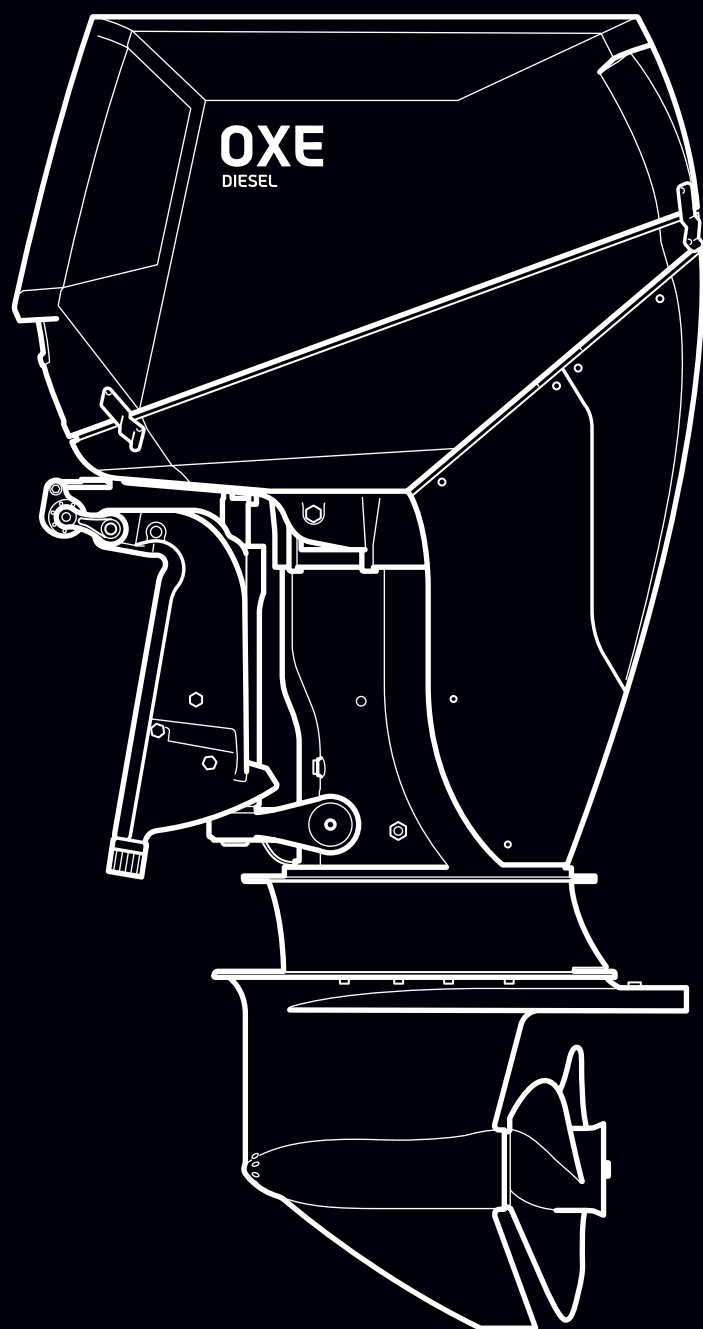


DIESEL ENGINE

SERVICE MANUAL 1.0



Publication No: ODM1004

PREFACE

This Service Manual is designed to facilitate competent repair of the outboard described here in.

The pictures and relevant descriptions show typical work that may not always be applicable to the outboard at hand. This does not mean that pictures and descriptions are inaccurate.

Plan and carry out the repair work in a similar way.

Expert knowledge necessary for handling Diesel engines is a requirement for correct handling of this powerhead.

NOTE! Only use fuels, lubricants etc. in accordance with Cimco Marine AB regulations. Otherwise the manufacturer's liability for defects will not apply!

For basic information on the fuels see table **Recommended Fluids and Grease**.

Any repair of components such as injection pump, alternator etc. ought to be left to Cimco certified, distributors, or OEM service departments.

Best regards

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Refer to your retailer if other publications are required.

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SAFETY REGULATIONS

Important safety regulations are summarized in this quick-reference overview and arranged by topic to effectively convey the knowledge necessary to avoid accidents causing injury, damage or environmental hazard. Additional information can be found in the User's Manual or Installation Manual of the outboard.

IMPORTANT!

Should an accident occur despite all precautionary measures, particularly one involving contact with corrosive acid, fuel contamination of the skin, scalding by hot oil, antifreeze splashing into the eyes etc. **seek medical assistance immediately.**

WARNING SIGNS / LEVELS OF WARNINGS

Important instructions concerning personal and technical safety are emphasized as follows..

DANGER

This refers to working and operating procedures which must be complied with in order to avoid personal injury.

WARNING

This refers to working and operating procedures which must be complied with in order to prevent damage to, or destruction of, material.

NOTE! Explanatory descriptions which help in understanding the relevant work or operating procedure to be carried out.

REGULATIONS FOR PREVENTION OF ACCIDENTS WITH PERSONAL INJURY

Inspection, adjustment and repair work may only be performed by authorized and skilled personnel.

DANGER

This refers to working and operating procedures which must be complied with in order to avoid personal injury.

- Prior to installation work, switch off the battery master switch.
- When carrying out maintenance and repair work, ensure that the engine cannot be accidentally started from the bridge by unauthorized personnel.
- The engine may only be started and operated by authorised personnel.
- When the engine is running, keep a safe distance to the rotating parts.
- Wear close-fitting working clothes.

- Do not touch hot engine with bare hands: Risk of burns.
- Keep area surrounding engine, ladders and stairways free of oil and grease. Accidents caused by slipping inflict serious injury.
- Only work with tools in good condition. Worn spanners / wrenches slip cause danger of injury.
- Personnel must not stand under an engine suspended on a crane hook. Keep lifting gear in order.
- Open the coolant circuit only when the engine has cooled down. If opening the coolant circuit while the engine is hot is unavoidable, observe the instructions in chapter **Maintenance** in the **User's Manual**.
- Do not tighten or undo pipes and hoses under pressure (lubricating oil circuit, coolant circuit and any downstream hydraulic oil circuits). Undoing pressurized hoses can inflict serious injury to the body.
- When working on the electrical system, disconnect the negative cable from the battery first. When reconnecting the battery power cables reconnect the negative cable last to reduce the risk of electrical damage to personnel and engine.
- Follow the manufacturer's instructions for handling batteries. Battery acid is toxic, caustic and battery gases are explosive.

REGULATIONS TO PREVENT DAMAGE TO ENGINE AND PREVENT WEAR

- **Clean the engine thoroughly prior to repairs.. Ensure that dirt, sand or foreign matter will not enter the engine during repair work.**
- If engine operation is abnormally, immediately Determine the cause of the disruption, rectify the cause prior to restart in order to prevent further damage to the outboard..
- Always use genuine OXE Diesel parts only. Installation of "equally" good parts from other suppliers may cause severe damage Any warranty is void, and the installing workshop is held liable for costs of damage to outboard and people..
- Never allow the engine to run dry, i.e. without lubricant or coolant.
Appropriate notices must be attached to engines that are not ready for operation.
- Modern components of diesel injection consist of high-precision parts which are exposed to extreme stresses. The high-precision technology requires the utmost cleanliness during all work on the fuel system. Even the smallest particle of dirt can lead to the failure of components.
- Use only OXE Diesel-approved service products (fuel, engine oil, anti-freeze and anti-corrosion agent). Pay attention to cleanliness. Diesel fuel must be free of water.
- **Do not fill engine oil beyond the max. level mark of the dipstick. Do not exceed the maximum permissible tilt of the engine.**
Serious damage to the engine may result if these instructions are not adhered to.
- Control and monitoring devices (charge control, oil pressure, coolant temperature) must be in perfect working order.

PREVENTION OF ENVIRONMENTAL DAMAGE

Engine oil and filter elements / cartridges, fuel / fuel filter

- Dispose of used oil according to local environmental legislation.
- Take strict precautions to ensure that no oil or Diesel fuel contaminate soil or drainages.



CAUTION

Risk of contamination of drinking water.

- Filter elements are classed as dangerous waste and must be treated as such.

Coolant

- Treat undiluted corrosion protection agents and / or antifreeze as hazardous waste.
- When disposing of used coolant, the environmental legislation issued by the relevant local authorities must be adhered to.

Notes on safety in handling used engine oil

Prolonged or repeated contact between the skin and any kind of engine oil Dries out and increases the risk of skin-related illnesses such as eczema. Common effects in the exposed skin are dry sensations, irritation and inflammation. Drying, irritation or inflammation of the skin may therefore occur. Used engine oil also contains hazardous substances that have caused skin cancer in tests on animals. If the basic principles of work safety and hygiene are followed, handling used engine oil does not represent a health hazard.

Precautionary measures to protect your health

- Avoid prolonged or repeated skin contact with used engine oil.
- Protect your skin by means of suitable agents (creams etc.) or wear protective gloves.
- Clean skin which has been in contact with engine oil.
 - Wash thoroughly with soap and water. A nail brush provides effective assistance here.
 - Special hand cleaning agents make it easier to clean dirty hands.
 - Do not use petrol (gasoline), diesel fuel, gas oil or solvents as washing agents.
- After washing apply a fatty skin cream to the skin.
- Change clothing and shoes that are soaked in oil.
- Do not put oily cloths in your pockets.

Ensure that used engine oil is disposed of in appropriate manner. Engine oil is a substance that endangers the water supply.

For this reason do not let engine oil get into the ground, waterways, the drains or the sewers. Violations of local environmental legislation are punishable by law.

Carefully collect and dispose of used engine oil. Information on collection points can be obtained from retailers, the supplier or the local authorities.

CLEANLINESS

Modern components of diesel injection consist of high-precision parts exposed to extreme stresses. The high-precision technology requires the utmost cleanliness during all work on the fuel system.

Even the smallest particle of dirt can lead to the failure of components.



WARNING

RISK OF DAMAGE OF EXPOSURE TO DIRT OR INFILTRATION OF FOREIGN PARTICULATES.!

The measures described as follows are essential before work begins:

- Before working on the clean side of the fuel system clean the engine and the engine compartment (high-pressure cleaner). During cleaning the fuel system must be closed.
- Carry out visual inspection for any leakage or damage to the fuel system.
- Do not spray the high-pressure cleaner direct onto the electric components, alternatively keep them covered.
- Do not carry out any welding or sanding work in the engine compartment during maintenance / repair.
- Avoid air movements (any swirling of dust when starting engines).
- The area of the still closed fuel system must be cleaned and dried with the aid of compressed air.
- Remove detached particles of dirt such as paint chippings and insulation material with a suitable extractor (industrial type vacuum cleaner).
- Cover areas of the engine compartment from where dust particles could be detached with clean foil.
- Wash your hands and put on clean work clothes before starting the disassembly work.
- Clean tools and working materials before starting to work.



WARNING

RISK OF DAMAGE FROM PENETRATION OF DIRT CONTAMINATION!

When carrying out the work it is essential to comply with the following measures:

- When the clean side of the fuel system has been opened it is not permissible to use compressed air for cleaning.
- During assembly work loose dirt must be removed with the aid of suitable extractors (industrial type vacuum cleaners).
- Use only fluff-free cleaning cloths on the fuel system.
- Only tools without any damage may be used.

NOTE! Avoid using cracked chrome coatings due to the risk of flaking and contamination.

- When removing and installing components do not use materials such as cloths, cardboard or wood since these could shed particles and fine fibres.
- If any paint chips / flakes off when connections are loosened (from possible over-coating) these chippings must be carefully removed before finally loosening the screw connection.
- The connection openings of all removed parts on the clean side of the fuel system are to be closed immediately with suitable caps (see special tools).
- These caps / stoppers must be packed protected from dust prior to use and to be disposed of after usage.
- Following this all the components must be carefully stored in a clean, closed container.
- Never use used cleaning or testing liquids for these components.
- New parts must not be removed from their original packing material until directly before use.
- Work on removed components may be carried out only at a workplace specially equipped for it.
- If removed parts are to be transported, always use the original packing material of the new part.

REPETITIVE ALERTS

Battery disconnect



DANGER

Unless directed otherwise, the ignition and start switch must be in the OFF or LOCK position, and all electrical loads must be OFF before servicing any electrical component. Switch OFF the battery main switch or disconnect the negative battery cable to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal. Failure to follow these precautions may result in personal injury and/or damage to the engine or its components.

Relieving hydraulic pressure warning

Before performing any service measures on the hydraulic system, ensure that there is no system pressure. To relieve system pressure follow this procedure:

- Turn the ignition key to IGN& ACC.
- Shift in gear a couple of times in order to release the hydraulic pressure.
- Turn off ignition.

Cleaning solvent



DANGER

Bodily injury may occur if the cleaning solvent is inhaled or exposed to the skin. Ensure proper ventilation!

Eye protection



DANGER

Approved safety glasses and gloves should be worn when performing this procedure to reduce the risk of personal injury.

Moving parts and hot surfaces



DANGER

In order to prevent physical injury avoid contact with moving parts and hot surfaces while working around a running engine.

Protective goggles and glove



DANGER

Always wear protective goggles and gloves when removing exhaust parts as falling rust and sharp edges from worn exhaust components could result in serious personal injury.

Safety goggles and fuel

 DANGER

Always wear safety goggles when working with fuel in order to protect the eyes from fuel splash.

Component fastener tightening

 WARNING

Replacement components must be the correct part number for the application. Components requiring the use of the thread locking compound, lubricants, corrosion inhibitors, or sealants are identified in the service procedure. Some replacement components may come with these coatings already applied. Do not use these coatings on components unless specified. These coatings can affect the final torque, which may affect the operation of the component. Use the correct torque specification when installing components in order to avoid damage.

Fastener

 WARNING

Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Do not use paints, lubricants, or corrosion inhibitors on fasteners, or fastener joint surfaces, unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems. When using fasteners that are threaded directly into plastic, use extreme care not to strip the mating plastic part(s). Use hand tools only, and do not use any kind of impact or power tools. Fastener should be hand tightened, fully seated, and not stripped.

Torque-to-yield fastener

 CAUTION

This engine is equipped with torque-to-yield or single use fasteners. Install a **NEW** torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the outboard or component.

SPECIFICATIONS

ENGINE MECHANICAL SPECIFICATIONS

Application 150/200	Specification	
	Metric	Imperial
General Data		
Engine Type	Diesel, L4	
Displacement	2.0 liter	122 cu in
Intake induction system	Turbocharged, intercooled	
Maximum Power @ Engine Speed kW/RPM - LBS (A20DTH)	147 kW at 4100 RPM	200 HP at 4100 RPM
Maximum Torque @ Engine Speed Nm /RPM - LBS (A20DTH)	415 Nm / 2500 RPM	306 lb ft / 2500 RPM
Fuel	Diesel	
Dry weight	340 kg	2459 lb ft
Wet weight	358 kg	2589 lb ft
Alternator output	130 A	
Rig length	20", 25" or 30"	
Cooling	Closed cooling circuit	
Starting	Electric	
Shift	Electro-hydraulic	
Clutch	Hydraulic multi-friction plate	
Gear ratios	1.73:1 or 2.17:1	
Dimensions (25" leg), LHW	1000 x 1880 x 680 mm	39.37 x 74.02 x 26.77 in
Bore	90.0 mm	3.54 in
Stroke	90.4 mm	3.56 in
Compression Ratio	16.5:1	
Idle Speed	850 RPM	
Firing Order	1-3-4-2	
Engine Height - Total Dimensions Oil Pan to Cover	708 mm	28 in
Engine Length - Mounting Bracket to Thermostat Housing	701 mm	27.6 in

SPECIFICATIONS

Application 150/200	Specification	
	Metric	Imperial
Crankshaft		
Axial Clearance	0.054 - 0.226 mm	0.0021 - 0.0089 in
Axial Thrust Washers	2.469 - 2.485 mm	0.0972 - 0.0978 in
Bearing Bore Diameter in Cylinder Block - Class A	63.705 - 63.709 mm	2.508 - 2.5082 in
Bearing Bore Diameter in Cylinder Block - Class B	63.709 - 63.714 mm	2.5082 - 2.5084 in
Bearing Bore Diameter in Cylinder Block - Class C	63.714 - 63.718 mm	2.5084 - 2.5086 in
Main Bearing Clearance	0.026 - 0.055 mm	0.001 - 0.0021 in
Main bearing Journal Standard Size		
Main Bearing Journal Diameter - Class A - Code no. 1 (red)	59.994 - 60.0 mm	2.3619 - 2.3622 in
Main Bearing Journal Diameter - Class B - Code no. 2 (blue)	59.988 - 59.994 mm	2.3617 - 2.3619 in
Main Bearing Journal Diameter - Class C - Code no. 3 (yellow)	59.982 - 58.988 mm	2.3614 - 2.3617 in
Main Bearing Shells - Class A - Code no. 1 (red)	1.831 - 1.837 mm	0.072 - 0.0723 in
Main Bearing Shells - Class B - Code no. 2 (blue)	1.836 - 1.844 mm	0.07228 - 0.0726 in
Main Bearing Shells - Class C - Code no. 3 (yellow)	1.843 - 1.849 mm	0.07256 - 0.07279 in
Main Bearing Journal Undersize	0.127 mm	(0.005 in)
Main Bearing Journal Diameter - Class A - Code no. 1 (brown)	59.867 - 59.982 mm	2.3569 - 2.3614 in
Main Bearing Journal Diameter - Class B - Code no. 2 (green)	59.861 - 59.867 mm	2.3567 - 2.3569 in
Main Bearing Journal Diameter - Class C - Code no. 3 (black)	59.855 - 59.861 mm	2.3564 - 2.3567 in
Main Bearing Shells - Class A - Code no. 1 (brown)	1.894 - 1.900 mm	0.07456 - 0.07480 in
Main Bearing Shells - Class B - Code no. 2 (green)	1.899 - 1.907 mm	0.07476 - 0.07507 in
Main Bearing Shells - Class C - Code no. 3 (black)	1.906 - 1.912 mm	0.07503 - 0.07527 in
Crank Pin Journal Diameter - Class A	50.799 - 50.805 mm	1.9999 - 2.0002 in
Crank Pin Journal Diameter - Class B	50.793 - 50.799 mm	1.9997 - 1.9999 in
Crank Pin Journal Diameter - Class C	50.787 - 50.793 mm	1.9995 - 1.9997 in
Crank Pin Journal Diameter Oversize - Class A	50.672 - 50.678 mm	1.995 - 1.9952 in

SPECIFICATIONS

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Application 150/200	Specification	
	Metric	Imperial
Crank Pin Journal Diameter Oversize - Class B	50.666 - 50.672 mm	1.9947 - 1.995 in
Crank Pin Journal Diameter Oversize - Class C	50.660 - 50.666 mm	1.9945 - 1.9947 in
Cylinder Head Gasket		
Thickness without Hole	0.95 mm	0.0374 in
Thickness with 1 Hole	1.05 mm	0.0413 in
Thickness with 2 Holes	1.15 mm	0.0452 in
Block		
Cylinder Block Height	236.5 mm	9.3 in
Cylinder Bore Diameter Grade A	83.0 mm	3.2677 in
Cylinder Bore Diameter Grade B	83.01 mm	3.2681 in
Cylinder Bore Diameter Grade C	83.02 mm	3.2685 in
Cylinder Bore Diameter Oversize	+0.1 mm	+0.0039 in
Compression Height	46.63 mm	1.84 in
Connecting Rod Length	145 mm	5.7 in
Engine Oil		
Viscosity	Refer to Recommended fluids and grease	
Quality	Refer to Recommended fluids and grease	
Oil Change Including Filter	Refer to Recommended fluids and grease	
Oil Consumption Liter/1 000 engine hours	max. 0.9 Liter/3200km	max. 37 cu in/200 miles
Standard Oil Pump		
Oil Pressure - @ Idle Speed @ 90°C (194°F)	>100 kPa	>14.50 psi
Oil Pressure - @ 4000 RPM @ 90°C(194°F)	>400 kPa	>58 psi
Exhaust Manifold		
Exhaust Manifold Surface Flatness	0.25 mm	0.0100 in
Piston Rings		
Piston Ring End Gap - First Compression Ring - @ 10 mm (0.393 in) down	0.20-0.35 mm	0.0078-0.0137 in
Piston Ring End Gap - Second Compression Ring - @ 18 mm (0.708 in) down	0.60-0.80 mm	0.0236-0.0

SPECIFICATIONS

Application 150/200	Specification	
	Metric	Imperial
Piston Ring End Gap - Oil Control Ring - @ 23 mm (0.905 in) down	0.25-0.50 mm	0.0098-0.0196 in
Piston Ring Groove Clearance - First Compression Ring - Maximum	0.143 mm	0.0056 in
Piston Ring Groove Clearance - Second Compression Ring - Maximum	0.073 mm	0.0028 in
Pistons and Pins		
Piston Diameter Grade A	82.935 mm	3.2651 in
Piston Diameter Grade B	82.945 mm	3.2655 in
Piston Diameter Grade C	82.955 mm	3.2659 in
Piston Diameter Oversize	+0.1 mm	+0.0039 in
Piston - Piston Clearance to Block Bore - 90° to Piston Pin @ 10 mm (0.3937 in) up	0.60-0.80 mm	0.0236-0.0314 in
Pin - Piston Pin Clearance to Connecting Rod Bore - Maximum	0.039 mm	0.0015 in
Piston - Piston Pin Clearance to Piston Pin Bore	0.005-0.015 mm	0.0002-0.0006 in
Connecting Rod		
Connecting Rod Bearing Thickness (Red)	1.527-1.531 mm	0.06012- 0.06028 in
Connecting Rod Bearing Thickness (Blue)	1.530-1.534 mm	0.06024- 0.06039 in
Connecting Rod Bearing Thickness (Yellow)	1.533-1.537 mm	0.06035- 0.06051 in
Connecting Rod Bearing Thickness Oversize (Brown)	1.591-1.595 mm	0.06264- 0.06279 in
Connecting Rod Bearing Thickness Oversize (Green)	1.594-1.598 mm	0.06276-0.06291 in
Connecting Rod Bearing Thickness Oversize (Black)	1.597-1.601 mm	0.06287-0.06303 in
Cooling System		
Coolant	Refer to Recommended fluids and grease	
Capacity	Refer to Recommended fluids and grease	
Thermostat		
Start to Open	75°C	167°F
Fully Open	77°C	170°F

ENGINE THRESHOLD VALUES

Display warning level		
Parameter	Display	
	Yellow warning	Red warning
Engine Coolant Temp [°C]	90	97
ECU Temp [°C]	85	90
Exhaust Gas Temp [°C]	800	850
Engine Oil Pressure [kPa abs]	-	200
Engine Oil Temp [°C]	130	140
Fuel Rail Pressure [Mpa]	-	185
Gearbox Oil Pressure High [kPa abs]	2400	2500
Gearbox Oil Pressure Low [kPa abs]	250	200
Manifold Air Pressure [kPa abs]	330	350
Manifold Air Temp [°C]	60	80
Battery Voltage High [V]	14.7	15
Battery Voltage Low [V]	12	11

We reserve the right to change values without further notice.

GENERAL TIGHTENING TORQUES

Hexagon nuts and bolts with metric coarse thread				
Thread (metric)	Strength class			
	8.8 or 8		10.9 or 10	
	Tightening torque			
	Nm	lb ft	Nm	lb ft
M4	2.4	1.77	3	2.21
M5	5	3.69	6.2	4.57
M6	8	5.9	10	7.38
M8	20	14.75	25	18.44
M10	39	28.76	49	36.14
M12	70	51.63	87	64.16
M14	112	82.60	140	103.25
M16	180	132.75	220	162.25
M18	240	177.00	300	221.25
M20	350	258.13	440	324.50
M22	490	361.38	610	449.88
M24	600	442.501	760	560.51

Hexagon nuts and bolts with metric fine thread				
Thread (metric)	Strength class			
	8.8 or 8		10.9 or 10	
	Tightening torque			
	Nm	lb ft	Nm	lb ft
M8x1	21	15.49	27	19.91
M10x1.25	42	30.98	52	38.35
M12x1.25	77	56.79	96	70.80
M14x1.5	120	88.50	150	110.63
M16x1.5	190	140.13	240	177.00
M18x1.5	270	199.13	340	250.75
M20x1.5	390	287.63	490	361.38
M22x1.5	530	390.88	670	494.13
M24x1.5	700	516.26	870	641.64

FASTENER TIGHTENING SPECIFICATIONS

Application	Specification	
	Metric	Imperial
Camshaft Sprocket Bolt	130 Nm	96 lb ft
Camshaft Cap Bolt	25 Nm	18 lb in
Camshaft Housing Bolt	25 Nm	18 lb ft
Camshaft Intermediate Drive Sprocket Bolt		
- First Pass	30 Nm	22 lb ft
- Final Pass	52 degrees	
Camshaft Position Actuator		
Camshaft Bolt	9 Nm	80 lb in
Camshaft Position Sensor Bolt	9 Nm	80 lb in
Exhaust Manifold Nut	25 Nm	18 lb ft
Connecting Rod Bolt		
- First Pass	25 Nm	18 lb ft
- Final Pass	60 degrees	
Coolant Outlet Bolt	9 Nm	80 lb in
Crankshaft Balancer Bolt	25 Nm	18 lb ft
Crankshaft Increment Wheel Bolts	12 Nm	106 lb in
Crankshaft Rear Oil Seal Bolt	9 Nm	80 lb in
Crankshaft Sprocket Bolt	340 Nm	251 lb ft
Crankshaft Main Bearing Bolt – Inner		
- First Pass	25 Nm	18 lb ft
- Final Pass	100 degrees	
Crankshaft Main Bearing Bolt – Outer		
- First Pass	25 Nm	18 lb ft
- Final Pass	100 degrees	
Crankshaft Main Bearing Bolt – Side		
- First Pass	25 Nm	18 lb ft
- Final Pass	100 degrees	

(1) = Use **new** fastener.

SPECIFICATIONS

Application	Specification	
	Metric	Imperial
Crankshaft Position Sensor	9 Nm	80 lb in
Crankshaft Position Sensor Bolt	9 Nm	80 lb in
Crankshaft Rear Oil Seal Housing Bolt	9 Nm	80 lb in
Cylinder Head – Ribe Bolts		
- First Pass	20 Nm (1)	15 lb ft (1)
- Second Pass	65 Nm	48 lb ft
- Third Pass	90 degrees	
- Fourth Pass	90 degrees	
- Final Pass	90 degrees	
Cylinder Head – Torx T60 Bolts		
- First Pass	20 Nm (1)	15 lb ft (1)
- Second Pass	65 Nm	48 lb ft
- Third Pass	90 degrees	
- Fourth Pass	90 degrees	
- Final Pass	90 degrees	
Cylinder Head Core Hole Plug	15 Nm	11 lb ft
Alternator Drive Belt		
- Idler Pulley Bolt	22 Nm	16 lb ft
- Tensioner Bolt	22 Nm	16 lb ft
- Drive Belt Tensioner Fastener (QtNm: 2)	22 Nm	16 lb ft
- Engine Flywheel Bolt	160 Nm	118 lb ft
- Engine Oil Pressure Switch	30 Nm	22 lb ft
Engine Wiring Harness Ground		
- Bolt – M6	9 Nm	80 lb in
- Bolt – M8	25 Nm	18 lb ft
Exhaust Camshaft Sprocket Bolt		
- First Pass	40 Nm	30 lb ft
- Final Pass	55 degrees	

(1) = Use **new** fastener.

SPECIFICATIONS

26

Application	Specification	
	Metric	Imperial
Exhaust Manifold Nut	25 Nm	18 lb ft
Front Transmission Fastener	40 Nm	30 lb ft
Fuel Injection Pump Bracket Bolt	25 Nm	18 lb ft
Fuel Injection Pump Driven Sprocket Nut	50 Nm	37 lb ft
Fuel Injection Pump Nut	20 Nm	15 lb ft
Fuel Injector Fuel Feed Pipe Nuts to Rail	19 Nm	14 lb ft
Fuel Injector Fuel Feed Pipe Nuts to Injector	25 Nm	18 lb ft
Fuel Rail Bolt	25 Nm	18 lb ft
Fuel Rail Fuel Feed Pipe Nut to Rail	19 Nm	14 lb ft
Fuel Rail Fuel Feed Pipe Nut to High Pressure Pump	25 Nm	18 lb ft
Glow Plug without Pressure Sensor (9 mm)	10 Nm	89 lb in
Generator Bolt	60 Nm	44 lb ft
Generator Bracket Bolt – Front	60 Nm	44 lb ft
Generator Bracket Bolt – Side	60 Nm	44 lb ft
High-Pressure Pump Drive Gear to High-Pressure Pump M14x1,5	50 Nm	37 lb ft
High-Pressure Pump to High-Pressure Pump Bracket	25 Nm	18 lb ft
Intake Camshaft Sprocket Bolt		
- First Pass	40 Nm	30 lb ft
- Final Pass	55 degrees	
Intake Manifold		
Engine Front Cover Bolt	9 Nm	80 lb in
Intake Manifold Fastener	25 Nm	18 lb ft
Oil Drain Plug	25 Nm	18 lb ft
Oil Feed Pipe to Cylinder Block	15 Nm	11 lb in
Oil Filter Cap	15 Nm	11 lb ft
Oil Filter Cover	25 Nm	18 lb ft

(1) = Use **new** fastener.

Application	Specification	
	Metric	Imperial
Oil Level Indicator Tube Bolt	8 Nm	71 lb in
Oil Pressure Sensor	15 Nm	11 lb ft
Oil Pump Bolt	9 Nm	80 lb in
Oil Separator Pipe	25 Nm	18 lb ft
Piston Oil Cooling Nozzle Bolt	9 Nm	80 lb in
Positive Crankcase Ventilation Oil Separator Bolt	9 Nm	80 lb in
Starter Motor Bolt	25 Nm	18 lb ft
Timing Belt		
Idler Pulley Bolt – Upper	25 Nm	18 lb ft
Idler Pulley Bolt – Lower	50 Nm	37 lb ft
Tensioner Bolt	25 Nm	18 lb ft
Timing Belt Tensioner Bracket Bolt	25 Nm	18 lb ft
Timing Belt Upper Front Cover Bolt	9 Nm	80 lb in
Timing Belt Upper Front Cover Fastener	3 Nm	27 lb in
Transmission Mount Bolt to Transmission		
First Pass	50 Nm	37 lb ft
Second Pass	60 degrees	
Final Pass	15 degrees	
Turbocharger to Exhaust Manifold fastener	25 Nm	18 lb ft
Turbocharger Oil Feed Pipe Fastener	20 Nm	15 lb ft
Turbocharger Oil Return Pipe to Turbocharger	9 Nm	80 lb in
Water Pump Bolt	25 Nm	18 lb ft

(1) = Use **new** fastener.

RECOMMENDED FLUIDS AND GREASE

Fluid	Quality	Quantity	
		Metric	Imperial
Fuel	EN 590 (with national environmental and cold weather standards) ASTM D 975 No. 1 and No. 2 JIS KK 2204	-	-
Engine oil change incl. filter	5w-30 dexos2 API SM/CF GM-LL-A025 / B025 ACEA A3/B4	5.5 liters	5.8 quarts
Hydraulic oil	Fully Synthetic Dual Clutch Transmission Fluid - DCT G-052-529/G-052-182	2.5 liters	2.1 quarts
Upper belt oil	WSS-M2C936-A 236.21/236.25	0.33 liters	0.34 quarts
Lower belt oil	SSTF-1 1161838/1161839	2 liters	2.1 quarts
Cooling system, coolant mixture	GM Long-Life Coolant - Specification B040 1065/ Distilled water (30/70)	7.5 liters	7.9 quarts
Grease	DIN 51502:KP2.5K-20 ISO 6743: ISO-L-XBCEB2.5	-	-
Power trim and tilt unit	ATF Dexron II	0.5-0.7 liters	0.52-0.73 quarts

NOTE! Only use fuels, lubricants etc. in accordance with Cimco Marine AB regulations or warranty will be void.

Diesel fuels

The composition of the fuels is vital for operation of the OXE diesel engine, its service life, and emissions. To meet the performance specified and to run the boat cleanly and quietly, it is important that fuel as recommended in table **Recommended fluids and grease** is used.

NOTE! The fuel must meet national and international standards.

OXE diesel engines can be operated on local diesel fuel, not exceeding 350 ppm sulphur. Using such fuel may slightly increase the engine's emission levels. Also, in order to avoid excessive wear and shorter lifetime, the OXE diesel engine will need more frequent service intervals.

NOTE! Large differences in composition occur in local fuel specifications. This can result in higher fuel consumption, higher emissions and less power output.

TOOLS AND EQUIPMENT

Special tools are listed and illustrated throughout this manual with a complete listing on the following pages. These tools, or their equivalents, are specially designed to quickly and safely accomplish the intended operations. The use of these special tools will also minimize possible damage to engine components.

Some precision measuring tools are required for inspection of certain critical components.

Torque wrenches and a torque angle meter are necessary for the proper tightening of various fasteners.

To properly service the engine assembly, the following items should be readily available:

- Approved eye protection and safety gloves
- Clean, well lit, work area
- Suitable cleaning tank for parts
- Compressed air supply
- Trays or storage containers to keep parts and fasteners organized
- Adequate set of hand tools
- Approved engine repair stand
- Approved engine lifting device that will adequately support the weight of the components.

SPECIAL TOOLS

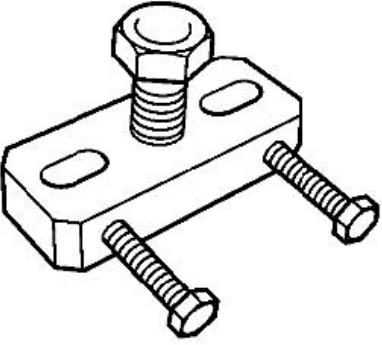
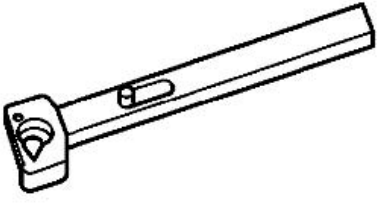
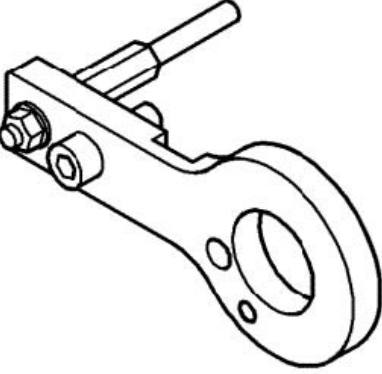
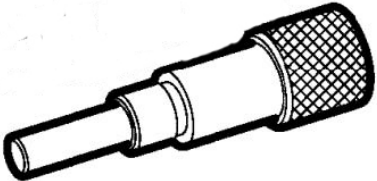
Illustration	Tool Number/Description
	<p>30-0160-014 ODT Puller</p>
	<p>30-0160-015 ODT Extension</p>
	<p>30-0160-016 ODT Crankshaft Fixing Tool</p>
	<p>30-0160-017 ODT Camshaft Locking Tool</p>

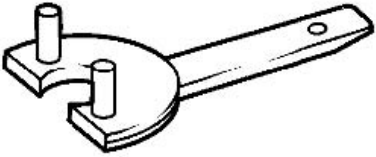
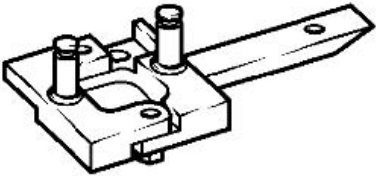
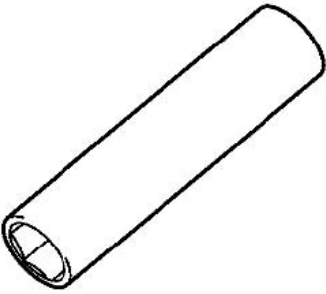
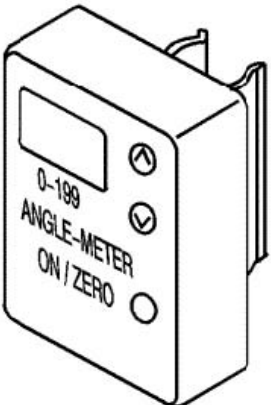
Illustration	Tool Number/Description
	<p>30-0160-018 ODT Camshaft Sprocket Holding Tool</p>
	<p>30-0160-019 ODT Fuel Injection Pump Sprocket Holder</p>
	<p>30-0160-020 ODT Remover/Installer Glow Plugs 9 mm</p>
	<p>30-0160-021 ODT Angle Meter</p>

Illustration	Tool Number/Description
	<p>30-0160-023 ODT Fitting tool, oil pump seal</p>
	<p>30-0160-025 ODT Remover Oil Seal</p>
	<p>30-0160-060 ODT Propshaft bearing fixing tool</p>
	<p>30-0160-001 ODT Gauge bar</p>

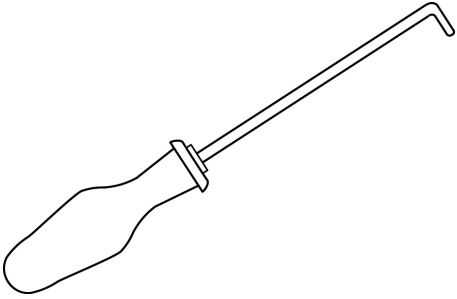
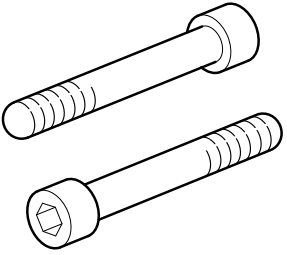
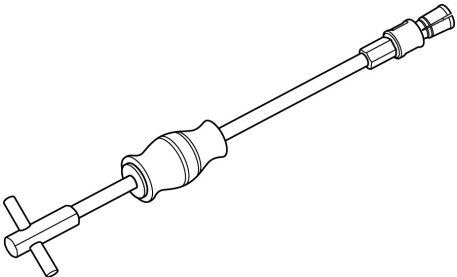
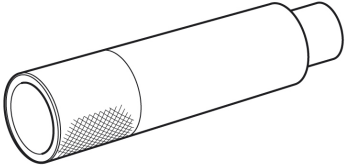
Illustration	Tool Number/Description
	<p>30-0160-002 ODT Hooking tool</p>
	<p>30-0160-003 ODT M6 Allen screw, rounded tip</p>
	<p>30-0160-004 ODT Sleeve removal tool</p>
	<p>30-0160-005 ODT Sleeve seating tool</p>

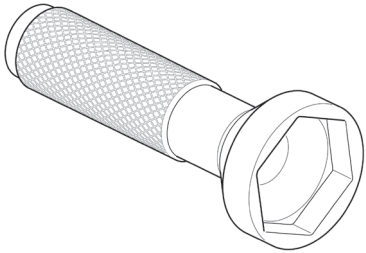
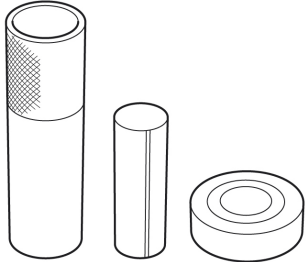

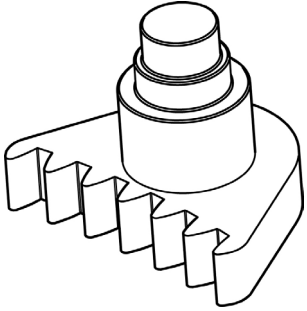
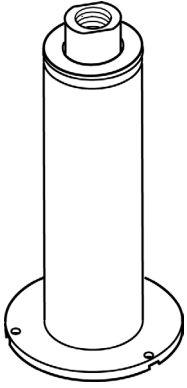
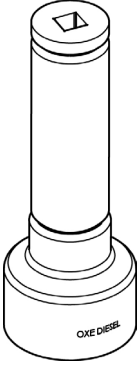
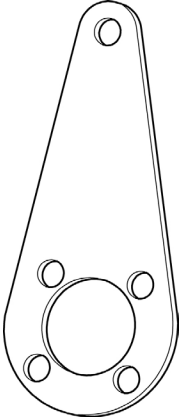
Illustration	Tool Number/Description
	<p>30-0160-006 ODT Seal forming tool</p>
	<p>30-0160-008 ODT 50mm Nut removing tool</p>
	<p>30-0160-009 ODT Bearing race driver</p>
	<p>30-0160-010 ODT OBD</p>

Illustration	Tool Number/Description
	<p>30-0160-034 ODT Flywheel blocking tool</p>
	<p>30-0160-110 Propeller shaft bearing remove/mount tool</p>
	<p>30-0160-112 50 mm nut removing tool</p>
	<p>30-0160-118 Crankshaft fixing tool</p>

ENGINE COMPONENT DESCRIPTION

Camshaft

Two camshafts are used, one for all intake valves, the other for all exhaust valves. The camshafts are cast iron. The second camshaft is driven by a cam to cam gear.

Camshaft drive

A timing belt is used for camshaft drive. There is a tensioner to control the tension of the belt.

Cylinder block

The cylinder block is a cast iron with 4 cylinder in-line. The block has 5 crankshaft bearings with the thrust bearing located on the third bearing from the front of the engine.

Crankshaft

The crankshaft is a steel crankshaft with 8 counterweights. It is supported in 5 main journals with main bearings which have oil clearance for lubricating. The 3rd bearing of the 5 main bearing is the thrust bearing where the crankshaft has properly axial end play. A crankshaft balancer is used to control torsional vibration.

Cylinder head

This cylinder head is of a double over head camshaft (DOHC) type and has 2 camshafts that open 4 valves per cylinder with the finger followers with roller type and the valve bridges. The camshaft sprocket wheel is installed in front of the camshaft. Because of the cam follower of the hydraulic type, it does not need to adjust for valve clearance. The cylinder head is made of aluminium alloy for better strength in hardness with light weight. The combustion chamber of plate type of the cylinder head is designed for increased squish and swirl efficiency in order to maximize diesel combustion efficiency in the entire rpm-range of the engine..

Exhaust manifold

The exhaust manifold is located to the side of the cylinder head and provide exhaust gases from the combustion chamber to the turbo charger. It is designed to properly function under high pressure at a high temperature.

Intake manifold

The intake manifold is air flow passage to the cylinder combustion chamber and the design is optimized for maximum engine torque, power driveability, fuel economy and performance and to minimize noise and emissions. The manifold is made of plastic for optimized strength and keeping it light weight.w

Oil dry sump

The oil dry sump includes an oil return pipe, which is connected to the oil pump. The dry sump is attached at the bottom of the engine block and the associated oil reservoir is integrated in the outboard rigg.

Oil pump – standard oil pump

The oil pump draws engine oil from the oil pan and feeds it under pressure to the various parts of the engine. When the crankshaft rotates, the oil pump drive gear rotates. This causes the space between the gears to constantly open and narrow, pulling oil in from the oil pan when the space opens and pumping the oil out to the engine as it narrows. At high engine speeds, the oil pump supplies a much higher amount of oil than required for lubrication of the engine. The oil pressure regulator prevents too much oil from entering the engine lubrication passages.

Turbocharger

The turbocharger supplies compressed hot air that is created from exhaust gas that passes the turbocharger's exhaust turbine driving the induction side turbine increasing airflow to the engine thus increase the power. A water-cooled intercooler is used before compressed hot air enters the engine in order to lower the temperature of the induce air for optimum power for the combustion process.

During normal engine operation water will flow through the turbocharger's center housing due to pressure created by the engine's water pump. After the engine is shut off and the water pump is no longer pumping, a 'thermal siphoning' pulls water through the turbocharger's center housing.

Valves

There are 2 intake and 2 exhaust valves per cylinder with "minilash" hydraulic adjusters with roller fingers.

Valve lash adjusters

The valve train uses a roller finger follower acted on by a hydraulic lash adjuster. The roller finger follower reduces friction and noise.

OUTBOARD OVERVIEWS

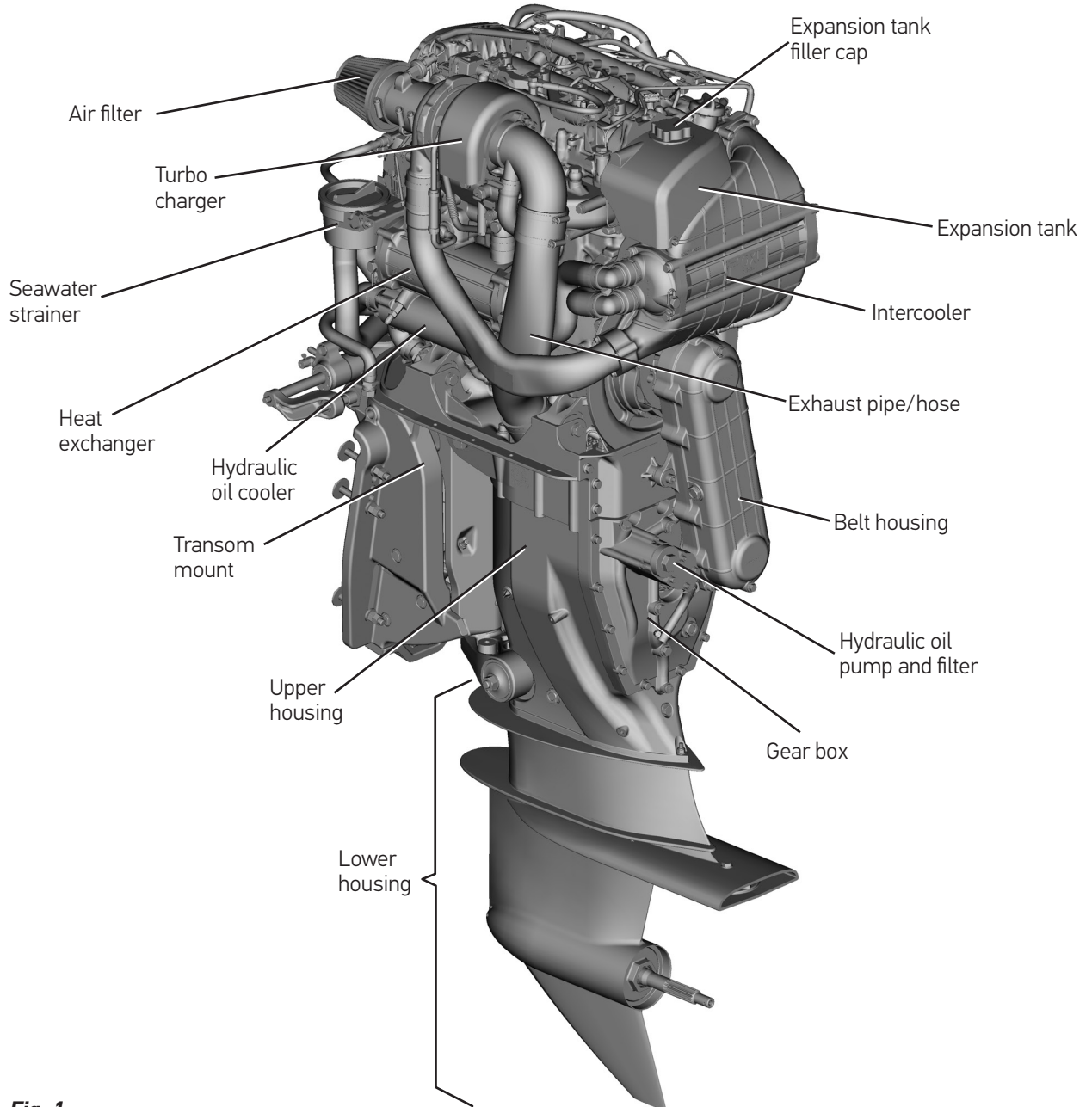


Fig. 1

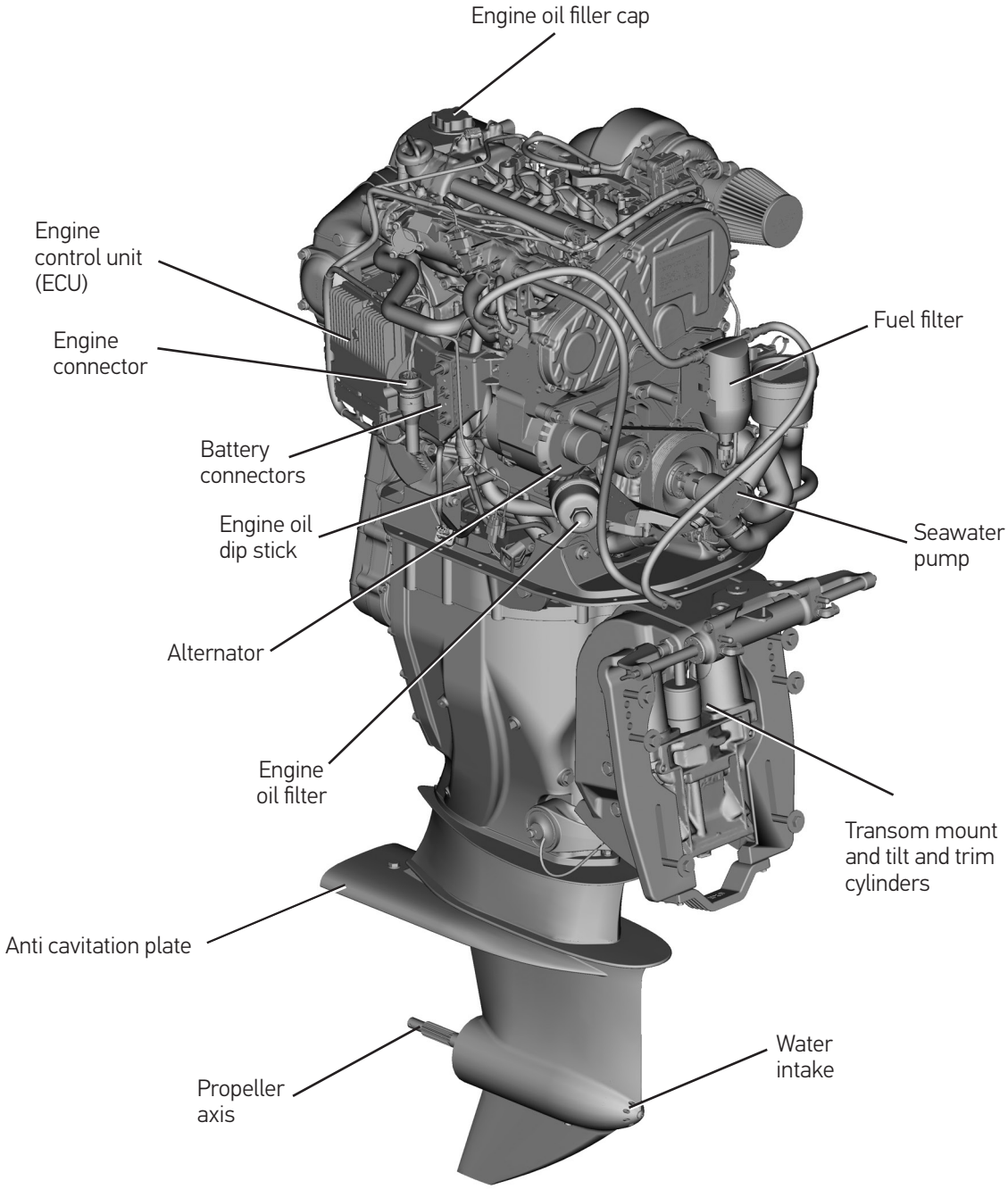


Fig. 2

SYSTEM AND ASSEMBLY OVERVIEWS

COOLING SYSTEM

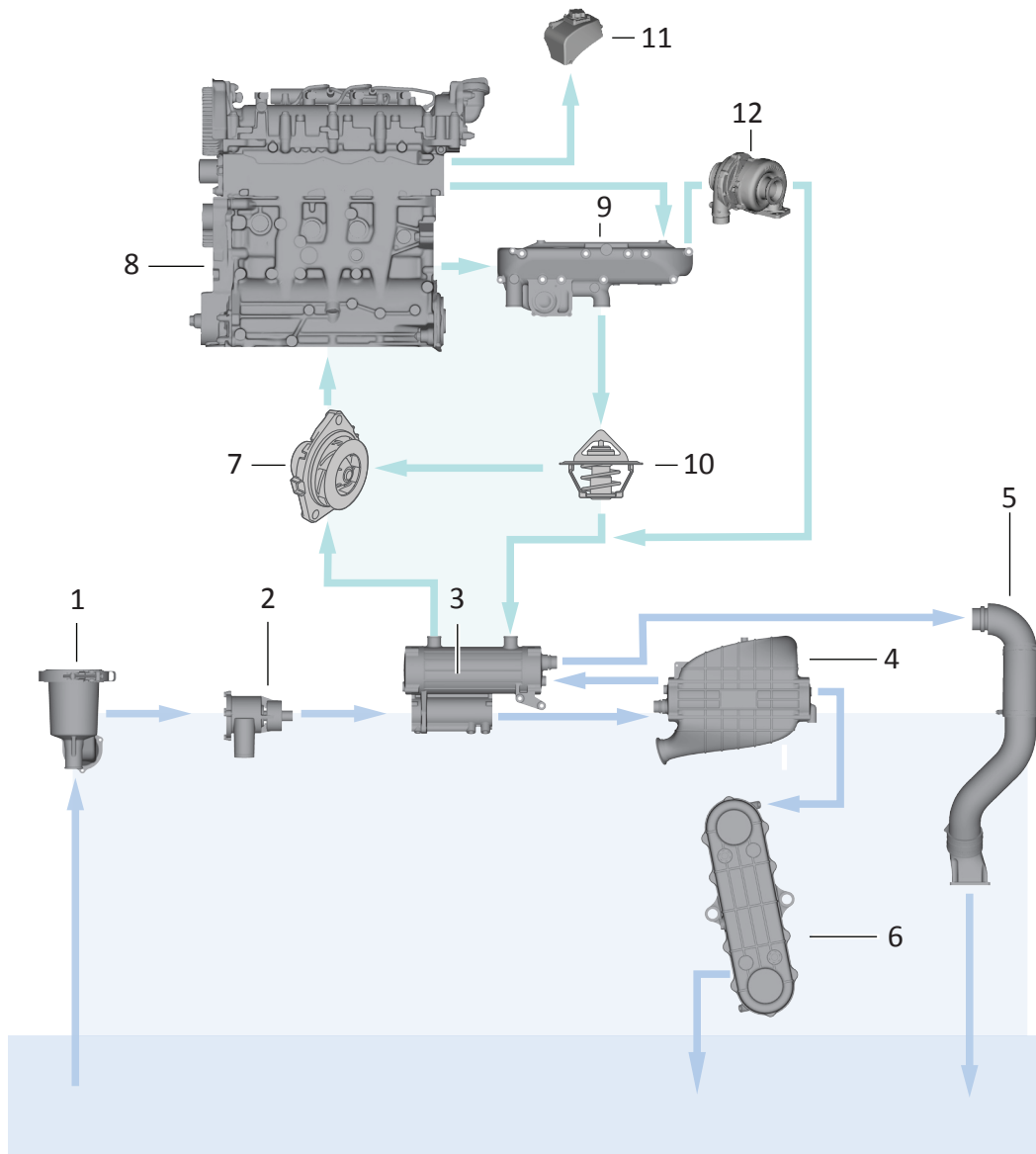
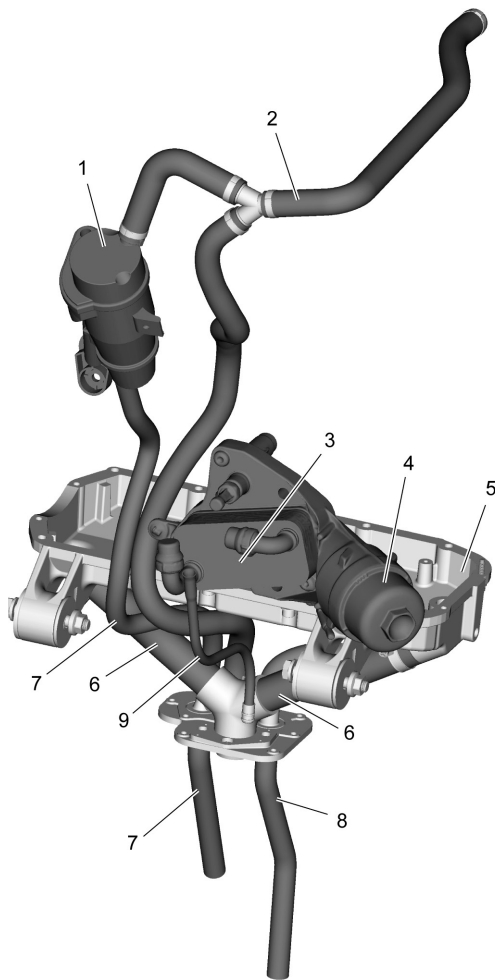


Fig. 3 Schematic diagram of the cooling system

- | | |
|---|-----------------------------|
| 1. Seawater strainer | 7. Engine water pump |
| 2. Seawater pump | 8. Engine |
| 3. Heat exchanger and hydraulic oil cooler | 9. Exhaust manifold |
| 4. Intercooler | 10. Thermostat |
| 5. Exhaust pipe | 11. Expansion tank |
| 6. Belt housing cooler | 12. Turbocharger |

ENGINE LUBRICATION SYSTEM



1. Crankcase ventilation oil separator
2. Breather hose
3. Oil cooler
4. Oil filter
5. Dry sump
6. Oil return pipe
7. Crankcase ventilation return pipe
8. Oil pick-up pipe
9. Oil dipstick tube

Fig. 4 Schematic diagram of engine lubrication system

Oil is applied under pressure to the crankshaft, connecting rods, camshaft bearing surfaces, valve lash adjusters, and turbocharger. All other moving parts are lubricated by gravity flow or splash. Oil is sucked by a pipe out of the **dry sump**.

The **oil pump** is driven by the crankshaft. The oil pump body is installed at the front side of the engine block. The pressurized oil from the pump passes through the oil filter.

The **oil filter** is located on the intake side of the engine block. The oil filter is housed in a casting that is flange-connected on the engine block. The oil filter is a disposable cartridge type.

A **by-pass valve** allows continuous oil flow in case the oil filter should become restricted. Oil then enters the gallery where it is distributed to the **crankshaft** and **camshafts**.

The **connecting rod bearings** are oiled by constant oil flow passages through the crankshaft connecting and the main journals to the rod journals. The pressurized oil passes through the cylinder head restrictor orifice into the cylinder head and then into each camshaft feed gallery. Cast passages feed each hydraulic element adjuster and each camshaft bearing surface. An engine oil pressure switch or sensor is installed at the oil filter adapter.

The **turbocharger** is lubricated with oil via a **feed pipe** and drained by a **return pipe**. Oil returns to the oil pan through cast passages in the engine block.

CAMSHAFT TIMING COMPONENTS

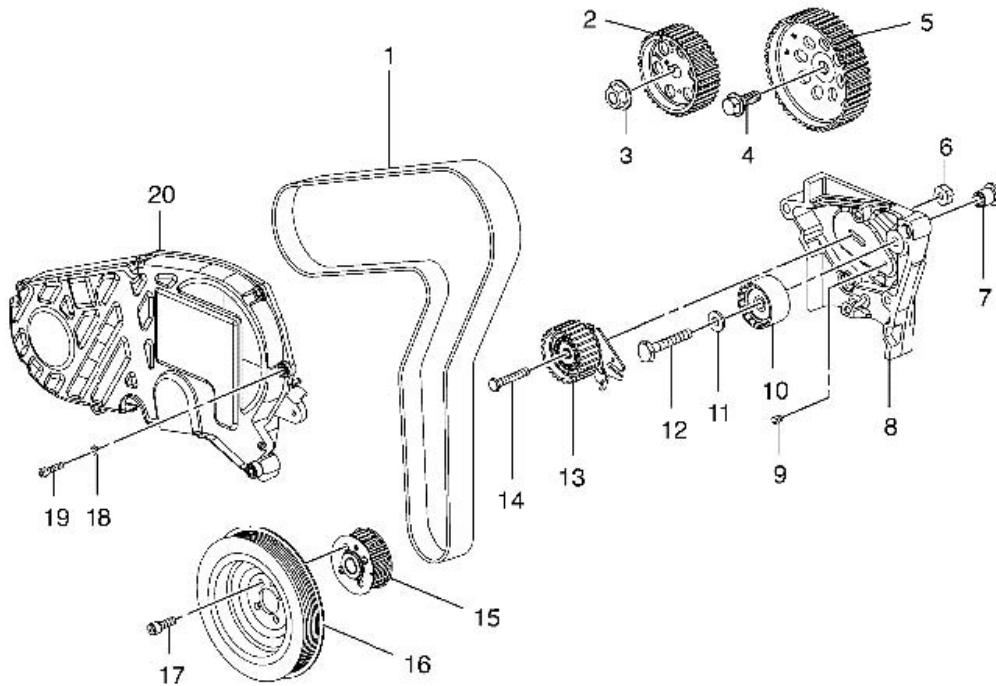


Fig. 5 Camshaft timing components

- | | |
|--|---------------------------------------|
| 1. Timing Belt | 13. Timing Belt Tensioner |
| 2. Fuel Injection Pump Sprocket Wheel | 14. Timing Belt Tensioner Bolt |
| 3. Fuel Injection Pump Sprocket Wheel Nut | 15. Crankshaft Sprocket Wheel |
| 4. Camshaft Sprocket Wheel Bolt | 16. Crankshaft Pulley |
| 5. Camshaft Sprocket Wheel | 17. Crankshaft Pulley Stud |
| 6. Timing Belt Tensioner Nut | 18. Timing Belt Cover Washer |
| 7. Timing Belt Tensioner Bracket Spacer | 19. Timing Belt Cover Bolt |
| 8. Timing Belt Tensioner Bracket | 20. Timing Belt Cover |
| 9. Timing Belt Tensioner Special Screw | |
| 10. Timing Belt Idler Pulley | |
| 11. Timing Belt Idler Pulley Washer | |
| 12. Timing Belt Idler Pulley Bolt | |

DRY SUMP, FILTER, AND TUBE

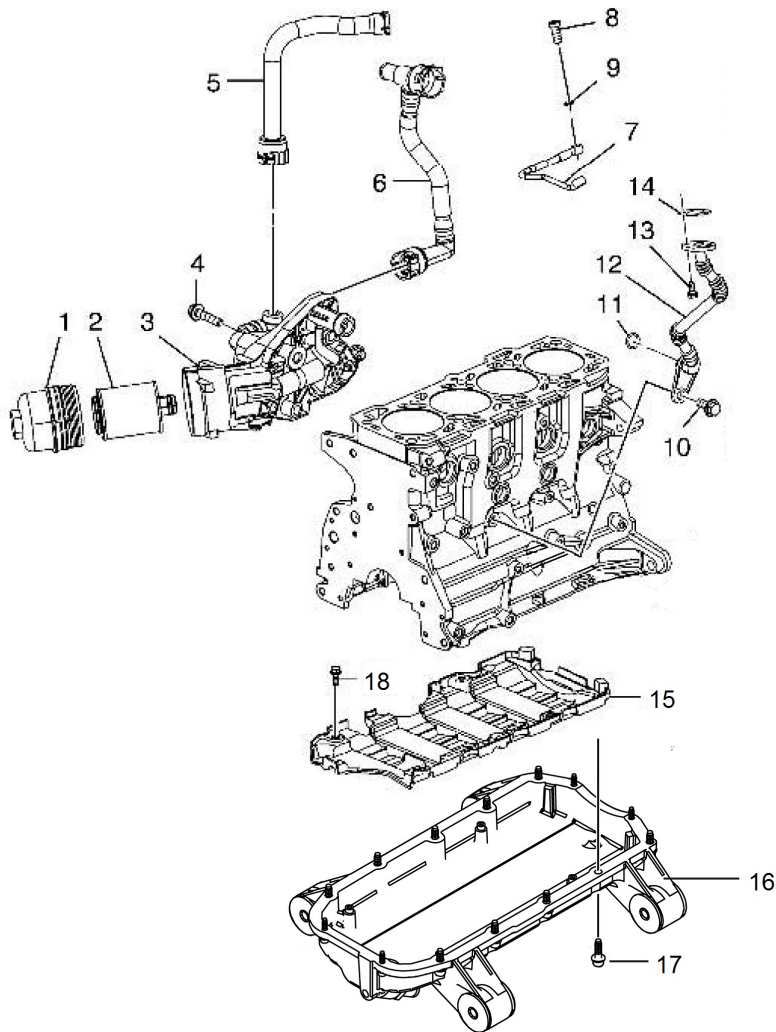


Fig. 6 Dry sump, filter, and tube

- | | |
|---|--|
| 1. Oil Filter Housing Cover | 11. Turbocharger Oil Return Pipe – O-Ring |
| 2. Oil Filter | 12. Turbocharger Oil Return Pipe |
| 3. Oil Filter Housing | 13. Turbocharger Oil Return Pipe – Bolt
Turbocharger |
| 4. Oil Filter Housing Bolt | 14. Turbocharger Oil Return Pipe – Gasket |
| 5. Oil Cooler Inlet Pipe | 15. Oil Pan Baffle |
| 6. Oil Cooler Outlet Pipe | 16. Dry sump |
| 7. Turbocharger Oil Feed Pipe | 17. Oil Pan Bolt |
| 8. Turbocharger Oil Feed Pipe – Bolt | 18. Oil Pan Baffle Bolt |
| 9. Turbocharger Oil Feed Pipe – O-Ring | |
| 10. Turbocharger Oil Return Pipe – Bolt Engine Block | |

CYLINDER HEAD ASSEMBLY

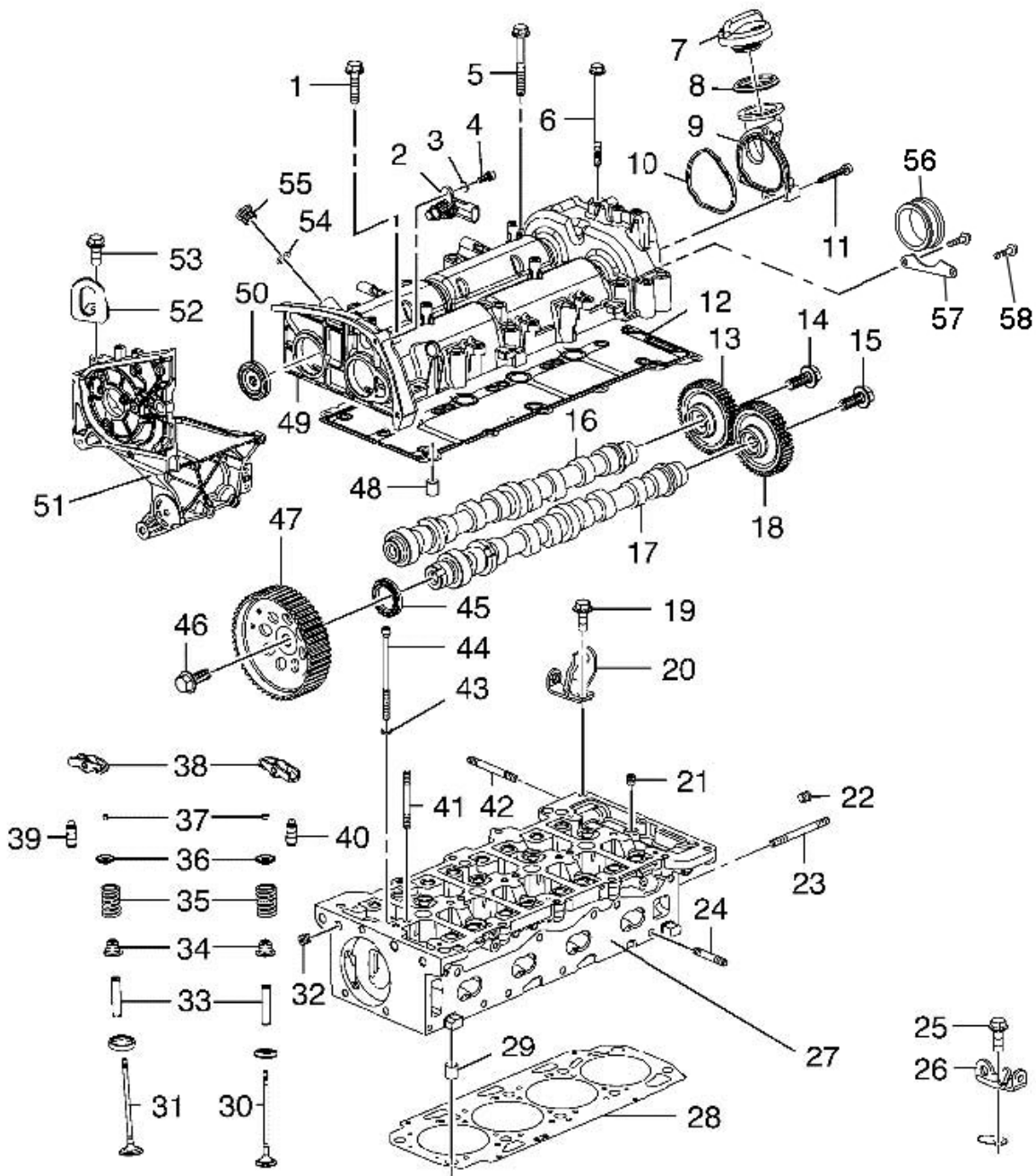


Fig. 7 Cylinder head assembly

- | | |
|---|---|
| 1. Camshaft Cover Housing Bolt – Short | 8. Oil Filler Cap Gasket |
| 2. Camshaft Position Sensor | 9. Camshaft Rear Cover |
| 3. Camshaft Position Sensor Washer | 10. Camshaft Rear Cover Gasket |
| 4. Camshaft Position Sensor Bolt | 11. Camshaft Rear Cover Bolt |
| 5. Camshaft Cover Housing Bolt – Medium | 12. Camshaft Housing Gasket |
| 6. Camshaft Cover Housing Bolt – Long | 13. Intake Camshaft Sprocket Wheel |
| 7. Oil Filler Cap | 14. Intake Camshaft Sprocket Wheel Bolt |

15. Exhaust Camshaft Sprocket Wheel Bolt
16. Intake Camshaft
17. Exhaust Camshaft
18. Exhaust Camshaft Sprocket Wheel
19. Intake Manifold Bracket Bolt
20. Intake Manifold Bracket
21. Threaded Plug
22. Threaded Plug
23. EGR Valve Bracket Stud
24. Exhaust Manifold Stud
25. Engine Lift Bracket Bolt – Camshaft Housing Rear
26. Engine Lift Bracket – Camshaft Housing Rear
27. Cylinder Head
28. Cylinder Head Gasket
29. Cylinder Head Locating Pin
30. Exhaust Valve
31. Intake Valve
32. Threaded Plug
33. Valve Guide
34. Valve Retainer
35. Valve Spring
36. Valve Retainer
37. Valve Stem Oil Seal
38. Roller Followers
39. Hydraulic Valve Lash Adjuster – Intake Valve
40. Hydraulic Valve Lash Adjuster – Exhaust Valve
41. Fuel Injector Bracket Stud
42. Intake Manifold Stud
43. Cylinder Head Bolt Washer
44. Cylinder Head Bolt
45. Exhaust Camshaft Gasket
46. Camshaft Sprocket Wheel Bolt
47. Camshaft Sprocket Wheel
48. Camshaft Housing Locating Pin
49. Camshaft Housing
50. Intake Camshaft Plug
51. Fuel Injection Pump Bracket
52. Engine Lift Bracket – High Pressure Pump
53. Engine Lift Bracket Bolt – High Pressure Pump
54. Plug Gasket
55. Plug
56. Lid
57. Retainer
58. Screw

ENGINE BLOCK ASSEMBLY

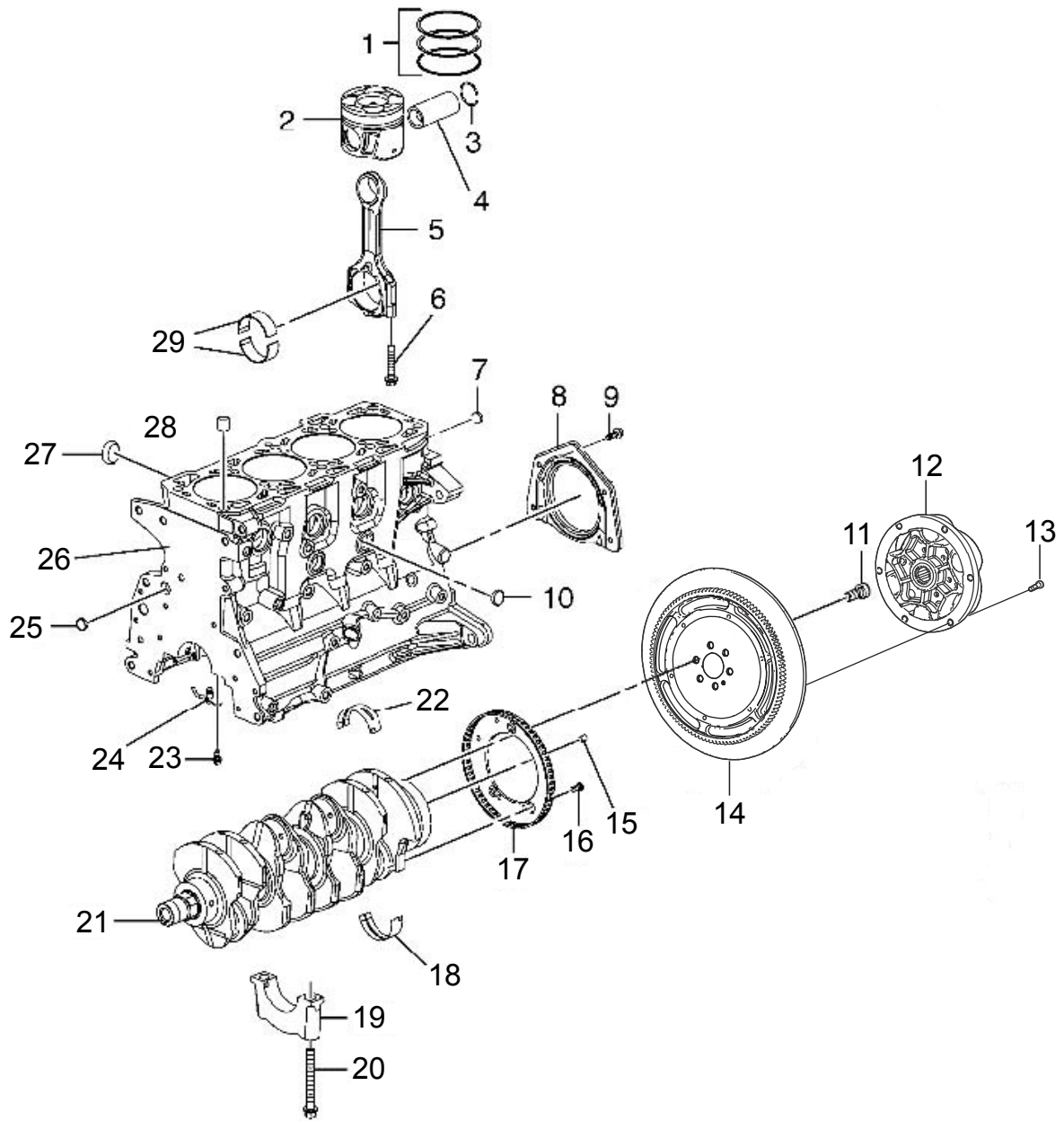


Fig. 8 Engine block assembly

- | | |
|--------------------------------------|---|
| 1. Piston Rings | 9. Crankshaft Rear Oil Gasket Bolt |
| 2. Piston | 10. Water Passage Plug |
| 3. Piston Pin Retainer | 11. Engine Flywheel Bolt |
| 4. Piston Pin | 12. Centaflex CF-R dual stage coupling |
| 5. Connecting Rod | 13. Centaflex Bolt |
| 6. Connecting Rod Bolt | 14. Engine Flywheel |
| 7. Plug | 15. Flywheel Dowel |
| 8. Crankshaft Rear Oil Gasket | 16. Increment Wheel Bolt |

- 17.** *Increment Wheel*
- 18.** *Crankshaft Lower Bearing*
- 19.** *Crankshaft Bearing Cap*
- 20.** *Crankshaft Bearing Cap Bolt*
- 21.** *Crankshaft*
- 22.** *Crankshaft Upper Bearing*
- 23.** *Piston Oil Nozzle Bolt*
- 24.** *Piston Oil Nozzle*
- 25.** *Plug*
- 26.** *Engine Block*
- 27.** *Water Passage Plug*
- 28.** *Cylinder Head Locating Pin*
- 29.** *Connecting Rod Bearing Caps*

INTAKE MANIFOLD

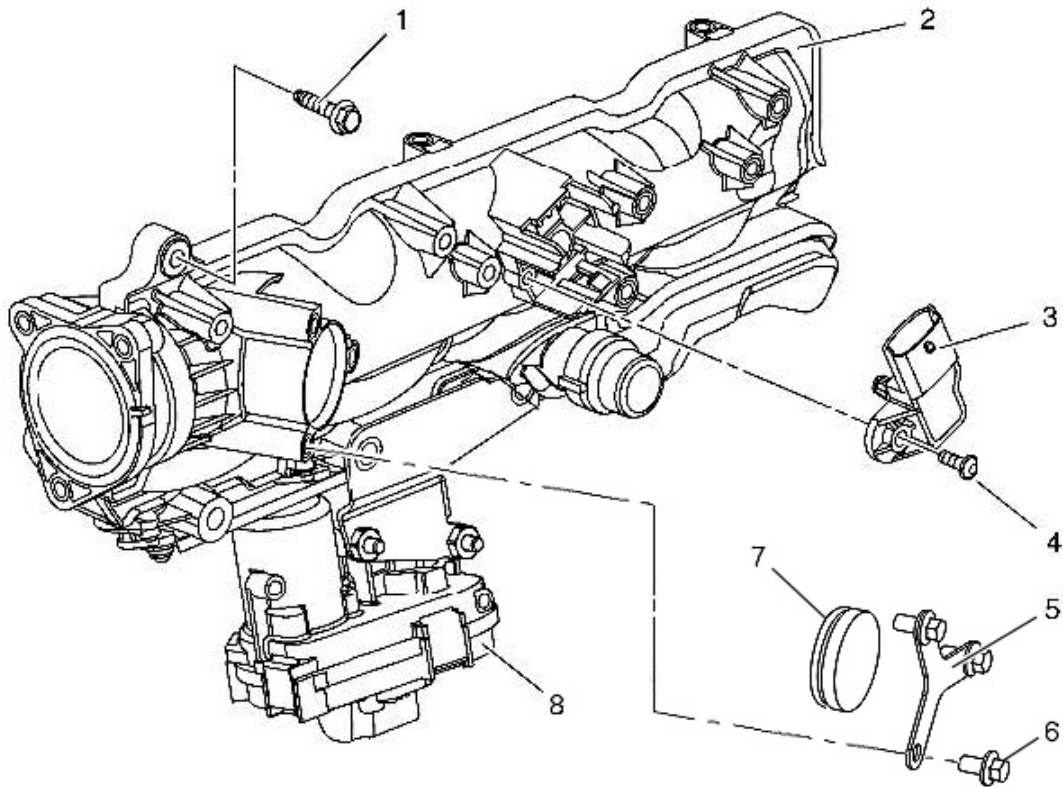


Fig. 9 Intake manifold

1. Intake Manifold Bolt
2. Intake Manifold
3. Manifold Temperature & Pressure Sensor
4. Manifold Absolute Pressure Sensor Bolt
5. EGR-plug retainer
6. Bolt
7. EGR-plug
8. Actuating Drive

TURBO CHARGER ASSEMBLY

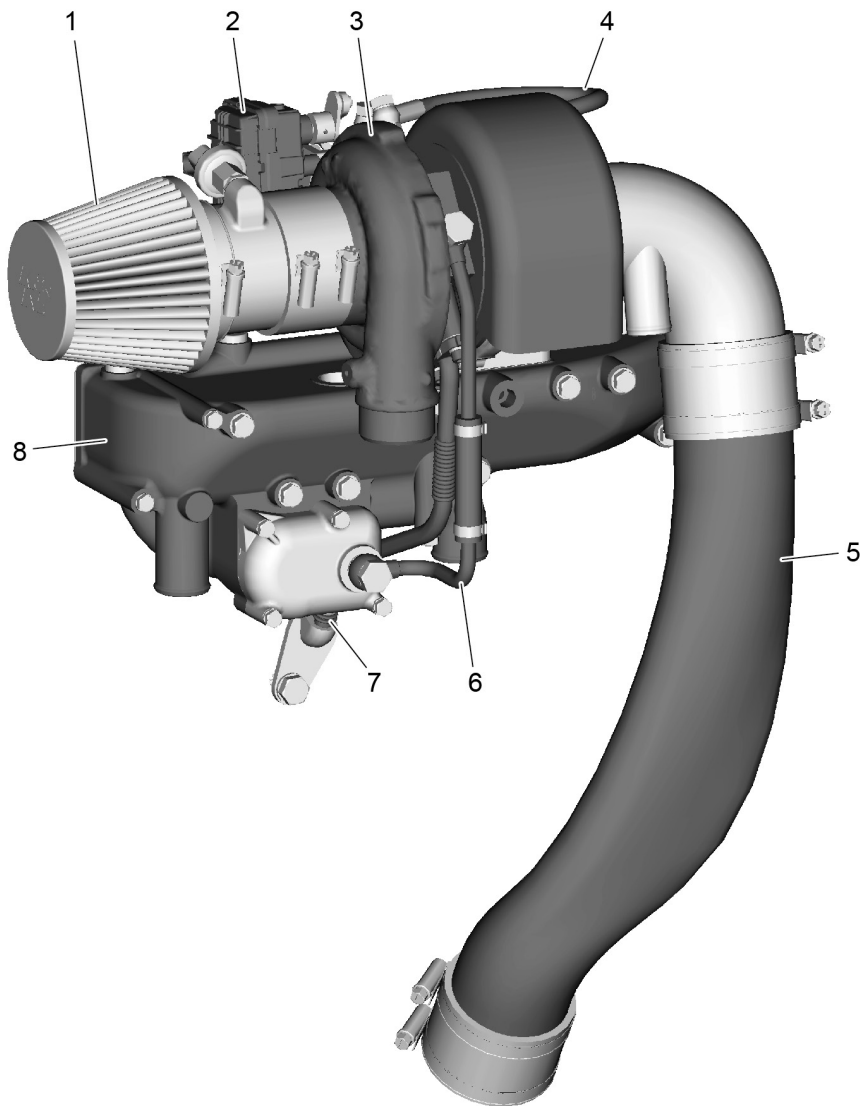


Fig. 10 Turbo charger assembly

1. Air filter
2. Turbo actuator
3. Turbo charger
4. Oil hose
5. Exhaust tube
6. Water pipe
7. Thermostat housing
8. Water cooled exhaust manifold

FUEL SYSTEM DESCRIPTION

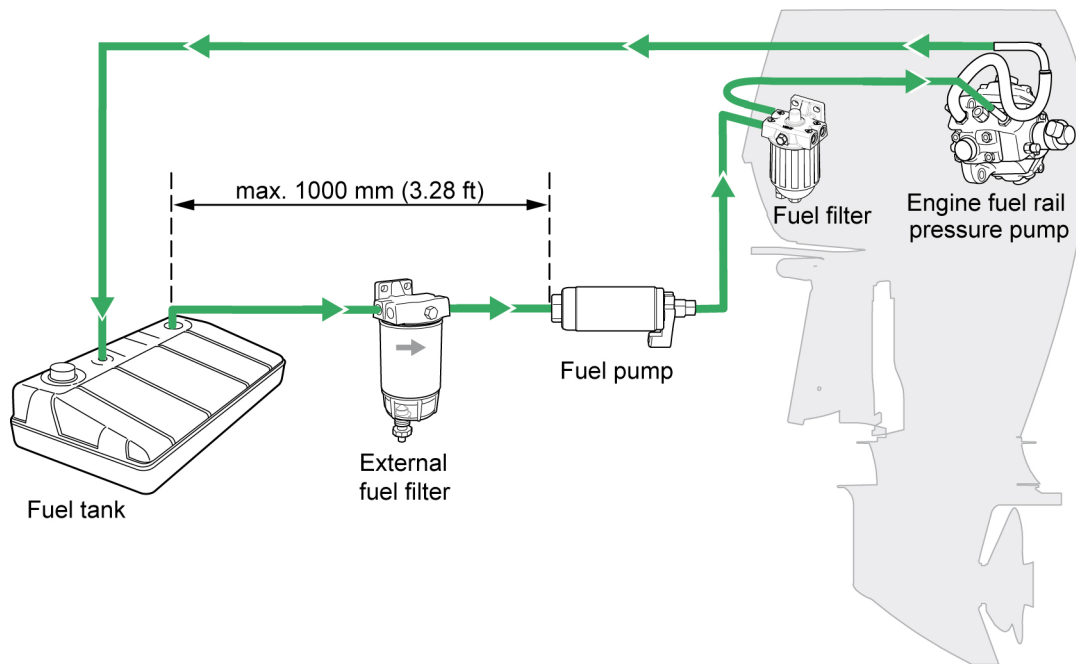


Fig. 11 Fuel system

The fuel enters the engine via the fuel filter and water separator.

