

Service and repair manual

Service Level 2
(Original Service and repair manual)

Diesel engine

KD36V16

From serial number 2017 17 0001

Diesel engine

KD45V20

From serial number 2017 18 0001

KOHLER®

en
33525088301_7_1
03-2021

Only for the United States of America:

WARNING

This product can expose you to chemicals, including carbon monoxide and benzene, which are known to the State of California to cause cancer.

For more information go to
www.P65Warnings.ca.gov

WARNING

This product can expose you to chemicals, including carbon monoxide and benzene, which are known to the State of California to cause birth defects or other reproductive harm.

For more information go to
www.P65Warnings.ca.gov

WARNING

Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

- Always start and operate the engine in a well-ventilated area.
- If in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information go to
www.P65warnings.ca.gov/diesel

List of changes

Version	From serial number	Comment	Date
33525088401_1_1	2017 18 0001	First version	December 2016
33525088401_2_1	2017 18 0001	Small amendments	April 2017
33525088401_3_1	2017 17 0001 2017 18 0001	KD36V16 integrated	December 2017
33525088401_4_1	2017 17 0001 2017 18 0001	Work descriptions for KD36V16 added	February 2018
33525088401_5_1	2017 17 0001 2017 18 0001	California Proposition 65	August 2018
33525088401_6_1	2017 17 0001 2017 18 0001	Manual is now also valid for Tier 4 (provisional). Reference to Tenneco manual added. Cleaning agents, locking agents and greases chapter revised.	January 2021
33525088401_7_1	2017 17 0001 2017 18 0001	List of sales agencies revised. Chapter 2.3.3 revised. Rail fastening screws tightening torque changed. Tightening torque for new high pressure lines/injection pipes added.	March 2021

		<p>Tightening torque for cable on injector changed. Checking and setting the valve clearance work description adjusted. Mounting bolt [0528470] replaced with [13445716]. Assembly tool [11171015] deleted. Designation of angle of rotation device [10023839] changed. Loctite 5910 replaced with Loctite SI 5990. Fuel diagram for engine KD45V20 Tier4 added. Coolant diagram for Tier4 added. Removing, installing the pressure pipe socket and injector for Tier4 added. Work descriptions adjusted.</p>	
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Valid is always the last published documentation, according to the serial number of the engine, see [29](#).

Preface



Information

Procedure for maintenance work on the exhaust aftertreatment system.

- See service manual from Tenneco (document part number: 82621307).
-

The service and repair manual has been written for technicians and operators of the product:

The service and repair manual contains the following information:

- Safety regulations
- Instructions for mounting and removal instructions for spare parts.
- Information on functions.

The service and repair manual is to be carefully read and applied before the first commissioning and later at regular time intervals by each person who is assigned to work with / on the diesel engine.

This facilitates familiarization with the diesel engine for the operator and prevents malfunctions due to improper handling.

Kohler Co. will not accept any warranty claims that arise due to improper handling, insufficient maintenance, use of unapproved fuel and operating fluids, or failure to observe the safety regulations.

Kohler Co. will cancel all possible obligations undertaken by Kohler Co. and/or its dealers, such as guarantee commitments, service agreements etc., without prior notice if parts other than original Kohler Co. parts or spare parts purchased from Kohler Co. are used for maintenance and repair.

Under extreme conditions, more frequent maintenance than scheduled in the maintenance and inspection schedule can be required.

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For further information, contact your nearest authorized Kohler customer service.

Service

For professional advice regarding performance requirements for power generators and conscientious service, please contact your nearest Kohler retailer or distributor.

- Visit the Kohler Co. website at KOHLERPower.com.
- Observe the tags and signs on your Kohler product, or read the appropriate literature or documents included in the scope of delivery of the product.
- In the U.S. and Canada, use the toll-free number 1-800-544-2444.
- Outside the U.S. and Canada, contact the nearest regional agency.

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To order special tools, use the order list in the appendix, see [176](#).

For KOHLER-SDMO power generators:

- Visit the website of KOHLER-SDMO at www.kohlersdmo.com.
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1 Safety

1.1 Safety instructions

The safety instructions are divided into the following four danger levels:



DANGER

Identifies an immediately dangerous situation that will result in death or serious bodily injuries if it is not avoided.



WARNING

Identifies an immediately dangerous situation that could result in death or serious bodily injuries if it is not avoided.



CAUTION

Identifies a dangerous situation that could result in minor or moderate bodily injuries if it is not avoided.

NOTE

Identifies a dangerous situation that can result in property damage if it is not avoided.

1.2 Target group

Preventive maintenance			Corrective maintenance
SL1 maintenance	SL2 maintenance (Content of this service manual and repair instructions)	SL3 maintenance	
Example: Refill oil or fuel .	Maintenance work that involves a partial dismantling of the engine on site (service at half of the service life). For example: Pump replacement.	Maintenance work requiring the complete dismantling of the engine and a test system.	Repair activities as well as component exchange, necessary to rectify defects or malfunctions that require components and manpower
By the customer or nearest authorized Kohler customer service.	By authorized customer employees or nearest authorized Kohler customer service.	By authorized customer employees or nearest authorized Kohler customer service.	By authorized customer employees or nearest authorized Kohler customer service.

Information

The manufacturer of the machine is responsible for:



- Checking the know-how and skills of personnel
- Defining the necessary additional, refresher, and further training
- Defining the responsibilities and authorizations
- Applying ILO-"C138 - Minimum Age Convention, 1973", with a minimum age for the work permit of 14 years
- Providing the necessary tools and spare parts.

1.2.1 International Standard Classification of Occupations

According to the International Standard Classification of Occupations ([ISCO-08](#)) of the International Labor Organization (ILO), the following occupational groups are listed as references to define the target groups, occupations and joint tasks.

1.2.2 Occupational references

The occupations listed perform the following work in accordance with the "General safety instructions" chapter:

- the main tasks described in this manual or these instructions
- the tasks identified as requirements to prepare the main tasks

For the SL1 maintenance of power generation engines: Maintenance personnel

In relation to ILO – Power Plant or Industrial Machinery Mechanics – unit group 7233 / ISCED-97 level 2).

The tasks on engines, machines as well as mechanical and electronic equipment include:

- Operating the machine and equipment.
- Performing scheduled maintenance work.
- Assembly, installation, assessment, adjustment, testing and maintenance.
- Locating defects.
- Recording the repair and maintenance work performed.

For the SL2 maintenance of power generation engines: Technician

In relation to ILO – Power Plant or Industrial Machinery Mechanics – unit group 7233 / ISCED-97 on at least a level of 3 to 4.

The tasks on engines, machines as well as mechanical and electronic equipment include:

- Operating the machine and equipment.
- Performing scheduled maintenance work.
- Assembly, installation, assessment, adjustment, testing and maintenance.
- Locating and diagnosing errors.
- Dismantling and reassembly of the machine as well as the mechanical and electronic equipment.
- Ensuring compliance with standards and specifications.
- Recording the repair and maintenance work performed.

For the SL3 maintenance of power generation engines: Mechanical technician

In relation to ILO – Power Plant or Industrial Machinery Mechanics – unit group 7233 / ISCED-97 on at least a level of 3 to 4.

The tasks on engines, machines as well as mechanical and electronic equipment include:

- Operating the machine and equipment.
- Performing scheduled maintenance work.
- Assembly, installation, assessment, adjustment, testing and maintenance.
- Locating and diagnosing errors.
- Dismantling and reassembly of the machine as well as the mechanical and electronic equipment.
- Replacement of complete engines or components.
- Repair of mechanical, hydraulic and electronic equipment.
- Checking the acceptability of repair work.
- Examination and testing of new machines and equipment.
- Ensuring compliance with standards and specifications.
- Recording the repair and maintenance work performed.

1.2.3 Unauthorized personnel

All other persons, including operators, supervisors and trainees, are classified as “unauthorized personnel” for maintenance work.

They are not permitted to maintain the engine or access the engine compartment or engine cowling.

For the operation of power generation engines: Operator

Power plant operators operate, monitor and maintain switchboards and related equipment in control centers, which control the production and distribution of power stations. The tasks include:

- Operating, monitoring and inspecting power plants.
- Operating and controlling power generating systems and equipment.
- Controlling start-up and shut-down of power plant equipment.
- Controlling switching operations, regulating coolant levels.
- Communicating with system operators to regulate and coordinate transmission loads, frequency and mains voltage.
- Reading graphics and measuring devices at established intervals, troubleshooting and performing corrective action as necessary.
- Completing and maintaining station records, logs and reports, and communicating with other plant personnel to assess the equipment operating status.
- Cleaning and maintenance of equipment, such as alternators for battery charging, pumps or compressors, in order to prevent defects or damage to the equipment.

1.3 Intended use

- Use the diesel engine for the intended purpose.
- Observe the following conditions from the manufacturer:
 - Operating conditions.
 - Maintenance conditions.
 - Repair conditions.
- Ensure that the following activities are only performed by persons according to the target group definition.
 - Use diesel engine.
 - Maintain diesel engine.
 - Repair diesel engine.

For further information, see ["Target group"](#) on page 9.

- Install guards and protective devices prior to commissioning and ensure their function.
- Observe safety instructions and operating instructions.
- Operate the engine in flawless condition.
- Screw the engine with the attached engine brackets to the machine or to the respective operation site with the respective tightening instructions.
- Have engine brackets and engine mounts that were not installed by the manufacturer approved by the manufacturer.
- Only operate the engine in areas that are not publicly accessible; therefore, only operate the engine with an enclosure or engine compartment cover.

1.4 Limitation of liability

The Service and repair manual was prepared according to the applicable standards and regulations and according to the state of the art.

Kohler Co. assumes no liability for:

- Disregarding the instructions.
- Improper use.
- Use of personnel that does not meet the requirements according to the target group, page 9.
- Changes and conversions to the diesel engine which were carried out without approval from Kohler Co.

General safety instructions

- Lubricants and fuels that have not been approved by Kohler Co.
- Use of non-KOHLER spare parts that have not been approved by Kohler Co., including any damages arising as a result.
- Circumventing and/or disregarding safety regulations.
- Disregarding international and national regulations for occupational safety.
- Disregarding international and national regulations for environmental protection.
- If the diesel engine is changed without authorization or the injection system and control system are manipulated.

1.5 General safety instructions

- Fulfill the requirements of the target groups for the work. See “Target group” on page 9.
- In order to guarantee help in the event of an accident: A second person is present or ensure that the emergency situation will be detected and help with take place.
- Make sure that the personnel are familiar with the Service and repair manual before assembly work.
- Only allow the following personnel to work on the diesel engine under the constant supervision of an experienced person:
 - Personnel to be trained.
 - Personnel to be taught.
 - Personnel to be instructed.
 - Personnel in apprenticeships.For further information, see “Target group” on page 9.
- Check the safety and hazard-conscious work of the personnel under the following conditions:
 - Observe the accident prevention regulations.
 - Observe the generally recognized safety and occupational health rules.
 - Observe the Service and repair manual.
- Make sure that the personnel wears safe work clothing. For further information, see page 15.
- Make sure that the following things are not worn:
 - Rings
 - Wristwatches
 - Neckties
 - Scarves
 - Open jackets
 - Loose-fitting clothing
- Make sure that the following equipment is available for the assembly, clean, complete and undamaged:
 - Basic tool kit
 - Required devices
 - Required special tools
- Replace damaged tools.
- Keep the workplace clean and orderly.
- Make preparations for emergencies that could occur.
- Have a fire extinguisher and first aid kit ready.
- Have emergency telephone numbers available.
- Make sure that the workplace has sufficient lighting.
- Perform assembly work only when the diesel engine is secured.
- Ensure that the diesel engine is not started by unauthorized individuals.

1.6 Preventing personal injuries

1.6.1 Crushing

- Do not lift heavy parts by hand.
- Fasten and simultaneously secure individual parts and larger assemblies carefully to lifting equipment during the replacement.
- Use KOHLER lifting gear according to the repair manual.
- Comply with the provisions for lifting points. For further information, see [58](#).
- Do not use load handling attachments that are damaged or that have insufficient load bearing capacity.
- Make sure that no persons reside under loads.
- If the diesel engine is running: make sure that no objects come in contact with rotating parts. Objects can be thrown back.

1.6.2 Burns

The diesel engine at operating temperature is hot.

- Only work on the cooled down diesel engine.
- Touch hot parts with appropriate thermal protection gloves. For further information, see [15](#).

When the diesel engine is at operating temperature, the cooling system is hot and is under pressure.

- Touch hot parts with appropriate thermal protection gloves. For further information, see [15](#).
- Avoid contact with parts carrying cooling water.
- When the end cover of the expansion tank has cooled down: Check the cooling water level.
- Open the lid carefully in order to release the overpressure.

When the diesel engine is at operating temperature, the engine oil is hot.

- Avoid any skin contact with hot oil or parts carrying oil.

1.6.3 Fires and explosions

- Smoking is prohibited in the immediate vicinity of the diesel engine.
- Fires, sparks and open flames are prohibited when handling fuels and flammable liquids.
- Start the diesel engine according to the provisions of the operating and maintenance manual and Service and repair manual.
- Eliminate leaks and replace defective parts.
Fuel and oil spurting out of leaky spots can lead to fires.
- When working on batteries: Wear safety goggles and protective gloves.
- Remove rags that are soaked with flammable liquids.
- When working on the electrical system: Disconnect the electrical power supply.

1.6.4 Poisoning

- Only allow the diesel engine to run in closed rooms when there is sufficient ventilation.
If a greater fresh air supply is required: Open doors and windows.
- Do not ingest operating fluids under any circumstances.
- Do not use beverage bottles for storage.

Escaping liquids can penetrate the skin and will lead to blood poisoning.

- Do not open any lines and hoses that are under pressure.
- Do not remove any lines and hoses that are under pressure.
- Protect hands, face and body against escaping liquids when searching for leaks on lines and hoses that are under pressure. For further information, see [15](#).

1.6.5 Electrical energy

- Persons with pacemakers: May not reside near the diesel engine when it is operational.
 - Do not touch live parts.
 - Before work on the electrical system: Disconnect the electrical power supply.
- Strong electrical radiation interferes with the electronics. Undefined behavior of the engine control unit
- Keep electrical radiation sources away from the diesel engine.

1.6.6 Danger due to noise

Possible permanent hearing loss due to noise levels above 84 dB(A). Sound levels up to 110 dB(A) possible!

- Keep all sound-insulating safeguards for the system closed when the engine is running.
- Do not reside near the running engine without hearing protection matched to the noise level.
- Observe the hearing protection measures according to the repair instructions of the generator.

Access to the safety zones (Fig. 1) is prohibited for the operator and unauthorized personnel when the engine is ready for operation or in operation, see 9. However, if a technician must reside by the unprotected engine for troubleshooting, he must wear hearing protection which is designed for the noise exposure.

1.7 Personal protective equipment

Danger due to electrical energy.

- Wear protective equipment for direct access to diesel engines.
- Make sure that:
 - Protective equipment is in good condition.
 - Protective function is ensured.

The following protective equipment is required to access the diesel engine:



Protective work clothing

Tight-fitting protective clothing that is not tear-resistant to protect against injuries and simple chemical substances

- Wear protective work clothing in the immediate vicinity of the engine.



Safety helmet

Protect against falling or flying objects and against bumping your head

- Wear a safety helmet in the immediate vicinity of the engine.



Safety shoes

Foot protection against falling objects and pinching of the foot in heavy parts.

Additional protection against slipping

- Wear safety shoes in the immediate vicinity of the engine.



Safety gloves

Protection against hot elements and chemicals

- Wear protective gloves when working with hot parts. (For example: shrinking the gear ring on the flywheel.)
- Wear protective gloves when working with operating fluids. (See manufacturer's specifications for the operating fluids and safety data sheet for the operating fluid.)



Safety goggles

Protection against flying splinters and splatters from chemicals

- Wear safety goggles when handling operating fluids. (See manufacturer's specifications for the operating fluids and safety data sheet for the operating fluid.)
- Wear safety goggles during mechanical interventions. (For example, use of compressed air)



Hearing protection

Protection against noise

- Wear hearing protection around the diesel engine when it is running.

1.8 Operating and maintenance areas

Safety instructions

Trapping points and mechanical parts flying around when the engine is ready for operation or in operation.

Serious injuries and risk of death.

- Keep away from the operational engine.
- Wear personal protective equipment. See 15.
- Technicians may reside in safety zone "A" for measurement purposes, if nothing else has been stated by the generator.

Hot parts when the engine is ready for operation or in operation.

Risk of burns.

- Keep away from the operational engine.
- Let the engine cool down sufficiently.
- Wear personal protective equipment. See 15.

High electric short-circuit currents during maintenance work.

Risk of burns from electric shock.

- Access to safety zones in maintenance condition, according to target group definition, see 9.
- Disconnect the electrical power supply.
- Use personal protective equipment, see 15.

Operating areas

Fig. 1 Safety zones for the engine that is ready for operation or in operation



143278

Pos. Name

- | | |
|---|---|
| A | Safety zone, ancillary support housing side |
| B | Safety zone next to engine |
| C | Safety zone, flywheel side |
| D | Safety zone above engine |
| E | Safety zone below engine |

Pos. Name

- a Horizontal plan (view from above)
b Vertical plan (view from flywheel side)

Safety zone, ancillary support housing side

Residing in this area is prohibited when the engine is running.

Safety zone next to engine

Residing in this area is prohibited when the engine is running.

Safety zone, flywheel side

Residing in this area is prohibited when the engine is running.

Safety zone above engine

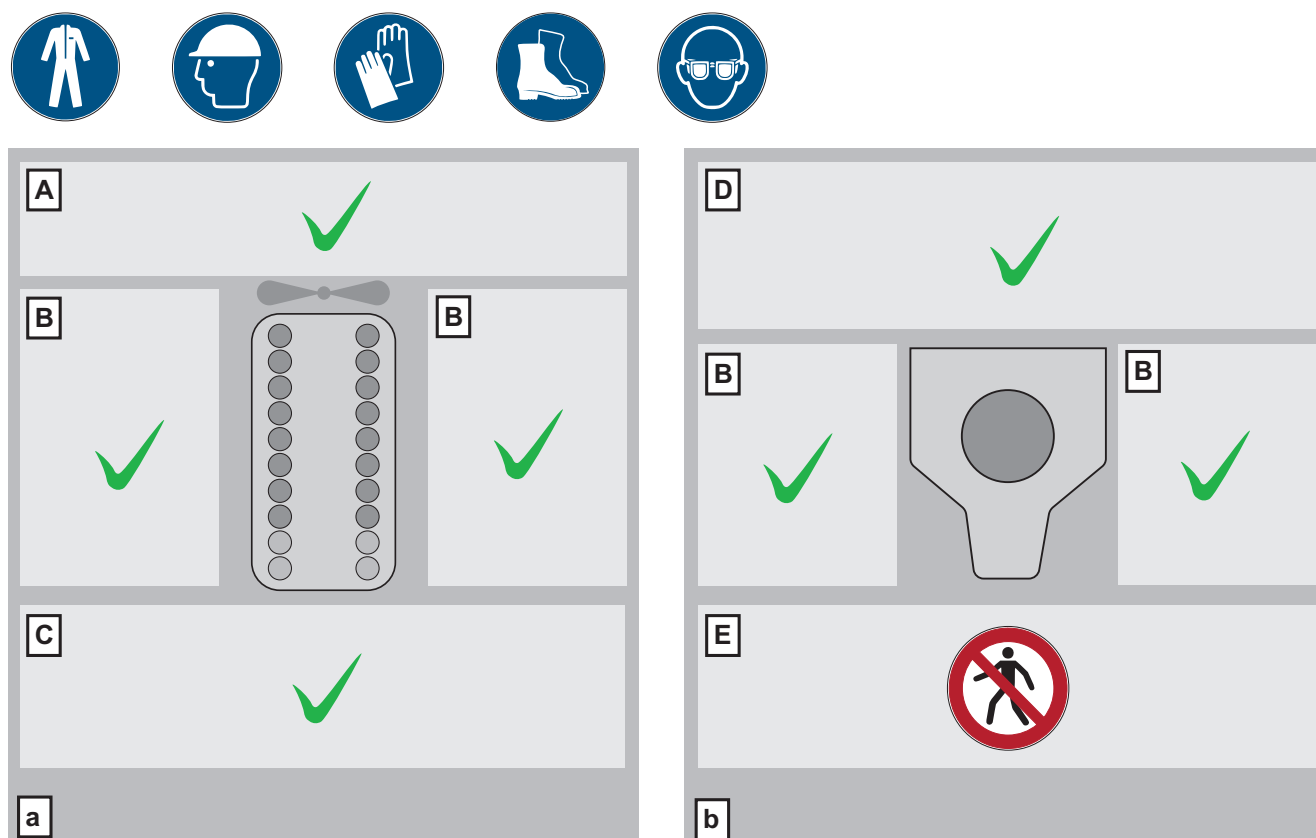
Residing above the engine is prohibited when the engine is ready for operation or in operation.

Safety zone below engine

Residing below the engine is prohibited for any personnel, even when the engine is not in operational condition.

Maintenance areas

Fig. 2 Safety zones for maintenance and repair when the engine is out of service



143279

Pos. Name

- A Safety zone, ancillary support housing side
B Safety zone next to engine
C Safety zone, flywheel side
D Safety zone above engine

Pos. Name

- | | |
|---|---|
| E | Safety zone below engine |
| a | Horizontal plan (view from above) |
| b | Vertical plan (view from flywheel side) |

Safety zone, ancillary support housing side

The engine must be cooled down to below 50° C (122° F). Secure the engine against unexpected start-up.

Safety zone next to engine

The engine must be cooled down to below 50° C (122° F). Secure the engine against unexpected start-up.

Safety zone, flywheel side

The engine must be cooled down to below 50° C (122° F). Secure the engine against unexpected start-up.

Safety zone above engine

The engine must be cooled down to below 50° C (122° F). Technicians are permitted to reach in briefly, such as for example, to release the oil drain plug, after the engine has cooled down.

1.8.1 Securing the diesel engine against unexpected start-up and releasing it

Access to the maintenance areas (see 17) must be secured against unexpected start-up before entering the safety zones.

Procedure:

Secure the diesel engine against unexpected start-up:

- Disconnect the electrical power supply and secure it against being switched back on.
- Mark the cut-off point with a tag.

Make the diesel engine operational:

- The following activities have been completed:
 - Installation activities
 - Maintenance activities
 - Repair activities.
- Make sure that all foreign objects are removed.
- All protective devices are installed and are functioning.
- Make sure that no outsiders are residing in danger zones.
- Remove the tag for the electrical power supply.
- Establish the electrical power supply.

1.8.2 Emergency stop

An emergency stop is available for hazardous situations which require an immediate shutdown of the diesel engine. The power supply to the diesel engine is interrupted immediately. Only the engine control unit continues to have power.






Examples of hazardous situations:

- Fire
- Person suffers an electric shock
- Diesel engine will not stop
- Diesel engine accelerates uncontrollably

Only actuate the emergency stop in emergency situations. Actuating the emergency stop can permanently damage the diesel engine. The emergency stop may not be used for an operational stop of the diesel engine.

1.8.3 Signage

Attach the following warning symbols so they are clearly visible and are in the immediate vicinity of the safety zones:

	ISO 7010 / W012 Warning against dangerous electrical voltage Only persons who know the dangers of electricity may work in the designated area. <ul style="list-style-type: none"> • See 14, "Electrical energy".
	ISO 7010 / W017 Warning against hot surfaces There are hot surfaces on the diesel engine which are not immediately apparent. <ul style="list-style-type: none"> • See 13, "Burns".
	ISO 7010 / W025 Warning of entanglement hazard Possible trapping points exist on the engine in the area of the belt and the alternator for battery charging. <ul style="list-style-type: none"> • Attach a warning sign if trapping points are not secured by guards (optional). • Enter the safety zone only when the diesel engine is turned off. • Secure the diesel engine against unexpected start-up.
	ISO 7010 / P007 No access for persons with pacemakers or implanted defibrillators Possible EMC radiation, which can affect pacemakers and implanted defibrillators. <ul style="list-style-type: none"> • See 14, "Electrical energy".
	ISO 7010 / M002 Observe instructions To ensure that personnel is familiar with all residual risks, the system documentation must be read and understood. <ul style="list-style-type: none"> • Ensure that all residual risks according to the risk assessment of the generator manufacturer are reflected in the system documentation. • Make documentation available to the personnel without restrictions according to the "Target group". (see 9).

Important!

The signs must withstand the environmental conditions. The operating company must ensure that they remain visible and legible during the entire life cycle. The signs are not included in the scope of delivery of the engine.

Additional warning symbols or adaptations to product standards (ISO 8528-13) are possible.

1.9 Preventing property damage

- Replace sealing material (e.g. o-rings, seals, etc.).
- Check reusable, removed parts for reusability, see corresponding information in the Service and repair manual.
- Removed parts that are not reusable: Replace removed parts.
- If no specific torques and tightening instructions are specified: Tighten screwed assemblies according to the standard torques. For further information, see: [163](#).
- Replace self-locking screwed assemblies.
- Thoroughly clean the diesel engine, connections and screw fittings of oil, fuel or care products before assembly.
- Use lint-free cleaning cloths.
- Do not touch electrical contacts. Connection will be affected by contamination or components will be destroyed by electrostatic discharge (ESD).
- Before cleaning the diesel engine: Cover or seal openings into which no water, steam or cleaning agents may enter due to safety or functional reasons.
- Remove covers or adhesives after cleaning.
- Inspect fuel lines, diesel engine oil lines and hydraulic lines for the following defects:
 - Leaks
 - Loose connections
 - Abrasion points
 - Damage.
- Make sure that the electrical power supply is securely connected when starting.
- Make sure that the engine is turned off to disconnect the electrical power supply.
- Use suitable test leads for measurements on plug connections.
- If no mating connector is attached: Protect the engine control unit against dust and water.

2 General information

2.1 Structure of this manual

The work descriptions in this manual are structured as follows, see [Fig. 3](#):

- 1 Chapter overview
- 2 Previous work with specification of chapter number and page number
- 3 Overview image with an assignment of where the respective assembly is located on the diesel engine and all affected parts of the assembly
- 4 Legend for the overview image with work instructions, safety instructions, special tools, tightening torques, lubricants, etc.
- 5 Special tools table
- 6 Standard tools table
- 7 Lubricant table
- 8 Tightening instructions table
- 9 Technical data table
- 10 Detailed work description with text and images

There are two types of work descriptions:

1. Brief work description (A)

This includes the above-mentioned elements (1) to (4) and, if the work process requires it, also elements (5) to (9).

This type can be recognized if there is a "Work instructions" table column (magnifying glass A) in the legend (4). The work process arises from the overview image. If necessary, work instructions are stated. Different symbols are used in order to distinguish between installation, removal or dismantling, assembly information. An explanation of the symbols can be found on the following pages.

2. Detailed work description (B)

This also includes the above-mentioned elements (1) to (4) and, if the work process requires it, also elements (5) to (9) and additionally element (10) with text and images.

This type can be recognized if there is not a "Work instructions" table column (magnifying glass B) in the legend (4).

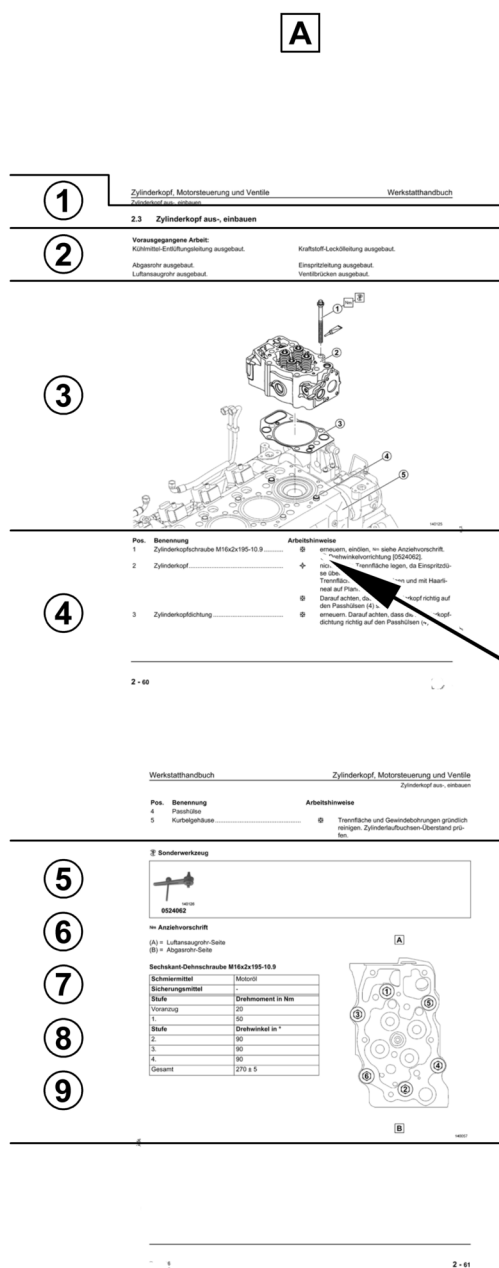
Please read through the complete work descriptions up to the end of the chapter first; this is the only way you will obtain all necessary information.

Various symbols are used in the images and in the text of this manual. An explanation of the symbols can be found on the following pages.

Interactive cross-references and links are marked with [blue](#) text.

Structure of this manual

Fig. 3 Example



Arbeitshinweise



erneuern



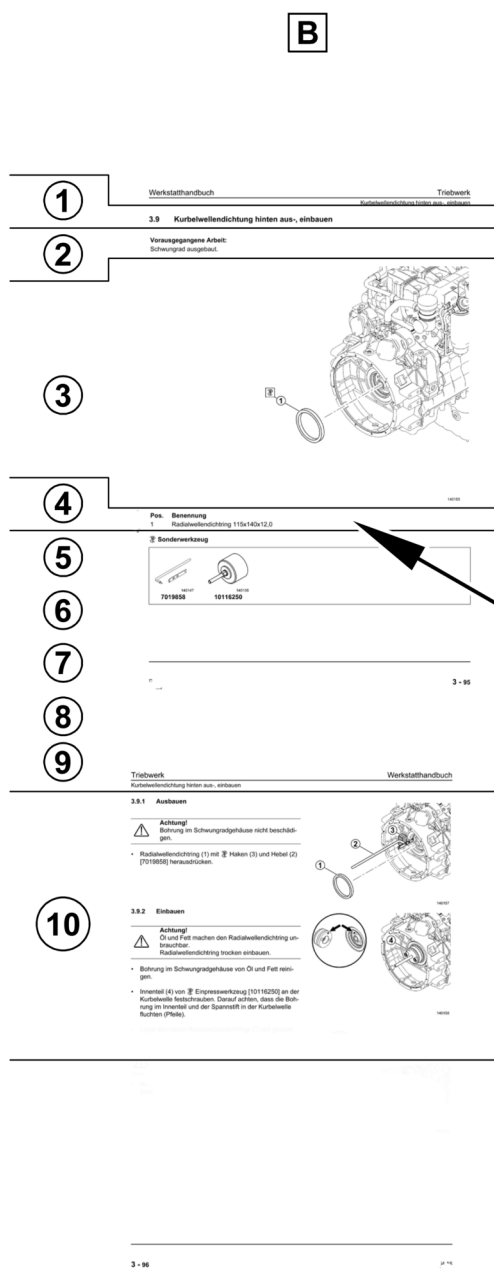
Dreh



nicht a









se üb

T



2.1.1 User guidance

This document must be carefully read and applied before the first use and later at regular time intervals by each person who works on the product. This document is part of the product. All specialists and operators of the product must be given access to a copy.

Symbol	Explanation	Symbol	Explanation
	Remove		Seal, secure, grease
	Dismantle		Special tool
	Assemble	Nm	Special torque or tightening instruction
	Install		Danger, warning, caution
	Information		

**Information**

Screw fittings without tightening instruction:

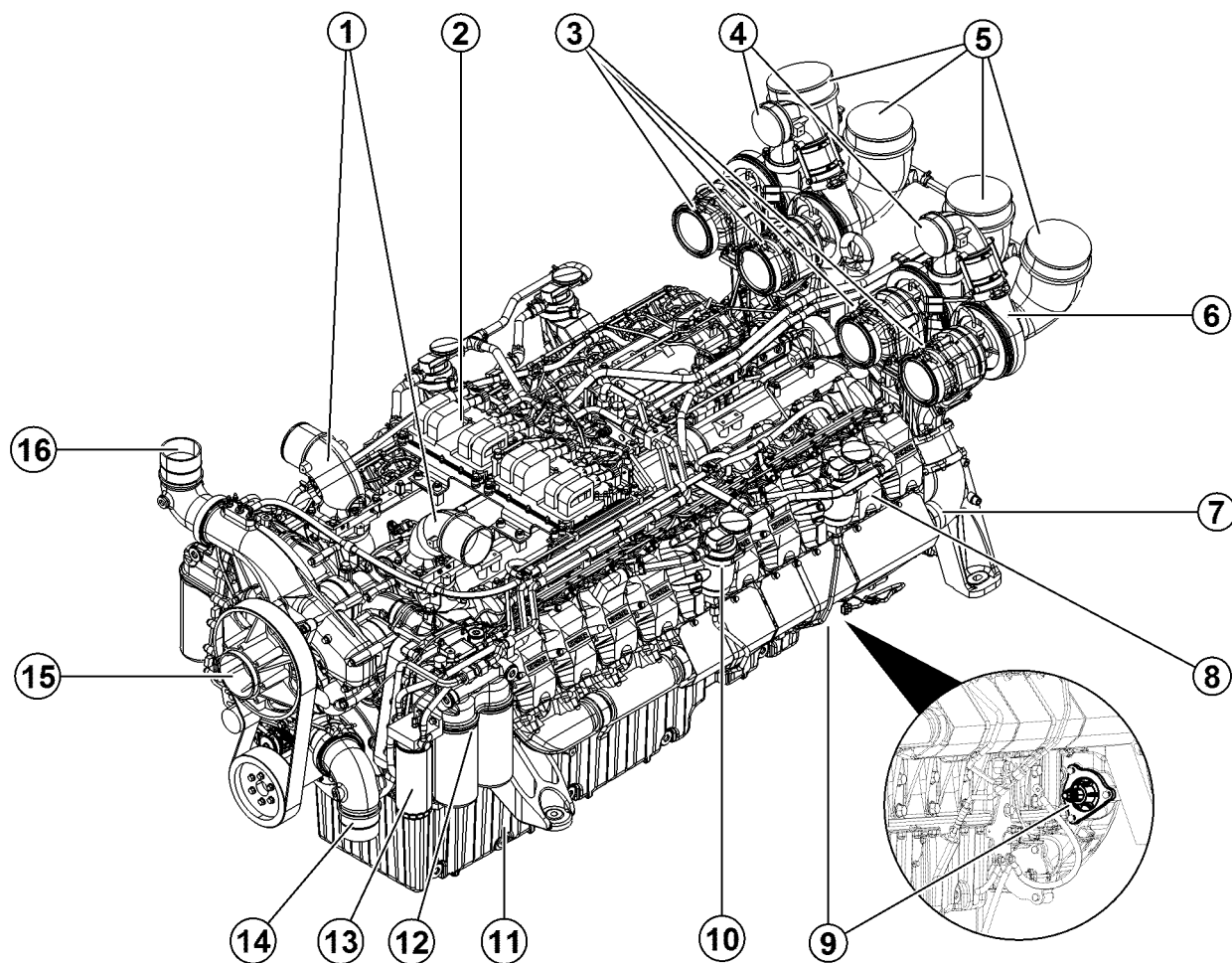
- Use standard torques, see [163](#).

The information in this data sheet does not release the user from the obligation to make independent assessments and checks.

2.2 Engine illustrations and engine parts

View from ancillary support housing side

Fig. 4 Overview of ancillary support housing side

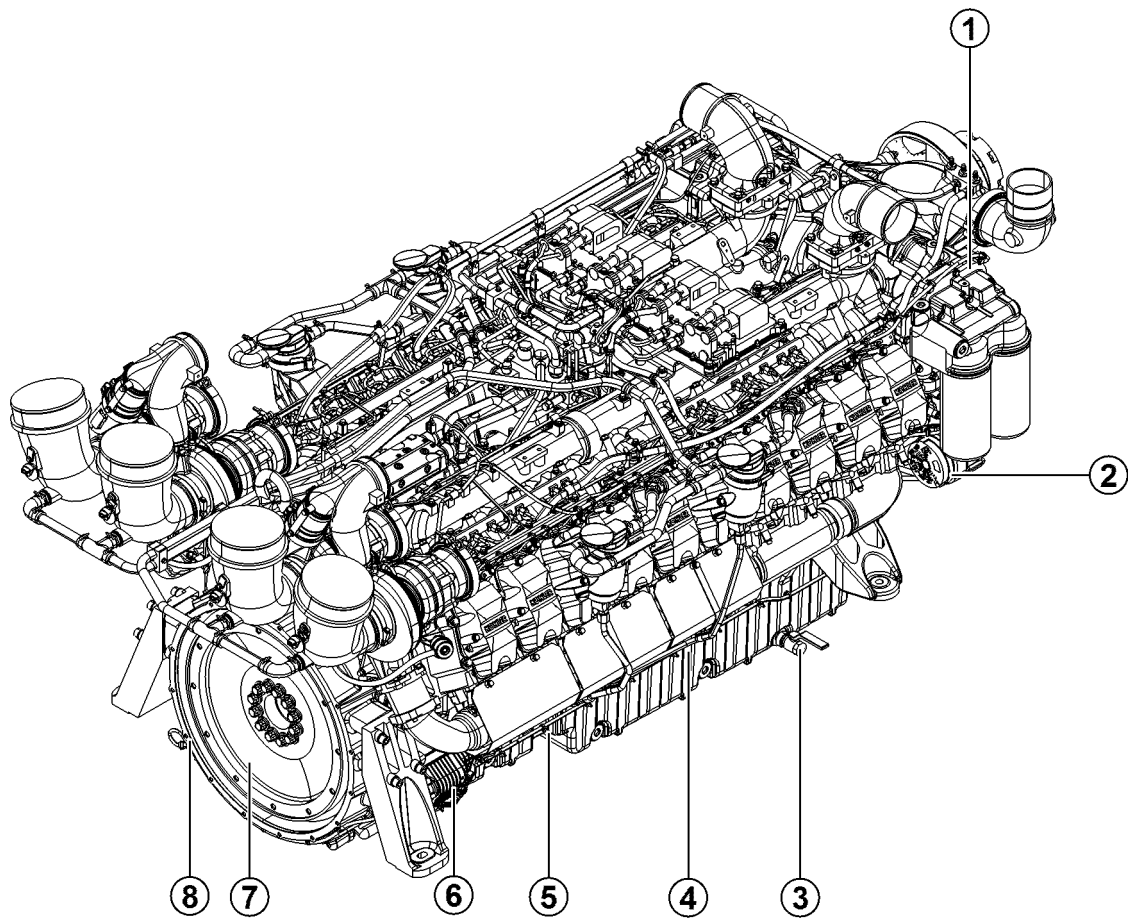


143228

- | | | | |
|---|---|----|--|
| 1 | Charge air connection line from charge air cooler | 9 | Installation location for turning device |
| 2 | Engine control unit | 10 | Crankcase breather system |
| 3 | Exhaust gas stub | 11 | Oil pan |
| 4 | Charge air connection line to charge air cooler | 12 | Oil module |
| 5 | Intake manifold | 13 | Fuel filter |
| 6 | Exhaust gas turbocharger | 14 | Coolant connection from coolant cooling |
| 7 | Exhaust manifold | 15 | Fan drive |
| 8 | Cylinder head cover | 16 | Coolant connection to coolant cooling |

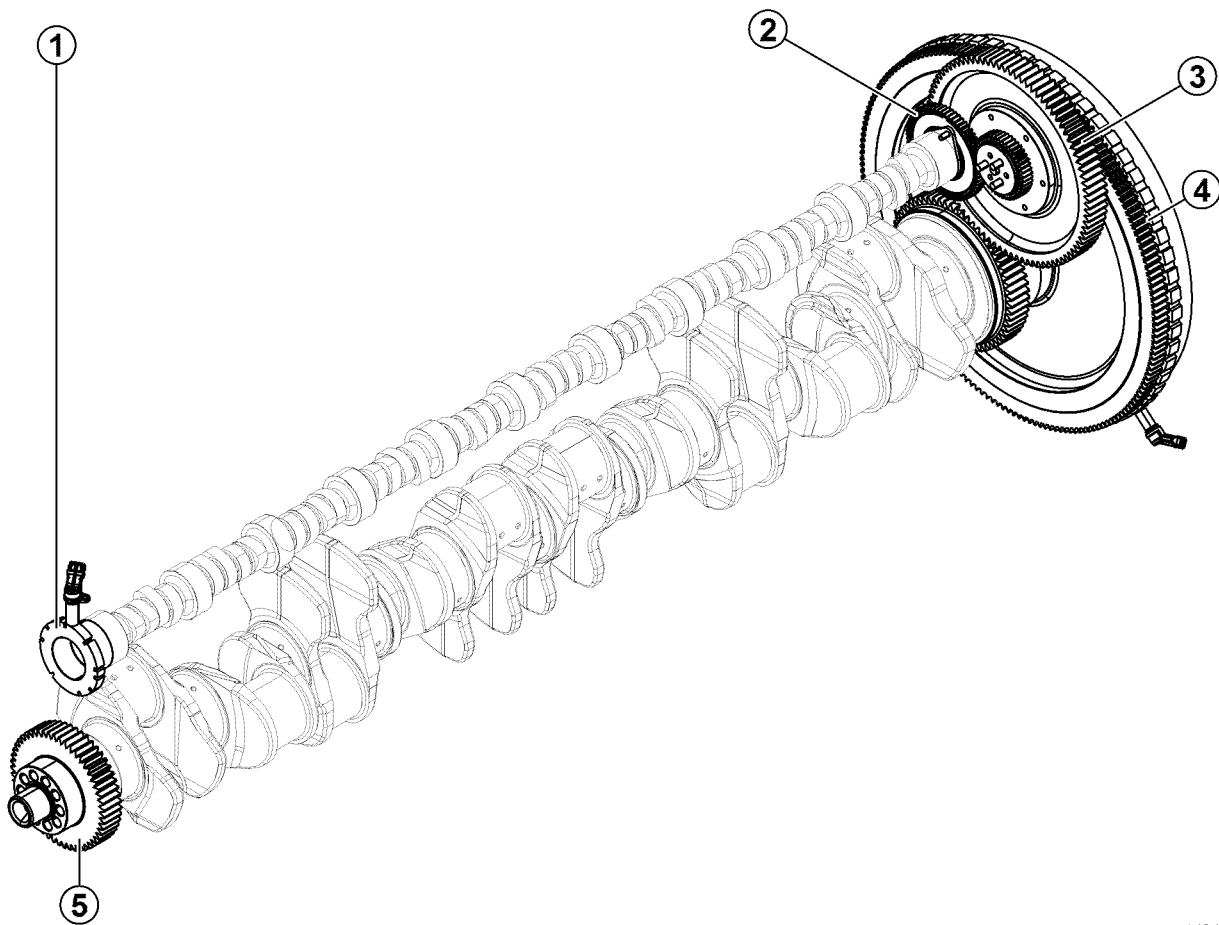
View from flywheel side

Fig. 5 Overview of flywheel side



143229

- | | | | |
|---|---------------------------------|---|-----------------|
| 1 | Oil cooler | 5 | Oil filler neck |
| 2 | Alternator for battery charging | 6 | Starter |
| 3 | Oil drain | 7 | Flywheel |
| 4 | Oil dipstick | 8 | Flywheel sensor |

Wheel drive**Fig. 6** *Wheel drive*

143471

- 1 Timing disk
- 2 Gear wheel - camshaft
- 3 Intermediate wheel

- 4 Flywheel
- 5 Gear wheel

2.3 Signage

Permanently affixed signs must remain in a clearly recognizable condition throughout the entire life cycle.

- Replace damaged signs
- Keep signs clean
- Do not obstruct visibility

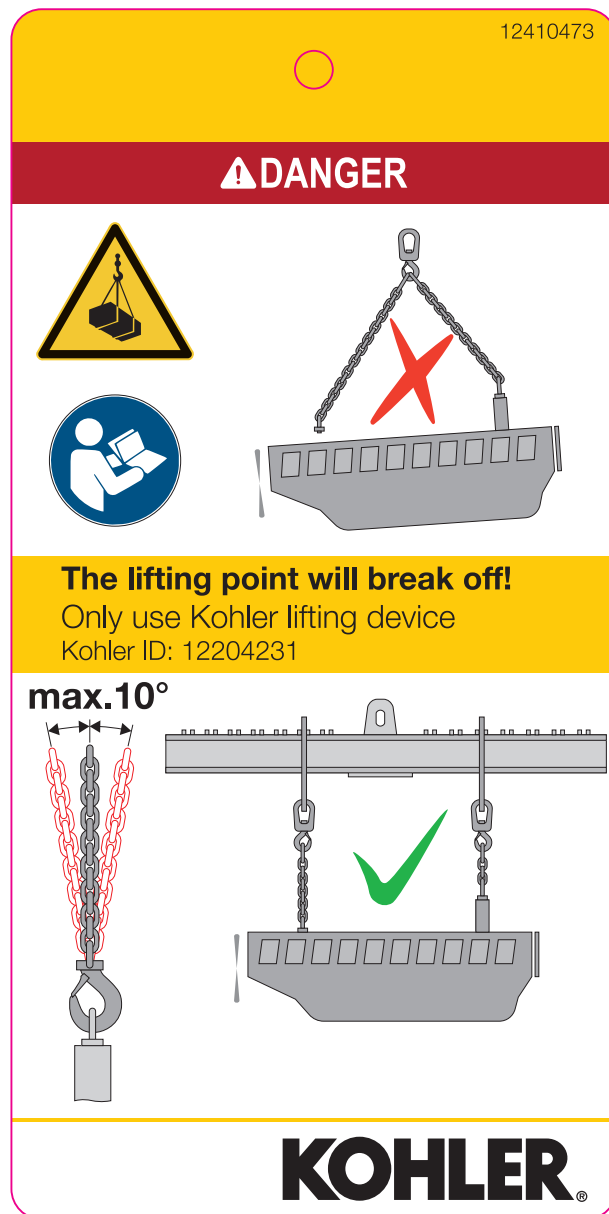
Keep unused tags with the device documentation on the device.

2.3.1 Safety labels

Lift diesel engine hang tag

Use correct lifting equipment for lifting the diesel engine.
For safety instructions and procedure, see [58](#).
Attach a hang tag to the device for later use of the device documentation.

Fig. 7 Lift diesel engine hang tag

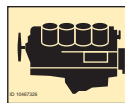


2.3.2 Information labels

Engine without engine oil hang tag

Attach a hang tag to the device for later use of the device documentation. If the diesel engine is without engine oil, attach the tag to the oil dipstick.

Fig. 8 Engine without engine oil hang tag



Achtung! Motor ohne Motoröl geliefert.

Attention! Moteur livré sans huile moteur

ATTENTION! Engine delivered without motor oil

Atención! Motor suministrado sin aceite del motor

Внимание! Двигатель поставляется без моторного масла.

2.3.3 Engine, general

Engine type designation KD36V16

K	D	36	V	16	-	5	A	F	C	Engine type designation
K										KOHLER
	D									Diesel engine
		36								Total displacement: 36 l (2197 cubic inches) = V16
			V							Cylinder configuration
				16						Number of cylinders
						5				Frequency: 5 = 50 Hz; 6 = 60 Hz
							A			Power group: A, wherein A is the smallest power group and E is the largest power group
								F		Optimization: F = Fuel optimization; E = Exhaust optimization
									C	Application: C = COP; P = Prime; S = Standby; D = Data center

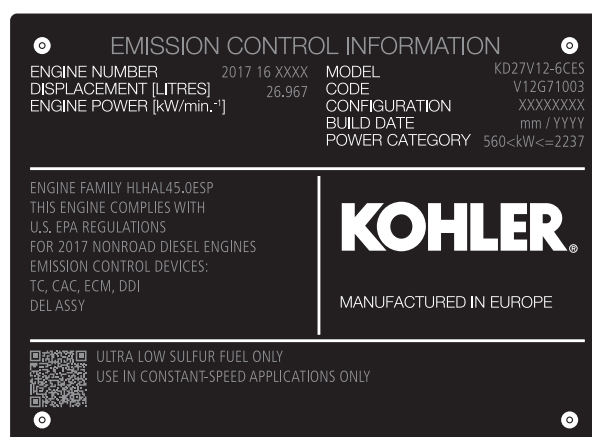
Engine type designation KD45V20

K	D	45	V	20	-	6	A	F	C	Engine type designation
K										KOHLER
	D									Diesel engine
		45								Total displacement: 45 l (2746 cubic inches) = V20
			V							Cylinder configuration
				20						Number of cylinders
						6				Frequency: 5 = 50 Hz; 6 = 60 Hz
							A			Power group: A, wherein A is the smallest power group and E is the largest power group
								F		Optimization: F = Fuel optimization; E = Exhaust optimization
									C	Application: C = COP; P = Prime; S = Standby; D = Data center

Labeling of the engines

The labeling of the engines is attached to the crankcase.

Fig. 9 Engine company name plate



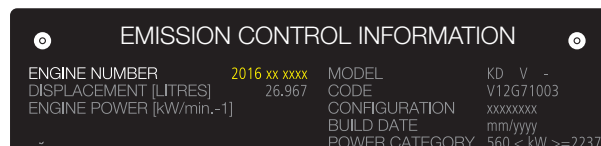
Engine serial number

The engine serial number is cast into the engine company name plate and into the crankcase.

2017	18	0001	Engine serial number
2017			Year of manufacture
	17 18		Engine type code: 17 = 16 cylinders 18 = 20 cylinders
		0001	Sequential production number

The engine serial number is cast into the engine company name plate in the field "Engine Number".

Fig. 10 Engine serial number on company name plate



Engine KD36V16 cylinder designation

Cylinder 1 is located across from the right side of the flywheel.

The direction of rotation of the engine is left viewed from the flywheel.

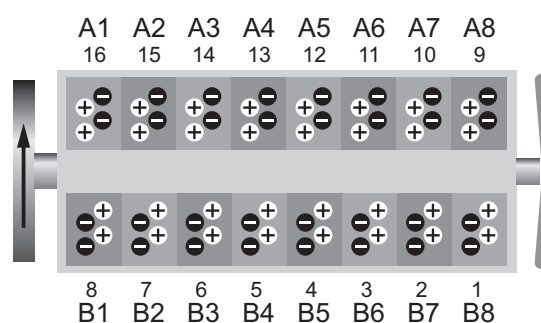
1 - 16 = Cylinder designation according to DIN 73021

A1 - B8 = Cylinder designation according to ISO 1204

"+" = Inlet valve 0.5 mm (0.02 in)

"-" = Outlet valve 0.6 mm (0.024 in)

Fig. 11 Cylinder designation



Engine KD45V20 cylinder designation

Cylinder 1 is located across from the right side of the flywheel.

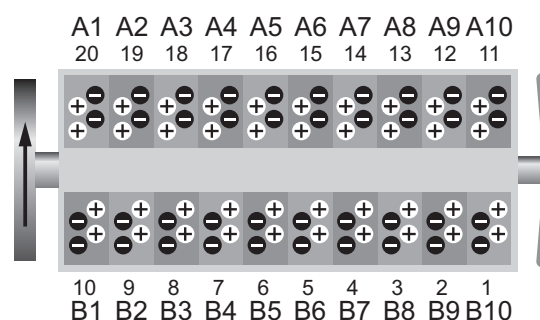
The direction of rotation of the engine is left viewed from the flywheel.

1 - 20 = Cylinder designation according to DIN 73021

A1 - B10 = Cylinder designation according to ISO 1204

"+" = Inlet valve 0.5 mm (0.02 in)

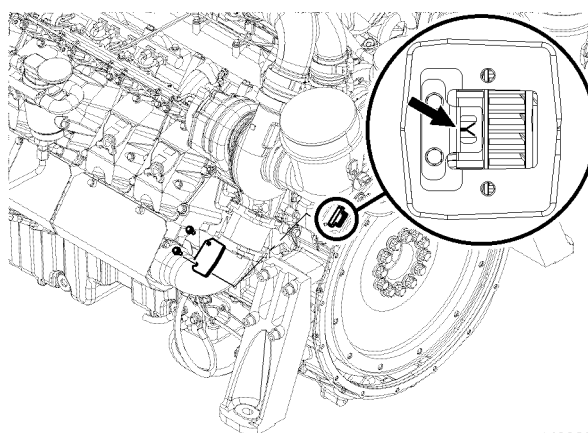
"-" = Outlet valve 0.6 mm (0.024 in)

Fig. 12 Cylinder designation

143261

The TDC mark is located in the flywheel housing.

The notch in the flywheel must align with the tip of the sheet metal in the flywheel housing (arrows).

Fig. 13 TDC mark

143262

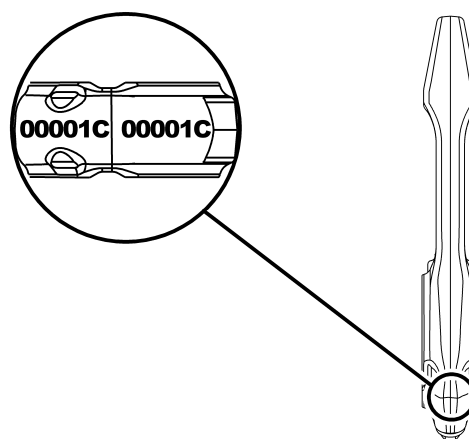
Connecting rod number (crack connecting rod)

The connecting rod number is cast on the connecting rod and on the connecting rod bearing cover.

00001 = Sequential production number

C = Code letter for the year of manufacture

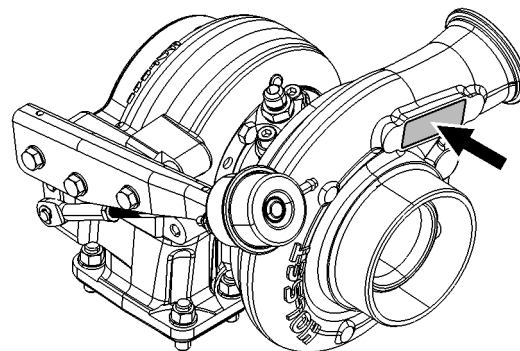
The connecting rod and connecting rod bearing cover are identified together by the connecting rod number.

Fig. 14 Connecting rod number

140009

Exhaust gas turbocharger company name plate

The exhaust gas turbocharger type plate is attached to the housing of the compressor.

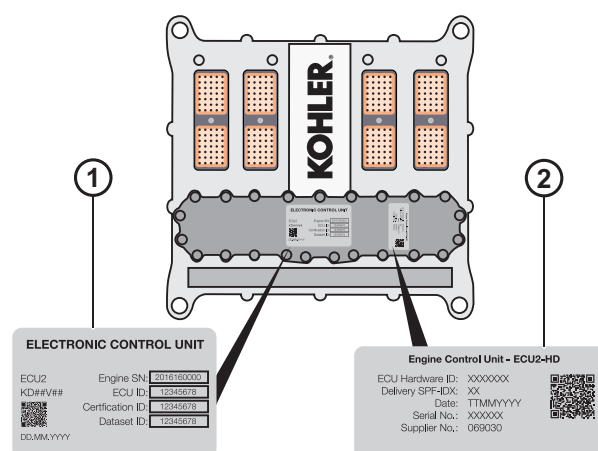
Fig. 15 Exhaust gas turbocharger company name plate

141724

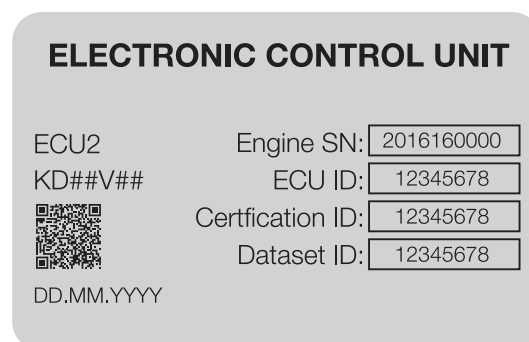
Engine control unit company name plates

There are two company name plates on the engine control unit.

- 1 Software company name plate
- 2 Hardware company name plate

Fig. 16 Engine control unit company name plates

The software company name plate contains all information that is required to load the correct firmware packages on the ECU, see KODIA operating instructions.

Fig. 17 Engine control unit software company name plate

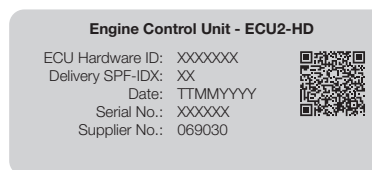
Signage

The engine control unit date of manufacture can be seen on the hardware company name plate.

The hardware generation can be seen via the Delivery SPF-IDX number.

