

G28 Engine

Safety, Operation, Maintenance & Parts Manual

LT40 Series

rev. F1.01



Safety is our #1 concern! Read and understand all safety information and instructions before operating, setting up or maintaining this machine.

Form #829

**This is the original language
for the manual.**

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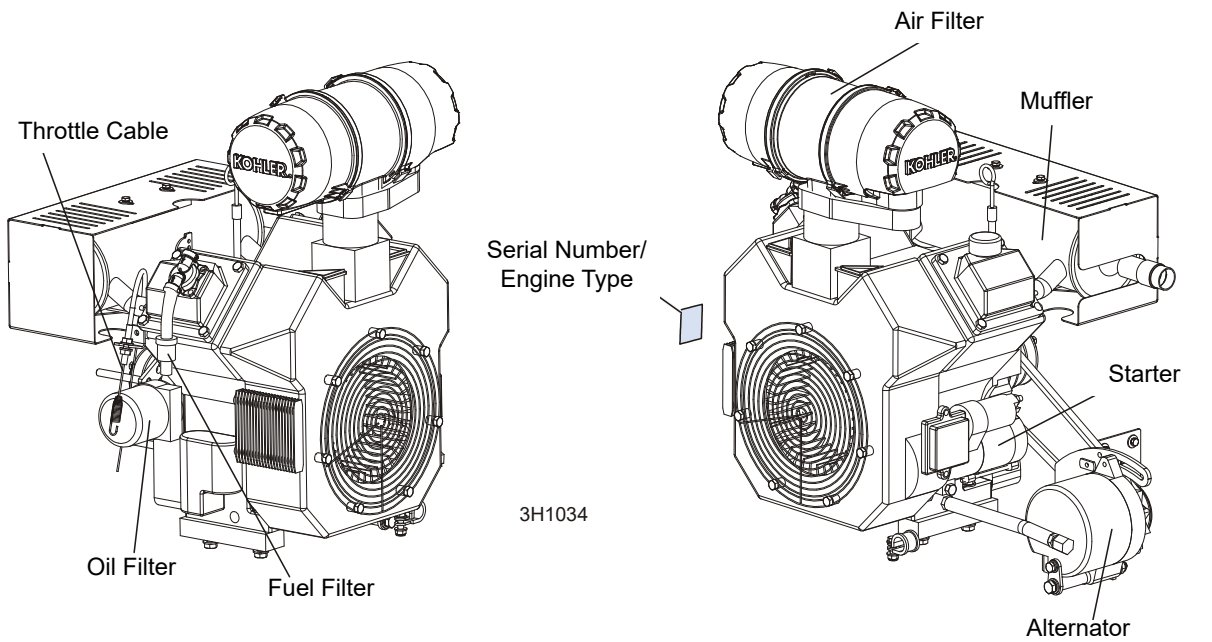
ABOUT THIS MANUAL

This manual is provided as a supplement to the equipment manufacturer's manuals. This manual provides information specific to the use of this equipment on the Wood-Mizer® sawmill. Refer to the sawmill operator's manual and manufacturer's manual before attempting to operate this equipment.



IMPORTANT! Read the sawmill operator's manual and engine manufacturer's manual for instructions and safety precautions before operating this equipment.

The information and instructions given in this manual do not amend or extend the limited warranties for the equipment given at the time of purchase.




ENGINE COMPONENTS

SECTION 1 OPERATION


1.1 Starting The Engine

Engine Control Lights

See Figure 1-1. The following indicator lights are located on the sawmill control panel.

 **Alternator Charge Indicator:** Lights up if the alternator is not charging the battery



 **EFI Diagnostic Indicator:** A diagnostic light is provided to help troubleshoot the electronic fuel injection system. [Appendix A](#) for details.

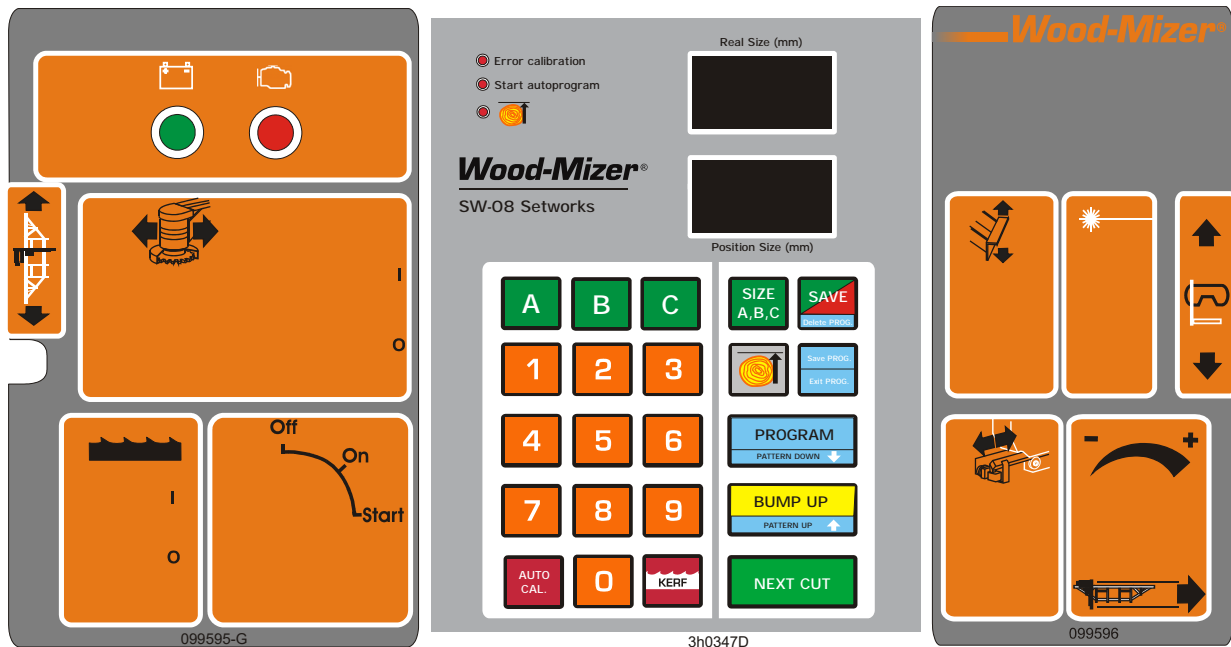


FIG. 1-1

Engine Start



DANGER! Always be sure the blade is disengaged and all persons are out of the path of the blade before starting the engine. Failure to do so will result in serious injury.

DANGER! Operate your engine/machine only in well ventilated areas. The exhaust gases of your engine can cause nausea, delirium and potentially death unless adequate ventilation is present.

DANGER! Never operate an engine with a fuel or oil leak. The leaking fuel or oil could potentially come in contact with hot surfaces and ignite into flames.



WARNING! Be sure the power feed switch is in the neutral position before turning the key switch to the “ON” or “START” position. This prevents accidental carriage movement, which may cause serious injury or death.

WARNING! Do not operate engine without proper and operational spark arrester/muffler. Sparks emitted from the engine exhaust could ignite surrounding materials, causing serious injury or death.

Turn the key switch to the “START” position and release.

For more information, see the engine manufacturer’s operation manual.

NOTE: If the engine dies after starting, check that the fuel pump is running. If the fuel pump is not running, check the relay inside the black control box on the side of the engine. Check the red wire connecting the relay to the fuel pump for voltage. Also check pin #30 & #86 for 12 volts. If voltage is found at the pins but not the red relay wire, replace the fuel pump relay. If no voltage is found at the pins, have the wiring harness checked by a qualified Kohler technician.

Engine Shutoff

Turn the key switch to the “OFF” position.

1.2 Engine Specifications

	G28 Kohler ECH749
Type	Air cooled, 4-cycle, gasoline, OHV, aluminum block, electronic fuel injection
Number of cylinders	2
Bore and stroke mm	83 x 69
Total displacement cm³	747
Power H.P. (SAEJ 1349) [HP/min⁻¹ (rpm)]	26.5/3600
Peak Torque (Nm)	54.2
Dry Weight kg [lbs.]	49 [108]
Oil Capacity (w/filter)	1.9L

SECTION 2 MAINTENANCE

Refer to the manufacturer's manual for maintenance intervals and procedures unless otherwise instructed in this manual. Follow the manufacturer's recommendations for dusty conditions.



IMPORTANT! This manual only provides information about additional procedures or procedures to be performed at different time intervals than found in the manufacturer's manuals. Refer to the manufacturer's manual for complete maintenance instructions.

2.1 Safety

Use caution when performing maintenance or service to the engine.



DANGER! Always be aware of and take proper protective measures against rotating shafts, pulleys, fans, etc. Always stay a safe distance from rotating members and make sure that loose clothing or long hair does not engage rotating members resulting in possible injury.

DANGER! Engine components can become very hot during operation. Avoid contact with any part of a hot engine. The exhaust components of your engine are especially hot during and following operation. Contact with hot engine components can cause serious burns. Therefore, never touch or perform service functions on a hot engine. Allow the engine to cool sufficiently before beginning any service function.



WARNING! Remove the blade before performing any engine service. Failure to do so may result in serious injury.

WARNING! Always wear proper and necessary safety equipment when performing service functions. Proper safety equipment includes eye protection, breathing protection, hand protection and foot protection.



This symbol identifies the interval (hours of operation) at which each maintenance procedure should be performed. "AR" signifies maintenance procedures which should be performed as required.

2.2 Engine Oil & Filter

8

Check the oil level every 8 hours of operation. Add oil as necessary. See the engine manual for oil viscosity and grade recommendations.



