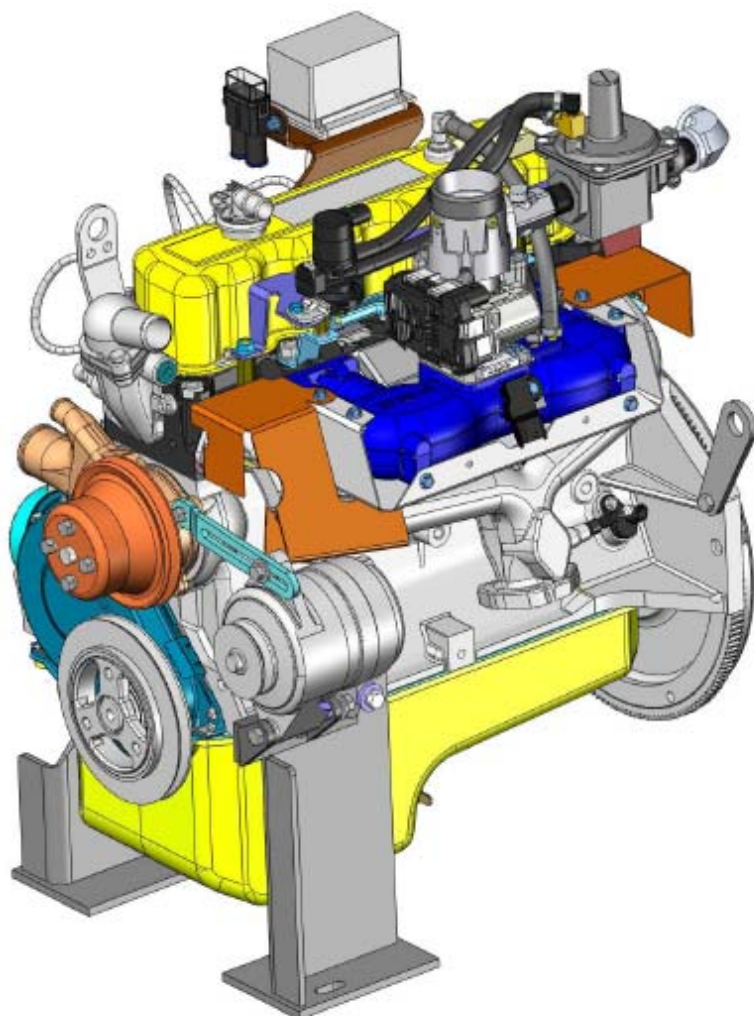




**IMPCO GM 3.0L “BVK”
STATIONARY NG/LP ENGINE
EMERGENCY POWER APPLICATION GUIDE**



PN 7044600

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1.0 Environmental Regulatory Information

THIS DOCUMENT CONTAINS EMISSION-RELATED INSTALLATION INSTRUCTIONS.

Failure to Follow These Instructions When Installing a Certified Engine in a Piece of Stationary Power Generating Equipment is a Violation of Federal Law 40 CFR §90.1003 and subject to civil penalty. Each violation constitutes a separate offense.

The following government regulations apply:

EPA 40 CFR Part 60 - Standards of Performance for New Stationary Sources

EPA 40 CFR Part 90 - Control of Emissions from Nonroad Spark-Ignition Engines
< 19 kW

2.0 Introduction

The IMPCO GM 3.0L Engine is an inline four cylinder water cooled design that has been specifically configured to run in stationary power generating applications, fueled by either natural gas or propane. The engine and fuel system components support UL 2200 applications.

The base engine has enjoyed many years of usage within the alternative fuel power generating environment and has a solid reputation for reliability and durability.

When correctly installed and matched with a generator platform, this engine package will typically provide 25kW of standby electrical power when using natural gas and 30 kW when using propane.

Switching between fuels is accomplished by performing the “Fuel Selection” instructions included in this guide.

This engine package has been configured and certified in accordance with the Federal Code of Regulations #40, part 60 for both of the following:

- 1) Emergency power: Gasoline and rich burn LPG, engines 25<HP<130.
- 2) Emergency power: Natural gas, engines 25<HP<130

Certification to the appropriate emission levels does not require an exhaust gas catalyst.

