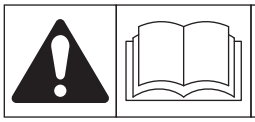
CASE

ENGINE REPAIR MANUAL

BACKHOE LOADER

F4GE9454H
F4GE9454J
F4GE9484D
F4HE9484A
F4HE9484C

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READ, UNDERSTAND, AND FOLLOW ALL SAFETY PRECAUTIONS AND INSTRUCTIONS FOUND IN THIS MANUAL BEFORE OPERATING THE MACHINE.

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ENGINE REPAIR MANUAL

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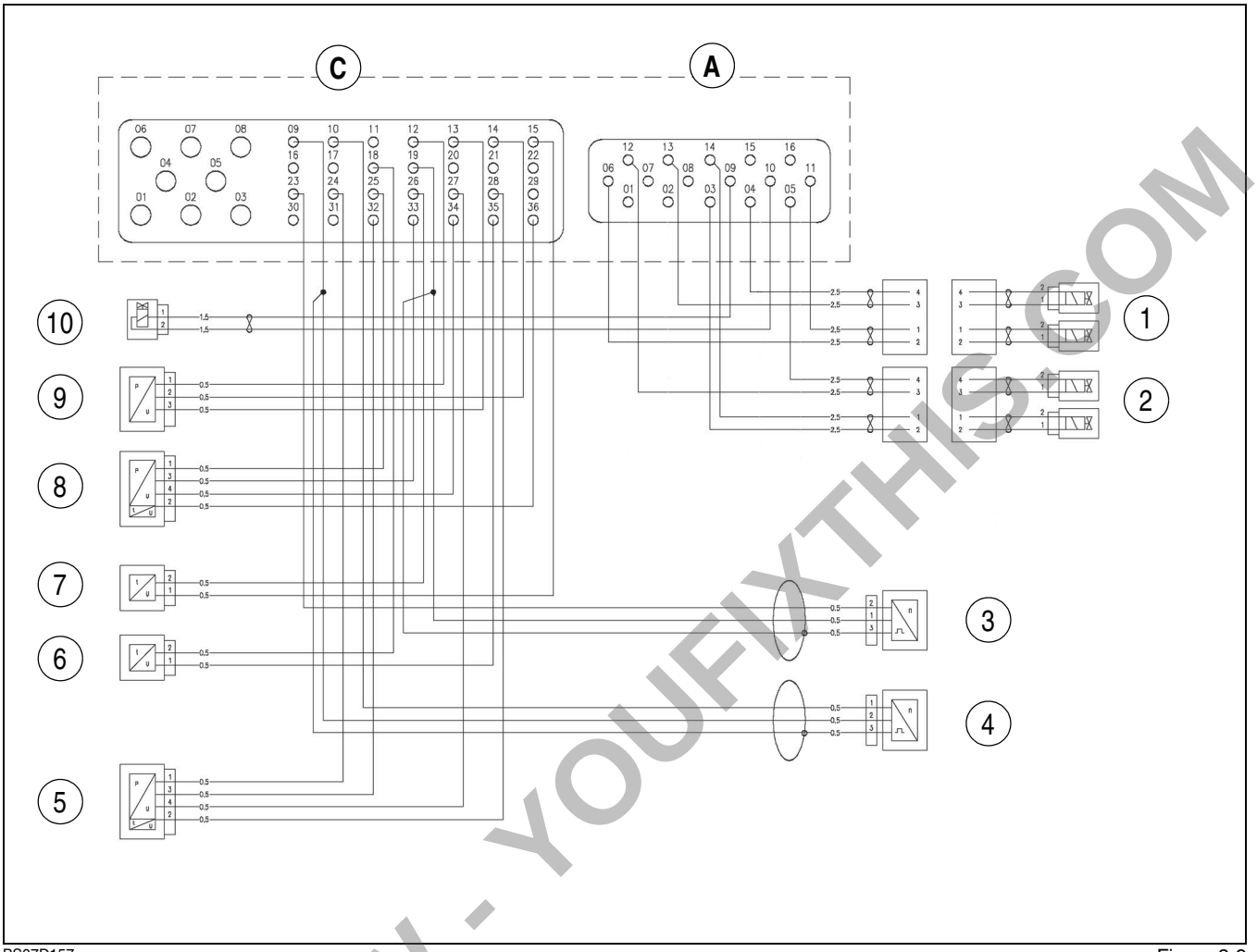
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CABLING CONNECTOR PINOUT ON ENGINE



