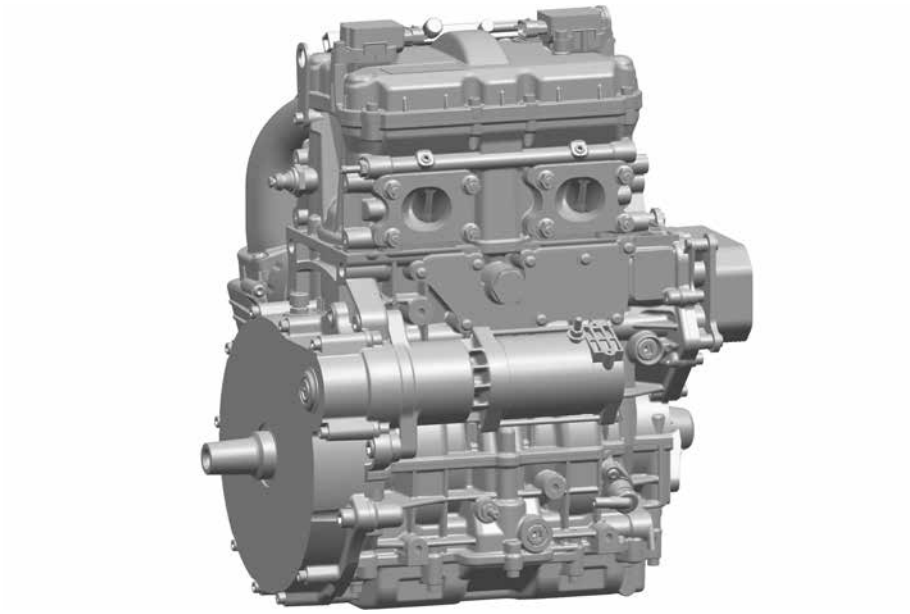
TEXTRON MOTORS



REPAIR MANUAL

4-Stroke Engine
MPE 850 OFF-ROAD

This repair manual is valid for the following engine models:

– 409135 I2 846 UTV NA-80

TD409135_RLF
Rev A
04.09.2015
en_English

Read the introductory chapter before performing the task on the engine.
Pay particular attention to the safety messages.

Textron Motors GmbH

Daimlerstraße 5

88677 Markdorf

Germany

www.weber-motor.com

Table of contents

1 About this document

This repair manual describes how to safely and correctly remove, install and replace engine components.

Observe the following information:

– Read through the service manual before performing any tasks.
– Some figures in this repair manual are general illustrations and may differ from the actual engine.

1.1 Meaning of the symbols and signal words

Item	Meaning
NOTICE	The signal word *NOTICE* indicates potential property damage.
Information	The signal word **Information** indicates specific features and recommendations.
	For the activity required special tools.
	For the activity additionally required spare parts.
	For the activity required supplies.
	For the activity additionally required documents.

1.2 Change management

Textron Motors GmbH strives to make continual improvements as part of the ongoing technical development of its products. You may find that descriptions in the repair manual are changed or amended. All changes are described in the chapter **Overview of revisions**.

Observe the following information:

– Always use the most current repair manual from the protected area on our web site www.weber-motor.com.
– Always print the required chapter and all chapters referred to completely and then destroy the printouts.

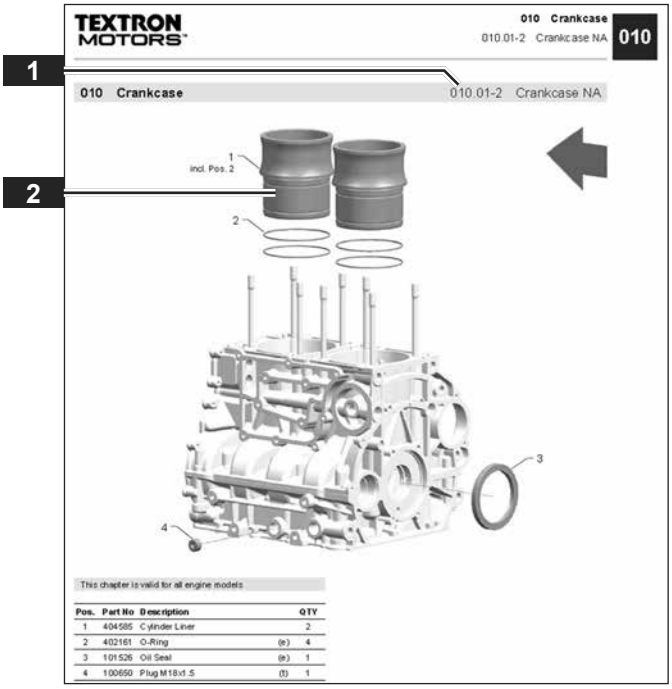
1.3 Finding the required information

When you planning a work on the engine, proceed as follows:

For example, you want to replace the cylinder liners **2**.

► Identify the corresponding component in the spare parts catalog..

The cylinder liners can be found in the spare parts catalog in chapter
010.01-2 Crankcase NA **1**



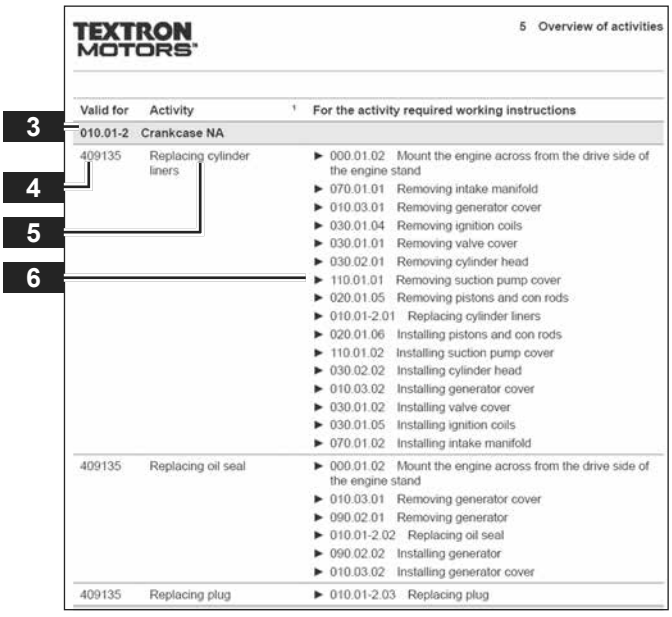
► Open chapter 5 **Overview of activities** in the repair manual.

► Locate the section with the same designation **010.01-2 Crankcase NA** **3**.

In this section you will find the activity **Replacing cylinder liners** **5**.

► Check whether the activity is valid for the engine model **4**.

► Perform all for the activity required working instructions **6** in the order shown.



Observe the following references:

– A list of all working instructions is located in chapter 6.1 **List of working instructions, single**.

– Each working instruction contains information on required special tools, additional required spare parts, supplies and documents.

2 Safety

This engine is state-of-the-art and built according to recognized safety-technical regulations. Ignoring the information in this repair manual may result in personal injury or property damage.

This repair manual is solely intended for use in a workshop authorized by Textron Motors or the vehicle manufacturer. All work on the engine must be performed by appropriately trained personnel.

Before beginning any work, trained personnel authorized to work on the engine must have access to the complete documentation of the engine. Make sure that trained personnel have read and understand all introductory chapters and in particular, the chapter on safety.

Observe all generally applicable laws and regulations in addition to the information in this repair manual:

– accident prevention
– environmental protection
– handling of hazardous materials
– personal safety equipment
– traffic laws

2.1 Meaning of the safety alert symbol and signal words

Item	Meaning
	The safety alert symbol draws your attention to possible dangers.
WARNING	The signal word **WARNING** indicates a potentially dangerous situation that may lead to a serious or fatal injury.
CAUTION	The signal word **CAUTION** indicates a potentially dangerous situation that may lead to a minor or moderately severe injury.

2.2 Important safety messages

Working instructions

You endanger the safety of personnel if you do not perform work exactly as described in this repair manual.

- ► Do not deviate from the working instructions in this repair manual.
- ► Pay attention to the safety messages in the vehicle manufacturer's documentation.

Malfunctions

Engine malfunctions can cause pose a safety risk to persons.

- ► Only operate the engine in perfect condition.

Defective components

Defective engine components can cause serious engine damages and pose a safety risk to persons.

- ► Check all components before installation.
- ► Always replace defective components.

Checking the work carried out

Work performed incorrectly poses a safety risk to personnel.

- ► Check the vehicle safety each time after working on the engine. (See chapter 3.3.2 Checking the work carried out.)

Spare parts

All the components in your engine have been carefully tested and fulfill strict quality and safety requirements.

- ► Textron Motors offers spare parts to the highest quality. Ensure that equivalent spare parts corresponds with this quality requirements.

Add-on parts and modifications

Engine modifications may pose a safety risk to persons.

- ► Do not install add-on parts or modify the engine.

Lift and transport the engine.

Spinal column injury due to incorrect lifting of heavy loads.

- ► Always use a workshop crane to lift and transport the engine on the brackets provided. (See chapter 3.2 Lift and transport the engine.)

Securing the engine

Crush injuries due to the engine overturning.

- ► Mount the engine to the engine stand before starting any work. (See chapter 3.2.2 Secure the engine while working.)

Tools and accessories

Unsuitable tools and accessories pose a safety risk to personnel.

- ► Always use tools listed in chapter 4 **Tools and accessories**.

Protective equipment

Missing protective equipment poses a safety risk to personnel.

► Attach all protective equipment after completing the tasks.

Hot engine components

Engine components become extremely hot during operation.

► Do not touch any engine components during operation.

► Switch off the engine and wait until the components have cooled.

Engine power supply

The engine must be disconnected from the power supply before any work is carried out. Leaving the engine connected to the power supply poses a risk to personnel.

► Only reconnect the power supply when prompted to do so by the vehicle manufacturer.

► Pay attention to the safety messages in the vehicle manufacturer’s documentation.

Engine exhaust gases

Engine exhaust gases contain carbon monoxide (CO). Inhalation of carbon monoxide can deprive the body of oxygen and result in organ damage or death by asphyxiation.

► Never operate the engine in enclosed spaces.

Fuel, engine oil and coolant handling

Engine fluids pose a health risk.

► Always read the manufacturer's instructions.

► Always wash your hands prior to eating, smoking and using the restroom as well as at the end of the working shift when working with engine fluids.

Engine fluids are hazardous to the environment.

► Never allow engine fluids to escape into the groundwater, water courses or sewage system. Always dispose of engine fluids according to applicable regulations.

Danger of slipping on spilled fluids.

► Always use a filler neck or funnel when filling the engine with fluids.

► Always clean up any spilled engine fluids immediately.

Fuel

Fuel is highly flammable. Vapors may ignite and cause an explosion.

► Do not smoke in the vicinity of the engine and do not allow open flames or sparks near the engine or the fuel system.

► Always turn off the engine before fueling.

► Never fill with fuel while the engine is running.

► Do not start the engine if you smell fuel or see a fuel leak.

► Fuel on hot surfaces can cause fires.

► In the event of a fire, use foam, dry chemical or carbon dioxide fire extinguishers. Do not extinguish with water.

Engine oil

Engine oil is flammable and can emit toxic gases.

- ► Do not smoke in the vicinity of the engine and do not allow open flames or sparks near the engine.
- ► Engine oil on hot surfaces can cause fires.
- ► In the event of a fire, use foam, dry chemical or carbon dioxide fire extinguishers. Do not extinguish with water.

3 Basic instructions for working on the engine

3.1 Before you begin working

The following requirements must be met before performing any tasks:

– The engine has been removed from the vehicle.
– The engine has been disconnected from the power supply.
– There is no engine oil or coolant in the engine.
– The engine is in original factory condition. You identify the factory condition in the spare parts catalog.

3.1.1 Removing engine from vehicle

See the vehicle manufacturer‘s documentation.

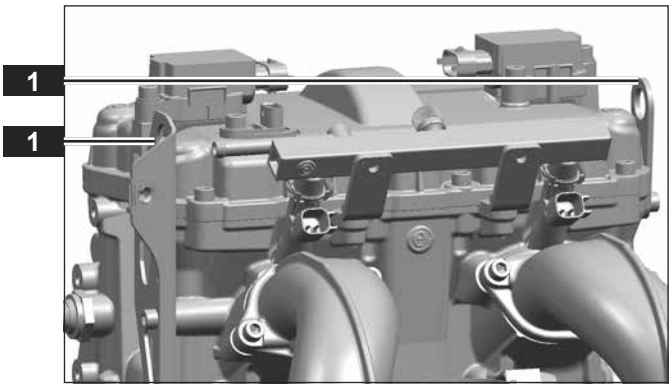
3.2 While working

3.2.1 Lift and transport the engine

WARNING! Spinal column injury due to incorrect lifting of heavy loads. Always lift the engine using a workshop crane.

NOTICE! Components can break. Lift the engine only using the brackets.

► Lift the engine using the brackets **1**.



3.2.2 Secure the engine while working

WARNING! Crush injuries due to the engine overturning. Mount the engine to the engine stand before starting any work.

If not otherwise specified, mount the engine on the drive side or across from the drive side. (See chapter 000.01 Mount the engine on the engine stand.)

3.2.3 Tightening torque

For all details about tightening torque in this repair manual, observe the following information:

– If not otherwise specified, threads are dry and free of engine oil.
– For components with coated threads, the tightening torques always refer to new components.

3.2.4 Cleaning

Observe the following information:

– Before assembling components, clean all joint surfaces.
– If there is contamination in the lubrication system, cooling system or fuel unit, clean all components concerned.

3.2.5 Disposal

When disposing of operating materials, replaced parts or the whole engine, always comply with the relevant applicable national laws and guidelines.

3.3 After working

3.3.1 Updating engine control unit calibration

Update the calibration of the engine control unit when engine installed again in the vehicle.

► Update the engine control unit calibration. (See the Textron Motors Diagnostic Tool manual.)
► Clear the trouble codes. (See the Textron Motors Diagnostic Tool manual.)

3.3.2 Checking the work carried out

Check the engine when installed again in the vehicle.

► Turn the ignition on for about a minute, until the throttle body opens and closes again.
► Allow the engine to warm up as described in the service manual of the engine. You should not hear any unusual noises.
► Perform a visual inspection. No fluids should be escaping.
► Run the engine through all operating modes.

4 Tools and accessories

4.1 Equipment workshop

4.1.1 Textron Motors special tools

Textron Motors offers a tool case that contains the following Textron Motors special tools. Visit our web site www.weber-motor.com for more information.

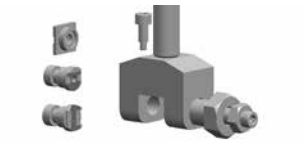
Figure	Description
	Locking tool crankshaft
	Chain tool
	Installation spike valve stem seal
	Remover bearing cap

Figure	Description
	TDC-adjusting tool
	Assembling kit oil seal crankshaft
	Pin punch axle intermediate gear
	Assembling kit slide ring seal

4.1.2 Textron Motors Diagnostic Tool

Textron Motors offers a diagnostic case that contains the Textron Motors Diagnostic Tool. The Textron Motors Diagnostic Tool is designed for fault diagnostics and service tasks for Textron engines using a Synerject engine management system. Visit your local vehicle dealer or our web site www.weber-motor.com for more information.

4.1.3 Commercially available workshop equipment and standard tools

In addition to the Textron Motors special tools, you will require the following tools and accessories. The figures are only examples of suitable tools. All tools and accessories are available from specialist retailers.

Abbildung	Bezeichnung
	Workshop crane with carrying strap Minimum lifting capacity 300 kg [650 lb]
	Engine stand Minimum lifting capacity 300 kg [650 lb] Mounting bolts M6 and M10
	Torque wrench 0,5 – 80 Nm [0.4 – 59 lbf ft] with extension and insert adapter
	Reversible ratchet with extension and insert adapter

Abbildung	Bezeichnung
	Torx® screwdriver T20, T30, T45
	Torx® screwdriver socket T20, T30, T45
	Hexagon screwdriver 4, 5, 6, 7, 8
	6-point socket 4, 5, 6, 7, 8

Abbildung	Bezeichnung
	Hexagon nut-driver 7
	6-point socket wrench 7, 10, 12, 14
	Open-end wrench 7, 12, 15, 19, 22, 24, 27
	Insert open-end wrench 7, 12, 15, 16, 19, 22, 24, 27
	Bar magnet
	Universal pliers
	Plastic hammer

Abbildung	Bezeichnung
	Lockring pliers (bore holes)
	Clamp pincer
	Pin punch 5, 7, 8
	Protective glasses
	Feeler gauge 0,05 – 2 mm
	Caliper Measuring accuracy 0,05 mm
	Drip tray

4.1.4 Commercially available special tools

In addition you will require the following commercially available special tools. In the working instructions will be separately referred on these special tools. The figures are only examples of suitable tools. All tools and accessories are available from specialist retailers.

Abbildung	Bezeichnung
	12-point socket wrench 12
	Stud extractor 8, 10
	Spark plug wrench Wrench size 16 mm [5/8“] Diameter: maximum 22 mm [0.87 in]
	Angle indicator
	Crown wrench Width of pins maximum 3 mm
	Universal strap wrench

Abbildung	Bezeichnung
	Valve refacer
	Piston ring compressor
	Cylinder liner puller
	Oil seal slide hammer
	Valve spring compressor
	Precision clearance gauges 0,025 mm - 0,04 mm

4.1.5 Supplies

You need the following supplies when working on the engine. Unless otherwise specified, use the products as directed by the manufacturer.

Supplies	Recommended products
Petroleum jelly for fitting o-rings and gaskets	– Commercial petroleum jelly for industrial applications
Lubricant for injectors o-rings	– Mobil DTE-24, DTE-25, DTE-26 – Exxon/Mobil Norpar 15
Silicone liquid seal	– Three Bond 1227E
Anti-Seize assembly paste for lubricating threaded connections	– Weicon Anti-Seize „High-Tech“ ASW 040 P – Loctite 8150
Thread locker, high strength	– Loctite 272
Thread locker, medium strength	– Loctite 243
Thread sealant	– Loctite 542 – Loctite 577
Valve grinding compound	– Teroson valve grinding compound
Sealing surface cleaner	– Liqui Moly brake and parts cleaner AIII

5 Overview of activities

Valid for	Activity	[1]	For the activity required working instructions
010 Crankcase			
010.01-1 Crankcase			
409135	Replacing crankcase		► Remove the crank drive. See section 020.01 **Crank drive** in this chapter. ► 010.01-1.01 Replacing crankcase ► Install the crank drive. See section 020.01 **Crank drive** in this chapter.
409135	Replacing welch plugs	s	► 010.01-1.02 Replacing welch plugs
409135	Replacing tie rod	s	► 010.01-1.03 Replacing tie rod
409135	Replacing plugs	s	► 010.01-1.04 Replacing plugs
010.01-2 Crankcase NA			
409135	Replacing cylinder liners		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 070.01.01 Removing intake manifold ► 010.03.01 Removing generator cover ► 030.01.04 Removing ignition coils ► 030.01.01 Removing valve cover ► 030.02.01 Removing cylinder head ► 110.01.01 Removing suction pump cover ► 020.01.05 Removing pistons and con rods ► 010.01-2.01 Replacing cylinder liners ► 020.01.06 Installing pistons and con rods ► 110.01.02 Installing suction pump cover ► 030.02.02 Installing cylinder head ► 010.03.02 Installing generator cover ► 030.01.02 Installing valve cover ► 030.01.05 Installing ignition coils ► 070.01.02 Installing intake manifold

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
409135	Replacing oil seal		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.01 Removing generator cover ► 090.02.01 Removing generator ► 010.01-2.02 Replacing oil seal ► 090.02.02 Installing generator ► 010.03.02 Installing generator cover
409135	Replacing plug		► 010.01-2.03 Replacing plug
010.01-3	**Crankcase**		
409135	Removing plug		► 000.01.01 Mount the engine on the drive side of the engine stand ► 010.01-3.01 Removing plug
409135	Installing plug		► 000.01.01 Mount the engine on the drive side of the engine stand ► 010.01-3.02 Installing plug
409135	Replacing plugs	s	► 010.01-3.03 Replacing plugs
409135	Removing fitting		► 000.01 Mount the engine on the engine stand ► 010.01-3.04 Removing fitting
409135	Installing fitting		► 000.01 Mount the engine on the engine stand ► 010.01-3.05 Installing fitting
409135	Removing sensor crankshaft		► 000.01 Mount the engine on the engine stand ► 010.01-3.06 Removing sensor crankshaft
409135	Installing sensor crankshaft		► 000.01 Mount the engine on the engine stand ► 010.01-3.07 Installing sensor crankshaft
409135	Removing sensor knock		► 000.01.01 Mount the engine on the drive side of the engine stand ► 010.01-3.08 Removing sensor knock
409135	Installing sensor knock		► 000.01.01 Mount the engine on the drive side of the engine stand ► 010.01-3.09 Installing sensor knock

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
010.02-1	**Oil cooler bracket**		
409135	Removing oil cooler bracket		► 000.01.01 Mount the engine on the drive side of the engine stand ► 050.03.01 Removing oil cooler ► 010.02-1.01 Removing oil cooler bracket
409135	Installing oil cooler bracket		► 000.01.01 Mount the engine on the drive side of the engine stand ► 010.02-1.02 Installing oil cooler bracket ► 050.03.02 Installing oil cooler
010.02-2	**Oil cooler bracket**		
409135	Replacing blanking cover		► 000.01.01 Mount the engine on the drive side of the engine stand ► 010.02-2.01 Replacing blanking cover
409135	Replacing plug		► 000.01.01 Mount the engine on the drive side of the engine stand ► 010.02-2.02 Replacing plug
409135	Sealing cover oil cooler bracket		► 000.01.01 Mount the engine on the drive side of the engine stand ► 050.03.01 Removing oil cooler ► 010.02-2.03 Sealing cover oil cooler bracket ► 050.03.02 Installing oil cooler
010.03	**Generator cover**		
409135	Removing generator cover		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.01 Removing generator cover
409135	Installing generator cover		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.02 Installing generator cover
409135	Replacing generator cover		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.01 Removing generator cover ► 010.03.03 Replacing generator cover ► 010.03.02 Installing generator cover

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
409135	Replacing oil seal		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.01 Removing generator cover ► 010.03.04 Replacing oil seal ► 010.03.02 Installing generator cover
409135	Replacing vent plug		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.05 Replacing vent plug
020 Crank drive			
020.01 Crankshaft			
409135	Removing crank drive		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.01 Removing generator cover ► 090.01.01 Removing starter ► 000.01.01 Mount the engine on the drive side of the engine stand ► 070.01.01 Removing intake manifold ► 050.03.01 Removing oil cooler ► 010.02-1.01 Removing oil cooler bracket ► 050.02.01 Removing impeller ► 050.02.03 Removing coolant pump ► 020.03.01 Removing crankshaft cover ► 000.01.02 Mount the engine across from the drive side of the engine stand ► 090.02.01 Removing generator ► 110.02.01 Removing oil pressure pump ► 110.01.01 Removing suction pump cover ► 030.01.04 Removing ignition coils ► 030.01.01 Removing valve cover ► 020.01.01 Removing crank drive

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
409135	Installing crank drive		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 020.01.02 Installing crank drive ► 110.02.02 Installing oil pressure pump ► 090.02.02 Installing generator ► 000.01.01 Mount the engine on the drive side of the engine stand ► 020.03.02 Installing crankshaft cover ► 050.02.04 Installing coolant pump ► 050.02.02 Installing impeller ► 010.02-1.02 Installing oil cooler bracket ► 050.03.02 Installing oil cooler ► 110.01.02 Installing suction pump cover ► 070.01.02 Installing intake manifold ► 090.01.02 Installing starter ► 030.01.02 Installing valve cover ► 030.01.05 Installing ignition coils ► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.02 Installing generator cover
409135	Replacing crankshaft		► Remove the crank drive. See section 020.01 **Crank drive** in this chapter. ► 020.01.03 Replacing crankshaft ► Remove the crank drive. See section 020.01 Cr**ank drive i**n this chapter.
409135	Replacing balance shaft		► Remove the crank drive. See section 020.01 **Crank drive** in this chapter. ► 020.01.04 Replacing balance shaft ► Install the crank drive. See section 020.01 **Crank drive** in this chapter.
409135	Removing pistons and con rods		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 070.01.01 Removing intake manifold ► 010.03.01 Removing generator cover ► 110.01.01 Removing suction pump cover ► 030.01.04 Removing ignition coils ► 030.01.01 Removing valve cover ► 030.02.01 Removing cylinder head ► 020.01.05 Removing pistons and con rods

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
409135	Installing pistons and con rods		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 020.01.06 Installing pistons and con rods ► 030.02.02 Installing cylinder head ► 110.01.02 Installing suction pump cover ► 030.01.02 Installing valve cover ► 030.01.05 Installing ignition coils ► 010.03.02 Installing generator cover ► 070.01.02 Installing intake manifold
409135	Replacing piston		► Remove the pistons and con rods. See section 020.01 **Crankshaft** in this chapter. ► 020.01.07 Replacing piston ► Install the pistons and con rods. See section 020.01 **Kurbelwelle** in this chapter.
409135	Replacing con rod		► Remove the pistons and con rods. See section 020.01 **Crankshaft** in this chapter. ► 020.01.08 Replacing con rod ► Install the pistons and con rods. See section 020.01 **Crankshaft** in this chapter.
409135	Checking con rod bearing play	s	► 020.01.09 Checking con rod bearing play
409135	Checking main bearing play	s	► 020.01.10 Checking main bearing play
020.02	**Stub shaft**		
409135	Removing stub shaft		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.01 Removing generator cover ► 020.02.01 Removing stub shaft
409135	Installing stub shaft		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 020.02.02 Installing stub shaft ► 010.03.02 Installing generator cover

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
020.03 Abdeckung Kurbelwelle			
409135	Removing crankshaft cover		► 000.01.01 Mount the engine on the drive side of the engine stand ► 020.03.01 Removing crankshaft cover
409135	Installing crankshaft cover		► 000.01.01 Mount the engine on the drive side of the engine stand ► 020.03.02 Installing crankshaft cover
030 Cylinder head			
030.01 Valve cover			
409135	Removing valve cover		► 000.01 Mount the engine on the engine stand ► 030.01.04 Removing ignition coils ► 030.01.01 Removing valve cover
409135	Installing valve cover		► 000.01 Mount the engine on the engine stand ► 030.01.02 Installing valve cover ► 030.01.05 Installing ignition coils
409135	Replacing valve cover		► 000.01 Mount the engine on the engine stand ► 030.01.04 Removing ignition coils ► 030.01.06 Removing sensor camshaft ► 030.01.01 Removing valve cover ► 030.01.03 Replacing valve cover ► 030.01.02 Installing valve cover ► 030.01.07 Installing sensor camshaft ► 030.01.05 Installing ignition coils
409135	Removing ignition coils		► 000.01 Mount the engine on the engine stand ► 030.01.04 Removing ignition coils
409135	Installing ignition coils		► 000.01 Mount the engine on the engine stand ► 030.01.05 Installing ignition coils
409135	Removing sensor camshaft		► 000.01 Mount the engine on the engine stand ► 030.01.06 Removing sensor camshaft
409135	Installing sensor camshaft		► 000.01 Mount the engine on the engine stand ► 030.01.07 Installing sensor camshaft

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
030.02	**Cylinder head**		
409135	Removing cylinder head		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 070.01.01 Removing intake manifold ► 010.03.01 Removing generator cover ► 030.01.04 Removing ignition coils ► 030.01.01 Removing valve cover ► 030.02.01 Removing cylinder head
409135	Installing cylinder head		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 030.02.02 Installing cylinder head ► 030.01.02 Installing valve cover ► 030.01.04 Removing ignition coils ► 010.03.02 Installing generator cover ► 070.01.02 Installing intake manifold
409135	Replacing cylinder head		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 070.01.01 Removing intake manifold ► 010.03.01 Removing generator cover ► 030.01.04 Removing ignition coils ► 030.02.04 Removing spark plugs ► 030.01.01 Removing valve cover ► 030.02.01 Removing cylinder head ► Remove all valves: 040.03.01 Removing valve ► 030.02.03 Replacing cylinder head ► Install all valves: 040.03.02 Installing valve ► 030.02.02 Installing cylinder head ► 030.01.02 Installing valve cover ► 030.02.05 Installing spark plugs ► 030.01.05 Installing ignition coils ► 010.03.02 Installing generator cover ► 070.01.02 Installing intake manifold
409135	Removing spark plugs		► 000.01 Mount the engine on the engine stand ► 030.01.04 Removing ignition coils ► 030.02.04 Removing spark plugs

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
409135	Installing spark plugs		► 000.01 Mount the engine on the engine stand ► 030.02.05 Installing spark plugs ► 030.01.05 Installing ignition coils
409135	Removing switch oil pressure		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 030.02.06 Removing switch oil pressure
409135	Installing switch oil pressure		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 030.02.07 Installing switch oil pressure
409135	Removing fitting		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 030.02.08 Removing fitting
409135	Installing fitting		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 030.02.09 Installing fitting
409135	Replacing plugs		► 000.01.01 Mount the engine on the drive side of the engine stand ► 030.02.10 Replacing plugs
040 Valve train			
040.01 Camshaft			
409135	Replacing camshaft		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 070.01.01 Removing intake manifold ► 010.03.01 Removing generator cover ► 030.01.04 Removing ignition coils ► 030.01.01 Removing valve cover ► 030.02.01 Removing cylinder head ► 040.01.01 Replacing camshaft ► 030.02.02 Installing cylinder head ► 030.01.02 Installing valve cover ► 030.01.05 Installing ignition coils ► 010.03.02 Installing generator cover ► 070.01.02 Installing intake manifold

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
409135	Replacing timing chain		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 030.01.04 Removing ignition coils ► 030.01.01 Removing valve cover ► 010.03.01 Removing generator cover ► 110.01.01 Removing suction pump cover ► 040.01.02 Replacing timing chain ► 110.01.02 Installing suction pump cover ► 010.03.02 Installing generator cover ► 030.01.02 Installing valve cover ► 030.01.05 Installing ignition coils
409135	Checking and setting valve timing		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 030.01.04 Removing ignition coils ► 030.01.01 Removing valve cover ► 010.03.01 Removing generator cover ► 090.02.01 Removing generator ► 040.01.03 Checking and setting valve timing ► 090.02.02 Installing generator ► 010.03.02 Installing generator cover ► 030.01.02 Installing valve cover ► 030.01.05 Installing ignition coils
409135	Replacing chain rail	s	► 040.01.04 Replacing chain rail
409135	Replacing chain guide	s	► 040.01.05 Replacing chain guide
040.02	**Rocker arms**		
409135	Replacing rocker arms		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 030.01.04 Removing ignition coils ► 030.01.01 Removing valve cover ► 010.03.01 Removing generator cover ► 040.02.01 Replacing rocker arms ► 010.03.02 Installing generator cover ► 030.01.02 Installing valve cover ► 030.01.05 Installing ignition coils

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
040.03 Valves			
409135	Removing valve		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 070.01.01 Removing intake manifold ► 010.03.01 Removing generator cover ► 030.01.04 Removing ignition coils ► 030.01.01 Removing valve cover ► 030.02.01 Removing cylinder head ► 040.03.01 Removing valve
409135	Installing valve		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 040.03.02 Installing valve ► 030.02.02 Installing cylinder head ► 030.01.02 Installing valve cover ► 030.01.05 Installing ignition coils ► 010.03.02 Installing generator cover ► 070.01.02 Installing intake manifold
050 Cooling system			
050.01 Thermostat housing			
409135	Removing thermostat housing		► 000.01 Mount the engine on the engine stand ► 070.01.01 Removing intake manifold ► 050.01.01 Removing thermostat housing
409135	Installing thermostat housing		► 000.01 Mount the engine on the engine stand ► 050.01.02 Installing thermostat housing ► 070.01.02 Installing intake manifold
409135	Removing fitting		► 000.01 Mount the engine on the engine stand ► 070.01.01 Removing intake manifold ► 050.01.03 Removing fitting
409135	Installing fitting		► 000.01 Mount the engine on the engine stand ► 050.01.04 Installing fitting ► 070.01.02 Installing intake manifold

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
409135	Replacing thermostat		► 000.01 Mount the engine on the engine stand ► 070.01.01 Removing intake manifold ► 050.01.03 Removing fitting ► 050.01.05 Replacing thermostat ► 050.01.04 Installing fitting ► 070.01.02 Installing intake manifold
409135	Replacing sensor coolant temperature		► 000.01 Mount the engine on the engine stand ► 070.01.01 Removing intake manifold ► 050.01.06 Replacing sensor coolant temperature ► 070.01.02 Installing intake manifold
409135	Replacing plug thermostat housing		► 000.01 Mount the engine on the engine stand ► 070.01.01 Removing intake manifold ► 050.01.07 Replacing plug thermostat housing ► 070.01.02 Installing intake manifold
409135	Removing closing cap thermostat housing		► 000.01 Mount the engine on the engine stand ► 070.01.01 Removing intake manifold ► 050.01.08 Removing closing cap thermostat housing
409135	Installing closing cap thermostat housing		► 000.01 Mount the engine on the engine stand ► 050.01.09 Installing closing cap thermostat housing ► 070.01.02 Installing intake manifold
050.02	**Coolant pump**		
409135	Removing impeller		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.01 Removing generator cover ► 000.01.01 Mount the engine on the drive side of the engine stand ► 050.03.01 Removing oil cooler ► 010.02-1.01 Removing oil cooler bracket ► 050.02.01 Removing impeller
409135	Installing impeller		► 000.01.01 Mount the engine on the drive side of the engine stand ► 050.02.02 Installing impeller ► 010.02-1.02 Installing oil cooler bracket ► 050.03.02 Installing oil cooler ► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.02 Installing generator cover

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
409135	Removing coolant pump		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.01 Removing generator cover ► 000.01.01 Mount the engine on the drive side of the engine stand ► 050.03.01 Removing oil cooler ► 010.02-1.01 Removing oil cooler bracket ► 050.02.01 Removing impeller ► 050.02.03 Removing coolant pump
409135	Installing coolant pump		► 000.01.01 Mount the engine on the drive side of the engine stand ► 050.02.04 Installing coolant pump ► 050.02.02 Installing impeller ► 010.02-1.02 Installing oil cooler bracket ► 050.03.02 Installing oil cooler ► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.02 Installing generator cover
050.03 Oil cooler			
409135	Removing oil cooler		► 000.01.01 Mount the engine on the drive side of the engine stand ► 050.03.01 Removing oil cooler
409135	Installing oil cooler		► 000.01.01 Mount the engine on the drive side of the engine stand ► 050.03.02 Installing oil cooler
060 Exhaust system			
060.01 Mounting exhaust manifold			
409135	Removing/Installing exhaust system		You require the following documents: – Vehicle manufacturer‘s documentation – 060.01.01 Instructions for mounting nuts and exhaust gasket
409135	Replacing studs		► 000.01 Mount the engine on the engine stand ► 060.01.02 Replacing studs

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
070 Intake area			
070.01 Intake manifold			
409135	Removing intake manifold		► 000.01 Mount the engine on the engine stand ► 070.01.01 Removing intake manifold
409135	Installing intake manifold		► 000.01 Mount the engine on the engine stand ► 070.01.02 Installing intake manifold
409135	Replacing intake manifold		► 000.01 Mount the engine on the engine stand ► 070.01.01 Removing intake manifold ► 070.02.01 Removing throttle body ► 070.01.05 Removing sensor intake manifold pressure/ temperature ► Replace the intake manifold. ► 070.01.02 Installing intake manifold ► 070.02.02 Installing throttle body ► 070.01.06 Installing sensor intake manifold pressure/ temperature
409135	Removing sensor intake manifold pressure/temperature		► 000.01 Mount the engine on the engine stand ► 070.01.05 Removing sensor intake manifold pressure/ temperature
409135	Installing sensor intake manifold pressure/ temperature		► 000.01 Mount the engine on the engine stand ► 070.01.06 Installing sensor intake manifold pressure/ temperature
409135	Replacing cap		► 070.01.07 Replacing cap
070.02 Mounting throttle body			
409135	Removing throttle body		► 000.01 Mount the engine on the engine stand ► 070.02.01 Removing throttle body
409135	Installing throttle body		► 000.01 Mount the engine on the engine stand ► 070.02.02 Installing throttle body
409135	Replacing throttle body		► 000.01 Mount the engine on the engine stand ► 070.02.01 Removing throttle body ► 070.02.03 Replacing throttle body ► 070.02.02 Installing throttle body
409135	Replacing rubber mount		► 000.01 Mount the engine on the engine stand ► 070.02.01 Removing throttle body ► 070.02.04 Replacing rubber mount ► 070.02.02 Installing throttle body

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity [1]	For the activity required working instructions
080 Engine management system		
	Sensor crankshaft	See section 010.01-3 **Crankcase** in this chapter.
	Sensor camshaft	See section 030.01 **Valve cover** in this chapter.
	Sensor coolant temperature	See section 050.01 **Thermostat housing** in this chapter.
	Sensor lambda	You require the following documents: – Vehicle manufacturer‘s documentation
	Sensor intake manifold pressure/temperature NA	See section 070.01 **Saugrohr** in this chapter.
	Sensor knock	See section 010.01-3 **Crankcase** in this chapter.
	Engine control unit NA	You require the following documents: – Vehicle manufacturer‘s documentation **Information!** When replacing the engine control unit, the throttle body must be recalibrated. Before putting the engine into operation again, turn the ignition on for about a minute, until the throttle body opens and closes again.
	Ignition coils	See section 030.01 **Valve cover** in this chapter.
	Spark plugs	See section 030.02 **Cylinder head** in this chapter.
	Injectors NA	See section 100.01 **Fuel rail** in this chapter.
	Throttle body	See section 070.02 **Mounting throttle body** in this chapter.
	Switch oil pressure	See section 030.02 **Cylinder head** in this chapter.
090 Starter, Generator		
090.01 Starter		
409135	Removing starter	► 000.01 Mount the engine on the engine stand ► 090.01.01 Removing starter
409135	Installing starter	► 000.01 Mount the engine on the engine stand ► 090.01.02 Installing starter
409135	Replacing starter	► 000.01 Mount the engine on the engine stand ► 090.01.01 Removing starter ► 090.01.03 Replacing starter ► 090.01.02 Installing starter

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
090.02 Generator			
409135	Removing generator		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.01 Removing generator cover ► 090.02.01 Removing generator
409135	Installing generator		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 090.02.02 Installing generator ► 010.03.02 Installing generator cover
090.03 Voltage regulator			
409135	Removing/Installing voltage regulator		You require the following documents: – Vehicle manufacturer‘s documentation
090.04 Relay starter			
409135	Removing/Installing relay starter		You require the following documents: – Vehicle manufacturer‘s documentation
100 Fuel system			
100.01 Fuel rail			
409135	Removing fuel rail		► 000.01 Mount the engine on the engine stand ► 100.01.01 Removing fuel rail
409135	Installing fuel rail		► 000.01 Mount the engine on the engine stand ► 100.01.02 Installing fuel rail
409135	Replacing injector		► 000.01 Mount the engine on the engine stand ► 100.01.01 Removing fuel rail ► 100.01.03 Replacing injector ► 100.01.02 Installing fuel rail
110 Lubrication system			
110.01 Dry sump			
409135	Removing suction pump cover		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.01 Removing generator cover ► 110.01.01 Removing suction pump cover
409135	Installing suction pump cover		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 110.01.02 Installing suction pump cover ► 010.03.02 Installing generator cover

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
409135	Replacing suction pump cover		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.01 Removing generator cover ► 110.01.01 Removing suction pump cover ► 110.01.04 Removing oil suction pump ► 110.01.03 Replacing suction pump cover ► 110.01.05 Installing oil suction pump ► 110.01.02 Installing suction pump cover ► 010.03.02 Installing generator cover
409135	Removing oil suction pump		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.01 Removing generator cover ► 110.01.01 Removing suction pump cover ► 110.01.04 Removing oil suction pump
409135	Installing oil suction pump		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 110.01.05 Installing oil suction pump ► 110.01.02 Installing suction pump cover ► 010.03.02 Installing generator cover
409135	Stutzen ersetzen		► 000.01 Mount the engine on the engine stand ► 110.01.06 Stutzen ersetzen
409135	Removing intermediate gear suction pump		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.01 Removing generator cover ► 110.01.01 Removing suction pump cover ► 000.01.01 Mount the engine on the drive side of the engine stand ► 110.01.07 Removing intermediate gear suction pump
409135	Installing intermediate gear suction pump		► 000.01.01 Mount the engine on the drive side of the engine stand ► 110.01.08 Installing intermediate gear suction pump ► 110.01.02 Installing suction pump cover ► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.02 Installing generator cover

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
110.02	**Oil pressure pump**		
409135	Removing oil pressure pump		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.01 Removing generator cover ► 090.02.01 Removing generator ► 110.02.01 Removing oil pressure pump
409135	Installing oil pressure pump		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 110.02.02 Installing oil pressure pump ► 090.02.02 Installing generator ► 010.03.02 Installing generator cover
110.03	**Oil pressure valve**		
409135	Removing oil pressure valve		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 010.03.01 Removing generator cover ► 110.01.01 Removing suction pump cover ► 110.03.01 Removing oil pressure valve
409135	Installing oil pressure valve		► 000.01.02 Mount the engine across from the drive side of the engine stand ► 110.03.02 Installing oil pressure valve ► 110.01.02 Installing suction pump cover ► 010.03.02 Installing generator cover
110.04	**Oil filter**		
409135	Removing oil filter		► 000.01.01 Mount the engine on the drive side of the engine stand ► 110.04.01 Removing oil filter
409135	Installing oil filter		► 000.01.01 Mount the engine on the drive side of the engine stand ► 110.04.02 Installing oil filter
409135	Removing threaded sleeve		► 000.01.01 Mount the engine on the drive side of the engine stand ► 070.01.01 Removing intake manifold ► 110.04.01 Removing oil filter ► 110.04.03 Removing threaded sleeve

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

Valid for	Activity	[1]	For the activity required working instructions
409135	Installing threaded sleeve		► 000.01.01 Mount the engine on the drive side of the engine stand ► 110.04.04 Installing threaded sleeve ► 110.04.02 Installing oil filter ► 070.01.02 Installing intake manifold
110.05 Oil tank			
409135	Removing/Installing oil tank		You require the following documents: – Vehicle manufacturer‘s documentation
120 Engine mount			
120.01 Lifting eye			
409135	Removing bracket on the drive side		► 000.01 Mount the engine on the engine stand ► 120.01.01 Removing bracket on the drive side
409135	Installing bracket on the drive side		► 000.01 Mount the engine on the engine stand ► 120.01.02 Installing bracket on the drive side
409135	Removing pipe clamp		► 000.01 Mount the engine on the engine stand ► 120.01.03 Removing pipe clamp
409135	Installing pipe clamp		► 000.01 Mount the engine on the engine stand ► 120.01.04 Installing pipe clamp
409135	Removing bracket across from the drive side		► 000.01 Mount the engine on the engine stand ► 120.01.05 Removing bracket across from the drive side
409135	Installing bracket across from the drive side		► 000.01 Mount the engine on the engine stand ► 120.01.06 Installing bracket across from the drive side

1 Activities which are marked with „s“, are not fully described in this overview of activities. Observe the references in the working instructions.

6 Working instructions, single

Observe that the single working instructions do not constitute a complete description of the activity. Always perform the activities, as described in chapter 5 **Overview of activities**.

6.1 List of working instructions, single

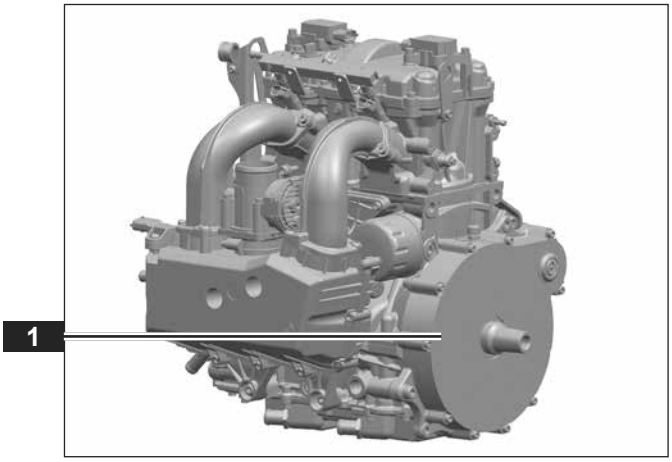
000.01 Mount the engine on the engine stand

WARNING! Crush injuries due to the engine overturning. Mount the engine to the engine stand before starting any work.

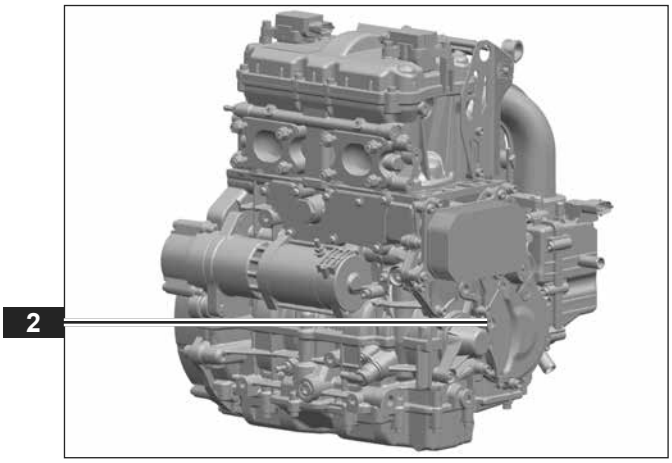
If not otherwise specified in the chapter, mount the engine on the drive side or across from the drive side.

► Mount the engine on the drive side 1 of the engine stand. (See chapter 000.01.01 Mount the engine on the drive side of the engine stand.)

or



► Mount the engine across from the drive side 2 of the engine stand. (See chapter 000.01.02 Mount the engine across from the drive side of the engine stand.)

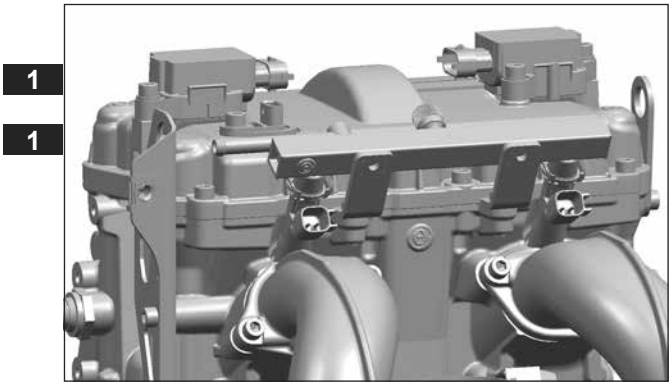


000.01.01 Mount the engine on the drive side of the engine stand

WARNING! Spinal column injury due to incorrect lifting of heavy loads. Always lift the engine using a workshop crane.

NOTICE! Breakage. Lift the engine only using the brackets.

► Lift the engine using the brackets 1.

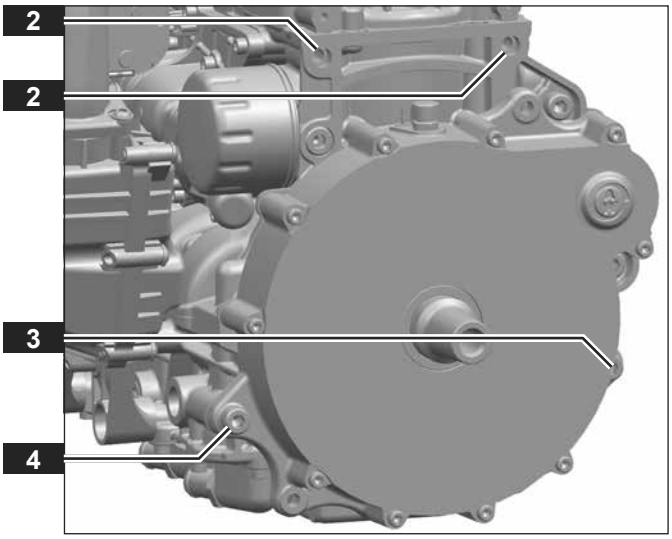


► Mount the engine on the engine stand.

Suitable mounting points M10:

– Depth of thread 2 30 mm
– Depth of thread 3 44 mm
– Depth of thread 4 46 mm

or

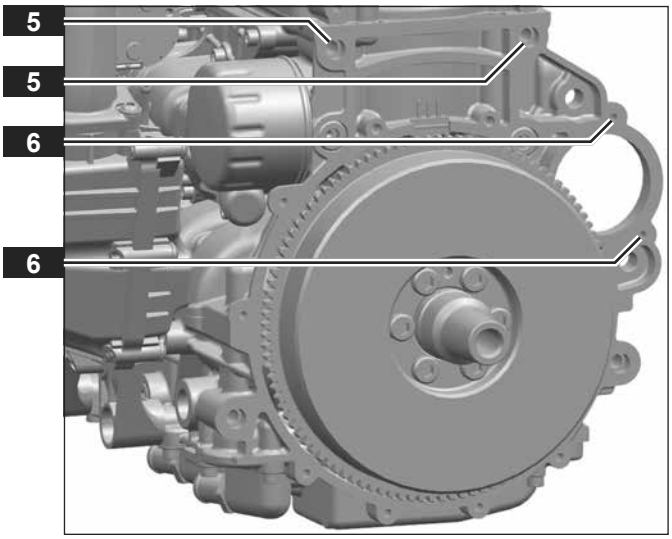


► Mount the engine on the engine stand.

Suitable mounting points M10:

– Depth of thread 5 30 mm

Suitable mounting points M6 6

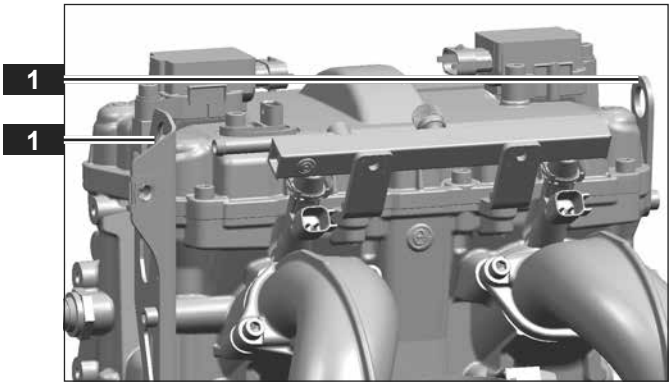


000.01.02 Mount the engine across from the drive side of the engine stand

WARNING! Spinal column injury due to incorrect lifting of heavy loads. Always lift the engine using a workshop crane.

NOTICE! Breakage. Lift the engine only using the brackets.

► Lift the engine using the brackets **1**.



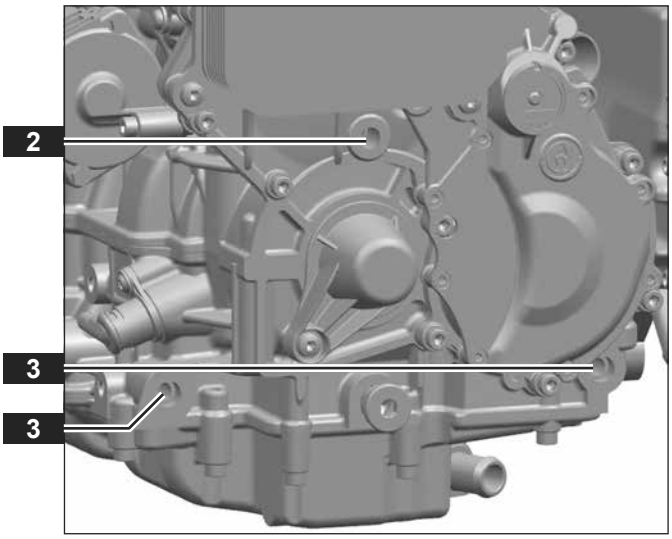
► Mount the engine on the engine stand.

Suitable mounting points M10:

– Depth of thread **2** 40 mm

– Depth of thread **3** 30 mm

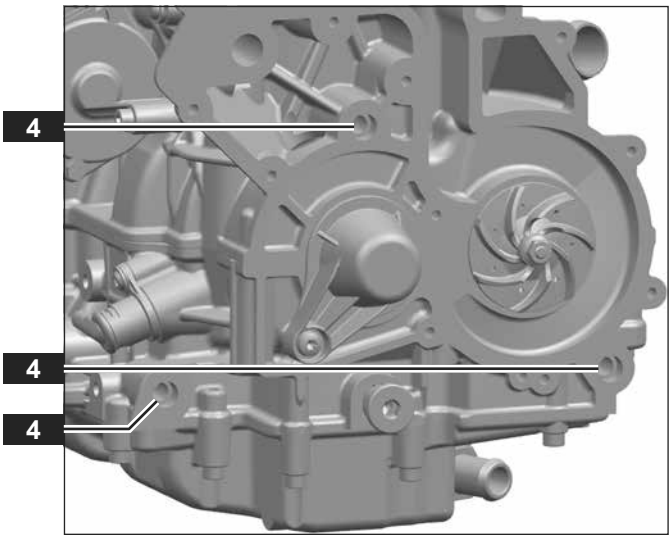
or



► Mount the engine on the engine stand.

Suitable mounting points M10:

– Depth of thread **4** 30 mm



010.01-1.01 Replacing crankcase

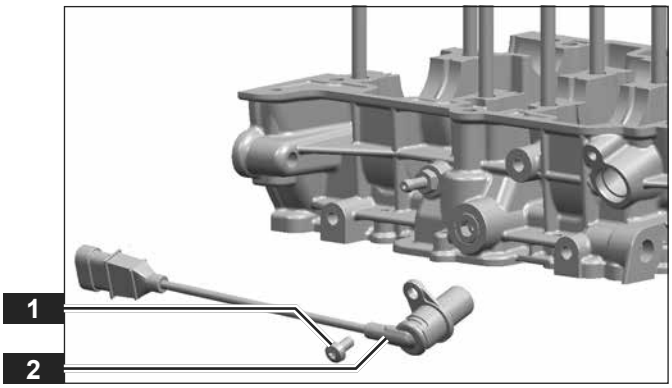
- Pin punch axle intermediate gear
- Universal strap wrench
- Crown wrench
- Cylinder liner puller

- Thread sealant
- Silicone liquid seal

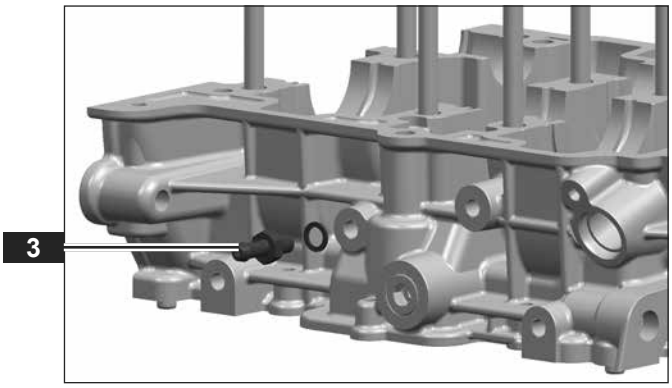
- 7 plugs M18x1.5
- 1 plug M10x1
- 1 Oil filter
- 1 Seal 8x12x1 Al
- 1 O-ring sensor crankshaft
- 1 Seal 18x22x1.5 Al
- 4 O-rings cylinder liner

► Unscrew the bolt 1.

► Pull the sensor crankshaft 2 out.

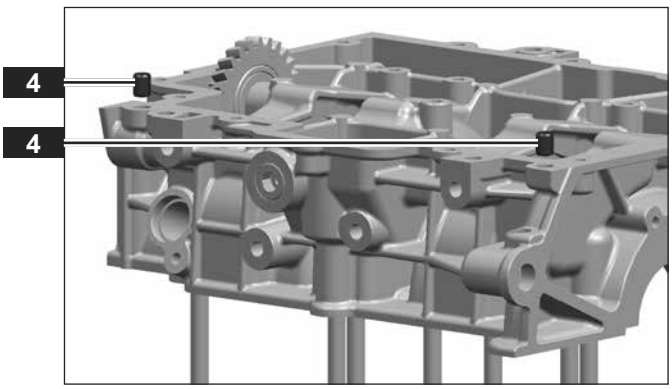


► Unscrew the fitting 3.

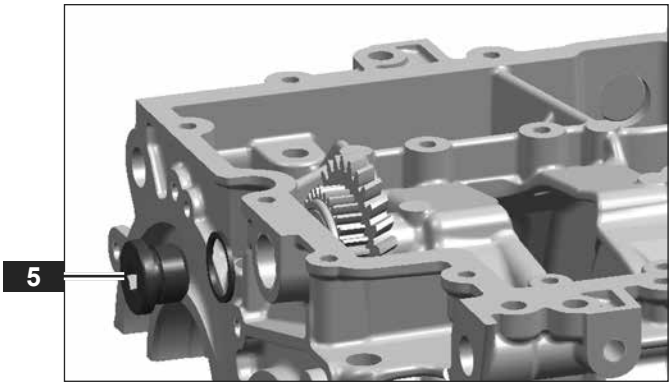


► Turn the lower case 180°.

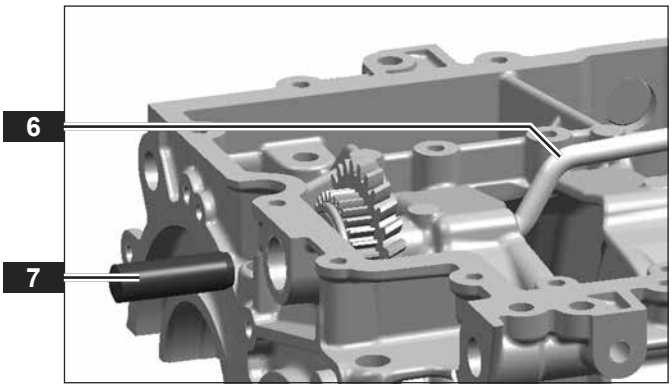
► Remove the sleeves 4.



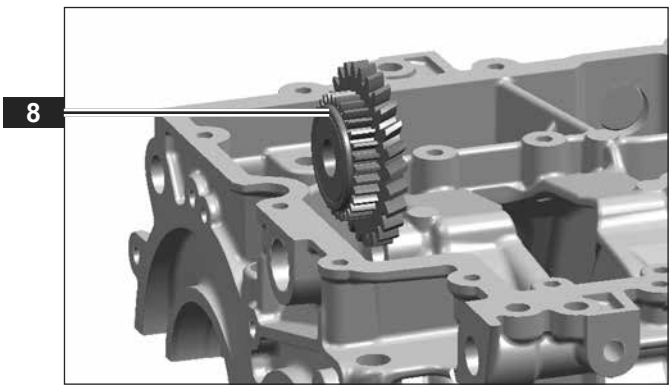
► Unscrew the plug 5.



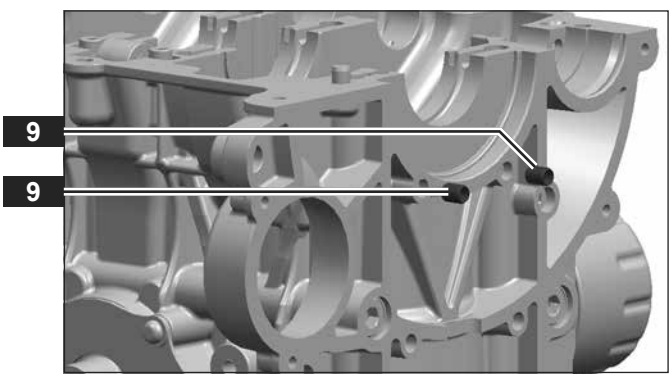
► Punch the axle 7 out using the pin punch axle intermediate gear 6 and plastic hammer.



► Remove the intermediate gear suction pump 8.

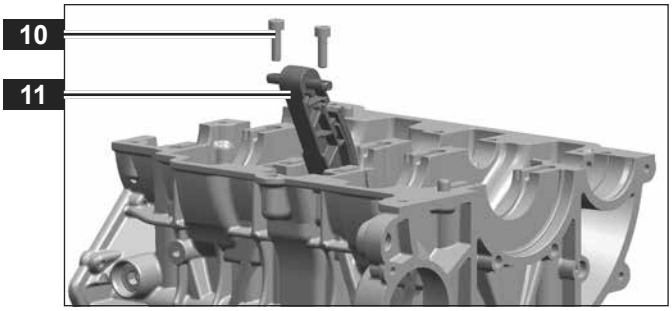


► Remove the sleeves 9.



► Unscrew the bolts **10**.

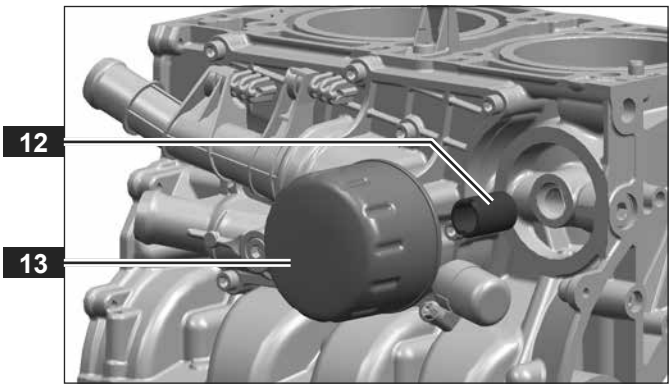
► Remove the chain rail **11**.



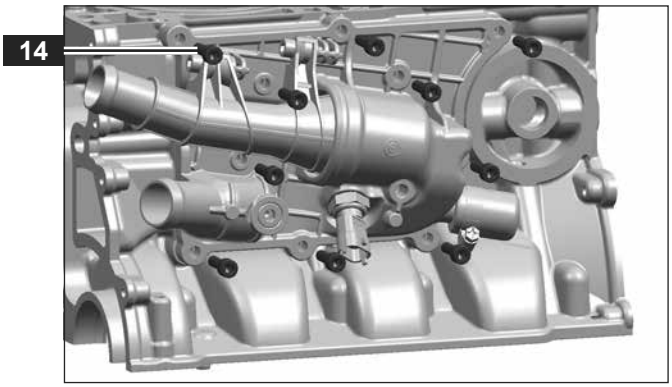
► Turn the upper case 180°.

► Unscrew the oil filter **13** using a universal strap wrench.

► Unscrew the threaded sleeve **12** using a crown wrench.

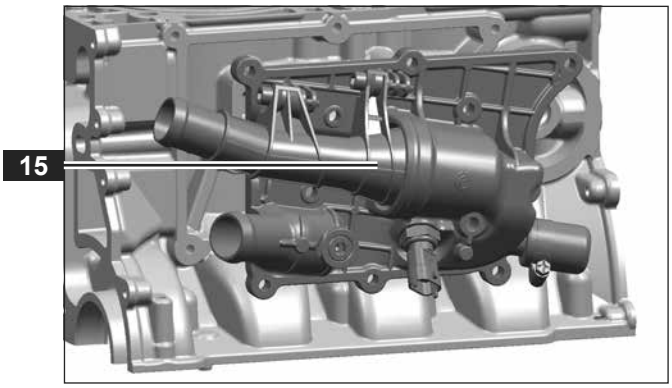


► Unscrew 10 bolts **14**.

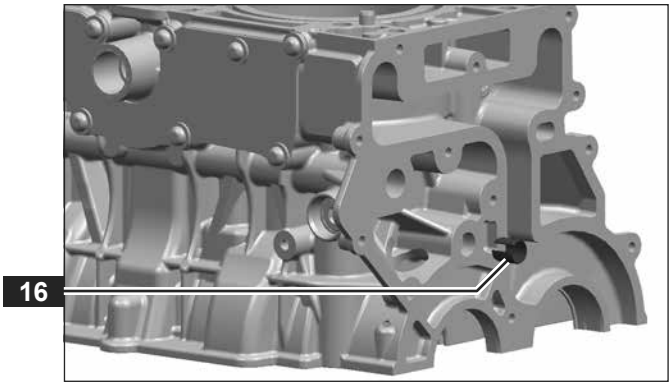


The thermostat housing is caulked with a silicone liquid seal.

► Remove the thermostat housing **15**.

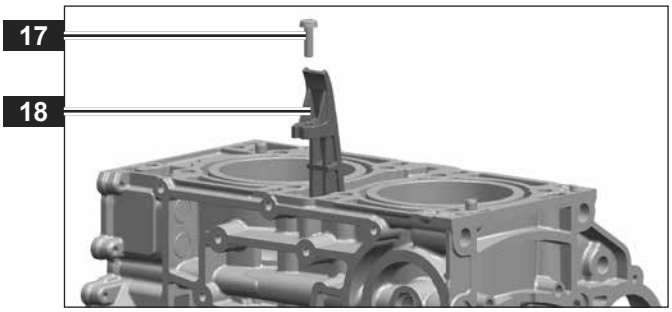


► Remove the sleeve 16.

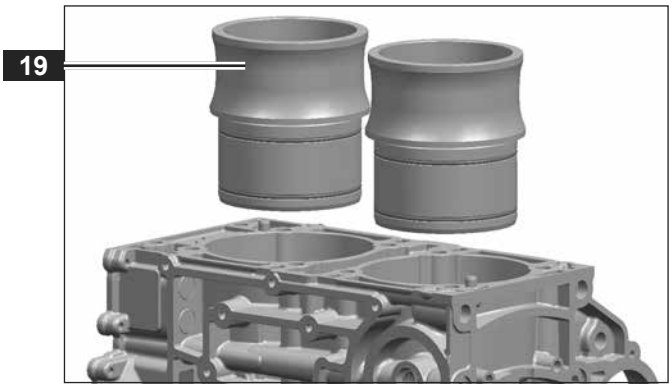


► Unscrew the bolt 17.

► Remove the chain rail 18.



► Remove the cylinder liners 19 using a cylinder liner puller.

