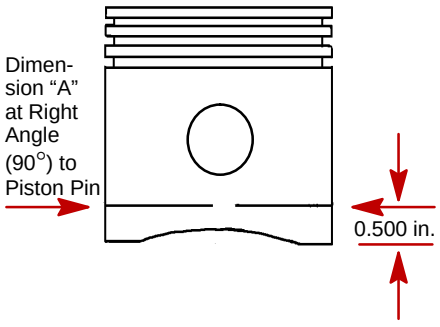
FUEL SYSTEM

Section 3B – Direct Fuel Injection

Table of Contents

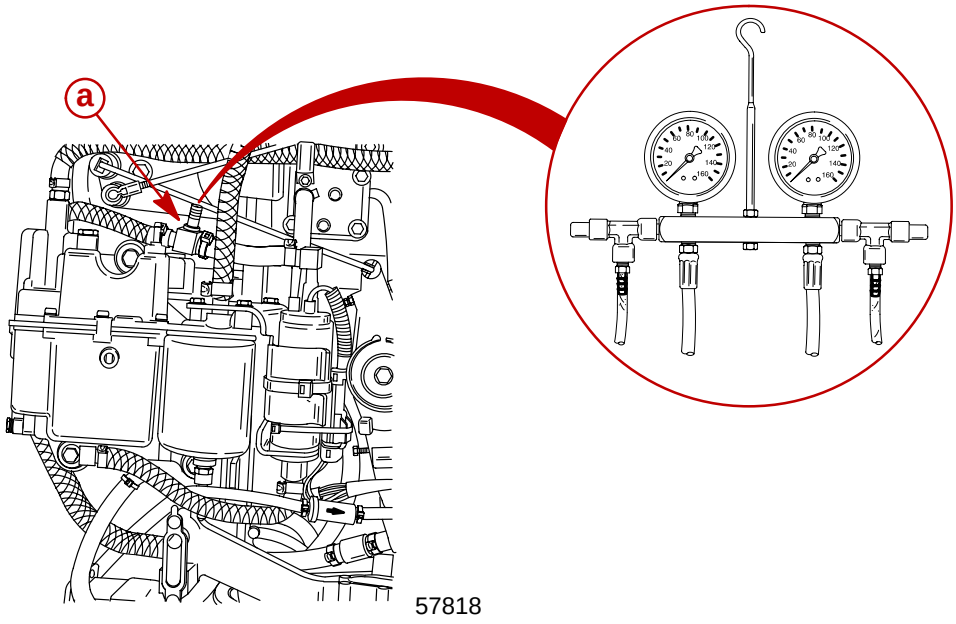
Specifications

Fuel System Specifications	
Fuel Pressure	90 ± 2 psi (613.5 ± 13.8 kPa)
Air Pressure	80 ± 2 psi (544.0 ± 13.8 kPa)
Fuel/Air Differential	10 psi (68.5 kPa)
High Pressure Electric Fuel Pump Amperage Draw	6-9 Amps
Low Pressure Electric Fuel Pump Amperage Draw	1-2 Amps
Low Pressure Electric Fuel Pump Output	6-10 psi (41.37 kPa - 68.95 kPa)
Fuel Injector Ohm Resistance	1.8 ± 0.1Ω
Direct Injector Ohm Resistance	1.3 ± 0.3Ω
Fuel Lift Electric Fuel Pump Output	1-10 psi (68.5 kPa)

Air Compressor Specifications		
Air Compressor	Type Compressor Output	Reciprocating Piston (1 to 1 ratio with engine RPM) @ Idle – 80 psi @ W.O.T. – 110 psi
Cylinder Block	Displacement	7.07 cu. in. (116 cc)
Cylinder Bore	Diameter (Standard) Taper/Out-of-Round/Wear Maximum Bore Type	2.5591 in. (65.0 mm) 0.001 in. (0.025 mm) Cast Iron
Stroke	Length	1.374 in. (34.9 mm)
Piston	Piston Type	Aluminum
Piston Diameter		2.5578 ± .0004 in. (64.97 ± 0.010 mm)
Piston Ring	End Gap Top Ring Middle Ring Bottom Ring	 0.0059 - 0.0098 in. (0.15 - 0.25 mm) 0.0059 - 0.0098 in. (0.15 - 0.25 mm) 0.0039 - 0.014 in. (0.10 - 0.35 mm)
Reeds	Reed Stand Open	0.010 in. (0.25 mm)

Special Tools

1. Duel Fuel/Air Pressure Gauge 160 psi – 91-852087A1/A2/A3



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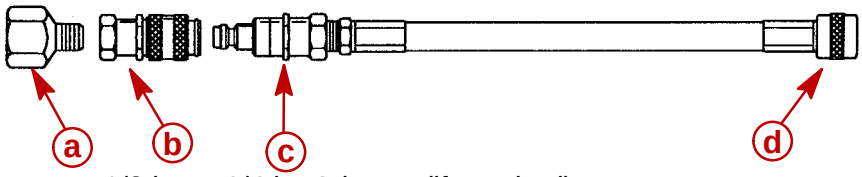
a - Schrader Valve “Tee” (22-849606)

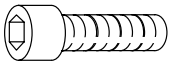
2. Adaptors to convert pressure gauge 91-852087A1/A2 to an A23

NOTE: *2 Adaptors 91-803804A2 are required to convert a pressure gauge set.*



a - 1/2 in. to 1/4 in. Adapter (if required)
b - Female Quick Disconnect
c - Male Quick Disconnect
d - Screw on Schrader

3. Screw (5 mm x 25 mm) (2 each) – 10-40073-25



4. Flat Washer (2 each) – 12-30164

5. Seal/Teflon Ring Installation Tool – 91-851980

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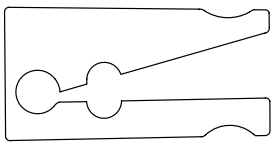
6. Seal/Teflon Ring Sizing Tool – 91-851980-1



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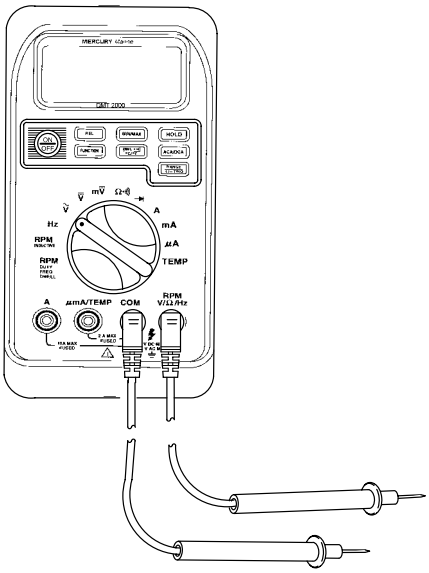
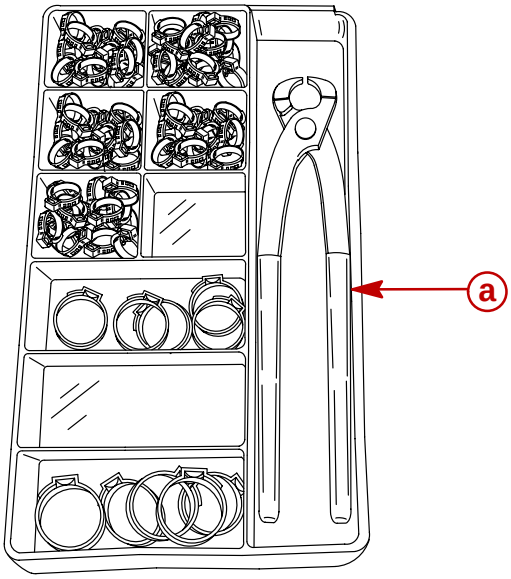
7. DMT 2000 Digital Tachometer Multi-meter P/N 91-854009A1



8. Clamp Tool Kit 91-803146A2



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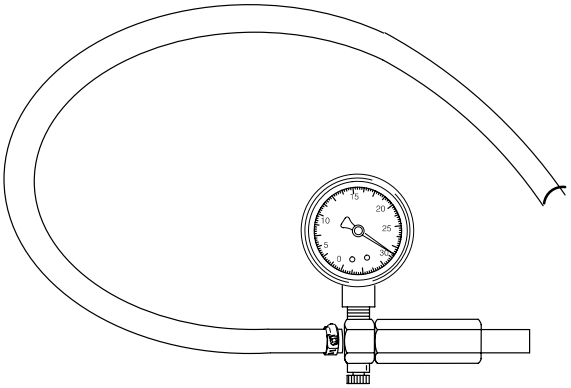
a - Clamp Tool 91-803146T

9. Gearcase Leakage Tester (FT-8950)



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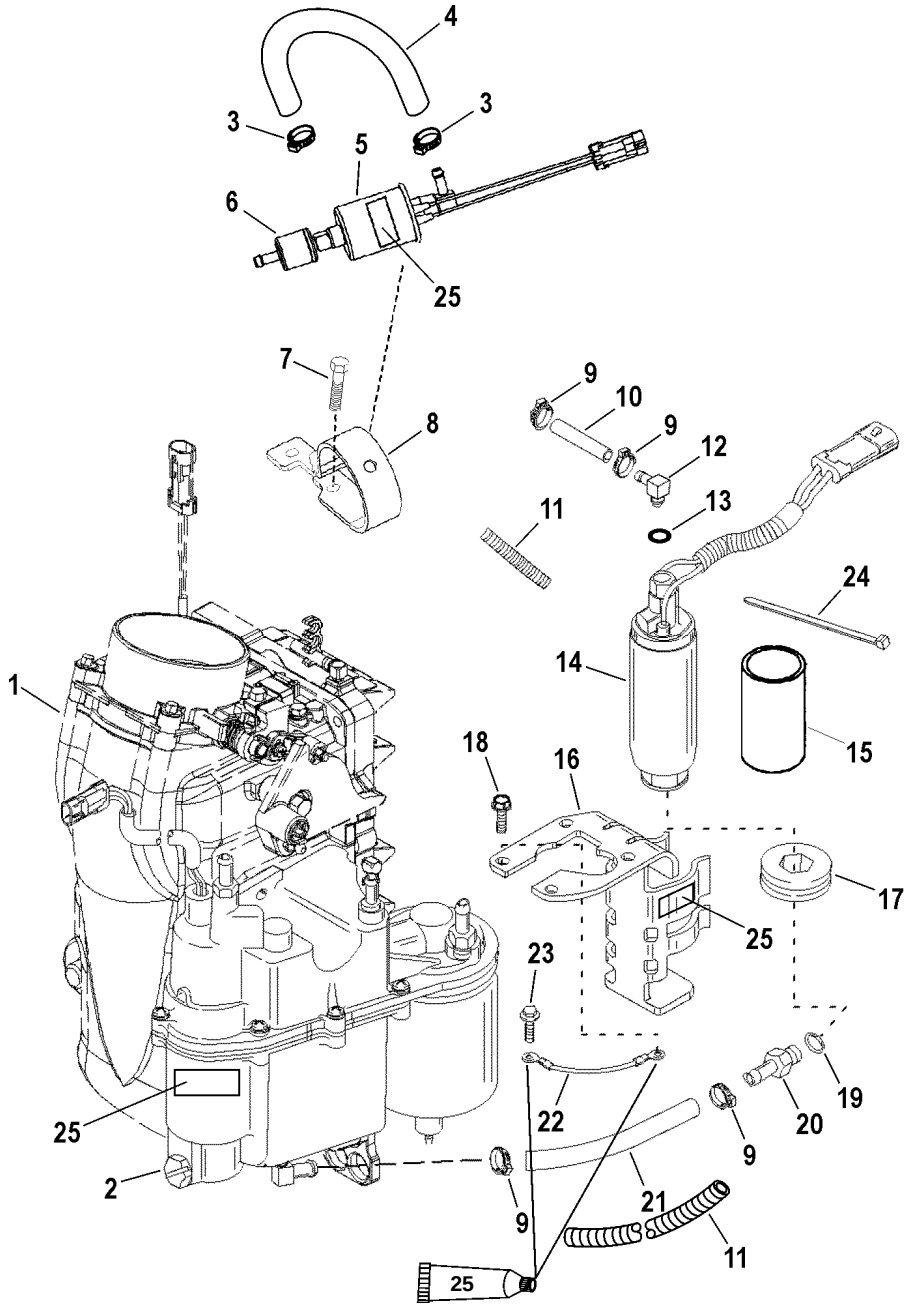
Notes:

Air Handler



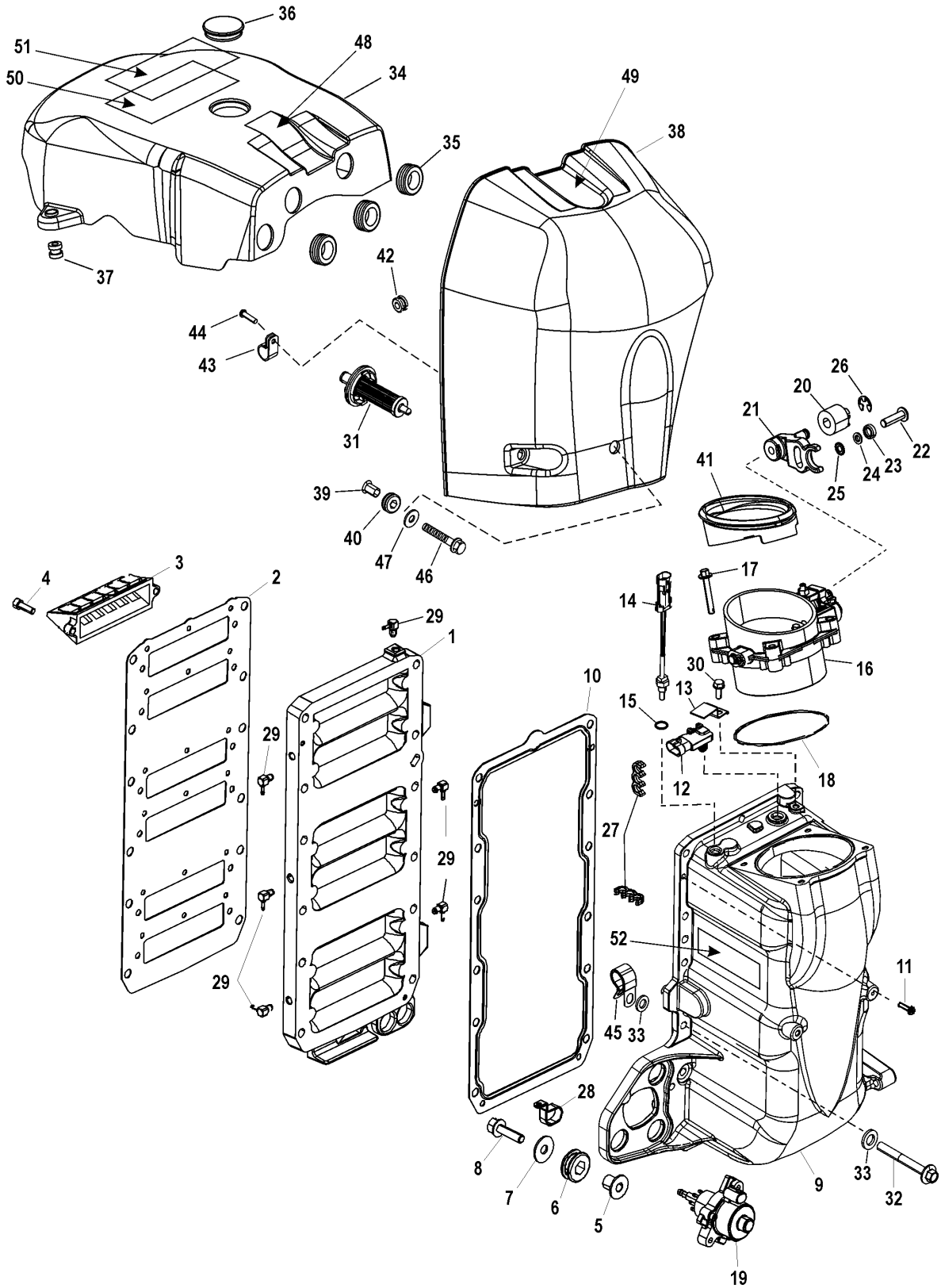
25 Liquid Neoprene

Air Handler

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
1	1	AIR HANDLER ASSEMBLY			
2	1	VAPOR SEPARATOR ASSEMBLY			
3	2	CLAMP (18.3)			
4	AR	HOSE (22 IN. Bulk)			
5	1	FUEL PUMP ASSEMBLY			
6	1	FILTER-Fuel Pump			
7	1	SCREW (M6 x 35)	100		11.3
8	1	BRACKET-Fuel Pump Mount			
9	4	CLAMP (18.3)			
10	1	HOSE			
11	AR	INSULATING SLEEVE			
12	1	ELBOW			
13	1	O RING			
14	1	FUEL PUMP ASSEMBLY			
15	1	SLEEVE-Gray			
16	1	BRACKET KIT			
17	1	GROMMET			
18	3	SCREW (M6 x 16)	100		11.3
19	1	O RING			
20	1	FITTING	45		5.1
21	1	HOSE			
22	1	WIRE ASSEMBLY-Ground			
23	1	SCREW (M6 x 10)	40		4.5
24	1	CABLE TIE (14 IN.)			
25	3	DECAL-Info			

NOTE: THE EPA LABEL HAS IMPORTANT INFORMATION ON EPA EMISSION REGULATIONS. REPLACE ANY MISSING OR UNREADABLE EPA LABEL.

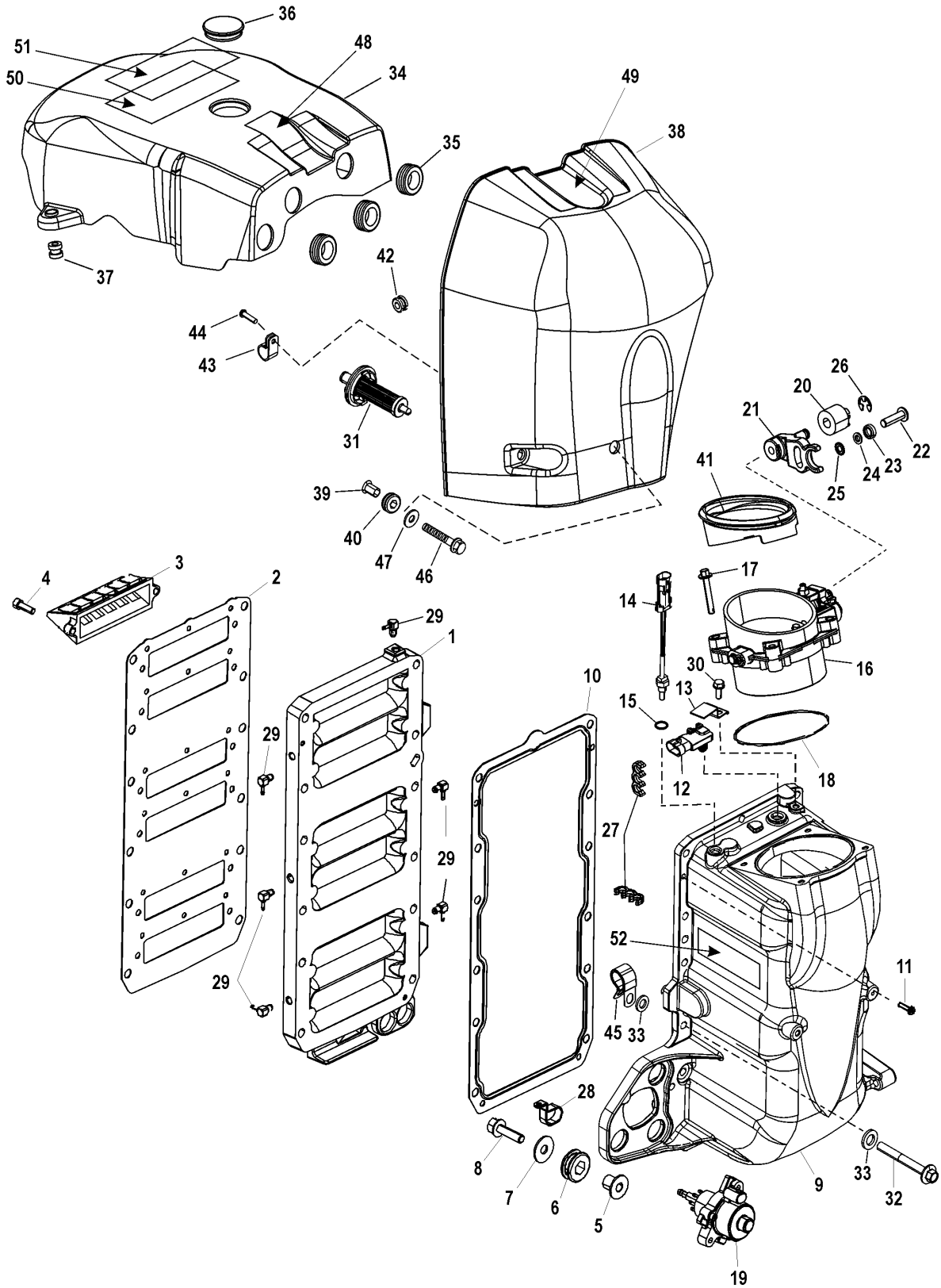
Air Handler Components



Air Handler Components

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
–	1	AIR HANDLER			
1	1	ADAPTOR PLATE			
2	1	GASKET			
3	6	REED BLOCK			
4	12	SCREW (M6 x 1)	90		10.2
5	3	BUSHING			
6	3	GROMMET			
7	3	WASHER			
8	3	SCREW (M8 x 30)	150		17
9	1	AIR PLENUM KIT			
10	1	GASKET			
11	2	SCREW (M4 x 16)	22		2.5
12	1	SENSOR–MAP			
13	1	BRACKET			
14	1	TEMPERATURE SENSOR			
15	1	O RING			
16	1	THROTTLE BODY KIT			
17	4	SCREW (M6 x 40)	65		7.3
18	1	O RING			
19	1	OIL PUMP			
20	1	ROLLER			
21	1	THROTTLE ROLLER			
22	1	SCREW	22		2.5
23	1	WASHER-Cupped			
24	1	WASHER-Spool			
25	1	LOCKWASHER (#10 External)			
26	1	RETAINING RING			
27	2	RETAINER-Hose Support			
28	1	CLAMP			
29	6	CHECK VALVE	40		4.5
30	1	SCREW (M6 x 16)	38		4.3
31	1	FILTER ASSEMBLY-Air			
32	12	SCREW (M6 x 40)	120		13.6
33	2	WASHER			
34	1	COVER ASSEMBLY-Flywheel			
35	3	GROMMET			
36	1	PLUG			
37	2	GROMMET			
38	1	ATTENUATOR ASSEMBLY-Air			
39	1	BUSHING			
40	1	GROMMET			

