DETROIT DIESEL

Series 50G and Series 60G Generator Set

Installation Manual

TP-5852 10/96

ATTENTION

This document is a guideline for qualified personnel. It is intended to be used by generator set manufacturers and installers and contains Detroit Diesel Corporation's recommendations for the ancillary systems supporting the Detroit Diesel engines covered by this document. The generator set manufacturer and installer are responsible for developing, designing, manufacturing and installing these systems, including component qualification. The manufacturer is also responsible for furnishing generator set users complete service and safety information for these systems. Detroit Diesel Corporation makes no representations or warranties regarding the information contained in this document and disclaims all liability or other responsibility for the design, manufacture or installation of these ancillary systems, or the preparation or distribution to users of appropriate information regarding these systems. The information contained in this document may not be complete and is subject to change without notice.

SERIES 50G AND SERIES 60G GENERATOR SET INSTALLATION

ABSTRACT

The purpose of these guidelines is to assist the installer by summarizing some of the key information required for proper installation and operation of Detroit Diesel powered natural gas generator sets.

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1 INTRODUCTION

This manual provides installation instructions for generator sets (gensets) powered by Detroit Diesel Series 50G and Series 60G engines.

For complete information and safety instructions refer to the following:

Engineering Bulletin 54, Series 50G and 60G Generator Set Engine Application and Installation (18SA0369)

Series 50G and 60G Generator Set Engine Operator's Guide (6SE551)

Series 50® Engine Service Manual (6SE50)

Series 60® Engine Service Manual (6SE483)

Generator Drive Engines - OEM Guide (18SA335)

DDEC® III Application and Installation (7SA800)

NOTES:

2 SAFETY PRECAUTIONS

The following safety measures are essential when installing the Series 50G or Series 60G engine.

CAUTION :

Exhaust products of an internal combustion engine may cause illness, injury, or death if inhaled in certain quantities. Always start and operate an engine in a well–ventilated area. If the vehicle is inside a building or other enclosed area, engine exhaust should be vented into the outside air. Do not modify or tamper with the exhaust system.

2.1 STANDS

Use safety stands in conjunction with hydraulic jacks or hoists. **Do not** rely on either the jack or the hoist to carry the load.

2.2 GLASSES

Select appropriate safety glasses for the job. Safety glasses *must* be worn when using tools such as hammers, chisels, pullers and punches.

2.3 WELDING

Wear welding goggles and gloves when welding or using an acetylene torch. Insure that a metal shield separates the acetylene and oxygen which must be chained to a cart. **Do not** weld or heat areas near fuel tanks or fuel lines. Utilize proper shielding around hydraulic lines.

2.4 WORK PLACE

CAUTION :

Do not work near open flames, pilot flames (gas or oil heaters), or sparks. Vent engine and fuel lines downstream of shutoff valve and then check for leaks before welding or carrying an open flame near engine. Do not weld or carry an open flame near the engine if you smell gas or otherwise suspect a leak.

Organize your work area and keep it clean. Eliminate the possibility of a fall by:

- ❑ Wiping up oil spills
- ❑ Keeping tools and parts off the floor

A fall could result in a serious injury.

After servicing or adjusting the engine:

- ❑ Reinstall all safety devices, guards or shields
- ❑ Check to be sure that all tools and servicing equipment are removed from the engine

2.5 CLOTHING

Safe work clothing fits and is in good repair. Work shoes are sturdy and rough-soled. Bare feet, sandals or sneakers are **not** acceptable foot wear when adjusting and/or servicing an engine.

CAUTION :

To avoid personal injury, do not wear rings, wrist watches, neck chains, or loose fitting clothing when working on an engine. Any of these items could catch on moving parts causing serious injury.

2.6 POWER TOOLS

Do not use defective portable power tools. Check for frayed cords prior to using the tool. Be sure all electric tools are grounded. Defective electrical equipment can cause severe injury. Improper use of electrical equipment can cause severe injury.

2.7 AIR

Do not apply compressed air to any part of the body or clothing. This can cause injury or death. Use only approved air blow guns that do not exceed 30 lb·in.^{2} (207 kPa). Be sure to wear safety glasses or goggles. Use proper shielding to protect everyone in the work area.

