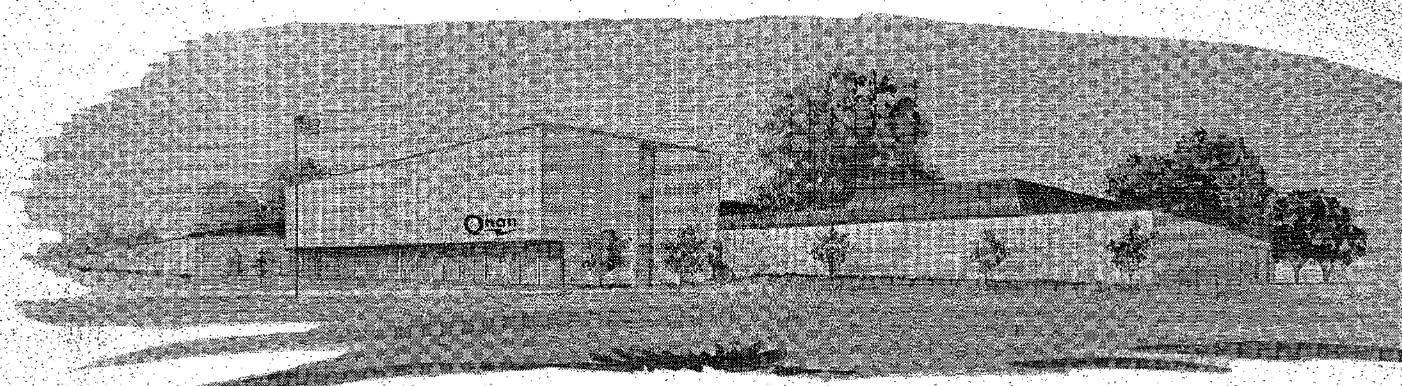
T-030

technical bulletin

INSTALLATION INFORMATION FOR ONAN LIQUID-COOLED ELECTRIC GENERATING SETS



SCOPE

Information in this bulletin presents general guidelines for design of an integrated standby generator set system. Base your design details on individual site requirements, local codes and regulations, on material in this bulletin and other bulletins or manuals. See the Bibliography for a list of reference publications.

WARNING **Onan uses this symbol throughout this manual to warn of possible serious personal injury.**

CAUTION **This symbol refers to possible equipment damage.**

Because Onan products appear on the world market, both metric and the American system of units (CU) are presented in this bulletin. To become familiarized, refer to the following terms.

TERM	METRIC	ENGLISH
Length	millimetre (mm) metre (m)	Inch (in.)
Pressure	kilopascals (kPa)	pounds per square inch (PSI)
Mass (Weight)	kilogram (kg)	pound (lb)
Volume (Liquid)	litre	gallon (gal)
Power	kilowatt	horsepower (HP)
Frequency	hertz (Hz)	cycles per second (CPS)
Energy	Joules (J)	BTU
Temperature	Celsius (°C)	Fahrenheit (°F)

The customary unit of horsepower (HP) becomes kilowatts (kW) when converted to SI metric units. Do not confuse this kW rating with the kW rating of the generator or motor which is always lower due to losses inherent with any electrical induction device.

NOTE: Throughout the manual references are made to tables according to the title of the table or by reference to the index of tables on page 28. Refer to this index on page 28 for the location of the specific table as referenced by table title throughout the text.

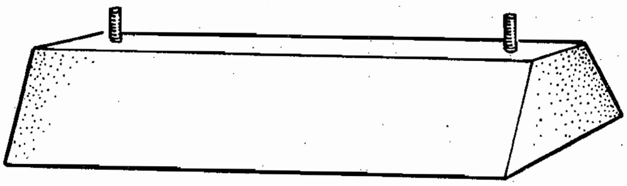
TABLE OF CONTENTS

MOUNTING

LOCATION

Generator set location is decided chiefly by related systems such as ventilation, wiring, fuel, and exhaust. Provide a location away from extreme ambient temperatures, protecting the generator set from adverse weather conditions, yet near as possible to the main power fuse box.

Plan for adequate access to the generator set for service and repair with lighting facilities around the unit. Wood floors should be covered with sheet metal extending 12 inches (305 mm) beyond the extremeties of the generator set.



TAPERED CONCRETE BLOCK

FIGURE 1. TYPICAL MOUNTING FOUNDATION (SMALLER UNITS)

MOUNTING

Mount and secure the generator set on a substantial and level base. A raised foundation will facilitate service and repair.

Foundations for small units can be concrete with anchored mounting bolts as shown in Figure 1 (steel beam sections make an acceptable alternate). Figure 2 shows a recommended foundation for gas or gasoline units of 100 kW and larger, or diesel units of 60 kW and larger. Bolt the generator set to the base to prevent unit movement during operation. Outline drawings with mounting locations and dimensions are available for all Onan generator sets.

After bolting down units 400 kW and larger, the generator mounting feet must be reshimmed to provide correct generator alignment. See the operator's manual for details.

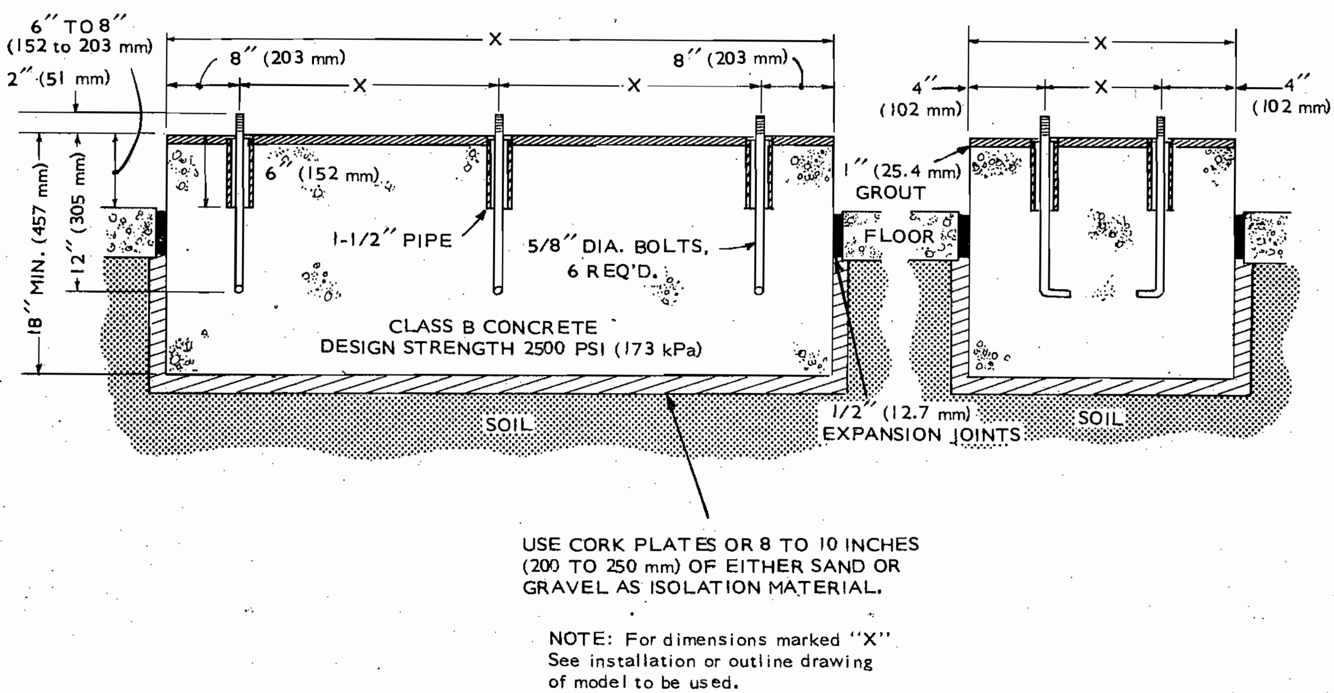


FIGURE 2. POURED CONCRETE FOUNDATION (100kW AND LARGER, GAS OR GASOLINE; DIESEL UNITS OVER 60 kW)

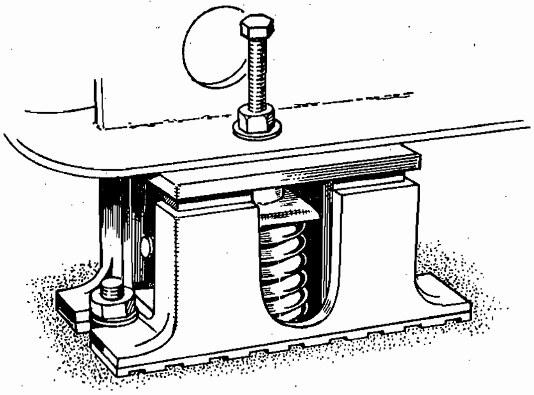


FIGURE 3. OPTIONAL SPRING TYPE VIBRATION ISOLATOR

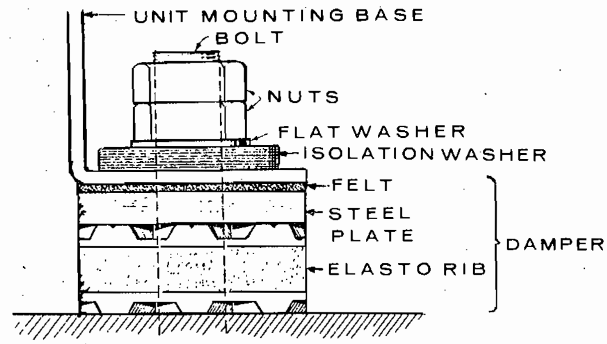


FIGURE 4. PAD TYPE VIBRATION ISOLATOR

VIBRATION CONTROL

Generator sets up through 180 kW include integral rubber vibration isolators which provide 75 to 85% vibration attenuation. Spring type (Figure 3) or pad type (Figure 4) isolators can be used with larger generator sets to achieve similar results. High deflection spring type isolators can be used with any generator set to achieve 95 to 98% vibration attenuation for critical installations.

NOISE CONTROL

You can attenuate exhaust noise by using proper mufflers. To attenuate other noises, use line-of-sight barriers, total acoustical enclosures, sound attenuating duct treatment, or install the generator set away from critical areas. Onan does not supply acoustical enclosures, but there are companies which design and supply such equipment.

VENTILATION

Generator sets reject considerable heat during operation which must be removed by proper ventilation. Outdoor installations rely on natural air circulation, but enclosed installations need properly-sized, properly-positioned inlet and outlet vents for required airflow.

Ventilation systems are designed and based on the presence or absence of a fan and radiator. With a radiator, the engine-pusher fan is sized to provide adequate airflow to remove all heat rejected by the engine, generator, and a few feet (metre or so) of uninsulated exhaust pipe *(Heat Loss From Uninsulated Exhaust Pipe and Mufflers)*. Generator set radiator cooling system airflow, radiator area, and coolant capacity are listed *(Cooling System Capacity Radiator Area and Airflow)*. Restrictive ducting or heat sources other than the generator set requires the use of auxiliary fans to increase airflow.

Page 28 gives an index of all the tables.

With other cooling options, ventilation fans are required to provide adequate ventilation. Size the fans to remove all heat rejected in the room by the generator set, uninsulated exhaust pipes and other heat producing equipment. Maintaining a temperature differential of 20° to 30° F (11° to 17° C) is usually satisfactory.

VENTS AND DUCTS

Locate vents so cool, incoming air passes through the immediate area of the installation before exhausting. Install the air outlet higher than the air inlet to allow for convection air movement. See Figure 5.

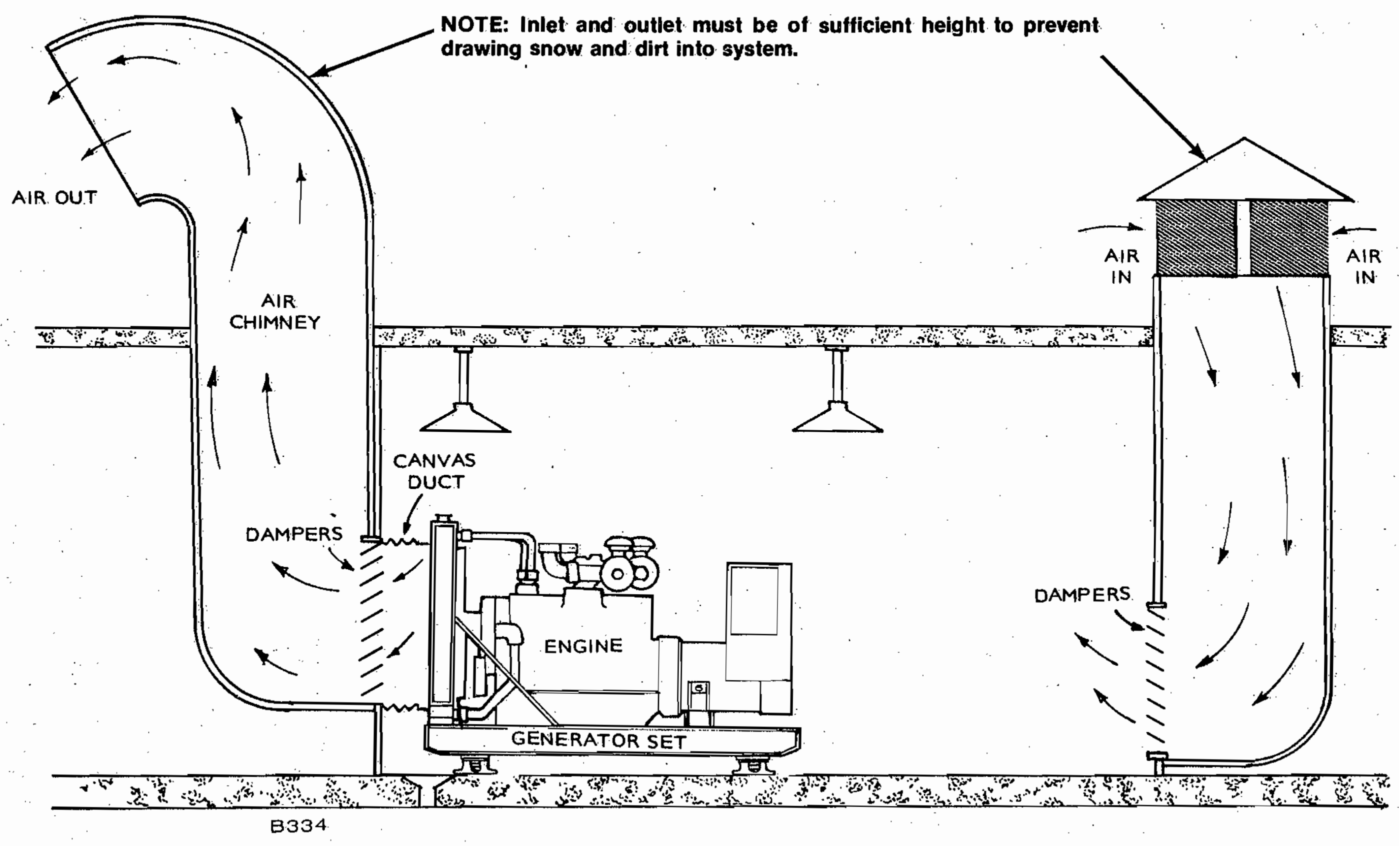


FIGURE 5. TYPICAL DUCT INSTALLATION WITH ROOFTOP AIR INLET AND OUTLET

The vents and ducts must be large enough to allow the required flow rate of air. "Free area" of louvers, screens and ducts must be as large as the radiator area (when radiator is used). If free air flow is in any way restricted by louvers or screens, the vents must be increased in area 1/4 to 1/2 times.

Cooling air travels from the rear of Onan generator sets to the front (engine end).

Wind will restrict free airflow if it blows directly into the air outlet vent. Consider prevailing wind directions when planning vent locations.

Ducts

Take care to eliminate a problem of recirculating cooling air. Two main types of recirculation occur:

1. Air recirculating around the radiator. Use a flexible, canvas duct between the radiator and discharge duct to eliminate this problem.
2. Air recirculating from the air discharge duct outlet to the air inlet duct—keep air discharge duct and air inlet duct apart.

The duct free area must be as large as the exposed area of the radiator. If bends in the duct are required, design them to minimize restrictions. See Figure 5.

For Onan 30 kW and larger electric generating sets, the inlet air size should be 1-1/2 times the size of the radiator duct outlet.

Refer to Section 2 of the ASHRAE "HANDBOOK OF AIR CONDITIONING, HEATING AND VENTILATION" for duct design data.

WARNING **Due to the deadly fumes in exhaust gases, do not terminate the exhaust system in the duct!**

DAMPERS

Dampers can be used in any system to block airflow through vents when the generator set is not running. Four types of dampers are discussed here.

1. Automatic: Not thermostatically-controlled, connect these dampers to open any time the ignition circuit is energized.
2. Manual: Must include interlock switches which prevent starting of the generator set until the dampers are opened.
3. Thermostatically-controlled: Depending on the type of cooling system used, a thermostatically-controlled damper must be connected as follows to ensure correct temperature in the power room.
   a. With integral radiator—Engine water temperature must be controlling factor of thermostat. A recirculating system as shown in Figure 6 provides the best temperature control. Note with this system, however, that it is necessary to connect the discharge dampers so one opens when the other closes.
   b. Without radiator—Outlet air temperature must be controlling factor of thermostat.
4. Fixed: Dampers which are fixed must have a free area at least as large as the radiator area.

REQUIRED COOLING AIR

To determine the air needed to remove generator set heat rejection in the installation enclosure or room for remote radiator, city water standpipe or heat exchanger cooled units, use the heat rejection factors from table *(Heat Rejection to Room Pipe Sizes and Required Water Flow)* and the following formula.

$$V = \frac{Q}{1.08 \quad \Delta T}$$

V is air in cubic feet/min needed to remove the heat and Q is heat in Btu/hr to be removed. ΔT is the permissible room temperature rise in degrees Fahrenheit.

EXAMPLE: Heat rejection to the room, determined from the table is 115,500 Btu/hr for the electric generator set. If the allowable temperature rise is 20 degrees, the required cooling air V is:

$$V = \frac{115{,}500}{1.08\ (20)}$$

$$V = \frac{115{,}500}{21.6}$$

V = 5,347 cubic feet/min.

To determine required cooling air in metric units, use V for air in cubic metres/min needed to remove the heat and Q for heat in megajoules/hr (MJ/hr) to be removed *(Heat Rejection to Room, Pipe Sizes and Required Water Flow)*. ΔT is the permissible room temperature rise in degrees Centigrade.

$$V = \frac{Q}{0.07242\ \Delta T}$$

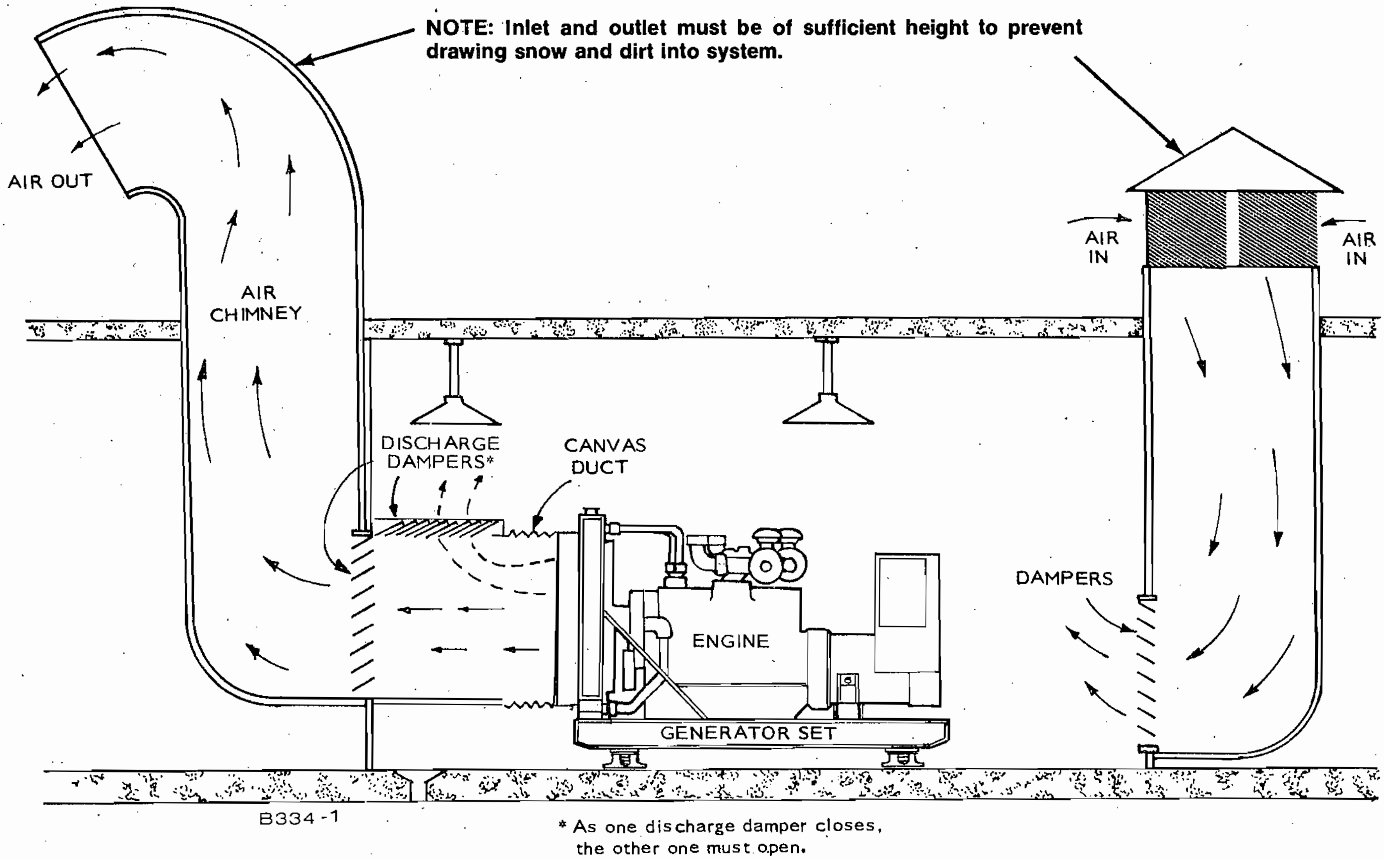


FIGURE 6. TYPICAL DUCT INSTALLATION WITH TWO DISCHARGE DAMPERS FOR RECIRCULATING AIRFLOW

COOLING SYSTEM

Engines using a liquid for cooling have jackets or passages around each cylinder and throughout the cylinder head. Coolant enters the jacket under pressure, and on its way to the outlet, absorbs heat from the engine. Water cooling systems are designed so the engine inlet and outlet temperature differential is maintained at a desirable level, usually not more than 15° F or 8° C.