IMPORTANT! During initial break-in, change the oil and the oil filter after the first 50 hours and every 100 hours thereafter. Continue to check oil level every 8 hours of operation and refill as necessary.

150

NOTE: Engine in factory is filled with 10W/40 Shell Helix HX7, semi-synthetic oil. The recommended oil level is 1.5 liter.

2.3 Cooling System

50

Brush off sawdust and debris every 50 hours of operation. Clean the grass screen, cooling fins, and external surfaces. Remove any dust, dirt or oil. See engine manual for further instructions.

2.4 Air Cleaner

8

Empty the air debris collector every 8 hours of operation.

Open the air filter intake cover by loosening latches and remove all debris and dust. After all debris has been emptied close the cover.



WARNING! Always wear proper and necessary safety equipment when performing service functions. Proper safety equipment includes eye protection, breathing protection, hand protection and foot protection.

250

Replace the outer air cleaner cartridge and check the inner cartridge every 250 hours of operation or more often if operating the sawmill in dirty conditions or if engine performance indicates a new cartridge is necessary.



CAUTION! Do not clean elements with water or compressed air. Do not handle the inner element unless it is to be changed. Handle new elements carefully. Contact with the element could cause damage and prevent the filter from operating properly.

1200

Replace the inner air cleaner cartridge every 1200 hours of operation or more often if operating the sawmill in dirty conditions.

2.5 Fuel Filter



Replace the fuel filter every 100 hours of operation or as required for engine performance.

2.6 Battery



Check the battery electrolyte level every 50 hours of operation. See manufacturer's manual for instructions.




DANGER! Batteries expel explosive gases. Keep sparks, flames, burning cigarettes, or other ignition sources away at all times. Always wear safety goggles and a face shield when working near batteries. Failure to do so will cause serious injury.¹



WARNING! Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.

1. Battery Council International, copyright 1987

2.7 Alternator Belt

 Adjust the alternator belt as needed. Check the alternator belt for tension and wear when battery is not charging properly or when the alternator belt is squealing.

To Tighten The Belt:

1. Unscrew three bolts (**A**) and remove alternator belt cover.

See Figure 2-1.

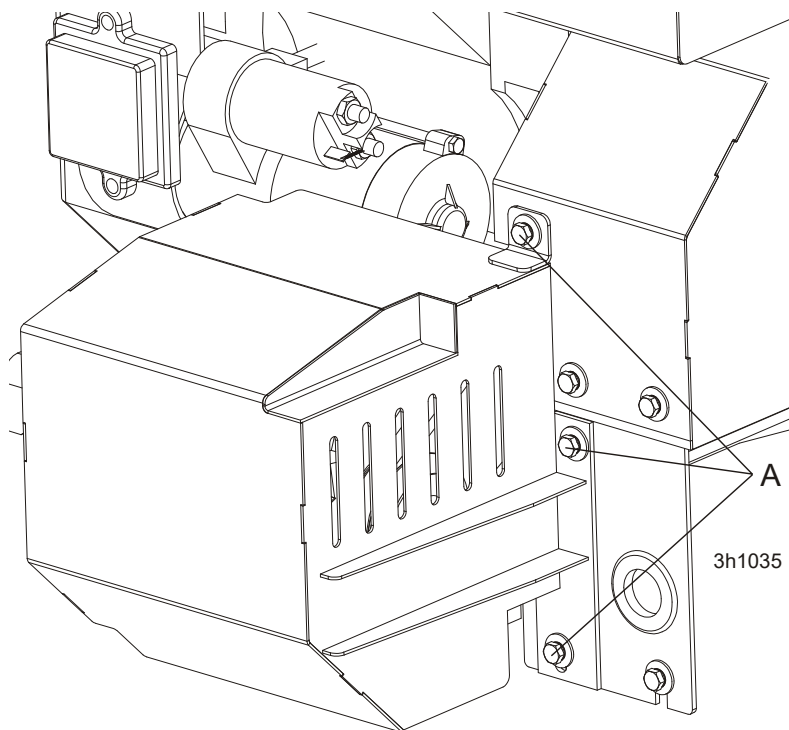


FIG. 2-1

2. Loosen the adjustment bolt (**1**). Pivot the alternator away from the motor until the belt has 3/16" (5 mm) deflection with a 5 lbf (2.3 kG). deflection force. Retighten the adjustment bolt.

See Figure 2-2.

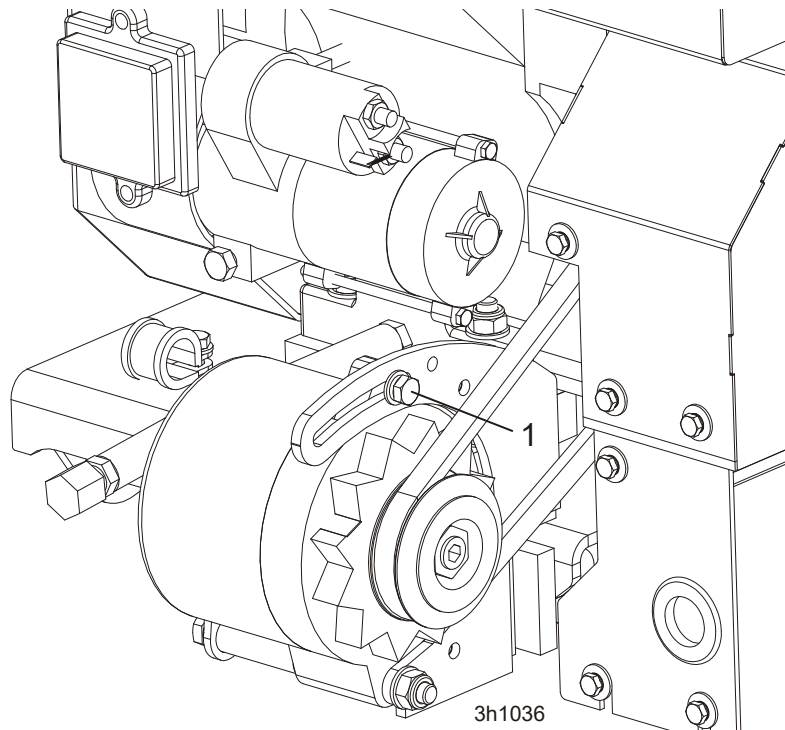


FIG. 2-2

3. Reinstall alternator belt cover.

2.8 RPM Adjustments



WARNING! Remove the blade before performing any engine service. Failure to do so may result in serious injury.



Check the RPM with a tachometer after the first 20 hours of operation and every 200 hours thereafter. High-end RPM should be 3750 RPM and low-end RPM should be 1800 RPM (± 100).

Before checking the RPM, make sure belt and brake strap tensions are correct (See Sawmill Maintenance). Also check oil, fuel, and coolant levels.

Make sure the throttle cable does not affect the engine RPM when the clutch handle is disengaged. Make sure the cable is not bent or kinked. Check that the cable spring, cable guide, cable, and throttle brackets are aligned. **NOTE:** It is important that the above components are aligned. Proper alignment allows any slack in the cable (when engine is idling) to slide down into the cable spring. This maintains free operation of the cable and

prevents the cable from kinking. Make sure the shoulder bolt does not rub against the crankcase vent tube.

1. Start the engine to measure the low-end RPM.
2. Refer to the engine manual to adjust the low-end RPM.
3. Engage the clutch handle to throttle the engine and measure the high-end RPM. The high-end RPM is factory-set at 3750. Readjust the throttle cable if necessary to increase or reduce the high-end engine speed.

The throttle cable should be tensioned just enough so that the engine revs as soon as the clutch/brake handle is engaged. **NOTE:** A properly adjusted throttle will extend the cable spring 1/4" to 3/8" (6.4 - 9.5 mm) when running and have a slight amount of slack in the cable when idling.

2.9 Miscellaneous Maintenance



Clean and inspect the spark arresters every 50 hours of operation. Replace if damaged.



Inspect the spark plugs every 100 hours of operation. Remove any deposits and adjust gap if necessary. See engine manual for further information.



CAUTION! Do not remove the plug wire to check for electrical spark. Damage to the ignition circuit will result.

SECTION 3 PARTS LIST

3.1 How To Use The Parts List

- Use the table of contents or index to locate the assembly that contains the part you need.
- Go to the appropriate section and locate the part in the illustration.
- Use the number pointing to the part to locate the correct part number and description in the table.
- Parts shown indented under another part are included with that part.
- Parts marked with a diamond (◆) are only available in the assembly listed above the part.

