

KEM EQUIPMENT, INC.

***Operation and
Maintenance Manual***

**Industrial Gasoline and Alternate
Fueled Engines**

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

KEM EQUIPMENT, INC.
10800 S.W. Herman Road
Tualatin, OR 97062
Phone: 503-692-5012 Fax: 503-692-1098
email: kempower@hotmail.com
www.kemequipment.com

THE UNIVERSITY OF CHICAGO

PHYSICS DEPARTMENT

5300 S. DICKINSON DRIVE

CHICAGO, ILLINOIS 60637

TEL: 773-936-3636

FAX: 773-936-3636

WWW.PHYSICS.UCHICAGO.EDU

PHYSICS 309

LECTURE 1

MECHANICS

LECTURE 2

LECTURE 3

LECTURE 4

LECTURE 5

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Introduction

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

KEM Equipment, Inc. 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.

KEM Equipment, 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 or may not be found on your engine or power unit.

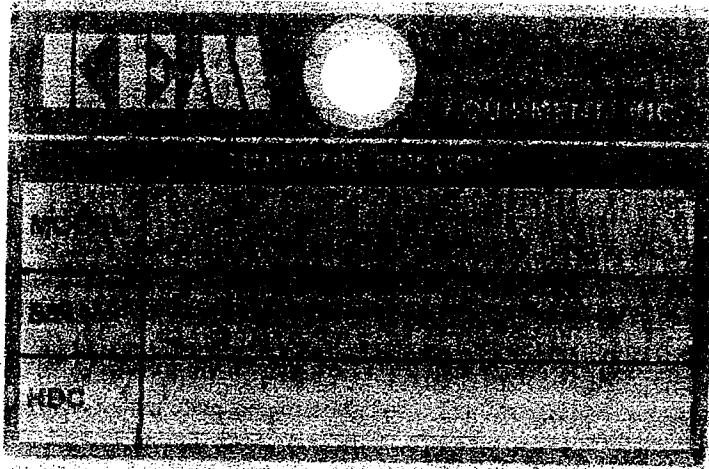
Please pay special attention to the **NOTES, CAUTIONS, and WARNINGS**. **WARNINGS** remind you to be careful in areas where carelessness can cause personal injury. **CAUTIONS** are given to prevent you from error that could cause damage to the equipment. **NOTES** give you added information designed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

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

KEM Equipment, Inc.
10800 S.W. Herman Road
Tualatin, OR 97062
Phone: 503-692-5012
Fax: 503-692-1098
email: kempower@hotmail.com

Engine Identification

An identification placard is affixed on the engine block. The label contains the engine model number and a serial number which identifies the engine from other KEM engines and the hot date code provided by **GM Powertrain**. 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 KEM Equipment, Inc. by calling the Parts Department or our Distributors. The engine model and serial number will be required when seeking information and/or ordering parts.

Technical support for **GM Powertrain** engines supplied by KEM Equipment, Inc. can be obtained by contacting the Technical Department.

Service Literature

Additional operation manuals and service manuals for specific **GM Powertrain** engines provided by KEM Equipment, Inc. can be purchased by contacting the Parts Department.

Operating Instructions

Controls

Ignition Switch

The ignition switch is located on the control panel. The system has a on/off switch, reset and start buttons. In the ON position, the electrical system is activated.

Safety Gauges

KEM Equipment, Inc., industrial power units are equipped with instrument panels which contain shut down gauges for High Engine Water Temperature and Low Engine Oil Pressure. When starting the engine it is necessary to "depress" the reset button until the engine starts. Hold the reset button down until oil pressure rises above 15 PSI, then release.

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: KEM Equipment, Inc. provides engines to many different original equipment manufacture's. Not all manufacturers use the pounds per square inch instrument panels. Please refer to the equipment Operators Manual for instructions on engine.

Fuel Systems

Several fuel systems have been used on KEM Equipment, 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.