CAUTION **High Engine Temperature Cutoff will shut down engine in an overheat condition only if coolant level is sufficiently high to physically contact shutdown switch. Loss of coolant will allow engine to overheat without protection of shutdown device, thereby causing severe damage to the engine. Adequate engine coolant levels must be maintained to ensure operational shutdown protection capability of engine cooling system.**

At the outlet the coolant may enter a radiator or heat exchanger, be tempered in a standpipe, or dumped into a drain. Consider initial cost, operating cost, space, ambient temperature, ventilation, noise and availability of satisfactory water. Note the advantages and disadvantages of each.

OPERATION PRINCIPLES

Radiator Cooling

A radiator is comprised of small finned tubes through which engine coolant passes. These fins provide a large surface area for transfer of heat from the coolant to the air stream. The air stream in Onan generator sets is produced by a pusher-type radiator fan which draws air over the engine and pushes it through the radiator. Radiator cooling provides low initial cost, is completely independent of any interruptible utility (as in contrast to city water cooling), and it can be freeze protected with antifreeze solution. However, radiator cooling requires large ventilation ducts and the radiator fans are relatively noisy.

CAUTION **For Onan generator sets having cooling system corrosion resistors, do not use antifreeze solutions with an antileak formula. The antileak formula will clog the element.**

Remote Radiator Cooling

Some installations require the radiator and fan mounted separately from the generator set. While these systems offer more versatility, require less power room ventilation, and can use low-noise fans, these systems are more expensive in original cost than the other cooling systems discussed. There are three categories of remote radiator designs (see *"Remote Radiator System Designs"*).

City Water Cooling

This type of cooling uses an external water source to cool the engine. It offers quieter operation than radiator cooling (no radiator fans) and less required ventilation, but it cannot be freeze protected throughout the system, it is dependent on the utility water source (unless independent source used), and operating cost is higher due to cost of supplying cooling water. Three types of city water cooling are available (see *"City Water Cooling Designs"*).

REMOTE RADIATOR SYSTEM DESIGNS

General Information

Pipe Sizing: When water flow is produced by the engine-driven water pump, total piping pressure drop must not exceed 7 psi (48.3 kPa) at rated engine water flow. If water flow is assisted by an auxiliary pump, piping pressure drop must be matched to pump capacity at desired water flow.

Refer to table on water pressure drop in PSI for standard DDV radiators. *(See Index of Tables).*

Remote Radiator Airflow: Remote radiators are designed for installations where no external airflow restrictions occur. If the remote radiator will ventilate a room, has any ducting, or its airflow is opposed by prevailing winds, the cooling capacity is reduced.

Deaeration: Because air enters the cooling system during generator set operation, a radiator top tank or surge tank must be installed at the highest point in the system. This point is the only place where air is adequately separated from the system (Figure 8 shows plumbing). A top tank or surge tank must have adequate volume so the inlet and outlet are below the normal running water level, and the air space provides not less than eight percent of the total volume of the engine water jacket, piping, and radiator.

CAUTION **If the radiator top tank or surge tank is not at the highest point in the system, high sections of plumbing can cause air pockets which prevent water flow and result in engine overheating.**

Auxiliary Pumps: The auxiliary pumps listed show the pumping capacity with approximately a 40-foot (12.2 m) head pressure. *(See Table on Auxiliary Water Pumps.)*

CAUTION **The 40-foot (12.2 m) head pressure limit is the maximum allowable for a single Onan pump and tank system. If vertical distance creates greater head pressures, add secondary pumps or higher capacity pumps and tanks. This type of system requires a qualified consulting engineer with hydraulic cooling system design experience.**

Proper pump and motor selection is based on pump duty, capacity and head loss. A restriction or gate valve may be required on the auxiliary pump outlet to maintain pump pressure head loading and prevent motor overloading. Check proper pump operating and loading by operating the entire system. If coolant is discharged from the radiator overflow or at the vent system outlet, slowly close the gate valve or increase the restriction in the pump outlet until the overflow action stops. Do not increase pump outlet loading so much that the pump overloads.

Electrical: Make connections of fans and auxiliary pumps to the generator set power distribution panel so the fans and pumps operate whenever the generator set operates. Special voltages are available.

Flexible Hoses: Install flexible hoses to isolate vibration at the engine and radiator water inlets and outlets.

Drain Valve: At the lowest point in the cooling system, install a drain valve for cleaning and flushing.

Heat Rejection: The heat rejection to coolant figures of Onan generator sets are listed separately for gasoline and diesel powered systems (refer to *Index of Tables*).

Radiator Selection

Remote radiators for Onan generator sets are available from the Perfex Corporation, Milwaukee, Wisconsin; or, from Young Radiator Company, Racine, Wisconsin. Sizing is determined by the particular generator set. (Refer to *Index of Tables* for a list of Perfex radiator models. Gasoline and diesel models listed separately).

Radiator sizes are based on 190°F (88°C) engine water outlet temperatures. Maximum operating radiator inlet temperatures are indicated at the top of the table and are rated at a maximum altitude of 1200 feet (366 m) above sea level. Operating at higher altitudes requires derating the cooling capacity 2 percent for each 1000 feet (305 m) above the first 1200 feet (366 m).

Consider radiator noise levels for each installation. Lower noise levels require lower speed fans but also require larger radiators (Table 8).

Short Remote Radiator Installation

The sum of the vertical distance from the engine centerline to the radiator top and the horizontal distance from the engine front to the radiator centerline must not exceed 15 feet (4.6 m). Figure 7 shows a typical schematic of the installation. The engine water pump provides adequate coolant circulation through the entire cooling system with proper plumbing.

Size the pipe the same as the engine inlet and outlet fittings throughout the entire system. (Refer to table on *Type DDV Radiators - Low and High Speed Fans - Column J* for minimum pipe size recommended. See *Index of Tables*.)

Long Remote Radiator Installation

The sum of vertical distance from the engine centerline to the radiator top and horizontal distance from engine front to the radiator centerline exceeds 15 feet (4.6 m), but the vertical distance alone does not exceed 15 feet (4.6 m). Figure 8 shows a typical schematic of the installation.

A surge tank and auxiliary water pump (in conjunction with engine water pump) in the system provide adequate coolant circulation. See *"General Information."*

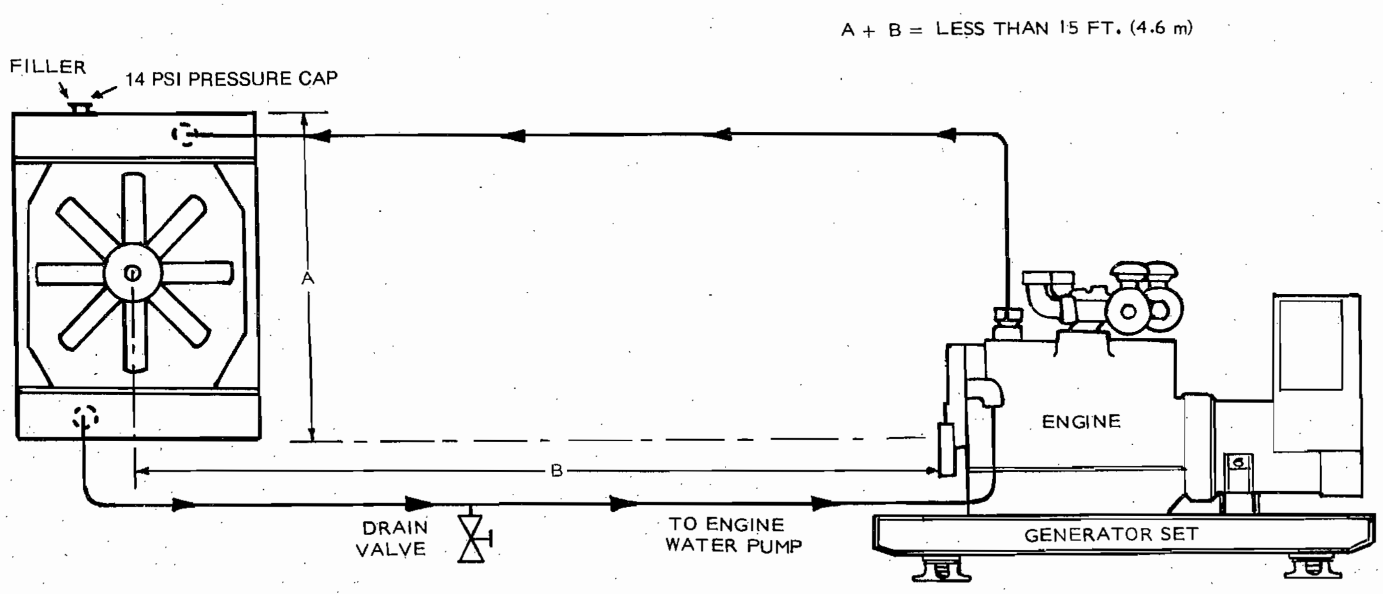


FIGURE 7. SHORT REMOTE RADIATOR INSTALLATION

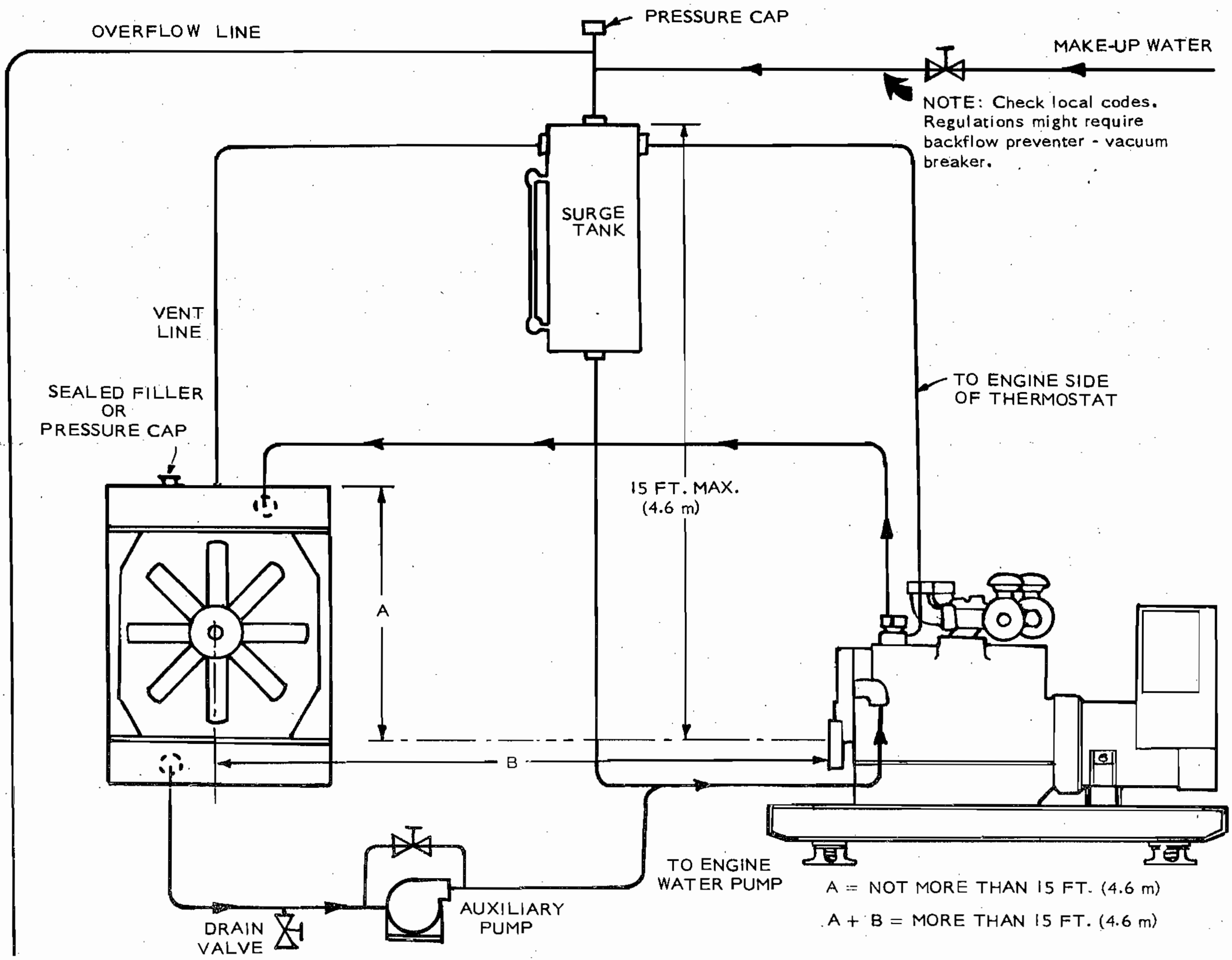


FIGURE 8. LONG REMOTE RADIATOR INSTALLATION WITH SURGE TANK

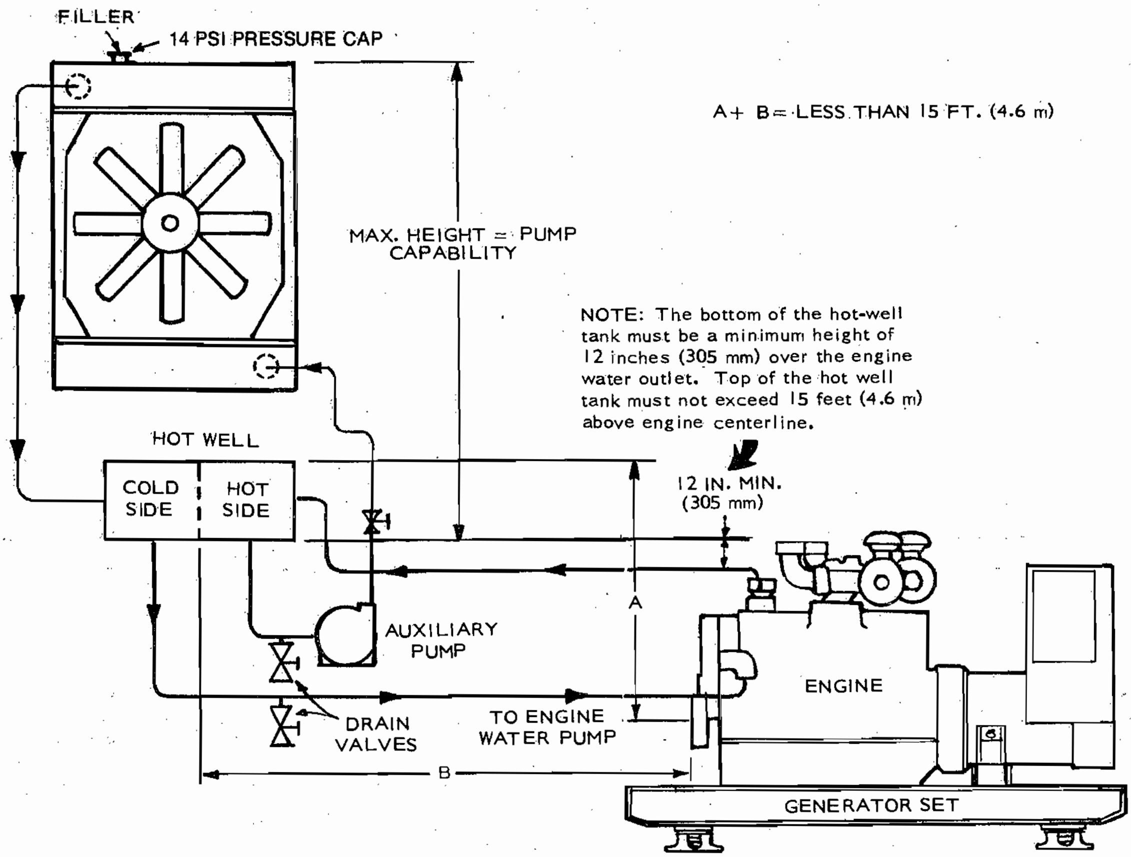


FIGURE 9. HIGH REMOTE RADIATOR INSTALLATION

High Remote Radiator Installation

If the radiator top is more than 15 feet (4.6 m) above the engine centerline, a hot-well tank and auxiliary pump between the engine and the radiator are required. See Figure 9. The tank is a storage tank which reduces the water head pressure on the engine to acceptable limits. It is a two-section tank with a partial baffle to separate the hot side (from engine outlet) and the cold side (to engine inlet).

The engine pump circulates water between the engine and hot-well tank, and the auxiliary pump circulates water between the hot-well tank and remote radiator (Figure 9). If the radiator is selected from the Tables (see *Index of Tables*), the auxiliary pump must supply the same water flow as the engine water pump. If not, a larger radiator is required.

Size the hot-well tank so it can contain the full-water capacity of the engine, piping, radiator, volume needed to keep inlets and outlets submerged, and eight percent of total for expansion. Inlets to the tank must be higher than the outlets, with both lower than the lowest possible operating water level. Because the radiator drains into the cold side of the hot-well tank after generator set shutdown, the baffle between the hot and cold side must have an opening large enough to allow free water passage up to the flow rate of engine or auxiliary pump, whichever is larger. As shown in Figure 10, the hot-well tank is vented to the atmosphere.

Maximum water level in the hot-well tank must never exceed 15 feet (4.6 m) above the engine centerline. The bottom of the tank must be a minimum of 12 inches (.305 m) over the engine water outlet. Vertical height between the bottom of the hot-well tank to the top of the radiator is limited by auxiliary pump capability. Supports for the hot-well tank must withstand the weight of the water plus 60 percent of the cooling system capacity (when the generator set is not running).

Mount the auxiliary pump at the tank hot side outlet below the running water level to prevent air from entering the pump during operation. If the proper pump and water line sizes are used, adequate water flow is maintained. For information on the pumps, see "Auxiliary Pumps.".

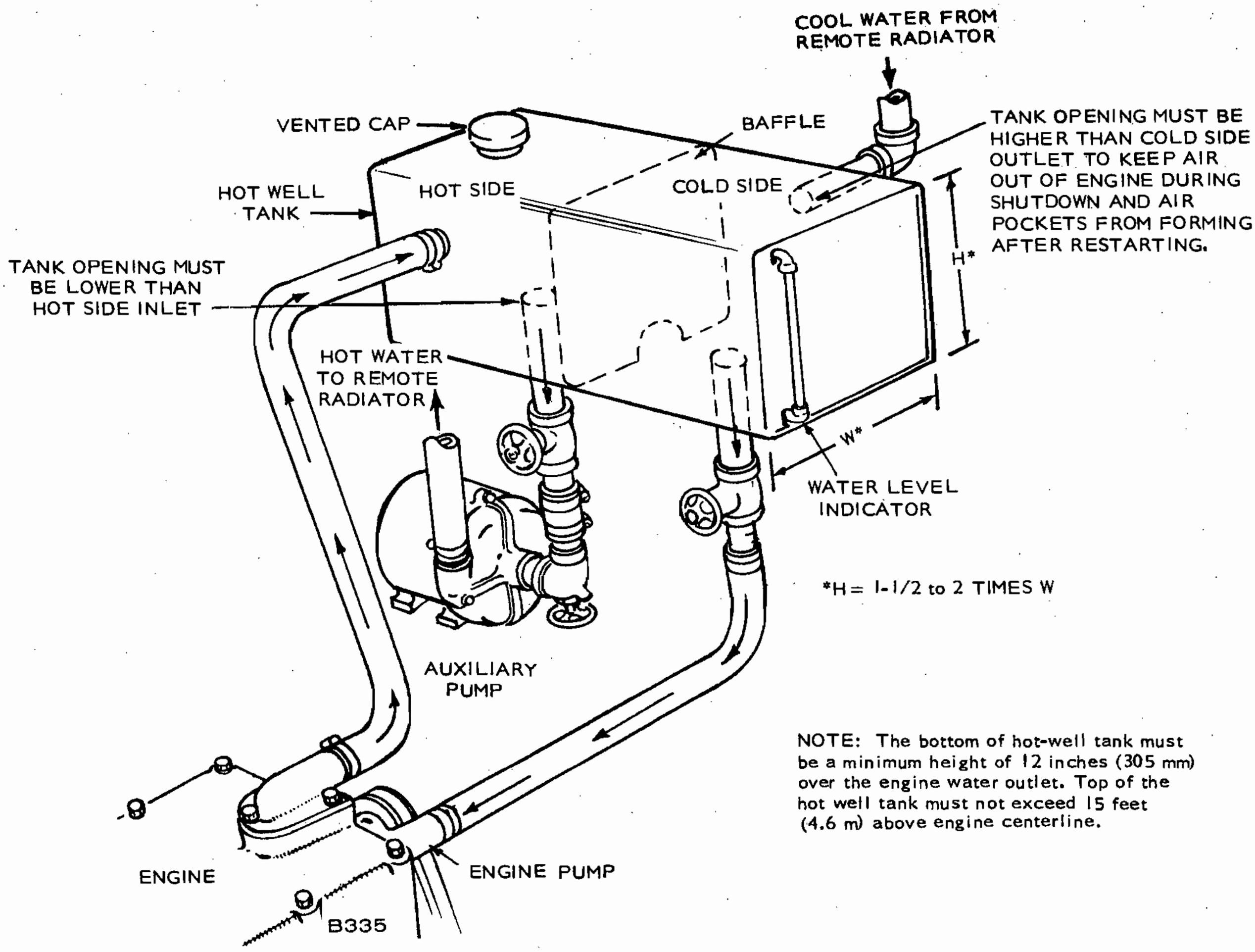


FIGURE 10. TYPICAL HOT WELL TANK

CITY WATER COOLING DESIGNS

Onan recommends using water-cooled exhaust manifolds on all city water cooling installations to further reduce the airflow ventilation requirement. Although the airflow requirement is much less than that for radiator cooled generator sets, plan the installation for airflow patterns much the same as with radiators. City water cooled models need sufficient airflow to remove heat radiated from the engine generator, exhaust and water plumbing. See *Index of Tables* on pipe sizes and required water flow cooling systems.

