exchanger**C183.15.01 Overview drawing**

- 1 Cooler insert
- 2 O-ring
- 3 Oil cooler housing
- 4 O-ring
- 5 Sealing washer
- 6 Nut for cooler insert

Lubricant: Engine oil
 Tightening torque: 100 Nm

7 Hex screw
 Lubricant: Engine oil
 Tightening torque: 45 Nm

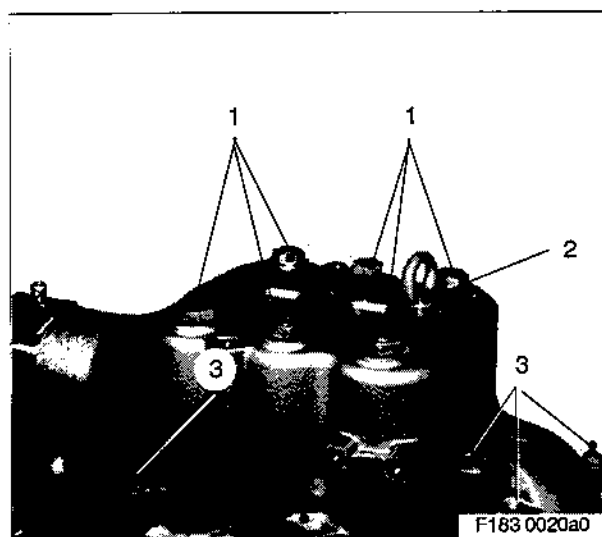
- 8 Hex screw
- 9 Plug-in pipe
- 10 O-ring
- 11 Bracket
- 12 Nut
- 13 O-ring

Lubricant: Engine oil
 Tightening torque: 45 Nm

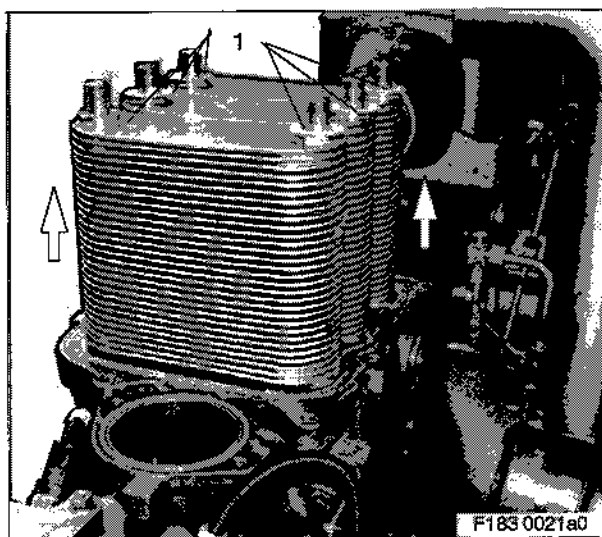
C183.15.04 Before-removal operations

For the following tasks, a distinction must be made as to whether:					
				Measure	See
x	-	-		Remove engine	→ B 003
x	-	-		Perform operations as per Disassembly Plan	→ B 004
-	-	x		Disable engine start	→ Operating Instructions
-	-	x		Drain engine coolant	→ Operating Instructions
-	-	x		Drain charge air coolant	→ Operating Instructions
-	x	x		Remove crankcase breather	→ C 018.10.05
-	x	x		Remove engine coolant vent lines	→ C 202.65.05
-	x	x		Remove coolant line from/to intercooler	→ C 203.25.05

C183.15.05 Removal



Remove hex screws (3) from oil cooler housing.
Release and remove nuts (1).
Screw eyebolt (2) into left and right oil cooler housing.
Using crane and rope, remove oil cooler housing from coolant distribution housing.



Remove sealing washers (1).

Carefully lift oil heat exchanger (arrow) vertically out of coolant distribution housing fit.

After removing all connections and openings, seal with suitable plugs.

C183.15.08 Inspection and repair

Replace oil filter cartridges.

Clean all components.

Check components for damage; machine or replace as necessary.

Replace cooler insert in event of damage.

Check oil cooler housing for cracks with red penetrant dye. If cracks are detected, replace part.

Check all sealing, mating and sliding surfaces for wear, scoring and indentations.

Remove minor wear, scoring and indentations by rubbing down with oilstone or emery paper; replace components as necessary.

Check condition of threads; re chase threads or replace component if necessary.

Replace gaskets, sealing rings, gasket and O-rings.

Make sure that oil chambers and oilways are perfectly clean.

Clean cooler inserts on coolant and oil side.

Note: The oil heat exchanger must be replaced if chippings have penetrated the engine oil system e.g. in event of piston scuffing or damage to bearings.

Cleaning coolant side:

It is essential to examine extent of contamination of water side prior to cleaning.

The coolant side must be cleaned if there is visible encrustation on the coolant side due to crustations, contamination and oil deposits.

Soak cooler element in a cleaning bath containing dissolved cleaning agent.



CAUTION

When using these chemical substances, it is essential to observe the manufacturer's instructions for use, safety instructions and waste disposal specifications.

An agent which is not aggressive to metal surfaces (e.g. Porodox from Henkel or Porozink from Parobe-Chemie, Basel) must be used to remove deposited material.

Follow the manufacturer's instructions to the letter when preparing the descaling solution.

Dwell time depends on the condition and temperature of the solution and the nature and stubbornness of the deposits.

Cleaning process is completed when loosened contaminants can be flushed away with a powerful water jet.

After cleaning, flush the cooler with water until pH values of clean water and rinsing water are approximately the same (difference 1 pH).

Normal water can be used for flushing purposes.

Cleaning/flushing oil side:

Connect oil side to sealed, forced-circulation flushing system.

Forced-circulation flushing system must be equipped with a filter (0.05 mm mesh).

Flush with cleaning agent in opposite direction of oil flow in normal operation.



CAUTION

When using these chemical substances, it is essential to observe the manufacturer's instructions for use, safety instructions and waste disposal specifications.

Suitable descaling agents are buffered alkaline agents such as a 3 to 5% solution of P3 FD from Henkel.

Cleaning can be improved by using ultrasonic equipment.

After cleaning, oil side must be flushed with water until pH values of fresh water and flushing water are roughly equal (permissible difference 1 pH).

This releases contaminants, particularly particles from wear parts, from swirl plates, so that they are flushed out with water.

Continue cleaning process until flushing medium leaving cooler is same as that entering.



Test fluid is highly pressurized. Risk of injury!

Liquids emerging under high-pressure can lead to serious injury!

Always wear protective clothing, protective gloves and protective goggles/safety mask.

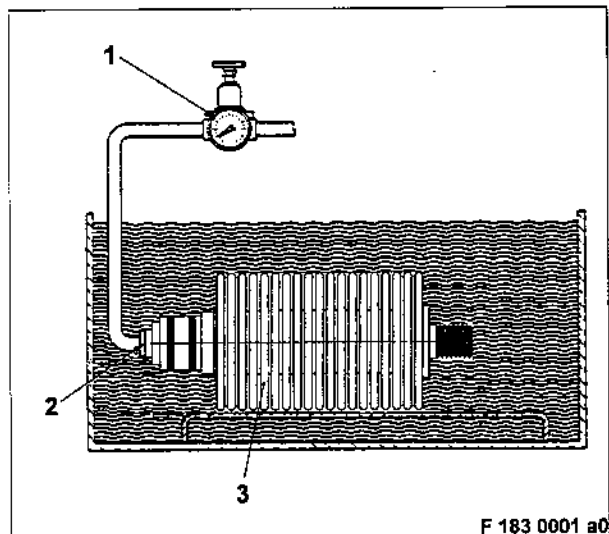
Flushing pressure 3 to 4 bar at 150 to 300 litres/minute.

Note: If the cooler is not put into operation immediately, dry oil side, preserve and seal the openings air-tight with suitable end covers.

Dry in a drying oven between 110 °C and 120 °C. Oven drying time: approx. 3 hours.

Spray preservation agent (Branol 32/10 from Brangs and Heinrich) into cooler. The preservation agent condenses and falls to form a protective layer over the inner surfaces.

Make sure dosages are correct! 2 ml Branorol 32/10 per litre of coolant.

Cooler insert leak check

Seal oil chamber connections of cooler insert (3) with suitable sleeves, blank plugs, plugs with connection (2) and clamps.

At plug with connection, seal compressed air line.

Compressed air is air pressurised by overpressure.

Test fluid is hot 80 °C (180°F).

Risk of injury!

Pressure must not exceed 0.5 bar (7.25 lb/in²).

Always wear protective clothing, protective gloves and protective goggles/safety mask.

Soak cooler insert in test basin filled with water heated to 80 °C.

CAUTION

Component is hot.

Risk of injury!

Handle components only when wearing protective gloves.

Open compressed air supply and set pressure reducer (1) to 0.5 bar.

Pressure-test intercooler for leaks with air in water bath; no bubbles should emerge.

If leaks are found, replace cooler insert.

After testing, remove compressed air line, sleeves and plugs.

CAUTION

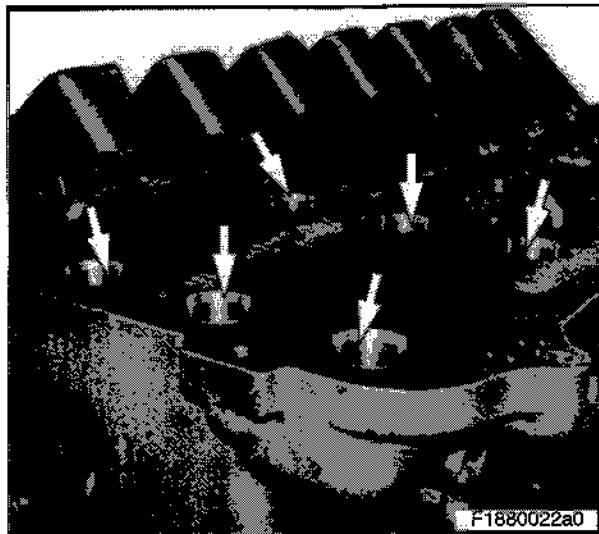
Compressed air is air pressurised by overpressure. Risk of injury!

If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask.

Compressed air must not be directed at the body. The pressure must not exceed 3.0 bar (40 lb/in²).

Blow out cooling fins of cooler insert with compressed air in vertical direction.

C183.15.11 Installation



Installing oil heat exchanger

Note: Prior to installation, remove all blanking plug and/or covers.

Make sure that oil chambers and oilways (arrow) are perfectly clean.

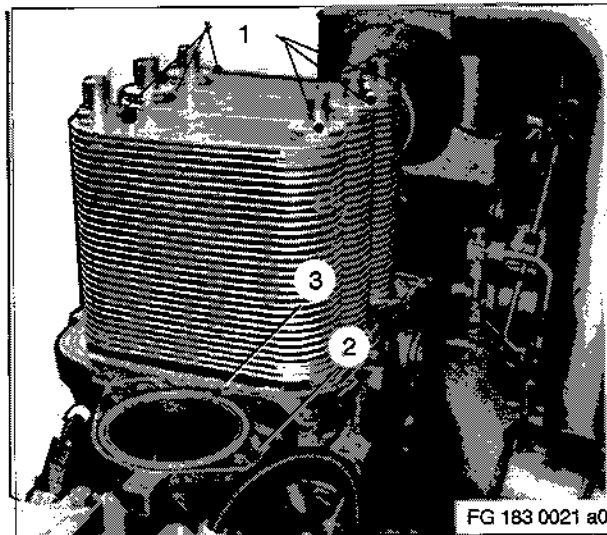


Before installing, coat O-rings (arrow) with petroleum jelly.



If necessary, remove blanking plug and/or covers in cooler insert.

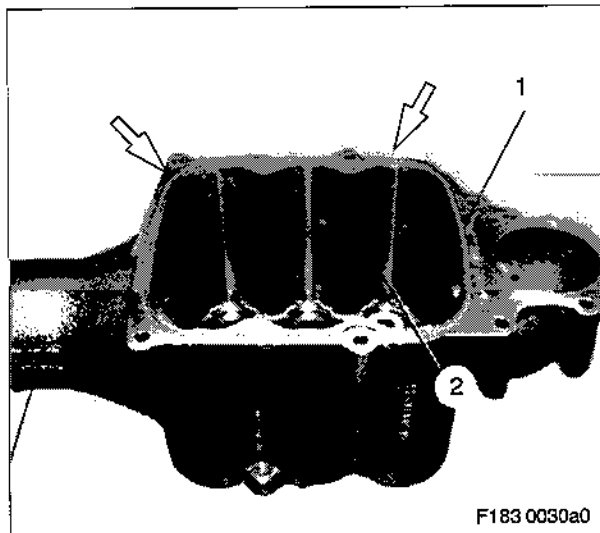
Insert oil heat exchanger in coolant distribution housing.



Place sealing washers (1) over thread of oil heat exchanger.

Coat O-ring (3) with petroleum jelly and insert in groove of elbow (2) for coolant pipework.

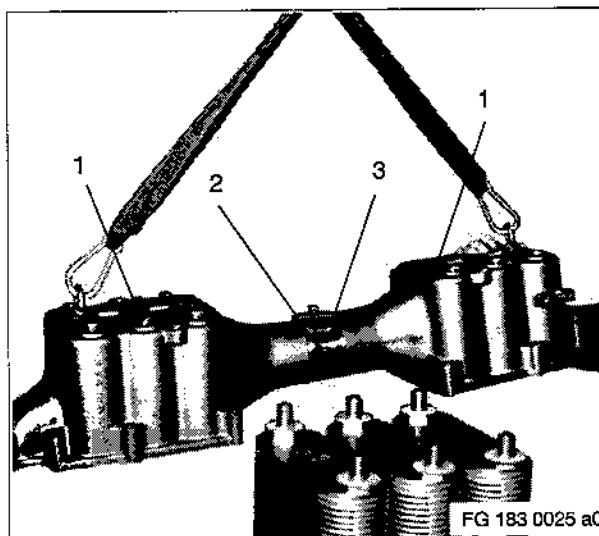
Note: Release securing screws from elbow (2).



Clean O-ring groove (arrow).

Coat O-ring (1) with petroleum jelly and insert in groove on oil cooler housing (2).

Note: First equipment (sealing oil cooler housing with gasket), assembly sequence is the same as with O-ring.



Check that sealing surface of coolant distribution housing is particularly clean.

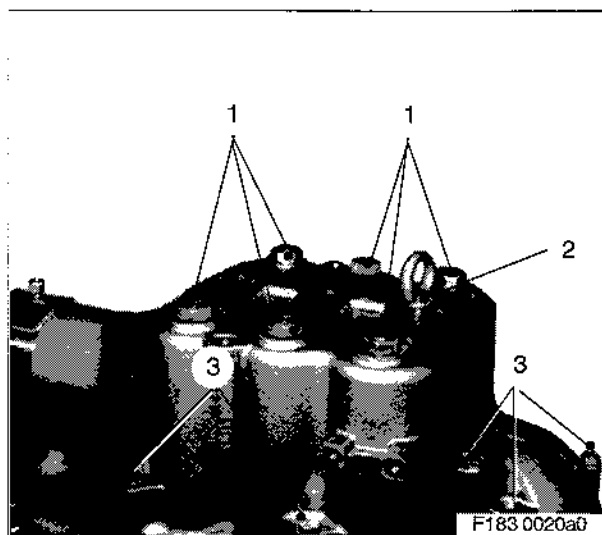
Before installing plug-in pipe (2), coat O-rings with petroleum jelly.

Install plug-in pipe (2) with bracket (3) on oil cooler housing as per Overview drawing – see C 183.15.01.



**Heavy object.
Risk of injury!
Use suitable tools and lifting equipment.**

Attach oil cooler housing (1) with lifting eyes, rope and crane and install on coolant distribution housing with hex screws.



Remove lifting eye (2).

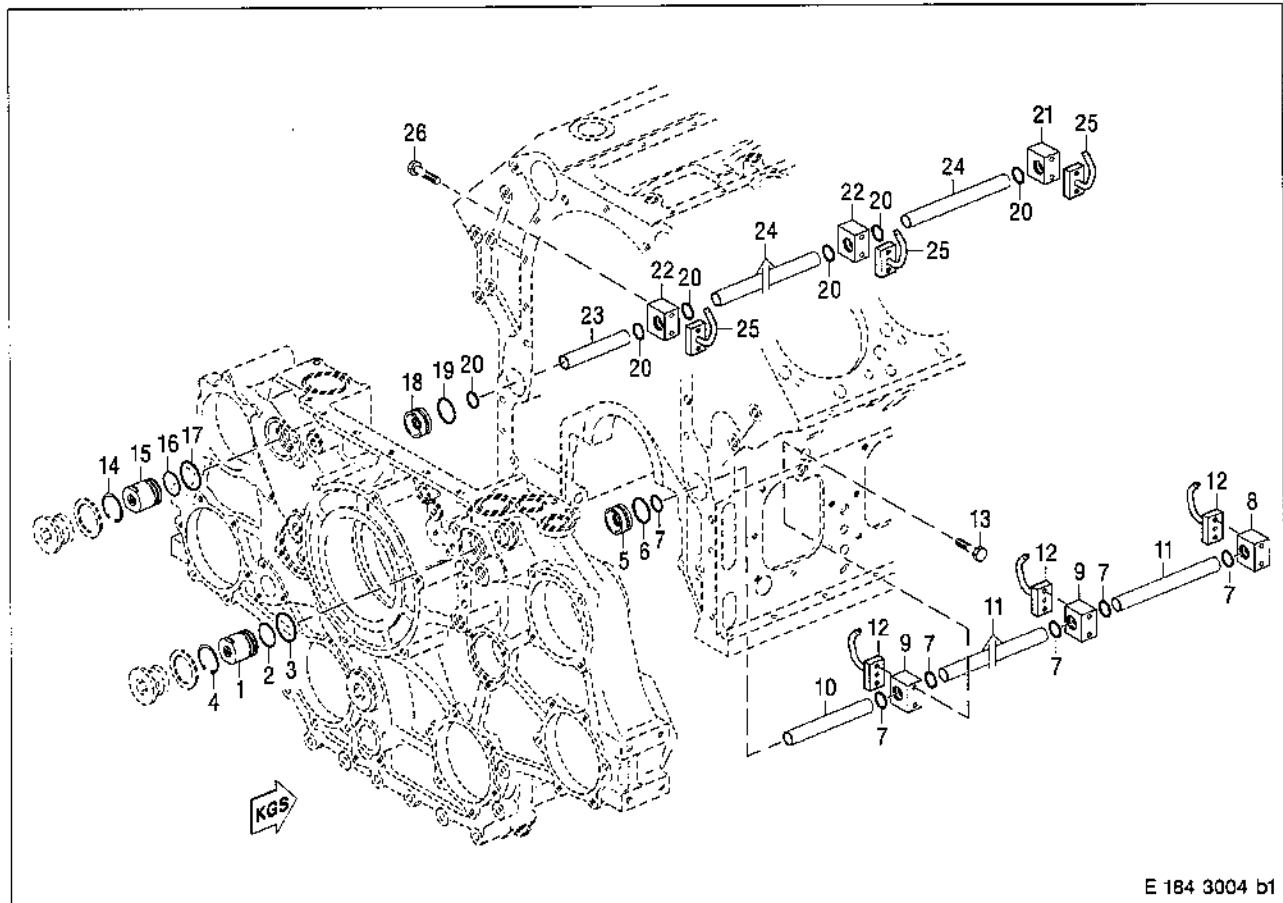
Tighten screws (3) to specified tightening torque – see Overview drawing C 183.15.01.

Fit nuts (1) and tighten to specified tightening torque – see Overview drawing C 183.15.01.

Note: Retighten loose securing screws on elbow.

C183.15.12 After-installation operations

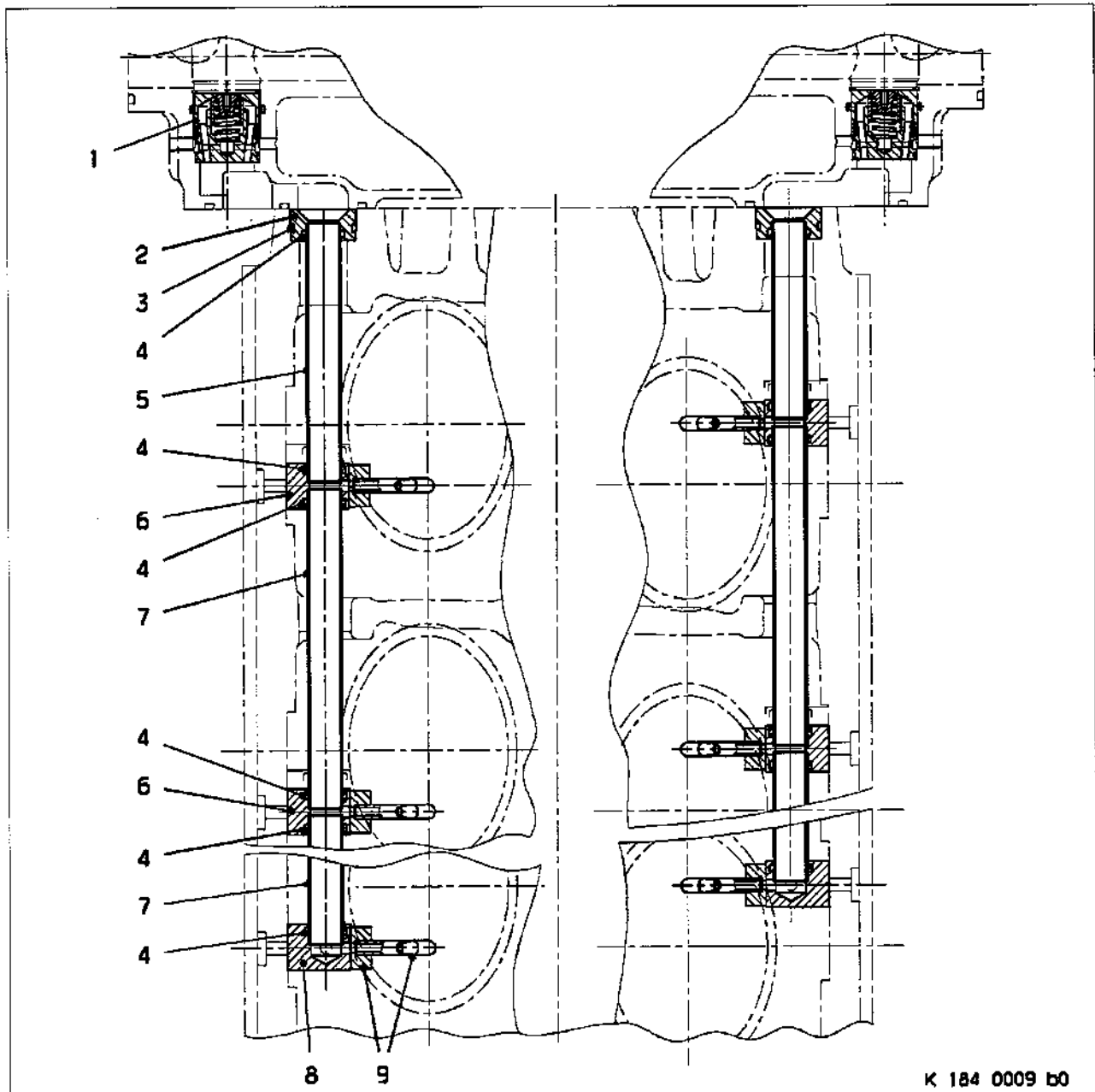
			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	x	x	Install coolant line from/to intercooler	→ C 203.25.11
–	x	x	Install engine coolant vent lines	→ C 202.65.11
–	x	x	Install crankcase breather	→ C 018.10.11
–	x	x	Fill charge air coolant system	→ Operating Instructions
–	–	x	Fill engine coolant system	→ Operating Instructions
–	–	x	Release engine start	→ Operating Instructions

C184.10 Oil system in crankcase**C184.10.01 Overview drawing****Piston cooling**

E 184 3004 b1

- | | | |
|------------------|---------------------------------|---------------------------------|
| 1 Delivery valve | 11 Pipe | 19 O-ring |
| 2 O-ring | 12 Oil spray nozzle | 20 O-ring |
| 3 O-ring | 13 Hex screw | 21 Bracket |
| 4 Snap ring | Lubricant: Engine oil | 22 Bracket |
| 5 Washer | Tightening torque: 21 Nm + 2 Nm | 23 Pipe |
| 6 O-ring | 14 Snap ring | 24 Pipe |
| 7 O-ring | 15 Delivery valve | 25 Oil spray nozzle |
| 8 Bracket | 16 O-ring | 26 Hex screw |
| 9 Bracket | 17 O-ring | Lubricant: Engine oil |
| 10 Pipe | 18 Washer | Tightening torque: 21 Nm + 2 Nm |

Piston cooling



- 1 Pressure valve
- 2 O-ring
- 3 Washer
- 4 O-ring
- 5 Pipe

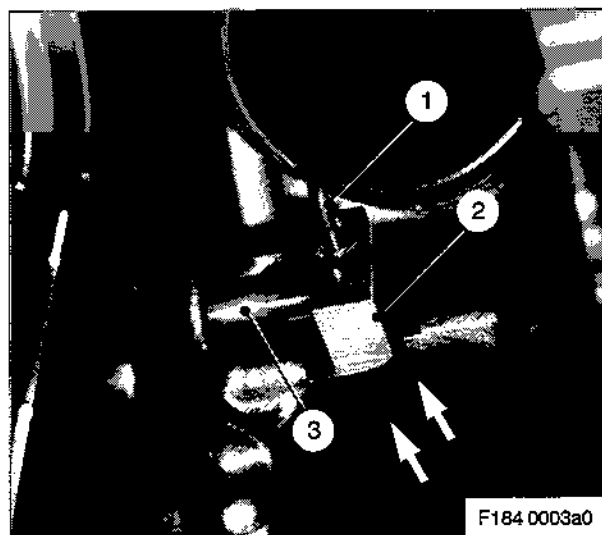
- 6 Bracket
- 7 Bracket
- 8 Bracket
- 9 Oil spray nozzle

C184.10.02 Special tools

Designation	Use/dimension	Number
• Test device	for oil spray nozzle	1
• Barring tool		1

C184.10.04 Before-removal operations

For the following tasks, a distinction must be made as to whether: → The engine is to be completely disassembled → The engine is to be removed but not disassembled → The engine is to remain installed				
			Measure	See
x	–	–	Remove engine	→ B 003
x	–	–	Perform operations as per Disassembly Plan	→ B 004
–	–	x	Disable engine start	→ Operating Instructions
–	x	x	Remove inspection port cover	→ C 011.05

C184.10.05 Removal**Removing oil spray nozzle**

Turn crankshaft until oil spray nozzle (1) to be removed is accessible.

Note: Mark oil spray nozzles appropriately. Disassembly starting at cylinder A1 or B1.

Remove hex screws (arrow) and remove oil spray nozzle (1) from bracket (2).

Protect oil spray nozzles from damage.

C184.10.08 Inspection and repair



CAUTION

**Compressed air is air pressurised by overpressure. If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask. Compressed air must not be directed at the body.
The pressure must not exceed 3.0 bar (40 lb/in²).**

Clean piston cooling oil spray nozzle with cleaner and carefully blow clear with dry air.

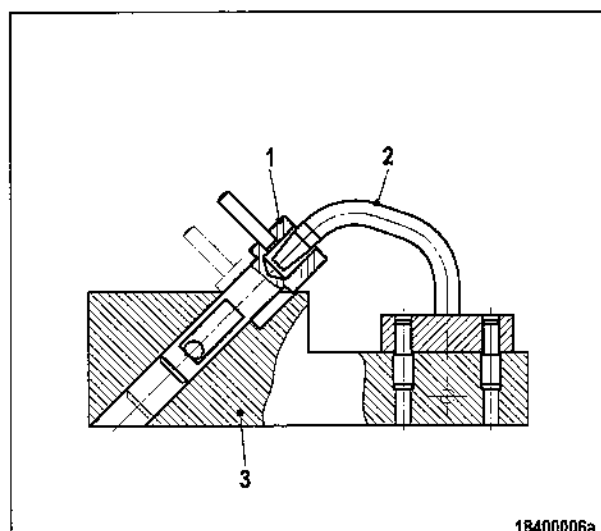
Visually inspect component for damage and defects; replace if necessary.

Use red penetrant dye to surface crack-test oil spray nozzle. If cracks are found, replace oil spray nozzle.

Check condition of threads; machine or replace components as necessary.

Check sealing and mating faces of oil spray nozzle; rub down with emery cloth or oilstone as necessary.

Check oil bore of oil spray nozzle for obstruction and ensure it is particularly clean.



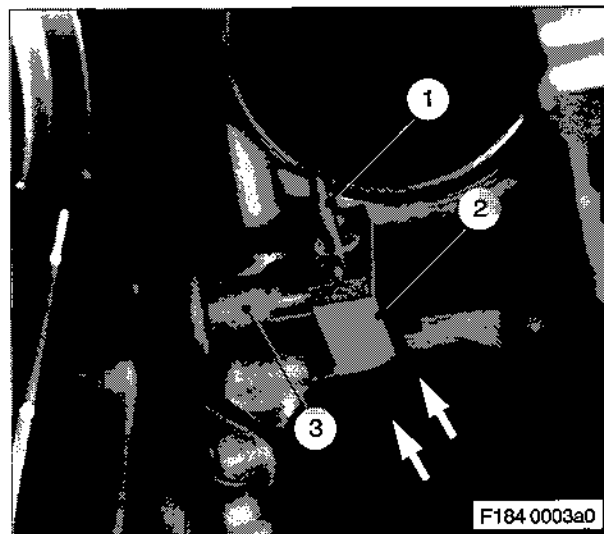
Checking spraying direction of oil spray nozzle

Attach oil spray nozzle (2) to testing device (3).

Check oil spray pipe with testing device (1) for deformation.

Replace oil spray nozzle in case of deformation.

Note: Do not re-bend the oil spray nozzle.

C184.10.11 Installation**CAUTION**

Compressed air is air pressurised by overpressure. Risk of injury!

If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask.

Compressed air must not be directed at the body. The pressure must not exceed 3.0 bar (40 lb/in²).

