



Operator's Manual

JB

JCA

JCB

GENERATOR SET

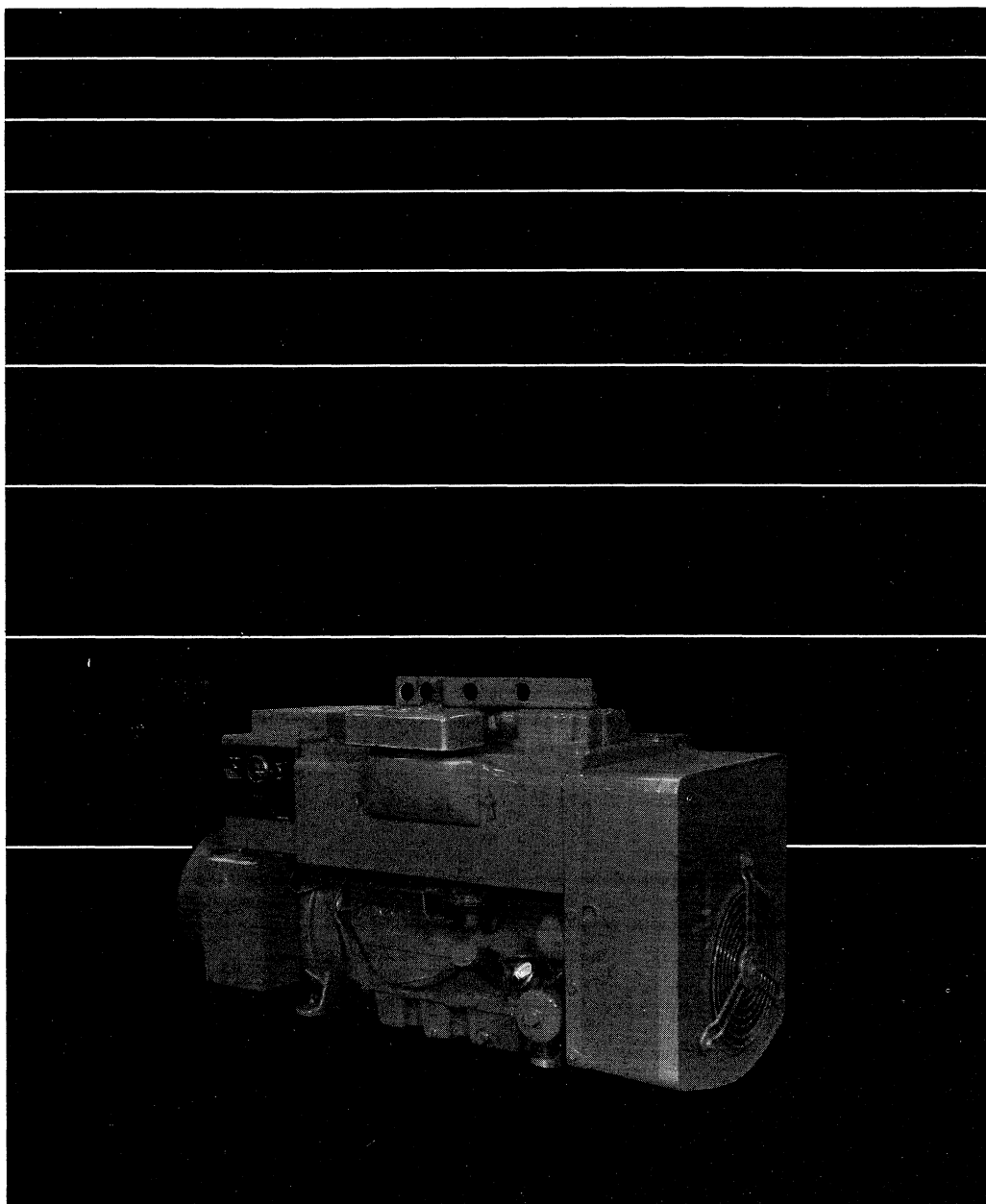




Table of Contents

SECTION	TITLE	PAGE
	SAFETY PRECAUTIONS	iii, iv
1	INTRODUCTION	1-1
	About This Manual	1-1
	Safety Considerations	1-1
	How To Obtain Service	1-1
2	SPECIFICATIONS	2-1
3	INSTALLATION	3-1
	General	3-1
	Location	3-1
	Mounting	3-3
	Ventilation	3-4
	Exhaust	3-5
	Oil Drain	3-6
	Fuel System	3-6
4	ELECTRICAL PREPARATION	4-1
	General	4-1
	Transfer Switch	4-2
	Generator Voltage Connections	4-3
	Load Connection	4-5
	DC Wiring	4-6
	Battery Connections	4-7
5	CONTROL DESCRIPTION	5-1
	General	5-1
	Standard Control Components/Options	5-1
	Deluxe Control Panel Components	5-2
	Optional AC Meter Panel Components (Housed Units Only)	5-3

 **WARNING:** 
The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

SECTION	TITLE	PAGE
6	OPERATION	6-1
	General	6-1
	Prestart Checks	6-2
	Starting	6-2
	Combination Gas/Gasoline Sets	6-2
	Connecting the Load	6-2
	Running	6-3
	Stopping	6-3
	Break-In	6-4
	No-Load Operation	6-4
	Exercising Unit	6-4
	Engine Ratings	6-5
	High/Low Operating Temperatures	6-5
	Dust And Dirt	6-5
	High Altitude	6-5
7	ADJUSTMENTS	7-1
	Output Voltage Adjustment (Optional)	7-1
	Charge Rate Adjustment	7-2
	Centrifugal Switch	7-2
8	TROUBLESHOOTING	8-1
	Safety Considerations	8-1
9	MAINTENANCE	9-1
	General	9-1
	Generator Set Inspection	9-3
	Lubrication System	9-3
	Fuel Filter	9-6
	Air Cleaners	9-7
	Heavy Duty Air Cleaner	9-7
	Governor Linkage	9-8
	Batteries	9-9
	Starter Disconnect Breaker Points	9-10
	Ignition System	9-10
	Crankcase Breather (Series JB Only)	9-11
	Generator	9-12
	PCV Valve (Series JCA and JCB Only)	9-12
	Torsional Washers	9-13
	Out-of-Service Protection	9-14
	Returning a Unit to Service	9-14
10	MAINTENANCE RECORD	10-1

Safety Precautions

Before operating the generator set, read the Operator's Manual and become familiar with it and the equipment. Safe and efficient operation can be achieved only if the equipment is properly operated and maintained. Many accidents are caused by failure to follow fundamental rules and precautions.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator, service personnel, or the equipment.

⚠ DANGER *This symbol warns of immediate hazards which will result in severe personal injury or death.*

⚠ WARNING *This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.*

⚠ CAUTION *This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.*

FUEL AND FUMES ARE FLAMMABLE

Fire, explosion, and personal injury or death can result from improper practices.

- DO NOT fill fuel tanks while engine is running, unless tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT permit any flame, cigarette, pilot light, spark, arcing equipment, or other ignition source near the generator set or fuel tank.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible line. Do not use copper piping on flexible lines as copper will become brittle if continuously vibrated or repeatedly bent.

- Be sure all fuel supplies have a positive shutoff valve.
- Be sure battery area has been well-ventilated prior to servicing near it. Lead-acid batteries emit a highly explosive hydrogen gas that can be ignited by arcing, sparking, smoking, etc..

EXHAUST GASES ARE DEADLY

- Provide an adequate exhaust system to properly expel discharged gases away from enclosed or sheltered areas and areas where individuals are likely to congregate. Visually and audibly inspect the exhaust daily for leaks per the maintenance schedule. Ensure that exhaust manifolds are secured and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Keep your hands, clothing, and jewelry away from moving parts.
- Before starting work on the generator set, disconnect battery charger from its AC source, then disconnect starting batteries, negative (-) cable first. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- Do not wear loose clothing or jewelry in the vicinity of moving parts, or while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surface to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages can cause injury or death. DO NOT tamper with interlocks.
- Follow all applicable state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- DO NOT CONNECT GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM. Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved isolation switch or an approved paralleling device.

GENERAL SAFETY PRECAUTIONS

- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator or heat exchanger pressure cap while the engine is running. Allow the generator set to cool and bleed the system pressure first.

- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Provide appropriate fire extinguishers and install them in convenient locations. Consult the local fire department for the correct type of extinguisher to use. Do not use foam on electrical fires. Use extinguishers rated ABC by NFPA.
- Make sure that rags are not left on or near the engine.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage which present a potential fire hazard.
- Keep the generator set and the surrounding area clean and free from obstructions. Remove any debris from the set and keep the floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.
- Substances in exhaust gases have been identified by some state or federal agencies as causing cancer or reproductive toxicity. Take care not to breathe or ingest or come into contact with exhaust gases.

KEEP THIS MANUAL NEAR THE GENSET FOR EASY REFERENCE

1. Introduction

ABOUT THIS MANUAL

This manual provides installation instructions, and information on operating, maintaining and adjusting the Onan® JB, JCA and JCB generator sets (gen-sets). Study this manual carefully and comply with each of its warnings and cautions. Using the generator set properly and performing regular maintenance can result in longer unit life, better performance, and safer operation.

SAFETY CONSIDERATIONS

The generator set has been carefully designed to provide safe and efficient service when properly installed and operated. However, the overall safety and reliability of the complete system is dependent on many factors outside the control of the generator set manufacturer. To avoid possible safety hazards, make all mechanical and electrical connections to the generator set exactly as specified in this manual. All systems external to the generator (fuel, exhaust, electrical, etc.) must comply with all applicable codes. Make certain all required inspections and tests have been completed and all code requirements have been satisfied before certifying the installation is complete and ready for service.

HOW TO OBTAIN SERVICE

When the generator set requires servicing, contact your nearest Cummins®/Onan® dealer or distributor. Factory-trained Parts and Service representatives are ready to handle all your service needs.

If you are unable to locate a dealer or distributor, consult the Yellow Pages. Typically, our distributors are listed under:

GENERATORS-ELECTRIC or
ELECTRICAL PRODUCTS

For the name of your local Cummins/Onan or Onan-only distributor in the United States or Canada, call 1-800-888-ONAN (this automated service utilizes touch-tone phones only). By entering your area code and the first three digits of your local telephone number, you will receive the name and telephone number of the distributor nearest you.

For outside North America, call Onan Corporation, 1-612-574-5000, 7:30 AM to 4:00 PM, Central Standard Time, Monday through Friday. Or, send a fax to Onan using the fax number 1-612-574-8087.

When contacting your distributor, always supply the complete Model Number and Serial Number as shown on the generator set nameplate.

WARNING

INCORRECT SERVICE OR PARTS REPLACEMENT CAN RESULT IN SEVERE PERSONAL INJURY, DEATH, AND/OR EQUIPMENT DAMAGE. SERVICE PERSONNEL MUST BE QUALIFIED TO PERFORM ELECTRICAL AND/OR MECHANICAL SERVICE.

2. Specifications

TABLE 2-1. STANDARD SERIES SPECIFICATION

MODELS	6.0 JB	7.5 JB	12.5 JCA	12.5 JCB	15.0 JCB
GENERATOR DETAILS					
AC Output					
Frequency (Hertz)	50	60	60	50	60
Rating (AC output)	6.0kW	7.5kW	12.5kW	12.5kW	15.0
ENGINE					
Engine Speed	1500 RPM	1800 RPM	1800 RPM	1500 RPM	1800 RPM
*Oil Capacity - qts (l)	3.5 (3.3)	3.5 (3.3)	6.5 (6)	6.5 (6)	6.5 (6)
Full Load Fuel Consumption					
Gasoline - gph (l/h)	1.04 (3.94)	1.24 (4.7)	2.1 (7.95)	2.2 (8)	2.4 (9.08)
Natural gas - cfh (m ³ /h)	110 (3.1)	134 (3.8)	230 (6.5)	220 (6.2)	255 (7.2)
Propane - cfh (m ³ /h)	53 (1.5)	68 (1.92)	92 (2.6)	90 (2.5)	110 (3.1)
ELECTRICAL SYSTEM					
Starting Voltage	12 Volts DC	12 Volts DC	12 Volts DC	12 Volts DC	12 Volts DC
Battery Charge Rate	2-5 Amps	2-5 Amps	2-5 Amps	2-5 Amps	2-5 Amps
Battery Requirements	74 Amp/Hr	74 Amp/Hr	74 Amp/Hr	74 Amp/Hr	74 Amp/Hr
REQUIREMENTS					
Fuel Pump Inlet Thrd Size	7/16-24 NPTF	7/16-24 NPTF	7/16-24 NPTF	7/16-24 NPTF	7/16-24 NPTF
Fuel Pump Max. Lift - ft (m)	6 (1.83)	6 (1.83)	6 (1.83)	6 (1.83)	6 (1.83)
Exhaust Outlet (Pipe Tapped)	1.25 inch	1.25 inch	1.5 inch	1.5 inch	1.5 inch
Maximum Exhaust Back					
Pressure - inch (mm) WC	27 (686)	27 (686)	27 (686)	27 (686)	27 (686)
Maximum Ambient Air Temp.	120 F (49 C)	120 F (49 C)	120 F (49 C)	120 F (49 C)	120 F (49 C)
Ventilation Required					
Engine - cfm (m ³ /min)	467 (13.2)	560 (16)	890 (25.2)	742 (21)	890 (25.2)
Generator - cfm (m ³ /min)	133 (3.8)	160 (4.5)	160 (4.5)	133 (3.8)	160 (4.5)
Combustion - cfm (m ³ /min)	21 (0.6)	25 (0.71)	45 (1.3)	42 (1.2)	50 (1.4)

* - Includes 0.5 quart (0.473 litre) for the oil filter.

TABLE 2-1. STANDARD SERIES SPECIFICATION (Cont'd)

MODELS	6.0 JB	7.5 JB	12.5 JCA	12.5 JCB	15.0 JCB
DIMENSIONS					
Height - inch (mm)	26.62 (676)	26.62 (676))	26.56 (675))	26.56 (675)	26.56 (675)
Width - inch (mm)	17.88 (454)	17.88 (454)	19.5 (495)	19.5(495)	19.5 (495)
Length - inch (mm)	32.69 (830)	32.69(830)	47.5 (1206)	47.5 (1206)	47.5 (1206)
Weight - pounds (kg)	470 (213)	470 (213)	668 (303)	668 (303)	668 (303)
ADJUSTMENT SPECS					
Cylinder Head Bolt Torque ft-lb (n•m)	28-30 (38-41)	28-30 (38-41)	28-30 (38-41)	28-30 (38-41)	28-30 (38-41)
Spark Plug Gap - inch (mm)	0.025 (0.64)	0.025 (0.64)	0.035 (0.89)	0.035 (0.89)	0.035 (0.89)
Ignition Breaker Point Gap inch (mm)	0.019-0.021 (0.48-0.53)	0.019-0.021 (0.48-0.53)	— —	— —	— —
Distributor Point Gap inch (mm)	— —	— —	0.018-0.022 (0.46-0.58)	0.018-0.022 (0.46-0.58)	0.018-0.022 (0.46-0.58)
Dwell Angle	—	—	48-54	48-54	48-54
Distributor Rotation	—	—	Clockwise	Clockwise	Clockwise
Firing Order	—	—	1-2-4-3	1-2-4-3	1-2-4-3
Ignition Timing (Degrass BTC, at 1800 RPM)					
Gasoline	25	25	25	25	25
Gas & Gas/Gasoline	35	35	35	35	35
Valve Clearances (Cold, crank at 10-45° ATC on power stroke)					
Gasoline					
Intake - inch (mm)	.0012 (0.30)	.0012 (0.30)	0.012 (0.30)	0.012 (0.30)	0.012 (0.30)
Exhaust - inch (mm)	0.015 (0.51)	0.015 (0.51)	0.015 (0.51)	0.015 (0.51)	0.015 (0.51)
Gas & Gas/Gasoline					
Intake - inch (mm)	.0013 (0.33)	0.013 (0.33)	0.013 (0.33)	0.013 (0.33)	0.013 (0.33)
Exhaust - inch (mm)	0.020 (0.51)	0.020 (0.51)	0.020 (0.51)	0.020 (0.51)	0.020 (0.51)
Starter Disconnect Breaker Point Gap - inch (mm)	.020 (.51)	.020 (.51)	.020 (.51)	.020 (.51)	.020 (.51)

3. Installation

GENERAL

Most generator set installations must be designed so that the generator set will function properly under all anticipated operating conditions. Figure 3-1 illustrates a typical installation. Use these instructions as a general guide only. Follow the instructions of the consulting engineer when locating or installing any components.

Generator set installations must conform to local building codes, fire ordinances, and other local, state and federal regulation. For more detailed installation instructions, consult Onan Application Manual T-029, or contact an authorized Onan service representative.

Requirements to be considered prior to installation:

- Level mounting surface
- Adequate cooling air
- Adequate fresh induction air

- Discharge of circulated air
- Discharge of exhaust gases
- Electrical connections
- Fuel connections
- Accessibility for operation and servicing
- Noise levels
- Vibration isolation
- Electrical connections

LOCATION

Provide a location for the genset that is dry, clean, dust-free, well-ventilated, and protected from the weather.

The side of the generator set, where generator air is discharged, requires a minimum clearance of 3 inches (76 mm) from the wall, so the set can rock on its mounts. There should be at least 24 inches (610 mm) clearance around all other sides for service access.

