

VANGUARD®



REPAIR MANUAL

Vanguard® EFI
Diagnostic and Repair

380000



BRIGGS & STRATTON, LLC

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Foreword

This manual was written to assist engine technicians and service personnel with the troubleshooting and repair procedures for Briggs & Stratton® and Vanguard® engines equipped with Electronic Fuel Injection (EFI). It assumes that persons using this manual have been properly trained and are familiar with the service procedures for these products, including the proper use of required tools and the application of appropriate safety practices. Persons untrained or unfamiliar with these procedures or products should not attempt to perform such work.

Proper repair is important to safe, reliable operation of all engines and engine-driven systems. The troubleshooting and repair procedures described in this manual are appropriate for the Briggs & Stratton and Vanguard engines described herein. Alternative methods or procedures may pose risks to both personal safety and engine reliability and are not endorsed or recommended by Briggs & Stratton.

All information, illustrations, and specifications contained in this manual were based on the data available at the time of publication. Briggs & Stratton reserves the right to change, alter, or otherwise improve the product or the product manuals at any time without prior notice.

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This engine troubleshooting and repair manual includes the following EFI equipped engine models:

- MODEL 380000

NOTE: Some models have limited service parts. Review the *Illustrated Parts List* for part availability before conducting any service work.

NOTE: The images in this document are representative and may differ according to model.

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DIAGNOSTIC INTRODUCTION

1 On-Board Diagnostic (OBD) System Check

The basic steps of any diagnosis are as follows:

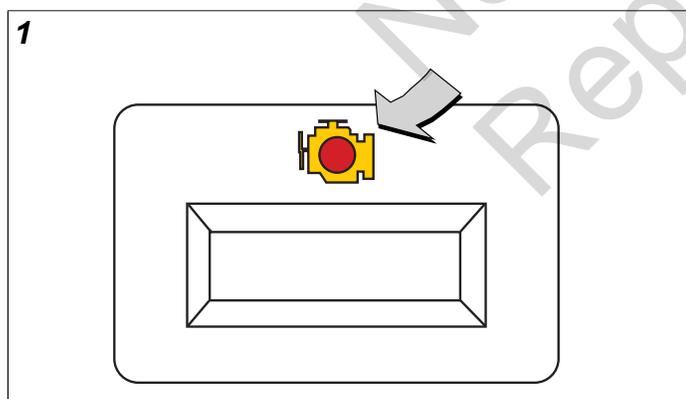
1. See Figure 1. Observe the Malfunction Indicator Lamp (MIL) with the engine running. If MIL is flashing, then current Diagnostic Trouble Codes (DTCs) are present.

NOTE: If engine will not start, install Briggs & Stratton Service Power Supply Harness (Part No. 847252) to observe MIL. See *Install Service Power Supply Harness* for more information.

2. Read DTC(s) using MIL, Tiny Scan Code Reader, or Diagnostic Tool software.
3. To diagnose system problem(s), proceed to the applicable Diagnostic Table(s) in *SECTION 2 - TROUBLESHOOTING DTCs*.
4. Once the problem is located and corrected through repair or replacement of faulty components, clear DTC(s) using the Tiny Scan Code Reader or the Diagnostic Tool software.

NOTE: For information on the location or replacement of specific components, see *SECTION 5 - REMOVAL/INSTALLATION*.

5. Start and run engine to validate repairs. Observe MIL to verify that no DTCs are set.
6. If no DTCs are set, but engine performance issues exist, see *SECTION 4 - SYMPTOMS*.



Diagnostic Trouble Codes (DTCs)

The ECM receives voltage signals from multiple sensors. Each sensor functions within an established set of parameters, which can be viewed as its operating “window.”

When a malfunction or fault condition occurs, a change in the signal voltage alerts the ECM that the sensor is

functioning outside its operating “window,” a DTC is set and stored in ECM memory, and the MIL is illuminated.

A default value temporarily replaces the erroneous sensor value to restore engine performance until the problem is corrected.

Malfunction Indicator Lamp (MIL)

As a bulb and diagnostic system check, the MIL illuminates when the engine is cranked. If it does not illuminate during cranking, then a problem exists in the MIL circuit.

When the engine is started, the MIL is extinguished if no current fault condition exists. If the MIL flashes, it is an indication that a current DTC is stored.

If the fault should correct itself, as in an intermittent condition, the MIL is extinguished after a ten second delay. The DTC remains stored in ECM memory as a historic code until cleared by the technician. The MIL does not indicate the existence of only historic codes.

Data Link Connector (DLC)

The DLC provides for direct communication with the ECM. By plugging the Tiny Scan Code Reader, or laptop with Diagnostic Tool and Communication Harness, into the 6-pin connector in the EFI wire harness, the DTCs stored in ECM memory can be read and cleared.

Non-Scan Diagnostics

In the Non-Scan diagnostic mode, either the MIL or the Tiny Scan Code Reader is used to read DTCs. The technician then refers to the applicable Diagnostic Table to troubleshoot the problem. Those tables labeled *Non-Scan Diagnostics* must be used, as the data stream provided by the ECM is not available for analysis.

Scan Diagnostics

In the more sophisticated diagnostic mode, the Diagnostic Tool software can facilitate the diagnosis of system problems through an expanded interface with the ECM. Through the use of data displays and menu selections, the technician has access to “live” data for analysis.

It is important to note that the software is not a stand-alone diagnostic tool for resolving DTCs, but must be used in conjunction with the Diagnostic Tables for the most efficient and effective diagnosis. Those tables that are applicable to users with access to the Diagnostic Tool software are labeled as *Scan Diagnostics*.

Install Service Power Supply Harness

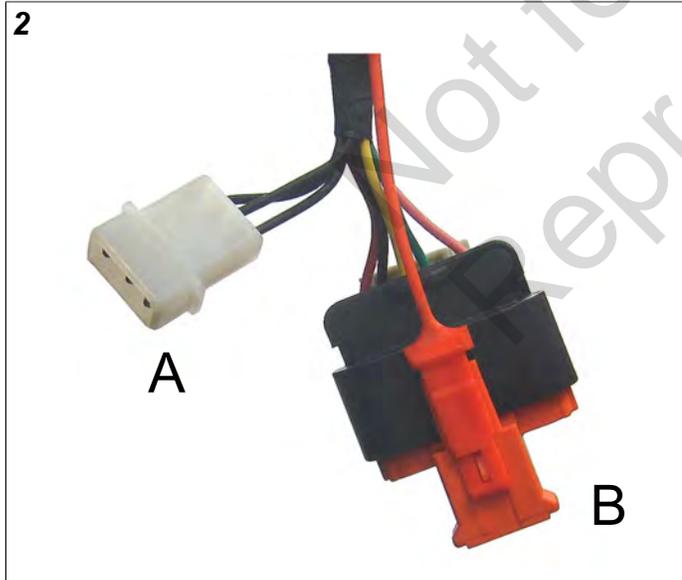
1. Obtain the Service Power Supply Harness from the Briggs & Stratton Diagnostic Harness Kit (Part No. 847252) and service battery.
2. Verify that service battery voltage is above 12v.



CAUTION

Observe the following precautions to avoid ECM damage.

- Do not connect the harness directly to a charging system or to a battery that is connected to a charging system.
 - Do not connect the harness to a battery that is connected to the engine charging system.
 - Although it may be used regardless of whether the engine is running or not, do not connect or disconnect the harness from either the engine or battery while the engine is running.
3. Install red wire alligator clip on Service Power Supply Harness to battery positive (+) terminal.
 4. Install black wire alligator clip on Service Power Supply Harness to battery negative (-) terminal.
 5. Connect Service Power Supply Harness to service power supply connector on EFI wire harness. See A of Figure 2.

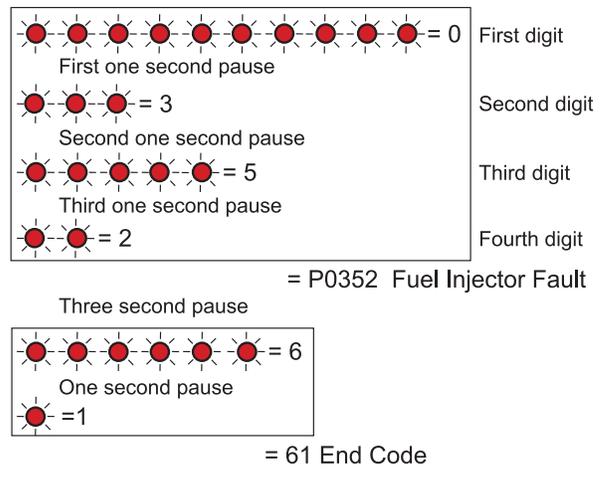


Use MIL to Read DTCs

1. See *Install Service Power Supply Harness*.
2. When a DTC exists, the MIL begins to flash. See Figure 3.

NOTE: While each DTC actually begins with the letter "P," only the numeric characters are flashed.

3



3. Count the number of flashes to obtain the first of four digits. If the first digit is zero, it is represented as a series of ten flashes.
4. Count the number of flashes after the first one second pause to obtain the second digit of the DTC.
5. Count the number of flashes after the second one second pause to obtain the third digit, and then count the number of flashes after the third one second pause to obtain the fourth digit.
6. Write down each digit as it is displayed.
7. If there is more than one DTC, the next DTC begins to flash after a three second pause.
8. After all DTCs are reported, the number "61" is flashed to indicate this condition to the technician. The flashing sequence is then restarted and the technician may choose to verify the DTCs written down or exit the routine.

NOTE: If "61" is the first code flashed, then no active DTCs are set.

Use Tiny Scan Code Reader to Read/Clear DTCs

NOTE: Always follow steps 1-9 for an accurate report of current DTCs. Failure to do so may generate a report that includes historic codes.

1. See *Install Service Power Supply Harness*.
2. Wait for 30 seconds to elapse.
3. Connect Briggs & Stratton Tiny Scan Code Reader (Part No. 19626) to DLC. See B of Figure 2.
4. Turn Ignition ON, Engine OFF.

NOTE: If the Tiny Scan Code Reader cannot connect to the ECM, "no-C" is displayed, which stands for "no communication." If communication is established, the tool displays the number of DTCs read. For example,

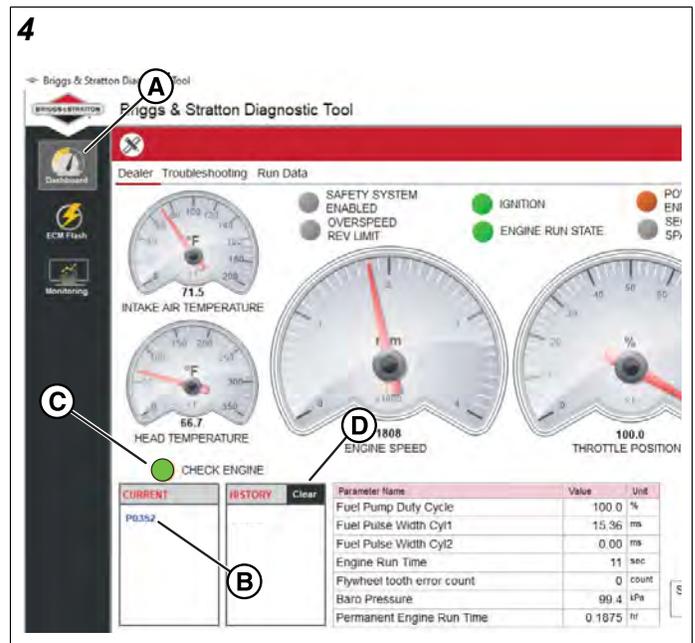
“dc-0” means that no DTCs were found, while “dc-4” means that four DTCs are recorded.

5. Press the select button to cycle through the list of DTCs.
6. Once the last DTC is displayed, “CLr?” appears. Press and hold the select button until “Hold” changes to “Done,” which indicates that all DTCs have been “cleared” from ECM memory.
7. Disconnect service power supply connector for a minimum of 20 seconds. See A of Figure 1-2.
8. Connect service power supply connector.
9. The tool displays the number of DTCs read.
10. Press the select button to cycle through the list of DTCs. Write down each DTC as it is displayed.

Use Diagnostic Tool to Read/Clear DTCs

1. Obtain Briggs & Stratton Diagnostic Tool (Part No. 19636) and the Communication Harness from the Diagnostic Harness Kit (Part No. 847252).
2. Connect one end of the USB cable to the Diagnostic Tool and the other end to the USB port on the laptop.
3. Connect one end of the Communication Harness to the Diagnostic Tool and the other end to the DLC on the EFI harness.
4. Turn Ignition ON, Engine OFF. The Diagnostic Tool can take up to 30 seconds to connect to the engine.
5. See Figure 4. Select the **Dashboard** icon (A) in the left sidebar to view the **Dealer** tab.
6. Observe the Current codes display (B).

NOTE: The **CHECK ENGINE** light (C) is orange if a current fault code is present. To display a description of the fault code, hover the cursor over the code.



NOTE: A Current codes display can also be viewed under the **Troubleshooting** tab.

7. Click **Clear** (D) to erase both current and historic DTCs.

NOTE: See the Briggs & Stratton EFI Diagnostic Tool Software User Manual for more information.

8. Turn Ignition OFF.

Back Probe Connector Terminals

NOTE: Do not insert probes into terminals on the mating side of any connector. The diameter of the test probes can damage terminals.

1. Obtain Briggs & Stratton Back Probe Wire Set (Part No. 19625).
2. Carefully slide metal pin on probe between the rubber seal and wire insulation on the back side (wire end) of the connector.
3. Gently push the pin in until it stops. Stop pushing when the pin “bottoms out,” or when the plastic sheath is very close to the connector housing.

DO NOT force the pin into the connector as terminal and/or probe pin damage can occur. Probe travel may be stopped by contact with insulation or core crimps. Try again after removing and re-positioning probe pin.

IMPORTANT:

- Use care to avoid deforming connector terminals, either by forcing the probe too far into the cavity or by using a probe that is too large. If terminal damage is suspected, test for proper terminal contact.

- A deformed terminal can cause a poor connection resulting in intermittent problems or even complete component failure. Do not use paper clips or other substitute devices as they also can damage terminals.
- Do not probe through connector seals, wire insulation, secondary ignition wires, boots, etc. Damage can occur that is not readily apparent and tiny holes can result in water intrusion, which leads to corrosion and eventual component failure.
- When connecting battery, always connect battery positive (+) cable first.
- When charging battery, turn Ignition OFF and remove battery negative cable (black) from battery negative (-) terminal.
- If electric welding on vehicle, remove battery negative cable (black) from battery negative (-) terminal, and disconnect the ECM electrical connector(s).

Avoid ECM Damage



CAUTION

A surge in voltage, current or both, is called a voltage spike. Voltage spikes can cause major damage to the ECM.

1. To avoid ECM failure due to accidentally induced voltage spikes, always observe the following precautions:
 - Do not start engine if battery cable connections are loose.
 - Do not use a battery charger to start engine.
 - Turn Ignition OFF before disconnecting and/or connecting battery cables.
 - When disconnecting battery, always disconnect battery negative (-) cable first.
1. Briggs & Stratton Spark Tester (Part No. 19368).
2. Briggs & Stratton Digital Volt Ohmmeter Extech Ma220 (Part No. 19602).
3. Briggs & Stratton Noid Light (Part No. 19623).
4. Briggs & Stratton BIG BLOCK™ Fuel Pressure Test Adapter (Part No. 19624).
5. Briggs & Stratton Back Probe Wire Set (Part No. 19625).
6. Briggs & Stratton Tiny Scan Code Reader (Part No. 19626).
7. Briggs & Stratton Fuel Pressure Gauge (Part No. 19627).
8. Briggs & Stratton Diagnostic Tool Kit (Part No. 19636).
9. Briggs & Stratton Diagnostic Harness Kit (Part No. 847252).

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DIAGNOSTIC TROUBLE CODES (DTCS)

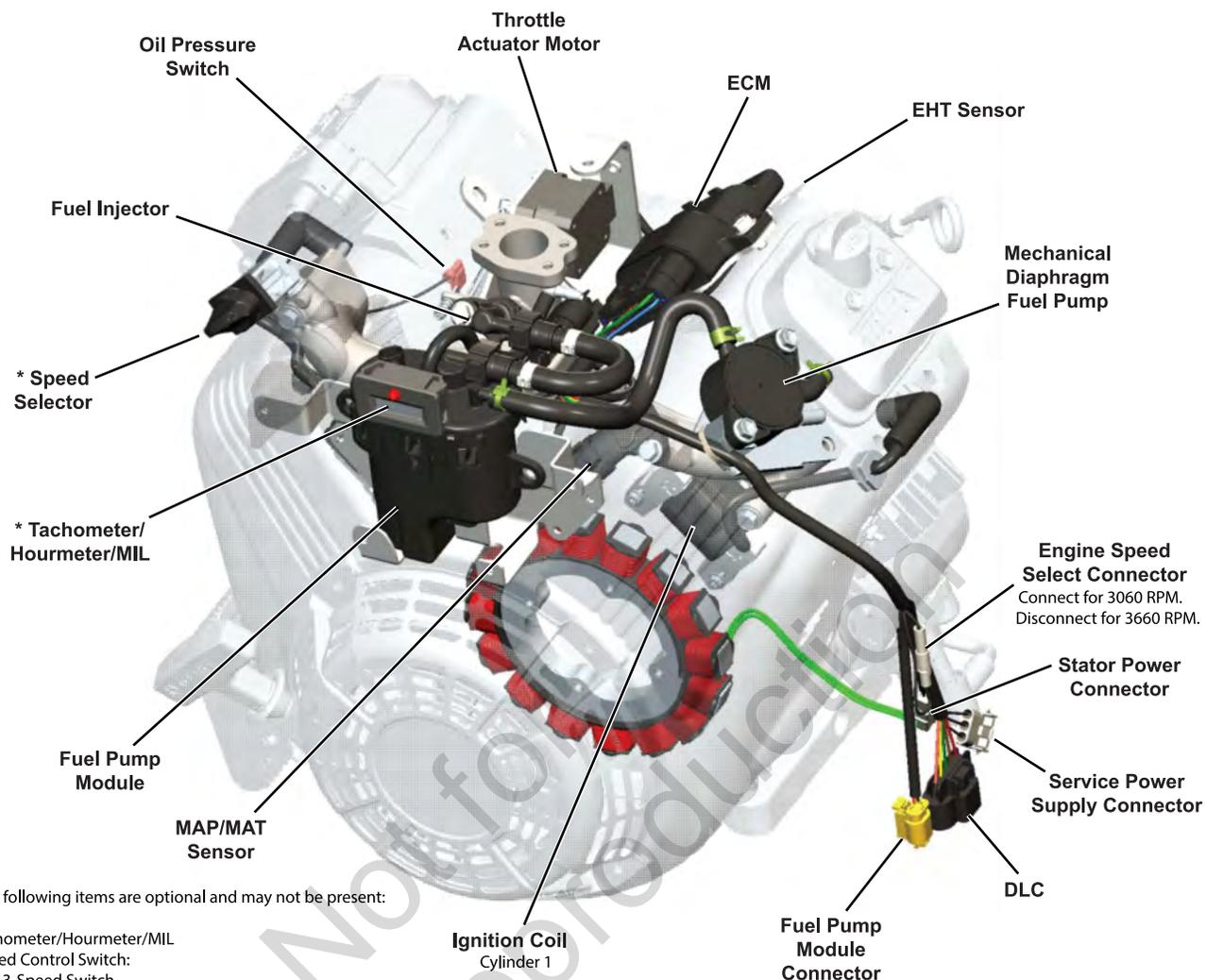
Component	DTC	Description
Manifold Absolute Pressure (MAP) Sensor	P0107	Signal Voltage Low
	P0108	Signal Voltage High
Manifold Air Temperature (MAT) Sensor	P0112	Signal Voltage Low
	P0113	Signal Voltage High
Engine Head Temperature (EHT) Sensor	P0117	Signal Voltage Low
	P0118	Signal Voltage High
Fuel Injector	P0201	Driver Circuit Open or Grounded
	P0262	Driver Circuit Shorted to B+
Fuel Pump Module	P0230	Signal Voltage Low, Open, or High
Cylinder 1 Ignition Coil	P0351	Circuit Open or Grounded
Cylinder 2 Ignition Coil	P0352	Circuit Open or Grounded
Throttle Actuator Motor	P0506	RPM Low
	P0507	RPM High
	P2102	Driver Circuit Open or Grounded
Engine Oil Pressure Switch	P0520	Switch Circuit Open or Grounded
	P0524	Low Oil Pressure
ECM Output Supply Voltage	P0562	Supply Voltage Low
	P0563	Supply Voltage High
MAT/MAP Sensor Power Supply Voltage	P0661	Supply Voltage Low
Tachometer	P1693	Driver Circuit Open or Grounded
	P1694	Driver Circuit Shorted to B+

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MODEL 380000 EFI COMPONENT LOCATIONS

5

2



* The following items are optional and may not be present:

- Tachometer/Hourmeter/MIL
- Speed Control Switch:
 - 3-Speed Switch
 - Variable Speed Switch
- Ignition Key Switch
- Throttle Actuator Motor

NOTE: Air cleaner assembly and fuel pump module cover removed for illustration purposes.

Removal Required for Back Probing Connector (x) or Replacing Component (o)			
To Access	Air Cleaner Assembly	Fuel Pump Module Cover	Blower Housing
ECM	xo		
Throttle Actuator Motor	xo		
MAP/MAT Sensor	xo	xo	xo
Ignition Coil	xo	xo	o
Mechanical Diaphragm Fuel Pump		o	
Fuel Pump Module		xo	
Fuel Injector	xo	xo	

NOTE: See SECTION 5 - REMOVAL/INSTALLATION for instructions.

VERIFY ECM POWERS UP

Circuit Description

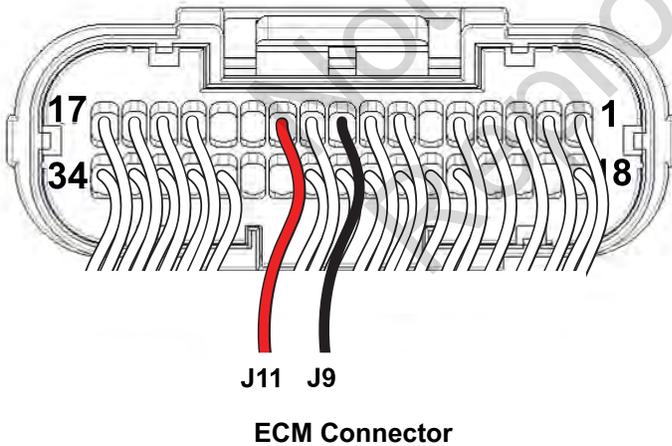
Since all EFI components are dependent on proper operation of the ECM, any diagnosis must include checking ECM power and grounds.

NOTE: When the ECM is powered up, you may hear the fuel pump module prime for two seconds. This is not definitive proof that the ECM is getting proper voltage.

2

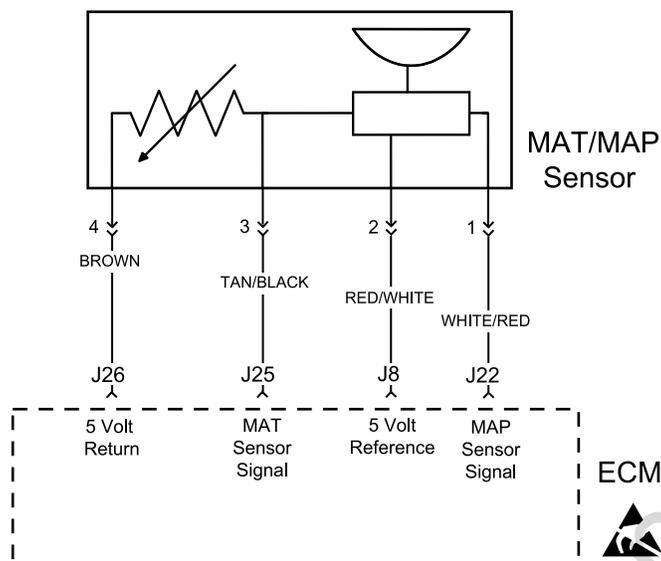
Check ECM Power and Grounds (Non-Scan Diagnostics)

Step	Action	Yes	No
1	<ol style="list-style-type: none">1. Back probe terminal J11 (Red wire) of ECM connector.2. Connect terminal J11 back probe to red meter test lead on DVOM.3. Back probe terminal J9 (Black wire) of ECM connector.4. Connect terminal J9 back probe to black meter test lead on DVOM.5. Set DVOM to read volts DC.6. Observe voltage on DVOM while cranking engine.7. Is reading greater than 9 volts DC?	System OK.	See DTC P0562.



