Contents

Torque - Minimum tightening torques for normal assembly

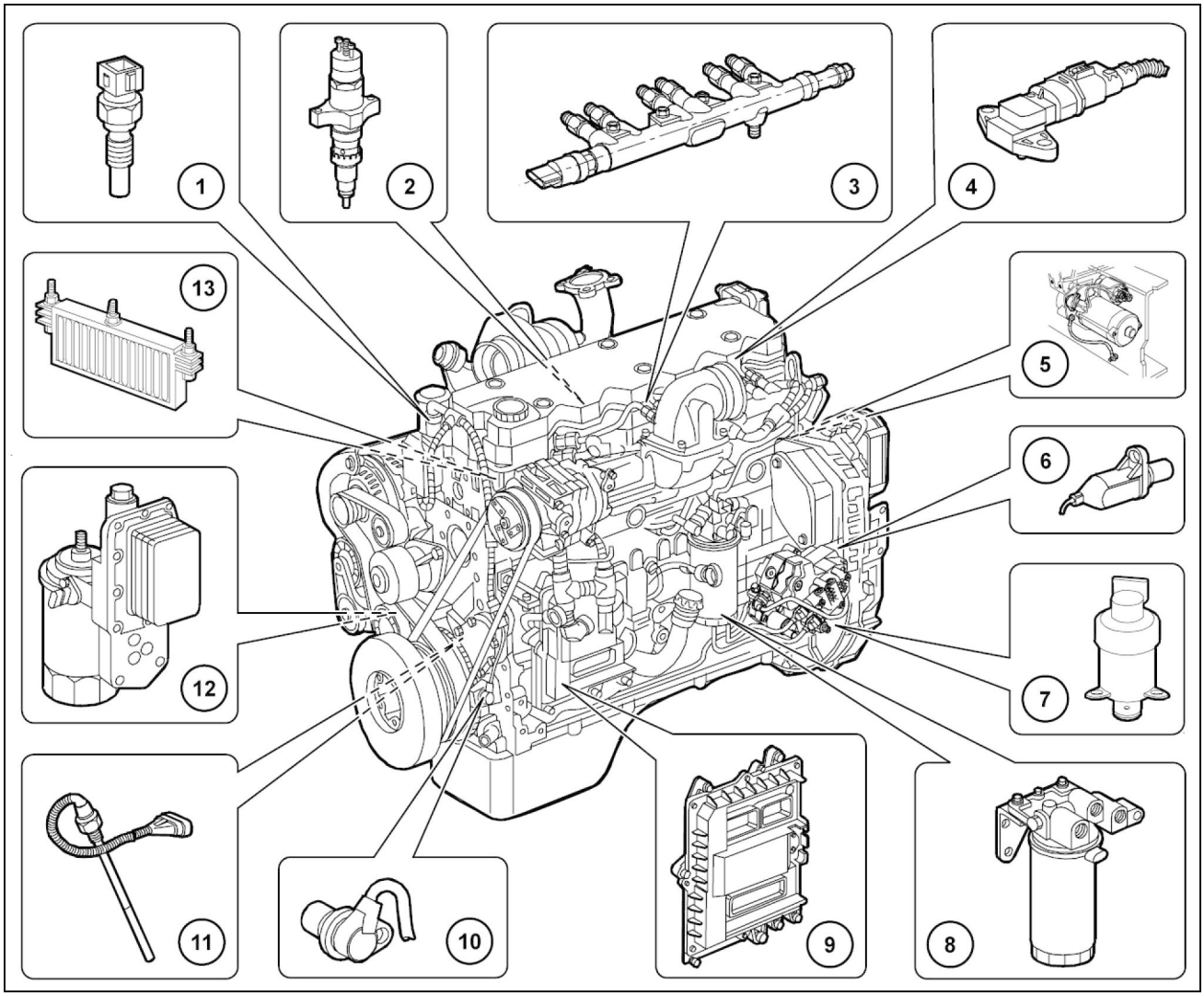
METRIC NON-FLANGED HARDWARE

NOM. SIZE	CLASS 8.8 BOLT and CLASS 8 NUT		CLASS 10.9 BOLT and CLASS 10 NUT		LOCKNUT CL.8 W/CL8.8 BOLT	LOCKNUT CL.10 W/CL10.9 BOLT
	UNPLATED	PLATED W/ZnCr	UNPLATED	PLATED W/ZnCr		
M4	2.2 N·m (19 lb in)	2.9 N·m (26 lb in)	3.2 N·m (28 lb in)	4.2 N·m (37 lb in)	2 N·m (18 lb in)	2.9 N·m (26 lb in)
M5	4.5 N·m (40 lb in)	5.9 N·m (52 lb in)	6.4 N·m (57 lb in)	8.5 N·m (75 lb in)	4 N·m (36 lb in)	5.8 N·m (51 lb in)
M6	7.5 N·m (66 lb in)	10 N·m (89 lb in)	11 N·m (96 lb in)	15 N·m (128 lb in)	6.8 N·m (60 lb in)	10 N·m (89 lb in)
M8	18 N·m (163 lb in)	25 N·m (217 lb in)	26 N·m (234 lb in)	35 N·m (311 lb in)	17 N·m (151 lb in)	24 N·m (212 lb in)
M10	37 N·m (27 lb ft)	49 N·m (36 lb ft)	52 N·m (38 lb ft)	70 N·m (51 lb ft)	33 N·m (25 lb ft)	48 N·m (35 lb ft)
M12	64 N·m (47 lb ft)	85 N·m (63 lb ft)	91 N·m (67 lb ft)	121 N·m (90 lb ft)	58 N·m (43 lb ft)	83 N·m (61 lb ft)
M16	158 N·m (116 lb ft)	210 N·m (155 lb ft)	225 N·m (166 lb ft)	301 N·m (222 lb ft)	143 N·m (106 lb ft)	205 N·m (151 lb ft)
M20	319 N·m (235 lb ft)	425 N·m (313 lb ft)	440 N·m (325 lb ft)	587 N·m (433 lb ft)	290 N·m (214 lb ft)	400 N·m (295 lb ft)
M24	551 N·m (410 lb ft)	735 N·m (500 lb ft)	762 N·m (560 lb ft)	1016 N·m (750 lb ft)	501 N·m (370 lb ft)	693 N·m (510 lb ft)

NOTE: *M4 through M8 hardware torque specifications are shown in pound-inches. M10 through M24 hardware torque specifications are shown in pound-feet.*

Engine - Component localisation

Location of main electrical components



CRIL04D081G01 1

(1) Coolant Temperature Sensor
(2) Electro-Injector
(3) Rail Pressure Sensor
(4) Air Temperature/Pressure Sensor
(5) Engine Starter
(6) Timing Sensor
(7) Solenoid Valve for Pressure Regulator
(8) Fuel Temperature Sensor
(9) EDC7 UC31
(10) Crankshaft Sensor
(11) Oil Level Sensor
(12) Engine Oil Temperature/Pressure Sensor
(13) Heating Element for Pre-Post Heating

The NEF F4HFE engines are fully driven by the electronic engine control module, which is assembled directly to the engine by means of a heat exchanger enabling it's cooling, utilizing rubber buffers to reduce vibration originated by the engine.
Through the engine control module it is possible to verify the correct working of the engine.