Blow out oil bore for oil spray nozzle (1) with compressed air and ensure they are perfectly clean and not obstructed.

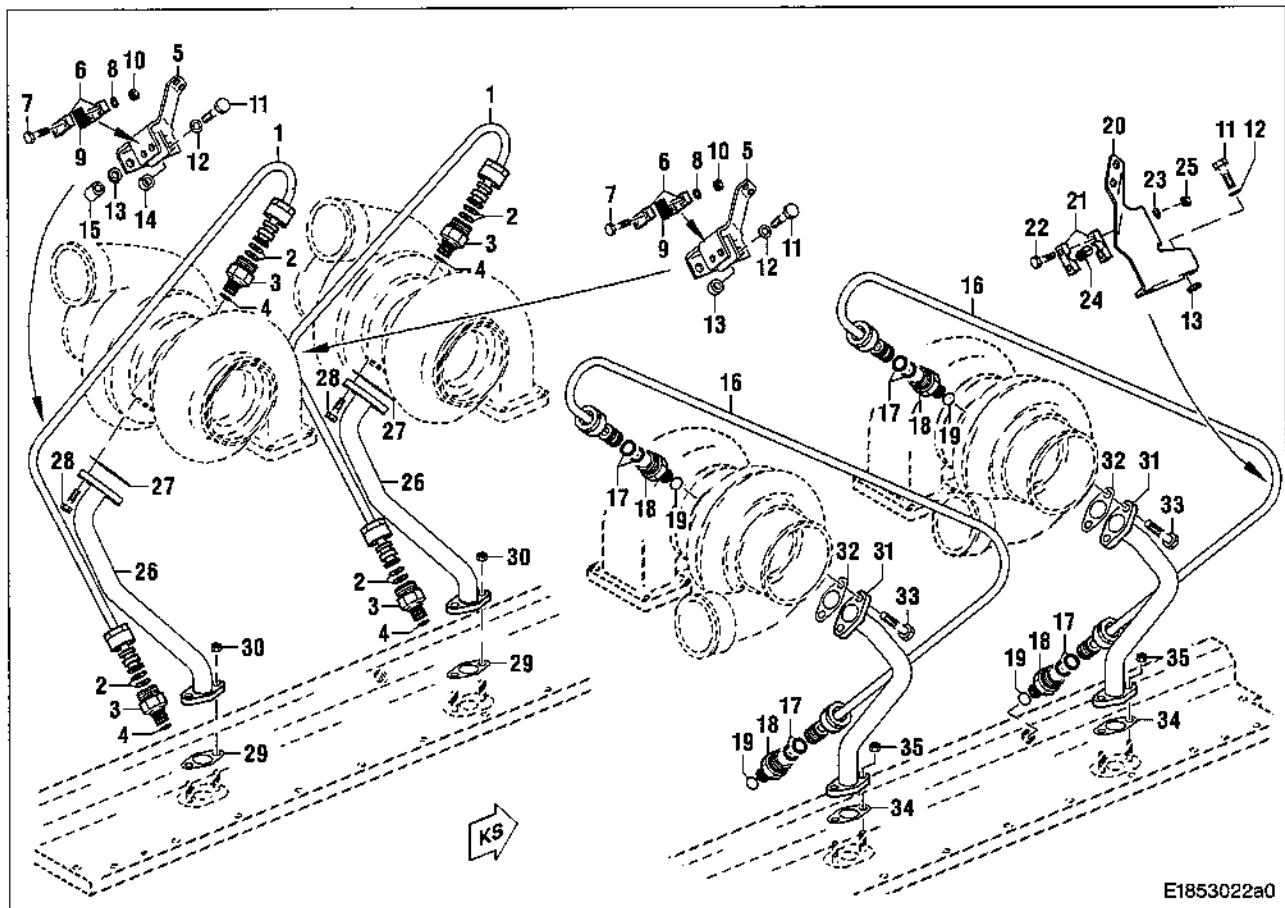
Mount oil spray nozzle on retainer (2).

Tighten hex screws (arrows) to specified tightening torque, see Overview drawing C 184.10.01.

After installing, bar engine and ensure there is clearance between oil spray nozzle and piston.

C184.10.12 After-installation operations

For the following tasks, a distinction must be made as to whether:			
↓ ↓ ↓ The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed			
		Measure	See
x	–	–	Perform operations as per Assembly Plan → B 005
x	–	–	Install engine → B 007
–	x	x	Install inspection port cover → C 011.05
–	–	x	Release engine start → Operating Instructions

C185.10 Oil supply lines for turbocharger**C185.10.01 Overview drawing**

E1853022a0

- | | | | |
|---------------------|---------------------------------|---------------------------------|-------------------------|
| 1 Oil line (supply) | Lubricant: Engine oil | 13 Washer | 25 Hex nut |
| | Tightening torque: 40 Nm + 5 Nm | 14 Spacer sleeve | 26 Pipe, left (return) |
| 2 O-ring | | 15 Spacer sleeve | 27 Gasket |
| 3 Union | | 16 Oil line (supply) | 28 Screw |
| 4 O-ring | | Lubricant: Engine oil | 29 Gasket |
| 5 Bracket | | Tightening torque: 40 Nm + 5 Nm | 30 Hex nut |
| 6 Pipe clamp half | | 17 O-ring | 31 Pipe, right (return) |
| 7 Hex screw | | 18 Union | 32 Gasket |
| 8 Washer | | 19 O-ring | 33 Screw |
| 9 Grommet | | 20 Bracket | 34 Gasket |
| 10 Hex nut | | 21 Pipe clamp half | 35 Hex nut |
| 11 Hex screw | | 22 Hex screw | |
| 12 Washer | | 23 Washer | |
| | | 24 Grommet | |

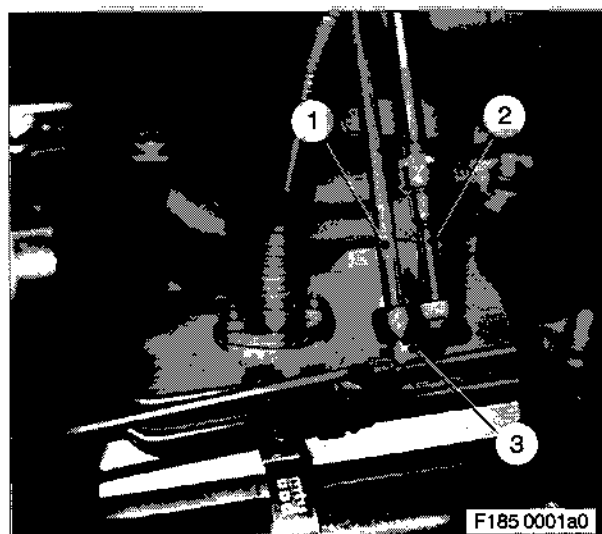
C185.10.02 Special tools

Designation	Use/dimension	Number
• Open-end wrench		1

C185.10.04 Before-removal operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Remove engine	→ B 003
x	–	–	Perform operations as per Disassembly Plan	→ B 004
–	–	x	Disable engine start	→ Operating Instructions

C185.10.05 Removal

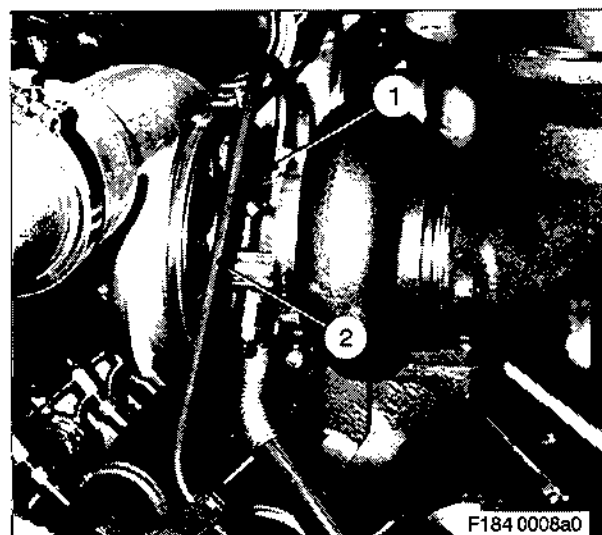


Removing oil supply line

Remove bracket from respective oil supply line – see Overview drawing C185.10.01.

Using an open tap ring wrench (2) and extension, remove threaded fitting from line (1).

Note: Adapter (3) must not also rotate. Use an open-end wrench to hold in position.



Unscrew threaded union (1) and remove line (2).

Seal connections with suitable plugs.

Protect oil line from damage.

C185.10.08 Inspection and repair

Note: Make sure parts are perfectly clean.

Clean oil lines with cleaner. Check condition of lines and inspect for damage; replace lines if necessary.

Pressure-test oil lines for leaks with air in water bath as necessary.

**WARNING**

Compressed air is air which has been compressed under pressure. Test fluid is hot. Risk of injury! Pressure must not exceed 0.5 bar (7.25 lb/in²). Always wear protective clothing, protective gloves and protective goggles/safety mask.

Water temperature min. 30° C, max. 40° C.

Note: The component must likewise reach this temperature.

Test pressure: 0.5 bar

If leaks are found, replace oil line.

**CAUTION**

**Compressed air is air pressurised by overpressure. If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask. Compressed air must not be directed at the body.
The pressure must not exceed 3.0 bar (40 lb/in²).**

Then blow dry lines with compressed air.

Check connecting components and fixtures of oil lines for damage and wear; replace components as necessary.

Check sealing and mating faces, smooth with oilstone or emery cloth if necessary.

Check condition of threads; machine or replace components as necessary.

Replace sealing rings and gaskets.

C185.10.11 Installation**Installing oil supply lines**

Note: Before installation, remove all blanking plugs.

**CAUTION**

**Compressed air is air pressurised by overpressure. If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask. Compressed air must not be directed at the body.
The pressure must not exceed 3.0 bar (40 lb/in²).**

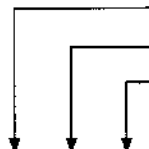
Blow out oil lines with compressed air and ensure that they are perfectly clean.

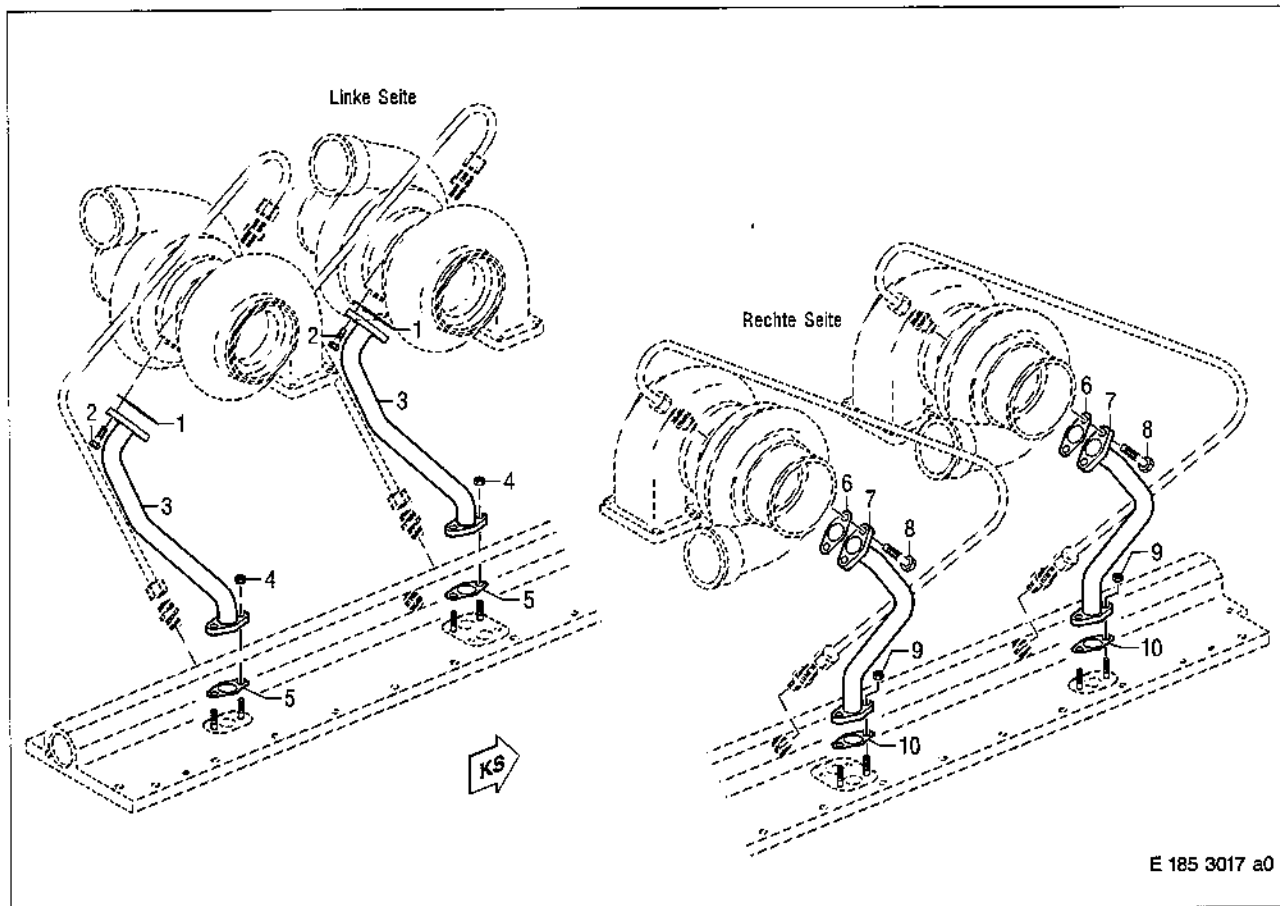
Install oil line as per Overview drawing (see C 185.10.01), ensuring it is tension-free.

Tightening torque – see Overview drawing C 185.10.01.

Note: After engine start, visually inspect oil lines for leaks.

C185.10.12 After-installation operations

For the following tasks, a distinction must be made as to whether:  The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed				
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	–	x	Release engine start	→ Operating Instructions

C185.25 Oil return lines for exhaust turbocharger**C185.25.01 Overview drawing**

- 1 Gasket
- 2 Hex screw
- 3 Pipework, left
- 4 Hex nut
- 5 Gasket

- 6 Gasket
- 7 Pipework, right
- 8 Hex screw
- 9 Hex nut
- 10 Gasket

C185.25.04 Before-removal operations

For the following tasks, a distinction must be made as to whether:			
The engine is to be completely disassembled			
The engine is to be removed but not disassembled			
The engine is to remain installed			
		Measure	See
x	—	Remove engine	→ B 003
x	—	Perform operations as per Disassembly Plan	→ B 004
—	—	x Disable engine start	→ Operating Instructions

C185.25.05 Removal

Removing oil return line

Remove oil return line with gaskets as per Overview drawing – see C185.25.01.

Seal connections with suitable plugs.

C185.25.08 Inspection and repair

Note: Make sure parts are perfectly clean.

Clean oil lines with cleaner. Check condition of lines and inspect for damage; replace lines if necessary.

Pressure-test oil lines for leaks with air in water bath as necessary.



WARNING

Compressed air is air which has been compressed under pressure. Test fluid is hot. Risk of injury! Pressure must not exceed 0.5 bar (7.25 lb/in²). Always wear protective clothing, protective gloves and protective goggles/safety mask.

Water temperature min. 30° C, max. 40° C.

Note: The component must likewise reach this temperature.

Test pressure: 0.5 bar

If leaks are found, replace oil line.

Check connecting components and fixtures of oil lines for damage and wear; replace components as necessary.

Check sealing and mating faces, smooth with oilstone or emery cloth if necessary.

Replace gaskets, sealing rings and gaskets.

C185.25.11 Installation**Mounting oil return lines**

Note: Before installation, remove all blanking plugs.

 CAUTION
Compressed air is air pressurised by overpressure. If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask. Compressed air must not be directed at the body. The pressure must not exceed 3.0 bar (40 lb/in²).

Blow out oil lines with compressed air and ensure that they are perfectly clean.

Install oil lines with new gaskets, sealing rings and gaskets free of tension as shown in Overview drawing – see C 185.25.01.

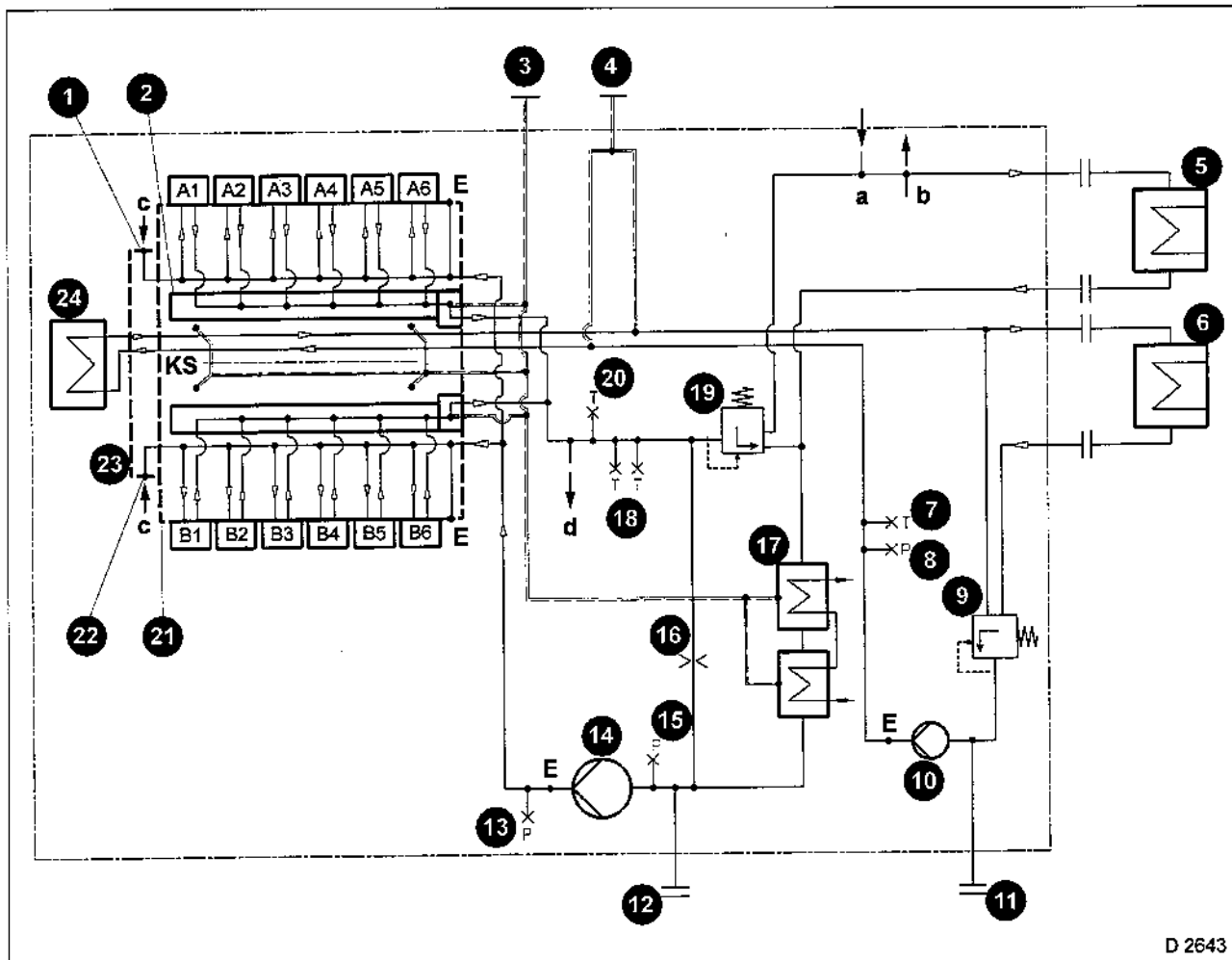
Note: After engine start, visually inspect oil lines for leaks.

C185.25.12 After-installation operations

For the following tasks, a distinction must be made as to whether:				
The engine is to be completely disassembled				
The engine is to be removed but not disassembled				
The engine is to remain installed				
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	–	x	Release engine start	→ Operating Instructions

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C200 Coolant system**Engine Coolant System**

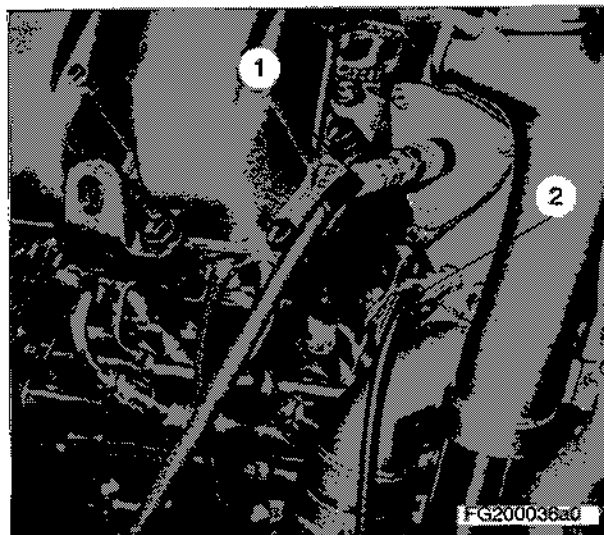
- | | | |
|--|---|---|
| 1 Coolant drain plug | 11 Coolant expansion line (low temperature) | 20 Measuring point, engine coolant temperature after engine |
| 2 Engine coolant collecting line | 12 Coolant expansion line (high temperature) | 21 (Crankcase) |
| 3 Engine coolant vent line | 13 Measuring point, pressure after engine coolant pump | 22 Coolant drain plug |
| 4 Vent line, low-temperature circuit | 14 Engine coolant pump | 23 (Flywheel housing) |
| 5 Heat exchanger (high temperature) | 15 Measuring point, pressure before engine coolant pump | 24 Intercooler |
| 6 Heat exchanger (low temperature) | 16 Restrictor, cooler bypass line | |
| 7 Measuring point, coolant temperature after charge air coolant pump | 17 Lube oil heat exchanger | a to compartment heating * |
| 8 Measuring point, pressure after charge air coolant pump | 18 Connection, temperature sensor after engine | b from compartment heating * |
| 9 Coolant thermostat (low temperature) | 19 Coolant thermostat (high temperature) | c from preheating unit |
| 10 Coolant pump, charge air coolant system | | d to preheating unit |
| | | E Drain |

* on appropriately equipped engine

C200.08 Pressure-testing coolant chamber

Only use hydraulic pressure-testing device specified by Manufacturer.

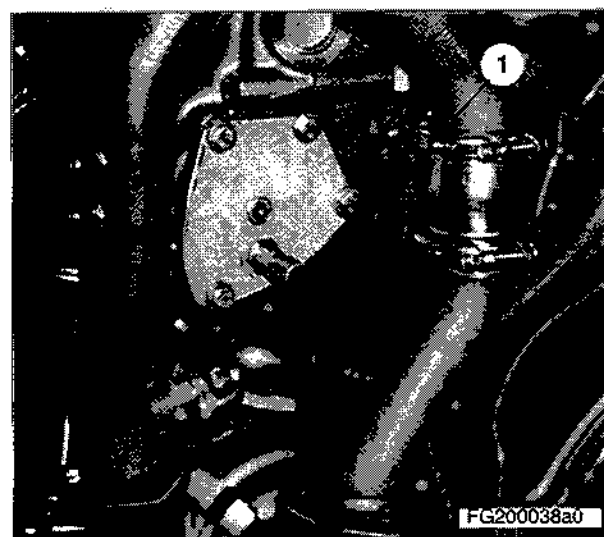
Observe specified safety and accident prevention regulations!



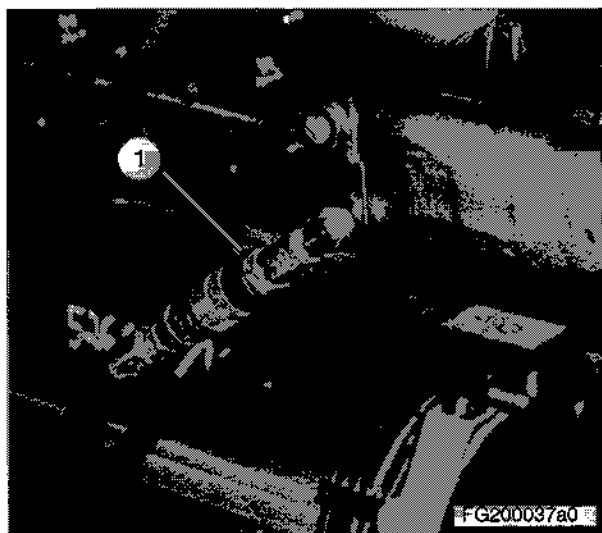
Note: After assembling engine, pressure-test coolant jackets with treated coolant and check for leaks.

Connect supply hose line (1) of hydraulic pressure testing device to thermostat housing.

Connect vent line (2) to thermostat housing.



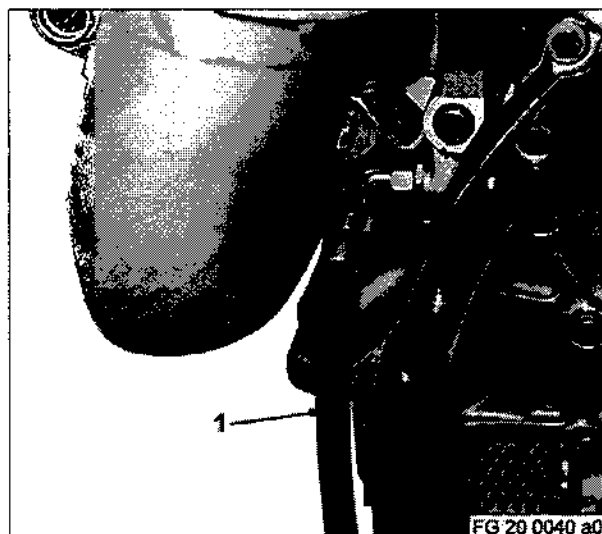
Connect vent line (1) to thermostat housing, free end.



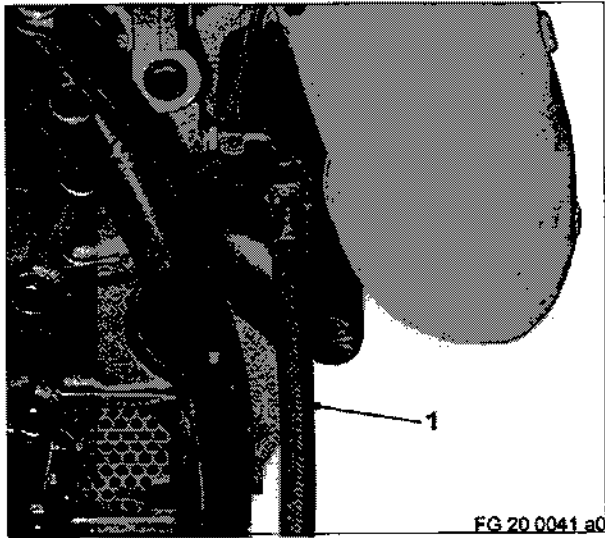
Connect coolant supply line (1) to elbow of engine coolant pump.



Connect vent line (1) of hydraulic pressure testing device to engine vent.



Connect drain hose line (1) of hydraulic pressure testing device to crankcase, left engine side (driving end).



Connect drain hose line (1) of hydraulic pressure testing device to crankcase, right engine side (driving end).

Test liquid is hot and highly pressurised. Risk of injury!
Liquids emerging under high pressure can lead to serious injury!
Always wear protective clothing, protective gloves and protective goggles/safety mask.

Connect pressure unit and fill engine coolant jackets with treated coolant.

Vent piping system.

Pressure-test coolant chambers with water at 80° C for one hour.

Test pressure = 5 bar

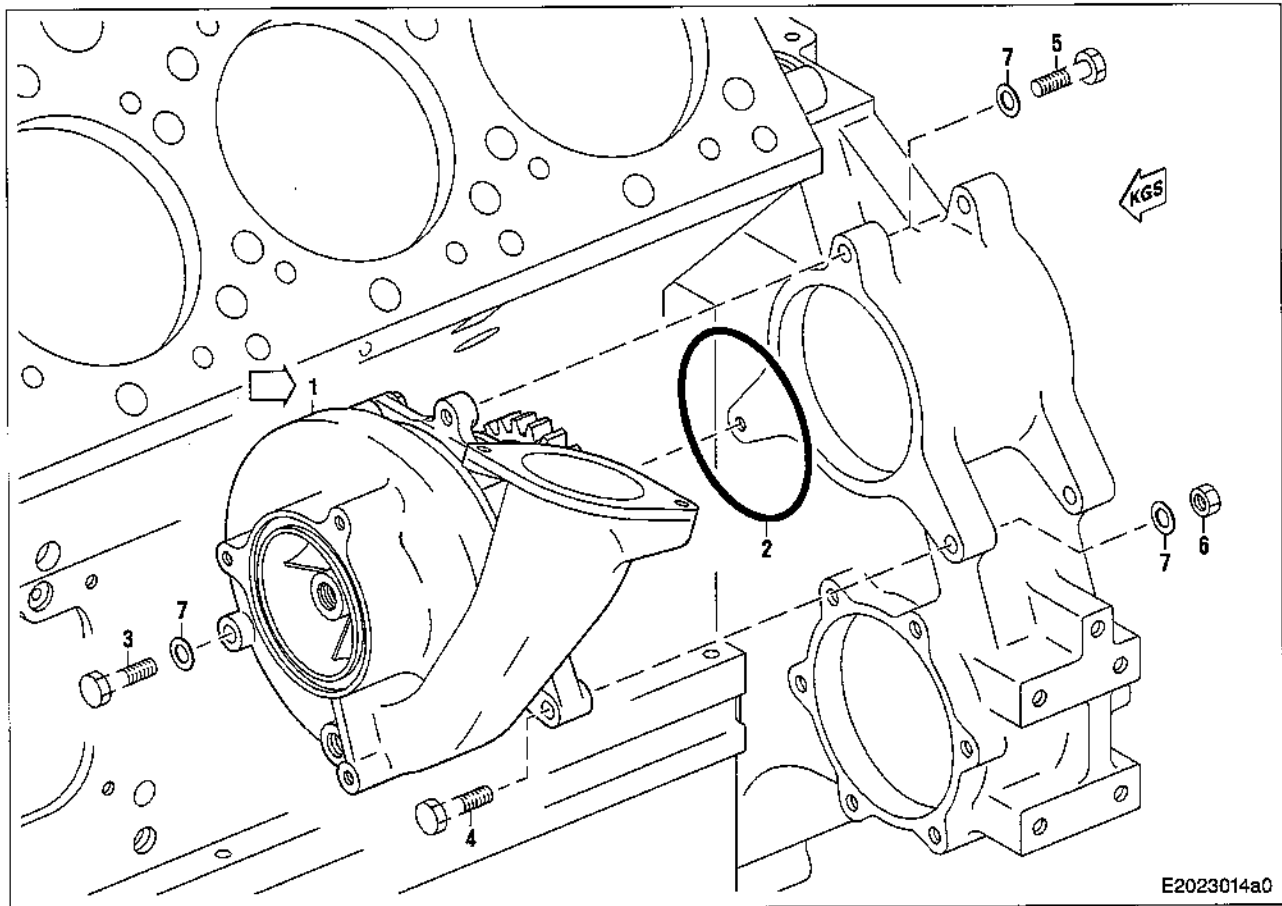
Check all coolant-carrying components for leaks.