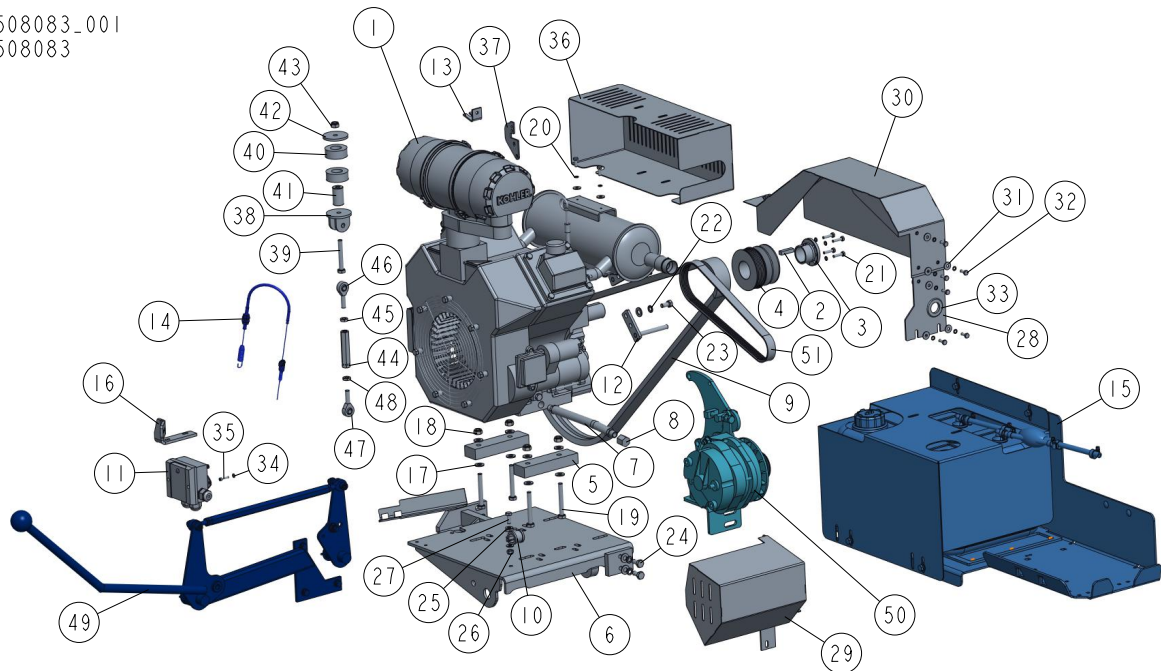
See the sample table below. Sample Part #A01111 includes part F02222-2 and subassembly A03333. Subassembly A03333 includes part S04444-4 and subassembly K05555. The diamond (◆) indicates that S04444-4 is not available except in subassembly A03333. Subassembly K05555 includes parts M06666 and F07777-77. The diamond (◆) indicates M06666 is not available except in subassembly K05555.

3.2 Sample Assembly				
REF	DESCRIPTION (◆ Indicates Parts Available In Assemblies Only)	PART #	QTY.	
	SAMPLE ASSEMBLY, COMPLETE (INCLUDES ALL INDENTED PARTS BELOW)	A01111	1	
1	Sample Part	F02222-22	1	
	Sample Subassembly (Includes All Indented Parts Below)	A03333	1	
2	Sample Part (◆ Indicates Part Is Only Available With A03333)	S04444-4	1	◆
	Sample Subassembly (Includes All Indented Parts Below)	K05555	1	
3	Sample Part (◆ Indicates Part Is Only Available With K05555)	M06666	2	◆
4	Sample Part	F07777-77	1	

To Order Parts:

- From Europe call our European Headquarters and Manufacturing Facility in Kolo, Poland at **+48-63-2626000** or **+48-3912-1319**. From the continental U.S., call **1-800-448-7881** to order parts. Have your customer number, vehicle identification number, and part numbers ready when you call.
- From other international locations, contact the Wood-Mizer distributor in your area for parts.

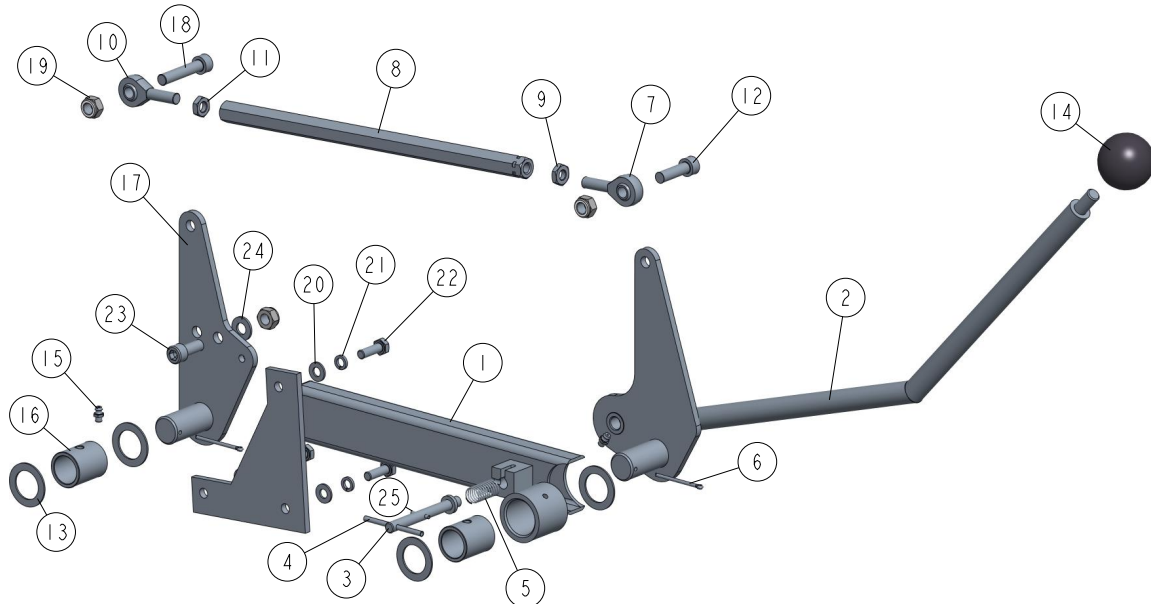
3.3 Engine Assembly G29-LT40 508083

508083_001
508083

REF	DESCRIPTION (◆ indicates parts available in assemblies only)	PART #	QTY
-	ENGINE ASSEMBLY, KOHLER G29-LT40 COMPLET	508083	1
1	ENGINE, 29 HP KOHLER GAS	065236	1
2	KEY, A9.52X8X36 ZINC	508060-1	1
3	BUSHING, H 1 7/16" THICK FLANGE ZINC	508059-1	1
4	PULLEY, G28 MOTOR ZINC	544298-1	1
5	BAR, GP25 ENGINE MOUNT PTD	091564-1	2
6	MOUNT WLDMT, MOTOR E11/E15 G15/G24 PTD	086803-1	1
7	HOSE, 7" OIL DRAIN	P10082	1
8	CAP, OIL DRAIN 3/8" PIPE	P04332	1
9	BELT, 2BX72 DRIVE (G25)	P09555-2	1
10	CLIP, RSGU 1.20/20 RETAINING	F81087-2	1
11	RELAY, SAFETY KEY SWITCH	086486	1
12	BRACKET WELDMNT,GP25 DRIVE BELT SUPPORT	091582-1	2
13	BRACKET, THROTTLE CABLE MOUNT	091567-1	1
14	CABLE ASSEMBLY, G29 THROTTLE - COMPLETE See Section 3.5	092552	1
15	TANK FLUEL See Section 3.7	518308	1
16	BRACKET, THROTTLE CABLE SPRING PTD	091587-1	1
17	WASHER, 10.5 FLAT ZINC	F81055-1	12
18	NUT, M10-8-B HEX NYLON ZINC LOCK	F81033-1	4
19	BOLT, M10X75-8.8 HEX HEAD ZINC	F81003-15	4
20	WASHER, Z6.1 SPLIT LOCK ZINC	F81053-3	15
21	BOLT, M6X25-5.8 HEX HEAD FULL THREAD ZIN	F81001-3	4
22	WASHER, Z 10.2 SPLIT LOCK ZINC	F81055-2	4
23	BOLT, 3/8-16 X 3/4" HEX HEAD	F05007-27	2
24	BOLT, M10X20-5.8 HEX HEAD FULL THREAD ZI	F81003-1	2

REF	DESCRIPTION (◆ indicates parts available in assemblies only)	PART #	QTY
25	WASHER, 8.4 FLAT ZINC	F81054-1	2
26	NUT, M8 8 HEX NYLON ZINC LOCK	F81032-2	1
27	BOLT, M8X20-8.8-B HEX HEAD FULL THREAD Z	F81002-4	1
28	GUARD, G18/G20/G25 SIDE ENGINE PULLEY	087178-1	1
29	GUARD, G28 LT40 ALTERNATOR	541014-1	1
30	GUARD WELDMENT, G18/G20/G25/G28/G29 ENGI	091571-1	1
31	WASHER, 6.5 SPECIAL FLAT ZINC	F81053-11	11
32	BOLT, M6 X 16 8.8 FE/ZN5 PN-M/82105	F81001-15	11
33	GROMMET, 1"ID RUBBER	P11765	1
34	WASHER 4,3 FE/ZN5 PN-M/82005	F81051-2	2
35	SCREW, M4X20 8.8 HEX SOCKET HEAD CAP ZIN	F81011-31	2
36	GUARD, MUFFLER COMPLETE-(GP25/GP18)WELD.	091859-1	1
37	BRACKET, G25 THROTTLE	091565-1	1
-	VIBRATION ABSORBER, CLUTCH	090666-1	1
38	BRACKET, CLUTCH MOUNT	W12411-1	1
39	BOLT, M10X70-8.8-HEX HEAD FULL THREAD ZI	F81003-20	1
40	BUSHING, MOTOR MOUNT VIBRATION	P05032	2
41	SPACER, MOTOR MOUNT VIBRATION BUSHING	506712	1
42	WASHER, 3/8" I.D. X 2 1/4" O.D. X 3/16"	S12412-0	1
43	NUT, M10-8-B HEX NYLON ZINC LOCK	F81033-1	1
-	TURNBUCKLE ASSEMBLY, CLUTCH/BRAKE LEVER	518339	1
44	TURNBUCKLE	518243-1	1
45	NUT, M10-04-A HEX THIN ZINC	F81033-6	1
46	END, SAL10 ROD THREAD	096431	1
47	ROD END, SA10	094236	1
48	NUT, M10 LH DIN 439 THIN LEFT	F81033-21	1
49	HANDLE ASSEMBLY, EXTENDED CLUTCH/BRAKE See Section 3.4	086242	1
50	ALTERNATOR ASSEMBLY, G28 See Section 3.6	541013	1
51	BELT, 140A S G28 PK 6 L=775 ALTERNATOR	544399	1

