

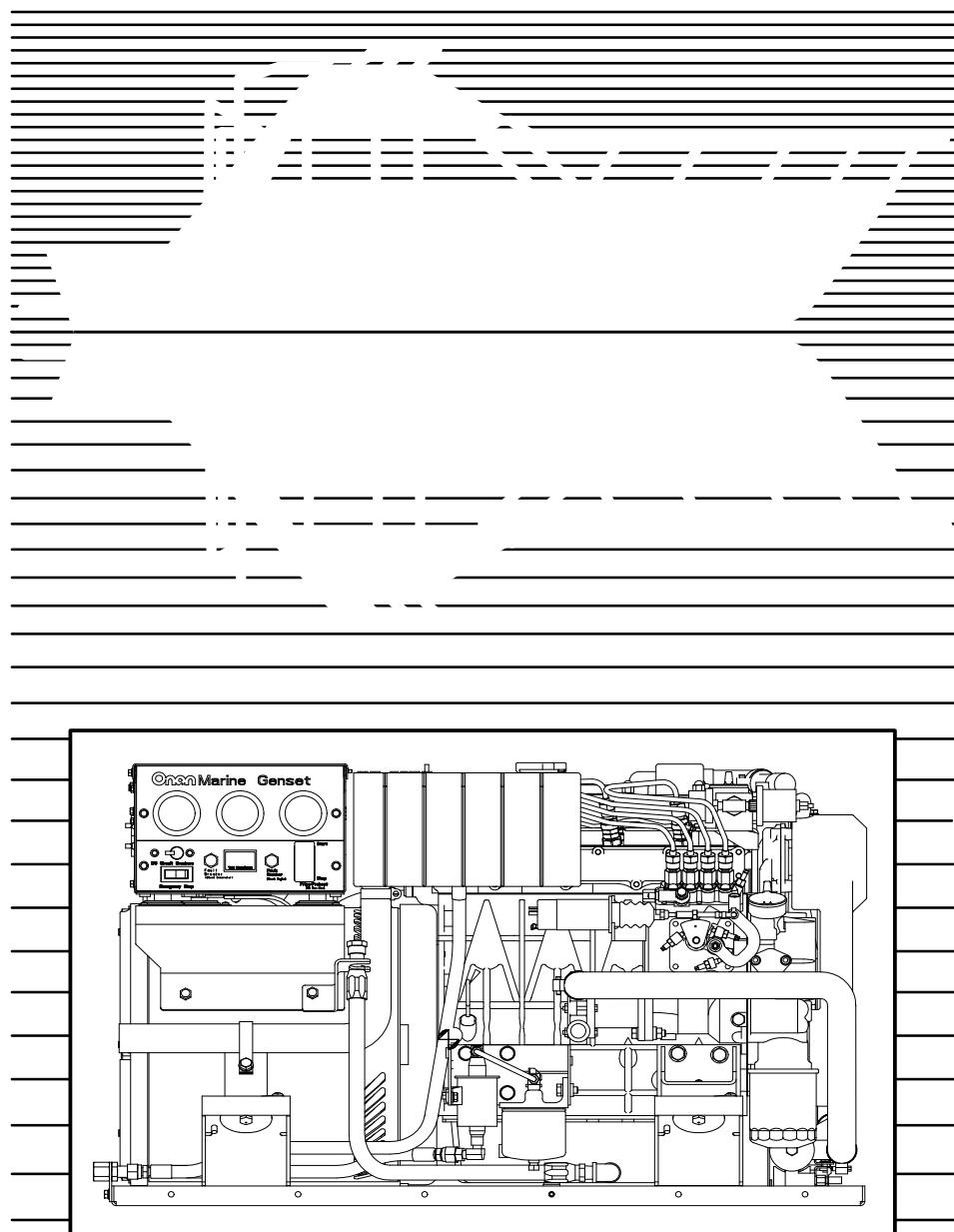
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MARINE

Installation Manual

MDKAL, MDKAA, MDKAB



California

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

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Safety Precautions

Thoroughly read the **OPERATOR'S MANUAL** before operating the genset. Safe operation and top performance can be obtained only by proper operation and maintenance.

The following symbols in this Manual alert you to potential hazards to the operator, service personnel and equipment.

⚠ DANGER *alerts you to an immediate hazard which will result in severe personal injury or death.*

⚠ WARNING *alerts you to a hazard or unsafe practice which can result in severe personal injury or death.*

⚠ CAUTION *alerts you to a hazard or unsafe practice which can result in personal injury or equipment damage.*

Electricity, fuel, exhaust, moving parts and batteries present hazards which can result in severe personal injury or death.

GENERAL PRECAUTIONS

- Keep ABC fire extinguishers handy.
- Make sure all fasteners are secure and torqued properly.
- Keep the genset and its compartment clean. Excess oil and oily rags can catch fire. Dirt and gear stowed in the compartment can restrict cooling air.
- Let the engine cool down before removing the coolant pressure cap or opening the coolant drain. Hot coolant under pressure can spray out and cause severe burns.
- Before working on the genset, disconnect the negative (-) battery cable at the battery to prevent starting.
- Use caution when making adjustments while the genset is running—hot, moving or electrically live parts can cause severe personal injury or death.

- Used engine oil has been identified by some state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale, or contact used oil or its vapors.
- Do not work on the genset when mentally or physically fatigued or after consuming alcohol or drugs.
- Carefully follow all applicable local, state and federal codes.
- Do not step on the genset, as when entering or leaving the engine room. The stress can break genset parts leading to possible fuel or exhaust leaks or electrocution.

GENERATOR VOLTAGE IS DEADLY!

- Generator output connections must be made by a qualified electrician in accordance with applicable codes.
- The genset must not be connected to the public utility or any other source of electrical power. Connection could lead to electrocution of utility workers, damage to equipment and fire. An approved switching device must be used to prevent interconnections.
- Use caution when working on live electrical equipment. Remove jewelry, make sure clothing and shoes are dry and stand on a dry wooden platform on the ground or floor.

FUEL IS FLAMMABLE AND EXPLOSIVE

- Keep flames, cigarettes, sparks, pilot lights, electrical arc-producing equipment and switches and all other sources of ignition well away from areas where fuel fumes are present and areas sharing ventilation.
- Fuel lines must be secured, free of leaks and separated or shielded from electrical wiring.
- Use approved non-conductive flexible fuel hose for fuel connections at the genset.

ENGINE EXHAUST IS DEADLY!

- Learn the symptoms of carbon monoxide poisoning in this manual.
- Never sleep in the vessel with the genset running unless the vessel is equipped with a working carbon monoxide detector.
- The exhaust system must be installed in accordance with the genset Installation Manual and be free of leaks.
- Make sure the bilge is adequately ventilated with a power exhauster.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not wear loose clothing or jewelry near moving parts such as PTO shafts, fans, belts and pulleys.
- Keep hands away from moving parts.
- Keep guards in place over fans, belts, pulleys, etc.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses and do not smoke while servicing batteries.
- When disconnecting or reconnecting battery cables, always disconnect the negative (-) battery cable first and reconnect it last to reduce arcing.

DO NOT OPERATE IN FLAMMABLE AND EXPLOSIVE ENVIRONMENTS

Flammable vapor can cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death. ***Do not operate a diesel-powered genset where a flammable vapor environment can be created by fuel spill, leak, etc., unless the genset is equipped with an automatic safety device to block the air intake and stop the engine.*** The owners and operators of the genset are solely responsible for operating the genset safely. Contact your authorized Onan/Cummins dealer or distributor for more information.

