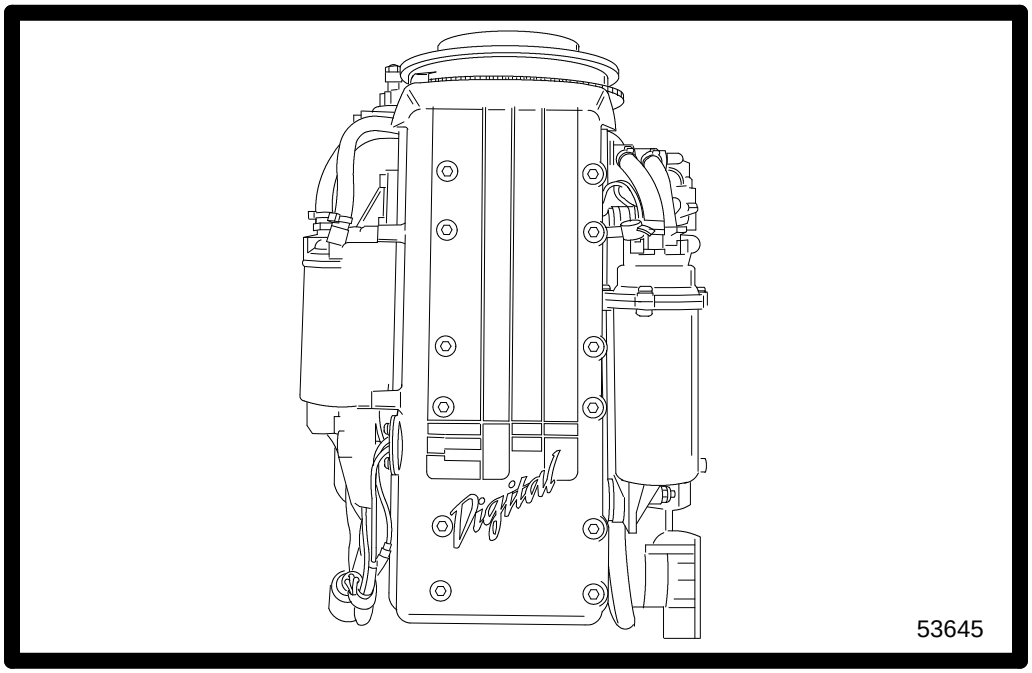
FUEL SYSTEMS

3

C



FUEL INJECTION

Table of Contents

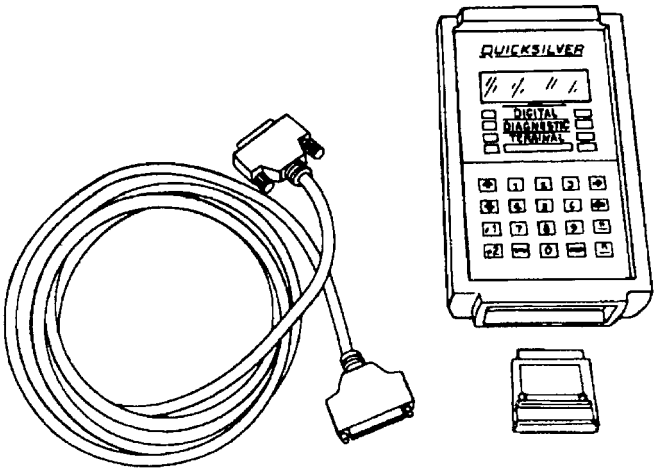
Specifications

Electronic Fuel Injection	
Idle RPM – All Models	650 ±50
Wide Open Throttle RPM – Model 225 EFI – Model 250 EFI	 5000 – 5800 5000 – 5800
Float Adjustment (Vapor Separator) – Float Level	 Preset @ Factory
Fuel Injectors –All Models (Quantity) – Fuel ECU Receives Signal from: – #2 Primary Ignition Circuit – #4 Primary Ignition Circuit – #6 Primary Ignition Circuit	 6 #1 and #2 Injectors (WHITE Lead) #3 and #4 Injectors (DARK BLUE Lead) #5 and #6 Injectors (YELLOW Lead)
Line Pressure @ Injectors	34 psi – 36 psi (234kPa – 248kPa)
ECM (either Fuel or Ignition) Amperage Draw with Ignition Switch in the ON or RUN Position	20 to 90 Milliamperes* (measured @ PURPLE lead @ respective ECM harness connector with inductive test meter)

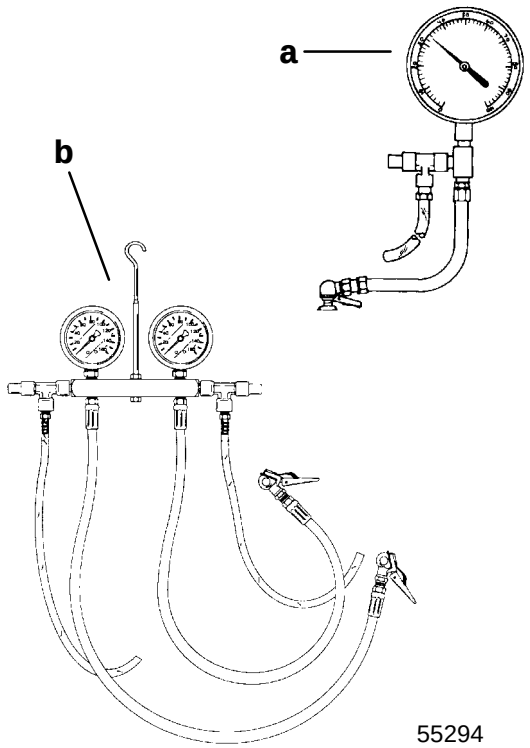
***NOTE:** The use of an in-series type test meter may result in different readings from those of an inductive test meter. Test results listed are approximate.*

Special Tools

Digital Diagnostic Terminal (DDT)



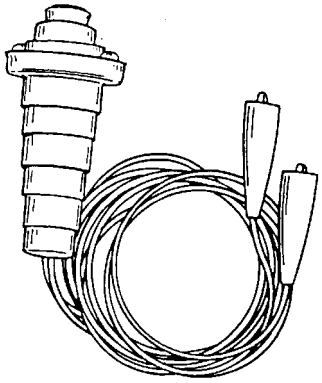
Fuel Pressure Gauge 91-16850 (a) or Fuel Pressure Gauge 91-852087A1 (b).



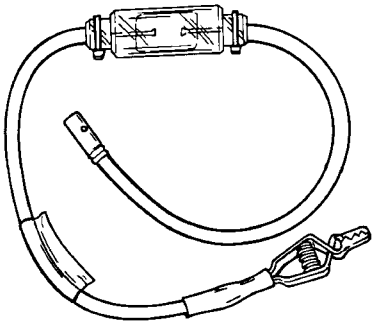
51796

55294

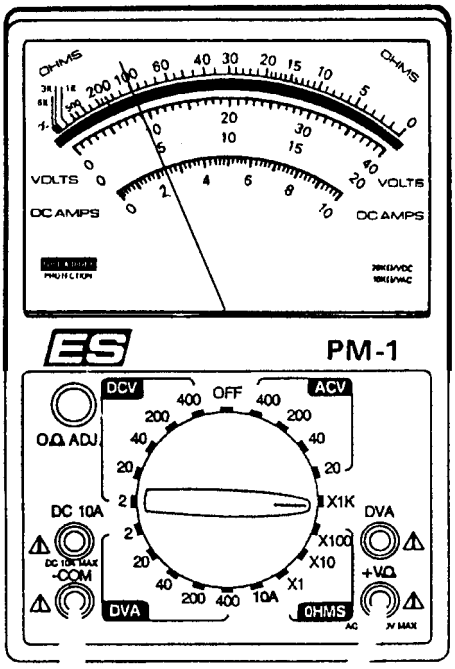
Remote Starter Switch 91-52024A1



Spark Gap Tester 91-63998A1

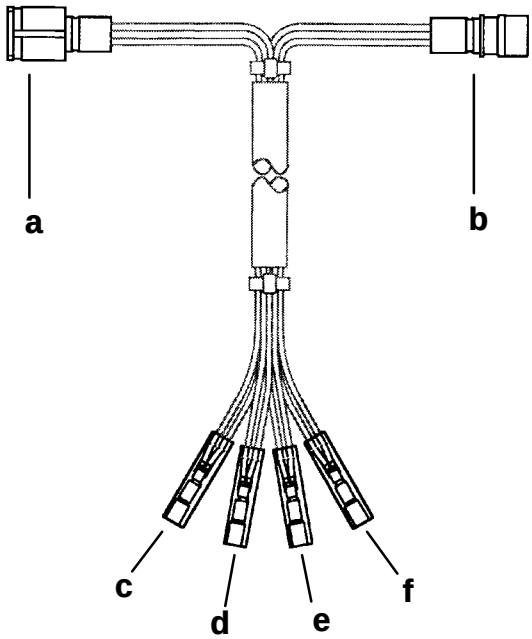


Multi-Meter DVA Tester 91-99750



***NOTE:** There are 3 different Multi-Meter DVA Testers using the part number 91-99750 or 91-99750A1 having a DVA built in. Any one of these testers will work with the small V-6 EFI system.*

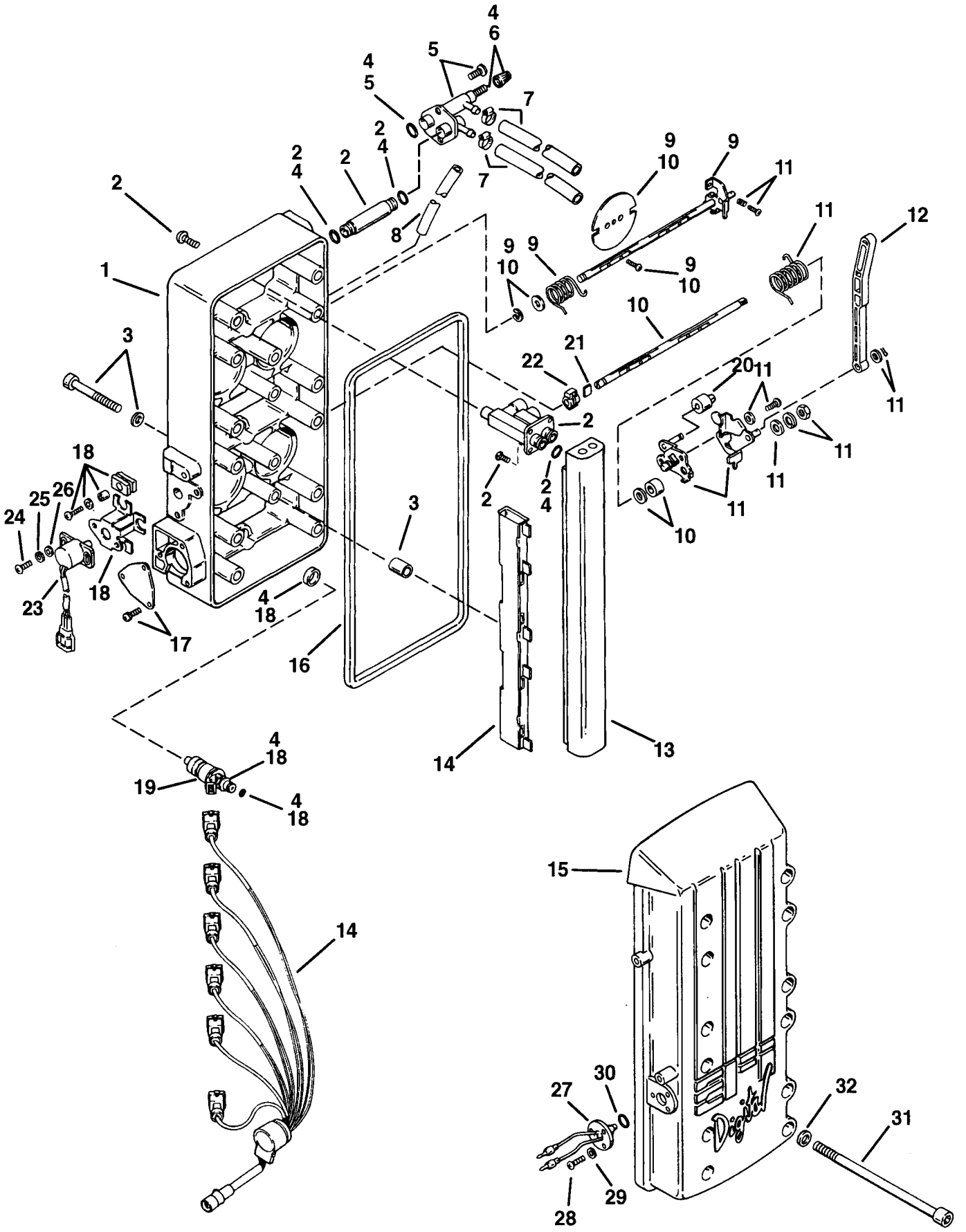
Injector Test Harness 91-833169A1
– For Mercury/Mainer 150 thru 250 HP with Electronic Fuel Injection
– For Hi-Performance 150 thru 300 HP PRO MAX/ SUPER MAGNUM models only
Can be used to verify that the ECM is supplying operating voltage to the injectors. Harness is connected between the injector harness 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

Notes:

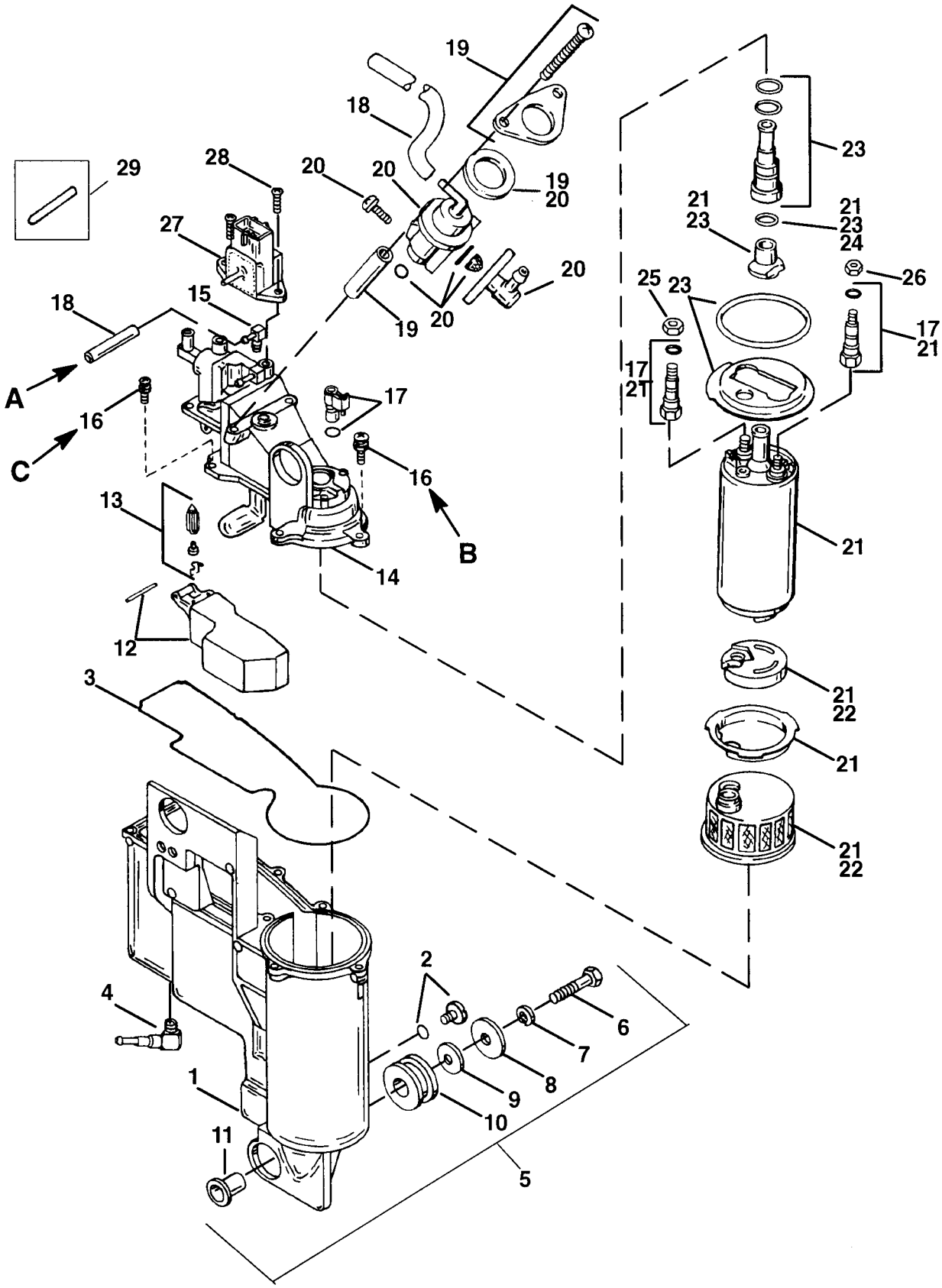
Fuel Management System



Fuel Management System

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
–	1	FUEL MANAGEMENT **(250 - 4 SHUTTER)**			
–	1	FUEL MANAGEMENT **(225 - 2 SHUTTER)**			
1	1	THROTTLE BODY **(4 SHUTTER)**			
1	1	THROTTLE BODY **(2 SHUTTER)**			
2	1	FUEL RAIL JOINT KIT	18		2.0
3	1	SCREW KIT-Fuel Rail	45		5.1
4	1	O-RING KIT			
5	1	FMA JOINT KIT	45		5.1
6	1	SCHRADER VALVE KIT			
7	1	TUBING KIT			
8	1	TUBING KIT			
9	1	THROTTLE SHAFT KIT **(TOP-4 SHUTTER)**			
10	1	THROTTLE SHAFT KIT **(BOTTOM)**			
11	1	LINK LEVER KIT			
12	1	LINK			
13	1	FUEL RAIL			
14	1	HARNESS KIT			
15	1	COVER			
16	1	SEAL			
17	1	RETAINING KIT			
18	5	BRACKET KIT-TPS			
19	6	INJECTOR KIT			
20	1	ROLLER			
21	1	KEY			
22	1	COUPLING			
23	1	SENSOR-Throttle Position			
24	2	SCREW (M4 x 10)	20		2.3
25	2	LOCKWASHER			
26	2	WASHER			
27	1	TEMPERATURE SENSOR			
28	3	SCREW (M4 x 10)	Drive Tight		
29	3	LOCKWASHER			
30	1	O RING			
31	12	SCREW		19	26.0
32	12	WASHER			

Fuel Management System

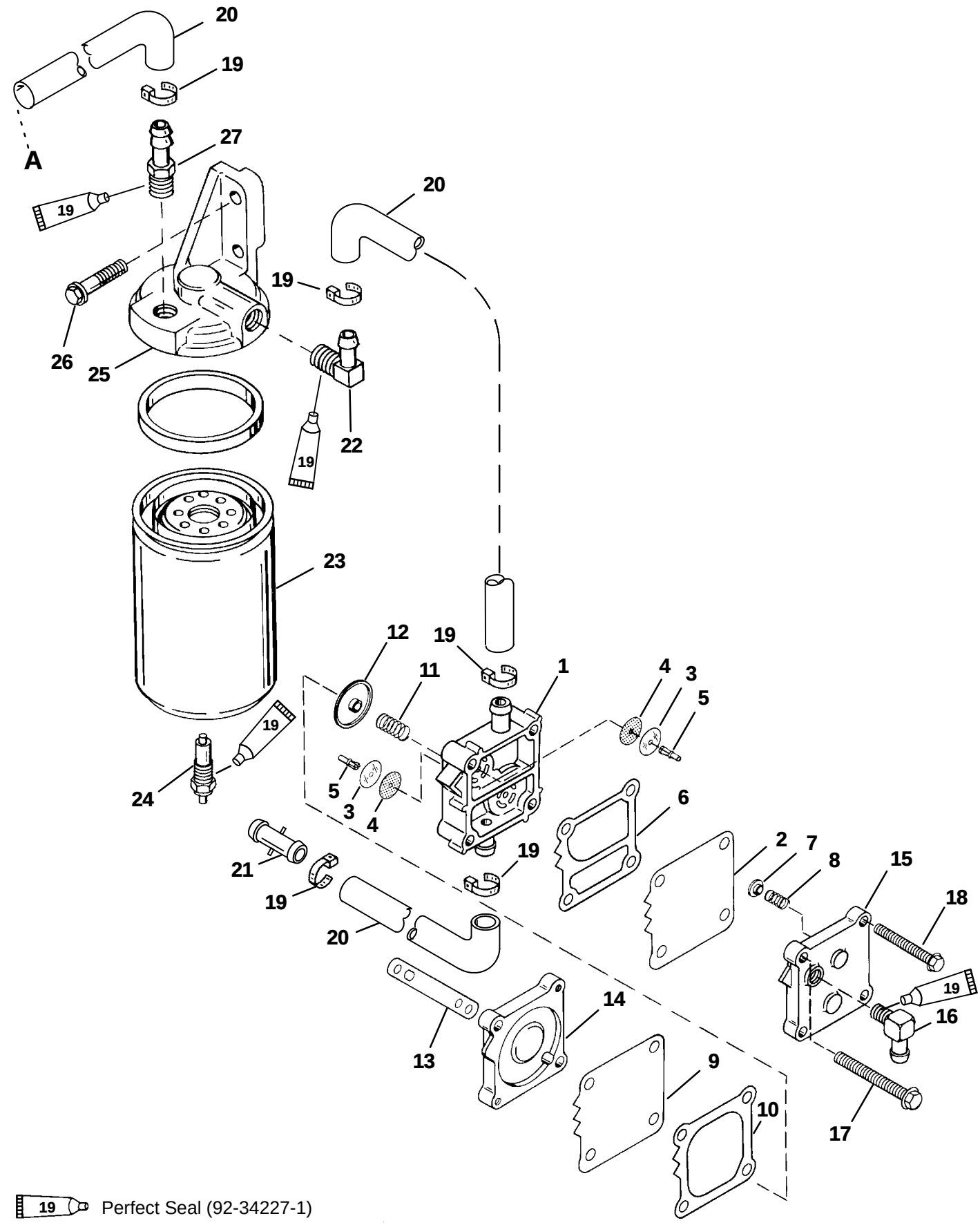


A – To Fuel Filter
B – Large Screws (5mm) [Torque to 30 lb. in. (3.4 N·m)]
C – Small Screws (4mm) [Torque to 20 lb. in. (2.3 N·m)]

Fuel Management System

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
–	1	FUEL MANAGEMENT **(250 - 4 SHUTTER)**			
–	1	FUEL MANAGEMENT **(225 - 2 SHUTTER)**			
1	1	VAPOR SEPARATOR BODY KIT			
2	1	DRAIN SCREW KIT			
3	1	O RING			
4	1	CHECK VALVE			
5	1	MOUNTING SCREW KIT			
6	3	BOLT	45		5.1
7	3	LOCKWASHER			
8	3	WASHER			
9	3	WASHER			
10	3	GROMMET			
11	3	COLLAR			
12	1	FLOAT KIT			
13	1	FLOAT VALVE KIT			
14	1	COVER			
15	1	ELBOW KIT			
16	1	SCREW KIT			
17	1	ELECTRICAL CONNECTION KIT			
18	1	TUBING KIT			
19	1	ATTACHING KIT-Pressure Regulator	30		3.4
20	1	PRESSURE REGULATOR KIT	45		5.1
21	1	FUEL PUMP KIT			
22	1	FUEL STRAINER KIT			
23	1	FUEL PUMP FITTING KIT			
24	1	O RING KIT			
25	1	NUT (M4 x .7)	6		0.7
26	1	NUT (M5 x .8)	8		0.9
27	1	MAP SENSOR			
28	2	SCREW (M6 x 12)	Drive Tight		
29	1	CAP **(BLACK) (S/N 0G438000 & UP)**			