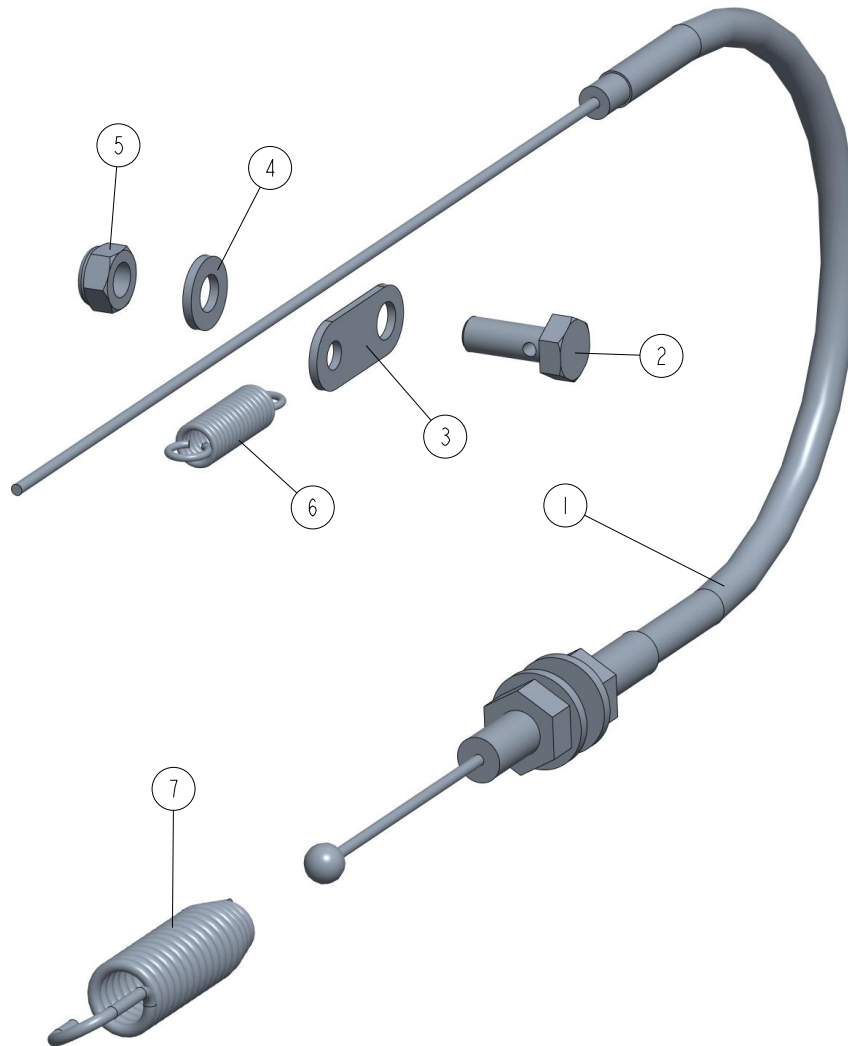
3.4 Handle Assembly, Extended Clutch/Brake 086242

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086242

REF	DESCRIPTION (◆ indicates parts available in assemblies only)	PART #	QTY
-	HANDLE ASSEMBLY, EXTENDED CLUTCH/BRAKE	086242	1
1	EXTENSION WELDMENT, CLUTCH HANDLE	086244-1	1
2	LEVER, CLUTCH/BRAKE	086339-1	1
3	PIN, CLUTCH DETENT	086243	1
4	PIN, 3/16 X 2 1/2" ROLL	F05012-27	1
5	SPRING, .58" OD X 1 1/8"	021243	1
6	PIN, 1/8" X 1 3/4" COTTER	F05012-43	2
7	END, SA10 ROD THREAD	096431	1
8	TURNBUCKLE	518342-1	1
9	NUT, M10 LH DIN 439 THIN LEFT	F81033-21	1
10	ROD END, SA10	094236	1
11	NUT, M10-04-A HEX THIN ZINC	F81033-6	1
12	SCREW, M10X35 8.8 HEX SOCKET HEAD CAP ZI	F81003-56	1
13	WASHER, CLUTCH/BRAKE PIVOT	087051-1	4
14	KNOB, PLASTIC ROUND	086337	1
15	FITTING, M6 TYPE A STRAIGHT GREASE	086280	2
16	BUSHING, CLUTCH/BRAKE PIVOT	095349	2
17	PLATE WELDMENT, CLUTCH PIVOT	087086-1	1
18	SCREW, M10X50-8.8 HEX SOCKET HEAD CAP ZI	F81003-114	1
19	NUT, M10-8-B HEX NYLON ZINC LOCK	F81033-1	3
20	WASHER, 8.4 FLAT ZINC	F81054-1	3
21	WASHER, 8.2 SPLIT LOCK ZINC	F81054-4	3
22	BOLT, M8X25-8.8-B HEX HEAD FULL THREAD Z	F81002-5	3
23	BOLT, M10 X 25 8.8, PN-M/82302	F81003-32	1
24	WASHER, 10.5 FLAT ZINC	F81055-1	1
25	PIN, 1/8" X 3/4" ROLL	F05012-6	1