POST THESE SUGGESTIONS IN POTENTIAL HAZARD AREAS OF THE VESSEL

Specifications

	MDKAL	MDKAA	MDKAB
GENERATOR: Single-Bearing, 4-Pole Rotating Field, Brushless, Electronically Regulated. See Genset Nameplate for Rating.			
FUEL CONSUMPTION:			
60 Hz: Full Load Half Load	0.8 gph (3.0 liter/hr) 0.5 gph (1.9 liter/hr)	1.0 gph (3.8 liter/hr) 0.6 gph (2.3 liter/hr)	1.2 gph (4.5 liter/hr) 0.7 gph (2.6 liter/hr)
50 Hz: Full Load Half Load	0.7 gph (2.6 liter/hr) 0.4 gph (1.5 liter/hr)	0.8 gph (3.0 liter/hr) 0.5 gph (1.9 liter/hr)	0.9 gph (3.4 liter/hr) 0.5 gph (1.9 liter/hr)
ENGINE: Kubota 4-Stroke Cycle, Indirect Injection Diesel, Water Cooled, Mechanically Governed (5% droop)			
Model	D1105	V1305	V1505
Number of Cylinders	3	4	4
Bore / Stroke	2.99 inch (76 mm) / 3.09 inch (78.4 mm)	2.99 inch (76 mm) / 2.90 inch (73.6 mm)	3.07 inch (78 mm) / 3.09 inch (78.4 mm)
Displacement	68 inch ³ (1124 cm ³)	81.5 inch ³ (1335 cm ³)	91.4 inch ³ (1498 cm ³)
Compression Ratio	22:1	22:1	22:1
Firing Order (Clockwise Rotation)	1-2-3	1-2-4-3	1-2-4-3
Fuel Injection Timing	15.5° - 17.5° BTDC	15.5° - 17.5° BTDC	15.5° - 17.5° BTDC
Valve Lash (cold)	0.0071 - 0.0087 inch (0.18 - 0.22 mm)	0.0071 - 0.0087 inch (0.18 - 0.22 mm)	0.0071 - 0.0087 inch (0.18 - 0.22 mm)
Engine Oil Capacity	4.2 quart (4.0 liter)	4.5 quart (4.3 liter)	4.5 quart (4.3 liter)
Engine Oil Drain Connection	3/8 NPT	3/8 NPT	3/8 NPT
Coolant Capacity	4.2 quart (4.0 liter)	5.3 quart (5.0 liter)	5.3 quart (5.0 liter)
Coolant Flow Rate: 60 Hz 50 Hz	5.0 gpm (19 liter/min) 4.2 gpm (16 liter/min)	5.0 gpm (19 liter/min) 4.2 gpm (16 liter/min)	5.0 gpm (19 liter/min) 4.2 gpm (16 liter/min)
Sea Water Flow Rate: 60 Hz 50 Hz	6.0 gpm (23 liter/min) 5.0 gpm (19 liter/min)	6.0 gpm (23 liter/min) 5.0 gpm (19 liter/min)	6.0 gpm (23 liter/min) 5.0 gpm (19 liter/min)
Maximum Sea Water Pump Lift	4 feet (1.2 m)	4 feet (1.2 m)	4 feet (1.2 m)
Sea Water Inlet Connection	1.0 inch (25.4 mm) ID Hose	1.0 inch (25.4 mm) ID Hose	1.0 inch (25.4 mm) ID Hose
Maximum Fuel Pump Lift	4 feet (1.2 m)	4 feet (1.2 m)	4 feet (1.2 m)
Fuel Supply Connection	1/4 NPT female	1/4 NPT female	1/4 NPT female
Fuel Return Connection	1/4 NPT female	1/4 NPT female	1/4 NPT female
Maximum Exhaust Back Pressure	3 inch (76 mm) Hg	3 inch (76 mm) Hg	3 inch (76 mm) Hg
Wet Exhaust Outlet Connection	2.0 inch (50.8 mm) ID Hose	2.0 inch (50.8 mm) ID Hose	2.0 inch (50.8 mm) ID Hose
Dry Exhaust Outlet Connection	1-1/4 NPT	1-1/4 NPT	1-1/4 NPT
BATTERIES:			
Nominal Battery Voltage	12 volts*, #	12 volts*, #	12 volts*, #
Minimum CCA Rating	360 amps	500 amps	500 amps
Charging Alternator Output	10 amps	10 amps	10 amps
APPROXIMATE WEIGHTS AND DIMENSIONS:			
Without Sound Shield Wet Weight Dimensions: L x W x H	540 lbs (245 kg) 32.5x18.9x22.1 inch (826x479x562 mm)	625 lbs (284 kg) 37.3x18.9x22.1 inch (946x479x562 mm)	625 lbs (284 kg) 37.3x18.9x22.1 inch (946x479x562 mm)
With Sound Shield Wet Weight Dimensions: L x W x H	625 lbs (284 kg) 36.0x22.4x23.5 inch (915x568x596 mm)	710 lbs (322 kg) 40.8x22.4x23.5 inch (1037x568x596 mm)	710 lbs (322 kg) 40.8x22.4x23.5 inch (1037x568x596 mm)
* - Isolated battery ground available as option. # - 24 volt battery system available as option.			

Introduction

A generator set (genset) must be installed properly to obtain safe, reliable and quiet operation. Read through this manual completely before starting the installation. It is a guide only. You must decide how to address the considerations peculiar to the installation.

Decisions you have to make will concern:

- Location and mounting
- Engine exhaust discharge and silencing
- Engine cooling
- Genset room ventilation
- Fuel connections
- Batteries
- Electrical connections
- Bonding for grounding
- Accessibility for operation and maintenance
- Noise and vibration.

Refer to the Operator's Manual regarding operation and maintenance.

STANDARDS FOR SAFETY

You must find out which standards for safety are applicable to the installation. The American Boat and

Yacht Council (ABYC) and the National Fire Protection Association (NFPA) are typical of agencies that publish safety standards for the installation of marine equipment. The United States Coast Guard (USCG) is a typical regulatory agency.

It is suggested that you obtain the following standards if you build for the U.S. domestic market:

- *Standards and Recommended Practices For Small Craft*,
American Boat and Yacht Council, Inc.
P.O. Box 747
Millersville, MD 21108
- NFPA No. 302, *Pleasure and Commercial Motor Craft*,
National Fire Protection Association
Batterymarch Park
Quincy, MA 02269
- USCG regulations are under Titles 33 and 46 of the Code of Federal Regulations (CFR),
U.S. Government Printing Office
Washington, D.C. 20404.

OUTLINE DRAWINGS

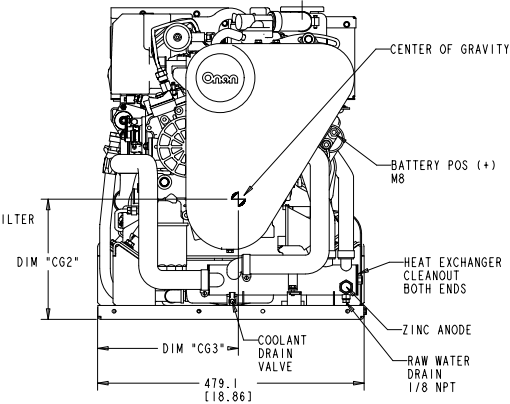
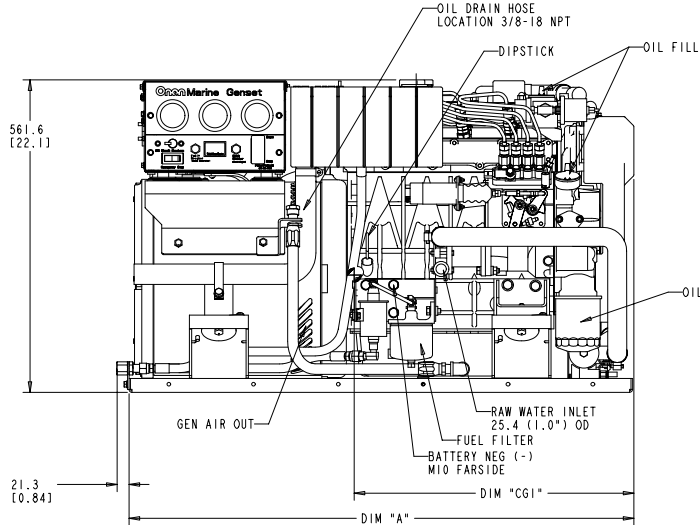
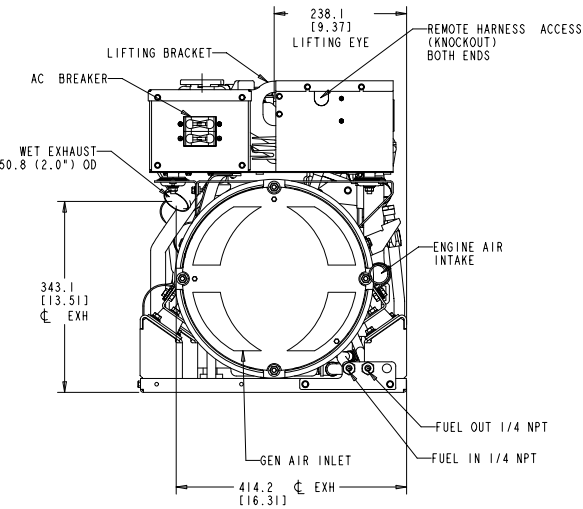
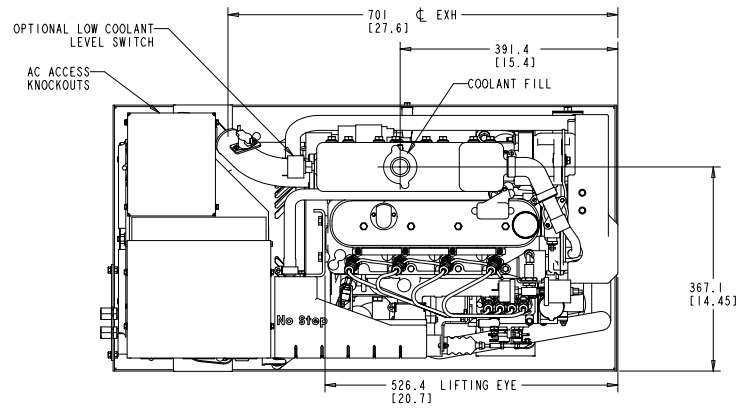
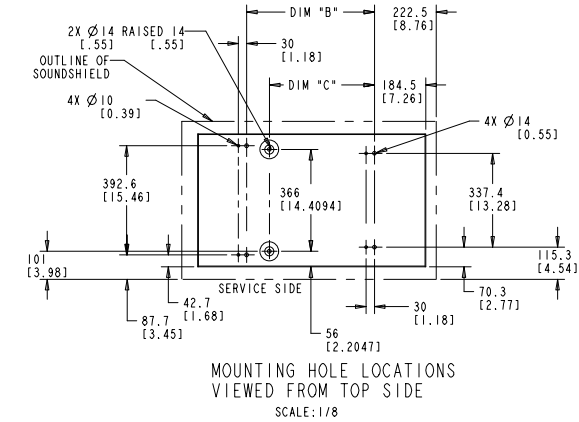
Typical genset outline drawings are shown in Figures 1 and 2. Larger scale drawings are available upon request. The drawings show dimensions, connection points, minimum clearances and mounting hole locations.

WARNING

Improper installation can lead to severe personal injury or loss of life and property due to fire, electrocution, mechanical breakdown or exhaust gas asphyxiation. You must be qualified to install marine generator sets, having knowledge of fuel, electrical and machinery hazards.