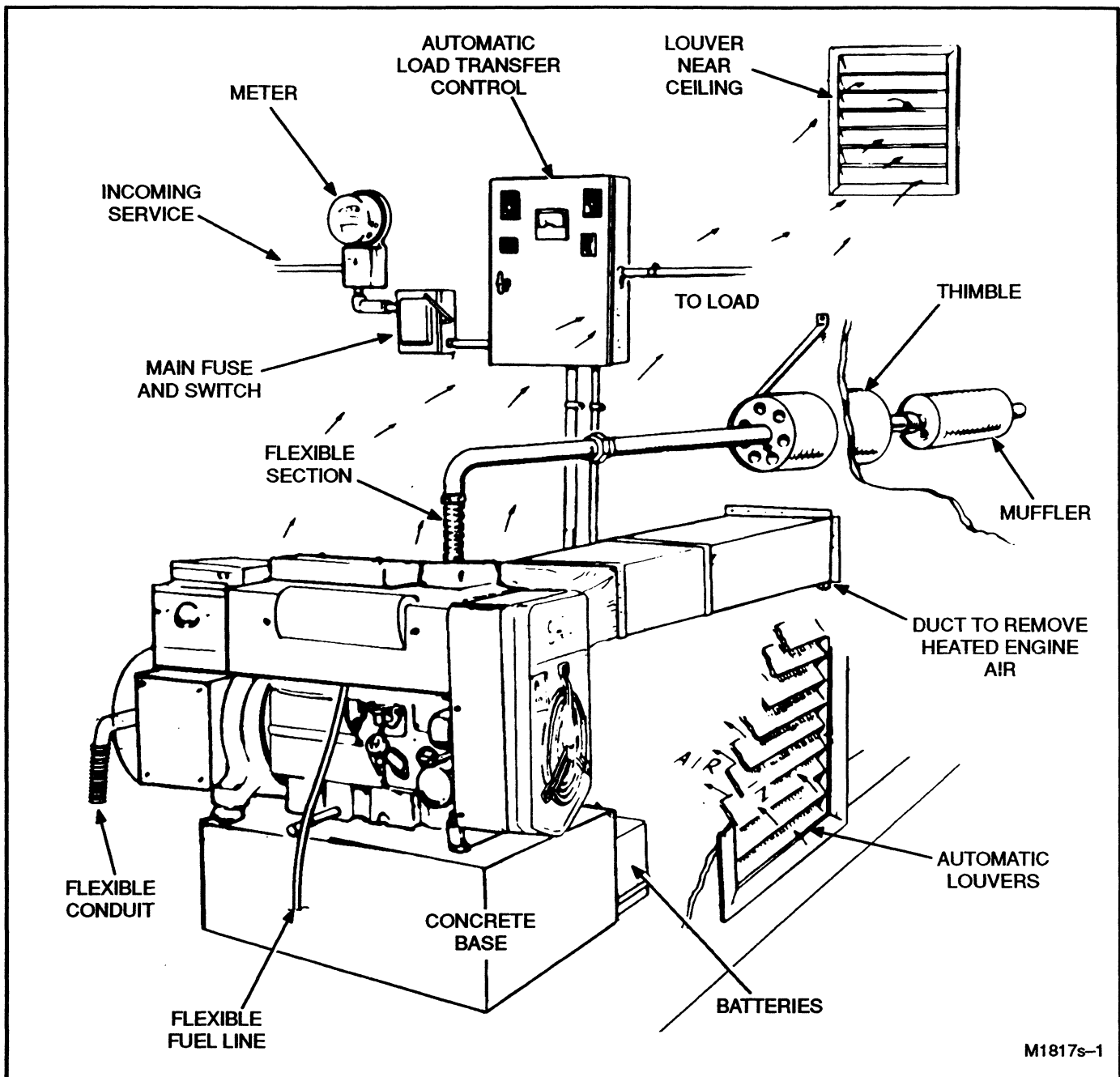


FIGURE 3-1. TYPICAL INSTALLATION

MOUNTING

A permanent genset installation must have a sturdy, level mounting base of concrete, heavy wood or structural steel.

Plan for access to the genset for servicing and provide adequate lighting around the unit. For convenience in general servicing such as changing the crankcase oil, the surface of the mounting base should be at least 12 inches (304.8 mm) above the floor.

On all installations of non-housed generator sets, assemble the mounting cushions, washers and spacer bushing carefully (Figure 3-2). The spacer bushing prevents compression of the snubber (upper rubber cushion). Four mounting cushions are provided. Series JB sets have number 4 and 5 cushions, and Series JCA/B sets have number 5 and 6 cushions. Cushions with the higher number are stiffer and should be placed under the generator, which is the heavier end.. The installation drawing packaged with the set indicates the correct spacing of the mounting bolts. The bolts should protrude out of the base at least 3-5/8 inches (92 mm).

⚠ CAUTION *The oil filter can be punctured easily by the end of the mounting bolt. For this reason, provide at least 1/2-inch (12.7 mm) clearance between the oil filter and the end of the mounting bolt, to avoid puncturing the filter.*

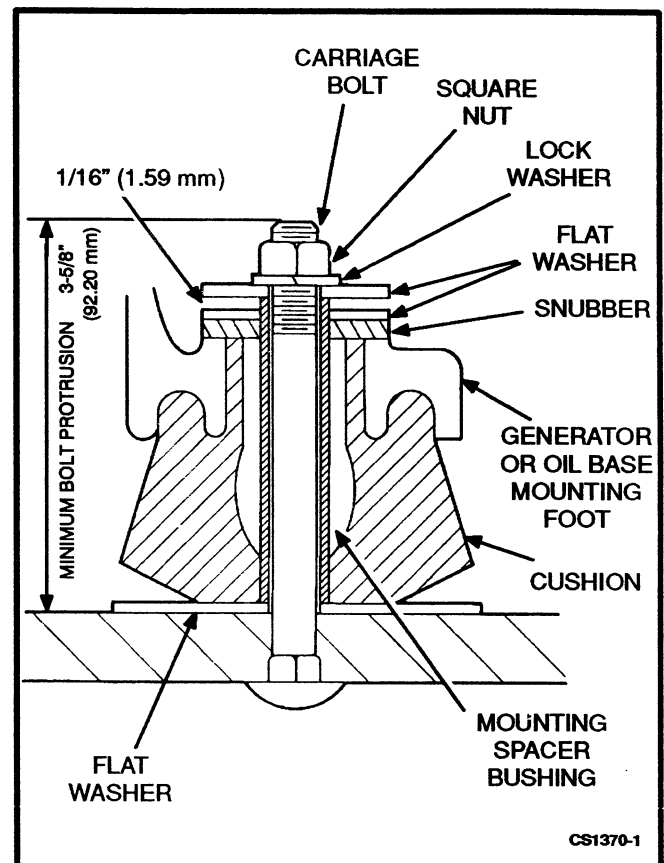


FIGURE 3-2. MOUNTING CUSHION INSTALLATION

VENTILATION

Air circulation is needed to dissipate heat produced by the engine and generator in normal operation. Outdoor installations can rely on natural circulation, but mobile, indoor or housed installations need proper size and positioned vents for required air flow. See *Specifications* section for air requirements.

Vent sizes depend on variable conditions:

- Size of enclosure
- Ambient temperature
- Electrical load
- Running time
- Restrictions imposed by screens, louvers, or filters
- Prevailing wind direction

The required volume of air must reach the unit, absorb the heat, and be discharged away from the installation.

Air Intake Requirements

Vacu-Flo® Cooling: The Vacu-Flo cooling inlet vent must be at least 1-1/3 square feet (1236 cm²) in area: the duct for discharged air should be at least as large as the scroll outlet. See *Specifications* section for air flow requirements.

JB Pressure Cooling: The pressure-cooled JB needs an inlet vent with an unrestricted opening of at least 3-1/2 square feet (3252 cm²). See *Specifications* section for air flow requirements for this set.

JCA/B - Pressure Cooling: The pressure-cooled JCA/B needs an inlet vent with an unrestricted opening of at least 5 square feet (4645 cm²). See *Specifications* section for air flow requirements for this set.

Air Discharge Requirements

JB and JCA/B Gensets: Install separate ducts for air discharge from the engine and generator (see exception) as follows:

1. The engine discharge duct must be the same size (or larger) as the engine outlet:
 - JB - 8 x 10 inches (203 x 254 mm).
 - JCA/B - 8 x 20 inches (203 x 508 mm).

If a screen is used in the duct, increase the duct size in proportion to the restriction. Consider installing the screen diagonally to limit the restriction. Increase the duct size at least 50 percent for runs over 8 feet (2.44 m) or if there are more than two 90 degree bends. If bends are necessary, use large radius elbows. Use a canvas section at the set to absorb vibration and noise.

2. Generator outlet ducts must be used when units are installed in compartments too small for the operator to walk. Ducts are recommended for all other indoor installations. The air outlet is 5-5/8 x 3 inches (140 x 76 mm). Follow the same principles of duct design and installation as used for the engine duct. Engine and generator require separate ducts.

Auxiliary fans can be used to increase airflow to units installed in small, poorly ventilated rooms. The fan size and location should be such that the air inlet to the engine doesn't exceed 120° F (49° C) when running at full rated load.

Onan engine mounted thermostatically controlled shutters can be used to aid warm-up after starting and keep cold air out during shutdown. When the discharged air reaches 120° F (49° C), shutters begin to open; at 140° F (62° C), the shutters completely open.

⚠ CAUTION *Generator set overheating can result in engine damage. To avoid this, never operate the generator set with any of the cooling system components removed.*

EXHAUST

Pipe exhaust gases outside the enclosure. Locate the exhaust outlet far from the air inlet to avoid gases re-entering the enclosure. Use flexible seamless tubing to connect between the engine exhaust and any rigid pipe extension to prevent transmission of vibration.

⚠ WARNING *Inhalation of exhaust gases can result in severe personal injury or death. Modifying the exhaust system can allow poisonous exhaust gases to escape. Use only original equipment replacement parts when servicing the exhaust system. Unauthorized modifications will also void the warranty and cancel the UL Listing/CSA Certification. Liability for injury or damages due to unauthorized modifications becomes the responsibility of the person making the change.*

Because an exhaust system is subjected to detrimental conditions such as extreme heat, infrequent operation, and light operating load, inspect the exhaust system frequently to be sure that it remains fume-tight.

⚠ WARNING *Inhalation of exhaust gas presents the hazard of severe personal injury or death. Exhaust gas can easily leak from a faulty manifold. Do not use exhaust manifold heat to warm a room or compartment.*

An approved thimble must be used (Figure 3-3) to pass exhaust pipes through walls or partitions. Build this thimble according to code (see National Fire Protection Association bulletin, Volume 4, section 211 on "Standards for Chimneys, Fireplaces, and Vents").

As the exhaust pipe length and number of bends increases, a larger pipe is required to reduce excessive exhaust restriction and back pressure. Excessive exhaust back pressure will reduce the air-fuel ratio, resulting in reduced output, smoke, wasted power, high exhaust temperatures and reduced engine life.

Total back pressure of all system components must not exceed maximum back pressure limits. Note that any exhaust restriction, even if less than maximum, will affect performance.

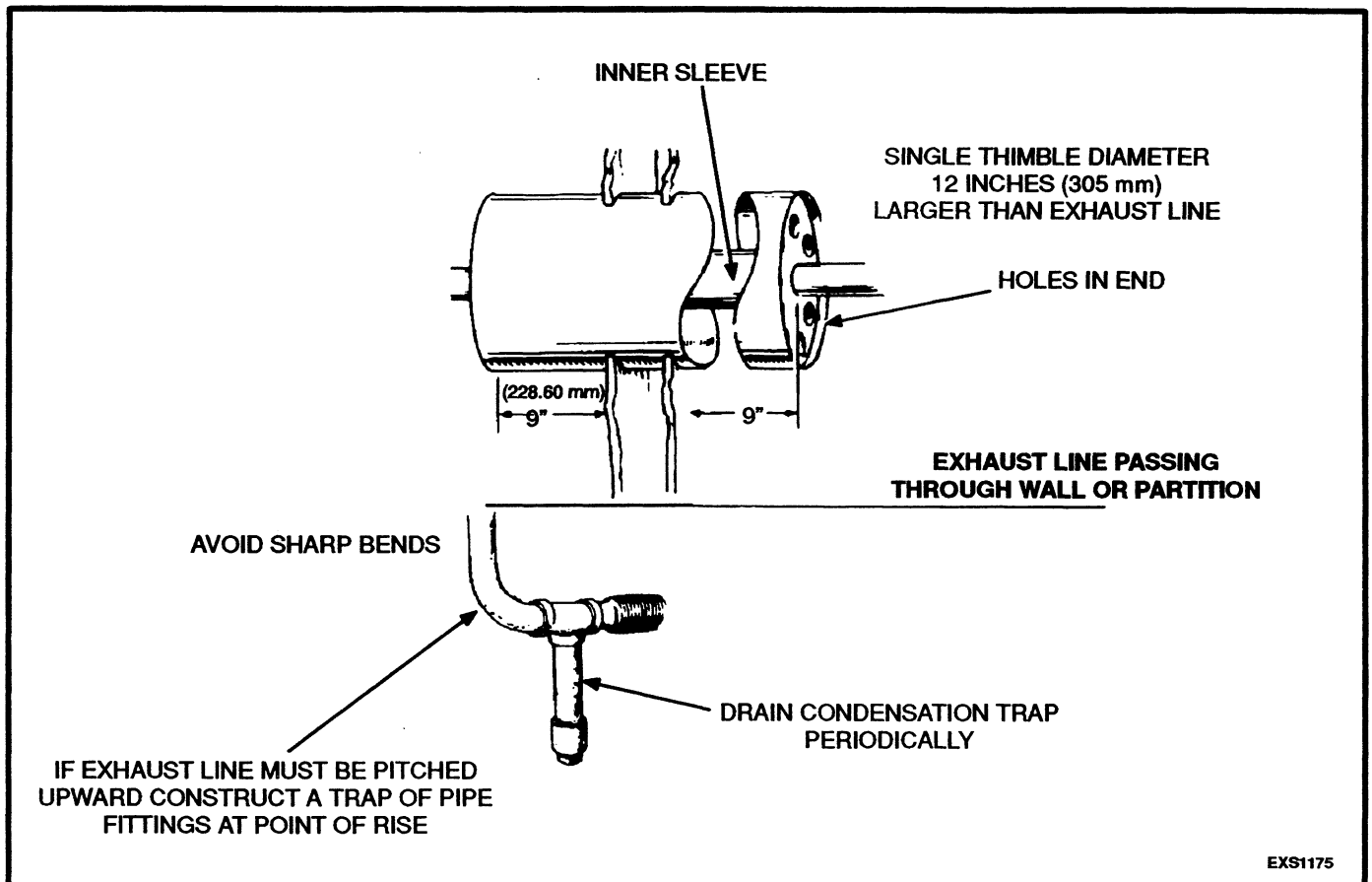


FIGURE 3-3. EXHAUST PIPING

OIL DRAIN

Extend the drain to suit the installation. The oil base has a 1/2-inch pipe size tapped hole.

⚠WARNING *Do not position the oil drain so that oil might drip onto the muffler, any exhaust components, or any other hot parts, causing a fire hazard. Fire presents the hazard of severe personal injury or death.*

FUEL SYSTEM

Sets can be equipped to operate on gasoline only, LPG (propane), gasoline/natural gas, gasoline/LPG and LPG/natural gas combinations.

The following items should be considered when installing a fuel supply system:

- Install an approved flexible fuel line at the fuel inlet to allow the set to rock on its mounts. Do not use copper tubing as a flexible fuel line - it will crack and spill gasoline.
- The highest fuel level in the fuel tank must be lower than the inlet of the fuel pump to prevent spillage of fuel if a leak occurs (because of a faulty connection, ruptured pump diaphragm, etc.).
- The bottom of the fuel tank suction line should not be more than 6 feet (1.83 m) below the inlet of the fuel pump.
- Provide a separate fuel line for each set served by the same fuel tank to prevent either set from being starved for fuel.
- Install a manual fuel shut-off valve at the outlet of an above-ground fuel tank to facilitate service.
- Install a manual or electric fuel shut-off valve on vehicle mounted sets.

⚠WARNING *A vehicle mounted set could be flooded with gasoline, leading to fire, if the vehicle evaporative emission control vent plugs up causing the fuel tank to become pressurized. A manual or electric shut-off valve must be installed to prevent flooding of the set when not in use.*

- For a combination gas/gasoline set, provide a manual shut-off valve in each fuel line. Plug an unused fuel inlet. The air/fuel ratio will be upset if both fuels are available at the same time or if air enters an unused fuel inlet, resulting in poor performance.
- Do not use galvanized piping, fittings or tanks. The zinc coating reacts with elements in the fuel, resulting in contamination of the fuel.

Gasoline Fuel

⚠WARNING *Fuel presents the hazard of fire or explosion which can result in severe personal injury or death. Do not smoke or allow any flame, spark, pilot light, arc-producing equipment, or switch, or other ignition sources around fuel or fuel components, or in the installation area or areas with shared ventilation. Keep a type ABC fire extinguisher nearby.*

Standard JB, JCA and JCB genset engines use a gasoline-carbureted fuel system to deliver a mixture of fuel and air to the combustion chamber. The system draws fuel from a tank, delivers it through a filter and fuel pump, to the carburetor float chamber. Air passing through the carburetor venturi draws fuel from the the float chamber.