After completion of pressure testing, relieve test pressure.

Drain system.

Remove hydraulic pressure testing device.

Refit plugs with new sealing rings.

C202.05 Engine coolant pump**C202.05.01 Overview drawing**

- 1 Engine coolant pump
- 2 O-ring
- 3 Hex screw
- 4 Hex screw

- 5 Hex screw
- 6 Hex nut
- 7 Washer

C202.05.04 Before-removal operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Remove engine	→ B 003
x	–	–	Perform operations as per Disassembly Plan	→ B 004
–	–	x	Disable engine start	→ Operating Instructions
–	–	x	Drain engine coolant	→ Operating Instructions
–	–	x	Remove engine coolant line	→ C 202.10

C202.05.05 Removal

Remove engine coolant pump

Remove securing screws for engine coolant pump, see Overview drawing C 202.05.01.


WARNING

Heavy object. Risk of injury!
Use suitable tools and lifting equipment.

Release engine coolant pump with crowbar from equipment carrier and remove.

If necessary, cover installation bore of engine coolant pump.

Remove O-ring from engine coolant pump.

C202.05.06 Disassembly

Disassembly of engine coolant pump is not planned.

The engine coolant pump is an exchangeable component and can be obtained in the exchange procedure.

C202.05.08 Inspection and repair

Check engine coolant pump externally for damage and condition; replace if necessary.

Check spiral housing and impeller for cavitation. In event of pitting, replace coolant pump.

Visually inspect sealing surfaces for wear, pitting and cavitation; rub down with emery cloth or an oilstone or replace component.

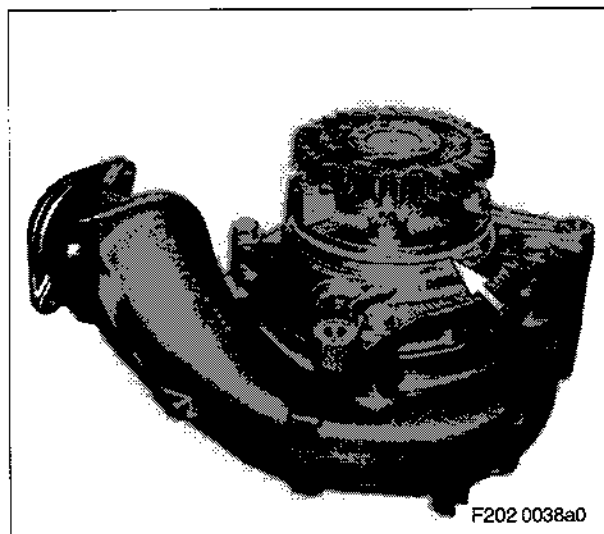
Turn pump shaft to check freedom of rotation.

Check gear for impressions, wear and damage and smooth slight wear and damage with emery cloth or oilstone; replace engine coolant pump if necessary.

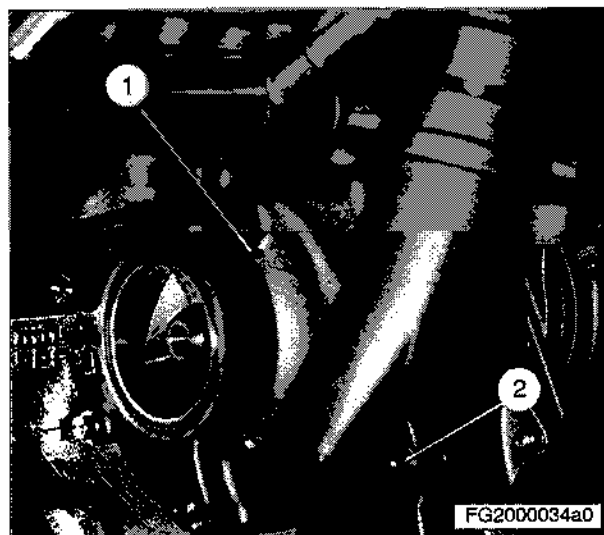
Replace O-ring.

C202.05.10 Assembly

See C 202.05.06

C202.05.11 Installation**Install engine coolant pump**

Coat O-ring (arrow) with petroleum jelly and insert in groove on bearing housing of engine coolant pump.



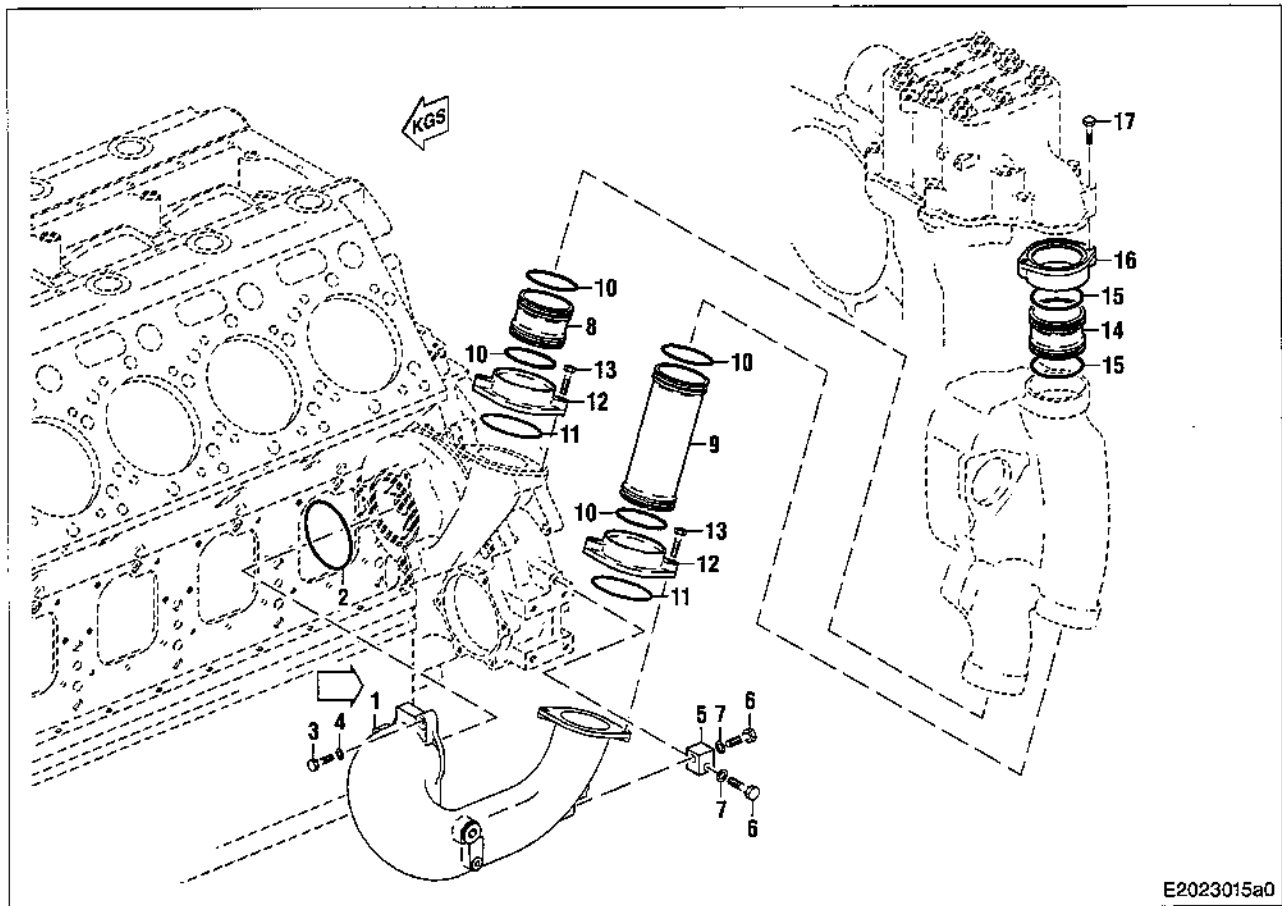
Note: Prior to installation, remove cover.

Positioning correctly, insert coolant pump (1) into bore in equipment carrier, ensuring that gear engages.

Install hex screws (2) with washers and tighten uniformly.

C202.05.12 After-installation operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	x	x	Assembly in reverse sequence to disassembly	→ C 202.05.04
–	–	x	Fill engine coolant system	→ Operating Instructions
–	–	x	Release engine start	→ Operating Instructions

C202.10 Engine coolant lines, engine coolant pump**C202.10.01 Overview drawing**

- | | | |
|-------------|----------------|-----------------|
| 1 Elbow | 7 Washer | 13 Hex screw |
| 2 O-ring | 8 Plug-in pipe | 14 Plug-in pipe |
| 3 Hex screw | 9 Plug-in pipe | 15 O-ring |
| 4 Washer | 10 O-ring | 16 Flange |
| 5 Bracket | 11 O-ring | 17 Hex screw |
| 6 Hex screw | 12 Flange | |

C202.10.04 Before-removal operations

For the following tasks, a distinction must be made as to whether:			
→ → → The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed			
Measure	See		
x - - Remove engine	→ B 003		
x - - Perform operations as per Disassembly Plan	→ B 004		
- - x Disable engine start	→ Operating Instructions		
- - x Drain engine coolant	→ Operating Instructions		

C202.10.05 Removal

Removing coolant lines

Note: Before removing lines, it is advisable to photograph the engine from all sides or attach metal tags to the lines and fixtures so that they can be reinstalled in their original positions.

Remove all monitoring units installed in coolant lines.

Remove lines in accordance with Overview drawing, see C 202.10.01.

After removing lines, seal all open connections by installing suitable plugs.

C202.10.08 Inspection and repair

Clean lines with cold cleaner and brush.

Visually inspect plug-in connections and ring grooves in elbows and connecting lines for wear, indentations and pitting; rub down with emery cloth or an oilstone if necessary or replace component.

Check all mating and sealing faces for wear and damage; rub down with emery cloth or an oilstone as necessary.

Check lines for damage and condition; if necessary repair and, using corrosion inhibitor, pressure-test with air in water bath for leaks.



WARNING

Compressed air is air which has been compressed under pressure. Test fluid is hot. Risk of injury! Pressure must not exceed 0.5 bar (7.25 lb/in²). Always wear protective clothing, protective gloves and protective goggles/safety mask.

Water temperature min. 30 ° C, max. 40 ° C.

Note: The component must likewise reach this temperature.

Test pressure: 0.5 bar

Replace gaskets and O-rings.

C202.10.11 Installation

Install coolant lines

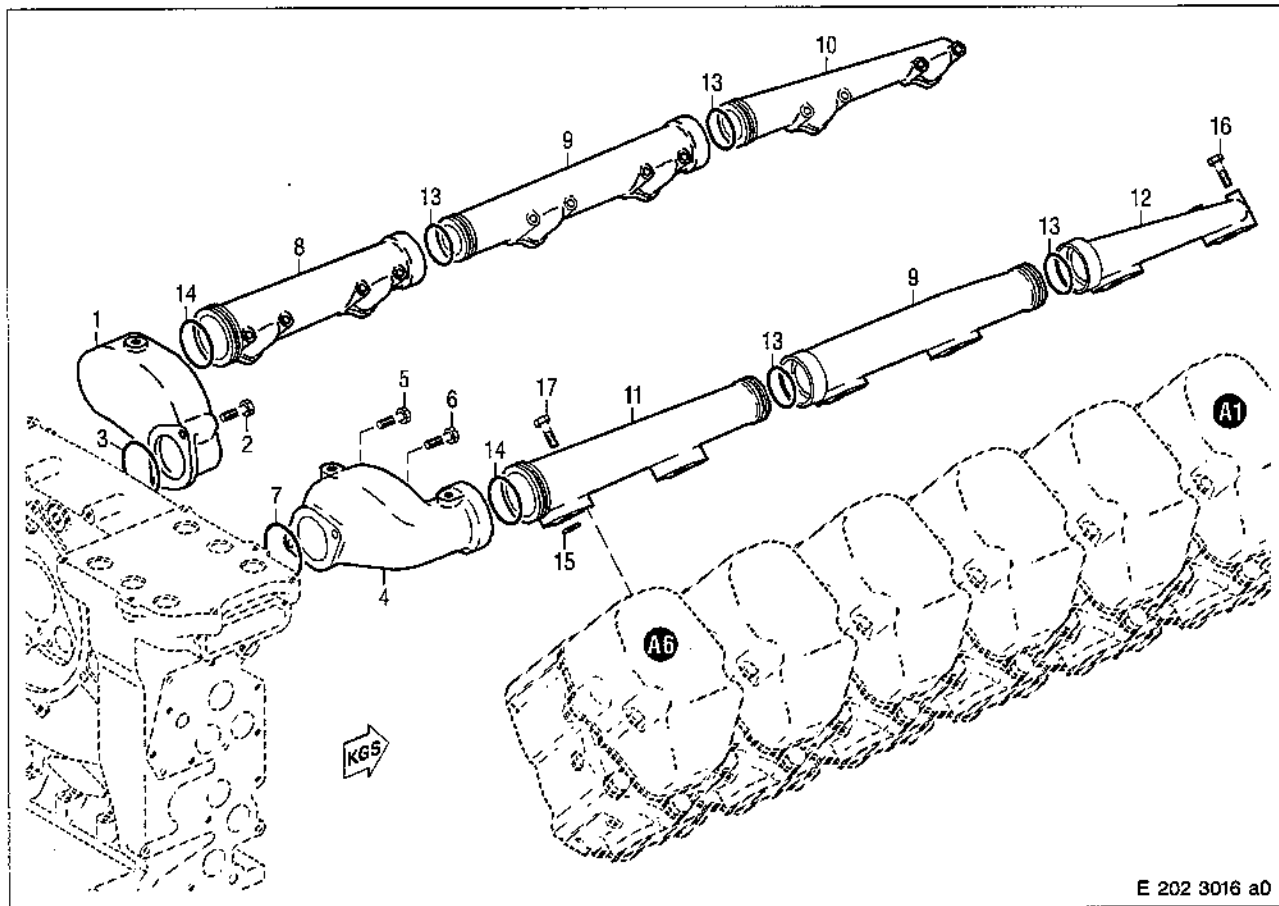
Note: Before installation, remove all blanking plugs.

Coat O-rings with petroleum jelly.

Install lines with new sealing rings and O-rings, with fixtures free of tension – see Overview drawing C 202.10.01, and photos.

C202.10.12 After-installation operations

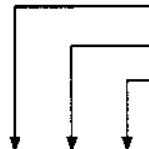
			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	–	x	Fill engine coolant system	→ Operating Instructions
–	–	x	Release engine start	→ Operating Instructions

C202.20 Coolant line after cylinder head**C202.20.01 Overview drawing**

- 1 Connector
- 2 Hex screw
- 3 O-ring
- 4 Connector
- 5 Hex screw
- 6 Hex screw
- 7 O-ring
- 8 Coolant collecting line
- 9 Coolant collecting line

- 10 Coolant collecting line
- 11 Coolant collecting line
- 12 Coolant collecting line
- 13 O-ring
- 14 O-ring
- 15 O-ring
- 16 Hex screw
- 17 Hex screw

C202.20.04 Before-removal operations

For the following tasks, a distinction must be made as to whether: 				
			Measure	See
x	–	–	Remove engine	→ B 003
x	–	–	Perform operations as per Disassembly Plan	→ B 004
–	–	x	Disable engine start	→ Operating Instructions
–	–	x	Drain engine coolant	→ Operating Instructions
–	–	x	Remove coolant vent line	→ C 202.65

C202.20.05 Removal

Removing coolant lines

Remove coolant lines and connectors as per Overview drawing – see C 202.20.01.

After removing lines, seal all open connections by installing suitable plugs.

C202.20.08 Inspection and repair

Clean lines and connectors with cold cleaner and brushes.

Visually inspect plug-in connections and ring grooves on connector and connecting lines for wear, indentations and pitting; rub down with emery cloth or an oilstone if necessary or replace component.

Check all mating and sealing faces for wear and damage; rub down with emery cloth or an oilstone as necessary.

Check lines for damage and condition; if necessary repair and, using corrosion inhibitor, pressure-test with air in water bath for leaks. .



Compressed air is air which has been compressed under pressure. Test fluid is hot. Risk of injury! Pressure must not exceed 0.5 bar (7.25 lb/in²). Always wear protective clothing, protective gloves and protective goggles/safety mask.

Water temperature min. 30° C, max. 40° C.

Note: The component must likewise reach this temperature.

Test pressure: 0.5 bar

Replace gaskets and O-rings.

C202.20.11 Installation**Install coolant lines**

Note: Before installation, remove all blanking plugs.

Coat O-rings with petroleum jelly.

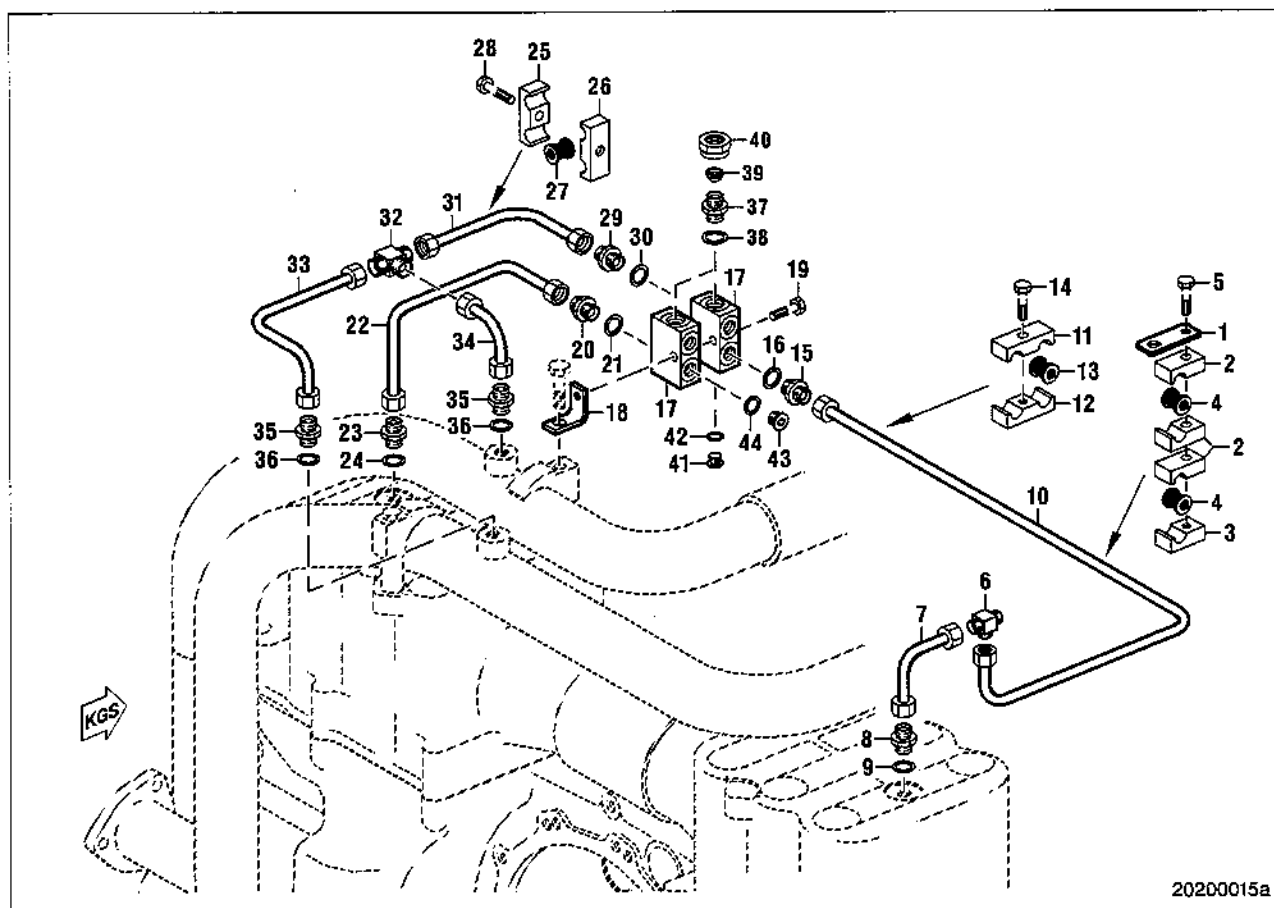
Mount lines and connectors free of tension as shown in Overview drawing C 202.20.01.

C202.20.12 After-installation operations

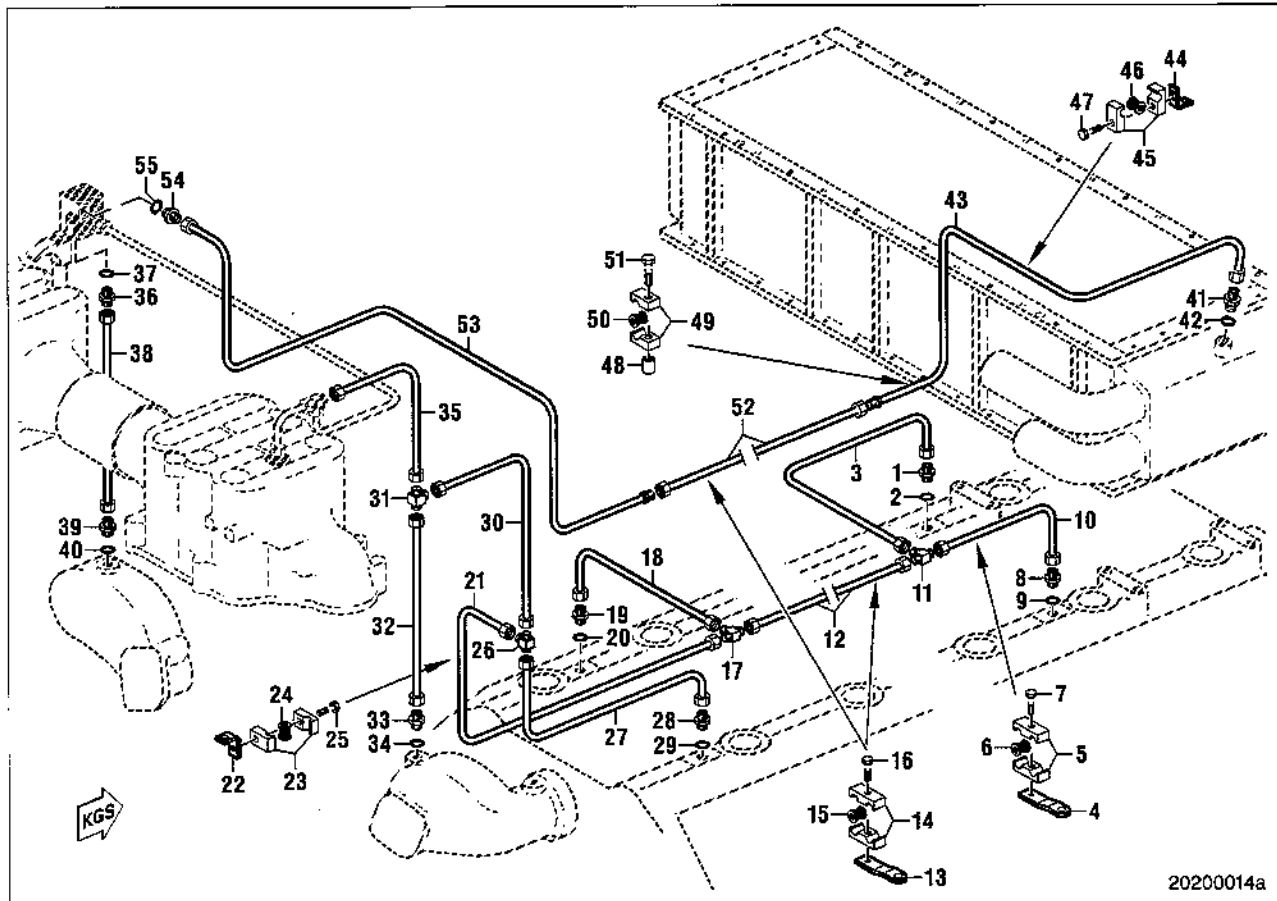
A distinction must be made as to whether:

- 1 — The engine was completely disassembled
 2 — The engine is removed but was not disassembled
 3 — The engine is installed

1	2	3	Operations	See
x	—	—	Perform operations as per Assembly Plan	B 005
x	—	—	Install engine	B 007
—	—	x	Install coolant vent line	C 202.65
—	—	x	Fill engine coolant system	Operating Instructions
—	—	x	Release engine start	Operating Instructions

C202.65 Coolant vent lines**C202.65.01 Overview drawing**

- | | | | |
|---------------------|----------------------|--------------------|--------------------|
| 1 Bracket, straight | 12 Pipe clamp half | 23 Reduction union | 34 Vent line |
| 2 Grommet | 13 Grommet | 24 Washer | 35 Reduction union |
| 3 Pipe clamp half | 14 Hex screw | 25 Pipe clamp half | 36 Washer |
| 4 Grommet | 15 Reduction union | 26 Pipe clamp half | 37 Reduction union |
| 5 Hex screw | 16 Washer | 27 Grommet | 38 Washer |
| 6 T-piece | 17 Distributor block | 28 Hex screw | 39 Sealing cone |
| 7 Vent line | 18 Bracket, angled | 29 Reduction union | 40 Plug |
| 8 Reduction union | 19 Hex screw | 30 Washer | 41 Plug |
| 9 Washer | 20 Reduction union | 31 Vent line | 42 Washer |
| 10 Vent line | 21 Washer | 32 T-piece | 43 Plug |
| 11 Pipe clamp half | 22 Vent line | 33 Vent line | 44 Washer |



- | | | | |
|----------------------|--------------------|-------------------------|-------------------------|
| 1 Reduction union | 15 Grommet | 30 Vent line | 44 Bracket, angled |
| 2 Washer | 16 Hex screw | 31 T-piece | 45 Pipe clamp half |
| 3 Vent line | 17 T-piece | 32 Vent line | 46 Grommet |
| 4 Bracket, straight | 18 Vent line | 33 Reduction union | 47 Hex screw |
| 5 Pipe clamp half | 20 Washer | 34 Washer | 48 Spacer bushing |
| 6 Grommet | 21 Vent line | 35 Vent line | 49 Pipe clamp half |
| 7 Hex screw | 22 Bracket, angled | 36 Reduction union | 50 Grommet |
| 8 Reduction union | 23 Pipe clamp half | 37 Washer | 51 Hex screw |
| 9 Washer | 24 Grommet | 38 Vent line | 52 Vent line |
| 10 Vent line | 25 Hex screw | 39 Reduction union | Low-temperature circuit |
| 11 T-piece | 26 T-piece | 40 Washer | 53 Vent line |
| 12 Vent line | 27 Vent line | 41 Reduction union | Low-temperature circuit |
| 13 Bracket, straight | 28 Reduction union | 42 Washer | 54 Reduction union |
| 14 Pipe clamp half | 29 Washer | 43 Vent line | 55 Washer |
| | | Low-temperature circuit | |

C202.65.04 Before-removal operations

For the following tasks, a distinction must be made as to whether:

- The engine is to be completely disassembled
- The engine is to be removed but not disassembled
- The engine is to remain installed

			Measure	See
x	-	-	Remove engine	→ B 003
x	-	-	Perform operations as per Disassembly Plan	→ B 004
-	-	x	Disable engine start	→ Operating Instructions
-	-	x	Drain engine coolant	→ Operating Instructions

C202.65.05 Removal**Disconnect vent lines**

Note: Before removing lines, it is advisable to photograph the engine from all sides or attach metal tags to the lines and fixtures so that they can be reinstalled in their original positions.

Remove lines in accordance with Overview drawing, see C 203.65.01.

After removal, seal all connections with suitable plugs.

C202.65.08 Inspection and repair

Clean lines with cold cleaner and brush.

Check lines for damage and condition; if necessary, check under water with air using corrosion inhibitor for leaks.



Compressed air is air which has been compressed under pressure. Test fluid is hot. Risk of injury! Pressure must not exceed 0.5 bar (7.25 lb/in²). Always wear protective clothing, protective gloves and protective goggles/safety mask.

Water temperature min. 30° C, max. 40° C.

Note: The component must likewise reach this temperature.

Test pressure: 0.5 bar

If leaks are detected, replace line.

Replace grommets and hose line as part of every W6 overhaul.

Replace sealing rings as part of every assembly.

C202.65.11 Installation

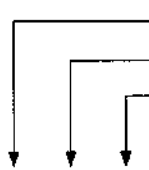
Connecting vent lines

 CAUTION
Compressed air is highly pressurized. Risk of injury! If compressed air is used for blowing out or blow-drying components, always wear protective goggles or safety mask. Pressure must not exceed 3.0 bar.

Prior to installing, remove all plugs and blow lines clear with compressed air.

Install lines with new sealing rings and securing components free of tension as shown in Overview drawing, see C 203.65.01.