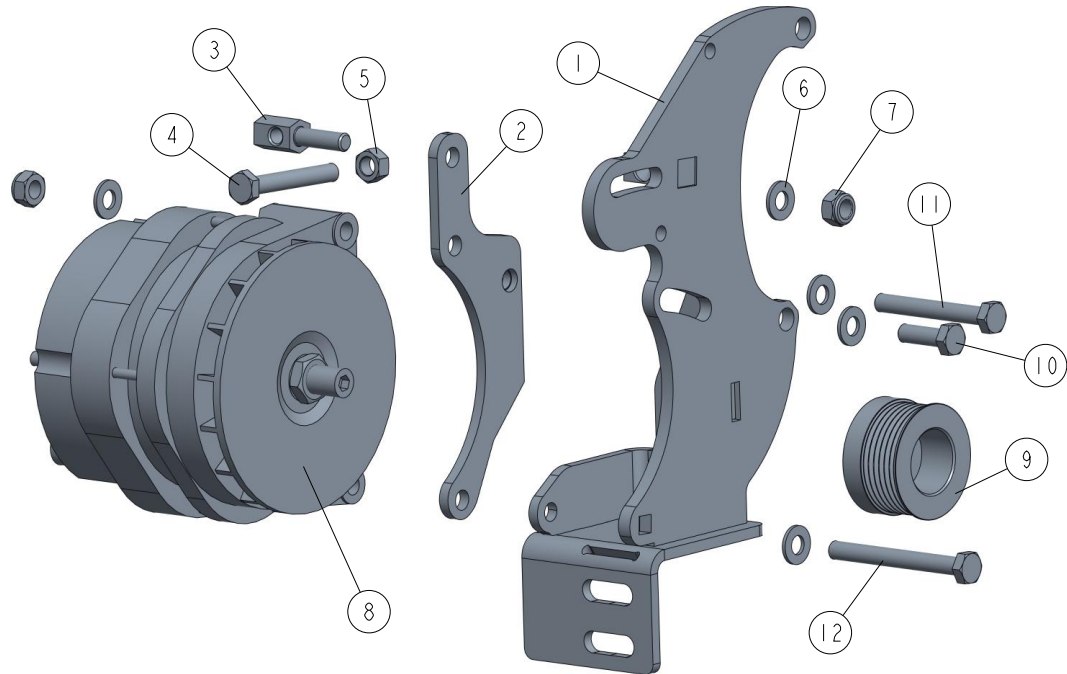
3.5 Cable Assembly 092552

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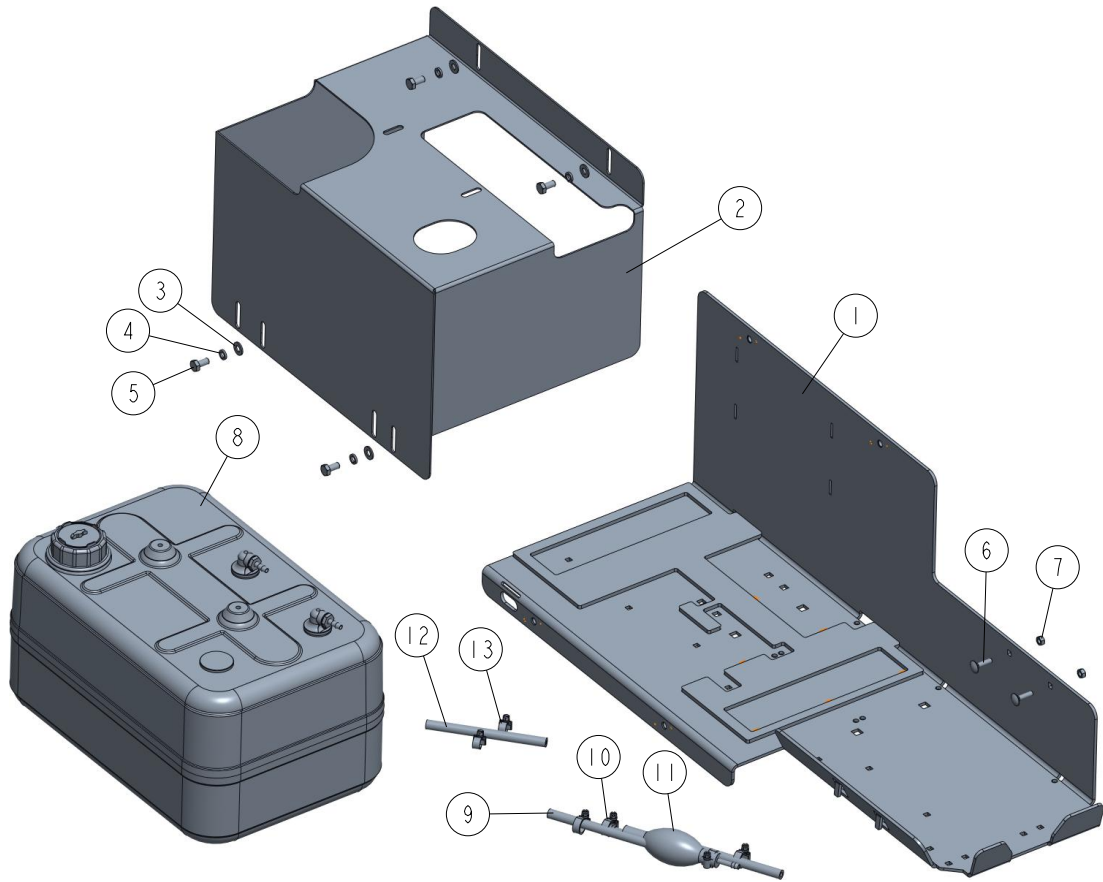
REF	DESCRIPTION (◆ indicates parts available in assemblies only)	PART #	QTY
-	CABLE ASSEMBLY, G29 THROTTLE - COMPLETE	092552	1
1	CABLE, THROTTLE	091924	1
2	BOLT, THROTTLE CABLE CLAMP ZINC	088120-1	1
3	PLATE, G18 THROTTLE CABLE SPRING MOUNT	092531	1
4	WASHER, 6.4 FLAT ZINC	F81053-1	1
5	NUT, M6-8-B HEX NYLON ZINC LOCK	F81031-2	1
6	SPRING, 1.3 X 8 X 20 EXTENSION	092549	1
7	SPRING 40X9X2.2 EXTENSION	089451	1

3.6 Alternator Assembly 541013

541013_001
541013

REF	DESCRIPTION (◆ indicates parts available in assemblies only)	PART #	QTY
-	ALTERNATOR ASSEMBLY, G28	541013	1
1	BRACKET, G28 ALTERNATOR	540346-1	1
2	PLATE WELDMENT, ALTERNATOR PIVOT	540168-1	1
3	STUD, BELT TENSION ADJUSTMENT ZINC-PLATE	091694-1	1
4	BOLT, M10X70-8.8-HEX HEAD FULL THREAD ZI	F81003-20	1
5	NUT, M10 8 HEX ZINC	F81033-3	1
6	WASHER, 10.5 FLAT ZINC	F81055-1	6
7	NUT, M10-8-B HEX NYLON ZINC LOCK	F81033-1	3
8	ALTERNATOR, 140 AMP	023695	1
9	PULLEY, ALTERNATOR	544299-1	1
10	BOLT, DIN933-M10X30-8.8-A2E HEX HEAD	F81003-111	1
11	BOLT, M10X75-8.8 HEX HEAD ZINC	F81003-15	1
12	BOLT, M10X90-8.8 HEX HEAD FULL THREAD ZI	F81003-90	1

3.7 Tank Fuel 518308

518308_001
518308

REF	DESCRIPTION (◆ indicates parts available in assemblies only)	PART #	QTY
-	TANK FUEL	518308	1
1	PLATE WELDMENT, FUEL TANK MOUNT	557141-1	1
2	COVER, FUEL TANK	550769-1	1
3	WASHER, 8.4 FLAT ZINC	F81054-1	4
4	WASHER, 8.2 SPLIT LOCK ZINC	F81054-4	4
5	BOLT M8X16 -8.8-B-FE/ZN5 PN-85/M-82105	F81002-20	4
6	BOLT, M6X25-8.8 ZINC	F81001-20	2
7	NUT, M6 8 HEX ZINC	F81031-1	2
8	FUEL TANK, 25-LITRE	550767	1
9	FUEL LINE, DIESEL ENGINE	P642	2
10	CLAMP, 12-20	F81080-3	4
11	BULB, FUEL PRIMER	014481	1
12	HOSE, 5X12 FUEL	R80703-4	1
13	CLAMP, 8-12MM DIA. WORM	F81080-1	2

Section 5

EFI Fuel System

Troubleshooting

General

When troubleshooting a problem on an engine with EFI, basic engine operating problems must be eliminated first before faulting the EFI system components. What appears to be an EFI problem could be something as simple as a fuel tank with debris in the bottom or a plugged vent. Be sure the engine is in good mechanical operating condition and all other systems are operating properly before attempting to troubleshoot the EFI system.

Troubleshooting Guide

Engine starts hard or fails to start when cold

1. Fuel pump not running
2. Faulty spark plugs
3. Old/stale fuel
4. Incorrect fuel pressure
5. Crankshaft position sensor loose or faulty
6. TPS set incorrect (ECU Reset and TPS Learn)
7. TPS faulty
8. Engine temp sensor faulty
9. Faulty coils
10. Low system voltage
11. Faulty injectors
12. Faulty battery
13. Loose or corroded connections

Engine starts hard or fails to start when hot

1. Faulty spark plugs
2. Fuel pump not running
3. Fuel pressure low
4. Insufficient fuel delivery
5. TPS set incorrect (ECU Reset and TPS Learn)
6. Crankshaft position sensor loose or faulty
7. TPS faulty
8. Engine temp sensor faulty
9. Faulty injectors

Engine stalls or idles roughly (cold or warm)

1. Faulty spark plugs
2. Insufficient fuel delivery
3. TPS set incorrect
4. TPS faulty
5. Faulty engine temperature sensor
6. Faulty injectors

Engine misses, hesitates, or stalls under load

1. Fuel injector(s), fuel filter, fuel line, or fuel pick-up dirty/restricted
2. Dirty air cleaner
3. Insufficient fuel pressure or fuel delivery
4. Vacuum (intake air) leak
5. Improper governor setting, adjustment or operation
6. TPS faulty, mounting problem or TPS Learn Procedure incorrect
7. Bad coil(s), spark plug(s), or wires

Low Power

1. Faulty/malfunctioning ignition system
2. Dirty air filter
3. Insufficient fuel delivery
4. Improper governor adjustment
5. Plugged/restricted exhaust
6. One injector not working
7. Basic engine problem exists
8. TPS faulty or mounting exists
9. Throttle plate in throttle body not fully opening to WOT stop (if so equipped)

Fuel System



WARNING: Fuel System Under Pressure!

The fuel system operates under high pressure. System pressure must be relieved through the fuel connector and the fuel pump module (see page 5.2) prior to servicing or removal of any fuel system components. Do not smoke or work near heaters or other fire hazards. Have a fire extinguisher handy and work only in a well-ventilated area.

The function of the fuel system is to provide sufficient delivery of fuel at the system operating pressure of 39 psi \pm 3. If an engine starts hard, or turns over but will not start, it may indicate a problem with the EFI fuel system. A quick test will verify if the system is operating.

1. Disconnect and ground the spark plug leads.
2. Complete all safety interlock requirements and crank the engine for approximately 3 seconds.

3. Remove the spark plugs and check for fuel at the tips.
 - a. If there is fuel at the tips of the spark plugs the fuel pump and injectors are operating.
 - b. If there is no fuel at the tips of the spark plugs, check the following:
 - 1) Make sure the fuel tank contains clean, fresh, proper fuel.
 - 2) Make sure that the vent in the fuel tank is open.
 - 3) Make sure the fuel tank valve (if so equipped) is fully opened.
 - 4) Make sure the battery is supplying proper voltage.
 - 5) Check that the fuses are good, and that no electrical or fuel line connections are damaged or broken.
 - 6) Test fuel pump module operation as described earlier under Fuel Pump – Service.
4. The MIL will blink a series of times. The number of times the MIL blinks represents a number in the blink code.
5. A sequence of four digits make up a fault code. There is a one (1) second pause between the blinks of a fault code. There is a three (3) second pause between separate fault codes. After the fault code(s) are blinked a two digit 61 is blinked to indicate the program has completed.
 - a. It's a good idea to write down the codes as they appear, as they may not be in numerical sequence.
 - b. Code 61 will always be the last code displayed, indicating the end of code transmission. If code 61 appears immediately, no other fault codes are present.

Fault Codes

The ECU continuously monitors engine operation against preset performance limits. If the operation is outside the limits, the ECU activates the MIL, if equipped, and stores a diagnostic code in its fault memory. If the component or system returns to proper function, the ECU will turn off the MIL. If the MIL stays illuminated, it warns the customer a fault is currently happening, and dealer service is required. Upon receipt, the dealer technician can access the fault code(s) to help determine what portion of the system is malfunctioning. The 4-digit fault codes available are listed on page 5.29.

The codes are accessed through the key switch and displayed as blinks or flashes of the MIL. Access the codes as follows:

1. Check that the battery voltage is above 11 volts.
2. Start with the key switch OFF.
3. Turn the key switch to the ON and OFF, then ON and OFF, then ON, leaving it on in the third sequence. Do not start the engine. The time between sequences must be less than 2.5 seconds.