BS07D157

Figure 3-9

CONNECTOR / CABLING DIAGRAM

A. CONNECTOR A (INJECTORS) EDC7UC31 ECU (POWER)
B. CONNECTOR B NOT SHOWN (SEE NOTE BELOW)
C. CONNECTOR C (SENSORS) EDC7UC31 ECU (SIGNAL)
1. INJECTORS FOR CYLINDERS 1-2
2. INJECTORS FOR CYLINDERS 3-4
3. CRANKSHAFT SENSOR
4. CAMSHAFT SENSOR
5. OIL PRESSURE AND TEMPERATURE SENSOR
6. FUEL TEMPERATURE
7. COOLANT TEMPERATURE SENSOR
8. BOOST AIR TEMPERATURE AND PRESSURE SENSOR
9. COMMON RAIL PRESSURE SENSOR
10. FUEL HIGH PRESSURE REGULATOR SENSOR

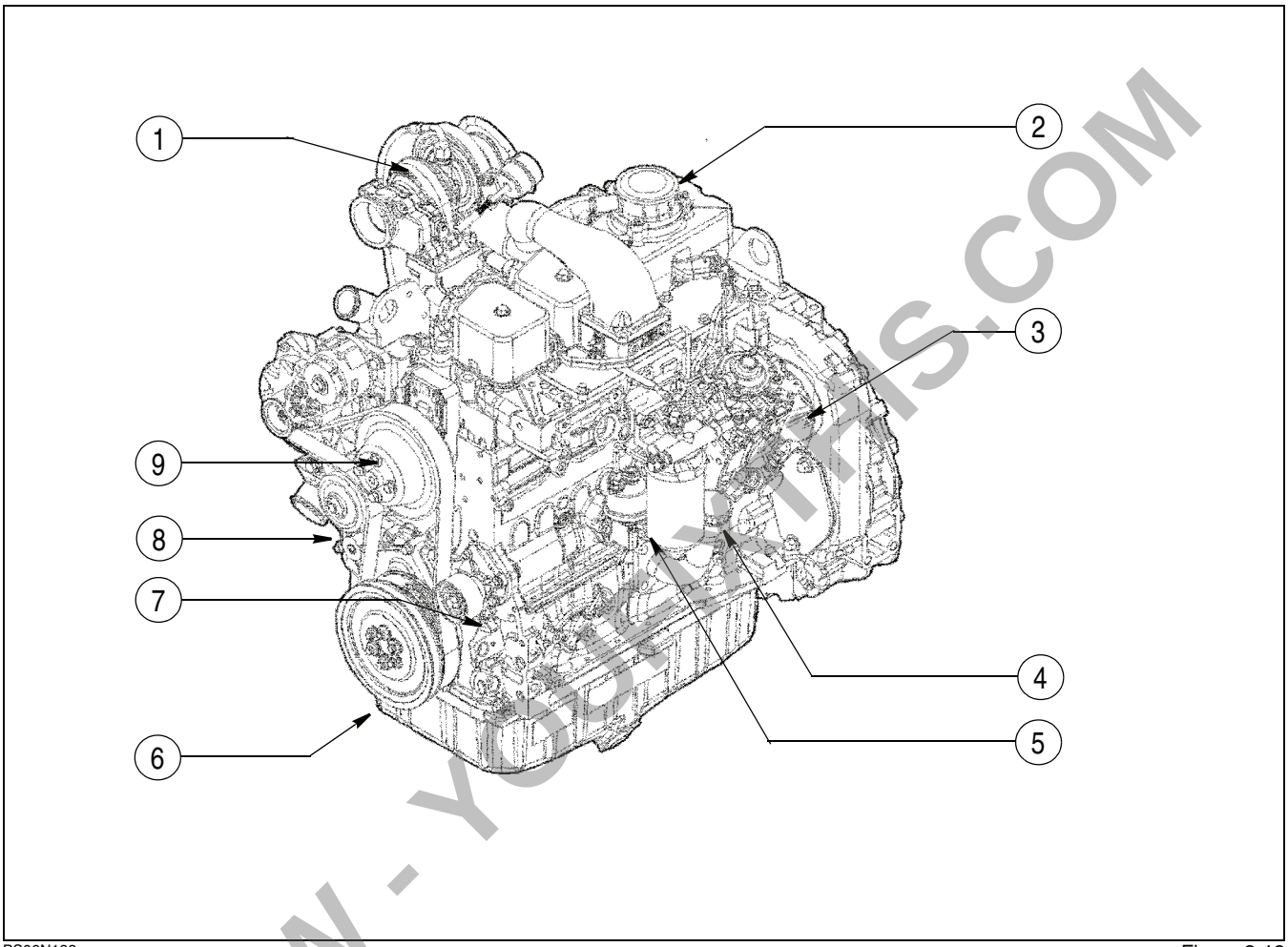
NOTE: *Connector B is not shown because it is specific to the machine application see the particular machine schematic.*

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F4GE - ENGINES

F4GE9454H AND F4GE9454J ENGINE



BS06N188

Figure 2-12

1. TURBOCHARGER
2. OIL VAPOR RECIRCULATION VALVE
3. ROTARY INJECTION PUMP
4. FUEL FILTER
5. PRIMING PUMP
6. CRANKSHAFT PULLEY
7. FIXED GUIDE PULLEY
8. WATER PUMP
9. FAN PULLEY

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TORQUE SPECIFICATIONS (F4GE) - ENGINES

PART ..... TORQUE - Nm (lb.-ft.)