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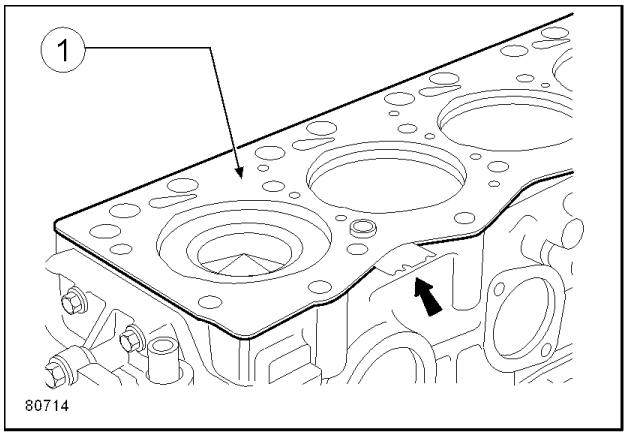
Engine - 10

Engine and crankcase - 001

Cylinder head - Install

Prior operation:
Cylinder head - Check (10.101)

1. Check the cleanliness of the cylinder head and engine block coupling surface.
2. Taking care not to foul the cylinder head gasket, set the gasket **(1)** with the marking "TOP" facing the head.
3. The arrow shows the point where the gasket thickness is given.



80714 1

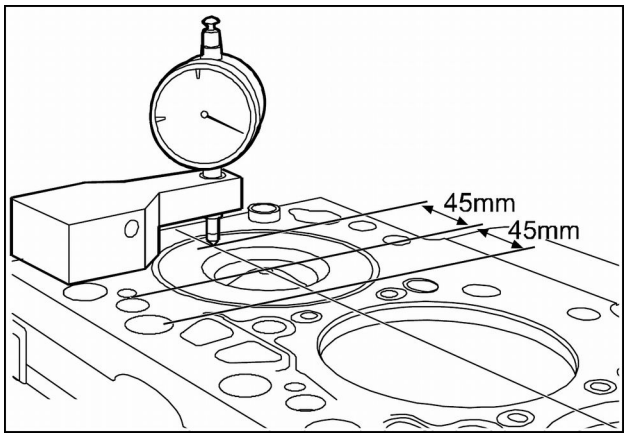
4. There are two head gasket thicknesses, (**1.25 mm** Type A and **1.15 mm** Type B).
   To determine the correct head gasket to use, piston protrusion must be measured.
   - For each piston, measure protrusion in two places **180 °** apart, at a distance of **45 mm** (**1.8 in**) from the center of the piston S1 and S2. Then calculate the average:

$$S_{cyl\ 1} = \frac{S1 + S2}{2}$$

   - Repeat the operation for pistons 2, 3, 4, 5 and 6 and calculate the average value.

$$S = \frac{S_{cyl\ 1} + S_{cyl\ 2} + S_{cyl\ 3} + S_{cyl\ 4} + S_{cyl\ 5} + S_{cyl\ 6}}{6}$$

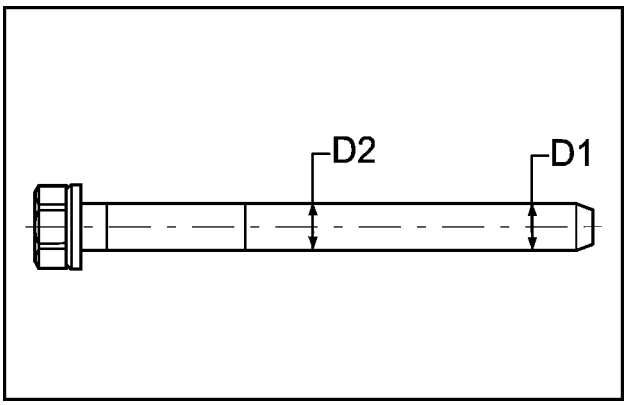
   - If S is > **0.40 mm** (**0.016 in**) use seal type A.
   - If S is < **0.40 mm** (**0.016 in**) use seal type B.



PROTRUSION 2

5. Before using the fixing screws again, measure them twice as indicated in the picture, checking D1 and D2 diameters:
   if D1 - D2 < **0.1 mm** (**0.004 in**) the screw can be utilized again;
   If D1 - D2 > **0.1 mm** (**0.004 in**) the screw must be replaced.

NOTE: *Before any assembly operation always verify that the hole and bolt threads have no evidence of dirt or wear.*



BACD04APH224ASA 3

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Engine - 10

Cylinder heads - 101

Engine block cover Rear - Cleaning

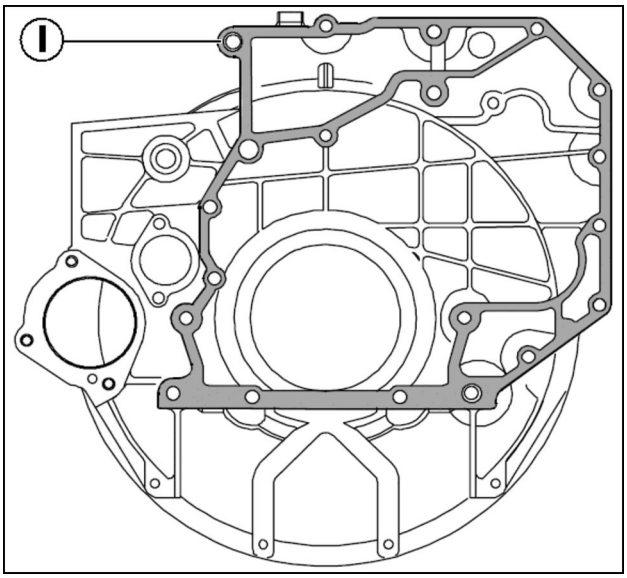
Prior operation:
Engine block cover Rear - Remove (10.102)

1. Clean the rear cover and it's mating surface on the timing gear cover.

NOTE: *A perfect seal is only obtained by completely cleaning the surface to seal. Any imperfection should be corrected as soon as possible. Avoid using excess sealant. Excessive sealant could squeeze out the sides and cause blockage of lubrication passages.*

2. Apply a thin bead of **LOCTITE 5205 (1)**, a few millimeters thick, to the sealing surface of the cover.

NOTE: *After applying the sealant, the cover should be assembled within 10 to 20 minutes.*



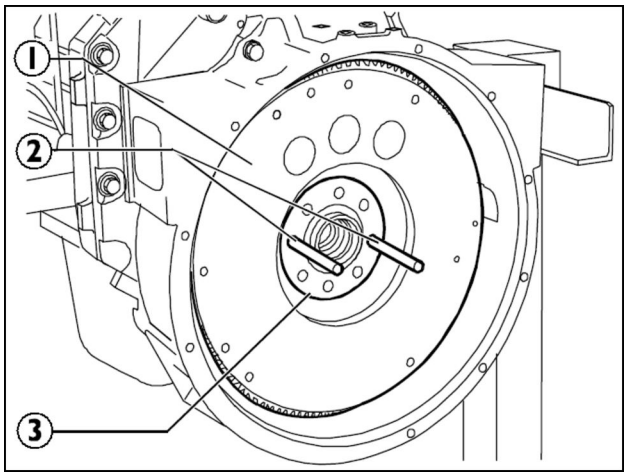
REARCOVERH 1

Next operation:
Engine block cover Rear - Install (10.102)