DTC P0107/P0108 MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

2



Circuit Description

The MAP sensor responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that varies between about 0.5 volts at idle to 4.5 volts at Wide Open Throttle (WOT).

If the MAP sensor fails, the ECM substitutes a default MAP value.

The MAP sensor voltage of 5 volts is delivered to the MAP sensor through ECM terminal J8. The MAP sensor sends a voltage signal back to the ECM on terminal J22 according to the manifold pressure value on the terminal.

Diagnostic Aids

Check for the following conditions:

1. Poor ECM connection. Inspect wire harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
2. Damaged wire harness and/or connectors. If harness appears to be OK, shake or wiggle wire harness and/or connector with DVOM or Diagnostic Tool connected. Radical voltage changes or a change in the MAP sensor display can indicate the location of the fault condition.

Always clear DTCs after performing repairs.

DTC P0107 Signal Voltage Low (Scan Diagnostics)

Step	Action	Yes	No
1	<ol style="list-style-type: none"> Select the Dashboard icon in the left sidebar and then the Troubleshooting tab. Observe the MAP Voltage display with or without the engine running. Is reading 0.5-4.5 volts DC? 	MAP sensor circuit OK.	Go to step 2.
2	Is reading below 0.5 volts DC?	Go to DTC P0107 Non-Scan Diagnostics.	-

2

The screenshot shows the Briggs & Stratton Diagnostic Tool interface. The left sidebar contains navigation icons for Dashboard, ECM Flash, and Monitoring. The main area displays various sensor data tables. The 'MAP Voltage' entry in the 'Pressure' section is highlighted with a red box and a white arrow pointing to it. The value is 4.02 V. Other data includes Baro Pressure (99.3 kPa), Fuel Pump Duty Cycle (100.0%), and various temperature and throttle readings.

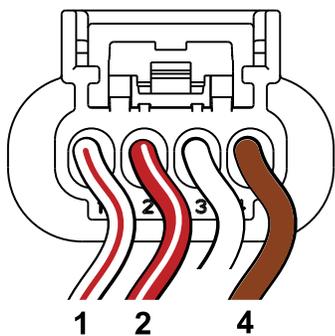
Parameter	Value	Unit
MAP Voltage	4.02	V
Baro Pressure	99.3	kPa
Fuel Pump Duty Cycle	100.0	%
Fuel Pulse Width Cyl1	15.33	ms
Fuel Pulse Width Cyl2	15.14	ms
Spark Advance Cyl1	16	CA
Total Engine Run Time	0.1875	hr
Permanent Engine Run Time	0.1875	hr
EHT Sensor	23	°C
Max Head Temp	23.6	°C
EHT (°F)	66.4	°F
EHT MAX (°F)	74.5	°F
EHT Voltage	4.23	V
IAT Sensor	22.4	°C
Max Intake Temp	24.8	°C
IAT (°F)	72.3	°F
IAT MAX (°F)	76.7	°F
IAT Voltage	3.14	V
Throttle Position	100.00	%

DTC P0107 Signal Voltage Low (Non-Scan Diagnostics)

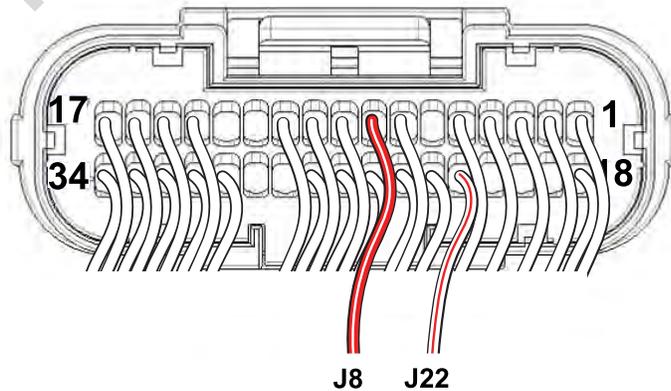
2

Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Disconnect and reconnect MAP sensor and ECM connectors. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect and reconnect service power supply connector. 5. Does DTC return? 	Go to step 2.	Problem corrected.
2	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Back probe terminal 2 (Red/White wire) of MAP sensor connector. 3. Connect terminal 2 back probe to red meter test lead on DVOM. 4. Back probe terminal 4 (Brown wire) of MAP sensor connector. 5. Connect terminal 4 back probe to black meter test lead on DVOM. 6. Set DVOM to read volts DC. 7. Connect service power supply connector. 8. Observe voltage. 9. Is reading 4.6-5.0 volts DC? 	Go to step 3.	Go to step 3.
3	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Remove probe from terminal 2, and back probe ECM connector terminal J8 (Red/White wire). 3. Connect service power supply connector. 4. Observe voltage on DVOM. 5. Is reading 4.6-5.0 volts DC? 	Go to step 6.	Go to step 4.

Continued...

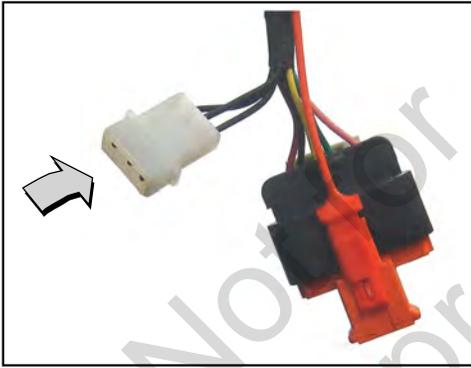


MAP Sensor Connector



ECM Connector

Step	Action	Yes	No
4	1. Disconnect service power supply connector. 2. Remove probe from terminal J8, and back probe terminal 1 (White/Red wire) of MAP sensor connector. 3. Connect service power supply connector. 4. Observe voltage on DVOM. 5. Is reading 3.7-4.2 volts DC?	MAP sensor OK.	Go to step 5.
5	1. Disconnect service power supply connector. 2. Remove probe from terminal 1, and back probe ECM connector terminal J22 (White/Red wire). 3. Connect service power supply connector. 4. Observe voltage on DVOM. 5. Is reading 3.7-4.2 volts DC?	EFI wire harness OK. Replace MAP sensor.	Go to step 6.
6	1. Not getting ground thru 5 volt return circuit. 2. Are both MAP sensor and ECM connectors fully mated?	Repair or replace EFI wire harness.	Connect connectors.



Service Power Supply Connector

DTC P0108 Signal Voltage High (Scan Diagnostics)

2

Step	Action	Yes	No
1	1. Select the Dashboard icon in the left sidebar and then the Troubleshooting tab. 2. Observe the MAP Voltage display with or without the engine running. 3. Is reading 0.5-4.5 volts DC?	MAP sensor circuit OK.	Go to step 2.
2	Is reading above 4.5 volts DC?	Go to DTC P0108 Non-Scan Diagnostics.	-

The screenshot shows the Briggs & Stratton Diagnostic Tool interface. The left sidebar contains navigation icons for Dashboard, ECM Flash, and Monitoring. The main area displays several data tables:

- Pressure Table:**

PARAMETER	Value	Unit
Baro Pressure	99.3	kPa
MAP Voltage	4.02	V
- VR Sensor Table:**

FLYWHEEL	Value	Unit
Cyl Identification Logic:	0	count
Engine Speed	1806	RPM
- Oxygen Sensor Table:**

OXYGEN SENSOR	Value	Unit
Closed Loop Cross Counts	0	count
Short Term Fuel Trim	1.00	%
Fuel BPW Corrected Cyl1	15.16	%
O2 Heater Enabled	1	state
HO2S Sensor	1014.8	mV
- Throttle Table:**

THRITTLE	Value	Unit
Throttle Position	100.00	%
- PARAMETER TABLE:**

PARAMETER	Value	Unit
Fuel Pump Duty Cycle	100.0	%
Fuel Pulse Width Cyl1	15.33	ms
Fuel Pulse Width Cyl2	15.14	ms
Spark Advance Cyl1	16	CA
Total Engine Run Time	0.1875	hr
Permanent Engine Run Time	0.1875	hr
- Head Temperature Table:**

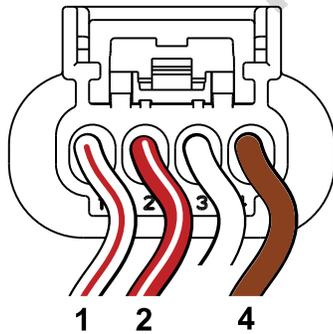
HEAD TEMPERATURE	Value	Unit
EHT Sensor	23	°C
Max Head Temp	23.6	°C
EHT (°F)	66.4	°F
EHT MAX (°F)	74.5	°F
EHT Voltage	4.23	V
- Intake Temperature Table:**

INTAKE TEMPERATURE	Value	Unit
IAT Sensor	22.4	°C
Max Intake Temp	24.8	°C
IAT (°F)	72.3	°F
IAT MAX (°F)	76.7	°F
IAT Voltage	3.14	V
- ECM Info:**
 - ENG Serial No:
 - Model No:
 - Cal ID:
 - Cal PN:
 - H/W Version:
 - F/W Version:
- CURRENT / HISTORY:** Two empty tables for monitoring current and historical data.

DTC P0108 Signal Voltage High (Non-Scan Diagnostics)

2

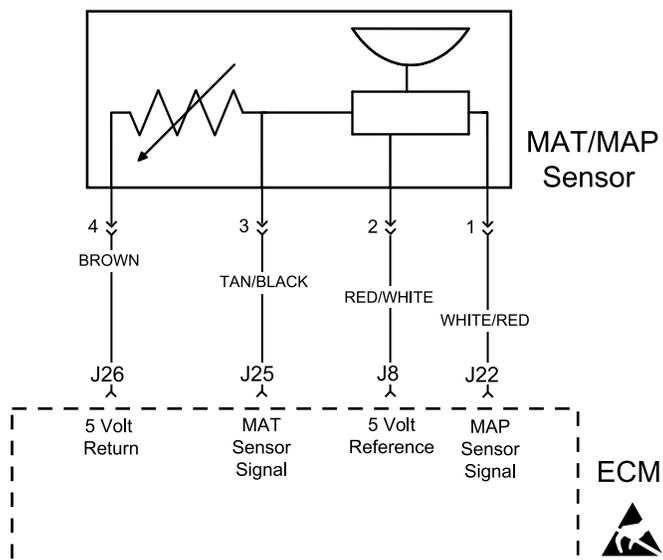
Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Disconnect and reconnect MAP sensor and ECM connectors. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect and reconnect service power supply connector. 5. Does DTC return? 	Go to step 2.	Problem corrected.
2	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Back probe terminal 2 (Red/White wire) of MAP sensor connector. 3. Connect terminal 2 back probe to red meter test lead on DVOM. 4. Back probe terminal 4 (Brown wire) of MAP sensor connector. 5. Connect terminal 4 back probe to black meter test lead on DVOM. 6. Set DVOM to read volts DC. 7. Connect service power supply connector. 8. Observe voltage on DVOM. 9. Is reading 4.7-5.0 volts DC? 	Go to step 3.	-
3	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Remove probe from terminal 2, and back probe terminal 1 (White/Red wire) of MAP sensor connector. 3. Connect service power supply connector. 4. Observe voltage on DVOM. 5. Is reading 0.5-4.5 volts DC? 	EFI wire harness OK.	Reading is above 4.5 volts DC. Replace MAP sensor.



MAP Sensor Connector

DTC P0112/P0113 MANIFOLD AIR TEMPERATURE (MAT) SENSOR

2



Circuit Description

The MAT sensor uses a thermistor to control signal voltage to the ECM. The ECM applies 5 volts on the sensor circuit. Sensor resistance changes as ambient temperature changes, which in turn affects the voltage return to the ECM.

Diagnostic Aids

Check for the following conditions:

1. Poor ECM connection.

2. Inspect wire harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
3. Damaged wire harness and/or connectors. If harness appears to be OK, shake or wiggle wire harness and/or connector with DVOM or Diagnostic Tool connected. Radical voltage changes or a change in the MAT sensor display can indicate the location of the fault condition.

Always clear DTCs after performing repairs.

DTC P0112 Signal Voltage Low (Scan Diagnostics)

2

Step	Action	Yes	No
1	1. Select the Dashboard icon in the left sidebar and then the Troubleshooting tab. 2. Observe the IAT Voltage display with or without the engine running. 3. Is reading 0.5-4.5 volts DC?	MAT sensor circuit OK.	Go to step 2.
2	Is reading below 0.5 volts DC?	Go to DTC P0112 Non-Scan Diagnostics.	-

The screenshot shows the Briggs & Stratton Diagnostic Tool interface. The main content area displays several data tables:

- Pressure Table:**

PARAMETER	Value	Unit
Baro Pressure	99.3	kPa
MAP Sensor	99.4	kPa
MAP Voltage	4.02	V
- VR Sensor Table:**

PARAMETER	Value	Unit
Cyl Identification Logic:	0	count
Cyl Identification Logic:	0	count
Engine Speed	1806	RPM
- Oxygen Sensor Table:**

PARAMETER	Value	Unit
Closed Loop Cross Counts	0	count
Short Term Fuel Trim	1.00	%
Fuel BPW Corrected Cyl1	15.16	%
O2 Heater Enabled	1	state
HO2S Sensor	1014.8	mV
- Throttle Table:**

PARAMETER	Value	Unit
Throttle Position	100.00	%
- PARAMETER TABLE:**

PARAMETER	Value	Unit
Fuel Pump Duty Cycle	100.0	%
Fuel Pulse Width Cyl1	15.33	ms
Fuel Pulse Width Cyl2	15.14	ms
Spark Advance Cyl1	16	CA
Total Engine Run Time	0.1875	hr
Permanent Engine Run Time	0.1875	hr
- Head Temperature Table:**

PARAMETER	Value	Unit
EHT Sensor	23	°C
Max Head Temp	23.6	°C
EHT (°F)	66.4	°F
EHT MAX (°F)	74.5	°F
EHT Voltage	4.23	V
- Intake Temperature Table:**

PARAMETER	Value	Unit
IAT Sensor	22.4	°C
Max Intake Temp	24.8	°C
IAT (°F)	72.3	°F
IAT MAX (°F)	76.7	°F
IAT Voltage	3.14	V

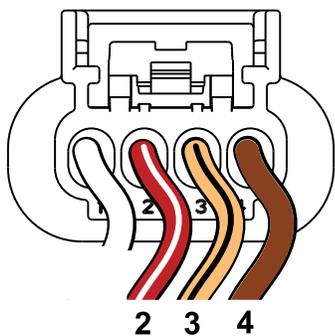
The IAT Voltage row in the Intake Temperature table is highlighted with a red box, and a white arrow points to the value 3.14 V.

DTC P0112 Signal Voltage Low (Non-Scan Diagnostics)

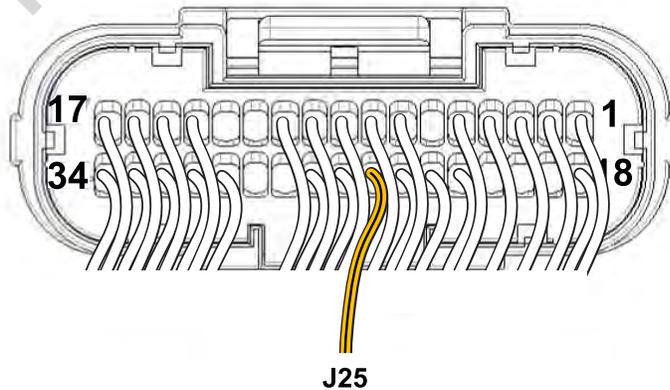
2

Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Disconnect and reconnect MAT sensor and ECM connectors. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect and reconnect service power supply connector. 5. Does DTC return? 	Go to step 2.	Problem corrected.
2	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Back probe terminal 2 (Red/White wire) of MAT sensor connector. 3. Connect terminal 2 back probe to red meter test lead on DVOM. 4. Back probe terminal 4 (Brown wire) of MAT sensor connector. 5. Connect terminal 4 back probe to black meter test lead on DVOM. 6. Set DVOM to read volts DC. 7. Connect service power supply connector. 8. Observe voltage on DVOM. 9. Is reading 4.7-5.0 volts DC? 	MAT sensor OK.	Go to step 3.
3	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Remove probe from terminal 2, and back probe terminal 3 (Tan/Black wire) of MAT sensor connector. 3. Connect service power supply connector. 4. Observe voltage on DVOM. 5. Is reading 0.5-4.5 volts DC? 	MAT sensor OK.	Reading is below 0.5 volts DC. Replace MAT sensor.

Continued...

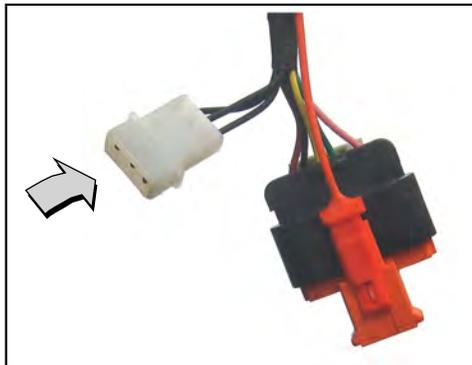


MAP Sensor Connector



ECM Connector

Step	Action	Yes	No
4	<ol style="list-style-type: none">1. Disconnect service power supply connector.2. Remove probe from terminal 3, and back probe ECM connector terminal J25 (Tan/Black wire).3. Connect service power supply connector.4. Observe voltage on DVOM.5. Is reading 0.5-4.5 volts DC?	MAT sensor circuit OK.	Go to step 5.
5	Are both MAT sensor and ECM connectors fully mated?	Repair or replace EFI wire harness.	Connect connectors.



Service Power Supply Connector

Not for
Reproduction

DTC P0113 Signal Voltage High (Scan Diagnostics)

2

Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Select the Dashboard icon in the left sidebar and then the Troubleshooting tab. 2. Observe the IAT Voltage display with or without the engine running. 3. Is reading 0.5-4.5 volts DC? 	MAT sensor circuit OK.	Go to step 2.
2	Is reading above 4.5 volts DC?	Go to DTC P0113 Non-Scan Diagnostics.	-

The screenshot shows the Briggs & Stratton Diagnostic Tool interface. The main display area is divided into several sections:

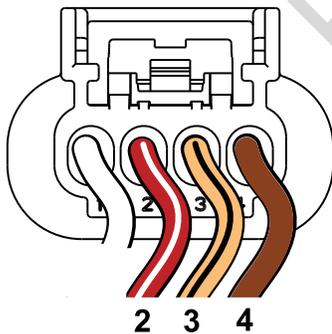
- Pressure:** Baro Pressure (99.3 kPa), MAP Sensor (99.4 kPa), MAP Voltage (4.02 V).
- VR Sensor:** FLYWHEEL, Cyl Identification Logic (0 count), Engine Speed (1806 RPM).
- Oxygen Sensor:** OXYGEN SENSOR, Closed Loop Cross Counts (0 count), Short Term Fuel Trim (1.00%), Fuel BPW Corrected Cyl1 (15.16%), O2 Heater Enabled (1 state), HO2S Sensor (1014.8 mV).
- Throttle:** THROTTLE, Throttle Position (100.00%).
- PARAMETER TABLE:** Fuel Pump Duty Cycle (100.0%), Fuel Pulse Width Cyl1 (15.33 ms), Fuel Pulse Width Cyl2 (15.14 ms), Spark Advance Cyl1 (16 CA), Total Engine Run Time (0.1875 hr), Permanent Engine Run Time (0.1875 hr).
- Head Temperature:** HEAD TEMPERATURE, EHT Sensor (23 °C), Max Head Temp (23.6 °C), EHT (°F) (66.4 °F), EHT MAX (°F) (74.5 °F), EHT Voltage (4.23 V).
- Intake Temperature:** INTAKE TEMPERATURE, IAT Sensor (22.4 °C), Max Intake Temp (24.8 °C), IAT (°F) (72.3 °F), IAT MAX (°F) (76.7 °F).
- IAT Voltage:** IAT Voltage (3.14 V) - This row is highlighted with a red box and an arrow.

On the right side, there is an **ECM Info** section with fields for ENG Serial No., Model No., Cal ID, Cal PN, H/W Version, and F/W Version. Below this are **CURRENT** and **HISTORY** tabs.

DTC P0113 Signal Voltage High (Non-Scan Diagnostics)

2

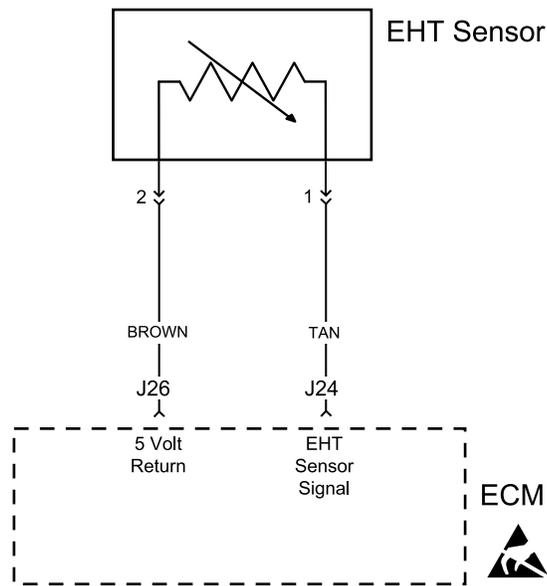
Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Disconnect and reconnect MAT sensor and ECM connectors. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect and reconnect service power supply connector. 5. Does DTC return? 	Go to step 2.	Problem corrected.
2	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Back probe terminal 2 (Red/White wire) of MAT sensor connector. 3. Connect terminal 2 back probe to red meter test lead on DVOM. 4. Back probe terminal 4 (Brown wire) of MAT sensor connector. 5. Connect terminal 4 back probe to black meter test lead on DVOM. 6. Set DVOM to read volts DC. 7. Connect service power supply connector. 8. Observe voltage on DVOM. 9. Is reading 4.7-5.0 volts DC? 	MAT sensor OK.	Go to step 3.
3	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Remove probe from terminal 2, and back probe terminal 3 (Tan/Black wire) of MAT sensor connector. 3. Connect service power supply connector. 4. Observe voltage on DVOM. 5. Is reading 0.5-4.5 volts DC? 	MAT sensor OK.	Reading is above 4.5 volts DC. Replace MAT sensor.



MAT Sensor Connector

DTC P0117/P0118 ENGINE HEAD TEMPERATURE (EHT) SENSOR

2



Circuit Description

The EHT sensor uses a thermistor to control signal voltage to the ECM. The ECM applies 5 volts on the sensor circuit. Sensor resistance changes as ambient temperature changes, which in turn affects the voltage return to the ECM.

Diagnostic Aids

Check for the following conditions:

1. Poor ECM connection.

2. Inspect wire harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
3. Damaged wire harness and/or connectors. If harness appears to be OK, shake or wiggle wire harness and/or connector with DVOM or Diagnostic Tool connected. Radical voltage changes or a change in the EHT sensor display can indicate the location of the fault condition.

Always clear DTCs after performing repairs.

