



FUEL SYSTEM

Section 3C - Fuel Injection

Table of Contents

Specifications	3C-2	Throttle Position Sensor Test	3C-48
Special Tools	3C-3	Map Sensor Test	3C-49
Ignition Controller and Detonation Module ..	3C-6	Problem Diagnosis	3C-50
ECM Assembly	3C-8	Engine Head Temperature Sensor Removal	3C-53
Fuel Management System	3C-10	EFI Induction Manifold Removal	3C-54
Fuel Pump	3C-14	Water Separating Filter Assembly	
Electronic Fuel Injection (EFI) System	3C-16	Removal	3C-55
Introduction	3C-16	Water Separating Filter Assembly	
Using the Test Procedures	3C-16	Installation	3C-56
EFI System Tests	3C-16	Throttle Position Sensor and Temperature	
Safety Precautions	3C-16	Sensor Fuel Injector Harness	
Fuel Injection System Function	3C-17	Disconnections	3C-56
Preliminary Checks	3C-17	Oil Reservoir Removal	3C-58
Ignition Spark Check	3C-17	Fuel Pressure Regulator Removal	3C-59
Electronic Fuel Injection Set Up	3C-18	Fuel Pressure Regulator Disassembly ..	3C-60
Fresh Quality Fuel	3C-18	Fuel Pressure Regulator Reassembly ...	3C-60
Low Battery Voltage	3C-18	Vapor Separator Removal	3C-61
Fuel Flow Diagram	3C-19	Vapor Separator Disassembly	3C-63
Fuel Flow Component Description	3C-20	Installing Vapor Separator Assembly to	
EFI Electrical Components	3C-21	Induction Manifold	3C-69
EFI Fuel Management		Manifold Removal	3C-72
(Low Pressure Fuel Route)	3C-24	EFI Induction Manifold Disassembly	3C-74
EFI Fuel Management		Air Temperature Sensor Removal	3C-74
(High Pressure Fuel Route)	3C-25	Throttle Position Sensor Removal	3C-75
Fuel Rail Electrical/Fuel Determination	3C-26	Fuel Rail Removal	3C-76
EFI System Test Procedures	3C-27	Fuel Rail Disassembly	3C-78
Fuel Gauge Connection/Pressure Test ..	3C-27	Fuel Injector Removal and Disassembly .	3C-78
Vapor Separator Fuel Delivery Test	3C-28	Injector Harness Removal	3C-80
Vapor Separator Float Test	3C-29	Throttle Linkage Removed	3C-81
Water Separating Filter Flow Test	3C-30	EFI System Cleaning and Inspection	3C-82
Pulse Fuel Pump Delivery Test	3C-31	Cleaning	3C-82
Final Filter Check and De-Pressurizing		Inspection	3C-82
EFI System Procedures	3C-32	Induction Manifold Assembly	3C-83
Pressure Regulator Test	3C-34	Injector Harness Installation	3C-83
Electric Fuel Pump Voltage Test	3C-36	Fuel Injector Assembly and Installation ..	3C-84
Injector Electrical Harness Test	3C-39	Fuel Rail Assembly	3C-86
ECM Injector Driver Test	3C-40	Fuel Rail Installation	3C-86
Injector Fuel Delivery Test	3C-40	Throttle Position Sensor Installation	3C-88
Injector Operation Test		Air Temperature Sensor Installation	3C-89
(Manifold Cover Removed)	3C-40	EFI Induction Manifold Installation	3C-91
Induction Manifold Leak Check		Oil Reservoir Installation	3C-93
(Manifold Cover Removed)	3C-43	Vapor Separator Installation	3C-94
Air Temperature Sensor Test	3C-45	Throttle Position Sensor, Air Temperature	
Engine Head Temperature Sensor Test ..	3C-46	Sensor and Fuel Injector Harness	
Detonation Control System Test		Connections	3C-96
(200 Models Only)	3C-46	ECM Installation	3C-98
Detonation Sensor Check	3C-47	Engine Head Temperature Sensor	
Detonation Control Module Check	3C-48	Installation	3C-99



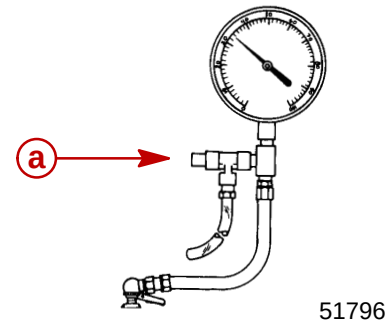
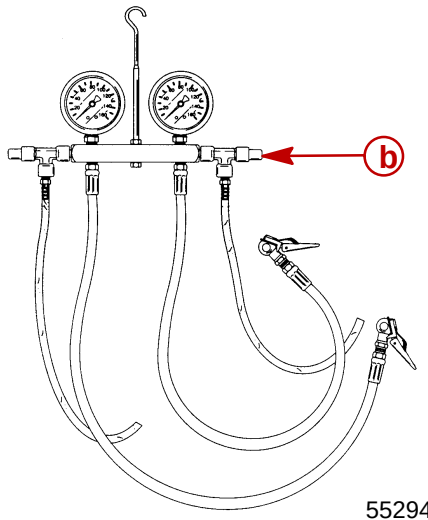
Specifications

Electronic Fuel Injection	
Idle RPM – All Models	1000 – 1100
Wide Open Throttle RPM	5750 – 6250
Float Adjustment (Vapor Separator) – Float Level	Preset @ Factory
Fuel Injectors –All Models (Quantity) –Ignition Controller Uses the Trigger Signal as an Injector Timing Signal as follows: – #1 Trigger Circuit – #3 Trigger Circuit – #5 Trigger Circuit	6 #3 and #4 Injectors #5 and #6 Injectors #1 and #2 Injectors
Line Pressure @ Injectors	34 psi – 36 psi (234kPa – 248kPa)

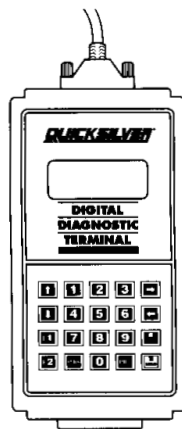


Special Tools

1. Fuel Pressure Gauge 91-16850A7 (a) or Fuel Pressure Gauge 91-852087A3(b).



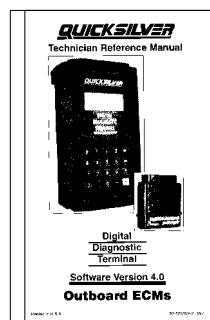
2. Digital Diagnostic Terminal (DDT) 91-823686T2



3. Software Cartridge 91-822608--5

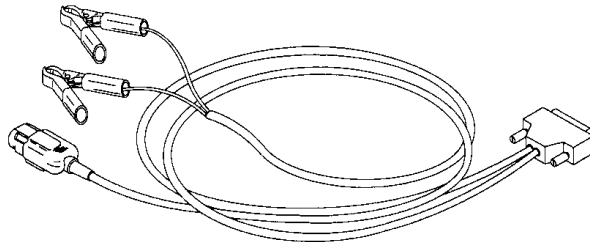


4. DDT Reference Manual 90-825159-3

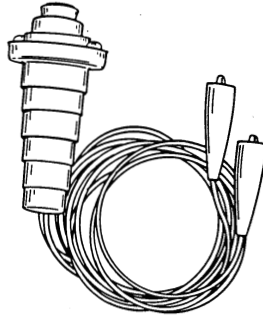




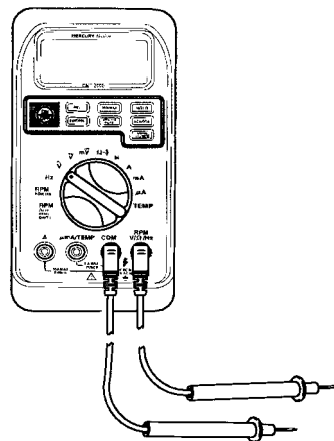
5. Adaptor Harness 84-822560A5 (use with DDT)



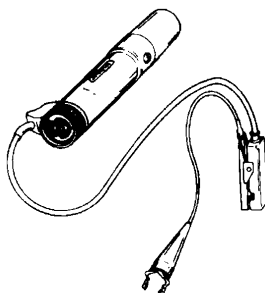
6. Remote Starter Switch 91-52024A1



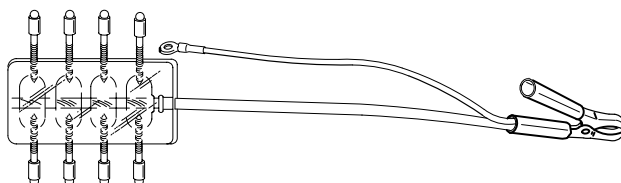
7. DMT 2000 Digital Tachometer Multi-meter P/N 91-854009A1



8. Inductive Timing Light 91-99379



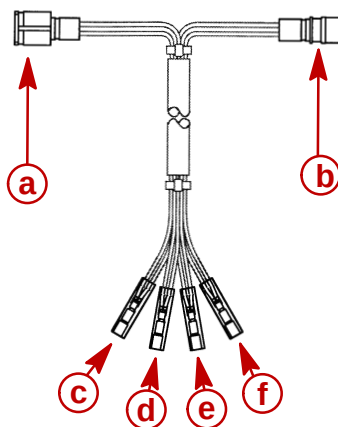
9. Spark Gap Tester 91-850439T



55117



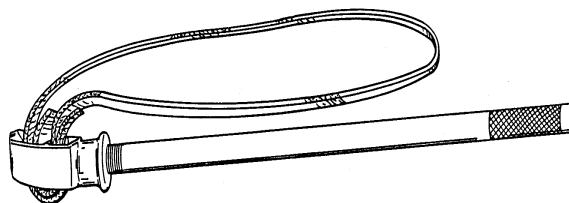
10. Injector Test Harness 91-833169A1. Can be used to verify that the ECM is supplying operating voltage to the injectors. Harness is connected between the injector harness and the engine harness. Harness is used in conjunction with DVA meter 91-99750A1. Harness will also serve as a convenient way to connect the injector harness to perform injector resistance test.



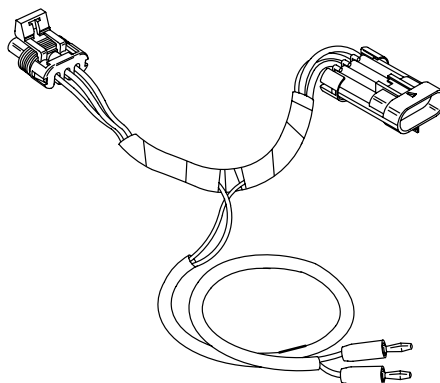
a - To Injector Manifold
b - To Engine Harness
c - RED

d - WHITE
e - BLUE
f - YELLOW

11. Strap Wrench 91-24937A1



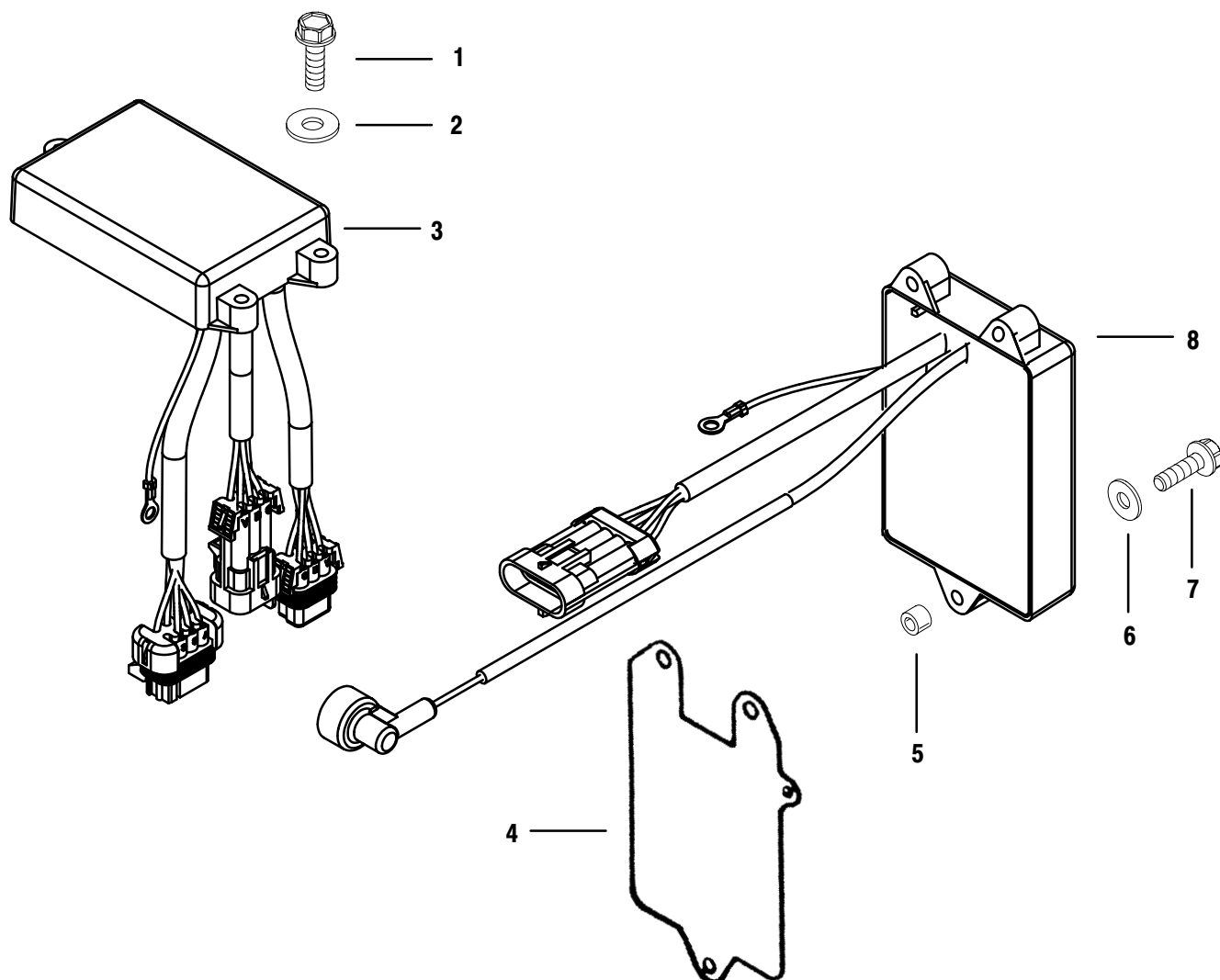
12. Throttle Position Sensor Test Harness (91-859199)



57766



Ignition Controller and Detonation Module



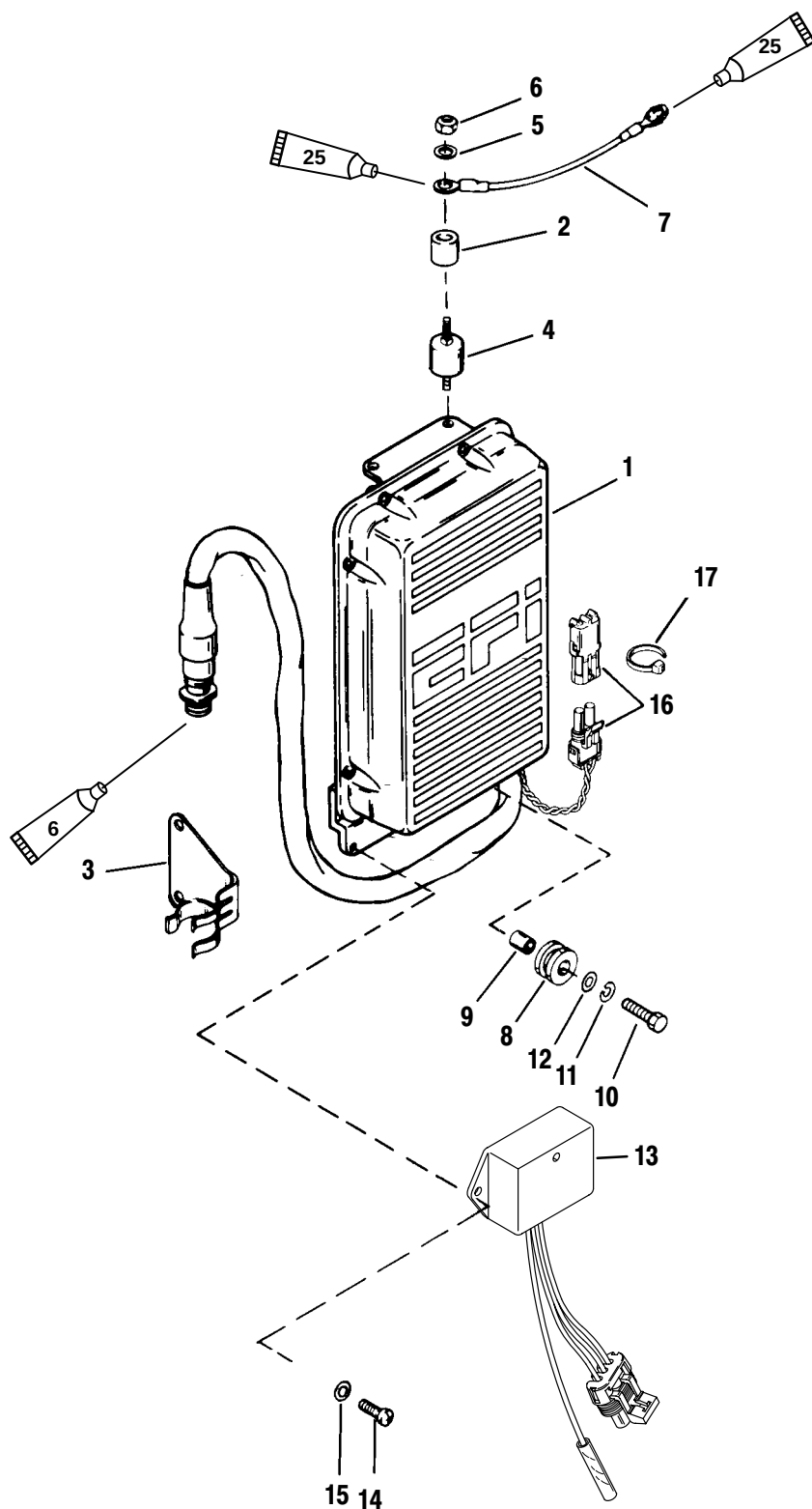


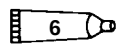
Ignition Controller and Detonation Module

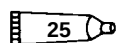
REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
1	3	SCREW (10-32 X 7/8)	30		3.5
2	3	WASHER			
3	1	IGNITION CONTROLLER			
4	1	PLATE			
5	3	BUSHING			
6	3	WASHER			
7	3	SCREW (3/16-32 X 1-5/8)	30		3.5
8	1	DETONATION MODULE			



ECM Assembly



 6 Dielectric Grease (92-823506--1)

 25 Liquid Neoprene (92-25711--2)

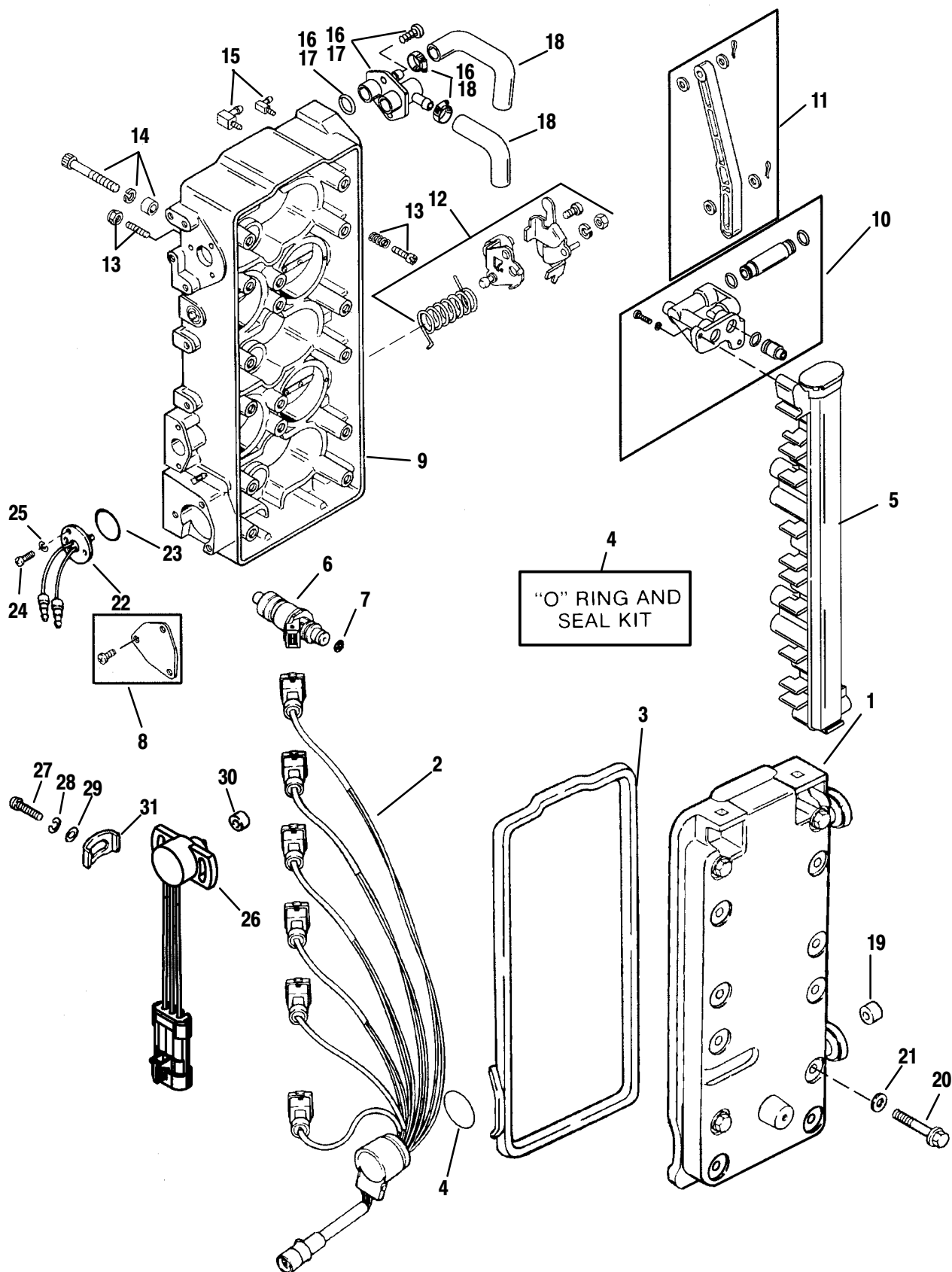


ECM Assembly

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
1	1	E.C.U. ASSEMBLY (150)			
	1	E.C.U. ASSEMBLY (175)			
	1	E.C.U. ASSEMBLY (200)			
2	2	SPACER			
3	1	CLIP			
4	2	MOUNT–cowl mounting bracket			
5	4	WASHER			
6	4	NUT	45		5
7	1	CABLE ASSEMBLY			
8	1	GROMMET			
9	1	BUSHING			
10	1	SCREW (1/4-20 x 1)	45		5
11	1	LOCKWASHER			
12	1	WASHER			
13	1	WATER SENSOR MODULE ASSEMBLY			
14	2	SCREW (3/16-32 x 1/2)	25		3
15	2	WASHER			
16	1	CONNECTOR (SERVICE)			
17	AR	STA–STRAP			



Fuel Management System



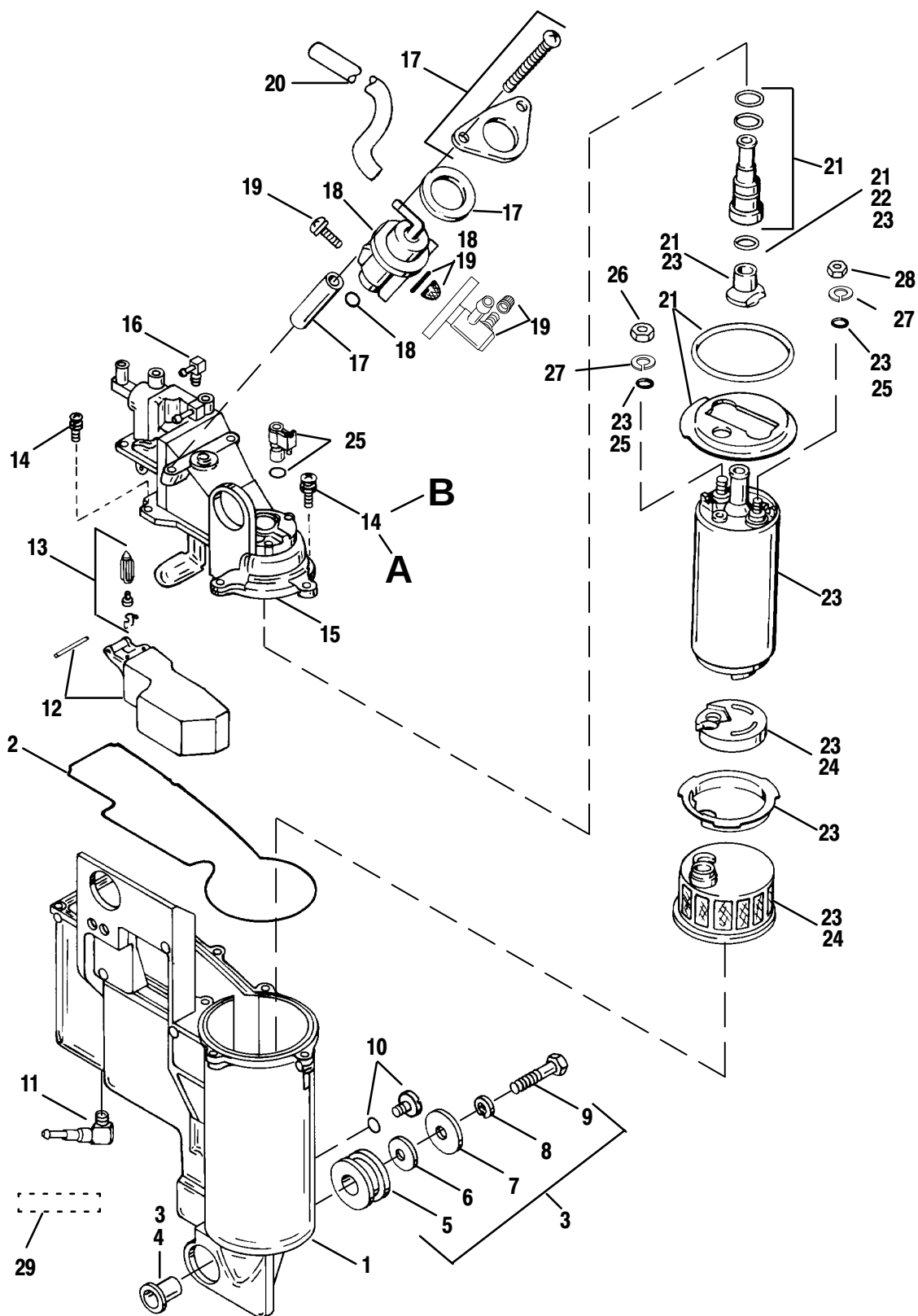


Fuel Management System

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
–	1	FUEL MANAGEMENT ASSEMBLY			
1	1	COVER			
2	1	HARNESS KIT			
3	1	SEAL			
4	1	O RING/SEAL KIT			
5	1	FUEL RAIL			
6	1	FUEL INJECTOR			
7	1	FILTER			
8	1	RETAINING KIT			
9	1	THROTTLE BODY			
10	1	JOINT KIT			
11	1	LINK			
12	1	LINK LEVER KIT			
13	1	STOP SCREW KIT			
14	1	SCREW KIT	45		5
15	1	ELBOW KIT			
16	1	SCHRADER VALVE KIT			
17	1	FMA JOINT KIT			
18	1	HOSE KIT			
19	1	ROLLER			
20	12	SCREW (1/4-20 x 4 IN.)	90		10
21	10	WASHER			
22	1	TEMPERATURE SENSOR ASSEMBLY			
23	1	O-RING			
24	3	SCREW (8-32 x 3/8)	Drive Tight		
25	3	LOCKWASHER			
26	1	INDICATOR–throttle position			
27	2	SCREW (8-32 x 5/8)	20		2
28	1	LOCKWASHER			
29	2	WASHER			
30	1	SLEEVE			
31	2	PLATE			



Fuel Management System



A = LARGE SCREW (5 MM) (TORQUE TO 30 LB. IN. (3.4 N.M))
B = SMALL SCREW (4 MM)(TORQUE TO 20 LB. IN. (2.3 N.M))