MODEL	CYL	DIM "A"	DIM "B"	DIM "C"	DIM "CG1"	DIM "CG2"	DIM "CG3"
MDKAL	3	825.5 [32.5]	459.2 [18.1]	377.7 [14.9]	428 [16.85]	244 [9.6]	245 [9.65]
MDKAA/AB	4	946 [37.25]	580.4 [22.85]	499 [19.65]			

DIMENSIONS ARE IN MILLEMMETERS [INCHES]

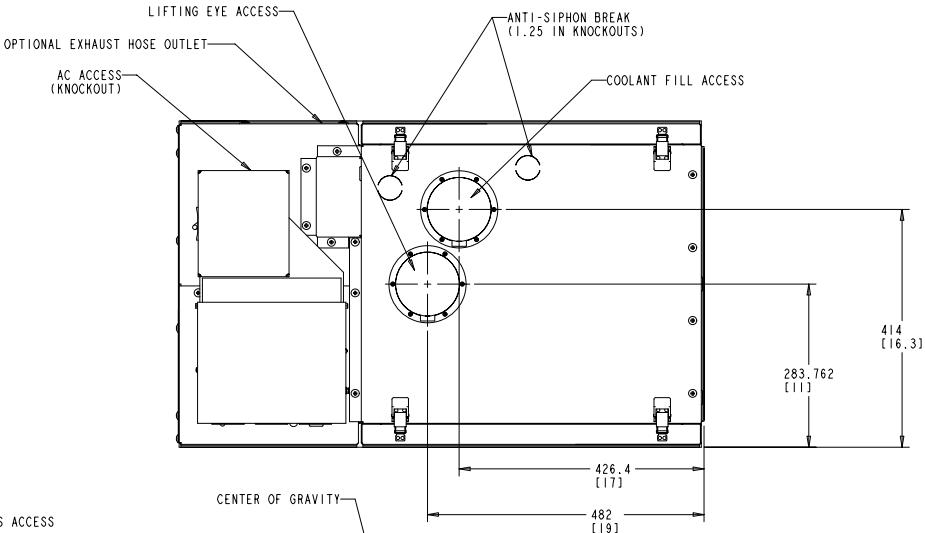


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FIGURE 1. TYPICAL GENSET OUTLINE WITHOUT SOUND SHIELD

MODEL	CYL	DIM "D"	DIM "CG4"	DIM "CG5"	DIM "CG6"
MDKAL	3	915 [36.0]	460 [18.1]	244 [9.6]	290 [11.4]
MDKAA/AB	4	1037 [40.83]			

DIMENSIONS ARE IN MILLEMMETERS [INCHES]



- NOTES:
1. DIMENSIONS IN [] ARE INCHES
 2. THROUGH HOLES FOR HOSE ROUTING INCLUDE RUBBER GROMMETS FOR ABRASION PROTECTION
 3. 25.4 (1.0) MIN CLEARANCE REQUIRED FOR AIR FLOW AT INLET AND OUTLET
 4. 51 (2.0) CLEARANCE REQUIRED ON TOP TO OPEN LATCH

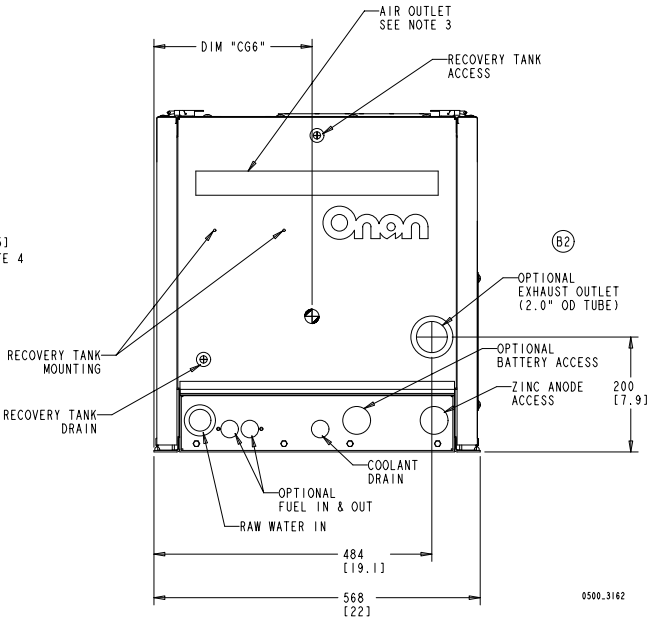
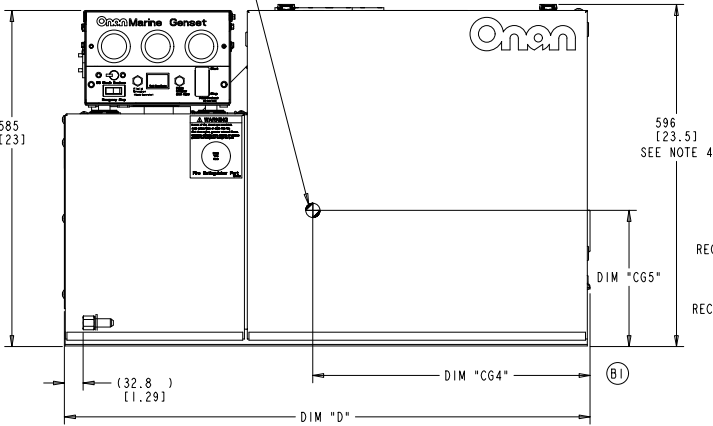
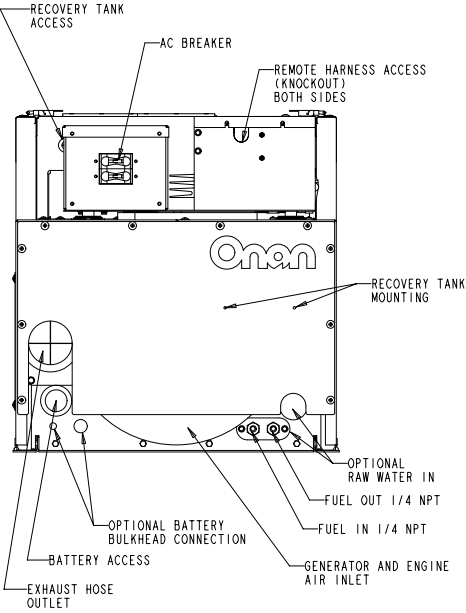


FIGURE 2. TYPICAL GENSET OUTLINE WITH SOUND SHIELD

Location and Mounting

LOCATION

See *Ventilation, Engine Exhaust, Engine Cooling* and *Fuel Supply* for other considerations that bear on location.

The genset is not “ignition protected” and therefore not permitted under USCG regulation 33CFR183 to be located in a gasoline fuel environment. If the vessel has gasoline-fueled propulsion engines, the genset will have to be located where it can be isolated from the gasoline fuel system by approved methods.

⚠WARNING *The genset can ignite gasoline fumes causing severe personal injury or death. Approved methods must be used to isolate the genset from a gasoline fuel environment.*

Because of noise, vibration and fumes, the generator compartment should be located as far from living quarters as possible.

Locate the genset where there will be enough room to perform periodic maintenance and service. Non-service sides should have at least 2 inches (51 mm) of clearance. *A sound shield requires at least 1 inch (25 mm) clearance on the ends for air flow through the genset and 2 inches (51 mm) on top to open the service door latches (Figure 2).* Make sure there is access for:

- Starting and stopping the genset
- Resetting line circuit breakers
- Checking, filling and draining engine oil
- Changing the engine oil filter
- Checking, filling and draining engine coolant
- Changing the fuel filter
- Making fuel connections
- Making battery and ground connections
- Replacing coolant and exhaust hoses
- Replacing the sea water pump impeller
- Replacing the V-belt
- Replacing the zinc anode

MOUNTING

The genset has integral vibration isolators. The supporting structure underneath should be as level as possible and able to support the weight of the genset. Floor or frame stiffness should be greatest under the vibration isolators. Bolt the genset in place using the bolt holes provided in the drip pan (Figure 1).

Ventilation

⚠️WARNING ***EXHAUST GAS IS DEADLY! Failure to provide proper ventilation can result in asphyxiation, fire and explosion. The ventilation system must meet applicable standards and regulations, including ABYC, NFPA and USCG (p. 5).***

VENTILATION

Ventilation is required to prevent dangerous concentrations of fuel vapors and exhaust fumes, hold down compartment temperatures and provide combustion air. See Table 1 for minimum U.S. Coast Guard requirements for ventilating fuel and exhaust fumes in passenger vessels.

TABLE 1. MINIMUM USCG AIR EXCHANGE RATES FOR VENTILATING FUEL AND EXHAUST FUMES

COMPARTMENT SIZE Cubic Feet (m ³)	MAXIMUM TIME TO EXCHANGE TOTAL AIR VOLUME (Minutes)
Less than 500 (14)	2
500 to 1000 (14 to 29)	3
1000 to 1500 (28 to 42)	4
1500 and Up (42 and Up)	5

To promote natural convective flow, good air exchange and fresh air for combustion and generator cooling, ventilating air should enter near the bottom of the compartment at the generator end and exit near the top at the other end. The free-air area of the inlet air cowl should be at least twice that of the duct. Use 40 in² (258 cm²) as the basis for calculations for

inlet and outlet air duct sizes and free-air areas of screens and louvers. Do not use flush air inlets or louvered transom outlets, which are easily blocked.