The mechanical fuel injection pump output is controlled by the engine control module (ECU), and provides fuel at the pressure needed by the fuel injectors. The fuel injectors supply fuel directly to the combustion chambers of the engine.

The mechanical fuel injection pump, fuel rail pressure, fuel injection timing, and injection duration are controlled by the ECU.

External fuel filter

(Not provided by Cimco Marine)

The 30-micron fuel filter is equipped with a water separator and installed after the fuel tank, on the suction side of the fuel system, between the fuel feed tank and the electric fuel feed pump.

External fuel pump

The electric fuel feed pump is mounted outside the fuel tank and is operated by the engine's ECU. An electric pump motor pushes fuel from fuel tank to the engine through fuel lines.

Fuel filter on engine

The fuel filter is a one-piece fuel filter water separator of snap-on model.

Fuel rail pressure pump

The fuel injection pump is a mechanical high pressure pump. Fuel is pumped to to the fuel rail at a specific pressure. Fuel pressure is regulated by the fuel pressure regulator, which is controlled by the ECU.

Fuel rail assembly

The fuel rail assembly attaches to the cylinder head. The fuel rail distributes pressurised fuel to the fuel injectors through the fuel lines.

The fuel rail pressure sensor gives the engine control mode (ECU) an indication of fuel pressure. The ECU uses this information to regulate fuel pressure, by commanding the fuel pressure regulator open or closed on the inlet of the fuel injection pump.

Fuel injectors

A fuel injector is a solenoid device, controlled by the ECU, that injects pressurised fuel to a single engine cylinder. Fuel from the injector tip is sprayed directly into the combustion chamber on the compression stroke of the engine.

The control functions for the fuel injection system are integrated in the engine control module ECU.

Quick-connect fitting

Quick-connect fittings provide a simplified means of installing and connecting fuel system components. The fittings consist of a unique female connector and a compatible male pipe end. O-rings, located inside the female connector, provide the seal. Integral locking tabs inside the female connector hold the fittings together.

Fuel pipe O-rings

O-rings seal the connections in the fuel system. Fuel system O-ring seals are made of a special material. Service the O-rings seals with the correct service part.

EVACUATING AIR FROM FUEL SYSTEM

NOTE! In order for the diesel fuel system to work properly, the fuel lines must be full of fuel and contain no air. If air gets into the fuel lines, it will be necessary to evacuate the air from the system to eliminate the air before operating the outboard. Air could have entered the system in any of the following ways:

- The engine ran out of fuel.
- The fuel lines have damaged/leaking joints.
- The filter was removed for service or replacement.
- The fuel lines were removed or disconnected for servicing.
- The fuel pump was removed for servicing.
- The fuel pre-filter water drain cock was opened while the engine was running.

If one or more of the above occurred, air has entered the fuel system and you will need to evacuate the air from the system prior to operating the outboard.

Bleeding fuel system

1. Turn the ignition key **ON**. The fuel pump will run for 20 seconds.

NOTE! Do not turn the ignition key to **START**. This could damage the injection pump.

2. Repeat three times.

TRANSMISSION COMPONENT DESCRIPTION

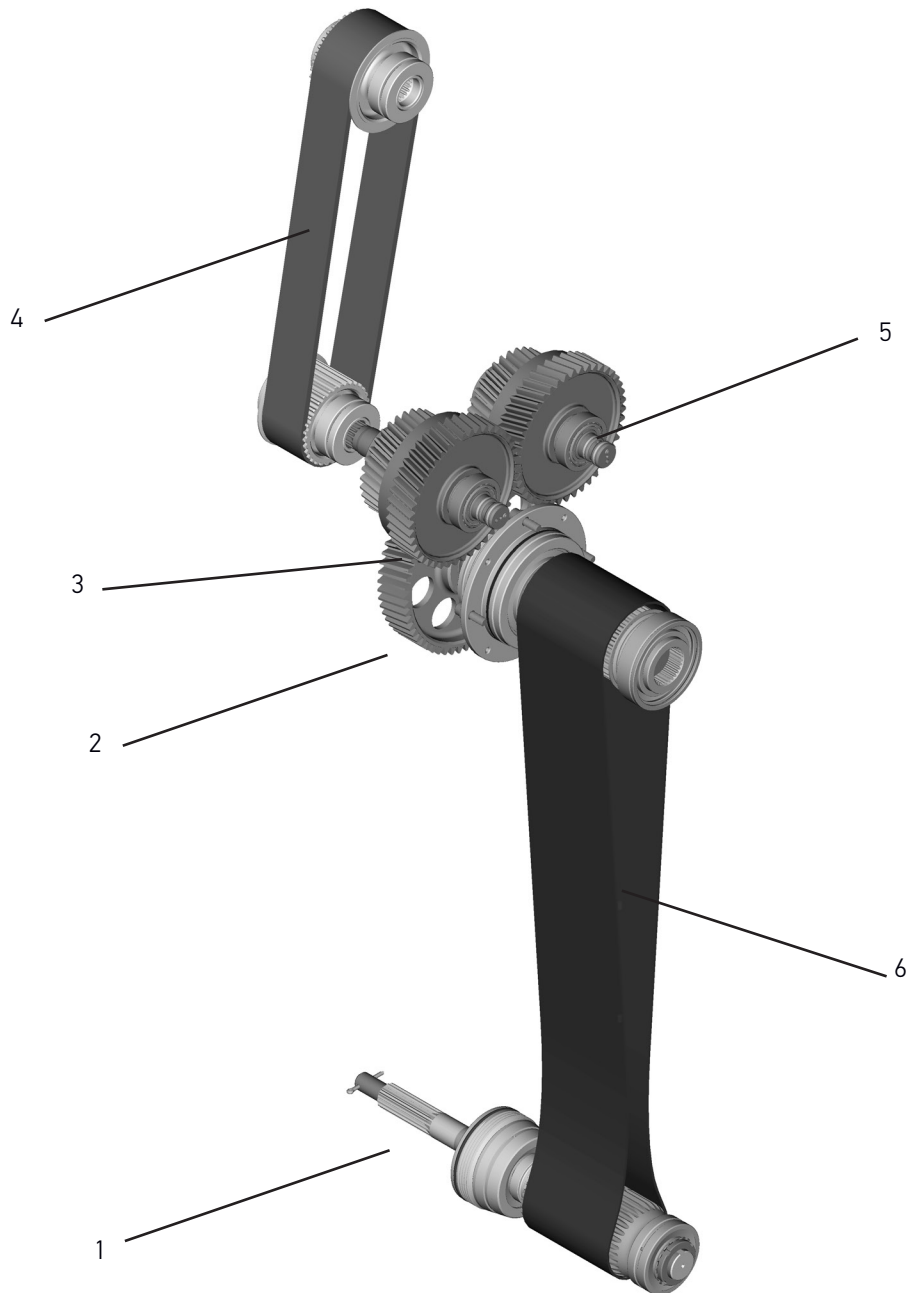


Fig. 12 Transmission

1. Propeller shaft
2. Output shaft assembly
3. Input shaft assembly
4. Upper belt
5. Reverse gear assembly
6. Lower belt

HYDRAULIC SYSTEM DESCRIPTION

- 1. Pressure sensor
- 2. Accumulator
- 3. Proportional pressure relief valve
- 4. Directional valve
- 5. Hydraulic pump and filter

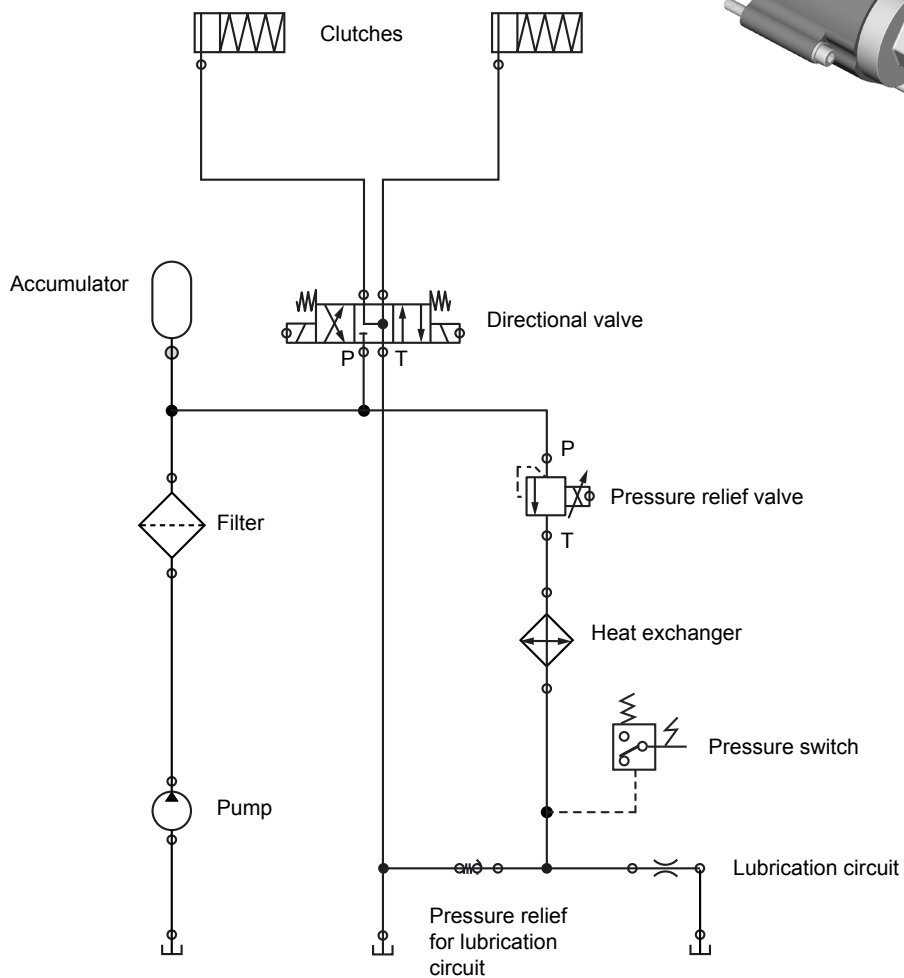
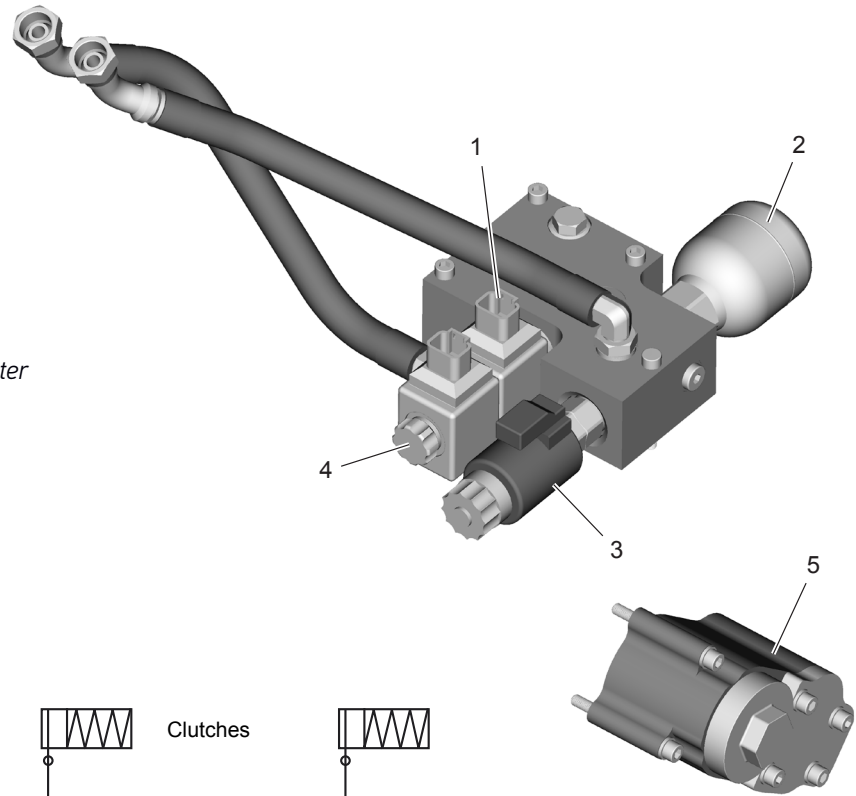


Fig. 13 Hydraulic system

REPETITIVE INSTRUCTIONS

REPLACING GASKETS

Gasket reuse and applying sealants

- Do not reuse any gasket unless specified.
- Gaskets that can be reused will be identified in the service procedure.
- Do not apply sealant to any gasket or sealing surface unless called for in the service information.

Separating components

- Use a rubber mallet to separate components.
- Bump the part sideways to loosen the components.
- Bumping should be done at bends or reinforced areas to prevent distortion of parts.

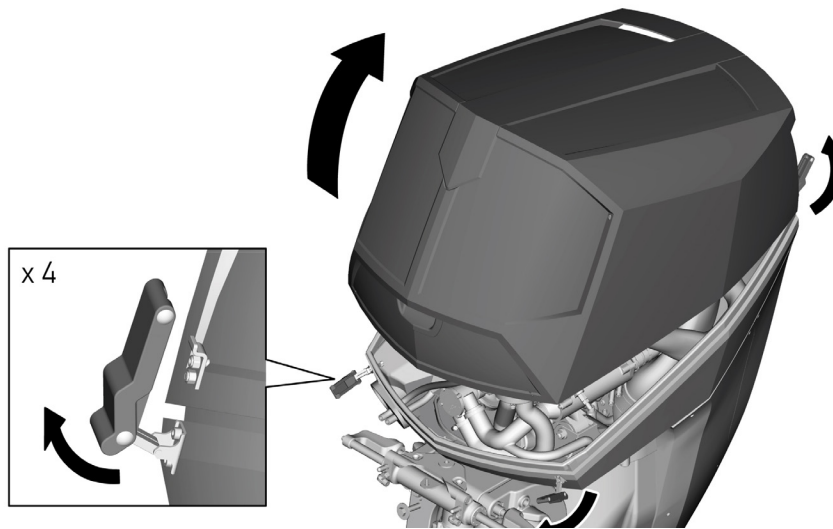
Cleaning gasket surfaces

- Remove all gasket and sealing material from the part using a suitable tool.
- Care must be used to avoid gouging or scraping the sealing surfaces.
- Do not use any other method or technique to remove sealant or gasket material from a part.
- Do not use abrasive pads, sand paper, or power tools to clean the gasket surfaces.
 - These methods of cleaning can cause damage to the component sealing surfaces.
 - Abrasive pads also produce a fine grit that the oil filter cannot remove from the oil.
 - This grit is abrasive and has been known to cause internal engine damage.

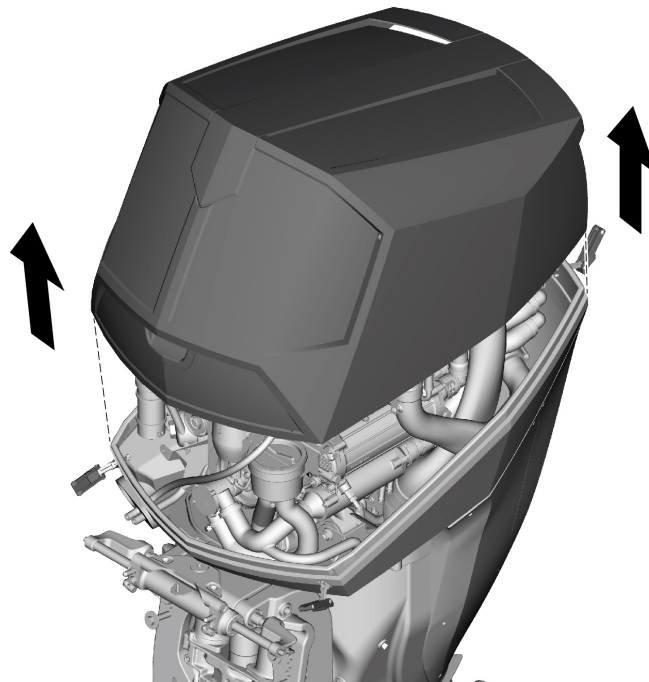
Assembling components

- When assembling components, use only the sealant specified or equivalent in the service procedure.
- Sealing surfaces should be clean and free of debris or oil unless otherwise specified.
- Specific components such as crankshaft oil seals or valve stem oil seals may require lubrication during assembly.
- Components requiring lubrication will be identified in the service procedure.
- When applying sealant to a component, apply the amount specified in the service procedure.
- Do not allow the sealant to enter into any blind threaded holes, as it may prevent the bolt from clamping properly or cause component damage when tightened.

REMOVE AND INSTALL THE TOP COWLING



To remove the top cowling undo the four hatches and lift the cowling upwards avoiding contact with engine components. Place the cowling out of the way on a soft surface in order to minimize cowling damage and work obstructions.



Before installing the top cowling, check that the seal is not dry, broken or worn, as this will allow water to enter the engine.

Lower the cowling carefully into place.

NOTE! Ensure that the hatches are folded outwards.

Close the hatches. Make sure that the top cowling is securely closed and that there are no gaps. A loose or improperly fitted cowling could allow water to enter the engine.

Check the fitting of the top cowling. Reinstall if the fit is not complete.

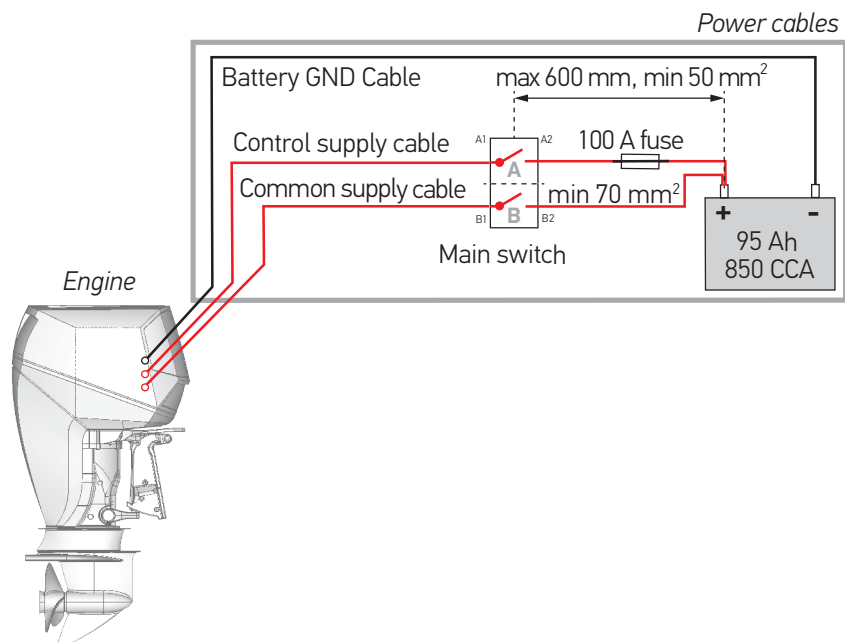
BATTERY DISCONNECT

The ignition and start switch must be in the OFF or LOCK position, the power at the main switch(es) must be switched off, and all electrical loads must be OFF before servicing any electrical component.

Switch off the battery main switch to prevent an electrical spark should a tool or equipment come in contact with an exposed electrical terminal.

 **DANGER**

Failure to follow these precautions may result in personal injury and/or damage to the outboard or its components.



FUEL INJECTION PUMP REPLACEMENT

Special tools

- 30-0160-014 puller

For equivalent regional tools, see **Special tools** .

DANGER

Always wear safety goggles when working with fuel in order to protect the eyes from fuel splash.

DANGER

Fuel Vapors can collect while servicing fuel system parts in enclosed areas. To reduce the risk of fire and increased exposure to vapors:

- Use forced air ventilation such as a fan.
- Plug or cap any fuel system openings in order to reduce fuel vapor formation.
- Clean up any spilled fuel immediately.
- Avoid sparks and any source of ignition.
- Use signs to alert others in the work area that fuel system work is in process.

DANGER

Place a dry chemical (Class B) fire extinguisher nearby before performing any on-outboard service procedures. Failure to follow these precautions may result in personal injury.

DANGER

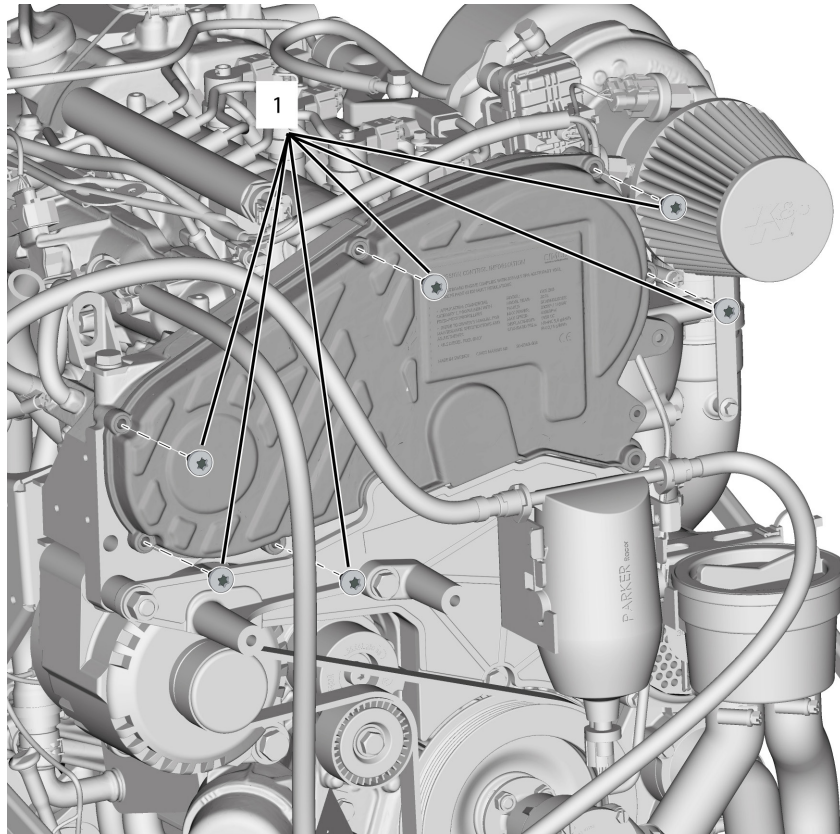
Do not allow smoking or the use of open flames in the area where work on the fuel or EVAP system is taking place. Anytime work is being done on the fuel system, switch off the battery main switch, except for those tests where battery voltage is required.

FUEL INJECTION PUMP REMOVAL

 **WARNING**

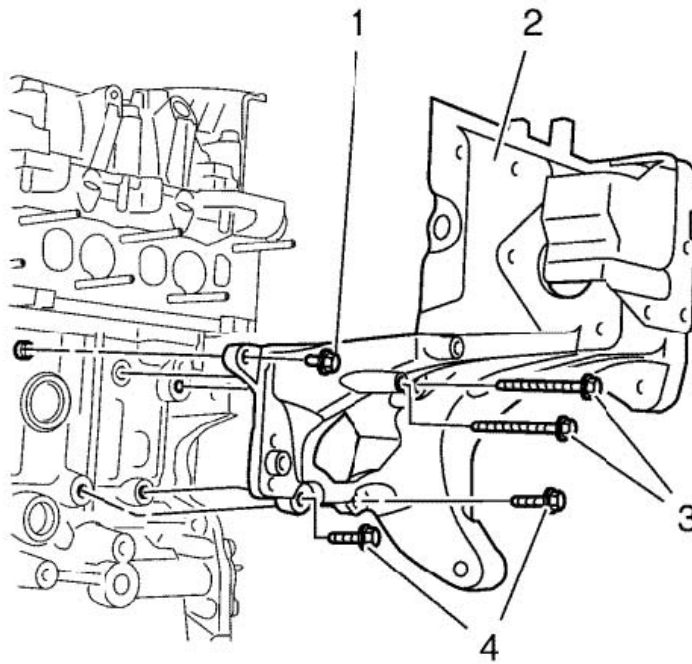
Be very thorough in terms of cleanliness when working in the fuel system. Malfunctions can also occur due to very small dirt particles. Prevent dirt from entering the fuel system by cleaning the hoses and plugging the pipes and lines upon removal. Store the components so that contaminants cannot enter.

1. Switch off the battery main switch. Refer to **Battery disconnect**.

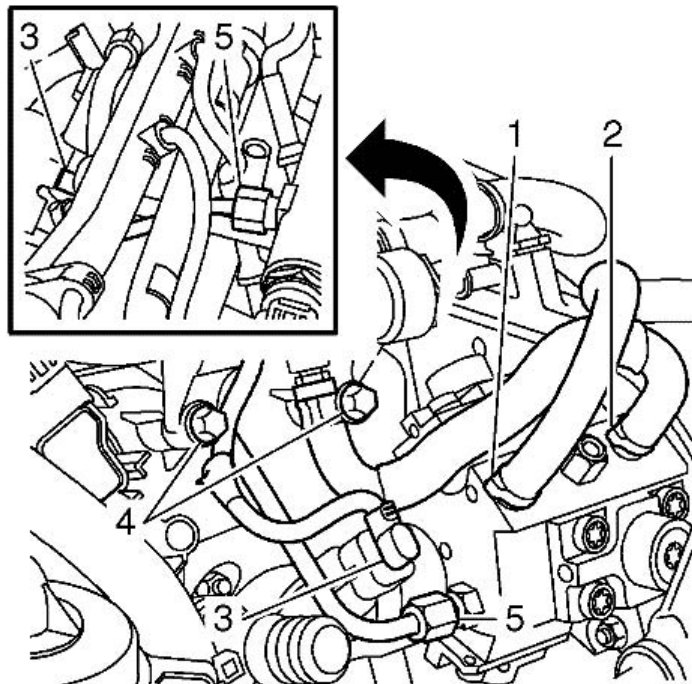


2. Remove the upper timing cover bolts (1).

FUEL INJECTION PUMP BRACKET REMOVAL



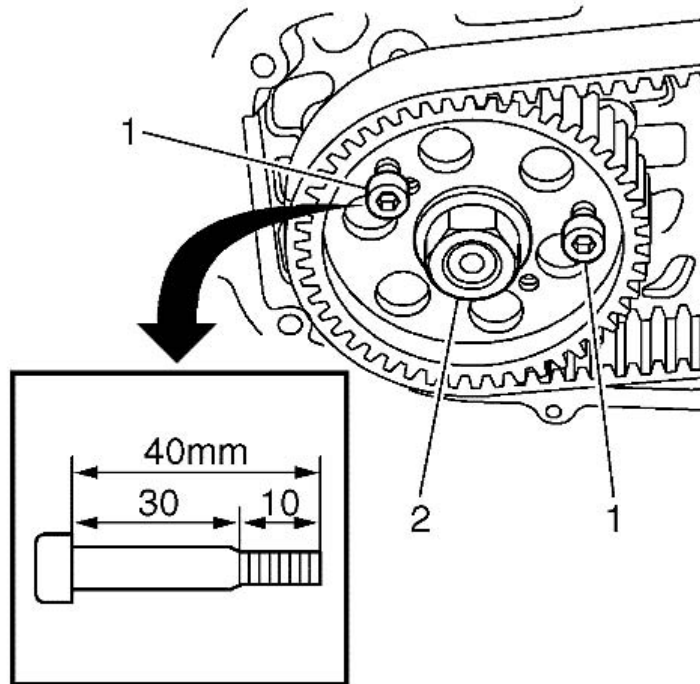
1. Remove the 6 fuel injection pump bracket bolts (1, 3, 4).
2. Remove the fuel injection pump bracket (2).



NOTE! Have a cloth on hand to catch any fuel spill.

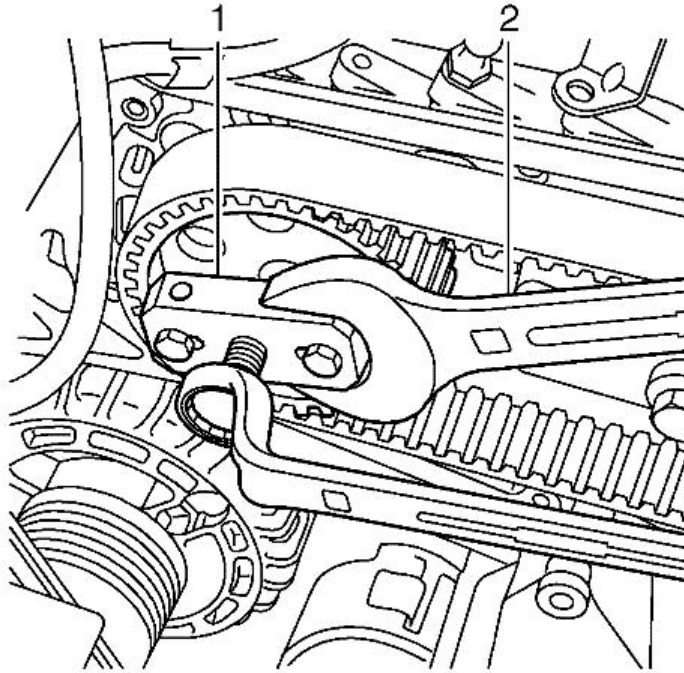
3. Detach the hoses on the high-pressure pump:
 - Plug all connections with plugs.
 - Release the clamp and detach the fuel supply hose **(1)** from the high pressure pump. Plug the hose.
 - Unplug the fuel pressure sensor connector **(3)** from the high pressure pump.
 - Detach the high-pressure fuel line **(5)**. Plug the nozzle pipe.

NOTE! Have a cloth on hand to catch any fuel spill.

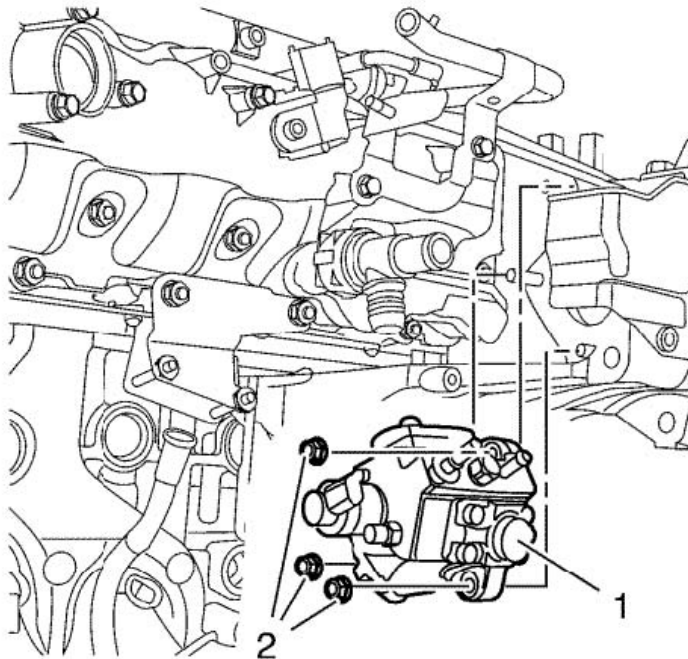


NOTE! When affixing the pulley, use two hex socket head screws M6 X 40 (30 mm unthreaded and 10 mm thread). The screws must be tightened the whole length of the thread. This way the pulley is prevented from moving out of position.

4. Remove the pulley nut:
 - Turn the engine so it is possible to fit 2 Allen bolts **(1)** M6 x 40 (30 mm unthreaded and 10 mm threaded) through the holes in the pulley and to threads in the high-pressure pump bracket.
 - Remove the pulley nut **(2)**.



5. Remove the high-pressure pump from the pulley by pressing the pump out with 30-0160-014 puller **(1)**. Counterhold with a 30 mm wrench **(2)**. Remove the puller.

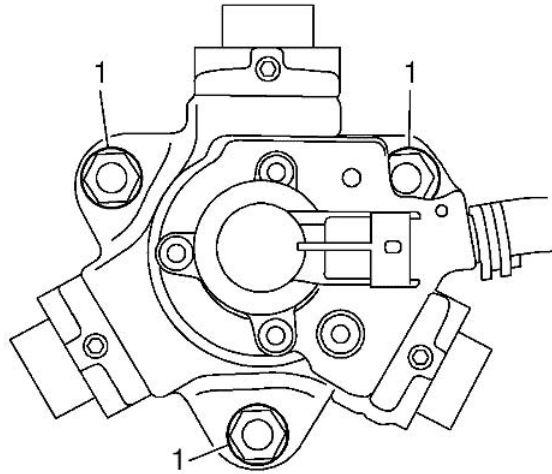


6. Remove the high-pressure pump:
 - Remove the nuts and any washers **(1)**. Use a magnet so as not to drop the washers.
 - Lift out the pump. Pay attention to the wedge.

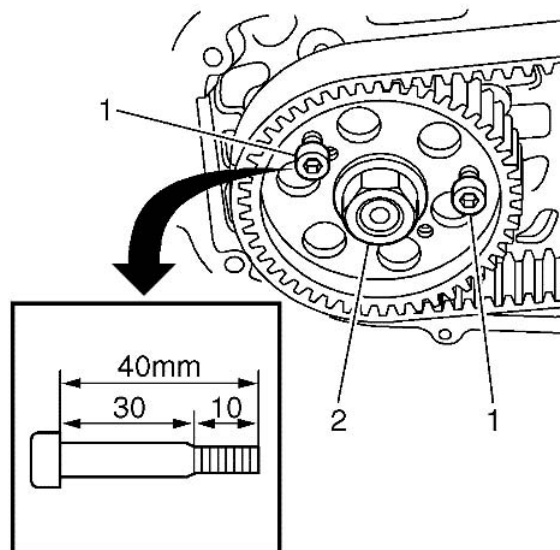
FUEL INJECTION PUMP INSTALLATION

 **WARNING**

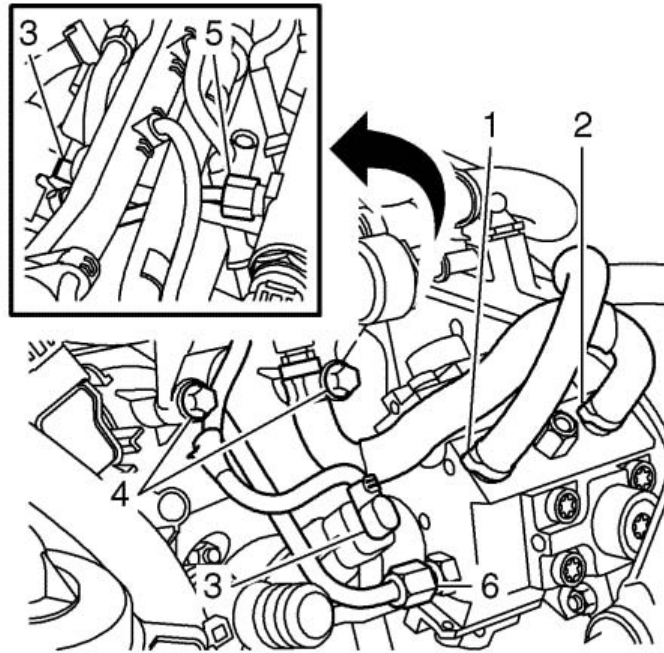
See **Fastener**.



1. Install the wedge to the pump and put the pump in place. Install any washers and nuts (**1**). It is important that the wedge fits into the groove on the pulley. Tighten to **25 Nm (18 lb ft)**.



2. Install the nut (**2**) to the high-pressure pump pulley. Tighten to **50 Nm (37 lb ft)**.
3. Remove the bolts (**1**) holding the pulley in place.

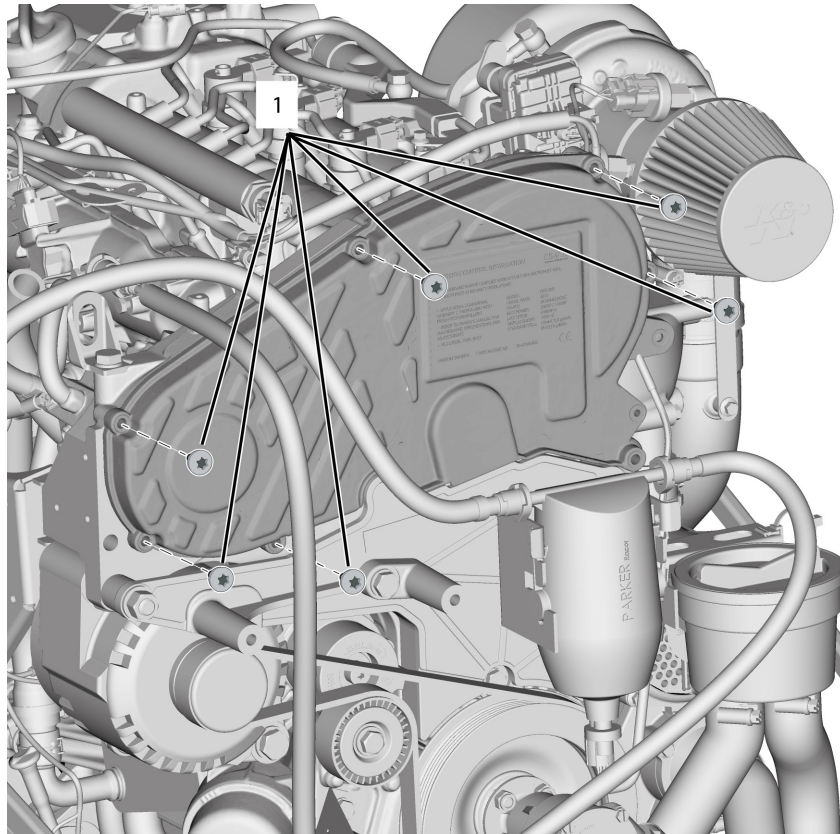


4. Attach the hoses to the pump:

- Remove all plugs from the pump connections.
- Remove the plug and attach the high-pressure fuel line to rail fastener **(5)**. Tighten to **19 Nm (14 lb ft)**. If it is difficult to get the fuel pipe in place, slacken the fuel rail retaining bolts slightly. Tighten fuel pipe fastener **(6)** to high pressure pump to **25 Nm (18 lb ft)**.
- Remove the plug and attach the fuel supply hose **(1)** and clamp to the pump.
- Attach the fuel pressure sensor connector **(3)** to the pump.

NOTE! Take note of the bolt locations.

5. Attach the return fuel line.



6. Install the upper timing belt belt cover with 7 bolts **(2)**.

7. Switch on the battery main switch.

 **DANGER**

See **Battery disconnect**.

8. To evacuate air from the fuel system, see **Bleed fuel system**.

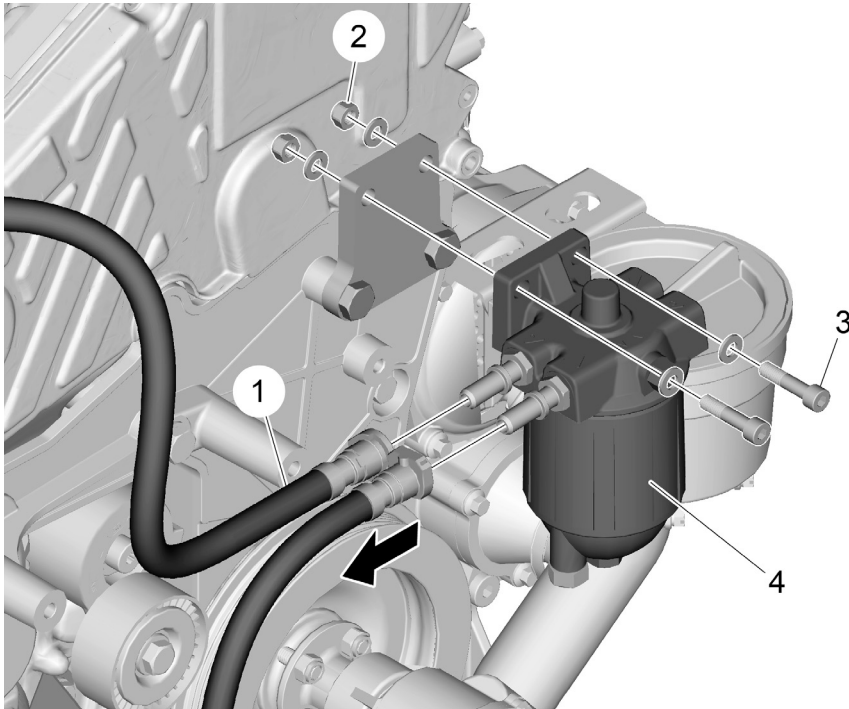
9. Start the engine and turn it off.

FUEL FILTER

FUEL FILTER REPLACEMENT

Fuel filter removal

Refer to **Cleanliness** and **Prevention of environmental damage**.



1. Apply a suitable container in order to collect fuel that may drain from the fuel lines or filter.



CAUTION

Risk of contamination of drinking water. Dispose of the fuel-water mixture according to local environmental legislation.

2. Disconnect the fuel lines (1) by disconnecting the quickrelease fuel connectors.
3. Remove bolts (3) and nuts (2) including washers. Remove the fuel filter (4) from the bracket.

Fuel filter installation

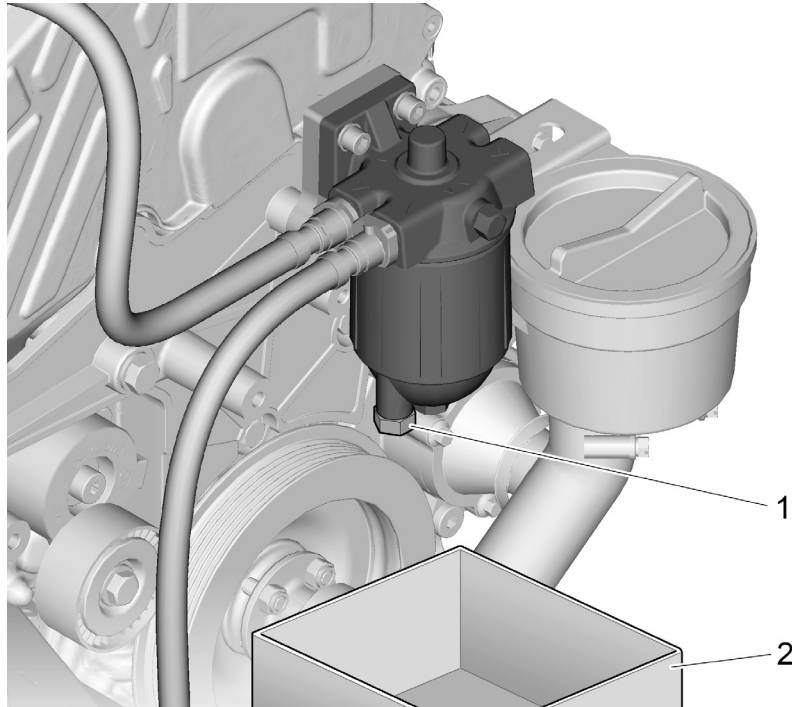
1. Reinstall the **new** fuel filter in opposite order. Tighten bolts to **xx Nm (xx lb ft)**.
2. Reconnect fuel lines (1).

DRAINING THE FUEL FILTER

Refer to **Cleanliness** and **Prevention of environmental damage**.

 **CAUTION**

Risk of contamination of drinking water. Dispose of the fuel-water mixture according to local environmental legislation.



1. Apply a suitable container **(2)** in order to collect the fuel-water mixture that drains from the fuel filter.
2. Loosen the draining screw **(1)** and release the fuel-water mixture into the container. Tighten the draining screw **(1)**.

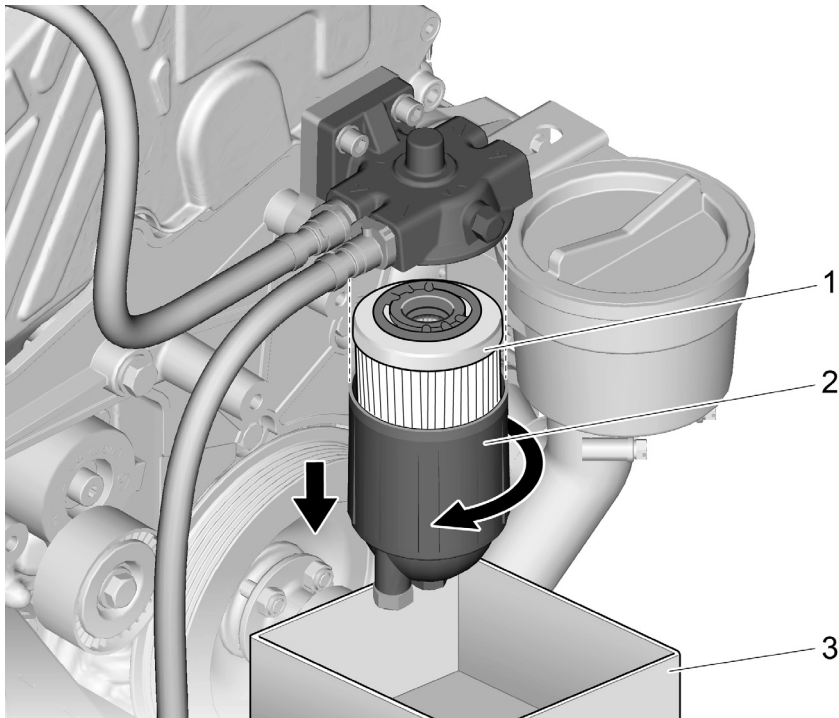
NOTE! Also drain the fuel prefilter in boat! Refer to **Fuel System description**.

REPLACING FUEL FILTER ELEMENT

Refer to **Cleanliness** and **Prevention of environmental damage**.

! CAUTION

Risk of contamination of drinking water. Dispose of the fuel-water mixture according to local environmental legislation.

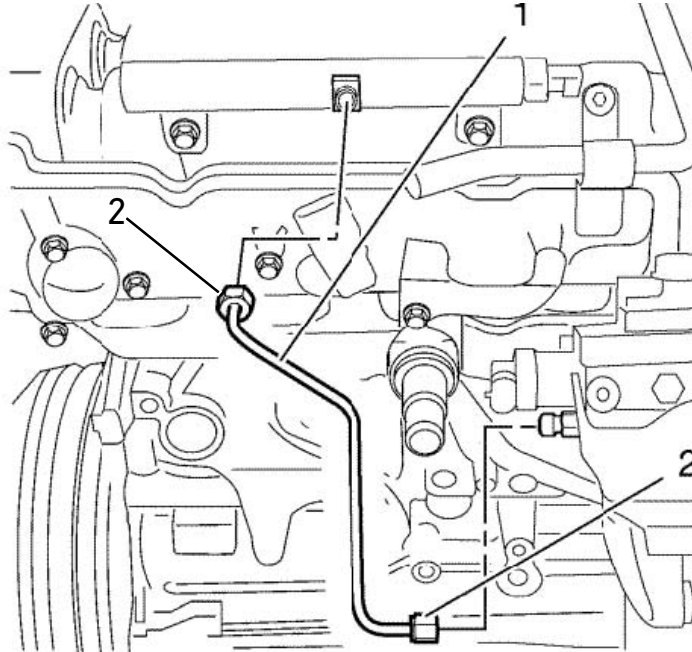


1. Apply a suitable container **(3)** in order to collect the fuel-water mixture that drains from the fuel filter.
2. Unscrew the fuel filter bowl **(2)**.
3. Remove the filter element **(1)** and discard according to **Local environmental legislation**.
4. Insert a **new** filter element **(1)** and reinstall the fuel filter bowl. Tighten by hand.

NOTE! Also replace fuel prefilter element in boat! Refer to **Fuel System description**.

FUEL INJECTOR FEED PIPE REPLACEMENT

FEED PIPE REMOVAL (FUEL PUMP TO RAIL)



! DANGER

Fuel or fuel vapors are highly flammable. A fire could occur if an ignition or heat source is present. Never drain or store diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.

! DANGER

Always wear safety goggles when working with fuel in order to protect the eyes from fuel splash.

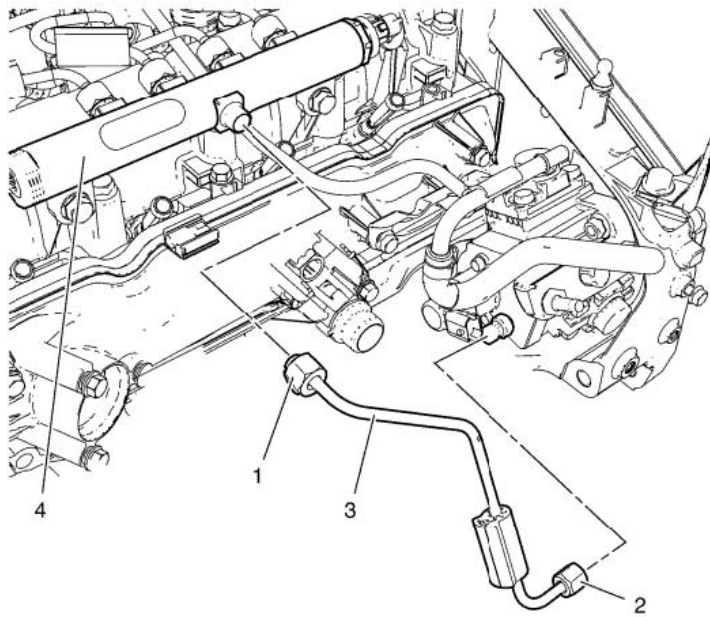
1. Switch off the battery main switch.

! DANGER

See **Battery disconnect**.

2. Remove the 2 fuel feed pipe nuts (**2**).
3. Remove the fuel feed pipe (**1**).

FEED PIPE INSTALLATION (FUEL PUMP TO RAIL)



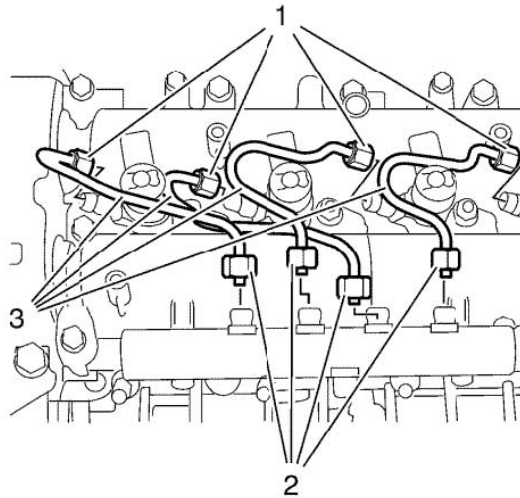
1. Install a **new** fuel feed pipe (**3**). Do not reuse!
2. Install the 2 fuel feed pipe nuts (**1, 2**) and hand tighten.

 **WARNING**

See **Fastener**.

3. Tighten the fuel feed pipe nuts (**1, 2**):
 - Fuel feed pipe to fuel rail (**4**) nut (**1**) tighten to **19 Nm (14 lb ft)**.
 - Fuel feed pipe to fuel injection pump nut (**2**) tighten to **25 Nm (18 lb ft)**.

FEED PIPE REMOVAL (RAIL TO INJECTORS)

 **DANGER**

Fuel or fuel vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.

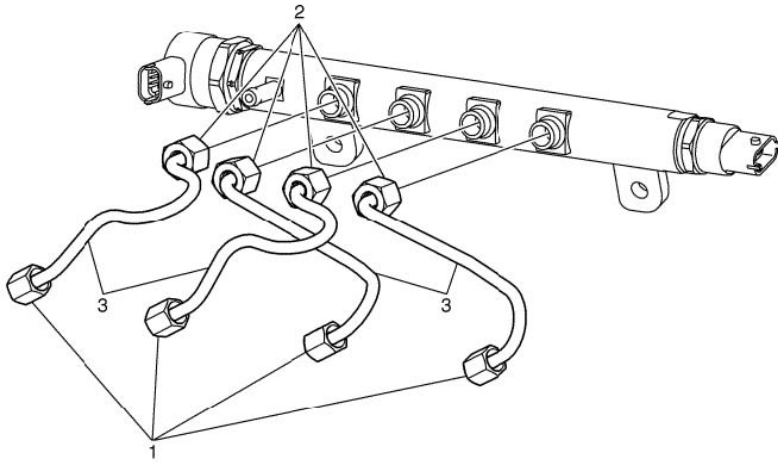
1. Switch off the battery main switch.

 **DANGER**

See **Battery disconnect**.

2. Remove the 8 fuel injector fuel feed pipe nuts (**1, 2**).
3. Remove the 4 fuel injector fuel feed pipes (**3**).

FEED PIPE INSTALLATION (RAIL TO INJECTORS)



1. Install 4 **new** fuel injector fuel feed pipes **(3)**. Do not reuse!

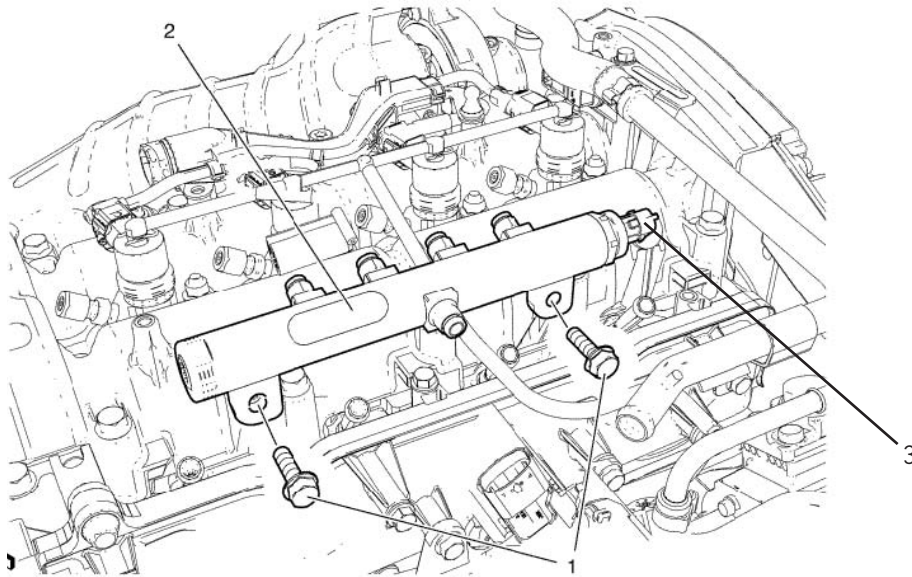
**WARNING**

See **Fastener**.

2. Install the 8 fuel injector fuel feed pipe nuts **(1, 2)** and hand tighten.
3. Tighten the 4 fuel injector fuel feed pipe nuts **(1)** to **25 Nm (18 lb ft)**.
4. Tighten the 4 fuel injector fuel feed pipe nuts **(2)** to **19 Nm (14 lb ft)**.

FUEL RAIL ASSEMBLY REPLACEMENT

FUEL RAIL ASSEMBLY REMOVAL



1. Switch off the battery main switch.



DANGER

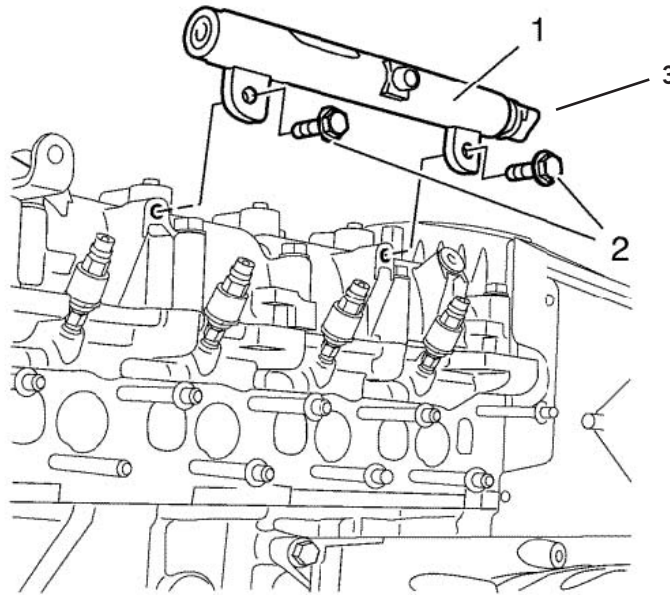
See **Battery disconnect**.

2. Remove the fuel fuel feed pipes, see **Fuel injector fuel feed pipe replacement**.

NOTE! Place caps on the open fuel rail connectors to avoid contamination from dirt as soon as the fuel rail pipes are removed.

3. Disconnect the fuel rail pressure sensor wiring harness plug **(3)**.
4. Remove the fuel rail bolts **(1)**.
5. Remove the fuel rail **(2)**.

FUEL RAIL ASSEMBLY INSTALLATION



1. Install the fuel rail (1).



WARNING

See *Fastener*.

2. Install the fuel rail bolts (2) and tighten to **25 Nm (18 lb ft)**.
3. Connect the fuel rail pressure sensor wiring harness plug (3).
4. Switch on the battery main switch.

FUEL RAIL PRESSURE SENSOR REPLACEMENT

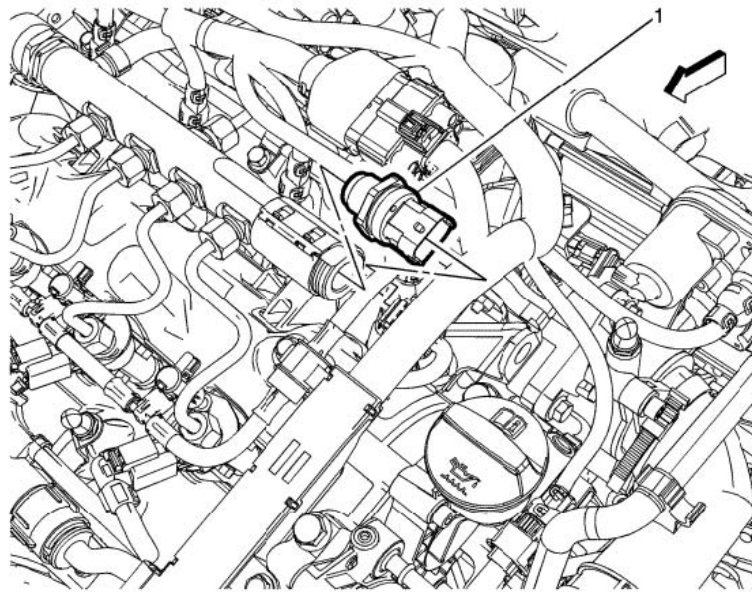
 DANGER

See *Battery disconnect*.

 WARNING

See *Fastener*.

See *Repetitive Alerts*.



 WARNING

Prepare for spillage, have a clean cloth to collect any fuel nearby. Ensure that no dirt enters the engine.

1. Disconnect the fuel rail pressure sensor harness connector.
2. Detach the fuel rail pressure sensor.
3. Install a new fuel rail pressure sensor. Tighten **70 Nm (52 lb ft)**.
4. Connect the fuel rail pressure sensor harness connector.

GLOW PLUG REPLACEMENT

GLOW PLUG REMOVAL

Special tools

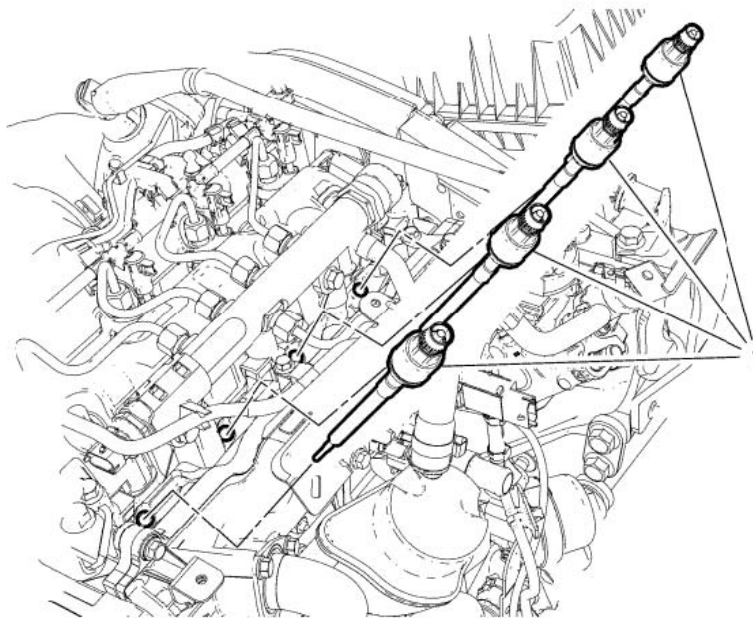
- 30-0160-020 remover/installer glow plugs 9 mm

For equivalent regional tools, see **Special tools**.

1. Disconnect the electrical connector at each of the glow plugs.
2. Clean around each of the glow plugs to avoid dirt from entering the engine.

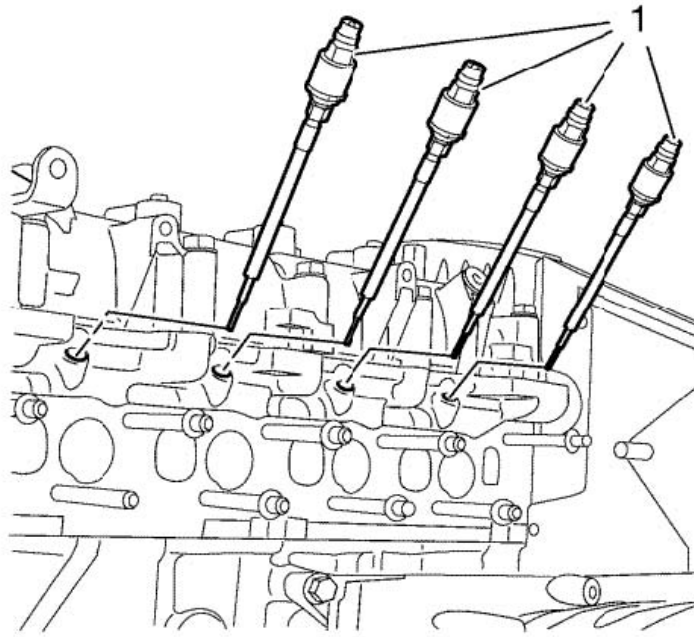
WARNING

Use care when disconnecting the glow plug electrical connector. Use of excessive force may damage the electrical connector.



3. Remove the glow plugs (1).

GLOW PLUG INSTALLATION

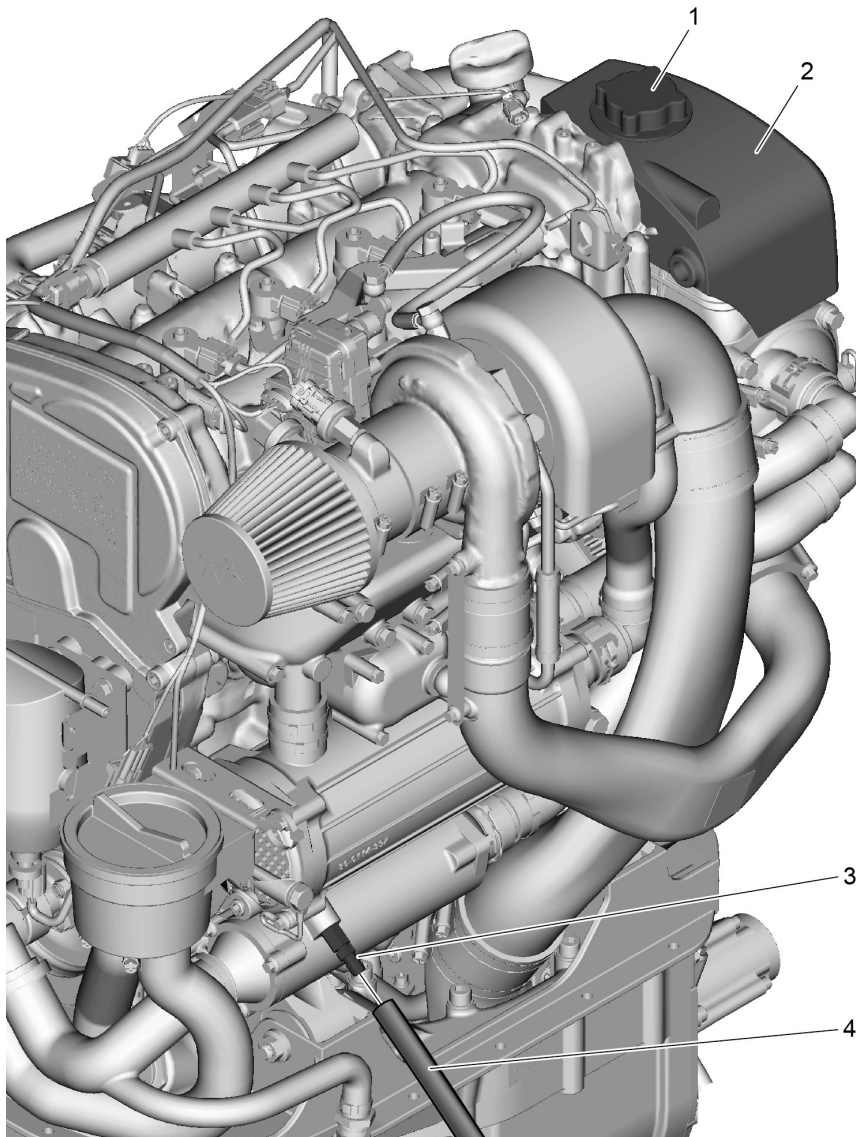
 **WARNING**

See **Component fastener tightening**.