2.8 FLUIDS AND PRESSURE

CAUTION :

Remove the coolant pressure control cap slowly and only when coolant is at ambient conditions. A sudden release of pressure from a heated cooling system can result in possible personal injury from the expulsion of hot coolant. Use a latching device which always closes.

Be extremely careful when dealing with fluids under pressure. Fluids under pressure can have enough force to penetrate the skin. These fluids can infect a minor cut or opening in the skin. See a doctor at once, if injured by escaping fluid. Serious infection or reaction can result without immediate medical treatment.

Do not put your hands in front of fluid under pressure.

2.9 BATTERIES

Electrical storage batteries give off highly flammable hydrogen gas when charging and continue to do so for some time after receiving a steady charge.

Do not under any circumstances allow an electric spark or open flame near the battery. An explosion may occur.

Always disconnect the battery cable before working on the electrical system.

2.10 FIRE

Keep a charged fire extinguisher within reach. Be sure you have the correct type of extinguisher for the situation. The correct fire extinguisher types for specific working environments are listed in Table 2–1.

Fire Extinguisher	Work Environment
Type A	Wood, Paper, Textile and Rubbish
Type B	Flammable Liquids
Type C	Electrical Equipment

Table 2–1 The Correct Type of Fire Extinguisher

2.11 NATURAL GAS

CAUTION :

Natural gas is highly flammable and explosive. The following cautions *must* be taken to avoid personal injury or engine damage:

- ❑ **Do not smoke when installing or servicing the engine or fuel system.**
- ❑ **Installation or servicing of natural gas equipment *must* only be conducted in well ventilated, natural gas compatible areas. Do not install or service equipment in an enclosed area where ignition sources are present without ensuring that an undetected gas leak may be safely vented without being ignited.**
- ❑ **Do not vent natural gas or permit leaks inside an enclosed area.**
- ❑ **Bleed natural gas lines before installing or servicing any component connected to the fuel lines. Use the venting procedures found in the Safety Precautions section. Refer to section 2.11.1 for operable engines and section 2.11.2 for inoperable engines.**
- ❑ **Use a combustible gas detector.**
- ❑ **Equipment fuel systems are the responsibility of the Original Equipment Manufacturer (OEM). Equipment fuel system guidelines *must* be adhered to when installing or servicing equipment. Refer to OEM guidelines specifying which maintenance procedures require venting of fuel lines.**
- ❑ **Vent systems on the equipment should be ducted to a safe area whenever equipment is in an enclosed area.**

2.11.1 Venting an Operable Engine to Relieve Natural Gas Pressure

CAUTION :

To avoid personal injury an operable natural gas engine must be kept in a well ventilated area away from open flames and sparks.

If the engine *can run*, use the following venting procedure to relieve the natural gas pressure downstream of the shutoff valve:

1. Shut off the main shutoff valve on the natural gas fuel supply line.
2. Start engine and run until it stalls due to fuel starvation.
3. Check to make sure gage pressure at the point on the natural gas fuel line to be vented has been reduced to zero. If not, repeat step 1. Then repeat step 2.
4. Disconnect batteries using switch(es) in battery compartment or by disconnecting battery ground cable.
5. Slowly open a fitting to assure all pressure has been relieved in the natural gas fuel line.
6. Check all connections that were loosened for leaks after installation, service and troubleshooting are completed. Refer to section 2.11.3 for leak check procedure.

2.11.2 Venting an Inoperable Engine to Relieve Natural Gas Pressure

CAUTION :

To avoid personal injury an inoperable natural gas engine must be kept in a well ventilated area away from open flames and sparks.

If the engine *cannot run*, use the following venting procedure to relieve the natural gas pressure downstream of the shutoff valve:

1. Shut off the main shutoff valve on natural gas fuel supply line.
2. Disconnect the batteries using switch(es) in battery compartment or by disconnecting battery ground cable.
3. Slightly loosen the natural gas fuel line fitting to be serviced in a well ventilated area to allow gas to vent.
4. Once the sound of escaping gas ceases, completely open the fitting that was slightly opened and allow any remaining gas to vent in a well ventilated area.

5. Check all connections that were loosened for leaks after installation, service and troubleshooting are completed. Refer to section 2.11.3 for leak check procedure.