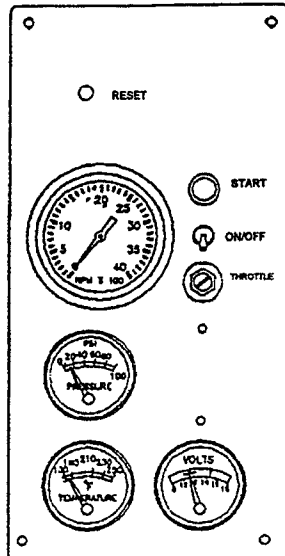
NOTE: Some fuel systems are installed by the original equipment manufacturer. Therefore it may be necessary to contact the equipment manufacturer for information pertaining to your specific fuel system if it cannot be found in the chart.

Governors

As with fuel systems, several governor controls have also been used with the KEM Equipment, 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 contract the equipment manufacturer.

Instruments



Oil Pressure Gauge

The oil pressure gauge shows the engine 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 oil pressure. 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. Do not continue to operate.

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 ensure 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 area where exhaust gases may accumulate. Avoid breathing these gases as they may contain poisonous carbon monoxide and other gases, 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.

LPG or NG Fuel Systems, Velocity Governors (Liquid Propane Gas, Natural Gas)

Turn on the gas supply to the engine. Push the START button. After the engine starts release the button.

KEM Fuel Injection (Gasoline/LPG) (Dual Fuel)

Select the desired fuel switch position for starting the engine (Gasoline/LPG). Push the ON, button.

Woodward

In demanding genset applications that require 'G3' performance but are also intolerant of cold start instability, the Woodward LCS control offers a cold start timer function that sets the gain of the controller to a lower-than-normal value until a programmable amount of time expires. This gives an engine time to warm up slightly before switching to a normal gain value. The cold start timer can be bypassed by programming.

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.

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.

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 engines 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.

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 KEM Equipment, 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

A: 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 1.

B: 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 leaks
- Repair any oil or coolant leaks
- 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

C: 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.

D: 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 'Fill' marks on the dipstick.

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

E: 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 extremely dirty areas, or during cold weather. No oil additives or break-in oil change are required.

F: 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 Liquid Propane Gas or Natural Gas 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**.

G: 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 should be used. Synthetic oils are not recommended for industrial or stationary engines.

H: Oil Filter

The KEM **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.

I: 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 which may 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 cause a rich fuel mixture and rough engine operation. Thus, it is extremely important that the air cleaner be serviced properly at the recommended intervals.

CAUTION: Service the air cleaner more frequently under severely 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.

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 fill neck seat of the radiator when the coolant is cold, but make sure core is covered. Whenever 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 condition while the engine is operating. Failure to follow these instructions could result in damage to the cooling system, engine, or cause personal injury.

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 50/50 is normal up to a maximum of 60% glycol, 40% water. Caution do not mix DEX-COOL (Pink / Orange Colored) with traditional (Green) ethylene glycol. GM recommends DEX-COOL (Pink / Orange Colored). The validation tests show longer water pump seal life as well as enhanced corrosion protection with the use of DEX-COOL.

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.

J: 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 hose 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.

K: TBI Engines

On KEM Fuel Injection or Fuel Injection/Dual Fuel, two fuel filters are used in the gasoline fuel supply line to the engine TBI (Throttle Body Injection) 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 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.

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 manufactures 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.

L: Ignition Systems

Types of Ignition Systems

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

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 VI in this manual.

M: Spark Plugs

Spark plugs should be replaced at the recommended intervals as 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 and top off radiator
- Store indoors if possible

N: 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
- 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

Maintenance Schedule
KEM Equipment, Inc.
GM Powertrain

3.0L,4.3L,5.7L,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 (4)	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 (3)		x						
	Inspect & Clean Radiator Exterior (3)		x						
	Clean Battery Cables (3)								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
	Replace Engine Coolant (3)(4)							x	
	Replace Fuel Filter (5)					x			
	Spark Plugs, Clean, Adjust & Test or Replace (3)						x		
	Replace PCV Valve (If Equipped)(3)							x	
	Check PCV Hoses, Tubes, and Fittings (3)							x	
	Replace Spark Plugs (3)								x
	Adjust Throttle & Governor (3)								x
7	Check All Bolts & Nuts for Tightness (3)								x

- (1) More frequent intervals may be required in dusty or dirty operating conditions.
- (2) Mechanical governor (belt driven).
- (3) Seasonal or as required.
- (4) Check engine coolant condition & protection, hoses & clamps annually (prior to cold weather).
- (5) More frequent intervals may be required with dirt in fuel system.

