mercruiser
STERN DRIVES & INBOARDS

service bulletin

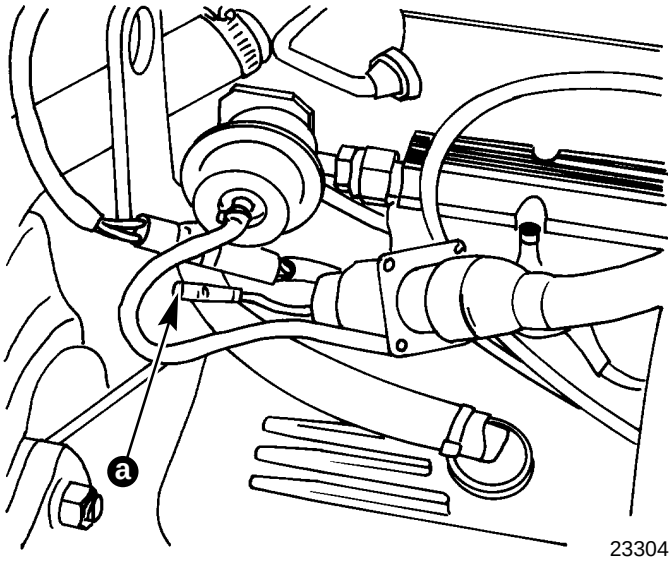
TO: SERVICE MANAGER ☐ TECHNICIANS ☐
PARTS MANAGER ☐

No. 87-20

MCM 320 EFI

Timing Procedure

It is essential to ground the red/yellow wire (Figure 1) located in the wire harness, for adjusting the timing. Failure to do so will obtain a retarded adjustment. The initial timing mark on the harmonic balancer is marked with a number 0 and should be adjusted to 12 degrees BTDC. This mark may not be highlighted. The full advance setting (Marked 34 degrees) can be checked after initial timing is adjusted.

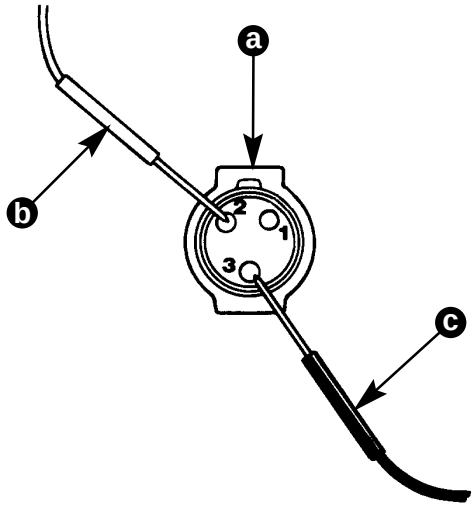


a - Red/Yellow Wire

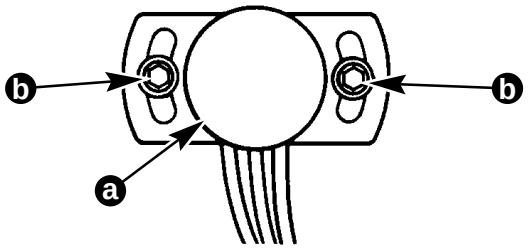
Figure 1.

Setting the Throttle Sensor

1. Connect the digital multi-meter (incorporated in tester P/N 91-16850) to connector (a) by putting red meter lead (b) in pin hole number 2 and black meter lead (c) in pin hole number 3.



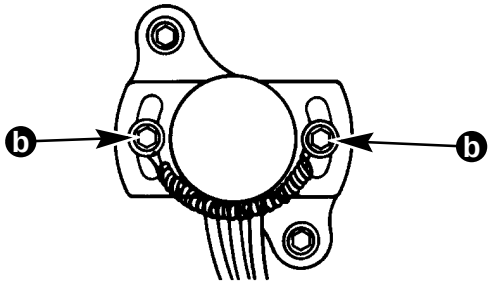
2. Put meter dial in 2K position. Rotate sensor (a) counterclockwise until a reading of 50 to 100 ohms is reached. Then tighten screws (b).



SAFETY WIRE INSTALLATION

IMPORTANT: Screws (b) securing throttle position sensor must be safety wired.

Safety wire the screws as shown below.



Importance of Return Lines

The fuel system for the 320 EFI incorporates an electric fuel pump with a water separating filter. The pump is pressure regulated to maintain a constant pressure of 39 PSI (268.90 kPa) between the fuel rails and intake manifold.

The system also incorporates a fuel return line. The return line must be installed and must not be any smaller than 1/4 in. (6.4mm) I.D. Failure to install or use the fuel return line could cause excessive pressure on the rails or injectors. The fuel pump and water separating filter must be mounted with in 12 in. (305mm) of the engine to comply with USCG regulations/specifications.

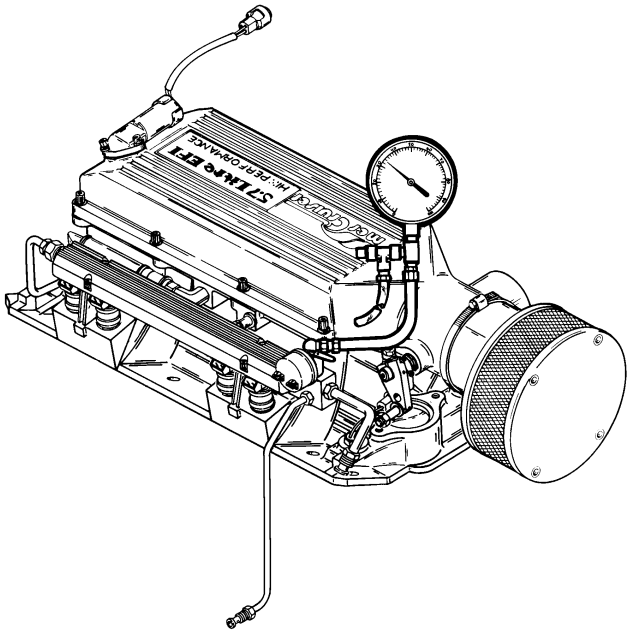
Electric Fuel Pump Pressure Tester (P/N 91-16850)

An Instruction Book accompanies the Tester.

MERCRUISER - ELECTRIC FUEL PUMP PRESSURE TEST

This test can tell if the electric fuel pump is capable of producing the correct fuel pressure of 30-40 PSI. (205 to 274 kPa) needed for normal engine operation.