DTC P0117 Signal Voltage Low (Scan Diagnostics)

2

Step	Action	Yes	No
1	1. Select the Dashboard icon in the left sidebar and then the Troubleshooting tab. 2. Observe the EHT Voltage display with or without the engine running. 3. Is reading 0.5-4.5 volts DC?	EHT sensor circuit OK.	Go to step 2.
2	Is reading below 0.5 volts DC?	Go to DTC P0117 Non-Scan Diagnostics.	-

The screenshot shows the Briggs & Stratton Diagnostic Tool interface. The main display area is divided into several data tables:

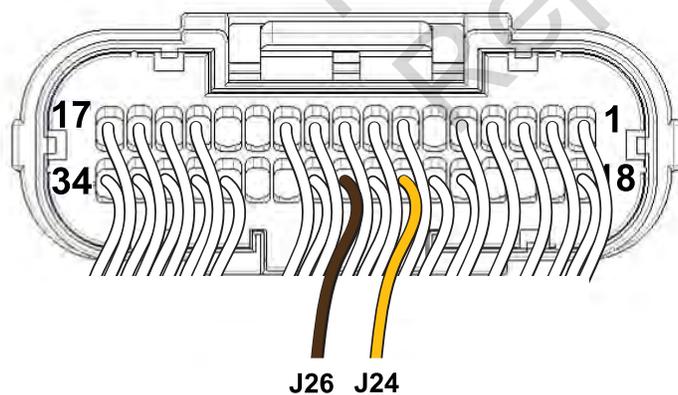
- Pressure:** Baro Pressure (99.3 kPa), MAP Sensor (99.4 kPa), MAP Voltage (4.02 V).
- VR Sensor:** Cyl Identification Logic (0 count), Engine Speed (1806 RPM).
- Oxygen Sensor:** Closed Loop Cross Counts (0), Short Term Fuel Trim (1.00%), Fuel BPW Corrected Cyl1 (15.16%), O2 Heater Enabled (1 state), HO2S Sensor (1014.8 mV).
- Throttle:** Throttle Position (100.00%).
- PARAMETER TABLE:** Fuel Pump Duty Cycle (100.0%), Fuel Pulse Width Cyl1 (15.33 ms), Fuel Pulse Width Cyl2 (15.14 ms), Spark Advance Cyl1 (16 CA), Total Engine Run Time (0.1875 hr), Permanent Engine Run Time (0.1875 hr).
- Head Temperature:** EHT Sensor (23 °C), Max Head Temp (23.6 °C), EHT (°F) (66.4 °F).
- EHT Voltage:** 4.23 V (highlighted with a red box and an arrow).
- Intake Temperature:** IAT Sensor (22.4 °C), Max Intake Temp (24.8 °C), IAT (°F) (72.3 °F), IAT MAX (°F) (76.7 °F), IAT Voltage (3.14 V).

On the right side, there is an **ECM Info** section with fields for ENG Serial No., Model No., Cal ID, Cal PN, H/W Version, and F/W Version. Below that are **CURRENT** and **HISTORY** tabs.

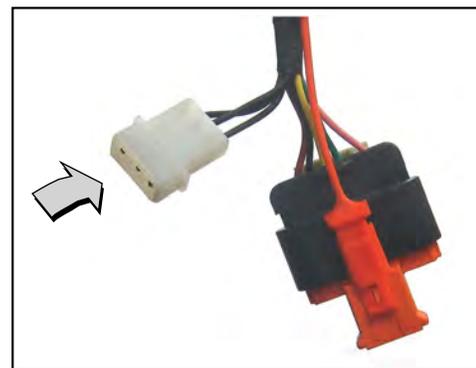
DTC P0117 Signal Voltage Low (Non-Scan Diagnostics)

2

Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Disconnect and reconnect ECM connector. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect and reconnect service power supply connector. 5. Does DTC return? 	Go to step 2.	Problem corrected.
2	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Back probe terminal J24 (Tan wire) of ECM connector. 3. Connect terminal J24 back probe to red meter test lead on DVOM. 4. Back probe terminal J26 (Brown wire) of ECM connector. 5. Connect terminal J26 back probe to black meter test lead on DVOM. 6. Set DVOM to read volts DC. 7. Connect service power supply connector. 8. Observe voltage on DVOM. 9. Is reading 0.5-4.5 volts DC? 	EHT sensor OK.	Go to step 3.
3	<ol style="list-style-type: none"> 1. Reading is below 0.5 volts DC. 2. Is ECM connector fully mated? 	<p>EHT sensor is bad. Replace EFI wire harness.</p> <p>NOTE: EHT sensor is an integral part of the EFI wire harness and is not sold separately.</p>	Connect connector.



ECM Connector



Service Power Supply Connector

DTC P0118 Signal Voltage High (Scan Diagnostics)

2

Step	Action	Yes	No
1	1. Select the Dashboard icon in the left sidebar and then the Troubleshooting tab. 2. Observe the EHT Voltage display with or without the engine running. 3. Is reading 0.5-4.5 volts DC?	EHT sensor circuit OK.	Go to step 2.
2	Is reading above 4.5 volts DC?	Go to DTC P0118 Non-Scan Diagnostics.	-

The screenshot shows the Briggs & Stratton Diagnostic Tool interface. The main display area is divided into several data tables:

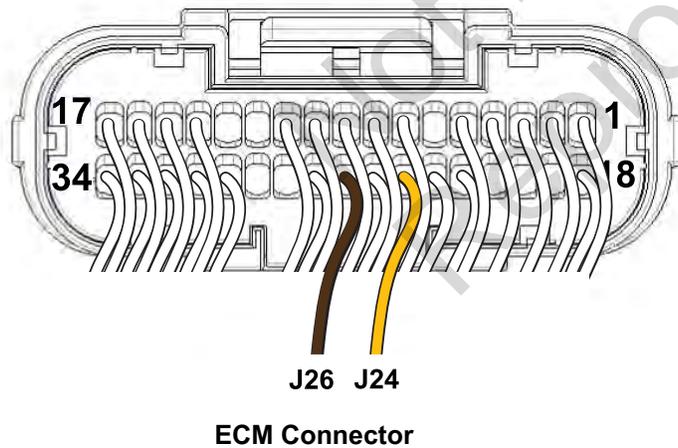
- Pressure:** Baro Pressure (99.3 kPa), MAP Sensor (99.4 kPa), MAP Voltage (4.02 V).
- VR Sensor:** Cyl Identification Logic (0 count), Engine Speed (1806 RPM).
- Oxygen Sensor:** Closed Loop Cross Counts (0), Short Term Fuel Trim (1.00%), Fuel BPW Corrected Cyl1 (15.16%), O2 Heater Enabled (1 state), HO2S Sensor (1014.8 mV).
- Throttle:** Throttle Position (100.00%).
- PARAMETER TABLE:** Fuel Pump Duty Cycle (100.0%), Fuel Pulse Width Cyl1 (15.33 ms), Fuel Pulse Width Cyl2 (15.14 ms), Spark Advance Cyl1 (16 CA), Total Engine Run Time (0.1875 hr), Permanent Engine Run Time (0.1875 hr).
- Head Temperature:** EHT Sensor (23 °C), Max Head Temp (23.6 °C), EHT (°F) (66.4 °F).
- Intake Temperature:** IAT Sensor (22.4 °C), Max Intake Temp (24.8 °C), IAT (°F) (72.3 °F), IAT MAX (°F) (76.7 °F), IAT Voltage (3.14 V).

The **EHT Voltage** value of 4.23 V is highlighted with a red box, and a white arrow points to it from the right. The interface also includes a sidebar with navigation icons (Dashboard, ECM Flash, Monitoring) and a top navigation bar with 'Remember Me', 'Welcome (Dealer)', 'About', and 'Logout' options.

DTC P0118 Signal Voltage High (Non-Scan Diagnostics)

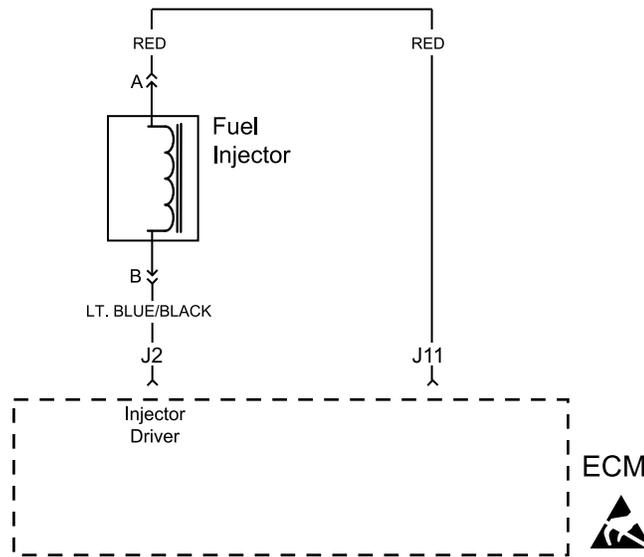
2

Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Disconnect and reconnect ECM connector. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect and reconnect service power supply connector. 5. Does DTC return? 	Go to step 2.	Problem corrected.
2	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Back probe terminal J24 (Tan wire) of ECM connector. 3. Connect terminal J24 back probe to red meter test lead on DVOM. 4. Back probe terminal J26 (Brown wire) of ECM connector. 5. Connect terminal J26 back probe to black meter test lead on DVOM. 6. Set DVOM to read volts DC. 7. Connect service power supply connector. 8. Observe voltage on DVOM. 9. Is reading 0.5 - 4.5 volts DC? 	EHT sensor OK.	<p>Reading is above 4.5 volts DC. EHT sensor is bad.</p> <p>Replace EFI wire harness.</p> <p>NOTE: EHT sensor is an integral part of the EFI wire harness and is not sold separately.</p>



DTC P0201/P0262 THROTTLE BODY FUEL INJECTOR FAULT

2



Circuit Description

The ECM controls the fuel injector by grounding the control circuit via a solid state device called a driver. If the ECM detects an unacceptable difference in resistance, a fuel injector control DTC is set.

Although the DTC indicates that the fuel injector is faulty, the technician must determine if the fault is in the ground circuit, the +12v circuit, or in the fuel injector.

NOTE: If an ignition coil fault code is active, the fuel injector will not inject fuel to the cylinder with the faulty ignition coil.

Diagnostic Aids

Check for the following conditions:

1. Poor ECM connection.
2. Inspect wire harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
3. Damaged wire harness and/or connectors. If harness appears to be OK, shake or wiggle wire harness and/or connector with DVOM attached. Radical voltage changes can indicate the location of the fault condition.

Always clear DTCs after performing repairs.

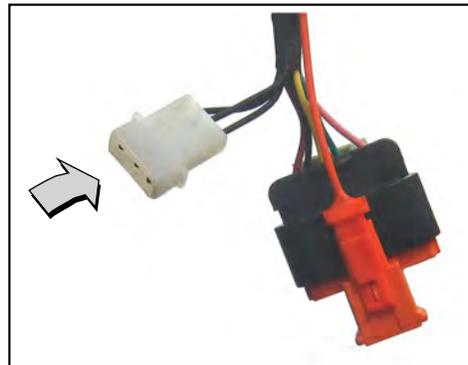
DTC P0201/P0262 Driver Circuit Open, Grounded or Shorted to B+ (Non-Scan Diagnostics)

2

Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Disconnect and reconnect fuel injector and ECM connectors. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect and reconnect service power supply connector. 5. Does DTC return? 	Go to step 2.	Problem corrected.
2	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Disconnect fuel injector connector. 3. Install Briggs & Stratton Noid Light (Part No. 19623). 4. Does Noid Light flash while cranking engine? 	Replace fuel injector.	Go to step 3.
3	<ol style="list-style-type: none"> 1. Connect service power supply connector. 2. Does Noid Light flash? 	Check charging circuit between stator and ECM. Refer to DTC P0562/P0563.	Go to step 4.
4	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Remove Noid Light and connect fuel injector connector. 3. Back probe (using fused patch cord) terminal A (Red wire) of fuel injector connector. 4. Connect terminal A back probe to red meter test lead on DVOM. 5. Connect black meter test lead on DVOM to a known good ground. 6. Set DVOM to read volts DC. 7. Connect service power supply connector. 8. Observe voltage on DVOM. 9. Is reading 12.2-13.5 volts DC? 	Go to step 5.	-
			Continued...

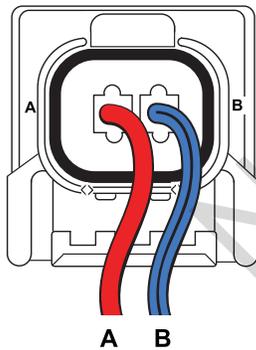


Noid Light (Part No. 19623)

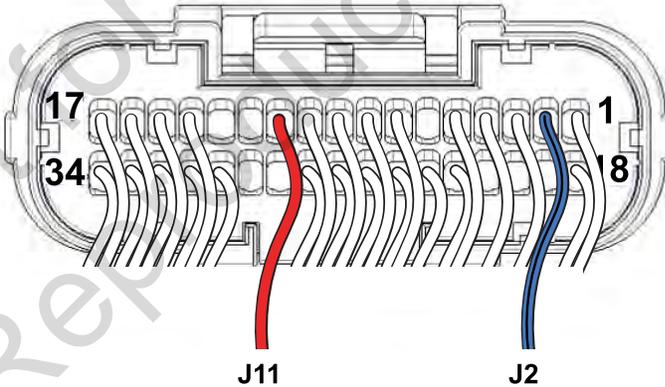


Service Power Supply Connector

Step	Action	Yes	No
5	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Disconnect fuel injector connector. 3. Disconnect ECM connector. 4. Remove probe from terminal A, and back probe terminal B (Lt. Blue/Black wire) of fuel injector connector. 5. Back probe terminal J2 (Lt. Blue/Black wire) of ECM connector. 6. Connect terminal J2 back probe to black meter test lead on DVOM. 7. Set DVOM to read resistance. 8. Observe resistance on DVOM. 9. Is reading less than 0.1 ohms? 	Go to step 6.	<p>Reading is above 0.1 ohms. Check terminals for corrosion or replace EFI wire harness.</p> <p>NOTE: If DTC still present after replacement of EFI wire harness, then replace ECM.</p>
6	<ol style="list-style-type: none"> 1. Remove probe from terminal B, and back probe terminal A (Red wire) of fuel injector connector. 2. Observe resistance on DVOM. 3. Is reading less than 0.1 ohms? 	Replace ECM.	<p>Reading is above 0.1 ohms. Check terminals for corrosion or replace EFI wire harness.</p> <p>NOTE: If DTC still present after replacement of EFI wire harness, then replace ECM.</p>



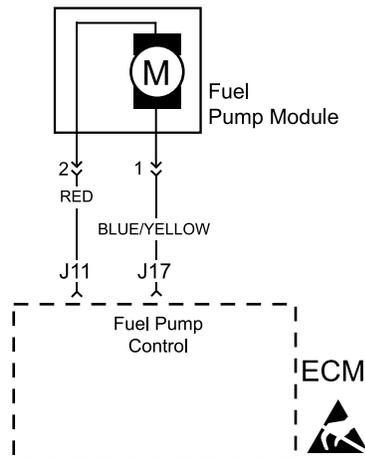
Fuel Injector Connector



ECM Connector

DTC P0230 FUEL PUMP MODULE FAULT

2



Circuit Description

The fuel pump module is controlled by the ECM via the ground circuit of the fuel pump plug. If resistance is unacceptable in that circuit the fuel pump DTC is set.

- DTC P0230 shows that the signal voltage is low, which indicates voltage is lost to the pump, that circuit resistance is high, or there is an open connection.

When power is supplied, the ECM activates the fuel pump module. The fuel pump module delivers fuel to the fuel rail and fuel injector.

Diagnostic Aids

The following conditions may have caused the fuel pump to malfunction:

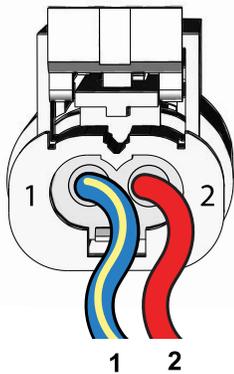
1. Intermittent short in the fuel pump power feed circuit.
2. Fuel pump has an intermittent internal problem.
3. Poor ECM connection.
4. Inspect wire harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
5. Inspect wire harness for damage.

Always clear DTCs after performing repairs.

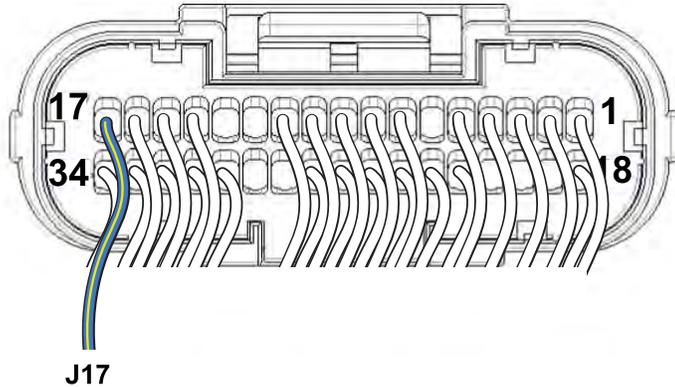
DTC P0230 Signal Voltage Low, Open or High (Non-Scan Diagnostics)

2

Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Disconnect and reconnect fuel pump module and ECM connectors. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect and reconnect service power supply connector. 5. Does DTC return? 	Go to step 2.	Problem corrected.
2	<ol style="list-style-type: none"> 1. Disconnect and reconnect service power supply connector. 2. Does fuel pump run for 2 seconds? 	Fuel pump module OK.	Go to step 3.
3	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Back probe terminal 2 (Red wire) of fuel pump module connector. 3. Connect terminal 2 back probe to red meter test lead on DVOM. 4. Connect black meter test lead on DVOM to a known good ground. 5. Set DVOM to read volts DC. 6. Connect service power supply connector. 7. Does DVOM read 12.2-13.5 volts DC? 	Go to step 4.	Go to DTC P0562.
4	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Disconnect fuel pump module connector. 3. Remove probe from terminal 2, and back probe terminal 1 (Blue/Yellow wire) of fuel pump module connector. 4. Disconnect ECM connector. 5. Back probe terminal J17 (Blue/Yellow wire) of ECM connector. 6. Connect terminal J17 back probe to black meter test lead on DVOM. 7. Set DVOM to read resistance. 8. Does DVOM read 0.5 ohm or less? 	Replace fuel pump module.	<p>Resistance reading is above 0.5 ohm.</p> <p>Check terminals for corrosion or replace EFI wire harness.</p>



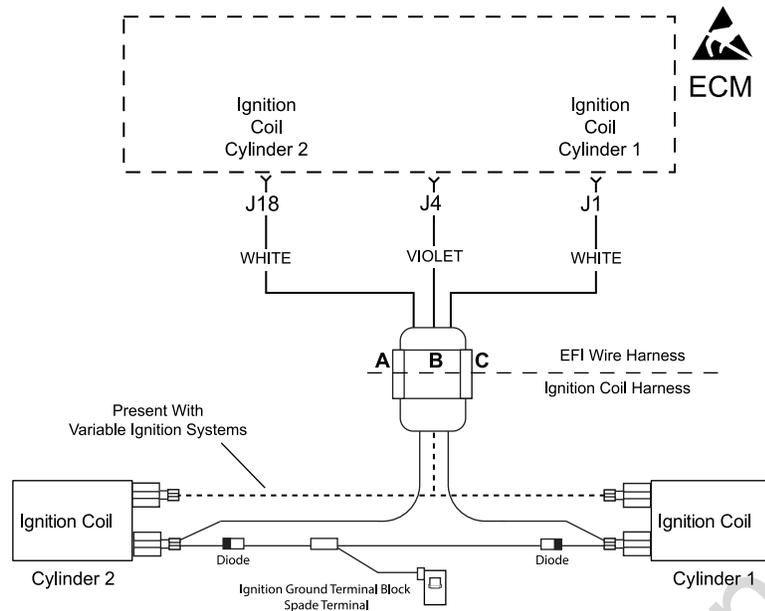
Fuel Pump Module Connector



ECM Connector

DTC P0351/P0352 CYLINDER 1 OR CYLINDER 2 IGNITION COIL FAULT

2



Circuit Description

The ECM is connected to the ignition coils to determine proper fuel injection timing. In some engines, the ECM also controls the ignition coils for spark timing. In addition to the two wires used in the standard fixed timing ignition system, these units can be identified by the presence of a third wire that connects to ECM terminal J4.

The DTCs indicate which ignition coil is faulty.

When an ignition coil fault is set, the ECM shuts down the fuel injection to the same cylinder. The engine continues to run on one cylinder if no fault code is set for the opposite cylinder.

Diagnostic Aids

Check for the following conditions:

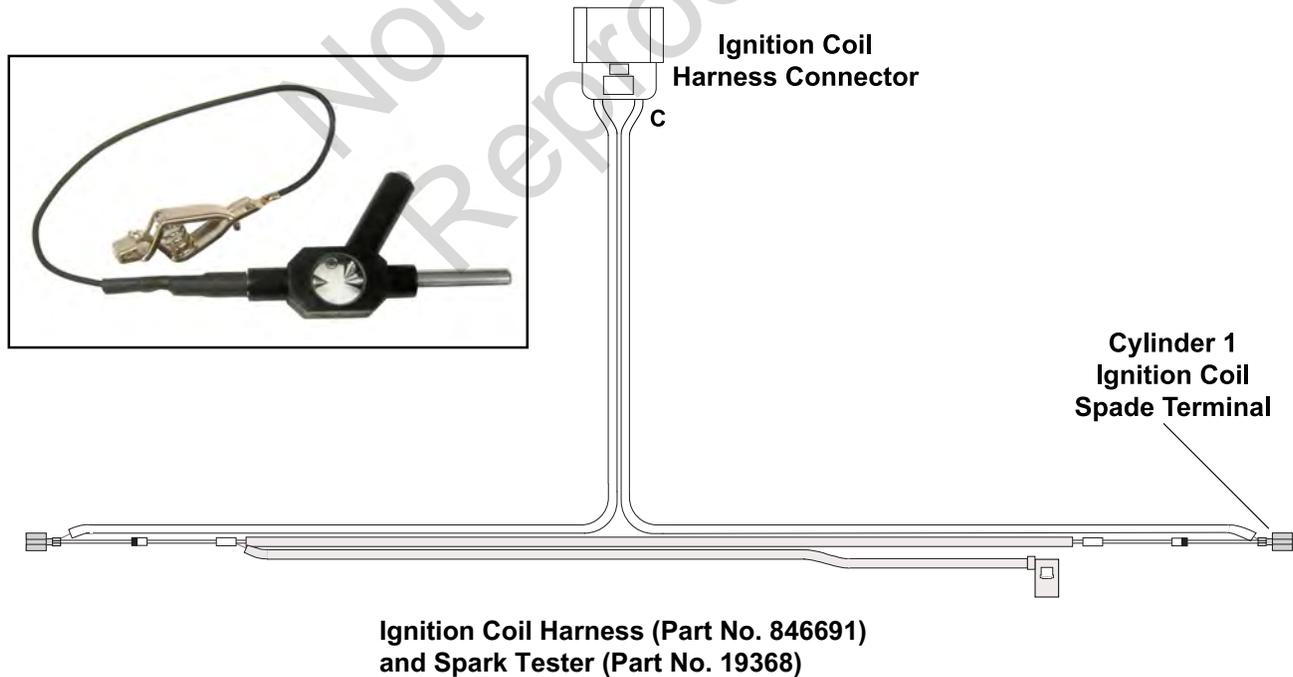
1. Poor ECM connection.
2. Inspect wire harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
3. Damaged wire harness and/or connectors. If harness appears to be OK, shake or wiggle wire harness and/or connector with DVOM attached. Radical voltage changes can indicate the location of the fault condition.

Always clear DTCs after performing repairs.

