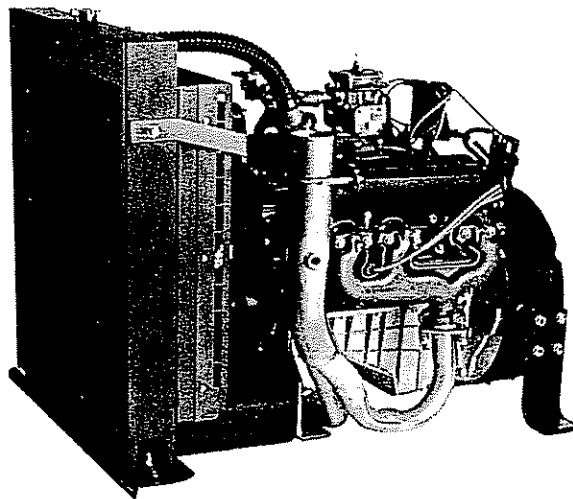




# Operation and Maintenance Manual



PSI's 4.3L OPU

## Industrial Gasoline and Alternate Fueled Engines

1.6L, 3.0L, 4.3L, 5.7L, 7.4L and 8.1L Engines

A GM Powertrain Product  
by Power Solutions, Inc.  
Wood Dale, IL 60191



## LC50 Initial Adjustments

The main adjustment screw (MAS) settings are measured from the MAS valve body (not the jam nut) to the exterior end of the MAS screw. The zero-pressure regulator settings are measured from the top of the spring adjustment screw to the top of the spring tower.

These initial settings should get the gensets up and running for final adjustment with an oxygen sensor or exhaust analyzer. The MAS should be adjusted first with significant (75-90%) load on the engine. The ZPR should then be adjusted at no-load. One or two more iterations at full load for the MAS and no load for the ZPR should provide the correct air/fuel ratio over the entire operating range.

For dual-fuel configurations, the standard NG fuel set up should have a tee added between the ZPR and MAS. The side-leg of the tee should then have the MAS and ZPR for the LP fuel. The initial settings for dual-fuel NG and LP are the same as the single-fuel settings below. The final air/fuel ratio adjustments should be done on NG first, then LP, using the procedure above for each fuel.

50mm LC50

NG: MAS (3/4") 19mm, ZPR (Maxitrol R600Z) 16mm

LP(vap): MAS (3/4") 16mm, ZPR (Maxitrol R500Z) 14mm (5.7L)

43mm LC50

NG: MAS (3/4") 17mm, ZPR (Maxitrol R600Z) 16mm

LP(vap): MAS (3/4") 15mm, ZPR (Maxitrol R500Z) 14mm (4.3L)

36mm LC50

NG: MAS (1/2") 11mm, ZPR (Maxitrol R500Z) 16mm

LP(vap): MAS (1/2") 9.5mm, ZPR (Maxitrol R500Z) 14mm (3.0L)



## Table of Contents

	<b>Page</b>
<b>Introduction</b>	1
How to Use This Manual	1
Engine Identification	2
Parts and Service	2
Service Literature	2
<b>Operating Instructions</b>	3
<b>Controls</b>	3
Ignition Switch	3
Safety Gauges	3
Fuel Systems	3
Governors	4
Instruments	4
Oil Pressure Gauge	4
Temperature Gauge	4
Voltmeter	5
Tachometer/Hourmeter	5
<b>Starting the Engine</b>	5
Carbureted, Mechanical Governor, Manual Choke	5
Carbureted, Electric Choke, Electronic Governor	6
LPG or NG Fuel Systems, Velocity Governors	6
PSI, Inc. Fuel Injection (Gasoline) Integral Governor	6
PSI, Inc. Fuel Injection (Dual Fuel) Integral Governor	6
Zenith Z.E.E.M.S. Throttle Body Fuel Injection, Integral Governor	6
<b>Stopping the Engine</b>	7
Normal Conditions	7
Abnormal Conditions (Carbureted)	7
Abnormal Conditions (Fuel Injected)	7
<b>Fuel Recommendations</b>	7
Fuel Quality	7
Anti-Knock Index (Octane Rating)	8
Gasohol and Alcohol/Gasoline Fuels	8
<b>Spark Plugs</b>	8
<b>Power Loss at Higher Elevations</b>	9
Carbureted Engines	9
Fuel Injected Engines	9
<b>Maintenance Instructions</b>	10
<b>Initial Start Up Maintenance</b>	10
<b>Routine Maintenance</b>	10

## Table of Contents (cont.)

<b>Scheduled Preventive Maintenance</b>	10
<b>Engine Oil Level Check</b>	10
<b>Adding Engine Oil</b>	10
<b>Changing Engine Oil and Filter</b>	11
<b>Engine Oil Quality</b>	11
<b>Engine Oil Recommendation</b>	11
<b>Oil Filter</b>	11
<b>Engine Air Cleaner</b>	12
Safety Element	12
<b>Cooling System</b>	12
Coolant Level	12
Radiator	13
Fan Belts	13
Serpentine Belt	14
V-Type Belt	14
<b>Fuel Filter</b>	14
Carbureted Engines	14
Fuel Injected Engines	14
<b>Ignition Systems</b>	15
Types of Ignition Systems	15
Ignition Timing	15
Spark Plugs	15
<b>Storage</b>	16
One to Six Months	16
Extended Periods	16
Removing the Engine From Storage	16
<b>Appendix</b>	
<b>Timing Procedures</b>	I
<b>Maintenance Schedule</b>	II
<b>Capacities</b>	II
<b>Filter Chart</b>	III
<b>Fuel System Chart</b>	IV
<b>Governor Chart</b>	IV
<b>General Specifications</b>	V

## **Table of Contents (cont.)**

**Spark Plug Wire Routing 3.0L**

**Spark Plug Wire Routing 4.3L**

**Spark Plug Wire Routing 5.7L**

**Spark Plug Wire Routing 7.4L**



## Introduction

Power Solutions, Inc. is pleased that you have selected a **GM Powertrain** engine for your requirements. Power Solutions, Inc. takes great pride in our tradition of quality products produced from the **GM Powertrain** line of industrial gasoline and alternative fuel engines.

Power Solutions engines are inspected and tested before leaving the factory. However, certain checks should be made before placing the engine into regular service. **Please read the Initial Start-Up inspection requirements in the Maintenance Section of this manual.**

## How to Use this Manual

This manual contains instructions on the safe operation and preventive maintenance of your **GM Powertrain** industrial engine. We urge you to read this manual prior to start up or operation of the engine.

The Table of Contents permits you to quickly open the manual to any section.

Power Solutions, Inc., engines are built with a variety of standard and/or optional components to suit a broad range of customer requirements. This manual **does not** identify equipment as standard or optional. All the equipment described in this manual may not be found on your engine or power unit.

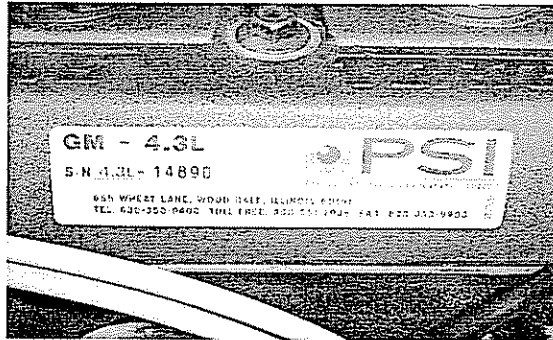
Please pay special attention to the **NOTES, CAUTIONS, and WARNINGS**. **WARNINGS** remind you to be careful in areas where carelessness can cause personal injury. **CAUTIONS** are given to prevent you from error that could cause damage to the equipment. **NOTES** give you added information designed to help you.