Engine flywheel - Install

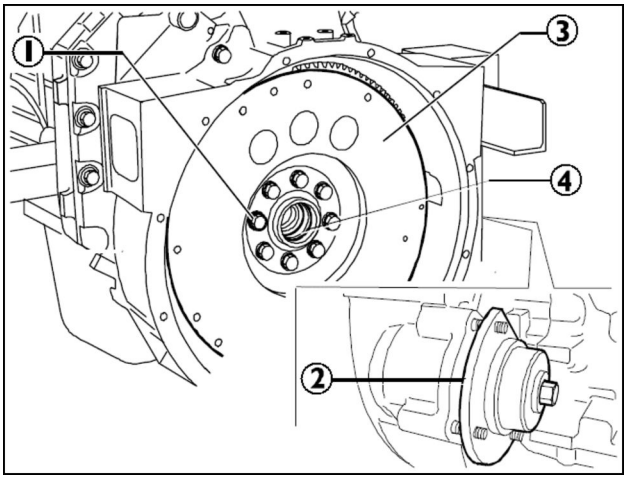
Prior operation:
Engine flywheel - Check (10.103)

1. Install two guide pins **(2)** having suitable length into crankshaft **(3)** holes.
2. Using the proper sling and hoist, install the flywheel **(1)**.



FLYWHEELH4 1

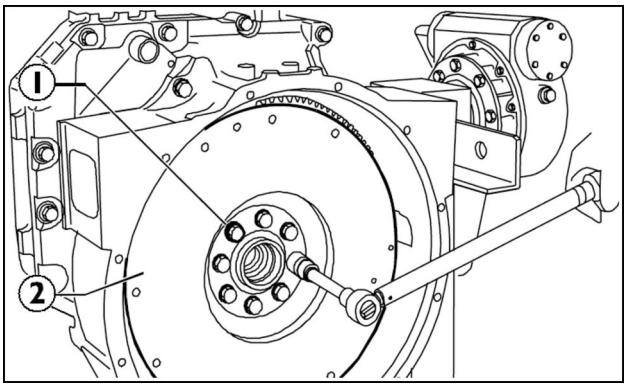
3. Apply tool **380000988 (2)** to the flywheel housing to stop rotation of the flywheel **(3)**.
4. Tighten the bolts **(1)** securing the flywheel **(3)** to the crankshaft **(4)**.



FLYWHEELH5 2

5. Tighten the flywheel bolts **(1)** in two stages:
   1. Torque bolts to **26 - 34 Nm** (**19 - 25 lb ft**).
   2. Finish by turning the bolts an additional **55 - 65 °**.

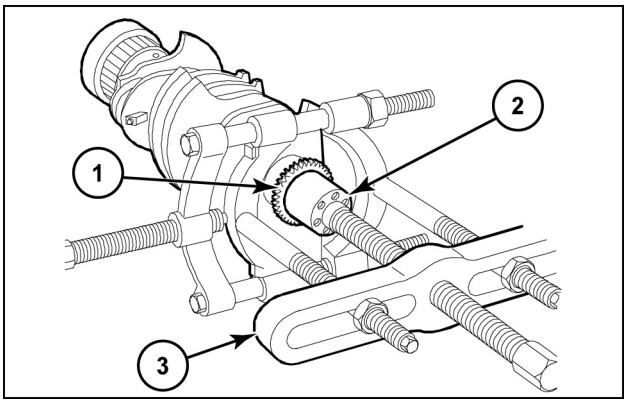
NOTE: *Torquing to an angle is performed by using the tool **380000304**.*
Before any assembly operation always verify that the hole and bolt threads have no evidence of wear or dirt.



FLYWHEELH6 3

Crankshaft gears - Replace

Check that gear toothing **(1)** is not damaged or worn, otherwise remove it from the crankshaft **(2)** using the proper puller **(3)**.
When installing the new gear, heat it to **180 °C** (**356 °F**) for 10 minutes in an oven and then key it to the crankshaft.

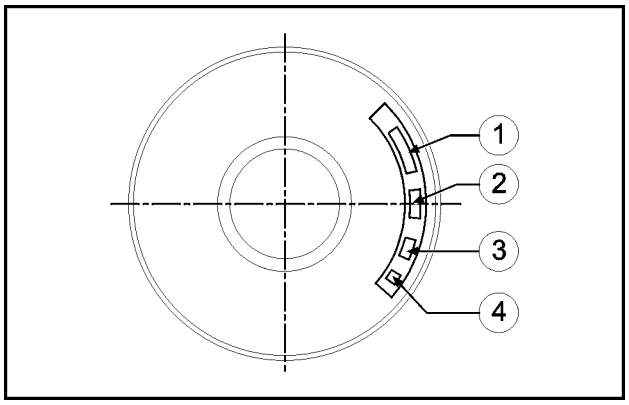


CRIL04J068A01 1

Connecting rod and piston - Assemble

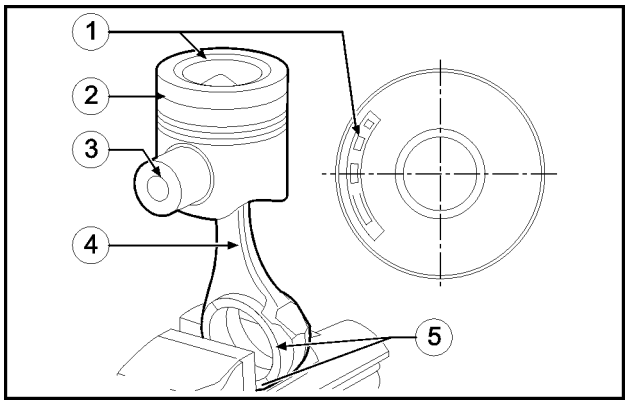
Prior operation:
Piston Pin - Remove (10.105)

1. The piston crown is marked as follows:
   1. Part number and design modification number.
   2. Arrow showing piston assembling direction into cylinder.
   3. Manufacturing date.
   4. Stamp indicating the ring carrier US inspection.



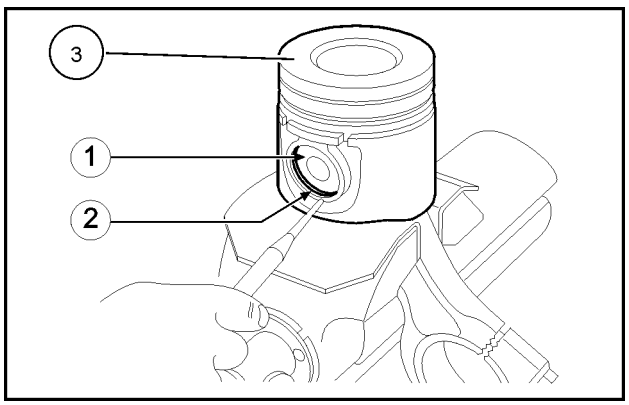
BACD04APH136ASA 1

2. Connect piston **(2)** to connecting rod **(4)** with pin **(3)** so that the reference arrow **(1)** for fitting the piston **(2)** into the cylinder barrel and the numbers **(5)** marked on the connecting rod **(4)** are read as shown in the figure.