Cylinder head fastening bolts.
- 1st phase. (pre lubricated with oil)
  - Bolts M12x1.75x70 ..... 45 to 55 Nm (33.2 to 40.6 pound-feet)
  - Bolts M12x1.75x140 ..... 35 to 45 Nm (25.8 to 33.2 pound-feet)
  - Bolts M12x1.75x180 ..... 65 to 75 Nm (47.9 to 55.3 pound-feet)
- 2nd phase (additional rotation) ..... 90 degrees ± 5 degrees
- 3rd phase (only for bolts 140 and 180 mm long additional rotation) ..... 90 degrees ± 5 degrees

Crankshaft main bearings.
- 1st phase (pre lubricate with oil). ..... 44 to 56 Nm (32.5 to 41.3 pound-feet)
- 2nd phase ..... 74 to 86 Nm (54.6 to 63.4 pound-feet)
- 3rd phase. (additional rotation). ..... 90 ± 5 degrees

Bolts fastening the pulley on the crankshaft ..... 105 to 115 Nm (77.4 to 84.8 pound-feet)

Connecting rod cap bolts.
- 1st phase. (pre lubricate with oil). ..... 27 to 33 Nm (19.9 to 24.3 pound-feet)
- 2nd phase ..... 55 to 65 Nm (40.5 to 47.9 pound-feet)
- 3rd phase. additional rotation ..... 60 ± 5 degrees

Engine flywheel fastening bolts. M12x1.5
- 1st phase. (pre lubricate with oil) ..... 26 to 34 Nm (19.2 to 25.1 pound-feet)
- 2nd phase. (additional rotation). ..... 60 ± 5 degrees

Flywheel housing
- M12x120 ..... 75 to 95 Nm (55.3 to 70.1 pound-feet)
- M12x80 ..... 75 to 95 Nm (55.3 to 70.1 pound-feet)
- M10x80 ..... 44 to 54 Nm (32.5 to 39.8 pound-feet)
- M10x40 ..... 44 to 54 Nm (32.5 to 39.8 pound-feet)

Assembly rear cover plate to flywheel housing (M8x1.25x16) ..... 20 to 28 Nm (14.8 to 20.7 pound-feet)
Fuel injectors. ..... 55 to 65 Nm (40.6 to 47.9 pound-feet)
Sump (oil pan) M8x1.25. ..... 20 to 28 Nm (14.8 to 20.7 pound-feet)
Sump (oil pan) M18x1.5 ..... 51 to 69 Nm (37.6 to 50.9 pound-feet)
Oil pan drain plug ..... 20 to 28 Nm (14.8 to 20.7 pound-feet)
Oil filter. ..... Contact + 3/4 turn
Oil bypass valve to lube filter head ..... 72 to 88 Nm (53.1 to 64.9 pound-feet)
Fuel filter. ..... Contact + 3/4 turn
Injection pump fastening bolts. ..... 20 to 30 Nm (14.8 to 22.1 pound-feet)
Injection pump gear (drive gear nut)
- 1st stage ..... 15 to 20 Nm (11.0 to 14.8 pound-feet)
- 2nd stage ..... 85 to 90 Nm (62.7 to 66.4 pound-feet)

Valve gear cover and case fastening bolts (front cover). ..... 20 to 30 Nm (14.8 to 22.1 pound-feet)
Intake manifold fastening bolts. ..... 20 to 28 Nm (14.8 to 20.7 pound-feet)
Assembly air intake connection M8x1.25 ..... 20 to 28 Nm (14.8 to 20.7 pound-feet)
Fuel pump fastening bolts M8 bolt. ..... 20 to 28 Nm (14.8 to 20.7 pound-feet)
Fuel pump fastening bolts M6 bolt ..... 9 to 11 Nm (6.6 to 8.1 pound-feet)
Fuel pump M6 nut ..... 9 to 11 Nm (6.6 to 8.1 pound-feet)
Exhaust manifold fastening bolts. ..... 37 to 49Nm (27.3 to 36.1 pound-feet)
Valve cover fastening nuts. ..... 20 to 28 Nm (14.8 to 20.7 pound-feet)
Rocker arm support fastening bolts. ..... 40 to 56 Nm (29.5 to 41.3 pound-feet)
Rocker arm adjusting nut. ..... 20 to 28 Nm (14.8 to 20.7 pound-feet)
Camshaft shoulder plate fastening bolts. ..... 20 to 30 Nm (14.8 to 22.1 pound-feet)
Camshaft retaining plate bolts M8 ..... 20 to 28 Nm (14.8 to 20.7 pound-feet.)
Fan support fastening bolts M10x1.5x20. ..... 28 to 38 Nm (20.7 to 28.0 pound-feet)
Fan pulley fastening bolts
- M6 ..... 8 to 12 Nm (5.9 to 8.8 pound-feet)
- M10 ..... 37 to 49 Nm (27.3 to 36.1 pound-feet)