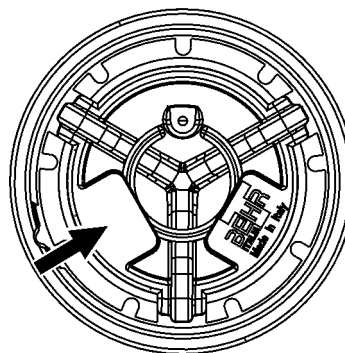
The compatibility with certain software generations can be derived via the ECU hardware ID.

Fig. 18 Engine control unit hardware company name plate

**Thermostat start of opening**

The thermostat start of opening is engraved in the area marked with an arrow.

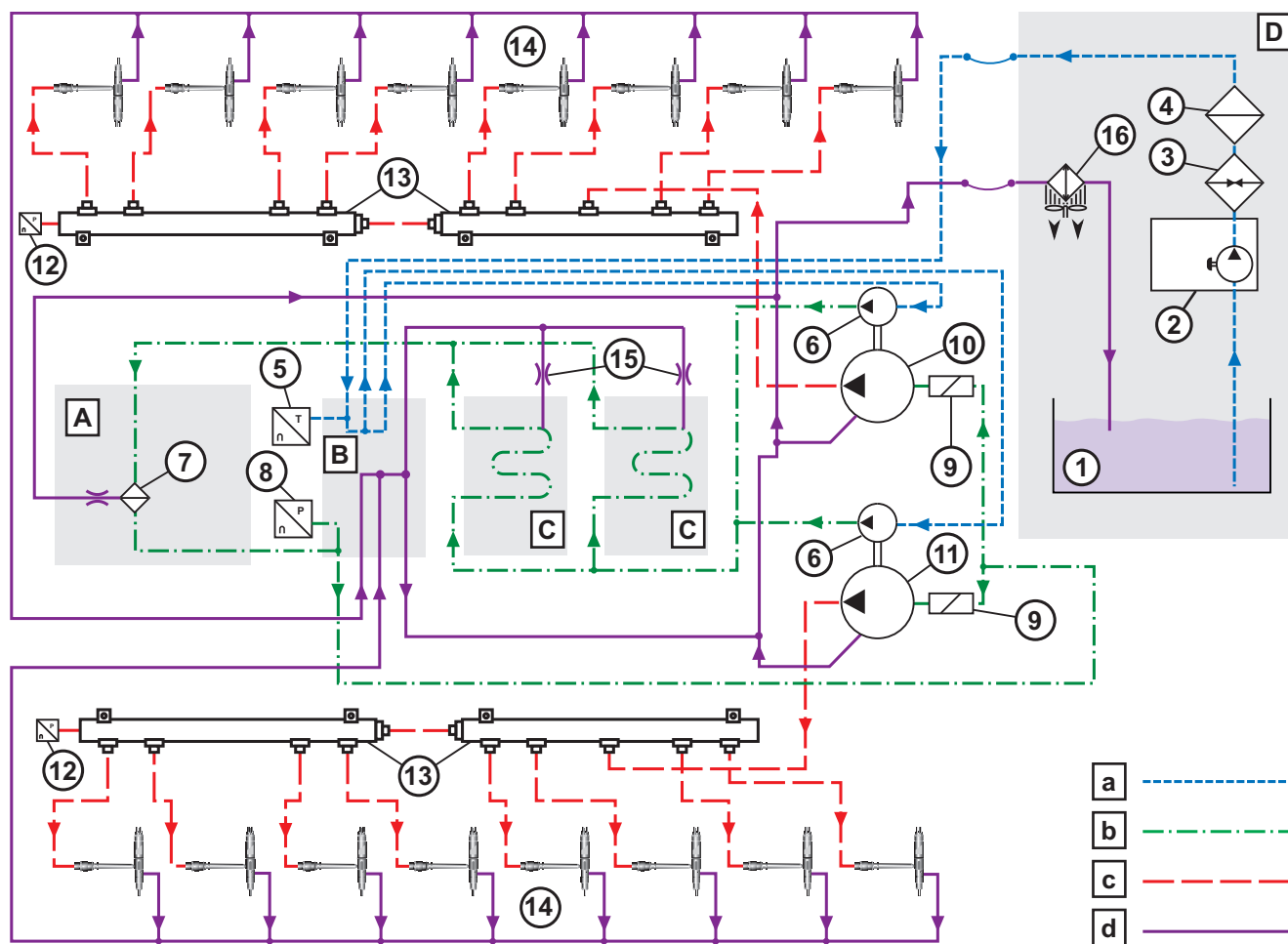
Fig. 19 Thermostat



143342

2.4 Fuel diagram (engine KD36V16)

Fig. 20 Fuel diagram



144014

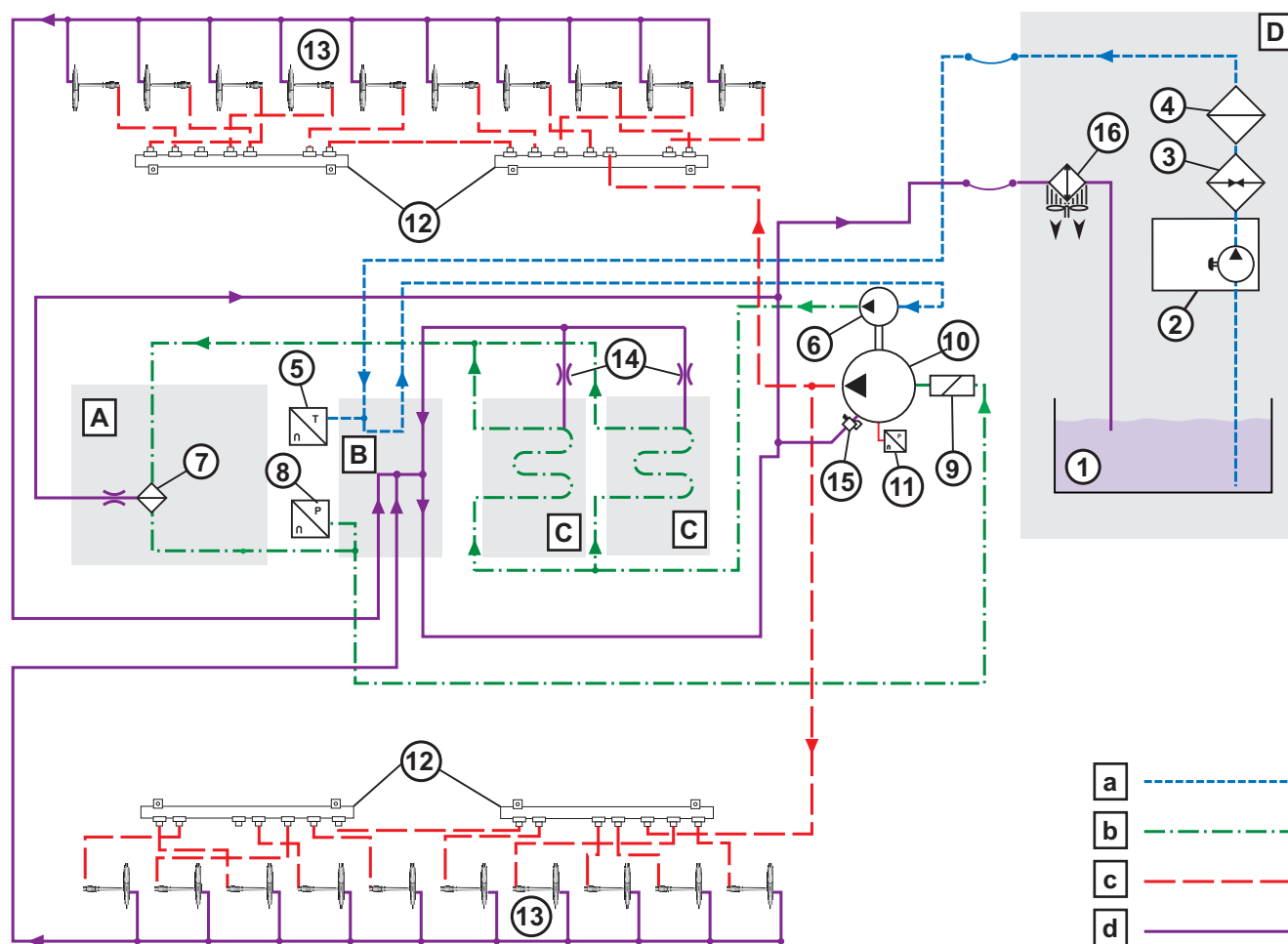
- a Suction pressure
- b Low pressure
- c High pressure
- d Return and continuous ventilation

- A Fuel fine filter
- B Distributor block
- C Engine control unit
- D Generator side

- 1 Fuel tank
- 2 Manual ventilation pump
- 3 Water separator
- 4 Fuel prefilter
- 5 Fuel temperature sensor
- 6 Fuel prefeeding pump
- 7 Filter insert
- 8 Fuel pressure sensor
- 9 Metering unit (VCV)
- 10 High pressure pump
- 11 High pressure pump
- 12 High pressure sensor
- 13 Common Rail
- 14 Injectors
- 15 Throttle
- 16 Fuel air cooler (optional)

2.5 Fuel diagram (engine KD45V20 Tier0)

Fig. 21 Fuel diagram



143375

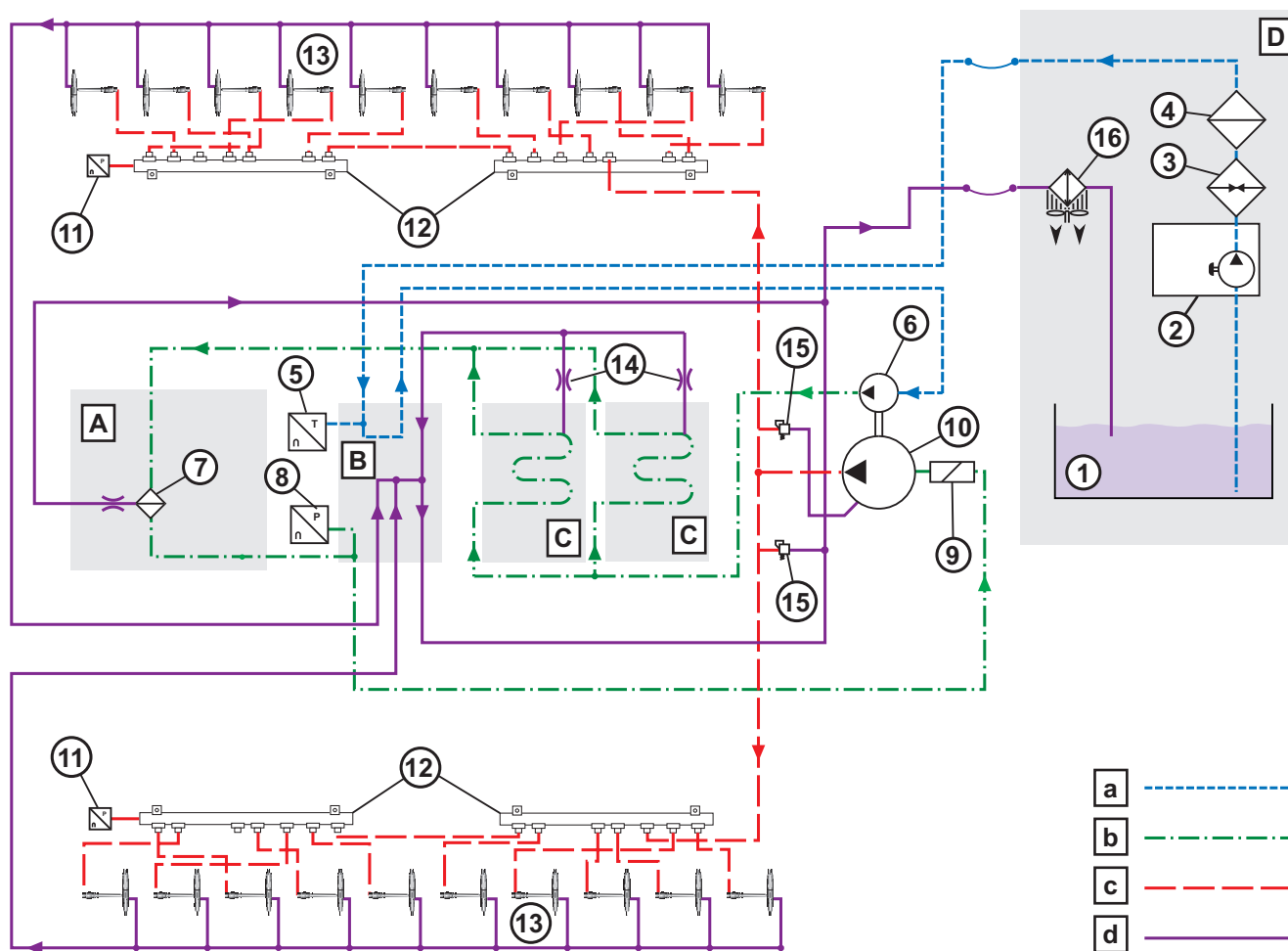
- a Suction pressure
- b Low pressure
- c High pressure
- d Return and continuous ventilation

- 1 Fuel tank
- 2 Manual ventilation pump
- 3 Water separator
- 4 Fuel prefilter
- 5 Fuel temperature sensor
- 6 Fuel prefeeding pump
- 7 Filter insert
- 8 Fuel pressure sensor
- 9 Metering unit (VCV)
- 10 High pressure pump
- 11 High pressure sensor
- 12 Common Rail
- 13 Injectors
- 14 Throttle
- 15 Integrated pressure control valve (PCV)
- 16 Fuel air cooler (optional)

- A Fuel fine filter
- B Distributor block
- C Engine control unit
- D Generator side

2.6 Fuel diagram (engine KD45V20 Tier4)

Fig. 22 Fuel diagram



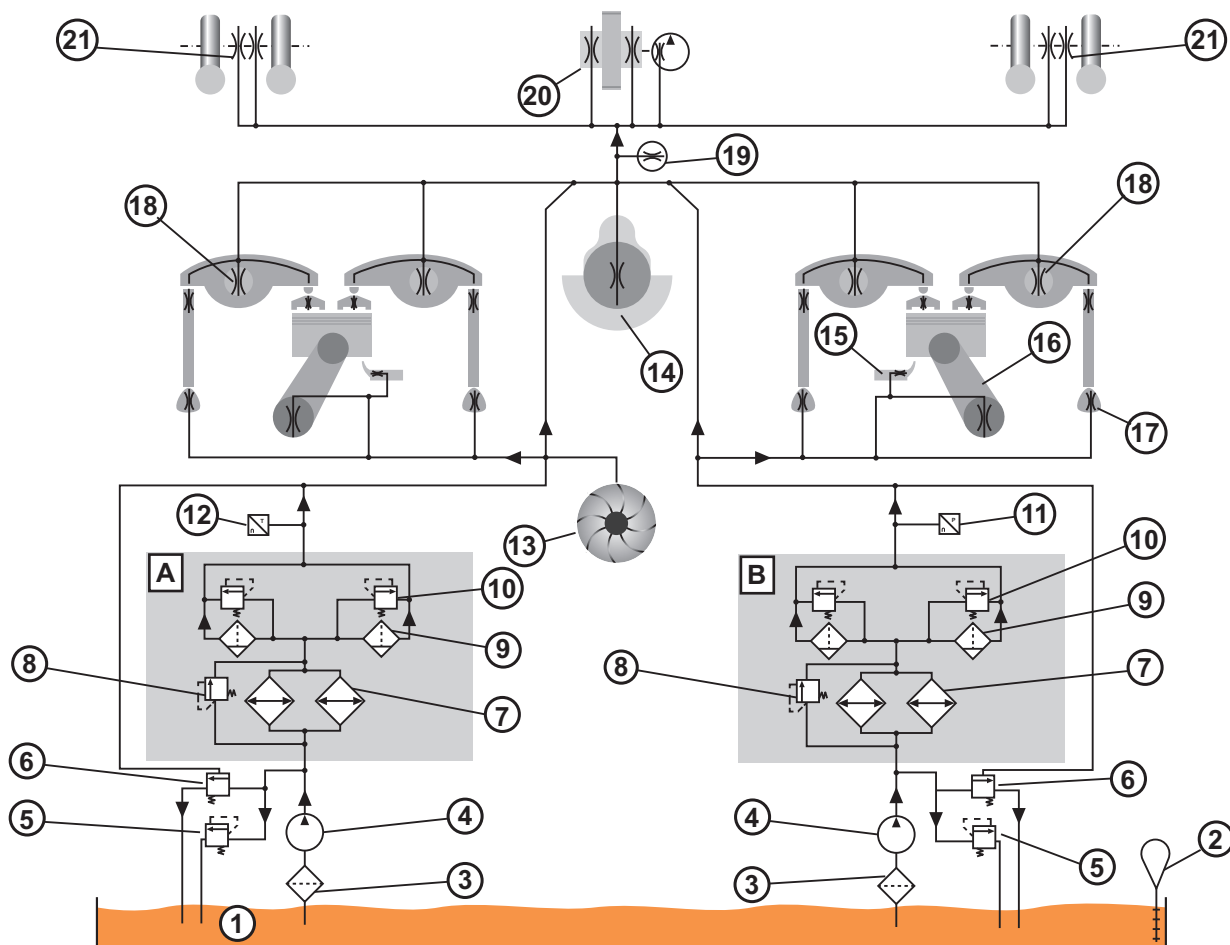
- a Suction pressure
- b Low pressure
- c High pressure
- d Return and continuous ventilation

- A Fuel fine filter
- B Distributor block
- C Engine control unit
- D Generator side

- 1 Fuel tank
- 2 Manual ventilation pump
- 3 Water separator
- 4 Fuel prefilter
- 5 Fuel temperature sensor
- 6 Fuel prefeeding pump
- 7 Filter insert
- 8 Fuel pressure sensor
- 9 Metering unit (VCV)
- 10 High pressure pump
- 11 High pressure sensor
- 12 Common Rail
- 13 Injectors
- 14 Throttle
- 15 Integrated pressure control valve (PCV)
- 16 Fuel air cooler (optional)

2.7 Lubricating oil diagram

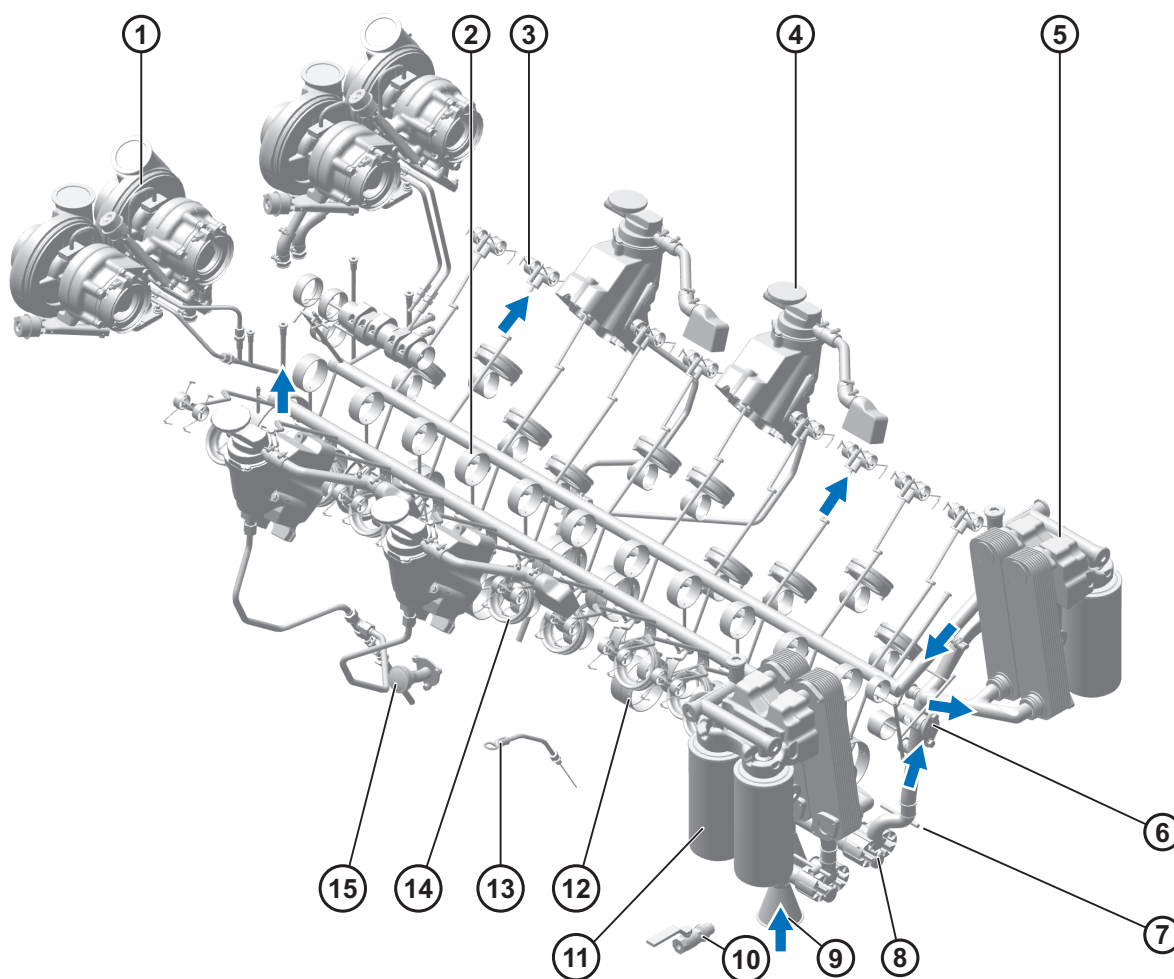
Fig. 23 Lubricating oil diagram



143376

A	Oil module	10	Filter bypass valve 2.5 bar (36 psi)
B	Oil module	11	Oil pressure sensor
		12	Temperature sensor
1	Oil pan	13	Water pump
2	Oil dipstick	14	Main bearing
3	Sieve insert (double or single)	15	Piston cooling nozzle
4	Oil pump	16	Connecting rod
5	Pressure control valve (cold start) 10 bar (145 psi)	17	Camshaft
6	Pressure control valve 5 bar (73 psi)	18	Rocker arm bracket
7	Oil cooler	19	Loose gear wheels drive bearing (camshaft)
8	Pressure control valve 3.6 bar (52 psi)	20	High pressure pump bearing
9	Oil filter	21	Turbocharger

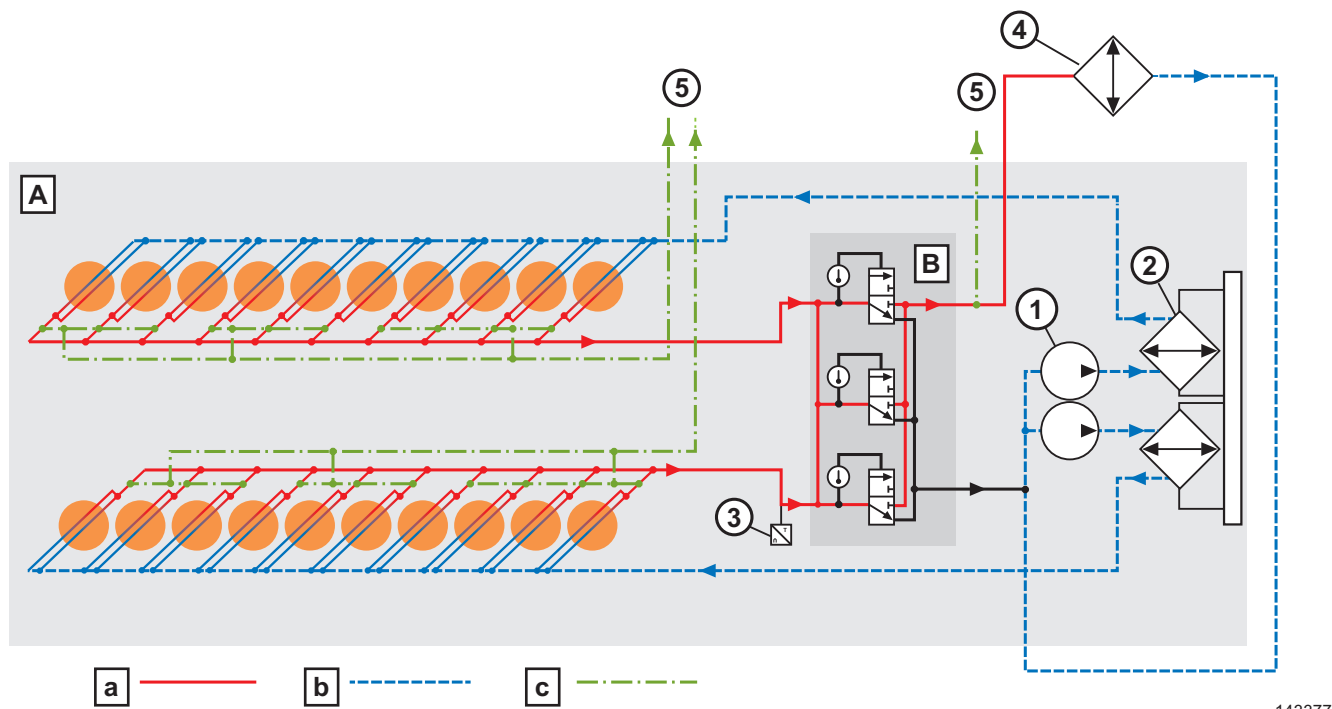
Fig. 24 Lubricating oil diagram



- | | | | |
|---|---|----|-----------------------|
| 1 | Exhaust gas turbocharger | 9 | Oil intake |
| 2 | Camshaft bearing | 10 | Oil drain |
| 3 | Cylinder head | 11 | Oil filter module |
| 4 | Crankcase breather system | 12 | Crankshaft bearing |
| 5 | Oil cooler | 13 | Oil dipstick |
| 6 | Pressure control valve 5 bar (145 psi) | 14 | Piston cooling nozzle |
| 7 | Pressure control valve (cold start) 10 bar (73 psi) | 15 | Oil filler neck |
| 8 | Oil pump | | |

2.8 Coolant diagram (Tier0)

Fig. 25 Coolant diagram



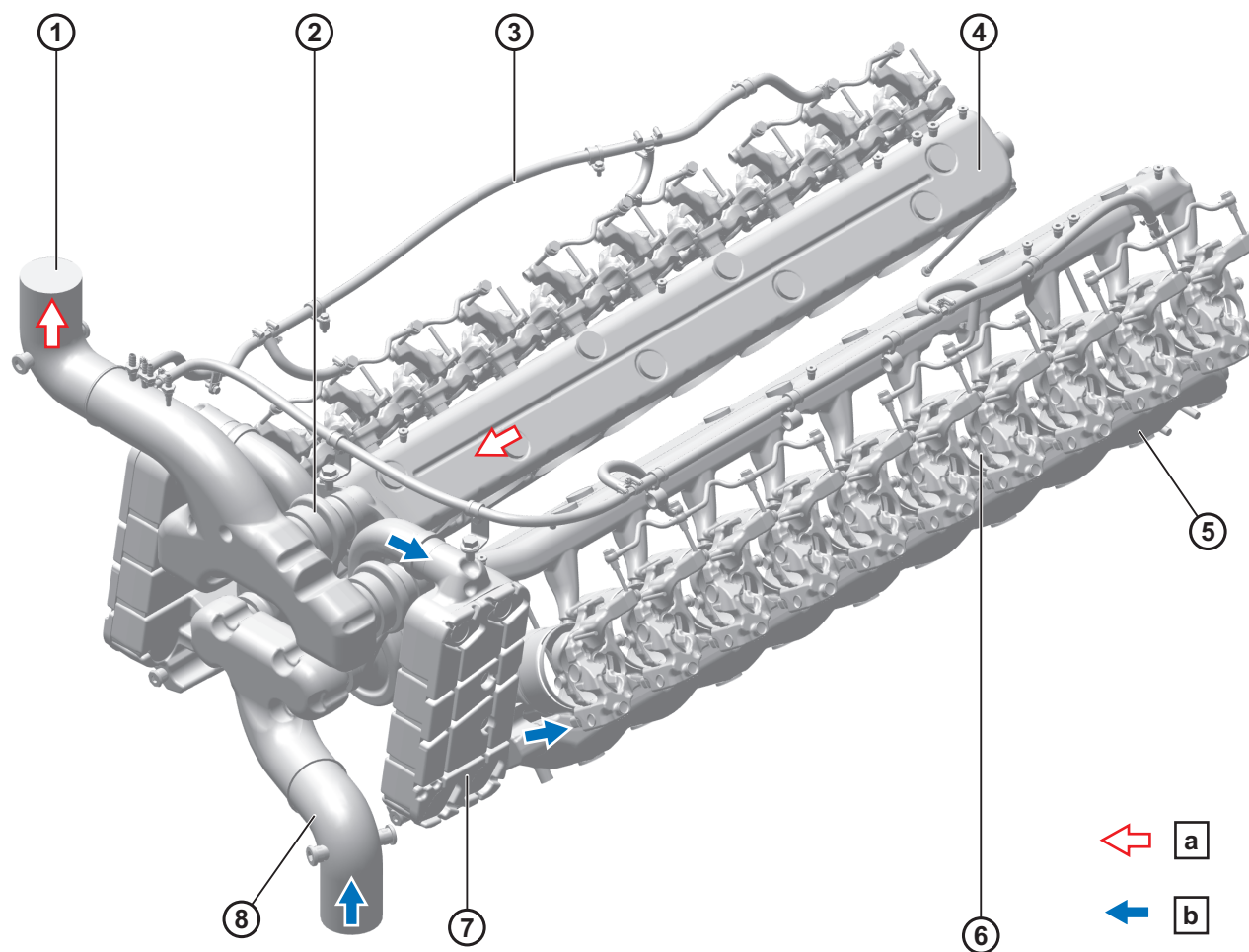
143377

- A Engine
B Thermostat housing with three thermostats

- 1 Water pump
2 Oil cooler
3 Temperature sensor
4 Water cooler
5 Coolant ventilation

- a Coolant, heated
b Coolant, cooled
c Ventilation

Fig. 26 Coolant diagram

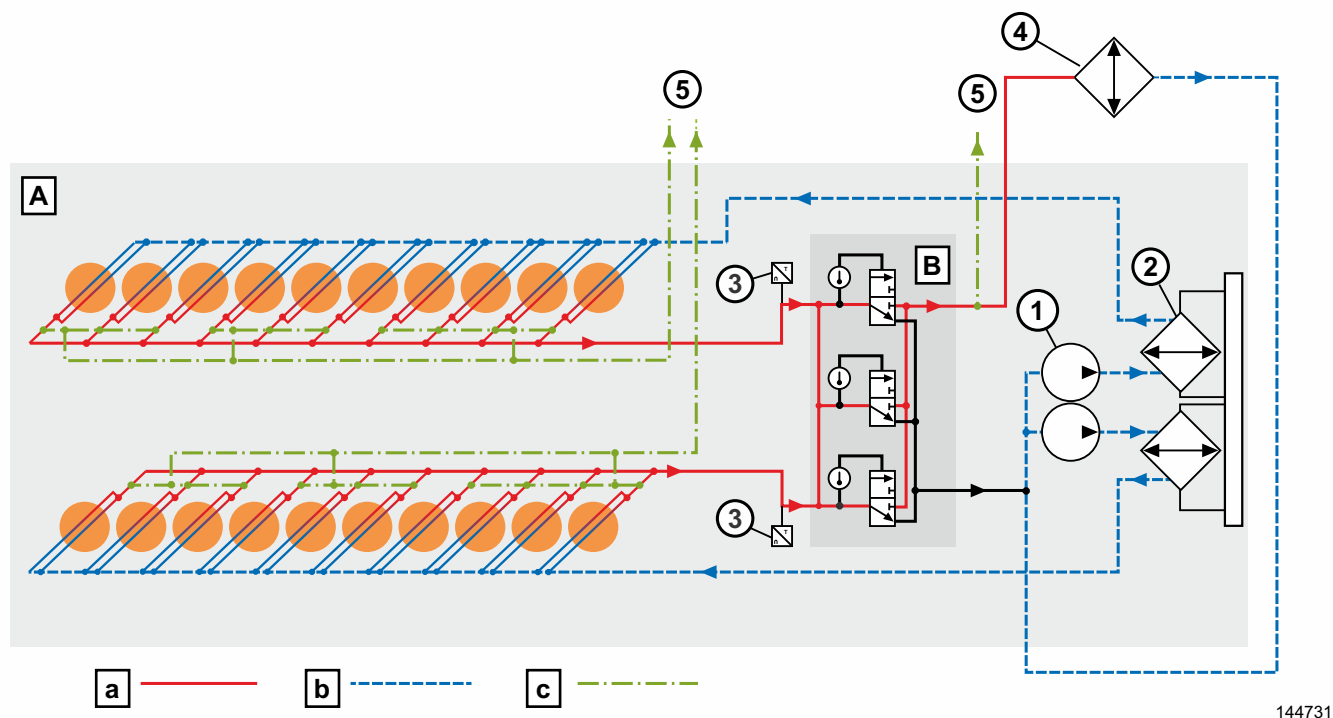


- a Coolant, heated
b Coolant, cooled

- 1 Supply from water cooler
2 Water pumps with thermostats
3 Continuous ventilation
4 Return from cylinder head
5 Supply to cylinder head
6 Cylinder head
7 Oil cooler
8 Return from water cooler

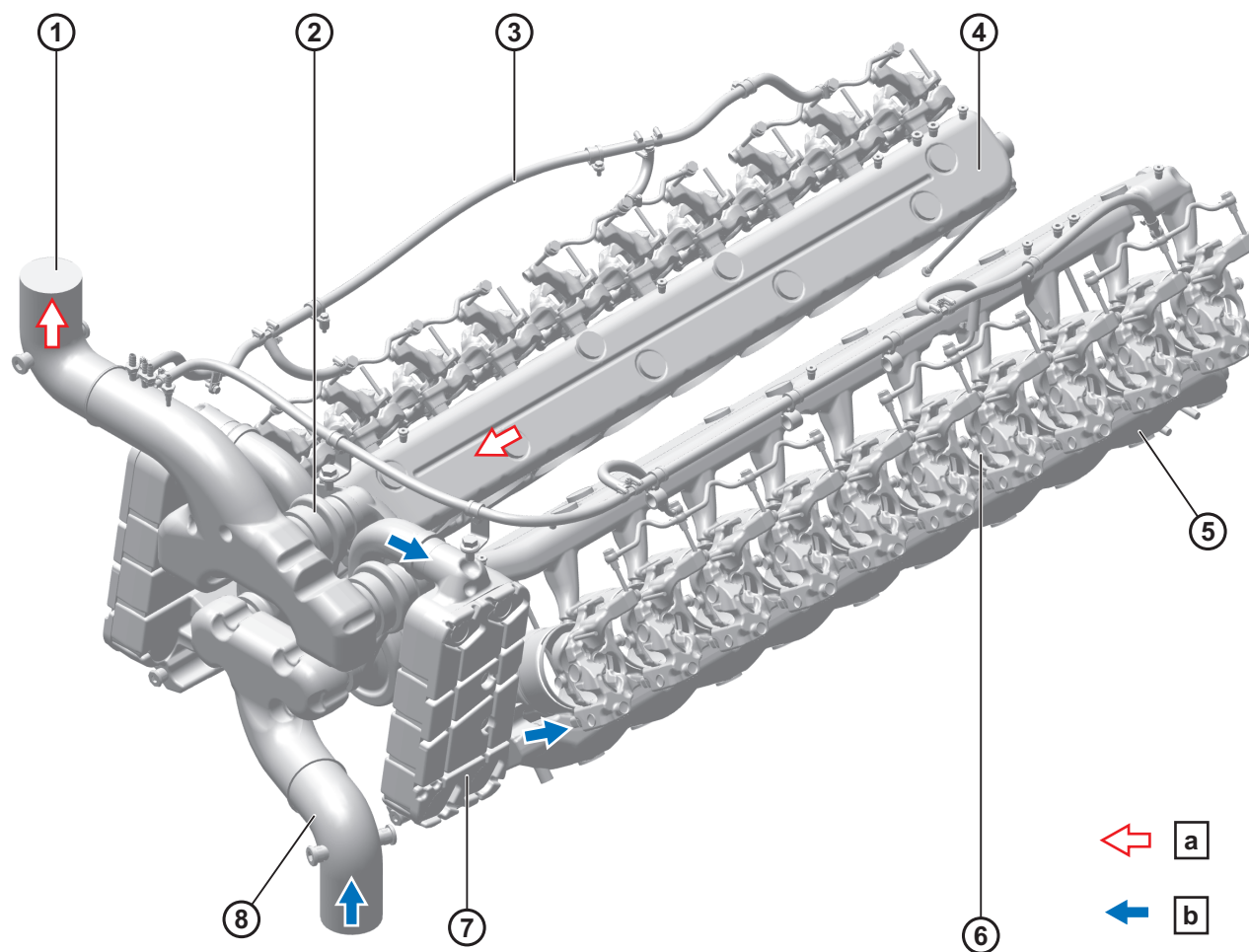
2.9 Coolant diagram (Tier4)

Fig. 27 Coolant diagram



144731

Fig. 28 Coolant diagram



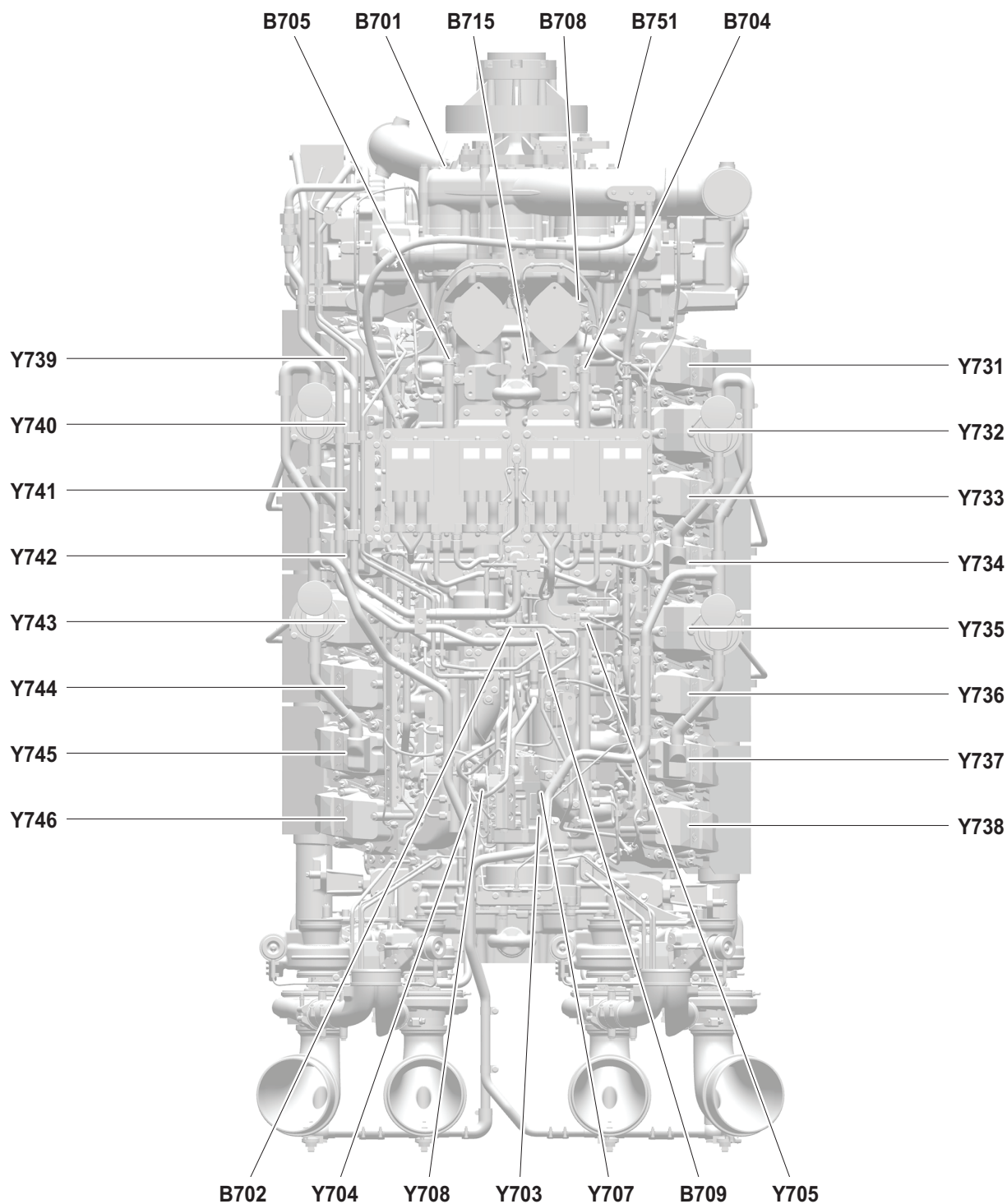
- a Coolant, heated
b Coolant, cooled

- 1 Supply from water cooler
2 Water pumps with thermostats
3 Continuous ventilation
4 Return from cylinder head
5 Supply to cylinder head
6 Cylinder head
7 Oil cooler
8 Return from water cooler

2.10 Engine electrics

2.10.1 Overview of sensors and actuators (engine KD36V16)

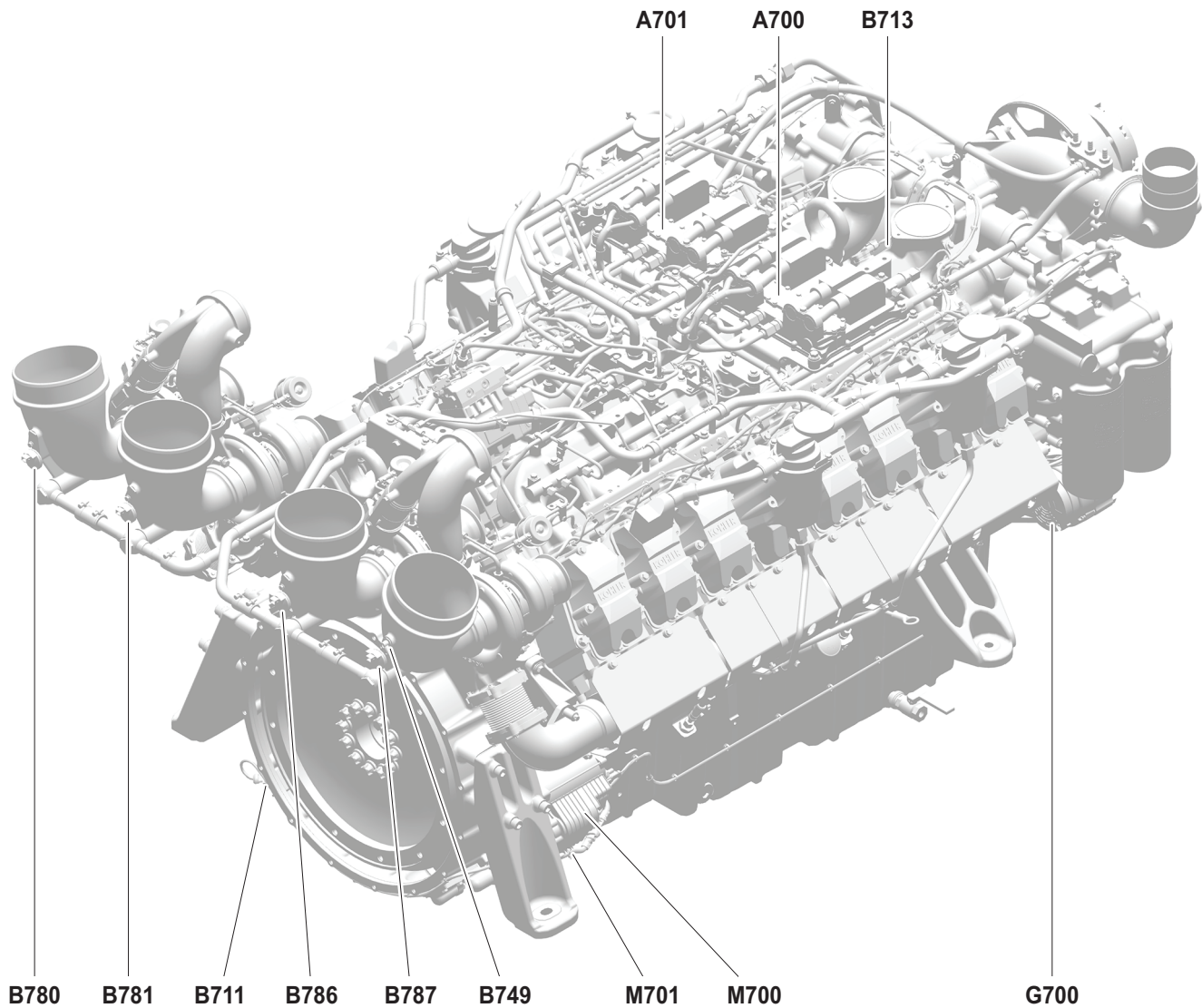
Fig. 29 Overview of sensors and actuators (with equipment identification)



B701 Oil pressure sensor
 B702 Fuel pressure sensor
 B704 Rail pressure sensor 1

Y733 Cylinder 3 injector
 Y734 Cylinder 4 injector
 Y735 Cylinder 5 injector

B705	Rail pressure sensor 2	Y736	Cylinder 6 injector
B708	Coolant temperature sensor	Y737	Cylinder 7 injector
B709	Fuel temperature sensor	Y738	Cylinder 8 injector
B715	Charge air temperature and pressure	Y739	Cylinder 9 injector
B751	Oil temperature sensor	Y740	Cylinder 10 injector
Y703	High pressure pump VCV1	Y741	Cylinder 11 injector
Y704	High pressure pump VCV2	Y742	Cylinder 12 injector
Y705	Wastegate control valve	Y743	Cylinder 13 injector
Y707	High pressure pump PCV1	Y744	Cylinder 14 injector
Y708	High pressure pump PCV2	Y745	Cylinder 15 injector
Y731	Cylinder 1 injector	Y746	Cylinder 16 injector
Y732	Cylinder 2 injector		

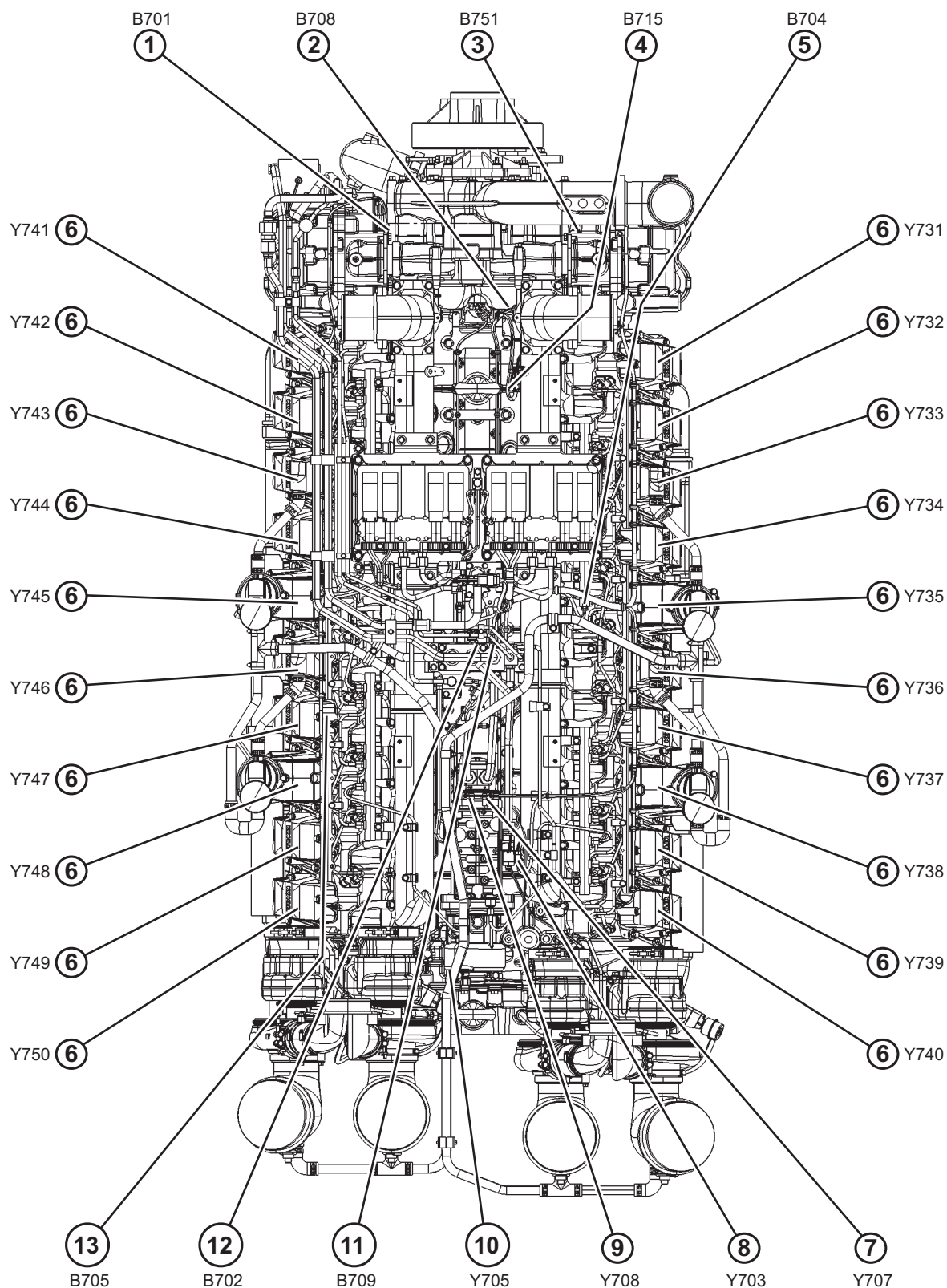
Fig. 30 Overview of sensors and actuators (with equipment identification)

A700 Engine control unit
 A701 Engine control unit
 B711 Speed sensor
 B713 Phase sensor
 B749 Air filter temperature sensor
 B780 Air filter pressure switch

B781 Air filter pressure switch
 B786 Air filter pressure switch
 B787 Air filter pressure switch
 G700 Alternator for battery charging
 M700 Starter
 M701 Starter

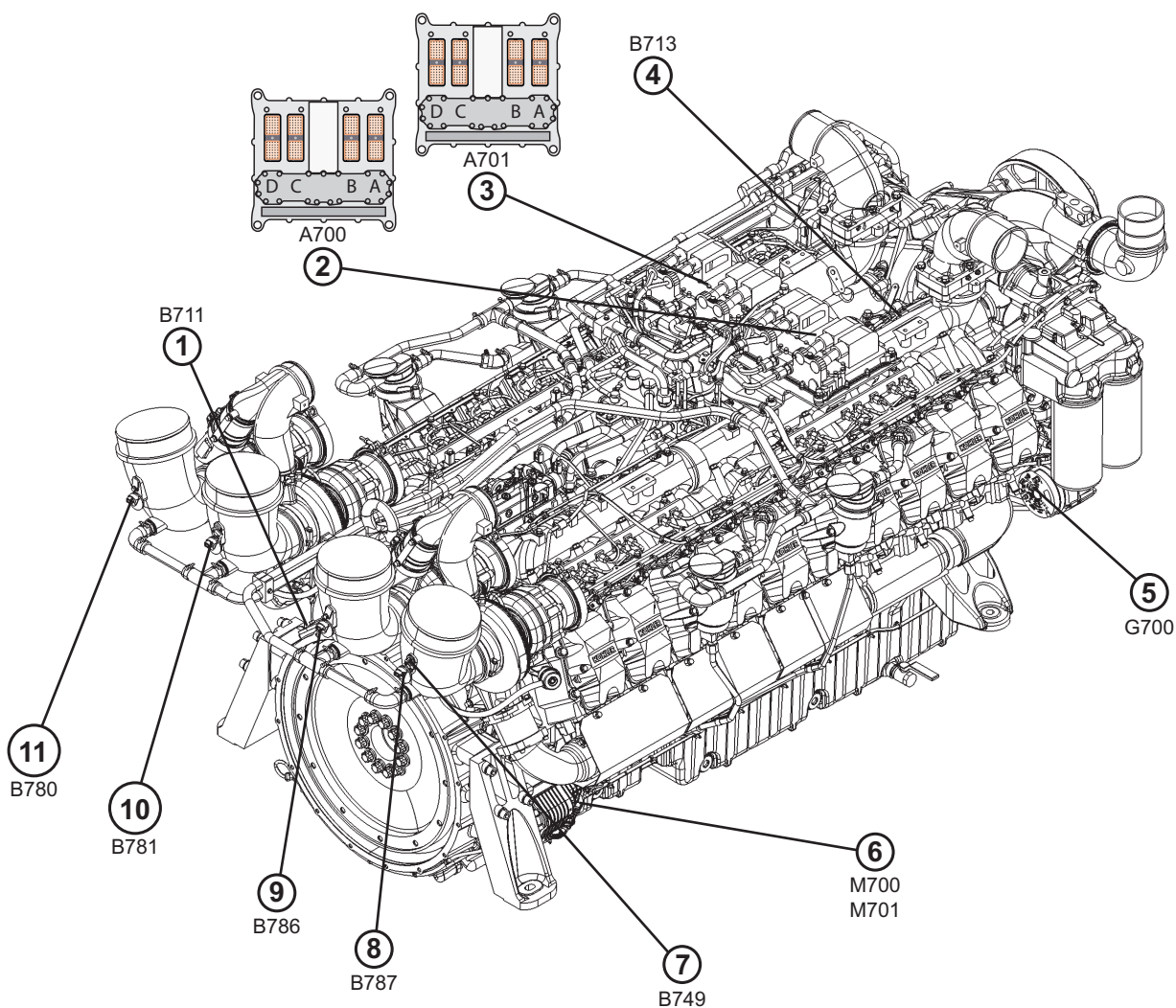
2.10.2 Overview of sensors and actuators (engine KD45V20)

Fig. 31 Overview of sensors and actuators (with equipment identification)



Engine electrics

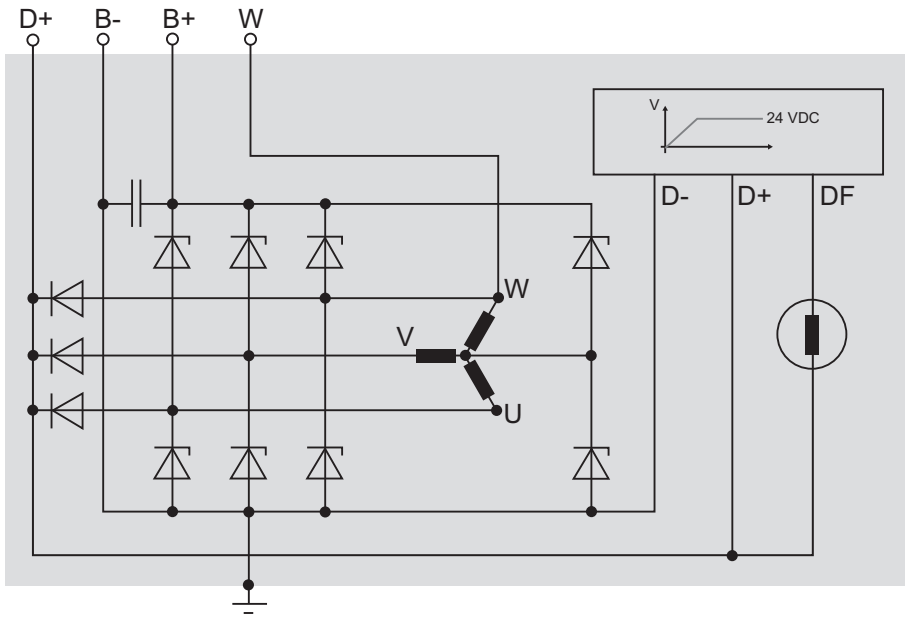
1	Oil pressure sensor	8	High pressure pump VCV
2	Coolant temperature sensor	9	High pressure pump PCV2
3	Oil temperature sensor	10	Wastegate control valve
4	Charge air temperature and pressure	11	Fuel temperature sensor
5	Rail pressure sensor 1	12	Fuel pressure sensor
6	Injector	13	Rail pressure sensor 2
7	High pressure pump PCV1		

Fig. 32 Overview of sensors and actuators (with equipment identification)

- | | | | |
|---|---------------------------------|----|-------------------------------|
| 1 | Speed sensor | 7 | Air filter temperature sensor |
| 2 | Engine control unit | 8 | Air filter pressure switch |
| 3 | Engine control unit | 9 | Air filter pressure switch |
| 4 | Phase sensor | 10 | Air filter pressure switch |
| 5 | Alternator for battery charging | 11 | Air filter pressure switch |
| 6 | Starter | | |

2.10.3 Alternator for battery charging function

Fig. 33 Internal electrical diagram for alternator for battery charging



142848

Pos.	Name	Functional information
D+	Diagnostics connection	Rectified DC voltage, used by the regulator to control the voltage between B+ and B-. The excitement of the alternator for battery charging occurs via connection D+, see 49.
B-	Ground connection	
B+	Battery voltage	Nominal voltage 28 V, nominal current 140 A
D-	Ground connection for regulator	
DF	Field controller	The magnetic field strength is controlled via DF.
W	Alternating current	The actual speed can be determined via the frequency of the alternating current signal. This function is not used.