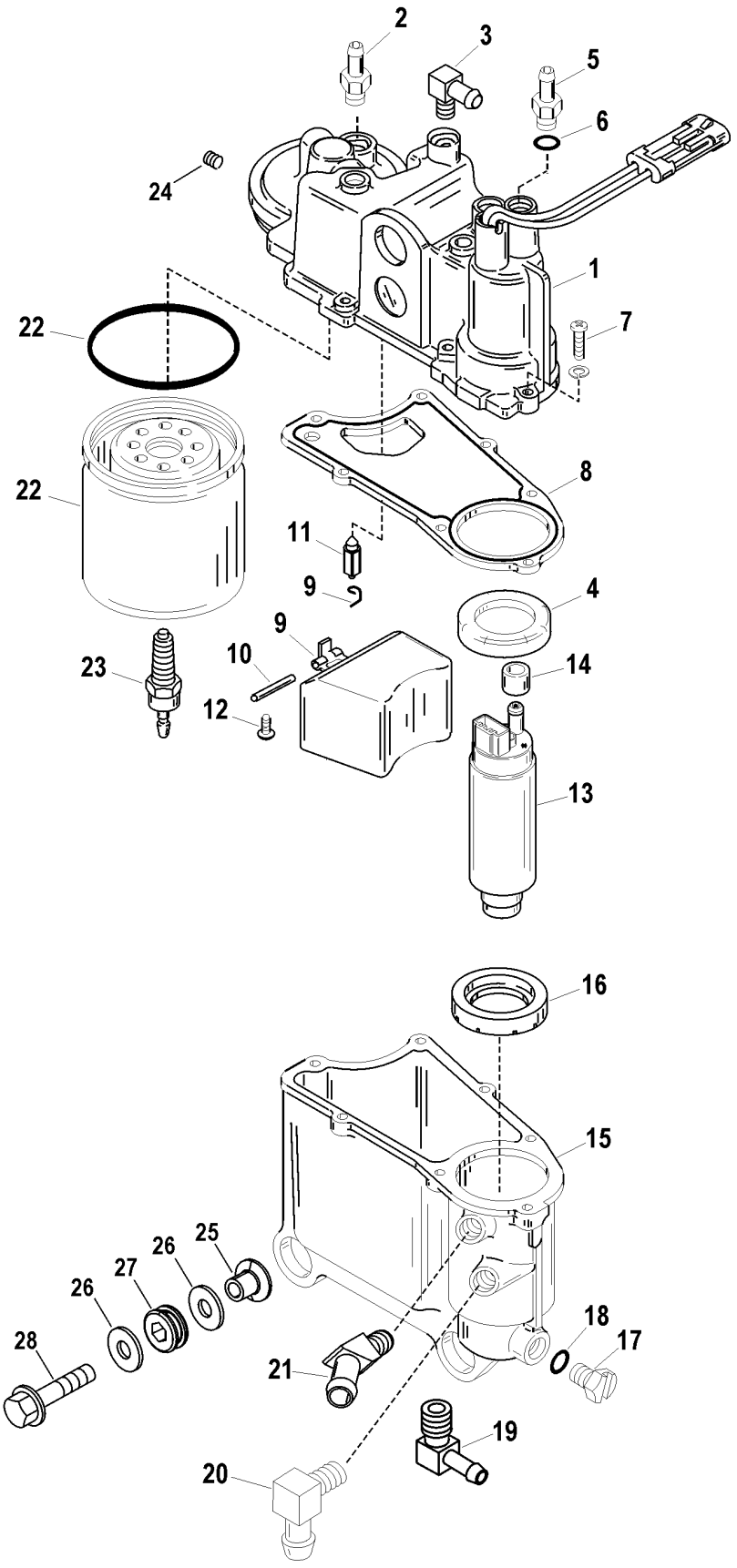
Air Handler Components



Air Handler Components

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
41	1	SEAL			
42	1	GROMMET			
43	1	CLIP			
44	1	SCREW (#10-16 X .750)			
45	1	CLAMP			
46	1	SCREW (M6 X 25)	90		10.2
47	1	WASHER			
48	1	DECAL-Logo (M2 Jet Drive)			
49	1	DECAL-Logo (3.0l V6)			
50	1	DECAL-Logo (Mercury Optimax 250)			
51	1	DECAL-EPA Label Info			

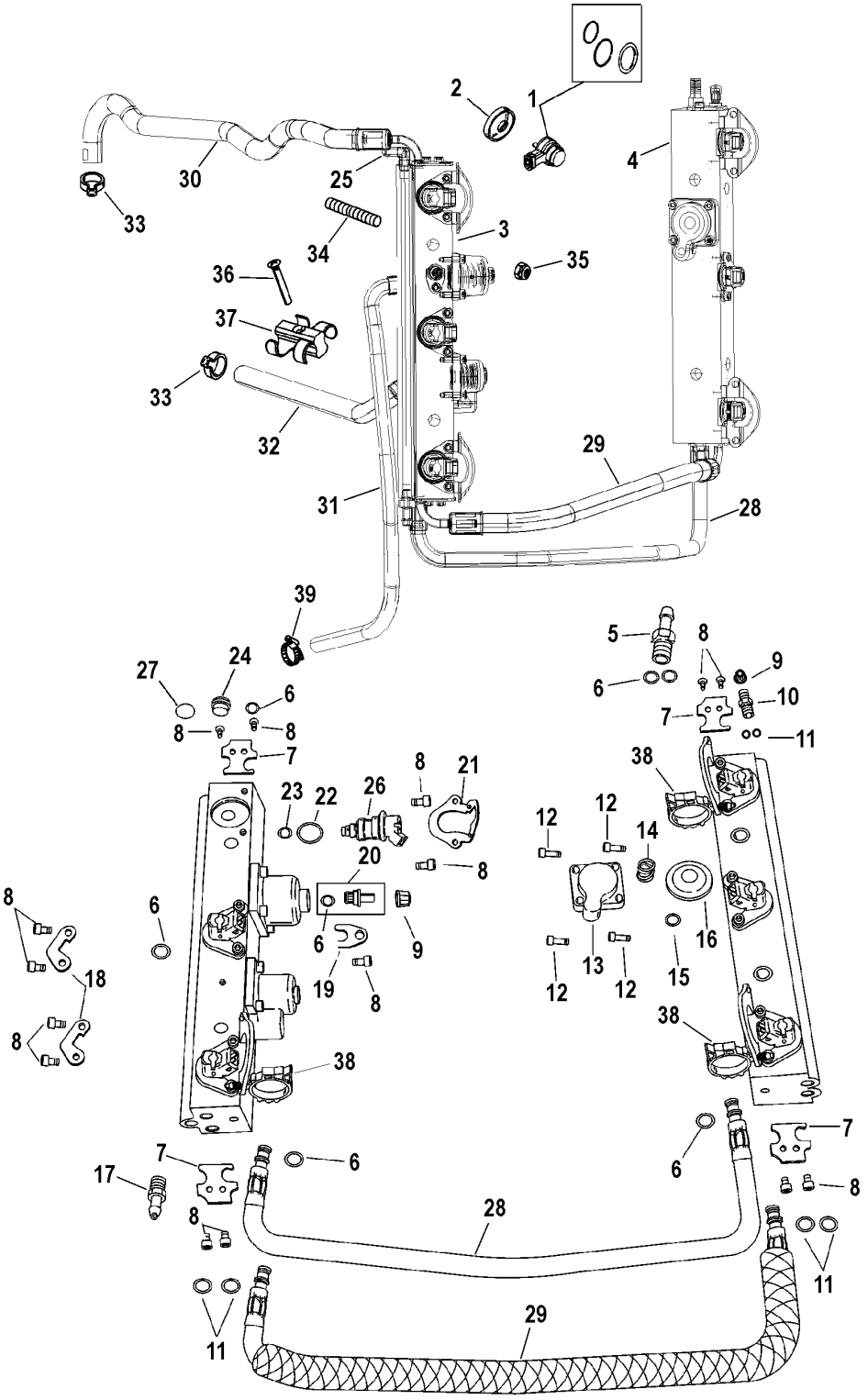
Vapor Separator Components



Vapor Separator Components

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	COVER KIT			
2	1	FITTING-Straight	65		7.3
3	1	FITTING-Elbow	50		5.7
4	1	SEAL			
5	1	FITTING KIT-Pump Outlet	75		8.5
6	1	O RING			
7	7	SCREW (#8-32 x .750)	22		2.5
8	1	GASKET			
9	1	FLOAT KIT			
10	1	SHAFT-Float			
11	1	NEEDLE VALVE			
12	1	SCREW (#6-32 x .187)	10		1.0
13	1	FUEL PUMP ASSEMBLY			
14	1	SLEEVE			
15	1	BOWL KIT			
16	1	SEAL			
17	1	PLUG KIT			
18	1	O-RING			
19	1	FITTING-Elbow	65		7.3
20	1	FITTING-Elbow	65		7.3
21	1	FITTING-Elbow	65		7.3
22	1	FUEL FILTER KIT			
23	1	PROBE-Water Sensing	22		2.5
24	1	PLUG (.125-27)			
25	3	BUSHING			
26	6	WASHER			
27	3	GROMMET			
28	3	SCREW (M8 X 35)			

Fuel Rails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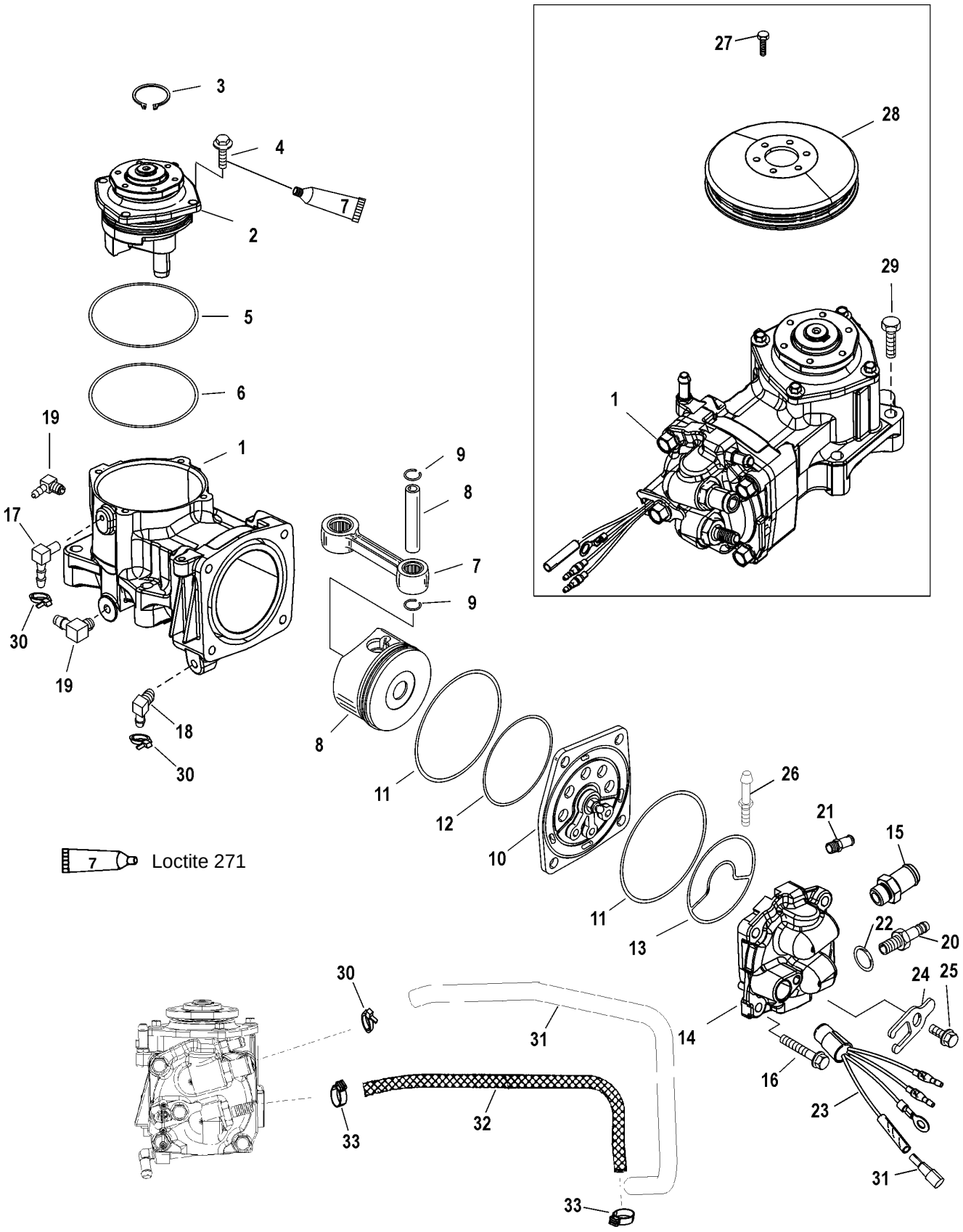
Fuel Rails

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
1	6	AIR INJECTOR KIT			
2	6	WASHER ASSEMBLY-Cupped			
3	1	FUEL RAIL **(PORT)**			
4	1	FUEL RAIL **(STARBOARD)**			
5	1	FITTING			
6	1	O-RING KIT			
7	4	CLAMP			
8	15	SCREW (M5 x 8)	70		8
9	2	CAP			
10	1	FUEL VALVE KIT			
11	1	O-RING KIT			
12	4	SCREW (M5 x 16)	70		8
13	1	COVER			
14	1	SPRING			
15	1	O-RING			
16	1	DIAPHRAGM			
17	1	FITTING			
18	2	CLAMP			
19	1	CLAMP			
20	1	AIR VALVE ASSEMBLY			
21	4	CLAMP			
22	1	O-RING KIT			
23	1	O-RING KIT			
24	1	AIR PLUG			
25	1	ELBOW			
26	6	FUEL INJECTOR			
27	1	SEAL			
28	1	HOSE ASSEMBLY-Air Balance			
29	1	HOSE ASSEMBLY-Fuel Balance			
30	1	HOSE ASSEMBLY-Fuel Supply			
31	1	HOSE ASSEMBLY-Air By Pass			
32	1	HOSE ASSEMBLY-Fuel By Pass			
33	2	CLAMP (18.3)			
34	4	STUD (M10 x 91)			
35	4	NUT (M10)			
36	1	SCREW (M5 x 35)			
37	1	CLAMP-Hose Support			
38	4	CLIP-Conduit Support			
39	1	CLAMP-Worm Gear			

Air Compressor Components



Air Compressor Components

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
1	1	AIR COMPRESSOR			
2	1	END CAP			
3	1	RING-Retaining			
4	4	SCREW (M6 X 20)	100		11.3
5	1	O RING			
6	1	O RING			
7	1	CONNECTING ROD			
8	1	PISTON ASSEMBLY			
9	2	LOCK RING			
10	1	REED PLATE ASSEMBLY			
11	2	O RING			
12	1	O RING			
13	1	SEAL			
14	1	COMPRESSOR HEAD KIT			
15	1	FITTING		25	33.9
16	4	SCREW (M8 x 35)	See Note		
17	1	ELBOW			
18	1	ELBOW			
19	2	CHECK VALVE			
20	1	FITTING		25	33.9
21	1	FITTING			
22	1	O RING			
23	1	TEMPERATURE SENSOR			
24	1	RETAINER			
25	1	SCREW (M8 x 14)	150		17
26	1	PIN	45		5.1
27	6	SCREW (M6 x 12)		14-15	19-20.3
28	1	PULLEY			
29	4	SCREW (M8 x 50)		20	27.1
30	4	CABLE TIE (8 IN.)			
31	1	HOSE			
32	1	HOSE ASSEMBLY			
33	2	CLAMP (15.3)			

NOTE: *Item #16 - Torque screws to 27.1 Nm (240 lb-in.), plus 90 degree turn*

DFI Operation

Air Induction Through Crankcase

Once inside the enclosure the air enters the plenum through the throttle shutter which is located in the plenum assembly. The air then continues through the reed valves and into the crankcase. The throttle shutter is actuated by the throttle shaft. Mounted on a separate shaft is a throttle position sensor (TPS). This sensor tells the engine control unit (ECM) the position of the throttle.

If the TPS should fail, the warning horn will sound. Engine speed will be reduced.

Air Compressor System

Air from inside the engine enclosure is drawn into the compressor through the air attenuator. This attenuator acts like a muffler to quiet compressor noise and contains a filter to prevent the ingestion of debris into the compressor. The compressor is driven by a belt from a pulley mounted on the flywheel and is automatically self adjusted using a single idler pulley. This air compressor is a single cylinder unit containing a connecting rod, piston, rings, bearings, reed valves, and a crankshaft. The compressor is water cooled to lower the temperature of the air charge and is lubricated by oil from the engine oil pump assembly. As the compressor piston moves downward inside the cylinder, air is pulled through the filter, reed valves and into the cylinder. After the compressor piston changes direction, the intake reeds close and the exhaust reeds open allowing compressed air into the hose leading to the air/fuel rails.

The air/fuel rails contain two passages; one for fuel, the second is the air passage. The air passage is common between all the cylinders included in the rail. A hose connects the starboard rail air passage to the air compressor. Another hose connects the starboard air rail passage to the port air rail passage. An air pressure regulator will limit the amount of pressure developed inside the air passages to approximately 10 psi below the pressure of the fuel inside the fuel passages (i.e. 80 psi air vs 90 psi fuel). Air exiting the pressure regulator is discharged through the adaptor plate.

Fuel

Fuel for the engine is stored in a typical fuel tank. A fuel lift pump draws fuel through the fuel line and fuel filter, then pushes the fuel through a water separating fuel filter. This filter removes any contaminates and water before the fuel reaches the vapor separator. Fuel vapors are vented through a hose to the fuel tank. The electric fuel pump in the VST is different than the fuel pump that is utilized on the standard EFI engine (non DFI), and is capable of developing fuel pressures in excess of 90 psi. Fuel inside the rail must remain pressurized at exactly 10 psi over the air rail pressure or the ECM (map) calibrations will be incorrect. Fuel from the vapor separator is supplied to the top of the port fuel rail. A fuel line connects the bottom of the first rail to the opposite fuel rail. Fuel is stored inside the rail until an injector opens. A fuel pressure regulator controls pressure in the fuel rails, and allows excess fuel to return into the vapor separator. The fuel regulator not only regulates fuel pressure but also regulates it at approximately 10 p.s.i. higher than whatever the air rail pressure is. The fuel regulator diaphragm is held closed with a spring that requires 10 p.s.i. to force the diaphragm off the diaphragm seat. The back side of the diaphragm is exposed to air rail pressure. As the air rail pressure increases, the fuel pressure needed to open the regulator will equally increase. Example: If there is 50 p.s.i. of air pressure on the air rail side of the diaphragm, 60 p.s.i. of fuel pressure will be required to open the regulator. The port fuel rail is water cooled.

To equalize the pulses developed by the pumps (both air and fuel) a tracker diaphragm is installed in the starboard rail. The tracker diaphragm is positioned between the fuel and air passages. The tracker diaphragm is a rubber diaphragm which expands and retracts depending upon which side of the diaphragm senses the pressure increase (pulse).

Oil

Oil in this engine is not mixed with the fuel before entering the combustion chamber. Oil is stored inside a standard remote oil reservoir. Crankcase pressure will force oil from the remote oil tank into the oil reservoir on the side of the powerhead. Oil will flow from the oil reservoir into the oil pump. The oil pump is a solenoid design. It is activated by the ECM and includes 7 pistons with corresponding discharge ports. The oil pump is mounted directly onto the powerhead. Each cylinder is lubricated by one of the discharge ports. The oil is discharged into the crankcase. Bleed hoses carry excess oil from the crankcase to the transfer ports. The seventh passage connects to the hose that leads to the air compressor for lubrication. Excess oil from the compressor provides lubrication for the upper and lower crank bearing.

The ECM will change the discharge rate of the oil pump, depending upon engine demand. The ECM will also pulse the pump on initial start up to fill the oil passages eliminating the need to bleed the oil system. The ECM provides additional oil for break in, as determined by its internal clock. The oil ratio varies with engine rpm and load.

Electrical

The electrical system consists of the ECM, crank position sensor (flywheel speed & crankshaft position), throttle position sensor (TPS), MAP sensor, engine temperature sensor, ignition coils and injectors (fuel & direct). The engine requires a battery to start (i.e. the ignition and injection will not occur if the battery is dead). The system will run off of the alternator.

Operation

The operation of the system happens in milliseconds (ms); exact timing is critical for engine performance. As the crankshaft rotates, air is drawn into the crankcase through the throttle shutter, into the plenum and through the reed valves. As the piston nears bottom-dead-center, air from the crankcase is forced through the transfer system into the cylinder. As the crankshaft continues to rotate the exhaust and intake ports close. With these ports closed, fuel can be injected into the cylinder. The ECM will receive a signal from the throttle position sensor (TPS), engine temperature sensor (TS) and the crank position sensor (flywheel speed and position sensor). With this information the ECM refers to the fuel calibration (maps) to determine when to activate (open and close) the injectors and fire the ignition coils. With the piston in the correct position, the ECM opens the fuel injector, 90 psi fuel is discharged into a machined cavity inside the air chamber of the air/fuel rail. This mixes the fuel with the air charge. Next the direct injector will open, discharging the air/fuel mixture into the combustion chamber. The direct injector directs the mixture at the bowl located in top of the piston. The piston's bowl directs the air/fuel mixture into the center of the combustion chamber. This air fuel mixture is then ignited by the spark plug.

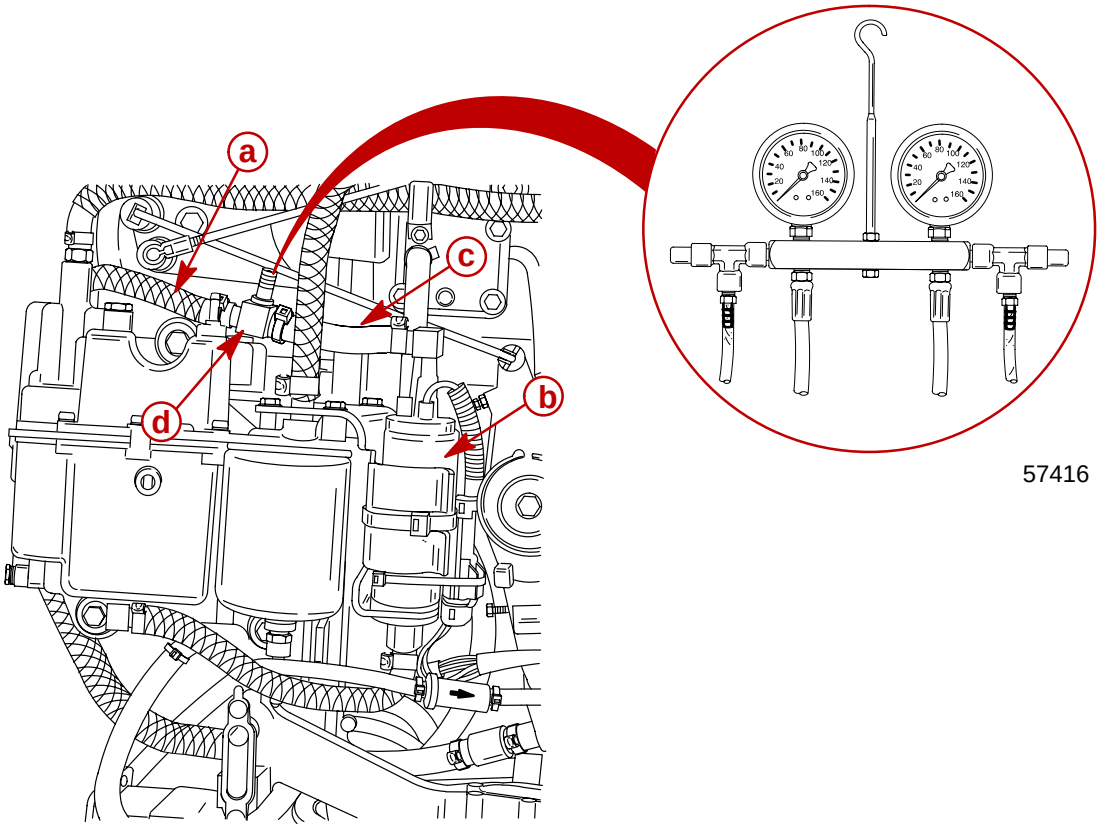
Compressor Notes: To aid in starting when the air rail pressure is low and before the compressor has time to build pressure, some direct injectors are held open by the ECM. This allows the compression from inside the cylinders to pressurize the air rail faster (1 or 2 strokes, or 60° of crankshaft rotation).

Testing Electric Fuel Pump Pressure Output

Low Pressure Electric Fuel Pump

IMPORTANT: After completing fuel pressure tests, reconnect and secure fuel outlet hose to fuel pump with full circle stainless clamps in Clamp Tool Kit 91-803146A1.

1. Remove outlet fuel hose from low pressure pump. Install a short piece of hose (obtain locally) onto pump outlet fitting. Install Schrader Valve t-fitting (22-849606) between outlet fuel hose (removed from pump) and new fuel hose (installed on pump). Secure hose connections with sta-straps. Due to the low pressure output of this pump, it is recommended that the air gauge of the Dual Fuel/Air Pressure Gauge (91-852087A1/A2/A3) be connected to the Schrader Valve. Gauge should indicate 6-9 psi (41.37 - 62.04 kPa).