Fuel Pump



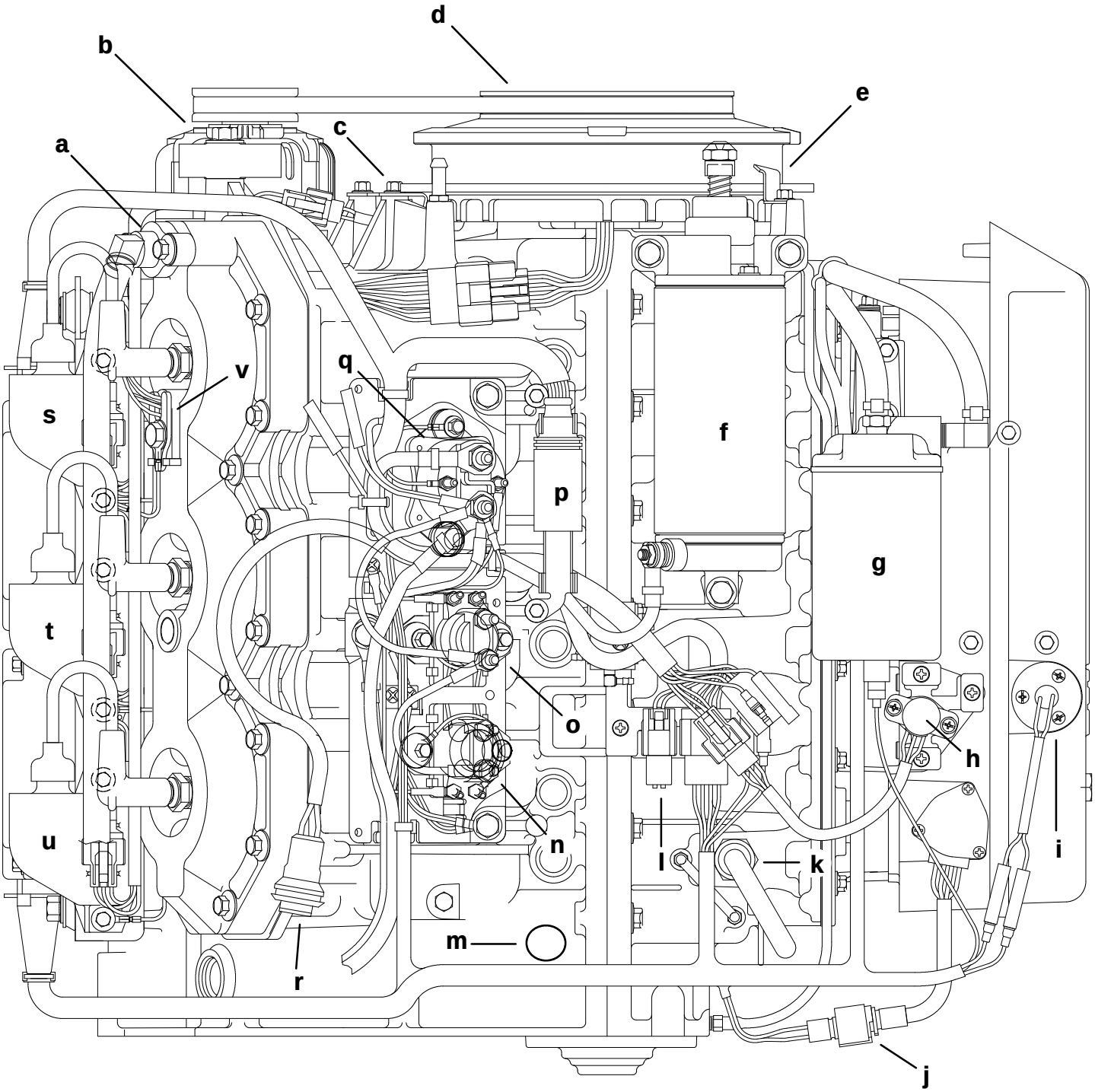
19 Perfect Seal (92-34227-1)

A = TO VAPOR SEPARATOR

Fuel Pump

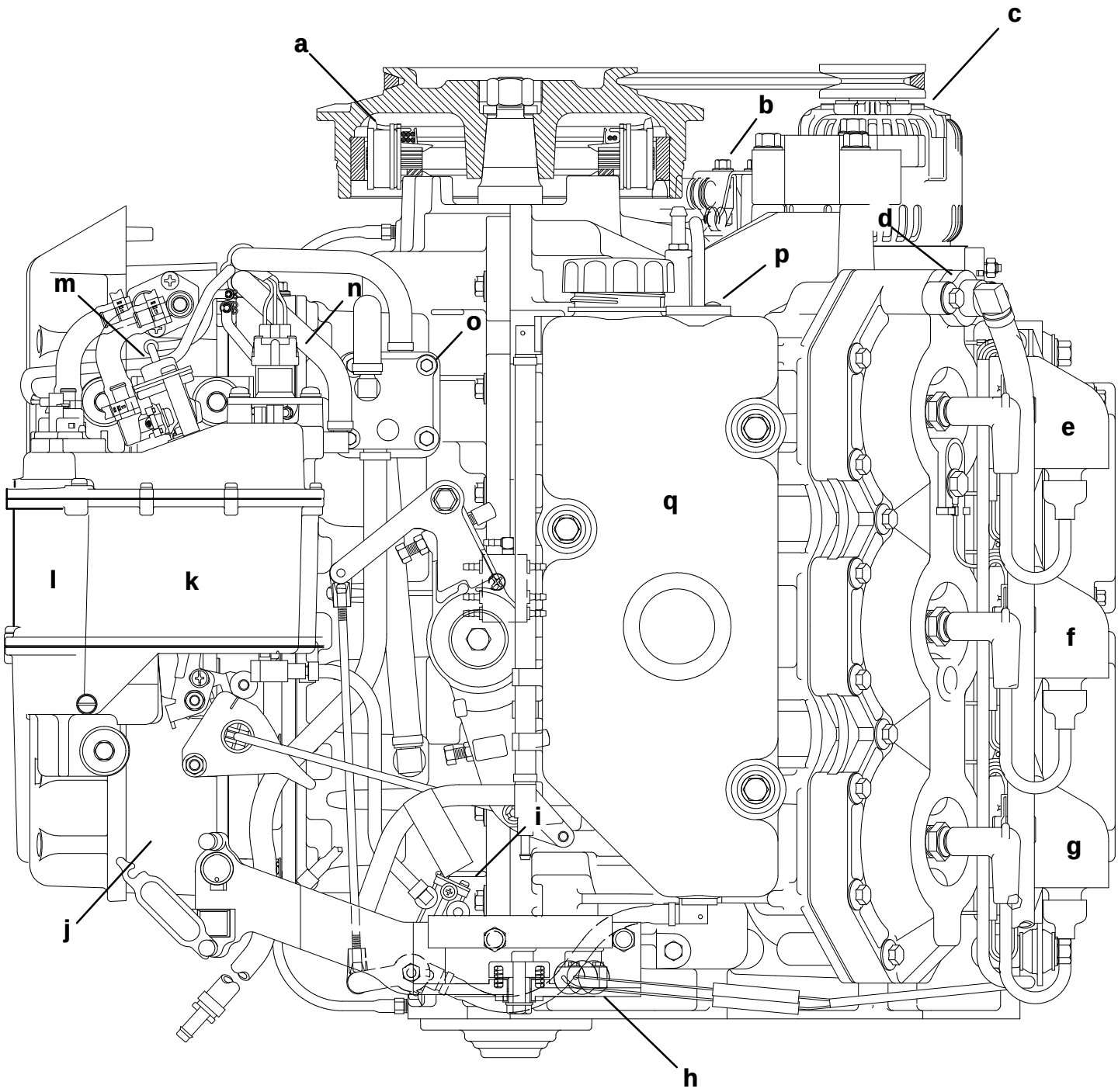
REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb. in.	lb. ft.	N·m
1	1	FUEL PUMP ASSEMBLY			
2	1	DIAPHRAGM KIT			
3	2	CHECK VALVE–rubber			
4	2	CHECK VALVE			
5	2	RETAINER			
6	1	GASKET–boost			
7	1	CAP			
8	1	SPRING			
9	2	DIAPHRAGM			
10	1	GASKET–pulse			
11	1	SPRING			
12	1	CAP			
13	1	GASKET–base			
14	1	BASE–fuel pump			
15	1	PLATE–fuel pump			
16	1	ELBOW (90°)			
17	2	SCREW–fuel pump to crankcase (M6 x 1)	60		6.8
18	2	SCREW–fuel pump (M5 x 0.8 x 40)	60		6.8
19	AR	STA-STRAP			
20	3	TUBING (17")			
21	1	CONNECTOR			
22	1	FITTING-Base (Included with Ref. #25)			
23	1	FUEL FILTER **S/N–0G303045 & BELOW**			
24	1	PROBE			
23	1	FUEL FILTER **S/N–0G303046 & UP**			
24	1	PROBE			
25	1	BASE-Fuel Filter			
26	2	SCREW (M6 x 30)	100		11.3
27	1	CONNECTOR (STRAIGHT)			

Powerhead View (Starboard)



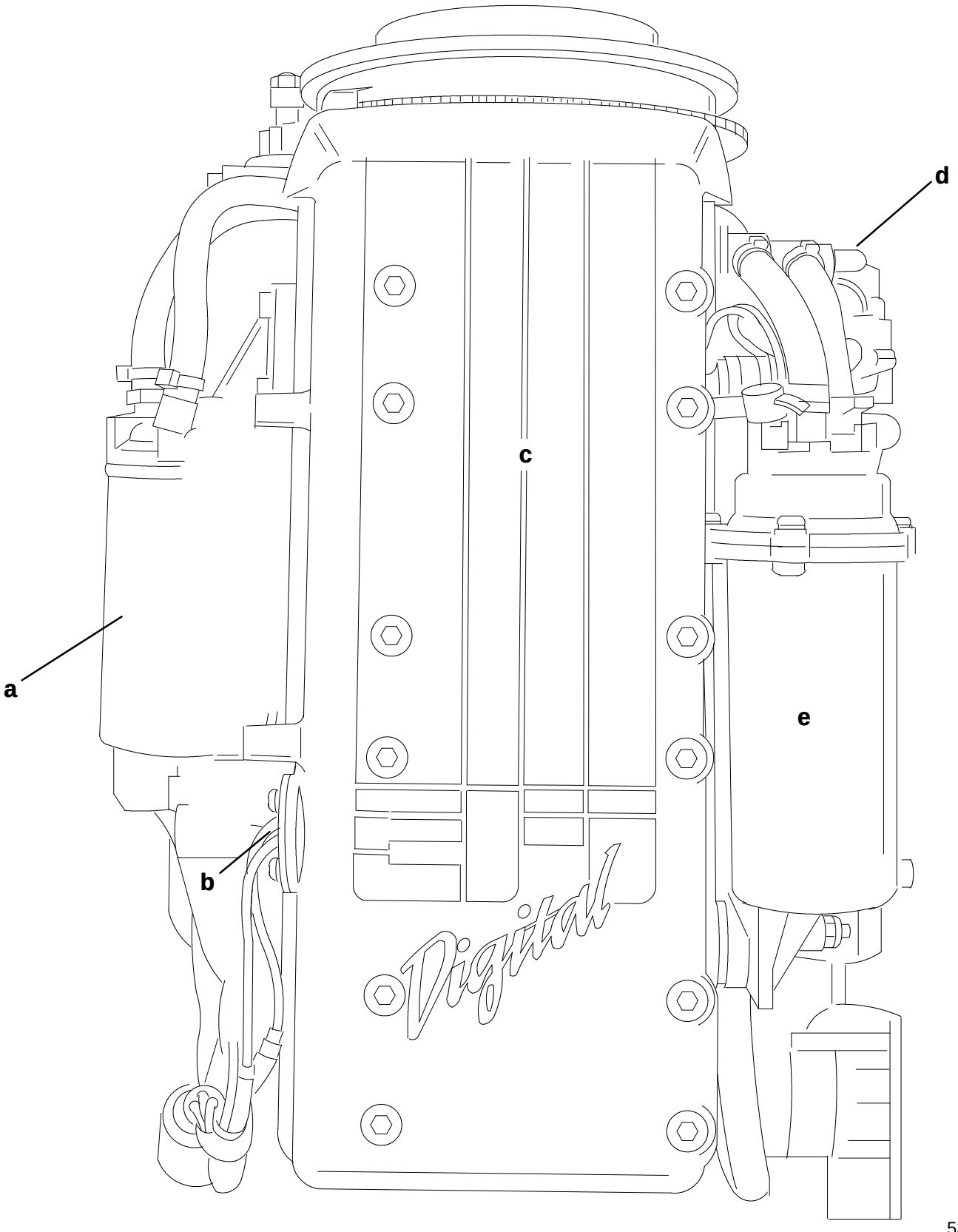
a - Thermostat (143°F)
b - 60 Ampere Alternator
c - Crank Position Sensor
d - Flywheel
e - Timing Pointer
f - Starter Motor
g - Water Separator
h - Throttle Position Sensor
i . - Air Temperature Sensor
j . - Injector Harness
k - Oil Tank Pressure Port
l - DDT Test Connector
m - Serial # Plug
n - DOWN Trim Solenoid
o - UP Trim Solenoid
p - Engine Harness Plug
q - Starter Solenoid
r - 20 Ampere Fuse
s - #1 Capacitor Discharge Module
t - #3 Capacitor Discharge Module
u - #5 Capacitor Discharge Module
v - Temperature Sensor

Powerhead View (Port)



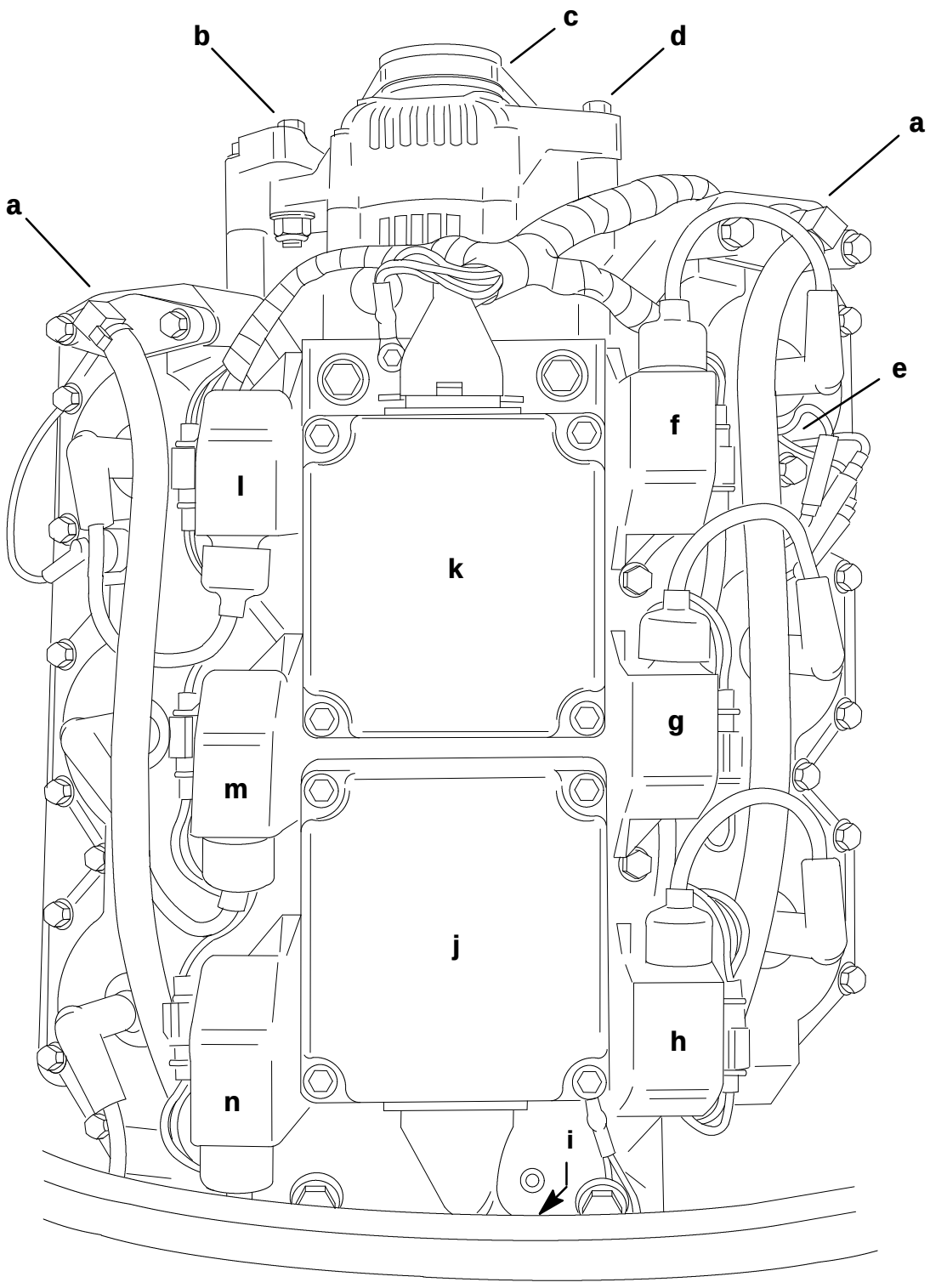
a - Stator
b - Crank Position Sensor
c - 60 Ampere Alternator
d - Thermostat (143 °F)
e - #2 Capacitor Discharge Module
f - #4 Capacitor Discharge Module
g - #6 Capacitor Discharge Module
h - Shift Interrupt Switch
i - Oil Injection Pump
j - Fuel Injection Manifold
k - Vapor Separator
l - Electric Fuel Pump
m - Fuel Rail Pressure Regulator
n - MAP Sensor
o - Fuel Pump
p - Low Oil Switch
q - Oil Tank [1.9 qt. (1.8 Liter)]

Powerhead View (Front)



a - Fuel Water Separator
b - Air Temperature Sensor
c - Fuel Injection Air Intake Cover
d - Fuel Rail Pressure Port
e - Electric Fuel Pump

Powerhead View (Rear)



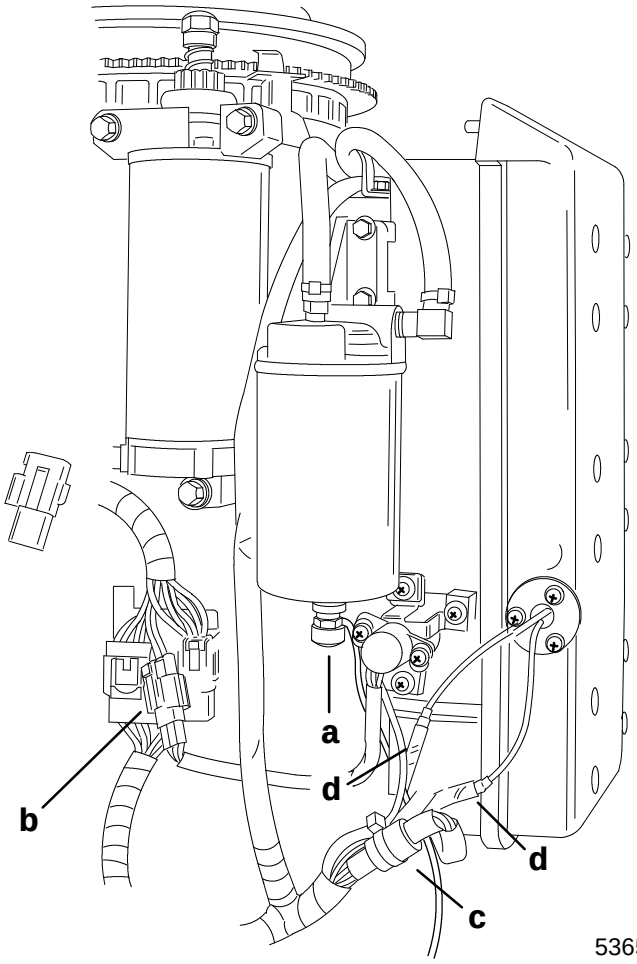
53644

a - Thermostat (143 °F)
b - Alternator Belt Tension Bolt
c - 60 Ampere Alternator
d - Alternator Pivot Bolt
e - Temperature Sensor
f - #1 Capacitor Discharge Module
g - #3 Capacitor Discharge Module
h - #5 Capacitor Discharge Module
i - Water Pressure Gauge Plug
j - EFI ECM
k - Ignition ECM
l - #2 Capacitor Discharge Module
m - #4 Capacitor Discharge Module
n - #6 Capacitor Discharge Module

Removal of Electronic Fuel Injection as an Assembly

If no problem exists with the fuel injection system and the powerhead must be disassembled, the EFI assembly may be removed without being disassembled as follows:

1. Disconnect Water Separator Fuel Filter warning lead.
2. Disconnect Detonation Module harness.
3. Disconnect Throttle Position Sensor harness.
4. Disconnect injector harness.
5. Disconnect Air Temperature Sensor bullet connectors.



53653

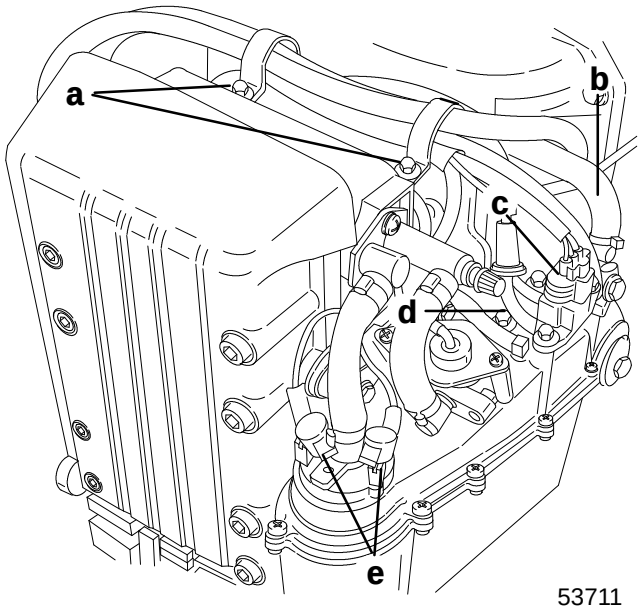
a - Water Separator Warning Lead
b - TPS Harness
c - Injector Harness
d - Air Temperature Sensor Bullet Connectors

6. Remove 2 hose clamp bolts.
7. Disconnect fuel pump outlet hose.
8. Disconnect MAP sensor harness.
9. Disconnect bleed hose.

⚠ CAUTION

Battery leads must be disconnected before removing electric fuel pump leads.

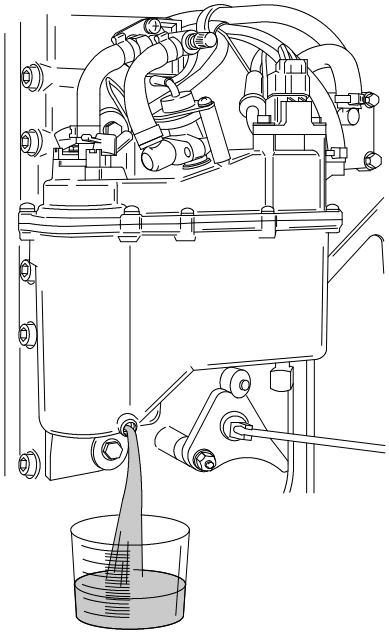
10. Disconnect electric fuel pump leads.



53711

a - Clamp Bolts
b - Fuel Pump Outlet Hose
c - MAP Sensor Harness
d - Bleed Hose
e - Electric Fuel Pump Leads

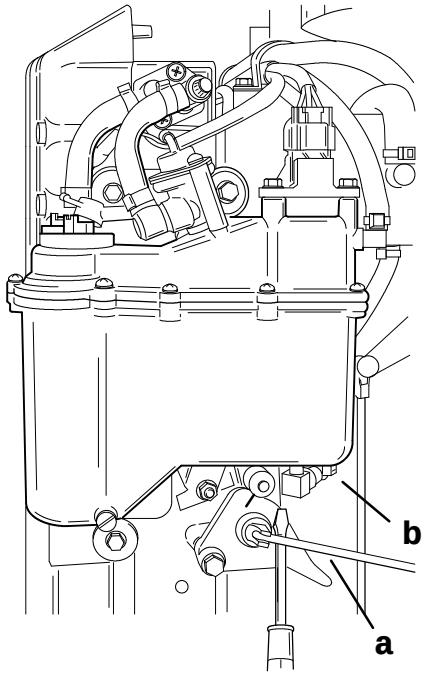
11. Place a suitable container underneath vapor separator drain plug and remove plug.



53652

12. Remove throttle link arm with screwdriver.

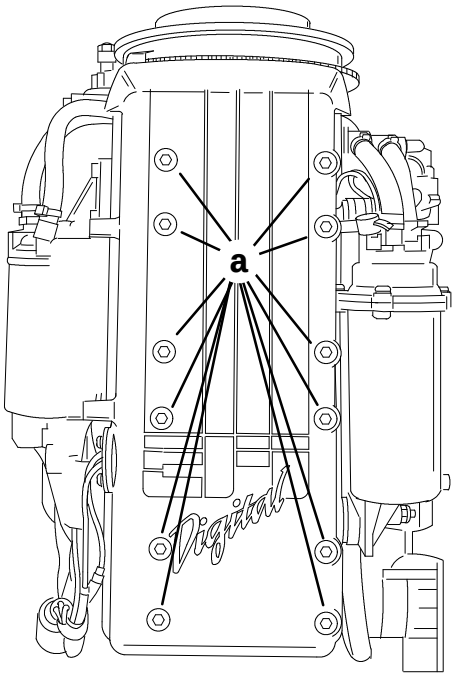
13. Disconnect oil injection hose.