3.0 Engine Specifications

3.1 Architecture

- Manufacturer: General Motors
- Engine: Model RT / AS2, , Industrial Powertrain
- 3.0 L, 4-Cycle, Inline 4.
- Naturally Aspirated
- Displacement: 3.0 L (181 cu.in.)
- Bore and Stroke: 101.6mm x 91.4mm (4.00in. x 3.60in.)
- Compression Ratio: 10.5:1
- Piston Speed: 329 m / min. (1080 ft / min.)
- Main Bearing Caps: 2-Bolt Cast Iron
- Cylinder Head Material: Cast Iron with sintered powder metal exhaust valve seat inserts
- Piston Material: High Silicon Aluminum
- Crankshaft Material: Nodular Cast Iron
- Governor Type: Electronic
- Frequency Regulation: No-Load to Full-Load Isochronous
- Frequency Regulation: Steady State $\pm 0.5\%$
- Air Cleaner Type: Dry

3.2 Electrical System

- Controller: Delphi MEFI 5
- Ignition system – HVS Electronically Controlled HVS Distributor and Coil
- Electronically Controlled Throttle Body: Magneti Marelli
- Battery charging alternator:
 - Negative Ground
 - 12 Volts DC
 - 70A Rating
- Battery:
 - recommended 630 Cold Cranking Amps –at 18⁰C (0°F)
 - Battery Voltage: 12V DC

3.0 Engine Specifications

3.3 Rated Power

	1800 RPM (60 Hz)		1500 RPM (50Hz)	
	Natural Gas	Propane	Natural Gas	Propane
Standby	27	33	19	25
Prime	24	30	18	23

3.4 Fluid Capacities and Types

- Oil pan capacity: 3.8L / 4.0 qt SAE 10W-30
- Oil pan with filter 4.1L / 4.3 qt
- Coolant: Engine only capacity 1.8 gal, 50% /50% water / ethylene glycol.

3.5 Mass and Dimensional Characteristics

- 385 lbs.: Fully dressed including intake and exhaust manifolds, sans air cleaner and exhaust down piping.
- Refer to Appendix A for dimensional Outline and Installation Drawings

4.0 Engine Control System Operational Principle

The IMPCO GM 3.0L Stationary engine features a low pressure single point fuel delivery system along with a state of the art control scheme and engine control unit. This technology allows the engine to maintain desired power and emission performance for its full range of power and speed settings, using the full anticipated range of fuel supply pressures and fuel compositions that are encountered in North America.

The heart of the systems control scheme is the Delphi MEFI5 engine control unit which has been programmed and calibrated by IMPCO Engineers to continually monitor exhaust gas composition using an automotive grade exhaust gas oxygen sensor along with engine coolant temperature and MAP, readings to adjust the engine's air/fuel ratio to ensure power and exhaust emission targets are maintained.

Engine speed is monitored and processed by the ECU 60 times per engine revolution to ensure that the electronic throttle is able to control the engine speed within ISO 8582 G3 operating limits.

5.0 Fuel Requirements

5.1 Supply Pressure and Flow Rates

Natural Gas: 420 scfh @ 6-in H₂O* < P < 15-in H₂O**

LP Gas: 180 scfh @ 6-in H₂O* < P < 15-in H₂O**

* Minimum inlet pressure defined as being measured at the inlet to the system's fuel pressure regulator, with engine under full load.

** Maximum inlet pressure defined as being measured at the inlet to the system's fuel pressure regulator, with engine under no load.

5.0 Fuel Requirements

5.2 Composition

- Fuel Composition Limits

	<u>Nat. Gas</u>	<u>LP Gas</u>
• Methane, % by volume	90 min.	—
• Ethane, % by volume	4.0 max.	—
• Propane, % by volume	1.0 max.	85 min.
• Propene, % by volume	0.1 max.	5.0 max.
• C4 and higher, % by volume	0.3 max.	2.5 max.
• Sulfur, ppm mass	25 max	25 max
• Lower heating value, KJ/m ³ (Btu/ft ³), min.	26.6 (890)	67.5 (2260)

6.0 Air Filtration Requirements

Dry filtration is required with maximum recommended 4-in H₂O restriction @ 75 cfm.. For every 2-in H₂O of additional restriction, maximum power capability will be reduced by 1%.

Air cleaner to venturi ducting of at least 2.0-in diameter is required; the boss on the venturi housing is configured for a 2.0-in diameter hose.