1. Connect pressure gauge to pressure port.



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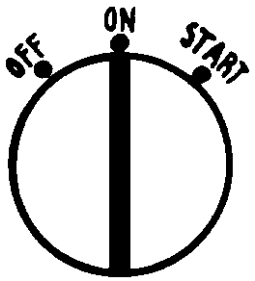
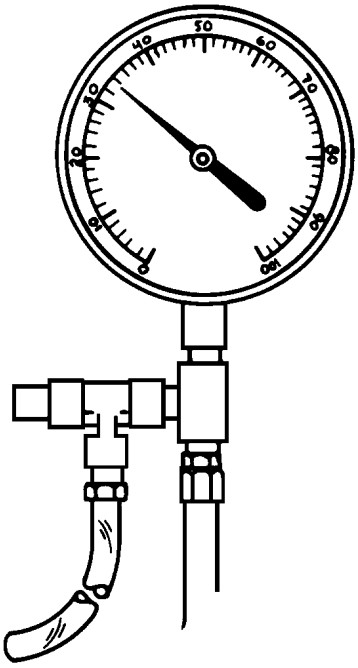
2. Put ignition key switch in “ON” position with oil pressure sensor bypassed.



3. Take fuel pressure reading.



4. Reading must be 30 to 40 PSI. (205 to 274 kPa). Refer to the Troubleshooting Chart following for further testing.

Troubleshooting Fuel System

COMPONENT CHECK	RESULT	REMEDY
1. **Testing Fuel Pump Circuit** (Turn Key to **run** position and oil pressure sensor bypassed.)	pump runs	Check fuel pressure STEP 4
	pump doesn't run	Check for 12 volts at the pump with key in **run** position and oil pressure sensor bypassed
		(No Voltage) Check harness, ECU box. (See test procedure following.)
		(Voltage) Check pump STEP 2.
2. **Pump Test** (Install jumper wire from 12V source to "+" terminal on pump)	pump runs	Check front mounted rectifier STEP 5
	pump doesn't run	Check oil pressure sensor STEP 3
3. **Oil Pressure Sensor** (Remove both leads from sensor and connect leads together.)	pump runs	Replace oil pressure sensor
	pump doesn't run	Replace pump
	pump doesn't run	Check wire harness, ECU box. (See test procedure following)
4. **Testing Fuel Pressure** (Install pressure tester P/N 91-16850 per instructions.)	high or low pressure	Replace fuel pressure regulator
5. **Checking Rectifier** (Unplug harness, check with ohm meter. One meter lead on terminal #3, other meter lead on terminal #1 or #2. Noting the value of the meter reading, reversing the connection should obtain the opposite value.)	shorted or open reading	Replace rectifier, refer to STEP 1 to retest pump
	checked ok	Check harness, ECU box. (See test procedure following)

Troubleshooting Chart

ENGINE TURN OVER WON'T START

COMPONENT CHECK	RESULT	REMEDY
1. **Spark Check**	No Spark	Check ignition, Section 4B of Service Manual 90-14499
	Spark	Check fuel system. Refer to trouble-shooting chart preceding
2. **Fuel Pressure** (Install gauge in pressure tap, turn ignition key to start position, minimum 32 lbs. fuel pressure)	Fuel Pressure	Check ECU box
	No Fuel Pressure	Check fuel supply, shut off valve, fuel filter, tank pick-up, tank vent
3. **Fuel Filter** (Change filter if plugged)	No Fuel Pressure	Check front mounted rectifier
4. **Checking Rectifier** (Unplug harness, check with ohm meter. One meter lead on terminal #3, other meter lead on terminal #1 or #2. Noting the value of the meter reading, reversing the connection should obtain the opposite value)	No Fuel Pressure	Check fuel pump
5. **Fuel Pump** (Install jumper wire from 12V source to "+" terminal on pump)	No Fuel Pressure	Replace pump
	Fuel Pressure	Check oil pressure sensor
6. **Oil Pressure Sensor** (Remove both leads from sensor and connect leads together)	Fuel Pressure	Check elsewhere in wiring of engine or boat
	No Fuel Pressure	Oil sensor bad or no oil pressure. CAUTION: Check oil in crankcase, start engine to check oil pressure. If oil pressure is ok, replace oil sensor

ENGINE ACCELERATION IS SLUGGISH
NO FAST IDLE WHEN COLD

COMPONENT CHECK	RESULT	REMEDY
1. **Throttle Position Sensor** (Ohms check Rx1; throttle closed 50–100 ohms. Throttle wide open over 180 ohms)	Low or High Ohm Reading	Replace throttle position sensor
2. **Air Valve** (Hold finger on valve opening to check for air flow into valve)	Air Valve Ok	Check ECU box
	Air Valve Not Working	Check water temperature sensor
3. **Water Temperature Sensor** (Remove leads and connect together)	Air Valve Ok	Replace sensor
	Air Valve Not Working	Replace air valve

ENGINE MISFIRES, RUNS ROUGH

COMPONENT CHECK	RESULT	REMEDY
1. **Spark Check**	No Spark	Refer to Section 4B of Service Manual 90-14499
	Spark	Check battery
2. **Battery Check** (Use volt meter, check for 12 volts)	Not 12V	Change battery
	12V	Check fuel system
3. **Fuel Pressure** (Install pressure gauge per instructions, pressure MUST range from 30 lbs. at idle to 40 lbs. at wide open throttle)	No or Low Pressure	Check fuel filter. Check fuel pump STEP 6.
	High Fuel Pressure	Change fuel regulator
	Low Fuel Pressure	Check fuel injectors. Change fuel regulator
4. **Injectors** (With engine warm and idling, remove electrical leads one at a time from injectors) NOTE: If there are four injectors misfiring at once such as 1, 4, 6, 7 or 2, 3, 5, 8 test ECU box	RPM Drop	Injectors Ok
	No RPM Drop	Replace injectors or spark plugs as needed
	Injectors Ok	Check ECU Check fuel filter
5. **Fuel Filter** (Replace if clogged)	No or Low Fuel Pressure	Check fuel pump
6. **Fuel Pump** (Must have 12V to pump and good ground connections)	No Fuel Pressure	Replace pump
	Low Fuel Pressure	Replace fuel regulator, if pressure is still low replace pump

Troubleshooting – the EFI Electrical System

IMPORTANT: When checking the electronic components of the EFI system, only the EFI Tester (P/N 91-11001A2) can be used. This tester tests the EFI components as a system.

By following the test procedure, a defective component can be found. Retest the complete system after the defective component is replaced.

Following is the set-up and testing procedure for the EFI Tester.