Section 5 EFI Fuel System

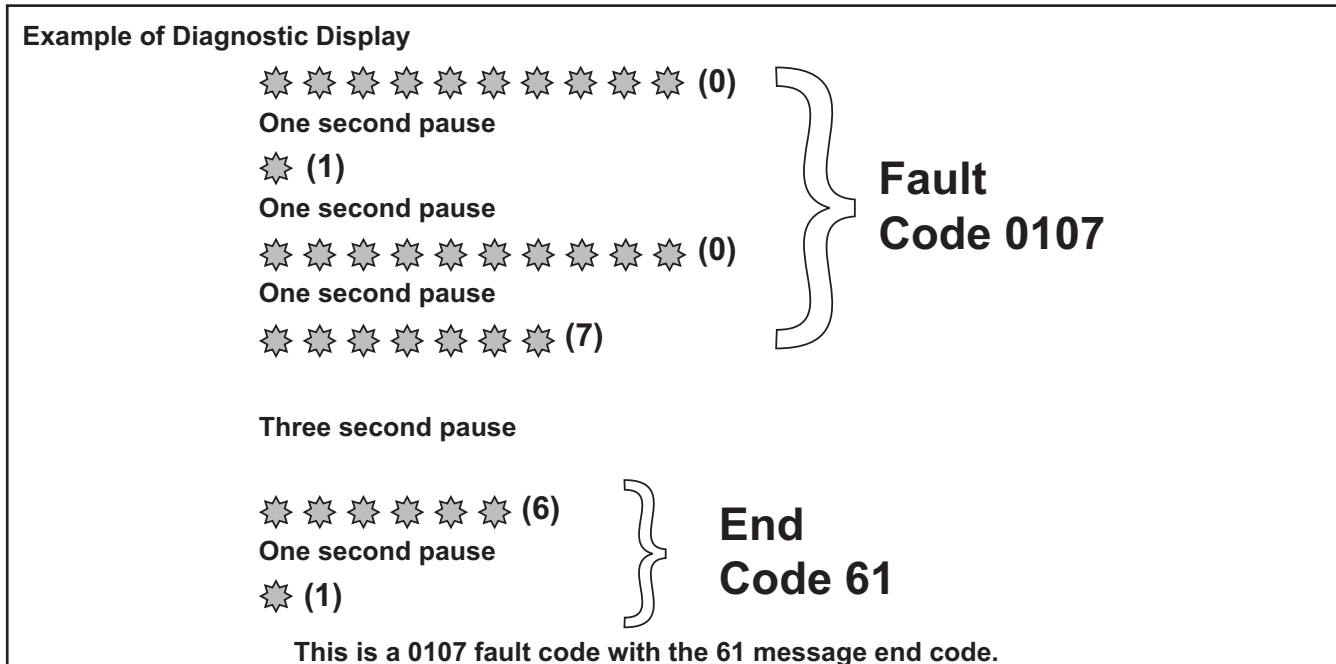


Figure 5-29.

After the problem has been corrected, the fault codes may be cleared by following the ECU Reset and TPS Learn Procedures.

The chart on the following page lists the fault codes, and what they correspond to. Following the chart is a list of the individual codes with an explanation of what triggers them, what symptoms might be expected, and the probable causes.

A MIL may not be provided with the engine. If the equipment manufacturer has not added a MIL to the equipment, one can be added easily for quick diagnostics. The main engine to vehicle connection will have a tan wire which is the ground for the MIL. Either incandescent or LED type bulbs can be used for the MIL as long as they do not draw more than 0.1 amps. The bulb needs to be rated at 1.4 Watts or less, or needs to have a total resistance of 140 Ω or more. LEDs typically draw less than 0.03 amps. Attach +12 volts to the positive terminal of the bulb and attach the ground terminal of the bulb to the tan wire.

Diagnostic Code Summary

Fault Code	Connection or Failure Description
0031	Oxygen Sensor Heater Circuit High Voltage
0032	Oxygen Sensor Heater Circuit Low Voltage
0107	Manifold Absolute Pressure Sensor Circuit Low Voltage or Open
0108	Manifold Absolute Pressure Sensor Circuit High Voltage
0112	Intake Air Temperature Sensor Circuit Low Voltage
0113	Intake Air Temperature Sensor Circuit High Voltage or Open
0117	Coolant/Oil Temperature Sensor Circuit Low Voltage
0118	Coolant/Oil Temperature Sensor Circuit High Voltage or Open
0122	Throttle Position Sensor Circuit Low Voltage or Open
0123	Throttle Position Sensor Circuit High Voltage
0131	Oxygen Sensor 1 Circuit Low Voltage, or Open
0132	Oxygen Sensor 1 Circuit High Voltage
0171	Maximum Adaptation Limit Exceeded
0172	Minimum Adaptation Limit Exceeded
0174	Lean Fuel Condition at High Load (Open Loop)
0201	Injector 1 Circuit Malfunction
0202	Injector 2 Circuit Malfunction
0230	Fuel Pump Module Circuit Low Voltage or Open
0232	Fuel Pump Module Circuit High Voltage
0336	Crankshaft Position Sensor Noisy Signal
0337	Crankshaft Position Sensor No Signal
0351	Cylinder 1 Ignition Coil Malfunction
0352	Cylinder 2 Ignition Coil Malfunction
0562	System Voltage Low
0563	System Voltage High
61	End of Code Transmission

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Code:	0031
Component:	Oxygen Sensor Heater
Fault:	O2S Heater Circuit High Voltage

Condition: System voltage too high, shorted connection or faulty sensor.

Possible Causes:

1. Oxygen Sensor Related
 - a. Sensor connector or wiring problem.
 - b. Sensor damaged.
 - c. Pin circuit wiring or connectors at Black 7.
2. ECU Related
 - a. ECU-to-harness connection problem.

Code:	0032
Component:	Oxygen Sensor Heater
Fault:	O2S Heater Circuit Low Voltage

Condition: System voltage too low, open connection or faulty sensor.

Possible Causes:

1. Engine Wiring Harness Related
 - a. Pin circuit wiring or connectors.
 1. ECU Black pin 7.
 2. Broken wire.
2. Oxygen Sensor Related
 - a. Sensor connector or wiring problem.
3. Poor system ground from ECU to engine or battery to engine.

Code:	0107
Component:	Manifold Absolute Pressure Sensor
Fault:	MAP Circuit Low Voltage or Open

Condition: Intake manifold leak, open connection or faulty sensor.

Possible Causes:

1. MAP Sensor Related
 - a. Sensor malfunction.
 - b. Vacuum leaks from loose manifold or sensor.
2. Wire Harness Related
 - a. Poor grounding or open circuit.
 - b. Wire harness and connectors loose, damaged or corroded.
 - c. Pin circuit wiring or connectors at Black 10, 11 and 16.
3. Bad TPS Learn.

Code:	0108
Component:	Manifold Absolute Pressure Sensor
Fault:	MAP Circuit High Voltage

Condition: Intake manifold leak, shorted connection or faulty sensor.

Possible Causes:

1. MAP Sensor Related
 - a. Sensor malfunction.
 - b. Vacuum leaks from loose manifold or sensor.
2. Wire Harness Related
 - a. Poor grounding.
 - b. Pin circuit wiring or connectors at Black 11.
3. Bad TPS Learn.

Code:	0112
Component:	Intake Air Temperature Sensor
Fault:	Intake Air Temperature Sensor Circuit Low Voltage

Condition: Shorted connection, faulty sensor or shorted wire.

Possible Causes:

1. Temperature Sensor Related
 - a. Sensor wiring or connection.
2. Engine Wiring Harness Related
 - a. Pin circuits Black 10 and Black 8 may be damaged or routed near noisy signal (coils, alternator, etc.).
 - b. ECU-to-harness connection problem.

Code:	0113
Component:	Intake Air Temperature Sensor
Fault:	Intake Air Temperature Sensor Circuit High Voltage or Open

Condition: Shorted connection, faulty sensor, broken wire or connection.

Possible Causes:

1. Temperature Sensor Related
 - a. Sensor wiring or connection.
2. Engine Wiring Harness Related
 - a. Pin circuits ECU Black pin 10 and 8 may be damaged.
 - b. ECU-to-harness connection problem or broken wire.

Code:	0117
Component:	Coolant/Oil Sensor
Fault:	Coolant/Oil Temperature Sensor Circuit Low Voltage

Condition: Shorted connection, faulty sensor or shorted wire.

Possible Causes:

1. Temperature Sensor Related
 - a. Sensor wiring or connection.
2. Engine Wiring Harness Related
 - a. Pin circuits Black 10 and Black 14 maybe damaged or routed near noisy signal (coils, stator, etc.).
 - b. ECU-to-harness connection problem.

Code:	0118
Component:	Coolant/Oil Sensor
Fault:	Coolant/Oil Temperature Sensor Circuit High Voltage or Open

Condition: Shorted connection, faulty sensor, open connection or broken wire.

Possible Causes:

1. Temperature Sensor Related
 - a. Sensor wiring or connection.
2. Engine Wiring Harness Related
 - a. Pin circuits ECU Black pin 10 and 14 may be damaged.
 - b. ECU-to-harness connection problem or broken wire.
3. System Related
 - a. Engine is operating above the 176°C (350°F) temperature sensor limit.

Code:	0122
Component:	Throttle Position Sensor (TPS)
Fault:	TPS Circuit Low Voltage or Open

Condition: Open connection, broken wire or faulty sensor.

Possible Causes:

1. TPS Related
 - a. TPS bad or worn internally.
2. Engine Wiring Harness Related
 - a. Broken or shorted wire in harness.
 1. ECU Black pin 10 to TPS pin 1.
 2. ECU Black pin 12 to TPS pin 3.

3. ECU Black pin 16 to TPS pin 2.

3. Throttle Body Related
 - a. Throttle shaft inside TPS worn, broken, or damaged.
 - b. Throttle plate loose or misaligned.
 - c. Throttle plate bent or damaged allowing extra airflow past, or restricting movement.
4. ECU Related
 - a. Circuit providing voltage or ground to TPS damaged.
 - b. TPS signal input circuit damaged.