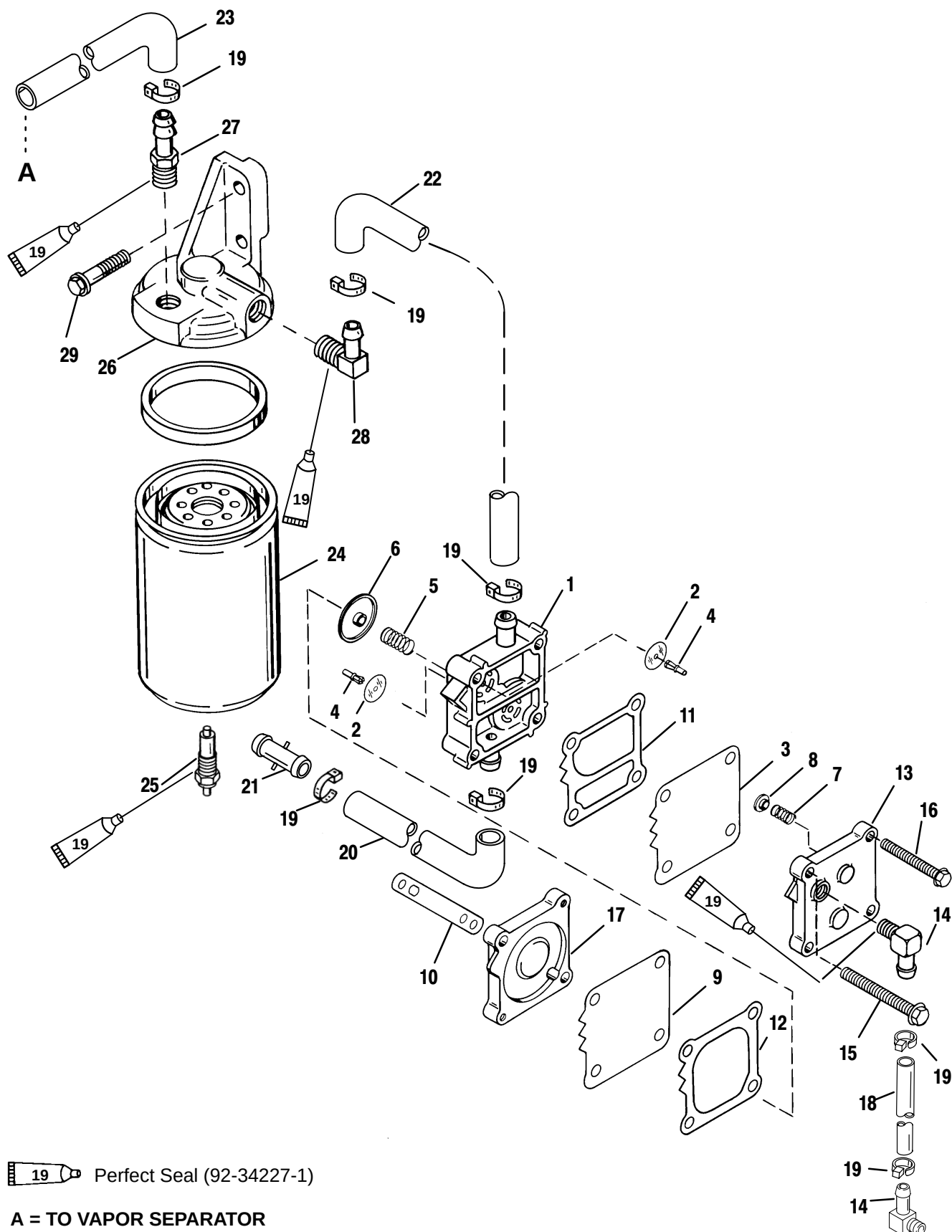


Fuel Management System

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
–	1	FUEL MANAGEMENT ASSEMBLY			
1	1	VAPOR SEPARATOR BODY KIT			
2	1	O RING			
3	1	MOUNTING SCREW KIT			
4	1	COLLAR			
5	3	GROMMET			
6	3	WASHER			
7	3	WASHER			
8	3	LOCKWASHER			
9	3	SCREW	45		5
10	1	DRAIN SCREW KIT			
11	1	CHECK VALVE			
12	1	FLOAT KIT			
13	1	FLOAT VALVE KIT			
14	1	SCREW KIT			
15	1	COVER KIT			
16	1	ELBOW KIT			
17	1	ATTACHING KIT	30		3.5
18	1	PRESSURE REGULATOR KIT			
19	1	SCHRADER VALVE KIT	45		5
20	1	TUBING KIT			
21	1	FUEL PUMP FITTING KIT			
22	1	O RING/SEAL KIT			
23	1	FUEL PUMP KIT			
24	1	FUEL STRAINER KIT			
25	1	ELECTRICAL CONNECTION KIT			
26	1	NUT (M4 x .7)	6		0.7
27	2	LOCKWASHER			
28	1	NUT (M5 x .8)	16		1.8
29	1	DECAL-EPA INFO (1998)			



Fuel Pump





Fuel Pump

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm.
–	1	FUEL PUMP ASSEMBLY			
1	1	FUEL PUMP ASSEMBLY			
2	1	CHECK VALVE			
3	1	DIAPHRAGM			
4	2	RETAINER			
5	1	SPRING			
6	1	CAP			
7	1	SPRING			
8	1	CAP			
9	1	DIAPHRAGM			
10	1	GASKET–base			
11	1	GASKET–Boost			
12	1	GASKET–Pulse			
13	1	PLATE–fuel pump			
14	2	ELBOW			
15	2	SCREW–pump to crankcase (M6 x 50)	55		6
16	2	SCREW–fuel pump (M5 x 40)	55		6
17	1	BASE–fuel pump			
18	1	FUEL LINE (6 IN.)			
19	7	STA STRAP			
20	1	FUEL LINE (10-1/2 IN.)			
21	1	CONNECTOR			
22	1	TUBING (15-1/2 IN.)			
23	1	TUBING (19 IN.)			
24	1	FUEL FILTER ASSEMBLY			
25	1	PROBE			
26	1	FUEL FILTER BASE			
27	1	CONNECTOR (STRAIGHT)			
28	1	ELBOW			
29	2	SCREW (1/4-20 x 1-1/8 IN.)			



Electronic Fuel Injection (EFI) System

Introduction

The troubleshooting information provided here consists of preliminary checks (checks to be followed before proceeding with EFI tests), diagrams (fuel flow and electrical wiring), component description (from diagrams), flow charts (low pressure fuel delivery, high pressure fuel delivery, fuel delivery vs. electrical delivery), problem diagnosis, and a series of test and check procedures that will help isolate problems associated with the fuel injection system. Each test/check (listed) can be completed without major fuel system disassembly.

Using the Test Procedures

Read the entire test before beginning to perform outlined procedures. Study the RESULTS material prior to testing. This will help in determining that each test is providing desired results.

EFI System Tests

- EFI Electrical System and ECM Check
- Fuel Gauge Connection/Pressure Test
- Vapor Separator Fuel Delivery Test
- Vapor Separator Float Test
- Water Separating Filter Flow Test
- Pulse Fuel Pump Delivery Test
- Final Filter Check
- Fuel Pressure Regulator Test
- Electric Fuel Pump Test
- Injector Electrical Test
- Injector Fuel Delivery Test
- Injector Operating Test (Manifold Cover Removed)
- Induction Manifold Leak Check (Manifold Cover Removed)
- Sensor Tests

Safety Precautions

⚠ CAUTION
Always use approved safety glasses or goggles when working on pressurized fuel systems.
⚠ DANGER
Motor fuels are extremely flammable. Do not show open sparks or flames when working near fuel systems.
⚠ WARNING
To avoid potential fire hazards, use extreme caution when connecting and disconnecting fuel line connections and test adaptors. Do not allow fuel to spill on hot engine parts or on live electrical connections.



⚠ CAUTION
Wipe up fuel spills immediately.
⚠ CAUTION
Depressurize fuel system prior to opening line connections or removing fuel system components.
⚠ DANGER
Perform the tests in this section in a well ventilated area to avoid being overcome by fuel vapors or poisonous exhaust gases.

Fuel Injection System Function

Fuel is delivered directly to the engine by way of fuel injectors. These injectors are provided with a constant supply of fuel (34 to 36 psi; 234 to 238 kPa) delivered to the fuel rail. The injectors are opened and closed electronically by the Electronic Control Module (ECM). The ECM receives input signals from various sensors in the EFI system which in turn transmits controlling outputs (open/close) to the injectors. The length of time the injectors stay open is considered pulse width. The pulse width will widen (richer) or narrow (leaner) depending on signals ECM receives from sensors, to allow efficient operation at all speeds and conditions.

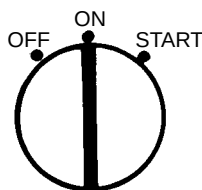
IMPORTANT: The following preliminary steps **MUST BE FOLLOWED** before attempting EFI problem diagnosis.

Preliminary Checks

Ignition Spark Check

Purpose: This test determines if the ignition system is delivering usable spark to the spark plugs. By performing this test, the probable cause can be isolated to either the ignition system or fuel system.

1. Disconnect all spark plug wires from spark plugs.
2. Connect spark gap tester Quicksilver (91-850439T) to a good ground on engine. Connect Spark Plug Extensions (91-877870A1) between tester and spark plug leads.
3. Connect Remote Starter Switch Quicksilver (91-52024A1).
 - a. Connect RED lead from switch to large positive (+) terminal with RED banded cable attached [(+) cable from battery].
 - b. Connect BLACK lead from switch to small terminal with YELLOW/RED lead attached.
4. Turn ignition key switch to the "ON" position.



5. Look at spark gap tester viewing port for presence of good quality spark.

Results: **IMPORTANT:** The presence of a good spark will not necessarily indicate condition of timing. Ignition timing may be off far enough to prevent the engine from starting, but still allow a good spark to be present in the spark gap tester.



A steady, blue spark should be present at each spark plug wire. If a good spark is present, problem may not be ignition related. If good spark is not present, problem may be ignition related. Trouble shoot ignition system or make sure engine timing is set correctly. Refer to appropriate ignition section in this service manual.

Ignition system failure (trigger, control module, wiring, etc.) can cause fuel delivery problems. Injectors are triggered in pairs by one, three, five trigger inputs.

No. 1 Triggers input No. 3 & 4 Injectors

No. 3 Triggers input No. 5 & 6 Injectors

No. 5 Triggers input No. 1 & 2 Injectors

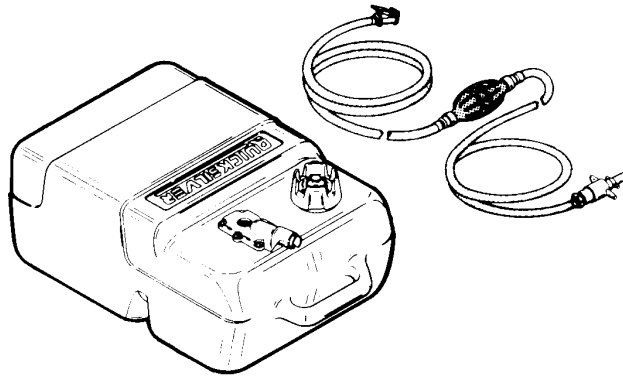
Failure in one or more of these primary circuits will cause no spark and no fuel to respective cylinders (above). Check spark and spark plugs on all cylinders before attempting EFI tests.

Electronic Fuel Injection Set Up

IMPORTANT: Follow EFI Timing/Synchronizing/Adjustment section 2C before attempting tests on EFI system.

EFI set up procedures must be followed before tests on system are performed (refer to Section 2C). Improper set up can result in poor engine performance (i.e. uncontrollable idle speeds, lean sneezing, low power during acceleration or engine will simply not run.) Failure to properly set up the EFI system can lead to misdirections in solving simple problems in the EFI system.

Fresh Quality Fuel



Using a remote fuel tank containing a major brand of premium unleaded gasoline, test run the outboard to eliminate any problems related to restricted fuel supply (clogged lines, malfunctioning anti-siphon valve, etc.) and/or marginal gasoline.

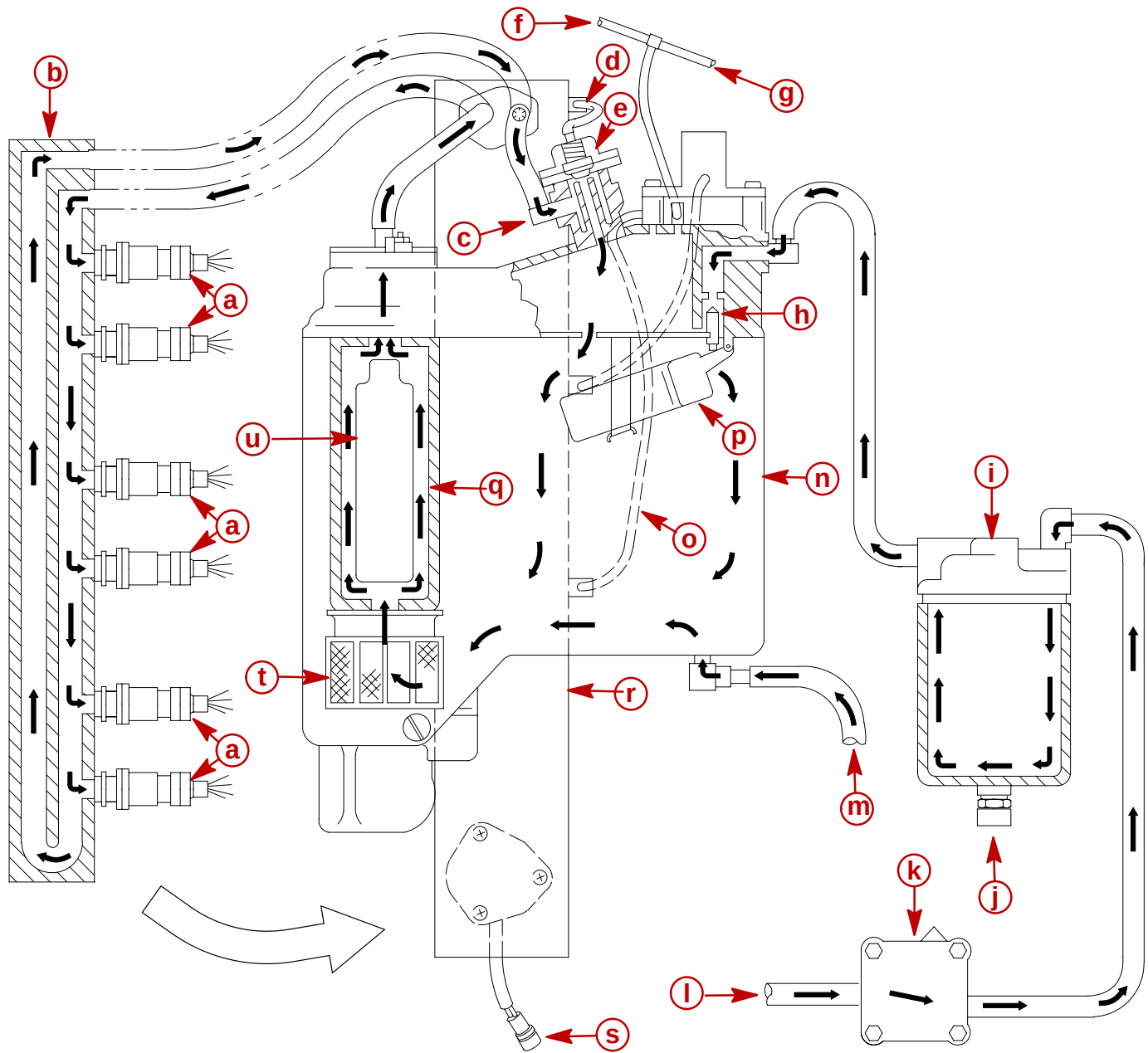
Low Battery Voltage

Low battery voltage can cause EFI system to deliver fuel in an inconsistent manner.

Inspect battery connections and charging system, refer to Section 2B. The EFI system requires a substantial amount of voltage to function properly. Operating engine at a low RPM for an extended period of time can cause low voltage.



Fuel Flow Diagram



58185

- | | |
|--|--|
| a - Fuel Injectors (6) | l - From Fuel Tank |
| b - Fuel Rail | m - From Oil Pump |
| c - Fuel Rail Pressure Port | n - Vapor Separator |
| d - Fuel Pressure Regulator Manifold Hose | o - Vapor Separator to Manifold Vent Hose |
| e - Fuel Pressure Regulator | p - Vapor Separator Float |
| f - To Starboard Bleed Junction Block | q - Electric Fuel Pump |
| g - To Port Bleed Junction Block | r - Manifold |
| h - Needle and Seat | s - Injector Wiring Harness |
| i - Water Separator | t - Final Filter |
| j - Water Sensor | u - Armature |
| k - Pulse Fuel Pump | |



Fuel Flow Component Description

Pulse Fuel Pump (k)

The pulse fuel pump operates through alternating crankcase pressure to deliver fuel through the water separating filter to the vapor separator.

Fuel pressure @ Idle – 2 – 3 psi (13.8 – 20.7 kPa) [Minimum – 1 psi (6.9 kPa)].

Fuel Pressure @ Wide-Open-Throttle – 6 – 8 psi (41.4 – 55.2) [Minimum – 4 psi (27.6 kPa)].

Water Separating Filter (i)

The water separating filter protects the fuel injectors from water and debris. The filter contains a sensor probe which monitors water level in the filter. If water is above the sensor probe, the water detection light will come on and the warning horn will begin a series of beeps.

Vapor Separator (n)

The vapor separator is a fuel reservoir which continuously blends and circulates fresh fuel, oil and unused fuel/oil from the fuel rail.

- a. Fuel Inlet – Fresh fuel delivered from the water separator by the crankcase mounted pulse fuel pump. The amount of fuel allowed to enter the vapor separator is controlled by a needle/seat and float assembly mounted in the cover of the vapor separator.
- b. Oil Inlet – Oil delivered by the crankshaft driven oil pump.
- c. Crankcase Bleed Inlet – Recirculated (unburned) fuel/oil mixture delivered from the bleed lines through a filter into the vapor separator.
- d. Fuel Pressure Regulator Inlet – Unused fuel/oil mixture being recirculated from the fuel rail back into the vapor separator.

Bleed System (f,g)

On carbureted engines, excess fuel which collects in the crankcase is channeled into the transfer ports to be burned.

On EFI engines, excess crankcase fuel is emptied into the vapor separator. It mixes with fresh incoming fuel and is pumped to the fuel rail and fed through the injectors.

Final Filter (t)

The final filter is located below the electric fuel pump in the vapor separator. The filter collects debris and prevents them from flowing through the electric pump and into the fuel rail and injectors.

Electric Fuel Pump (Inside Vapor Separator) (q)

The electric fuel pump runs continuously while providing fuel in excess of engine demands. The excess fuel is circulated through the fuel rail to the fuel pressure regulator and back to the vapor separator. Normal fuel pressure is 34 – 36 psi (234 to 248 kPa).



Fuel Injectors (a)

The fuel injectors are located inside the induction manifold on the fuel rail. The injector valve body consists of a solenoid actuated needle and seat assembly. The injector receives signals from the EFI Electronic Control Module. These signals determine how long the needle is lifted from the seat (pulse width) allowing a measured fuel flow. The pulse width will widen (richer) or narrow (leaner) depending on various signals received from sensors connected to the EFI ECM. The ECM receives signals from the primary ignition circuit of cylinders #1, #3 and #5 to fire each pair of injectors accordingly.

A four wire harness connects the fuel injectors to the ECM. The RED wire is at 12 volts and connects to all injectors. The BLUE, YELLOW and WHITE wires each go to a pair of injectors and are normally at 12 volts for a zero differential. To fire the injectors this voltage is brought down to near ground creating a potential across the injectors.

Induction Manifold (r)

The induction manifold is a common plenum chamber for accurate pressure measurement. It contains 4 throttle shutters on 2 throttle shafts. The shutter opening (idle air opening) can be adjusted during EFI set-up procedure. The manifold contains the fuel rail, injectors, throttle position sensor and air temperature sensor. A fuel rail pressure port is located on the fuel pressure regulator.

Fuel Pressure Regulator (e)

The fuel pressure regulator is located on top of the vapor separator and is continuously regulating fuel pressure produced by the electric fuel pump. The electric pump is capable of producing 90 psi (621 kPa) of fuel pressure. The pressure regulator limits fuel pressure at the injectors to 34 to 36 psi (234 to 248 kPa).

EFI Electrical Components

ELECTRONIC CONTROL MODULE (ECM)

The ECM is continually monitoring various engine conditions (engine temperature, engine detonation control, engine throttle opening) and climate conditions (induction air temperature, barometric pressure and altitude level) needed to calculate fuel delivery (pulse width length) of injectors. The pulse width is constantly adjusted (rich/lean conditions) to compensate for operating conditions, such as cranking, cold starting, climate conditions, altitude, acceleration and deceleration, allowing the outboard to operate efficiently at all engine speeds.

12 Volt Battery - The 12 volt battery provides power to the ECM even with the ignition switch in the "OFF" position.

IMPORTANT: When disassembling EFI System DISCONNECT BATTERY CABLES.

Starter Solenoid - Provides 12 volt signal when key is in the "start" position. In the "start" position, injector pulse widths are tripled when engine head temperature is below 90° F (32.2° C) to provide adequate fuel for quick start up. When key is returned to the run position or engine head temperature is above 90° F (32.2° C), pulse widths return to normal value.

Fuel Injectors - A four wire harness connects the fuel injectors to the ECM. The red wire is at 12 volts and connects to all injectors. The blue, yellow and white wires each go to a pair of injectors and are normally at 12 volts for a zero differential. To fire the injectors this voltage is brought down to near ground creating a potential across the injectors.



Electric Fuel Pump - The ECM contains a fuel pump driver circuit that provides power to the electric fuel pump. The fuel pump does not have its negative terminal (–) “BLACK/RED wire” grounded to the pump housing. The fuel pump positive terminal (+) “RED wire” and the negative terminal (–) are at 12 volts with the ignition switch in the off position for a zero differential. When the pump is on, the negative terminal is brought down to near ground (i.e. 1.5 volts).

SENSOR INTERACTION WITH THE ECM

IMPORTANT: DO NOT run engine for extended periods of time with sensors disconnected or bypassed (shorted). Serious engine damage may result.

AIR TEMPERATURE SENSOR

The air temperature sensor transmits manifold absolute air temperature, through full RPM range, to the ECM. As air temperature increases “sensor” resistance decreases causing the ECM to decrease fuel flow (leaner mixture). Disconnecting the air temp sensor (open circuit) will increase fuel flow (richen mixture) by 10%. Bypassing air temp sensor (short in circuit) will cause fuel flow to decrease 10%. The air temperature sensor circuit can be tested using the EFI tester. The air temperature sensor can be tested following air temperature sensor test on page 3C-45.

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The map sensor is a non-serviceable sensor mounted in the ECM box. The MAP sensor is used to sense changes in manifold absolute pressure and is connected to the intake manifold by the way of a vacuum hose. The MAP sensor is functioning through the full RPM range and is continually signaling induction manifold pressure readings to the ECM. The ECM in turn determines fuel flow as signals are received. Drawing a vacuum on the MAP sensor hose will create a lean fuel condition altering engine operation. If no change occurs when drawing vacuum, MAP sensor is not functioning properly.

MAP sensor can be tested with the DDT tester, page 3C-50.

ENGINE HEAD TEMPERATURE SENSOR (PORT CYLINDER HEAD)

The Engine Head Temperature Sensor provides the ECM signals related to engine temperature to determine level of fuel enrichment during engine warm up. The ECM is receiving information at all engine temperatures but stops fuel enrichment at an engine temperature of 90° F (32° C). An open circuit on the temperature sensor will increase fuel flow up to 40% but will not be affected at wide open throttle. If no change occurs when sensor is disconnected, sensor may not be functioning properly. The engine head temperature sensor can be tested following Engine Head Temperature Sensor Test on page 3C-46.

NOTE: *If sensor does not make clean contact with cylinder head a rich condition may exist.*

THROTTLE POSITION SENSOR (TPS)

The TPS transmits information to the ECM during low speed and mid range operation, related to throttle angle under various load conditions. TPS adjustment is a critical step in engine set up (Section 2C). Disconnecting the TPS will increase fuel flow 40% at idle but does not effect WOT. The TPS can be tested following the Throttle Position Sensor Test on page 3C-49.

NOTE: *The higher the voltage, the richer the fuel flow. Refer to TPS Adjustment (Section 2C).*



WATER SENSING SYSTEM

The system consists of a water separating fuel filter (starboard side powerhead), sensing probe (bottom of filter) and a water sensing module (below ECM box). The water sensing module has four wires:

PURPLE - Connects to 12 volt power supply.

LIGHT BLUE - Connects to lube alert, which sounds the warning horn when activated.

TAN - Connects to sensing probe.

BLACK - Connects to ground.

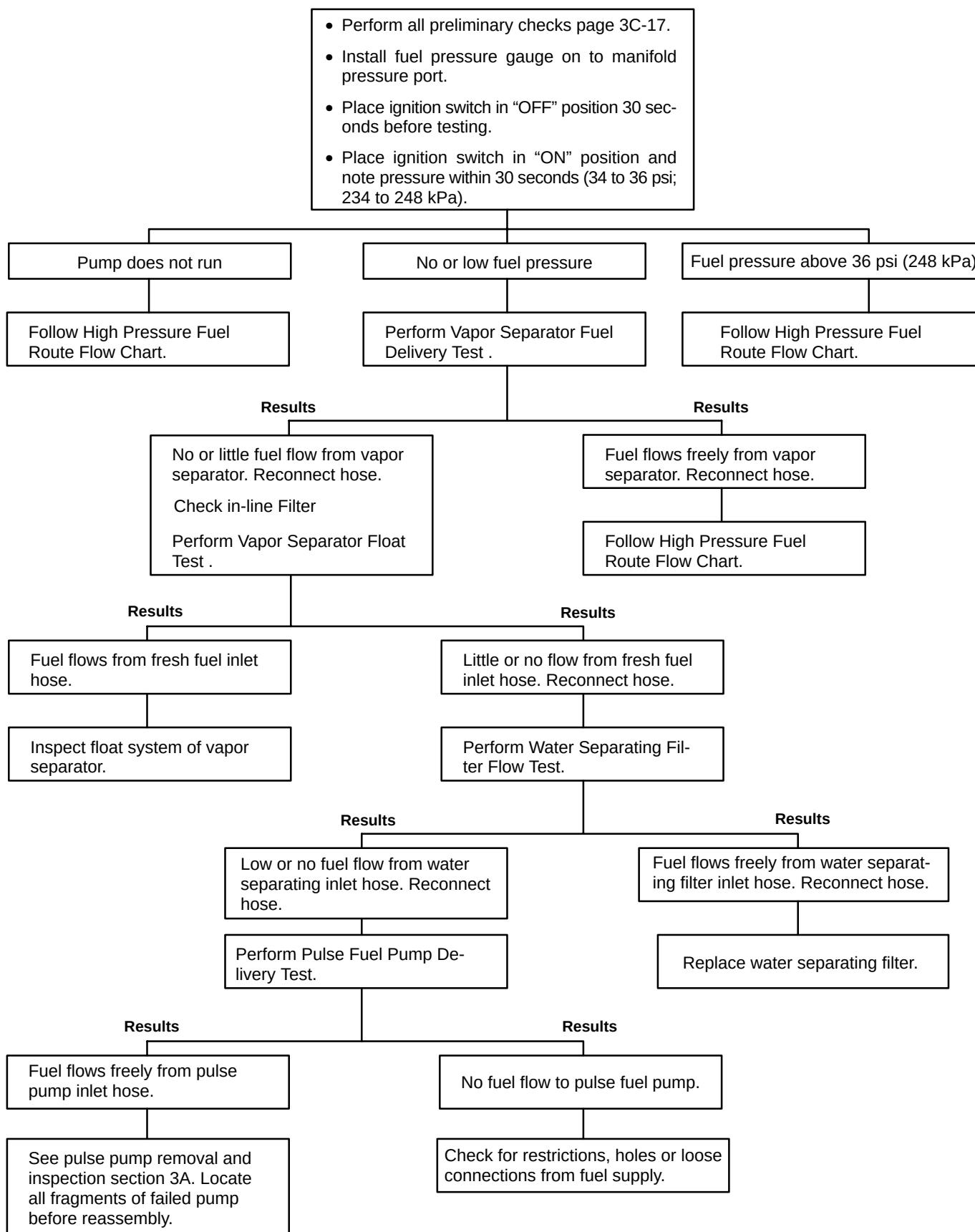
WATER SENSING SYSTEM FUNCTION

1. The filter separates the accumulated water from the fuel.
2. A voltage is always present at sensing probe. When water reaches top of probe it completes the circuit to ground.
3. The completed circuit activates the warning. The warning has a 5-10 second delay, then the module's red light illuminates and warning horn intermittently sounds.

The system can be tested by disconnecting the TAN wire from sensor probe and holding to a good engine ground connection for 10 seconds.