Standpipe Installation

With this system, the engine water pump pulls cooling water from the standpipe, moves it through the engine and back to the standpipe. The city water supply forces water into the standpipe and out an overflow line to the drain (Figure 11). Heated water from the engine and cooler water mix in the standpipe to continually provide a proper temperature water supply for engine cooling. The vacuum relief valve in the standpipe eliminates a siphoning effect caused by a long drain discharge line.

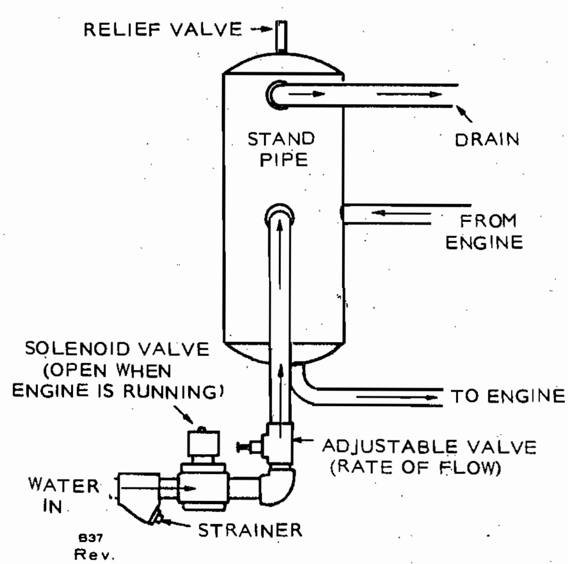


FIGURE 11. STANDPIPE COOLING SYSTEM

CAUTION **1. Since the incoming water enters the engine cooling passages, the water must be very clean and have very low corrosion levels to prevent clogging engine passages. Otherwise, engine overheating and damage will result.**

2. With standpipe cooling, the entire cooling system must be drained during freezing conditions to prevent equipment damage.

Flow rate of the city water supply must be adequate to cool the engine. Water flow rate can be controlled by a manual valve (set for proper cooling of engine at full load) or by an automatic valve which uses the engine coolant outlet temperature as an adjustment reference.

Onan uses a solenoid shutoff valve before the control valve in the incoming city water line (Figure 11). It stops city water flow when the generator set is stopped. More importantly, it ensures an automatic cold water supply when the generator set starts.

Heat Exchanger Installation

The heat exchanger consists of tubing within a surrounding "shell." Engine water in the shell side of the heat exchanger does not mix with city or raw water within the tubes (Figure 12). Raw water passing through the tubes absorbs engine heat from the separated engine coolant in the heat exchanger. Because the engine coolant is not mixed with the city or raw cooling water, the engine coolant can include antifreeze and anti-corrosion solutions for engine protection.

CAUTION **While you can protect the engine coolant from freezing with antifreeze solution, cooling raw water cannot be protected. If freezing temperatures are encountered, the heat exchanger's raw water system must be drained.**

Flow rate of cooling raw water is controlled either by a manual or automatic valve. A manual valve must be adjusted for proper engine cooling while running under full load. If an automatic valve is used, the engine coolant outlet temperature must be used as an adjustment reference. A solenoid valve is included in

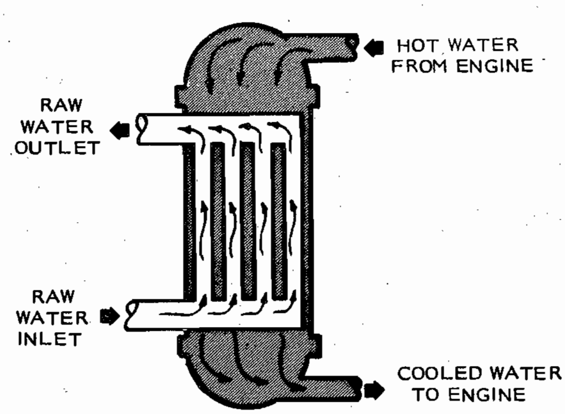


FIGURE 12. TYPICAL HEAT EXCHANGER

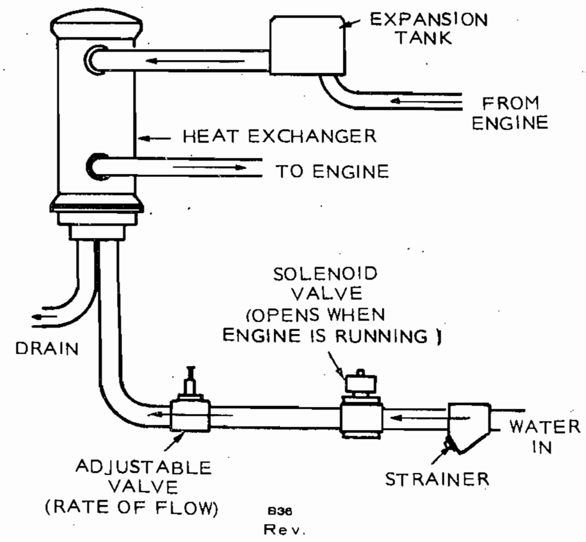


FIGURE 12A. HEAT EXCHANGER SYSTEM

the incoming raw water line and opens during generator set operation. Figure 12A shows a heat exchanger system.

Direct Flow Installation

With this sytem, a city or raw water cooling supply under pressure forces water directly into the engine, through the engine and to the outlet. An adjustable valve controls the incoming water flow rate to obtain correct engine water temperature, as measured at engine coolant water outlet while the generator set is operating under full load. A solenoid valve is coordinated with the generator set system to open during set operation. (See Figure 13 on next page).

CAUTION **Restrict inlet water pressure to a maximum of 7 psi or 48.3 kPa, otherwise engine gaskets and seals will leak.**

Raw water cooling is often undesirable because:

1. The water supply must be very clean or engine deposits will result.
2. A high temperature differential between the cold incoming water into the engine and warm discharged water can put damaging stresses on engine components (no overall uniform engine temperature).

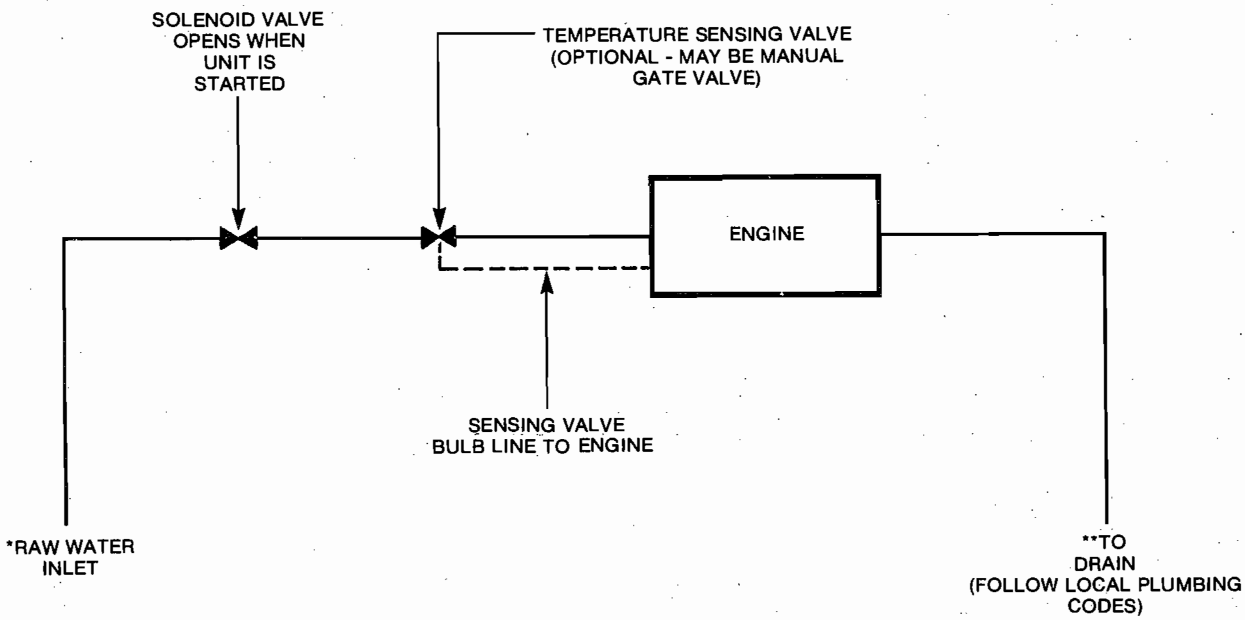
COOLANT HEATERS

Engine coolant heaters with thermostats, available from Onan, are important for any unattended, standby application. They increase:

1. Starting reliability,
2. Engine life,
3. Unit ability for load acceptance.

Due to starting difficulty of diesel generator sets in cold temperatures, Onan recommends coolant heaters whenever the ambient temperature surrounding the set is 50°F (10°C) or lower. Commercial power is used to operate the heater whenever the generator set is idle.

Thermostats are used to control operation of the heaters by sensing coolant or engine block temperature.



* MUST BE RESTRICTED TO 7 PSI MAXIMUM.
** MUST BE RESTRICTED TO 1 PSI MIN. AND 7 PSI MAXIMUM WHEN A TEMPERATURE SENSING VALVE IS USED.

FIGURE 13. TYPICAL DIRECT COOLING SCHEMATIC (USED ON STANDBY APPLICATIONS ONLY)

FUEL SYSTEM

For gaseous fuel systems such as natural, manufactured, or LP gas, see technical bulletin T-015, *"USE OF GASEOUS FUEL WITH ONAN ELECTRIC GENERATING SETS"* for installation information.

WARNING **Due to the potential hazard of fire and explosion with any fuel, carefully design and install the fuel system observing applicable codes.**

STORAGE TANKS

Tank Size

If the generator set must run for long periods of time without an operator, the fuel tank should be large enough to supply the engine for the expected time plus an extra safety factor time. Generally, fuel tanks should have the capacity to sustain full load operation of the generator set for 36 hours without refueling.

Determine tank size by using Table *(see Index of Tables)* which gives fuel consumption figures (generator set operation at full load) and fuel-lifting capabilities of different units. Onan can supply underground or aboveground fuel tanks with 55- to 560-gallon (208- to 2120-litre) capacities. These tanks can accommodate a fill pipe, vent pipe, drop tube and two return lines.

Tank Location

The fuel tank can be installed above or below the ground, but locate it near as possible to the generator set. Because the fuel pump influences fuel tank location *(refer to Index of Tables)*, for fuel pump lift figures of the generator sets.

If the sum of the fuel pressure drop and vertical lift exceeds the lift capabilities of the standard fuel pump shown in Table 13, use an auxiliary fuel pump and day tank.

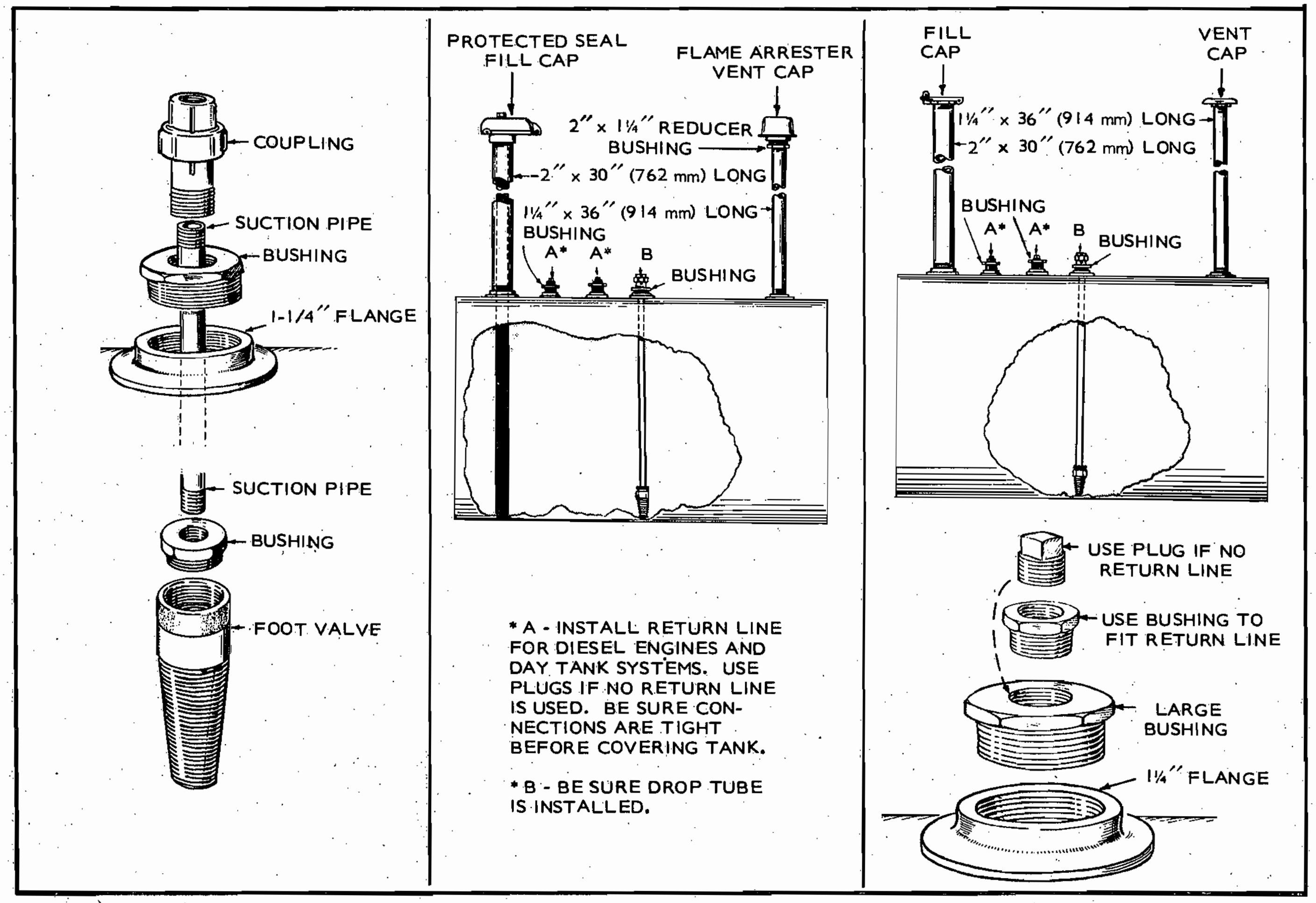


FIGURE 14. FUEL TANK FITTINGS

WARNING Because of fire hazard, never install a fuel tank or fuel line near exhaust pipes.

Day tanks are fuel transfer tanks used when the standard engine fuel pump hasn't the necessary lift to draw fuel from the supply tank (auxiliary pump is also required). For overhead fuel tanks, day tanks are used to remove fuel head pressures which otherwise would be placed on the engine fuel system components. See *"Diesel Day Tanks"* or *"Gasoline Day Tanks,"* whichever applies.

A gasoline primer tank replenishes fuel evaporated from the carburetor of gasoline generator sets which require quick, dependable starts. See *"Gasoline Primer Tanks"* for more information.

Under National Fire Prevention Bulletin No. 37, gravity feed of fuel is permitted only from integral tanks of 25 gallons (94.6 litres) or less. If the fuel tank is located higher than the generator set and gravity feeds directly to the unit fuel pump, use an anti-siphon system for proper operation and safety with gasoline systems (see *"Gasoline Anti-Siphon System"*).

Tank Fill and Vent Pipe

Figure 14 shows typical fuel tank fittings for the fill and vent pipes. If the fuel tank is underground, height of the pipes may vary. Make sure the fittings are air and moisture tight. Use a removable wire screen in the fill pipe neck, about 1/16-inch (1.6 mm) mesh, to trap contaminants whenever the tank is filled.

Levelometer

The levelometer, available from Onan, is an easy-to-read fuel level indicating gauge designed for underground fuel tank installations up to 12 feet (3.7 m) deep. The gauge operates on the hydrostatic principle and can therefore be installed at any reasonable distance from the fuel tank. See Figure 15.

Low Level Alarm Switch

A low level alarm switch, single-pole, double-throw, is available and senses the fuel level in an underground tank by pressure changes. When activated, the circuit to an alarm (furnished by customer) is completed.

Adjust the riser extension pipe so the bottom inlet is 1 inch (25 mm) below the minimum fuel tank level for pipe depths up to 10 feet (3 m). For longer pipe lengths in deeper tanks, the riser extension pipe should extend one more inch below the minimum fuel level for each additional 10 feet (or 8.3 mm for each metre). See Figure 16.

If tank depth is 15 feet (4.6 m), switch actuation should occur when the tank fuel level drops within 1.5 inches (38 mm) of the riser pipe bottom inlet.

All the switch and riser connections must be airtight to ensure proper operation. After the pipe connections are made from the tank, install the wiring and conduit from the alarm.

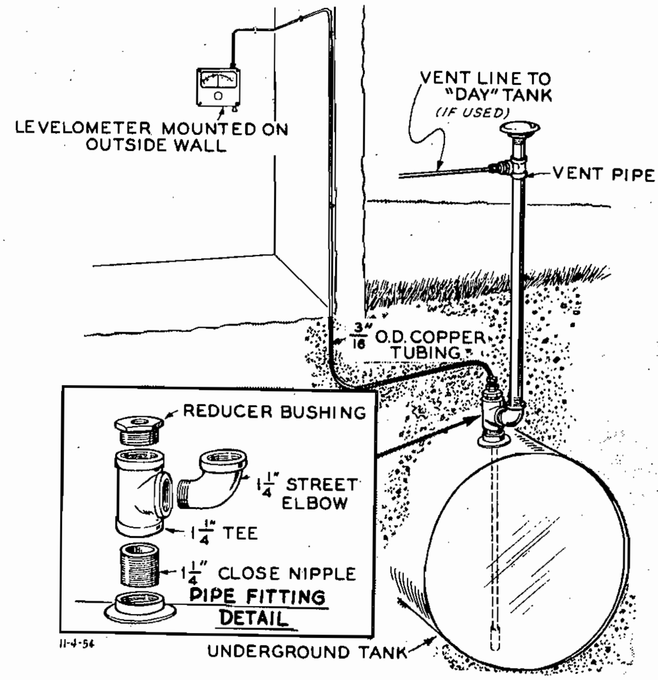


FIGURE 15. LEVELOMETER INSTALLATION

GENERAL FUEL PLUMBING

When buried fuel lines are used, use compatible metal fuel lines to avoid electrolysis. Onan has available copper fuel lines with brass fittings basically used for underground fuel tanks. See *Index of Tables.*

CAUTION **Never use galvanized fuel lines, fittings or fuel tanks with diesel fuel systems. Condensation in the tank and lines combines with the sulfur in diesel fuel to produce sulfuric acid. The zinc coating on galvanized lines or tanks reacts with the acid and flakes off to contaminate the fuel.**

Use a flexible section of tubing between the engine and fuel supply line to withstand generator set vibration (note diesel generator sets also require a separate fuel return line). All fuel line and tank fittings must be properly located and airtight to keep air from getting into the fuel lines.

Lifting capabilities are reduced by elbows, bends, and long lateral distances in the fuel line. Note during the descriptions of the various fuel systems using auxiliary fuel transfer pumps, the vertical lift is limited by the pump capability of the Onan transfer pump. With a larger capacity fuel pump, the vertical distance must not exceed 40 feet (12.4 m) lift. Fuel lifted long heights causes a pressure drop to the point where eventually the fuel boils, produces a vapor, and causes vapor lock.

An electric solenoid shutoff valve in the supply line is always desirable and required for indoor automatic or remote starting installations. Connect the solenoid wires to the battery ignition circuit to open the valve during generator set operation.

Carefully clean all fuel system components before putting the generator set in operation.

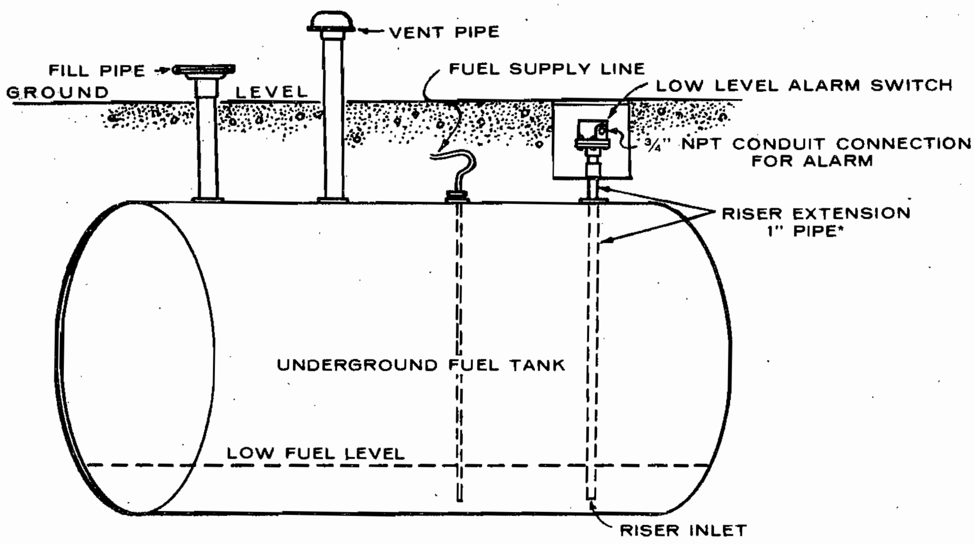


FIGURE 16. LOW LEVEL ALARM SWITCH INSTALLATION

DIESEL DAY TANKS

Day tanks are fuel transfer tanks which are used when the standard engine fuel pump hasn't the capacity to draw the fuel from the supply tank; or, the supply tank is overhead and presents problems of high fuel head pressure for the fuel return. *Refer to Chart on following page Figure 17 for Maximum Allowable Static Head Pressure.* If the top of the fuel supply tank is lower than the engine injection system and the engine fuel pump has the necessary lift capability, a day tank and auxiliary fuel pump are not required.