BACD04APH137ASA 2

3. Position the piston **(3)** on the connecting rod according to the diagram shown in the figure and fit the pin **(1)** and stop at the stop rings **(2)**.



BACD04APH138ASA 3

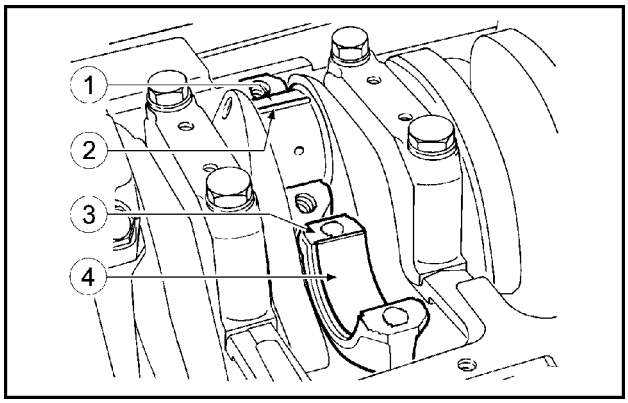
Next operation:
Connecting rod and piston - Install (10.105)

Connecting rod bearing - Clearance

Prior operation:
Connecting rod and piston - Install (10.105)

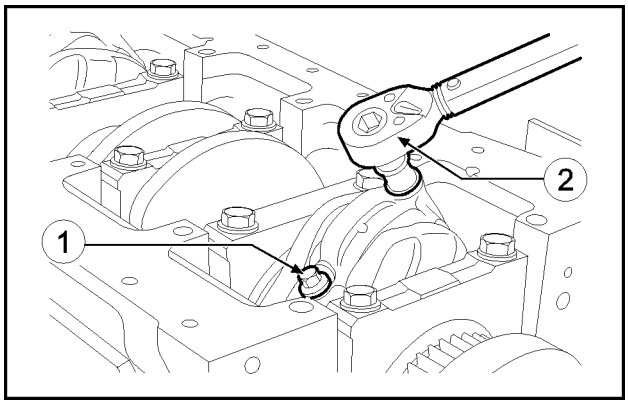
1. Clean the parts accurately and remove any trace of oil.
2. Set a piece of calibrated wire **(2)** on the crank pins **(1)**.
3. Fit the connecting rod caps **(3)** with the relevant half bearings **(4)**.

NOTE: *Before the final fitting of the connecting rod cap fastening screws, check that their diameter measured at the center of the thread length is not <* ***0.1 mm*** *(****0.004 in****) than the diameter measured at approximately* ***10 mm*** *(****0.394 in****) from the screw end.*



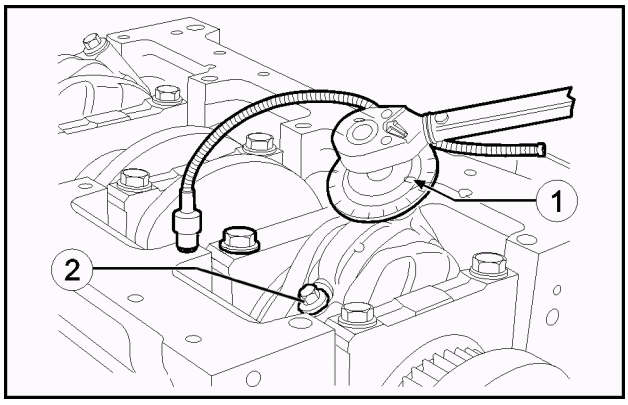
BAPH04APH139ASA 1

4. Lubricate the screws **(1)** with engine oil and then tighten them to the specified torque using the torque wrench **(2)**.



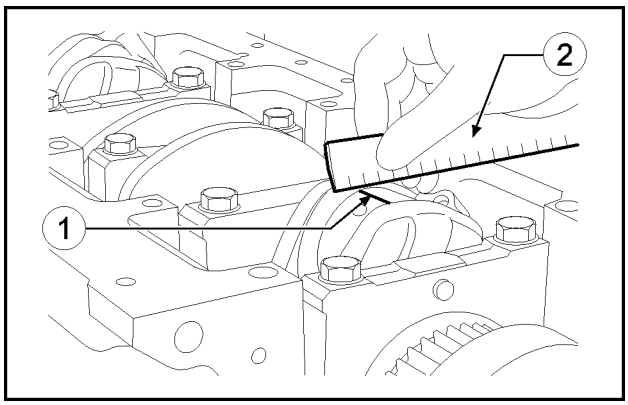
BACD04APH140ASA 2

5. Apply tool **380001001 (1)** to the socket wrench and tighten screws **(2)** to **60 °**.



0B00200405BACD0 3

6. Remove the cap and find the existing clearance by comparing the calibrated wire width **(1)** with the scale on the wire envelope **(2)**.
7. If a different clearance value is found, replace the half bearings and repeat the check.
8. Once the specified clearance has been obtained, lubricate the half bearings and fit them by tightening the connecting rod cap fastening screws to the specified torque.

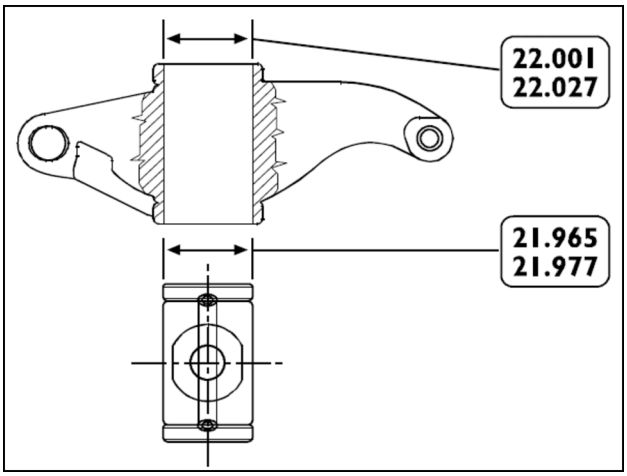


BACD04APH141ASA 4

Rocker shaft - Clearance

Prior operation:
Rocker arm - Disassemble (10.106)

1. Check that the shaft/rocker coupling surfaces are not showing excessive wear or damage.



SHAFTMEASURE 1

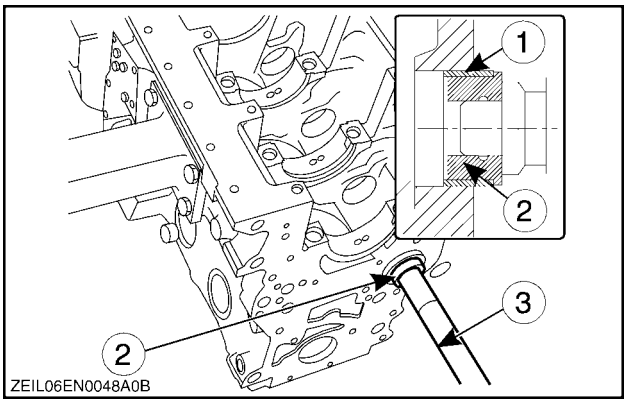
Next operation:
Rocker arm - Install (10.106)

Camshaft bushings - Replace

Prior operation:
Camshaft - Measure (10.106)

Remove and install the bushing **(1)** using the beater **(2)** and the hand-grip **380000145 (3)**.