NOTE! Be sure that you not interchange the electrical connectors.

1. Install the 4 glow plugs **(1)**.

DRAINING AND FILLING COOLANT



1. Filler cap
2. Coolant expansion tank
3. Drain adapter
4. Hose

DRAINING COOLANT

1. Remove coolant filler cap **(1)**.
2. Connect a hose **(4)** to the drain adapter **(3)** and drain the coolant into a suitable container.



CAUTION

Risk of contamination of drinking water. Dispose of used coolant/water-mixture according to local legislation.

FILLING COOLANT

The cooling system of the engine is to be filled with a mixture of distilled water and antifreeze based on ethylene glycol and / or anticorrosion additive. Refer to **Recommended fluids and grease** for appropriate ratios.



WARNING

Use only approved fuels, lubricants etc. (see table *Recommended fluids and grease*). Otherwise the manufacturer's warranty will become null and void.

Coolant must be added **at the filler cap only**.

Do not add cold coolant to a warm engine.

Ensure that the mixing ratio "water-antifreeze" is preserved.

1. Remove coolant filler cap **(1)**.
2. Slowly fill up with coolant via filler neck on expansion tank until fluid level has reached just 4 cm below the filling neck.
3. Start the engine and let it run at a speed of 2,000 rpm for approx. 15 minutes.
4. Switch off engine, carefully turn cap with safety valve to the first detent to relieve pressure and then carefully remove cap and top up with coolant.



DANGER

Risk of scalding and burning yourself!

5. Before the engine is next put into operation (with the engine cold) check the coolant level and top up if necessary.
6. Repeat this procedure until appropriate coolant level have been reached and the level is the same at appropriate level 4 cm below the filling neck.



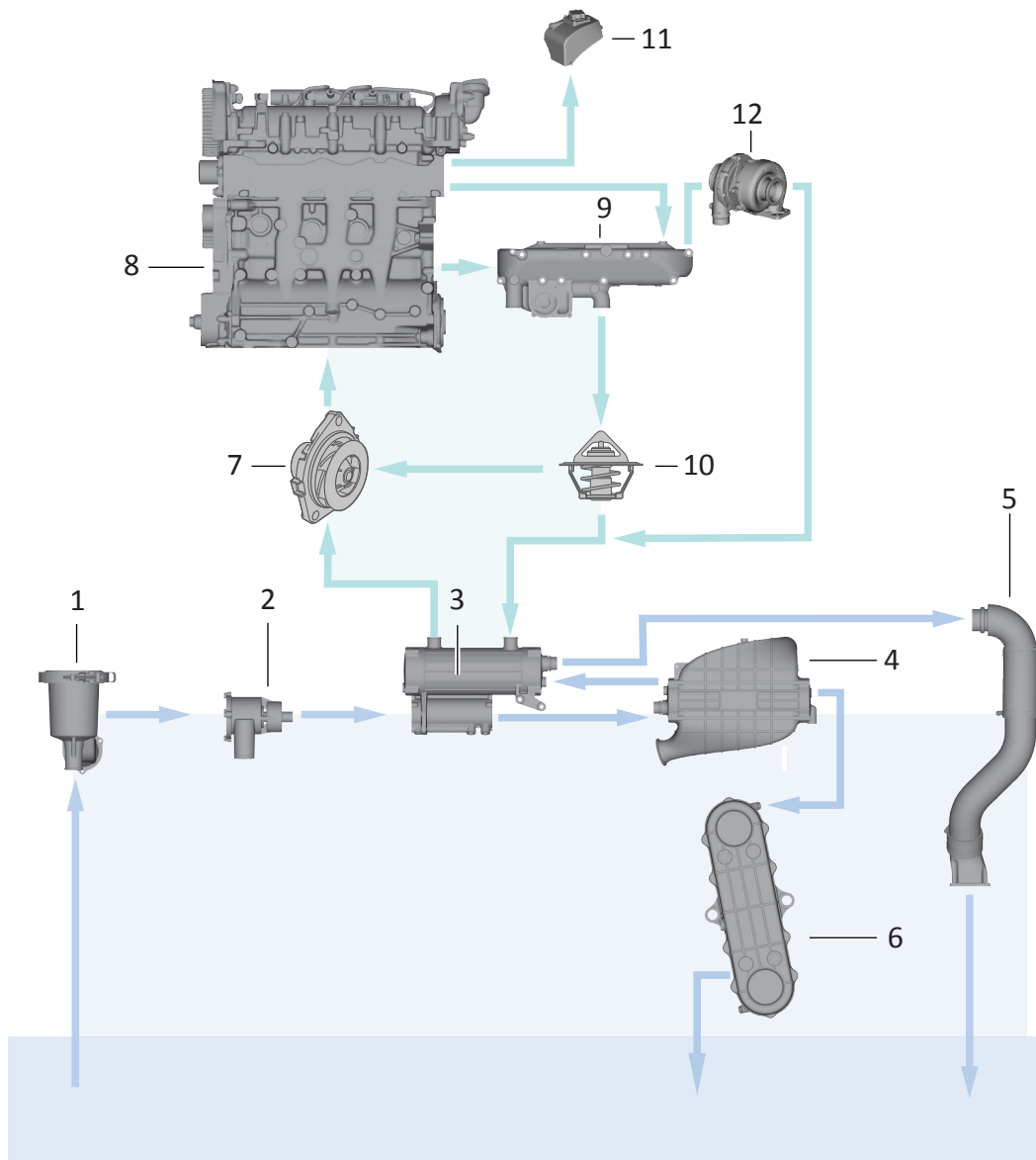
DANGER

If, in an exceptional case, the coolant level has to be checked in an engine that has reached operating temperature, first carefully turn the cap with safety valve to the first stop, let off pressure, then open carefully.

NOTE! Don't open the cooling system when the engine is at operating temperature. This causes a pressure loss in the cooling system.

The cooling system must only be filled up when the engine is cold.

CHECK COOLANT SYSTEM

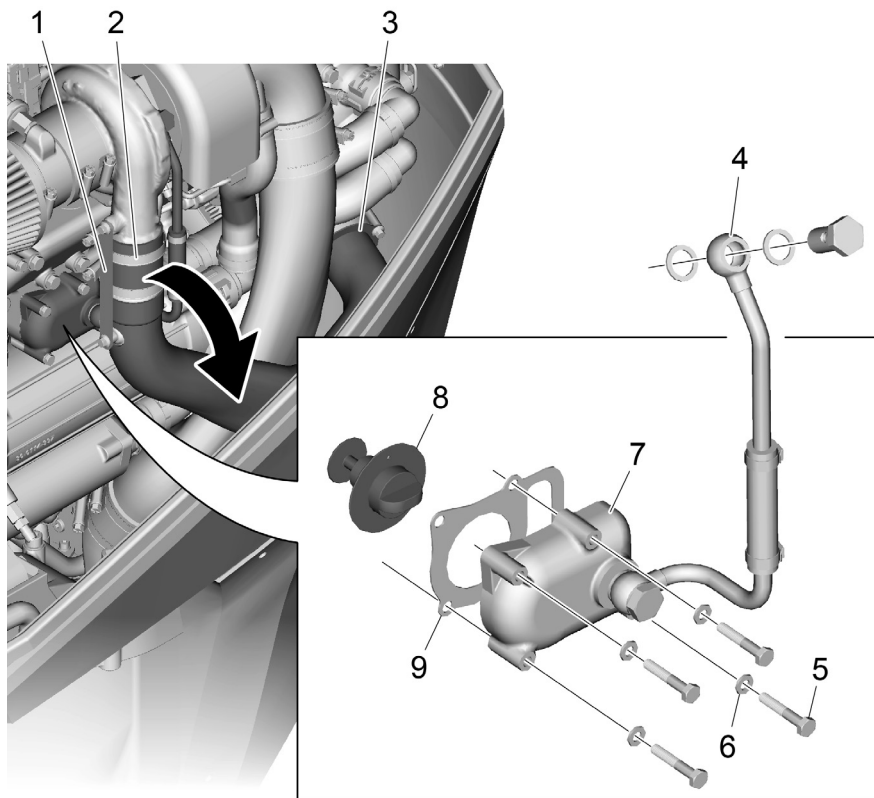


1. Seawater strainer
2. Seawater pump
3. Heat exchanger and hydraulic oil cooler
4. Intercooler
5. Exhaust pipe
6. Transmission cooler
7. Engine water pump
8. Engine
9. Exhaust manifold
10. Thermostat
11. Expansion tank
12. Turbocharger

Check the system regularly.

- Check hoses for fissures and damage. Replace, if necessary.
- Check that the water intake is not blocked. Clean, if necessary.
- Check the seawater filter. Clean if necessary.
- Check coolant level and mixture. Fill up, if necessary.
- Check that the telltale is not blocked.
- Check hydraulic oil cooler water outlet for clogging. Clean with pipe cleaner or similar.

THERMOSTAT REPLACEMENT



1. Remove the pressure pipe retainer **(1)** and the clamp **(2)**.
2. Remove the pressure pipe intercooler retainer **(3)**.
3. Remove the pressure pipe assembly.
4. Remove the turbo water outlet **(4)**.
5. Loosen screws **(5)**, washers **(6)**, and thermostat housing lid **(7)**.
6. Remove thermostat **(8)** and gasket **(9)**.
7. Install a **new** thermostat.
NOTE! Install a **new** gasket.
8. Reinstall the thermostat housing lid with 4 screws and washers.
Tighten to **9 Nm (14 lb ft)**.
9. Fill up according to **Filling coolant**.

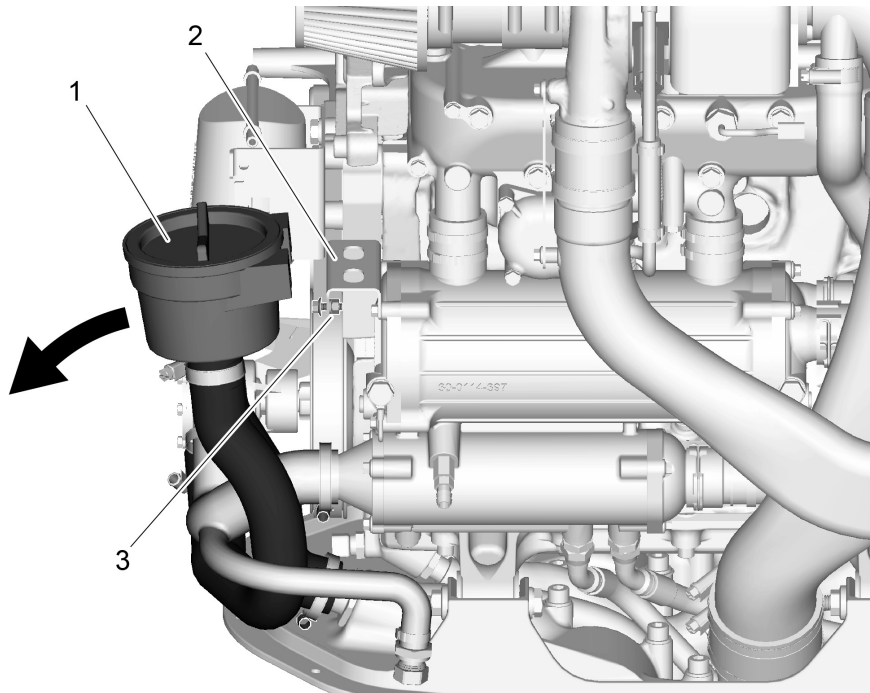
HEAT EXCHANGER REPLACEMENT

1. Remove all heat protection cover.

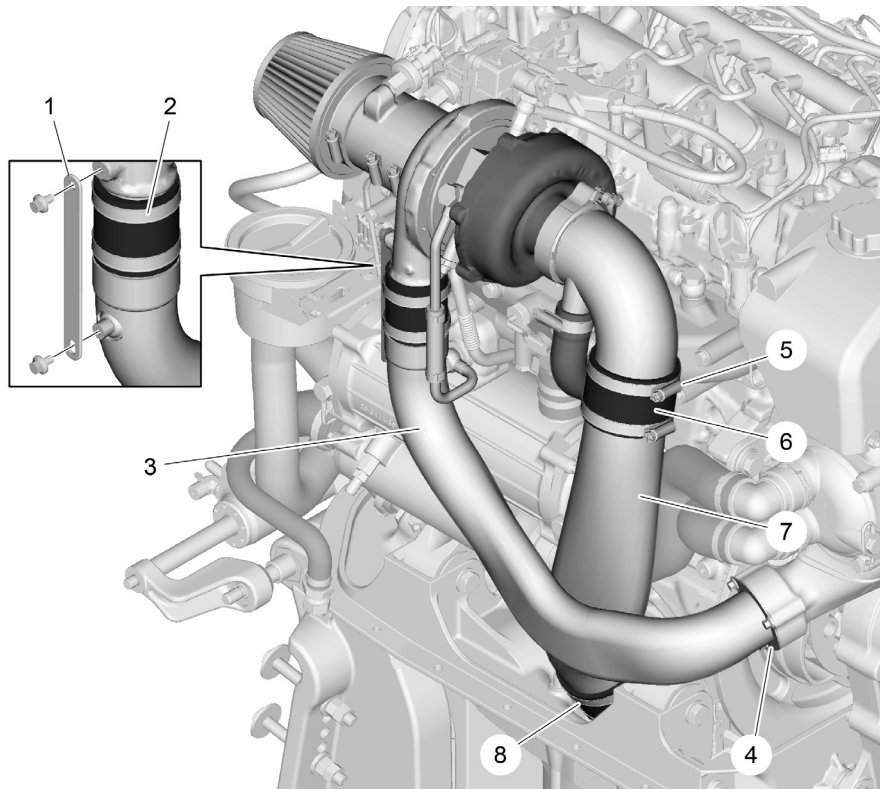
HEAT EXCHANGER REMOVAL

2. Drain the coolant. Refer to *Draining and filling coolant*.

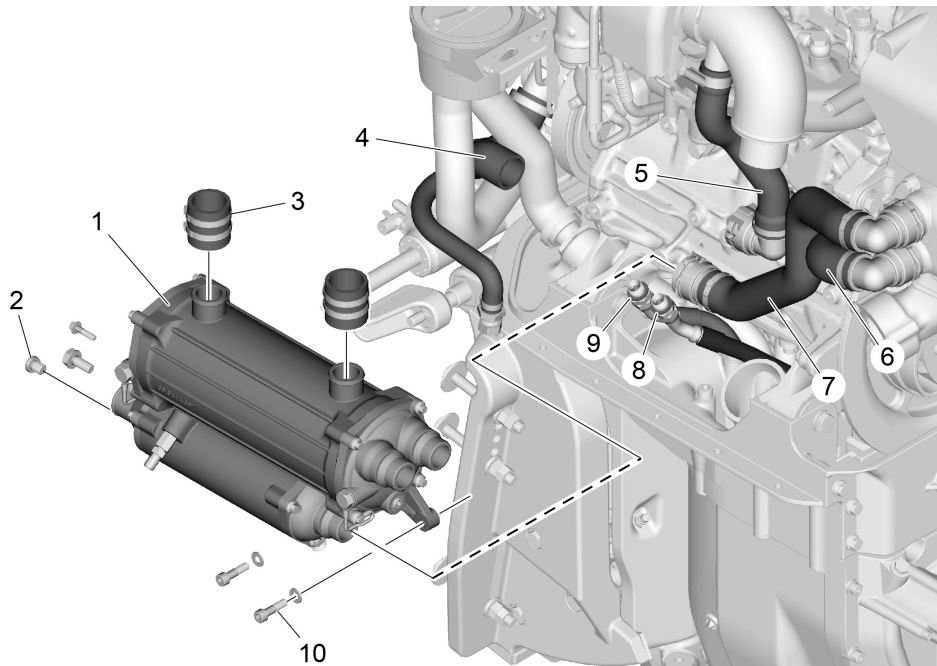
NOTE! Dispose of coolant fluid according to local environmental legislation.



3. Loosen nuts **(3)** on bracket **(2)** and remove the strainer by lifting it upwards.
4. Bend the Seawater strainer **(1)** forward.



5. Remove the pressure pipe retainer **(1)** and the clamp **(2)**.
Refer to **Thermostat replacement, step 1 to 3**.
6. Remove the pressure pipe intercooler retainer **(4)**.
7. Remove the pressure pipe assembly **(3)**.
8. Remove clamp **(5)** and flex hose **(6)**.
9. Remove clamp **(8)** and exhaust hose assembly **(7)**.



! DANGER

The hydraulic system is pressurized. Before removing any component or hose pressure must be released. Turn the ignition on and shift in gear a couple of times. Refer to *Repetitive Alerts, Relieve hydraulic pressure.*

! WARNING

Prepare for spillage, have a clean cloth to collect any oil nearby. Ensure that no dirt enters the engine by plugging hydraulic oil hose connections.

10. Remove the oil plug (2) and drain the hydraulic oil into a suitable container.
NOTE! Dispose of hydraulic oil according to local environmental legislation.
11. Remove the hoses (4-8) to and from the intercooler, the hose from the seawater pump and the heat exchanger out hose. Disconnect the quick release connectors (8, 9) of the hydraulic oil hoses.
12. Cut the hoseclamps (3) and remove the coolant hoses.
13. Remove screws and washers (10).
14. Pull the heat exchanger (1) down and outwards.

CLEANING THE HEAT EXCHANGER

Cleaning seawater heat exchanger

Deposits may form on the seawater side of the pipe cluster in the heat exchanger, impairing the heat transition to such an extent that the coolant heat can no longer be sufficiently conducted away. This is bound to cause an increase in the coolant temperature.

In the event of an increase in coolant temperature, check all other components of the cooling system first.

- Seawater filter contaminated.
- Seawater inlet blocked.
- Insufficient seawater flow rate.
- Worn or damaged seawater pump/impeller.

If all components of the cooling system are in order, but the coolant temperature remains high, cleaning the heat exchanger may eliminate the fault.

Proceed as follows:

1. Place removed heat exchanger in a suitable container made of synthetic material.
2. Fill container with undiluted genuine pickling liquid at room temperature until the heat exchanger is completely submerged.
3. Allow pickling fluid to soak in for approx. 10 hours. If this period of time is not sufficient, allow another 5 hours.
4. The pickling period can be shortened by heating up the pickling fluid up to a maximum of 50°C and by moving heat exchanger from time to time.
5. After the pickling the heat exchanger is to be intensively rinsed with tap water.
6. Install heat exchanger to engine and check for leaks.

Waste water treatment

Drained and spent cleaning and pickling fluid should be brought up to a pH value of 7.5 to 8.5 with the aid of caustic soda. Once the precipitation has settled to the bottom of the container, the clear fluid above can be tipped into the sewer system.



CAUTION

Risk of contamination of drinking water. Dispose of the sludge at the bottom according to local environmental legislation.

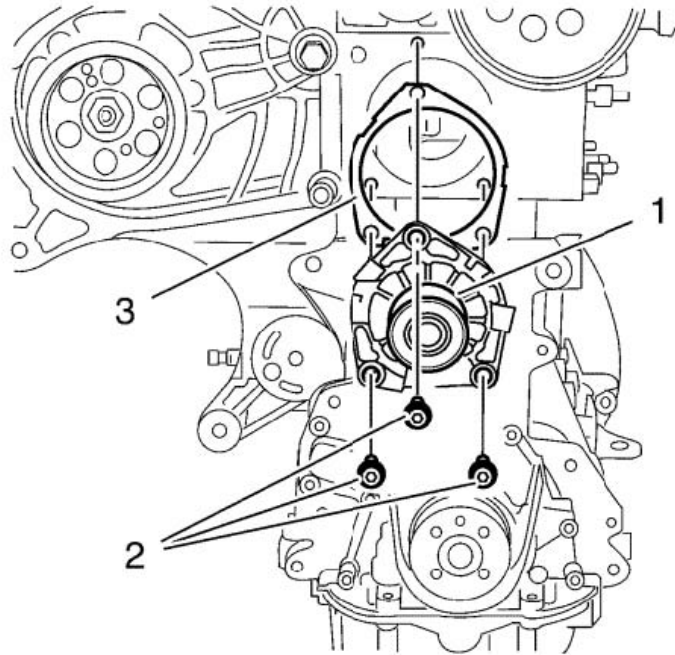
HEAT EXCHANGER INSTALLATION

1. Remount the heat exchanger
2. Reinstall all hoses and hose clamps.
3. Reinstall the Seawater strainer.
4. Reinstall the oil plug and tighten to **20 Nm (14.8 lb ft)**.
5. Refill hydraulic oil according to **Lower belt replacement, Refill hydraulic oil**.
6. Refill coolant, according to **Draining and filling coolant**.

FRESHWATER PUMP REPLACEMENT

FRESHWATER PUMP REMOVAL

1. Remove the timing belt, refer to **Timing belt removal**.
2. Drain coolant, refer to **Draining and filling coolant**.



3. Remove the three water pump bolts (2).
4. Remove the water pump (1).
5. Remove the water pump gasket (3).

FRESHWATER PUMP INSTALLATION

1. Install a new water pump gasket (3).
2. Install the water pump (1).



WARNING

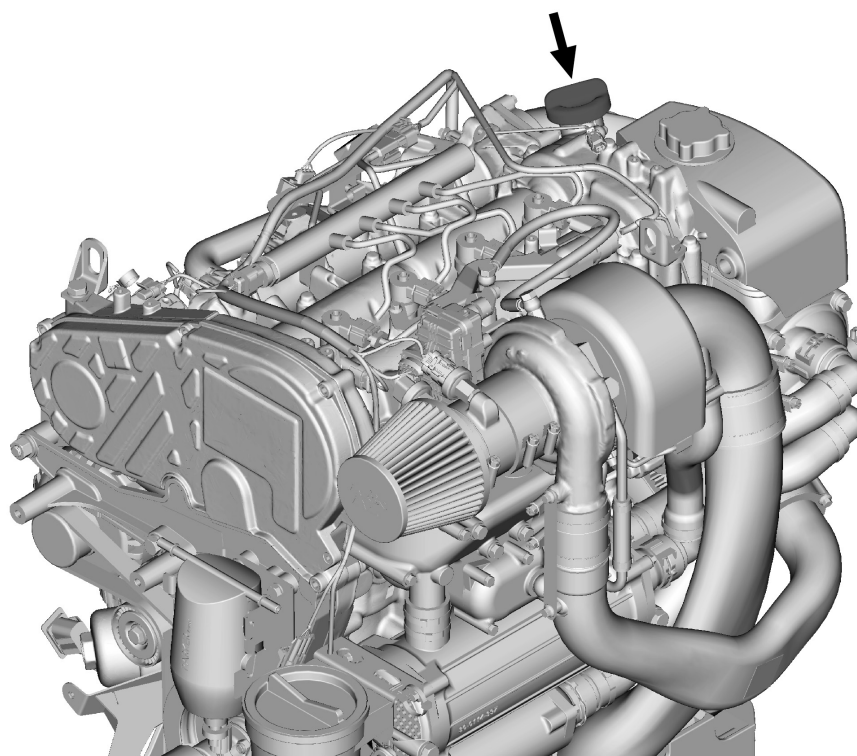
See **Fastener**.

3. Install the 3 water pump bolts (2) and tighten to **25 Nm (18 lb ft)**.
4. Fill up coolant, refer to **Draining and filling coolant**.
5. Reinstall the timing belt, refer to **Timing belt installation**.

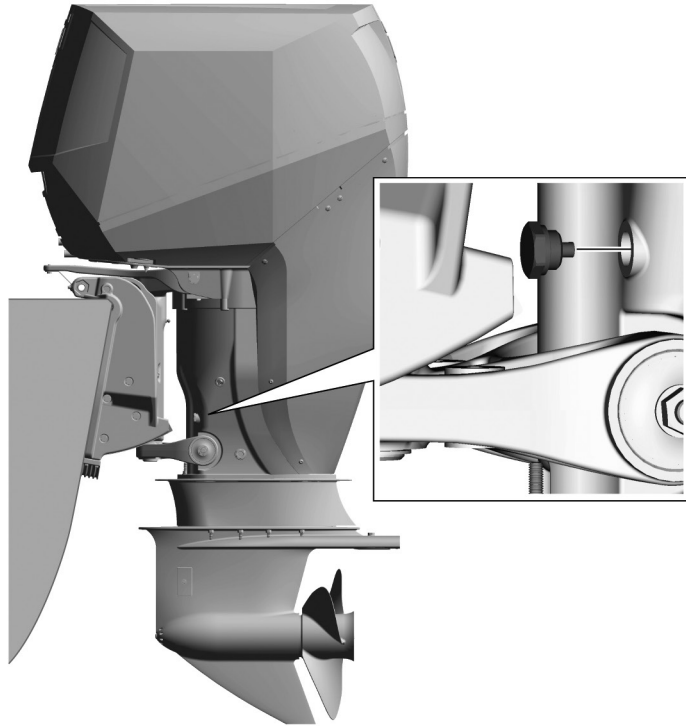
ENGINE OIL AND OIL FILTER REPLACEMENT

ENGINE OIL AND OIL FILTER REMOVAL

Change engine oil



1. Open the oil filler cap.

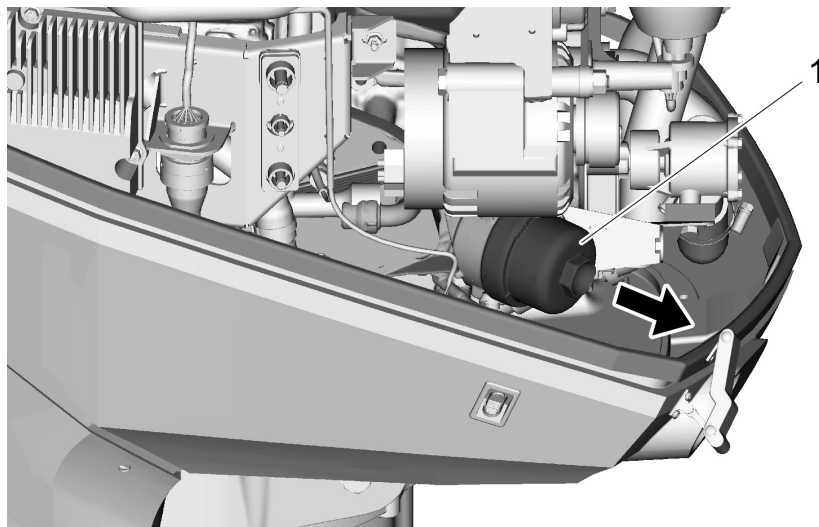


2. Remove the oil draining plug and washer.
3. Drain the engine oil into a suitable container.

 **CAUTION**

Risk of contamination of drinking water. Dispose of used oil according to local environmental legislation!

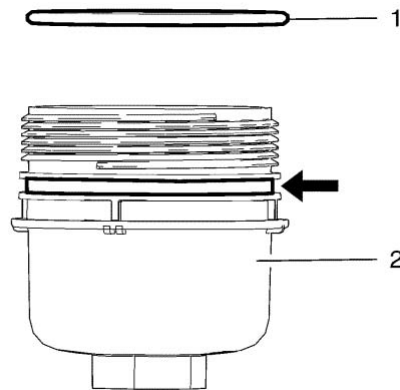
4. Fit a **new** washer and tighten the oil draining plug to **9 Nm (6.6 ft-lb)**.
5. Place a suitable container below the oil filter.



NOTE! Use a 6-point socket to remove the oil filter cap.

6. Remove the oil filter cap (**1**).
7. Remove and discard the oil filter cartridge.

ENGINE OIL AND OIL FILTER INSTALLATION



! WARNING

Lubrication must be applied to the threads of the oil filter cap prior to installation. Failure to lubricate the oil filter cap threads can hinder later removal and cause possible oil filter cap damage.

1. Install the **new** seal ring (1) with clean engine oil to the oil filter cap (2).

! WARNING

Very important for appropriate sealing: Place the seal ring into the correct groove, marked with an arrow.

! WARNING

Proper oil filter cap tightening is mandatory. Failure to tighten the oil filter cap to the proper specification can hinder later removal and cause possible oil filter cap damage.

NOTE! Use an appropriate 6-point socket to remove the oil filter cap.

2. Install the **new** oil filter cartridge.
3. Install the oil filter cap and tighten to **25 Nm (18 lb ft)**.
4. Fill the engine with the appropriate oil type and quantity. Refer to **Recommended fluids and grease**. Install the oil filter cap.

OIL FILTER ADAPTER AND OIL COOLER ASSEMBLY REPLACEMENT

OIL FILTER ADAPTER AND OIL COOLER ASSEMBLY REMOVAL

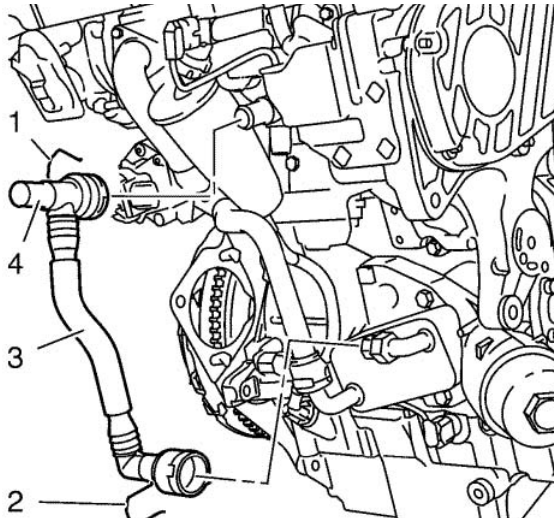
1. Switch off the battery main switch.



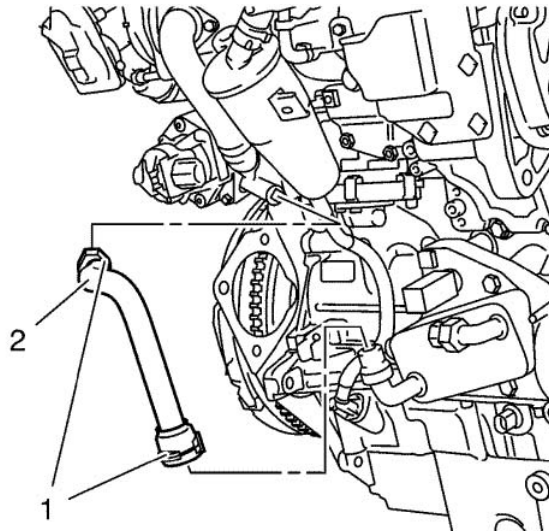
DANGER

See *Battery Disconnect.*

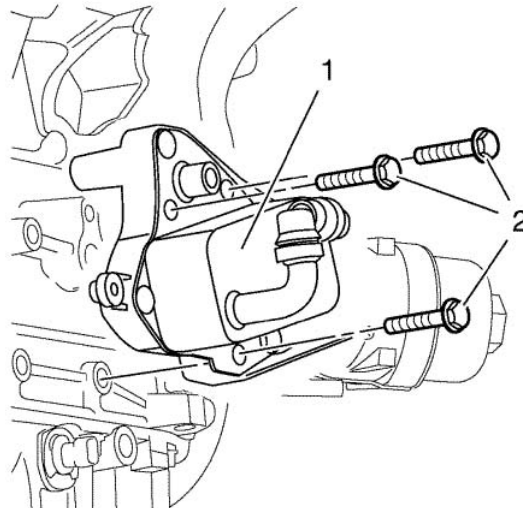
2. Drain the coolant, see ***Drain and fill coolant.***
3. Place a receptacle under the engine to collect oil and coolant.
4. Undo the cable clip from the oil cooler.
5. Unplug the connector of the oil pressure switch.



6. Remove the engine oil cooler coolant outlet hose clamps **(1, 2)**.
7. Remove the engine oil cooler coolant outlet hose **(3)** and the snap lock **(4)**.
8. Remove the oil filter cap, refer to ***Engine oil and oil filter replacement.***



- 9.** Remove the engine oil cooler coolant inlet hose clamps **(1)**.
- 10.** Remove the engine oil cooler coolant inlet hose **(2)**.



- 11.** Remove the oil filter adapter and oil cooler assembly bolts **(2)** from engine block and place in a clean environment.
- 12.** Remove the oil filter adapter and oil cooler assembly **(1)**.
- 13.** Remove and discard the oil filter adapter and oil cooler assembly gasket.

OIL FILTER ADAPTER AND OIL COOLER ASSEMBLY INSTALLATION

1. Install a **new** oil filter adapter gasket.
2. Install the oil filter adapter **(1)**.



WARNING

See **Fastener**.

3. Install the 3 oil filter adapter bolts **(2)** and tighten to **50 Nm (37 lb ft)**.



WARNING

See **Oil filter adapter and oil cooler assembly replacement**.

4. Install engine oil cooler coolant inlet hose and clamps.
5. Install engine oil cooler coolant outlet hose, clamps and the snap lock.
6. Carry out cooling system, pressure testing.
7. Carry out filling and bleeding the cooling system, refer to **Filling Coolant**.
8. Fit the oil cooler using **new** seals greased with Vaseline.
9. Check the oil level and top up if necessary.
10. Switch on the battery main switch.



DANGER

See **Battery Disconnect**.

11. Start the engine and check that the oil cooler is not leaking.

OIL PUMP REPLACEMENT

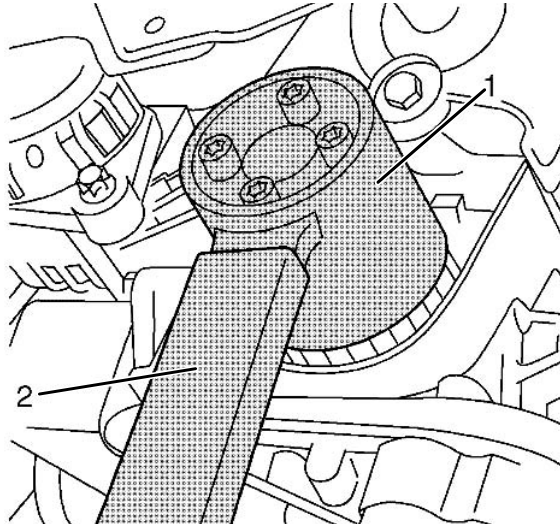
Special tools

- 30-0160-015 Extension
- 30-0160-022 Holder, crankshaft
- 30-0160-016 Crankshaft fixing tool
- 30-0160-017 Camshaft holding tool
- 30-0160-023 Fitting tool, oil pump seal

Refer to **Special Tools**.

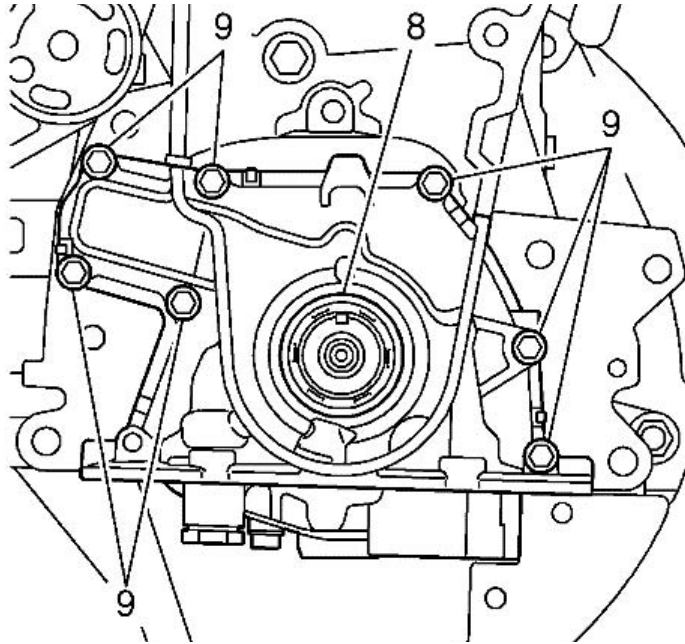
OIL PUMP REMOVAL

1. Remove the timing belt, see **Timing belt removal**.
2. Remove the dry sump, see **Oil pan baffle removal**.



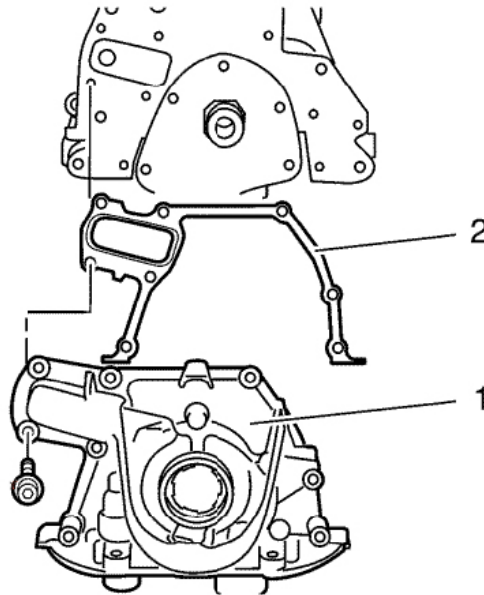
NOTE! The bolt has a left hand thread.

3. Remove the belt pulley using 30-0160-022 Holder **(1)** in combination with 30-0160-015 Extension **(2)**.



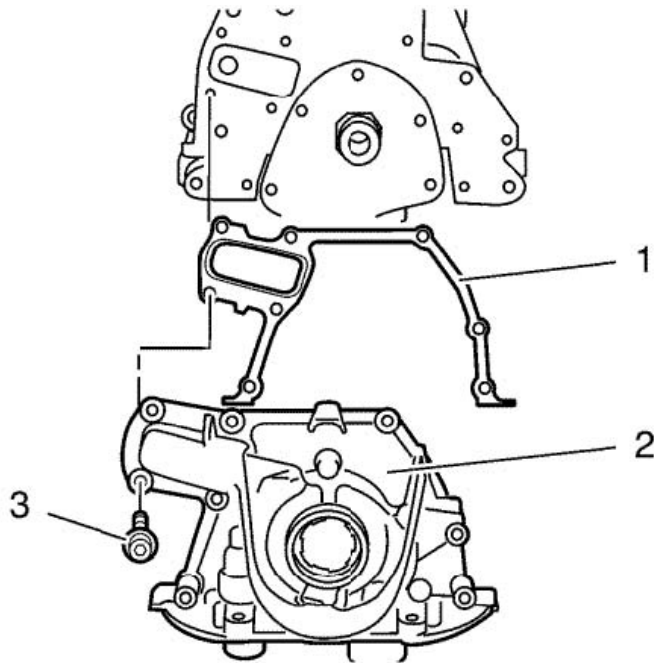
NOTE! Pry loose the radial seal from the oil pump using a suitable tool without damaging the sealing surfaces.

4. Remove the oil pump radial seal (8).
5. Remove the eight oil pump bolts (9). Unscrew the stud from 30-0160-016 fixing tool.



6. Remove the oil pump (1).
7. Remove the oil pump gasket (2).
8. Remove and discard the front radial seal.
9. Clean the threads and all of the gasket surfaces.

OIL PUMP INSTALLATION

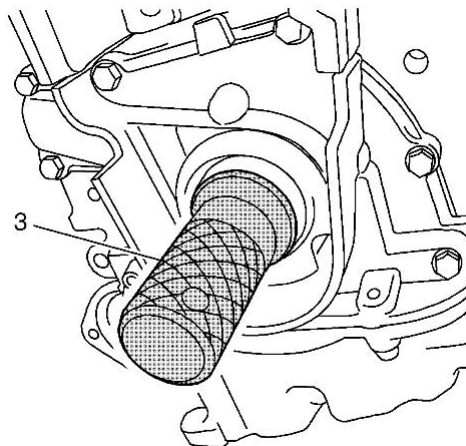


1. Fit the oil pump with a **new** gasket (1).
2. Install the oil pump (2).

 **WARNING**

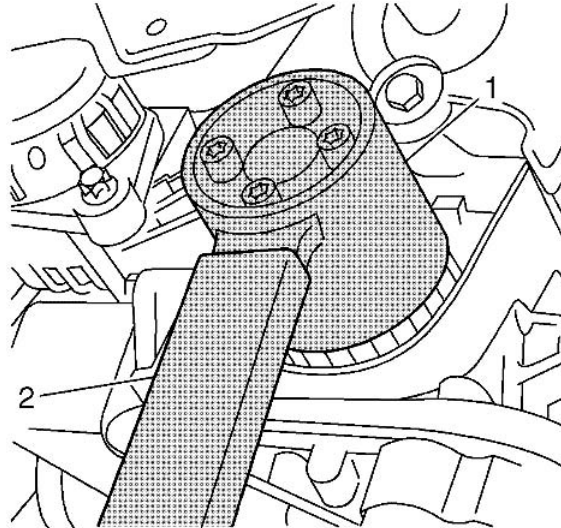
See **Fastener**.

3. Use locking agent **Loctite** on the 8 M6x20 oil pump bolts (3) and tighten to **9 Nm (80 lb in)**.



NOTE! Moisten the gasket sealing lip with a little silicone grease (white).

4. Fit the oil pump seal using 30-0160-023 fitting tool (3).



 **WARNING**

See **Fastener**.

5. Fit the belt pulley using 30-0160-022 holder crankshaft **(1)** in combination with 30-0160-015 Extension **(2)**. Tighten bolt to **380 Nm (280 lb ft)**.

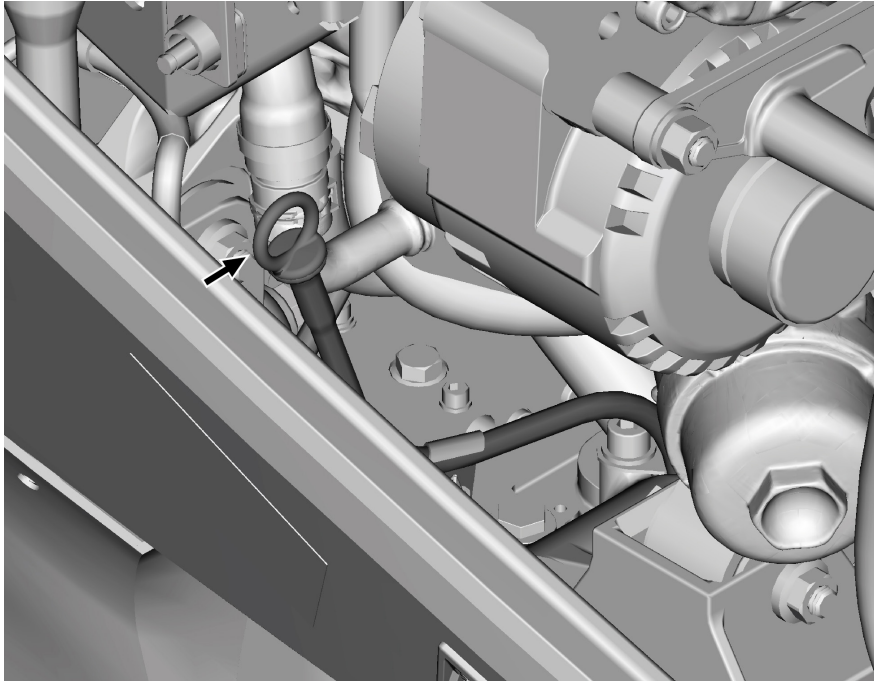
NOTE! The bolt has a left-hand thread.

6. Remove 30-0160-022 holder **(1)** and EN-977 holding tool **(2)**.
7. Fit the dry sump. See **Dry sump and Oil pan baffle replacement**.

FILLING UP WITH ENGINE OIL

 **WARNING**

Do not fill engine oil beyond the max. notch on the dipstick. Overfilling will result in damage to the engine.



 **CAUTION**

Ensure a horizontal position of the outboard.

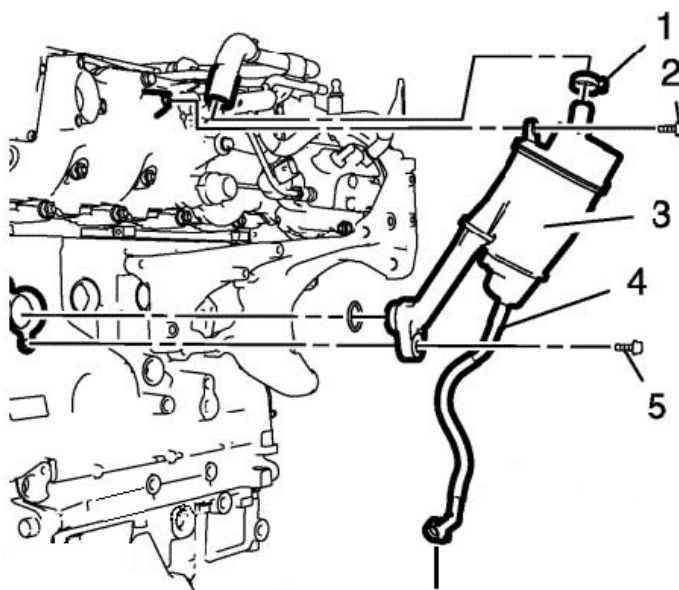
1. Refill with fresh engine oil at the oil filler neck, refer to **Outboard overview**.
2. After filling, start the engine and let it run for a few minutes at low speed.

 **WARNING**

If no oil pressure builds up after approx. 10 seconds switch off the engine immediately.

3. Check oil pressure and leaks.
4. Then shut down the engine. After about 20 minutes, check the oil level.
5. The oil level should be between the two notches in the dipstick and must never fall below the lower notch. Top up oil as necessary. Do not overfill.

POSITIVE CRANKCASE VENTILATION OIL SEPARATOR REPLACEMENT



POSITIVE CRANKCASE VENTILATION OIL SEPARATOR REMOVAL

1. Remove the positive crankcase ventilation oil separator hose clamp **(1)**.
2. Remove the positive crankcase ventilation oil separator hose.
3. Remove the positive crankcase ventilation oil separator bolts **(2, 5)**.
4. Remove the positive crankcase ventilation oil separator drain hose **(4)**.
5. Remove the positive crankcase ventilation oil separator **(3)**.
6. Check hoses and clamps for wear or damage.

POSITIVE CRANKCASE VENTILATION OIL SEPARATOR INSTALLATION

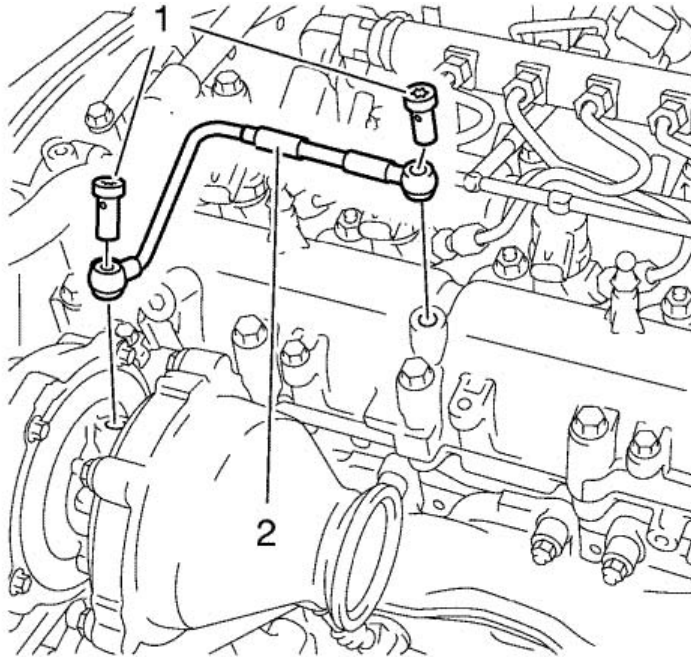
1. Install the positive crankcase ventilation oil separator **(3)**.
2. Install the positive crankcase ventilation oil separator drain hose to oil pan **(4)**.

 **WARNING**

See **Fastener**.

3. Install the positive crankcase ventilation oil separator drain hose.
4. Install the positive crankcase ventilation oil separator bolts **(2, 5)** and tighten to **9 Nm (80 lb in)**.
5. Install the positive crankcase ventilation oil separator hose.
6. Install the positive crankcase ventilation oil separator hose clamp **(1)**.

TURBOCHARGER OIL FEED PIPE REPLACEMENT



TURBOCHARGER OIL FEED PIPE REMOVAL

1. Remove the turbocharger oil feed pipe bolts **(1)**.
2. Remove the 4 turbocharger oil feed pipe gaskets.
3. Remove the turbocharger oil feed pipe **(2)**.

TURBOCHARGER OIL FEED PIPE INSTALLATION

1. Install the **new** turbocharger oil feed pipe gaskets.
2. Install the turbocharger oil feed pipe **(2)**.

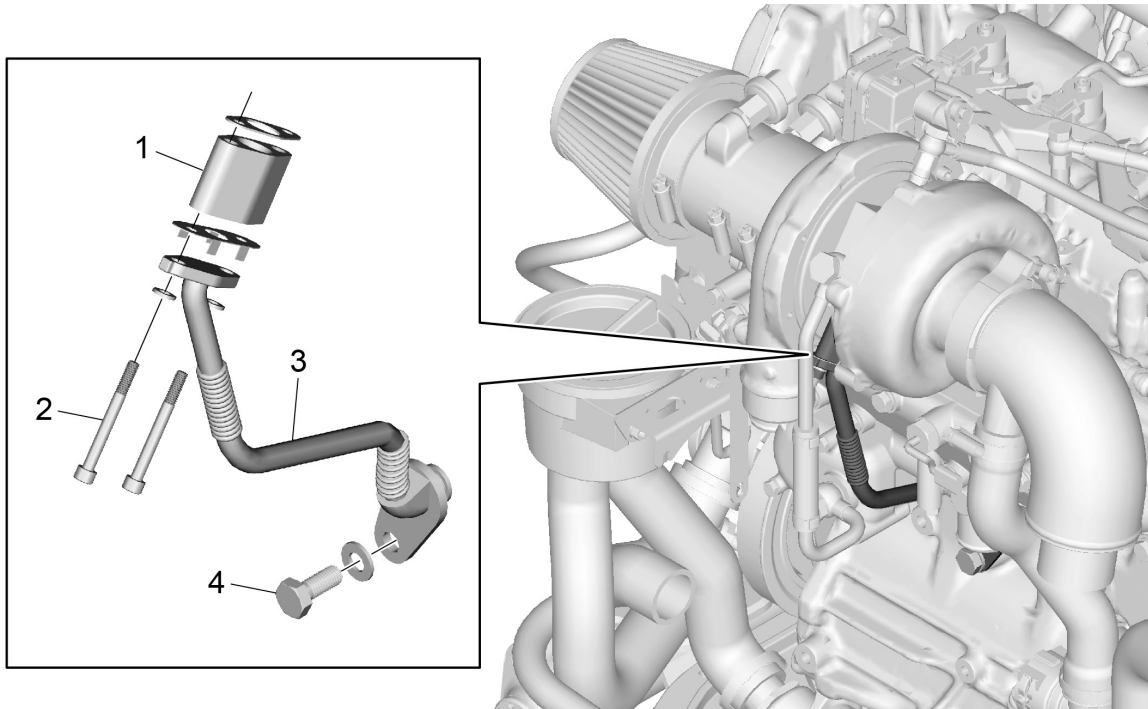
 **WARNING**

See **Fastener**.

3. Install the 2 turbocharger oil feed pipe bolts **(1)** and tighten to **9 Nm (80 lb in)**.

100 TURBOCHARGER OIL RETURN PIPE REPLACEMENT

1. Remove the heat exchanger, refer to *Heat exchanger replacement*.



TURBOCHARGER OIL RETURN PIPE REMOVAL

1. Remove the 3 turbocharger oil return pipe bolts (**2, 4**).
2. Remove the turbocharger oil return pipe (**3**).
3. Remove the turbocharger oil return pipe gaskets.

TURBOCHARGER OIL RETURN PIPE INSTALLATION

1. Install the **new** turbocharger oil return pipe gaskets.
2. Install the turbocharger oil return pipe (**3**).

NOTE! Ensure the correct direction of the spacer and gaskets: Wide hole towards the turbocharger!

! WARNING

See *Fastener*.

3. Install the 2 turbocharger oil return pipe bolts (**2**) and tighten to **9 Nm (80 lb in)**.
4. Install the turbocharger oil return pipe bolt (**4**) and tighten to **25 Nm (18 lb ft)**.

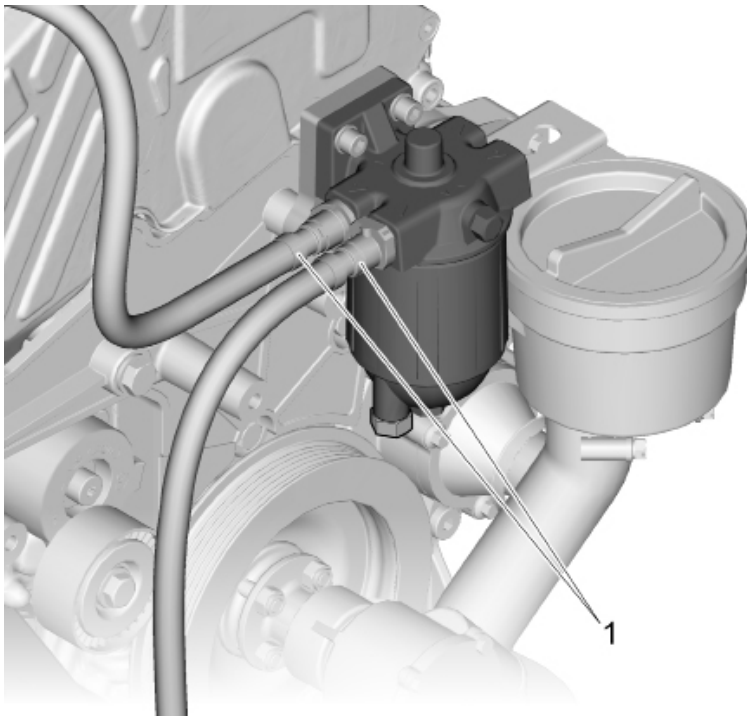
ALTERNATOR BELT REPLACEMENT

ALTERNATOR DRIVE BELT REMOVAL

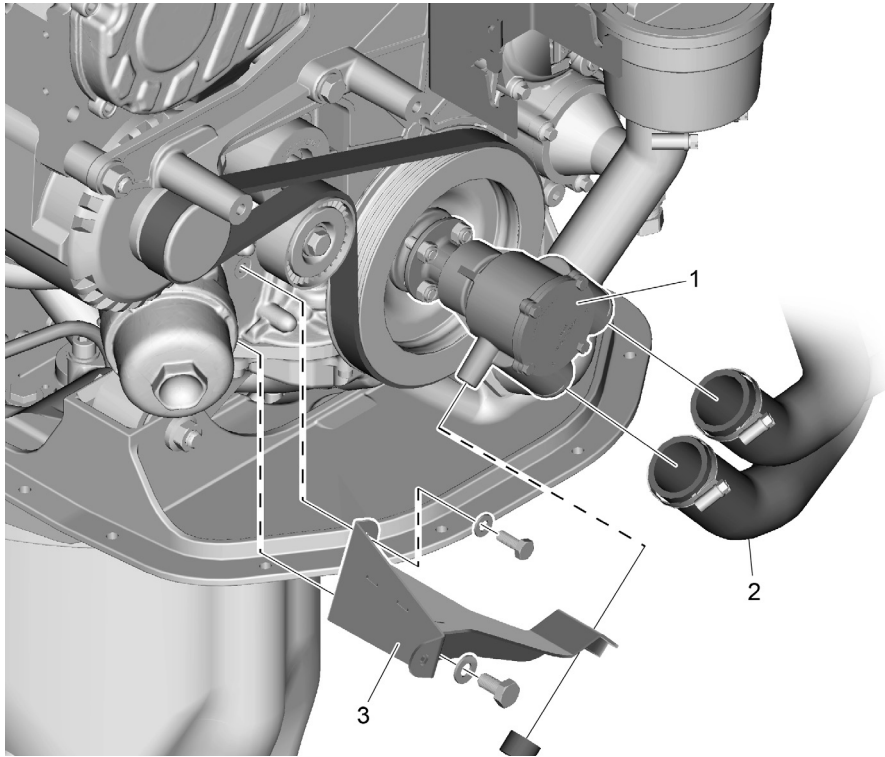
1. Remove upper cowling.
2. Switch off the battery main switch.



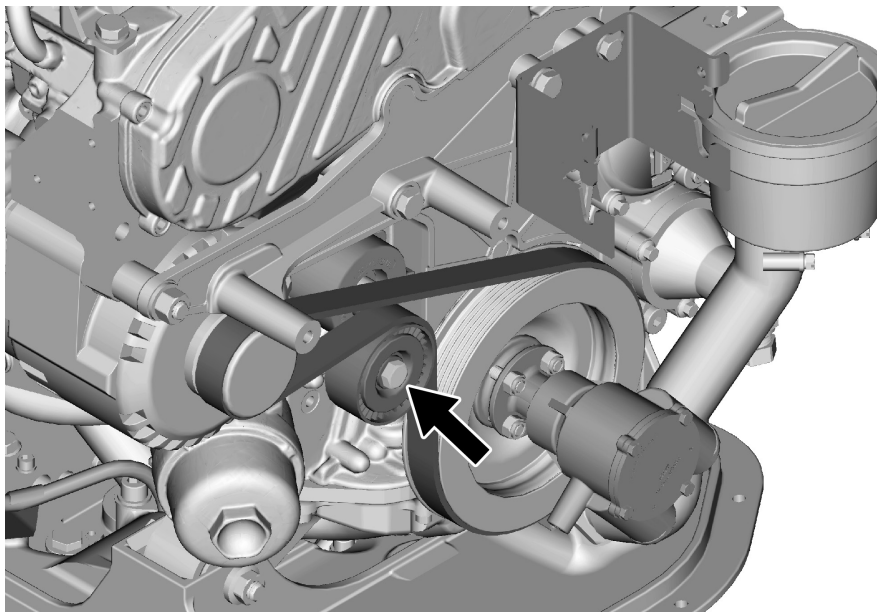
See **Battery disconnect**.



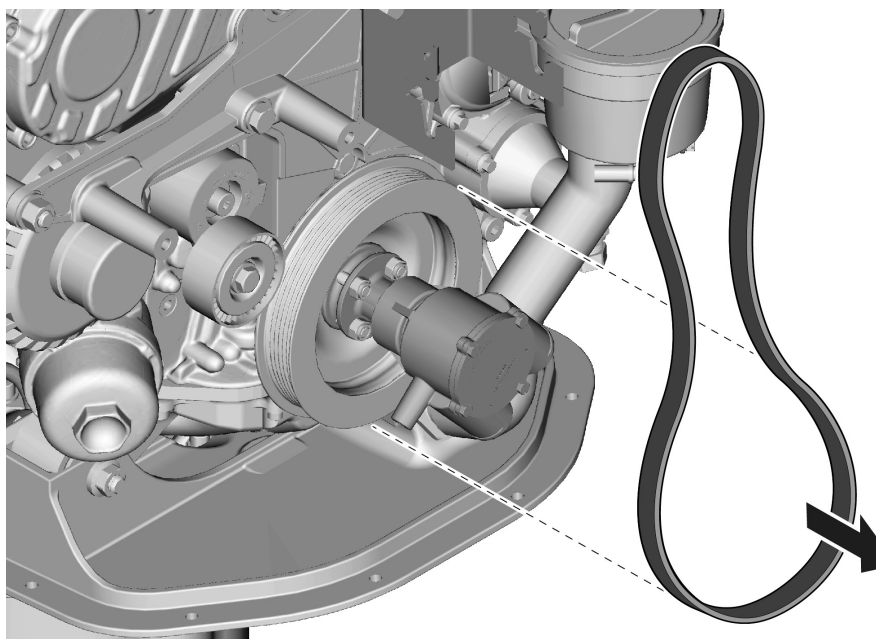
3. Remove fuel hoses from fuel filter and pull the filter off the bracket.



4. Loosen seawater hoses **(2)** from seawater pump **(1)**.
5. Unscrew the seawater pump bracket **(3)**.



6. Release the tension on the drive belt by rotating the tensioner pulley fastener clockwise.



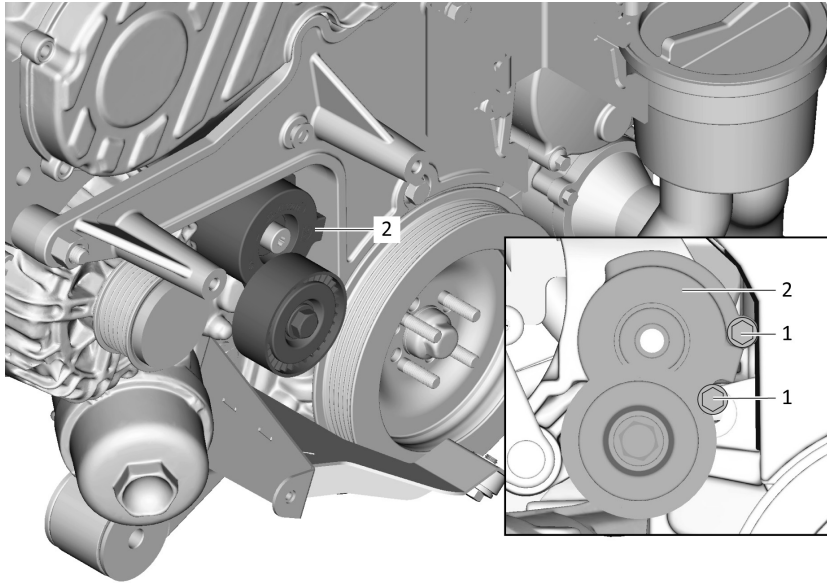
- 7.** Remove the alternator belt.
- 8.** Rotate tensioner pulley fastener clockwise to mount the belt.
- 9.** Install removed parts in reverse order

ALTERNATOR BELT TENSIONER REPLACEMENT

1. Remove the alternator drive belt.
See **Alternator belt replacement**.

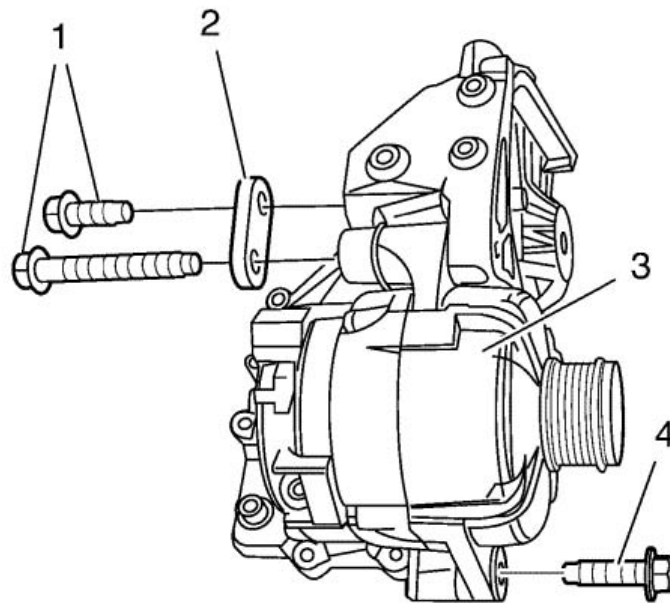


See **Fastener**.



2. Unscrew bolts **(1)**.
3. Lift off the alternator belt tensioner **(2)**.
4. Install in reverse order.
5. Tighten **22 Nm (16 lb ft)**.

ALTERNATOR REPLACEMENT



ALTERNATOR REMOVAL

1. Remove the alternator drive belt, see **Alternator belt replacement**.
2. Remove the alternator support bolts **(1)**.
3. Remove the alternator support **(2)**.
4. Remove the alternator bolt **(4)**.
5. Remove the alternator **(3)**.

ALTERNATOR INSTALLATION

1. Install the alternator **(3)**.
2. Install the alternator support **(2)**.

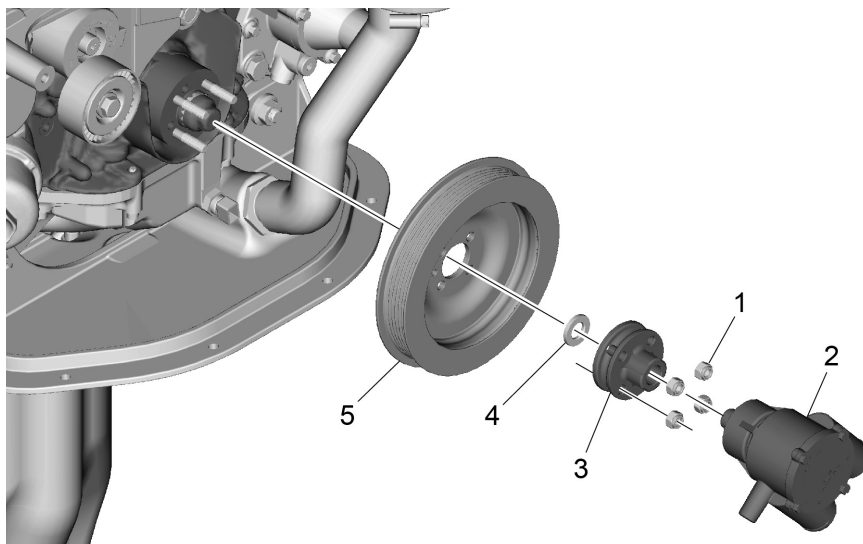
 **WARNING**

See **Fastener**.

3. Install the alternator support bolt **(4)** and tighten to **60 Nm (44 lb ft)**.
4. Install the alternator.
5. Install the alternator bolts **(1)** and tighten to **60 Nm (44 lb ft)**.
6. Install the alternator drive belt.

CAMSHAFT TIMING BELT REPLACEMENT

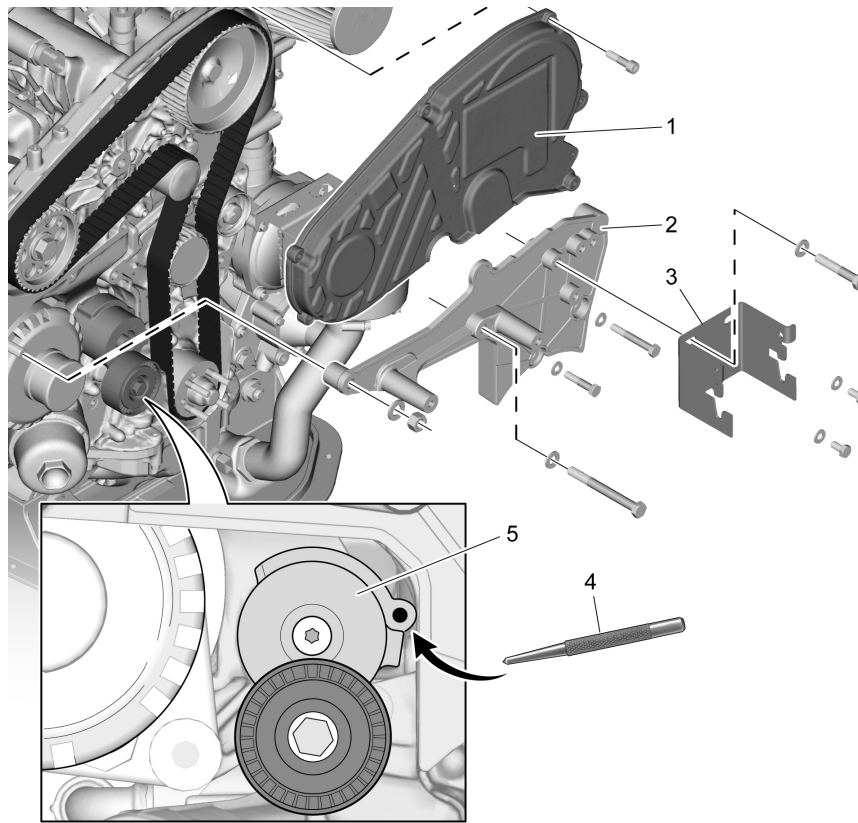
WATER PUMP AND CRANK SHAFT BALANCER REMOVAL



1. Remove seawater pump nuts **(1)**.
2. Take off seawater pump **(2)**, seawater pump drive flange **(3)**, and sealing **(4)**.
3. Take off the crankshaft balancer **(5)**.

TIMING BELT REMOVAL

4. Remove the alternator drive belt, see **Alternator belt replacement**.



5. Remove cover (1).

6. Remove cover (2) and fuel filter bracket (3).

⚠ CAUTION

Release the tensioner pulley by rotating it clockwise. Lock the tensioner (5) in place by means of a mandrel (4) as it otherwise could clamp the timing belt lower front cover.

NOTE!

- Check condition of timing belt for signs of damage to help determine the root cause of the failure.
- The timing belt cannot be reused.
- Avoid the contact with cooling fluid and oil, it will damage the timing belt. A damaged timing belt can not be reused.

TIMING BELT INSPECTION

The following table describes conditions of the timing belt you may encounter during inspection and the possible causes.

NOTE! Failure to follow the described timing belt inspection and maintenance may result in a broken timing belt and cause severe engine damage.

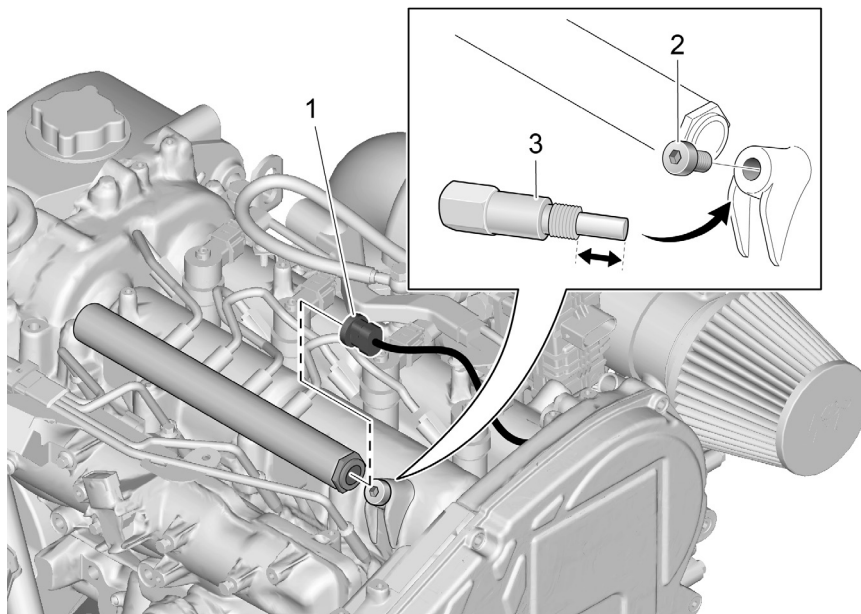
Condition	Cause
Tooth is broken and/or tooth root is cracked	<ul style="list-style-type: none"> - Camshaft jamming - Damaged camshaft/crankshaft oil seal and/or coolant leak - Old age - Tensioner not functioning properly
Back surface of the belt is cracked/worn/scratched/scored	<ul style="list-style-type: none"> - Excessive cold starts - Tensioner jamming - Overheated engine - Interference with the belt cover
Side of belt surface is worn	<ul style="list-style-type: none"> - Improper installation of the belt - Overload or misalignment of the cam drive components - Tensioner jamming - Heavy thrust loading against the idler guide flanges - Damaged idler guide
Teeth are worn	<ul style="list-style-type: none"> - Poor belt cover sealing - Excessive belt tension - Tensioner jamming - Rough and/or scored cam sprockets
Clean break across fibers	<ul style="list-style-type: none"> - Kinked belt before and/or during assembly - Foreign material under the belt
Oil/Coolant impregnated and/or swollen belt	<ul style="list-style-type: none"> - Poor oil sealing - Coolant leak at pump - Poor belt cover seal

TIMING BELT REMOVAL

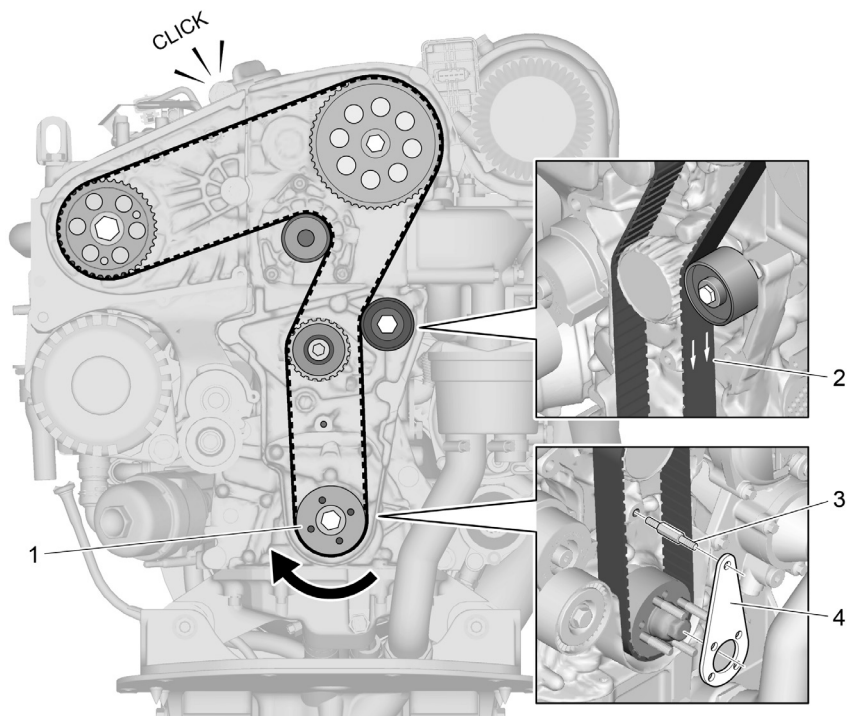
Special tools

- 30-0160-015 extension
- 30-0160-016 crankshaft fixing tool
- 30-0160-017 camshaft locking tool
- 30-0160-018 camshaft sprocket holding tool
- For equivalent regional tools, see **Special tools**.