See *Specifications* section for gasoline inlet size. Fuel lift should not exceed 6 feet (2 m). Horizontal distance between the set and fuel tank should not exceed 50 feet (15 m). Use 3/8 inch tubing up to 25 feet (7.6 m), 1/2 inch tubing up to 50 feet (15 m).

Gaseous Fuel

A combination gasoline-gaseous fuel carburetor or straight gaseous fuel carburetors are available for use with gaseous fuels. A gaseous fuel system uses a fuel regulator (Figure 3-4) to control the flow of gas from the lines to the carburetor. At the carburetor, the gaseous fuel is mixed with the incoming air.

Gaseous-fuel supply system design, materials, components, fabrication, assembly, installation, testing, inspection, operation and maintenance must comply with the applicable codes. See MFPA Standards No. 37, No. 54 and No. 58.

Gas Pressure: Gas pressure must not exceed 14 inches (356 mm) water column (WC). Measure pressure as shown in Figure 3-4 while cranking the

engine (so that the fuel solenoid opens) with the fuel hose to the carburetor disconnected (so that the engine will not start). If necessary, install and adjust the primary regulator to reduce the supply pressure to 14 inches (356 mm) WC. (If there is a secondary pressure regulator in the line, adjust the secondary regulator instead.)

Recommended gas pressure with the set running under full load is 7 to 10.5 inches (178 mm to 254 mm) WC, as measured in Figure 3-4. Minimum acceptable pressure is 3.5 inches (89 mm) WC. Adjust the primary regulator as necessary, but not so that the maximum allowable pressure would be exceeded. If the minimum pressure cannot be maintained, either supply tank is too small to provide the rate of vaporization necessary or the supply line is too restrictive.

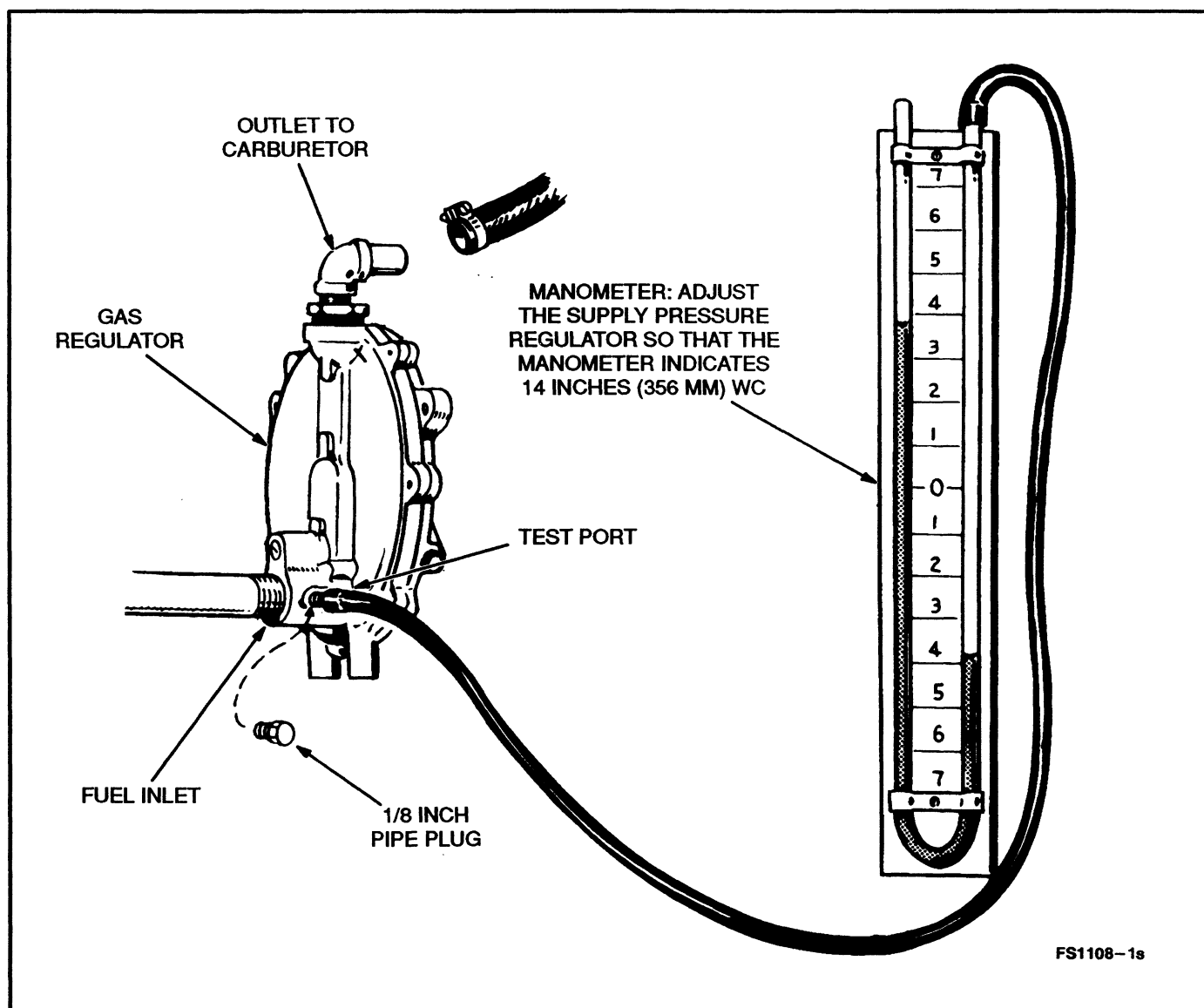


FIGURE 3-4. ADJUSTING THE SUPPLY PRESSURE

Natural Gas: The following should be considered when installing a natural gas fuel system:

- The layout and sizing of the gas supply piping must be adequate for supplying the volume of gas required at full load, while maintaining at least the minimum required supply pressure – typically **3.5 Inches (89 mm) WC**. Refer to Table 3-1 to determine required pipe size for natural gas systems. Final determination of pipe sizes must, however, be based upon the method approved by the authority having jurisdiction (see Appendix C, NFPA No. 54).
- Most installations will require a service gas pressure regulator. The gas supply pressure to the genset regulator cannot exceed **14 Inches (356 mm) WC**. Depending on distribution gas pressure, more than one stage of pressure regulation may be required. **High pressure (25 psi) gas piping is not permitted inside buildings.** Gas pressure regulators must be vented to the out-of-doors according to code.
- Approved flexible fuel hose must be used for connections at the engine to take up generator set movement and vibration.
- Most codes require both manual and electric (battery-powered) shutoff valves ahead of the flexible fuel hose(s). The manual valve should be of the indicating type.
- A dry fuel filter should be installed in each line to protect the sensitive pressure regulating components and orifices downstream from harmful foreign substances carried along in the gas stream (rust, scale, etc.).

⚠WARNING *Natural Gas is highly flammable and explosive. Accidental ignition can lead to severe personal injury or death. Therefore, do not smoke near equipment or when you smell gas. Keep all ignition sources well away—flames, sparks, pilot lights, arc-producing equipment, or switch, etc.*

The installation, testing and inspection of the gas supply system must be performed by qualified persons in accordance with the applicable codes.

Upon completing the installation, open supply valves and test every joint and fitting in the natural gas supply system using an approved method, such as soap bubbles.

⚠WARNING *Testing for gas leaks with a flame can cause a fire or explosion that could lead to severe personal injury or death. Use approved methods only.*

LPG (Liquified Petroleum Gas): The same kinds of requirements apply for LPG as for natural gas. The following items should also be considered when installing an LPG fuel supply system:

- The method of pipe sizing is the same for LPG as for natural gas. Refer to Table 3-2 to determine required pipe size for LPG gas systems.
- An LPG fuel supply system must be dedicated for the emergency power system if it is the required alternate fuel.
- Ambient temperature affects the rate of vaporization in an LPG supply tank. In colder climates, a way to compensate for the reduced rate of vaporization is to install a larger supply tank. Table 3-3 and 3-4 can be used as a quick reference for sizing the propane tank to account for expected low ambient temperatures.

⚠WARNING *Propane is highly flammable and explosive. Accidental ignition can lead to severe personal injury or death. Therefore, do not smoke near gas tanks or equipment or when you smell gas. Keep all ignition sources well away—flames, sparks, pilot lights, arc-producing equipment, or switch, etc.*

The installation, testing and inspection of the gas supply system must be performed by qualified persons in accordance with the applicable codes.

Upon completing the installation, fill the propane tank and test every joint and fitting in the propane supply system using an approved method, such as soap bubbles.

⚠WARNING *Testing for gas leaks with a flame can cause a fire or explosion that could lead to severe personal injury or death. Use approved methods only.*

TABLE 3-1. NATURAL GAS FUEL LINE SIZE - vs - FUEL LINE LENGTH
(Required to Maintain 0.5 Inch H₂O Pressure Drop
for an 11 Inch H₂O Supply Line)

UNIT	kW	CFH* (m ³ /hr)	15 FT (4.6 m)	25FT (7.6m)	50 FT (15 m)	75 FT (23 m)	100 FT (30 m)	150 FT (46 m)	200 FT (61 m)	300 FT (91 m)
JB	7.5	126 (3.57)	3/4	3/4	3/4	1-1/4	1-1/4	1-1/4	1-1/4	1-1/2
JCA / B	12.5	230 (6.5)	1	1-1/4	1-1/4	1-1/4	1-1/2	1-1/2	1-1/2	2
JCB	15.0	255 (7.22)	1	1-1/4	1-1/4	1-1/4	1-1/2	1-1/2	1-1/2	2

* - Full load fuel consumption.

TABLE 3-2. LPG VAPOR FUEL LINE SIZE - vs - FUEL LINE LENGTH
(Required to Maintain 0.5 Inch H₂O Pressure Drop
for an 11 Inch H₂O Supply Line)

UNIT	kW	CFH* (m ³ /hr)	15 FT (4.6 m)	25FT (7.6m)	50 FT (15 m)	75 FT (23 m)	100 FT (30 m)	150 FT (46 m)	200 FT (61 m)	300 FT (91 m)
JB	7.5	63 (1.78)	3/4	3/4	3/4	1	1	1	1-1/4	1-1/4
JCA / B	12.5	92 (2.6)	3/4	3/4	3/4	3/4	1	1	1-1/4	1-1/4
JCB	15.0	110 (3.11)	3/4	1	1	1	1-1/4	1-1/4	1-1/2	2

* - Full load fuel consumption.

TABLE 3-3. 20-GALLON (76-LITRE) PROPANE CYLINDERS REQUIRED FOR
INDICATED TEMPERATURES WHEN KEPT AT LEAST 1/2 FULL

WITHDRAWAL RATE	LOWEST AVERAGE WINTER TEMPERATURE						
	32° F (0° C)	20° F (-7.2° C)	10° F (-12° C)	0° F (-18° C)	-10° F (-23° C)	-20° F (-29° C)	-30° F (-34° C)
10 cfh-25,000 BTU/hr (0.28 m ³ /hr-26.4 MJ/hr)	1	1	1	1	1	1	2
25 cfh-62,500 BTU/hr (0.71 m ³ /hr-65.9 MJ/hr)	1	1	1	2	2	3	4
50 cfh-125,000 BTU/hr (1.4 m ³ /hr-131.9 MJ/hr)	2	2	3	3	4	5	9
100 cfh-250,000 BTU/hr (2.8 m ³ /hr-263.8 MJ/hr)	4	4	5	6	7	10	20

TABLE 3-4. REQUIRED PROPANE TANK SIZE IN GALLONS (LITRES) FOR
INDICATED TEMPERATURES WHEN KEPT AT LEAST 1/2 FULL

WITHDRAWAL RATE	LOWEST AVERAGE WINTER TEMPERATURE						
	32° F (0° C)	20° F (-7.2° C)	10° F (-12° C)	0° F (-18° C)	-10° F (-23° C)	-20° F (-29° C)	-30° F (-34° C)
50 cfh-125,000 BTU/hr (1.4 m ³ /hr-131.9 MJ/hr)	115 (435)	115 (435)	115 (435)	250 (945)	250 (945)	400 (1515)	600 (2270)
100 cfh-250,000 BTU/hr (2.8 m ³ /hr-263.8 MJ/hr)	250 (945)	250 (945)	250 (945)	400 (1515)	500 (1890)	1000 (3785)	1500 (5675)
150 cfh-375,000 BTU/hr (4.2 m ³ /hr-395.6 MJ/hr)	300 (1135)	400 (1515)	500 (1890)	500 (1890)	1000 (3785)	1500 (5675)	2500 (9460)
200 cfh-500,000 BTU/hr (5.7 m ³ /hr-527.5 MJ/hr)	400 (1135)	500 (1890)	750 (2840)	1000 (3785)	1200 (4540)	2000 (7570)	3500 (13250)
300 cfh-750,000 BTU/hr (8.5 m ³ /hr-791.2 MJ/hr)	750 (2840)	1000 (3785)	1500 (5675)	2000 (7570)	2500 (9460)	4000 (15140)	5000 (18925)

4. Electrical Preparation

GENERAL

The genset electrical system includes connecting the load, installing the control wiring and connecting the batteries. Connect the batteries last to avoid accidental starting of the unit during installation.

⚠ CAUTION *Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.*

⚠ WARNING *Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [-] first).*

Arcing can ignite the explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur if the negative (-) battery cable is connected and a tool being used to connect or disconnect the positive (+) battery cable accidentally touches the frame or other grounded metal part of the set. To prevent arcing, always remove the negative (-) cable first, and reconnect it last.

The following paragraphs contain the procedures that are used to connect the electrical system of the genset.

⚠ WARNING *Each of the operations described in this section should be done only by persons trained and experienced in electrical maintenance. Improper procedures may result in property damage, bodily injury or death.*

Connecting the genset electrical system involves:

- Installation of transfer switch (standby service only)
- Generator voltage connections
- Load connection
- Control wiring
- Battery connection

Local regulations often require that wiring connections be made by a licensed electrician, and that the installation be inspected and approved before operation. All connections, wire sizes, materials used, etc. must conform to the requirements of electrical codes in effect at the installation site.

⚠ WARNING *Improper wiring can cause a fire or electrocution, resulting in severe personal injury or death and/or property and equipment damage.*

Before starting the genset, verify that all electrical connections are secure, and that all wiring is complete. Replace and secure any access panels that have been removed during installation. Check that the load cables from the genset are properly connected.

⚠ WARNING *Backfeed to utility system can cause electrocution or property damage. Do not connect to any building electrical system except through an approved device and after building main switch is opened.*

TRANSFER SWITCH

If the installation is for standby service, a transfer switch must be used for switching the load from the normal power source to the genset (see Figure 4-1). Either a manual or automatic transfer switch may be used. Follow the installation instructions provided with the transfer switch when connecting the load and control wiring.

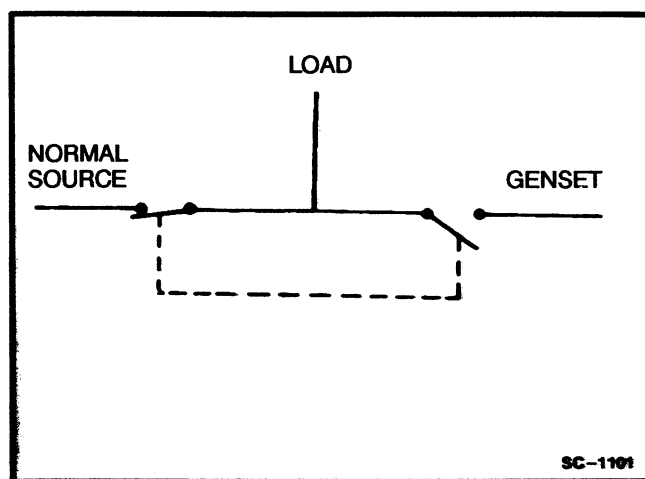


FIGURE 4-1. TYPICAL LOAD TRANSFER FUNCTION

GENERATOR VOLTAGE CONNECTIONS

⚠ CAUTION *Reconnecting factory connected generator sets to lower voltages may reduce set ratings, and also render line circuit breakers too small. Consult with your distributor before performing reconnection for different voltage.*

The generator output voltages and maximum current rating are specified on the generator nameplate. Line-to-neutral voltage is always the lower voltage shown on the nameplate. Line-to-line voltage is the higher rating.

The factory ships special-order sets with control panels especially wired for the voltage specified by the customer. Standard sets without instruments are shipped with the T1-T4 or T1-T12 output leads separated in the output box. These single-phase and broad-range generators may be connected to provide any of the output voltages shown in the Reconnection Diagram (see Figure 4-3). **The installer must always check the stator lead connections and perform any necessary reconnections to obtain the desired voltage.**

Refer to the Reconnection Diagram (see Figure 4-3) when reviewing the voltage connection information,

and use the electrical schematic supplied with your genset when actually performing load connections.

⚠ DANGER HAZARDOUS VOLTAGE *Touching uninsulated live parts inside the AC control box can result in severe personal injury or death. Measurements and adjustments must be done with care to avoid touching uninsulated live parts.*

For your protection, stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry and use tools with insulated handles.