Information



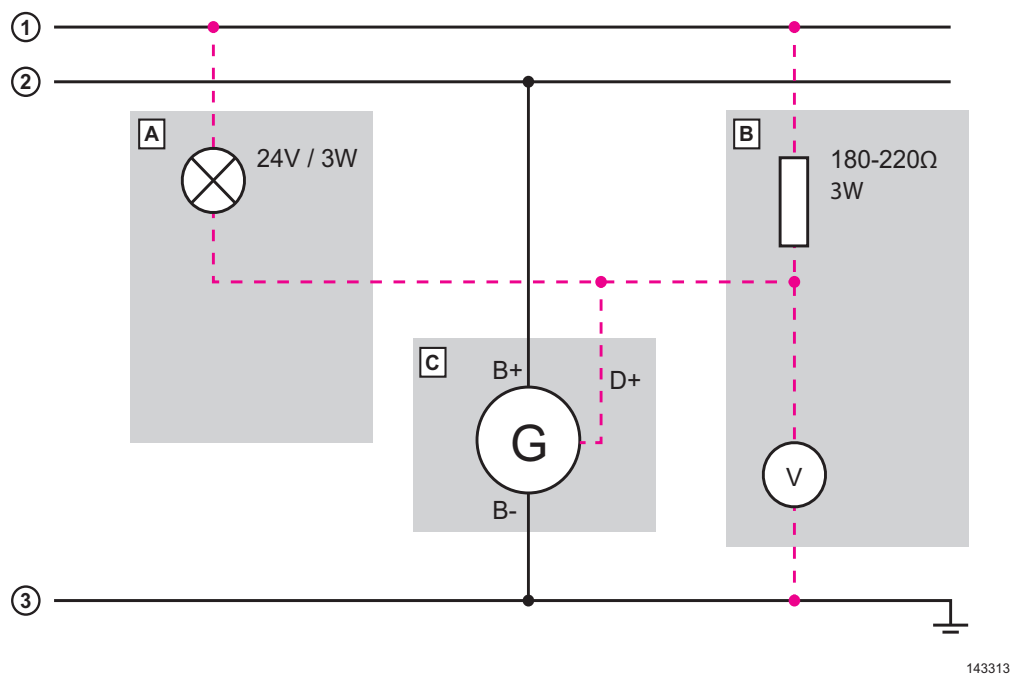
Permissible voltage drop between the alternator for battery charging and the battery, maximum of 0.5 V at 140 A:

- Use short cables if possible.
- All cable contacts must be free of grease and paint. Protect against oxidation.

Excitement for alternator for battery charging

The alternator for battery charging needs a minimum voltage at the connection (D+) to build up a magnetic field. No current is generated without a starting voltage.

Fig. 34 Excitement for alternator for battery charging

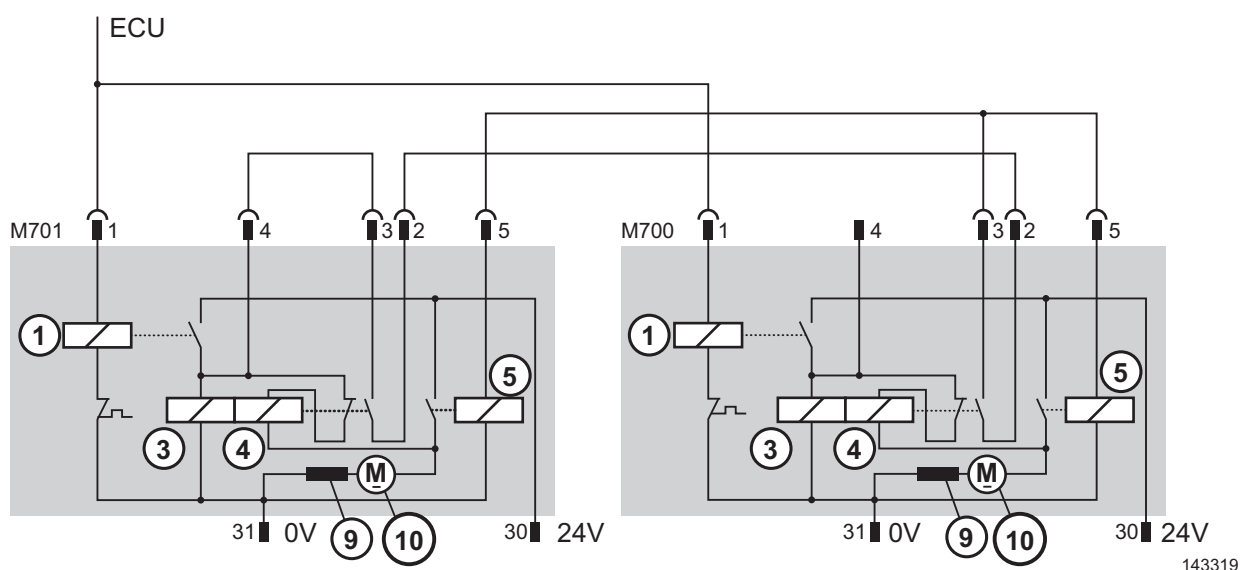
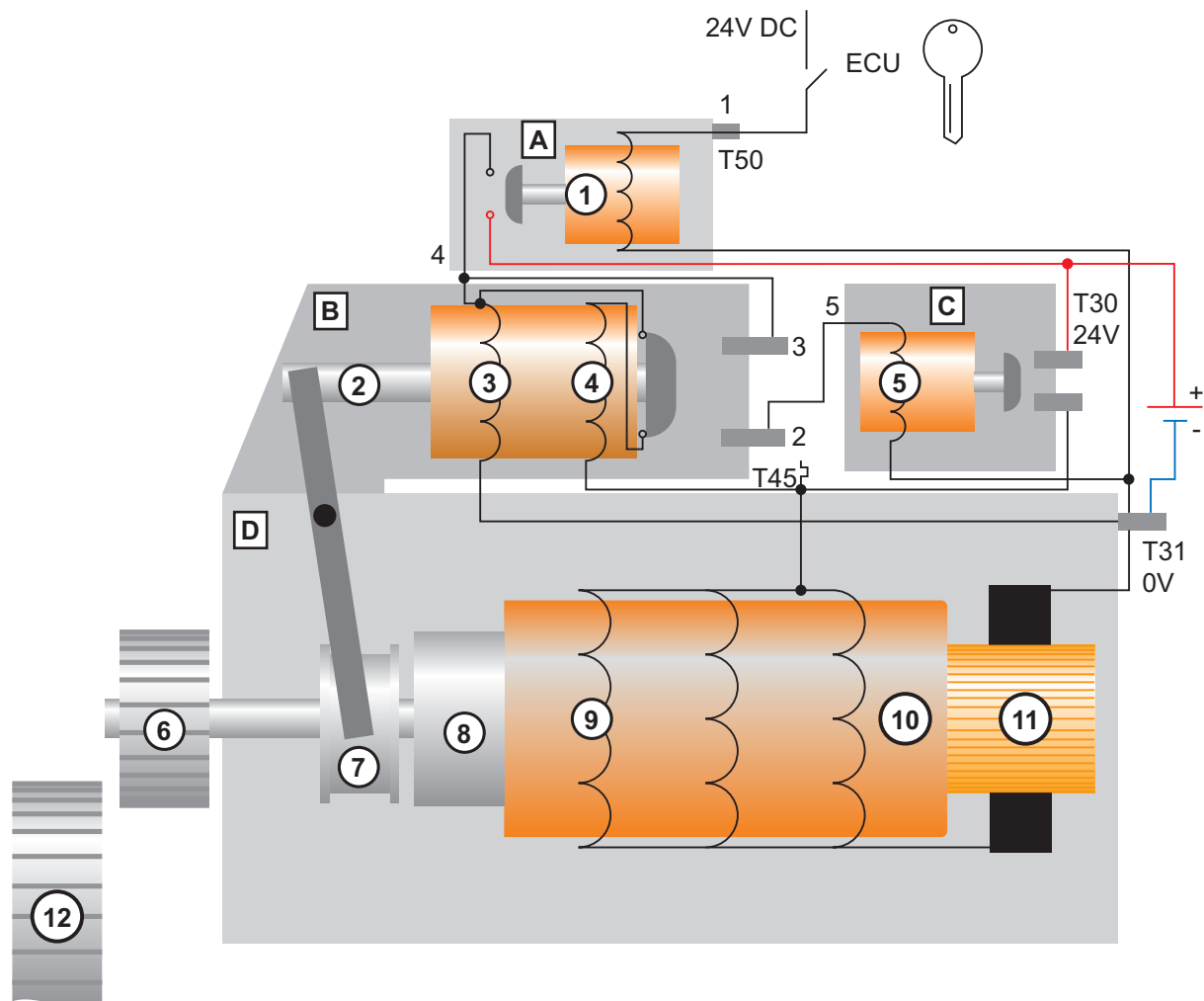


Pos.	Name	Functional information
A	Option 1	The presence of the external excitation current is displayed by the light bulb.
B	Option 2	The excitation current is limited by the resistor. Voltage monitoring is the feedback that an excitation is present.
C	Alternator for battery charging	
1	Ignition	
2	Battery plus	
3	Ground	

2.10.4 Starter function

The individual starter and the electrical diagram for parallel operation are shown below. The parallel connection is controlled by M700-M701 of the ECU master. The starter motors do not switch to full torque until both pinions are engaged in the flywheel.

Fig. 35 Starter design



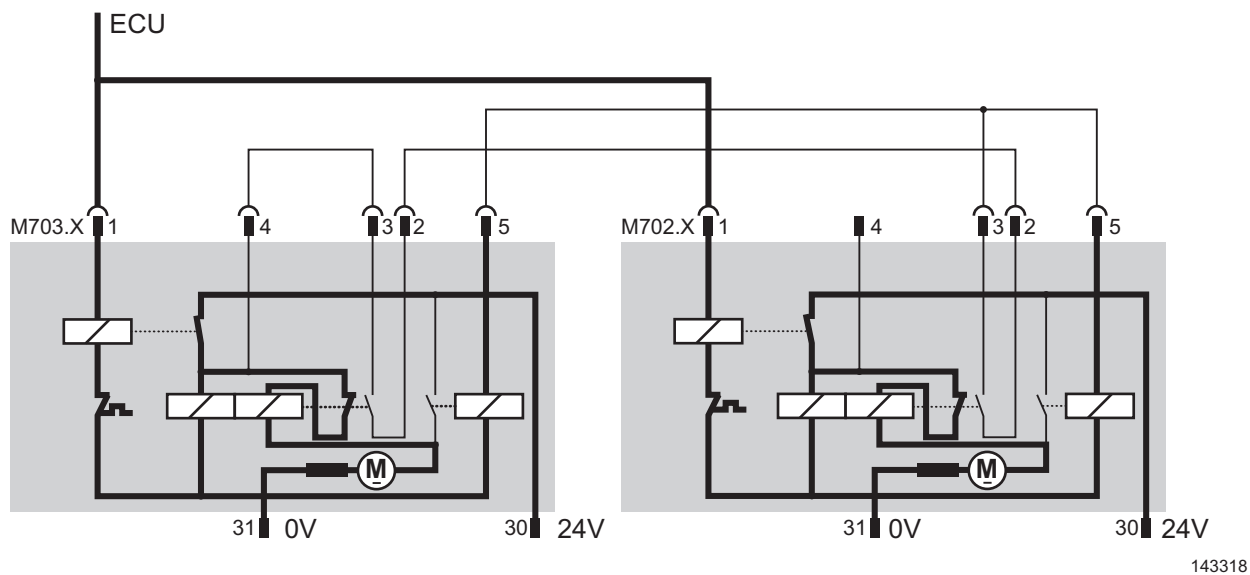
143319

Pos.	Name	Functional information
A	Starter relay	
B	Feed system	
C	Power relay	
D	Starter motor	
1	Starter relay	
2	Piston	
3	Holding winding	
4	Pull-in winding	
5	Power relay coil	
6	Pinion	
7	Slider	
8	Gear box with overspeed clutch	
9	Starter stator winding	
10	Starter rotor winding	
11	Collector	
12	Starter gear ring	
T30	Battery voltage connection	
T31	Battery ground connection	
T45	Starter motor winding connection	A temperature sensor is attached to the terminal. The starter relay interrupts in case of overheating.
T50	Start signal from ECU	

Starting the diesel engine

See Fig. 35 for details

Fig. 36 Starting the ignition diagram



- ECU gives signal to starter relay (1).
- Current flows through holding winding (3) and pull-in winding (4).
- The piston (2) moves the pinion (6) to the starter gear ring (12).
- Since the pull-in winding (4) and the starter windings (9 and 10) are connected in series, the starter turns slowly.

Fig. 37 Starting the ignition

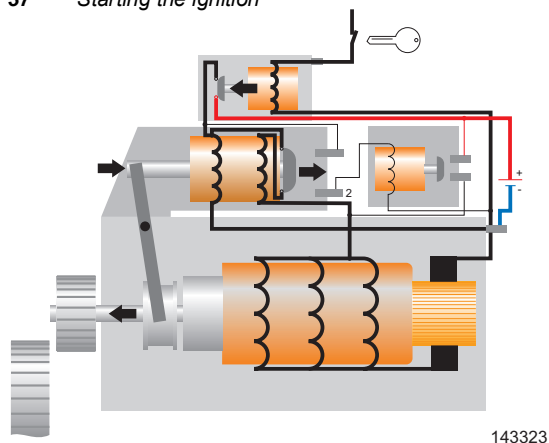
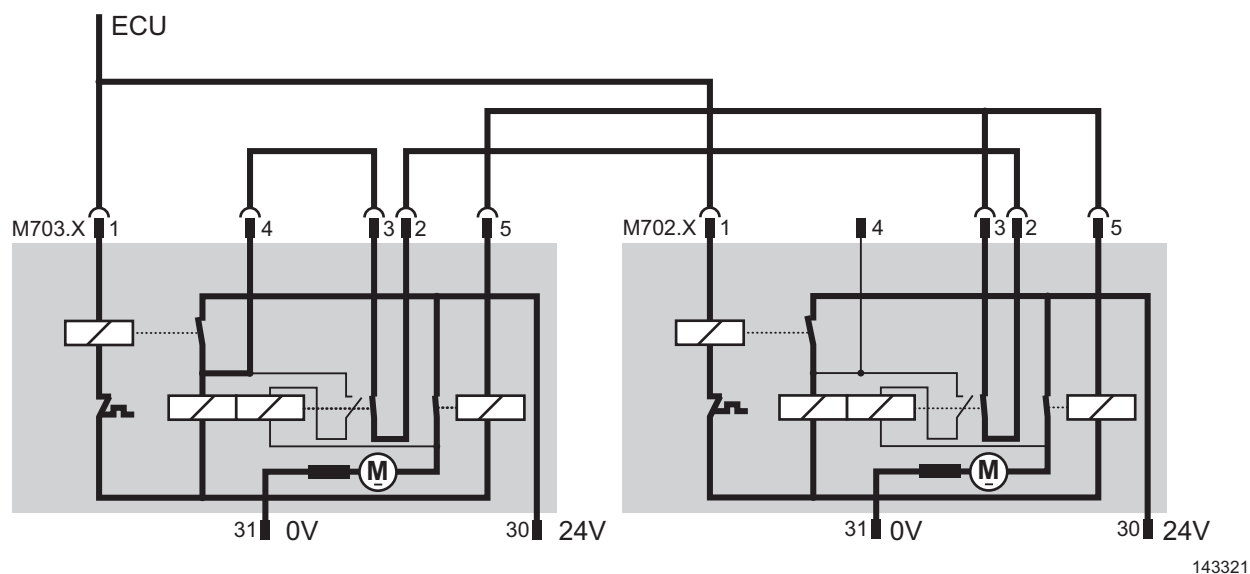


Fig. 38 Starting the diesel engine diagram

- As soon as the pinion (6) engages in the starter gear ring (12), the contact to the power relay (5) is closed.
- The pull-in winding (4) becomes inactive.
- The total voltage (approx. 24 V) is via the starter windings (9 and 10).
- Starter turns with maximum torque.

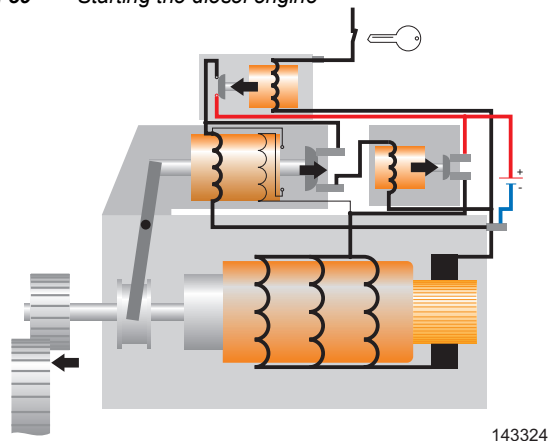
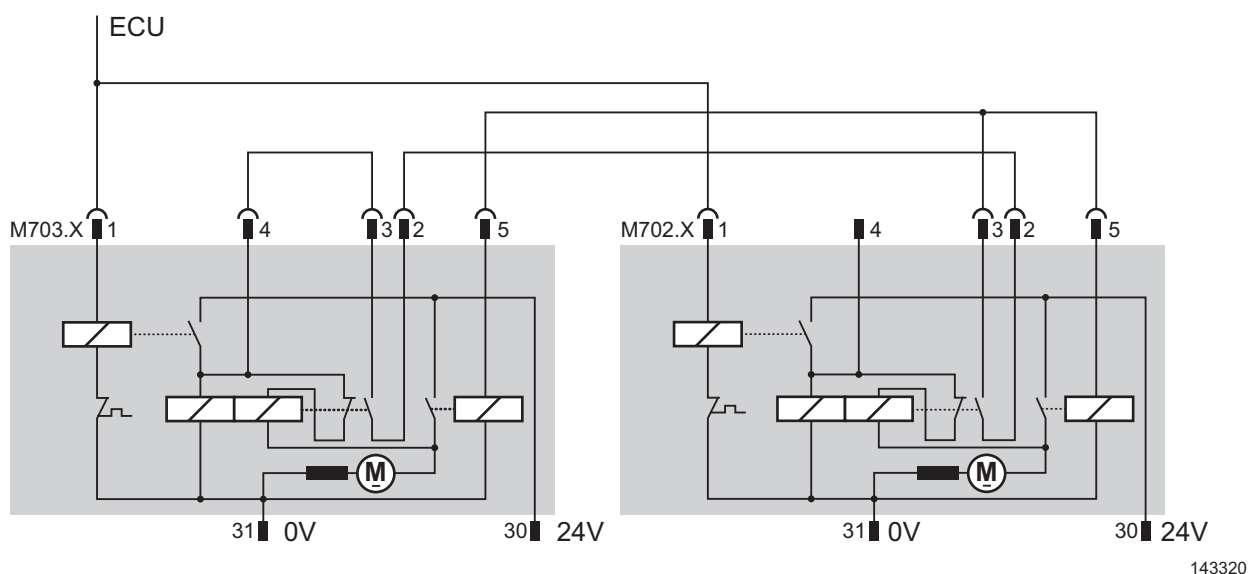
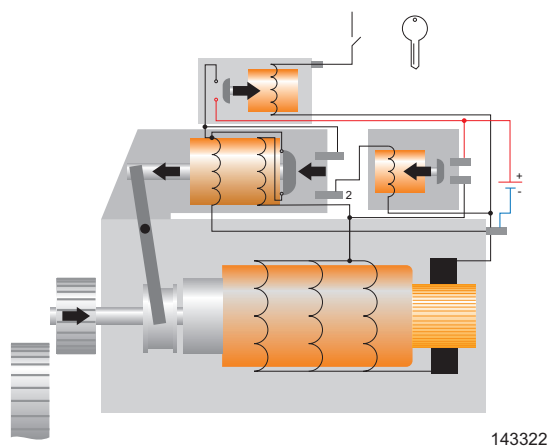
Fig. 39 Starting the diesel engine

Fig. 40 Diesel engine is started diagram

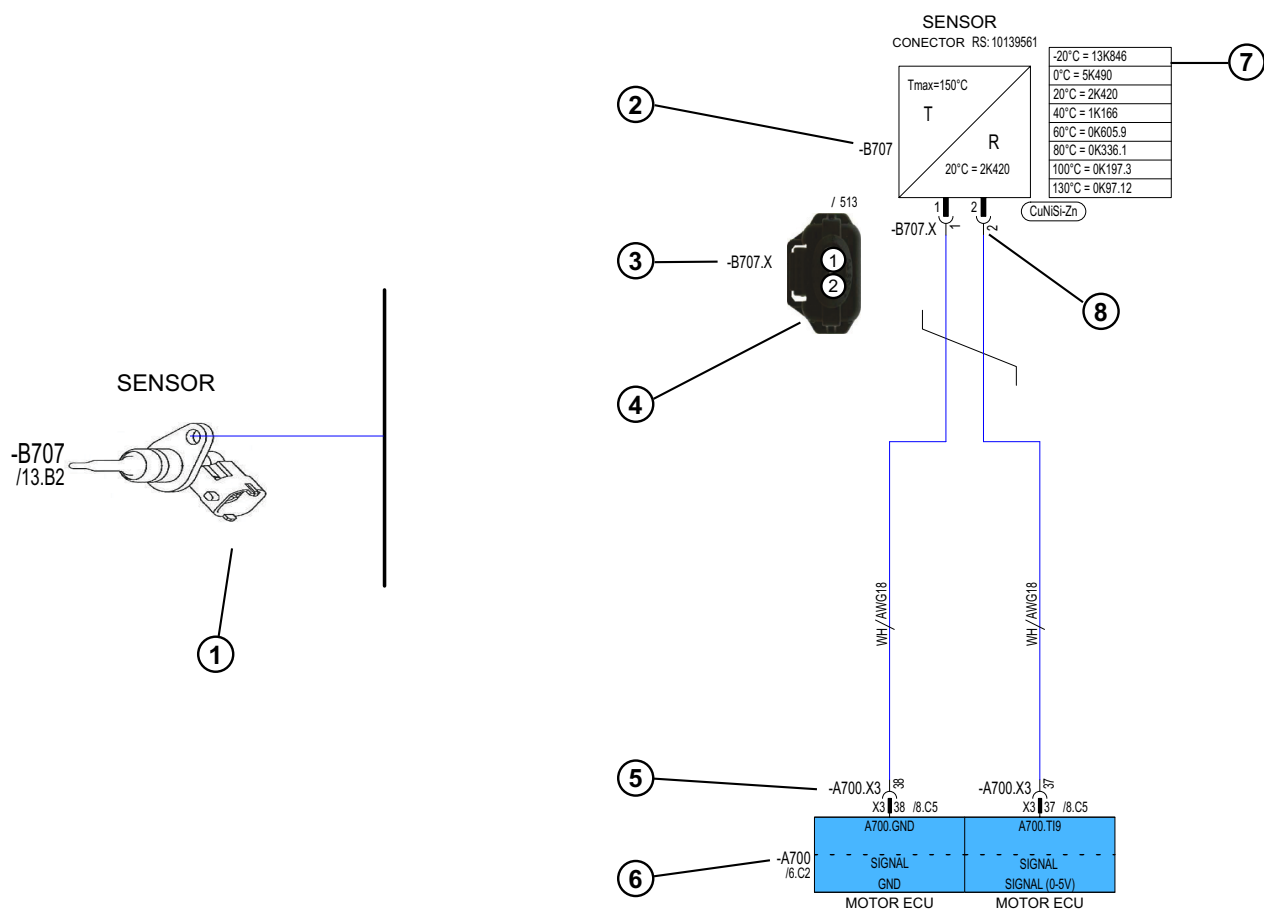
- As soon as the diesel engine fires, the ECU takes away the signal at the starter relay (1).
- The holding winding (3) no longer gets any current.
- The pinion (6) is pulled out of the starter gear ring (12).
- The power relay (5) interrupts the current to the starter windings (9 and 10).

Fig. 41 Diesel engine is started

2.10.5 Itemization of cable designation according to circuit diagram

Example:

Fig. 42 Circuit diagram example



141356

- | | | | |
|---|--|---|---------------------------------------|
| 1 | Figure in cable diagram | 5 | Plug connection to control |
| 2 | Component designation (equipment identification) | 6 | Connection to control |
| 3 | Plug designation | 7 | Technical info for component |
| 4 | Plug representation | 8 | Plug designation with pin connections |

Example: B707X:

- B Definition of which element type it is
 707 Reference in circuit diagram
 X Plug

Reference identifier according to standard:

- A Control unit, assemblies
 B Sensor
 E Radiator
 F Fuse
 G Alternator
 K Relay

Engine electrics

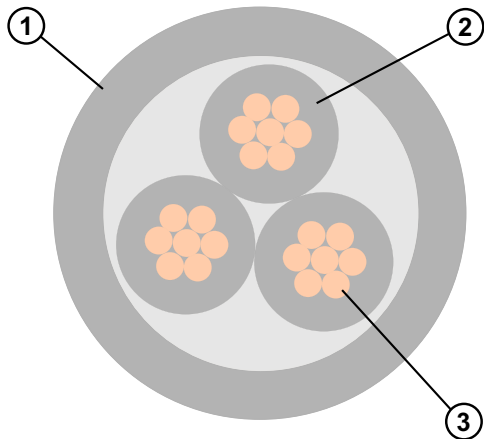
- M Engine
- R Resistor
- S Switch
- X Plug, socket, terminal
- Y Valve

Itemization of strand designation according to circuit diagram

Cable design (cut)

- 1 Cable
- 2 Strand in cable
- 3 Cores (conductors) in strands

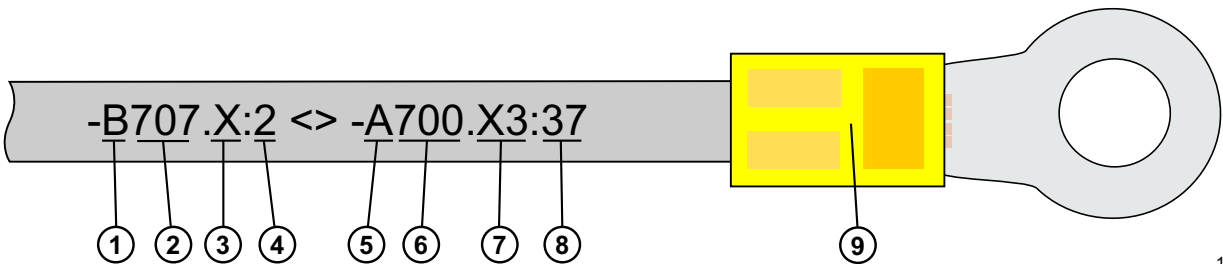
Fig. 43 Cable construction



141358

Example of strand designation:

Fig. 44 Strand designation

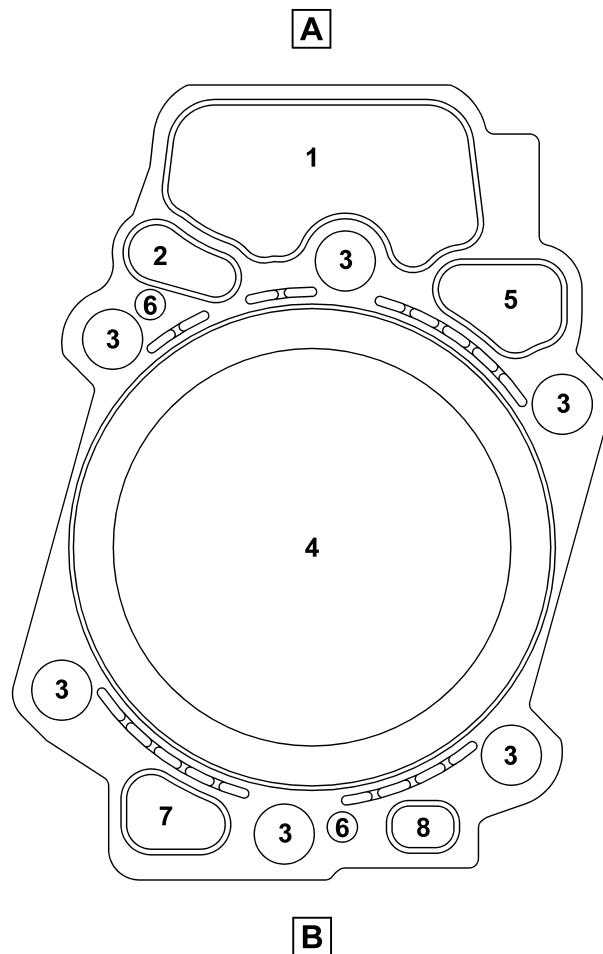


141357

- | | | | |
|---|--|---|--|
| 1 | Origin- equipment identification | 6 | Destination - according to circuit diagram |
| 2 | Origin - according to circuit diagram | 7 | Destination - plug |
| 3 | Origin - plug | 8 | Destination - pin on plug |
| 4 | Origin - pin on plug | 9 | Crimp contact |
| 5 | Destination (equipment identification) | | |

2.11 Assignment of the channels in the crankcase and in the cylinder head

Fig. 45 Assignment of the crankcase and cylinder head channels



140653

- | | | | |
|---|----------------------|---|---------------------------|
| A | Air intake pipe side | 1 | Push rod |
| B | Exhaust pipe side | 2 | Oil supply (pressure oil) |
| | | 3 | Cylinder head screw |
| | | 4 | Combustion chamber |
| | | 5 | Coolant return |
| | | 6 | Positioning pin |
| | | 7 | Coolant supply |
| | | 8 | Oil return |

2.12 Transport device and fastening parts



Information

When the engine is delivered, check it for transport damage:

- Report any transport damage immediately.

2.13 Lifting device and fastening parts



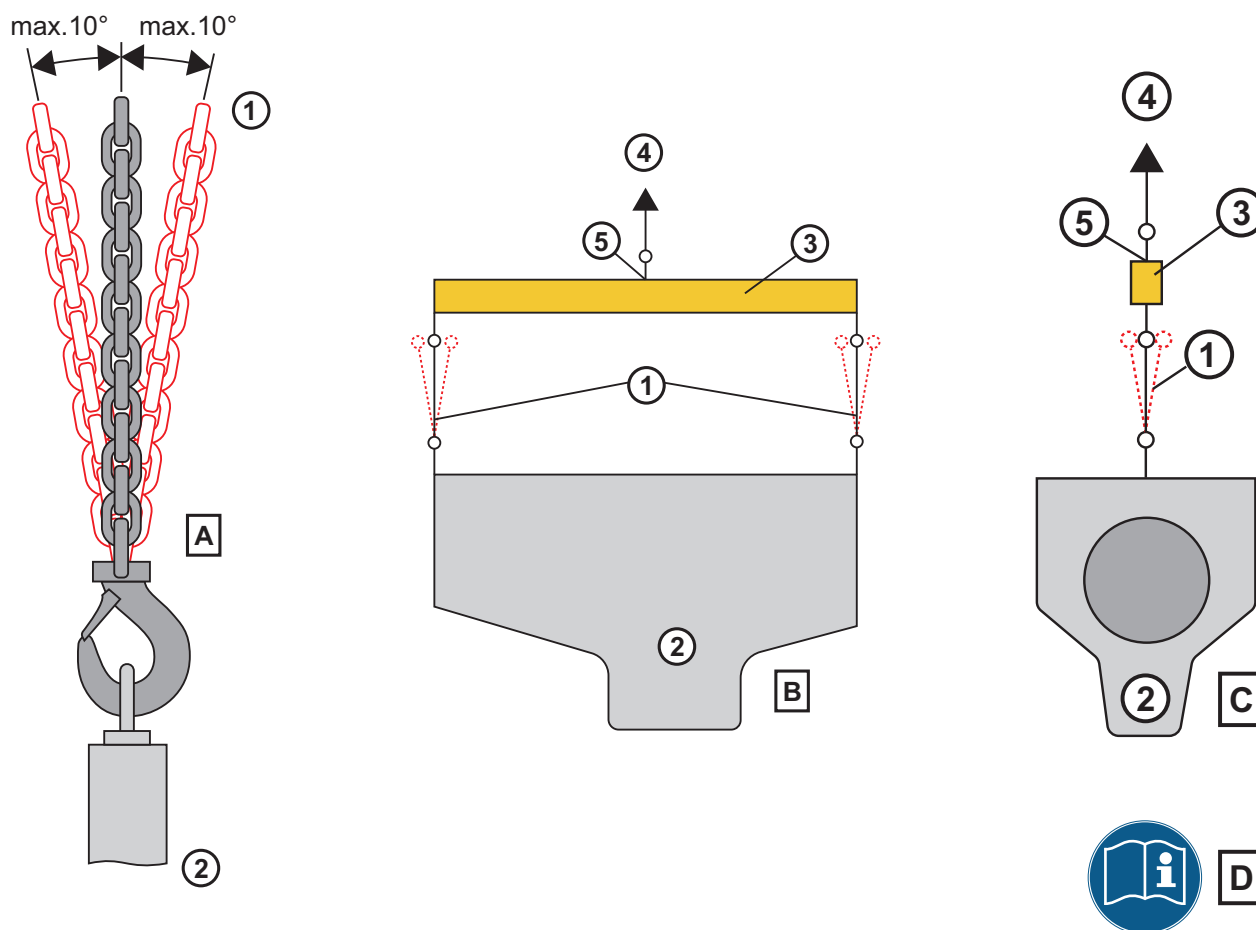
DANGER

Pulling out of the lifting device and falling of the engine.

Causes serious injuries or death.

- No access under suspended loads. Maintain safety distance.
- Observe maximum weight for lifting points.
- Maintain a maximum of a 10° deviation from the vertical to the engine axis.
- Use a KOHLER lifting traverse, see [174](#).
- Remove gear box or other attachments before lifting the diesel engine.
- Take safety instructions / warning signs from the operator's manual of the lifting traverse into account.
- Observe national and international guidelines for lifting heavy loads.

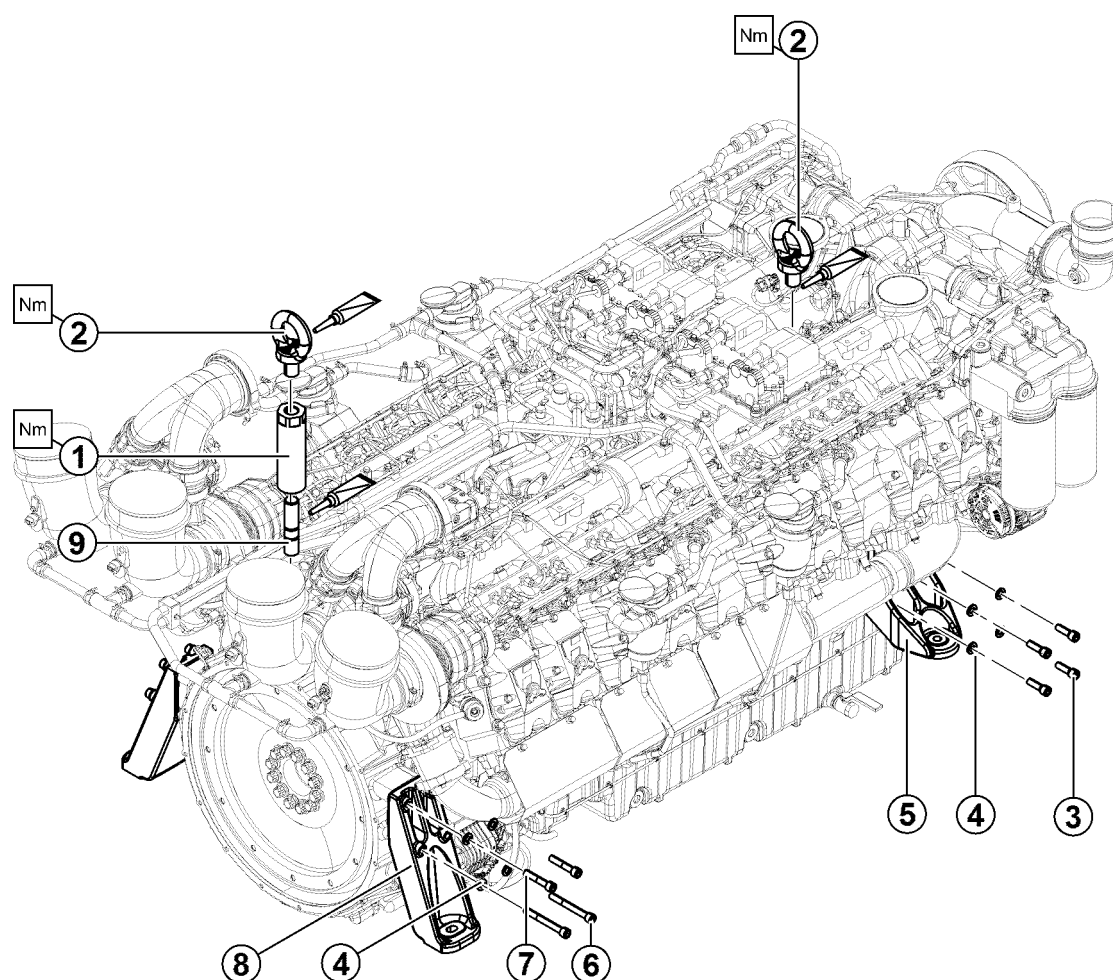
Fig. 46 Lifting device



143266

Pos. Name

- A Lifting device detail view
 B Engine view from the side
 C Engine view from the front / back
 D Take lifting traverse operator's manual into account.
 1 Tolerance for maximum deviation to motor axis.
 2 Engine block
 3 Lifting traverse, see [174](#).
 4 Lifting point for engine with lifting traverse (observe maximum total load)
 5 Tolerance for maximum horizontal deviation

2.13.1 Removing, installing the fastening parts**Fig. 47** Fastening parts

143460

Pos. Name

- 1 Spacer
 2 M36x54x46 C15E ring bolt
 3 M16x50 10.9 cylinder screw
 4 Washer
 5 Fastening parts
 6 M16x130 10.9 cylinder screw

Work instructions

- ✱ See tightening instruction [60](#)
 ✱ See tightening instruction [60](#)

Lifting device and fastening parts

Pos.	Name	Work instructions
7	M16x80 10.9 cylinder screw	
8	Fastening parts	
9	Stud bolt	

Lifting device tightening instruction

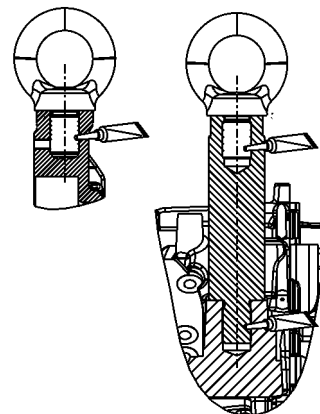
Ring bolt and spacer

Lubricant	-
Locking agent	Loctite 243
Part contact surfaces	
Screws reusable?	Yes
Stage	Torque
1.	110 ±10 Nm (81 ft lb)

After tightening, check the following:

- Ring bolt completely screwed in
- Ring bolt rests fully on the contact surface.

Fig. 48 Lifting hook



143236

2.14 Transporting the diesel engine

**DANGER**

Lack of stability when transporting the diesel engine.
Causes serious injuries or death.

- Use the original transport devices that were used by Kohler Co. for the delivery.
- Secure transport device with attached engine against slipping and falling over when transporting on a vehicle.

**DANGER**

Protective atmosphere against oxidation damage inside the protective foil.
Risk of suffocation. Causes serious injuries or death.

- Remove and store protective foil only in well ventilated areas.
- Protective foil may only be stored in areas that are inaccessible to children.

**CAUTION**

Incorrect waste disposal.
Environmental and health hazards.

- Observe national and international guidelines for disposal of waste materials.
- Dispose of all waste in appropriate containers.
- Store waste in designated areas.

NOTE

Incorrect setting down of the diesel engine.
Engine damage.

- Do not lay diesel engine on the oil pan.
- Lay diesel engine on the corresponding fastening parts, see [Fig. 47](#).

NOTE

Improper storage.
Oxidation damage.

- Only store the diesel engine in dry locations.
- Do not expose the diesel engine to severe temperature fluctuations.
- Only remove the transport protective foil shortly before installation, see [Fig. 49](#).
- When the diesel engine is removed: Apply new protective foil and observe climatic conditions for storage.

NOTE

Storage conditions are the responsibility of the machine owner.
In the event of uncertainties, contact your nearest authorized Kohler customer service.

NOTE

The machine owner is responsible for observing the maximum floor load.
Check the maximum floor load before setting the diesel engine down on it.
The weight data can be found in the technical data sheet.

**Information**

Only use preservatives approved by Kohler Co.

2.14.1 Transport attachment

Fig. 49 Example of transport attachment

**DANGER**

Lack of stability when transporting the diesel engine.
Causes serious injuries or death.

- Only transport the diesel engine with a transport device.
- Make sure that the transport device is in technically perfect condition.
- Secure the transport device against shifting and falling in all directions.
- Observe information on the center of gravity.

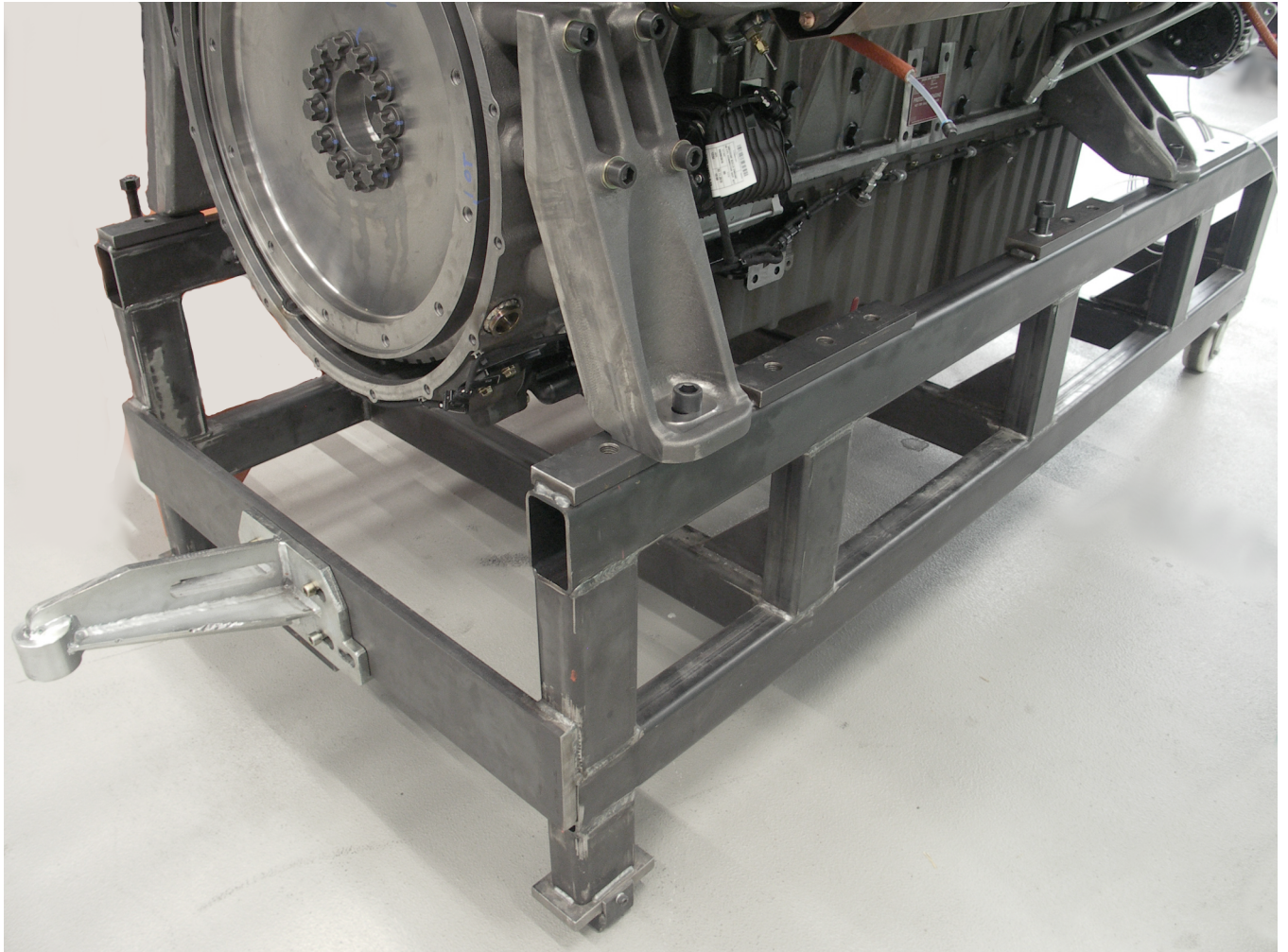
**DANGER**

Falling or tilting of the diesel engine. Improper loading or unloading of the diesel engine.
Causes serious injuries or death.

- Make sure that only trained and authorized personnel load or unload the diesel engine.
- Make sure that the crane or forklift is designed for the weight to be lifted.
- If a crane is used: Use a Kohler Co. lifting traverse, see [58](#).
- Make sure that no persons reside in the danger zones during the loading or unloading.
- Observe information on the center of gravity.

2.14.2 Steel transport device

Fig. 50 Steel transport device

**DANGER**

Lack of stability when transporting the diesel engine.
Causes serious injuries or death.

- The diesel engine must be screwed together securely with the transport device.

**Information**

Return steel transport devices to Kohler Co.

2.14.3 Wood transport device

Fig. 51 Wood transport device

**DANGER**

Lack of stability when transporting the diesel engine.
Causes serious injuries or death.

- The diesel engine must be screwed together securely with the transport device.

**Information**

Wood transport devices do not need to be returned to Kohler Co.
Keep for later use.

2.15 Starting the engine



WARNING

Unexpected engine start.

Can cause serious injuries or death.

- Make sure that there are no persons in the safety zones of the diesel engine, see 16.
- Make sure that all protective devices are in position and are functioning (enclosure is closed).
- Secure external system parts against unexpected movement.
- Remove persons from the danger zones.

NOTE

Continuous operation.

Damage to the starter.

- Let the starter run a maximum of 30 seconds.
- After the first start attempt, wait at least two minutes until the next attempt.
- After the second start attempt, wait at least five minutes for each additional attempt.
- ECU software can prevent the starting process, depending on the start time and start attempts, to protect against overheating.

NOTE

Insufficient lubrication.

Engine damage.

- Make sure that oil pressure builds up immediately after starting the diesel engine.

Prerequisites:

- Oil level is OK.
- Coolant is filled.
- Charge air is connected.
- Outflow of exhaust gases is ensured.
- The electrical power supply is ready.
- Fuel supply is connected.

Procedure:

- Take safety instructions from the “Safety” chapter on page 9 into account.
- Turn electrical power supply on (battery voltage).
- Using the KODIA diagnostics program, check that there are no fault messages.
- If fault messages exist: Rectify faults.
- There may not be any faults pertaining to the diesel engine on the system.
- If faults exist: Rectify faults.
- Activate the starter a maximum of 30 seconds.
- If the engine does not start: Wait at least two minutes, and activate the starter again for a maximum of 30 seconds. For each additional attempt, wait at least five minutes.
- The engine does not start after repeated start attempts: Make sure that connections are attached correctly and sufficient operating materials are present.
Troubleshooting with KODIA diagnostics program.

2.15.1 Final check

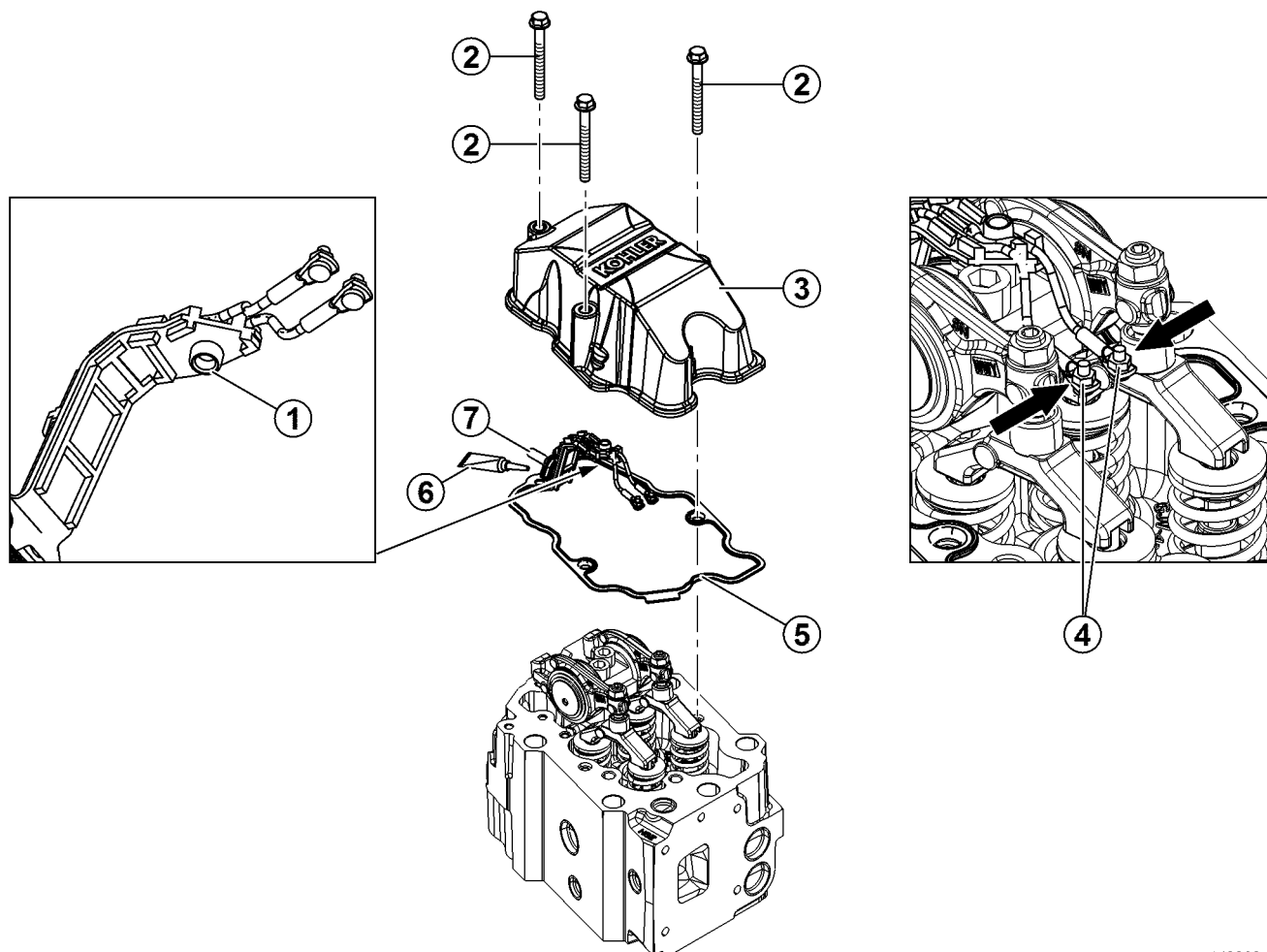
After a successful engine start, stop the engine and perform the following checks. If required, refill operating fluids.

- Check oil level.
- Check coolant level.
- Visually ensure that there are no leaks to be found on the lines.
- Check KODIA fault messages.
- Check generator side fault messages.

3 Cylinder head, engine control unit and valves

3.1 Removing, installing the cylinder head cover

Fig. 52 Cylinder head cover



143868

Pos.	Name	Work instructions	
1	Fastening nubs		
2	M8x40 8.8 hexagonal collar screw		
3	Cylinder head cover		
4	Electrical connection	✱	see 68
5	Cylinder head cover seal	✱	see 68
6	Optimol White T	✱	see 68
7	Cable feed-through		

Cable harness on injector tightening instruction**NOTE**

Exposed cable connections. The cable lug rotates as it is tightened.
Short circuit possible.

- Hold the cable lug in place (see arrow)!

NOTE

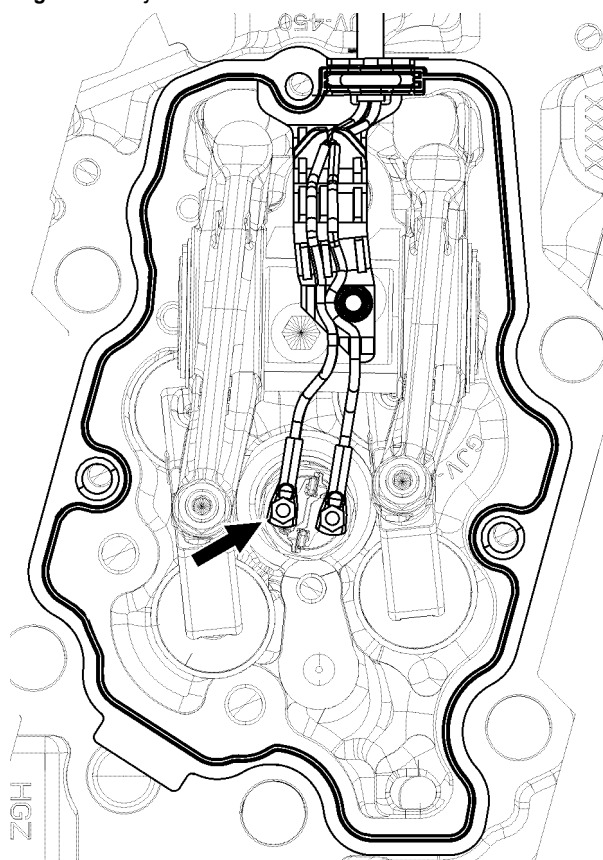
The connection thread in the solenoid valve can be twisted.

The injector will be destroyed.

- Use tightening torque according to the tightening instruction!

M4 hex nut

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes
Stage	Torque
1.	1.8 +0.2 Nm (1.3 +0.15 ft lb)

Fig. 53 Injector**3.1.1 Installing the cylinder head cover seal****NOTE**

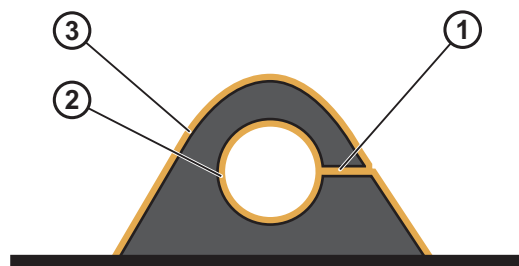
Oil contamination due to incorrect installation of the seal.

- Coat the area of the cable feed-through with Optimol White T.
- After each removal of the cylinder head cover, remove any contamination and coat with Optimol White T again.

To ensure tightness, the contact surface of the plastic feed-through must be lubricated with Optimol White T.

Lubricate the following areas:

- 1 Feed-through slot
- 2 Cable feed-through
- 3 Contact surface to cylinder head cover

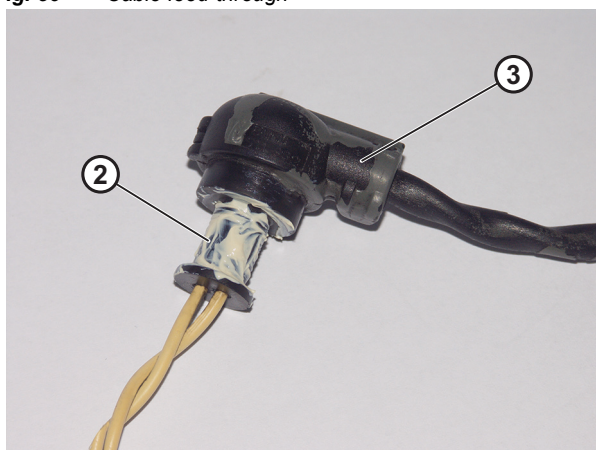
Fig. 54 Areas to be greased

Procedure

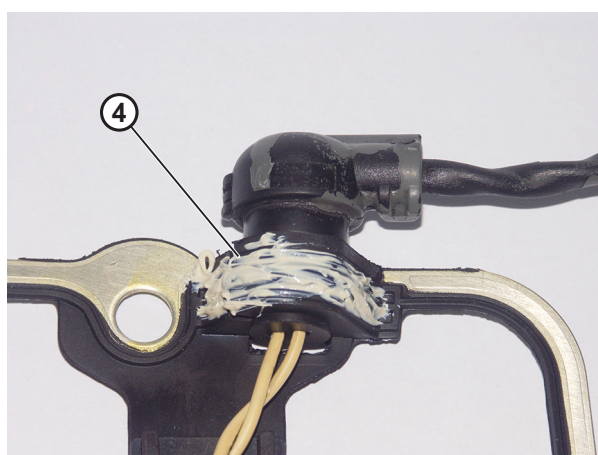
- Check seal for damage. Damages to the seal are:
 - Deformation of the seal
 - Visible cracks on the seal
 - Visible cracks on the cylinder head cover.
- If the seal is damaged:
 - Replace seal.
- Open cable feed-through a little by hand.
- Apply Optimol White T in the closing area (1).

Fig. 55 Sealing slit

- Apply Optimol White T to cable feed-through in the area of the feed-through (2).
- Insert cable (3) in cable feed-through (Fig. 54, pos.2).