53693

a - Throttle Link Arm
b - Oil Injection Hose

14. Remove 12 allen screws securing EFI assembly to powerhead and remove assembly.



53645

a - Allen Screws

Safety Precautions

Always use approved safety glasses or goggles when working on pressurized 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.

⚠ WARNING

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 to the powerhead by fuel injectors. These injectors are provided with a constant supply of fuel [34 – 36 psi (234 to 248 kPa)] from the fuel rail. The injectors are opened and closed electrically 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.

Troubleshooting

Marine engines are, by the nature of their environment, engineered to be trouble-free, durable power plants. The experienced mechanic, when investigating a possible marine engine problem, will isolate boat related support systems from the marine engine. This can be accomplished through the use of a remote fuel tank filled with fresh fuel and utilizing a known good fuel line/primer bulb assembly. If the engine runs properly after being connected to the remote fuel tank, the mechanic's troubleshooting time will be spent in the boat checking for pinched/damaged fuel lines, stuck anti-siphon valves, plugged filters or draining fuel tanks of poor quality fuel.

If the engine does not run properly on the remote fuel tank, the mechanic can sometimes further isolate the the problem by squeezing the fuel line primer bulb. If the engine runs properly, the problem lies in fuel delivery – defective or weak mechanical fuel pump, electric fuel pump, plugged filters or leaking fuel lines.

Poor running characteristics of a particular outboard can usually be identified as the result of a problem in one of three areas: Mechanical, Electrical, or Fuel Management.

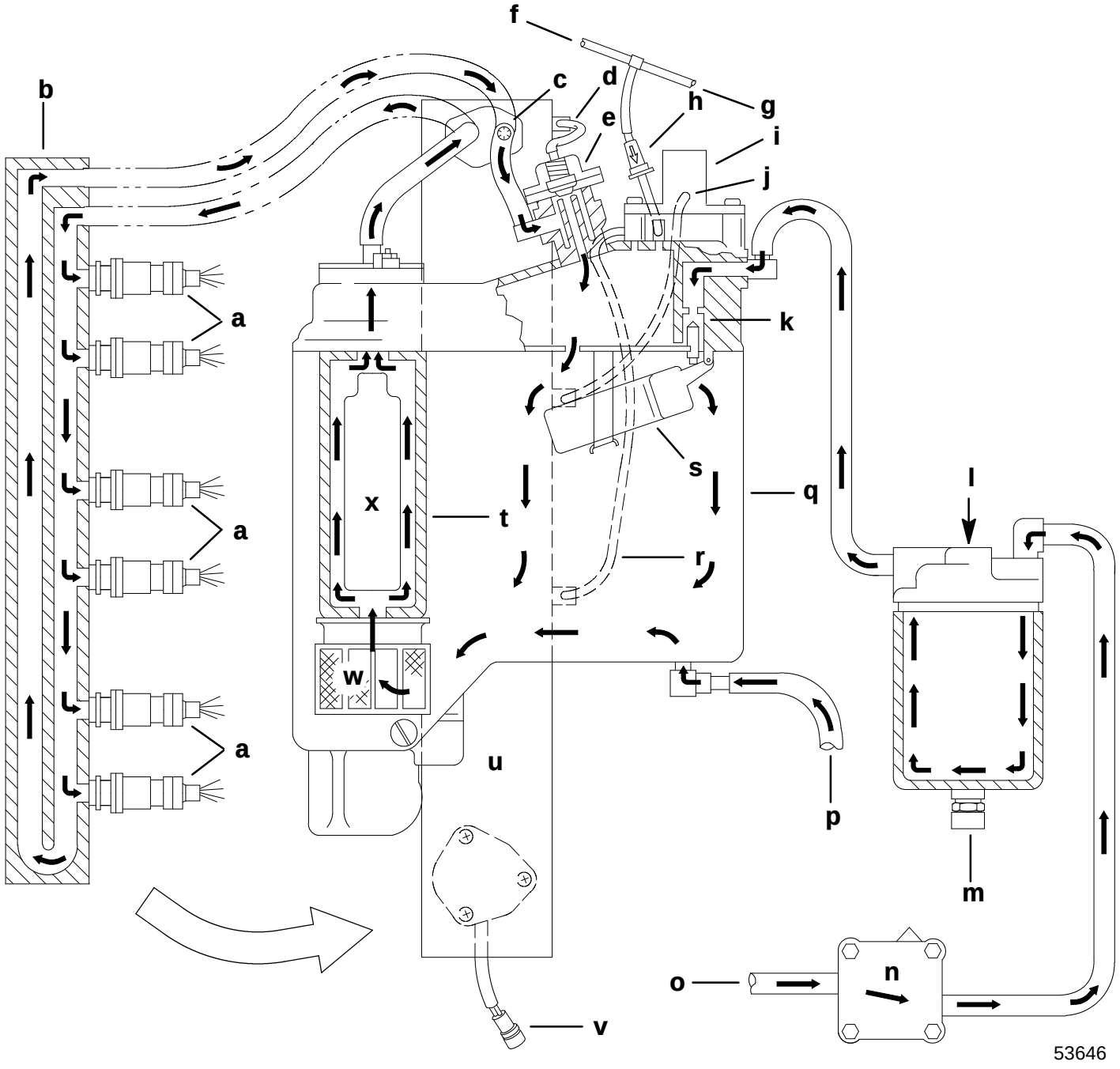
Before disassembling and replacing EFI components, the experienced mechanic will isolate the problem(s) to one (or more) of the 3 aforementioned areas.

Mechanical – A compression check should be performed with the powerhead warm (if possible), all spark plugs removed, the throttle shutters held wide open and a fully charged battery employed for cranking duties. Normal compression psi should be 100 to 110 psi (689 to 758 kPa) for 225/250 horsepower engines and 80 to 90 psi (551 to 620 kPa) for 3 Litre Work engines. Inspect powerhead for leaking seals, gaskets or broken/disconnected throttle spark linkages.

Due to the precise fuel delivery characteristics of electronic fuel injection and its dependency on many sensors to determine the correct fuel/air ratio during all conditions, IT IS IMPERATIVE THAT SET-UP PROCEDURES BE FOLLOWED EXACTLY AS STATED IN FACTORY SERVICE LITERATURE.

Electrical – The ignition system can be quickly checked through the use of a good inductive timing light. With all spark plugs installed (and torqued), water being supplied to the water pump (in case engine starts), crank the outboard while sequentially attaching the timing light pickup to each spark plug lead. The timing light should flash brightly and steadily. If timing light does not flash on 1 or more cylinders, test the individual cylinder ignition components with a Direct Voltage Adaptor (DVA) or with a volt/ohm meter. Refer to SECTION 2A for ignition test specifications.

Fuel Flow Diagram



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

Fuel Flow Component Description

Pulse Fuel Pump

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 (Minimum – 1 psi).
Fuel Pressure @ Wide-Open-Throttle – 6-8 psi (Minimum – 4 psi).

Water Separating Filter

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 4 beeps. If the outboard continues to run, the light will stay on and the horn will beep every 2 minutes.

Vapor Separator

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

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 directed through a filter (to eliminate contaminates) and 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

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

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.

Fuel Injectors

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 FUEL ECM and the IGNITION ECM.

Induction Manifold

The induction manifold is a common plenum chamber for accurate pressure measurement. It contains either 4 throttle shutters on 2 throttle shafts for the 250 hp model or 2 throttle shutters on 1 throttle shaft for the 225 hp model. 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

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

EFI Electronic Control Module

The ECM continuously monitors various engine conditions (temperature, 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.

Sensor Interaction with the ECM

The ECM relies on sensor feedback to provide proper fuel rates and timing advance for optimum engine performance under all conditions.

Should a sensor fail, the ECM will try to compensate for lack of sensor information by providing predetermined fuel rates and timing advance for average conditions.

Therefore, a change in engine performance may not be readily noticeable. However, a sensor failure will result in the ECM activating a warning horn to alert the operator.

Air Temperature Sensor

The air temperature sensor transmits manifold air temperature, through full RPM range, to the EFI ECM. As air temperature increases "sensor" resistance decreases causing the ECM to decrease fuel flow (leaner mixture).

***NOTE:** A warning horn will sound if the sensor fails or is disconnected on 1996 models, only.*

The air temperature sensor circuit can be tested using a volt/ohm meter. Test procedures are on page 9-31.

Manifold Absolute Pressure (MAP) Sensor

The MAP sensor is mounted on the vapor separator. This sensor monitors changes in manifold absolute pressure and is connected to the intake manifold by a vacuum hose. The MAP sensor functions through the full RPM range and is continually signaling induction manifold pressure readings to the EFI ECM. The EFI ECM 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.

***NOTE:** A warning horn will sound if sensor fails or is disconnected on 1996 models, only. The engine may, however, run rough at idle if the sensor is inoperative on all models.*

Engine Head Temperature Sensor

This sensor provides the EFI ECM with signals related to engine temperature to determine level of fuel enrichment during engine warm-up. The EFI ECM receives information at all engine temperatures but stops fuel enrichment at an engine temperature of 110 °F (43 °C).

An overheat condition will occur if engine temperature exceeds 200 °F (93 °C). A constant warning horn will sound as long as the overheat condition exists. If the overheat condition should occur at wide-open-throttle, the engine RPM will be reduced to 3000. The engine will return to normal operating condition when the temperature drops below 200 °F (93 °C).

The temperature sensor can be tested using a digital volt/ohm meter. Test procedures are on page 2A-7.

***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).

OTHER COMPONENTS ASSOCIATED WITH THE ECM.

IMPORTANT: When disassembling EFI System DISCONNECT BATTERY CABLES.

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 EFI ECM contains a fuel pump driver circuit that provides power to the electric fuel pump. The amount of time the fuel pump operates varies with the RPM of the engine. Above approximately 3000 RPM, the fuel pump is operating continuously (or at 100% of its duty cycle).

Water Sensing System

The system consists of a water separating fuel filter (starboard side powerhead) and a sensing probe (bottom of filter).

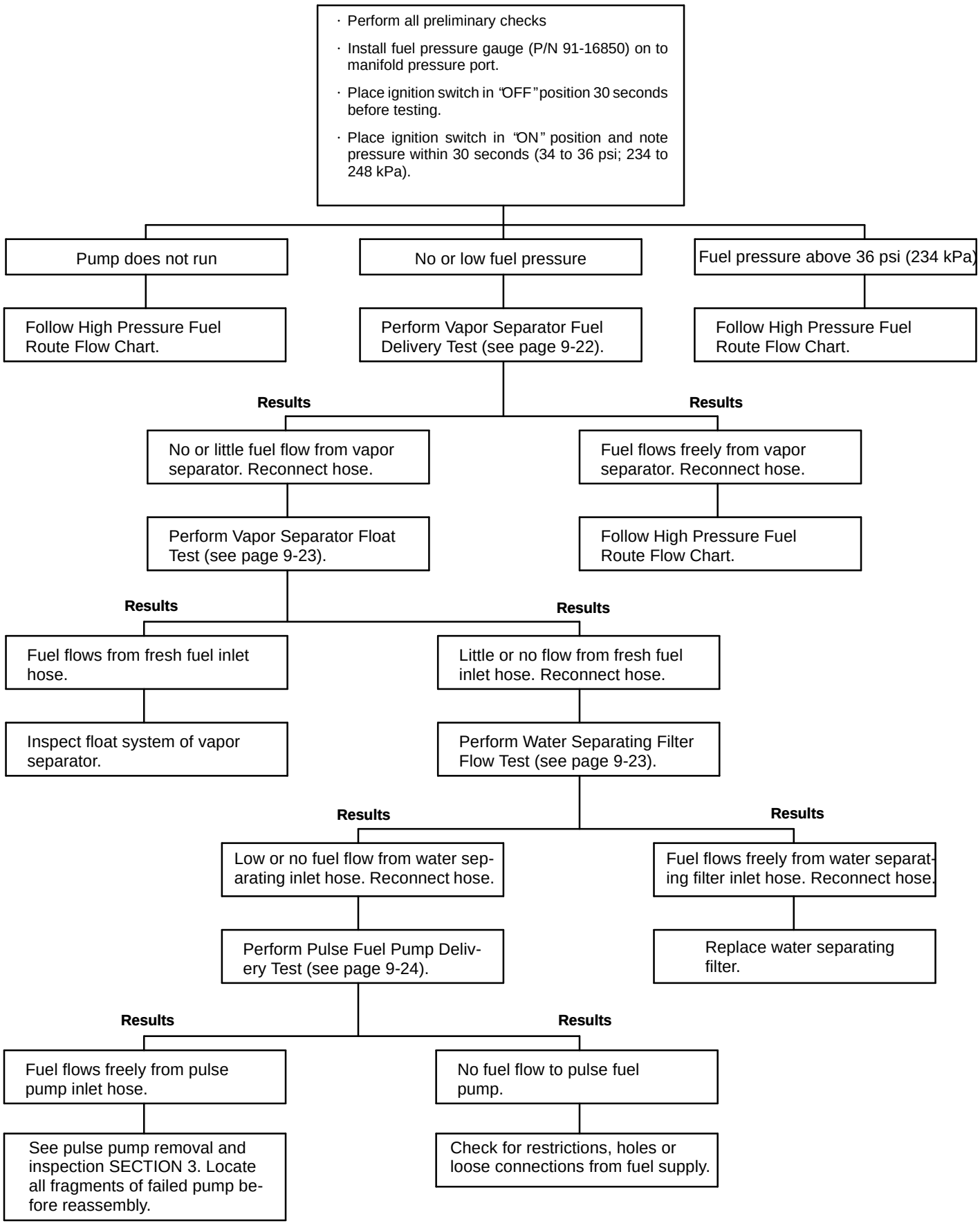
WATER SENSING SYSTEM FUNCTION

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.

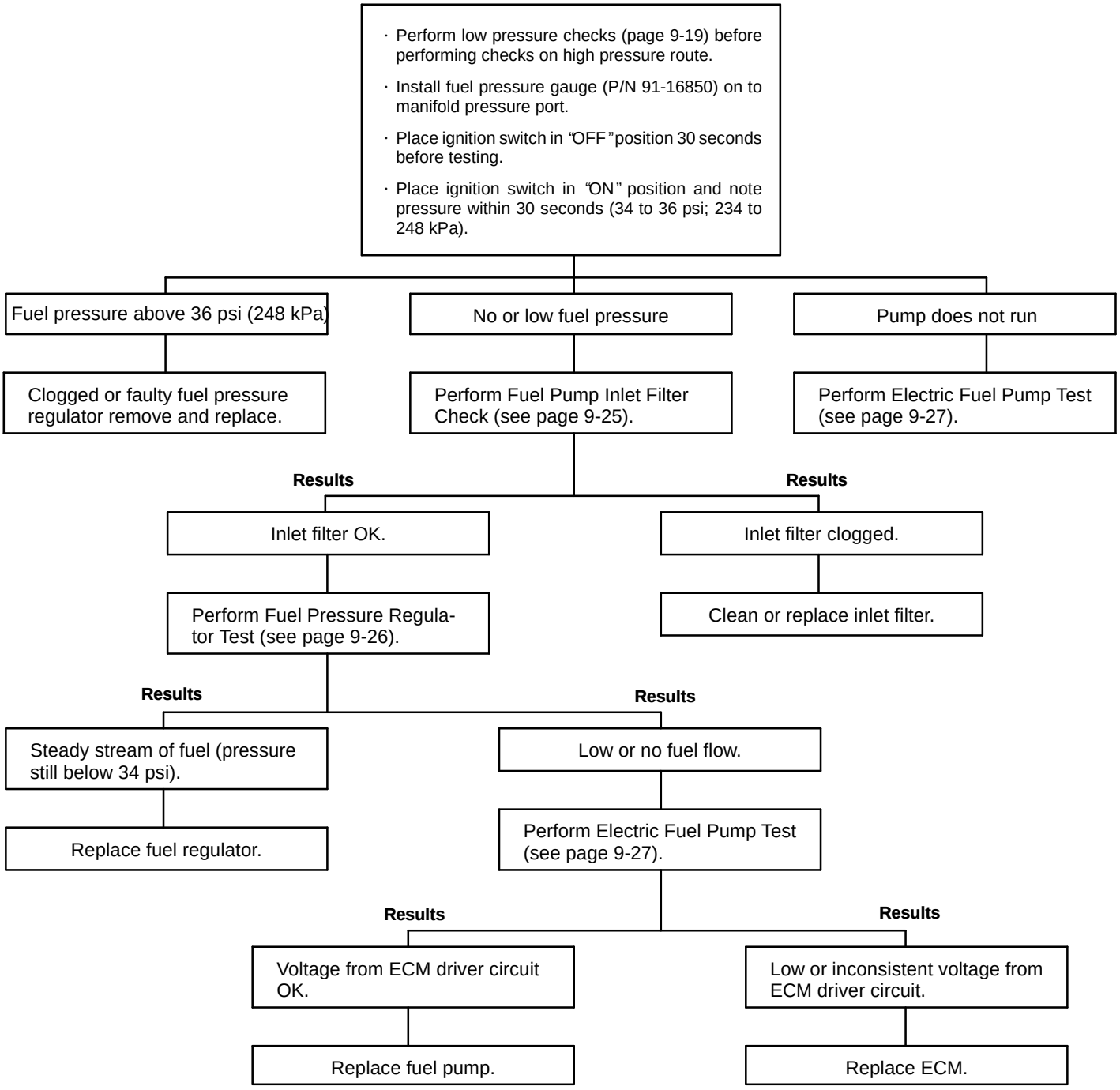
***NOTE:** The water detection light will stay on and the warning horn will "BEEP" 4 times and remain off for 2 minutes. This cycle will continue until the water is removed. This warning is the same as for the "Low Oil" warning.*

The system can be tested by disconnecting the TAN wire from sensor probe and holding to a good engine ground connection for 30 seconds.

EFI Fuel Management (Low Pressure Fuel Route)



EFI Fuel Management (High Pressure Fuel Route)



EFI System Test Procedures

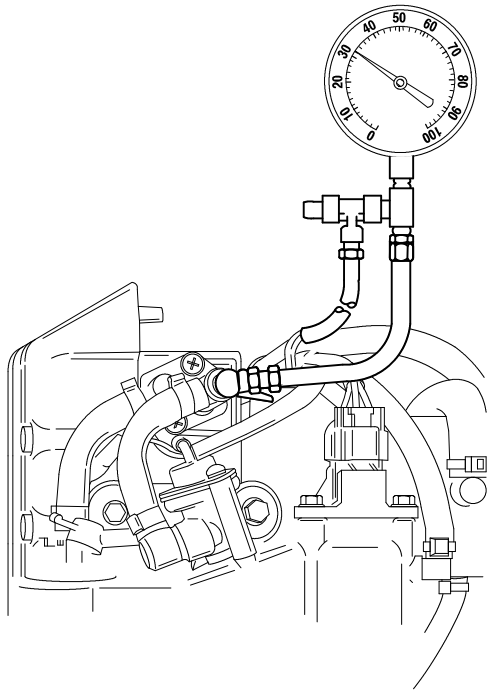
Fuel Gauge Connection/Pressure Test

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.

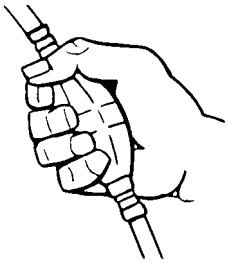
IMPORTANT: Fuel pressure should be monitored through full RPM range to determine fuel supply problems at high engine speeds.

1. Connect fuel pressure gauge (91-16850) to induction manifold pressure port.

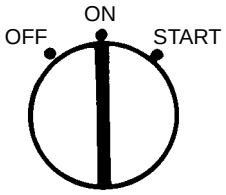


53709

2. Prime engine using fuel primer bulb.



3. Turn ignition key switch to "On" position.



4. 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.*

5. 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.

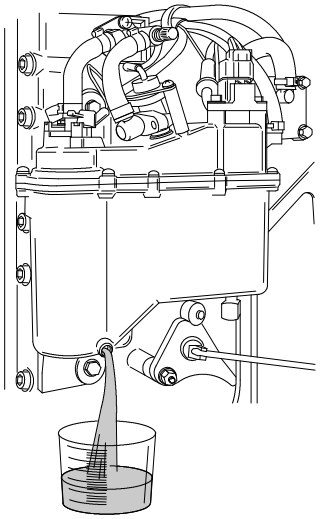
If fuel pressure is above 36 psi (248 kPa) go to fuel pressure regulator test.

Vapor Separator Fuel Delivery Test

***NOTE:** Full capacity of vapor separator is approximately 380 ml.

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.

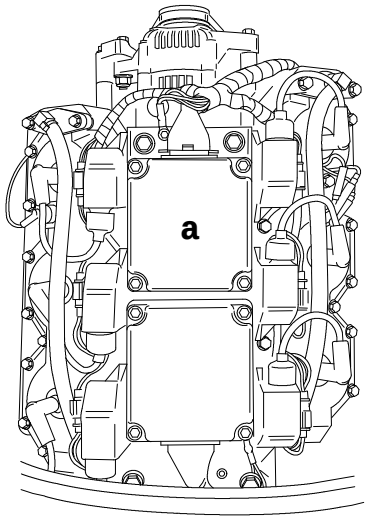
1. Remove vapor separator drain plug and place a clean container under drain.



53652

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

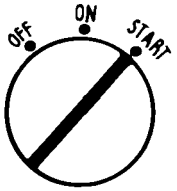
2. Disconnect Ignition ECM to prevent engine from starting.



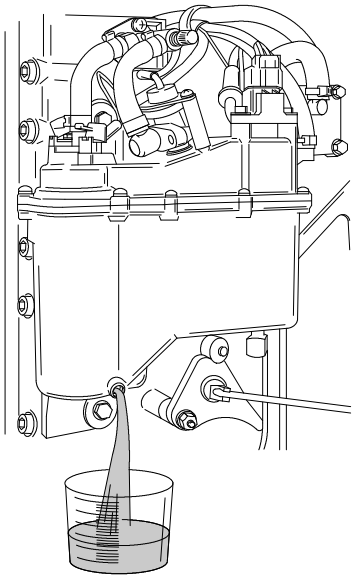
53638

a - Ignition ECM

3. Turn ignition key switch to "START" and operate starter motor for 10 to 20 seconds.



4. Look for fuel flow from drain hole.



53652

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

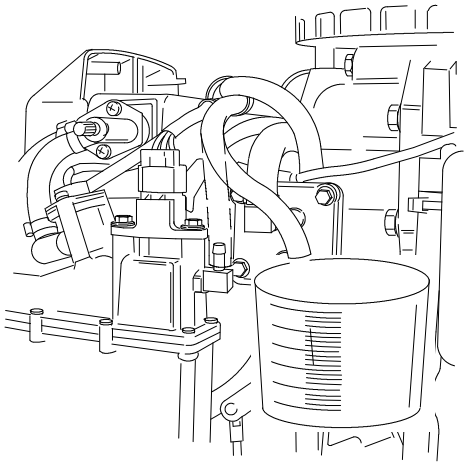
Vapor Separator Float Test

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.*

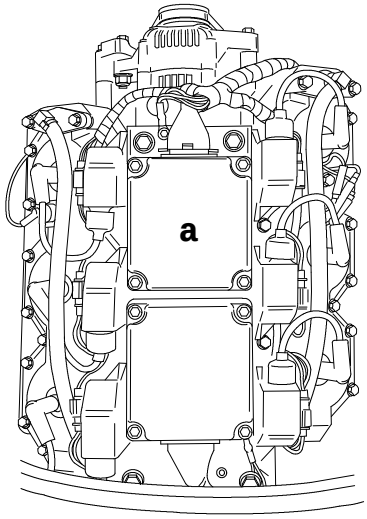
Procedure: If float is suspected of sticking in the up position:

1. Remove fuel inlet hose from vapor separator and put end of hose in clean container.



53654

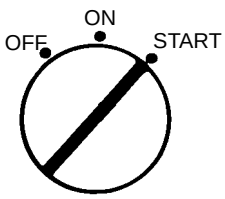
2. Disconnect Ignition ECM to prevent from engine starting.