The descriptions and specifications contained in this manual were in effect at the time of publication. Power Solutions, Inc. reserves the right to discontinue models at any time, or to change specifications or design without notice and without incurring obligation.

Power Solutions, Inc.  
655 Wheat Lane  
Wood Dale, IL 60191

## Engine Identification

An identification label is affixed to the right side of the engine on the rocker cover when looking at the engine from the flywheel end.. (The engine serial number is also stamped into the left side of the cylinder block near the engine flywheel.) The label contains the engine model number (i.e. 4.3L, 5.7L, etc.) and a serial number which identifies the engine from other **GM Powertrain** engines provided by Power Solutions, Inc. The engine model and serial number are required when seeking information concerning the engine and/or ordering replacement service parts.



## Parts and Service

Replacement parts can be obtained from Power Solutions, Inc. by calling the Service Parts Department at **800-551-2938**. The engine model and serial number will be required when seeking information and/or ordering parts.

Service and technical support for **GM Powertrain** engines supplied by Power Solutions, Inc. can be obtained by contacting the Service Department at **800-551-2938**.

## Service Literature

Additional operator manuals and service manuals for specific **GM Powertrain** engines provided by Power Solutions, Inc. can be obtained by contacting the Parts or Service Department at **800-551-2938**

# Operating Instructions

## Controls

### Ignition Switch

The ignition switch is located on the control panel. The switch is a 3 position switch, OFF, RUN and START. The OFF position disconnects the electrical system from the battery. The key can be removed from the switch when it is in this position.

In the RUN position, the electrical system is activated.

Engage the starter by turning the key to the START position. Release the key when the engine starts and it will return to the ON position.

### Safety Gauges

Power Solutions, Inc., industrial power units are equipped with instrument panels which contain shut down gauges for High Engine Water Temperature and Low Engine Oil Pressure. A push button 'Tattletale' relay is utilized with this system. When starting the engine it is necessary to 'depress' the safety switch override button, until the engine starts and engine oil pressure is obtained (usually 2 to 5 seconds). The engine will continue to run when the button is released.

**CAUTION:** If the engine does not continue to run when the button is released, it will be necessary to check the instrument panel fuse and/or the engine lubrication system (i.e. oil level, etc.) before restarting the engine.

**NOTE:** Power Solutions, Inc. provides engines to many different original equipment manufacturers. Not all manufacturers use the PSI instrument panel. Please refer to the equipment Operators Manual for instructions on engine starting.

### Fuel Systems

Several different fuel systems have been used on Power Solutions, Inc. **GM Powertrain** engines. A chart identifying the different types of fuel systems used by engine model can be found in the back of this manual.

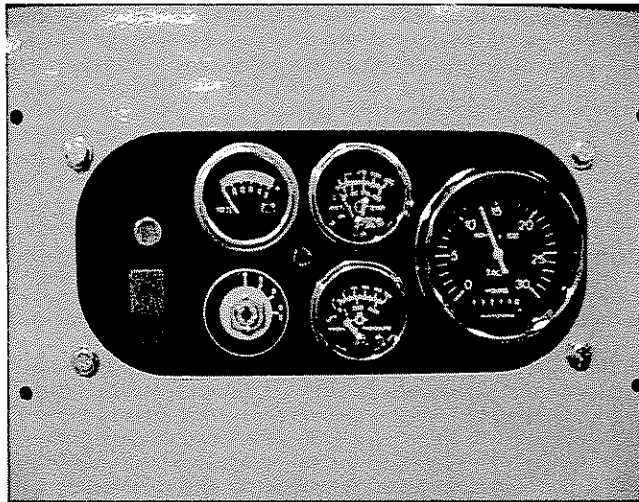
**NOTE:** Some fuel systems are installed by the original equipment manufacturer. Therefore it may be necessary to contact the equipment manufacturer for information pertaining to your specific fuel system if it cannot be found in the chart.

## Governors

As with fuel systems, several different governor controls have also been used with the Power Solutions, Inc. **GM Powertrain** engines. A chart identifying the different types of governor systems used is included at the back of this manual.

**NOTE:** Some governors are installed by the original equipment manufacturer. If your governor is not included in the chart, it will be necessary to contact the equipment manufacturer.

## Instruments



### **Oil Pressure Gauge**

The oil pressure gauge shows the engine lubrication system pressure in pounds per square inch (psi) and should be checked frequently to ensure that the system is functioning correctly. Should the pressure fluctuate or drop, stop the engine and find the cause. Do not operate the engine at lower than normal oil pressure (see maintenance schedule for minimum engine oil pressure).

**CAUTION:** Do not continue to operate your engine below the normal operating range. Severe engine damage could occur.

### **Temperature Gauge**

The temperature gauge registers the coolant temperature and will indicate overheating which may arise from low coolant level, plugged radiator, loose fan belt or faulty thermostat. Coolant level should be checked daily.

**CAUTION:** If the engine continues to overheat, have the cooling system checked and serviced.

## Instruments (cont.)

### **Voltmeter**

The voltmeter indicates the battery charging voltage. If the meter consistently indicates less than 13 volts or more than 15.7 volts under normal operating conditions, you should have the engine electrical system checked by a qualified service technician.

### **Tachometer/Hourmeter**

The tachometer indicates the engine speed in hundreds of revolutions per minute (rpm). It serves, as a guide to insure that engine speed is set correctly.

The hourmeter records the hours of operation and is used to determine when periodic maintenance is required.

## Starting the Engine

### **Warning:**

**All internal combustion engines give off various fumes and gases while running. Do not start or run the engine in a closed or poorly ventilated building where exhaust gases can accumulate. Avoid breathing these gases as they may contain poisonous carbon monoxide, which can endanger your health or life if inhaled steadily for even a few minutes.**

If the engine is equipped with a manual clutch it must be disengaged prior to starting the engine. Starting the engine with the clutch engaged imposes unnecessary strain on the battery, starter, and driven components.

**CAUTION: If the engine stalls or falters during starting, wait 3 to 4 seconds before re-engaging the starter. This will prevent possible damage to the starter or the engine. DO NOT operate the starter for periods longer than 30 seconds at a time. An interval of at least 1-minute should be observed between cranking periods to protect the starter from overheating.**

### **Carbureted, Mechanical Governor, Manual Choke**

Pull the throttle cable out approximately ½ inch, and the choke out full. Turn the ignition key to the START position. After the engine starts, release the key, decrease the throttle setting and adjust the choke cable for fast idle warm-up. When the engine is at operating temperature, push the choke in all the way.

When the engine is warm, it may not be necessary to use the choke for starting.

### **Carbureted, Electric Choke, Electronic Governor**

Turn the On/Off switch on the instrument panel to the ON position. Turn the ignition key to the ON position. This allows the electric choke to pre-set prior to starting. Turn the ignition key to the START position. After the engine starts release the key to the ON position. Allow a few minutes for the engine to warm up. Move the governor control switch to the LOW position. Engage the clutch, then move the governor control switch to the HI position.

### **LPG or NG Fuel Systems, Velocity Governors**

Turn on the gas supply to the engine. Turn the ignition key to the START position. After the engine starts release the key to the ON position.

### **PSI Fuel Injection (Gasoline)**

Turn the ignition key to the ON position, this energizes the electric fuel pump to charge the fuel system with fuel. Turn the ignition key to the START position. After the engine starts release the key to the ON position.

### **PSI Fuel Injection (Gasoline/LPG)(Dual Fuel)**

Select the desired fuel switch position for starting the engine (Gasoline/LPG). Turn the ignition key switch ON, then move ignition key to the START position. After the engine starts release the key to the ON position.