Onan has day tanks with float switches available from 8 to 60 gallons (30.3 to 227 litres) in capacity. Day tanks with a float valve are also available (usually used with overhead fuel supply tanks).

With Supply Tank Lower Than Engine

With this installation (Figure 17), the day tank is installed near the generator set and within the engine fuel pump lift capability, but below the fuel injection system (lift capabilities in Table based on *no* horizontal run). An auxiliary fuel pump is installed close as possible to the supply tank and pumps fuel from the supply tank to the day tank. A float switch in the day tank controls operation of the auxiliary fuel pump.

The supply tank top must be below the day tank top to prevent siphoning from the fuel supply tank to the day tank.

A return line must be provided from the engine injection system return connection to the day tank (near the top) and extend down below the minimum fuel level of the day tank. Otherwise, drain-back from the engine fuel pump and filters may occur.

The Detroit diesel engine is an exception. The fuel return line must go back to the main supply tank (see *"Detroit Diesel Engine"* following).

A day tank overflow line must be provided to the supply tank in case the float switch fails to shut off the fuel transfer pump (Figure 17).

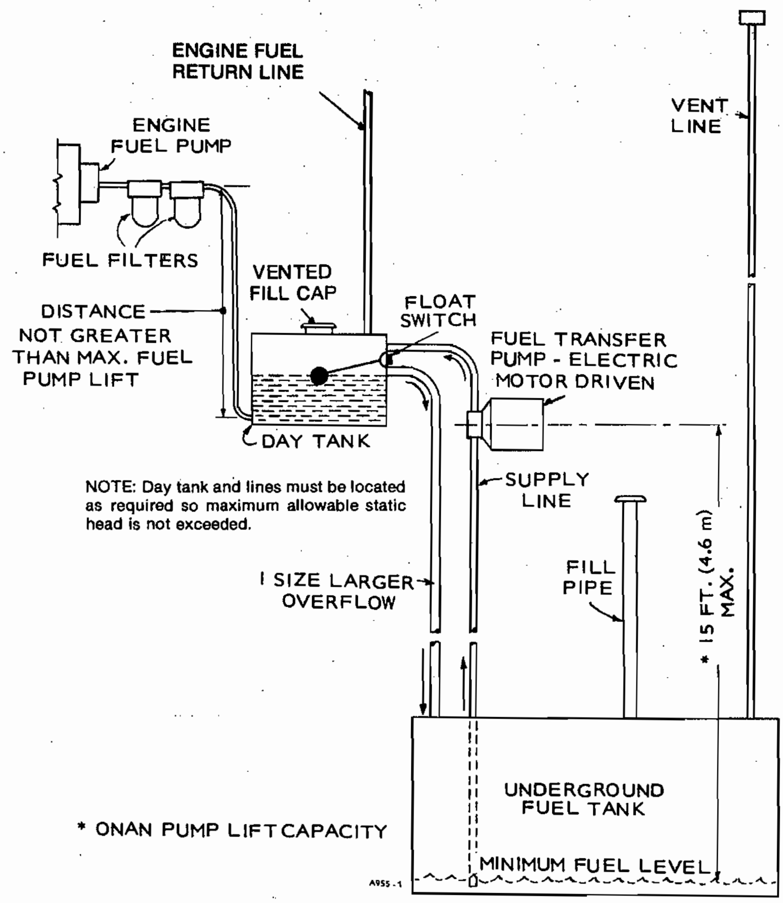


FIGURE 17. TYPICAL DIESEL FUEL SYSTEM WITH SUPPLY TANK BELOW GENERATOR SET

FUEL RETURN LINE - MAXIMUM STATIC HEAD PRESSURE

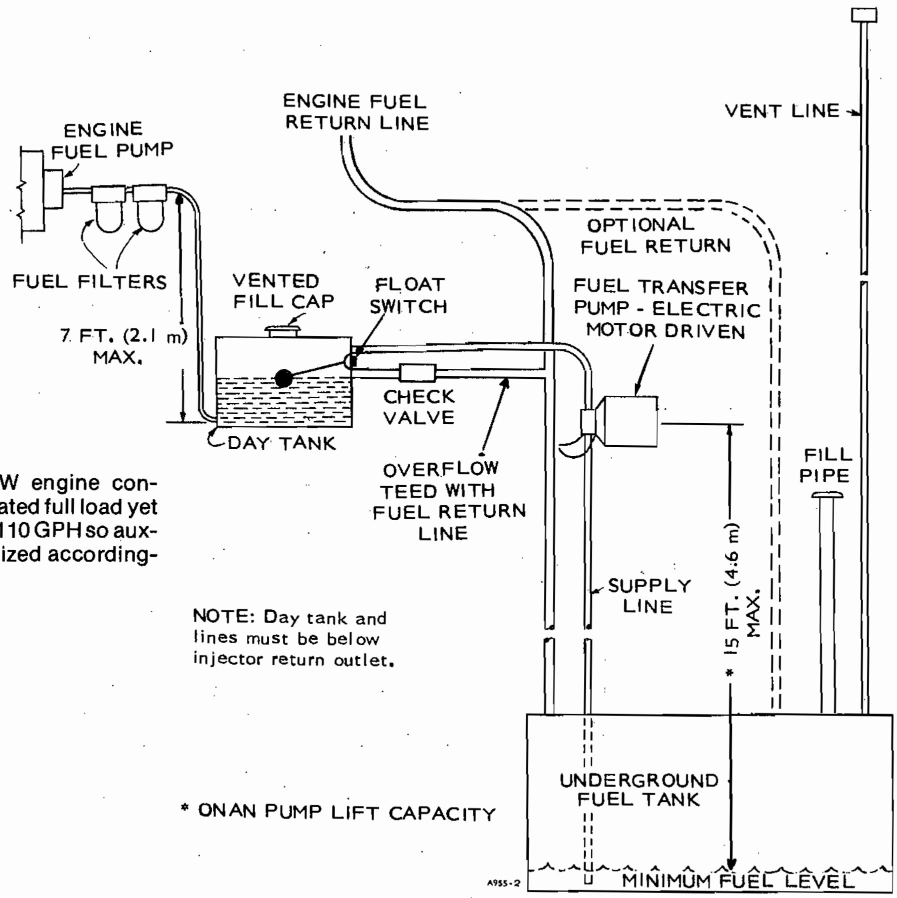
Engine	Maximum Head
Allis Chalmers with Roosa pumps	2 feet (0.61 m)
Allis Chalmers with Bosch pumps	10 feet (3.05 m)
John Deere	Not above injector nozzle
Ford	Not above injector nozzle
Detroit Diesel	Below injectors
Cummins	Below injectors
Waukesha	Not above injector nozzle
Onan 4 cyl. DJ series	9 Feet (2.74 m)
Onan 2 cyl. DJ series	9 Feet (2.74 m)
Onan 1 cyl. DJ series	Not above injector nozzle

* - Return Fuel must go to main tank, not day tank.

Detroit Diesel Engine: Because the fuel of this injection fuel return is used for cooling components in the engine, route the fuel return line to the main fuel supply tank, not to the day tank. Otherwise, the hot returning fuel increases the fuel temperature in the day tank and causes an engine power loss.

The fuel return line can be teed with the day tank overflow line provided the return system head and friction losses do not exceed the restriction limit of 102 inches (2.6 m) mercury. Install a check valve in the overflow line between the day tank and the tee to prevent returning fuel from filling the day tank. If the overflow line is used for fuel return, make sure the line extends down below the minimum fuel level of the supply tank (Figure 18).

As an option, the fuel return line can go directly back to the supply tank but must extend down below the minimum fuel level of the fuel supply tank.



NOTE: Typical 350 kW engine consumes 28.7 gallons at rated full load yet pumps approximately 110 GPH so auxiliary pumps must be sized accordingly.

FIGURE 18. TYPICAL DETROIT DIESEL FUEL SYSTEM WITH SUPPLY TANK BELOW GENERATOR SET

With Supply Tank Above Engine

Due to the danger of hydraulic lock (fuel trapped on top of pistons) which causes serious engine damage, do not use a gravity feed fuel system directly to the engine fuel pump. The problem of such a system is the head on the engine fuel return line due to the overhead tank. Fuel returns must gravity feed from the injection system to a day tank located below the injectors.

With a Detroit diesel engine, the fuel return must be returned to the supply tank. See *"Detroit Diesel Engine"* **for installation information.**

Figure 19 shows a typical installation when a day tank is used with overhead fuel supply tanks for diesel engines. The day tank is installed near the generator set and within the engine fuel pump lift capability, but below the fuel injection system (fuel pump lift capabilities in Table are based on *no* horizontal run). Use fuel line at least as large as the fuel pump inlet. The engine fuel return line must enter the day tank and extend down below the minimum fuel level of the day tank. Otherwise, drain back of fuel from the engine fuel pump and filters may occur when the generator set is not operating.

Note in Figure 19 a shutoff solenoid must be included in the fuel line between the fuel supply tank and the day tank. It stops fuel flow when the fuel level of the day tank reaches the preset optimum level (solenoid energized by ignition circuit).

Detroit Diesel Engine: Install the day tank near the generator set, below the injection system, but within engine fuel pump capability (lift capabilities in Table not based on any horizontal run). Use fuel line at least as large as the fuel pump inlet. A shutoff solenoid must be included in the supply line between the fuel supply tank and day tank as shown in Figure 20. It stops the fuel flow when the fuel level in the day tank reaches the preset optimum level (solenoid energized by ignition circuit).

Fuel from the engine fuel return line must not enter the day tank because it has been used for cooling components in the engine. If it is returned to the day tank, it increases the fuel temperature within the tank and causes an engine power loss.

Therefore, the engine fuel return line must enter a separate return tank (similar structure as day tank) as shown in Figure 20. A float switch in this tank energizes a shutoff solenoid and fuel transfer pump in the fuel return line to the overhead fuel tank. Note the engine fuel return line must enter the return tank and extend down below the minimum fuel level of the return tank. Otherwise, drain-back from the engine fuel pump and filters may occur when the generator set is not operating. The fuel return line enters the

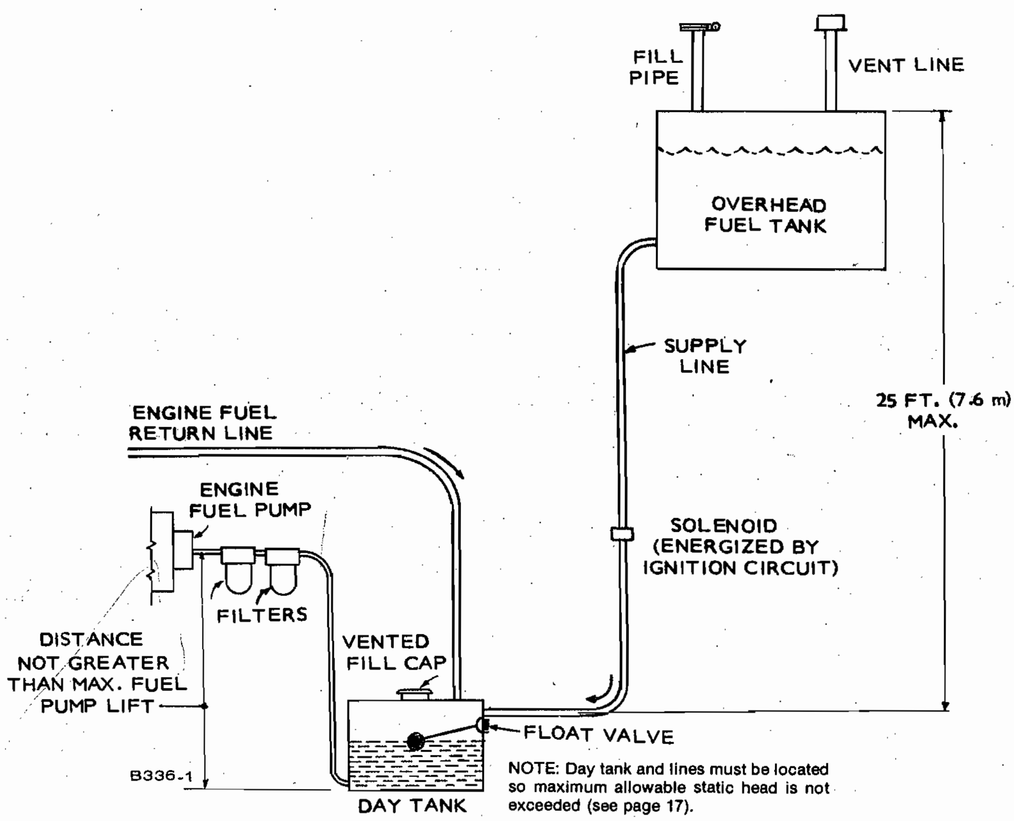


FIGURE 19. TYPICAL DIESEL FUEL SYSTEM WITH OVERHEAD FUEL TANK

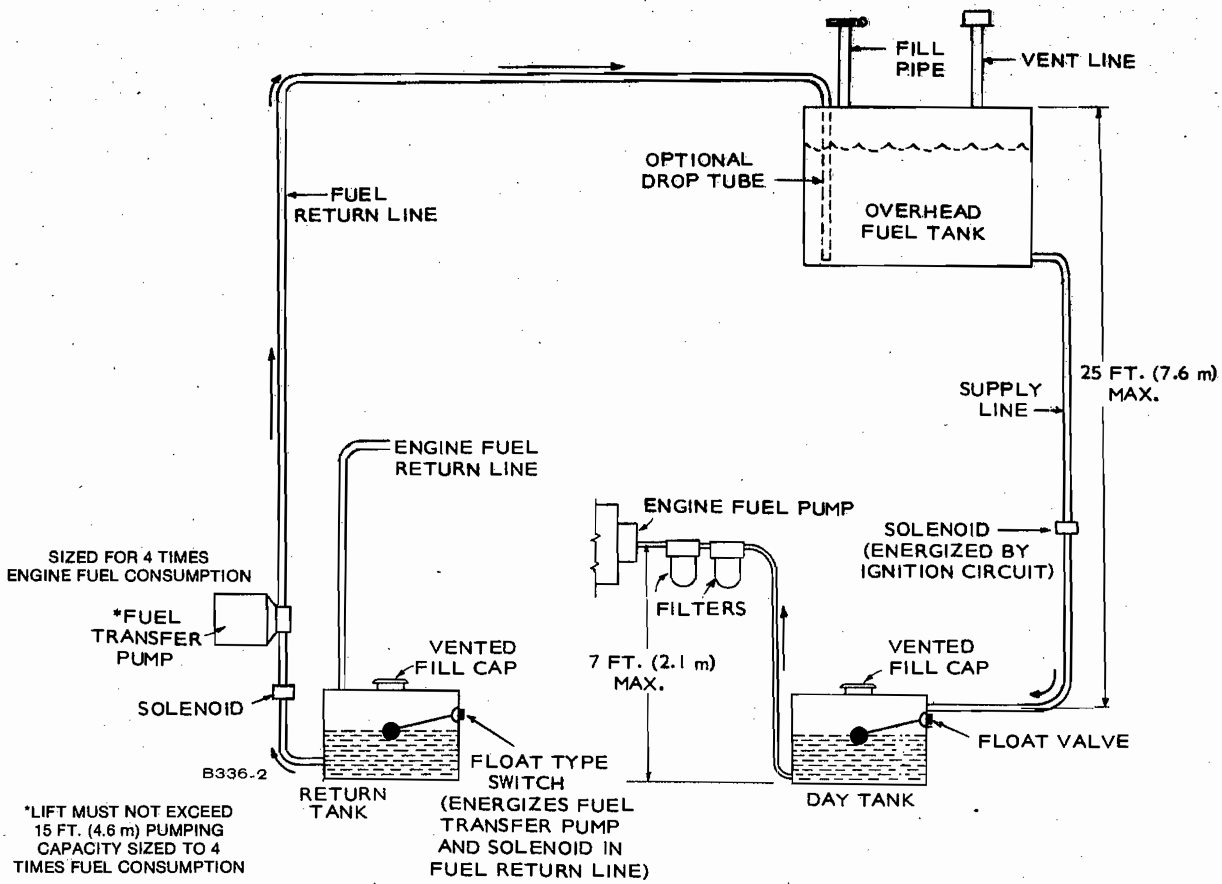


FIGURE 20. TYPICAL DETROIT DIESEL FUEL SYSTEM WITH OVERHEAD FUEL TANK

overhead fuel tank and can have an optional drop tube which extends down into the fuel (Figure 20).

GASOLINE DAY TANKS

Installations with gasoline day tank systems have many of the same requirements as the diesel day tank systems discussed earlier. The day tank must be located below the carburetor, but within lift capability of the engine fuel pump. Day tanks for gasoline fuel systems do not use a fuel return line from the engine. Follow building codes for gasoline system details.

WARNING **With gasoline fuel systems, the day tank must not have a vented fill cap due to the danger of fire or explosion from escaping gasoline fumes.**

GASOLINE PRIMER TANKS

Because gasoline evaporates from the carburetor bowl during long shutdowns of gasoline-fueled generator sets, Onan has available gasoline primer tanks which gravity feed fuel to the carburetor to ensure an immediate fuel supply upon engine cranking. A solenoid valve, which opens during generator set operation, is used between the primer tank and carburetor inlet (upon generator set shutdown, it also prevents gasoline from draining into the engine). See Figure 21.

The primer tank is pressurized by using a restrictive bushing in the return line. The return line to the supply tank, serving as a vent, will not gravity feed if the line includes any dips which trap fuel and block free air movement through the line.

GASOLINE ANTI-SIPHON SYSTEM

An anti-siphon fuel system is often used when the fuel tank is located above the generator set. It prevents siphoning of fuel directly to the engine fuel pump through use of special design plumbing. See Figure 22.

Fuel from the supply tank fills a void created in a vacuum pipe by the engine fuel pump. The vacuum pipe is about four times greater in diameter than the line leading from the fuel tank to the vacuum pipe. For example, if the smaller fuel line between the fuel tank and vacuum pipe is 5/16 inch, then the vacuum pipe is 1-1/4 inches.

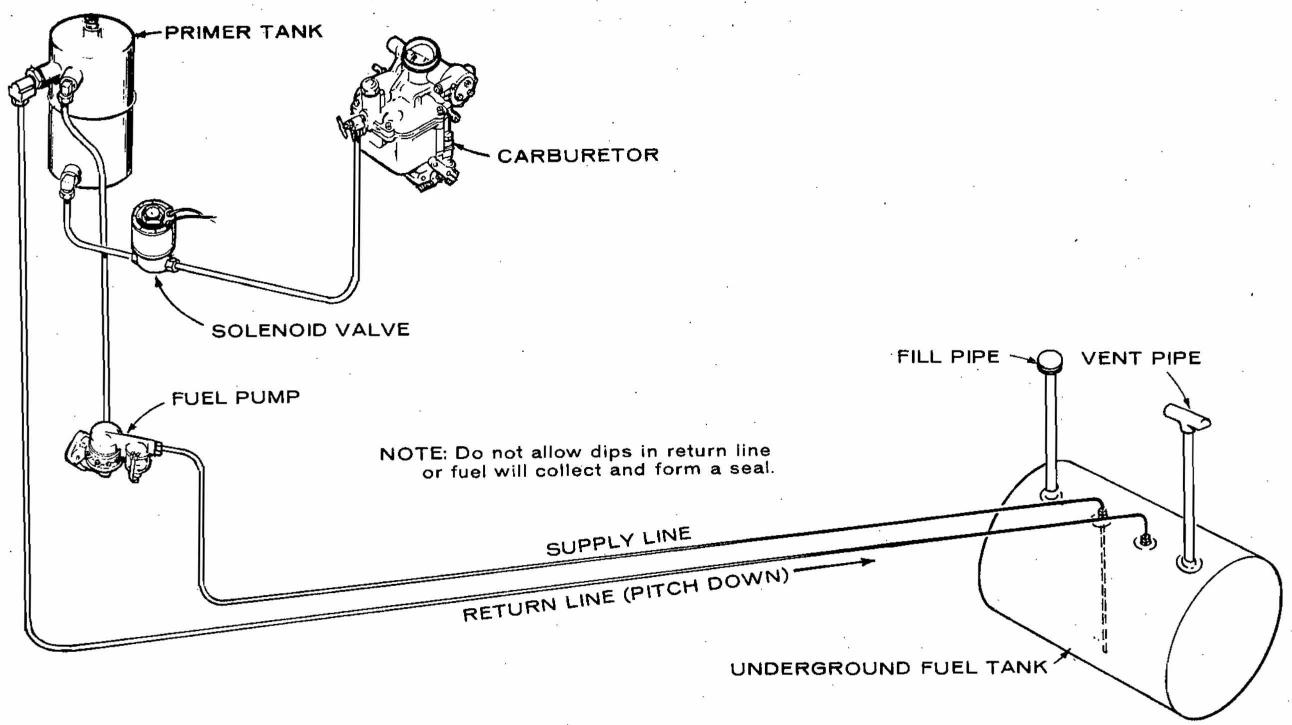


FIGURE 21. GASOLINE PRIMER TANK SYSTEM

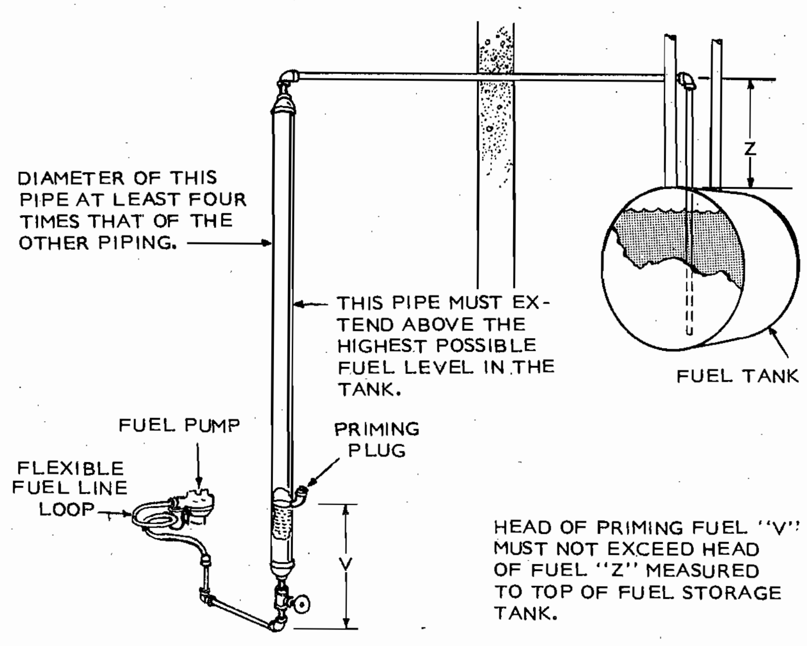


FIGURE 22. GASOLINE ANTI-SIPHON FUEL SYSTEM

EXHAUST SYSTEM

The purpose of the exhaust system is to direct engine exhaust from the engine and allow the exhaust to discharge into the atmosphere. A muffler should be connected into the exhaust system, either inside or outside the generator set enclosure. For maximum efficiency, operation economy, and prevention of engine damage, design the exhaust system so it does not create excessive back pressure on the engine. Choice of proper pipe size, connections and muffler, if properly installed, will ensure satisfactory operation.