Turbocharger fastening bolts. ..... 37 to 49 Nm (27.3 to 36.1 pound-feet)
Starter motor fastening bolts. ..... 44 to 54 Nm (32.5 to 39.8 pound-feet)

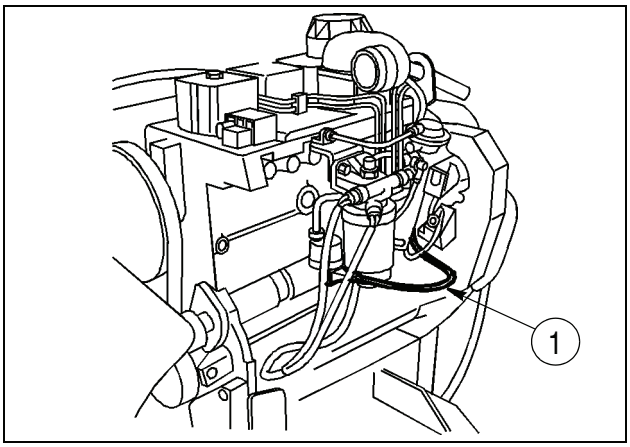
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SPECIAL DISASSEMBLY - F4GE ENGINES

DISASSEMBLING ENGINE

STEP 1



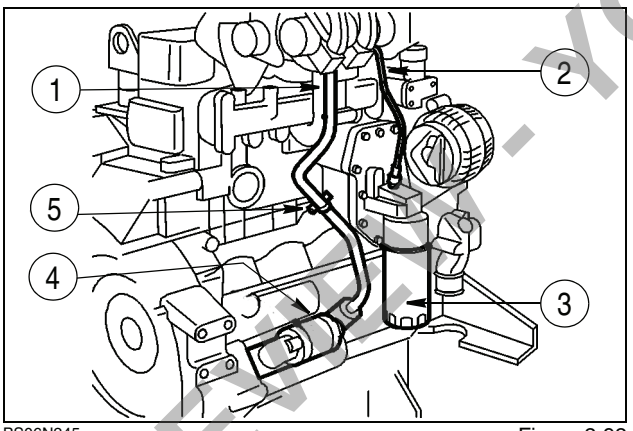
BS06N244 Figure 2-91

Drain the engine oil by taking the plug off the oil pan and the oil filling cap of the valve cover.

Remove the fan unit from the fan pulley.

In order to apply the brackets to the engine block to fix it on the stand for overhaul it is necessary to remove electrical wiring (1).

STEP 2

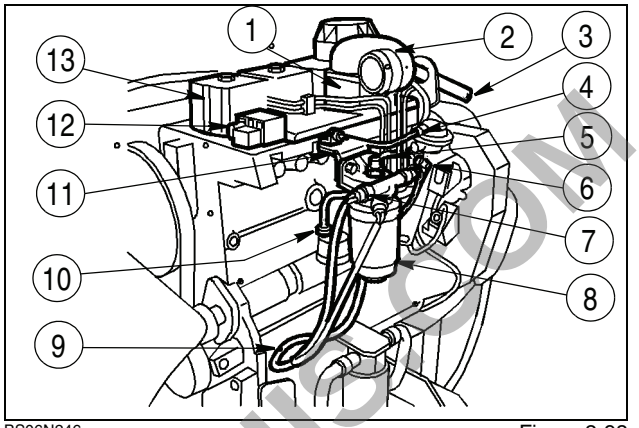


BS06N245 Figure 2-92

Remove the following:

- Fastening bracket (5) from electrical wiring (1).
- Starter (4)
- turbine lubrication delivery pipe (2).
- Oil filter (3).

STEP 3



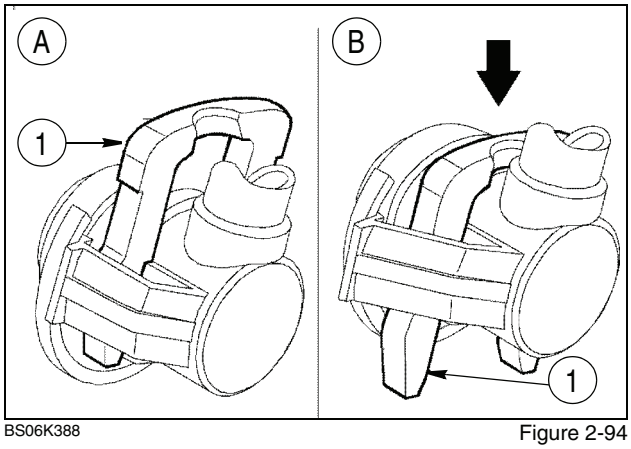
BS06N246 Figure 2-93

Version F4GE9484D

Remove the following:

- Grid heater (1).
- Intake manifold (2).
- Oil recovery pipe from blow-by (3).
- Pipe for LDA intake manifold (4).
- Piping for LDA system (5).
- Quick-couplings pipes (6), (7), (10) see step 4.
- Fuel filter (8).
- Electrical wiring (9).
- Fuel filter support (11).
- Grid heater control unit (12).
- Tappet covers (13).