### **Zenith Z.E.E.M.S. Throttle Body Fuel Injection, Integral Governor**

Turn the ignition key to the ON position to energize the fuel pump. Ensure that the Hi/Lo switch on the instrument is in the Lo position. Turn the ignition key to the START position. After the engine starts release the key to the ON position. Allowing a few minutes for engine warm-up, move the Hi/Lo switch to the Hi position.

## **Stopping the Engine**

**Normal Conditions:** Following normal operating conditions, **lower the engine speed to idle**, pushing the throttle cable in on mechanical systems or with electronic systems placing the Hi/Lo switch in the Lo position.

If the machine is equipped with a clutch, move the clutch lever to the disengaged position.

Run engine for a few minutes at idle to allow the coolant system to cool down before turning the ignition switch to the OFF position.

**Abnormal Conditions (Carbureted):** Under abnormally overheated conditions, the engine may continue to run after the switch is turned OFF. If this is encountered, turn the ignition switch to the ON position immediately and allow the engine to run at idle until it has cooled down enough to stop.

**(Fuel Injected)** Fuel injected engines generally will not after run, even if hot. These systems require that the fuel delivery be shut off completely when turning the ignition switch to the OFF position.

### **WARNING:**

**Avoid injury when checking a Hot Engine. Allow the engine to cool down before removing the radiator cap.**

**CAUTION: Before restarting the engine ensure that both the coolant system and the engine oil level have been checked and re-filled if necessary.**

## **Fuel Recommendations**

### **Fuel Quality**

Using a high quality unleaded gasoline will help maintain the power, fuel economy and emissions performance of your engine. A properly formulated gasoline will be comprised of well refined hydrocarbons and chemical additives and will perform the following functions:

- Minimize varnish, lacquer, and other induction system deposits.
- Prevent gum formation or other deterioration during storage.

Protect fuel tank and other fuel system components from corrosion or degradation.

## **Fuel Recommendations (cont.)**

- Provide the correct seasonally and geographically adjusted volatility which should provide easy starting in the winter and summer.
- Avoid fuel system icing.

In addition, the fuel must be free of water, debris, and other impurities.

It is recommended that the fuel supply be kept fresh when the engine is in storage (especially in hot weather). The fuel tank should be kept at least  $\frac{3}{4}$  full.

Fuel stored for more than two months should be drained, properly discarded, and the fuel tank re-filled.

## **Anti-Knock Index (Octane Rating)**

This engine is designed to operate on unleaded 87 or 89 octane gasoline with an (R + M)/2" minimum anti-knock index. Federal regulations require that each retail gasoline dispensing pump must display a label bearing the minimum index rating.

Use of unleaded gasoline with anti-knock index rating lower than 87 can cause persistent, heavy spark knock, which can lead to engine damage. If your engine knocks heavily when you use gasoline with an anti-knock index rating of 87 or higher, or if you hear continuous spark knock while maintaining constant operating speeds, consult a dealer or qualified technician.

## **Gasohol and Alcohol/Gasoline Fuels**

Gasohol, a mixture of gasoline and ethanol (grain alcohol), is available in some areas. PSI, GM *Powertrain* engines should operate satisfactorily on gasohol blends containing no more than 10% ethanol by volume and having an anti-knock index of 87 or 89.

**CAUTION: In some cases, methanol (wood alcohol) or other alcohol's may be added to gasoline. PSI GM *Powertrain* engines should operate satisfactorily on blends containing up to 5% methanol by volume when cosolvents and other necessary additives are used. DO NOT USE blends containing more than 5% methanol by volume or blends that do not contain cosolvents and corrosion inhibitors.**

**CAUTION: Discontinue use of any gasohol or alcohol/gasoline blend if fuel system problems occur. Do not use such fuels unless they are UNLEADED.**

## **Spark plugs**

Always use the recommended spark plugs for your engine. Hotter or colder plugs, or similar plugs that are not exact equivalents to the recommended plugs, can cause permanent engine damage, reduce the engine's useful life, and cause many other problems such as hard starting, spark knock and run-on. Installing new spark plugs regularly is one of the best ways to keep your engine at peak performance.

## **Power Loss at Higher Elevations**

All engines will experience power loss when operated at elevations above sea level, unless they are turbocharged or supercharged. Turbochargers and superchargers are mechanical pumps that put extra air into the engine to make up for the lower air density at higher elevations.

### **Carbureted Engines**

Carbureted engines will lose power for two reasons. First, power is reduced 3.5% for each 1000 feet it is operated above sea level due to the decreased air density. With less dense air, the engine receives less oxygen to burn the fuel. The engine power is decreased in direct proportion to the reduction of available oxygen. Second, the reduced oxygen causes the fuel mixture to have too much fuel for the available oxygen. This is a rich mixture (rich with fuel) and not only causes the engine to produce sooty black exhaust, but causes additional loss of power and premature spark plug fouling. Engines that are operated over 3000 feet of elevation, that exhibit black smoke or produce less than optimum power should have the fuel system re-calibrated. For additional information on optimizing your engine for higher elevations contact your dealer or Power Solutions, Inc. at 800-551-2938.

Caution: Engines re-calibrated for high elevations will run *lean* at lower elevations. Lean running can burn valves, will reduce valve and valve seat life and can cause engine overheating. Failures caused by these problems are not covered by warranty.

### **Fuel Injected Engines**

Fuel injected engines will lose 3.5% power for every 1000 feet the engine is operated above sea level. All fuel injection systems installed by Power Solutions, Inc. are equipped with a "manifold absolute pressure sensor" (MAP Sensor). The MAP sensor senses barometric pressure and automatically corrects the fuel system calibration for changes in altitude. This means the air/fuel mixture will always be optimized, regardless of elevation (or barometric pressure), however, the engine will still lose 3.5% power for every 1000 feet increase in elevation.

# MAINTENANCE INSTRUCTIONS

## Initial Start Up Maintenance

The initial start-up checks must be made before putting the engine into service. Please refer to the Maintenance Schedule on page II and perform the initial start-up operations in the sequence shown in column I.

## Routine Maintenance

Routine maintenance provides the best solution for making sure that the engine is ready when you are. The following are some routine service points:

- Keep the fuel tank filled. A full tank of fuel reduces the possibility of condensation forming in the fuel tank and moisture entering the fuel system
- Make frequent checks of the engine oil and coolant levels
- Repair any oil or coolant leaks immediately
- Check battery condition and cables frequently
- Keep the engine air filter clean
- Monitor engine coolant temperature
- Monitor engine oil pressure
- Check voltmeter and charging system

## Scheduled Preventive Maintenance

Refer to the Maintenance Schedule on page II to ensure that all of the maintenance items listed are checked and replaced as recommended at the hours shown.

## Engine Oil Level Check

The engine oil level should be checked daily. It is recommended that the oil be checked just before the engine is started for the first time for that day. The oil level should be between the 'Add' and the 'Full' marks on the dipstick.

**CAUTION: Do not operate the engine with the oil level below the bottom or 'Add' mark on the dipstick, or above the top or 'Full' mark on the dipstick.**

## Adding Engine Oil

It is normal to add some oil in the period of time between oil changes. The amount will vary with the severity of operation. When adding or replacing engine oil, be sure the oil meets or exceeds the recommended specification.

## Changing Engine Oil and Filter

The engine oil and filter must be changed every 200 hours or every 3 months whichever occurs first. Under normal operating conditions, you do not need to change them more often if you use oil and filters of the recommended quality.

The oil and filter should be changed more often if the engine is operating in dusty or extremely dirty areas, or during cold weather. No oil additives or break-in oil change is required.