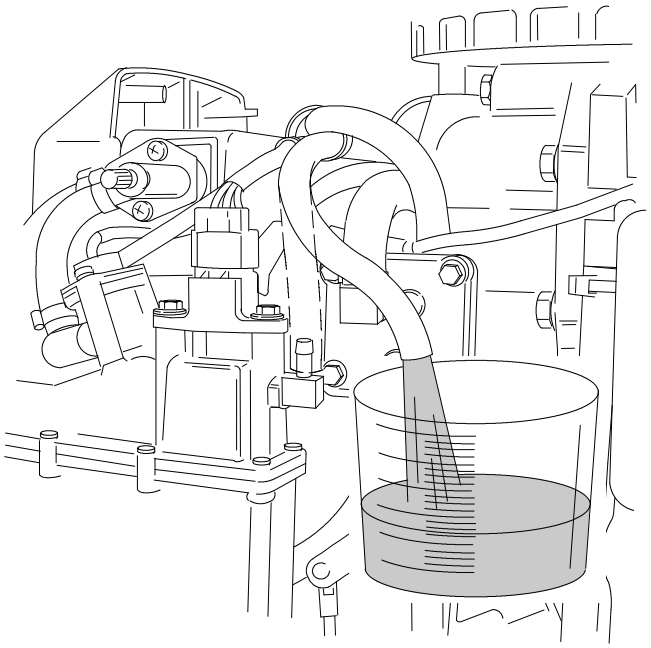
53638

a - Ignition ECM

3. Turn ignition key switch to "START" position and operate starter motor for 15 to 20 seconds.



4. Look for fuel flow from hose.



53654

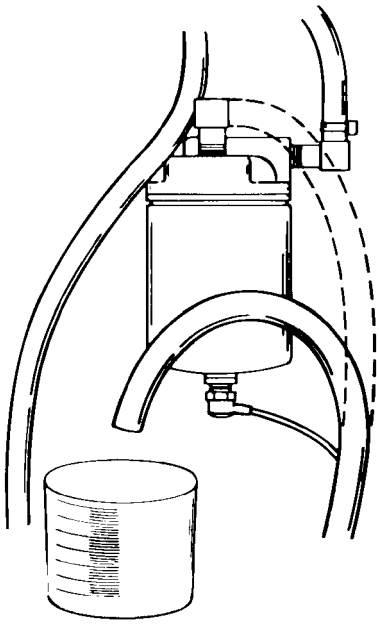
Results: If fuel flow is present at hose, remove, disassemble and inspect float assembly. See vapor separator disassembly.

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

Water Separating Filter Flow Test

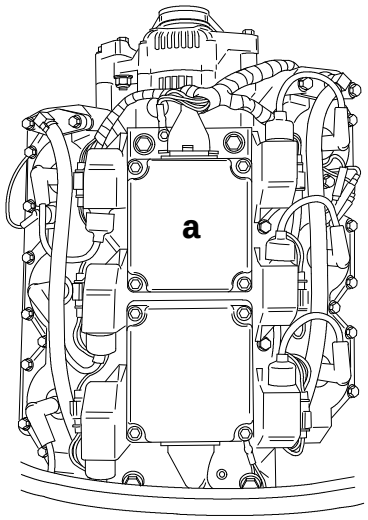
Purpose: This test will indicate if water separating filter is clogged.

1. Remove fuel inlet hose to water separating filter. Put end of hose in clean container.



50346

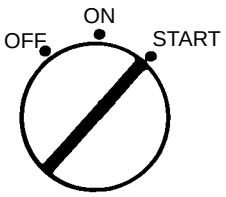
2. Disconnect Ignition ECM to prevent engine from starting.



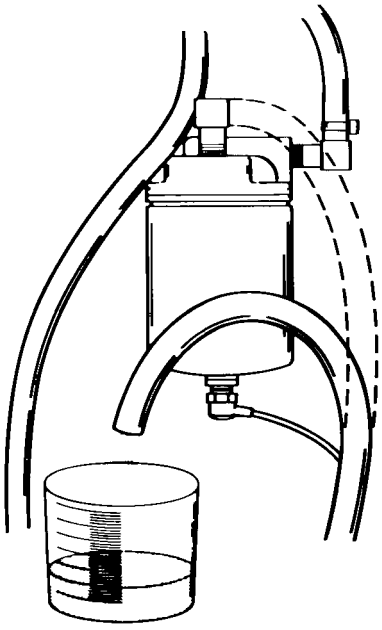
53638

a - Ignition ECM

3. Turn ignition key switch to "START" and operate starter motor for 10 to 20 seconds.



4. Look for fuel flow from hose.



50346

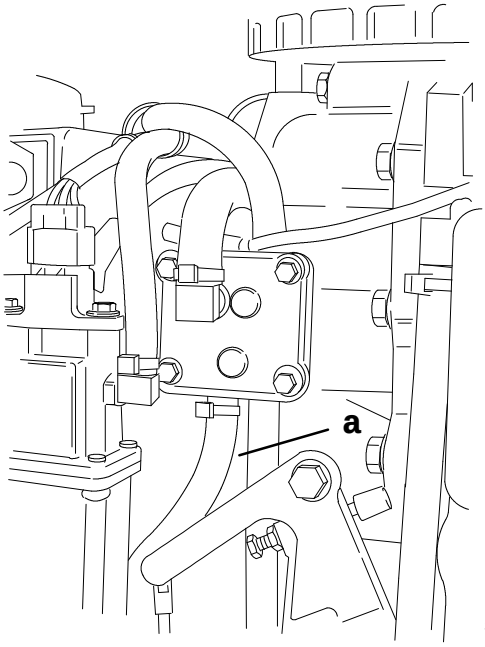
Results: Fuel flows from water separating inlet hose. Remove and replace clogged filter.

Low or no fuel flow from water separating inlet hose. Perform pulse fuel pump delivery test.

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.

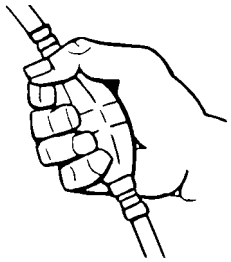
1. Remove inlet hose to pulse fuel pump and put end into clean container.



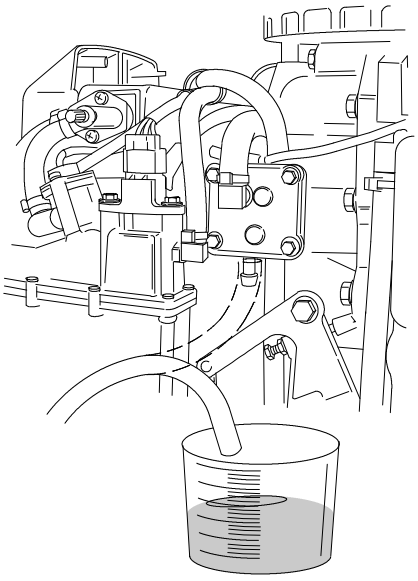
53643

a - Inlet Hose

2. Squeeze primer bulb several times.



3. Look for fuel flow from hose.



53655

Results: Fuel flows freely from pulse pump inlet hose. Remove, disassemble, and inspect pulse fuel pump (SECTION 3).

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

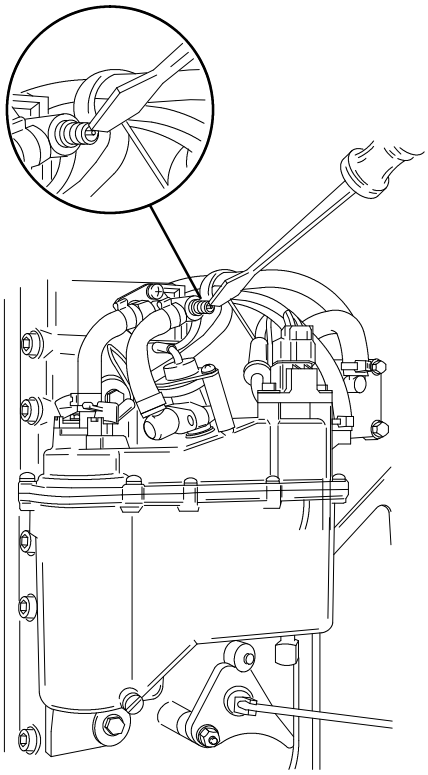
No or low fuel flow from pulse pump inlet hose. Check for restrictions, holes, or loose connections from fuel supply.

***NOTE:** Inspect anti-siphon valve on tank.*

Inlet Filter Check and De-pressurizing EFI System Procedures

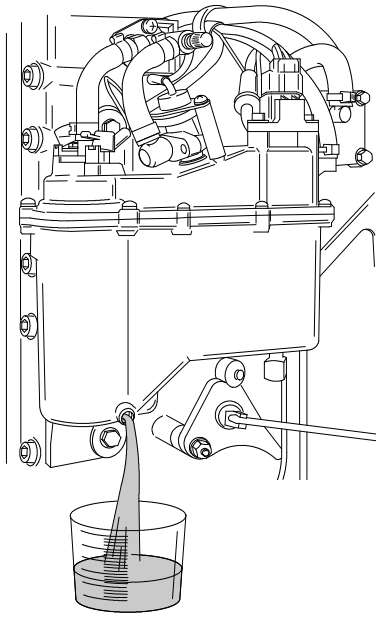
Purpose: Checking the Inlet filter for obstructions, damage etc. eliminates this component as a possible source of restriction in the system.

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.



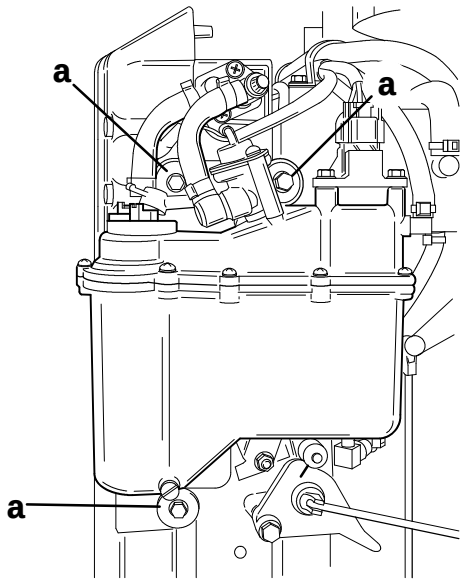
53651

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



53652

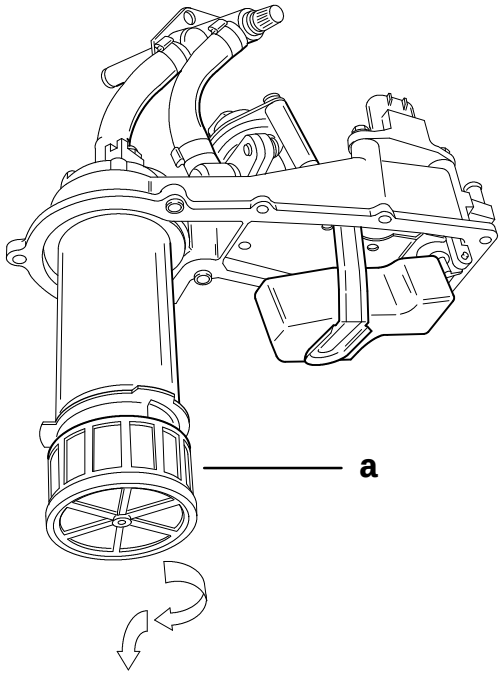
3. Remove 3 bolts securing vapor separator assembly to manifold.



53657

a - Attaching 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.



53696

a - Inlet Filter

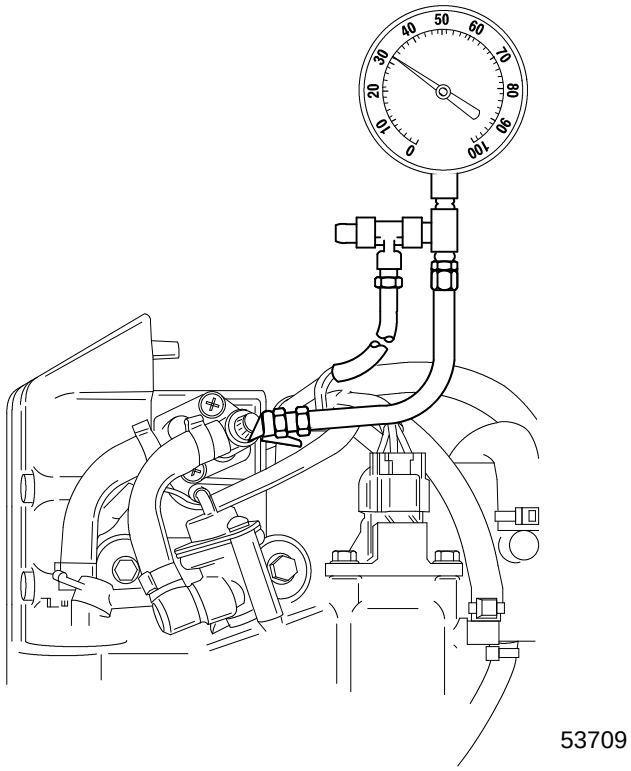
7. Inspect filter for debris or damage.

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 36 psi (248 kPa), perform fuel pressure regulator test.

Pressure Regulator Test

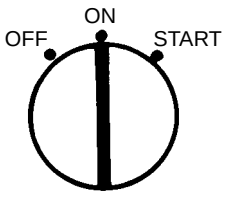
Purpose: This test will determine if a weak, plugged or open pressure regulator is causing inadequate fuel pressure in the system.

1. Connect pressure gauge (91-16850) to fuel pressure test port.

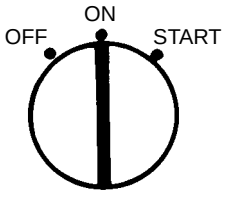


53709

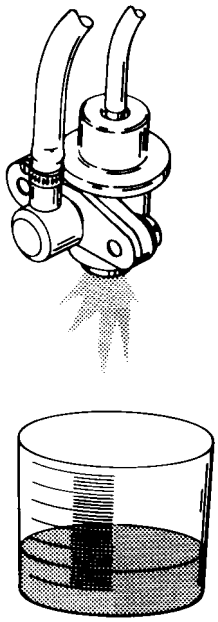
2. Turn ignition key switch to "ON" position and check fuel pressure reading on gauge. If pressure reading is below 34 psi (234 kPa) go to step 3 following.



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.

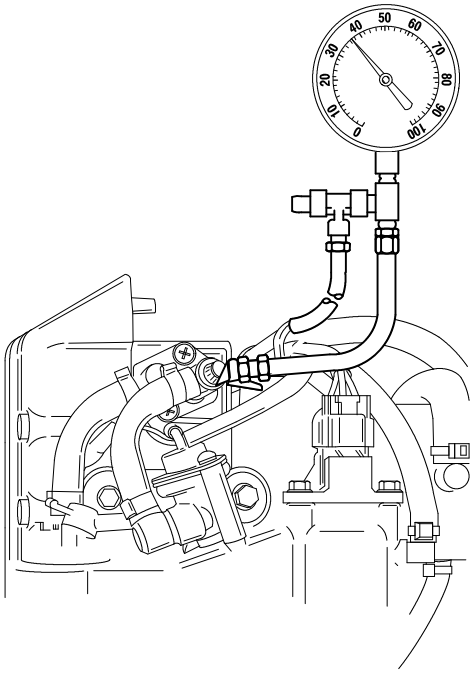
If low or no fuel exits regulator into container and pressure is below 34 psi (234 kPa) perform electric fuel pump pressure test.

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

Electric Fuel Pump Test

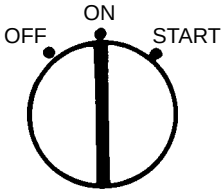
Purpose: This test will determine if electric fuel pump is capable of producing adequate fuel pressure needed for normal engine operation, 34 to 36 psi (234 to 248 kPa).

1. Connect pressure gauge (91-16850) to pressure port.

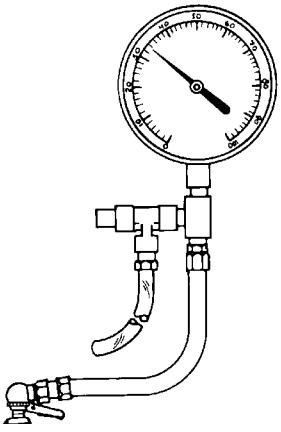


53709

2. Put ignition key switch in "ON" position.



3. Take a fuel pressure reading, within 30 seconds.

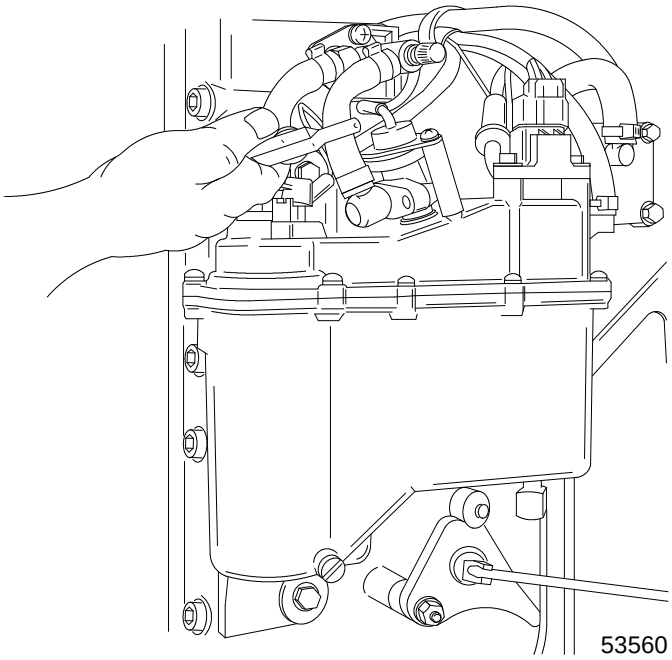


51796

⚠ CAUTION

Do not close-off fuel hose completely in step 4, or damage could result to hose or pump.

4. Partially close off fuel hose to pressure regulator.



53560

5. Check pressure gauge for increase in pressure.

Results: Fuel pressure increases as hose is partially closed off. Electric fuel pump OK, perform Fuel Rail Leak Check.

Fuel pressure does not increase when hose is partially closed off. This may indicate defective electric fuel pump. Before replacing, perform procedure following.

⚠ CAUTION

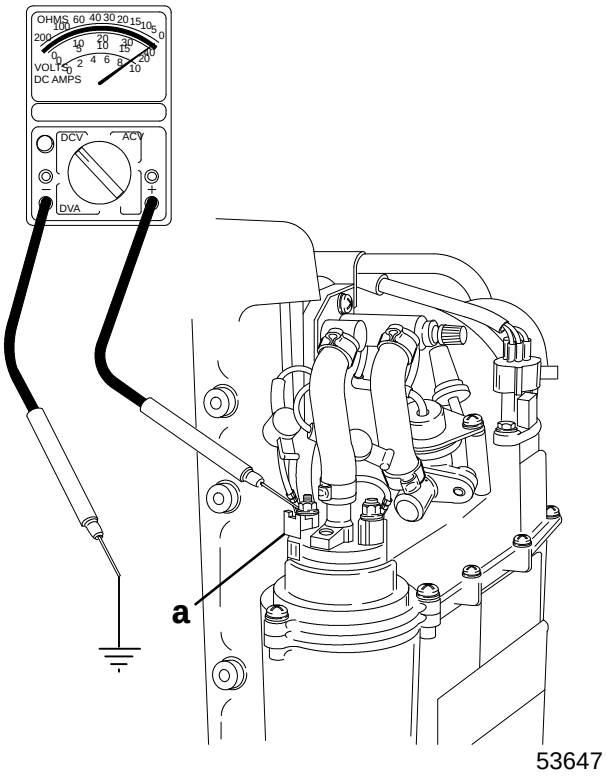
When checking voltage at pump, DO NOT pry boot covers off terminals with a metal object, as each terminal is at 12 volts when engine is off. Serious damage to electric fuel pump and/or ECM can result.

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

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

***NOTE:** Refer to voltage test chart for voltage readings.*

Positive Test Terminal

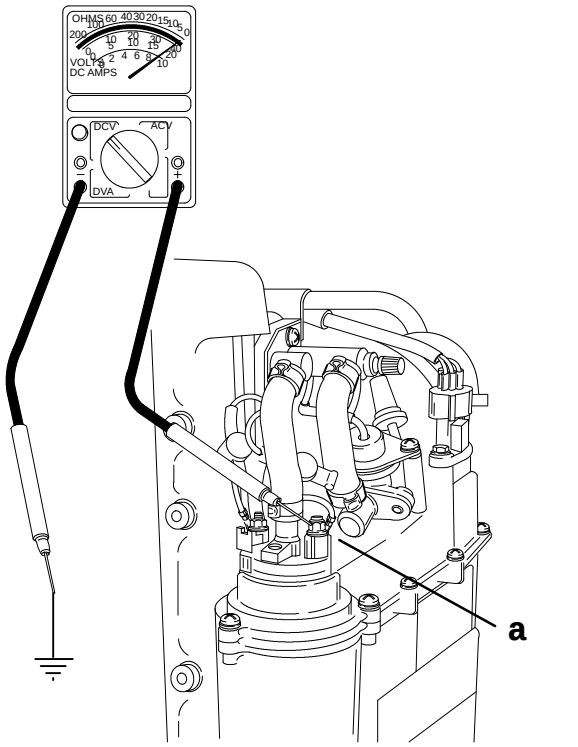


53647

a - POSITIVE (+) Terminal

7. 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



53648

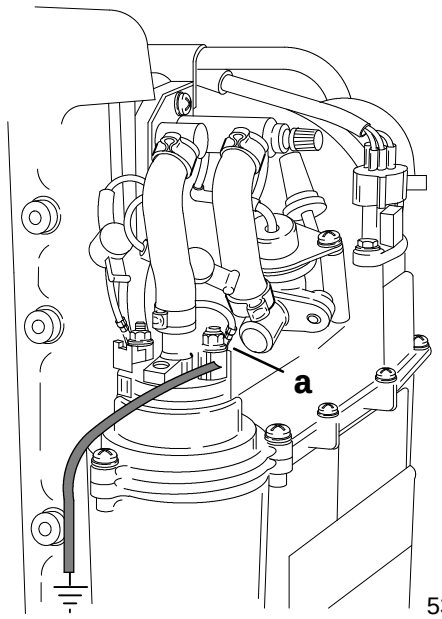
a - NEGATIVE Terminal

8. Perform voltage tests below.

VOLTAGE TEST CHART			
Engine Mode	**Black Meter Lead To Engine Ground, Red Meter Lead To:**	**Approx. Voltage Reading**	**If Approx. Voltage Is Not Obtained, This Indicates:**
All models	(+) terminal of fuel pump.	12-13.5 Volts	If reading is below 12 volts, the battery is bad or discharged, or a bad con- nection(s) on bat- tery harness. If reading is higher than 13.5 volts, the battery is over- charged.
Ignition key in "off" posi- tion.	(-) terminal of fuel pump.	Same reading should be obtained as reading in check No. 1 (above).	If reading is lower than in check 1, the ECM or wire in harness is defective.
Ignition key in "on" posi- tion and engine NOT running.	(-) terminal of fuel pump.	1 volt or less (voltage should then raise to 12-13.5 volts after approx. 15 seconds).	Defective ECM or fuel pump*
Engine being cranked.	(-) terminal of fuel pump.	1 volt or less.	Defective ECM or fuel pump*
Engine running below approx. 3000 RPM.	(-) terminal of fuel pump.	The voltage will vary as engine RPM changes.	Defective ECM or fuel pump*
Engine running above approx. 3000 RPM.	(-) terminal of fuel pump.	1 volt or less.	Defective ECM or fuel pump*

*Check for proper electrical operation of electric fuel pump

9. Disconnect RED/PURPLE wire to NEGATIVE terminal on electric fuel pump. Connect a ground jumper wire from NEGATIVE pump terminal to a good engine ground.



53649

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 RED/PURPLE (-) lead and harness for good continuity.

***NOTE:** RED/PURPLE lead is connected to pin 9 of EFI ECM harness.*

Fuel Injector Electrical Harness Test

1. Disconnect injector harness (4 pin connector).
2. Remove spark plug leads from spark plugs to prevent engine from starting.

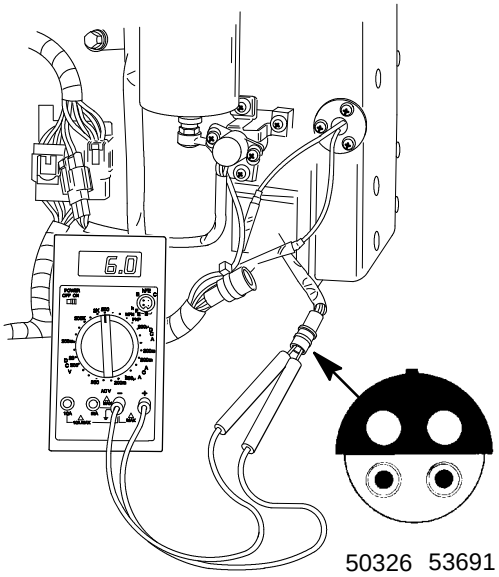
IMPORTANT: Use digital ohmmeter when testing injector harness.