Testing EFI Electrical System

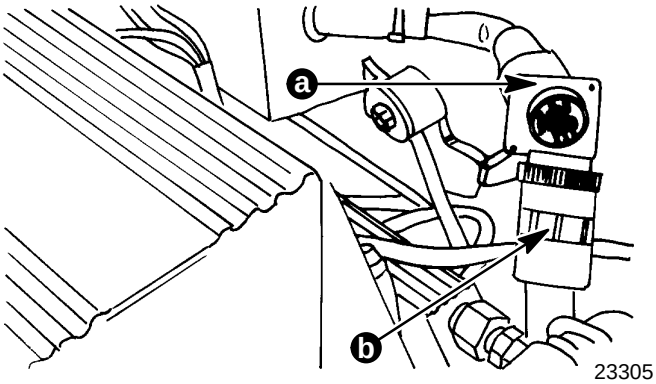
EFI TESTER SET-UP PROCEDURE – FOR CHECKING EFI SYSTEM ON ENGINE

⚠ CAUTION

Do not start or run engine with EFI system tester connected.

IMPORTANT: Check engine battery voltage before using tester. If below 10 volts, recharge or replace battery.

1. Disconnect EFI harness (a) from ECU (b).



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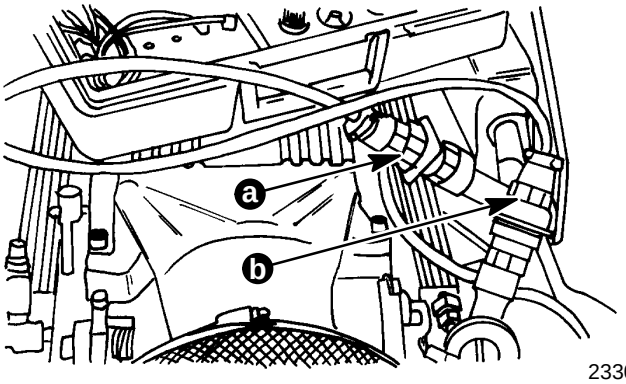
2. Connect tester harness (a) to ECU and tester harness (b) to EFI harness.



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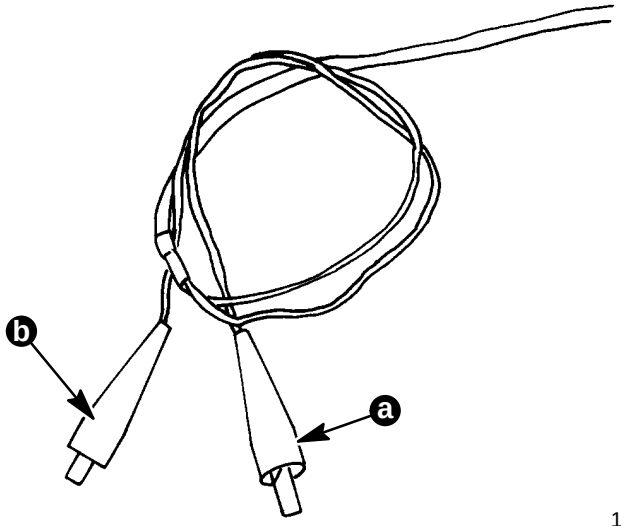
3. Connect (red color) tester battery clip lead (a) to +12V terminal.

   Connect (black color) tester battery clip lead (b) to engine ground.



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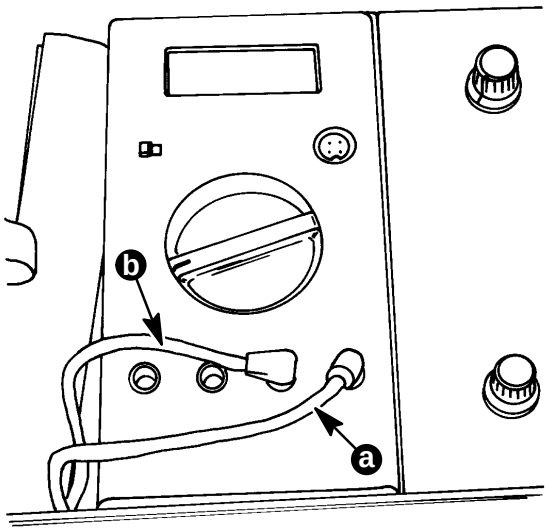
4. Connect red (a) and black (b) color test leads into meter.



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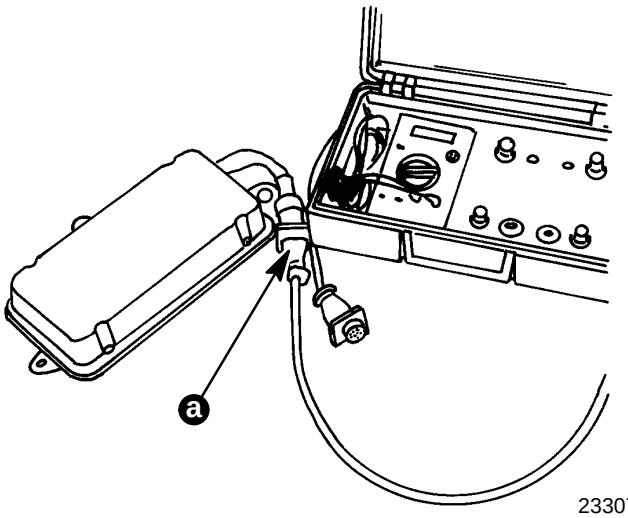
5. a. Turn meter selector (a) to 20VDC position.
   b. Turn power switch to “ON”.
   c. Meter reading should be more than 0.00V.
   d. If meter doesn’t read over 0.00V, then check tester battery clip leads for good connections or correct polarity.
6. The EFI tester is now set-up for checking the EFI system.

EFI – TESTER SET-UP PROCEDURE – FOR TESTING ECU IF REMOVE FROM ENGINE

IMPORTANT: Check battery voltage of the 12 volt battery used in Step 2 before using tester. If below 10 volts, recharge or replace battery.

1. Connect tester harness (a) to ECU.



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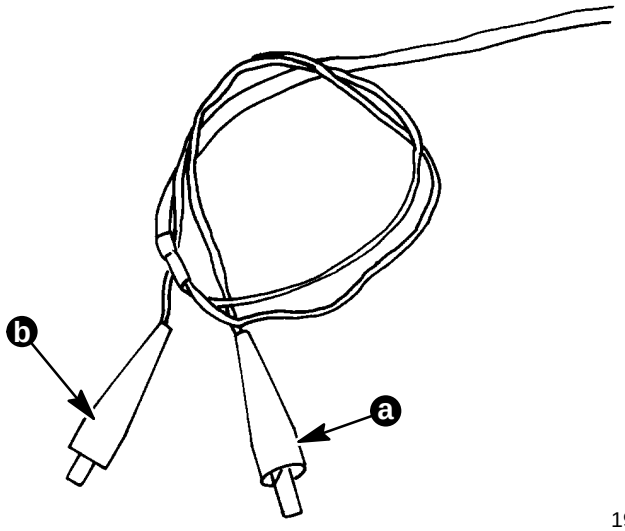
2. Connect (red color) tester battery clip (a) to positive (+) terminal on a 12 volt battery.