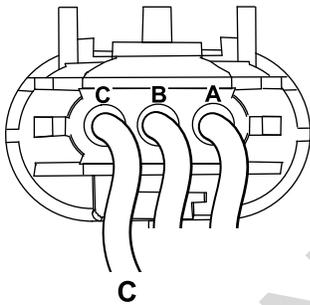
DTC P0351 Cylinder 1 Ignition Coil Circuit Open or Grounded (Non-Scan Diagnostics)

2

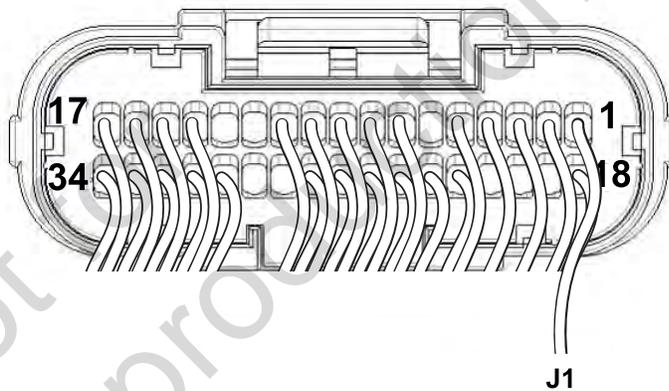
Step	Action	Yes	No
1	1. Disconnect and reconnect ignition coil and ECM connectors. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect and reconnect service power supply connector. 5. Does DTC return?	Go to step 2.	Problem corrected.
2	1. Obtain two Briggs & Stratton Spark Testers (Part No. 19368). 2. Install spark testers in line with high tension leads and spark plugs. 3. Crank engine and look for spark in tester windows. 4. Is spark observed?	Go to step 3.	See Vanguard OHV V-Twin Repair Manual.
3	1. Check ignition coil harness for damaged wires and faulty connections. 2. Is a problem found?	Repair.	Go to step 4.
4	1. Back probe terminal J1 (White wire) of ECM connector. 2. Connect terminal J1 back probe to red meter test lead on DVOM. 3. Connect probe of black meter test lead on DVOM to cylinder 1 ignition coil spade terminal. 4. Set DVOM to read resistance. 5. Observe resistance on DVOM. 6. Is reading 0.1 ohms or less?	Check ignition system. See Vanguard OHV V-Twin Repair Manual.	Go to step 5.
Continued...			



Step	Action	Yes	No
5	<ol style="list-style-type: none"> 1. Remove probe of black meter test lead from cylinder 1 ignition coil spade terminal. 2. Back probe terminal C (White wire) of ignition coil connector (EFI wire harness side). 3. Connect terminal C back probe to black meter test lead on DVOM. 4. Observe resistance on DVOM. 5. Is reading 0.1 ohms or less? 	Go to step 6.	Repair or replace EFI wire harness.
6	<ol style="list-style-type: none"> 1. Remove probe from ECM terminal J1, and back probe terminal C (White wire) of ignition coil connector (ignition harness side). 2. Observe resistance on DVOM. 3. Is reading 0.1 ohms or less? 	Go to step 7.	Inspect pin and socket halves of ignition coil harness connector for loose or backed out terminals. Repair as necessary.
7	<ol style="list-style-type: none"> 1. Remove probe from terminal C of ignition coil connector (EFI wire harness side), and probe cylinder 1 ignition coil spade terminal. 2. Observe resistance on DVOM. 3. Is reading 0.1 ohms or less? 	Return to step 1.	Repair or replace Ignition Coil Harness (Part No. 846691).



**Ignition Coil Harness Connector
(EFI Wire Harness Side)**



ECM Connector

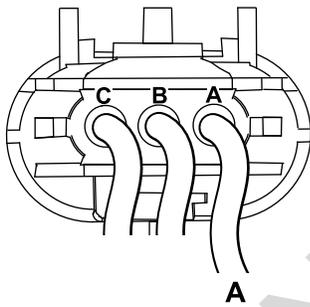
DTC P0352 Cylinder 2 Ignition Coil Circuit Open or Grounded (Non-Scan Diagnostics)

2

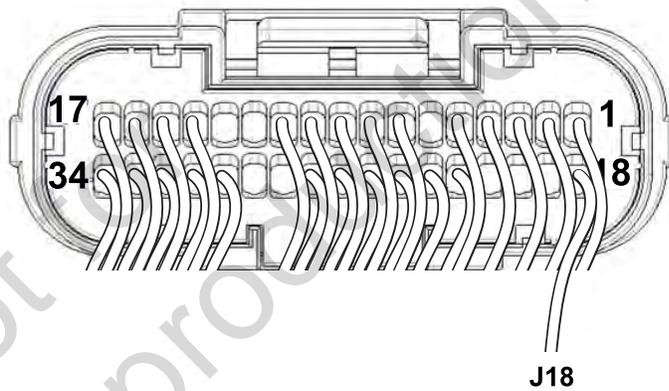
Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Disconnect and reconnect ignition coil and ECM connectors. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect and reconnect service power supply connector. 5. Does DTC return? 	Go to step 2.	Problem corrected.
2	<ol style="list-style-type: none"> 1. Obtain two Briggs & Stratton Spark Testers (Part No. 19368). 2. Install spark testers in line with high tension leads and spark plugs. 3. Crank engine and look for spark in tester windows. 4. Is spark observed? 	Go to step 3.	See Vanguard OHV V-Twin Repair Manual.
3	<ol style="list-style-type: none"> 1. Check ignition coil harness for damaged wires and faulty connections. 2. Is a problem found? 	Repair.	Go to step 4.
4	<ol style="list-style-type: none"> 1. Back probe terminal J18 (White wire) of ECM connector. 2. Connect terminal J18 back probe to red meter test lead on DVOM. 3. Connect probe of black meter test lead on DVOM to cylinder 2 ignition coil spade terminal. 4. Set DVOM to read resistance. 5. Observe resistance on DVOM. 6. Is reading 0.1 ohms or less? 	<p>Check ignition system.</p> <p>See Vanguard OHV V-Twin Repair Manual.</p>	Go to step 5.
Continued...			



Step	Action	Yes	No
5	<ol style="list-style-type: none"> 1. Remove probe of black meter test lead from cylinder 2 ignition coil spade terminal. 2. Back probe terminal A (White wire) of ignition coil connector (EFI wire harness side). 3. Connect terminal A back probe to black meter test lead on DVOM. 4. Observe resistance on DVOM. 5. Is reading 0.1 ohms or less? 	Go to step 6.	Repair or replace EFI wire harness.
6	<ol style="list-style-type: none"> 1. Remove probe from ECM terminal J18, and back probe terminal A (White wire) of ignition coil connector (ignition harness side). 2. Observe resistance on DVOM. 3. Is reading 0.1 ohms or less? 	Go to step 7.	Inspect pin and socket halves of ignition coil harness connector for loose or backed out terminals. Repair as necessary.
7	<ol style="list-style-type: none"> 1. Remove probe from terminal A of ignition coil connector (EFI wire harness side), and probe cylinder 2 ignition coil spade terminal. 2. Observe resistance on DVOM. 3. Is reading 0.1 ohms or less? 	Return to step 1.	Repair or replace Ignition Coil Harness (Part No. 846691).



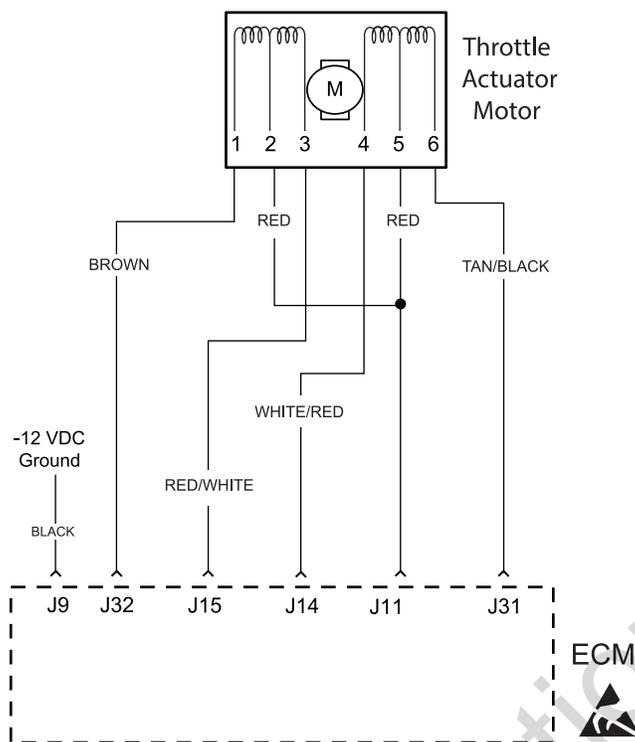
**Ignition Coil Harness Connector
(EFI Wire Harness Side)**



ECM Connector

DTC P0506/P0507/P2102 THROTTLE ACTUATOR MOTOR FAULT

2



Circuit Description

The ECM controls engine speed by using the throttle actuator motor to regulate the position of the throttle. Power flows through the circuits in the throttle actuator motor as shown in the circuit diagram above.

Before performing circuit diagnosis for DTCs P0506 and P0507, proceed as follows:

- Verify that the throttle actuator motor lever and linkage is installed correctly (see Figure on next page). Linkage and link spring between throttle actuator motor and throttle lever must be properly installed, and throttle lever, throttle actuator motor lever, and linkage must move freely without binding.
- Engines with a fixed speed typically have a speed selection wire and connector in the EFI wire harness (see Figure 15). For generator applications, connector is connected for 50 Hz and disconnected for 60 Hz. Verify correct connect/disconnect based on application. For non-generator applications without a variable speed control, verify correct speed. No speed change could indicate faulty speed circuit wires or connector.

- If equipped with variable speed control, look for the appropriate speed change when the control is actuated. No speed change or inappropriate speed change could indicate a faulty switch, circuit wires, or connector.

Diagnostic Aids

Check for the following conditions:

1. Poor ECM connection.
2. Inspect wire harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
3. Damaged wire harness and/or connectors. If harness appears to be OK, shake or wiggle wire harness and/or connector with DVOM attached. Radical voltage changes can indicate the location of the fault condition.

Always clear DTCs after performing repairs.

DTC P0506/P0507 Throttle Actuator Motor RPM Low or High (Non-Scan Diagnostics)

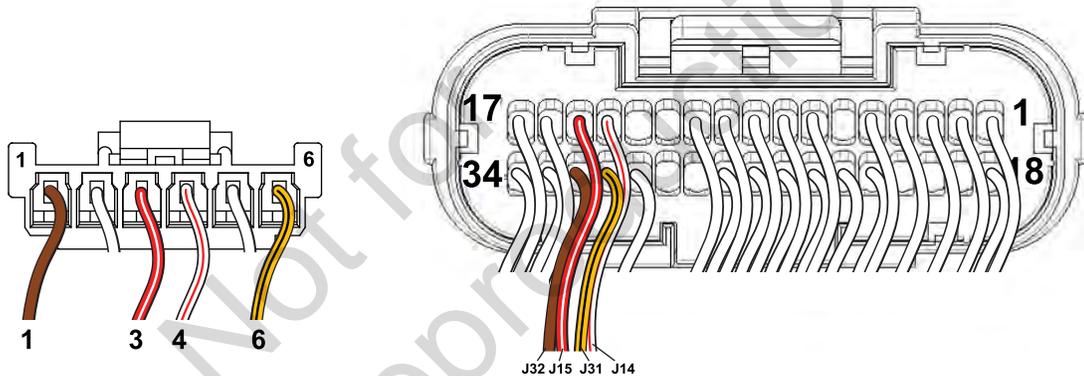
2

Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Disconnect and reconnect throttle actuator motor and ECM connectors. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect and reconnect service power supply connector. 5. Does DTC return? 	Go to step 2.	Problem corrected.
2	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Disconnect throttle actuator motor connector. 3. Back probe terminal 1 (Brown wire) of throttle actuator motor connector. 4. Connect terminal 1 back probe to red meter test lead on DVOM. 5. Disconnect ECM connector. 6. Back probe terminal J32 (Brown wire) of ECM connector. 7. Connect terminal J32 back probe to black meter test lead on DVOM. 8. Set DVOM to read resistance. 9. Does DVOM read 0.5 ohm or less? 	Go to step 3.	Resistance reading is above 0.5 ohm. Check terminals for corrosion or replace EFI wire harness.
Continued...			



Verify Proper Installation of Throttle Actuator Motor Lever and Linkage.

Step	Action	Yes	No
3	1. Remove probe from terminal 1, and back probe terminal 3 (Red/White wire) of throttle actuator motor connector. 2. Remove probe from terminal J32, and back probe terminal J15 (Red/White wire) of ECM connector. 3. Does DVOM read 0.5 ohm or less?	Go to step 4.	Resistance reading is above 0.5 ohm. Check terminals for corrosion or replace EFI wire harness.
4	1. Remove probe from terminal 3, and back probe terminal 4 (White/Red wire) of throttle actuator motor connector. 2. Remove probe from terminal J15, and back probe terminal J14 (White/Red wire) of ECM connector. 3. Does DVOM read 0.5 ohm or less?	Go to step 5.	Resistance reading is above 0.5 ohm. Check terminals for corrosion or replace EFI wire harness.
5	1. Remove probe from terminal 4, and back probe terminal 6 (Tan/Black wire) of throttle actuator motor connector. 2. Remove probe from terminal J14, and back probe terminal J31 (Tan/Black wire) of ECM connector. 3. Does DVOM read 0.5 ohm or less?	Return to step 6.	Resistance reading is above 0.5 ohm. Check terminals for corrosion or replace EFI wire harness.
6	1. Repeat step 1. 2. Does DTC return?	Go to DTC P2102.	Problem corrected.



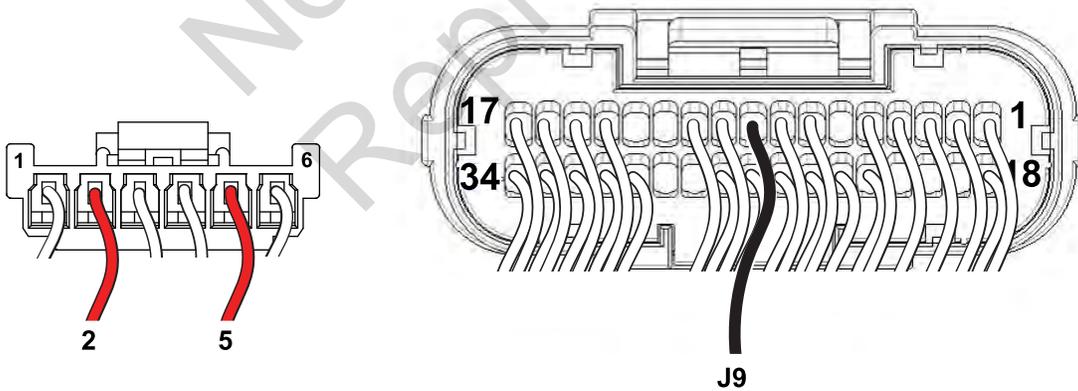
Throttle Actuator Motor Connector

ECM Connector

DTC P2102 Throttle Actuator Motor Driver Circuit Open or Grounded (Non-Scan Diagnostics)

2

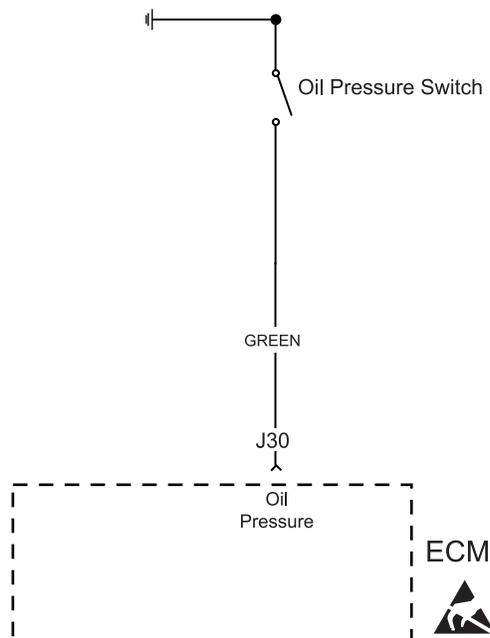
Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Disconnect and reconnect throttle actuator motor and ECM connectors. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect and reconnect service power supply connector. 5. Does DTC return? 	Go to step 2.	Problem corrected.
2	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Back probe terminal 2 (Red wire) of throttle actuator motor connector. 3. Connect terminal 2 back probe to red meter test lead on DVOM. 4. Back probe terminal J9 (Black wire) of ECM connector. 5. Connect terminal J9 back probe to black meter test lead on DVOM. 6. Set DVOM to read volts DC. 7. Does DVOM read 12.2-13.5 volts DC while cranking engine? 	Go to step 3.	<p>No power going to throttle actuator motor.</p> <p>Go to DTC P0562/P0563.</p>
3	<ol style="list-style-type: none"> 1. Remove probe from terminal 2, and back probe terminal 5 (Red wire) of throttle actuator motor connector. 2. Does DVOM read 12.2-13.5 volts DC while cranking engine? 	<p>Check throttle actuator motor connector terminals and EFI harness for corrosion. Clean or replace as necessary.</p> <p>Replace throttle actuator motor if other corrections fail.</p>	<p>No power going to throttle actuator motor.</p> <p>Go to DTC P0562/P0563.</p>



Throttle Actuator Motor Connector

ECM Connector

DTC P0520/P0524 ENGINE OIL PRESSURE SWITCH FAULT



2

Circuit Description

The normally closed contacts of the oil pressure switch are held open by engine oil pressure when the engine is running. If oil pressure drops below 7-10 psi, the contacts close to complete a circuit to ground, and DTC P0524 is set.

The ECM will also check to verify a closed circuit (switch contacts closed) when the engine is not running. The Service Power Supply Harness (Part No. 847252) must be used to do this check. If an open circuit is detected, then DTC P0520 is displayed after a delay of 30 seconds (but the code is not stored).

Diagnostic Aids

Check for the following conditions:

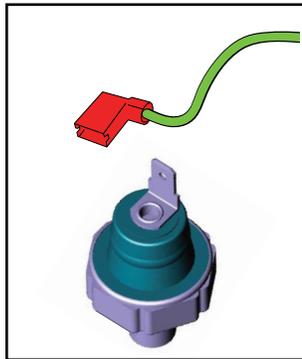
1. Poor ECM connection or oil pressure switch terminal connection.
2. Inspect wire harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
3. Damaged wire harness and/or connectors. If harness appears to be OK, shake or wiggle wire harness and/or connector with DVOM attached. Radical voltage changes can indicate the location of the fault condition.

Always clear DTCs after performing repairs.

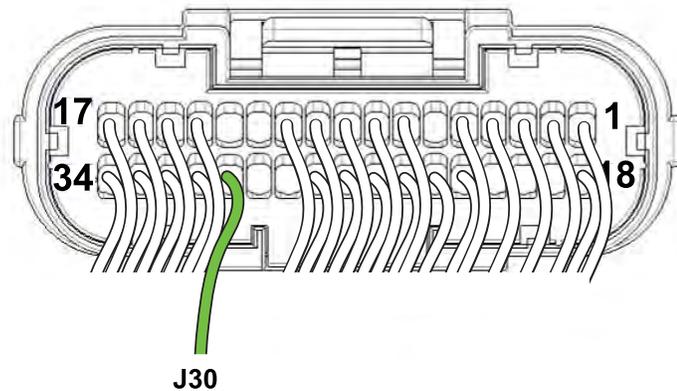
DTC P0520 Engine Oil Pressure Switch Circuit Open or Grounded (Non-Scan Diagnostics)

2

Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Disconnect and reconnect oil pressure switch and ECM connectors. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect code reader. 5. Disconnect and reconnect service power supply connector. 6. Wait for 30 seconds to elapse. 7. Connect code reader. 8. Does DTC return? 	Go to step 2.	Problem corrected.
2	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Back probe terminal J30 (Green wire) of ECM connector. 3. Connect terminal J30 back probe to red meter test lead on DVOM. 4. Disconnect oil pressure switch connector. 5. Connect black meter test lead on DVOM to spade socket terminal. 6. Set DVOM to read resistance. 7. Observe resistance on DVOM. 8. Is reading 0.1 ohms or less? 	Green wire is OK. Go to step 3.	Repair or replace EFI wire harness or connectors.
3	<ol style="list-style-type: none"> 1. Connect red meter test lead on DVOM to oil pressure switch spade terminal. 2. Connect black meter test lead to metal portion of switch body. 3. Observe resistance on DVOM. 4. Is reading 0.1 ohms or less? 	Oil pressure switch OK. Go back to step 1.	Replace oil pressure switch.



Oil Pressure Switch

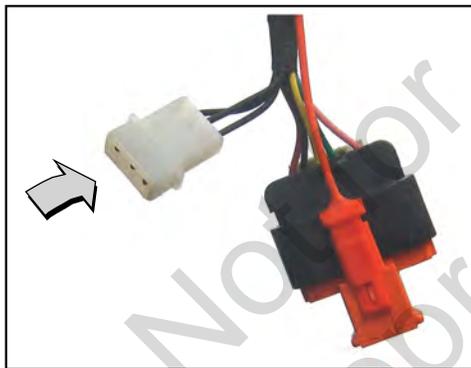


ECM Connector

DTC P0524 Engine Low Oil Pressure (Non-Scan Diagnostics)

Step	Action	Yes	No
1	1. Check engine oil level. 2. Is engine oil level low? Add oil as necessary.	Go to step 3.	Go to step 2.
2	1. Check oil pressure switch wire. 2. Is oil pressure switch wire shorting to ground?	Repair. Go to step 3.	Replace oil pressure switch.
3	1. Install Service Power Supply Harness (Part No. 847252). 2. Clear codes. 3. Disconnect code reader. 4. Disconnect and reconnect service power supply connector. 5. Wait for 30 seconds to elapse. 6. Connect code reader. 7. Does DTC return?	Check oil pump. See Vanguard OHV V-Twin Repair Manual.	Problem corrected.

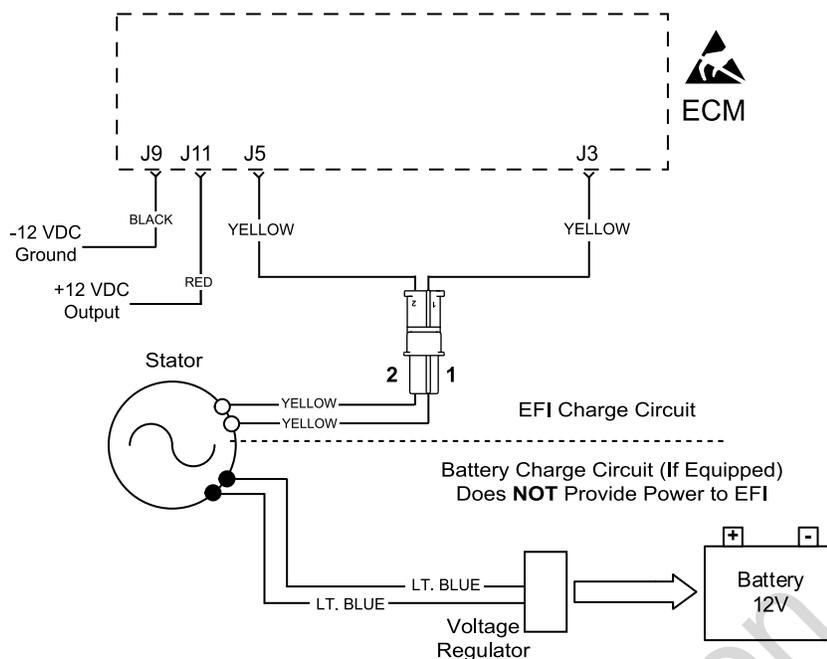
2



Service Power Supply Connector

DTC P0562/P0563 ECM OUTPUT SUPPLY VOLTAGE

2



Circuit Description

The EFI system operates with a voltage of 9-16 volts. If the system voltage drops below 6.2 volts the ECM will reset. During normal operation, the MIL is illuminated if the voltage is below 9 volts (setting P0562) or above 16 volts (setting P0563) for a specified amount of time.

NOTE: The M38 EFI charging system operates independently of the battery charge system (if equipped) and is only used for powering the EFI system. Any battery charge system that may be supplied does not provide power to the EFI system.

