Electrical Panel Components

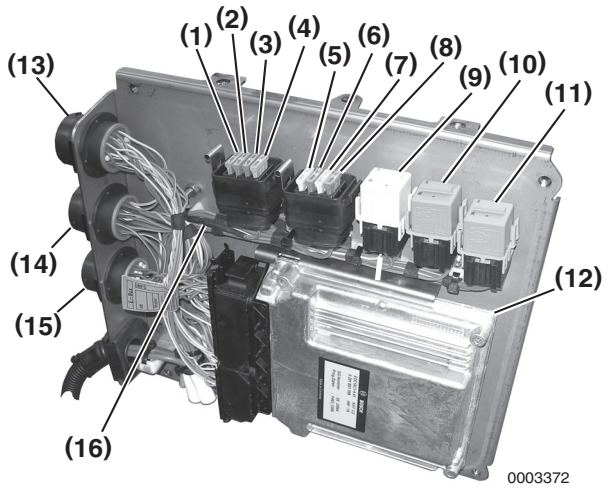


Figure 12-3

1 – Fuse F1 (3 A) - Switched B+ to CAN
2 – Fuse F2 (10 A) - B+ to Key Switch
3 – Fuse F3 (15 A) - Fuel Supply Pump
4 – Fuse F4 (30 A) - Switched B+ to ECU
5 – Fuse F5 (20 A) - Power to Sensors and Actuators
6 – Fuse F6 (10 A) - Auxiliary Power
7 – Jumper Fuse F7 (3 A) - Single / Port Selection, default is single / port (fuse in). Remove fuse for starboard configuration.
8 – Jumper Fuse F8 (3 A) - CAN / Analog Throttle Selection, default is analog (fuse out). Insert 3 A fuse to configure for CAN.
9 – K1 - Starter Relay
10 – K3 - Fuel Supply Pump Relay
11 – K2 - Main Power Relay
12 – ECU
13 – Connector X1 - Communication to Helm Display
14 – Connector X21/1 - Engine Wiring Harness
15 – Connector X22/1 - Fuel Injector Wiring Harness
16 – Blocking Diode V1

NOTICE: The electrical panel cables must be connected directly to the battery, and must have a circuit breaker installed in the B+ (red) lead.

Electrical Panel Connector (X1) Connections

The ECU is connected to other components and systems via connector X1 **(Figure 12-4)**. The graphic and table show the pin locations and assignments.