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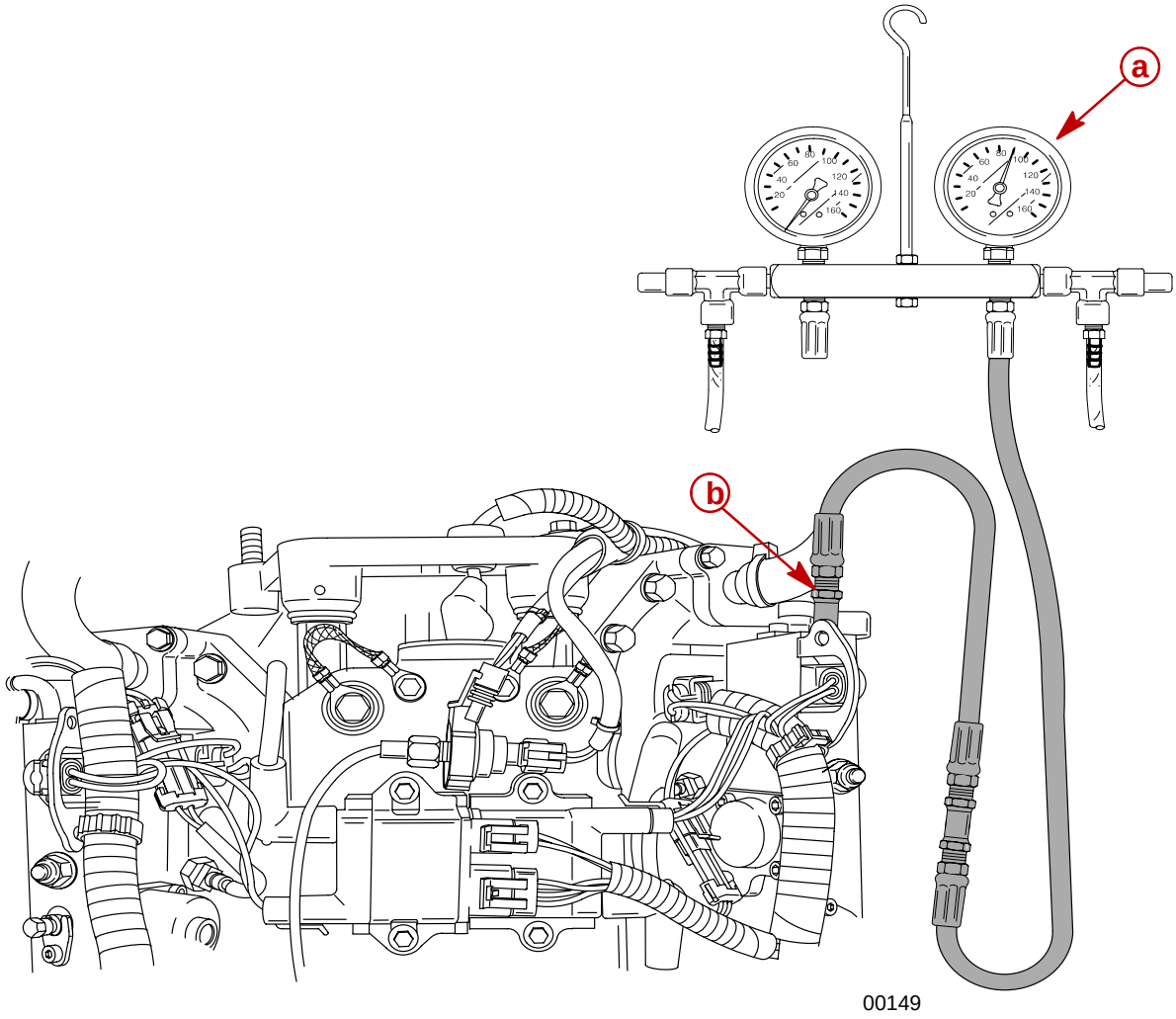
a - Outlet Fuel Hose
b - Low Pressure Electric Fuel Pump
c - Fuel Hose (obtain locally)
d - Schrader Valve (22-849606)

High Pressure Electric Fuel Pump

1. Install Pressure Gauge Assembly (91-852087A1/A2/A3) to starboard fuel rail pressure test valve.

NOTE: *If low air or low fuel pressure is indicated, swap hoses between air and fuel test ports. If low reading moves, gauge accuracy should be checked.*

NOTE: *After 15 seconds of cranking engine with starter motor, fuel pressure gauge should indicate 90 ± 2 psi (620.5 ± 13.8 kPa).*



a - Fuel Pressure Gauge [Should Indicate 90 ± 2 psi (620.5 ± 13.8 kPa)]
b - Fuel Pressure Test Valve

Fuel Management Assembly Removal

⚠ CAUTION

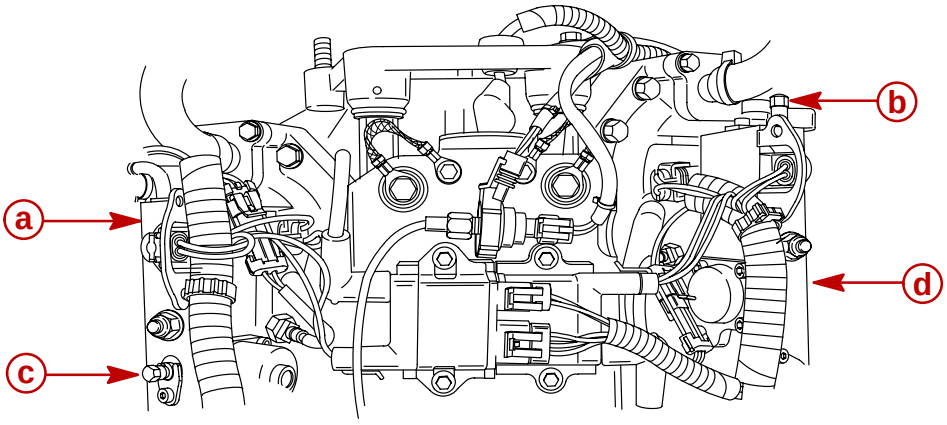
Fuel system must be bled off prior to removal of fuel system components.

⚠ WARNING

Drain fuel from vapor separator tank (VST) into a suitable container. Even though VST has been drained, fuel may still remain in fuel rails and hoses. Normal precautionary procedures should be adhered to while working with the fuel system. Avoid sparks, smoking and open flame while in the presence of liquid fuel or fuel vapors.

NOTE: *Use Fuel/Air Pressure Gauge 91-16850--1 or 91-852087A1/A2/A3 to de-pressurize air hose first and then fuel hose.*

1. Remove flywheel cover.
2. Remove air attenuator mounting screw and air attenuator.
3. De-pressurize fuel system.



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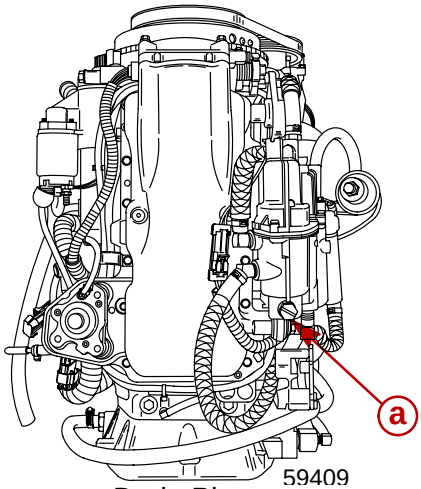
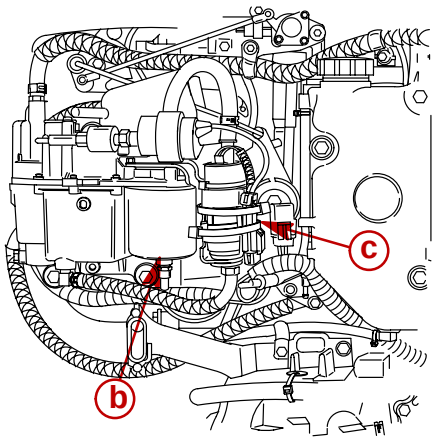
a - Port fuel rail
b - Air pressure test valve
c - Fuel pressure test valve
d - Starboard fuel rail

4. Place suitable container underneath vapor separator drain plug and remove plug.
5. Disconnect water separator sensor lead.
6. Disconnect electric fuel pump harness connectors.



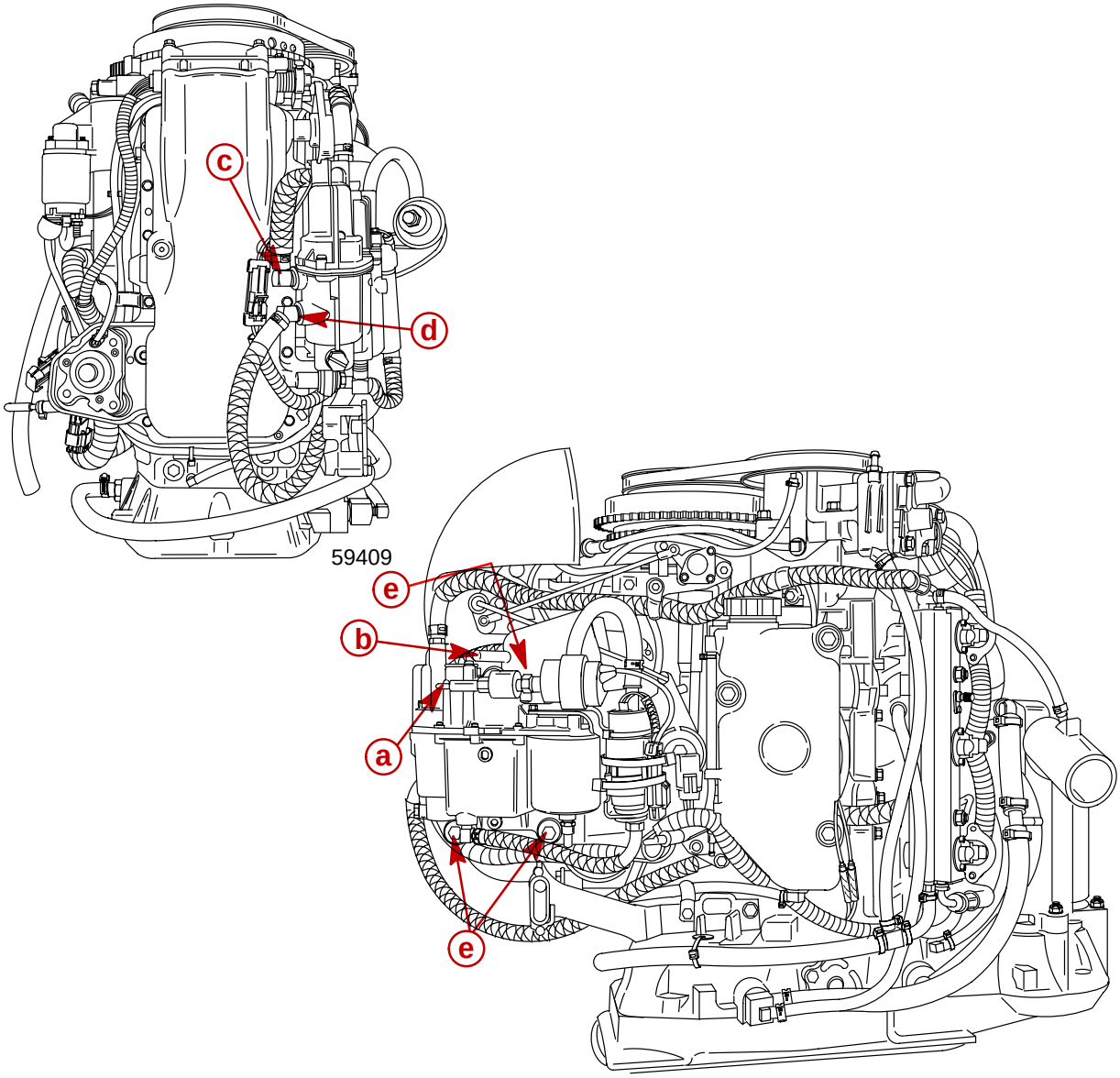
59409



a - Drain Plug
b - Sensor Lead
c - Harness Connectors

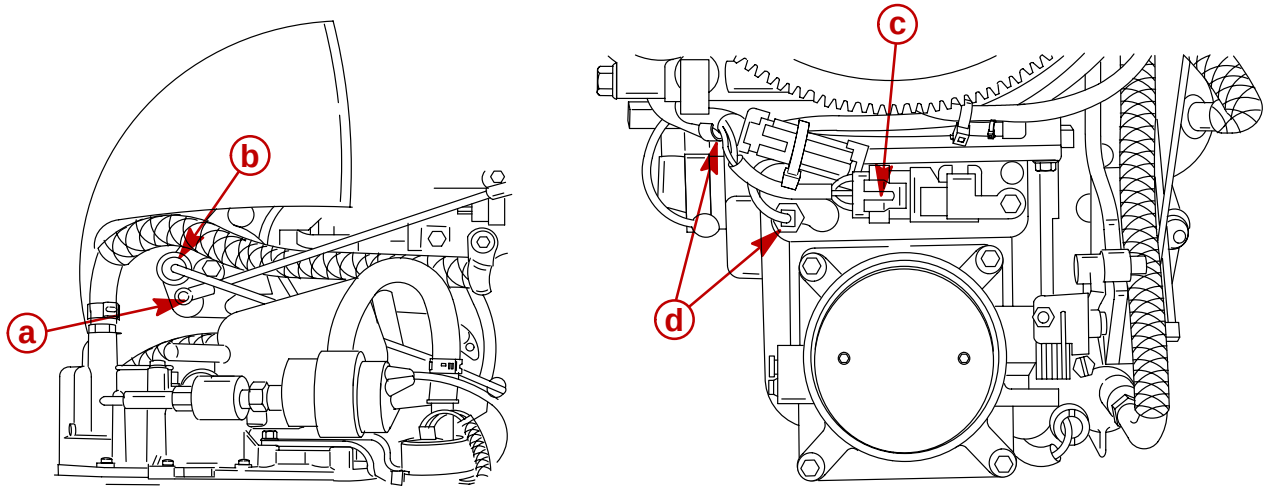
NOTE: *Lower fuel hose is excess fuel return from fuel rails. Upper fuel hose is fuel inlet from electric circulating pump beside fuel/water separator.*

7. Remove vapor separator vent hose.
8. Remove the fuel outlet hose and fuel return hose from fuel rails.
9. Remove vapor separator ground lead.
10. Remove 3 mounting bolts and remove separator.



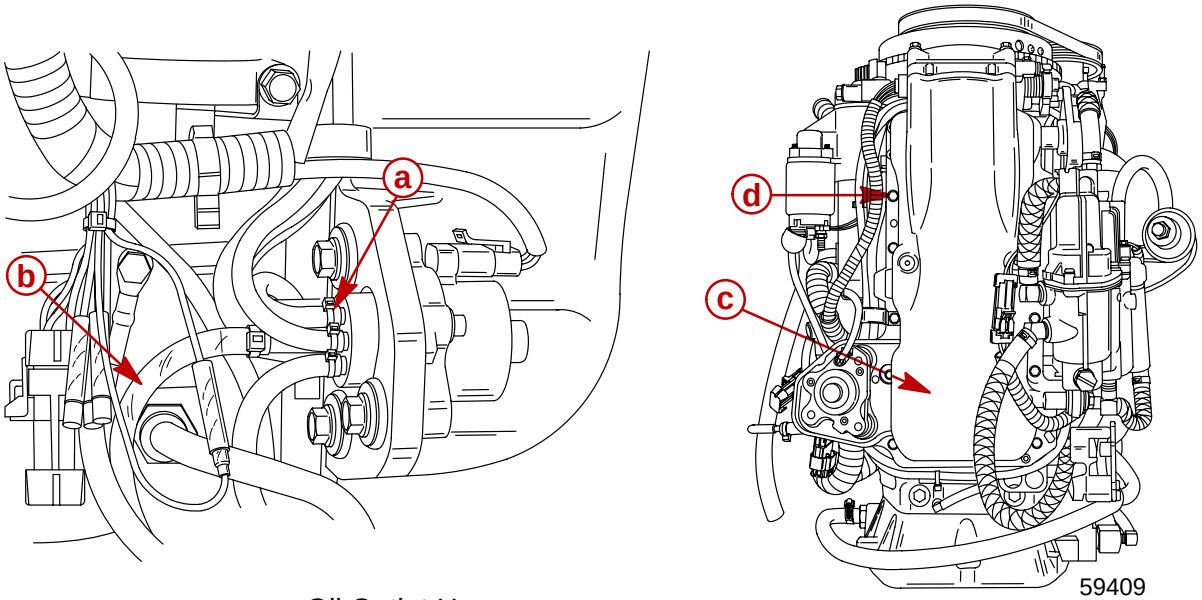
a - Fuel Inlet Hose to Fuel Lift Pump
b - Vapor Separator Vent Hose
c - Fuel Hose Low Pressure Pump to High Pressure Pump
d - Fuel Rail Return Hose
e - Mounting Bolts (3)

11. Disconnect throttle cam link rod and the Throttle Position Sensor link rod.
12. Disconnect MAP sensor and temperature sensor from air management assembly.



a - Throttle Cam Link Rod
b - Throttle Position Sensor Link Rod
c - MAP Sensor
d - Temperature Sensor

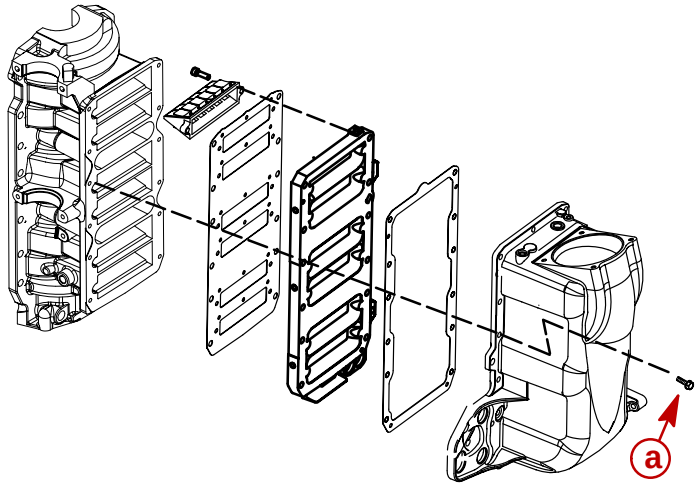
13. Disconnect oil outlet hoses from oil pump.
14. Remove and plug oil inlet hose to oil pump.
15. Remove 12 bolts securing air management assembly to crankcase and remove assembly.



a - Oil Outlet Hoses
b - Oil Inlet Hose
c - Air Plenum
d - Bolts (12 each)

Reed Block Assembly Removal

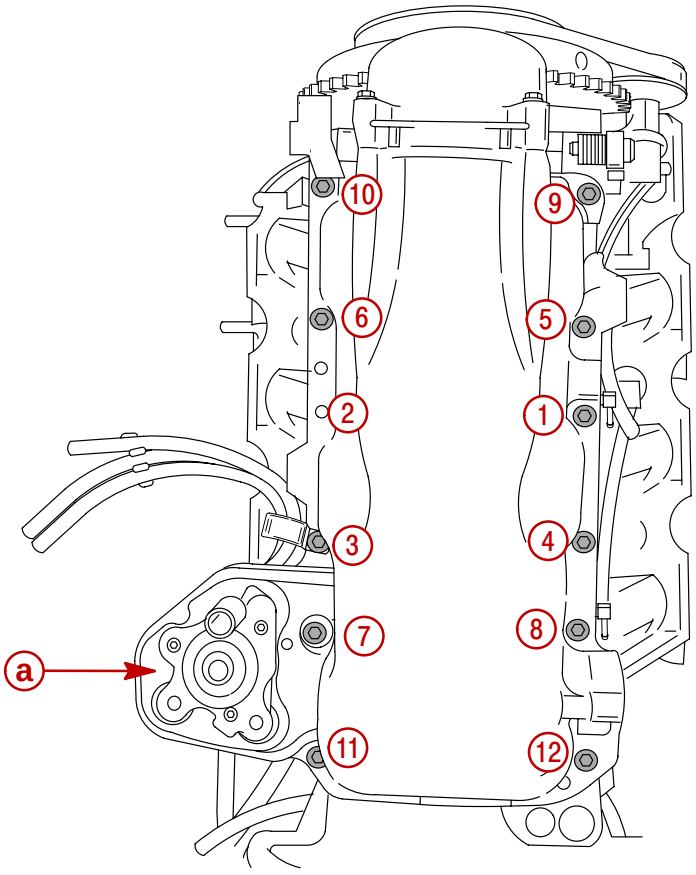
1. Remove 12 screws securing air plenum to crankcase cover.



a - Screws (12 each) M6x40

Reed Block Assembly Installation

1. Secure oil pump to air plenum with 3 bolts. Torque bolts to 140 lb. in. (16 Nm).
2. Secure air plenum/reed block assembly to crankcase cover with 12 screws. Torque screws in appropriate torque sequence to 120 lb.in. (13.5 Nm).

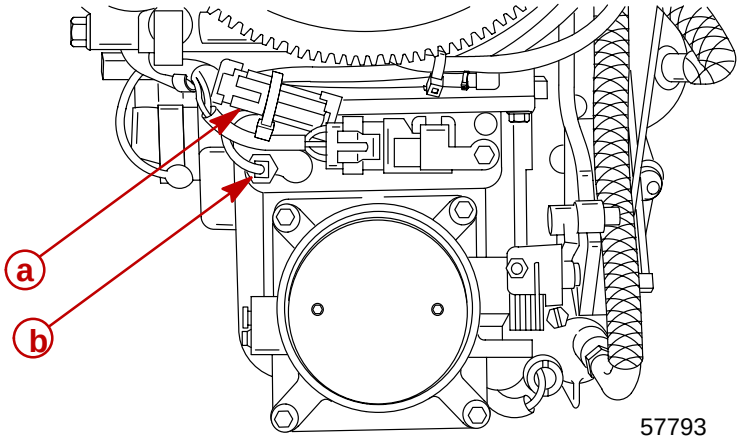


57997

a - Oil Pump

Air Temperature Sensor Removal

Disconnect sensor harness and unscrew sensor.



57793

a - Air Temperature Sensor Harness Connector
b - Air Temperature Sensor

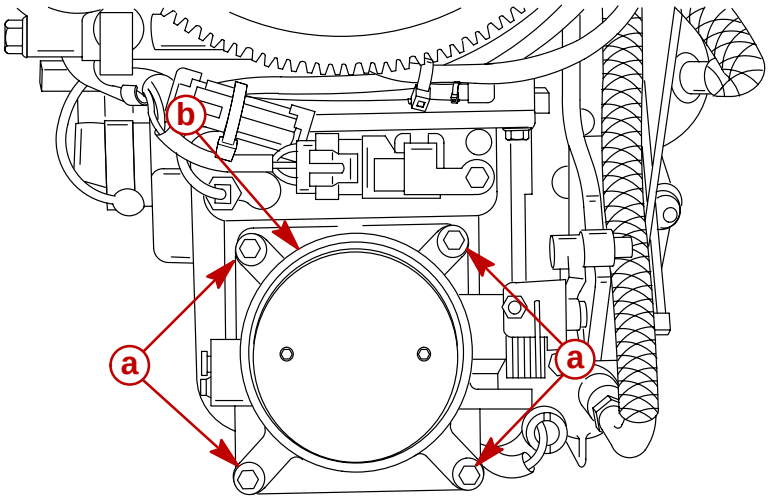
Air Temperature Sensor Installation

Screw sensor into air plenum. Reconnect sensor harness.

Throttle Plate Assembly Removal

NOTE: *The throttle plate assembly is calibrated and preset for proper running characteristics and emissions at the factory. Other than complete assembly removal from the air plenum, no further disassembly should be made.*

Remove 4 bolts securing throttle plate assembly to air plenum and remove assembly.