USCG requires power exhausters, which may also be necessary for genset cooling, especially when the vessel is not under way. Operating a genset in ambient temperatures above 104° F (40° C) will result in noticeable loss of power. Operating a genset in ambient temperatures higher than 122° F (50° C) will reduce the life of electrical components, generator windings, rubber materials and the like.

CARBON MONOXIDE

All openings and feed-through holes for wiring, conduit, pipe and hose must be sealed to prevent exhaust gases from entering the rest of the vessel. Wiring conduit must be sealed inside as well as outside.

Cabin plumbing drains must have approved traps to prevent the entrance of exhaust gases from outside.

Carbon monoxide (CO) detectors, listed for marine applications, should be installed in the living quarters of the vessel. Wind shifts, boat motion, exhaust from other boats at dockside and other conditions can cause exposure to harmful concentrations of carbon monoxide even when proper ventilation is provided and living quarters are sealed off from engine rooms.

Fuel Supply

⚠ WARNING *Diesel fuel is combustible and can cause severe personal injury or death due to fire or explosion. Fuel tank construction, location, installation, bonding for grounding, ventilation, piping, inspection and leak testing must be performed by qualified persons in accordance with applicable standards and regulations, including ABYC, NFPA and USCG (p. 5).*

GENSET FUEL FITTINGS AND FLEXIBLE FUEL LINES

The genset fuel fittings are mounted on a bracket that can be bolted at several locations around the drip pan (Figure 3). (Only one location on each end is available when the genset is equipped with a sound shield.) When relocating the bracket make sure that the fuel hoses will not become kinked, rub against other parts or come in contact with sharp edges, hot surfaces or wiring.

The genset is equipped with fuel hose that meets USCG requirement 33CFR183.558 and that is stamped “USCG TYPE A.” The hose is electrically non-conductive so that the fuel lines do not become paths for cranking current. Flexible hose is required because the engine is mounted on vibration isolators. Substitute hose must be of the same type.

⚠ WARNING *Engines and fuel tanks must be bonded to the common grounding bus of the vessel. Non-conducting fuel hose must be used for connections at the engine to prevent cranking current from flowing through the fuel lines, igniting the fuel and causing severe personal injury or death due to fire or explosion.*

FUEL FILTERS

See the Operator’s Manual for recommended fuels. ***Dirt and water in the fuel supply system can disable the engine.*** Keep dirt and debris out when making fuel connections. The fuel supply system should be equipped with a fuel filter and water separator ahead of the connections at the genset.

CONSTRUCTION AND MATERIALS

To prevent fuel starvation the genset should not share fuel lines and distribution manifolds with other equipment.

In a common fuel supply tank the genset dip tube should be shorter than those for the propulsion engines so that fuel is left to get back to port. Make sure fuel tanks are large enough to cool returning fuel.

The fuel lift pump mounted on the genset can handle fuel suction heads of up to 4 feet (1.2 m) due to lift height and pipe friction.

If the highest level of fuel in the fuel supply tank is higher than the fuel injectors, an approved method must be used to prevent flow when the engine is not running.

⚠ CAUTION *Do not use galvanized fuel tanks, fittings and pipes. Sulfur in diesel fuel attacks the galvanized (zinc) coat causing debris that can clog fuel filters, pumps and injectors.*

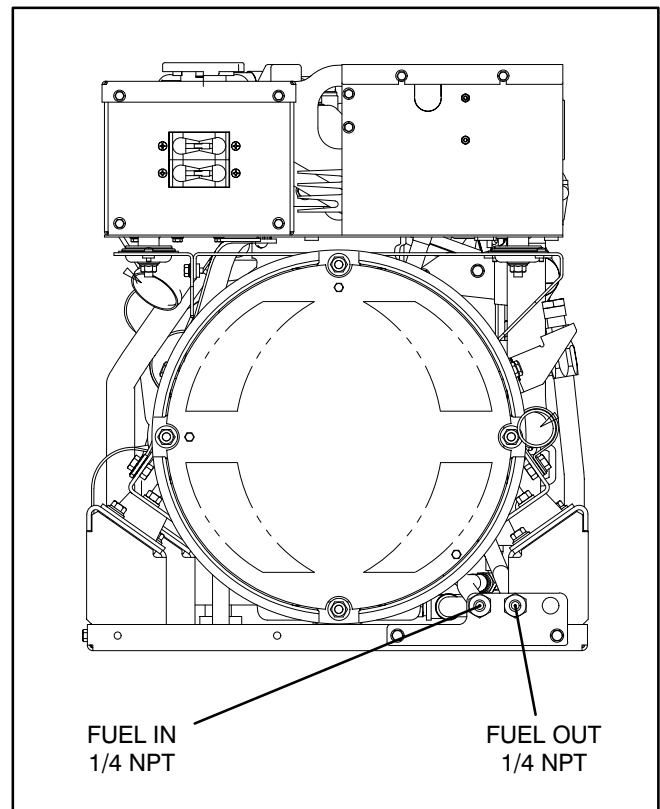


FIGURE 3. FUEL CONNECTIONS

Engine Cooling

COOLING CONFIGURATIONS

The engine is cooled by a pressurized, closed-loop liquid cooling system. Coolant is pumped through passages in the engine block, head and exhaust manifold and is cooled in a genset-mounted heat exchanger or keel cooler. The top V-belt pulley drives the coolant pump.

If the genset has a heat exchanger and/or a wet exhaust elbow, the engine is equipped with a sea water* pump driven by a power takeoff on the engine. The sea water cools the heat exchanger and/or exhaust gases and exits the vessel through the exhaust system. Figure 4 illustrates a typical installation of a genset equipped with a heat exchanger, wet exhaust elbow and sea water pump. Available configurations are as follows:

- Heat exchanger and wet exhaust
- Keel cooling and wet exhaust
- Keel cooling and dry exhaust.

SYSTEM COMPONENTS

Sea Water Pump

The sea water pump mounted on the genset can handle suction heads of up to 4 feet (1.2 m) due to lift height and hose friction. The pump impeller must be wetted with water to establish initial pump lubrication and suction. See the Operator's Manual.

Sea Water Hose

Use 1 inch (25.4 mm) I. D. SAE 20R3 or equivalent hose not less than 1 foot (300 mm) long, to take up genset movement. The hose must be able to resist a slight vacuum. The ends of the sound shield have hose exits with grommets.

Sea Water Strainer

A sea water strainer is necessary to keep sea weed and dirt out of the pump, heat exchanger and exhaust system.

Sea Cock

The sea water hull fitting must be equipped with an approved sea cock for service and emergency purposes (broken hose, loose hose clamp).

Sea Water Hull Strainer

Secure the strainer to the hull fitting with the slots parallel to the keel for best flow when the vessel is under way. Also, stagger the sea water inlets along the keel so that downstream inlets are not starved.

⚠ CAUTION *Do not use a scoop-type hull fitting. A forward-facing scoop can develop enough ram pressure to flood the engine. A rear-facing scoop can develop enough suction to impede flow.*

Heat Exchanger

Install the genset so that the cleanout covers and zinc anode are accessible for maintenance.

Keel Cooler

See *Specifications* regarding coolant flow when sizing the keel cooler.

Coolant Recovery Tank

The genset is shipped with a coolant recovery tank for mounting near the genset. The sound shield (when provided) has screw holes in the end panel for mounting the recovery tank. ***The tank must be accessible for daily inspection and refilling.*** Clamp the recovery hose to the nipple on the coolant fill spout. Route the tank drain hose to the drip pan. Fill the tank in accordance with the Operator's Manual.

Initial Coolant Fill

Gensets with heat exchangers are shipped from the factory with coolant, unless prohibited by shipping regulations. Fill the system, if necessary, in accordance with the Operator's Manual.

⚠ CAUTION *Running the genset without coolant will severely damage the engine.*

* In this manual, "sea water" refers to floatation water.

