



Emission Related Installation Instructions

Constant Speed ONLY Certified Wellhead Gas Engines

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**THE INFORMATION IN THIS DOCUMENT IS CONFIDENTIAL AND
PROPRIETARY TO KEM EQUIPMENT, INC.**



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NOTE: These instructions are intended to give the installer of the engine all of the information that is necessary to properly install the engine and related components into the equipment chassis. The United States Environmental Protection Agency (EPA) requires that the manufacturer of the engine provide installation instructions to the equipment manufacturers as defined in the Code of Federal Regulations (40CFR 1048.130).

NOTE: Failing to follow these instructions when installing a certified engine violates federal law (40CFR 1068.105(b)), subject to fines or other penalties as described in the Clean Air Act.

NOTE: If you install the engine in a way that makes the engine's emission control information label hard to read during normal engine maintenance, you must place a duplicate label on the equipment, as described in the Code of Federal Regulations (40 CFR 1068.105)

NOTE: This engine is certified for constant speed use only. Installing this engine into any variable speed equipment application is a violation of the Clean Air Act.



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Air Intake

The air filter element must be sized for the application according to the filter manufacturer, and that a proper maintenance schedule is given to the final customer. The filter needs to be located in an area with good air circulation and is away from possible hazards. Limit the intake restriction to 5" H₂O or 1.24 kPa. The crankcase vent needs to be plumbed into the intake between the air filter and the mixer.

The EPA and CARB require every certified industrial engine to have a closed crankcase and no crankcase emissions may be vented to the atmosphere as described in the Code of Federal Regulations (40CFR 1048.115).

Fuel System

This fuel system is very versatile, and has been tested to meet emissions standards on fuels with energy contents of 700BTU per cubic foot to 2500BTU per cubic foot with the proper fuel select switch setting and fuel pressure. The engine control panel has a fuel selector switch with 5 set points which is where the fuel energy level is selected. This panel mounted switch is the only adjustment on the engine. Set the fuel selector switch to the fuel energy content setting that is closest to the actual value before starting the engine. The MVP display panel will show engine parameters. Observe the coolant temperature on the MVP gauge while the engine is running at idle speed with no load. When it reaches 71°C or 160°F push both the Menu and Enter button at the same time. Now push the menu button until "Engine Parameters" is displayed. Push the up arrow until "BLM Bank A" is displayed. Adjust the fuel selector switch one step at a time until the BLM value is between .88 and 1.12. If the BLM is less than 1, turn the knob to a higher BTU fuel. If the BLM is greater than 1, turn the knob to a lower BTU fuel position.

Be sure to use a coalescing filter before the GV1 fuel controller, as liquid ingestion will damage the unit and is not covered under warranty.

Natural Gas or Higher Fuel Energy Density Fuel Pressure:

The supply fuel pressure to the engine can be anywhere between 15" H₂O and 4.5PSI as long as the fuel energy density is equivalent to Natural Gas or higher. This supply pressure must be measured on a running/loaded engine to be sure it can maintain that pressure range at any engine condition. The supply line sizing will limit the fuel flow if too small for the engine demand.

Fuel Pressure With Fuel Energy Density Below Natural Gas:

When running on fuel with an energy density below Natural Gas, the fuel pressure needs to be 4 to 4.5PSI. A higher fuel pressure is needed to account for the increase in fuel flow. This supply pressure must be measured on a running/loaded engine to be sure it can maintain that



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pressure range at any engine condition. The supply line sizing will limit the fuel flow if too small for the engine demand.

Exhaust System

For the exhaust, the maximum restriction should be limited to 6" HG measured no more than 1" downstream of the exhaust manifold flange. Also, keep exhaust backpressure as low as possible. The backpressure can be reduced by changing factors such as:

- Larger exhaust pipe diameter
- Reducing length of exhaust pipe between manifold and muffler
- Reducing the number of sharp bends in the system
- Installing a less restrictive muffler

The U.S. EPA certification regulations for LSI engines require the engine manufacturer (KEM Equipment, Inc.) to notify the equipment manufacturer that sampling of exhaust emissions must be possible after engines are installed in equipment and placed in service. If this cannot be done by simply adding a 20-centimeter extension to the exhaust pipe, you, as the equipment manufacturer, must demonstrate to KEM Equipment, Inc. how to sample exhaust emissions in a way that prevents diluting the exhaust sample with ambient air.

The Heated Exhaust Gas Oxygen Sensor (O₂) is an important part in controlling the air to fuel ratio of the engine. The O₂ sensor measures the amount of oxygen in the exhaust gas and transmits the data to the ECM. If the O₂ sensor is reading a low oxygen level, the engine is running rich; in turn the ECM will lean the mixture, and vice versa. Therefore, the location of the O₂ sensor in the exhaust flow is critical for accurate engine management.