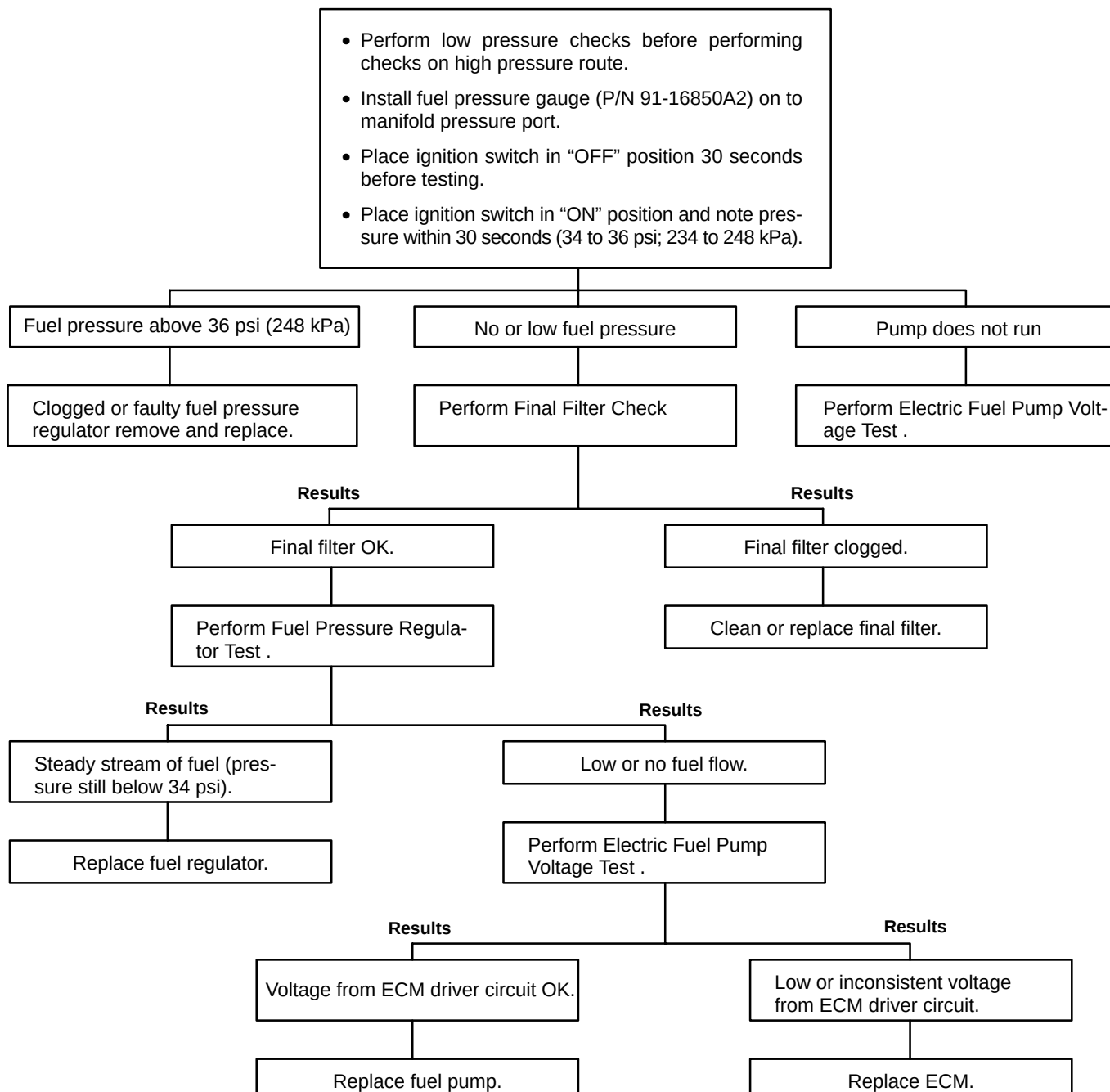


EFI Fuel Management (Low Pressure Fuel Route)





EFI Fuel Management (High Pressure Fuel Route)

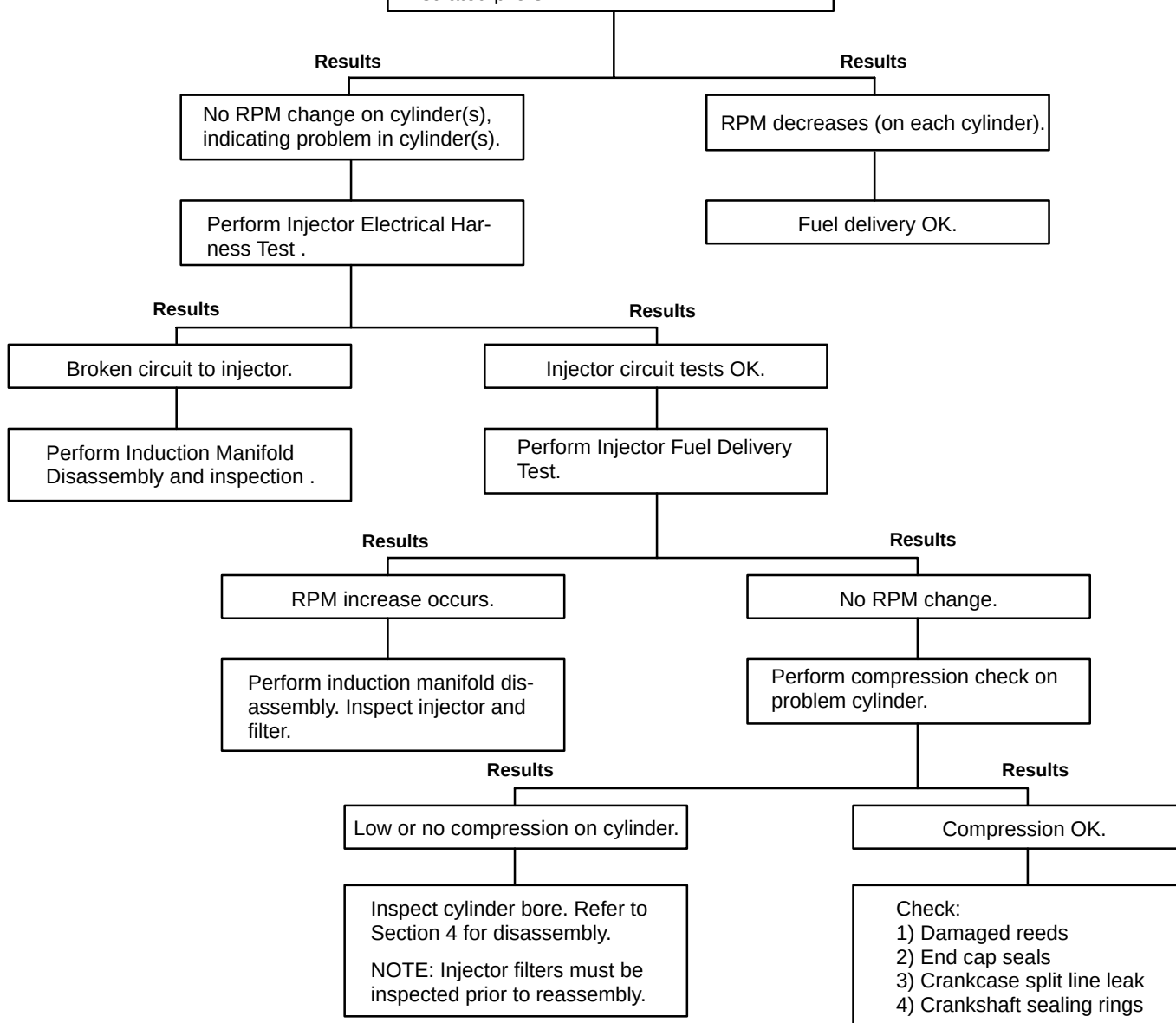




Fuel Rail Electrical/Fuel Determination

- Perform all preliminary checks page 3C-17.
- Adequate fuel pressure (34 to 36 psi; 234 to 248 kPa) follow Low/High Fuel Route Flow Charts.
- Place sport jet in water and run engine between 2000 and 2500 RPM.

With engine running (2000-2500 RPM) remove spark plug leads one at a time using insulated pliers.





EFI System Test Procedures

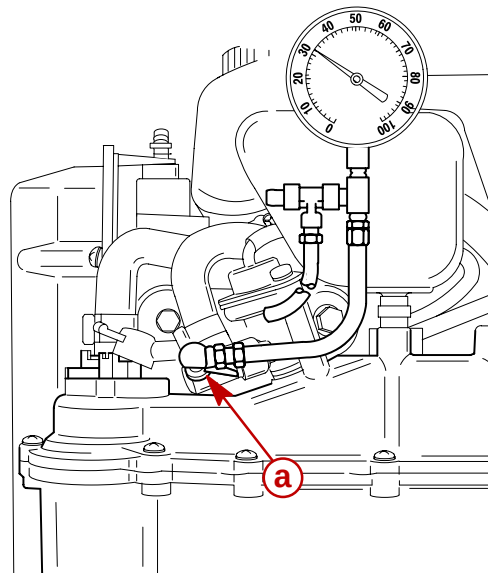
Fuel Gauge Connection/Pressure Test

IMPORTANT: When checking fuel pressure while engine is running, fuel pressure may fluctuate. Fuel pressure fluctuation (i.e. 34 to 36 psi “234 to 248 kPa”) is common, as the regulated pressure is a differential between fuel rail and manifold vacuum.

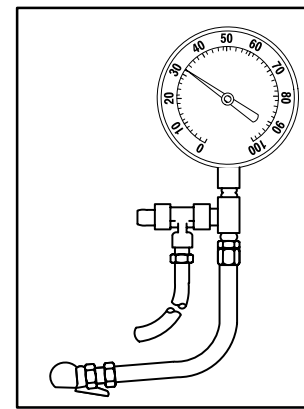
Purpose: Checking fuel manifold pressure ensures that fuel under usable pressure is available to the fuel injectors. This test isolates the probable cause as either a fuel delivery or EFI electrical system failure.

IMPORTANT: Fuel pressure should be monitored through full RPM range to determine fuel supply problems at high engine speeds.

1. Connect fuel pressure gauge to induction manifold pressure port.



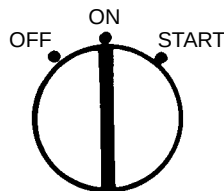
a - Pressure Port



91-16850

55180

2. Turn ignition key switch to “ON” position.



3. Operate electric fuel pump for approximately 10 seconds.

NOTE: Fuel pump will only operate for approximately 30 seconds. By turning the key switch to “OFF” and then back to “ON” the pump will operate for 30 seconds more.

4. Take reading on fuel pressure gauge.

Results: If pressure reading is 34 to 36 psi (234 to 248 kPa), the electric fuel pump is providing fuel with enough pressure to be used by the injectors. Pump malfunction is not the cause of EFI trouble.

If fuel pressure is well below 34 psi (234 kPa), fuel delivery to electric fuel pump, fuel pump failure or other related problem exists. Follow low/high fuel pressure flow charts.

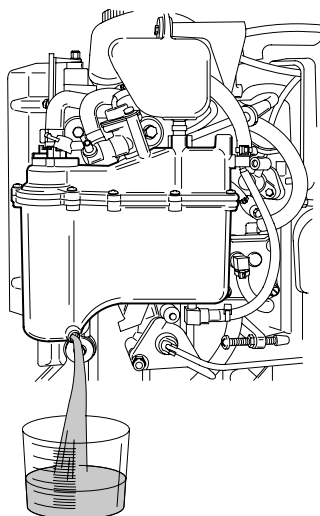
If fuel pressure is above 36 psi (248 kPa) go to fuel pressure regulator test.



Vapor Separator Fuel Delivery Test

Purpose: Verifying there is adequate fuel flow to the electric fuel pump (through full RPM range) will determine components in low pressure fuel system are functioning correctly.

1. Remove vapor separator drain plug and place a clean container under drain.



55177

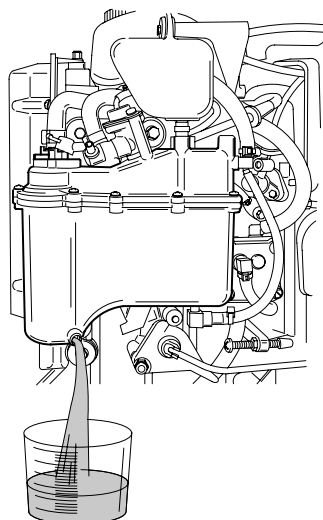
Results: If fuel flow is present, fuel is being delivered to electric fuel pump. Go to high pressure flow chart.

If fuel flow is not present, proceed to step 2.

2. Place emergency stop switch in OFF position to prevent engine from starting. If boat is not equipped with a emergency stop switch, connect a jumper lead from the BLACK/YELLOW bullet connector to engine ground.
3. Turn ignition key switch to “START” and operate starter motor for 10 to 20 seconds.



4. Look for fuel flow from hose.



55177

Results: If low or no fuel flow is present, inspect water separating fuel filter and perform Vapor Separator Float Test.

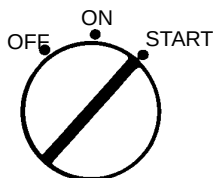


Vapor Separator Float Test

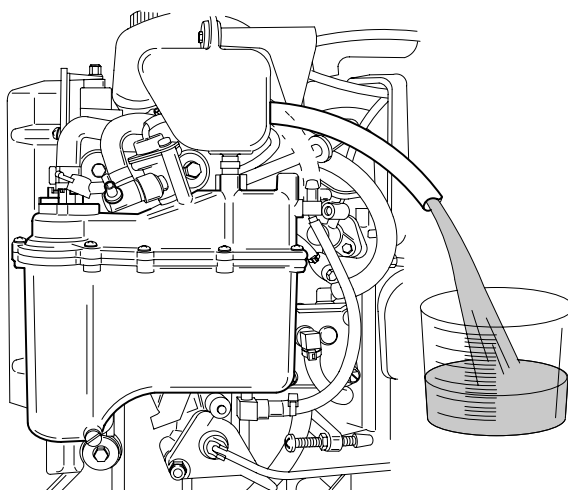
Purpose: This test will indicate if float is stuck in the up position.

NOTE: If float is stuck down, vapor separator will over flow causing a rich condition.

1. Remove fuel inlet hose from vapor separator and put end of hose in clean container.
2. Remove all spark plugs from engine to prevent engine from starting.
3. Turn ignition key switch to "START" position and operate starter motor for 15 to 20 seconds.



4. Look for fuel flow from hose.



55178

Results: If fuel flow is present at hose, remove, disassemble and inspect float assembly. See vapor separator disassembly.

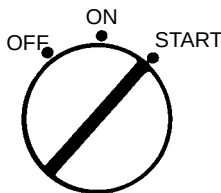
If fuel flow is low or not present, perform Water Separating Filter Flow Test.



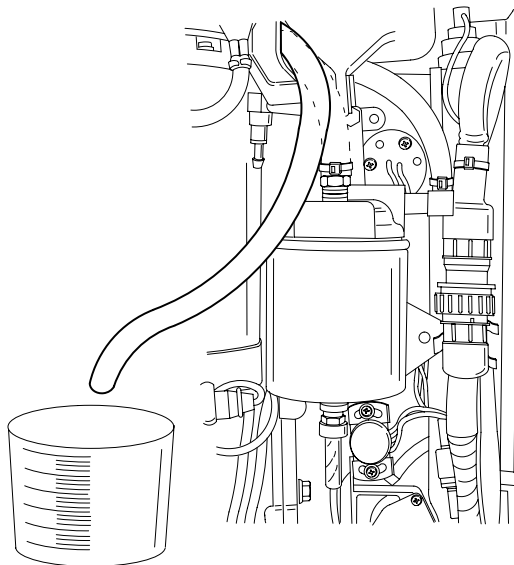
Water Separating Filter Flow Test

Purpose: This test will indicate if water separating filter is clogged.

1. Remove fuel inlet hose to water separating filter. Put end of hose in clean container.
2. Place emergency stop switch in OFF position to prevent engine from starting. If boat is not equipped with a emergency stop switch, connect a jumper lead from the BLACK/YELLOW bullet connector to engine ground.
3. Turn ignition key switch to "START" and operate starter motor for 10 to 20 seconds.



4. Look for fuel flow from hose.



55183

Results: Fuel flows from water separating inlet hose. Remove and replace clogged filter.

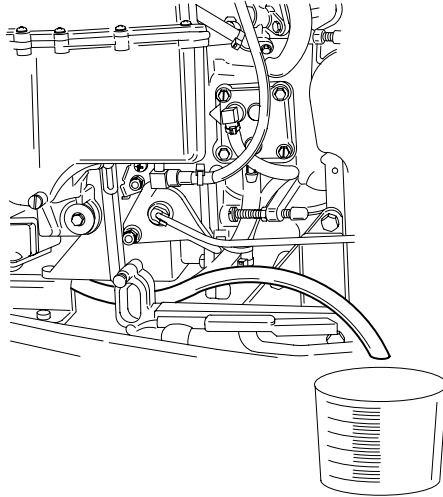
Low or no fuel flow from water separating inlet hose. Perform electric fuel pump delivery test. If test results are ok, disassemble pulse fuel pump and inspect for damaged check valves, gaskets, etc. All fragments of failed pump must be located before reassembly.



Pulse Fuel Pump Delivery Test

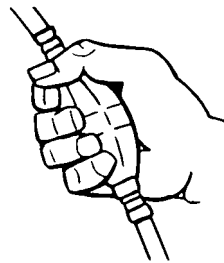
Purpose: This test will indicate pulse fuel pump is capable of supplying the low pressure fuel route with adequate fuel supply.

1. Remove inlet hose to pulse fuel pump and put end into clean container.

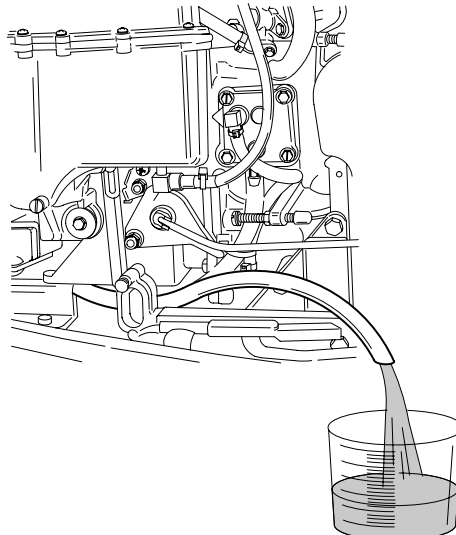


55188

2. Squeeze primer bulb several times.



3. Look for fuel flow from hose.



55187

Results: Fuel flows freely from pulse pump inlet hose. Remove, disassemble, and inspect pulse fuel pump.

IMPORTANT: All fragments of failed pump must be located before re-assembly.

No or low fuel flow from pulse pump inlet hose. Check for restrictions, holes, or loose connections from fuel supply.

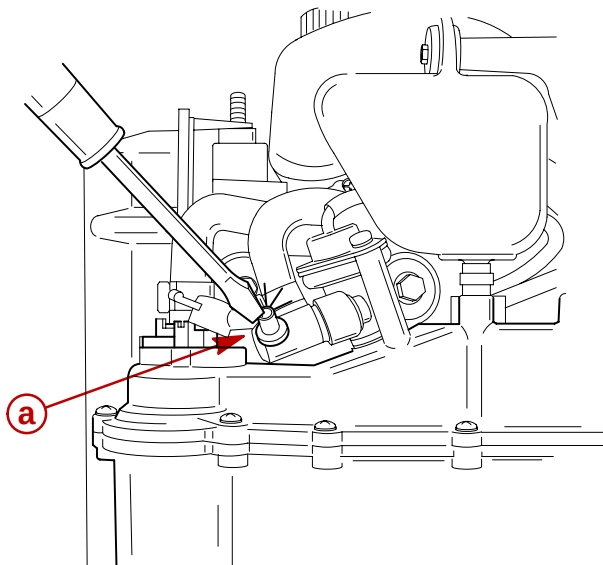
NOTE: Inspect anti-siphon valve on tank.



Final Filter Check and De-Pressurizing EFI System Procedures

Purpose: Checking the final filter for obstructions, damage etc. eliminates this component as a possible source of restriction in the system.

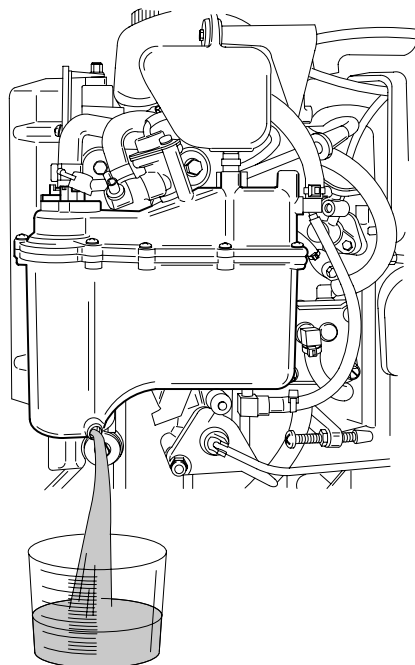
1. De-pressurize EFI fuel system by wrapping a clean cloth around pressure port valve and inserting tip of screwdriver into valve, depressing valve core. Let fuel drain from valve.



55179

a - Pressure Port

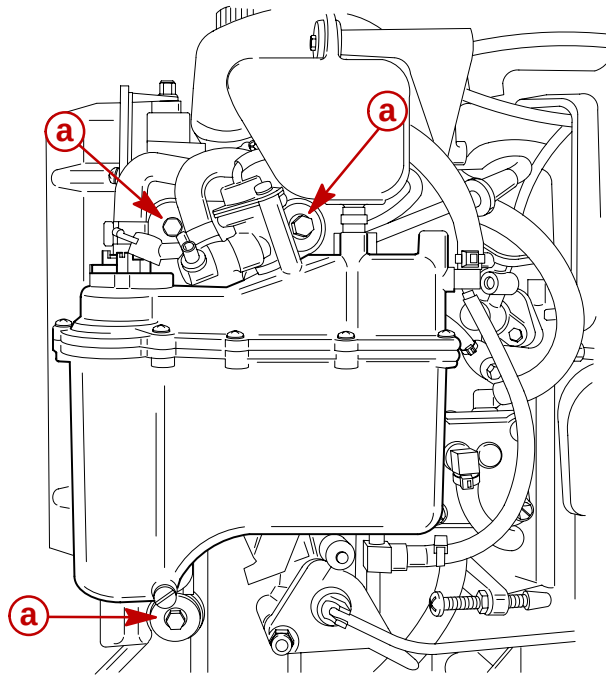
2. Remove drain plug from vapor separator and allow fuel to drain into suitable container.



55177



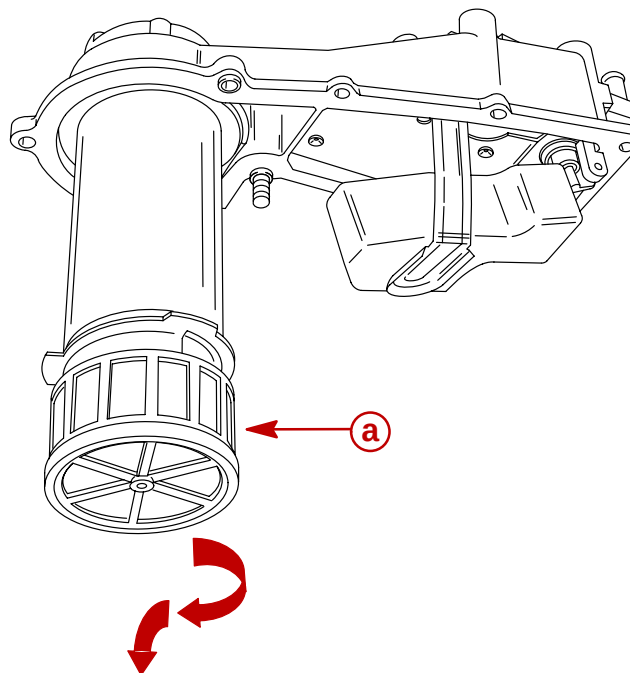
3. Remove 3 bolts securing vapor separator assembly to manifold.



55176

a - Bolts

4. Tilt vapor separator assembly out from manifold and remove 9 screws securing cover.
5. Remove vapor separator tank from cover.
6. Rotate inlet filter counterclockwise and pull downward to remove filter from fuel pump.



58163

a - Inlet Filter

7. Inspect filter for debris or damage.

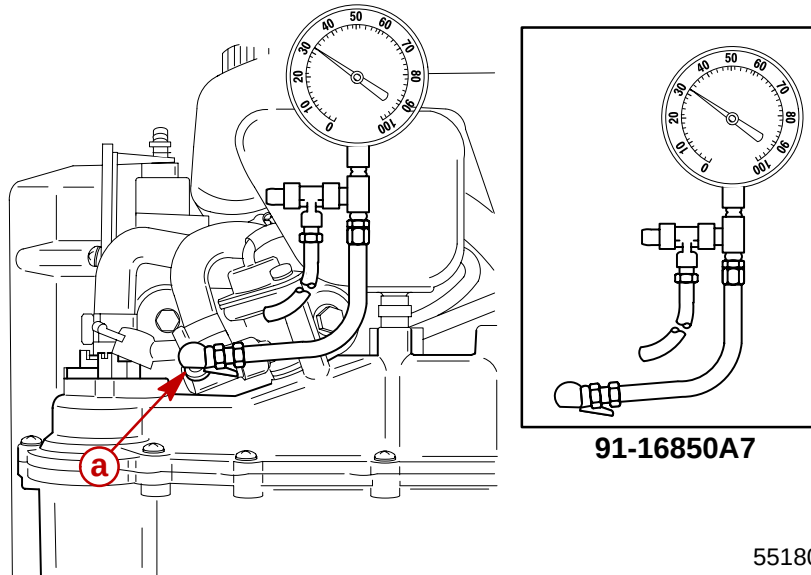
Results: If filter is clogged with debris, clean filter with solvent and compressed air or replace filter. Reassemble vapor separator to manifold and recheck fuel pressure. If pressure is still below 34 psi (234 kPa), perform fuel Pressure Regulator Test.



Pressure Regulator Test

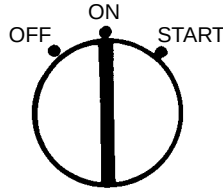
Purpose: This test will determine if a weak, plugged or open pressure regulator is causing inadequate fuel pressure in the system.

1. Connect pressure gauge to EFI test port.

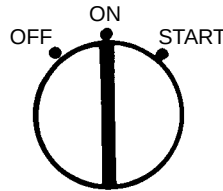


a - Test Port

2. Turn ignition key switch to "ON" position and check fuel pressure reading on gauge. If pressure reading is below 34 psi (234 kPa) go to step 3 following.

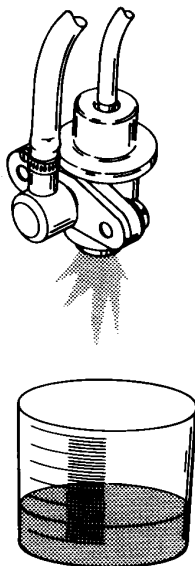


3. Remove fuel pressure regulator, but do not disconnect any hoses from regulator.
4. Put discharge end of regulator in clean container.
5. Turn ignition key switch to "ON" position.





6. Check for fuel flow out of regulator.



Results: If steady stream of fuel exits regulator into container and pressure is below 34 psi (234 kPa), replace pressure regulator.

If low or no fuel exits regulator into container and pressure is below 34 psi (234 kPa), perform voltage checks on electric fuel pump, following.

If low or no fuel flow exits regulator into container and pressure is above 36 psi (248 kPa), replace regulator.



Electric Fuel Pump Voltage Test

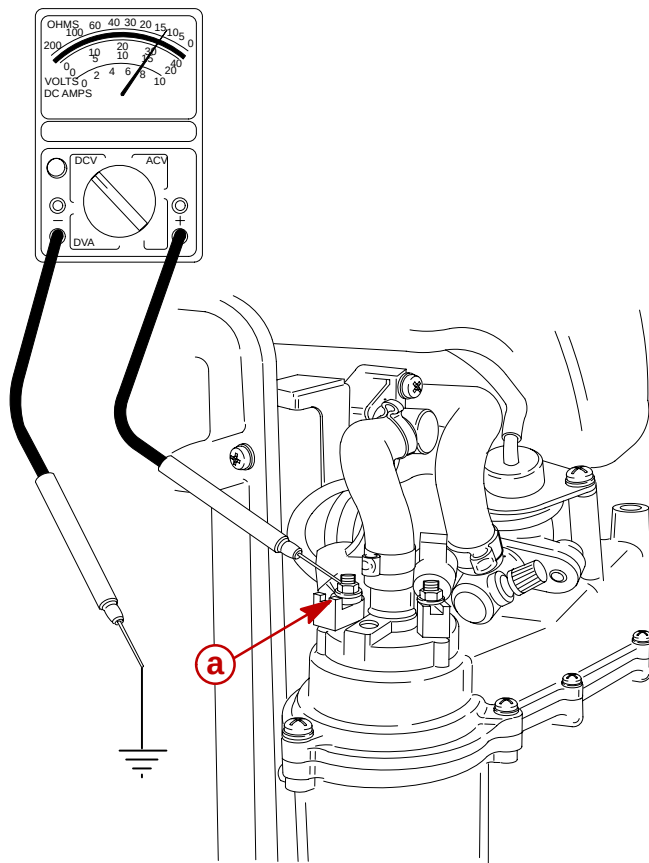
⚠ CAUTION

When checking voltage at pump, DO NOT pry boot covers off terminals with a metal object, as each terminal is at 12 volts when engine is off. Serious damage to electric fuel pump and/or ECM box can result.

Purpose: If insufficient electrical power is available at the pump, no or low fuel pressure will be developed.

1. Set volt meter to read battery voltage and connect black test lead to ground, positive test lead to positive (+) post of fuel pump.

NOTE: Positive test lead can be pierced through boot cover for testing. Refer to voltage test chart (page 3C-37) for voltage readings.