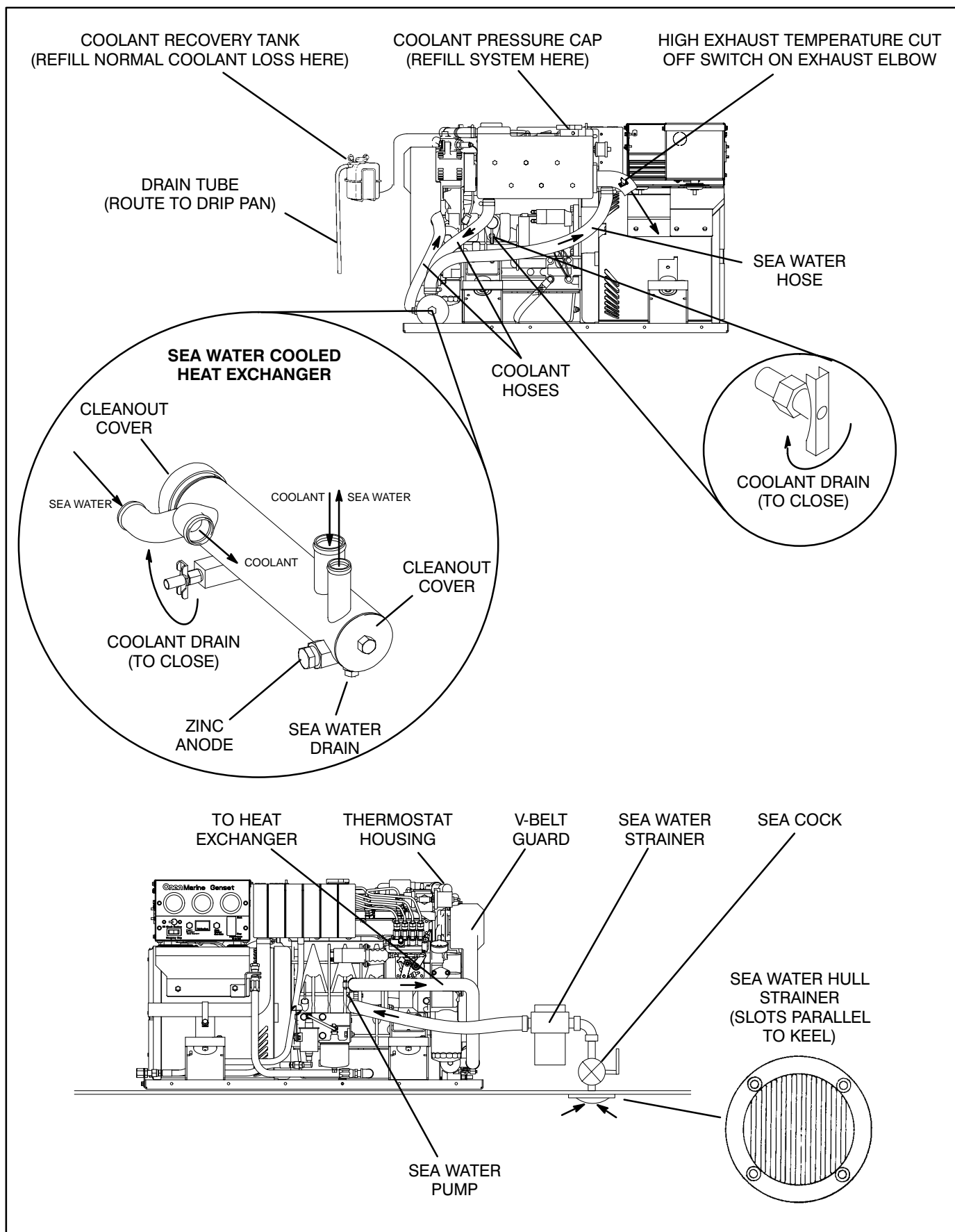


FIGURE 4. TYPICAL HEAT EXCHANGER-TYPE COOLING SYSTEM INSTALLATION

Engine Exhaust

⚠ WARNING ***EXHAUST GAS IS DEADLY! The exhaust system must be leak-free and convey all exhaust outside, away from windows, doors and vents.***

WET EXHAUST SYSTEMS

Figure 5 illustrates a typical exhaust system where the engine exhaust elbow is above the load water line and Figures 6 and 7 where it is below. See *Engine Cooling* regarding sea water connections. The installation must comply with applicable standards and regulations, including ABYC, NFPA and USCG (p. 5).

Note: The load water line must be verified by actual sea trials at all speeds (forward and reverse) with the vessel fully loaded.

Exhaust Hose

Hose Material and Routing: Use hose that has been approved for wet exhaust systems. Except where hose rises from the muffler to a water separator (Figures 5 and 6) or crest (Figure 7), hose must slope down at least 1/2 inch per foot (42 mm/meter) and be supported such that there are no sags. *The entire run of hose must be accessible for regular, visual inspections and replacement.* The ends of the sound shield have exhaust hose exits with grommets. A kit is available for front exhaust exit.

Hose Clamps: Use two stainless steel hose clamps, each at least 1/2 inch (12.7 mm) wide, at each end of each exhaust hose.

Fitting and Hose Diameters: No fitting or hose section in the exhaust system may have a smaller inside diameter than the engine outlet. The length of hose between the engine and muffler should not exceed 10 feet (3 meters). If the total run of exhaust hose is more than 20 feet (6 meters), measure exhaust back pressure and use larger diameter hose if back pressure exceeds *Specifications*.

Hull Fitting: The exhaust hull fitting must be above the load water line and the hose leading from the muffler must peak at least 12 inches (305 mm) above the hull fitting to reduce wave wash-in (Figure 7). If a water separator is used (Figures 5 and

6), the top of the water separator must be at least 18 inches (450 mm) above the load water line.

Muffler

Secure the muffler at a location where:

- The inlet will be approximately 1 foot (305 mm) below the engine exhaust outlet to reduce the risk of engine flooding
- The length of hose between the engine and muffler will not exceed 10 feet (3 meter)
- The base of the muffler will not be more than 54 inches (1.4 meter) below the water separator (Figures 5 and 6) or 48 inches (1.2 meter) below the highest point in the piping (Figure 7).
- Air can circulate underneath the muffler to prevent condensation and mold.

Water Separator

When a water separator (Figures 5 and 6) is used, the muffler outlet and water separator inlet diameters must be the same size. The hull fitting for the water drain hose should be below the water line and have a sea cock.

⚠ CAUTION ***Backflow can cause major engine damage. The sea trials must verify that there is no backflow through the exhaust hull fittings.***

Because the operator will not be able to look for water discharge from the hull to tell whether the genset is running, an exhaust temperature signal device should be used in conjunction with a water separator.

Siphon Break

Install a siphon break (Figures 6 and 7) between the engine heat exchanger and exhaust elbow unless the port is more than 6 inches (152 mm) above the load waterline. The top panel of the sound shield has knockouts for the hoses to pass through and the siphon break kit has grommets for the openings.

⚠ CAUTION ***Failure to install a siphon break can lead to severe engine damage due to flooding of the combustion chambers with water.***