Diagnostic Aids

Check for the following conditions:

1. Poor ECM connection.
2. Inspect wire harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
3. Damaged wire harness and/or connectors. If harness appears to be OK, shake or wiggle wire harness and/or connector with DVOM attached. Radical voltage changes can indicate the location of the fault condition.

Always clear DTCs after performing repairs.

DTC P0562 System Voltage Low (Scan Diagnostics)

Step	Action	Yes	No
1	1. Select the Dashboard icon in the left sidebar to view the Dealer tab. 2. Observe the Ignition Voltage display with or without the engine running. 3. Is reading 9.0-15.0 volts DC?	System voltage OK.	Go to step 2.
2	Is reading below 9.0 volts DC?	Go to DTC P0562 Non-Scan Diagnostics.	-

2

The screenshot shows the Briggs & Stratton Diagnostic Tool interface. The main display area contains several gauges and status indicators:

- INTAKE AIR TEMPERATURE:** 71.5 °F
- HEAD TEMPERATURE:** 66.7 °F
- ENGINE SPEED:** 1808 RPM
- THROTTLE POSITION:** 100.0 %
- IGNITION VOLTAGE:** 12.2 volts (highlighted with a red box and a white arrow)
- MANIFOLD AIR PRESSURE:** 99.4 kPa
- HEATED OXYGEN SENSOR:** 1014.8

Below the gauges is a data table with the following parameters:

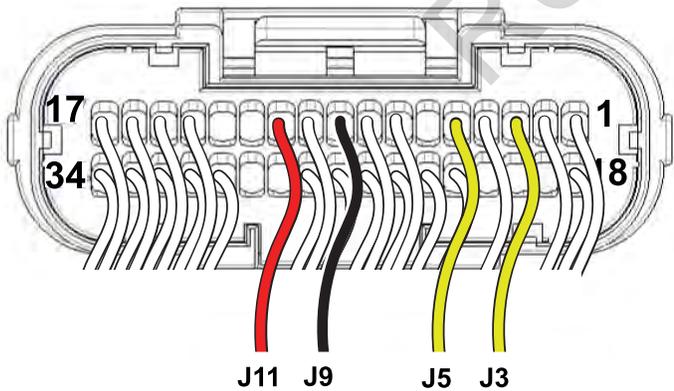
Parameter Name	Value	Unit
Fuel Pump Duty Cycle	100.0	%
Fuel Pulse Width Cyl1	15.36	ms
Fuel Pulse Width Cyl2	0.00	ms
Engine Run Time	11	sec
Flywheel tooth error count	0	count
Baro Pressure	99.4	kPa
Permanent Engine Run Time	0.1875	hr

Additional information at the bottom right includes Spark Advance (16.2 CA) and Final Fuel AFR (11.8 AFR).

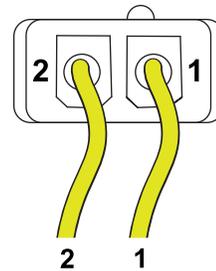
DTC P0562 ECM Output Supply Voltage Low (Non-Scan Diagnostics)

2

Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Disconnect and reconnect ECM connector. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect and reconnect service power supply connector. 5. Does DTC return? 	Go to step 2.	Problem corrected.
2	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Back probe terminal J11 (Red wire) of ECM connector. 3. Connect terminal J11 back probe to red meter test lead on DVOM. 4. Back probe terminal J9 (Black wire) of ECM connector. 5. Connect terminal J9 back probe to black meter test lead on DVOM. 6. Set DVOM to read volts DC. 7. Observe voltage on DVOM while cranking engine. 8. Is reading 12-16 volts DC? 	System OK.	Go to step 3.
3	<ol style="list-style-type: none"> 1. Disconnect fuel pump module, fuel injector, and throttle actuator motor connectors. 2. Observe voltage on DVOM while cranking engine. 3. Is reading 12-16 volts DC? 	Go to step 4.	Go to step 7.
4	<ol style="list-style-type: none"> 1. Connect fuel pump module connector. 2. Observe voltage on DVOM while cranking engine. 3. Is reading 12-16 volts DC? 	Go to step 5.	Replace fuel pump module.
Continued...			



ECM Connector



Stator Power Connector (Stator Side)

Step	Action	Yes	No
5	<ol style="list-style-type: none"> 1. Connect fuel injector connector. 2. Observe voltage on DVOM while cranking engine. 3. Is reading 12-16 volts DC? 	Go to step 6.	Replace fuel injector.
6	<ol style="list-style-type: none"> 1. Connect throttle actuator motor connector. 2. Observe voltage on DVOM while cranking engine. 3. Is reading 12-16 volts DC? 	Go to step 7.	Replace throttle actuator motor.
7	<ol style="list-style-type: none"> 1. Disconnect stator power connector. 2. Back probe terminal 1 (Yellow wire) of stator power connector (stator side). 3. Connect terminal 1 back probe to red meter test lead on DVOM. 4. Back probe terminal 2 (Yellow wire) of stator power connector (stator side). 5. Connect terminal 2 back probe to black meter test lead on DVOM. 6. Set DVOM to read volts AC. 7. Observe voltage on DVOM while cranking engine. 8. Is reading 44-52 volts AC? 	Go to step 8.	Replace stator.
8	<ol style="list-style-type: none"> 1. Remove probe from terminal 2, and back probe terminal J3 (Yellow wire) of ECM connector. 2. Set DVOM to read resistance. 3. Observe resistance on DVOM. 4. Is reading 0.1 ohms or less? 	Go to step 9.	Repair or replace EFI wire harness/stator connector.
9	<ol style="list-style-type: none"> 1. Remove probe from terminal J3, and back probe terminal J5 (Yellow wire) of ECM connector. 2. Remove probe from terminal 1, and back probe terminal 2 (Yellow wire) of stator power connector (stator side). 3. Observe resistance on DVOM. 4. Is reading 0.1 ohms or less? 	Replace ECM and retest.	Repair or replace EFI wire harness/stator connector.

DTC P0563 System Voltage High (Scan Diagnostics)

2

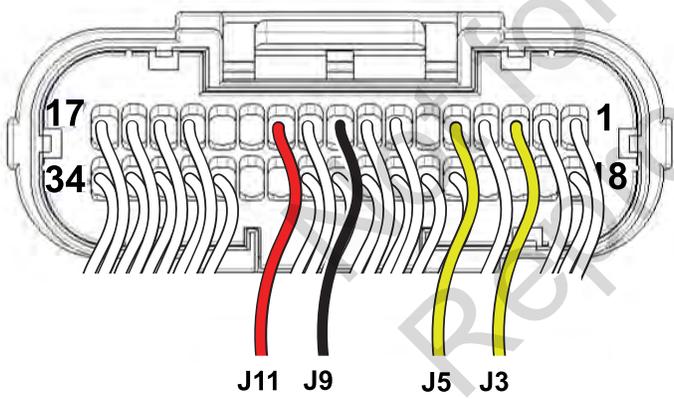
Step	Action	Yes	No
1	1. Select the Dashboard icon in the left sidebar to view the Dealer tab. 2. Observe the Ignition Voltage display with or without the engine running. 3. Is reading 9.0-15.0 volts DC?	System voltage OK.	Go to step 2.
2	Is reading above 15.0 volts DC?	Go to DTC P0563 Non-Scan Diagnostics.	-

The screenshot displays the Briggs & Stratton Diagnostic Tool interface. The main dashboard area contains several gauges and data tables. The Ignition Voltage gauge is highlighted with a red box and a white arrow pointing to it, showing a reading of 12.2 volts. Other gauges include Intake Air Temperature (71.5°F), Head Temperature (66.7°F), Engine Speed (1808 RPM), Throttle Position (100.0%), and Manifold Air Pressure (99.4 kPa). A table of engine parameters is also visible, including Fuel Pump Duty Cycle (100.0%), Fuel Pulse Width Cyl1 (15.36 ms), Fuel Pulse Width Cyl2 (0.00 ms), Engine Run Time (11 sec), Flywheel tooth error count (0 count), Baro Pressure (99.4 kPa), and Permanent Engine Run Time (0.1875 hr). The interface also features a 'CHECK ENGINE' indicator and a 'HEATED OXYGEN SENSOR' gauge showing 1014.8.

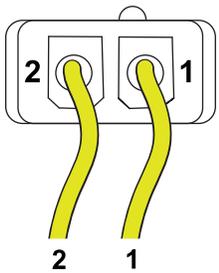
DTC P0563 ECM Output Supply Voltage High (Non-Scan Diagnostics)

2

Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Disconnect and reconnect ECM connector. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect and reconnect service power supply connector. 5. Does DTC return? 	Go to step 2.	Problem corrected.
2	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Back probe terminal J11 (Red wire) of ECM connector. 3. Connect terminal J11 back probe to red meter test lead on DVOM. 4. Back probe terminal J9 (Black wire) of ECM connector. 5. Connect terminal J9 back probe to black meter test lead on DVOM. 6. Set DVOM to read volts DC. 7. Observe voltage on DVOM while cranking engine. 8. Is reading 12-16 volts DC? 	System OK.	Go to step 3.
Continued...			



ECM Connector

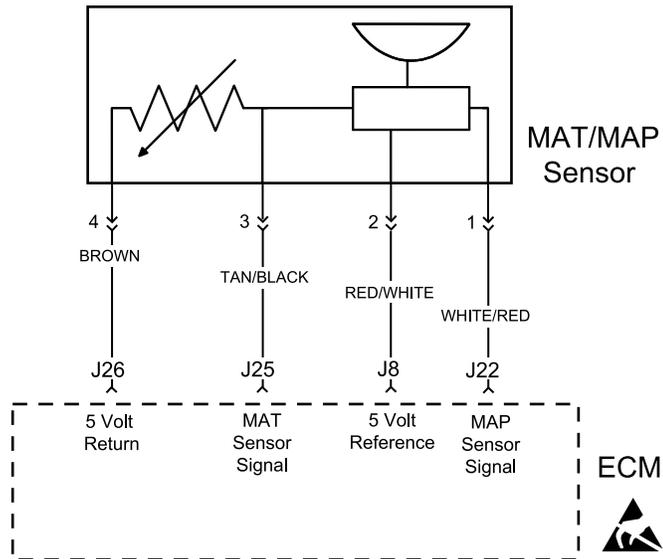


Stator Power Connector (Stator Side)

Step	Action	Yes	No
3	<ol style="list-style-type: none"> 1. Disconnect stator power connector. 2. Probe terminal 1 (Yellow wire) of stator power connector (stator side). 3. Connect terminal 1 back probe to red meter test lead on DVOM. 4. Probe terminal 2 (Yellow wire) of stator power connector (stator side). 5. Connect terminal 2 back probe to black meter test lead on DVOM. 6. Set DVOM to read volts AC. 7. Observe voltage on DVOM while cranking engine. 8. Is reading 44-52 volts AC? 	Go to step 4.	Replace stator.
4	<ol style="list-style-type: none"> 1. Remove probe from terminal 2, and back probe terminal J3 (Yellow wire) of ECM connector. 2. Set DVOM to read resistance. 3. Observe resistance on DVOM. 4. Is reading 0.1 ohms or less? 	Go to step 5.	Repair or replace EFI wire harness/stator connector.
5	<ol style="list-style-type: none"> 1. Remove probe from terminal J3, and back probe terminal J5 (Yellow wire) of ECM connector. 2. Remove probe from terminal 1, and back probe terminal 2 (Yellow wire) of stator power connector (stator side). 3. Observe resistance on DVOM. 4. Is reading 0.1 ohms or less? 	Replace ECM and retest.	Repair or replace EFI wire harness/stator connector.

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DTC P0661 MAT/MAP SENSOR POWER SUPPLY VOLTAGE LOW



2

Circuit Description

The MAT/MAP sensor uses a thermistor to control signal voltage to the ECM. The ECM applies 5 volts on the sensor circuit. Sensor resistance changes as ambient temperature changes, which in turn affects the voltage return to the ECM.

Diagnostic Aids

Check for the following conditions:

1. Poor ECM connection.

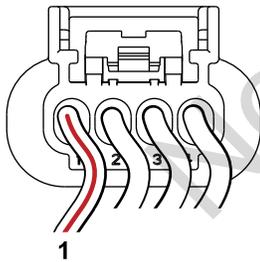
2. Inspect wire harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
3. Damaged wire harness and/or connectors. If harness appears to be OK, shake or wiggle wire harness and/or connector with DVOM attached. Radical voltage changes can indicate the location of the fault condition.

Always clear DTCs after performing repairs.

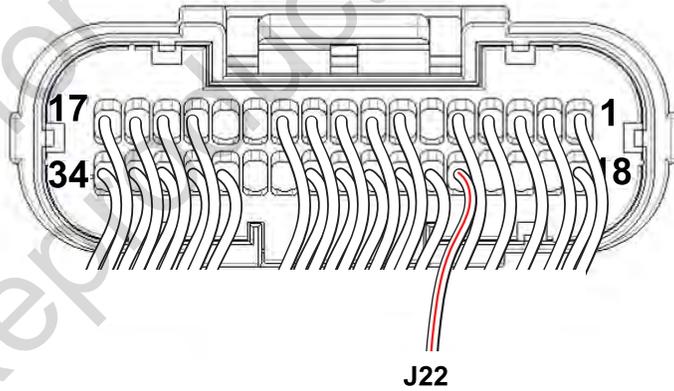
DTC P0661 MAT/MAP Sensor Power Supply Voltage Low (Non-Scan Diagnostics)

2

Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Disconnect and reconnect MAP sensor and ECM connectors. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect and reconnect service power supply connector. 5. Does DTC return? 	Go to step 2.	Problem corrected.
2	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Back probe terminal 1 (White/Red wire) of MAP sensor connector. 3. Connect terminal 1 back probe to red meter test lead on DVOM. 4. Back probe terminal J22 (White/Red wire) of ECM connector. 5. Connect terminal J22 back probe to black meter test lead on DVOM. 6. Set DVOM to read resistance. 7. Observe resistance on DVOM. 8. Is reading 0.1 ohms or less? 	System OK.	Repair or replace EFI wire harness or connectors.



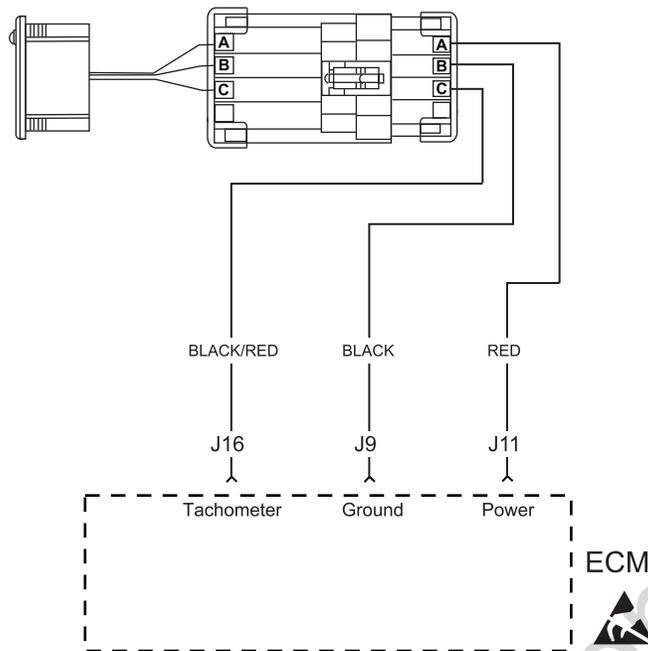
MAP Sensor Connector



ECM Connector

DTC P1693/P1694 TACHOMETER FAULT

2



Circuit Description

The unit consists of a MIL and LCD display, which shows RPM when the engine is running and total engine running hours when it is not.

Diagnostic Aids

Check for the following conditions:

1. Poor ECM connection.

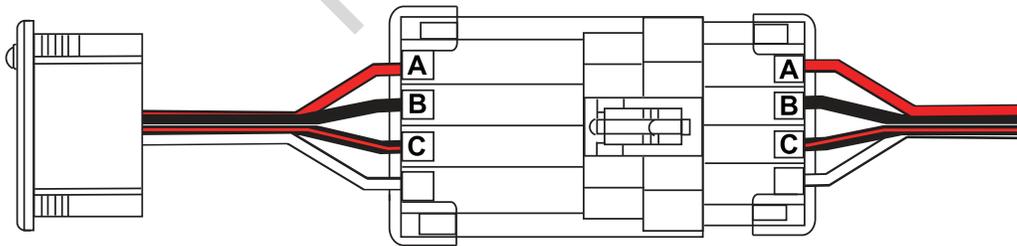
2. Inspect wire harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
3. Damaged wire harness and/or connectors. If harness appears to be OK, shake or wiggle wire harness and/or connector with DVOM attached. Radical voltage changes can indicate the location of the fault condition.

Always clear DTCs after performing repairs.

DTC P1693/P1694 Tachometer Driver Circuit Open, Grounded, or Shorted to B+ (Non-Scan Diagnostics)

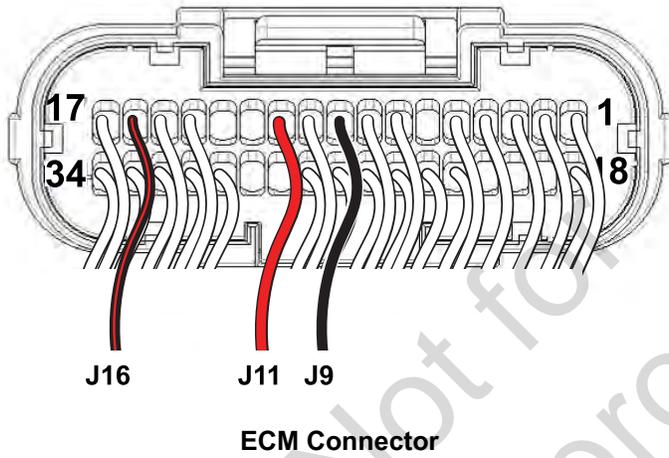
2

Step	Action	Yes	No
1	<ol style="list-style-type: none"> 1. Disconnect and reconnect tachometer and ECM connectors. 2. Install Service Power Supply Harness (Part No. 847252). 3. Clear codes. 4. Disconnect and reconnect service power supply connector. 5. Does DTC return? 	Go to step 2.	Problem corrected.
2	<ol style="list-style-type: none"> 1. Back probe terminal J11 (Red wire) of ECM connector. 2. Connect terminal J11 back probe to red meter test lead on DVOM. 3. Back probe terminal J9 (Black wire) of ECM connector. 4. Connect terminal J9 back probe to black meter test lead on DVOM. 5. Set DVOM to read volts DC. 6. Observe voltage on DVOM while cranking engine. 7. Is reading greater than 9 volts DC? 	Replace tachometer.	Go to step 3.
3	<ol style="list-style-type: none"> 1. Disconnect service power supply connector. 2. Remove probe from terminal J9, and back probe terminal A (Red wire) of tachometer connector. 3. Set DVOM to read resistance. 4. Observe resistance on DVOM. 5. Is reading 0.1 ohms or less? 	Go to step 4.	Repair or replace EFI wire harness or connectors.
Continued...			



Tachometer Connector

Step	Action	Yes	No
4	<ol style="list-style-type: none"> 1. Remove probe from terminal A, and back probe terminal B (Black wire) of tachometer connector. 2. Remove probe from terminal J11, and back probe terminal J9 (Black wire) of ECM connector. 3. Observe resistance on DVOM. 4. Is reading 0.1 ohms or less? 	Go to step 4.	Repair or replace EFI wire harness or connectors.
5	<ol style="list-style-type: none"> 1. Remove probe from terminal B, and back probe terminal C (Black/Red wire) of tachometer connector. 2. Remove probe from terminal J9, and back probe terminal J16 (Black/Red wire) of ECM connector. 3. Connect terminal J16 back probe to black meter test lead on DVOM. 4. Observe resistance on DVOM. 5. Is reading 0.1 ohms or less? 	Replace tachometer.	Repair or replace EFI wire harness or connectors.



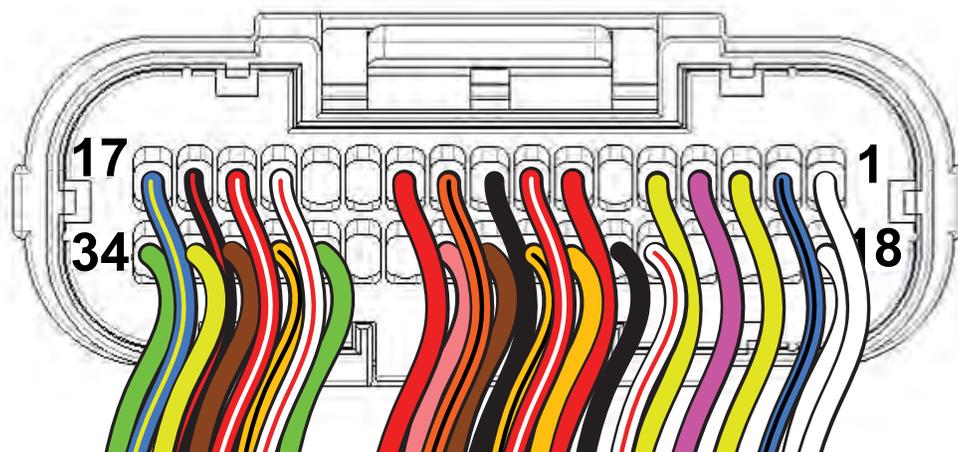
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SECTION 3 - WIRE SCHEMATICS AND PIN-OUTS

ECM CONNECTOR PIN-OUT	62
MODEL 380000 EFI ELECTRICAL SCHEMATIC	64

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ECM CONNECTOR PIN-OUT



Connector-Pin Number	Wire Color	Function
J1	White	Cylinder 1 Ignition Coil Signal Input
J2	Lt. Blue/Black	Fuel Injector
J3	Yellow	Exciter Coil High
J4	Violet	Engine Spark Timing
J5	Yellow	Exciter Coil Low
J6	NOT USED	
J7	Red	Battery Input (EFI Diagnostics Only)
J8	Red/White	5 Volt Reference (5VREF)
J9	Black	Power Ground
J10	Orange/Black	Malfunction Indicator Lamp (MIL)
J11	Red	Pump/Injector Power Output (MPR), Throttle Actuator Motor (If Equipped)
J12	NOT USED	
J13	NOT USED	
J14	White/Red	Throttle Actuator Motor Control A
J15	Red/White	Throttle Actuator Motor Control B
J16	Black/Red	Tachometer
J17	Blue/Yellow	Fuel Pump
J18	White	Cylinder 2 Ignition Coil Signal Input
J19	NOT USED	
J20	NOT USED	
J21	NOT USED	
J22	White/Red	Manifold Absolute Pressure (MAP) Sensor
J23	Black	Engine Speed Select Connector: Disconnect for 3660 RPM; connect for 3060 RPM.
J24	Tan	Engine Head Temperature (EHT) Sensor
J25	Tan/Black	Manifold Air Temperature (MAT) Sensor
J26	Brown	Signal Ground
J27	Pink	Serial Data (K-Line)