Code:	0123
Component:	Throttle Position Sensor (TPS)
Fault:	TPS Circuit High Voltage

Condition: Shorted connection or faulty sensor.

Possible Causes:

1. TPS Sensor Related
 - a. Sensor connector or wiring.
 - b. Sensor output affected or disrupted by dirt, grease, oil, wear.
 - c. Sensor loose on throttle body manifold.
2. Throttle Body Related
 - a. Throttle shaft or bearings worn/damaged.
3. Engine Wiring Harness Related
 - a. ECU pins Black 10, 12 and 16 damaged (wiring, connectors).
 - b. ECU pins Black 10, 12 and 16 routed near noisy electrical signal (coils, alternator).
 - c. Intermittent 5 volt source from ECU (pin Black 16).
 - d. ECU-to-harness connection problem.

Code:	0131
Component:	Oxygen Sensor
Fault:	O2S 1 Circuit Low Voltage

Condition: Open connection, broken wire or faulty sensor.

Possible Causes:

1. Oxygen Sensor Related
 - a. Sensor connector or wiring problem.
 - b. Sensor contaminated, corroded or damaged.
 - c. Poor ground path.
 - d. Pin circuit wiring or connectors.
ECU Black pin 10 or 17.

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2. TPS Learn Procedure Incorrect
 - a. Lean condition (check oxygen sensor signal with VOA and see Oxygen Sensor section).
3. Engine wiring harness related such as a cut wire, broken or pinched.

Code:	0132
Component:	Oxygen Sensor
Fault:	O2S 1 Circuit High Voltage

Condition: Shorted connection or faulty sensor.

Possible Causes:

1. Oxygen Sensor Related
 - a. Sensor connector or wiring problem.
 - b. Sensor contaminated or damaged.
 - c. Poor ground path.
 - d. Pin circuit wiring or connectors.
ECU Black pin 10 or Black pin 17.
2. Engine Wiring Harness Related
 - a. Difference in voltage between sensed voltage and actual sensor voltage.
 - b. Short in wire harness.

Code:	0171
Component:	Fuel System
Fault:	Maximum adaptation limit exceeded

Condition: Fuel inlet screen/filter plugged, low pressure at high pressure fuel line, TPS malfunction, shorted connection, faulty sensor, low fuel or wrong fuel type.

Possible Causes:

1. Oxygen Sensor Related
 - a. Corrosion or poor connection.
 - b. Sensor contaminated or damaged.
 - c. Air leak into exhaust.
 - d. Poor ground path.
 - e. Pin circuit wiring or connectors.
 1. ECU Black pin 10 or Black pin 17.
2. TPS Sensor Related
 - a. Throttle plate position incorrect during Learn procedure.
 - b. TPS problem or malfunction.
3. Engine Wiring Harness Related
 - a. Difference in voltage between sensed voltage and actual sensor voltage.
 - b. Problem in wiring harness.
 - c. ECU-to-harness connection problem.

4. Systems Related
 - a. Ignition (spark plug, plug wire, ignition coil).
 - b. Fuel (fuel type/quality, injector, fuel pressure too low, fuel pump module or lift pump).
 - c. Combustion air (air cleaner dirty/restricted, intake leak, throttle bores).
 - d. Base engine problem (rings, valves).
 - e. Exhaust system leak (muffler, flange, oxygen sensor mounting boss, etc.).
 - f. Fuel in the crankcase oil.

Code:	0172
Component:	Fuel System
Fault:	Minimum adaptation limit exceeded

Condition: Too high pressure at high pressure fuel line, TPS malfunction, shorted connection, faulty sensor or fuel pump module failure.

Possible Causes:

1. Oxygen Sensor Related
 - a. Sensor connector or wiring.
 - b. Sensor contaminated or damaged.
 - c. Poor ground path.
 - d. Pin circuit wiring or connectors.
ECU Black pin 10 or 17.
2. TPS Sensor Related
 - a. Throttle plate position incorrect during Learn procedure.
 - b. TPS problem or malfunction.
3. Engine Wiring Harness Related
 - a. Difference in voltage between sensed voltage and actual sensor voltage.
 - b. Problem in wiring harness.
 - c. ECU-to-harness connection problem.
4. Systems Related
 - a. Ignition (spark plug, plug wire, ignition coil).
 - b. Fuel (fuel type/quality, injector, fuel pressure too high, fuel pump module or lift pump).
 - c. Combustion air (air cleaner dirty/restricted).
 - d. Base engine problem (rings, valves).
 - e. Fuel in the crankcase oil.
 - f. Fuel pump module is over filled.
 - g. Lift pump diaphragm is ruptured.

Code:	0174
Component:	Fuel System
Fault:	Lean fuel condition

Condition: Fuel inlet screen/filter plugged, low pressure at high pressure fuel line, TPS malfunction, shorted connection or faulty sensor.

Possible Causes:

1. TPS Learn Incorrect
 - a. Lean condition (check oxygen sensor signal with VOA and see Oxygen Sensor section).
2. Engine Wiring Harness Related
 - a. Pin circuit wiring or connectors. ECU pin Black 10, 12, 16 and 17.
3. Low Fuel Pressure
 - a. Plugged filters.
 - b. Bad lift pump.
4. Oxygen Sensor Related
 - a. Sensor connector or wiring problem.
 - b. Exhaust leak.
 - c. Poor ground.
5. Poor system ground from ECU to engine, causing rich running while indicating lean.
6. Fuel pump module connection. See Fuel Components.

Code:	0201
Component:	Fuel Injector
Fault:	Injector 1 Circuit Malfunction

Condition: Injector damaged or faulty, shorted or open connection.

Possible Causes:

1. Injector Related
 - a. Injector coil shorted or opened.
2. Engine Wiring Harness Related
 - a. Broken or shorted wire in harness. ECU pin Black 5.
 - b. Wiring from Ignition.
3. ECU Related
 - a. Circuit controlling injector #1 damaged.

Code:	0202
Component:	Fuel Injector
Fault:	Injector 2 Circuit Malfunction

Condition: Injector damaged or faulty, shorted or open connection.

Possible Causes:

1. Injector Related
 - a. Injector coil shorted or opened.
2. Engine Wiring Harness Related
 - a. Broken or shorted wire in harness. ECU pin Black 6.
 - b. Wiring from Ignition.
3. ECU Related
 - a. Circuit controlling injector #2 damaged.

Code:	0230
Component:	Fuel Pump
Fault:	Circuit Low Voltage or Open

Condition: Shorted or open connection.

Possible Causes:

1. Fuel Pump Related
 - a. Fuel pump module open or shorted internally.
2. Engine Wiring Harness related
 - a. Broken or shorted wire in harness. ECU pin Black 9 or Grey 17.
3. ECU Related
 - a. The ECU is damaged.

Code:	0232
Component:	Fuel Pump
Fault:	Circuit High Voltage

Condition: Shorted connection.

Possible Causes:

1. Fuel Pump Related
 - a. Fuel pump module damaged internally.
2. Charging Output System Too High.

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Code:	0336
Component:	Crankshaft Position Sensor
Fault:	Crankshaft Position Sensor Noisy Signal

Condition: Air gap incorrect, loose sensor, faulty/bad battery, shorted or faulty connection, faulty sensor or faulty sensor grounding.

Possible Causes:

1. Crankshaft Position Sensor Related
 - a. Sensor connector or wiring.
 - b. Sensor loose or air gap incorrect.
2. Crankshaft Position Sensor Wheel Related
 - a. Damaged teeth.
 - b. Gap section not registering.
3. Engine Wiring Harness Related
 - a. Pin circuit wiring or connectors.
ECU pin Black 4 and Black 13.
 - b. ECU-to-harness connection problem.
4. Ignition System Related
 - a. Non-resistor spark plug(s) used.
 - b. Faulty or disconnected ignition coil or secondary lead.

Code:	0337
Component:	Crankshaft Position Sensor
Fault:	Crankshaft Position Sensor No Signal

Condition: Air gap incorrect, loose sensor, open or shorted connection or faulty sensor.

Possible Causes:

1. Crankshaft Position Sensor Related
 - a. Sensor connector or wiring.
 - b. Sensor loose or air gap incorrect.
2. Crankshaft Position Sensor Wheel Related
 - a. Damaged teeth.
3. Engine Wiring Harness Related
 - a. Pin circuit wiring or connectors.
ECU pin Black 4 or Black 13.
 - b. ECU-to-harness connection problem.
4. If code is stored in fault history and starts normally. Clear code, no other service required.

Code:	0351
Component:	Ignition Coil
Fault:	Cylinder 1 Ignition Coil Malfunction

Condition: Broken wire in harness (may not be visible), shorted connection or faulty sensor.

Possible Causes:

1. Engine Wiring Harness Related
 - a. Connection to ignition or fuse.
 - b. Pin circuit wiring or connectors.
ECU pin Black 1.
 - c. ECU-to-harness connection problem.
2. Ignition System Related
 - a. Incorrect spark plug(s) used.
 - b. Poor connection to spark plug.

Code:	0352
Component:	Ignition Coil
Fault:	Cylinder 2 Ignition Coil Malfunction

Condition: Broken wire in harness (may not be visible), shorted connection or faulty sensor.

Possible Causes:

1. Engine Wiring Harness Related
 - a. Connection to ignition or fuse.
 - b. Pin circuit wiring or connectors.
ECU pin Grey 10.
 - c. ECU-to-harness connection problem.
2. Ignition System Related
 - a. Incorrect spark plug(s) used.
 - b. Poor connection to spark plug.