## Engine Oil Quality

To achieve proper engine performance and durability, it is important that you use only engine lubricating oils of the correct quality in your engine. Proper quality oils also provide maximum efficiency for crankcase ventilation systems, which reduces pollution.

**Important:** use only engine oils displaying the American Petroleum Institute (API) “Starburst” Certification Mark ‘**FOR GASOLINE ENGINES**’ on the container.

Gasoline engines that are converted for LPG or NG fuels **MUST** use oils labeled ‘**FOR GASOLINE ENGINES**’. Do not use oils that are specifically formulated for Diesel Engines only. CC or CD classification oils, even when labeled Heavy Duty or for Natural Gas Engines, **ARE NOT ACCEPTABLE**.

## Engine Oil Recommendation

Multi-viscosity oils are recommended. SAE 10W-30 is recommended for your engine from 0 degrees F (-18 degrees C) or above. If ambient temperatures are consistently below 0 degrees F, SAE 5W-30 oil can be used. Synthetic oils are not recommended for industrial or stationary engines.

## Oil Filter

The PSI GM *Powertrain* engines use an AC Delco oil filter as original equipment. An equivalent oil filter must be used when servicing the engine (see Engine Specifications for the recommended oil filter for your engine).

The filter protects your engine from harmful, abrasive, or sludgy particles without blocking the flow of oil to vital engine parts.

To replace the filter, use a proper filter wrench to remove the filter.

Clean the filter mounting base and lightly coat the gasket surface of the new filter with engine oil. Hand tighten the filter until the gasket contacts the base, then tighten another ½ turn. Fill the engine with the correct amount of oil, run the engine and check for oil leaks at the drain plug and oil filter gasket. Tighten as necessary to stop any oil leakage noted.

## **Engine Air Cleaner**

The engine air cleaner filters air entering the engine intake system and acts as a silencer and flame arrester when assembled to the intake system.

Air that contains dirt and grit produces an abrasive fuel mixture and can cause severe damage to the cylinder walls and piston rings. Damage to the cylinder walls and piston rings will cause high oil consumption and shorten engine life.

A restricted or dirty air cleaner will also cause a rich fuel mixture. Thus, it is extremely important that the air cleaner be serviced properly at the recommended intervals.

**CAUTION: Service the air cleaner more frequently under severe dusty or dirty conditions.**

Remove the primary air cleaner element from the air cleaner assembly and inspect the element for foreign material restrictions or signs of excessive wear or damage. Replace the element if necessary.

Remove all dust and foreign matter from the air cleaner housing.

Reinstall the air cleaner element. Reinstall the air cleaner cup, and securely fasten the retaining clips.

### **Safety Element**

If your engine is equipped with an air cleaner which utilizes a safety element, ensure that the element is properly in place before installing the primary element.

Change the safety element annually.

## **Cooling System**

### **Coolant Level**

Check the coolant level of the radiator daily and only when the engine is cool. Generally a good time to do this is just prior to starting the engine for the first time each day.

Maintain the coolant level at  $\frac{3}{4}$  to  $1\frac{1}{2}$  inches below the filler neck seat of the radiator when the coolant is cold. When ever coolant level checks are made inspect the condition of the radiator cap rubber seal. Make sure it is clean and free of any dirt particles which would keep it from seating on the filler neck seat. Rinse off with clean water if necessary. Also make sure that the filler neck seat is free of any dirt particles.

## **WARNING**

Never remove the radiator cap under any conditions while the engine is operating. Failure to follow these instruction could result in damage to the cooling system, engine, or cause personal injury. To avoid having scalding hot coolant or steam blow out of the radiator, use extreme caution when removing the radiator cap from a hot radiator. If possible, wait until the engine has cooled, then wrap a thick cloth around the radiator cap and turn slowly to the first stop. Step back while the pressure is released from the cooling system. When all the pressure has been released, press down on the cap and remove it slowly.

**DO NOT** add coolant to any engine that has become overheated until the engine cools. Adding coolant to an extremely hot engine can result in a cracked block or cylinder head.

Use only a permanent-type coolant when refilling or flushing the coolant system. Recommended ethylene glycol mix 52/48 is normal up to a maximum of 60% glycol, 40% water.

Refer to the mixture chart on the container for additional antifreeze protection information. **DO NOT** use alcohol or methanol antifreeze, or mix them with the specified coolant.

Plain water may be used in an emergency (except in freezing temperatures), but replace it with the specified coolant as quickly as possible to avoid damage to the system.

### **Radiator**

Inspect the exterior of the radiator for obstructions. Remove all bugs, dirt or foreign material with a soft brush or cloth. Use care to avoid damaging the core fins. If available, use low pressure compressed air or a stream of water in the opposite direction of the normal air flow.

Check all hoses and connections for leaks. If any of the hoses are cracked, frayed, or feel spongy, they must be replaced.

### **Fan Belts**

The water pump is usually belt driven. The same belt may also drive the fan and/or the alternator. The drive belts should be properly adjusted at all times. A loose belt can cause improper alternator, fan and water pump operation, in addition to overheating.

## **Serpentine Belt**

Some GM *Powertrain* engines utilize serpentine belts on the front of the engine. This type of belt system incorporates a belt tensioning device which keeps the belt at the proper tension.

This belt should be checked routinely for cracks or 'checking' on the groove side of the belt. If cracks or 'checking' are apparent the belt must be changed.

## **V-Type Belt**

V-Type belts are generally tensioned by adjusting the alternator, or through a mechanical belt tensioner. The belt is generally correctly tensioned when there is an ½ inch of depression on the belt between the water pump and the crankshaft pulley.

## **Fuel Filter**

### **Carbureted Engines**

On carbureted engines, an in-line fuel filter is incorporated into the fuel supply line. It is recommended that this filter be changed every 250 hours or every 6 months which ever occurs first.

### **TBI Engines**

On PSI Fuel Injection or Fuel Injection/Dual Fuel two fuel filters are used in the gasoline fuel supply line to the engine TBI unit.

A coarse fuel filter is located in the supply line between the fuel tank and the electric fuel pump. This filter protects the fuel pump from debris in the fuel tank. This filter must be changed every 200 hours or every 6 months which ever occurs first.

A primary fuel filter is located between the fuel pump and the TBI unit on the engine. This filter protects the injectors from microscopic particles in the fuel which can cause plugging of the injectors. This filter **MUST** be changed every 500 hours or annually which ever occurs first.

Zenith Z.E.E.M.S. TBI Fuel Injection requires an in-line fuel filter in the fuel supply line from the fuel tank to the TBI unit, ahead of the electric fuel supply pump. This filter must be changed every 200 hours or every 6 months which ever occurs first.

**CAUTION: Failure to change the fuel system filters as recommended can result in premature failure of the TBI fuel system components.**

**NOTE:** Some original equipment manufacturers install their own fuel systems. Please refer to the manufacturers manual if the gasoline fuel system is different than described here.

## **WARNING**

Use extreme care when changing the fuel filters on gasoline engines. Gasoline is highly flammable and should not be exposed to open flame, sparks, or hot engine components. Allow the engine to cool to ambient temperatures prior to changing fuel filters.

## **Ignition Systems**

### **Types of Ignition Systems**

Three types of ignition systems are used on PSI GM *Powertrain* engines. Solid state electronic distributor, solid state electronic distributor with ECU (Electronic Control Unit) and distributor-less electronic ignition with ECU.

Please refer to the General Specification chart to determine the ignition system used on your particular engine.

### **Ignition Timing**

Proper adjustment of the ignition timing must be obtained to provide the optimum engine power output and economy.

To properly adjust timing refer to the timing procedure section of this manual.