   Connect (black color) tester battery clip (b) to negative (-) terminal on the battery.



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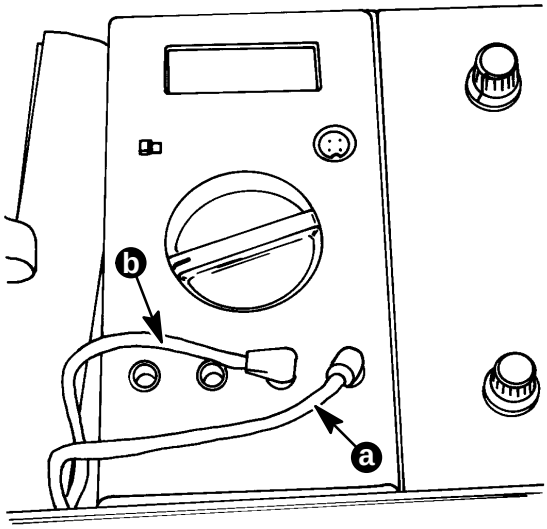
3. Connect red (a) and black (b) color test leads into meter.



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4. a. turn meter selector to 20VDC position.
   b. Turn switch to “ON”.
   c. Meter reading should be more than 0.00V.
   d. If meter doesn’t read over 0.00V, then check tester battery clip leads for good connections for correct polarity.
5. The EFI tester is now set-up for checking the EFI system.

EFI HARNESS AND EFI WIRE CONTINUITY TEST

FOR 320 EFI 4 CYCLE MODELS

Refer to Page 2 to set-up tester

FUEL INJECTOR TEST

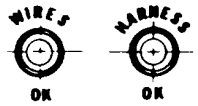
EFI HARNESS TEST

Testing EFI Harness if Engine is on Boat

1. "Wires OK" test lamp should light which indicates harness is good.
2. "Harness OK" test lamp not used in 320 EFI continuity test.

Testing EFI Harness if Engine is Removed from Boat

1. Connect engine battery leads to a 12 volt battery.



Corrective Action if Test Lamp does not Light

Refer to EFI wire continuity check below to independently check each wire in the harness to locate the defective wire(s).

EFI WIRE CONTINUITY TEST

Testing EFI Wires if Engine is on Boat

1. Turn ignition key to "ON" position
2. Turn continuity check switch to each of the following wire check position.

Testing EFI Wires if Engine is Removed from Boat

1. Connect engine battery leads to a 12 volt battery.
2. Turn continuity check switch to each of the following wire check position.

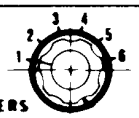
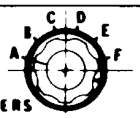
Locating Faulty Wire(s)

If test lamp lights, wire indicated in chart below is good

If test lamp does not light, the problem is in the indicated wire

H1	circuit between No. 1, 4, 6, 7 injectors and ECU
H3	circuit between No. 2, 3, 5, 8 injectors and ECU
H4	12V wire to ECU
H5	12V wire to ECU
H10	Ground to ECU Box wire(s)

FUEL INJECTOR TEST

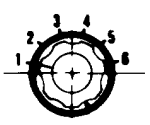
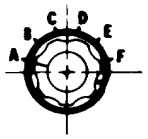
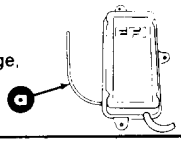
	Switch Position ECU PARAMETERS 	Switch Position SYSTEM PARAMETERS 	Testing Injectors
Test Steps	Set ECU PARAMETERS Switch to each of the following positions.	Set SYSTEM PARAMETERS switch to each of the following position.	Place your finger on the terminal part of the injectors being tested. If injector is good, you will feel the injector pulsating.
1	6	D	Operates No. 1, 4, 6, 7 injectors.
2	6	F	Operates No. 2, 3, 5, 8 injectors.

ECU TEST
THROTTLE SENSOR TEST
AIR TEMPERATURE SENSOR TEST
COLD START ENRICHMENT TEST
IGNITION KIT TEST
PRESSURE TRANSDUCER TEST