If at all possible KEM Equipment will choose the location of the oxygen sensors and install them prior to shipment. For situations where the end user installs the sensors follow the instructions below:

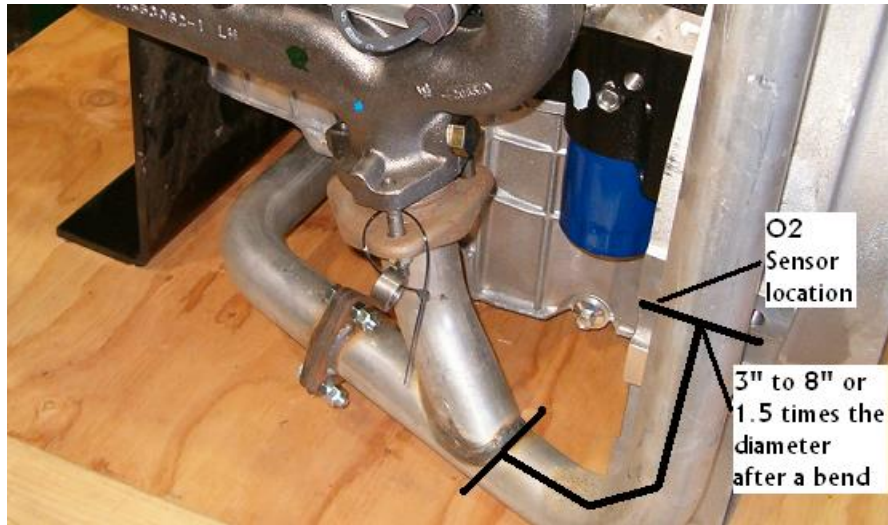


Figure 1: Pre-O₂ sensor positioning

The O₂ sensor needs to be installed 3 to 8 inches from the crossover pipe. If a bend is used in this range, the center of the bung must be a distance of 1.5 times the diameter of the pipe from the end of the bend; the bung must be mounted on a straight run of pipe (figure 1).

Mount the O₂ sensor bung so the sensor centerline is at least 10° above the horizontal plane (figure 2) with respect to the engine mounted in the equipment.

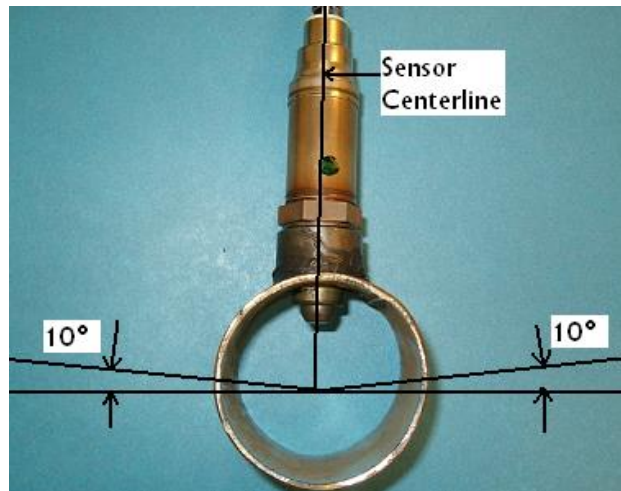


Figure 2: Mounting of O₂ sensor in exhaust system

Route the sensor wire in a manner that it does not contact the exhaust tubing and is away from moving parts. If positioning of the O₂ sensor does not allow the wire on the engine harness to reach the connector on the sensor an extension harness can be provided.

The catalytic converter is a very important part of a low emission engine. Mounting the catalytic converter in the proper location will control the operation of the catalytic converter to optimum performance. The catalytic converter needs to be mounted not more than 38 inches from the exhaust manifold flange (from point A to C in Figure 3) and a minimum of 6 inches from the Y pipe (between points B and C in Figure 3), all bends need to be accounted for in the measurement. In order to comply with the U.S. EPA certification durability requirements for this engine, we suggest the use of 409 stainless steel or equivalent material between the catalyst and muffler and also after the catalyst muffler. Take into account that the internal catalyst temperatures may exceed 1600 degrees Fahrenheit, use good engineering judgment in the design of the exhaust system for your equipment.

It is critical that all exhaust system routing and junctions remain completely (100%) leak free.