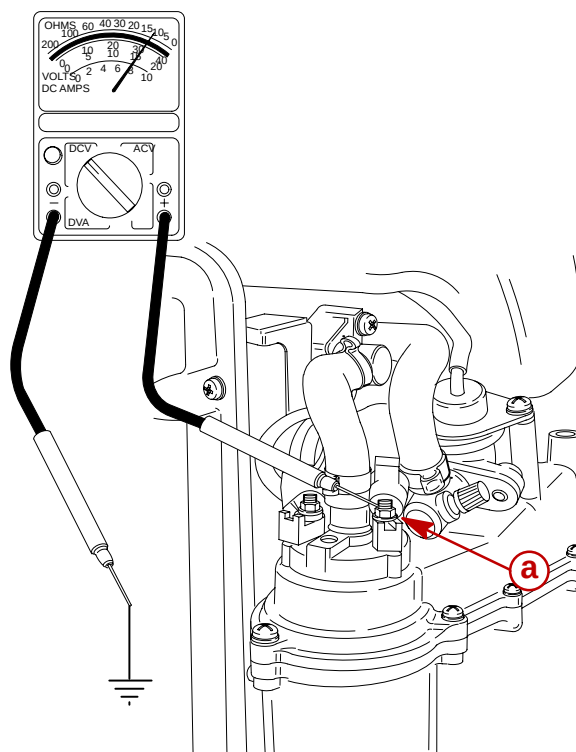
a - Positive (+) Terminal

55191



- Set volt meter to read battery voltage and connect BLACK test lead to ground, POSITIVE test lead to NEGATIVE (–) post of fuel pump.

Negative Test Terminal



55192

a - Negative (–) Terminal

- Perform voltage tests below.

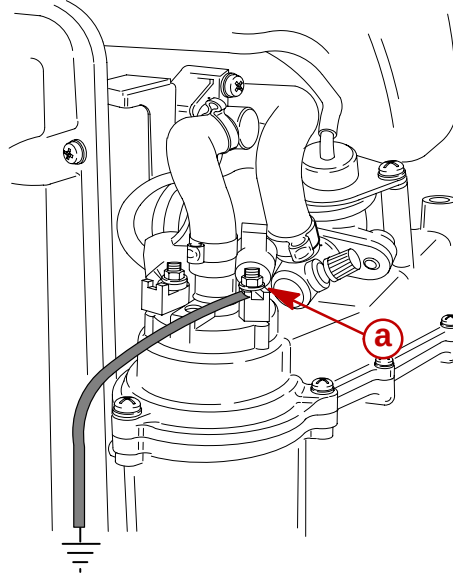
VOLTAGE TEST CHART

Engine Mode	BLACK Meter Lead to Engine Ground; RED Meter Lead to:	Approximate Voltage Reading	If Approximate Voltage is not obtained, this indicates:
1. All models	(+) terminal of fuel pump	12 – 13.5 volts	If reading is below 12 volts, the battery is bad, discharged or has bad connection(s). If reading is higher than 13.5 volts, the battery is over-charged
2. Ignition key in “OFF” position.	(–) terminal of fuel pump.	Same reading should be obtained as reading in check No. 1 (above)	If reading is lower than in test 1, the ECM is bad or there is an open circuit in fuel pump.
3. Ignition key in “ON” position and engine NOT running.	(–) terminal of fuel pump.	1.5 volt or less (voltage should rise to 12 – 13.5 volts after approximately 30 seconds.	Bad ECM or bad fuel pump*.
4. Engine being cranked.	(–) terminal of fuel pump.	1.5 volt or less.	Bad ECM or bad fuel pump.*

*Check for proper electrical operation of electric fuel pump. (Step 4)



4. Disconnect BLACK/RED wire to negative terminal on electric fuel pump. Connect a ground jumper wire from negative pump terminal to a good engine ground.



a - Negative Terminal

Results: Pump does not operate. Replace electric fuel pump.

Pump operates. But, pressure reading does not change when performing electric fuel pump pressure test. Replace electric fuel pump.

Pump operates. Check BLACK/RED (–) lead and harness for good continuity.

NOTE: BLACK/RED lead is connected to pin 2 of EFI harness.



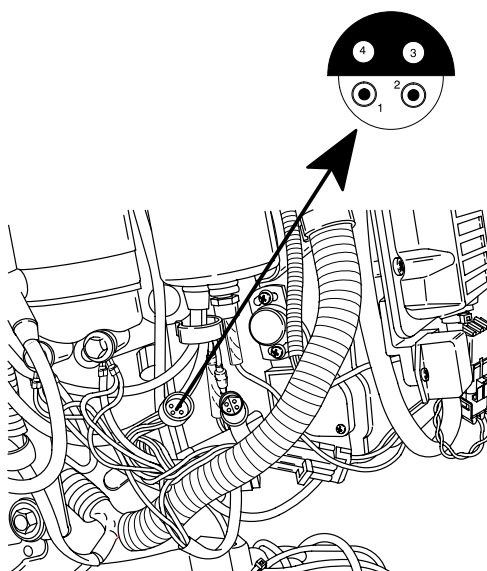
Injector Electrical Harness Test

Purpose: This test will determine if electrical or fuel delivery problem exists during the fuel delivery process by checking for open circuits in injector harness.

1. With outboard in water, start and allow to warm up. Raise engine speed to 2000-2500 RPM. Remove spark plug leads one at a time and note RPM change. Determine non-working (no RPM change) cylinder. Stop engine.
2. Disconnect injector harness (4 pin connector).

IMPORTANT: Use DMT Tester (91-854009A1) and Test Harness (91-833169A1) when testing injector harness.

3. Connect digital ohmmeter (dial set at 200 scale) leads. POSITIVE lead from ohmmeter connects to POSITIVE prong "2" (RED wire) of harness connector. Connect NEGATIVE lead from ohmmeter to the remaining wires of harness connector as follows:
 - **WHITE Lead** = Injectors, Cylinders 1 and 2
 - **DARK BLUE Lead** = Injectors, Cylinders 3 and 4
 - **YELLOW** = Injectors, Cylinders 5 and 6



58166

- 1 - YELLOW
- 2 - RED
- 3 - DARK BLUE
- 4 - WHITE

Results: If readings are $1.1 \pm .2$ both injector circuits are complete. Perform Injector Fuel Delivery Test.

If readings are $2.2 \pm .2$ one injector does not have a complete circuit. Perform induction manifold disassembly and inspection following.



ECM Injector Driver Test

To verify that the ECM is operating the injector pairs, connect test harness between manifold connector and engine harness. Start engine.

Use DVA meter (91-99750) or DMT (91-854009T1). Set meter to 200 scale. Connect BLACK meter lead to engine ground and RED test lead to each BLUE, WHITE or YELLOW female bullet connector

Normal voltage for a 2.5L engine will be 25 to 60 volts. Voltage will vary with RPM.

Injector Fuel Delivery Test

Purpose: This test will determine if injector is delivering fuel when signal is received.

NOTE: It is recommended that the Digital Diagnostic Terminal 91-823686A2 be utilized following the procedure listed with its' instruction manual.

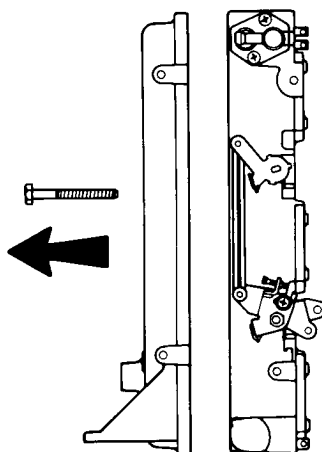
Injector Operation Test (Manifold Cover Removed)

Purpose: This test determines if the injectors are actually injecting fuel into the engine at a normal rate.

⚠ WARNING

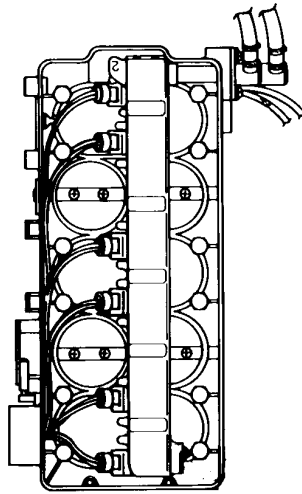
Do not start engine with induction manifold cover removed. Disable ignition system prior to doing this test.

1. Remove induction manifold cover using procedures outlined under "Induction Manifold Removal."

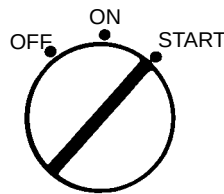




2. Re-attach induction manifold to engine using 1/4-20 x 2-3/4" screws.



3. Connect a jumper wire between the ECU metal case and a good engine ground.
4. Disconnect all spark plug wires from spark plugs and seal leads with electrical tape to prevent sparking.
5. Put ignition key switch in "START" position.



6. Look at injector spray pattern using an explosive proof flashlight.

Results A: If fuel spray is not present in all injectors or spray pattern is extremely weak, check wiring harness to injector connectors, or injector filters for plugging.

If spray patterns are available in most of the injectors, but not all, perform Procedure B.

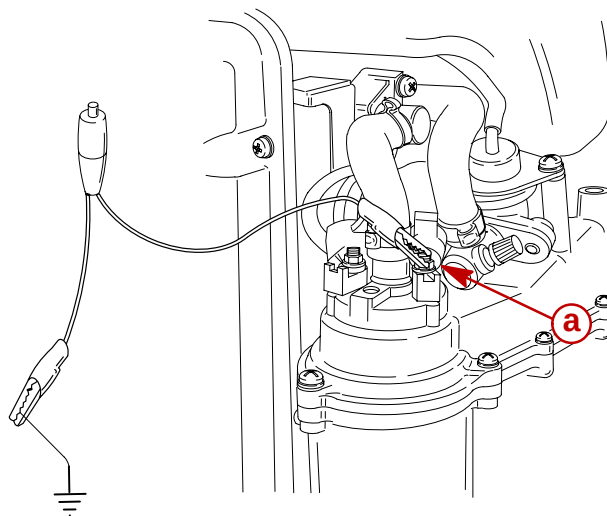
7. Connect EFI tester. Steps outlined in electrical system and ECM check.



8. Connect remote starter Quicksilver (91-52024A1) to NEGATIVE terminal of electric fuel pump and a good engine ground. Depress remote start switch, pump will operate as long as switch is depressed.

⚠ WARNING

Do not operate pump for more than 20 seconds continuously.



55197

a - Negative Terminal

9. Perform fuel injector test procedures (outlined) while depressing remote starter switch.

Results B: If fuel spray is present using EFI tester, but not present while cranking, perform switch box DVA tests Section 2A (1, 3, 5 switch box failure).

If fuel spray pattern is equal on all injectors, system is functioning normally.



Induction Manifold Leak Check (Manifold Cover Removed)

Purpose: Lack of good fuel pressure may be caused by an internal leak in the fuel induction manifold and not caused by a weak pump. This test eliminates the possibility of induction manifold leaks as a probable cause.

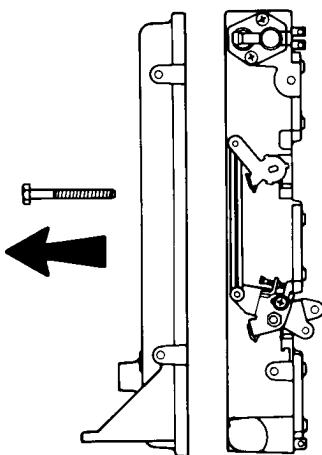
⚠ WARNING

Do not start engine with induction manifold cover removed. Disable ignition system prior to performing this test.

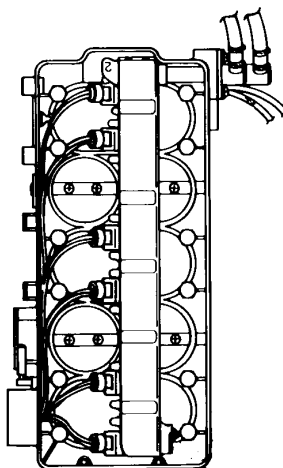
⚠ WARNING

Operation of EFI system with cover removed can allow fuel to spray components. Be extremely careful when operating the fuel system in this condition.

1. Remove induction manifold cover using procedures outlined under "Induction Manifold Removal."



2. Reattach manifold body without cover to engine using twelve 1/4-20 x 2-3/4" screws in place of screws normally used.



3. Connect a jumper wire between the metal case of ECM and a good engine ground.

⚠ WARNING

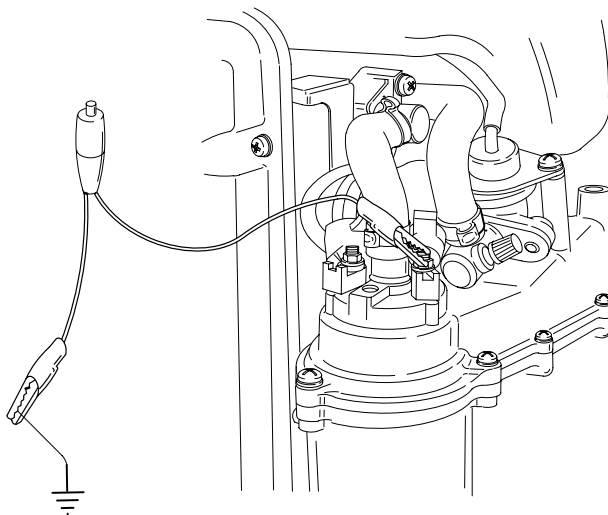
If a serious leak is present in the induction manifold, fuel may spray out of bad seal. Have clean up rags available to remove excess fuel from components.



4. Place emergency stop switch in OFF position to prevent engine from starting. If boat is not equipped with a emergency stop switch, connect a jumper lead from the BLACK/YELLOW bullet connector to engine ground.
5. Connect remote starter Quicksilver (91-52024A1) to NEGATIVE terminal of electric fuel pump and a good engine ground. Depress remote start switch, pump will operate as long as switch is depressed.

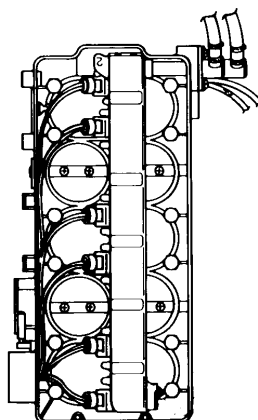
⚠ WARNING

Do not operate pump for more than 20 seconds continuously.



55197

6. Look for leak points on induction manifold while depressing remote starter switch.



Results: If no leaks are present, replace cover and gasket using normal length screws.

If fuel leak is present between sealing surfaces, rebuild system using new o-rings.

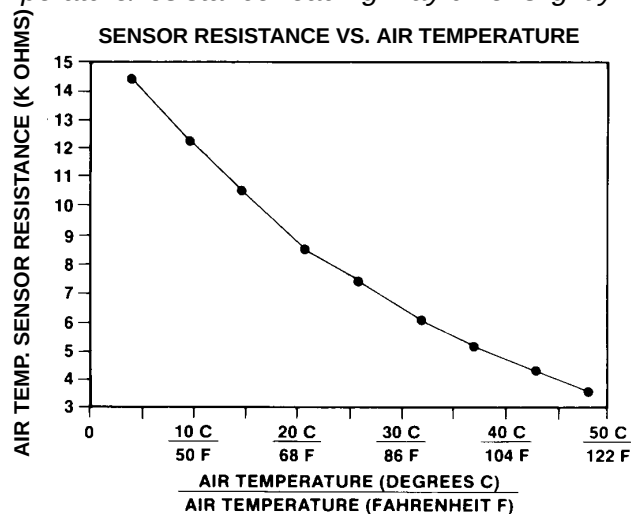


Air Temperature Sensor Test

Purpose: This test eliminates possibilities of improper fuel delivery related to air temperature sensor.

1. Disconnect and remove Air Temperature Sensor from induction manifold.
2. Connect DMT (91-854009T1) to leads of sensor.
3. Place sensor in ice water while monitoring meter reading. Use graph (below) for reference.

NOTE: Temperature/resistance reading may differ slightly from graph curve.



Results: Resistance does not change inversely with temperature change. Replace defective Air Temperature Sensor.

Resistance changes inversely with temperature change. Air Temperature Sensor OK.

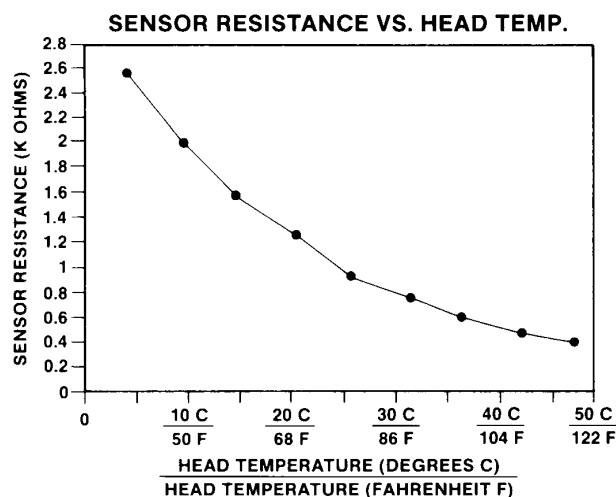


Engine Head Temperature Sensor Test

Purpose: This test eliminates possibilities of improper fuel delivery related to the water temperature sensor.

1. Disconnect and remove Engine Head Temperature Sensor (see page 3C-54).
2. Connect DMT (91-854009T1) to bullet leads of sensor.
3. Place sensor in ice water while monitoring meter reading. Use graph (below) for reference.

NOTE: Temperature/resistance reading may differ slightly from graph curve.



Results: Resistance does not change inversely with temperature change. Replace defective Engine Head Temperature Sensor.

Resistance changes inversely with temperature change. Engine Head Temperature Sensor OK.

Detonation Control System Test (200 Models Only)

Purpose: This test eliminates possibilities of improper fuel delivery due to failure in detonation control.

1. Place outboard in water, install timing light to number one cylinder.
2. Start engine, allow to warm up. Advance throttle (between 3000-3500 RPM in gear).
NOTE: Timing advancement.

Results: Timing advances from 18° to 24° BTDC system functioning properly.

Timing advance from 18° to 24° but retards while maintaining a steady throttle position. System functioning properly, detonation may be occurring. See Detonation Sensor/Module Checks (following).

Timing advancement does not occur (18° to 24° BTDC). System functioning properly, detonation may be occurring. See Detonation Sensor/Module Checks (following).

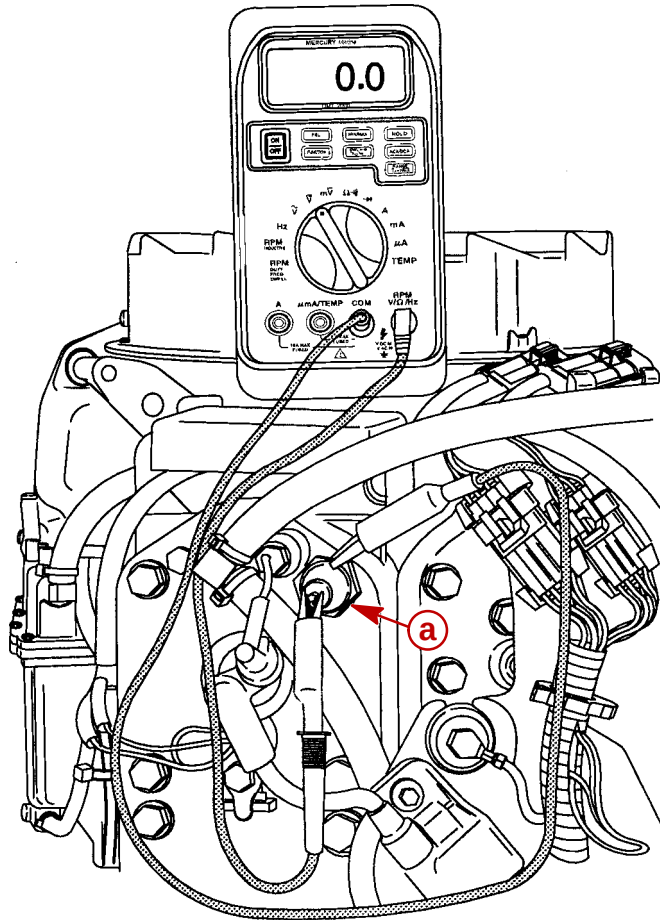


Detonation Sensor Check

IMPORTANT: When testing detonation control system keep all test leads away from high tension leads (i.e. spark plug lead, electrical wiring etc.) to avoid false readings.

Purpose: This check will determine if sensor is correctly signaling control module.

1. Connect DMT 2000 Digital Tachometer Multi-Meter (91-854009A1) to detonation sensor as shown. RED "V-Ω" test lead to sensor terminal, BLACK "com" test lead to sensor housing (ground).



58067

a - Detonation Sensor

2. Turn meter dial to 200 MV volts, AC position and power switch in ON position. Place outboard in water.
3. Start and operate engine at idle speed.
4. Check meter reading. A typical reading of 0.075 to 0.120 volts AC should be present.

NOTE: As RPM increases, volt readings will increase.

Results: If voltage reading is not within 0.075 to 0.120 volts AC replace detonation sensor. Torque sensor to 144 lb. in. (16.0 N·m).

If voltage reading is within 0.075 to 0.120 volts AC perform check on detonation control module.

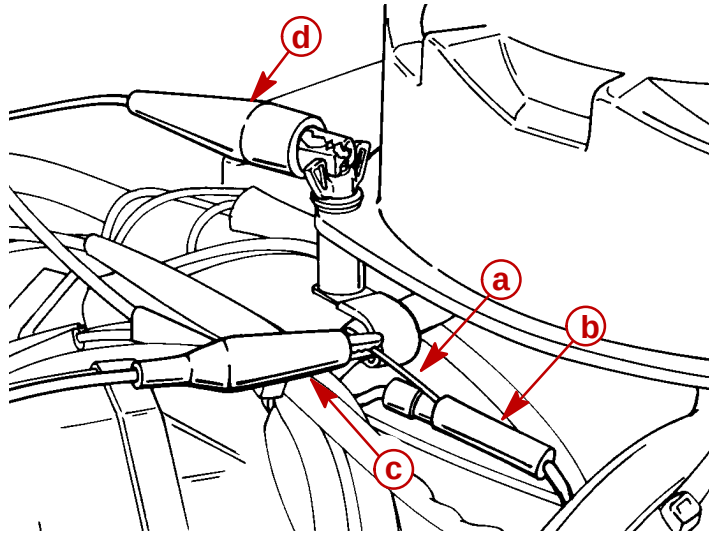
IMPORTANT: Handle detonation sensor with care when testing or replacing. Rough handling could cause undetectable internal damage causing false readings to be transmitted to detonation module.



Detonation Control Module Check

Purpose: This check will determine if control module is correctly signaling ECM when signals are received from sensor.

1. Insert probe (a) (i.e. paper clip) to gray/white wire connector (b). Connect digital volt meter (from EFI tester 91-11001A2 or DMT 2000 91-854009A1) positive clip (c) to probe and ground clip (d) to engine ground as shown.



51795

- a** - Probe
- b** - Connector
- c** - Positive Clip
- d** - Ground Clip

2. Turn meter dial to 20 volts DC position and power switch in ON position. Place out-board in water.
3. Start and operate engine at idle.
4. Check meter reading. A reading between 0.30 to 0.70 volts DC should be attained.
5. Increase engine speed (with engine in gear) between 3000-4000 RPM. Check meter reading. A typical reading should be 0.01 volts DC.

Results: If meter reading is 0.30 to 0.70 volt DC at idle and 0.01 volts DC at 3000-4000 RPM, detonation control unit is functioning properly (no detonation occurring).

If voltage reading does not fall within range (0.30 to 0.70 volts DC) at idle, control module may be bad.

If voltage reading is above 0.01 volts DC and between 1.0 to 6.6 volts DC at 3000 to 4000 RPM detonation is occurring. A constant voltage of 6.6 volts DC would indicate bad detonation control module.



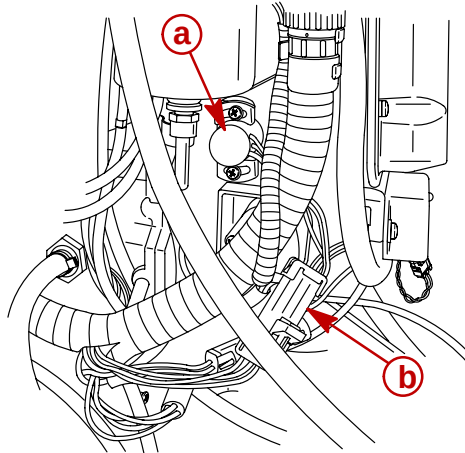
Throttle Position Sensor Test

Purpose: This test eliminates possibilities of improper fuel delivery related to the throttle position indicator. Refer to EFI electrical system and ECM test.

NOTE: Engine harness *MUST BE* disconnected from the EFI tester 91-11001A2 (if being used) and reconnected in the normal running configuration in order to test or adjust the throttle position sensor.

IMPORTANT: TPS can be adjusted using a digital meter (DMT). Analog (needle) type may be used although it may be difficult to read the low voltage setting accurately with most meters.

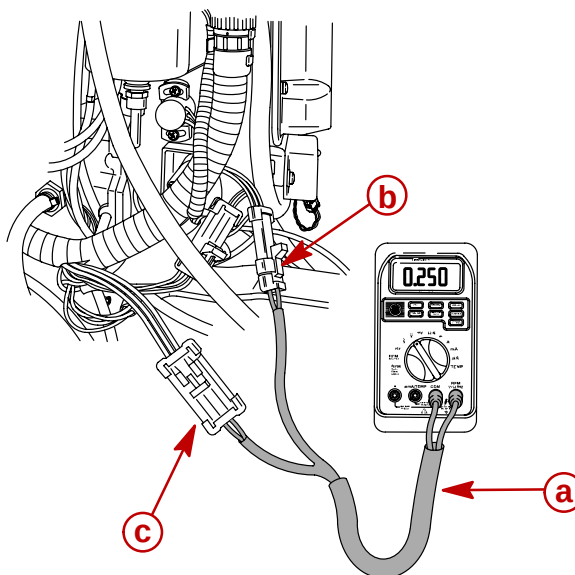
1. Disconnect TPS from EFI harness.



58053

- a** - Throttle Position Sensor (TPS)
- b** - TPS Harness Connector

2. Connect digital using TPS Test Lead Assembly (91-816085) between TPS connector and EFI harness connector. Set voltmeter to 2 DC volts.



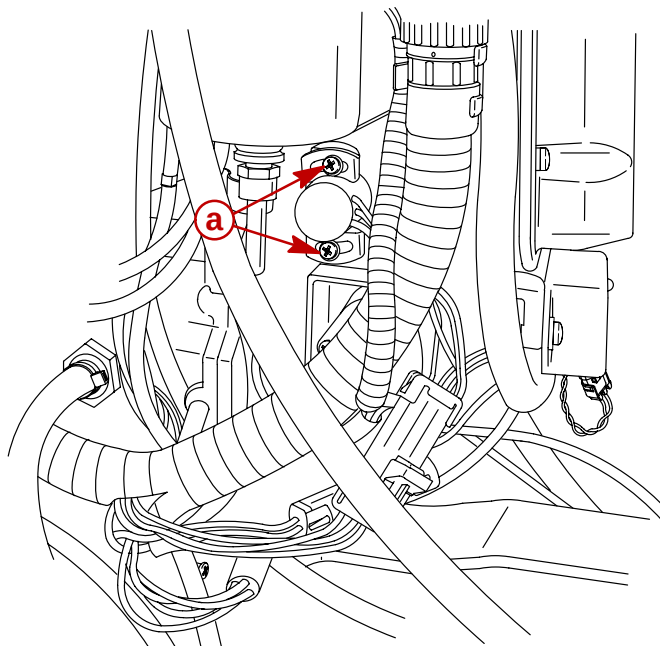
58054

- a** - TPS Test Lead Assembly (91-816085)
- b** - TPS Connector
- c** - EFI Harness Connector

IMPORTANT: TAN/BLK head temperature leads must be disconnected from port cylinder head before adjusting TPS.



3. Disconnect TAN/BLACK engine head temperature sensor leads located on port cylinder head.
4. Turn key to the "ON" position.
5. Loosen screws (a) securing TPS to manifold.



58055

a - Screws

6. Rotate TPS fully clockwise (holding throttle shaft in closed position). Voltmeter should read **.200 - .300**. If readout is not within specifications, adjust TPS to obtain readout of **.240 - .260**.
7. Tighten TPS screws to 20 lb. in. (2 Nm) holding correct tolerance.
8. Disconnect remote control cable from throttle lever.
9. Slowly move throttle lever to full open position while monitoring voltage reading. Voltage reading should increase and decrease smoothly
10. Set volt meter to 20 DC volts. Maximum voltage reading at full throttle is approximately 7.46 volts.
11. Remove test lead and reconnect TPS harness to EFI harness.
12. Reconnect TAN/BLACK engine head temperature sensor leads located on port cylinder head.

NOTE: If engine appears to run too rich or too lean, TPS can be readjusted. Decreasing voltage yields leaner mixture. Increasing voltage yields richer mixture.

Map Sensor Test

Purpose: This test eliminates possibilities of improper fuel delivery caused by the map sensor. Refer to Electronic Fuel Injection Tester (91-11001A2) and its test manual. The Digital Diagnostic Terminal (91-823686A2) may also be used to test the MAP Sensor. It will display an LED failure light, a PASS/NO operational indication as well as a numeric display value.