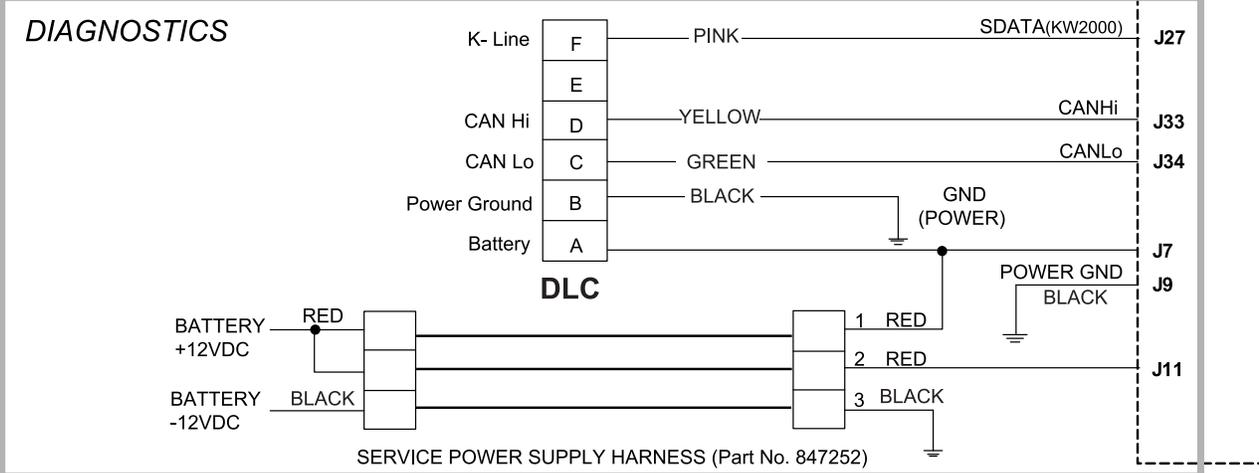
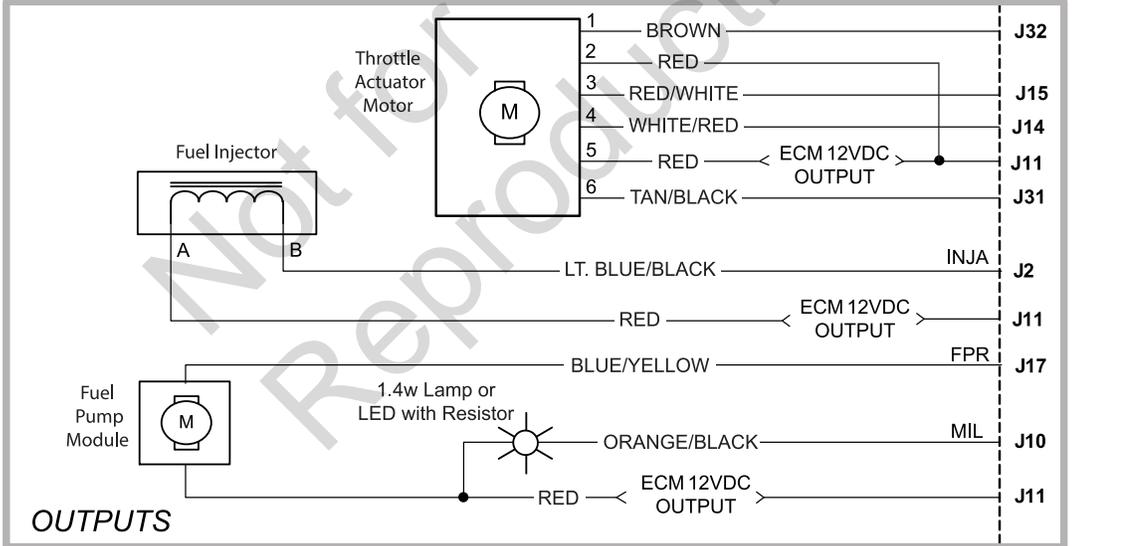
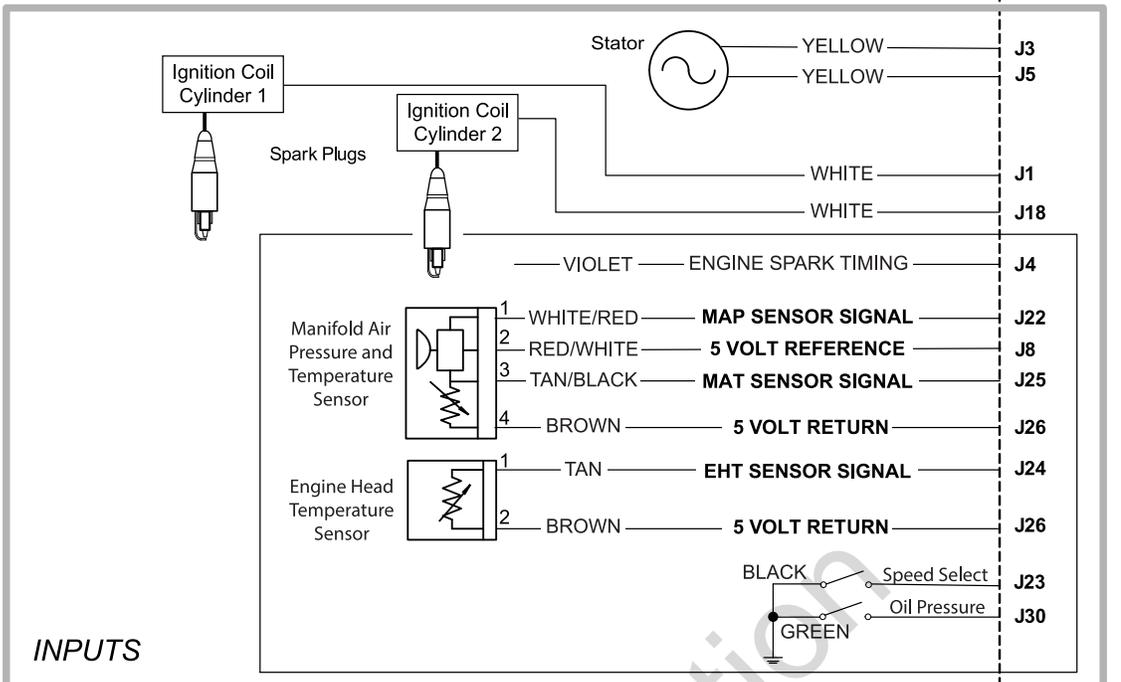
Connector-Pin Number	Wire Color	Function
J28	NOT USED	
J29	NOT USED	
J30	Green	Oil Pressure Switch
J31	Tan/Black	Throttle Actuator Motor Control C
J32	Brown	Throttle Actuator Motor Control D
J33	Yellow	CAN-Hi (Used only for ECM-to-ECM communication)
J34	Green	CAN-Lo (Used only for ECM-to-ECM communication)

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MODEL 380000 EFI ELECTRICAL SCHEMATIC

ECM 

3



SECTION 4 - SYMPTOMS

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INTRODUCTION

Verify Customer Complaint

Verify customer complaint and then move to the Diagnostic Table that best describes the problem.

- Engine does not crank.
- Engine cranks but does not start.
- Engine exhibits hard start symptoms.
- Engine power output low.
- Engine hunts and surges.

4

Perform Visual Check

Each Diagnostic Table contains an instruction to perform a careful visual check. This check should always include the following:

- Verify that ECM grounds and sensor connections are clean, tight and in their proper location.
- Look for air leaks at the throttle body mounting and intake manifold sealing surfaces.
- Inspect ignition wires for cracks, hardness, improper routing and carbon tracking.
- Inspect wires for kinks, cuts, burns, abraded insulation, and other damage.
- Look for moisture in primary or secondary ignition circuit connections.
- Look for salt corrosion on electrical connections and exposed throttle body linkages.

Check electrical connectors for the following:

- Poor mating of connector halves, or a terminal not fully seated in the connector body (backed out or loose).
- Improperly formed or damaged terminals and/or connectors.
- Improper contact tension of connector pin and socket terminals in the problem circuit.

- Poor terminal to wire connection (both core and insulation crimps).

Intermittents

IMPORTANT: Intermittents may not cause the MIL to illuminate or set a DTC. DO NOT use the DTC Tables to diagnose intermittent problems. The fault condition must be present to locate the problem. Many intermittent problems are caused by faulty electrical connections or wiring.

The engine may be operated with a DVOM connected to the suspect circuit. If an abnormal voltage is observed when a malfunction occurs, it is a good indication that there is a fault in the circuit. The Diagnostic Tool also may be used to help detect intermittents.

Check DTC Memory Loss

Disconnect MAP sensor and idle engine until MIL is illuminated. DTC P0107 should be set and stored in ECM memory when the ignition is turned OFF. If it is not, then the ECM is faulty. After performing this test, be sure to clear the DTC from memory.

An intermittent MIL with no stored DTC may be caused by one or more of the following conditions:

- Ignition coil is shorted to ground and arcing is present at ignition wires or plugs.
- MIL wire to ECM is shorted to ground.
- Poor ECM grounds.
- An electrical system interference caused by a sharp electrical surge. The problem normally occurs when the faulty component is operated.
- Secondary ignition components are shorted to ground, or there is an open in the ignition coil ground.
- Engine components, such as starters, alternators or relays, are internally shorted to ground.

ENGINE DOES NOT CRANK

Step	Action	Yes	No
1	Perform OBD System Check. Are any DTCs found?	Go to applicable DTC Table.	Go to step 2.
2	Perform a careful visual check. Is a problem found?	Repair	Go to step 3.
3	Verify PTO clutch is not engaged. Is PTO clutch engaged?	Disengage PTO clutch.	Go to step 4.
4	Verify safety interrupt is NOT active or faulty, if equipped. Is a problem found?	Repair	Go to step 5.
5	Verify ignition switch is working properly. See Vanguard OHV V-Twin Repair Manual. Is a problem found?	Repair	Go to step 6.
6	Verify starter is operating properly. See Vanguard OHV V-Twin Repair Manual. Is a problem found?	Repair	Go to step 7.
7	Review diagnostic procedures in this table. If all steps have been completed and no problems have been found, proceed as follows: <ul style="list-style-type: none"> • Repeat visual check. • Review Diagnostic Tool/Code reader data. • Check all electrical connections within the suspect circuit and/or system. Is a problem found?	Repair	Go to step 8.
8	Carefully review data under <i>ECM CONNECTOR SYMPTOMS</i> in this section. Is a problem found?	Repair	Contact engine manufacturer.

ENGINE CRANKS BUT DOES NOT START

Step	Action	Yes	No
1	Perform OBD System Check. Are any DTCs found?	Go to applicable DTC Table.	Go to step 2.
2	Perform a careful visual check.* Is a problem found?	Repair	Go to step 3.
3	Verify fuel in tank(s). Is there insufficient fuel in tank(s)?	Add fuel.	Go to step 4.
4	Check fuel shut off valve, if equipped. Is fuel shut off valve closed?	Open fuel shut off valve.	Go to step 5.
5	Check the following fuel system components for dirt, water, or other contaminants. <ul style="list-style-type: none"> • Fuel tanks • Fuel filter • Fuel lines • Fuel pumps Is a problem found?	Repair	Go to step 6.
6	Verify that fuel pressure is 38-43 psi (262-296 kPa). See <i>CHECK/RELIEVE FUEL SYSTEM PRESSURE</i> in SECTION 5 - REMOVAL/INSTALLATION. Is a problem found?	Repair	Go to step 7.
7	Verify safety interrupt is NOT active or faulty, if equipped. Is a problem found?	Repair	Go to step 8.
8	Verify that each cylinder is getting spark. See Vanguard OHV V-Twin Repair Manual. Is a problem found?	Repair	Go to step 9.
9	See <i>VERIFY ECM POWERS UP</i> in SECTION 2 - TROUBLESHOOTING DTCs. Is a problem found?	Repair	Go to step 10.
10	Check engine for the following mechanical problems: <ul style="list-style-type: none"> • Low compression. • Leaking cylinder head gaskets. • Proper valve set up. See Vanguard OHV V-Twin Repair Manual. Is a problem found?	Repair	Go to step 11.
Continued...			

Step	Action	Yes	No
11	Review diagnostic procedures in this table. If all steps have been completed and no problems have been found, proceed as follows: <ul style="list-style-type: none"> • Repeat visual check. • Review Diagnostic Tool/Code reader data. • Check all electrical connections within the suspect circuit and/or system. Is a problem found?	Repair	Go to step 12.
12	Carefully review data under <i>ECM CONNECTOR SYMPTOMS</i> in this section. Is a problem found?	Repair	Contact engine manufacturer.

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ENGINE EXHIBITS HARD START SYMPTOMS

Definition: Engine cranks OK, but does not start for a long time. Engine does run, or may start but immediately die.

Step	Action	Yes	No
1	Perform OBD System Check. Are any DTCs found?	Go to applicable DTC Table.	Go to step 2.
2	Perform a careful visual check. Is a problem found?	Repair	Go to step 3.
3	Check the following fuel system components for dirt, water, or other contaminants. <ul style="list-style-type: none"> • Fuel tanks • Fuel filter • Fuel lines • Fuel pumps Is a problem found?	Repair	Go to step 4.
4	Verify that fuel pressure is 38-43 psi (262-296 kPa). See <i>CHECK/RELIEVE FUEL SYSTEM PRESSURE</i> in SECTION 5 - <i>REMOVAL/INSTALLATION</i> . Is a problem found?	Repair	Go to step 5.
5	Check for intermittent opens or shorts to ground in MAP sensor circuit. Is a problem found?	Repair	Go to step 6.
6	Check engine for the following mechanical problems: <ul style="list-style-type: none"> • Low compression. • Leaking cylinder head gaskets. • Proper valve set up. See Vanguard OHV V-Twin Repair Manual. Is a problem found?	Repair	Go to step 7.
7	Review diagnostic procedures in this table. If all steps have been completed and no problems have been found, proceed as follows: <ul style="list-style-type: none"> • Repeat visual check. • Review Diagnostic Tool/Code reader data. • Check all electrical connections within the suspect circuit and/or system. Is a problem found?	Repair	Go to step 8.
8	Carefully review data under <i>ECM CONNECTOR SYMPTOMS</i> in this section. Is a problem found?	Repair	Contact engine manufacturer.

4

ENGINE POWER OUTPUT LOW

Step	Action	Yes	No
1	Perform OBD System Check. Are any DTCs found?	Go to applicable DTC Table.	Go to step 2.
2	Perform a careful visual check. Is a problem found?	Repair	Go to step 3.
3	Check the following fuel system components for dirt, water, or other contaminants. <ul style="list-style-type: none"> • Fuel tanks • Fuel filter • Fuel lines • Fuel pumps Is a problem found?	Repair	Go to step 4.
4	Verify that fuel pressure is 38-43 psi (262-296 kPa). See <i>CHECK/RELIEVE FUEL SYSTEM PRESSURE</i> in SECTION 5 - <i>REMOVAL/INSTALLATION</i> . Is a problem found?	Repair	Go to step 5.
5	Verify crankcase oil is at the correct level. Is a problem found?	Add crankcase oil.	Go to step 6.
6	Verify air filter element is clean and dry. Is a problem found?	Replace air filter element.	Go to step 7.
7	Verify engine is not supporting a greater load than intended for its application? Check for the following: <ul style="list-style-type: none"> • Damaged drive belt. • For mowers, verify blades are not restricted by debris. • Faulty pulley bearing(s). Is a problem found?	Repair	Go to step 8.
8	Verify spark plugs are: <ul style="list-style-type: none"> • Gapped properly. • Not gas fouled. • Not excessively worn. Is a problem found?	Repair	Go to step 9.
9	Verify exhaust is not restricted. Is a problem found?	Repair	Go to step 10.
Continued...			

Step	Action	Yes	No
10	Check engine for the following mechanical problems: <ul style="list-style-type: none"> • Low compression. • Leaking cylinder head gaskets. • Proper valve set up. See Vanguard OHV V-Twin Repair Manual. Is a problem found?	Repair	Go to step 11.
11	Review diagnostic procedures in this table. If all steps have been completed and no problems have been found, proceed as follows: <ul style="list-style-type: none"> • Repeat visual check. • Review Diagnostic Tool/Code reader data. • Check all electrical connections within the suspect circuit and/or system. Is a problem found?	Repair	Go to step 12.
12	Carefully review data under <i>ECM CONNECTOR SYMPTOMS</i> in this section. Is a problem found?	Repair	Contact engine manufacturer.

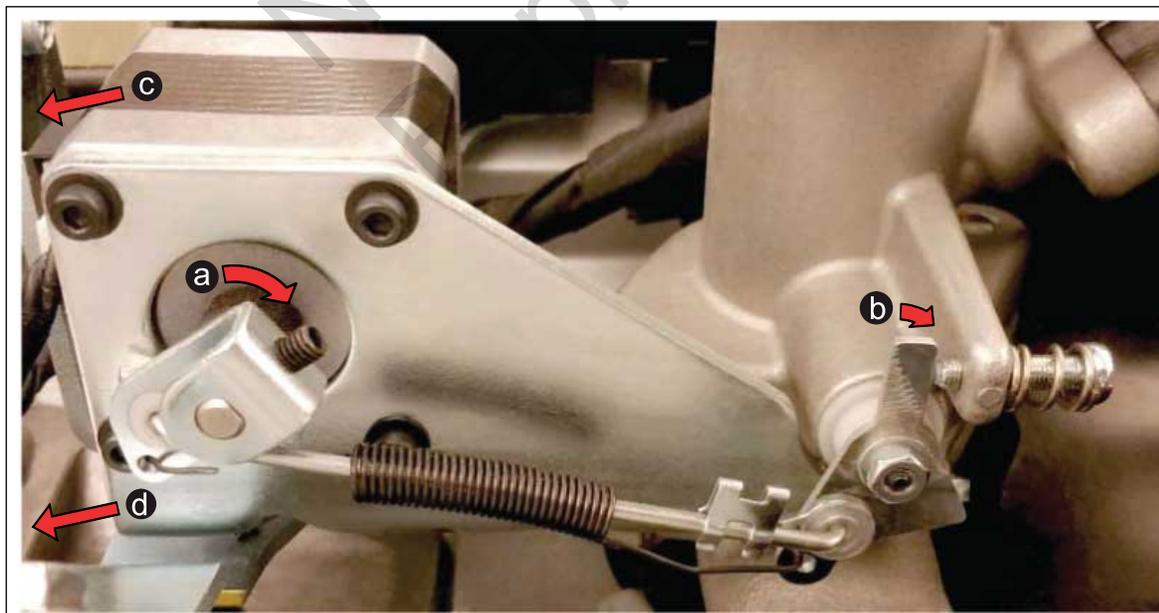
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ENGINE HUNTS AND SURGES

Step	Action	Yes	No
1	Perform OBD System Check. Are any DTCs found?	Go to applicable DTC Table.	Go to step 2.
2	Perform a careful visual check. Is a problem found?	Repair	Go to step 3.
3	Check the following fuel system components for dirt, water, or other contaminants. <ul style="list-style-type: none"> • Fuel tanks • Fuel filter • Fuel lines • Fuel pumps Is a problem found?	Repair	Go to step 4.
4	Verify that fuel pressure is 38-43 psi (262-296 kPa). See <i>CHECK/RELIEVE FUEL SYSTEM PRESSURE</i> in SECTION 5 - <i>REMOVAL/INSTALLATION</i> . Is a problem found?	Repair	Go to step 5.
5	Verify crankcase oil is at the correct level. Is a problem found?	Add crankcase oil.	Go to step 6.
6	Verify air filter element is clean and dry. Is a problem found?	Replace air filter element.	Go to step 7.
7	Verify governor is set up properly. See Vanguard OHV V-Twin Repair Manual for mechanical governor information. Is a problem found?	Repair	Go to step 8.
8	Inspect governor link spring for damage or improper installation. Is a problem found?	Repair	Go to step 9.
9	Disconnect governor spring, and check for binding or uneven resistance in the governor arm travel from stop to stop. Is a problem found?	Repair	Go to step 10.
10	Inspect governor spring and controls for damage or improper installation. Is a problem found?	Repair	Go to step 11.
Continued...			

Step	Action	Yes	No
11	<p>If equipped with electronic governor, inspect electrical connector and wires.</p> <p>Check throttle actuator motor lever to verify correct assembly and orientation. Verify correct assembly of linkage and link spring. Referencing the figure below, proceed as follows:</p> <p>a) Rotate throttle actuator motor lever in a clockwise direction until it stops.</p> <p>b) Holding throttle actuator motor lever in the stopped position, verify that throttle lever makes contact with the dead idle screw.</p> <p>c) If throttle lever rotation is not stopped by the dead idle screw, but by contact with the throttle link, loosen four throttle actuator motor bracket screws. Moving throttle actuator motor as far from throttle body as possible, alternately tighten screws to 9-13 in-lbs (1-2 Nm).</p> <p>d) If throttle lever rotation is still not stopped by the dead idle screw, loosen two throttle body to intake manifold screws. Moving throttle actuator motor bracket away from throttle body, tighten two throttle body to intake manifold screws to 70 in-lbs (8 Nm).</p> <p>Adjust dead idle screw to 1200 RPM (typical).</p> <p>Is problem corrected?</p>	-	Go to step 12.
12	<p>Review diagnostic procedures in this table. If all steps have been completed and no problems have been found, proceed as follows:</p> <ul style="list-style-type: none"> • Repeat visual check. • Review Diagnostic Tool/Code reader data. • Check all electrical connections within the suspect circuit and/or system. <p>Is a problem found?</p>	Repair	Go to step 13.

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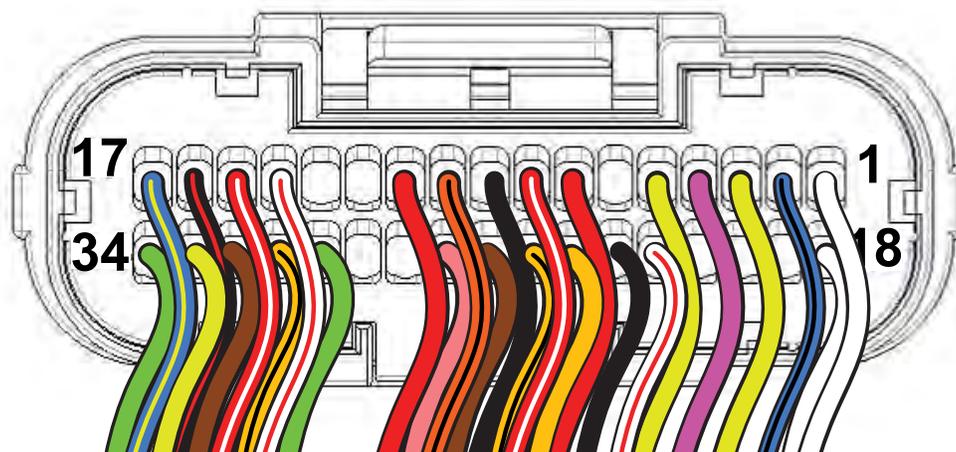


Verify Proper Installation of Throttle Actuator Motor Lever and Linkage.

Step	Action	Yes	No
13	Carefully review data under <i>ECM CONNECTOR SYMPTOMS</i> in this section. Is a problem found?	Repair	Contact engine manufacturer.

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ECM CONNECTOR SYMPTOMS



4

Connector-Pin Number	Function	Wire Color	Possible Symptom(s) From Faulty Circuit
J1	Cylinder 1 Ignition Coil Signal Input	White	Misfire, backfire, afterfire, will not run, rough idle
J2	Fuel Injector	Lt. Blue/Black	Misfire, will not run, rough idle
J3	Stator Coil High	Yellow	Will not run
J4	EST (Engine Spark Timing)	Violet	Low power, knock
J5	Stator Coil Low	Yellow	Will not run
J6	NOT USED		
J7	Battery Input (EFI Diagnostics Only)	Red	(For Service Power Supply Harness)
J8	5 Volt Reference (5VREF)	Red/White	Low power, surging, rough idle, exhaust odor
J9	Power Ground	Black	Will not run
J10	Malfunction Indicator Lamp (MIL)	Orange/Black	MIL inoperative
J11	Pump/Injector Power Output (MPR)	Red	Will not run
J12	NOT USED		
J13	NOT USED		
J14	Throttle Actuator A	White/Red	Governed speed unstable or incorrect
J15	Throttle Actuator B	Red/White	Governed speed unstable or incorrect
J16	Tachometer	Black/Red	Tachometer inoperative
J17	Fuel Pump	Blue/Yellow	Will not run
J18	Cylinder 2 Ignition Coil Signal Input	White	Misfire, backfire, afterfire, will not run, rough idle
J19	NOT USED		
J20	NOT USED		
J21	NOT USED		
J22	Manifold Absolute Pressure (MAP) Sensor	White/Red	General poor performance, surging, exhaust odor, poor fuel economy
J23	Engine Speed Select Connector Connected (Closed): 3060 RPM Disconnected (Open): 3660 RPM	Black	Incorrect speed
J24	Engine Head Temperature (EHT) Sensor	Tan	Hard starting, rough idle, exhaust odor, poor fuel economy
J25	Manifold Air Temperature (MAT) Sensor	Tan/Black	Rough idle

Continued...