1. Remove the timing belt front covers upper and lower, see **Timing belt front cover removal**.



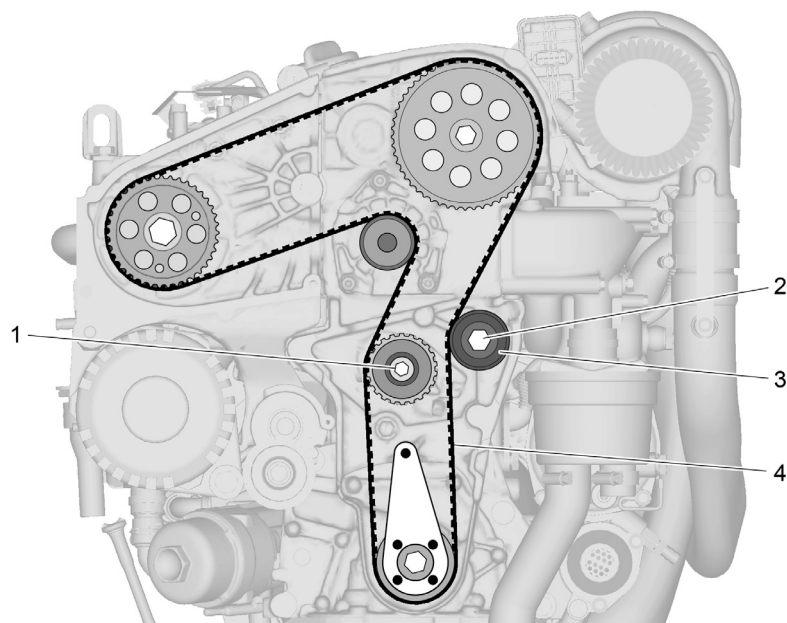
2. Set cylinder one to TDC:
 - Remove the camshaft housing bolt **(2)**.
 - Install the 30-0160-017 locking tool **(3)** in the camshaft housing.



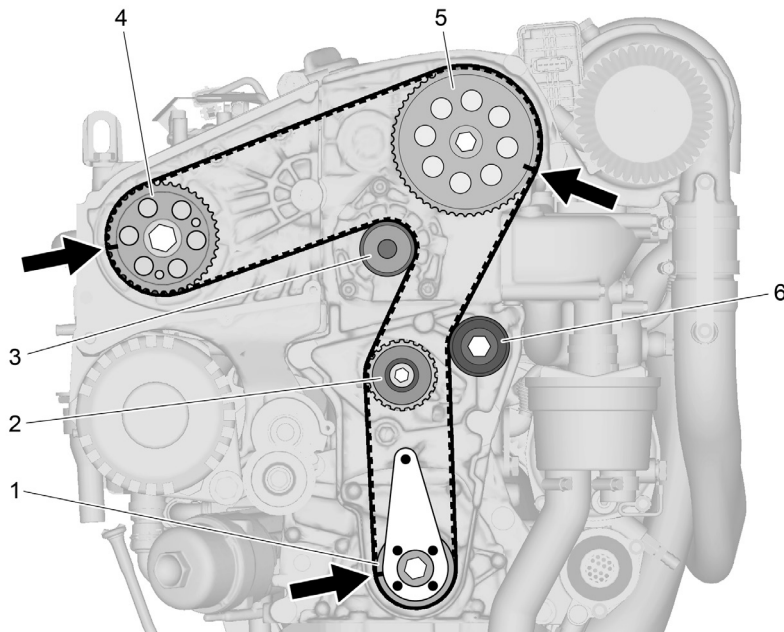
- Turn the crankshaft **(1)** clockwise until the 30-0160-017 locking tool audibly engages.

NOTE! Observe the direction of timing belt rotation **(2)**.

3. Remove the bolt and install the fixing tool stud **(3)**.
4. Lock the crankshaft, using the 30-0160-016 fixing tool **(4)**.



5. Loosen the timing belt tensioner bolt **(1)** to release tension from the timing belt.
6. Remove the belt idler pulley bolt **(2)** and the idler pulley **(3)**.
7. Remove the timing belt **(4)**.



8. Remove and install **new** timing belt tensioner **(2)**.
9. Remove and install **new** water pump **(3)**. Refer to **Fresh water pump replacement**.

INSTALLING A NEW TIMING BELT

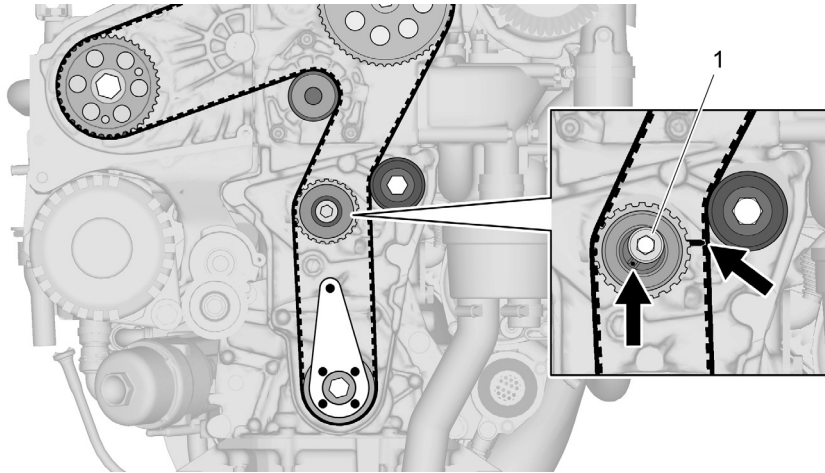
1. Install a **new** timing belt in the following sequence:

NOTE! The marks on the timing belt must fit to the marks on the sprockets, see arrows in picture.

NOTE! The timing belt tensioner must be loose.

NOTE! Make sure that the timing belt does not fall out of the sprocket during the installation procedure.

- Start with the crankshaft sprocket **(1)**.
- Second the timing belt tensioner **(2)**.
- Third the water pump **(3)**.
- Fourth the high pressure pump sprocket **(4)**.
- Fifth the camshaft sprocket **(5)**.
- Install a new belt idler pulley **(6)** and fit the timing belt.



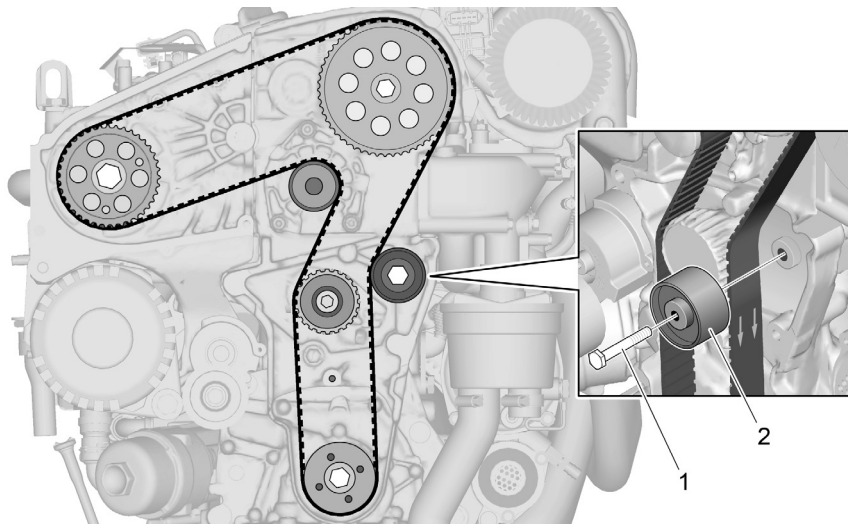
! **WARNING**

See **Fastener**.

2. Bring the tensioner **(1)** in correct tension.
 - Loosen the tensioner bolt.
 - Bring the mobile index to the reference position (bore), see at arrows in picture.
 - Tighten the tensioner bolt to **25 Nm (18 lb ft)**.
3. Install and tighten the timing belt idler pulley bolt **(2)** to **50 Nm (37 lb ft)**
4. Install the timing belt front cover. Cross-tighten bolts **3 Nm (27 lb in)**.
5. Remove the 30-0160-016 fixing tool and the 30-0160-017 locking tool. Replace the camshaft housing bolt.

NOTE! It is absolute necessary to turn the engine clockwise, not in another direction.
6. Rotate the engine 360°.
7. Check the engine timing.
8. Lock the belt tensioner in place with a mandrel. Refer to Timing belt removal.
9. Mount at the same time the fuel filter bracket and the lower timing belt cover, refer to Timing belt removal.
10. Remove the mandrel from the belt tensioner.
11. Reinstall the upper timing belt cover. Cross-tighten bolts **3 Nm (27 lb in)**.
12. Reinstall the crankshaft balancer. Ensure proper fitting.
13. Install the alternator belt. Rotate tensioner pulley fastener clockwise to mount the belt.
14. Install the seawater pump. Refer to Water pump and crank shaft balancer removal.
15. Reinstall seawater pump bracket and connect seawater hoses to the pump. Refer to Alternator drive belt removal.

TIMING BELT IDLER PULLEY REPLACEMENT – LOWER



1. Remove the timing belt, *see Timing belt removal*.
2. Remove the timing belt idler pulley bolt (1).
3. Remove the timing belt idler pulley (2).
4. Install the *new* timing belt idler pulley (2) in reverse order.

 **WARNING**

See Fastener.

5. Tighten the timing belt idler pulley bolt (2) to **50 Nm (37 lb ft)**.

CAMSHAFT HOUSING REPLACEMENT, CLEANING AND INSPECTION

CAMSHAFT HOUSING REMOVAL



WARNING

Always wear safety goggles when working with fuel in order to protect the eyes from fuel splash.



WARNING

Fuel Vapors can collect while servicing fuel system parts in enclosed areas such as a trunk. To reduce the risk of fire and increased exposure to vapors:

- Use forced air ventilation such as a fan set outside of the trunk.
- Plug or cap any fuel system openings in order to reduce fuel vapor formation.
- Clean up any spilled fuel immediately.
- Avoid sparks and any source of ignition.
- Use signs to alert others in the work area that fuel system work is in process.



WARNING

Place a dry chemical (Class B) fire extinguisher nearby before performing any on-outboard service procedures. Failure to follow these precautions may result in personal injury.



WARNING

Do not allow smoking or the use of open flames in the area where work on the fuel or EVAP system is taking place. Anytime work is being done on the fuel system, switch off the battery main switch, except for those tests where battery voltage is required.



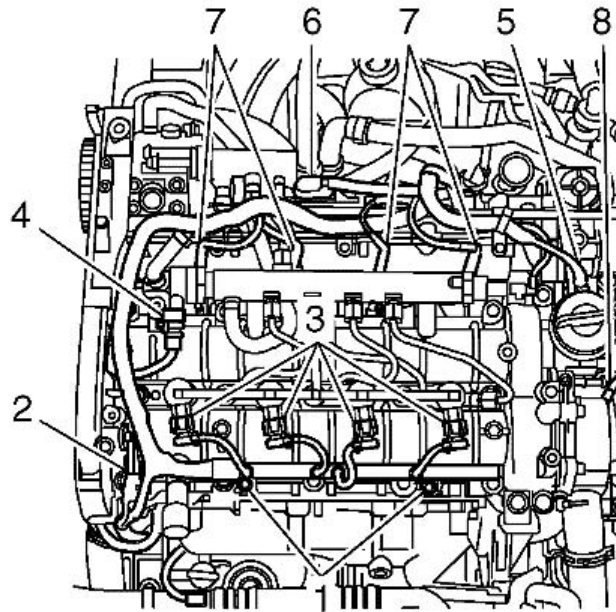
WARNING

Fuel that flows out at high pressure can cause serious injury to the skin and eyes. **Always** depressurize the fuel system before removing components that are under high fuel pressure.



WARNING

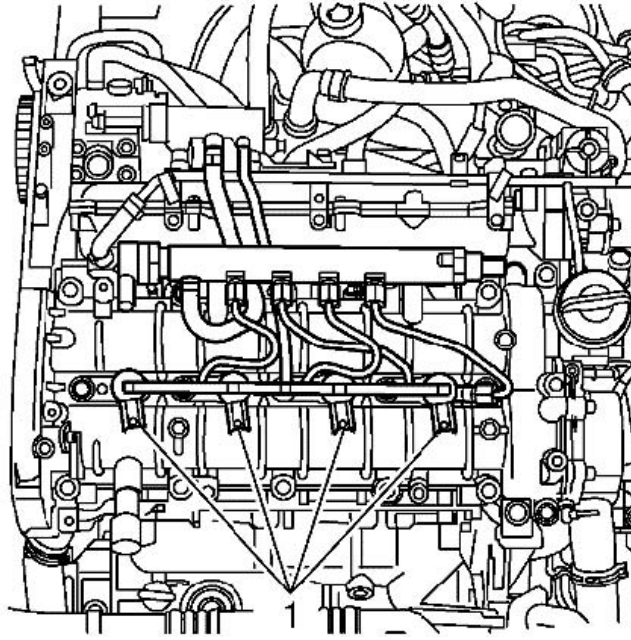
With a pressurized cooling system, the coolant temperature in the radiator can be considerably higher than the boiling point of the solution at atmospheric pressure. Removal of the surge tank cap, while the cooling system is hot and under high pressure, causes the solution to boil instantaneously with explosive force. This will cause the solution to spew out over the engine, the fenders, and the person removing the cap. Serious bodily injury may result.



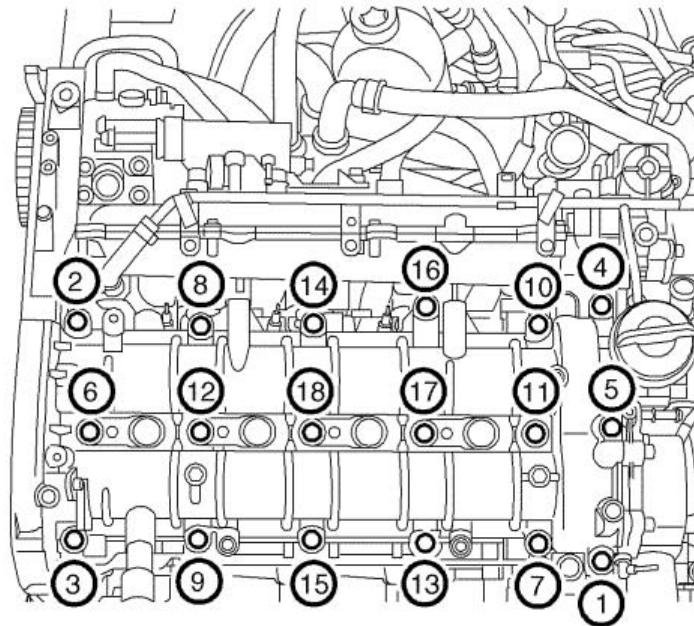
1. Remove alternator drive belt, see **Alternator belt replacement**.
2. Remove camshaft timing belt, see **Camshaft replacement**.
3. Remove the following connectors:
 - Camshaft position sensor **(2)**
 - Injectors **(3)**
 - Fuel pressure control valve **(4)**
 - Throttle body actuator unit **(5)**
 - Intake air sensor **(6)**
 - Glow plug connector **(7)**
 - Coolant temperature sensor **(8)**.

NOTE! If the injectors are to be refitted, mark the injectors so that they can be refitted to the same cylinder.

4. Fold away the engine wiring harness.
5. Remove the fuel delivery pipe **(2)** between the pump and the fuel rail, see **Fuel injector fuel feed pipe removal (fuel pump to rail)**.



6. Remove the injectors (1). See **Fuel injector fuel feed pipe replacement**. Refer to **Fuel Injector Replacement**.
7. Remove the fuel rail and hose, see **Fuel injection fuel rail assembly replacement**.



8. Undo and remove the camshaft housing and guide sleeves. Loosen bolts alternately in order as illustrated.

CAMSHAFT COVER CLEANING

1. Clean the camshaft covers in solvent.

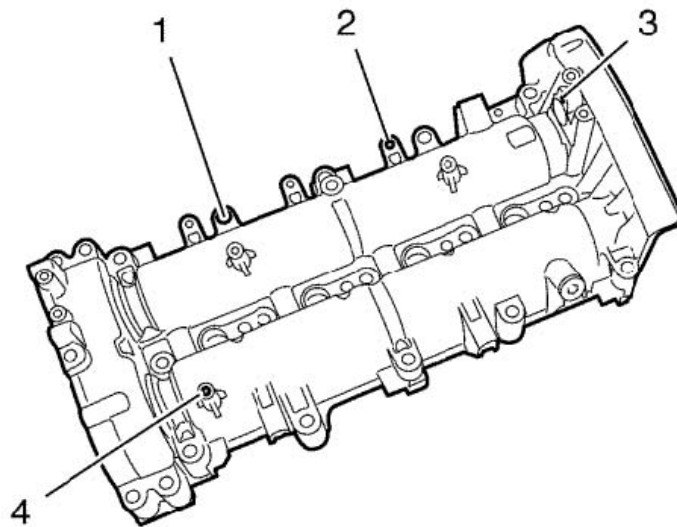


Refer to *Cleaning solvent and Eye protection*.

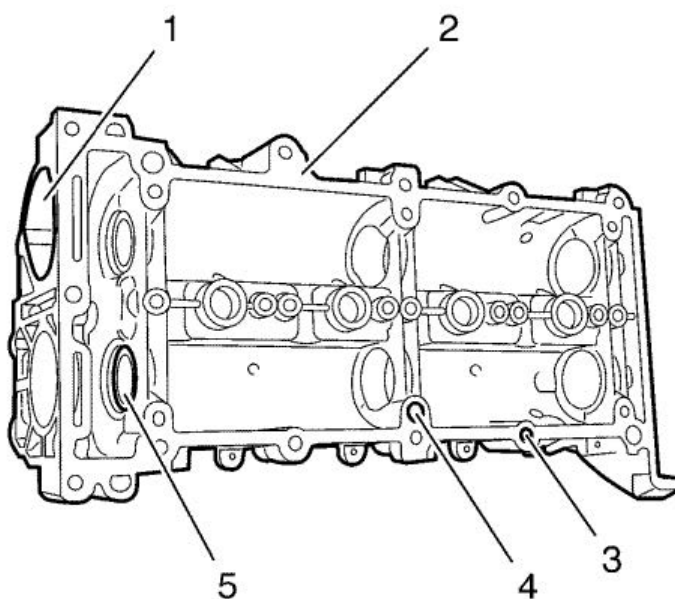
2. Dry the camshaft covers with compressed air.

CAMSHAFT COVER INSPECTION

1. Inspect each camshaft cover for dents or damage to the exterior. A dented or damaged camshaft cover may:
 - Leak engine oil.
 - Affect crankcase ventilation.
 - Interfere with the camshafts.
 - Interfere with the ignition coil sealing.
 - Allow water or condensation to enter the engine.



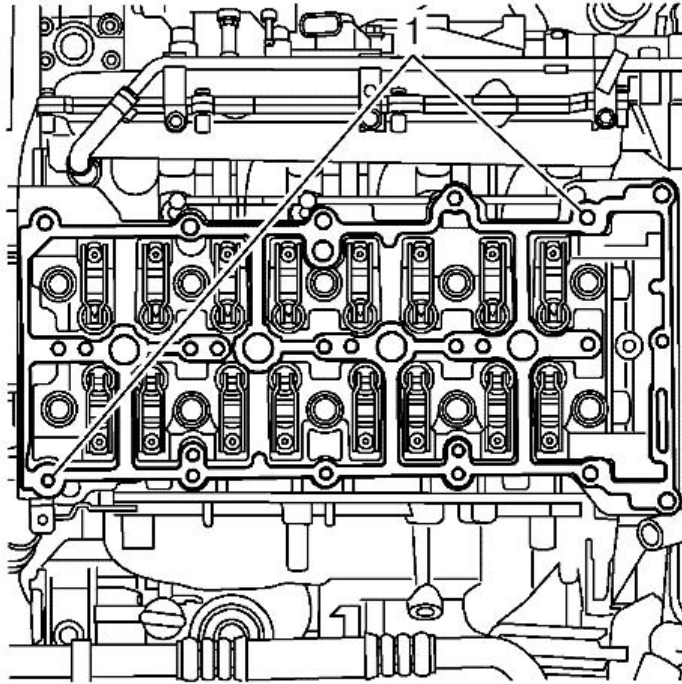
2. Inspect the exterior of the camshaft cover for the following conditions:
 - Damage to the camshaft cover bolt holes **(1, 2)**.
 - Damage to the camshaft sensor mounting hole **(3)**.
 - Damage to the under pressure hose bracket bolt holes **(4)**.



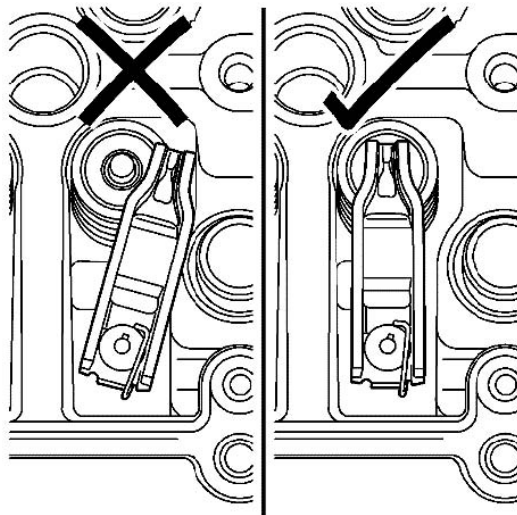
- 3.** Inspect the interior of the camshaft cover for the following conditions:
- Inspect the camshaft cover bolt holes **(3, 4)**.
 - Inspect the camshaft cover for cracks or damage **(1, 2, 5)**.

CAMSHAFT HOUSING INSTALLATION

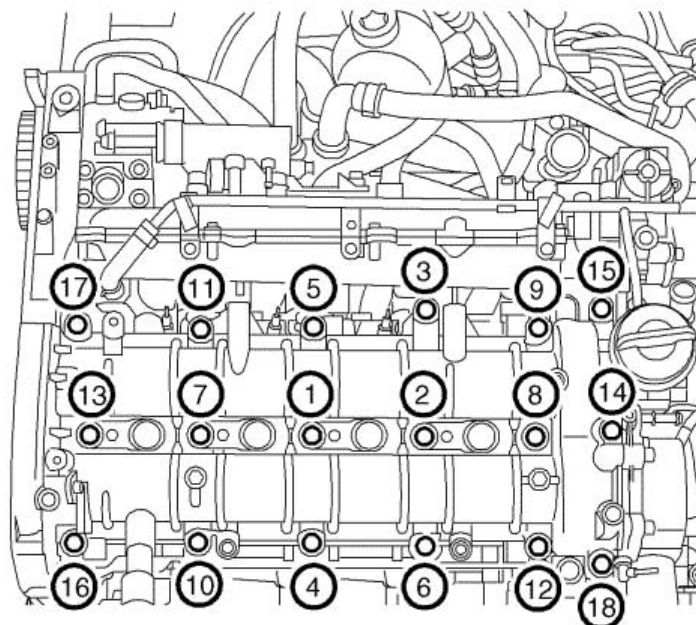
1. Clean the cylinder head and camshaft housing sealing surfaces from any gasket residue.



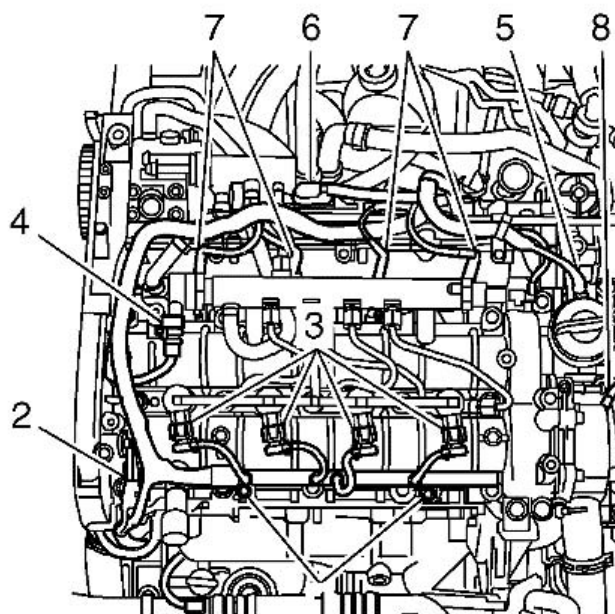
2. Fit the guide sleeves (1) and fit a new gasket onto the cylinder head.



3. Check that all the rocker arms are positioned correctly on the valve stems.



- 4.** Fit the camshaft housing, tighten the bolts in sequence **1–18**. Make sure the guide sleeves are positioned correctly in the camshaft housing.
Tighten **25 Nm (18 lb ft)**.
- 5.** Fit the timing belt, see **Timing belt removal**.
- 6.** Fit the fuel rail and hose, see **Fuel injection fuel rail assembly replacement**.
- 7.** Fit the fuel delivery pipe between the pump and the fuel rail.
Tighten **25 Nm (18 lb ft)**.

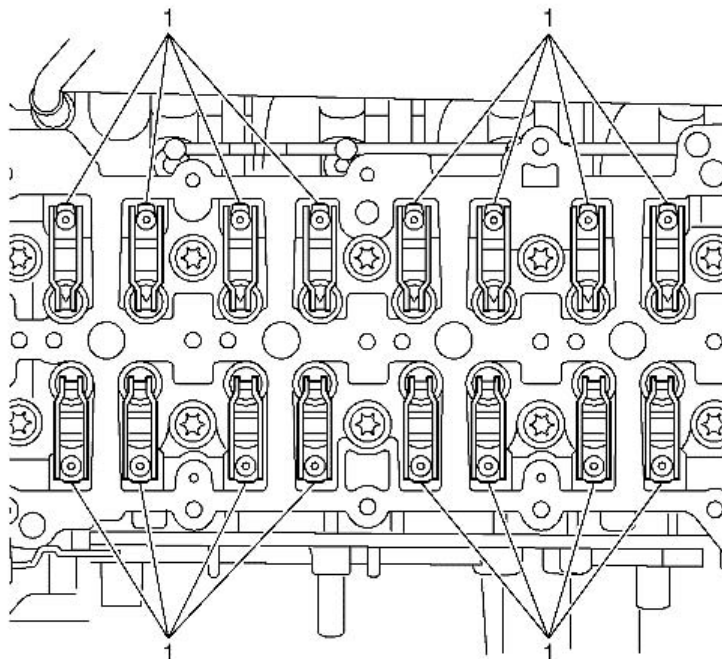


8. Fold the engine wiring harness back in place and fit the following connectors:

- Camshaft position sensor **(2)**
- Injectors **(3)**
- Fuel pressure control valve **(4)**
- Throttle body actuator unit **(5)**
- Intake air sensor **(6)**
- Glow plug connector **(7)**
- Coolant temperature sensor **(8)**.

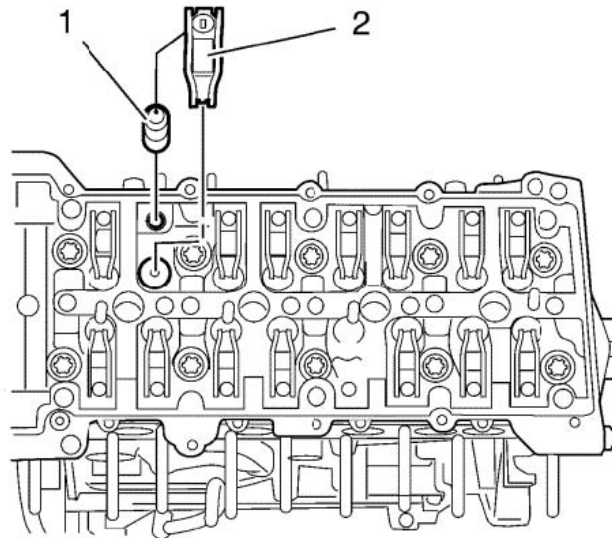
VALVE ROCKER ARM COVER REPLACEMENT

1. Remove the camshaft housing, see **Camshaft housing replacement, cleaning and inspection.**



2. Lubricate the rocker arm with engine oil. Fit the rocker arms to the hydraulic valve tappets and the valves.
3. Mark up the valve rocker arm covers position, to ensure that the same position will be used when refitting.

VALVE LIFTER ROLLER REPLACEMENT



NOTE! Used roller followers *must* be returned to their original position on the camshaft.

If the camshaft is being replaced, the roller followers actuated by the camshaft must also be replaced.

VALVE LIFTER ROLLER REMOVAL

1. Remove the valve lifter roller from the hydraulic lash adjuster **(1)**.
2. Remove the valve lifter roller **(2)**.

VALVE LIFTER ROLLER INSTALLATION

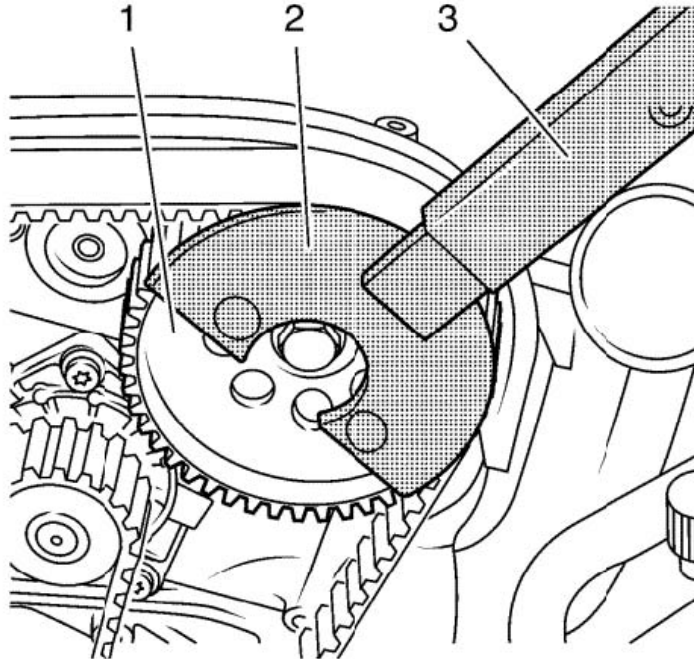
1. Install the valve lifter roller **(2)** on the top of the valve stem and on the lash adjuster **(1)**.
2. Lubricate the roller followers **(2)**. See **Camshaft housing replacement, cleaning and inspection**.

CAMSHAFT SPROCKET REPLACEMENT

Special tools

- 30-0160-018 camshaft sprocket holding tool
- 30-0160-015 extension

For equivalent regional tools, **see *Special tools***.



1. Remove alternator belt, see **Alternator belt replacement**.
2. Remove timing belt, see **Timing belt removal**.
3. Install the 30-0160-018 holding tool **(2)** with 30-0160-015 extension **(3)**.
4. Remove the camshaft sprocket bolt.
5. Remove the camshaft sprocket **(1)**.

 **WARNING**

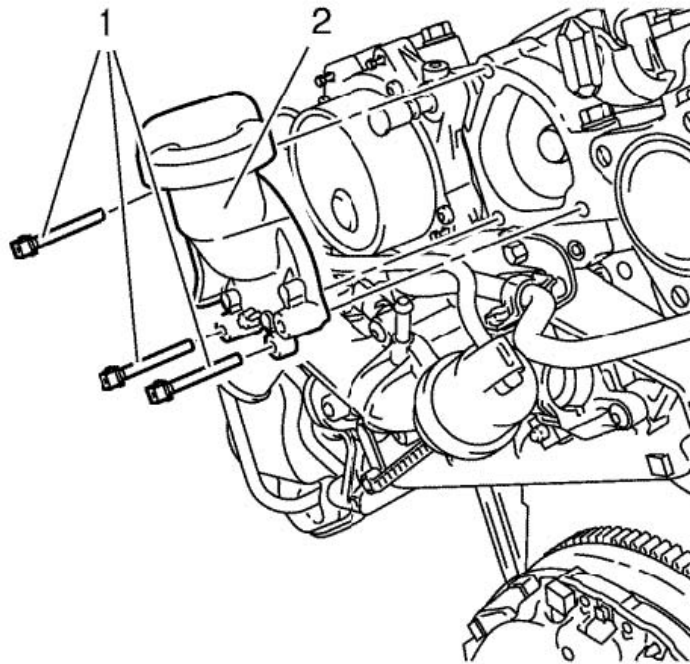
See **Fastener**.

6. Install the camshaft sprocket bolt and tighten to **130 Nm (96 lb ft)**.

CAMSHAFT REAR COVER REPLACEMENT

CAMSHAFT REAR COVER REMOVAL

1. Remove the 3 camshaft cover bolts (1).
2. Remove the camshaft rear cover (2).
3. Remove the camshaft rear cover gasket.



CAMSHAFT REAR COVER INSTALLATION

1. Install the camshaft rear cover gasket.
2. Install the camshaft rear cover (2).

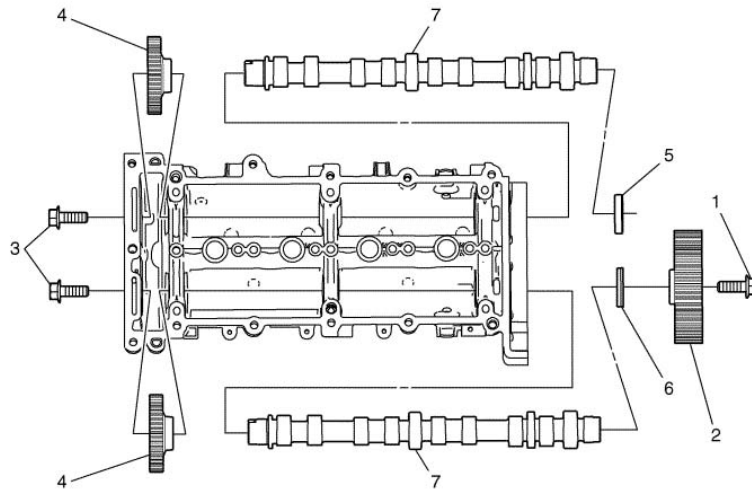


WARNING

See *Fastener*.

3. Install the 3 camshaft rear cover bolts (1) and tighten to **9 Nm (80 lb in)**.

CAMSHAFT REPLACEMENT



1. *Timing Belt Sprocket Fastener*
2. *Timing Belt Sprocket*
3. *Camshaft Sprocket Fastener*
4. *Camshaft Sprocket*
5. *Camshaft Plug*
6. *Camshaft Sealing Ring*
7. *Camshaft*

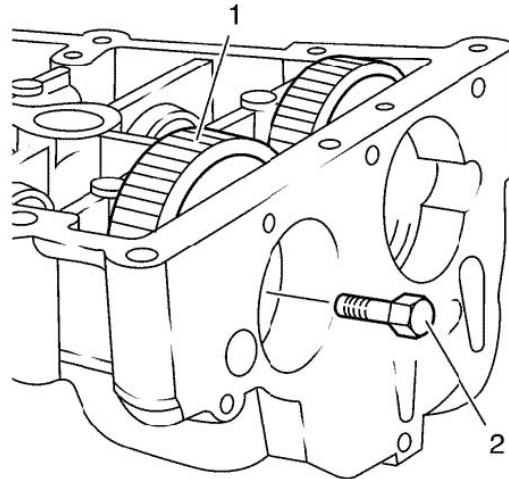
Special tools

- 30-0160-021 angle meter
- EN-46789 camshaft fixing tool

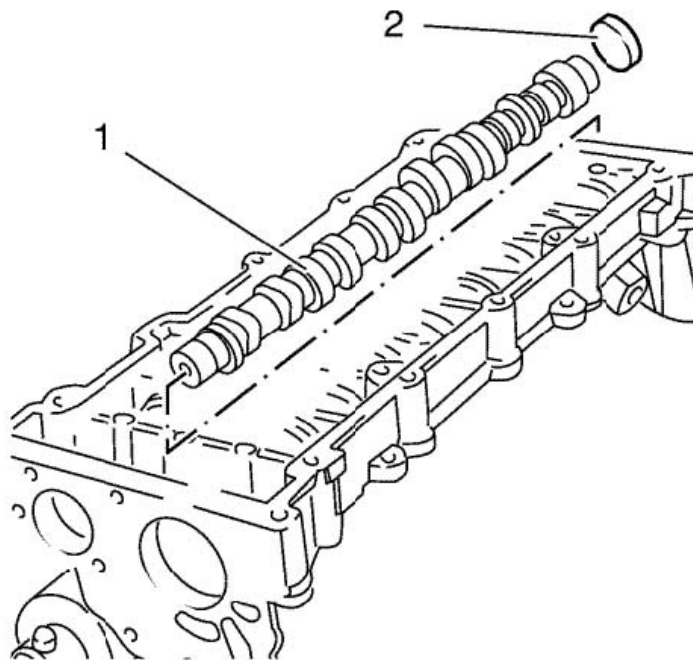
For equivalent regional tools, see **Special tools**.

INTAKE CAMSHAFT REMOVAL

1. Remove the camshaft housing, see **Camshaft housing replacement, cleaning and inspection**.
2. Install EN-4678 camshaft fixing tool.

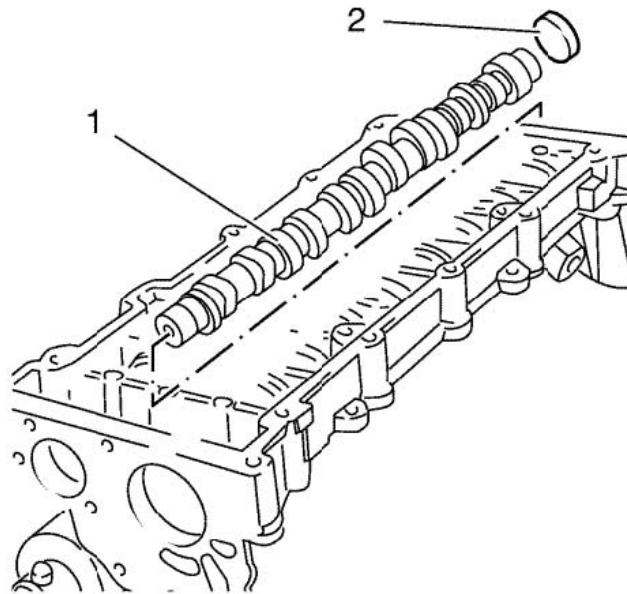


3. Install the EN-46789 fixing tool .
4. Remove and **discard** the intake camshaft sprocket bolt (2).
5. Remove the intake camshaft sprocket (1).
6. Remove the EN-46789 fixing tool .

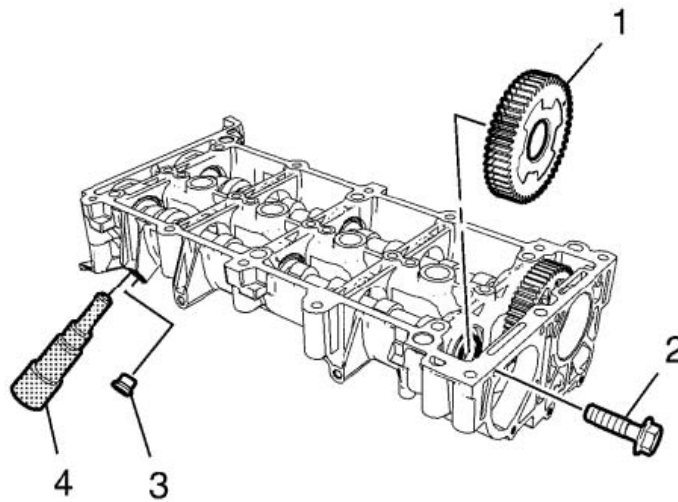


7. Remove the intake camshaft plug (2).
8. Remove the intake camshaft (1).

INTAKE CAMSHAFT INSTALLATION



1. Install the intake camshaft **(1)**.
2. Install the intake camshaft sealing ring **(2)**.



3. Remove the hole plug **(3)**.
4. Install the EN-46789 fixing tool **(4)**.
5. Turn the camshaft until the EN-46789 fixing tool audibly engages.
6. Install the intake camshaft sprocket **(1)**.

 **WARNING**

See *Fastener*.

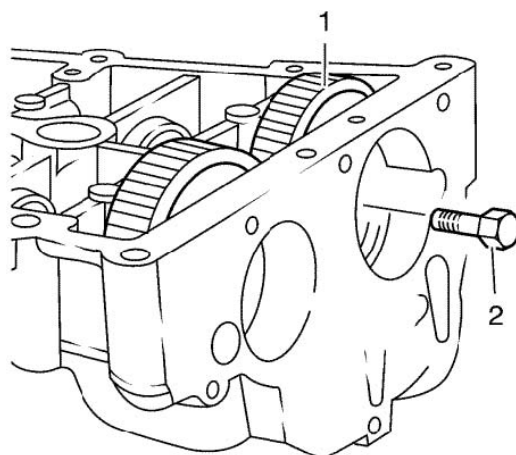
7. Install the **new** intake camshaft sprocket bolt **(2)** and tighten a first pass to **40 Nm (30 lb ft)**.

 **WARNING**

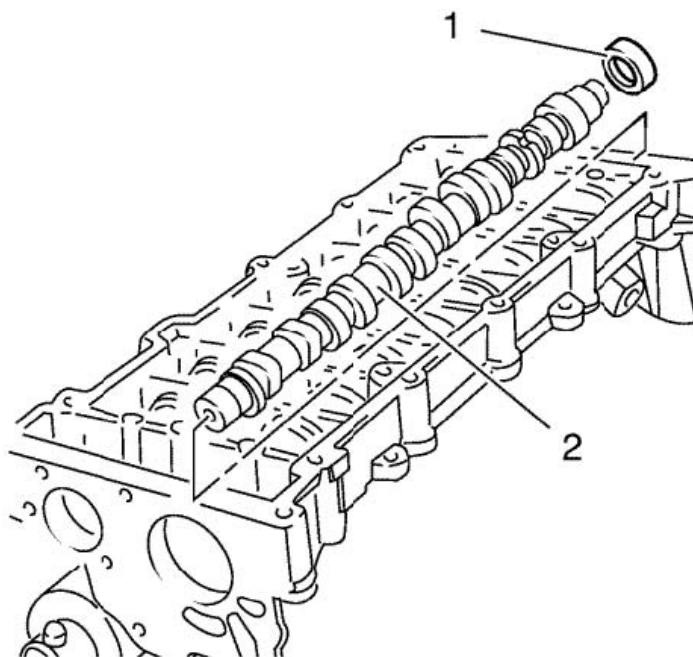
See *Fastener*.

8. Tighten the **new** intake camshaft sprocket bolt a final pass to an additional 55 degrees, using the 30-0160-021 meter.
9. Remove the EN-46789 fixing tool **(4)**.
10. Install the hole plug **(3)** and tighten to **25 Nm (18 lb ft)**.

EXHAUST CAMSHAFT REMOVAL

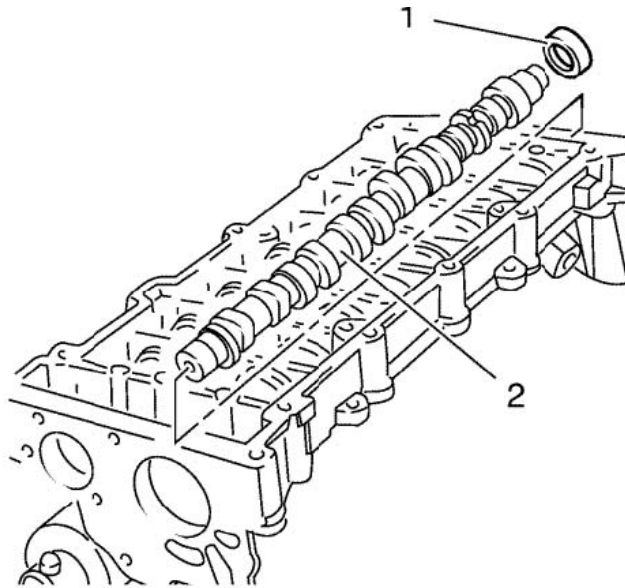


1. Install the EN-46789 fixing tool .
2. Remove the exhaust camshaft sprocket bolt **(2)**.
3. Remove the exhaust camshaft sprocket **(1)**.
4. Remove the EN-46789 fixing tool .

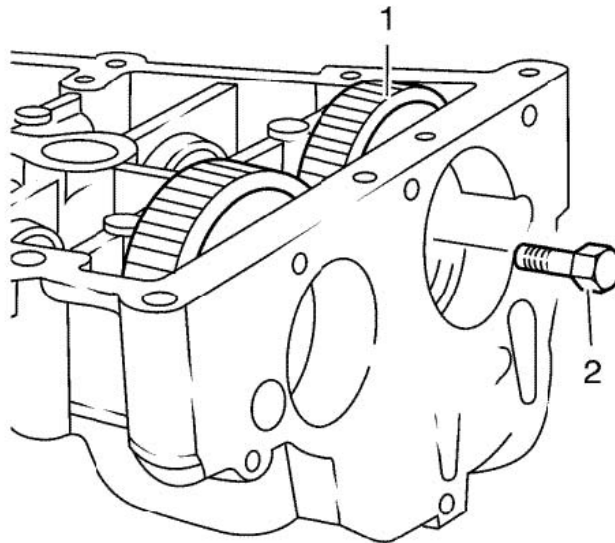


5. Remove the exhaust camshaft sealing ring **(1)**.
6. Remove the exhaust camshaft **(2)**.

EXHAUST CAMSHAFT INSTALLATION



1. Install the exhaust camshaft **(2)**.
2. Install the exhaust camshaft sealing ring **(1)**.



3. Install the EN 46789 fixing tool.
4. Install the exhaust camshaft sprocket **(1)**.

 **WARNING**

See **Fastener**.

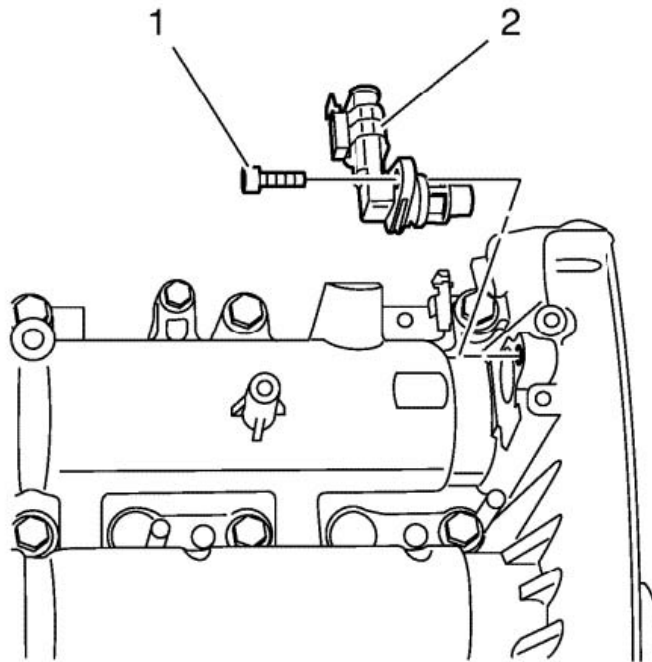
 **WARNING**

See **Torque-to-yield fastener**.

5. Install the **new** exhaust camshaft sprocket bolt **(2)** and tighten in 2 passes:
 - First pass to **40 Nm (30 lb ft)**.
 - Second pass an additional **55 degrees**, using the 30-0160-021 meter.

CAMSHAFT POSITION SENSOR REPLACEMENT

1. Remove the camshaft position sensor bolt **(1)**.
2. Remove the camshaft position sensor **(2)**.
3. Remove the camshaft position sensor O-ring.



4. Install the camshaft position sensor **(2)**.

 **WARNING**

See *Fastener*.

5. Install the camshaft position sensor bolt **(1)** and tighten to **10 Nm (89 lb in)**.

CYLINDER HEAD REPLACEMENT

Special tools

- 30-0160-021 angle meter

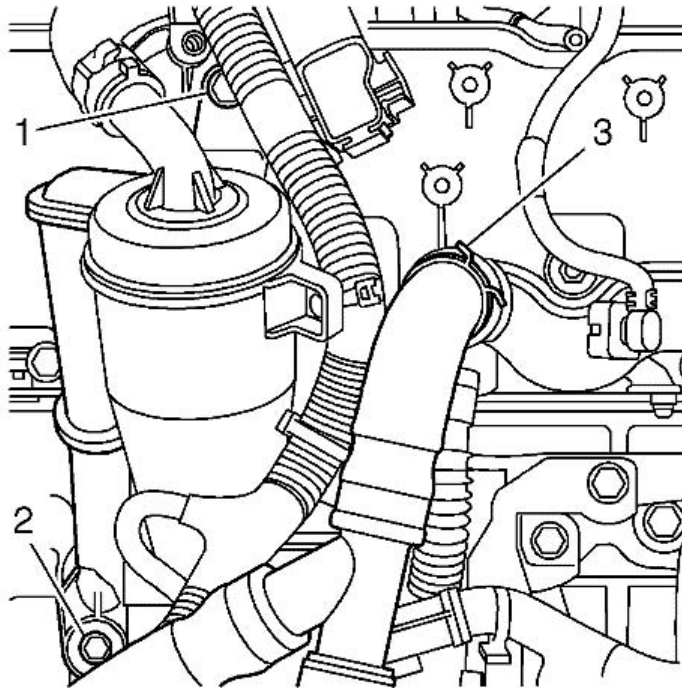
For equivalent regional tools, see **Special tools**.

CYLINDER HEAD REMOVAL

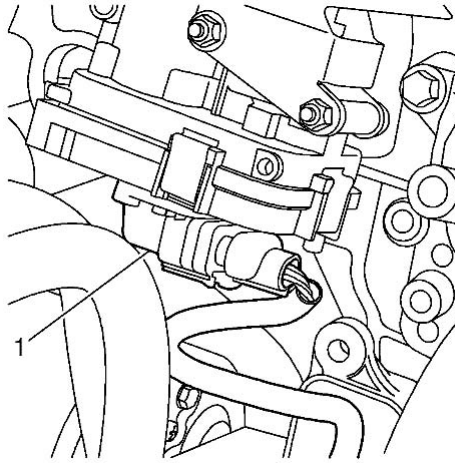
DANGER

Always wear safety goggles when working with fuel in order to protect the eyes from fuel splash.

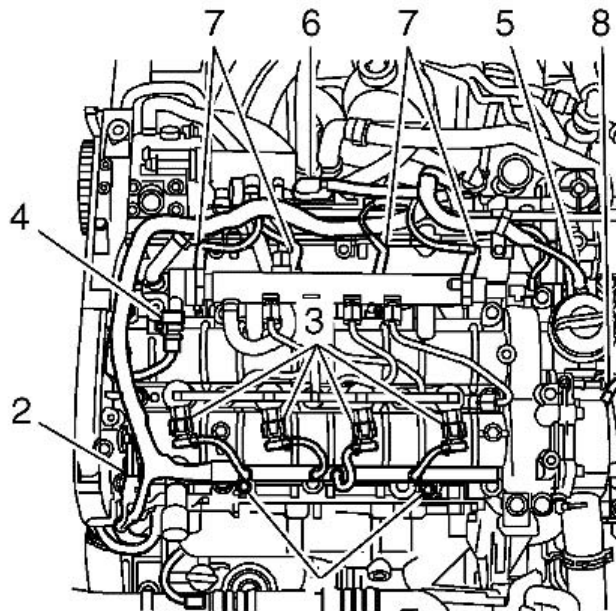
1. Remove the air filter. See **Check lower belt tension**.
2. Remove the timing belt. See **Timing belt removal**.
3. Remove the upper belt drive. Refer to **Upper belt assembly removal**



4. Undo and remove the crankcase ventilation hose **(1)** from the oil trap and the bolts **(2)** holding the oil trap bracket and remove the cooling hose **(3)**.



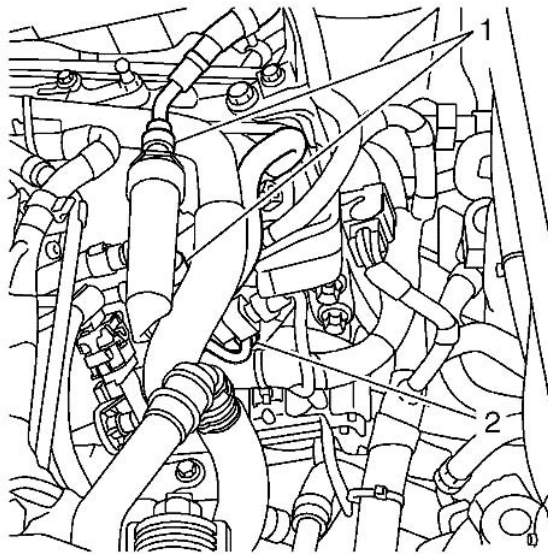
5. Remove the connector **(1)** to the combustion circulation actuator.



6. Remove the cable duct retaining screws **(1)**.
7. Remove the following connectors:
- Camshaft position sensor **(2)**
 - Injectors **(3)**
 - Fuel pressure control valve **(4)**
 - Throttle body actuator unit **(5)**
 - Intake air sensor **(6)**
 - Glow plug connector **(7)**
 - Coolant temperature sensor **(8)**.

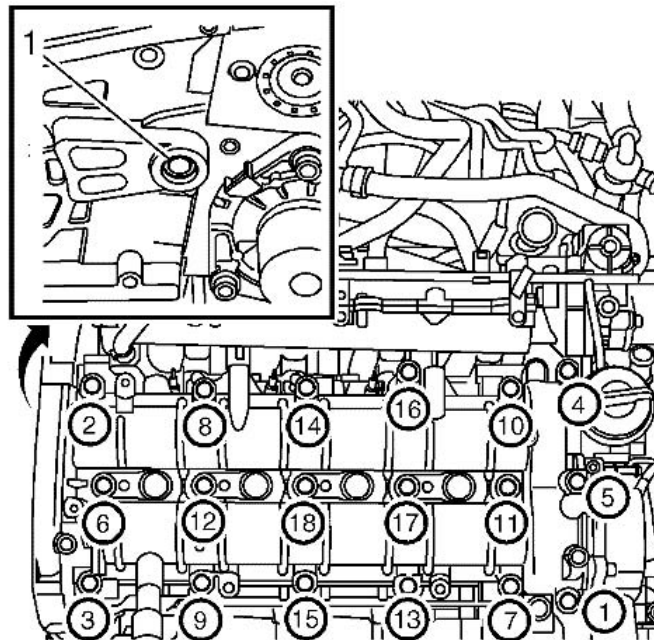
FOLD AWAY THE ENGINE WIRING HARNESS

135

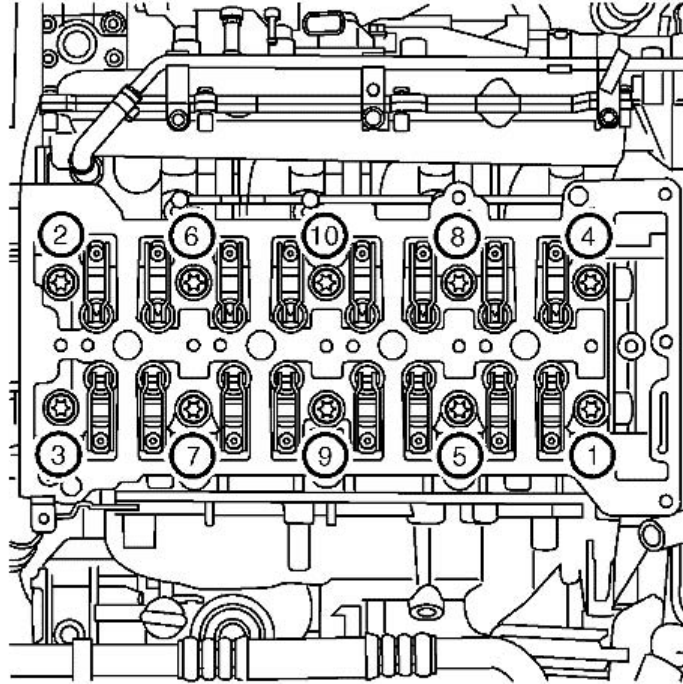


NOTE! If the injectors are to be refitted, mark the injectors so that they can be refitted to the same cylinder.

8. Remove the injectors, see **Fuel injection fuel rail assembly replacement**. Refer to **Fuel Injector Replacement**.
9. Remove the fuel rail and hose, see **Fuel injection fuel rail assembly replacement**.



10. Remove the bolt (**1**) between the fuel pump bracket and cylinder head, screw out the spacer bolt a few turns.
11. Undo and remove the camshaft housing and guide sleeves. Loosen bolts alternately in order as illustrated.

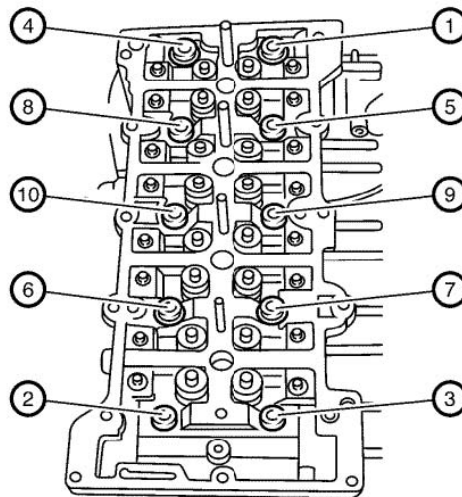


12. Remove the cylinder head by undoing the bolts in the illustrated order.

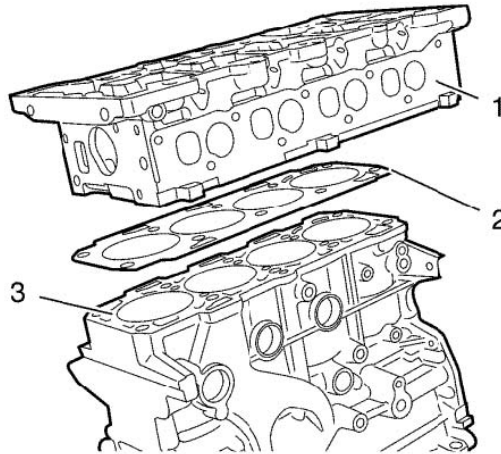
13. Carefully lift off the cylinder head.

NOTE! Do not confuse the engine block guide sleeves with the camshaft guide sleeves.

14. Remove the engine block guide sleeves.



15. Remove the 10 cylinder head bolts as shown in sequence. Discard the bolts.



16. Remove the cylinder head **(1)**.
17. Remove the cylinder head gasket **(2)**.
18. Clean all of the gasket surfaces.
19. Use the following procedures when cleaning the cylinder head and cylinder block surfaces **(3)**:

NOTE! Do not use any other method or technique to clean these gasket surfaces.

- Use a razor blade gasket scraper to clean the cylinder head and cylinder block gasket surfaces. Do not scratch or gouge any surface.

NOTE! Be careful not to gouge or scratch the gasket surfaces. Do not gouge or scrape the combustion chamber surfaces. The feel of the gasket surface is important, not the appearance. There will be indentations from the gasket left in the cylinder head after all of the gasket material is removed. These small indentations will be filled in by the new gasket.

- Use a **new** razor blade for each cylinder head and cylinder block.

NOTE! Do not use a tap to clean the cylinder head bolt holes.

- Hold the razor blade as parallel to the gasket surface as possible.

20. Clean the old sealer/lube and dirt from the bolt holes.
21. Clean the bolt holes with a nylon bristle brush.

 **DANGER**

Wear safety glasses when using compressed air in order to prevent eye injury.

22. When cleaning the cylinder head bolt holes use a suitable commercial spray liquid solvent and compressed air from an extended-tip blow gun to reach the bottom of the holes.

CYLINDER HEAD INSTALLATION

Special tools

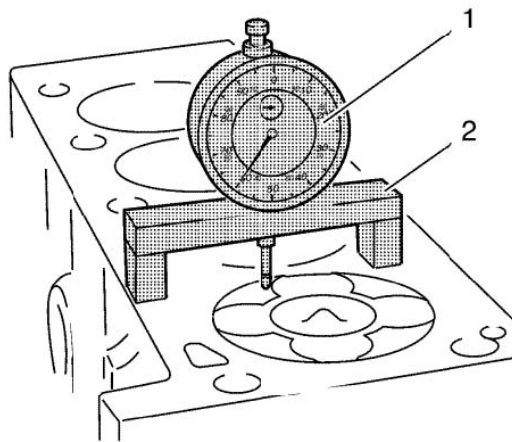
- EN-301 measurement bridge
- 30-0160-021 angle meter
- GE-517-B dial

For equivalent regional tools, see *Special tools*.

1. Clean the sealing surfaces.

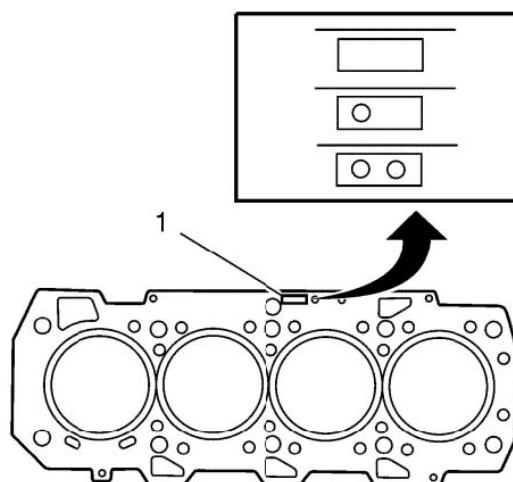
NOTE! Ensure that the cylinder head and the cylinder block sealing surfaces are clear of oil, grease and old gasket material.

2. Inspect the flatness of cylinder head and cylinder block sealing surfaces.



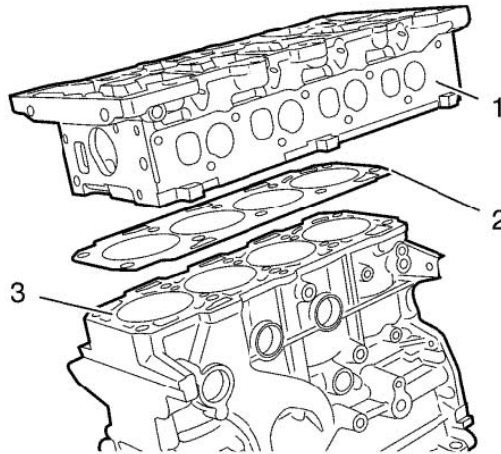
NOTE! For the measurement, the piston has to stay on TDC.

3. Install the EN-301 measurement bridge (2) in compound with the GE-517-B dial (1).



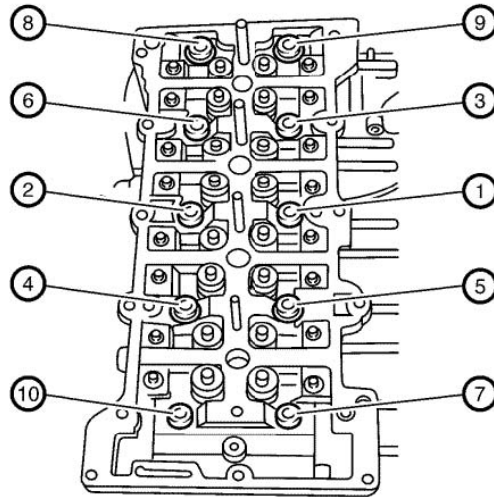
NOTE! The largest measured piston overhang value is determining for the choice of the cylinder head gasket.

4. Measure the piston overhang of all pistons and compare with the identification on the cylinder head gasket **(1)**.
 - Piston overhang 0.110 mm - 0.230 mm (0.0043 in - 0.0090 in) , choose cylinder head gasket without holes.
 - Piston overhang 0.231 mm - 0.330 mm (0.0091 in - 0.0130 in) , choose cylinder head gasket with one hole.
 - Piston overhang 0.331 mm - 0.425 mm (0.0131 in - 0.0167 in) , choose cylinder head gasket with two holes.



NOTE! Do not use any sealing material.

5. Install the **new** cylinder head to block gasket **(2)** at the engine block **(3)**.
6. Install the cylinder head.



! WARNING

See **Fastener**.

! WARNING

See **Torque-to-yield fastener**.

7. Install the 10 **new** cylinder head bolts.
 8. Tighten the 10 **new** cylinder head bolts in following order:
- NOTE!** The following tightening order applies to ribe cylinder head bolts.

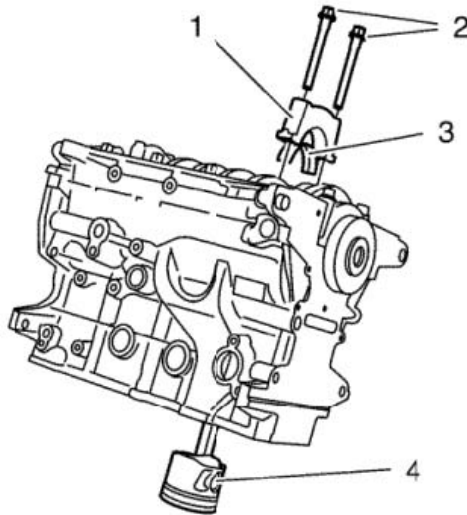
- First pass in sequence to **20 Nm (15 lb ft)**.
- Second pass in sequence to **65 Nm (48 lb ft)**.
- Third pass in sequence to an additional **90 degrees** using the 30-0160-0021 meter.
- Fourth pass in sequence to an additional **90 degrees** using the 30-0160-0021 meter.
- Fifth pass in sequence to an additional **90 degrees** using the 30-0160-0021 meter.

NOTE! The following tightening order applies to torx T60 cylinder head bolts.

- First pass in sequence to **20 Nm (15 lb ft)**.
- Second pass in sequence to **65 Nm (48 lb ft)**.
- Third pass in sequence to an additional **90 degrees**, using the 30-0160-0021 meter.
- Fourth pass in sequence to an additional **90 degrees**, using the 30-0160-0021 meter.
- Fifth pass in sequence to an additional **90 degrees**, using the 30-0160-0021 meter.
- Sixth pass in sequence to an additional **90 degrees**, using the 30-0160-0021 meter.

PISTON, CONNECTING ROD, AND BEARING REPLACEMENT

PISTON, CONNECTING ROD, AND BEARING REMOVAL



1. Rotate the crankshaft to a position where the connecting rod bolts are the most accessible.
2. Mark the connecting rod and cap with the cylinder position. Also mark their orientation. This will ensure the caps and connecting rods are re-assembled properly.
3. Remove any ridge at the top of the cylinder bore to avoid damage to the piston ring lands.
4. Remove the connecting rod bolts **(2)**.
5. Remove the connecting rod cap **(1)**.
6. Remove the connecting rod bearing **(3)**.
7. Remove the piston and connecting rod assembly **(4)**.

PISTON AND CONNECTING ROD DISASSEMBLE/ ASSEMBLE

Special tools

- 30-0160-026 piston pin retainer remover/installer

For equivalent regional tools, see **Special tools**.

Piston and connecting rod disassemble



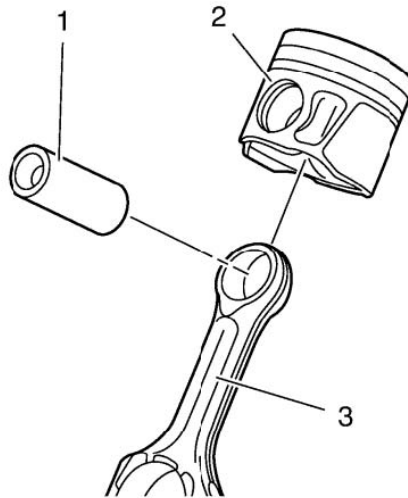
DANGER

Handle the piston carefully. Worn piston rings are sharp and may cause bodily injury.

1. Disassemble the piston rings from the piston **(2)**. Use a suitable tool to expand the rings. The piston rings must not be reused.

NOTE! Two retainers hold the piston pins in place. Ensure that the piston pin is not damaged. Do not reuse the retainers.

2. Remove the piston pin retainers using the 30-0160-026 remover/installer.
3. Remove the piston pin **(1)**.
4. Disassemble the piston from the connecting rod **(3)**.



Piston and connecting rod assemble

1. Assemble the piston to the connecting rod **(3)**.
2. Install the piston pin **(1)**.
3. Install the piston pin retainers using the 30-0160-026 remover/installer.



DANGER

Handle the piston carefully. Worn piston rings are sharp and may cause bodily injury.

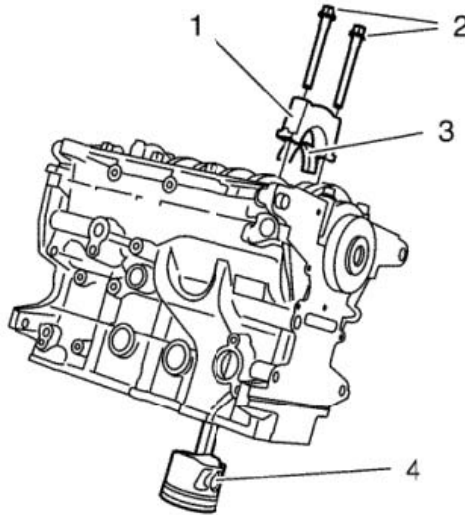
4. Assemble the **new** piston rings to the piston **(2)**. Use a suitable tool to expand the rings.

PISTON, CONNECTING ROD, AND BEARING INSTALLATION

Special tools

- 30-0160-021 angle meter

For equivalent regional tools, see **Special tools**.



1. Lubricate the piston rings, piston, inner cylinder bore surface and a piston ring compressor with clean engine oil.
2. Install the piston ring compressor in order to compress the piston rings.
3. Install the piston and connecting rod assembly **(4)**.
4. Install the connecting rod bearing **(3)**.
5. Install the connecting rod cap **(1)**.

! WARNING

See **Fastener**.

! WARNING

See **Torque-to-yield fastener**.

6. Install the **new** connecting rod bolts **(2)** and tighten a first pass to **25 Nm (19 lb ft)**.
7. Tighten the **new** connecting rod bolts **(2)** a final pass to an additional **60 degrees** using the 30-0160-021 meter.
8. Assemble the caps and connecting rods in the marked position.
9. Rotate the crankshaft to a position where the connecting rod bolts are in the best situation for install.

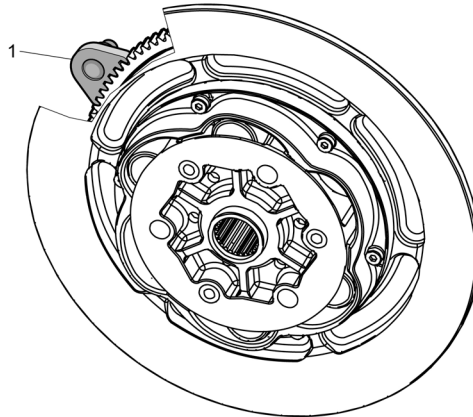
ENGINE FLYWHEEL REPLACEMENT

ENGINE FLYWHEEL REMOVAL

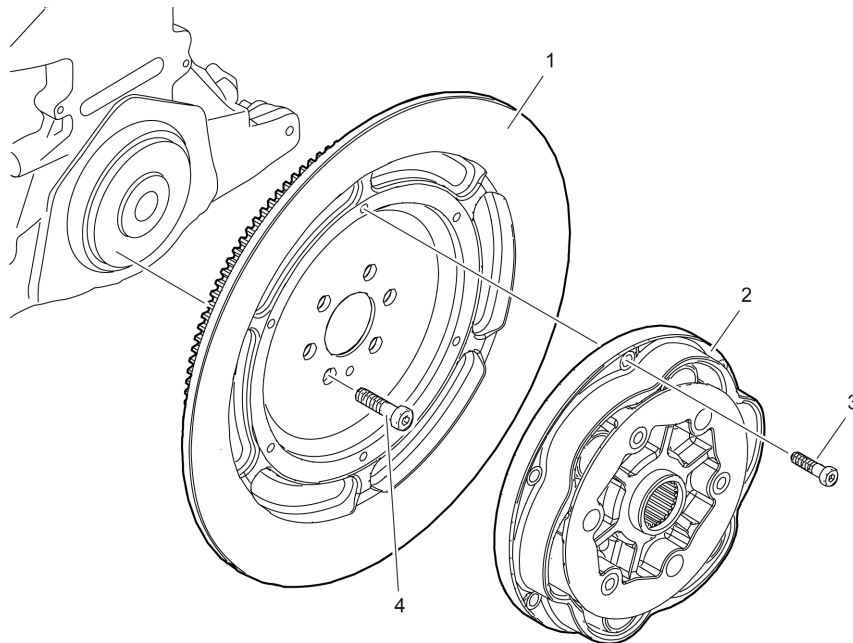
Special tools

- 30-0160-034 flywheel blocking tool

For equivalent regional tools, see **Special tools**.



1. Install the 30-0160-034 flywheel blocking tool in order to hold the crankshaft.



2. Remove the flexible coupling (2), 6 bolts (3).

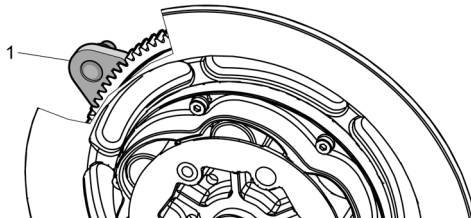
WARNING

The flexible coupling must not be disassembled. If so, it is important to reassemble it according to specification, otherwise it will break and warranty void.

3. Remove and **discard** the 6 flywheel bolts (2).
4. Remove the flywheel (1).
5. Check the crankshaft rear oil seal (1), replace if necessary. See **Crankshaft oil seal replacement**.

ENGINE FLYWHEEL INSTALLATION

6. Install the engine flywheel (1).
NOTE! Clean the thread before inserting a **new** bolt with locking compound.
7. Install the 6 **new** engine flywheel bolts (2).



8. Install 30-0160-034 flywheel blocking tool locking tool (1) to fix the engine flywheel.

 **WARNING**

See **Fastener**.

 **WARNING**

See **Torque-to-yield fastener**.

9. Tighten the 6 **new** engine flywheel bolts to **105 Nm (77 lb ft)**.

CRANKSHAFT OIL SEAL REPLACEMENT

Special tools

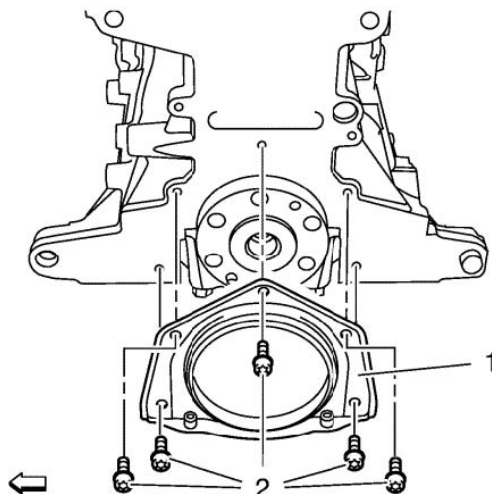
- 30-0160-025 remover oil seal
- EN-48251 installer oil seal

For equivalent regional tools, see **Special tools**.

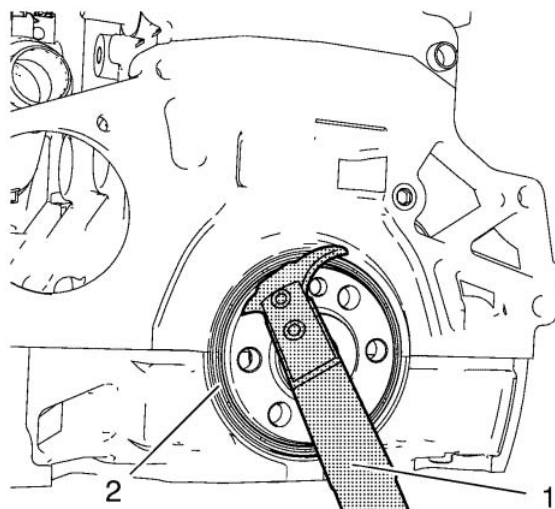
CRANKSHAFT OIL SEAL REMOVAL

WARNING

See **Engine flywheel replacement**.