Problem Diagnosis

Condition	Possible Source	Action
Engine Down On Power Or RPM	– Failed Switch Box	Refer to Section 2 Electrical and Ignition Tests.
	– Failed Stator	Refer to Section 2 Electrical and Ignition Tests.
	– Failed CDM	Refer to Section 2 Electrical and Ignition Tests.
	– Low Compression	Refer to Section 4 Power Head.
	– Broken Reed	Perform Injector Fuel Delivery Test.
	– Fuel Delivery Problem	Follow Low/High Pressure Fuel Route Flow Charts and Fuel Rail Electrical/Fuel Determination Flow Chart.
	– Manifold Fuel Leak	Perform Induction Manifold Leak Check.
	– Vapor Separator Flooding Over, Engine Running Rich.	Check for fuel coming out of vapor separator vent hose.
	– Cylinder Head Temperature Sensor Circuit Failed.	Check cylinder head temperature sensor.
Poor Acceleration – Idles Ok, Top Speed Ok	– Improper EFI Set Up.	Refer to Section 2 Electrical and Ignition for proper EFI set up procedures.
	– Water Covering Idle Relief Exhaust Ports.	Boats with extended transoms or low engine mount can cause engine to load up on acceleration.
	– T.P.S. Failure.	Refer to page 3C-49.
	– MAP Sensor Failure	Refer to page 3C-50.
	– R.F.I. Problem*	Install BPZ8HS-10 Spark Plugs.



Condition	Possible Source	Action
Poor Acceleration – Idles Ok, Top Speed Ok (Continued)	– Timing Not Advancing.	Check for stuck trigger.
Engine Surges Between 4000 And 5000 RPM	– Intermittant CDM Failure. – Final Filter Clogging. – T.P.S. – Improper Adjustment. – Injector Connector Problem. – Vapor Separator Flooding Over. – Injector Filter Clogged.	Refer to Section 2A Electrical and Ignition for tests. Perform Final Filter Check. Refer to Section 2C Electrical and Ignition for T.P.S. adjustment. Perform Injector Fuel Delivery Test. Check for fuel coming out of vapor separator vent hose. Refer to Injector Fuel Delivery Test.
Engine Idles Ok But Stumbles At Off Idle Speeds	– Improper EFI Setup. – Failed CDM. – Failed Or Disconnected EFI Sensors. – Fuel Delivery Problem. – Manifold Fuel Leak. – R.F.I.* Problem. – Stator. – Induction Manifold Air Leak.	Refer to Section 2C Electrical and Ignition for proper EFI set up procedures. Refer to Section 2A Electrical and Ignition Tests. Perform EFI sensor tests. Follow Low/High Pressure Fuel Route Flow Charts and Fuel Rail Electrical/Fuel Determination Flow Chart. Perform Induction Manifold Leak Check. Install BPZ8HS-10 Spark Plugs. Refer to Section 2A Electrical and Ignition for tests. Check manifold cover gasket, manifold to reed block housing gasket and reed block housing to crankcase gasket.
Engine Idles Rough (May Lean Sneeze) – Acceleration Ok; Full Throttle Ok	– Improper EFI Setup. – MAP Sensor Failure.	Refer to Section 2C Electrical and Ignition for proper EFI set up procedures. Refer to page 3C-50.



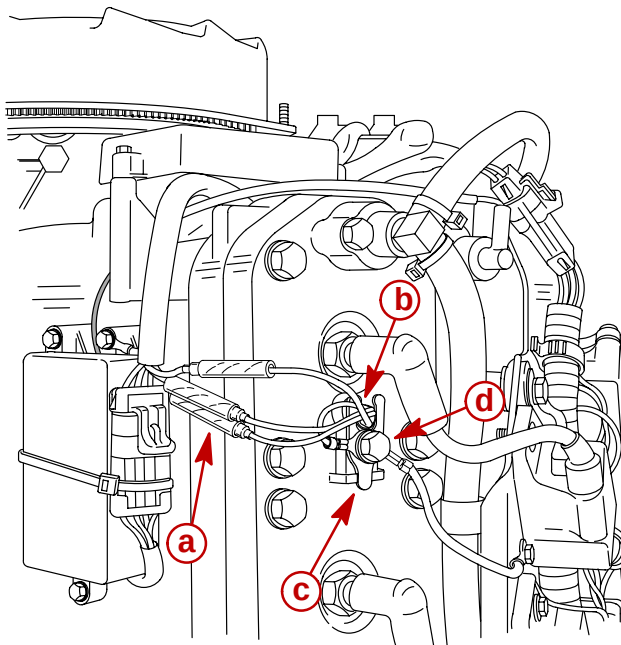
Condition	Possible Source	Action
Engine Idles Rough (May Lean Sneeze) – Acceleration OK; Full Throttle Ok. (continued)	– CDM Failure. – Broken Reed.	Refer to Section 2A Electrical and Ignition Tests. Perform Injector Fuel Delivery Test.
Engine Runs but Slowly Drops RPM then Dies.	– Restrictions in Fuel System between Tank and Engine. – Clogged Final Filter. – Pulse Fuel Pump Failure. – Electric Fuel Pump Delivery Failure.	Install remote gas tank with fresh, high quality fuel. Perform Final Filter Check. Follow Low Pressure Fuel Route Flow Chart. Follow High Pressure Fuel Route Flow Chart.
Engine Stops for No Apparent Reason or Does Not Start.	– Battery Undercharged. – EFI Harness Connections. – Ignition System Failure. – Pulse Fuel Pump Failure. – Electric Fuel Pump Failure. – ECM Failure.	Check battery connections, under charged battery or worn out battery. Check EFI harness connector for improper connection. Refer to Section 2A Electrical and Ignition Tests. Follow Low Pressure Fuel Route Flow Chart. Follow High Pressure Fuel Route Flow Chart. The DDT (91-823686T2) will monitor information coming from sensors or switches to the ECM and will indicate if the sensor or switch is defective. For a more thorough analysis of the ECM, refer to EFI Tester Manual 91-11001A2.
Engine Stops for No Apparent Reason, but will Restart.	– Battery Overcharged. – Restriction in Fuel System	Check battery voltage with engine running. Should be less than 15.5 volts. Refer to Service Bulletin 96-2. Check fuel pressure on fuel rail at the RPM that failure occurs.

*R.F.I. Radio Frequency Interference. High voltage can alter signals ECM receives from sensors causing improper fuel delivery. Route all sensor wires away from high voltage leads (i.e. spark plug leads)



Engine Head Temperature Sensor Removal

1. Remove screw and retaining plate.
2. Disconnect wires and remove sensor.



58052

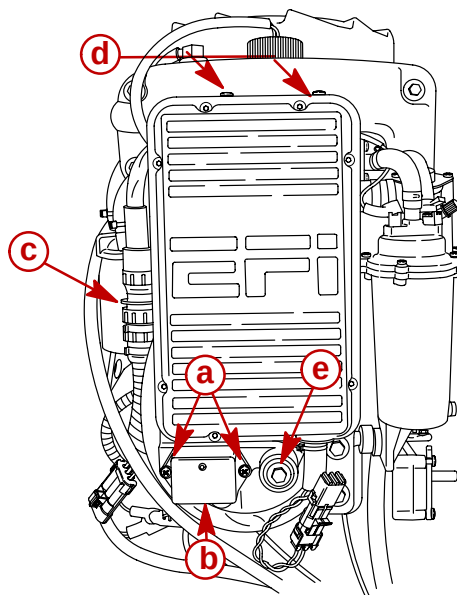
- a** - Wires
- b** - Sensor
- c** - Retainer
- d** - Screw



EFI Induction Manifold Removal

IMPORTANT: Remove battery cables from battery before Induction Manifold Removal and Disassembly.

1. Disconnect ECM at harness connector.
2. Remove attaching screws.
3. Remove water sensing module.
4. Remove nuts and bolt.

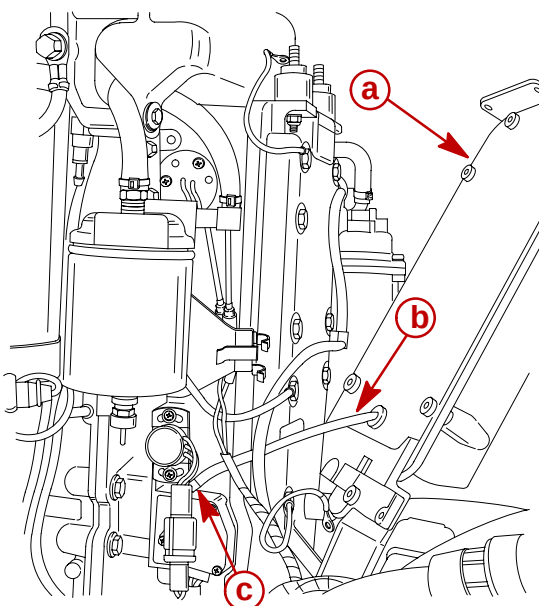


58031

a - Screws
b - Water Sensing Module
c - Harness Connector

d - Nuts
e - Bolt

5. Carefully raise ECM from studs. Disconnect MAP sensor hose at manifold fitting and remove ECM.



55199

a - ECM
b - MAP Sensor Hose

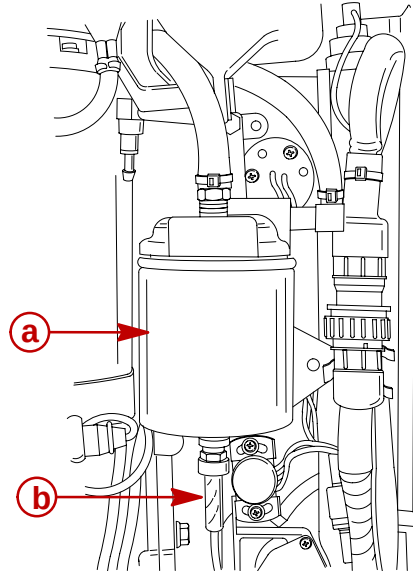
c - Manifold Fitting



Water Separating Filter Assembly Removal

NOTE: To inspect or replace water separator, it is not necessary to remove inlet and outlet fuel lines or to unbolt bracket from manifold.

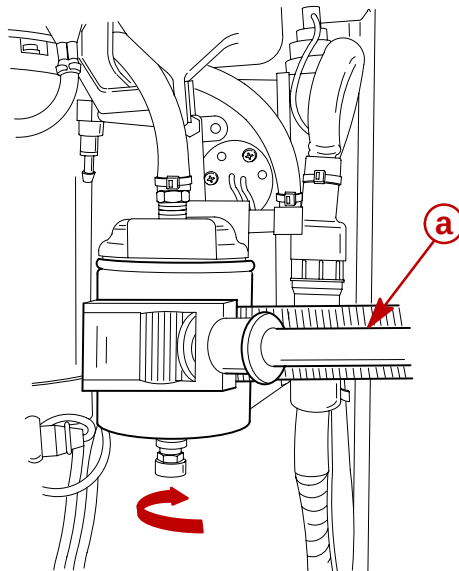
1. Remove water sensor lead from bottom of separator.



55182

- a** - Water Separator
- b** - Water Sensor Lead

2. With wipe towels available, use Strap Wrench (91-24937A1) to remove water separator.



55184

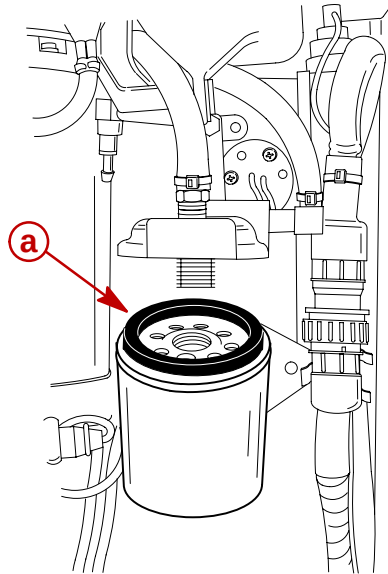
- a** - Strap Wrench (91-24937A1)



Water Separating Filter Assembly Installation

IMPORTANT: Apply a light coat of outboard oil to the rectangular sealing ring on the water separator before installation.

1. After applying oil to sealing ring of water separator, install separator onto bracket.
2. HAND TIGHTEN SEPARATOR. DO NOT use strap wrench or other tool to tighten separator.
3. Reconnect water sensor lead to bottom of separator.

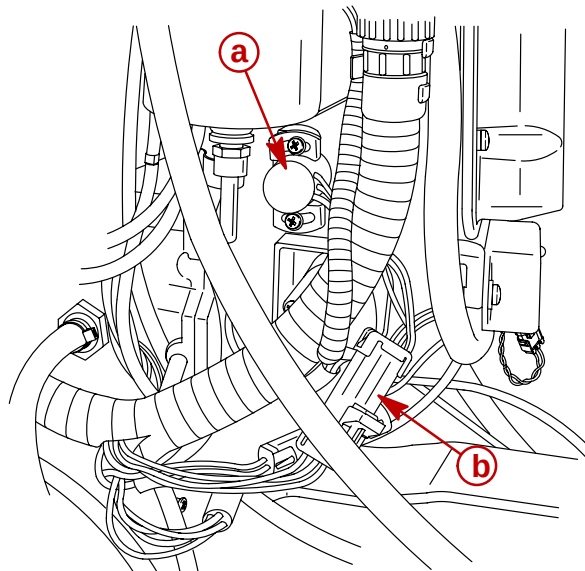


55185

a - Sealing Ring

Throttle Position Sensor and Temperature Sensor Fuel Injector Harness Disconnections

1. Disconnect throttle position sensor at 3 pin connector.

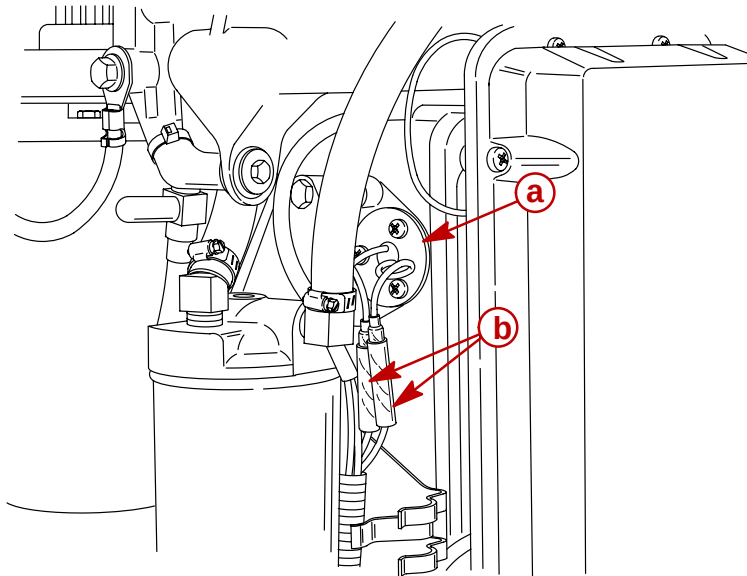


58055

a - Throttle Position Sensor
b - 3 Pin Connector



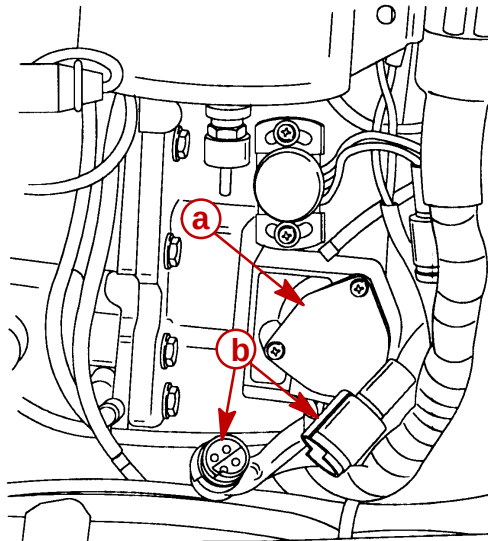
2. Disconnect air temperature sensor at connectors.



58170

- a** - Air Temperature Sensor
- b** - Connectors

3. Disconnect fuel injector harness at 4 pin connector.



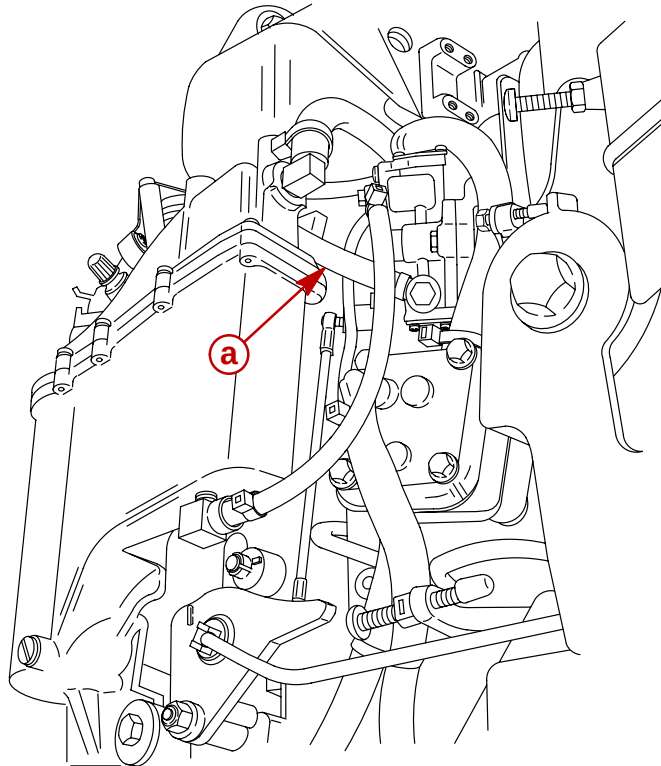
55193

- a** - Fuel Injector Harness
- b** - 4 Pin Connector



Oil Reservoir Removal

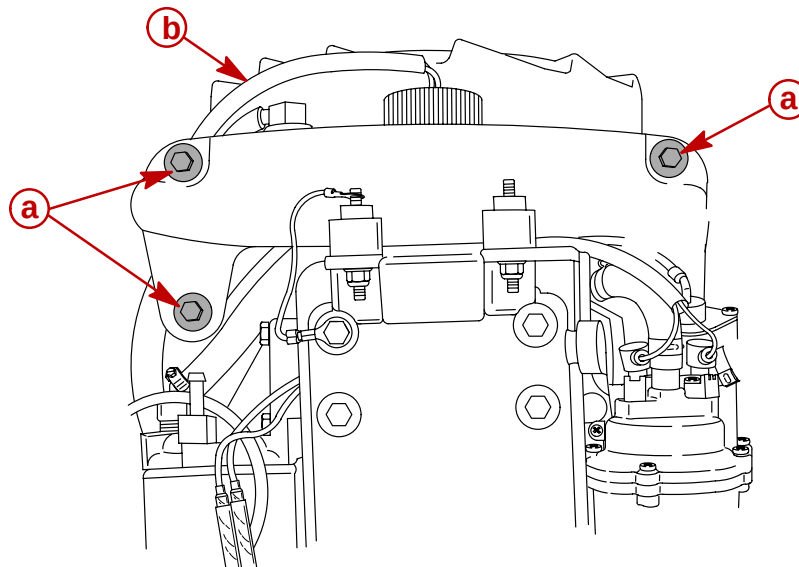
1. Disconnect low oil sensor bullet connectors (BLUE leads located below fuel/water separator)
2. Remove sta-strap securing reservoir hose to oil pump and remove hose. Plug hose to prevent leakage.



58050

a - Reservoir Hose

3. Remove 3 screws and remove reservoir.



58172

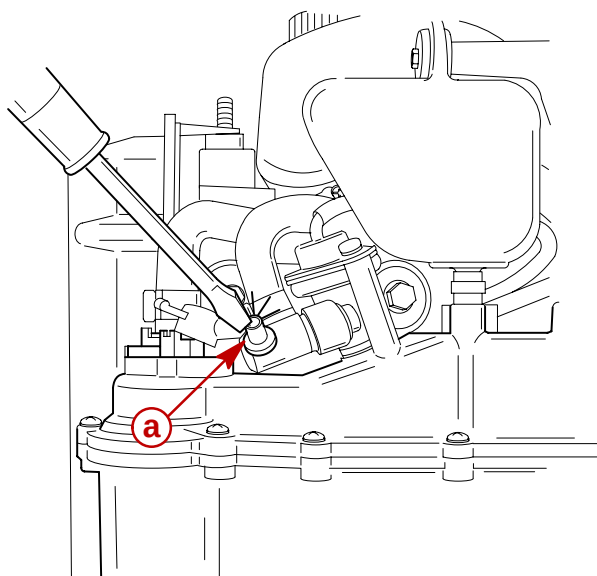
a - Screws

b - Low Oil Sensor Harness (BLUE lead bullet connectors located below fuel/water separator)



Fuel Pressure Regulator Removal

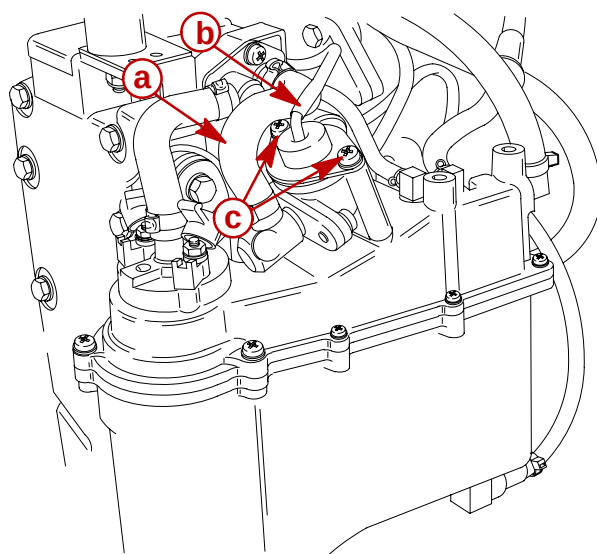
1. Disconnect boat battery from engine harness.
2. De-pressurize EFI fuel system by wrapping a clean cloth around pressure port valve and inserting tip of screwdriver into valve, depressing valve core. Let fuel drain from valve.



55179

a - Pressure Port

3. Remove return fuel line from pressure regulator.
4. Remove regulator hose from regulator.
5. Remove 2 screws securing regulator to separator and remove regulator.



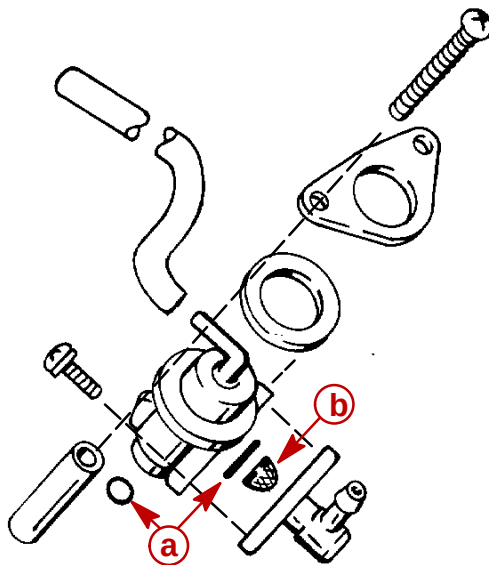
55204

a - Return Fuel Line
b - Regulator Hose
c - Screws



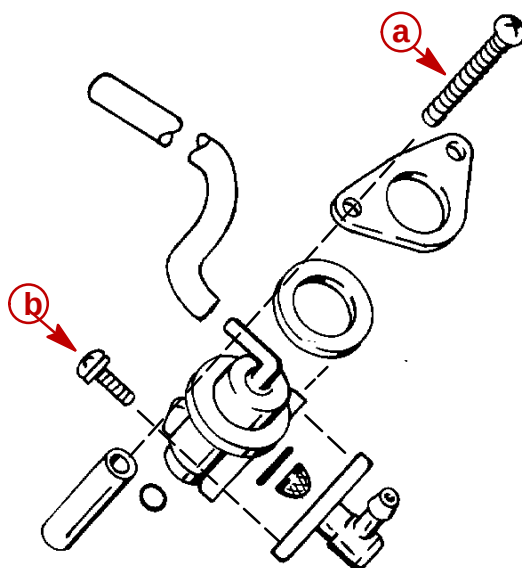
Fuel Pressure Regulator Disassembly

1. Inspect O-rings for cuts and abraisions. Replace as required.
2. Inspect fuel filter for debris. Clean with solvent as required.



- a** - O-Rings
b - Filter

Fuel Pressure Regulator Reassembly

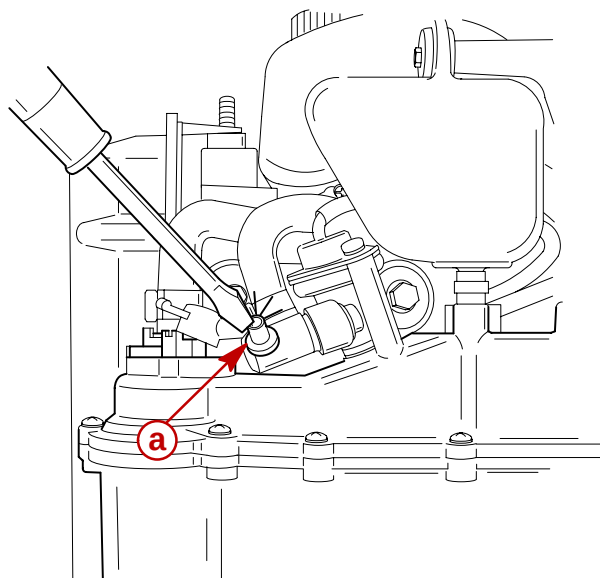


- a** - Screw (2) [Torque to 30 lb. in. (3.5 Nm)]
b - Screw (2) [Torque to 45 lb. in. (5 Nm)]



Vapor Separator Removal

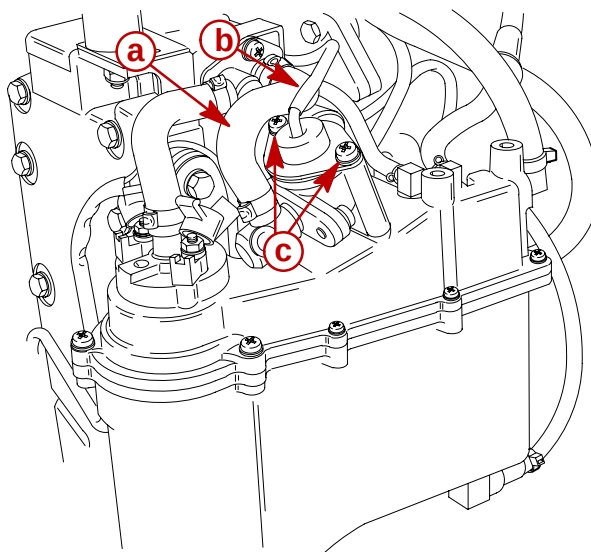
1. Disconnect boat battery from engine harness.
2. De-pressurize EFI fuel system by wrapping a clean cloth around pressure port valve and inserting tip of screwdriver into valve, depressing valve core. Let fuel drain from valve.



55179

a - Pressure Port

3. Remove return fuel line from pressure regulator.
4. Remove regulator hose from regulator.
5. Remove 2 screws securing regulator to separator and remove regulator.

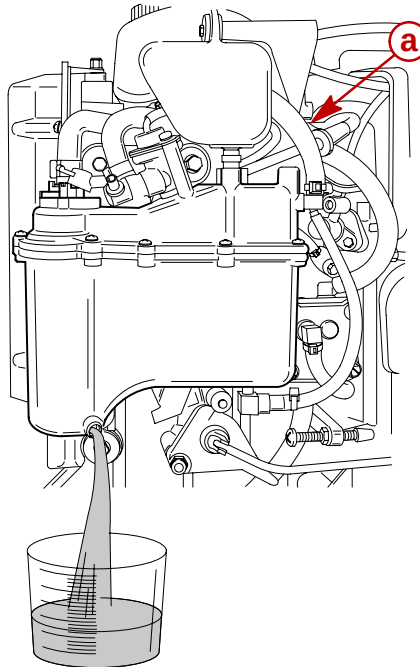


55204

a - Return Fuel Line
b - Regulator Hose
c - Screws



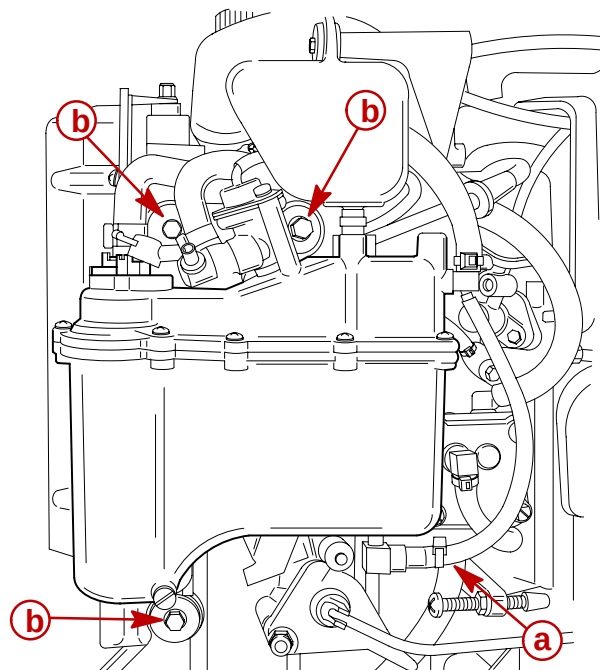
6. Remove drain screw from separator and drain fuel into suitable container.
7. Remove fuel inlet hose to vapor separator.