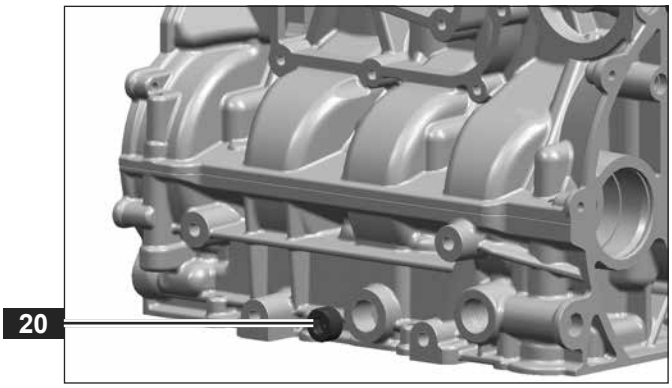


Prepare the new crankcase

► Replace the crankcase.

► Screw in a new plug 20.

Tightening torque:
20 Nm +4 Nm [14.8 lbf ft +3 lbf ft]



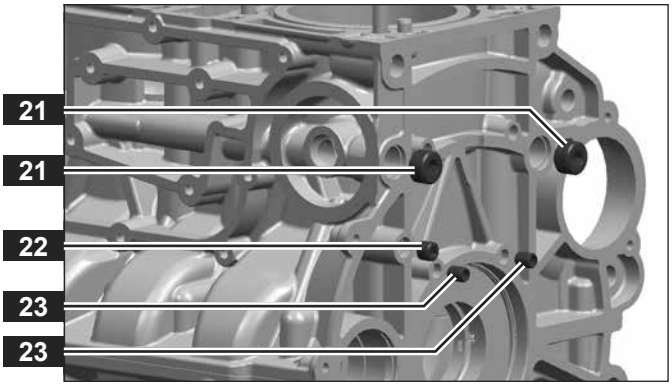
► Screw in new plugs 21.

Tightening torque:
20 Nm +4 Nm [14.8 lbf ft +3 lbf ft]

► Screw in a new plug 22.

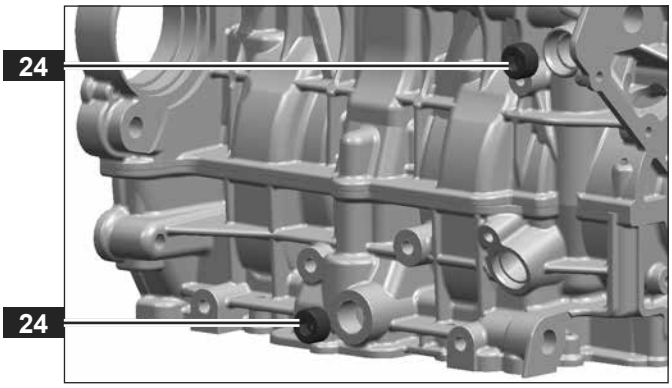
Tightening torque:
9 Nm +2 Nm [6.6 lbf ft +1.5 lbf ft]

► Insert the sleeves 23.



► Screw in new plugs 24.

Tightening torque:
20 Nm +4 Nm [14.8 lbf ft +3 lbf ft]



Two threaded holes M18 25 remain open.

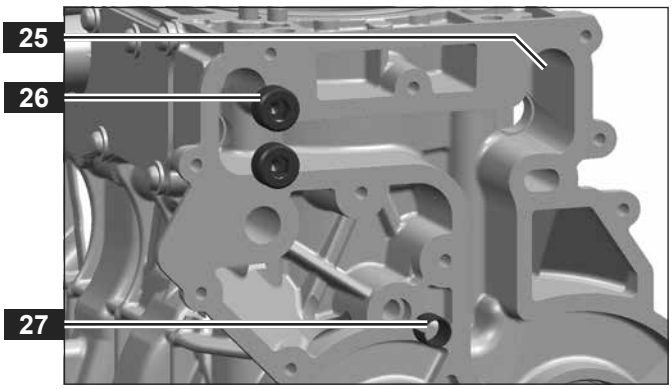
Use new plugs 26.

► Coat the threads on the plugs with thread sealant.

► Screw in plugs.

Tightening torque:
20 Nm +4 Nm [14.8 lbf ft +3 lbf ft]

► Insert the sleeve 27.



WARNING! Crush injuries due to a dropped crankcase.

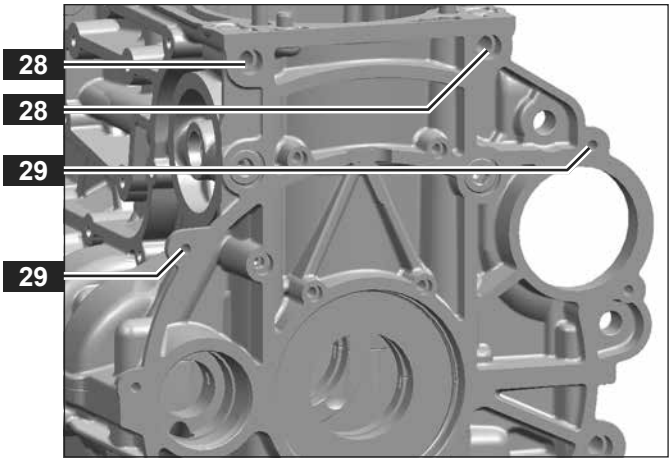
► Lift the crankcase using a carrying strap.

► Mount the crankcase on the engine stand.

Suitable mounting points M10 28:

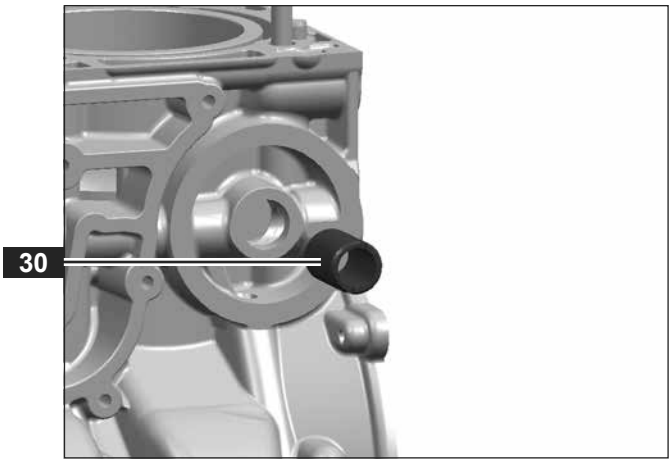
– Depth of thread 30 mm

Suitable mounting points M6 29.



► Screw in the threaded sleeve 30 using a crown wrench.

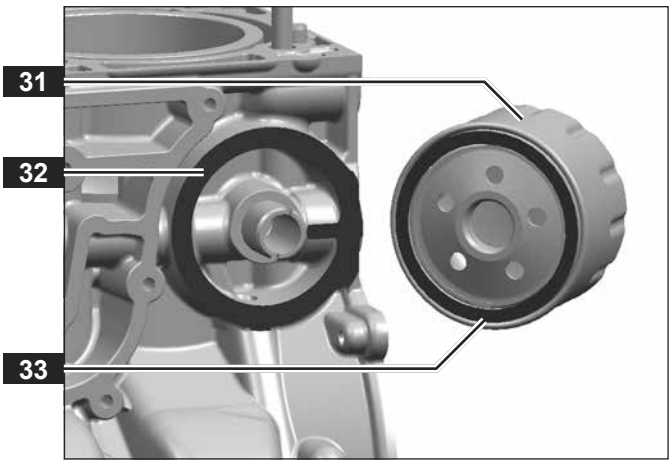
Tightening torque:
17 Nm +3 Nm [12.5 lbf ft +2.2 lbf ft]



► Clean the sealing surface 32 with sealing surface cleaner.

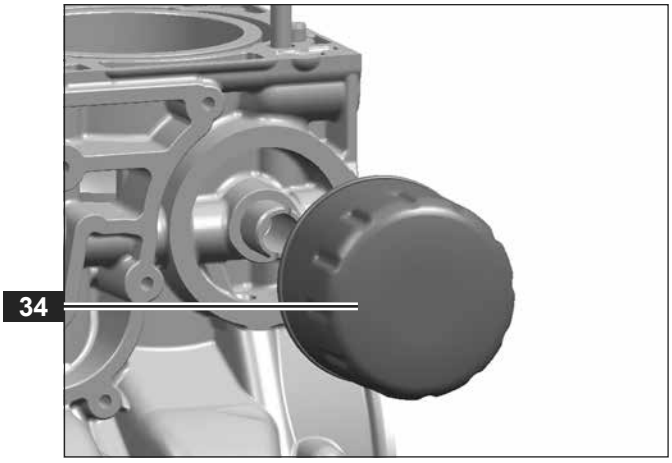
► Use a new oil filter 31.

► Coat the oil filter seal 33 lightly with engine oil.

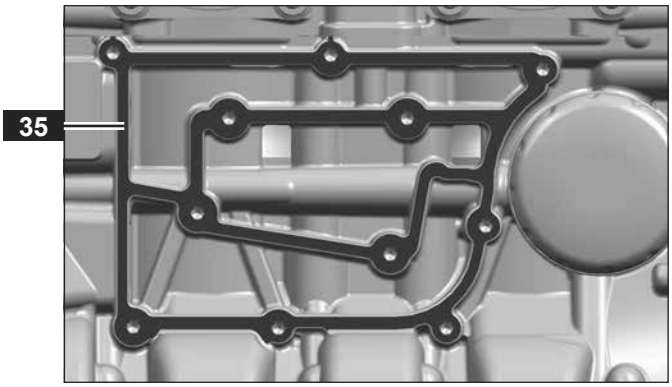


► Screw in the oil filter 34 by hand.

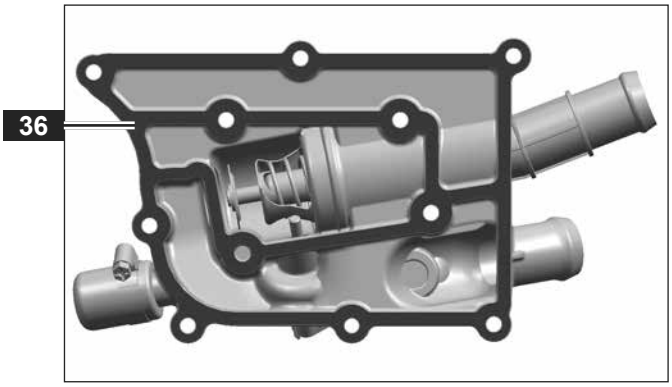
Tightening torque:
10 Nm [7.4 lbf ft]



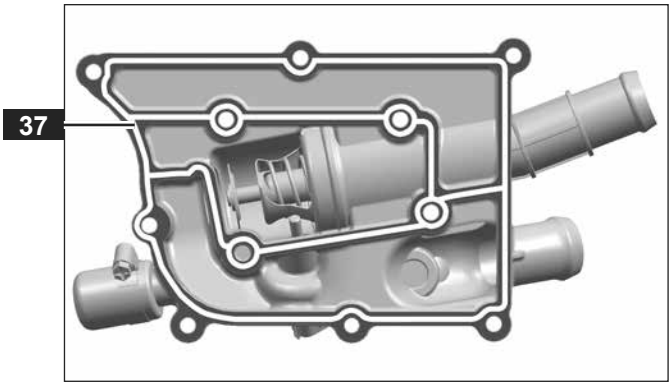
► Clean the sealing surface 35 with sealing surface cleaner.



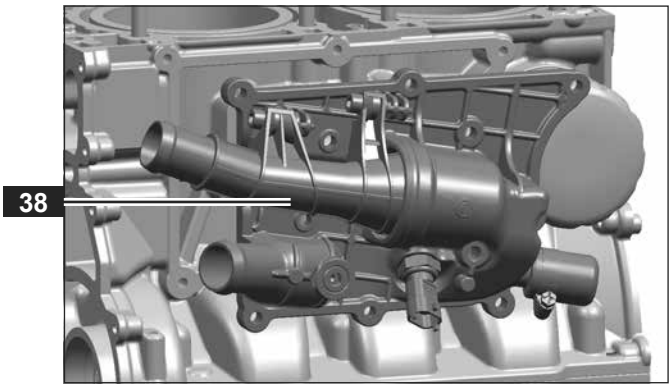
► Clean the sealing surface 36 with sealing surface cleaner.



► Apply the silicone liquid seal 37 without gaps as illustrated.

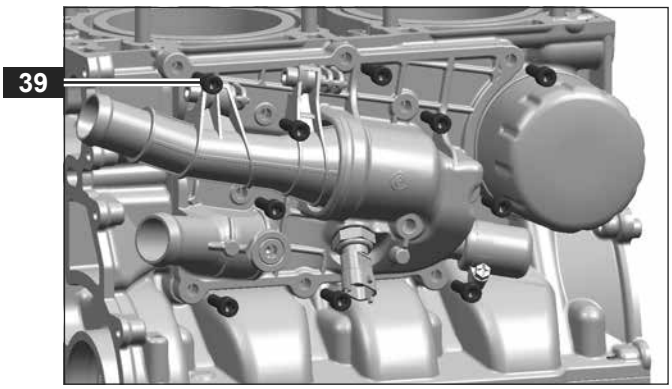


► Hold the thermostat housing 38 in position.



► Screw in 10 bolts 39.

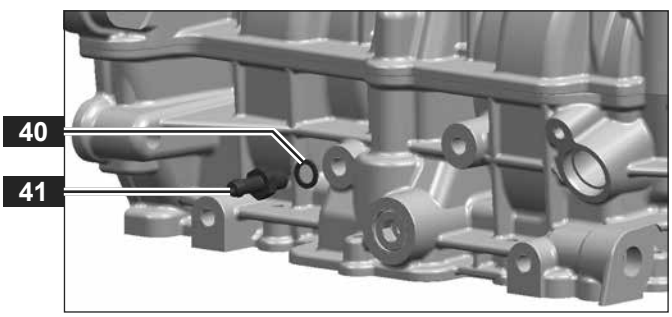
Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



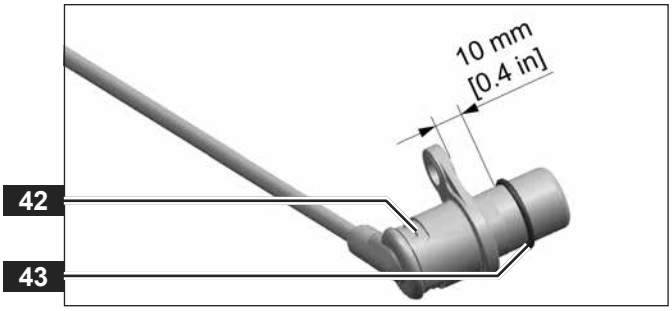
► Replace the seal 40.

► Screw in the fitting 41.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]

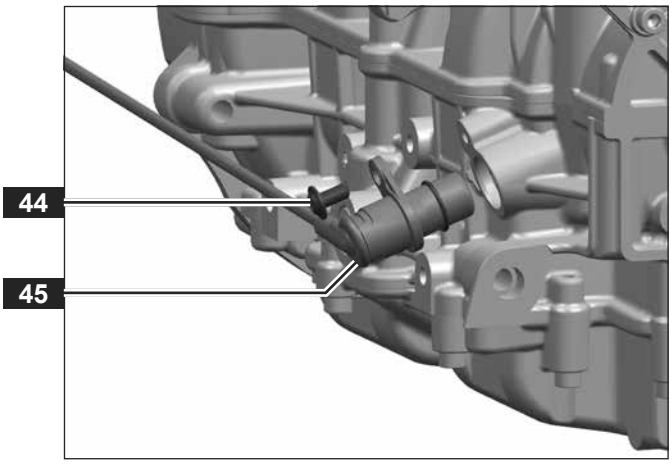


- ► Replace the o-ring 42 on the sensor crankshaft 43.
- ► Coat the o-ring lightly with petroleum jelly.
- ► Slide on the o-ring as illustrated.

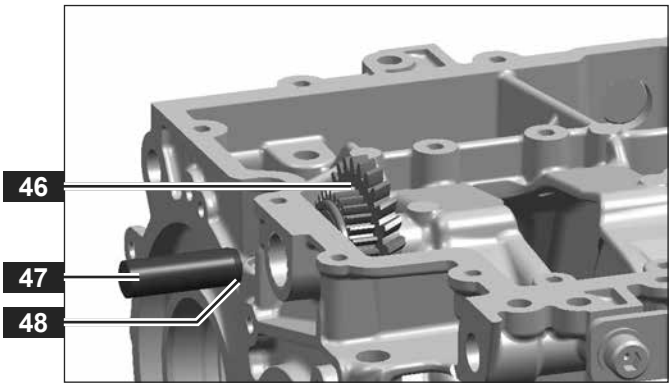


- ► Insert the sensor crankshaft 45.
- ► Screw in the bolt 44.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]

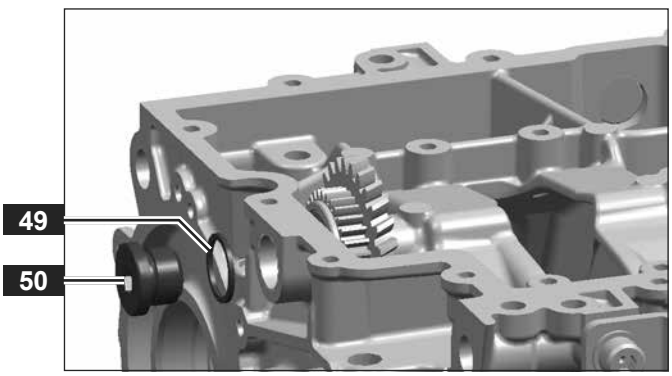


- ► Turn the crankcase 180°.
- ► Hold the intermediate gear suction pump 46 in position.
- ► Slide in the axle 47. Observe the position of the bevel 48.

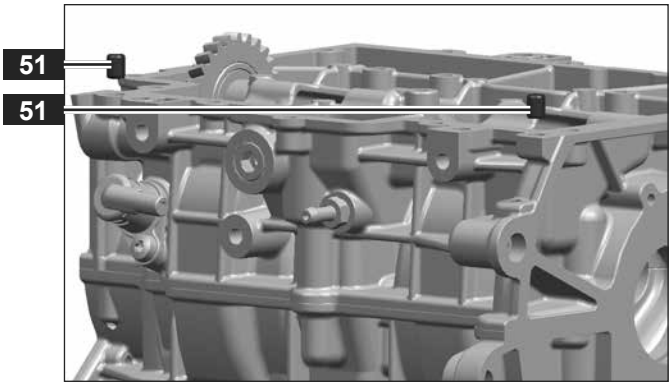


- ► Replace the seal 49.
- ► Screw in the plug 50.

Tightening torque:
20 Nm +4 Nm [14.8 lbf ft +3 lbf ft]

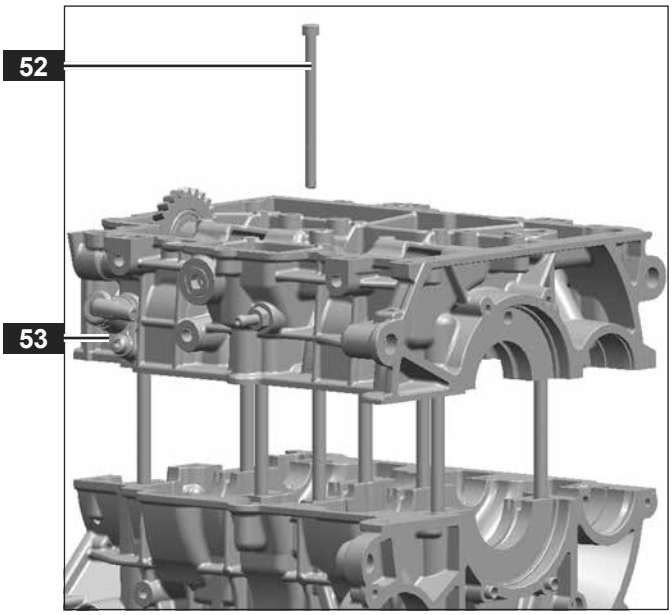


► Insert the sleeves 51.

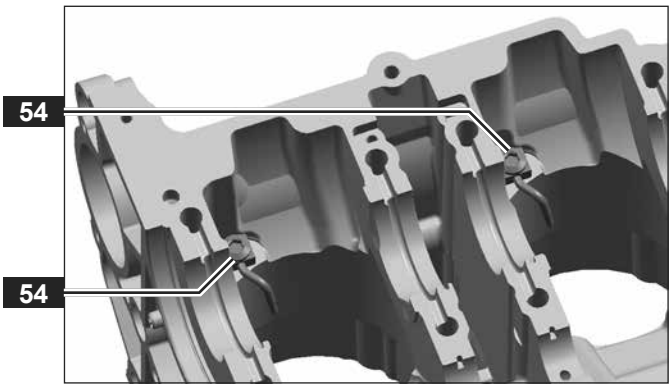


► Unscrew the bolt 52.

► Remove the lower case 53.

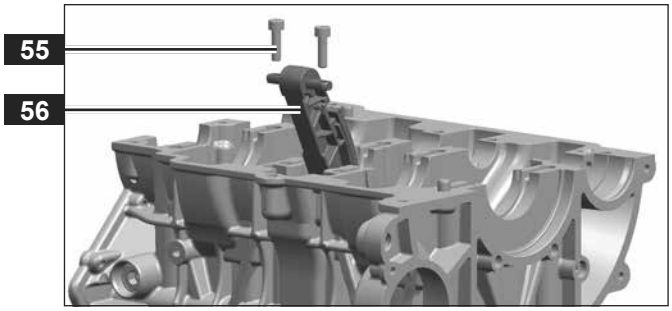


► Check if the welch plugs 54 are installed.



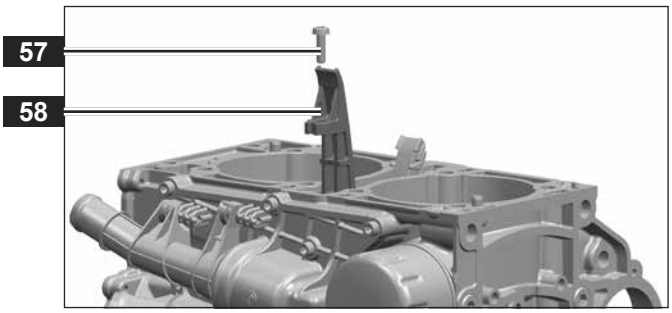
- ► Insert the chain guide 56.
- ► Screw in the bolts 55.

  Tightening torque:
  8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]

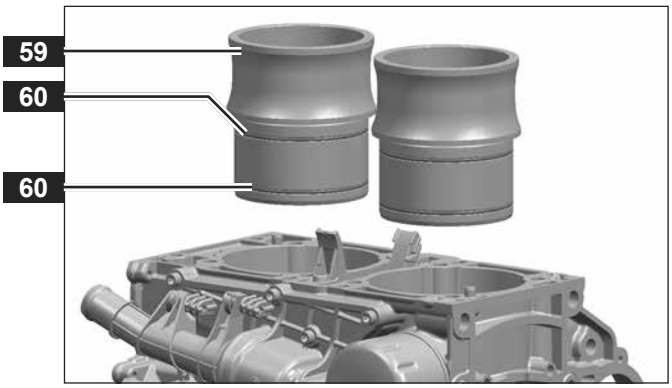


- ► Turn the upper case 180°.
- ► Insert the chain rail 58.
- ► Screw in the bolt 57.

  Tightening torque:
  8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



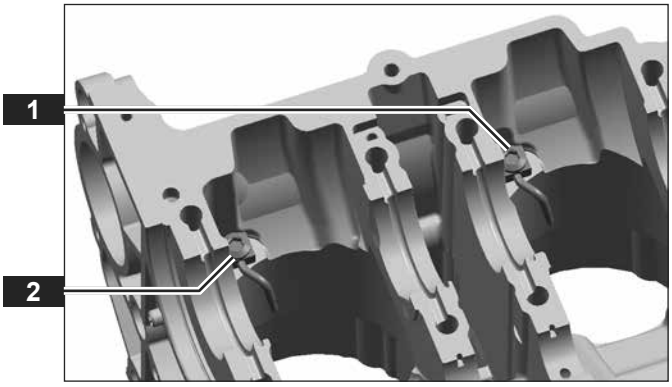
- ► Replace the o-rings 60.
- ► Coat the o-rings lightly with petroleum jelly.
- ► Insert the cylinder liners 59.



010.01-1.02 Replacing welch plugs

The upper case is disconnected from the crankcase.

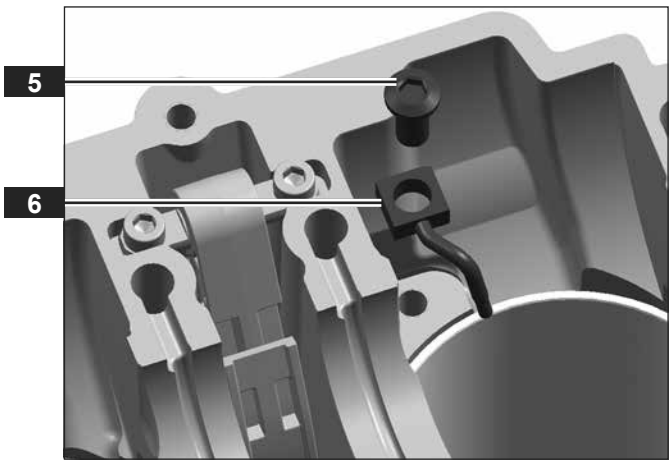
– Welch plug 1 **1**
– Welch plug 2 **2**



► Unscrew the banjo bolt **3**.
► Remove the welch plug **4**.

► Replace the welch plug **6**.
► Hold the welch plug in position.
► Screw in the banjo bolt **5**.

Tightening torque:
20 Nm +2 Nm [14.8 lbf ft +1.5 lbf ft]



010.01-1.03 Replacing tie rod

– Stud extractor

– Anti-Seize assembly paste

The lower case is disconnected from the crankcase.

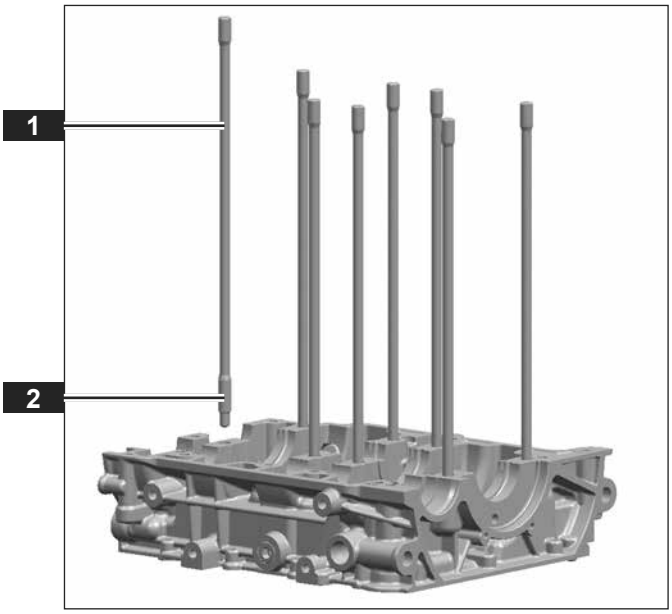
► Unscrew the tie rod 1 using a stud extractor.

► Replace tie rod.

► Apply Anti-Seize assembly paste to all threads 2.

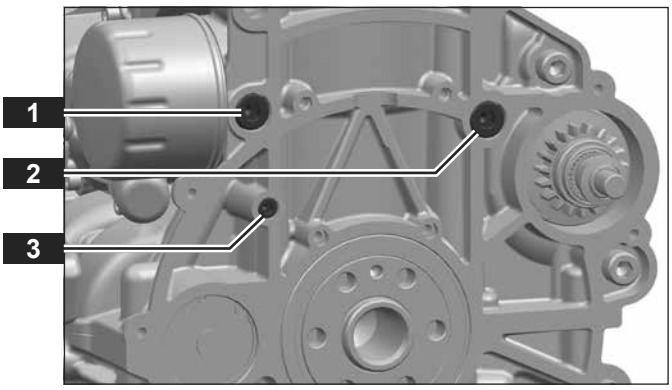
► Screw in the tie rod using a stud extractor.

Tightening torque:
18 Nm +2 Nm [13.3 lbf ft +1.5 lbf ft]



010.01-1.04 Replacing plugs

- Plug 1 1
- Plug 2 2
- Plug 3 3



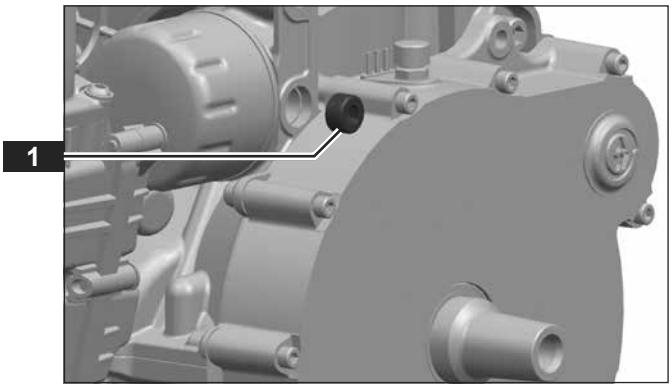
Replacing plug 1

► Unscrew the plug 1.

► Replace the plug.

► Screw in the plug.

Tightening torque:
20 Nm +4 Nm [14.8 lbf ft +3 lbf ft]



Replacing plug 2

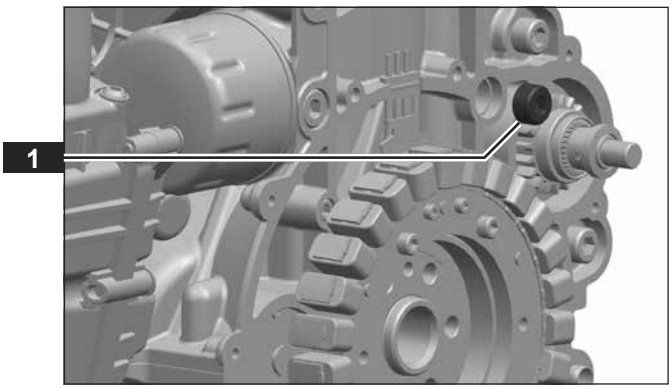
The generator cover and rotor are removed.

► Unscrew the plug 1.

► Replace the plug.

► Screw in the plug.

Tightening torque:
20 Nm +4 Nm [14.8 lbf ft +3 lbf ft]



Replacing plug 3

The generator cover and generator are removed.

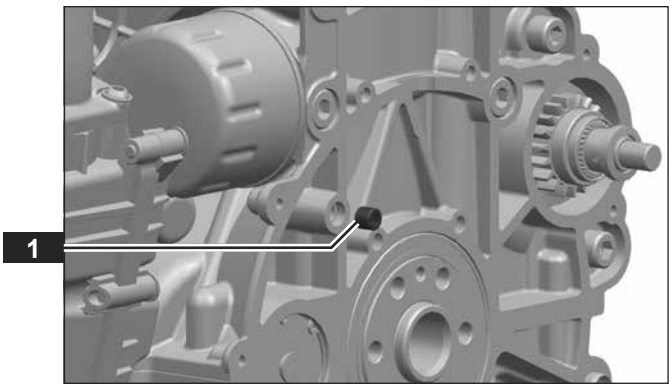
► Unscrew the plug 1.

► Replace the plug.

► Screw in the plug.

Tightening torque:

9 Nm +2 Nm [6.6 lbf ft +1.5 lbf ft]



010.01-2.01 Replacing cylinder liners

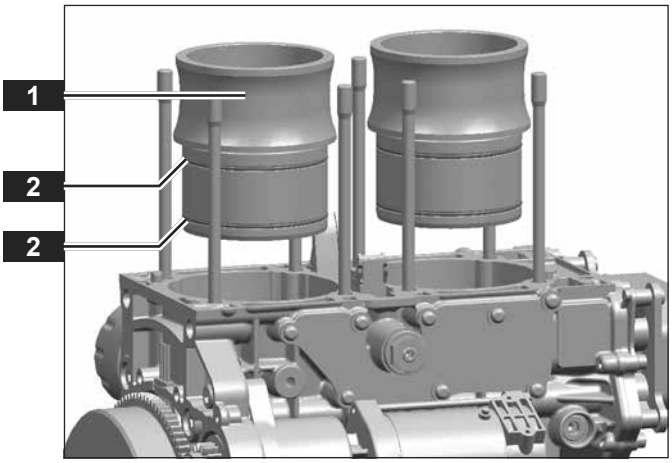
– Cylinder liner puller

► Remove the cylinder liners 1 using a cylinder liner puller.

► Replace the cylinder liners.

► Coat the o-rings 1 lightly with petroleum jelly.

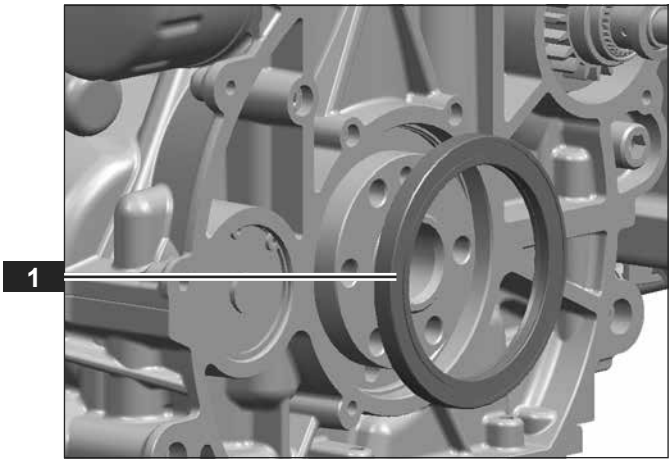
► Insert the cylinder liners.



010.01-2.02 Replacing oil seal

– Oil seal slide hammer
– Assembling kit oil seal crankshaft

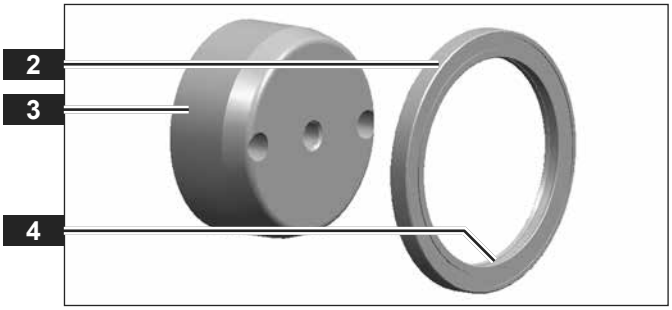
► Pull the oil seal 1 out using the oil seal slide hammer.



► Replace the oil seal 2.

► Coat the inside of the oil seal 4 lightly with petroleum jelly.

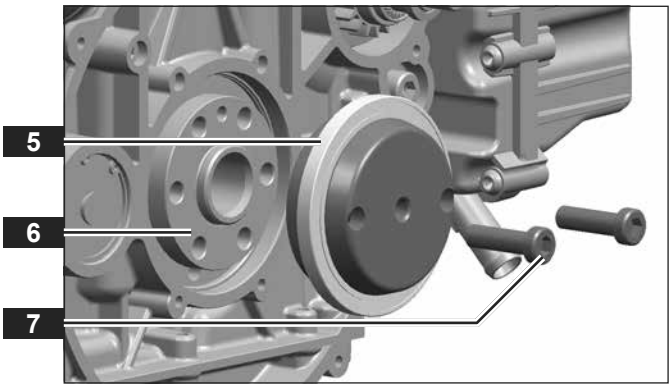
► Slide the oil seal onto guide sleeve 3.



► Slide the guiding sleeve 5 onto crankshaft 6.

Use the M10x1x35 bolts you removed on the rotor.

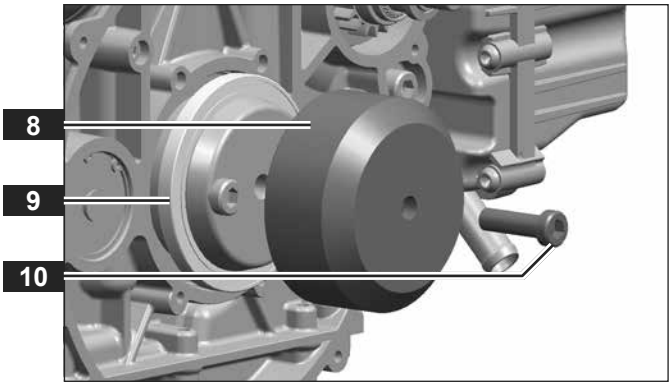
► Screw in the bolts 7.



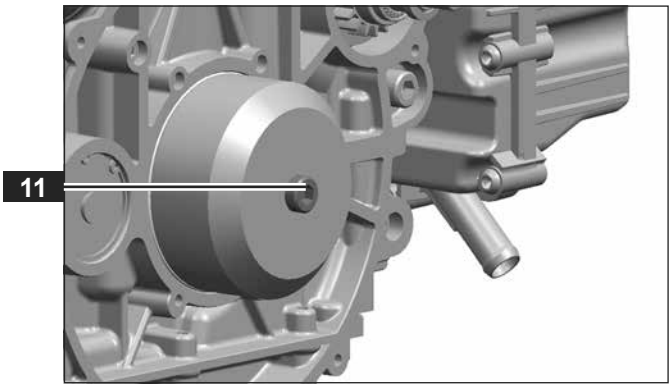
► Hold the sliding sleeve 8 in position on the oil seal 9.

Use the M10x1x35 bolts you removed on the rotor.

► Screw in the bolt 10.

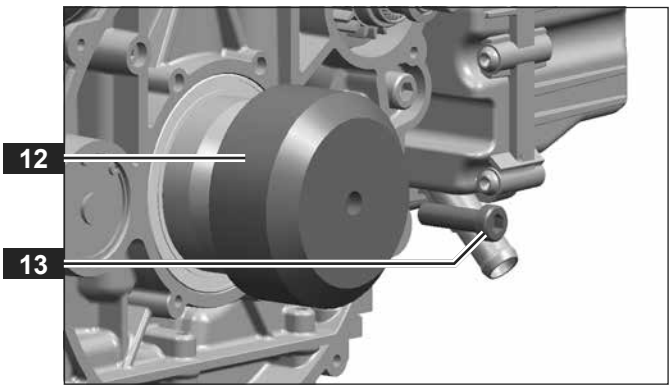


► Screw in the bolt 11 until the oil seal is flush with the crankcase.



► Unscrew the bolt 13.

► Remove the sliding sleeve 12.

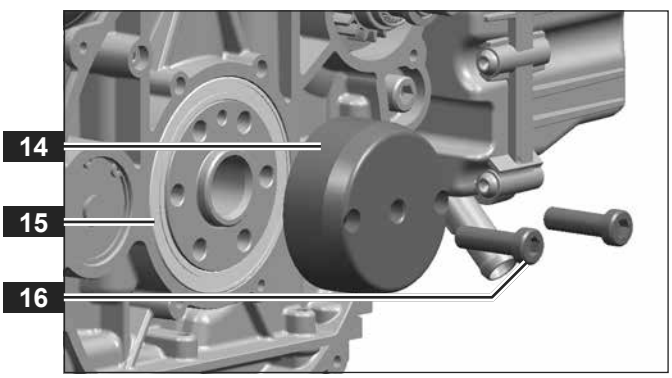


► Unscrew the bolts 16.

► Remove the guiding sleeve 14.

► Check if the oil seal 15 is tilted.

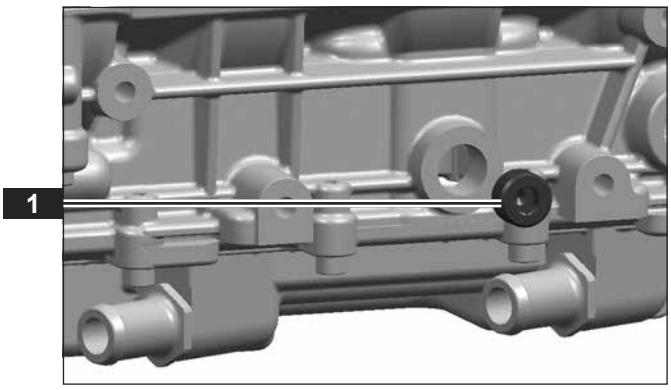
► If the oil seal is tilted, it must be replaced.



010.01-2.03 Replacing plug

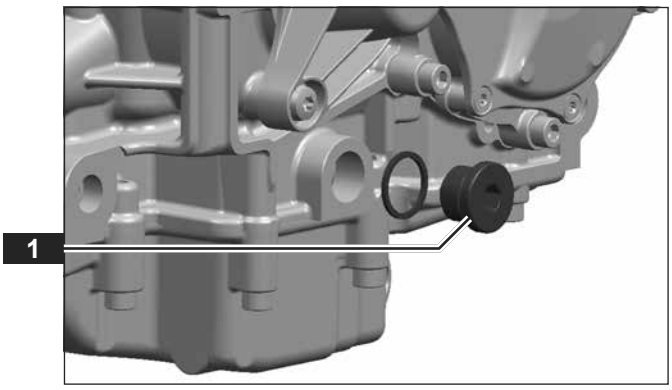
- ► Unscrew the plug 1.
- ► Replace the plug.
- ► Screw in the plug.

  Tightening torque:
  20 Nm +4 Nm [14.8 lbf ft +3 lbf ft]



010.01-3.01 Removing plug

► Unscrew the plug 1.



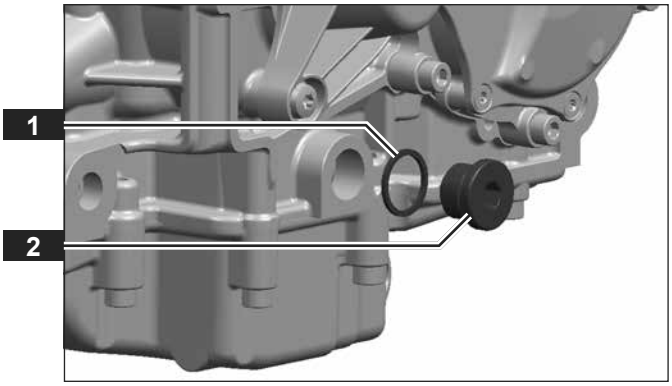
010.01-3.02 Installing plug

– 1 Seal 18x22x1.5 Al

► Replace the seal 1.

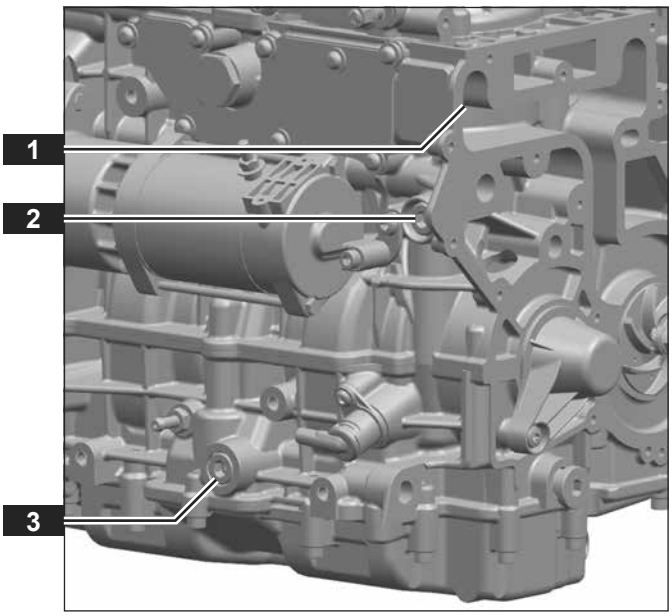
► Screw in the plug 2.

Tightening torque:
20 Nm +4 Nm [14.8 lbf ft +3 lbf ft]



010.01-3.03 Replacing plugs

– Plugs 1 **1**
– Plug 2 **2**
– Plug 3 **3**



Replacing plugs 1

The oil cooler bracket is removed.

Two threaded holes M18 **1** remain open.

► Unscrew the plugs **2**.

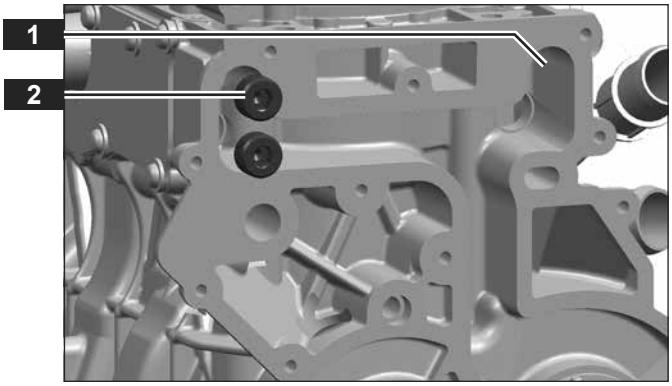
► Replace the plugs.

► Coat the threads on the plugs with thread sealant.

► Screw in the plugs.

Tightening torque:

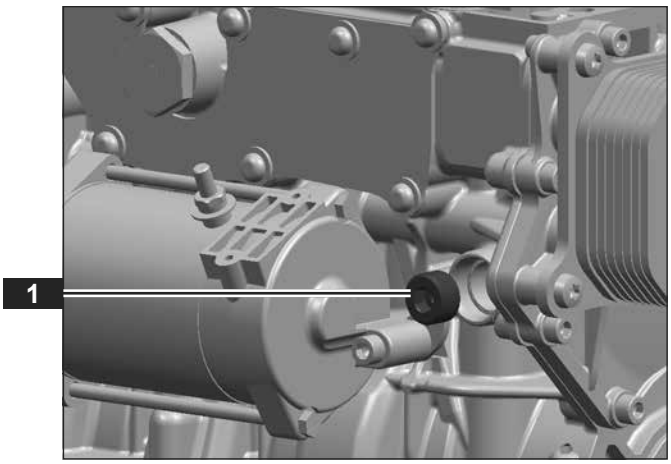
20 Nm +4 Nm [14.8 lbf ft +3 lbf ft]



Replacing plug 2

- ► Unscrew the plug 1.
- ► Replace the plug.
- ► Screw in the plug.

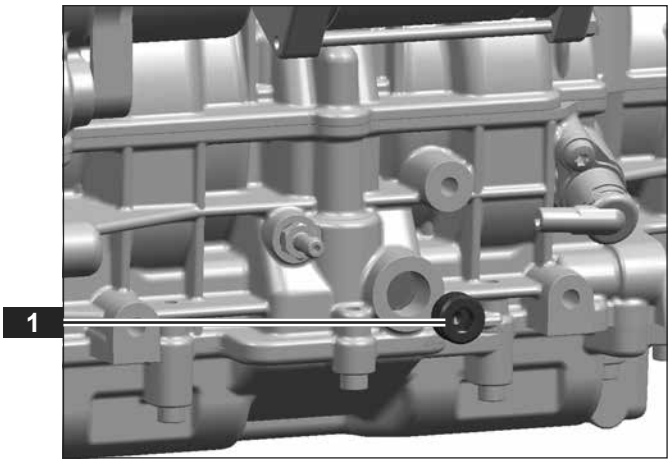
Tightening torque:
20 Nm +4 Nm [14.8 lbf ft +3 lbf ft]



Replacing plug 3

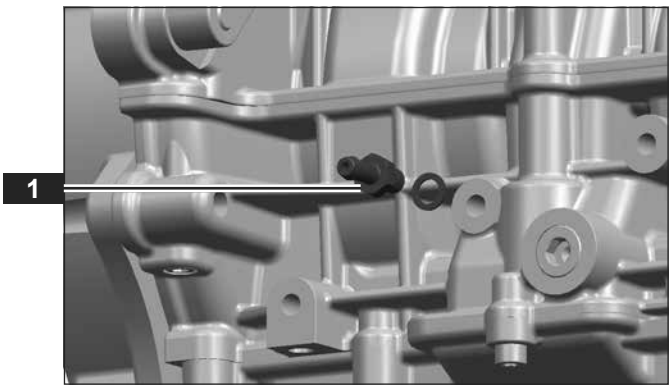
- ► Unscrew the plug 1.
- ► Replace the plug.
- ► Screw in the plug.

Tightening torque:
20 Nm +4 Nm [14.8 lbf ft +3 lbf ft]



010.01-3.04 Removing fitting

► Unscrew the fitting 1.



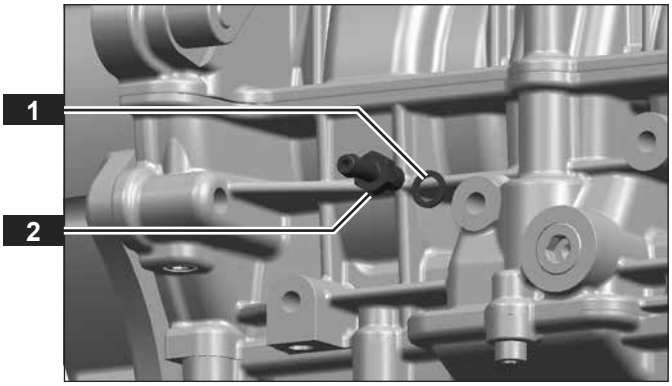
010.01-3.05 Installing fitting

– 1 Seal 8x12x1 Al

► Replace the seal 1.

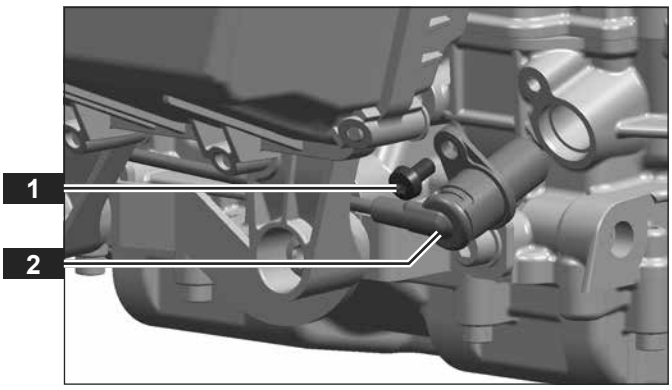
► Screw in the fitting 2.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



010.01-3.06 Removing sensor crankshaft

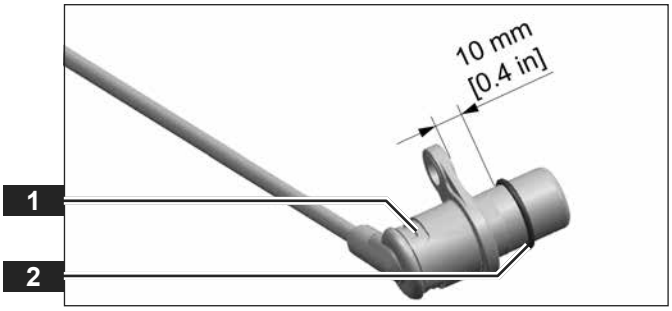
- ► Unscrew the bolt 1.
- ► Pull the sensor crankshaft 2 out.



010.01-3.07 Installing sensor crankshaft

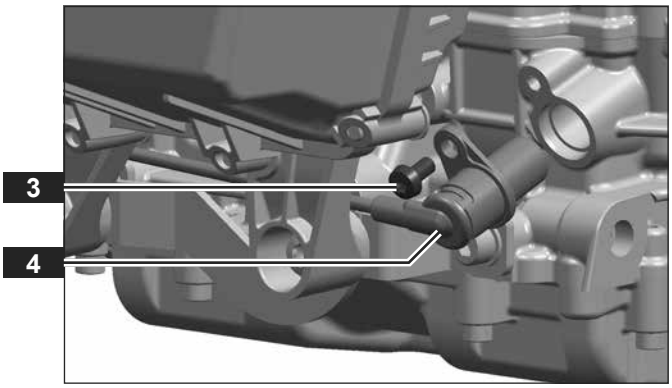
– 1 O-ring sensor crankshaft

- ► Replace the o-ring 2 on the sensor crankshaft 1.
- ► Coat the o-ring lightly with petroleum jelly.
- ► Slide on the o-ring as illustrated.



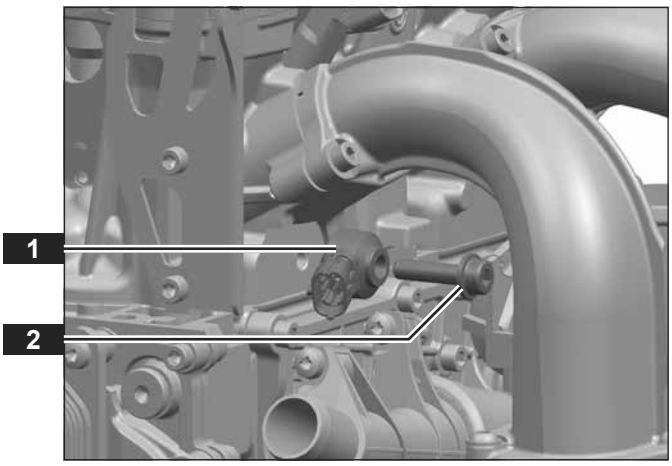
- ► Insert the sensor crankshaft 4.
- ► Screw in the bolt 3.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



010.01-3.08 Removing sensor knock

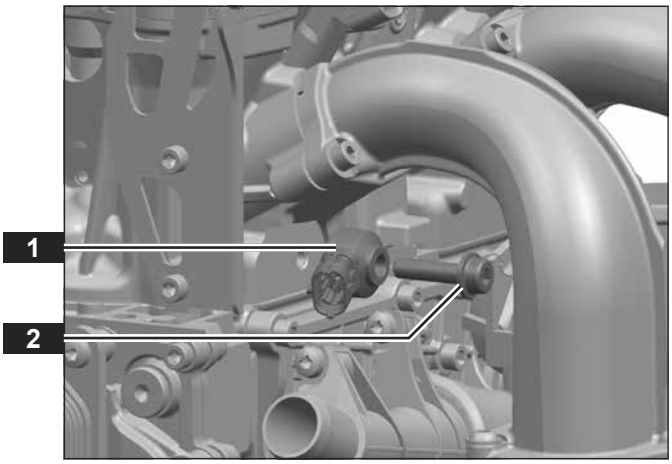
- ► Unscrew the bolt 2.
- ► Remove the sensor knock 1.



010.01-3.09 Installing sensor knock

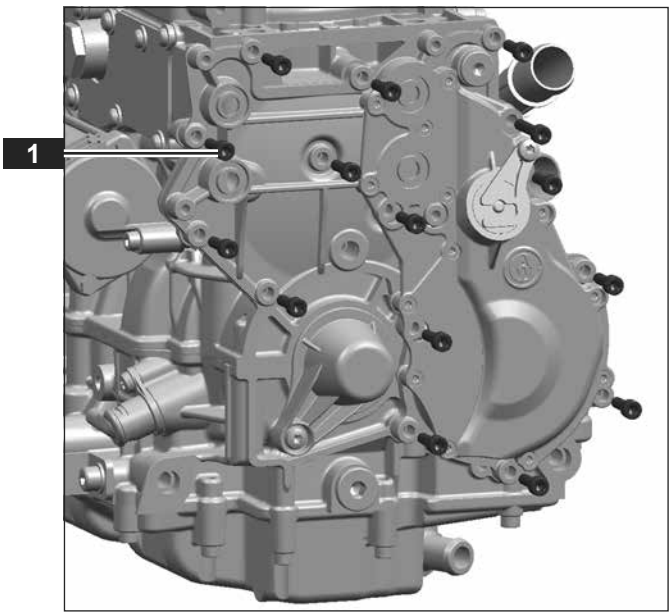
- ► Hold the sensor knock 1 in position.
- ► Screw in the bolt 2.

Tightening torque:
20 Nm +4 Nm [14.8 lbf ft +3 lbf ft]

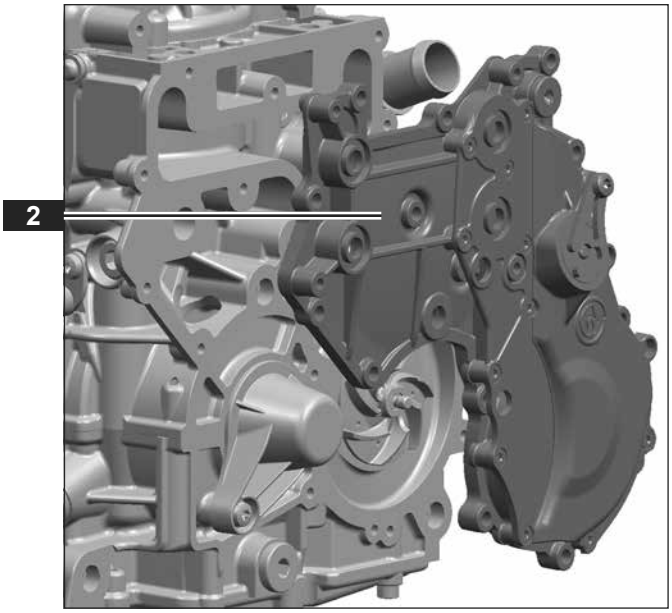


010.02-1.01 Removing oil cooler bracket

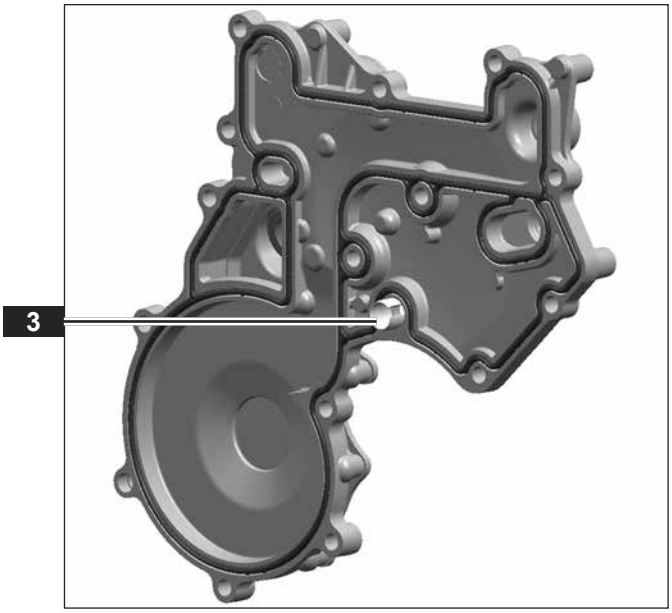
► Unscrew 15 bolts **1**.



► Remove the oil cooler bracket **2**.



► Remove the sleeve 3.



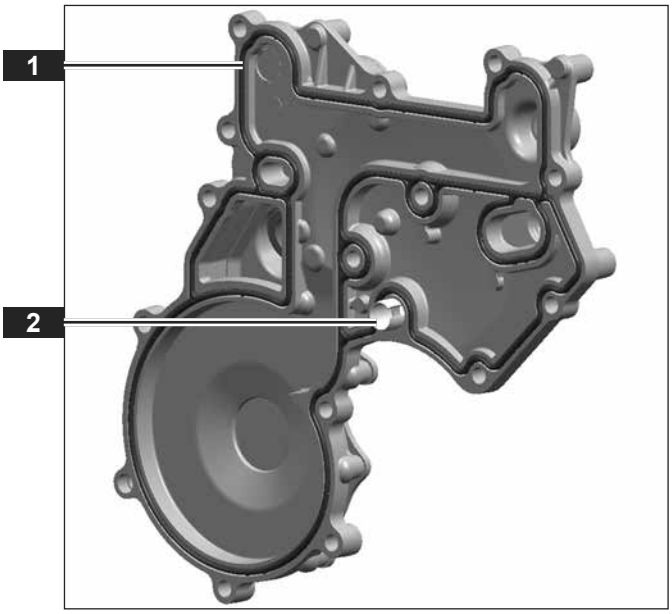
010.02-1.02 Installing oil cooler bracket

– 1 Gasket oil cooler bracket

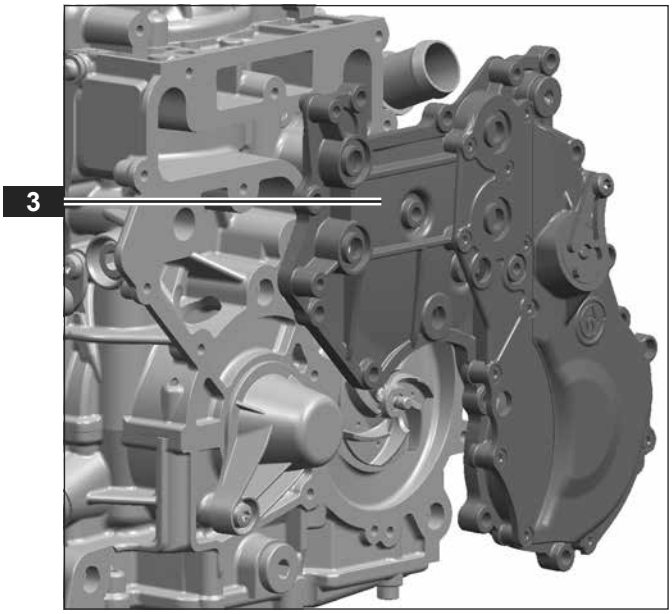
► Replace the gasket 1.

► Insert the gasket into the groove and lightly coat with petroleum jelly.

► Insert the sleeve 2.



► Hold the oil cooler bracket 3 in position.

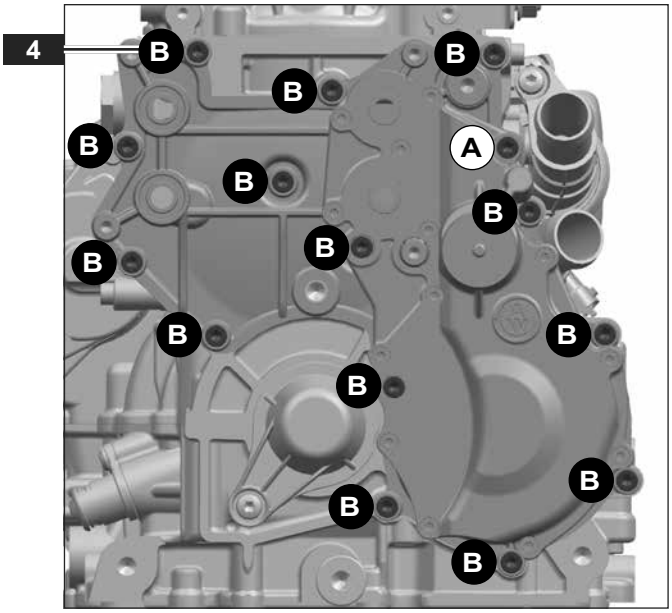


► Screw in 1 bolt M6x30 Ⓐ.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]

► Screw in 14 bolts M6x20 Ⓑ.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



010.02-2.01 Replacing blanking cover

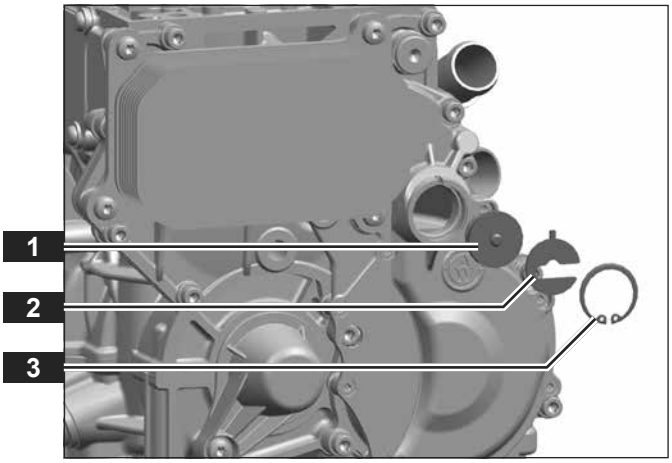
– 1 O-ring blanking cover

WARNING! Serious eye injuries due to a flying circlip. Wear protective glasses.

► Remove the circlip 3 using a lockring pliers.

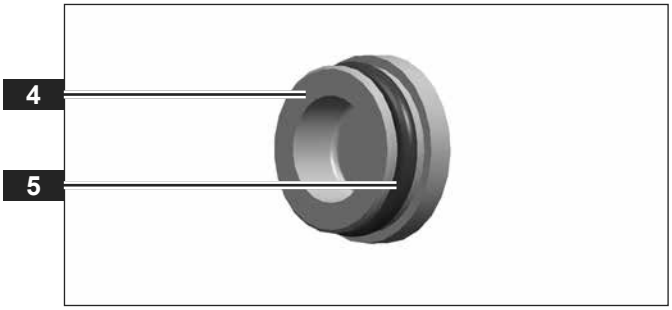
► Remove the clamp ring 2.

► Remove the blanking cover 1.



► Replace the blanking cover 4 and the o-ring 5.

► Coat the o-ring lightly with petroleum jelly.

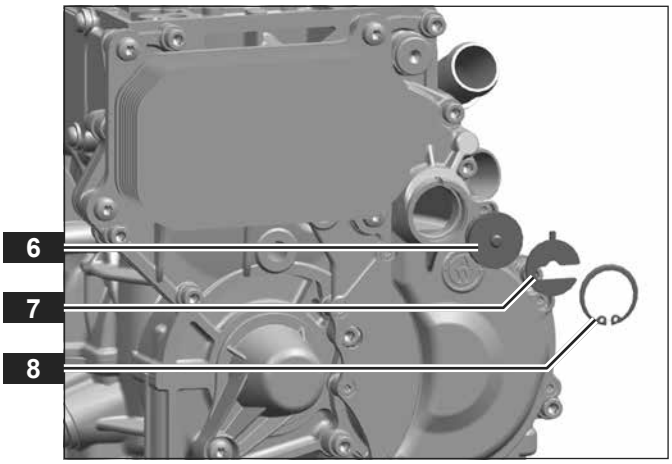


► Insert the blanking cover 6.

► Insert the clamp ring 7.

WARNING! Serious eye injuries due to a flying circlip. Wear protective glasses.

► Install the circlip 8 using a lockring pliers.

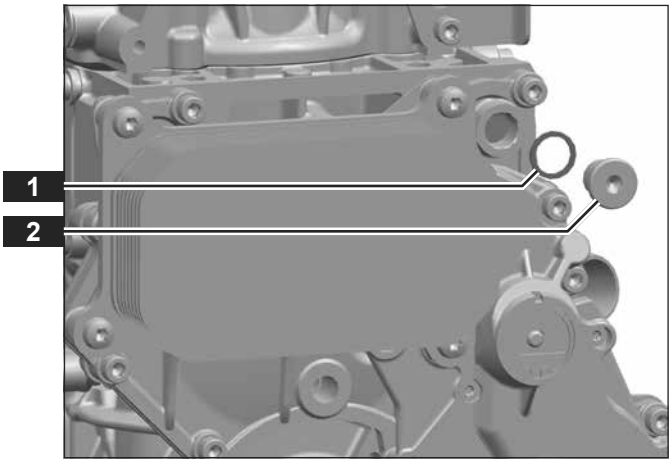


010.02-2.02 Replacing plug

– 1 Seal 14x18x1.5 Al

► Unscrew the plug **2**.
► Replace the plug.
► Replace the seal **1**.
► Screw in the plug.