7.0 Exhaust System Requirements

Exhaust flow at rated power: At 1500 rpm, volumetric flow is 6.2 m³/min (220 cfm) @ 670⁰ C (1150⁰ F). At 1800 rpm, volumetric flow is 7.7 m³/min (270 cfm) @ 670⁰ C (1240⁰ F).

Maximum backpressure at rated speed as measured at the inlet of the muffler should not exceed 2.5-in Hg. For every additional 1.0-in Hg of restriction, up to 4.0-in Hg total, maximum power will be reduced 1% for each additional 1.0-in Hg of restriction. Exhaust piping of at least 2.0-in I.D. is recommended in conjunction with an appropriate muffler and tailpipe extension.

8.0 Power Output and Fuel Consumption

3.0L RT/ AS2 Fuel Consumption - LP			
			Fuel
RPM	Percent Load	Output (kW)	Consumption (scfh)
1500	10%	3.5	54
1500	25%	8.6	76
1500	50%	17.7	120
1500	75%	26.2	163
1500	100%	34.7	214
1800	10%	4.3	65
1800	25%	10.6	95
1800	50%	20.7	143
1800	75%	31.8	198
1800	100%	41.9	246

3.0L RT/AS2 Fuel Consumption - NG			
			Fuel
RPM	Percent Load	Output (kW)	Consumption (scfh)
1500	10%	3.0	113
1500	25%	8.0	163
1500	50%	16.0	242
1500	75%	24.0	326
1500	100%	32.0	412
1800	10%	4.0	139
1800	25%	10.0	195
1800	50%	20.0	300
1800	75%	29.0	388
1800	100%	39.0	480

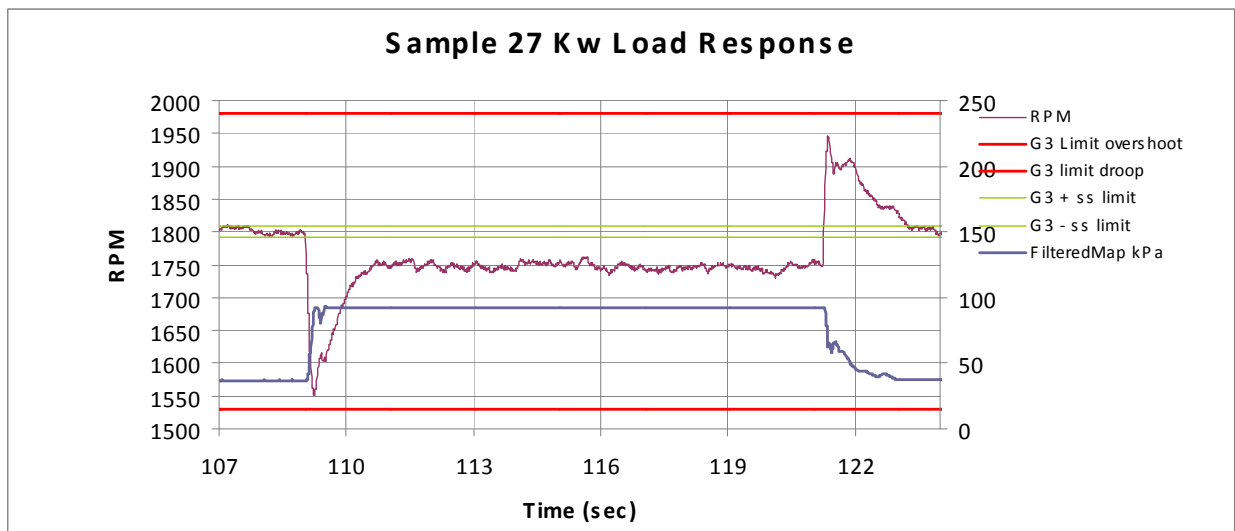
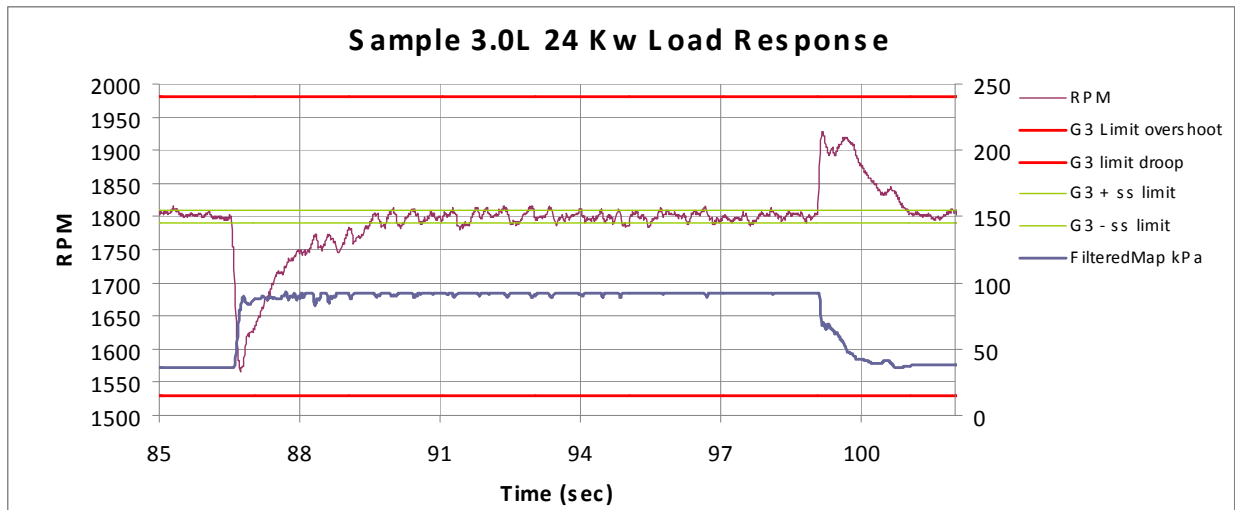
9.0 Cooling System Requirements and Heat Rejection Characteristics