NOTICE: *When installing the bushing , take note of orientation to make sure the lubricating holes coincide with the holes on the block housing.*



ZEIL06EN0048A0B 1

Next operation:
Camshaft - Install (10.106)

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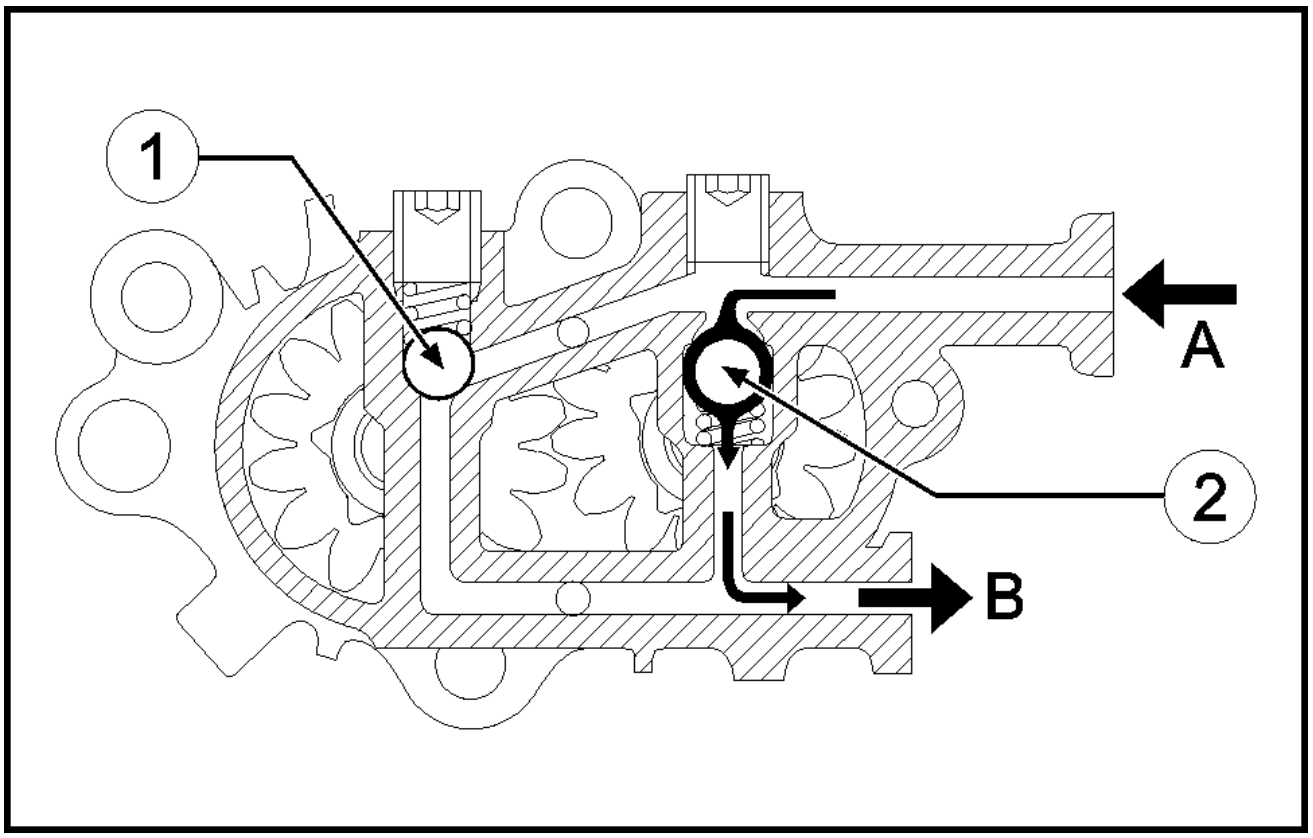
Engine - 10

Balancer and damper - 110

Fuel heater - Overview

The ECU drives the filter heater at fuel temperature less than our equal to **5 °C** (**41 °F**).

Jettison condition



BACD04APH165ASA 3

The dump by-pass valve **(2)** is activated in case, when the engine is off, it is necessary to fill the feeding system through the priming pump. In this condition the by-pass **(1)** keeps closed while the dump by-pass valve **(2)** opens up due to the pressure effect on the entry unit so the fuel flows to the exhaust unit **(B)**.

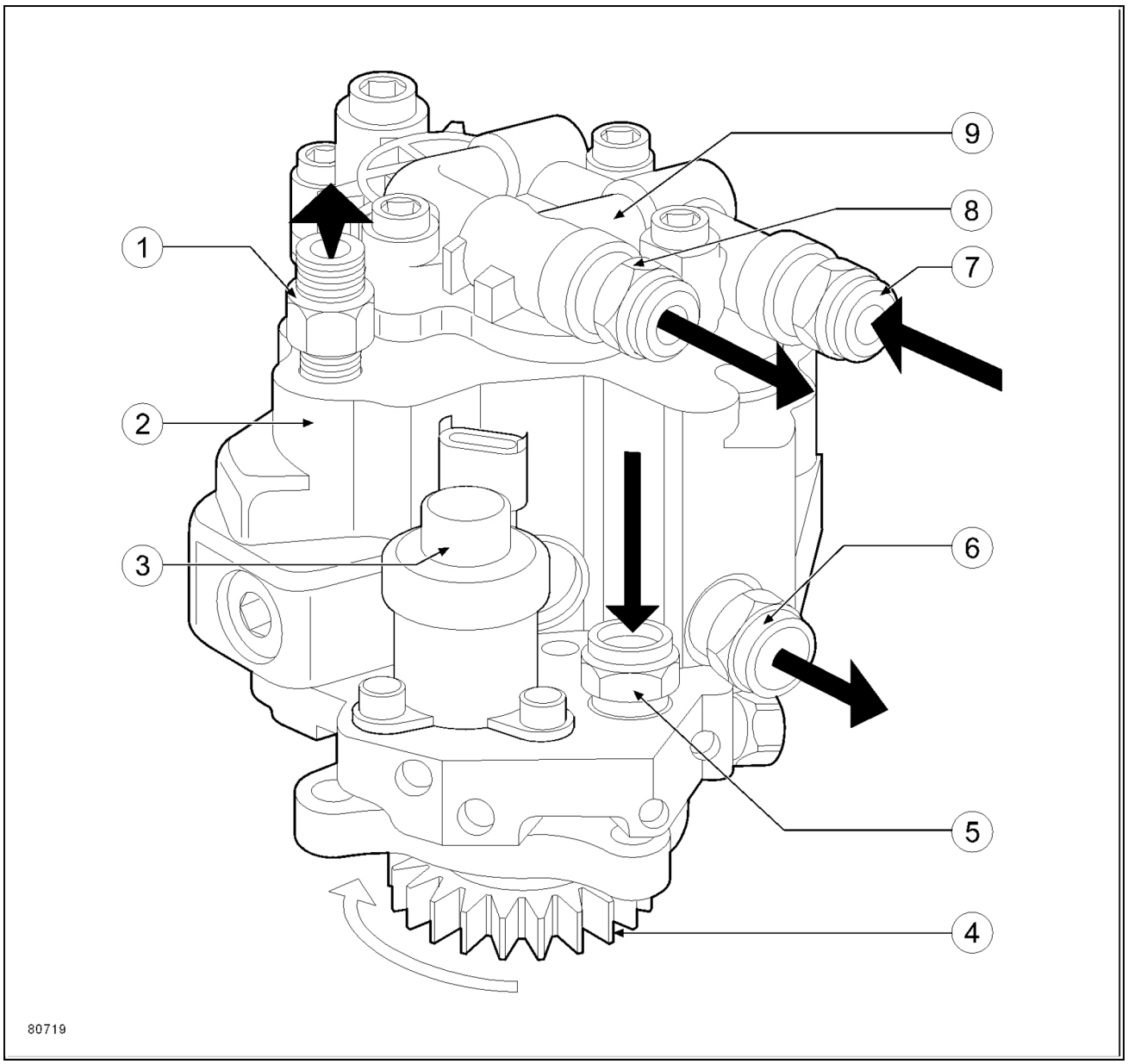
NOTE: *The mechanical feeding pump cannot be replaced separately, therefore it must not be disassembled from the high pressure pump.*