Capacities

Engines	3.0L	4.3L	5.7L	8.1L
Oil Capacity Without Filter	5 qt.	4.5 qt.	5 qt.	8 qt.
Coolant Capacity Without Radiator	4 qt.	7 qt.	7.8 qt.	14.5 qt.
Coolant Capacity With Radiator	12 qt.	17 qt.	17.5 qt.	28 qt. 31 qt. (Turbo)

KEM Equipment, Inc.

GM Powertrain Industrial Engines

Filter Chart

Engine	3.0L	4.3L	5.7L	8.1L
Oil Filter	P-25 or Equivalent	PF-1069 Equivalent	PF-25 Equivalent	PF-454 or Equivalent
Fuel Filter (KEM TBI)	25121741	C085001		
Air Filter Primary (KEM Power Unit)	C065001		C085002	59-5022

Fuel System Chart

Engine	3.0L	4.3L	5.7L	8.1L
Woodward	X	X	X	X
Nolff LPG Fuel System	X	X	X	X
Nolff Natural Gas Mixer			X	X
KEM Fuel Injection (Gasoline)		X	X	X
KEM Fuel Injection/LPG Mixer (Dual Fuel)			X	X

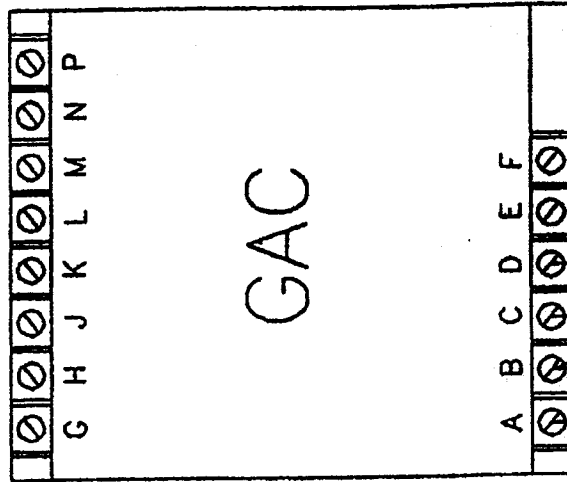
Governor Chart

Engine	3.0L	4.3L	5.7L	8.1L
Hoof Mechanical	X	X	X	X
Hoof Velocity Governor	X	X	X	X
Woodward	X	X	X	X

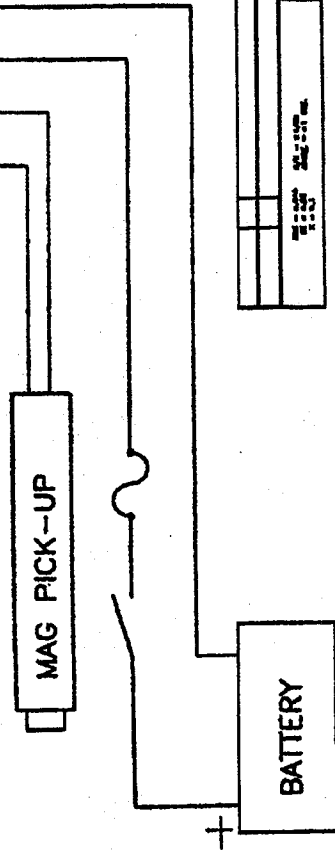
GENERAL SPECIFICATIONS
KEM Equipment, Inc.
GM Powertrain Industrial Engines