WARNING **Plan the exhaust system carefully. Exhaust gases are deadly!**

When planning the exhaust system, keep in mind that the exhaust system should not pass near any flammable material. A fireproof, insulative material wrapped around the exhaust system, covered with a metal retainer, reduces heat radiation in the enclosure (also reduces exhaust noise radiation).

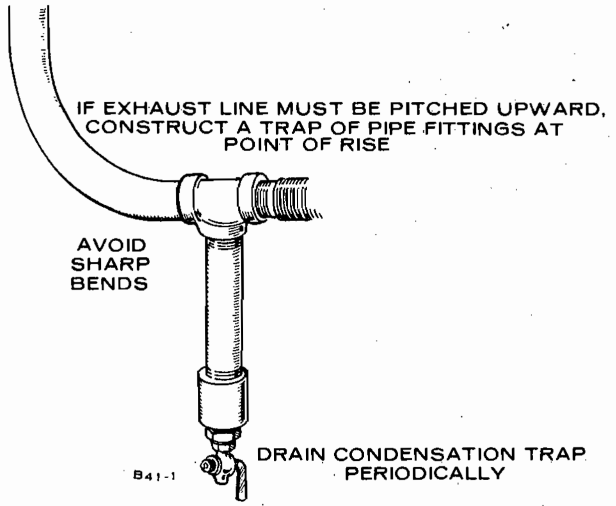


FIGURE 23. CONDENSATION TRAP

EXHAUST PIPING

As the exhaust pipe length and number of bends increases, larger pipe is required to eliminate excessive exhaust restriction and back pressure. The exhaust system is properly sized if the maximum equivalent pipe length for the particular generator set does not exceed back pressure limitations shown in tables.

Refer to the *Index of Tables* for additional information on maximum equivalent exhaust pipe length in feet, equivalent lengths of pipe fittings, exhaust back pressure limitations and linear expansion of steel pipe lines.

CAUTION **Total back pressure of all system components must not exceed maximum back pressure limits for the units shown in Table. (See *Index of Tables* on page 28.) Otherwise, engine damage can result.**

Pitch exhaust pipes downward away from the generator set in a horizontal run or install a condensation trap with a means of drain where a rise in the exhaust system begins. Figure 23 shows a typical condensation trap. Be sure a flexible pipe section is included at the engine and the system is properly supported.

Flexible Pipe Section

A piece of flexible, bellows type exhaust pipe must be used between the engine exhaust connection and the exhaust piping system to permit generator set movement and thermal expansion of piping without placing stress on the exhaust system. When selecting flexible pipe and length, consider:

1. Vibration isolators used—allow for 1 inch (25 mm) movement of engine exhaust outlet in all directions.
2. Expansion of pipe—depending on exhaust pipe support, note which direction expansion occurs.

Thimble and Rain Caps

An approved thimble must be used (Figure 24) where exhaust pipes pass through walls or partitions. Build the thimble according to codes (see National Fire Protection Association bulletin, Volume 4, section 211 on "Standards for Chimneys, Fireplaces and Vents"). Install a drip cap on the thimble when installed vertically as shown in Figure 24.

Onan has rain caps available for the discharge end of vertical exhaust pipes. The rain cap clamps onto the end of the pipe and opens due to exhaust discharge force from the generator set. When the generator set is stopped, the rain cap automatically closes, protecting the exhaust system from rain, snow, etc.

Attentuation is sound reduction given in decibels. Typical attenuation curves for industrial, residential and critical mufflers are shown in Figure 25.

For determining approximate sound level reduction for different distances from the sound source, subtract six decibels every time the distance is doubled. As an example, a sound level of 92 decibels at 100 feet (30 m) will be approximately 80 decibels at 400 feet (120 m).

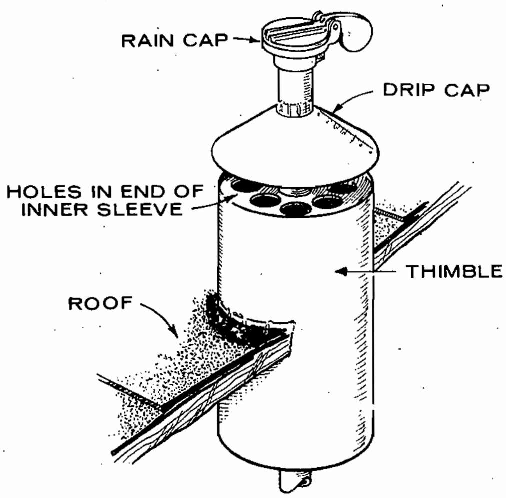


FIGURE 24. TYPICAL EXHAUST PIPE THIMBLE

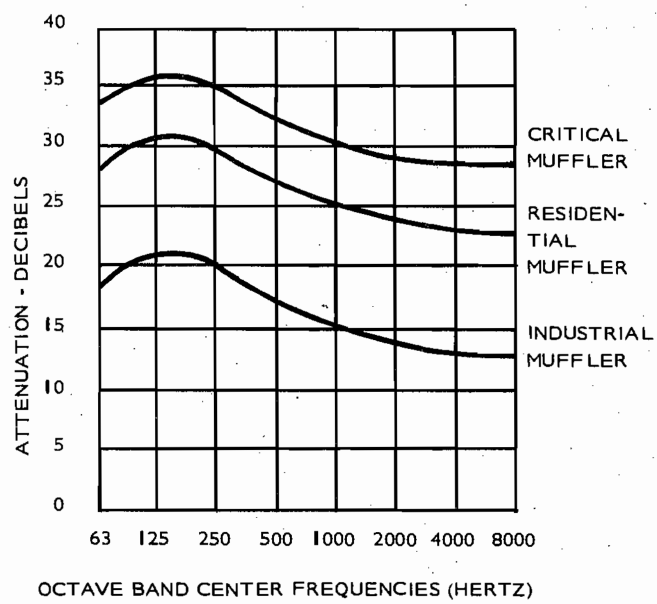


FIGURE 25. TYPICAL MUFFLER ATTENUATION CURVES

Exhaust Support

The exhaust pipes and muffler must be completely supported so no weight or stress is applied to the engine exhaust manifold or turbocharger. In some installations damping supports may be needed to reduce exhaust noise vibration transmission.

CAUTION **Weight applied to the engine manifold or turbocharger can result in manifold or turbocharger damage.**

MUFFLERS

Select a muffler to reduce noise of the exhaust system to levels required at the installation site. Onan mufflers are listed (see *Index of Tables*) for the different generator sets 30 kW and larger. Three muffler types are available.

1. Industrial Muffler—Suitable for industrial areas or remote installation where attentuation is not critical.
2. Residential Muffler—Suitable where some low background noise is always present.
3. Critical Muffler—Suitable for the areas of hospitals, residential dwellings, etc. where background noise is minimal.

Location

Install the muffler as close as possible to the engine. Cool mufflers collect undesirable carbon residues and moisture.

Draining and servicing the muffler is more convenient if installed near the engine.

If the muffler is installed near the engine and is within reach of personnel standing on the installation floor level, protect it with a guard and/or insulation. If the muffler is installed outside the installation enclosure, it should have a guard or shield around it.

ELECTRICAL SYSTEMS

AC ELECTRICAL SYSTEM

Most local regulations require a licensed electrician perform the wiring of a generator set. A local inspector must then approve the installation before operation. All connections, wire sizes, etc. must conform to local codes and regulations.

Install a flexible section of conduit at the generator set control box for the load and remote start-stop control wires. This section permits generator set movement without placing damaging stress on the solid conduit and control box. See the typical installations in the next section.

If the installation is a standby system, use a double-throw transfer switch (manual or automatic) which protects against the possibility of commercial and generator power connecting to the load at the same time. Instructions for connecting transfer switches are included with the equipment.

Onan has automatic transfer switches to match capacity of the generator sets. For more information, see Onan technical bulletin T-026, "AUTOMATIC TRANSFER SWITCHES."

DC ELECTRICAL SYSTEM

A battery-powered electric motor performs the starting of all Onan liquid-cooled generator sets listed in this technical bulletin. Cranking speed depends on battery capacity, oil viscosity and ambient temperature around the generator set. Follow the battery recommendations in the Onan specification sheets and operator's manuals for the generator sets.

For low temperatures, use engine coolant heaters, lube oil heaters, etc. to ensure starting dependability (especially important with diesel sets).

Battery Location

Resistance in the starting circuit has a significant effect on starting ability of the engine. Therefore, locate the batteries as close as possible to the generator set (batteries should be accessible for servicing).

If the batteries are located relatively far from the starter motor, increase the battery cable size to avoid excessive voltage drop.

Most Onan sets have a "built-in" battery rack for the batteries. For the other models, mount the batteries on a wood or metal platform near the generator set.

Battery Charger

Most standby generator sets run too seldom to maintain full charge of the starting batteries. For such installations, a battery float charger is desirable because it can maintain battery potential after a start cycle of the generator set. The battery charger is connected to the AC line source so it operates constantly during normal power.

A float charger is not designed to recharge batteries quickly.

Onan also has an SCR equalize battery charger with a charge timer which has a maximum charge rate up to 10 amperes for 12-volt systems, up to 6 amperes for 24-volt systems. For fast charging, the equalize charge timer can be manually set for any time period up to 12 hours (most battery manufacturers recommend 24 hours of equalize charging every month). Setting the timer raises the charger's output and maintains high charging voltage for the selected time. After this period, the timer automatically switches back to float voltage.

Nickel cadmium batteries do not require equalize battery charging.

TYPICAL INSTALLATIONS

Following are typical installations, one of a gasoline generator set with radiator cooling, one of a gasoline set with city water cooling, and another of a diesel set generator set with radiator cooling. Each individual installation must be considered separately and should not necessarily be similar to these shown. For installation details on the individual generator set, consult the Onan specification sheet and operator's manual.

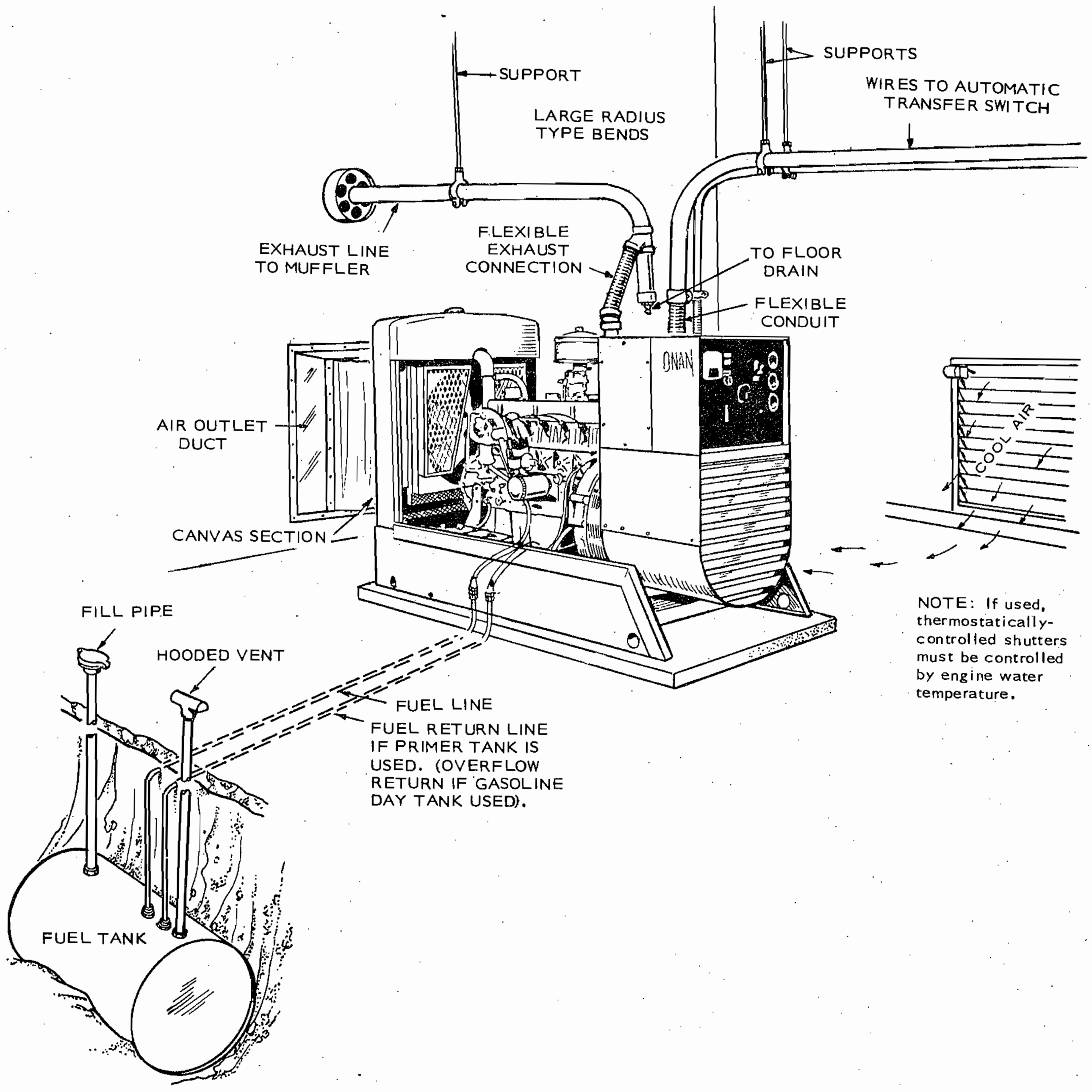


FIGURE 26. TYPICAL GASOLINE INSTALLATION, RADIATOR COOLING

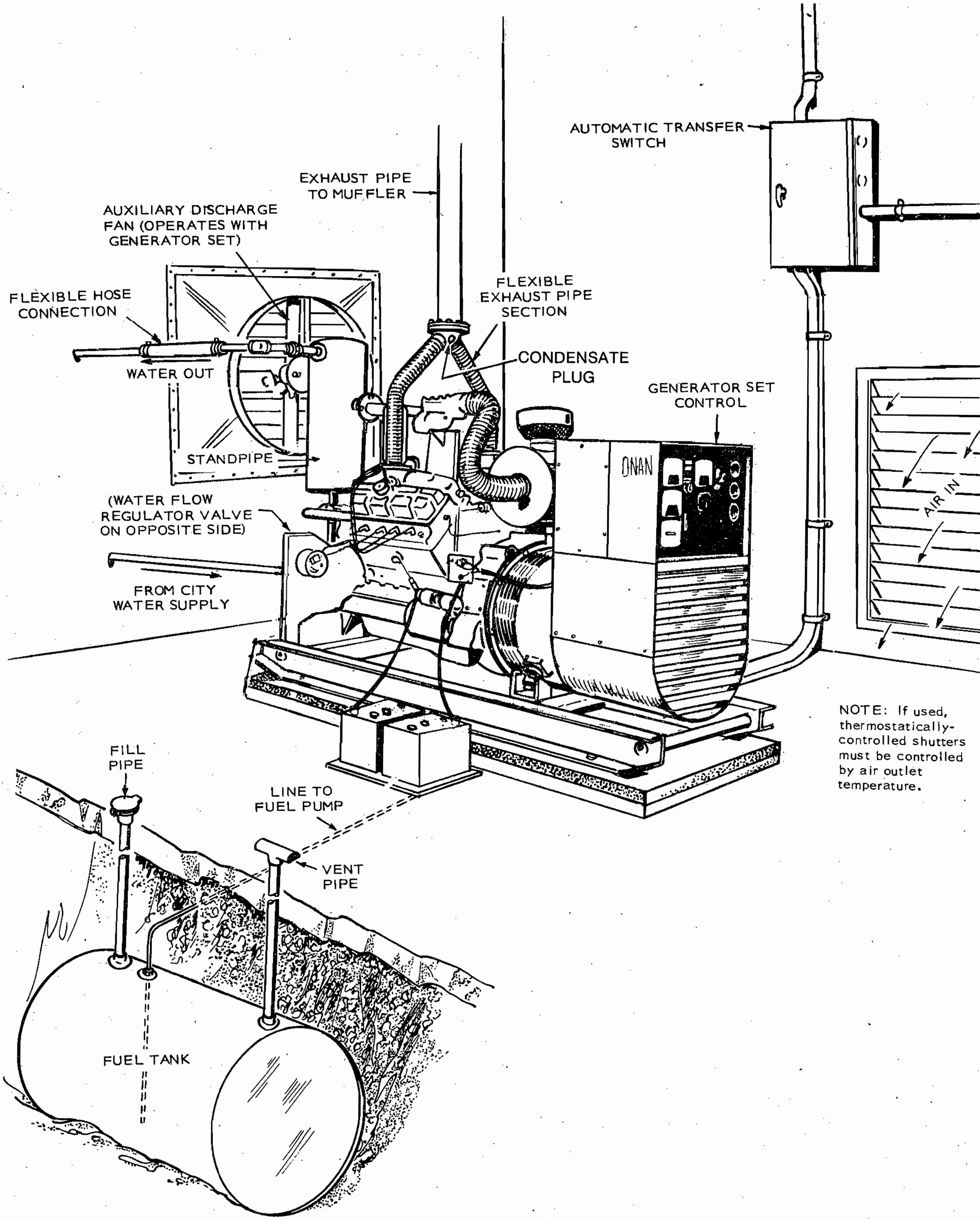


FIGURE 27. TYPICAL GASOLINE INSTALLATION, CITY WATER COOLING (STANDPIPE)