57793

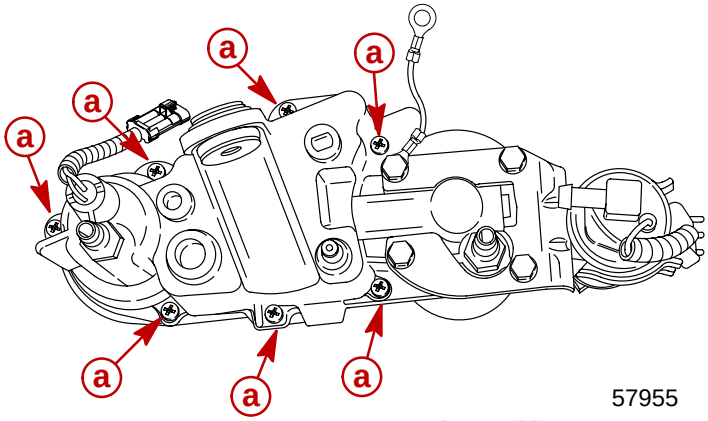
a - Bolts
b - Throttle Plate Assembly

Throttle Plate Assembly Installation

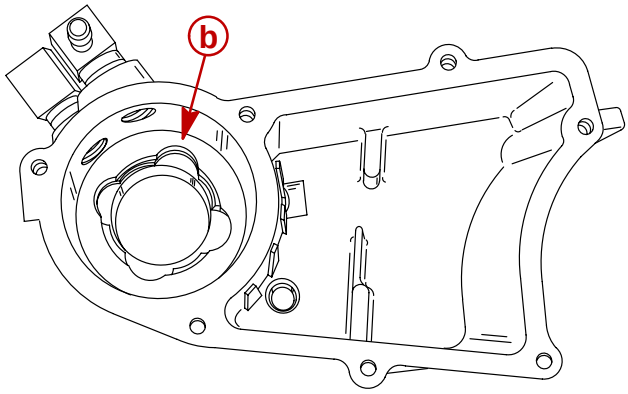
Secure throttle plate assembly to air plenum with 4 bolts. Torque bolts to 65 lb. in. (7.3 Nm).

Vapor Separator Disassembly

1. Remove 7 screws securing separator cover and remove cover.
2. Inspect seal in fuel pump chamber of separator tank for cuts and abraisions. Replace seal if necessary. If seal is serviceable, apply 2-4-C with Teflon to seal lips.



57955



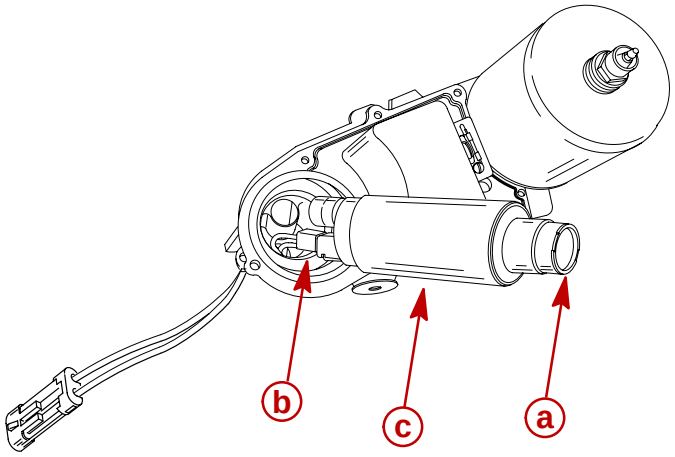
57342

a - Screws (7 each)
b - Seal

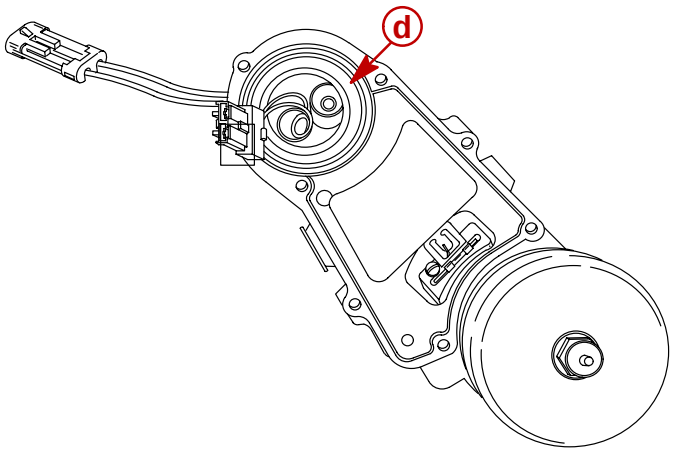
3. Fuel pump may be removed from cover by wiggling slightly while pulling outward.

IMPORTANT: DO NOT twist pump during removal as wire harness may be damaged.

4. Disconnect harness from pump to separate pump from cover. Inspect filter screen for debris. Screen may be pried out of pump and cleaned as required.
5. Inspect seal above fuel pump for cuts or abraisions. Replace seal if necessary. Apply 2-4-C with Teflon to seal lips.



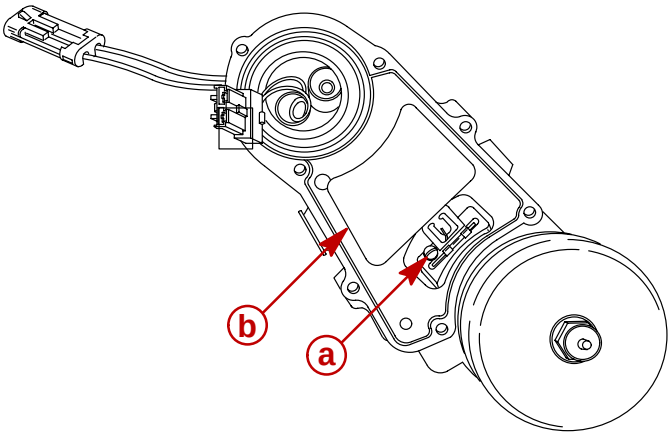
56057



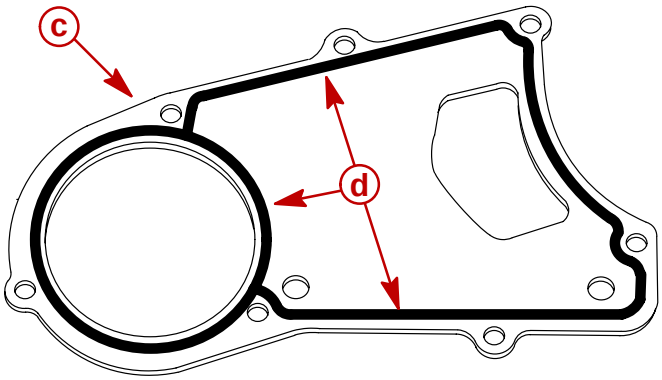
56058

a - Filter Screen
b - Harness Connector
c - Pump
d - Seal (Seal shoulder faces OUT)

6. Loosen screw securing float assembly and remove float. Inspect float for deterioration or fuel retention. Replace float as required.
7. Remove phenolic sealing plate and inspect imbedded neoprene seal on both sides of plate for cuts or abraisions. Replace plate/seal assembly as required.



56058

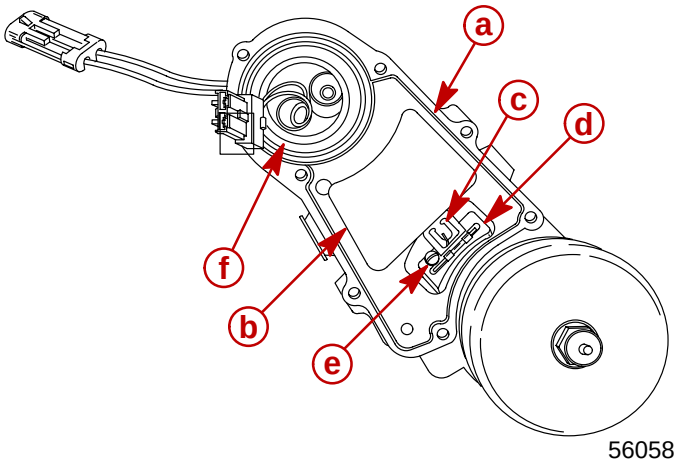


56059

a - Screw
b - Float
c - Plate
d - Seal

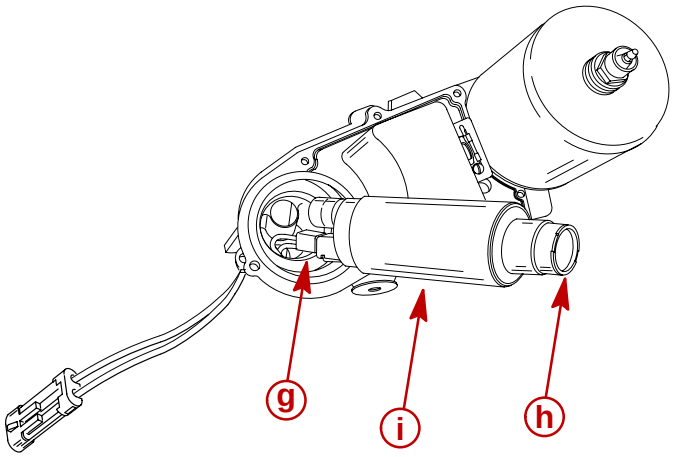
Vapor Separator Reassembly

1. Reinstall phenolic sealing plate onto vapor separator cover.
2. Secure float, needle and pivot pin assembly to separator cover with screw. Torque screw to 10 lb. in. (1.0 Nm).
3. Apply 2-4-C with Teflon to lips of seal in separator cover.
4. Connect electrical harness to fuel pump. Inspect fuel pump filter screen for debris. Remove screen and clean as required.
5. Seat fuel pump and harness into separator cover being careful not to pinch harness.



56058

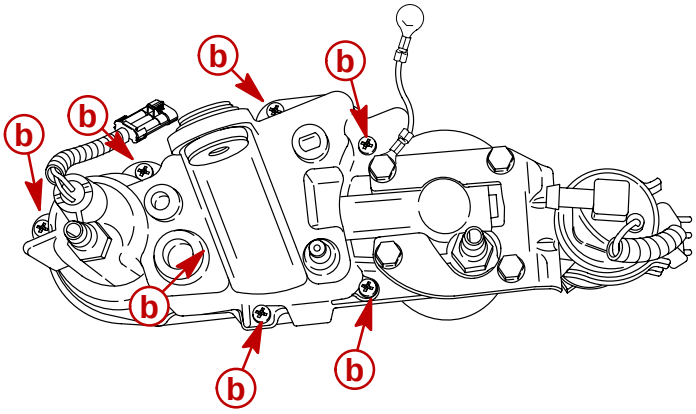
a - Sealing Plate
b - Float
c - Needle
d - Pivot Pin
e - Screw [Torque to 10 lb. in. (1.0 N·m)

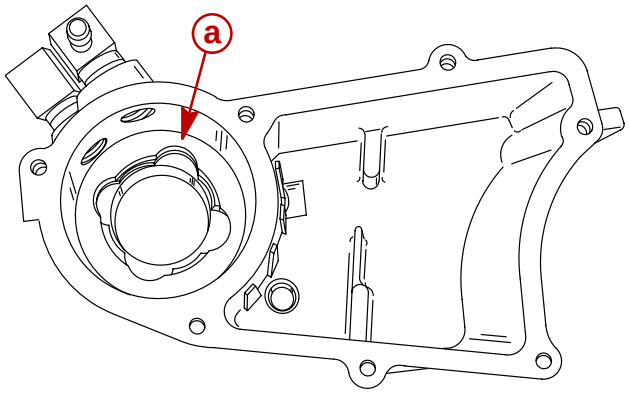


56057

f - Seal (Seal shoulder faces OUT)
g - Harness
h - Filter
i - Fuel Pump

6. Apply 2-4-C with Teflon to lips of seal in separator tank.
7. Install separator cover with pump onto separator tank.
8. Secure cover to tank with 7 screws. Torque screws to 30 lb. in. (3.5 Nm).



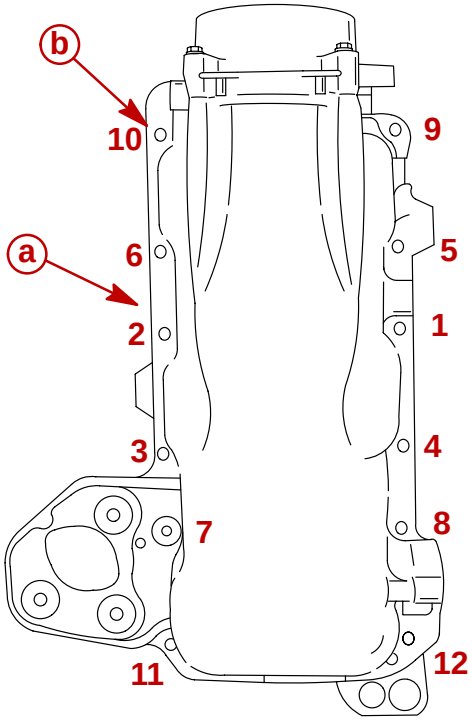


57342

a - Seal
b - Screws [Torque to 30 lb. in. (3.5 Nm)]

Air Plenum Installation

Secure plenum to crankcase with 12 bolts. Torque bolts to 100 lb. in. (11.5 Nm). in sequence shown.



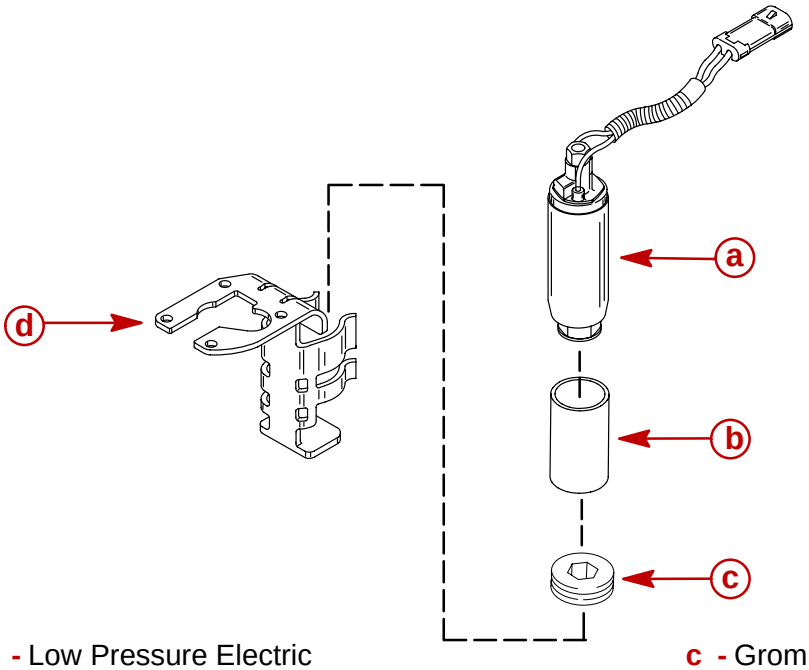
57915

a - Air Plenum
b - Bolts [Torque to 100 lb. in. (11.5 Nm)]

Low Pressure Electric Fuel Pump Installation

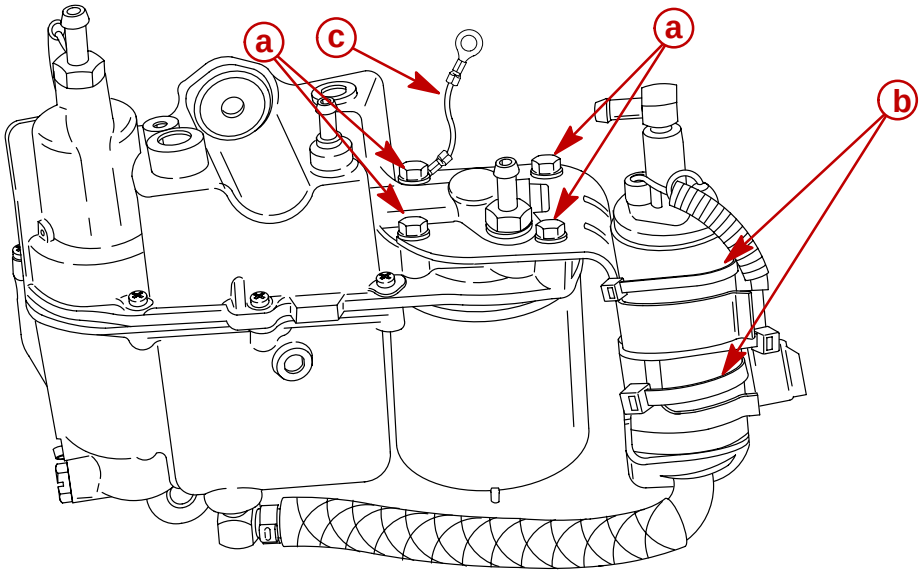
NOTE: *If pump does not have a sleeve or grommet, refer to Service Bulletin 98-8.*

1. Seat electric fuel pump with sleeve against grommet in pump bracket. Secure pump to bracket with sta-strap.



a - Low Pressure Electric Fuel Pump
b - Sleeve
c - Grommet
d - Bracket

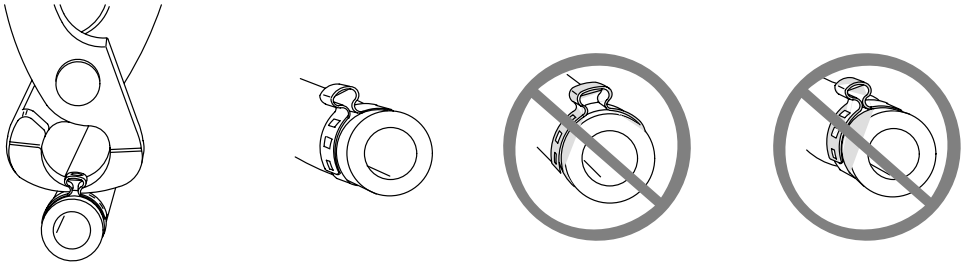
2. Secure bracket assembly to vapor separator with 2 screws. Torque screws to 100 lb. in. (11.5 Nm).



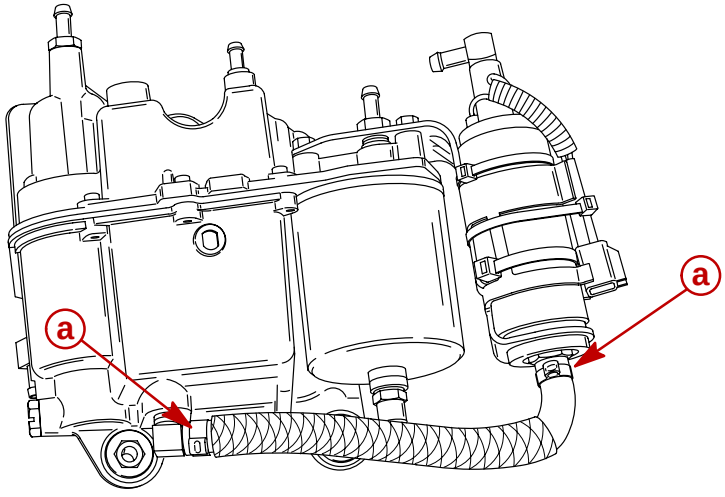
57964

a - Screws – Torque to 100 lb. in. (11.5 Nm)
b - Sta-strap securing pump to bracket
c - Ground lead – attach to air plenum

IMPORTANT: Only use tool 91-803146T (or Snap-On equivalent YA3080) to crimp full circle clamps. Using a different tool could result in a crimp that is too loose, or too tight. Do not use screw type metal hose clamp as it may damage hose.



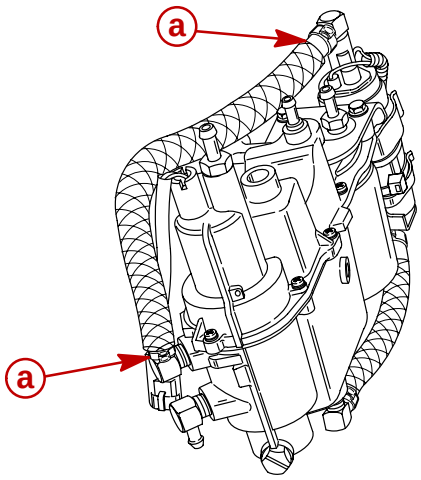
3. Connect fuel hose from bottom of low pressure fuel pump to 90° elbow in bottom of vapor separator. Secure hose with 18.3 mm full circle clamp (54-880141) using crimping tool 91-803146T.



57965

a - Secure Fuel Hose with 18.3 mm Full Circle Clamp (54-880141)

4. Connect fuel hose from top of low pressure fuel pump to 90° elbow on back side of vapor separator. Secure hose with 18.3 mm full circle clamp (54-880141) using crimping tool 91-803146T.

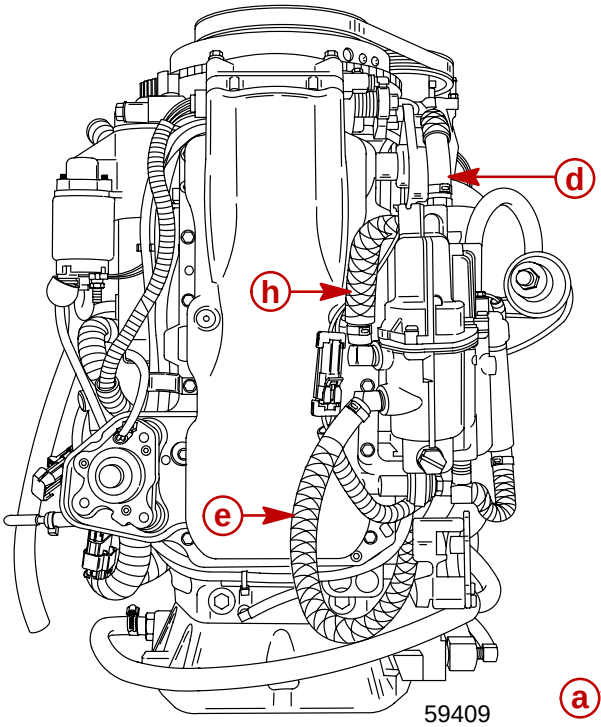


57966

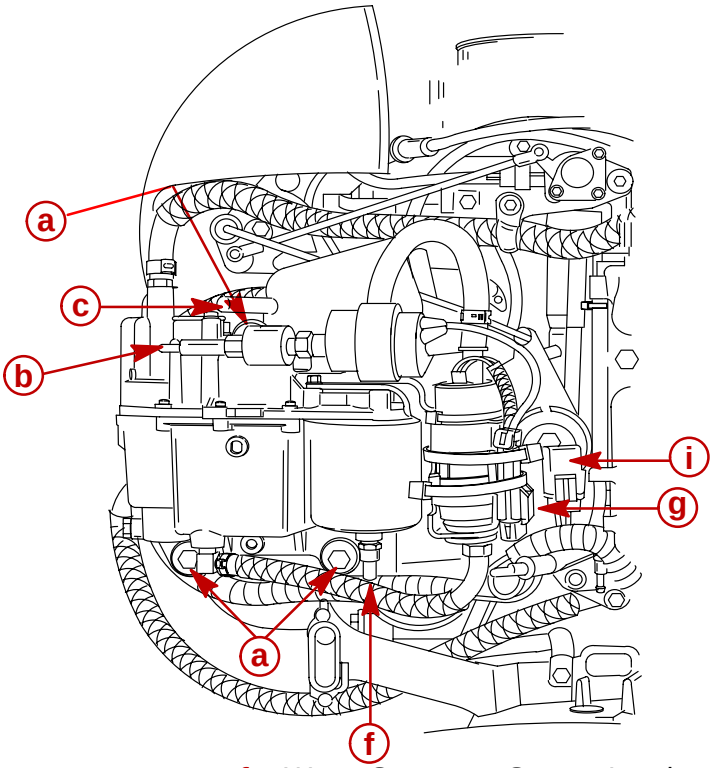
a - Secure Fuel Hose with 18.3 mm Full Circle Clamp (54-880141)

Vapor Separator Installation

1. Secure vapor separator to air plenum with 3 bolts. Torque bolts to 140 lb. in. (16.0 Nm).
2. Connect fuel inlet hose to fuel lift pump.
3. Connect vent hose to vapor separator.
4. Connect fuel outlet hose and fuel return hose to vapor separator.
5. Connect water separator sensor lead to water separator.
6. Connect electric fuel pump harnesses.