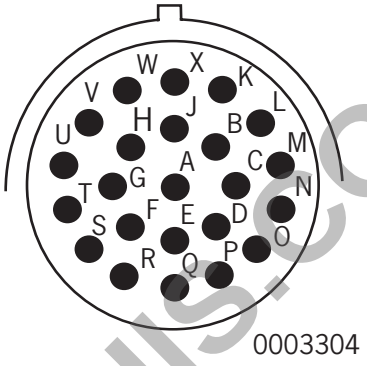


Figure 12-4

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CYLINDER HEAD

Cylinder Head Components

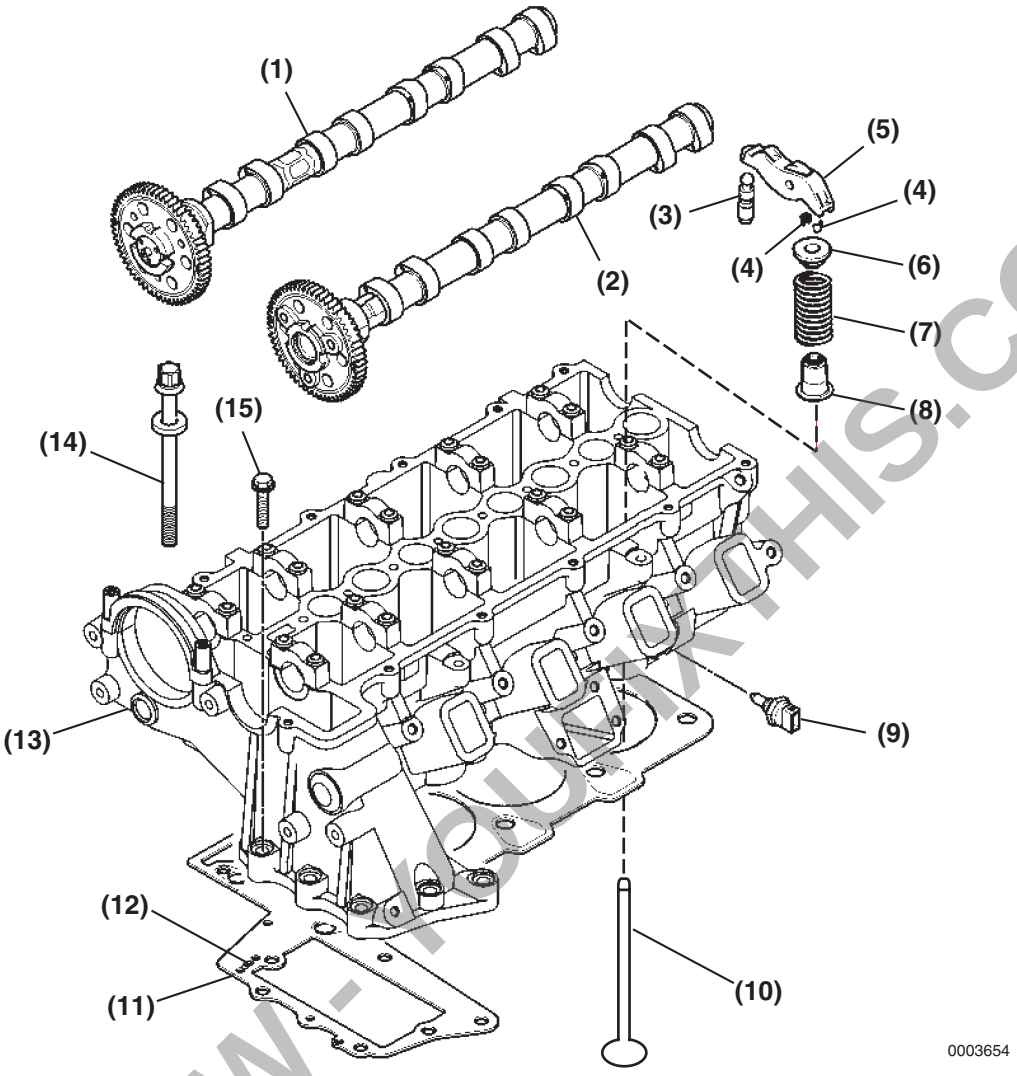


Figure 5-2

1 – Exhaust Camshaft
2 – Intake Camshaft
3 – Hydraulic Rocker Arm Pivot
4 – Valve Keeper (2 used each valve)
5 – Cam Follower
6 – Valve Spring Retainer
7 – Valve Spring
8 – Valve Stem Seal
9 – Coolant Temperature Sensor
10 – Valve
11 – Cylinder Head Gasket
12 – Head Gasket Identification Holes
13 – Cylinder Head
14 – Cylinder Head Bolt
15 – Bolt

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SPECIAL TORQUE CHART

System	Component	Model	Thread	Comments	Specification
Engine Block	Main Bearing Replace, wash and oil	4BY 6BY	M10x80 Steel Bolts	Initial Torque Torque Angle	23 N·m (204 in.-lb) Plus 90°
	Coolant Drain Plug to Crankcase	4BY 6BY	M14x1.5	Replace Sealing Ring	25 N·m (221 in.-lb)
	Clamping and Guide Rails to Crankcase	4BY 6BY	M14	Torque	20 N·m (177 in.-lb)
	Engine Mount Nut	4BY 6BY	M20	Torque	300 N·m (221 ft-lb)
Torsion Damper	Torsional Vibration Damper	4BY	M18x1.5	Initial Torque	100 N·m (74 ft-lb)

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TROUBLE CODES

Working Procedure

Try to form a comprehensive view of the problem. Start by asking the operator the following:

- Symptoms
- Conditions in which the fault occurs
- How often the fault occurs
- If the trouble codes have been erased

Then, extract all the stored trouble codes.