High pressure pump - Dynamic description

CP3 high pressure pump

Pump provided with 3 radial pumping elements driven by the timing system gear, no need for timing. The mechanical feeding pump driven by the high pressure pump's shaft is assembled to the rear side of the high pressure pump.

NOTE: *The high pressure pump unit - feeding pump is not subject to overhaul. Do not disassemble or tamper with the retaining bolts.*
The only serviceable components are the control gear and pressure regulator.



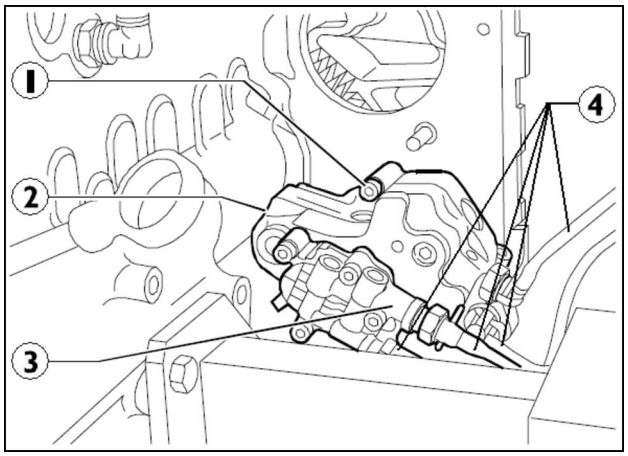
80719 1

(1) Outlet to common rail
(2) High pressure pump
(3) Pressure regulator valve
(4) Drive gear
(5) Supply fuel inlet from filter
(6) Return to filter
(7) Inlet from primary filter
(8) Outlet to secondary filter
(9) Transfer pump

High pressure pump - Remove

Prior operation:
Injector fuel lines - Disconnect (10.218)
Prior operation:
Fuel supply lines Low pressure - Disconnect (10.210)

1. Disconnect all fuel lines **(4)** on the high pressure pump **(2)**.
2. Remove the mounting nuts **(1)** and remove the high pressure pump **(2)** and feed pump **(3)** together as one unit.



HPPUMPDH 1

Next operation:
High pressure pump - Install (10.218)