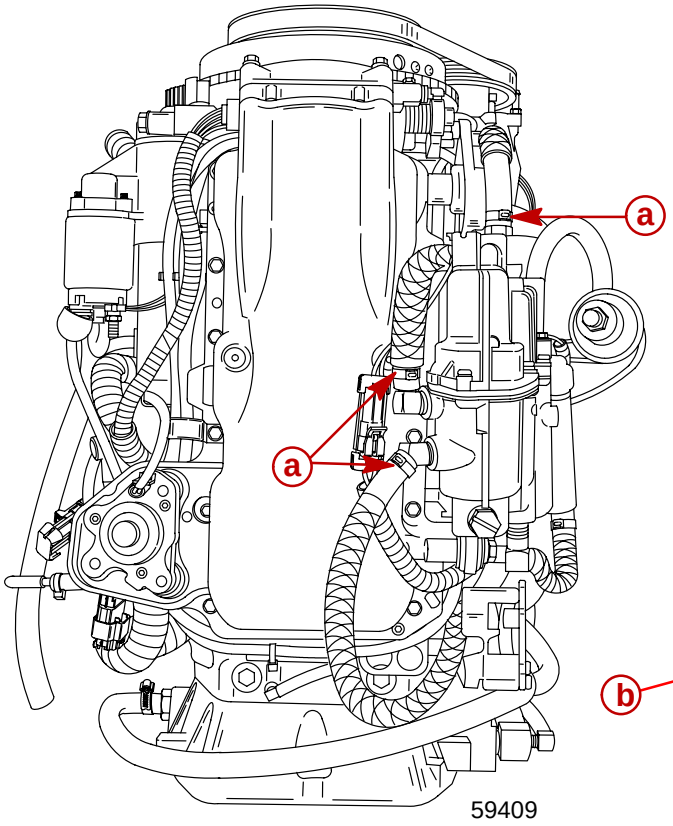


59409



a - Mounting Bolts [Torque to 140 lb. in. (16.0 Nm)
b - Fuel Inlet Hose
c - Vent Hose
d - Fuel Outlet Hose (90 psi)
e - Fuel Return Hose from rail
f - Water Separator Sensor Lead
g - Electrical Harness
h - Fuel Outlet from Low Pressure Pump
i - 5 AMP. Fuse Electric Fuel Pump

7. If fuel hoses were removed, secure hoses with proper full circle clamp using tool 91-803146T (or Snap-On equivalent YA3080) to crimp clamps. Use stainless screw clamp on vapor separator vent hose and inlet fuel hose to fuel lift pump.



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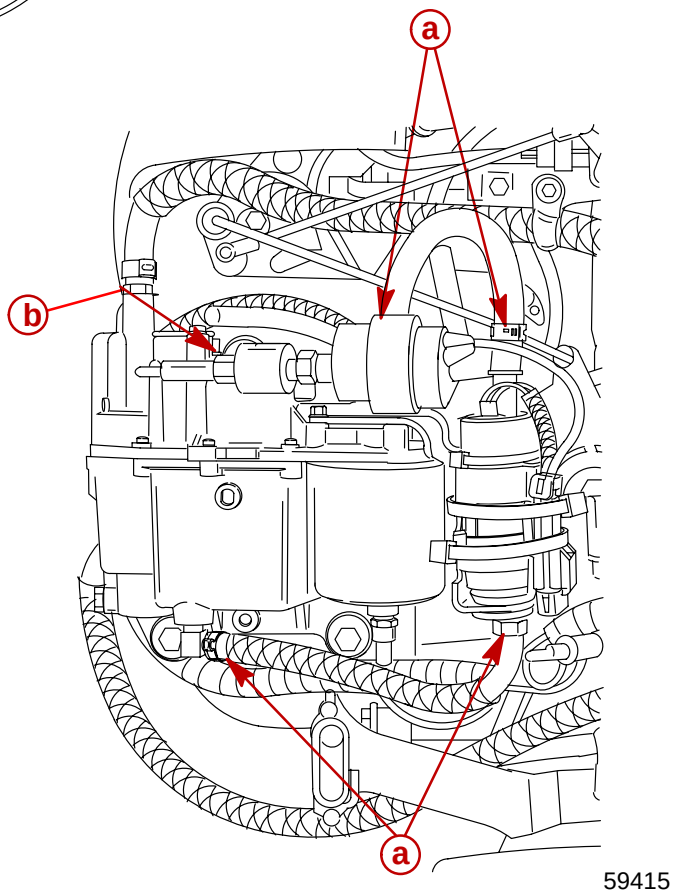


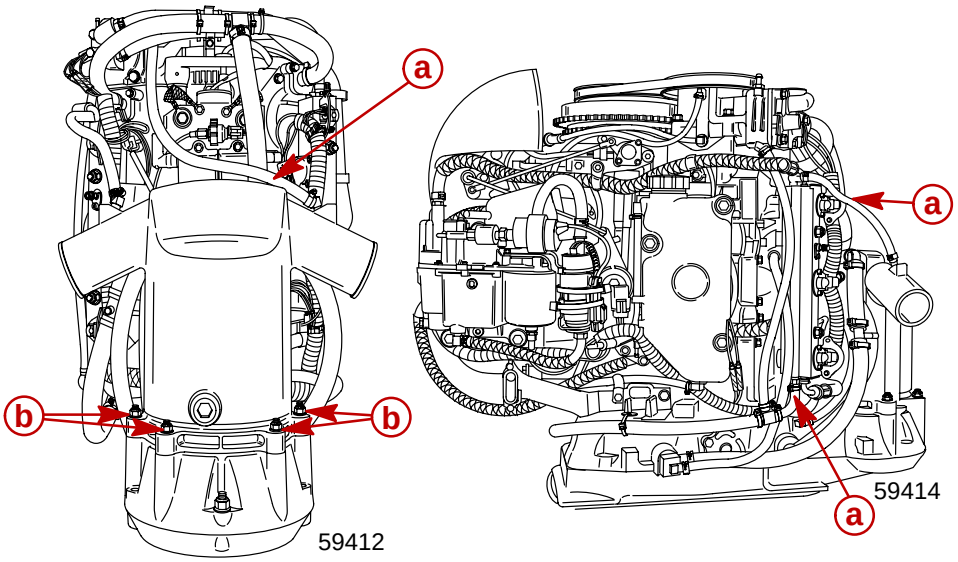
59415

a - Full Circle Clamp
b - Stainless Screw Clamp

Fuel Rail Removal

NOTE: *To provide improved access to the fuel rails, it is recommended that the expansion chamber be removed as follows:*

1. Remove coolant hose between air compressor and expansion chamber, and rail and expansion chamber.
2. Remove 6 nuts securing expansion chamber and lay chamber off to one side.



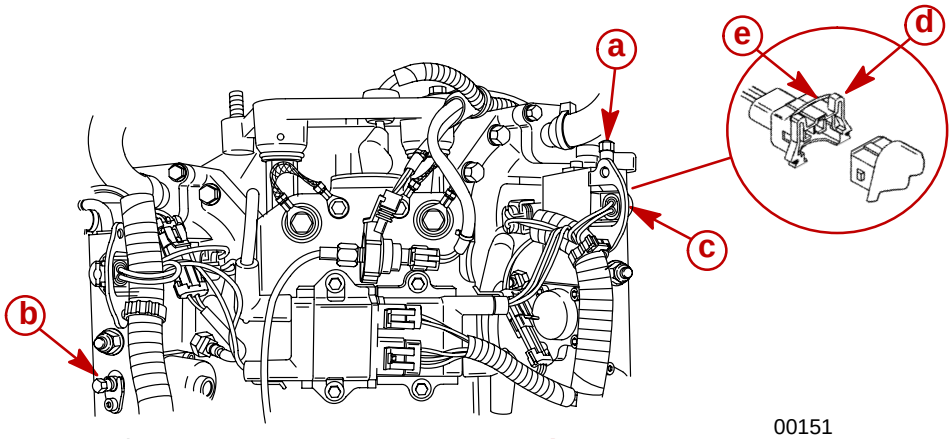
a - Coolant Hose
b - Nuts (6)

⚠ CAUTION

Fuel system must be bled off prior to removal of fuel system components.

NOTE: *Use Fuel/Air Pressure Gauge 91-16850--1 or 91-852087A1/A2 to de-pressurize air hose first and then fuel hose.*

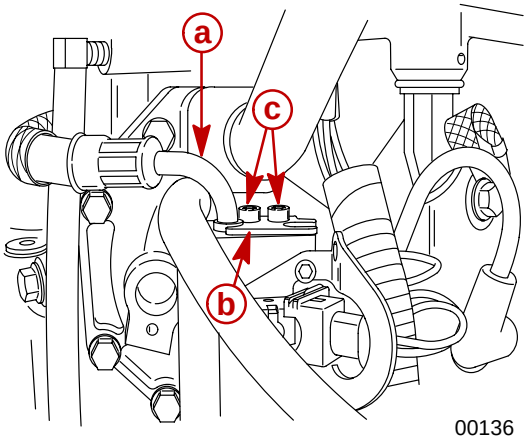
1. De-pressurize fuel system.
2. Remove fuel injector harness from each injector by compressing spring clip with flat tip screw driver while pulling on connector.



a - Fuel Pressure Port
b - Air Pressure Port
c - Fuel Injector
d - Harness Connector
e - Spring Clip

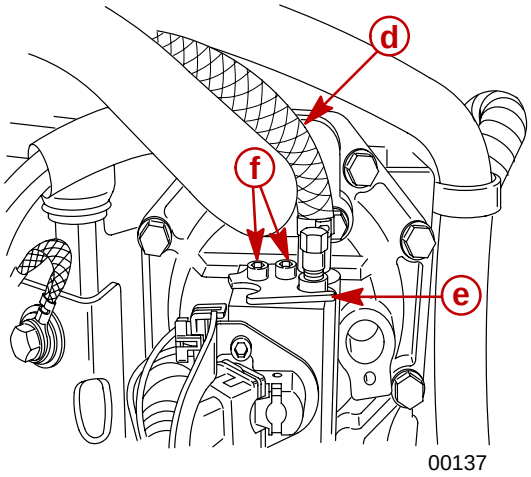
NOTE: *Always remove fuel/air hose and fitting together by removing fitting retainer rather cutting clamps.*

3. Remove fuel, water and air hoses from fuel rail.



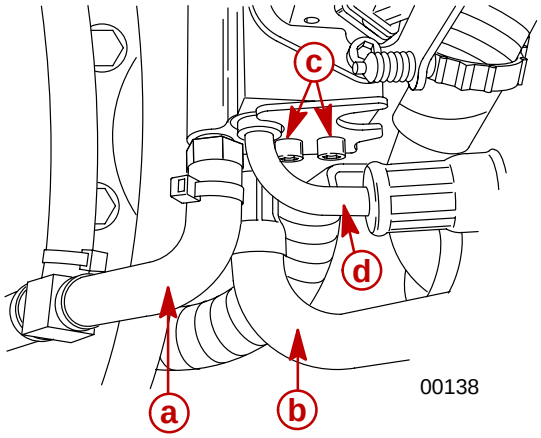
Port Top Fuel Rail Connections

- **a** - Water Inlet Hose to Compressor
- **b** - Retainer
- **c** - Allen Screws (remove)



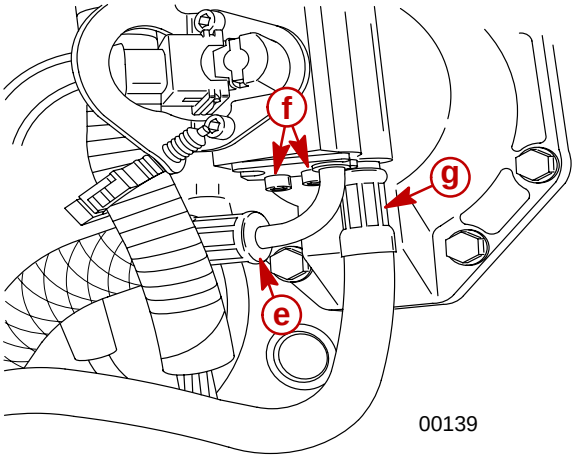
Starboard Top Fuel Rail Connections

- **d** - Air Hose
- **e** - Retainer
- **f** - Allen Screws (remove)



Port Bottom Fuel Rail Connections

- **a** - Water Inlet Hose to Fuel Rail
- **b** - Air Hose
- **c** - Allen Screws (remove)
- **d** - Fuel Hose



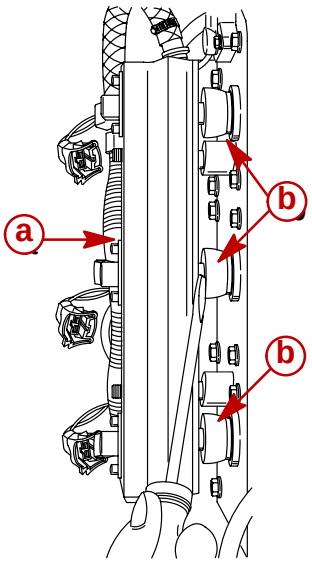
Starboard Bottom Fuel Rail Connections

- **e** - Air Hose
- **f** - Allen Screws
- **g** - Fuel Hose

NOTE: *It is recommended that direct injectors remain in the cylinder head (if they are not to be replaced) while removing the fuel rail. The direct injectors have a teflon seal which may expand if the injector is removed from the head. This expansion may cause reinstallation difficulty or require the replacement of the seal.*

4. Remove 2 nuts securing fuel rail.

5. As fuel rail is removed, use a flat tip screw driver to hold direct injectors in cylinder head.



56121

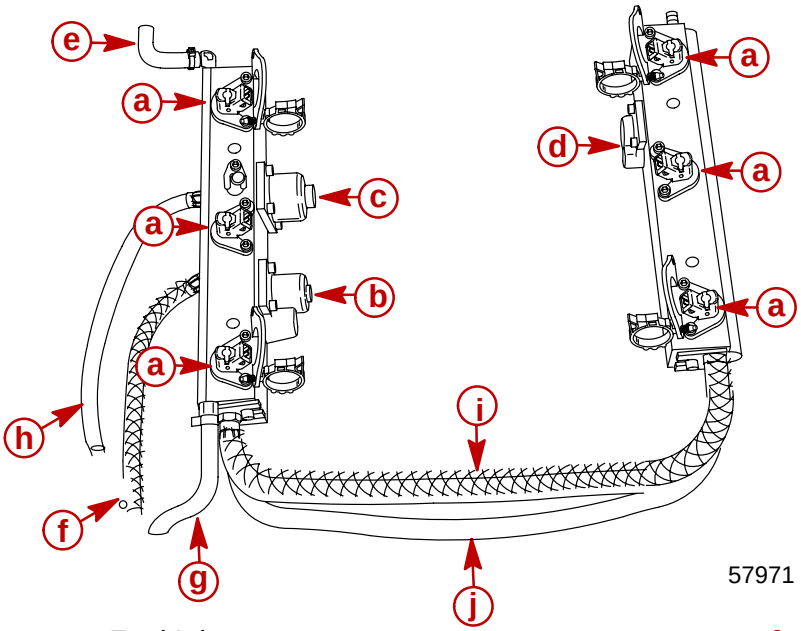
a - Fuel Rail

b - Direct Injectors

The starboard fuel rail contains 3 fuel injectors and a tracker valve.

The port fuel rail contains 3 fuel injectors, 1 fuel regulator, and 1 air regulator.

NOTE: *Each fuel/air inlet or outlet hose adaptor has 2 o-ring seals. These o-rings should be inspected for cuts or abraisions and replaced as required when fuel rail is disassembled for cleaning.*



57971

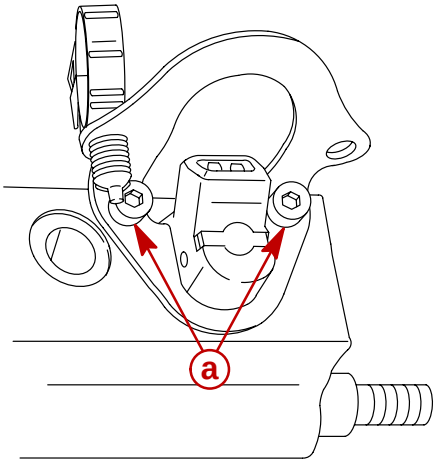
a - Fuel Injector
b - Fuel Regulator
c - Air Regulator
d - Tracker Valve
e - Coolant Inlet to Expansion Chamber
f - Return Fuel to VST
g - Water Inlet for Cooling Fuel Rail
h - Excess Air to Adaptor Plate
i - 90 psi (616 kPa) Fuel
j - 80 psi (547.8 kPa) Air

FUEL INJECTOR REMOVAL

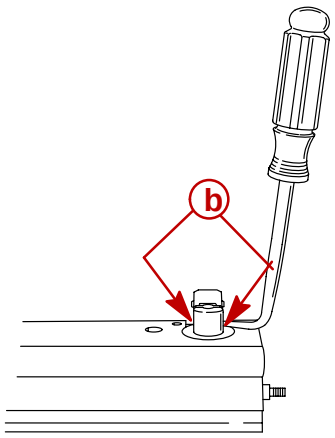
1. Remove 2 screws securing injector.

NOTE: *Use a cotter pin extractor tool in pry holes to remove injectors.*

2. Gently pry up on injector to loosen o-ring adhesion and remove injector.



57970

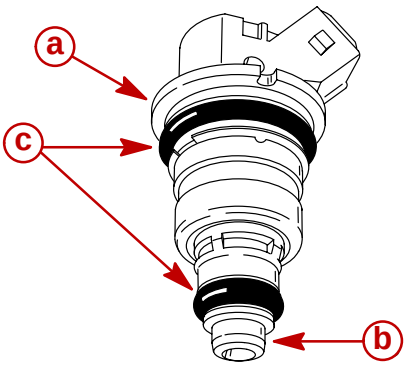


57967

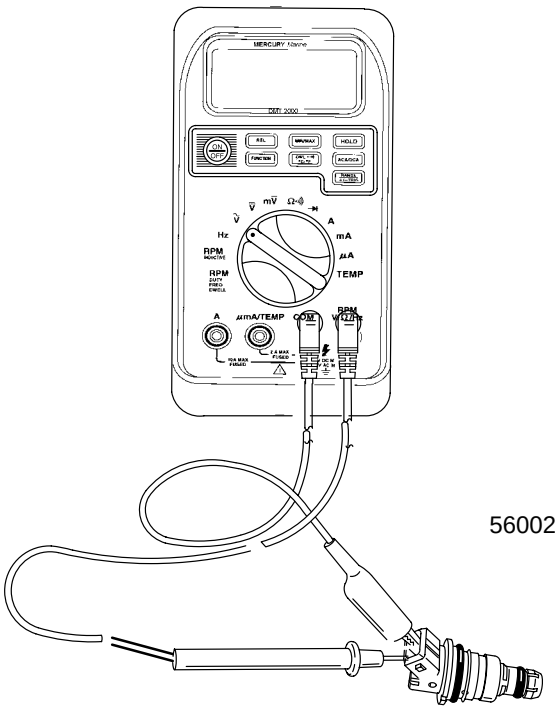
a - Screws
b - Pry Holes

3. Inspect fuel injector orifices for foreign debris; o-rings for cuts or abraisions and plastic components for heat damage. Replace components as required.

4. An ohm test of the fuel injector may be made by connecting test leads to injector terminals. Ohm reading should be 1.8 ± 0.1 ohm.



56124



56002

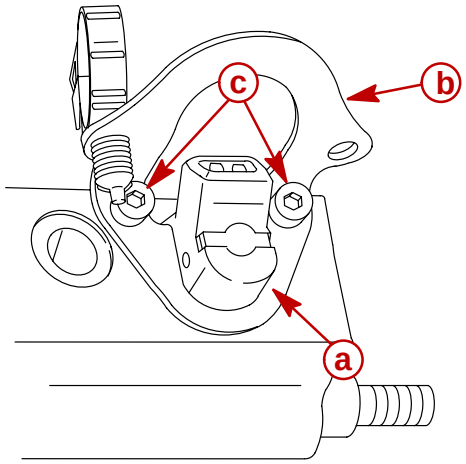
a - Fuel Injector
b - Fuel Nozzle
c - O-Rings

FUEL INJECTOR INSTALLATION

NOTE: *Apply anti-seize grease (obtain locally) or 2-4-C with Teflon to fuel injector attaching screw threads.*

1. Insert fuel injector into fuel rail with connector pins facing (inwards) towards center of engine.

NOTE: *Turn injector back-and-forth slightly to seat injector o-rings in fuel rail while securing injector with retainer and 2 screws. Torque screws to 70 lb. in. (8.0 Nm).*

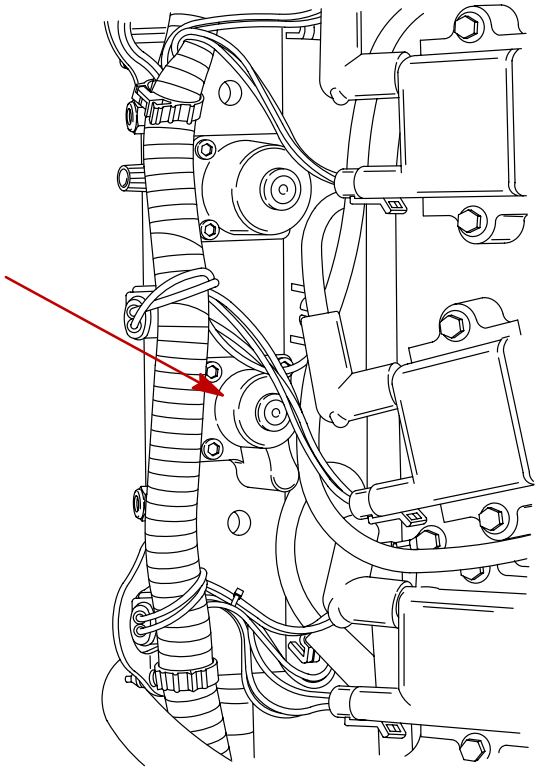


57970

a - Injector
b - Retainer
c - Screws [Torque to 70 lb. in. (8.0 Nm)]

Fuel Pressure Regulator

The fuel regulator is located on the port fuel rail.



57980

The fuel pump is capable of delivering more fuel than the engine can consume. Excess fuel flows through the fuel pressure regulator, interconnecting passages/hoses, fuel cooler, and back to the vapor separator tank. This constant flow of fuel means that the fuel system is always supplied with cool fuel, thereby preventing the formation of fuel vapor bubbles and minimizing the chances of vapor lock.

The fuel pressure regulator is calibrated to raise the fuel pressure to 10 psi above the air pressure.

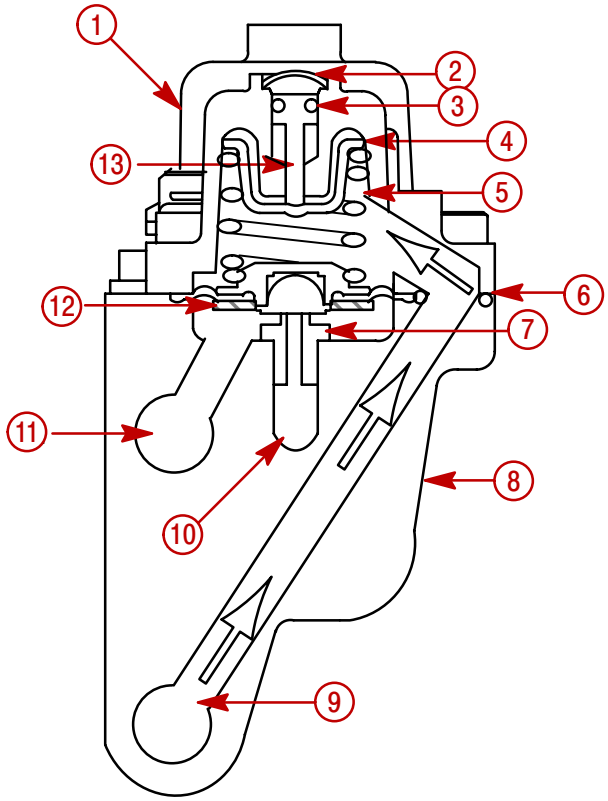
The fuel regulator is mounted on the port fuel rail, near the bottom. This regulator relies on both air and spring pressure to control the fuel pressure. Inside the regulator assembly is a 10 lb. spring, this spring holds the diaphragm against the diaphragm seat. The contact between the diaphragm and diaphragm seat closes the passage between the incoming fuel (from the electric fuel pump) and the fuel return passage.

When the engine is not running (no air pressure on the spring side of the diaphragm) the fuel pressure required to move the diaphragm is 10 psi.