Engine	3.0L	4.3L	5.7L	8.1L/8.1L TURBO
Type	3.0L L4	4.3L V-6	5.7L V-8	8.1L V-8
Displacement cc (c.i.d)	2966 (181)	4294 (262)	5735 (350)	8127 (496)
Valve Configuration	Push Rod Actuated	Push Rod Actuated	Push Rod Actuated	Push Rod Actuated
Valve Lifters	Flat Follower	Hydraulic Roller	Hydraulic Roller	Hydraulic Roller
Bore x Stroke mm (Inches)	101.60x91.44 (4.00x3.60)	101.60x88.39 (4.00x3.48)	101.60x88.39 (4.00x3.48)	107.95x111 (4.25x4.37)
Main Bearing Caps	2 bolt	2 bolt	2 bolt	4 bolt
Balance Method	External	Internal Balance Shaft	External	External
Intake Manifold	TBI, Carburetor	TBI, Carburetor	Mixer	Mixer
Firing Order	1-3-4-2	1-6-5-4-3-2	1-8-4-3-6-5-7-2	1-8-7-2-6-5-4-3
Oil Capacity With Oil Filter	5 qts. (4.7L) 5.5 qts. (5.2L)	4.5 qts. (4.3L) 5 qts. (4.7L)	4.5 qts. (4.3L) 5 qts. (4.7L)	6 qts. (5.7L) 6.5 qts. (6.1L)
Oil Filter	PF-25	PF-1069	PF-25	PF-454
Coolant Capacity (Engine)	4 qts. (3.78L)	7.75 qts. (7.3L)	8.1 qts. (7.8L)	14.5 qts. (13.7L)
Fuel Type	Gasoline, LPG NG	Gasoline, LPG NG	LPG, NG	LPG, NG
Engine Rotation (Flywheel End)	CCW	CCW	CCW	CCW
Ignition System	Solid State Distributor	Solid State Distributor	Solid State Distributor	Distributor-less Electronic ECM
Ignition Timing (Degrees BTUC) Gasoline (TBI) LPG NG Dual Fuel	0 10 (4 Europe) 10 0	0 10 (4 Europe) 10 0	0 10 (4 Europe) 10 0	
Spark Plugs	AC Delco R46TS	AC Delco 41-932	AC Delco 41-932	Platinum
Spark Plug Gap TBI LPG NG Dual Fuel		.045 .045 .045 .045	.045 .045 .045 .045	.060 .060 .060 .060
Valve Clearance (Lash) Intake Exhaust	½ to 1 Turn 0 Lash	Net Lash No adjustment	Turn Down From 0 Lash	Net Lash No adjustment
Manufactured	Toluca, Mexico	Tonawanda N.Y.	Toluca, Mexico	Tonawanda, N.Y.

- A RED MAG PICK-UP
- B BLACK MAG PICK-UP WITH SHIELD
- C IGNITION POWER (SEE NOTE)
- D GROUND (BLK REMOTE SHUT-DOWN TERMINAL)
- E RED FROM ACTUATOR
- F WHT FROM ACTUATOR
- G RED REMOTE SHUT-DOWN TERMINAL
- H BLK REMOTE SHUT-DOWN TERMINAL (SPLICE TO TERMINAL D)
- J
- K RED POTENTIOMETER
- L WHT POTENTIOMETER
- M BLK POTENTIOMETER



NOTE TOP TERMINAL 117 WITH FUSE IN CIRCUIT
OR BOTTOM TERMINAL 117 WITH NO FUSE



GOVERNOR SPEED SETTING

The governed speed setpoint is increased by a clockwise rotation of the SPEED adjustment control. Fine, precise speed adjustments can be obtained with an optional Speed Trim control.

GOVERNOR PERFORMANCE

Once the engine is at the operating speed and at no load, the following governor performance adjustments can be made.

- A. Rotate the GAIN adjustment clockwise until instability develops. Gradually move the adjustment counterclockwise until stability returns. Then move the adjustment 1/8 turn counterclockwise to insure stable performance.
- B. Rotate the STABILITY adjustment clockwise until instability develops. Gradually move the adjustment counterclockwise until stability returns: Then move the adjustment 1/8 turn counterclockwise to insure stable performance.
- C. Gain and stability adjustments may require minor changes after engine load is applied. Normally, adjustments at no load achieve satisfactory performance.
- D. The dead time compensation can be changed with posts E1, E2, and E3 to optimize the control system. If a rapid instability, greater than 2Hz., is present at the actuator lever, cut the jumper between post E1 and E2. If the fast instability is still present, remove the jumper between posts E4 and E5. If slow instability, low gain setting, or poor response exists, add a 22 mfd. Capacitor between posts E2 (-) and E3 (-).