320 EFI 4 CYCLE ECU PART NO. 11350A3

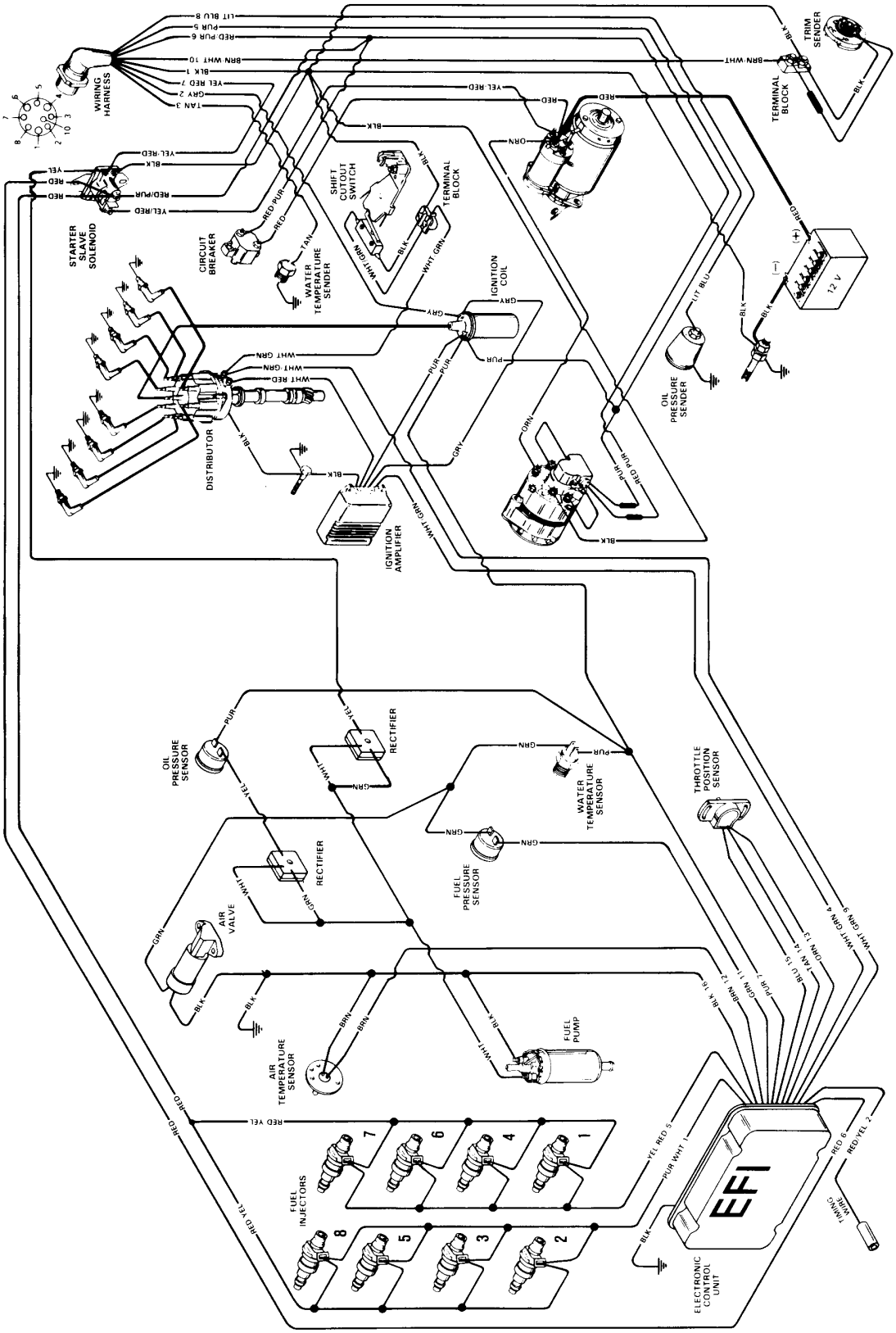
Refer to Page 2 to set-up tester

IMPORTANT: The original EFI tester is in an aluminum carrying case and must not be used to test a 320 EFI. May result in damage to ECU.

		Switch Position  ECU PARAMETERS	Switch Position  SYSTEM PARAMETERS	**Normalizing** the EFI System  ECU NORMALIZE	1. Set ECU Parameters switch to position 2. 2. Set System Parameters switch to Position A. 3. Rotate ECU Normalize knob to obtain reading of 1.10 on tester meter. Do not move ECU Normalize knob once 1.10 reading is obtained. The system is now normalized. 4. If you can not obtain 1.10 meter reading the ECU is faulty.
	Test Steps	Set ECU PARAMETERS Switch to each of the following positions.	Set SYSTEM PARAMETERS switch to each of the following positions.	Specified Reading	CORRECTIVE ACTION if you cannot match specified reading.
EFI COMPONENTS TEST	ECU TEST	**NORMALIZE** THE EFI SYSTEM. REFER TO INSTRUCTIONS IN UPPER RIGHT HAND CORNER OF THIS CHART.			
		1	3	A	.73 ± .02	Faulty ECU
		2	4	A	.73 ± .02	Faulty ECU
		3	5	A	.47 ± .02	Faulty ECU
		4	6	A	.28 ± .02	Faulty ECU
	THROTTLE SENSOR TEST	**NORMALIZE** THE EFI SYSTEM. REFER TO INSTRUCTIONS IN UPPER RIGHT HAND CORNER OF THIS CHART.			
		1	4	B	**Closed Throttle Low .74** Wide Open Throttle High 1.40	Throttle sensor faulty or out of adjustment or harness faulty if meter reading does not change with sudden throttle motion. Note (1)
	AIR TEMPERATURE SENSOR TEST	**NORMALIZE** THE EFI SYSTEM. REFER TO INSTRUCTIONS IN UPPER RIGHT HAND CORNER OF THIS CHART.			
		1	2	C	Low 1.02 High 1.17	If meter reading is above 1.17, there is a faulty air temperature sensor or open sensor lead. If meter reading is below 1.02, there is a faulty air temperature sensor or shorted sensor lead.
	COLD START ENRICHMENT TEST	**NORMALIZE** THE EFI SYSTEM. REFER TO INSTRUCTIONS IN UPPER RIGHT HAND CORNER OF THIS CHART.			
		1	6	A	Press cold start enrichment button. Meter reading should be .28 - 1.50. If meter reeading is not .28 - 1.50 the ECU or harness is faulty.  COLD START ENRICHMENT	
	IGNITION KILL TEST	**NORMALIZE** THE EFI SYSTEM. REFER TO INSTRUCTIONS IN UPPER RIGHT HAND CORNER OF THIS CHART.			
		1	2	A	Press Ignition Kill button. Meter reading should decrease 2 to 3 times, then fall to 0.01 Example: 1.10 0.40 0.01  IGNITION KILL	
	PRESSURE TRANSDUCER TEST	**NORMALIZE** THE EFI SYSTEM. REFER TO INSTRUCTIONS IN UPPER RIGHT HAND CORNER OF THIS CHART.			
		1	2	A	Disconnect ECU transducer tube (a) from fitting on engine. Draw air from tube. Meter reading should decrease as air is drawn from tube. If no number change, the ECU is Faulty 	

***NOTE: (1)** The wide open throttle reading will only appear momentarily with a quick throttle movement.*

Engine Electrical System Wiring Diagram



How EFI System Operates

Fuel Delivery System – An electric fuel pump (Figure 2) delivers fuel to the Fuel Injectors, via the fuel rails. (Figure 1)

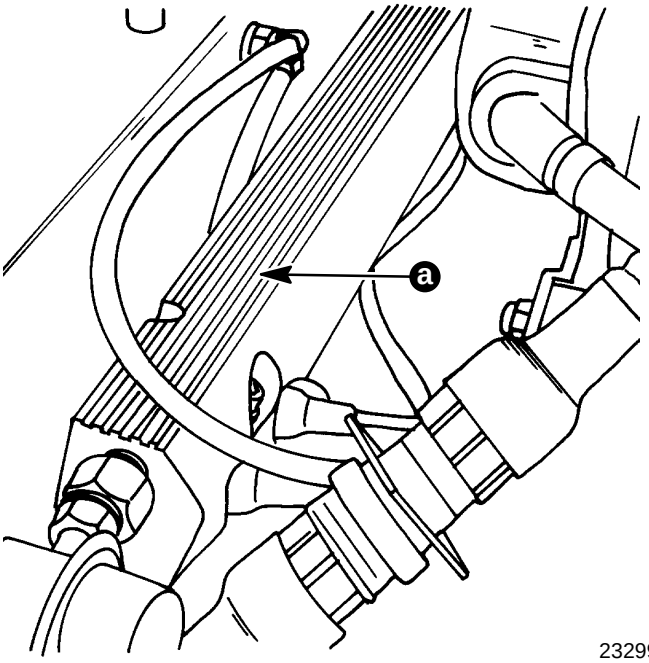


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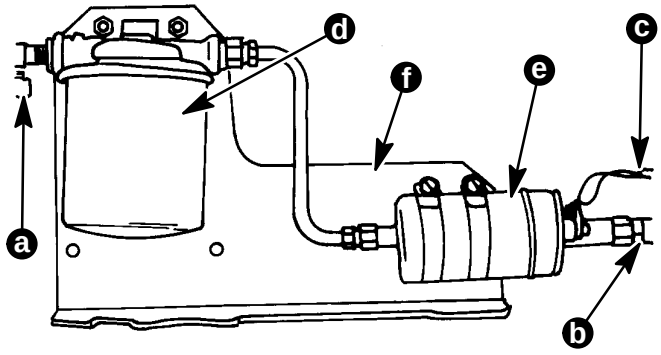
Figure 1. A Fuel Rails

A Water Separating Fuel Filter (Figure 2) is located on the outlet side of the pump, to remove impurities before they reach the fuel injection system.