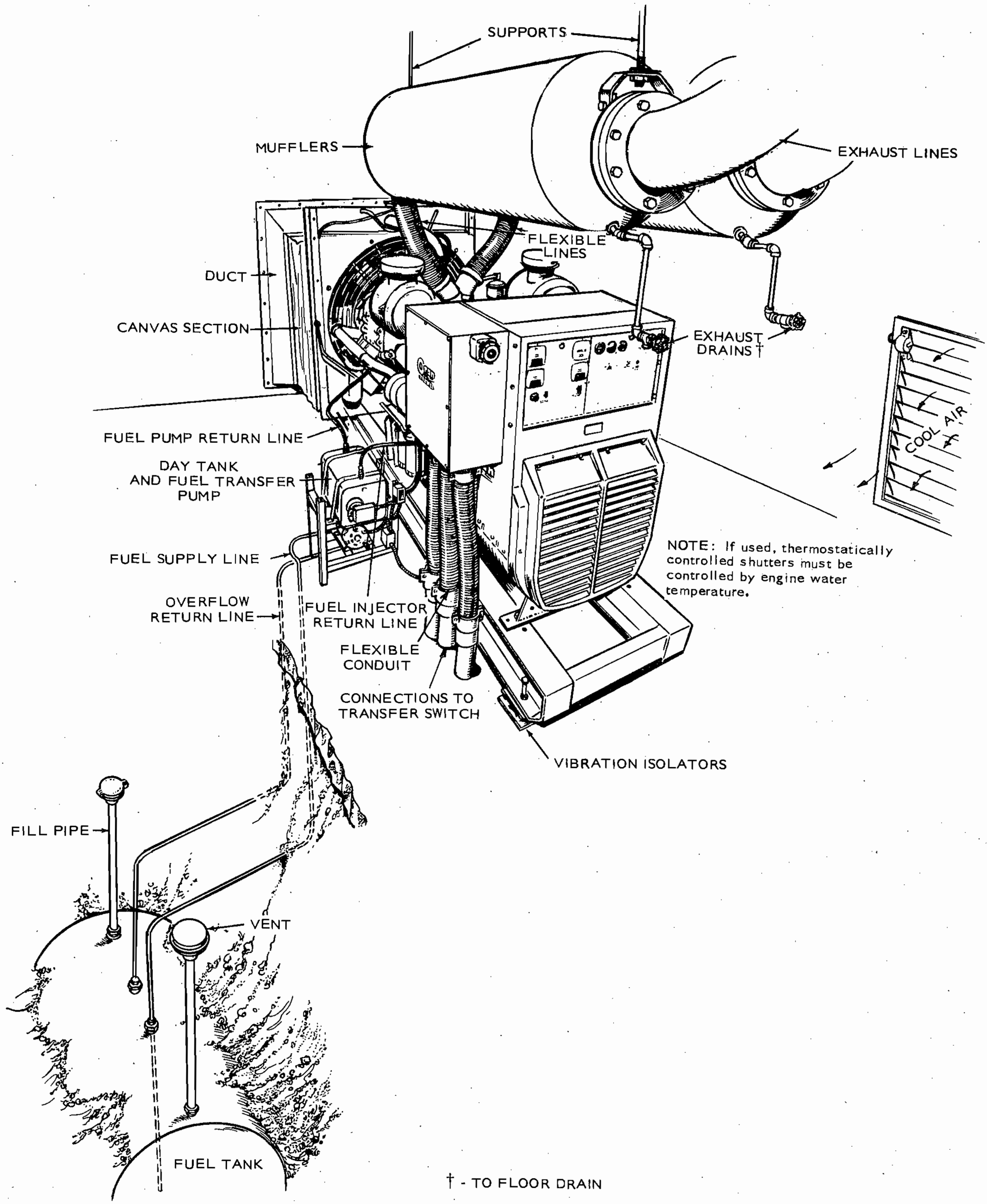


FIGURE 28. TYPICAL DIESEL INSTALLATION, RADIATOR COOLING

INDEX OF TABLES

TABLE 1. HEAT LOSS FROM UNINSULATED EXHAUST PIPE AND MUFFLERS

PIPE SIZE	Uninsulated, Steel Pipe Heat Loss		Uninsulated, Critical Muffler Heat Loss	
Inch	BTU/Hr/Linear Foot	MJ/Hr/Linear Metre	BTU/Hr	MJ/Hr
1.5	2,800	0.9004	17,800	5.7238
2	3,480	1.1190	29,400	9.4540
2.5	4,180	1.3441	47,100	15.1457
3	5,040	1.6207	66,000	21.2232
3.5	5,750	1.8490	84,500	27.1721
4	6,450	2.0741	106,000	34.0858
5	7,930	2.5500	150,000	48.2346
6	9,350	3.0066	213,000	68.4931
8	12,000	3.9231	328,000	105.4730
10	14,950	4.8074	510,000	163.9980
12	17,600	5.6595	605,000	194.5460

TABLE 2. COOLING SYSTEM CAPACITY, RADIATOR AREA AND AIRFLOW
(Metric equivalents in parentheses where applicable)

UNIT	COOLING SYSTEM			AIRFLOW CFM (m^3/min.)
	Capacity—Gallons (Litres)		Radiator Outlet Size - In. (Millimetres)	
	Engine	Engine & Radiator		
RJC	1.75 (6.6)	3 (11.4)	19 (483) x 17 (432)	2.750 (78)
EK, EM	2.5 (9.5)	5 (18.9)	22 (559) x 21 (533)	5,335 (131)
EN	N.A.	7.5 (28.4)	27.5 (699) x 27 (686)	8,500 (238)
KR	5.25 (19.9)	10 (37.8)	27 (686 x 27 (686)	11,260 (319)
WA	9.75 (36.9)	20 (75.7)	37 (940) x 40 (1020)	12,500 (354)
WB	11.75 (44.5)	29 (109.8)	41 (1040) x 47 (1194)	19,100 (541)
RDJC, RDJF	1.75 (6.6)	3 (11.4)	19 (483) x 17 (432)	2,750 (78)
DDA	1.75 (6.6)	4.25 (16.1)	22 (559) x 21 (533)	3,800 (107)
DEH	1.75 (6.6)	4 (15.1)	22 (559) x 21 (533)	6,000 (170)
DEF	2.25 (8.5)	4.5 (17.0)	22 (559) x 21 (533)	6,500 (182)
DYJ	1.75 (6.6)	6.8 (25.7)	27.5 (699) x 27 (686)	4,500 (126)
DDB	2.25 (8.5)	5.0 (18.9)	22 (559) x 21 (533)	3,750 (105)
DEG	2.25 (8.5)	4.5 (17.0)	22 (559) x 21 (533)	6,500 (182)
DYA	1.75 (6.6)	6.8 (25.7)	22 (559(x 21 (533)	4,500 (126)
DYC (75 and 90 kW)	4.6 (17.4)	8.5 (32.2)	27 (686) x 27 (686)	6,700 (188)
DYC (100 kW)	4.6 (17.4)	9.0 (34.0)	27.5 (699) x 27 (686)	7,650 (214)
DYD	5.5 (20.8)	11 (41.6)	37 (940) x 40 (1020)	8,400 (235)
DYG	7.5 (28.4)	16.5 (62.4)	41 (1040) x 48 (1220)	18,400 (521)
DFE	5.0 (19.0)	14.0 (53.0)	41 (1040) x 47.5 (1207)	14,500 (406)
DFP	5.0 (19.0)	14.0 (53.0)	41 (1040) x 47.5 (1207)	14,500 (406)
DFM	5.5 (19.0)	14.5 (53.0)	41 (1040) x 47.5 (1207)	14,500 (406)
DYB	9 (34.1)	19.0 (71.9)	41 (1040) x 48 (1220)	23,800 (674)
DYH	7.5 (28.4)	16.5 (62.5)	41 (1040) x47.5 (1207)	18,400 (521)
DFS	7.5 (28.4)	23.0 (87.0)	47.5 (1207) x 52 (1321)	19,400 (543)
DFN	8.0 (30.2)	23.5 (89.0)	47.5 (1207) x 52 (1321)	19,400 (543)
DHB	13.75 (52)	36.5 (138.2)	50 (1270) x 50 (1270)	33,000 (934)
DFV	21 (79.5)	37.5 (141.9)	51 (1300) x 55 (1400)	32,500 (920)
DFW	21 (79.5)	50. (189.2)	50 (1270 x 69 (1750)	34,700 (983)
DFY	21 (79.5)	48 (181.7)	53 (1350) x 54 (1370)	35,000 (991)
DFX	26.5 (100.3)	54 (204.3)	68.56 (1741)x 59.5 (1511)	42,500 (1190)
DFZ	30.5 (115.4)	55 (208.2)	68.56 (1741) x 59.5 (1511)	42,500 (1190)

TABLE 3. CONTENTS OF PIPES AND CYLINDRICAL TANKS, WITH HORIZONTAL AXIS AND FLAT ENDS, PER FOOT (305 mm) OF LENGTH FOR ANY DEPTH OF LIQUID

h = Depth of Liquid	d = Diameter of Tank, Inches (mm)														
	12 (305)			18 (457)			24 (610)			30 (762)			36 (914)		
Inches (mm)	Gal	Cu Ft	Litre	Gal	Cu Ft	Litre	Gal	Cu Ft	Litre	Gal	Cu Ft	Litre	Gal	Cu Ft	Litre
2 (51)	0.64	0.0860	2.42	0.80	0.1072	3.03	0.93	0.1244	3.52	1.05	0.1400	3.97	1.15	0.154	4.35
4 (102)	1.73	0.2317	6.55	2.18	0.2920	8.25	2.57	0.3440	9.73	2.90	0.3878	11.0	3.21	0.429	12.1
6 (152)	2.94	0.3927	11.1	3.85	0.5149	14.6	4.59	0.6140	17.4	5.23	0.6988	19.8	5.80	0.775	22.0
8 (203)	4.14	0.5637	15.7	5.67	0.7578	21.5	6.85	0.9152	25.9	7.85	1.049	29.7	8.75	1.17	33.1
10 (254)	5.23	0.6994	19.8	7.55	1.009	28.6	9.26	1.238	35.0	10.72	1.432	40.6	12.0	1.60	45.4
12 (305)	5.87	0.7854	22.2	9.38	1.252	35.5	11.75	1.571	44.5	13.72	1.833	51.9	15.4	2.03	58.3
14 (356)				11.04	1.476	41.8	14.24	1.903	53.9	16.82	2.248	63.7	19.0	2.54	71.9
16 (406)				12.43	1.6959	47.0	16.65	2.226	63.0	19.90	2.660	75.3	22.6	3.02	85.5
18 (457)				13.22	1.767	50.0	18.91	2.527	71.6	23.00	3.075	87.1	26.4	3.53	99.9
20 (508)							20.93	2.797	79.2	26.00	3.476	98.4	29.6	3.95	112.0
22 (559)							22.57	3.017	85.4	28.85	3.859	109.2	33.4	4.46	126.4
24 (610)							23.50	3.1416	88.9	31.49	4.209	119.2	37.4	5.00	141.6
26 (660)										33.82	4.521	128.0	40.4	5.40	152.9
28 (711)										35.67	4.768	135.0	43.7	5.84	165.4
30 (762)										36.72	4.908	139.0	46.6	6.23	176.4
32 (813)													49.1	6.55	185.8
34 (864)													51.2	6.85	193.8
36 (914)													52.9	7.07	200.2
38 (965)															
40 (1016)															
42 (1067)															
44 (1118)															
46 (1168)															
48 (1219)															
50 (1270)															

TABLE 4. HEAT REJECTION TO ROOM, PIPE SIZES, AND REQUIRED WATER FLOW (Metric equivalents in parentheses where applicable)

GENERATOR SET	HEAT REJECTION TO ROOM** BTU/hr (MJ/hr)	WATER FLOW IN GPM (Litres/Min) AND PIPE SIZES									
		STANDPIPE AND DIRECT					HEAT EXCHANGER				
		PIPE SIZE—IN.		40° F (4.4° C)	60° F (15.6° C)	80° F (26.7° C)	PIPE SIZE—IN.		40° F (4.4° C)	60° F (15.6° C)	80° F (26.7° C)
		INLET	OUTLET				INLET	OUTLET			
12.5RJC	21,000 (22.16)	0.5	0.375	2.3 (8.7)	2.8 (10.6)	3.5 (13.2)	0.5	0.375	2.7 (10.2)	3.6 (13.6)	5.4 (20.4)
15.0RJC	25,570 (26.98)	0.5	0.375	2.3 (8.7)	2.8 (10.6)	3.5 (13.2)	0.5	0.375	2.7 (10.2)	3.6 (13.6)	5.4 (20.4)
15.0RDJC	17,570 (18.54)	0.5	0.375	2.3 (8.7)	2.8 (10.6)	3.5 (13.2)	0.5	0.375	2.7 (10.2)	3.6 (13.6)	5.4 (20.4)
17.5RDJF	23,600 (24.90)	0.5	0.375	2.3 (8.7)	2.8 (10.6)	3.5 (13.2)	0.5	0.375	2.7 (10.2)	3.6 (13.6)	5.4 (20.4)
30.0EK	56,700 (59.82)	0.5	0.75	3.5 (13.2)	4.4 (16.6)	5.9 (22.3)	0.5	0.75	9.5 (36.0)	12 (45.4)	16 (60.6)
30.0DDA	31,000 (32.70)	0.5	0.75	3.4 (12.9)	4.2 (15.9)	5.6 (21.2)	0.5	0.75	9 (34.1)	11 (41.7)	13 49.3)
30.0DEH	35,700 (37.66)	0.5	0.75	3.5 (13.2)	4.4 (16.6)	5.9 (22.3)	0.5	0.75	9 (34.1)	11 (41.6)	13 (49.2)
45.0EM	68,000 (71.74)	0.5	0.75	4.5 (17.0)	5.7 (21.6)	7.3 (27.6)	0.5	0.75	13.3 (50.3)	16 (60.6)	20 (57.5)
45.0DEF	49,000 (51.70)	0.5	0.75	4.5 (17.0)	5.7 (21.6)	7.3 (27.6)	0.5	0.75	10 (37.8)	13 (49.2)	18 (68.1)
45.0DYJ	48,000 (50.64)	0.75	1	4.5 (17.0)	5.7 (21.6)	7.3 (27.7)	1	1.5	11 (41.7)	14 (53.1)	19 (72.0)
50.0DDB	49,000 (51.70)	0.75	1	4.9 (18.6)	6.0 (22.7)	7.6 (28.8)	1	1.5	11 (41.7)	14 (53.1)	19 (72.0)
50.0DEG	55,500 (58.55)	0.5	0.75	5 (19.0)	6.1 (23.1)	7.8 (29.5)	0.5	0.75	11 (41.6)	14 (53.0)	19 (71.9)
60.0DYA	53,500 (56.44)	0.75	1.5	3.5 (13.2)	4.0 (15.1)	4.7 (17.8)	1	1.5	6 (22.7)	8 (30.3)	10 (37.8)
55.0EN	—	0.75	1	3.5 (13.2)	4.0 (15.1)	5.0 (19.0)	0.5	0.75	—	—	—
70.0EN	—	0.75	1	4.5 (17.0)	5.5 (20.8)	6.5 (24.6)	0.5	0.75	—	—	—
70.0KR	131,800 (131.05)	0.75	1	7.5 (28.4)	9.7 (36.7)	12.5 (47.3)	1	1.5	9.5 (36.0)	11.5 (43.5)	19.5 (73.8)
75.0DYC	81,700 (86.19)	0.75	1	4 (15.1)	4.7 (17.8)	6 (22.7)	1	1.5	7.5 (28.4)	9.6 (36.3)	11 (41.6)
85.0KR	142,500 (150.34)	0.75	1	8.8 (33.3)	11.6 (43.9)	14.5 (54.9)	1	1	10 (37.8)	12 (45.4)	20 (57.5)
90.0DYC	104,500 (110.25)	0.75	1	5.8 (22.0)	6.6 (25.0)	8 (30.3)	1	1.5	8.9 (33.7)	11.6 (43.9)	13.7 (51.8)
100.0DYC	120,000 (126.58)	0.75	1	6.5 (24.6)	8.0 (30.3)	10 (37.8)	1	1.5	8.9 (33.7)	11.6 (43.9)	13.7 (51.8)
100.0DYD	110,500 (116.58)	1	1.5	5.8 (22.0)	6.6 (25.0)	8 (30.3)	1.25	1.5	30 (113.6)	35 (132.5)	40 (151.4)

(Continued on next page)

TABLE 4. (Continued)
HEAT REJECTION TO ROOM, PIPE SIZES, AND REQUIRED WATER FLOW
(Metric equivalents in parentheses where applicable)

GENERATOR SET	HEAT REJECTION TO ROOM** BTU/hr (MJ/hr)	WATER FLOW IN GPM (Litres/Min) AND PIPE SIZES									
		STANDPIPE AND DIRECT					HEAT EXCHANGER				
		PIPE SIZE—IN.		40°F (4.4°C)	60°F (15.6°C)	80°F (26.7°C)	PIPE SIZE—IN.		40°F (4.4°C)	60°F (15.6°C)	80°F (26.7°C)
		INLET	OUTLET				INLET	OUTLET			
115.0WA	175,000 (184.63)	0.75	1.5	8 (30.3)	9 (34.1)	11 (41.6)	1.25	1.5	16 (60.6)	16 (60.6)	48 (181.7)
125.0DYD	133,500 (140.84)	1	1.5	7 (26.5)	8 (30.3)	10 (37.8)	1.25	1.5	35 (132.5)	40 (151.4)	45 (170.3)
150.0DYG	154,600 (163.10)	1	1.5	8.7 (32.9)	10 (37.8)	12 (45.4)	2	2	45 (170.3)	55 (208.2)	60 (227.1)
155.0DFE*	185,000 (195.20)	1	1.25	9.0 (34.1)	11.0 (41.6)	14.0 (53.0)	—	—	—	—	—
170.0WB	228,000 (240.54)	1	1.5	12 (45.4)	13 (49.2)	16 (60.6)	1.25	2	25 (94.6)	25 (94.6)	40 (151.4)
175.0DYG	172,700 (182.20)	1	1.5	10 (37.8)	12 (45.4)	14 (53.0)	2	2	50 (189.2)	60 (227.1)	68 (257.4)
180.0DFE*	197,100 (207.90)	1	1.25	10.5 (39.8)	12.5 (47.3)	15.5 (58.7)	—	—	—	—	—
200.0DFP*	209,100 (220.56)	1	1.25	11.5 (43.5)	13.5 (51.1)	17.0 (64.3)	—	—	—	—	—
200.0DYG	170,000 (179.32)	1	1.5	11.0 (41.6)	13.5 (51.1)	16.5 (62.5)	—	—	—	—	—
230.0DFP*	215,100 (226.89)	1	1.25	12.5 (47.3)	15.0 (56.7)	18.5 (70.0)	—	—	—	—	—
250.0DFM*	216,200 (228.05)	1	1.25	13.0 (49.2)	15.5 (58.7)	19.0 (71.9)	—	—	—	—	—
250.0DYB	233,500 (246.34)	1.25	1.5	13 (49.2)	15 (56.8)	18 (68.1)	2	2	32 (121.1)	48 (181.7)	65 (246.0)
250.0DYH	194,000 (204.63)	1	1.5	12 (45.4)	14.5 (54.9)	18 (68.1)	—	—	—	—	—
300.0DFS*	300,000 (316.44)	1.25	2	14.5 (54.9)	17 (64.3)	21.5 (81.4)	—	—	—	—	—
350.0DFN*	346,500 (365.48)	1.25	2	16 (60.5)	19.0 (71.2)	24 (90.8)	—	—	—	—	—
350.0DHB	392,000 (413.56)	1.25	2	22.3 (84.5)	26.4 (100.0)	32.1 (121.6)	2	2.5	83 (314.6)	85 (322.2)	87 (329.7)
400.0DFV	403,000 (425.16)	1.25	2	23.8 (90.1)	28.2 (106.7)	34.8 (131.7)	2	2.5	78 (295.2)	80 (302.8)	82 (310.4)
450.0DFW	446,500 (471.06)	1.25	2	28.1 (106.4)	33.6 (127.2)	41.8 (158.2)	2	2.5	70 (264.9)	80 (302.8)	90 (340.6)
500.0DFY	494,800 (422.01)	1.25	2	31.2 (118.1)	37.2 (140.8)	46.3 (175.2)	2	2.5	78 (295.2)	88 (302.8)	99 (374.7)
600.0DFX*	567,000 (598.07)	1.25	2	28 (106.0)	34 (128.7)	42 (159.0)	—	—	—	—	—
750.0DFZ*	657,000 (693.00)	1.25	2	36 (136.3)	43 (162.8)	54 (204.4)	—	—	—	—	—

* Values for these units are estimates.

** Heat rejection to room for city water standpipe, heat exchanger or remote radiator cooled units. Includes heat radiated by engine and alternator at rated load.

TABLE 5. WATER PRESSURE DROP IN PSI FOR STANDARD DDV RADIATORS
(Pressure in metric units, kPa, is given in parentheses)

GALLONS PER MINUTE (Litres per minute given in parentheses)	STANDARD DDV MODELS										
	10	**15**	**25**	**35**	**45**	**60**	**75**	**90**	**100**	**110**	**130**
5 (18.9)	1.00 (6.9)										
8 (30.3)	1.00 (6.9)	1.00 (6.9)									
25 (94.6)	2.00 (13.8)	1.32 (9.1)	1.12 (7.7)								
30 (113)		1.60 (11.0)	1.37 (9.4)	1.30 (9.0)							
40 (151)		2.12 (14.6)	1.80 (12.4)	1.70 (11.7)	1.00 (6.9)						
50 (189)		2.82 (19.4)	2.25 (15.5)	2.12 (14.6)	1.12 (7.7)	1.00 (6.9)	1.00 (6.9)				
60 (227)				2.50 (17.2)	1.35 (9.3)	1.13 (7.8)	1.00 (6.9)	1.00 (6.9)			
65 (246)				2.75 (19.0)	1.45 (10.0)	1.35 (9.3)	1.10 (7.6)	1.00 (6.9)	1.00 (6.9)		
70 (265)				3.00 (20.7)	1.55 (10.7)	1.40 (9.7)	1.30 (9.0)	1.20 (8.3)	1.10 (7.6)	1.00 (6.9)	
85 (322)				3.35 (23.1)	1.90 (13.1)	1.60 (11.0)	1.40 (9.7)	1.30 (9.0)	1.20 (8.3)	1.10 (7.6)	1.00 (6.9)
90 (341)				3.80 (26.2)	2.00 (13.8)	1.70 (11.7)	1.50 (10.4)	1.40 (9.7)	1.30 (9.0)	1.20 (8.3)	1.00 (6.9)
175 (663)					3.90 (26.9)	3.37 (23.2)	2.80 (19.3)	2.60 (17.9)	2.40 (16.6)	2.25 (15.5)	1.90 (13.1)
200 (757)						3.80 (26.2)	3.50 (24.2)	3.30 (22.8)	3.20 (22.1)	2.65 (18.3)	2.20 (15.2)
300 (1136)							5.00 (34.5)	4.90 (33.8)	4.80 (33.1)	4.00 (27.6)	3.30 (22.8)
400 (1515)										5.25 (36.2)	4.40 (30.4)

NOTE: For flows not listed, interpolate the pressure drop (not over 400 gal/min or 1516 litres/min).