If the throttle is erratic, but performance is good, remove the E4 and E5 jumper will tend to steady the throttle.

To be performed by qualified personnel only.

AIR INDUCTION SYSTEM

Diaphragm Operated Air-Gas Valve Carburetion

All but one model of the IMPCO air valve carburetors use diaphragms of fiberglass and synthetic rubber or silicone material. Model 50 uses a metal piston with a sealing ring in place of a diaphragm for the purpose of reducing the carburetor size for small engines. The principle applied is the same for both. Cranking the engine lowers pressure in shaded area as the piston descends. Through passages (P) in the air valve, lowered pressure is communicated to the upper side of the diaphragm (D). As a result, atmospheric pressure pushing upward on the diaphragm lifts it against the downward pressure of the metering spring (S).

Approximately 0.2 PSI (6" W.C.) of pressure is required to lift the air valve off its seat. Approximately 0.5 PSI (13.8" W.C.) lifts the valve to the top of its travel in full open position.

Lowered pressure communicated to the top of the diaphragm varies with engine speed and position of the throttle valve opening (T). The air valve assembly measures the air flow into the engine by moving precisely in response to the demands of the engine and throttle valve position.

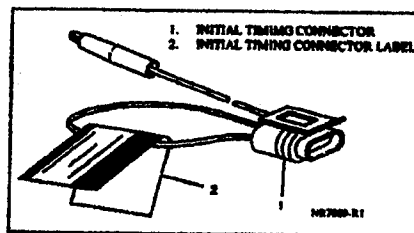
The controlled pressure drop of 0.2 to 0.5 PSI (6" - 13.8" W.C.) set up by the metering spring provides the signal or force necessary to draw fuel into the air stream within the carburetor. The gas metering valve (V) is attached to the air valve assembly and is shaped to admit the correct amount of fuel from the gas jet to mix with incoming air at any opening of the air valve.

TIMING PROCEDURE

1. Do not use a timing light that requires piercing of the secondary insulation. Use only a timing light with inductive pick-up or jumper type connectors. Piercing the secondary insulation will cause spark plug misfiring and may damage the internal conductor resulting in failure of the secondary wire later.
2. Install timing light at #1 spark plug lead, per manufacturer's instructions.
3. Do not connect alligator clip lead of the initial timing connector to a B+ source until after engine is started. If the initial timing connector is connected to b+ source while engine is started, the ignition control module (ICM) in the distributor may be damaged. If the engine must be restarted while the initial timing connector is installed, detach alligator clip lead from B+ source to avoid damaging the ICM.
4. Start the engine and allow it to warm to operating temperature. (Follow engine manufacturer's instructions.) Connect alligator clip on long lead of the initial timing connector to convenient B+ voltage source, such as battery terminal on starter solenoid. This removes all advance from electronic spark timing. Engine will probably slow down when connection is made. Engine speed should be around 650 RPM. Loosen the distributor, and set base timing to specification shown for engine.

ENGINE TIMING SPECIFICATION		
INDUSTRIAL		DO NOT EXCEED:
454	INITIAL 6°	TOTAL 30°
350	INITIAL 6°	TOTAL 28°
262	INITIAL 2°	TOTAL 26°
181	INITIAL 0°	TOTAL 20°
Set idle speed to 700 RPM \pm 50 RPM		
NOTE: Reduce initial timing if total exceeds limits.		

5. When timing is set to specification, secure distributor in position with clamp screw.
6. Tighten clamp screw to torque specified.
7. Recheck timing to assure that distributor did not move during tightening.



Installing Initial Timing Connector Label

8. Disconnect the initial timing connector from B+ source and remove the connector from the distributor. Label the initial timing connector as shown by folding adhesive label (in package) over one of the wires, matching the edges to cover the adhesive. Store connector in safe place; keep with engine for future use.