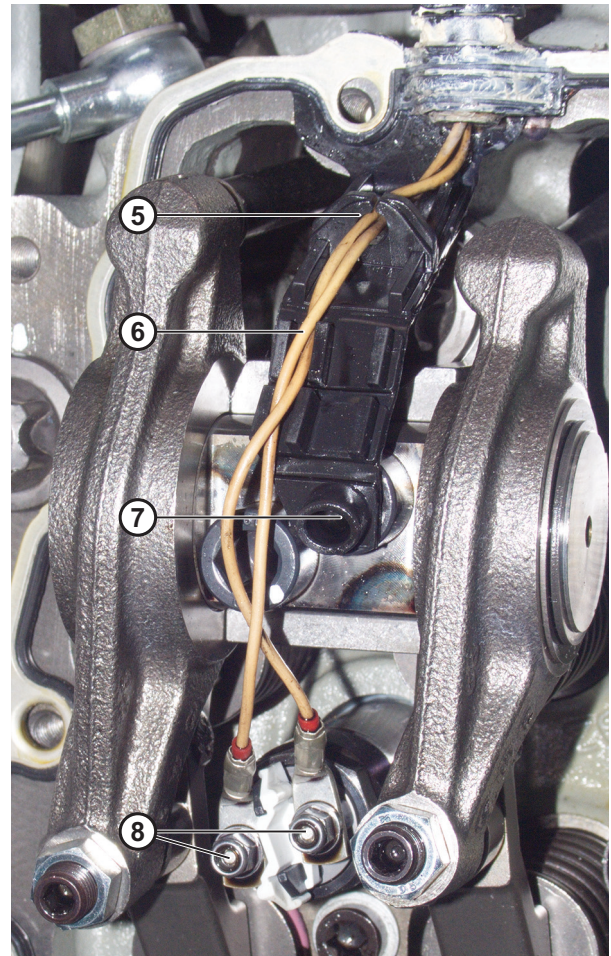
Fig. 56 Cable feed-through

- Apply Optimol White T to contact surface to cylinder head cover (4).

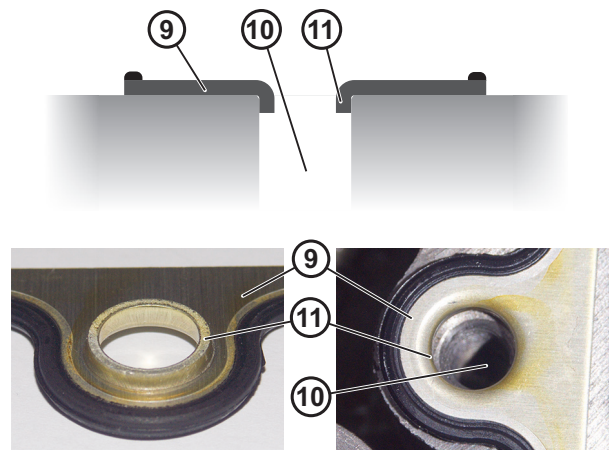
Fig. 57 Contact surface to cylinder head cover

Removing, installing the cylinder head cover

- Insert strand in feed-through (5).
- Insert strand in guide (6).
- Insert fastening nubs (7) on screw head.
- Tighten strands on injector according to tightening instruction, see 68.

Fig. 58 Routing of strands

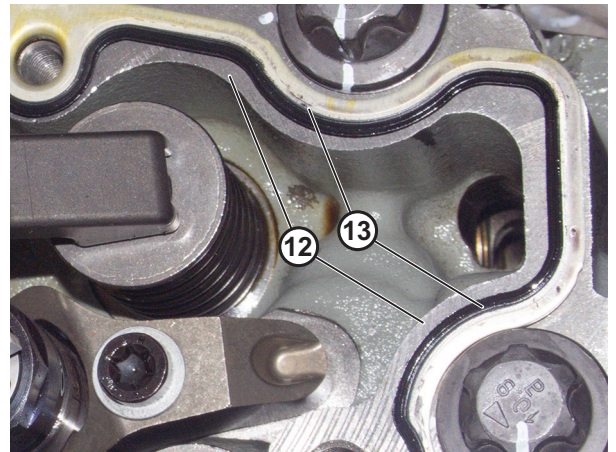
- Align position (11) of seal (9) to hole of cylinder head (10).

Fig. 59 Aligning the seal

The seal can be distorted by improper handling.

- Visually check the position of the seal (13). The seal may not be outside the sealing surface (12). Replace seals that have a distorted shape.
- Install cylinder head cover so that the seal (Fig. 59, pos. 9) is not moved out of position (Fig. 59, pos. 11).

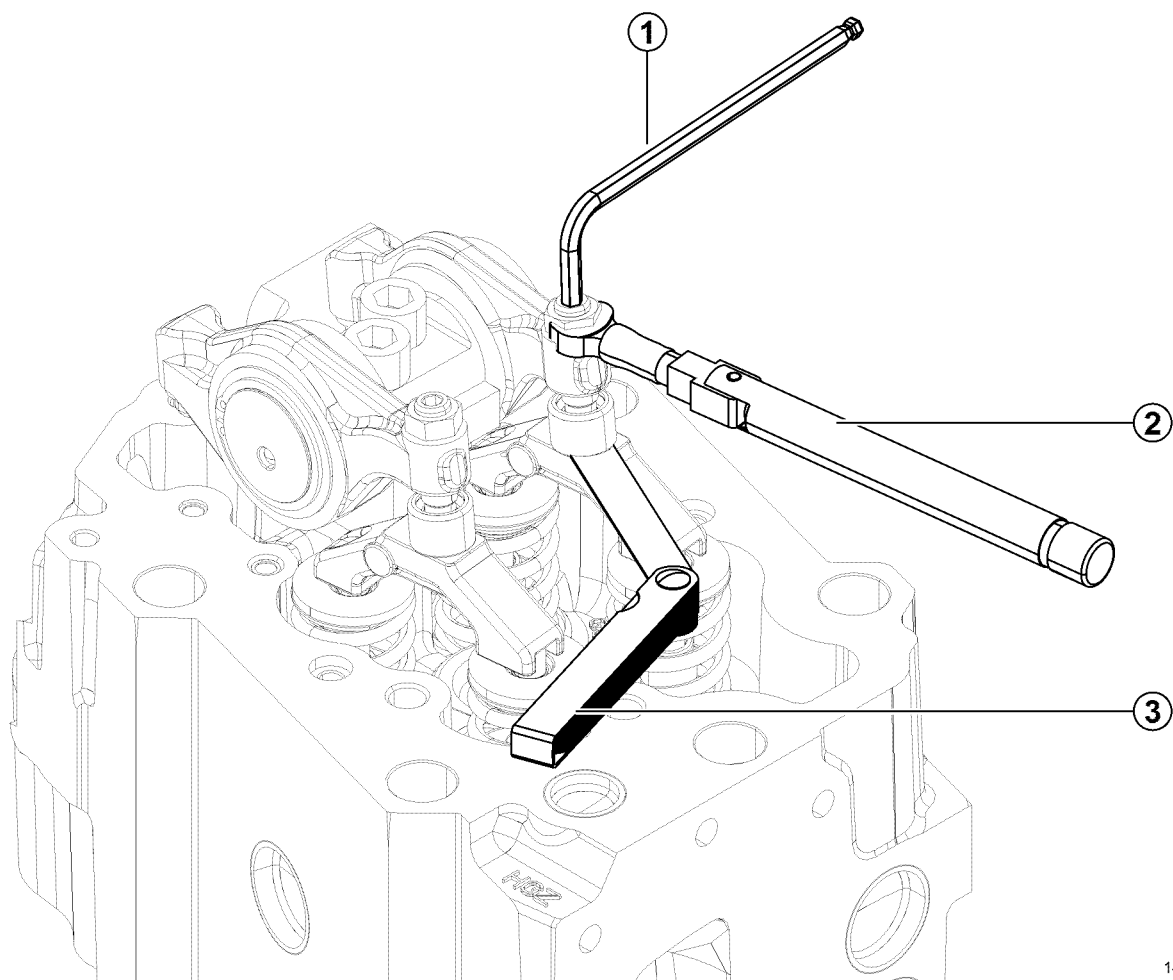
Fig. 60 Checking the seal position



3.2 Checking and setting the valve clearance (engine KD36V16)

Previous work:	See	Remarks
Cylinder head cover removed.....	67	

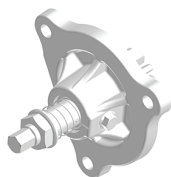
Fig. 61 Valve setting



143333

Pos.	Name
1	Allen wrench
2	Torque wrench
3	Feeler gauge

Special tool



10123791

Additional special tools:

- Allen wrench
- Feeler gauge
- Torque wrench

Cylinder 1 is located across from the right side of the flywheel.

The direction of rotation of the engine is left viewed from the flywheel.

1 - 16 = Cylinder designation according to DIN 73021

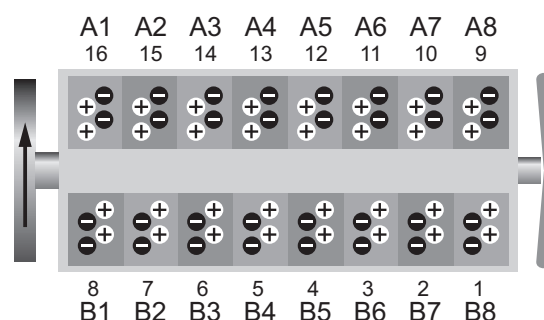
A1 - B8 = Cylinder designation according to ISO 1204

Setting temperature between 15° C and 40° C (59° F and 104° F). Reference is coolant temperature.

“+” = Inlet valve 0.5 mm (0.02 in)

“-” = Outlet valve 0.6 mm (0.024 in)

Fig. 62 Firing order



Firing order																
DIN 73021	1	15	6	13	8	4	16	7	11	5	9	2	14	10	3	12
ISO 1204	B8	A2	B3	A4	B1	B5	A1	B2	A6	B4	A8	B7	A3	A7	B6	A5

Setting occurs according to the following scheme:

Setting position	Crankshaft position	Inlet valve for cylinder	Outlet valve for cylinder
1	TDC	1 - 2 - 3 - 10 - 12 - 14 - 15	1 - 4 - 6 - 8 - 13 - 15
2	TDC +180°	6	7 - 16
3	TDC +360°	4 - 5 - 7 - 8 - 11 - 13 - 16	2 - 5 - 9 - 10 - 11 - 14
4	TDC +450°	9	3 - 12

Setting position “TDC”


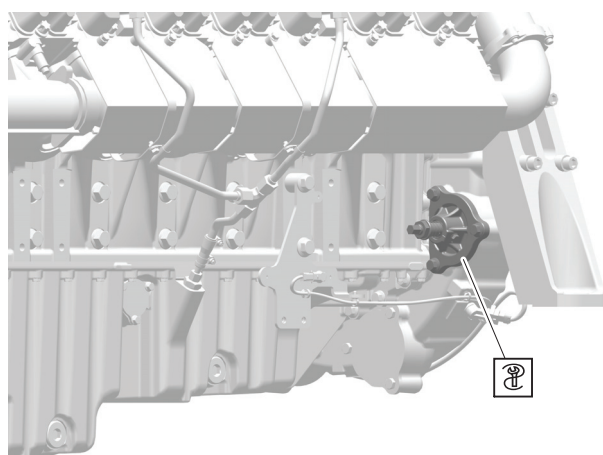
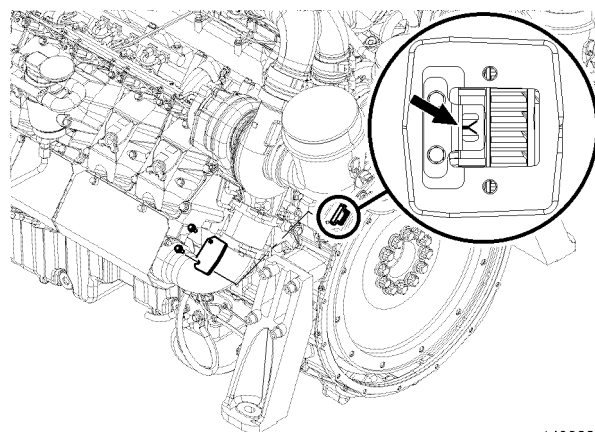
- Install  turning device [10123791].

Fig. 63 Turning device




**Information**

Observe direction of rotation of the engine, see page 73

Fig. 64 Setting position

143262

- Turn engine with  turning device [10123791] until the piston of the 1st cylinder is at ignition TDC.
 - TDC marking on flywheel aligns with marking on flywheel housing.
 - Valves of the 11th cylinder are at overlap.

- Set / check inlet valves 1 - 2 - 3 - 10 - 12 - 14 - 15.
- Set / check outlet valves 1 - 4 - 6 - 8 - 13 - 15.
- Does the clearance not match the settings, see Fig. 62?
 - Release lock nut on the adjusting screw of the respective rocker arm and correct setting.
 - Tighten lock nut with 45 Nm, holding the adjusting screw against it with the Allen wrench while doing so.
- Check setting again.

Setting position “TDC +180°”

- Continue to turn the engine 180° in the direction of rotation until the 180° marking on the flywheel is aligned with the marking on the flywheel housing, see Fig. 64.
- Set / check inlet valve 6.
- Set / check outlet valves 7 - 16.
 - All valves at the 2nd setting position for 180° are set / checked.
- Does the clearance not match the settings, see Fig. 62?
 - Release lock nut on the adjusting screw of the respective rocker arm and correct setting.
 - Tighten lock nut with 45 Nm, holding the adjusting screw against it with the Allen wrench while doing so.
- Check setting again.

Setting position “TDC +360°”

- Continue to turn the engine 180° in the direction of rotation until the TDC marking on the flywheel is aligned with the marking on the flywheel housing, see Fig. 64.
- Set / check inlet valves 4 - 5 - 7 - 8 - 11 - 13 - 16.
- Set / check outlet valves 2 - 5 - 9 - 10 - 11 - 14.
 - All valves at the 3rd setting position for 360° are set / checked.
- Does the clearance not match the settings, see Fig. 62?
 - Release lock nut on the adjusting screw of the respective rocker arm and correct setting.
 - Tighten lock nut with 45 Nm, holding the adjusting screw against it with the Allen wrench while doing so.
- Check setting again.

Setting position “TDC +450°”

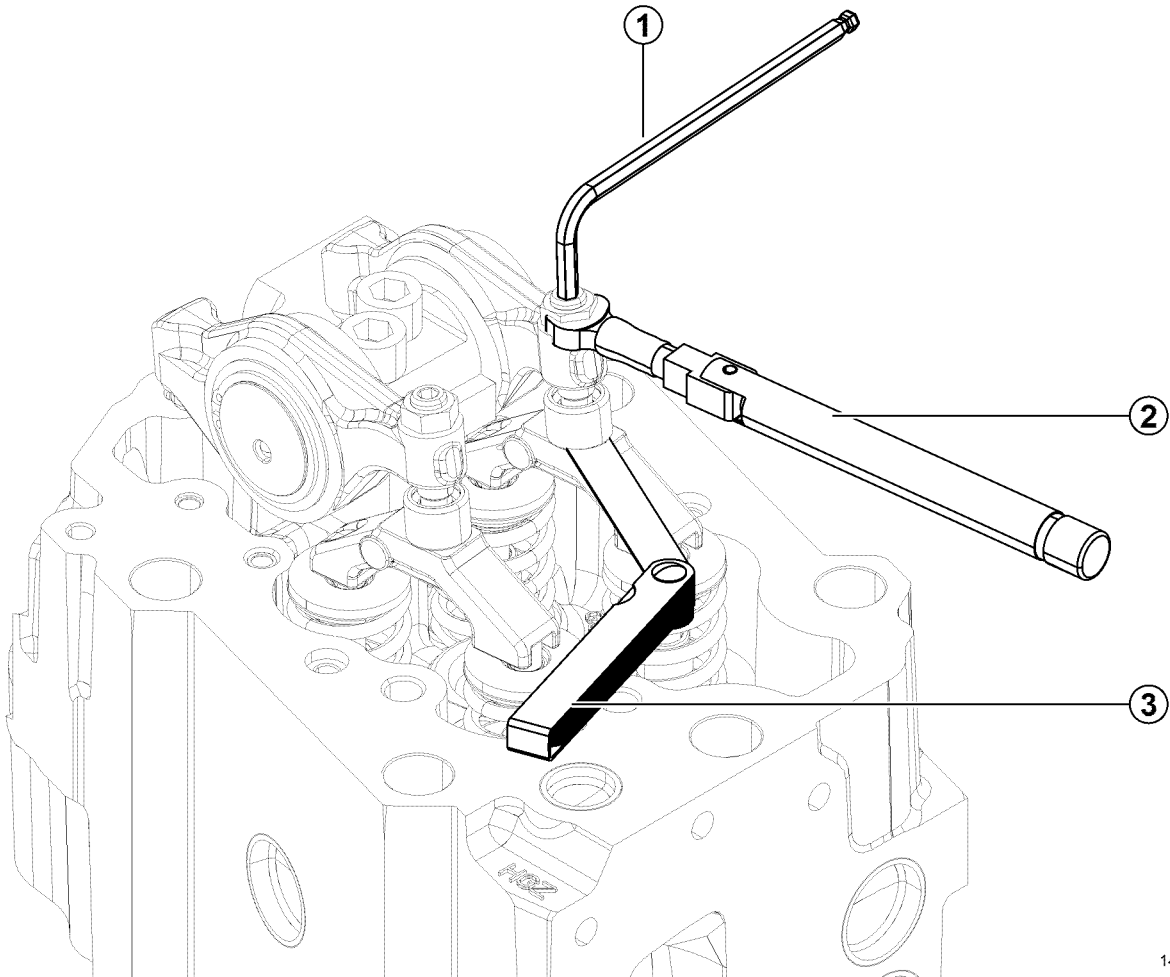
- Continue to turn the engine 90° in the direction of rotation until the 450° marking on the flywheel is aligned with the marking on the flywheel housing, see Fig. 64.
- Set / check inlet valve 9.
- Set / check outlet valves 3 - 12.
 - All valves at the 4th setting position for 450° are set / checked.
- Does the clearance not match the settings, see Fig. 62?
 - Release lock nut on the adjusting screw of the respective rocker arm and correct setting.
 - Tighten lock nut with 45 Nm, holding the adjusting screw against it with the Allen wrench while doing so.

- Check setting again.
- After checking and/or setting all valves, attach cylinder head cover with seals that have been checked to ensure they are not damaged.
- Remove turning device, see [Fig. 63](#).

3.3 Checking and setting the valve clearance (engine KD45V20)

Previous work:	See	Remarks
Cylinder head cover removed.....	67	


Fig. 65 Valve setting



143333

Pos.	Name
1	Allen wrench
2	Torque wrench
3	Feeler gauge

Special tool



10123791

Additional special tools:

- Allen wrench
- Feeler gauge
- Torque wrench

Cylinder 1 is located across from the right side of the flywheel.

The direction of rotation of the engine is left viewed from the flywheel.

1 - 20 = Cylinder designation according to DIN 73021

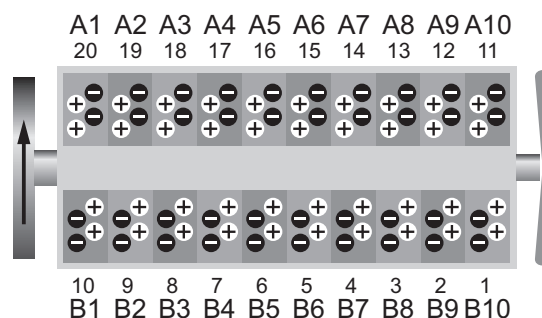
A1 - B10 = Cylinder designation according to ISO 1204

Setting temperature between 15° C and 40° C (59° F and 104° F). Reference is coolant temperature.

“+” = Inlet valve 0.5 mm (0.02 in)

“-” = Outlet valve 0.6 mm (0.024 in)

Fig. 66 Firing order



143261

Firing order

DIN 73021	1	15	4	20	8	17	2	13	6	19	10	16	7	11	3	14	9	18	5	12
ISO 1204	B10	A6	B7	A1	B3	A4	B9	A8	B5	A2	B1	A5	B4	A10	B8	A7	B2	A3	B6	A9

Setting occurs according to the following scheme:

Setting position	Crankshaft position	Inlet valve for cylinder	Outlet valve for cylinder
1	TDC	1 - 3 - 5 - 9 - 11 - 12 - 14 - 15 - 18	1 - 2 - 4 - 12 - 13 - 15 - 17 - 20 - 8
2	TDC +180°	4	6
3	TDC +360°	2 - 6 - 8 - 10 - 13 - 16 - 17 - 19 - 20	3 - 7 - 9 - 10 - 11 - 14 - 16 - 18 - 19
4	TDC +450°	7	5

Setting position “TDC”


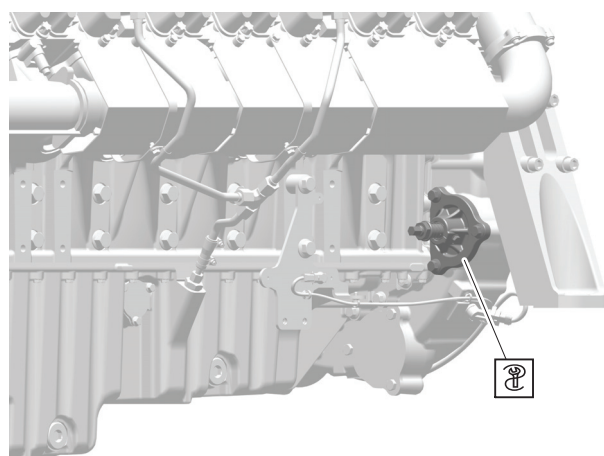
- Install  turning device [10123791].

Fig. 67 Turning device



**Information**

Observe direction of rotation of the engine, see page 77


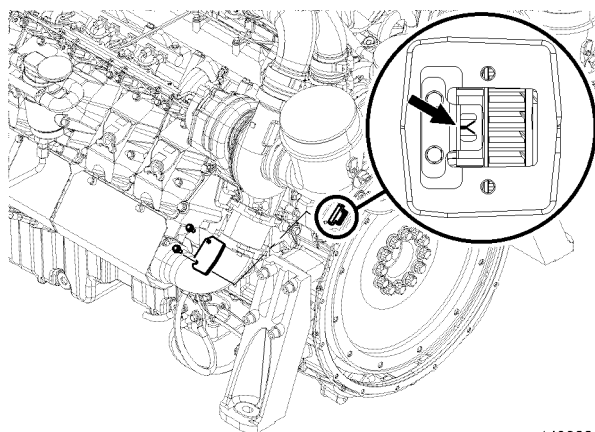
- Turn engine with  turning device [10123791] until the piston of the 1st cylinder is at ignition TDC.
 - TDC marking on flywheel aligns with marking on flywheel housing.
 - Valves of the 10th cylinder are at overlap.

Fig. 68 Setting position

143262

- Set / check inlet valves 1 - 3 - 5 - 9 - 11 - 12 - 14 - 15 - 18.
- Set / check outlet valves 1 - 2 - 4 - 12 - 13 - 15 - 17 - 20 - 8.
- Does the clearance not match the settings, see Fig. 66?
 - Release lock nut on the adjusting screw of the respective rocker arm and correct setting.
 - Tighten lock nut with 45 Nm, holding the adjusting screw against it with the Allen wrench while doing so.
- Check setting again.

Setting position “TDC +180°”

- Continue to turn the engine 180° in the direction of rotation until the 180° marking on the flywheel is aligned with the marking on the flywheel housing, see Fig. 68.
- Set / check inlet valve 4.
- Set / check outlet valve 6.
 - All valves at the 2nd setting position for 180° are set / checked.
- Does the clearance not match the settings, see Fig. 66?
 - Release lock nut on the adjusting screw of the respective rocker arm and correct setting.
 - Tighten lock nut with 45 Nm, holding the adjusting screw against it with the Allen wrench while doing so.
- Check setting again.

Setting position “TDC +360°”

- Continue to turn the engine 180° in the direction of rotation until the TDC marking on the flywheel is aligned with the marking on the flywheel housing, see Fig. 68.
- Set / check inlet valves 2 - 6 - 8 - 10 - 13 - 16 - 17 - 19 - 20.
- Set / check outlet valves 3 - 7 - 9 - 10 - 11 - 14 - 16 - 18 - 19.
 - All valves at the 3rd setting position for 360° are set / checked.
- Does the clearance not match the settings, see Fig. 66?
 - Release lock nut on the adjusting screw of the respective rocker arm and correct setting.
 - Tighten lock nut with 45 Nm, holding the adjusting screw against it with the Allen wrench while doing so.
- Check setting again.

Setting position “TDC +450°”

- Continue to turn the engine 90° in the direction of rotation until the 450° marking on the flywheel is aligned with the marking on the flywheel housing, see Fig. 68.
- Set / check inlet valve 7.
- Set / check outlet valve 5.
 - All valves at the 4th setting position for 450° are set / checked.
- Does the clearance not match the settings, see Fig. 66?
 - Release lock nut on the adjusting screw of the respective rocker arm and correct setting.
 - Tighten lock nut with 45 Nm, holding the adjusting screw against it with the Allen wrench while doing so.

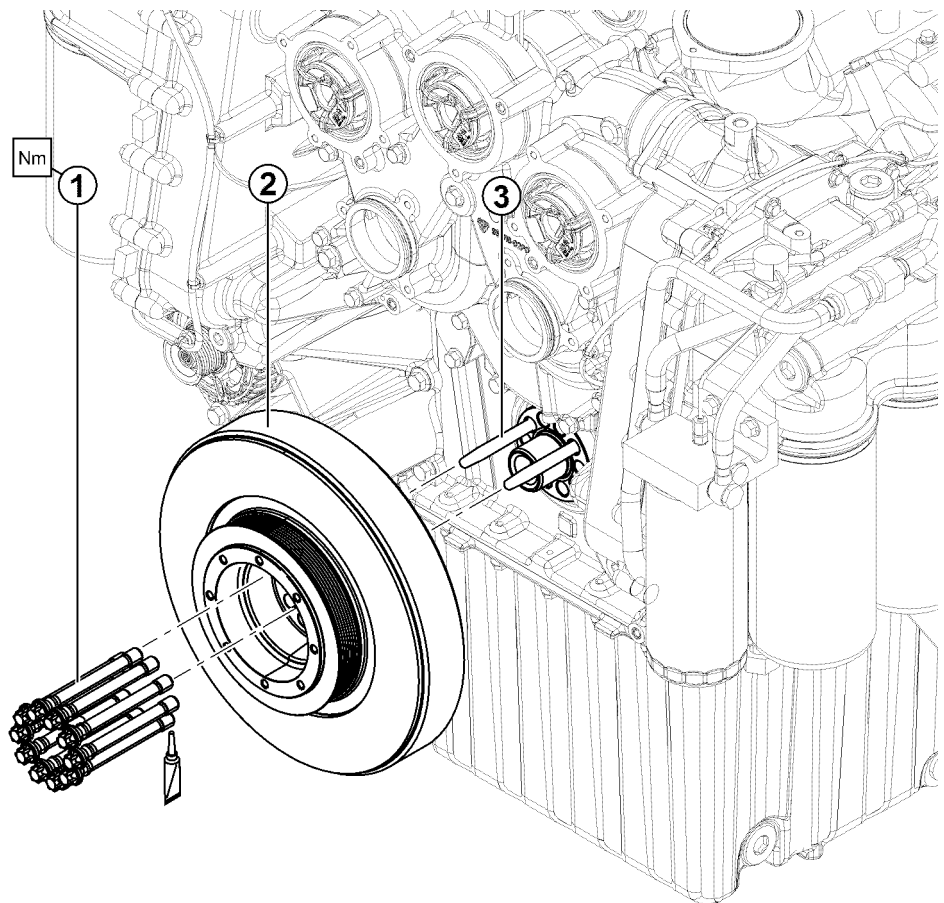
- Check setting again.
- After checking and/or setting all valves, attach cylinder head cover with seals that have been checked to ensure they are not damaged.
- Remove turning device, see [Fig. 67](#).

4 Driving gear



4.1 Removing, installing the crankshaft attachments

Previous work:	See	Remarks
Belt	Fig. 141	Pos. 3 removed


Fig. 69 Crankshaft attachments



143343

Pos.	Name		Work instructions
1	M16x1.5x160.5-10.9 torx expansion screw	✚	Replace,  apply engine oil to the thread and contact surface of the screw head, screw tight according to the associated Nm tightening instruction.
2	Viscous damper	✚	Degrease contact surfaces.
3	 Mounting bolts [13445716]	✚	Screw two into crankshaft.

Special tool



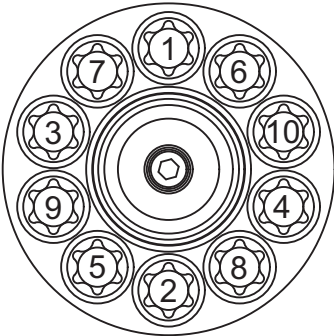
13445716

Crankshaft attachments tightening instruction

M16x1.5x160.5-10.9 torx expansion screw

Lubricant	Engine oil
Locking agent	-
Part contact surfaces	degreased
Screws reusable?	No
Stage	Torque
1	25 Nm (18 ft lb)
2	60 Nm (44 ft lb)
3	120°
4	90°
5	90°

Fig. 70 Crankshaft attachments tightening sequence



5 Fuel and injection system

5.1 Safety instructions for working on the fuel and injection system

5.1.1 Preventing personal injuries

**WARNING**

When the diesel engine is running, the fuel lines are constantly under a fuel pressure of up to 2400 bar (34810 psi).

Escaping liquids can penetrate the skin and will lead to injuries.

- Only work on the fuel and injection system when the diesel engine is turned off.
- Reduce the pressure to below 10 bar (145 psi) with the KODIA diagnostics program.
- Check the residual pressure in the KODIA diagnostics program.
- Use suitable protective equipment when working on the fuel and injection system, see [15](#).
- Do not open any fuel lines and hoses that are under pressure.
- Do not remove any fuel lines and hoses that are under pressure.
- Protect hands, face and body against escaping liquids when searching for leaks on lines and hoses that are under pressure. For further information, see [15](#).
- Screw connections on the injection system tight with the prescribed tightening torque.

5.1.2 Preventing property damage

Components of the fuel and injection system consist of highly precise parts that are subjected to extreme loads. Even the smallest particles of dirt can lead to failure of components.

- When working on the fuel and injection system, ensure the utmost cleanliness.

Before starting work, observe the following:

- Perform work on the fuel and injection system in areas, in which no dust is stirred up and no other particles of dirt get into the work area.
- When working on the fuel and injection system, use an appropriate workshop or assembly shop.
- Hang clean covering foil around engine hoods.
- Before parts are removed: Thoroughly clean and dry the relevant parts of the engine.
- Perform a visual inspection for leaks or damage to the fuel and injection system.
- Use clean and undamaged tools.
- Replace damaged tools in a timely manner.
- Change work clothing that was previously worn during dusty work.
- Wash hands before starting work.
- Use lint-free cleaning cloths.

During the work, observe the following:

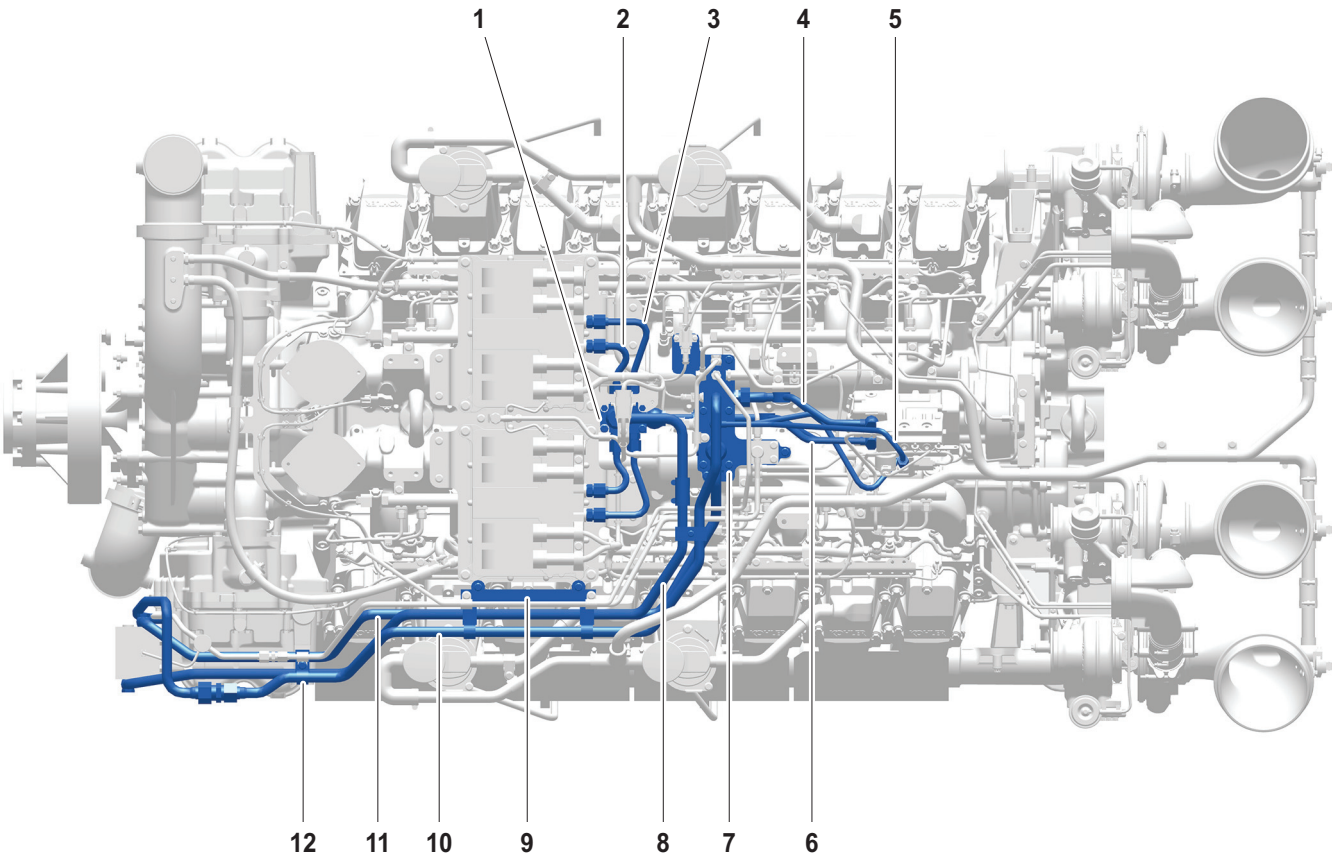
- If the clean side fuel system has been opened: Do not use compressed air.
- Remove loose dirt (e.g. paint chips) during the work.
- Seal open line connections so they are dust and moisture proof.
- Package and store removed parts so they are dust and moisture proof.
Do not dismantle removed parts of the injection system (high pressure pump, pressure pipe socket, injector).
- Do not remove “new” parts from the original packing until just before installation and check their reusability.
- When working on removed components, ensure cleanliness.
- Use unused cleaning fluids.
- If removed components are being shipped: Use the original packing of the “new” part.

5.2 Removing, installing the fuel lines


5.2.1 Low pressure fuel lines (engine KD36V16)

Previous work:	See	Remarks
Observe safety instructions for working on the fuel and injection system.	83	
Fuel supply closed		Generator side
Fuel system emptied		
Engine control unit removed	161	

Fig. 71 Fuel lines



1	Distributor block	7	Distributor block
2	Fuel line (ECU to distributor block)	8	Fuel line (distributor block to fuel filter)
3	Fuel line (distributor block to ECU)	9	Holder
4	Fuel line (distributor block to pre-feed pump)	10	Fuel line (connection "IN" to distributor block)
5	Fuel line (distributor block to high pressure pump)	11	Fuel line (fuel fine filter to distributor block)
6	Fuel line (pre-feed pump to distributor block)	12	Holding clamp

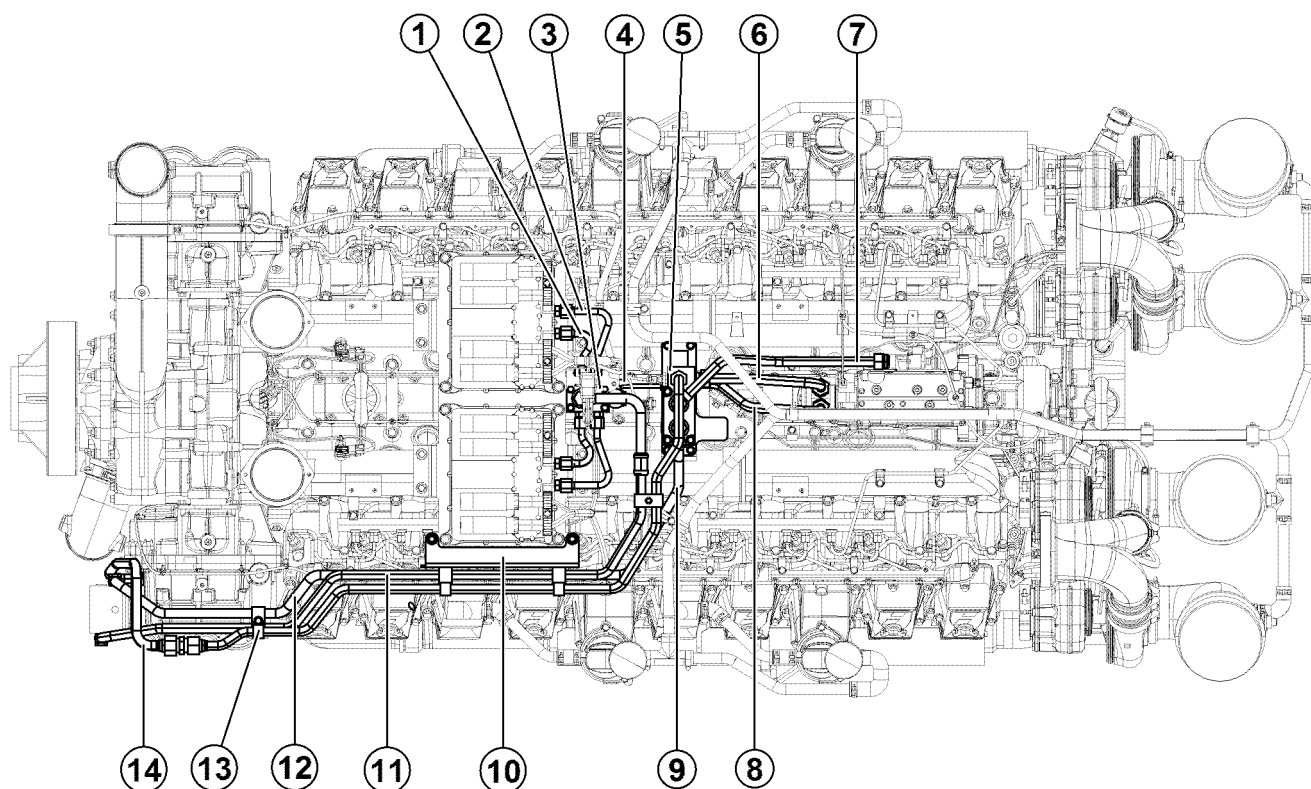


NOTE
After installing the respective fuel line: Ventilate fuel system, see operator's manual for the generator.

5.2.2 Low pressure fuel lines (engine KD45V20)

Previous work:	See	Remarks
Observe safety instructions for working on the fuel and injection system.	83	
Fuel supply closed		Generator side
Fuel system emptied		
Engine control unit removed	161	

Fig. 72 Fuel lines



143238

1	ECU to distributor block	8	Distributor block to fuel prefeeding pump inlet
2	Distributor block to ECU	9	Distributor block to fuel filter
3	Distributor block	10	Holder
4	Distributor block to fuel prefeeding pump inlet	11	Screw fitting to distributor block
5	Distributor block	12	Fuel filter to distributor box
6	Fuel prefeeding pump to distributor block	13	Holding clamp
7	Distributor block to high pressure pump	14	Fuel connection "IN" to screw fitting



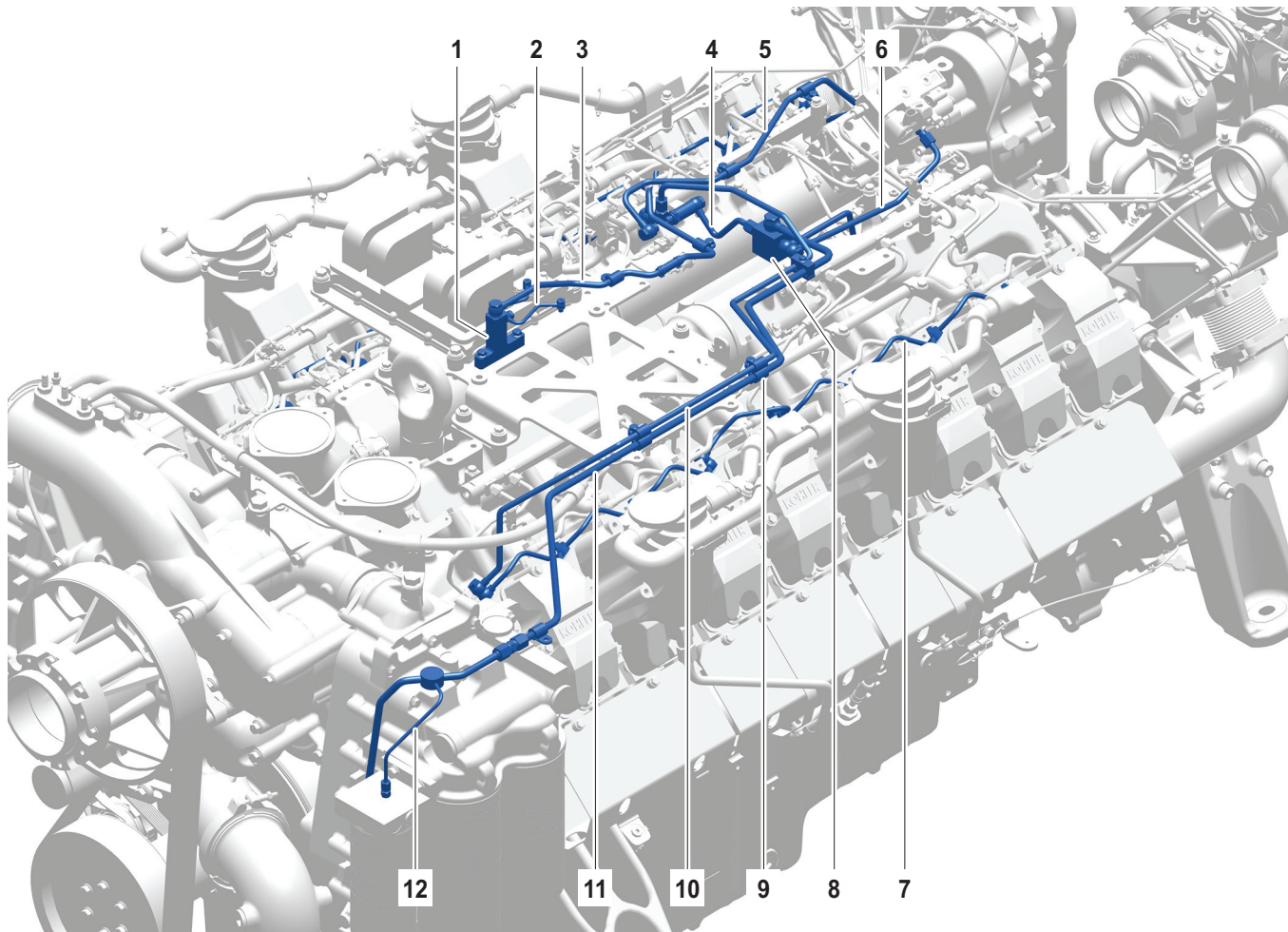
NOTE

After installing the respective fuel line: Ventilate fuel system, see operator's manual for the generator.

5.2.3 Fuel lines - return and continuous ventilation (engine KD36V16)

Previous work:	See	Remarks
Observe safety instructions for working on the fuel and injection system.	83	
Fuel supply closed		Generator side
Fuel system emptied		
Engine control unit removed	161	
Ventilation line removed	151	

Fig. 73 Return and continuous ventilation



1	Distributor block	7	Fuel line (injector return)
2	Fuel line (ECU to distributor block)	8	Distributor block
3	Fuel line (distributor block to distributor block)	9	Holding clamp
4	Fuel line (distributor block to distributor block)	10	Fuel line (injector return)
5	Fuel line (injector return)	11	Fuel line (distributor block return)
6	Fuel line (high pressure pump return)	12	Fuel line (fuel filter ventilation)

5.2.4 Fuel lines - return and continuous ventilation (engine KD45V20)

Previous work:

Observe safety instructions for working on the fuel and injection system.

Fuel supply closed

Fuel system emptied

Engine control unit removed 161

Ventilation line removed 151

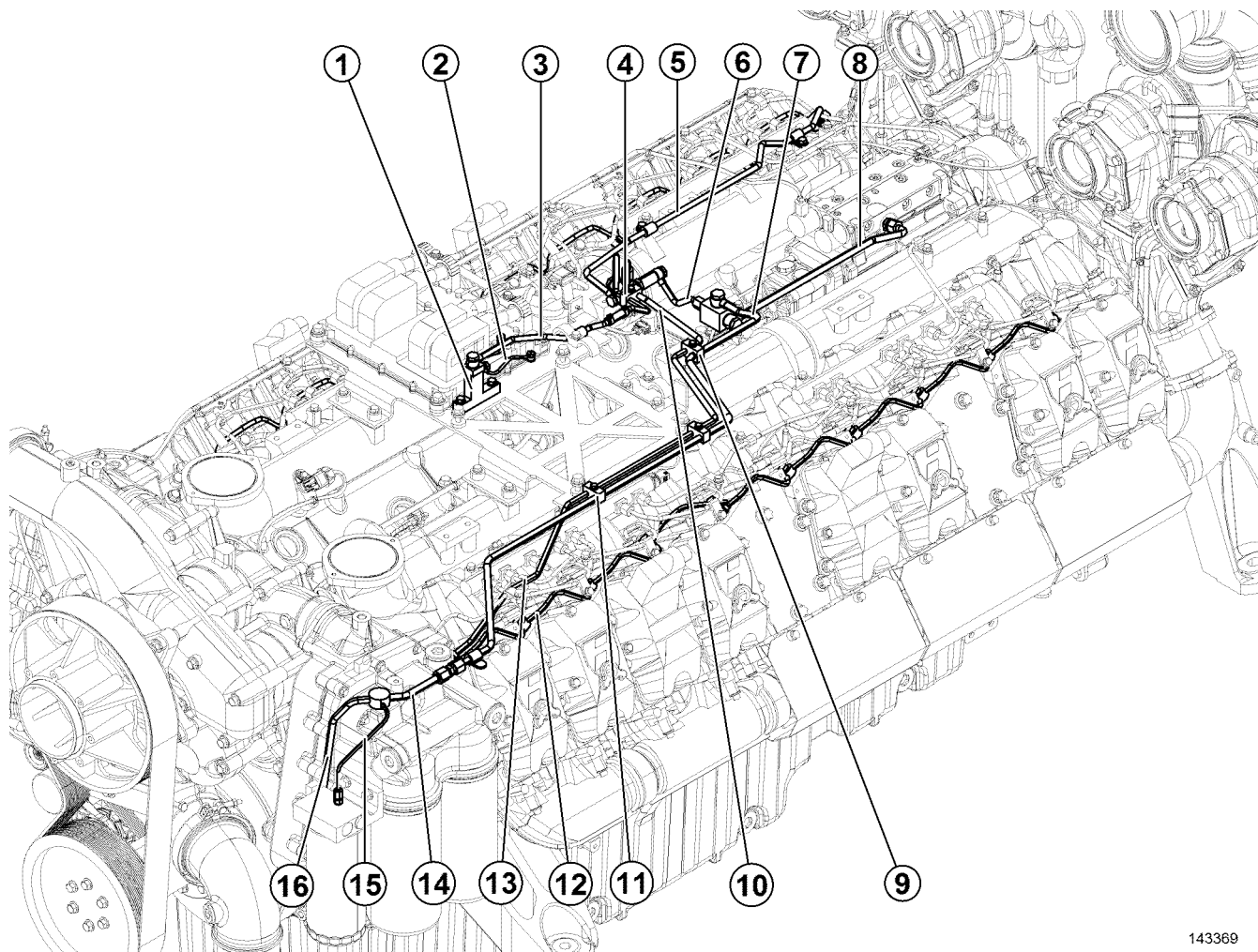
See

83

Remarks

Generator side

Fig. 74 Return and continuous ventilation



143369

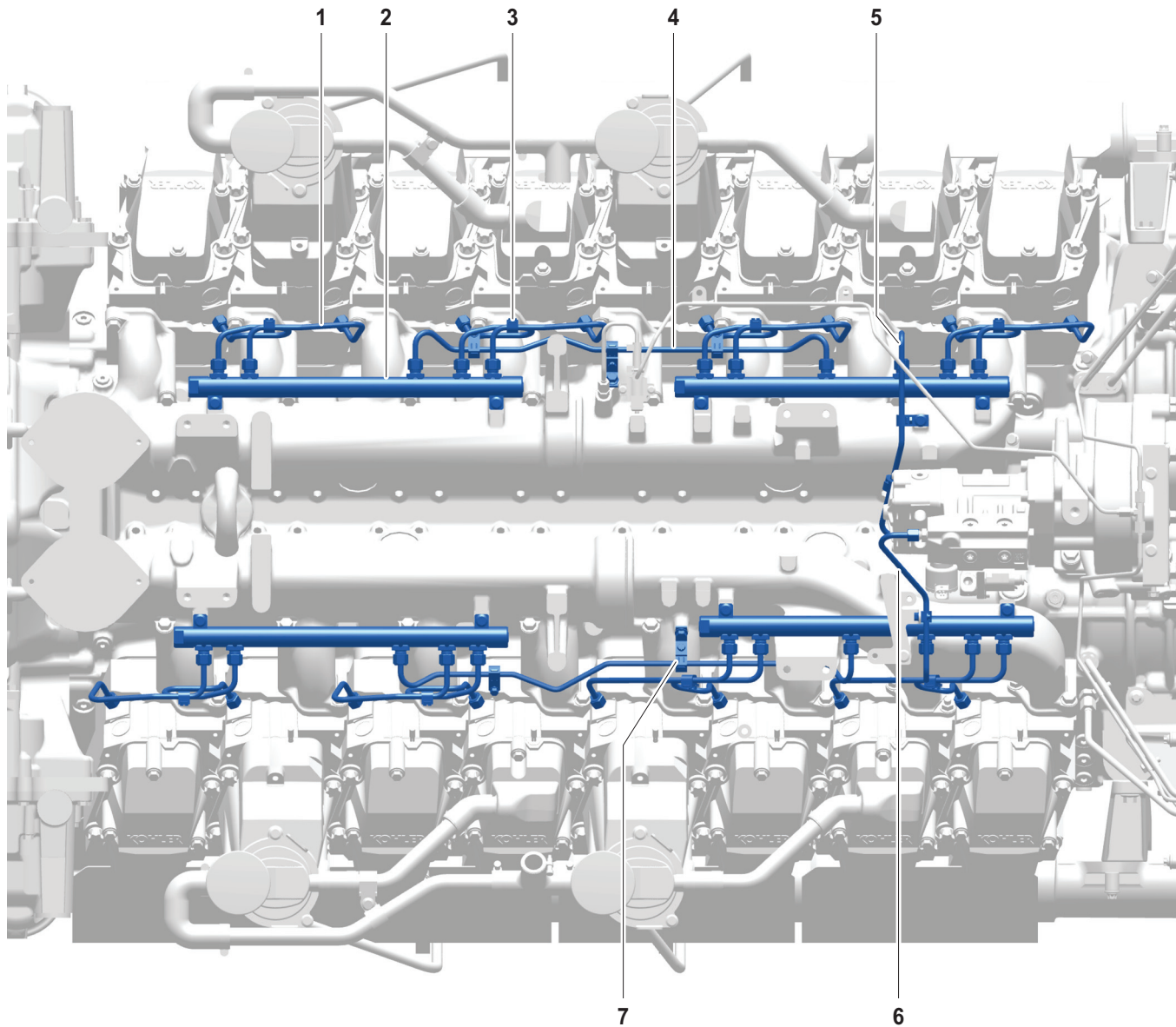
- | | | | |
|---|---|----|--|
| 1 | Distributor block | 9 | Holding clamp |
| 2 | ECU ventilation to distributor block | 10 | Left injector to distributor block |
| 3 | Distributor block to distributor block | 11 | Holding clamp |
| 4 | Distributor block | 12 | Fuel return line injector |
| 5 | Fuel return line to distributor block | 13 | Fuel return line to distributor block |
| 6 | Distributor block to distributor block | 14 | Screw fitting to fuel tank ventilation |
| 7 | Distributor block to screw fitting | 15 | Fuel filter ventilation |
| 8 | High pressure pump to distributor block | 16 | Fuel tank ventilation connection |

Removing, installing the injection pipe (engine KD36V16)




5.3 Removing, installing the injection pipe (engine KD36V16)

Previous work:	See	Remarks
Observe safety instructions for working on the fuel and injection system.	83	
Engine control unit removed	161	

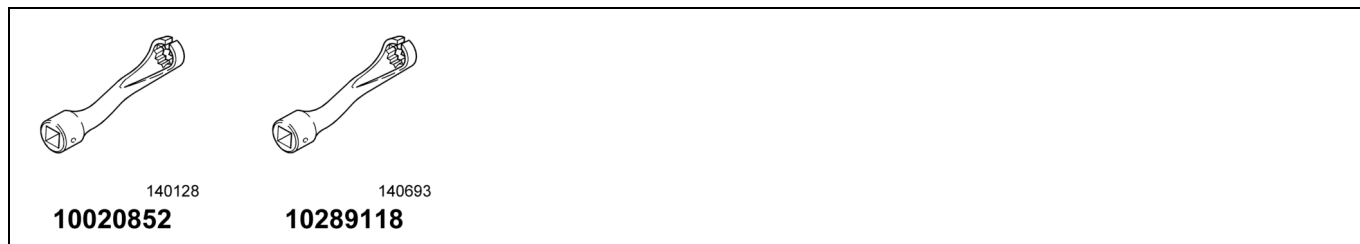
Fig. 75 Injection pipes



Pos.	Name	Work instructions
1	Injection pipe (rail to pressure pipe socket)	⊠ See tightening instruction and assembly instructions, 92.
2	Rail	⊠ see 97
3	Holding clamp	⊠ Holding clamp is pre-assembled on injection pipes, see tightening instruction, 91.
4	Injection pipe (rail to rail)	⊠ See tightening instruction and assembly instructions, 92.

Pos.	Name		Work instructions
5	Injection pipe (high pressure pump to rail)		See tightening instruction and assembly instructions, 92 .
6	Injection pipe (high pressure pump to rail)		See tightening instruction and assembly instructions, 92 .
7	Holding clamp		Holding clamp is pre-assembled on injection pipe see tightening instruction, 91 .

Special tool



Injection pipe tightening instruction

NOTE



Improper reuse of the injection pipes may result in fuel leaks.

- Injection pipes must be replaced after being removed three times.
- During each removal: Mark injection pipes on box nut (width across flats 19 mm).
- Install injection pipes free of stress and abrasion.

Injection pipes - box nut width across flats 17 (initial installation)

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes, max. 2x
Stage	Torque
1.	hand tight
2.	15 Nm (11 ft lb)
3.	60°

Removing, installing the injection pipe (engine KD36V16)

Injection pipes - box nut width across flats 17 (reuse)

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes, max. 2x
Stage	Torque
1.	hand tight
2.	15 Nm (11 ft lb)
3.	30°

Injection pipes - box nut width across flats 19 (initial installation)

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes, max. 2x
Stage	Torque
1.	hand tight
2.	15 Nm (11 ft lb)
3.	60°

Injection pipes - box nut width across flats 19 (reuse)

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes, max. 2x
Stage	Torque
1.	hand tight
2.	15 Nm (11 ft lb)
3.	30°

Holding clamp - M6x16 8.8 hex head screw

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes
Stage	Torque
1.	hand tight
2.	23 Nm (17 ft lb)

Holding clamp - M8x16 8.8 hex head screw

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes
Stage	Torque
1.	hand tight
2.	23 Nm (17 ft lb)

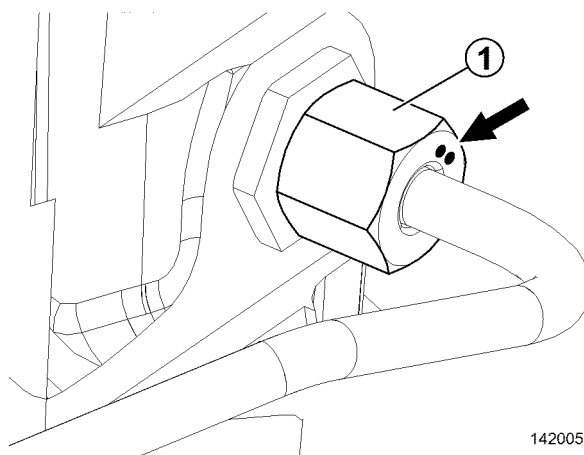
5.3.1 Removing**NOTE**

Leaky injection pipes.