STEP 4



BS06K388 Figure 2-94

IMPORTANT: *Push clamp (1), as shown in figure B to disconnect the low pressure fuel lines 6, 7, 10 from the corresponding connections. After disconnecting the line, reset the clamp (1) to position in figure A to prevent distortion to the clamp.*

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CONNECTOR (A) INJECTORS PINOUT DIAGRAM

EDC7UC31 ECU PIN	FUNCTION
1.	Not Used
2.	Not Used
3.	Cylinder 4 injector
4.	Cylinder 1 injector
5.	Cylinder 3 injector
6.	Cylinder 2 injector
7.	Not Used
8.	Not Used
9.	High pressure regulator with fuel metering
10.	High pressure regulator with fuel metering
11.	Cylinder 2 injector
12.	Cylinder 3 injector
13.	Cylinder 1 injector
14.	Cylinder 4 injector
15.	Not Used
16.	Not Used

NOTE: *Connector B is not shown because it is specific to the machine application see the particular machine schematic.*

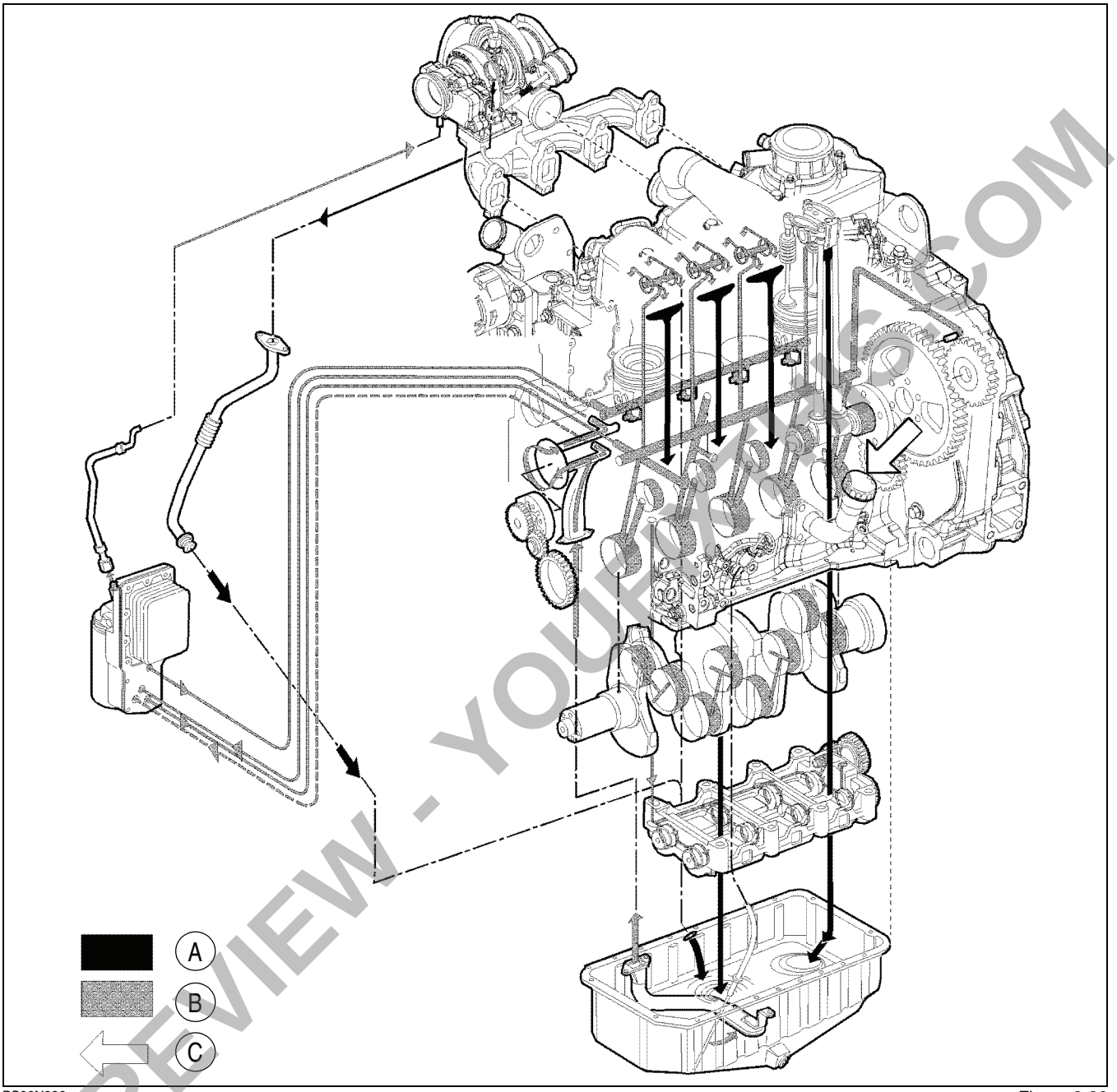
CONNECTOR (C) SENSORS PINOUT DIAGRAM

EDC7UC31 ECU PIN	FUNCTION
1.	Not Used
2.	Not Used
3.	Not Used
4.	Not Used
5.	Not Used
6.	Not Used
7.	Not Used
8.	Not Used
9.	Camshaft speed sensor - Signal
10.	Camshaft speed sensor - Ground
11.	Not Used
12.	Common rail temperature and pressure sensor - Ground
13.	Common rail temperature and pressure sensor - Positive
14.	Common rail temperature and pressure sensor - Signal
15.	Coolant temperature sensor - Signal
16.	Not Used
17.	Not Used
18.	Fuel temperature sensor - Signal
19.	Crankshaft speed sensor - Ground
20.	Not Used
21.	Not Used
22.	Not Used
23.	Crankshaft speed sensor - Signal
24.	Engine oil pressure and temperature sensor - Ground
25.	Boost intake pressure sensor - Ground
26.	Coolant temperature sensor - Ground
27.	Oil pressure sensor - Signal
28.	Oil temperature sensor- Signal
29.	Not Used
30.	Not Used
31.	Not Used
32.	Engine oil pressure and temperature sensor - Positive
33.	Boost intake pressure sensor - Positive
34.	Boost intake pressure sensor - Signal
35.	Fuel temperature sensor - Signal
36.	Boost intake temperature sensor - Signal

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ENGINE LUBRICATION - F4GE ENGINES



BS06N236

Figure 2-36