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Engine - 10

Fuel injection system - 218

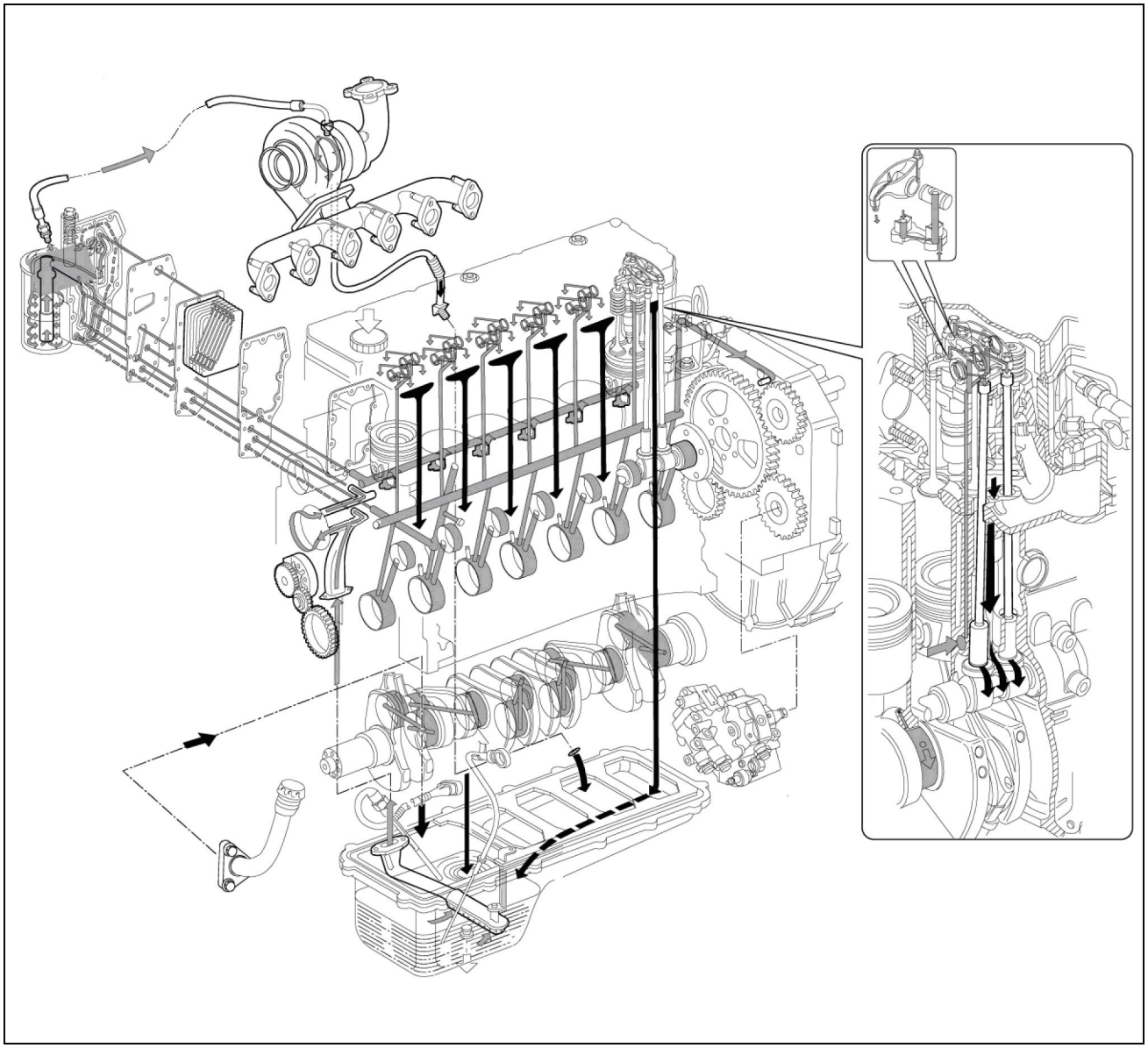
Engine - 10

Intake and exhaust manifolds and muffler - 254

F4HFA413A*E002
F4HFA613B*E002
F4HFA613C*E002
F4HFA613D*E002
F4HFA613F*E003

Engine lubrication system - Exploded view

Lubrication by forced circulation is achieved through an oil rotary expansion pump. It is located on the front of the block and driven by a straight-tooth gear that is splined to the shafts bar hold. This pump provides lubrication for the crankshaft, camshaft and to the valve drive.

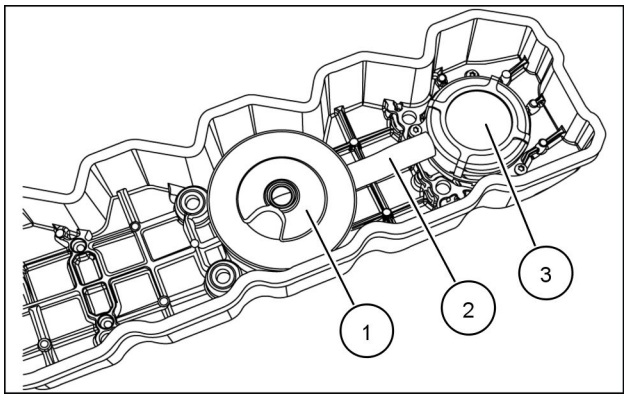


4C0O200406CRIL0 1

Blowby re-circulation system - Install - Internal filter

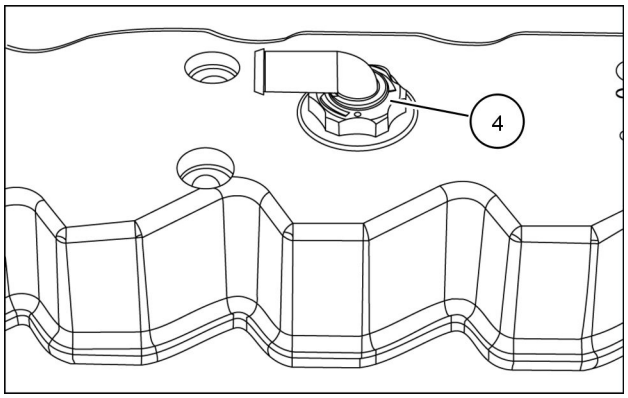
1. Lubricate the O-ring seal on the filter.
2. Install the filter **(1)** into the bottom side of the valve cover.

NOTE: *Be sure to connect the hose **(2)** between the filter **(1)** and pressure regulator **(3)**.*



93110965 1

3. Install the retaining nut **(4)** on the top side of the valve cover.



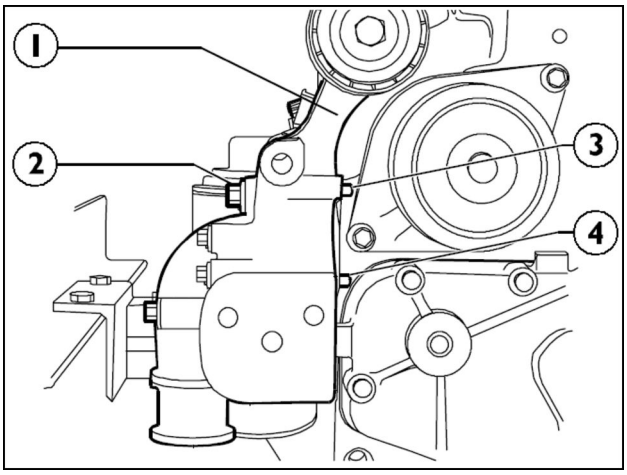
93110964 2

Water pump Water manifold - Install

Prior operation:
Water pump Water manifold - Remove (10.400)

1. Position the water manifold/alternator support **(1)** so that the pins **(3)** and **(4)** are set against the engine block.
2. Tighten the mounting bolts **(2)** to the specified torque.

NOTE: *Before any assembly operation always verify that the hole and bolt threads have no evidence of wear or dirt.*



WATERMANIFOLDH2 1

Next operation:
Alternator - Install (55.301)

Engine - 10

Fan and drive - 414

F4HFA413A*E002
F4HFA613B*E002
F4HFA613C*E002
F4HFA613D*E002
F4HFA613F*E003

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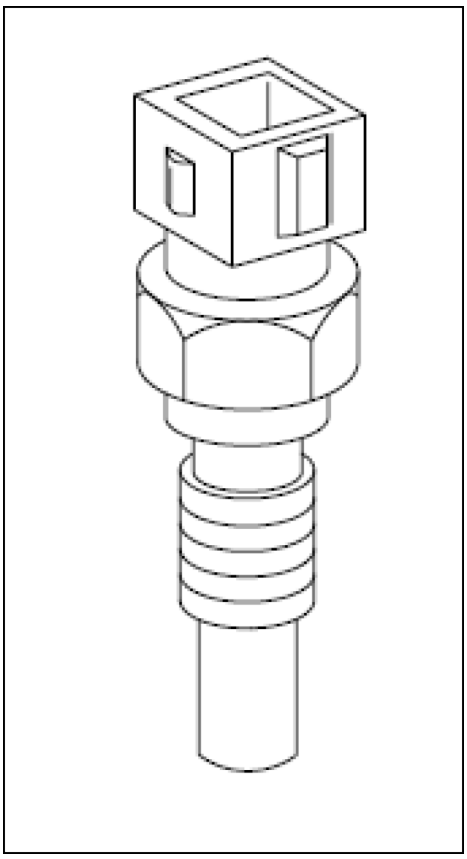
Engine - 10