55177

a - Fuel Inlet Hose

8. Disconnect and plug oil inlet hose to vapor separator.
9. Remove 3 bolts securing separator to manifold assembly.



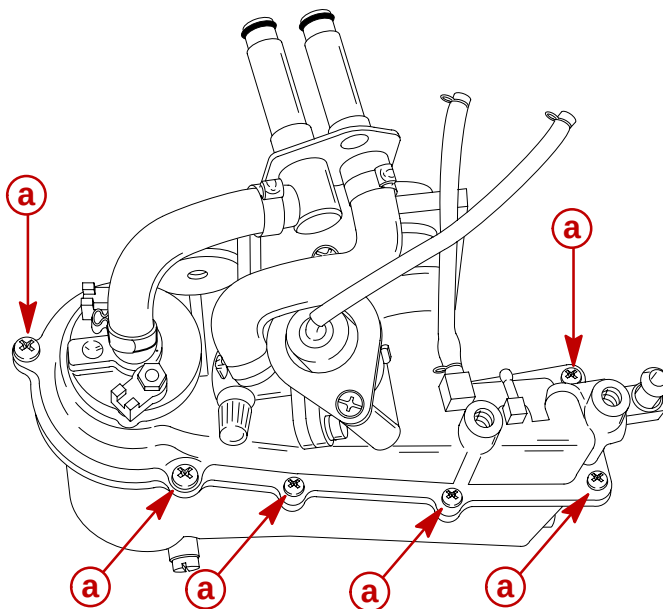
55176

a - Oil Inlet Hose
b - Bolts



Vapor Separator Disassembly

Remove 9 screws securing cover to vapor separator and remove separator tank.

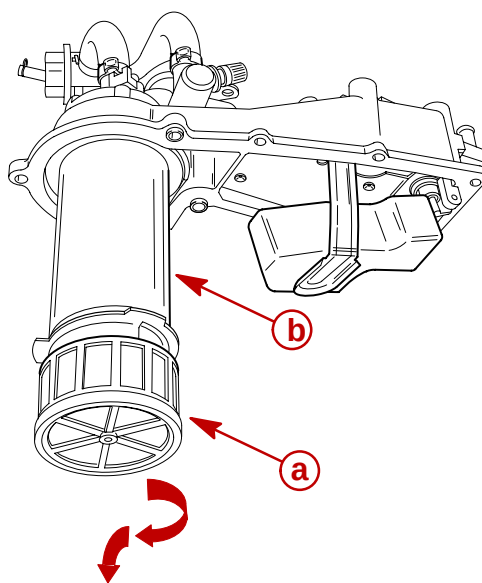


55209

a - Screws (3 screws are hidden on back side)

FINAL FILTER REMOVAL

Rotate final filter counterclockwise and pull down.



55205

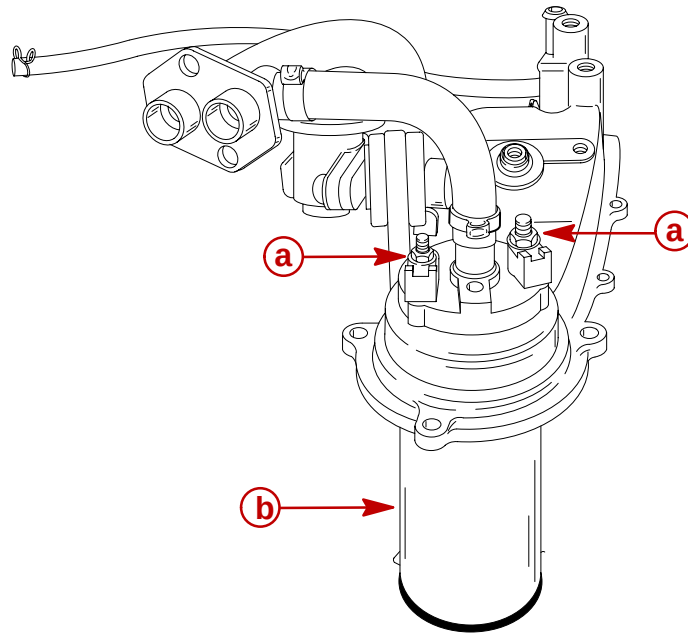
a - Final Filter
b - Electric Fuel Pump



ELECTRIC FUEL PUMP REMOVAL

NOTE: There are no individually replaceable parts within the electric pump. If brushes or armature fails, entire pump must be replaced.

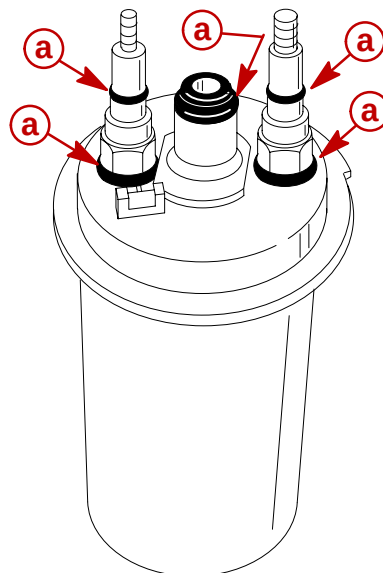
1. Remove 2 nuts on POSITIVE and NEGATIVE terminals. Remove pump from separator cover.



55206

a - Nuts
b - Pump

2. Inspect pump O-rings for cuts or abrasions. Replace O-rings as required.



53702

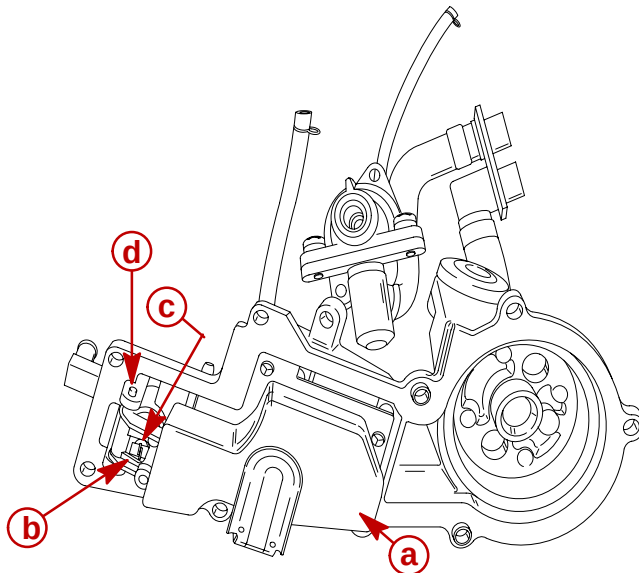
a - O-rings



VAPOR SEPARATOR FLOAT REMOVAL

NOTE: Inspect float for fuel absorption or deterioration. DO NOT attempt to bend float arm to adjust float height. Float height is preset at factory. Inspect float needle for grooves. Inspect needle seat for debris or corrosion. Replace float, needle and seat* as required.

1. Remove float pivot pin.
2. Remove float and needle for inspection. Replace as required.



55207

- a** - Float
- b** - Float Arm
- c** - Float Needle (Hidden)
- d** - Pivot Pin

*Seat and separator cover must be replaced as an assembly.



ELECTRIC FUEL PUMP INSTALLATION

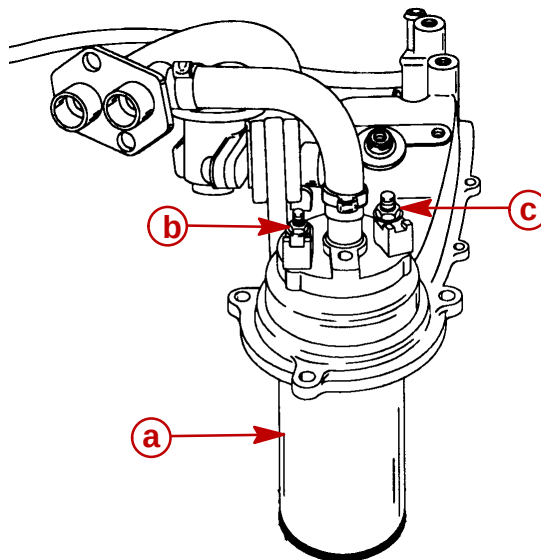
1. Slide fuel pump into separator cover.

NOTE: Fuel pump electrical studs are different diameters. Pump will install properly into cover only one way.

⚠ CAUTION

DO NOT over torque fuel pump **POSITIVE** and **NEGATIVE** attaching nuts as damage to fuel pump will result.

2. Secure pump to cover with 2 nuts. Torque **POSITIVE** nut to 6 lb. in. (0.7 Nm). Torque **NEGATIVE** nut to 16 lb. in. (1.8 Nm).



- a** - Electric Pump
- b** - POSITIVE (+) Stud (Small Diameter)
- c** - NEGATIVE (−) Stud (Large Diameter)



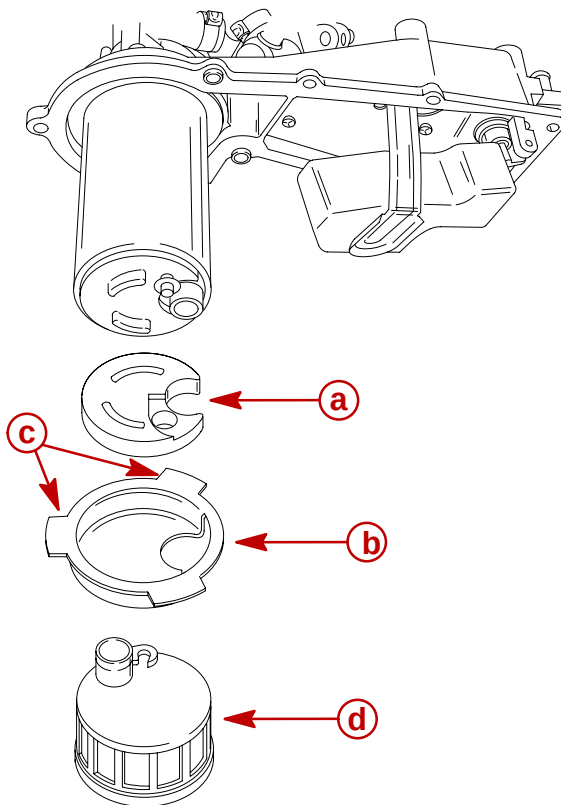
3. Install rubber pad on bottom of pump.

NOTE: Rubber pad is molded to fit flush on bottom of pump on one side only.

4. Install pump support ring.

NOTE: Pump support ring fits over pad onto pump properly only one way (Tabs face up).

5. Install final filter into pump bottom. Rotate filter clockwise to lock filter onto pump.



a - Rubber Pad
b - Support Ring

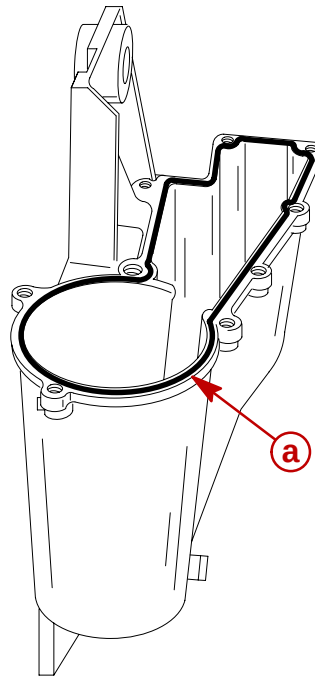
c - Tabs (face up)
d - Final Filter



INSTALLING SEPARATOR COVER ASSEMBLY ONTO SEPARATOR TANK

1. Inspect separator tank sealing O-ring for cuts or abrasions. Replace O-ring as required.

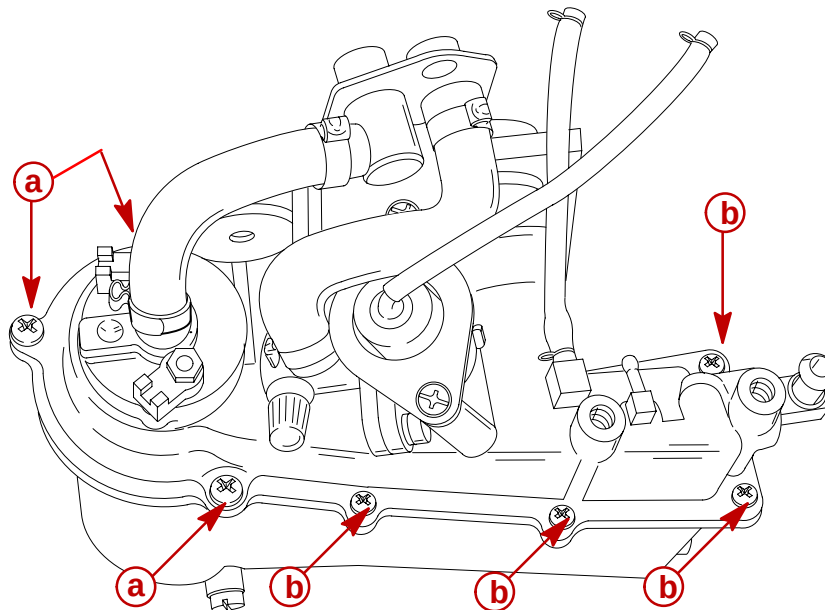
NOTE: If O-ring swells due to fuel and air exposure and will not fit in tank O-ring groove, replace O-ring. DO NOT cut O-ring to make it fit as fuel leakage will result.



53701

a - O-ring

2. Install cover assembly onto separator tank. Secure cover to tank with 9 screws. Torque 5mm screws to 30 lb. in. (3.5 Nm). Torque 4mm screws to 20 lb. in. (2.5 Nm).



55209 58171

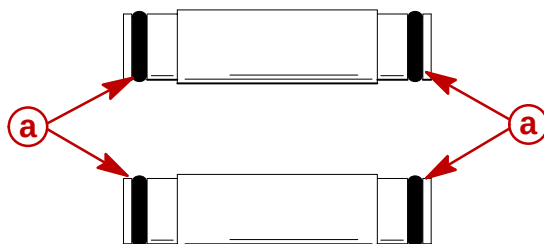
a - Large Screws (3) (5mm) Torque to 30 lb. in. (3.5 Nm)

b - Small Screws (6) (4mm) Torque to 20 lb. in. (2.5 Nm)



Installing Vapor Separator Assembly to Induction Manifold

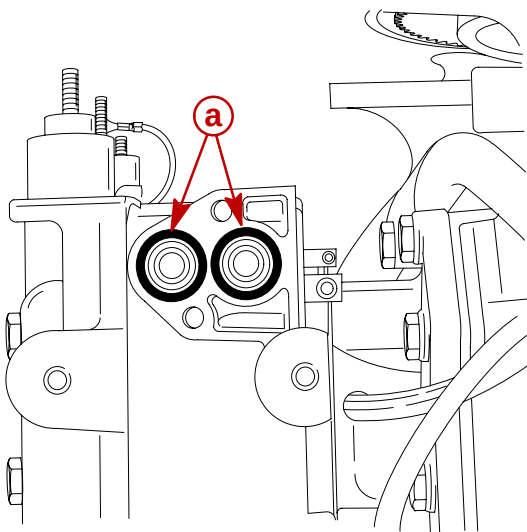
1. Inspect O-rings on ends of separator fuel tubes for cuts or abrasions. Replace O-rings as required.



55217

a - O-rings

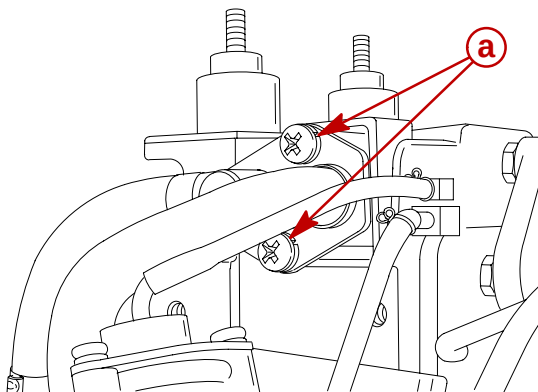
2. Install fuel tubes into manifold. Inspect adaptor plate O-rings for cuts or abrasions. Replace O-rings as required.



55215

a - O-rings

3. Secure adaptor plate to manifold with 2 screws. Torque screws to 45 lb. in. (5 Nm).



55216

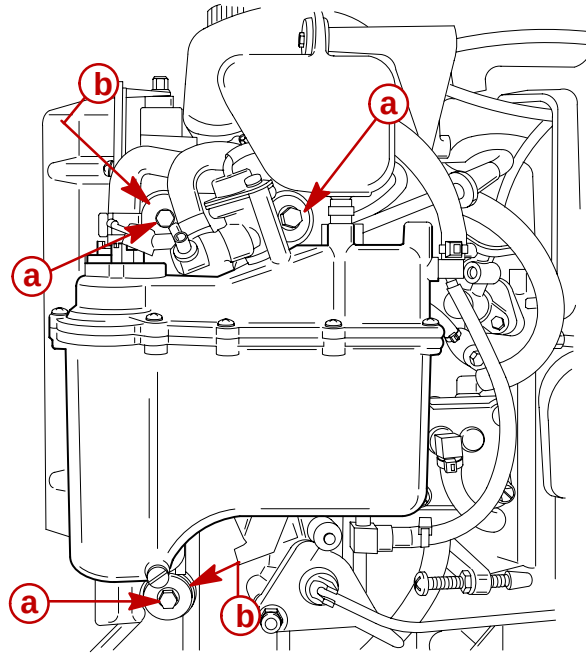
a - Screws [Torque to 45 lb. in. (5 Nm)]



NOTE: For ease of reassembly, reinstall oil reservoir on engine **BEFORE** installing vapor separator.

4. Secure vapor separator to manifold with 3 screws and washers. Torque screws to 45 lb. in. (5 Nm).

NOTE: Spacers are positioned between separator and manifold at the top front and bottom attaching screw locations.



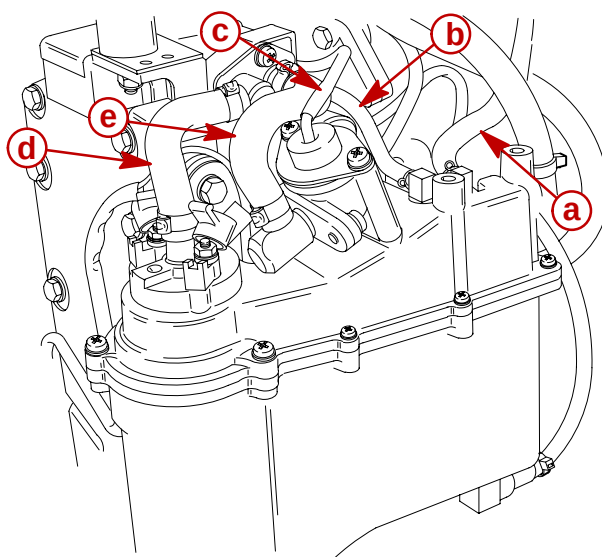
55176

- a** - Screws [Torque to 45 lb. in. (5 Nm)]
b - Spacers

IMPORTANT: If fuel outlet hose from electric fuel pump or fuel return hose from manifold to pressure regulator was disconnected, stainless steel hose clamps **MUST BE USED** to secure connections. If outlet/return hoses are to be replaced, replacement tubing kit (32-827694) **MUST BE INSTALLED** to prevent rupturing or leakage. **DO NOT** use sta-straps to secure high pressure fuel lines as leakage will occur.



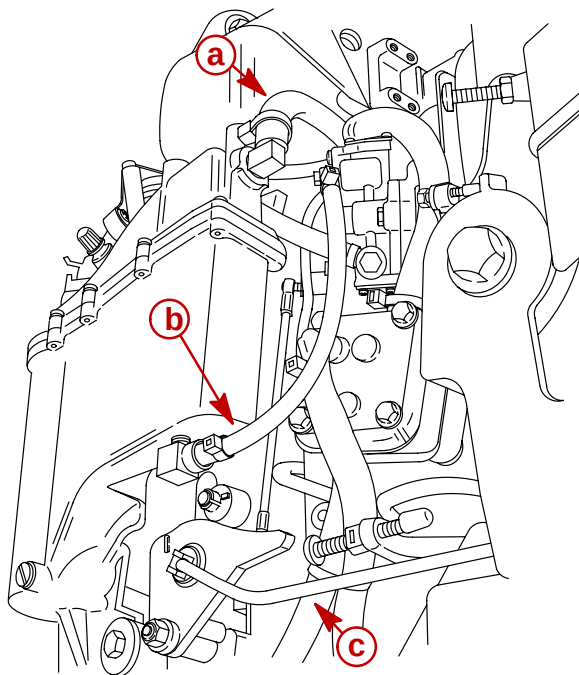
5. Reconnect engine bleed hose to fitting on vapor separator.
6. Reconnect vapor separator over flow hose between separator and manifold.
7. Reconnect pressure regulator hose to top fitting on regulator.



55204

- a** - Over Flow Hose
- b** - Bleed Hose
- c** - Pressure Regulator Hose
- d** - Fuel Outlet Hose
- e** - Fuel Return Hose

8. Connect fuel inlet hose to vapor separator. Secure hose with sta-strap.
9. Connect oil inlet hose to vapor separator. Secure hose with sta-strap.
10. Install throttle link arm to throttle cam.

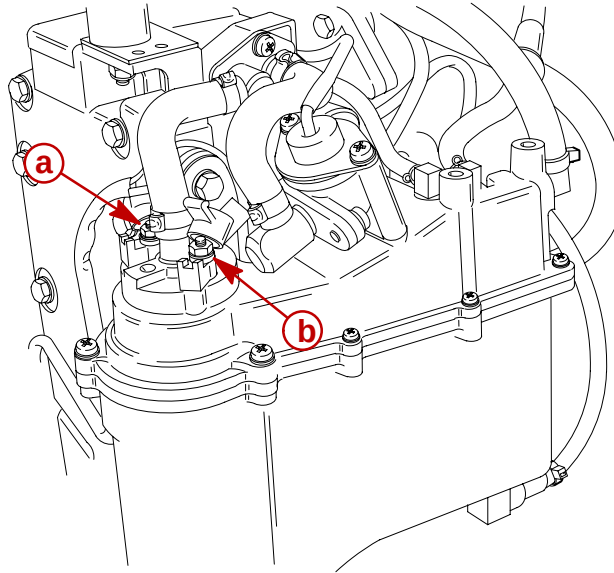


58050

- a** - Fuel Inlet Hose
- b** - Oil Inlet Hose
- c** - Throttle Link Arm



11. Connect RED (POSITIVE) lead to STARBOARD terminal of electric fuel pump and BLACK/RED (NEGATIVE) lead to PORT terminal of fuel pump. Torque POSITIVE nut to 6 lb. in. (0.7 Nm) and the NEGATIVE nut to 16 lb. in. (1.8 Nm).

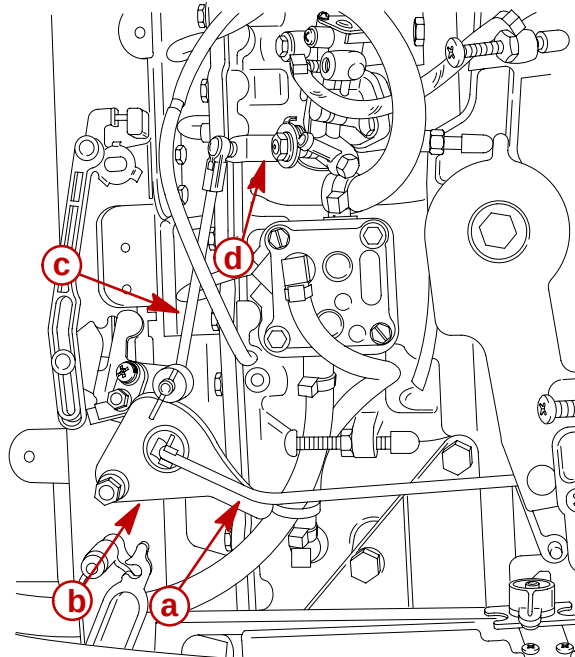


55204

- a** - RED (+) Terminal [Torque nut to 6 lb. in. (0.7 Nm)]
b - BLACK/RED (-) Terminal [Torque nut to 16 lb. in. (1.8 Nm)]

Manifold Removal

1. Disconnect throttle link rod from throttle cam.
2. Disconnect oil injection link rod from injector arm.



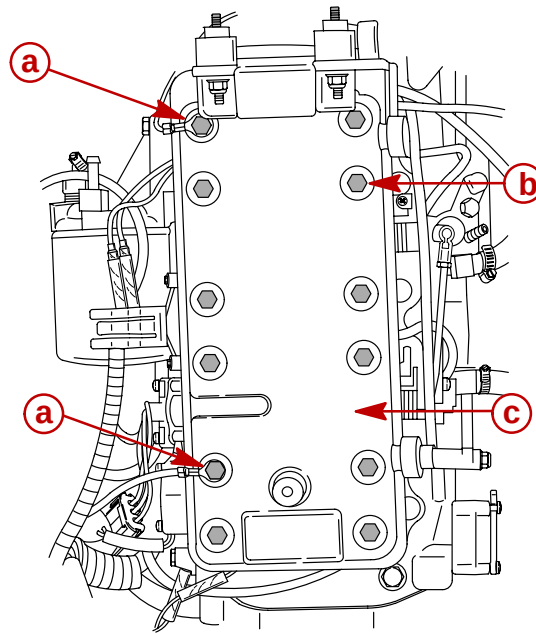
55213

- a** - Throttle Link Rod
b - Throttle Cam
c - Oil Injection Link Rod
d - Injector Arm

3. Identify location of 2 ground wires for reassembly purposes.
4. Remove 12 screws securing manifold cover to manifold.



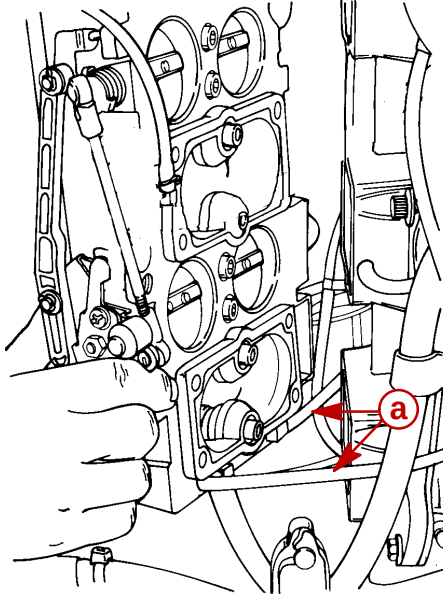
5. Remove manifold cover.



58176

- a** - Ground Wires
- b** - Screws (12)
- c** - Manifold Cover

6. Disconnect bleed line hoses from manifold fittings.
7. Remove manifold assembly and place on clean work surface.



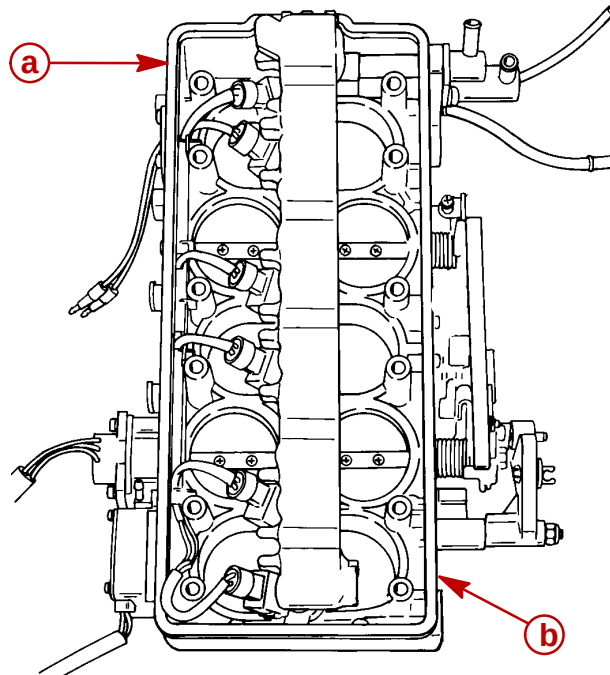
51795

- a** - Bleed Hoses



EFI Induction Manifold Disassembly

1. Remove manifold cover seal from manifold.

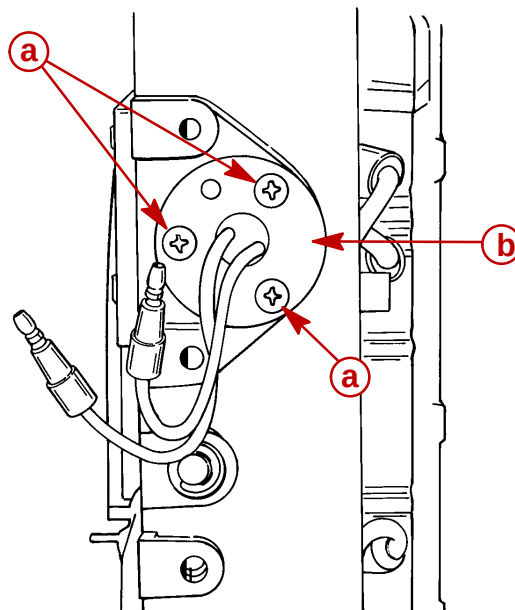


51785

- a** - Manifold Cover Seal
- b** - Manifold

Air Temperature Sensor Removal

1. Remove screws and sensor.

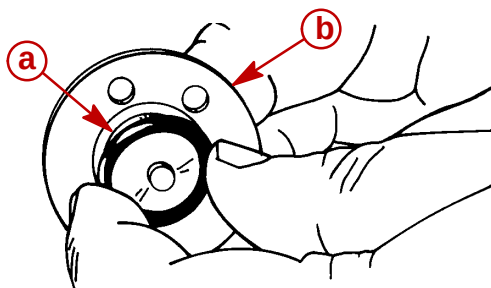


51790

- a** - Screws
- b** - Sensor



2. Remove O-ring from sensor.



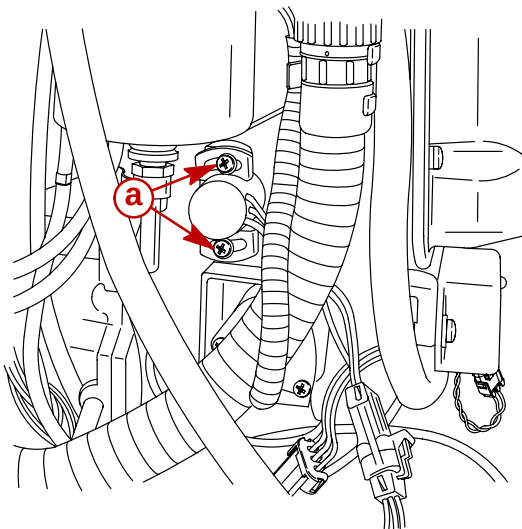
51791

- a** - O-ring
b - Sensor

Throttle Position Sensor Removal

IMPORTANT: Sensor position will need to be set after induction manifold assembly has been installed.