3. Connect digital ohmmeter (dial set at R200 OHM 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 = Injectors, Cylinders 1 and 2

   Dark Blue = Injectors, Cylinders 3 and 4

   Yellow = Injectors, Cylinders 5 and 6



50326 53691

(1) Yellow
(2) Red
(3) Dark Blue
(4) White

Results: If readings are 6.0 ±1.0, both injector circuits are complete. Perform Injector Fuel Delivery Test.

If readings are 12.0 ± 1.0, one injector does not have a complete circuit. Perform induction manifold disassembly and inspection.

Injector Operation Test

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

The DIGITAL DIAGNOSTIC TERMINAL (DDT) (91-823686A2) is required for this test. Refer to the instruction manual provided with the DDT for proper test set-up and this service manual (90-822900R3) for specifications.

Fuel Rail Leak Check (Manifold Cover Removed)

Purpose: Lack of good fuel pressure may be caused by an internal leak in the fuel rail 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. Remove spark plug leads from spark plugs 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.

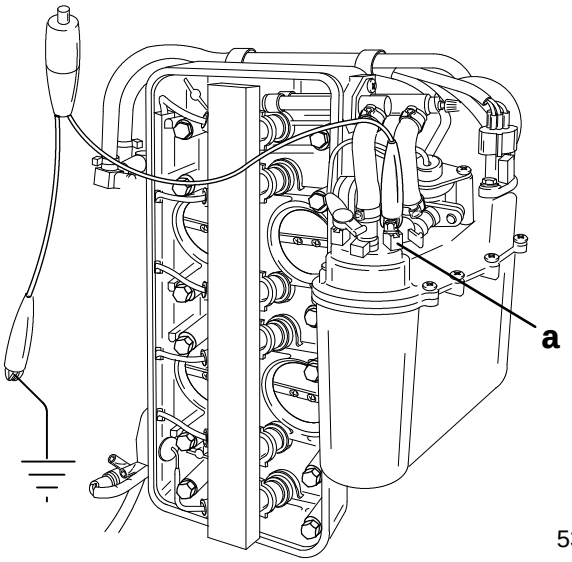
⚠ WARNING

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.

1. Remove spark plug leads from spark plugs to prevent engine from starting.
2. 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.

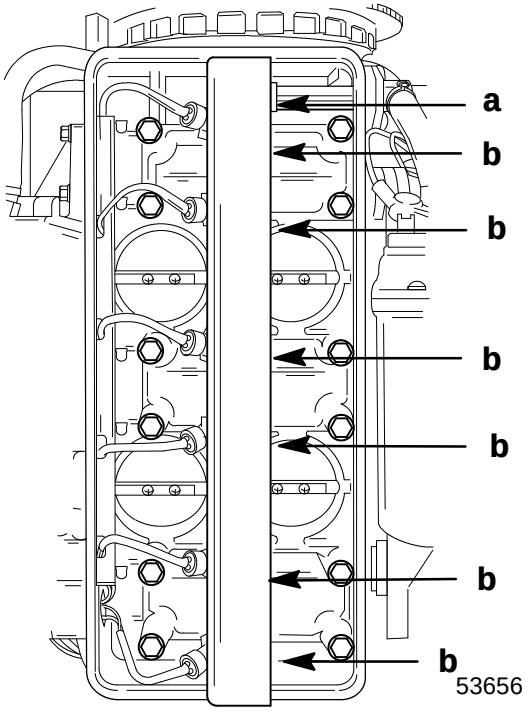
⚠ WARNING

Do not operate pump for more than 20 seconds continuously.



a - NEGATIVE Terminal

3. Look for leak points on fuel rail while depressing remote starter switch.



a - Check for leaks at fuel tube o-rings
b - Check for leaks at injector o-rings on fuel rail

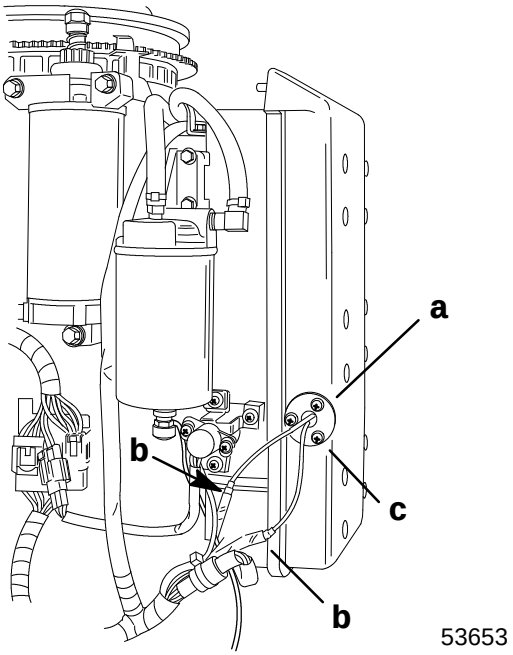
Results: If no leaks are present, reinstall cover and gasket. Torque screws to 19 lb. ft. (26.0 N·m).

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.

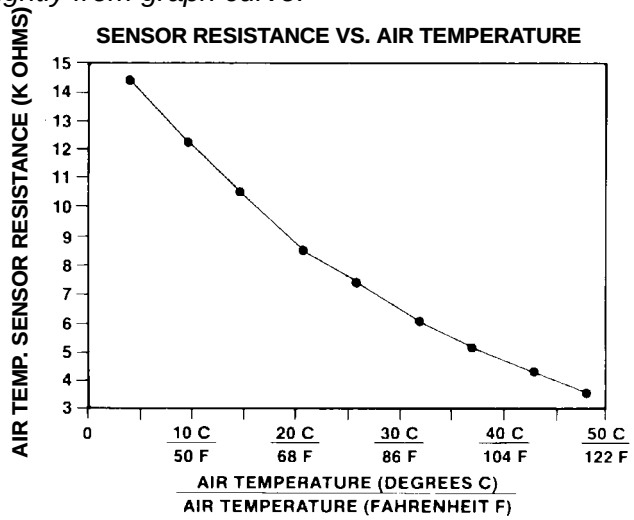
1. Disconnect and remove Air Temperature Sensor from induction manifold.



a - Air Temperature Sensor
b - Bullet Connectors
c - Screws (3)

2. Connect digital meter set at 20K scale 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.

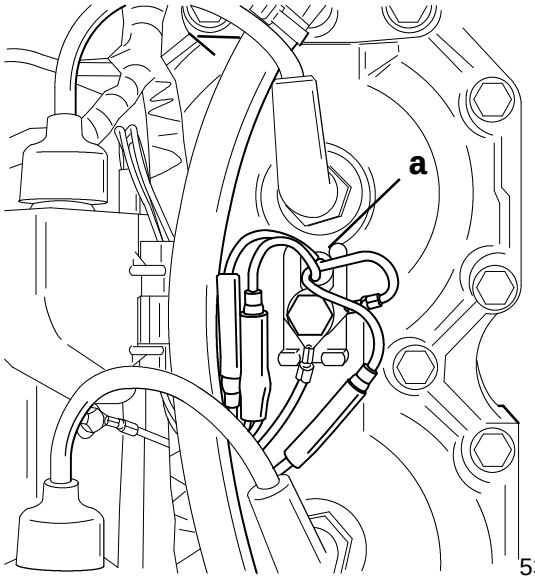
(Continued next page)

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.

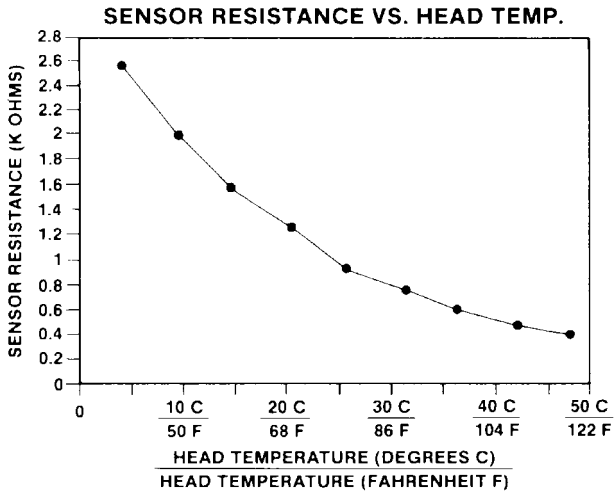
1. Disconnect and remove Engine Head Temperature Sensor.



a - Temperature Sensor

2. Connect Digital Meter set at 2K Scale to 2 TAN/BLACK 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.

***NOTE:** 1 TAN/BLACK temperature sensor lead is normally shorted to ground in the engine harness. The ECM recognizes this and uses the other TAN/BLACK sensor lead for information.*
There should be NO CONTINUITY between each TAN/BLACK lead and the sensor case (Ground). If resistance (continuity) is noted, sensor is shorted internally and should be replaced.
Normal continuity reading between both TAN/BLACK leads out of sensor is 1000Ω ±100Ω at room temperature.

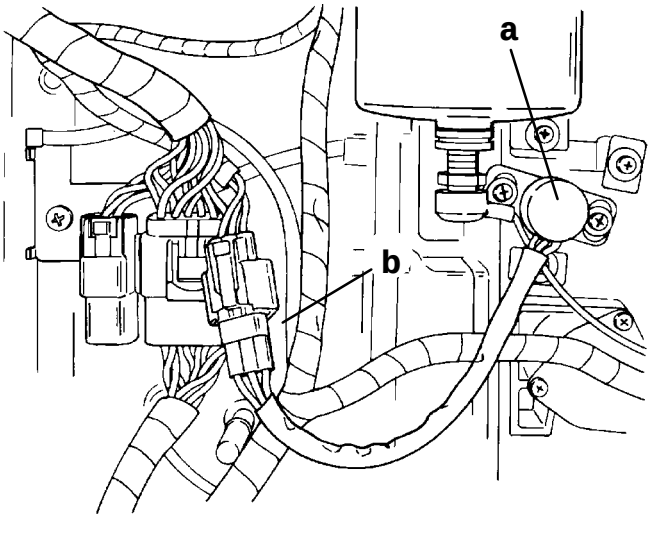
Throttle Position Sensor Test

Purpose: This test eliminates possibilities of improper fuel delivery related to the throttle position indicator.

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

TPS ADJUSTMENT USING A DIGITAL VOLTMETER

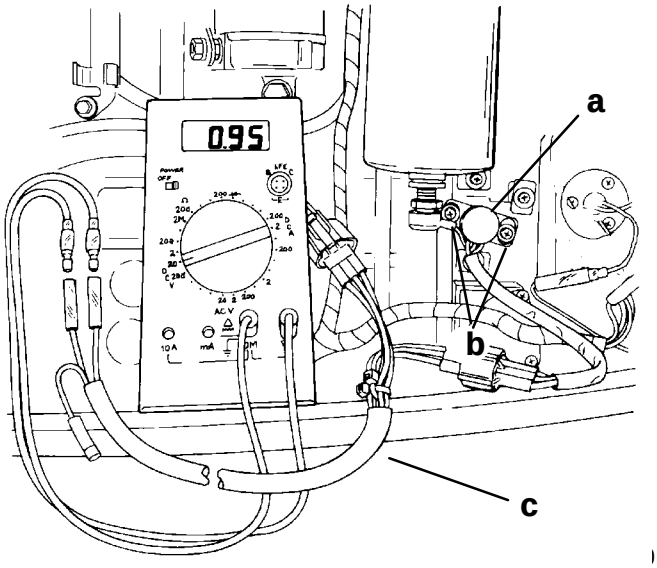
1. Disconnect TPS from ignition harness.



a - TPI
b - TPI Harness

2. Connect digital voltmeter using TPS/CDM TEST LEAD ASSEMBLY (84-825207A1) between TPS connector and EFI harness connector.

3. Connect RED voltmeter lead to RED lead of harness assembly and BLACK voltmeter lead to WHITE lead of harness assembly for a TPS measurement. Set voltmeter to 20 VDC.
4. Turn ignition key to "ON" position.
5. With throttle shaft at the close position, voltmeter should read 0.95 ± 0.05 volts. Loosen TPS set screws and adjust as necessary.



a - TPS
b - Set Screws
c - TPS/CDM TEST HARNESS

6. Slowly move throttle lever to WIDE OPEN THROTTLE position and then back to IDLE while monitoring voltage reading. Voltage reading should increase (throttle opens) and decrease (throttle closes) smoothly.
7. At WIDE OPEN THROTTLE, **using a digital voltmeter**, maximum voltage reading should be approximately 3.80 ± 0.25 volts.

***NOTE:** If using the **DIGITAL DIAGNOSTIC TERMINAL** to monitor TPS voltage, the maximum voltage reading at WIDE OPEN THROTTLE should be 4.00 ± 0.20 volts. The idle TPS voltage will be the same – 0.95 ± 0.05 volts – whether the DIGITAL DIAGNOSTIC TERMINAL or digital voltmeter is used.*

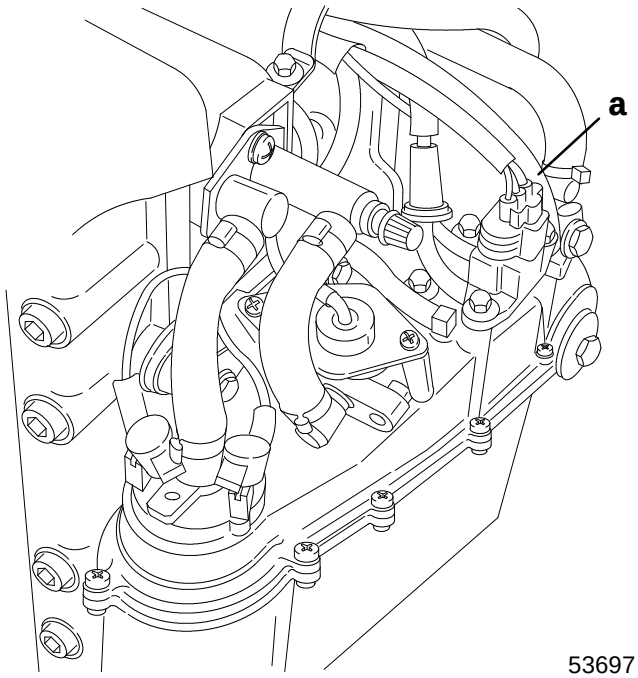
8. Torque TPS screws to 20 lb. in. (2.3 N·m).
9. Remove test harness and reconnect TPS harness to EFI harness.

MAP Sensor Test

MAP Sensor failure will be indicated by audible warning horn activation.

***NOTE:** If using the Digital Diagnostic Terminal (91-823686A2), a PASS or FAIL indicator will be displayed as to the serviceability of the MAP sensor.*

***NOTE:** If MAP sensor is functioning properly, disconnecting sensor harness connector while engine is running may result in deterioration of engine's running characteristics.*



a - Harness Connector

Problem Diagnosis

CONDITION	POSSIBLE SOURCE	ACTION
Engine Down on Power or RPM	Defective CDM (s) Defective Stator Coil(s)	See Section 2A "Electrical and Ignition" for Ohm/Voltage tests. See Section 2A "Electrical and Ignition" for Ohm tests.
	Low Compression Broken Reed(s)	See Section 4 "Power Head". Inspect Visually
	Fuel Delivery Problem	Follow Low/High Pressure Fuel Route Flow Charts and Fuel Rail Electrical/Fuel Determination Flow Chart.
	Fuel Rail Leak	Perform Fuel Rail Leak Check.
Poor Acceleration - Idles OK, Top Speed OK	Improper EFI Setup	See Section 2C "Timing/Synchronizing/Adjusting" 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.
	TPS Failure	Engine will not accelerate. See Section 2C "Timing/Synchronizing/Adjusting" for proper EFI set up procedures.
	MAP Sensor Failure	Engine runs rough. Maximum RPM Approx. 2000. Perform EFI Electrical System and ECM Check.
	R.F.I. Problem*	Install Champion QL77CC Spark Plugs
Engine Surges Between 4000 & 5000 RPM	Final Filter Clogging	Perform Inlet Filter Check.
	TPS - Improper Adjustment	See Section 2C "Timing/Synchronizing/Adjusting" for TPS Adjustment
	Injector Fuel Delivery Problem	Perform Injector Operation Test with DDT.

*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).

CONDITION	POSSIBLE SOURCE	ACTION
Engine Idles Rough and loses RPM @ W.O.T.	Spark Plugs	Check Condition of Spark Plugs and Replace if Worn.
	Ignition Problem	Refer to Section 2A for Trouble-shooting Ignition. NOTE: If idle speed is to low, engine will idle rough. Increase idle speed to recommended specification – 650 ± 50 RPM
Engine Will Not Start – No Spark at Spark Plugs	Stop Wire (BLACK/YELLOW) Shorted	Replace Harness.
	Open Circuit in Crank Position Sensor Harness	Replace Harness.
	No Power (12VDC) on PURPLE Wire to Ignition ECM	Check Battery Connections or Replace Harness.
	Improperly Positioned or Defective Crank Position Sensor	Refer to Section 2A for Setup and Testing.
	Shorted CDM	Refer to Section 2A for Testing CDM.
	Incorrect Spark Plugs Installed	Install Champion QL77CC for EFI Models Install NGK - BP8H-N-10 or NGK - BPZ8H-N-10 for Carb Models
	Failed Ignition ECM	Replace ECM.
Engine Idles OK but Stumbles at Off Idle Speeds	Improper EFI Set Up	See Section 2C "Timing,Synchronizing, Adjusting" for set up procedures.
	Failed or Disconnected EFI Sensors	Perform EFI Sensor Tests
	Fuel Delivery Problem	Follow Low/High Pressure Fuel Route Flow Charts and Fuel Rail Electrical/Fuel Determination Flow Chart.
	Fuel Leak Rail Leak	Perform Fuel Rail Leak Check. Install Champion QL77CC Spark Plugs.
	R.F.I. Problem	See Section 2A "Electrical and Ignition" for tests
	Defective Stator Coil(s)	

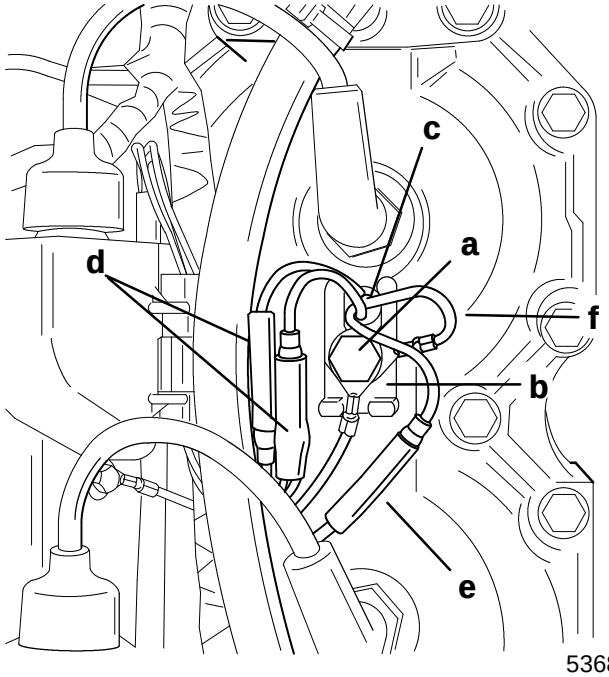
CONDITION	POSSIBLE SOURCE	ACTION
Engine Idles Rough (May Lean Sneeze) - Acceleration OK, Full Throttle OK	Improper EFI Set Up	See Section 2C "Timing,Synchronizing, Adjusting" for set up procedures.
	Failed MAP Sensor	Perform MAP Sensor Test (See EFI Electrical System and ECM Check.
	Coolant Sensor Failure	Perform "Engine Head Temperature Sensor Test".
	Broken Reed	Visual Inspection
Engine Runs but Slowly Drops RPM then Dies	Restrictions in Fuel System (Between Tank and engine)	Install remote gas tank with fresh high quality fuel.
	Clogged Inlet Filter	Perform Inlet Filter Check.
	Pulse Fuel Pump Failure	Follow Low Pressure Fuel Route Flow Chart.
	Electric Fuel Pump Failure	Follow High Pressure Fuel Route Flow Chart.
Engine Stops for No Apparent Reason or Does Not Start	Battery Undercharged (Less than 8.0 Volts)	Check battery connections, undercharged battery or worn out battery
	EFI Harness Connections	Check EFI harness connectors for loose/corroded connections.
	Ignition System Failure	See Section 2A "Electrical and Ignition" for test procedures.
	Pulse Fuel Pump Failure	Follow Low Pressure Fuel Route Flow Chart.
	Electric Fuel Pump Failure	Follow High Pressure Fuel Route Flow Chart
	Incorrect Spark Plugs Installed	Install Champion QL77CC Spark Plugs.
	ECM Failure	Replace ECM

EFI Component Removal and Installation

Engine Head Temperature Sensor Removal

1. Remove bolt and retaining plate.
2. Disconnect bullet connectors.

***NOTE:** 1 TAN/BLACK temperature sensor lead is normally shorted to ground in the engine harness. The ECU recognizes this and uses the other TAN/BLACK sensor lead for information.*
There should be NO CONTINUITY between each TAN/BLACK lead and the sensor case (Ground). If resistance (continuity) is noted, sensor is shorted internally and should be replaced.
Normal continuity reading between both TAN/BLACK leads out of sensor is 1000Ω ±100Ω. at room temperature.



53685

a - Bolt
b - Retaining Plate
c - Temperature Sensor
d - TAN/BLACK Leads (See note above)
e - TAN/BLUE Lead (for Temperature Gauge)
f - BLACK Lead (Ground)

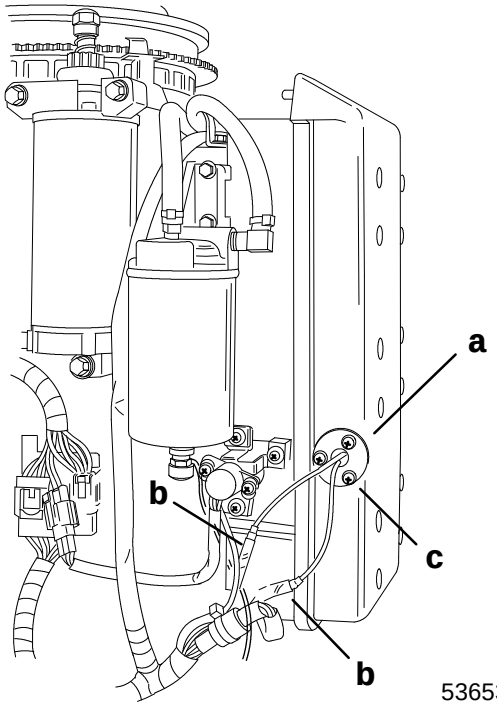
Engine Head Temperature Sensor Installation

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

1. Connect bullet connectors.
2. Install sensor and secure with retaining plate and bolt.
3. Torque bolt to 17 lb. ft. (23.0 N·m).

Air Temperature Sensor Removal

1. Disconnect TAN lead bullet connectors.
2. Remove 3 screws securing sensor to manifold cover.
3. Remove sensor and inspect O-ring for cuts or abraisions. Replace O-ring as required.



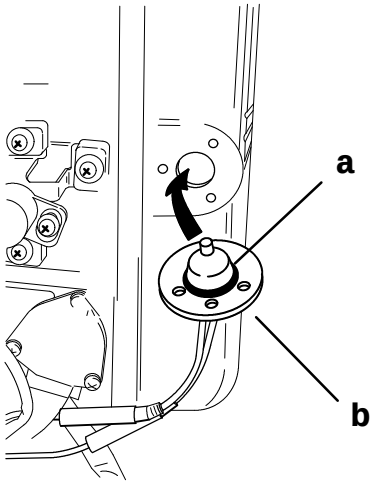
53653

a - Air Temperature Sensor
b - TAN Leads
c - Screws

Air Temperature Sensor Installation

1. Reinstall O-ring and install sensor into cover.
2. Secure sensor with 3 screws. Drive screws tight.

3. Reconnect TAN bullet connector leads.



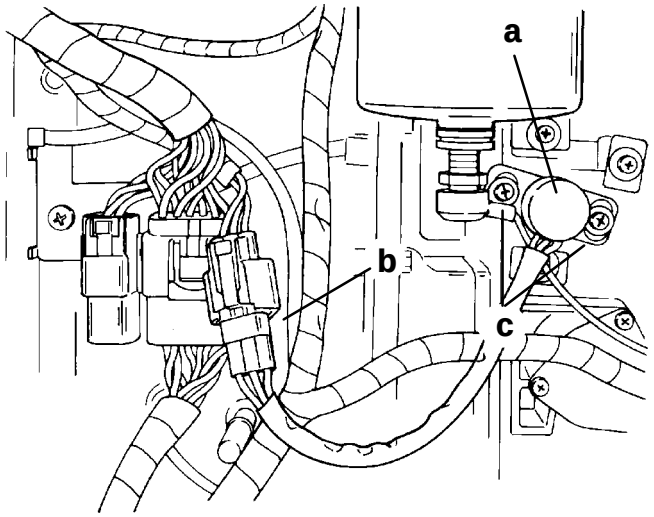
53688

a - O-ring
b - Air Temperature Sensor

Throttle Position Sensor (TPS) Removal

IMPORTANT: TPS will need to be set after installation.