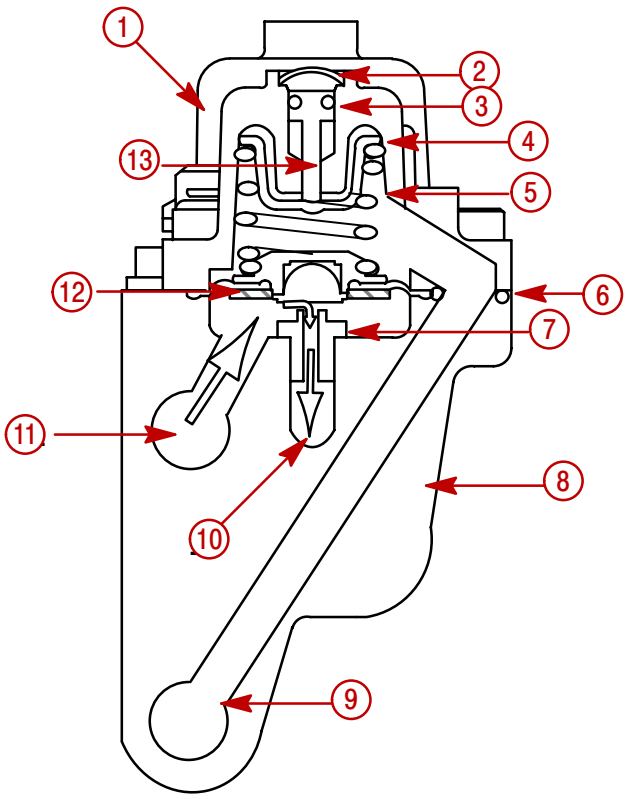
When the engine is running, air pressure from the air compressor (80 psi) is routed through the air passages, to the spring side of the fuel pressure regulator diaphragm.

The air pressure (80 psi) and spring pressure (10 psi) combine to regulate system fuel pressure to 90 psi - or 10 psi higher than the air pressure in the DFI system fuel/air rails.

Regulator Closed



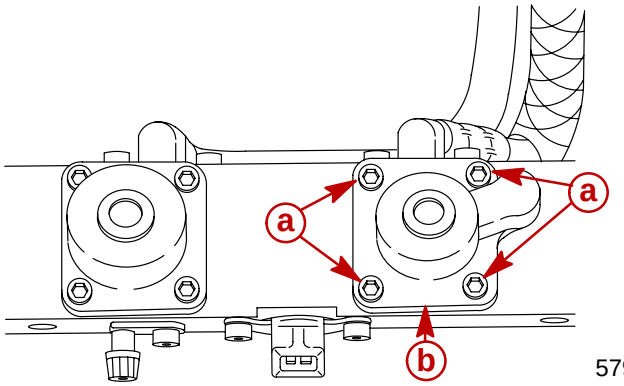
Regulator Open



1 - Top Cover
2 - Expansion Plug
3 - O-ring
4 - Spring Retainer
5 - Spring
6 - O-ring
7 - Diaphragm Seat
8 - Air Rail
9 - Air Passage (from Air Compressor)
10 - Fuel Return Passage (to Vapor Separator)
11 - Fuel Inlet Passage (from Electric Fuel Pump)
12 - Diaphragm Assembly
13 - Calibration Screw (Do Not Turn)

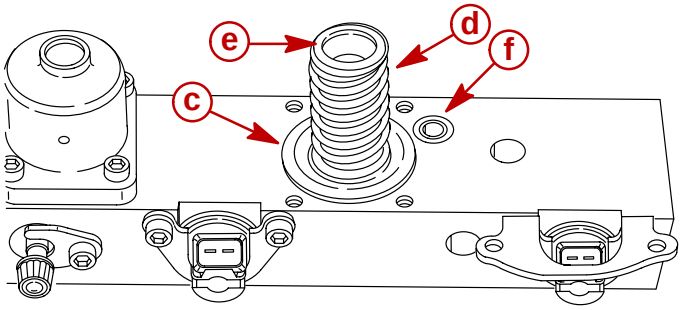
FUEL REGULATOR REMOVAL

1. Remove 4 screws securing regulator and remove regulator.
2. Inspect regulator diaphragm for cuts or tears.
3. Inspect regulator housing o-ring for cuts and abraisions. Replace components as required.



57968

a - Screws
b - Fuel Regulator
c - Diaphragm



57969

d - Spring
e - Cup
f - O-Ring

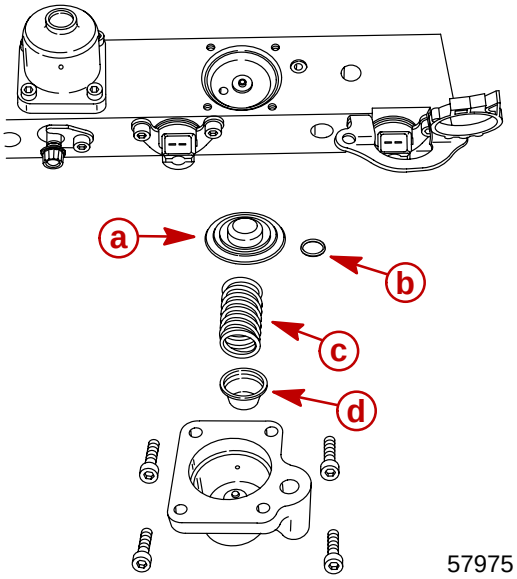
FUEL REGULATOR INSTALLATION

NOTE: *Apply a light coat of 2-4-C with Teflon to diaphragm surface and o-ring to aid in the retention of diaphragm and o-ring on fuel rail during reassembly.*

1. Position diaphragm on fuel rail.
2. Position o-ring on fuel rail.
3. Position spring and cup onto diaphragm.

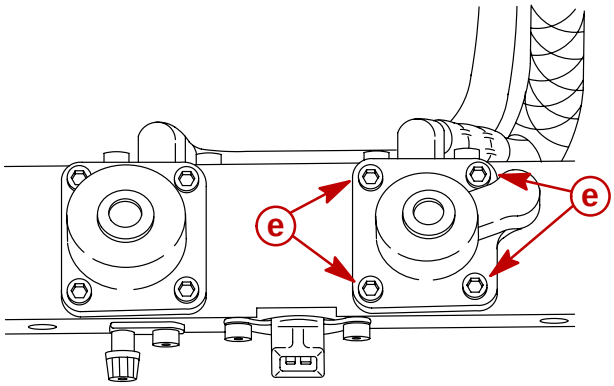
NOTE: *Apply anti-seize grease (obtain locally) or 2-4-C with Teflon to regulator attaching screw threads.*

4. Place cover over spring/cup/diaphragm assembly and secure with 4 screws. Torque screws to 70 lb. in. (8.0 Nm).



57975

a - Diaphragm
b - O-Ring
c - Spring

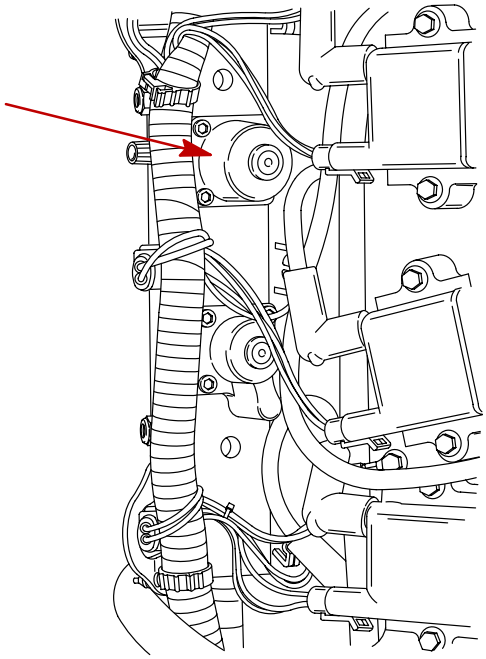


57968

d - Cup
e - Screws [Torque to 70 lb. in. (8.0 Nm)]

Air Pressure Regulator

The air pressure regulator is located on the port fuel rail.



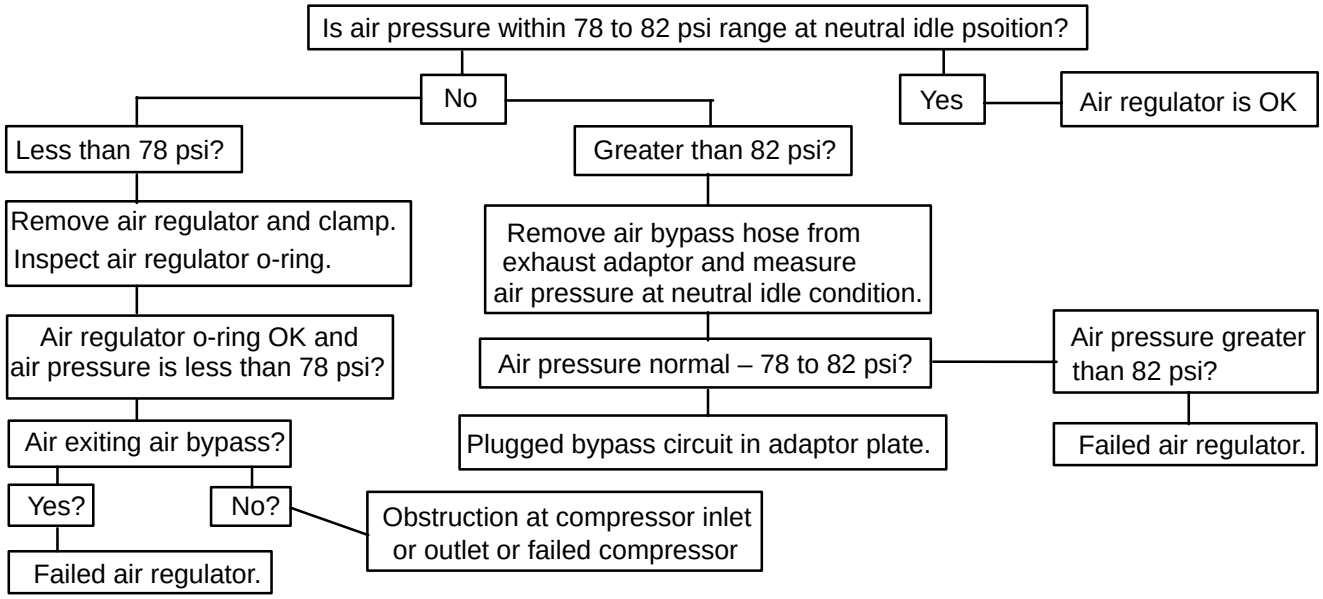
57980

The air pressure regulator is designed to limit the air pressure inside the rails to approximately 80 psi.

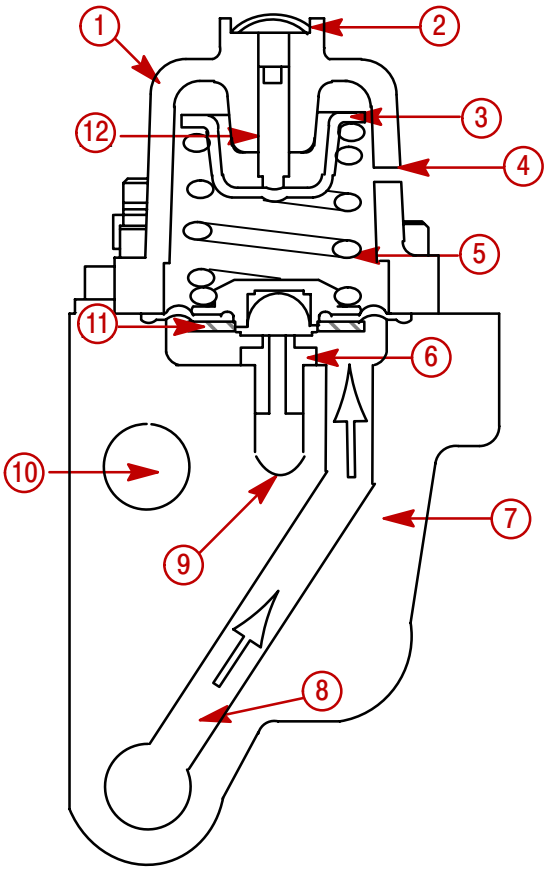
The air regulator uses a spring (pressure) to control the air pressure. This spring (80 psi) holds the diaphragm against the diaphragm seat. The contact area blocks (closes) the air inlet passage from the excess air, return passage. As the air pressure rises (below the diaphragm), it must reach a pressure equal to or greater than the spring pressure holding the diaphragm closed. Once this pressure is achieved, the spring compresses, allowing the diaphragm to move. The diaphragm moves away from the diaphragm seat, allowing air to exit through the diaphragm seat, into the excess air passage leading to the air plenum.

Air Regulator Troubleshooting

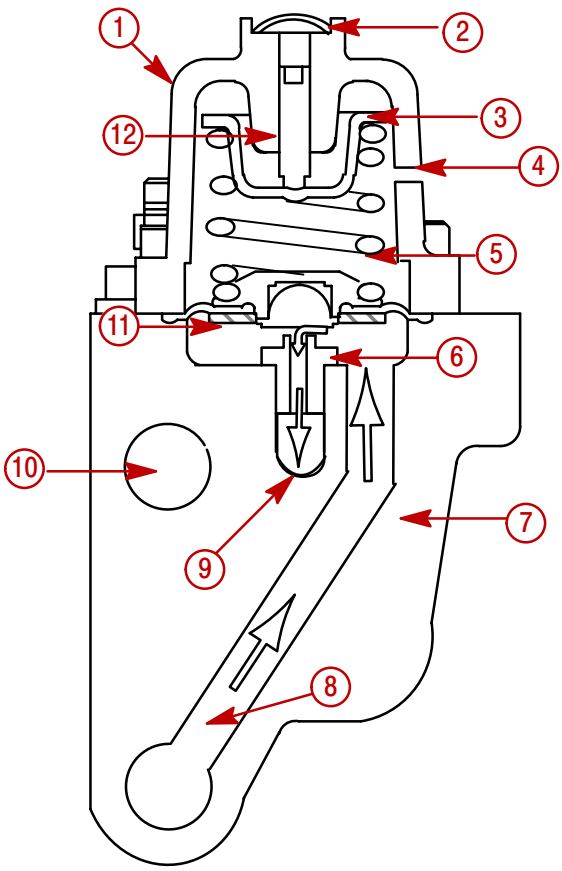
Air pressure should be measured at the air schrader valve located near the middle of the port fuel rail assembly.



Regulator Closed



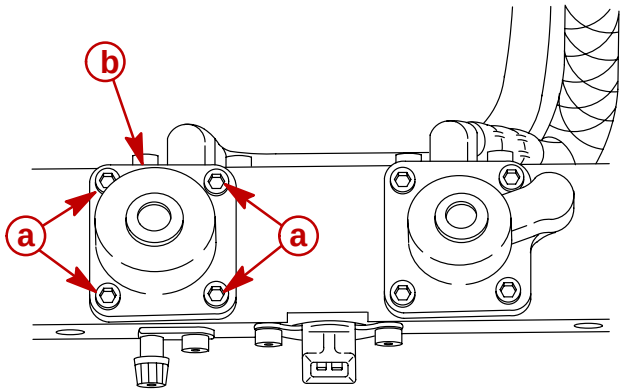
Regulator Open



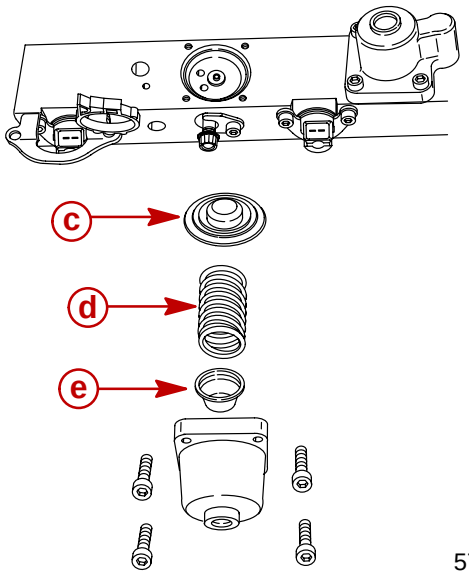
1 - Top Cover
2 - Expansion Plug
3 - Spring Retainer
4 - Vent
5 - Spring
6 - Diaphragm Seat
7 - Air Rail
8 - Air Passage (from Air Compressor)
9 - Excess Air Passage (to Exhaust Adaptor)
10 - Fuel Inlet Passage (from Electric Fuel Pump)
11 - Diaphragm Assembly
12 - Calibration Screw (Do Not Turn)

AIR REGULATOR REMOVAL

1. Remove 4 screws securing regulator and remove regulator.
2. Inspect regulator diaphragm for cuts or tears. Replace as required.



57968



57974

a - Screws
b - Air Regulator
c - Diaphragm
d - Spring
e - Cup

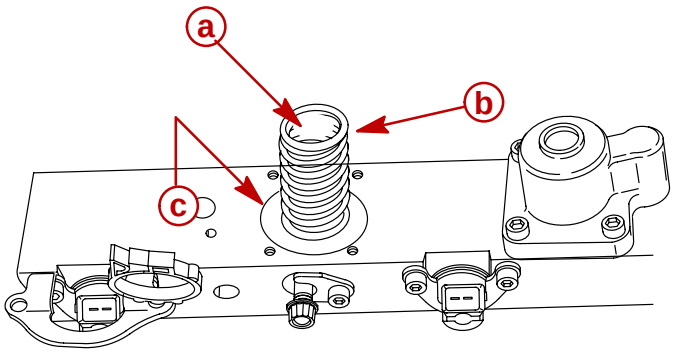
AIR REGULATOR INSTALLATION

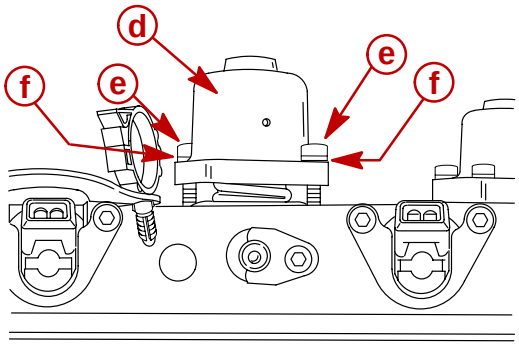
NOTE: *Apply a light coat of 2-4-C with Teflon to diaphragm surface to aid in the retention of diaphragm on fuel rail during reassembly.*

1. Position diaphragm, spring and cup onto fuel rail with fuel rail in horizontal position.

NOTE: *Apply anti-seize grease (obtain locally) or 2-4-C with Teflon to regulator attaching screw threads.*

NOTE: *Due to the stiffness of the regulator spring, it is recommended that 2 longer screws (5mm x 25mm long) (10-40073 25) and 2 flat washers (12-30164) be installed through cover first to begin compression. This will allow 2 shorter screws (5mm x 15mm long) to be installed. Remove 2 long screws with flat washers and install remaining 2 short screws (5mm x 15mm). Torque screws to 70 lb. in. (8.0 Nm).*



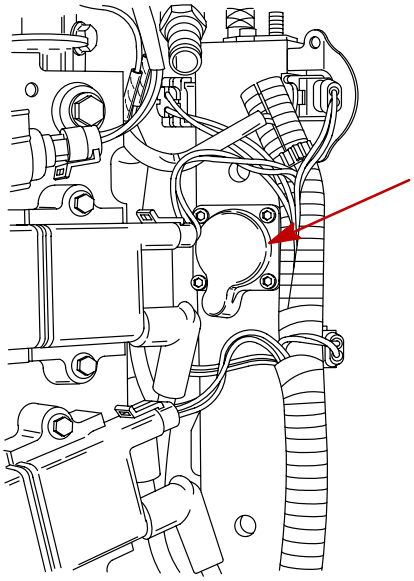


57973

a - Cup
b - Spring
c - Diaphragm
d - Cover
e - Screws
f - Flat Washers

Tracker Valve

The tracker valve is located on the starboard fuel/air rail assembly.



57979

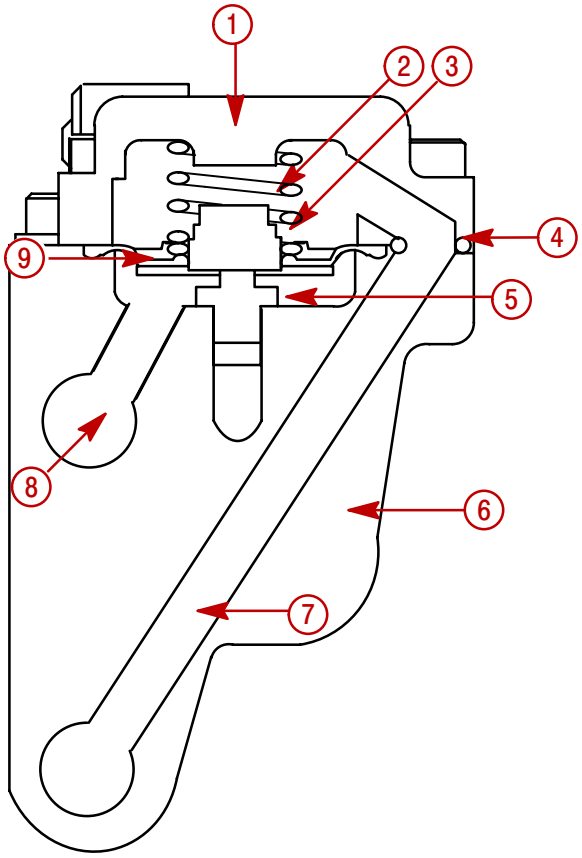
The DFI system must maintain a constant 10 psi pressure difference between the fuel pressure and air pressure in the rails, at all times. The tracker is designed to maintain the 10 psi differential when the air or fuel pressure suddenly raises (i.e. pulses generated by the compressor's piston or by the fuel injectors opening and closing). The tracker contains a spring on the air side of the diaphragm. This spring positions the diaphragm against the diaphragm's seat (when the engine is not running).

After the engine starts, and the fuel and air pressure reach normal operating range, the fuel pressure will compress the spring and the diaphragm will move slightly away from the seat (to a neutral position). At this point the pressure on both sides of the tracker diaphragm is equal (10 psi spring pressure + 80 psi air pressure = 90 psi fuel pressure).

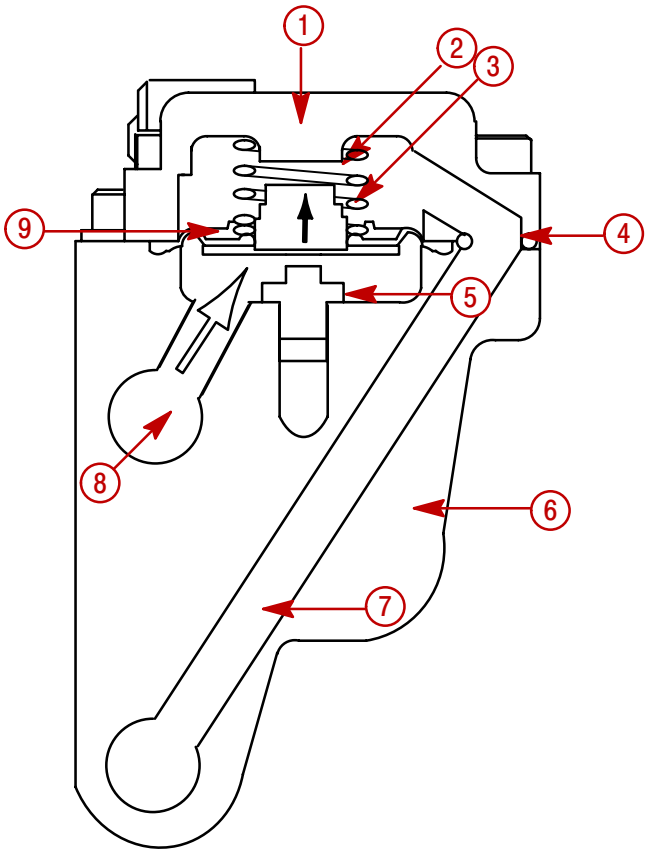
Any air or fuel pressure "spikes" on one side of the diaphragm will transfer this pressure rise to the other system (air or fuel) on the other side of the diaphragm. Both systems will have a momentary increase in pressure so that the 10 psi difference between air and fuel system pressures can be maintained.