- When operating at peak output the IMPCO GM 3.0L engine will reject approximately 43 kW of heat; 34 kW through the water jackets to the radiator and 9kW radiated.
- Engine water jacket capacity is 1.8 gal.
- Peak coolant flow rate is 42 gal/min @ 1800 rpm via centrifugal engine driven pump.

10.0 Governor Performance

Isochronous governor performance is at or better than ISO 8528 “G3” levels.

When the engine is properly calibrated and installed according to the recommendations of this document, the load acceptance and load rejection performance plots shown below should be expected for 24kW (standby)/ 27 kW (prime power) gensets.



11.0 Engine/Fuel System Communication Protocol

Engine operating parameters and commands as well as system diagnostic trouble codes are communicated via CAN bus using standard SAE J1939 protocol. Refer to the System Operational Manual for detailed information.

12.0 Thermal Operating Limits

Key fuel system and engine control electrical components are automotive grade, designed to operate in temperatures from -20⁰ C to 105⁰C.

Low temperature starting characteristics:

Unassisted start: 0F

Assisted start (block heater active): -20 F

High temperature starting characteristics:

Unassisted start: +104 F

Fuel handling and fuel supply components are designed to operate within the performance constraints as outlined in UL 2200. When integrating non-engine mounted fuel system components, it is recommended that customer engineering staffs confer with IMPCO Technologies application engineers to ensure that acceptable component thermal limits are maintained during all anticipated operating conditions.

The engine control system features a calibratable engine over-temperature protection function. When an initial threshold is reached the engine is forced to return to an idle condition and a malfunction illumination light (MIL) is triggered. If the engine reaches a second higher programmed threshold, the engine is shut-down and a second MIL condition triggered.

13.0 Fuel Selection

The IMPCO GM 3.0L Stationary Power Generating engine is easily configurable for use with either natural gas or liquid propane (vapor) gas. As supplied to the customer the engine is configured for operation on natural gas. To convert for use with LP, the mechanical fuel selector switch on the unit is then changed from 'NG' to 'LP' mode using an IMPCO supplied tool; the system is then ready to be connected to and operated on LP gas.

14.0 Available Options

- Remote oil drain
- Remote oil fill
- Freeze plug coolant fitting (pre-heat?)
- Front Engine Mounts
- Engine Bell housing SAE #3 or SAE #4

15.0 Warranty Information

- Emissions related components: 2 years warranty – parts and labor.
- GM provided components: IMPCO provides GM warranty.
- Base engine: 3 years or 3500 hours.
- All other components: First of 12 months or 2000 hours.