### **Spark Plugs**

Spark plugs should be replaced at the recommended intervals described in the Maintenance Schedule. Use only the recommended spark plug or an equivalent as described in the General Specifications.

Spark plug gap, should be adjusted as recommended in the General Specifications.

When removing spark plugs, always note which cylinder each plug came out of. Look at the porcelain around the center electrode of each plug. You can detect many engine problems from the color and type of deposits that have built up on the white porcelain. For example, if the deposits are a glossy brown, that cylinder is burning excess oil. If the deposits are a very dark gray or sooty black color, your engine is running rich, and you are burning excess fuel. The optimum color of the deposits on the porcelain is light tan or light brown. This shows optimum fuel mixture and proper engine running conditions. If the deposits are almost white, the engine may be running excessively lean. Lean running is very detrimental to your engine life, and should be corrected immediately.

If one or more cylinders are burning oil, the smoke from the engine will be a blue-gray color. Most common causes are piston rings (worn out or not broken in) and valve stem seals (cut, nicked, or worn out). If the engine is running rich the exhaust smoke will be a sooty black color and it will smell like gasoline (on gasoline engines).

## **Storage**

### **One to Six Months**

If the engine or machine is to be placed in storage for a period of one to six months it is recommended that the following steps be followed:

- Add '**Stabil**' or equivalent fuel conditioner to the fuel tank as recommended on the bottle. Run the engine for approximately 10 to 15 minutes to insure that the treated fuel is completely through the fuel system.
- Fill the fuel tank with fuel
- Protect the air cleaner inlet from water entry
- Protect the exhaust outlet or muffler outlet from water entry
- Check the coolant protection and top off radiator
- Store indoors if possible

### **For Extended Periods**

Follow the above recommended procedures, plus do the following:

- Drain the engine crankcase and refill with recommended oil
- Change the oil filter
- Disconnect and remove the battery
- Clean exterior surface of the engine
- If the engine is equipped with an automotive type clutch or PTO clutch, make sure that the clutch is disengaged

### **Removing the Engine From Extended Storage**

When removing the engine from extended storage:

- Install a fully charged battery
- Remove all protective coverings from the air inlet, air cleaner, exhaust, and muffler openings
- Check the coolant level in the radiator and verify the protection level of the coolant

### **Removing the Engine From Extended Storage (cont.)**

- Start the engine and allow it to run at slow idle. Verify engine oil pressure
- Run the engine at idle until the coolant temperature approaches 120 degrees F (49 degrees C)
- Run the engine a various speeds for approximately 15 minutes
- Shut the engine down, drain the oil, change the oil filter, and re-fill with the recommended grade of oil

## GM Engine Timing Procedures

### Carbureted, LPG and NG 3.0L, 4.3L, 5.7L, 7.4L PSI/GM Engines

PSI Timing Connector Part Number 33000036 **MUST** be used when checking and adjusting the engine timing.

1. With the engine shut-off, plug the 33000036 Timing Connector into the distributor. **DO NOT** connect the alligator clip to any positive or negative terminal. (Connecting this wire to any battery terminal prior to starting the engine will cause the distributor module to fail when starting the engine.)
2. Start the engine and run at slow idle. 800 to 1000 rpm.
3. Connect the alligator clip to a B+ terminal. (This connection cancels the programmed timing advance from the distributor module. You will notice a change in engine sound and rpm when making this connection.)
4. Connect an electronic timing light to the No.1 spark plug wire. (The front cylinder on the 3.0L engine and the front cylinder on the left bank of the 4.3L, 5.7L and 7.4L engines.)
5. Check and adjust the distributor as necessary viewing the timing mark on the crankshaft pulley in relation to the pointer on the engine timing case. (On some engines there may be a timing port in the flywheel housing also.)
6. Refer to the General Specifications chart in this manual, for the initial timing specification for your engine and type of fuel being used.

### PSI Fuel Injected and Dual Fuel engines

For engines equipped with this type of fuel system, the engine timing is controlled by the ECM (Engine Control Module).

**Checking the initial timing on engines equipped with PSI fuel injected and dual fuel engines incorporating an ECM can only be accomplished when using a laptop computer or a hand held diagnostic meter. It will be necessary to contact the OEM or PSI for the necessary equipment and instructions for checking and adjusting the engine timing. (CAUTION: Failure to follow the correct specified procedures when checking and adjusting the engine timing, can cause severe damage to the engine.)**

### Zenith Z.E.E.M.S. Throttle Body Fuel Injected Engines

**Engine timing for Zenith TBI fuel injected engines is checked and adjusted following the procedures noted under Carbureted engines. Check the General Specifications chart for the correct engine timing.**

### Generator Timing

**PSI/GM engines operating on generators are timed at 1800 RPM. Timing procedures are the same as for Carbureted engines. Check the General Specifications chart for the correct engine timing for the type of fuel being used.**

# Maintenance Schedule

## Power Solutions, Inc.

### GM Powertrain

## 1.6L, 3.0L, 4.3L, 5.7L, 7.4L, and 8.1L Engines

Initial Start-Up Sequence Checks	Operation	Daily	Weekly	Every 50 hrs	Every 100 hrs	Every 200 hrs	Every 400 hrs	Every 800 hrs	As Req.
1	Check Engine Oil Level	x							
2	Check Coolant Level	x							
3	Check for Fluid Leaks	x							
4	Governor, Mechanical (Check oil level)(2)		x						
	Change Engine Oil & Filter (1)					x			
5	Battery, Check Charge & Fluid Level		x						
	Inspect & Clean Radiator Exterior		x						
	Clean Battery Cables								x
6	Check Belts and Belt Tension				x				
	Lubricate Throttle, Governor & Choke Linkage (Carbureted Engines Only)				x				
	Check & Adjust Idle Speed (Carbureted Engines Only)								x
	Inspect and Clean Air Cleaner Element		x						
	Replace Primary Air Cleaner Element (1)						x		
	Replace Safety Air Cleaner Element								x
	Check Coolant Protection & Tighten Hose Clamps						x		
	Replace Engine Coolant (3)							x	
	Replace Gasoline Fuel Filter (4)						x		
	Replace LPG Filter – Zenith EFI (4)							x	
	Replace PCV Valve (If Equipped)							x	
	Check PCV Hoses, Tubes, and Fittings							x	
	Replace Spark Plugs (3)							x	
	Distributor Cap & Rotor (5)							x	
	Secondary Ignition Wires								x
	Adjust Throttle & Governor (3)								x
7	Check All Engine Bolts & Nuts for Tightness								x

- (1) More frequent intervals may be required in dusty or dirty operating conditions.
- (2) Mechanical governor (belt driven).
- (3) To be performed at specified interval or annually, whichever occurs first.
- (4) More frequent intervals may be required with dirt in the fuel system.
- (5) Does not apply to engines with DIS ignition.