C202.65.12 After-installation operations

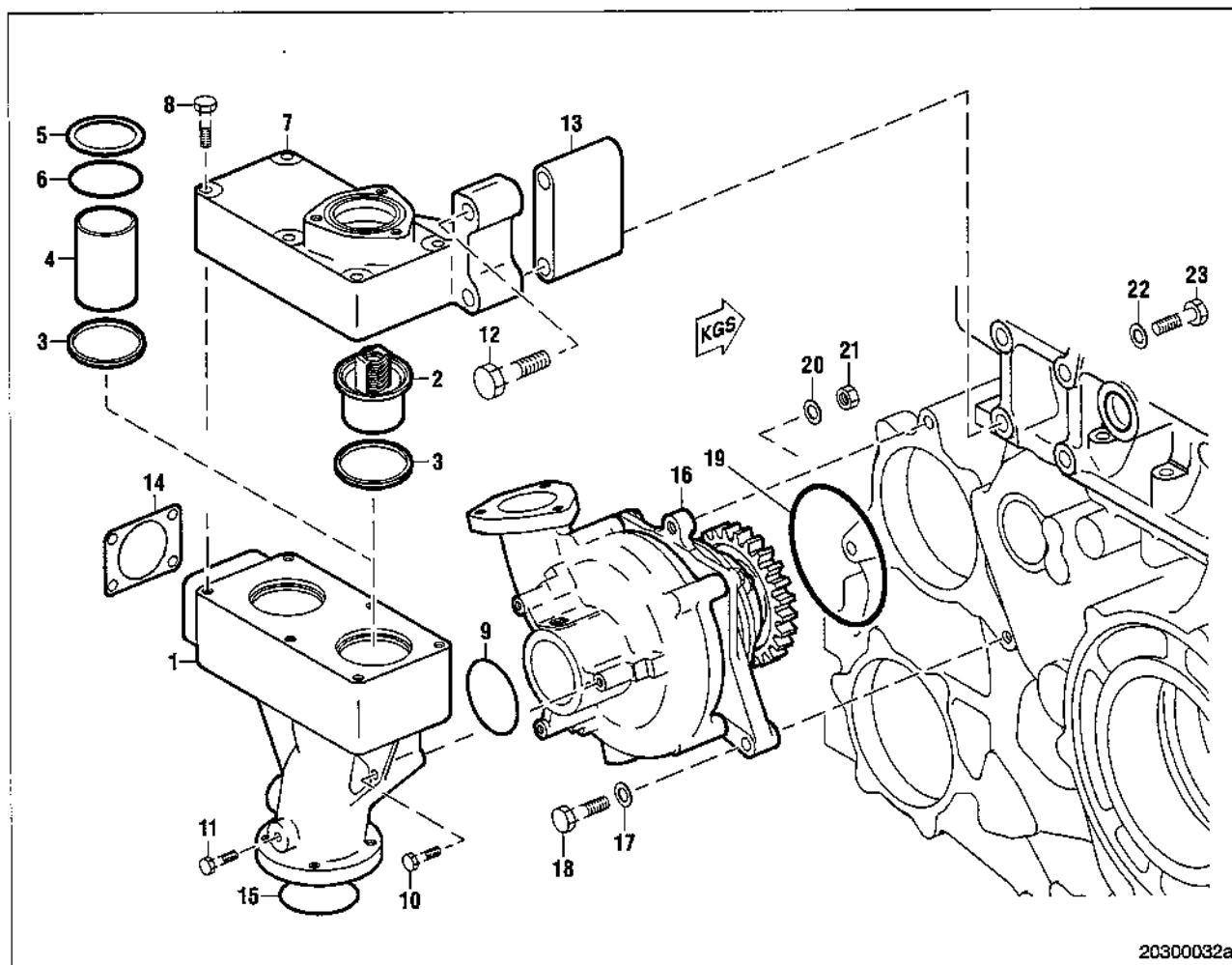
For the following tasks, a distinction must be made as to whether: 				
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	–	x	Fill engine coolant system	→ Operating Instructions
–	–	x	Release engine start	→ Operating Instructions

C203 Coolant system – low-temperature circuit

C203.05 Charge air coolant pump

C203.05.01 Overview drawing

Charge Air Coolant Pump with Attachments



- 1 Thermostat housing
- 2 Thermostat element
- 3 Sealing ring
- 4 Sleeve
- 5 Sealing ring
- 6 O-ring
- 7 Cover
- 8 Hex screw

- 9 O-ring
- 10 Hex screw
- 11 Hex screw
- 12 Hex screw
- 13 Spacer sleeve
- 14 Gasket
- 15 O-ring
- 16 Charge air coolant pump

- 17 Washer
- 18 Hex screw
- 19 O-ring
- 20 Washer
- 21 Nut
- 22 Washer
- 23 Hex screw

C203.05.02 Special tools

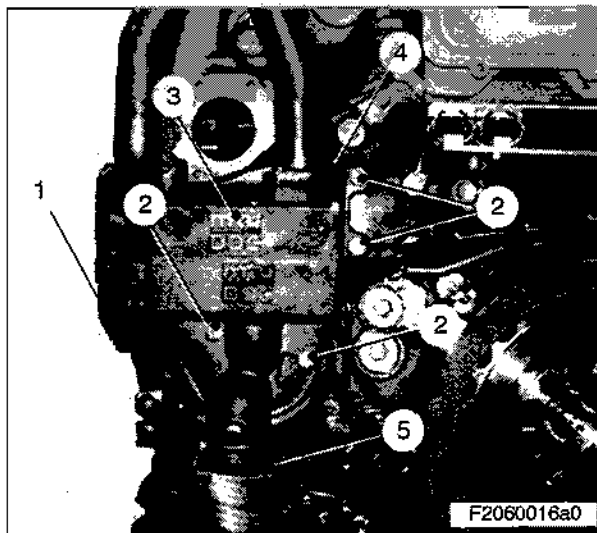
Designation	Use/dimension	Number
• Installation mandrel	for thermostat housing sealing ring	1

C203.05.04 Before-removal operations

For the following tasks, a distinction must be made as to whether: → The engine is to be completely disassembled → The engine is to be removed but not disassembled → The engine is to remain installed		
Measure	See	
x – – Remove engine	→ B 003	
x – – Perform operations as per Disassembly Plan	→ B 004	
– – x Disable engine start	→ Operating Instructions	
– – x Drain charge air coolant	→ Operating Instructions	
– x x Remove temperature switch	→ C 500	

C203.05.05 Removal

Removing thermostat housing



Remove hex screws (4) from flange (inlet).
Remove pipework from flange (1) and (5).
Remove hex screws (2) and remove thermostat housing (3).

Remove charge air coolant pump

Remove coolant line from charge air coolant pump – see Overview drawing C 203.25.01.

Remove securing screws for charge air coolant pump – see Overview drawing C 203.05.01.



Heavy object. Risk of injury!
Use suitable tools and lifting equipment.

Release charge air coolant pump with crowbar from equipment carrier and remove.

If necessary, cover installation bore of charge air coolant pump.

Remove O-ring from charge air coolant pump.

C203.05.06 Disassembly**Charge air coolant pump**

Disassembly of charge air coolant pump is not planned.

The charge air coolant pump is an exchangeable component and can be obtained in the exchange procedure.

Thermostat housing

Remove securing screws and cover.

Remove thermostat elements and sealing rings from thermostat housing – see Overview drawing C203.05.01.

C203.05.08 Inspection and repair**Charge air coolant pump**

Check charge air coolant pump externally for damage and condition; replace if necessary.

Check spiral housing and impeller for cavitation. In event of pitting, replace charge air coolant pump.

Visually inspect sealing surfaces for wear, pitting and cavitation; rub down with emery cloth or an oilstone or replace component.

Turn pump shaft to check freedom of rotation.

Check gear for impressions, wear and damage and smooth slight wear and damage with emery cloth or oilstone; replace charge air coolant pump if necessary.

Replace O-ring.

Thermostat housing

Using the surface crack-testing method with red penetrant dye, check thermostat housing for cracks; replace if cracks are found.

Check support bores of thermostat elements for damage. Smooth with emery cloth if necessary.

Replace all gaskets, sealing rings and O-rings.

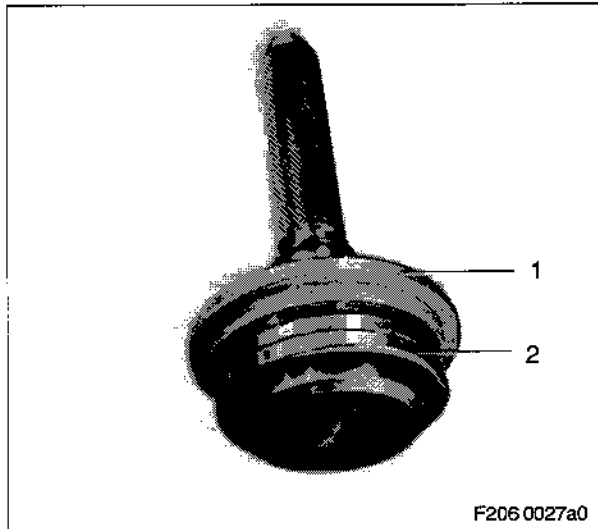
Check thermostat elements – see C206.05.08.

C203.05.10 Assembly

Charge air coolant pump

See C 203.05.06

Thermostat housing



Install sealing ring in thermostat housing

Fit sealing ring (2) with flat end facing drift (1) onto drift.

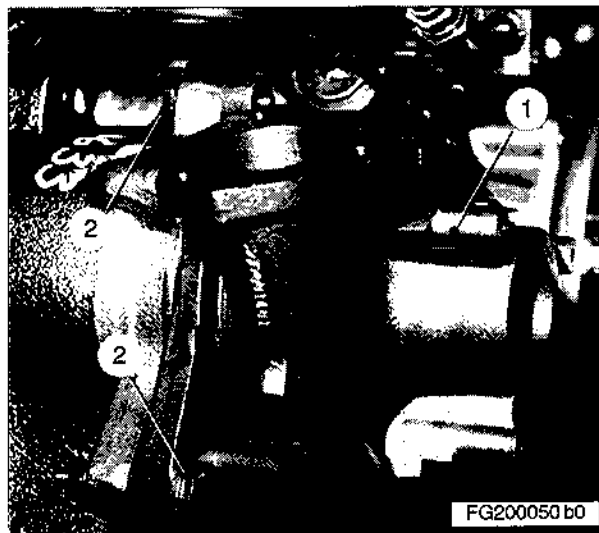
Using mandrel, strike sealing rings into thermostat housing until drift makes contact with thermostat housing.

Coat sealing ring on thermostat element with petroleum jelly.

Press thermostat elements into thermostat housing by hand and assemble thermostat housing – see Overview drawing C203.05.01.

C203.05.11 Installation

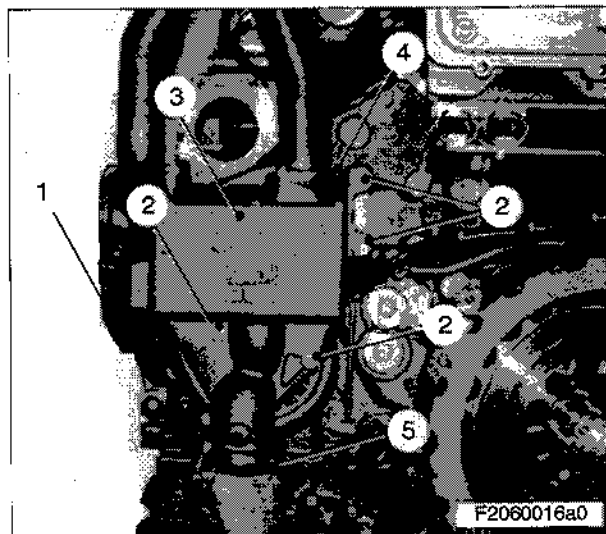
Install charge air coolant pump



Coat O-ring with petroleum jelly (see Overview drawing C 203.05.01) with petroleum jelly and insert in groove on pump housing of charge air coolant pump.

Positioning correctly, insert charge air coolant pump (1) into bore in gear case, ensuring that gear engages.

Install hex screws (2) with washers and tighten uniformly.

Installing thermostat housing

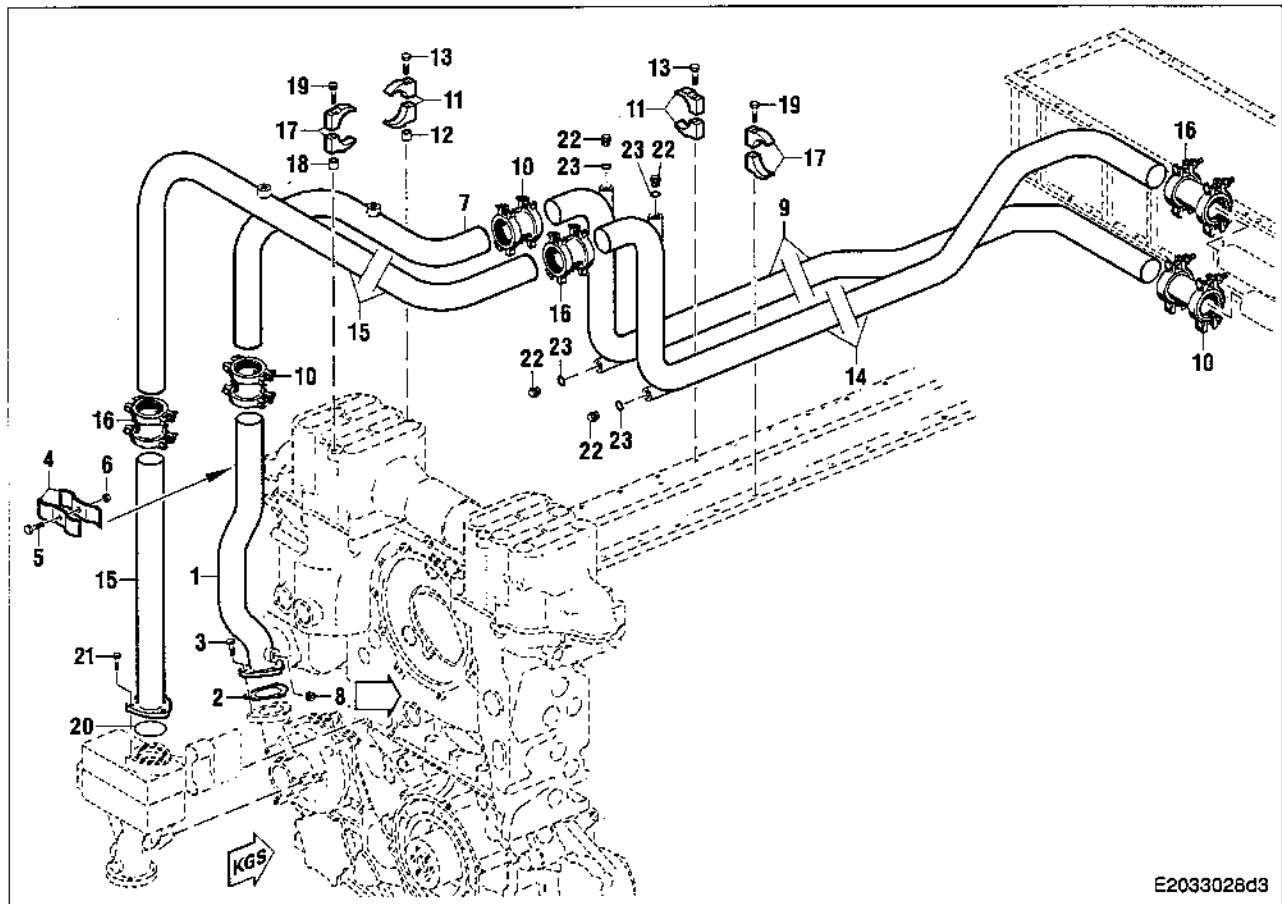
Coat O-ring (see Overview drawing C 203.05.01) with petroleum jelly and insert into groove in thermostat housing (3).

Install thermostat housing with spacer and hex screws (2) – see Overview drawing C203.05.01.

Fit corresponding pipes to flanges (5), (1) and (4).

C203.05.12 After-installation operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	x	x	Assembly in reverse sequence to disassembly	→ C 203.05.04
–	–	x	Fill engine coolant system	→ Operating Instructions
–	–	x	Release engine start	→ Operating Instructions

C203.25 Coolant pipework from/to intercooler**C203.25.01 Overview drawing**

- | | | |
|-----------------|--------------------|-----------------|
| 1 Pipeline | 9 Coolant line | 17 Bracket |
| 2 Gasket | 10 Pipe connection | 18 Spacer |
| 3 Hex screw | 11 Bracket | 19 Screw |
| 4 Bracket | 12 Spacer | 20 O-ring |
| 5 Screw | 13 Screw | 21 Hex screw |
| 6 Nut | 14 Coolant line | 22 Plug |
| 7 Pipeline | 15 Coolant line | 23 Sealing ring |
| 8 Blanking plug | 16 Pipe connection | |

C203.25.04 Before-removal operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Remove engine	→ B 003
x	–	–	Perform operations as per Disassembly Plan	→ B 004
–	–	x	Disable engine start	→ Operating Instructions
–	–	x	Drain charge air coolant	→ Operating Instructions
–	–	x	Remove coolant vent lines	→ C 202.65

C203.25.05 Removal

Removing coolant lines

Remove coolant lines with fixtures as per Overview drawing – see C 203.25.01.

After removing coolant lines, seal all connections with suitable plugs.

C203.25.08 Inspection and repair

Clean all components.

Visually inspect components for damage and wear; replace components as necessary.

Check sealing and mating faces for damage and defects; rub down with an oilstone or replace parts if necessary.

Check coolant lines for damage and condition; if necessary repair and, using corrosion inhibitor, pressure-test with air in water bath for leaks.



Compressed air is air which has been compressed under pressure. Test fluid is hot. Risk of injury! Pressure must not exceed 0.5 bar (7.25 lb/in²). Always wear protective clothing, protective gloves and protective goggles/safety mask.

Water temperature min. 30° C, max. 40° C.

Note: The component must likewise reach this temperature.

Test pressure: 0.5 bar

Check thread for ease of movement; if necessary, recut or replace part.

Replace gaskets.

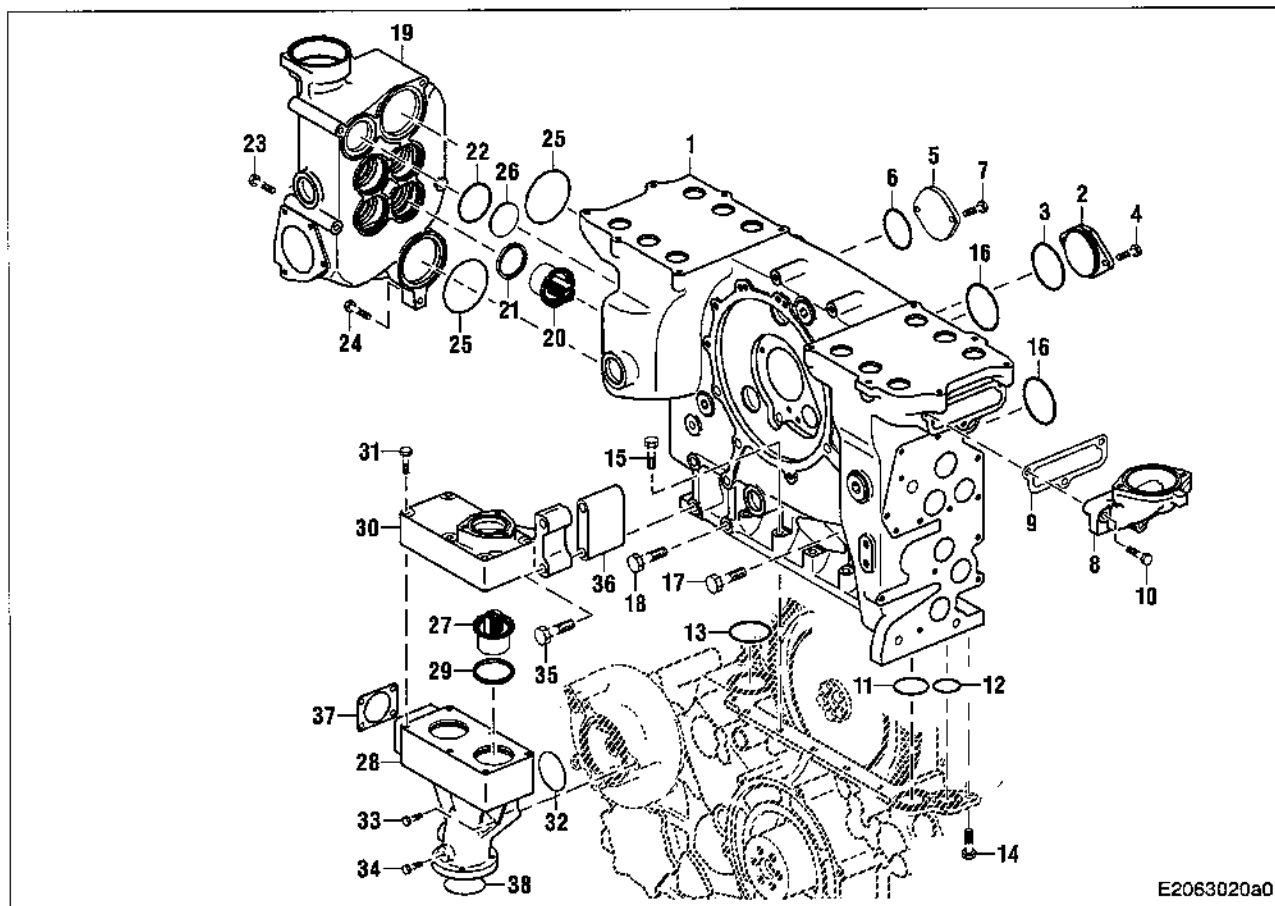
C203.25.11 Installation

Note: Before installation, remove all blanking plugs.

Install coolant lines, Flexmaster pipe connections, gaskets and securing components as per Overview drawing C 203.05.01 and in accordance with installation instructions for Flexmaster pipe connections – see A001.

C203.25.12 After-installation operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	x	x	Assembly in reverse sequence to disassembly	→ C 203.05.04
–	–	x	Fill engine coolant system	→ Operating Instructions
–	–	x	Release engine start	→ Operating Instructions

C206.05 Coolant pipework with thermostat**C206.05.01 Overview drawing**

1 Coolant distribution housing	12 O-ring	21 Sealing ring	30 Cover
2 Cover	13 O-ring	22 O-ring	31 Hex screw
3 O-ring	14 Hex screw	23 Hex screw	32 O-ring
4 Hex screw	15 Hex screw	24 Hex screw	33 Hex screw
5 Cover	16 O-ring	25 O-ring	34 Hex screw
6 O-ring	17 Hex screw	26 O-ring	35 Hex screw
7 Hex screw	18 Hex screw	27 Thermostat element	36 Spacer sleeve
8 Elbow	19 Thermostat housing	(low-temperature circuit)	37 Gasket
9 Gasket	(high-temperature circuit)	28 Thermostat housing	38 O-ring
10 Hex screw	20 Thermostat element	(low-temperature circuit)	
11 O-ring	(high-temperature circuit)	29 Sealing ring	

C206.05.02 Special tools

Designation	Use/dimension	Number
• Installation mandrel	for thermostat housing sealing ring	1
• Installation tool	installing/removing restrictors, coolant distribution housing	1
• Guide journal	for restrictor	1
• Guide journal	for restrictor	1
• Guide journal	for restrictor	1
• Guide journal	for restrictor	1

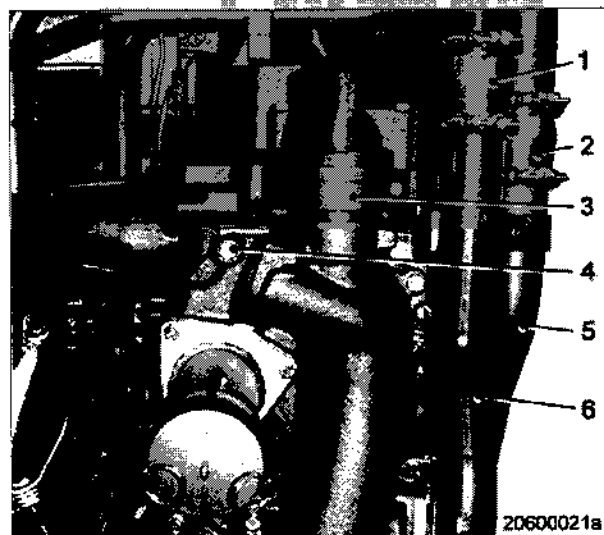
C206.05.04 Before-removal operations

For the following tasks, a distinction must be made as to whether: → The engine is to be completely disassembled → The engine is to be removed but not disassembled → The engine is to remain installed				
			Measure	See
x	-	-	Remove engine	→ B 003
x	-	-	Perform operations as per Disassembly Plan	→ B 004
-	-	x	Disable engine start	→ Operating Instructions
-	-	x	Drain engine coolant	→ Operating Instructions
-	-	x	Drain charge air coolant	→ Operating Instructions
-	x	x	Remove oil filter *	→ C.183.05
-	x	x	Remove centrifugal oil filter *	→ C.183.10
-	x	x	Remove crankcase ventilation*	→ C.018.10
-	x	x	Remove engine oil heat exchanger *	→ C.183.15
-	x	x	Remove coolant pipe after cylinder *	→ C.202.20
-	x	x	Remove charge air coolant pump *	→ C.203.05
-	x	x	Disconnect electric wiring	→ C 500

* – in addition only for removal of coolant distribution housing

C206.05.05 Removal**Removing thermostat housing (high-temp. circuit)**

Remove hex screws from flange (1) and (2) and press flange from respective sealing surface.



Remove hex nuts for pipe connection (1) and (2). Remove V-clamps and slide pipe connection onto remaining pipe.

Remove hex screws from pipe flange/thermostat housing connection and remove pipes (5) and (6).

Remove hex screws from flange (3) and press flange from respective sealing surface.

Remove hex screws (4).

Note: Replace 2 hex screws with guide pins – see next illustration.



Press off thermostat housing (1) from coolant distribution housing.



Remove restrictor or 4 x coolant thermostats, sealing rings and O-rings.

Removing coolant distribution housing



Suspended load. Risk of injury!

Only use lifting device provided by manufacturer and observe lifting instructions. Never stand beneath a suspended load.

Screw eyebolts into coolant distribution housing and attach to crane and lifting rope.

Remove hex screws and washers for coolant distribution housing, see Overview drawing C 206.05.01.

Using a crane and rope, remove coolant distribution housing from gearcase. Remove O-rings.

C206.05.08 Inspection and repair

Clean all parts with cold cleaner.

Check components for damage and defects; replace components as necessary.

Using the surface crack-testing method with red penetrant dye, check coolant distribution housing and thermostat housing for cracks; replace coolant distribution housing if cracks are found.

Check all mating and sealing faces for wear and damage; rub down with emery cloth or an oilstone as necessary.

Check support bores of thermostat elements for damage. Smooth with emery cloth if necessary.

Check condition of thread in coolant distribution housing; replace thread insert if necessary.

Replace gaskets, sealing rings and O-rings.

Make sure that oil chambers are perfectly clean.

If necessary pressure-test coolant and oil chambers of coolant distribution housing with air in water bath (with corrosion inhibitor) for leaks (excepting coolant chamber to coolant chamber).

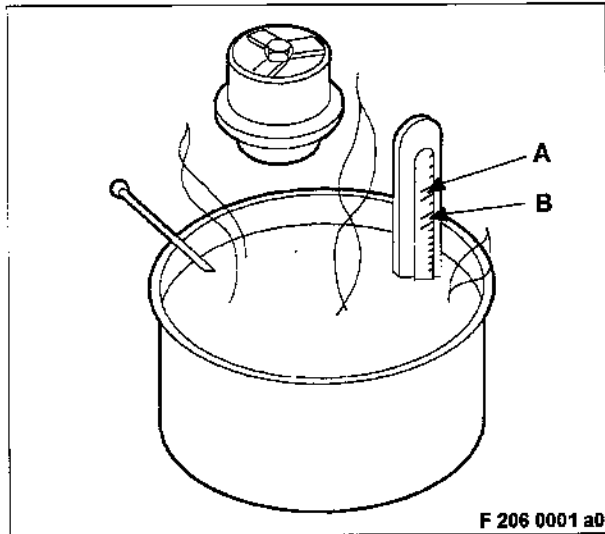


Compressed air is highly pressurized.

Risk of injury! Pressure must not exceed 0.5 bar.

Always wear protective clothing, protective gloves and protective goggles/safety mask.

Test pressure: 0.5 bar

Checking thermostat element (high and low temperature)

Hang thermostat insert on a wire in a container filled with water; thermostat insert must not contact container.

Heat water with suitable heat source.

As of approx. 10 °C under start-of-opening temperature (B), the heating speed must not exceed 1 °C per minute.

High-temperature circuit

- Start of opening (B): 75 °C ± 2 °C
- Fully opened (A): 88 °C ± 2 °C

Low-temperature circuit

- Start of opening (B): 45 °C ± 2 °C
- Fully opened (A): 58 °C ± 2 °C

Note: Start-of-opening temperature is stamped on thermostat insert.

Note: Never use welding torch or blow torch to heat thermostat insert!

CAUTION

Component is hot.

Risk of injury!

Handle components only when wearing protective gloves.

Check thermostat insert for start of opening with heat supply uniform and water constantly circulated.

Replace thermostat insert if results of check are negative.

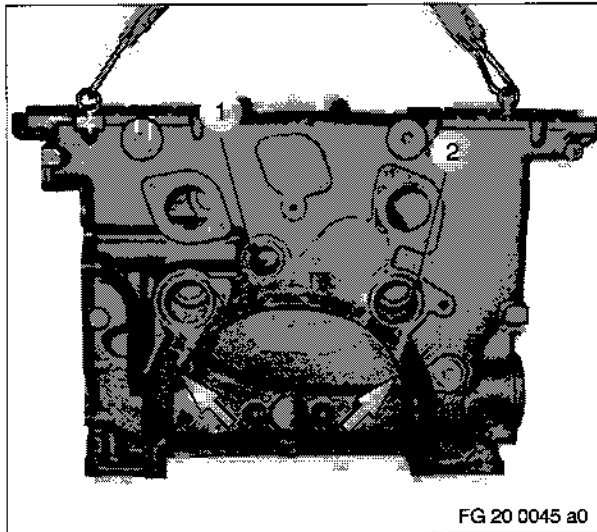
Continue to heat coolant to full-opening temperature (A).