- Injection pipes may be tightened a maximum of three times according to the tightening instruction (including initial installation). Injection pipes that already have 2 center punches must be replaced after removal.

- Mark each release of the injection pipes with a center punch on the box nut with width across flats of 19 mm (1). Injection pipes whose box nuts already have two markings must be replaced after removal.
- Release box nuts and remove injection pipe.
- Attach a protecting cap immediately on all open connections.

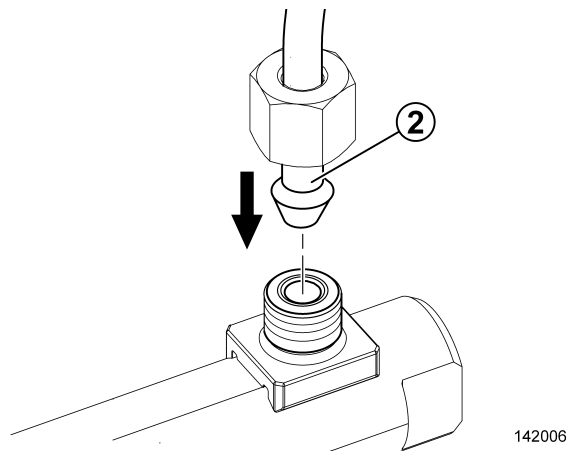
Fig. 76 Marking

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5.3.2 Installing

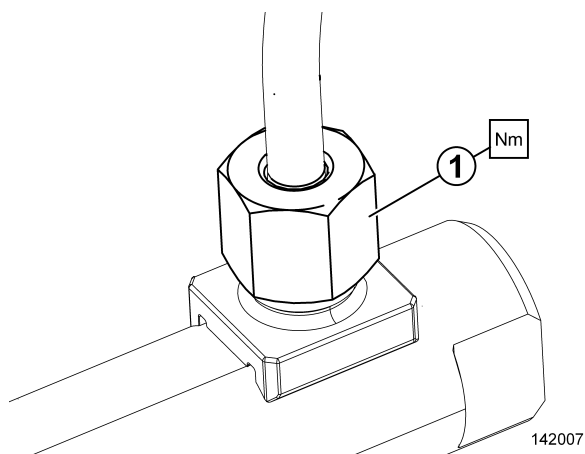
- Tighten hex head screws of rail hand tight, see 97.
- Push the cone (2) of the injection pipe into the connection stub (rail, HP pump or pressure pipe socket) and tighten box nut hand tight.
- Perform the process on the opposite side analogously.

Fig. 77 Connection



- Tighten box nuts (1) with socket wrench with final torque, see tightening instruction 89.
- Tighten hex head screw on rail according to tightening instruction, see 97.

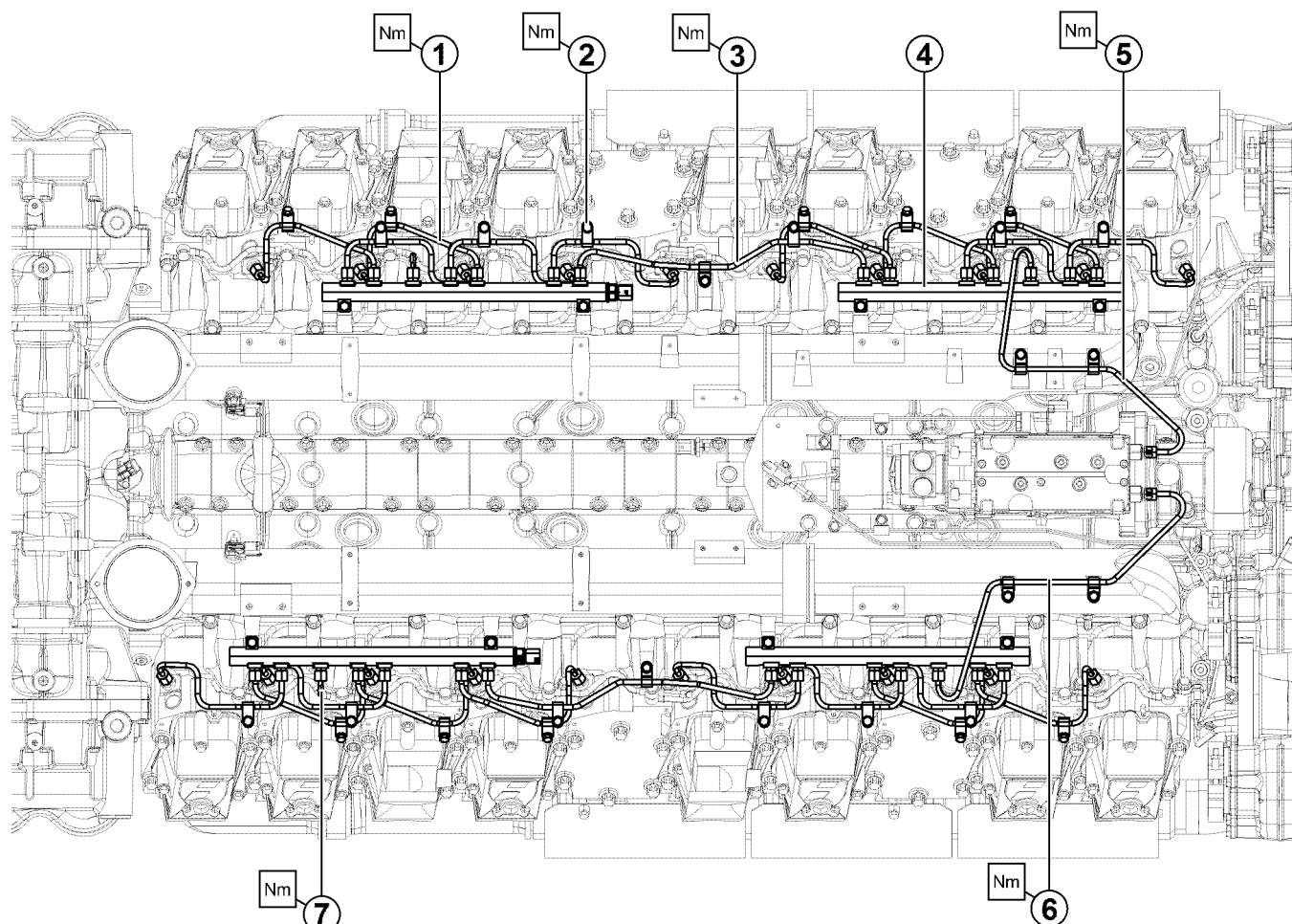
Fig. 78 Final torque



5.4 Removing, installing the injection pipe (engine KD45V20)

Previous work:	See	Remarks
Observe safety instructions for working on the fuel and injection system.	83	
Engine control unit removed	161	

Fig. 79 Injection pipes



143240

Pos.	Name	Work instructions
1	Rail to pressure pipe socket	✖ See tightening instruction and assembly instructions, 96.
2	Hex head screw	✖ Holding clamp is pre-assembled on high pressure lines, see tightening instruction, 95.
3	Rail to rail	✖ See tightening instruction and assembly instructions, 96.
4	Rail	✖ see 97
5	High pressure pump to rail	✖ See tightening instruction and assembly instructions, 96.
6	High pressure pump to rail	✖ See tightening instruction and assembly instructions, 96.
7	Sealing plug	✖ See tightening instruction and assembly instructions, 96.

Removing, installing the injection pipe (engine KD45V20)

Special tool**Injection pipe tightening instruction****NOTE**

Improper reuse of the injection pipes may result in fuel leaks.

- Injection pipes must be replaced after being removed three times.
- During each removal: Mark injection pipes on the box nut.
- Install injection pipes free of stress and abrasion.

Injection pipes - box nut width across flats 19 (initial installation)

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes, max. 2x
Stage	Torque
1.	hand tight
2.	15 Nm (11 ft lb)
3.	60°

Injection pipes - box nut width across flats 19 (reuse)

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes, max. 2x
Stage	Torque
1.	hand tight
2.	15 Nm (11 ft lb)
3.	30°

Sealing plug - box nut width across flats 19

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes, max. 2x
Stage	Torque
1.	hand tight
2.	30 Nm (22 ft lb)

M8x16 8.8 hex head screws

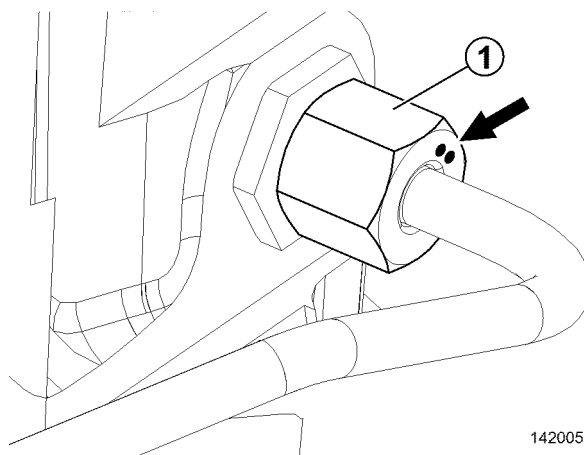
Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes
Stage	Torque
1.	hand tight
2.	23 Nm (17 ft lb)

5.4.1 Removing**NOTE**

Leaky injection pipes.

- Injection pipes may be tightened a maximum of three times according to the tightening instruction. Injection pipes that already have 2 center punches must be replaced after removal.

- Mark each release of the corresponding box nut (1) with a center punch. Box nuts that already have two markings must be replaced.
- Release box nut and remove injection pipe.
- Attach a protecting cap immediately on all open connections.

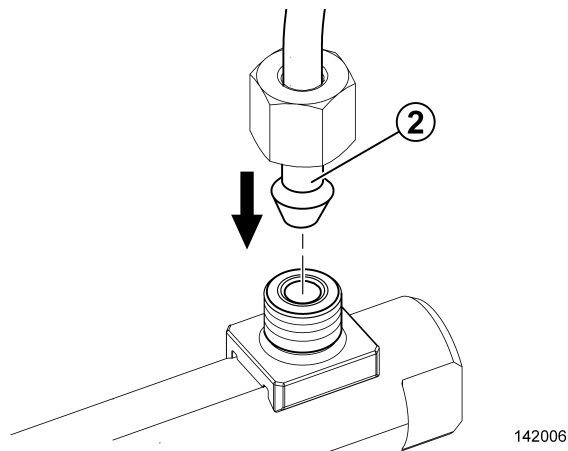
Fig. 80 Marking

142005

5.4.2 Installing

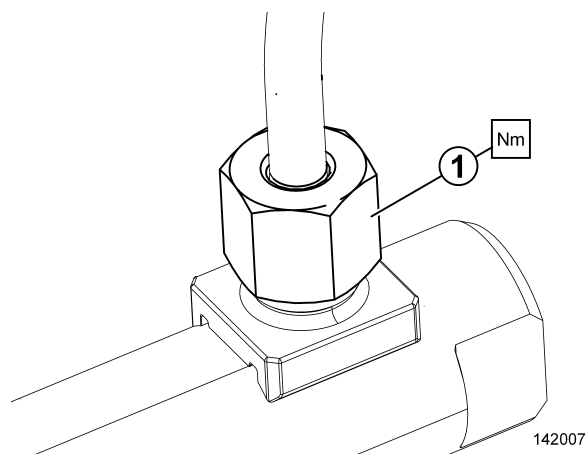
- Tighten hex head screws of rail hand tight, see 97.
- Push the cone (2) of the injection pipe into the connection stub (rail, HP pump or pressure pipe socket) and tighten box nut hand tight.
- Perform the process on the opposite side analogously.

Fig. 81 Connection



- Tighten box nut (1) with socket wrench [10289118] (width across flats 19 mm) with final torque, see tightening instruction.
- Tighten hex head screw on rail according to tightening instruction, see 97.

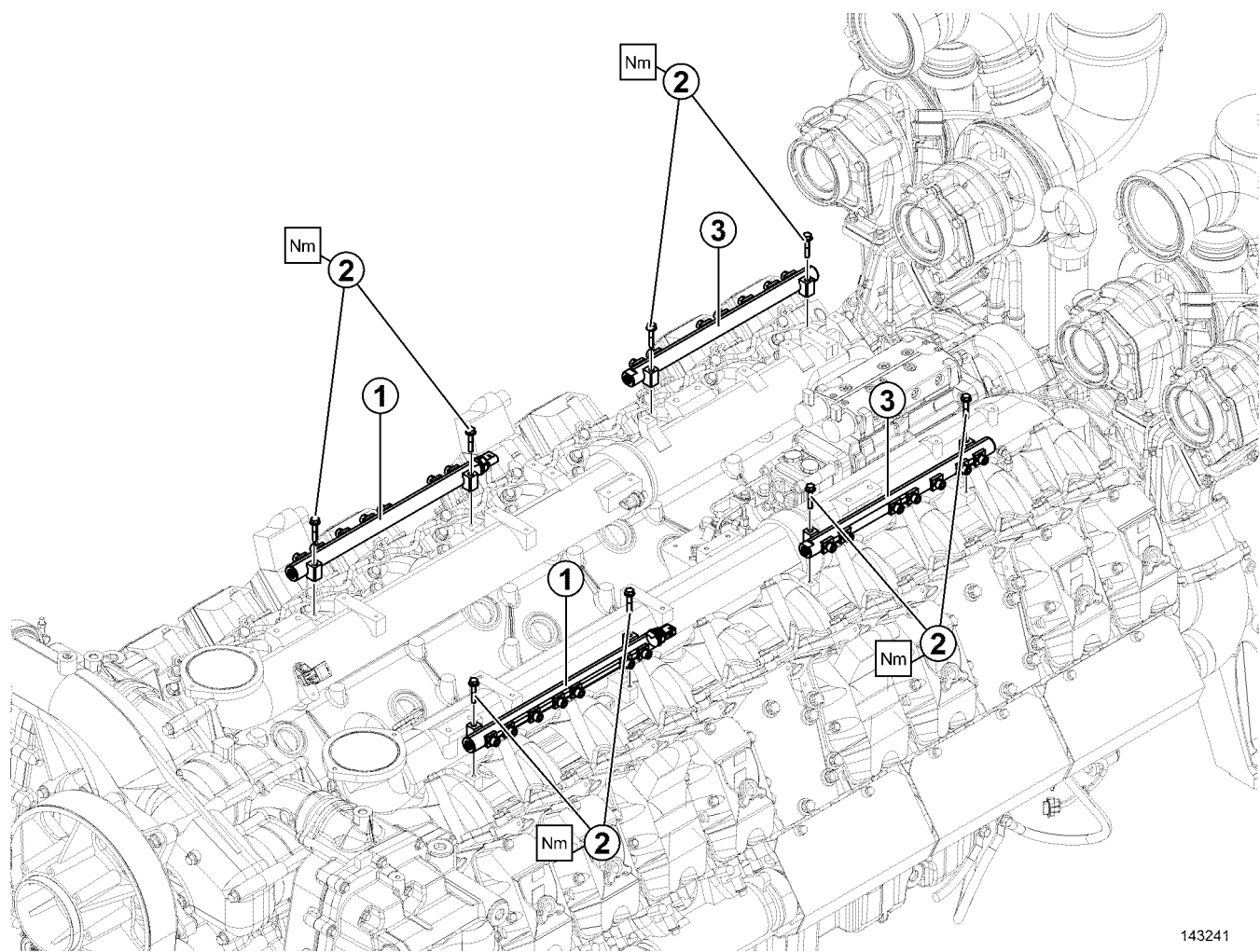
Fig. 82 Final torque



5.5 Removing, installing the rail

Previous work:	See	Remarks
Observe safety instructions for working on the fuel and injection system.	83	
Engine control unit removed	161	
High pressure lines removed	95	

Fig. 83 Rail



143241

Pos.	Name	Work instructions
1	Pressure pipe rail	
2	M8x50 8.8 hexagonal collar screw	 Instructions for mounting, see 98

Procedure for installing the rail

- Position rail and tighten hexagonal collar screws (Fig. 83 pos. 2) hand tight.
- Push the cone of the line connections (Fig. 79 pos. 1) into the connection stub (Fig. 81) and tighten box nut (Fig. 82 pos. 1) hand tight.
- Push the cone of the line connection (Fig. 79 pos. 6) into the connection stub (Fig. 81) and tighten box nut (Fig. 82 pos. 1) hand tight.
- Push the cones of the line connection (Fig. 79 pos. 3) into the connection stub (Fig. 81) and tighten box nut (Fig. 82 pos. 1) hand tight.
- Tighten clamps (Fig. 79 pos. 2) hand tight.
- Tighten all box nuts according to tightening instruction, see 95.
- Tighten hexagonal collar screws of rail (Fig. 83 pos. 2) according to tightening instruction, see 98.
- Tighten clamps (Fig. 79 pos. 2) according to tightening instruction, see 95.
- Install sealing plug (Fig. 79 pos. 7) and tighten according to tightening instruction, see 95.

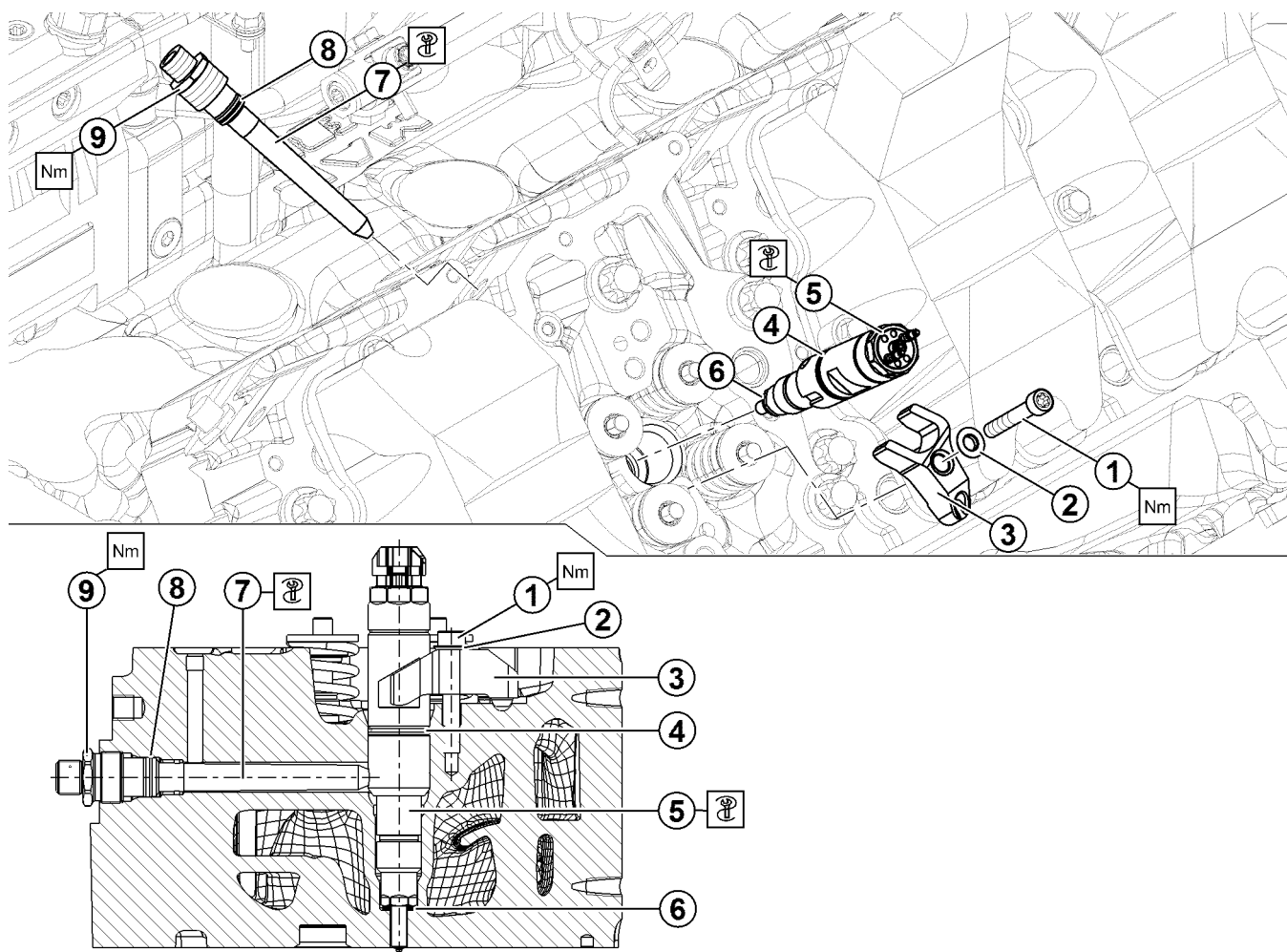
M8x50 8.8 hexagonal collar screws

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes
Stage	Torque
1.	hand tight
2.	standard

5.6 Removing, installing the pressure pipe socket and injector (Tier0)

Previous work:	See	Remarks
Observe safety instructions for working on the fuel and injection system.	83	
Cylinder head cover removed	67	
High pressure lines	Fig. 79	Pos. 1, 2 removed
Air intake pipe removed	138	Only if pressure pipe socket Fig. 84 pos. 7 is stuck.

Fig. 84 Pressure pipe socket and injector

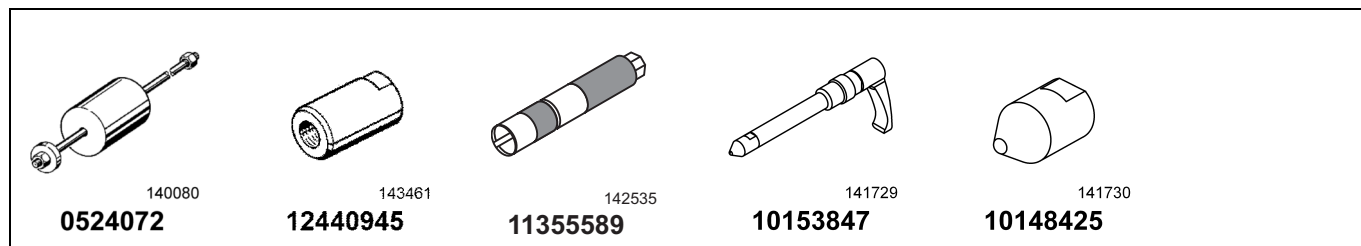


143293

Pos.	Name		
1	M8x55 10.9 cylinder screw	✳	See tightening instruction 104
2	Spherical washer		
3	Claw		
4	O-ring		
5	Injector		
6	Sealing washer		
7	Pressure pipe socket		
8	O-ring		
9	M24x1.5 box nut	✳	See tightening instruction 104

Removing, installing the pressure pipe socket and injector (Tier0)

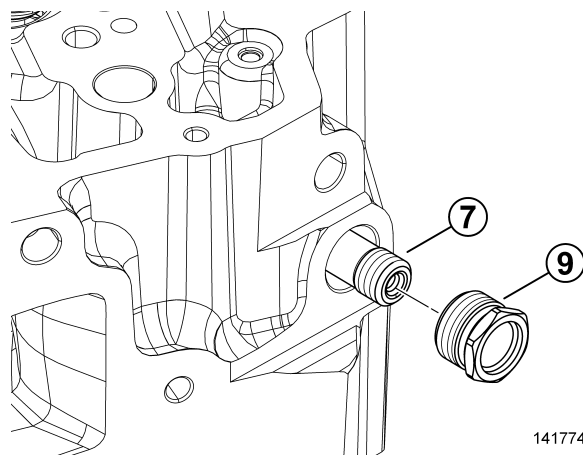
Special tool



5.6.1 Removing

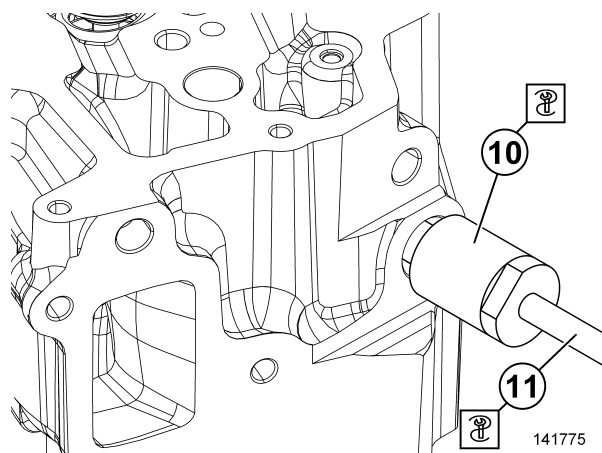
- Disconnect cable on the injector and remove together with the cylinder head cover seal.
- Unscrew box nut (9) from the pressure pipe socket (7).

Fig. 85 Releasing the pressure pipe socket

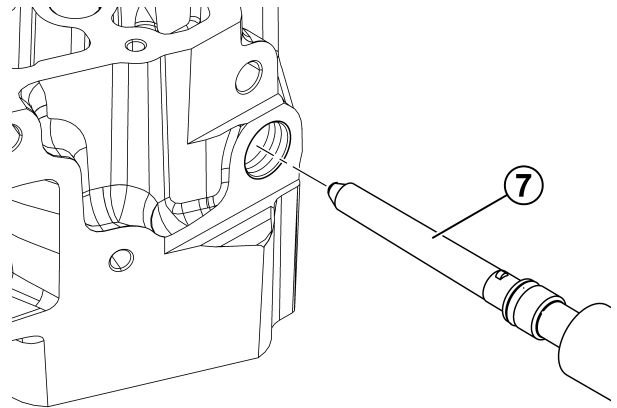


- If the pressure pipe socket is stuck, install adapter (10) [12440945] and impact extractor (11) [0524072] on the pressure pipe socket.

Fig. 86 Pressure pipe socket impact extractor

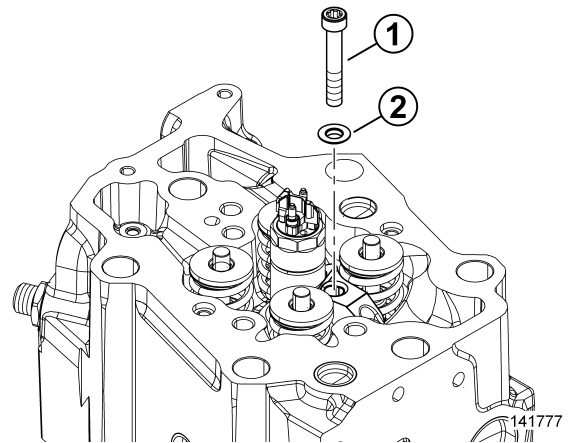


- Pull pressure pipe socket (7) out of the cylinder head.
- Seal the hole immediately with an appropriate protecting cap.

Fig. 87 Sealing the hole

141776

- Unscrew cylinder screw (1) and remove spherical washer (2).

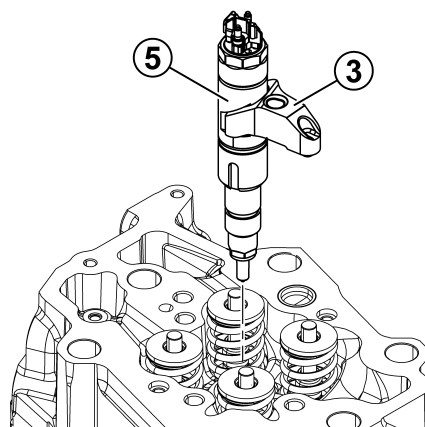
Fig. 88 Cylinder screw and spherical washer

141777

Removing, installing the pressure pipe socket and injector (Tier0)

- Remove injector (5) and claw (3) from the cylinder head and set them down.

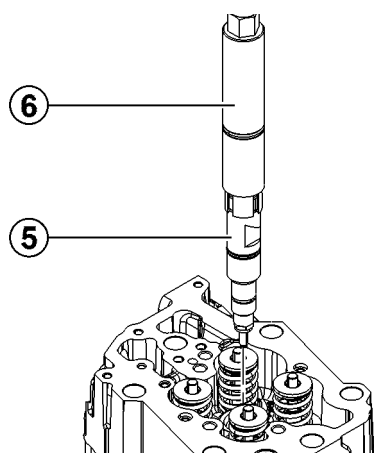
Fig. 89 Injector with claw



141778

- If the injector (5) is stuck, use special tool (6) [11355589] with impact extractor [0524072].

Fig. 90 Pulling out a stuck injector



144001



NOTE

Damage to the nozzle tip.

- Remove the sealing washer carefully.

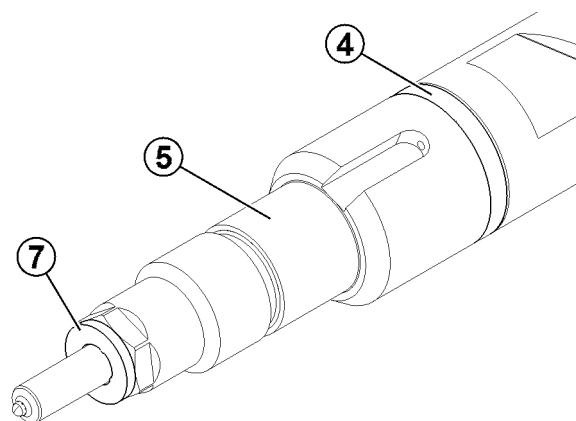


NOTE

If the sealing washer is stuck, replace injector sleeve. This requires a service level 3 technician.

- Remove o-ring (4) from injector (5).
- Remove sealing washer (7) from injector.

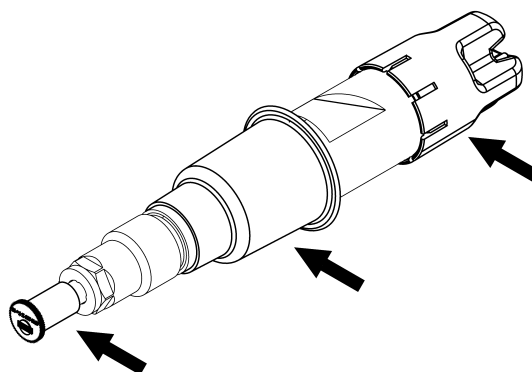
Fig. 91 *Injector seals*



144002

- Seal injector immediately with protecting caps.
- Cover the hole for the injector in the cylinder head.

Fig. 92 *Protecting caps for injector*



141779

Removing, installing the pressure pipe socket and injector (Tier0)

5.6.2 Installing

NOTE



Use new sealing washers according to spare parts catalog.

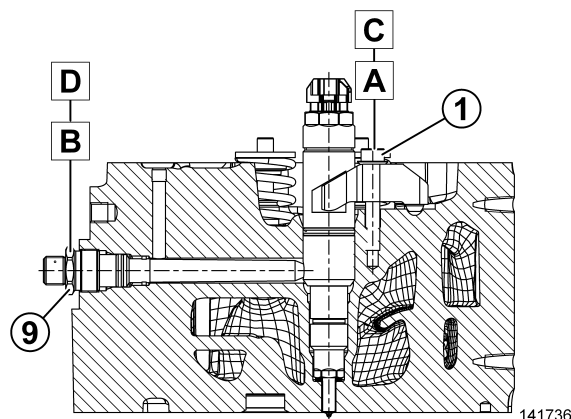
The centering nubs on the sealing washer prevent one-sided contact with the nozzle shaft and thus lateral forces on the nozzle shaft.

Injector and pressure pipe socket tightening instruction

M8x50 10.9 cylinder screw (1)

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes
Stage	Torque
1. (A)	5 Nm (3.7 ft lb)
2. (C)	28 Nm (21 ft lb)

Fig. 93 Injector and pressure pipe socket



M24x1.5 box nut (2)

Lubricant	Engine oil
Locking agent	-
Part contact surfaces	-
Screws reusable?	No
Stage	Torque
1. (B)	5 Nm (3.7 ft lb)
2. (D)	35 Nm (26 ft lb)

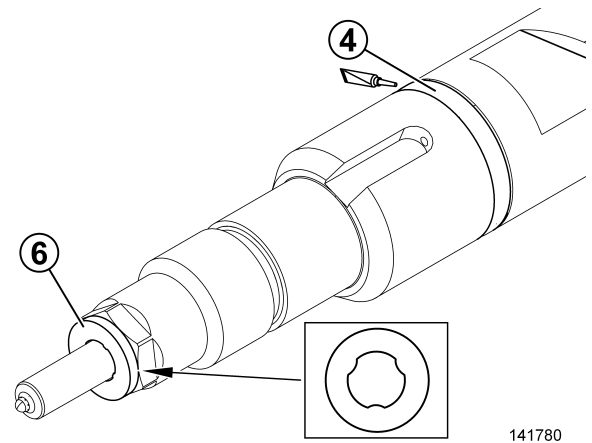
NOTE



Use new sealing washers according to spare parts catalog.

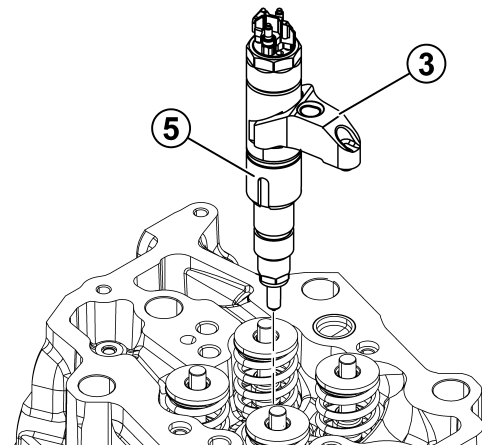
The centering nubs on the sealing washer prevent one-sided contact with the nozzle shaft and thus lateral forces on the nozzle shaft.

- Install new o-ring (4) on injector and lubricate it with NBU 30.
- Replace sealing washer (6). Sealing washer is symmetrical and therefore does not have a specified installation side.

Fig. 94 Lubricating the o-ring

141780

- Insert and align injector (5) with attached claw (3) in the cylinder head.
- Press injector into the cylinder head by hand

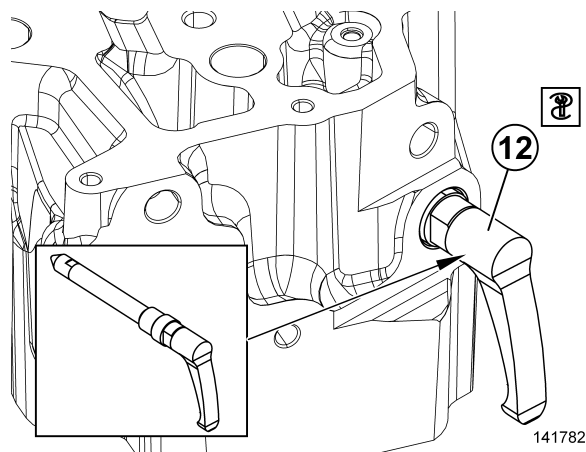
Fig. 95 Injector with claw

141781

Removing, installing the pressure pipe socket and injector (Tier0)

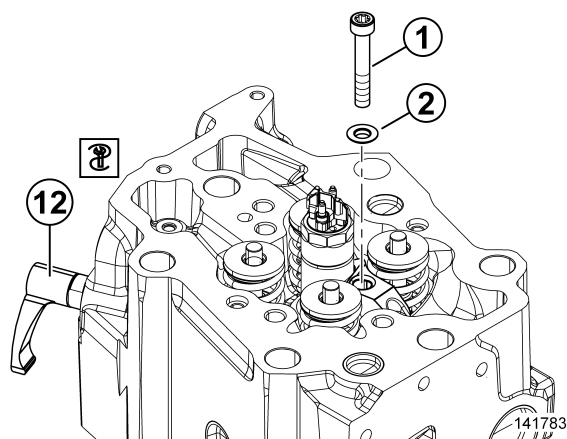
- Insert centering aid (12) [10153847] in the hole of the pressure pipe socket.
- Apply slight pressure on the face to center the injector hole.

Fig. 96 Centering aid



- Fit spherical washer (2).
- Screw tight cylinder screw (1), see tightening instruction for 1st stage.
- Remove centering aid (12).

Fig. 97 Spherical washer and cylinder screw



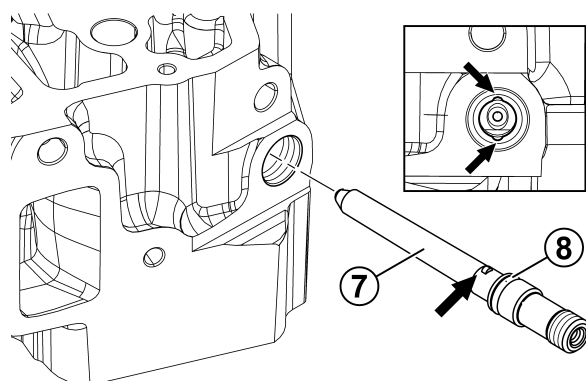
NOTE

Leaks on the pressure pipe socket.

- The pressure pipe socket must be replaced after each removal.

- Lubricate new o-ring (8) of the pressure pipe socket (7).
- Install pressure pipe socket (7) so that the centering lugs on the pressure pipe socket and the recesses in the cylinder head align (arrows).

Fig. 98 Installing the pressure pipe socket



141784

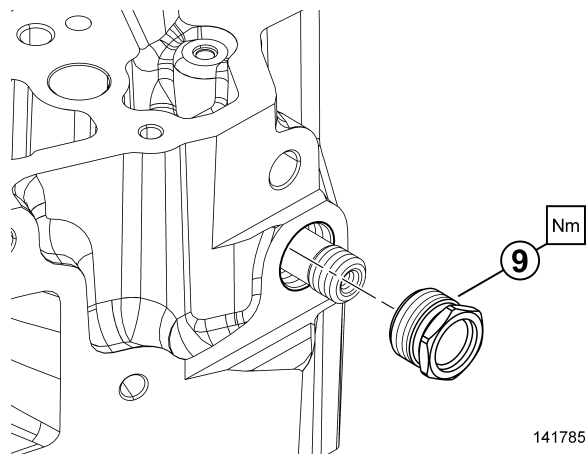
**NOTE**

Leaky high pressure connections.

- The box nut must be replaced after each removal.

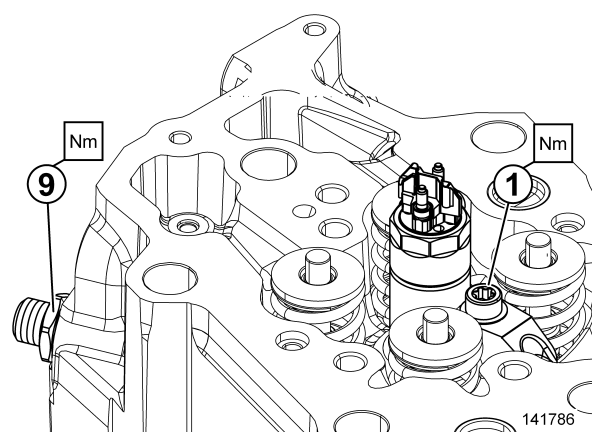
- Screw tight new box nut (9), see tightening instruction for 1st stage.

Fig. 99 Tightening pressure pipe socket 1st stage



- Screw tight cylinder screw (1), see tightening instruction for 2nd stage.
- Screw tight box nut (9), see tightening instruction for 2nd stage.
- Connect cable on injector, see installation and tightening instruction 68.

Fig. 100 Tightening 2nd stage



Removing, installing the pressure pipe socket and injector (Tier4)

5.7 Removing, installing the pressure pipe socket and injector (Tier4)

Previous work:

Observe safety instructions for working on the fuel and injection system.

Cylinder head cover removed 67

High pressure lines Fig. 79

Air intake pipe removed 138

See

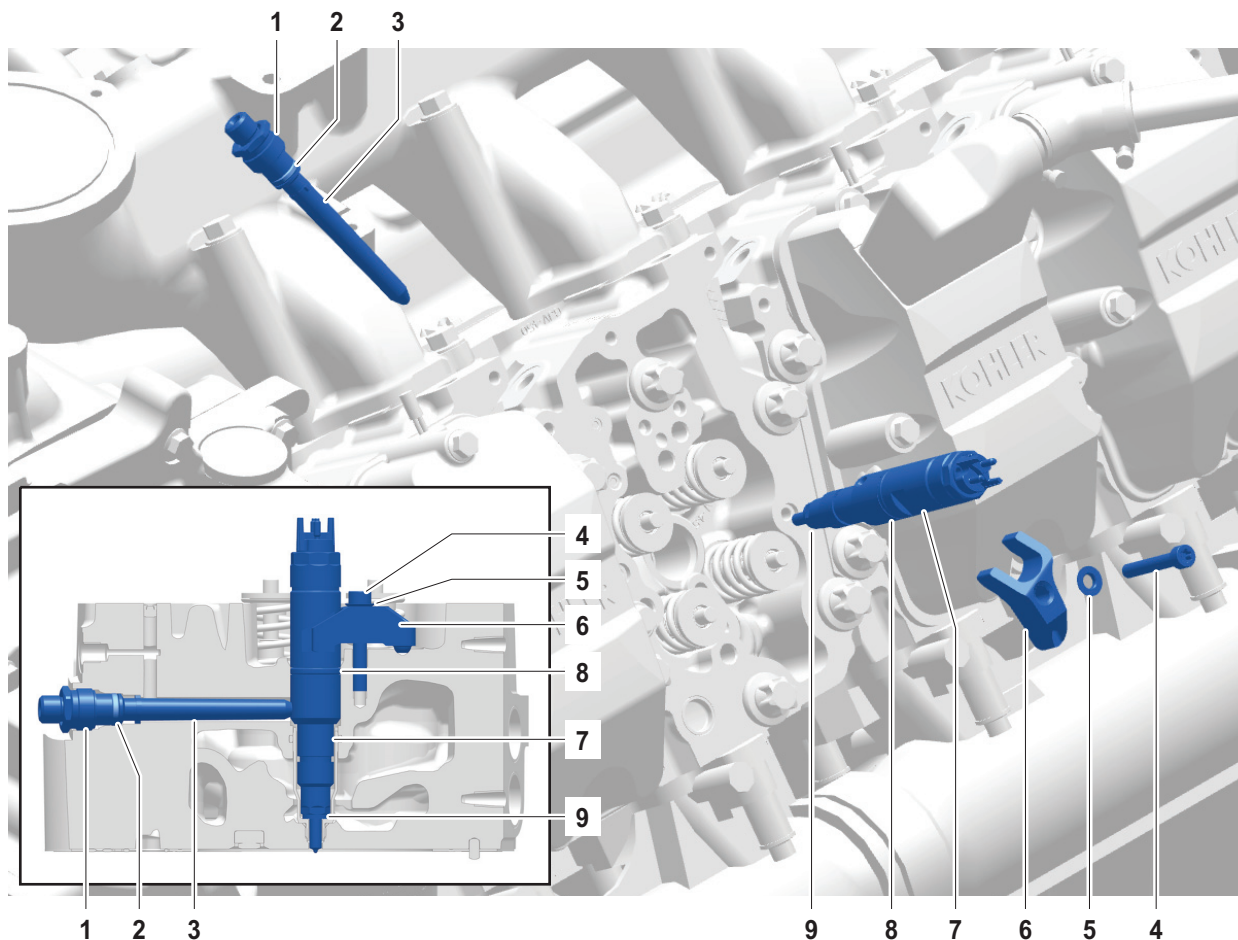
83

Remarks

Pos. 1, 2 removed

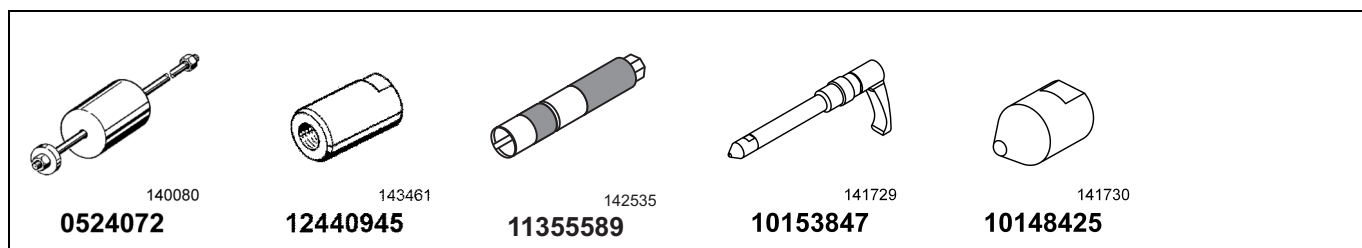
Only if pressure pipe socket Fig. 101 pos. 3 is stuck.

Fig. 101 Pressure pipe socket and injector

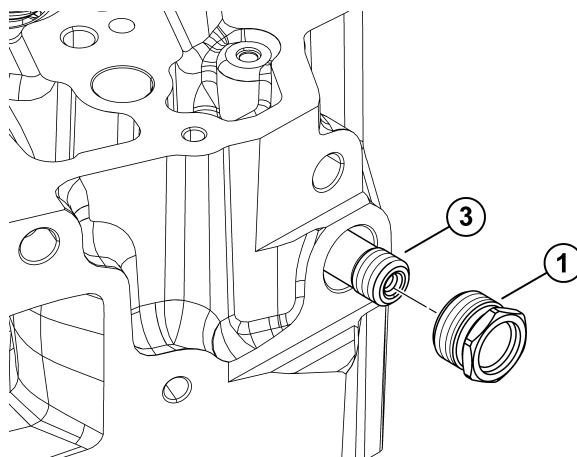


Pos. Name

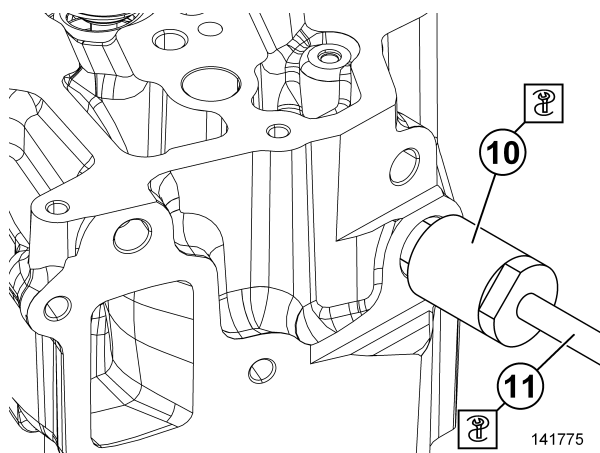
- | | | | |
|---|---------------------------------|---|--------------------------------|
| 1 | M24x1.5 box nut | ⊗ | See tightening instruction 113 |
| 2 | O-ring | | |
| 3 | Pressure pipe socket | | |
| 4 | M8x55 10.9 cylinder screw | ⊗ | See tightening instruction 113 |
| 5 | Spherical washer | | |
| 6 | Claw | | |
| 7 | Injector | | |
| 8 | O-ring | | |
| 9 | Sealing washer | | |

Special tool**5.7.1 Removing**

- Disconnect cable on the injector and remove together with the cylinder head cover seal.
- Unscrew box nut (1) from the pressure pipe socket (3).

Fig. 102 Releasing the pressure pipe socket

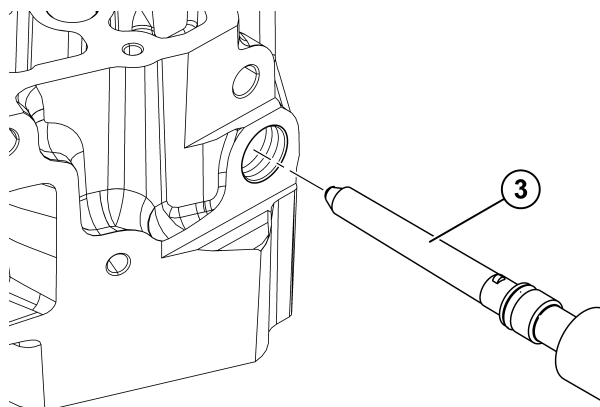
- If the pressure pipe socket is stuck, install adapter (10) [12440945] and impact extractor (11) [0524072] on the pressure pipe socket.

Fig. 103 Pressure pipe socket impact extractor

Removing, installing the pressure pipe socket and injector (Tier4)

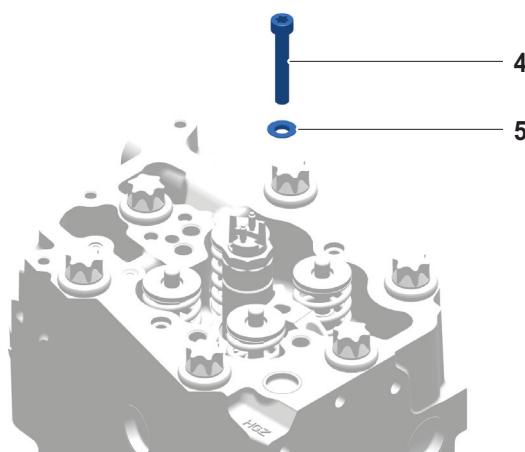
- Pull pressure pipe socket (3) out of the cylinder head.
- Seal the hole immediately with an appropriate protecting cap.

Fig. 104 Sealing the hole

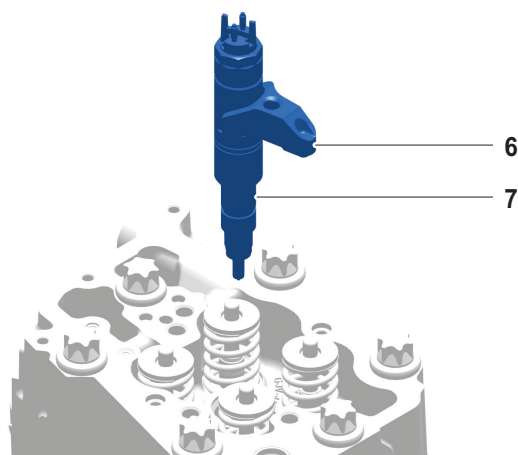


- Unscrew cylinder screw (4) and remove spherical washer (5).

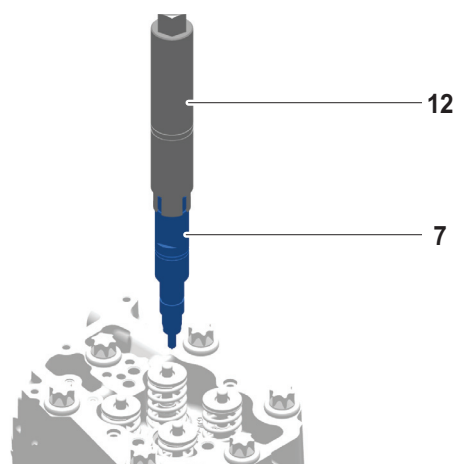
Fig. 105 Cylinder screw and spherical washer



- Remove injector (7) and claw (6) from the cylinder head and set them down.

Fig. 106 *Injector with claw*

- If the injector (7) is stuck, use special tool (12) [11355589] with impact extractor [0524072].

Fig. 107 *Pulling out a stuck injector***NOTE**

Damage to the nozzle tip.

- Remove the sealing washer carefully.

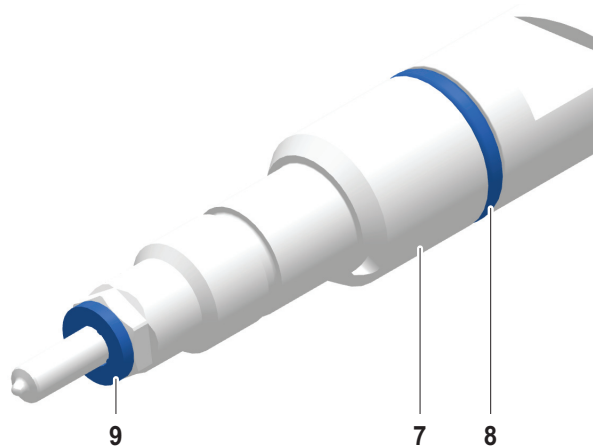
**NOTE**

If the sealing washer is stuck, replace injector sleeve. This requires a service level 3 technician.

Removing, installing the pressure pipe socket and injector (Tier4)

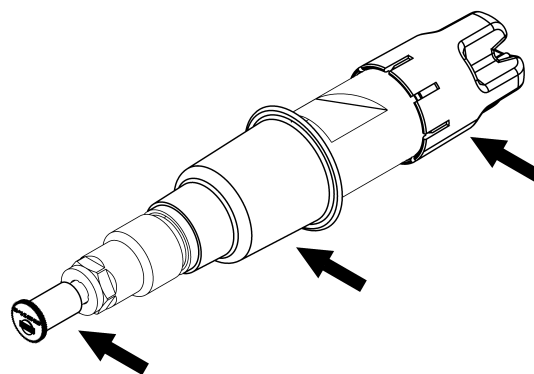
- Remove o-ring (8) from injector (7).
- Remove sealing washer (9) from injector.

Fig. 108 *Injector seals*



- Seal injector immediately with protecting caps.
- Cover the hole for the injector in the cylinder head.

Fig. 109 *Protecting caps for injector*



141779

5.7.2 Installing

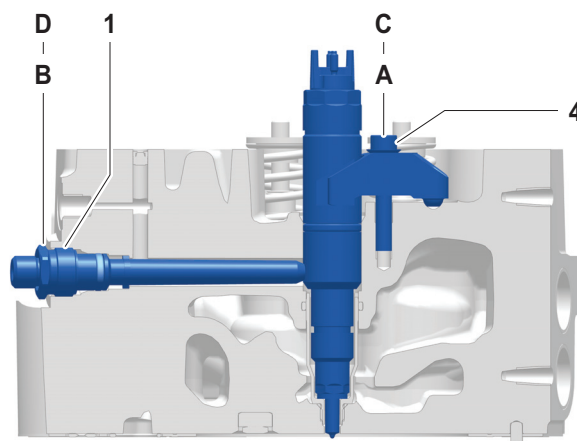
NOTE

Use new sealing washers according to spare parts catalog.

The centering nubs on the sealing washer prevent one-sided contact with the nozzle shaft and thus lateral forces on the nozzle shaft.

Injector and pressure pipe socket tightening instruction**M8x50 10.9 cylinder screw (4)**

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes
Stage	Torque
1. (A)	5 Nm (3.7 ft lb)
2. (C)	28 Nm (21 ft lb)

Fig. 110 *Injector and pressure pipe socket***M24x1.5 box nut (1)**

Lubricant	Engine oil
Locking agent	-
Part contact surfaces	-
Screws reusable?	No
Stage	Torque
1. (B)	5 Nm (3.7 ft lb)
2. (D)	35 Nm (26 ft lb)

NOTE

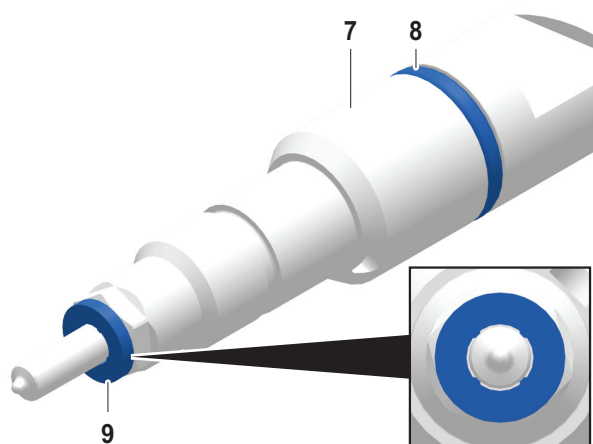
Use new sealing washers according to spare parts catalog.

The centering nubs on the sealing washer prevent one-sided contact with the nozzle shaft and thus lateral forces on the nozzle shaft.

Removing, installing the pressure pipe socket and injector (Tier4)

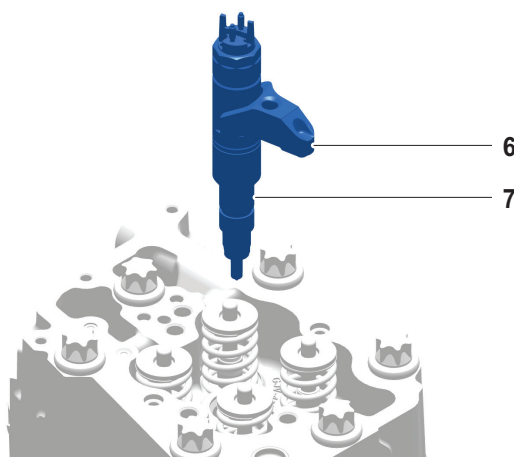
- Install new o-ring (8) on injector (7) and lubricate it with NBU 30.
- Replace sealing washer (9). Sealing washer is symmetrical and therefore does not have a specified installation side.