LUBRICATION SYSTEM LAYOUT FOR F4GE ENGINES

A. GRAVITY OIL RETURN PATH B. PRESSURIZED OIL PATH C. OIL SUPPLY

Pressurized lubrication is performed by the following components:

Gerotor oil pump housed in the front of the engine block, is driven by the spur tooth gear force fitted on the crankshaft.

Water / oil cooler, is housed in the engine block.

A by-pass valve in case the oil filter becomes clogged. To cut out oil filter, is built into the cooler unit.

The filter is a cartridge- type oil filter.

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TROUBLESHOOTING

ENGINE WON'T START

Batteries fully charged.	No →	Perform the checks described in the electrical section of the shop manual.
Yes ↓		
Connections to battery terminals are tight and clean.	No →	Inspect, clean, tighten nuts or replace terminals if excessively corroded.
Yes ↓		
Starter motor working properly.	No →	Perform the checks described in the electrical section of the repair manual.
Yes ↓		
Fuel filters plugged.	Yes →	Replace.
No ↓		
Fuel in tank.	No →	Refuel tank.
Yes ↓		
Grid heater system working properly.	No →	Check using multi meter replace or repair. Refer to Chapter 3 pages 3-5 and 3-14.
Yes ↓		
Injection pump timed properly.	No →	Verify timing described in Chapter 2 page 2-120 and 2-141 for mechanical injection. Common rail pump bring to certified pump shop.
Yes ↓		
Injectors working properly.	No →	On common rail engines check using Electronic Service Tool (EST). Mechanical injection loosen (crack) injection lines.
Yes ↓		
The fuel system or injection pump shows signs of air in system.	Yes →	Check and repair air leaks. For mechanical injection see Chapter 2 page 2-56
No ↓		
The fuel system shows traces of water.	Yes →	Check and clean the fuel system including the fuel tank.
No ↓		
Fuel pump working properly.	No →	Check fuel pump and replace if necessary.
Yes ↓		
Cold start advance solenoid and shut off solenoid both in working order.	No →	Check and replace defective parts. See Chapter 2 page 2-55
Yes ↓		
Compression good on all cylinders.	No →	Check cylinders for proper compression, overhaul engine or make repairs on defective parts,.