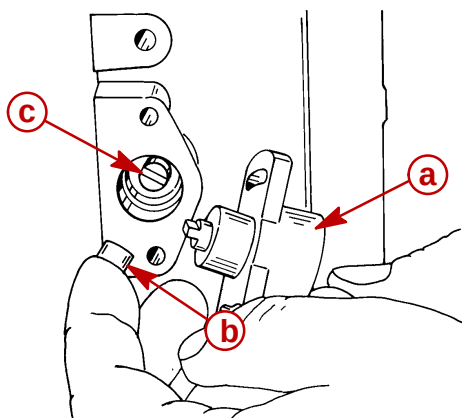
1. Remove throttle position sensor screws.



58053

- a** - Screws

2. Remove sensor and sleeve from throttle shaft.



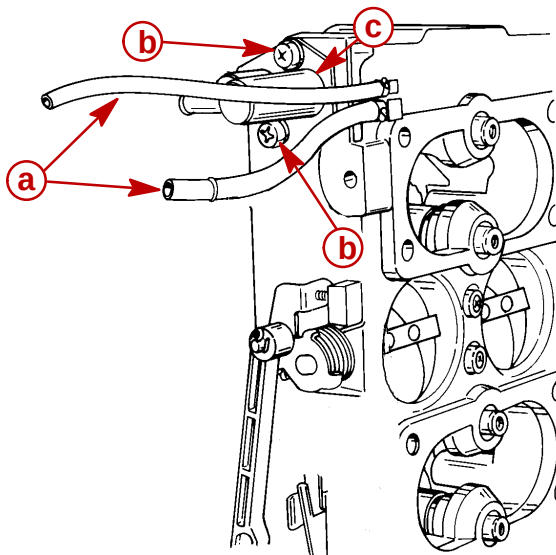
51788

- a** - Sensor
b - Sleeve
c - Throttle Shaft



Fuel Rail Removal

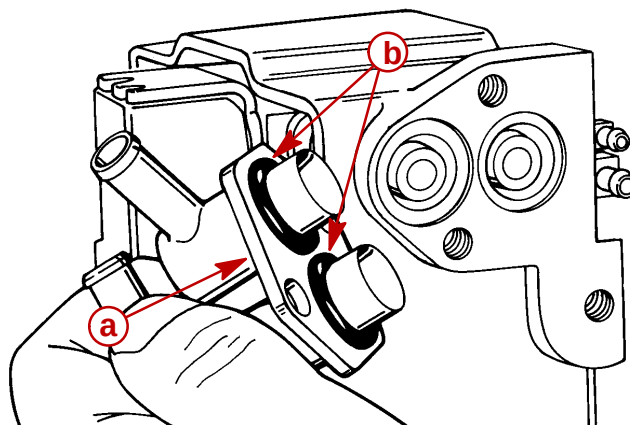
1. Remove manifold vacuum hoses.
2. Remove engine bleed hose.
3. Remove screws securing manifold fitting to manifold.



51789

- a** - Vacuum Hoses
- b** - Screws
- c** - Manifold Fitting

4. Remove manifold fitting and O-rings.

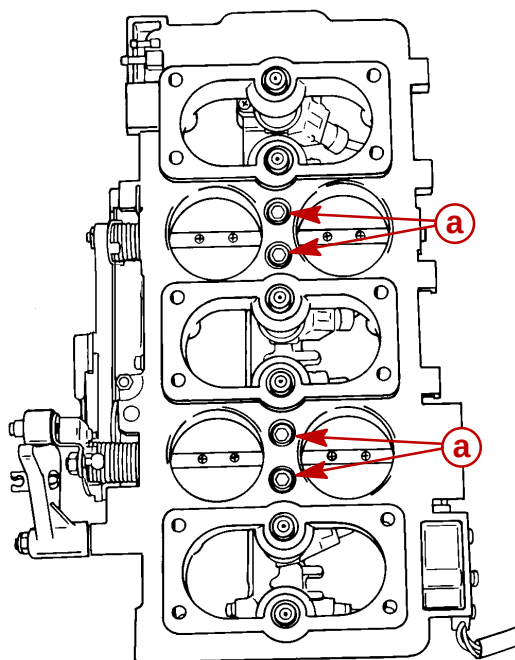


51791

- a** - Manifold Fitting
- b** - O-rings



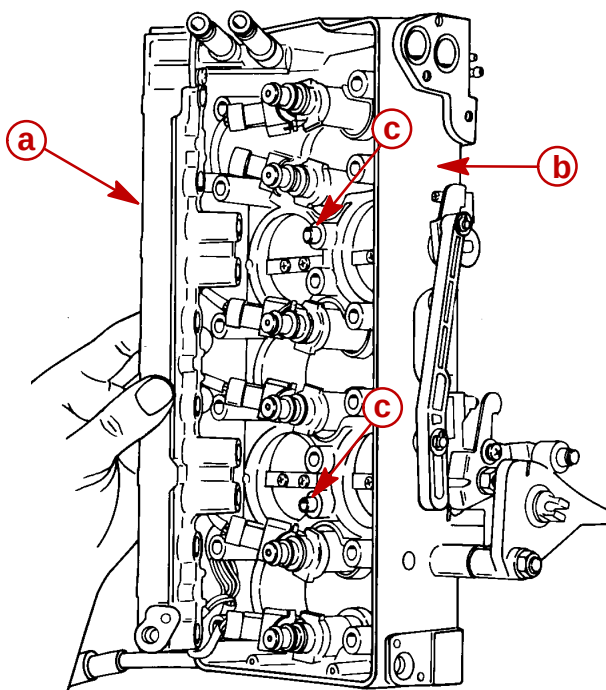
5. Remove 4 screws securing fuel rail to manifold.



51784

a - Screws (4)

6. Lift fuel rail from manifold. Note fuel rail guides.



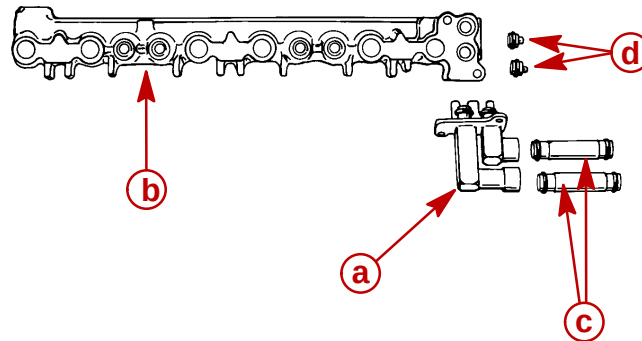
51788

a - Fuel Rail
b - Manifold
c - Guides



Fuel Rail Disassembly

1. Remove tube support from fuel rail.
2. Remove plugs from fuel rail.
3. Remove tubes from tube support.
4. Remove O-rings from plugs, tube support and tubes.

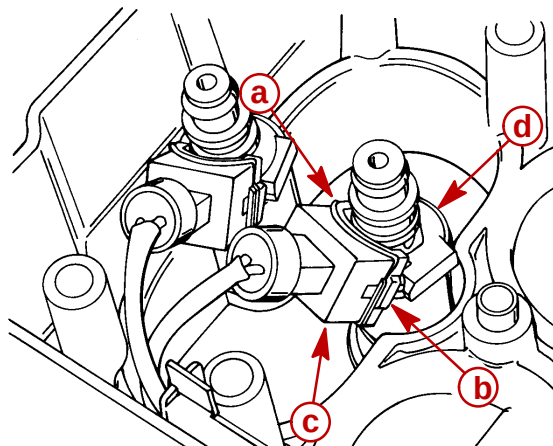


51795

- a** - Tube Support
- b** - Fuel Rail
- c** - Tubes
- d** - Plugs

Fuel Injector Removal and Disassembly

1. Lift wire clamp from slot.
2. Disconnect connector from injector.

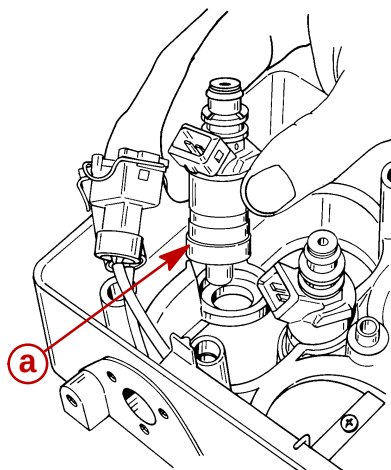


51792

- a** - Clamp
- b** - Slot
- c** - Connector
- d** - Injector



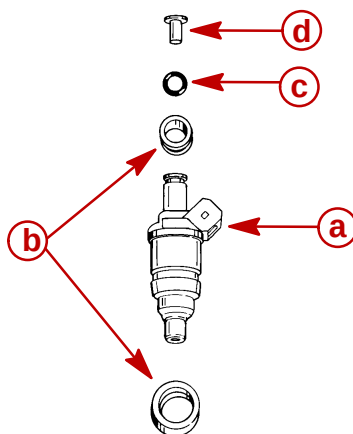
3. Remove injector from manifold.



51789

a - Injector

4. Place injector on clean work surface. Remove seals, O-ring and injector filter.



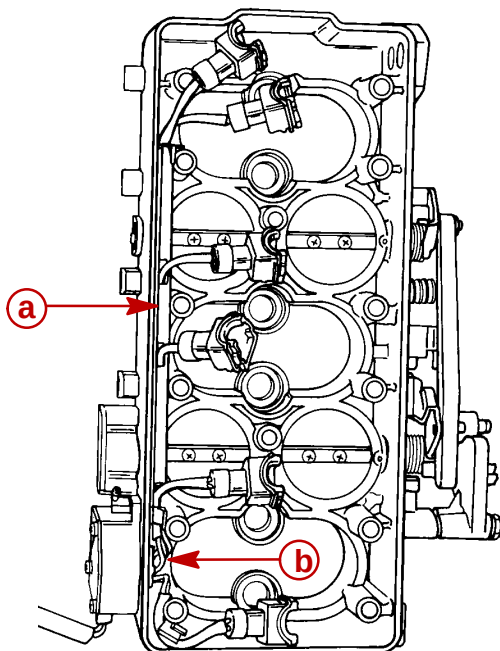
51789

a - Injector
b - Seals
c - O-Ring
d - Filter



Injector Harness Removal

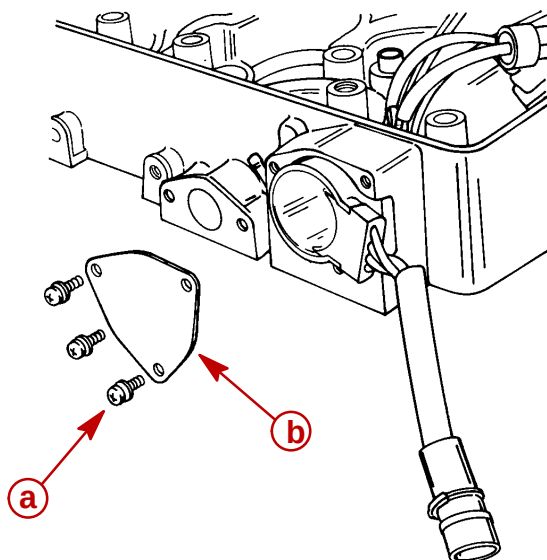
1. Remove protective casing from injector wiring harness. Note position of wires for reassembly.



51795

- a** - Casing
- b** - Harness

2. Remove screws and injector harness plate.

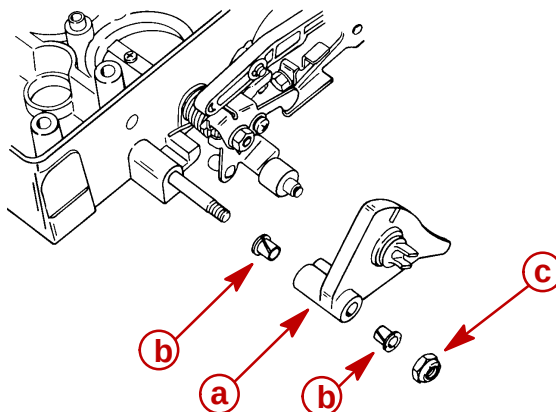


51792

- a** - Screws
- b** - Plate

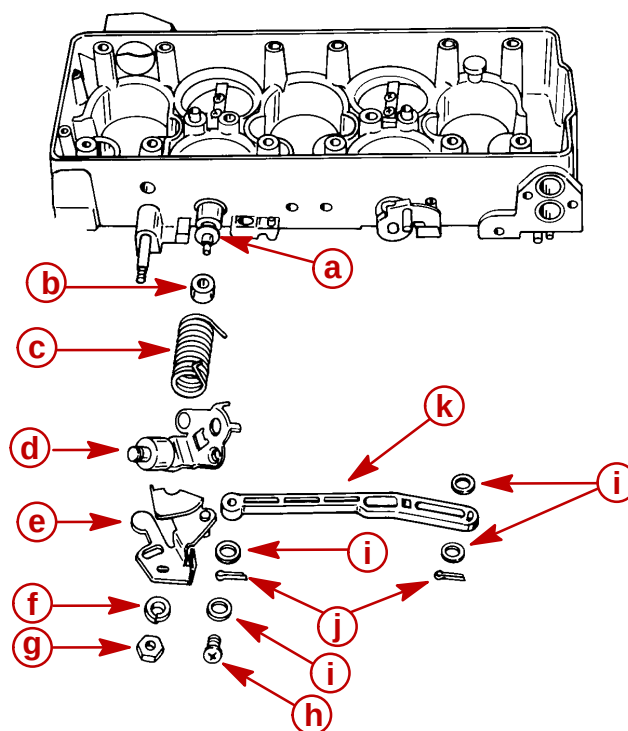


Throttle Linkage Removed



51786

- a** - Throttle Cam
- b** - Bushings
- c** - Nut; Tighten until snug against cam, then back off 1/4 turn



51789

- a** - Fiber Washer
- b** - Bushing
- c** - Spring
- d** - Roller Cam Bracket
- e** - Bracket (Shutter Link)
- f** - Lock Washer
- g** - Nut
- h** - Screw
- i** - Flat Washer
- j** - Cotter Key
- k** - Progressive Shutter Link



EFI System Cleaning and Inspection

Cleaning

1. Clean all non-electrical metal parts using a good grade solvent.
2. Use a soft bristle brush for removing large accumulations of dirt or grease and oil.
3. Varnish type coating of induction manifold parts may be removed using carburetor cleaner.
4. Wiring harnesses can be wiped down with a slightly solvent dampened rag.
5. Clean all fuel passages in induction manifold.
6. Dry all components using clean lint free cloths that are free of abrasives such as metal shavings or dirt.
7. Compressed air may be used to dry parts if the air used is free of moisture and un-lubricated.

Inspection

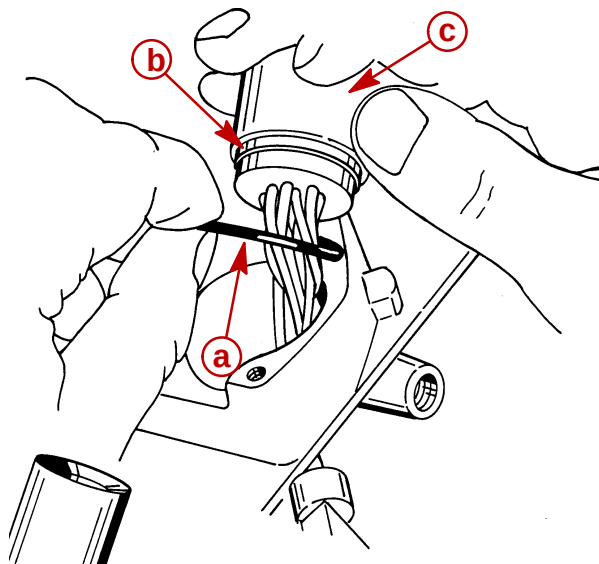
1. Look at entire system for signs of an obvious problem such as poor condition of wire insulation, leaking fitting, cracked or loose hoses and lines.
2. Look for fuel or oil leaks wherever these fluids are used (i.e. fuel filter cap, fuel pump, vapor separator cap, etc.).
3. Check for signs of tampering or abuse such as modifications to wiring or hose routing.
4. Look at main connector between engine harness and ECM box for missing, corroded or bent contact pins and socket. Check for dislodged grommet in ECM where harness enters box.
5. Look at all sensors (throttle position, air temperature and water temperature) connectors and harnesses for bad connections or poor insulation conditions such as fraying, stripping, cracks or signs of abrasion wear.
6. Look for loose, missing or damaged mounting hardware such as stripped threads on screws.
7. Look at sensors for signs of wear or damage such as cracks, chips, etc.
8. Look at filter housing for cracks, holes or other damage. Check for secure mounting.
9. Look at vapor separator for leaks, cracks, pitting or other damage.
10. Check all rubber mounting grommets for swelling tears, cracks or other conditions that would render parts unserviceable.
11. Check vapor separator float for signs of fuel entry in the float. Look at needle for wear of point.
12. Look at injectors for signs of plugging or looseness in fit with induction manifold.
13. Look at throttle linkage for bends, kinking or binding. Check spring for kinks.
14. Inspect all rubber seals and gaskets for swelling, cracks or slices that would cause improper sealing.



Induction Manifold Assembly

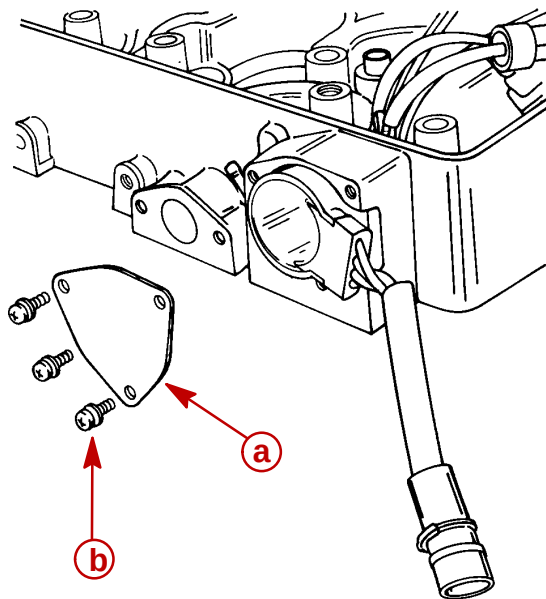
Injector Harness Installation

1. Carefully route injector harness into manifold.
2. Install O-ring into groove on injector harness insert. Install harness insert into manifold port.



- a** - O-Ring
b - Groove
c - Insert

3. Install injector harness plate using screws. Tighten securely.

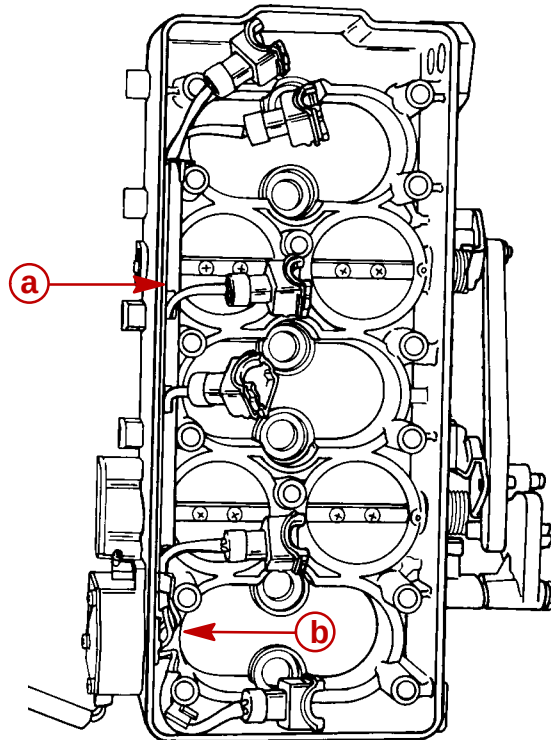


- a** - Plate
b - Screws

51792



4. Install protective casing over positioned injector wiring harness and insert into manifold.

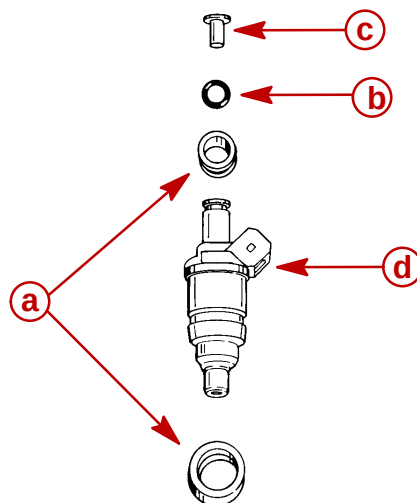


51795

- a** - Casing
- b** - Harness

Fuel Injector Assembly and Installation

1. Install inspected seals, O-ring and injector filter to injector.

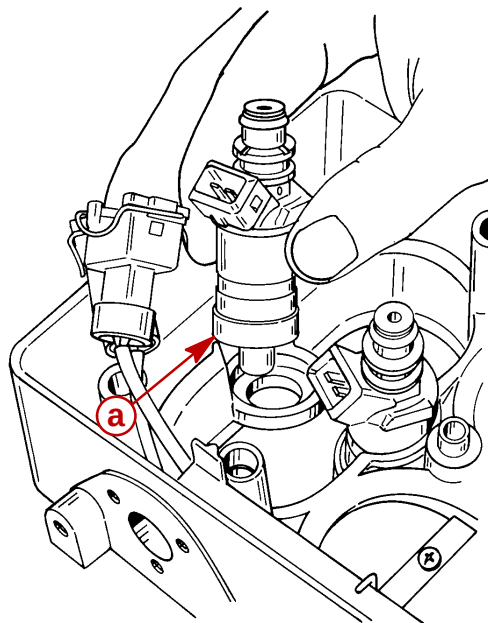


51789

- a** - Seals
- b** - O-Ring
- c** - Filter
- d** - Injector



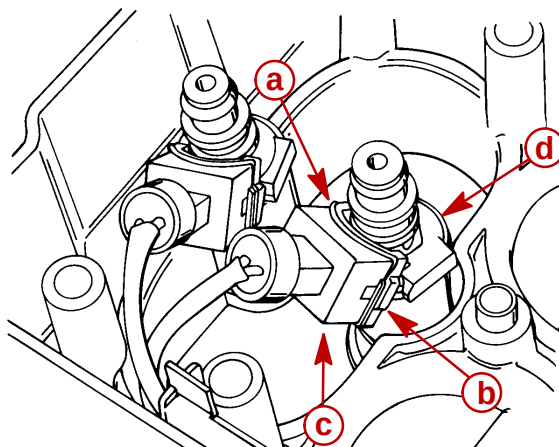
2. Install injector into manifold.



51789

a - Injector

3. Install wire clamp into slot on injector connector.
4. Connect to injector.



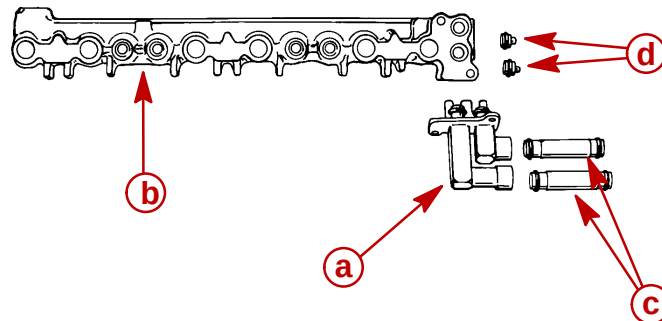
51792

a - Clamp
b - Slot
c - Connector
d - Injector



Fuel Rail Assembly

1. Install inspected O-rings to plugs, tube support and tubes.
2. Install tubes to tube support.
3. Install plugs to fuel rail.
4. Install tube support to fuel rail.

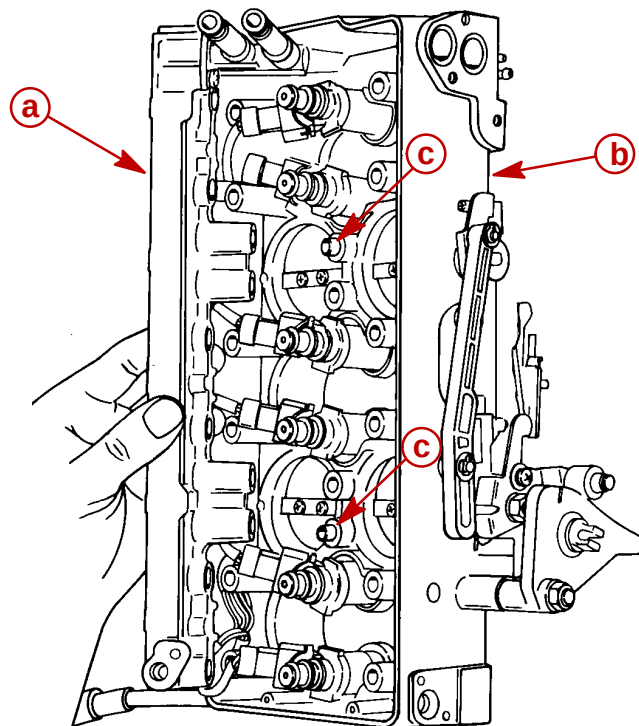


- a** - Tube Support
- b** - Fuel Rail
- c** - Tubes
- d** - Plugs

51795

Fuel Rail Installation

1. With fuel rail guides in place, install fuel rail to manifold.

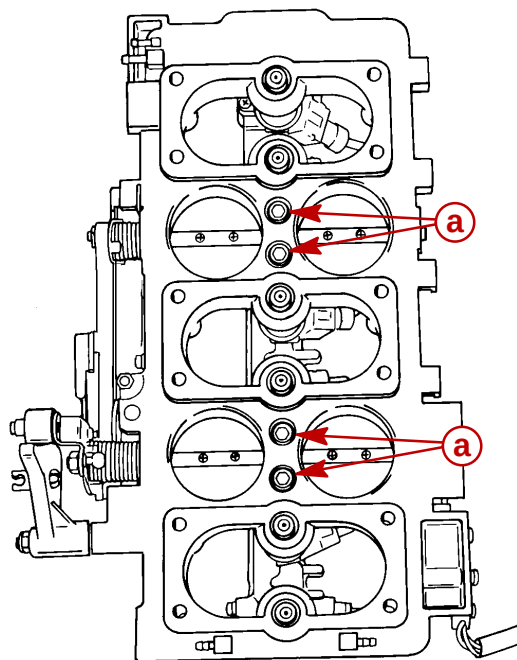


- a** - Fuel Rail
- b** - Manifold
- c** - Guides

51788



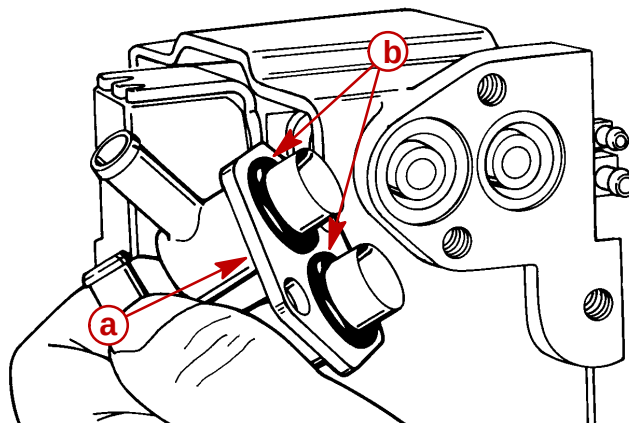
2. Install 4 screws securing fuel rail to manifold. Torque to 35 lb. in. (4 Nm).



51784

a - Screws (4)

3. Install O-rings to manifold fitting. Install fitting to manifold.

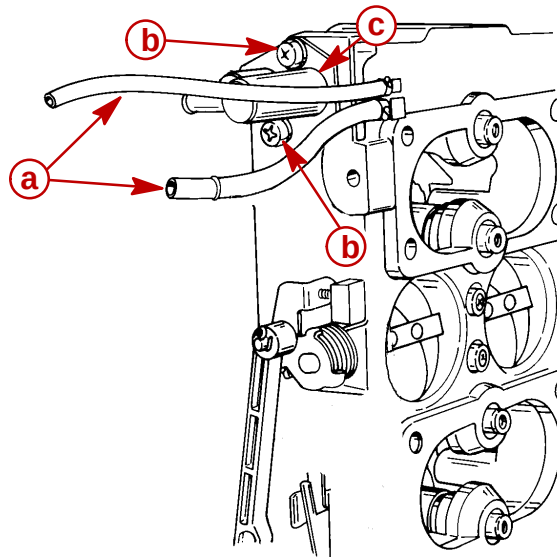


51791

a - Manifold Fitting
b - O-rings



4. Install screws securing manifold fitting to manifold. Torque screws to 45 lb. in. (5 Nm).
5. Install engine bleed hose.
6. Install manifold vacuum hoses.