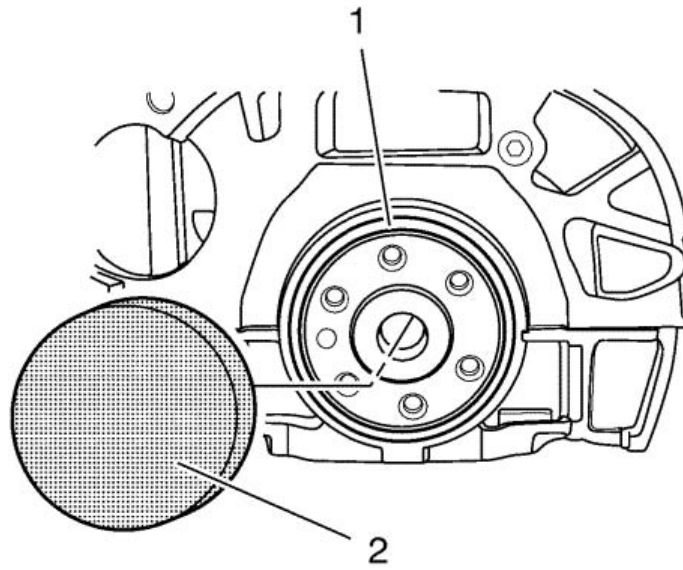
1. Remove the 5 crankshaft rear oil seal bolts **(2)**.
2. Remove the crankshaft rear oil seal **(1)**.



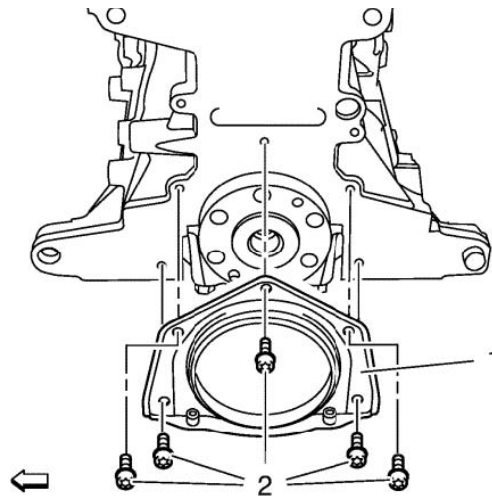
NOTE! Be careful do not damage the sealing surfaces.

3. Use 30-0160-025 remover **(1)** to remove the crankshaft rear oil seal **(2)**.

CRANKSHAFT OIL SEAL INSTALLATION



1. Use the EN-48251 installer **(2)** to install a **new** crankshaft rear oil seal **(1)**.
2. Install the **new** crankshaft rear oil seal **(1)**.

 **WARNING**

See **Fastener**.

3. Install the 5 crankshaft rear oil seal bolts **(2)** and tighten to **9 Nm (80 lb in)**.

CRANKSHAFT AND BEARING REPLACEMENT

CRANKSHAFT END PLAY MEASUREMENT

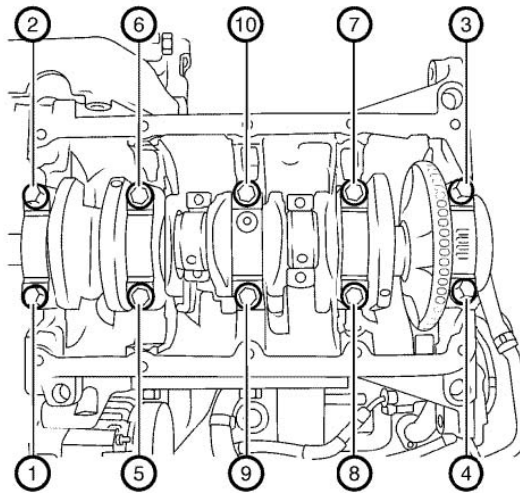
1. Place a dial indicator at the crankshaft nose.
2. Gently force the crankshaft to the extreme front and rear positions with a pry tool while monitoring the movement of the dial indicator.
3. The crankshaft end play should not exceed specifications, see **Specifications**.
4. If the specifications are exceeded inspect the thrust bearing thrust OD and the crankshaft thrust wall for wear and/or excessive runout, see **Specifications**.
5. Replace the thrust bearing or crankshaft as necessary.



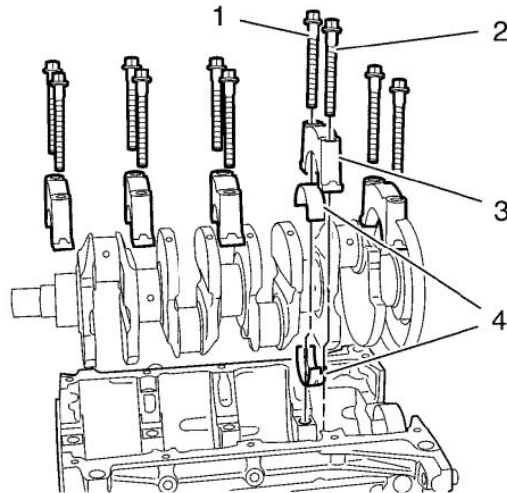
WARNING

See **Crankshaft oil seal replacement**.

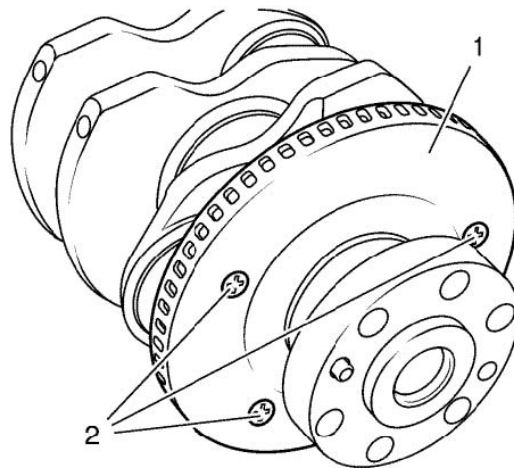
CRANKSHAFT AND BEARING REMOVAL



1. Loosen the 10 crankshaft bearing cap bolts in sequence.



2. Remove the 10 crankshaft bearing cap bolts **(1, 2)**.
3. Remove the 5 crankshaft bearing caps **(3)**.
4. Using both hands, lift the crankshaft straight up from the engine block.
5. Place the crankshaft in a secure place.
6. Prepare a piece of cardboard or equivalent, numbered (1–5) for bearing identification. Main bearing journals are numbered from the front of the engine.
7. Remove the 10 crankshaft bearing halves **(4)** from the cylinder block and the crankshaft. Note the position of the thrust bearing.
8. Place the 10 crankshaft bearing **(4)** on the cardboard in the correct positions.



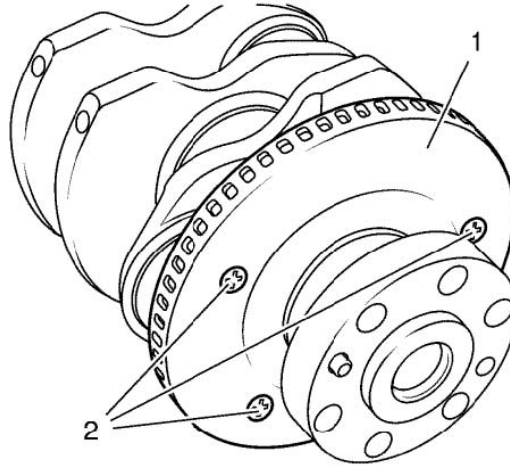
9. Remove the 3 increment wheel bolts **(2)**.
10. Remove the increment wheel **(1)**.

CRANKSHAFT AND BEARING INSTALLATION

Special tools

- 30-0160-021 angle meter

For equivalent regional tools, see **Special tools**.

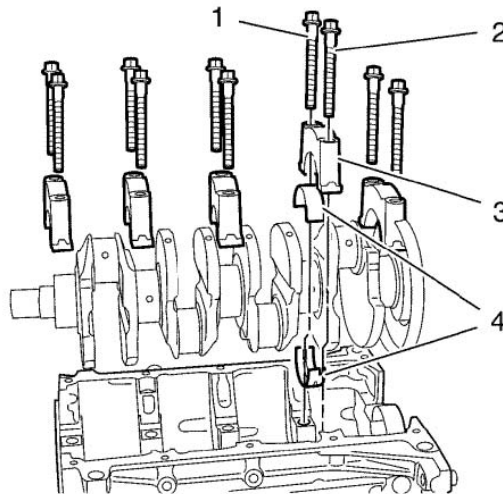


1. Install the increment wheel (1).

**WARNING**

See **Fastener**.

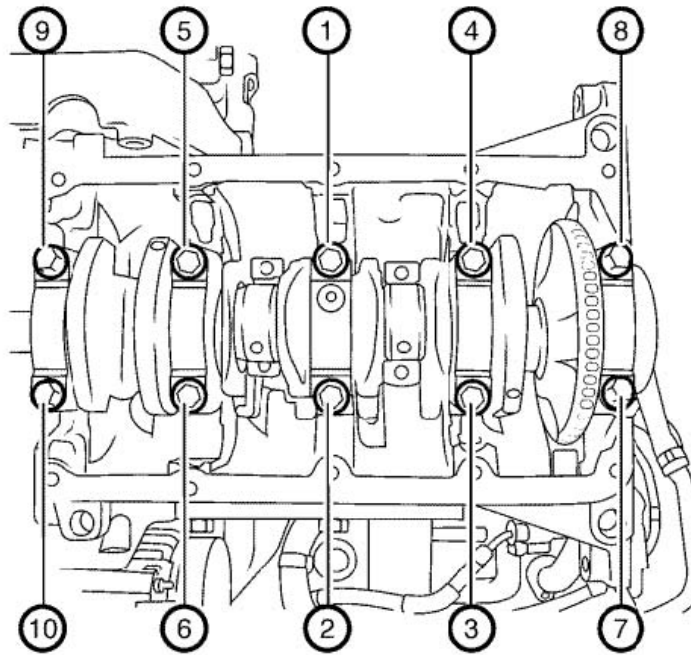
2. Install the 3 increment wheel bolts (2) and tighten to **12 Nm (106 lb in)**.



NOTE! If the crankshaft bearings have been used in a running engine, you must replace them with **new** crankshaft bearings for reassembly.

3. Clean the crankcase crank bore with a lint-free cloth.
4. Clean all the oil from the backside of new bearing halves.

5. Install the 10 crankshaft bearing halves **(4)** into position. Ensure that the upper bearing insert contains the oil transfer hole and groove. Roll the bearing into position so that the lock tang engages the crank slot. The bearing must fit flush with the upper crankcase.
6. Using two hands, install the crankshaft straight up to the engine block.
7. Install the 5 crankshaft bearing caps **(3)**.
8. Install the 10 **new** crankshaft bearing cap bolts **(1, 2)**.



! WARNING

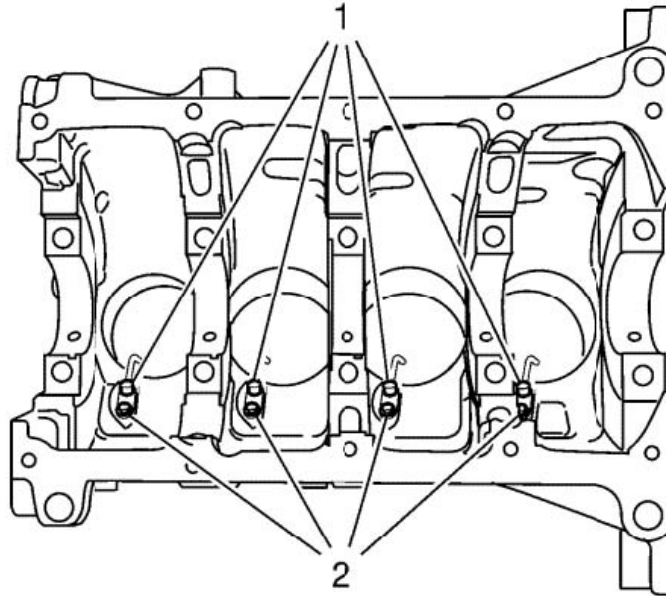
See *Torque-to-yield fastener*.

9. Tighten the 10 **new** crankshaft bearing cap bolts in sequence (1-10) in 2 passes:
 - First pass in sequence to **25 Nm (19 lb ft)**.
 - Second pass in sequence to an additional **100 degrees** using the 30-0160-021 meter.

! WARNING

Refer to *Crankshaft oil seal replacement*.

PISTON OIL NOZZLE REPLACEMENT



PISTON OIL NOZZLE REMOVAL

1. Remove the crankshaft see (crankshaft and bearing replacement)
2. Remove the 4 piston oil nozzle bolts **(2)**.
3. Remove the 4 piston oil nozzles **(1)**.

PISTON OIL NOZZLE INSTALLATION

1. Install the 4 piston oil nozzles **(1)**.
2. Install the 4 piston oil nozzle bolts **(2)**.



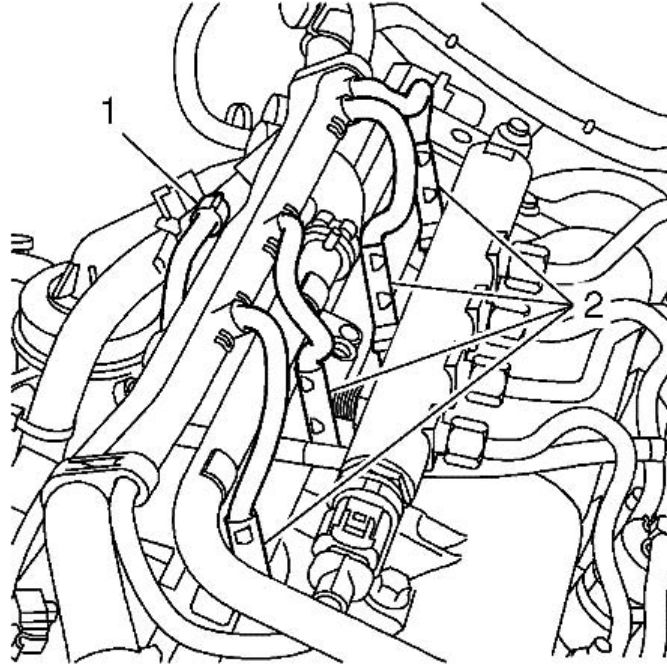
WARNING

See **Fastener**.

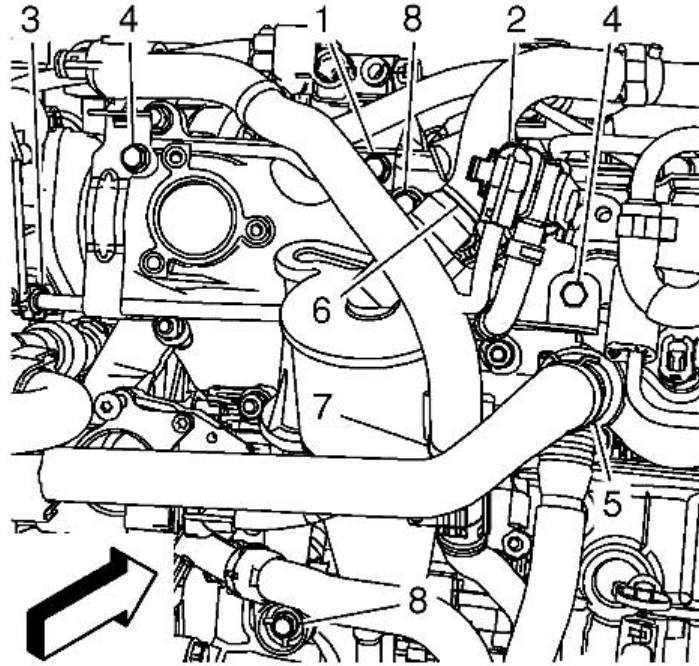
3. Tighten the 4 piston oil nozzle bolts **(2)** to **9 Nm (80 lb in)**.

INTAKE MANIFOLD REPLACEMENT

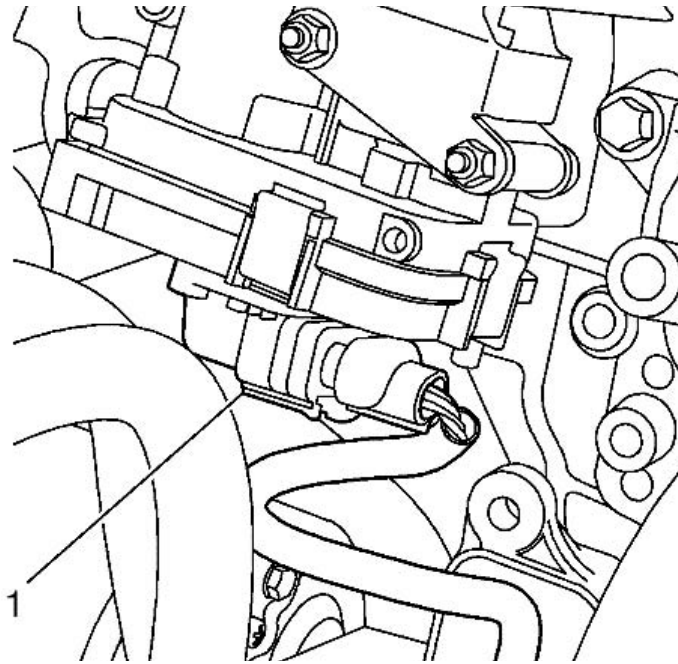
INTAKE MANIFOLD REMOVAL



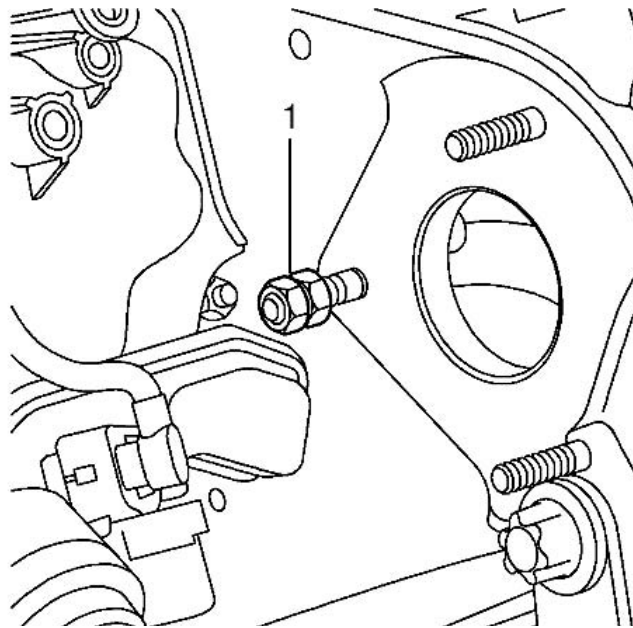
1. Remove the fuel pump. See **Fuel injection pump replacement**.
2. Unplug the intake air sensor connector (1) and the glow plug connector (2).



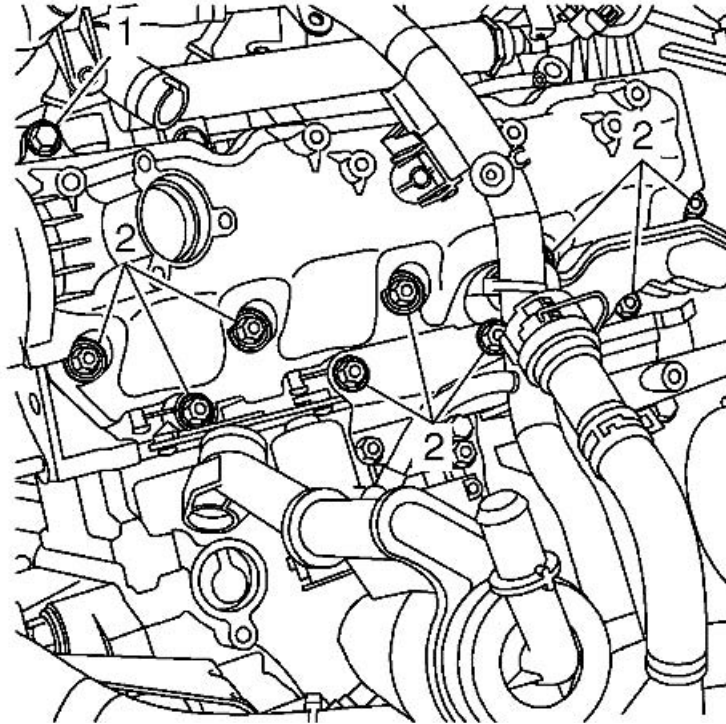
3. Detach the engine control module wiring harness bracket fastener **(1)**.
4. Detach the exhaust pressure sensor electrical connector **(2)**.
5. Loosen the exhaust pressure pipe clamp **(3)** and disconnect the hose.
6. Remove the exhaust pressure pipe bracket bolts **(4)**.
7. Remove the exhaust pressure pipe from the engine.
8. Remove coolant hose quick connection **(5)**.
9. Disconnect the upper hose connection **(6)** from the PCV oil separator.
10. Remove the retaining clips **(7)**.
11. Remove the PCV oil separator retaining bolts **(8)**.
12. Remove the PCV oil separator from the engine block and move the oil trap aside.



- 13.** Unplug the connector **(1)** of the combustion circulation actuator.



- 14.** Remove the fuel injection pump bracket stud **(1)** holding the pump in place. Lock two M8 nuts with each other and remove the bolt.

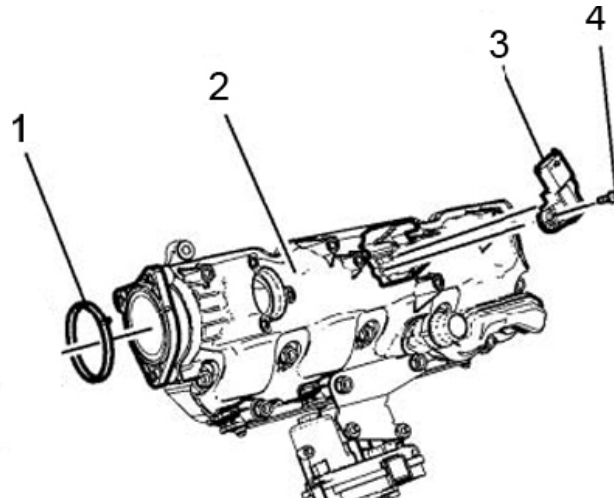


- 15.** Remove the bolt towards the lifting eye **(1)**.
- 16.** Remove the nine intake manifold nuts **(2)**.
- 17.** Remove the four manifold gaskets.
- 18.** Remove the intake manifold.

 **WARNING**

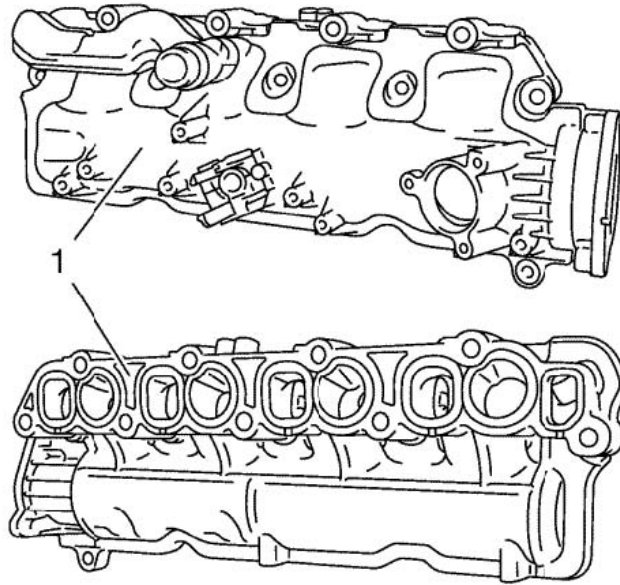
Plug the intake passages so that no obstacles can enter the engine.

INTAKE MANIFOLD DISASSEMBLY

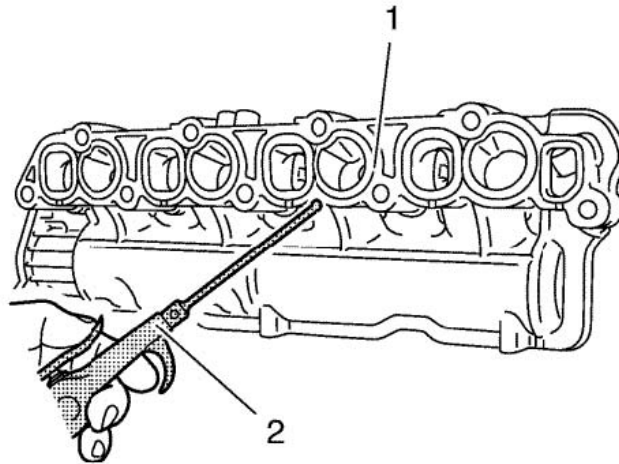


1. Remove the absolute pressure sensor bolt **(4)**.
2. Remove the absolute pressure sensor **(3)** from the intake manifold **(3)**.
3. Remove the the seal ring **(1)**.

INTAKE MANIFOLD CLEANING AND INSPECTION



1. Clean the intake manifold mating surfaces.
2. Inspect the intake manifold (**1**) for damage.
3. Inspect the intake manifold for cracks near metallic inserts.

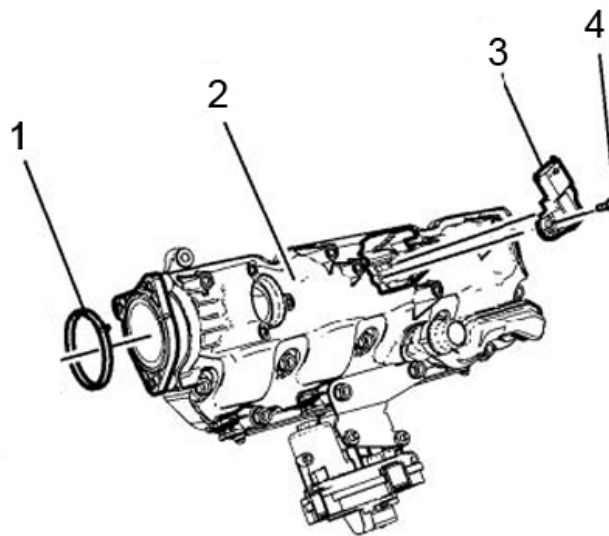


 DANGER

- Ensure all hoses and components are appropriately rated to handle the supplied pressure from the compressor.
- **Always** use the lowest pressure that will do the job.
- **Always** use a gun or similar device with an OSHA compliant, pressure reducing nozzle if the pressure of your compressed air is greater than 29 psi.
- When there is a risk for particulate exposure, **always** wear goggles or a face shield over safety glasses to protect the eyes. High pressure injection of particles or liquids may damage eyes or skin.

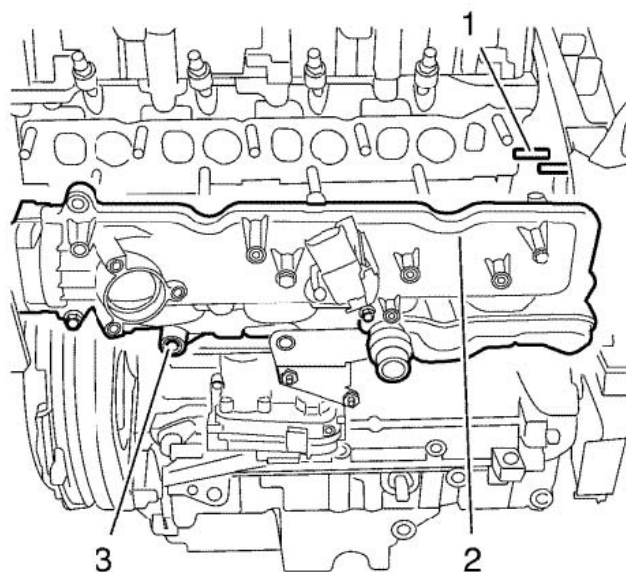
- Use a noise reducing air gun and wear hearing protection when peak noise levels are greater than 85 decibels. Excessive noise may cause hearing loss and rupture eardrums.
 - **Wear** the appropriate gloves to protect your hands.
 - **Never** use compressed air to clean your clothes or body.
 - **Never** tamper with air guns to modify them in any way.
 - **Never** point an air gun or direct air towards another individual or your skin. Compressed air entering the bloodstream through a break in the skin or through a body opening can create an air bubble (embolism), a dangerous (and potentially deadly) medical condition.
 - Dangling hoses can present a trip hazard.
4. Clean the passages **(1)** with compressed air **(2)** if necessary. Use a maximum of **172 kPa (25 psi)** of air pressure.
 5. Replace the intake manifold as necessary.

INTAKE MANIFOLD ASSEMBLY



1. Install the absolute pressure sensor **(3)** to the intake manifold **(2)**.
2. Install the absolute pressure sensor bolt **(4)**.
3. Install a **new** seal ring **(1)**.

INTAKE MANIFOLD INSTALLATION



! WARNING

Remove the protective plugs from the intake passages. Ensure that no obstacles have entered the engine's combustion chambers.

1. Install the intake manifold (2).
2. Install the 4 **new** intake manifold gaskets.

! WARNING

Use the correct fastener in the correct location. Replacement fasteners must be the correct part number for that application. Do not use paints, lubricants, or corrosion inhibitors on fasteners, or fastener joint surfaces, unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener.

Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems. When using fasteners that are threaded directly into plastic, use extreme care not to strip the mating plastic part(s). Use hand tools only, and do not use any kind of impact or power tools. Fastener should be hand tightened, fully seated, and not stripped.

3. Install the 9 intake manifold nuts (3) and tighten to **22 Nm (16 lb ft)**.

! WARNING

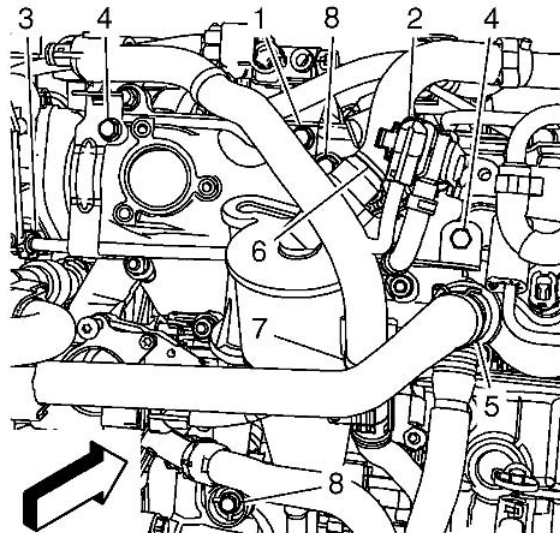
See *Intake manifold removal*.

4. Install the fuel injection pump bracket stud (1).

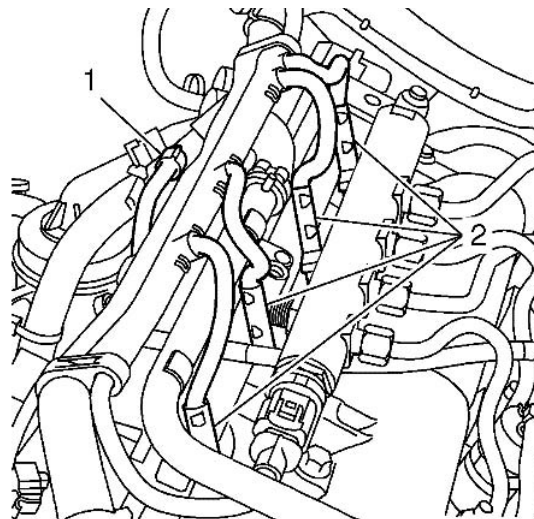
! WARNING

See *Intake manifold removal, step 13*.

5. Plug the connector (1) of the combustion circulation actuator, see *Intake manifold removal, step 13*.

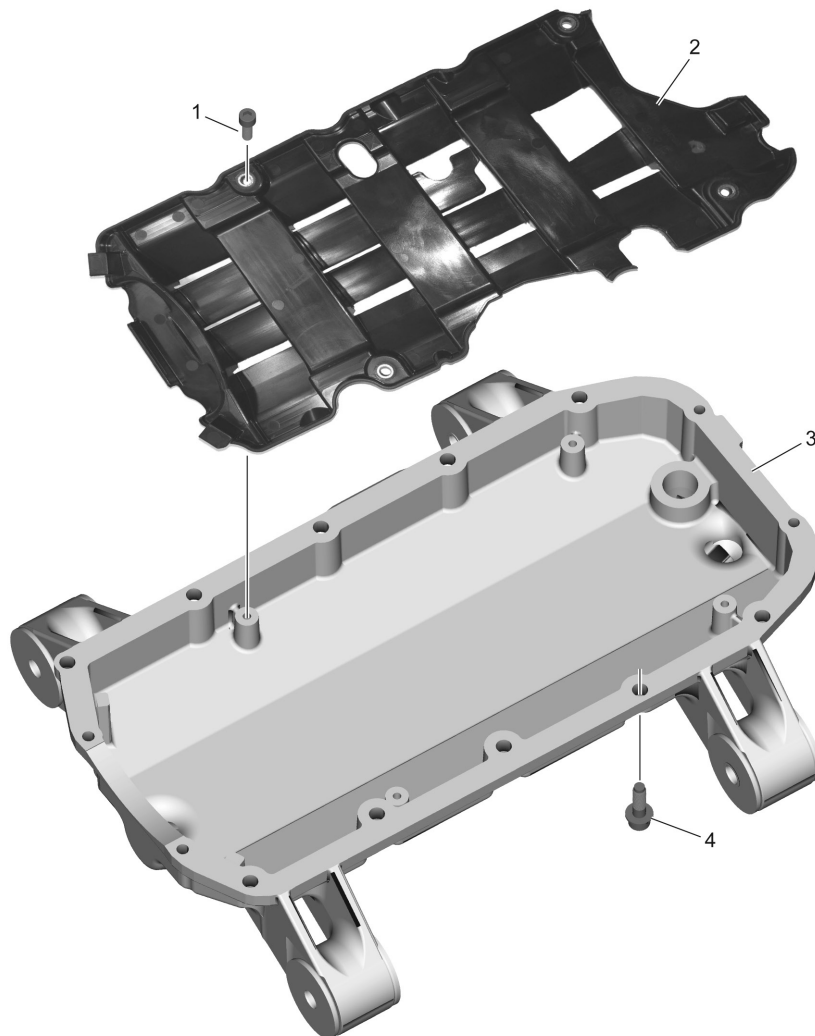


6. Position the exhaust pressure pipe and install the retaining fasteners (4) and tighten to **9 Nm (80 lb in)**.
7. Connect the exhaust pressure pipe hose and position the clamp (3).
8. Connect the exhaust pressure sensor harness connector.
9. Install the PCV oil separator to the engine block, and tighten the fasteners (8) and tighten to **9 Nm (80 lb in)**.
10. Connect the upper PCV oil separator hose connection (6).
11. Install the retaining clips (7).
12. Attach the coolant hose quick connection (5).
13. Attach the engine control module wiring harness bracket fastener (1) and tighten to **9 Nm (80 lb in)**.



14. Plug in the intake air sensor connector (1) and the glow plug connectors (2).
15. Fit the fuel pump, see **Fuel injection pump replacement**.
16. Connect an exhaust hose and start the engine. Check there are no leaks. Connect the diagnostic tool and clear any DTCs.

DRY SUMP AND OIL PAN BAFFLE REPLACEMENT



OIL PAN BAFFLE REMOVAL

1. Loosen 8 bolts (4) and remove the drysump (3)
2. Remove the 4 oil pan baffle bolts (1).
3. Remove the oil pan baffle (2).

OIL PAN BAFFLE INSTALLATION

1. Install the oil pan baffle (2).



WARNING

See **Fastener**.

2. Install the 4 oil pan baffle bolts (1) and tighten to **9 Nm (80 lb in)**.
3. Reinstall the drysump (3) and tighten 8 bolts (4)..

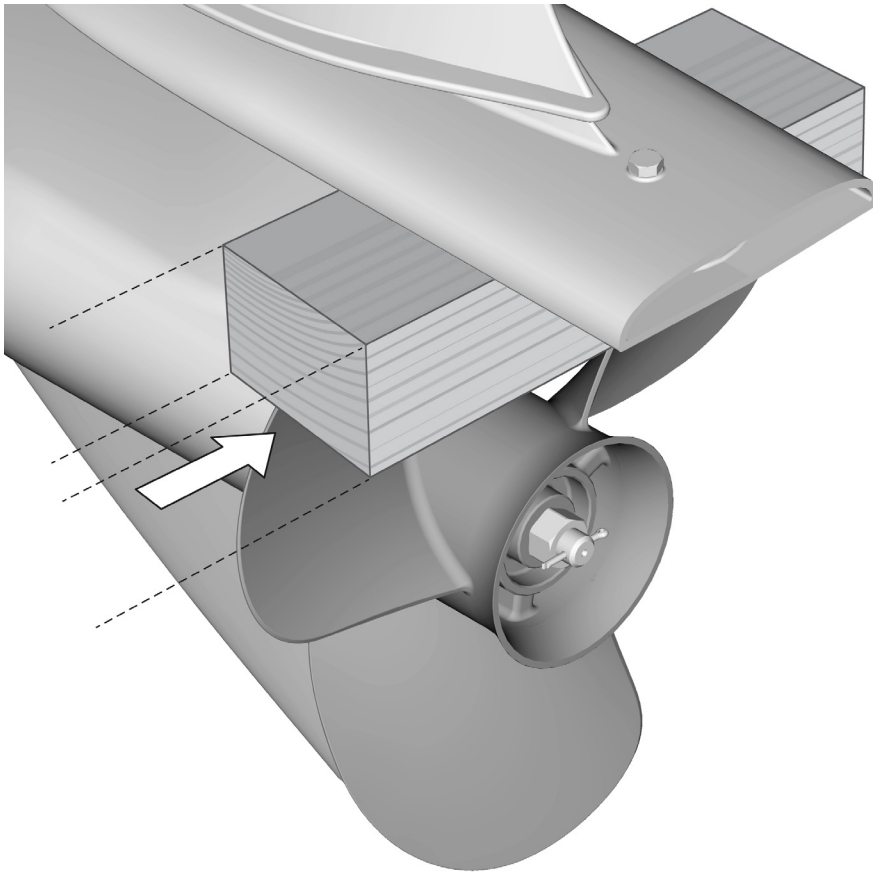
PROPELLER REPLACEMENT

PROPELLER REMOVAL

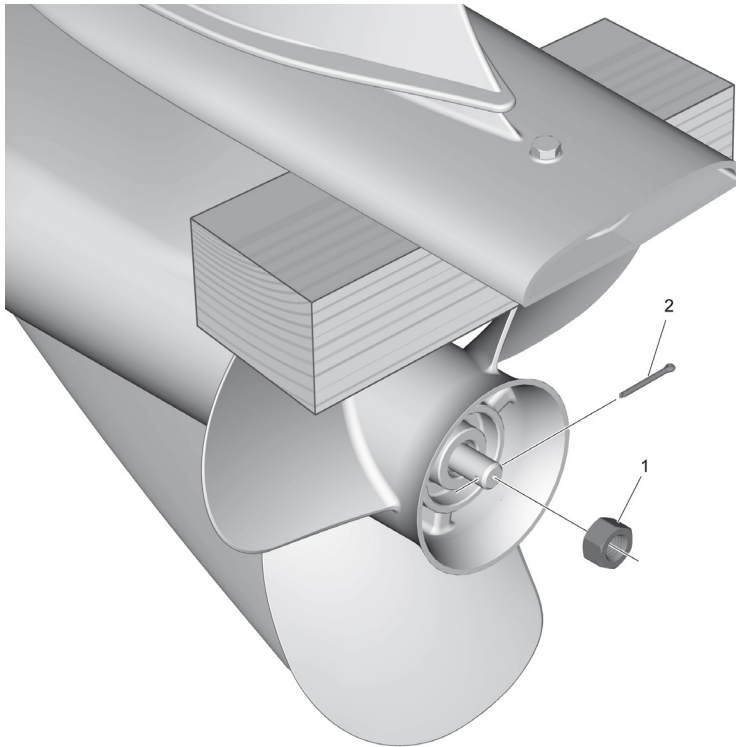


DANGER

Do not use any body parts to hold the propeller when loosening or tightening the propeller nut.

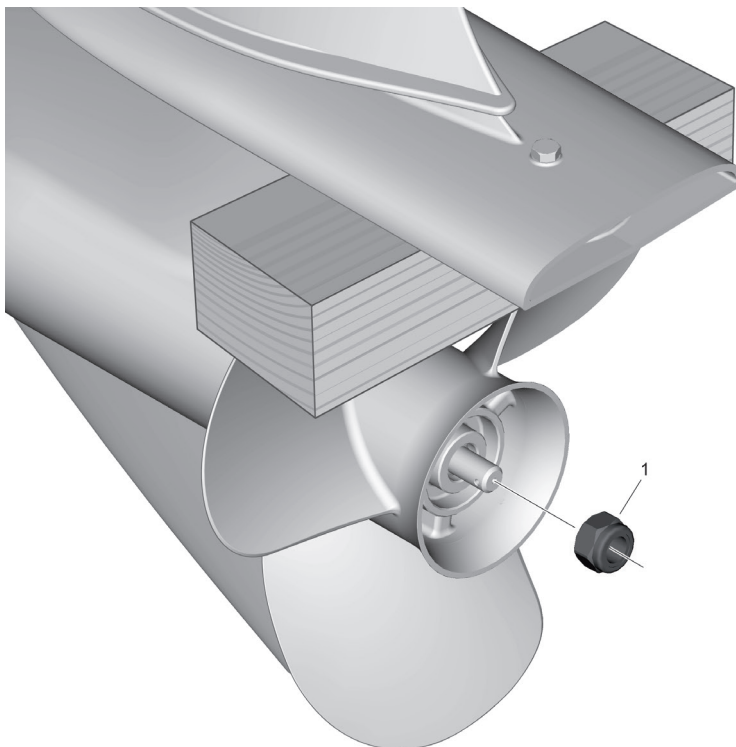


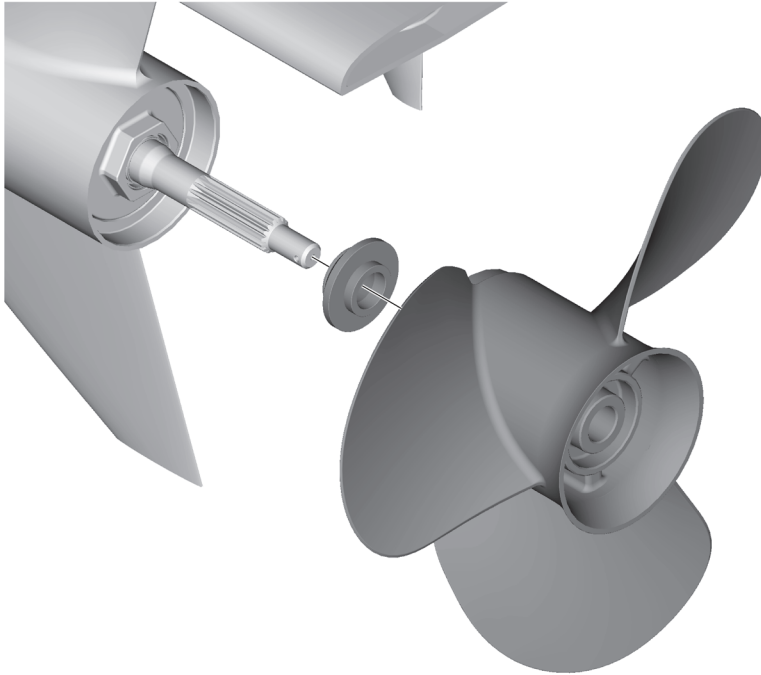
1. Place a wooden block between the anti-cavitation plate and the propeller in order to prevent the propeller from moving.



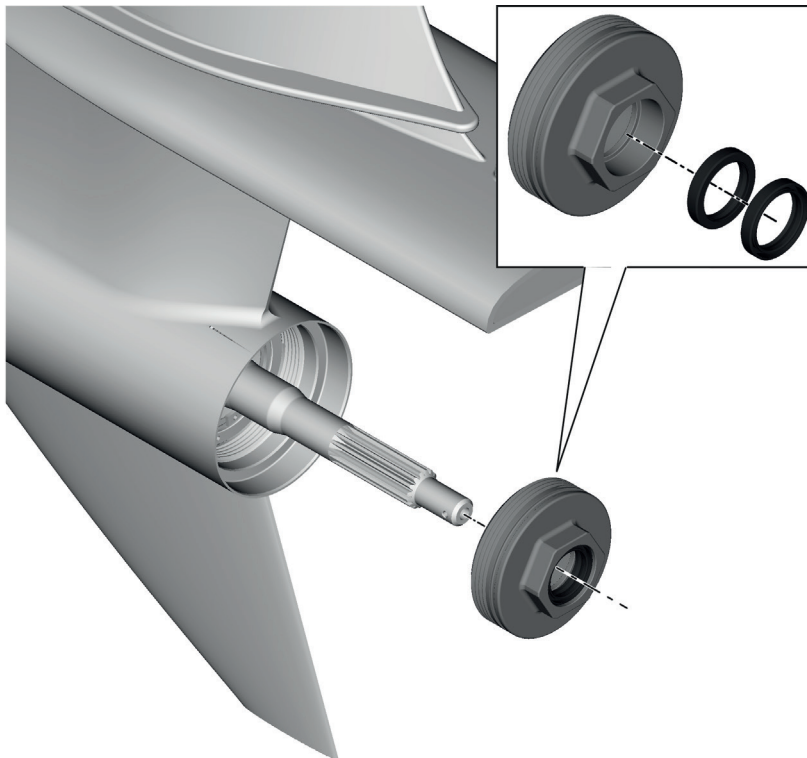
1. Straighten the cotter pin **(2)** and pull it out using a pair of pliers.
2. Remove the propeller nut **(1)**.

NOTE! Some engines are equipped with a Nyloc-lock nut **(1)** and do not have a cotter pin. **Never reuse** a Nyloc-locking nut!





3. Remove the propeller and thrust washer.

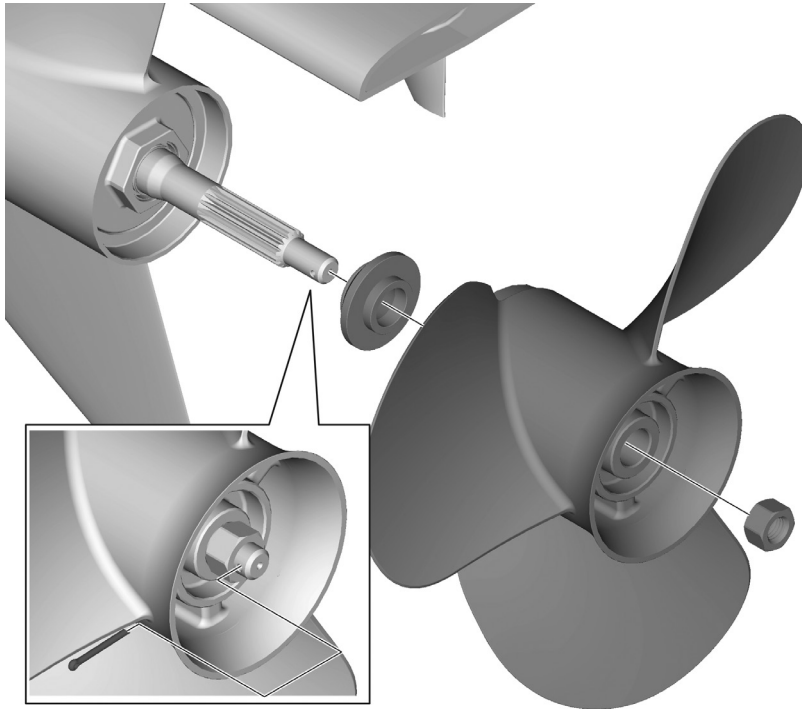


4. Check the oil seals for leakage.

NOTE! If the oil seal looks leaks, is damaged, or worn, refer to **Lower belt replacement, No 16**, for sealant replacement.

PROPELLER INSTALLATION

NOTE! A hub kit is recommended when installing a propeller.

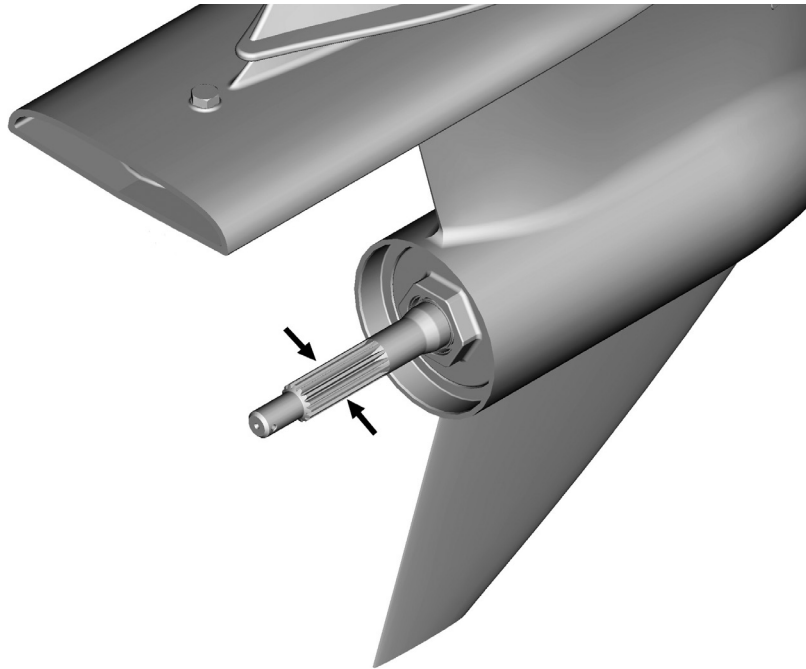


1. Replace the thrust washer, the propeller and the nut.
2. Fit a **new** cotter pin and secure or fit a **new** locking-nut.

⚠ CAUTION

Be sure to use a new cotter pin and bend the ends over securely. Otherwise

the propeller could come off during operation and be lost.

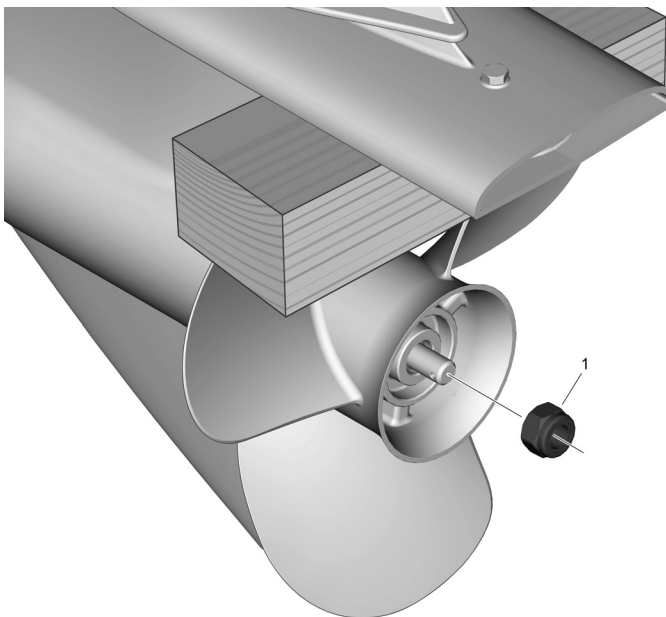


3. Apply marine grease or a corrosion resistant grease to the propeller shaft. Refer to **Recommended fluids and grase.**

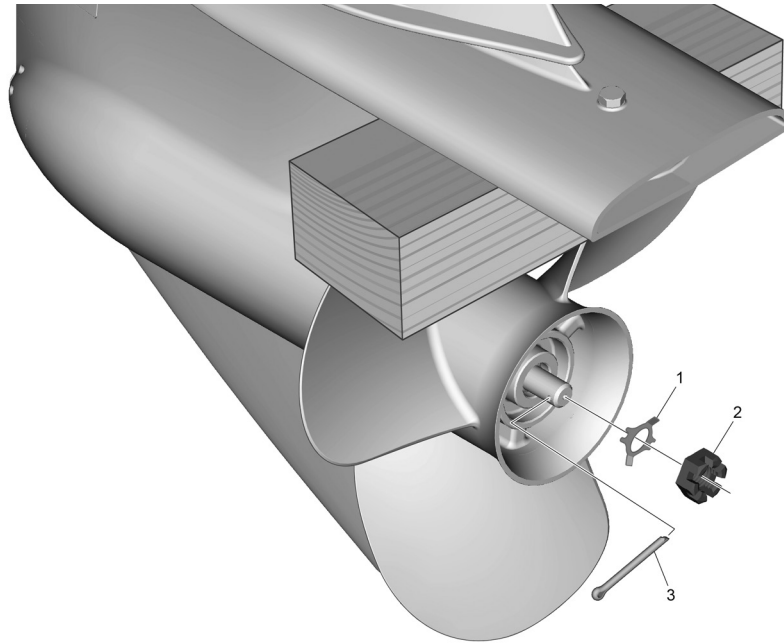
4. Install the propeller washer and propeller on the propeller shaft.

NOTE! Be sure to install the propeller washer before installing the propeller, otherwise the lower case and propeller boss could be damaged.

NOTE! Some outboards are equipped with a Nyloc locking nut (1) and do not have a cotter pin. Do **NOT** reuse a Nyloc locking nut!



NOTE! Some models use a retainer (1) and a castlrelated nut (2) combined with a cotter pin (3).



5. Tighten the propeller nut to the specified torque.
***Propeller nut tightening torque:
55.0 Nm (5.61 kgf-m, 40.6 ft-lb).***
6. Align the propeller nut with the propeller shaft hole. Insert a new cotter pin in the hole and bend the cotter pin ends.

NOTE! Do not reuse the cotter pin or Nyloc-nut installed. Otherwise the propeller can come off during operation.

NOTE! If the propeller nut does not align with the propeller shaft hole after tightening to the specified torque, tighten the nut further to align it with the hole.

Ensure that the propeller is undamaged and rotates freely of the lower housing.

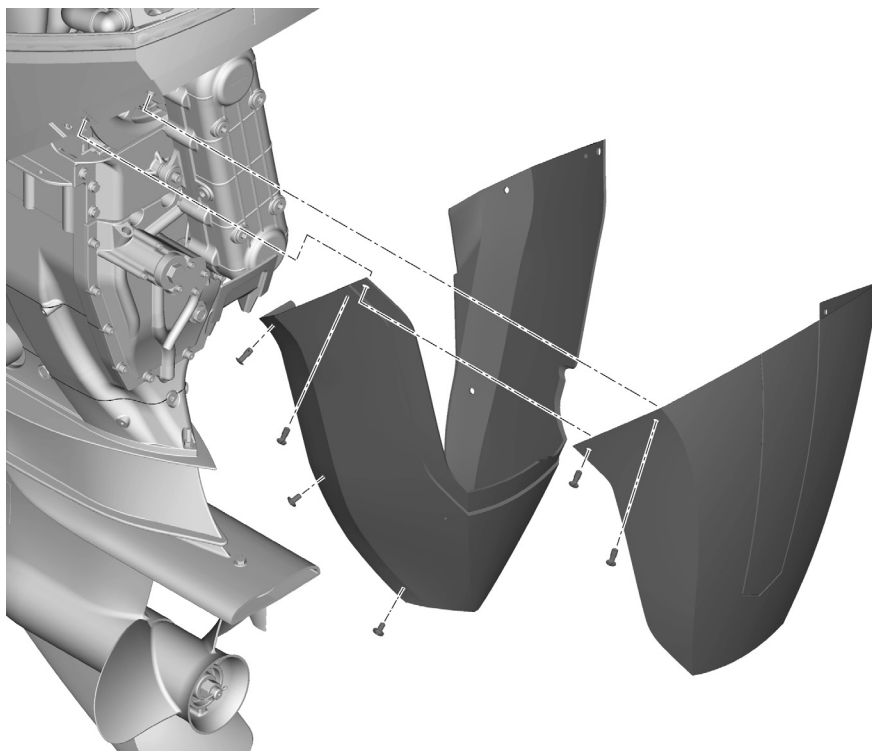
NOTE! Always have an extra propeller including necessary tools on board.

LOWER BELT REPLACEMENT

169

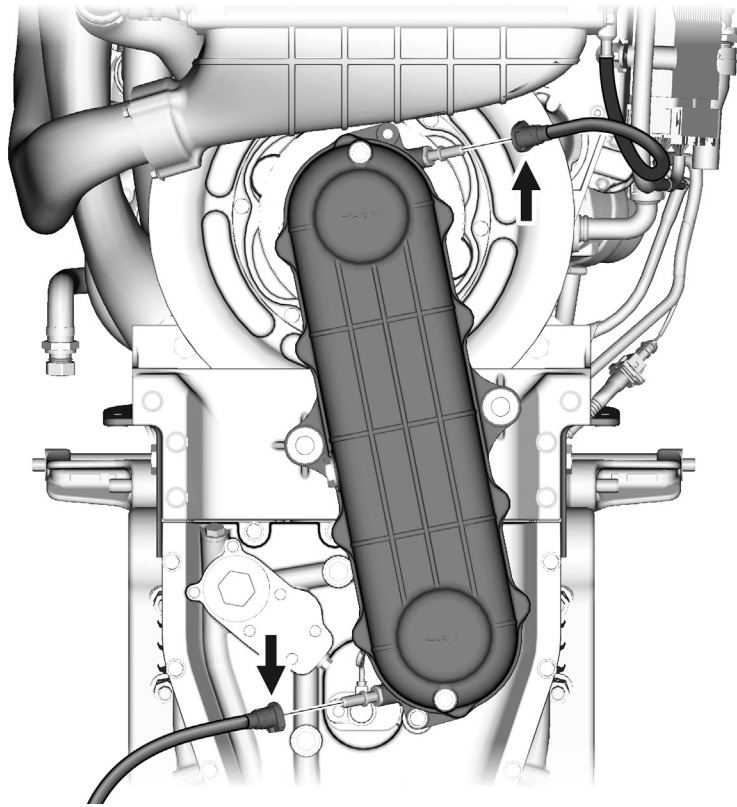
COWLING REMOVAL

1. Remove the top cowl. Refer to ***Remove and install the top cowl.***

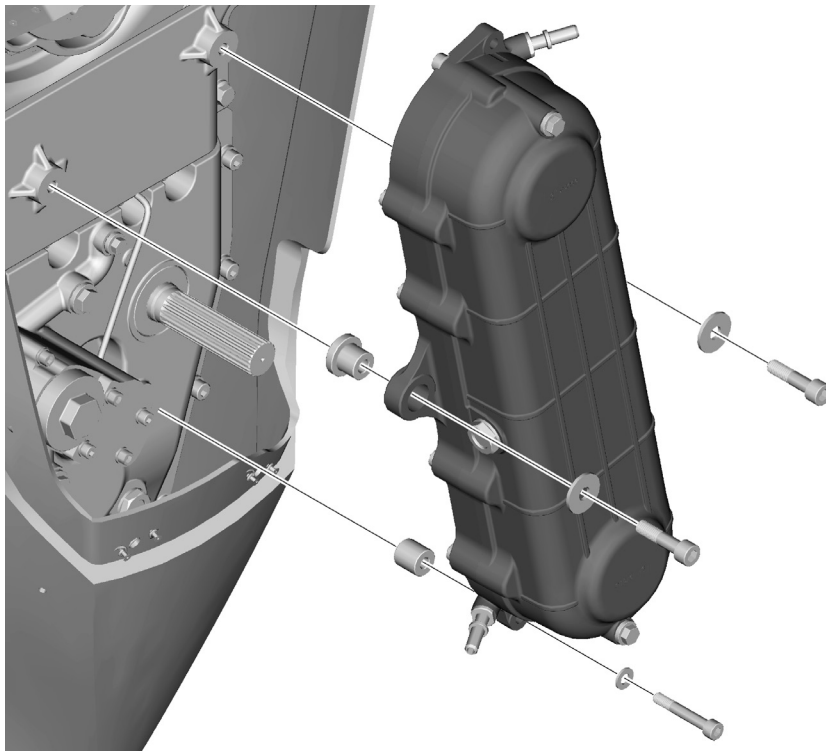


2. Remove the screws and washers of the back cowl.
3. Remove the back cowl.

UPPER BELT HOUSING REMOVAL



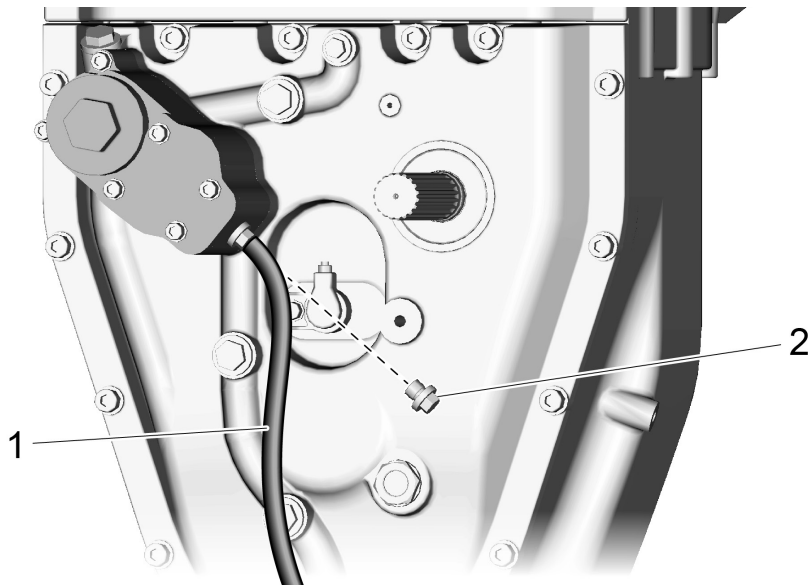
- 4.** Disconnect the cooling water hoses from the upper belt housing.



- Loosen bolts and remove the upper belt housing.

NOTE! Do not loose the mounting hole bushings!

DRAINING HYDRAULIC OIL IN GEARBOX

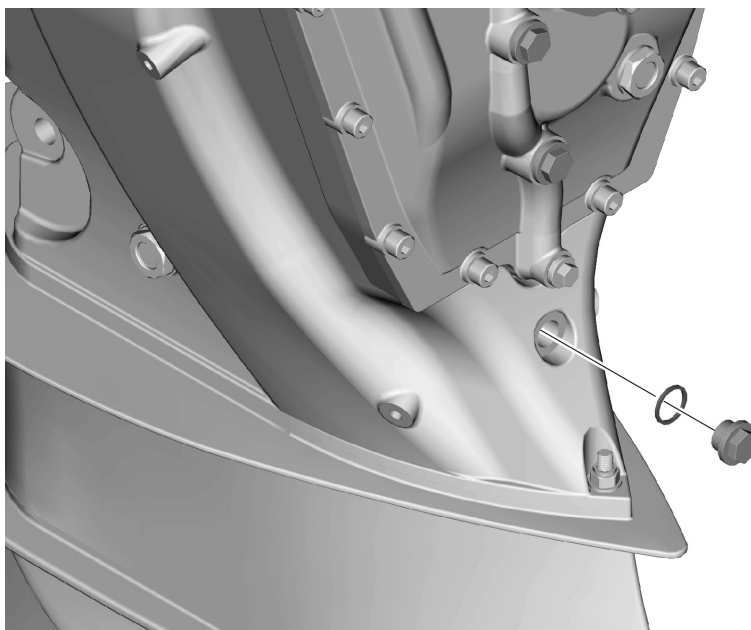


NOTE! When performing **800h service** it is necessary to remove the hydraulic pump. Refer to **Hydraulic pump replacement**.

- Remove the magnetic plug and washer. Use an oil extractor and extract the hydraulic oil into a suitable container.

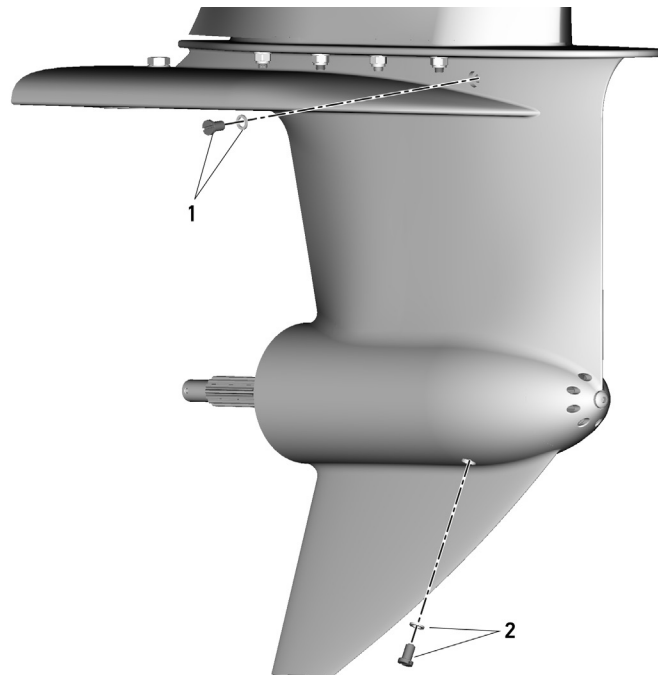
⚠ CAUTION

Risk of contamination of drinking water. Dispose of oil according to local environmental legislation!

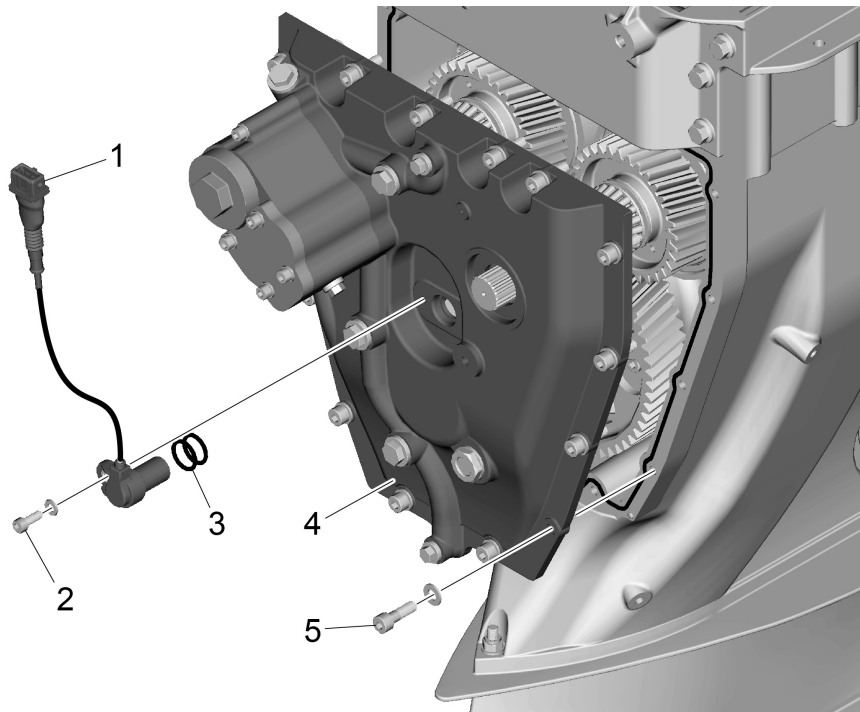


- Remove the magnetic plug and O-ring. Drain any remaining gear oil into a suitable container.

DRAINING HYDRAULIC OIL IN LOWER HOUSING



8. Remove the magnetic plug and washer **(1)**.
9. Remove the magnetic plug and washer **(2)**. Drain the lower belt oil into a suitable container.

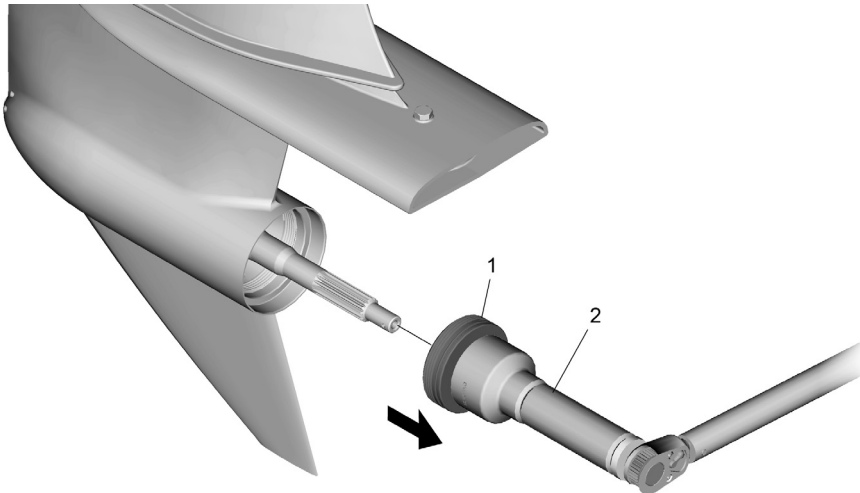


10. Take off the propeller speed sensor. Secure the speed sensor so it will not disturb the gear box dismantling.
11. Remove 14 screws with washers and take off the gearbox housing lid.

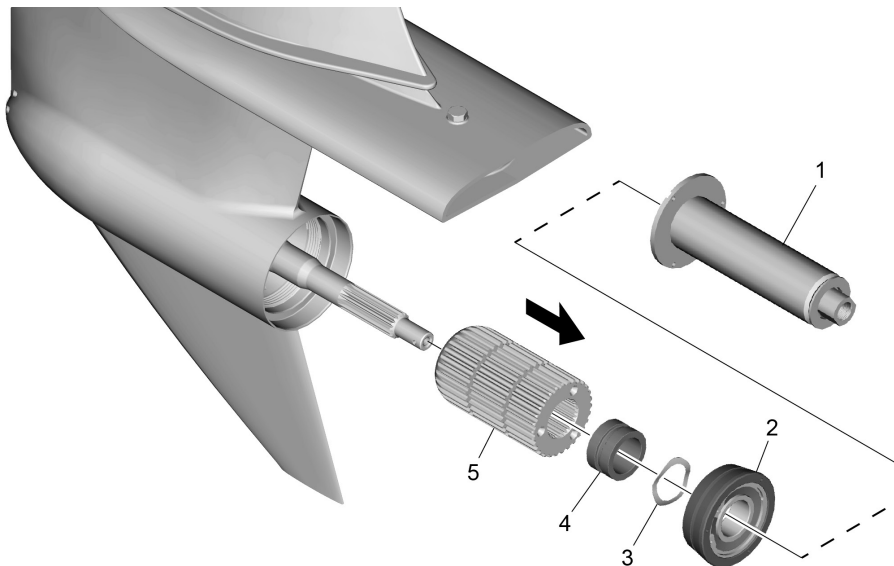
LOWER HOUSING DISASSEMBLY

Special tools

- 30-0160-008 ODT 50mm Nut removing tool
- 30-0160-110 Propshaft bearing remove/mount tool



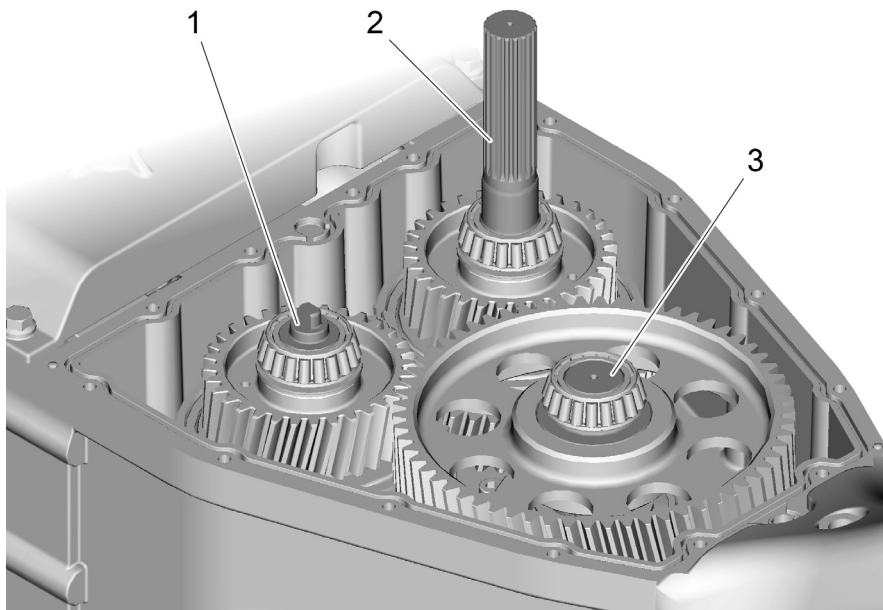
1. Remove the propeller nut **(1)** using the 50 mm Nut removing tool **(2)**.



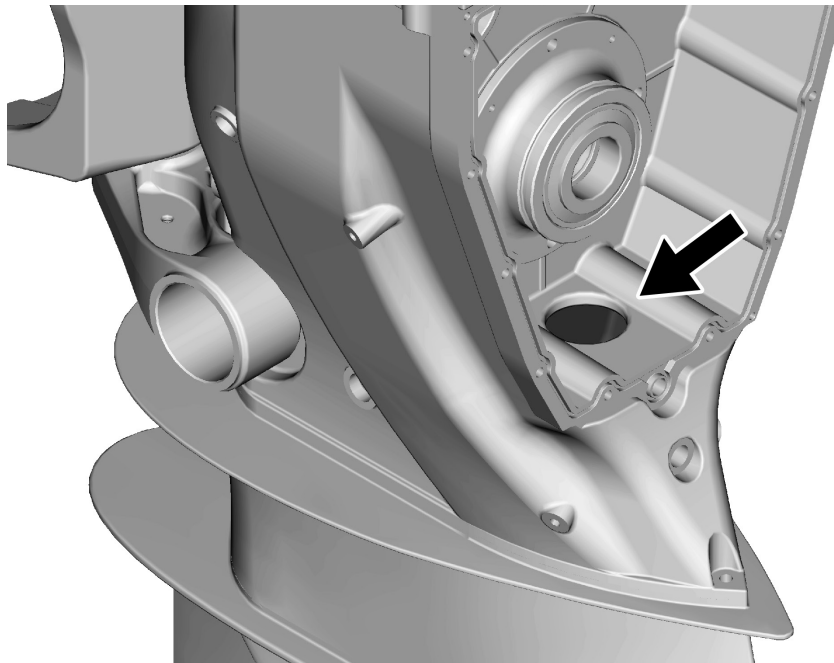
2. Remove the outer bearing using **(2)** the Propshaft bearing remove/mount tool **(1)**.
3. Remove the propeller shaft spring washer **(3)** and propeller shaft spacer **(4)**.
4. Remove the belt pulley **(5)**.

NOTE! The use of one or two M6 screws might facilitate removing the belt pulley.