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a - To Fuel Rails
b - From Fuel Tank
c - 12 volt Supply
d - Water Separating Fuel Filter
e - Electric Fuel Pump
f - Mounting Bracket

Figure 2.

The pressure of the fuel delivered to the Fuel Injectors is controlled by a Fuel Pressure Regulator which senses intake manifold pressure (vacuum) and maintains the fuel pressure at 39 PSI (268.90 kPa) above the manifold pressure, under all operating conditions. In this manner, the fuel pressure drop, across the Fuel Injectors is maintained constant, at all times. The pump delivers more fuel than the maximum requirement of the engine, so that the pressure in the fuel delivery system can be maintained, under all operating conditions. Excess fuel diverted by the Pressure Regulator is returned to the fuel tank (under no pressure) via the Return Line.

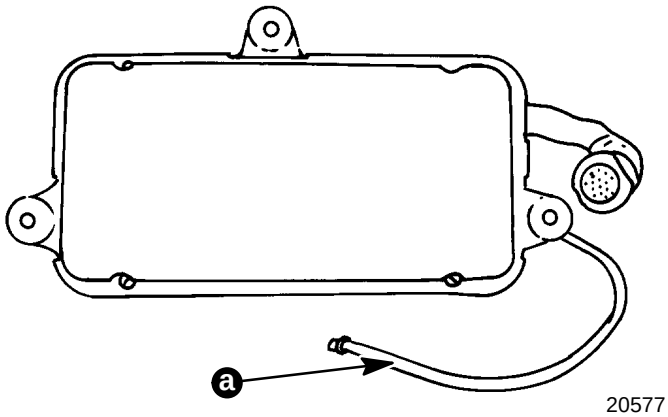
Electronic Control Unit (ECU) – The solenoid operated Fuel Injectors are controled by an Electronic Control Unit (ECU) (Figure 3) which generates electrical pulses. The electrical pulses produce a magnetic field in the Injectors solenoid winding. This draws the armature back and lifts the nozzle valve from its seat, allowing fuel to flow from the nozzle.

The Fuel Injectors are divided into two separate groups, with four injectors in each group connected electronically together and opening simultaneously. To provide uniform distribution of the fuel mixture, each group of Fuel Injectors open twice per engine cycle (once per engine revolution), delivering one-half of the required fuel per opening of the injectors. The group of Fuel Injectors are opened 180 degrees apart from one another, to balance out the demands on the fuel delivery system. Injection frequency is determined by the ECU, by monitoring the electrical pulses on the primary side of the ignition system.

The amount of fuel injected into the engine is controlled by the duration of the electrical pulses generated by the ECU. These requirements are calculated by the ECU, based upon information received from the following components: Pressure Sensor, Intake Air Temperature Sensor and Throttle Position Sensor.

Pressure Sensor – The Pressure Sensor, a component of the ECU is connected to the intake manifold via a hose coming out of the back of the ECU (Figure 3) and monitors intake manifold pressure (vacuum) to determine the load on the engine. Under light to moderate loads (Throttle Plate completely or partially closed), the air pressure in the intake manifold is low (compared to atmospheric pressure). The Pressure Sensor, under this condition, signals the ECU to deliver less fuel. As the load increases, the air pressure in the intake manifold increases, and the Pressure Sensor signals the ECU to deliver more fuel. Monitoring the manifold pressure in this manner, allows the injection system to react quickly to changes in load, so that the proper air/fuel mixture can be maintained. This is one of the key elements to the system's ability to provide excellent throttle response and smoothness. In addition to sensing the engine load, the Pressure Sensor also compensates for changes in barometric pressure and elevation. When the barometric

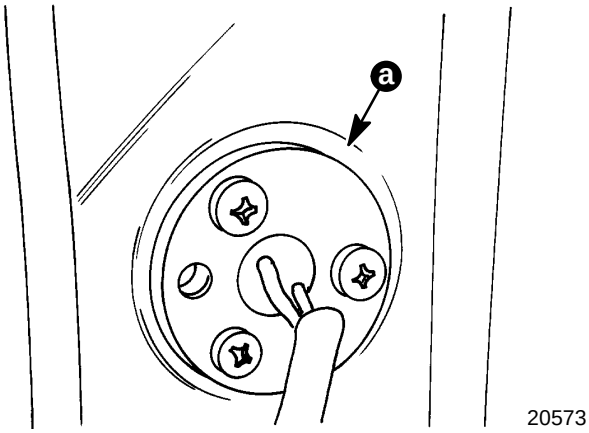
pressure is low, or when operating at high elevation, the Pressure Sensor senses the lower atmospheric pressure and advises the ECU to inject less fuel. The Pressure Sensor commands the ECU to deliver more fuel when the barometric pressure is high.



a - Pressure Sensor

Figure 3.

Intake Air Temperature Sensor – The quantity of fuel injected into the engine, once the engine is warm, is controlled primarily by the ECU Pressure Sensor. Air temperature affects air density which affects requirements. This is performed by the Intake Air Temperature sensor (Figure 4), located in the Air Intake System.

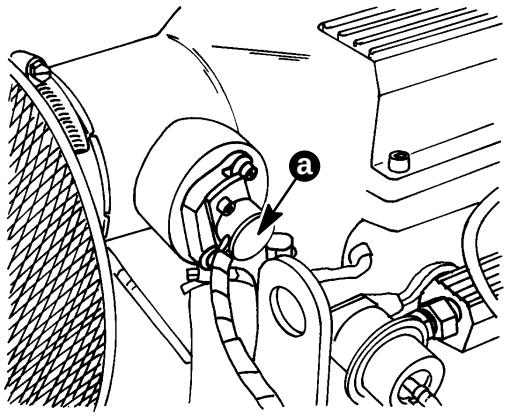


a - Intake Air Temperature Sensor

Figure 4.

As the air temperature decreases (air density increases), the sensor operating through the ECU, causes the amount of fuel injected to be increased, to maintain the proper air fuel mixture. The sensor causes the opposite to happen, when the intake air temperature increases.