## Capacities

Engine	1.6L	3.0L	4.3L	5.7L	7.4L	8.1L
Oil Capacity Without Filter	3.4 qts.	4 qts.	4.5 qts.	5 qts.	8 qts.	8 qts.
Oil Capacity With Filter	3.7 qts.	4.5 qts.	5 qts.	5.5 qts.	9 qts.	9 qts.
Coolant Capacity Without Radiator	3.5 qts.	4 qts.	7.75 qts.	8.1 qts.	14.5 qts.	14.5 qts.
Coolant Capacity With Radiator	10 qts.	12 qts.	17 qts.	17.5 qts.	28 qts.	28.5 qts.
					31 qt (Turbo)	

Revised 12/27/01

**Power Solutions, Inc.**  
**GM Powertrain Industrial Engines**

**Filter Chart**

Engine	1.6L	3.0L	4.3L	5.7L	7.4L/7.4LT	8.1L
Oil Filter	94632619	P-25 or Equivalent	PF-47/PF-52 or Equivalent	PF-1218 Equivalent	PF-1218 or Equivalent	PF-454 or Equivalent
Fuel Filter (Carbureted)		32500020 (101021)	32500020 (101021)			
Fuel Filter (PSI TBI Course)		32500111	32500111			
Fuel Filter (PSI TBI Fine)		32500058	32500058			
Fuel Filter Zenith Z.E.E.M.S	Gasoline C282-224 LPG C282-5	32500292	32500292			
Air Filter Primary (PSI Power Unit)		P822768	P8228889			
Air Filter Safety (PSI Power Unit)		P822769	P829333			

Revised 05/31/00

**Power Solutions, Inc.**  
**GM Powertrain Industrial Engines**

**Fuel System Chart**

Engine	1.6 L	3.0L	4.3L	5.7L	7.4L/T	8.1L
Zenith Carburetor (013448) Manual Choke		x				
Zenith Carburetor (015017) Electric Choke		x				
Zenith Carburetor (015052) used w/Dual Fuel System		x	x			
Holley Carburetor (0-7448) Electric Choke			x			
Holley Carburetor(0-82010) Electric Choke			x			
Impco LPG Fuel System		x	x	x	x	
Nolff LPG Fuel System	x	x	x	x	x	x
PSI Fuel Injection (Gasoline)	x	x	x			
PSI Fuel Injection/LPG Mixer (Dual Fuel)	x	x	x			
Impco Natural Gas Mixer		x	x	x	x	
Nolff Natural Gas Mixer	x	x	x	x	x	
Zenith Z.E.E.M.S Fuel Injection	x	x	x			

**Governor Chart**

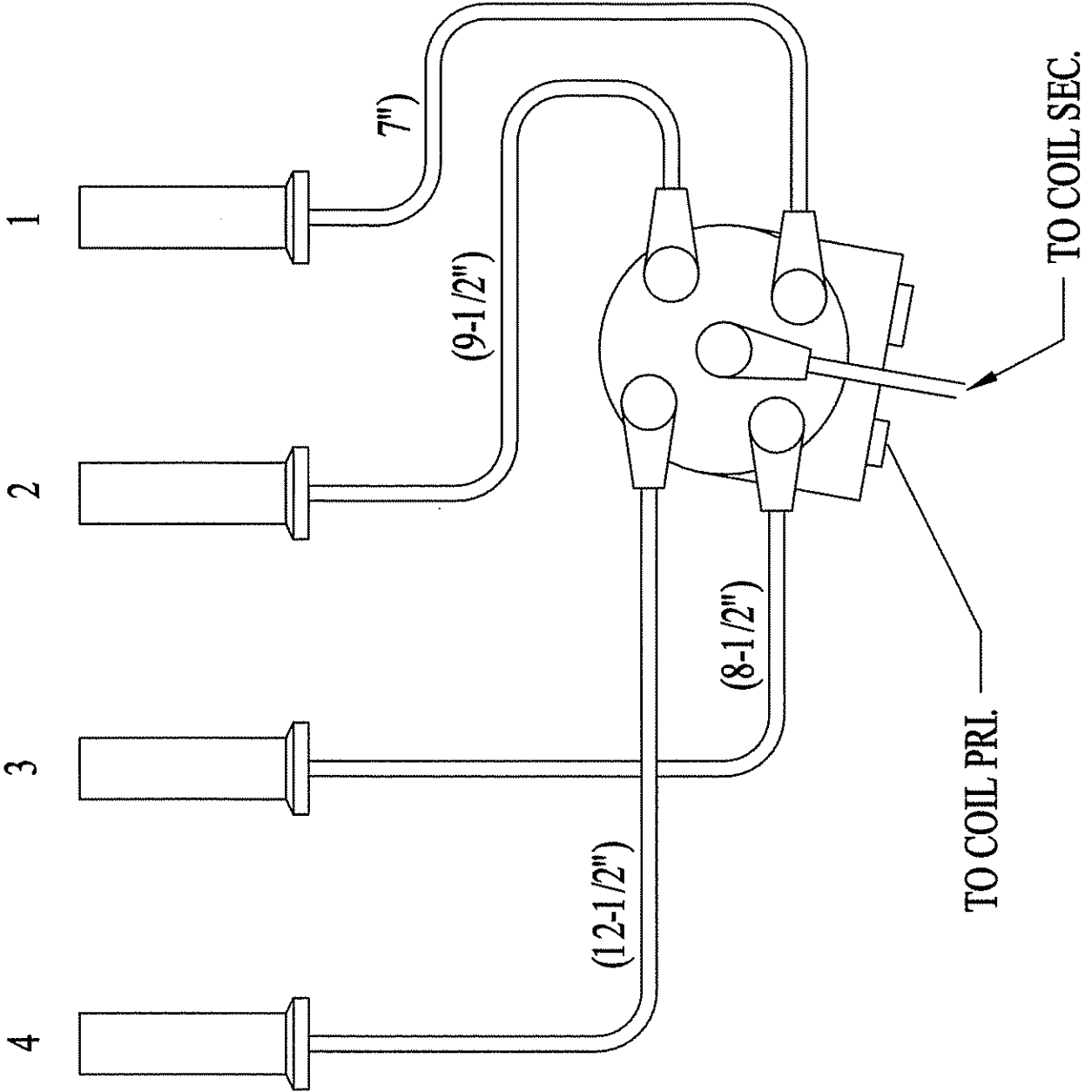
Engine	1.6L	3.0L	4.3L	5.7L	7.4L/T	8.1L
Hoof Mechanical (Belt Driven)(No Longer Available)		x				
Hoof Velocity Governor		x(NLA)	x(NLA)	x	x	
Aisan Velocity Governor		x	x			
Barber Colman Electronic		x	x			
Governors America		x	x	x	x	
Barber Colman Power Flow, PSI ECU		x	x	x		x
Zenith Z.E.E.M.S. Fuel Injection	Integral	Integral	Integral	x		
Woodward						x