The AC control box (mounted above the control panel assembly) contains the automatic voltage regulator (AVR) printed circuit board. The AVR controls the output of the generator so that a constant voltage is maintained under varying load conditions. There are two types of AVR's available; one requiring jumper adjustments when connecting or changing load connections. If the genset contains the AVR shown in Figure 4-2, be sure to connect jumper W10 between terminal V4 (common) and V1, V2, or V3 as listed on the reconnection diagram.

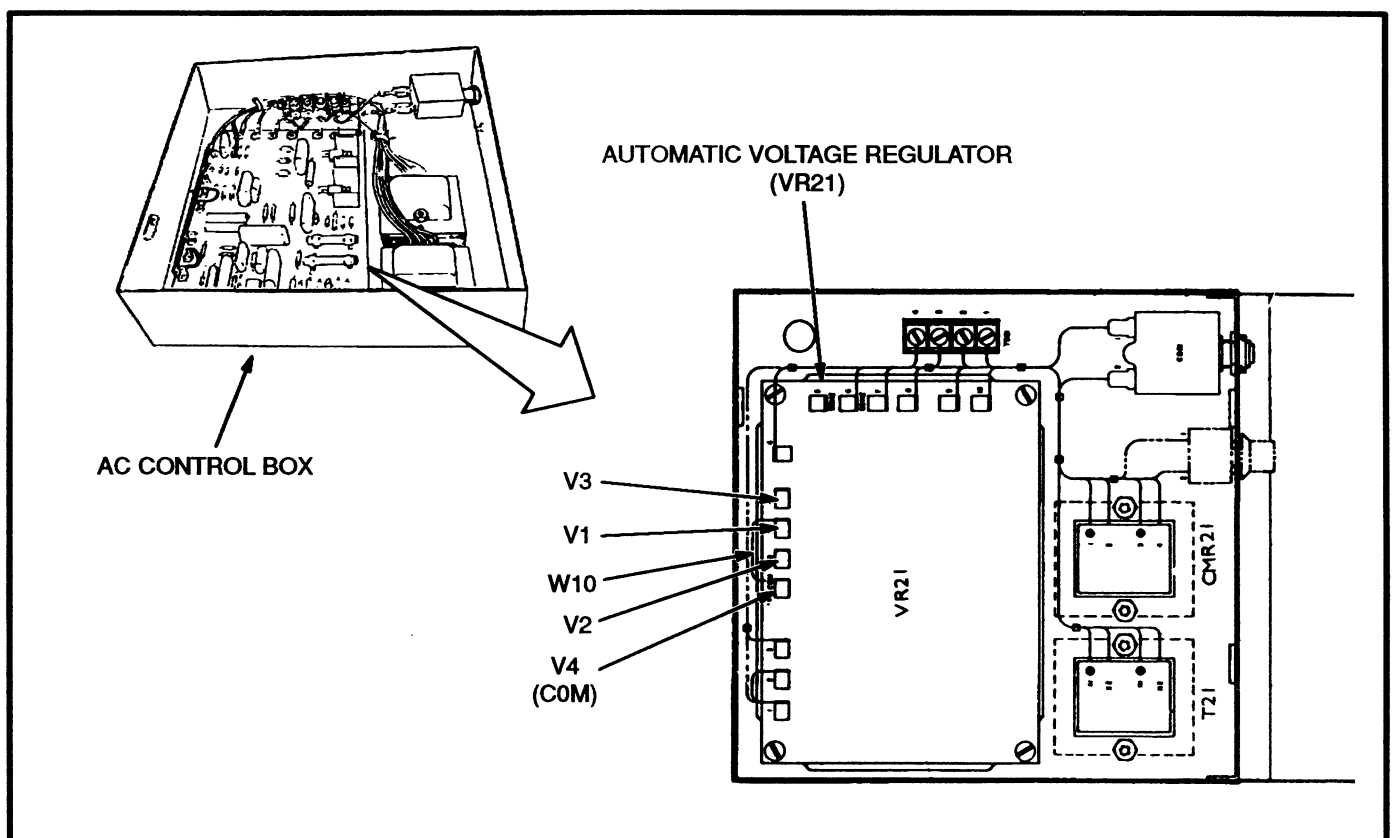


FIGURE 4-2. AVR SELECTION JUMPERS (P/N 300-1540)

NAMEPLATE VOLTAGE CODE	VOLTAGE	PHASE	FREQUENCY	CONNECT W/O JUMPER WIRE FROM V1 TO:	GENERATOR CONNECTION	GENERATOR CONNECTION SCHEMATIC DIAGRAM	GENERATOR CONNECTION WIRING DIAGRAM
3C	120/240	1	60	V1		A	
53C	120/240	1	50	V1		B	
	115/230	1	50	V2		C	
	110/220	1	50	V3			
18	120/208	3	60	V1	PARALLEL WYE		
	127/220	3	60	V2			
	139/240	3	60	V4			
518	110/190	3	50	V1			
	115/200	3	50	V2			
	120/208	3	50	V3			
	127/220	3	50	V4			
18	240/416	3	60	V1	SERIES WYE		
	254/440	3	60	V2			
	277/480	3	60	V4			
518	220/380	3	50	V1			
	230/400	3	50	V2			
	240/416	3	50	V3			
	254/440	3	50	V4			
18	120/240	3	60	V1	SERIES DELTA		
518	110/220	3	50	V1			
	115/230	3	50	V2			
	120/240	3	50	V3			
18	120/240	1	60	V1	DOUBLE DELTA		
518	110/220	1	50	V1			
	115/230	1	50	V2			
	120/240	1	50	V3			
18	120	1	60	V1	PARALLEL DELTA		
518	110	1	50	V1			
	115	1	50	V2			
	120	1	50	V3			
9X	347/600	3	60	V1	WYE		

B200

FIGURE 4-3. GENERATOR VOLTAGE CONNECTIONS

LOAD CONNECTION

The output box (junction box) has knockout sections to accommodate load wires. Use flexible conduit and stranded load wires near the set to isolate vibration and permit movement. Use suitable size insulated wires for the load rating applied.

Connect each load wire to the proper generator output lead inside the output box. Insulate bare ends of ungrounded wires. Use bolt provided on the output box to connect the generator ground lead or earth wire. Install a fused main switch (or circuit breaker) between the generator and load. If a test-run indicates wrong rotation of 3 phase motors in the load circuit, switch the connections at any two of the generator terminals.

⚠ WARNING *Backfeed to utility system can cause electrocution or property damage. Do not connect to any building electrical system except through an approved device and after building main switch is opened.*

⚠ CAUTION *Phase rotation of the genset and utility must be the same. Equipment damage can occur. Check and reconnect as necessary.*

Check the rotation of 3-phase motors before loading and reconnect if necessary.

Balancing Loads

When connecting loads to the genset, balance the loads so that the current flow from each line terminal (L1, L2 and L3) is roughly the same. This is especially important if both single phase and three phase loads are connected. Any combination of single phase and three phase loading may be used as long as all line currents are roughly the same (within 10 percent of median value) and no line current exceeds the nameplate rating of the generator. Check the current flow from each load cable after connections are made, by observing the control panel ammeter if available.

Grounding

Grounding involves making a conducting connection between the metal parts of the generator set or one of its electrical circuits and the earth. The design and installation of a grounding system is affected by many factors such as the use of multiple transformers, ground fault protection requirements, and physical location of the generator. Follow the recommendations of the consulting engineer when installing the grounding system.

⚠ WARNING *Contact with electrical equipment can result in severe personal injury or death. Bonding and equipment grounding must be properly done. All metallic parts that could become energized under abnormal conditions must be properly grounded.*

DC WIRING

Remote Control Connections

Provisions are made inside the control box for adding optional remote starting and stopping. Connections are made on the terminal block (TB11) located inside the control box. Connect the remote switches across the remote terminals and ground (TB11-1) terminal (Figure 4-3).

If the distance between the generator set and remote stations is less than 1000 feet (305 m), use 18 gauge stranded copper wire. If the distance is 1000 to 2000 feet (305 to 610 m), use 16 gauge stranded

copper wire. Always run control circuit wiring in a separate conduit from the AC power cables to avoid inducing currents that could cause problems within the control.

Remote Monitor Connections

Provisions are made inside the control box for adding optional remote monitoring on gensets employing the deluxe control panel (three lamp panel). Connections are made on the terminal block (TB13) located inside the control box (Figure 4-3).

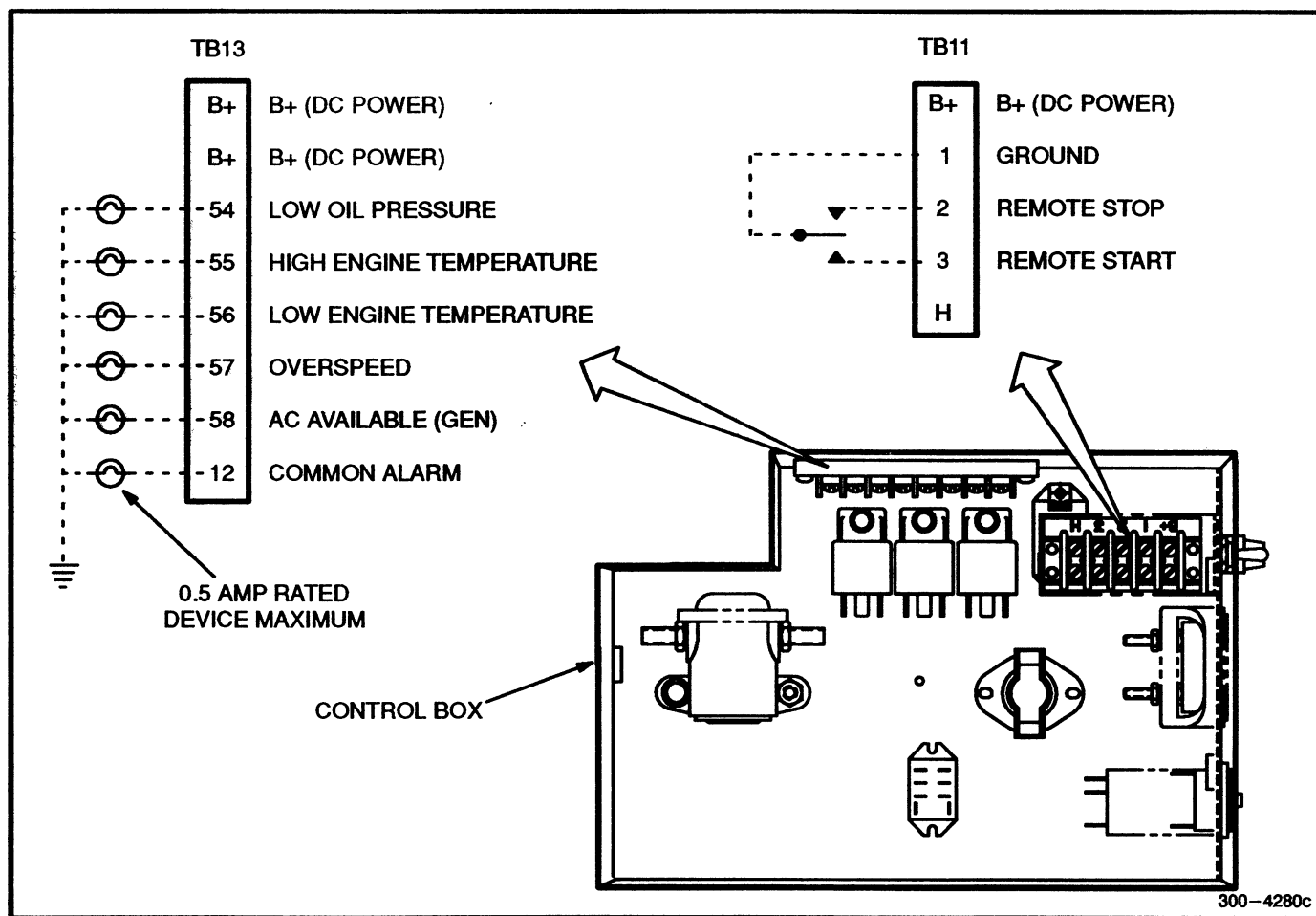


FIGURE 4-3. REMOTE CONTROL AND REMOTE MONITOR CONNECTIONS

BATTERY CONNECTIONS

Starting the unit requires 12 volt battery current. Use one, 12 volt battery for a normal installation (Figure 4-4). (Refer to Section 2, *Specifications* for battery type.)

Necessary battery cables and rack are on the unit. Service battery as necessary. Infrequent use (as in emergency standby service), may allow battery to self-discharge to the point where it cannot start the unit. If installing an automatic transfer switch that has no built-in charge circuit, connect a separate trickle charger. Onan automatic transfer switches can include an optional battery charging circuit.

⚠ WARNING *Ignition of explosive battery gases can cause severe personal injury. Always connect battery negative (-) last to prevent arcing.*

⚠ WARNING *Do not smoke or allow any other ignition source in area while servicing the batteries. Explosive gases are emitted from batteries in operation. Ignition of these gases can cause severe personal injury.*

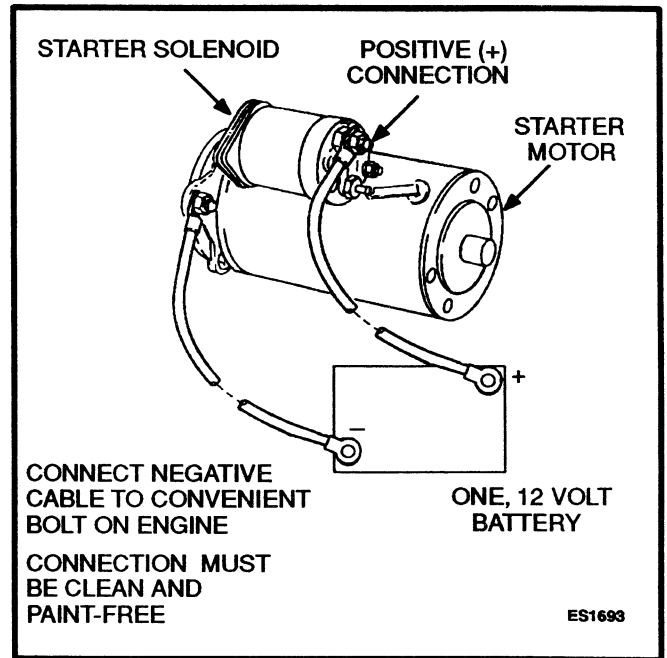


FIGURE 4-4. BATTERY CONNECTIONS

5. Control Description

GENERAL

This section covers a description of the controls for the standard control panel (Figure 5-1) the deluxe control panel (Figure 5-2) and the optional meter panel (Figure 5-3) used on housed gensets.

STANDARD CONTROL COMPONENTS/OPTIONS

Start / Stop Switch (S11): This switch is a single-pole, double-throw (SPDT) toggle type switch used for starting and stopping the generator set.

Holding the switch in the Start position will initiate engine cranking. When the engine reaches approximately 450 to 570 rpm, the starter motor will automatically disengage, preventing starter motor damage. The switch will automatically return to the center (Run) position when released.

Pushing the switch to the Stop position will initiate the stop function.

DC Ammeter (M21): The DC ammeter indicates the rate in amperes at which the battery is being charged/discharged.

Running Time Meter (M12): This meter indicates the accumulated number of hours the set has run.

Common Fault Circuit Breaker (CB4): This fault circuit breaker shuts down the engine when any fault shutdown switch is energized. A fault shutdown is indicated when the breaker reset button extends out past normal. Push the button to restore operation (after reason for fault has been determined).

Fuse (F1): A 10-ampere fuse that provides protection to the control box wiring and remote wiring from short circuits or overload.

Exciter Field Circuit Breaker: Protects the exciter and the alternator if the voltage regulator malfunctions.

Voltage Adjust Rheostat (Optional): Rheostat providing approximately plus or minus five percent adjustment of the rated output voltage.

Oil Pressure Gauge: Indicates pressure of lubricating oil in engine. (Gauge is located on side of engine block.)