Connector-Pin Number	Function	Wire Color	Possible Symptom(s) From Faulty Circuit
J26	Signal Ground	Brown	Low power, surging, rough idle, exhaust odor
J27	Serial Data (K-Line)	Pink	(For service diagnostics)
J28	NOT USED		
J29	NOT USED		
J30	Oil Pressure Switch	Green	Incorrect oil pressure signal
J31	Throttle Actuator C	Tan/Black	Governed speed unstable or incorrect
J32	Throttle Actuator D	Brown	Governed speed unstable or incorrect
J33	CAN-Hi (for ECM-to-ECM Communication Only)	Yellow	(For service diagnostics or communication with other ECM)
J34	CAN-Lo (for ECM-to-ECM Communication Only)	Green	(For service diagnostics or communication with other ECM)

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SECTION 5 - REMOVAL/INSTALLATION

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CHECK/RELIEVE FUEL SYSTEM PRESSURE

Safety Precautions

Always observe the following safety precautions before removing any fuel system components.



- Wear proper eye protection.
- Relieve fuel system pressure.
- Be sure there is no open flame or potential ignition sources in the area.
- When removing a fuel hose or fitting, cover with a shop towel to catch any fuel leakage.
- Collect any fuel and/or shop towels in approved containers and dispose of properly.
- Exercise care to keep dirt and debris out of fuel lines and fuel pump.
- Keep a dry chemical fire extinguisher on hand in case of emergencies.

Check/Relieve Fuel System Pressure



The fuel in the fuel rail is under high pressure. To avoid an uncontrolled discharge or spray of fuel, and to reduce the risk of fire and personal injury, always relieve fuel system pressure before servicing.

NOTE: Perform all steps if checking fuel system pressure. If only relieving fuel system pressure, perform steps 1-3.

1. See *Fuel Pump Module Cover, Removal*.
2. Cut cable strap to release fuel pump module connector conduit from socket/pin housing. Pull out grey secondary lock and press to disconnect fuel pump module connector.
3. Crank engine for 10 seconds using electric starter (or 12 pulls of rewind cord) to relieve fuel system pressure.
4. Obtain the following tools:
 - Briggs & Stratton Fuel Pressure Gauge (Part No. 19627).
 - Briggs & Stratton BIG BLOCK Fuel Pressure Test Adapter (Part No. 19624).
5. Squeeze two tabs on quick disconnect fitting to release fuel rail from fuel outlet port of fuel pump module.

NOTE: Wrap shop towel around fitting to catch any fuel leakage.

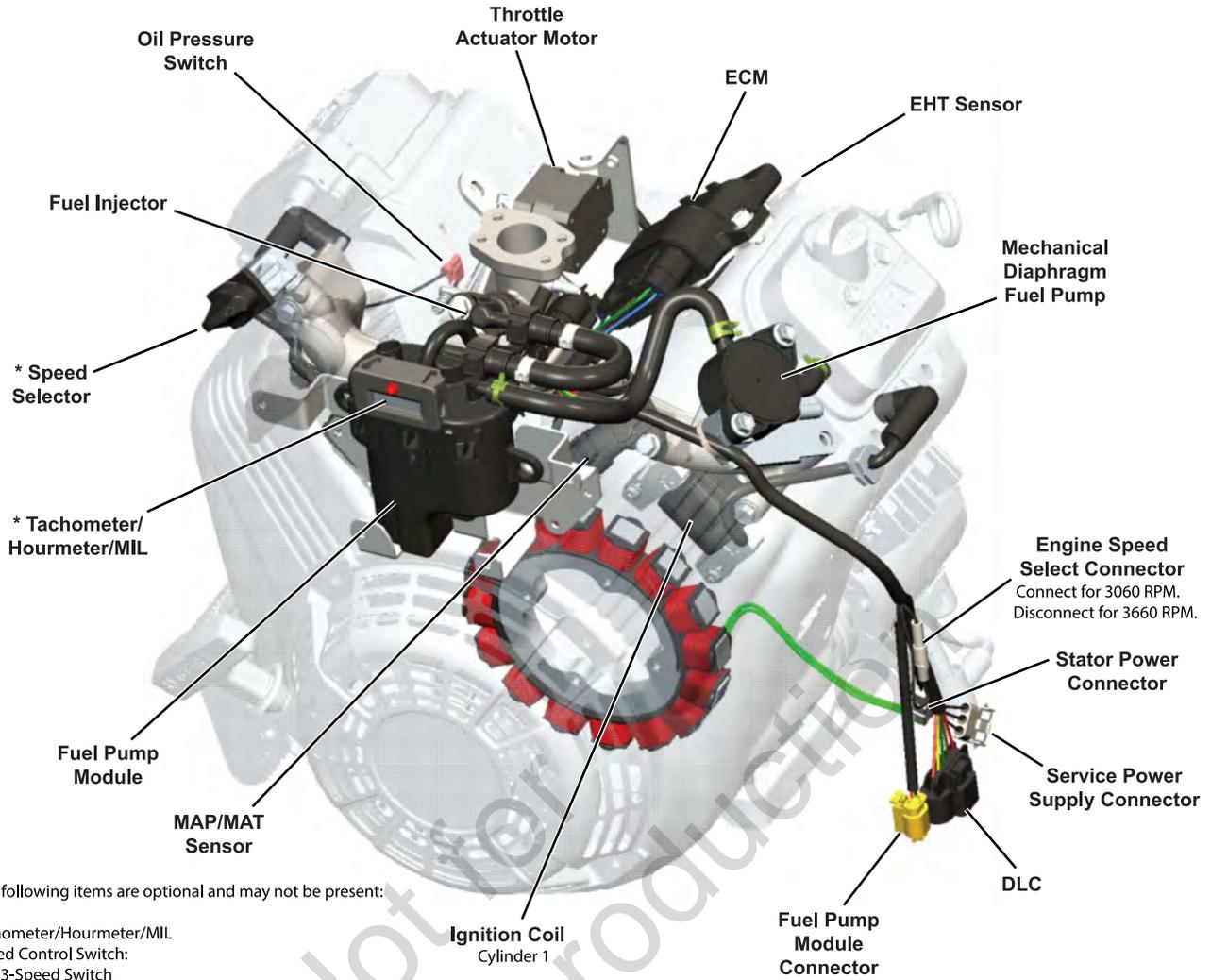
6. Install fuel pressure test adapter between fuel rail and fuel pump module.
7. Remove protective cap from Schrader valve on fuel pressure test adapter and install fuel pressure gauge.
8. Connect fuel pump module connector. Push in grey secondary lock to secure.
9. Install **new** cable strap to secure fuel pump module connector conduit to socket/pin housing.
10. Cut cable strap to release fuel injector connector conduit from socket/pin housing. Press latch to disconnect fuel injector connector.
11. Crank engine for 10 seconds using electric starter (or 12 pulls of rewind cord) to pressurize fuel system.
12. Note the reading of the fuel pressure gauge. Fuel pressure should remain steady at **38-43 psi** (262-296 kPa).
13. Position the clear bleed tube in an approved container and press the pressure relief button on the gauge assembly to relieve fuel system pressure. Fully depress and hold the pressure relief button until pointer on the dial face is resting on the stop pin.
14. Remove fuel pressure gauge from Schrader valve on fuel pressure test adapter.

NOTE: A small amount of gasoline may drain from the Schrader valve when the gauge is removed. Wrap a shop towel around the valve fitting to catch any fuel leakage.

15. Install protective cap on Schrader valve.
16. Remove fuel pressure test adapter between fuel rail and fuel pump module.
17. Firmly push quick disconnect fitting on fuel rail onto fuel outlet port of fuel pump module. Gently tug on fitting to verify that it is properly seated and secure.
18. Crank engine for 10 seconds using electric starter (or 12 pulls of rewind cord) to pressurize fuel system. Check for fuel leaks.
19. Connect fuel injector connector.
20. Install **new** cable strap to secure fuel injector connector conduit to socket/pin housing.
21. See *Fuel Pump Module Cover, Installation*.

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* The following items are optional and may not be present:

- Tachometer/Hourmeter/MIL
- Speed Control Switch:
 - 3-Speed Switch
 - Variable Speed Switch
- Ignition Key Switch
- Throttle Actuator Motor

NOTE: Air cleaner assembly and fuel pump module cover removed for illustration purposes.

MODEL 38000 FUEL SYSTEM COMPONENTS

Air Cleaner Assembly

Removal

1. See Figure 7. Disengage two retaining clips to release air filter cover (A).
2. Remove thumb nut (B) from threaded rod.
3. Remove metal retainer plate (C).
4. Remove air filter element (D).
5. Remove four hex flange screws to release air filter mount (E) from throttle body. Remove hex flange screw to release air filter mount from ECM bracket.
6. Squeeze clip and remove vacuum hose to valve cover fitting.
7. At bottom of air filter mount, squeeze clip and remove EVAP tube from fuel pump module.

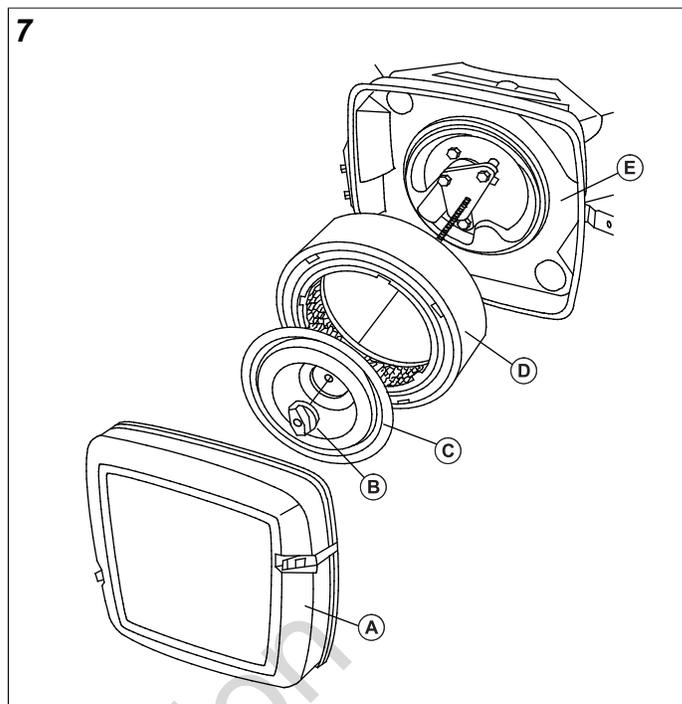
Installation

1. Thoroughly clean air filter mount, metal retainer plate, and air filter cover of any dust, dirt, or debris.
2. At bottom of air filter mount, squeeze clip and install EVAP tube from fuel pump module.
3. Squeeze clip and install vacuum hose to valve cover fitting.
4. Install four hex flange screws to fasten air filter mount (E) to throttle body. Install hex flange screw to fasten air filter mount to ECM bracket. Alternately tighten screws to **80 lb-in** (9 Nm) using a crosswise pattern.
5. Place air filter element (D) onto air filter mount (E).
6. Fit metal retainer plate (C) evenly and snugly into air filter element.
7. Install thumb nut (B) onto threaded rod and tighten until snug.
8. Install air filter cover (A).
9. Engage two retaining clips to secure air filter cover.

Fuel Pump Module Cover

Removal

1. Loosen or remove six Phillips screws to release front and top of cover from fuel pump module bracket.
2. Loosen two Phillips screws to release side of cover from cover bracket.
3. Access inboard side of cover, and based on the options present, proceed as follows:
 - A. Disconnect tachometer/hourmeter/MIL connector.



- A. Disconnect tachometer/hourmeter/MIL connector.
- B. Disengage 3-speed switch connector conduit from slot at bottom of cover or disconnect variable speed switch connector.
- C. Disconnect ignition key switch connector.

Installation

1. Access inboard side of cover, and based on the options present, proceed as follows:
 - A. Connect tachometer/hourmeter/MIL connector.
 - B. Engage 3-speed switch connector conduit in slot at bottom of cover or connect variable speed switch connector.
 - C. Connect ignition key switch connector.
2. Start two Phillips screws to fasten side of cover to cover bracket.
3. Start six Phillips screws to fasten front and top of cover to fuel pump module bracket.
4. Alternately tighten eight cover screws to **10 lb-in** (1 Nm).

Blower Housing

Removal

1. See *Fuel Pump Module Cover, Removal*.
2. On cylinder 1 side, proceed as follows:

- A. Cut cable strap to release EFI wire harness from mechanical diaphragm fuel pump bracket.
 - B. Remove two hex flange screws to release mechanical diaphragm fuel pump from bracket.
 - C. Squeeze hose clip and remove crankcase vacuum hose from pulse line fitting on mechanical diaphragm fuel pump.
 - D. Remove upper outside hex flange screw to release lifting eye, mechanical diaphragm fuel pump bracket, and blower housing from intake manifold.
 - E. Remove upper inside hex flange screw to release lifting eye, mechanical diaphragm fuel pump bracket, blower housing, and heat shield flange from intake manifold.
 - F. Remove two lower hex flange screws to release blower housing from heat shield and flywheel backplate flanges.
3. On cylinder 2 side, proceed as follows:
 - A. Remove two hex flange screws to release valve cover from cylinder head.
 - B. Remove upper outside hex flange screw to release fuel pump module cover bracket and blower housing from intake manifold.
 - C. Remove upper inside hex flange screw to release fuel pump module cover bracket, blower housing, and heat shield flange from intake manifold.
 - D. Remove two lower hex flange screws to release oil cooler bracket and blower housing from heat shield and flywheel backplate flanges.
 4. Squeeze clip and remove EVAP tube from vent port at top of fuel pump module.
 5. Cut cable strap to release fuel pump module connector conduit from socket/pin housing. Pull out grey secondary lock and press to disconnect fuel pump module connector.
 6. Squeeze two tabs on quick disconnect fitting to release fuel rail from fuel outlet port of fuel pump module.

NOTE: Wrap shop towel around fitting to catch any fuel leakage.
 7. Remove blower housing and fuel pump module with attached mechanical diaphragm fuel pump as a single assembly.
- A. Start two lower hex flange screws to fasten blower housing to heat shield and flywheel backplate flanges.
 - B. Start upper inside hex flange screw to fasten lifting eye, mechanical diaphragm fuel pump bracket, blower housing, and heat shield flange to intake manifold.
 - C. Start upper outside hex flange screw to fasten lifting eye, mechanical diaphragm fuel pump bracket, and blower housing to intake manifold.
3. On cylinder 2 side, proceed as follows:
 - A. Start two lower hex flange screws to fasten oil cooler bracket and blower housing to heat shield and flywheel backplate flanges.
 - B. Start upper inside hex flange screw to fasten fuel pump module cover bracket, blower housing and heat shield flange to intake manifold.
 - C. Start upper outside hex flange screw to fasten fuel pump module cover bracket and blower housing to intake manifold.
 4. Alternately tighten four upper blower housing to intake manifold screws to **135 lb-in** (15 Nm) using a crosswise pattern.
 5. Alternately tighten four lower blower housing to heat shield/flywheel backplate screws to **90 lb-in** (10 Nm) using a crosswise pattern.
 6. Install two hex flange screws to fasten valve cover to cylinder head. Alternately tighten screws to **35-48 lb-in** (4-5 Nm).
 7. Install two hex flange screws to fasten mechanical diaphragm fuel pump to bracket. Alternately tighten screws to **45 lb-in** (5 Nm).
 8. Squeeze hose clip and install crankcase vacuum hose onto pulse line fitting of mechanical diaphragm fuel pump.
 9. Install **new** cable strap to secure EFI wire harness to outside leg of mechanical diaphragm fuel pump bracket.
 10. Firmly push quick disconnect fitting on fuel rail onto fuel outlet port of fuel pump module. Gently tug fitting to verify that it is properly seated and secure.
 11. Connect fuel pump module connector. Push in grey secondary lock to secure.
 12. Install **new** cable strap to secure fuel pump module connector conduit to socket/pin housing. See Figure 11.
 13. Squeeze clip and install EVAP tube to vent port at top of fuel pump module.
 14. See *Fuel Pump Module Cover, Installation*.

Installation

1. Align upper holes in blower housing with those in intake manifold. Align lower holes in blower housing with weld nuts on heat shield and flywheel backplate flanges.
2. On cylinder 1 side, proceed as follows:

ECM

Removal

1. See *Air Cleaner Assembly, Removal*.
2. Remove two hex flange screws to release ECM from ECM bracket.
3. Disconnect ECM connector.

Installation

1. Connect ECM connector.
2. Install two hex flange screws to fasten ECM to ECM bracket. Alternately tighten screws to **43-52 lb-in** (5-6 Nm).
3. See *Air Cleaner Assembly, Installation*.

MAP/MAT Sensor

Removal

1. See *Air Cleaner Assembly, Removal*.
2. See *Blower Housing, Removal*.
3. Pull out red secondary lock and press to disconnect MAP/MAT sensor connector.
4. Remove hex flange screw to release sensor flange from intake manifold.
5. Remove sensor from intake manifold.

Installation

1. Lightly lubricate O-ring of MAP/MAT sensor.
2. Install sensor into intake manifold aligning hole in flange with hole in intake manifold.
3. Install hex flange screw and tighten to **78- 96 lb-in** (9-11 Nm).
4. Connect MAP/MAT sensor connector. Push in red secondary lock to secure.
5. See *Blower Housing, Installation*.
6. See *Air Cleaner Assembly, Installation*.

Ignition Coil

Removal

1. See *Air Cleaner Assembly, Removal*.
2. See *Blower Housing, Removal*.
3. Disconnect ignition coil connector.
4. Remove ignition coil. See Vanguard OHV V-Twin Repair Manual.

Installation

1. Install ignition coil. See Vanguard OHV VTwin Repair Manual.

2. Connect ignition coil connector.
3. See *Blower Housing, Installation*.
4. See *Air Cleaner Assembly, Installation*.

Fuel Filter

Removal

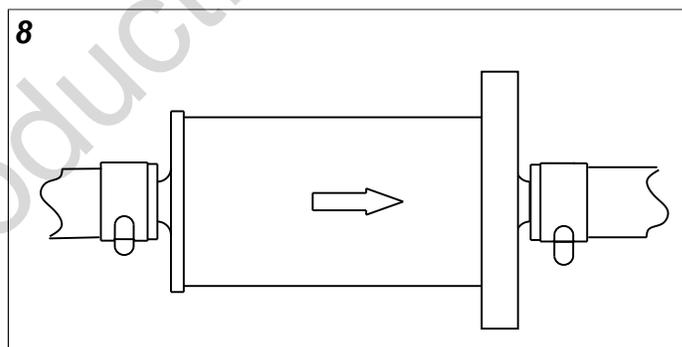
1. Relieve fuel system pressure. See *CHECK/RELIEVE FUEL SYSTEM PRESSURE* in this section.
2. Squeeze hose clip and remove fuel inlet hose from fuel filter fitting.

NOTE: Wrap shop towel around fuel filter fittings to catch any fuel leakage.

3. Squeeze hose clip and remove fuel outlet hose from fuel filter fitting.

Installation

1. With the arrow pointing in the direction of fuel flow, install fuel filter between fuel inlet and outlet hoses. See Figure 8.
2. Crank engine using electric starter or rewind cord to pressurize fuel system. Check for fuel leaks.



Mechanical Diaphragm Fuel Pump

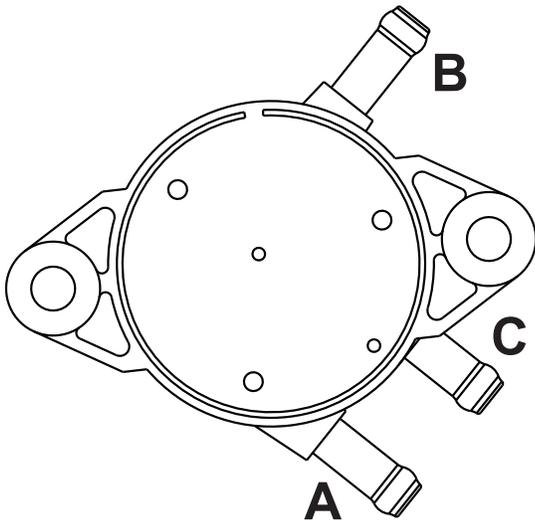
Removal

1. See *Fuel Pump Module Cover, Removal*.
2. Squeeze hose clip at fuel inlet port (A) and remove hose from fuel filter. See Figure 9.

NOTE: Wrap shop towel around fittings to catch any fuel leakage.

3. Squeeze hose clip at fuel outlet port (B) and remove hose to fuel pump module.
4. Squeeze hose clip and remove crankcase vacuum hose from pulse line fitting (C).
5. Remove two hex flange screws to release fuel pump from bracket.

9



5

Installation

1. Orient fuel pump with the backside facing out and the crankcase vacuum port pointing toward the valve cover as shown in Figure 9.
2. Install two hex flange screws to secure fuel pump to bracket. Alternately tighten screws to **45 lb-in** (5 Nm).
3. Squeeze hose clip and install hose from fuel filter onto fuel inlet port (**A**).
4. Squeeze hose clip and install hose to fuel pump module onto fuel outlet port (**B**).
5. Squeeze hose clip and install crankcase vacuum hose onto pulse line fitting (**C**). Be sure hose is not twisted after installation.
6. Crank engine using electric starter or rewind cord to pressurize fuel system. Check for fuel leaks.
7. See *Fuel Pump Module Cover, Installation*.

Fuel Pump Module

Removal

1. Relieve fuel system pressure. See *CHECK/RELIEVE FUEL SYSTEM PRESSURE* in this section.
2. See *Fuel Pump Module Cover, Removal*.
3. Squeeze clip and remove EVAP tube from vent port (**A**) at top of fuel pump module. See Figure 10.
4. Cut cable strap to release fuel pump module connector conduit from socket/pin housing. Pull out grey secondary lock and press to disconnect fuel pump module connector (**B**).
5. Squeeze two tabs on quick disconnect fitting to release fuel rail from fuel outlet port (**C**).

NOTE: Wrap shop towel around fitting to catch any fuel leakage.

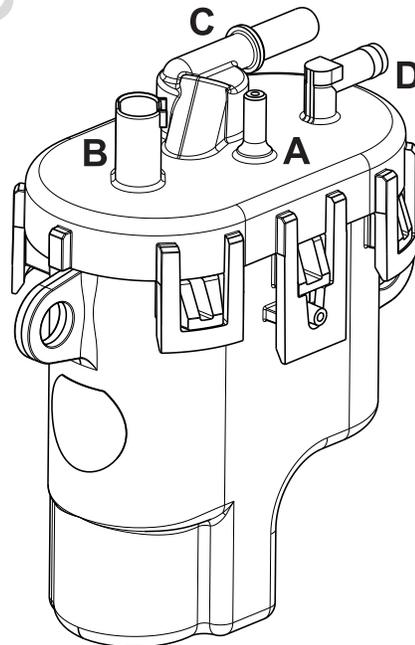
6. Squeeze hose clip at fuel inlet port (**D**) and remove hose from mechanical diaphragm fuel pump.
7. Remove three hex screws to release fuel pump module from bracket.

NOTE: Fuel pump module may contain a small quantity of fuel. Hold fuel pump module with inlet and outlet fittings pointing upward until fuel can be drained into suitable container.

Installation

1. Install three hex screws to fasten fuel pump module to bracket. Alternately tighten screws to **78-96 lb-in** (9-11 Nm).
2. Squeeze hose clip and install hose from mechanical diaphragm fuel pump onto fuel inlet port (**D**) of fuel pump module.
3. Firmly push quick disconnect fitting on fuel rail onto fuel outlet port (**C**). Gently tug fitting to verify that it is properly seated and secure.
4. Connect fuel pump module connector (**B**). Push in grey secondary lock to secure.
5. Install **new** cable strap to secure fuel pump module connector conduit to socket/pin housing. See Figure 11.