Thermostat insert must be completely open after 6 to 8 minutes.

Measure stroke travel of thermostat insert.

Stroke must be min. 9.5 mm; if not, replace thermostat element.

C206.05.11 Installation



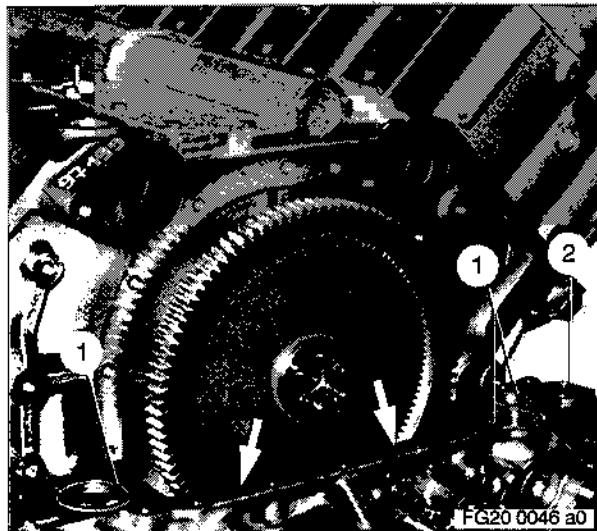
Assembling and installing coolant distribution housing

Install elbow (not shown – see Overview drawing C 206.05.01) on coolant distribution housing.

Screw end cover into coolant distribution housing and tighten.

Coat O-rings (1, 2) with petroleum jelly and insert on back of coolant distribution housing.

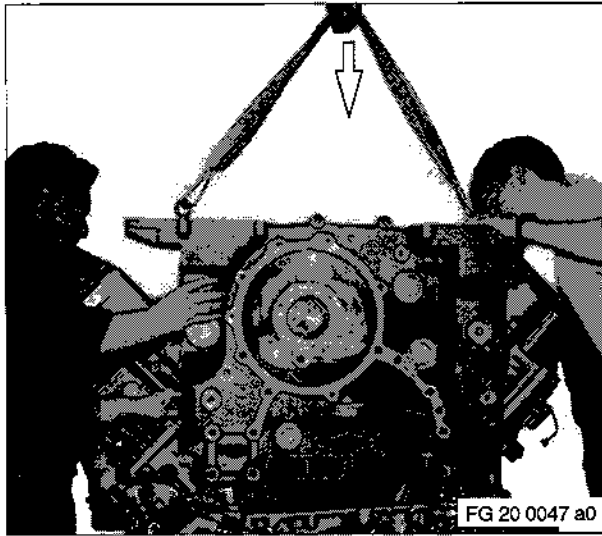
Coat mating face (arrow) between rear of coolant distribution housing and crankcase with surface sealant 518.



Coat O-rings (1) with petroleum jelly and insert into grooves in equipment carrier.

Fit blanking plugs (2) on equipment carrier.

Coat mating face of coolant distribution housing on equipment carrier with surface sealant 518 (see arrow).

**Suspended load.****Risk of injury!**

Only use lifting device provided by manufacturer and observe lifting instructions.

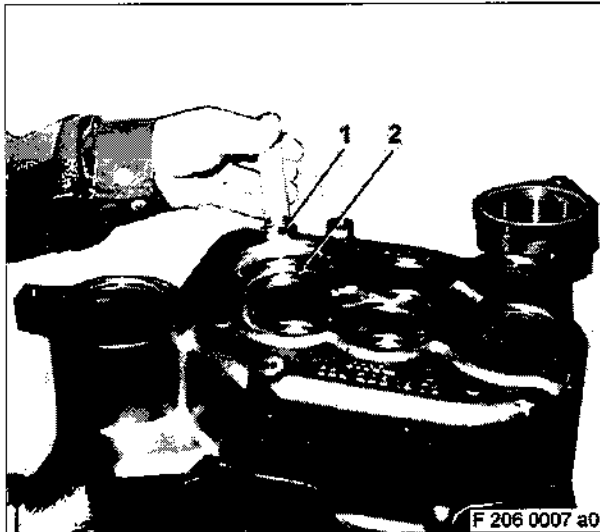
Never stand beneath a suspended load.

Carefully align coolant distribution housing, attached to crane with a rope, on equipment carrier.

Place coolant distribution housing on equipment carrier.

Note: When positioning the coolant distribution housing, make sure that O-rings on back of coolant distribution housing are not crushed.

Fit and tighten hex screws and washers for coolant distribution housing, see Overview drawing C 206.05.01.

**Installing thermostat elements**

Guide sealing ring (2) over installation tool (1) so that sealing lip of sealing ring is not facing collar of insertion tool.

Drive sealing rings with installation mandrel into thermostat housing.



Check sealing and mating faces for contamination; clean as necessary.

Coat sealing surfaces (arrow) of thermostat elements with petroleum jelly and insert in support bores.

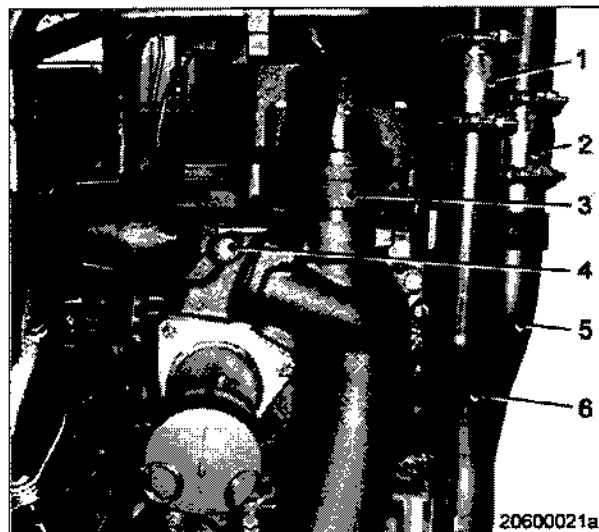
Coat O-rings with petroleum jelly and insert in annular grooves.



Installing thermostat housing (high-temp. circuit)

Insert restrictor (arrow) into support bore.

Install thermostat housing on coolant distribution housing by means of guide pins.



Screw in hex screws (4), remove guide pins and replace with hex screws.

Coat seals (1) and (2) with petroleum jelly. Fit pipe connection on pipes (5) and (6), centre and tighten hex nuts of V-clamps.

Install flange (3) with new O-ring.



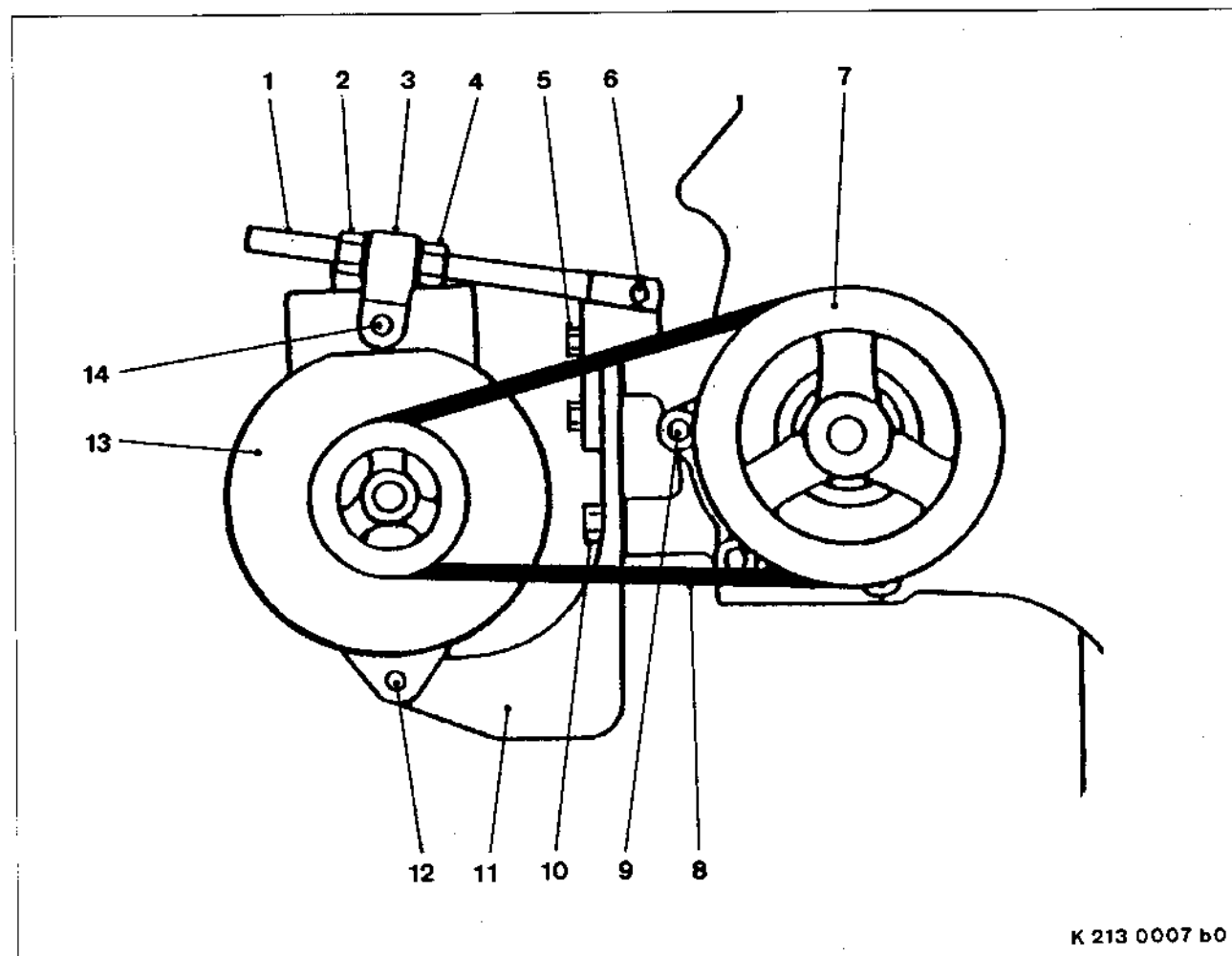
Install flanges (1) and (2) with new O-rings.

Note: See also Overview drawing C202.10.01.

C206.05.12 After-installation operations

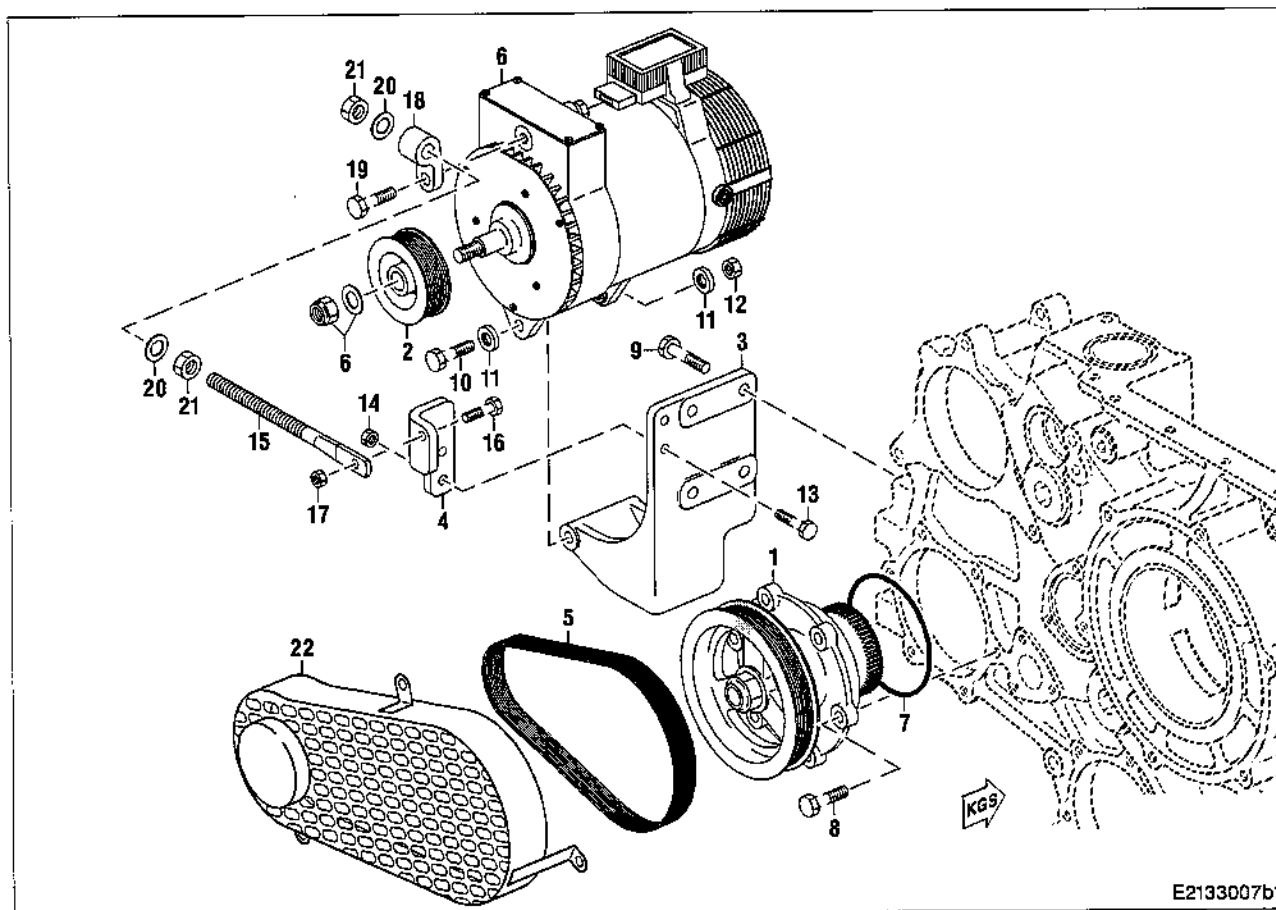
			For the following tasks, a distinction must be made as to whether:	
			↓ ↓ ↓ The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed	
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	x	x	Assembly in reverse sequence to disassembly	→ C 206.05.04
–	–	x	Fill charge air coolant system	→ Operating Instructions
–	–	x	Fill engine coolant system	→ Operating Instructions
–	–	x	Fill oil system with engine oil	→ Operating Instructions
–	–	x	Release engine start	→ Operating Instructions
–	–	x	Vent fuel system	→

C210	Power supply, engine side	C – 1
C213.05	Generator	C – 3
C213.05.01	Overview drawing	C – 3
C213.05.04	Before-removal operations	C – 4
C213.05.05	Removal	C – 4
C213.05.06	Disassembly	C – 6
C213.05.08	Inspection and repair	C – 6
C213.05.10	Assembly	C – 6
C213.05.11	Installation	C – 7
C213.05.12	After-installation operations	C – 9

C210 Power supply, engine side

- 1 Stud
- 2 Locknut
- 3 Link
- 4 Clamping nut
- 5 Hex screw
- 6 Hex nut
- 7 Alternator drive

- 8 Belt pulley
- 9 Hex screw
- 10 Hex screw
- 11 Bracket
- 12 Hex screw
- 13 Generator
- 14 Hex screw

C213.05 Generator**C213.05.01 Overview drawing**

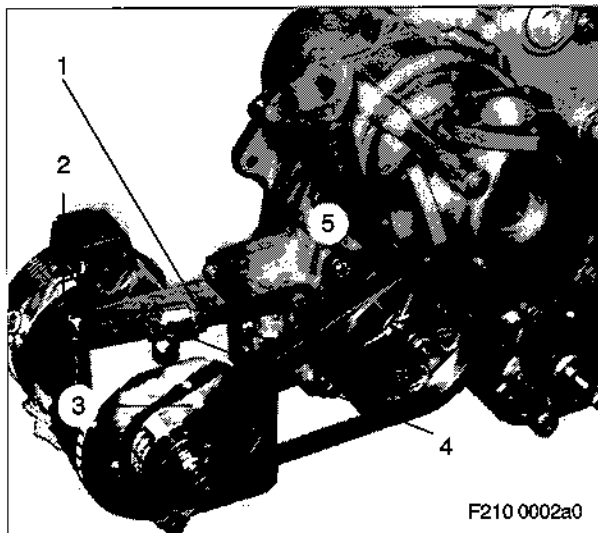
E2133007b1

- | | |
|-------------------------------------|--------------|
| 1 Alternator drive | 12 Nut |
| 2 Belt pulley | 13 Hex screw |
| 3 Bracket | 14 Hex nut |
| 4 Bracket | 15 Stud |
| 5 V-belt | 16 Hex screw |
| 6 Alternator/nut | 17 Hex nut |
| Lubricant: Engine oil | 18 Link |
| Tightening torque: 360 Nm to 400 Nm | 19 Screw |
| 7 O-ring | 20 Washer |
| 8 Hex screw | 21 Hex nut |
| 9 Hex screw | 22 Cover |
| 10 Screw | |
| 11 Washer | |

C213.05.04 Before-removal operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	-	-	Remove engine	→ B 003
x	-	-	Perform operations as per Disassembly Plan	→ B 004
-	-	x	Disable engine start	→ Operating Instructions
-	x	x	Mark and disconnect electric cables	→ -
-	x	x	Remove cover	→ -

C213.05.05 Removal



Removing generator

Note: Before removal, ensure that the negative battery pole is disconnected!

Release clamping nut (1).

WARNING

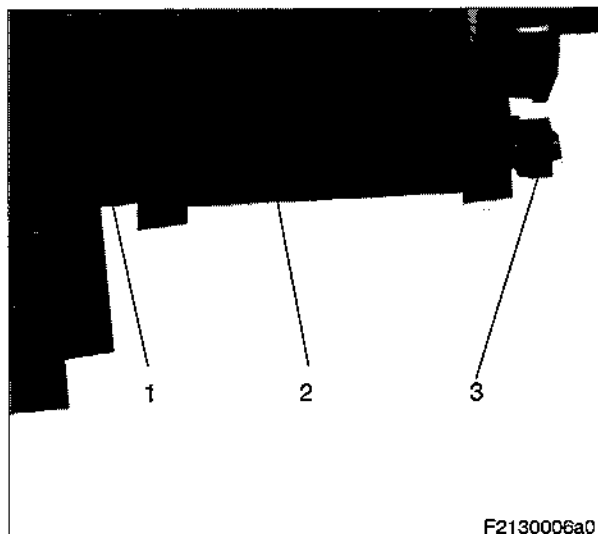
**Heavy object.
Risk of injury!
Use suitable tools and lifting equipment.**

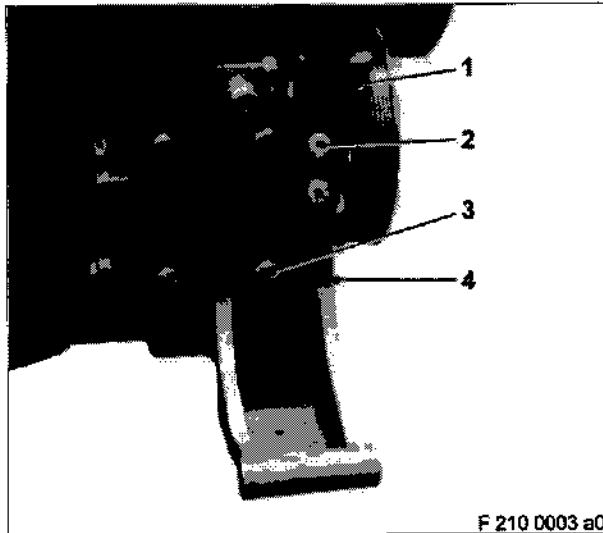
Tilt generator (2) in direction of engine and remove V-ribbed belt (3).

Release hex nut (4) from stud.

Release nut (3) and withdraw hex screw (1) from bracket.

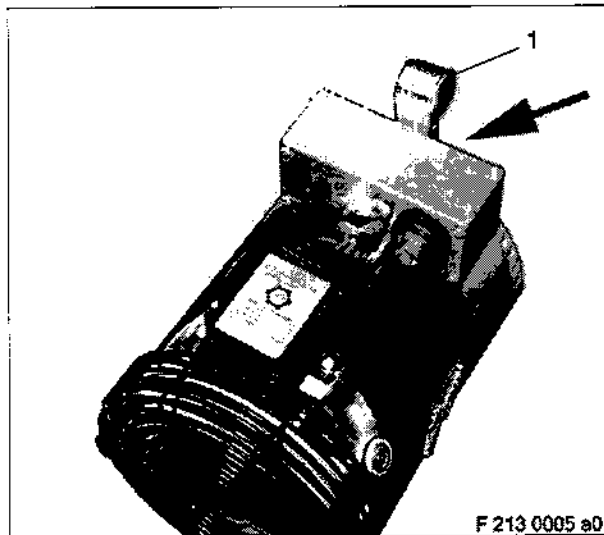
Carefully pull down generator (2).



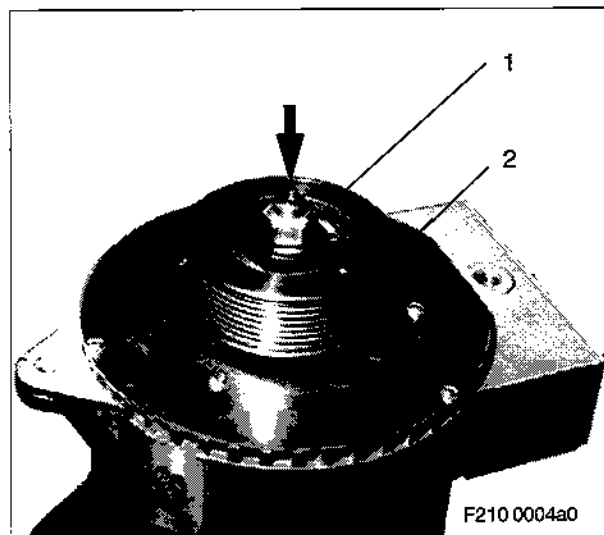
**Removing bracket**

Unscrew hex screws (3) and remove bracket (4).

Unscrew nut (not shown) from hex screw (2) and remove bracket (1).

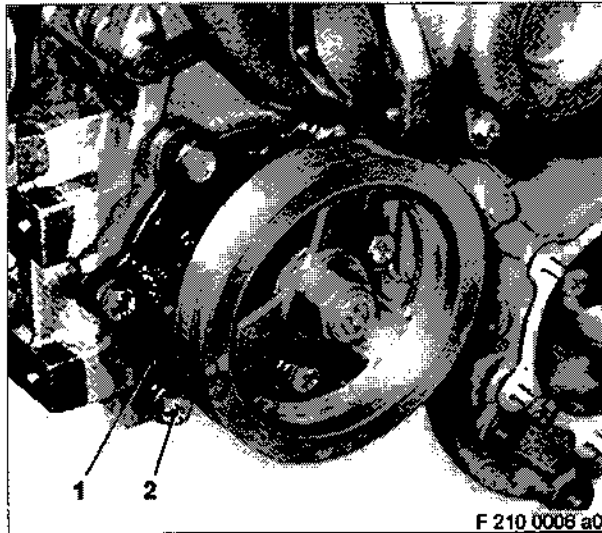
**Removing tab from generator.**

Release hex screw (arrow) and remove connecting element (1) from generator.

**Removing belt pulley from generator.**

Unscrew nut (1) while holding armature shaft in position with Allen key (see arrow).

Remove belt pulley (2) from shaft.



Removing alternator drive

Unscrew hex screws (2).

Carefully remove alternator drive (1) from gear train.

C213.05.06 Disassembly

Disassembly of the generator is not planned.

The generator is an exchangeable component and can be obtained in the exchange procedure.

C213.05.08 Inspection and repair

Visually inspect outside of generator for damage and defects.

Clean all components and visually inspect condition and check for damage; replace component as necessary.

Check all mating faces and fits. Rub down with oilstone or emery cloth as necessary.

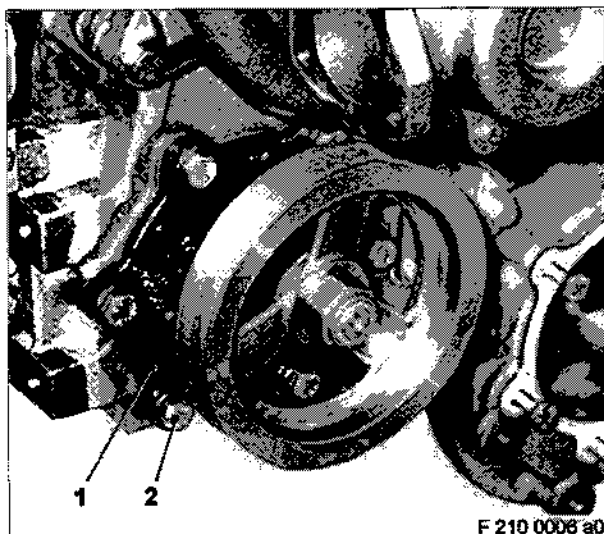
Check condition of threads; machine or replace components as necessary.

Check alternator drive for abnormal running noises, replace component if necessary.

Always replace V-ribbed belt during major overhaul.

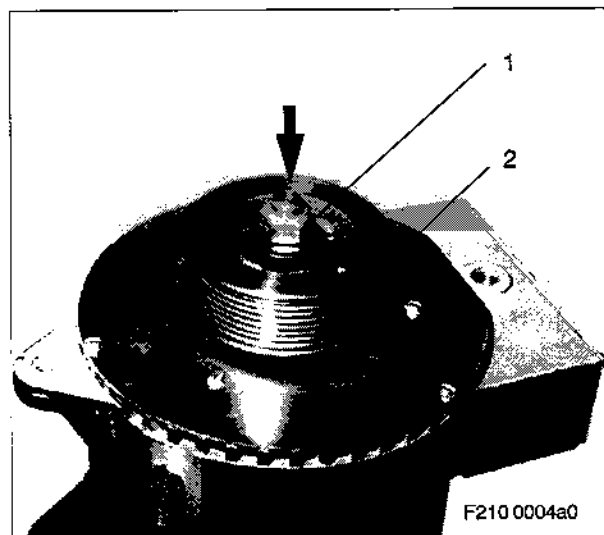
C213.05.10 Assembly

See C 213.05.06

C213.05.11 Installation**Installing alternator drive**

Carefully insert alternator drive (1) into gear train.

Insert hex screws (2) and tighten diagonally and evenly.

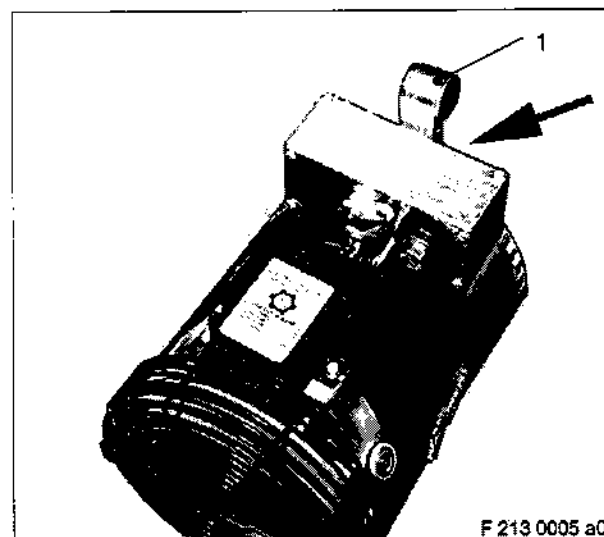
**Mounting belt pulley on generator**

Fit belt pulley (2) on armature shaft, ensuring it is correctly positioned.

Note: Fit belt pulley on armature shaft so that projecting collar faces generator. Use straightedge to make comparison.

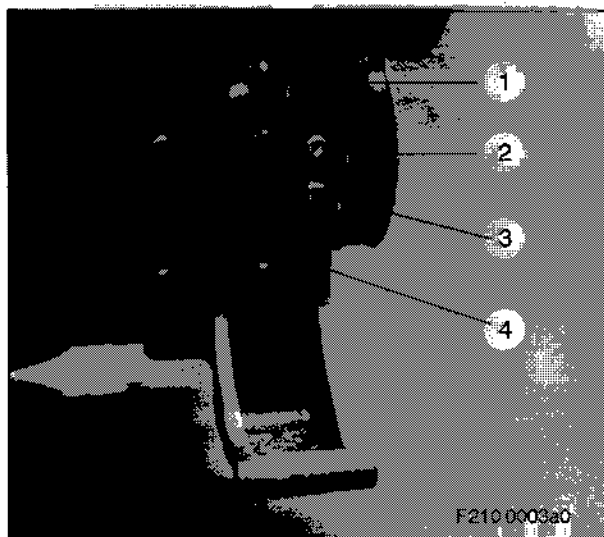
Fit nut (1) and tighten – see Overview drawing C 213.05.01.

Note: When tightening nut, hold armature shaft in position with Allen key.

**Installing connecting element on generator**

Fit connecting element (1) with hex screw (arrow) on generator.

Note: First tighten hex screw only by hand so that connecting element can be moved to and fro. Tighten hex screw only when generator has been installed.

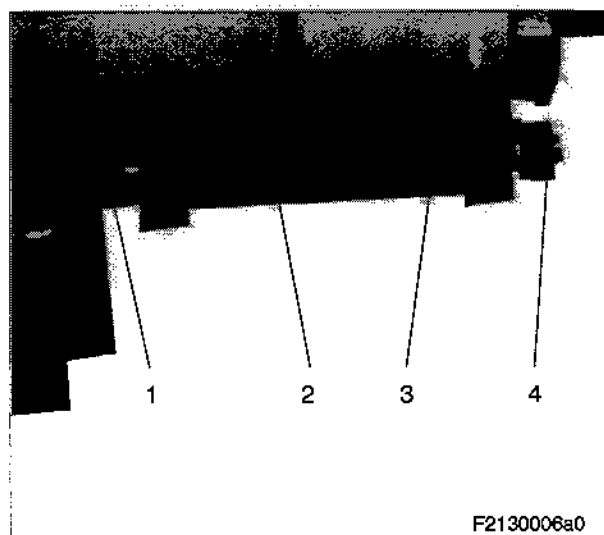


Installing bracket

Position bracket (4) on engine.