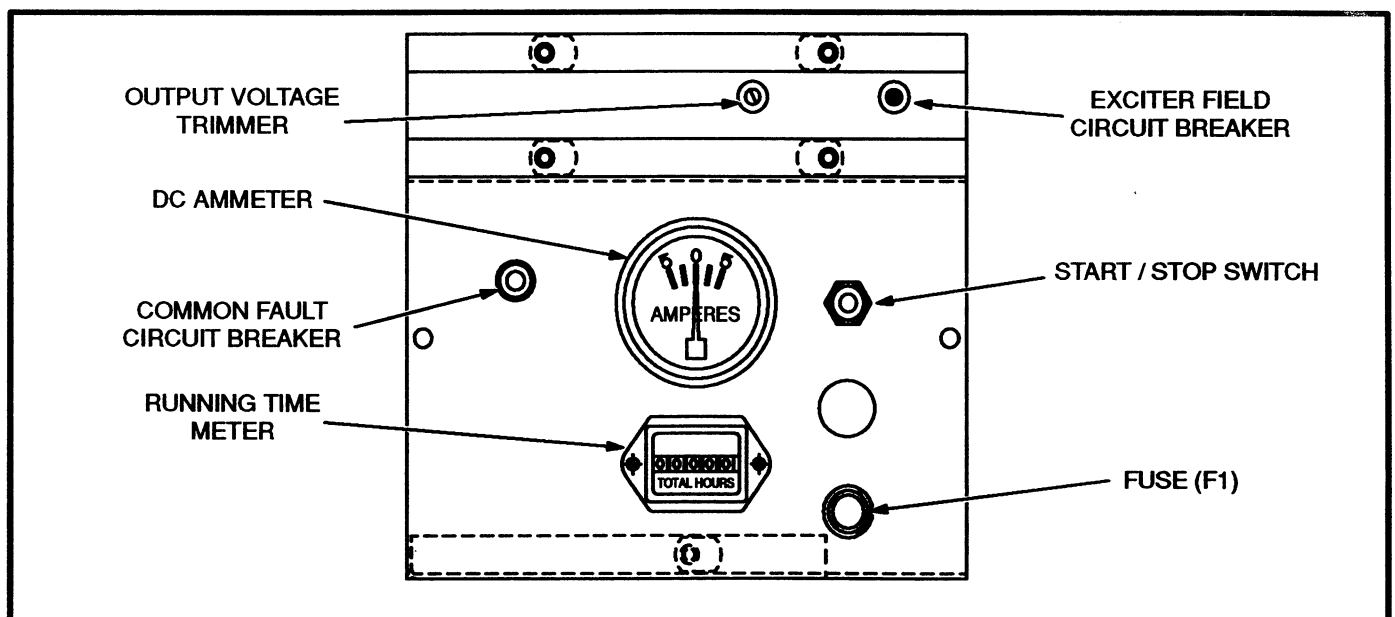


FIGURE 5-1. STANDARD CONTROL PANEL

DELUXE CONTROL PANEL COMPONENTS

The deluxe control panel (Figure 5-2) has the following fault indicators and circuit breakers in addition to the standard control panel controls.

Start / Stop / Test Switch (S11): In addition to the Start / Stop function provided on the standard control panel, a test position is provided on the deluxe control panel. In the Stop / Test position, this switch will light all fault indicator lamps on the deluxe control panel and remote annunciator panel. (Replace lamps that do not light.)

Individual Fault Circuit Breakers (CB4, CB5, CB6): An individual fault circuit breaker is provided in connection with each fault shutdown switch to shut down the engine when the contacts of a fault switch close. Each breaker is identified according to fault by the fault indicator above it on the panel.

Fault shutdown is indicated when the fault indicator lights and the breaker reset button extends out past normal. Push the button to restore operation (after the reason for the fault has been serviced).

Fault Indicator Lamps: An individual fault lamp is provided in connection with each fault shutdown switch to indicate the following fault conditions.

- **Low Oil Pressure:** This lamp indicates that the engine oil pressure is abnormally low (less than 14 psi ± 2 psi).
- **High Air Engine Temperature:** This lamp indicates that engine air temperature is abnormally high (greater than 375° F [190.5° C]).
- **Overspeed:** This lamp indicates that the engine shut down because of overspeed (60 Hz units at 2100 ± 90 r/min, and 50 Hz at 1850 ± 50 r/min).

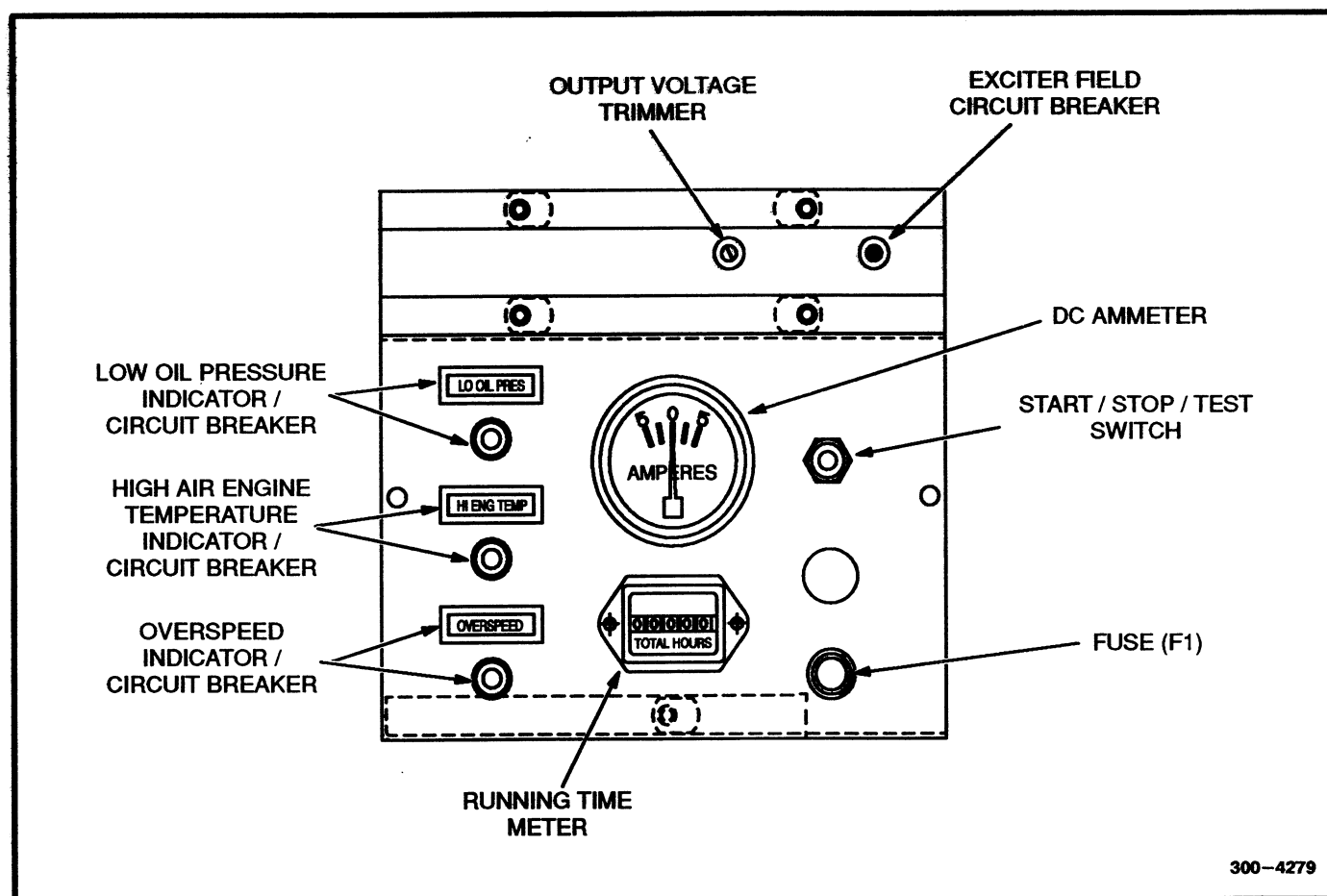


FIGURE 5-2. DELUXE CONTROL PANEL

OPTIONAL AC METER PANEL COMPONENTS (HOUSED UNITS ONLY)

The optional AC meter panel (Figure 5-3) used on housed units only, has the following components:

AC Voltmeter (M1): The voltmeter indicates output voltage for the phase selected.

Voltmeter Phase Selector Switch (S1): Selects the phase of the generator output voltage to be measured.

Running Time Meter (M5): This meter indicates the accumulated number of hours the set has run.

Frequency Meter (M6): Indicates the frequency of the output voltage in hertz. It can be used to check engine speed (30 rpm-produces one hertz).

AC Ammeter (M2, M3, M4): The ammeter indicates output amperage for each phase. Ammeter M2 is used on three phase units only.

Line Circuit Breaker (CB1): Protects generator from line overloads.

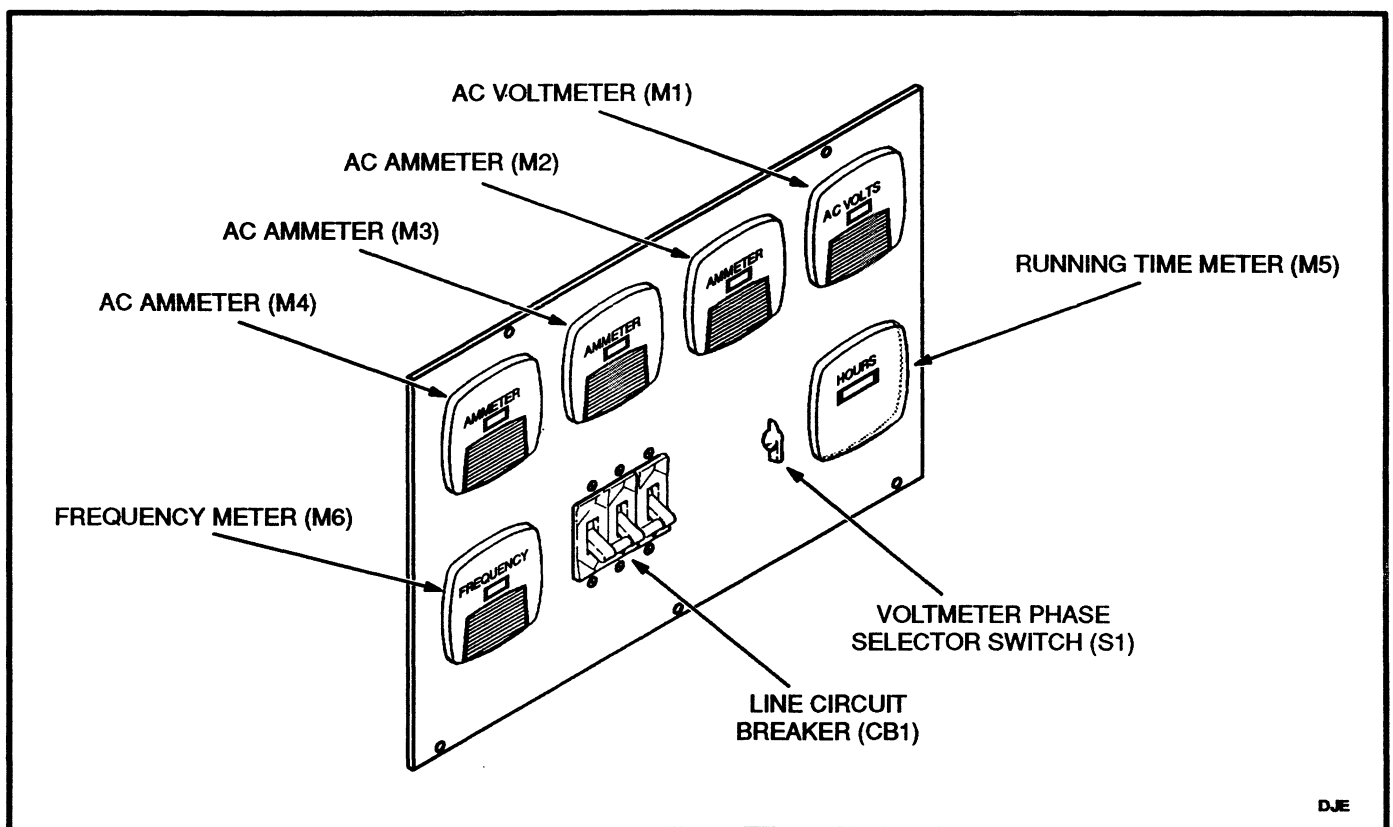


FIGURE 5-3. AC METER PANEL

6. Operation

⚠ WARNING

EXHAUST GAS IS DEADLY!

Exhaust gases contain carbon monoxide, an odorless and colorless gas. Carbon monoxide is poisonous and can cause unconsciousness and death. Symptoms of carbon monoxide poisoning can include:

- **Dizziness**
- **Nausea**
- **Headache**
- **Weakness and Sleepiness**
- **Throbbing In Temples**
- **Muscular Twitching**
- **Vomiting**
- **Inability to Think Coherently**

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET OUT INTO THE FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the unit and do not operate until it has been inspected and repaired.

Protection against carbon monoxide inhalation also includes proper installation and regular, frequent visual and audible inspections of the complete exhaust system.

GENERAL

This section covers prestart checks, starting and stopping and operating the generator set. Each operator should read through this entire section before attempting to start the set. It is essential that the operator be completely familiar with the set for safe operation.

⚠ CAUTION **Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.**

⚠ WARNING **Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [–] first).**

Arcing can ignite the explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur if the negative (–) battery cable is connected and a tool being used to connect or disconnect the positive (+) battery cable accidentally touches the frame or other grounded metal part of the set. To prevent arcing, always remove the negative (–) cable first, and reconnect it last.

PRESTART CHECKS

Before starting, be sure the following checks have been made and the unit is ready for operation. Refer to the *Maintenance* section for the recommended procedures.

Mechanical Checks

Before the generator set is activated, check all components for mechanical integrity. If an abnormal condition, defective part, or operating difficulty is detected, repair or service the genset as required. Keep the generator set free of dust, dirt, and spilled oil or fuel.

Make sure all the air shrouds and service access covers are in place.

⚠ CAUTION *Pressure cooled engines can quickly overheat and be damaged if run without the front air shroud/access cover in place.*

Lubrication

Check the engine oil level. Keep the oil level near as possible to the dipstick high mark without overfilling.

Fuel

Make sure the fuel tank has sufficient fuel.

DC Electrical System

⚠ CAUTION *Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.*

With the genset off, check the terminals on the battery for clean and tight connections. Loose or corroded connections create resistance that can hinder starting. Clean and reconnect the battery cables if loose. Always connect the negative battery cable last.

⚠ WARNING *Ignition of explosive battery gases can cause severe personal injury. Do not permit any flame, cigarette, pilot light, spark, arcing switch or equipment or other ignition source near the battery.*

STARTING

⚠ CAUTION *Phase rotation of the genset and utility must be the same. Equipment damage can occur. Check and reconnect as necessary.*

Check the rotation of 3-phase motors before loading and reconnect if necessary.

1. Engage the Start switch. When the engine reaches approximately 900 rpm, the starter motor will automatically disengage with the switch held in the Start position, preventing starter motor damage. The Start switch will automatically return to the center (Run) position when released.
2. If the engine fails to start after 30 seconds of cranking, repeat Step 1 after waiting one minute.
3. A new set may not start right away if the spark plug electrodes are coated by the rust inhibiting oil injected into the cylinders at the factory. Remove the spark plugs and clean the oil off. Also, heavy smoke on the initial start-up is temporary, and is caused by burn-off of the rust inhibiting oil.
4. Check the oil pressure gauge: it should read at least 20 psi (138 kPa).
5. Connect the load as noted in the following procedure. Follow the break-in procedure for the initial start-up.

COMBINATION GAS/GASOLINE SETS

1. The engine will not run properly if it can draw on both fuel sources at the same time. Select the fuel to be used and close the supply valve for the other fuel.
2. Engage the choke lock wire to keep the choke open when using gas fuel and release it when using gasoline fuel.

CONNECTING THE LOAD

1. When possible, allow the set to warm up before connecting the full load.
2. When possible, connect the load in steps.
3. Carbon deposits can form in the exhaust system during operation under light loads. Occasionally connect the full rated load to burn off the carbon deposits.

RUNNING

With the genset running, listen for any unusual noises that may indicate mechanical problems and check the oil pressure frequently. Investigate anything that indicates possible mechanical problems.

Before operating the genset under load, make certain the genset will perform correctly by checking the following areas.

Exhaust System

⚠WARNING *Inhalation of exhaust gases can result in severe personal injury or death. Inspect exhaust system audibly and visually for leaks daily. Repair any leaks immediately.*

Inspect the entire exhaust system including the exhaust manifold, muffler and exhaust pipe. Visually and audibly check for leaks at all connections, welds, gaskets, and joints. Make sure exhaust pipes are not heating surrounding area. If any leaks are detected, have them corrected immediately.

Fuel System

⚠WARNING *Leaking fuel will create a fire hazard that can result in severe personal injury or death if ignited by a spark. If any leaks are detected, have them corrected immediately.*

Inspect the fuel supply lines, filters, and fittings for leaks. Check any flexible sections for cuts, cracks, and abrasions and make sure they are not rubbing against anything that could cause breakage.

Engine Gauges

Check the following while the genset is operating.

Oil Pressure Gauge: The oil pressure should be at least 20 psi (138 kPa).

DC Ammeter: The DC ammeter indicates the rate in amperes at which the battery is being charged. The charge rate should be approximately 2 amperes.

Generator AC Meters (Optional)

Check the following meters while the genset is operating.

Frequency Meter: The generator frequency should be stable and the reading should be the same as the nameplate rating (50 Hz - 1500 RPM, 60 Hz - 1800 RPM $\pm 5\%$).

AC Voltmeter: On three phase gensets, turn the phase selector switch to each line-to-line phase selection shown on the volts scale (L1-L2, L2-L3, and L1-L3). At no load, the line-to-line voltage should be the same as the genset nameplate rating. If the reading is incorrect, refer to the *Adjustment* section for the correct procedure.

AC Ammeter: At no load, the current readings should be zero. With a load applied, each line current should be approximately the same, and no line current should exceed the genset nameplate rating.

⚠CAUTION *Overloading can cause the generator to overheat and fail. the load may exceed the nameplate rating only momentarily, such as during the starting of a large motor.*

STOPPING

1. Run the generator set at no load for ten minutes before stopping. This allows the lubricating oil to carry heat away from the combustion chamber and bearings.
2. Push the Start / Stop switch to the Stop position until the engine stops.
3. If a safety circuit stops the engine (high engine temperature or low oil pressure), determine the cause and service or repair as necessary before placing the set back into service.