Fan and drive - 414

Engine coolant temperature sensor - Overview

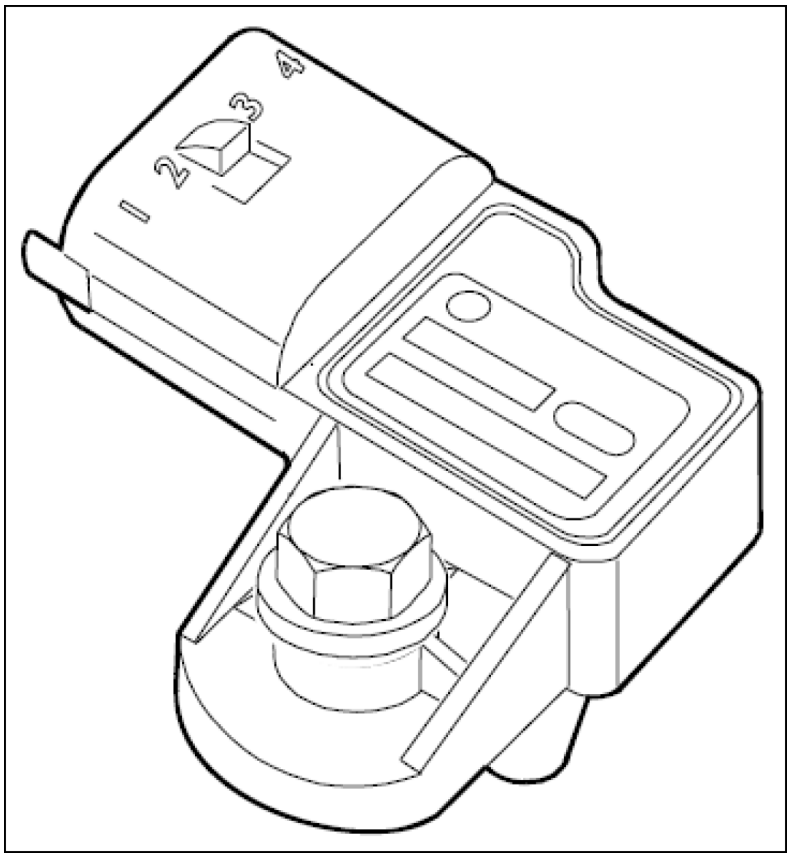


COOLANTTEMP 1

This is a variable resistance sensor able to read the coolant temperature in order to provide the control unit with an indication of the thermal status of the engine.
The same signal is utilized by the control unit to drive an instrument panel gauge, if present.
The sensor is connected to the control unit on pins 15C - 26C.
The impedance of the coolant temperature sensor at **20 °C** (**68 °F**) is approximately **2.50 Ω**.

Reference	Description	EDC pin
1	Ground	15C
2	Temperature signal	26C

Intake air pressure and temperature sensor - Overview



AIRPRESSTEMP 1

This component incorporates a temperature sensor and a pressure sensor.
Mounted on the intake manifold, the sensor measures the maximum flow rate of air supplied, which serves to make an accurate calculation of the quantity of fuel to be injected in each cycle.
The sensor is connected to the control unit on pins 25C - 36C for temperature and 33C - 34C for pressure.
The power supply is 5 volts.
Voltage at the sensor output is proportional to the detected pressure or temperature.

Reference	Description	EDC pin
1	Ground	25C
2	NTC signal (temperature)	36C
3	+5 V power input	33C
4	Signal (pressure)	34C

Connector C - Sensors

EDC pin #	Function
1	-
2	-
3	-
4	-
5	-
6	-
7	-
8	-
9	Timing sensor
10	Timing sensor
11	-
12	Negative for rail temperature and pressure sensor
13	Positive for rail temperature and pressure sensor
14	Signal from rail temperature and pressure sensor
15	Coolant temperature sensor
16	-
17	-
18	signal from fuel temperature sensor
19	Engine RPM sensor
20	-
21	-
22	-
23	Engine RPM sensor
24	Negative for engine oil pressure and temperature sensor
25	Negative for air temperature and pressure sensor
26	Coolant temperature sensor
27	Signal from engine oil pressure sensor
28	Signal from engine oil temperature
29	-
30	-
31	-
32	Positive for engine oil pressure and temperature sensor
33	Positive for air temperature and pressure sensor
34	Signal from air pressure sensor
35	Negative for fuel temperature sensor
36	Signal from air temperature sensor

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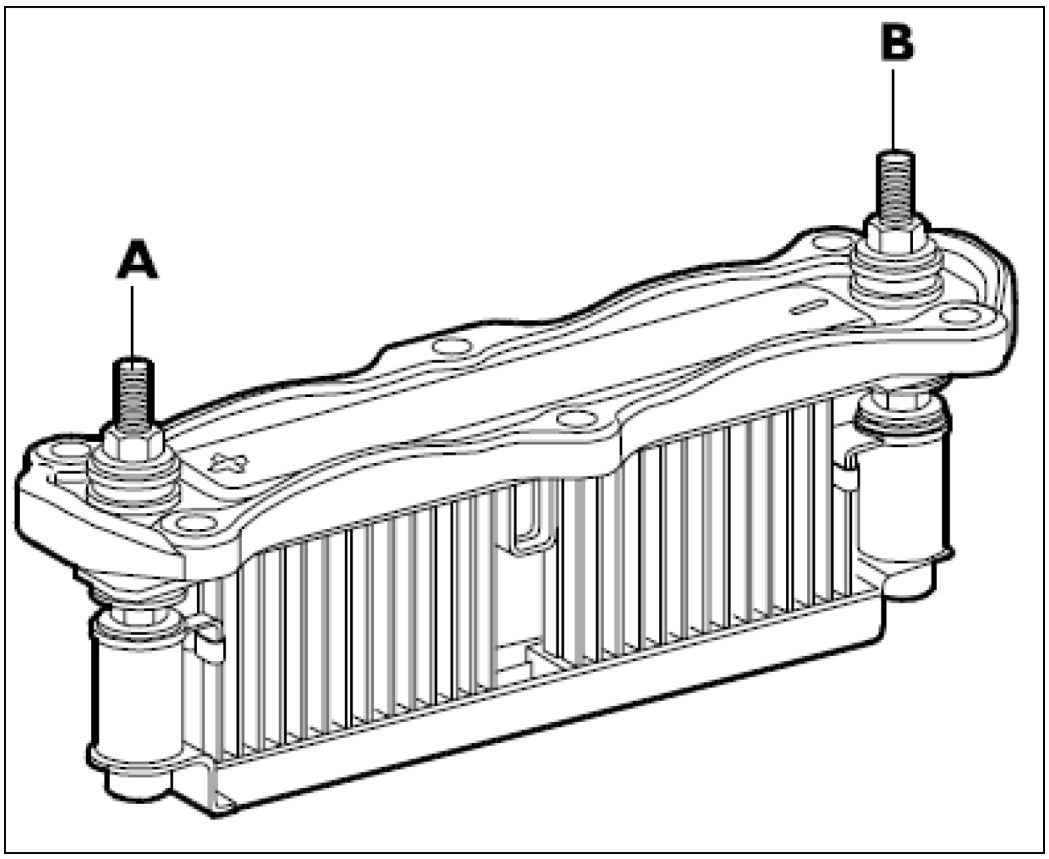
Electrical systems - 55

Engine control system - 015

Grid heater - Overview



GRIDHEATER 1

The pre-post heating resistance is located on the intake manifold.
The resistance serves to heat the air in pre / post heating operations. The resistance is powered by a contactor.
The resistance impedance is approximately **0.5 Ω**.

The control contactor is connected to the control unit **(B)** connector.
The contactor is tripped with water and/or fuel temperature below **5 °C** (**41 °F**).
The contactor impedance is approximately **15 Ω**.

⚠ **WARNING** ⚠

This engine is equipped with an intake air (grid) heater. DO NOT use starting fluid on this engine. Use of starting fluid can cause explosion, personal injury or property damage. Failure to comply could result in death or serious injury.

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