Fig. 111 Lubricating the o-ring

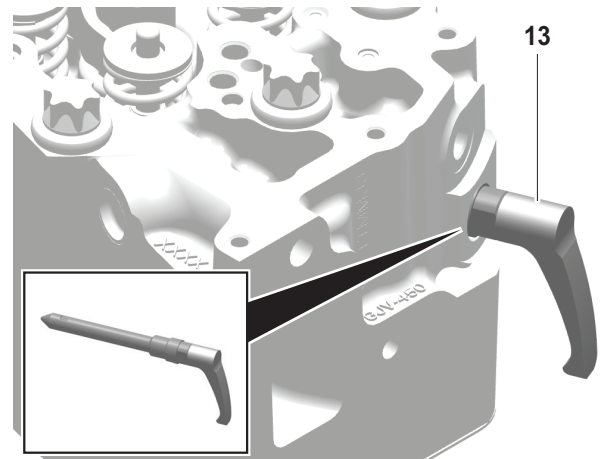


- Insert and align injector (7) with attached claw (6) in the cylinder head.
- Press injector into the cylinder head by hand

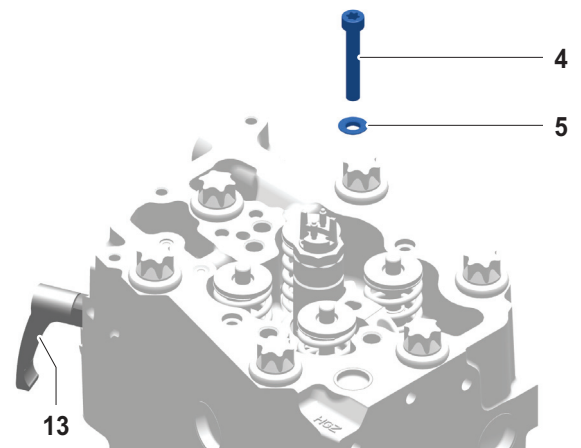
Fig. 112 Injector with claw



- Insert centering aid (13) [10153847] in the hole of the pressure pipe socket.
- Apply slight pressure on the face to center the injector hole.

Fig. 113 Centering aid

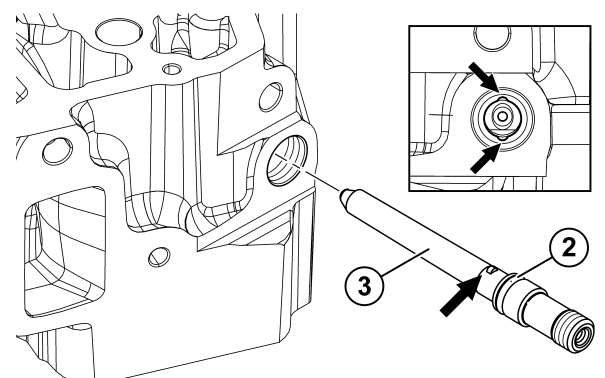
- Fit spherical washer (5).
- Screw tight cylinder screw (4), see tightening instruction for 1st stage.
- Remove centering aid (13).

Fig. 114 Spherical washer and cylinder screw**NOTE**

Leaks on the pressure pipe socket.

- The pressure pipe socket must be replaced after each removal.

- Lubricate new o-ring (2) of the pressure pipe socket (3).
- Install pressure pipe socket (3) so that the centering lugs on the pressure pipe socket and the recesses in the cylinder head align (arrows).

Fig. 115 Installing the pressure pipe socket

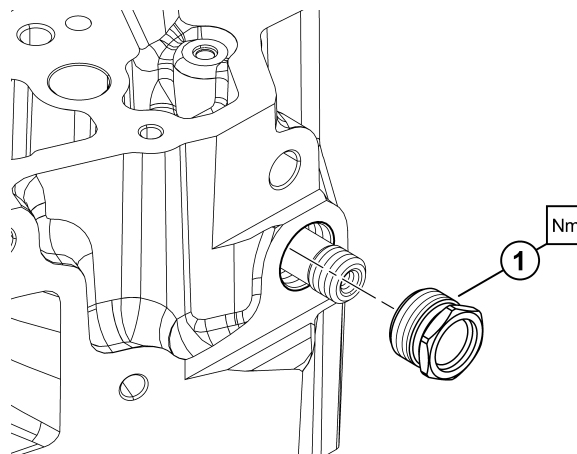

NOTE

Leaky high pressure connections.

- The box nut must be replaced after each removal.

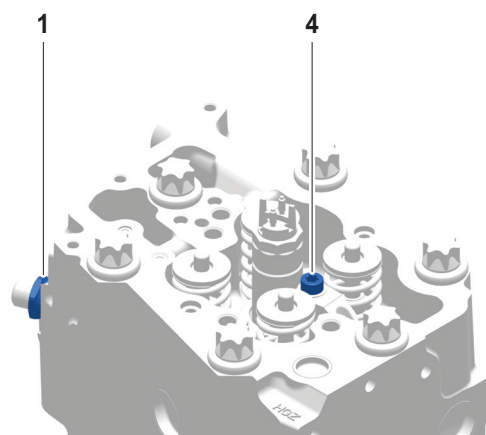
- Screw tight new box nut (1), see tightening instruction for 1st stage.

Fig. 116 Tightening pressure pipe socket 1st stage



- Screw tight cylinder screw (4), see tightening instruction for 2nd stage.
- Screw tight box nut (1), see tightening instruction for 2nd stage.
- Connect cable on injector, see installation and tightening instruction [68](#).

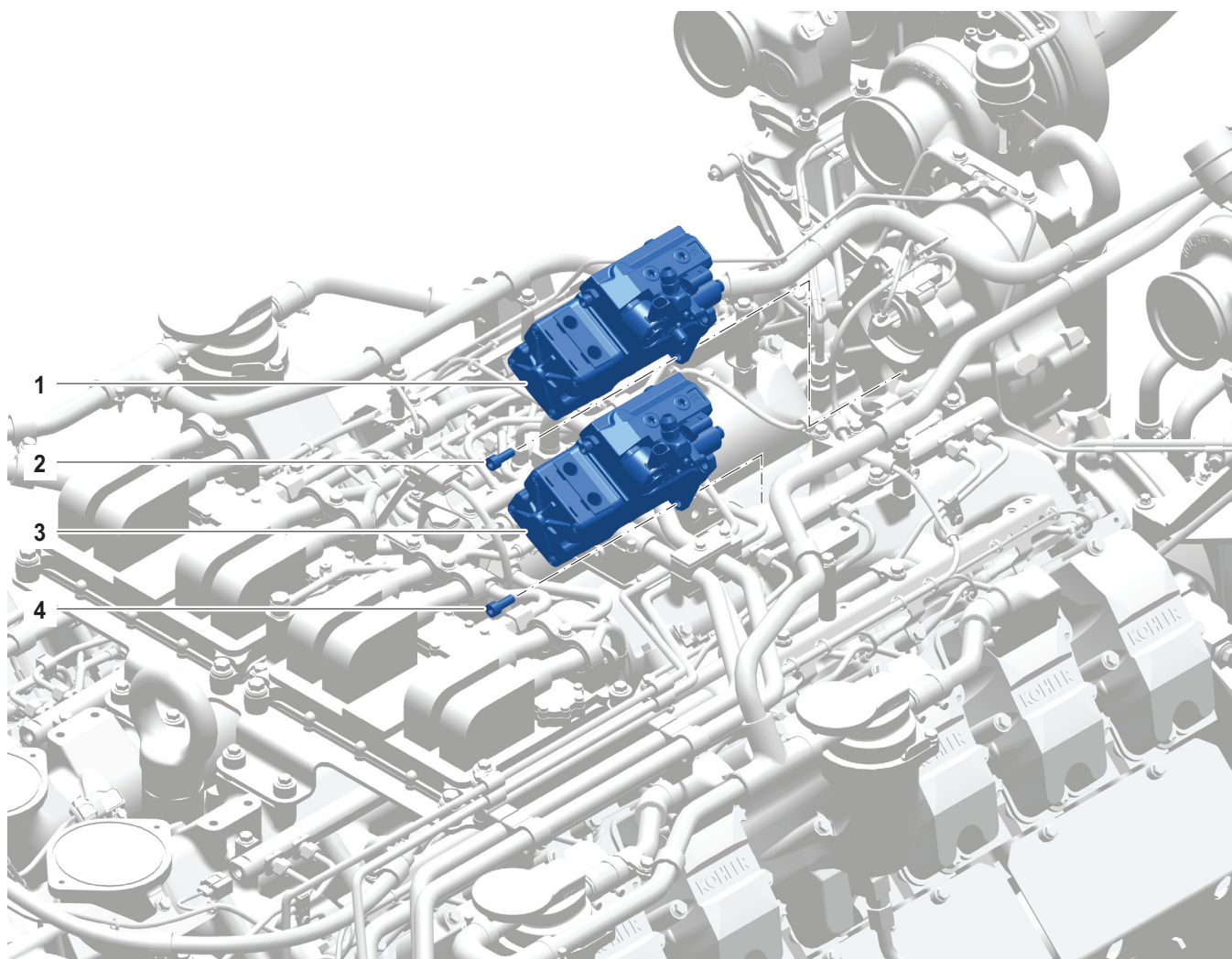
Fig. 117 Tightening 2nd stage



5.8 Removing, installing the high pressure pumps (engine KD36V16)

Previous work:	See	Remarks
First cylinder set to ignition TDC.		
Safety instructions for working on the fuel and injection system observed.	83	Residual pressure in injection pipes reduced to below 10 bar (145 psi) with KODIA diagnostics program.
High pressure pumps electrically disconnected		
Fuel lines	85	Pos. 6, 7, 8 removed
Fuel lines - continuous ventilation	87	Pos. 8 removed
Injection pipes	93	Pos. 5, 6 removed
Engine lifting device removed	59	Ring bolt 2 and spacer 1 of the engine lifting device removed on the flywheel side.

Fig. 118 High pressure pumps



Pos.	Name	Work instructions
1	Top high pressure pump	✚ Basic setting: Set oil hole of pump shaft to horizontal position, ✍ See, 119
2	M10x25 10.9 cylinder screw.....	✚ Screw tight, Nm see tightening instruction. Observe the order.

Removing, installing the high pressure pumps (engine KD36V16)

Pos.	Name	Work instructions
3	Bottom high pressure pump	✂ Basic setting: Set oil hole of pump shaft to horizontal position, ✍ See, 119
4	M10x25 10.9 cylinder screw	✂ Screw tight, N_m see tightening instruction. Observe the order.

Special tool

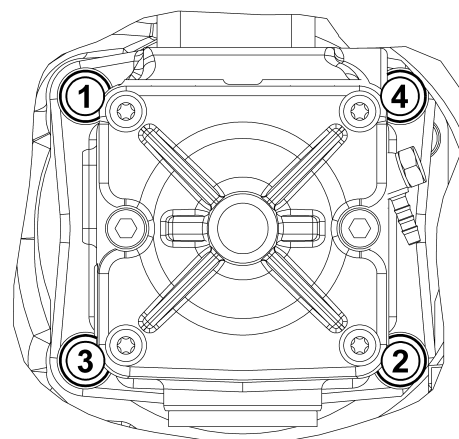


High pressure pump tightening instruction

M10x30-10.9 cylinder screw

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes
Stage	Torque
1.	15 Nm (11 ft lb)
2.	68 Nm (50 ft lb)

Fig. 119 High pressure pump tightening sequence



141034

5.8.1 Removing the high pressure pumps

NOTE

Damage of the injectors due to contamination in the fuel system.



- Before disassembly, clean the area around the high pressure pump.
- Avoid damage to disassembled components for later analysis.
- Seal opened lines immediately with protecting caps.
- Seal openings of high pressure pump immediately with protecting caps.
- Failure to comply with the assembly instructions will void the warranty.

5.8.2 Installing the high pressure pumps


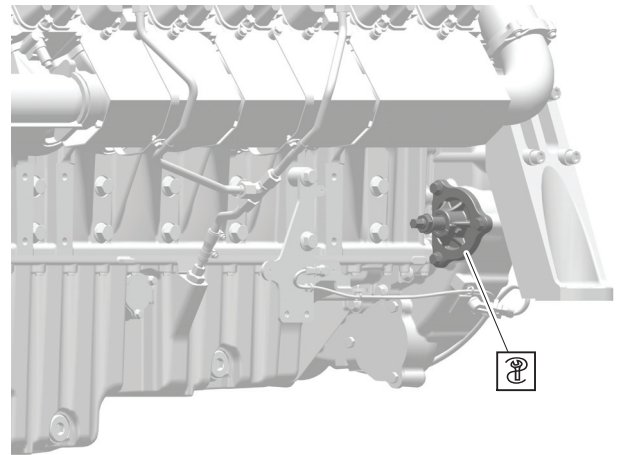
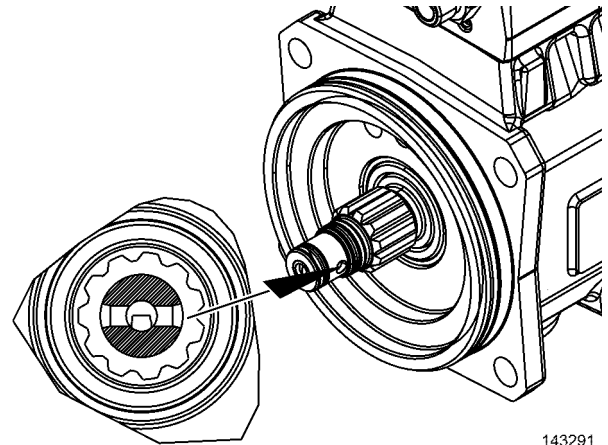
- Install  turning device [10123791].
- Make sure that the 1st cylinder is at ignition TDC.

Fig. 120 Turning device



- Position the oil inlet hole of the shaft horizontally.

Fig. 121 Aligning the high pressure pump rotor

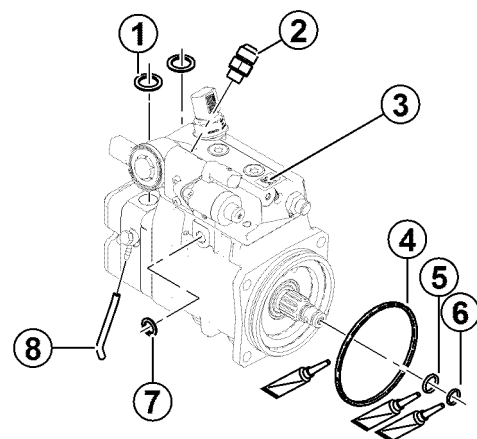


143291

Install both high pressure pumps:

- Replace o-ring (4), lubricate it and insert it in the groove.
- Replace o-ring (5), lubricate it and insert it in the groove.
- Replace o-ring (6), lubricate it and insert it in the groove.
- Starting from the bottom, install high pressure pumps inclined 45° (Fig. 118) without twisting the shaft (Fig. 121).
- Remove protecting caps on the fuel inlets, outlets.
- Replace o-rings (1) and (7).
- Replace screw fitting (2).
- Connect connection lines.

Fig. 122 Preparing for high pressure pump installation

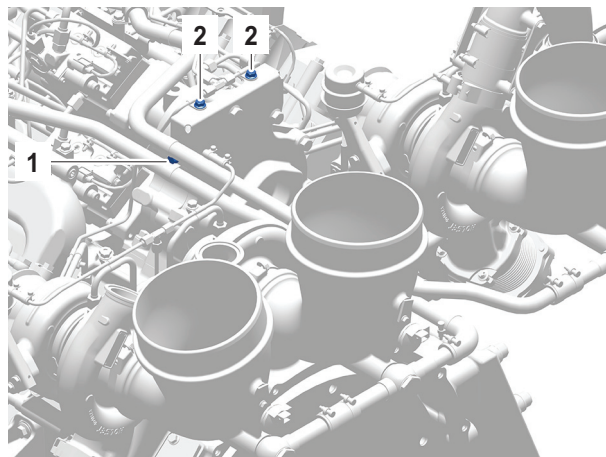


143227

5.8.3 Setting the high pressure pumps

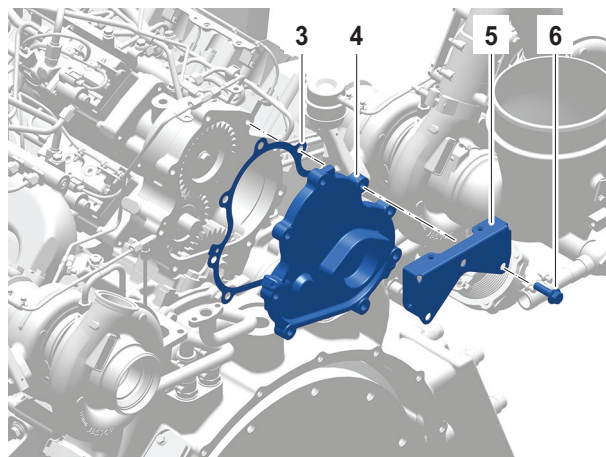
- Unscrew hex head screw (1) and release crankcase breather system pipelines from the high pressure pump drive.
- Unscrew hex head screws (2) and release charging pressure regulation pipeline from the high pressure pump drive.

Fig. 123 Releasing the lines from the high pressure pump drive



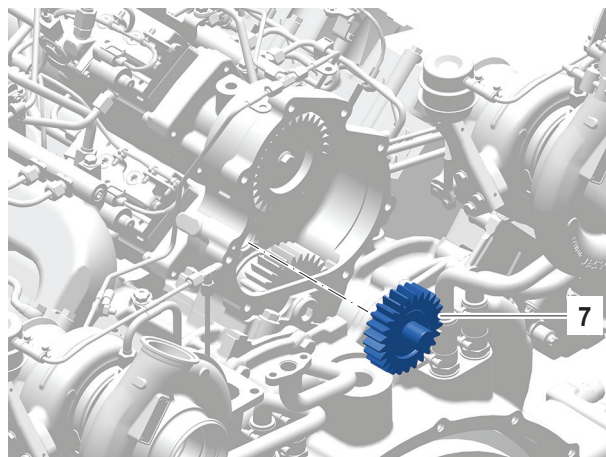
- Unscrew hex head screws (6).
- Remove holder (5) from high pressure pump drive.
- Remove lid (4) from high pressure pump drive.
- Remove seal (3).

Fig. 124 Removing the high pressure pump drive lid



- Pull out intermediate gear wheel (7).

Fig. 125 Removing the intermediate gear wheel




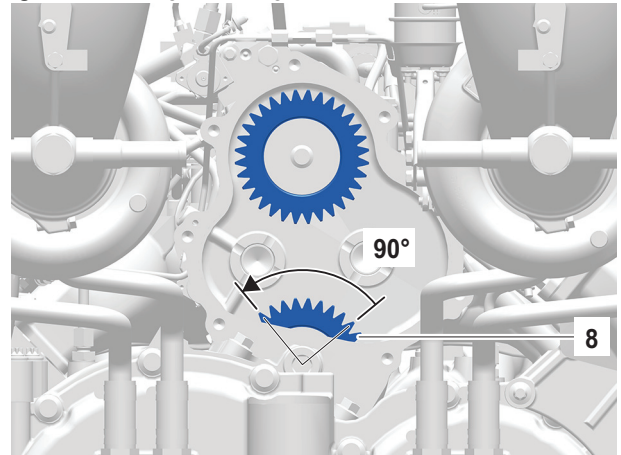
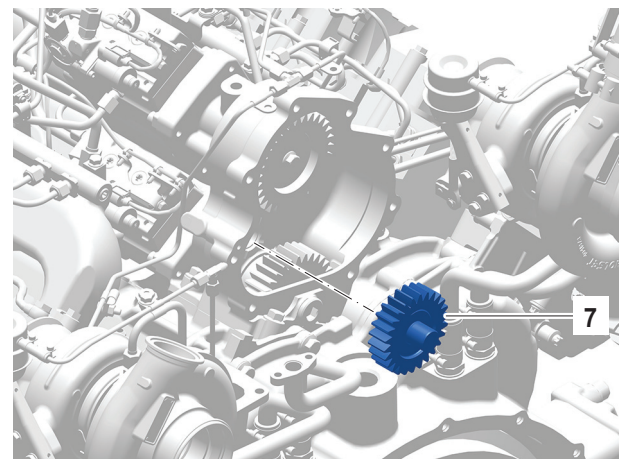
- Mark drive gear (8) of bottom high pressure pump to high pressure pump drive housing.
- Turn engine with  turning device [10123791] in the engine direction of rotation until drive gear (8) has been turned further by **eight teeth** (90°).
- For definition of engine direction of rotation, see [29](#)

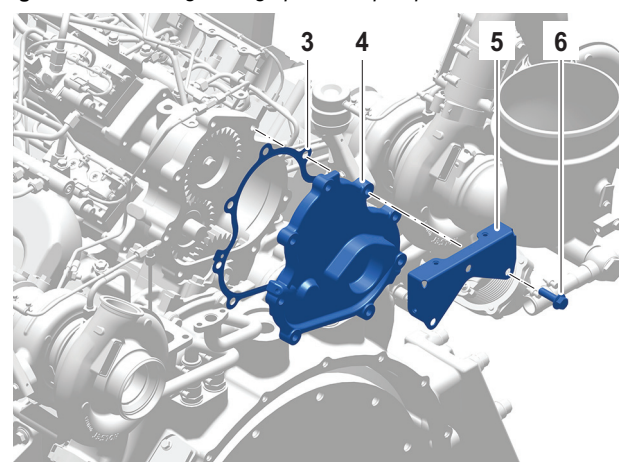
Fig. 126 Setting the drive gear**NOTE**

If the angle is not set correctly, the diesel engine will not achieve the full rated power. In this case, carry out the entire setting process again.

- Install intermediate gear wheel (7).

Fig. 127 Installing the intermediate gear wheel

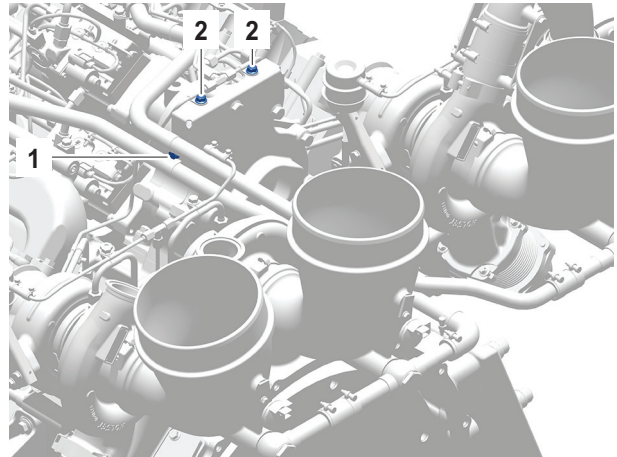
- Replace seal (3).
- Attach lid (4) with seal (3) to high pressure pump drive.
- Attach holder (5) to high pressure pump drive.
- Screw in hex head screws (6) and tighten.

Fig. 128 Installing the high pressure pump drive lid

Removing, installing the high pressure pumps (engine KD36V16)

- Attach charging pressure regulation pipeline to high pressure pump drive and screw in hex head screws (2).
- Attach crankcase breather system pipelines to high pressure pump drive and screw in hex head screw (1).

Fig. 129 Installing the high pressure pump drive lid



5.9 Removing, installing the high pressure pump drive (engine KD36V16)

Previous work:

First cylinder set to ignition TDC.

Crankcase breather system pipelines removed. [147](#)

Charge air regulation pipelines removed. [137](#)

High pressure pumps removed [117](#)

Engine lifting device removed [59](#)

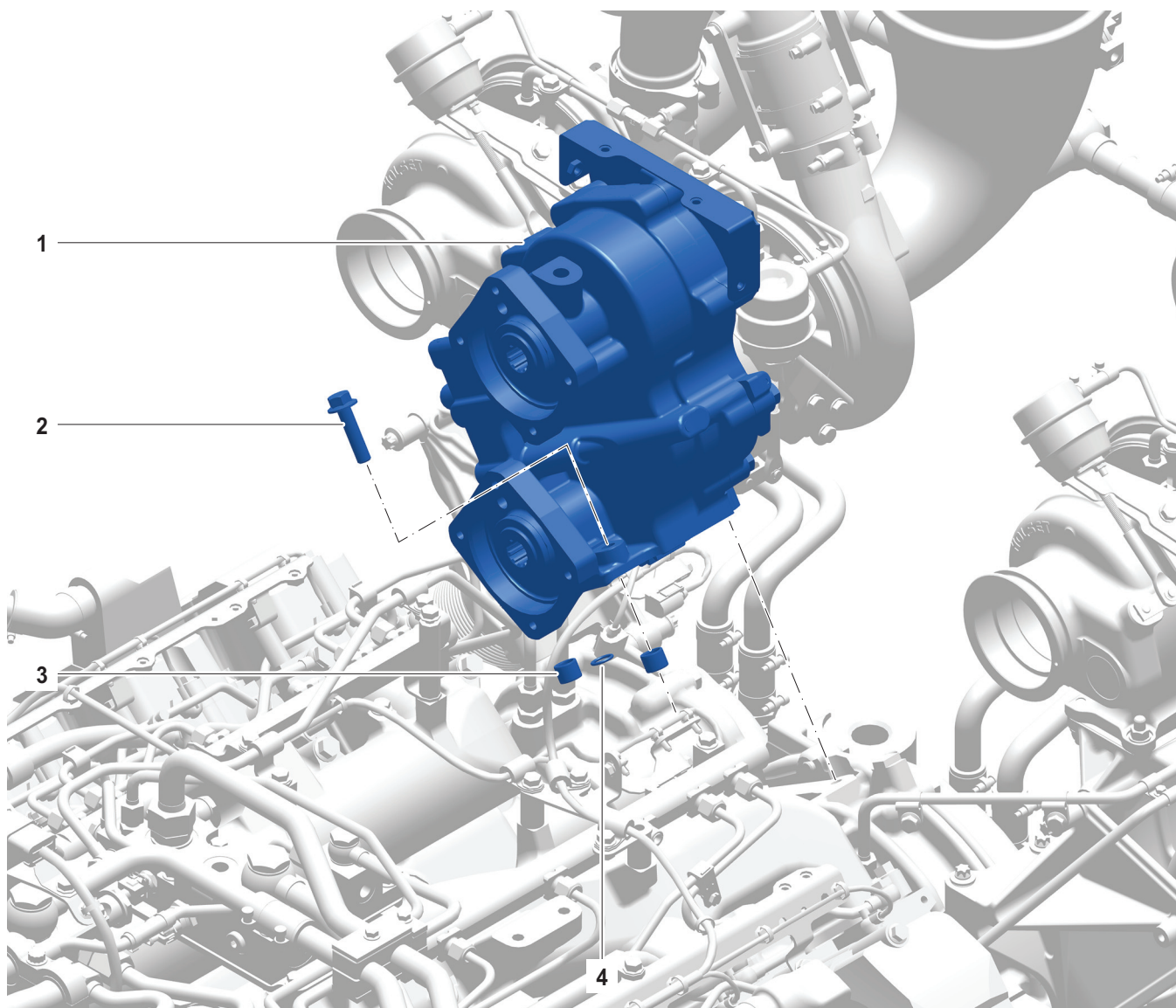
See

Remarks

Pos. 4, 5 removed.

Ring bolt 2 and spacer 1 of the engine lifting device removed on the flywheel side.

Fig. 130 High pressure pump drive



Pos.	Name	Work instructions
1	High pressure pump drive	✳ Seal with Loctite SI 5990, see 124
2	M12x50 8.8 hex head screw	
3	Fitting sleeve	✳ Pay attention to correct seat in the crankcase and high pressure pump drive
4	Sealing ring	✳ Replace

Removing, installing the high pressure pump drive (engine KD36V16)

5.9.1 High pressure pump drive sealing process



NOTE

Clean sealing surfaces on crankcase and high pressure pump drive.
- The sealing surfaces must be free of old sealant, oil and grease


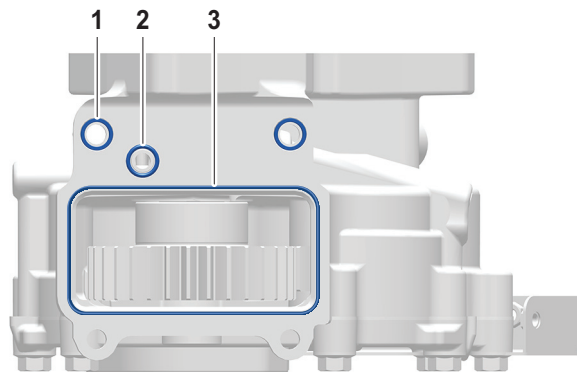
- Apply  Loctite SI 5990 sealant to the area indicated (3) with a diameter of 2.5 mm.
- Replace sealing ring (2).
- Pay attention to correct seat of the fitting sleeves (1) in the crankcase and high pressure pump drive.

Fig. 131 High pressure pump drive sealing process



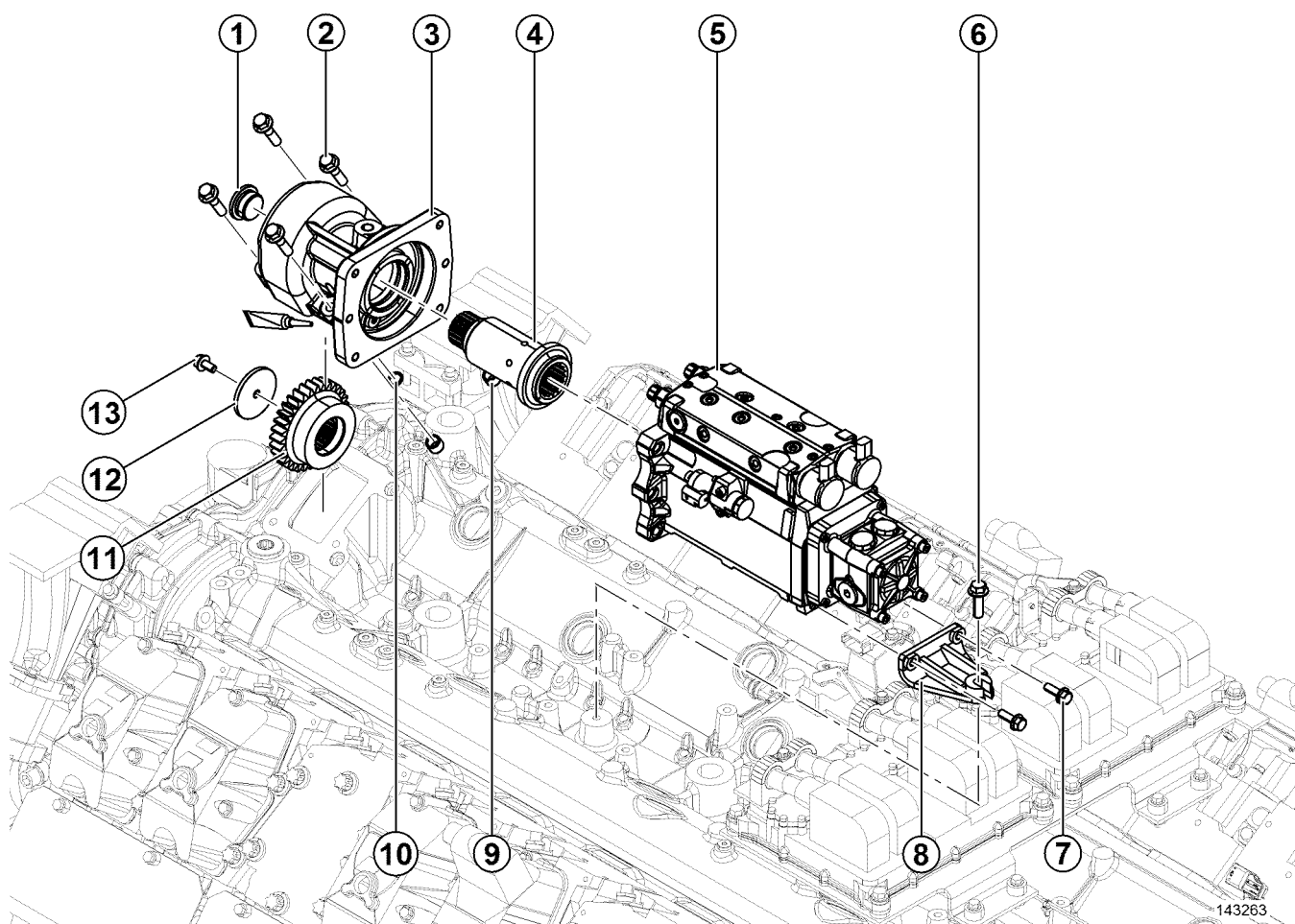
5.10 Removing, installing the high pressure pump drive (engine KD45V20)

Previous work:

First cylinder set to ignition TDC.

	See	Remarks
Fuel lines	Fig. 72	Pos. 6, 8 removed
Fuel line	Fig. 72	Box nut from pipe pos. 7 to distributor block pos. 6 released.
Injection pipes	Fig. 79	Pos. 5, 6 removed
Crankcase breather system	Fig. 156	Pos. 4, 5 removed

Fig. 132 High pressure pump drive

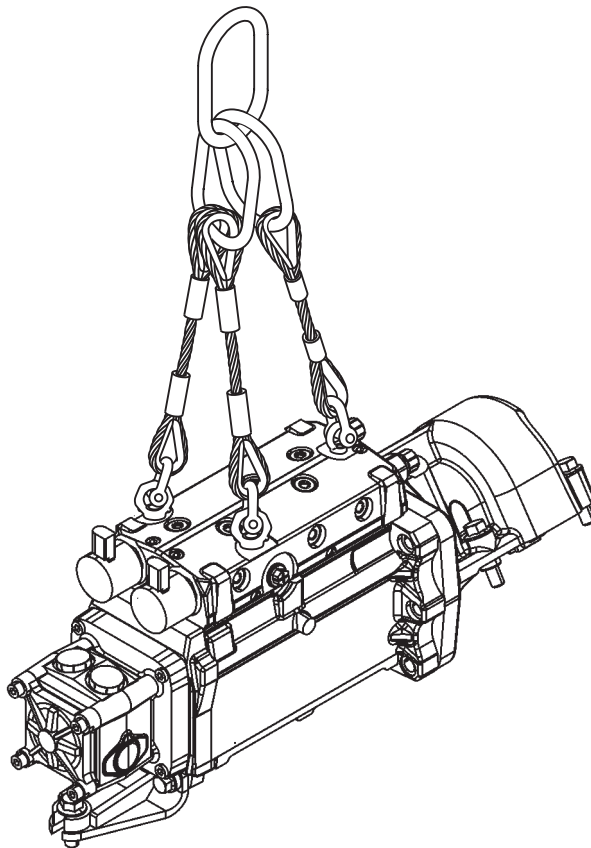


Pos.	Name	Work instructions
1	Screw plug	
2	M10x20 8.8 hex head screw	
3	Housing, pre-assembled	✱ Replace seal, see 127
4	Drive shaft	
5	High pressure pump	
6	M12x40 8.8 hex head screw	
7	M10x30 8.8 hex head screw	
8	Holder	
9	Fitting sleeve	
10	O-ring	✱ Replace

Removing, installing the high pressure pump drive (engine KD45V20)

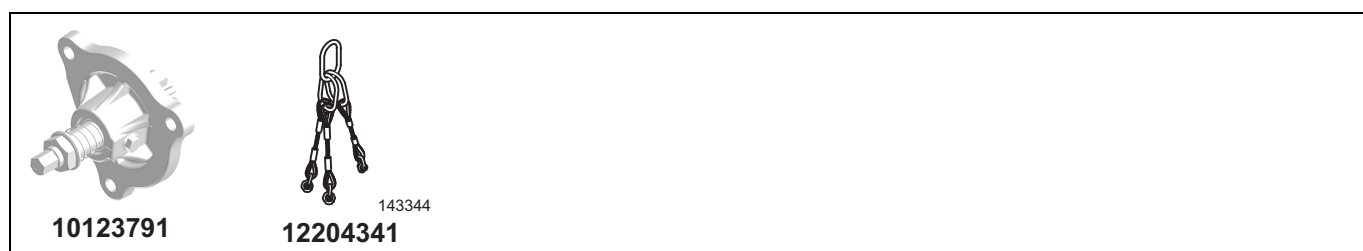
Pos.	Name	Work instructions
11	Gear wheel	
12	Washer	
13	M10x20 8.8 hex head screw	

Fig. 133 Lifting the high pressure pump drive



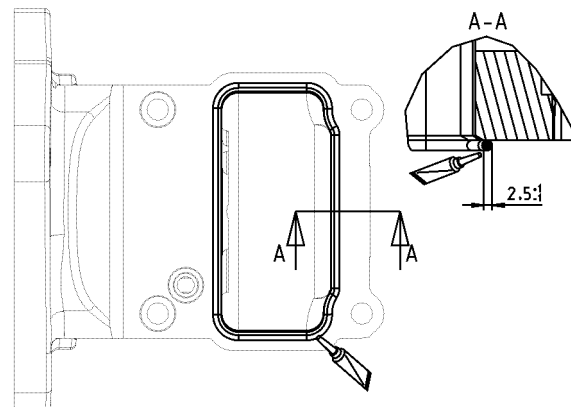
143347

Special tool



High pressure pump drive assembly instructions**M10 10.9 hexagonal collar screw**

Lubricant	-
Sealant	Loctite SI 5990
Part contact surfaces	degreased
Screws reusable?	Yes
Stage	Torque
1.	Standard

Fig. 134 High pressure pump drive

143264

5.10.1 Removing the high pressure pump with high pressure pump drive**NOTE**

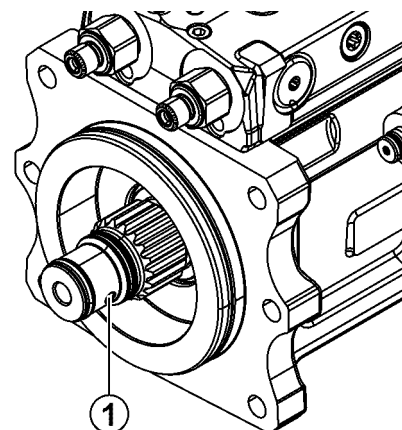
Damage of the injectors due to contamination in the fuel system.



- Before disassembly, clean the area around the high pressure pump.
- Avoid damage to disassembled components for later analysis.
- Seal opened lines immediately with protecting caps.
- Seal openings of high pressure pump immediately with protecting caps.
- Failure to comply with the assembly instructions will void the warranty.

5.10.2 Installing the high pressure pump drive with high pressure pump

- Set diesel engine to TDC mark (Fig. 13).
- Set high pressure pump hole (1) to horizontal.

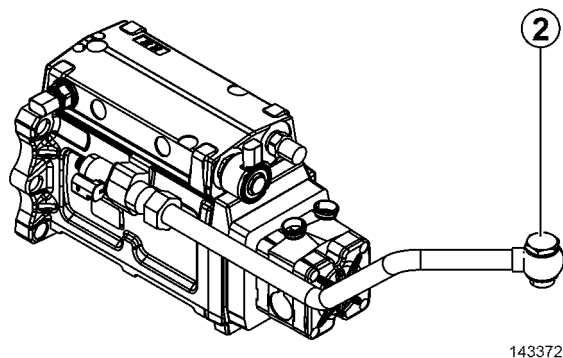
Fig. 135 High pressure pump marking

143268

Removing, installing the high pressure pump drive (engine KD45V20)

- Place high pressure pump on a level surface and align the fuel line connection (2) horizontally.
- Tighten fuel line to final torque.
- Check horizontal alignment of the connection.

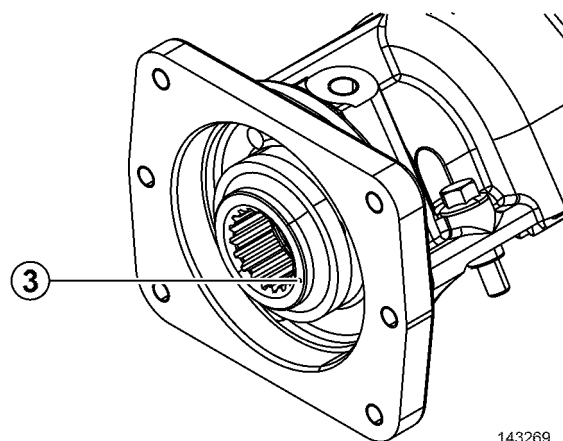
Fig. 136 High pressure pump with fuel line



143372

- Align high pressure pump drive marking (3) to high pressure pump hole (Fig. 135 pos. 1).
- Assemble high pressure pump and high pressure pump drive.
- Apply sealing compound to high pressure pump drive, Fig. 134.

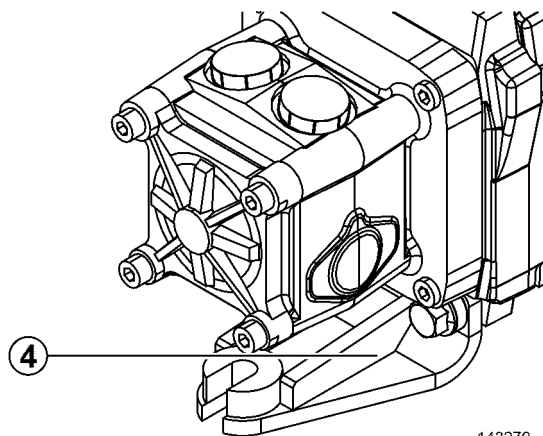
Fig. 137 High pressure pump drive marking



143269

- Fasten holder (4) to high pressure pump.
- Install high pressure pump with high pressure pump drive to diesel engine.
- Tighten all fastening screws.

Fig. 138 Fastening of high pressure pump, pre-assembled



143270

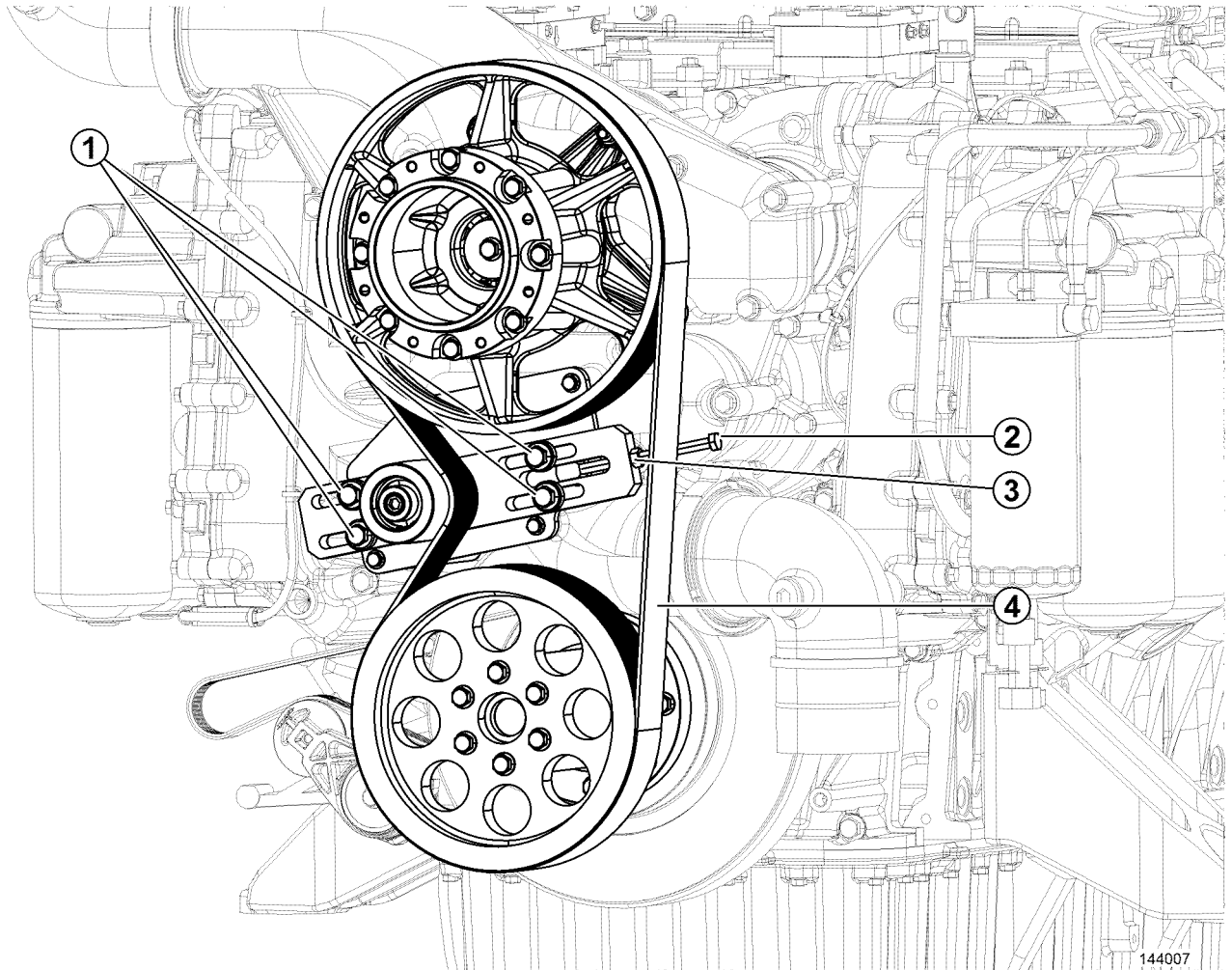
6 Belt drive

6.1 Removing, installing the belt

6.1.1 Removing, installing the fan drive belt

Previous work:	See	Remarks
Fan disassembled		Generator side

Fig. 139 Fan drive belt

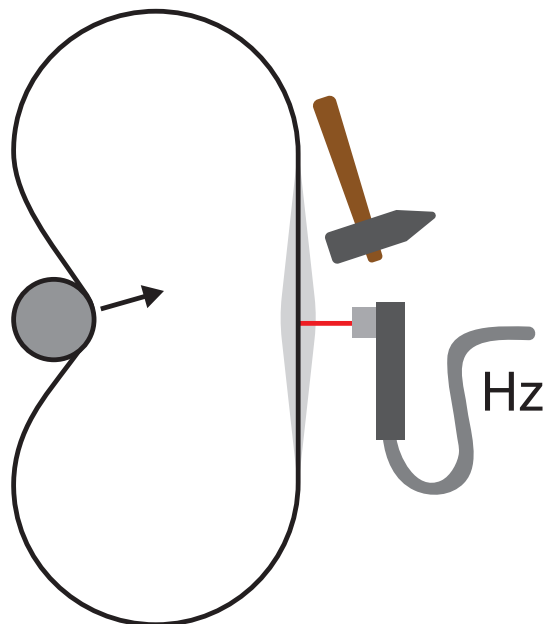


Pos.	Name	Work instructions
1	M12x40 8.8 hex head screw	
2	M10x150 10.9 hex head screw	✚ See setting the belt tension, 130 .
3	M10 hex nut	
4	Belt	

Setting the belt tension

- Release hex head screws Fig. 139 pos. 1.
- Remove locknut Fig. 139 pos. 3.
- Place frequency meter in measuring position and switch it on according to manufacturer's instructions.
- Using a hammer, strike the belt lightly to put it in vibration.
 - Measurement takes place.
- Set the belt to 111 Hz with adjusting screw Fig. 139 pos. 2.
- Fix adjusting screw with locknut Fig. 139 pos. 3.
- Tighten hex head screws Fig. 139 pos. 1.
- Check belt tension.
- Allow to run in for 30 minutes.
- Release hex head screws Fig. 139 pos. 1.
- Remove locknut Fig. 139 pos. 3.
- Place frequency meter in measuring position and switch it on according to manufacturer's instructions.
- Using a hammer, strike the belt lightly to put it in vibration.
 - Measurement takes place.
- Set the belt to 94 Hz with adjusting screw Fig. 139 pos. 14.
- Fix adjusting screw with locknut Fig. 139 pos. 3.
- Tighten hex head screws Fig. 139 pos. 1.
- Check belt tension.

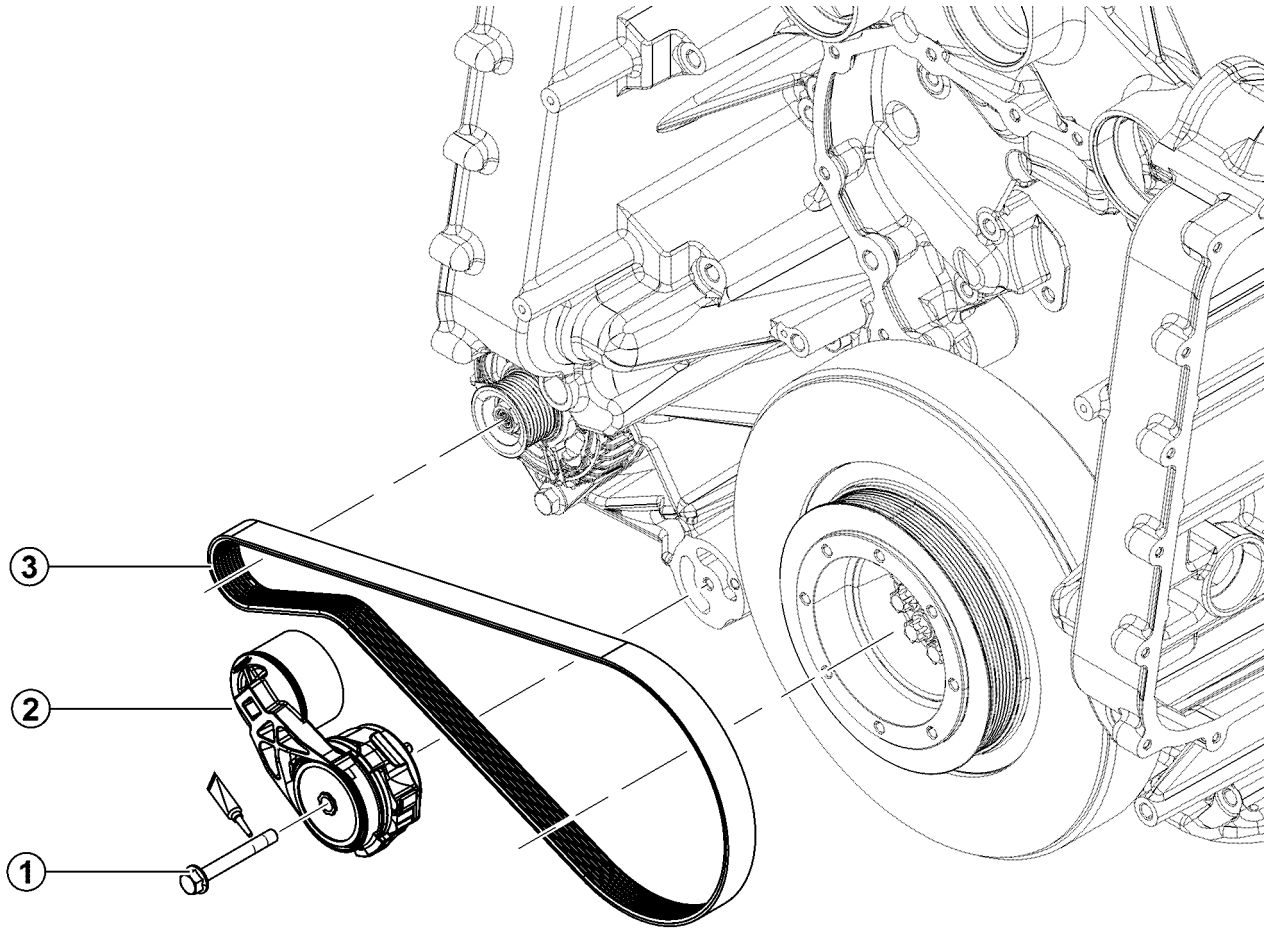
Fig. 140 Setting the belt tension



6.1.2 Belt tensioning device with automatic belt tensioner

Previous work:	See	Remarks
Fan drive belt removed	129	

Fig. 141 Belt



143273

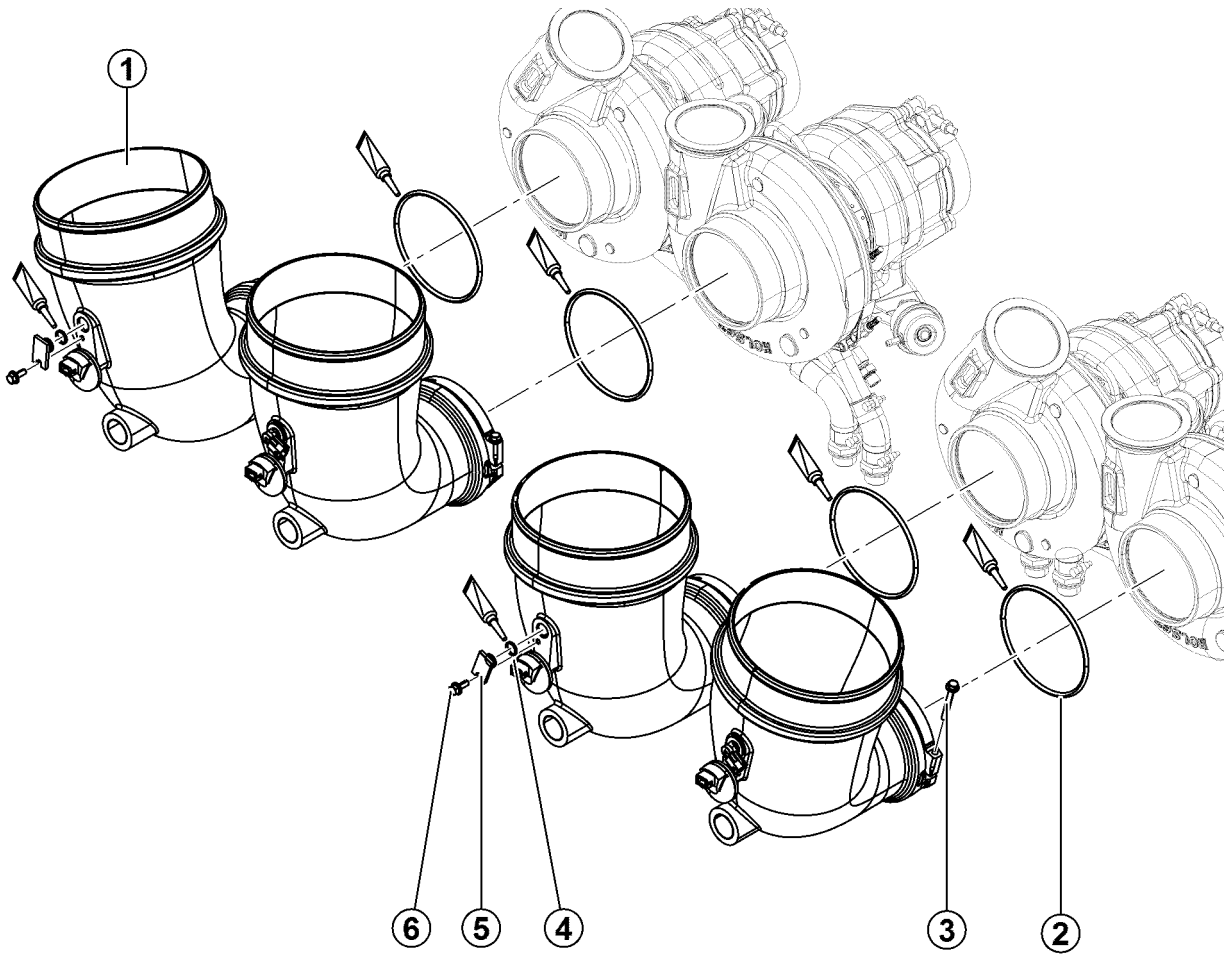
Pos.	Name	Work instructions
1	M10x80 8.8 hex head screw	✚ Secure with Loctite 243
2	Tensioning device	
3	Belt	

7 Charge air and exhaust system

7.1 Removing, installing the intake manifold before the compressor

Previous work:	See	Remarks
Generator side suction pipe removed		
Sensors on intake manifold removed		
Crankcase breather system	Fig. 156	Pos. 1, 2, 21 removed