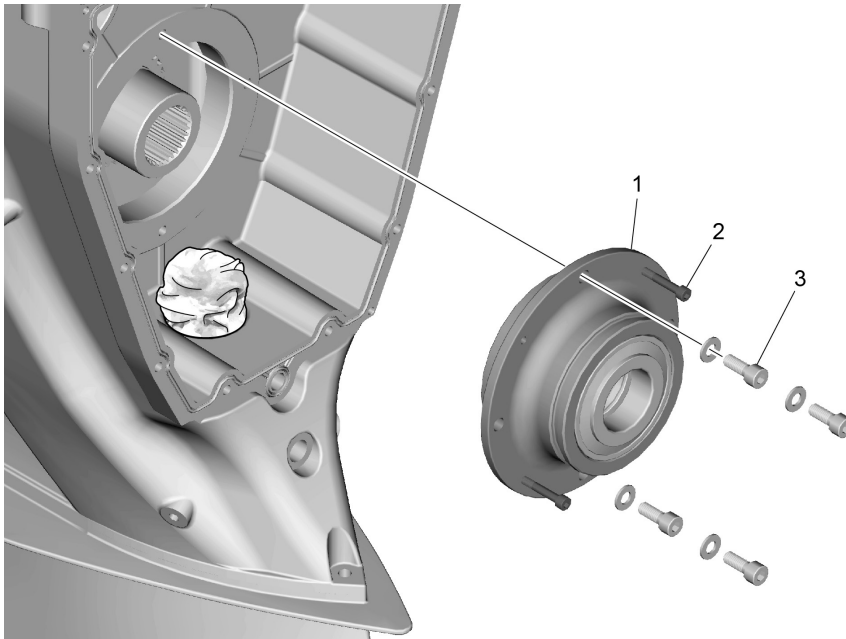
GEARBOX DISASSEMBLING



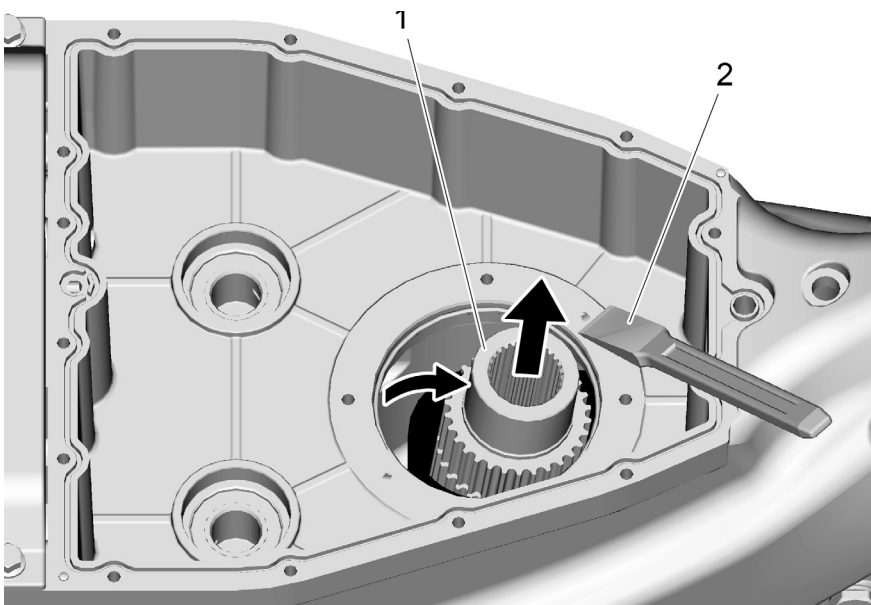
1. Remove the gearbox shafts starting with the output shaft **(3)**.
2. Remove the port shaft **(1)** and the starboard input shaft **(2)**.



3. Make sure to cover the hole at the bottom of the gear case, not to drop any tools or impurities into the belt housing.



4. Remove 4 bolts and washers (2).
Use two M6 Allen-screws (3) with rounded ends to remove the bearing housing (1). Screw the bolts inwards in an alternating fashion, half a turn each time, in order to keep a parallel motion out of the seat of the bearing.
5. Check the O-ring, replace if damaged or worn.



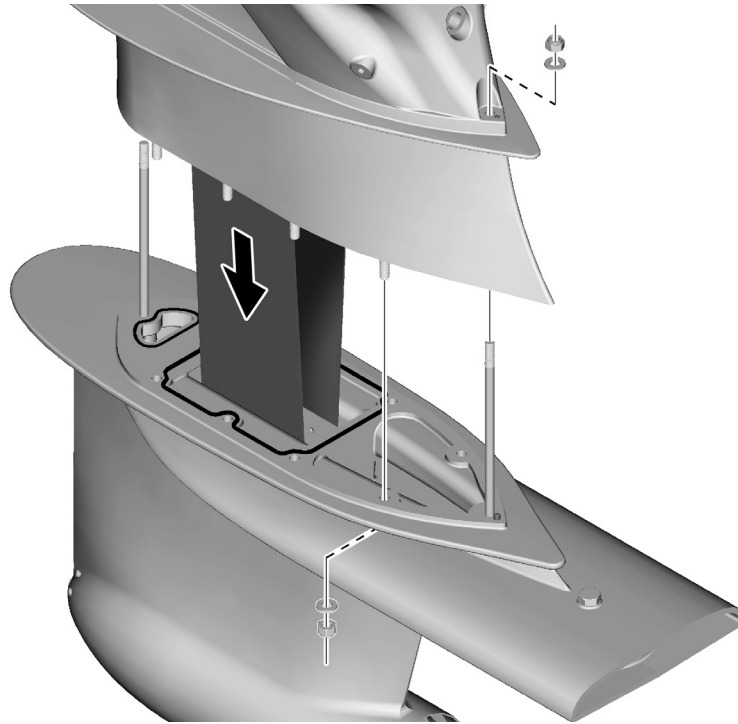
6. Remove shaving and foreign debris.

⚠ CAUTION

Ensure to remove any material shavings in order not to enter the lower housing or remain in the gearbox.

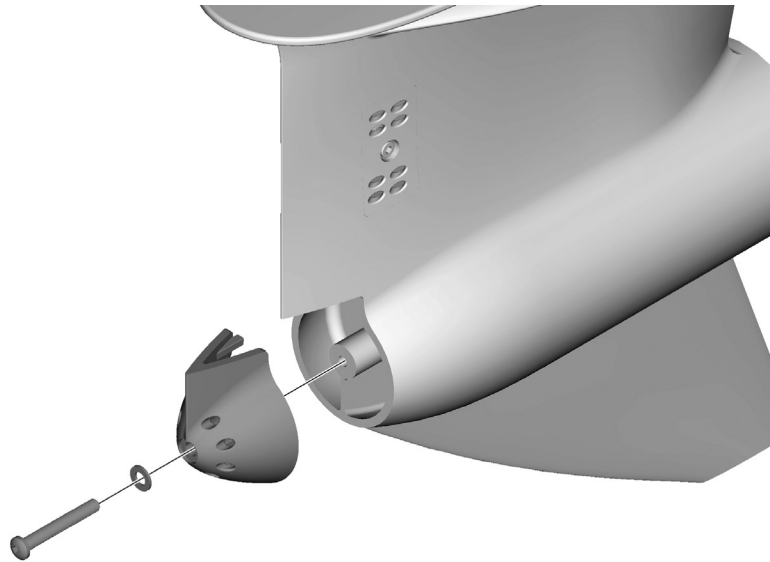
7. Lean the pulley downwards before removing it from belt and housing.

Remove lower housing

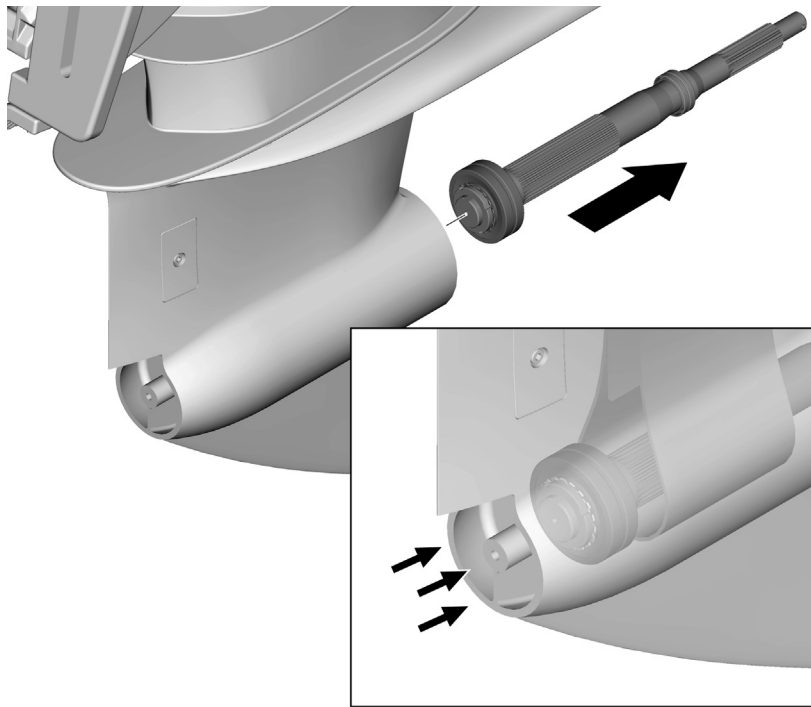


1. Remove 8 short nuts and washers. Leave the 2 long bolts, not to drop the lower housing.
2. Remove the 2 long bolts and pull down the lower housing including belt and adapter plate.

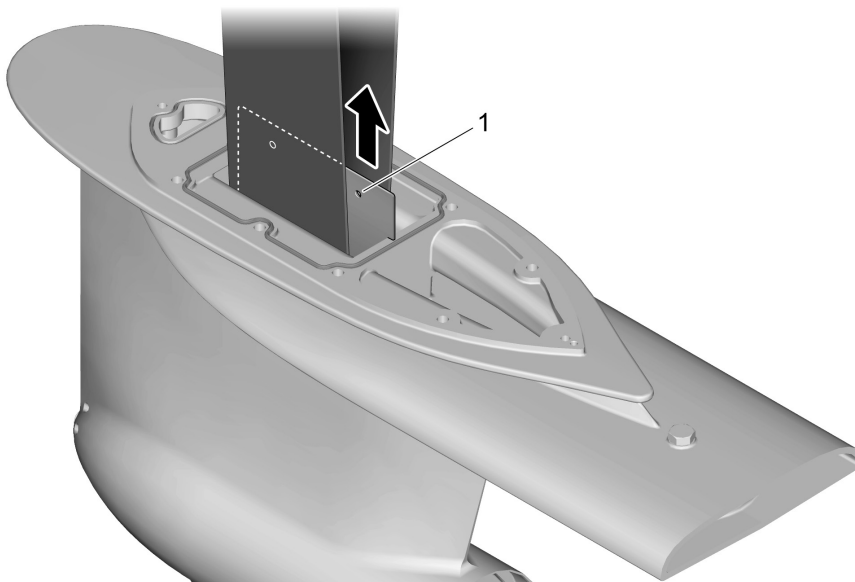
Propeller shaft removal



1. Loosen the nose cone bolt and remove the nose cone.

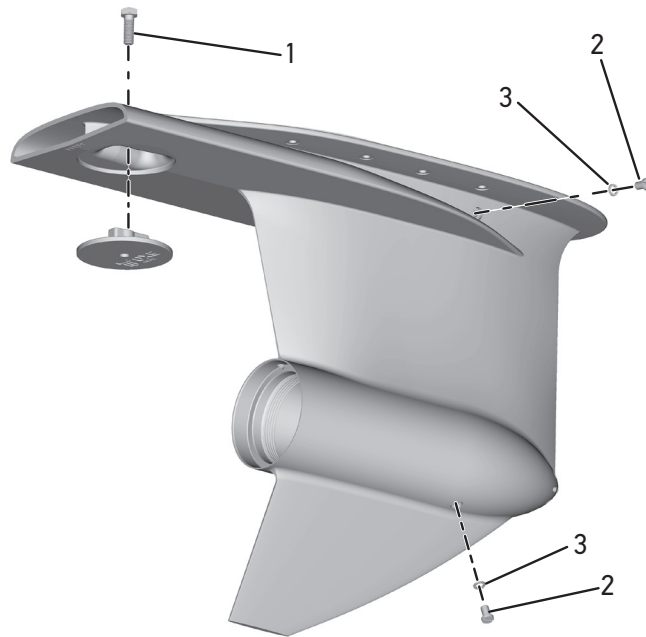


2. Heat **the area behind the nose cone** until the bearing is released.
3. Pull out the propeller shaft and bearing.

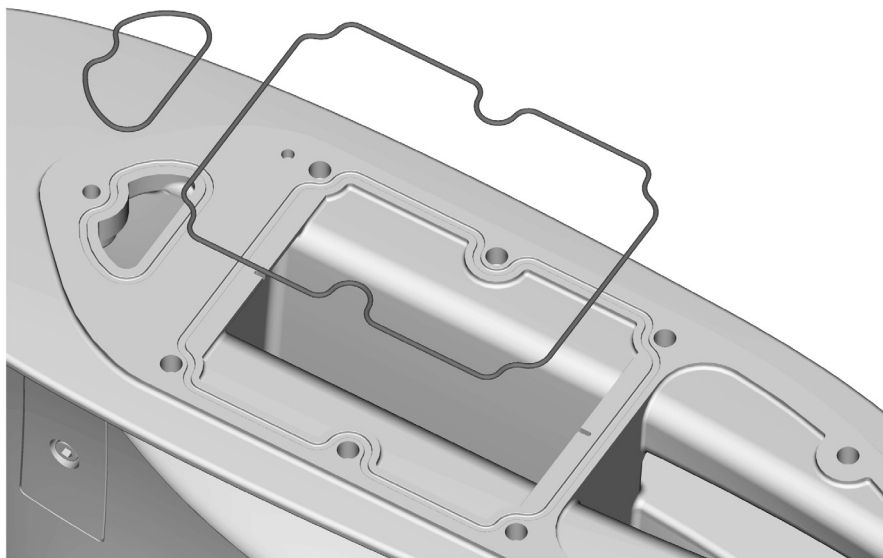


12. Remove the divider plate. Use a tool that fits into the holes in the upper end of the plate to pull it up.
13. Pull up the lower belt.

LOWER BELT INSTALLATION



1. Install a **new** anode (1).
2. Clean oil plugs (2), Fit **new** washers (3) and install. Tighten to **9 Nm (6.63 lb ft)**.



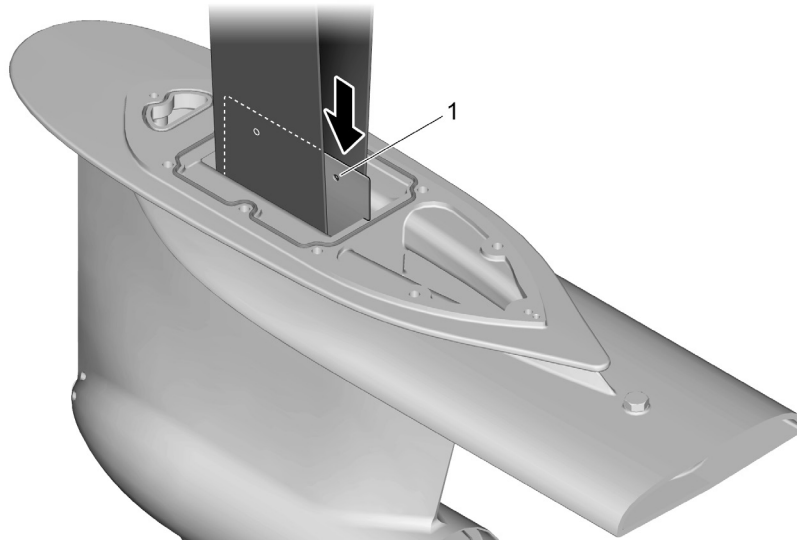
3. Fit **new** O-rings.

4. Place the parts of the lower belt housing on a working bench. Place the **new** lower belt into the lower housing with care using a **wooden board with a rounded edge**.

NOTE! Rotate the belt 10 cm in order to avoid sharp folds. Maintain a loop big enough to freely insert the propeller shaft and bearing.

 **CAUTION**

Sharp folds could damage the lower belt and shorten its life span.



 **CAUTION**

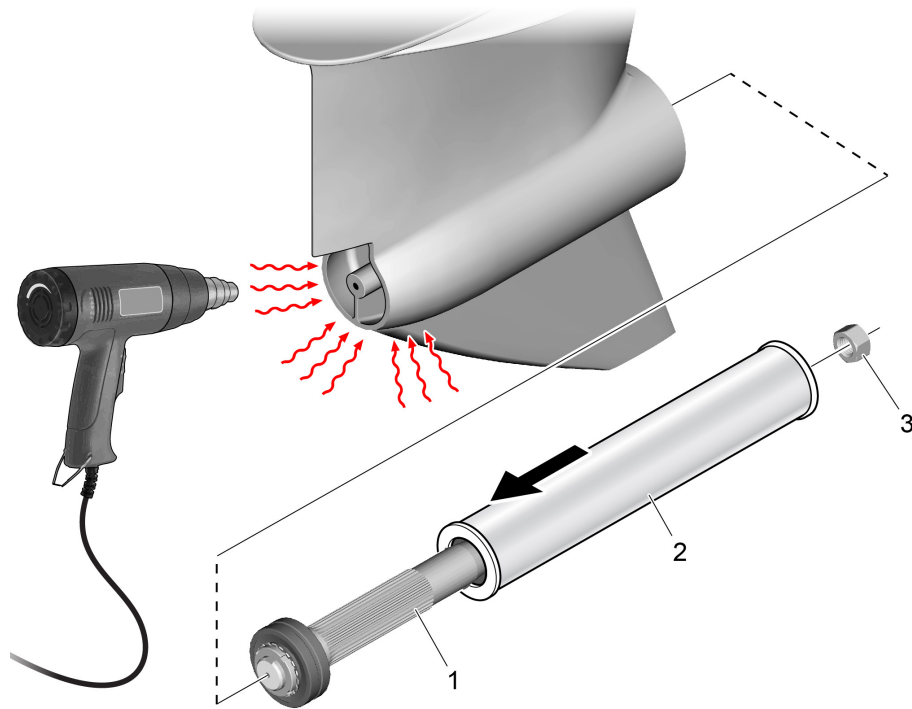
Never reuse a belt. Always install a **new** belt!

5. Install the divider plate. Use some tool to fit into the holes (1) in order to ease the mounting.

 **CAUTION**

The divider plate is very tightly seated. Grinding for easier mounting is **not** allowed!

Reinstall the propeller shaft



14. Slide the propshaft bearing fixing tool (2) on to the propeller shaft (1) until it is in close contact with the spherical bearing.
15. Secure the propshaft bearing fixing tool with the propeller nut (3).
16. Gently heat **the area behind the nose cone** with a heat gun.

 **DANGER**

Do not exceed 110°C. Slowly rotate the belt to avoid pointed heating.

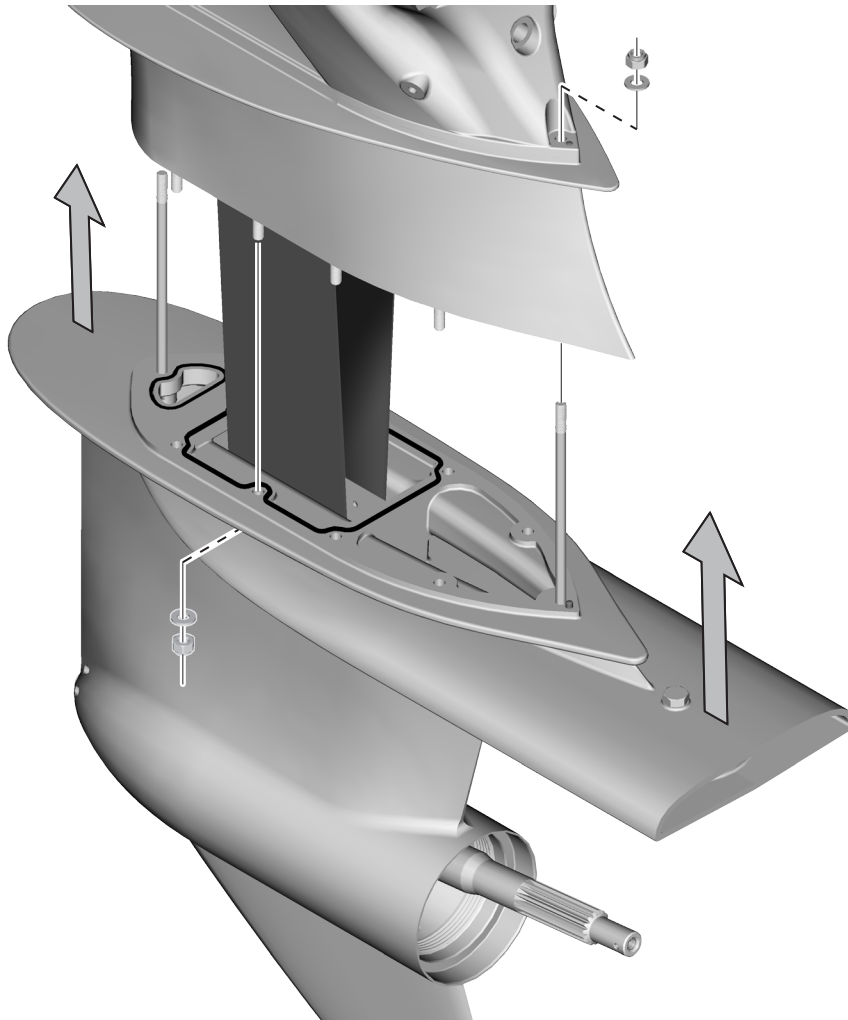
17. Reinstall the shaft and bearing.

NOTE! Every time this operation fails and the bearing skew, the area behind the nose cone has to be heated up again. Therefore move the belt about **10 cm (4 in)** prior to each heating operation.
18. Insert the propeller shaft bearing fixing tool and spherical bearing into the propeller shaft housing.

The tool (2) centers the spherical bearing into the bearing race. When the bearing is in place, remove the propeller shaft bearing fixing tool.
19. Reinstall the nose cone.
20. Slide the propeller belt through the adapter into the upper housing. The resilience of the belt will make it stay in place.

**CAUTION**

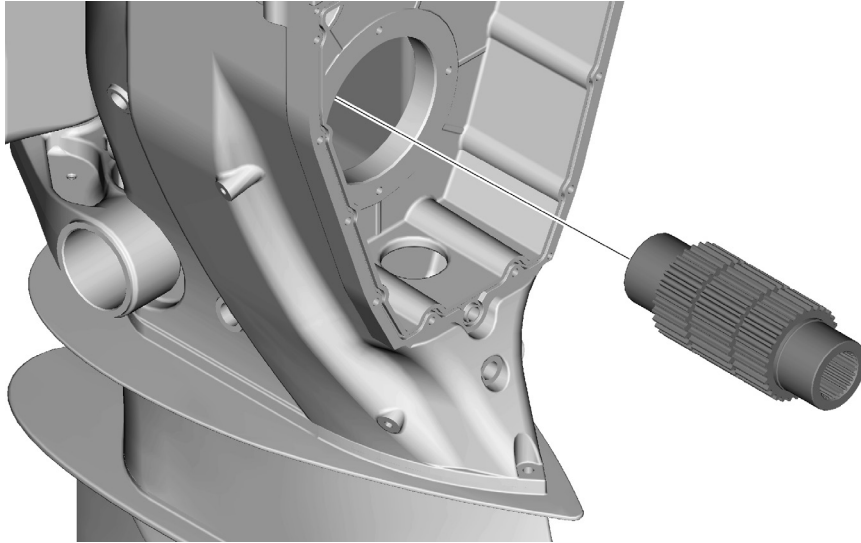
Sharp folds could damage the lower belt and shorten its life span.

Reinstalling the lower housing

Start off with the 2 long bolts in order to position the keep the lower housing in place while applying washers and nuts to the short bolts joining the lower and upper housing.

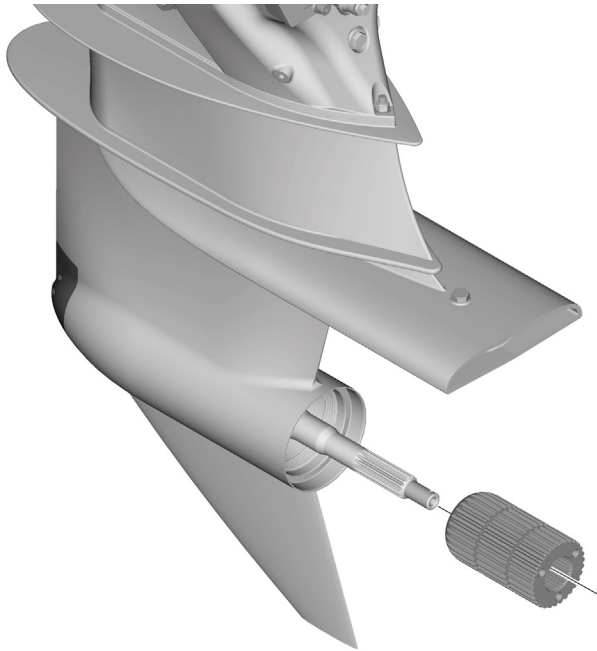
Tighten the bolts from the center and outwards, refer to gearbox lid.

Tighten to **25 Nm (18.44 lb ft)**.



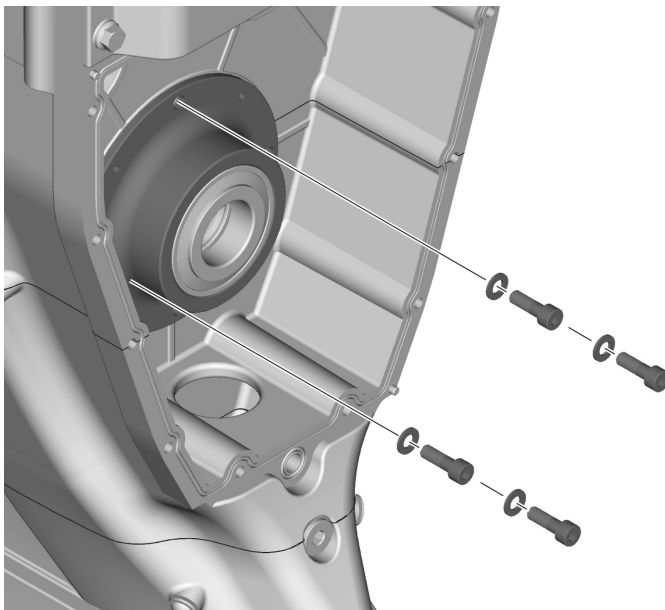
NOTE! Lean the propeller shaft upwards to facilitate reinserting the belt pulley.

- 1.** Reinsert the belt pulley through the upper loop of the belt by leaning the rear of the pulley down and aiming the front of the pulley in to the bearing race.
- 2.** Joggle the upper and the lower belt pulley up and down until the belt fits properly on both pulleys.



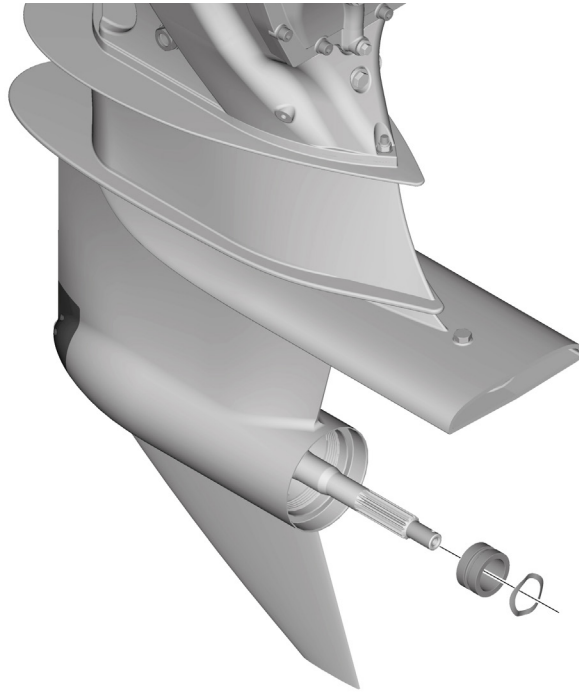
3. Reinstall the lower belt pulley on the propeller shaft.

REINSTALLING BEARING HOUSING IN GEARBOX

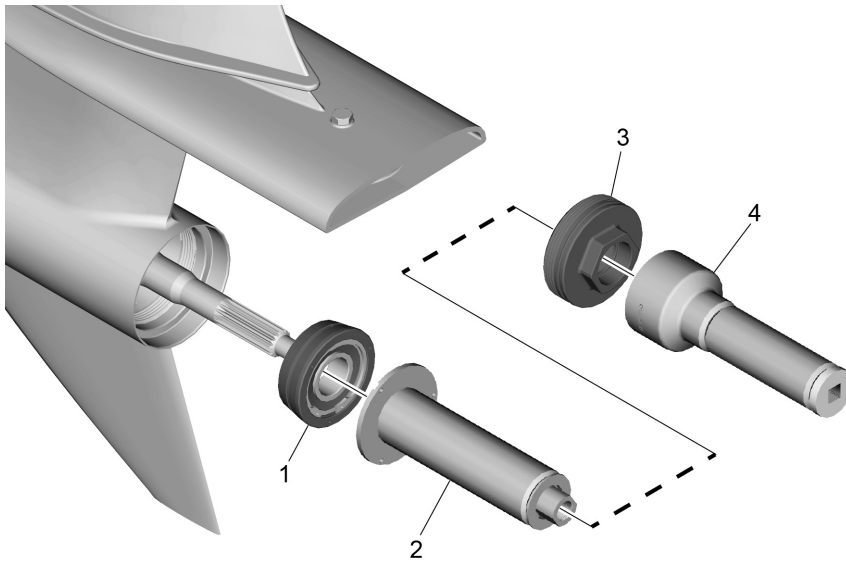


1. Reinstall bearing housing, 4 bolts and washers.
NOTE! This procedure is tricky. Guide the bearing housing in position with one of the bolts, alternately hammering with a plastic mallet until the bearing housing slides into places.
2. When in place, cross-tighten the bolts to **25 Nm (18.44 lb ft)**.

REINSTALLING PROPELLERSHAFT COMPONENTS



1. Reinstall the propeller shaft distance and spring washer.

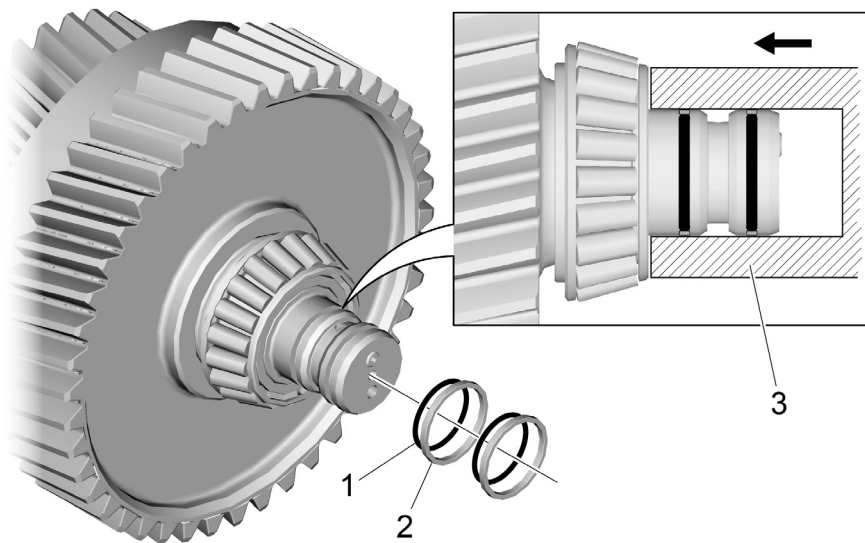


! CAUTION

Check that the oil seals are undamaged. Replace if necessary.

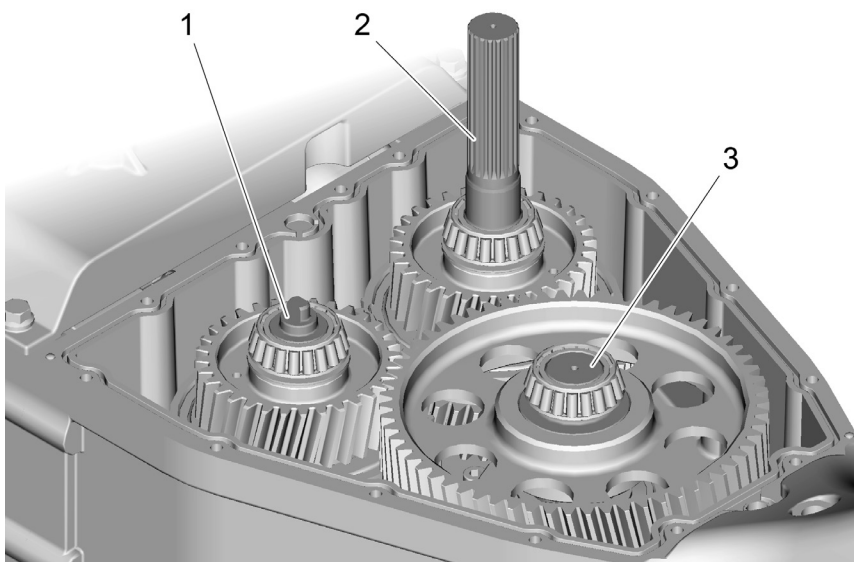
2. Use the Propshaft bearing mounting tool **(2)** to reinstall the propeller shaft outer bearing **(1)**.
3. Use the 50mm Nut removing tool **(4)** and reinstall the retainer **(3)**.

REASSEMBLING THE GEARBOX COMPONENTS

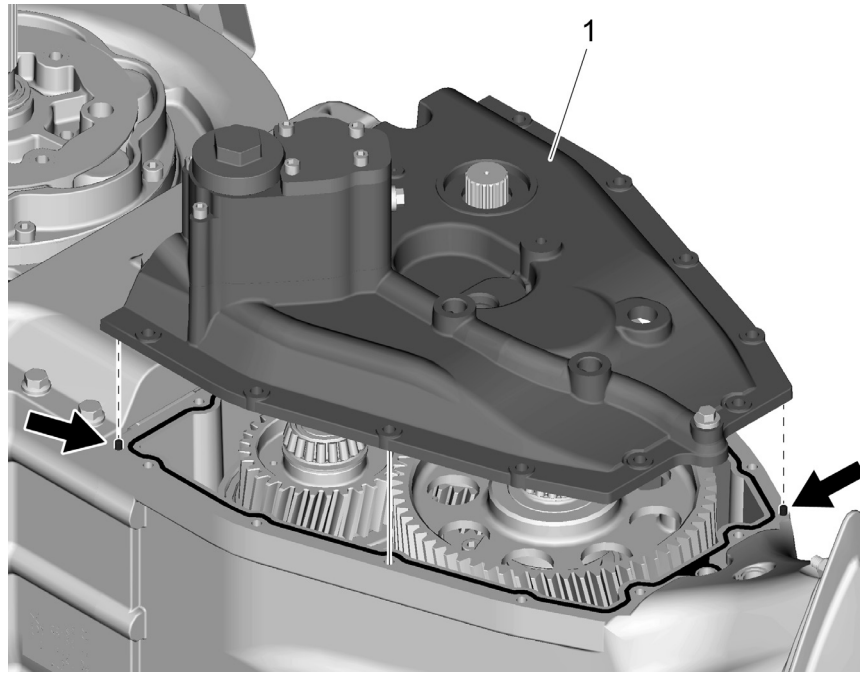


1. Check shaft wear.
2. Replace the O-rings **(1)** if worn.
3. Fit **new** radial seals **(2)** onto the gearbox shafts using the seal forming tool **(3)**.

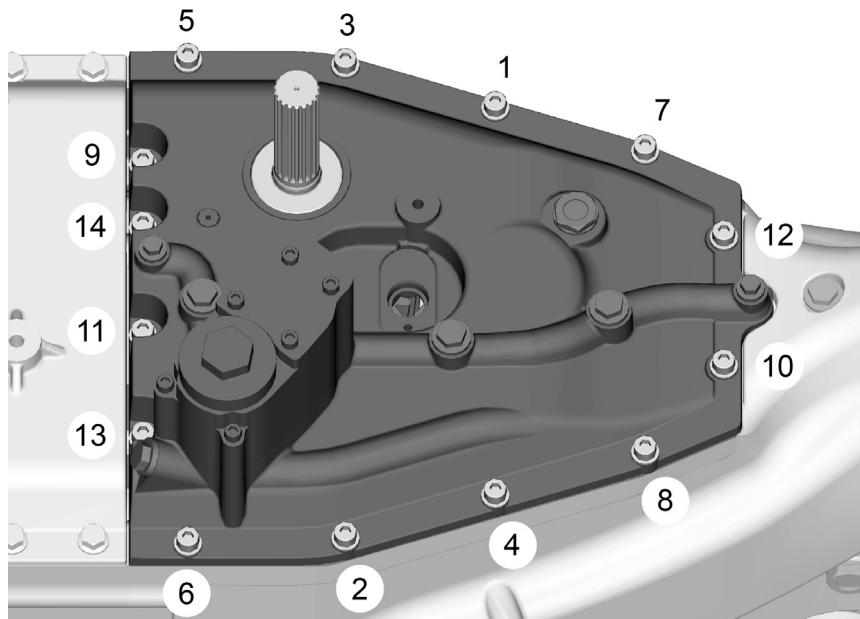
NOTE! that the O-rings go into the shaft slots prior to the radial seals. Take care not to deform the radial seals excessively when installing them.



4. Reinsert the gearbox shafts in the following order: Port shaft **(1)**, starboard input shaft **(2)** and output shaft **(3)**.
Apply marine grease to shafts and gear wheels. Refer to **Recommended fluids and grease**.
5. Clean the the gear box and the gear box lid mounting surface.



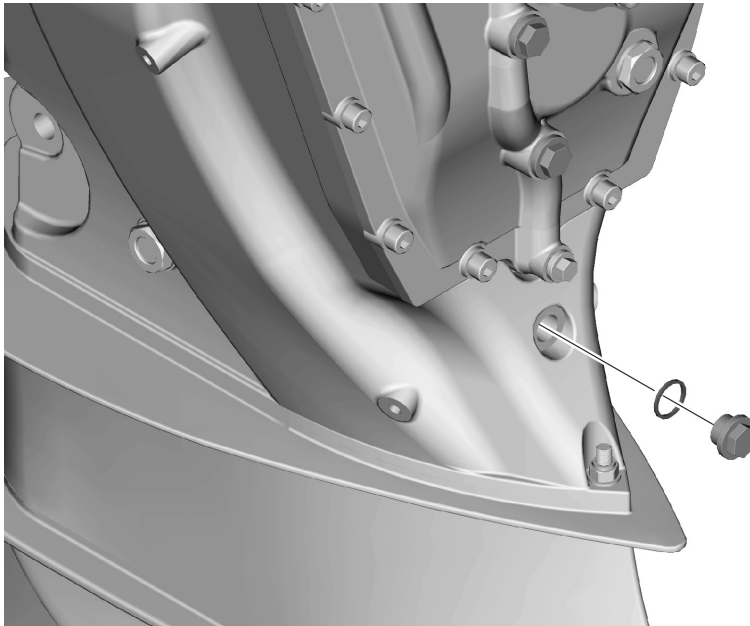
6. Fit a **new** O-ring.
7. Prior to installing the gear house lid (**1**), insert the two housing lid guide pins (Part No. 30-0122-230) into their holes respectively.



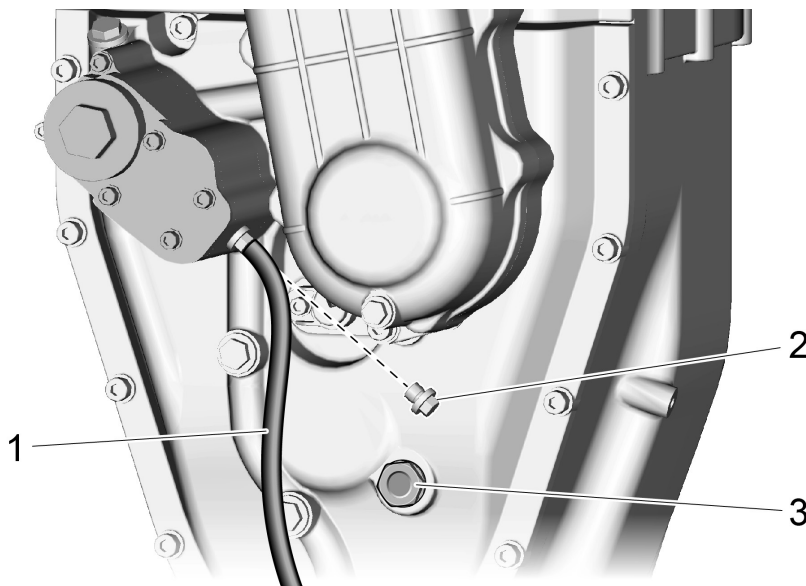
8. Reinstall the gear box lid. Put Loctite on the 14 screws, fit washers on each and tighten with **25 Nm (18.44 lb ft)**.
9. Fit the hydraulic pump coupling to the port shaft and install the pump.
NOTE! Rotate the input shaft until the hydraulic pump coupling snaps into place.

REFILL HYDRAULIC OIL

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1. Clean the magnetic plug.
2. Fit the plug with a **new** O-ring.
3. Reinstall and tighten to **30 Nm (22.127 lb ft)**.



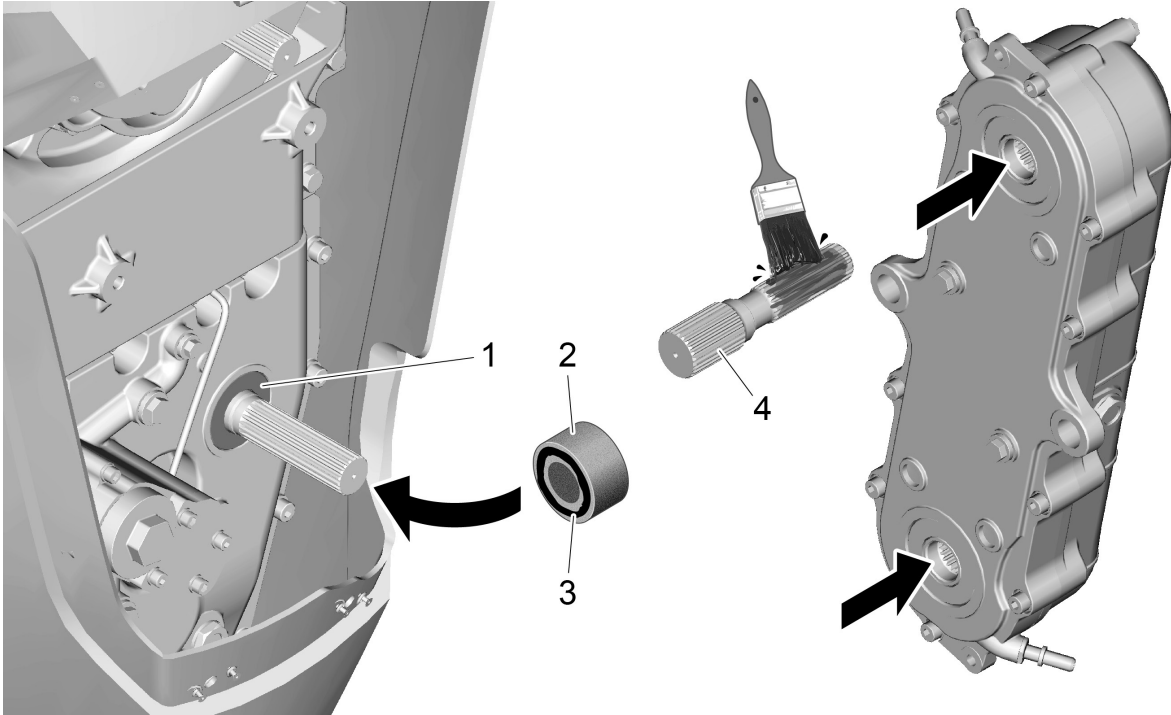
4. Use an oil filling device **(1)** and refill gear box oil up to sight glass **(3)**. Refer to **Recommended Grease and Fluids**.

NOTE! Clean the magnetic oil plugs. Install **new** washers.

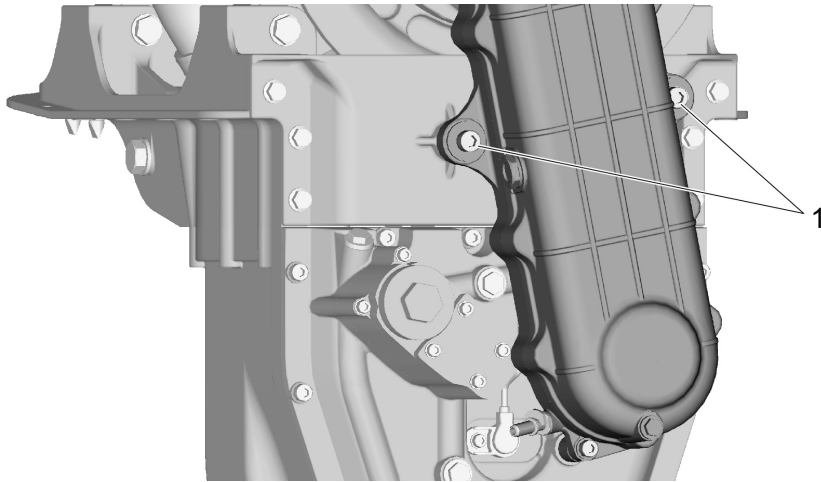
5. Remove the filling hose and tighten oil plug **(2)** to **9 Nm (6.6 ft-lb)**.

REINSTALL THE UPPER BELT HOUSING

- Feeler gauge and shims for M8 bolt sourced locally.
- 30-0110-086 Pipe insulation, minimum **28/55 mm (1.102/2.165 in) inner/outer diameter** and **25mm (0.984 in) high**.
- Silicon marine grade, source locally
- 30-0110-904 Paste



- 1.** Add plenty of paste to the starboard/input shaft **(1)**. Paste the inner splines with the output shaft **(4)**. Add more paste before greasing the second inner spline.
- 2.** Add silicon **(3)** on the gearbox side of the insulation **(2)** and place it on the starboard/input shaft, silicon towards the gearbox.

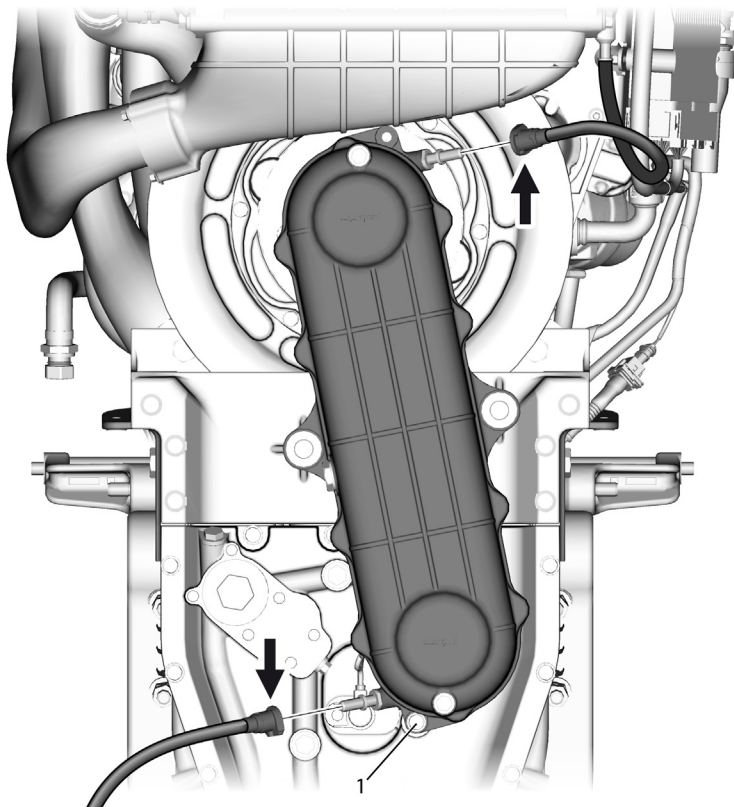


 **CAUTION**

It is important to first mount the upper mounting points (1).

3. Fit the belt housing and tighten the upper bolts to **23 Nm (16.963 lb ft)**.

NOTE! Tightening the upper bolts first will ensure that no offset angle will stress the mounting points.



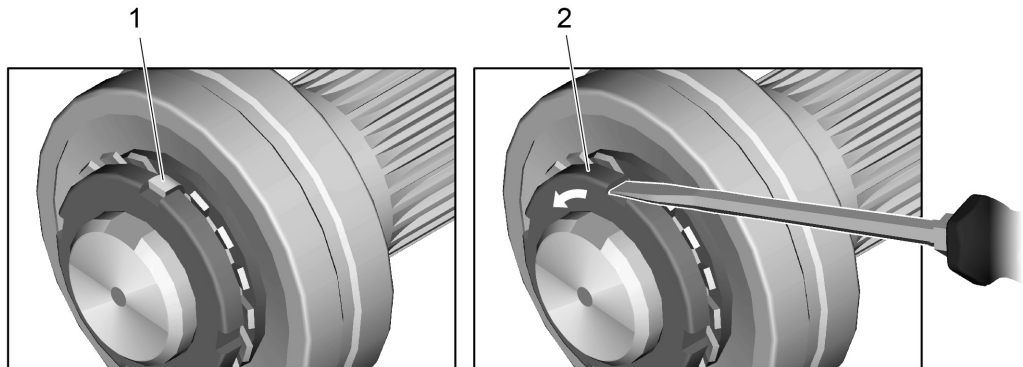
4. Tighten the lower bolt (1) to **23 Nm (16.963 lb ft)**.
5. Connect the cooling water hoses to the upper belt housing.

PROPELLER SHAFT BEARING REPLACEMENT

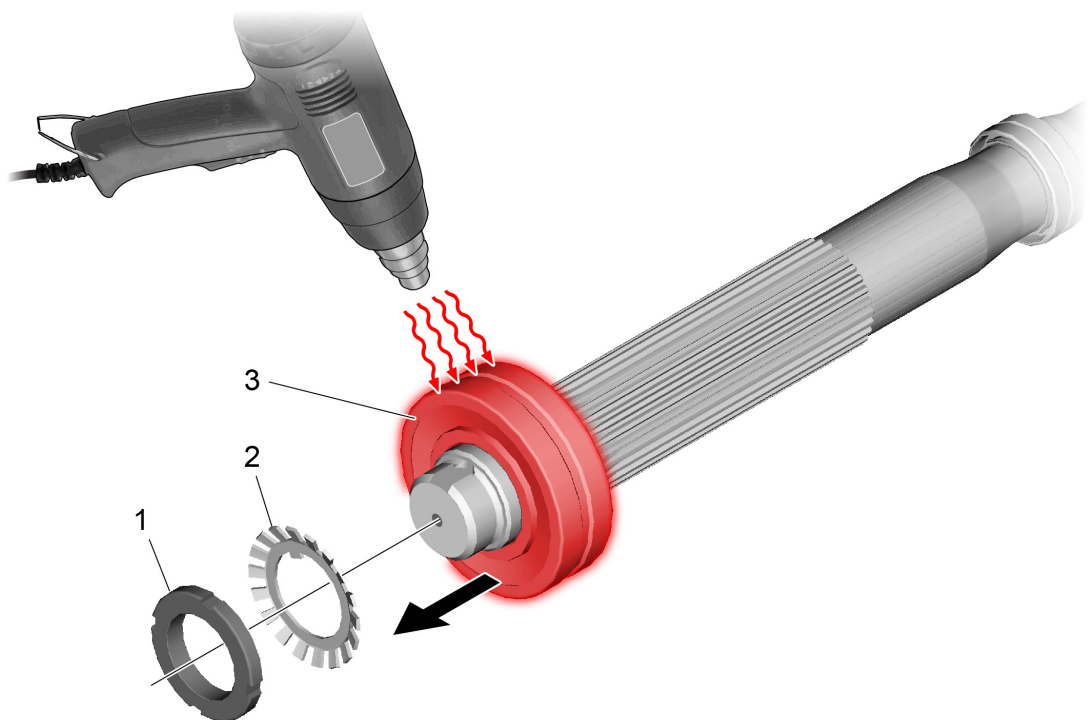
800 H SERVICE

Remove the propeller shaft bearing

Refer to **Lower belt replacement**.



- 10.** Bend up the tab of the lock washer **(1)** and loosen the nut **(2)** from the propeller shaft.

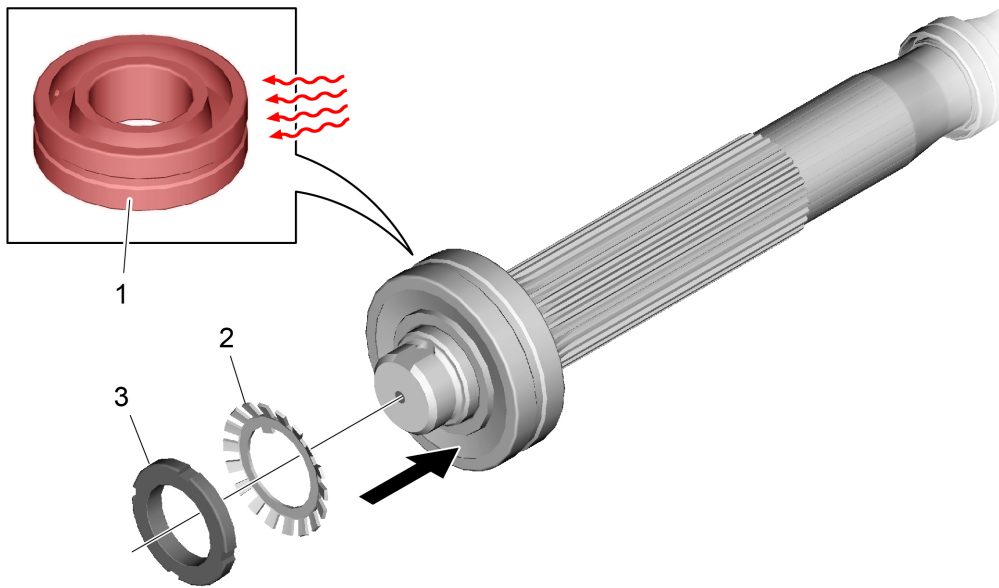


- 1.** Take off the nut **(1)** and lock washer **(2)**.
- 2.** Heat up the spherical bearing **(3)** until it comes off.



DANGER

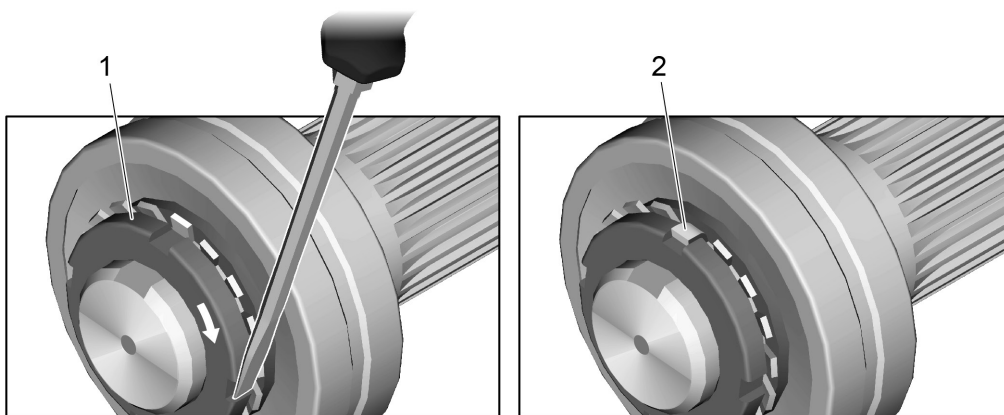
Risk of burns.



3. Heat up the spherical bearing **(1)** until it fumes.
4. Apply the hot bearing to the propeller shaft.

 **DANGER**
Risk of burns.

5. Fit the lock washer **(2)** and nut (3) when the bearing has cooled down enough to handle.



6. Tighten the nut **(1)** and bend up a tab **(2)** against one of the slots of the nut.

SHIMS, SHAFT SLEEVES AND RADIAL SEALS REPLACEMENT IN GEARBOX

800 H SERVICE

An increasing axial free play in gear box shafts, beyond specified tolerances, is due to incorrect diameter shims riding on the radius in the bearing race cut out of the gear box lid, indicating an incorrect axial free play during factory assembly.

When load is applied on a running outboard, the gear box shaft pushes the shims and bearing races axially to the bottom of the casted cut out in the gearbox housing lid and the gearbox housing, thus causing deformation of the shims and increasing the axial free play beyond specifications.

Damage can be inflicted on the sleeves and radial seals of the shafts, in turn causing damage to the gear box shafts and malfunction of the gearbox.

Replace the used shims with shims of correct dimensions. Replace the gear box shaft sleeves or radial seals if damage have been inflicted to these parts.



CAUTION

Inspect the gearbox sleeves, gearbox radial seals and gearbox shafts for wear and damage.

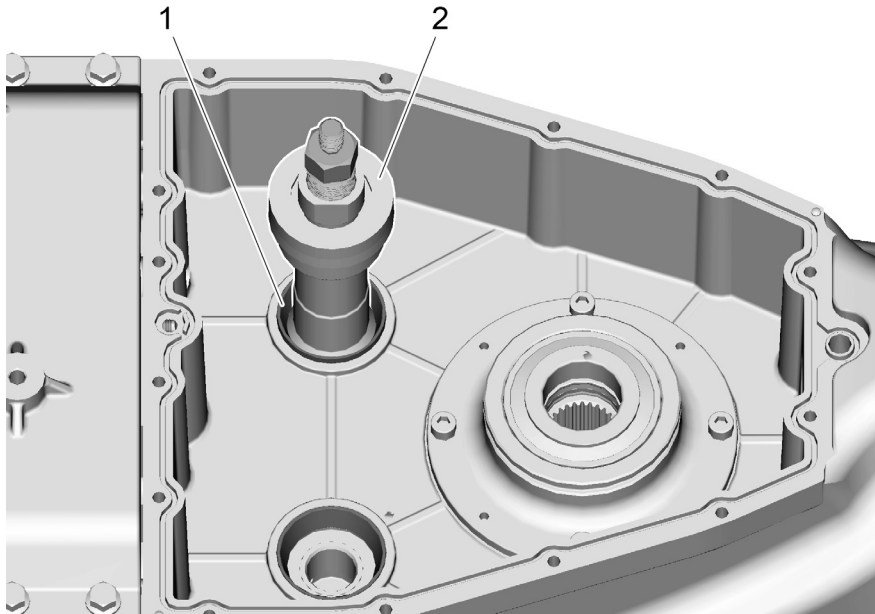
Replace gearbox sleeves and radial seals if damaged.

If gearbox shafts are damaged, take a photo of the damage and contact Cimco

Marine Technical Support or your OXE Diesel retailer.

REMOVING AND INSTALLING THE INNER GEARBOX BEARINGS

Refer to ***Gearbox disassembling***.



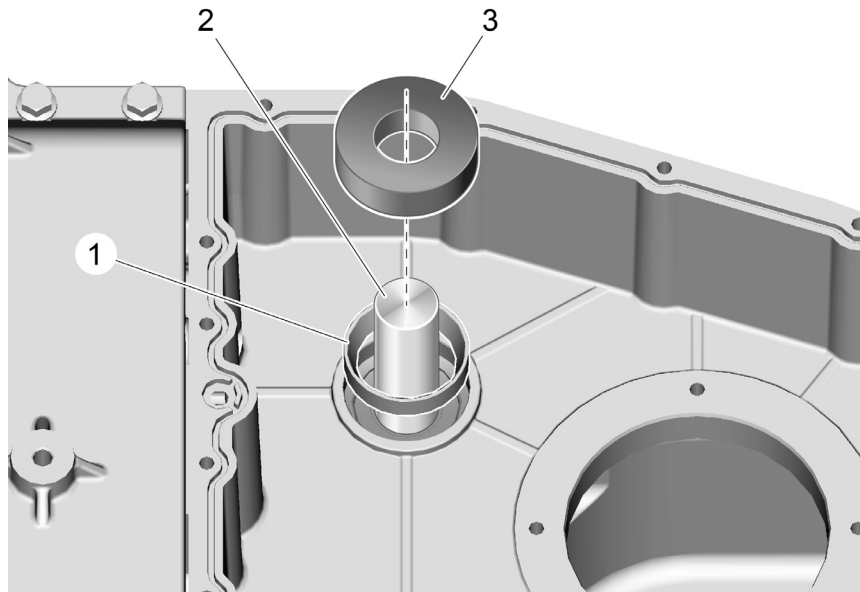
1. Inner bearing race
2. 30-0160-004 A ODT Puller 25 mm
3. 30-0160-014 ODT Puller tool

1. Remove the inner bearing races with the puller tool equipped with a 25 mm puller.

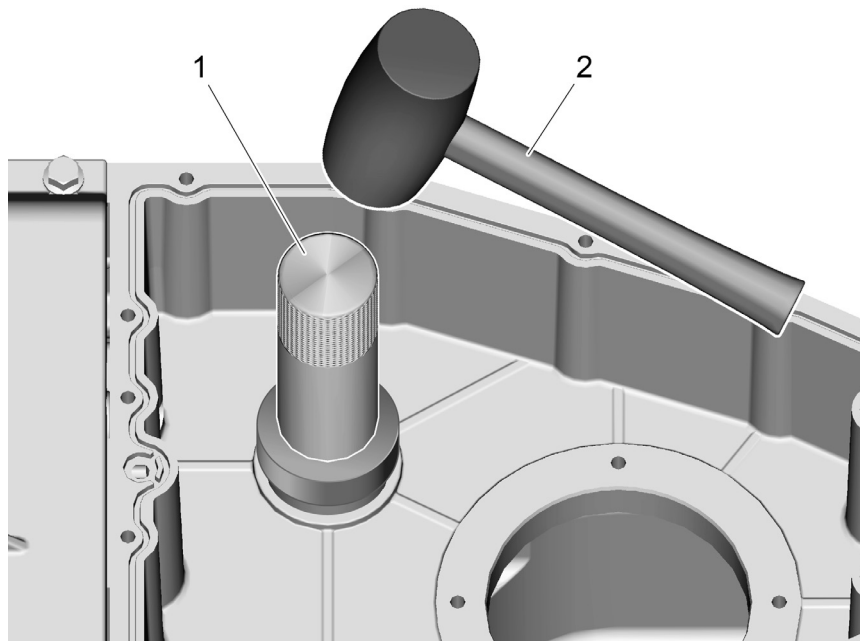
NOTE! The inner shims could be damaged during the removal procedure and need to be replaced.

2. Shim to 1.5 mm using 1 pcs of each
 - 30-0120-041
 - 30-0120-040.

NOTE! Apply a thin layer of bearing grease in order to hold the shims in place while assembling the bearing races.



1. Sleeve
2. 30-0160-004 A ODT Puller 25mm
3. 30-0160-014 ODT Puller tool
3. Fit the bearing race driver flange **(2)** into the sleeve and mount the bearing race **(1)**.
4. Insert the bearing race driver flange on the shaft.



5. Put the bearing race driver flange on the shaft.
6. Place the driver handle on top of the flange and on to the shaft.
7. Softly hammer until the race is properly seated.

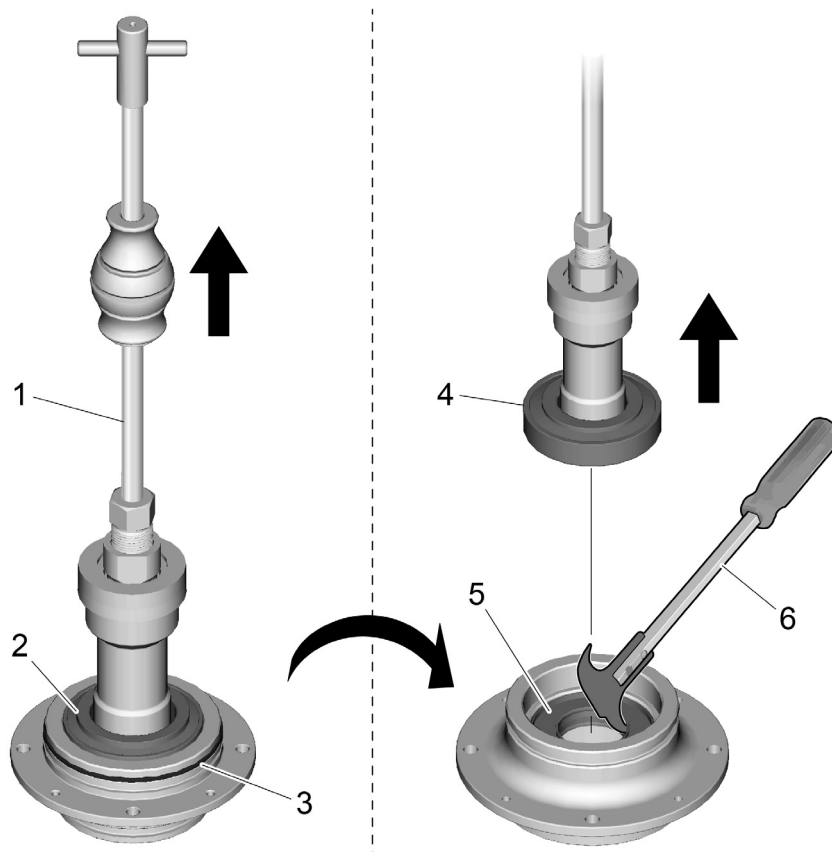
REMOVING AND INSTALLING BEARINGS AND OIL SEALS IN THE BEARING HOUSING

Refer to ***Gearbox disassembling***

Special tools

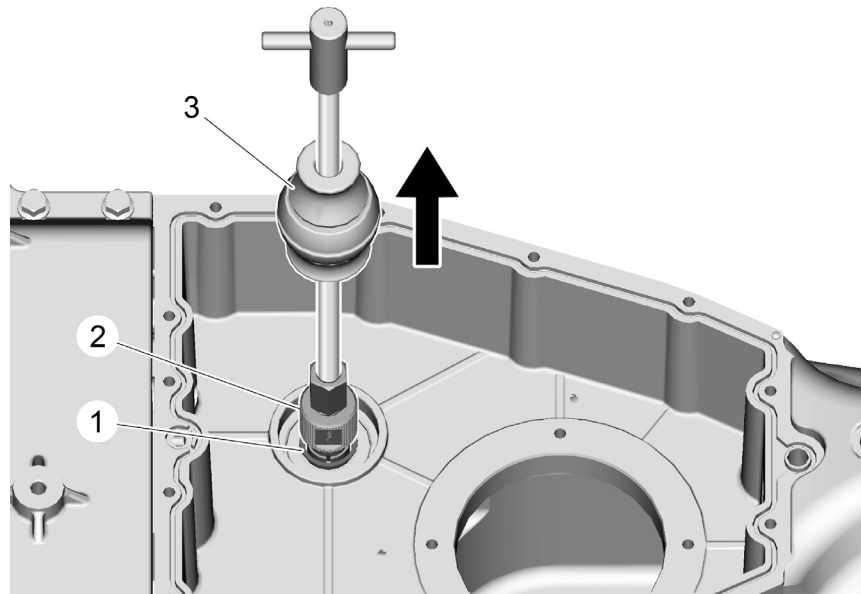
30-0160-004 Puller tool

30-0160-025 ODT Remover Oil Seal

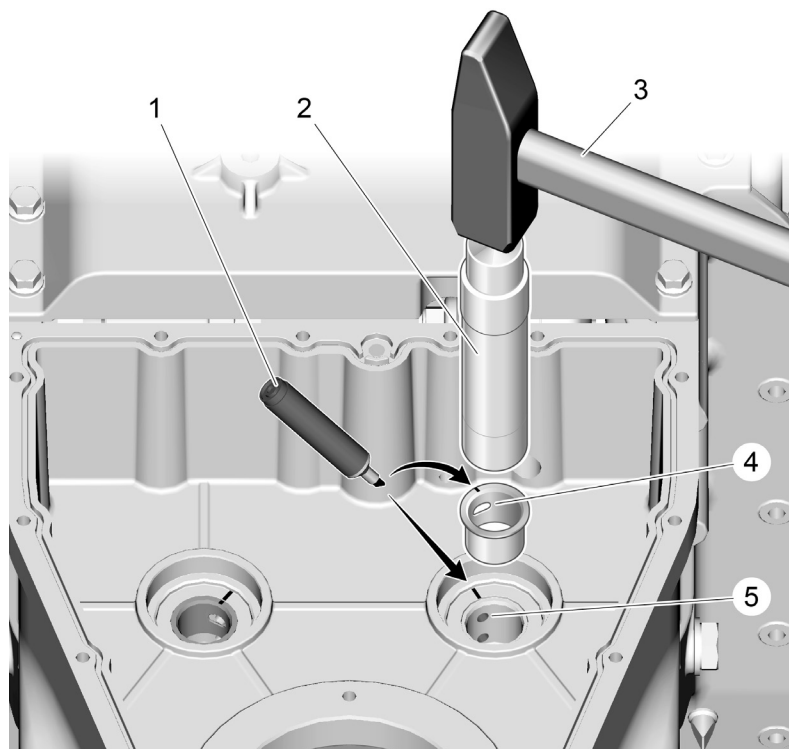


1. Put the bearing housing on a working bench.
2. Use the puller tool **(1)** to remove the bearing **(2)**.
3. Remove the O-ring **(3)** and replace with a new.
4. Turn the bearing housing up-side-down.
5. Remove bearing **(4)**.
6. Use the Oil seal remover **(6)** to remove the oil seals **(5)**, 2 pcs.
7. Check bearings **(2, 4)** for wear and/or damage. Replace if necessary.

REMOVING AND INSTALLING THE SLEEVES



1. Push the tool (2) inwards far enough for the sharp edge at the bottom of the tool to grip the inside end of the sleeve (1).
2. Adjust the grip to expand so that the inwards end of the sleeve is locked against the tool end.
3. Use the hammer (3) to remove the sleeve.



4. Using a marker pen (1), mark the face of the gear housing (5) cutout in line with the hydraulic oil supply channel. Mark the new sleeve accordingly.

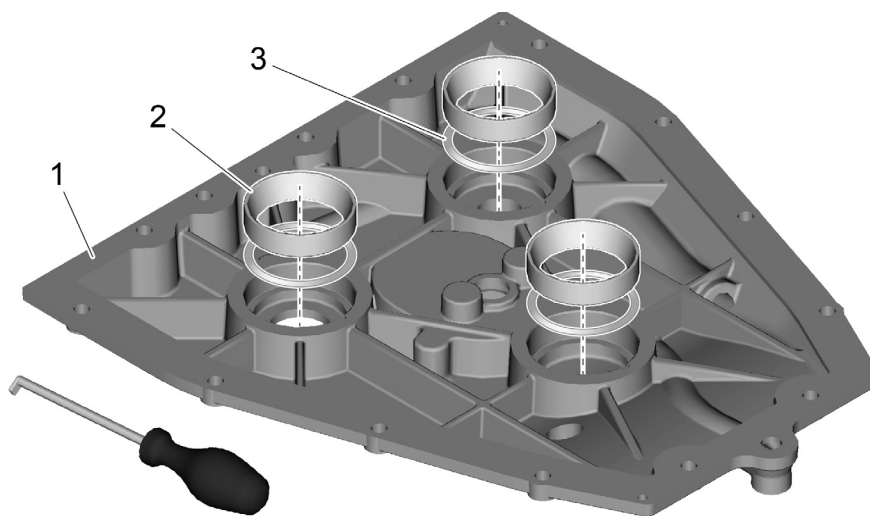
NOTE! It is important to align these marks with each other in order to seat the new sleeve so it does not restrict the hydraulic oil supply to the gear house shaft.

5. Position the new sleeve so that the marks align.
6. Use the sleeve seating tool **(2)** to seat the new sleeve.
7. Use a rubber hammer **(3)** to hammer the sleeve in squarely until firmly seated.

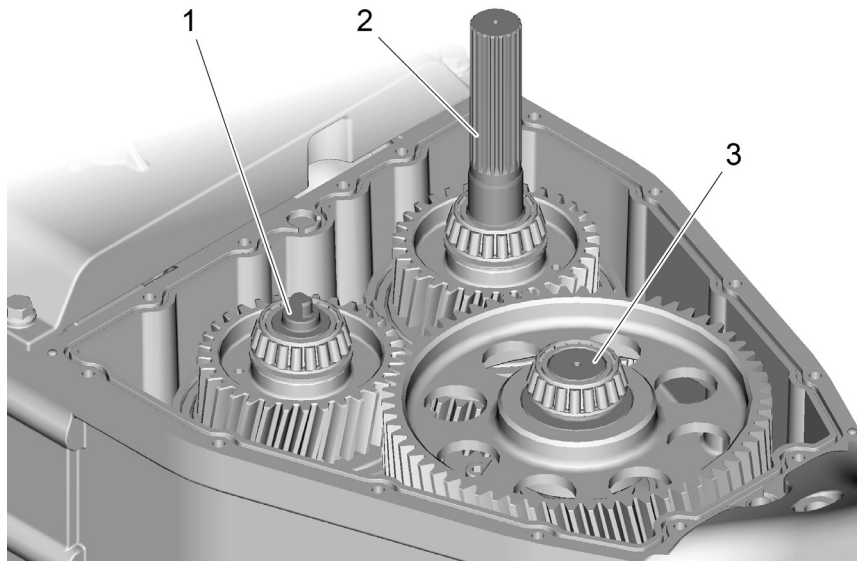
REMOVING AND INSTALLING BEARING RACES AND SHIMS IN THE GEARBOX LID

1. Use a bearing puller to remove the bearing races (2) from the gearbox lid (1).
2. Use a hooker tool to remove the shims (3).