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ENGINE PROPERTIES

A	F4GE9454H	F4GE9454H	F4GE9454J	F4GE9454J	F4GE9484D	F4GE9484D	F4HE9484A	F4HE9484C
B	*J601	*J602	*J600	*J601	*J601	*J602	* J101	*J101/*J102
C	4 Cylinders							
D	4485 cm³ (273.7 cubic inches)							
E	74 kW (100 h.p.) 2000 rpm	74 kW (100 h.p.) 2000 rpm	66 kW (90 h.p.) 2000 rpm	66 kW (90 h.p.) 2000 rpm	93 kW (126 h.p.) 2200 rpm	93 kW (126 h.p.) 2200 rpm	104 kW (141 h.p.) 2200 rpm	82 kW (110 h.p.) 2200 rpm
F	Direct Injection							
G	Rotary Injection pump						High pressure Common rail EDC7UC31	
H	T.C. (Boosted)				T.A.A.- (Boosted by Intercooler)			

A. Type of engine
B. Engine model
C. Number of cylinders
D. Total displacement
E. Maximum power currently available
F. Type of Injection
G. Injection system
H. Air supply system

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- Debris in the tank, clean as required.
- The fuel pick-up tube in the fuel tank, checking for cracks, plugging, or contact with the bottom or side walls of the tank.
- The fuel tank cap, assuring that a vacuum is not being formed in the fuel tank, which would reduce the fuel supply pressure to the injection pump inlet.

NOTE: *Vacuum in the fuel tank might not be observed during short-term running.*

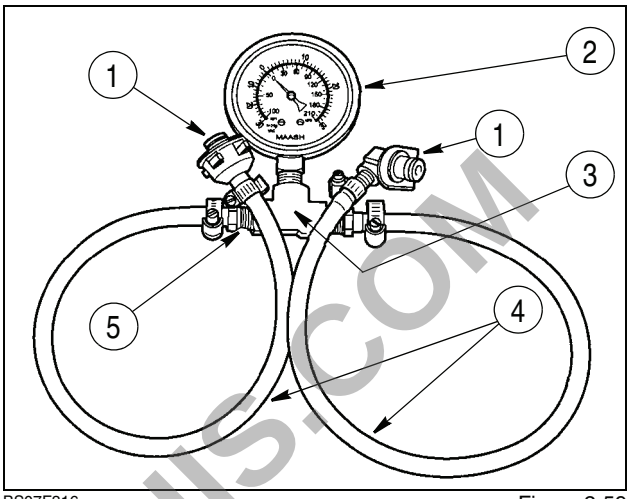
- These instructions apply only to engines with external electrical fuel shutoff valve assemblies. Ensure that fuel supplied to and from the valve assembly is properly plumbed. Fuel supplied from the fuel filter enters the shutoff valve at port number 1. Port number 2 supplies fuel to the inlet of the Bosch VE injection pump.

STEP 5

If the checks in Step 4 were made and all necessary corrective actions were taken, **Retest**. If the pressure is still low, preform the following tests:

- From the gauges previously used to measure pressure, remove one section of test line and a barbed fitting from the tee. Install in there place a gasket and a connector. This will allow installation of the gauges between the supply pump inlet and the fuel supply line from the tank. After installation of the gauges, run the engine and observe the clear tube remaining on the gauges to ensure that air is not entering. The vacuum here should not exceed 50.8 mm (2.0 inches) of Hg under full load. If the vacuum is greater than that, look for a plugged fuel supply line or debris in the fuel tank.
- An alternative vacuum test method would be to supply fuel from an alternate fuel source, such as a five gallon container, with a known good supply line. Fit it directly to the supply pump inlet fitting, then rerun the test. If the pressures return to normal, check the fuel supply line and tank of the vehicle for leaks or restrictions.
- Upon completion of the diagnostic procedures, remove the test line and the gauge, and reinstall the standard fuel line.

Parts needed for pressure/ vacuum testing



BS07F316 Figure 2-59

SETUP FOR MEASURING PRESSURE

To build a fuel system test set for pressure testing, obtain the following :