NOTE: *To prevent excessive wear in the seat, the tracker is calibrated to allow the diaphragm to be slightly away from the seat during normal operation.*

Engine Off (No Pressure)



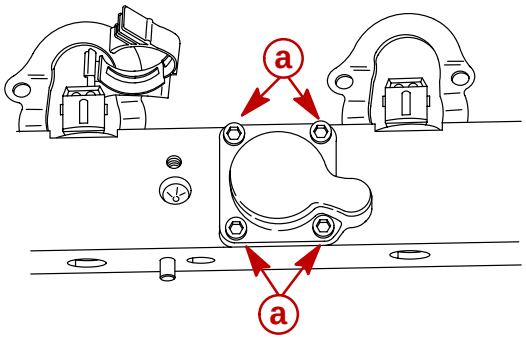
Engine at Operating Pressures



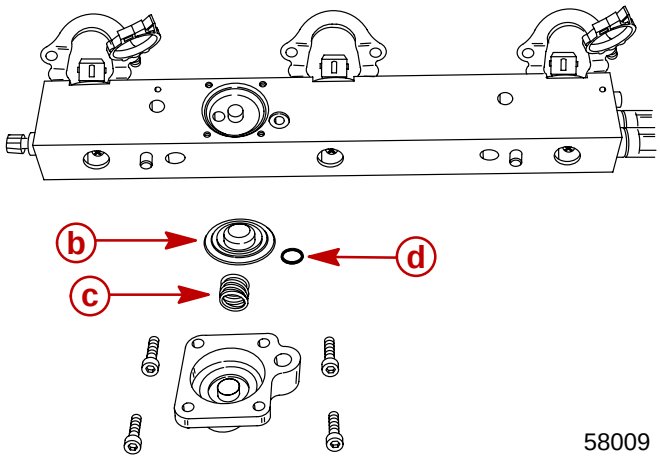
1 - Top Cover
2 - Spring Retainer (not shown)
3 - Spring
4 - O-ring
5 - Diaphragm (at rest) Seat
6 - Air Rail
7 - Air Passage (from Air Compressor)
8 - Fuel Inlet Passage (from Electric Fuel Pump)
9 - Diaphragm Assembly

TRACKER VALVE REMOVAL

1. Remove 4 screws securing tracker valve and remove tracker assembly.
2. Inspect tracker diaphragm for cuts and tears.
3. Inspect tracker cover o-ring for cuts and abraisions. Replace components as required.



57802



58009

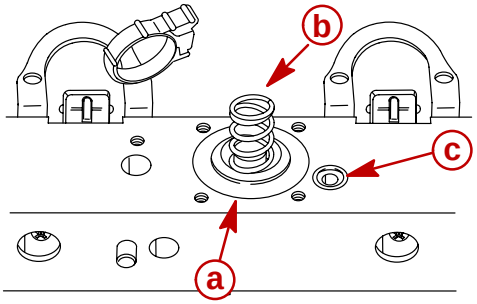
a - Screws
b - Diaphragm
c - Spring
d - O-Ring

TRACKER VALVE INSTALLATION

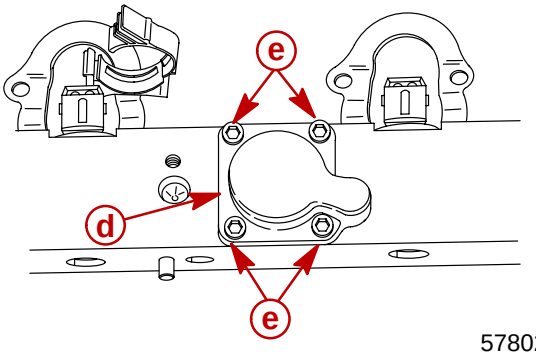
NOTE: *Apply a light coat of 2-4-C with Teflon to tracker diaphragm and cover o-ring to aid in their retention on fuel rail while reinstalling tracker valve to fuel rail.*

NOTE: *Apply anti-seize grease (obtain locally) or 2-4-C with Teflon to tracker valve attaching screw threads.*

1. Position diaphragm, spring and o-ring onto fuel rail.
2. Place cover over diaphragm/spring/o-ring assembly and secure with 4 screws. Torque screws to 70 lb. in. (8.0 Nm).



57919



57802

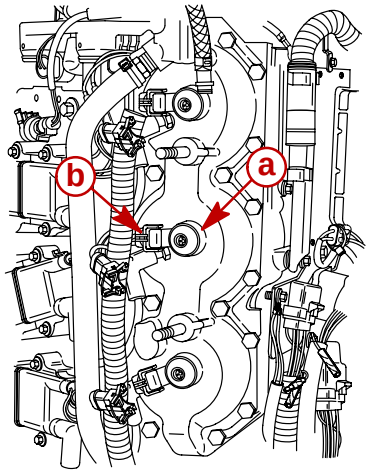
a - Diaphragm
b - Spring
c - O-Ring
d - Cover
e - Screws [Torque to 70 lb. in. (8.0 Nm)]

Fuel Rail Cleaning

After all fuel injectors, air regulator, tracker valve, fuel regulator, inlet hoses and outlet hoses have been removed, the fuel rails may be flushed out with a suitable parts cleaning solvent. Use compressed air to remove any remaining solvent.

Direct Injector Removal

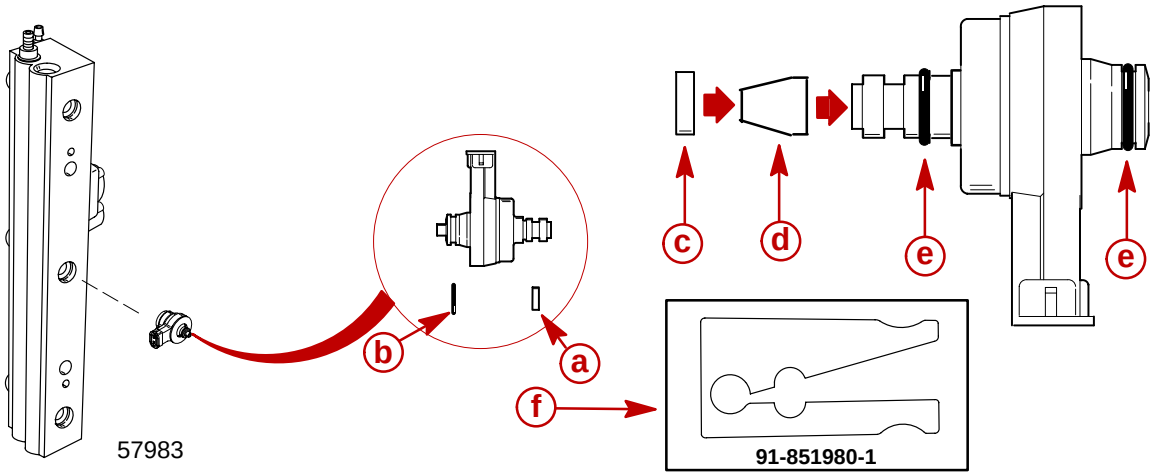
1. Remove harness connectors from direct injectors.
2. Remove direct injector from cylinder head



57985

a - Direct Injector (3 each cylinder head)
b - Harness Connector

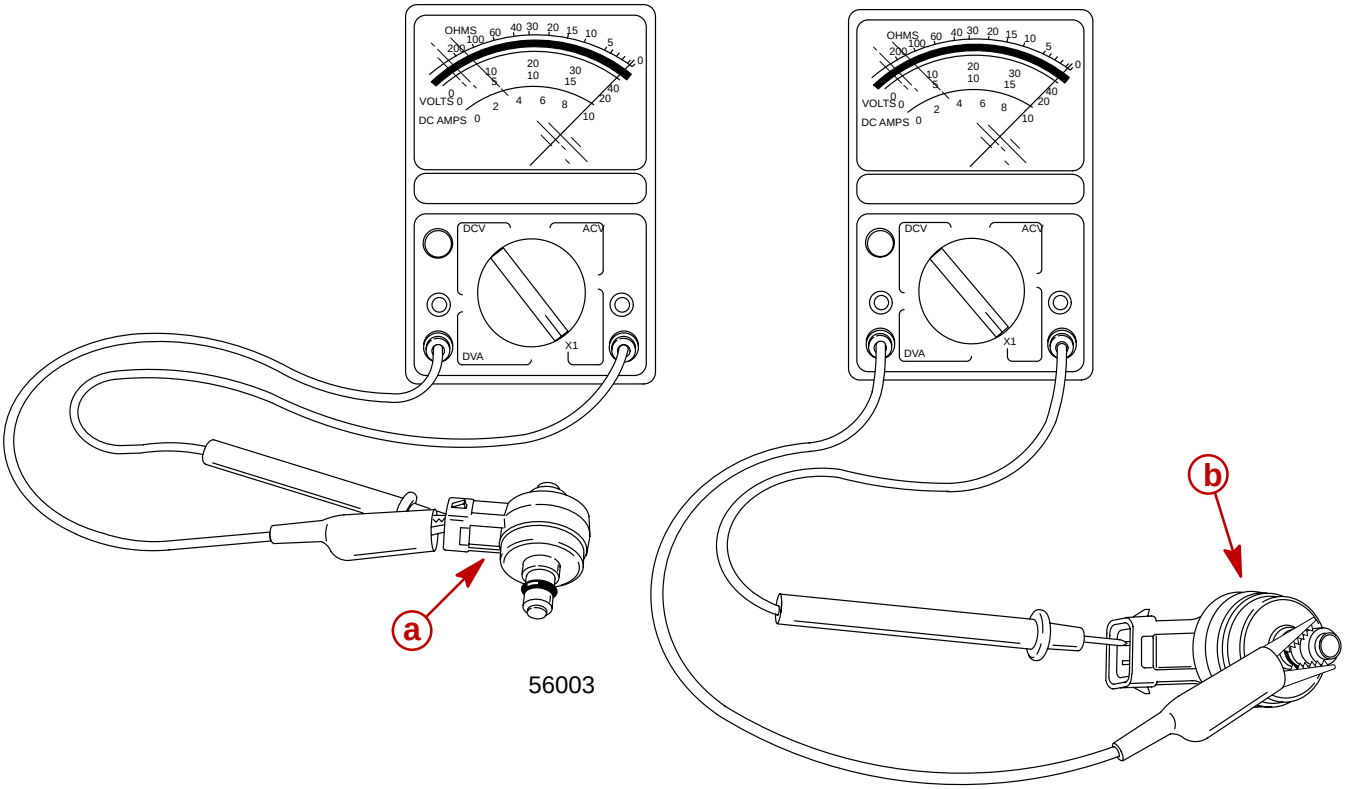
3. Inspect injector teflon sealing ring (white) for signs of combustion blowby (teflon ring will be streaked brownish black). If blowby is present, replace teflon sealing ring. If blowby is not present, sealing ring may be reused.
4. Inspect o-rings and teflon ring for cuts or abraisions. Replace components as required.
5. If teflon seal requires replacement, use teflon ring installation tool 91-851980 to slide new seal onto injector. Following installation of teflon ring, the teflon ring sizing tool (91-851980-1) can be used to compress the teflon seal to aid in the installation of the injector into the cylinder head.



57983

a - Teflon Sealing Ring
b - O-Ring
c - Teflon Seal
d - Seal Installation Tool (91-851980)
e - O-Ring
f - Teflon Ring Sizing Tool (91-851980-1)

6. An ohm test of the direct injector may be made by connecting test leads to injector terminals. Ohm reading should be 1.3 ± 0.3 ohm.
7. An ohm test to determine if direct injector windings are shorted to ground can be made by connecting one ohm lead to either injector pin while touching the other ohm lead to the injector metal case. There should be no continuity. If there is continuity, the internal windings are shorted and the injector must be replaced.



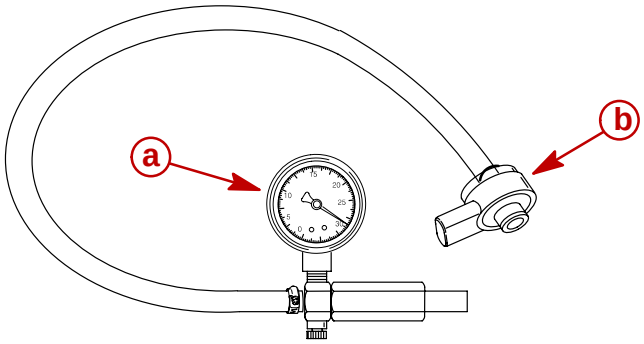
56003

58456

a - Direct Injector Ohm Test (1.3 ± 0.3 ohm)
b - Direct Injector Short to Ground Ohm Test (no continuity)

Direct Injector Leak Test

1. Attach Gearcase Leakage Tool (FT-8950) to discharge side of injector.

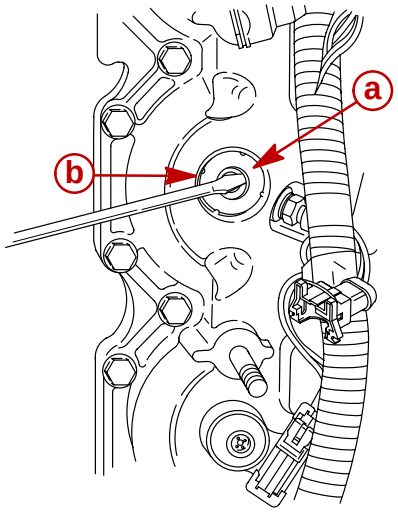


57714

a - Gearcase Leakage Tool (FT-8950)
b - Direct Injector

2. Pump up leakage tool to indicate 25 - 30 psi (172.4 - 206.8 kPa).
3. Direct injector should not leak down more than 1/2 psi (3.5 kPa) in 1 minute.
4. If injector does not meet the above specifications, replace injector.

NOTE: *If cylinder head is going to be replaced, remove cup washers from each direct injector port by prying out with a flat tip screwdriver. Reinstall washers with retainers into new cylinder head. Washers provide tension between direct injectors, cylinder head and fuel rails.*



57984

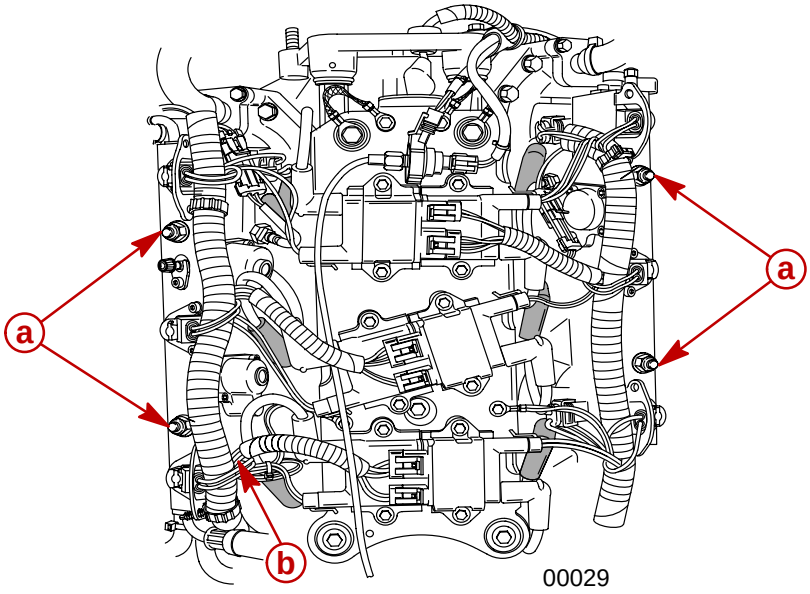
a - Cup Washer
b - Retainer

Fuel Rail and Direct Injector Installation

1. Use Teflon Ring Sizing Tool (91-851980-1) to compress new teflon sealing rings prior to installation of injector into cylinder head.
2. Carefully slide fuel rail over mounting studs and onto direct injectors.

IMPORTANT: ALL fuel and air hoses attached to the fuel rails MUST be secured with stainless steel hose clamps.

3. Secure each fuel rail with 2 nuts. Torque nuts to 33 lb. ft. (44 Nm).
4. Reinstall direct injector harness connectors.

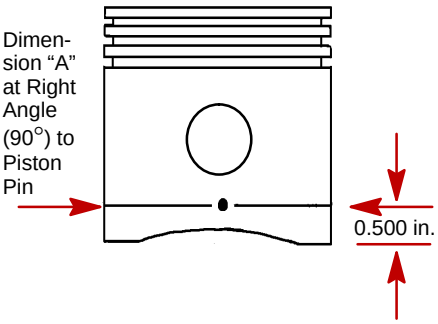


00029

a - Nuts [Torque to 33 lb.ft. (44 Nm)]
b - Direct Injector Harness Connectors (6) (3 each fuel rail)

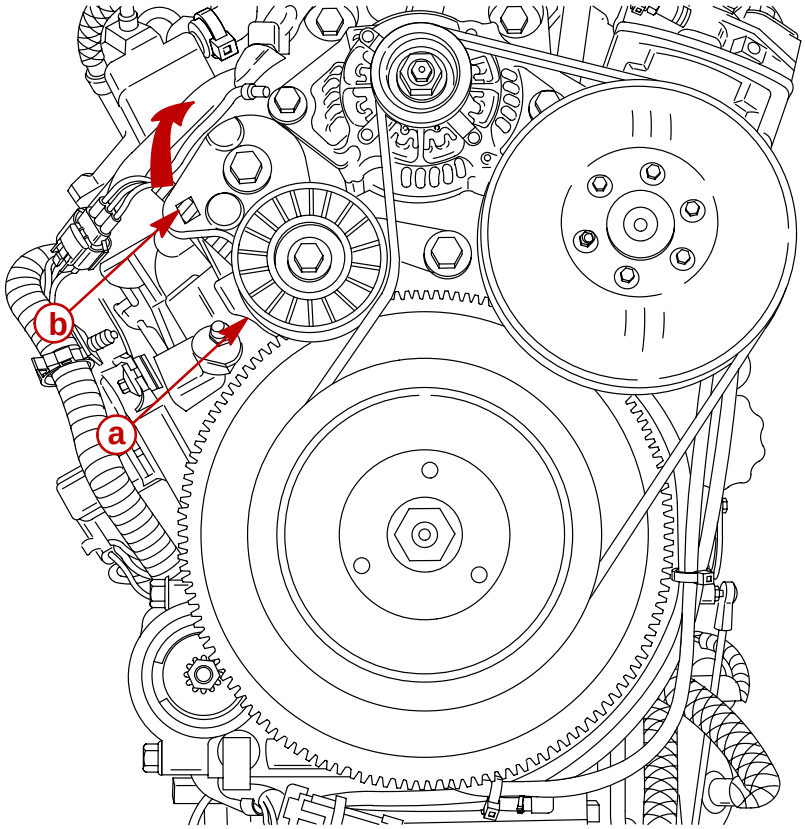
Air Compressor

Air compressor is a single cylinder, water cooled and lubricated by the outboard oil pump.

Air Compressor Specifications		
Air Compressor	Type Compressor Output	Reciprocating Piston (1 to 1 ratio with engine RPM) @ Idle – 80 psi @ W.O.T. – 110 psi
Cylinder Block	Displacement	7.07 cu. in. (116 cc)
Cylinder Bore	Diameter (Standard) Taper/Out-of-Round/Wear Maximum Bore Type	2.5591 in. (65.0 mm) 0.001 in. (0.025 mm) Cast Iron
Stroke	Length	1.374 in. (34.9 mm)
Piston	Piston Type	Aluminum
Piston Diameter		2.5578 ± .0004 in. (64.97 ± 0.010 mm)
Piston Ring	End Gap Top Ring Middle Ring Bottom Ring	 0.0059 - 0.0098 in. (0.15 - 0.25 mm) 0.0059 - 0.0098 in. (0.15 - 0.25 mm) 0.0039 - 0.014 in. (0.10 - 0.35 mm)
Reeds	Reed Stand Open	0.010 in. (0.25 mm)

COMPRESSOR REMOVAL

1. Disconnect battery cables from battery terminals.
2. Remove flywheel cover.
3. Use 3/8 inch (9.5 mm) drive on belt tensioner arm to relieve belt tension. Remove belt.



57806

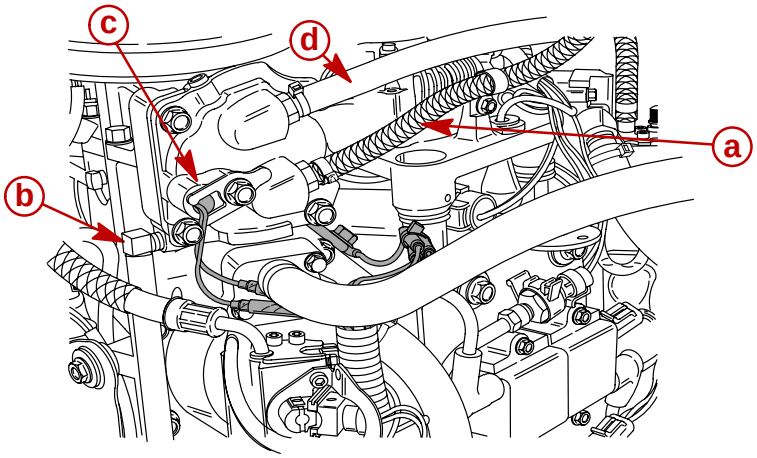
a - Belt Tensioner
b - 3/8 in. (9.5 mm) drive

⚠ CAUTION

If engine has been recently run, air pressure outlet hose fittings may be extremely hot. Allow components to cool off before beginning disassembly.

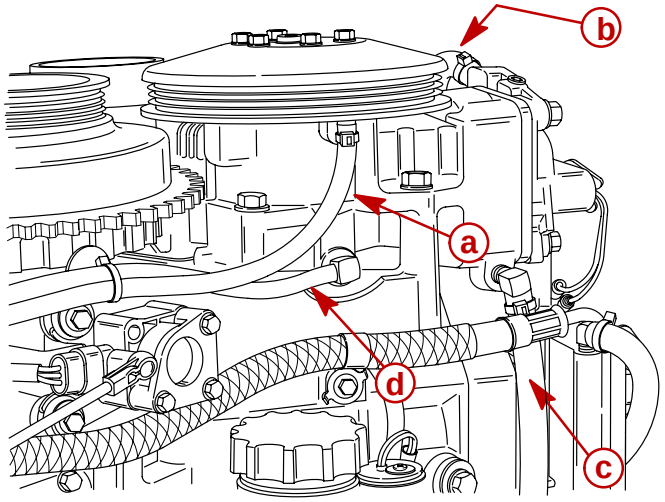
NOTE: *Remove 2 screws securing retainer plate to remove air pressure outlet hose. Inspect o-rings on air pressure hose fitting for cuts or abraisions. Replace o-rings as required.*

4. Remove air pressure outlet hose.
5. Remove air compressor inlet hose.
6. Disconnect compressor water inlet hose.



a - Air Pressure Outlet Hose
b - Compressor Water Inlet Hose
c - Compressor Temperature Sensor
d - Air compressor inlet hose

7. Disconnect air compressor oil inlet hose.
8. Disconnect water outlet hose to expansion chamber.
9. Disconnect excess oil return hoses.