2.11.3 Leak Checking the Natural Gas Fuel System

CAUTION :

To avoid personal injury or engine damage from potentially explosive leaking of natural gas:

- ❑ **Always close manual valve (s) on NG supply line before working on engine.**
- ❑ **Always apply anaerobic pipe sealant containing Teflon such as SWAK™ to the component threads (except for compression fittings), when replacing a threaded natural gas carrying component.**
- ❑ **Always test for leaks with soapy water or equivalent after any service is performed.**

Use the following steps to check for leaks:

1. Spray soapy water or commercially available leak checking solutions on connections which are pressurized to working pressure. Bubbles will form if there is a leak.
2. Repair any leak found by:
   a. Tightening connection using the fitting manufacturer's technique.

NOTE:
Bleed the fuel lines before replacing leaking components using the procedure in this section. This will prevent a discharge of gas.

   b. Replacing leaking component.
   c. Replace the pipe threaded connector with a new one if the leak is a pipe thread connection. Use anaerobic sealant with Teflon (such as SWAK) applied to the threads.
3. Re-check connection with procedure in step 1.
4. Check for presence of natural gas using a combustible gas detector.
5. Continue looking for leaks until the location of all the leaks is determined.
6. Repair the leak using the procedure in step 2.

2.12 FLUOROELASTOMER (VITON)

Fluoroelastomer (Viton) parts such as O–rings and seals are perfectly safe to handle under normal design conditions. A potential hazard may occur if these components are raised to a temperature above 600°F (316°C) (in a fire for example). Fluoroelastomer will decompose (indicated by charring or the appearance of a black, sticky mass) and produce hydrofluoric acid. This acid is extremely corrosive and, if touched by bare skin, may cause severe burns (the symptoms could be delayed for several hours).

CAUTION :

Avoid injury by wearing eye protection (goggles and faceplate) and neoprene or PVC gloves when handling fluoroelastomer O–rings or seals which have been degraded by excess heat. Do not handle engine parts until they have cooled. Wash equipment and parts well with lime water (calcium hydroxide solution) before reusing if hydrogen fluoride condensate is expected. Discard gloves after handling degraded fluoroelastomer.

NOTES:

3 AIR, EXHAUST, AND COOLING SYSTEMS

The air inlet system has a direct effect on engine output, fuel consumption, exhaust emissions, and engine life.

The exhaust system removes the exhaust gases to an appropriate discharge location and reduces the engine noise to a satisfactory level.

The cooling system must perform within specifications after normal system degradation occurs.

3.1 AIR SYSTEM

If the generator set is to be installed in a relatively clean environment, such as the basement of an office building, a single stage filter may be acceptable. Generator sets operating in industrial or other dusty environments should use a heavy duty two stage filter.

Regardless of the type of filter selected, the filter should be replaced when the air inlet restriction reaches 20 in.H_2O (5.0 kPA) or annually in the case of standby generator sets with relatively few operating hours.

3.2 EXHAUST SYSTEM

Minimum recommended exhaust pipe diameter:	5 in. (127 cm)
Maximum exhaust back pressure:	3 in.Hg (10.1 kPA)

3.3 COOLING SYSTEM

Before starting the engine check to be certain that the cooling system is filled with the correct level of properly inhibited coolant.

3.3.1 Coolant Selection

Use a 50/50 mix of clean, soft water and genuine Detroit Diesel **Power Cool®** or an equivalent ethylene glycol coolant (low silicate formulation) that meets or exceeds the standard of either the GM 6038-M formulation (GM 1899-M performance), or ASTM D 4985 requirements.

Detroit Diesel Maintenance Product supplemental corrosion inhibitors are also added in the right concentration.

Only non-chromate inhibitors should be used with coolant solutions.

When installing coolant in an engine it is important to keep in mind the fact that the entrapment of air in the cooling system may result in a "false fill" condition. Operate the engine at no load for 10 or 15 minutes to allow the trapped air to be cleared, then re-check the coolant level, adding coolant as required.

4 FUEL SYSTEM

Proper engine operation requires that a supply of good clean fuel be maintained.

In order to keep the restriction at the engine to a minimum, fuel piping must be no smaller than 2 inches in diameter.

4.1 FUEL REQUIREMENTS

The low pressure fuel system consists of a venturi type fuel mixer, a pulsewidth modulated stepper motor valve (PSV), which controls the fuel rate, throttle actuator, and low pressure regulator. The fuel filter should be located on the supply side of the primary pressure regulator. If supply pressure exceeds the filter manufacturers limits, then the filter may be located after the regulator. See Figure 4–1.