10



11



12



NOTE: Acting as a strain relief, cable strap allows connector conduit to be flexed without putting stress on terminal connections. Movement or vibration of conduit without cable strap may cause eventual component failure.

6. Squeeze clip and install EVAP tube to vent port (A) at top of fuel pump module.
7. Crank engine using electric starter or rewind cord to pressurize fuel system. Check for fuel leaks.
8. See *Fuel Pump Module Cover, Installation*.

Fuel Rail/Fuel Injector

Removal

1. Relieve fuel system pressure. See *CHECK/RELIEVE FUEL SYSTEM PRESSURE* in this section.
2. See *Fuel Pump Module Cover, Removal*.
3. See *Air Cleaner Assembly, Removal*.
4. Cut cable strap to release fuel injector connector conduit from socket/pin housing.
5. Press latch to disconnect fuel injector connector.

6. Remove hex flange screw to release fuel injector cap flange from throttle body.
7. Remove retaining clip to release fuel injector cap from fuel injector. Note orientation of the retaining clip prior to removal.
8. Remove fuel injector from throttle body.
9. Squeeze two tabs on quick disconnect fitting to release fuel rail from fuel pump module.

NOTE: Wrap shop towel around fitting to catch any fuel leakage.

Installation

1. Lightly lubricate fuel injector O-rings with clean engine oil.
2. Install fuel injector into throttle body.
3. Install retaining clip to secure fuel injector cap to fuel injector. Orient retaining clip as noted during removal. Be sure retaining clip is fully engaged.
4. Install hex flange screw to fasten fuel injector cap flange to throttle body. Tighten screw to **104-122 lb-in** (12-14 Nm).
5. Connect fuel injector connector.
6. Install **new** cable strap to secure fuel injector connector conduit to socket/pin housing. See Figure 12.

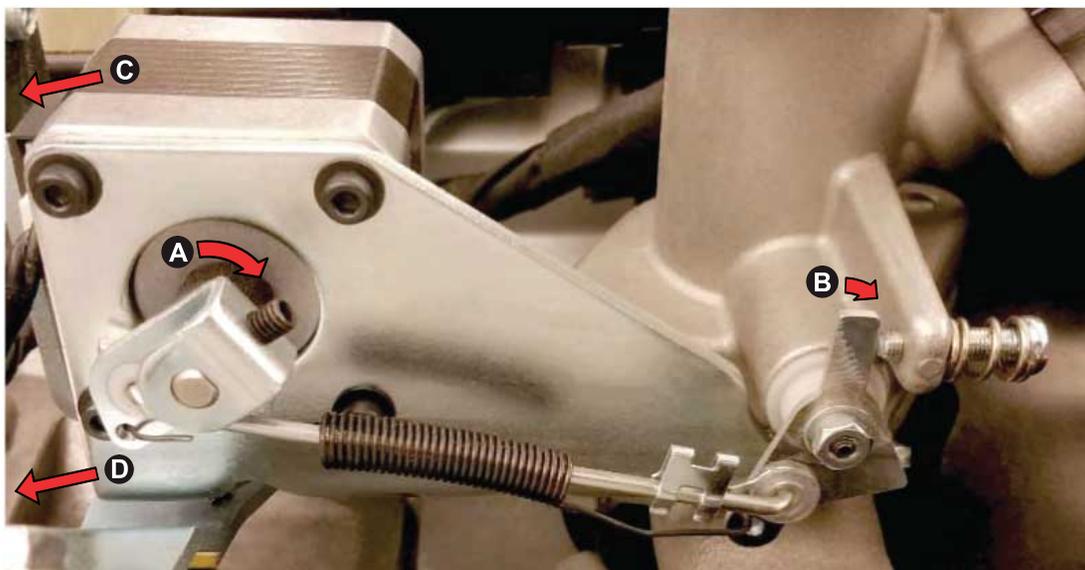
NOTE: Acting as a strain relief, cable strap allows connector conduit to be flexed without putting stress on terminal connections. Movement or vibration of conduit without cable strap may cause eventual component failure.

7. Firmly push quick disconnect fitting onto fuel pump module. Gently tug on fitting to verify that it is properly seated and secure.
8. Crank engine using electric starter or rewind cord to pressurize fuel system. Check for fuel leaks.
9. See *Air Cleaner Assembly, Installation*.
10. See *Fuel Pump Module Cover, Installation*.

Throttle Actuator Motor

Removal

1. See *Air Cleaner Assembly, Removal*.
2. Remove rubber boot from throttle actuator motor.
3. Disconnect throttle actuator motor connector.
4. Loosen set screw to release throttle actuator motor lever from motor shaft.
5. Remove four allen head screws (with flat washers) to release throttle actuator motor from bracket.
6. Remove foam dust seal from throttle actuator motor shaft.



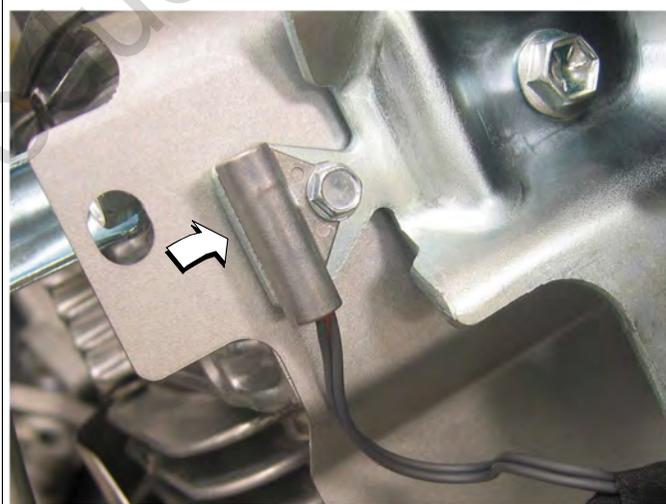
Installation

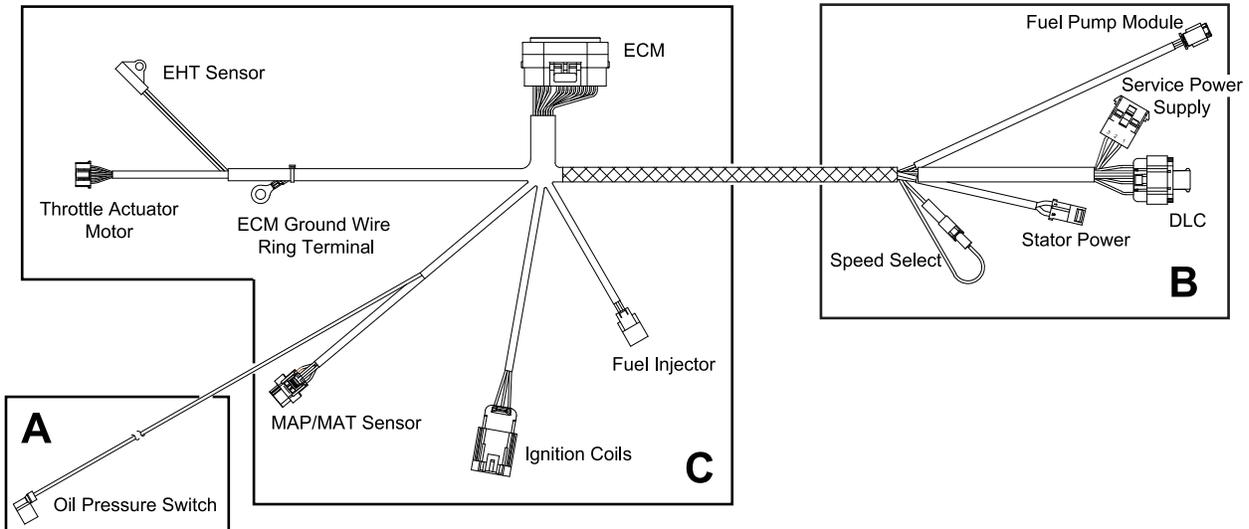
1. Start four allen head screws (with flat washers) to fasten throttle actuator motor to bracket.
2. See A of Figure 13. Moving throttle actuator motor as far from throttle body as possible, tighten screws to **9-13 lb-in** (1-2 Nm).
3. Install foam dust seal onto throttle actuator motor shaft.
4. Install throttle actuator motor lever onto motor shaft. Verify that lever is flush with end of shaft, and that set screw contacts flat on shaft.
5. See B of Figure 13. Rotate throttle actuator motor lever in a clockwise direction until it stops.
6. See C of Figure 13. Holding throttle actuator motor lever in the stopped position, verify that throttle lever makes contact with the dead idle screw.
7. If throttle lever rotation is not stopped by the dead idle screw, but by contact with the throttle link, loosen two throttle body to intake manifold screws.
8. See D of Figure 13. Moving throttle actuator motor bracket away from throttle body, tighten two throttle body to intake manifold screws to **70 lb-in** (8 Nm).
9. Connect throttle actuator motor connector.
10. Adjust dead idle screw to 1200 RPM (typical).
11. Install rubber boot over throttle actuator motor.
12. See *Air Cleaner Assembly, Installation*.

EHT Sensor

NOTE: See Figure 14. The EHT sensor is an integral part of the EFI wire harness and is not sold separately. Replace EFI wire harness if EHT sensor is bad.

14





EFI Wire Harness

Removal

- See *Air Cleaner Assembly, Removal*.
 - See B of Figure 15. On cylinder 1 side of engine, proceed as follows:
 - Disconnect stator power connector.
- NOTE:** Fuel pump module connector is disconnected during blower housing removal.
- See *Blower Housing, Removal*.
 - See A of Figure 15. On cylinder 2 side of engine, proceed as follows:
 - Disconnect oil pressure switch connector. Release wire from high tension lead grommet on cylinder heat shield. Cut cable strap to release wire from bottom of intake manifold.
 - See C of Figure 15. Proceed as follows:
 - Cut cable strap to release fuel injector connector conduit from fuel injector socket/pin housing. Disconnect fuel injector connector.
 - Cut cable strap to release MAP/MAT sensor conduit and ignition "kill switch" wires from intake manifold. Disconnect MAP/MAT sensor connector.
 - Disconnect ignition coil connector.
 - Disconnect throttle actuator motor connector.
 - Remove two hex flange screws to release ECM from ECM bracket. Disconnect ECM connector.
 - Remove hex flange screw to release ECM ground wire ring terminal from ECM bracket.
 - Remove hex screw to release EHT sensor bracket from ECM bracket.

Installation

- Position EFI wire harness at top of intake manifold separating conduit and connectors into three groups as shown in Figure 15.
- See C of Figure 15. Proceed as follows:
 - Install hex screw to fasten EHT sensor bracket to ECM bracket. Tighten screw to **15-25 lb-in** (2-3 Nm).
 - Install hex flange screw to fasten ECM ground wire ring terminal to ECM bracket. Tighten screw to **50 lb-in** (6 Nm).
 - Connect ECM connector. Install two hex flange screws to fasten ECM to ECM bracket. Alternately tighten screws to **43-52 lb-in** (5-6 Nm).
 - Route throttle actuator motor conduit outside of ECM bracket vertical support and then back to connect connector.
 - Connect ignition coil connector.
 - Route MAP/MAT sensor conduit between heat shield and intake manifold, around bottom of intake manifold, and then up to sensor. Connect connector. Push in red secondary lock to secure.
 - Connect fuel injector connector.
- See A of Figure 15. On cylinder 2 side of engine, proceed as follows:
 - Route oil pressure switch wire toward cylinder 2 following bottom of intake manifold. Capture wire in grommet on cylinder heat shield and connect connector.
- Secure EFI wire harness as follows:
 - Install **new** cable strap to secure oil pressure switch wire at bottom of intake manifold. See A of Figure 16.

- B. Verify that ignition “kill switch” wire is captured in cable clip on valley shield. See B of Figure 16.
- C. Install **new** cable strap around intake manifold capturing MAP/MAT sensor conduit and ignition “kill switch” wire on inboard side. Verify proper clearance between wires and edges of valley shield. See C of Figure 16.
- D. Verify presence of cable strap securing cylinder 1 ignition coil cable to intake manifold. Install cable strap if missing. See D of Figure 16.
- E. Verify presence of cable strap securing ignition “kill switch” wire to cylinder 1 high tension lead. Install cable strap if missing. See E of Figure 16.
- F. Install **new** cable strap to secure fuel injector connector conduit to fuel injector socket/pin housing. See F of Figure 16.

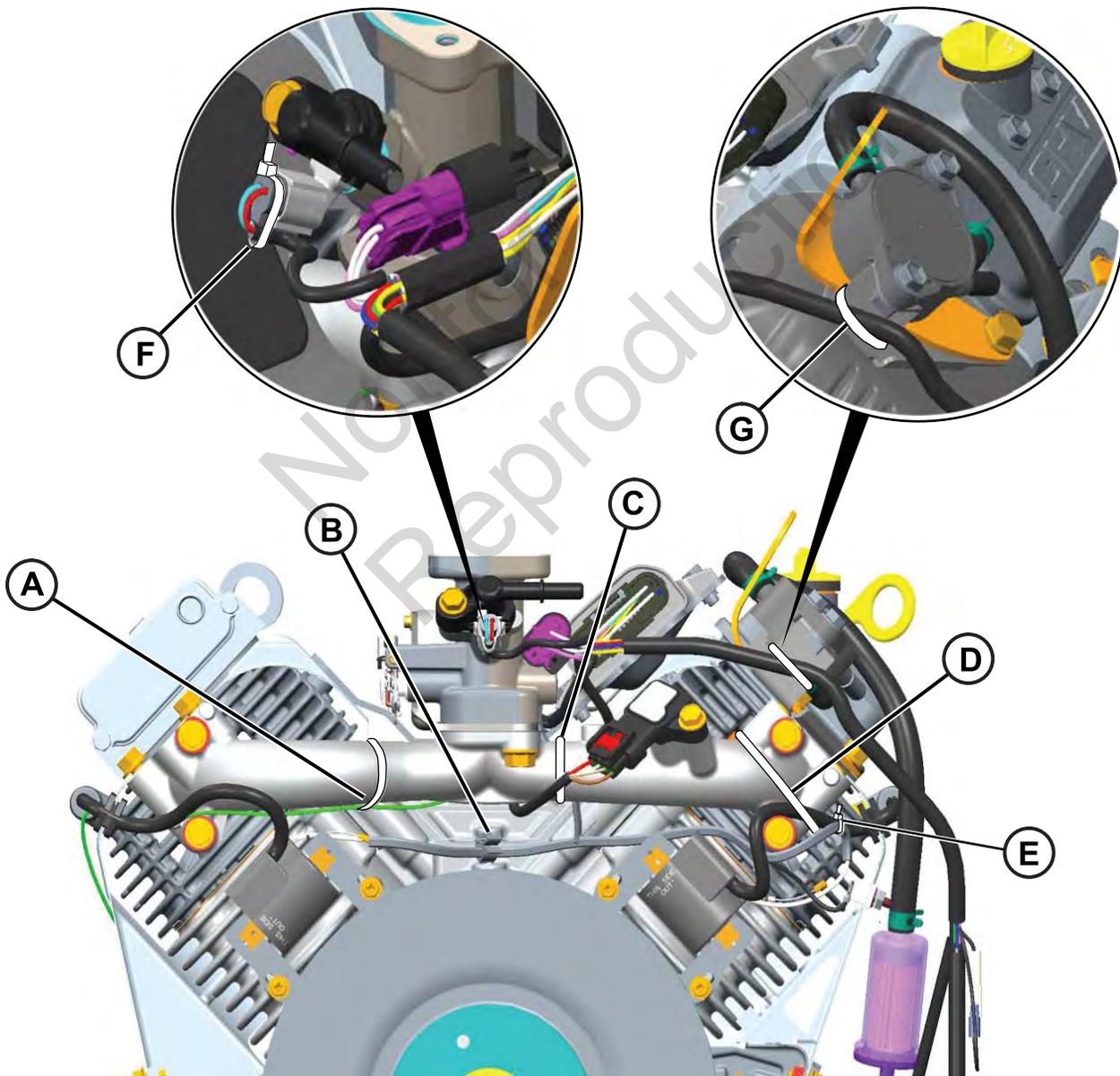
5. See *Blower Housing, Installation*.

NOTE: Fuel pump module connector is connected during blower housing installation. Be sure to install **new** cable strap to secure fuel pump module connector conduit to socket/pin housing. See Figure 11.

6. See B of Figure 15. On cylinder 1 side of engine, proceed as follows:
 - Connect stator power connector.
 - If missing, install **new** cable strap to secure EFI wire harness to outside leg of mechanical diaphragm fuel pump bracket. See G of Figure 16.
7. See *Air Cleaner Assembly, Installation*.

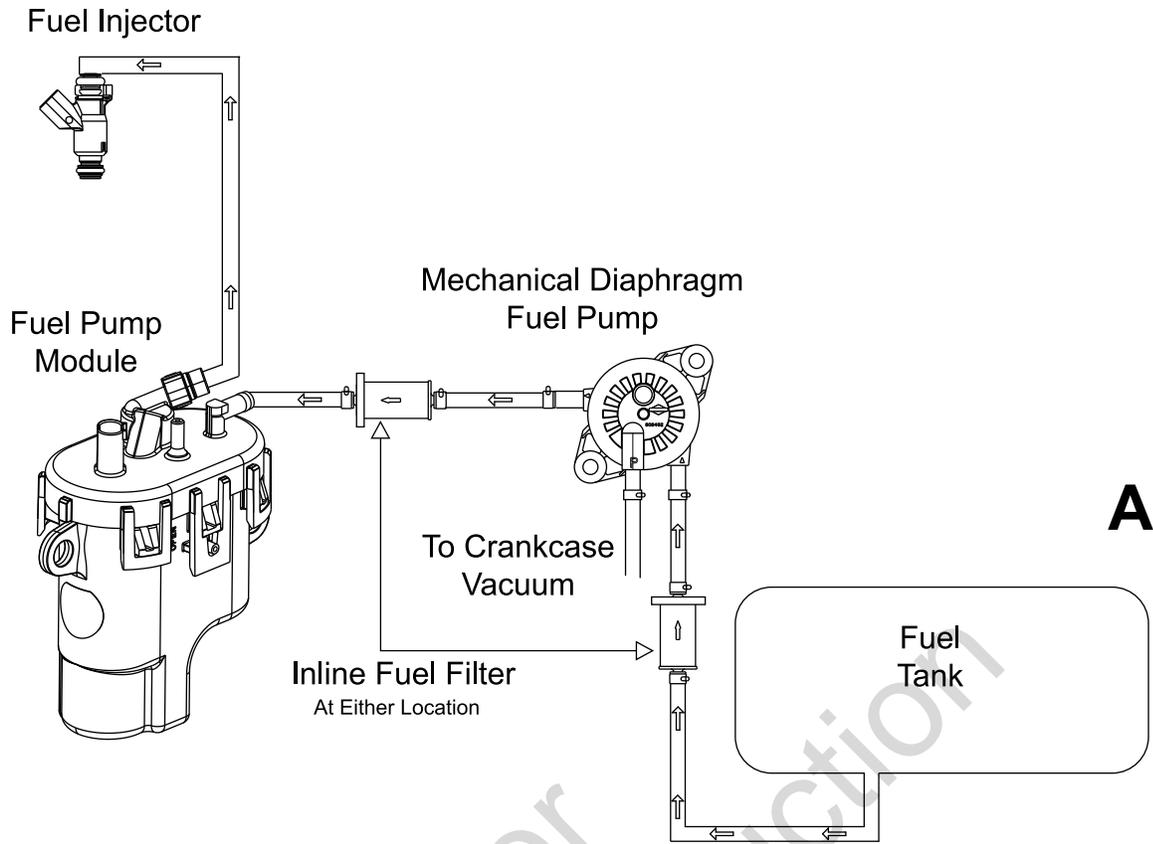
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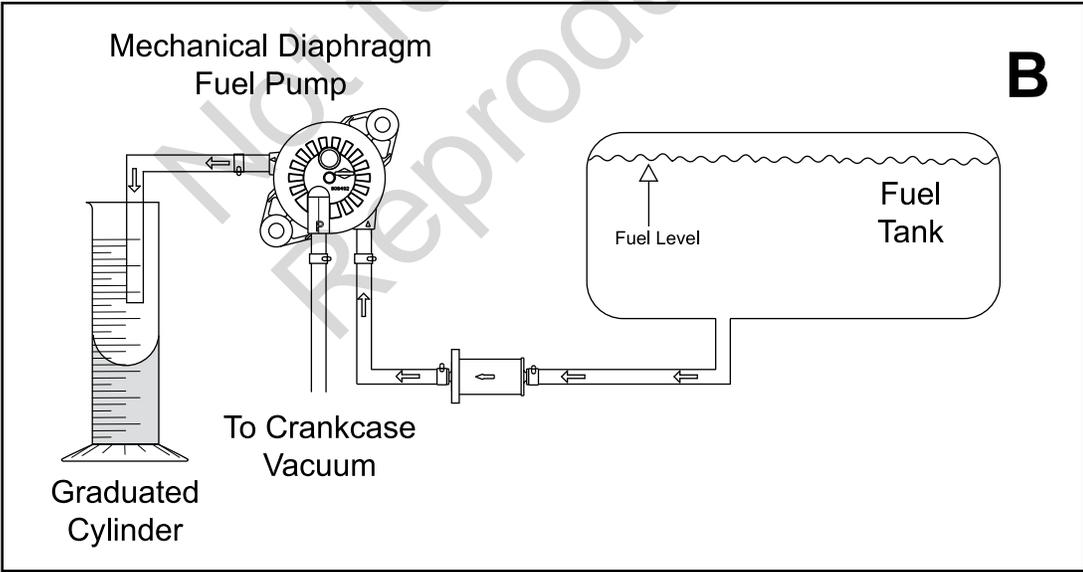


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A



B

MECHANICAL DIAPHRAGM FUEL PUMP FOR MODEL 380000

Volumetric Test

Perform a volumetric test to verify that the proper amount of fuel is being delivered to the engine. See A of Figure 17 for a typical fuel flow diagram for Model 380000. Proceed as follows:

1. Relieve fuel system pressure. See *CHECK/RELIEVE FUEL SYSTEM PRESSURE* in this section.
2. Squeeze clip at fuel outlet port and remove hose to fuel pump module.
NOTE: Wrap shop towel around fitting to catch any fuel leakage.
3. Obtain a stop watch and a graduated cylinder.
4. Attach suitable hose to fuel outlet port and direct free end into graduated cylinder. See B of Figure 17.
5. Install battery negative cable (black) to battery negative (-) terminal.
6. Start engine and watch for fuel discharge from outlet port hose. Start the stopwatch as soon as fuel flow is observed.
7. Run engine for 30 seconds at 2200 RPM.
8. After the time has elapsed, turn off the engine and stop the watch.
9. Measure the volume of fuel discharged into the graduated cylinder. See the table below for the approximate amount of fuel that should be discharged.

Pump Fuel for 30 Seconds	
Approximate Fuel Amount	237 m
	0.5 pint
	0.25 quart
	1.0 cup

NOTES:

- Position the fuel tank so that it is near level with the fuel pump. Do not place the graduated cylinder **BELOW** the fuel pump or gravity feed will produce false results.
- The engine will run longer than the 30 second test interval using fuel trapped in the fuel pump module.
- View the graduated cylinder with your eyes directly level with the fuel. Note that the fuel curves up the sides of the graduated cylinder. This curve is called a meniscus. For the most accurate reading, read the measurement from the bottom of the meniscus.
- The volumetric measurement is only approximate. The fuel pump is likely functioning

properly if the test results are within 10% of the approximate fuel amount.

Engine Cranks But Will Not Start

Crank engine for 10 seconds using electric starter (or 12 pulls of rewind cord). See the table below for the approximate amount of fuel that should be discharged.

Crank Engine for 10 Seconds	
Approximate Fuel Amount	65 ml
	0.13 pint
	0.06 quart
	0.27 cup

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