TABLE 6. AUXILIARY WATER PUMPS

CAPACITY 40 FT (12.2 m) MAX. HEAD		MOTOR HP AT 3500 RPM		PUMP SIZE AND PERFEX MODEL NO.
Gal/Min.	Litre/Min.		kW	
0-41	0-155	0.5	0.37	1½ x 1½ x 5 RRS
41-55	155-208	0.75	0.56	1½ x 1½ x 5 RR
55-63	208-238	1	0.75	1½ x 1½ x 5 RR
63-74	238-280	1.5	1.12	1½ x 1½ x 5 RR
74-96	280-363	1.5	1.12	2 x 2 x 4½ WR
96-120	363-454	2	1.49	2 x 2 x 4½ WR
120-165	454-624	2	1.49	2½ x 2½ x 4½ WR
165-200	624-757	3	2.24	2½ x 2½ x 4½ WR
200-300	757-1136	5	3.73	3 x 3 x 4½ WR
300-375	1136-1419	7.5	5.59	3 x 3 x 4½ WR
375-465	1419-1760	7.5*	5.59	4 x 3 x 9 LR

Pumps have 3 phase, 230/460 volt drip-proof motors.
Three phase, 200 or 208 volt drip-proof motors are available
*1750 RPM All Others 3500 RPM

TABLE 7. HEAT REJECTION TO COOLANT
(Metric equivalents in parentheses where applicable)

GENERATOR SET	GAS ENGINE		BTU PER MINUTE (MJ/Min.) WET MANIFOLD
	MANUFACTURER	COOLANT PUMP CAPACITY GPM (Litres/min.)	
12.5RJC	Onan	24 (91)	1050 (1.108)
15.0RJC	Onan	24 (91)	1250 (1.319)
30.0EK	Ford	34 (129)	3200 (3.376)
45.0EM	Ford	34 (129)	3900 (4.114)
55.0EN	Ford	44 (166.5)	3388 (3.574)
70.0EN	Ford	44 (166.5)	4360 (4.536)
70.0KB	International	65 (246)	6700 (7.068)
85.0KR	International	65 (246)	5900 (6.277)
115.0WA	Waukesha	84 (318)	8000 (8.440)
170.0WB	Waukesha	165 (624)	12100 (12.766)

TABLE 7A. HEAT REJECTION TO COOLANT
(Metric equivalents in parentheses where applicable)

GENERATOR SET	DIESEL ENGINE		BTU PER MINUTE (MJ/Min.) WET MANIFOLD
	MANUFACTURER	COOLANT PUMP CAPACITY GPM (Litres/min.)	
15.0RDJC	Onan	24 (91)	1,800 (1.899)
17.5RDJF	Onan	24 (91)	2,100 (2.216)
30.0DDA	John Deere	41 (155)	1,600 (1.688)
30.0DEH	Ford	27.5 (104)	2,550 (2.690)
45.0DYJ	Allis-Chalmers	42 (159)	3,300 (3.482)
45.0DEF	Ford	27.5 (104)	3,250 (3.429)
50.0DDB	John Deere	48 (182)	2,700 (2.848)
50.0DEF	Ford	27.5 (104)	3,600 3.798)
60.0DYA	Allis-Chalmers	42 (159)	3,950 (4.167)
75.0DYC	Allis-Chalmers	47 (178)	4,500 (4.748)
90.0DYC	Allis-Chalmers	47 (178)	5,400 (5.697)
100.0DYC	Allis-Chalmers	65 (246)	6,500 (6.856)
125.0DYD	Allis-Chalmers	69 (261)	8,900 (9.390)
150.0DYG	Allis-Chalmers	107 (405)	8,600 (9.073)
155.0DFE	Cummins	120 (454)	9,000 (9.493)*
175.0DYG	Allis-Chalmers	107 (405)	9,800 (10.339)
180.0DFE	Cummins	120 (454)	10,200 (10.758)*
200.0DFP	Cummins	120 (454)	11,300 (11.919)*
200.0DYG	Allis-Chalmers	107 (405)	11,000 (11.602)*
230.0DFP	Cummins	120 (454)	12,300 (12.974)*
250.0DFM	Cummins	120 (454)	12,600 (13.290)*
250.0DYB	Allis-Chalmers	107 (405)	13,600 (14.348)
250.0DYH	Allis-Chalmers	107 (405)	12,000 (12.657)*
300.0DFS	Cummins	170 (644)	14,150 (14.925)*
350.0DFN	Cummins	192 (727)	15,800 (16.665)*
350.0DHB	Detroit	210 (795)	19,300 (20.362)
400.0DFV	Cummins	190 (719)	18,900 (19.940)
450.0DFW	Cummins	190 (719)	20,940 (22.092)
500.0DFY	Cummins	190 (719)	22,602 (23.845)
600.0DFX	Cummins	411 (1556)	28,000 (29.534)*
750.0DFZ	Cummins	411 (1556)	36,000 (37.972)*

* - Estimated

TABLE 8. RADIATOR SELECTIONS WITH 100° F (37.8° C) RADIATOR INLET TEMPERATURE

GENERATOR SET	GAS ENGINE—HIGH SPEED FANS WET MANIFOLD	
	WATER DDV MODEL	50% E.G. DDV MODEL
30.0EK	15	15
45.0EM	15	15
55.0EN	15	15
70.0EN	15	15
70.0KR	25	25
85.0KR	25	25
115.0WA	25	35
170.0WB	35	45
GAS ENGINES—LOW SPEED FANS		
30.0EK	25	25
45.0EM	35	45
55.0EN	25	35
70.0EN	45	45
70.0KR	45	60
85.0KR	45	60
115.0WA	60	60
170.0WB	75	90

* - Consult Factory.
NOTE: Selections based on 190° F (87.8° C) water to radiator and 2000 feet (366 metre) elevation or lower.

E.G = Ethylene Glycol.

TABLE 9. RADIATOR SELECTIONS WITH 110° F (43.3° C) RADIATOR INLET TEMPERATURE

GENERATOR SET	GAS ENGINES—HIGH SPEED FANS WET MANIFOLD	
	WATER DDV MODEL	50% E.G. DDV MODEL
30.0EK	15	15
45.0EM	15	15
55.0EN	15	15
70.0EN	15	15
70.0KR	25	25
85.0KR	25	25
115.0WA	25	35
170.0WB	35	45
GAS ENGINES—LOW SPEED FANS		
30.0EK	25	45
45.0EM	45	45
55.0EN	35	45
70.0EN	45	45
70.0KR	60	60
85.0KR	60	60
115.0WA	75	75
170.0WB	90	90

*Consult Factory.

NOTE: Selections based on 190° F (87.8° C) water to radiator and 2000 feet (366 metre) elevation or lower.

E.G. = Ethylene Glycol.

TABLE 10. RADIATOR SELECTIONS WITH 100° F (37.8° C) RADIATOR INLET TEMPERATURE

GENERATOR SET	DIESEL ENGINES—HIGH SPEED FANS	
	WET MANIFOLD	
	WATER DDV MODEL	50% E.G. DDV MODEL
30.0DDA	15	15
30.0DEH	15	25
45.0DEF	25	25
45.0DYJ	25	25
50.0DDB	25	25
50.0DEG	25	35
60.0DYA	25	35
75.0DYC	35	35
90.0DYC	35	35
100.0DYC	45	45
125.0DYD	60	60
150.0DYG	60	60
150.0DFE	60	60
175.0DYG	60	75
180.0DFE	60	75
200.0DFP	75	75
200.0DYG	75	75
230.0DFP	75	75
250.0DFM	75	75
250.0DYB	75	75
250.0DYH	75	75
300.0DFS	75	75
350.0DFN	75	75
350.0DHB	90	910
400.0DFV	90	910
450.0DFW	90	910
500.0DFY	910	7.5
600.0DFX	110-10	110-10
750.0DFZ	110-20	110-25

* - Consult Factory.

NOTE: Selections based on 190° F (87.8° C) water to radiator and2000 feet(366 metre) elevation or lower.

E.G. = Ethylene Glycol.

TABLE 10A. RADIATOR SELECTIONS WITH 110° F (43.3° C) RADIATOR INLET TEMPERATURE

GENERATOR SET	DIESEL ENGINES—HIGH SPEED FANS	
	WET MANIFOLD	
	WATER DDV MODEL	50% E.G. DDV MODEL
30.0DDA	15	15
30.0DEH	25	25
45.0DEF	25	35
45.0DYJ	25	35
50.0DDB	25	25
50.0DEG	35	35
60.0DYA	35	35
75.0DYC	35	35
90.0DYC	45	45
100.0DYC	45	60
125.0DYD	60	75
150.0DYG	60	75
155.0DFE	60	75
175.0DYG	75	75
180.0DFE	75	75
200.0DFP	75	75
200.0DYG	75	75
230.0DFP	75	75
250.0DFM	75	75
250.0DYB	75	90
250.0DYH	75	75
300.0DFS	75	90
350.0DFN	90	90
350.0DHB	910	100-7.5
400.0DFV	910	100-7.5
450.0DFW	910	100-10
500.0DFY	100-10	100-15
600.0DFX	110-10	110-20
750.0DFZ	130-15	130-20

* - Consult Factory.

NOTE: Selections based on 190°F (87.8°C) water to radiator and 2000 feet (366 metre) elevation or lower.

E.G. = Ethylene Glycol.

TABLE 11. RADIATOR SELECTIONS WITH 100° F (37.8° C) RADIATOR INLET TEMPERATURE

GENERATOR SET	DIESEL ENGINES—LOW SPEED FANS	
	WET MANIFOLD	
	WATER DDV MODEL	50% E.G. DDV MODEL
30.0DDA	25	25
30.0DEH	25	25
45.0DEF	25	35
45.0DYJ	25	35
50.0DDB	25	25
50.0DEG	35	45
60.0DYA	45	45
75.0DYC	45	45
90.0DYC	45	45
100.0DYC	60	60
125.0DYD	75	75
150.0DYG	60	75
155.0DFE	60	75
175.0DYG	75	75
180.0DFE	75	75
200.0DFP	75	90
200.0DYG	75	90
230.0DFP	90	90
250.0DFM	90	90
250.0DYB	75	75
250.0DYH	90	90
300.0DFS	90	90
350.0DFN	90	100-5
350.0DHB	100-5	100-7.5
400.0DFV	100-5	100-7.5
450.0DFW	100-5	100-7.5
500.0DFY	100-7.5	110-5
600.0DFX	130-17.5	130-17.5
750.0DFZ	130-17.5	130-17.5

* - Consult Factory.

NOTE: Selections based on 190°F (87.8°C) water to radiator and 2000 feet (366 metre) elevation or lower.

E.G. = Ethylene Glycol.

TABLE 11A. RADIATOR SELECTIONS WITH 110° F (43.3° C) RADIATOR INLET TEMPERATURE

GENERATOR SET	DIESEL ENGINES—LOW SPEED FANS	
	WET MANIFOLD	
	WATER DDV MODEL	50% E.G. DDV MODEL
30.0DDA	25	25
30.0DEH	25	25
45.0DEF	45	45
45.0DYJ	35	45
50.0DDB	25	25
50.0DEG	45	45
60.0DYA	45	45
75.0DYC	45	45
90.0DYC	45	60
100.0DYC	60	60
125.0DYD	75	90
150.0DYG	75	75
155.0DFE	75	75
175.0DYG	75	90
180.0DFE	75	90
200.0DFP	90	90
200.0DYG	90	90
230.0DFP	90	90
250.0DFM	90	910
250.0DYB	90	90
250.0DYH	90	90
300.0DFS	910	100-5
350.0DFN	100-5	100-7.5
350.0DHB	110-5	110-5
400.0DFV	100-7.5	110-5
450.0DFW	110-7.5	110-5
500.0DFY	110-5	130-17.5
600.0DFX	130-17.5	130-17.5
750.0DFZ	*	*

* - Consult Factory.

NOTE: Selections based on 190° F (87.8° C) water to radiator and 2000 feet (366 metre) elevation or lower.

E.G. = Ethylene Glycol.

TABLE 12. TYPE DDV RADIATORS—LOW AND HIGH SPEED FANS
(Metric equivalents in parentheses where applicable)

A	B			C	D	E	F	G	H	I	J	K	L
PERFEX MODEL NO.	APPROXIMATE SIZE—IN. (mm) HEIGHT	WIDTH	DEPTH	SHIPPING WEIGHT, LB (kg)	FAN DIAMETER, IN. (mm)	FAN TIP SPEED, FT/MIN (m/m)	OPENING, IN.	CAPACITY, GAL (litres)	MOTOR HP (kW)	RPM	MINIMUM PIPE SIZE, IN.	DECIBELS** AT 20 FT.	RADIATOR AIRFLOW—CFM (m³/min.)
DDV-15 LO	29.4 (748)	20.9 (530)	17.9 (456)	300 (136)	16 (406)	7,350 (2240)	1.5 (38)	6 (22.7)	0.5 (0.37)	1750	1.5 (38)	65	1380 (39.1)
DDV-15 HI	29.4 (748)	20.9 (530)	17.9 (456)	300 (136)	16 (406)	14,700 (4480)	1.5 (38)	6 (22.7)	1 (0.75)	3500	1.5 (38)	87	3100 (87.8)
DDV-25 LO	34.5 (876)	26.5 (673)	20 (508)	400 (181)	22 (559)	10,100 (3078)	1.5 (38)	9 (34.1)	1.5 (1.1)	1750	2 (50.8)	72	4,600 (130.2)
DDV-25HI	34.5 (876)	26.5 (673)	20 (508)	400 (181)	22 (559)		1.5 (38)	9 (34.1)			2 (50.8)		
DDV-35 LO	40 (1020)	31.5 (800)	20.5 (521)	500 (227)	27 (686)	8,230 (2508)	2 (50.8)	11 (41.6)	1 (0.75)	1160	2 (50.8)	67	4,700 (133)
DDV-35 HI	40 (1020)	31.5 (800)	20.5 (521)	500 (227)	27 (686)	12,400 (3779)	2 (50.8)	11 (41.6)	2 (1.5)	1750	2 (50.8)	80	6,580 (186.3)
DDV-45 LO	46 (1170)	34.5 (876)	23 (584)	600 (272)	30 (762)	9,140 (2783)	3 (76.2)	14 (53)	2 (1.5)	1160	2 (50.8)	70	7,200 (203.9)
DDV-45 HI	46 (1170)	34.5 (876)	23 (584)	600 (272)	30 (762)	13,800 (4206)	3 (76.2)	14 (53)	3 (2.2)	1750	2 (50.8)	84	11,200 (317.2)
DDV-60 LO	52 (1320)	42 (1070)	24.5 (622)	700 (317)	30 (762)	9,140 (2783)	3 (76.2)	17 (64.3)	3 (2.2)	1160	3 (76.2)	70	11,200 (317.2)
DDV-60 HI	52 (1320)	42 (1070)	24.5 (622)	700 (317)	30 (762)	13,800 (4206)	3 (76.2)	17 (64.3)	5 (3.7)	1750	3 (76.2)	84	14,500 (410.6)
DDV-75 LO	59 (1500)	47.5 (1210)	30.5 (775)	900 (408)	42 (1070)	9,630 (2935)	3 (76.2)	20 (75.7)	5 (3.7)	875	3 (76.2)	71	14,900 (421.82)
DDV-75 HI	59 (1500)	47.5 (1210)	30.5 (775)	900 (408)	42 (1070)	12,800 (3901)	3 (76.2)	20 (75.7)	7.5 (5.6)	1160	3 (76.2)	81	22,700 (642.9)
DDV-90 LO	65 (1650)	54 (1370)	31.5 (800)	1200 (544)	48 (1220)	11,000 (3353)	3 (76.2)	23 (87.0)	5 (3.7)	875	3 (76.2)	75	20,000 (566.2)
DDV-90 HI	65 (1650)	54 (1370)	31.5 (800)	1200 (544)	48 (1220)	14,600 (4450)	3 (76.2)	23 (87.0)	7.5 (5.6)	1160	3 (76.2)	87	28,100 (795.8)
DDV-910 LO	65 (1650)	54 (1370)	38 (965)	1300 (589.55)	48 (1220)	11,000 (3353)	3 (76.2)	23 (87.0)	5 (3.7)	875	3 (76.2)		21,300 (603)
DDV-910 HI	65 (1650)	54 (1370)	38 (965)	1300 (589.55)	48 (1220)	14,600 (4450)	3 (76.2)	23 (87.0)	10 (7.5)	1160	3 (76.2)		
DDV-100-5 LO	74.5 (1890)	67 (1700)	35 (889)	2100 (952.35)	48 (1220)	11,000 (3353)	3 (76.2)	23 (87.0)	5 (3.7)	875	3 (76.2)	75	20,400 (577.52)
DDV-100-7.5 LO	74.5 (1890)	67 (1700)	35 (889)	2200 (997)	48 (1220)	11,000 (3353)	3 (76.2)	23 (87.0)	7.5 (5.6)	875	3 (76.2)	75	24,100 (682.27)
DDV-100-7.5 HI	74.5 (1890)	67 (1700)	35 (889)	2200 (997)	48 (1220)	14,300 (4358)	3 (76.2)	23 (87.0)	7.5 (5.6)	1140	3 (76.2)	85	27,400 (776.0)
DDV-100-10 HI	74.5 (1890)	67 (1700)	35 (889)	2200 (997)	48 (1220)	14,300 (4358)	3 (76.2)	23 (87.0)	10 (7.5)	1140	3 (76.2)	85	30,300 (858.1)
DDV-100-15 HI	74.5 (1890)	67 (1700)	35 (889)	2200 (997)	48 (1220)	14,300 (4358)	3 (76.2)	23 (87.0)	15 (11.2)	1140	3 (76.2)	85	36,200 (1025.2)
DDV-110-5 LO	81 (2060)	74 (1880)	35 (889)	2800 (1269.8)	60 (1520)	11,000 (3353)	4 (101.6)	26 (98.41)	5 (3.7)	690	4 (101.6)		25,800 (730.4)
DDV-110-10 HI	81 (2060)	74 (1880)	35 (889)	2800 (1269.8)	60 (1520)	14,200 (4328)	4 (101.6)	26 (98.41)	10 (7.5)	900	4 (101.6)	85	
DDV-110-20 HI	81 (2060)	74 (1880)	35 (889)	2800 (1269.8)	60 (1520)	14,200 (4328)	4 (101.6)	26 (98.41)	20 (14.9)	900	4 (101.6)	85	
DDV-110-25 HI	81 (2060)	74 (1880)	35 (889)	2800 (1269.8)	60 (1520)	14,200 (4328)	4 (101.6)	26 (98.41)	25 (18.6)	900	4 (101.6)	85	
DDV-130-15 HI	94 (2390)	88 (2240)	35 (889)	3700(1677.95)	60 (1520)	14,200 (4328)	4 (101.6)	31 (117.33)	15 (11.2)	900	4 (101.6)	85	
DDV-130-20 HI	94 (2390)	88 (2240)	35 (889)	3700(1677.95)	60 (1520)	14,200 (4328)	4 (101.6)	31 (117.33)	20 (14.9)	900	4 (101.6)	85	
DDV-130-17.5LO	94 (2390)	88 (2240)	35 (889)	3700(1677.95)	60 (1520)	11,000 (3353)	4 (101.6)	31 (117.33)	17.5 (13.05)	690	4 (101.6)		43,600 (1234.3)

* - Use the typical volumes to determine gallons per foot or litres per metre of pipe (diameter in inches) for the system: 1 in. = 0.045 gal/ft (0.56 l/m); 2 in. = 0.174 gal/ft (2.16 l/m); 2½ in. = 0.249 gal/ft (3.1 l/m); 3 in. = 0.384 gal/ft (4.78 l/m); 3.5 in. = 0.514 gal/ft (6.4 l/m); 4 in. = 0.661 gal/ft (8.2 l/m); 5 in. = 1.04 gal/ft (12.9 l/m); 6 in. = 1.5 gal/ft (18.6 l/m); and 8 in. = 2.66 gal/ft (33.1 l/m).