Insert hex screws (3) and tighten to specified torque.

Position angle element (1) on bracket, fit hex screws (2) and tighten to specified torque.



Install generator

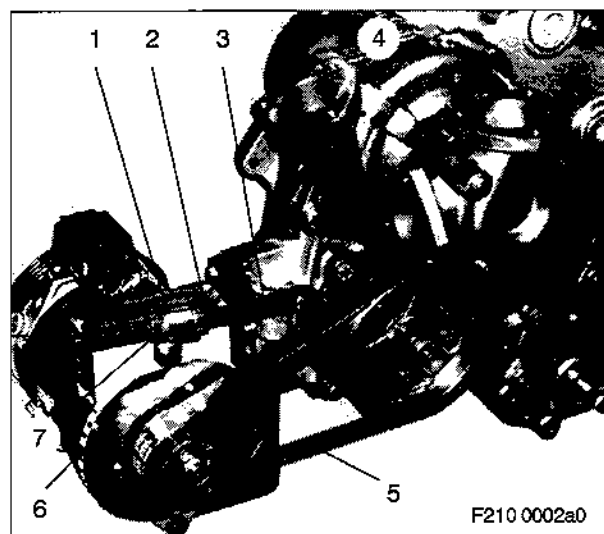


**Heavy object.
Risk of injury!
Use suitable tools and lifting equipment.**

Align generator (2) with securing elements on hinge of bracket (3).

Insert hex screw (1) through securing elements and hinge.

Fit nut (4) on hex screw and tighten to specified tightening torque.



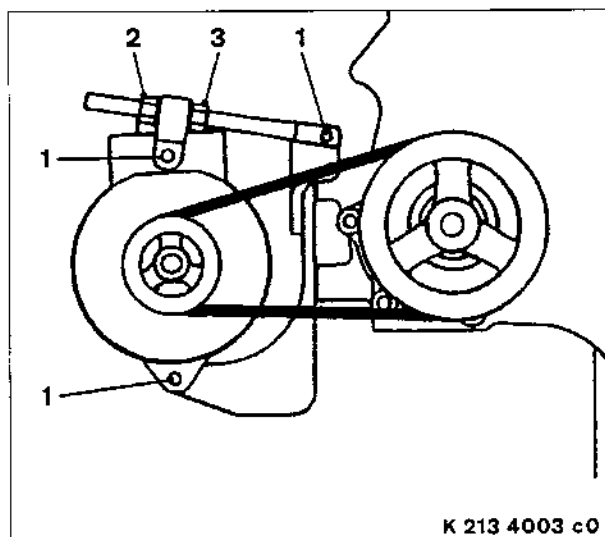
Fit clamping nut (2) on stud (3) and screw on to end of thread.

Insert stud into connecting element (1) and secure with securing screw (4) hand-tight on equipment carrier.

Fit locknut (7) on spring pin and screw on until it engages.

Tilt generator (6) in direction of equipment carrier.

Fit V-ribbed belt (5) and pretension generator.



Pretensioning V-belt

If measured value does not correspond to specified value, V-ribbed belt tension must be corrected.

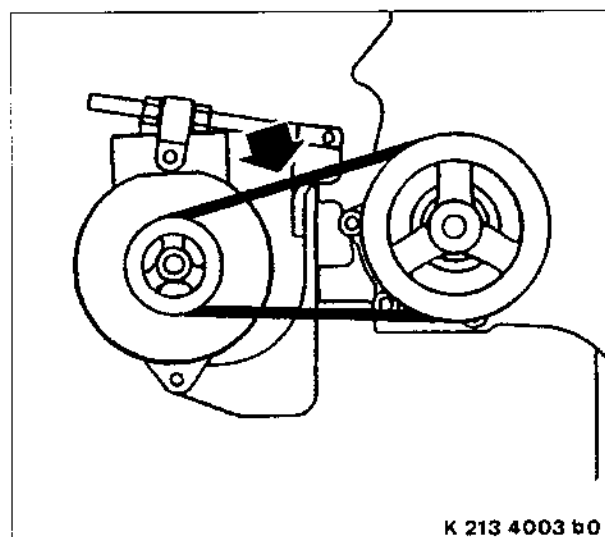
Tighten clamping nut (3) to tension V-ribbed belt away from engine until value on V-belt tension gauge (see next illustration) is within the specified range.

Tighten locknut (2) as per tightening specifications.

Tighten securing screws (1) as per tightening specifications.

Again check V-ribbed belt tension.

Note: If measured value does not correspond to specified value, retension V-belt.



Checking V-belt tension

Position V-belt tension gauge in centre between V-ribbed belt pulleys on V-ribbed belt.

Read off measured value on display.

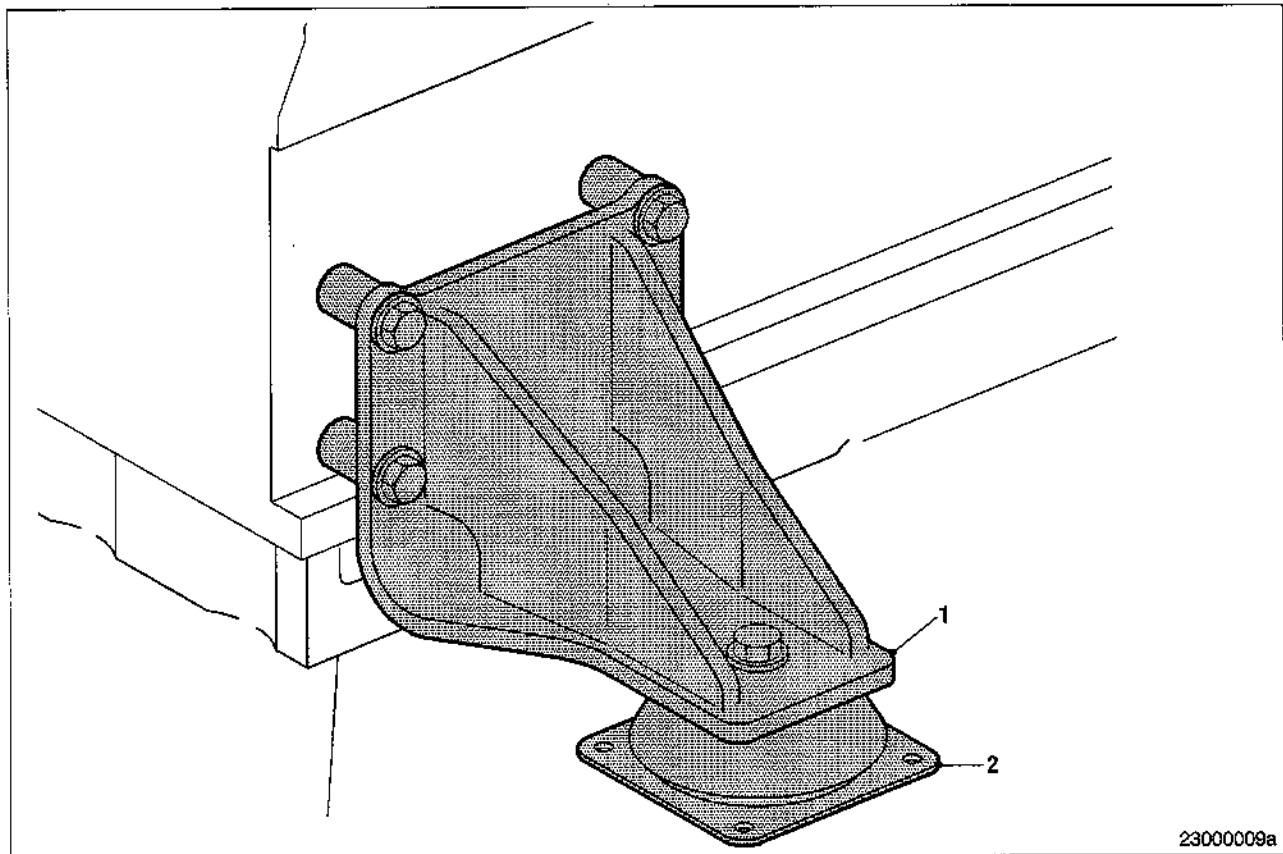
– Settings: 57–70 kg (125–155 lbs)

Install cover as per Overview drawing C 213.05.01.

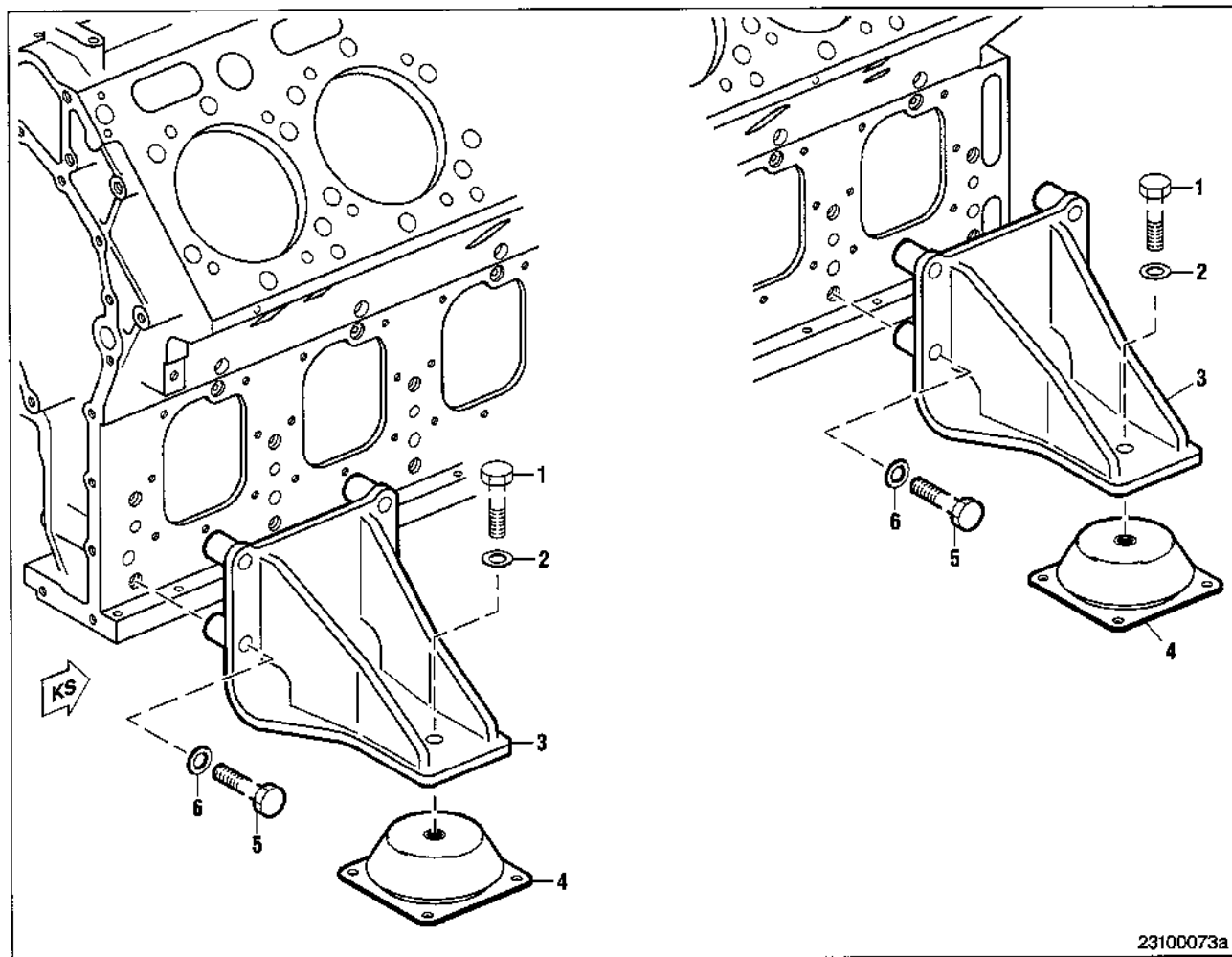
C213.05.12 After-installation operations

			For the following tasks, a distinction must be made as to whether:	
			↓ ↓ ↓	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	x	x	Connect electrical cables in accordance with markings	→
–	x	x	Install cover	→
–	–	x	Release engine start	→ Operating Instructions

C230	Mounting/support	C – 1
C231.10	Engine mount	C – 3
C231.10.01	Overview drawing	C – 3
C231.10.04	Before-removal operations	C – 5
C231.10.05	Removal	C – 5
C231.10.08	Inspection and repair	C – 6
C231.10.11	Installation	C – 6
C231.05.12	After-installation operations	C – 6

C230 Mounting/support

- 1 Engine carrier
- 2 Damping element

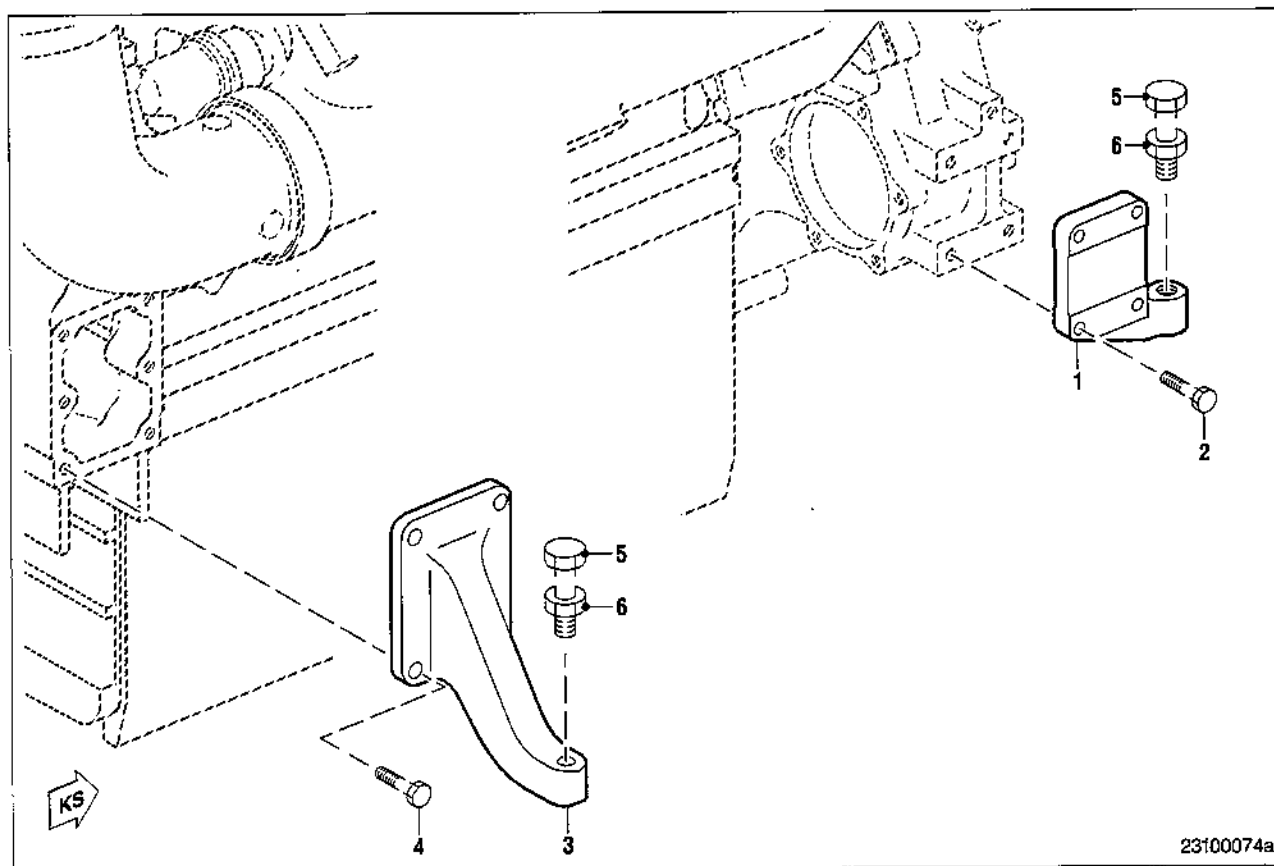
C231.10 Engine mount**C231.10.01 Overview drawing**

23100073a

- 1 Hex screw
Lubricant: Engine oil
Tightening torque: 190 Nm + 19 Nm
2 Washer
3 Engine carrier

- 4 Damper bearing
5 Hex screw
Lubricant: Engine oil
Tightening torque: 500 Nm +50 Nm
6 Washer

Engine supports



1 Engine support

2 Hex screw

Lubricant:

Tightening torque:

Engine oil

74 Nm + 7 Nm

3 Engine support

4 Hex screw

Lubricant:

Tightening torque:

Engine oil

180 Nm + 18 Nm

5 Hex screw

6 Hex nut

C231.10.04 Before-removal operations

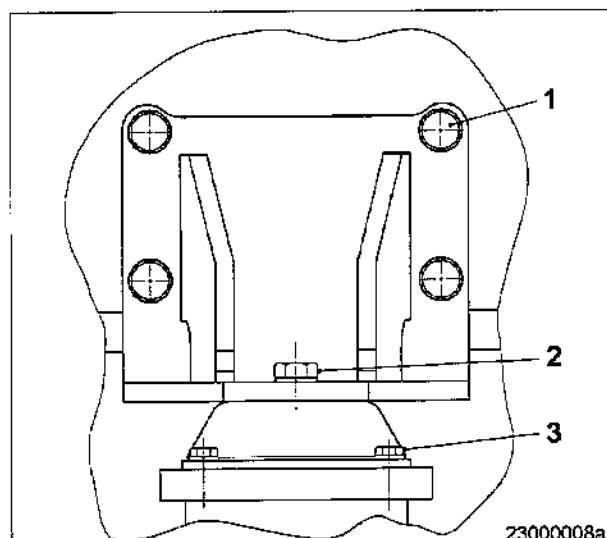
For the following tasks, a distinction must be made as to whether:

The engine is to be completely disassembled

The engine is to be removed but not disassembled

The engine is to remain installed

Measure			See
x	-	-	Remove engine → B 003
x	-	-	Perform operations as per Disassembly Plan → B 004
-	-	x	Disable engine start → Operating Instructions
-	-	x	Drain engine coolant → Operating Instructions
-	-	x	Drain charge air coolant → Operating Instructions
-	-	x	Disconnect coolant supply and return lines from engine → -
-	-	x	Remove coolant pump when disassembling engine mount, left engine side, free end → C 202.05.05
-	-	x	Separate engine from alternator → -

C231.10.05 Removal**Removing engine carrier with damping element**

Note: Replace rubber mounts singly, one after the other.

WARNING

**Engine may tilt.
Risk of injury!**
Prior to removing engine mount, support or attach engine.
Only use lifting device provided by manufacturer and observe lifting instructions.

With engine installed and engine supports not installed. Install engine support.

Remove foundation screws (3) and hex screw (2) from damping mount to be removed.

Screw in jackscrews of engine supports into foundation far enough to allow the damping mount to be removed.

Remove securing screws (1) for engine carrier, supporting carrier against dropping, and remove engine carrier.

Removing engine support

Note: Remove supports only if necessary. Ensure that supports are not stressed by engine.

Remove screws and washers for engine support and lift engine support off crankcase, see Overview drawing C 231.10.01.

C231.10.08 Inspection and repair

Note: Protect damping mount from exposure to oil and fuel!

Clean all components.

Rub down rubber faces with dry cloth only, never use organic cleaning agents.

Using the surface crack-testing method with red penetrant dye, check mounting bracket for cracks.

If cracks are detected, replace part.

Visually inspect damping mount for damage, cracking and deformation; replace as necessary.

Check bolt-on surfaces for irregularities and smooth with oilstone if necessary.

Check condition of threads; machine or replace components as necessary.

C231.10.11 Installation

Installing engine support

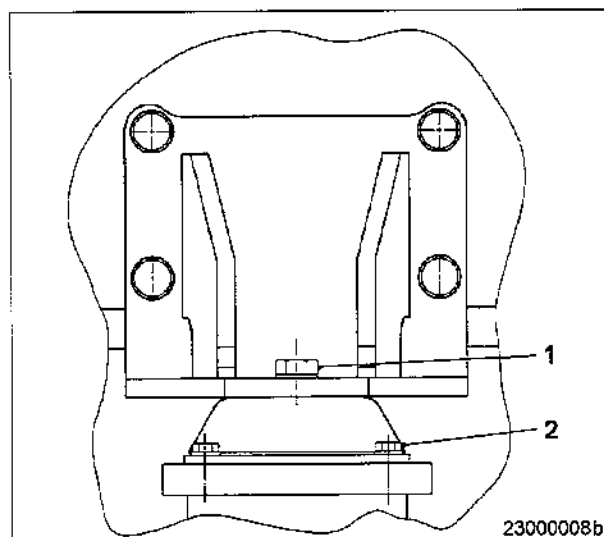
Install engine support with screws and washers in accordance with installation position on flywheel housing and equipment carrier.

For installation position and tightening torque, see Overview drawing C 231.10.01.

Mounting engine carrier

Install engine carrier in accordance with installation position on crankcase.

For installation position and tightening torque, see Overview drawing C 231.10.01.



Installing damping mount

Note: Replace damping elements only individually and one after the other.

WARNING

**Heavy object.
Risk of injury!
Use suitable tools and lifting equipment.**

Install damping mount on engine carrier and align longitudinally in relation to the engine; tighten hex nut provisionally by hand.

By turning all jacking screws uniformly and alternately, lower support onto foundation.

Back off jackscrew by one turn and secure with hex nut.

Bolt damping mount to foundation with hex screws (2).

Tightening torque: 74 Nm + 7 Nm

Tighten hex screw to specified tightening torque – see Overview drawing C 231.10.01.

C231.05.12 After-installation operations

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007

			For the following tasks, a distinction must be made as to whether:	
			The engine is to be completely disassembled	
			The engine is to be removed but not disassembled	
			The engine is to remain installed	
			Measure	See
–	–	x	Check engine alignment; realign if necessary	→ –
–	–	x	Connect engine to alternator	→ –
–	–	x	Secure bearing elements to foundation.	→ –
–	–	x	Install coolant supply and return lines on engine	→ –
–	–	x	Install coolant pump only after disassembly of engine mount, left engine side, free end	→ –
–	–	x	Fill charge air coolant system	→ Operating Instructions
–	–	x	Fill engine coolant system	→ Operating Instructions
–	–	x	Release engine start	→ Operating Instructions

C500	Monitoring, control and regulation devices	C – 1
C507.00	Wiring – Engine Wiring Harnesses	C – 1
C507.00.01	Overview	C – 2
C507.00.04	Before-removal operations	C – 5
C507.00.05	Removal	C – 5
C507.00.08	Inspection and repair	C – 7
C507.00.11	Installation	C – 8
C507.00.12	After-installation operations	C – 10
C507.98	Sensors and actuators	C – 1
C507.98.01	Overview	C – 1
C507.98.04	Before-removal operations	C – 3
C507.98.05	Removal	C – 4
C507.98.08	Inspection and repair	C – 7
C507.98.11	Installation	C – 8
C507.98.12	After-installation operations	C – 11
C508.95	Electronic control system – ECU 4	C – 13
C508.95.01	Overview	C – 13
C508.95.04	Before-removal operations	C – 13
C508.95.05	Removal	C – 14
C508.95.08	Inspection and repair	C – 15
C508.95.11	Installation	C – 16
C508.95.12	After-installation operations	C – 17

C500 Monitoring, control and regulation devices

The following is a list of auxiliary equipment and materials needed for the assembly operations:

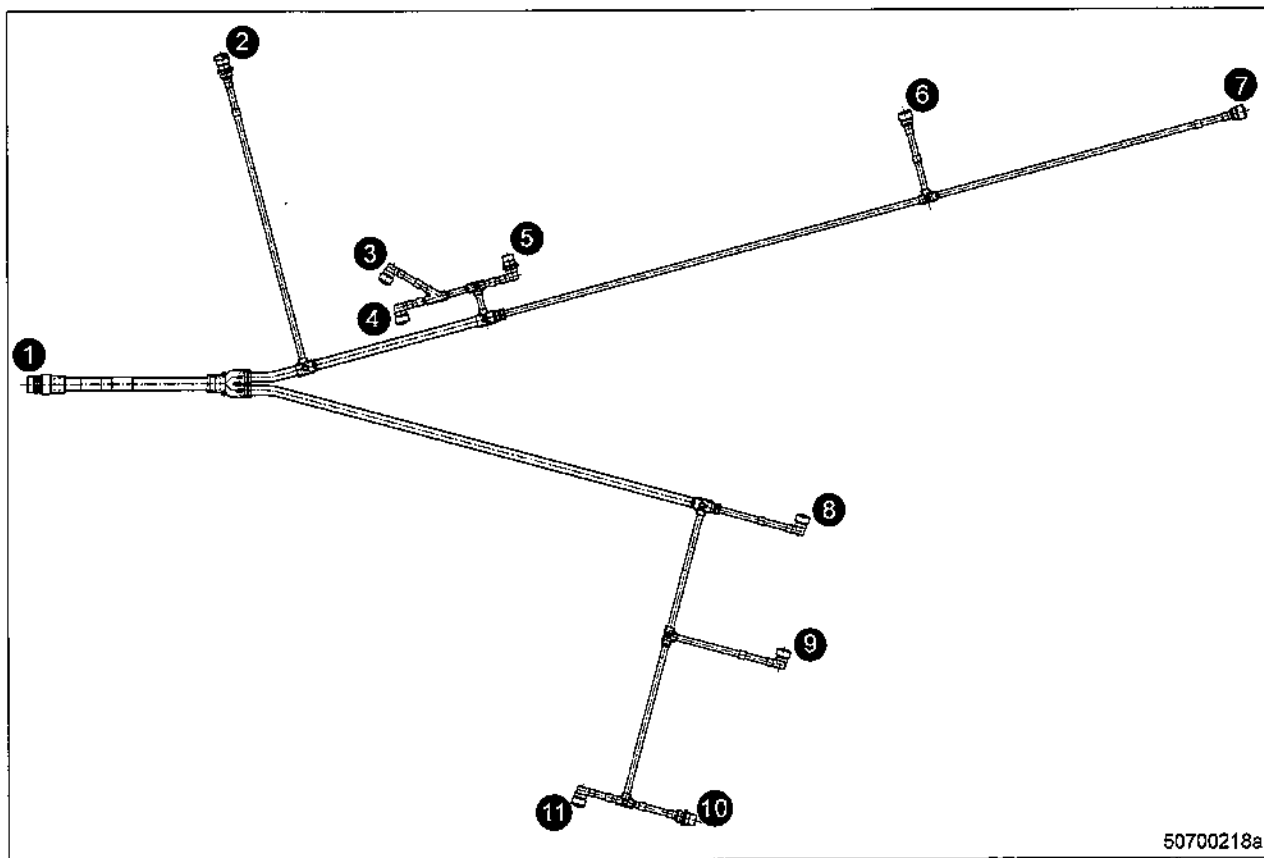
Materials and consumables	Order No.	Remarks
Connector pliers	013 531 54 83	For assembly of ECU bayonet plug
Cable clamp		Fasteners for cables and wiring harnesses
Petroleum jelly, white	40317	For assembly of rubber sealing rings
Isoprophyl alcohol	46181	Cleaning contaminated sensors and contacts

C507.00 Wiring – Engine Wiring Harnesses

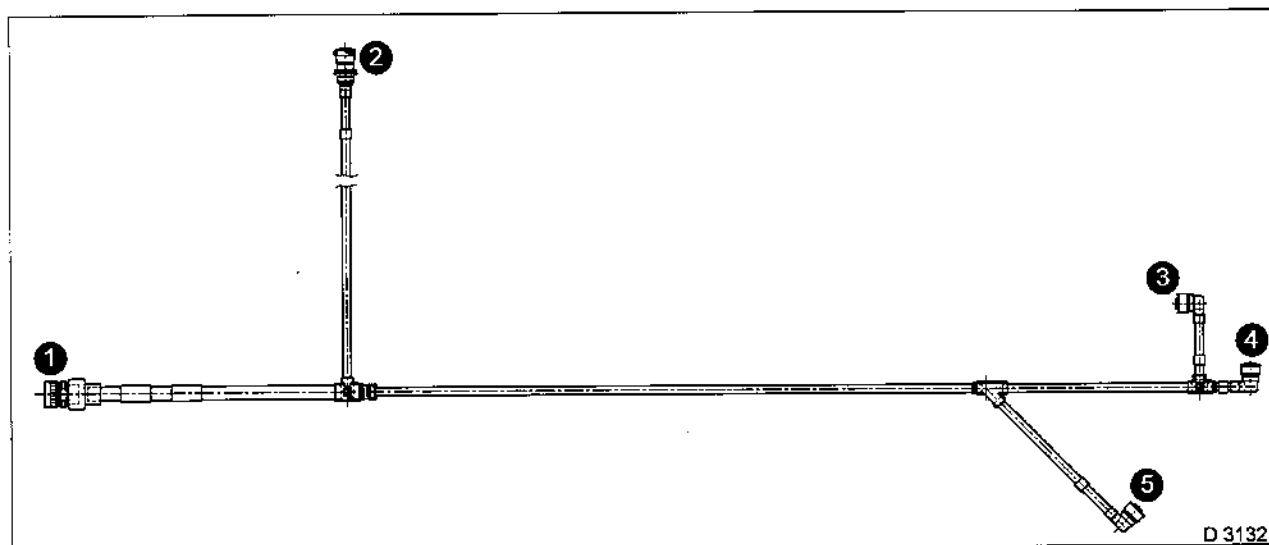
Designation	Connection assignment	
Engine wiring harness W2	• X2 Connector to ECU 4 • B 1 Camshaft speed sensor • B 5 Lube oil pressure sensor • B 6 Engine coolant temperature sensor • B 7 Engine oil temperature sensor • B 9 Charge air temperature sensor • B 10 Charge air pressure sensor • B 13 Engine speed sensor • B 26 Charge air coolant temperature sensor • B 34 Fuel pressure sensor after filter • XF57 Connection for external sensor F57 (charge air coolant level)	
Engine wiring harness W3	• X3 Connector to ECU 4 • B 33 Fuel temperature sensor (rail) • B 48 Fuel pressure sensor (rail) • XF33 Connection for external sensor F33 (engine coolant level) • M8 H.P. fuel pump actuator	
Engine wiring harness W4	• X4 Connector to ECU 4 • Y39.1 to Y39.6 Injectors, engine side A • Y39.11 to Y39.16 Injectors, engine side B	
System cable W003 (power supply)	• X5 ECU 4	
System cable W004 (alternator control)	• X1 ECU 4	