Revised 06/05/01

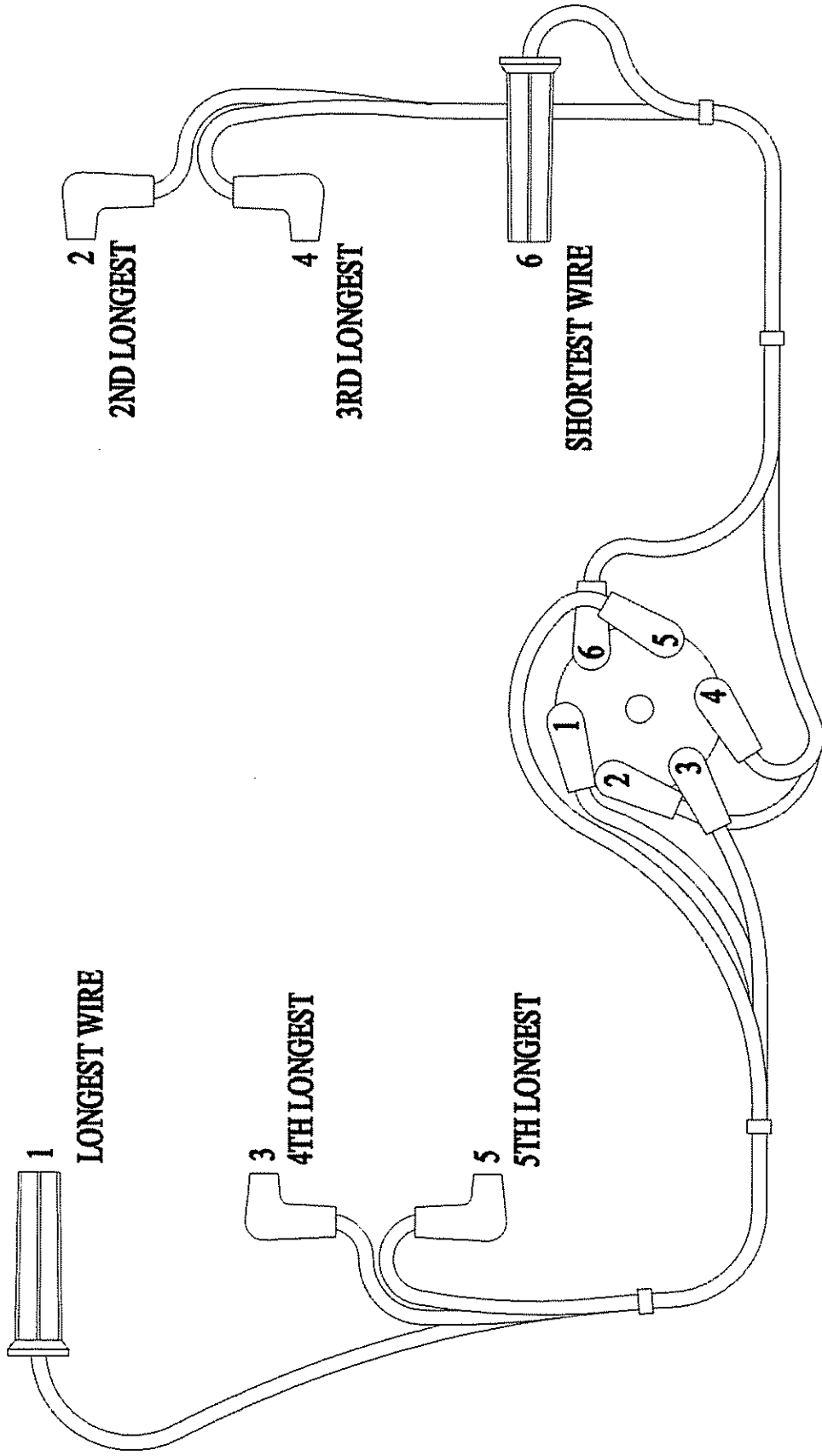
**GENERAL SPECIFICATIONS**  
**Power Solutions, Inc.**  
**GM Powertrain Industrial Engines**

Engine	1.6L	3.0L	4.3L	5.7L	7.4L/7.4L Turbo	8.1L/8.1L Turbo
Type	1.6-2V	3.0L L4	4.3L V-6	5.7L V-8 GEN-1E	7.4L V-8	8.1L V-8
Displacement cc (c.i.d.)	1600 (98)	2966 (181)	4294 (262)	5735 (350)	7441 (454)	8127 (496)
Compression Ratio	9.4:1	9.2:1	9.4:1	9.4:1	8.9:1	9.1:1
Valve Configuration	Overhead Cam	Push Rod Actuated Overhead Valve	Push Rod Actuated Overhead Valve	Push Rod Actuated Overhead Valve	Push Rod Actuated Overhead Canted Valve	Push Rod Actuated Overhead Valve
Valve Lifters	Hydraulic	Flat Follower	Hydraulic Roller	Hydraulic Roller	Hydraulic Roller	Hydraulic Roller
Bore x Stroke mm (inches)	79.0x81.5 (3.11x3.21)	101.60x91.44 (4.00x3.60)	101.60x88.39 (4.00x3.48)	101.60x88.39 (4.00x3.48)	107.95x101.60 (4.25x4.00)	107.95x111 (4.25x4.37)
Main Bearing Caps	2 Bolt	2 Bolt	2 Bolt	2 Bolt	4 Bolt	4 Bolt
Balance Method	External	External	Internal Balance Shaft	External	External	External
Intake Manifold	TBI	TBI, Carburetor, Mixer	TBI, Carburetor, Mixer	Mixer	Mixer	Mixer
Firing Order	1-3-4-2	1-3-4-2	1-6-5-4-3-2	1-8-4-3-6-5-7-2	1-8-4-3-6-5-7-2	1-8-7-2-6-5-4-3
Oil Capacity With Oil Filter	3.4 qts. (3.2L) 3.7 qts. (3.5L)	4 qts. (3.8L) 5 qts. (4.7L)	4.5 qts. (4.3L) 5 qts. (4.7L)	4.5 qts. (4.3L) 5 qts. (4.7L)	8 qts. (7.6L) 9 qts. (8.5L)	8 qts. (7.6L) 9 qts. (8.5L)
Oil Filter	PF-25 or Equivalent	PF-25 or Equivalent	PF-47/PF-52 or Equivalent	PF-1218 or Equivalent	PF-1218 or Equivalent	PF-454 or Equivalent
Minimum Oil Pressure (Hot)	21 psi @ idle	6 psi @ 1000 rpm 18 psi @ 2000 rpm	6 psi @ 1000 rpm 18 psi @ 2000 rpm	6 psi @ 1000 rpm 18 psi @ 2000 rpm	6 psi @ 1000 rpm 18 psi @ 2000 rpm	5 psi @ 1000 rpm 15 psi @ 2000 rpm
Coolant Capacity (Engine)	3.5 qts.	4 qts. (3.78L)	7.75 qts. (7.3L)	8.1 qts. (7.8L)	14.5 qts. (13.7L)	14.5 qts. (13.7L)
Coolant Capacity (W/PSI Rad)	10 qts.	12 qts. (11.4L)	17 qts. (16L)	17.5 qts. (16.6L)	28 (26.5L)	28 qts. (26.5L)
Fuel Type	Gasoline, LPG	Gasoline, LPG, NG	Gasoline, LPG, NG	LPG, NG	LPG, NG	LPG, NG
Engine Rotation (Flywheel End)	CCW	CCW	CCW	CCW	CCW	CCW
Ignition System	Distributor-less Electronic (ECU)	Solid State Distributor	Solid State Distributor	Solid State Distributor	Solid State Distributor	Distributor-less Electronic ECU
Ignition Timing (Degrees BTDC)	Gasoline (Carb) Gasoline (TBI) LPG NG Dual Fuel	0 0 10 (4 Europe) 10 0	0 0 10 (4 Europe) 10 0	0 0 10 (4 Europe) 10 0	0 0 10 10 0	0 0 10 10 0
Ignition Timing (Degrees BTDC) Generators 1800 RPM	LPG NG	DIS No Adjustment	DIS No Adjustment	DIS No Adjustment	DIS No Adjustment	DIS No Adjustment
Spark Plugs	AC Delco 93206675	AC Delco R45TS	AC Delco 41-932	AC Delco 41-932	AC Delco MR-43LTS	AC Delco R42LTS
Spark Plug Gap	.8mm-.9mm all	.045 all	.035 .035 .035 .035	.035 .035 .035 .035	.035 .035 .035 .035	.030/.025T .030/.025T .030/.025T
Valve Clearance (Lash)	Intake Exhaust	No Adjustment OHC Engine	1/2 to 1 Turn Down From 0 Lash	1 Turn Down From 0 Lash	Net Lash No Adjustment	Net Lash No Adjustment
Manufactured	Brazil	Toluca, Mexico	Toluca, Mexico	Toluca, Mexico	Tonawanda, NY	Tonawanda, NY