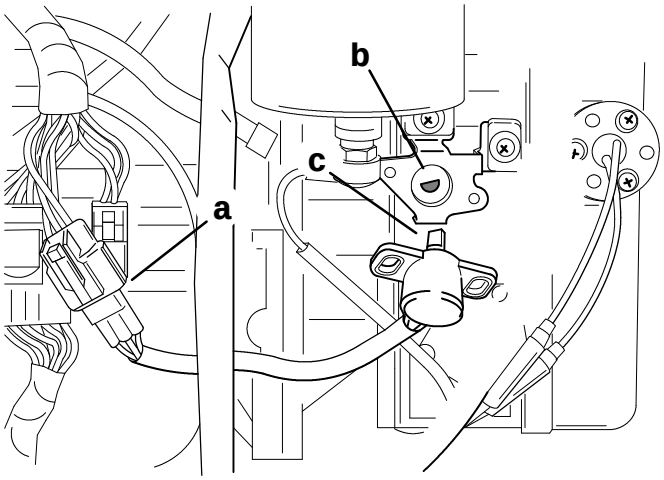
1. Disconnect TPS harness.
2. Remove 2 screws securing TPS and remove TPS.



a - Throttle Position Indicator
b - TPI Harness
c - Screws

Throttle Position Sensor (TPS) Installation

1. Reconnect TPS harness.
2. With throttle closed (at idle) flat on TPS coupler should be UP and slightly aft.
3. Align flat of TPS shaft with coupler flat and reinstall TPS.
4. Secure TPS with 2 screws, lock washers and flat washers.
5. Refer to Section 2C "Timing/Synchronizing/Adjusting" for proper TPS adjustment procedure.



53694

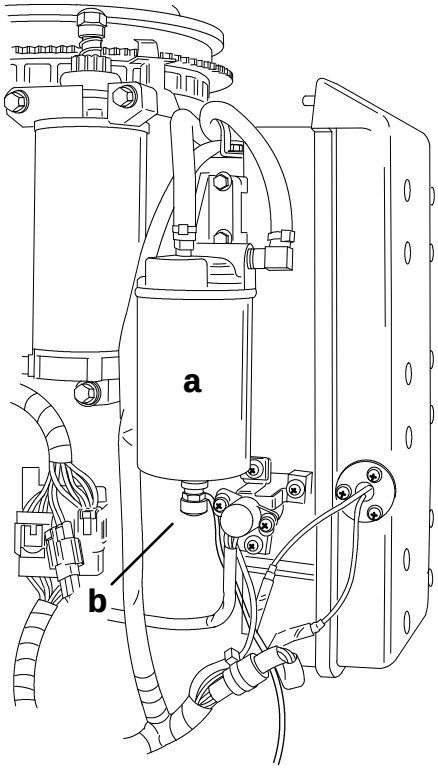
a - TPS Harness
b - Coupler Flat
c - TPS Flat

6. After final adjustment of TPS is completed, torque screws to 20 lb. in. (2.3 N·m). Recheck TPI setting after screws are torqued.

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.*

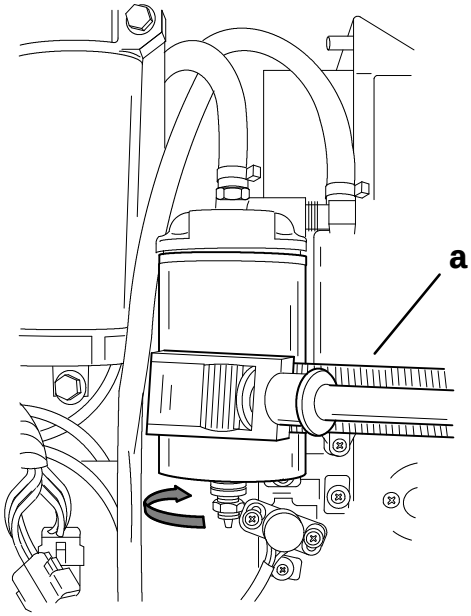
1. Remove water sensor lead from bottom of separator.



53653

a - Water Separator
b - Water Sensor Lead

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



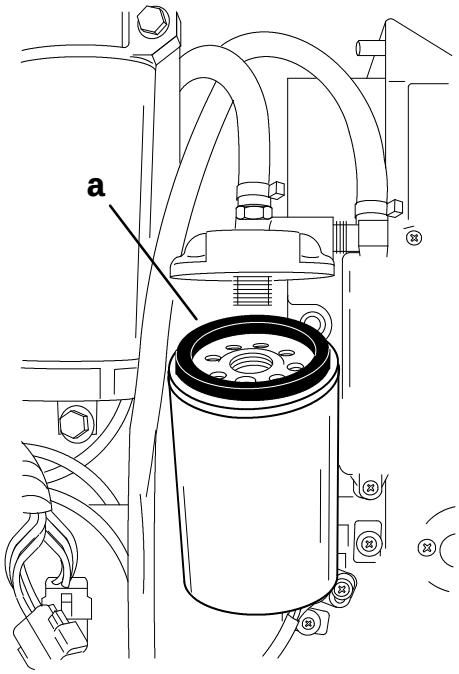
53698

a - Strap Wrench (91-24937A1)

Water Separating Filter Assembly Installation

IMPORTANT: Apply a light coat of outboard oil to the sealing rectangular 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.

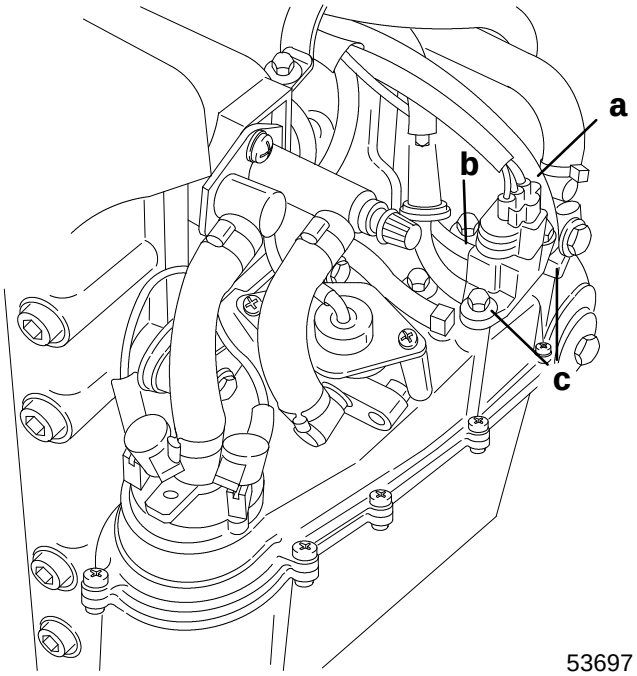


53699

a - Sealing Ring (apply oil)

MAP Sensor Removal

1. Disconnect MAP sensor harness.
2. Disconnect MAP sensor hose.
3. Remove 2 bolts securing sensor.



a - Harness
b - Hose
c - Bolts

MAP Sensor Installation

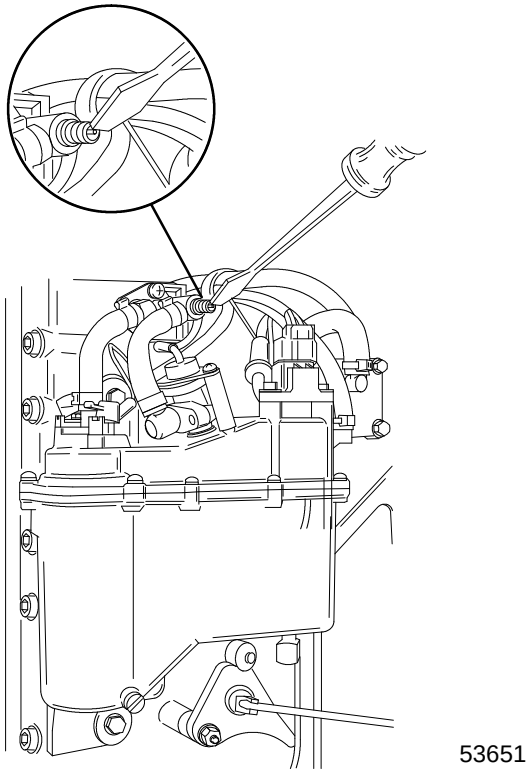
1. Secure MAP sensor to vapor separator with 2 bolts. Drive bolts tight.
2. Connect MAP sensor hose.

***NOTE:** Verify MAP sensor connector gasket is in place before reconnecting sensor harness.*

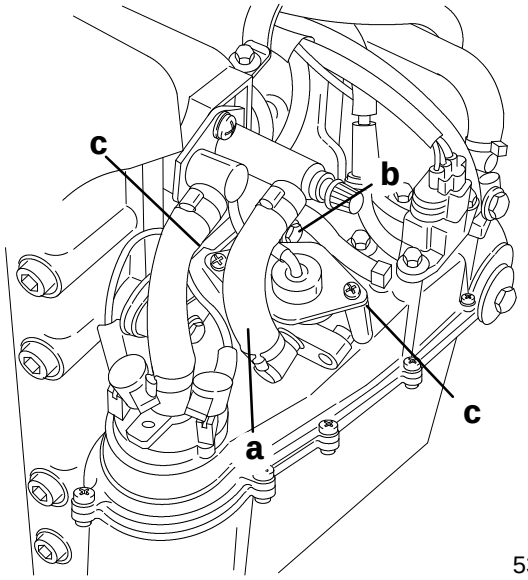
3. Connect MAP sensor harness.

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.



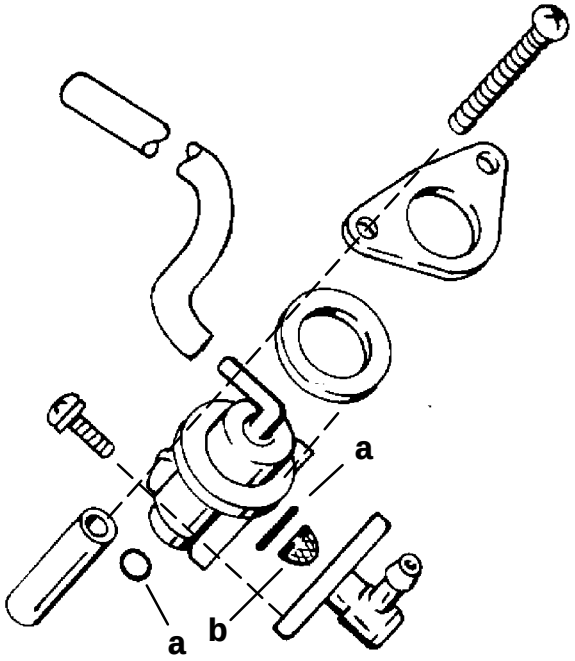
3. Remove return fuel line from pressure regulator.
4. Remove regulator hose from regulator.
5. Remove 2 screws securing regulator to separator and remove regulator.



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

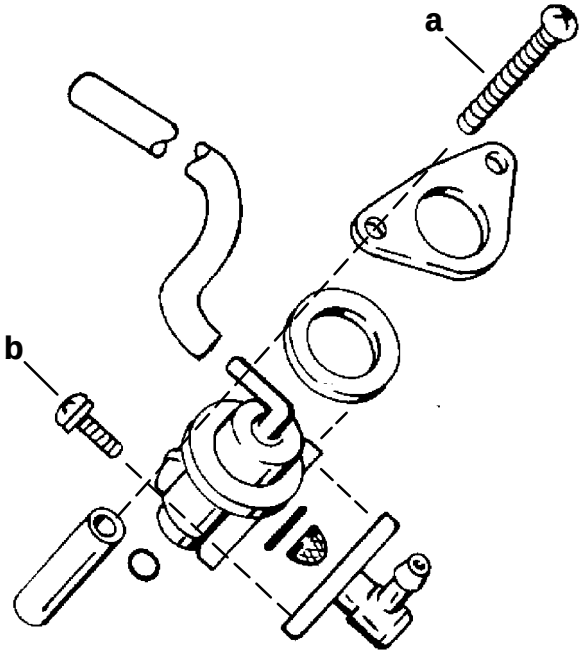
Fuel Pressure Regulator Disassembly

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

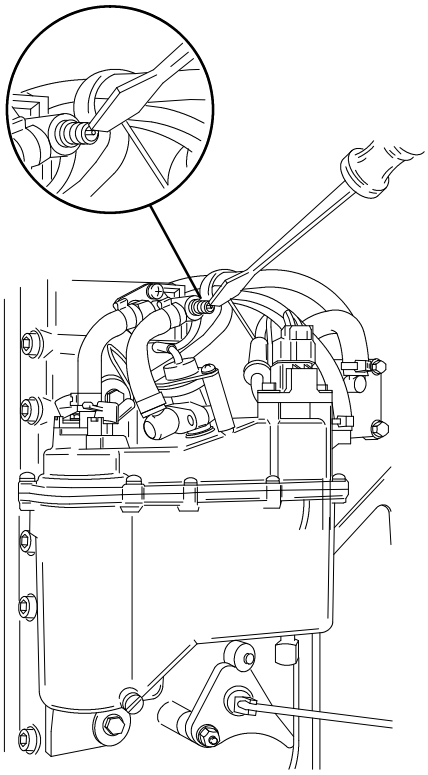
Fuel Pressure Regulator Reassembly



a - Screw (2) [Torque to 30 lb. in. (3.4 N·m)]
b - Screw (2) [Torque to 45 lb. in. (5.1 N·m)]

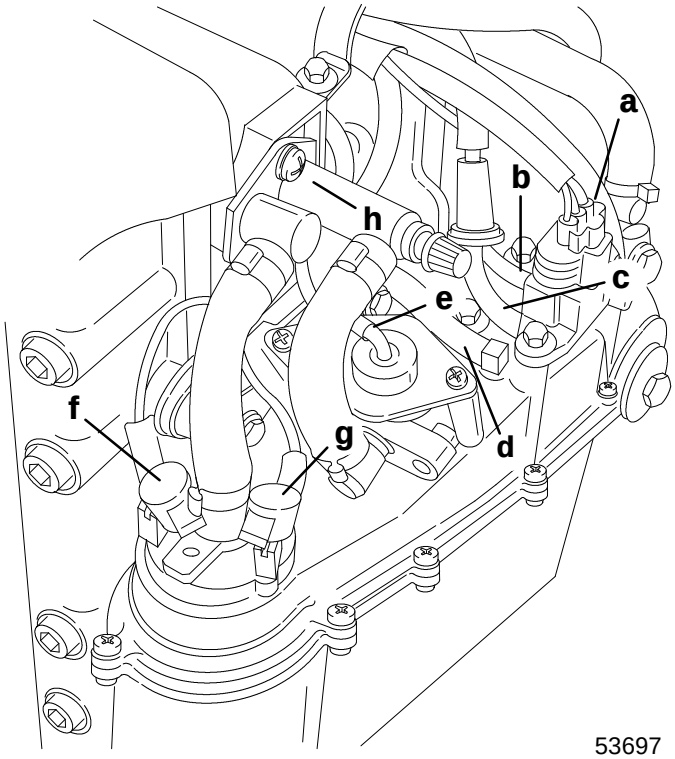
Vapor Separator Removal

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.



53651

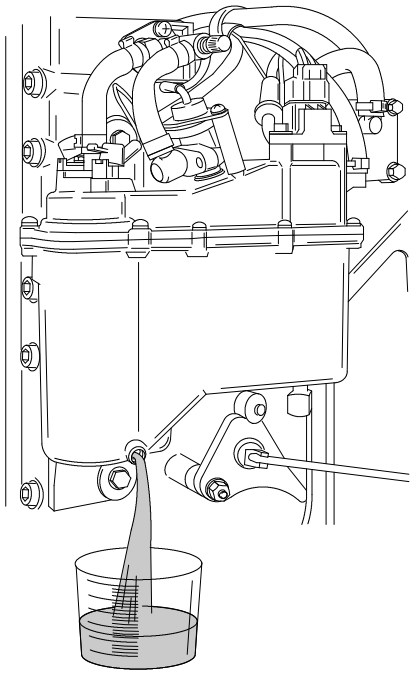
3. Disconnect MAP sensor harness.
4. Disconnect MAP sensor manifold hose.
5. Disconnect separator bleed and vacuum hoses.
6. Disconnect pressure regulator manifold hose.
7. Disconnect POSITIVE (+) and NEGATIVE (–) leads from electric fuel pump.
8. Remove 2 screws securing inlet/outlet fuel lines to manifold.



53697

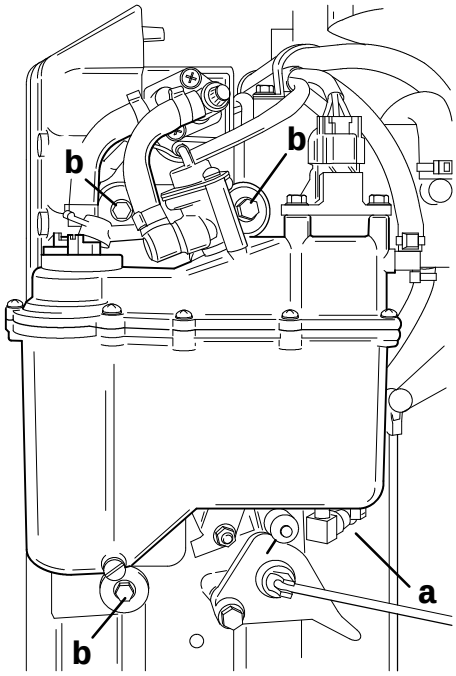
a - MAP Sensor Harness
b - MAP Sensor Manifold Hose
c - Separator Bleed Hose
d - Separator Vacuum Hose
e - Pressure Regulator Manifold Hose
f - POSITIVE (+) Lead
g - NEGATIVE (–) Lead
h - 2 Screws (1 hidden)

9. Remove drain screw from separator and drain fuel into suitable container.



53652

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

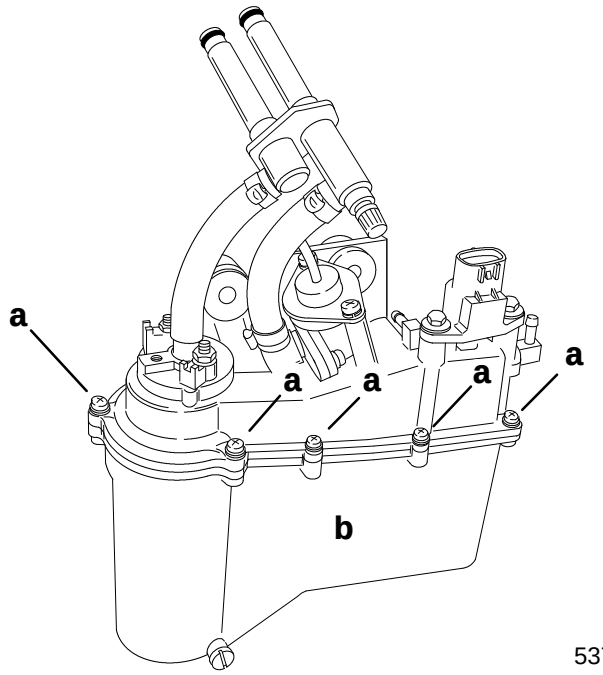


53657

a - Oil Inlet Hose
b - Bolts

Vapor Separator Disassembly

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

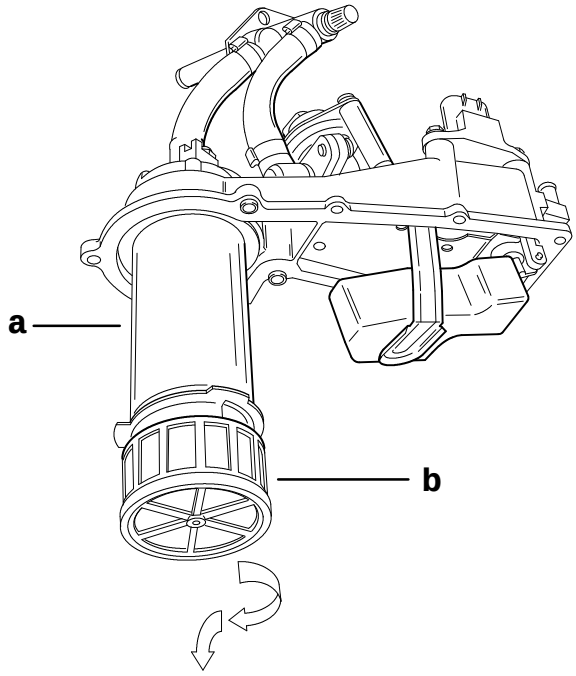


53710

a - Screws (4 screws are hidden on back side)
b - Separator Tank

FINAL FILTER REMOVAL

1. Rotate final filter counterclockwise and pull down.



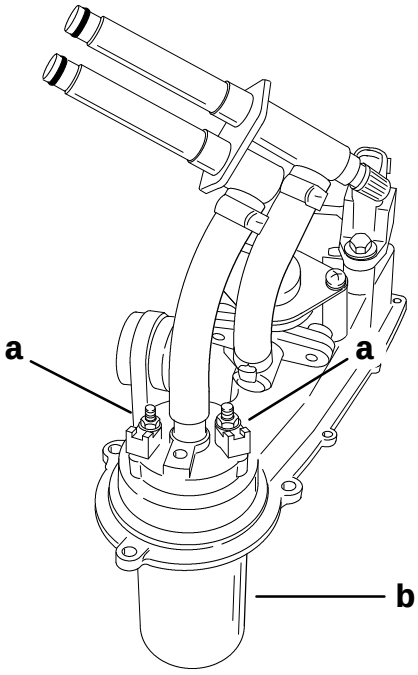
53696

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.*

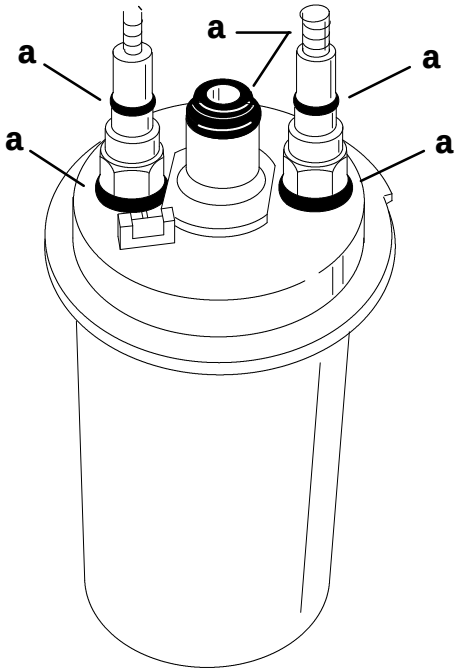
1. Remove 2 nuts on POSITIVE and NEGATIVE terminals. Remove pump from separator cover.



53700

a - Nuts
b - Pump

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



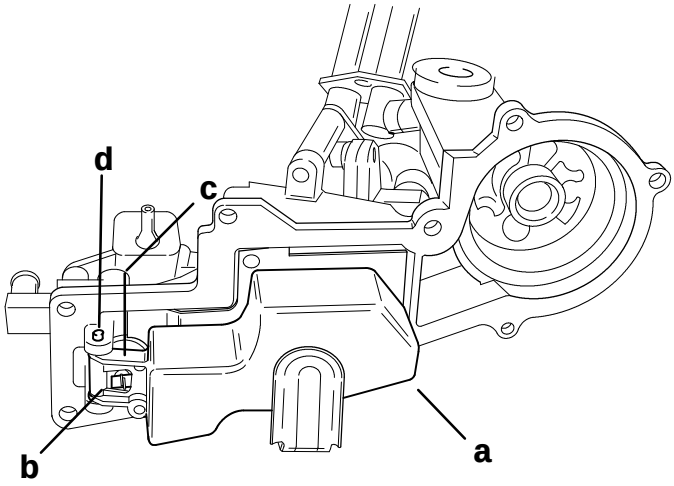
53702

a - O-rings

VAPOR SEPARATOR FLOAT REMOVAL

***NOTE:** Inspect float for fuel absorbtion 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.



53692

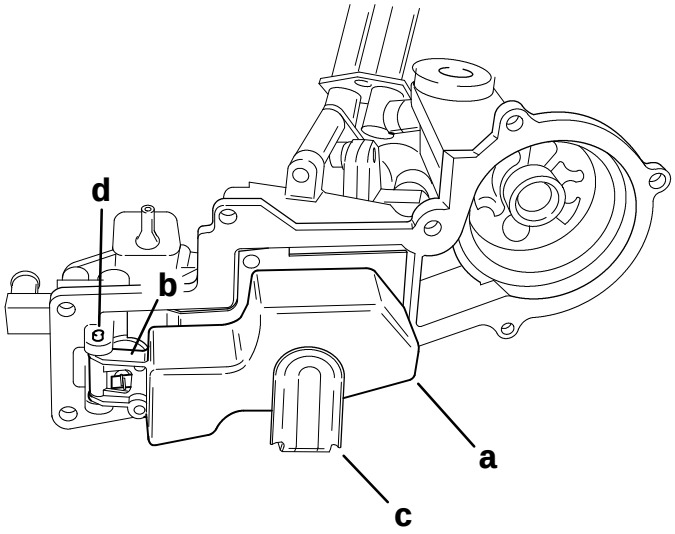
a - Float
b - Float Arm
c - Float Needle (Hidden)
d - Pivot Pin

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

Vapor Separator Reassembly

VAPOR SEPARATOR FLOAT INSTALLATION

1. Attach float needle to float arm.
2. Guide float/needle assembly under float drop limit bracket and place needle into seat.
3. Slide pivot pin through float arms.
4. Verify float's freedom of movement through pivot range.