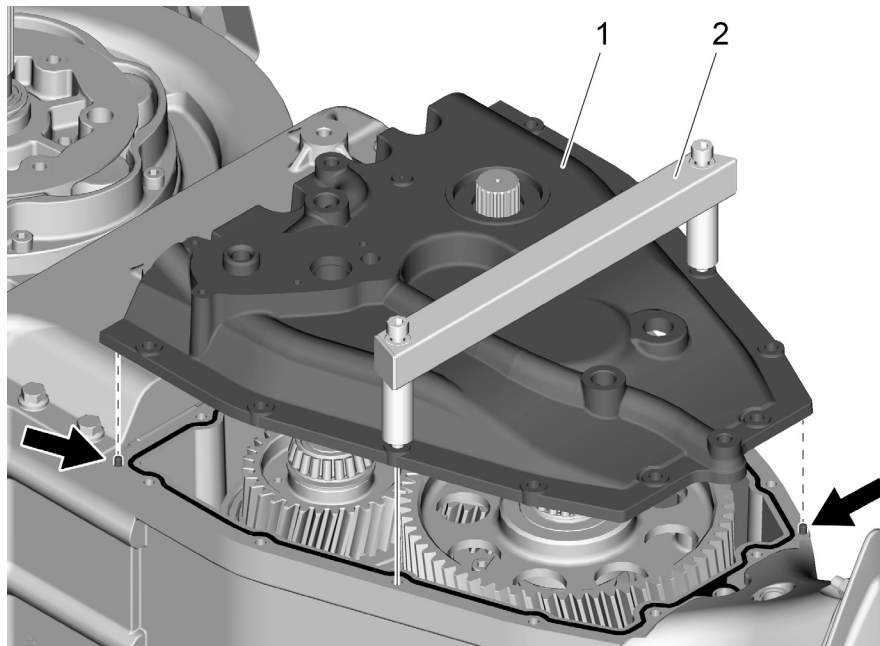
NOTE! The inner shims could be damaged during the removal procedure and need to be replaced.



3. Use a hydraulic press to reinsert the bearing races and press them all the way to the bottom of the casting cut out.
4. Check the radial seals of the gearbox shafts. If damaged, remove O-rings and radial seals and replace with new.



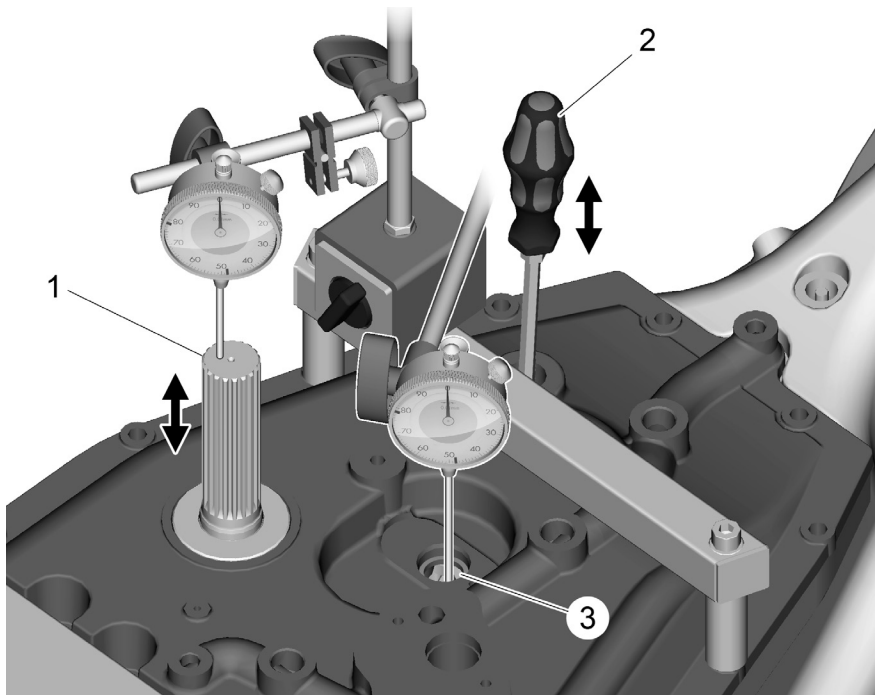
5. Reinsert the gearbox shafts in the following order: Port shaft **(1)**, starboard input shaft **(2)** and output shaft **(3)**.



6. Prior to installing the gear house lid **(1)**, insert the two housing lid guide pins (Part No. 30-0122-230) into their holes respectively as well as the O-ring.
7. Tighten the lid with the gauge bar **(2)** in the middle. Tighten the lid with at least 6 screws evenly distributed with **25 Nm (18.44 lb ft)**.

MEASURING THE AXIAL FREE PLAY

Measure the axial free play on the starboard shaft (input shaft)



1. Place the dial indicator equipped with a **40 mm (1.575 in) indicator pin** on top of the gauge bar and tighten the magnetic lock.
2. Push the shaft into the gearbox while turning the shafts in order to make them seat properly.
3. Dial in the dial indicator against the end of the shaft so that the pin is actuating the indicator.
4. Set the indicator to zero.
5. With your own hands, pull as hard as you can up and down while noting the gap. Repeat this procedure of seating the shaft in its bearing races up and down three times to confirm the gap.
6. Record the findings and note the average gap.

Measure the gap on the port shaft

NOTE! The port shaft bearing race tolerances have the same span as the starboard shaft bearing races.

Measure the axial free play of the outboard shaft

- 7.** Place the dial indicator equipped with a **120 mm (4.724 in) indicator pin** on top of the gauge bar. aim down in the hole of the propeller speed sensor and tighten the magnetic lock.
- 8.** Through the sight glass hole, push the output shaft inwards the gearbox with an extension tool, for example the hooking tool, while turning the input shaft in order to make it seat properly. Turn the output pulley until there is an opening for the pin of the dial indicator to pass through.
- 9.** Dial in the indicator against the end of the shaft gear so that the pin is actuating the indicator and set it to zero.
- 10.** Through the sight glass hole, lift up the output shaft by means of the hooking tool. Note the dial indicator free play reading!
- 11.** Repeat the procedure of seating the shaft and measuring the gap three times. Record the findings and note the average gap!

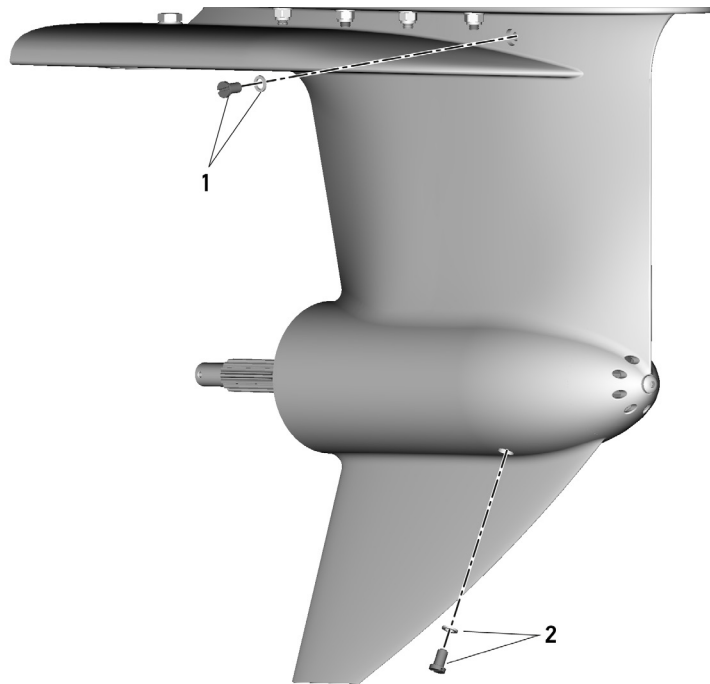
Installing shims in the gearbox housing lid

NOTE! The axial free play tolerance specification is **0 to 0.05 mm (0.197 in)**.

- 12.** Remove the gauge bar and screws and take off the gearbox lid.
- 13.** Remove the bearing races (3 pcs.) with a puller end pulling tool.
- 14.** Install the required shims. Shims come in thicknesses of **0.05, 0.1, 0.2, 0.5, 1 mm (0.037, 0.074, 0.148, 0.369, 0.738 in)**.
Use a hydraulic press to reinsert the bearing races and press them to the bottom of the casting cutout. Check that the shims are centered and the races are bottomed out, locking the shims in space.
- 15.** Install the gearbox lid and mont the gauge bar with 4 additional screws evenly distributed and tightened to **25 Nm (18.439 lb ft)**.
If the free play is not within tolerance, repeat the shims procedure on the shaft in question.
If satisfactory results are obtained, continue with reassembling.
- 16.** Remove the gauge bar and the 4 additional screws. Take off the lid.

CHANGE LOWER BELT OIL

201



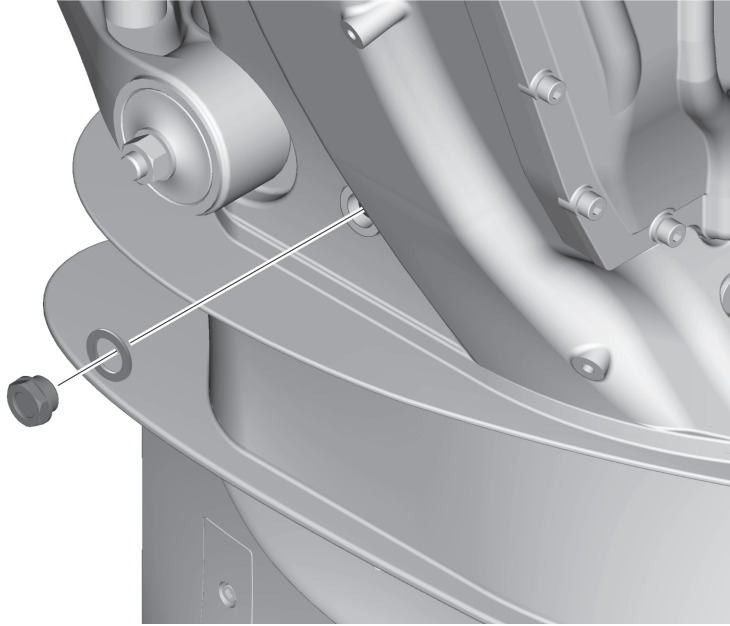
1. Remove the magnetic plug and washer **(1)** above the anti-cavitation plate.
2. Remove the magnetic plug and washer **(2)** under the propeller shaft housing. Drain the oil into a suitable container.
3. Check drained oil quality:
The oil should be red to dark red.
If the oil looks milky and foamy, water has entered the lower housing. Check for leakage!

NOTE! Clean the magnetic oil plugs. Install **new** washers.

 **CAUTION**

Dispose of the belt oil according to local, environmental legislation!

4. Reinstall and tighten oil plug **(2)** to **9 Nm (6.6 ft-lb)**



5. Remove the sight glass and washer. Fill up with belt oil until the oil comes out at the upper oil plug (1). Refer to **Recommended fluids and grease**.
6. Clean the sightglass. Install a **new** washer. Tighten to **16 Nm (11.8 ft-lb)**.



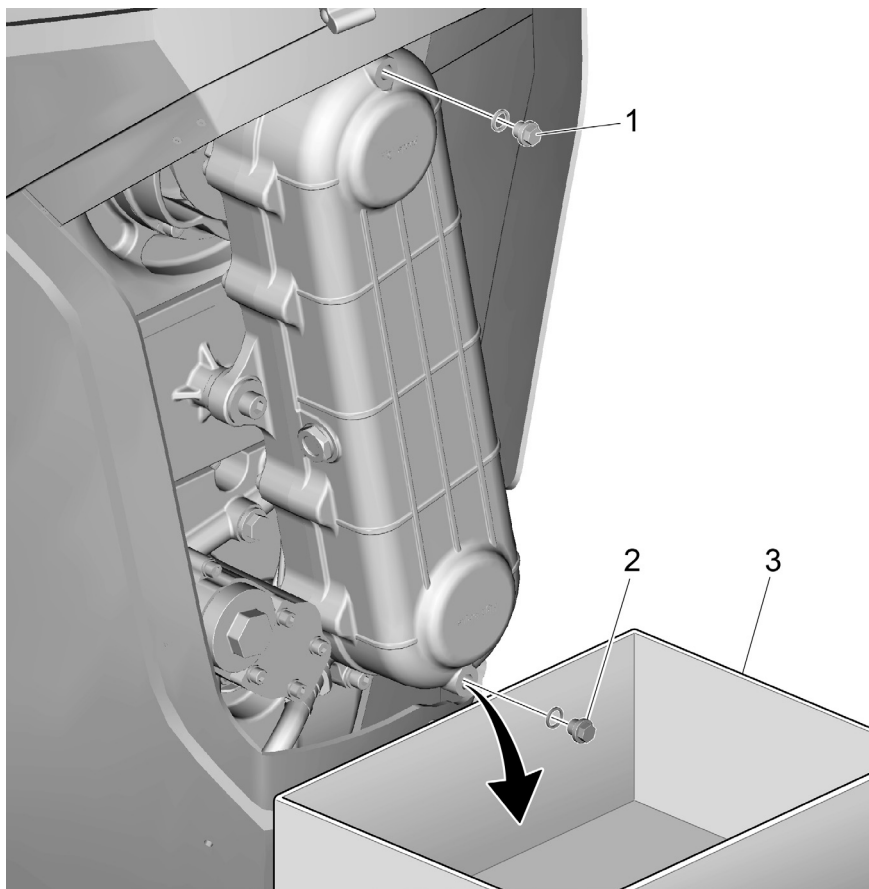
7. Alternatively, use an oil filling device and fill up the oil through the oil plug hole (2) **until oil comes out at oil plug hole (1)**.

NOTE! Clean the magnetic oil plugs. Install **new** washers.

8. Remove the filling hose and tighten oil plug (2) and (1) to **9 Nm (6.6 ft-lb)**.

CHANGE UPPER BELT OIL

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1. Remove the top cowling. Refer to **Repetitive Instructions, Remove top cowl**.
2. Remove rear cowl, refer to **Lower belt replacement, Cowl removal**.
3. Remove the upper oil plug and sealing (1).
4. Remove the lower oil plug and sealing (2). Let all the oil run out, into a suitable container (3).

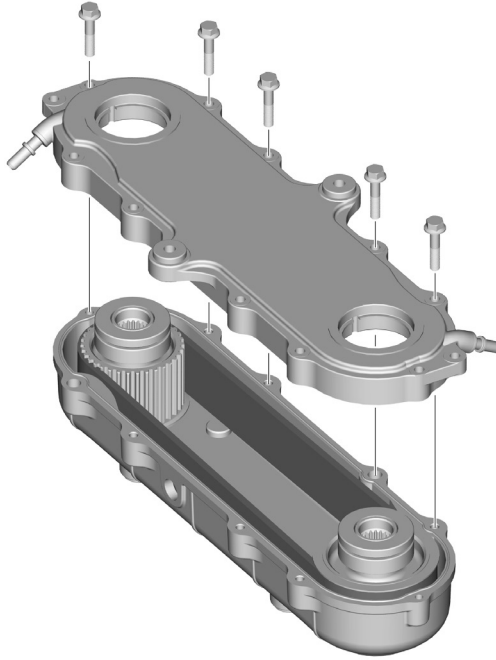
 **CAUTION**

Risk of contamination of drinking water. Dispose of oil according to local environmental legislation!

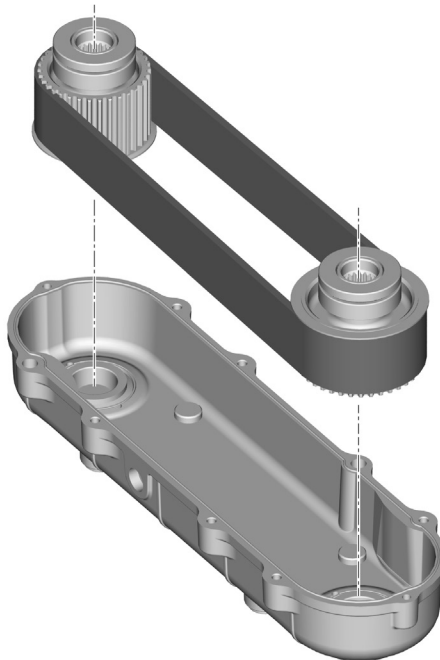
5. Inject 0,33 L belt oil into the sight glass/oil level plug hole, using a pressurised filling device. For oil quality, see **Recommended fluids and grease**.
6. Clean oil plugs and put **new** sealings on.
Tighten to **16 Nm (11.80 lb in)**.

UPPER BELT REPLACEMENT

1. Remove upper belt assembly, *refer to **Upper belt assembly removal.***
2. Drain gear oil, refer to **Change Upper belt oil.**



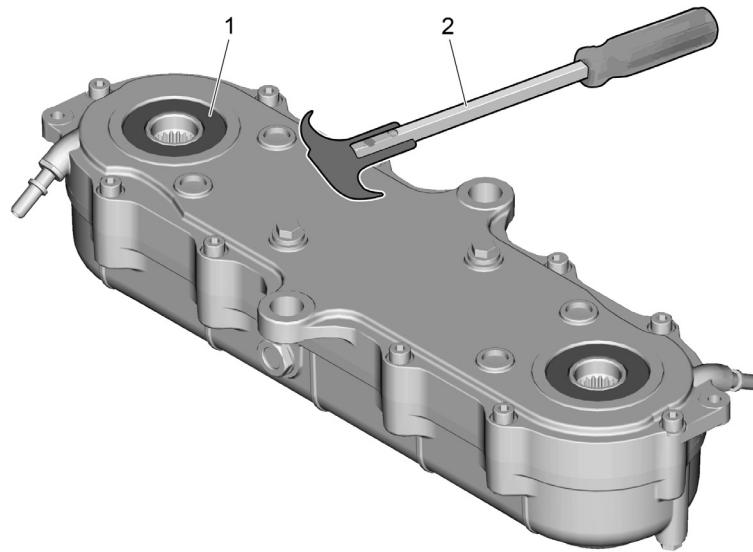
3. Put the unit on a workbench, belt housing bracket upwards.
4. Remove 10 bolts and lift off the belt housing bracket.



5. Lift up the belt pulleys and belt.
NOTE! The belt pulleys fit in just one hole respectively. Guide pins ensure correct belt housing assembling.
6. Replace the belt and mount in reverse order.

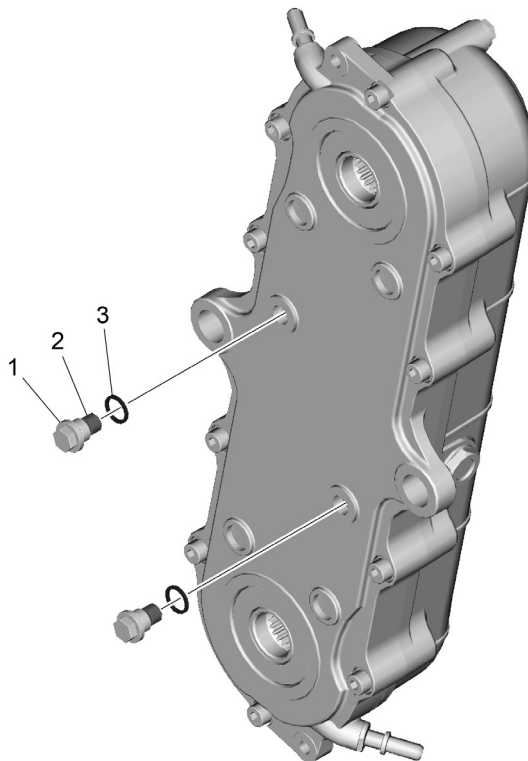
REPLACE BELT PULLEY SEALS

- 30-0160-025 ODT Remover Oil Seal



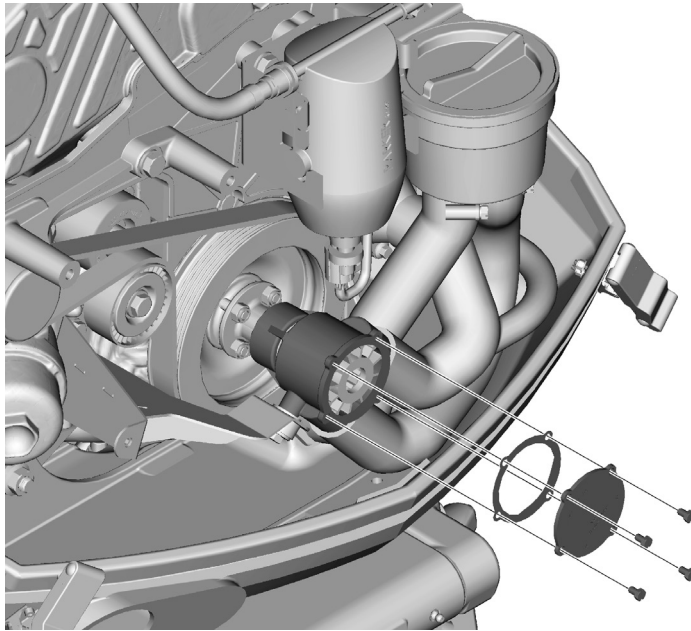
1. Remove the seals **(1)** using the oil seal remover **(2)**. Install **new** seals
2. Reinstall upper belt housing. Refer to **Reinstall the upper belt housing**.

REPLACE ZINC ANODES

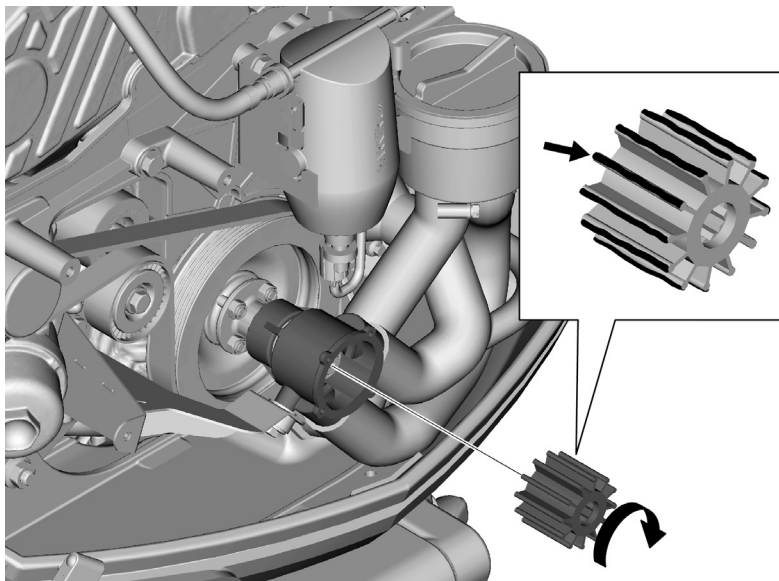


3. Remove the bolt holding the anode and the O-ring.
4. Replace with **new** anode and **new** O-ring.
Tighten bolts to **20 Nm (14.8 lb ft)**.

SEAWATER PUMP IMPELLER REPLACEMENT



1. Remove 4 screws and lid.
2. Take off used impeller and sealing.



3. Install a **new** sealing.

 **WARNING**

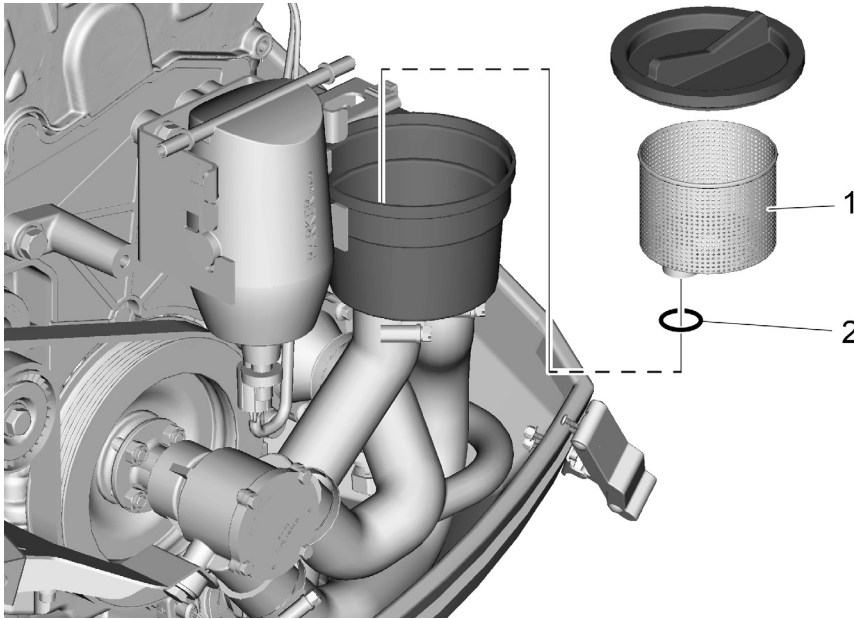
Rotate impeller clockwise until it fits!

4. Lubricate **new** impeller and install.

Tighten to **2 Nm (1.47 lb in)**.

CLEAN SEAWATER STRAINER

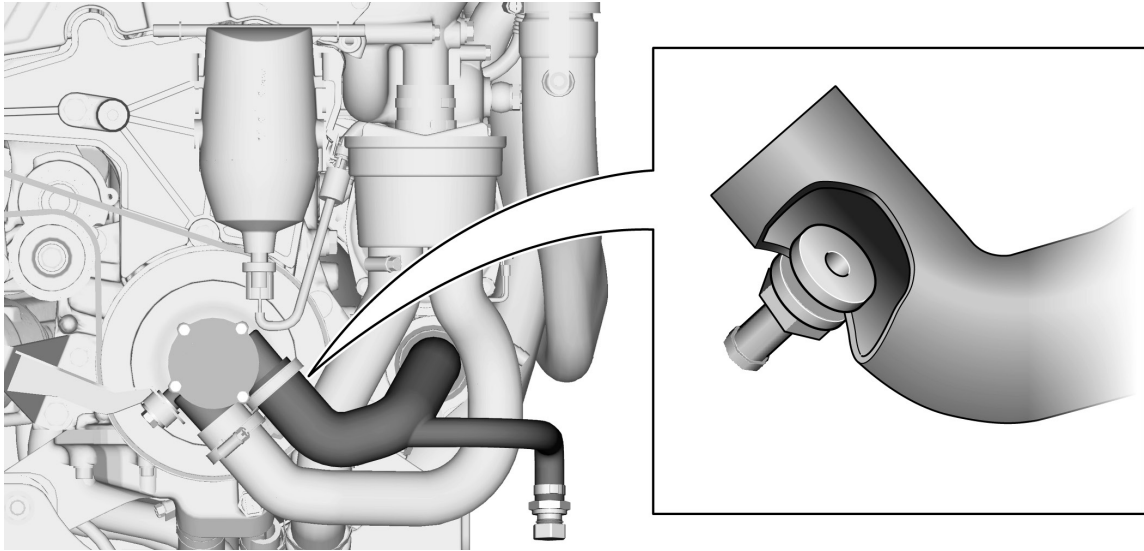
207



1. Remove the lid.
2. Pull out the filter element **(1)**.
3. Clean the filter element, check that the o-ring **(2)** stays in place. Replace O-ring if damaged.
4. Reinstall and close the strainer.

REPLACE SEAWATER OUTLET NIPPLE

The procedure can be carried while the vessel is in calm waters or on dry land.



1. Trim the engine to vertical position.
2. Remove the upper engine cover and safely store.
3. Disconnect the outlet hose from the seawater pump.
4. Disconnect the water hose from the wide inspection hose. Remove the hose assembly from the engine and drain any water.
5. Remove the nipple from the hose and discard.

Check the rubber hose surface where the nipple was fastened for any signs of damage or wear. Insert and fasten new nipple in order as per figure.

NOTE! The lip on the washer and the nipple face towards the hose for good sealing.

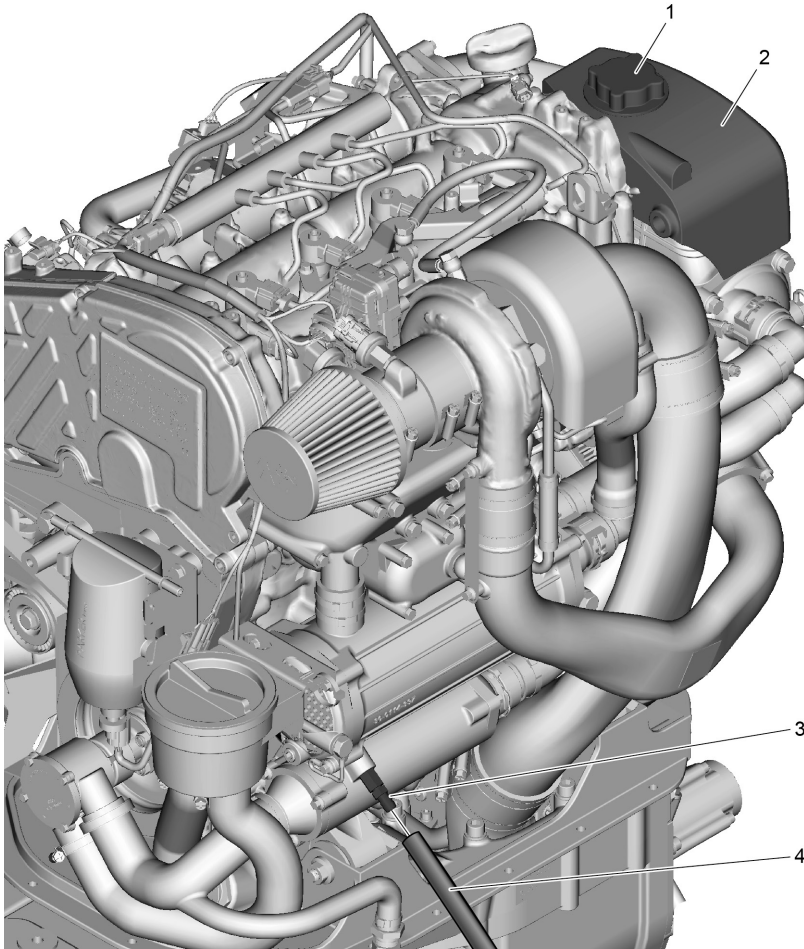
6. Tighten the securing nut assembly until it firmly presses against the rubber.
7. Reinstall hose assembly and connect hoses.

⚠ CAUTION

Connect water to drive if on land.

8. Start engine.
9. Check for water leaks.
10. Check for water circulation from the outlet jet on the engine cowling.

DRAIN AND FILL COOLANT



1. Remove the cap **(1)** of the expansion tank **(2)**.
2. Fit a hose **(4)** to the coolant drain adapter **(3)**.
3. Drain the coolant/water-mixture into a suitable container.

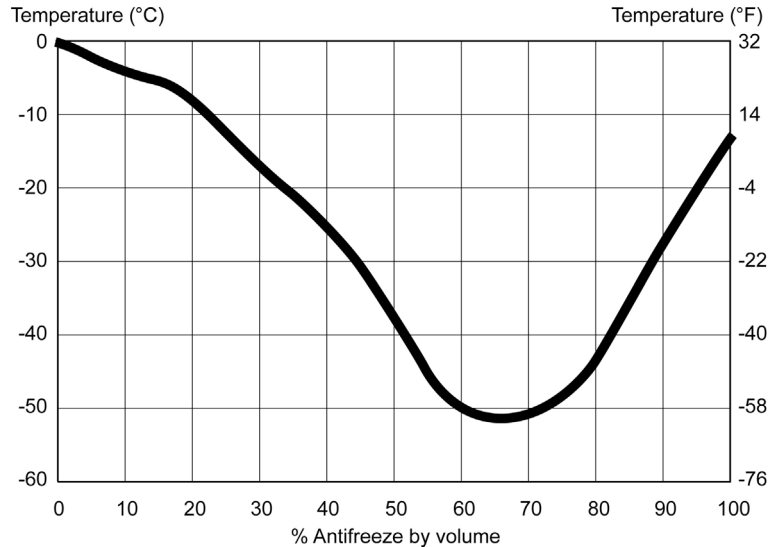
**CAUTION**

Risk of contamination of drinking water. Dispose of used coolant/water-mixture according to local environmental legislation.

4. Remove the hose from the drain adapter.

FILL COOLANT

The cooling system of the engine is to be filled with a mixture of approx. 70 % distilled water and 30% antifreeze based on ethylene glycol and /or anticorrosion additive, see diagram below.



WARNING

Use only approved fuels, lubricants etc. (see table “Fuels, lubricants etc.”). Otherwise the manufacturer’s warranty will become null and void.

Coolant must be added **at the filler cap only**.

Do not add cold coolant to a warm engine.

Ensure that the mixing ratio “water-antifreeze” is preserved.

1. Remove coolant filler cap **(1)**.
2. Slowly fill up with coolant via filler neck on expansion tank **(2)** until fluid level has reached up to 4 cm beneath the filler neck.
3. Let engine run at a speed of 2,000 rpm for approx. 15 minutes.
4. Switch off engine, carefully turn cap with safety valve to the first detent to relieve pressure and then carefully remove cap and top up with coolant.



DANGER

Risk of scalding and burning yourself!

Before the engine is next put into operation (with the engine cold) check the coolant level and top up if necessary.

Repeat this procedure until no more coolant can be added.



DANGER

If, in an exceptional case, the coolant level has to be checked in an engine that has reached operating temperature, first carefully turn the cap (large cap) with safety valve to the first stop, let off pressure, then open carefully.

NOTE! Do not open the cooling system when the engine is at operating temperature. This causes a pressure loss in the cooling system.

If the cooling system has been opened when the engine is at operating temperature this can lead to the alarm “pressure in the expansion tank” when the engine is then put into operation and to a reduction in the engine output.

Coolant pressure in the expansion tank is only built up again when the engine has cooled down.

The cooling system must therefore only be filled up when the engine is cold.



WARNING

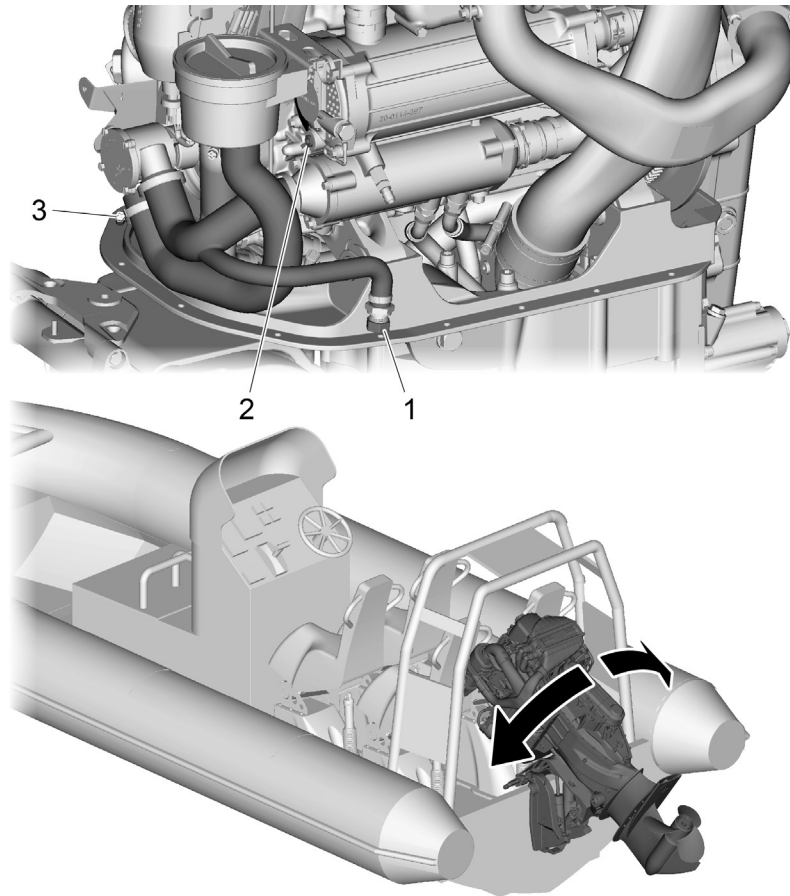
When the cover is opened with working valves, there is a danger that it is not properly sealed when closed again. The required overpressure is no longer set up in the cooling system. Premature simmering and loss of coolant result. To avoid damage to the engine, this cover should as a general rule only be opened in exceptional cases and then replaced by a *new* one.

ANTIFREEZE PRESERVATION OF SEAWATER SYSTEM

When storing an engine for a prolonged period of time or in sub-zero temperatures several important procedures should be performed to prevent engine issues.

For both short-term and long-term storage, see instruction below and picture

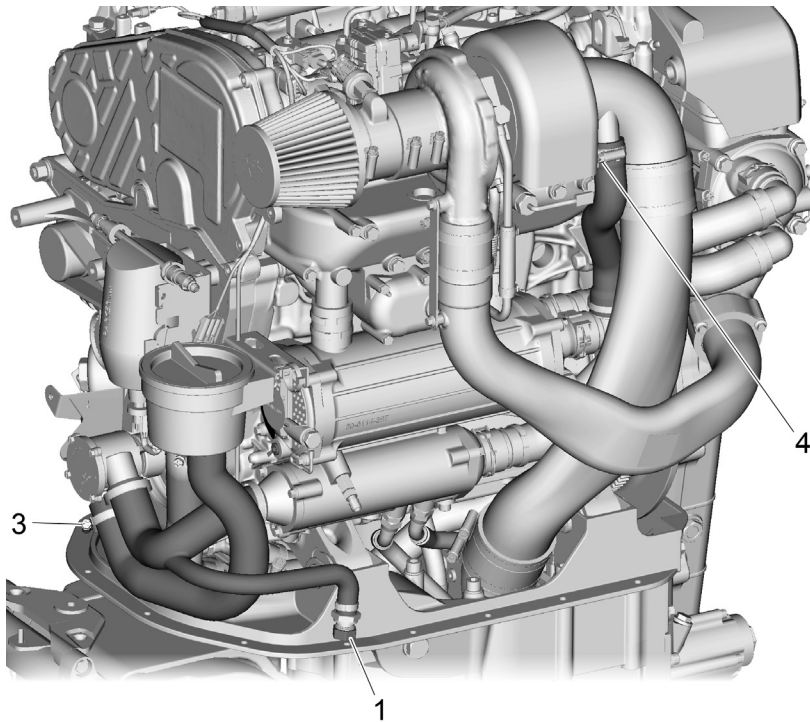
SHORT-TERM STORAGE



1. Open connection **(1)**.
2. Unscrew the plug on the side of the heat exchanger **(2)**.
3. Undo the hose on the seawater pump **(3)** and drain the seawater
4. Tilt the outboard to a 45° angle to drain as much as possible of the seawater out of the system.
5. When in this position, steer the outboard fully to starboard and port. Repeat if necessary.

LONG-TERM STORAGE

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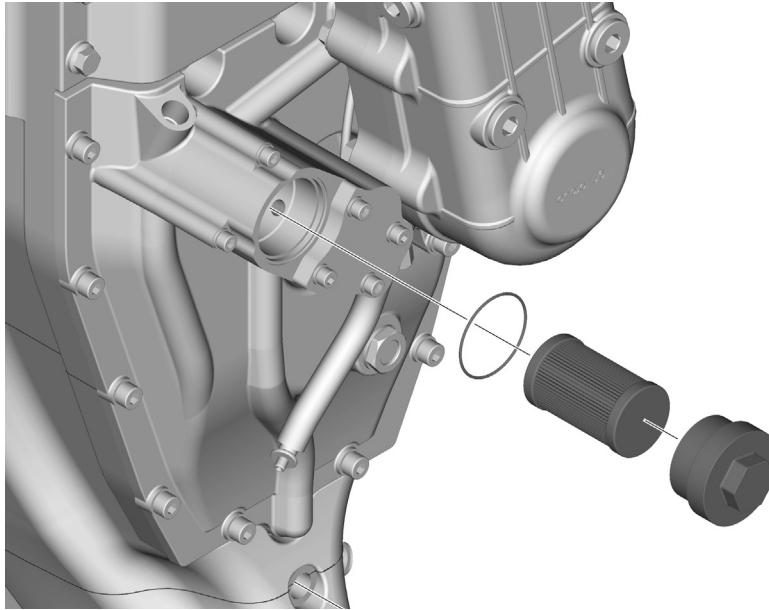
1. Open connection **(1)** and place a container beneath
2. Open the lower connection for the seawater on the belt housing and place a container beneath.
3. Open connection **(4)** and fill with coolant fluid of sufficient grade temperature-wise until it exits from connection **(1)**.
4. Undo the hose on the seawater pump **(3)** and drain the seawater.

Alternative solution for long-term storage

Water intake

1. Run the outboard with the water-intake point in the front of the lower housing lowered into a coolant fluid mixture of sufficient grade.
2. Run the outboard until the entire sea-water part of the system is filled with coolant fluid and thus protected from freezing and corrosion.

HYDRAULIC OIL FILTER REPLACEMENT



⚠ WARNING

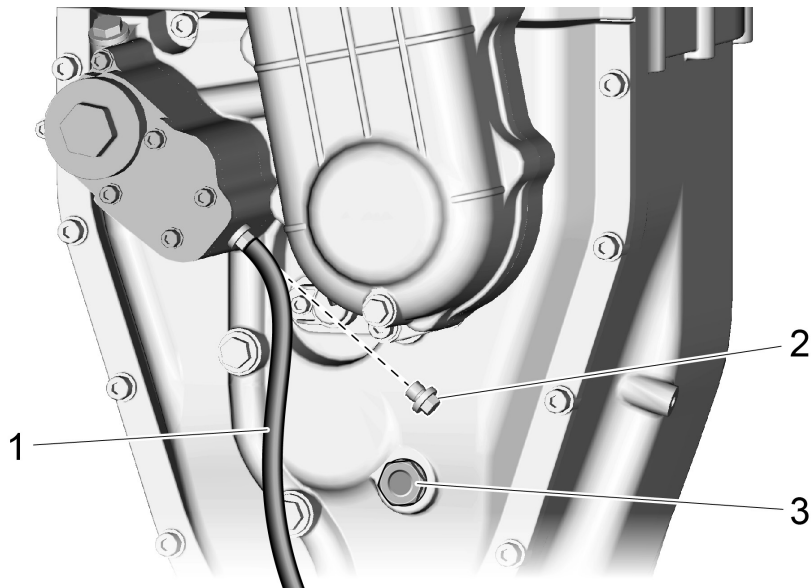
The hydraulic oil filter is pressurised. Before removing it the pressure must be released.

1. Turn the ignition ON and shift gear from forward to reverse a couple of times.
2. Tilt the outboard in order to minimize oil spill. Carefully clean the area around the gearbox oil filter with pressurised air.
3. Remove the filter cap. Have a cloth nearby to collect the oil in the filter.

⚠ CAUTION

Risk of contamination of drinking water. Dispose of oil according to local environmental legislation!

4. Clean and reinstall the hydraulic oil filter element. If the filter is damaged, install a **new** filter.
5. Tighten the hydraulic oil filter end cover.



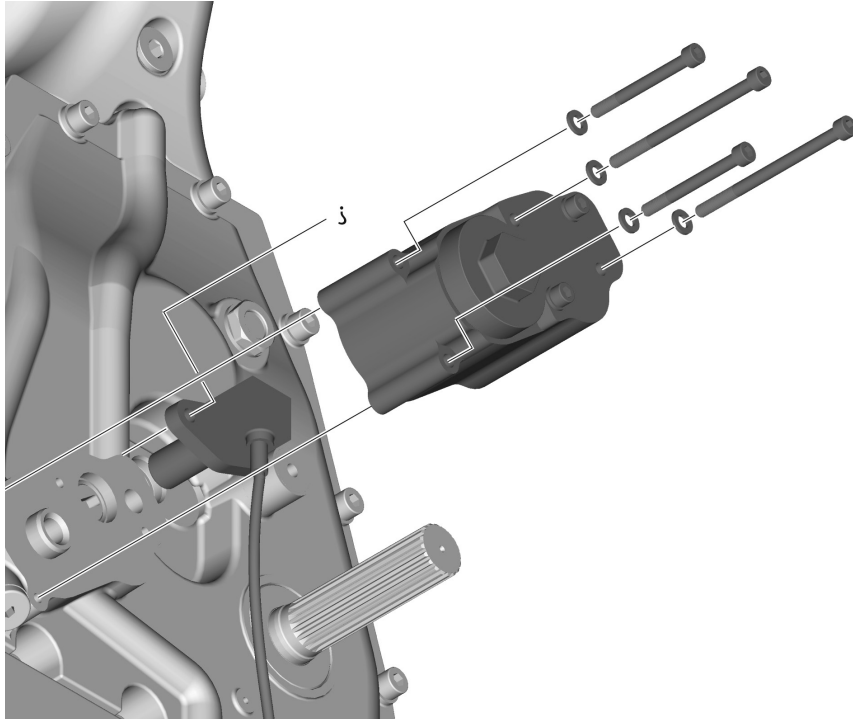
6. Check the hydraulic oil level in sightglass **(3)** and fill up if necessary.
7. Remove the oil plug **(2)** and use a filling device **(1)**
8. Fill with oil up to sight glass. See **Recommended fluids and grease** .
9. Clean the magnetic plug **(2)** and reinstall.

If the hydraulic oil pressure is low the proportional valve or the hydraulic pump has to be replaced.

If you discover water in the oil (the oil is milky) all hydraulic seals have to be replaced.

Refer to **Hydraulic system description** and **Hydraulic pump replacement**.

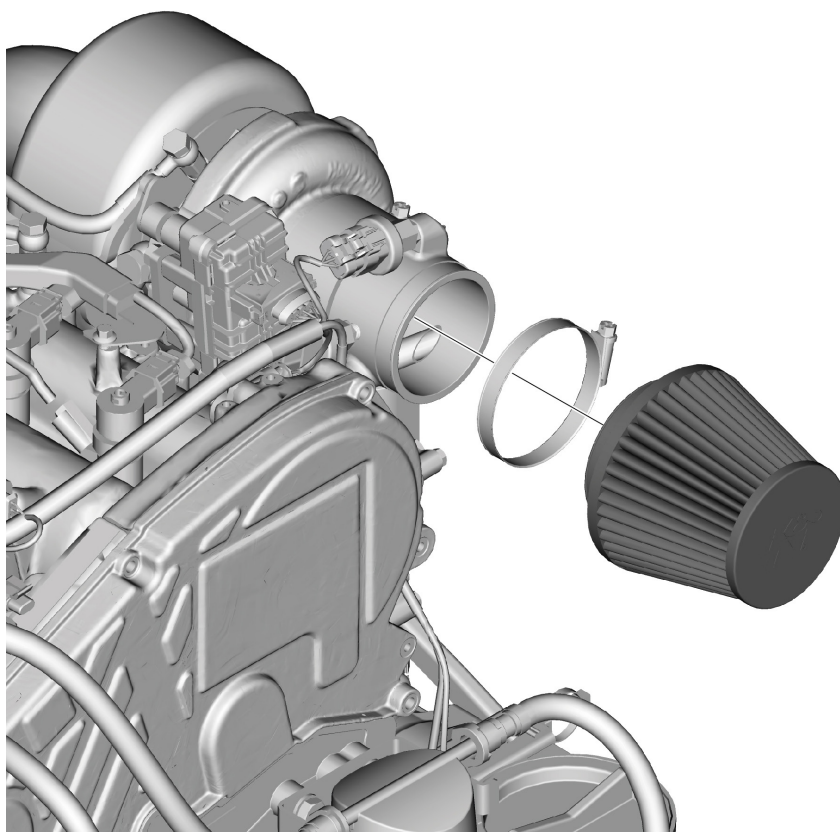
HYDRAULIC PUMP REPLACEMENT



1. Remove 4 screws and washers of hydraulic pump end cover. Remove the pump unit.
2. Install **new** pump unit in opposite order.
3. Tighten bolts to **20 Nm (14.8 lb ft)**.

AIR FILTER REPLACEMENT

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AIR FILTER REMOVAL

1. Remove the clamp.
2. Pull off the air filter element.

CLEAN THE TURBO CHARGER

3. Clean the inside of the main tube, inlet hose and inlet of the turbo charger with a cloth moistened with solvent.

AIR FILTER INSTALLATION

4. Install a **new** air filter.
5. Tighten clamp.

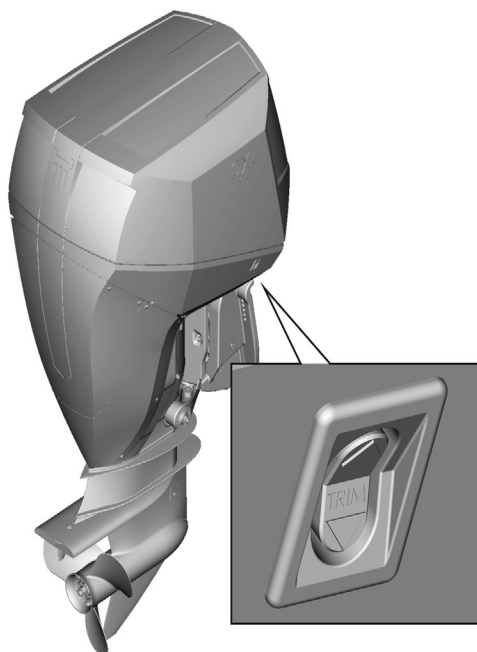
CHECK POWER TILT AND TRIM SYSTEM

CHECKING THE POWER TILT AND TRIM FUNCTION

 **WARNING**

Never get under the lower unit while it is tilted. Risk for severe injury if the outboard accidentally falls!

Make sure no person is under the outboard before performing this test. Risk of body parts to be crushed between outboard and clamp bracket when the outboard is trimmed or tilted. Check the power trim and tilt unit for any signs of oil leaks.



Tilt and trim switch on cowling

1. Operate each of the power trim and tilt switches on the remote control and lower cowling to check that all switches work.

NOTE! The ignition key must be in **IGN&ACC** position.

2. Tilt up the outboard and check that the tilt rod and trim rods are extended completely.
3. Check that the tilt rod and trim rods are free from corrosion or other flaws.
4. Activate the tilt-down switch until the rods have retracted completely into the cylinders.

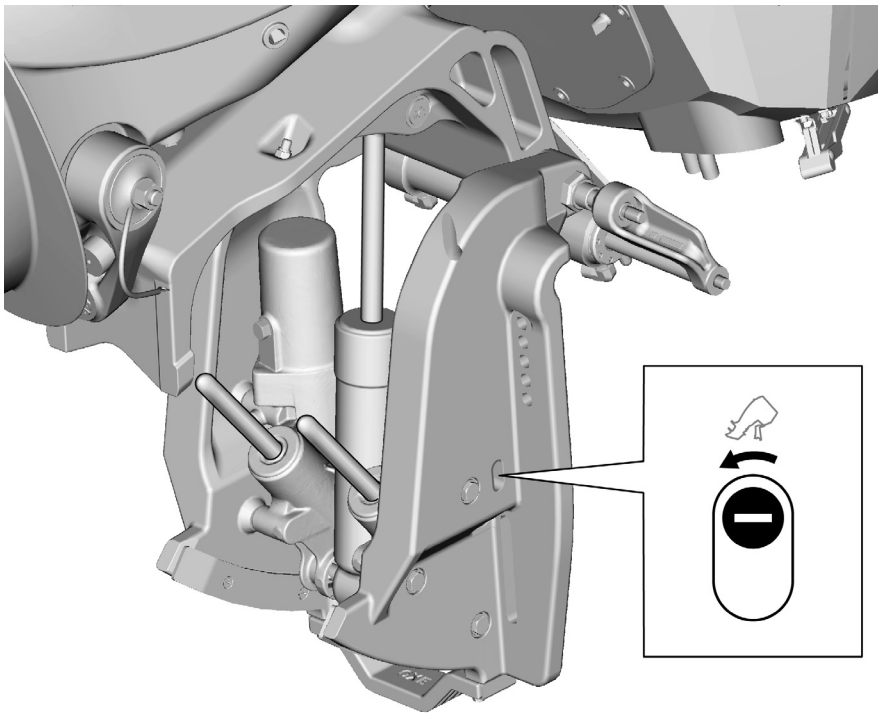
5. Tilt the outboard completely up and down a couple of times and check that the trim and tilt system operates smoothly. Check the hydraulic fluid if necessary. Also check wear of pistons and joints.

NOTE! Check if the Power-tilt-and-trim (PTT) motors make abnormal sounds.

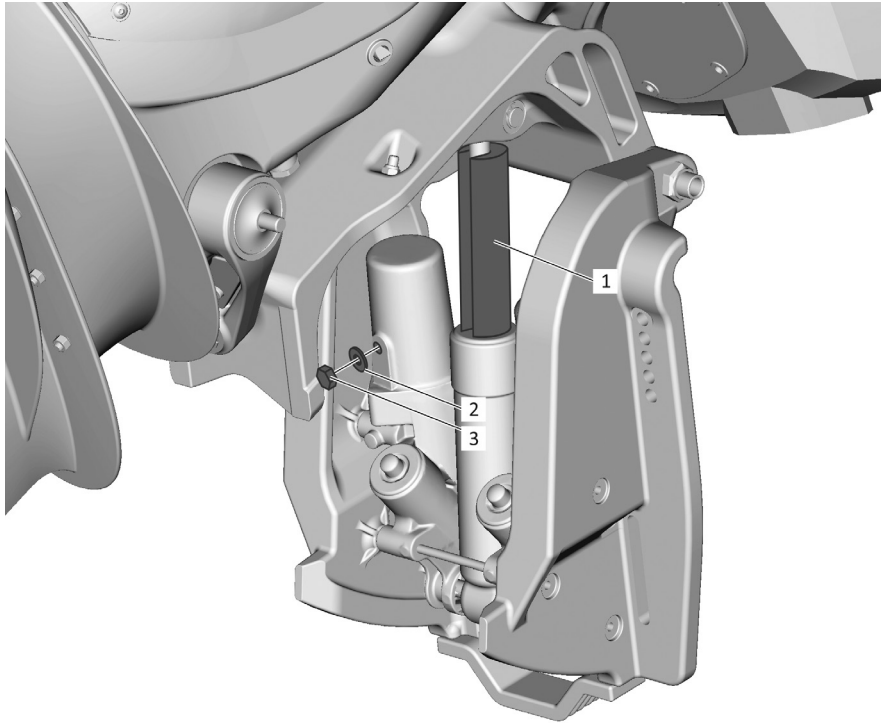
 **CAUTION!**

The outboard can be lowered by carefully turning manual valve, should the electric system fail.

Ensure that the manual valve is tightened before starting the outboard.



Tilt and trim rods, manual valve

CHECK THE POWER TILT AND TRIM FLUID LEVEL

1. Tilt up the outboard completely and support the tilt cylinder with a transom saver **(1)**.

 **WARNING**

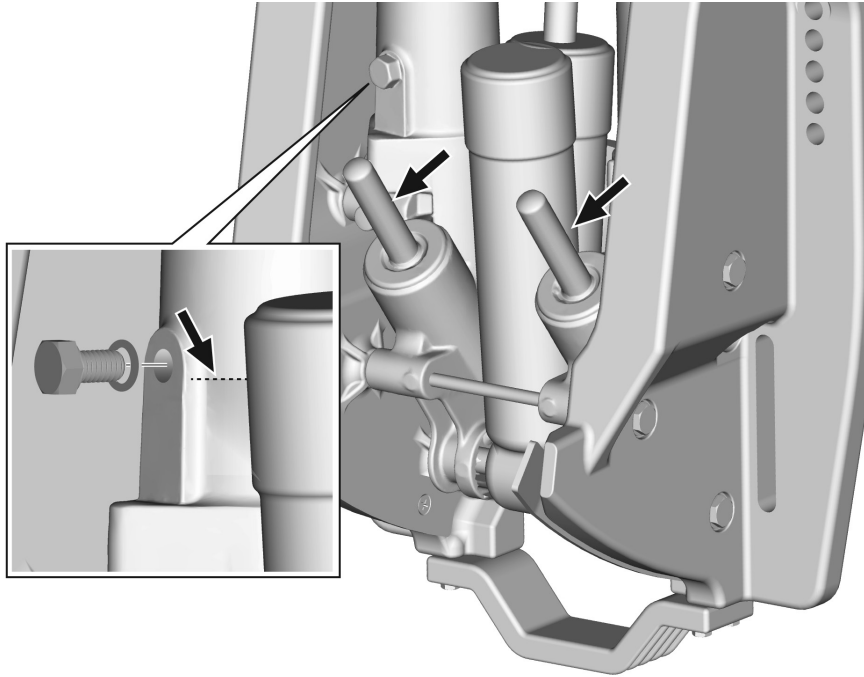
Make sure to support the outboard with the transom tilt saver. Otherwise the outboard can fall down accidentally if the power tilt and trim unit loses pressure.

2. Remove the filling plug **(3)** and seal **(2)**. Check the fluid level in the reservoir.

! WARNING

Ensure that the trim and tilt rods are fully extended when the plug is removed. Otherwise the fluid can spray from the reservoir due to internal pressure.

NOTE! If the fluid is correctly levelled, only a small amount of fluid should come out of the filling hole when the plug is removed.



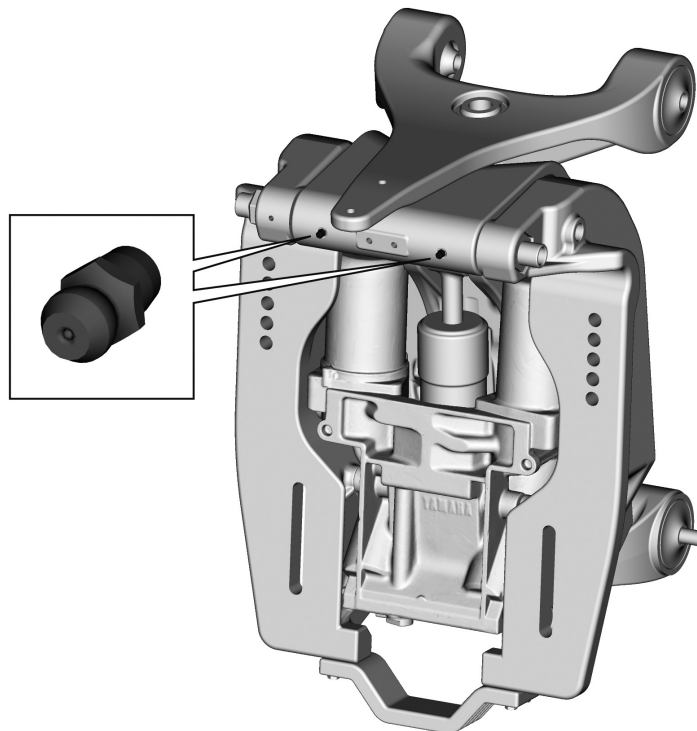
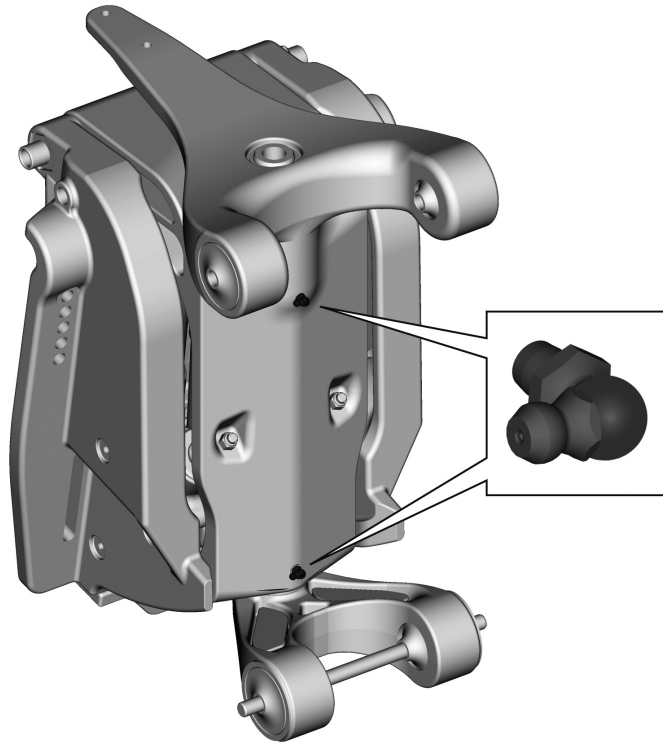
3. If necessary, fill up with fluid of recommended type until it comes out of the filling hole. See **Recommended fluids and grease**.

NOTE! Install **new** O-rings and filling plug.

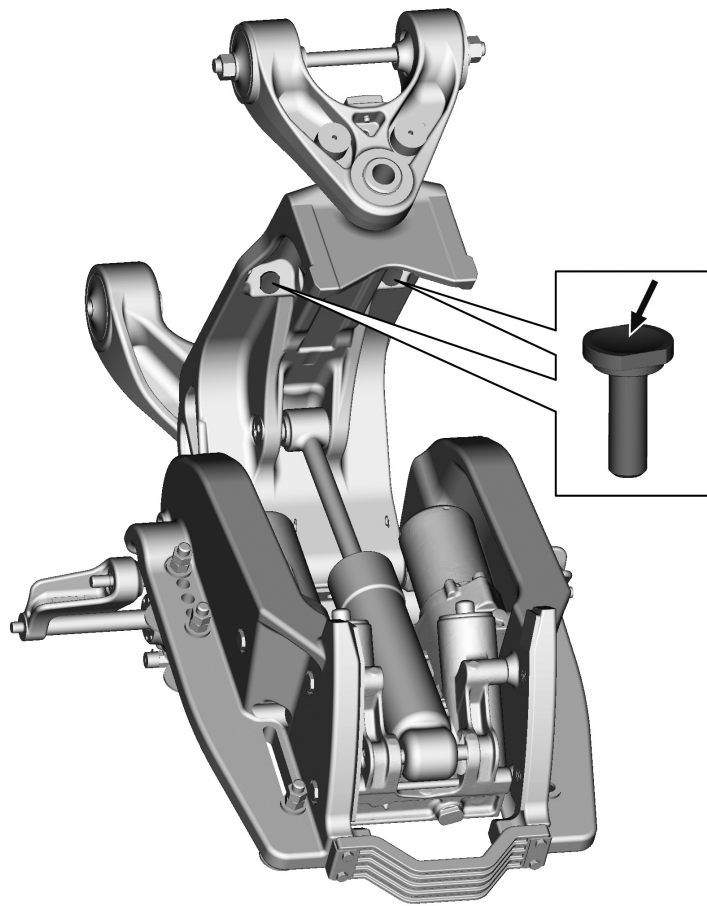
Tighten the plug to **2 Nm (1.5 lb ft)**.

Tighten reservoir cap: **7 Nm (5.1 lb ft)**

LUBRICATING AND GREASING THE PPT-UNIT



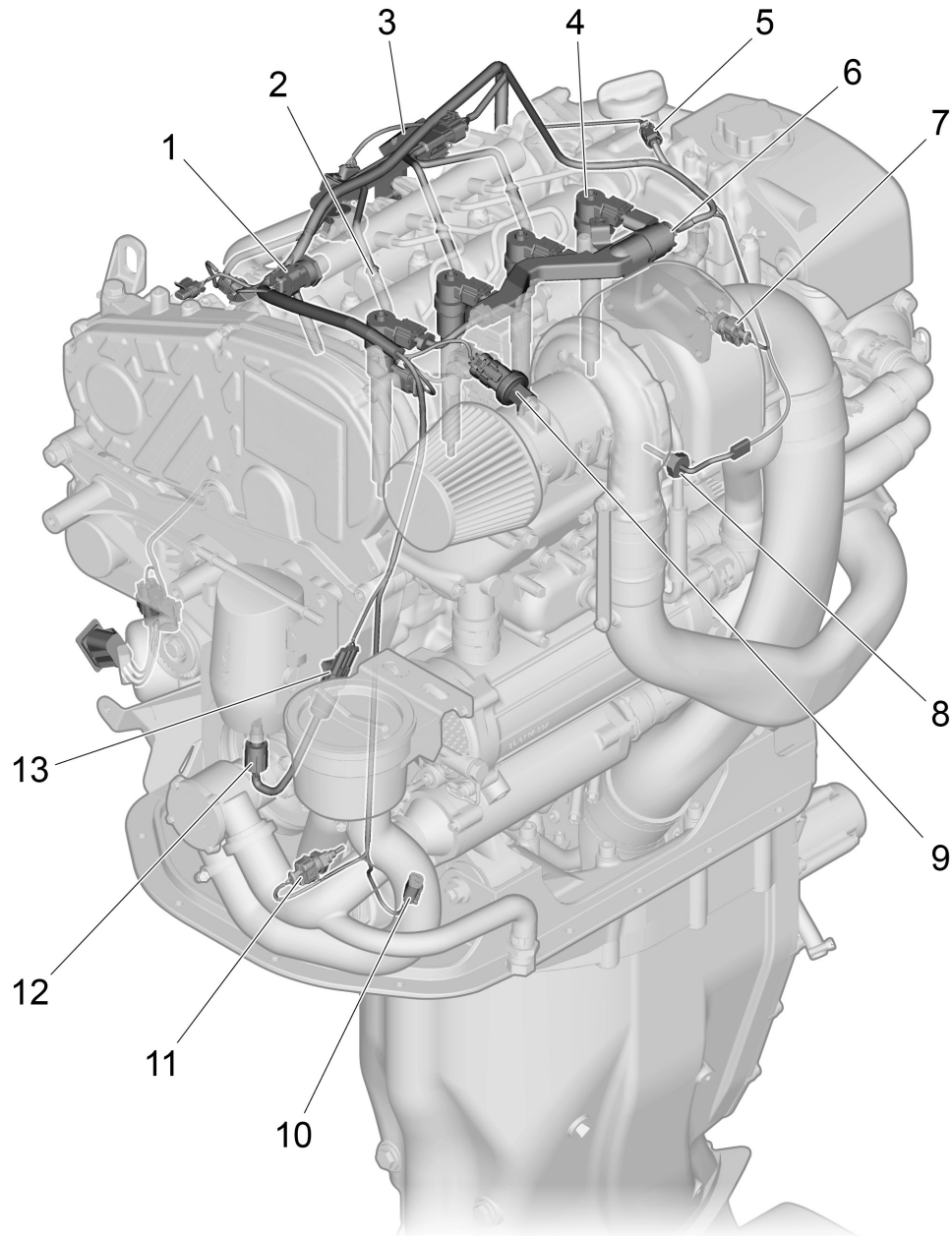
1. Use a grease gun and fill up with recommended grease until the grease comes out at the joints or ends of shaft.
Refer to **Recommended fluids and grease.**



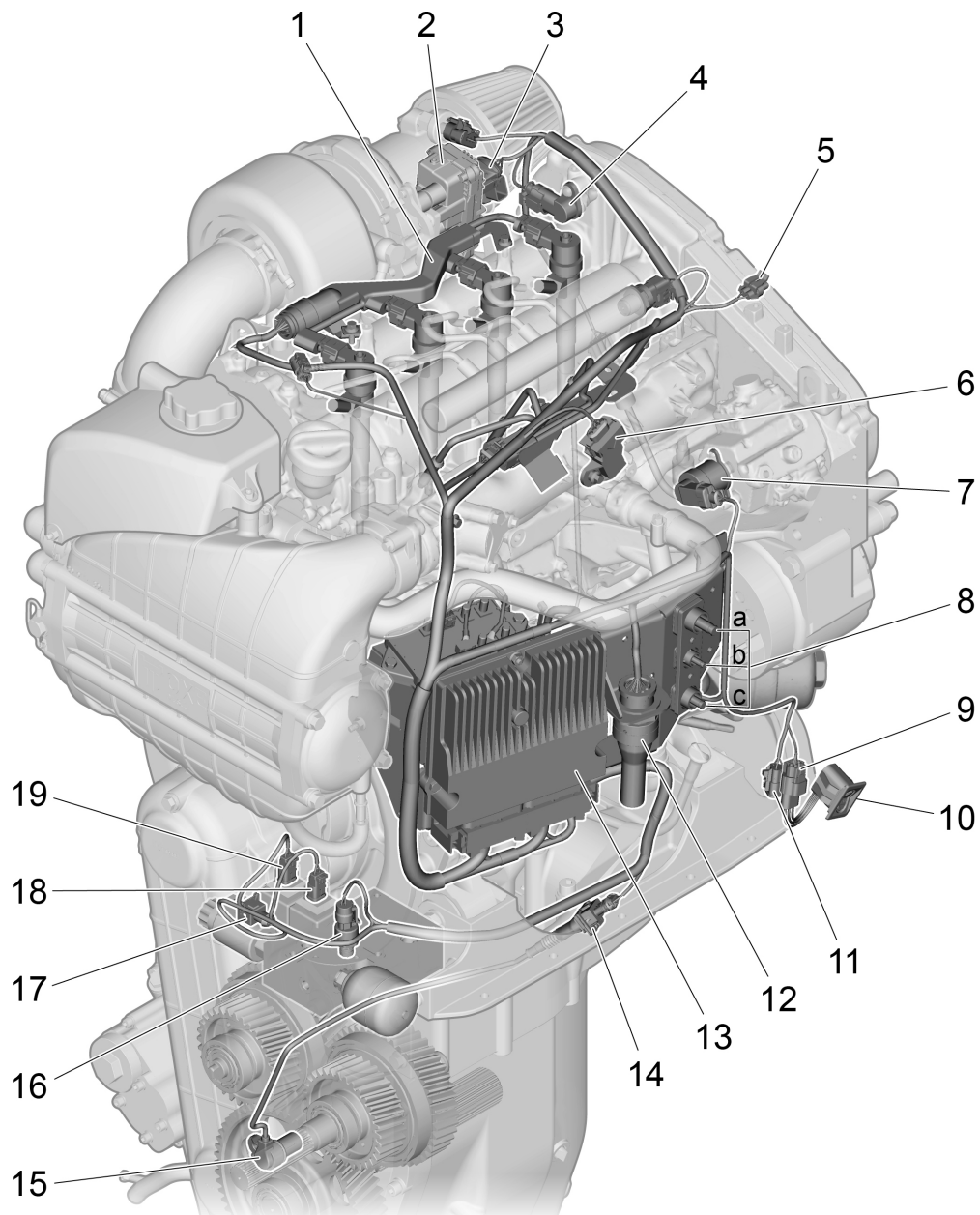
2. Fill the seatings with grease for smoother tilt operation. Use grease according to ***Recommended fluids and grease.***

ELECTRICAL SYSTEM

ELECTRICAL COMPONENTS

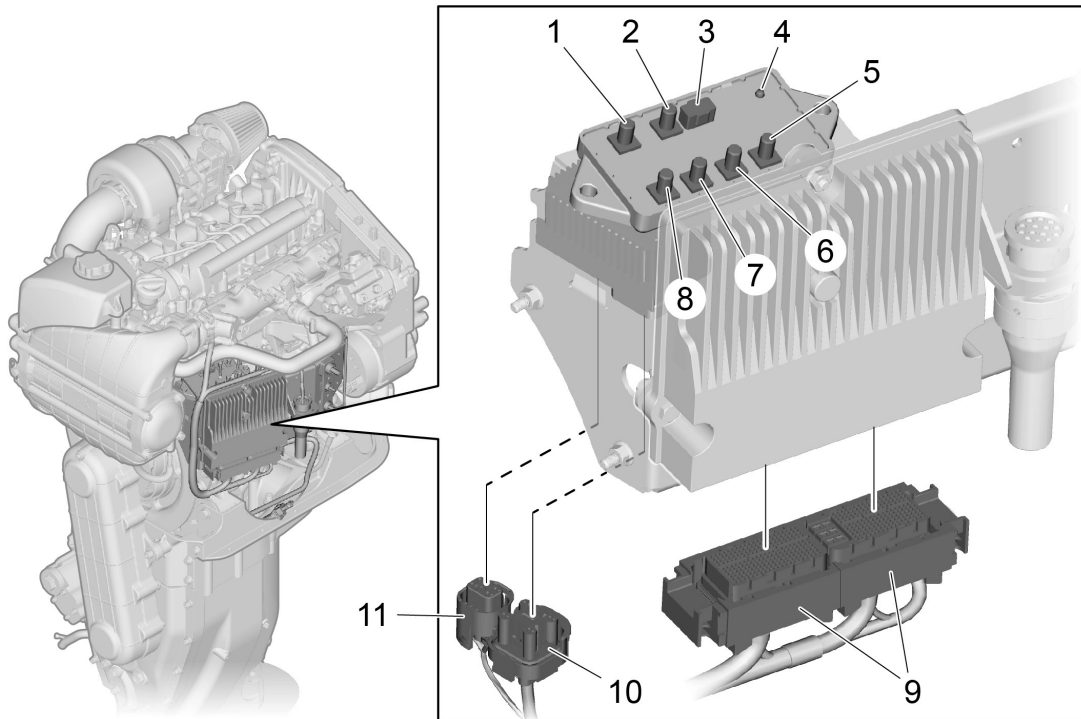


- | | |
|---|--|
| 1. Fuel rail pressure sensor connector | 8. Exhaust gas temperature sensor |
| 2. Glow plug (4 pcs) | 9. Air filter restriction sensor |
| 3. Glow plug harness connector | 10. Gearbox oil pressure switch connector |
| 4. Injector (4 pcs) | 11. Engine oil temperature sensor |
| 5. Exhaust gas temperature sensor connector | 12. Water-in-fuel sensor |
| 6. Injector harness connector | 13. Water-in-fuel sensor connector |
| 7. Engine coolant temperature sensor/connector | |



- | | |
|--|---|
| 1. <i>Injector harness</i> | 9. <i>PTT cowl connector</i> |
| 2. <i>Actuator</i> | 10. <i>PTT-switch</i> |
| 3. <i>Turbo actuator connector</i> | 11. <i>PTT sensor connector</i> |
| 4. <i>Camshaft position sensor</i> | 12. <i>Engine connector</i> |
| 5. <i>Fuel supply modul (FSM) connector</i> | 13. <i>ECU</i> |
| 6. <i>Temperature and air mass meter</i> | 14. <i>Gearbox output speed sensor connector</i> |
| 7. <i>Fuel pressure control valve</i> | 15. <i>Gearbox output speed sensor</i> |
| 8. <i>Power cable connector</i> | 16. <i>Gearbox oil pressure sensor</i> |
| <i>a) GND</i> | 17. <i>Trolling valve</i> |
| <i>b) ECU & Helm power</i> | 18. <i>Starboard gear coil</i> |
| <i>c) Engine starter power</i> | 19. <i>Port gear coil</i> |

ENGINE CONTROL UNIT (ECU)

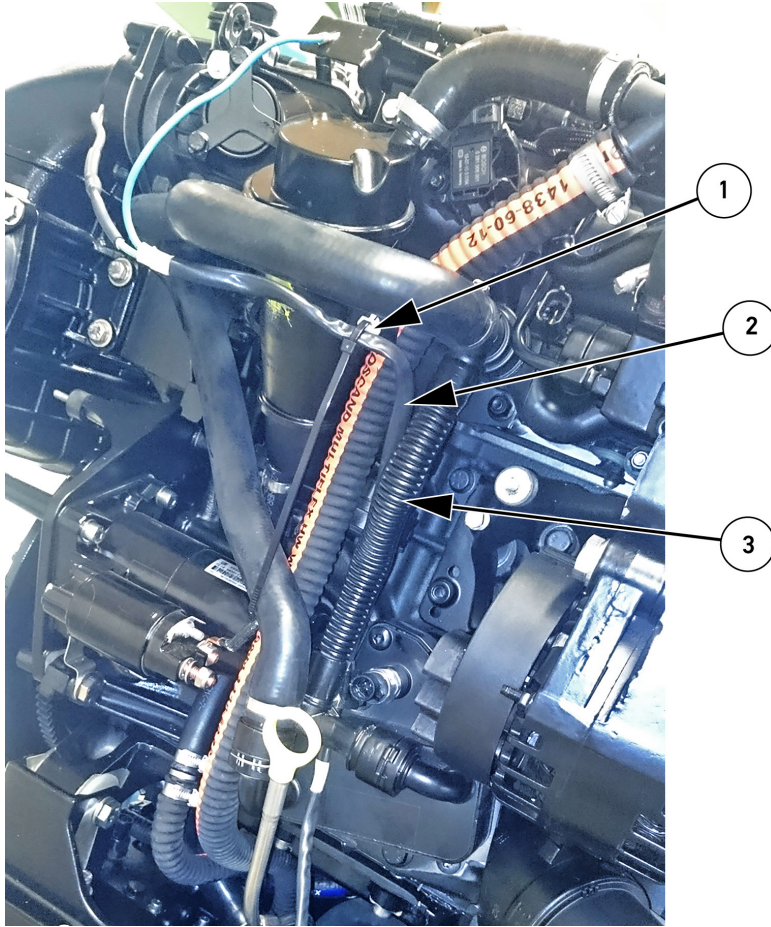


1. *GND*
2. *Supply*
3. *PSU control and feedback*
4. *PSU OK LED-indicator*
5. *ECU and helm*
6. *Glow plug control module*
7. *PTT up*
8. *PTT down*
9. *ECU connectors*
10. *Glow module, control, feedback, supply*
11. *Glow module, output*

WIRING

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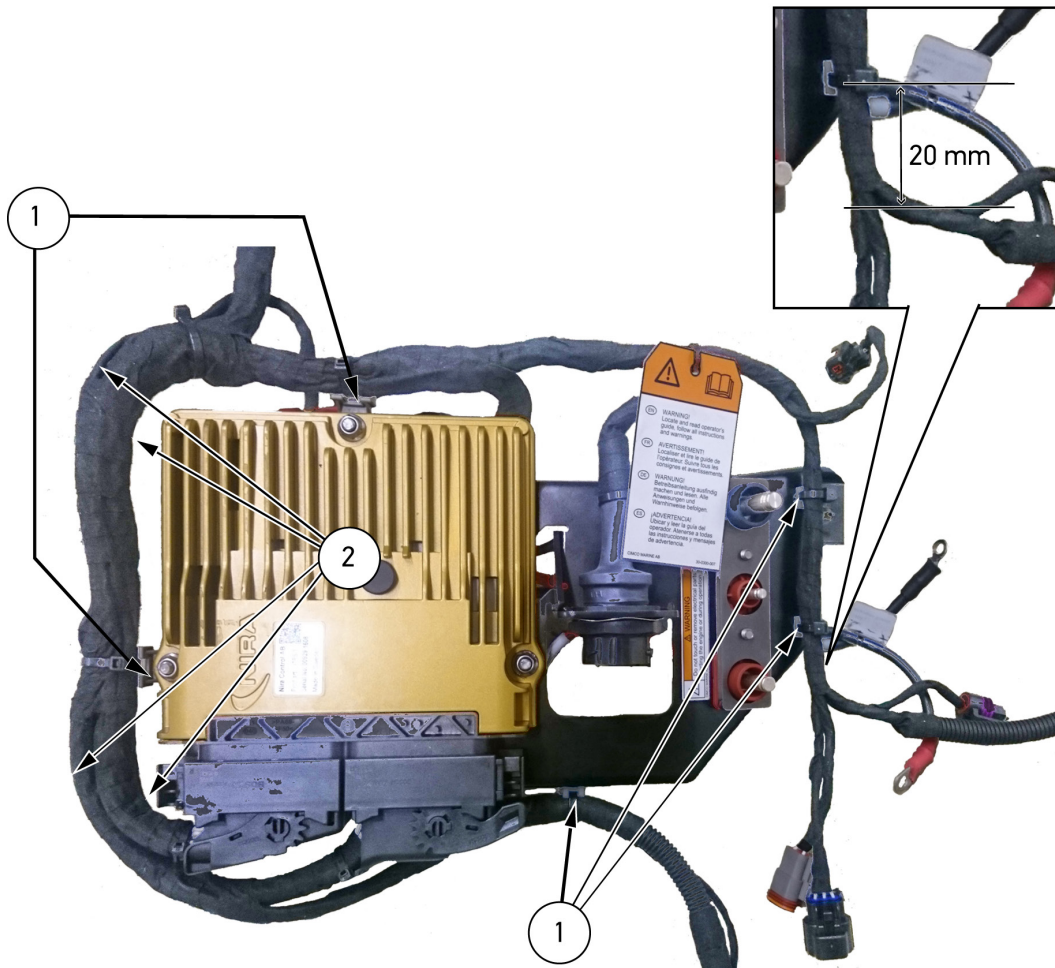
Power trim and tilt unit power cable assembly



1. Use an arrow head clip **(1)** on cyclon in order to fasten the PTT power cable.
2. Route the ppt power cable **(2)** behind the cooling fluid return pipe **(3)** from the oil cooler.