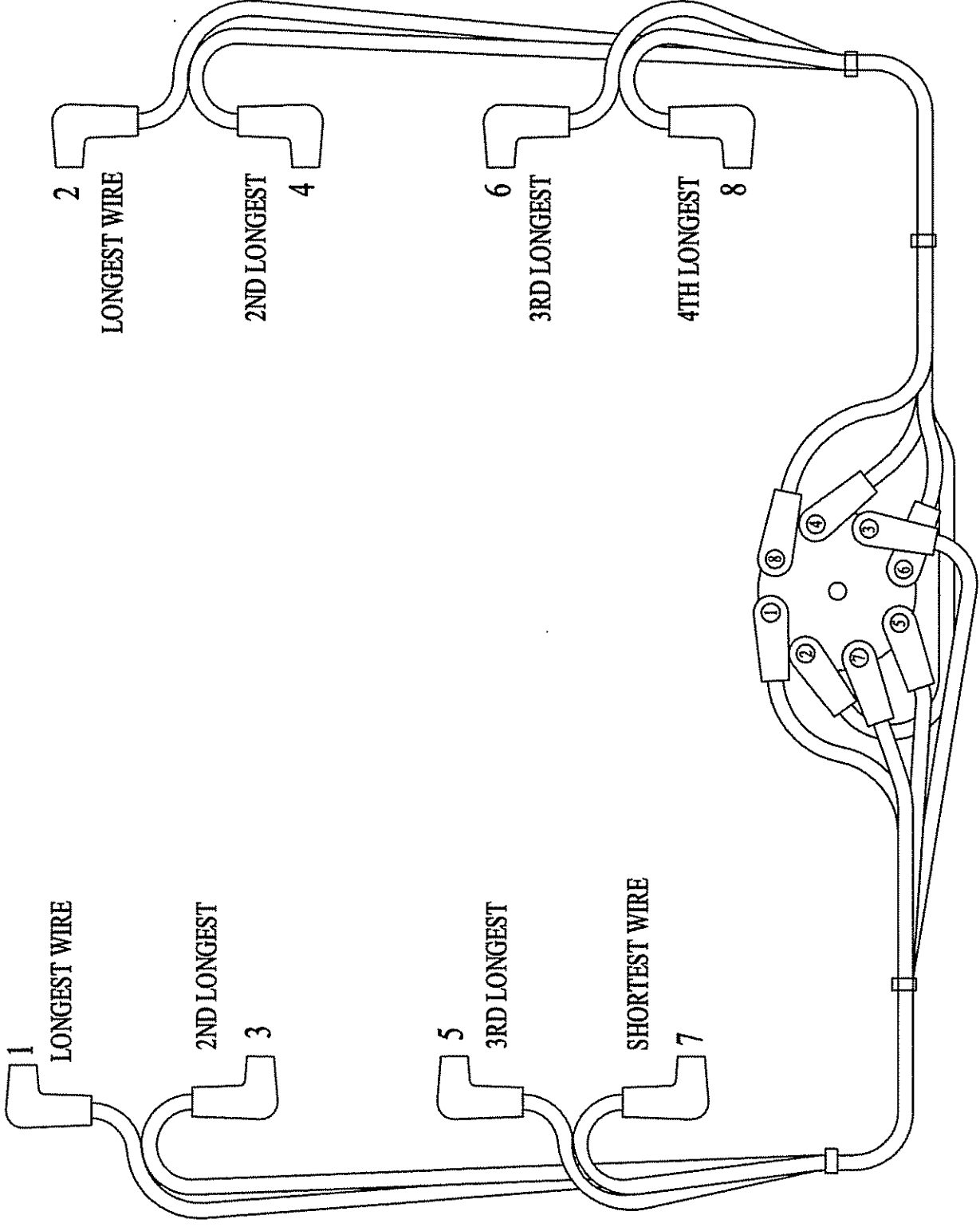
Revised 02/09/02



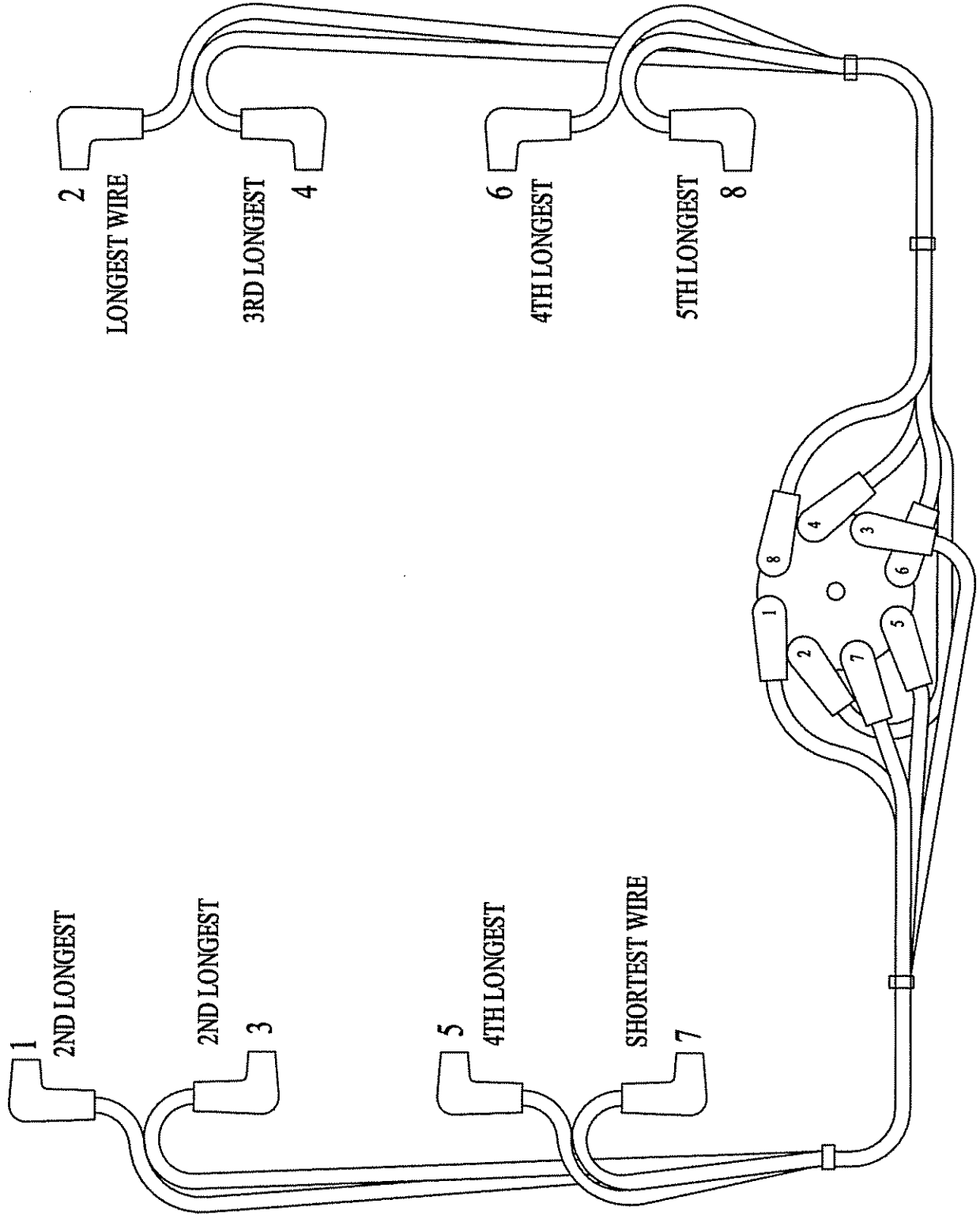
3.0L Engine Spark Plug Wire Routing



4.3L Engine Spark Plug Wire Routing



5.7L Engine Spark Plug Wire Routing



7.4L Engine Spark Plug Wire Routing