Code:	0562
Component:	System Voltage
Fault:	System Voltage Low

Condition: Faulty voltage regulator, bad fuse or shorted connection.

Possible Causes:

1. Corroded Connections
2. Bad Stator
3. Bad Battery
 - a. Low output charging system.
 - b. Poor magnet in flywheel.
 - c. Bad or missing fuse.

Code:	0563
Component:	System Voltage
Fault:	System Voltage High

Condition: Faulty voltage regulator or shorted connection.

Possible Causes:

1. Faulty Rectifier-Regulator
2. Bad Stator.
3. Bad Battery.

Code:	61
Fault:	End of Code Transmission

Troubleshooting Flow Chart

The following flow chart provides an alternative method of troubleshooting the EFI system. The chart will enable you to review the entire system in about 10-15 minutes. Using the chart, the accompanying diagnostic aids (listed after the chart), and any signaled fault codes, you should be able to quickly locate any problems within the system. See Figure 5-30.

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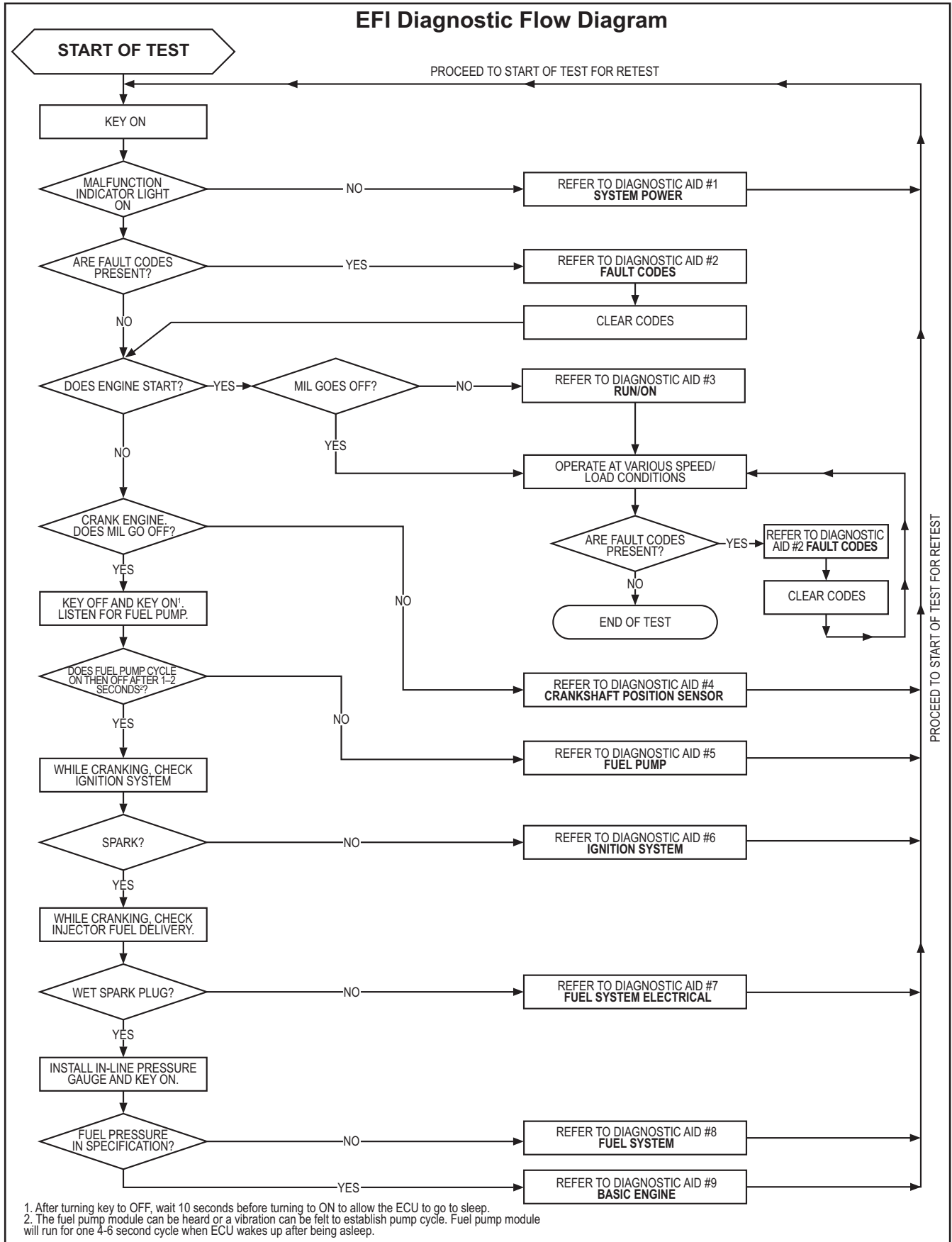


Figure 5-30. Troubleshooting Flow Chart.

Flow Chart Diagnostic Aids

Diagnostic Aid #1 SYSTEM POWER

(MIL does not illuminate when key is turned ON)

NOTE: MIL is installed by vehicle OEM. Twelve volt supply to bulb will be part of vehicle wire harness. Kohler key switch model will have MIL on engine with 12V supply to bulb.

Possible causes:

1. Battery
2. Main system fuse
3. MIL light bulb burned out
4. MIL electrical circuit problem
Pin circuits Grey 3.
5. Ignition switch
6. Permanent ECU power circuit problem
Pin circuit Black 18.
7. Switched ECU power circuit problem
Pin circuit Black 15.
8. ECU grounds
9. ECU

Diagnostic Aid #2 FAULT CODES

(Refer to detailed fault code listing before flow chart and servicing information for the respective components)

- Code 0031 - Oxygen Sensor Heater Circuit High Voltage
- Code 0032 - Oxygen Sensor Heater Circuit Low Voltage
- Code 0107 - Manifold Absolute Pressure Sensor Circuit Low Voltage or Open
- Code 0108 - Manifold Absolute Pressure Sensor Circuit High Voltage
- Code 0112 - Intake Air Temperature Sensor Circuit Low Voltage
- Code 0113 - Intake Air Temperature Sensor Circuit High Voltage or Open
- Code 0117 - Coolant/Oil Temperature Sensor Circuit Low Voltage
- Code 0118 - Coolant/Oil Temperature Sensor Circuit High Voltage or Open
- Code 0122 - TPS Circuit Low Voltage or Open
- Code 0123 - TPS Circuit High Voltage
- Code 0131 - O2S 1 Circuit Low Voltage or Open
- Code 0132 - O2S 1 Circuit High Voltage
- Code 0171 - Maximum adaptation limit exceeded
- Code 0172 - Minimum adaptation limit exceeded
- Code 0174 - Lean fuel condition at high load or open loop
- Code 0201 - Injector 1 Circuit Malfunction
- Code 0202 - Injector 2 Circuit Malfunction

- Code 0230 - Fuel Pump Module Circuit Low Voltage or Open
- Code 0232 - Fuel Pump Module Circuit High Voltage
- Code 0336 - Crankshaft Position Sensor Noisy Signal
- Code 0337 - Crankshaft Position Sensor No Signal
- Code 0351 - Cylinder 1 Ignition Coil Malfunction
- Code 0352 - Cylinder 2 Ignition Coil Malfunction
- Code 0562 - System Voltage Low
- Code 0563 - System Voltage High
- Code 61 - End of Code Transmission.

Diagnostic Aid #3 RUN/ON

(MIL remains ON while engine is running)*

Possible causes:

1. All current fault codes will turn on MIL when engine is running.

NOTE: Either incandescent or LED type bulbs can be used for the MIL as long as they do not draw more than 0.1 amps. The bulb needs to be rated at 1.4 Watts or less, or needs to have a total resistance of 140 Ω or more. LEDs typically draw less than 0.03 amps.

Diagnostic Aid #4 CRANKSHAFT POSITION SENSOR

(MIL does not turn off during cranking)

Possible causes:

1. Crankshaft position sensor
2. Crankshaft position sensor circuit problem, pin circuits Black 4 and Black 13.
3. Crankshaft position sensor/toothed wheel air gap
4. Toothed wheel
5. Flywheel key sheared
6. ECU

Diagnostic Aid #5 FUEL PUMP

(fuel pump not turning on)

Possible causes:

1. Main fuse
2. Fuel pump circuit problem, pin circuits Black 9 and Grey 17.
3. Fuel pump module

Diagnostic Aid #6 IGNITION SYSTEM

(no spark)

Possible causes:

1. Spark plug
2. Plug wire
3. Coil
4. Coil circuit(s), pin circuits Grey 10 and Black 1.
5. ECU grounds

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6. ECU
7. Vehicle safety interlocks, ground signal on safety wire.

Diagnostic Aid #7 FUEL SYSTEM ELECTRICAL

(no fuel delivery)

Possible causes:

1. No fuel
2. Air in high pressure fuel line
3. Fuel valve shut OFF
4. Fuel filter/line plugged
5. Injector circuit(s), pin circuits Black 5 and Black 6
6. Injector
7. ECU grounds
8. ECU
9. Lift pump not working

Diagnostic Aid #8 FUEL SYSTEM

(fuel pressure)

Possible causes for low fuel system pressure:

1. Low fuel
2. Fuel filter plugged
3. Fuel supply line plugged
4. Lift fuel pump - insufficient fuel supply
5. Fuel pump (lift or module) - internally plugged

Possible causes for high fuel system pressure:

1. Pressure regulator not functioning properly inside fuel pump module.

Diagnostic Aid #9 BASIC ENGINE

(cranks but will not run)

Possible causes:

1. Refer to basic engine troubleshooting charts within service manual sections 3, 5, and 7.