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TROUBLESHOOTING CHART

Starting Trouble

Problem / Symptom	Cause	Action
Engine Will Not Crank	Discharged battery	Charge / replace battery
	Blown fuse	Replace fuse
	Defective starter motor	Replace starter motor
	Loose wiring connections	Tighten connections
	Electrical panel power circuit breaker tripped	Reset circuit breaker
Engine Cranks but Will Not Start	No fuel to engine	Check fuel level in tank
		Ensure all valves are on
	No fuel to cylinders	Clean or replace fuel filter / water separator
		Replace clogged fine filter
		Bleed fuel system
		Blown fuse - F3, F4, F5
		ECU / software problem
	Low ambient temperature	Install optional glow plug control
		Install block heater
	Oil viscosity too high	Replace with correct viscosity oil for operating conditions

Exhaust Color

Problem / Symptom	Cause	Action
White Smoke	Cold engine	Allow engine to warm to operating temperature
		Defective thermostat
	Incorrect fuel	Replace fuel with correct type
	Defective (leaking) fuel injector	Test / replace fuel injector
	Injection timing is incorrect	ECU / software problem
White Smoke with Water Vapor	Leaking cylinder head gasket	Replace
	Leaking charge air cooler	Repair as necessary
	Cracked cylinder head	
	Cracked cylinder	
Blue Smoke	Worn piston rings / cylinders	Repair as necessary
	Oil leak in turbocharger (oil present in intake manifold)	
	Damaged piston cooling nozzles	

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PRINCIPAL ENGINE SPECIFICATIONS

Engine Model	4BY150 / 150Z	4BY180 / 180Z	6BY220 / 220Z	6BY260 / 260Z
Application Design	Models numbers with no suffix letter are used in marine gear applications. Models having a "Z" suffix are used with stern drive.			
Number of Cylinders	In-line 4		In-line 6	
Type	15° inclined, water-cooled, dual overhead camshaft, 4-cycle diesel			
Combustion System	Direct injection			
Aspiration	Turbocharged with charge air cooler			
Bore x Stroke	84 mm x 90 mm (3.307 in. x 3.543 in.)			
Displacement	1.995 L (121.7 cu in.)		2.993 L (182.6 cu in.)	

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Throttle Position Sensor

This sensor is located in the remote control head. It communicates with the ECU with varying signals based on throttle position. The ECU then calculates the position of the throttle lever in percent, and adjusts fuel injection to adjust engine speed. The ECU supplies 5V and ground connections.

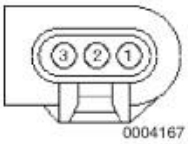


Figure 12-22

1 – Pin 1 - Ground (ECU pin 1/78)
2 – Pin 2 - Out (ECU pin 1/56)
3 – Pin 3 - 5V (ECU pin 1/30)

Results of Failed Sensor

Failure of the sensor results in:

- One failed sensor - limitation of the injection rate

Voltage Set-Point Values

Sensor	Low Idle	High Idle

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Oil Pressure Sensor

This sensor measures the engine oil pressure and sends the signal to the helm gauge. It is a pressure sensitive variable resistor. It is mounted in the front heat exchanger bracket and is connected to the engine block via a pressure line.

The sensor output is not used by the ECU.

Results of Failed Sensor

Failure of the sensor results in:

- Loss of engine oil pressure monitoring

If this sensor is defective, no P-codes will be generated.

Test Values

- Resistance at 0 bar (0 psi): 10 +3 -5 ohm
- Resistance at 2 bar (29 psi): 52 ±4 ohm
- Resistance at 4 bar (58 psi): 88 ±4 ohm
- Resistance at 6 bar (87 psi): 124 ±5 ohm

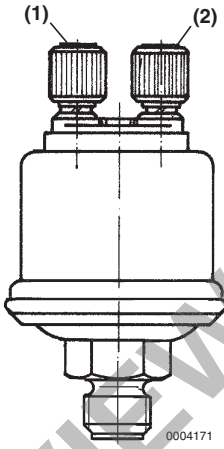


Figure 12-9

1 – Engine harness
2 – Engine harness

Note: Polarity of wire connections is not important. Either wire can be connected to either terminal.