Tightening torque:
14 Nm +2 Nm [10.3 lbf ft +1.5 lbf ft]

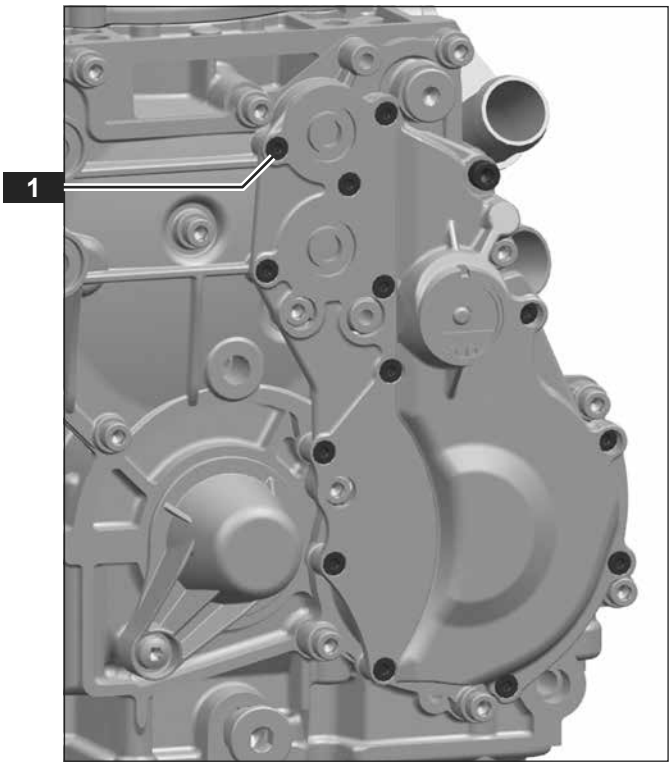


010.02-2.03 Sealing cover oil cooler bracket

– Silicone liquid seal

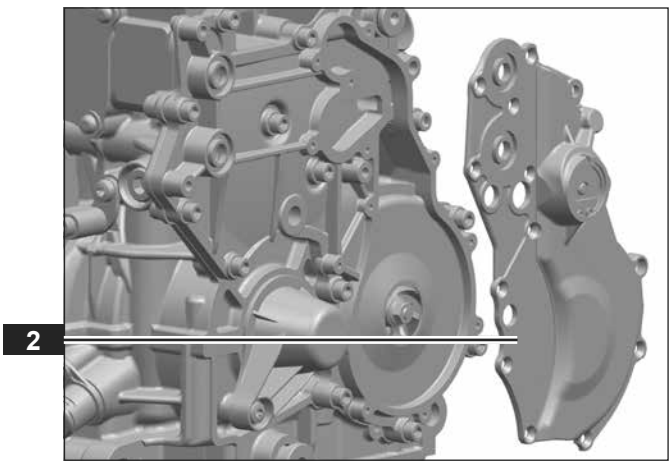
Information! The cover oil cooler bracket should only be removed if it leaks. Textron Motors recommends replacing the entire oil cooler bracket.

► Unscrew 14 bolts 1.

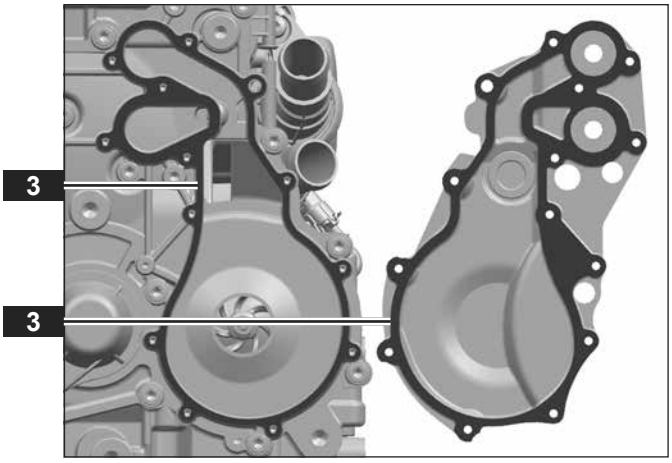


The cover oil cooler bracket is caulked with a silicone liquid seal.

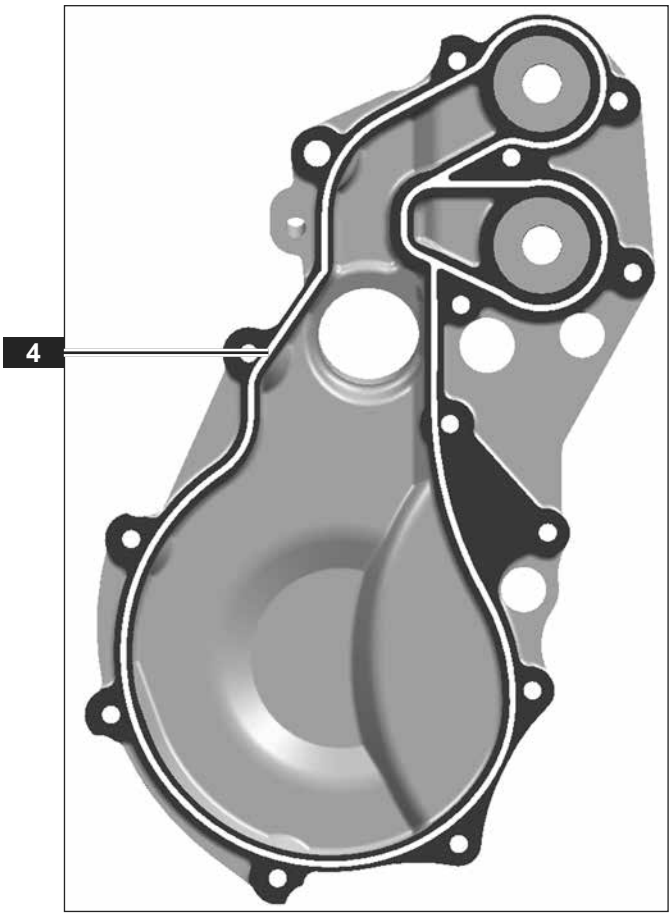
► Remove the cover oil cooler bracket 2.



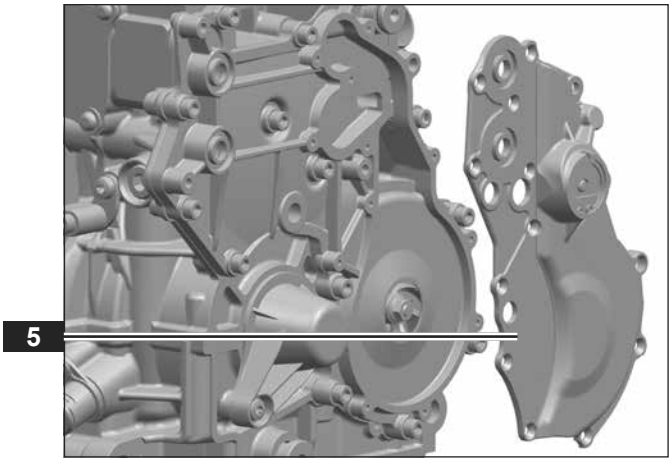
► Clean the sealing surfaces 3 with sealing surface cleaner.



► Apply the silicone liquid seal 4 without gaps as illustrated.



► Hold the cover oil cooler bracket **5** in position.

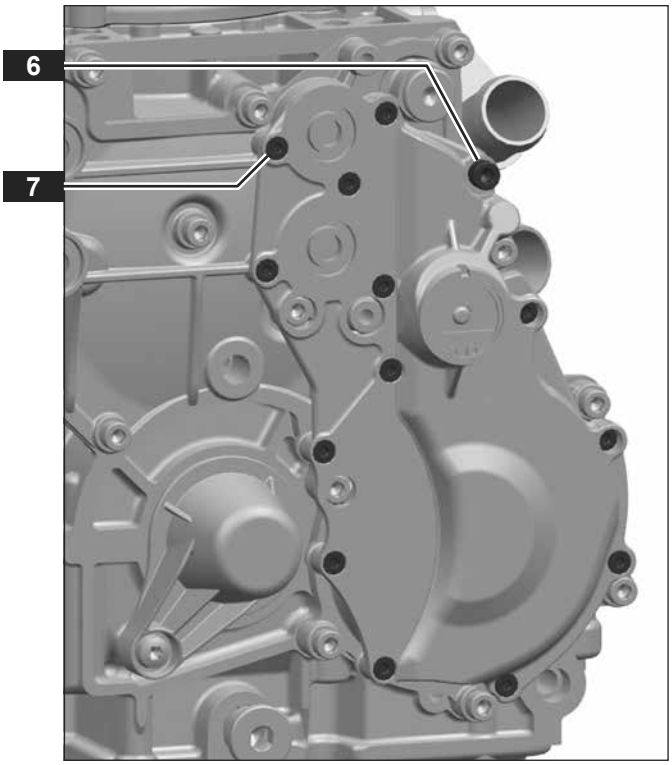


► Screw in the bolt **6**.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]

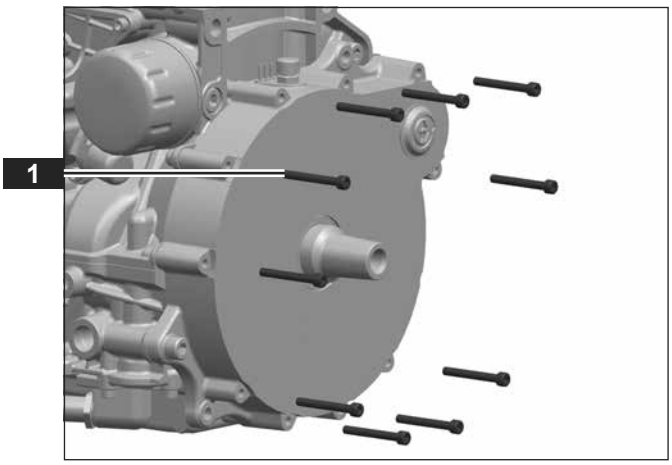
► Screw in 13 bolts **7**.

Tightening torque:
5 Nm +1 Nm [3.7 lbf ft +0.7 lbf ft]

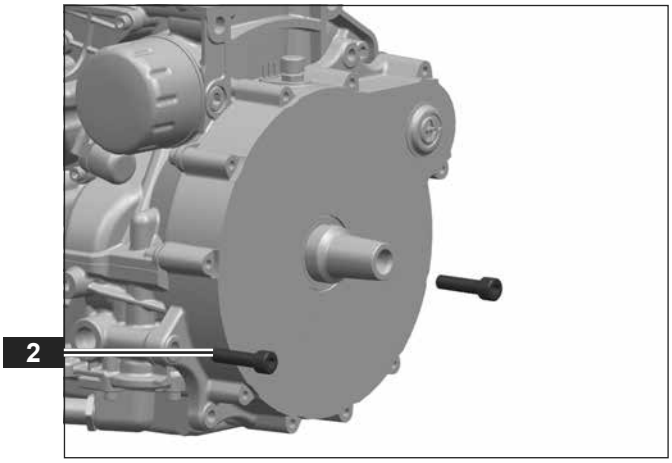


010.03.01 Removing generator cover

► Unscrew 10 bolts 1.

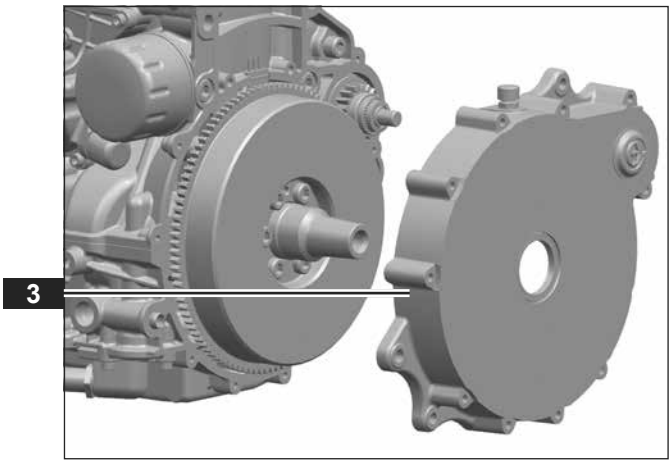


► Unscrew 2 bolts 2.



The generator cover is caulked with a silicone liquid seal.

► Remove the generator cover 3.

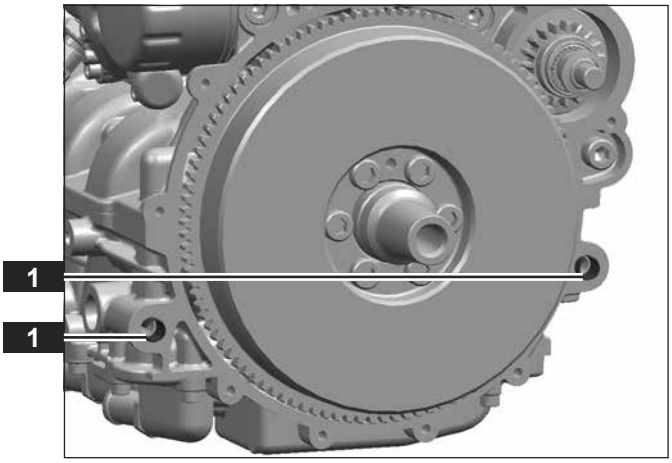


010.03.02 Installing generator cover

– 1 Oil seal generator cover
– 1 Seal 10x16x1 Al

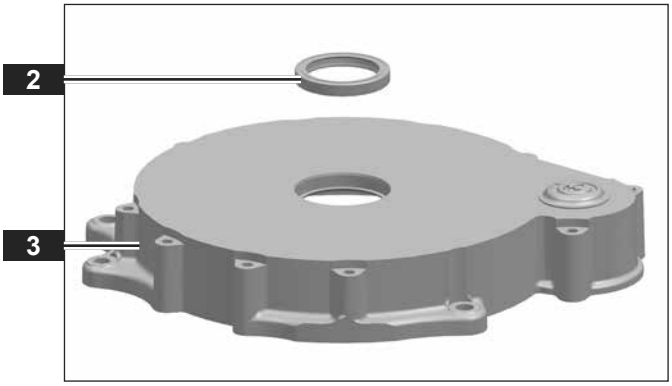
– Silicone liquid seal

► Check if the sleeves 1 are installed.

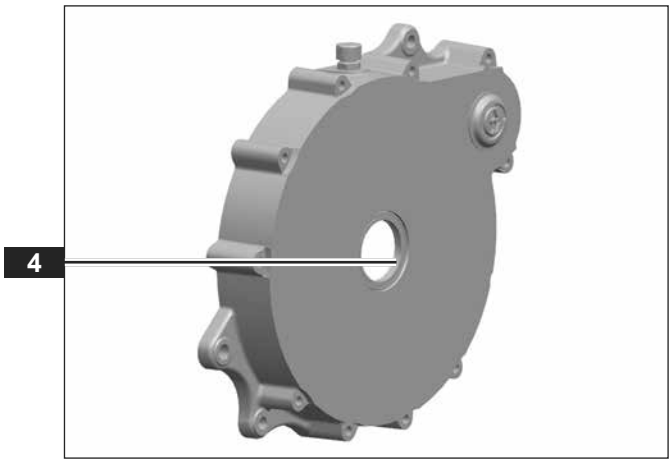


► Replace the oil seal 2.

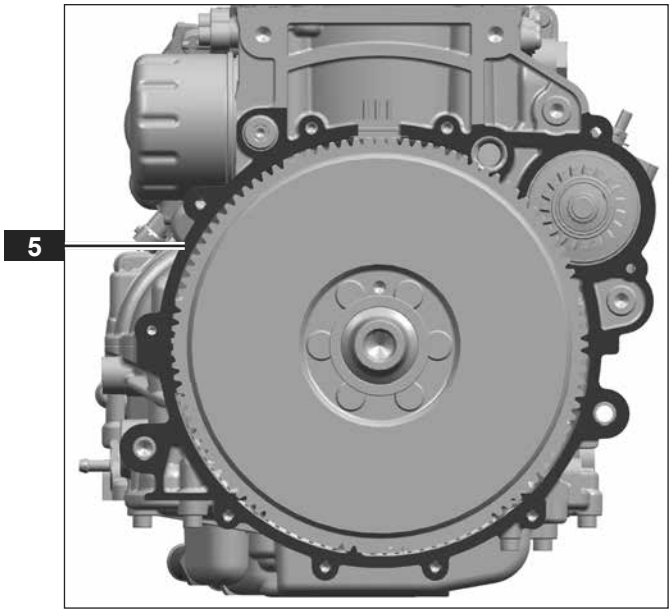
► Push the oil seal into the generator cover 3.



► Coat the inside of the oil seal 4 lightly with petroleum jelly.

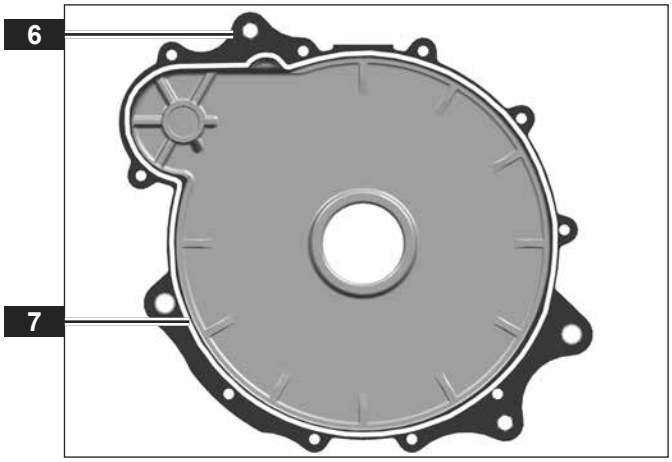


► Clean the sealing surface 5 with sealing surface cleaner.

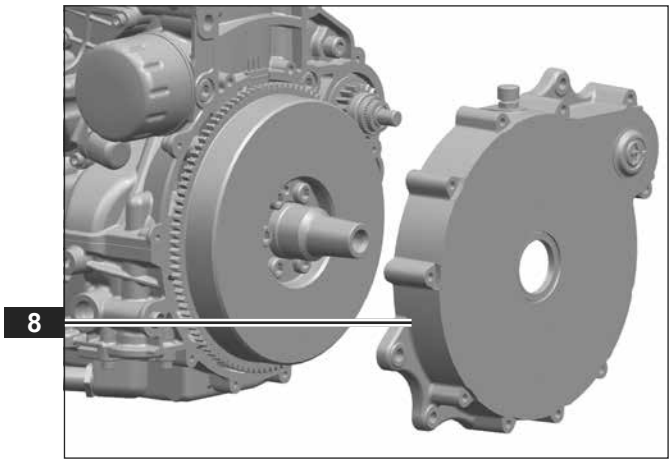


► Clean the sealing surface 6 with sealing surface cleaner.

► Apply the silicone liquid seal 7 without gaps as illustrated.

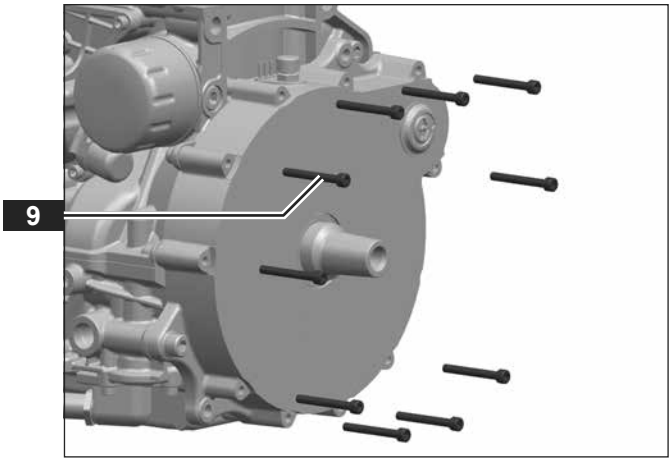


► Hold the generator cover 8 in position.



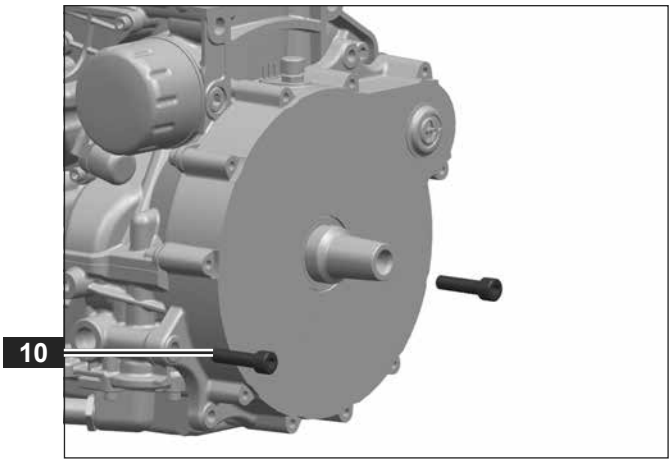
► Screw in 10 bolts 9.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



► Screw in 2 bolts 10.

Tightening torque:
40 Nm +8 Nm [29.5 lbf ft +5.9 lbf ft]



► Unscrew the vent plug 11.

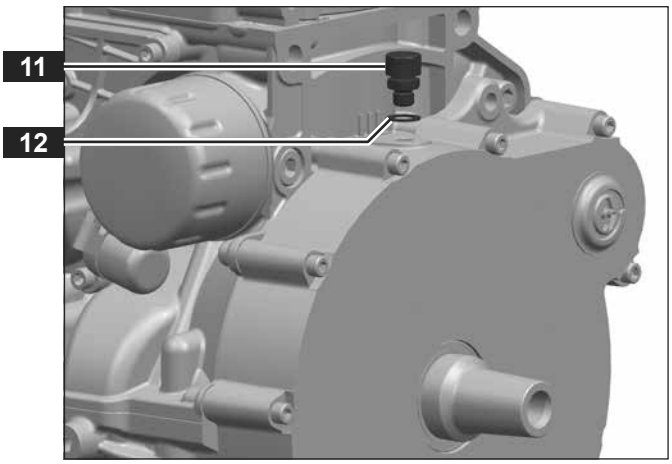
If too much engine oil has been filled, engine oil may leak at the plug.

► Fill in 40 ml [0.04 qt (US)] engine oil.

► Replace the seal 12.

► Screw in the vent plug.

Tightening torque:
9 Nm +2 Nm [6.7 lbf ft +1.5 lbf ft]



010.03.03 Replacing generator cover

– 1 Seal 10x16x1 Al

► Replace the generator cover 3.

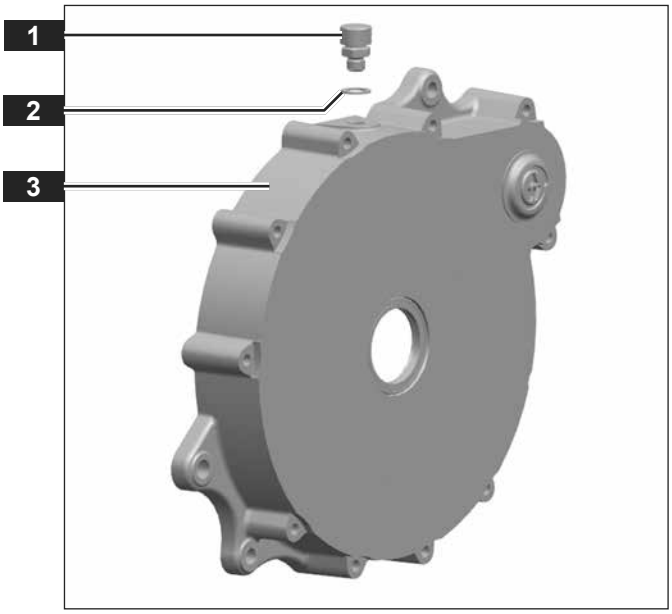
► Remove the plug from the old generator cover.

► Replace the seal 2.

► Screw in the plug 1.

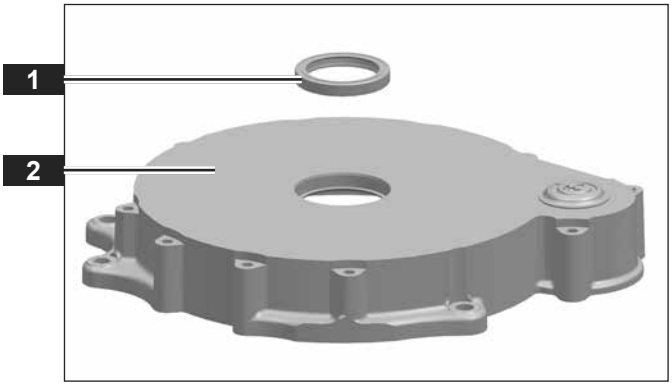
Tightening torque:

9 Nm +2 Nm [6.7 lbf ft +1.5 lbf ft]



010.03.04 Replacing oil seal

- ► Pull the oil seal **1** out.
- ► Replace the oil seal.
- ► Push the oil seal into the generator cover **2**.

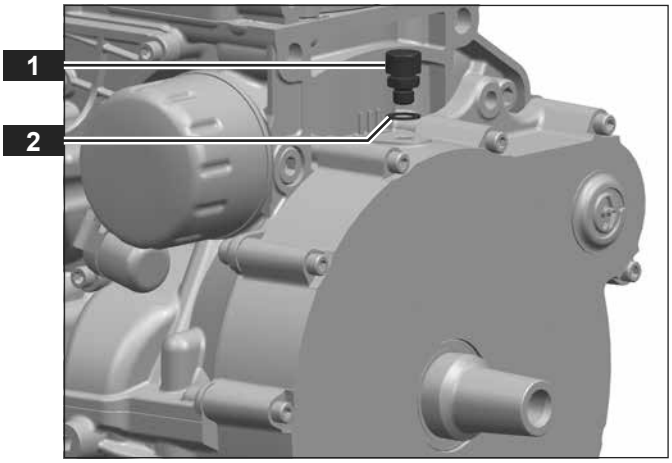


010.03.05 Replacing vent plug

– 1 Seal 10x16x1 Al

► Unscrew the vent plug **1**.
► Replace the vent plug.
► Replace the seal **2**.
► Screw in the vent plug.

Tightening torque:
9 Nm +2 Nm [6.7 lbf ft +1.5 lbf ft]



020.01.01 Removing crank drive.

– Chain tool
– Stud extractor
– 12-point socket wrench 12

– Anti-Seize assembly paste

– Instruction manual chain tool

NOTICE

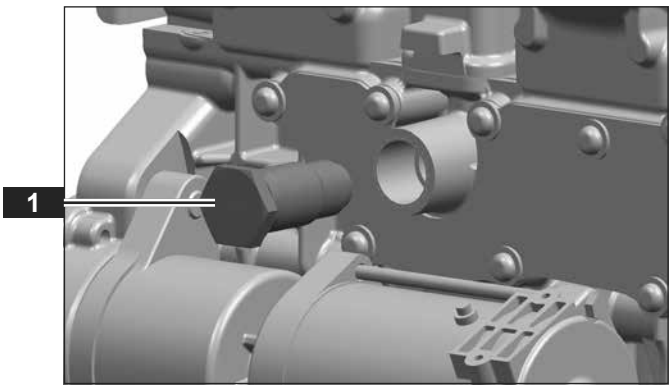
Bearing damage, increased wear and leaks due to installing components swapped over.

All components in the crank drive are inserted together. If the components are installed swapped over, they no longer fit together well.

► When removing the components, mark the cylinder assignment and installation position.

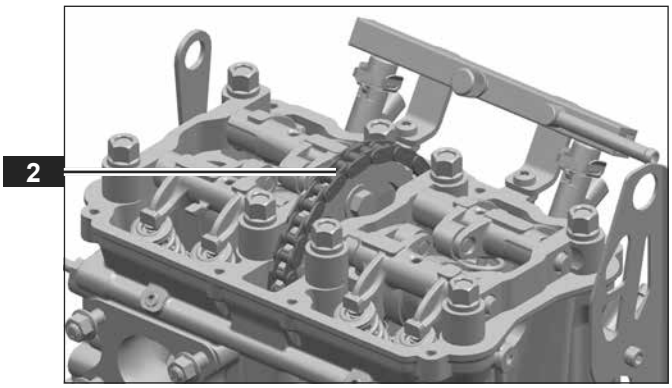
► Install all components back into the place from which they were removed.

► Unscrew the chain tensioner 1.



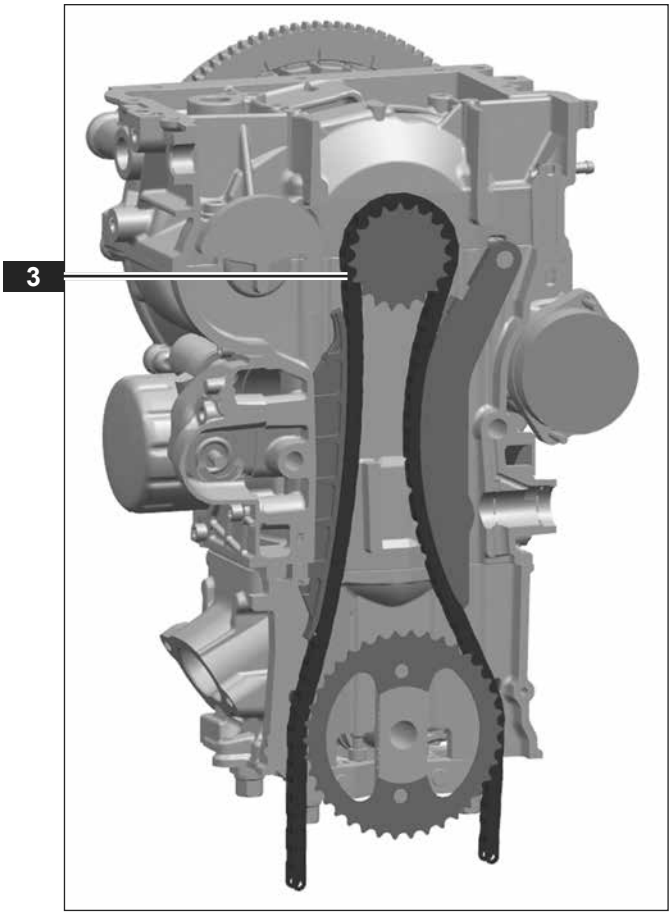
► Mark the running direction of the timing chain 2.

► Open the timing chain. (See the instruction manual of the chain tool.)



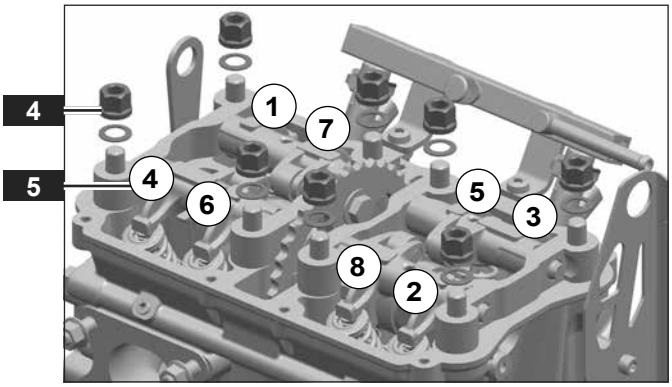
► Turn the engine 180°.

► Remove the timing chain 3.

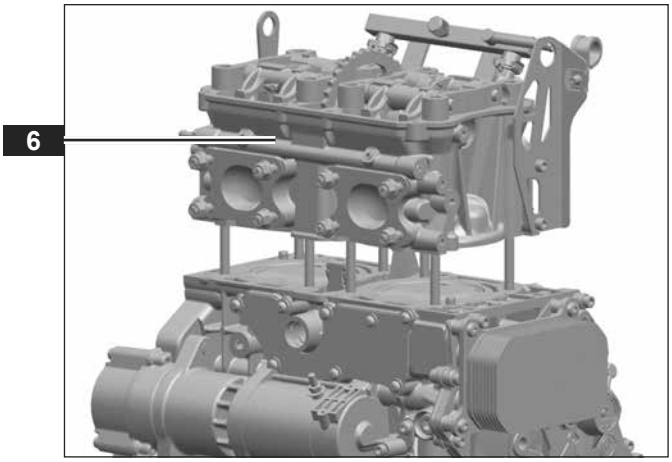


► Unscrew the nuts 4 in the sequence as illustrated 5.

The rocker arm and cross bars are no longer firmly attached to the cylinder head. Do not turn the cylinder head.



► Remove the cylinder head 6.

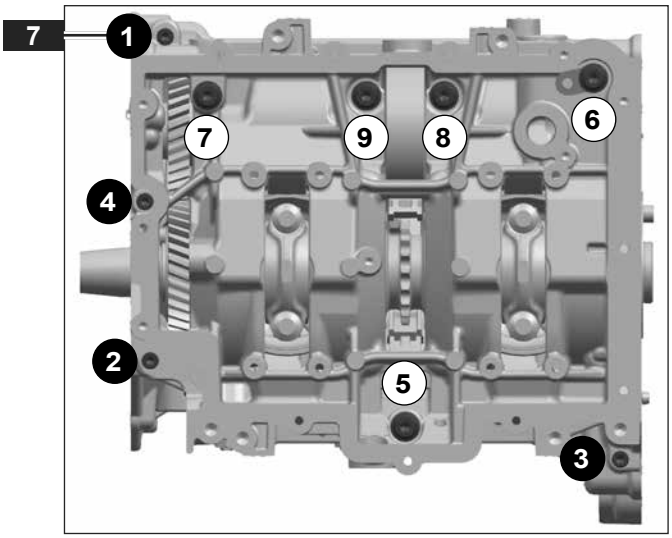


► Turn the engine 180°.

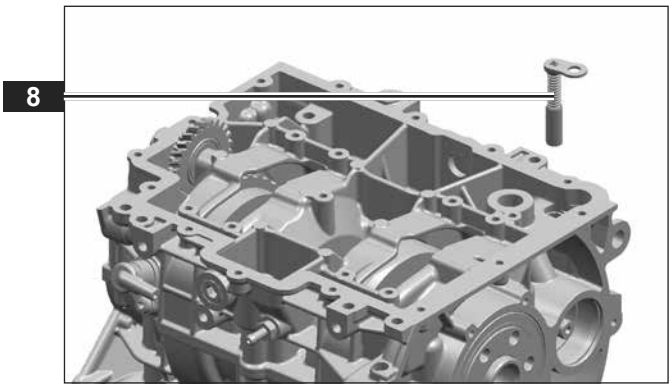
Unscrew all bolts in the sequence as illustrated 7.

► Unscrew 4 bolts M6 ❶ – ❹.

► Unscrew 5 bolts M8 ⑤ – ⑨.



► Pull the oil pressure valve 8 out using a bar magnet.



The crankcase is caulked with a silicone liquid seal.

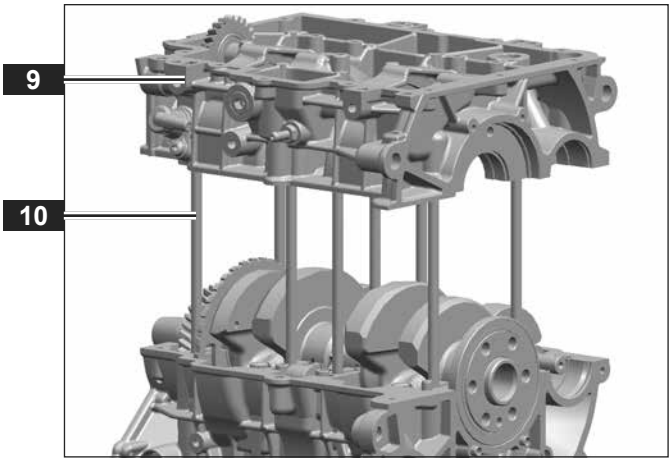
► Remove the lower case 9.

► If the screw connection of a tie rod 10 has loosened unscrew the tie rod using a stud extractor.

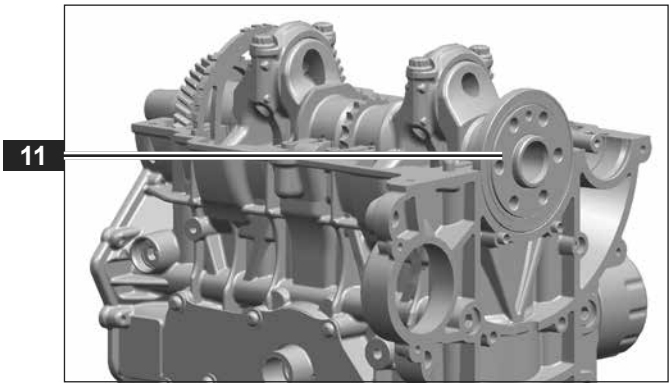
► Apply Anti-Seize assembly paste to all threads.

► Screw in the tie rod using a stud extractor.

Tightening torque:
18 Nm +2 Nm [13.3 lbf ft +1.5 lbf ft]



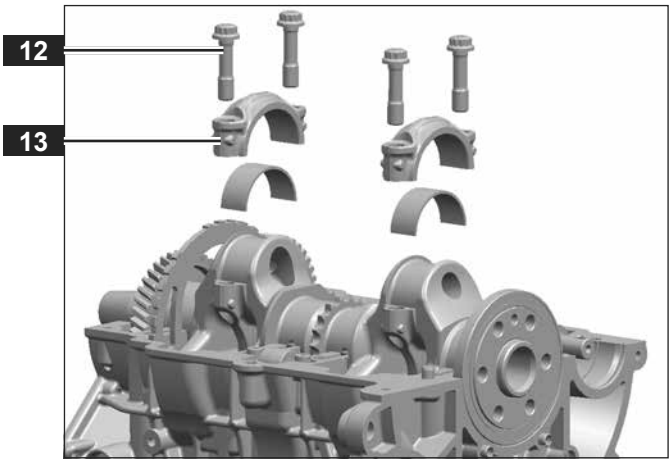
► Turn the crankshaft 11 180°.



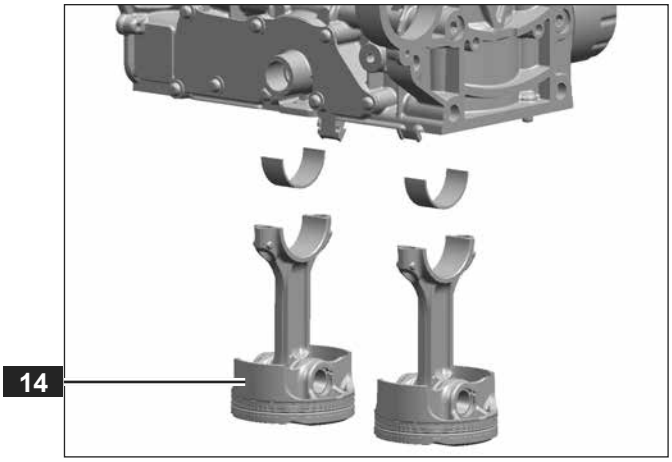
► Mark the cylinder assignment and installation position on the piston, con rod, con rod cover and bearing shells.

► Unscrew the con-rod bolts 12.

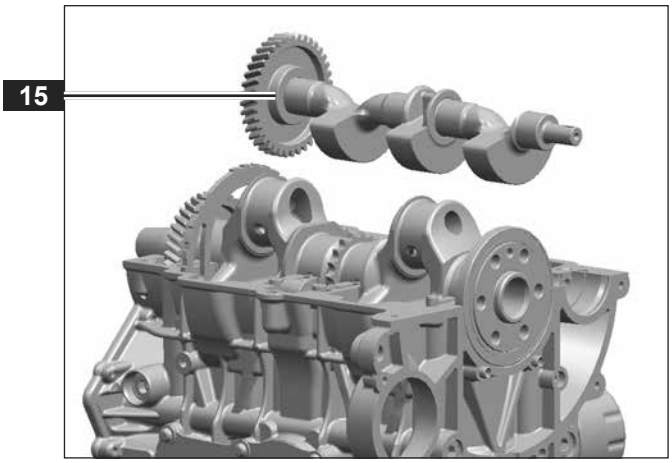
► Remove the con-rod cover 13.



► Pull the pistons 14 out.

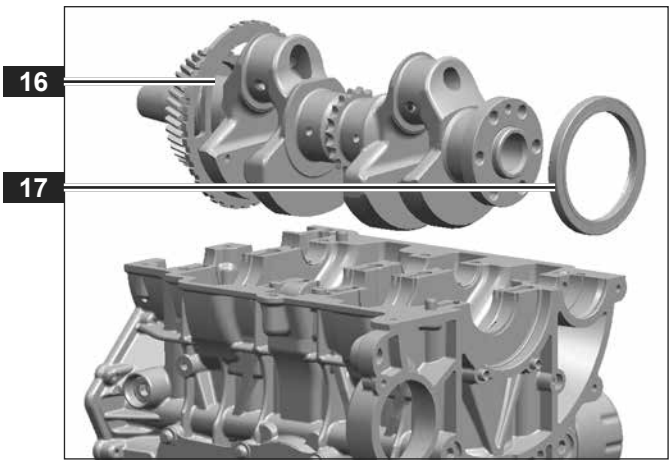


► Remove the balance shaft 15.



► Remove the crankshaft 16.

► Remove the oil seal 17.



020.01.02 Installing crank drive.

– Piston ring compressor
– 12-point socket wrench 12
– Assembling kit oil seal crankshaft
– TDC-Adjusting tool
– Chain tool

– Service manual of the engine
– Instruction manual chain tool

– 4 Con rod bolts
– 1 Cylinder head gasket
– 1 Oil seal crankshaft
– 1 Chain tensioner
– 1 Chain link

– Silicone liquid seal

NOTICE

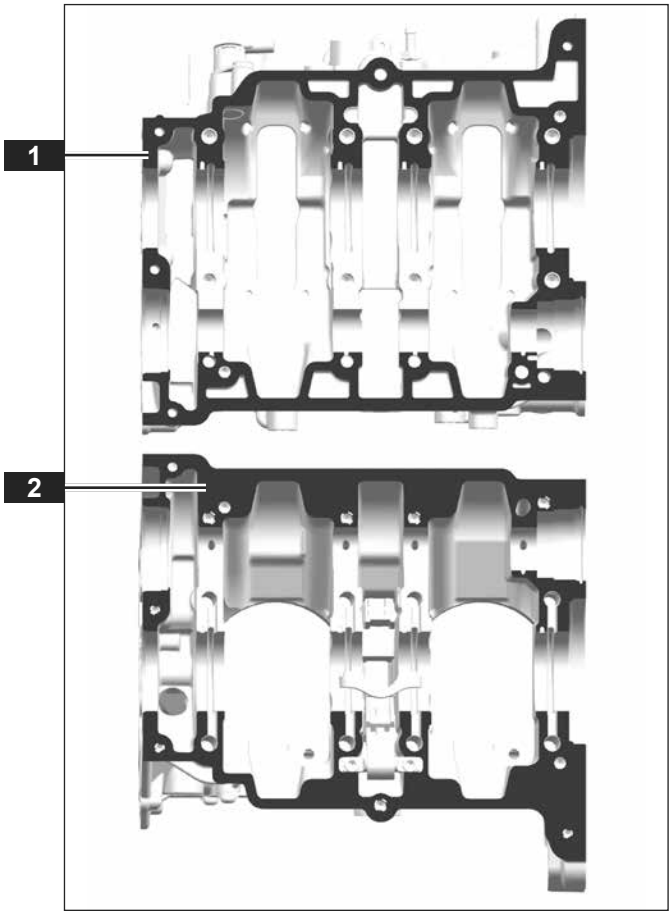
Bearing damage, increased wear and leaks due to installing components swapped over.

All components in the crank drive are inserted together. If the components are installed swapped over, they no longer fit together well.

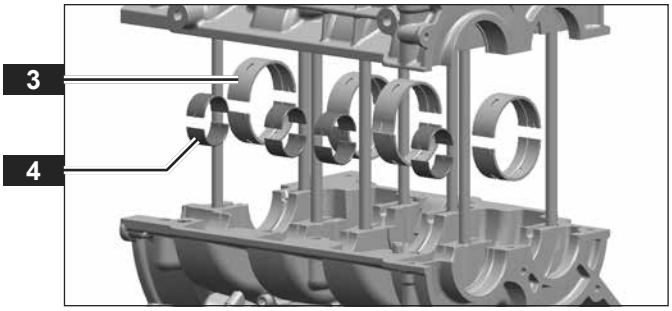
► When removing the components, mark the cylinder assignment and installation position.

► Install all components back into the place from which they were removed.

► Clean the crankcase sealing surfaces 1 2 with sealing surface cleaner.



► Check if the main bearing shells 3 and bearing shells balance shaft 4 are installed.

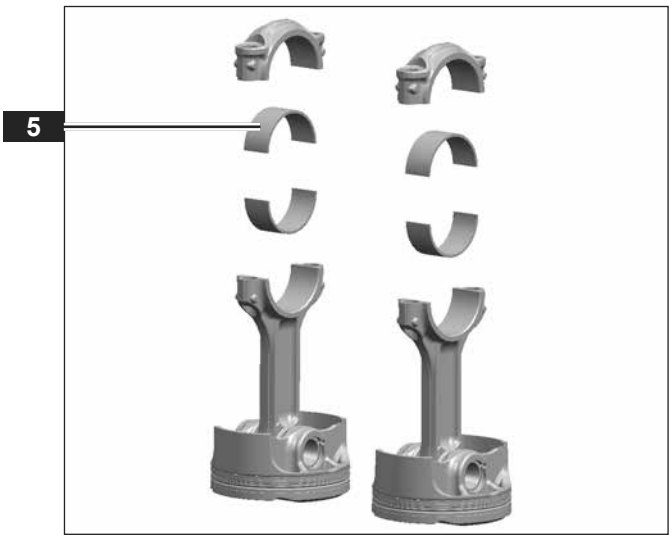


► When replacing a piston, continue with chapter 020.01.07 **Replacing piston**.

► When replacing a con rod, continue with chapter 020.01.08 **Replacing con rod**.

► Coat the con rod bearing shells 5 lightly with engine oil.

► Insert con rod bearing shells in con rod and con rod cover. Observe the installation instructions for the con rod bearing.

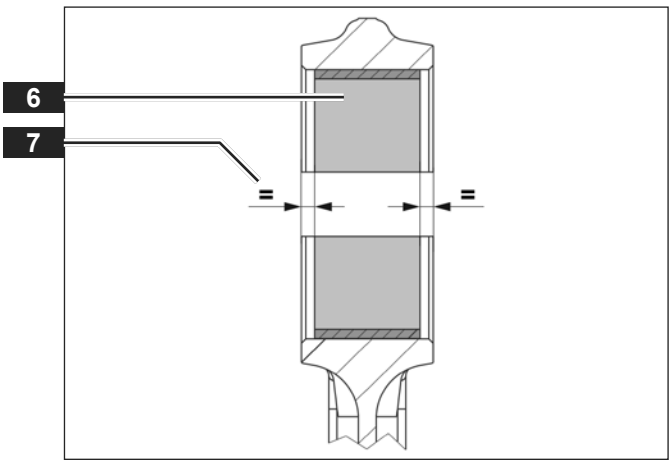


Installation instructions for the con rod bearings

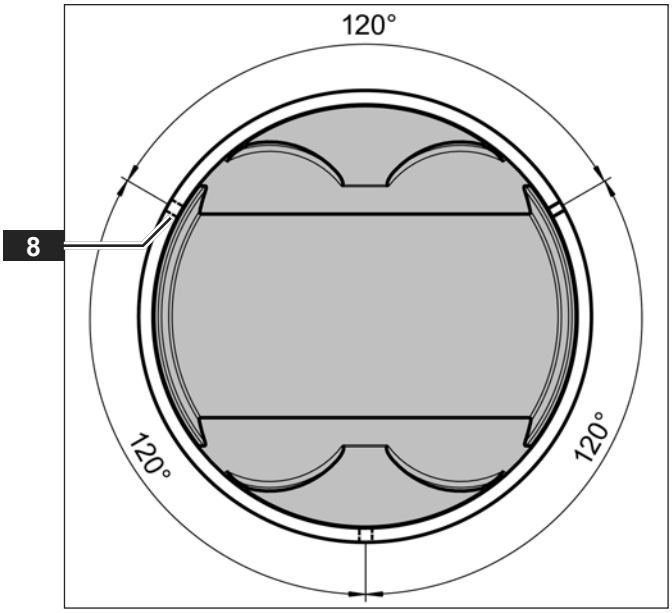
NOTICE! Serious damage to bearings due to con rod bearing shells being installed incorrectly.

► Insert the con rod bearing shells 6 centered on the con rod.

► Measure whether the dimensions "=" 7 are equal.



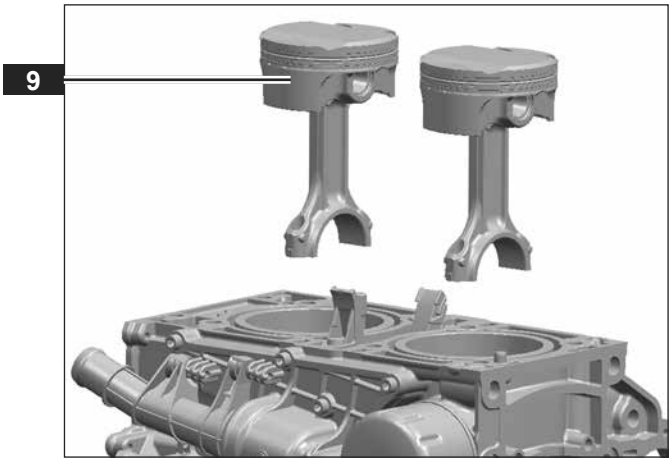
► Displace the ring joints 8 of the three piston rings 120°.



► Turn the engine 180°.

► Coat the pistons 9 lightly with engine oil.

► Slide in the pistons using a piston ring compressor.

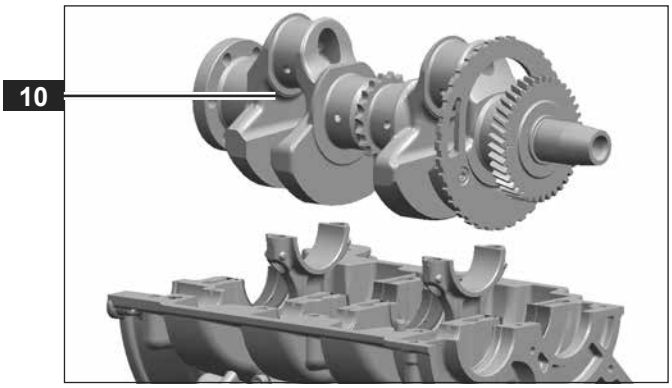


► Turn the engine 180°.

► When replacing the crankshaft, check the main bearing play and con rod bearing play. (See chapter 020.01.09 Checking con rod bearing play.) (See chapter 020.01.10 Checking main bearing play.)

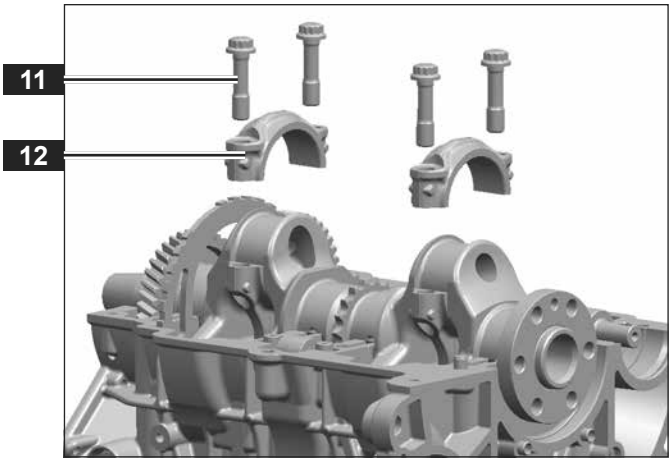
► When replacing the crankcase, check the main bearing play. (See chapter 020.01.10 Checking main bearing play.)

► Insert the crankshaft 10.



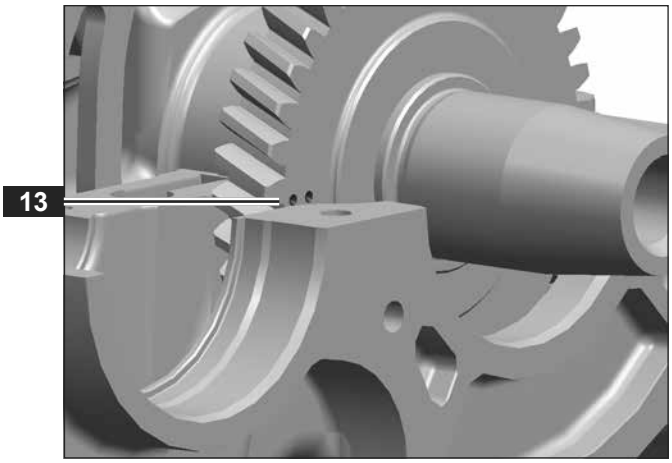
- ► Insert con-rod covers 12.
- ► Replace the con-rod bolts 11.
- ► Tighten the con-rod bolts in three stages.

Tightening torque:
First stage 10 Nm [7.4 lbf ft]
Second stage 20 Nm [14.8 lbf ft]
Third stage +115°

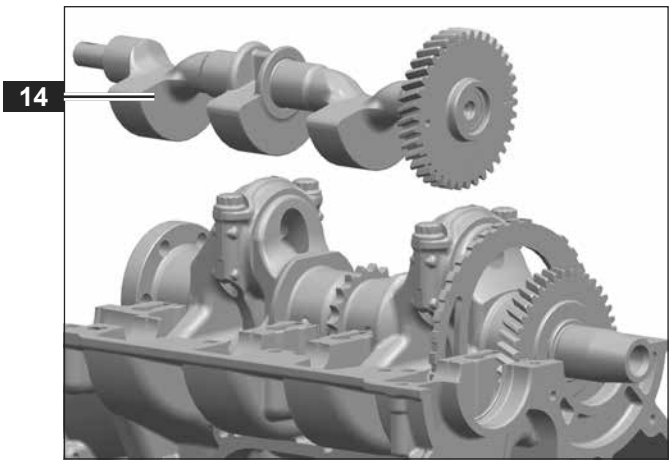


- ► Observe the marking 13.

  The marking ends flush with the crankcase.



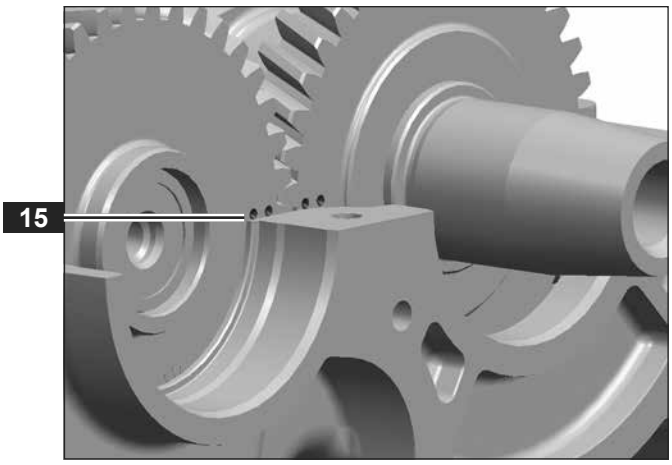
- ► When replacing the balance shaft 14, replace the bearing shells balance shaft.
- ► Insert the balance shaft.



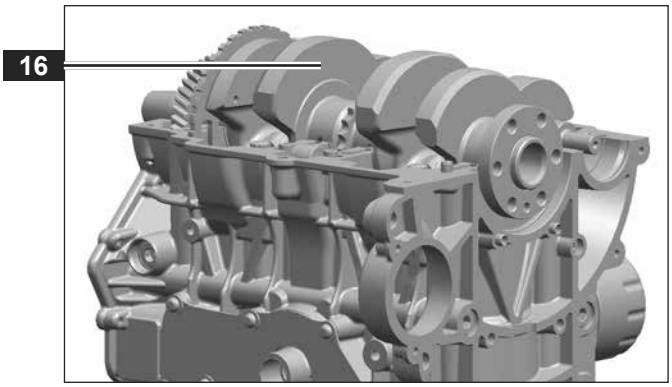
Aligning the balance shaft to the crankshaft

► Observe the marking **15**.

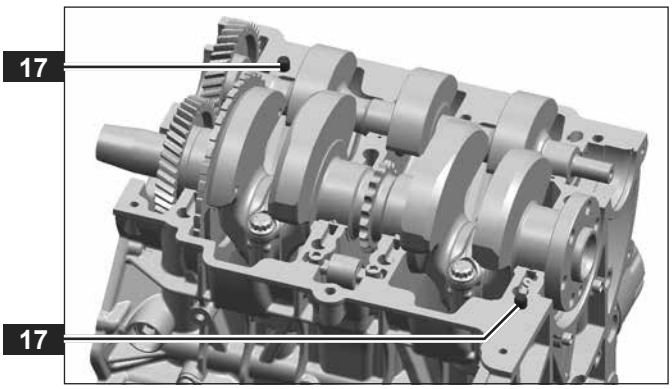
The marking ends flush with the crankcase.



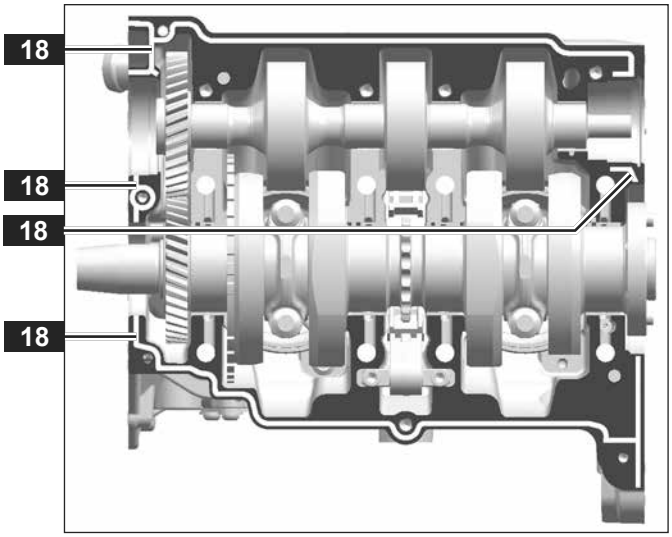
► Turn the crankshaft **16** 180°.



► Check if the centering pins **17** are installed.



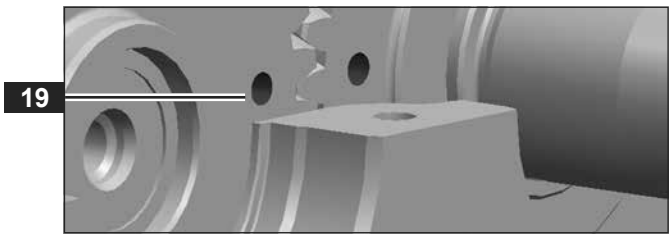
► Apply the silicone liquid seal 18 without gaps as illustrated.



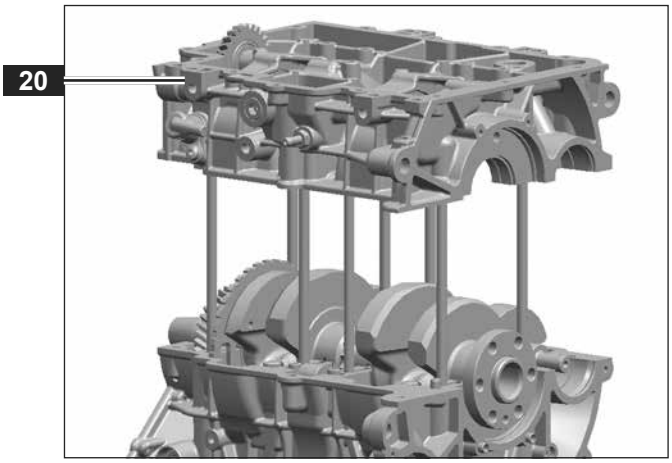
Checking the alignment of the balance shaft / crankshaft

► Check the markings 19.

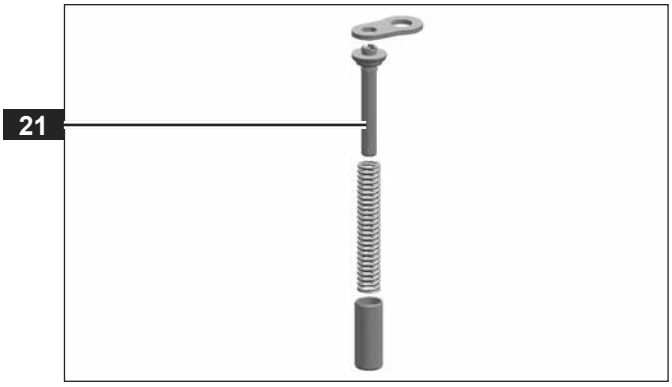
Both markings appear as shown.



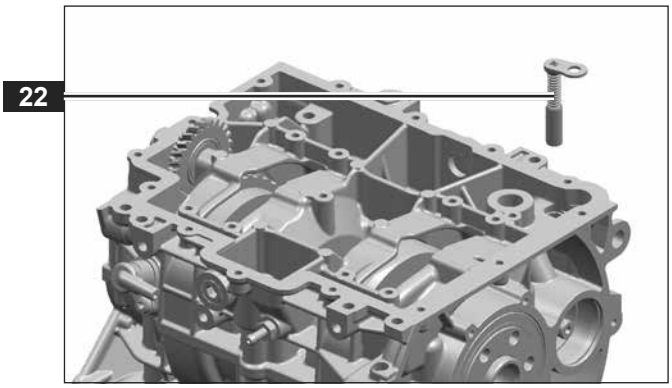
► Put the lower case 20 on.



► Assemble the oil pressure valve in the sequence as illustrated 21.



► Insert the oil pressure valve 22.



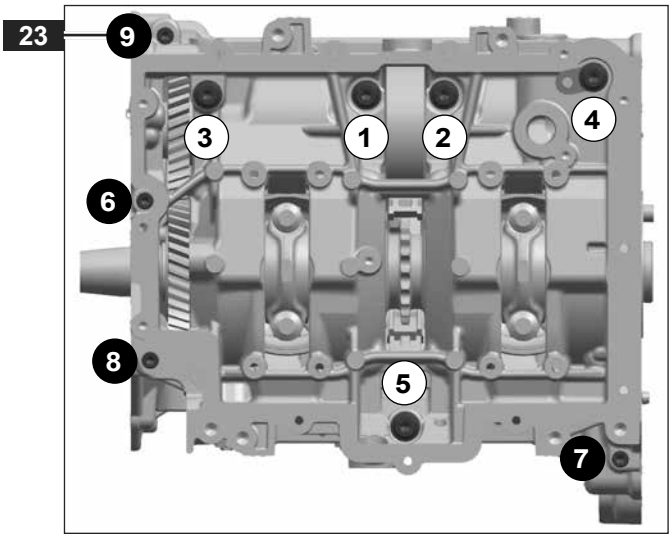
Screw in all bolts in the sequence as illustrated 23.

► Screw in 5 bolts M8 ① – ⑤.

Tightening torque:
9 Nm +1 Nm [6.6 lbf ft +0.7 lbf ft]

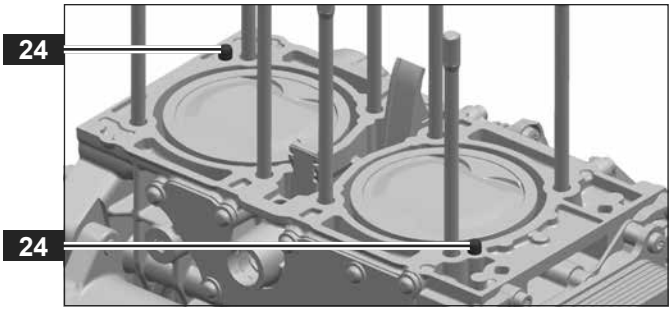
► Screw in 4 bolts M6 ❻ – ❾.

Tightening torque:
Maximum 5 Nm [3.7 lbf ft]



► Turn the engine 180°.

► Check if the centering pins 24 are installed.

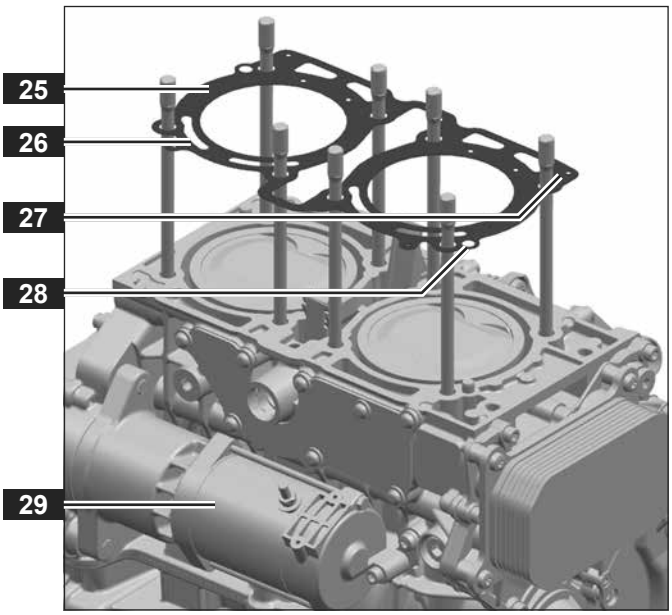


► Replace the cylinder head gasket 25.

► Put the cylinder head gasket on.