Engine Monitor Indicator Lamps (Optional)

With the genset stopped, briefly engage the Stop / Test switch. All indicator lamps should light. Verify all of the lamps are on and then release the switch. Contact an Onan distributor if any lamps require replacement.

Mechanical Checks

With the genset stopped, check for leaking fittings and gaskets, and for any signs of mechanical damage. If any problems are found, have them corrected immediately.

BREAK-IN

Observe the following schedule for genset break-in:

1. One half hour at 1/2 load.
2. One half hour at 3/4 load.
3. Full load.

During the first few hundred hours of operation, the genset load should be at least 1/2 to full load. Continuous operation below this load recommendation can result in poor piston ring seating, causing higher-than-normal oil consumption and blowby.

Drain and replace the crankcase oil after the first 50 hours of operation on new gensets. Refer to the *Maintenance* section of this manual for the recommended procedures.

NO-LOAD OPERATION

Periods of no-load operation should be held to a minimum. If it is necessary to keep the engine running for long periods of time when no electric output is required, best engine performance will be obtained by connecting a "dummy" electrical load. Such a load could consist of a heater element, etc.

EXERCISING UNIT

⚠ CAUTION *Improper exercising may cause more damage than no exercising at all.*

Significant amounts of water and raw fuel will remain in the lubrication oil if the unit is run at a low operating temperature. Also, operating the engine at no load or at low temperatures causes carbon buildup and exhaust system fouling. Continued operation in this manner may cause starting failure and/or engine damage. Exercising a generator set without exercising its associated controls and switchgear does not test the operation of the controls and switchgear. If the control systems are not fully functional, the system may fail to provide power when required.

Infrequent use of the generator set can cause it to deteriorate. The following can occur:

- Condensation in the fuel and lubrication system, causing contamination and/or corrosion
- Loss of protective oil film on moving engine parts
- Battery discharge due to internal and external current leakage
- Breakdown of generator insulation due to water absorption

Proper exercising does the following:

- Elevates engine oil temperature to at least 180° F (82.2° C)
- Evaporates water from engine lubrication system
- Re-establishes a protective oil film on engine parts
- Recharges battery to full normal potential
- Brings generator to normal operating temperature through load application

The generator set should be exercised at least once each week. The engine oil temperature should be held at 180° F (82.2° C) for at least 30 minutes during this exercise.

To exercise the generator set, do the following:

1. Perform all required maintenance checks, start the unit, and apply a load (50 percent or more) by creating a simulated power failure*. This exercises the control and switchgear systems.
2. After the genset has reached its normal operating temperature, allow the genset to run an additional 30 minutes.
4. Shut the unit down by simulating the return of normal power*. Run the set for approximately three to five minutes with no load to allow the engine to cool down.

* This applies to a standby genset only. Other units should be started and loaded by control and load application systems normally associated with operation of the unit.

After each exercise period, refill the fuel tank and check the engine for leaks and overall condition. Locate the cause of any leaks and correct.

ENGINE RATINGS

Ratings apply to altitudes up to 1000 feet (305 m), gensets using standard cooling and normal ambient temperatures. Consult the nearest authorized Onan service center for operating characteristics under other conditions.

HIGH/LOW OPERATING TEMPERATURES

The generator set has been designed to operate satisfactorily in both high (above 100° F) and low (below 0° F) temperatures. Use the oil recommended in the *Maintenance* section of this manual for the expected temperature conditions.

High Operating Temperatures

1. See that nothing obstructs air flow to and from the set.
2. Keep cooling fins clean. Cylinder air housings should be properly installed and undamaged.

Low Operating Temperatures

1. Use correct viscosity oil for temperature conditions. Change oil only when engine is warm. If an unexpected temperature drop causes an emergency, move the set to a warm location or apply heated air (never use open flame) externally until oil flows freely.
2. Keep batteries in a well charged condition.
3. Partially restrict cool air flow but use care to avoid overheating.

DUST AND DIRT

1. Keep the generator set and the cooling system clean.
2. Service the air cleaner as frequently as necessary.
3. Change the crankcase oil every 100 operating hours.
4. Keep oil and fuel in dust-tight containers.
5. Keep governor linkage clean.

HIGH ALTITUDE

Maximum power is reduced approximately 4 percent for each 1000 feet (305 m) altitude above sea level after the first 1000 feet (305 m).

7. Adjustments

OUTPUT VOLTAGE ADJUSTMENT (OPTIONAL)

⚠ CAUTION Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.

⚠ WARNING Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [-] first).

Arcing can ignite the explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur if the negative (-) battery cable is connected and a tool being used to connect or disconnect the positive (+) battery cable accidentally touches the frame or other grounded metal part of the set. To prevent arcing, always remove the negative (-) cable first, and reconnect it last.

Output voltage can be adjusted plus or minus five percent of nominal voltage by the adjustment screw (output voltage trimmer) located above the control panel (Figure 7-1). Call your distributor if the required voltage cannot be obtained by this adjustment.

⚠ WARNING Use extreme caution when working on electrical components. High voltages can cause injury or death. Stand on rubber mat or wooden platform. Do not wear jewelry, damp clothing (particularly wet shoes) or allow skin surface to be damp when handling electrical equipment.

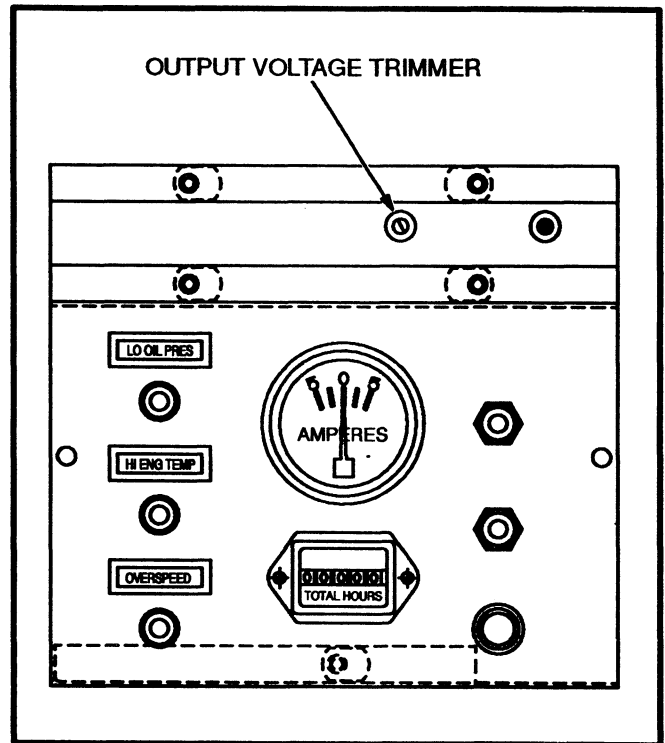


FIGURE 7-1. OUTPUT VOLTAGE ADJUSTMENT

CHARGE RATE ADJUSTMENT

The adjustable resistor slide tap (Figure 7-2) in the charging circuit is set to produce a 2 ampere charging rate. This resistor is found in the generator air outlet. For applications requiring frequent starts, check the battery specific gravity periodically. If necessary, increase the charging rate slightly (move the slide tap up). Adjust this slide tap only when the engine is stopped.

⚠ WARNING *Batteries present the hazard of explosion, which can result in severe personal injury. Because batteries produce explosive gas, do not smoke or allow any flame, sparks, or arc-producing devices in the battery area.*

Avoid overcharging the battery. Make small increments of change until the proper rate has been determined to keep the battery charged.

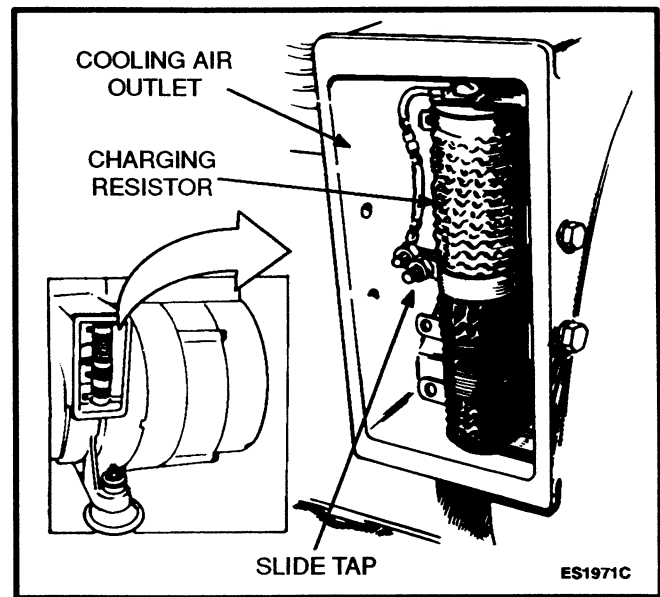


FIGURE 7-2. CHARGING RESISTOR

CENTRIFUGAL SWITCH

The start-disconnect centrifugal switch (Figure 7-3) is located on the side of the engine, above the oil filter. The switch opens when the engine stops, and closes when engine speed reaches 900 rpm. If necessary, loosen the stationary contact and adjust the point gap to 0.020 inch (51 mm). Replace burned or faulty points.

⚠ CAUTION *Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.*

⚠ CAUTION *To avoid possible equipment damage, disconnect the battery cable, negative (–) terminal first, before settling the breaker point gap.*

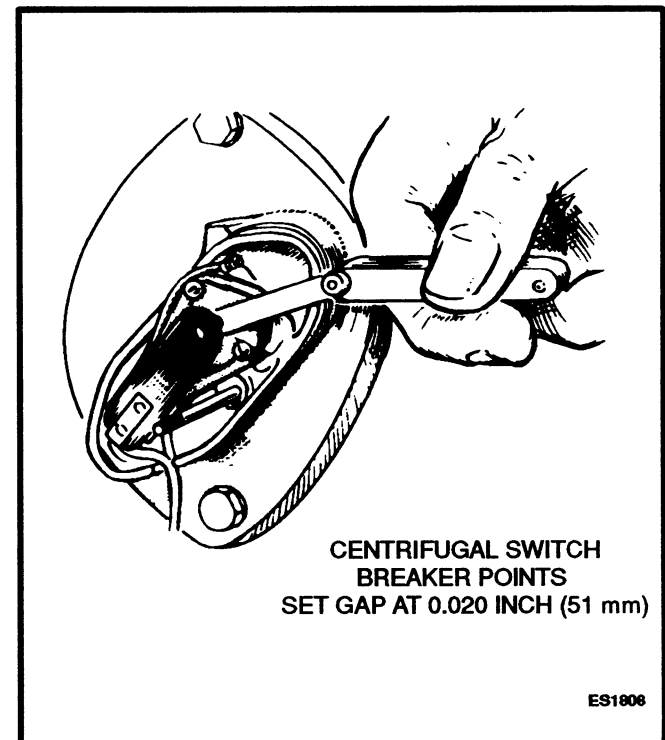


FIGURE 7-3. CENTRIFUGAL SWITCH ADJUSTMENT

8. Troubleshooting

The generator set has sensors that continuously monitor the engine for low oil pressure, high engine temperature and overspeed. If an abnormal condition occurs, the fault circuit breaker will trip, (optional fault lamp will light) and the engine shuts down. After the problem is corrected, reset the fault circuit breaker to restart the generator set.

Table 8-1 describes the operation of the fault condition system (including optional features) and lists troubleshooting procedures.

SAFETY CONSIDERATIONS

High voltages are present within the control box and generator output box when the generator is running. Do not open the control box or generator output box while the set is running.

⚠ WARNING *Contacting high voltage components can cause severe personal injury or death. Keep control and output box covers in place during troubleshooting.*

Generator set installations are normally designed for automatic starting or remote starting. When troubleshooting a set that is shut down, make certain the generator set cannot be accidentally restarted. To prevent accidental starting, always re-

move the negative battery cable from the set starting battery.

⚠ CAUTION *Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.*

⚠ WARNING *Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [-] first).*

Arcing can ignite the explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur if the negative (-) battery cable is connected and a tool being used to connect or disconnect the positive (+) battery cable accidentally touches the frame or other grounded metal part of the set. To prevent arcing, always remove the negative (-) cable first, and reconnect it last.

When a fault condition occurs during operation, follow the procedures in Table 8-1 to locate and correct the problem. If a major problem is indicated, contact an Onan Distributor for service.

TABLE 8-1. TROUBLESHOOTING

⚠ WARNING *Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages iii and iv..*

SYMPTOMS	CHECKS AND CORRECTIVE MEASURES
1. The engine will not crank.	<p>1a. Indicates possible fault with control or starting system. Check for the following conditions:</p> <ul style="list-style-type: none"> a. Fuse F1 has blown. Replace the fuse with one of the same type and amp rating. b. Fault circuit breaker has tripped. Service the fault, and re-set the circuit breaker. c. Poor battery cable connections. Clean the battery terminals and tighten all connections. <p>1b. Indicates insufficient battery voltage due to:</p> <ul style="list-style-type: none"> a. Batteries not charged. b. Battery connections loose or dirty. c. Insufficient battery charging voltage (contact an Onan distributor for assistance). d. Contact an Onan distributor for assistance if none of the above.
2. The engine cranks, but does not start or starts and then shuts down.	<p>2. Indicates possible fuel system problem.</p> <ul style="list-style-type: none"> a. Check for empty fuel tank, fuel leaks, or plugged fuel lines and correct as required. b. Check for dirty fuel filter and replace if necessary (see <i>Maintenance</i> section). c. Check for dirty or plugged air filter and replace if necessary (see <i>Maintenance</i> section). d. Check ignition system (see <i>Maintenance</i> section). e. Contact an Onan distributor for assistance if none of the above.
3. Engine runs and then shuts down (fault circuit breaker trips and optional OVER-SPEED lamp lights.	<p>3. Indicates engine has exceeded normal operating speed. Contact an Onan distributor for service.</p>

TABLE 8-1. TROUBLESHOOTING (Continued)

⚠WARNING *Many troubleshooting procedures present hazards that can result in severe personal injury or death. Only qualified service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review safety precautions on pages III and IV.*

SYMPTOMS	CHECKS AND CORRECTIVE MEASURES
4. Engine runs and then shuts down (fault circuit breaker trips and optional HI ENG TEMP lamp lights).	4. Indicates engine has overheated. Allow engine to cool down completely before proceeding with the following checks: a. Check for obstructions to cooling airflow and correct as necessary. Keep cooling fins clean. b. Incoming air is too hot. Open doors or windows in generator area to increase ventilation. c. Overloaded. Disconnect as many non-critical loads as possible so that the engine will run cooler. d. Reset fault circuit breaker after locating and correcting problem. Contact an Onan distributor for assistance if none of the above.
5. Engine runs and then shuts down (fault circuit breaker trips and optional LO OIL PRES lamp lights).	5. Indicates engine oil pressure has dropped below 20 psi (138 kPa). Check oil level, lines and filters. If oil system is okay but oil level is low, replenish. Reset fault circuit breaker. Contact an Onan distributor for assistance if oil pressure is not 20 psi or above.
6. Fault lamp lights but no fault exists. Engine gauges show oil pressure.	6. Engine sensor is faulty. Contact an Onan distributor for assistance.
7. Fault lamp(s) does not light when Alarm Test switch is engaged.	7. Replace defective lamp(s).
8. No AC output voltage because the line circuit breaker (if provided) or the field circuit breaker has tripped.	8. Determine the cause (overload or short circuit) and clear the fault. Reset the line circuit breaker and/or the field circuit breaker. Contact an Onan distributor if voltage buildup causes breaker to trip.

9. Maintenance

GENERAL

Establish a maintenance/service schedule based on the type of application, and on the severity of the environment. The Table 9-1 lists the recommended service intervals. In extreme operating conditions, reduce the service intervals accordingly. Factors that affect the maintenance schedule include the following:

- Use for continuous duty (prime power)
- Extremes in ambient temperature
- Exposure to elements
- Exposure to salt water
- Exposure to windblown dust or sand

Consult with an authorized service center if the set is subject to extreme operating conditions, and determine a suitable maintenance schedule. Perform all service at the time period indicated, or after the number of operating hours indicated, whichever comes first. Use Table 9-1 to determine the re-

quired maintenance. Refer to this section for maintenance procedures.

⚠ CAUTION *Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.*

⚠ WARNING *Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [-] first).*

Arcing can ignite the explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur if the negative (-) battery cable is connected and a tool being used to connect or disconnect the positive (+) battery cable accidentally touches the frame or other grounded metal part of the set. To prevent arcing, always remove the negative (-) cable first, and reconnect it last.