C507.00.01 Overview

Engine wiring harness W2



- | | |
|--|--|
| 1 Connector X2 (to ECU 4) | 7 Sensor B6 (engine coolant temperature) |
| 2 Connection XF57 for external sensor F57 (charge air coolant level) | 8 Sensor B7 (lube oil temperature) |
| 3 Sensor B10 (charge air pressure) | 9 Sensor B5 (lube oil pressure) |
| 4 Sensor B9 (charge air temperature) | 10 Sensor B1 (camshaft speed) |
| 5 Sensor B13 (engine speed) | 11 Sensor B34 (fuel pressure after filter) |
| 6 Sensor B26 (charge air coolant temperature) | |

Engine wiring harness W3

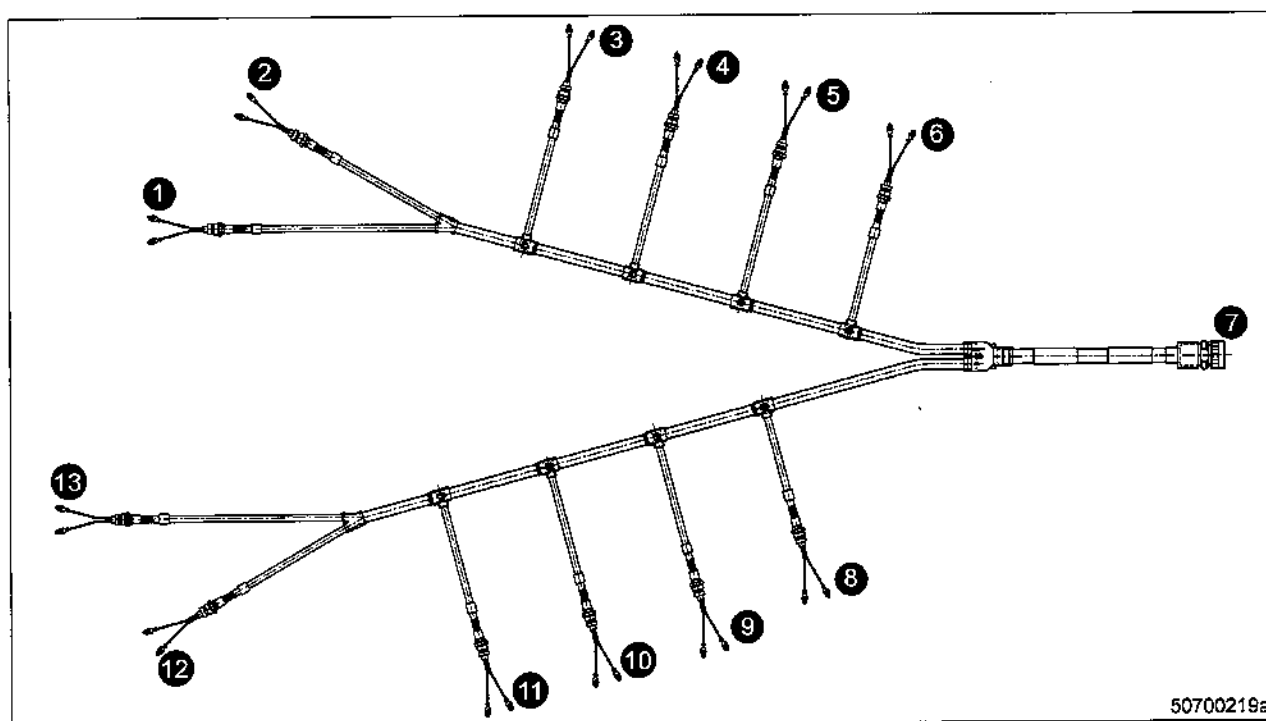
1 Connector X3 (to ECU 4)

2 Connection XF33 for external sensor F33 (engine coolant level)

3 H.P. fuel pump M8

4 Sensor B33 (fuel temperature)

5 Sensor B48 (fuel pressure after high-pressure pump)

Engine wiring harness W4

1 Injector Y39.6 (cylinder A6)

2 Injector Y39.5 (cylinder A5)

3 Injector Y39.4 (cylinder A4)

4 Injector Y39.3 (cylinder A3)

5 Injector Y39.2 (cylinder A2)

6 Injector Y39.1 (cylinder A1)

7 Connector X4 (to ECU 4)

8 Injector Y39.11 (cylinder B1)

9 Injector Y39.12 (cylinder B2)

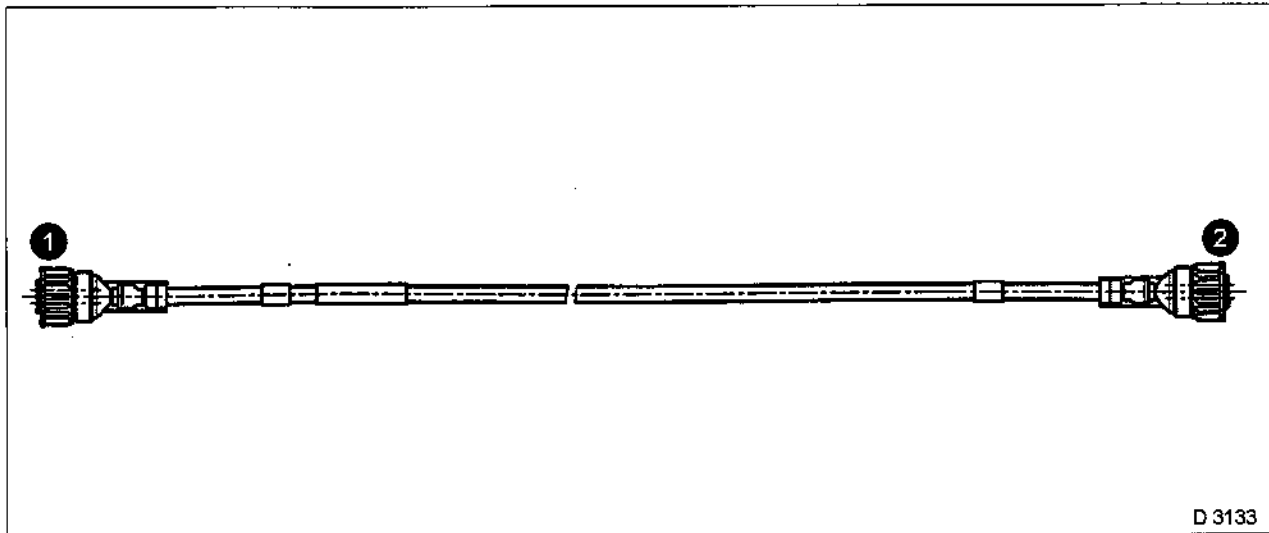
10 Injector Y39.13 (cylinder B3)

11 Injector Y39.14 (cylinder B4)

12 Injector Y39.15 (cylinder B5)

13 Injector Y39.16 (cylinder B6)

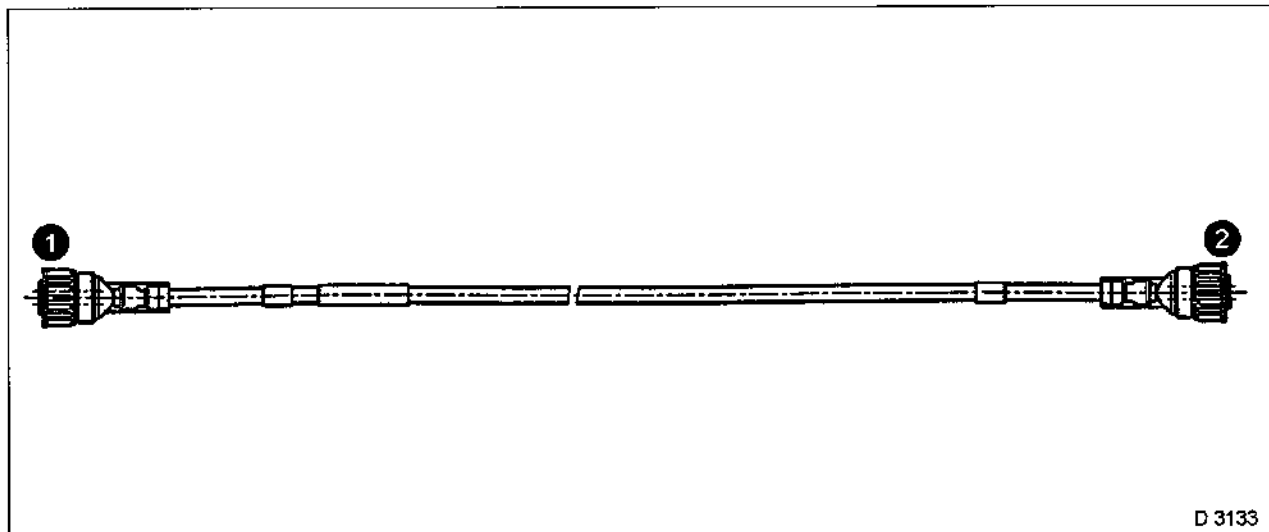
Connecting cable for external sensor F33



1 Connection on adapter XF33

2 Connection on F33 sensor

Connecting cable for external sensor F57



1 Connection on adapter XF57

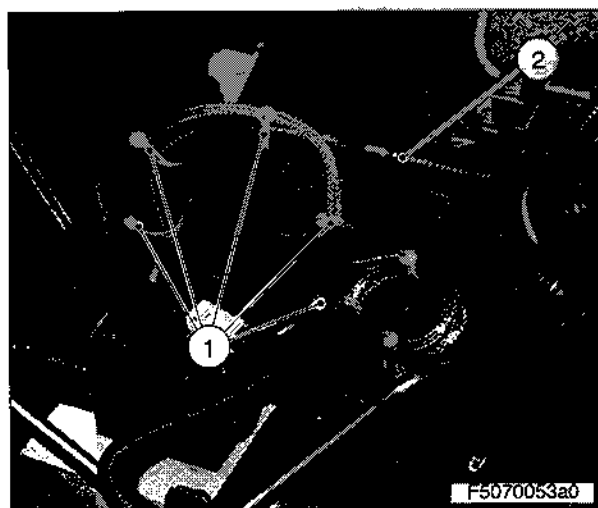
2 Connection on F57 sensor

C507.00.04 Before-removal operations**Risk of injury!**

Before work is carried out on the engine, it must be ensured that:

- the engine is shut down and the power supply switched off and secured against unauthorised switching on
- the engine, coolant, engine oil and exhaust pipework have cooled down

For the following tasks, a distinction must be made as to whether: The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed			
		Measure	See
x	-	- Remove engine	→ B 003
x	-	- Perform operations as per Disassembly Plan	→ B 004
-	-	x Disable engine start	→ Operating Instructions

C507.00.05 Removal**Removing engine wiring harnesses W2 and W3**

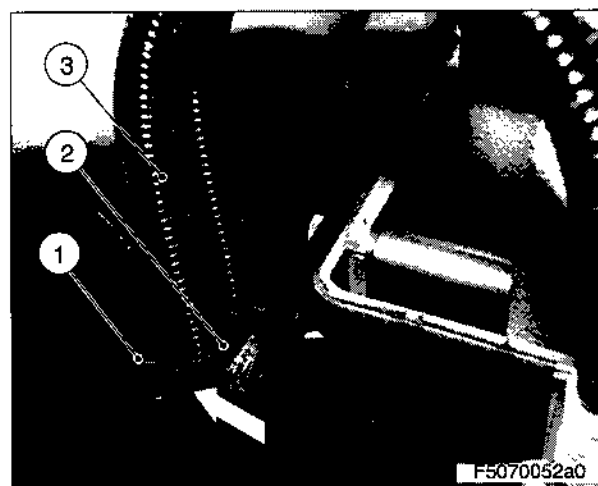
Use the lettering kit (near ECU connector) to identify wiring harness and determine wiring route.

Release bayonet connector at ECU 4 (if necessary using pliers) and withdraw.

Release plug-in connections of connected sensors or actuators and remove.

Remove cable clamps (1) which are secured to wiring harness (2) to be changed.

Note: Note position of cable clamps. The cable clamps must be installed in the position they were in prior to disassembly.

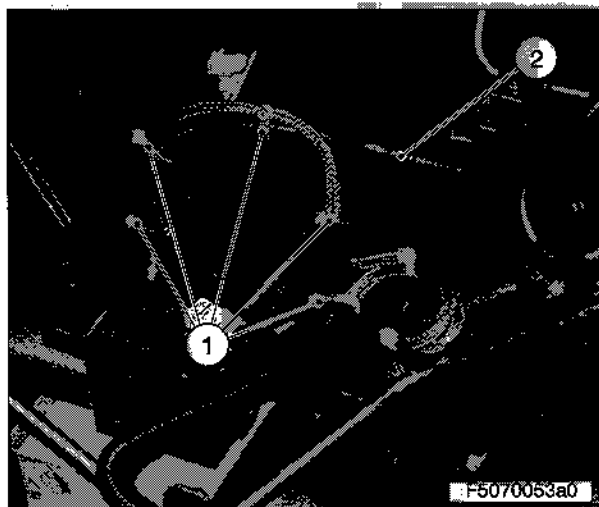


Using a screwdriver, open sealing clips (1) of all cable fasteners (2) and remove (arrow indicates application point of screwdriver).

Withdraw wiring harness (3) from all open cable fasteners.

Carefully remove wiring harness.

Removing engine wiring harness W4



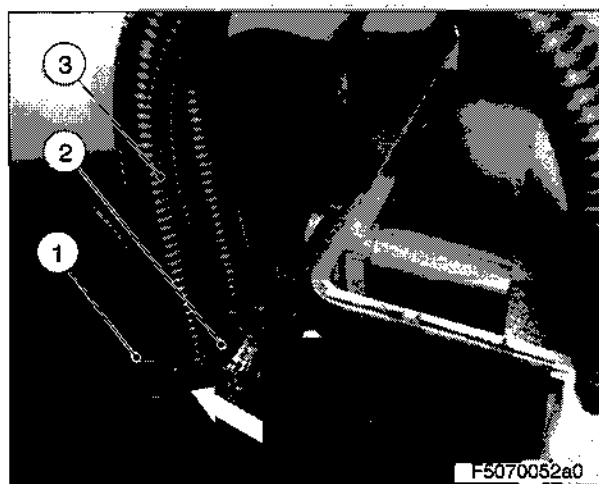
Use the lettering kit (near ECU connector) to identify wiring harness and determine wiring route.

Release bayonet connector at ECU 4 (if necessary using pliers) and withdraw.

Release plug-in connections of connected sensors or actuators and remove.

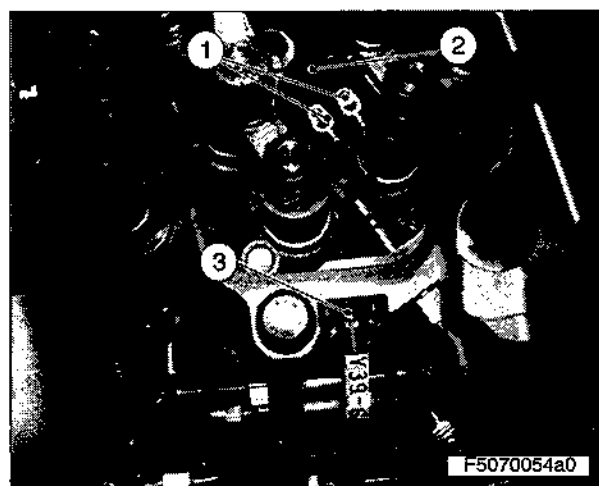
Remove cable clamps (1) which are secured to wiring harness (2) to be changed.

Note: Note position of cable clamps. The cable clamps must be installed in the position they were in prior to disassembly.



Using a screwdriver, open sealing clips (1) of all cable fasteners (2) and remove (arrow indicates application point of screwdriver).

Withdraw wiring harness (3) from all open cable fasteners.



Remove cylinder head covers

Release cable terminals (1) and withdraw from injector (2).

Release cable entry (3) and carefully withdraw connecting wires from cable entry.

Remove wiring harness.

C507.00.08 Inspection and repair

The function of these electrical subassemblies is continuously monitored by the Engine Control Unit ECU 4. Defective electrical component groups, cable breakages, short-circuits or sensor values that lie outside the plausible range are recorded by the ECU 4 and reported to the connected monitoring system.

The electrical function of the engine wiring system does not have to be examined separately in the course scheduled maintenance work.

Maintenance work therefore mainly consists of visible inspections to detect mechanical damage, loose connectors or screws. If deficiencies are found, they must be eliminated immediately.

Component group / test point	Activity
• Engine wiring	Check for: • Cracks, buckles, chafing → Repair with insulating tape or shrinkable hose if necessary → Replace complete cable if necessary → Fasten again with cable clamps if necessary • Loose cables → Fasten again with cable clamps if necessary • Damage to shrink sleeves → Replace shrink sleeve if necessary • Condition of plug contacts (only necessary if plug was not correctly connected) → Correct plug contacts or replace as required

C507.00.11 Installation

Installing engine wiring harnesses W2 and W3

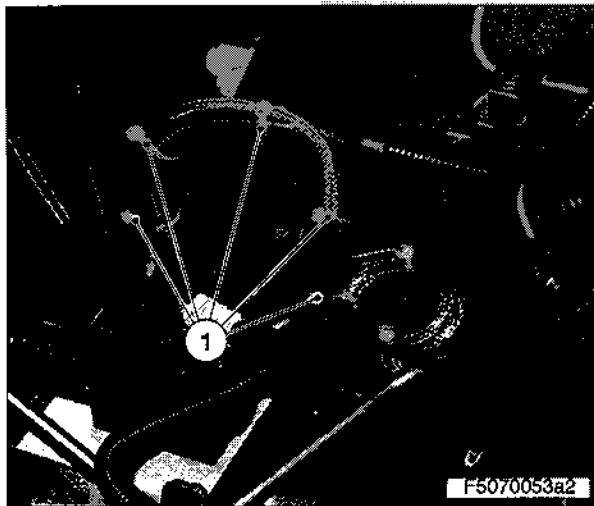


Place wiring harness (3) in position but do not yet press into cable fastener (2).

Align wiring harness so that it is free of tension and can reach the sensors and actuators to be connected.

Connect plug-in connections to sensors and actuators and tighten.

Press wiring harness into cable fasteners. Then press clips (1) firmly onto cable fasteners until they are heard to engage.



Secure cables and wiring harnesses with cable clamps (1).

Note: The cable clamps must be installed in the position they were in prior to disassembly.

Connect cable connector to ECU 4. Tighten union nut of bayonet connector first by hand and then with connector pliers until it engages firmly in position.

Note: It is not sufficient to tighten the union nut by hand. There is the risk that the lock does not properly engage and the connector may then come loose during engine operation.

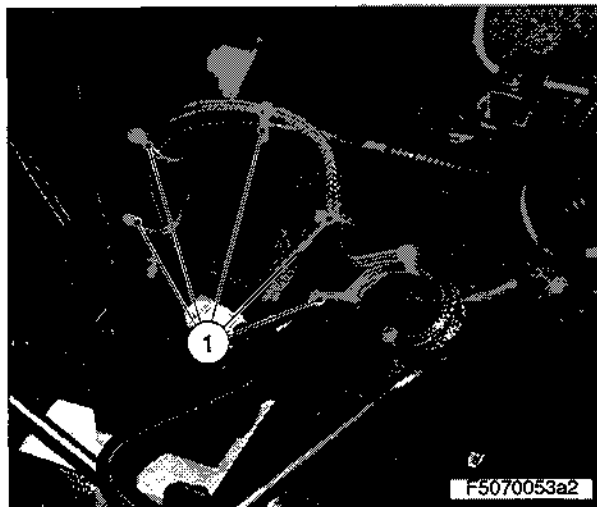
Installing engine wiring harness W4



Place wiring harness (3) in position but do not yet press into cable fasteners (2).

Align wiring harness so that it is free of tension and can reach the injectors to be connected.

Press wiring harness into cable fasteners. Then press clips (1) firmly onto cable fasteners until they are heard to engage.

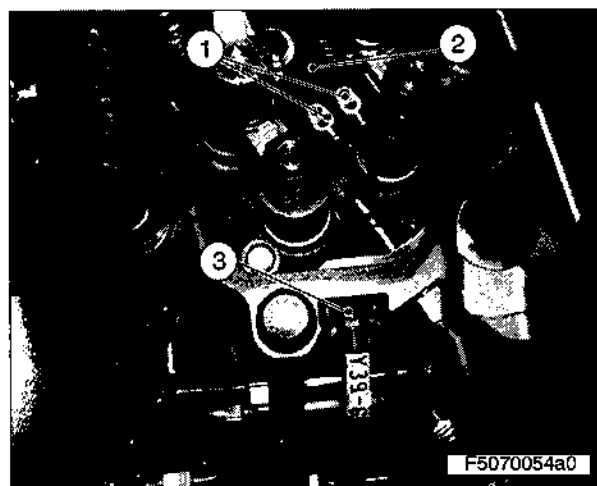


Secure cables and wiring harnesses with cable clamps (1).

Note: When installing, ensure that the new cable clamps are fitted at the same places.

Connect cable connector to ECU 4. Tighten union nut of bayonet connector first by hand and then with connector pliers until it engages firmly in position.

Note: It is not sufficient to tighten the union nut by hand. There is the risk that the lock does not properly engage and the connector may then come loose during engine operation.



Insert the connecting wires carefully into the cable entries (3) and connect the cable terminals (1) to the injector (2).

Installing cylinder head cover

C507.00.12 After-installation operations

Note: Before the engine is restarted, the regulations and operating sequences as stated in the operating instructions must be observed.

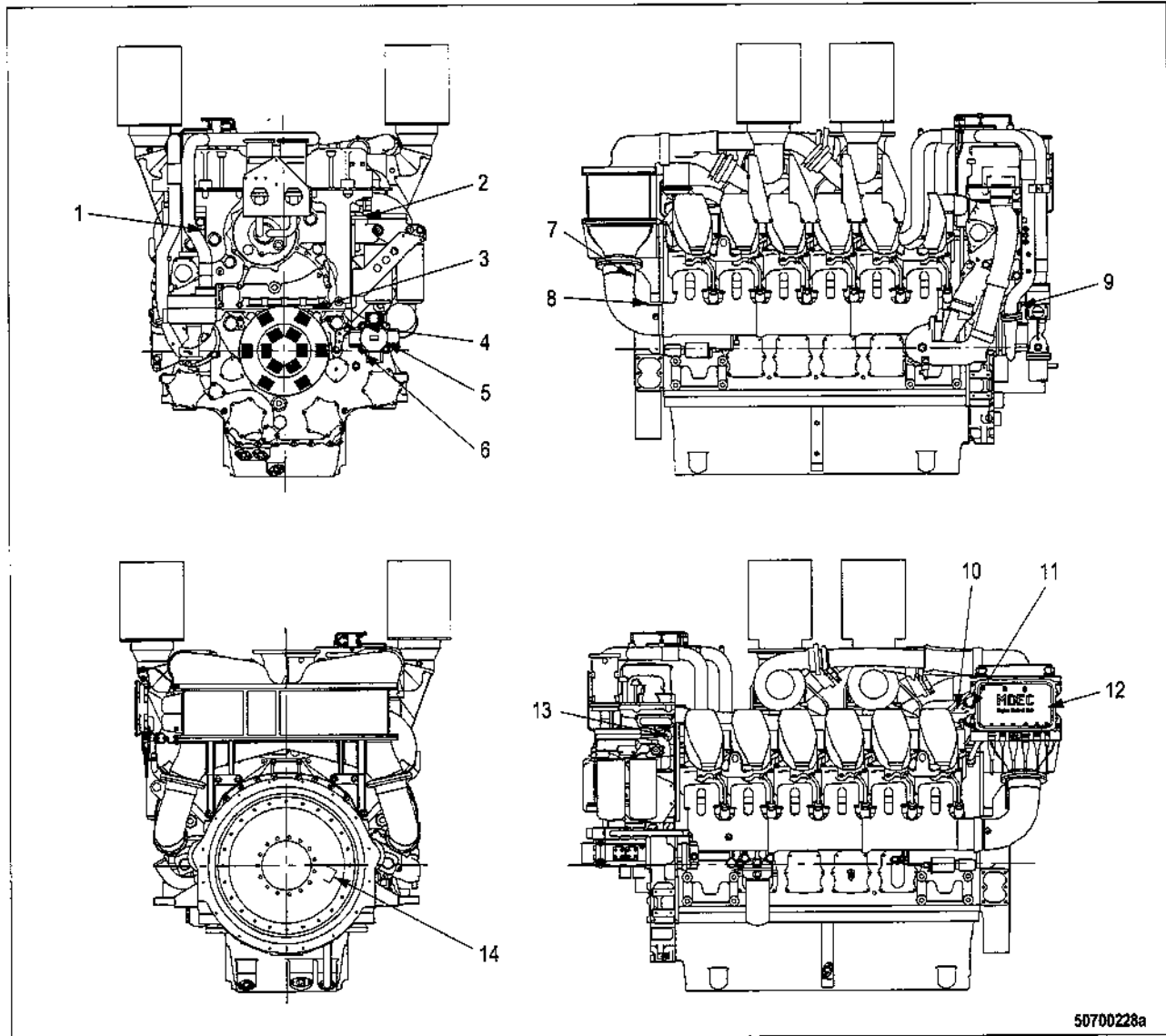
				Measure	See
x	-	-	-	Perform operations as per Assembly Plan	→ B 005
x	-	-	-	Install engine	→ B 007
-	-	-	x	Release engine start	→ Operating Instructions

Maintenance and repair work must be checked to ensure it has been carried out in a professional manner.

The following final checks must be carried out according to the services carried out:

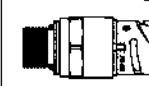
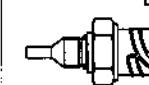
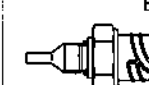
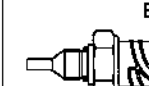
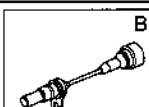
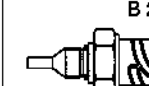
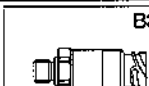
- Check security and perfect seating of all wiring harnesses and sensors
- Check sensor threaded fittings for leak-tightness
- Check security and perfect seating of all plug-in connections
- If necessary, sensor connecting lines must be rolled out to correct length and secured by cable clamps.
- The engine wiring must be secured such that, with respect to vibrations, it forms a unit with the respective subassembly. In the case of vibrations and oscillations, relative motion must not occur between connector and cable.

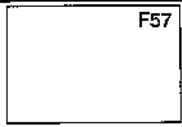
Note: When the Engine Control Unit ECU 4 is switched on, the operation of the electrical component groups is checked and continuously monitored. Defective or incorrectly connected electrical component groups, cable breakages, short-circuits or sensor values that lie outside the plausible range are recorded by the ECU 4 and reported to the connected monitoring system.

C507.98 Sensors and actuators**C507.98.01 Overview****Sensors and actuators**

50700228a

- | | |
|---|--|
| 1 Sensor B6 (engine coolant temperature) | 8 Sensor B9 (charge air temperature) |
| 2 Sensor B5 (lube oil pressure) | 9 Sensor B26 (charge air coolant temperature) |
| 3 Sensor B1 (camshaft speed) | 10 Connection for external sensor F57 (charge air coolant level) |
| 4 Sensor B34 (fuel pressure after filter) | 11 Connection for external sensor F33 (engine coolant level) |
| 5 Sensor B33 (fuel temperature) | 12 Engine Control Unit ECU 4 |
| 6 Sensor B48 (fuel pressure after high-pressure pump) | 13 Sensor B7 (lube oil temperature) |
| 7 Sensor B10 (charge air pressure) | 14 Sensor B13 (crankshaft speed) |

Sensor	Model	Operation	Tightening torque
 B1	Speed sensor	Camshaft speed	—
 B5	Pressure sensor	Lube oil pressure	20 Nm ... 45 Nm
 B6	Temperature sensor Pt1000	Engine coolant temperature	15 Nm ... 30 Nm
 B7	Temperature sensor Pt1000	Lube oil temperature	15 Nm ... 30 Nm
 B9	Temperature sensor Pt1000	Charge air temperature	15 Nm ... 30 Nm
 B10	Pressure sensor	Charge air pressure	20 Nm ... 70 Nm
 B13	Speed sensor	Engine speed	—
 B 26	Temperature sensor Pt1000	Charge air coolant temperature	15 Nm ... 30 Nm
 B33	Temperature sensor Pt1000	Fuel temperature	15 Nm ... 30 Nm
 B34	Pressure sensor	Fuel pressure after filter	20 Nm ($\pm$ 3 Nm)
 B48	Pressure sensor	Fuel high pressure	30 Nm ($\pm$ 3 Nm)
 F33	Level monitor	Coolant level (external sensor)	—

Sensor	Model	Operation	Tightening torque
 F57	Level monitor	Water in fuel prefilter (external sensor)	—
 M 8	Actuator	Intake restrictor actuator of high-pressure pump	—

C507.98.04 Before-removal operations**Risk of injury!**

Before work is carried out on the engine, it must be ensured that:

- the engine is shut down and the power supply switched off and secured against unauthorised switching on
- the engine and exhaust system have cooled down

**Poisoning hazard from engine oil!**

Engine oil can contain combustion residues which are harmful to health.

Oil vapours must therefore not be inhaled. Direct skin contact must be prevented by means of suitable protective measures (e.g. protective gloves, safety mask).