Observe the installation position:

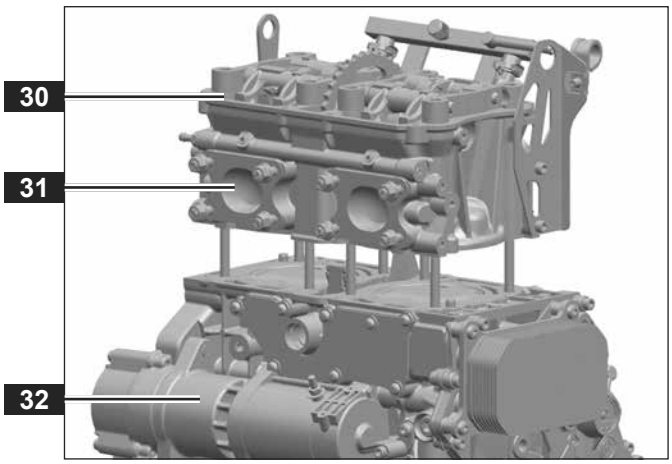
– Exhaust side 26
– Inscription 27
– Centering pins 28
– Starter 29



► Put the cylinder head 30 on.

Observe the installation position:

– Exhaust side 31
– Starter 32

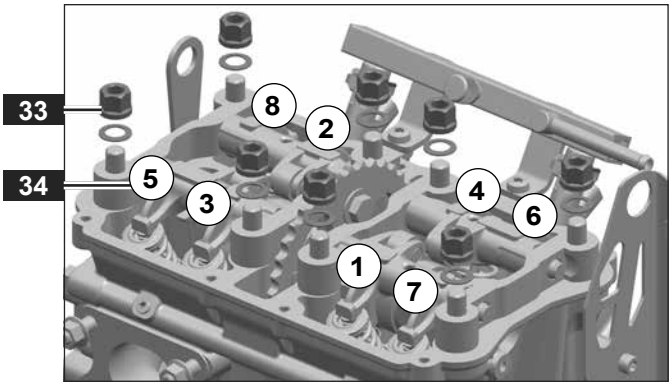


► Lubricate the nuts 33 with engine oil.

► Screw on the nuts by hand. Do not tighten.

► Tighten the nuts in the sequence as illustrated 34 in three stages.

Tightening torque:
First stage
20 Nm ±3 Nm [14.8 lbf ft ±2.2 lbf ft]
Second stage
40 Nm ±3 Nm [29.5 lbf ft ±2.2 lbf ft]
Third stage
180° ±4°



► Turn the engine 180°.

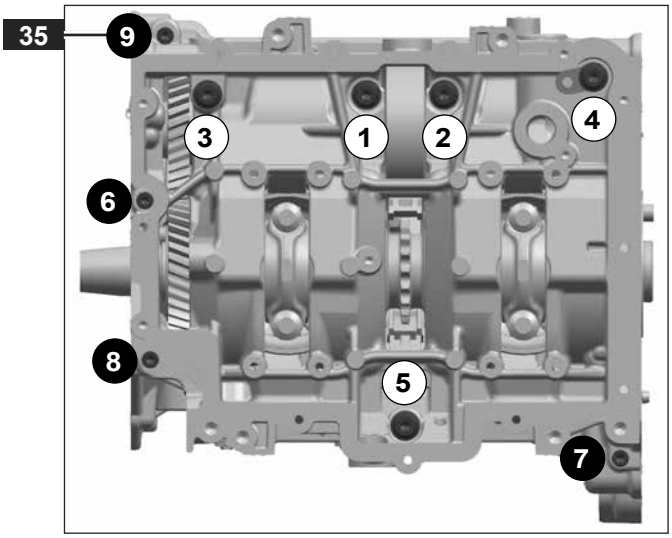
Tighten all bolts in the sequence as illustrated 35.

► Tighten 5 bolts M8 ① – ⑤.

Tightening torque:
23 Nm +2 Nm [17 lbf ft +1.5 lbf ft]

► Tighten 4 bolts M6 ❻ – ❾.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



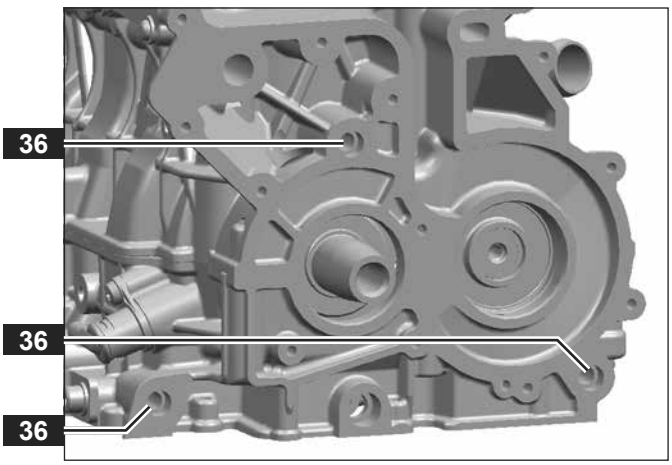
► Lift the engine. (See chapter 3.2.1 Lift and transport the engine.)

► Remove the engine from the engine stand.

► Turn the engine and mount on the engine stand.

Suitable mounting points M10 36:

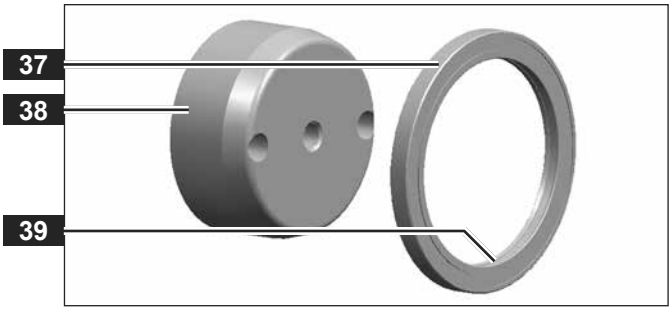
– Depth of thread 30 mm.



► Replace the oil seal 37.

► Coat the inside of the oil seal 39 lightly with petroleum jelly.

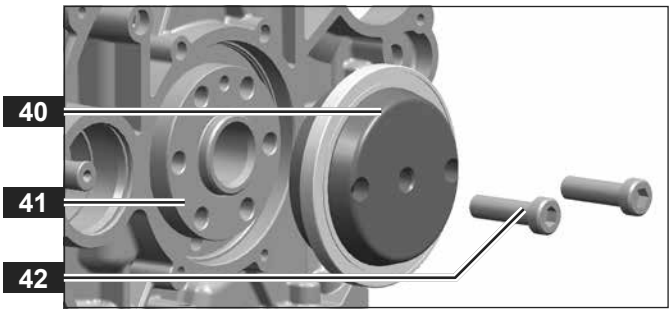
► Slide the oil seal onto guiding sleeve 38.



► Slide the guiding sleeve 40 onto crankshaft 41.

Use the M10x1x35 bolts you removed on the rotor.

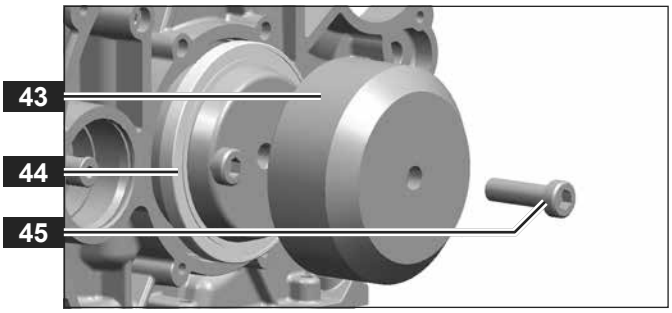
► Screw in the bolts 42.



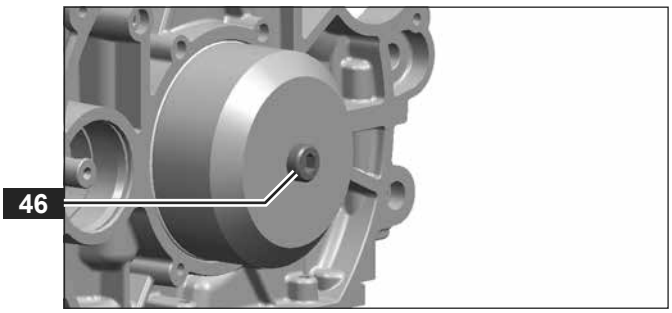
► Hold the sliding sleeve 43 in position on the oil seal 44.

Use a M10x1x35 bolt that you removed from the rotor.

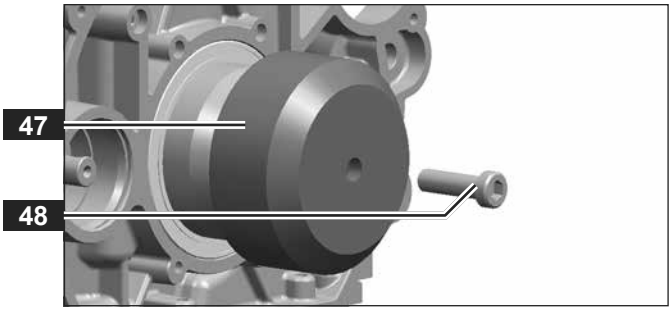
► Screw in the bolt 45.



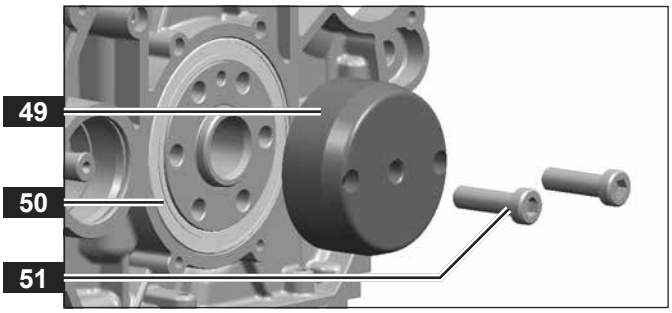
► Screw in the bolt 46 until the oil seal is flush with the crankcase.



► Unscrew the bolt 48.
► Remove the sliding sleeve 47.



► Unscrew the bolts 51.
► Remove the guiding sleeve 49.
► Check if the oil seal 50 is tilted.
► If the oil seal is tilted, it must be replaced.



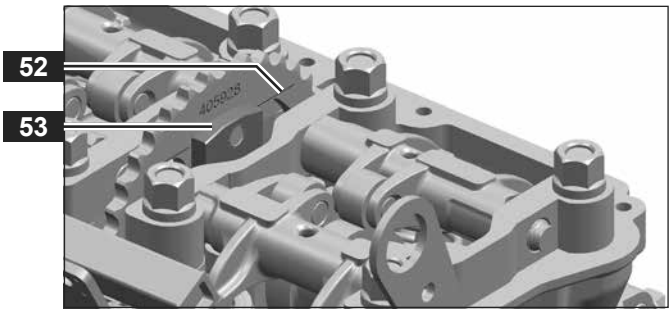
Setting valve timing

► Check whether the camshaft is at the crossing point.

The position of the camshaft is as illustrated 53.

The marking 52 ends flush with the cross bar.

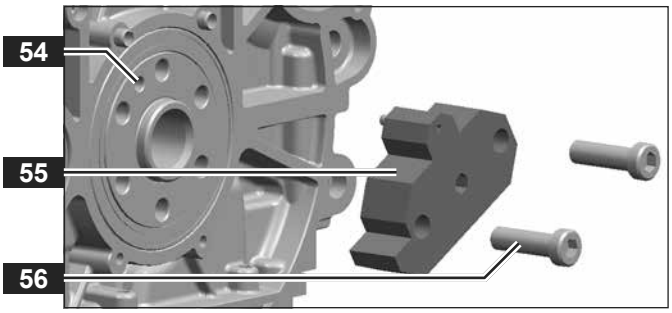
► If the camshaft does not appear as shown, turn it.



► Hold the TDC-adjusting tool 55 in position. Observe the positioning pin and positioning bore 54.

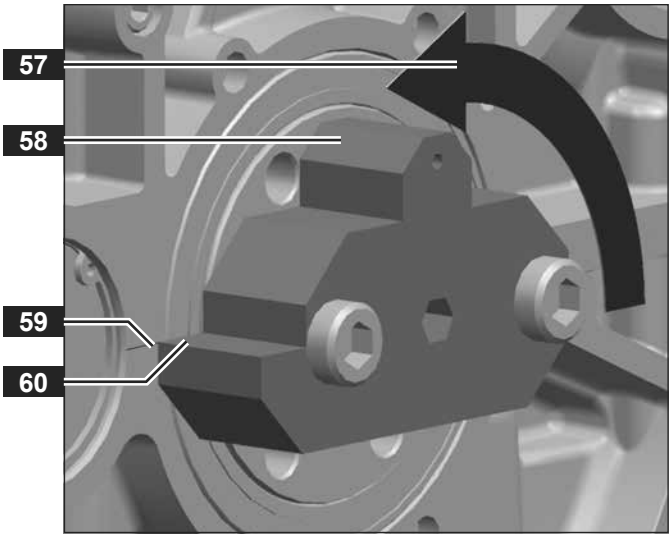
Use the M10x1x35 bolts you removed on the rotor.

► Screw in the bolts 56.



Use a hexagon screwdriver socket 8 and reversible ratchet.

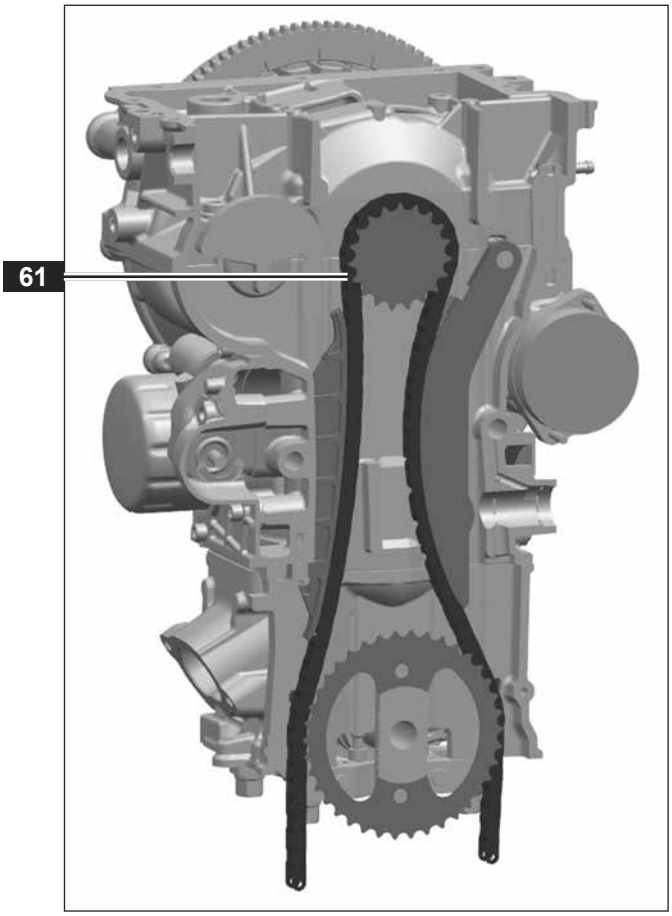
► Turn the crankshaft on the TDC-adjusting tool 58 in the direction shown 57 until the marking 60 ends flush with the crankcase halves 59.



► Turn the engine 180°.

If not installing a new timing chain, observe the running direction marked.

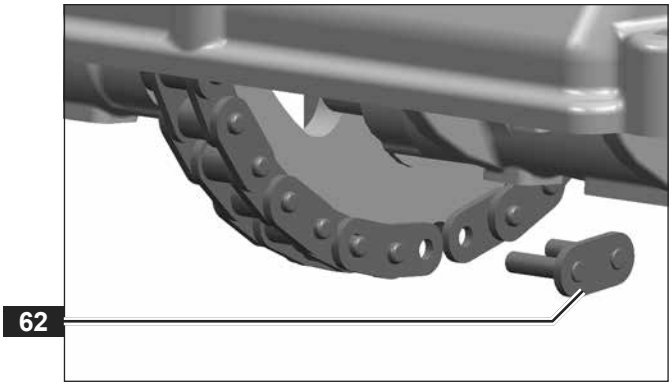
► Insert the timing chain 61 as illustrated.



► Insert the chain link 62 on the open ends of the timing chain.

► Turn the engine 180°.

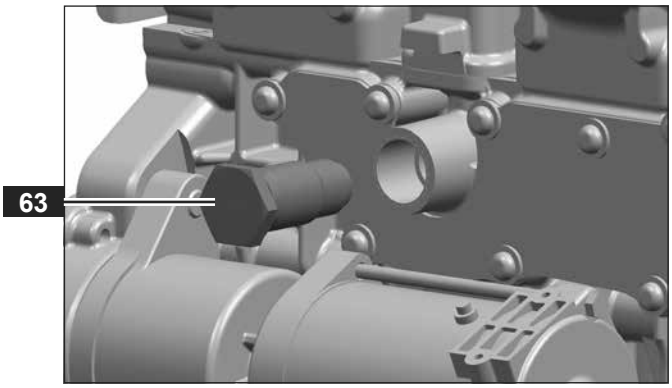
► Close the timing chain. (See the instruction manual of the chain tool.)



► Replace the chain tensioner 63.

► Screw in the chain tensioner.

Tightening torque:
40 Nm +5 Nm [29.5 lbf ft +3.7 lbf ft]



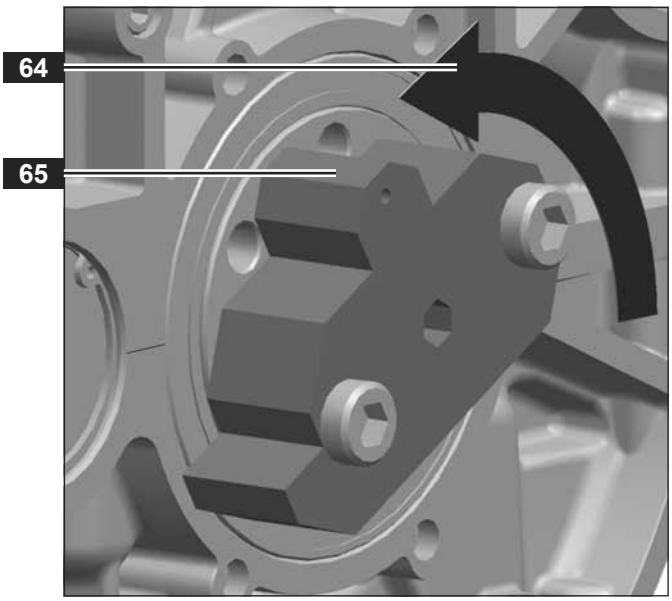
Checking the alignment of the balance shaft / crankshaft

Use a hexagon screwdriver socket 8 and reversible ratchet.

► Turn the crankshaft on the TDC-adjusting tool 65 several times in the direction shown 64.

The crankshaft can be turned.

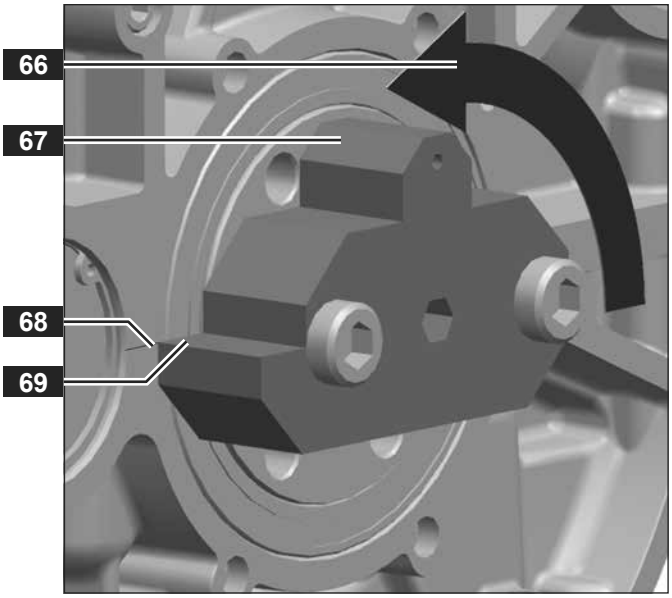
► If the crankshaft does not turn, check the alignment of the balance shaft / crankshaft.



Checking valve timing

Use a hexagon screwdriver socket 8 and reversible ratchet.

► Turn the crankshaft on the TDC-adjusting tool 67 in the direction shown 66 until the marking 69 ends flush with the crankcase halves 68.



► Check whether the camshaft is at the crossing point.

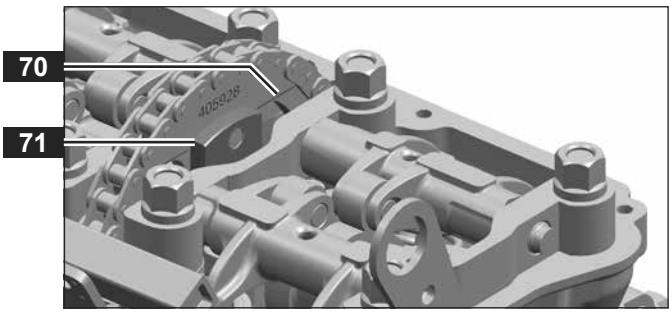
The position of the camshaft is as illustrated 71.

The marking 70 ends flush with the cross bar.

► If the camshaft does not appear as shown, set the valve timing again.

or

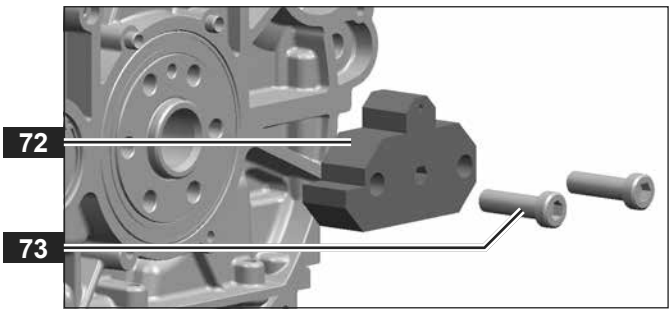
► If the camshaft does not appear as shown several times, replace the timing chain. (See chapter 040.01.02 Replacing timing chain.)



► Unscrew the bolts 73.

► Remove the TDC-adjusting tool 72.

► Check the valve lash. (See the service manual of the engine.)



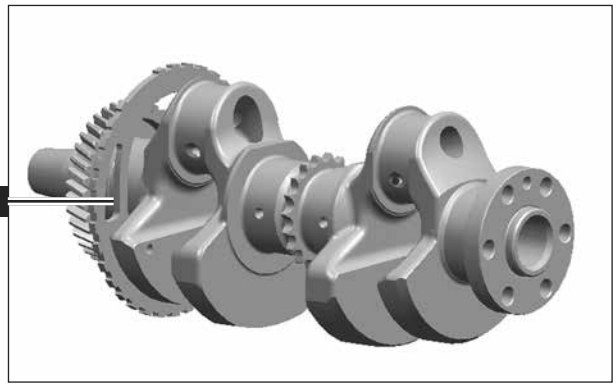
020.01.03 Replacing crankshaft

– 020.01.10 Checking main bearing play
– 020.01.09 Checking con rod bearing play

► Replace the crankshaft 1.

► Check the main bearing play. (See chapter 020.01.10 Checking main bearing play.)

► Check the con rod bearing play. (See chapter 020.01.09 Checking con rod bearing play.)



020.01.04 Replacing balance shaft

– 8 Bearing shell balance shaft

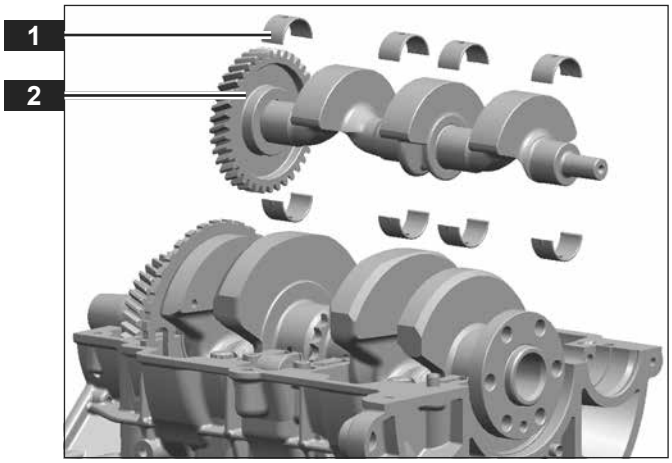
► Replace the bearing shells balance shaft 1.

► Coat the bearing shells balance shaft lightly with engine oil.

► Insert the main bearing shells in crankcase.

► Replace the balance shaft 2.

► Insert the balance shaft.



020.01.05 Removing pistons and con rods

– 12-point socket wrench 12

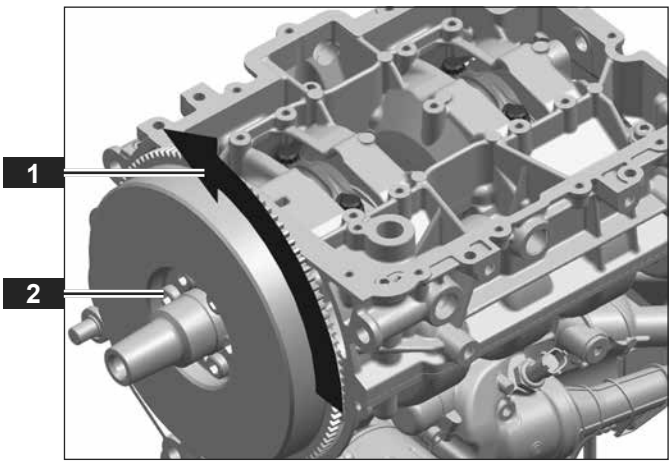
NOTICE

Bearing damage, increased wear and leaks due to installing components swapped over.

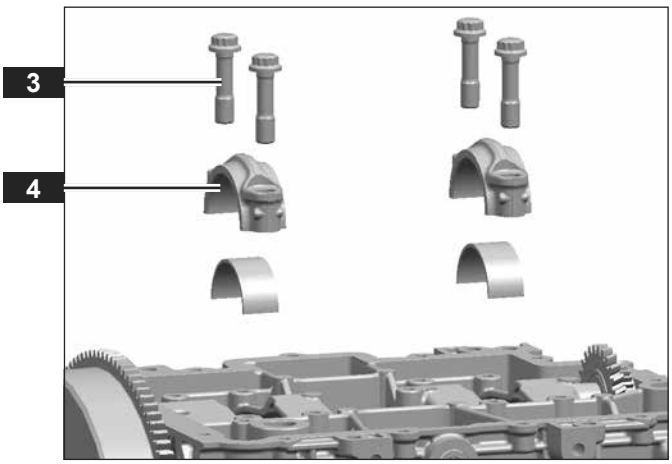
All components in the crank drive are inserted together. If the components are installed swapped over, they no longer fit together well.

- ► When removing the components, mark the cylinder assignment and installation position.
- ► Install all components back into the place from which they were removed.

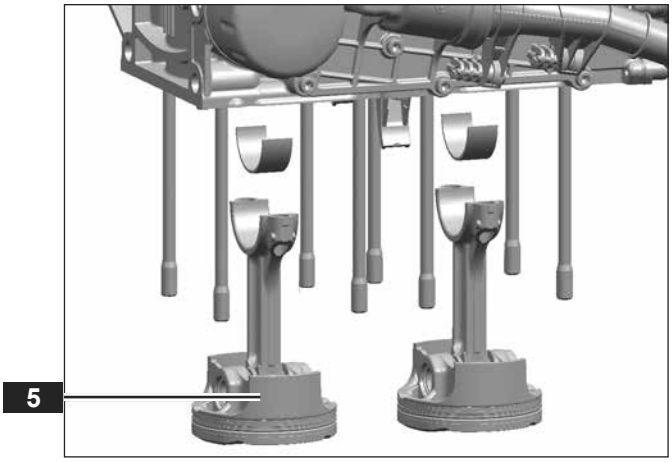
- ► Turn the engine 180°.
- ► Turn the crankshaft on a bolt 2 in the direction shown 1 until the crankshaft stops at BDC (Bottom Dead Center).



- ► Mark the cylinder assignment and installation position on the piston, con rod, con rod cover and bearing shells.
- ► Unscrew the con-rod bolts 3.
- ► Remove the con-rod cover 4.



► Pull the pistons 5 out.



020.01.06 Installing pistons and con rods

– Piston ring compressor
– 12-point socket wrench 12

– 4 Con rod bolts

NOTICE

Bearing damage, increased wear and leaks due to installing components swapped over.

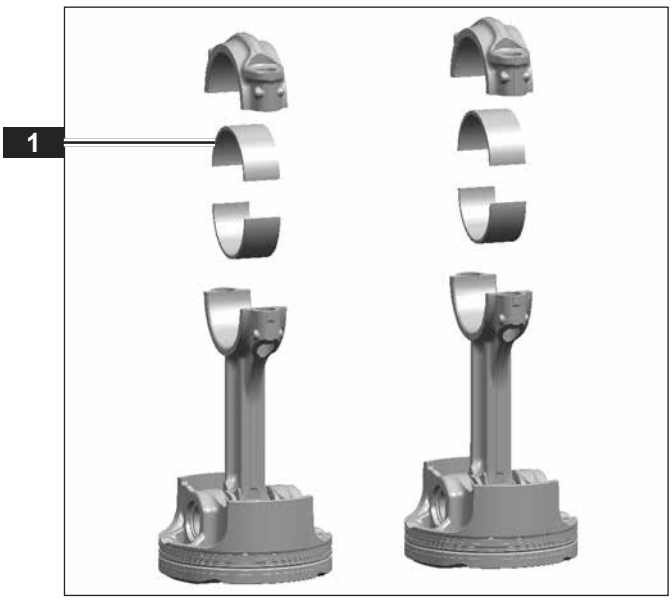
All components in the crank drive are inserted together. If the components are installed swapped over, they no longer fit together well.

► When removing the components, mark the cylinder assignment and installation position.

► Install all components back into the place from which they were removed.

► Coat the con rod bearing shells 1 lightly with engine oil.

► Insert con rod bearing shells in con rod and con rod cover. Observe the installation instructions for the con rod bearing.

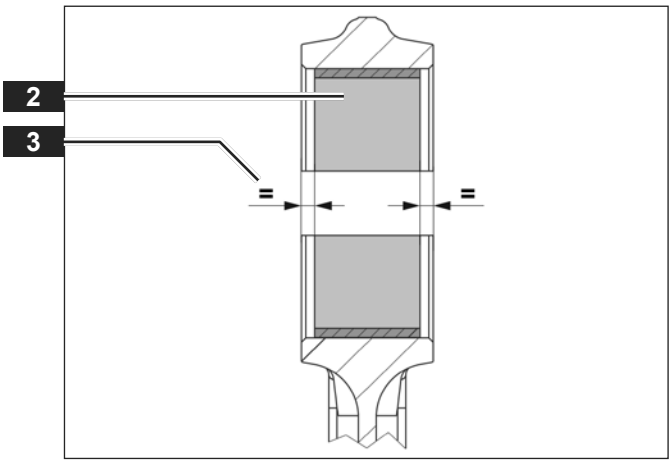


Installation instructions for the con rod bearings

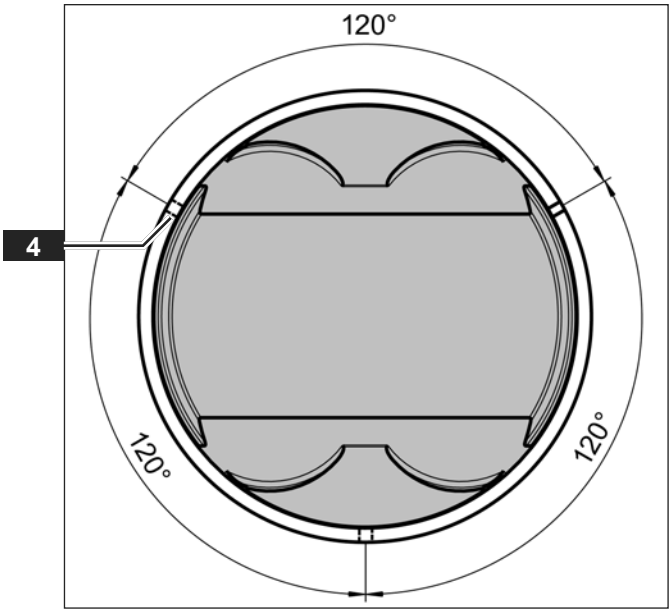
NOTICE! Serious damage to bearings due to con rod bearing shells being installed incorrectly.

► Insert the con rod bearing shells 2 centered on the con rod.

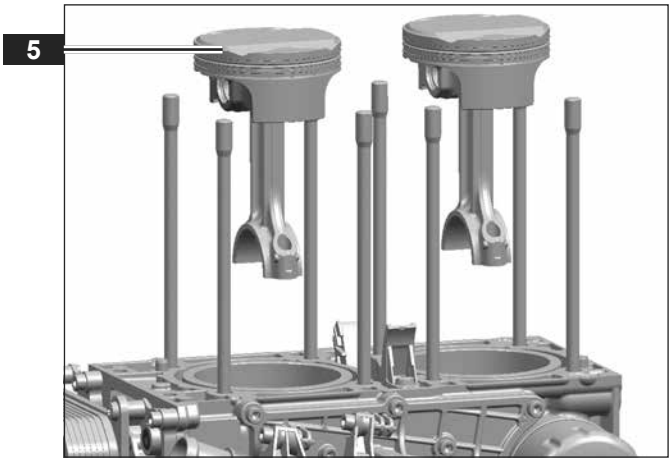
► Measure whether the dimensions "=" 3 are equal.



► Displace the ring joints 4 of the three piston rings 120°.

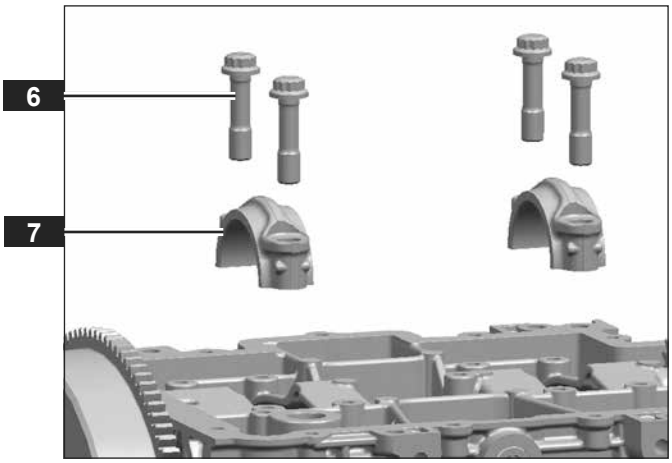


► Turn the engine 180°.
► Coat the pistons 5 lightly with engine oil.
► Slide in the pistons using a piston ring compressor.



► Turn the engine 180°.
► Insert con-rod covers 7.
► Replace the con-rod bolts 6.
► Tighten the con-rod bolts in three stages.

Tightening torque:
First stage 10 Nm [7.4 lbf ft]
Second stage 20 Nm [14.8 lbf ft]
Third stage +115°



020.01.07 Replacing piston

⚠ WARNING

Serious eye injuries due to a flying circlip.

When installing or removing the circlip, it can be thrown at great speed and cause serious eye injuries.

► Wear protective glasses, along with any bystanders.

NOTICE

Bearing damage, increased wear and leaks due to installing components swapped over.

All components in the crank drive are inserted together. If the components are installed swapped over, they no longer fit together well.

► When removing the components, mark the cylinder assignment and installation position.

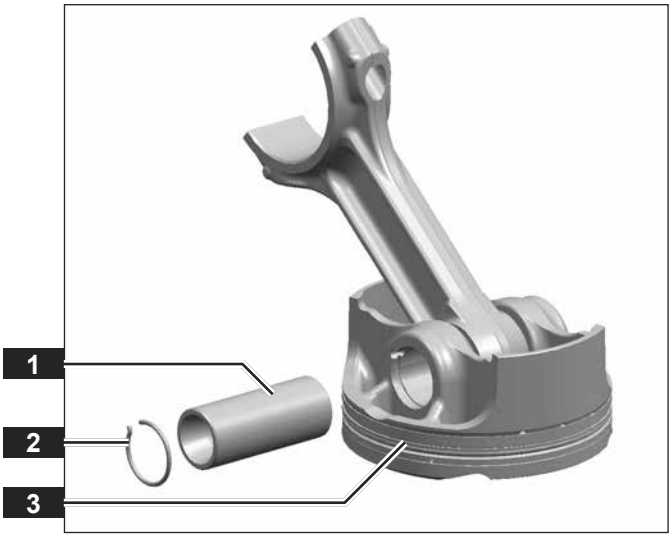
► Install all components back into the place from which they were removed.

The piston and con rod are removed.

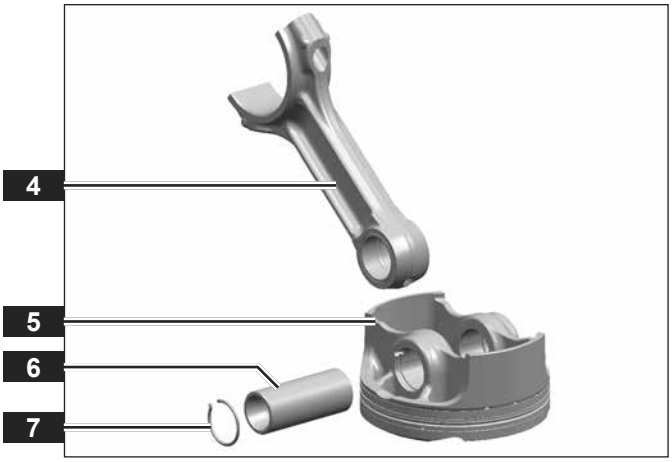
► Install the circlip 2 using a litte screwdriver.

► Pull the piston pin 1 out.

► Remove the piston 3.

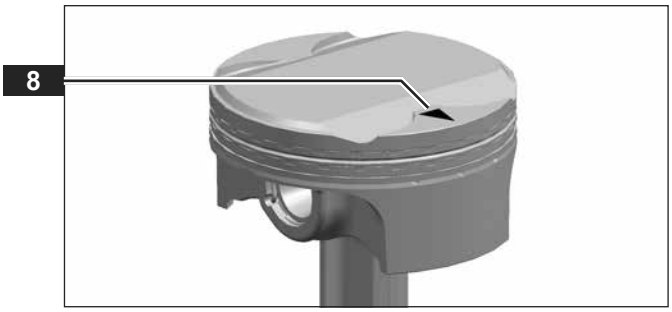


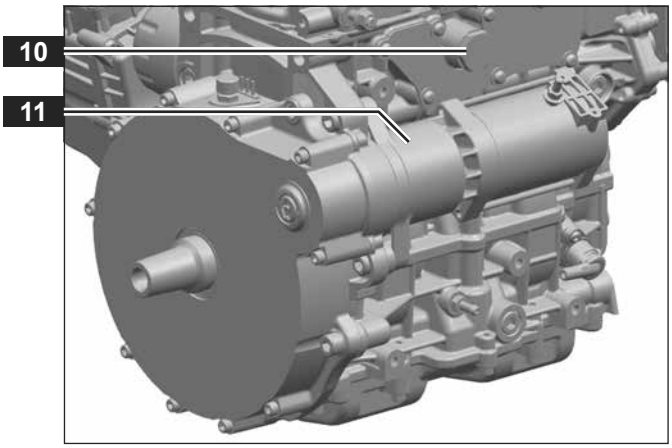
- ► Replace the piston 5.
- ► Install the circlip 7 using a litte screwdriver.
- ► Pull the piston pin 6 out.
- ► Hold the con rod 4 in position. Observe the piston's installation position.



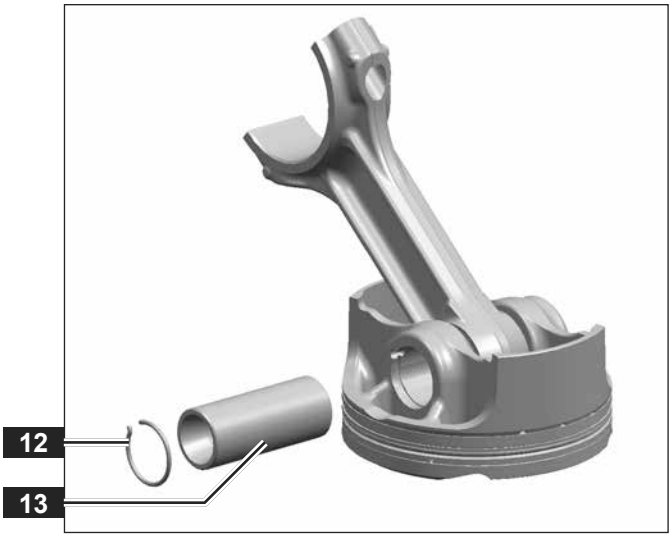
Installation position piston

Arrow on top 8 and inside arrow 9 in the direction of the chain tensioner 10 and starter 11.





- ► Coat the piston pin 13 lightly with engine oil.
- ► Slide in the piston pin.
- ► Install the circlip 12 using a litte screwdriver.



020.01.08 Replacing con rod

– 020.01.09 Checking con rod bearing play

WARNING

Serious eye injuries due to a flying circlip.

When installing or removing the circlip, it can be thrown at great speed and cause serious eye injuries.

► Wear protective glasses, along with any bystanders.

NOTICE

Bearing damage, increased wear and leaks due to installing components swapped over.

All components in the crank drive are inserted together. If the components are installed swapped over, they no longer fit together well.

► When removing the components, mark the cylinder assignment and installation position.

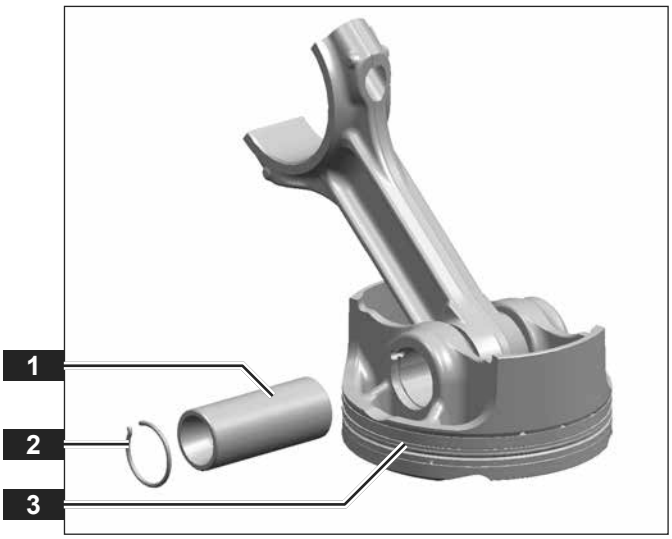
► Install all components back into the place from which they were removed.

The crankshaft, piston and con rod are removed.

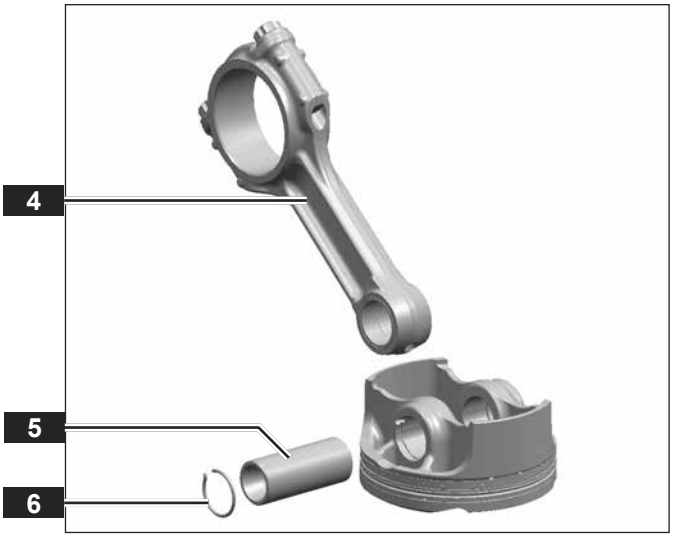
► Install the circlip 2 using a litte screwdriver.

► Pull the piston pin 1 out.

► Remove the piston 3.



- ► Replace the con rod 4.
- ► Hold the con rod in position.
- ► Coat the piston pin 5 lightly with engine oil.
- ► Slide in the piston pin.
- ► Install the circlip 6 using a litte screwdriver.
- ► Check the con rod bearing play. (See chapter 020.01.09 Checking con rod bearing play.)



020.01.09 Checking con rod bearing play

– Precision clearance gauges

– Con rod bearing shells in different thicknesses

Information! Con rod bolts are extension bolt and must be replaced after removal. However, when measuring the con rod bearing play, you can use the removed con rod bolts.

NOTICE

Bearing damage, increased wear and leaks due to installing components swapped over.

All components in the crank drive are inserted together. If the components are installed swapped over, they no longer fit together well.

► When removing the components, mark the cylinder assignment and installation position.

► Install all components back into the place from which they were removed.

The crankshaft, piston and con rod are removed.

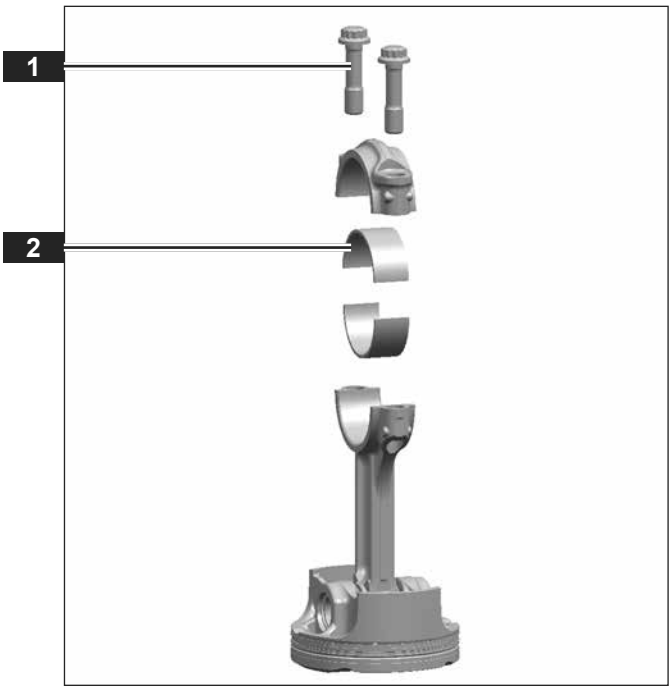
NOTICE! Bearing damage due to incorrect con rod bearing play. When replacing a con rod or the crankshaft, the con rod bearing play must be checked.

► Unscrew the con-rod bolts 1.

Use the removed con rod bearing shells.

► Coat the con rod bearing shells 2 lightly with engine oil.

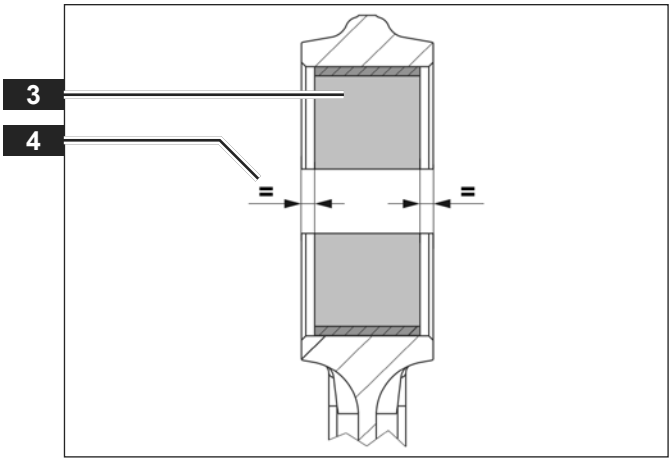
► Insert con rod bearing shells 2 in con rod and con rod cover. Observe the installation instructions for the con rod bearing.



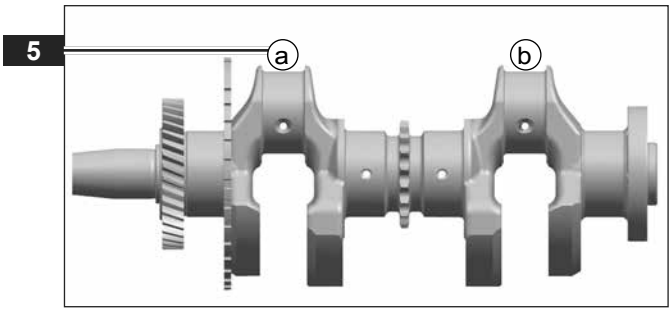
Installation instructions for the con rod bearings

NOTICE! Serious damage to bearings due to con rod bearing shells being installed incorrectly.

- ► Insert the con rod bearing shells **3** centered on the con rod.
- ► Measure whether the dimensions "=" **4** are equal.



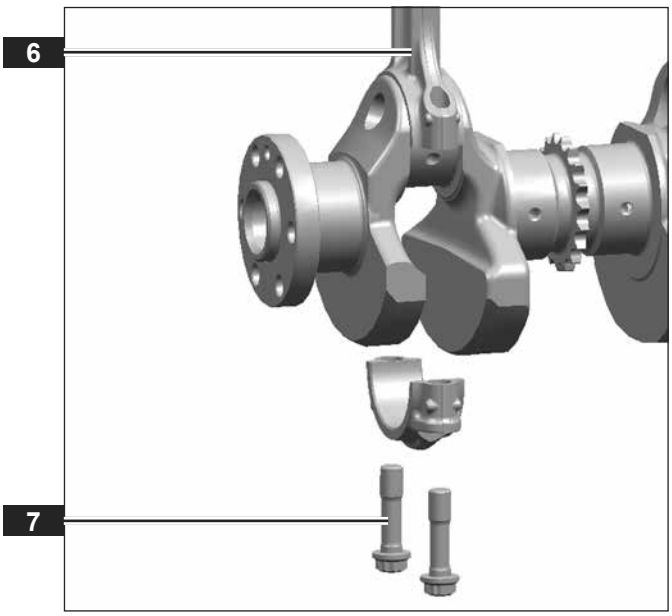
- ► Affix the precision clearance gauges to the bearing positions of the crankshaft **5** ⓐ or ⓑ according to the manufacturer's instructions.



- ► Hold the con rod **6** in position.
- ► Tighten the con-rod bolts **7** in three stages.

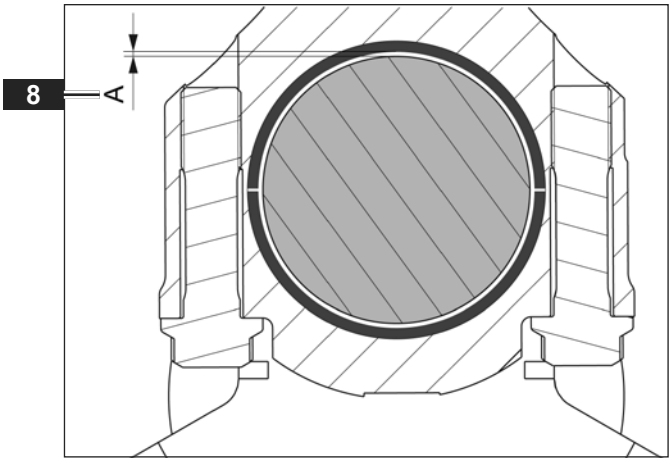
Tightening torque:
First stage 10 Nm [7.4 lbf ft]
Second stage 20 Nm [14.8 lbf ft]
Third stage +115°

- ► Unscrew the con-rod bolts.
- ► Remove the con rod.



► Read con rod bearing play "A" 8 on the precision clearance gauges according to the manufacturer's instructions.

Required con rod bearing play:
0,025 – 0,040 mm

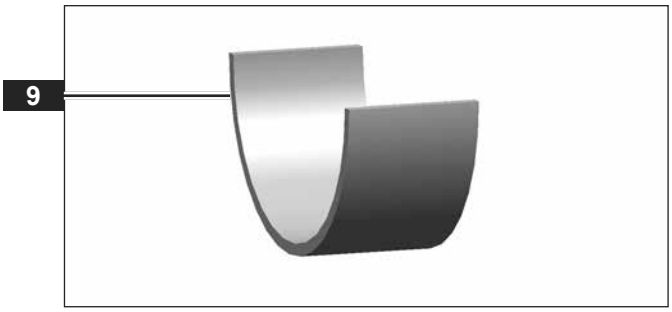


The thicknesses of the upper and lower con rod bearing shell may differ.

► If the con rod bearing play is incorrect, repeat the process using another con rod bearing shell thickness.

► Clean the bearing positions carefully.

The con rod bearing shells are marked on the side 9 in color. Each color represent a specific thickness of the con rod bearing shell.



Available thicknesses con rod bearing shells:

– Red 1,721 mm
– Yellow 1,726 mm
– Blue 1,731 mm
– Green 1,736 mm
– Brown 1,741 mm

020.01.10 Checking main bearing play

– Precision clearance gauges

– Main bearing shells in different thicknesses

NOTICE

Bearing damage, increased wear and leaks due to installing components swapped over.

All components in the crank drive are inserted together. If the components are installed swapped over, they no longer fit together well.

► When removing the components, mark the cylinder assignment and installation position.

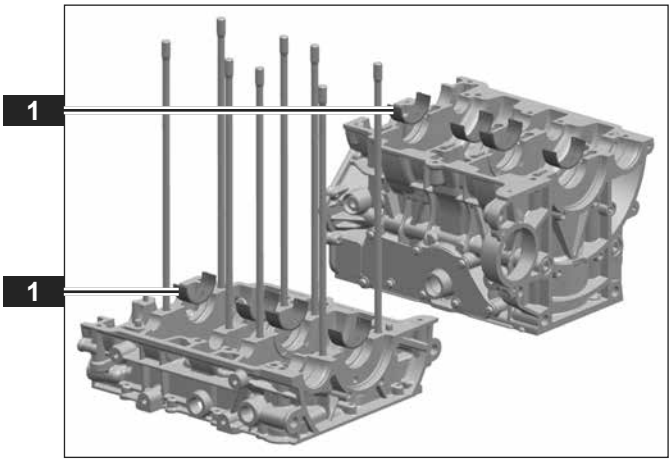
► Install all components back into the place from which they were removed.

The crankshaft, piston and con rod are removed.

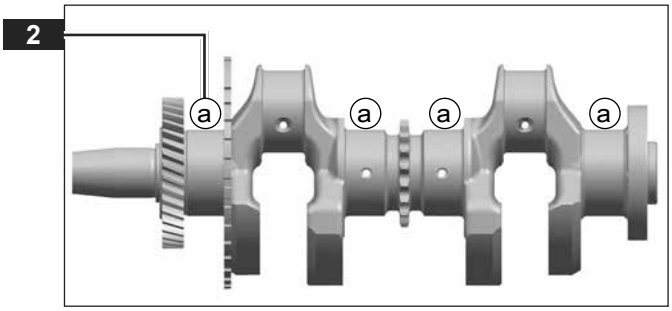
NOTICE! Bearing damage due to incorrect con rod bearing play. When replacing the crankcase or crankshaft, the main bearing play must be checked.

Use the removed main bearing shells.

► Insert main bearing shells **1** in crankcase.

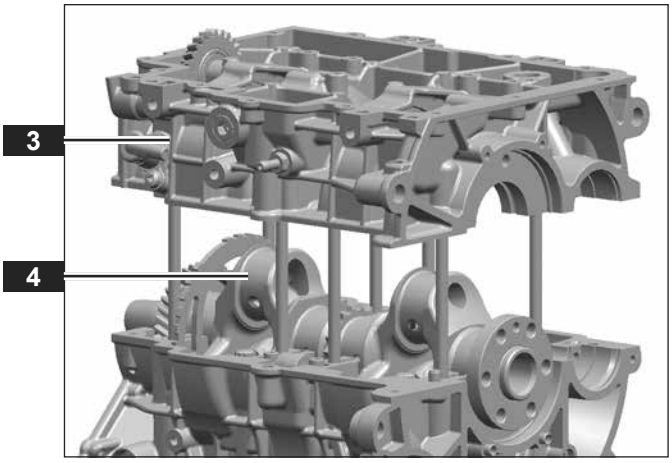


► Affix the precision clearance gauges to all bearing positions of the crankshaft **2** ⓐ according to the manufacturer's instructions.

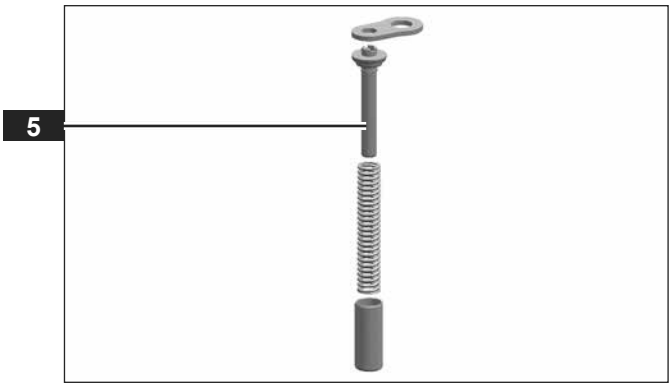


► Insert the crankshaft 4.

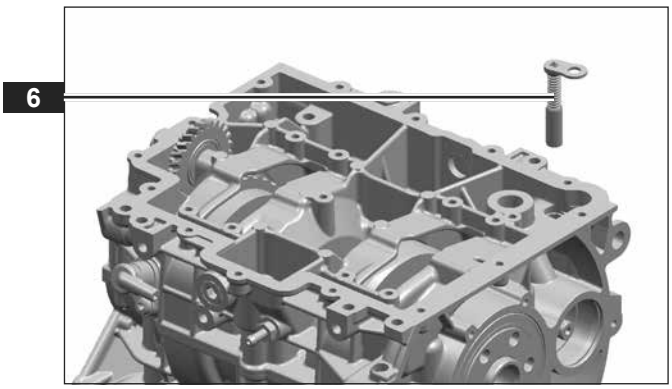
► Put the lower case 3 on.



► Assemble the oil pressure valve in the sequence as illustrated 5.



► Insert the oil pressure valve 6.



Screw in all bolts in the sequence as illustrated 7.

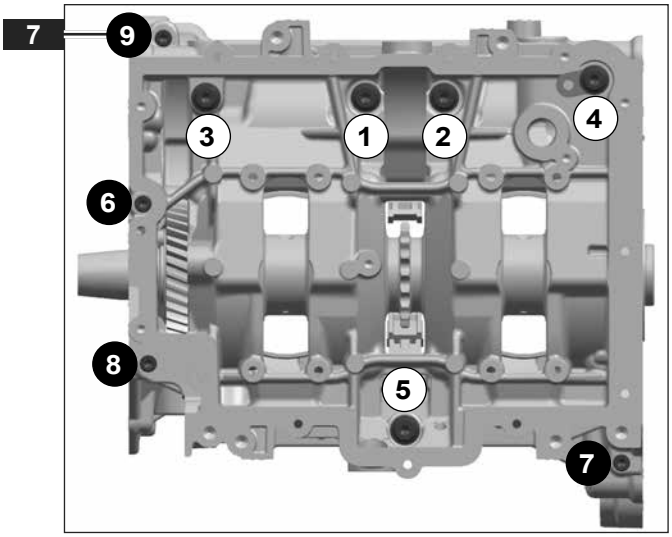
► Screw in 5 bolts M8 ① – ⑤.

Tightening torque:
9 Nm +1 Nm [6.6 lbf ft +0.7 lbf ft]

► Screw in 4 bolts M6 ❻ – ❾.

Tightening torque:
Maximum 5 Nm [3.7 lbf ft]

► Turn the engine 180°.

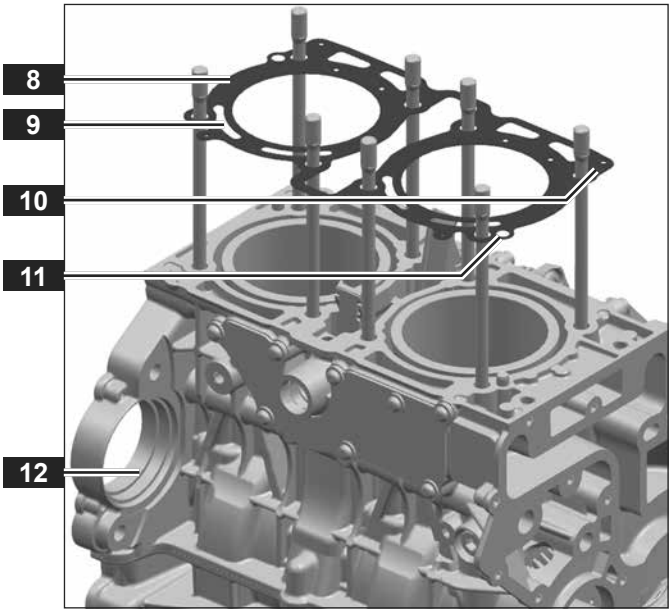


Information! The cylinder head gasket must be replaced after removal. However, when measuring the main bearing play, you can use the removed cylinder head gasket.

► Put the cylinder head gasket 8 on.

Observe the installation position:

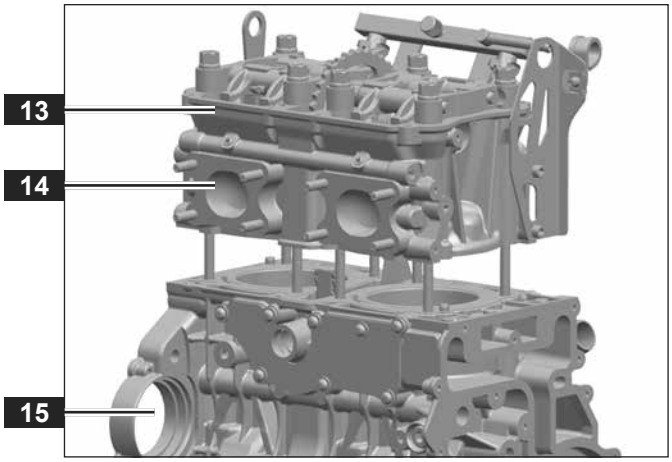
– Exhaust side 9
– Inscription 10
– Centering pins 11
– Starter side 12



► Put the cylinder head 13 on.

Observe the installation position:

– Exhaust side 14
– Starter side 15

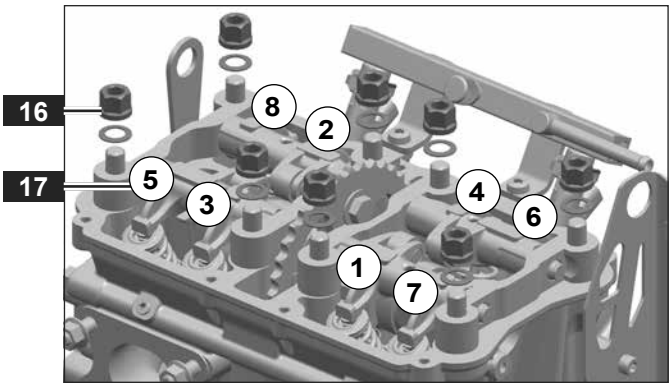


► Lubricate the nuts 16 with engine oil.

► Screw on the nuts by hand. Do not tighten.

► Tighten the nuts in the sequence as illustrated 17 in three stages.

Tightening torque:
First stage
20 Nm ±3 Nm [14.8 lbf ft ±2.2 lbf ft]
Second stage
40 Nm ±3 Nm [29.5 lbf ft ±2.2 lbf ft]
Third stage
180° ±4°



► Turn the engine 180°.

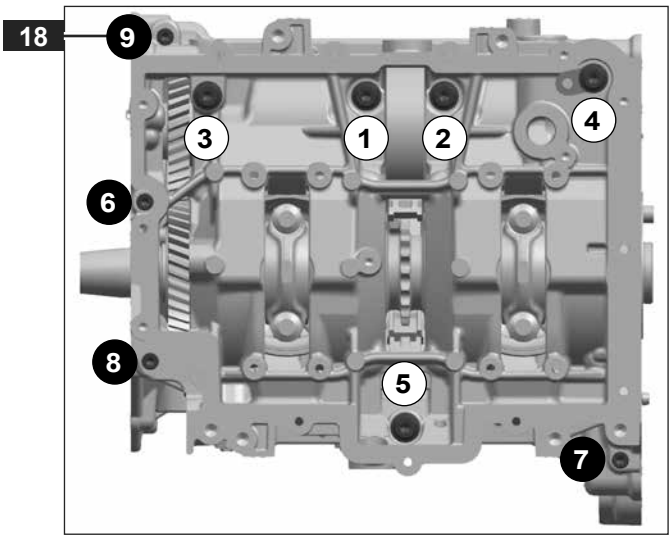
Tighten all bolts in the sequence as illustrated 18.

► Tighten 5 bolts M8 ① – ⑤.

Tightening torque:
23 Nm +2 Nm [17 lbf ft +1.5 lbf ft]

► Tighten 4 bolts M6 ❻ – ❾.

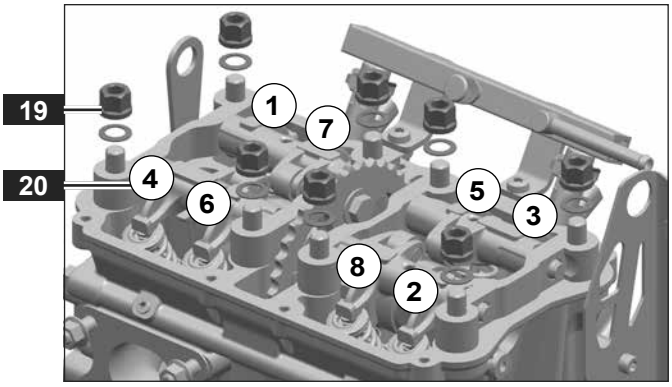
Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



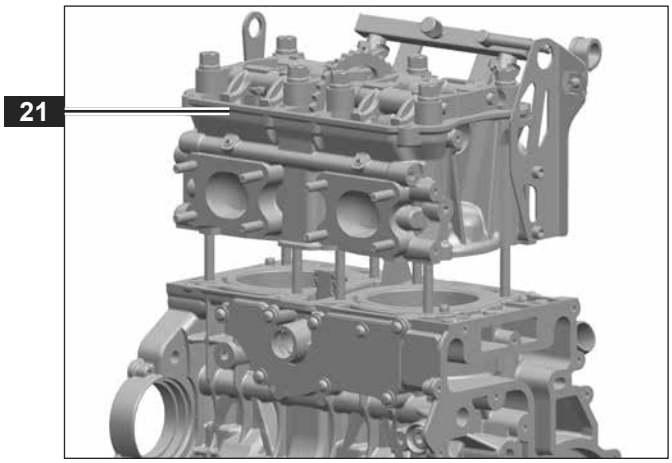
► Turn the engine 180°.