53692

a - Float
b - Needle
c - Float Drop Limit Bracket
d - Pivot Pin

ELECTRIC FUEL PUMP INSTALLATION

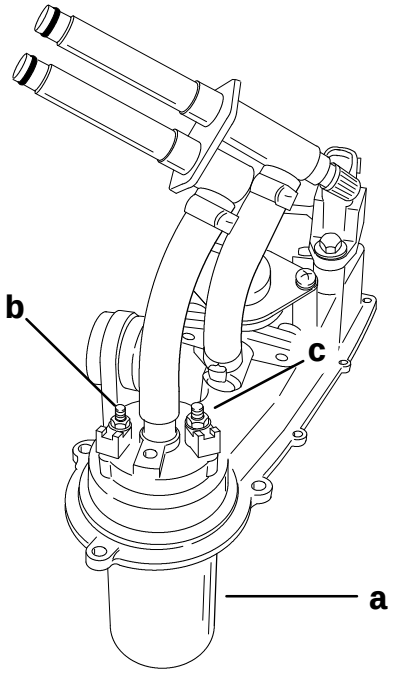
1. Slide fuel pump into separator cover.

***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 N·m). Torque NEGATIVE nut to 8 lb. in. (0.9 N·m).



53700

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

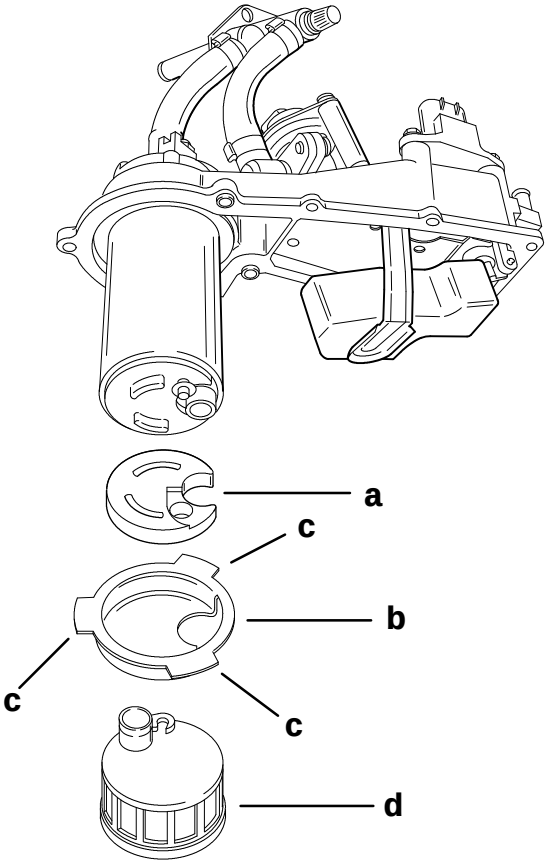
3. Install rubber pad on bottom of pump.

***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).*

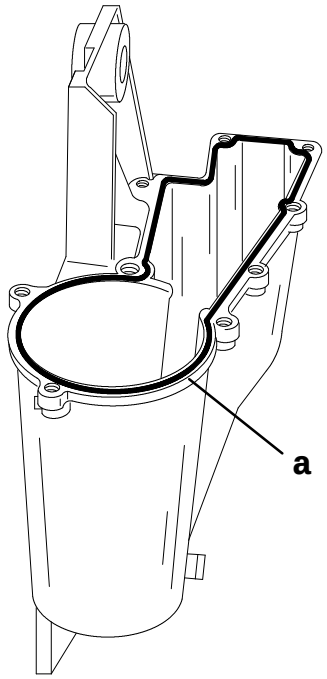
5. Install final filter into pump bottom. Rotate filter clockwise to lock filter onto pump.



a - Rubber Pad
b - Support Ring
c - Tabs (face up)
d - Final Filter

INSTALLING SEPARATOR COVER ASSEMBLY ONTO SEPARATOR TANK

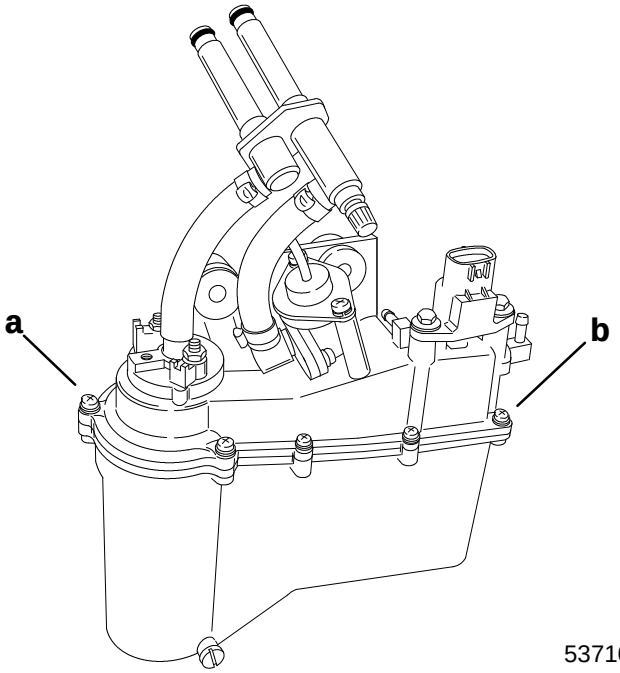
1. Inspect separator tank sealing O-ring for cuts or abraisions. Replace O-ring as required.



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. (3.4 N·m). Torque 4mm screws to 20 lb. in. (2.3 N·m).

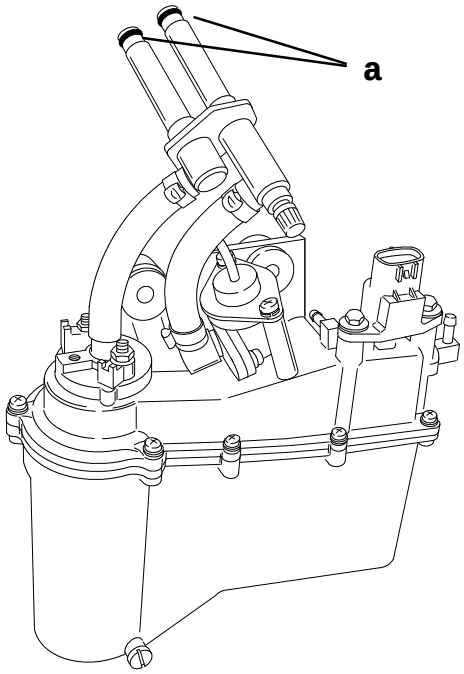


53710

a - Large Screws (4) (5mm) Torque to 30 lb. in. (3.4 N·m)
b - Small Screws (5) (4mm) Torque to 20 lb. in. (2.3 N·m)

Installing Vapor Separator Assembly to Induction Manifold

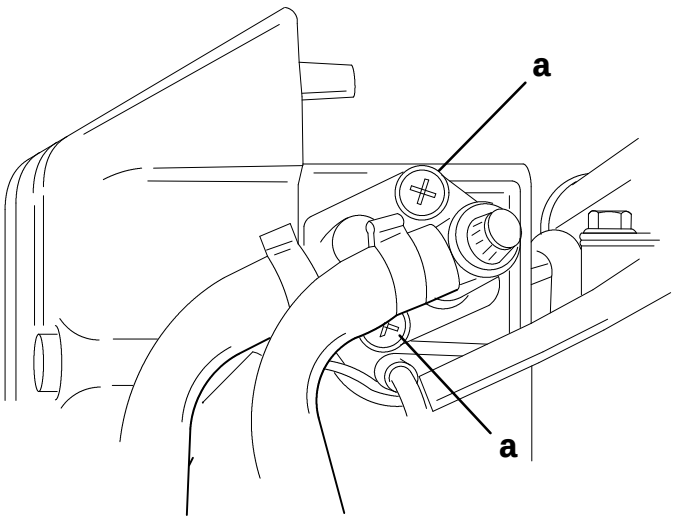
1. Inspect O-rings on end of separator fuel tubes for cuts or abraisions. Replace O-rings as required.



53710

a - O-rings

2. Guide fuel tubes into manifold. Secure tube assembly with 2 screws. Torque screws to 45 lb. in. (5.1 N·m).

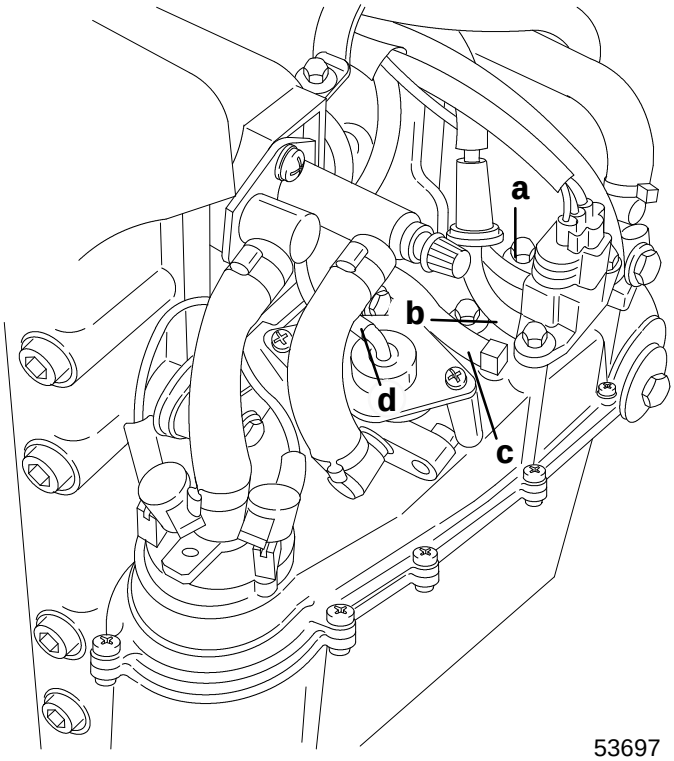


53657

a - Screws [Torque to 45 lb. in. (5.0 N·m)]

***NOTE:** Refer to fuel flow diagram for proper placement of hoses when reinstalling separator to manifold.*

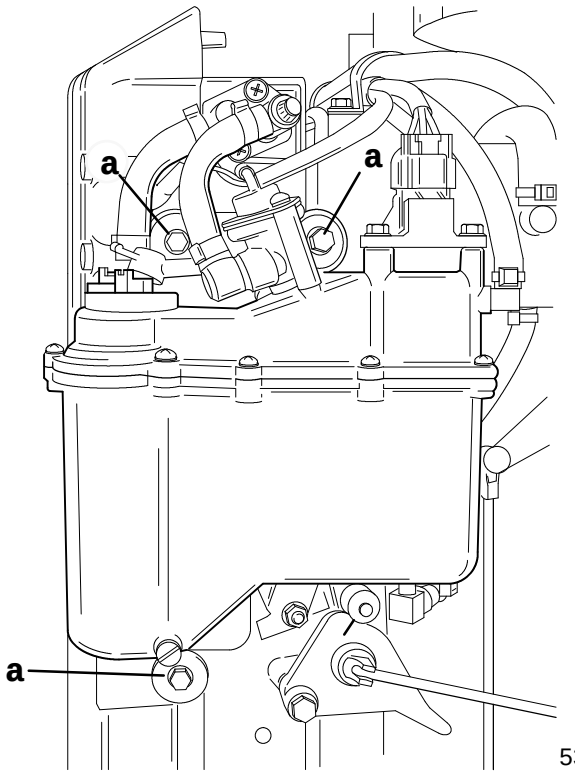
3. Reconnect MAP sensor hose to middle fitting on manifold.
4. Reconnect engine bleed hose (with filter) to fitting under MAP sensor.
5. Reconnect vapor separator hose (next to MAP sensor) to bottom fitting on manifold.
6. Reconnect pressure regulator hose to top fitting on manifold.



53697

a - MAP Sensor Hose
b - Engine Bleed Hose
c - Vapor Separator Hose
d - Pressure Regulator Hose

7. Secure separator assembly to manifold with 3 bolts and washers. Torque bolts to 45 lb. in. (5.1 N·m).



53657

a - Bolts and Washers [Torque to 45 lb. in. (5.0 N·m)]

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.

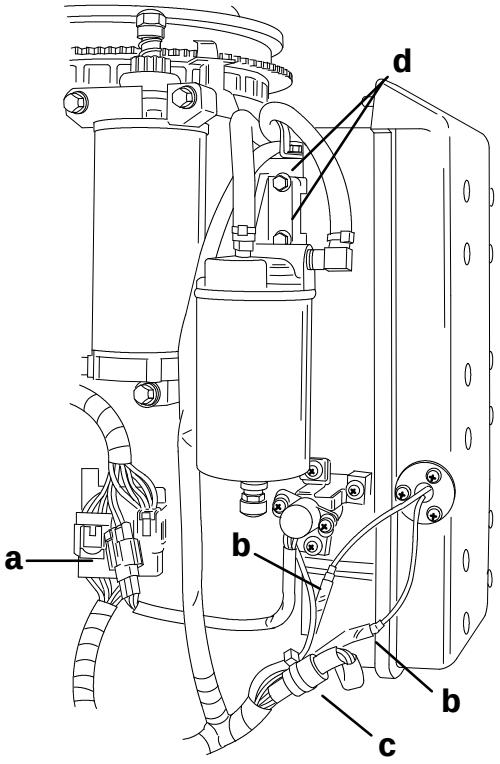
Inspection

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 ECU box for missing, corroded or bent contact pins and socket. Check for dislodged grommet in ECU 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 Removal

IMPORTANT: Disconnect battery cables from battery before removing and disassembling induction manifold.

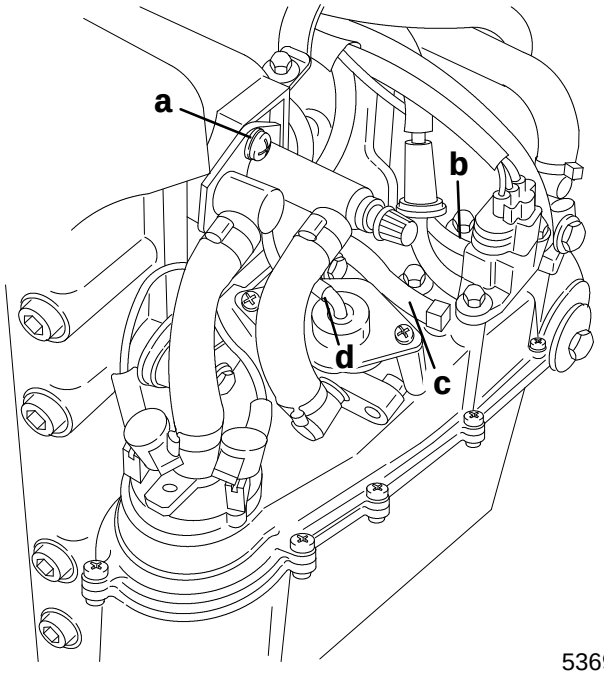
1. Disconnect TPI harness.
2. Disconnect Air Temperature Sensor bullet connectors.
3. Disconnect injector wiring harness.
4. Remove 2 bolts securing water separator filter and lay filter off to one side.



53653

a - TPI Harness
b - Air Temperature Sensor Bullet Connectors
c - Injector Wiring Harness
d - Water Separator Filter Attaching Bolts

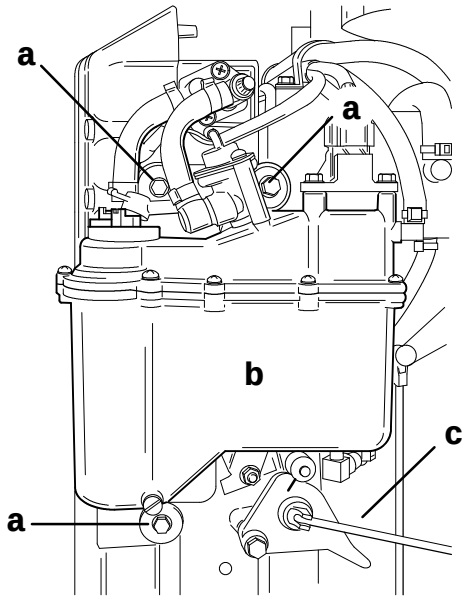
5. Remove 2 screws securing fuel inlet/outlet pipes to manifold.
6. Remove MAP sensor hose.
7. Remove Vapor Separator hose.
8. Remove Fuel Pressure Regulator hose.



53697

a - Fuel Inlet/Outlet Pipe Screws
b - Map Sensor Hose
c - Vapor Separator Hose
d - Fuel Pressure Regulator Hose

9. Pry throttle link arm from throttle cam with screw driver.
10. Remove 3 bolts securing vapor separator assembly to manifold and lay separator off to one side.

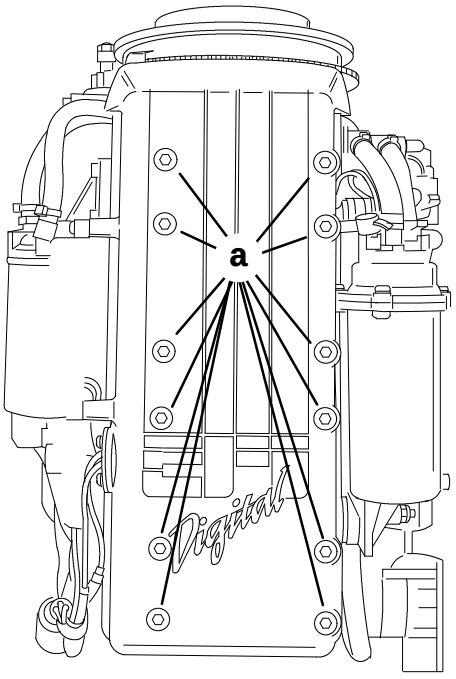


53657

a - Bolts
b - Vapor Separator
c - Throttle Link Arm

***NOTE:** Screws that attach cover to induction manifold also secure induction manifold to cylinder block. Support induction manifold as last screws are removed.*

11. Remove 12 screws securing intake cover and induction manifold to cylinder block. Remove induction manifold assembly from cylinder block.

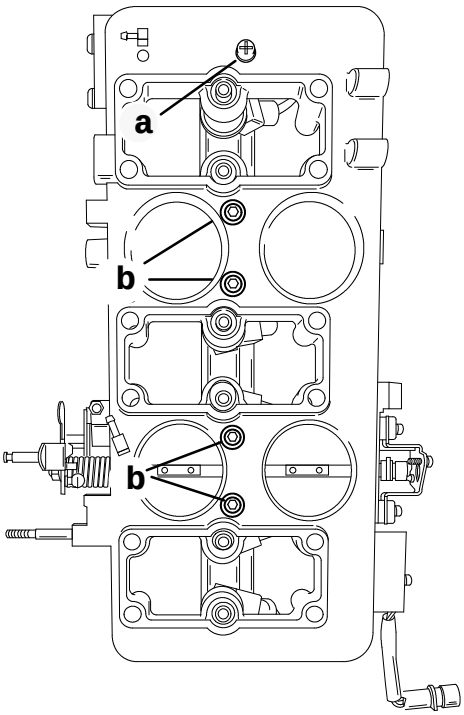


53645

a - Screws

FUEL RAIL REMOVAL

1. Remove 5 screws securing fuel rail to induction manifold and remove fuel rail.



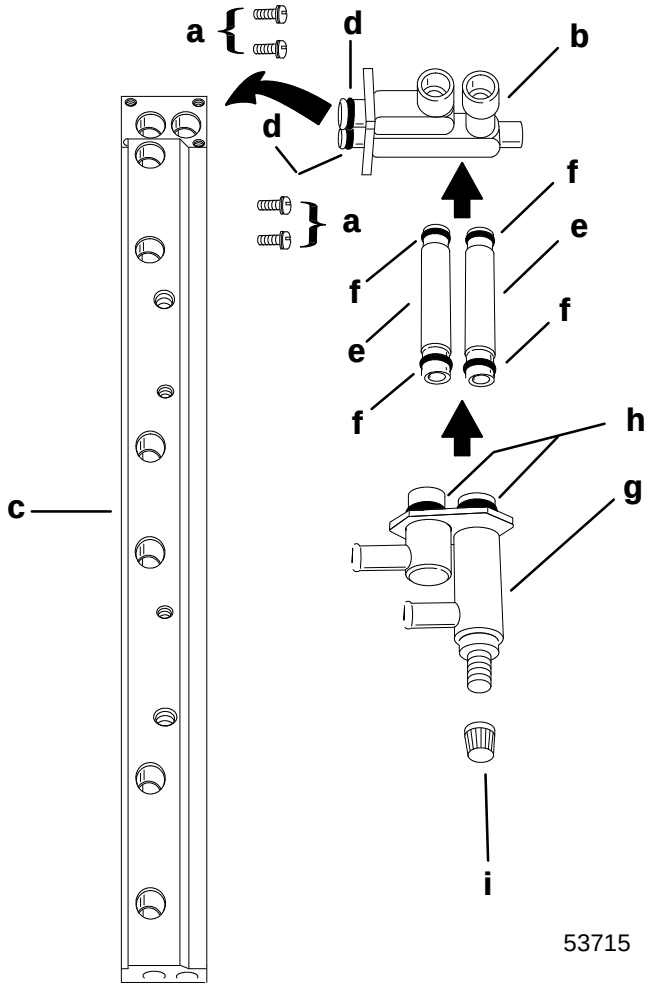
53707

a - Philips Screw
b - Allen Screw

2. Fuel injectors are held into fuel rail by O-ring tension. Pull out on injector to remove from fuel rail.

FUEL RAIL DISASSEMBLY

1. Remove 4 screws securing inlet/outlet elbow to fuel rail and remove elbow.
2. Inspect O-rings on elbow for cuts and abraisions. Replace as required.
3. Remove transfer tubes from external fuel pressure regulator joint.
4. Inspect O-rings on transfer tubes for cuts and abraisions. Replace as required.
5. Inspect O-rings on regulator joint for cuts and abraisions. Replace as required.

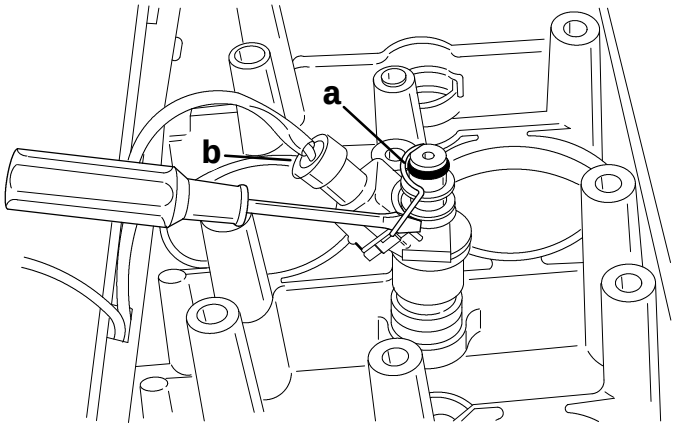


53715

a - Screws
b - Inlet/Outlet Elbow
c - Fuel Rail
d - O-rings
e - Transfer Tubes
f - O-rings
g - Regulator Joint
h - O-rings
i - Dust Cap

FUEL INJECTOR DISASSEMBLY AND REASSEMBLY

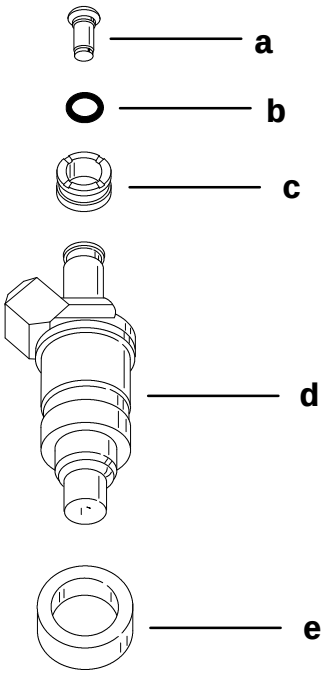
1. Pry out on spring clip with small flat tipped screwdriver to unlock electrical connector from injector.