LCS Control Specifications

	Specifications
Power Supply	12 V systems (8–16 Vdc) Reverse polarity protection
Power Consumption	64 W maximum
Torque	0.34 N·m (0.25 lb-ft)
Mass/Weight	425 g (15 oz)

	Control Characteristics
Speed Input and Range	Magnetic pickup, ignition coil input, or DIS input
MPU input	100 to 12 000 Hz
IGN input	1, 2, 3, 4, 5, 6, & 8 cylinder engines with rated speeds of 1200–4000 rpm
Engine Type	2-cycle or 4-cycle gasoline, diesel, or gaseous fuel
Target speed	Programmable
Actuator Torque	High-efficiency torque motor delivers 0.34 N·m (0.25 lb-ft) (standard model) over 60° travel range to operate fuel or air control

Steady State Speed Regulation	Fuel Type:	Gasoline	Diesel	Gaseous
	MPU Input:	±0.35%	±0.25%	±0.35%
	Ignition Input:	±0.50%	n/a	±0.50%


	Functions/Auxiliary Inputs
Function Options	Isochronous speed (50 or 60 Hz), multiple speeds, two or three speed, droop, dual dynamics, adjustable max fuel stop, manifold air pressure-biased fuel limiter
Programmable	Through 12-pin Deutsch connector
Aux1 Options	Auxiliary load sharing, remote speed setting, MAP fuel limiting, 50/60 Hz select, isochronous load sharing/droop select
Aux2 Options	Lower speed, isochronous speed control/droop select, isochronous load sharing/droop select, idle/rated select, three speed select
Aux3 Options	Raise speed, dual dynamics select, three speed select
Aux4 Options	50/60 Hz select, isochronous speed control/droop select, isochronous load sharing/droop select, dual dynamics select, three speed select
Aux5 Options	Is permanently configured as an output to drive a relay

	Environment
Ambient	
Operating Temperature	–40 to +85 °C (–40 to +185 °F)
Storage Temperature	–40 to +125 °C (–40 to +257 °F)
EMI/RFI	EN50081-1 (emissions) EN50082-2 (immunity)
Humidity	US MIL-STD 810E, Method 507.3, Procedure III
Salt Spray	US MIL-STD 810E, Method 509.3, Procedure I
Shock	US MIL-STD 810E, Method 516.4, Procedure I
Random Vibration	US MIL-STD 202F, Procedure 214A, Test Condition ID
Drop	SAE J1211, Paragraph 4.8.3 (modified)
Thermal Shock	SAE J1455, Paragraph 4.1.3.2
Dust	SAE J1455, Paragraph 4.7
Pressure Wash	A modified SAE J1455, Paragraph 4.5
Fluid Resistance	A modified SAE J1455, Paragraph 4.4
Electrical Load Power Connection	
Electrical Transient	2 J per SAE J1455, Paragraph 4.11.2.2.1

	Compliance
UL/cUL	Listed (UL requires a Class 2 power source)
CE	Compliant
Y2K	Compliant
Other	89/392/EEC Machinery Directive

Reliability and Quality Goals

The LCS control system has a reliability target of 17 500 hours MTBF. It also has a quality goal of less than 25 PPM when measuring out-of-the-box defects. This quality goal is a target based on continuous improvement.



The documents contained in this package are subject to change and become updated with out notice.

KEM Equipment, Inc. reserves the right to request your maintenance schedules for each engine under warranty service at that time.

If you have any questions – you may contact our office to have assistance.

Thank you for purchasing your Kodiak Powered Product –

Sincerely

Sh.
Warranties

PROPRIETARY DATA NOTICE

This data shall not be disclosed outside the recipient and shall not be duplicated, used or disclosed in whole or in part for any other purpose other than to familiarize and train the operator of the equipment. The recipient shall have no right to duplicate or disclose the data.

KEM Equipment, Inc.
10800 SW Herman Rd – Tualatin Oregon 97062
Ph: 503-692-5012 – Fx: 503-692-1098
Email: kempower@hotmail.com
www.kemequipment.com
reprint: 041402sh.
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