TABLE 9-1. MAINTENANCE SCHEDULE

HOURS OF OPERATION	MAINTENANCE TASK
8	<ul style="list-style-type: none">• Inspect exhaust system; See Note 1• Inspect generator set• Check fuel supply; See Note 1• Check oil level
50	<ul style="list-style-type: none">• Check condition of battery• Check air cleaner; See Note 2• Change crankcase oil after first 50 hours• See Notes 3 and 4
100	<ul style="list-style-type: none">• Clean governor linkage• Change crankcase oil (or annually)• Clean fuel filter sediment bowl
200	<ul style="list-style-type: none">• Service ignition breaker points (Series JB) or distributor (Series JCA/B); See Note 4• Inspect (check gap) or replace spark plugs• Clean crankcase breather (Series JB)• Replace oil filter• Clean the generator
500	<ul style="list-style-type: none">• Service starter disconnect breaker points• Clean the PCV valve (Series JCA/B)
1000	<ul style="list-style-type: none">• Grind valves (if required); See Note 4• Remove and clean oil pan
1500	<ul style="list-style-type: none">• Check torsional washers for corrosion; See Note 5

1. Every 8 hours of operation or each time set is started, whichever comes first. If any leaks are detected, visually, audibly, or by smell, stop genset and repair immediately.
2. Perform more often in extremely dusty conditions.
3. Tighten head bolts and adjust valve clearance after first 50 hours on new and overhauled engines, and then adjust valve clearance each 500 hours thereafter.
4. Contact an authorized service center for service.
5. Check yearly on non-commercial sets.

GENERATOR SET INSPECTION

During operation, be alert for mechanical problems that could create unsafe or hazardous conditions. Section 6 of this manual covers the areas that should be frequently inspected for continued safe operation.

LUBRICATION SYSTEM

The engine oil was drained from the crankcase before shipment. Before the initial start, the lubrication system must be filled with oil of the recommended classification and viscosity. Refer to *Specifications* section for the lubricating oil capacity.

Oil Recommendations

The use of quality engine lubricating oils combined with appropriate oil drain and filter change intervals are critical factors in maintaining engine performance and durability.

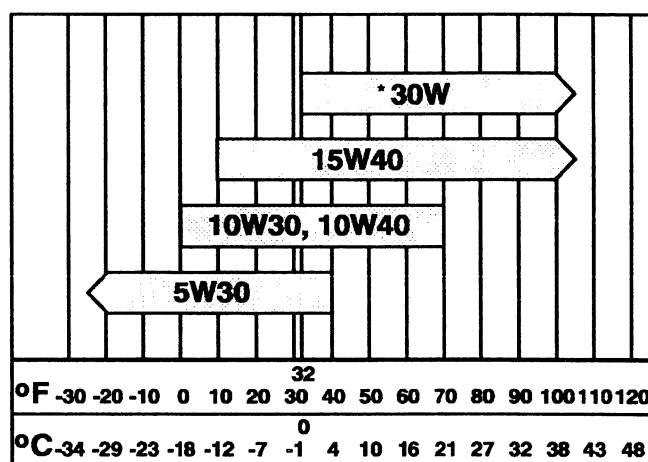
Use SAE 30 oil that meets the American Petroleum Institute (API) Classification SG or SG/CE. Table 9-2 shows the preferred oil grades for ambient temperatures indicated.

Oil consumption may be higher with a multigrade oil than with a single-grade oil. For this reason, single grade oils are preferable unless wide temperature variations are anticipated.

⚠ CAUTION *Limited use of low viscosity oils, such as 5W-30 may be used for easier starting and providing sufficient oil flow at ambient temperatures below 23° F (-5° C). However, continuous use of low viscosity oils can decrease engine life due to wear. Refer to the accompanying chart.*

In extremely dusty or dirty conditions, oil should be changed more frequently. When adding oil between changes, use the same brand as already in the engine. Various brands of oil may not be compatible when mixed.

TABLE 9-2. OIL VISCOSITY/TEMPERATURE CHART



* PREFERRED SUMMER

Engine Oil Level

⚠ CAUTION *Do not operate the engine with the oil level below the LOW mark or above the FULL mark. Overfilling can cause foaming or aeration of the oil while operation below the ADD mark can cause loss of oil pressure.*

Check the engine oil level during engine shutdown periods at the intervals specified in the Maintenance Schedule. The oil dipstick and oil fill are located on the side of the engine (Figure 9-1). The dipstick is stamped with FULL and LOW to indicate the level of oil in the crankcase. For accurate readings, shut off the engine and wait approximately 10 minutes before checking the oil level. This allows oil in the upper portion of the engine to drain back into the crankcase.

Keep the oil level as near as possible to the FULL mark on the dipstick. Remove the oil fill cap and add oil of the same quality and brand when necessary.

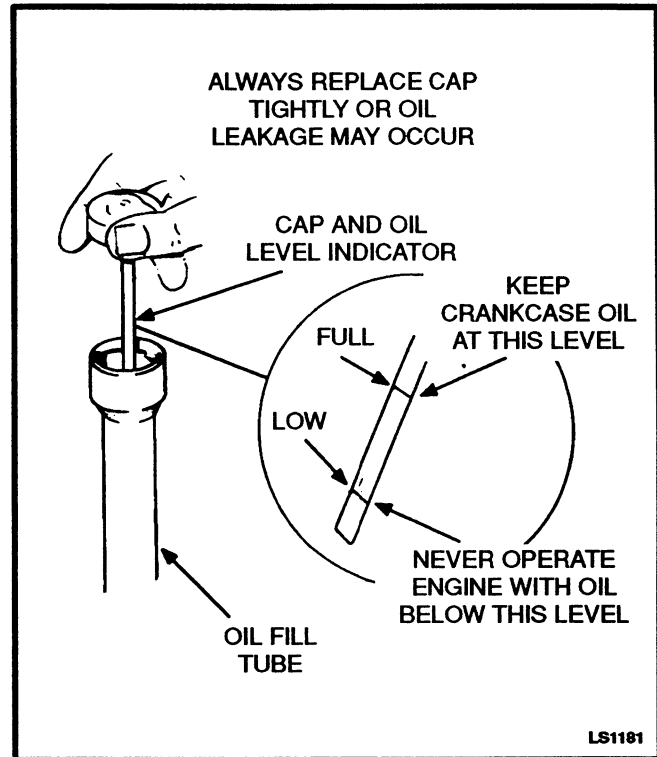


FIGURE 9-1. OIL LEVEL INDICATOR

Oil Change

⚠WARNING *Hot crankcase oil can cause burns if it is spilled or splashed on skin. Keep fingers and hands clear when removing the oil drain plug and wear protective clothing.*

Change the oil and filter at the intervals recommended in the Maintenance Schedule.

Stop the engine and drain the crankcase oil while the engine is still hot. Place a pan under the drain outlet and remove the oil drain plug or open the oil drain valve. After the oil is completely drained, replace the drain plug or close the drain valve. Replace oil filter if necessary before adding oil.

Refill with oil of the correct API designation and SAE viscosity grade for the temperature conditions (refer to Table 9-2).

Check the oil level indicator after every 8 hours of operation, and maintain the oil level at the FULL mark (Figure 9-1). Refer to the *Specifications* section for crankcase and filter capacity.

Oil Filter Change

⚠WARNING *Hot crankcase oil can cause burns if it is spilled or splashed on skin. Keep fingers and hands clear when removing the oil drain plug and wear protective clothing.*

Place a container under the oil filter and remove the filter by turning it counterclockwise. Clean the filter mounting area. Oil filter gasket with clean oil. To install the new filter, turn the filter on clockwise until the gasket touches the mounting base, then tighten 1/2 turn.

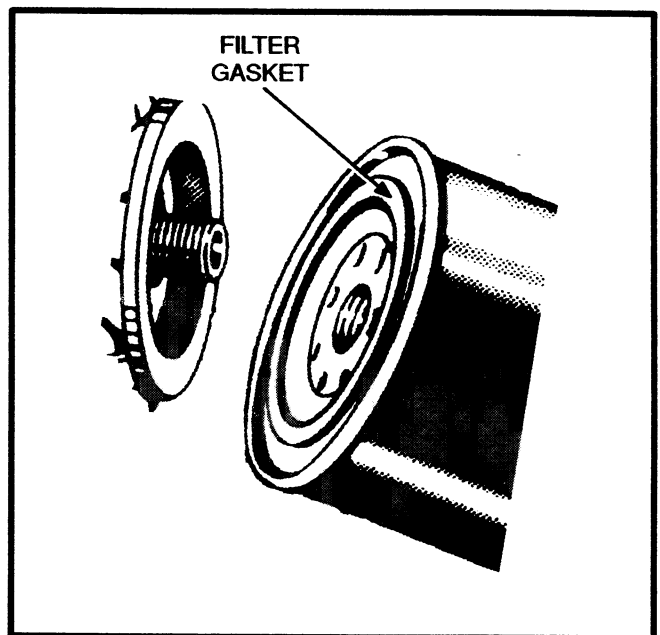


FIGURE 9-2. ENGINE OIL FILTER

FUEL FILTER

Clean out the fuel filter sediment bowl (Figure 9-3). Make sure the gasket and screen are assembled correctly and that it does not leak.

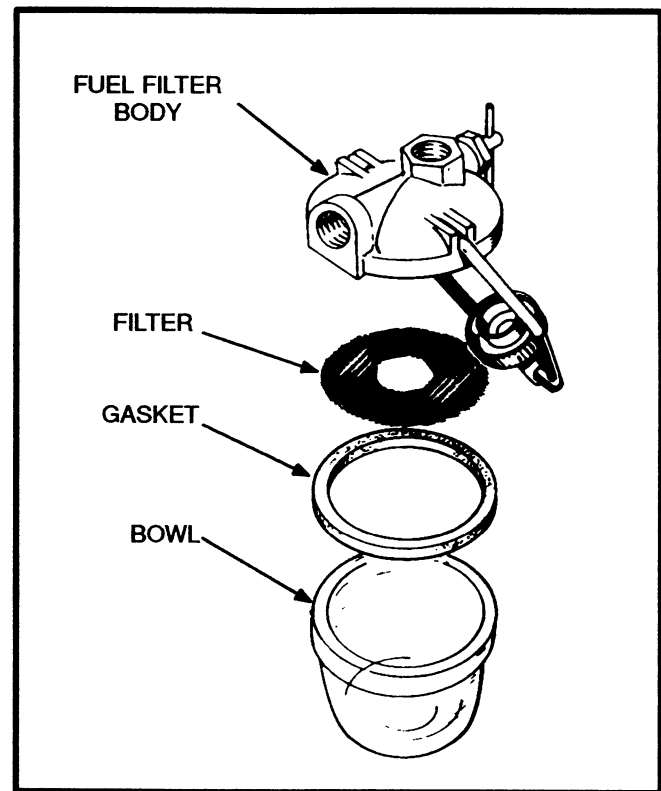


FIGURE 9-3. FUEL PUMP SEDIMENT BOWL

AIR CLEANERS

⚠ CAUTION *Filters should be handled with care to prevent damage. If the filter does become damaged, install recommended replacement part.*

After every 50 hours of operation, remove and clean the filter element (Figure 9-4). After washing the element in solvent, dip the element in engine oil and squeeze it as dry as possible.

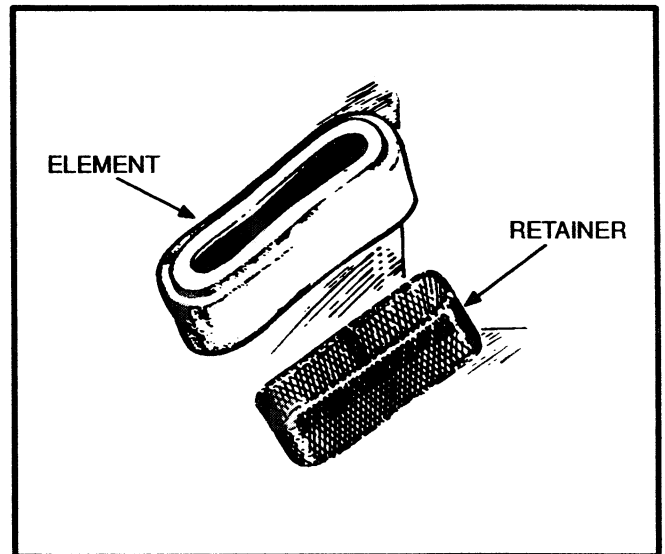


FIGURE 9-4. POLYURETHANE FOAM AIR CLEANER

HEAVY DUTY AIR CLEANER

1. Remove pre-cleaner (Figure 9-5) and wash out dirt. Dry and reinstall.
2. Loosen clamp and remove end cover.
3. Remove thumbscrew and take out element. Wash element in detergent and water (use new element after 6 washings). Dry and reinstall.
4. Remove air cleaner baffle from cover, wash out dirt, and reinstall in cover.
5. Install cover with "TOP" up and tighten clamp.

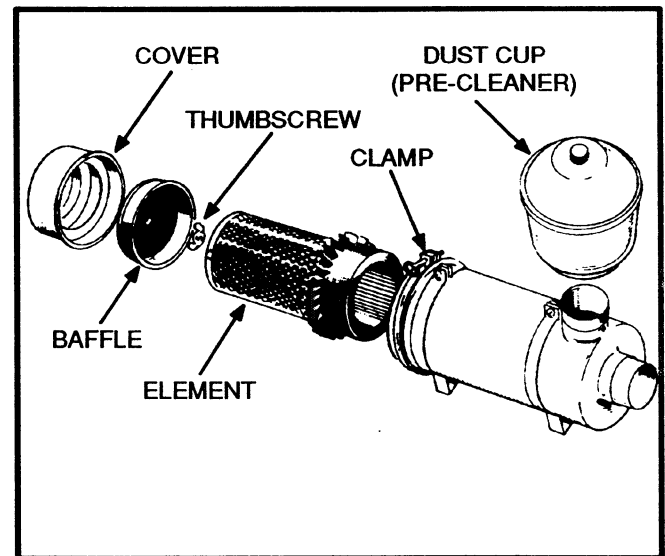


FIGURE 9-5. HEAVY DUTY AIR CLEANER

GOVERNOR LINKAGE

Every 100 hours, carefully pull the neoprene governor ball joints apart and clean them. Do not lubricate these joints. See Figure 9-6.

⚠ CAUTION *Some solvents can damage the neoprene governor ball joints. Read the manufacturer's recommendations before using any lubricants or solvents near the ball joints.*

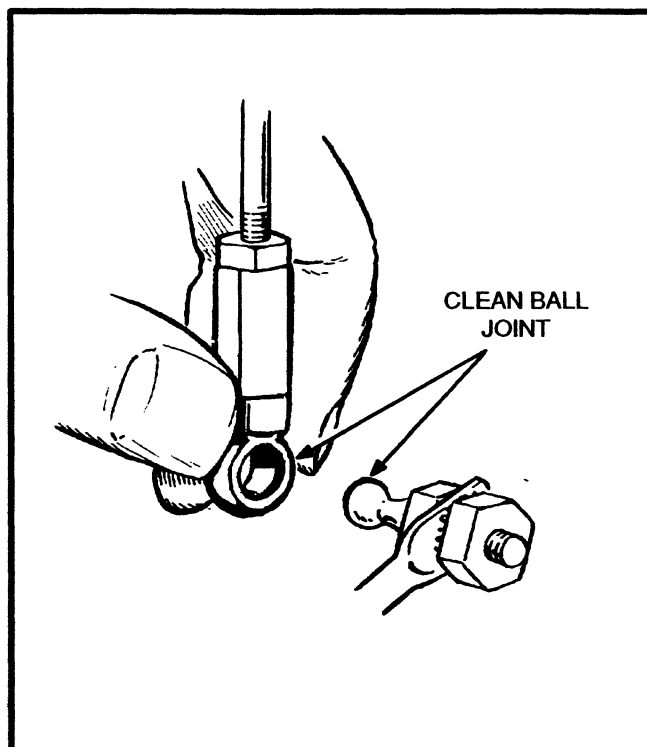


FIGURE 9-6. GOVERNOR BALL JOINT

BATTERIES

⚠ WARNING *Ignition of explosive battery gases can cause severe personal injury. Do not smoke or allow any source of ignition while servicing batteries.*

Check the condition of the starting battery at the interval specified in the maintenance schedule. To prevent dangerous arcing, always disconnect the negative ground strap from the battery before working on any part of the electrical system or the engine. Disregard the sections on Checking Specific Gravity and Checking Electrolyte Level if using a "maintenance-free" battery.

⚠ CAUTION *Always disconnect a battery charger from its AC source before disconnecting the battery cables. Otherwise, disconnecting the cables can result in voltage spikes high enough to damage the DC control circuits of the set.*

⚠ WARNING *Accidental starting of the generator set while working on it can cause severe personal injury or death. Prevent accidental starting by disconnecting the starting battery cables (negative [-] first).*

Arcing can ignite the explosive hydrogen gas given off by batteries, causing severe personal injury. Arcing can occur if the negative (-) battery cable is connected and a tool being used to connect or disconnect the positive (+) battery cable accidentally touches the frame or other grounded metal part of the set. To prevent arcing, always remove the negative (-) cable first, and reconnect it last.

Cleaning Batteries

Keep the batteries clean by wiping them with a damp cloth whenever dirt appears excessive.

If corrosion is present around the terminal connections, remove battery cables and wash the terminals with an ammonia solution or a solution consisting of 1/4 pound of baking soda added to 1 quart of water.

Be sure the vent plugs are tight to prevent cleaning solution from entering the cells.

After cleaning, flush the outside of the battery and surrounding areas with clean water.

Keep the battery terminals clean and tight. After making connections, coat the terminals with a light application of petroleum jelly or non-conductive grease to retard corrosion.

Checking Specific Gravity

Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell.