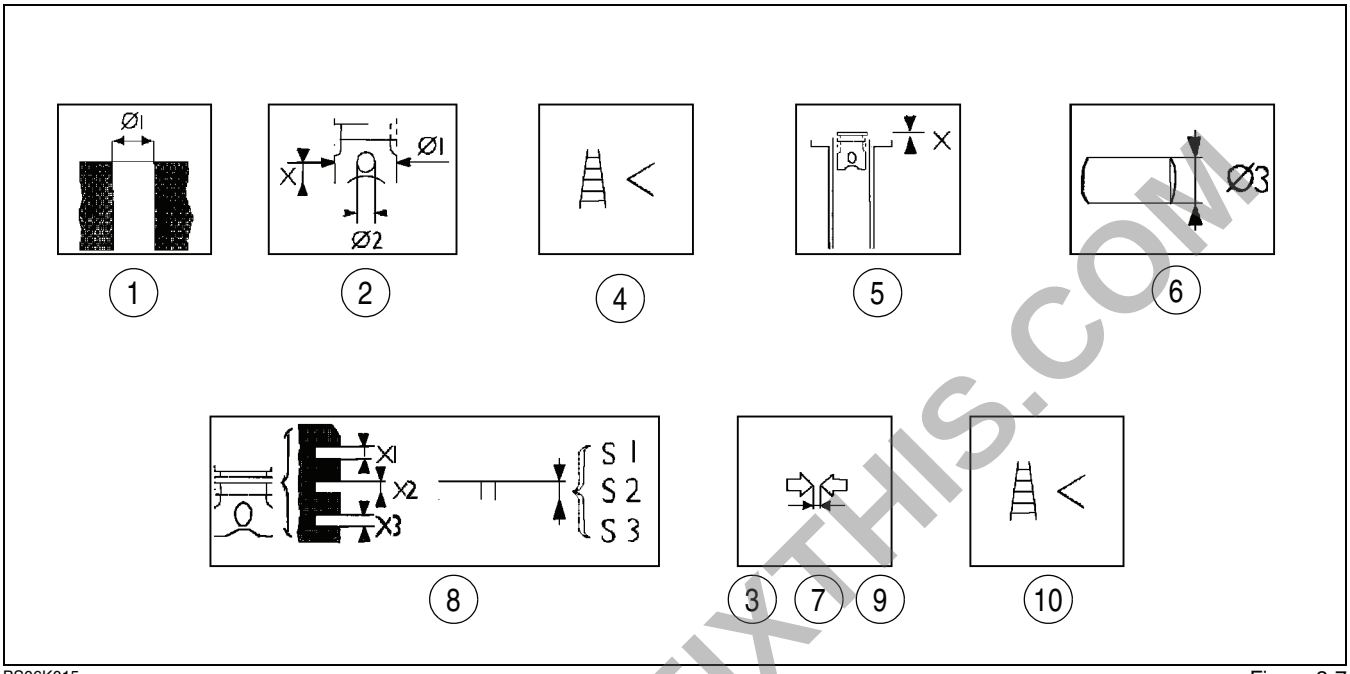
NOTE: *Voss o-ring type connectors can be obtained either by purchasing the connectors, or by purchasing a fuel line for the application being worked on, then carefully removing the plastic Voss type connectors (1), from the plastic tube for re-use with poly-vinyl tubing.*

Quan.	Description	ID #
2	Voss type brass barbed hose connectors	1
1	6.35 mm (1/4 inch)- NPT tee fitting	3
2	6.35 mm (1/4 inch)- NPT to 7.54 mm (5/16 inch) barb connectors	5
1	Five feet of 7.54 mm (5/16 inch) O.D. poly-vinyl tubing	4
1	Dampened compound gauge which will measure 0 to 762 mm (0 to 30 inches) of Hg and 0 to 2.07 bar (0 to 30 psi).	2

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CRANK GEAR COMPONENTS AND CYLINDER ASSEMBLY



BS06K015

Figure 2-7

REF. NO.	ENGINE TYPE	F4GE9454H		F4GE9454J		F4GE9484D		F4HE9484A	F4HE9484C
		J601	J602	J600	J601	J601	J602	J101	J101 / J102
1	Cylinder bore.	104.000 to 104.024 mm. (4.0945 to 4.0954 in.)							
2	Pistons:								
	Measurement dimension.	X = 55.90 mm. (2.20 in.)							
	Outer diameter.	Ø1= 103.714 to 103.732 mm. (4.0832 to 4.0839 in.)							
	Pin seat.	Ø2= 38.010 to 38.016 mm. (1.4965 to 1.4967 in.)							
3	Piston - cylinder liners.	0.252 to 0.294 mm. (0.0099 to 0.0116 in.)							
4	Piston diameter.	Ø= 0.4 mm. (0.0157 in.)							
5	Protrusion of pistons from crankcase.	0.28 to 0.52 mm (0.01102 to 0.02047 in.)							
6	Piston pin.	Ø3= 37.994 to 38.000 mm. (1.4958 to 1.4961 in.)							
7	Piston pin-Pin seat.	0.01 to 0.022 mm. (0.0004 to 0.0009 in.)							
8	Piston ring grooves (measured on Ø of 99.0mm 3.898 in.)	X1= 2.705 to 2.735 mm. (0.1065 to 0.1077 in.)							
		X2= 2.44 to 2.46 mm. (0.0961 to 0.0969 in.)							
		X3= 4.03 to 4.05 mm. (0.1587 to 0.1594 in.)							
	Piston rings (measured 1.5 mm 0.05905 in. away from external Ø).	S1= 2.560 to 2.605 mm. (0.1008 to 0.1026 in.)							
		S2= 2.350 to 2.380 mm. (0.0925 to 0.0937 in.)							
		S3= 3.970 to 3.990 mm. (0.1563 to 0.1571 in.)							
9	Piston rings - Slots.	1= 0.100 to 0.175 mm. (0.0039 to 0.0069 in.)							
		2= 0.060 to 0.110 mm. (0.0024 to 0.0043 in.)							
		3= 0.040 to 0.080 mm. (0.0016 to 0.0031 in.)							
10	Piston rings.	0.40 mm. (0.0157 in.)							

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