Fig. 142 Intake manifold



143255

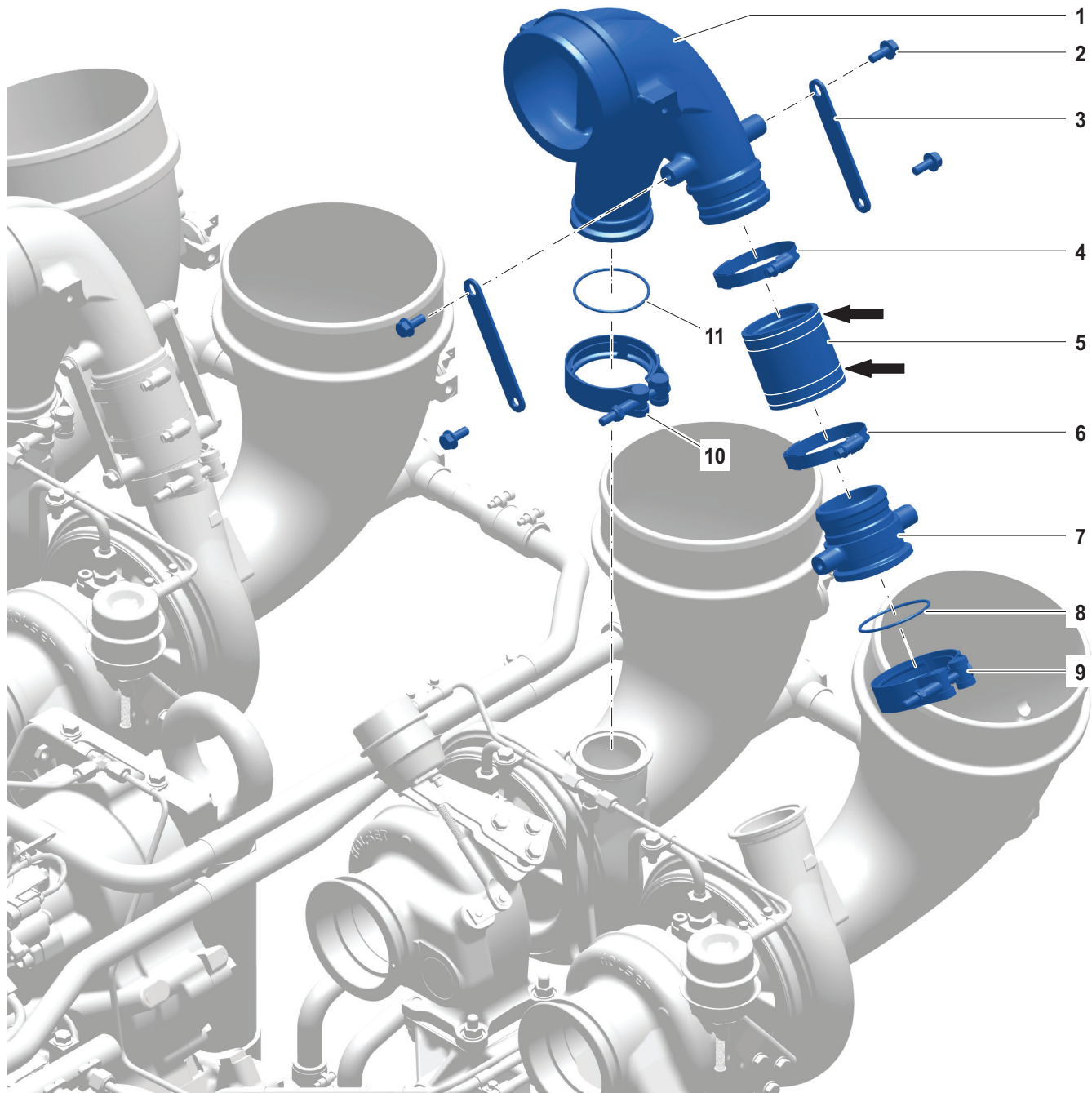
Pos.	Name	Work instructions
1	Intake manifold	
2	O-ring	✱ Replace, grease with NBU 30
3	M6x50 8.8 hex head screw	
4	O-ring	✱ Replace, grease with NBU 30
5	Lid	
6	M6x16 8.8 hex head screw	

Removing, installing the charge air pipe





7.2 Removing, installing the charge air pipe

Previous work:	See	Remarks
Generator side charge air pipe removed		

Fig. 143 Removing, installing the charge air pipe



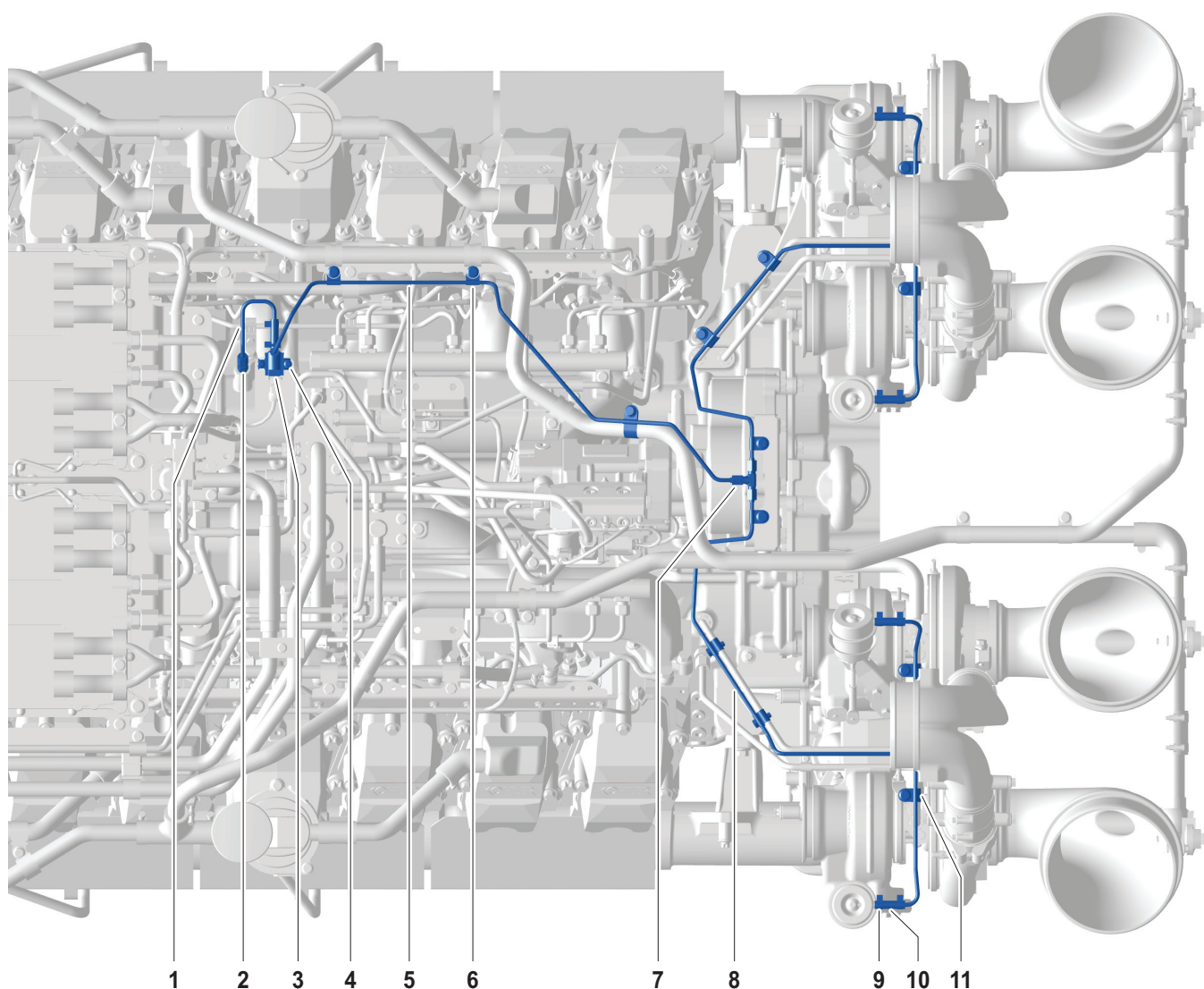
Pos.	Name	Work instructions
1	Charge air pipe	
2	M8x20 8.8 hex head screw	
3	Sheet metal	

Pos.	Name	Work instructions	
4	Hose clamp		Ensure correct assembly of the hose clamps (4 and 6). The hose clamps must be installed between the two white lines on the rubber sleeve (5) (arrows).
5	Rubber sleeve		
6	Hose clamp		Ensure correct assembly of the hose clamps (4 and 6). The hose clamps must be installed between the two white lines on the rubber sleeve (5) (arrows).
7	Charge air pipe		
8	O-ring		Replace
9	Tension clamp		
10	Tension clamp		
11	O-ring		Replace

Removing, installing the charge air regulation (engine KD36V16)

7.3 Removing, installing the charge air regulation (engine KD36V16)

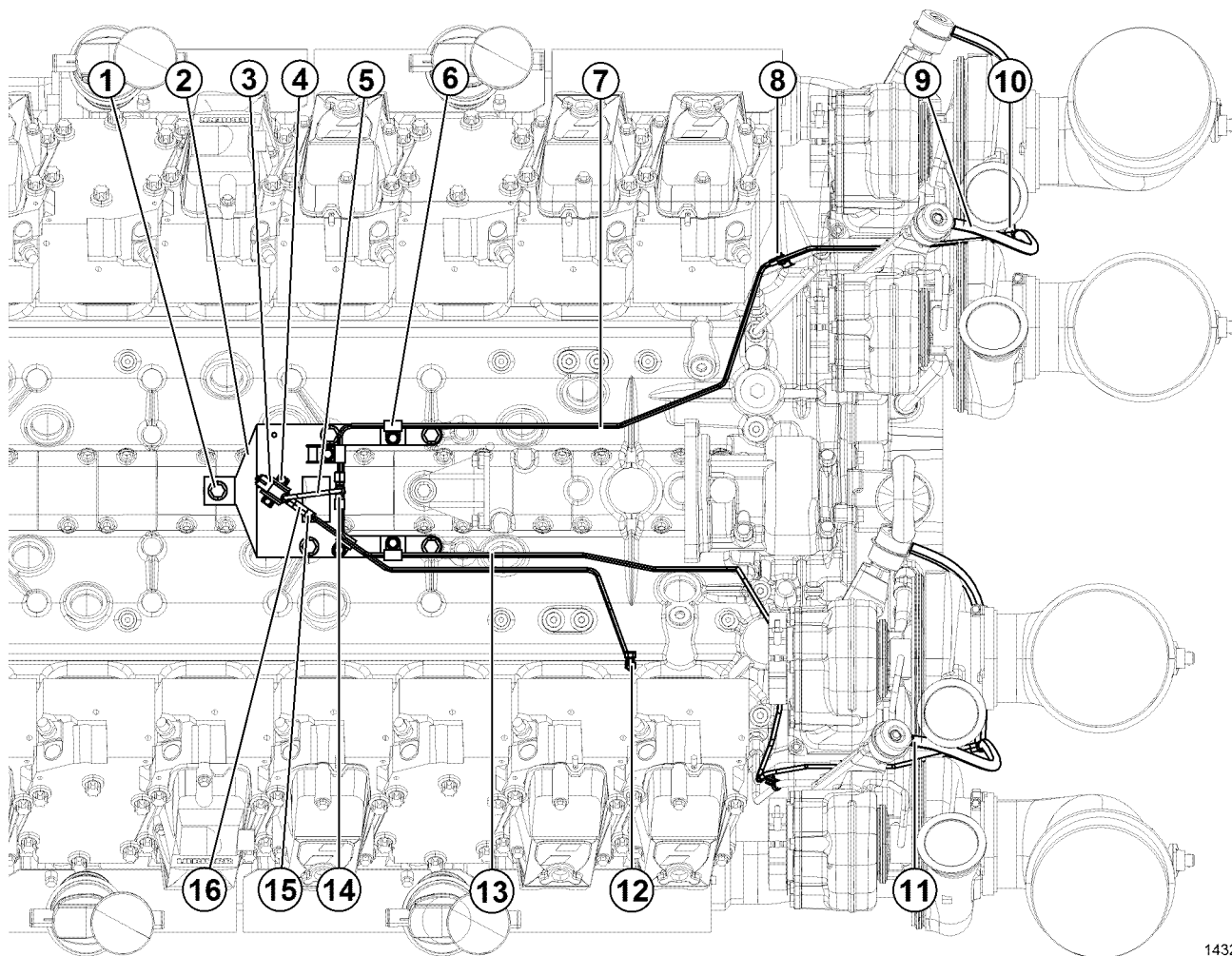
Fig. 144 Charge air regulation



Pos.	Name	Work instructions
1	Pipeline	
2	M10x1.0/7/16-20 screw fitting	
3	Cycle valve	
4	M5x16 8.8 hex head screw	
5	Pipeline	
6	Holding clamp	
7	M12x1.5 screw fitting	
8	Pipeline	
9	Hose clamp	
10	Rubber sleeve	
11	Holding clamp	

7.4 Removing, installing the charge air regulation (engine KD45V20 only 1800 rpm)

Fig. 145 Charge air regulation



143257

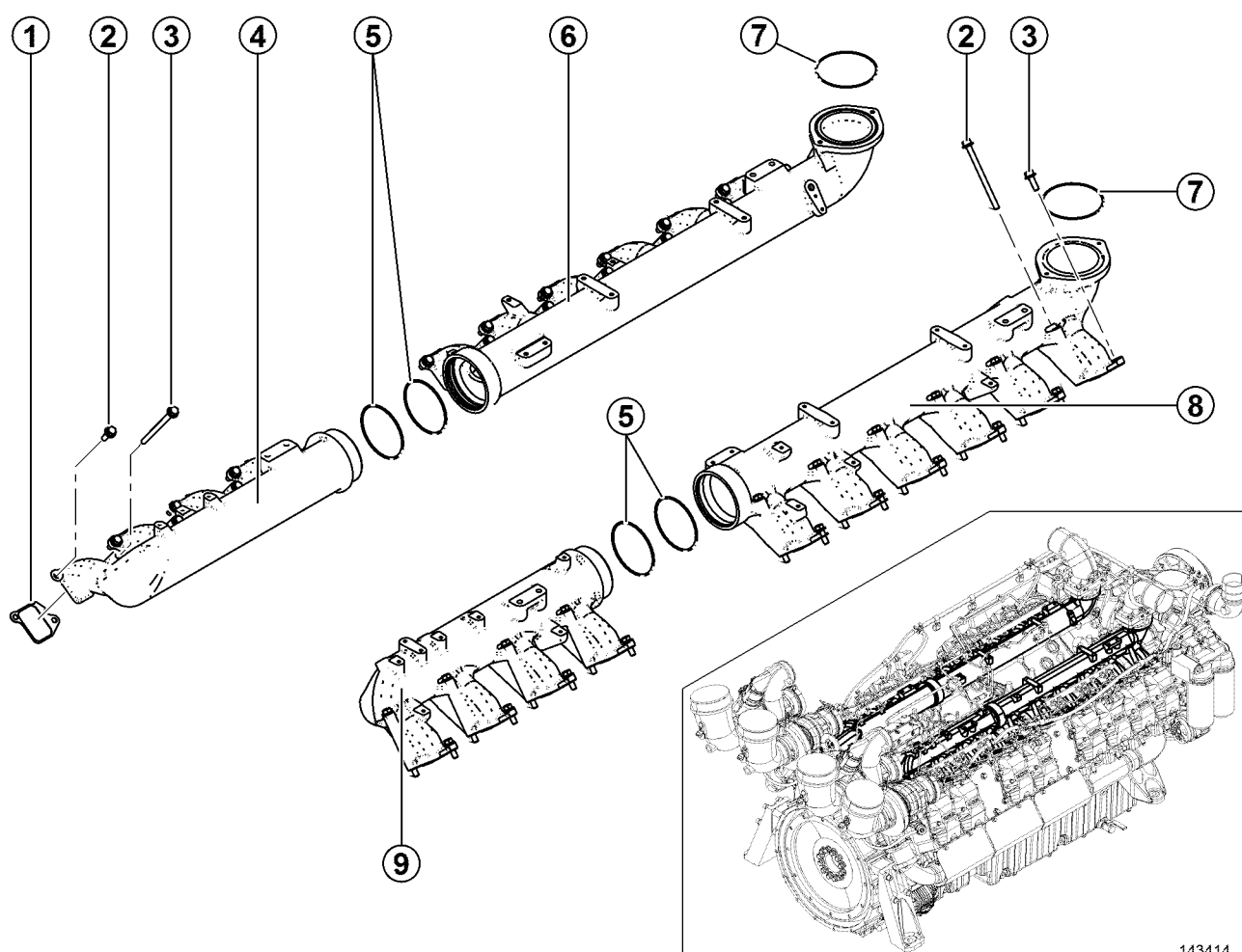
Pos.	Name	Work instructions
1	M12x30 8.8 hex head screw	
2	Sheet metal	
3	Cycle valve	
4	M5x16 8.8 hex head screw with washer	
5	Pipeline	
6	Holding clamp	
7	Pipeline	
8	Holding clamp	
9	Rubber sleeve	
10	Hose nipple	
11	Hose clamp	
12	M10x1.0/7/16-20 screw fitting	
13	Pipeline	
14	M12x1.5 screw fitting	
15	Hose clamp	
16	Rubber sleeve	

7.5 Removing, installing the air intake pipe

Previous work:

Previous work:	See	Remarks
Engine control unit removed	161	
Charge air pipes removed	134	
Fuel lines	Fig. 72	Pos. 1,2,10,11 removed
Return and continuous ventilation	Fig. 74	Pos. 5, 13 removed
Rail removed	97	
Crankcase breather system	Fig. 156	Pos. 4, 5 removed

Fig. 146 Air intake pipe



143414

Pos. Name

- 1 Seal
- 2 M10x30 8.8 hex head screw
- 3 M10x140 8.8 hex head screw
- 4 Right charge air pipe
- 5 O-ring
- 6 Right charge air pipe
- 7 O-ring
- 8 Left charge air pipe
- 9 Left charge air pipe

Work instructions

- ✖ Replace, grease with NBU 30
- ✖ Replace, grease with NBU 30

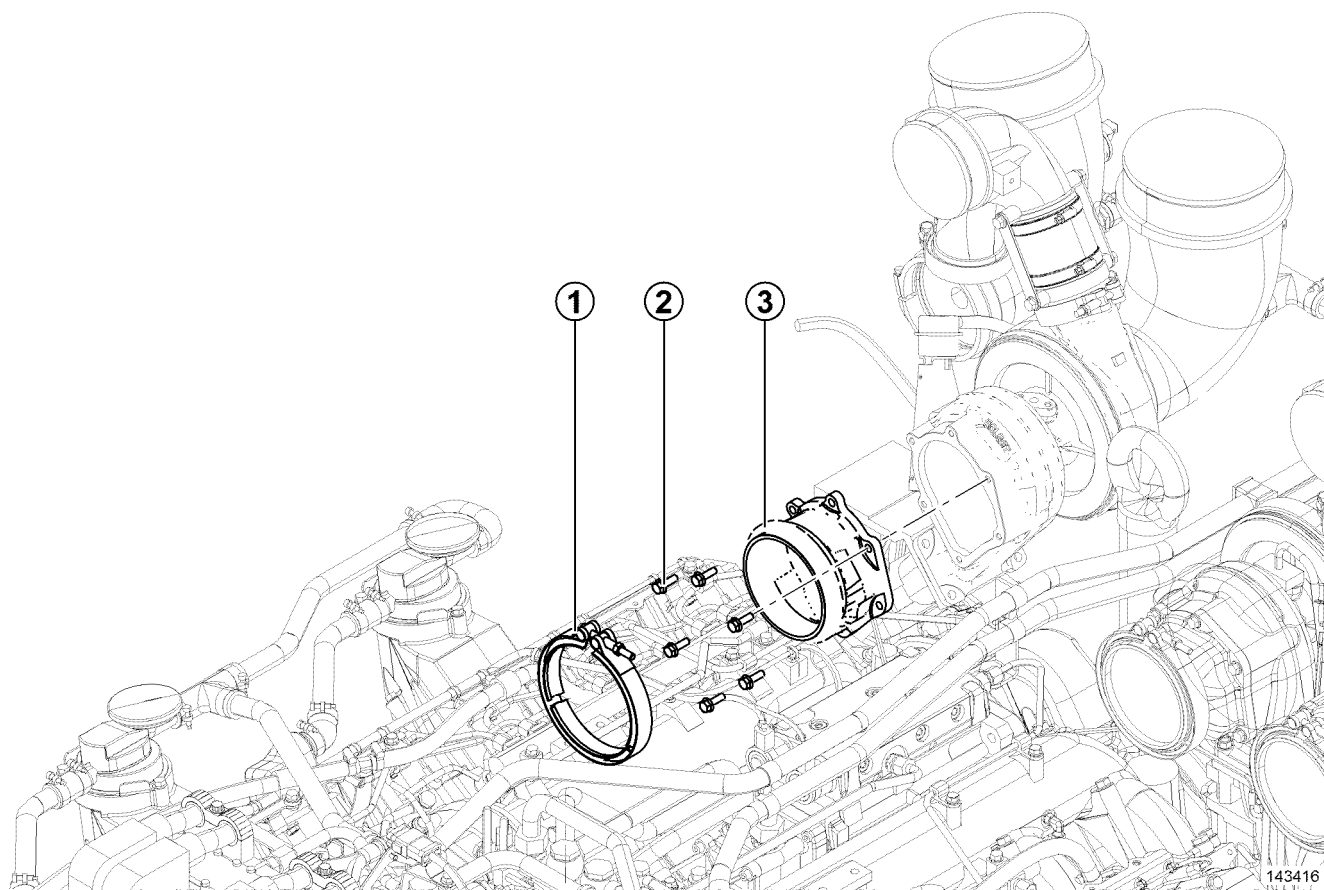
7.6 Removing, installing the exhaust gas stub

Previous work:

External exhaust connections released

See**Remarks**

Fig. 147 Exhaust gas stub

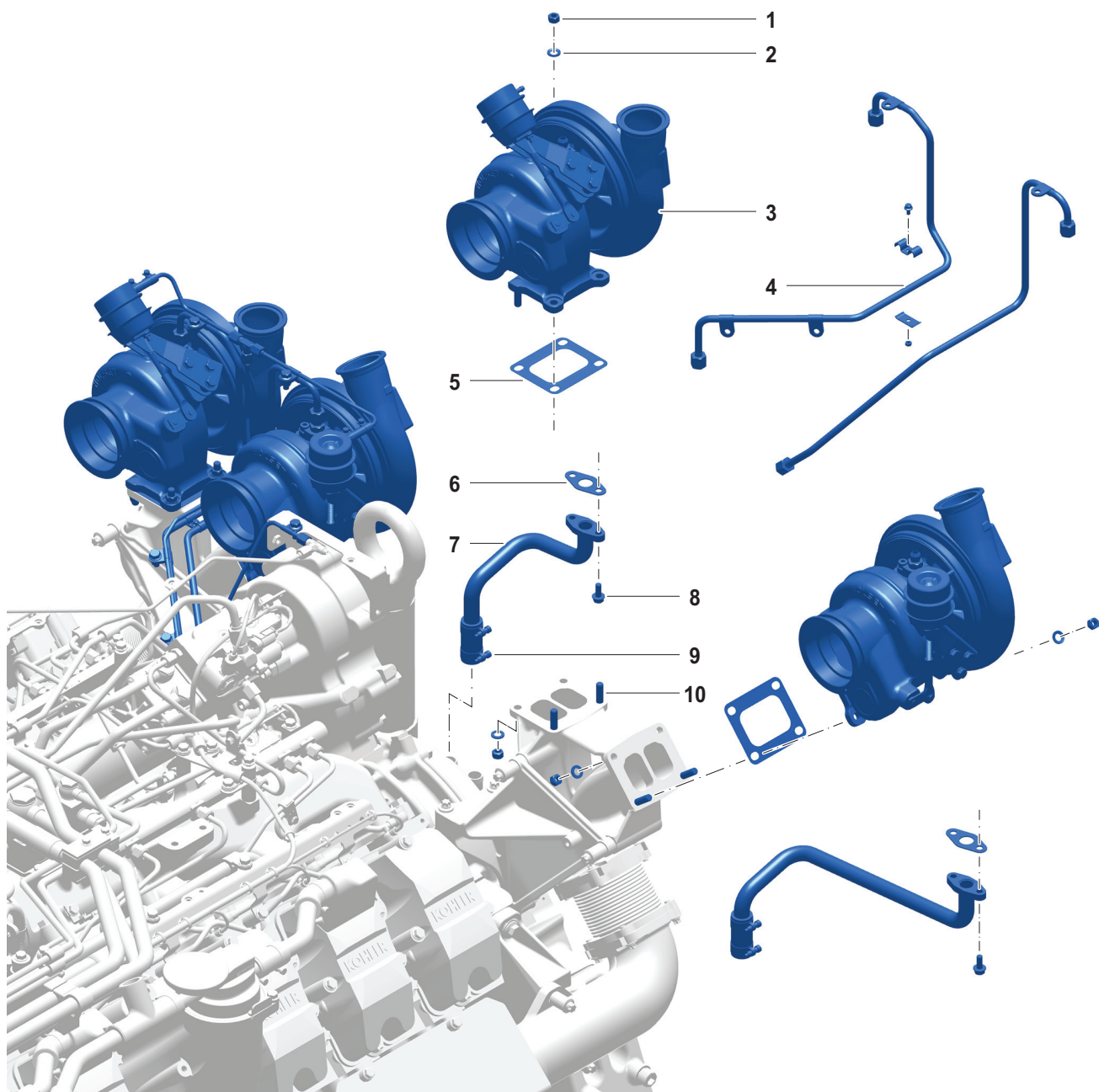


Pos.	Name	Work instructions
1	Tension clamp	
2	M8x30 hexalobular flange head screw, highly heat resistant	
3	Exhaust gas stub	

7.7 Removing, installing the exhaust gas turbocharger (engine KD36V16)

Previous work:	See	Remarks
Intake manifold removed	133	
Charging pressure regulation	Fig. 145	Pos. 9, 10, 11 removed
Charge air pipe removed	134	

Fig. 148 Exhaust gas turbocharger



Pos.	Name	Work instructions
1	M10x1.5 ball hex nut	⊠ See tightening instruction
2	Washer	
3	Exhaust gas turbocharger	

Pos.	Name	Work instructions
4	Oil line	
5	Seal	✖ Replace
6	Seal	✖ Replace
7	Oil return line	
8	M8x20 8.8 hex head screw	
9	Hose clamp	
10	Stud bolt	✖ Grease with copper paste

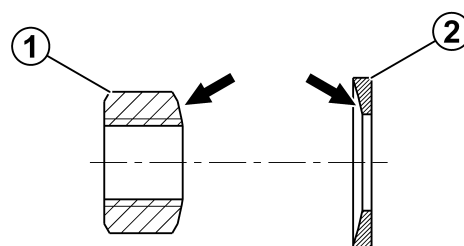
Turbocharger and flange on turbocharger tightening instruction



Information

During installation, ensure that the roundings of the ball hex nut (1) and the spherical washer (2) are joined together correctly (arrows).

Fig. 149 Nut

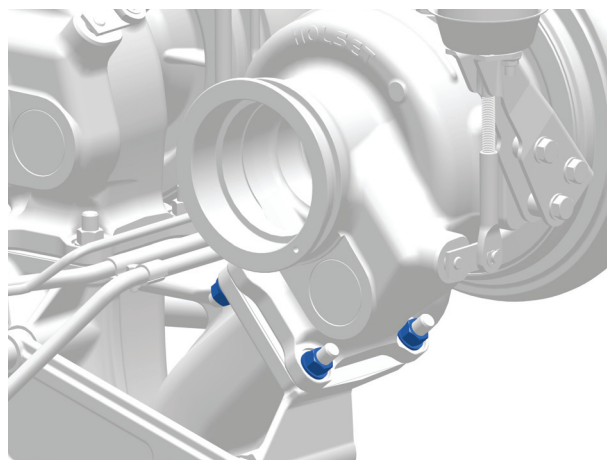


140778

M10 ball hex nut

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes
Stage	Torque
1.	20 Nm (15 ft lb)
2.	44 Nm (33 ft lb)

Fig. 150 Ball hex nut



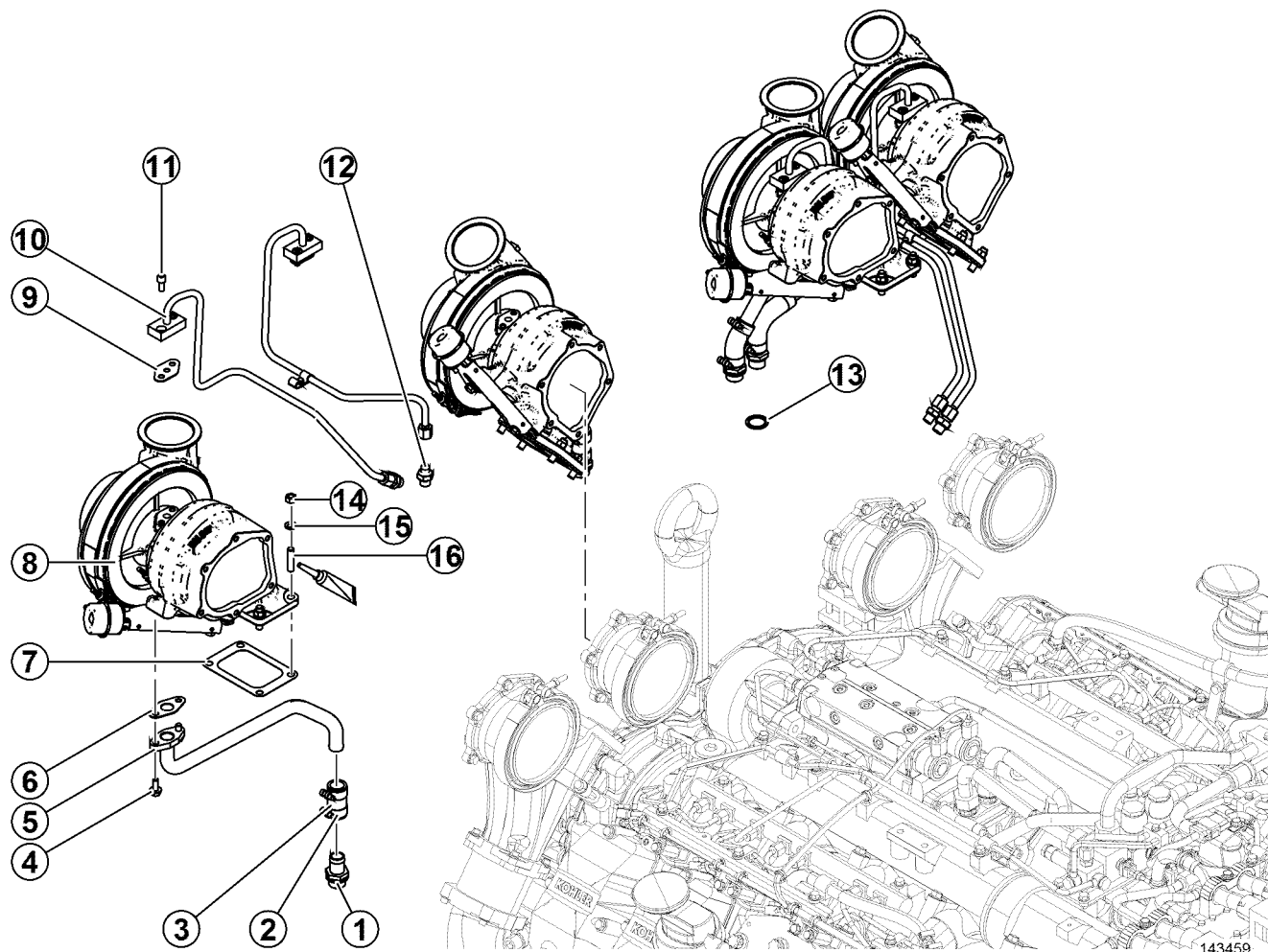
Removing, installing the exhaust gas turbocharger (engine KD45V20)

7.8 Removing, installing the exhaust gas turbocharger (engine KD45V20)




Previous work:

Previous work:	See	Remarks
Intake manifold removed	133	
Charging pressure regulation	Fig. 145	Pos. 9, 10, 11 removed (only 1800 rpm)
Charge air pipe removed	134	

Fig. 151 Exhaust gas turbocharger

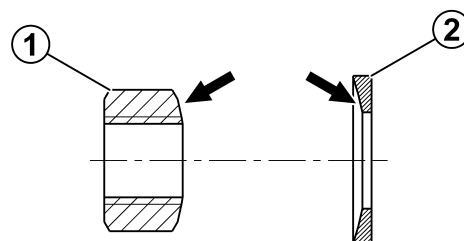


Pos.	Name	Work instructions
1	Hose nipple	
2	Hose clamp	
3	Rubber sleeve	
4	M8x20 8.8 hex head screw	
5	Oil return line	
6	Seal	⊠ Replace
7	Seal	⊠ Replace
8	Exhaust gas turbocharger	
9	Seal	⊠ Replace
10	Oil line	
11	M8.20 8.8 cylinder screw	
12	Screw fitting	

Pos.	Name	Work instructions
13	Seal	 Replace
14	M10x1.5 nut, highly heat resistant	 See tightening instruction
15	Washer	
16	Stud bolt	 Grease with copper paste

Turbocharger and flange on turbocharger tightening instruction**Information**

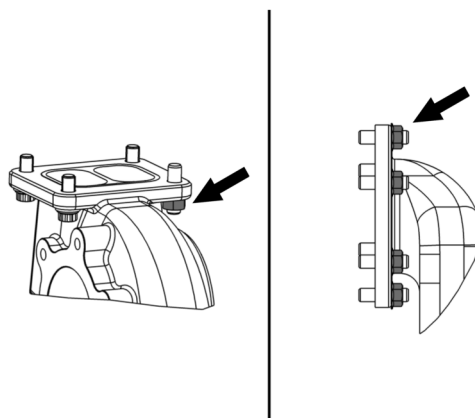
During installation, ensure that the roundings of the ball hex nut (1) and the spherical washer (2) are joined together correctly (arrows).

Fig. 152 Nut

140778

M10 ball hex nut

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes
Stage	Torque
1.	20 Nm (15 ft lb)
2.	44 +3 Nm (32 +2.2 ft lb)

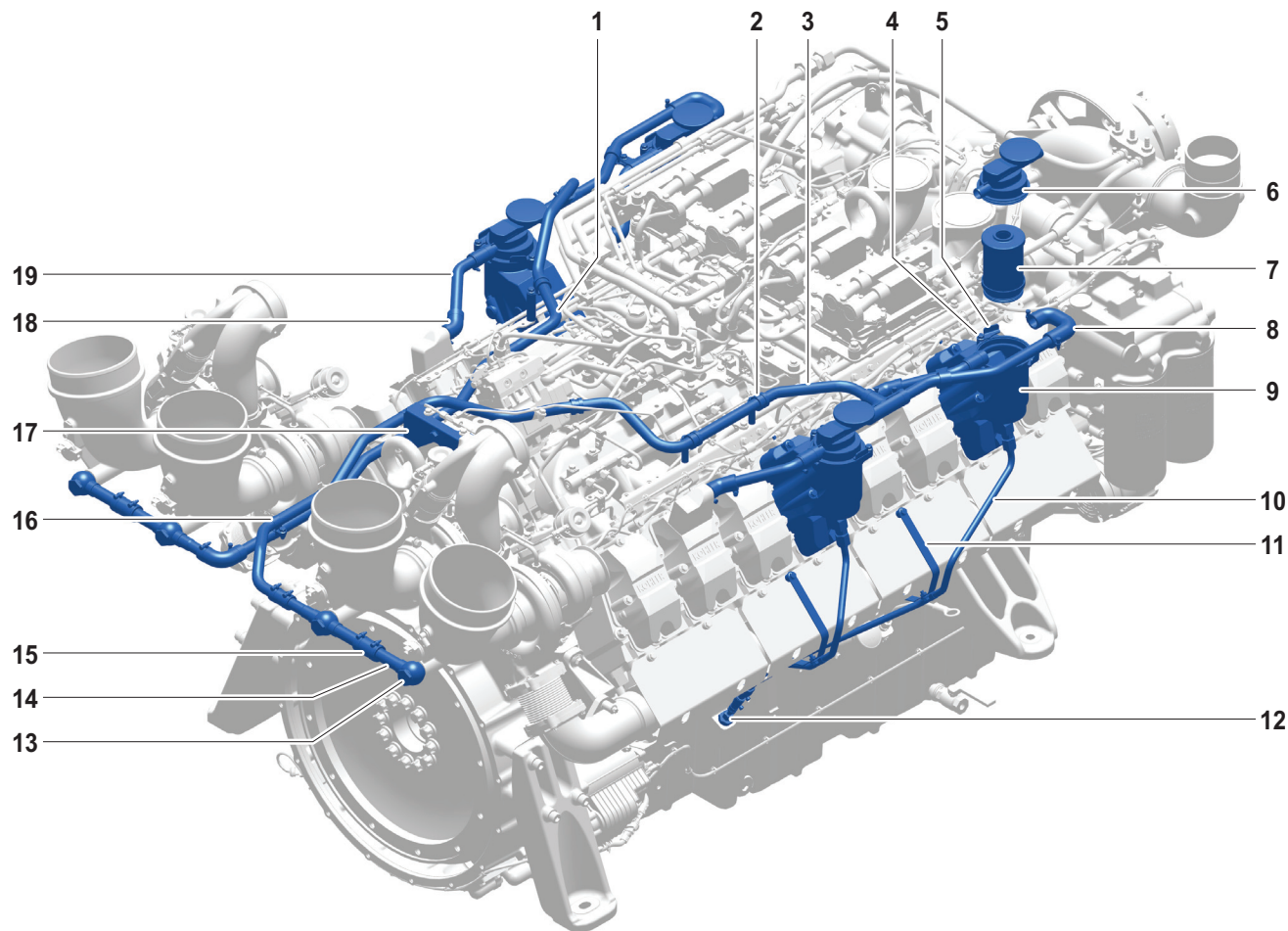
Fig. 153 Ball hex nut


140236

8 Lubricating system

8.1 Removing, installing the crankcase breather system pipeline (engine KD36V16)

Fig. 154 Crankcase breather system

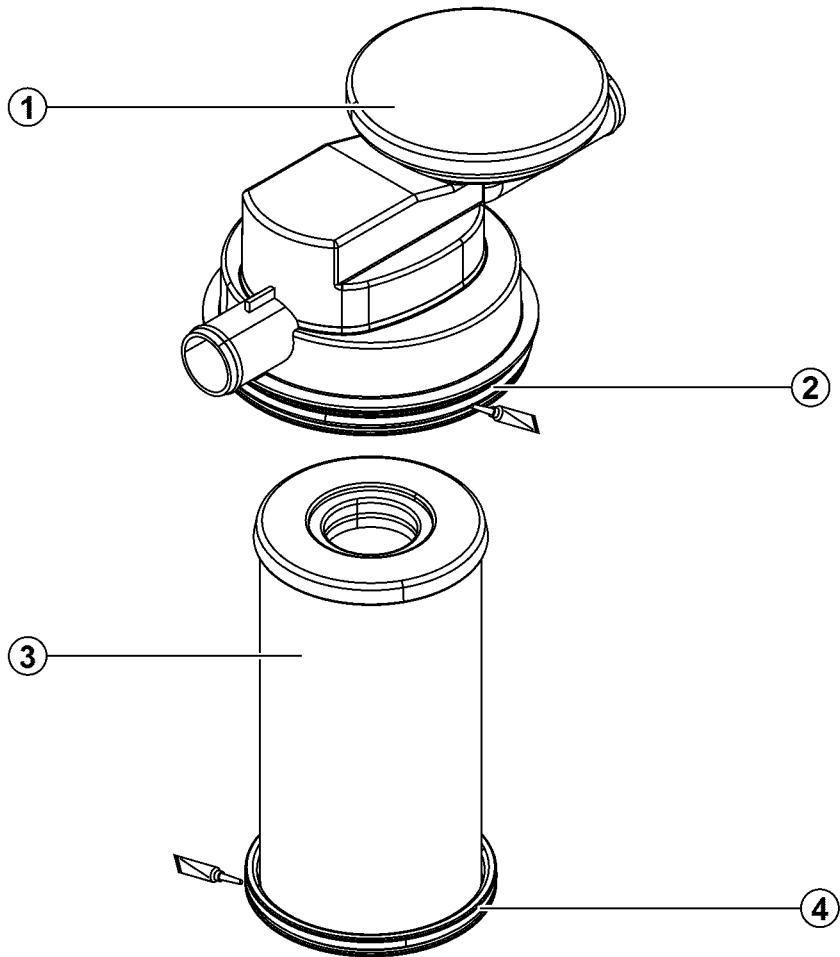


Pos.	Name	Work instructions
1	Pipe	
2	Clamp	
3	Pipe	
4	M8x20 8.8 hex head screw	
5	Holder	
6	Oil separator	
7	Filter insert	 see Fig. 157
8	Rubber sleeve	
9	Cylinder head cover	
10	Oil return line	
11	Console	
12	Non-return valve	
13	Banjo bolt	
14	Pipe	

Removing, installing the crankcase breather system pipeline (engine KD36V16)

Pos.	Name	Work instructions
15	Rubber sleeve	
16	Clamp	
17	Holder	
18	Rubber sleeve	
19	Pipe	

Fig. 155 Filter insert

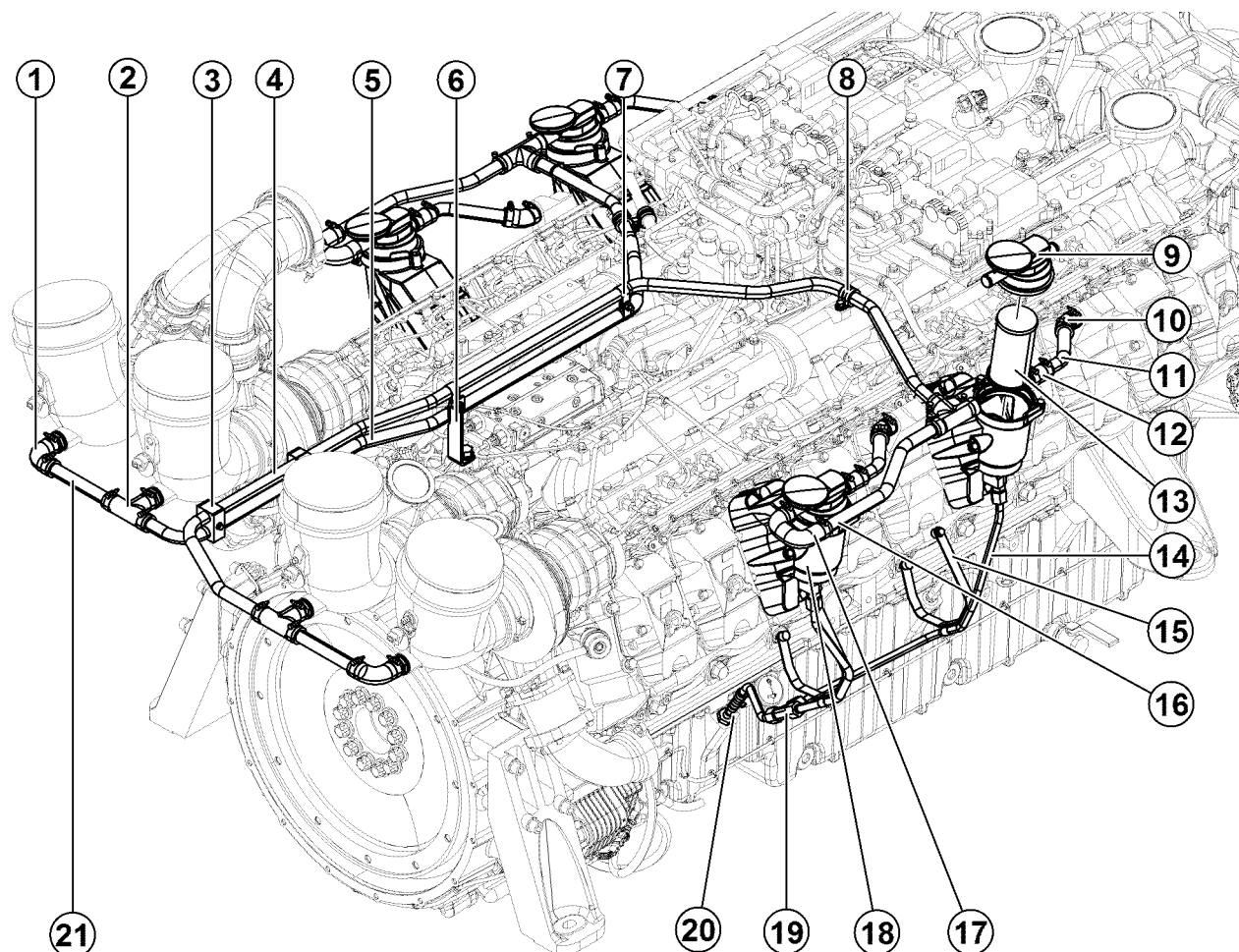


143272

Pos.	Name	Work instructions
1	Oil separator	
2	O-ring	⊠ Replace, lubricate with engine oil
3	Filter insert	
4	O-ring	⊠ Replace, lubricate with engine oil

8.2 Removing, installing the crankcase breather system pipeline (engine KD45V20)

Fig. 156 Crankcase breather system



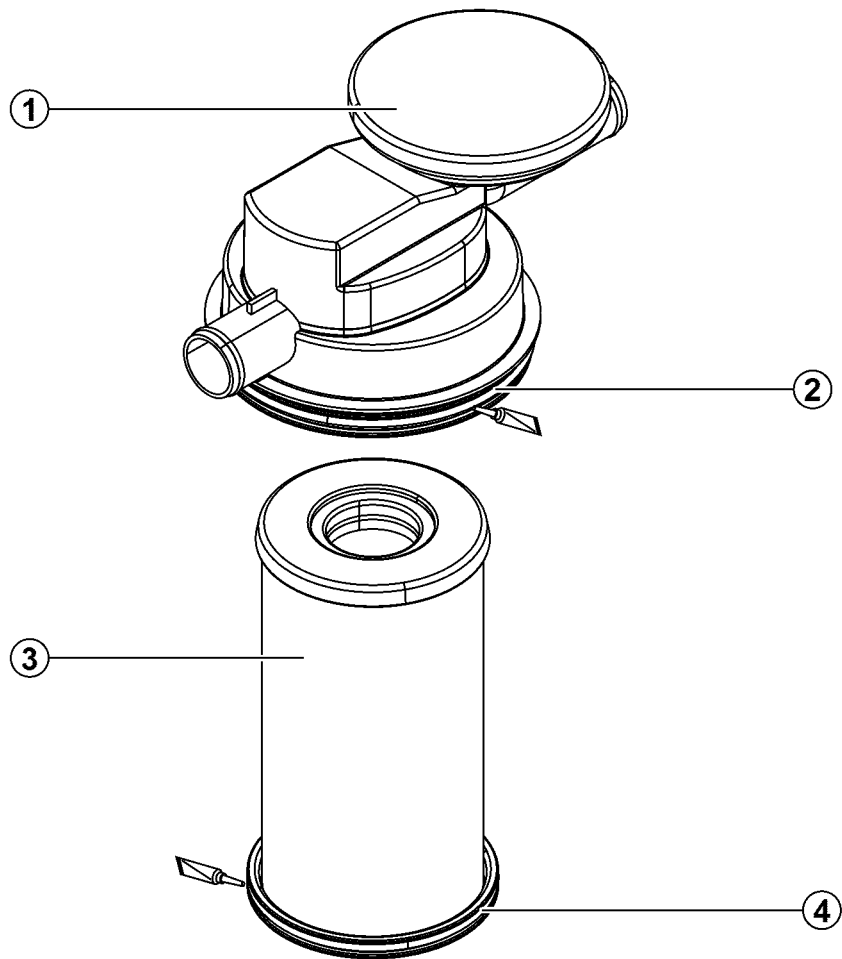
143271

Pos.	Name	Work instructions
1	Rubber sleeve	
2	Rubber sleeve	
3	Holding clamp	
4	Pipe	
5	Pipe	
6	Holder	
7	Clamp	
8	Clamp	
9	Oil separator	
10	Rubber sleeve	
11	Pipe	
12	Rubber sleeve	
13	Filter insert	✱ see Fig. 157
14	Oil line	
15	Console	
16	Pipe	
17	Rubber sleeve	

Removing, installing the crankcase breather system pipeline (engine KD45V20)

Pos.	Name	Work instructions
18	Cylinder head cover attachment	
19	Screw fitting T14 15 16 7/8-14	
20	Non-return valve	
21	Pipe	

Fig. 157 Filter insert



143272

Pos.	Name	Work instructions
1	Oil separator	
2	O-ring	⊠ Replace, lubricate with engine oil
3	Filter insert	
4	O-ring	⊠ Replace, lubricate with engine oil

9 Cooling system

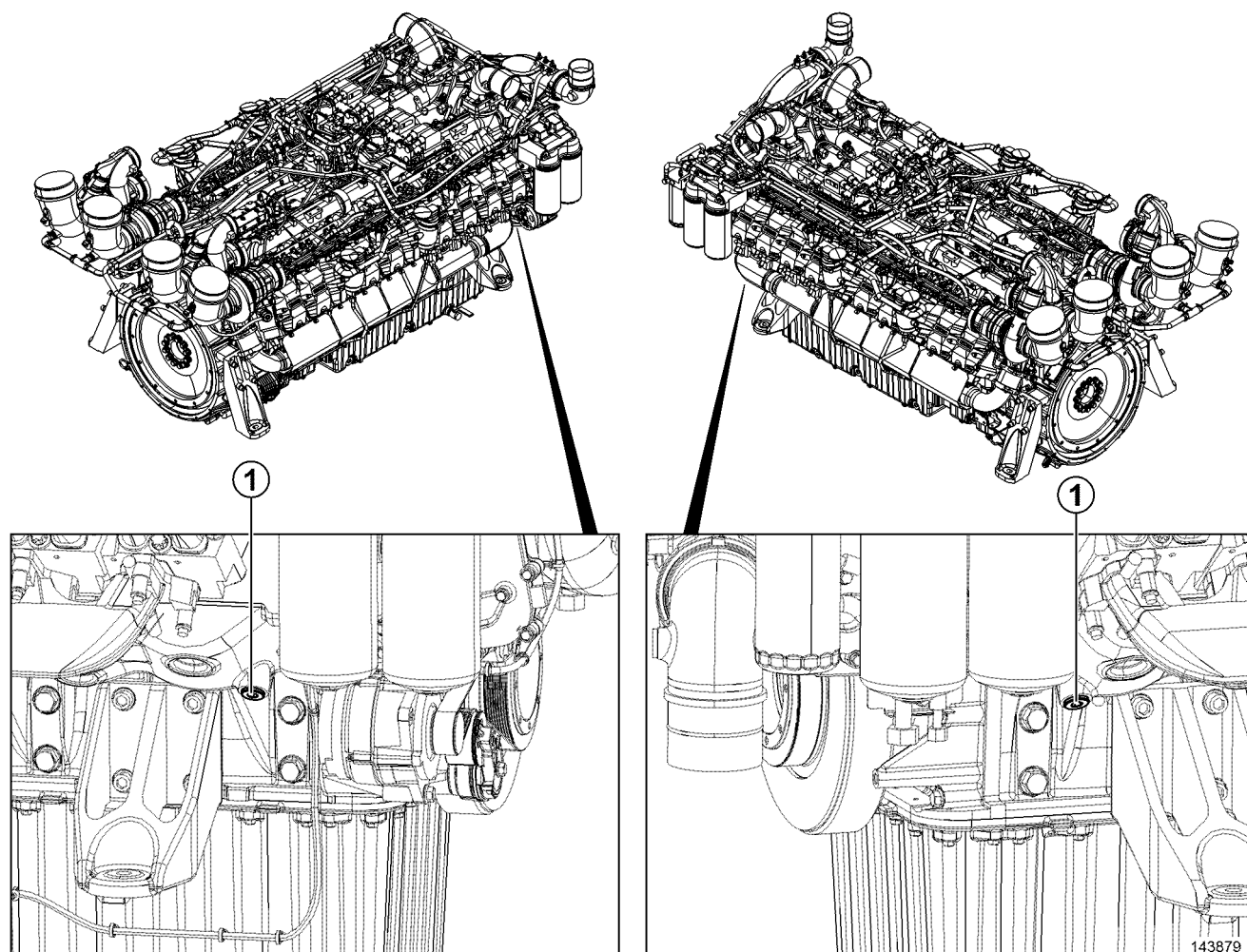
9.1 Emptying the coolant circuit

Previous work:

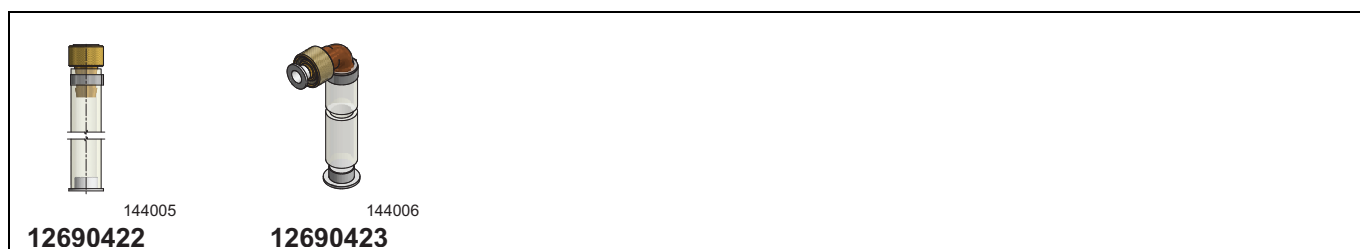
A collection container with the necessary capacity is available.

See
Remarks

Fig. 158 Draining the coolant



Pos.	Name
1	Drain valves

Work instructions
Special tool


Procedure**DANGER**

Hot cooler fluid!

Injuries, burns!

Causes serious injuries or death!



- Let engine cool off before opening the filler neck.
- Note overpressure when opening the filler neck.
- Do not fill up the cooling system when the engine is hot under any circumstances.

**CAUTION**

Coolant can lead to eye injuries and allergic skin reactions!

- Avoid skin contact with coolant at all costs.
- Follow the manufacturer's instructions.
- When mixing coolant, wear rubber gloves and safety goggles.
- Wash splatters in the eyes or on the skin out with water immediately.

- Put a collection container under the diesel engine.
- Unscrew generator side sealing cap on the expansion tank until the overpressure escapes, then open it.
- Open protecting cap of the drain valves (Fig. 158 pos.1).
- Screw drain hose [12690422 or 12690423] onto the drain valves (Fig. 158 pos.1) one after the other.
The drain valve is opened while doing so. Coolant from oil cooler housing, crankcase and cooler flows into the container.

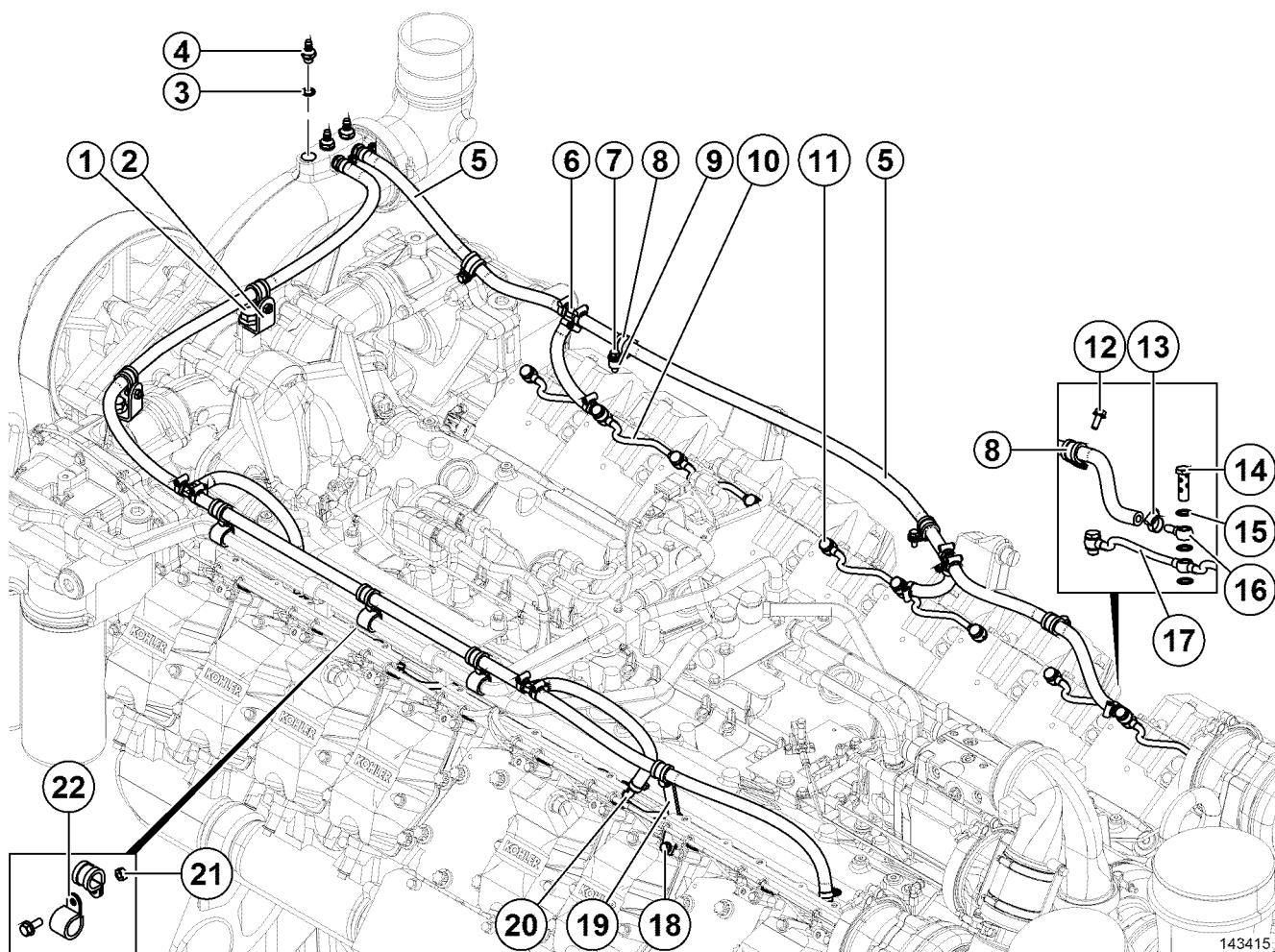
The coolant has drained:

- Unscrew drain hose from the drain valves (Fig. 158 pos.1).
- Screw on protecting caps.