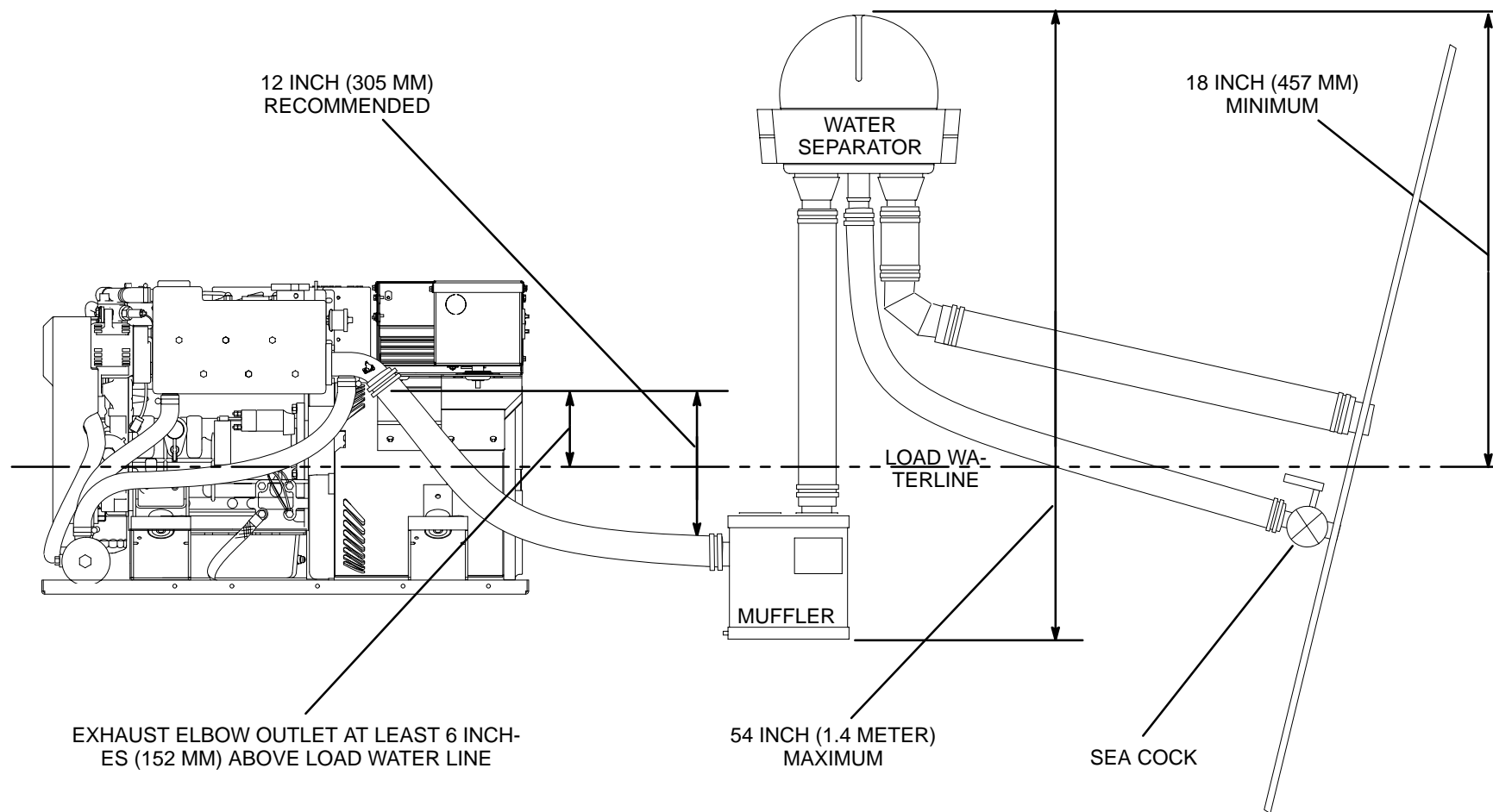


FIGURE 5. TYPICAL INSTALLATION ABOVE LOAD WATERLINE—WITH A WATER SEPARATOR

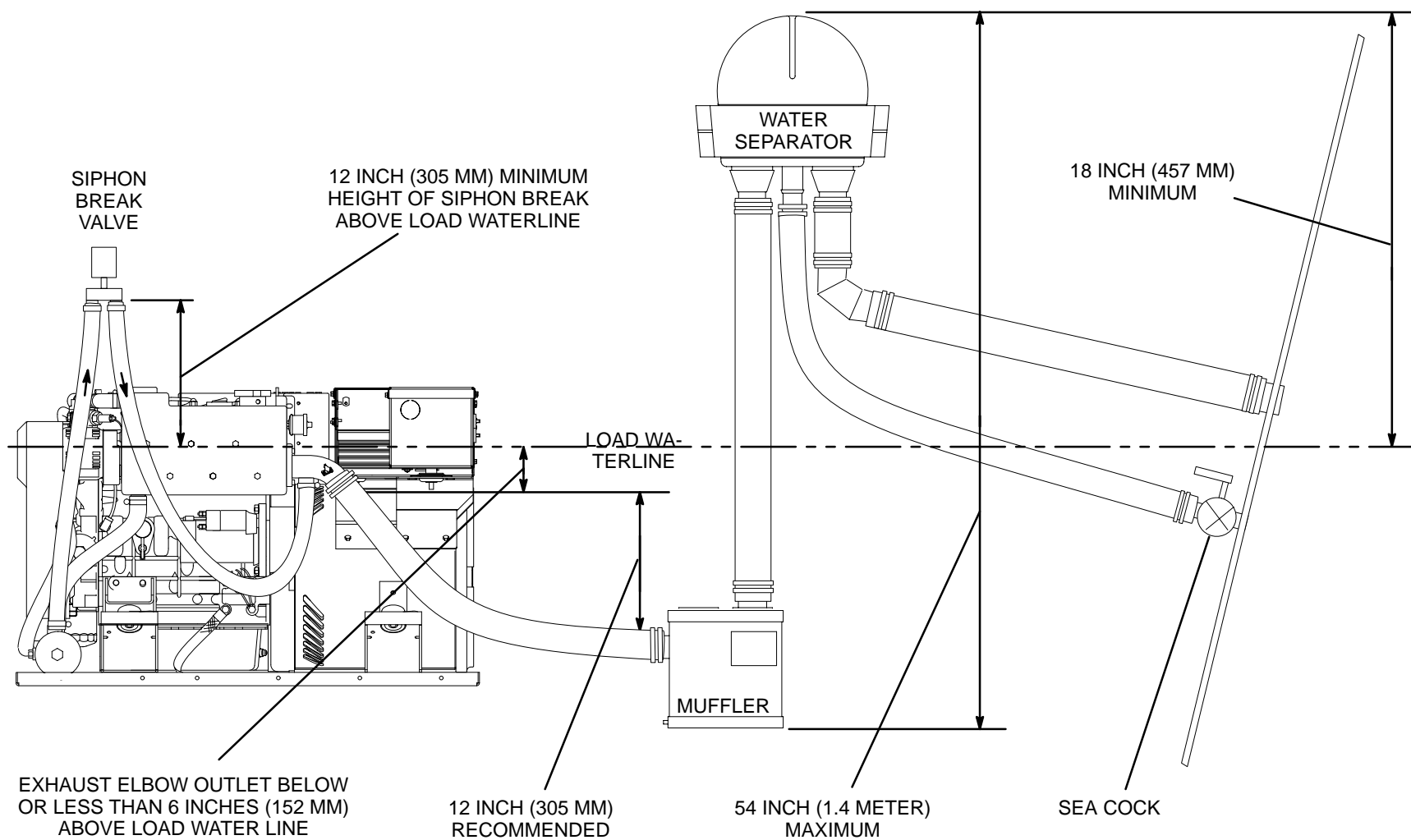


FIGURE 6. TYPICAL INSTALLATION BELOW LOAD WATERLINE—WITH A WATER SEPARATOR AND A VALVE-TYPE SIPHON BREAK

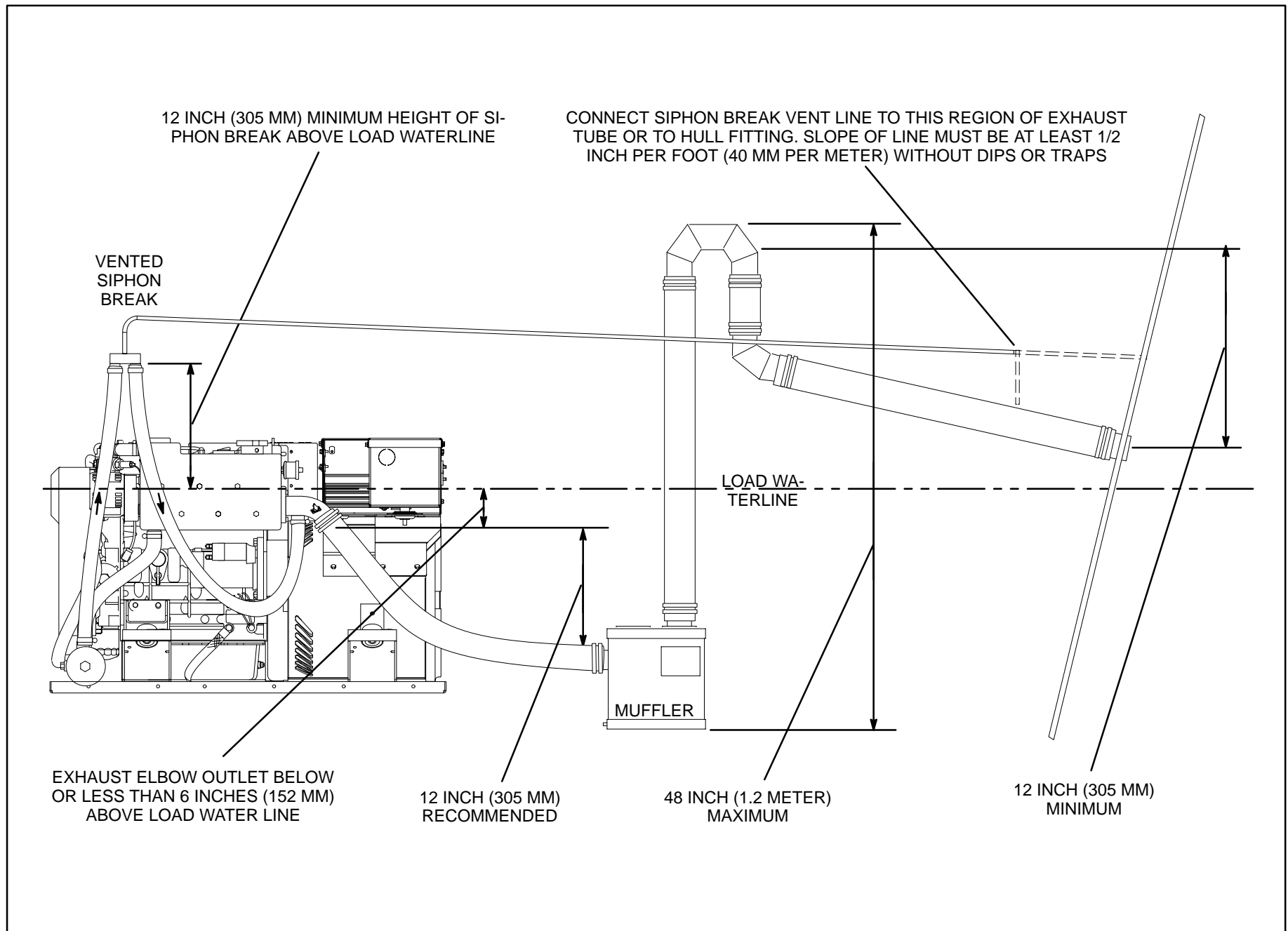


FIGURE 7. TYPICAL INSTALLATION BELOW LOAD WATERLINE—WITH A VENTED-TYPE SIPHON BREAK AND WITHOUT A WATER SEPARATOR

DRY EXHAUST SYSTEMS

Figure 8 shows a typical dry exhaust system. A separate exhaust system must be provided for each engine. Soot, corrosive condensate and high gas temperatures can damage idle engines served by a common exhaust system.

Consult the factory about exhaust pipe routing if the genset is equipped with a sound shield.

The exhaust system must be supported independently of the engine. Weight on the engine exhaust outlet can crack the exhaust manifold.

A flexible, bellows-type stainless steel section at least 18 inches (300 mm) long must be connected at the engine exhaust outlet to take up thermal expansion and engine movement.

Long runs of exhaust pipe (vertical or horizontal) should include a flexible, bellows-type stainless steel section to take up thermal expansion. Flexible exhaust sections must not be used to compensate for misaligned piping or for forming bends.

Horizontal runs of exhaust piping should slope downwards from the engine to a drain trap and plug,

which should be located where the piping turns to rise vertically.

Exhaust piping must be routed at least 9 inches (229 mm) away from combustible construction. Where a 9 inch clearance cannot be maintained, the pipe may be insulated with material rated to withstand at least 1000°F (538°C). The surface temperature of the insulation must not exceed 160°F (71°C).

Exhaust piping and mufflers must be shielded or insulated to prevent burns if accidental contact is likely. The surface of the shield or insulation must not exceed 200°F (93°C).

The entire exhaust system must be accessible for regular, visual inspection and repair.

See *Specifications* for maximum allowable exhaust back pressure. Application Manual T-030 has example exhaust back pressure calculations.