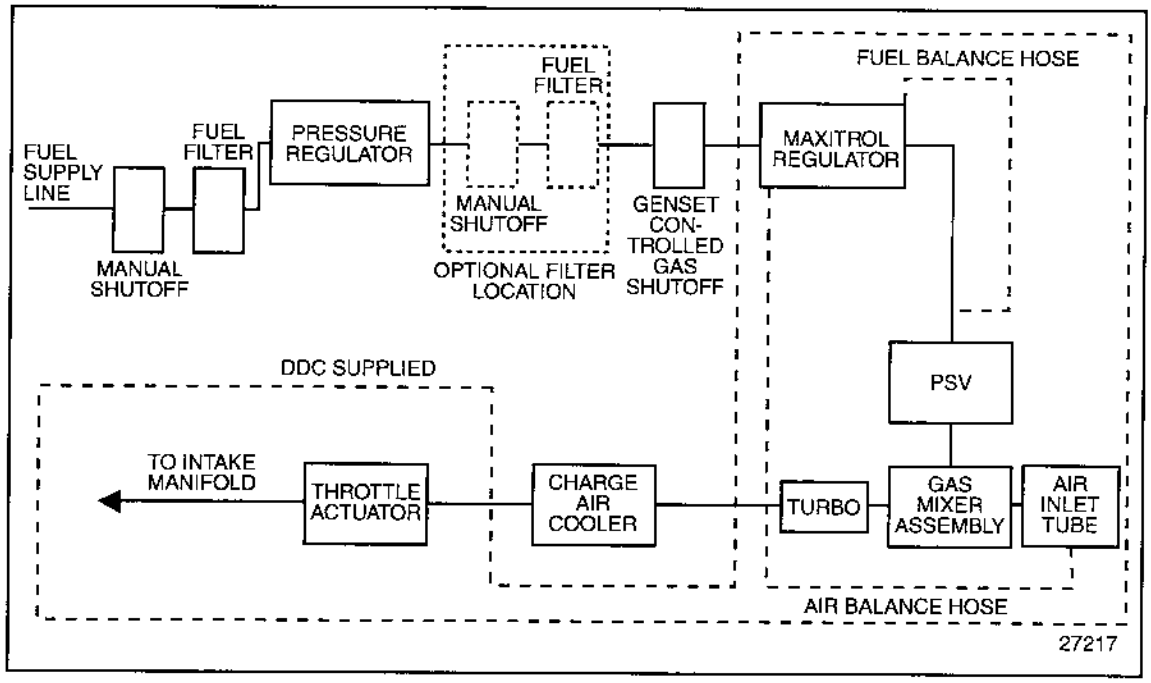

Figure 4–1 Typical Low Pressure Natural Gas Fuel System

These engines require fuel delivery at pressures from 5 to 20 in.H_2O (1.24 to 4.98 kPA) at the inlet to the low pressure regulator (mounted on the generator set) and at temperatures from –4 to 125°F (–20 to 52° C). The maximum fuel delivery rate for the Series 50G and the Series 60G is listed in Table 4–1.

Engine	Maximum Fuel Delivery Rate
Series 50G	102 lb/hr (46.3 Kg/hr)
Series 60G	140 lb/hr (63.5 Kg/hr)

Table 4–1 Maximum Fuel Delivery Rate

The natural gas specifications for generator set engines are listed in Table 4–2.

Property	Limit	ASTM Test Method
Hydrocarbon	**mole percent**	
Methane	88% min.	D 1945
Ethane	6% max.	
Propane	1.7% max.	
C4 and higher	0.3% max.	
Other Gaseous Species	**mole percent**	
Hydrogen	0.1% max.	D 2650
Carbon Dioxide + Nitrogen + Oxygen	5.0% max.	D 1945
Oxygen	0.5% max.	D 1945
Carbon Monoxide	0.1% max.	D 2650
Other Species		
Methanol	0% mass max.	No test method
Sulfur, total	1.0 grains / 100 SCF, max. (32 ppm mass, max., ‖)	ASTM D 5504
Performance Related Properties		*
Motor Octane Number	115 min.	D 2623
Wobbe Number	1290–1380 BTU/SCF	D 3588
Contaminants	†	
Pressure Water Dew Point Temperature, max.	‡	D 1142
Pressure Hydrocarbon Dew Point Temperature, max.	‡ Below which will form 1% condensate	D 1142
Odorant	§	—

* Test method D 2623 was obsoleted by ASTM in 1991. Wobbe Index (WI), also known as Wobbe Number, is a measure of fuel energy flow rate through a fixed orifice under given inlet conditions. Numerically, WI = (dry, higher heating value) / (specific gravity).