9.2 Removing, installing the ventilation line

Previous work:	See	Remarks
Emptying the coolant circuit	149	

Fig. 159 Ventilation line



Pos.	Name	Work instructions
1	M16x30 8.8 hex head screw	
2	Holder	
3	Sealing ring	
4	Hose nipple	
5	Hose	
6	Hose nipple	
7	M8x30 8.8 hex head screw	
8	Clamp	
9	Spacer sleeve	
10	Ventilation line	
11	Banjo bolt 10-3	
12	M8x20 8.8 hex head screw	
13	Hose clamp	
14	Double banjo bolt 10-6	

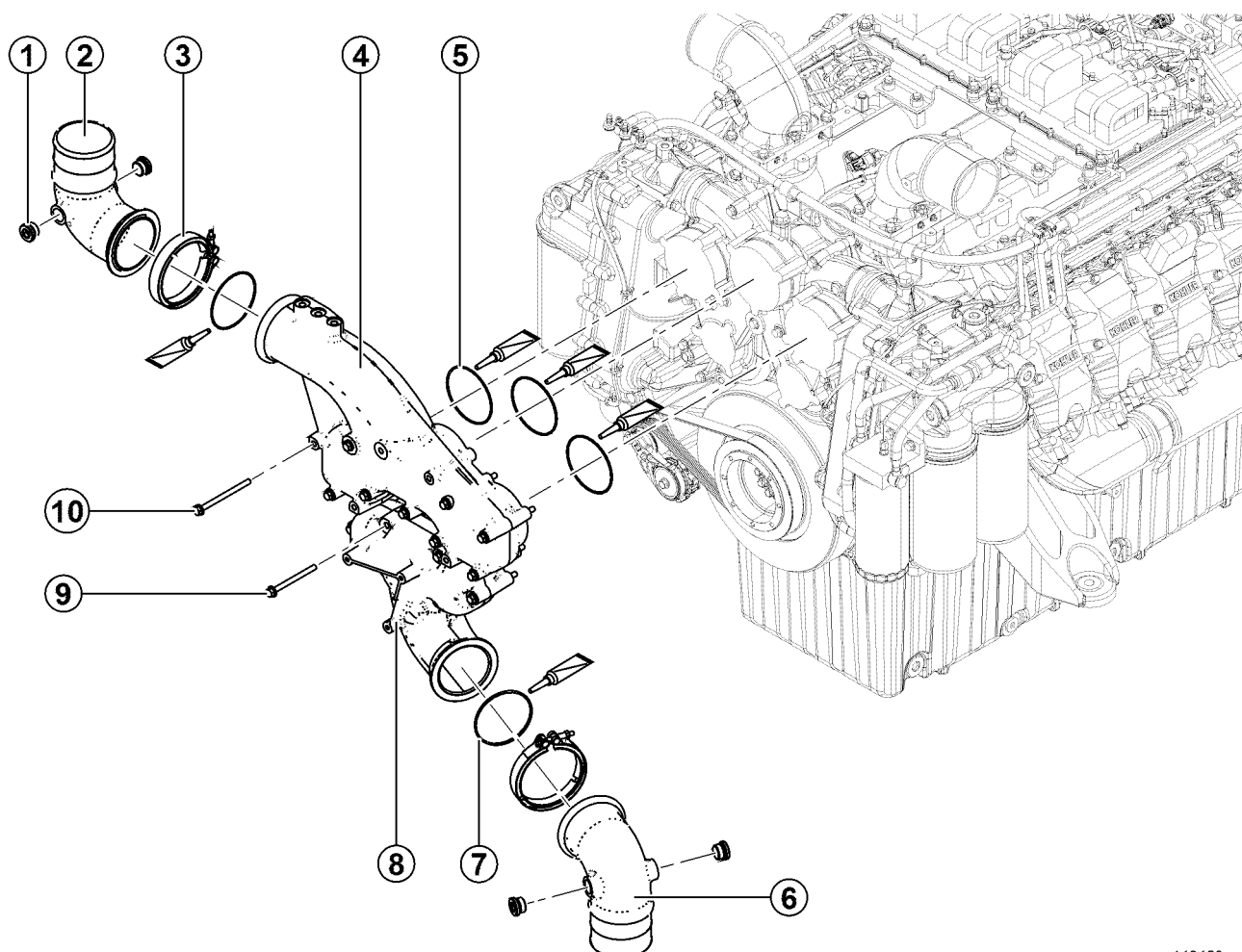
Removing, installing the ventilation line

Pos.	Name	Work instructions
15	Sealing ring	
16	Nozzle	
17	Ventilation line	
18	M8x20 8.8 hex head screw	
19	Holder	
20	Hose clamp	
21	M8 hex nut	
22	Clamp	

9.3 Removing, installing the thermostat housing

Previous work:	See	Remarks
Emptying the coolant circuit	149	
Fan drive belt removed	129	

Fig. 160 Thermostat housing



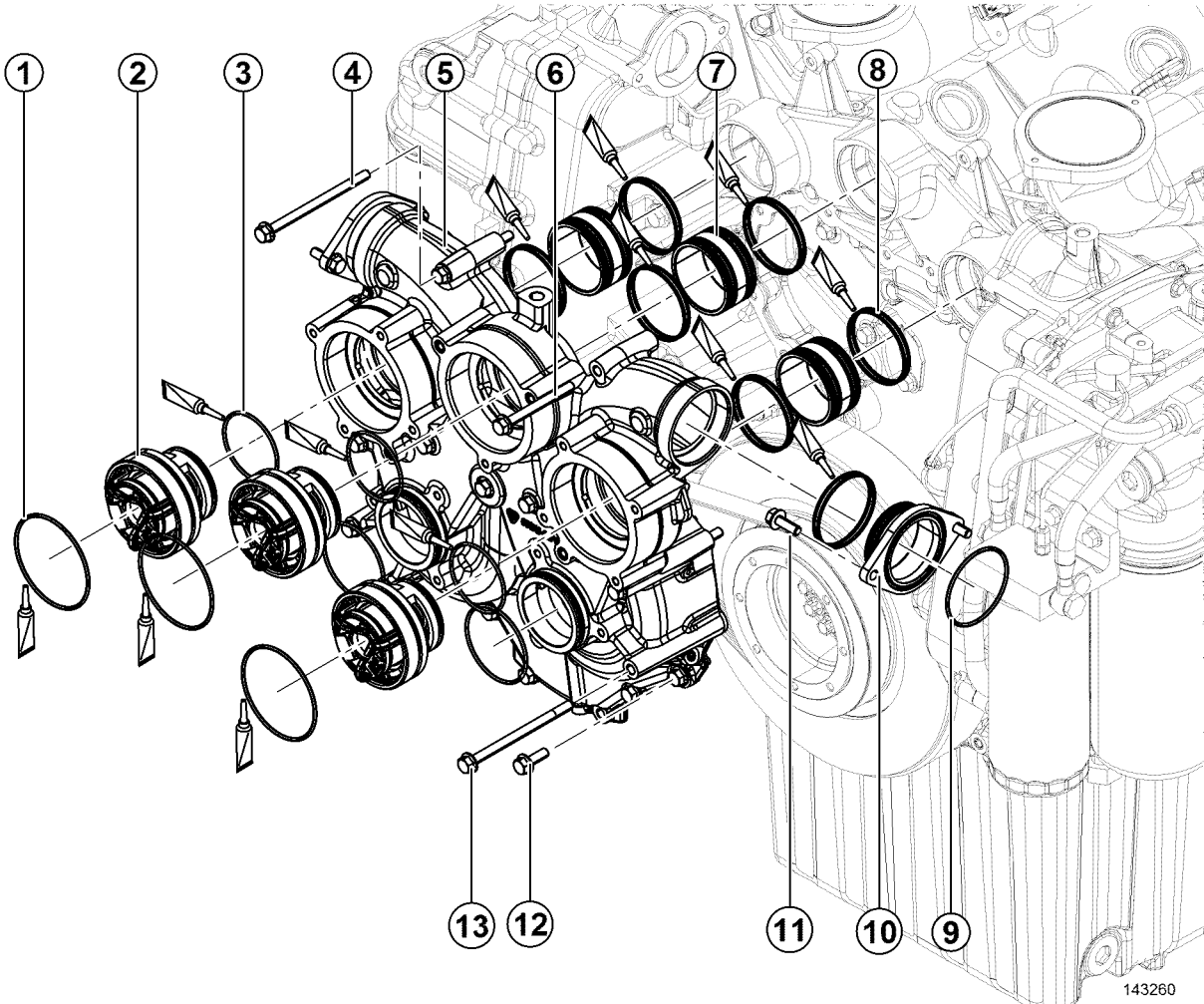
143458

Pos.	Name	Work instructions
1	Screw plug	
2	Water line connections	
3	Tension clamp	
4	Connecting elbow	
5	O-ring	✖ Replace, grease with NBU 30
6	Water line connections	
7	O-ring	✖ Replace, grease with NBU 30
8	Connecting elbow	
9	M10x120 8.8 hex head screw	
10	M10x140 8.8 hex head screw	

9.4
 Removing, installing the coolant pump

Previous work:	See	Remarks
Thermostat housing removed	153	

Fig. 161
 Coolant pump

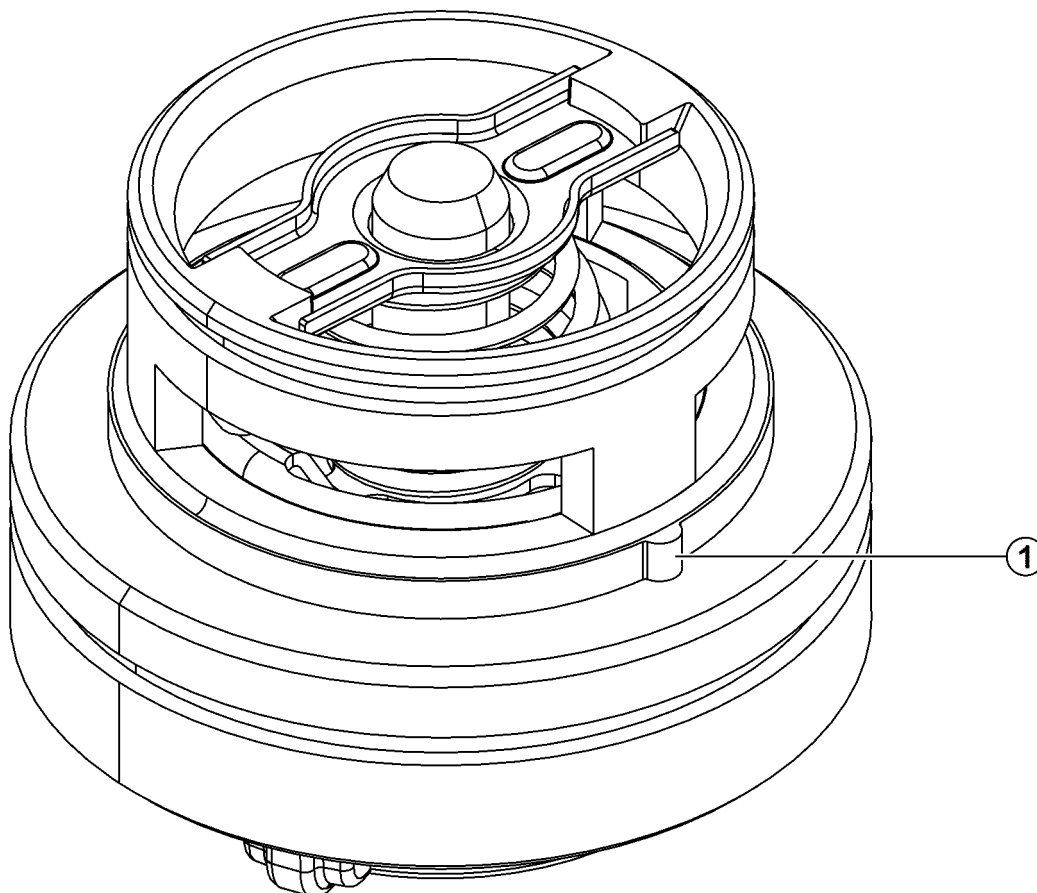


Pos.	Name	Work instructions
1	O-ring	⊠ Replace, grease with NBU 30
2	Thermostat	⊠ Align, see Fig. 162
3	O-ring	⊠ Replace, grease with NBU 30
4	M10x100 8.8 hex head screw	
5	Water pump, pre-assembled	
6	M10x100 8.8 hex head screw	
7	O-ring	⊠ Replace, grease with NBU 30
8	Pipe	
9	O-ring	
10	Flange	
11	M10x30 8.8 hex head screw	
12	M10x40 10.9 hex head screw	
13	M10x150 8.8 hex head screw	

9.5 Thermostat

Previous work:	See	Remarks
Coolant pump	Fig. 161	Pos. 1, 2, 3 removed

Fig. 162 Thermostat



143277

Pos.	Name	Work instructions
1	Position	✚ Align notch in water pump

Technical data

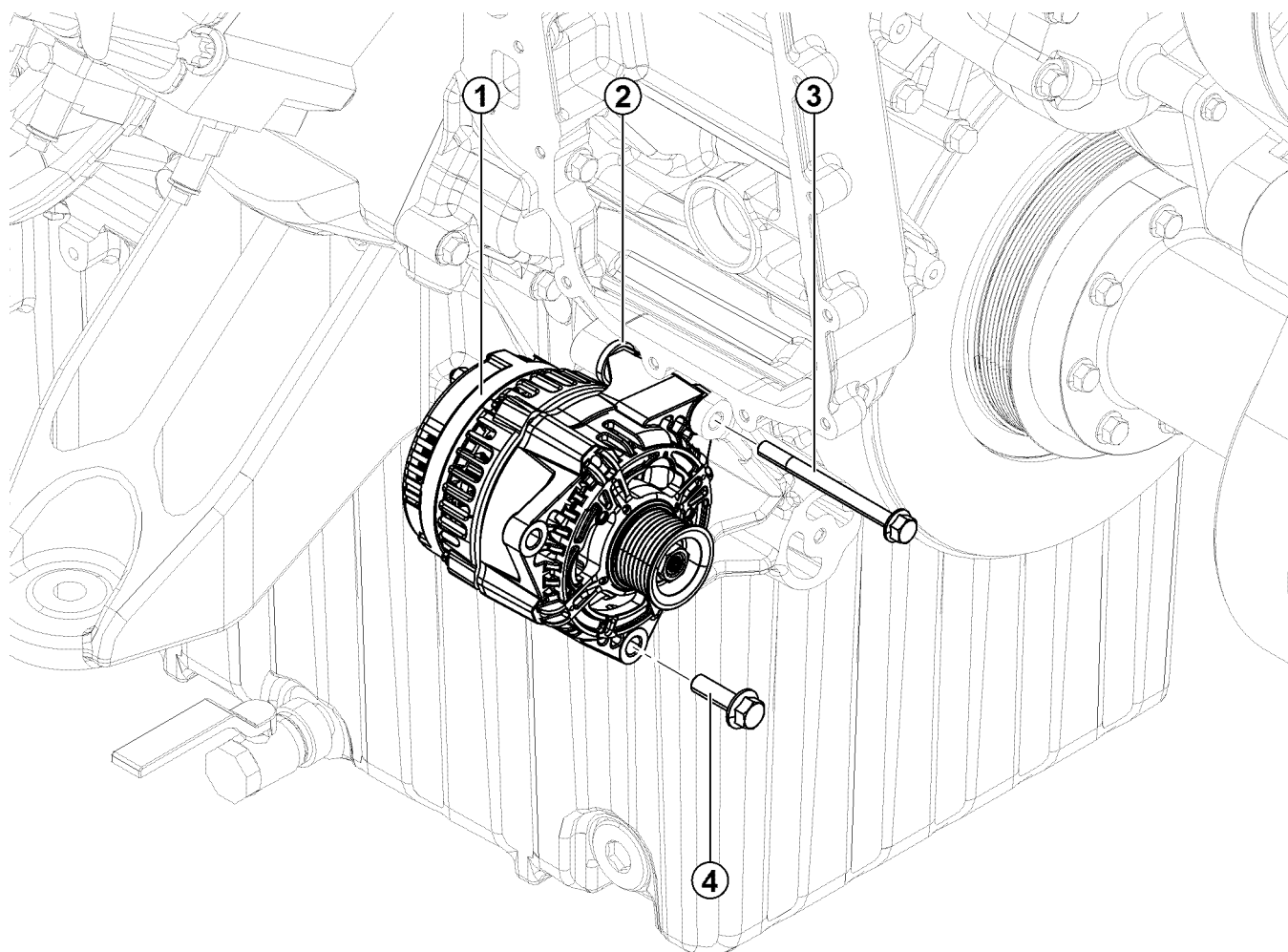
	Thermostat			
Temperature at the start of opening	82 °C (179.6 °F)			
Temperature at full opening	90 °C (194 °F)			
Stroke (A) at full opening	≥ 15 mm (0.6 in)			

10 Electrical system

10.1 Removing, installing the alternator for battery charging

Previous work:	See	Remarks
Electrical power supply interrupted	18	
Cable on alternator for battery charging disconnected		
Belt removed	131	

Fig. 163 Installing the alternator for battery charging



143258

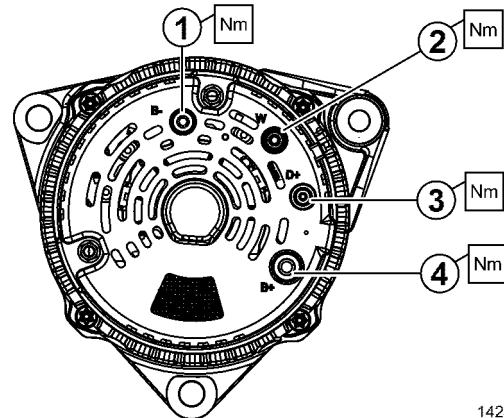
Pos.	Name	Work instructions
1	Alternator for battery charging	
2	Spacer	
3	M10x120 8.8 hex head screw	
4	M12x40 8.8 hex head screw	

Removing, installing the alternator for battery charging

Alternator for battery charging tightening instruction

- 1 (B-) Ground connection 5.1 ± 0.9 Nm (3.8 ± 0.7 ft lb)
- 2 Is not used
- 3 (D+) Diagnostics connection,
 $2 +0.3/-0.4$ Nm ($8.8 +0.22/-0.3$ ft lb)
- 4 (B+) Battery voltage, 11 ± 2 Nm (8.1 ± 0.15 ft lb)

Fig. 164 Alternator for battery charging tightening instruction



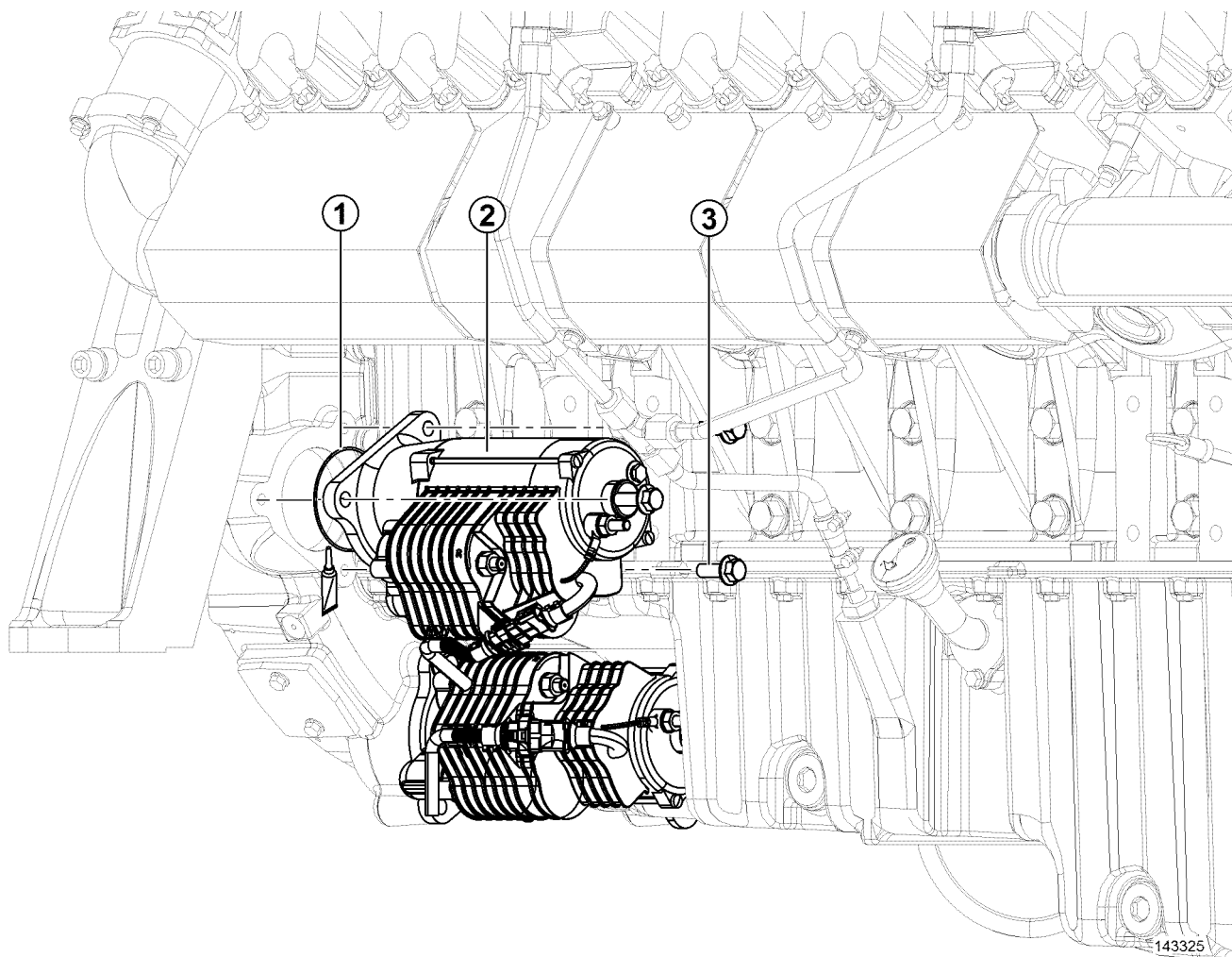
142847

10.2 Removing, installing the starter

Previous work:

Electrical power supply disconnected 18

Cable on starter disconnected

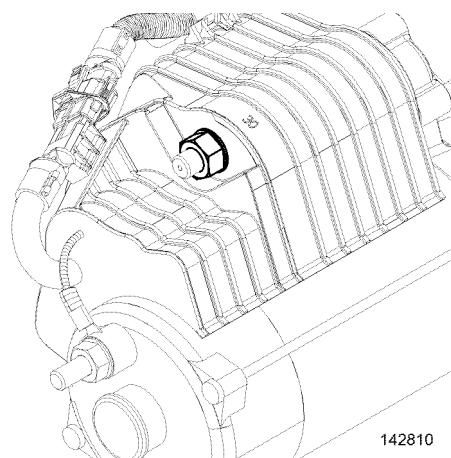
See**Remarks****Fig. 165** Starter

Pos.	Name	Work instructions
1	O-ring	✖ Replace, grease with NBU 30
2	Starter	
3	M12x25 8.8 hex head screw	

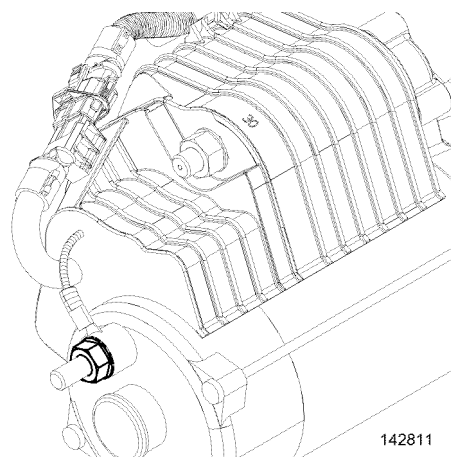
Removing, installing the starter

Starter tightening instruction**Battery connection M12 hexagonal collar nut**

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes
Stage	Torque in Nm
1.	26 ±4 Nm (19 ±0.3 ft lb)

Fig. 166 Electrical connection**Ground connection M10 hexagonal collar nut**

Lubricant	-
Locking agent	-
Part contact surfaces	-
Screws reusable?	Yes
Stage	Torque in Nm
1.	24 ±4 Nm (18 ±0.3 ft lb)

Fig. 167 Electrical connection

10.3 Removing, installing the engine control unit including engine control unit attachment

Previous work:

Battery disconnected

Fuel lines

Fuel lines - continuous ventilation

Plug on engine control unit released and removed

See

[Fig. 72](#)

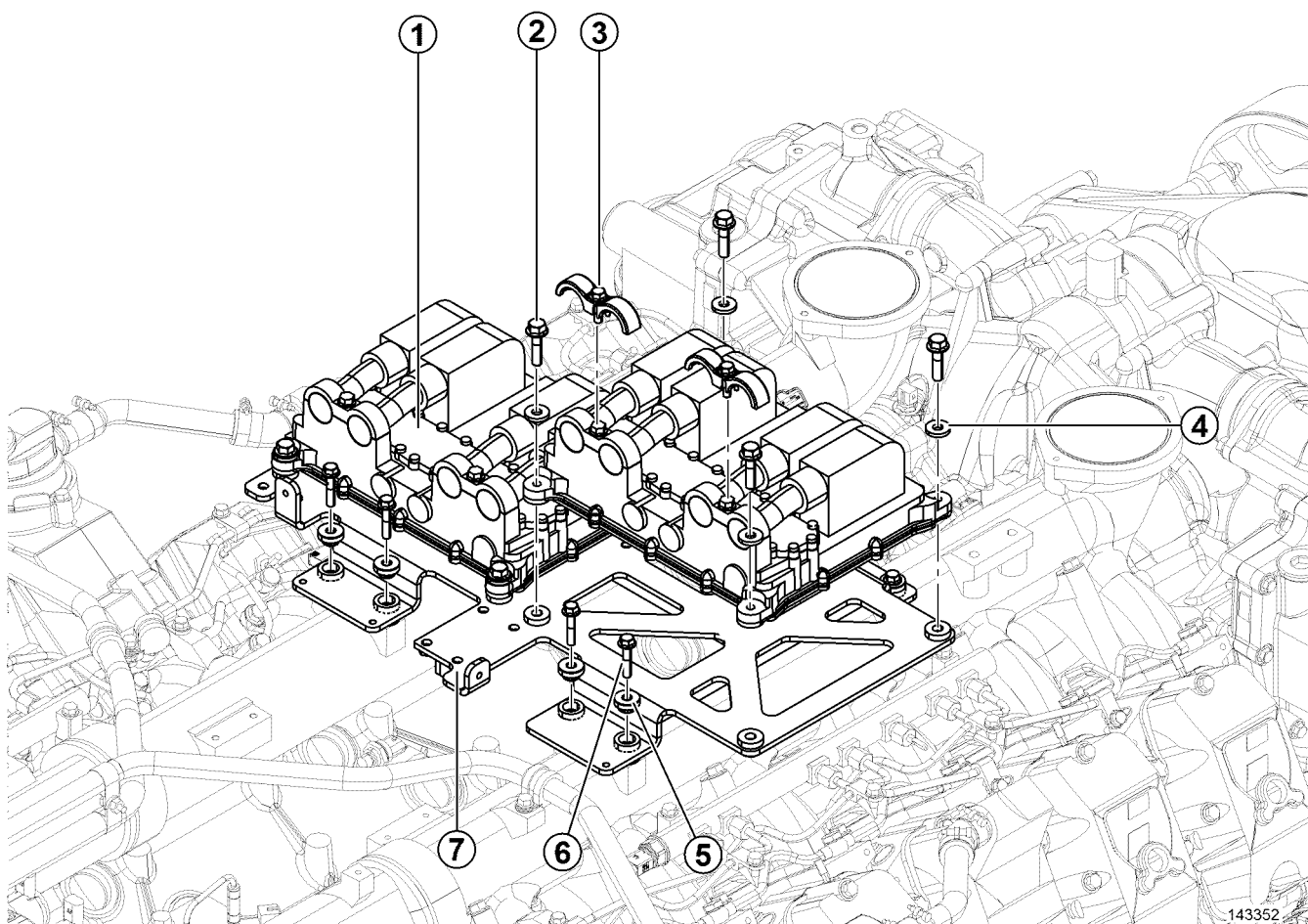
[Fig. 74](#)

Remarks

Pos. 1, 2 removed

Pos. 1, 2, 3 removed

Fig. 168 Engine control unit



Pos. Name

- | | |
|---|---------------------------|
| 1 | Engine control unit |
| 2 | M10x40 8.8 hex head screw |
| 3 | Fastening clip |
| 4 | Washer |
| 5 | Rubber buffer |
| 6 | M8x40 8.8 hex head screw |
| 7 | Control unit attachment |

Work instructions



Tightening instruction, see [162](#)

**WARNING**

Incorrect engine control unit software on the engine. Engine is in an unstable, dangerous condition. Can cause serious injuries or death.

- When changing the engine control unit, check the software version as soon as the electrical power supply is switched on.
- The engine control unit must be replaced if the engine type is incorrect.

10.3.1 Engine control unit removal instructions

- Disconnect electrical power supply to the engine control unit.
- Close fuel supply to the engine (alternator side).
- Disconnect fuel lines from the engine control unit and let the fuel drain.
- Carefully remove the generator side (A700A.X1 and A700B.X2) and engine side (A700C.X3 and A700D.X4) plug connectors using a suitable tool.
- Engine control unit can now be removed mechanically.

10.3.2 Engine control unit instructions for mounting

- Make sure that the electrical power supply is interrupted.
- Install engine control unit mechanically.

**Information**

The engine control unit is protected by vibration dampers.

- Replace vibration damper when replacing the engine control unit.

- Connect fuel lines to engine control unit.
- Turn generator side fuel supply back on.
- Carefully connect the generator side (A700A.X1 and A700B.X2) and engine side (A700C.X3 and A700D.X4) plug connectors.

NOTE

Damage due to leaks.

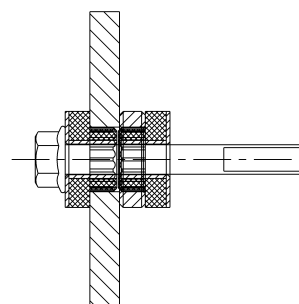
- Check the connections and seals for leaks (visually).

- Establish electrical power supply to the engine control unit.
- Check if the correct software is installed on the new engine control unit.
- If necessary, perform a software update.
- Start engine and check for proper functionality.

Engine control unit attachment tightening instruction**M10-8.8 hex head screw**

Lubricant	-
Locking agent	Loctite 243
Part contact surfaces	-
Screws reusable?	Yes
Stage	Torque
1.	10 Nm (7.4 ft lb)

Fig. 169 Engine control unit fastening



140062

11 Appendix

11.1 Standard torques

11.1.1 Standard torques for screw connections

For hex screws in accordance with: ISO 4014, ISO 4017, ISO 8765, ISO 8676.

For socket head screws in accordance with: ISO 4762.

For hexalobular internal screws (Torx screws) in accordance with: DIN 34800.

Values for a mean friction coefficient of $\mu = 0.12$.

Regular thread	Nm / ft lb	Nm / ft lb	Nm / ft lb	Regular thread	Nm / ft lb	Nm / ft lb	Nm / ft lb
	8.8	10.9	12.9		8.8	10.9	12.9
M 4	3 / 2.2	4 / 3	5 / 3.7	M 18	280 / 210	390 / 290	460 / 340
M 5	6 / 4.4	8 / 6	10 / 7.4	M 20	390 / 290	560 / 410	650 / 480
M 6	10 / 7.4	14 / 10	17 / 12	M 22	530 / 390	750 / 550	880 / 650
M 7	16 / 12	23 / 17	27 / 20	M 24	670 / 490	960 / 710	1120 / 830
M 8	23 / 17	34 / 25	40 / 29	M 27	1000 / 740	1400 / 1030	1650 / 1220
M 10	46 / 34	68 / 50	79 / 58	M 30	1350 / 1000	1900 / 1400	2250 / 1660
M 12	79 / 58	117 / 86	135 / 100	M 33	1850 / 1360	2600 / 1920	3000 / 2210
M 14	125 / 92	185 / 140	215 / 160	M 36	2350 / 1730	3300 / 2430	3900 / 2880
M 16	195 / 140	280 / 210	330 / 240	M 39	3000 / 2210	4300 / 3170	5100 / 3770

Standard tool for external hexalobular screws:

Regular thread	Torx External drive
M 5	E6
M 6	E8
M 8	E10
M 10	E12
M 12	E14
M 14	E18
M 16	E20
M 18	E 24
M 24	E32
M 30	E40
M 36	E44

Standard torques

Fine thread	Nm / ft lb	Nm / ft lb	Nm / ft lb	Fine thread	Nm / ft lb	Nm / ft lb	Nm / ft lb
	8.8	10.9	12.9		8.8	10.9	12.9
M 8 x 1	25 / 18	36 / 27	43/32	M 24 x 1.5	760 / 560	1090 / 800	1270 / 940
M 9 x 1	36 / 27	53 / 39	62/46	M 24 x 2	730 / 540	1040 / 770	1220 / 900
M 10 x 1	52 / 38	76 / 56	89/66	M 27 x 1.5	1110 / 820	1580 / 1170	1850 / 1370
M 10 x 1.25	49 / 36	72 / 53	84/62	M 27 x 2	1070 / 790	1500 / 1110	1800 / 1330
M 12 x 1.25	87 / 64	125 / 92	150/110	M 30 x 1.5	1540 / 1140	2190 / 1610	2560 / 1890
M 12 x 1.5	83 / 61	122 / 90	145/110	M 30 x 2	1490 / 1100	2120 / 1560	2480 / 1830
M 14 x 1.5	135 / 100	200 / 150	235/170	M 33 x 1.5	2050 / 1510	2920 / 2150	3420 / 2520
M 16 x 1.5	205 / 150	300 / 220	360/270	M 33 x 2	2000 / 1470	2800 / 2060	3300 / 2430
M 18 x 1.5	310 / 230	440 / 320	520/380	M 36 x 1.5	2680 / 1980	3820 / 2820	4470 / 3300
M 18 x 2	290 / 210	420 / 310	490/360	M 36 x 3	2500 / 1840	3500 / 2580	4100 / 3020
M 20 x 1.5	430 / 320	620 / 460	720/530	M 39 x 1.5	3430 / 2530	4890 / 3610	5720 / 4220
M 22 x 1.5	580 / 430	820 / 600	960/710	M 39 x 3	3200 / 2360	4600 / 3390	5300 / 3910

11.1.2 Standard torques for screw plugs and hollow screws

For hollow screws in accordance with DIN 7643 with copper sealing ring in accordance with DIN 7603,

Screw plug in accordance with DIN 910 with copper sealing ring in accordance with DIN 7603.

Screw plug in accordance with DIN 908 with copper sealing ring in accordance with DIN 7603.

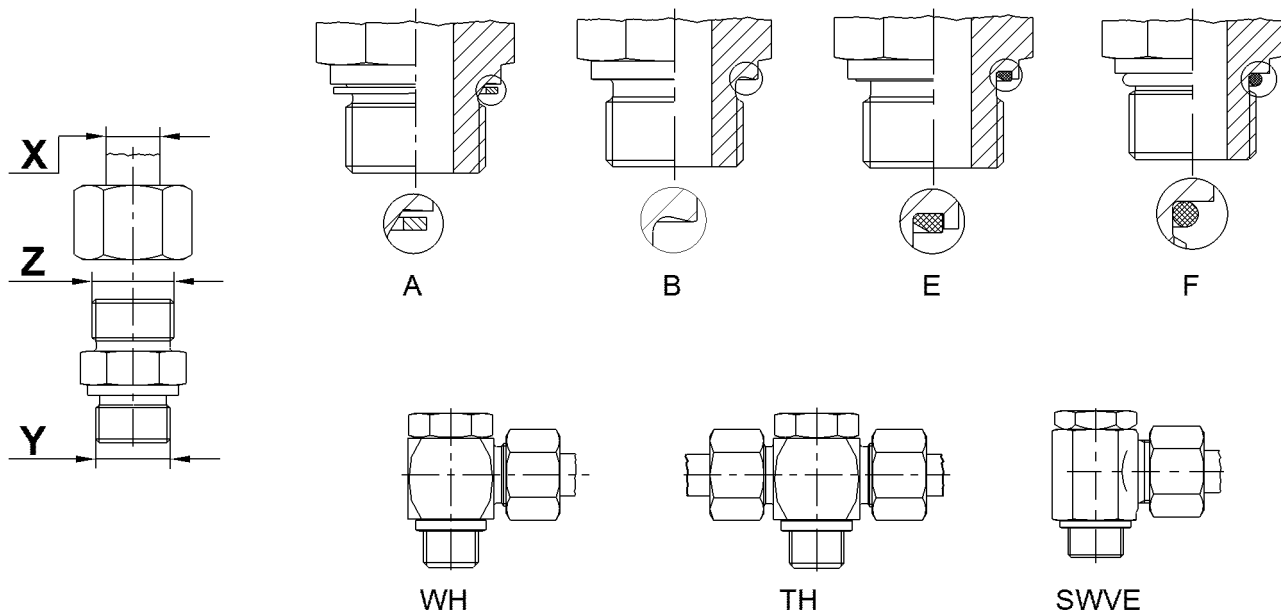
Thread	Nm	ft lb		Thread	Nm	ft lb	
M 6 x 1	7	5.2		M 36 x 1.5	155	110	
M 8 x 1	7.5	5.5		M 36 x 2	155	110	
M 8 x 1.5	7.5	5.5		M 38 x 1.5	171	130	
M 10 x 1	15	11		M 39 x 2	215	160	
M 10 x 1.25	15	11		M 42 x 1.5	240	180	
M 12 x 1.5	20	15		M 42 x 2	240	180	
M 14 x 1.5	27	20		M 45 x 1.5	270	200	
M 16 x 1.5	37	27		M 45 x 2	270	200	
M 18 x 1.5	40	30		M 48 x 1.5	300	220	
M 20 x 1.5	47	35		M 48 x 2	300	220	
M 22 x 1.5	57	42		M 52 x 1.5	380	280	
M 24 x 1.5	68	50		M 52 x 2	380	280	
M 26 x 1.5	75	55		M 56 x 2	430	320	
M 27 x 2	87	64		M 60 x 2	510	380	
M 30 x 1.5	115	85		M 64 x 2	570	420	
M 30 x 2	115	85		M 65 x 2	620	460	
M 33 x 2	120	89					

**Information**

Oil the thread and sealing surfaces with engine oil.

11.1.3 Standard torques for flange joints

Fig. 170 Overview of flange joints



142876

Information



Tightening torques apply for mating material: steel.

Tolerance for the tightening torques specified in the table: + 10 %.

Oil the screw-in thread with engine oil before screwing in.

Metric flange joints, series L (light) acc. to Fig. 170

Dimensions		Nm / ft lb						
Tube di- ameter X	Thread Y	Form A with sealing ring	Form B with edge seal	Form E with flat (ED) gasket	Form F with O-ring	WH	TH	SWVE
6	M 10 x 1.0	9 / 6.6	18 / 13	18 / 13	15 / 11	18 / 13	18 / 13	18 / 13
8	M 12 x 1.5	20 / 15	30 / 22	25 / 18	25 / 18	45 / 33	45 / 33	35 / 26
10	M 14 x 1.5	35 / 26	45 / 33	45 / 33	35 / 26	55 / 41	55 / 41	50 / 37
12	M 16 x 1.5	45 / 33	65 / 48	55 / 41	40 / 29	80 / 59	80 / 59	60 / 44
15	M 18 x 1.5	55 / 41	80 / 59	70 / 52	45 / 33	100 / 74	100 / 74	80 / 59
18	M 22 x 1.5	65 / 48	140 / 100	125 / 92	60 / 44	140 / 100	140 / 100	120 / 89
22	M 26 x 1.5	90 / 66	190 / 140	180 / 130	100 / 74	320 / 240	320 / 240	130 / 96
28	M 33 x 2.0	150 / 110	340 / 250	310 / 230	160 / 120	360 / 270	360 / 270	
35	M 42 x 2.0	240 / 180	500 / 370	450 / 330	210 / 150	540 / 400	540 / 400	
42	M 48 x 2.0	290 / 210	630 / 460	540 / 400	260 / 190	700 / 520	700 / 520	

Metric flange joints, series S (heavy) acc. to Fig. 170

Dimensions		Nm / ft lb						
Tube di- ameter X	Thread Y	Form A with sealing ring	Form B with edge seal	Form E with flat (ED) gasket	Form F with O-ring	WH	TH	SWVE
6	M 12 x 1.5	20 / 15	35 / 26	40 / 29	35 / 26	45 / 33	45 / 33	35 / 26
8	M 14 x 1.5	35 / 26	55 / 41	40 / 29	45 / 33	55 / 41	55 / 41	50 / 37
10	M 16 x 1.5	45 / 33	70 / 52	70 / 52	55 / 41	80 / 59	80 / 59	60 / 44
12	M 18 x 1.5	55 / 41	110 / 81	90 / 66	70 / 52	100 / 74	100 / 74	80 / 59
14	M 20 x 1.5	55 / 41	150 / 110	125 / 92	80 / 59	125 / 92	125 / 92	110 / 81
16	M 22 x 1.5	65 / 48	170 / 120	135 / 100	100 / 74	135 / 100	135 / 100	120 / 88
20	M 27 x 2.0	90 / 66	270 / 200	180 / 130	170 / 120	320 / 240	320 / 240	135 / 100
25	M 33 x 2.0	150 / 110	410 / 300	310 / 300	310 / 300	360 / 270	360 / 270	
30	M 42 x 2.0	240 / 180	540 / 400	450 / 330	330 / 240	540 / 400	540 / 400	
38	M 48 x 2.0	290 / 210	700 / 520	540 / 400	420 / 310	700 / 520	700 / 520	

Standard torques

Imperial flange joints, series L (light) acc. to Fig. 170

Dimensions		Nm / ft lb						
Tube diameter X	Thread Y	Form A with sealing ring	Form B with edge seal	Form E with flat (ED) gasket		WH	TH	SWVE
6	G 1/8A	9 / 6.6	18 / 13	18 / 13		18 / 13	18 / 13	18 / 13
8	G 1/4A	35 / 26	35 / 26	35 / 26		45 / 33	45 / 33	40 / 29
10	G 1/4A	35 / 26	35 / 26	35 / 26		45 / 33	45 / 33	40 / 29
12	G 3/8A	45 / 33	70 / 52	70 / 52		70 / 52	70 / 52	65 / 48
15	G 1/2A	65 / 48	140 / 100	90 / 66		120 / 88	120 / 88	90 / 66
18	G 1/2A	65 / 48	100 / 75	90 / 66		120 / 88	120 / 88	90 / 66
22	G 3/4A	90 / 66	180 / 130	180 / 130		230 / 170	230 / 170	125 / 92
28	G 1A	150 / 110	330 / 240	310 / 230		320 / 240	320 / 240	
35	G 1 1/4A	240 / 180	540 / 400	450 / 330		540 / 400	540 / 400	
42	G 1 1/2A	290 / 210	630 / 470	540 / 400		700 / 520	700 / 520	

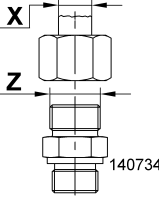
Imperial flange joints, series S (heavy) acc. to Fig. 170

Dimensions		Nm / ft lb						
Tube diameter X	Thread Y	Form A with sealing ring	Form B with edge seal	Form E with flat (ED) gasket		WH	TH	SWVE
6	G 1/4A	35 / 26	55 / 41	40 / 29		45 / 33	45 / 33	40 / 29
8	G 1/4A	35 / 26	55 / 41	40 / 29		45 / 33	45 / 33	40 / 29
10	G 3/8A	45 / 33	90 / 66	80 / 59		70 / 52	70 / 52	65 / 48
12	G 3/8A	45 / 33	90 / 66	80 / 59		70 / 52	70 / 52	65 / 48
14	G 1/2A	65 / 48	150 / 110	115 / 85		120 / 88	120 / 88	90 / 66
16	G 1/2A	65 / 48	130 / 96	115 / 85		120 / 88	120 / 88	90 / 66
20	G 3/4A	90 / 66	270 / 200	180 / 130		230 / 170	230 / 170	125 / 92
25	G 1A	150 / 110	340 / 250	310 / 230		320 / 240	320 / 240	
30	G 1 1/4A	240 / 180	540 / 400	450 / 330		540 / 400	540 / 400	
38	G 1 1/2A	290 / 210	700 / 520	540 / 400		700 / 520	700 / 520	

Metric flange joints, series L (light) for aluminum acc. to [Fig. 170](#)

Dimensions		Nm / ft lb						
Tube di- ameter X	Thread Y	Form A with sealing ring	Form B with edge seal	Form E with flat (ED) gasket	Form F with O-ring	WH	TH	SWVE
6	M 10 x 1.0	15 / 11		12 / 8.8				
8	M 12 x 1.5							
10	M 14 x 1.5	30 / 22		30 / 22				
12	M 16 x 1.5	40 / 29	40 / 29	40 / 29				
15	M 18 x 1.5							
18	M 22 x 1.5	80 / 59		80 / 59				
22	M 26 x 1.5	80 / 59		150 / 111				
28	M 33 x 2.0							
35	M 42 x 2.0							
42	M 48 x 2.0							

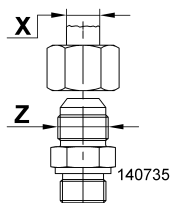
11.1.4 Standard torques for cutting ring flange joints

Dimension			Nm	ft lb
				
Series	Tube diameter X	Thread Z		
LL	6	M 10 × 1	14	10
L	6	M 12 × 1.5	14	10
	8	M 14 × 1.5	20	15
	10	M 16 × 1.5	27-30	20-22
	12	M 18 × 1.5	60	44
	15	M 22 × 1.5	105	77
	18	M 26 × 1.5	150	110
	22	M 30 × 2	200	150
	28	M 36 × 2	250	180
	35	M 45 × 2	450	330
	42	M 52 × 2	600	440
S	16	M 24 × 1.5	150	110
	20	M 30 × 2	250	180
	25	M 36 × 2	450	330
	30	M 42 × 2	600	440
	38	M 52 × 2	750	550

Information

- Tighten screw-on connection with set torque.
- Secure screw-on connection.
- Screw on box nut up to clearly noticeable increase in force (without wrench extension).
- Tighten box nut to aforementioned torque.

11.1.5 Standard torques for Triple Lock flange joints

Dimension				Nm / ft lb	
					
Series	Tube diameter X		Thread Z	Steel	Stainless steel
	mm	inch	UN/UNF		
4	6	1/4	7/17-20	15 / 11	30 / 22
5	8	5/16	1/2-20	20 / 15	40 / 29
6	10	3/8	9/16-18	30 / 22	60 / 44
8	12	1/2	3/4-16	60 / 44	115 / 85
10	14, 15, 16	5/8	7/8-14	75 / 55	145 / 110
12	18, 20	3/4	1 1/16-12	110 / 81	180 / 130
16	22,	7/8,	1 5/16-12	135 / 100	225 / 170
16	25	1	1 5/16-12	175 / 130	255 / 190
	28		1 5/8-12	260 / 190	295 / 220
20	30, 32	1 1/4	1 5/8-12	260 / 190	295 / 220
	35		1 7/8-12	340 / 250	345 / 250
24	38	1 1/2	1 7/8-12	340 / 250	345 / 250
28	42	-	2 1/4-12	380 / 280	400 / 290
32	-	2	2 1/2-12	450 / 330	470 / 350

Information

- Tighten screw-on connection with set torque.
- Secure screw-on connection.
- Screw on box nut up to clearly noticeable increase in force (without wrench extension).
- Tighten box nut to aforementioned torque.

Standard torques

11.1.6 Standard torques for VSTI screw plugs

Thread	Nm	ft lb		Thread	Nm	ft lb	
M 10 x 1	10	7.4		M 27 x 2	120	88	
M 12 x 1.5	20	15		R 3/4"	120	88	
M 14 x 1.5	30	22		M 30 x 1.5	120	88	
M 16 x 1.5	40	29		M 33 x 2	200	150	
M 18 x 1.5	50	37		M 38 X1.5	280	210	
M 20 x 1.5	60	44		M 42 x 2	350	260	
M 22 x 1.5	80	59		M 48 x 2	400	290	
M 24 x 1.5	90	66					
M 26 X 1.5	100	74					

11.2 Cleaning agents, locking agents and greases

This listing includes all locking agents and greases which are required for repair and maintenance work on the engines. Some of these substances are used later during the operating time of the diesel engine. The application is described in the respective work descriptions.

**Information**

If a locking agent must be used, clean, degrease and dry the respective screw thread and screw-in thread beforehand.

Cleaning and locking agents

Designation	Quantity	Reference source
Loctite 243	250 ml	LOCTITE®
Loctite SI 5990	300 ml	LOCTITE®

Greases

Designation	Quantity	Reference source
Staburags NBU 30	1.20 kg	Klüber
Copper paste; Motorex 14	0.85 kg	MOTOREX
High temperature spray; Anti Seize ASW	400 ml	WEICON

**Information**

Safety data sheets for cleaning agents, locking agents and greases, see manufacturer's website (source).

11.3 Tools

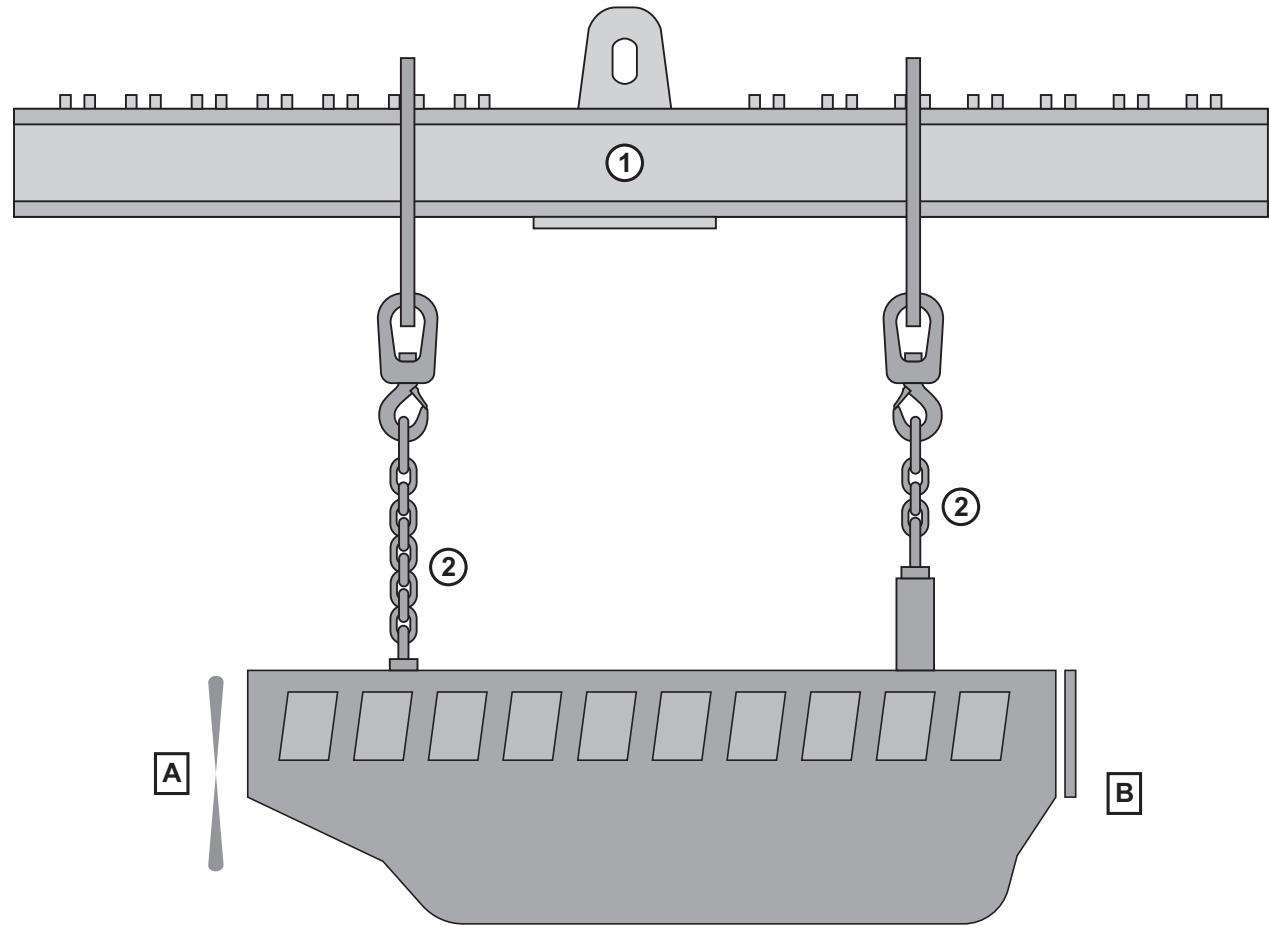
11.3.1 Special tools

Lifting traverse



- DANGER**
Pulling out of the transport device and falling of the engine.
Causes serious injuries or death.
- Observe maximum weight for lifting points.
 - Maintain a maximum of a 10° deviation from the vertical to the engine axis.
 - Use a KOHLER lifting traverse.
 - Remove alternator or other attachments before lifting the diesel engine.
 - Take safety instructions / warning signs from the operator's manual of the lifting traverse into account.

Fig. 171 Lifting traverse





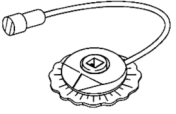

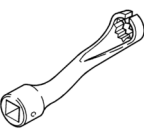
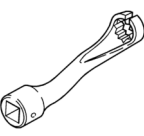
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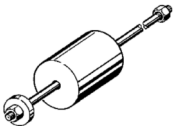
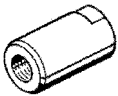
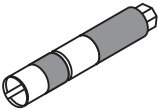
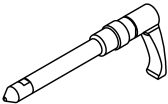
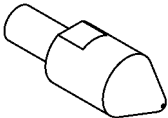

Pos.	Name	Identifi- cation number	Remark
1	Lifting traverse	13493625	
2	Lifting gear		Not part of the scope of delivery

- A Ancillary support housing side
- B Flywheel side





Tools

11.3.2 Special tools with order number

	Description	Number	Identification	Order number
 10123791	Manual drive	1	10123791	230610006
 13445716	M16x280 mounting bolt	2	13445716	
 140411 10023839	Angle of rotation device for 3/4" drive	1	10023839	230610015
 140364 7014716	Torx tools	1	7014716	230610016
 140128 10020852	Assembly tool for high pressure lines, width across flats 17	1	10020852	230610017
 140693 10289118	Assembly tool for high pressure lines, width across flats 19	1	10289118	230610018

	Description	Number	Identification	Order number
 140080 0524072	Disassembly tool	1	0524072	230610020
 143461 12440945	Adapter for pressure pipe socket	1	12440945	230610021
 142535 11355589	Disassembly tool for injector	1	11355589	230610022
 141729 10153847	Assembly tool for injector	1	10153847	230610023
 142519 10148425	Replacement tip for assembly tool for injector [10153847]	1	10148425	230610024
 144005 12690422	Straight drain hose	1	12690422	230611084

Tools

	Description	Number	Identification	Order number
 144006 12690423	Drain hose 90°	1	12690423	230611085
 143344 12204341	Lifting device for high pressure pump	1	12204341	230610043
 13493625	Lifting traverse	1	13493625	230613705
	Hang tag	as needed	12410473	230611087

11.4 Terms used (glossary)

Term	Explanation
Operational	The engine is ready to be started.
In operation	The engine is running.
Emergency operation	Short-term operating mode in which the engine can be operated with restricted power / functionality. Not permitted if the safety of persons is not guaranteed.
Safety zone	Designated area around the engine; the accessibility of this area in the various operating modes is described in chapter "Operating and maintenance areas" on page 16 .

11.5 Abbreviations used

Short	Written out	Explanation
ATL	Exhaust gas turbocharger	
CAN	Control area network	Serial bus system, for communication between individual components
CR	Common rail	High pressure reservoir
CRS	Common rail system	Diesel injection system (also called reservoir injection system)
PCV	Pressure control valve	
DC	Direct current	Direct current (electric)
DRS	Pressure pipe socket	
ECU	Electronic control unit	Electronic control (control unit)
EMC	Electromagnetic compatibility	
ESD	Electrostatic discharge	Electrostatic discharge
If necessary	If necessary	
TDC	Top dead center	
PCV	Pressure control valve	Pressure control valve
PVG	Pump distributor gear box	
SCR	Selective Catalytic Reduction	Selective Catalytic Reduction
BDC	Bottom dead center	
VCV	Volume control valve	Flow control valve
ZME	Metering unit	

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