⚠ CAUTION ***Excessive exhaust back pressure reduces the air-fuel ratio, resulting in reduced power, excessive smoke, high exhaust temperature and reduced engine life.***

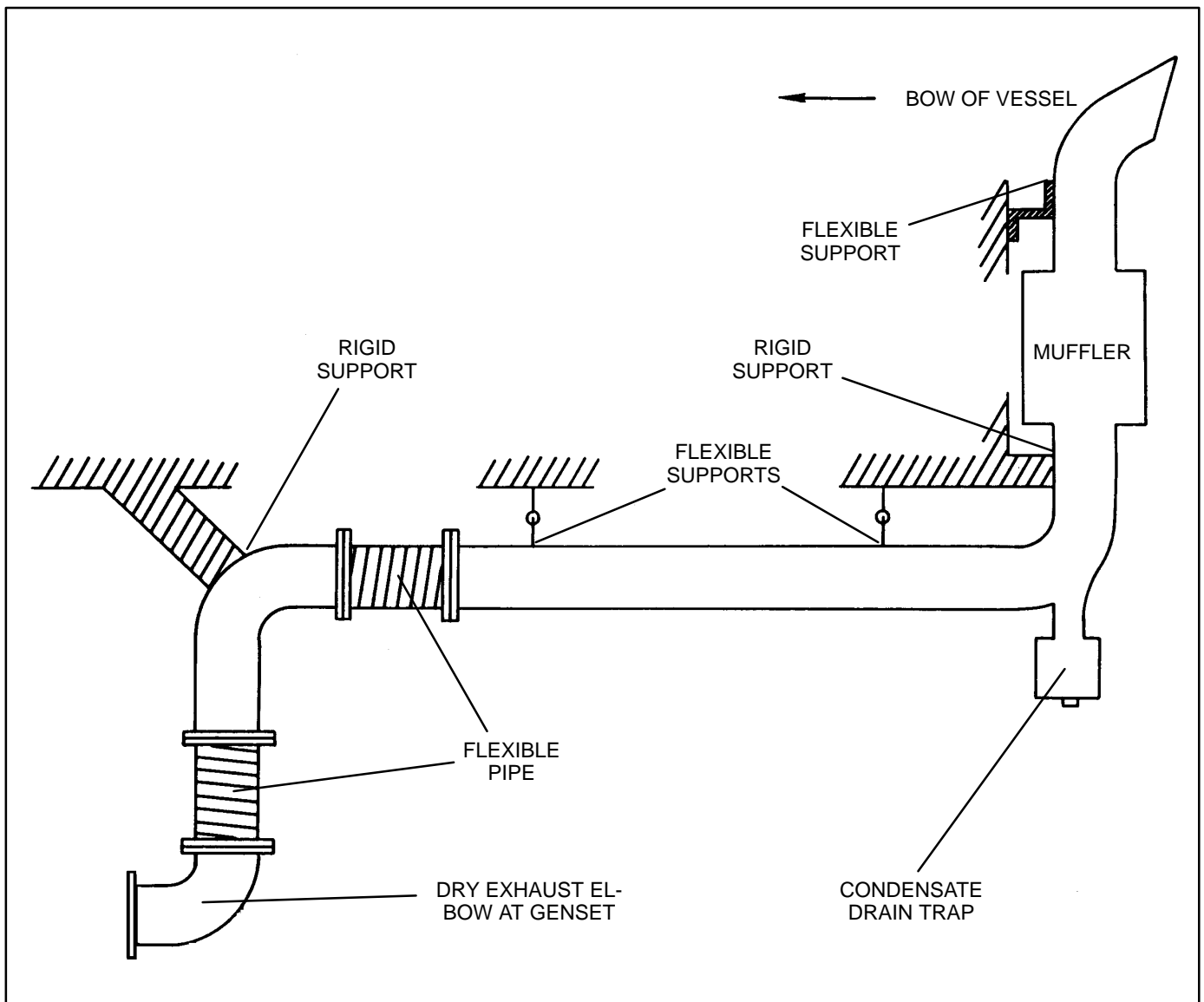


FIGURE 8. SCHEMATIC OF TYPICAL DRY EXHAUST SYSTEM

Electrical Connections

GENERATOR CONNECTIONS

⚠WARNING *Improper wiring can cause fire or electrocution resulting in severe personal injury or death.*

⚠WARNING **HAZARDOUS VOLTAGE!** *Touching uninsulated live parts inside the output box can result in severe personal injury or death. For your protection, stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry from your hands and use tools with insulated handles.*

⚠WARNING *Accidental starting can cause severe personal injury or death. To prevent accidental starting, push the control panel switch to OFF and disconnect the negative (-) battery cable from the battery before working on the genset.*

Wiring Methods

All wiring methods, connections, wire ampacities, equipment grounding, materials, etc. must be inspected and comply with applicable regulations.

Use flexible conduit and stranded conductors to make connections at the genset output box (Figure 9) to take up movement and vibration. Make connections directly to the generator leads or to the circuit breaker terminals, if so equipped.

Generator Reconnections

These generators are reconnectable as indicated by the reconnection diagrams inside the cover (Figure 10).

If the generator is equipped with line circuit breakers and generator reconnections are made, the line circuit breakers may have to be replaced with circuit breakers having appropriate ampere ratings.

Also, it may be necessary to readjust voltage and frequency. See *Voltage and Frequency Adjustments*.

Grounding

The genset, power supply wiring and all connected electrical equipment must be bonded to the com-

mon grounding bus of the vessel in accordance with applicable regulations.

⚠WARNING *Faulty bonding for grounding can cause fire and electrocution, resulting in severe personal injury or death.*

Transfer Switch

Use an approved transfer switch if provision is made for connecting the vessel to shore power.

⚠WARNING *Backfeed to shore power can cause electrocution and damage to equipment. Use an approved device to prevent the genset from being interconnected with shore power.*

Load Balancing

Check load balance between L1 and L2 on one-phase gensets and between L1, L2 and L3 on three-phase gensets. Redistribute the loads as necessary so that current does not exceed nameplate rating for any phase. Loads should be balanced within 10 percent.

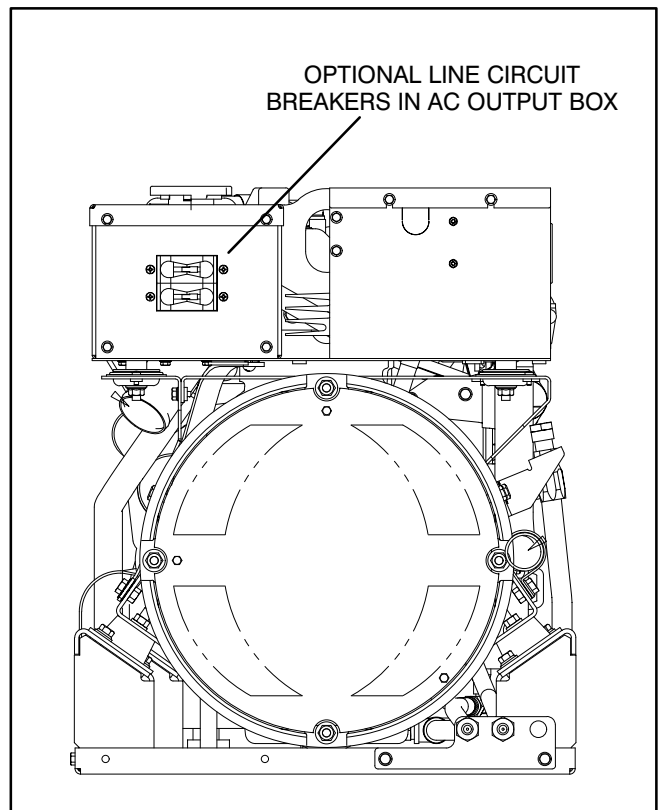
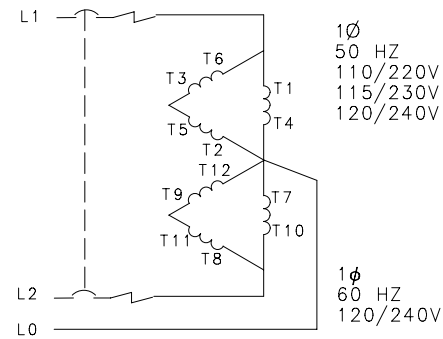
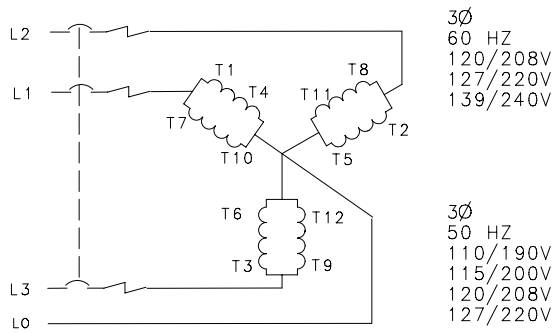
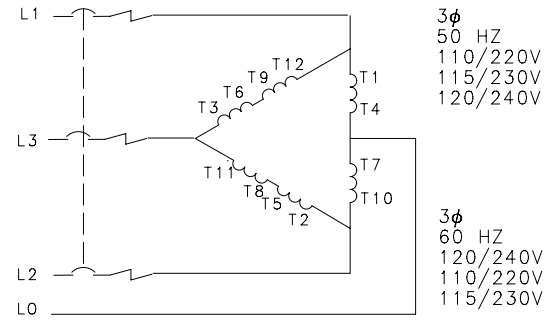
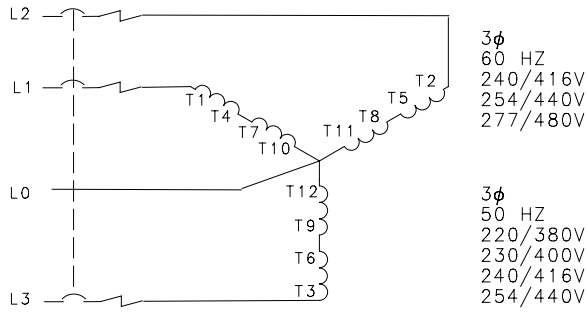


FIGURE 9. AC OUTPUT BOX

3-PHASE GENERATORS



1-PHASE GENERATORS

	A	B	C	HZ
VOLTAGE	100 120	200 240	100/200 120/240	60
	110 115	220 230	110/220 115/230	50
SCHEMATIC				

FIGURE 10. GENERATOR RECONNECTION DIAGRAMS

REMOTE CONTROL CONNECTIONS

Optional control panels and wiring harnesses of various lengths are available as shown in Figure 11. The switch and gauges function the same way as the ones on the genset-mounted control panel.