Throttle Position Sensor – When the Throttle Plate opens quickly (mild to hard acceleration), a slight delay occurs before the Pressure Sensor reports this condition to the ECU. This slight delay results from the fact that the rise in pressure in the Pressure Sensor takes slightly longer than the change in the position of the Throttle Plate. In order to bridge this slight delay in response and prevent the engine from bogging, a Throttle Position Sensor (Figure 5) is incorporated into the system, which acts through the ECU to momentarily enrichen the air/fuel mixture. The throttle position sensor consists of a potentiometer (variable resistor), which is attached directly to the throttle shaft. When the throttle valve is opened, the ECU senses the speed at which the throttle is being opened, by calculating the change in resistance of the throttle position sensor. If mild to hard accleration is sensed, the ECU momentarily lengthens the electrical pulses to injection valves to inject more fuel. The amount of fuel added is a function of the throttle movement. **Above 3000 RPM, the acceleration circuit is disabled.**



a - Throttle Position Sensor

Figure 5.

COLD START/WARM UP DEVICES

NOTE: *These items are not separate components. They are incorporated, or components combined with, the ECU circuitry.*

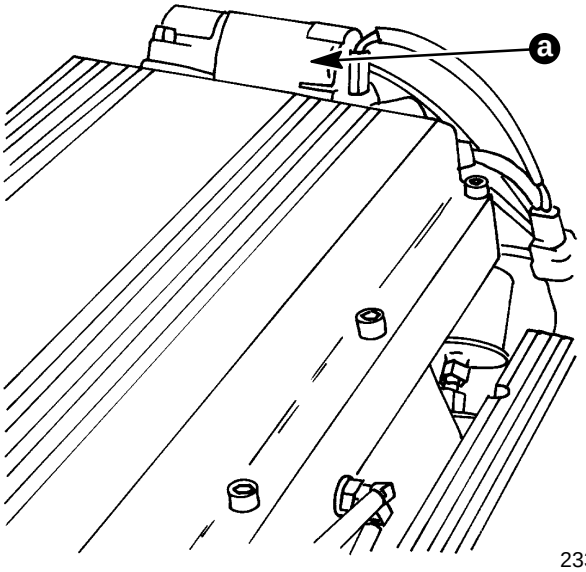
In a cold engine, fuel condenses on the intake manifold and cylinder heads. As a result, less fuel mixes with the intake air, than in a warm engine. Additional fuel must be added, under these circumstances, to obtain an ignitable air fuel mixture. To overcome the increased friction of a cold engine and maintain a steady idle speed, additional air also must be added, to increase the power output of the engine at idle. To handle the cold engine requirements, special circuitry is incorporated in the ECU, that works in conjunction with a cooling system Water Temperature Switch, Fuel Pressure Switch and an Auxiliary Air Valve.

When the engine is below 120° F (66° C) the cooling system Water Temperature Switch signals the ECU that additional fuel and air are required.

All cylinders are simultaneously primed with fuel once, during initial start up. This is accomplished by holding the the injection valves open for up to one-half second. The duration of the prime is a function of engine temperature, which is monitored by a thermistor in the ECU. The prime is initiated, only after the fuel pressure in the fuel rails reaches 25 PSI, (172 kPa) as established by the Fuel Pressure Switch. The 25 PSI (172 kPa) is necessary to prevent an insufficient prime, should there be air in the fuel rails. The prime mode can be repeated, if needed, by turning the ignition switch off and then repeating the starting cycle.

After the initial prime, fuel enrichment is determined by the thermistor in the ECU, which controls the length of time that the Fuel Injectors are held open during each engine revolution.

The thermistor gradually reduces the amount of enrichment as the engine warms up. Once the engine reaches 120° F (66° C) the cooling system Water Temperature Switch commands the ECU to cease fuel enrichment. When the engine is below 120° F (66° C), the Water Temperature Sensor actuates the Auxiliary Air Valve (Figure 6), to provide additional air to the engine. This air mixes with the enriched fuel supply, causing the engine to produce more power for easier starting and smooth warm up operation. This system works in conjunction with the Idle Stabilizer Circuit, incorporated in the ECU box, to produce a stable fast idle speed of approximately 1000 RPM during the warm up period. The engine automatically returns to normal idle speed (600 RPM), when the cooling system Water Temperature Switch senses the engine has reached 120° F (66° C).



23300

a - Auxiliary Air Valve

Figure 6.

Idle Stabilizer – On engines with fuel injection, the fluctuations in intake manifold pressure can cause engine to hunt at idle, as the pressure sensor is continually attempting to compensate for the pressure changes. To prevent this condition, and to allow low, stable idle speeds, an Idle Stabilizer was incorporated in the ECU box.

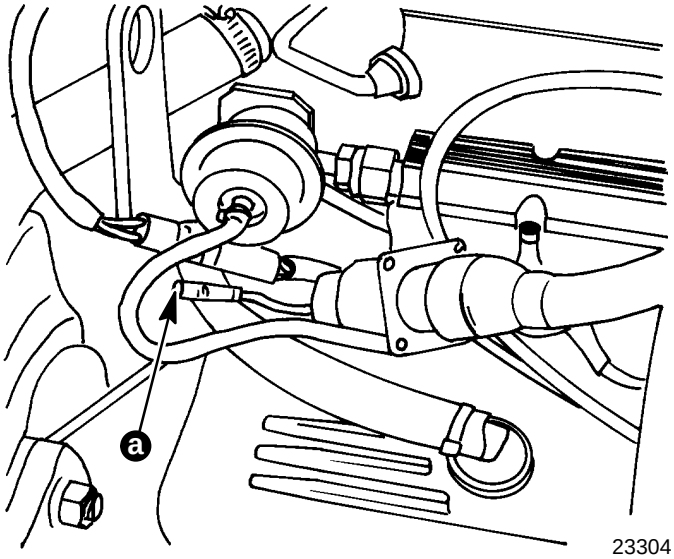
The Idle Stabilizer consists of a special circuit that works in conjunction with the Thunderbolt IV (H.E.I.) System. The circuit controls the electronic advance in the ignition amplifier, at the low RPM range, retarding and advancing the timing as necessary. Since retarding the timing decreases the engine power, and advancing the timing increases the power, the idle stabilizer acts like a governor to stabilize the idle speed and minimize the possibility of stalling. An in gear idle speed of 600 RPM and out of gear idle speed of 620 RPM is obtained with this approach. Above 800 RPM, the timing is progressively advanced until it reaches the initial timing curve at approximately 2200 RPM. The initial timing curve is maintained above 2200 RPM by the Thunderbolt IV (H.E.I.) System with the Idle Stabilizer circuit no longer working.

When the engine is below 120° F (66° C) or whenever the engine is being cranked, the ignition timing is advanced equal to or slightly retarded from the initial timing curve, to allow easy starting and obtain a smooth idle. A thermistor in the ECU gradually retards the timing in accordance with the temperature of the air surrounding the engine, to maintain a fast idle speed of approximately 1000 RPM.