Wiring on ECU bracket assembly

Front view



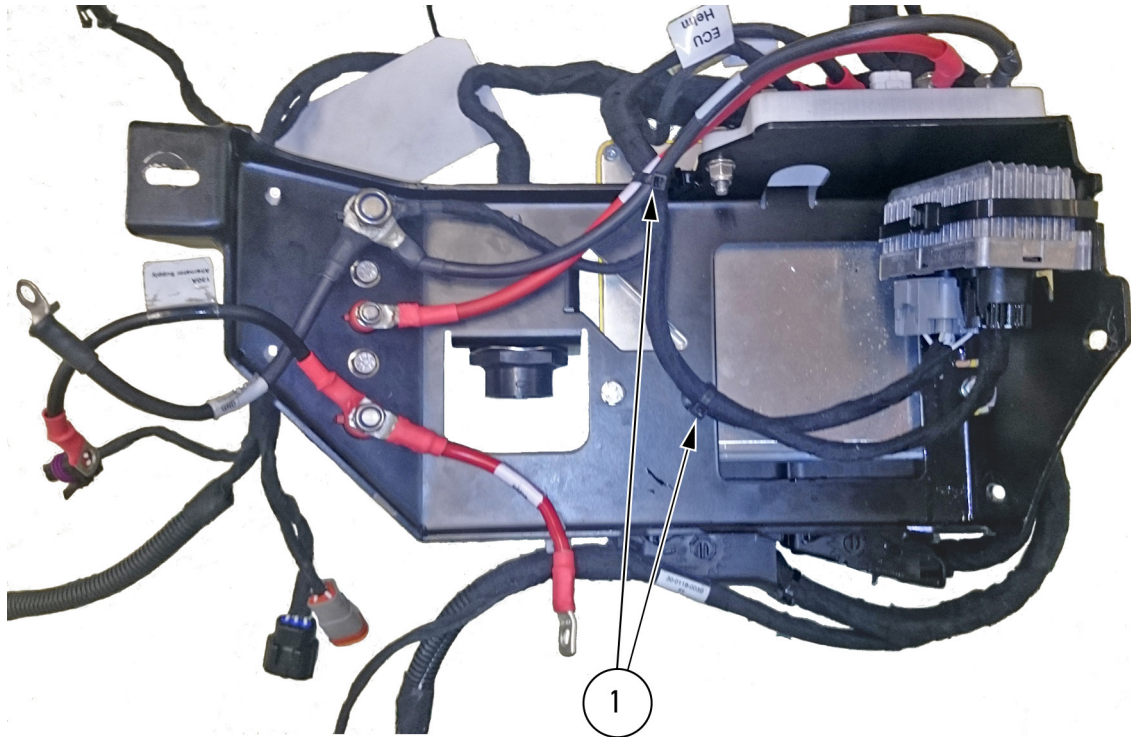
1. Fasten and secure wiring with clips (1).

! CAUTION

It is very important that the harness branches are laid out as shown in picture above, to avoid fretting at exposed critical areas (2) and to ensure correct cabling length.

Always double check wiring layout after the ECU bracket assembly is mounted on the engine to ensure that there is no fretting risk.

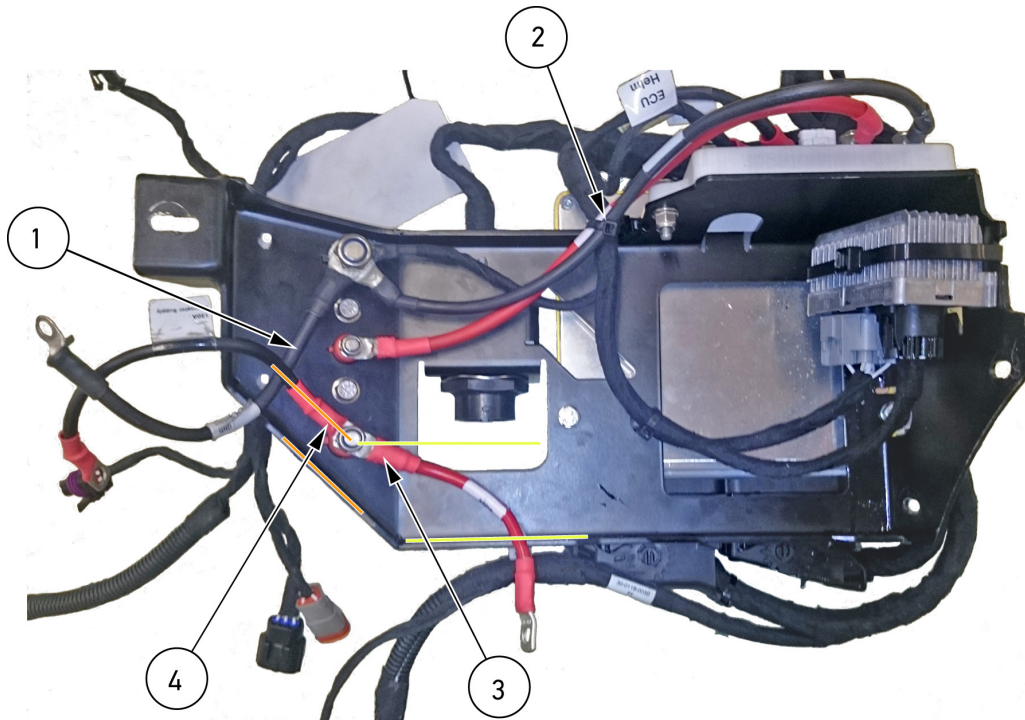
Rear view



1. Fasten and secure wiring with clips **(1)**.

Power cable assembly

Power connectors, short starter motor cable (<160 mm, 6.33 in)

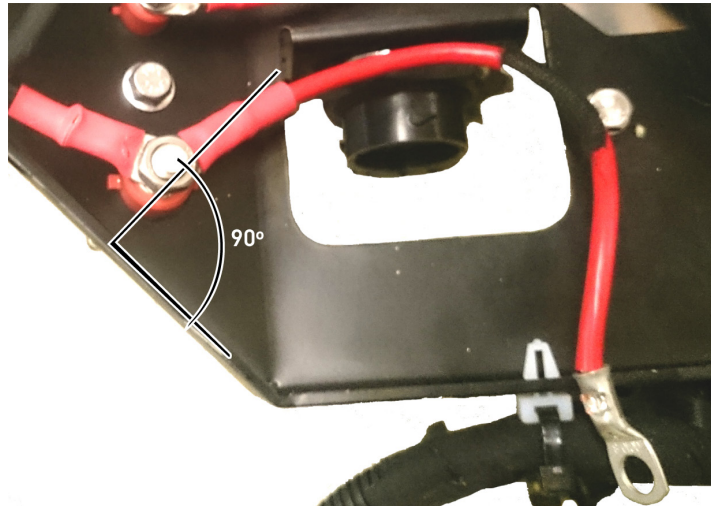


Supply cabling order		GND cabling order	
1	Starter motor supply	1	Engine harness GND
2	Alternator supply	2	PSU GND cable
		3	Engine block GND

1. Place the engine block ground cable **(1)** closest to the bracket .
2. Secure/fasten all cables and the harness within the cable clip **(2)**.
3. Cable **(3)** and cable **(4)** should be mounted in parallell with bracket edges.

Power connectors, long starter motor cable (>170 mm, 6.72 in)

231



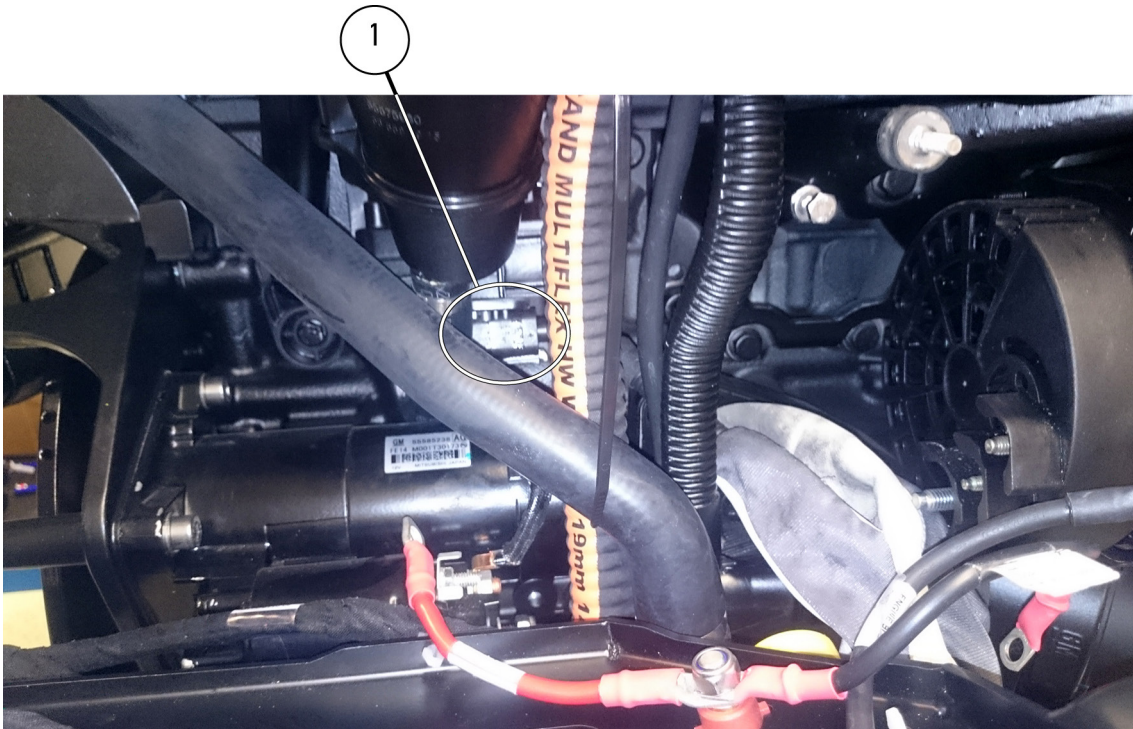
1. Mount the starter motor cable **(1)** in an right angle to the bracket edge.

Power connectors, PSU

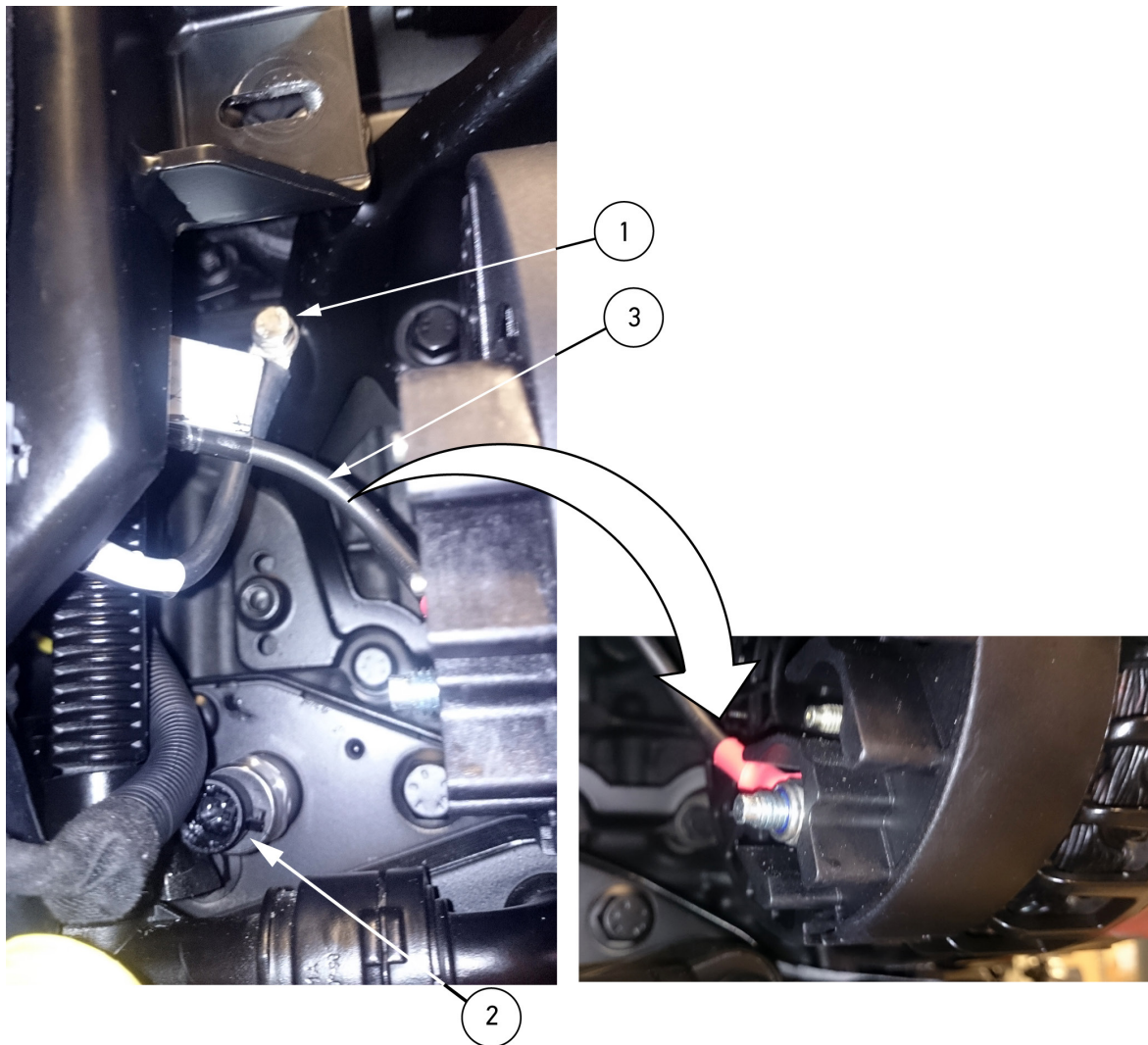


1. Mount the power cables at recommended angles as shown in picture above.

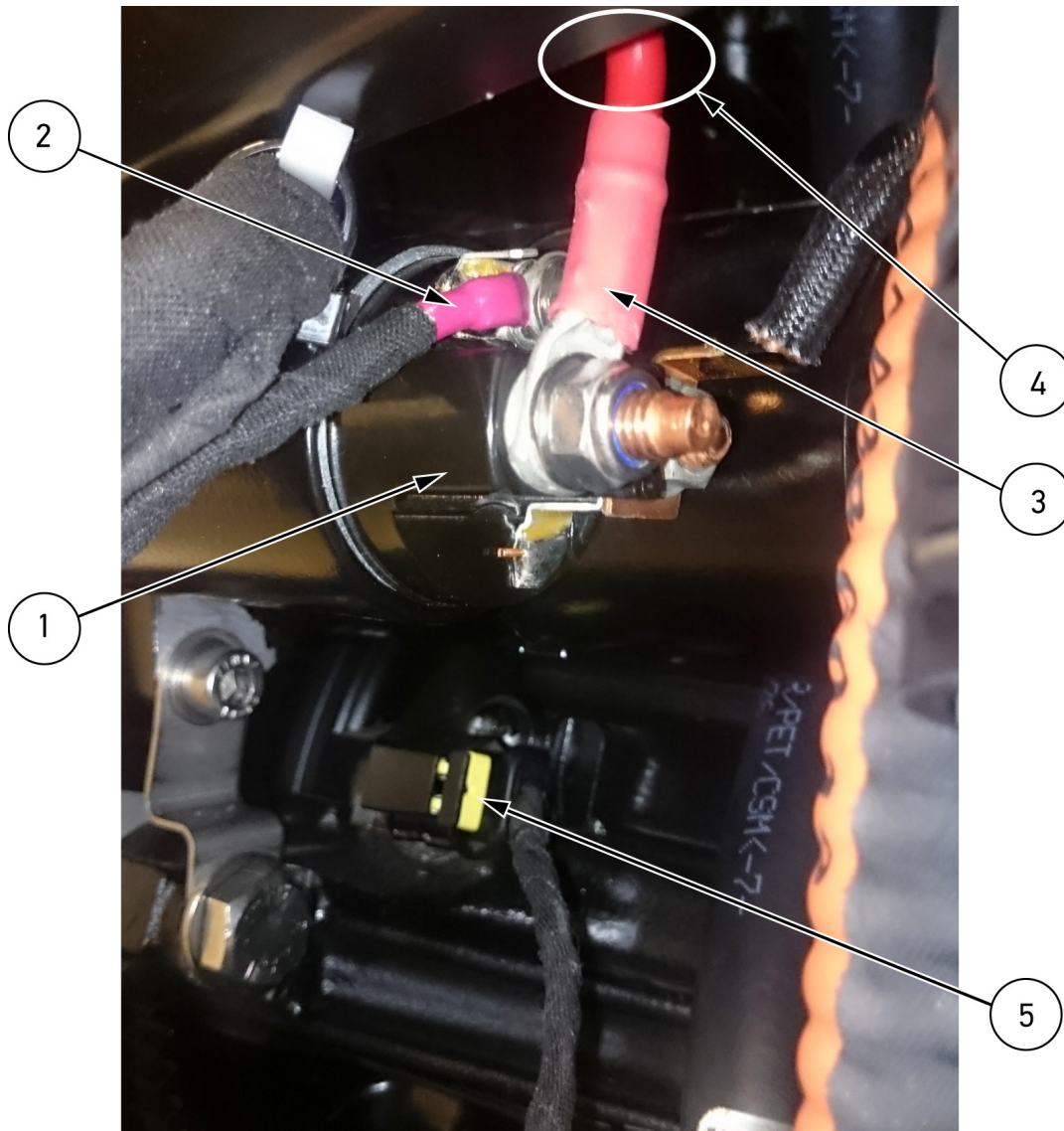
Mounting the ECU bracket assembly on the engine



1. First connect the swirl valve **(1)**.
NOTE! Ensure it click's.
2. Slide the secondary lock (yellow) in place.
3. Fit the ECU bracket in place and secure loosely with screws/nuts.
NOTE! Rear side of engine only.



4. Mount engine block GND cable **(1)** on the engine block.
NOTE! Ensure that the contact surface is free from paint.
5. Connect the engine oil pressure sensor connector **(2)**.
NOTE! Ensure it *click's*.
6. Mount the alternator supply **(3)** on the alternator.
NOTE! Route the cable towards the engine.



7. Mount the starter motor cable **(2)** horizontally.
8. Mount the starter motor supply cable **(3)** to the starter motor solenoid **(1)** and lead it as vertical as possible.

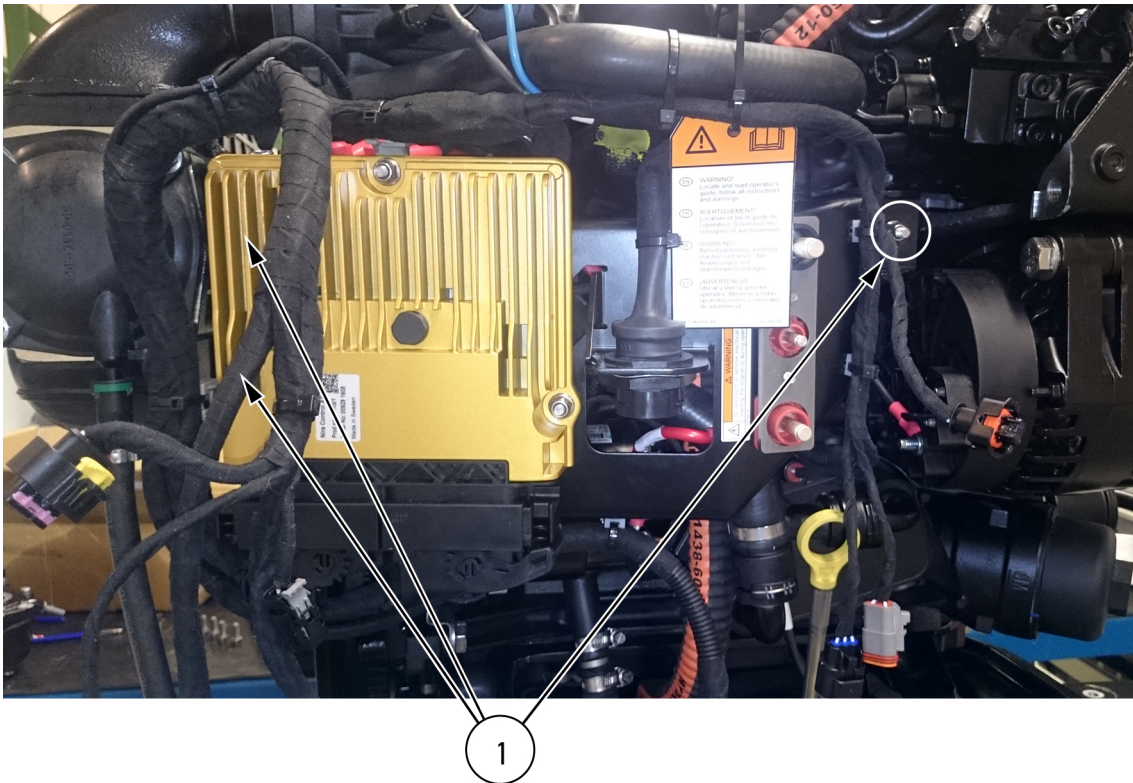
⚠ CAUTION

Ensure no fretting on starter motor cables **(4)**. Recommended clearance >10 mm (>0.394 in).

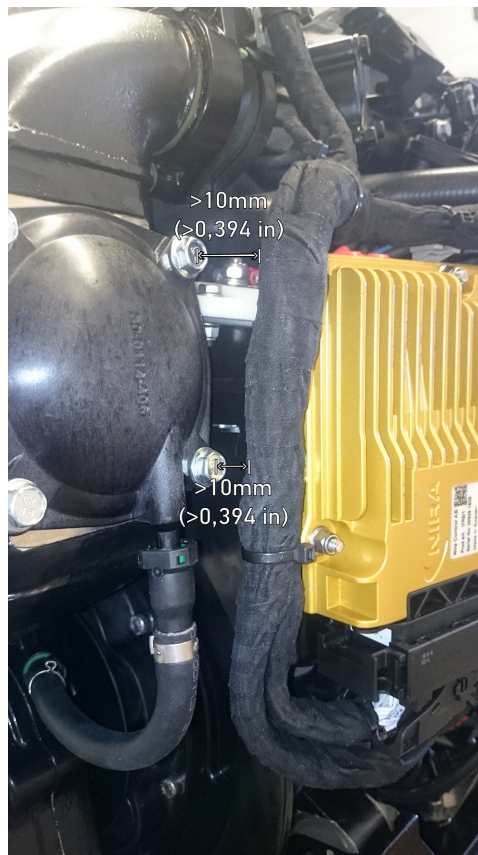
9. Connect the crankcase sensor connector **(5)**.

NOTE! Ensure it *click's*.

10. Slide the secondary lock (yellow) in place.

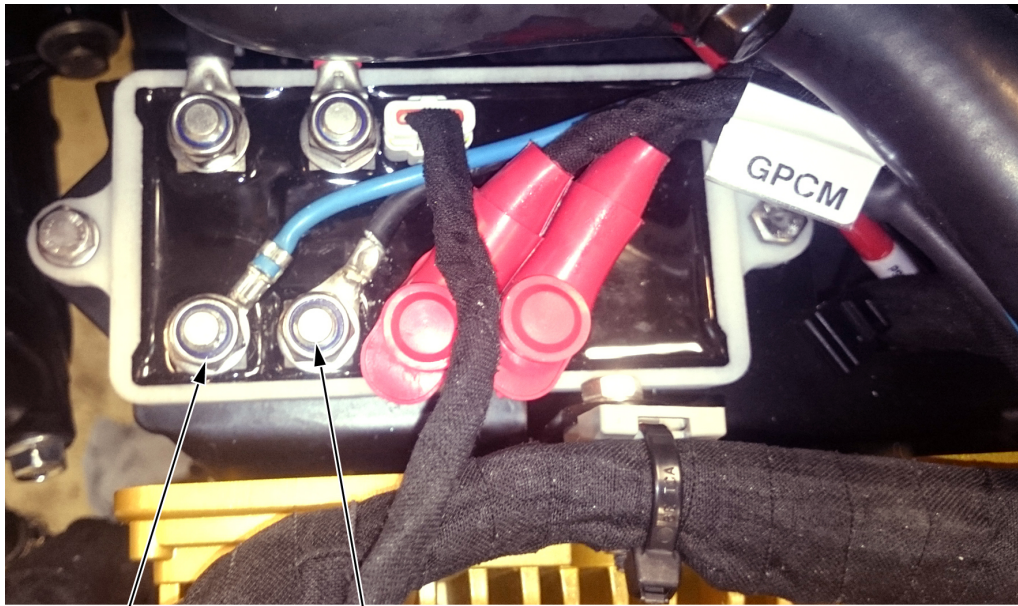


11. Tighten 3 screw-nuts **(1)**. Adjust the ECU bracket assembly to ensure not fretting.



⚠ CAUTION

Ensure that fretting is not possible. Recommended clearance **>10 mm (>0.394 in)**.



1

2

12. Mount the PTT-power cables.

- blue cable **(1)** closest to the rear end of the engine
- black/green cable **(2)** second closest to the rear end of the engine



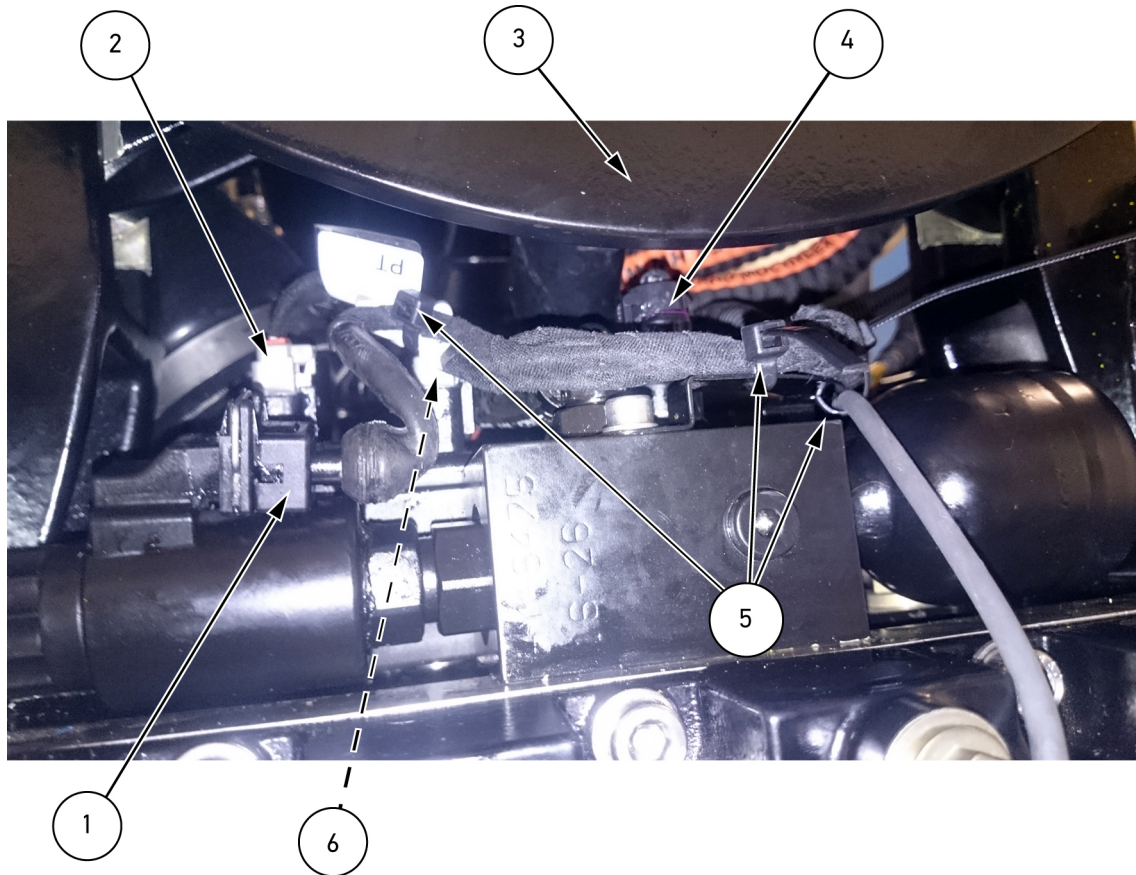
1

13. Connect the fuel pressure control valve **(1)**.

NOTE! Ensure it *click's*.

Mounting of remaining engine harness on engine

Gearbox connectors

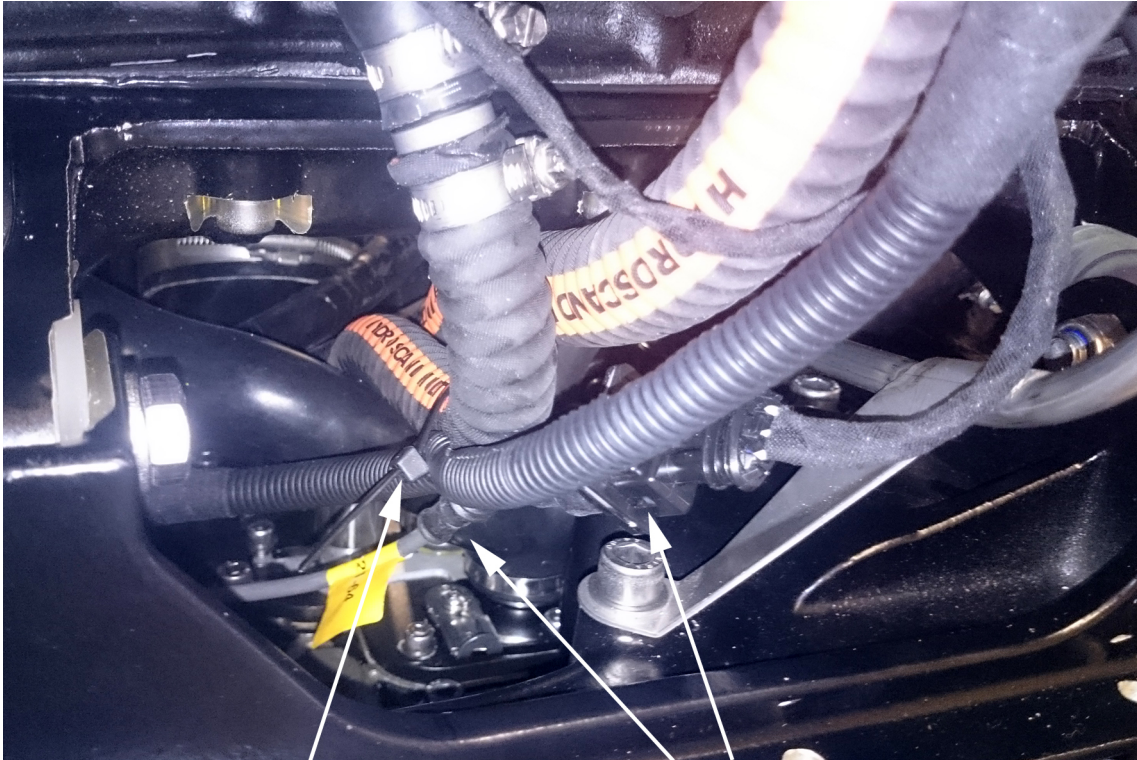


1. Trolling valve connector
2. Port selector coil connector, **FWD** gear
3. Flywheel
4. Gearbox oil pressure sensor connector
5. Cable ties
6. Starboard selector coil connector, **REV** gear

! WARNING!

Make sure the cables are tightly secured so that no contact with the flywheel is possible! Recommended clearance: >15 mm.

1. Ensure that all connectors **click**.



1

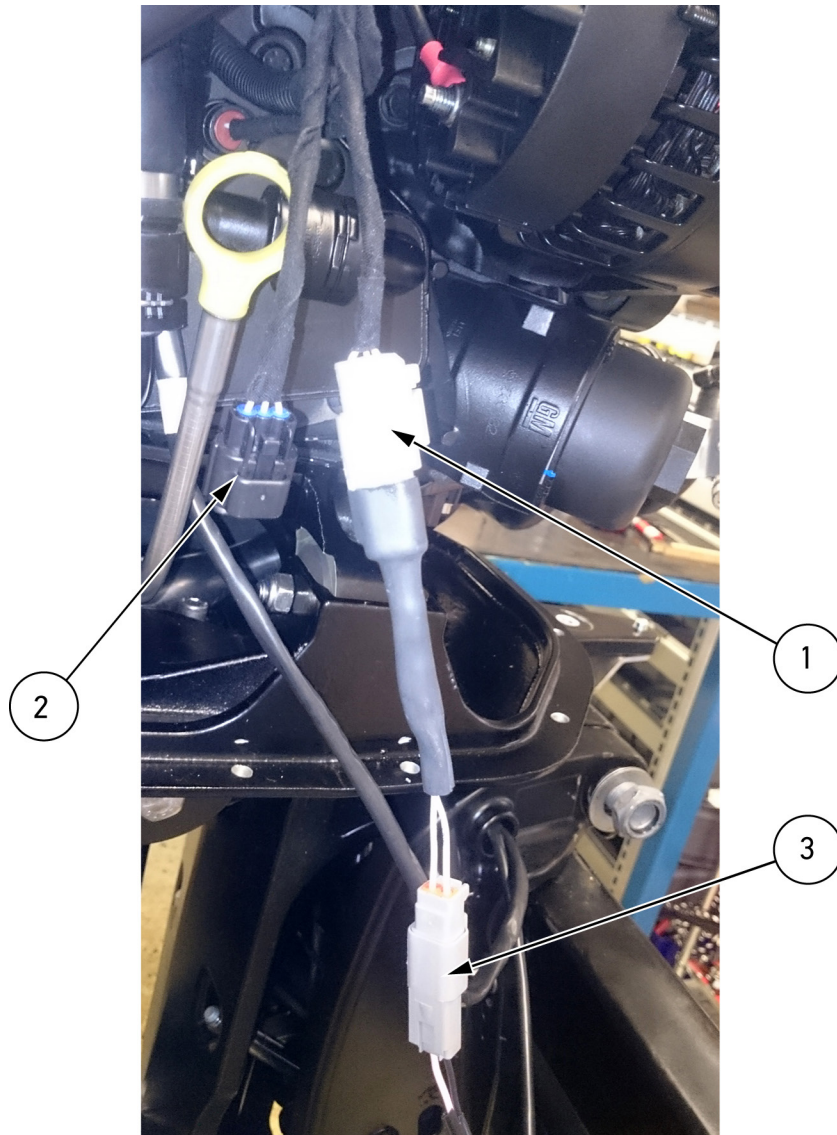
2

1. Cable tie

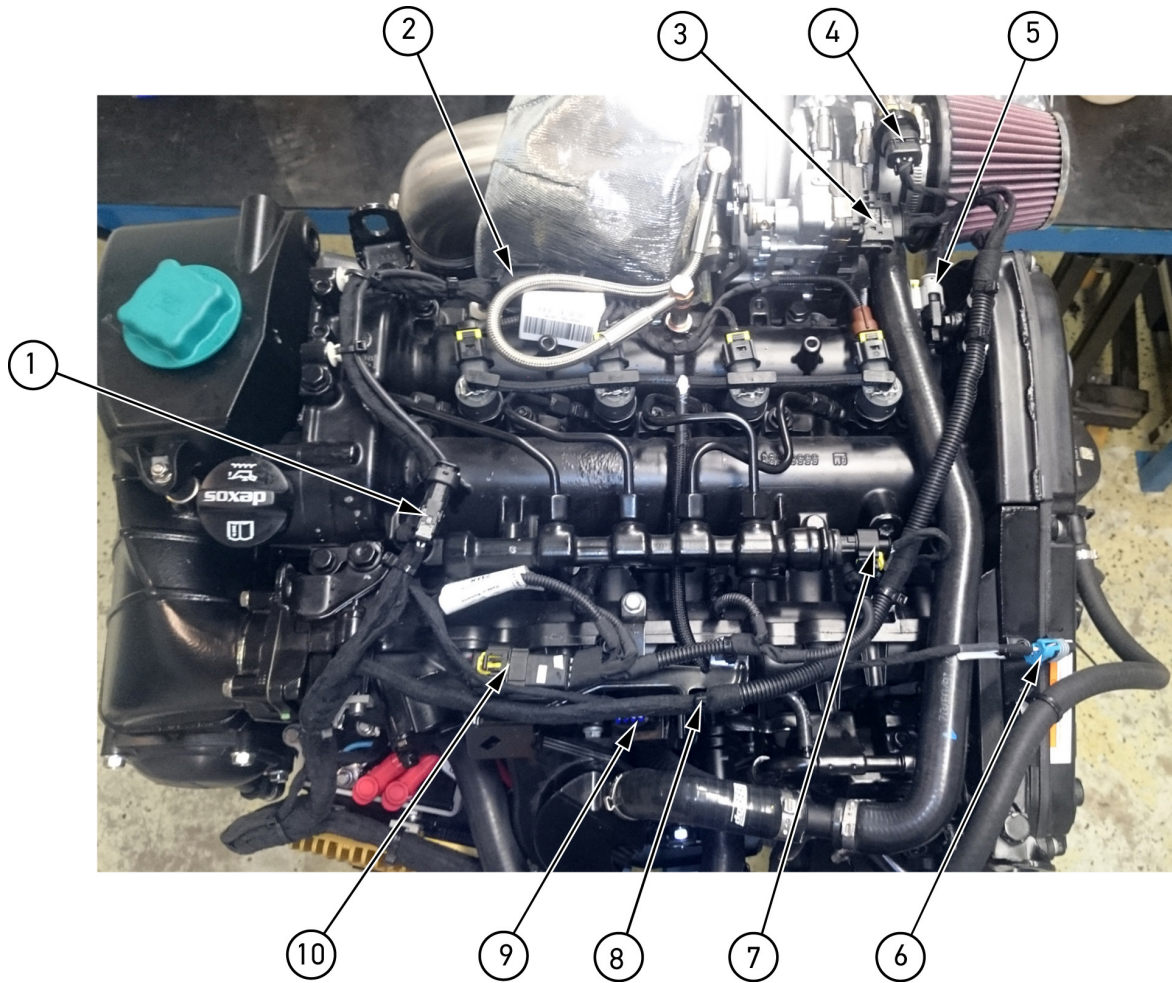
2. Connect the propeller speed sensor connector **(2)**. Make sure it **clicks!**

Remaining engine sensor and actuator connectors

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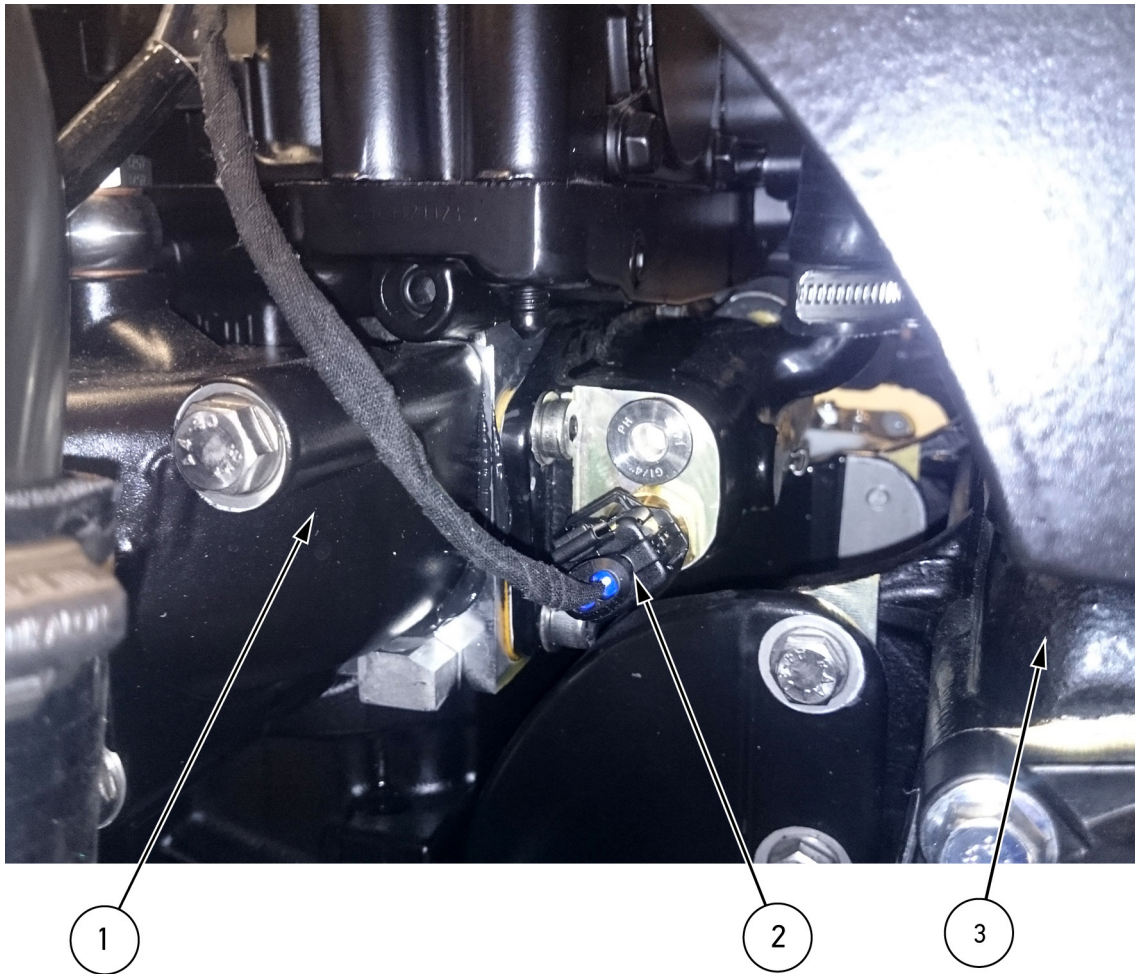


1. Connect the PTT sensor adapter **(1)** to the engine harness. Make sure it **clicks!**
2. Connect the PTT cowl switch **(2)**. Make sure it **clicks!**
3. Connect the PTT sensor adapter to the PTT sensor **(3)**. Make sure it **clicks!**



1. T-MAP connector.
2. Glow plug harness connector.
3. EGT connector
4. Injector harness connector
5. Air filter restriction connector
6. Turbo actuator connector
7. Cam shaft angle sensor connector
8. Fuel rail pressure sensor connector
9. Cable tie
10. FSM connector
11. Clips

NOTE! Make sure all connectors **click** and push the yellow or red secondary lock in place!



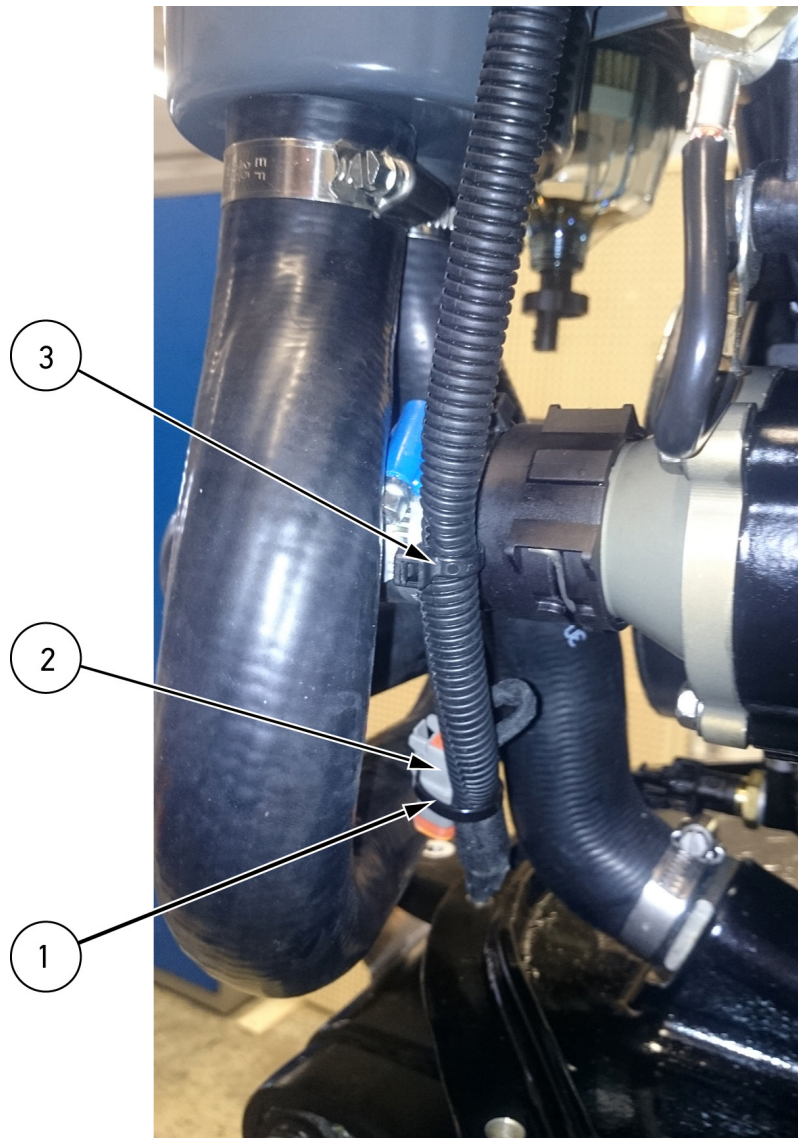
1. *Exhaust manifold*
2. *Intercooler*
3. *ECT connector*

NOTE! Make sure The ECT connector clicks when connecting.

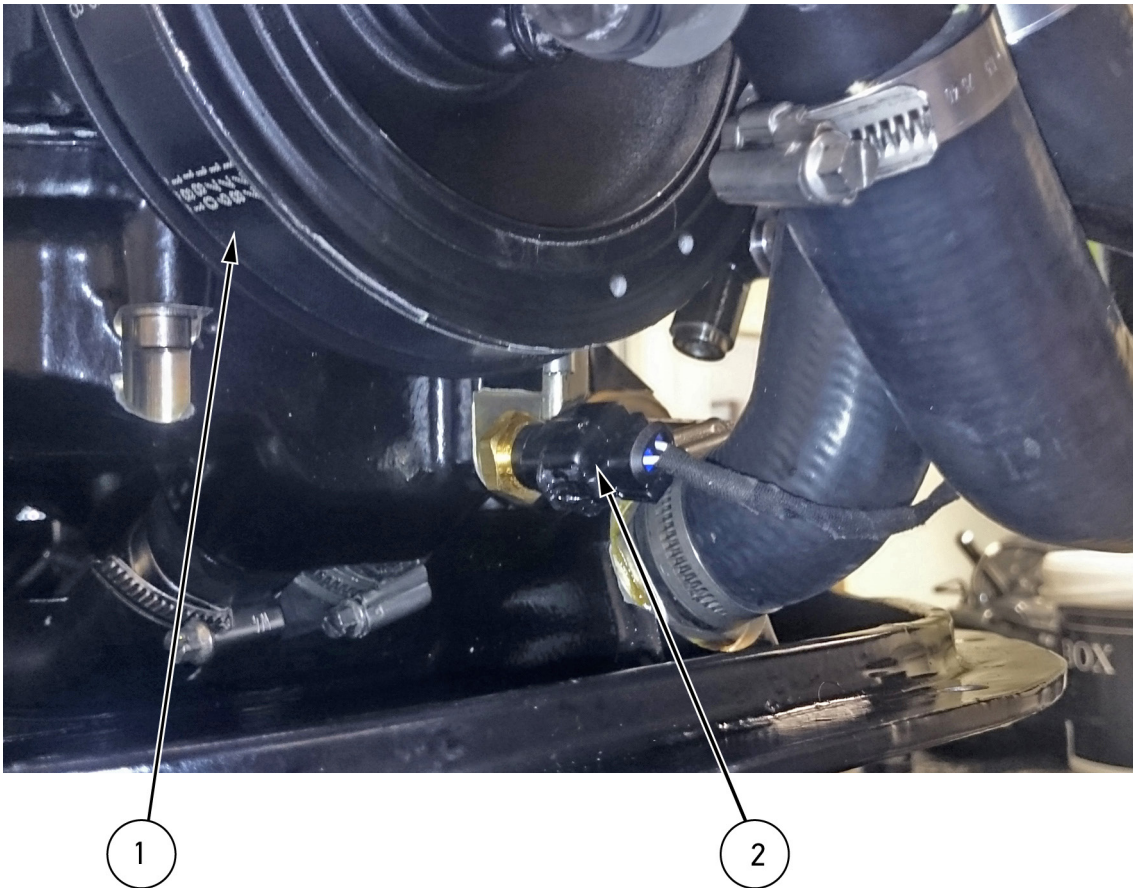


- 1. *Clip*
- 2. *Water-in-fuel sensor connector*
- 3. *Clip*
- 4. *Cable tie*

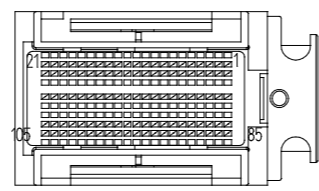
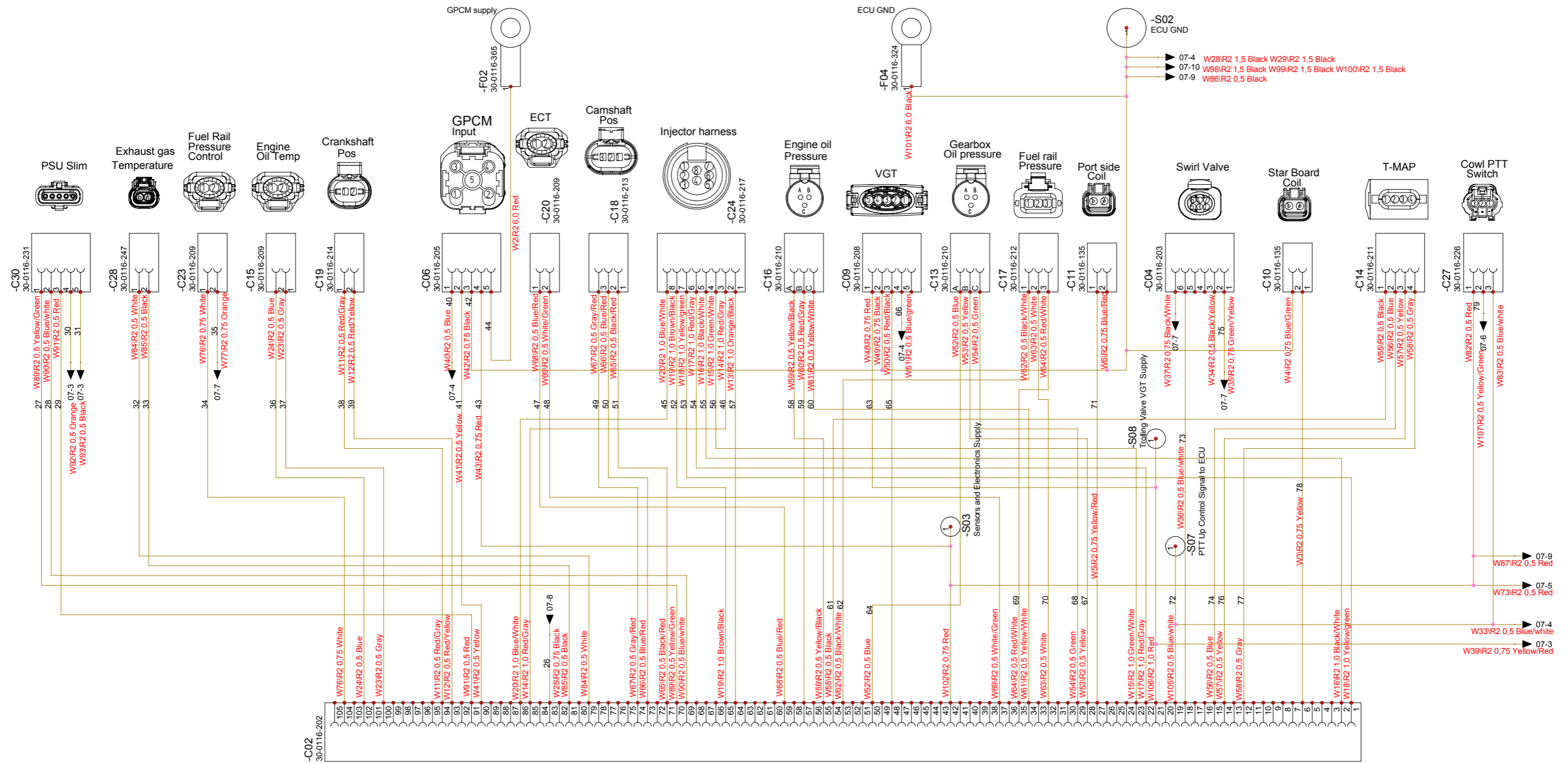
1. Fix the Water-in-fuel sensor **(3)** connector with a cable tie **(4)**.



2. Fix the Gearbox lubricating oil pressure switch connector **(2)** with a cable tie **(1)**.
3. Secure the cable with a clip **(3)**.



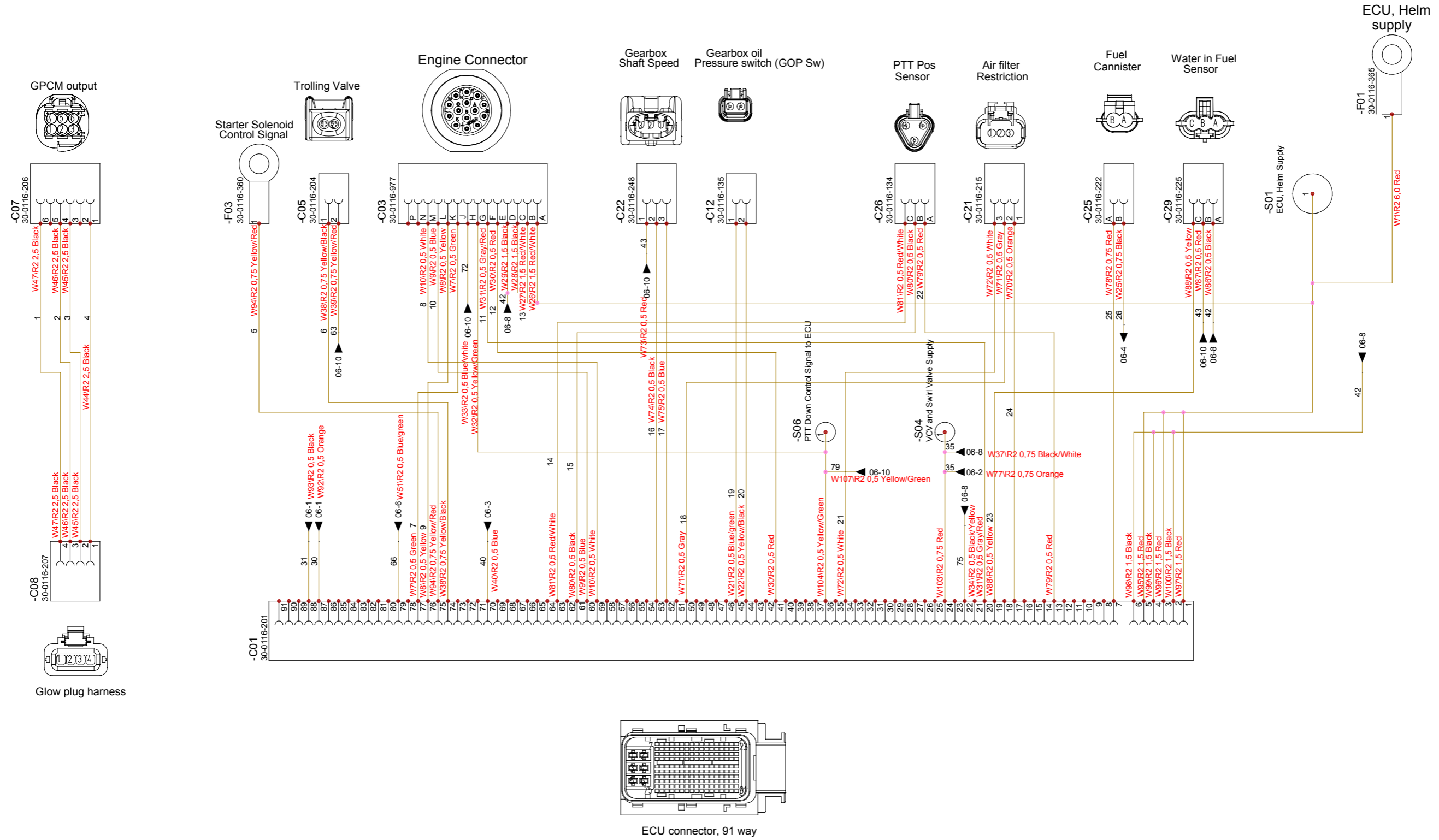
1. Alternator belt
2. Engine oil pressure sensor connector
4. Connect the Engine oil pressure sensor connector **(2)**. Make sure it **clicks!**



ECU connector, 105 way

Engine harness

ELECTRICAL SYSTEM



Main electrical closet
30-0116-003B Scheme 07

MAINTENANCE SCHEDULES

FIRST INSPECTION

Checklist					
1st inspection, after 50 h	Check	Fill up	Clean	Change/Replace	Refer to
Start and warm up engine - Water/oil/fuel leakage - Power steering and Power trim, function and leakage - No DTCs are triggered (diagnostic tool) - Unusual engine/transmission sounds	X				
Stop engine - Engine oil and filter		X		X	Engine oil and oil filter replacement
Restart engine - Oil pressure and leakage	X				Display manual
Gear box oil and filter				X	Hydraulic oil filter Replacement
Coolant level and mixture	X				Drain and fill coolant
Fluid level power trim	X				Check the power tilt and trim fluid level
Seawater filter			X		Clean Seawater strainer
Upper belt tension	X				Check upper belt tension
Lower belt tension	X				Check lower belt tension
Upper belt oil				X	Change upper belt oil
- Magnetic plug, Upper belt oil			X		Change upper belt oil
Lower belt oil				X	Change lower belt oil
- Magnetic oil plug, Lower belt oil			X		Change lower belt oil
Seawater outlet nipple				X	Replace seawateroutlet nipple
Display/gauges, function	X				Display Manual

SERVICE AT 200 HOURS

Checklist					
Every 200 h or once a year	Check	Fill up	Clean	Change/Replace	Refer to
Start and warm up engine <ul style="list-style-type: none"> - Water/oil/fuel leakage - Power steering and Power trim, function and leakage - No DTCs are triggered (diagnostic tool) - Unusual engine/transmission sounds 	X				
Stop engine <ul style="list-style-type: none"> - Engine oil and filter 		X		X	Engine oil and oil filter replacement
Restart engine <ul style="list-style-type: none"> - Oil pressure and leakage 	X				Display manual
Fluid level power trim	X				Check the power tilt and trim fluid level
Upper belt tension	X				Check upper belt tension
Lower belt tension	X				Check lower belt tension
Coolant level and mixture	X				Drain and fill coolant
Crank case ventilation	X				Check hoses and clamps
Air filter				X	Air Filter Replacement
Display/gauges function	X				Display Manual
Turbo charger			X		Clean the turbo charger
Exhaust hose	X				Outboard views
Alternator drive belt tension	X				Self adjusting, check for wear
Seawater strainer			X		Clean Seawater strainer
Seawater pump, impeller	X				Seawater pump impeller replacement
Anodes. Intercooler, heat exchanger, transom mount				X	User's Manual Inspect anodes
Fuel filter				X	Fuel filter replacement
Gearbox, oil and filter, washer, plug and O-ring				X	Hydraulic oil filter replacement
Upper belt oil - magnetic plug, washer	X				Change Upper Belt Oil,
Lower belt oil - magnetic plug, washer	X				Change lower belt oil

MAINTENANCE SCHEDULE

250

Checklist					
Every 200 h or once a year	Check	Fill up	Clean	Change/ Replace	Refer to
Painting			X		Owner's Manual Check painted surfaces
Inspection, exhaust hose and cooling hoses	X				Outboard view
Hoses/pipes, connections, hose clamps	X				Outboard view
Condition of rubber hoses	X				Outboard view
Hydraulic hoses, connections (leakage, wear, aging)	X				Outboard view

SERVICE AT 800 HOURS

Checklist					
Each 800 h/once every 3d year minimum	Check	Fill up	Clean	Change/Replace	Refer to
Start and warm up engine					
- Water/oil/fuel leakage					
- Power steering and Power trim, function and leakage	X				
- No DTCs are triggered (diagnostic tool)					
- Unusual engine/transmission sounds					
Stop engine					
- Engine oil and filter		X		X	Engine oil and oil filter replacement
Restart engine					
- Oil pressure and leakage	X				Display manual
Fuel filter				X	Fuel filter replacement
Turbo charger	X		X		Clean the turbo charger
Heat exchanger	X				Cleaning heat exchanger
Anodes. Intercooler, heat exchanger, transom mount				X	User's Manual Inspect anodes
Exhaust hose and coolant hoses	X				Outboard view
Hoses/pipes, connections and hose clamps	X				Outboard view
Condition of rubber hoses	X				Outboard view
Crank case ventilation	X				Check hoses and clamps
Alternator drive belt				X	Alternator belt replacement
Cables, connectors, and cable glands	X				Outboard view
Coolant				X	Drain and fill coolant
Trim pistons, hoses, hydraulic hoses. Fluid level power trim. Leakage.	X				Check power tilt and trim system
Hoses, hydraulic hoses, connections. Leakage, wear, aging	X				Outboard view
Steering, Function	X				See Steering System's Manual
Steering pistons, hoses, hydraulic hoses. Leakage	X				See Steering System's Manual
Upper belt oil, packing, plug				X	Change upper belt oil
Upper belt				X	Upper belt replacement

MAINTENANCE SCHEDULE

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Checklist					
Each 800 h/once every 3d year minimum	Check	Fill up	Clean	Change/ Replace	Refer to
Upper belt seals				X	Check upper belt pulley seals
Gear, function and wear	X				Lower belt replacement
Gearbox seals				X	Lower belt replacement
Lower belt pulley seals				X	Lower belt replacement
Propeller shaft oil seal				X	Propeller replacement
Lower belt oil, packing, plug	X			X	Change lower belt oil
Lower belt and related parts				X	Lower belt replacement Please fill in the Service record on the following pages: Date of replacement, part No and batch No.
Seawater strainer			X		Clean Seawater strainer
Seawater pump, impeller	X				Seawater pump impeller replacement
Air filter				X	Air Filter Replacement
Painting			X		Owner's Manual Check painted surfaces
Cowling. Hatches, mounting	X				Remove/install cowling

SERVICE RECORD - LOWER BELT

DATE	Engine run time / engine hours
Belt part No.	OBSERVATIONS
Batch No.	
DATE:	Engine run time / engine hours
Belt part No.	OBSERVATIONS
Batch No.	
DATE	Engine run time / engine hours
Belt part No.	OBSERVATIONS
Batch No.	
DATE	Engine run time / engine hours
Belt part No.	OBSERVATIONS
Batch No.	
DATE	Engine run time / engine hours
Belt part No.	OBSERVATIONS
Batch No.	

SERVICE RECORD - LOWER BELT

DATE	Engine run time / engine hours
Belt part No.	OBSERVATIONS
Batch No.	
DATE:	Engine run time / engine hours
Belt part No.	OBSERVATIONS
Batch No.	
DATE	Engine run time / engine hours
Belt part No.	OBSERVATIONS
Batch No.	
DATE	Engine run time / engine hours
Belt part No.	OBSERVATIONS
Batch No.	
DATE	Engine run time / engine hours
Belt part No.	OBSERVATIONS
Batch No.	

TROUBLESHOOTING

OPERATING FAULTS AND POSSIBLE CAUSES

We recommend

A repair is only complete when both the damage that occurred and the possible causes have been eliminated. Finding out the cause of damage is often more difficult than repairing the damage that occurred. We therefore recommend that you obtain a precise description of the operating fault before removing and dismantling components. Then use a process elimination (questions) to pin-point the probable causes and investigate and eliminate these successively on the basis of the table **and your own experience**. This helps to reduce repairs to the required scale and to counteract claims regarding “over-eager” replacement of parts and complaints about expensive work and down time.

NOTE! The following list is conceived as an aid to memory for experts so that to causes of damage are overlooked when dealing with faults. The precondition for this, however, is that the experts are familiar with the Service Manual for the engine as well as the accompanying Operating Instructions.

FAULT TABLE

1. ECU self-diagnosis or flash code output										
2. Starter motor turns over engine slowly or not at all										
3. Starter motor turns, engine fails to start, engine fails to start / difficult to start when cold										
4. Engine stalls (dies) during operation, no longer starts (starter motor turns), engine fails to start / difficult to start when hot										
5. Sudden, temporary engine shutdown, engine does not reach full revs										
6. Engine runs at idle speed only, no throttle response										
7. Engine runs at increased idle speed only, no throttle response										
8. Rated engine speed significantly reduced (even at no load)										
9. Reduced power output in all ranges										
10. Irregular engine operation, loss of traction										
11. Unstable idle speed, engine surges, misfiring, engine knocking										
12. Engine judder										
13. Unusual combustion noises										
14. Excessive smoke emission: white smoke / blue smoke										
15. Excessive smoke emission: black smoke										
16. Engine temperature too high (coolant loss)										
17. Fuel consumption too high										
18. Lubrication oil pressure too low										
19. Lube oil pressure too high										
20. Lube oil consumption too high										
21. Engine too "loud" / mechanical noises										
Possible causes										
x	x									Battery flat, battery lead connections loose or corroded, break in power circuit
x										Crankshaft drive blocked
x	x									Starter solenoid switch sticks (clicks) / damaged, cable connection loose or damaged
x	x									Starter motor / starter interlock relay defective (carbon brushes worked loose / worn, winding damaged, short to ground)
x						x	x	x		Engine oil viscosity unsuitable, not suitable for ambient temperature, lube oil quality does not comply with specifications
									x	Oil level in oil pan too high
									x	Oil level in pan too low, oil in oil pan too thin (mixed with condensate or fuel)
									x	Engine temperature too high
									x	Oil filter clogged
									x	Oil pressure gauge defective
									x	Safety valve in the oil circuit defective (does not close, spring fatigued or broken)
									x	Heavy bearing wear
									x	Oil pump gears heavily worn
									x	Timing gears worn, tooth flank backlash too great
									x	Engine cold
									x	Lube oil entering combustion chamber (piston rings worn, piston rings broken) – valve stem guide worn – overpressure in crankcase (crankcase breather clogged)
									x	Safety valve in oil circuit defective (does not open), oil lines / oil galleries clogged
									x	Leaks in lube oil circuit, particularly at turbocharger and oil cooler
									x	Piston rings heavily worn, broken
									x	Piston pins or crankshaft bearings loose
									x	Valve stems heavily worn, bent
									x	Valve clearance not correct
									x	Valves jammed
									x	Compression deficient, or more than 3–4 bar pressure difference between individual cylinders
									x	Valve seats leaking
									x	Increased power input due to defective secondary loads / consumers such as hydraulic pumps, fan etc., power take-off engaged
									x	Air filter fouled or clogged, charge air system leaking, air intake / exhaust lines clogged / leaking
									x	Fuel low pressure system: Fuel tank, prefilter, water trap faulty / clogged / mould / fungal attack, fuel unsuitable / contaminated (paraffin added)
									x	Fuel low pressure system: fuel lines leaking, broken, clogged

x = likely to apply o = might apply

1.	ECU self-diagnosis										
2.	Starter motor turns over engine slowly or not at all										
3.	Starter motor turns, engine fails to start, engine fails to start / difficult to start when cold										
4.	Engine stalls (dies) during operation, no longer starts (starter motor turns), engine fails to start / difficult to start when hot										
5.	Sudden, temporary engine shutdown, engine does not reach full revs										
6.	Engine runs at idle speed only, no throttle response										
7.	Engine runs at increased idle speed only, no throttle response										
8.	Rated engine speed significantly reduced (even at no load)										
9.	Reduced power output in all ranges										
10.	Irregular engine operation, loss of traction										
11.	Unstable idle speed, engine surges, misfiring, engine knocking										
12.	Engine judder										
13.	Unusual combustion noises										
14.	Excessive smoke emission: white smoke / blue smoke										
15.	Excessive smoke emission: black smoke										
16.	Engine temperature too high (coolant loss)										
17.	Fuel consumption too high										
18.	Lubrication oil pressure too low										
19.	Lube oil pressure too high										
20.	Lube oil consumption too high										
21.	Engine too "loud" / mechanical noises										
									Possible causes		
	x	x	x		x	x	x	x	Fuel low pressure system: Air in system (turn on ignition when bleeding system)		
	x	x	x		x	x	x	x	Fuel low pressure system: Feed pump, main filter		
	x				x	x	x	x	o	x	Fuel high pressure system: Injectors defective / clogged / leaking / coked
					x	x	x	x	o	Fuel high pressure system: pressure lines – constriction, cavitation, leaking	
	x				x	o	x	x	x	o	Fuel high pressure system: High-pressure pump worn
					x	x	o				ECU rpm sensor, polarity reversed
	x	x	x	o		o			o		ECU detects incorrect engine speed (interference signal on rpm sensor lead)
	x				x				x		ECU boost pressure sensor: faulty, incorrect, implausible with atmospheric pressure sensor, line fault
					x	x			o	x	Exhaust turbocharger leaking or defective
										x	Turbine and compressor wheel in the turbocharger soiled (running off balance)
										x	Intercooler leaking, defective
	x	o			x	x			o	x	ECU coolant temperature sensor: faulty, line fault
	x				x	x					ECU charge-air temperature sensor: faulty, line fault
	o				x				x		Heat exchanger fouled or failure of cooling system (temperatures too high)
									x		Coolant level too low, air in the coolant circuit
									x	x	Incorrect belt tension
									x		Coolant pump leaking, defective / thermostat defective, does not open
									x		Coolant lines leaking, blocked or twisted
										x	Coolant entering combustion chamber (cylinder head / gasket leaking)
	x	x	x	o		o					Power supply to ECU control unit interrupted or battery voltage too low
					x				x		Thermostat defective
						x					Engine bearings worn

x = likely to apply
o = might apply

CIMCO
Endurance by Engineering

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