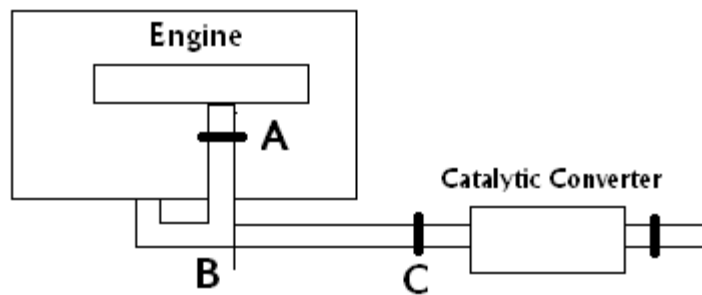


Figure 3: Catalytic Converter Location

Care should be taken in the placement of the catalyst as it can reach excessive temperatures. The catalyst should not be mounted near flammable material, and equipment components should be protected with heat shielding. Mount the catalyst in an open area with good air circulation.

ECM/Bussmann Fuse Box Installation instructions

The ECM should be mounted in such a way that the connectors are facing sideways or down. The housing is vibration and water resistant, however, be sure to mount with the supplied rubber isolators. Mount in a location that is out of harms way, and the connectors are not subjected to direct pressure washing.

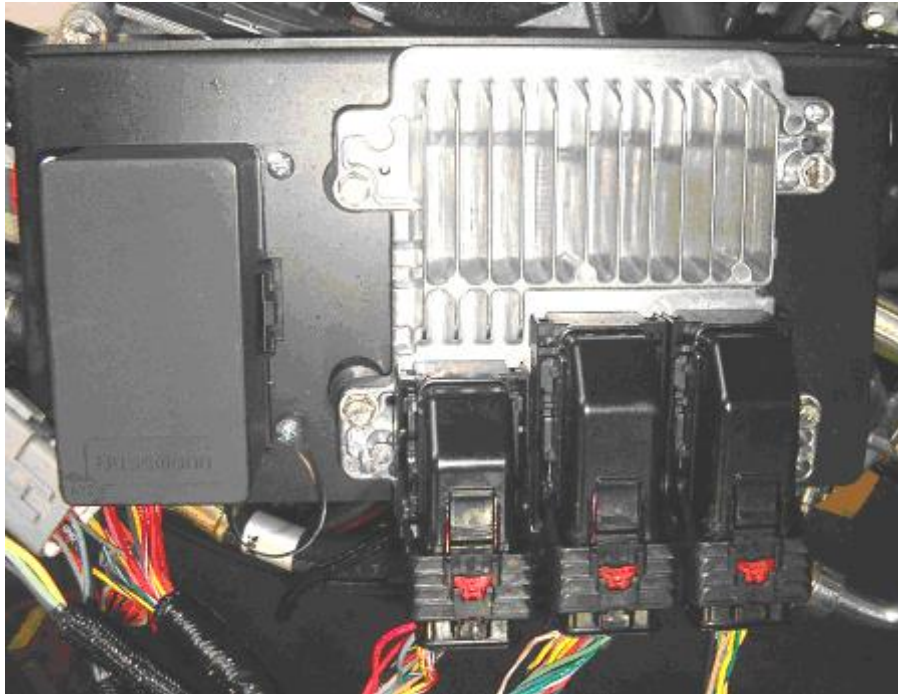


Figure 3: Example of ECM/Bussmann positioning

The fuse and relay box is completely sealed and should not leak under normal circumstances. It should never be mounted in a manner that it could be submitted to continuous submersion in any liquid or directly pressure washed. Be sure to mount it so maintenance workers have easy access to the fuse/relay box and wires are not overly strained (figure 3).

Diagnostic connection

A Check Engine Lamp (CEL) must be installed on the equipment to indicate trouble conditions. There is also a secondary Malfunction Indicator Lamp (MIL) for less severe trouble codes that can be installed (This is only with MEFI controlled engines, if it is both lamps will be shipped with the engine). The other option is a gauge on the dash that has an integral CEL. The wiring needed for the CEL and MIL can be seen on the wiring diagram on the last page of this document.

To connect the engine to diagnostic equipment, there is a 6-pin Delphi connector located near the ECM and other interface connections. There is also a 3-pin Deutsch connector in the same area to connect to J1939/CAN communications devices, many of which can view diagnostic information. If using software such as Diacom, install the software according to their respective instructions, and connect the cable to the appropriate connector on the engine.



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Emissions Installation Checklist:

Description	Yes/No	Notes
Fuel lines are routed correctly		
Air filter meets specifications and restriction is limited in any intake plumbing between filter and engine		
Exhaust is made of satisfactory materials and restriction is limited		
ECM mounted without strain on wires and in a fashion that the connectors won't gather moisture		
Fuse/Relay box is mounted without strain on the wires and is easily accessible to maintenance workers		
Install Engine Information Label supplied by KEM in a location that is readily visible once the engine is installed in the equipment ¹ .		

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¹ "If you install the engine in a way that makes the engine's emission control information label hard to read during normal engine maintenance, you must place a duplicate label on the equipment, as described in 40CFR 1068.105".