► Unscrew the nuts 19 in the sequence as illustrated 20.

The rocker arm and cross bars are no longer firmly attached to the cylinder head. Do not turn the cylinder head.



► Remove the cylinder head 21.

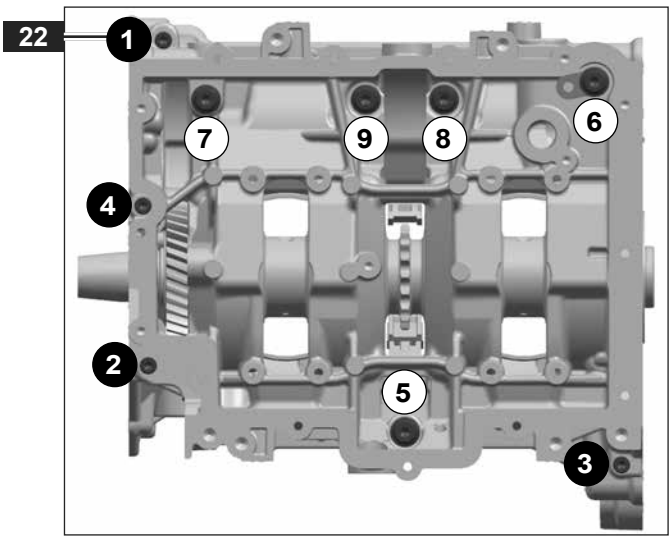


► Turn the engine 180°.

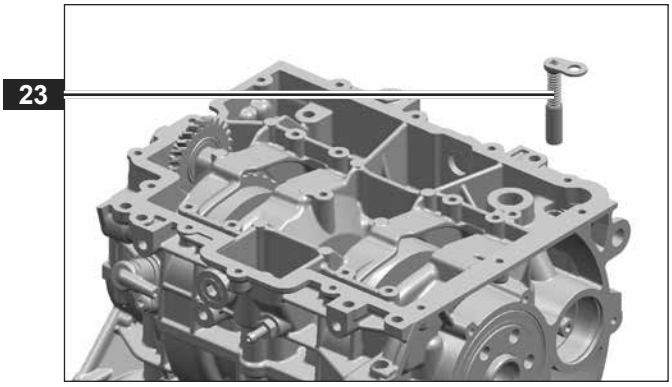
Unscrew all bolts in the sequence as illustrated 22.

► Unscrew 4 bolts M6 ❶ – ❹.

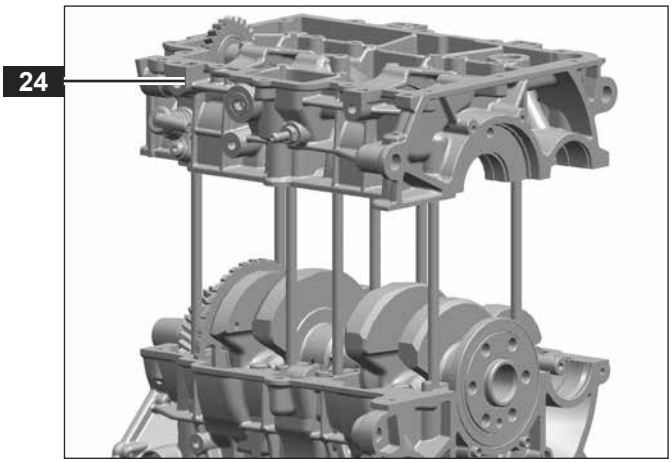
► Unscrew 5 bolts M8 ⑤ – ⑨.



► Pull the oil pressure valve 23 out using a bar magnet.

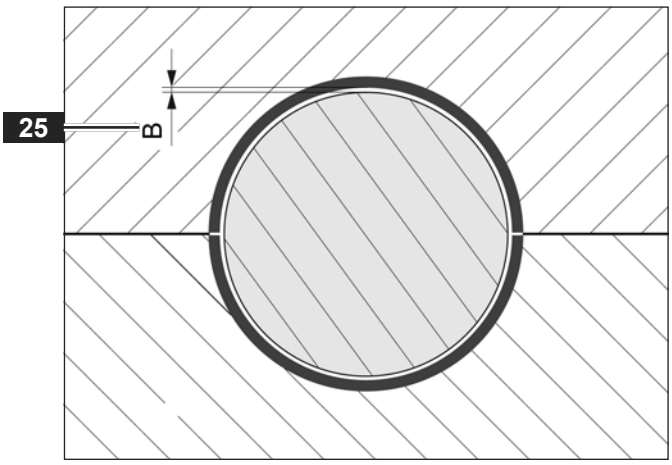


► Remove the lower case 24.



► Read main bearing play "B" 25 on the precision clearance gauges according to the manufacturer's instructions.

Required main bearing play:
0,04 – 0,06 mm



The thicknesses of the upper and lower main bearing shell may differ.

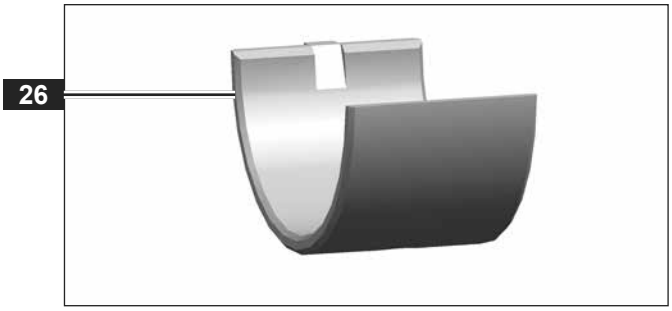
► If the main bearing play is incorrect, repeat the process using another main bearing shell thickness.

► Clean the bearing positions carefully.

The main bearing shells are marked on the side 26 in color. Each color represent a specific thickness of the main bearing shells.

Available thicknesses main bearing shells:

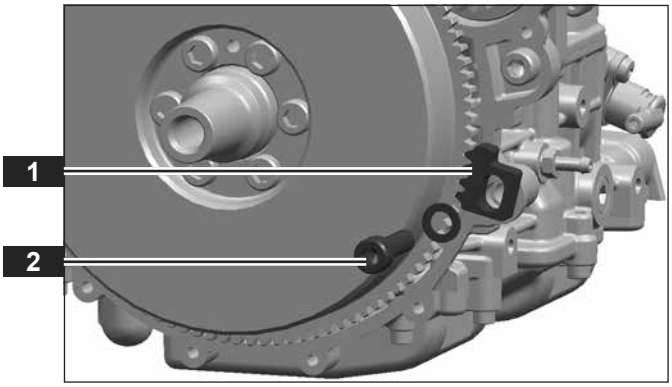
– Red 1,990 mm
– Yellow 1,995 mm
– Blue 2,000 mm
– Green 2,005 mm
– Brown 2,010 mm



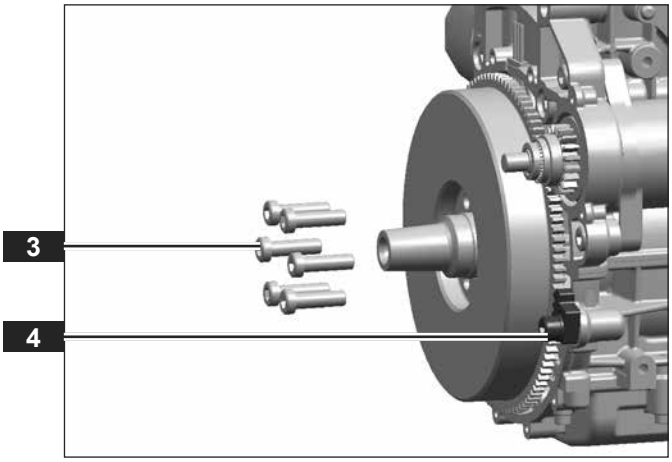
020.02.01 Removing stub shaft

– Locking tool crankshaft

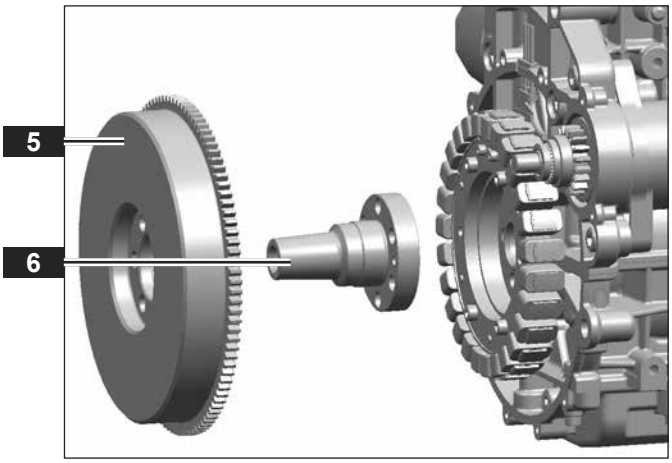
► Hold the locking tool crankshaft 1 on rotor.
► Screw in the bolt 2 and washer.



► Unscrew the bolts 3.
► Remove the locking tool crankshaft 4.



► Remove the rotor 5.
► Remove the stub shaft 6.



020.02.02 Installing stub shaft

– Locking tool crankshaft

– 6 Bolts M10x1x35

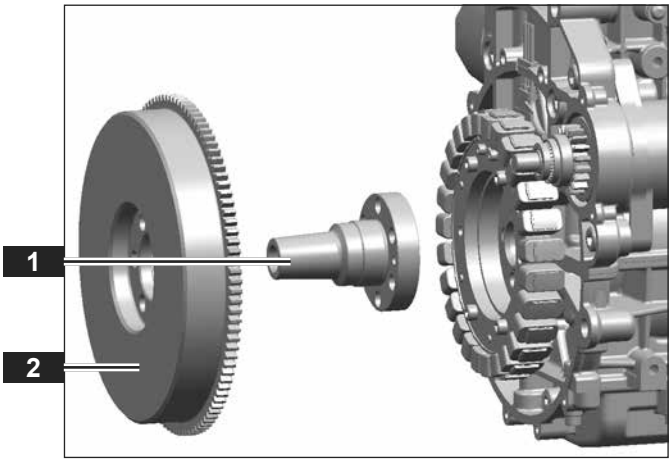
NOTICE

Leaks due to damage to the coating on the bolts.

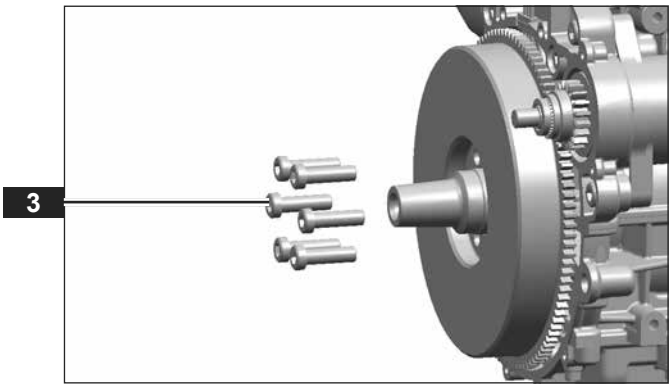
The threads of the 6 bolts on the rotor have a micro encapsulated coating. During fastening the bolt, the microcapsules will burst and the contained adhesive and curing agent are released and mixed. The coating begins to cure within a short time. If the bolts are moved again later, the coating becomes ineffective and engine oil can escape.

- ► Replace the bolts after removing.
- ► After inserting the bolts by hand, continue the task quickly until the bolts are tight.
- ► Never tighten the bolts again later.

- ► Hold the stub shaft **1** in position.
- ► Slide on the rotor **2**.

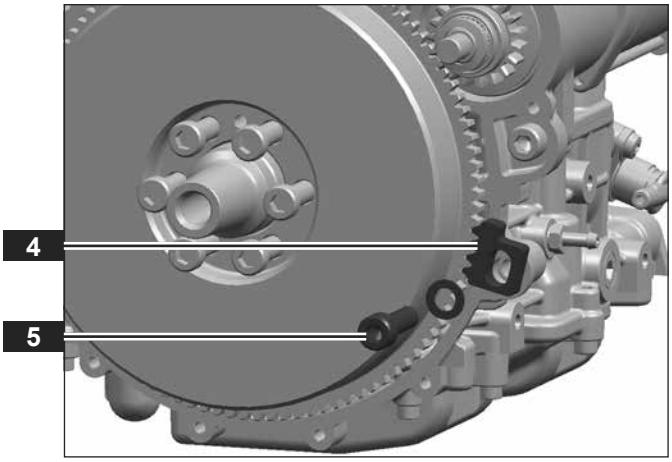


- ► Replace the bolts **3**.
- ► Screw in the bolts by hand. Do not tighten.



► Hold the locking tool crankshaft 4 on rotor.

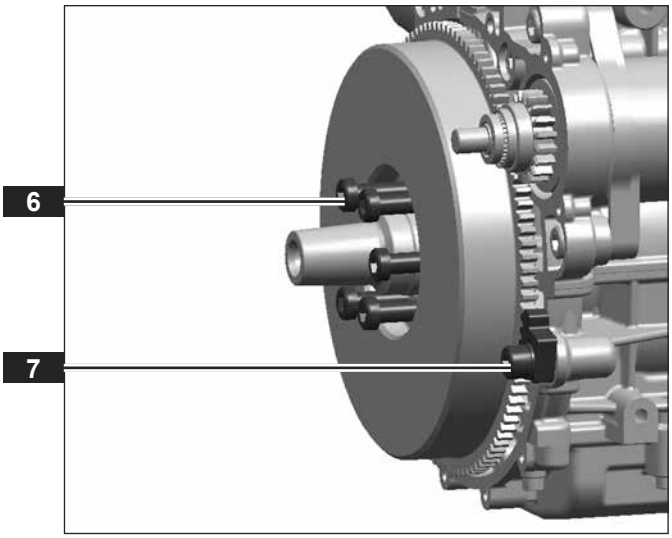
► Screw in the bolt 5 and washer.



► Tighten the bolts 6.

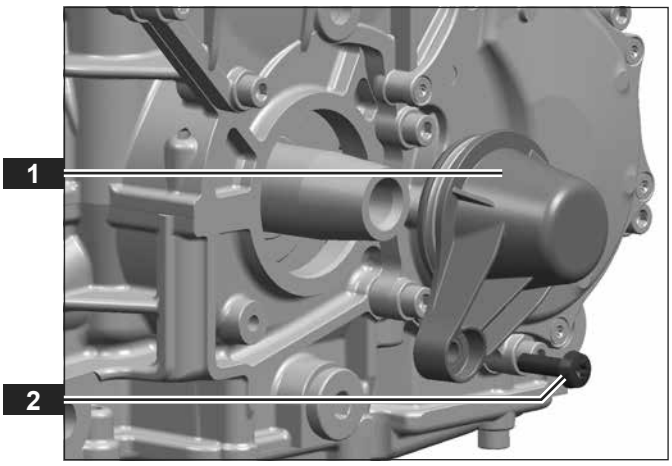
Tightening torque:
60 Nm +10 Nm [44.3 lbf ft +7.4 lbf ft]

► Remove the locking tool crankshaft 7.



020.03.01 Removing crankshaft cover

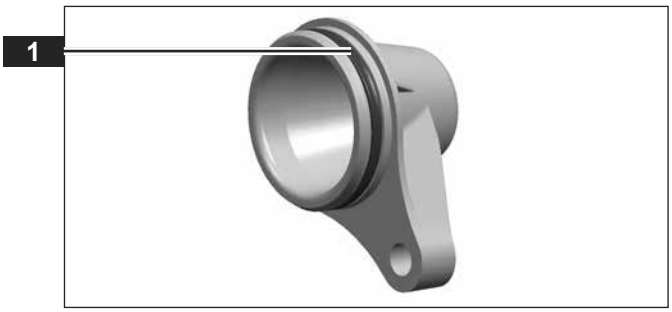
- ► Unscrew the bolt 2.
- ► Remove the cover 1.



020.03.02 Installing crankshaft cover

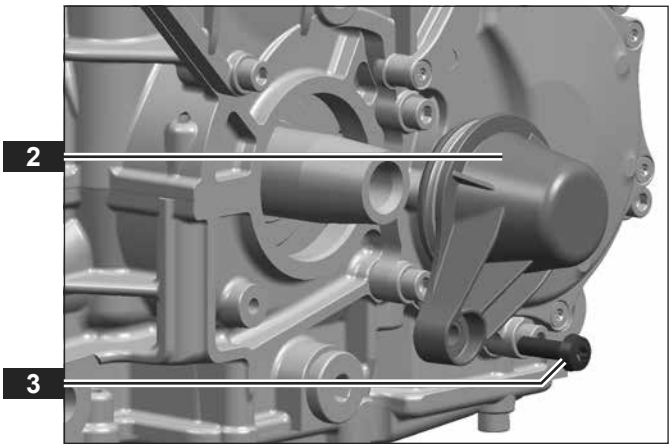
– 1 Gasket crankshaft cover

- ► Replace the gasket 1.
- ► Coat the gasket lightly with petroleum jelly.



- ► Insert the cover 2.
- ► Screw in the bolt 3.

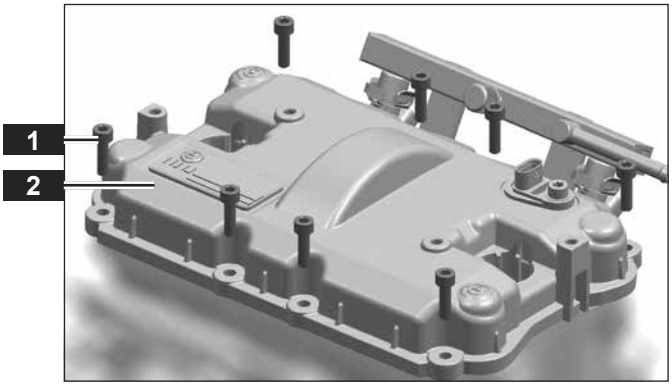
Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



030.01.01 Removing valve cover

► Unscrew the bolts 1.

► Remove the valve cover 2.

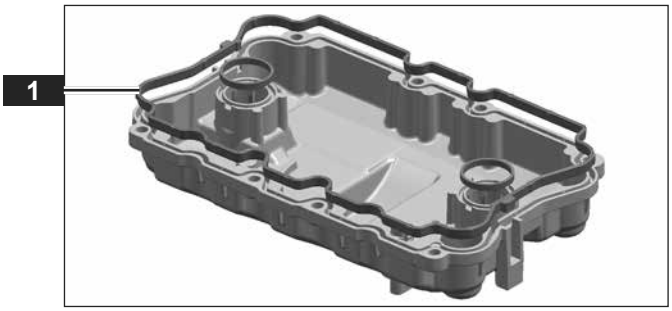


030.01.02 Installing valve cover

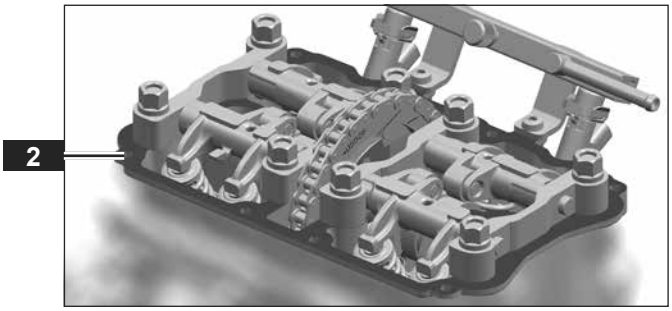
– 1 Sealing kit valve cover

– Anti-Seize assembly paste

► Replace the valve cover seals 1.



► Clean the sealing surface 2 with sealing surface cleaner.



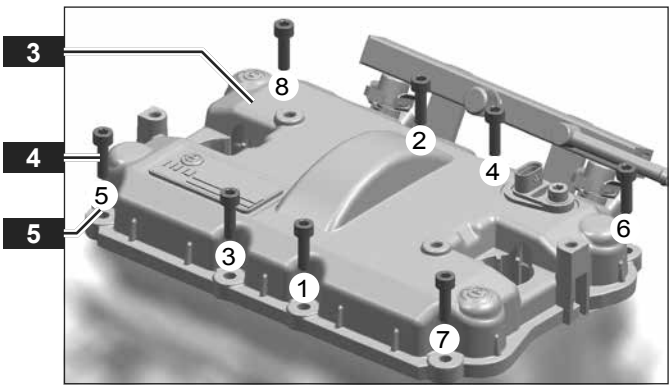
► Put the valve cover 3 on.

► Apply Anti-Seize assembly paste to all bolts 4.

► Screw in the bolts in the sequence as illustrated 5.

Tightening torque:

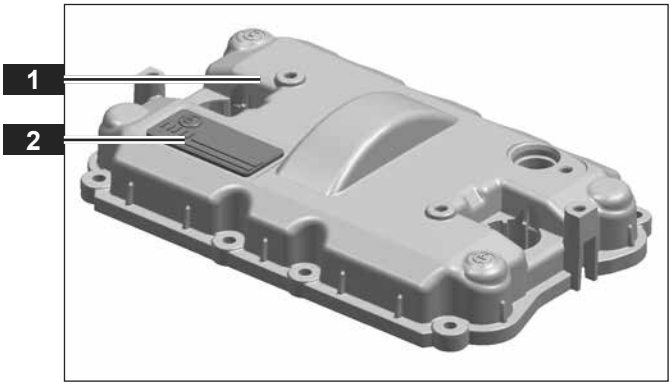
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



030.01.03 Replacing valve cover

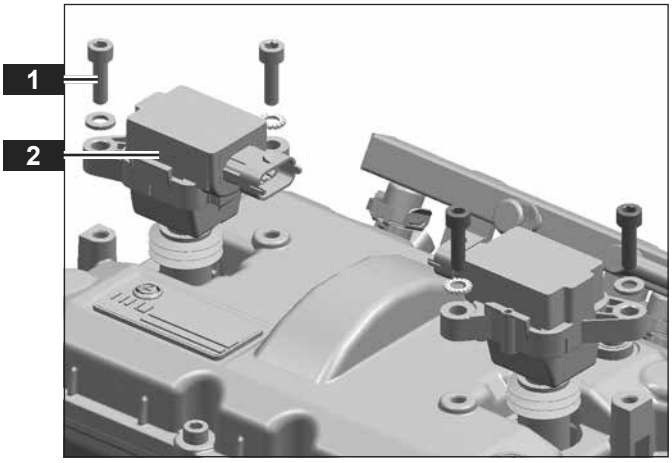
► Replace the valve cover 1.

► Affix the engine badge 2 included with the valve cover.



030.01.04 Removing ignition coils

- ► Unscrew the bolts 1.
- ► Pull the ignition coils 2 out.

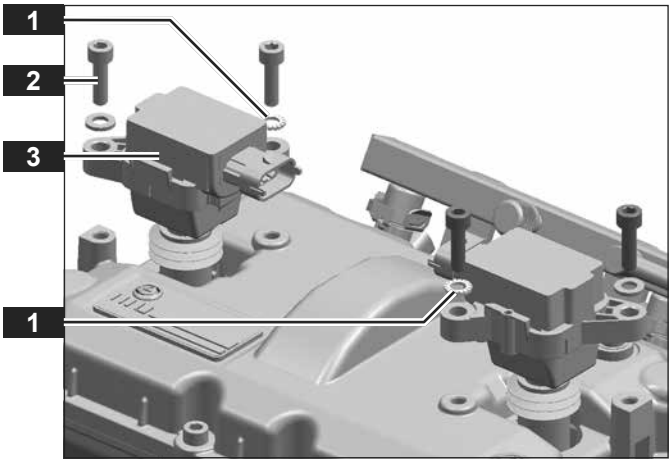


030.01.05 Installing ignition coils

– 2 Serrated lock washers

- ► Insert the ignition coils 3.
- ► Replace the serrated lock washers 1.
- ► Screw in the bolts 2. Observe the arrangement of the serrated lock washers and washers.

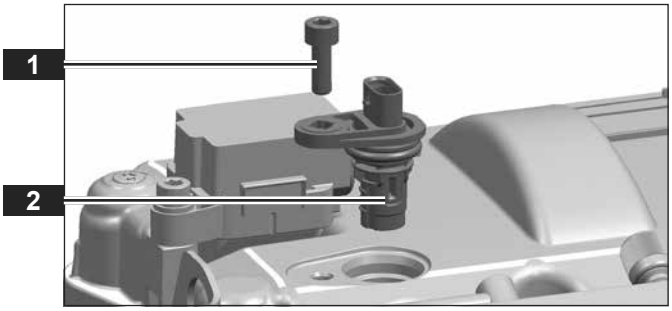
Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



030.01.06 Removing sensor camshaft

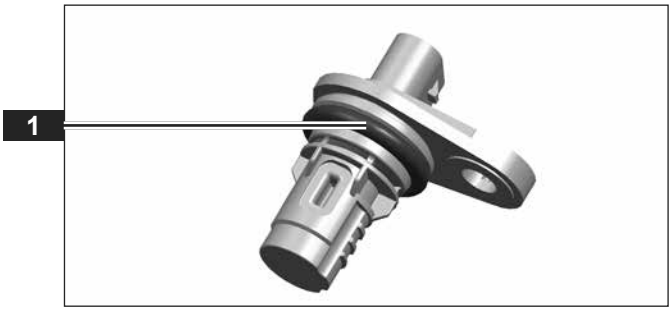
► Unscrew the bolt 1.

► Pull the sensor camshaft 2 out.



030.01.07 Installing sensor camshaft

► Coat the o-ring 1 lightly with petroleum jelly.

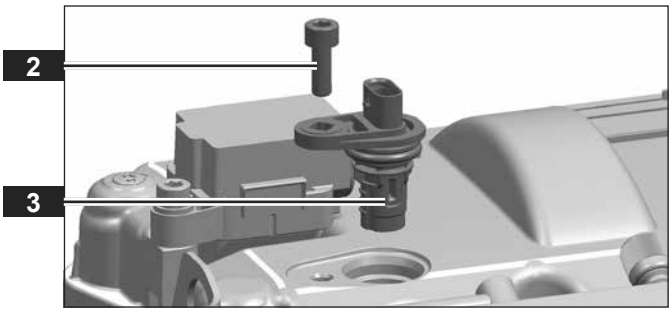


► Insert the sensor camshaft 3.

► Screw in the bolt 2.

Tightening torque:

8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



030.02.01 Removing cylinder head

– Chain tool

– Instruction manual chain tool

NOTICE

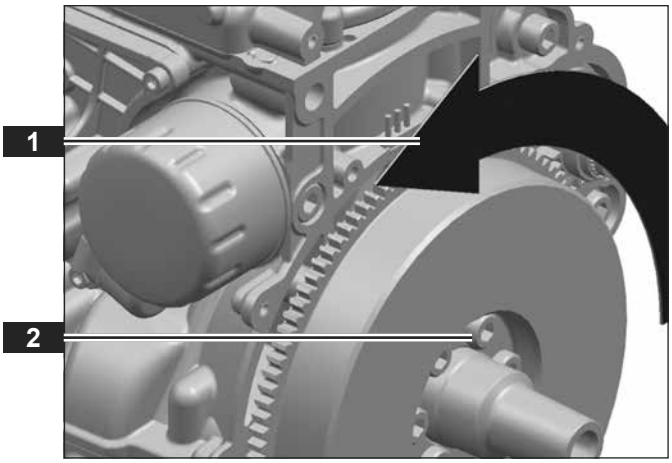
Engine damage from small components in the engine or cylinder head.

Operating the engine when there are small components in the crankcase and cylinder head can result in serious damage and cause the crank drive to seize.

► When removing small components, always cover the chain channel.

Setting valve timing

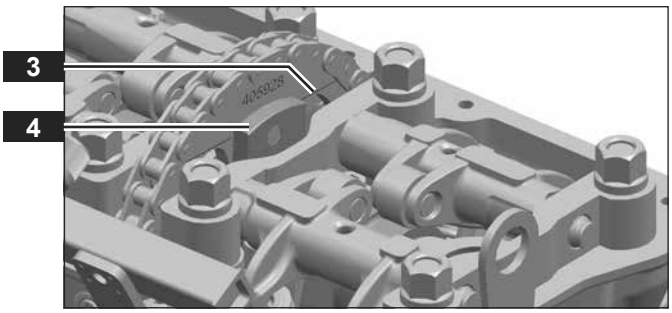
► Turn the crankshaft on a bolt 2 in the direction shown 1 until the camshaft stops as shown in the following figure.



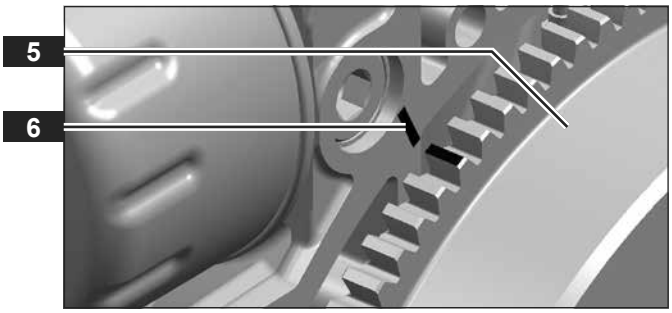
► Check whether the camshaft is at the crossing point.

The position of the camshaft is as illustrated 4.

The marking 3 ends flush with the cross bar.



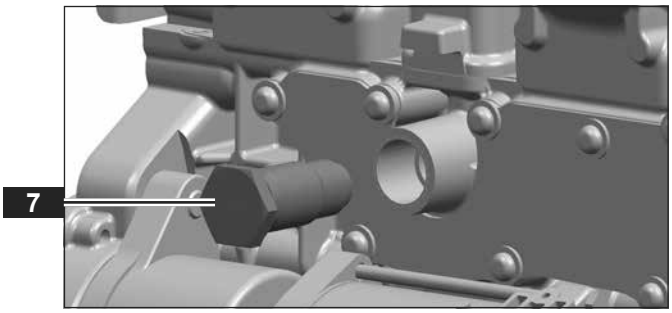
► Mark the position of the rotor 5 to the crankcase 6.



► Unscrew the chain tensioner 7.

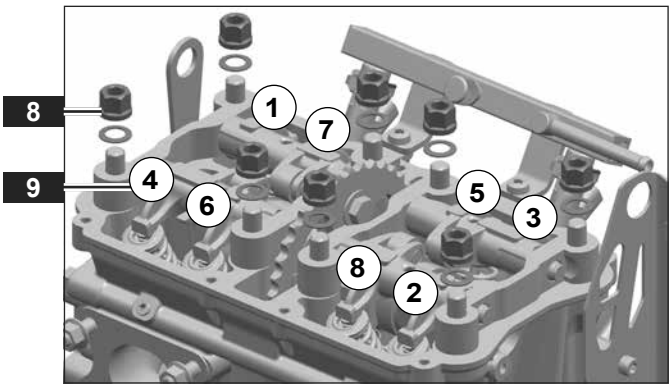
► Open the timing chain. (See the instruction manual of the chain tool.)

► Secure the ends of the timing chain.

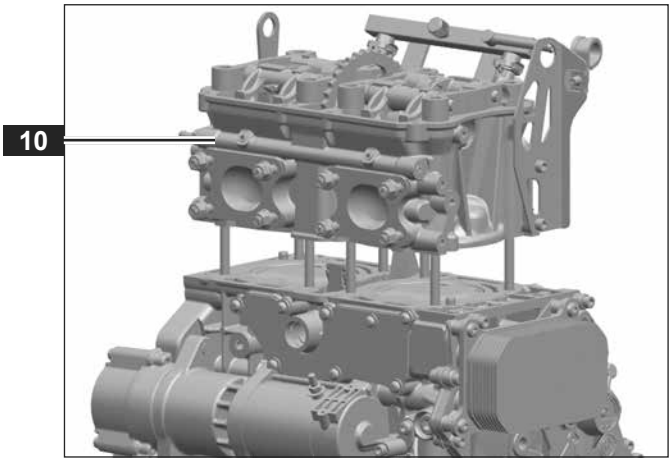


► Unscrew the nuts 8 in the sequence as illustrated 9.

The rocker arm and cross bars are no longer firmly attached to the cylinder head. Do not turn the cylinder head.



► Remove the cylinder head 10.



030.02.02 Installing cylinder head

– Chain tool
– 12-point socket wrench 12

– Instruction manual chain tool
– Service manual of the engine

– 1 Cylinder head gasket
– 1 Chain tensioner
– 1 Chain link

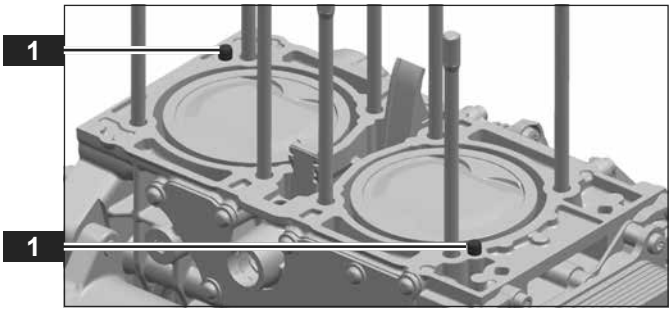
NOTICE

Engine damage from small components in the engine or cylinder head.

Operating the engine when there are small components in the crankcase and cylinder head can result in serious damage and cause the crank drive to seize.

► When removing small components, always cover the chain channel.

► Check if the centering pins 1 are installed.

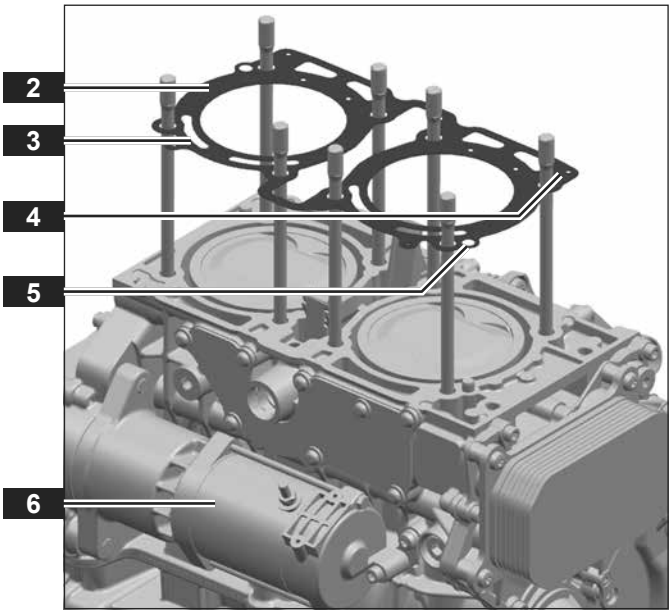


► Replace the cylinder head gasket 2.

► Put the cylinder head gasket on.

Observe the installation position:

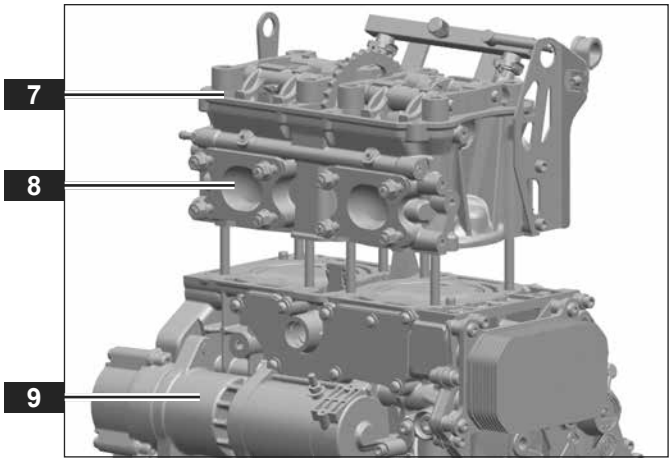
– Exhaust side 3
– Inscription 4
– Centering pins 5
– Starter 6



► Put the cylinder head 7 on.

Observe the installation position:

– Exhaust side 8
– Starter 9

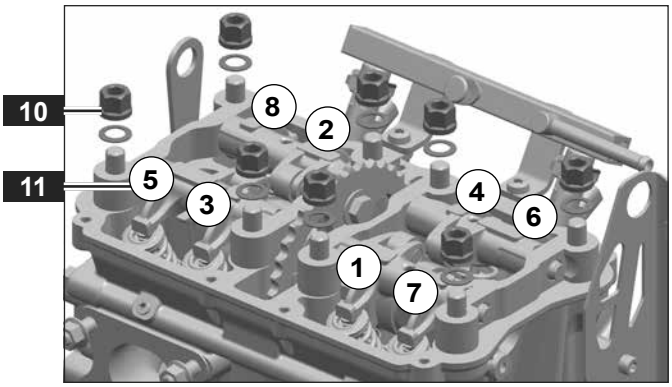


► Lubricate the nuts 10 with engine oil.

► Screw on the nuts by hand. Do not tighten.

► Tighten the nuts in the sequence as illustrated 11 in three stages.

Tightening torque:
First stage
20 Nm ±3 Nm [14.8 lbf ft ±2.2 lbf ft]
Second stage
40 Nm ±3 Nm [29.5 lbf ft ±2.2 lbf ft]
Third stage
180° ±4°



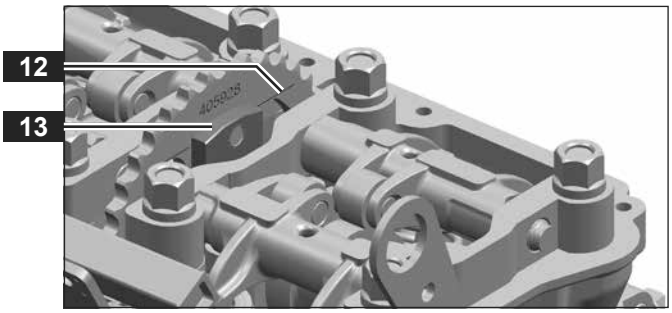
Setting valve timing

► Check whether the camshaft is at the crossing point.

The position of the camshaft is as illustrated 13.

The marking 12 ends flush with the cross bar.

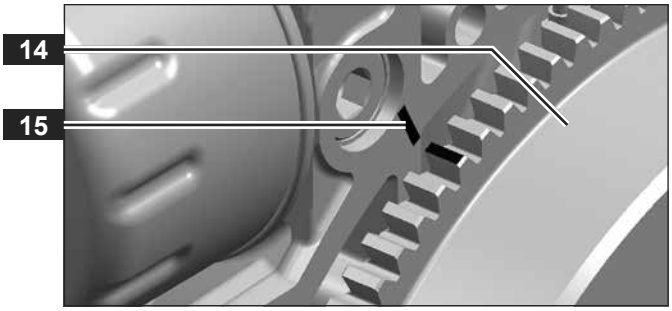
► If the camshaft does not appear as shown, turn it.



► Check whether the crankshaft is at TDC (Top Dead Center).

The markings 15 fit together.

► If the markings do not line up, turn the rotor 14.



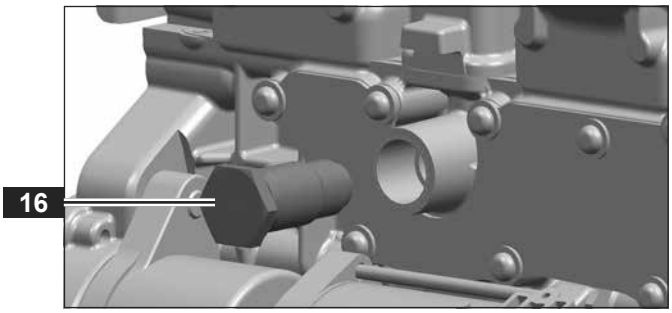
► Close the timing chain. (See the instruction manual of the chain tool.)

► Replace the chain tensioner 16.

► Screw in the chain tensioner.

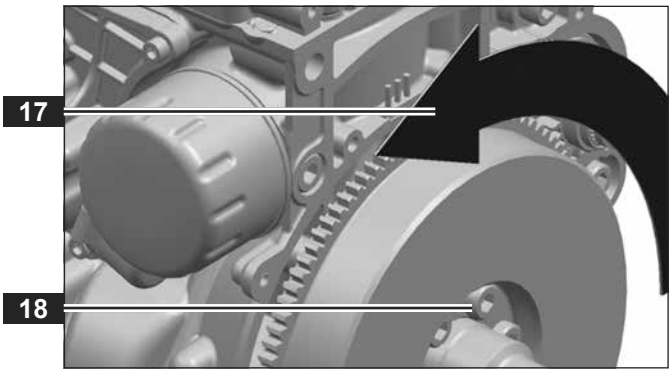
Tightening torque:

40 Nm +5 Nm [29.5 lbf ft +3.7 lbf ft]



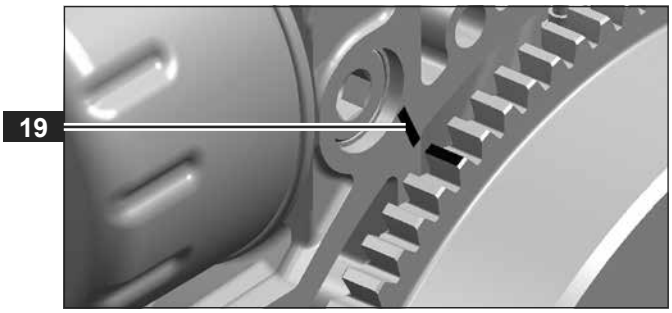
Checking valve timing

► Turn the crankshaft on a bolt 18 several times in the direction shown 17.



► Turn the crankshaft on a bolt in the direction shown until the crankshaft is at TDC (Top Dead Center).

The markings 19 fit together.



► Check whether the camshaft is at the crossing point.

The position of the camshaft is as illustrated 21.

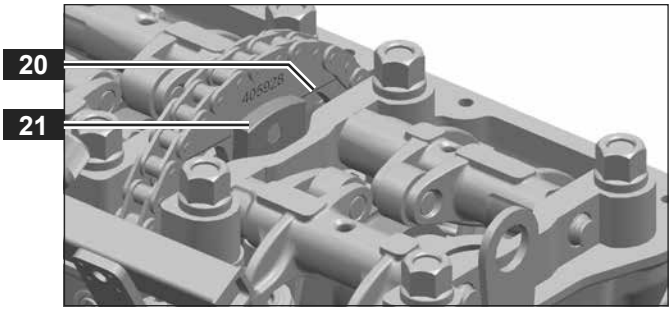
The marking 20 ends flush with the cross bar.

► If the camshaft does not appear as shown, set the valve timing again.

or

► If the camshaft does not appear as shown several times, replace the timing chain. (See chapter 040.01.02 Replacing timing chain.)

► Check the valve lash. (See the service manual of the engine.)



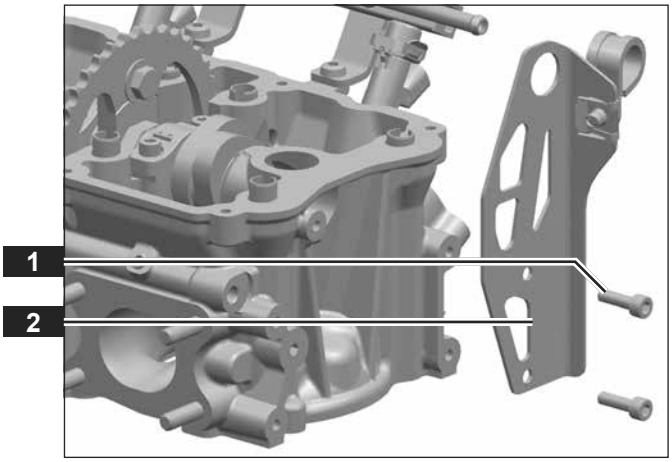
030.02.03 Replacing cylinder head

– Remover bearing cap
– Stud extractor

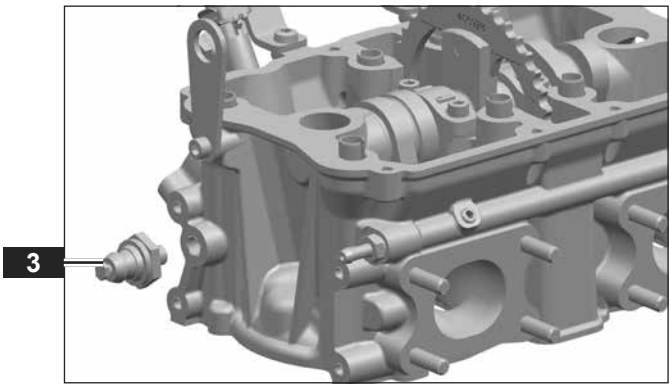
– Lubricant for injectors o-rings
– Thread sealant

– 1 Seal 8x12x1 Al
– 1 Plug M8x1
– 1 Plug M10x1

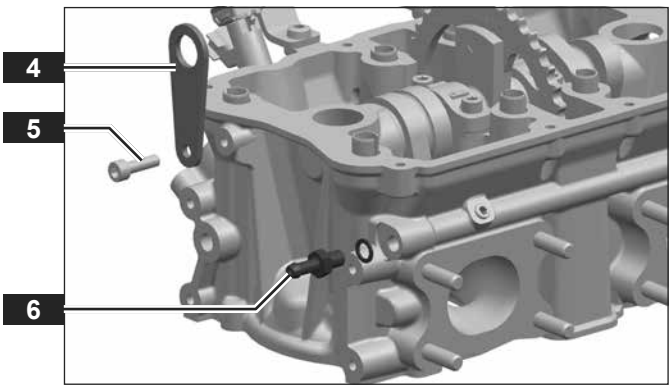
► Unscrew the bolts 1.
► Remove the bracket 2.



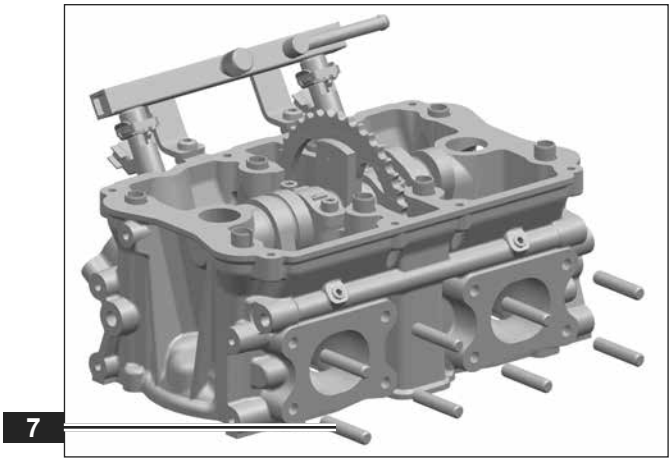
► Unscrew the switch oil pressure 3.



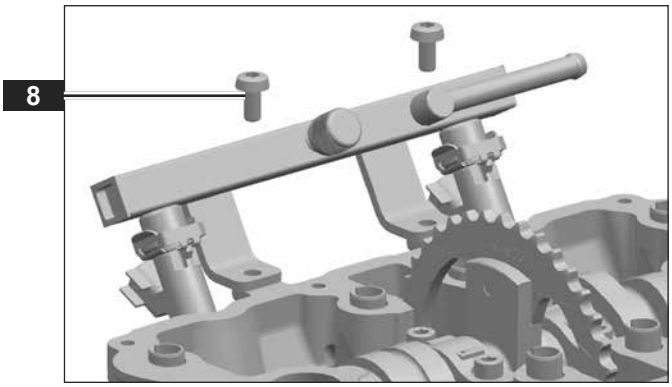
► Unscrew the bolt 5.
► Remove the bracket 4.
► Unscrew the fitting 6.



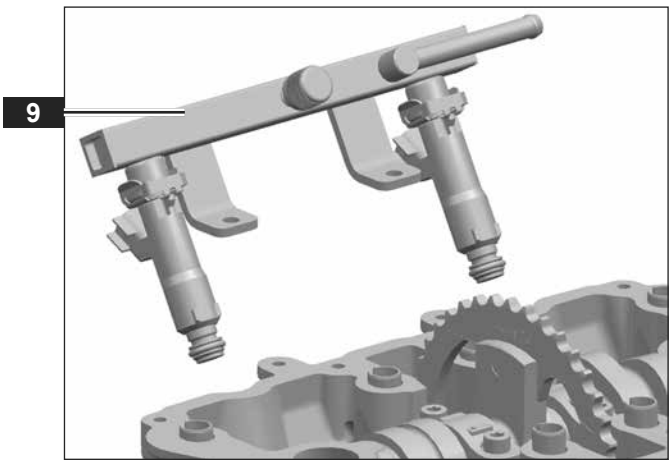
► Unscrew the studs 7 using a stud extractor.



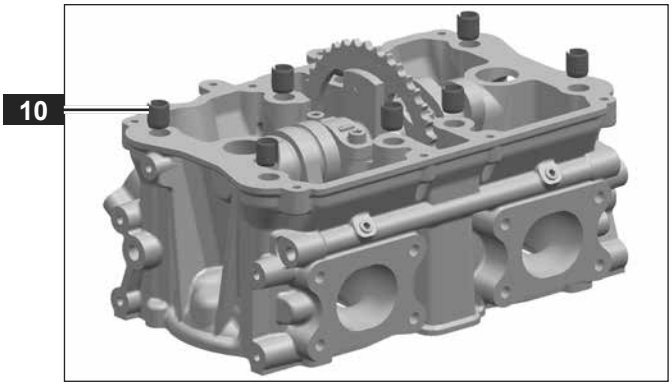
► Unscrew the bolts 8.



► Remove the fuel rail 9.

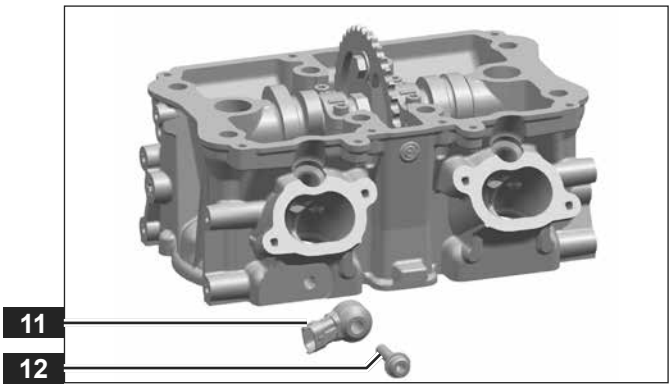


► Remove the sleeves 10.

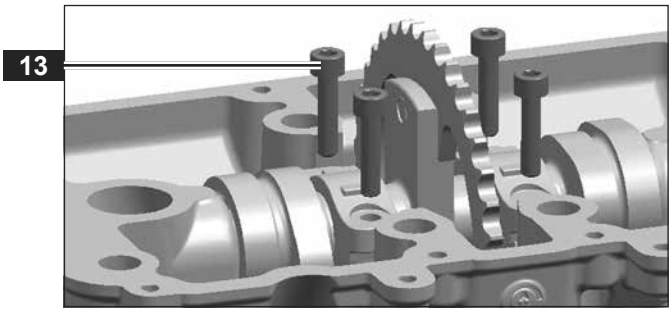


► Unscrew the bolt 12.

► Remove the sensor knock 11.

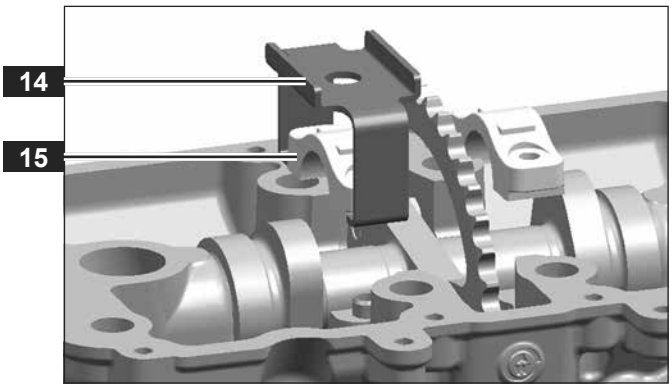


► Unscrew the bolts 13.

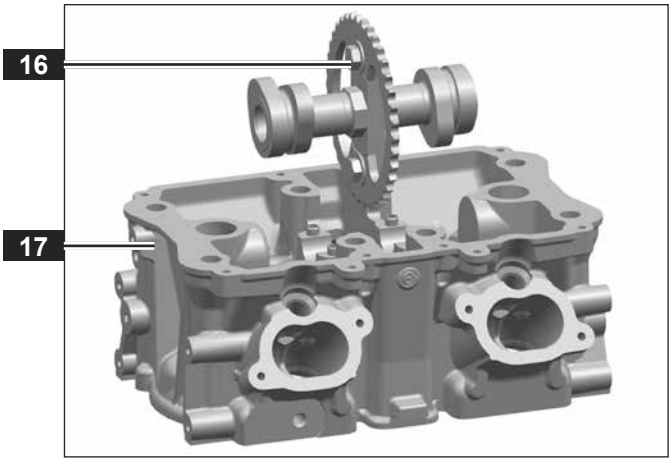


The hole in the remover bearing cap is provided for mounting a slide hammer.

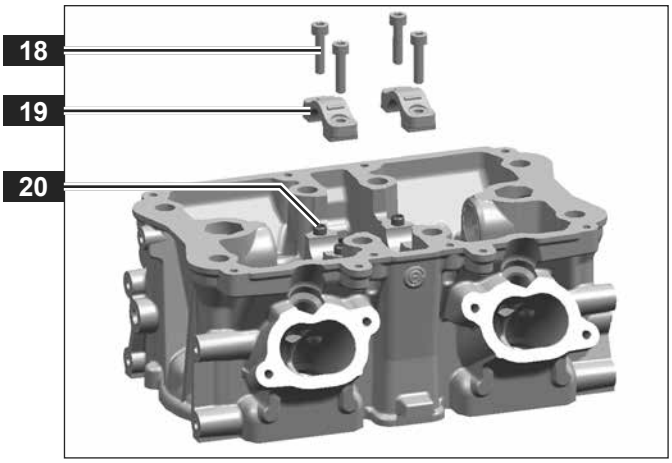
► Remove the bearing cap 15 using the remover bearing cap 14.



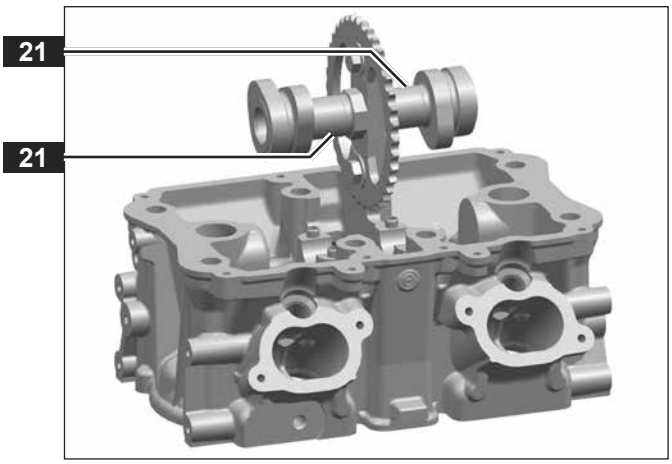
► Remove the camshaft 16.
► Replace the cylinder head 17.



► Unscrew the bolts 18.
► Remove the bearing cap 19.
► Check if the sleeves 20 are installed.



► Coat the camshaft on the bearing surfaces 21 lightly with engine oil.

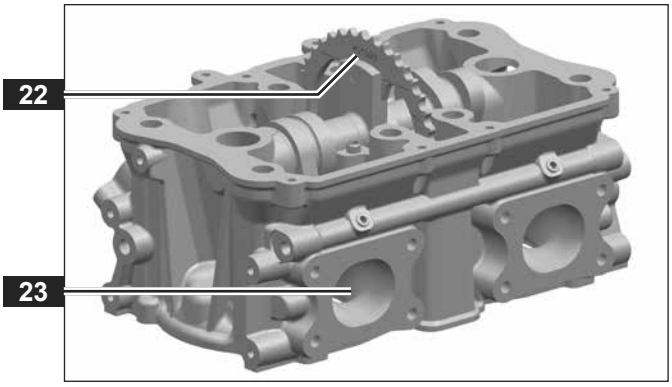


► Insert the camshaft.

The camshaft is marked at the 1st cylinder end only.

Observe the installation position:

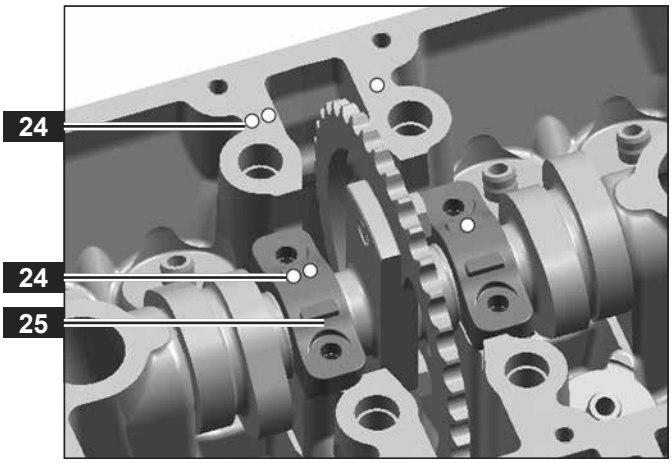
– Inscription 22
– Exhaust side 23



NOTICE! Bearing damage due to the bearing cap being installed incorrectly. The bearing surfaces for supporting the camshaft in the cylinder head and in the bearing cap are processed together. Therefore, only use the bearing cap originally installed. Observe the markings 24 during installation.

► Insert the bearing cap 25.

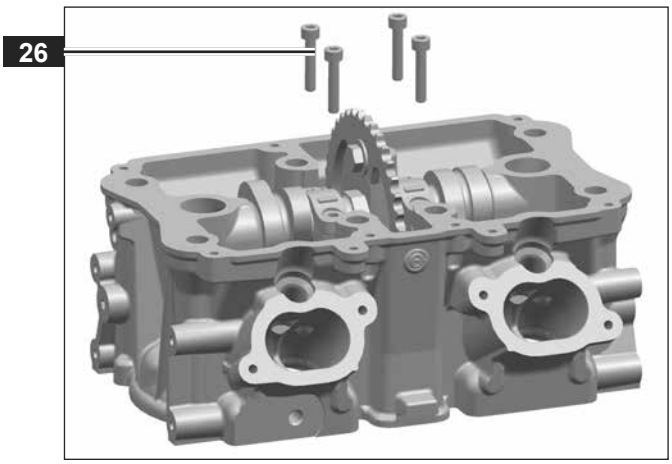
Observe the installation position.



► Screw in the bolts 26.

Tightening torque:

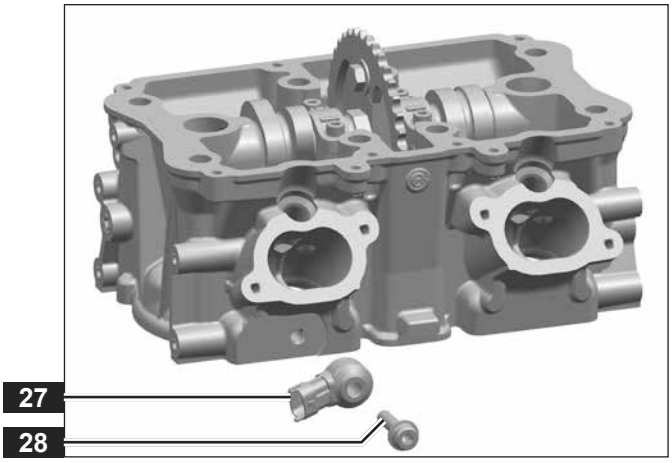
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



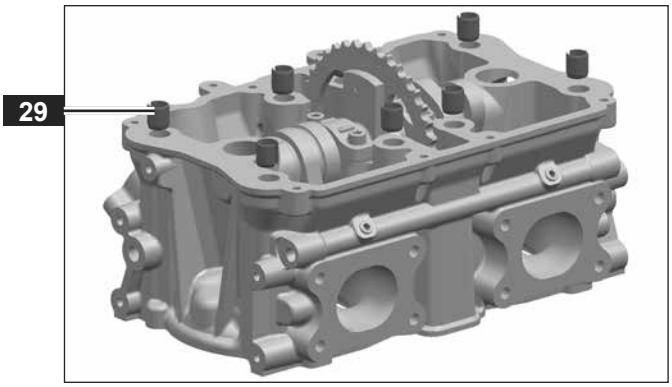
► Hold the sensor knock 27 in position.

► Screw in the bolt 28.

Tightening torque:
20 Nm +4 Nm [14.8 lbf ft +3 lbf ft]

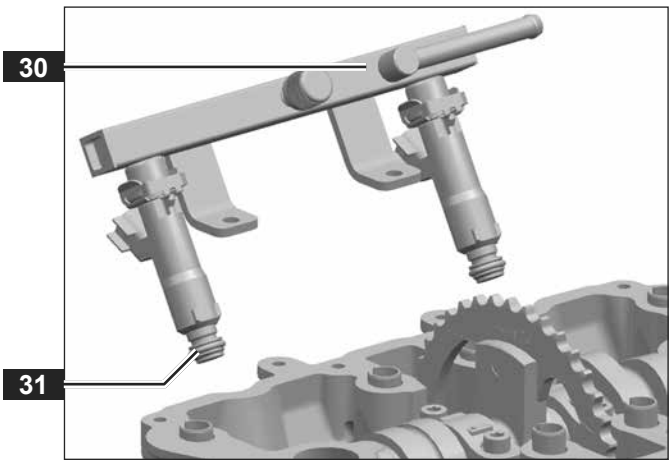


► Insert the sleeves 29.



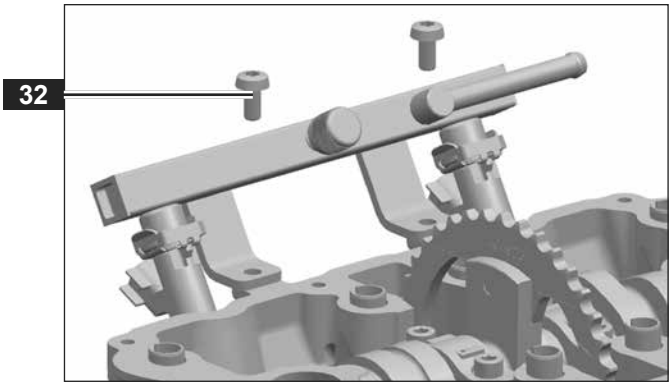
► Coat the o-rings 31 lightly with lubricant.

► Insert the fuel rail 30.



► Screw in the bolts 32.

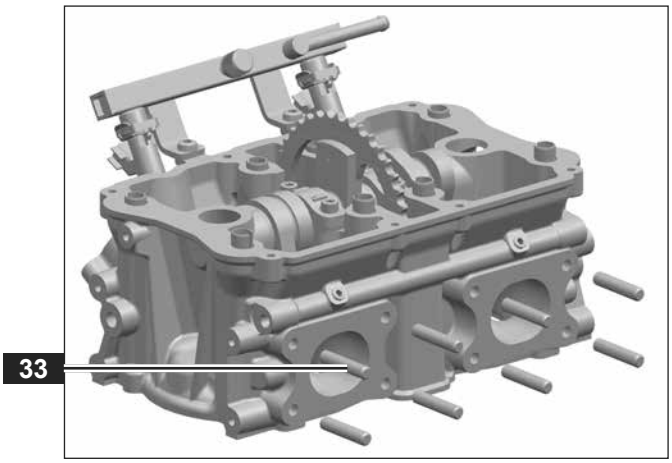
Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



► Apply Anti-Seize assembly paste to all studs 33.

► Screw in the studs using a stud extractor.

Tightening torque:
16 Nm +4 Nm [11.8 lbf ft +3 lbf ft]



► Hold the bracket 34 in position as illustrated.

► Coat the thread on the bolt 35 with high strength thread locker.

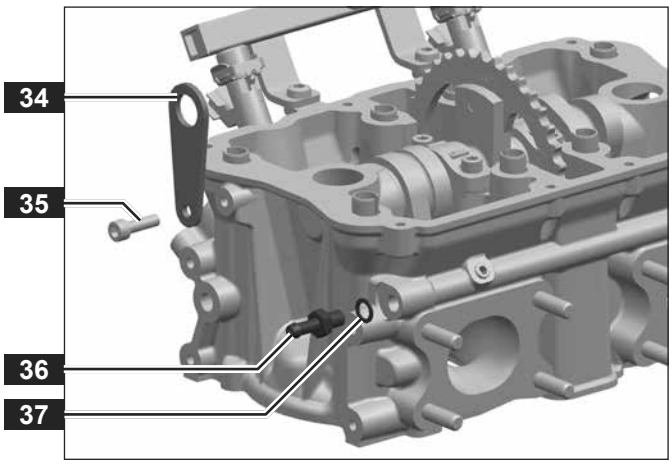
► Screw in the bolt.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]

► Replace the seal 38.

► Screw in the fitting 37.

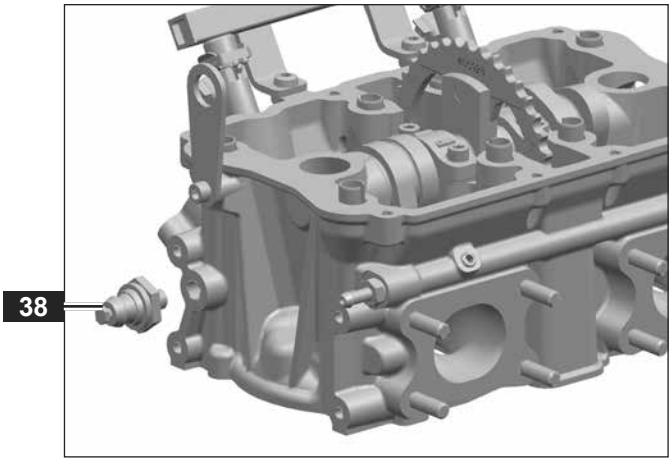
Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



► Coat the thread on the switch oil pressure 38 with thread sealant.