** - Noise level in decibels, 20 feet (6.1 metre) in front of fan.

TABLE 13. FUEL CONSUMPTION AND FUEL LIFTING CAPABILITIES

UNIT	CONSUMPTION		FUEL LIFT	
	Gal/hr	Litre/hr	Feet	Metre
12.5RJC	2.0	7.6	6	1.8
15.0RJC	2.2	8.3	6	1.8
30.0EK	4.9	18.5	6	1.8
45.0EM	7.3	27.6	6	1.8
55.0EN	7.8	29.5	6	1.8
70.0EN	9.0	34.0	6	1.8
85.0KR	13.0	49.2	6	1.8
115.0WA	15.3	57.9	6	1.8
170.0WB	23.7	89.7	6	1.8
15.0RDJC	1.3	4.9	6	1.8
17.5RDJF	1.7	6.4	6	1.8
30.0DDA	2.5	9.5	10	3.0
30.0DEH	2.6	9.8	6	1.8
45.0DEF	3.5	13.2	6	1.8
45.0DYJ	4.1	15.5	8	2.4
50.0DDB	3.9	14.8	10	3.0
50.0DEG	4.0	15.1	6	1.8
60.0DYA	4.8	18.2	8	2.4
75.0DYC	5.8	22.0	8	2.4
90.0DYC	8.0	30.3	8	2.4
100.0DYC	8.4	31.8	8	2.4
100.0DYD	8.2	31.0	8	2.4
125.0DYD	9.8	37.1	8	2.4
150.0DYG	11.5	43.5	6	1.8
155.0DFE	12.9	48.8	5	1.52
175.0DYG	13.5	51.1	6	1.8
180.0DFE	14.8	56.0	5	1.52
200.0DFP	16.5	24.6	5	1.52
200.0DYB	18.0	68.1	8	2.4
250.0DYH	19.0	71.9	8	2.4
300.0DFS	22.2	84.0	5	1.52
350.0DFW	25.5	96.5	5	1.52
350.0DHB	28.3	107.1	7	2.1
400.0DFV	32.5	123.0	5	1.52
450.0DFW	35.5	134.4	5	1.52
500.0DFY	39.6	149.9	5	1.52
600.0DFX	43.7	165.4	5	1.52
750.0DFZ	54.7	207.0	5	1.52

TABLE 14. COPPER FUEL LINES AVAILABLE FROM ONAN
(Basically used with underground tanks)

GENERATOR SET	TYPE OF LINE USE		
	SUPPLY	RETURN (No Tank)	RETURN (Tank)
RJC	5/16	—	5/16
EK EM EN KR	3/8	—	5/16
WA WB	1/2	—	5/16
DJA DJB DJC RDJC RDJF	5/16	5/16	5/16
DEF DEG DEH	3/8	5/16	1/2
DFE DFM DFN DFP DFS DFV DFW DFY DFX DFZ DHB	5/8	1/2	5/8
DYH DYD DYD	3/8	3/8	1/2
DYB DYG DYH	1/2	3/8	1/2

TABLE 15. MAXIMUM EQUIVALENT EXHAUST PIPE LENGTH IN FEET (METRES IN PARENTHESES), ONE CRITICAL MUFFLER INCLUDED

	EXHAUST PIPE SIZE IN INCHES										
UNIT	1.5	1.75	2	2.5	3	3.5	4	5	6	8	10
RJC	11 (3.4)	24 (7.3)	46 (14)	124 (38)	391 (119)						
EK				33(10)	167 (51)	288 (88)					
EM				9 (2.7)	89 (27)	168 (51)					
55.0EN							67 (20)	224 (68)			
70.0EN							67 (20)	224 (68)			
70.0KR						80 (24)	180 (54)	500 (152)			
85.0KR						60 (18)	154 (47)	457 (139)			
WA							76 (23)	260 (79)	530 (161)		
WB								60 (18)	180 (55)	700 (213)	
RDJC	14 (4.3)	28 (9)	56 (17)	148 (45)	466 (142)						
RDJF[1]	4 (1.2)	9 (2.7)	18 (5.5)	49 (15)	160 (49)						
RDJF[2]	17 (5.2)	35 (11)	70 (21)	188 (57)	614 (187)						
DDA				58 (18)	191 (58)	419 (128)					
DEH				34 (10)	166 (51)						
DEF					67 (20)	167 (51)					
DYJ				42 (13)	136 (41)	302 (92)	598 (182)				
DDB				27 (83)	87 (27)	192 (59)					
DEG					60 (18)	176 (54)	272 (83)				
DYA						95 (29)	200 (61)	550 (168)			
DYC							75 (23)	250 (76)	500 (152)		
DYD								160 (49)	400 (122)		
DYG								50 (15)	150 (46)	500 (152)	
155DFE									460 (140)		
180DFE									315 (96)		
200DFP									255 (78)		
230DFP									175 (53)		
DFM									100 (30)	450 (137)	
DHB,DYB									80 (24)	300 (91)	
DYH									80 (24)	300 (91)	
DFS										813 (248)	
DFN										375 (114)	
DHB										100 (30)	350 (107)
DHB*									59 (18)	387 (118)	
DFV*								41 (13)	165 (50)		
DFV									125 (38)	200 (61)	500 (152)
DFW*									59 (18)	387 (118)	
DFW										100 (30)	350 (107)
DFY*								36 (11)	115 (35)	400 (122)	
DFY									35 (11)	155 (47)	400 (122)
DFX											400 (122)
DFZ											200 (61)

* - Dual Exhaust System Figure Is For Each Pipe.
[1] - With 1.5-inch muffler.
[2] - With 2-inch muffler.

TABLE 16. EQUIVALENT LENGTHS OF PIPE FITTINGS
(Metric equivalents in parentheses where applicable)

TYPE OF FITTING Inches	1.5	2	2.5	3	3.5	4	5	6	8	10	12
STANDARD ELBOW Feet (Metres)	4.4 (1.34)	5.3 (1.62)	6.4 (1.95)	8.1 (2.47)	9.6 (2.93)	11 (3.35)	14 (4.27)	16 (4.88)	21 (6.40)	26 (7.92)	32 (9.75)
LONG RAD. ELBOW Feet (Metres)	2.8 (0.85)	3.5 (1.07)	4.2 (1.28)	5.2 (1.58)	6 (1.83)	7 (2.13)	9 (2.74)	11 (3.35)	14 (4.27)	17 (5.18)	20 (6.10)
MED. RAD. ELBOW Feet (Metres)	3.6 (1.10)	4.6 (1.40)	5.4 (1.64)	6.8 (2.07)	8 (2.44)	9 (2.74)	12 (3.66)	14 (4.27)	18 (5.49)	22 (6.70)	26 (7.92)
STANDARD TEE Feet (Metres)	9.3 (2.83)	13 (3.96)	14 (4.27)	17 (5.18)	19 (5.79)	22 (6.70)	27 (8.23)	34 (10.36)	44 (13.41)	56 (17.07)	67 (20.42)

TABLE 17. BACK PRESSURE
(Metric equivalents in parentheses where applicable)

GENERATOR SET	DISPLACEMENT Cubic Inches (Litres)	COMBUSTION AIR Cubic Feet/Min. (m^3/Min.)	EXHAUST FLOW Cubic Feet/Min. (m^3/Min.)	EXHAUST TEMPERATURE °F (°C)	MUFFLER SIZE Inches	MAX. ALLOWABLE BACK PRESSURE Inches H2O (Millimetres H2O)	MUFFLER BACK PRESSURE DROP - RESIDENTIAL Inches H2O (Millimetres H2O)	MUFFLER BACK PRESSURE DROP - CRITICAL Inches H2O (Millimetres H2O)	EXHAUST SYSTEM EXIT LOSS Inches H2O (Millimetres H2O)
15.0RJC	120 (1.97)	50 (1.42)	160 (4.53)	1150 (621)	1.5	27.2 (691)	11.9 (302)	14.4 (366)	2.71 (68.8)
30.0EK	300 (4.92)	100 (2.83)	320 (9.06)	1150 (621)	2.5	20.4 (518)	8.4 (213)	10.1 (256)	1.90 (48.3)
45.0EM	300 (4.92)	125 (3.54)	400 (11.32)	1150 (621)	3	20.4 (518)	5.5 (140)	6.7 (170)	1.25 (31.8)
55.0EN	460 (7.54)	190 (5.38)	580 (16.42)	1150 (621)	3.5	20.4 (518)	6.5 (165)	7.9 (201)	1.50 (38.1)
70.0EN	460 (7.54)	190 (5.38)	580 (16.42)	1150 (621)	3.5	20.4 (518)	6.5 (165)	7.9 (201)	1.50 (38.1)
70.0KR	549 (9.00)	230 (6.51)	600 (17.00)	1100 (593)	4	24.5 (622)	5.0 (127)	6.1 (155)	1.00 (25.4)
85.0KR	549 (9.00)	230 (6.51)	708 (20.04)	1230 (666)	4	24.5 (622)	5.5 (140)	6.6 (168)	.90 (22.9)
115.0WA	817 (13.40)	340 (9.63)	846 (24.00)	1160 (627)	5	18.0 (457)	3.3 (84)	4.0 (102)	.75 (19.1)
170.0WB	1197 (19.62)	497 (14.10)	1326 (37.60)	1326 (719)	6	18.0 (457)	3.7 (94)	4.4 (112)	1.30 (33.0)
15.0RDJC	120 (1.97)	62 (1.76)	155 (4.39)	1100 (593)	1.5	27.2 (691)	11.3 (287)	13.6 (345)	2.60 (66.0)
17.5RDJF	140 (2.29)	62 (1.76)	180 (5.10)	1100 (593)	1.5	27.2 (691)	15.5 (394)	18.7 (475)	3.50 (88.8)
30.0DDA	219 (3.59)	135 (3.82)	274 (7.76)	875 (468)	2.5	25.0 (635)	7.5 (191)	9.0 (229)	1.70 (43.2)
30.0DEH	254 (4.16)	104 (2.94)	316 (8.95)	1100 (593)	2.5	20.4 (518)	8.4 (213)	10.1 (257)	2.10 (53.3)
45.0DEF	362 (5.93)	146 (4.13)	437 (12.40)	1100 (593)	3	20.4 (518)	6.8 (173)	8.2 (208)	160 (40.6)
45.0DYJ	301 (4.94)	157 (4.45)	375 (10.62)	1000 (538)	3	27.2 (691)	5.4 (137)	6.5 (165)	1.20 (30.5)
50.0DDB	329 (5.39)	200 (5.66)	411 (11.64)	963 (534)	3	25.0 (635)	6.5 (165)	7.9 (201)	1.50 (38.1)
50.0DEG	380 (6.23)	160 (4.53)	450 (12.74)	1100 (593)	3	20.4 (518)	7.2 (183)	8.7 (221)	1.70 (43.2)
60.0DYA	301 (4.94)	216 (6.12)	540 (15.30)	1100 (593)	3	27.2 (691)	10.3 (262)	12.7 (322)	2.40 (61.0)
75.0DYC	426 (7.00)	250 (7.08)	810 (22.90)	1050 (566)	4	27.2 (691)	7.5 (190)	9.1 (231)	1.80 (45.7)
90.0DYC	426 (7.00)	300 (8.50)	900 (25.50)	1100 (593)	4	27.2 (691)	9.3 (236)	11.2 (284)	2.20 (55.9)
100.0DYC	426 (7.00)	315 (8.92)	1110 (31.42)	1100 (593)	5	27.2 (691)	6.1 (155)	7.4 (188)	1.40 (35.6)
100.0DYD	516 (8.50)	380 (10.80)	1245 (35.25)	1050 (566)	5	27.2 (691)	5.9 (150)	7.2 (183)	1.40 (35.6)
125.0DYD	516 (8.50)	415 (11.80)	1245 (35.25)	1100 (593)	5	27.2 (691)	7.6 (193)	9.2 (234)	1.70 (43.2)
150.0DYG	844 (13.84)	640 (18.12)	1860 (52.70)	1075 (579)	6	27.2 (691)	8.4 (213)	8.4 (213)	1.90 (48.7)
155.0DFE	855 (14.00)	660 (18.69)	1620 (45.90)	970 (525)	6	40.6 (1031)	6.8 (173)	8.2 (208)	1.60 (40.6)
175.0DYG	844 (13.84)	690 (19.53)	1945 (55.10)	1125 (607)	6	27.2 (691)	8.7 (221)	10.6 (269)	1.95 (49.5)
180.0DFE	855 (14.00)	700 (19.81)	1880 (53.20)	970 (525)	6	40.6 (1031)	9.2 (234)	11.0 (279)	2.10 (53.3)

* - Figures for dual exhaust system.

TABLE 17. (Continued on next page)

TABLE 17. BACK PRESSURE (Continued)
(Metric equivalents in parentheses where applicable)

GENERATOR SET	DISPLACEMENT Cubic Inches (Litres)	COMBUSTION AIR Cubic Feet/Min. (m^3/Min.)	EXHAUST FLOW Cubic Feet/Min. (m^3/Min.)	EXHAUST TEMPERATURE °F (°C)	MUFFLER SIZE Inches	MAX. ALLOWABLE BACK PRESSURE Inches H2O (Millimetres H2O)	MUFFLER BACK PRESSURE DROP - RESIDENTIAL Inches H2O (Millimetres H2O)	MUFFLER BACK PRESSURE DROP - CRITICAL Inches H2O (Millimetres H2O)	EXHAUST SYSTEM EXIT LOSS Inches H2O (Millimetres H2O)
200.0DFP	855 (14.00)	730 (20.66)	2040 (57.75)	970 (525)	6	40.6 (1031)	10.2 (259)	12.3 (312)	2.30 (58.4)
200.0DYG	844 (13.84)	670 (18.97)	1925 (54.50)	1100 (593)	6	27.2 (691)	8.8 (224)	10.6 (269)	2.00 (50.8)
230.0DFP	855 (14.00)	790 (22.36)	2370 (67.10)	970 (525)	6	40.6 (1031)	14.6 (371)	17.6 (447)	3.30 (83.9)
250.0DFM	855 (14.00)	950 (26.90)	2490 (70.50)	970 (525)	6	40.6 (1031)	15.9 (404)	19.1 (485)	3.60 (91.4)
250.0DYB	844 (13.84)	743 (21.03)	2300 (65.11)	1100 (593)	6	27.2 (691)	12.3 (312)	14.8 (376)	2.95 (74.9)
250.0DYH	844 (13.84)	900 (25.47)	2150 (60.87)	1100 (593)	6	27.2 (691)	10.9 (277)	13.0 (330)	2.50 (63.5)
300.0DFS	1150 (18.85)	975 (27.60)	2645 (74.88)	1035 (562)	8	40.6 (1031)	5.8 (147)	17.0 (178)	1.30 (33.0)
350.0DFN	1150 (18.85)	1100 (31.20)	3135 (88.75)	1000 (538)	8	40.6 (1031)	8.4 (213)	10.1 (257)	1.90 (48.7)
350.0DHB*	852 (14.00)	1675 (47.42)	4200 (118.90)	740 (393)	2-6	27.2 (691)	6.3 (168)	7.5 (191)	1.50 (38.1)
400.0DFV	1710 (28.02)	1200 (34.00)	3570 (101.10)	1120 (604)	1-8	27.2 (691)	10.0 (254)	12.0 (305)	2.25 (57.2)
400.0DFV*	1710 (28.02)	1200 (34.00)	3570 (101.10)	1120 (604)	2-6	27.2 (691)	7.5 (191)	9.0 (229)	1.80 (45.7)
450.0DFW	1710 (28.02)	1560 (44.20)	4200 (118.90)	1200 (649)	1-10	27.2 (691)	5.8 (147)	6.8 (173)	1.20 (30.5)
450.0DFW*	1710 (28.02)	1560 (44.20)	4200 (118.90)	1200 (649)	2-6	27.2 (691)	9.6 (244)	11.6 (295)	2.20 (55.9)
500.0DFY	1710 (28.02)	1580 (44.73)	4300 (121.73)	1250 (677)	1-10	27.2 (691)	6.4 (162)	7.7 (196)	1.30 (33.0)
500.0DFY*	1710 (28.02)	1580 (44.73)	4300 (121.73)	1250 (677)	2-6	27.2 (691)	10.0 (254)	12.0 (305)	2.30 (58.4)
600.0DFX	2300 (37.70)	1950 (55.20)	5450 (154.29)	990 (537)	1-10	40.6 (1031)	10.0 (254)	12.0 (305)	2.30 (58.4)
600.0DFX*	2300 (37.70)	1950 (55.20)	5450 (154.29)	990 (537)	2-8	40.6 (1031)	6.4 (162)	7.7 (196)	1.50 (38.1)
750.0DFZ	2300 (37.70)	2480 (70.21)	6530 (184.87)	970 (525)	1-12	40.6 (1031)	7.1 (180)	8.5 (215)	1.60 (40.6)
750.0DFZ*	2300 (37.70)	2480 (70.21)	6530 (184.87)	970 (525)	2-8	40.6 (1031)	9.1 (231)	11.1 (282)	2.10 (53.3)

* - Figures for dual exhaust system.

TABLE 18. LINEAR EXPANSION OF STEEL PIPE LINES
(Metric equivalents in parentheses)

TEMPERATURE INCREASE	INCREASE IN LENGTH* Inches/100 Ft (Millimetres/30 Metres)
100° F (55.6° C)	0.76 (19.0)
150° F (83.3° C)	1.15 (28.7)
200° F (111.1° C)	1.57 (39.2)
250° F (138.9° C)	1.99 (49.7)
300° F (166.7° C)	2.47 (61.7)
350° F (194.4° C)	2.94 (73.5)
400° F (222.2° C)	3.46 (86.5)
450° F (250.0° C)	4.08 (102.0)
500° F (277.8° C)	4.67 (116.7)
550° F (305.6° C)	5.30 (132.5)
600° F (333.3° C)	5.98 (149.5)
650° F (361.1° C)	7.05 (176.2)
700° F (388.9° C)	7.86 (196.5)
750° F (416.7° C)	8.36 (209.0)
800° F (444.4° C)	9.31 (232.7)

* If necessary, determine values for other lengths by direct proportion. For more information, see a mechanical engineering handbook.

TABLE 19. AVAILABLE MUFFLERS FOR 30 kW AND LARGER SETS

UNIT	PIPE SIZE—IN.		APPLICATION		
	ENGINE	MUFFLER	INDUSTRIAL	RESIDENTIAL	CRITICAL
EK	2	2.5	155-1108	155-0516	155-0189
EM	2	3	155-1108	155-0481	155-0188
DYA	3	3	155-0459	155-0481	155-1087
EN	3	3.5	155-0459	155-0632	155-0191
KR	3	4	155-0459	155-0642	155-0605
DEH, DDA	2	2.5	155-0917	155-0516	155-0189
DEF, DEG DDB, DYJ	2	3	155-0917	155-0481	155-0188
DYC 75 & 90 kW	4	4	155-1021	155-0642	155-0605
WA	3	5	155-1022	155-0645	155-0598
DYD	5	5	155-1022	155-0645	155-0598
DYC (100 kW)	4	5	155-1022	155-0645	155-0598
DHB*	5	6	155-1023	155-0651	155-0650
DFW*,DFY*	5	6	155-1023	155-0651	155-0650
DFV*	5	6	155-1023	155-0651	155-0650
DYB,DYG,DYH	6	6	155-1023	155-0651	155-0650
DFV**	10	8	155-1024	155-0845	155-0995
DFS,DFN	5	8	155-1024	155-0845	155-0995
DFX*,DFZ*	5	8	155-1024	155-0845	155-0995
DFW**,DFY**	10	10	155-1025	155-1026	155-1027
DFX**	10	10	155-1025	155-1026	155-1027
DFZ**	12	12	155-1085	155-1086	155-1087

* - Flanges and Two Mufflers Required.
** - With Exhaust Header, Flanges and One Muffler.

NOTE: See following table on muffler sizes for Dimensions and Weights.

TABLE 20. MUFFLER DIMENSIONS
(Metric equivalent in parentheses)

MUFFLER PART NO.	LENGTH	OUTSIDE DIAMETER	WEIGHT
155-0188	48 in. (1.22 m)	12 in. (305 mm)	57 lbs. (25.9 kg)
155-0189	42 in. (1.06 m)	10 in. (254 mm)	48 lbs. (21.8 kg)
155-0191	54 in. (1.37 m)	14 in. (356 mm)	102 lbs. (46.3 kg)
155-0459	31 in. (787 mm)	7 in. (178 mm)	22 lbs. (10.0 kg)
155-0481	47 in. (1.19 m)	10 in. (254 mm)	52 lbs. (23.6 kg)
155-0516	33 in. (838 mm)	10 in. (254 mm)	37 lbs. (16.8 kg)
155-0598	77 in. (1.96 m)	16 in. (406 mm)	215 lbs. (97.5 kg)
155-0605	66 in. (1.68 m)	14 in. (356 mm)	135 lbs. (61.3 kg)
155-0632	48 in. (1.22 m)	12 in. (305 mm)	52 lbs. (23.6 kg)
155-0642	52 in. (1.32 m)	14 in. (356 mm)	115 lbs. (52.2 kg)
155-0645	59 in. (1.50 m)	16 in. (406 mm)	165 lbs. (74.9 kg)
155-0650	96 in. (2.44 m)	18 in. (457 mm)	310 lbs. (140.7 kg)
155-0651	72 in. (1.83 m)	18 in. (457 mm)	225 lbs. (102.2 kg)
155-0845	99 in. (2.51 m)	24 in. (610 mm)	475 lbs. (215.6 kg)
155-0917	18 in. (457 mm)	6 in. (152 mm)	8 lbs. (3.6 kg)
155-0995	110 in. (2.79 m)	24 in. (610 mm)	550 lbs. (249.7 kg)
155-1021	40 in. (1.02 m)	12 in. (305 mm)	45 lbs. (20.4 kg)
155-1022	47 in. (1.19 m)	14 in. (356 mm)	65 lbs. (29.5 kg)
155-1023	60 in. (1.52 m)	16 in. (406 mm)	170 lbs. (77.2 kg)
155-1024	73 in. (1.85 m)	18 in. (457 mm)	200 lbs. (90.8 kg)
155-1025	81 in. (2.06 m)	24 in. (610 mm)	425 lbs. (192.9 kg)
155-1026	118 in. (3.00 m)	30 in. (762 mm)	775 lbs. (351.8 kg)
155-1027	136 in. (3.45 m)	30 in. (762 mm)	985 lbs. (447.2 kg)
155-1085	95 in. (2.4 m)	30 in. (762 mm)	745 lbs. (338 kg)
155-1086	126 in. (3.2 m)	36 in. (914 mm)	1,010 lbs. (458 kg)
155-1087	143 in. (3.6 m)	36 in. (914 mm)	1295 lbs. (587 kg)
155-1108	14.75 in. (375 mm)	4.375 in. (111 mm)	10 lbs. (4.5 kg)

BIBLIOGRAPHY

NFPA pamphlet No. 30, "Storage, Handling and Use of Flammable Liquids"

NFPA pamphlet No. 37, "Installation and Use of Internal Combustion Engines"

NFPA pamphlet No. 54, "Installation of Gas Piping and Gas Appliances in Buildings"

NFPA pamphlet No. 58, "Storage and Handling of Liquefied Petroleum Gases"

NFPA pamphlet No. 70, "National Electrical Code"

National Building Code

Building Code Standards for Heat Producing Appliances, etc.

Fire Prevention Code

Onan manufactures a complete line of electric power systems from 1 to 750 kW (generator sets • automatic transfer switches • industrial engines), gas-, gasoline- or diesel-driven. For standby power in homes, industrial plants, commercial buildings and institutions. For auxiliary or portable power in boats, recreational vehicles, service trucks and construction equipment.

PREPARED BY
ONAN
TECHNICAL PUBLICATIONS DEPARTMENT
ONAN PRESS PUBLICATION