**Risk of injury!**

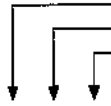
During engine operation, the engine oil and coolant may become very hot and highly pressurised.

Work on the engine must therefore only be carried out when the oil and coolant are cooled and not pressurised.

**Risk of fire and explosion!**

Fuels are combustible. Therefore, when working on the fuel system all open flames and sparks must be avoided.

The safety regulations for the use of combustible materials must be observed.

			For the following tasks, a distinction must be made as to whether:	
			Measure	See
x	—	—	Remove engine	→ B 003
x	—	—	Perform operations as per Disassembly Plan	→ B 004
—	—	x	Disable engine start	→ Operating Instructions
—	—	x	Drain engine coolant (only for removal of coolant sensors)	→ Operating Instructions

C507.98.05 Removal

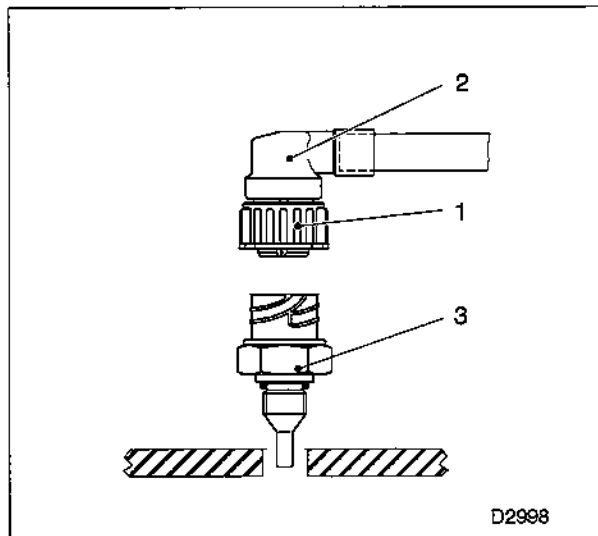
Removing temperature sensors (B6, B7, B9, B26, B33)

The sensors are identical with regard to design and electrical system. Removal of the sensors is identical.

The arrangement and position of the sensors is shown in the section "C507.98.01 Overview".

For the sensors listed, the following must be noted before removal:

- **Sensor B6 (engine coolant temperature)**
Before removal of sensor B6, the coolant must be drained and refilled after installation. The necessary procedure and the safety instructions to be followed are described in the operating instructions, section "Engine coolant changing".
- **Sensor B (lube oil temperature)**
When sensor B7 is removed, small quantities of engine oil may emerge. Measures must be taken to collect this engine oil (e.g. suitable containers must be provided).
- **Sensor B26 (charge air coolant temperature)**
Before removal of sensor B26 the coolant must be drained and refilled after installation. The necessary procedure and the safety instructions to be followed are described in the operating instructions, section "Charge air coolant changing".
- **Sensor B33 (fuel temperature)**
When sensor B33 is removed, small quantities of fuel may emerge. Measures must be taken to collect this fuel (e.g. suitable containers must be provided).



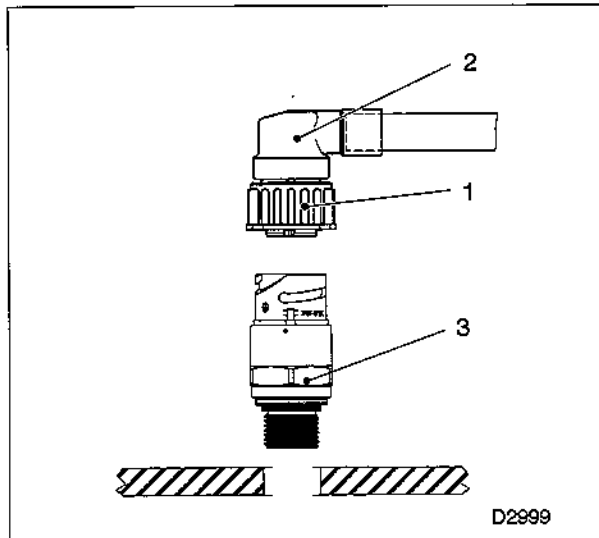
Release bayonet lock (1) and withdraw connector (2).
Place wrench on nut (3) and unscrew sensor.

Removing pressure sensors (B5, B10)

The sensors are identical with regard to design and electrical system. Removal of the sensors is identical.

The arrangement and position of the sensors is shown in the section "C507.98.01 Overview".

When sensor B5 is removed (lube oil pressure), small quantities of engine oil may emerge. Measures must be taken to collect this engine oil (e.g. suitable containers must be provided).

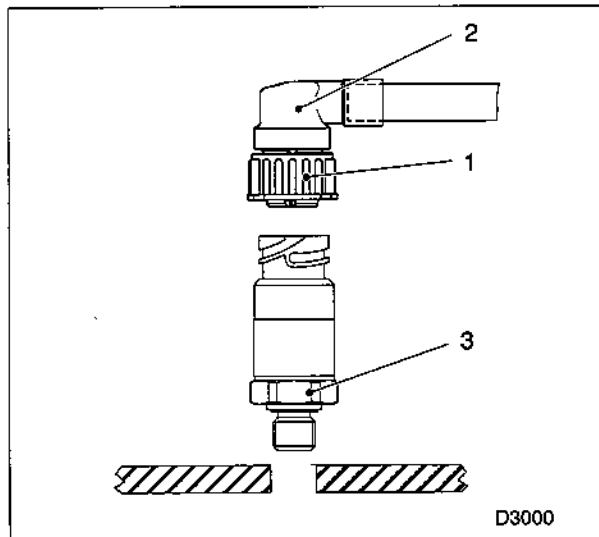


Release bayonet lock (1) and withdraw connector (2).
Place wrench on nut (3) and unscrew sensor.

Removing pressure sensor (B34)

The arrangement and position of the sensor is shown in the section "C507.98.01 Overview".

When sensor B34 is removed (fuel pressure after filter), small quantities of fuel may emerge. Measures must be taken to collect this fuel (e.g. suitable containers must be provided).

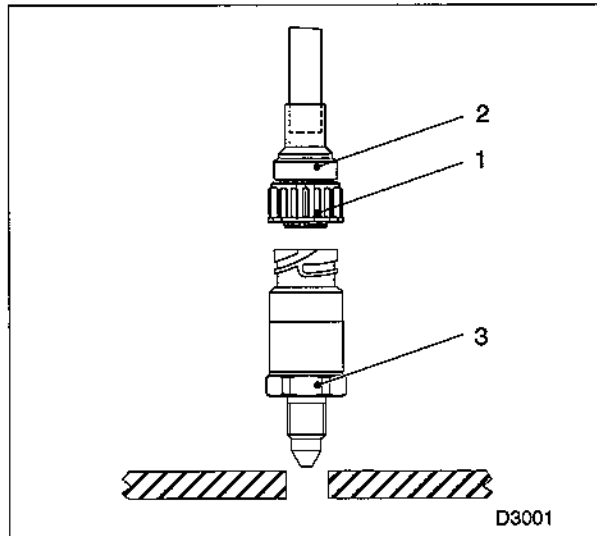


Release bayonet lock (1) and withdraw connector (2).
Place wrench on nut (3) and unscrew sensor.

Removing pressure sensor (B48)

The arrangement and position of the sensor is shown in the section "C507.98.01 Overview".

When sensor B48 is removed (H.P. fuel pressure), small quantities of fuel may emerge. Measures must be taken to collect this fuel (e.g. suitable containers must be provided).

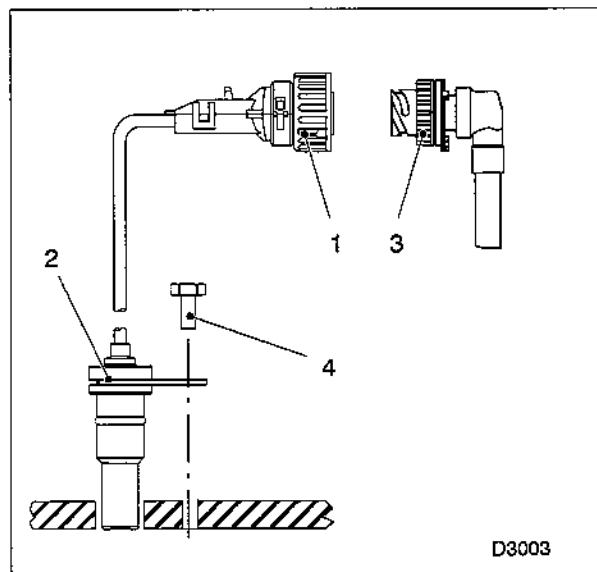


Release bayonet lock (1) and withdraw connector (2).
Place wrench on nut (3) and unscrew sensor.

Removing speed sensors (B1, B13)

The sensors are identical with regard to design and electrical system. Removal of the sensors is identical.

The arrangement and position of the sensors is shown in the section "C507.98.01 Overview".



Release bayonet catch (1) of speed sensor (2) and remove connector (3) from engine wiring system.
Release and remove screw (4).
Carefully withdraw speed sensor (2).

C507.98.08 Inspection and repair

The sensors and actuators installed on the engine are largely maintenance-free and have a long service life.

The function of these electrical subassemblies is continuously monitored by the Engine Control Unit ECU 4. Defective electrical component groups, cable breakages, short-circuits or sensor values that lie outside the plausible range are recorded by the ECU 4 and reported to the connected monitoring system.

The electrical function of the sensors and actuators does not have to be examined separately in the course of scheduled maintenance work.

Maintenance work therefore mainly consists of visible inspections to detect mechanical damage, loose connectors or screws. If deficiencies are found, they must be eliminated immediately.

Component group / test point	Activity
• Installed sensors and actuators	Check for: • Security in installation position → Retighten securing screws if necessary • Security of connectors → Insert connectors properly and tighten if necessary • Mechanical damage which could impair operation → Replace affected subassembly immediately
• Removed sensors and actuators	Check for: • Mechanical damage which could impair operation → Replace affected subassembly immediately. • Contamination (e.g. oil sludge) which could lead to impairment of operation → Clean affected assembly with isopropyl alcohol

C507.98.11 Installation

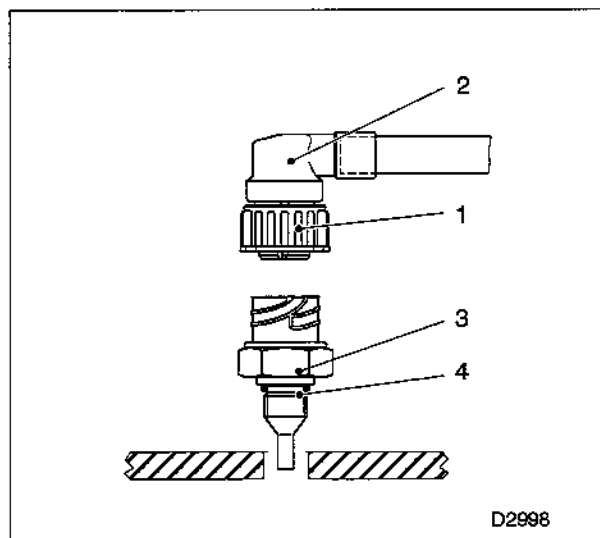
Installing temperature sensors (B6, B7, B9, B26, B33)

The sensors are identical with regard to design and electrical system. Removal of the sensors is identical.

The arrangement and position of the sensors is shown in the section "C507.98.01 Overview".

For the sensors listed, the following must be noted before removal:

- **Sensor B6 (engine coolant temperature)**
Before removal of sensor B6, the coolant must be drained and refilled after installation. The necessary procedure and the safety instructions to be followed are described in the operating instructions, section "Engine coolant changing".
- **Sensor B (lube oil temperature)**
When sensor B7 is removed, small quantities of engine oil may emerge. Measures must be taken to collect this engine oil (e.g. suitable containers must be provided).
- **Sensor B26 (charge air coolant temperature)**
Before removal of sensor B26 the coolant must be drained and refilled after installation. The necessary procedure and the safety instructions to be followed are described in the operating instructions, section "Charge air coolant changing".
- **Sensor B33 (fuel temperature)**
When sensor B33 is removed, small quantities of fuel may emerge. Measures must be taken to collect this fuel (e.g. suitable containers must be provided).



Coat O-ring (4) of sensor with petroleum jelly.

Insert sensor in bore and screw in by hand.

Place wrench on nut (3) and tighten sensor.

(The tightening torque is 15 Nm ... 30 Nm.

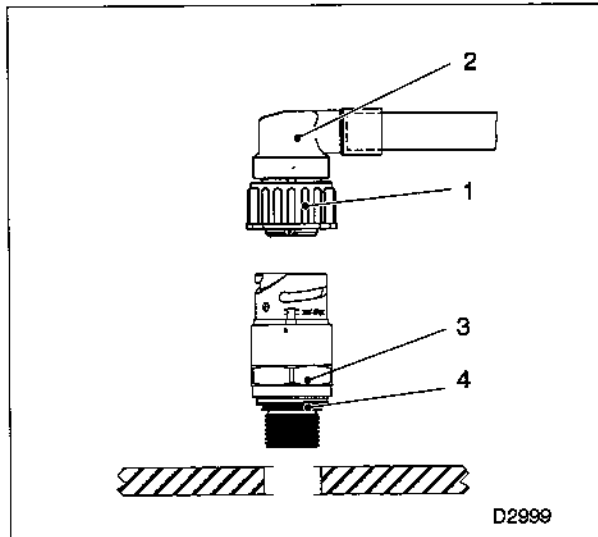
Fit connector (2) and tighten bayonet catch (1).

Note: After installation, sensor threaded fitting must be checked for leaks. In event of leaks, check the tightening torque or replace gasket.

Installing pressure sensors (B5, B10)

The sensors are identical with regard to design and electrical system. Installation of the sensors is identical.

The arrangement and position of the sensors is shown in the section "C507.98.01 Overview".



Coat O-ring (4) of sensor with petroleum jelly.

Insert sensor in bore and screw in by hand.

Place wrench on nut (3) and tighten sensor.

The tightening torques of the sensors is:

B5 = 20 Nm ... 45 Nm

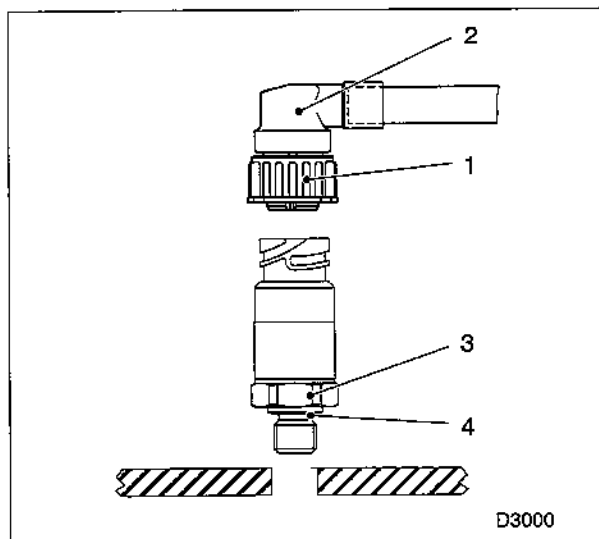
B10 = 20 Nm ... 70 Nm.

Fit connector (2) and tighten bayonet catch (1).

Note: After installation, sensor threaded fitting must be checked for leaks. In event of leaks, check the tightening torque or replace gasket.

Removing pressure sensor (B34)

The arrangement and position of the sensor is shown in the section "C507.98.01 Overview".



Coat O-ring (4) of sensor with petroleum jelly.

Insert sensor in bore and screw in by hand.

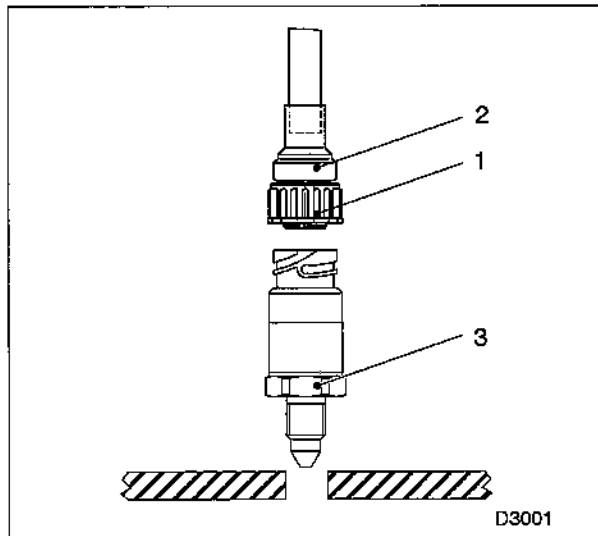
Place wrench on nut (3) and tighten sensor. The tightening torque of the sensor is 20 Nm (± 3 Nm).

Fit connector (2) and tighten bayonet catch (1).

Note: After installation, sensor threaded fitting must be checked for leaks. In event of leaks, check the tightening torque or replace gasket.

Installing pressure sensor (B48)

The arrangement and position of the sensor is shown in the section "C507.98.01 Overview".



Insert sensor in bore and screw in by hand.

Place wrench on nut (3) and tighten sensor. The tightening torque of the sensor is 30 Nm (± 3 Nm).

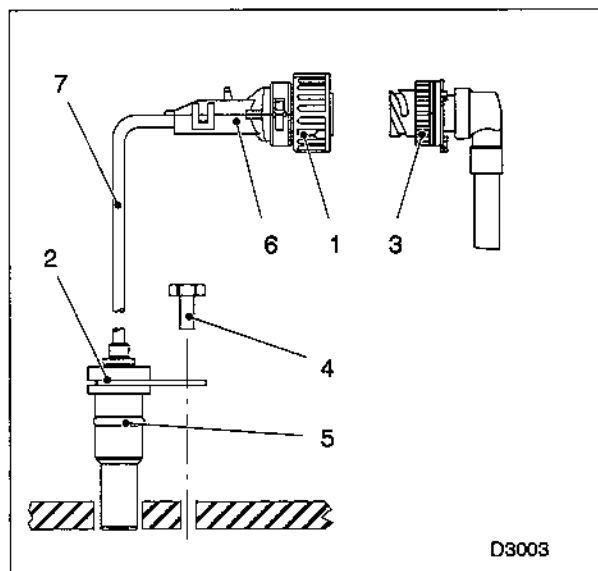
Fit connector (2) and tighten bayonet catch (1).

Note: After installation, sensor threaded fitting must be checked for leaks. In event of leaks, check the tightening torque or replace gasket.

Installing speed sensors (B1, B13)

The sensors are identical with regard to design and electrical system. Installation of the sensors is identical.

The arrangement and position of the sensors is shown in the section "C507.98.01 Overview".



Coat O-ring (5) of sensor with petroleum jelly.

Fit sensor in bore and press in firmly.

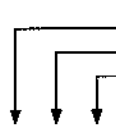
Locate sensor (2) with screw (5) and tighten screw.

Plug connector of speed sensor (6) into bush (3) of engine wiring system and tighten bayonet lock (1) firmly.

Note: If necessary, sensor cable (7) must be rolled out to correct length and secured by cable clamps.

C507.98.12 After-installation operations

Note: Before the engine is restarted, the regulations and operating sequences as stated in the operating instructions must be observed.

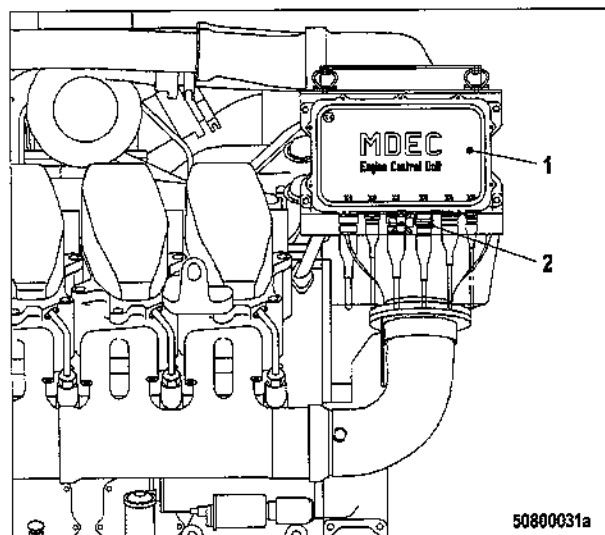
 For the following tasks, a distinction must be made as to whether: The engine was completely disassembled The engine is removed but was not disassembled The engine is installed				Measure	See
x	–	–		Perform operations as per Assembly Plan	→ B 005
x	–	–		Install engine	→ B 007
–	–	x		Fill engine coolant system	→ Operating Instructions
–	–	x		Release engine start	→ Operating Instructions

Maintenance and repair work must be checked to ensure it has been carried out in a professional manner.

The following final checks must be carried out according to the services carried out:

- Check security and perfect seating of all wiring harnesses and sensors
- Check sensor threaded fittings for leak-tightness
- Check security and perfect seating of all plug-in connections
- If necessary, sensor connecting lines must be rolled out to correct length and secured by cable clamps.
- The engine wiring must be secured such that, with respect to vibrations, it forms a unit with the respective sub-assembly. In the case of vibrations and oscillations, relative motion must not occur between connector and cable.

Note: When the Engine Control Unit ECU 4 is switched on, the operation of the electrical component groups is checked and continuously monitored. Defective or incorrectly connected electrical component groups, cable breakages, short-circuits or sensor values that lie outside the plausible range are recorded by the ECU 4 and reported to the connected monitoring system.

C508.95 Electronic control system – ECU 4**C508.95.01 Overview****Electronic governor ECU 4**

- 1 Governor, ECU 4
2 Engine wiring connections

C508.95.04 Before-removal operations**Risk of injury!**

Before work is carried out on the engine, it must be ensured that:

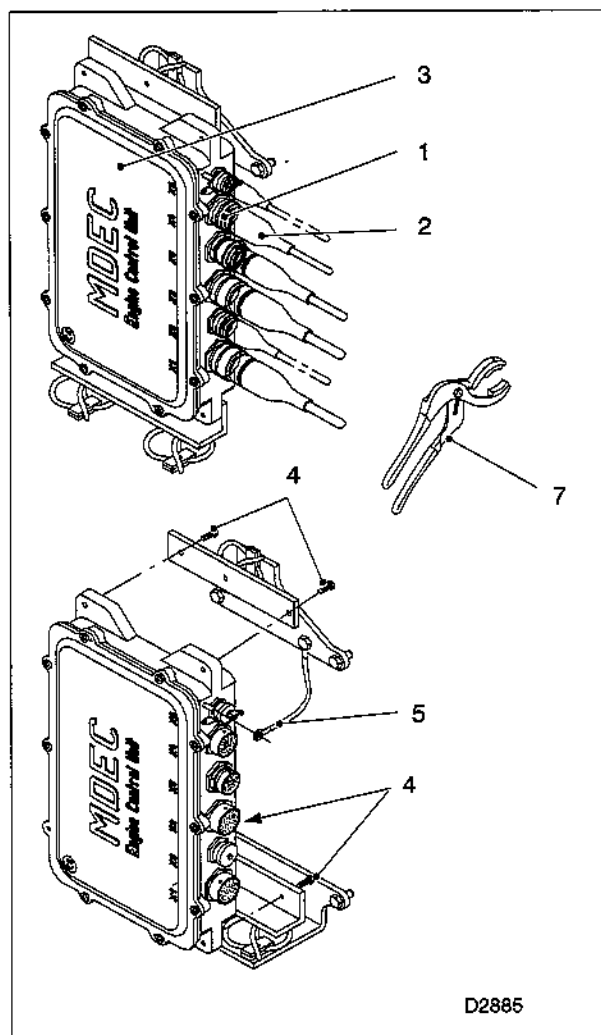
- the engine is shut down and the power supply switched off and secured against unauthorised switching on
- the engine and exhaust system have cooled down

For the following tasks, a distinction must be made as to whether:				Measure	See
The engine is to be completely disassembled The engine is to be removed but not disassembled The engine is to remain installed					
x	-	-	Remove engine		→ B 003
x	-	-	Perform operations as per Disassembly Plan		→ B 004
-	-	x	Disable engine start		→ Operating Instructions

C508.95.05 Removal

The arrangement and position of the ECU 4 is shown in section "C508.95.01 Overview".

Removing ECU 4



Release all union nuts (1) of bayonet connector and remove all connectors (2) from the ECU 4 (3).

Note: The union nuts can be easily released with connector pliers (7).

Seal all open connecting sockets of the ECU 4 and all engine wiring connectors with dust caps.

Unscrew ground lead (5) from the ECU 4.

Release the four securing screws (M6 x 60) (4) for the ECU 4 and remove the ECU 4.

Note: The ECU 4 weighs approx. 7 kg.

Inside the ECU 4 there are two data modules (MEM) on which engine- and plant-specific software is stored.

When changing ECU 4, these data modules must be taken over into the new ECU 4. The procedure is described in the Electronics Documentation.

C508.95.08 Inspection and repair

The Engine Control Unit ECU 4 is almost completely maintenance-free and has a long service life.

The function of the Engine Control Unit ECU 4 is continuously checked by an integrated monitoring and test system. Deviations from target state are indicated on the ECU 4 display or on the connected monitoring system. For this reason, the function does not require separate examination in the framework of scheduled maintenance work.

Maintenance work therefore mainly consists of visible inspections to detect mechanical damage, loose connectors or screws. If deficiencies are found, they must be eliminated immediately.

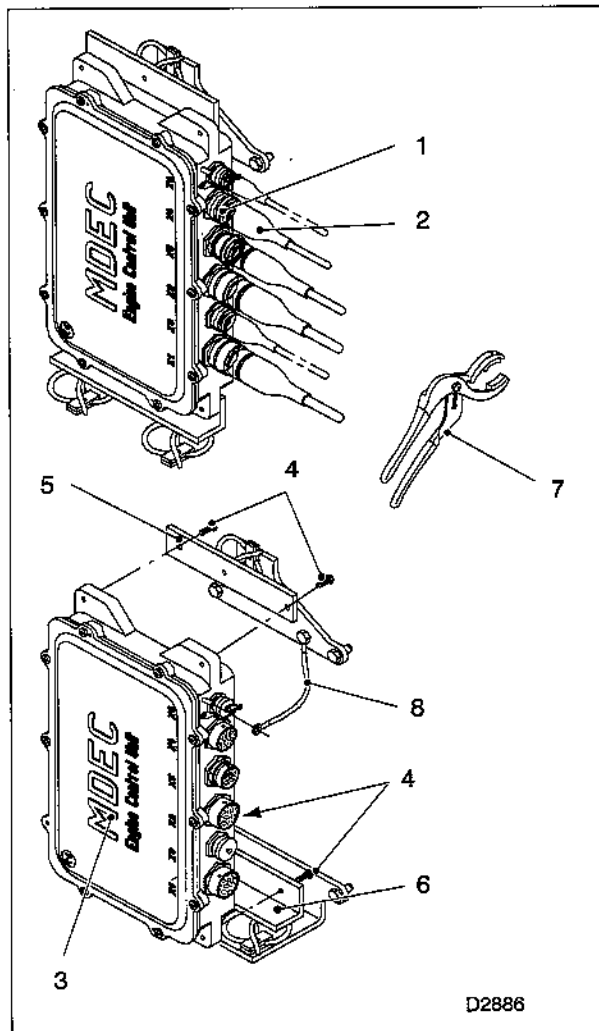
Note: Inside the ECU 4 there are two data modules (MEM) on which engine- and plant-specific software is stored. When changing ECU 4, these data modules must be taken over into the new ECU 4. The procedure is described in the Electronics Documentation.

Component group / test point	Activity
With ECU 4 installed	Check for: - Security in installation position → Retighten securing screws if necessary - Security of connectors → Insert connectors properly and tighten if necessary - Mechanical damage which could impair operation → Replace affected subassembly immediately
With ECU 4 removed	Check for: - Mechanical damage or contamination of connecting sockets (only necessary if a connector of engine wiring system has become loose during engine operation!) → Clean connectors, contacts and connector bushes with isopropyl alcohol as necessary. → Replace ECU 4 if necessary - Contamination of housing (e.g. oil sludge) → Clean housing of ECU 4 with isopropyl alcohol

C508.95.11 Installation

The arrangement and position of the ECU 4 is shown in section "C508.95.01 Overview".

Installing ECU 4



Inside the ECU 4 there are two data modules (MEM) on which engine- and plant-specific software is stored.

If the ECU 4 was replaced, the data modules from the old ECU 4 must be incorporated in the new ECU 4.

The procedure is described in the Electronics Documentation.

Place the ECU 4 (3) on the adapter plates (plate (5) and bracket (6)).

Note: The ECU 4 weighs approx. 7 kg.

Secure the ECU 4 with the four securing screw (M6 x 60) (4) and screw in securely. Tightening torque is 4 Nm.

Screw ground lead (8) onto the ECU 4.

Connect engine wiring connector (2) to corresponding connecting sockets of ECU 4.

Note: To avoid confusion when reconnecting, the connecting sockets of the ECU 4 and engine cables are clearly marked.

Tighten union nut (1) of bayonet connector first by hand and then with connector pliers (7) until engages firmly in position.

Note: It is not sufficient to tighten the union nut by hand. There is the risk that the lock does not properly engage and the connector may then come loose during engine operation. Pliers must therefore be used to tighten the union nuts.

C508.95.12 After-installation operations

Note: Before the engine is restarted, the regulations and operating sequences as stated in the operating instructions must be observed.

For the following tasks, a distinction must be made as to whether: The engine was completely disassembled The engine is removed but was not disassembled The engine is installed			Measure	See
x	–	–	Perform operations as per Assembly Plan	→ B 005
x	–	–	Install engine	→ B 007
–	–	x	Release engine start	→ Operating Instructions

Maintenance and repair work must be checked to ensure it has been carried out in a professional manner.

The following final checks must be carried out according to the services carried out:

- Check security and perfect seating ECU 4
- Check security and perfect seating of all plug-in connections
- The engine wiring must be secured such that, with respect to vibrations, it forms a unit with the respective subassembly. In the case of vibrations and oscillations, relative motion must not occur between connector and cable.

Note: When the Engine Control Unit ECU 4 is switched on, operation is checked by an integrated monitoring and test system. Deviations from target state are indicated on the ECU 4 display or on the connected monitoring system.