► Screw in the switch oil pressure.

Tightening torque:
9 Nm +2 Nm [6.6 lbf ft +1.5 lbf ft]

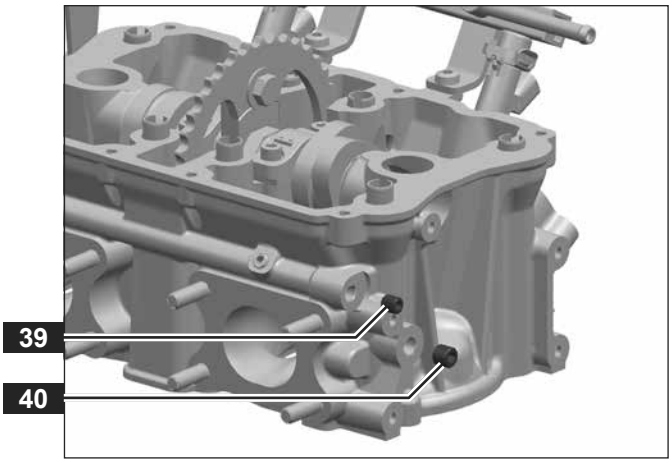


► Screw in a new plug 39.

Tightening torque:
6 Nm +2 Nm [4.4 lbf ft +1.5 lbf ft]

► Screw in a new plug 40.

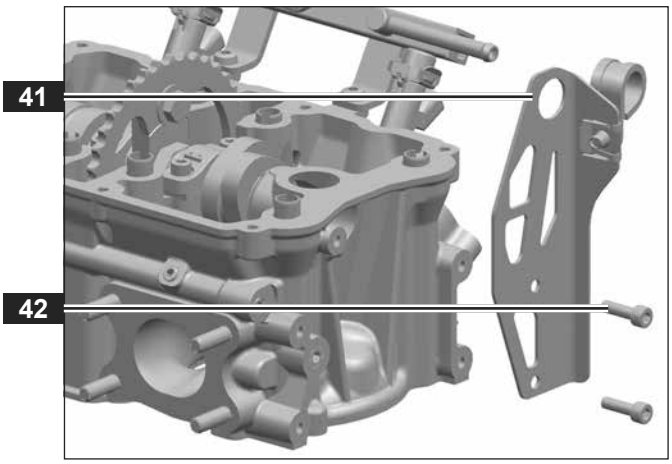
Tightening torque:
9 Nm +2 Nm [6.6 lbf ft +1.5 lbf ft]



► Hold the bracket 41 in position.

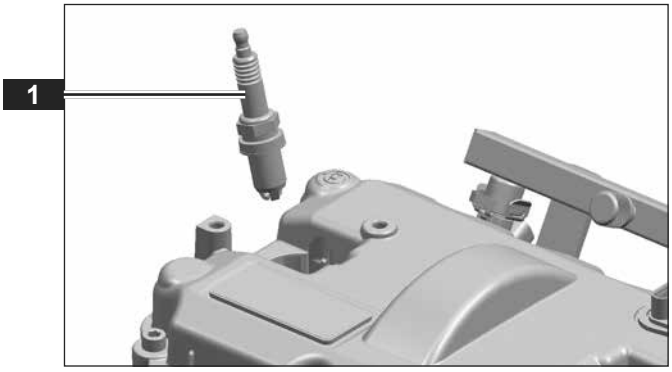
► Screw in the bolts 42.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



030.02.04 Removing spark plugs

► Unscrew the spark plugs 1 using a spark plug wrench.



030.02.05 Installing spark plugs

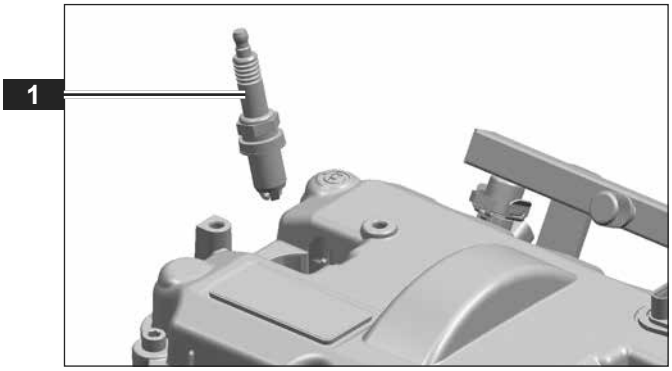
– Spark plug wrench size 16 mm

– Service manual of the engine

► Check the spark plugs. (See the service manual of the engine.)

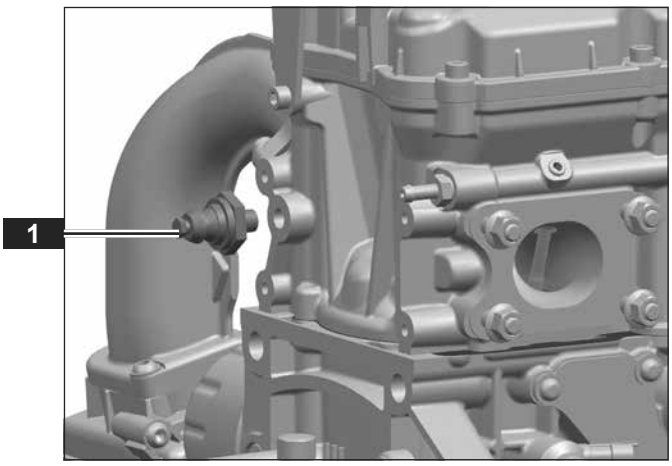
► Screw in the spark plugs 1 using a spark plug wrench.

Tightening torque:
22 Nm +10 Nm [16.2 lbf ft +7.4 lbf ft]



030.02.06 Removing switch oil pressure

► Unscrew the switch oil pressure 1.



030.02.07 Installing switch oil pressure

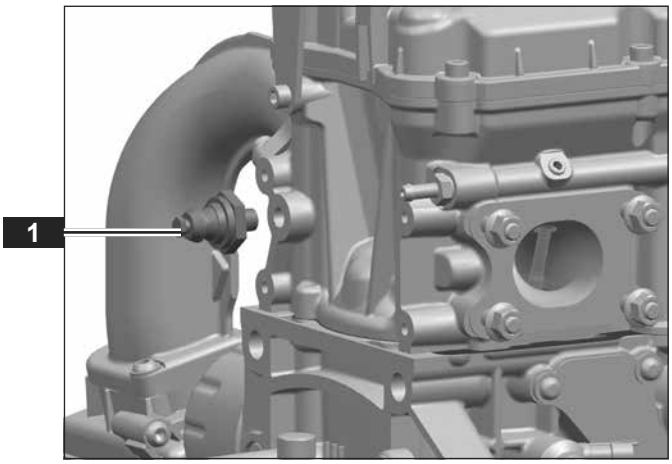
– Thread sealant

► Coat the thread on the switch oil pressure 1 with thread sealant.

► Screw in the switch oil pressure.

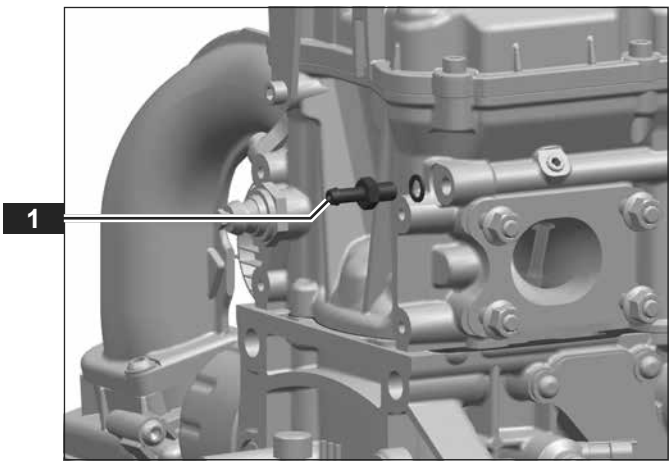
Tightening torque:

9 Nm +2 Nm [6.6 lbf ft +1.5 lbf ft]



030.02.08 Removing fitting

► Unscrew the fitting 1.



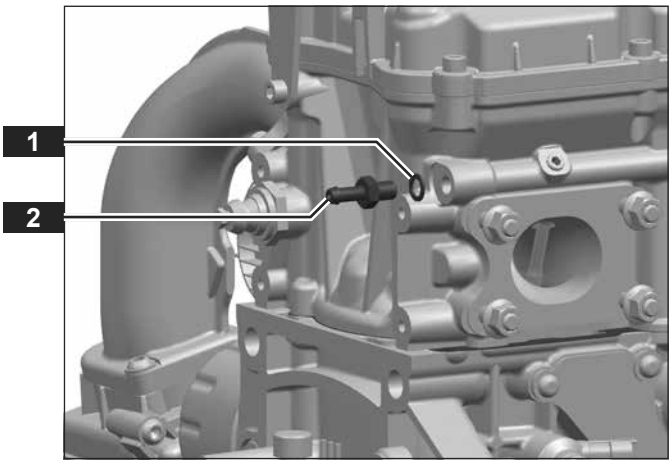
030.02.09 Installing fitting

– 1 Seal 8x12x1 Al

► Replace the seal 1.

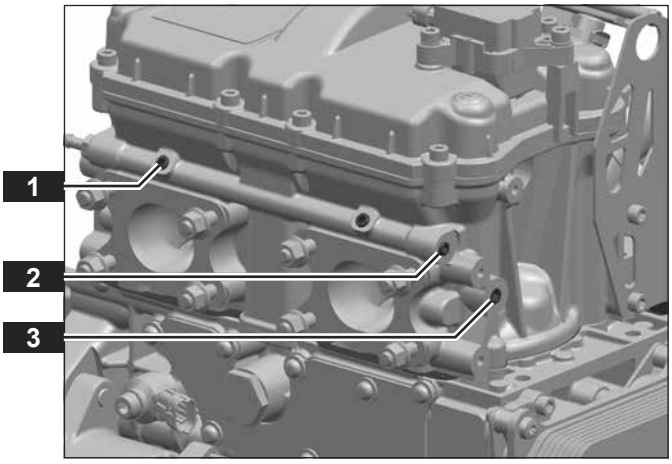
► Screw in the fitting 2.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



030.02.10 Replacing plugs

- Plugs 1 **1**
- Plug 2 **2**
- Plug 3 **3**



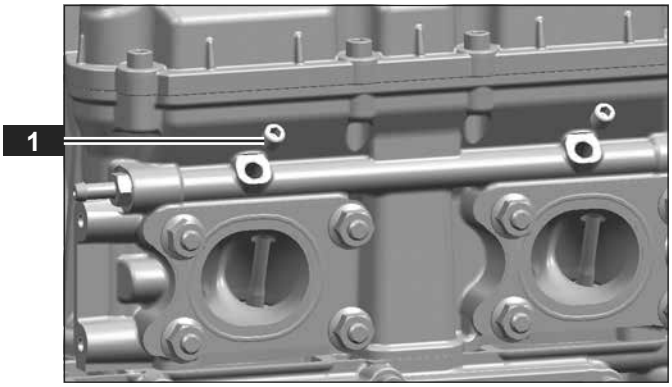
Replacing plugs 1

► Unscrew the plugs **1**.

► Replace the plugs.

► Screw in the plugs.

Tightening torque:
6 Nm +2 Nm [4.4 lbf ft +1.5 lbf ft]



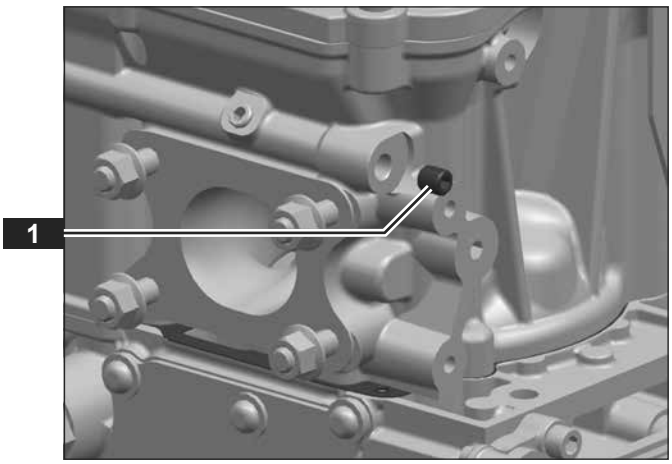
Replacing plug 2

► Unscrew the plug **1**.

► Replace the plug.

► Screw in the plug.

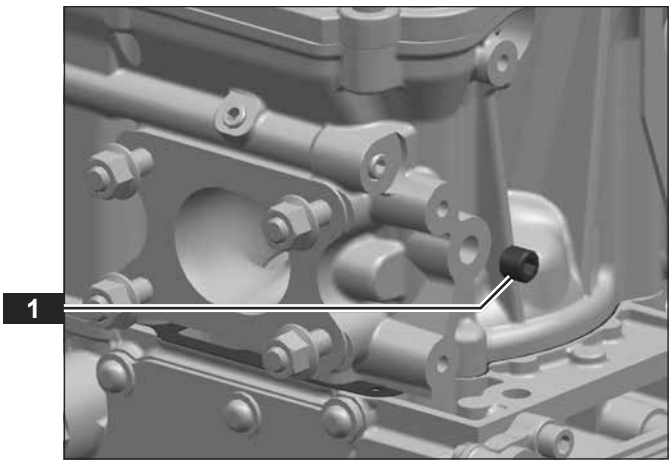
Tightening torque:
6 Nm +2 Nm [4.4 lbf ft +1.5 lbf ft]



Replacing plug 3

- ► Unscrew the plug 1.
- ► Replace the plug.
- ► Screw in the plug.

Tightening torque:
9 Nm +2 Nm [6.6 lbf ft +1.5 lbf ft]



040.01.01 Replacing camshaft

– Remover bearing cap

NOTICE

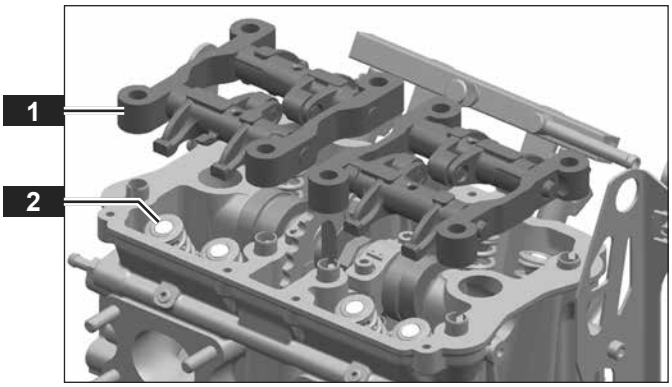
Increased wear and leaks due to installing components swapped over.

All components in the valve train are inserted together. If the components are installed swapped over, they no longer fit together well.

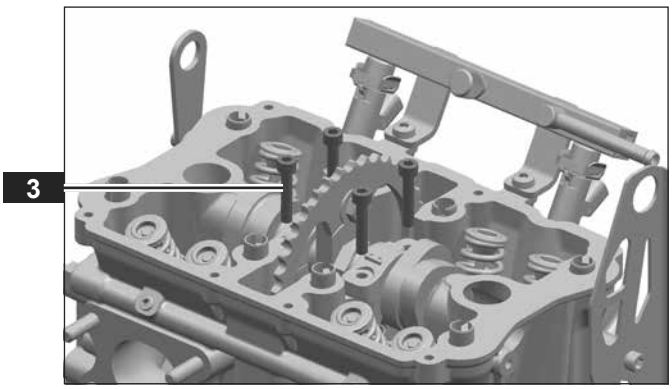
► Install all components back into the place from which they were removed.

► Remove the rocker arms and cross bars 1.

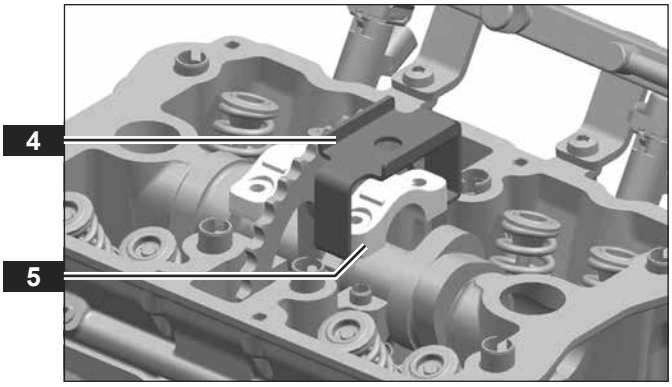
► Remove the valve adjustment shims 2 using a bar magnet.



► Unscrew the bolts 3.



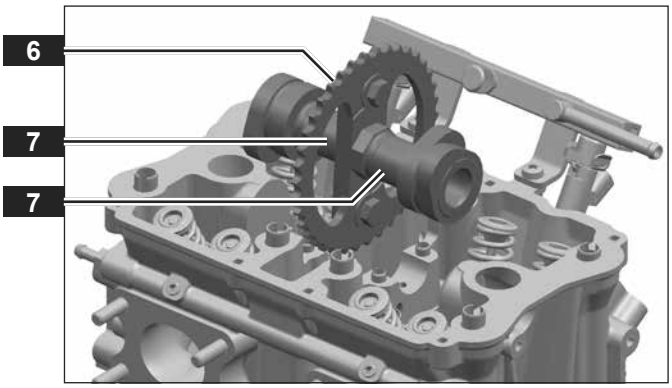
► Remove the bearing cap 5 using the remover bearing cap 4.



► Remove the camshaft 6.

► Replace the camshaft.

► Coat the camshaft on the bearing surfaces 7 lightly with engine oil.

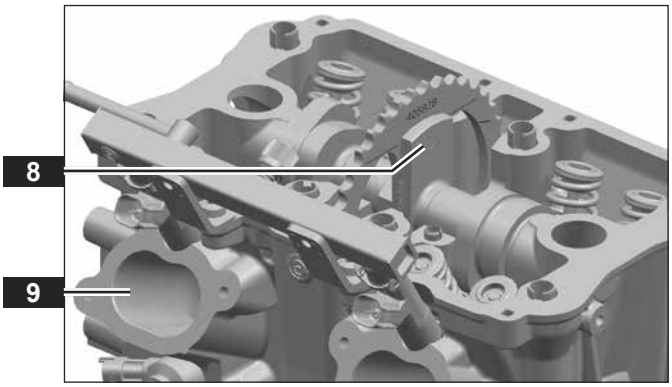


► Insert the camshaft.

The camshaft is marked at the 1st cylinder end only.

Observe the installation position.

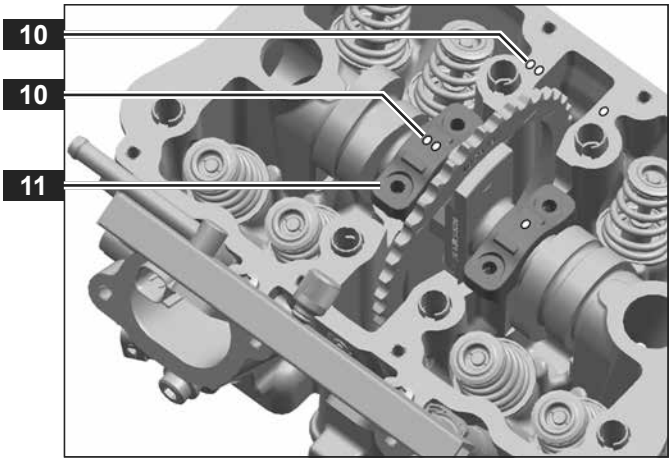
– Inscription 8
– Intake side 9



NOTICE! Bearing damage due to the bearing cap being installed incorrectly. The bearing surfaces for supporting the camshaft in the cylinder head and in the bearing cap are processed together. Therefore, only use the bearing cap originally installed. Observe the markings **10** during installation.

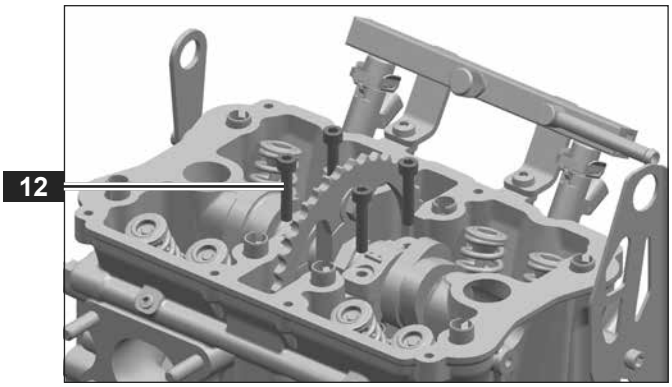
► Insert the bearing cap **11**.

Observe the installation position.



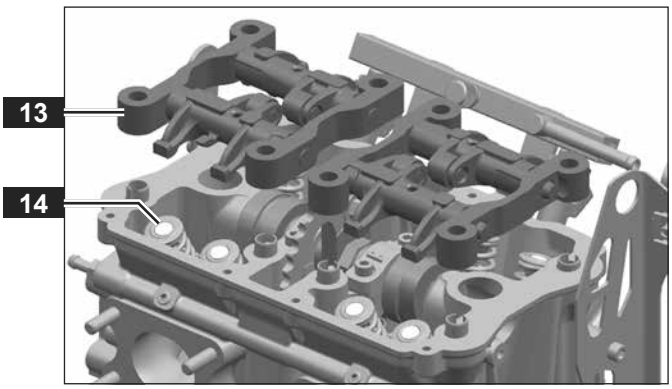
► Screw in the bolts **12**.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



► Insert the valve adjustment shims **14**.

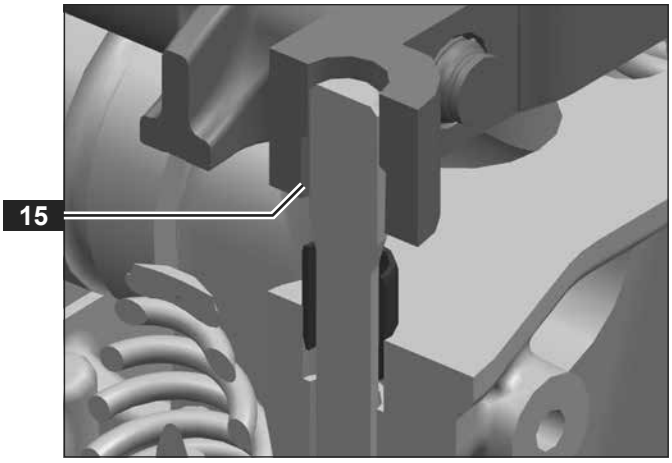
► Insert the rocker arms and cross bars **13**. Observe the installation instructions for rocker arms and cross bars.



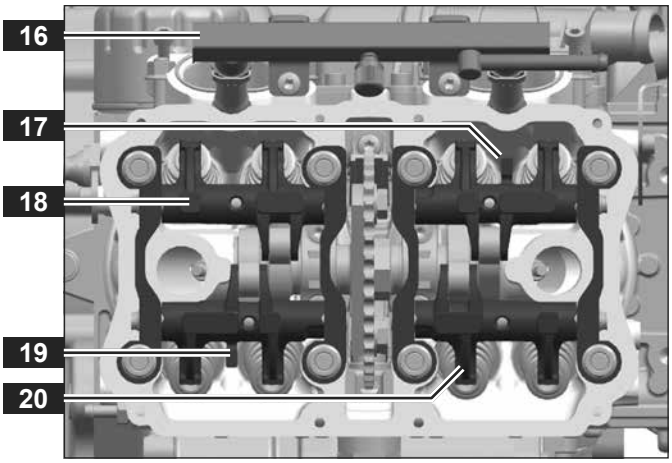
Installation instructions for rocker arms and cross bars

Observe the installation position:

– Counterbore **15**



– Fuel rail **16**
– Rocker arm short **17** **19** with cam spike
– Rocker arm long **18** **20**



040.01.02 Replacing timing chain

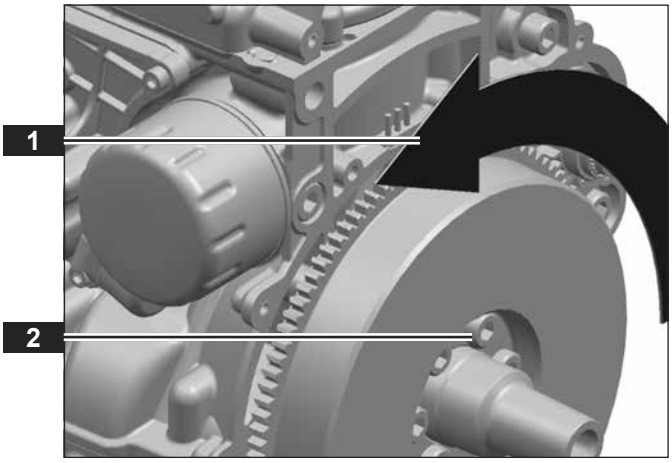
– Chain tool

– Instruction manual chain tool

– 1 Chain tensioner
– 1 Chain link

Setting valve timing

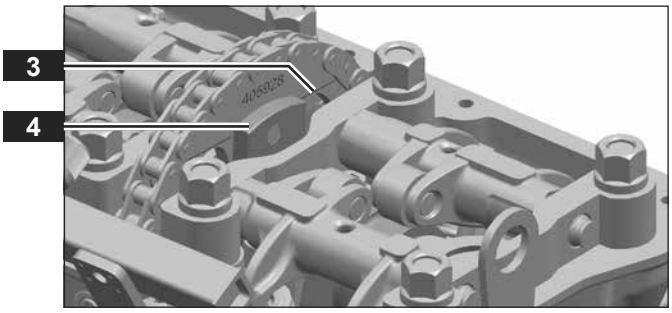
► Turn the crankshaft on a bolt 2 in the direction shown 1 until the camshaft stops as shown in the following figure.



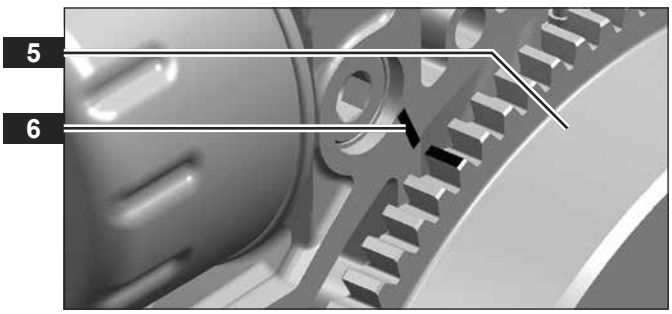
► Check whether the camshaft is at the crossing point.

The position of the camshaft is as illustrated 4.

The marking 3 ends flush with the cross bar.

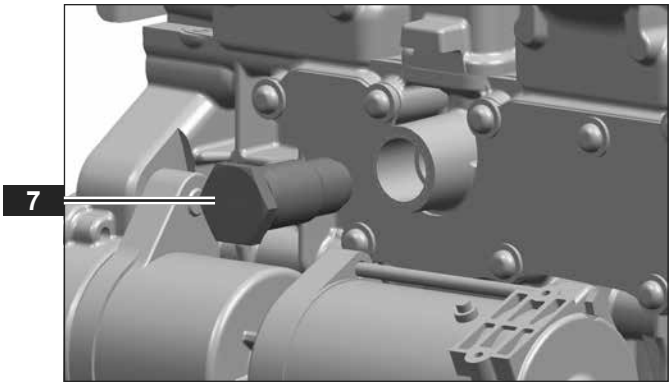


► Mark the position of the rotor 5 to the crankcase 6.

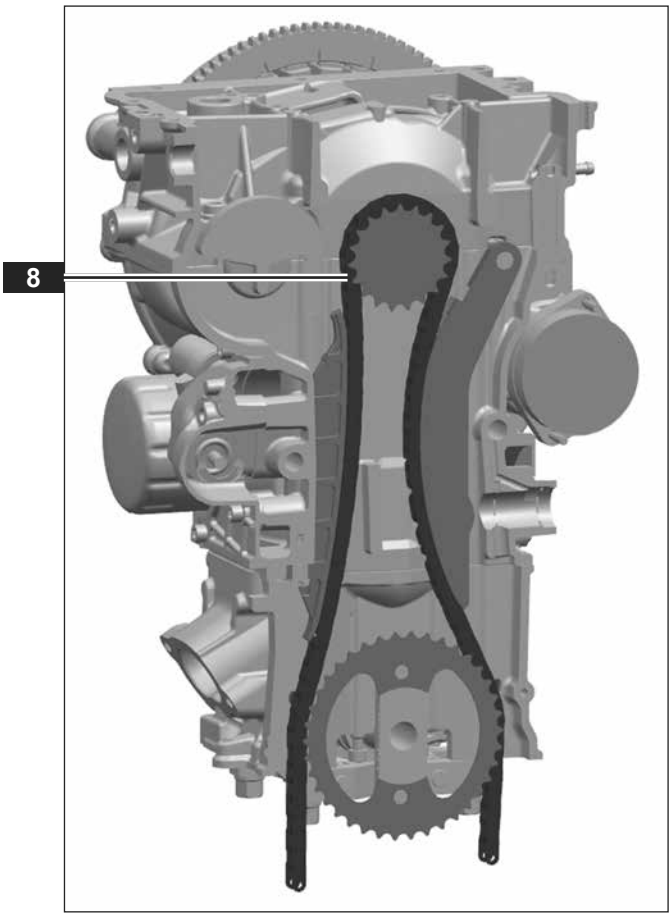


Replacing timing chain

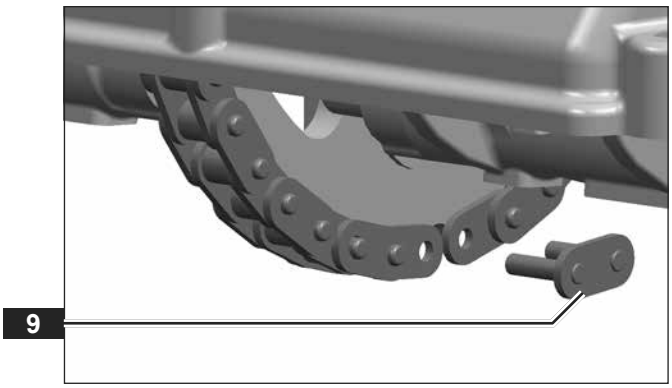
- ► Unscrew the chain tensioner 7.
- ► Open the timing chain. (See the instruction manual of the chain tool.)



- ► Turn the engine 180°.
- ► Remove the timing chain 8.
- ► Replace the timing chain.
- ► Insert the timing chain as illustrated.



- ► Insert the chain link 9 on the open ends of the timing chain.
- ► Turn the engine 180°.

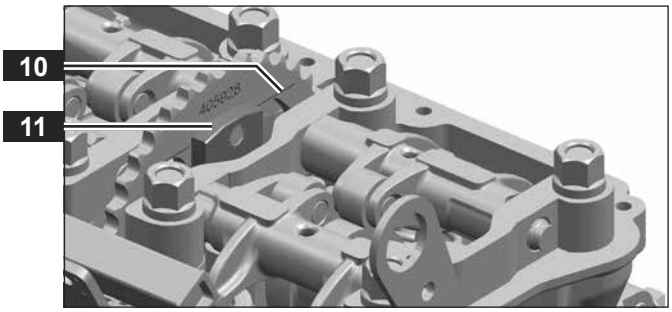


Setting valve timing

- ► Check whether the camshaft is at the crossing point.

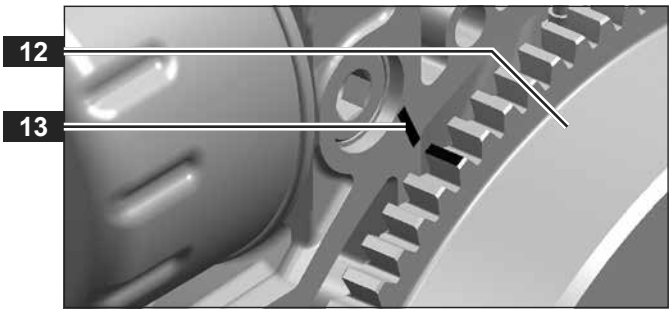
  The position of the camshaft is as illustrated 11.

  The marking 10 ends flush with the cross bar.
- ► If the camshaft does not appear as shown, turn it.



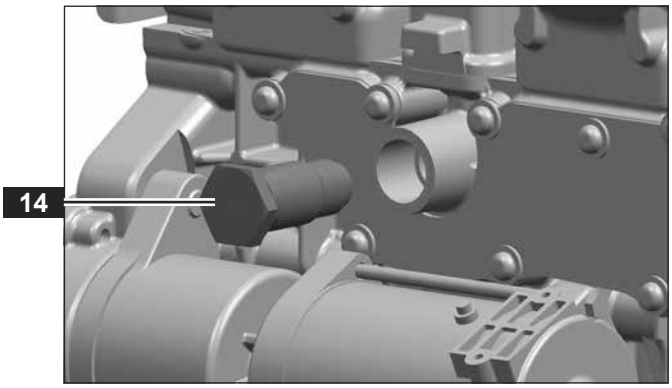
- ► Check whether the crankshaft is at TDC (Top Dead Center).

  The markings 13 fit together.
- ► If the markings do not line up, turn the rotor 12.



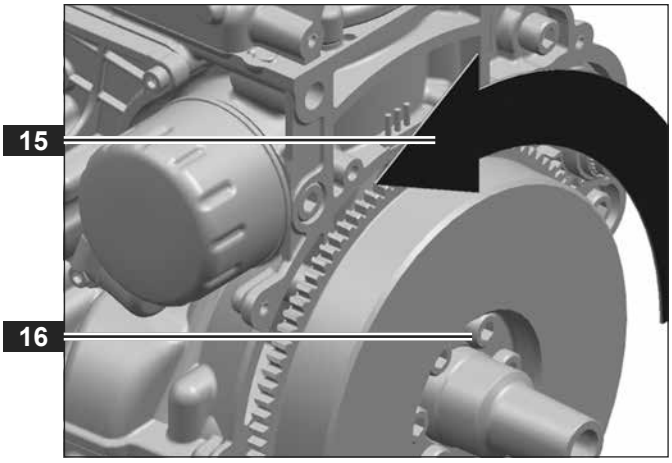
- ► Close the timing chain. (See the instruction manual of the chain tool.)
- ► Replace the chain tensioner 14.
- ► Screw in the chain tensioner.

Tightening torque:
40 Nm +5 Nm [29.5 lbf ft +3.7 lbf ft]



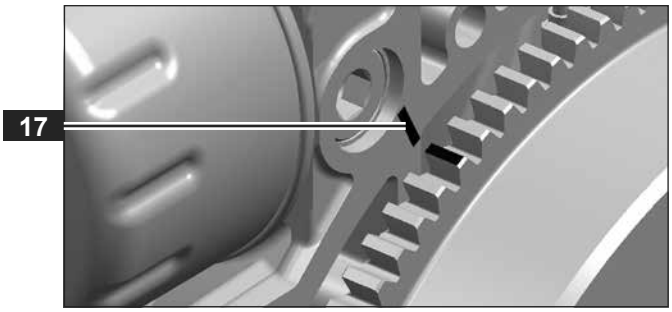
Checking valve timing

► Turn the crankshaft on a bolt **16** several times in the direction shown **15**.



► Turn the crankshaft on a bolt in the direction shown until the crankshaft is at TDC (Top Dead Center).

The markings **17** fit together.

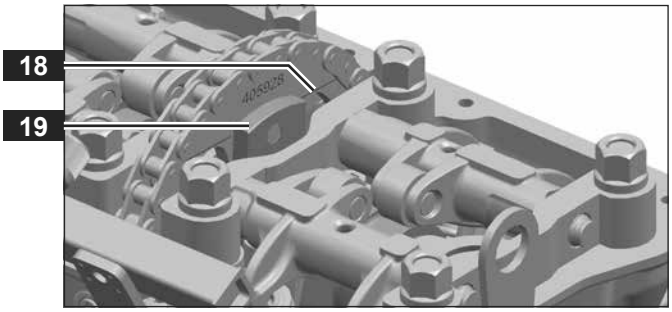


► Check whether the camshaft is at the crossing point.

The position of the camshaft is as illustrated **19**.

The marking **18** ends flush with the cross bar.

► If the camshaft does not appear as shown, set the valve timing again.



040.01.03 Checking and setting valve timing

– TDC-Adjusting tool
– Chain tool

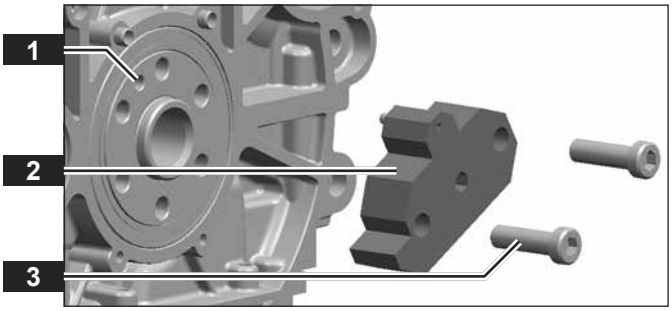
– 1 Chain tensioner
– 1 Chain link

– Instruction manual chain tool

► Hold the TDC-adjusting tool 2 in position. Observe the positioning pin and positioning bore 1.

Use the M10x1x35 bolts you removed on the rotor.

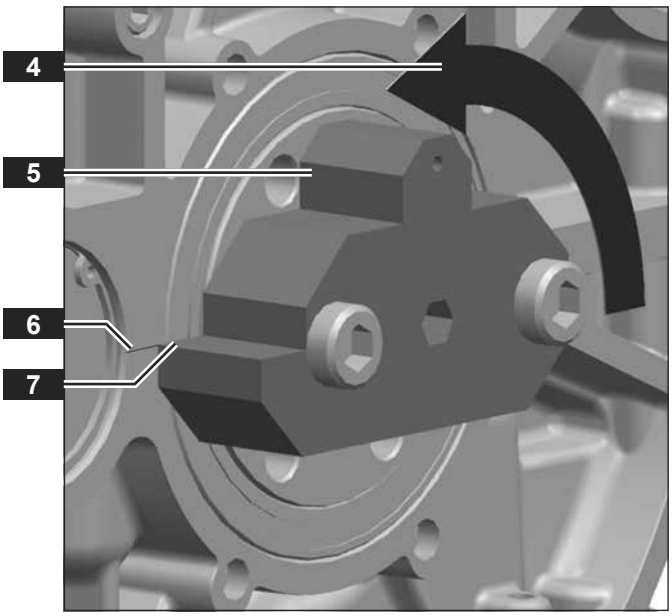
► Screw in the bolts 3.



Checking valve timing

Use a hexagon screwdriver socket 8 and reversible ratchet.

► Turn the crankshaft on the TDC-adjusting tool 5 in the direction shown 4 until the marking 7 ends flush with the crankcase halves 6.

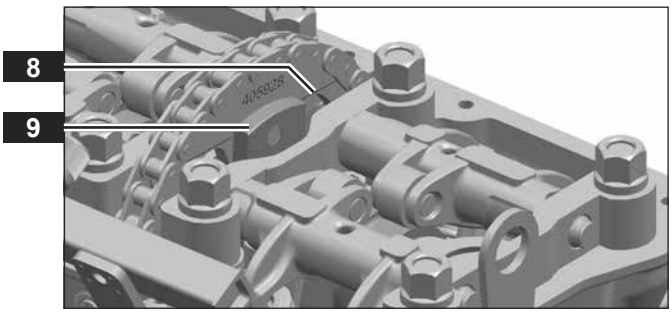


► Check whether the camshaft is at the crossing point.

The position of the camshaft is as illustrated 9.

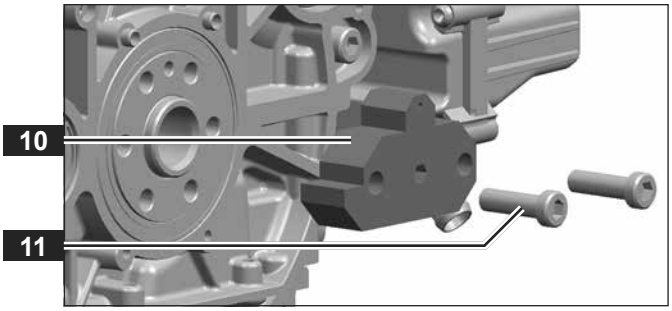
The marking 8 ends flush with the cross bar.

► If the camshaft does not appear as shown, continue with section **Setting valve timing**.



► Unscrew the bolts 11.

► Remove the TDC-adjusting tool 10.

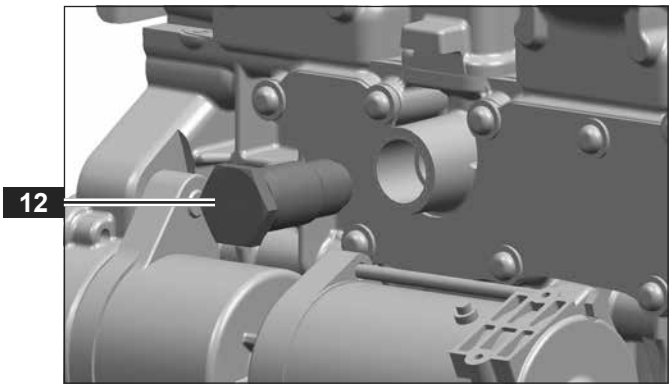


Setting valve timing

► Unscrew the chain tensioner 12.

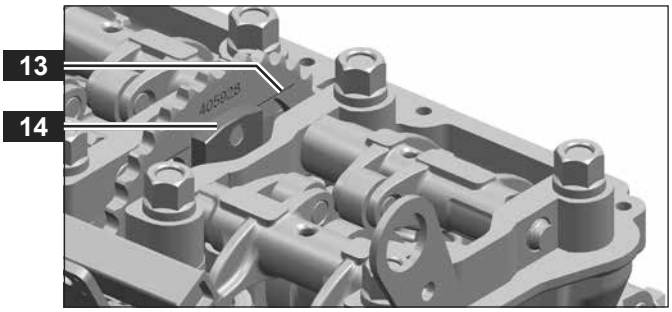
► Open the timing chain. (See the instruction manual of the chain tool.)

► Secure the ends of the timing chain.



► Turn the camshaft until the position of the camshaft is as illustrated 14.

The marking 13 ends flush with the cross bar.



► Close the timing chain. (See the instruction manual of the chain tool.)

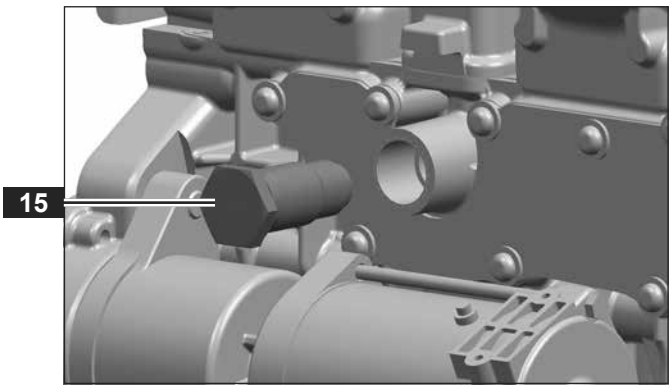
► Replace the chain tensioner 15.

► Screw in the chain tensioner.

Tightening torque:
40 Nm +5 Nm [29.5 lbf ft +3.7 lbf ft]

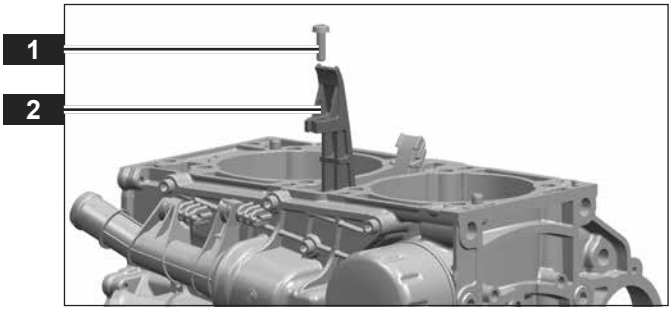
► Turn the crankshaft on the TDC-adjusting tool several times in the direction shown.

► Check the valve timing again



040.01.04 Replacing chain rail

The cylinder head is removed.

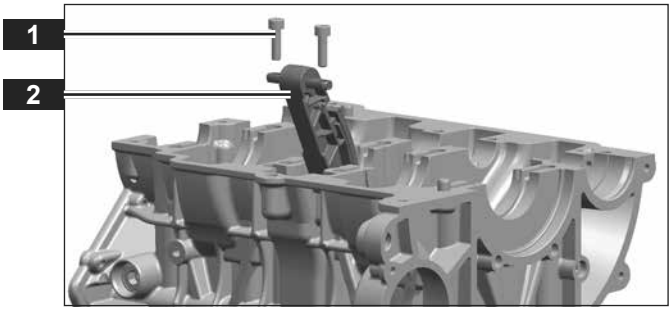


- ► Unscrew the bolt 1.
- ► Remove the chain rail 2.
- ► Replace the chain rail.
- ► Insert the chain rail.
- ► Screw in the bolt.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]

040.01.05 Replacing chain guide

The upper case is disconnected from the lower case.



- ► Unscrew the bolts 1.
- ► Remove the chain guide 2.
- ► Replace the chain guide.
- ► Insert the chain guide.
- ► Screw in the bolts.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]

040.02.01 Replacing rocker arms

– Service manual of the engine

NOTICE

Increased wear and leaks due to installing components swapped over.

All components in the valve train are inserted together. If the components are installed swapped over, they no longer fit together well.

► Install all components back into the place from which they were removed.

NOTICE

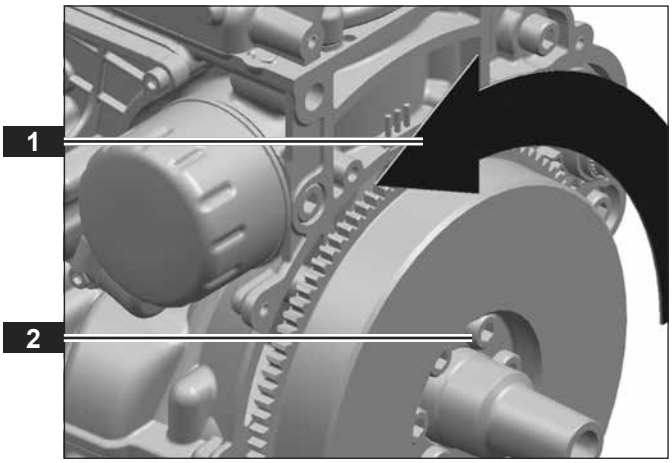
Engine damage from small components in the engine or cylinder head.

Operating the engine when there are small components in the crankcase and cylinder head can result in serious damage and cause the crank drive to seize.

► When removing small components, always cover the chain channel.

Replacing a rocker arm on the 1st cylinder

► Turn the crankshaft on a bolt 2 in the direction shown 1 until the camshaft stops as shown in the following figure.



The camshaft is marked at the 1st cylinder end only.

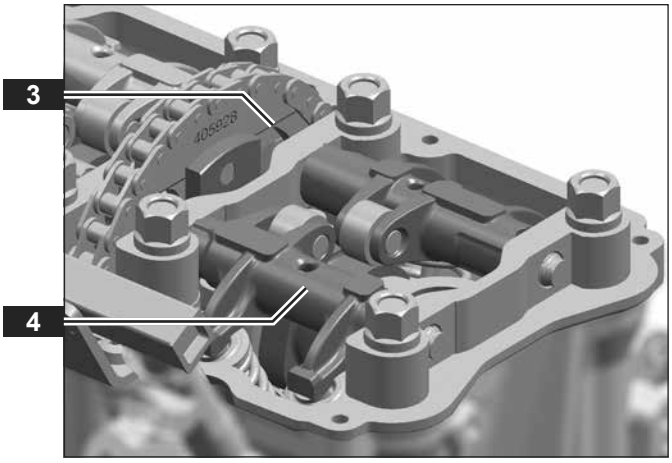
► Check whether the camshaft is at the crossing point.

The position of the camshaft is as illustrated.

The marking 3 ends flush with the cross bar.

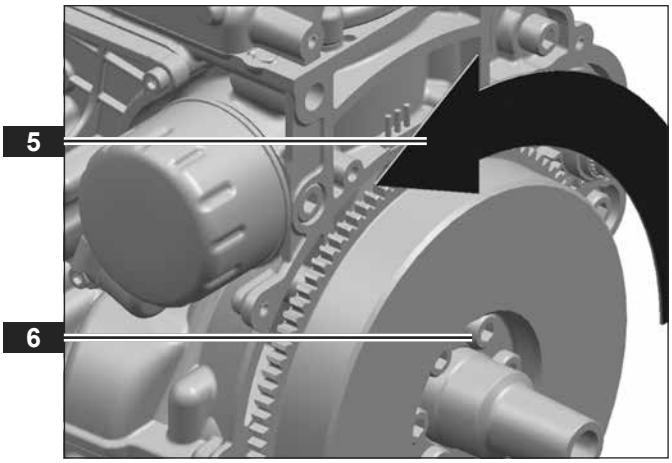
All rocker arms 4 on the cylinder have a certain amount of play.

► Continue with the section **Replacing a rocker arm**.



Replacing a rocker arm on the 2nd cylinder

► Turn the crankshaft on a bolt 6 in the direction shown 5 until the camshaft stops as shown in the following figure.



The camshaft is marked at the 1st cylinder end only.

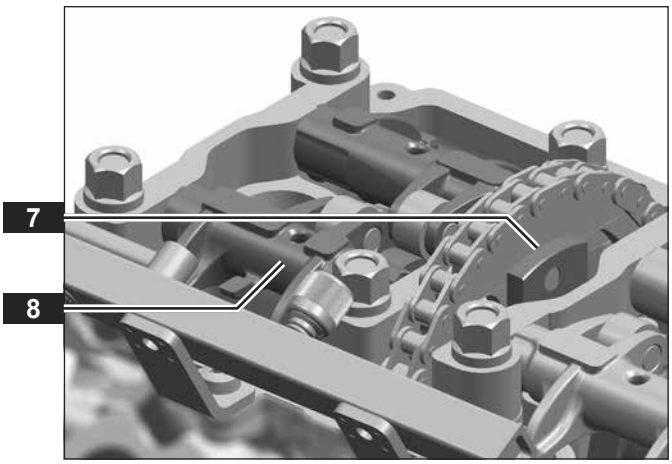
► Check whether the camshaft is at the crossing point.

The position of the camshaft is as illustrated.

The inscription 7 is not visible.

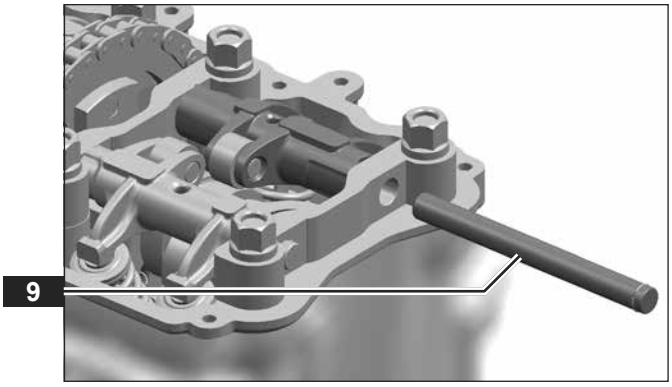
All rocker arms 8 on the cylinder have a certain amount of play.

► Continue with the section **Replacing a rocker arm**.

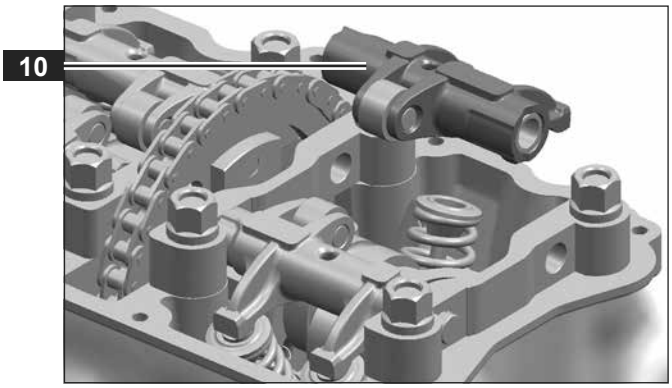


Replacing a rocker arm

► Remove the rocker axle 9 using a universal pliers.



► Remove the rocker arm 10.



► Replace the rocker arm 11.

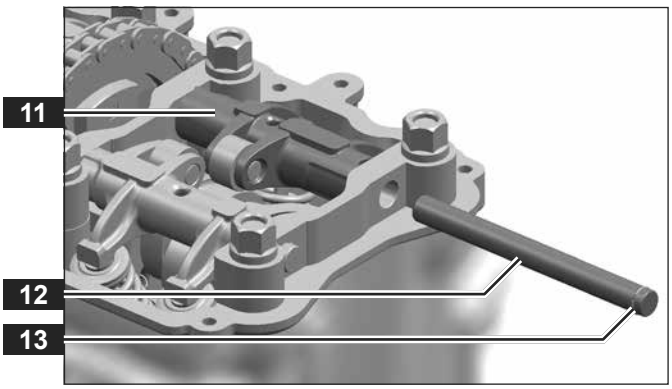
► Hold the rocker arm in position.

► Check if the circlip 13 is installed.

► Slide in the rocker axle 12.

NOTICE! Valve breakage due to insufficient valve lash.

► Check the valve lash. (See the service manual of the engine.)



040.03.01 Removing valve

– Valve spring compressor

Information! The following chapter describes how to remove one valve. If you want to remove several valves, apply the procedure for any number of valves.

NOTICE

Increased wear and leaks due to installing components swapped over.

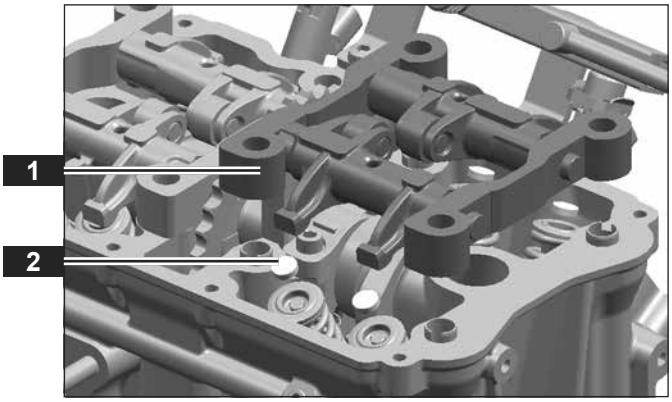
All components in the valve train are inserted together. If the components are installed swapped over, they no longer fit together well.

► Install all components back into the place from which they were removed.

The cylinder head is removed.

► Remove the rocker arms and cross bars 1.

► Remove the valve adjustment shim 2 using a bar magnet.

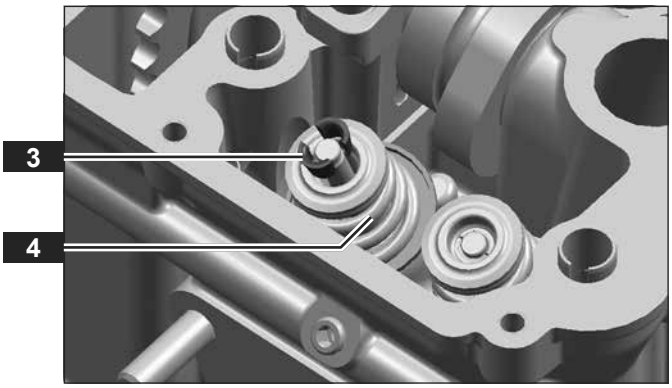


► Install the valve spring compressor according to the manufacturer's instructions.

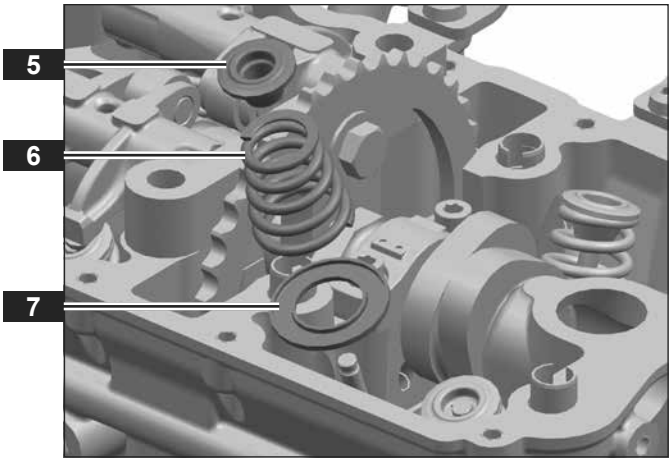
► Press the valve spring 4 together using the valve spring compressor according to the manufacturer's instructions.

► Remove the collet valves 3 using a bar magnet.

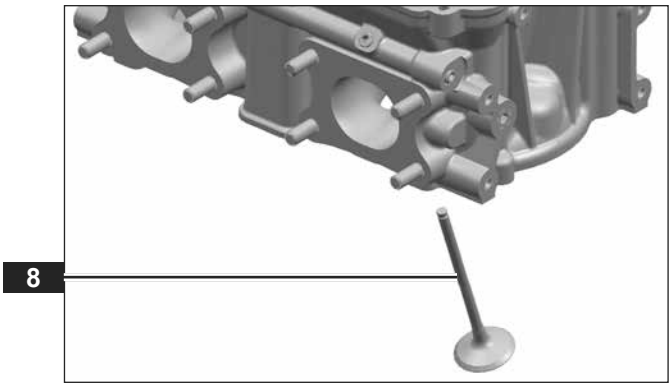
► Remove the valve spring compressor.



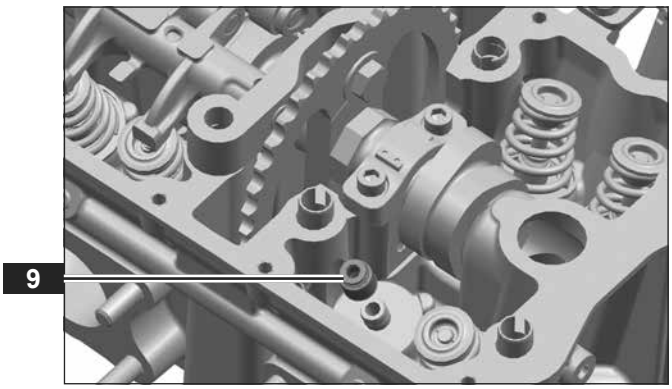
► Remove the spring cup 5, valve spring 6 and spring pad 7.



► Pull the valve 8 out.



► Remove the valve stem seal 9.



040.03.02 Installing valve

– Piston ring compressor
– Valve spring compressor

– 1 Valve stem for each removed valve

– Valve grinding compound

Information! The following chapter describes how to install a valve. If you want to install several valves, apply the procedure for any number of valves.

NOTICE

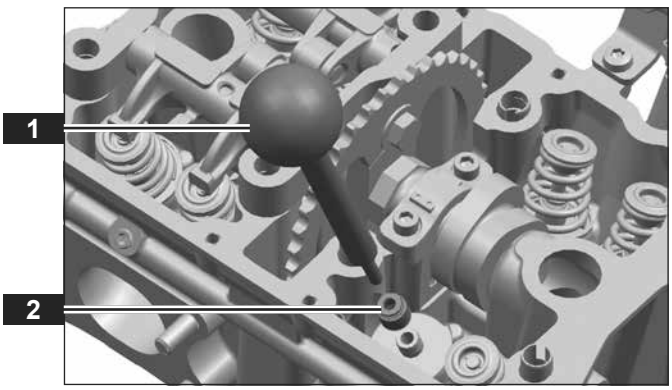
Increased wear and leaks due to installing components swapped over.

All components in the valve train are inserted together. If the components are installed swapped over, they no longer fit together well.

► Install all components back into the place from which they were removed.

► Replace the valve stem seal 2.

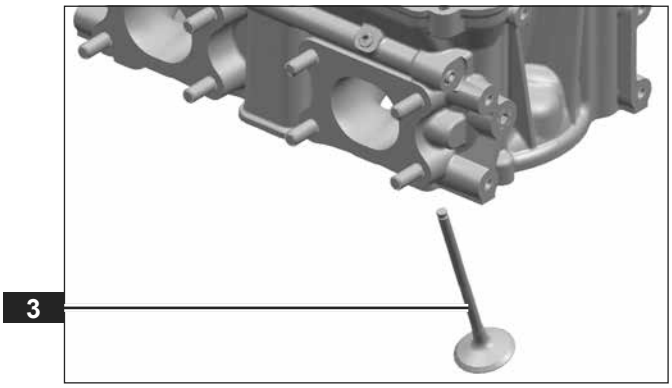
► Install the valve stem seal using a installation spike valve stem seal 1.



► Coat the valve stem 3 lightly with engine oil.

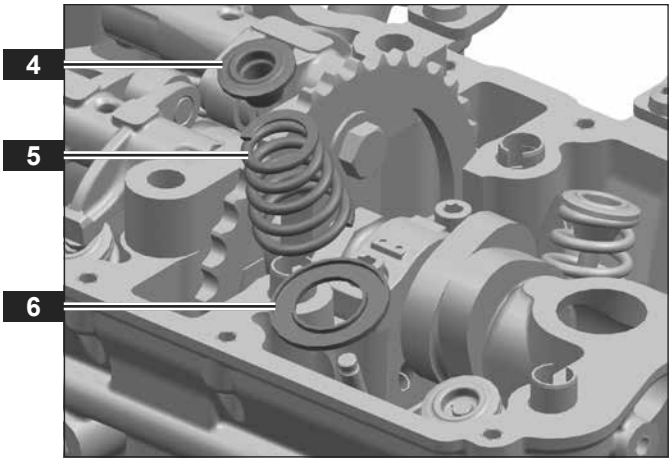
► Slide in the valve.

► Insert the valve using the valve refacer.



Valve springs are sidewise color-coded. If you replace valve springs, all installed valve springs must have the same color-code.

► Insert the spring pad 6, valve spring 5 and spring cup 4.

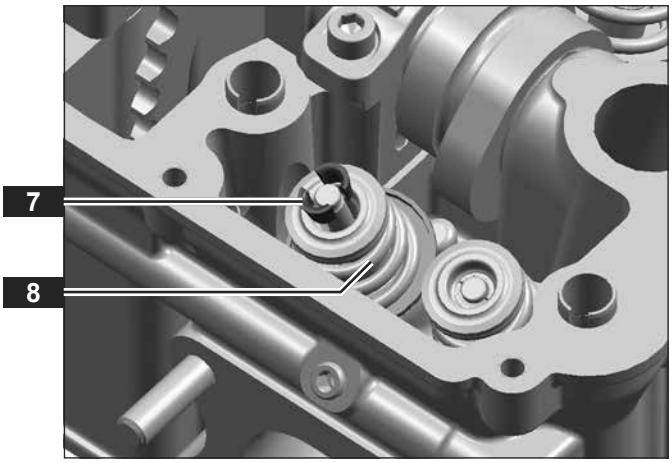


► Install the valve spring compressor according to the manufacturer's instructions.

► Press the valve spring 8 together using the valve spring compressor according to the manufacturer's instructions.

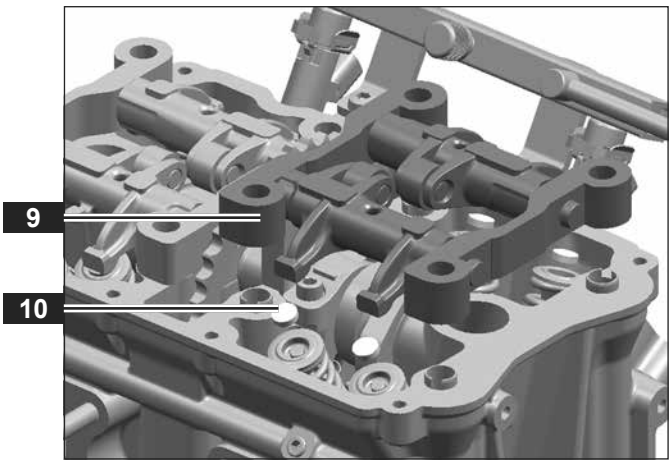
► Insert the collet valves 7.

► Remove the valve spring compressor.



► Insert the valve adjustment shims 10.

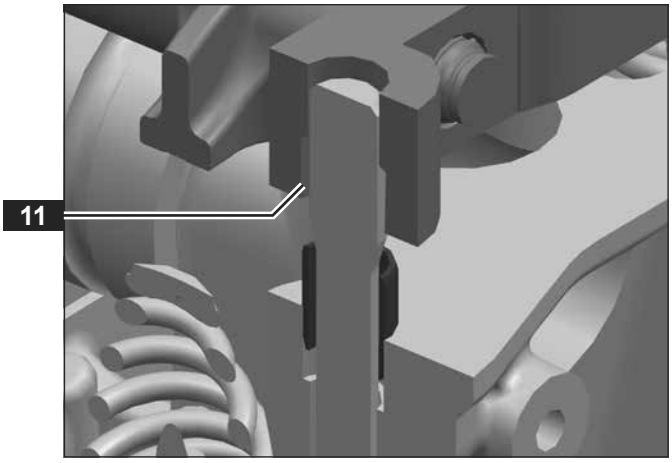
► Insert the rocker arms and cross bars 9. Observe the installation instructions for rocker arms and cross bars.