Once the engine reaches 120° (66° C), as established by the cooling system Water Temperature Switch, the Idle Stabilizer resumes its normal operation and the idle speed returns to 600 – 620 RPM.

The Idle Stabilizer also works in conjunction with the Throttle Position Sensor. Under a mild to hard acceleration from idle, the ignition timing is instantly advanced to the initial timing curve. This helps prevent a backfire and improves the throttle response.

Due to the Idle Stabilizer, a special procedure must be used to set the ignition timing. The timing must be set with the engine warmed up and idling, and with the RED-YELLOW WIRE (Figure 7), located on the front of the engine, grounded. This disables one bank of Fuel Injectors and advances the timing to the initial timing curve. The idle speed under this condition will be approximately 600 RPM.

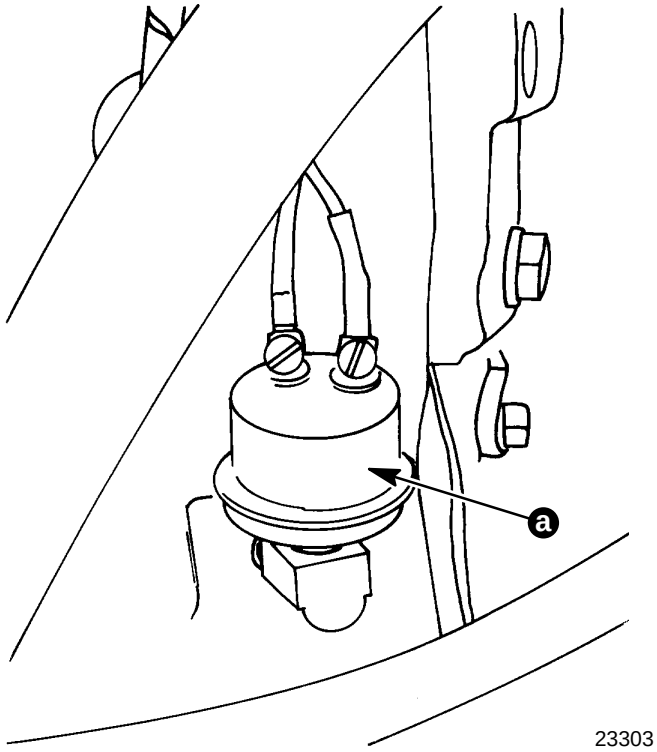


a - Red/Yellow Wire

Figure 7.

Overspeed Protection – In the event that the load on the engine should be lost (propeller leaving the water), the ECU incorporates special circuitry to limit the engine speed to 5600 RPM to help prevent internal engine damage. The special circuitry acts through the ignition system and causes the engine to miss, when it reaches the rev limit.

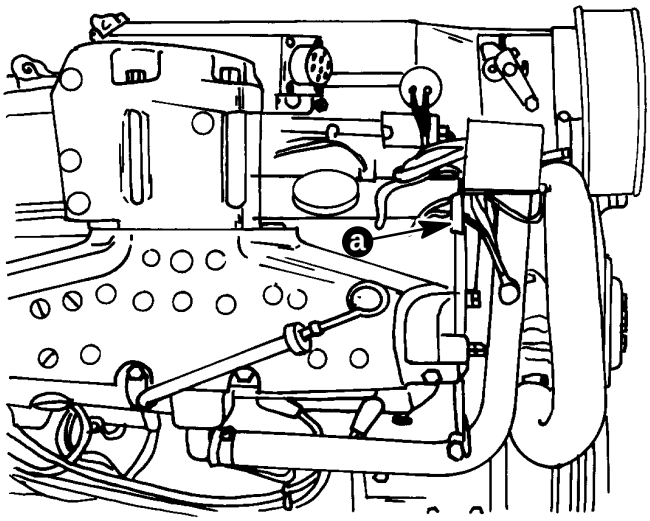
Fuel Pump Control/Loss of Oil – Pressure Protection – The fuel pump is controlled through the Ignition Switch and Oil Pressure Switch (Figure 8). The Ignition Switch activates the fuel pump only during cranking, to ensure instantaneous pump response. Once the engine starts and at least 4 PSI is generated in the lubrication system, the Oil Pressure Switch closes and energizes the pump. In the event of oil pressure failure or a stalled engine, the fuel pump will be automatically turned off by the Oil Pressure Switch.



a - Oil Pressure Switch

Figure 8.

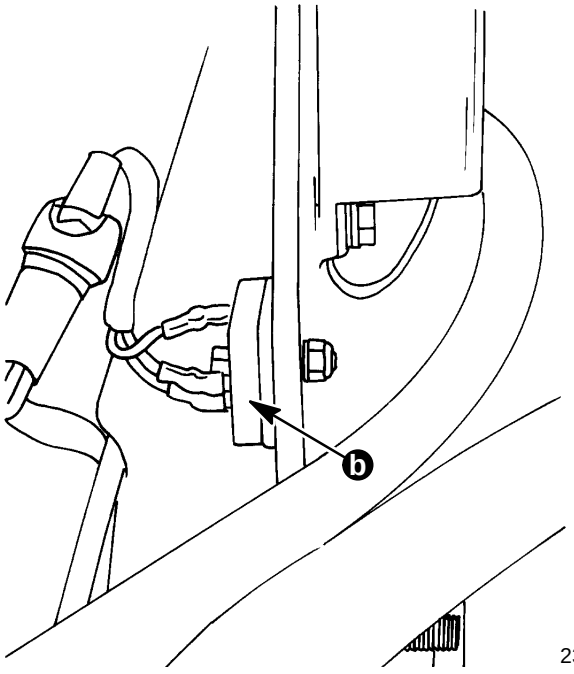
Blocking Rectifiers – As mentioned earlier, the auxiliary Air Valve and Fuel Pump are energized during the cranking mode. This is accomplished by an interconnection into the starter motor excitation circuit using Blocking Rectifiers (Figure 9). If a direct connection was made into this circuit, the possibility exists that the engine could momentarily start if a remote start switch was used to run the starter. It would also be possible to actuate the starter if the fuel pump was hot wired during servicing. Incorporating the Blocking Rectifiers prevents this from occurring.



20967

a - Front Rectifier

Figure 9.



23302

b - Rear Rectifier

Figure 9.

Limp-Home Feature – The MerCruiser EFI system been designed to allow the engine to run (with some degradation in performance), if one or more of following should fail:

1. Throttle Position Sensor
2. Intake Air Temperature Sensor
3. Cooling System Water Temperature Switch
4. Pressure Sensor
5. Injector Valve Bank
6. Fuel Pressure Switch
7. Oil Pressure Switch
8. Some ECU Circuitry