53716

a - Spring Clip
b - Connector

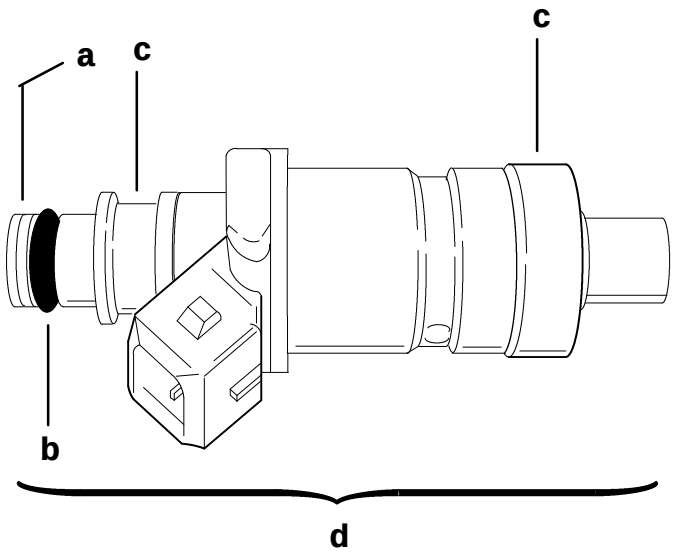
2. Place injector on clean work surface and remove filter, O-ring and seals.
3. Inspect O-ring and seals for cuts or abraisions. Replace as required.
4. Inspect filter for debris. Flush with solvent. DO NOT reinstall injector without filter as injector will require replacement if debris enters injector assembly.



53712

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

5. Reassemble injector.

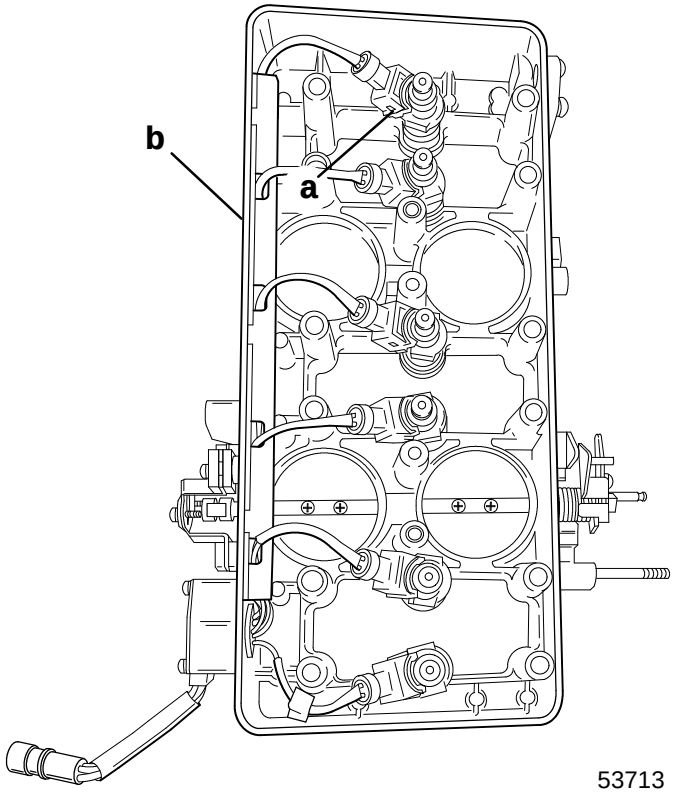


53704

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

INJECTOR HARNESS REMOVAL

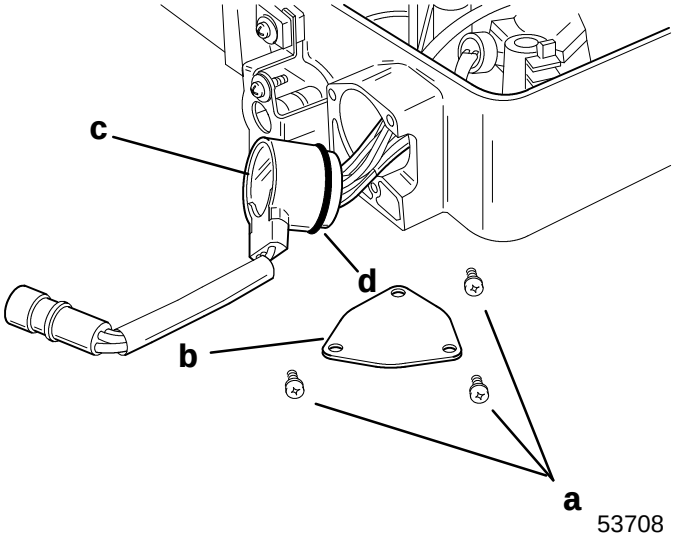
1. Note position of wiring for reassembly.
2. Remove locking spring clip from each injector harness connector and disconnect each injector.
3. Remove protective casing from harness.



53713

a - Spring Clip
b - Protective Casing

4. Remove 3 screws and injector harness plate.
5. Remove harness plug from manifold.
6. Inspect harness plug o-ring for cuts or abraisions. Replace as required.

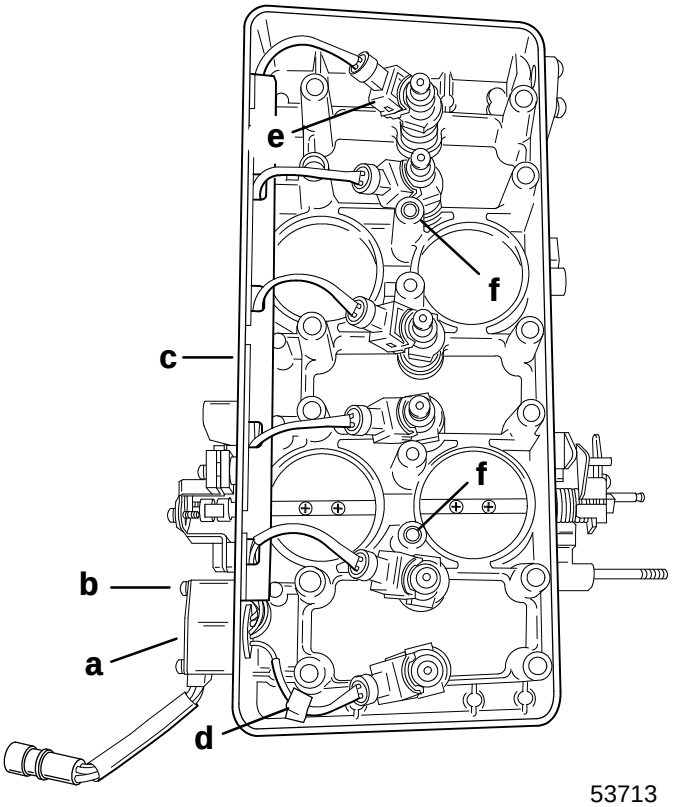


53708

a - Screws
b - Plate
c - Harness Plug
d - O-ring

INJECTOR HARNESS INSTALLATION

1. Seat O-ring on harness plug and install plug into manifold receptacle.
2. Secure plug in manifold with plate and 3 screws. Drive screws tight.
3. Install harness case onto harness and route injector connectors to each injector.
4. Secure connector to each injector with spring clip.
5. Reinstall fuel rail alignment sleeves (if removed).

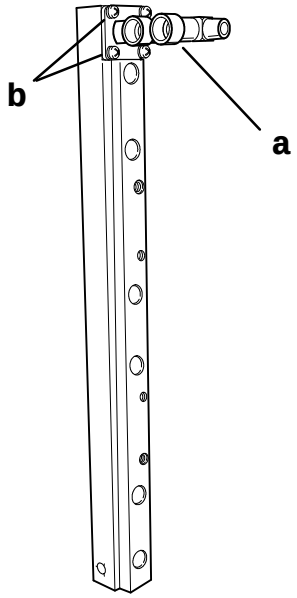


53713

a - Plate
b - Screws (3) (Drive Tight)
c - Harness Case
d - Harness Guide
e - Spring Clip
f - Alignment Sleeves

FUEL RAIL REASSEMBLY AND INSTALLATION

1. Install inlet/outlet elbow to fuel rail. Torque screws to18 lb. in. (2.0 N·m).

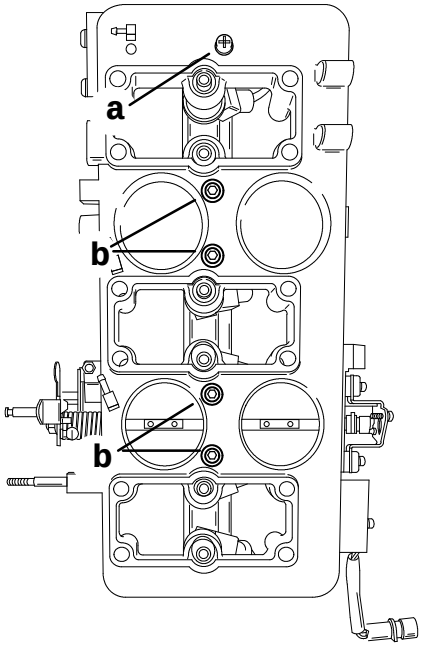


53707

a - Inlet/Outlet Elbow
b - Screws [Torque to 18 lb. in. (2.0 N·m)]

2. Align fuel rail over injectors and carefully press rail downward. Adjust individual injectors as required to facilitate the seating of the injectors into the fuel rail.

3. When fuel rail is seated fully onto injectors and alignment sleeves, carefully turn induction manifold over and secure fuel rail with 1 philips screw and washer and 4 allen screws and washers. Torque screws to 45 lb. in. (5.1 N·m).

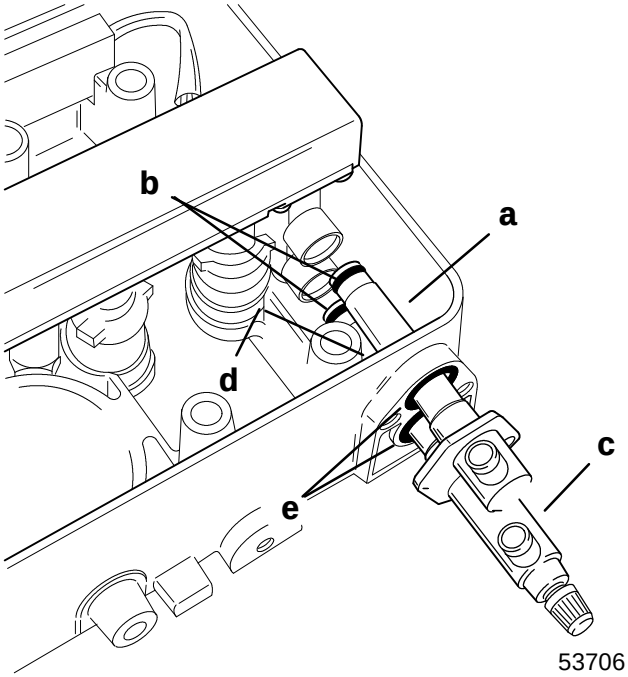


53707

a - Philips Screw and Washer
b - Allen Screws and Washer

4. Install inlet/outlet tubes with O-rings into fuel pressure regulator elbow.

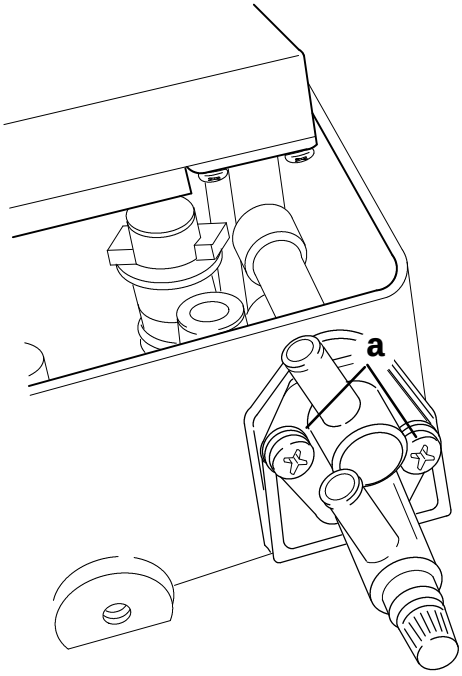
5. Install O-rings on fuel ports on manifold. Slide inlet/outlet tube and regulator assembly through ports and into inlet/outlet elbow on fuel rail.



53706

a - Inlet/Outlet Tubes
b - O-rings
c - Pressure Regulator Elbow
d - O-rings (hidden)
e - O-rings (Fuel Ports)

6. Secure pressure regulator assembly to manifold with 2 screws and washers. Torque screws to 45 lb. in. (5.1 N·m).

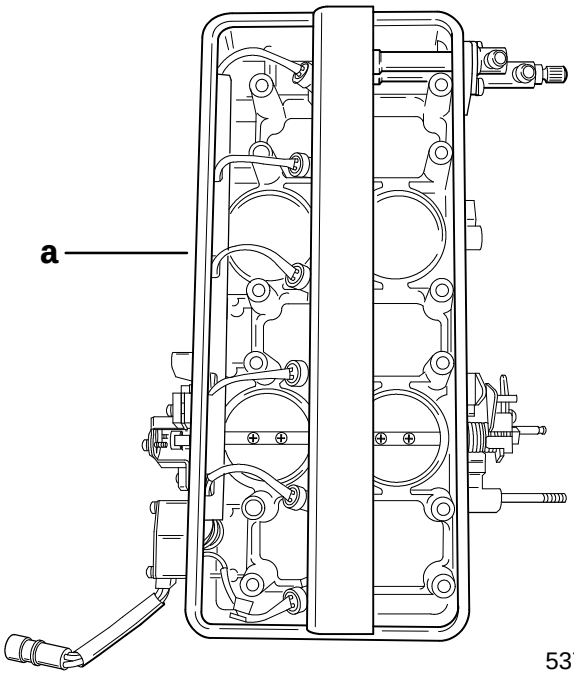


53705

a - Screws and Washers

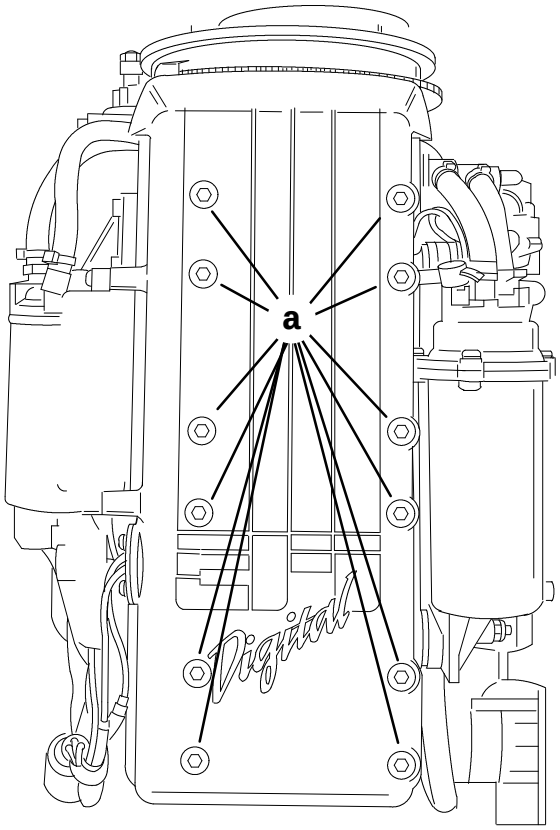
Induction Manifold Installation

1. Inspect induction manifold cover seal for cuts or abraisions. Replace as required.



a - Seal

2. Place cover onto manifold assembly and install cover/manifold assembly onto cylinder block. Secure assembly with 12 allen screws. Torque screws to 19 lb. ft. (26.0 N·m).

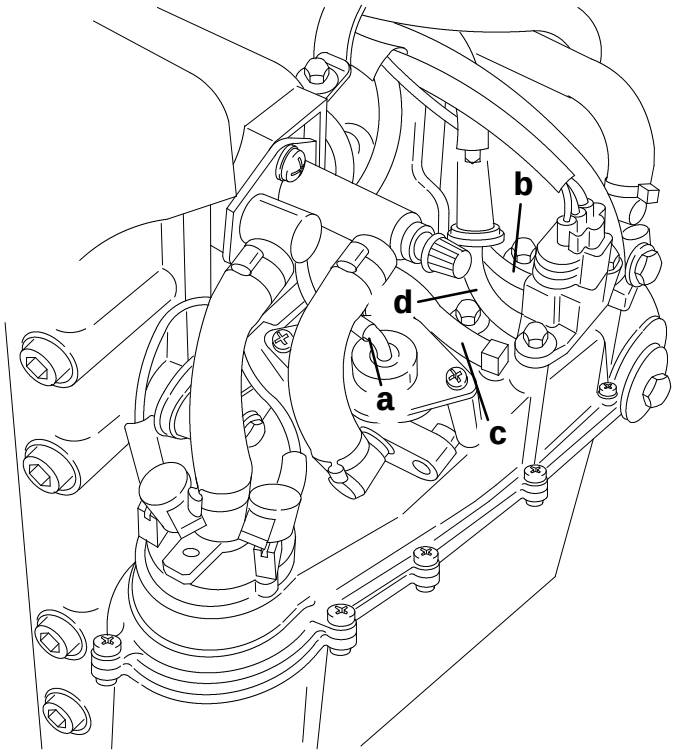


a - Screws [Torque to 19 lb. ft. (26.0 N·m)]

3. Connect fuel pressure regulator hose to top manifold fitting.
4. Connect MAP sensor hose to middle manifold fitting.
5. Connect vapor separator hose to bottom manifold fitting.
6. Connect engine bleed hose (with white filter) to fitting under MAP sensor.

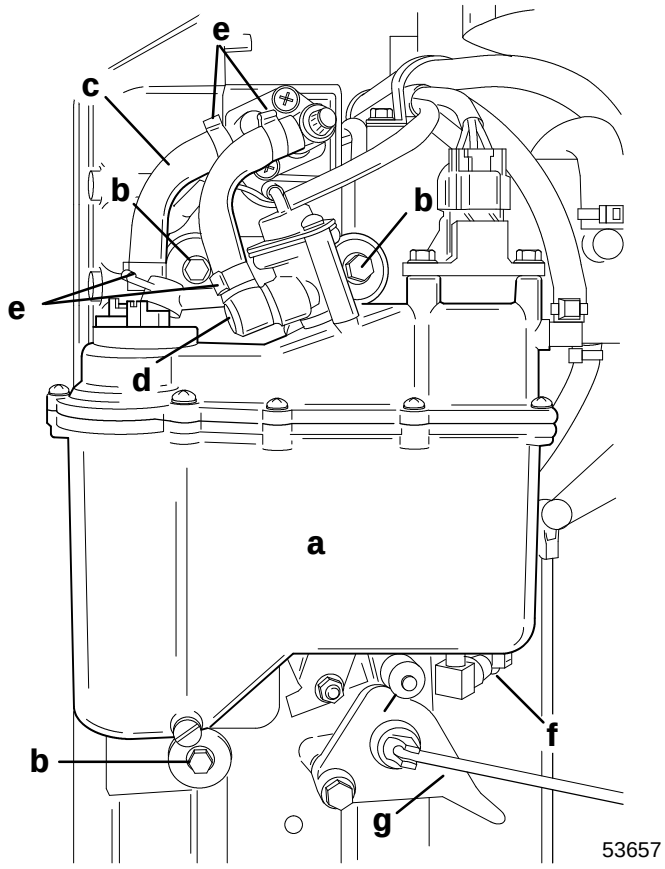
***NOTE:** Refer to FUEL FLOW DIAGRAM for visual aid of hose placement*

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 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.



a - Pressure Regulator Hose
b - MAP Sensor Hose
c - Vapor Separator Hose
d - Engine Bleed Hose

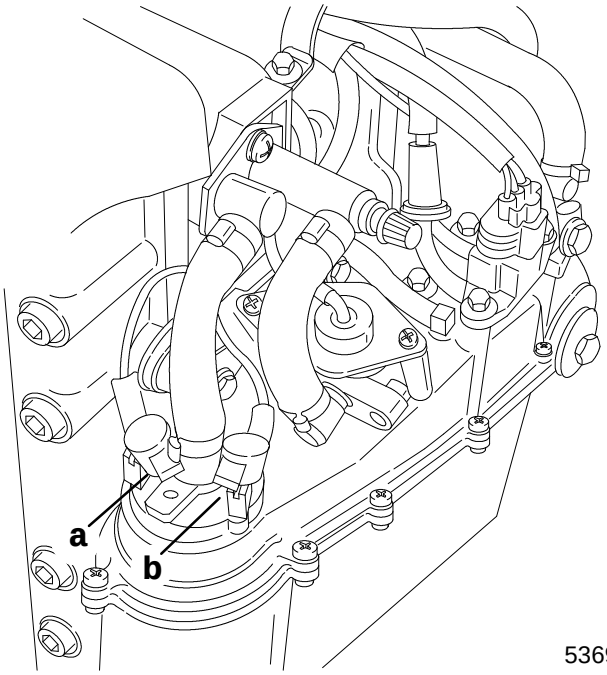
7. Secure vapor separator to induction manifold with 3 bolts and washers. Torque bolts to 45 lb. in. (5.1 N·m).
8. Secure fuel outlet hose and return hose to manifold with hose clamps, if removed, or install tubing kit (32-827694) if hoses are to be replaced.
9. Reconnect oil inlet hose to vapor separator. Secure hose with sta-strap.
10. Install throttle link rod to throttle cam.



53657

a - Vapor Separator
b - Bolts and Washers [Torque to 45 lb. in. (5.1 N·m)]
c - Fuel Outlet Hose
d - Fuel Return Hose
e - Steel Clamps
f - Oil Inlet Hose
g - Throttle Link Rod

11. Connect RED (POSITIVE) lead to PORT terminal of electric fuel pump and RED/PURPLE (NEGATIVE) lead to STARBOARD terminal of electric fuel pump.



53697

a - RED (POSITIVE) Lead
b - RED/PURPLE (NEGATIVE) Lead

1995 225 EFI Wiring Diagram

1 - Stator
2 - Crank Position Sensor
3 - Throttle Position Sensor
4 - Low Oil Switch
5 - 60 Ampere Alternator
6 - Temperature Sensor
7 - Starter
8 - Shift Interrupt Switch
9 - #1 Fuel Injector
10- #2 Fuel Injector
11- #3 Fuel Injector
12- #4 Fuel Injector
13- #5 Fuel Injector
14- #6 Fuel Injector
15- Fuel Pump
16- Water Sensor
17- Detonation Module Harness (Not Used)
18- Knock Sensor Harness (Not Used)
19- Trim Motor
20- Cowl Trim Switch
21- DOWN Trim Solenoid
22- UP T rim Solenoid
23- Starter Solenoid
24- 20 Ampere Fuse
25- MAP Sensor
26- Air Temperature Sensor
27- #5 CDM
28- #3 CDM
29- #1 CDM
30- Ignition ECM
31- EFI (Fuel) ECM
32- #6 CDM
33- #4 CDM
34- #2 CDM

BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LT = Light
DRK = Dark

1996/1997/1998 225 EFI/250 EFI Wiring Diagram

1 Stator
2 Crank Position Sensor
3 Throttle Position Sensor
4 Low Oil Switch
5 60 Ampere Alternator
6 Temperature Sensor
7 Starter
8 Shift Interrupt Switch
9 #1 Fuel Injector
10 #2 Fuel Injector
11 #3 Fuel Injector
12 #4 Fuel Injector
13 #5 Fuel Injector
14 #6 Fuel Injector
15 Fuel Pump
16 Map Sensor
17 Water Sensor
18 Air Temperature Sensor
19 To Remote Trim Switch
20 Cowl Trim Switch
21 Remote Control Harness
22 DOWN Trim Solenoid
23 UP Trim Solenoid
24 Starter Solenoid
25 20 Ampere Fuse
26 Diagnostic Harness
27 To 12 Volt Battery
28 Trim Motor
29 Terminal Block
30 #5 CDM
31 #3 CDM
32 #1 CDM
33 Ground
34 EFI (Fuel) ECM
35 Ignition ECM
36 #6 CDM
37 #4 CDM
38 #2 CDM

BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LT = Light
DRK = Dark