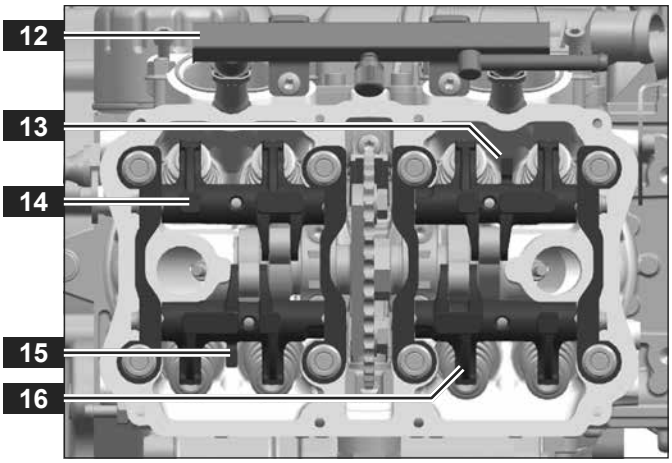
Installation instructions for rocker arms and cross bars

Observe the installation position:

– Counterbore 11

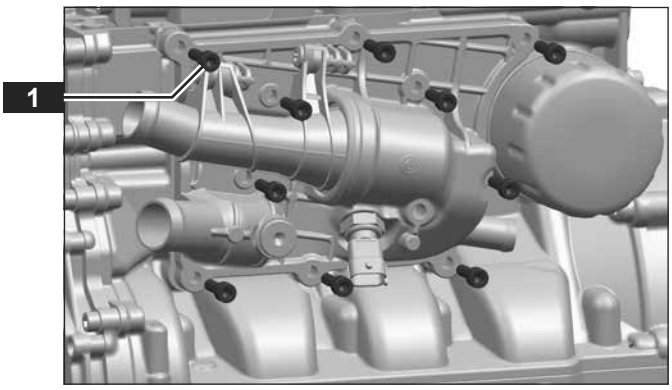


– Fuel rail 12
– Rocker arm short 13 15 with cam spike
– Rocker arm long 14 16



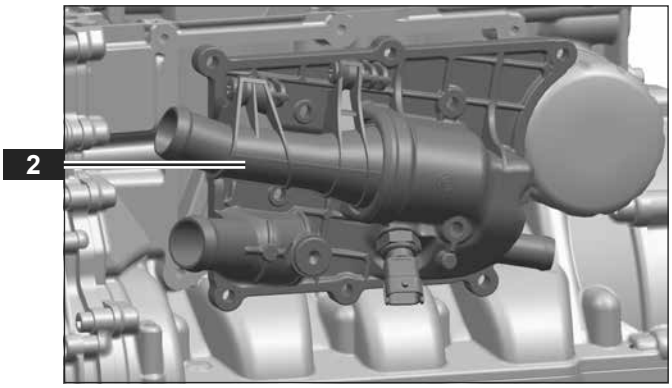
050.01.01 Removing thermostat housing

► Unscrew 10 bolts **1**.



The thermostat housing is caulked with a silicone liquid seal.

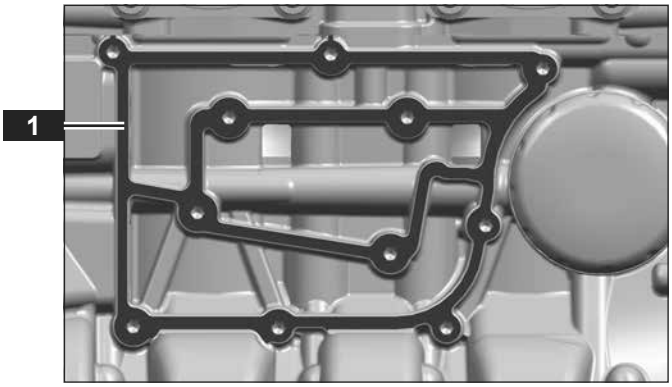
► Remove the thermostat housing **2**.



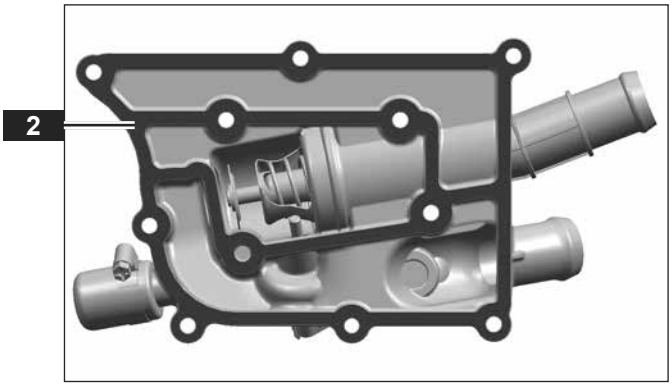
050.01.02 Installing thermostat housing

– Silicone liquid seal

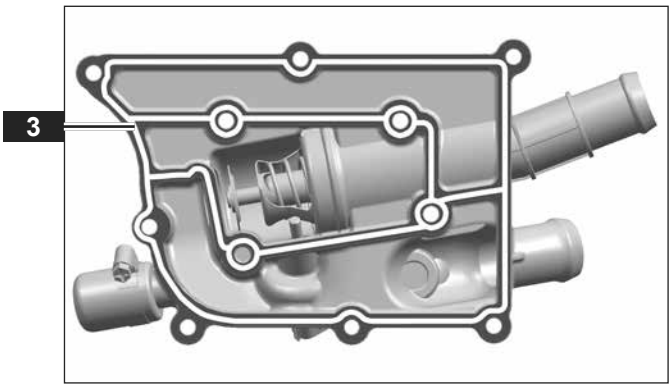
► Clean the sealing surface **1** with sealing surface cleaner.



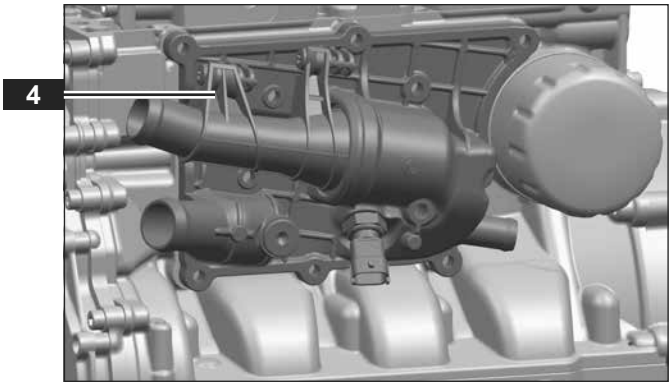
► Clean the sealing surface **2** with sealing surface cleaner.



► Apply the silicone liquid seal **3** without gaps as illustrated.

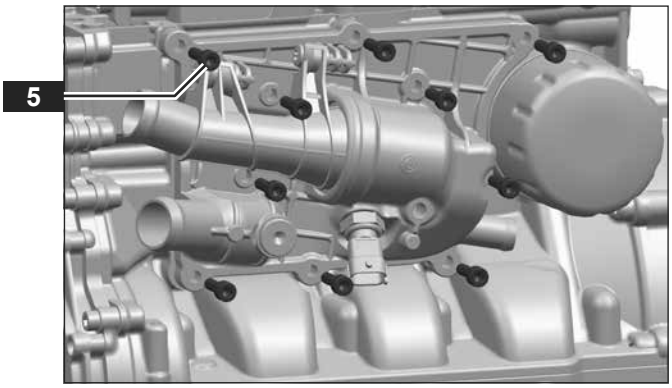


► Hold the thermostat housing **4** in position.



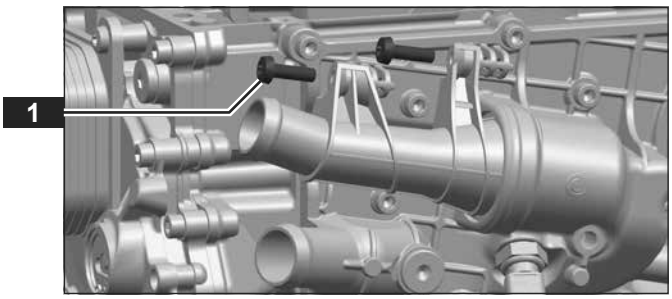
► Screw in 10 bolts **5**.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]

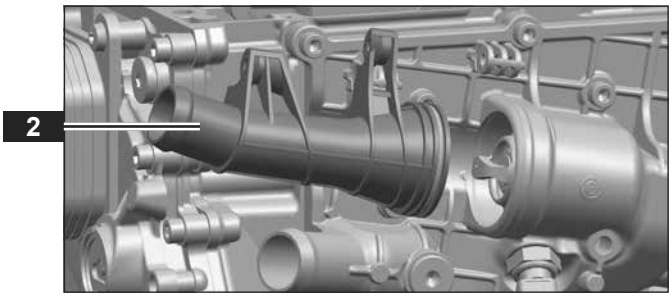


050.01.03 Removing fitting

► Unscrew 2 bolts 1.



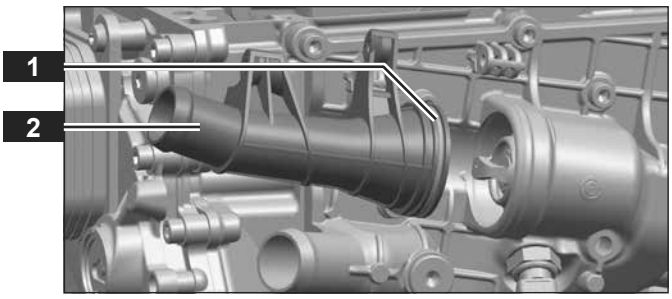
► Remove the fitting 2.



050.01.04 Installing fitting

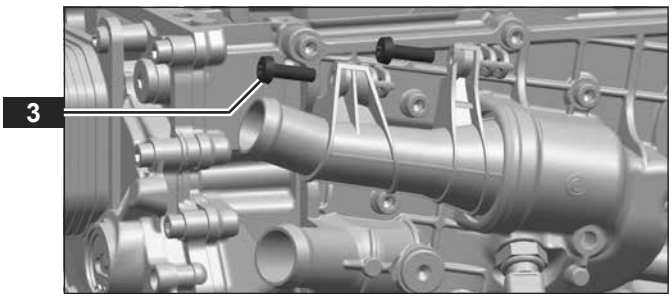
– 1 O-ring fitting thermostat housing

► Replace the o-ring 1.
► Coat the o-ring lightly with petroleum jelly.
► Insert the fitting 2.



► Screw in 2 bolts 3.

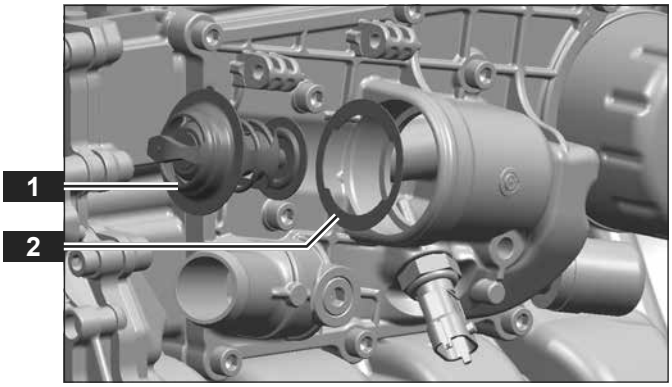
Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



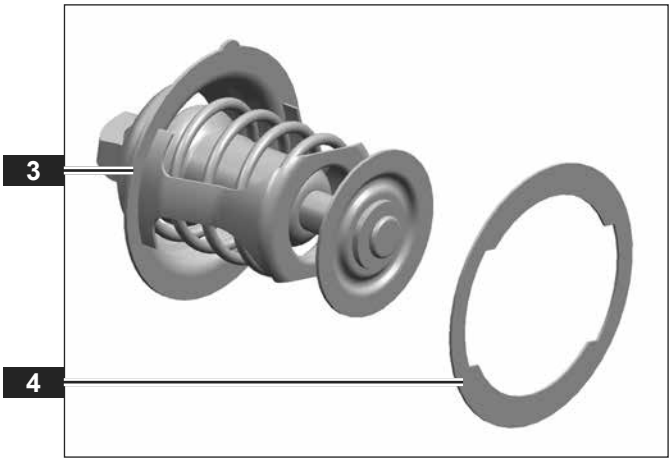
050.01.05 Replacing thermostat

– 1 Distance washer

► Remove the thermostat 1 and distance washer 2.



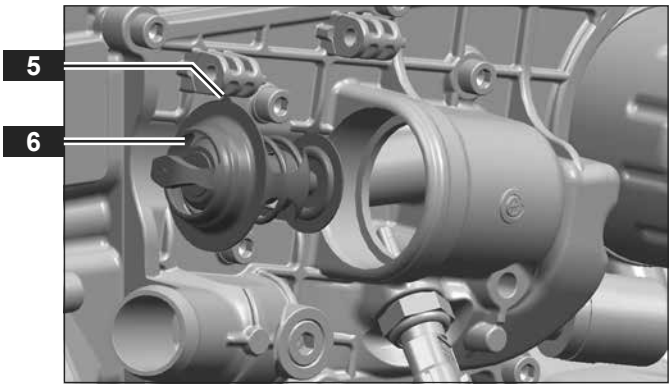
► Replace the thermostat 3.
► Replace the distance washer 4.
► Put the distance washer on thermostat.



Observe the installation position:

– Locating tab 5 at thermostat

► Insert the thermostat 6.



050.01.06 Replacing sensor coolant temperature

– Thread sealant

► Unscrew the sensor coolant temperature 1.

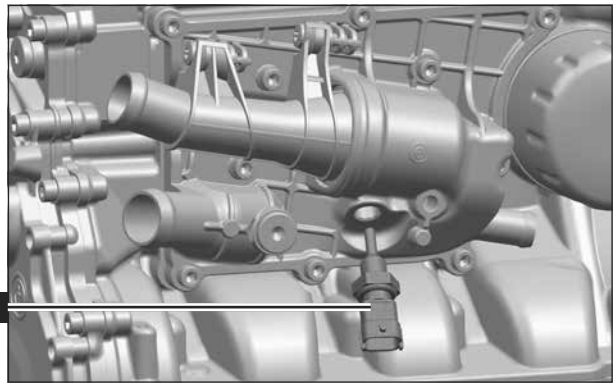
► Replace the sensor coolant temperature.

► Coat the thread on the sensor coolant temperature with thread sealant.

► Screw in the sensor coolant temperature.

Tightening torque:

18 Nm +7 Nm [13.3 lbf ft +5.2 lbf ft]



050.01.07 Replacing plug thermostat housing

– Thread sealant

► Unscrew the plug **1**.

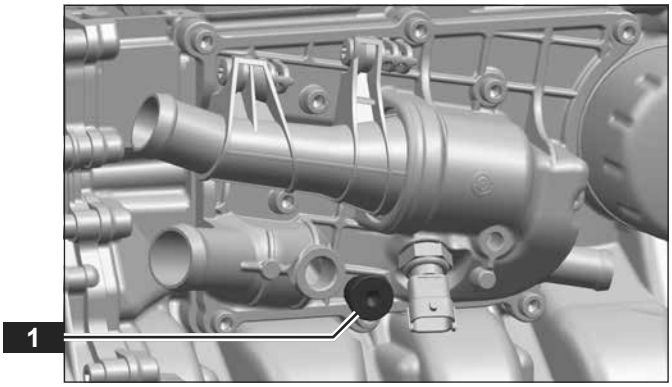
► Replace the plug.

► Coat the thread on the plug with thread sealant.

► Screw in the plug.

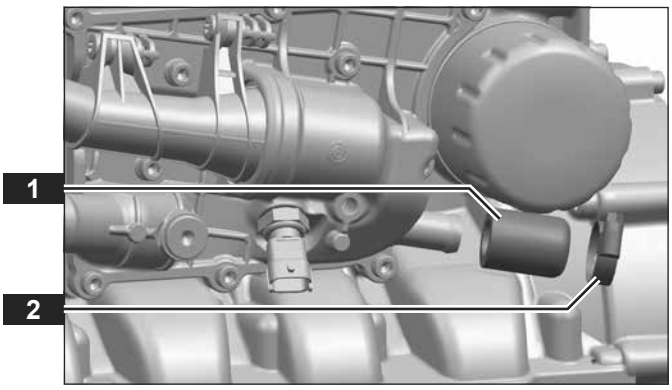
Tightening torque:

14 Nm +2 Nm [10.3 lbf ft +1.5 lbf ft]



050.01.08 Removing closing cap thermostat housing

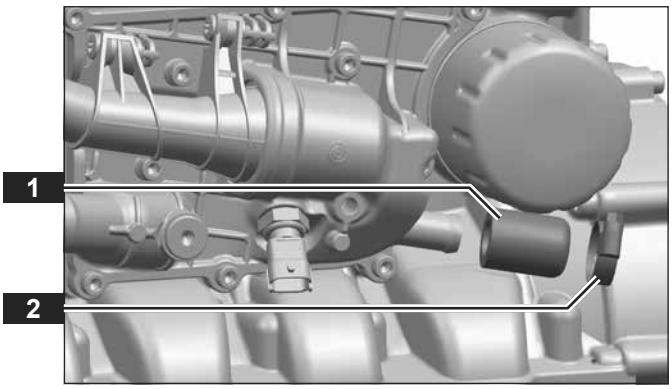
- ► Open the hose clamp 2.
- ► Remove the closing cap 1.



050.01.09 Installing closing cap thermostat housing

- ► Insert the closing cap 1.
- ► Close the hose clamp 2.

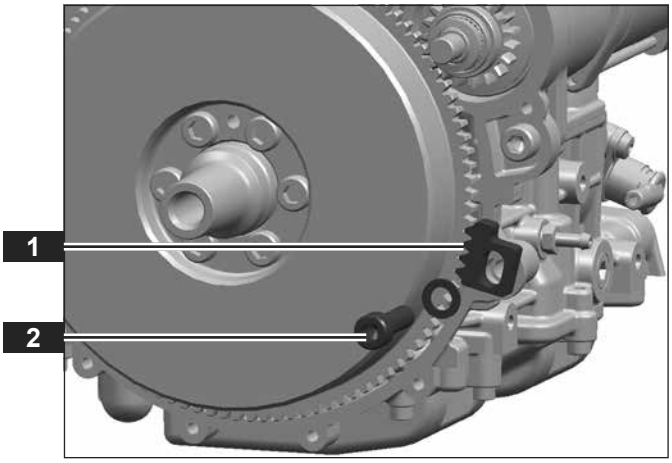
Tightening torque:
3 Nm +0,5 Nm [2.2 lbf ft +0.4 lbf ft]



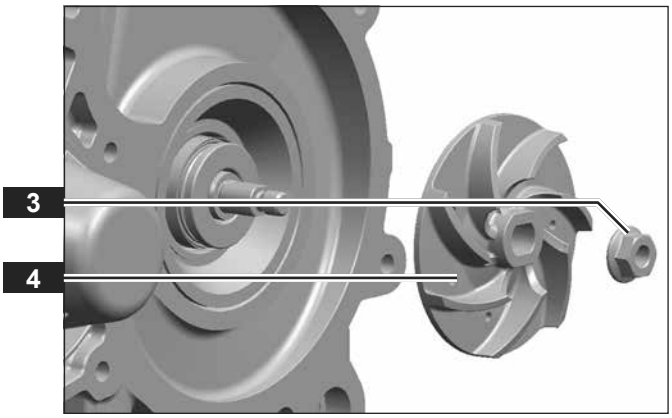
050.02.01 Removing impeller

– Locking tool crankshaft

► Hold the locking tool crankshaft 1 on rotor.
► Screw in the bolt 2 and washer.



► Unscrew the nut 3.
► Remove the impeller 4.



050.02.02 Installing impeller

– Locking tool crankshaft

– Thread locker, medium strength

The locking tool crankshaft is still installed.

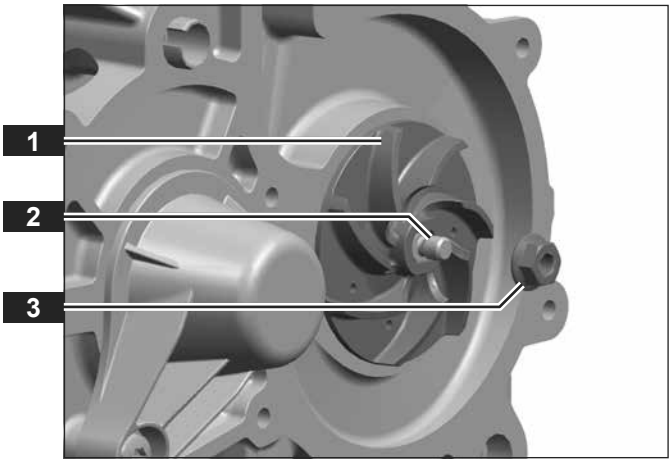
► Insert the impeller 1.

► Coat the thread on the water pump axle 2 with medium strength thread locker.

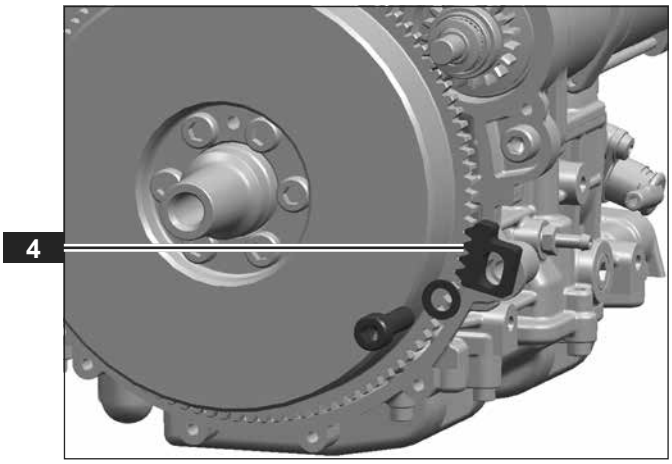
► Screw on the nut 3.

Tightening torque:

6 Nm +2 Nm [4.4 lbf ft +1.5 lbf ft]



► Remove the locking tool crankshaft 4.

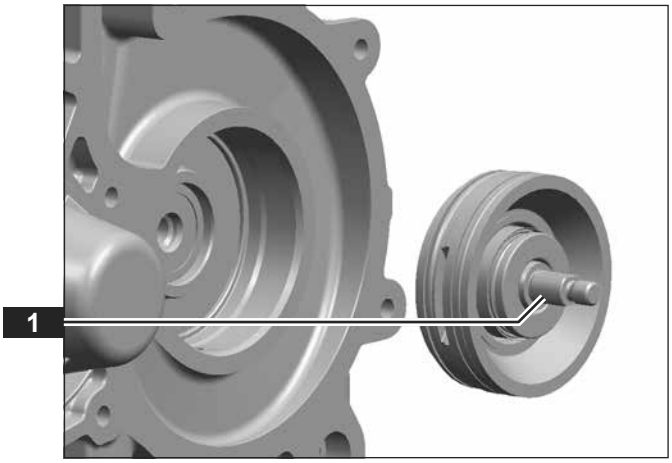


050.02.03 Removing coolant pump

– Locking tool crankshaft

The locking tool crankshaft is still installed.

► Unscrew the water pump axle 1 using a open-end wrench.



050.02.04 Installing coolant pump

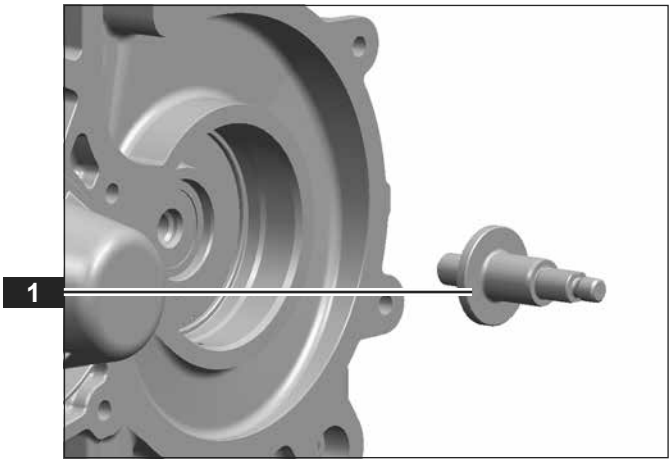
– Locking tool crankshaft
– Assembling kit slide ring seal

– 1 Repair kit slide ring seal

The locking tool crankshaft is still installed.

► Replace the water pump axle 1.

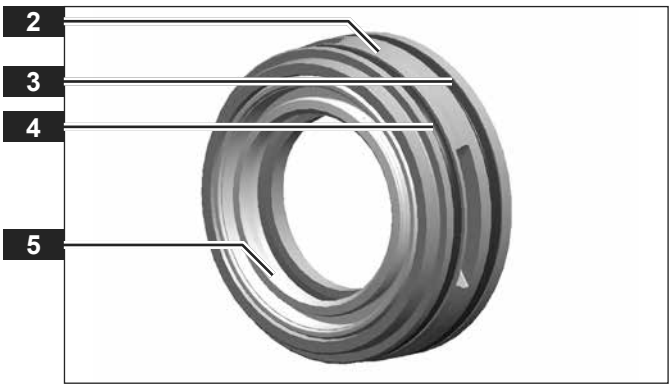
► Screw in the water pump axle using a open-end wrench. Avoid damaging the water pump axle when doing so.



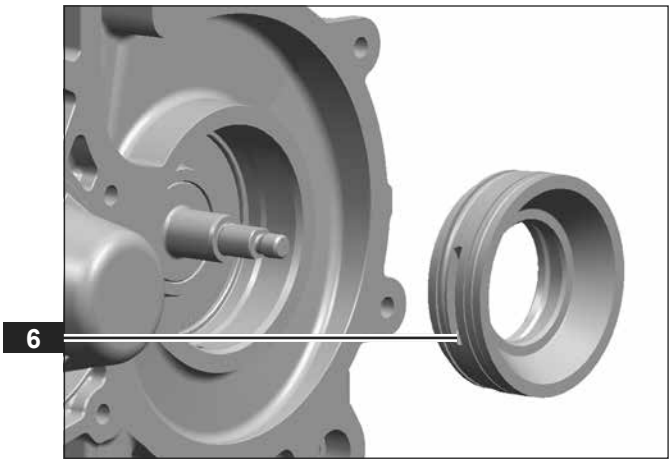
► Replace the sealing bracket 2.

► Coat the gasket 3 and o-ring 4 lightly with petroleum jelly.

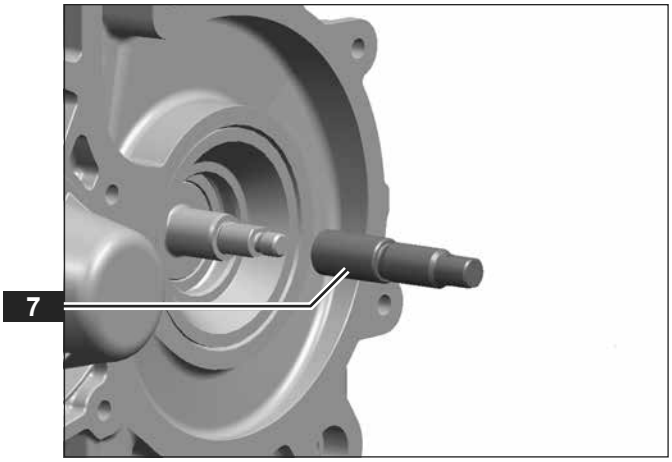
► Coat the inside of the oil seal 5 lightly with petroleum jelly.



► Insert the sealing bracket 6.

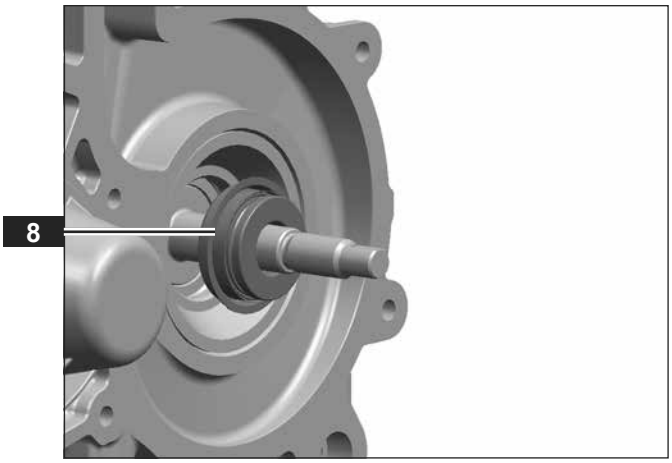


► Screw in the guide 7 using a open-end wrench.



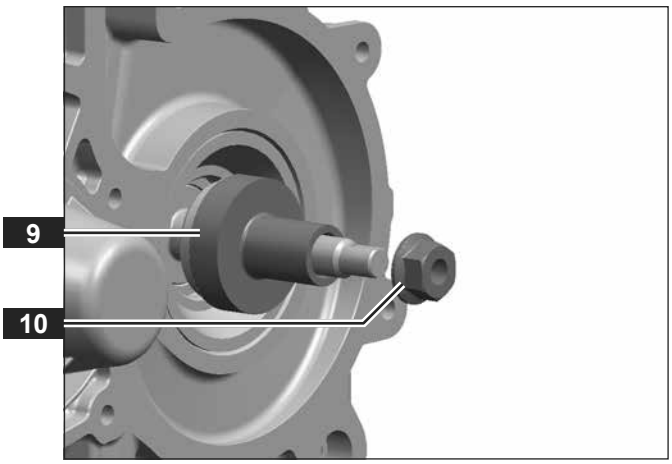
► Replace the slide ring seal 8.

► Slide the slide ring seal onto guide.



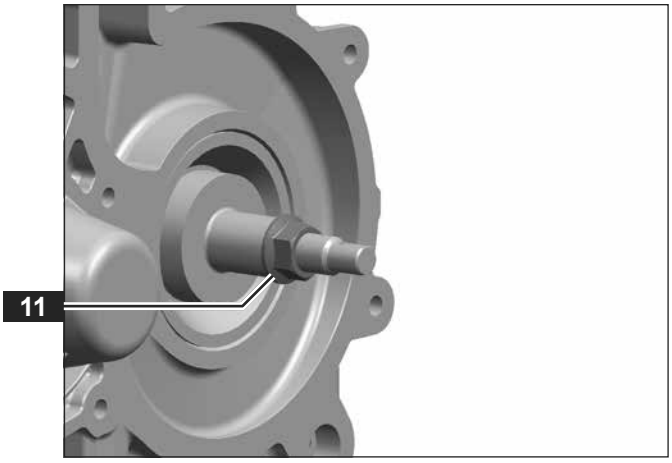
► Hold the sliding sleeve 9 in position.

► Screw on the nut 10.



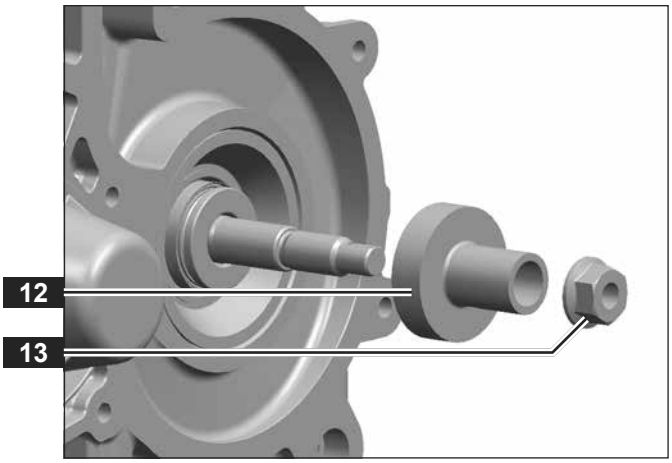
► Screw in the nut 11 using a open-end wrench until the slide ring seal is inserted completely.

Tightening torque:
10 Nm +1 Nm [7.4 lbf ft +0.7 lbf ft]

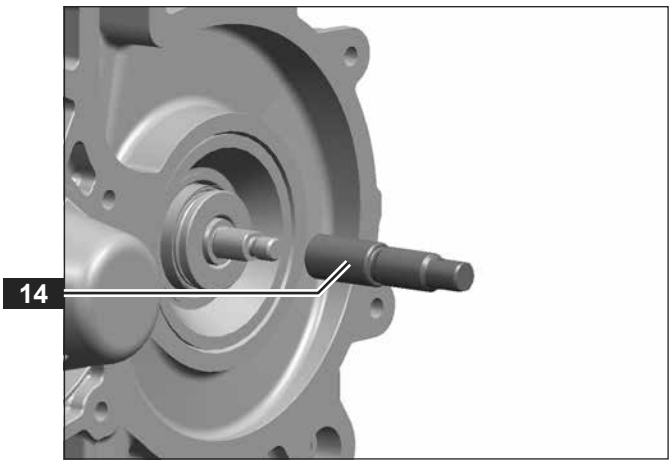


► Unscrew the nut 13.

► Remove the sliding sleeve 12.

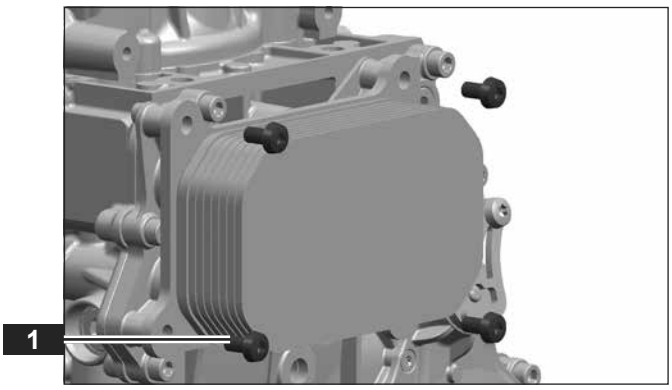


► Unscrew the guide 14 using a open-end wrench.

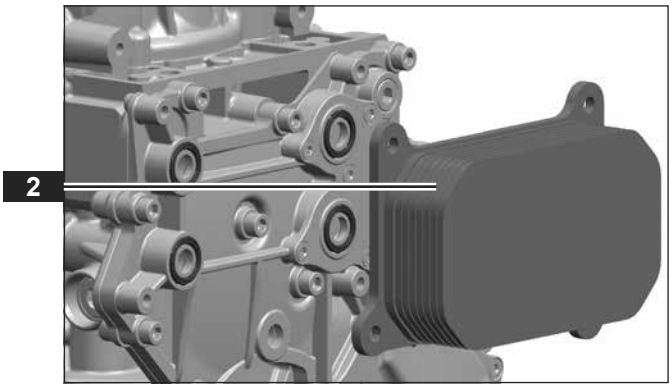


050.03.01 Removing oil cooler

► Unscrew the bolts 1.



► Remove the oil cooler 2.

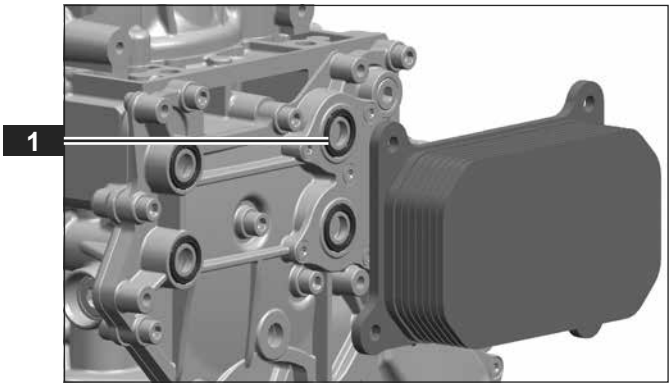


050.03.02 Installing oil cooler

– 4 Gaskets oil cooler

► Replace the gaskets 1.

► Insert the gaskets into the grooves and lightly coat with petroleum jelly.

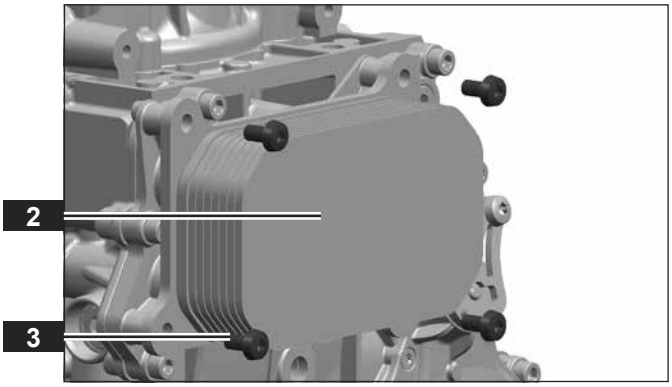


► Hold the oil cooler 2 in position.

► Screw in the bolts 3.

Tightening torque:

8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



060.01.01 Instructions for mounting nuts and exhaust gasket

– 8 Nuts
– 2 Exhaust gaskets

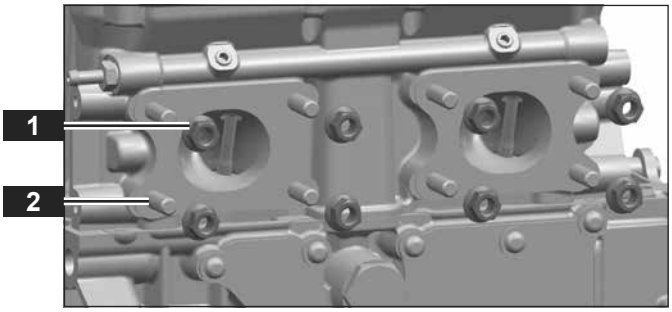
– Anti-Seize assembly paste

► Replace the nuts 1.

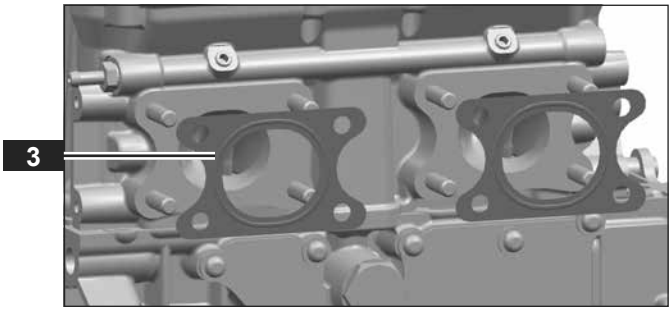
► Apply Anti-Seize assembly paste thoroughly to all studs 2.

► Screw on the nuts.

Tightening torque:
22 Nm +4 Nm [16.2 lbf ft +3 lbf ft]



► Replace the exhaust gaskets 3.



060.01.02 Replacing studs

– Stud extractor

– Anti-Seize assembly paste

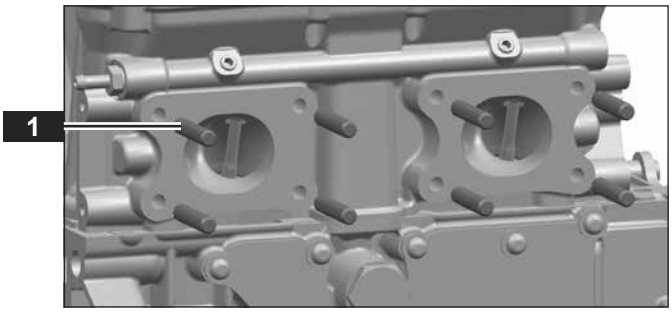
► Unscrew the studs 1 using a stud extractor.

► Replace the studs.

► Apply Anti-Seize assembly paste to all studs.

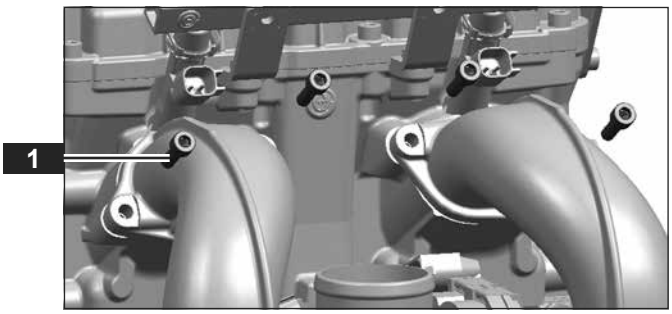
► Screw in the studs using a stud extractor.

Tightening torque:
16 Nm +4 Nm [11.8 lbf ft +3 lbf ft]

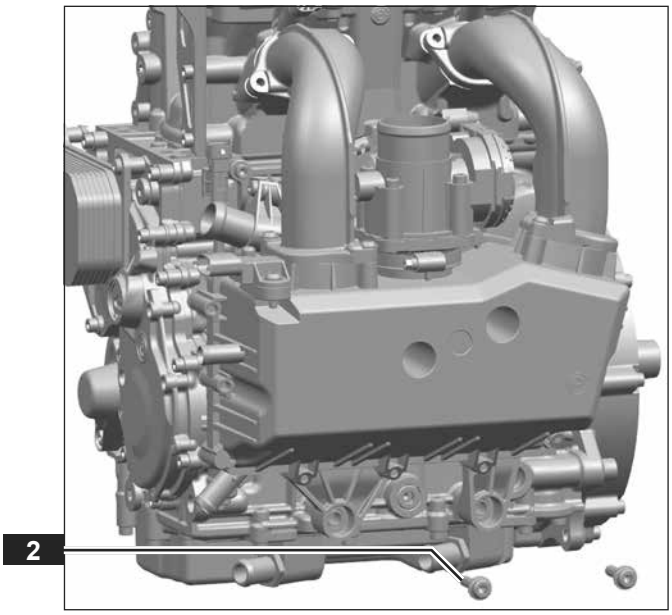


070.01.01 Removing intake manifold

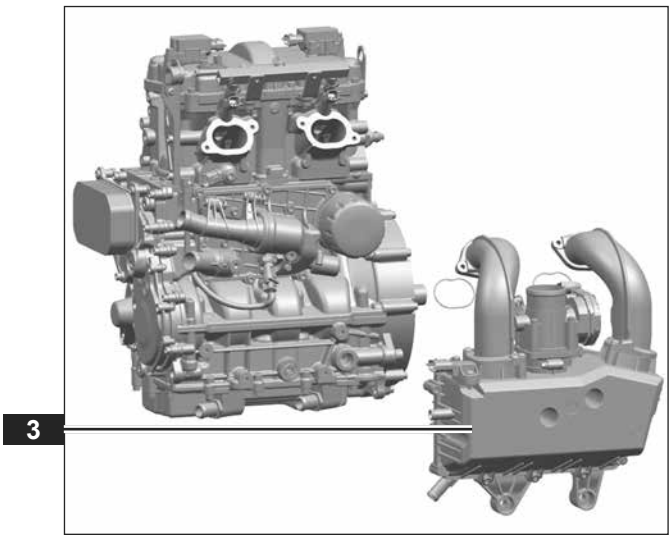
► Unscrew 4 bolts 1.



► Unscrew the bolts 2.



► Remove the intake manifold 3.

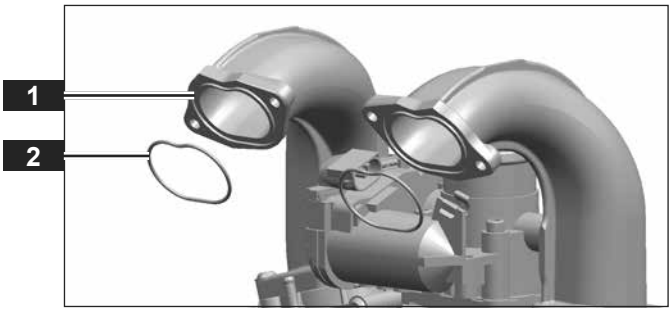


070.01.02 Installing intake manifold

– 2 O-rings intake manifold

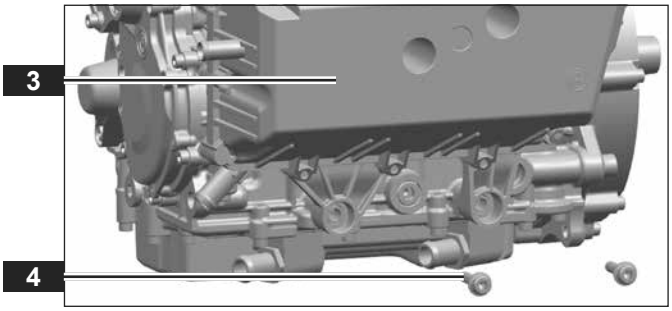
► Replace the o-rings 2.

► Insert the o-rings into the grooves 1 and lightly coat with petroleum jelly.



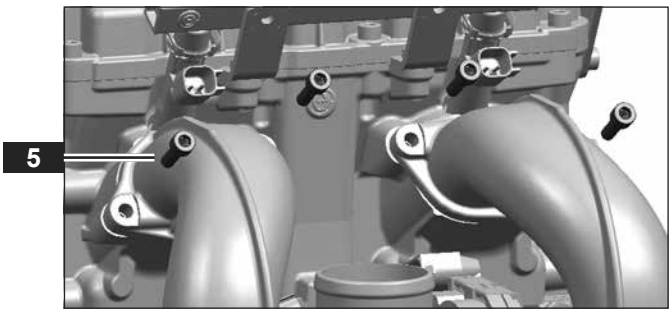
► Hold the intake manifold 3 in position.

► Screw in the bolts 4 lightly. Do not tighten.



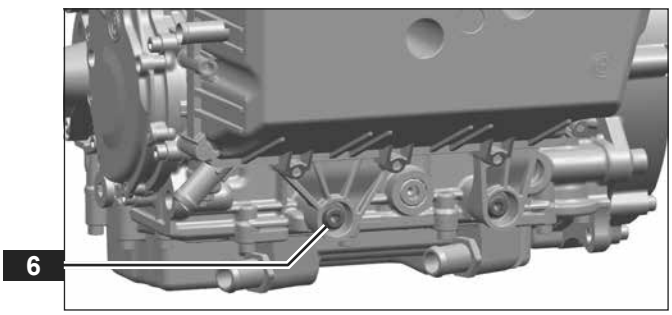
► Screw in 4 bolts 5.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



► Tighten the bolts 6.

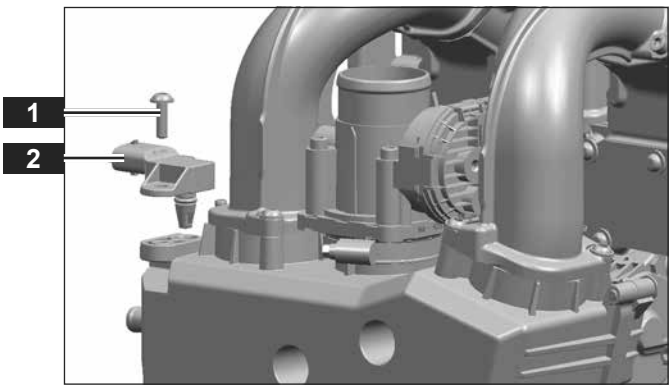
Tightening torque:
20 Nm +4 Nm [14.8 lbf ft +3 lbf ft]



070.01.05 Removing sensor intake manifold pressure/temperature

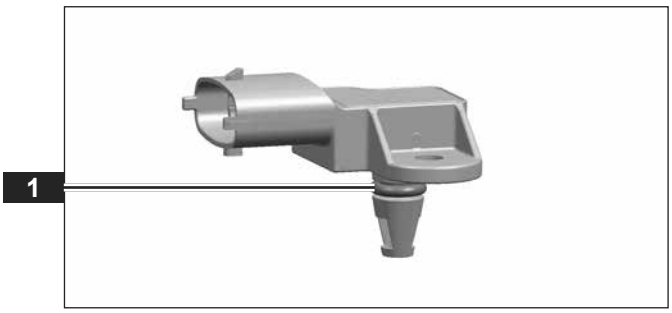
► Unscrew the bolt 1.

► Pull the sensor intake manifold pressure/ temperature 2 out.



070.01.06 Installing sensor intake manifold pressure/temperature

► Coat the o-ring 1 lightly with petroleum jelly.

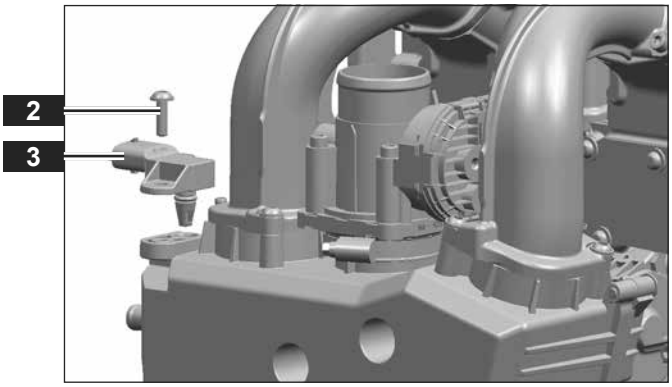


► Insert the sensor intake manifold pressure/ temperature 3.

► Screw in the bolt 2.

Tightening torque:

4,5 Nm +1 Nm [3.3 lbf ft +0.7 lbf ft]



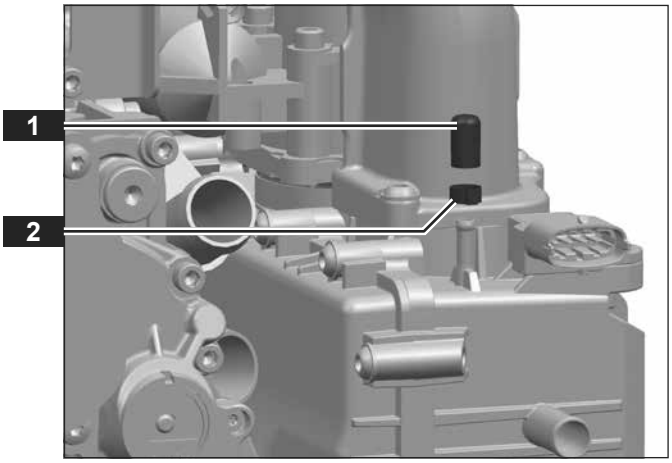
070.01.07 Replacing cap

– Clamp pincer

– 1 Hose clamp 8.8-10.5/5

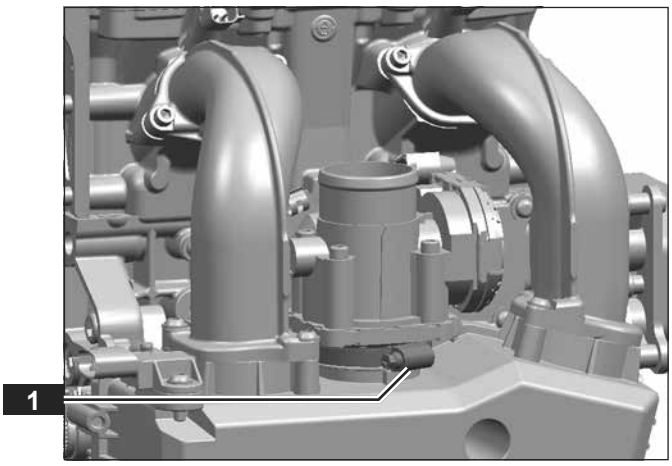
The hose clamp will be destroyed during removal.

- ► Remove the hose clamp 1.
- ► Remove the cap 2.
- ► Replace the cap.
- ► Insert the cap.
- ► Replace the hose clamp.
- ► Close the hose clamp using a clamp pincer.

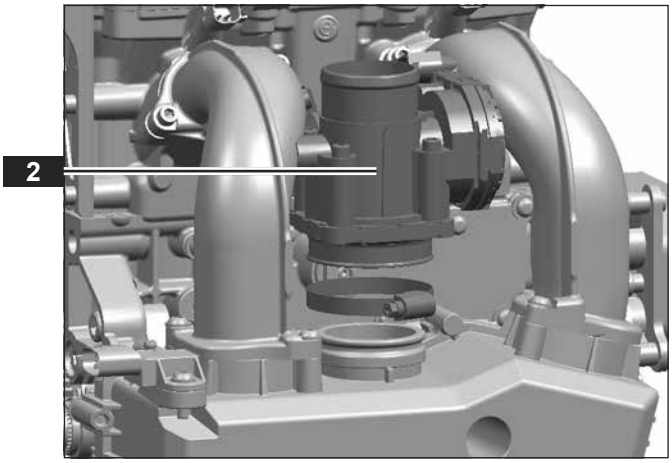


070.02.01 Removing throttle body

► Open the hose clamp **1**.

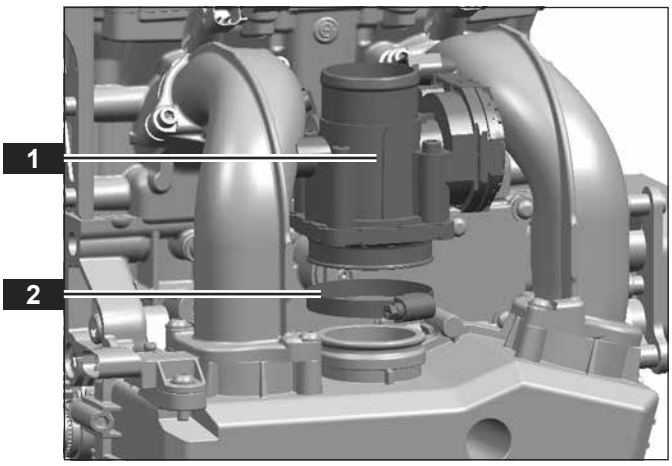


► Remove the throttle body **2**.



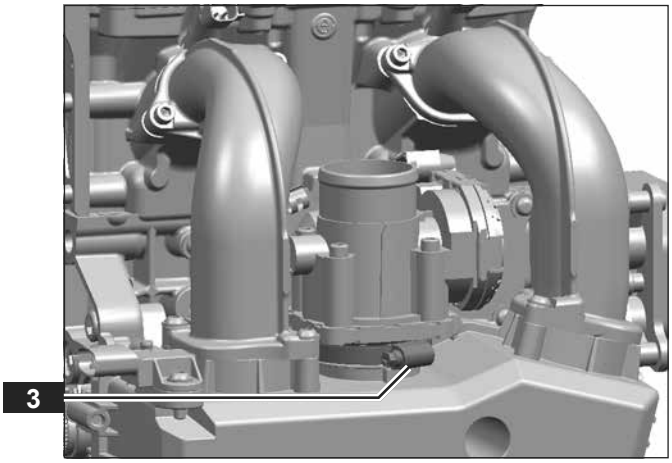
070.02.02 Installing throttle body

► Insert the hose clamp **2** and throttle body **1**.



► Close the hose clamp **3**.

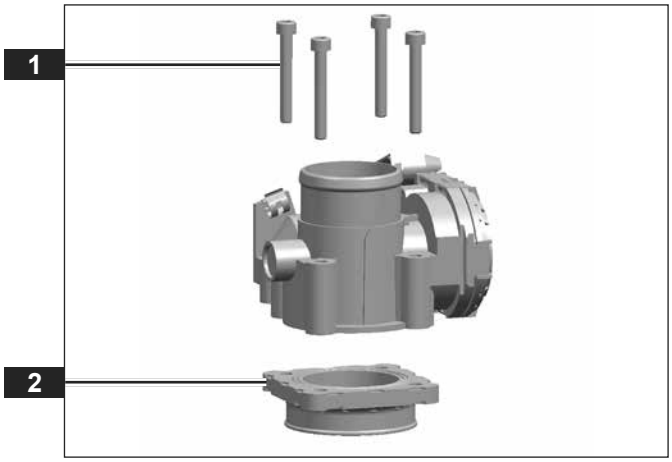
Tightening torque:
3 Nm +0,5 Nm [2.2 lbf ft +0.4 lbf ft]w



070.02.03 Replacing throttle body

Information! When replacing the throttle body, it must be recalibrated. Before putting the engine into operation again, turn the ignition on for about a minute, until the throttle body opens and closes again.

- ► Unscrew the bolts 1.
- ► Remove the rubber mount 2.

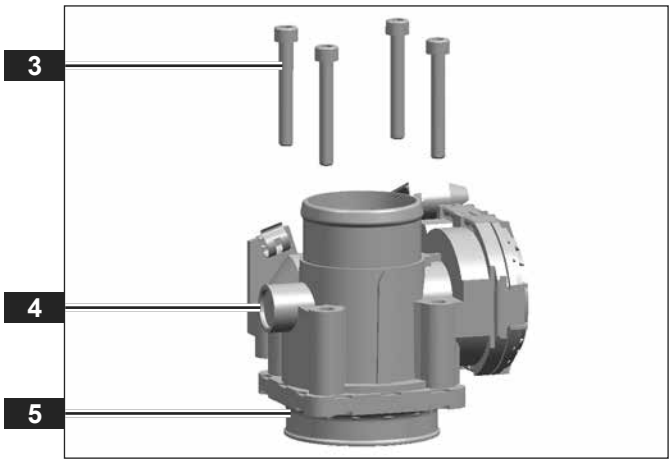


- ► Replace the throttle body 4.
- ► Hold the rubber mount 5 in position.

Observe the orientation of the throttle body to the rubber mount. Screw in the bolts evenly crosswise.

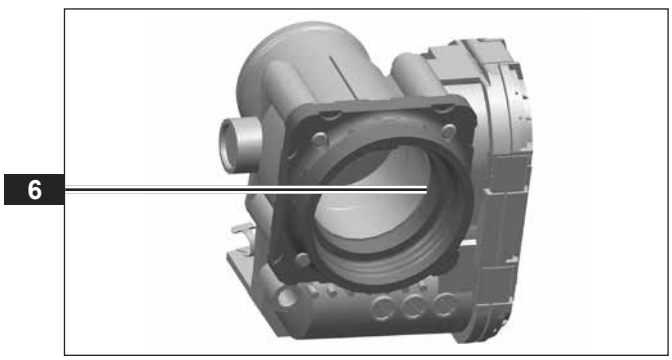
- ► Screw in the bolts 3 by hand. Do not tighten.
- ► Tighten the bolts.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



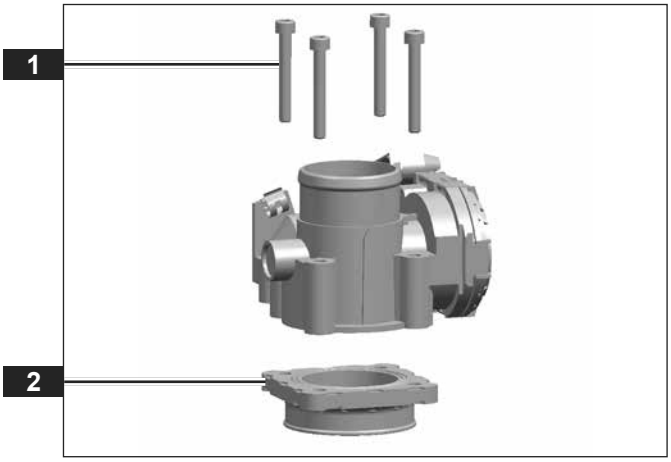
- ► Observe the orientation of the throttle body to the rubber mount.

  A regular edge 6 is visible.



070.02.04 Replacing rubber mount

- ► Unscrew the bolts 1.
- ► Remove the rubber mount 2.

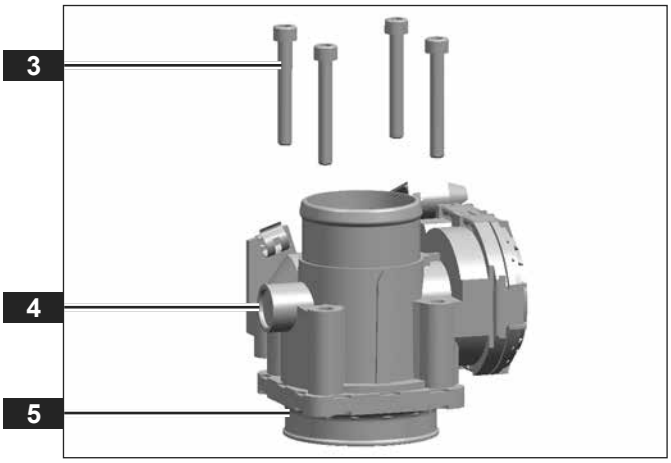


- ► Replace the rubber mount 5.
- ► Hold the rubber mount in position.

Observe the orientation of the throttle body 4 to the rubber mount. Screw in the bolts evenly crosswise.

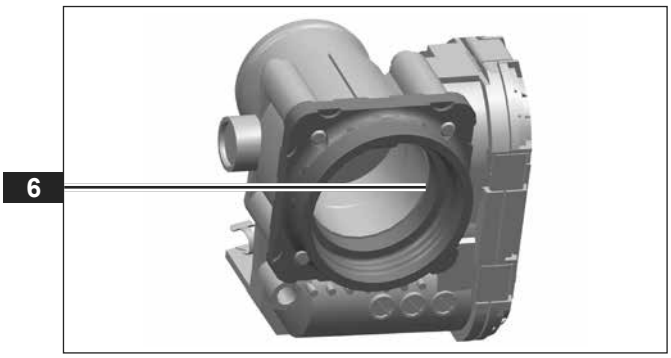
- ► Screw in the bolts 3 by hand. Do not tighten.
- ► Tighten the bolts.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



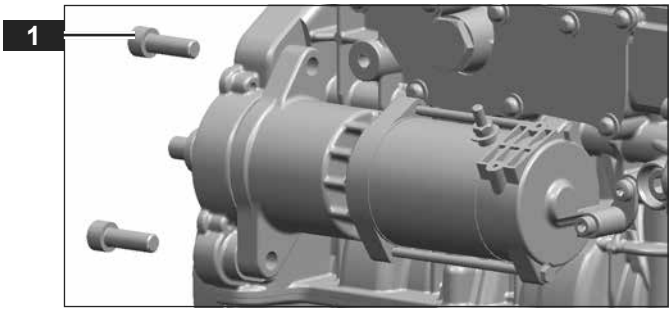
- ► Observe the orientation of the throttle body to the rubber mount.

  A regular edge 6 is visible.



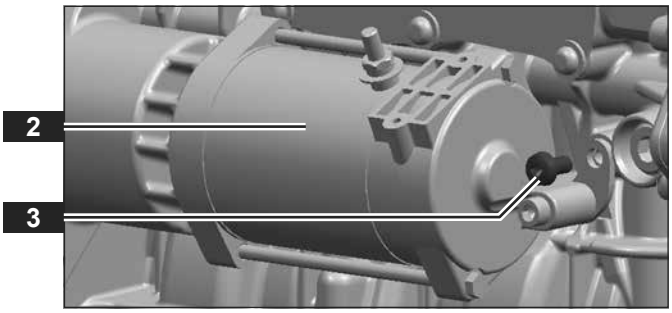
090.01.01 Removing starter

► Unscrew 2 bolts 1.



► Unscrew the bolt 3.

► Remove the starter 2.

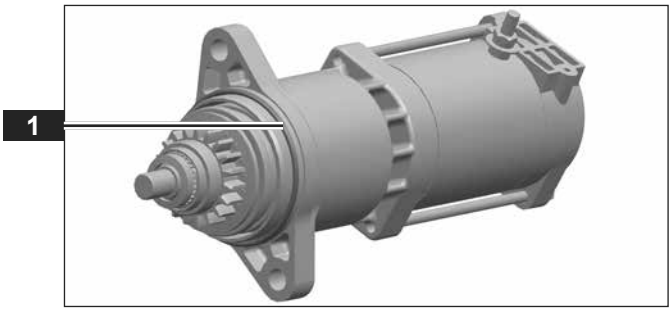


090.01.02 Installing starter

– 1 O-ring starter

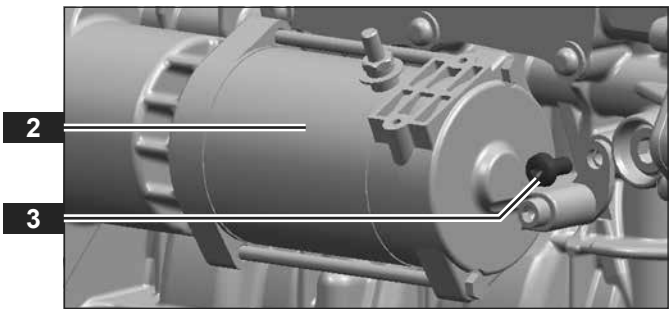
► Replace the o-ring 1.

► Coat the o-ring lightly with petroleum jelly.



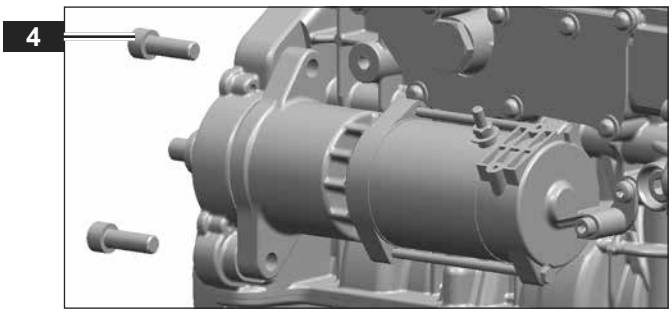
► Hold the starter 2 in position.

► Screw in the bolt 3 lightly. Do not tighten.



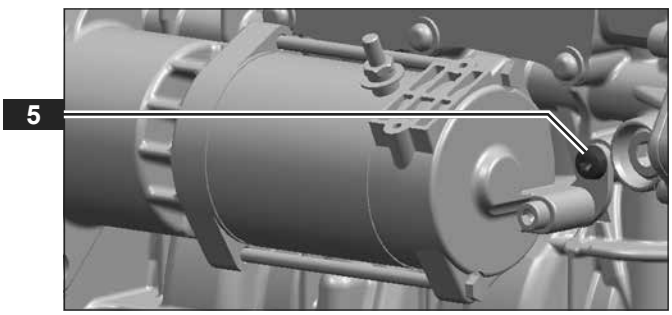
► Screw in 2 bolts 4.

Tightening torque:
40 Nm +8 Nm [29.5 lbf ft +5.9 lbf ft]



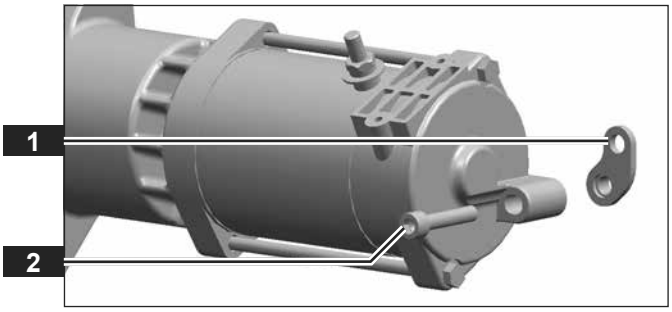
► Tighten the bolt 5.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



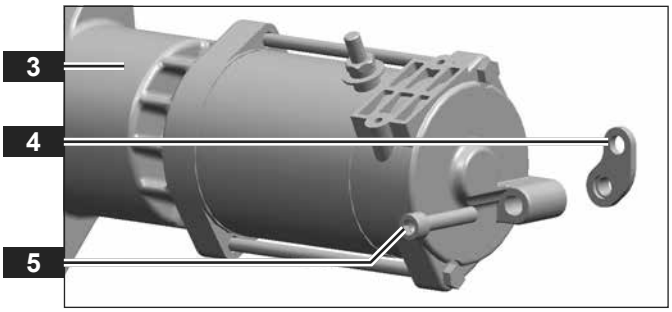
090.01.03 Replacing starter

- ► Unscrew the bolt 2.
- ► Remove the bracket 1.