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a - Air Compressor Oil Inlet Hose
b - Water Outlet Hose Expansion Chamber
c - Water Inlet Hose
d - Excess Oil Return Hoses

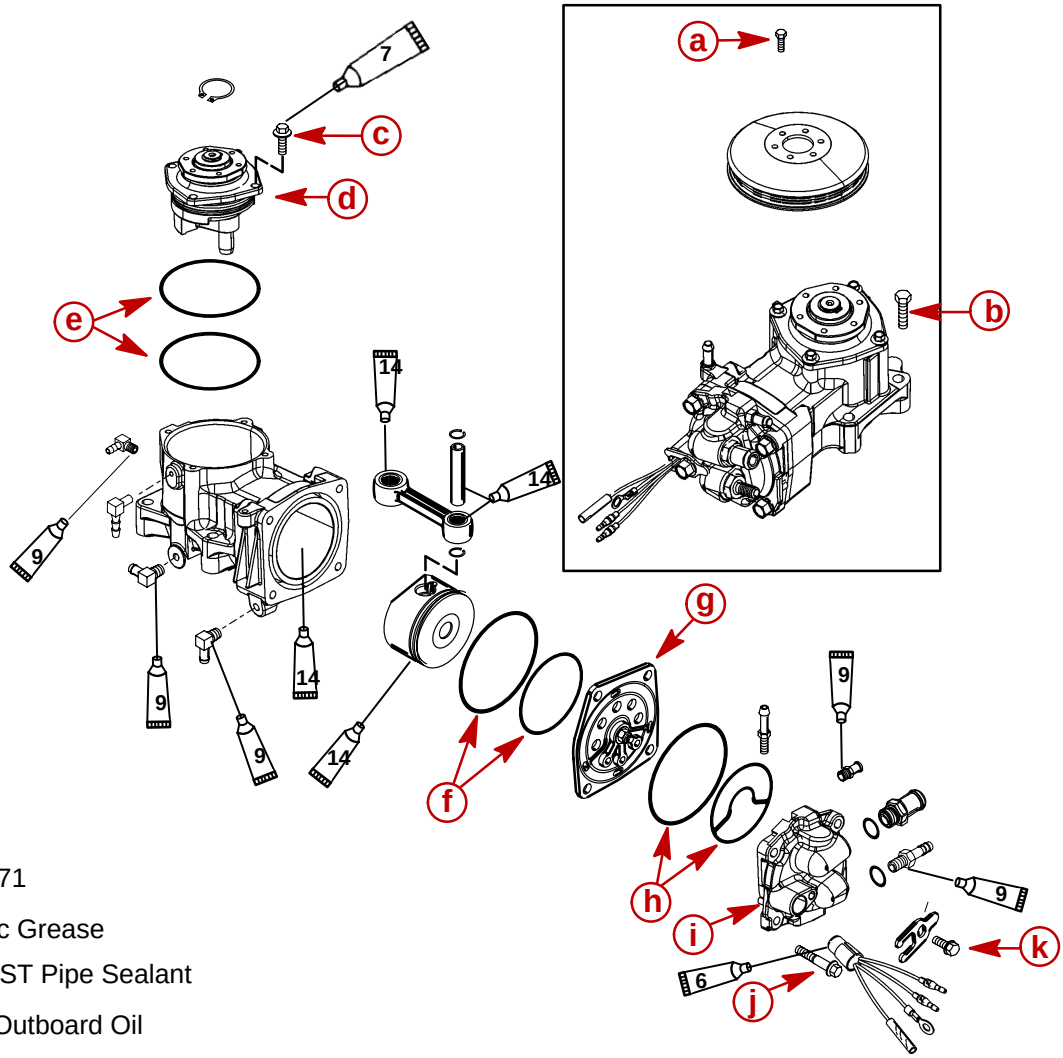
10. Remove pulley (6 bolts).

Air Compressor Disassembly/Reassembly

IMPORTANT: If an internal failure of the air compressor has occurred, i.e. broken reed, scuffed piston, bearing failure, etc. – all air hoses, fuel rails and injectors should be disassembled and inspected for metal debris. Failure to remove all metal debris will result in poor performance and/or powerhead failure.

NOTE: *If cylinder bore is scored, air compressor must be replaced as an assembly.*

NOTE: *The piston and rings are not sold separately. They must be replaced as an assembly. The connecting rod and bearings are not sold separately. They must be replaced as an assembly.*



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NOTE: *End cap bearing and seal are not sold separately. End cap must be replaced as an assembly*

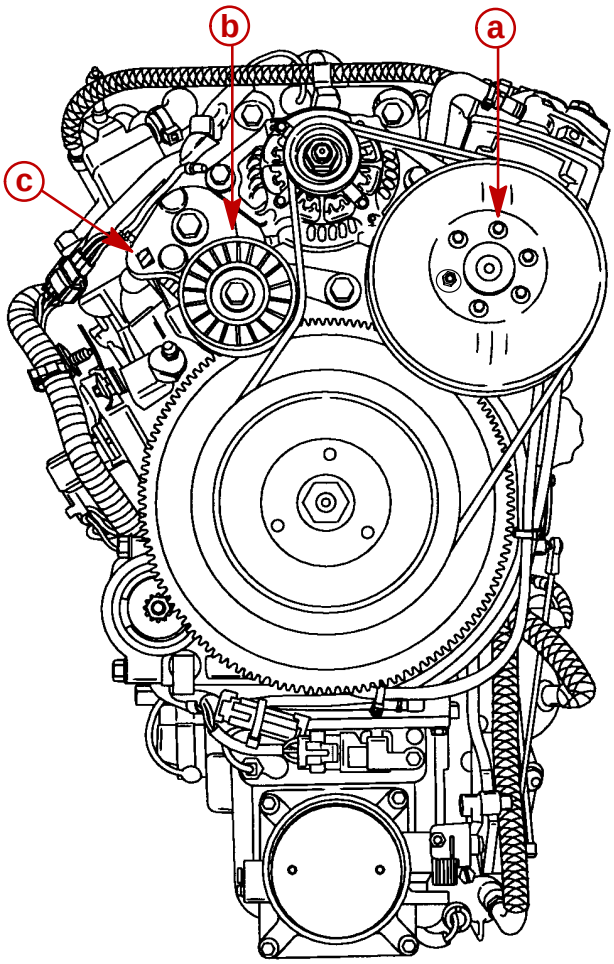
NOTE: *Piston Installation – use a metal hose clamp for piston ring compressor. Stagger piston ring openings.*

- **a** - Bolt (6 each) (GOLD Pulley) – Torque to 190 lb. in. (21.5 Nm)
  (BLACK Pulley) – Torque to 170 lb. in. (19 Nm)
- **b** - Bolt (4 each) [Torque to 20 lb. ft. (27 Nm)]
- **c** - Bolt (4 each) [Torque to 100 lb. in. (11.5 Nm)]
- **d** - End Cap Assembly (Inspect bearing for roughness)
- **e** - O-Rings (Inspect for cuts or abraisions)
- **f** - Reed Plate (Inspect for broken or chipped reeds/stops) Maximum Reed Stand-Open – 0.010 in. (0.254 mm)
- **g** - O-Rings (Inspect for cuts or abraisions)
- **h** - Cylinder Head
- **i** - Bolt (Torque to 20 lb. ft. [27 Nm])
- **j** - Temperature Sensor
- **k** - Bolt (Torque to 20 lb. ft. [27 Nm])

Air Compressor End Cap/Crankshaft Removal and Reassembly

DISASSEMBLY

1. Remove flywheel cover.
2. Use 3/8-inch (9.5 mm) drive on belt tensioner arm to relieve belt tension, and remove belt.
3. Remove the 6 bolts that retain the pulley to the pulley flange.



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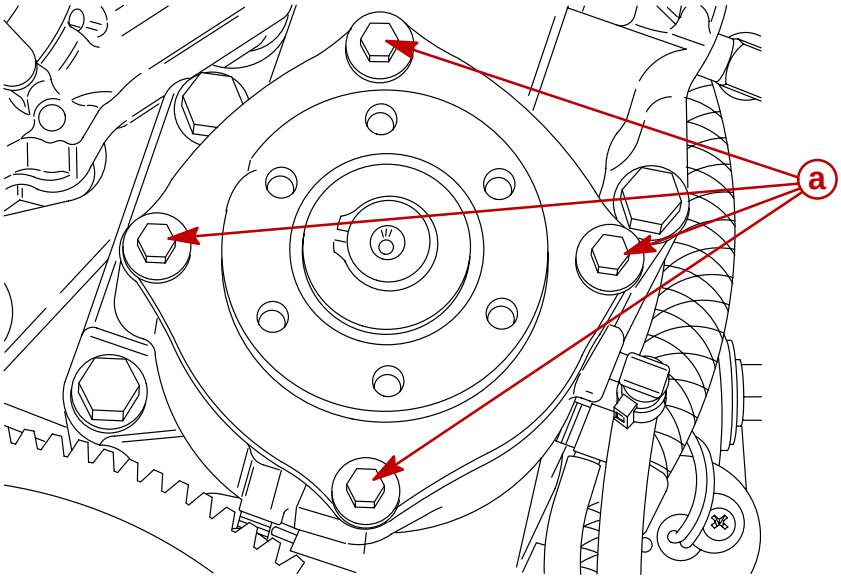
a - Pulley retaining bolts (6)
b - Tensioner
c - 3/8 (9.5 mm) square drive

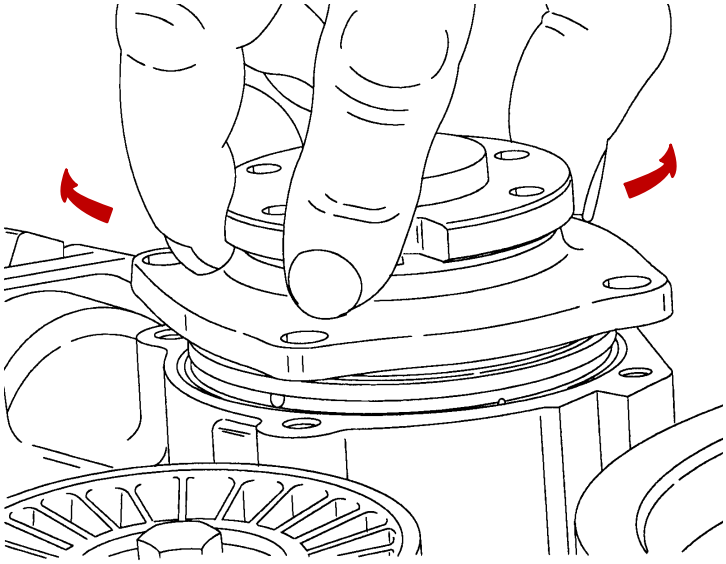
4. Remove the 4 bolts that retain the end cap to the compressor body.



57809

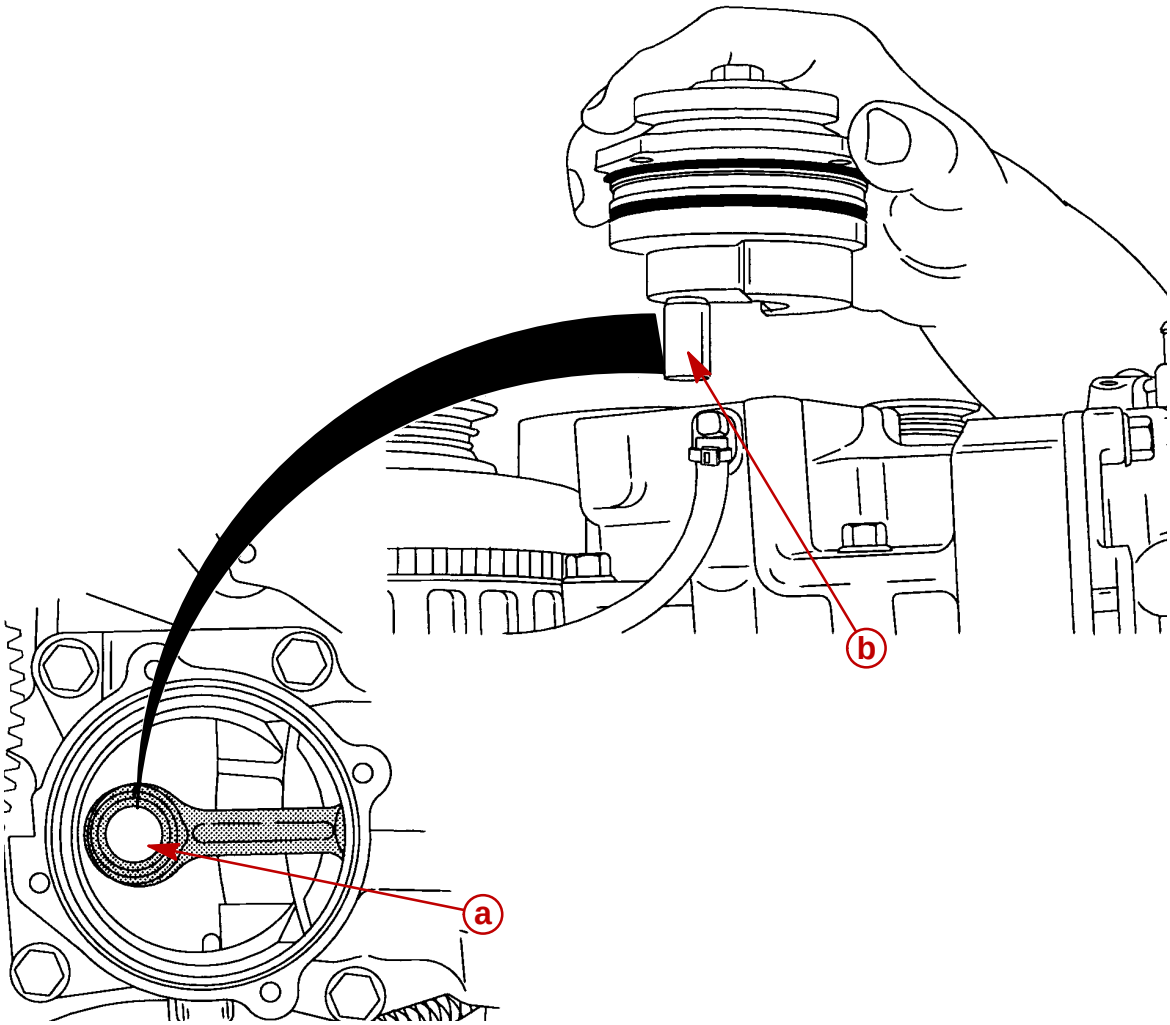
a - End cap retaining bolts (4)

5. While rotating the pulley flange alternately clockwise and counterclockwise about 1/8 to 1/4 turn, pull outward on the pulley flange. Continue rotating until the end cap assembly has been removed from the compressor body.



REASSEMBLY

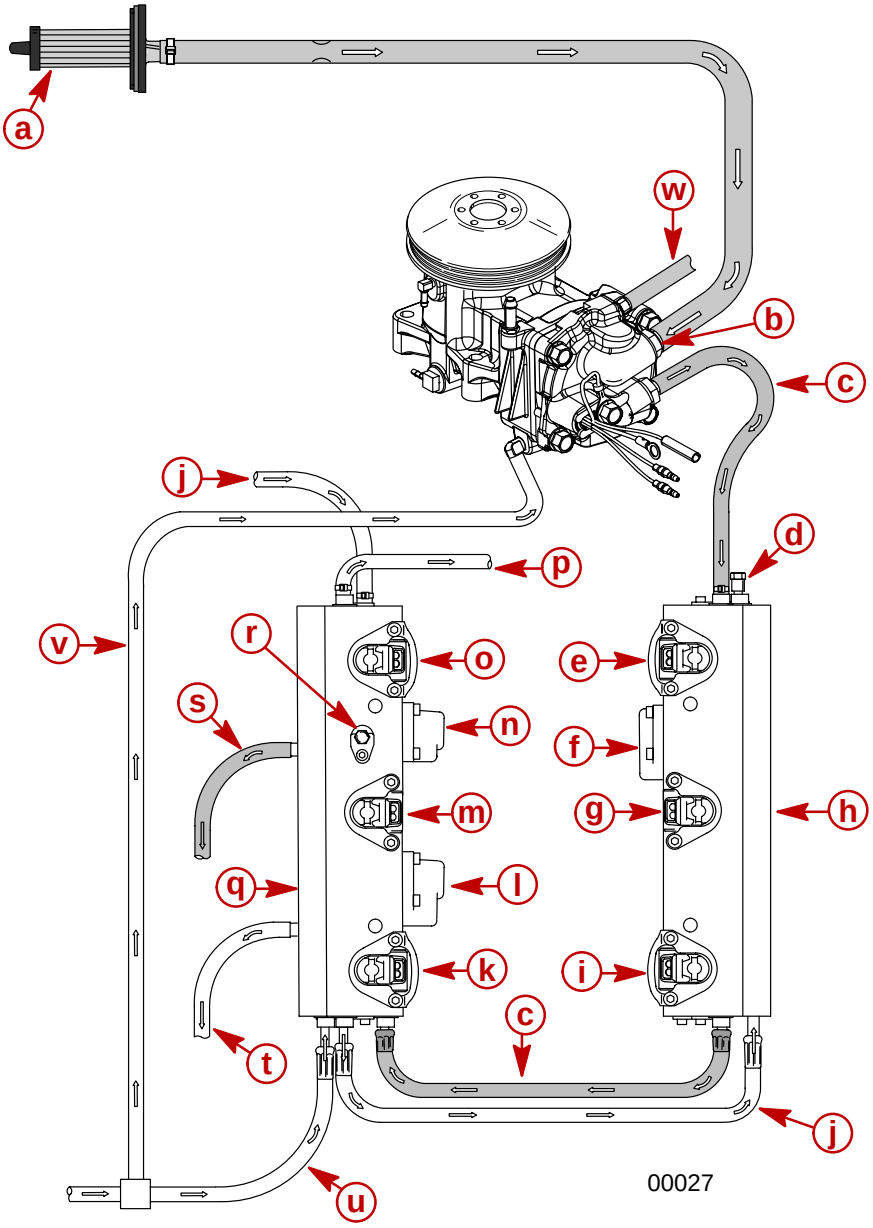
1. Lubricate end cap O-ring and O-ring contact area in compressor body with two cycle oil.
2. Slide the new end cap assembly into the compressor body, keeping the connecting rod journal lined up with the open end of the connecting rod, until the crankshaft just enters the open end of the connecting rod.



a - Connecting rod open end
b - Crankshaft connecting rod Journal

3. While rotating the pulley flange clockwise and counterclockwise, push the end cap into the compressor. Continue rotating the flange until the end cap is all the way down against the compressor body.
4. To confirm that the connecting rod journal has properly engaged with the connecting rod, rotate the flange until you feel resistance from the piston trying to compress air in the cylinder.
5. Apply Loctite 271 to the threads of the end cap retaining bolts and torque to 100 lb. in. (11.5 Nm).
6. Apply Loctite 271 to the pulley retaining bolts. Torque to 170 lb. in. (19 Nm).
7. Install compressor/alternator belt.
8. Run engine to confirm that compressor is functioning correctly.

Air Compressor Flow Diagram

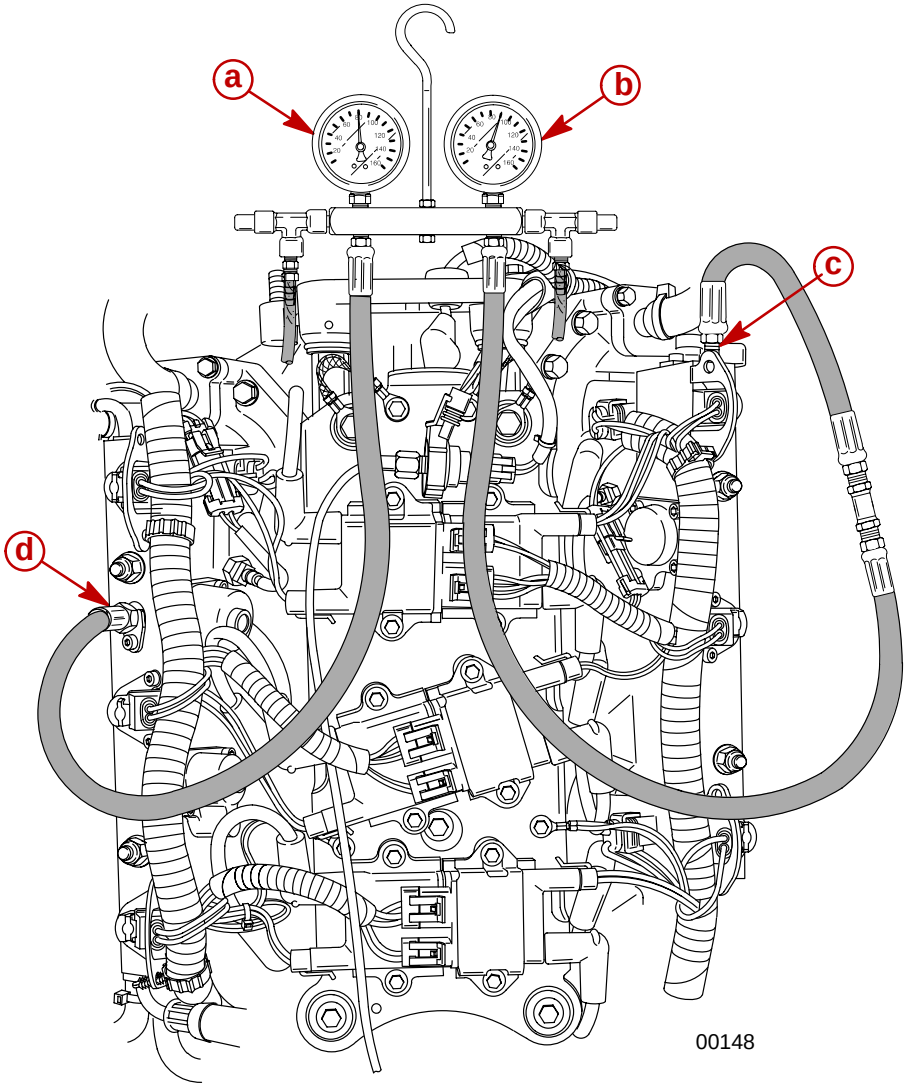


a - Air Filter
b - Compressor Air Inlet
c - Air [80 ± 2 psi (551.6 ± 13.8 kPa)]
d - Fuel System Pressure Test Valve
e - #1 Fuel Injector
f - Tracker Valve
g - #3 Fuel Injector
h - Starboard Fuel Rail
i - #5 Fuel Injector
j - High Pressure Fuel [90 ± 2 psi (620.5 ± 13.8 kPa)]
k - #6 Fuel Injector
l - Fuel Regulator [90 ± 2 psi (620.5 ± 13.8 kPa)]
m - #4 Fuel Injector
n - Air Regulator [80 ± 2 psi (551.6 ± 13.8 kPa)]
o - #2 Fuel Injector
p - Rail Water to Expansion Chamber
q - Port Fuel Rail
r - Air Pressure Test Valve
s - Excess Air Return to Adapter Plate
t - Excess Fuel Return to VST
u - Water Inlet to Fuel Rail
v - Water Inlet to Compressor
w - Compressor Water to Expansion Chamber

Air Compressor Pressure Test

Install Pressure Gauge Assembly 91-852087A1/A2/A3 to fuel rail pressure test valves. Starboard rail has fuel pressure test valve. Port fuel rail has air pressure test valve.

NOTE: *After 15 seconds of cranking engine with starter motor, air pressure gauge should indicate 80 ± 2 psi (551.6 ± 13.8 kPa) and fuel pressure gauge should indicate 90 ± 2 psi (620.5 ± 13.8 kPa).*



a - Air Pressure Gauge (Should Indicate 80 ± 2 psi (551.6 ± 13.8 kPa)
b - Fuel Pressure Gauge (Should Indicate 90 ± 2 psi (620.5 ± 13.8 kPa)
c - Fuel Pressure Test Valve
d - Air Pressure Test Valve

FUEL PRESSURE AND AIR PRESSURE TROUBLESHOOTING CHART

PROBLEM	CORRECTIVE ACTION
Fuel Pressure and Air Pressure are Both Low	1. Inspect air compressor air intake (air filter in flywheel cover) for blockage. 2. Remove air compressor cylinder head and inspect for scuffing of cylinder wall. Inspect for broken reeds and/or reed stops. 3. Tracker Valve – Remove and inspect diaphragm for cuts or tears and seat damage on diaphragm and rail. 4. Air Regulator – Remove and inspect diaphragm for cuts or tears on diaphragm and rail.
Fuel Pressure Low or Fuel Pressure Drops while Running (Air Pressure Remains Normal)	1. Each time key is turned to the RUN position, both electric pumps should operate for 2 seconds. If it they do not run, check 20 ampere fuse and wire connections. Check 5 AMP. fuse if electric fuel lift pump does not run. 2. If pumps run but have no fuel output, check vapor separator (remove drain plug) for fuel. 3. If no fuel present in vapor separator, check fuel/water separator for debris. 4. Check high pressure pump amperage draw. Normal draw is 6 - 9 amperes; if draw is below 2 amperes, check fuel pump filter (base of pump) for debris. If filter is clean, replace pump. If amperage is above 9 amperes, pump is defective – replace pump. Check low pressure output – 6-9 psi. Check low pressure electric fuel pump amperage draw. Normal draw is 1 - 2 amperes; if draw is below 1 ampere, check for blockage between pump inlet fitting and vapor separator tank. If ampere draw is above 2 amperes, replace pump. 5. Check electric lift pump. 6. Fuel Regulator – Remove and inspect diaphragm for cuts or tears.
Fuel Pressure High and Air Pressure is Normal	1. Debris blocking fuel regulator hole. 2. Faulty pressure gauge
Fuel and Air Pressure Higher than Normal	1. Debris blocking air regulator passage. 2. Air dump hose (rail to air plenum) blocked/plugged.