† The compressed natural gas shall not contain dust, sand, dirt gums, oils or other substances in an amount sufficient to be injurious to the fuel system.

‡ The water and hydrocarbon dew point at fuel supply pressure shall be at least 10°F below the 99.0% winter design temperature listed in Chapter 24, Table 1, Climactic Conditions for the United States, in the *American Society of Heating, Refrigerating and Air Conditioning Engineer's (ASHRAE) Handbook*, 1989 fundamentals volume. Testing for water and hydrocarbon vapor shall be in accordance with ASTM D 1142, utilizing the Bureau of Mines apparatus.

§ The natural gas at ambient conditions must have a distinctive odor potent enough for its presence to be detected down to a concentration in air of 1% by volume.

‖ When using fuel containing sulfur in excess of 16 ppm, the oil change interval must be reduced; oil change intervals are listed in Table 5–2.

Table 4–2 Natural Gas Specifications for Generator Set Engines

4.2 FUEL FILTER

The precision fuel metering systems of the Series 50G and Series 60G require that a fuel filter be used to screen the fuel of liquids and debris that may be carried along with the fuel in the pipeline.

The filter should not allow infiltration of particles larger than 0.05 mm, and have a filter element with a high capacity for accumulated dust.

The restriction offered by a new filter should not exceed 12 in.H_2O (30 mbar).

The system pressure requirements as stated in the performance curves must be maintained AFTER any pressure losses caused by the filter.

A filter that meets these criteria is available from the Maxitrol Company. Filters meeting these criteria may also be available from other sources.

MAXITROL Co.
23555 Telegraph Rd.
PO Box 2230
Southfield, MI 48037
Phone: (810) 356-1400
FAX: (810) 356-0829

MAXITROL Model: GF80-1-1616

Maximum inlet pressure for the Maxitrol model GF80-1-1616 is 15 psi (1034 mbar).

NOTES:

5 LUBRICATION SYSTEM

Always check the engine dipstick to make certain lubricating oil is at the proper operating level before starting the engine.

5.1 OIL SELECTION

No API category currently exists for natural gas engine lubricating oils. Selection of oils must be limited to lubricants that have demonstrated adequate performance in these engines. These include:

Mobil Delvac Super GEO 15W–40

Exxon Estor Super 15W–40

5.2 OIL PAN CAPACITY

To the "full" mark on the dipstick:

S50G 22 Quarts (28 Quarts including the filters)

S60G 32 Quarts (38 Quarts including the filters)

5.3 OIL CHANGE INTERVALS

Lubricating oil undergoes deterioration from combustion by–products and contamination during engine operation . Oil drain intervals may vary in length depending on engine operation, fuel quantity, and lubricant quality.

NOTICE:
Operation with fuels having total sulfur greater than 32 ppm, on a mass basis, may result in engine damage, and is not recommended by Detroit Diesel Corporation.

The oil drain intervals listed in Table 5–1 and Table 5–2 should be considered **maximum.**

Genset	Interval
Standby Duty	250 Hours or 12 Months
Continuous Duty	250 Hours or 3 Months

Table 5–1 Oil Change Intervals with Recommended Fuel

Genset	Interval
Standby Duty	200 Hours or 6 Months* 150 Hours or 3 Months†
Continuous Duty	200 Hours or 3 Months* 150 Hours or 3 Months†

* Fuel with total sulfur greater than 17 ppm, but less than 24 ppm.

† Fuel with total sulfur greater than 24 ppm, but less than 32 ppm.

Table 5–2 Oil Change Intervals with High Sulfur Fuels

5.4 OIL FILTER

The oil filter must be changed when the engine oil is changed.

Use Detroit Diesel Part Number 23518480 oil filter, or equivalent.

DETROIT DIESEL
CORPORATION

13400 Outer Drive, West / Detroit, Michigan 48239-4001

TP-5852 10/96