51789

- a** - Vacuum Hoses
- b** - Screws
- c** - Manifold Fitting

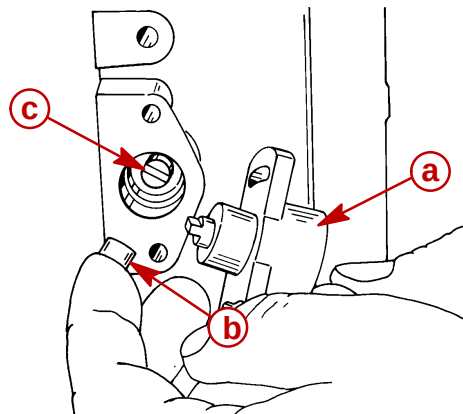
⚠ CAUTION

Use extreme care when installing induction manifold so as to eliminate any possibility for air leaks.

Throttle Position Sensor Installation

IMPORTANT: Throttle position sensor must be adjusted following reassembly (see Section 2C - Timing, Synchronizing, Adjustment).

1. Install sleeve to throttle position sensor.
2. Install sensor into manifold. Sleeve must guide sensor to throttle shaft.

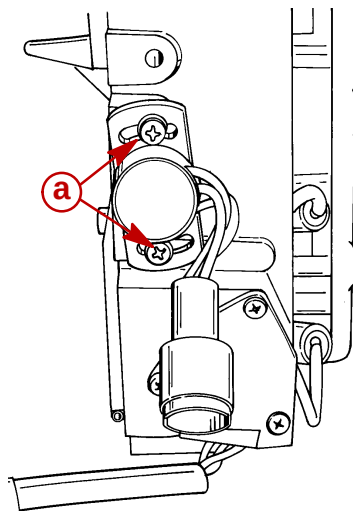


51788

- a** - Sensor
- b** - Sleeve
- c** - Throttle Shaft



3. Tighten screws after induction manifold installation and throttle position sensor adjustments are completed. Torque screws to 20 lb. in. (2 Nm).

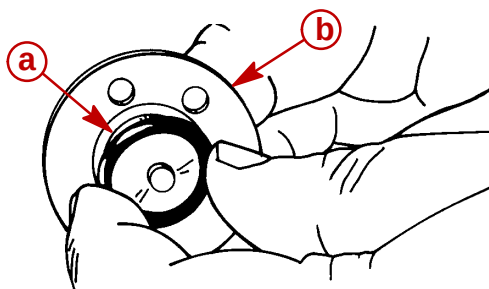


51790

a - Screws

Air Temperature Sensor Installation

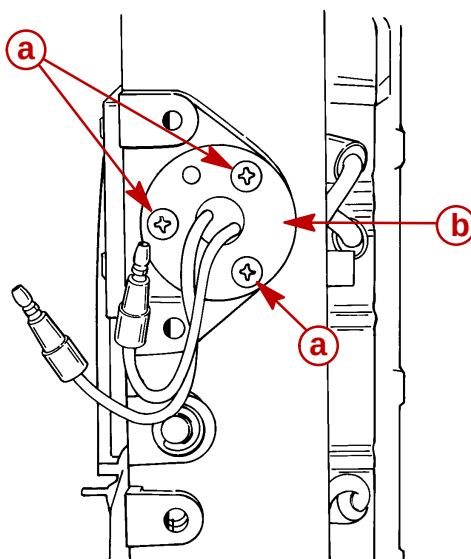
1. Install O-ring to air temperature sensor.



51791

a - O-ring
b - Sensor

2. Install air temperature sensor and secure with screws. Tighten screws securely.

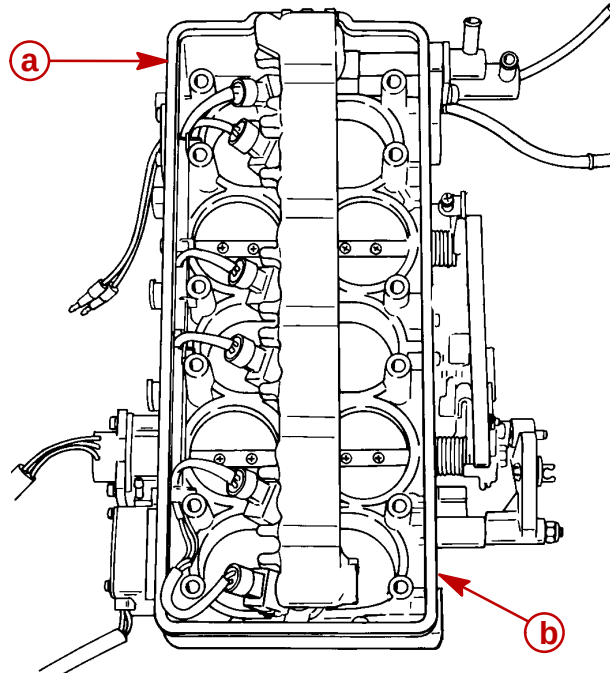


51790

a - Screws
b - Sensor



3. Carefully install manifold cover seal to manifold.

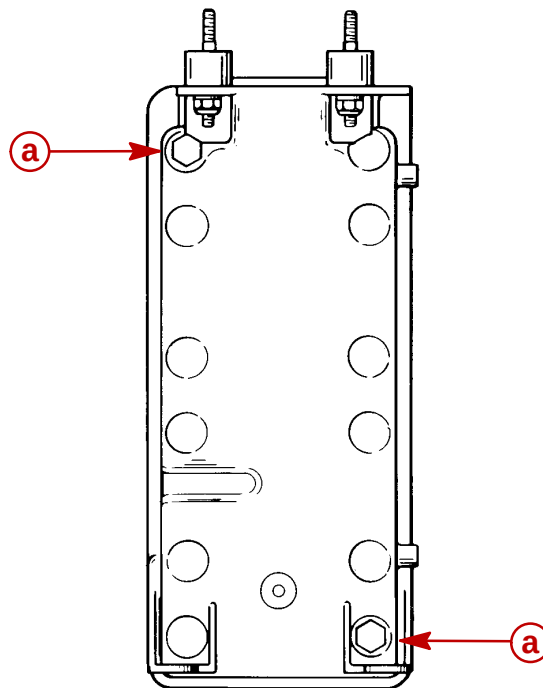


51785

- a** - Manifold Cover Seal
- b** - Manifold

4. Install manifold cover to manifold and secure with M8 x 1.25 x 38mm long bolts through holes.

NOTE: This will aid in induction manifold installation.

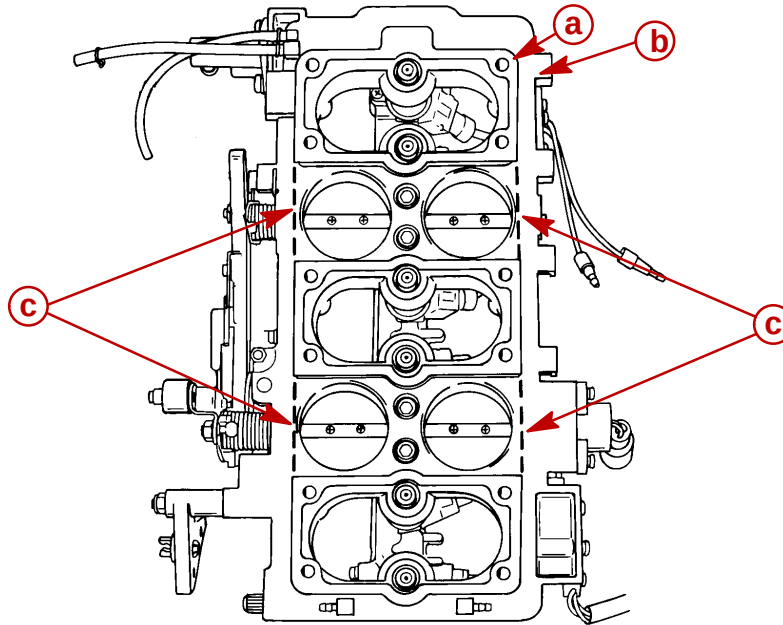


- a** - Holes



EFI Induction Manifold Installation

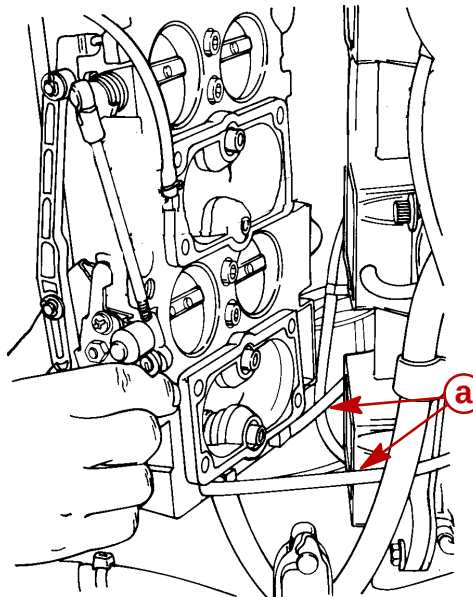
1. Install new gasket on induction manifold as shown. Removing dotted line sections after manifold installation.



51784

- a** - Gasket
- b** - Induction Manifold
- c** - Dotted Line Sections— Remove After Installation

2. With induction manifold held in place, connect bleed line hoses to manifold fittings.



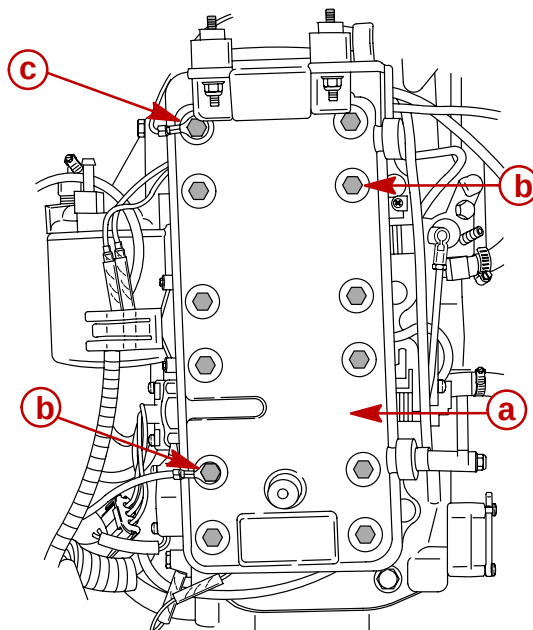
51795

- a** - Bleed Hoses



- Secure induction manifold assembly to engine with screws. Torque screws to 90 lb. in. (10.0 N·m) using torque sequence shown below.

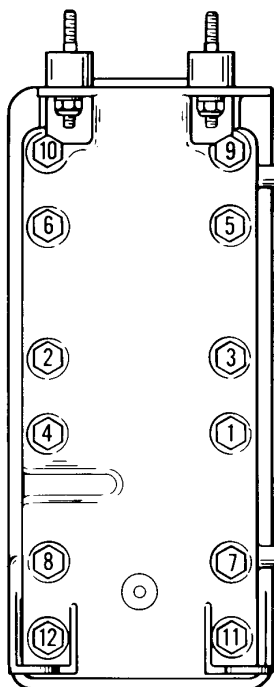
NOTE: Remove M8 x 1.25 x 38mm long bolts used for reassembly and install remaining screws. Install ground wires to proper location.



58176

- a** - Manifold
- b** - Screws [Torque to 90 lb. in. (10 Nm)]
- c** - Ground Wires

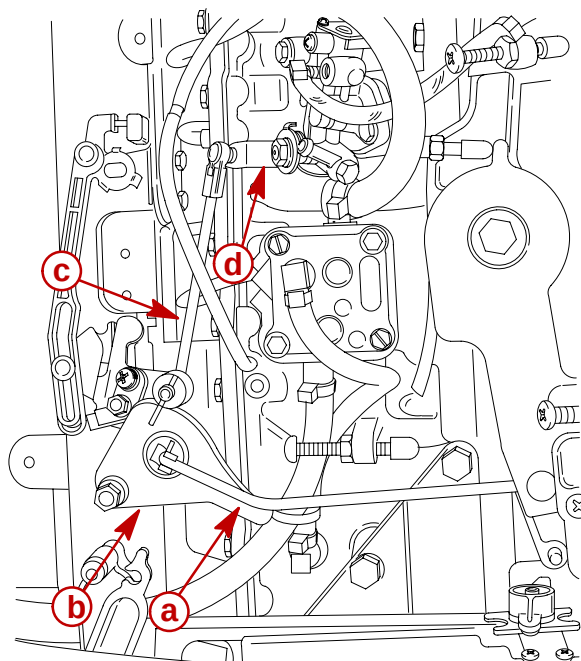
Cover Screw Torque Sequence





IMPORTANT: Before connecting oil pump control rod verify pump quadrant is rotated to the clockwise of center.

4. Connect oil injection link rod to injector arm.
5. Connect throttle link rod to throttle cam.



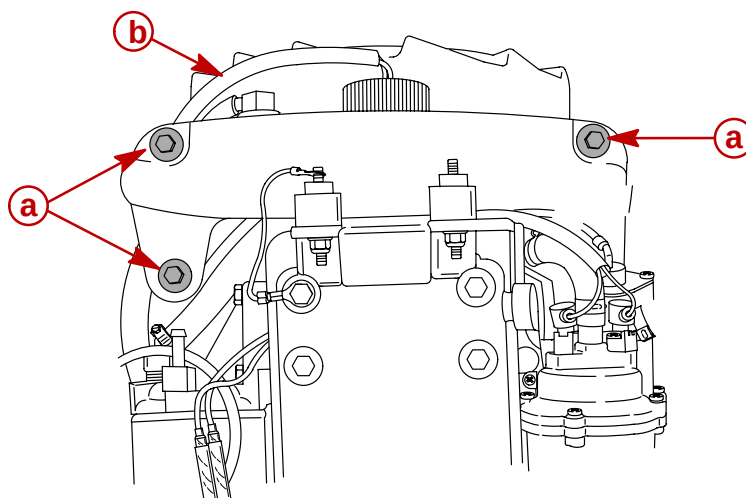
55213

a - Throttle Link Rod
b - Throttle Cam

c - Oil Injection Link Rod
d - Oil Injection Arm

Oil Reservoir Installation

1. Install oil reservoir to engine. Connect hose to oil pump fitting and secure with strap.
2. Reconnect low oil sensor harness bullet connectors (BLUE leads below fuel/water separator).
3. Secure reservoir using screws. Torque screws to 25 lb. in. (3 Nm).



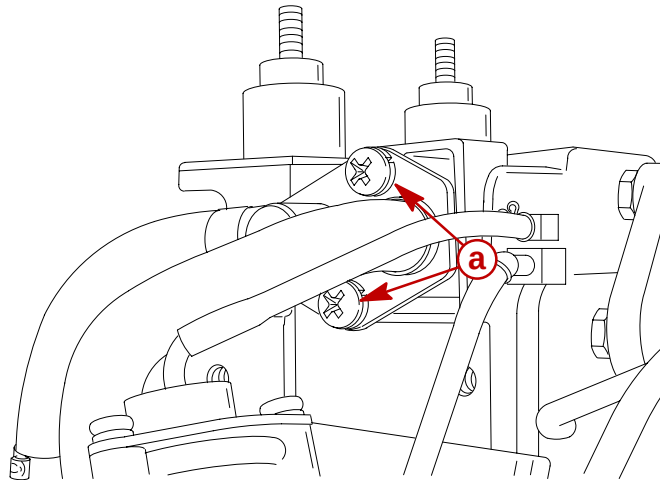
58172

a - Screws [Torque 25 lb. in. (3 Nm)]
b - Low Oil Sensor Harness (BLUE lead bullet connectors below fuel/water separator)



Vapor Separator Installation

1. Secure adaptor plate to manifold with 2 screws. Torque screws to 45 lb. in. (5 N·m).



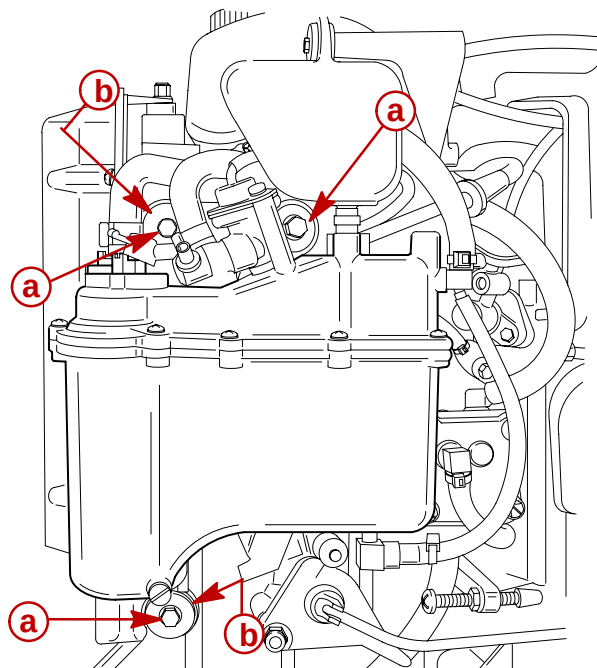
55216

a - Screws [Torque to 45 lb. in. (5 Nm)]

NOTE: For ease of reassembly, reinstall oil reservoir on engine *BEFORE* installing vapor separator.

2. Secure vapor separator to manifold with 3 screws and washers. Torque screws to 45 lb. in. (5 Nm).

NOTE: Spacers are positioned between separator and manifold at the top front and bottom attaching screw locations.



55176

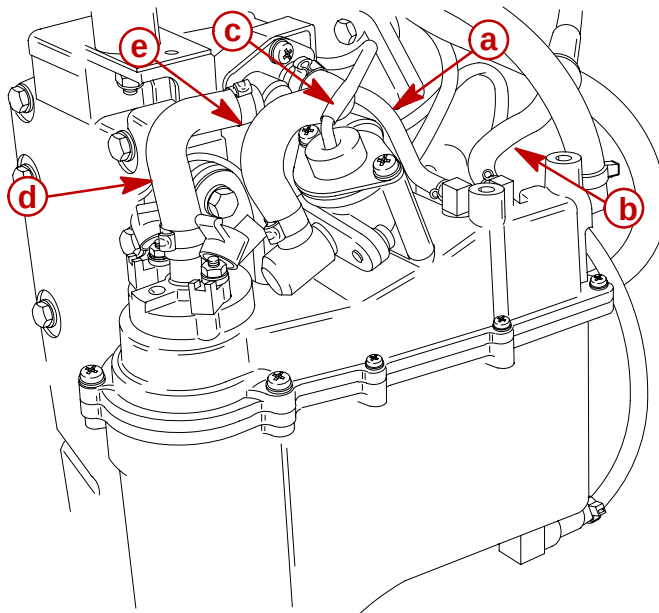
a - Screws [Torque to 45 lb. in. (5 Nm)]

b - Spacers



IMPORTANT: If fuel outlet hose from electric fuel pump or fuel return hose from manifold to pressure regulator was disconnected, stainless steel hose clamps **MUST BE USED** to secure connections. If outlet/return hoses are to be replaced, replacement tubing kit (32-827694) **MUST BE INSTALLED** to prevent rupturing or leakage. **DO NOT** use sta-straps to secure high pressure fuel lines as leakage will occur.

3. Connect vapor separator over flow hose between manifold and separator.
4. Connect engine bleed hose to separator.
5. Connect fuel pressure regulator hose to top fitting on manifold.



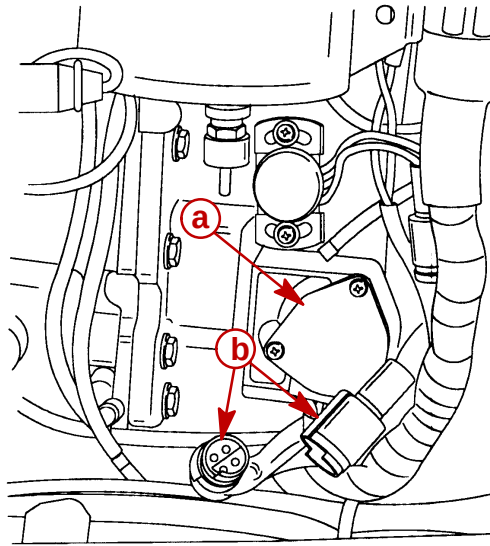
55204

- a** - Over Flow Hose
- b** - Bleed Hose
- c** - Pressure Regulator Hose
- d** - Fuel Outlet Hose
- e** - Fuel Return Hose



Throttle Position Sensor, Air Temperature Sensor and Fuel Injector Harness Connections

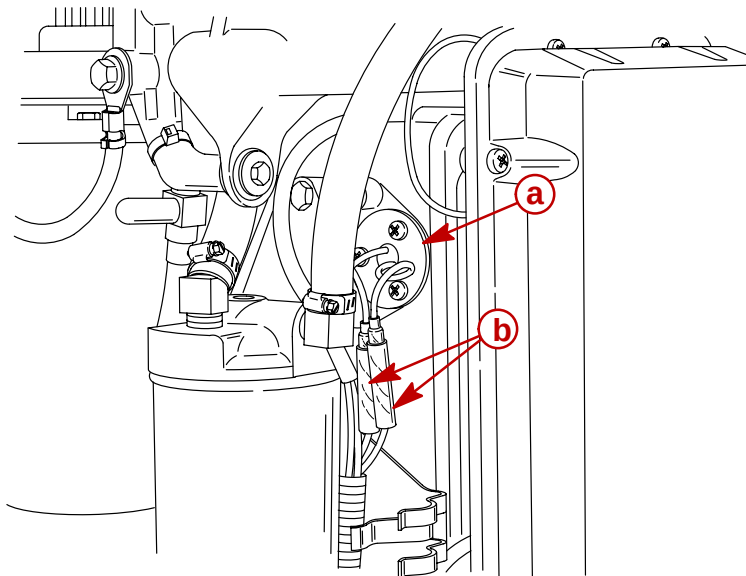
1. Connect fuel injector harness at 4 pin connector.



55193

- a** - Fuel Injector Harness
- b** - 4 Pin Connector

2. Connect air temperature sensor leads to bullet connectors.

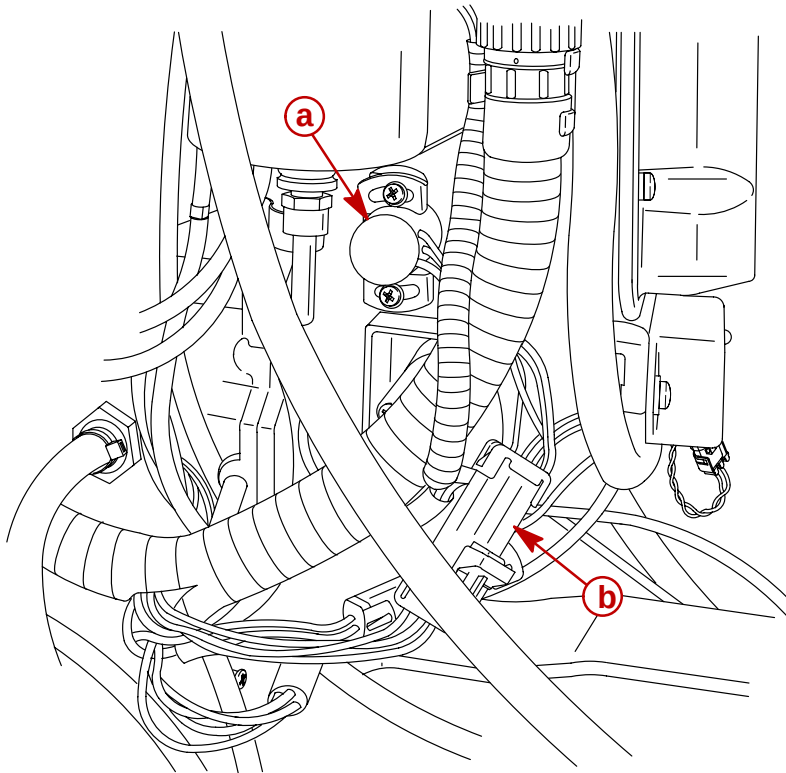


58170

- a** - Air Temperature Sensor
- b** - Connectors



3. Connect throttle position sensor at 3 pin connector.



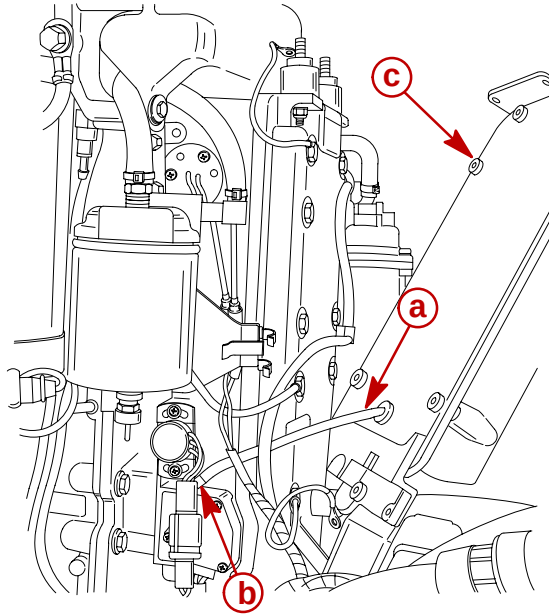
58055

- a** - Throttle Position Sensor
b - 3 Pin Connector



ECM Installation

1. Connect MAP sensor hose from ECM to manifold fitting. Place ECM on manifold studs.



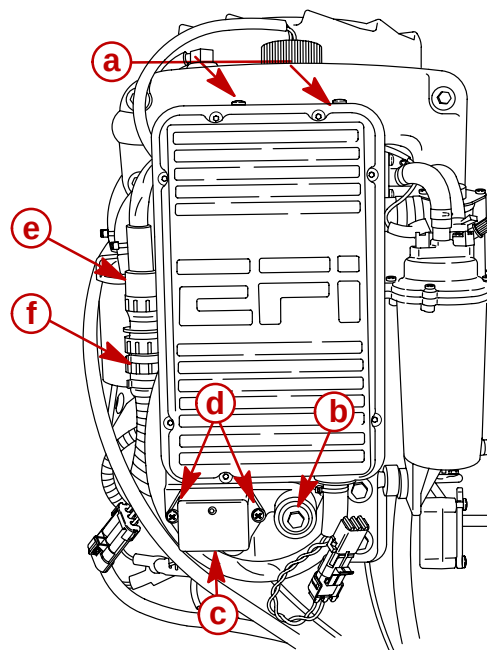
55199

a - MAP Sensor Hose
b - Fitting

c - ECM

2. Secure ECM to manifold using nuts and screw. Torque nuts and screw to 45 lb. in. (5 Nm).
3. Secure water sensing module with screws. Torque screws to 25 lb. in. (3 Nm).
4. Connect ECM harness to engine harness at connector. Install harness into harness bracket with connecting ring below or above bracket arms.

IMPORTANT: Do not force connecting ring between bracket arms.



58031

a - Nuts
b - Screw
c - Water Sensing Module

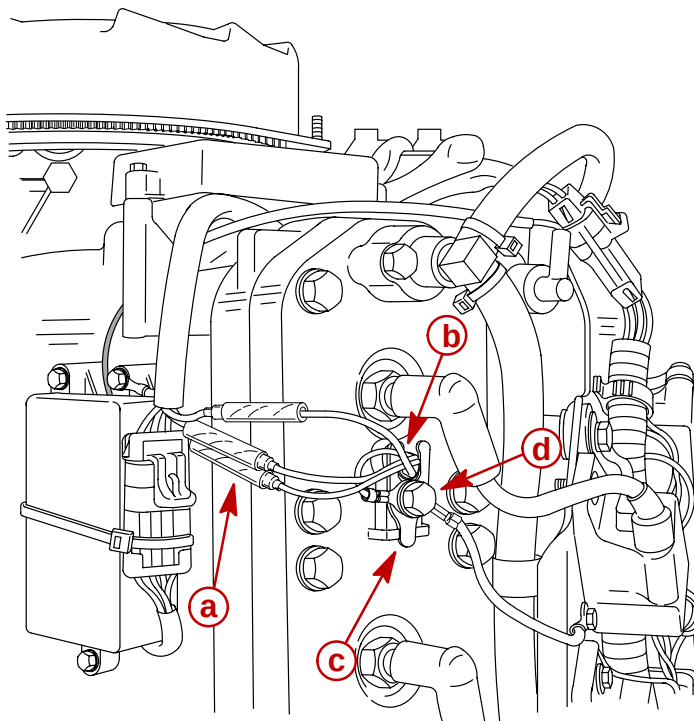
d - Screws
e - ECM Harness
f - Engine Harness



Engine Head Temperature Sensor Installation

IMPORTANT: Engine Head Temperature Sensor must make clean contact with cylinder head for circuit to function properly.

1. Connect wires and install sensor.
2. Install retaining plate and screw. Torque screw to 200 lb. in. (22.5 Nm).



58052

- a** - Wires
- b** - Sensor
- c** - Retainer
- d** - Screw [Torque to 200 lb. in. (22.5 Nm)]