Fuel Injector

The fuel injectors are continuously supplied with high-pressure fuel and are electronically triggered by the ECU. The ECU controls the frequency, duration and timing of injection.

Results of Failed Injector

If an injector-related failure occurs, the following P-codes may be generated:

- P2049 - Short circuit on high side to ground or B+
  - 4BY - engine will stop
  - 6BY - engine may continue to run
- P2052 - Short circuit on high side to ground or B+
  - Engine may continue to run
- P0261, P0264, P0267, P0270, P0273, P0276 - short circuit to B+
- P0201, P0202, P0203, P0204, P0205, P0206, - no connection / short to ground

Note: A minimum of two injectors must function for the 4BY to run. A minimum of three injectors must function for the 6BY to run.

Test Values

- Resistance at 20°C (68°F): 0.4 ohm

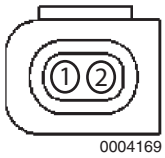


Figure 12-10

1 – Pin 1 - Low side
2 – Pin 2 - High side

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PERIODIC MAINTENANCE SCHEDULE

Daily and periodic maintenance is important to keep the engine in good operating condition. The following is a summary of maintenance items by periodic maintenance intervals. Periodic maintenance intervals vary depending on engine application, loads, diesel fuel and engine oil used and are hard to establish definitively. The following should be treated only as a general guideline.

○: Check ◇: Replace

System	Item	Periodic Maintenance Interval					
		Daily	Every 50 hours or monthly whichever	Every 250 hours or one year whichever	Every 500 hours or 2 years whichever	Every 1000 hours or 4 years whichever	Every 2000 hours or 8 years whichever

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REPAIR

Before performing any repair procedures, always do the following first:

1. Disconnect battery cables at the battery. Always disconnect negative (-) battery cable first.
2. Close all valves in the fuel supply system.
3. Remove electrical connections, intake and exhaust system connections and fuel supply lines from engine. Cap or plug all open fuel connections.

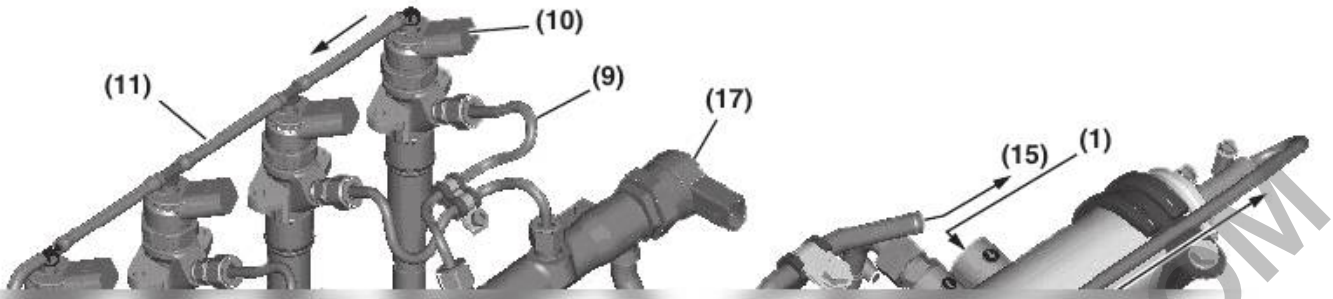
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ENGINE PIPING DIAGRAMS

Fuel Flow



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TABLE OF CONTENTS

Page

Introduction 1-1
Safety 2-1
General Service Information 3-1
Periodic Maintenance 4-1
Engine 5-1
Fuel System 6-1
Cooling System 7-1
Lubrication 8-1
Turbocharger 9-1
Starter Motor 10-1
Alternator 11-1
Electrical and ECU 12-1
Troubleshooting 13-1

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