- ► Replace the 3 starter.
- ► Hold the bracket 4 in position.
- ► Screw in the bolt 5.

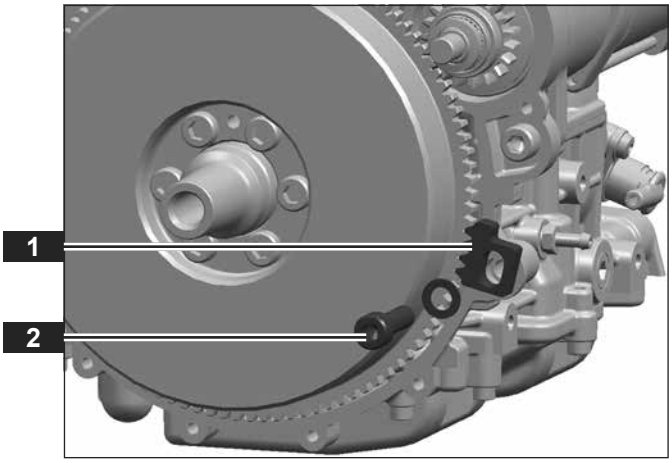
Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



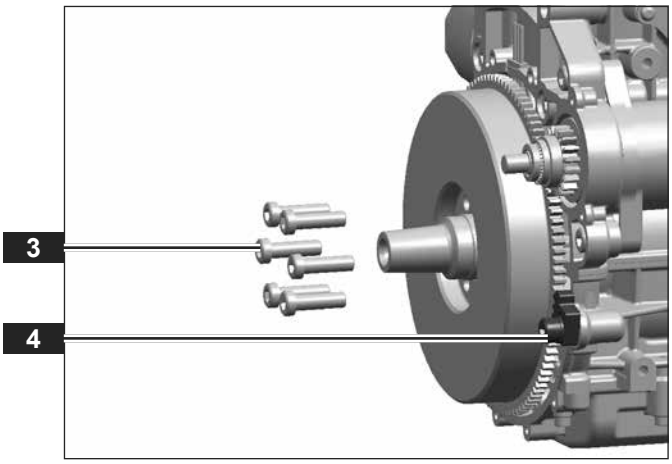
090.02.01 Removing generator

– Locking tool crankshaft

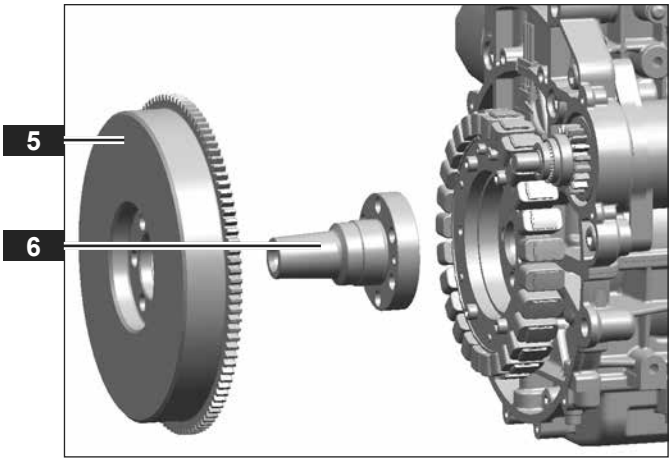
► Hold the locking tool crankshaft 1 on rotor.
► Screw in the bolt 2 and washer.



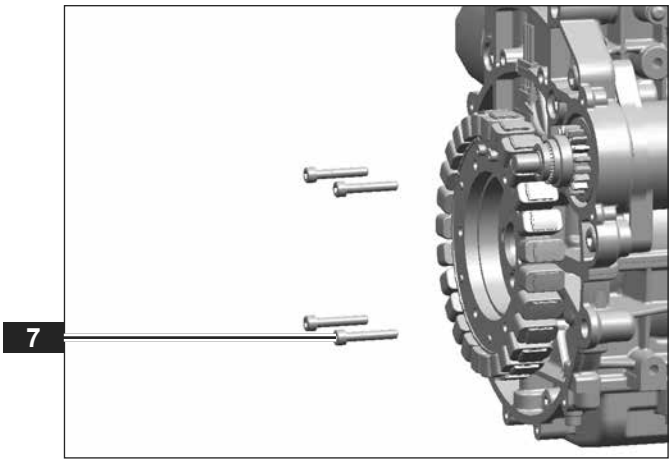
► Unscrew the bolts 3.
► Remove the locking tool crankshaft 4.



► Remove the rotor 5.
► Remove the stub shaft 6.

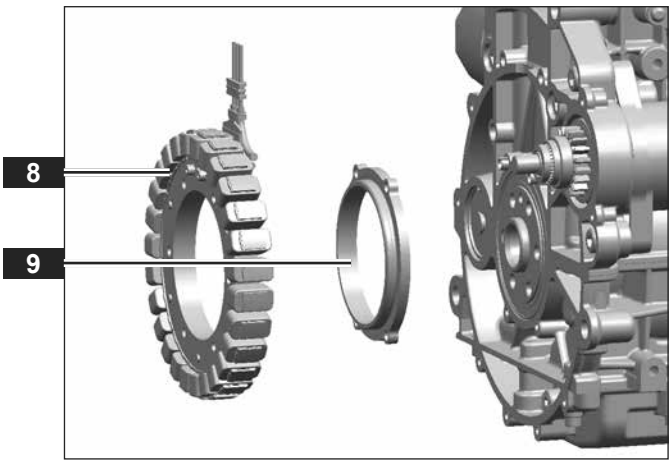


► Unscrew the bolts 7.



The connector plug of the stator is not shown.

► Disconnect the connector plug of the stator.
► Remove the stator 8.
► Remove the distance washer 9.



090.02.02 Installing generator

– Locking tool crankshaft

– 6 Bolts M10x1x35

– Thread locker, medium strength

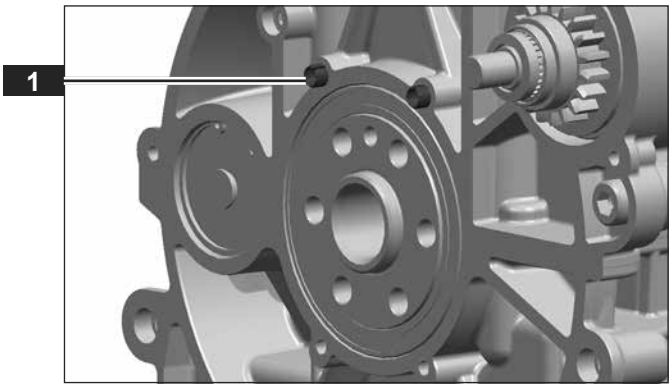
NOTICE

Leaks due to damage to the coating on the bolts.

The threads of the six bolts on the rotor have a micro encapsulated coating. During fastening the bolt, the microcapsules will burst and the contained adhesive and curing agent are released and mixed. The coating begins to cure within a short time. If the bolts are moved again later, the coating becomes ineffective and engine oil can escape.

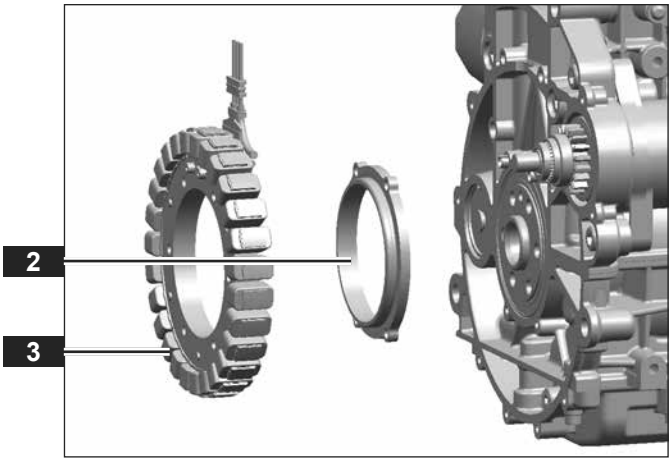
- ► Replace the bolts after removing.
- ► After inserting the bolts by hand, continue the task quickly until the bolts are tight.
- ► Never tighten the bolts again later.

► Check if the sleeves 1 are installed.



► Insert the distance washer 2.

► Hold the stator 3 in position.



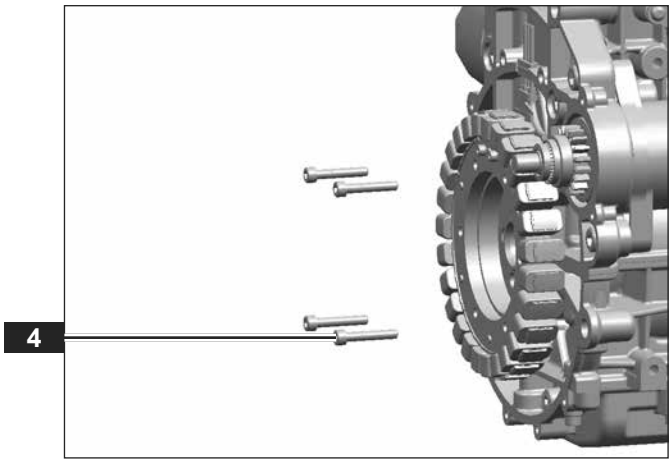
► Coat the thread on the bolts 4 with medium strength thread locker.

► Screw in the bolts.

Tightening torque:
7 Nm +1 Nm [5.2 lbf ft +0.7 lbf ft]

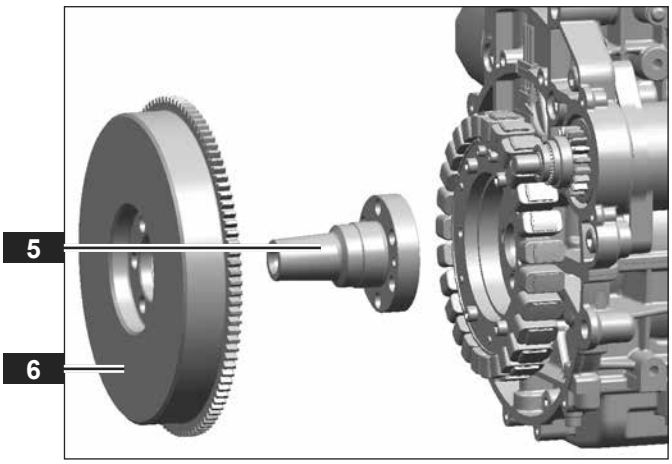
The connector plug of the stator is not shown.

► Connect the connector plug of the stator.

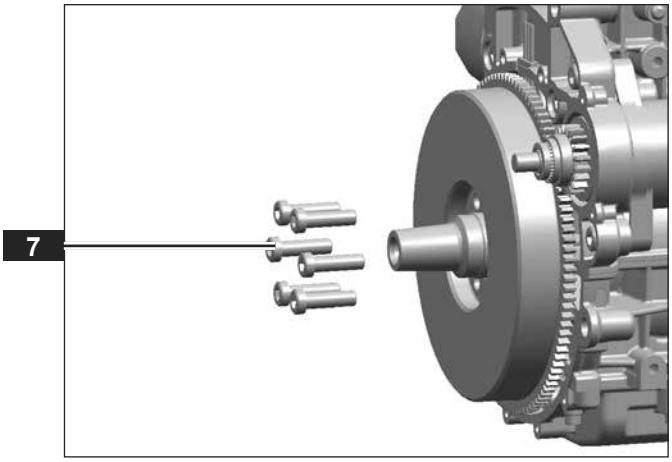


► Hold the stub shaft 5 in position.

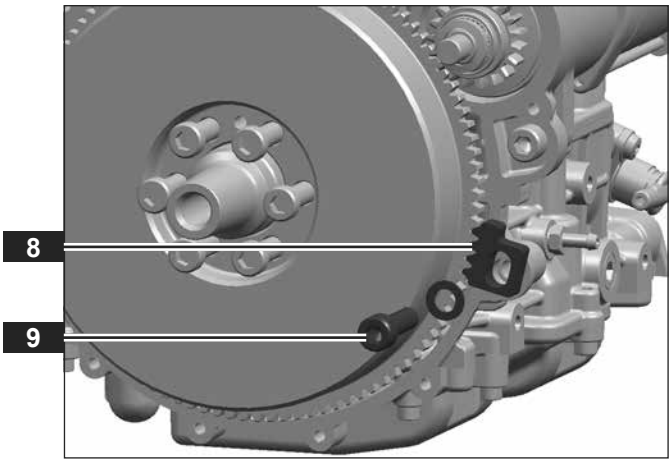
► Slide on the rotor 6.



- ► Replace the bolts 7.
- ► Screw in the bolts by hand. Do not tighten.



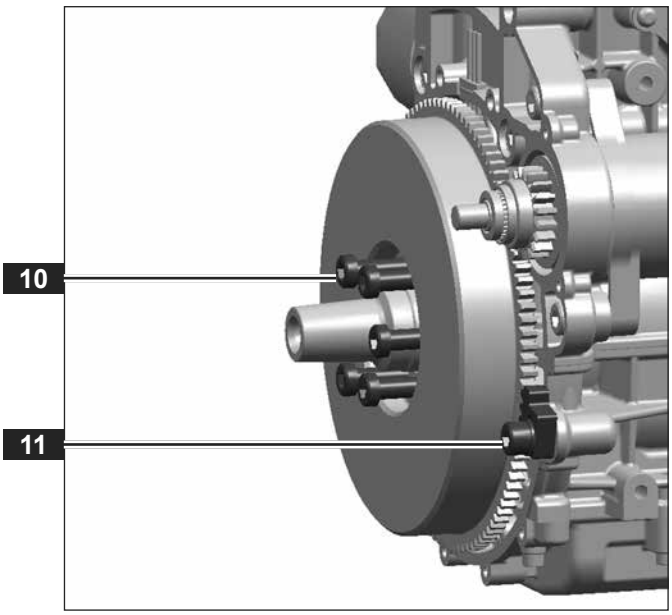
- ► Hold the locking tool crankshaft 8 on rotor.
- ► Screw in the bolt 9 and washer.



- ► Tighten the bolts 10.

Tightening torque:
60 Nm +10 Nm [44.3 lbf ft +7.4 lbf ft]

- ► Remove the locking tool crankshaft 11.



100.01.01 Removing fuel rail

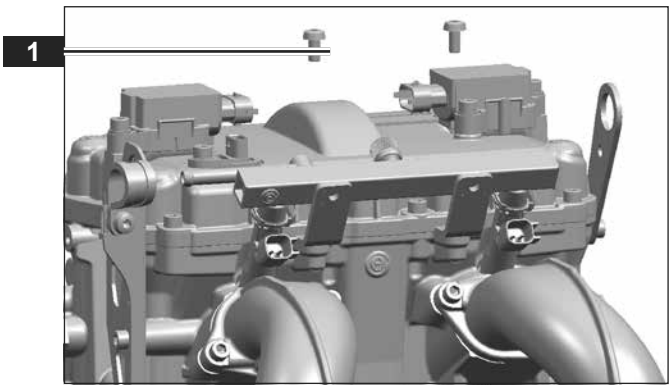
⚠ WARNING

Burn injuries due to ignited fuel.

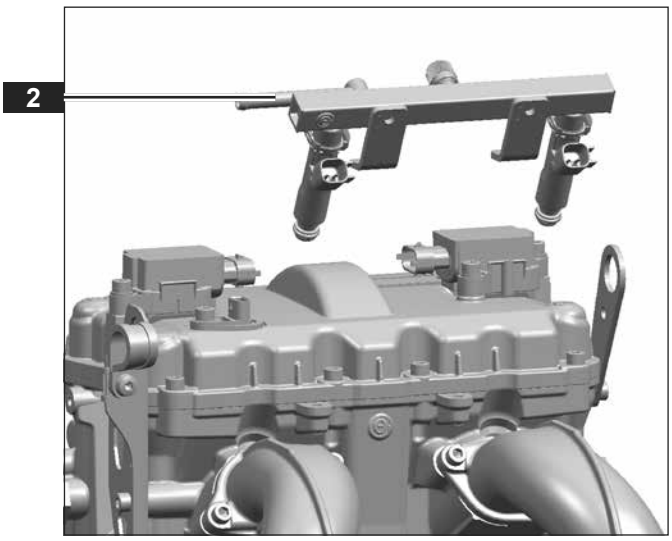
Fuel is highly flammable. Leaks in the fuel system can lead to burns and vapors may ignite and cause an explosion.

- ► When working on the fuel system, observe the safety messages in chapter 2.2 **Important safety messages**.
- ► Only remove the fuel rail if absolutely necessary.
- ► If you find that the fuel rail or injectors are defective, replace them immediately,
- ► If you find that o-rings are defective, replace the injector immediately.
- ► After the repair, always ensure that the fuel system has no leaks.

► Unscrew the bolts 1.



► Remove the fuel rail 2.



100.01.02 Installing fuel rail

– Lubricant for injectors o-rings

WARNING

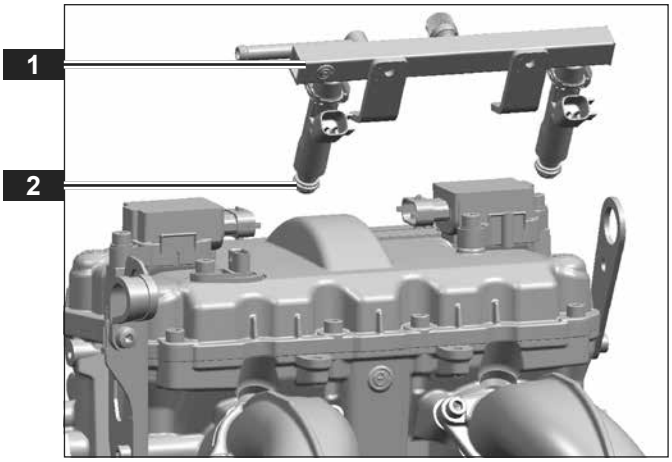
Burn injuries due to ignited fuel.

Fuel is highly flammable. Leaks in the fuel system can lead to burns and vapors may ignite and cause an explosion.

- ► When working on the fuel system, observe the safety messages in chapter 2.2 **Important safety messages**.
- ► Only remove the fuel rail if absolutely necessary.
- ► If you find that the fuel rail or injectors are defective, replace them immediately,
- ► If you find that o-rings are defective, replace the injector immediately.
- ► After the repair, always ensure that the fuel system has no leaks.

► Coat the o-rings 2 lightly with lubricant for injectors o-rings.

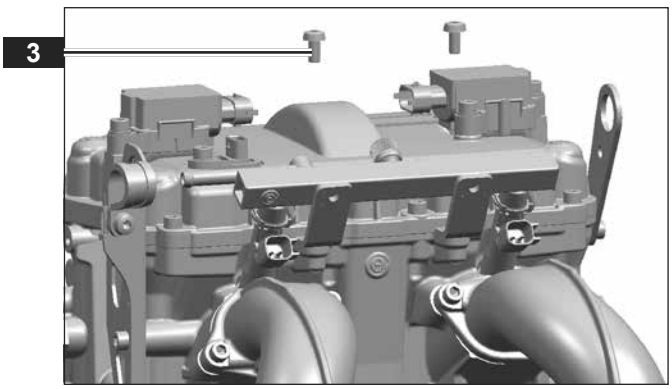
► Insert the fuel rail 1.



► Screw in the bolts 3.

Tightening torque:

8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



100.01.03 Replacing injector

– Lubricant for injectors o-rings

⚠ WARNING

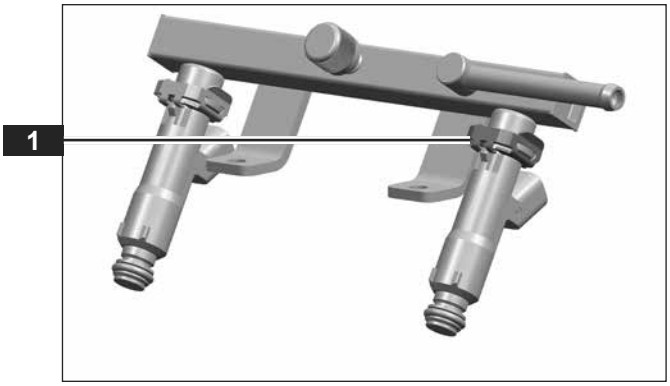
Burn injuries due to ignited fuel.

Fuel is highly flammable. Leaks in the fuel system can lead to burns and vapors may ignite and cause an explosion.

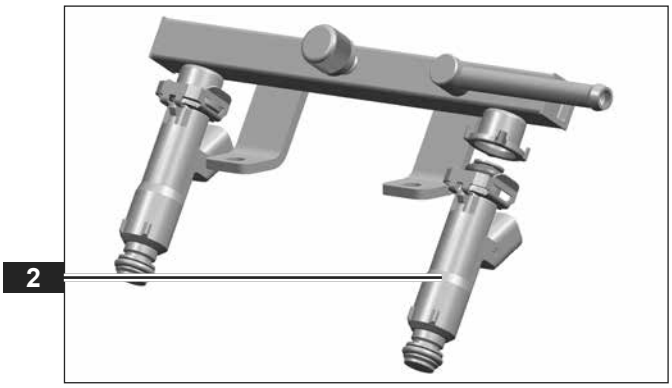
- ► When working on the fuel system, observe the safety messages in chapter 2.2 **Important safety messages**.
- ► Only remove the injectors if you have to replace them.
- ► If you find that the fuel rail or injectors are defective, replace them immediately,
- ► If you find that o-rings are defective, replace the injector immediately.
- ► After the repair, always ensure that the fuel system has no leaks.

WARNING! Serious eye injuries due to a flying bracket. Wear protective glasses.

► Carefully push apart the brackets 1.



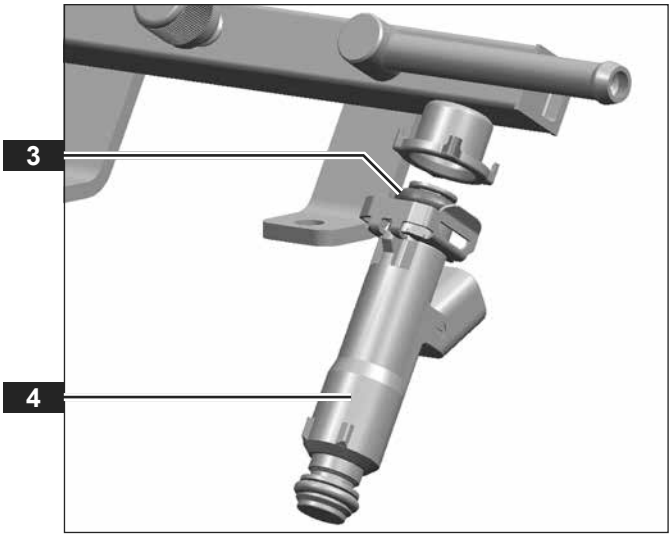
► Pull the injector 2 out.



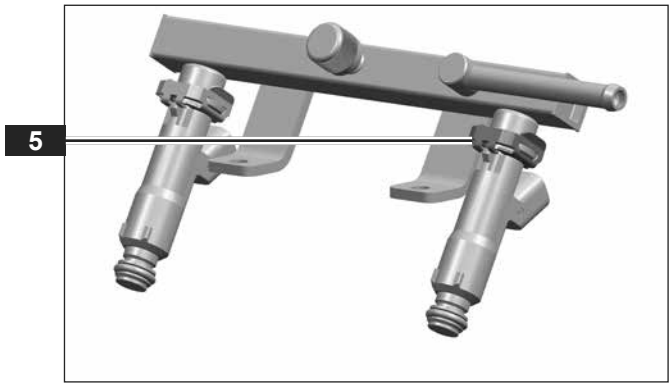
► Replace the injector 4.

► Coat the o-ring 3 lightly with lubricant for injectors o-rings.

► Insert the injector until it engages in the bracket.



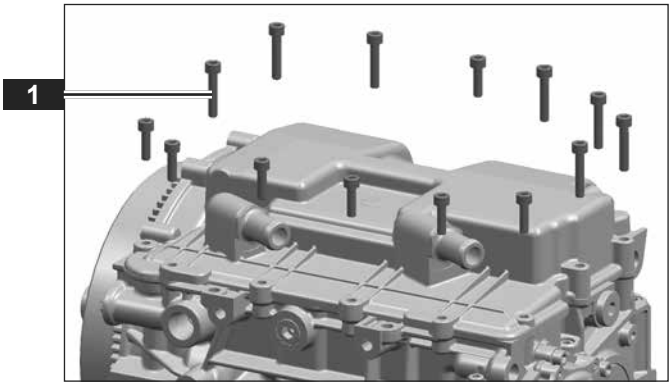
► Check that the injector is engaged in the bracket 5.



110.01.01 Removing suction pump cover

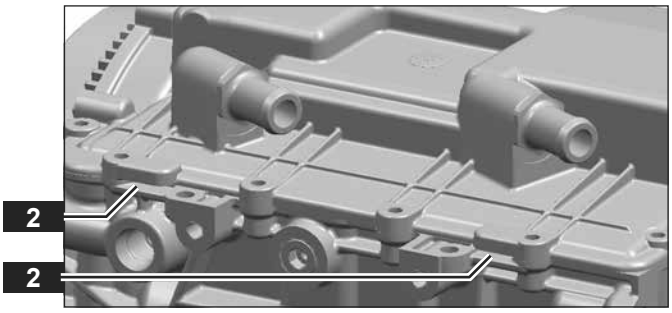
► Turn the engine 180°.

► Unscrew 14 bolts 1.

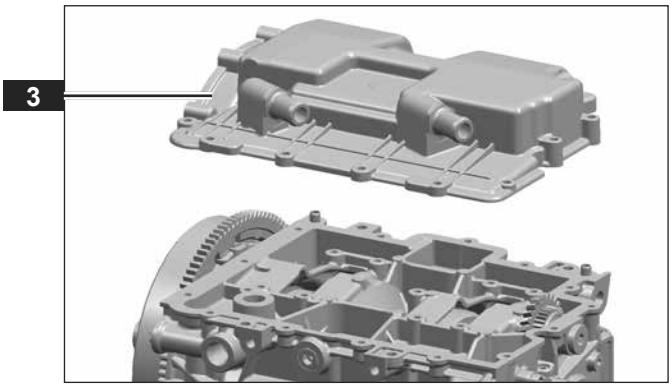


The suction pump cover is caulked with a silicone liquid seal.

► Prize off the suction pump cover using the grooves 2.



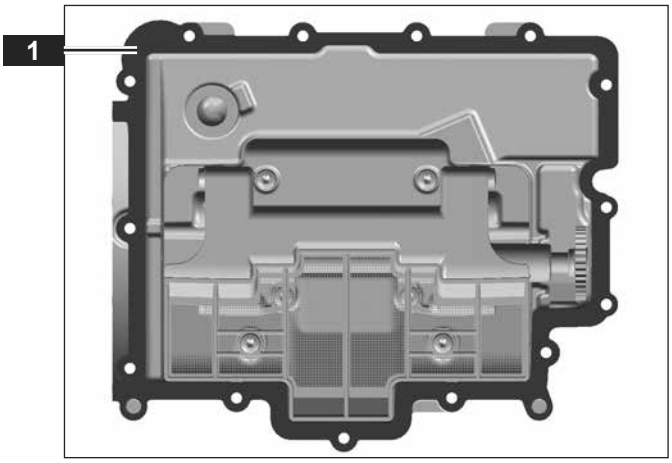
► Remove the suction pump cover 3.



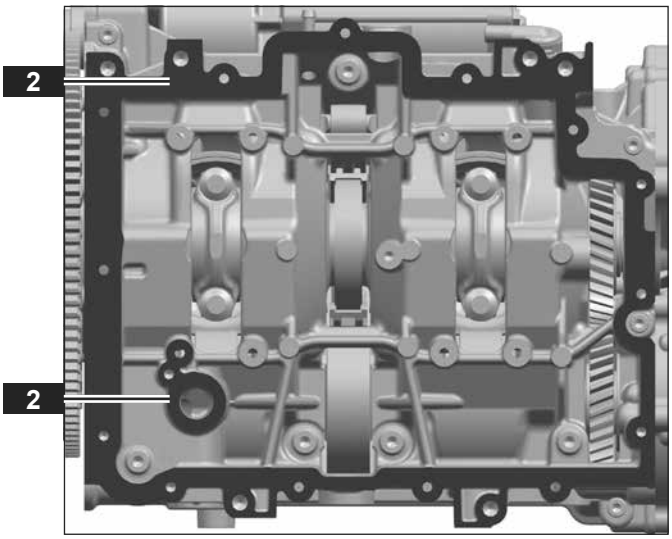
110.01.02 Installing suction pump cover

– Silicone liquid seal

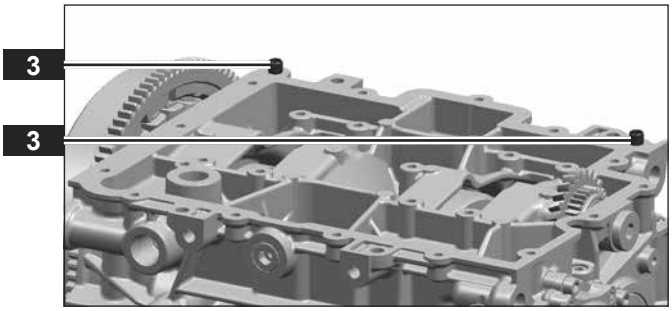
► Clean the sealing surface 1 with sealing surface cleaner.



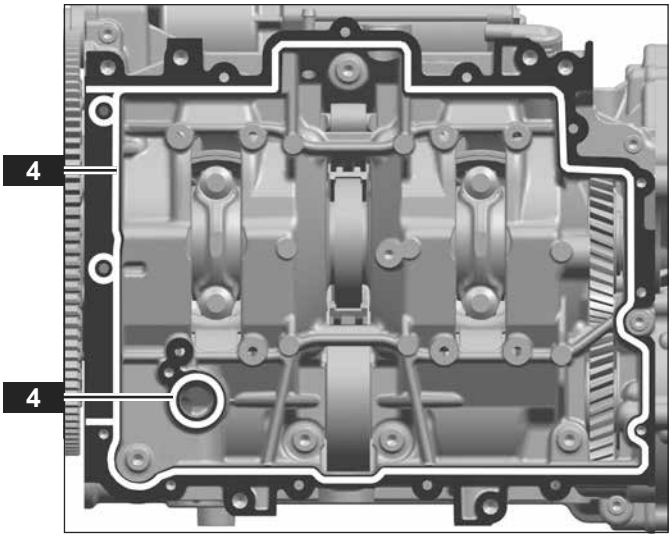
► Clean the sealing surface 2 with sealing surface cleaner.



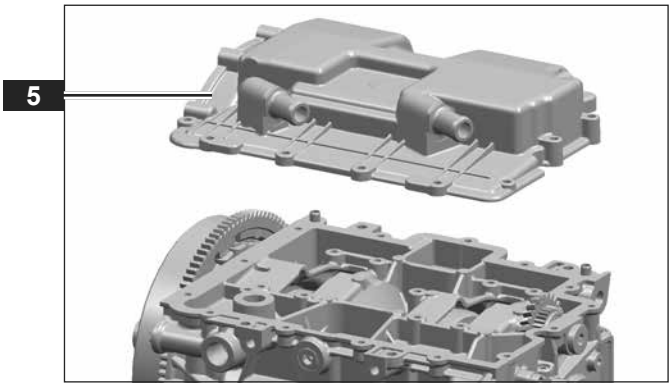
► Check if the sleeves 3 are installed.



► Apply the silicone liquid seal 4 without gaps as illustrated.



► Put the suction pump cover 5 on.



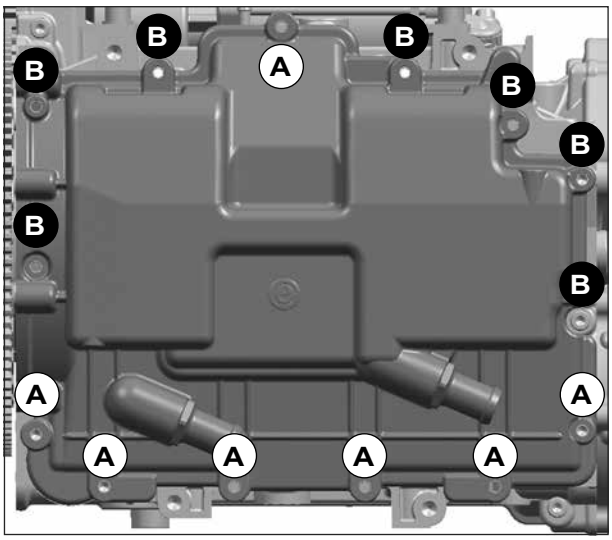
► Screw in 7 bolts M6x20 Ⓐ.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]

► Screw in 7 bolts M6x30 Ⓑ.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]

► Turn the engine 180°.



110.01.03 Replacing suction pump cover

– 1 Seal 18x22x1.5 Al

– Thread sealant

► Replace the suction pump cover 1.

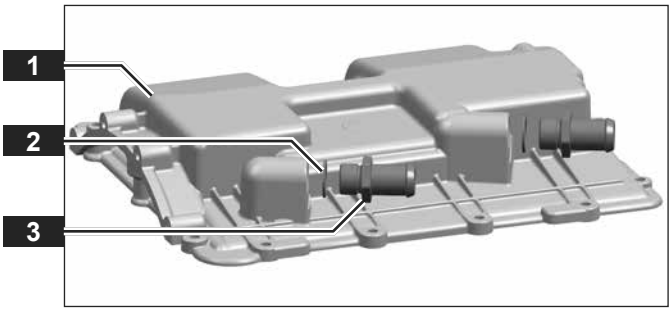
► Replace the seals 2.

► Coat the thread on the fittings 3 with thread sealant.

► Screw in the fittings.

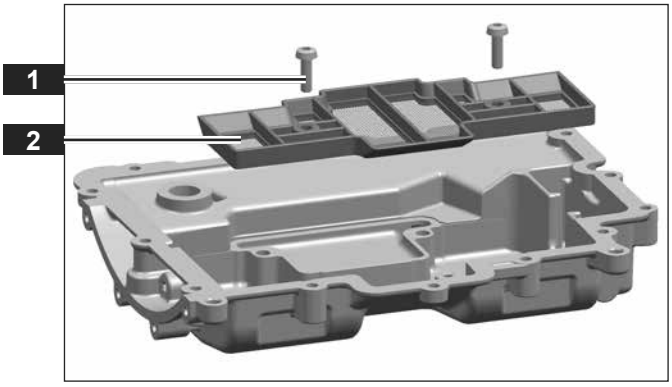
Tightening torque:

10 Nm +2 Nm [7.4 lbf ft +1.5 lbf ft]

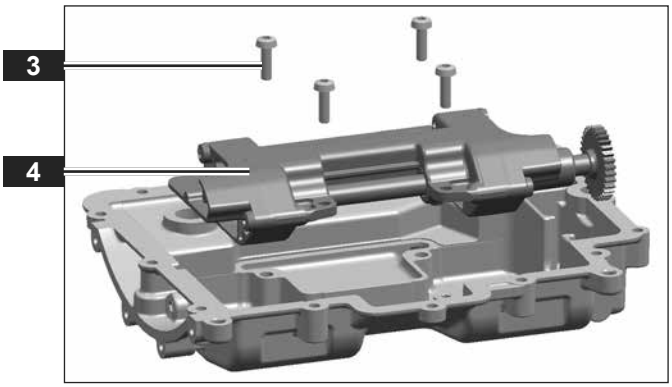


110.01.04 Removing oil suction pump

- ► Unscrew the bolts 1.
- ► Remove the oil screen 2.



- ► Unscrew the bolts 3.
- ► Remove the oil suction pump 4.

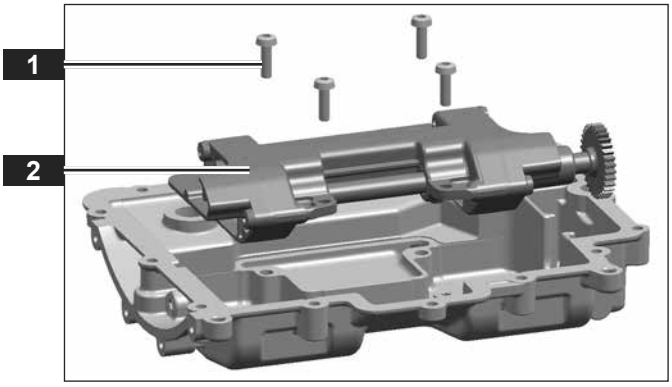


110.01.05 Installing oil suction pump

► Insert the oil suction pump 2.

► Screw in the bolts 1.

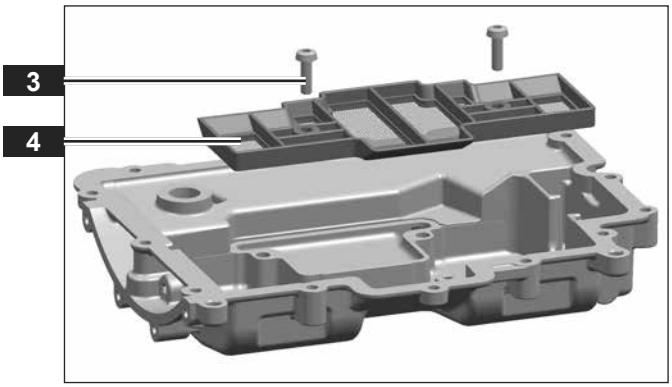
Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



► Insert the oil screen 4.

► Screw in the bolts 3.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



110.01.06 Replacing fitting

– 1 Seal 18x22x1.5 Al

– Thread sealant

► Turn the engine 180°.

► Unscrew the fitting 1.

► Replace the fitting.

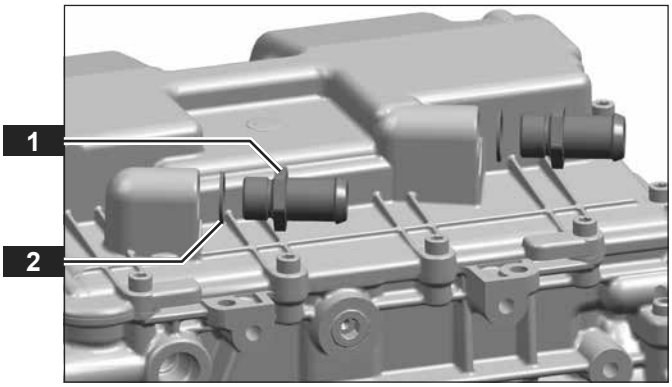
► Replace the seal 2.

► Coat the thread on the fitting with thread sealant.

► Screw in the fitting.

Tightening torque:
10 Nm +2 Nm [7.4 lbf ft +1.5 lbf ft]

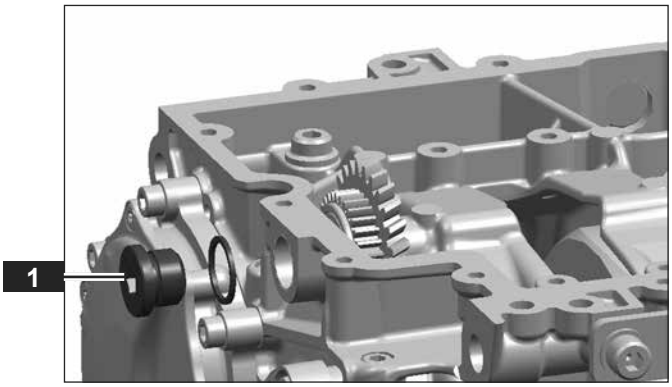
► Turn the engine 180°.



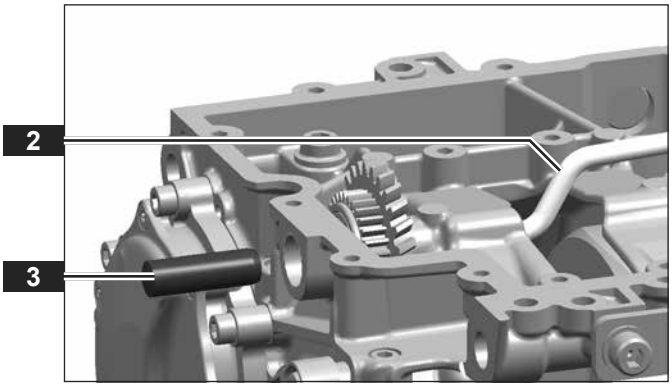
110.01.07 Removing intermediate gear suction pump

– Pin punch axle intermediate gear

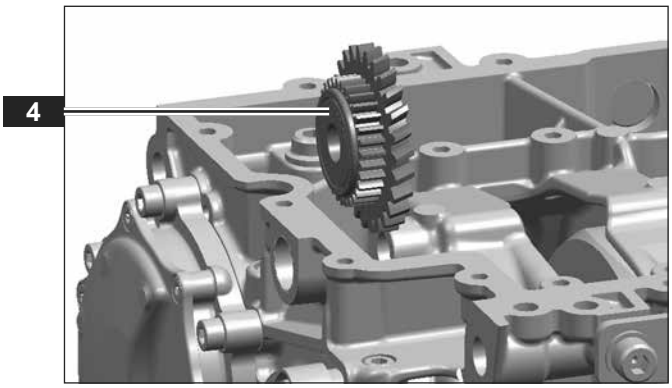
► Unscrew the plug 1.



► Punch the axle 3 out using the pin punch axle intermediate gear 2 and plastic hammer.



► Remove the intermediate gear suction pump 4.

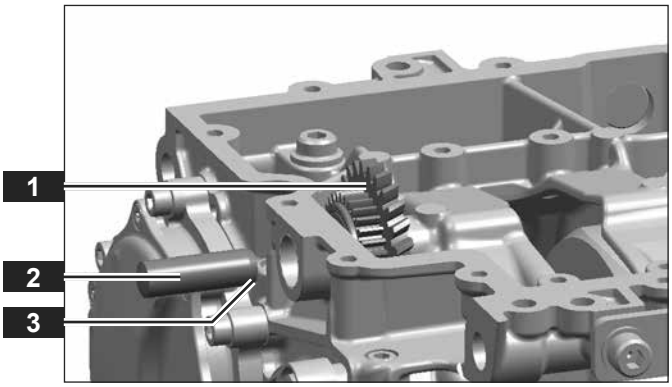


110.01.08 Installing intermediate gear suction pump

– 1 Seal 18x22x1.5 Al

► Hold the intermediate gear suction pump 1 in position.

► Slide in the axle 2. Observe the position of the bevel 3.

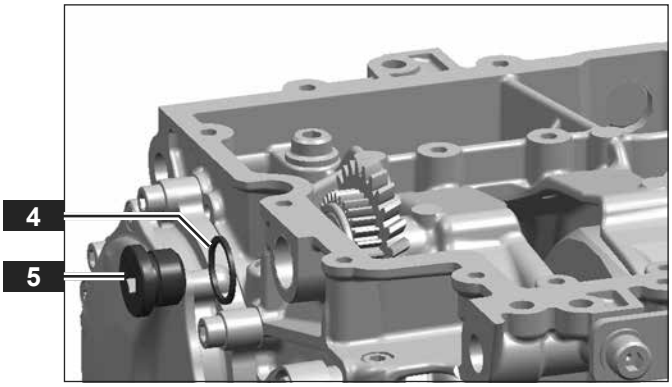


► Replace the seal 4.

► Screw in the plug 5.

Tightening torque:

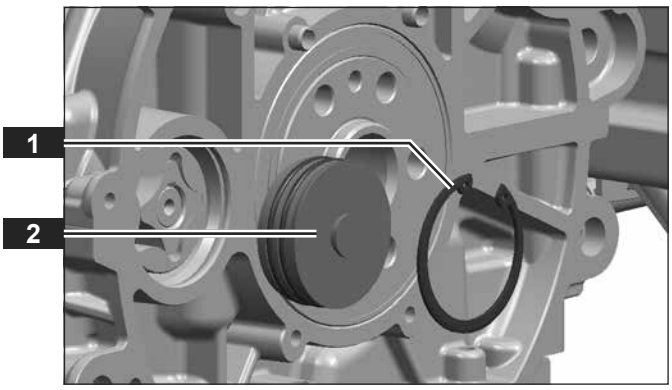
20 Nm +4 Nm [14.8 lbf ft +3 lbf ft]



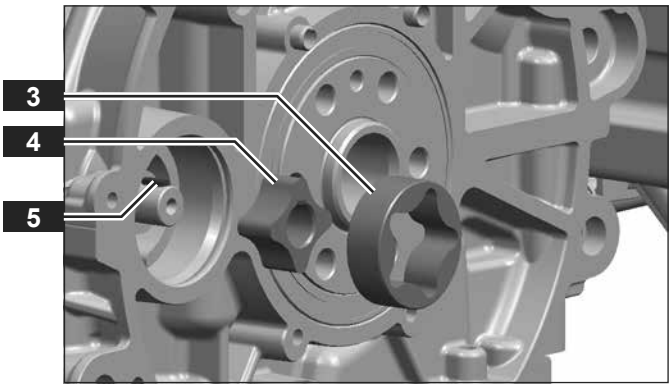
110.02.01 Removing oil pressure pump

WARNING! Serious eye injuries due to a flying circlip. Wear protective glasses.

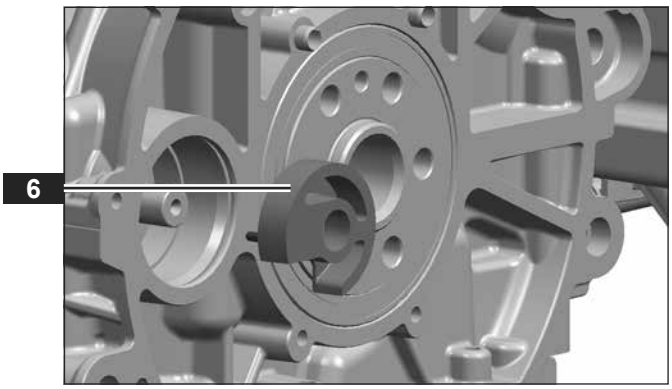
- ► Remove the circlip 1 using a lockring pliers.
- ► Remove the oil pump cover 2 using a universal pliers.



- ► Remove the outer rotor 3 of the oil pressure pump.
- ► Remove the inner rotor 4 of the oil pressure pump.
- ► Remove the key 5.



- ► Remove the timing insert 6.

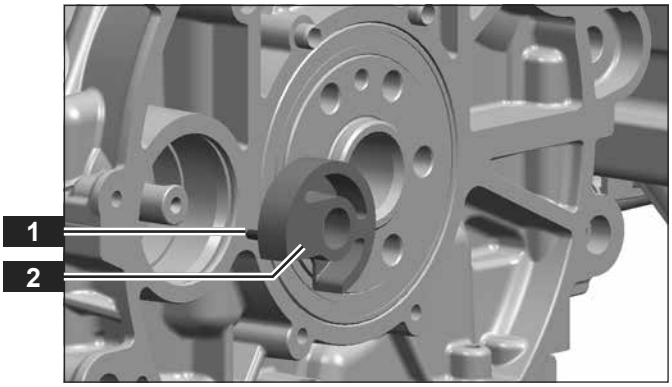


110.02.02 Installing oil pressure pump

– 4 O-rings oil pump cover

NOTICE! Engine damage due to the lack of lubrication. If the timing insert is installed in reverse, the engine cannot build up any oil pressure. Insert the side with centering pin 1 first.

► Insert the timing insert 2. Observe the installation position.



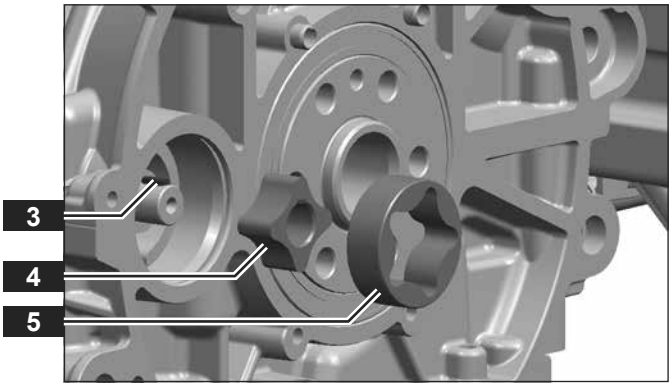
NOTICE! Engine damage due to the lack of lubrication. If the key 3 is not installed, the engine cannot build up any oil pressure. Always install the key.

► Replace the key.

► Insert the key.

► Insert the inner rotor 4 of the oil pressure pump.

► Insert the outer rotor 5 of the oil pressure pump.



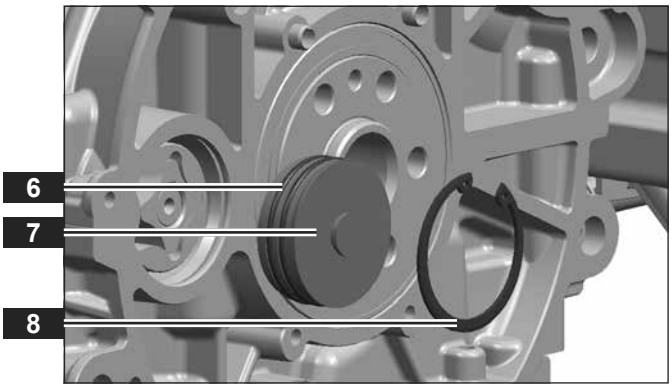
► Replace the o-rings 6.

► Coat the o-rings lightly with petroleum jelly.

► Insert the oil pump cover 7.

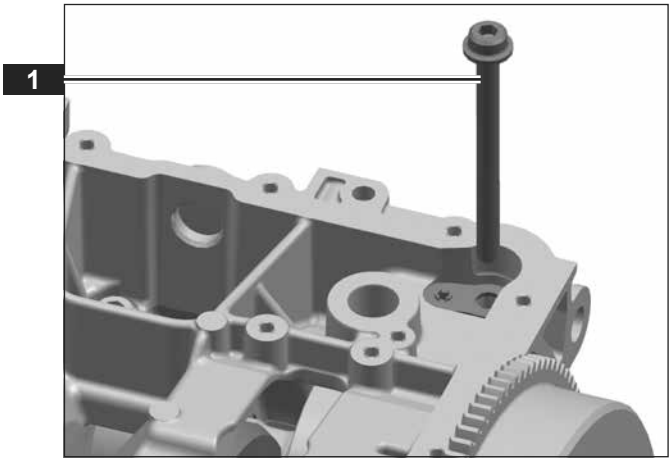
WARNING! Serious eye injuries due to a flying circlip. Wear protective glasses.

► Install the circlip 8 using a lockring pliers.

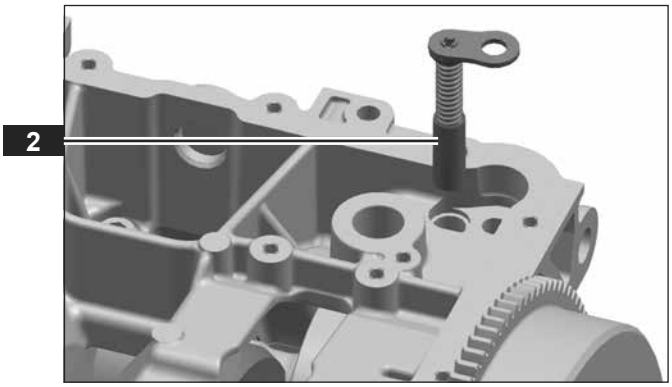


110.03.01 Removing oil pressure valve

► Unscrew the bolt 1.

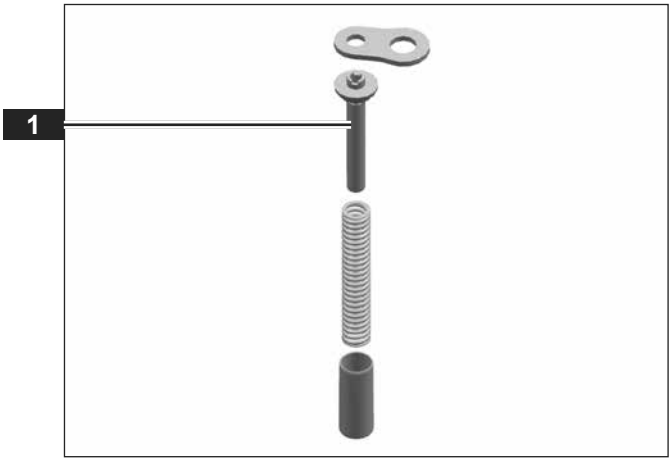


► Pull the oil pressure valve 2 out using a bar magnet.

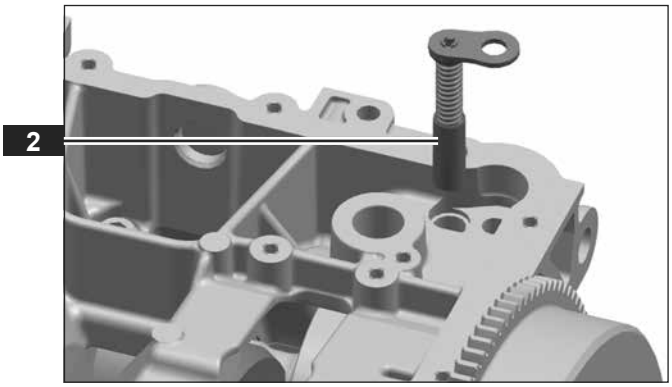


110.03.02 Installing oil pressure valve

► Assemble the oil pressure valve in the sequence as illustrated 1.

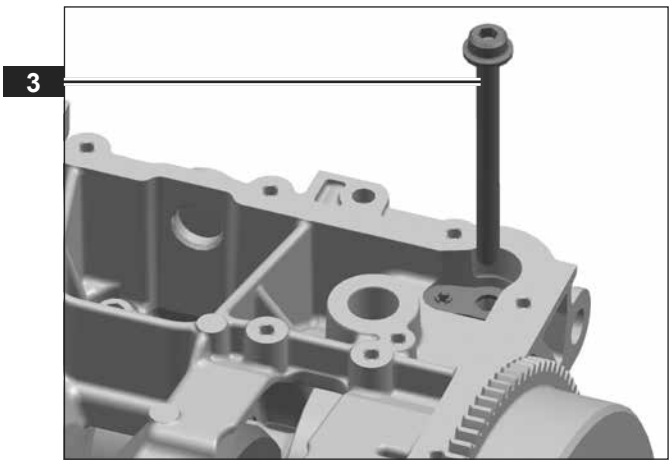


► Insert the oil pressure valve 2.



► Screw in the bolt 3.

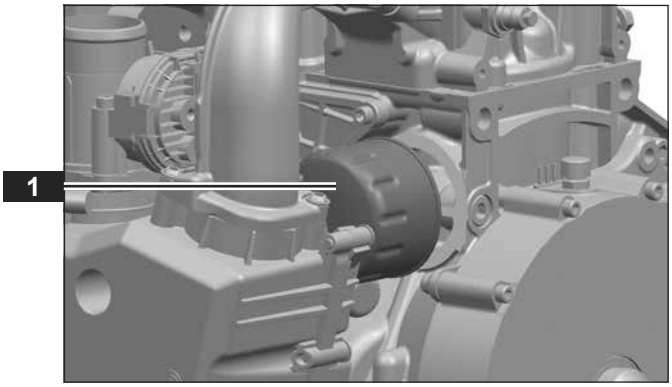
Tightening torque:
23 Nm +2 Nm [17 lbf ft +1.5 lbf ft]



110.04.01 Removing oil filter

– Universal strap wrench

► Unscrew the oil filter 1 using a universal strap wrench.



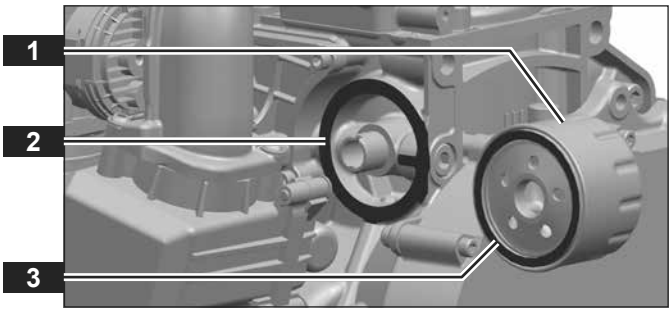
110.04.02 Installing oil filter

– 1 Oil filter

► Replace the oil filter 1.

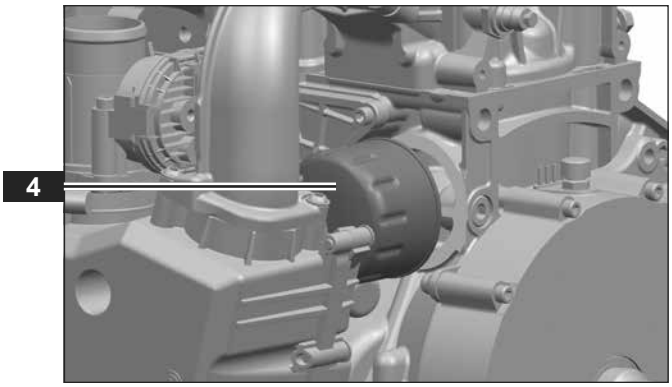
► Clean the sealing surface 2 with sealing surface cleaner.

► Coat the oil filter seal 3 lightly with engine oil.



► Screw in the oil filter 4 by hand.

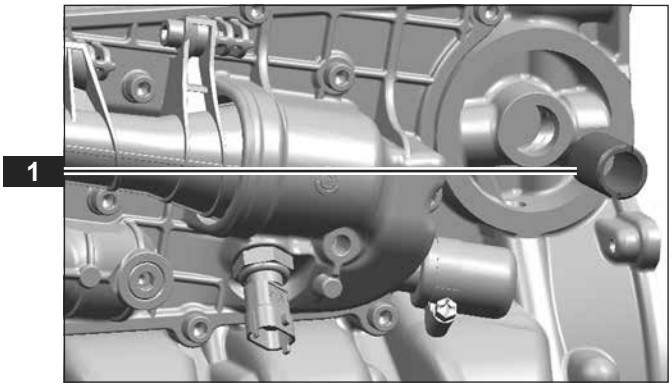
Tightening torque:
10 Nm [7.4 lbf ft]



110.04.03 Removing threaded sleeve

– Crown wrench

► Unscrew the threaded sleeve 1 using a crown wrench.



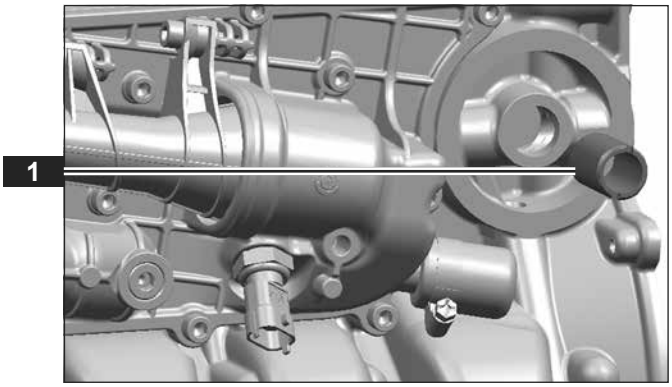
110.04.04 Installing threaded sleeve

– Crown wrench

► Screw in the threaded sleeve 1 using a crown wrench.

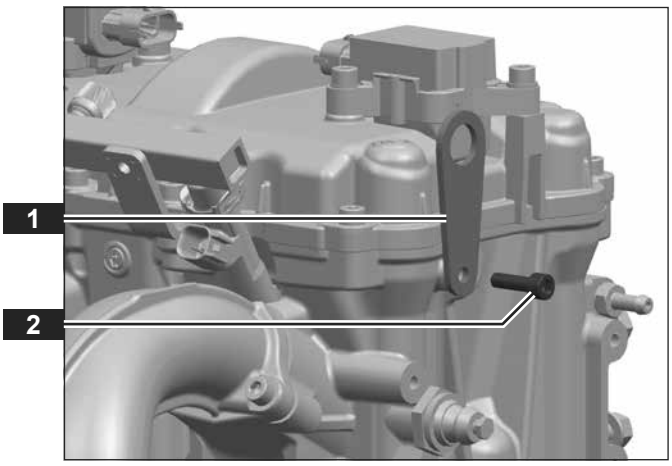
Tightening torque:

17 Nm +3 Nm [12.5 lbf ft +2.2 lbf ft]



120.01.01 Removing bracket on the drive side

- ► Unscrew the bolt 2.
- ► Remove the bracket 1.

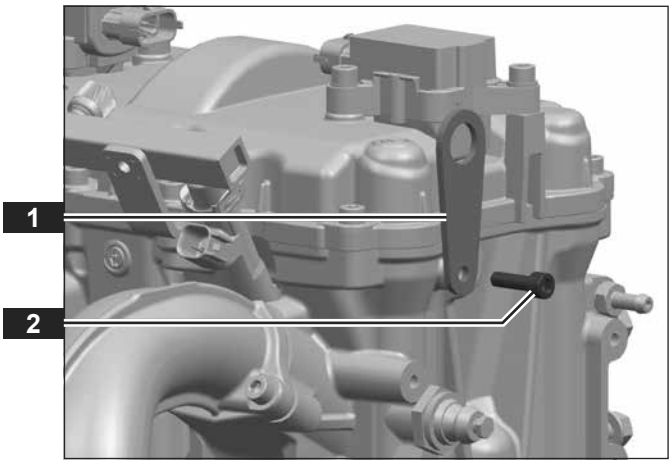


120.01.02 Installing bracket on the drive side

– Thread locker, high strength

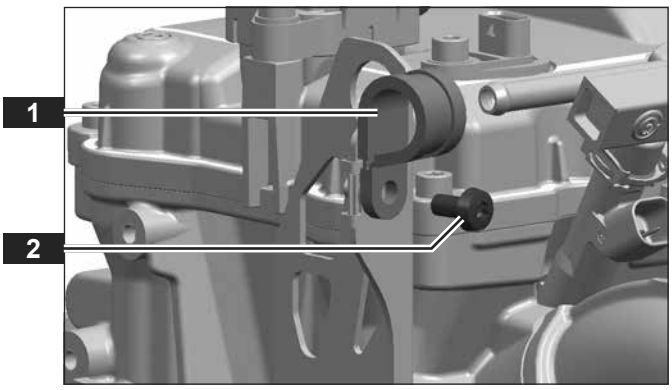
- ► Hold the bracket 1 in position as illustrated.
- ► Coat the thread on the bolt 2 with high strength thread locker.
- ► Screw in the bolt.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



120.01.03 Removing pipe clamp

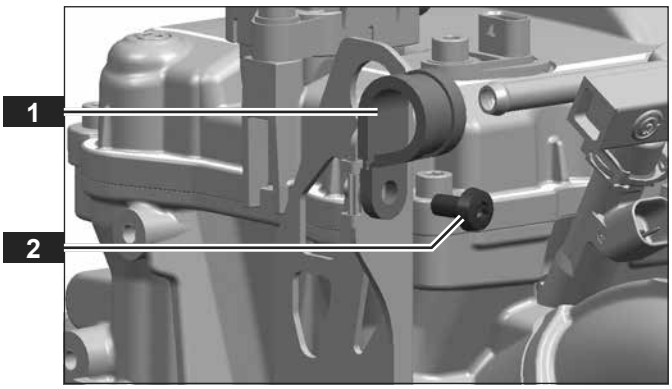
- ► Unscrew the bolt 2.
- ► Remove the pipe clamp 1.



120.01.04 Installing pipe clamp

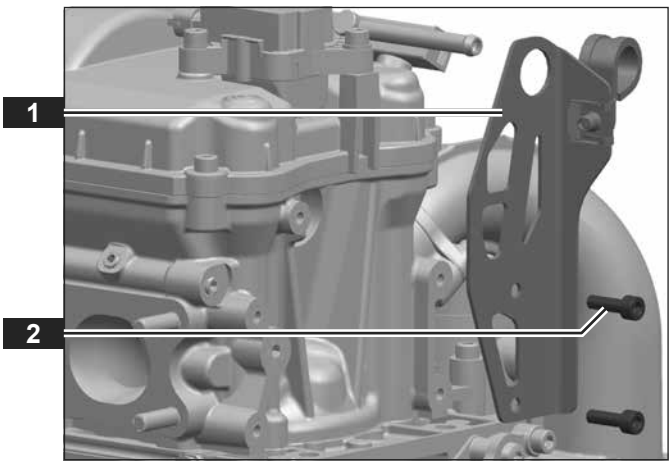
- ► Hold the pipe clamp 1 in position.
- ► Screw in the bolt 2.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



120.01.05 Removing bracket across from the drive side

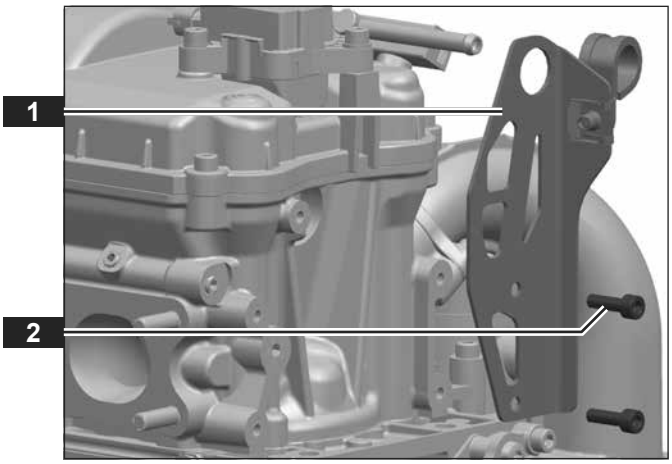
- ► Unscrew the bolts 2.
- ► Remove the bracket 1.



120.01.06 Installing bracket across from the drive side

- ► Hold the bracket 1 in position.
- ► Screw in the bolts 2.

Tightening torque:
8 Nm +2 Nm [5.9 lbf ft +1.5 lbf ft]



Appendix

Overview of revisions

Revision	Date	Chapter	Description	Note
Rev 1.0	04.09.2015	–	1st edition repair manual	–

Index