Hold the hydrometer vertical and take the reading. Correct the reading by adding four gravity points (0.004) for every ten degrees the electrolyte temperature is above 80° F (27° C). A fully charged battery will have a corrected specific gravity of 1.260. Charge the battery if the reading is below 1.215.

Checking Electrolyte Level

⚠ CAUTION *Do not add water in freezing weather unless the engine will run long enough (two to three hours) to assure a thorough mixing of water and electrolyte.*

Check the level of the electrolyte (acid and water solution) in the batteries at least every 200 hours of operation.

Fill the battery cells to the bottom of the filler neck. If cells are low on water, add distilled water and recharge. If one cell is low, check case for leaks. Keep the battery case clean and dry. An accumulation of moisture will lead to a more rapid discharge and battery failure.

STARTER DISCONNECT BREAKER POINTS

The starter disconnect breaker points (Figure 9-7) are open when the engine is not running. They are closed by a centrifugal mechanism when the engine reaches approximately 900 RPM. The starter is disconnected as a result.

See *Specifications* section for the breaker point gap.

IGNITION SYSTEM

⚠ CAUTION *The engine will not perform satisfactorily unless the ignition system is serviced and timed properly. It is recommended that you contact an authorized Onan dealer to perform the following service procedures.*

Spark Plug Gap

Remove the spark plugs and inspect for damaged or cracked insulators, worn electrodes, damaged gaskets or excessive carbon deposits. Replace the spark plug if any of these conditions are noted.

If the spark plugs show any of the following conditions, the engine may require additional service. Contact your authorized service distributor for help.

- Carbon fouled - Overly rich mixture
- Oil fouled - High oil consumption
- Burned - Excessive engine temperature

Clean and re-gap the spark plugs (Figure 9-8). See *Specifications* section for the spark plug gap.

Breaker Points

Check the ignition breaker points and replace if dirty or pitted and adjust the gap (Figures 9-7 and 9-9).

Distributor Cap and Rotor

Check the distributor cap and rotor (Series JCA/B) for cracks, carbon runners, corroded high tension terminals and burned contacts. Add three drops of medium engine oil to the felt in the end of rotor shaft. Add one drop of light engine oil to the breaker arm and fly weight hinge pins. Grease each cam lobe lightly. Do not over lubricate the distributor. Wipe up excess grease and oil.

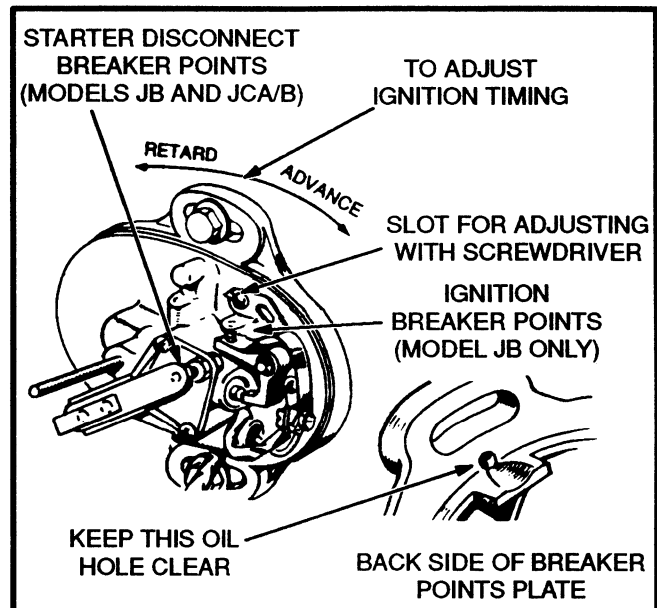


FIGURE 9-7. BREAKER POINTS

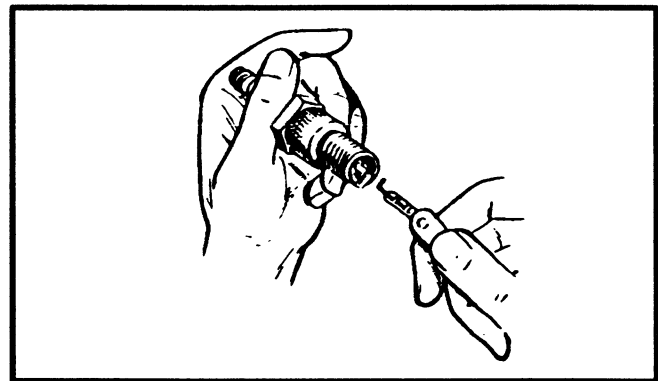


FIGURE 9-8. SPARK PLUG

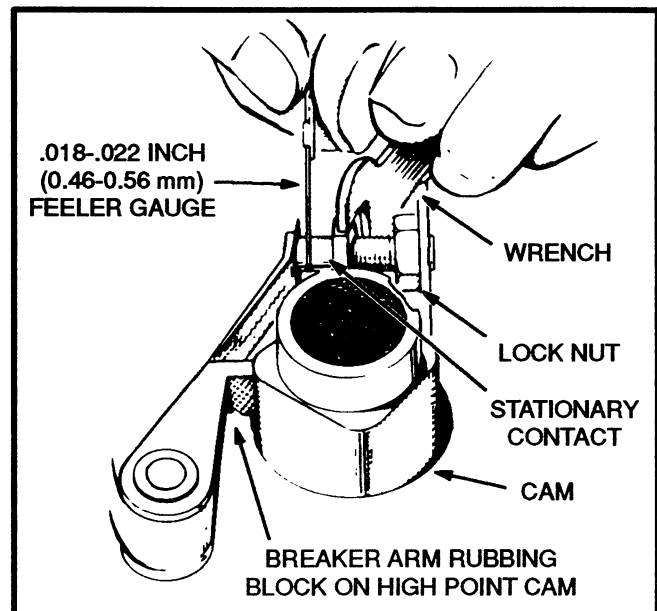


FIGURE 9-9. SETTING DISTRIBUTOR BREAKER POINTS (MODEL JCA/B ONLY)

Timing

It is recommended that a timing light be used. The timing mark is visible as shown in Figure 9-10. See *Specifications* for timing specifications.

High Tension Wires

Check the spark plug wires and coil wire for good contact at the coil, distributor cap and spark plugs. Terminal connections should be tight and fully seated. All spark plug covers and cable end boots should be in good condition and fit tightly. There should be no breaks or cracks in the insulation. Replace the wire if any of these conditions are noted.

CAUTION *High tension wires can be damaged if removed incorrectly from terminals. Grasp wire by spark plug boot to prevent damage to conductor.*

Ignition Coil

Clean the top of the ignition coil and check for cracks, carbon tracks or corrosion in the high tension terminal hole. Replace the coil if any of these conditions are noted.

CRANKCASE BREATHER (Series JB Only)

Unclamp the cap and remove the valve and baffle for cleaning (Figure 9-11). Replace defective parts.

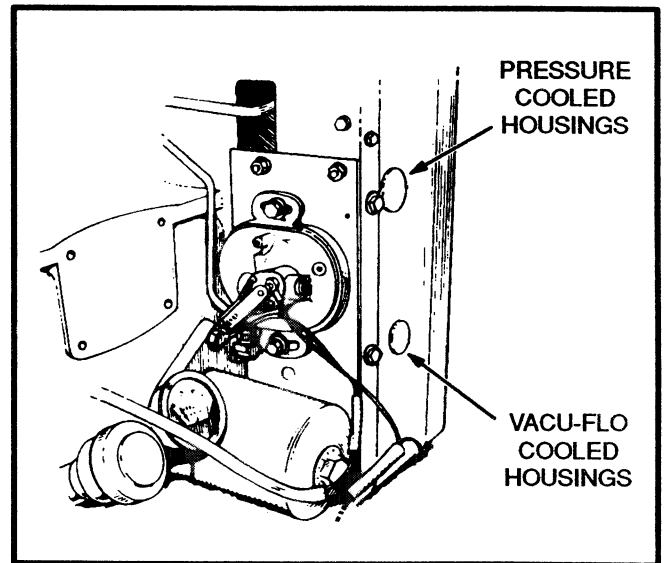


FIGURE 9-10. LOCATION OF OPENINGS TO VIEW FLYWHEEL TIMING MARKS

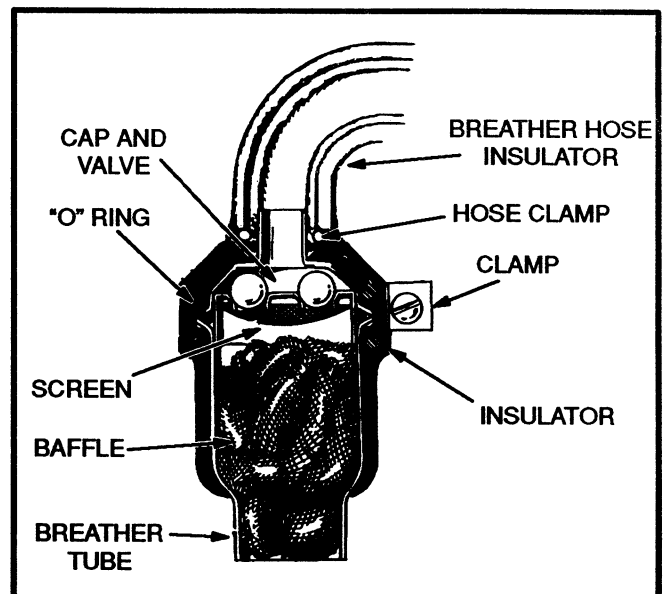


FIGURE 9-11. CRANKCASE BREATHER

GENERATOR

Remove the generator end cover for access to the rotating rectifiers (Figure 9-12). Use filtered, low pressure compressed air to blow away accumulated dust on the diodes. Also, torque the diode studs to 25 ft-lbs (33 Nm). Loose or dust covered diodes can overheat and fail.

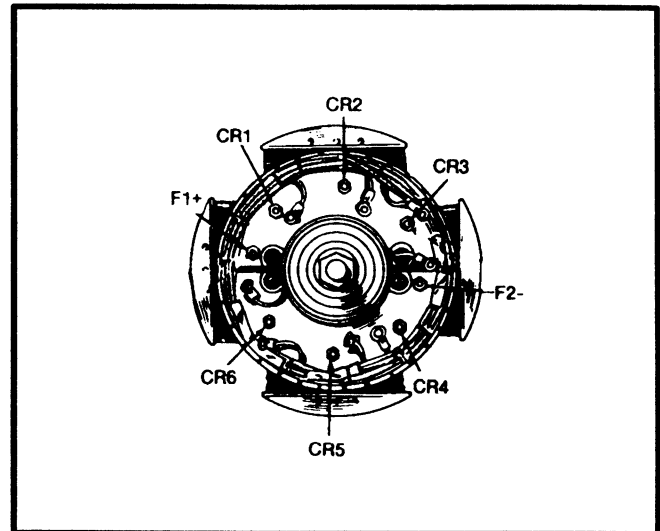


FIGURE 9-12. ROTATING RECTIFIERS

PCV VALVE (Series JCA/B Only)

Remove both rocker covers for access (Figure 9-13). Remove the circlip in each PCV to disassemble and clean. Be careful not to let the parts fly off when the circlip is removed.

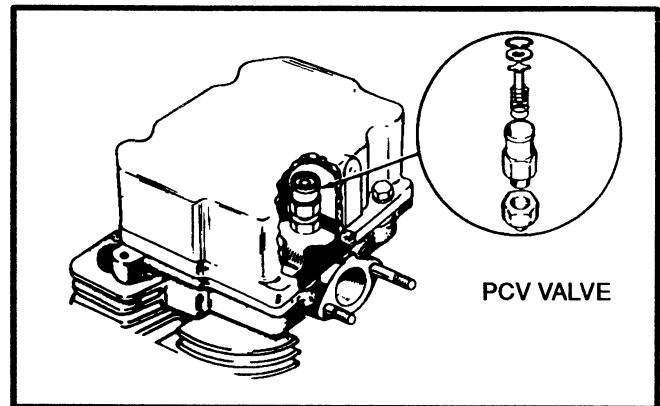


FIGURE 9-13. PCV VALVE

TORSIONAL WASHERS

Four torsional washer assemblies are bolted inside the flywheel pulley hub (Figure 9-10). When functioning properly, they react to relieve torsion

stresses on the crankshaft. Inspect the assemblies periodically for movement of washers and freedom from corrosion (1500 hours commercial, yearly non-commercial). If condition is questionable, contact an Onan service center or distributor.

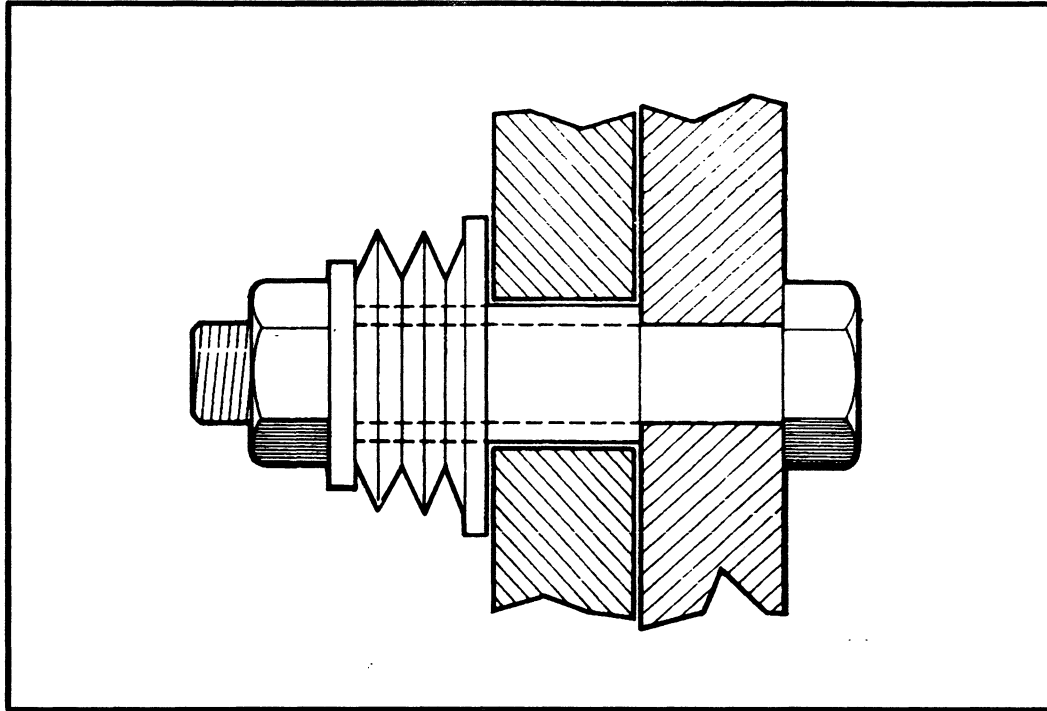


FIGURE 9-10. TORSION WASHER ASSEMBLY

OUT-OF-SERVICE PROTECTION

If you are unable to exercise the generator set regularly, and the set will not be in use for more than 30 days, the following procedure is recommended.

1. Exercise the generator set as described in the *Operation* section until the engine is up to operating temperature.
2. Shut down the genset.
3. Drain the oil base while the genset is still warm. Refill and attach a warning tag indicating the viscosity of oil used.
4. Pour one ounce of rust inhibiting oil (or SAE Grade 10) into each cylinder. Crank the engine several times and replace the spark plugs.
5. Disconnect battery and store in a cool, dry place. Connect battery to a charger every 30 days to maintain it at full charge.
6. Service the air cleaner.
7. Clean throttle and governor linkage and protect by wrapping with a clean cloth.
8. Plug the exhaust outlet to prevent entrance of moisture, bugs, dirt, etc.
9. Clean and wipe the entire unit. Coat parts susceptible to rust with a light coat of grease or oil.
10. Provide a suitable cover for the entire unit after unit has cooled down.

RETURNING A UNIT TO SERVICE

2. Check the warning tag on the oil base and verify that the oil viscosity is still correct for the existing ambient temperature.
3. Clean cooling fin areas.
4. Clean and check the battery. Measure the specific gravity (1.260 at 80° F [27° C]) and verify that the level is at the split ring. If the specific gravity is low, charge until the correct value is obtained. If the level is low, add distilled water and charge until the specific gravity is correct. **DO NOT OVERCHARGE.**

⚠ WARNING Ignition of explosive battery gases can cause severe personal injury. Do not smoke or allow any ignition source while servicing batteries.
5. Connect the starting battery (ground terminal last).
6. Check the fuel level.
7. Remove all loads before starting the engine.
8. Start engine and observe oil pressure gauge and charge rate ammeter.

After engine has started, excessive blue smoke will be exhausted until the rust inhibitor or oil has burned away.
9. After start, apply load to at least 50 percent of rated capacity.
10. Unit is ready for service and load may be applied.

10. Maintenance Record

Keep a record of all periodic and unscheduled maintenance. Record the service date and the number of operating hours from the hour meter.

Refer to the Maintenance Schedule in Section 8 for the time interval between maintenance procedures. Record the name and address of your Onan service center and keep all of your service receipts.

[illegible]

Record the name, address, and phone number of your authorized Onan service center.



Onan

Onan Corporation
1400 73rd Avenue N.E.
Minneapolis, MN 55432
Telex: 275477
Fax: 612-574-8087

Onan is a registered trademark of Onan Corporation
Cummins is a registered trademark of Cummins Engine Company