When a remote panel with gauges is installed, oil pressure and coolant temperature normally display at the remote panel rather than at the genset. A momentary gauge switch on the genset panel can be provided to read the gauges on the genset panel.

An 8-pin connector for remote connections is stowed inside the control box. If remote connections are to be made, remove the control box cover,

knock out the most convenient knockout in the top edge of the box (one on either side), pull out the connector and attached wiring, fit the grommet into the knockout slot and resecure the cover.

Install the remote panels as instructed in the kit instructions and connect the wiring harness to the genset connector. The schematic in Figure 12 shows the pins in the genset remote control connector to which to connect the Start/Stop switch, run lamp, hour meter and the various gauges when sourced elsewhere. Both positions of the Start/Stop switch must be of the momentary-contact type. Use 16 AWG conductors if the harness is sourced elsewhere.

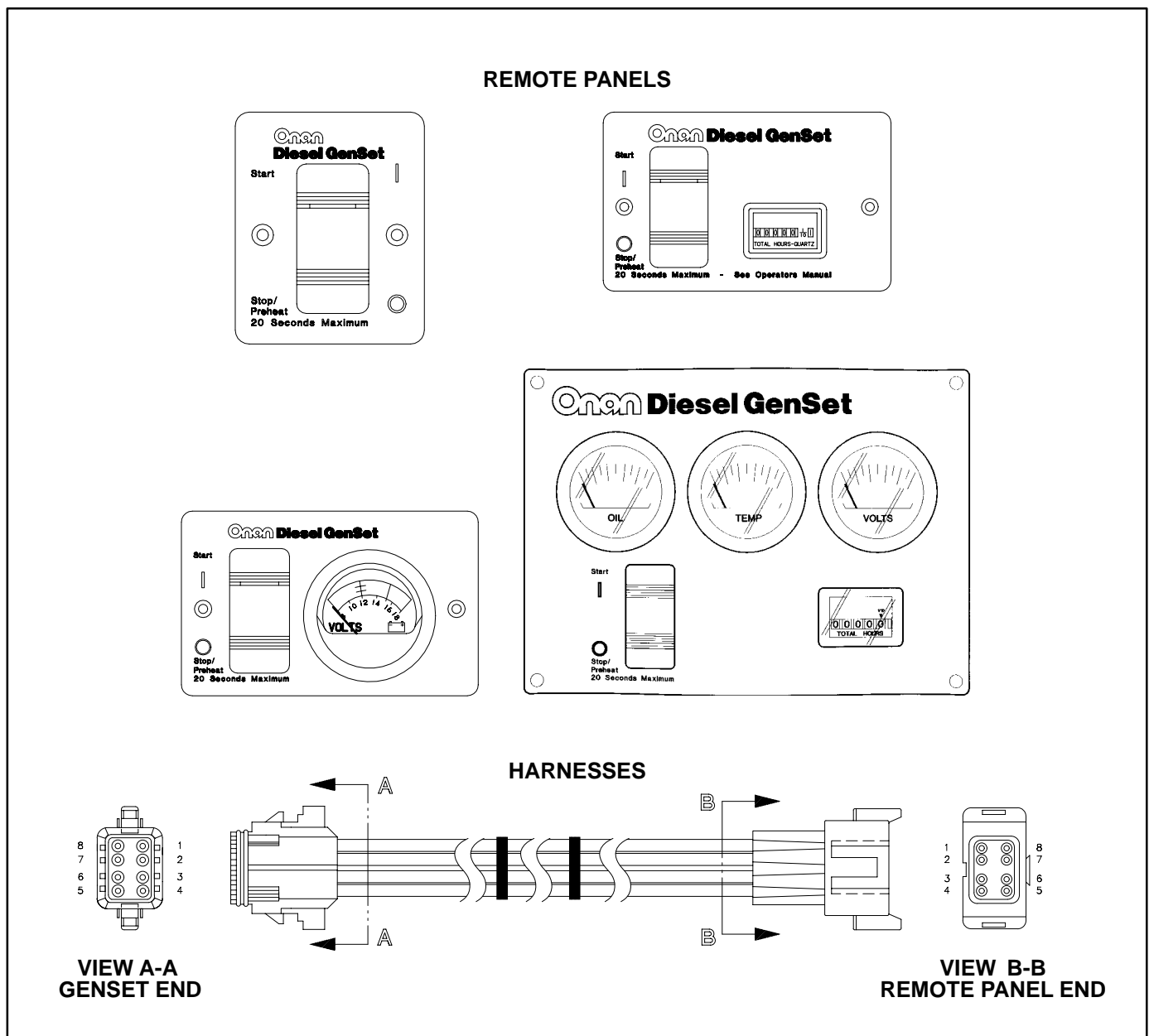


FIGURE 11. REMOTE CONTROL PANELS AND WIRE HARNESSES AVAILABLE

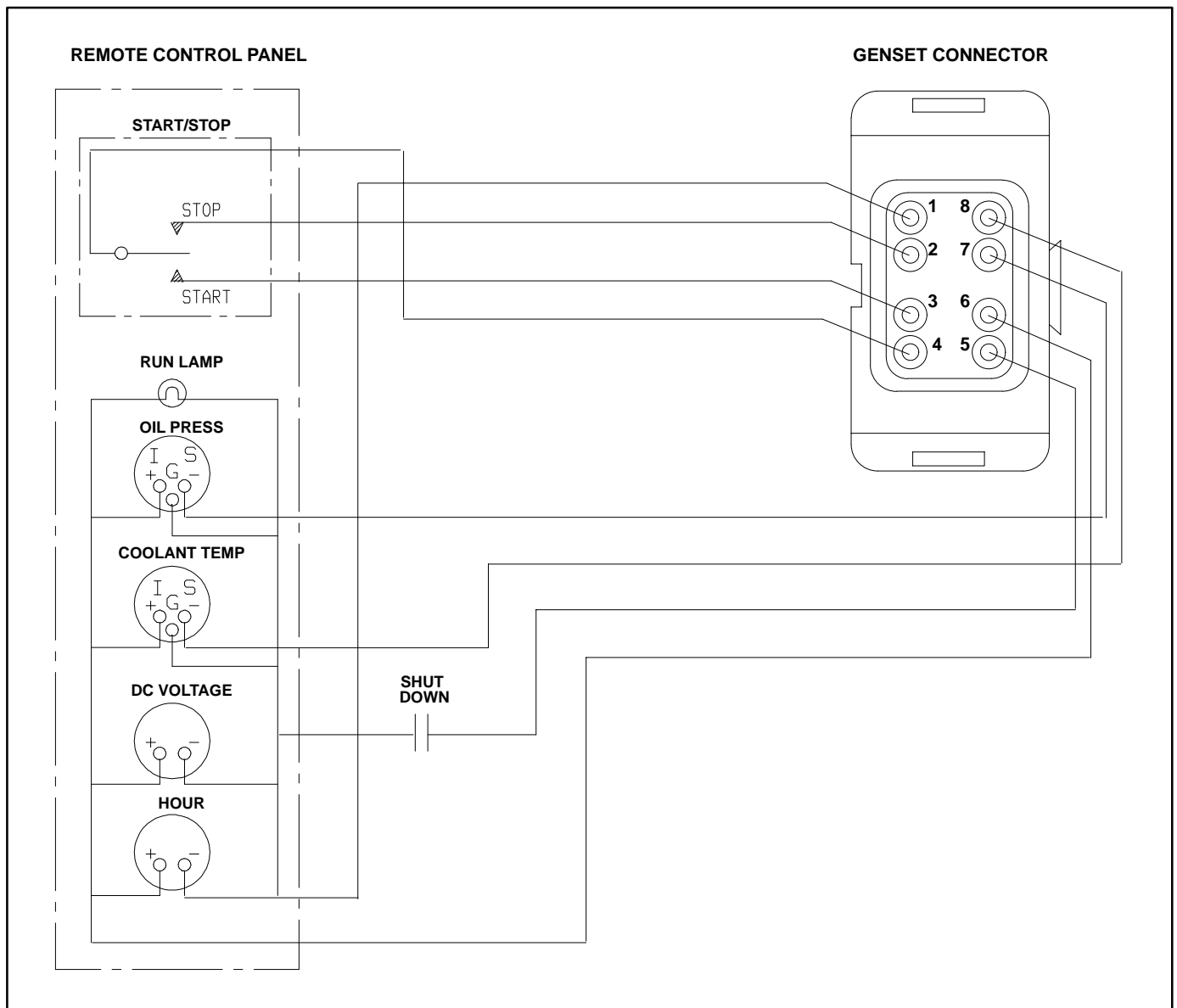


FIGURE 12. TYPICAL REMOTE CONTROL WIRING

BATTERY CONNECTIONS

The genset control and cranking circuits are negative (-) grounded and require a 12 volt battery. Isolated-ground and 24 volt genset control and cranking systems are available.

To prevent accidental starting of the genset during installation, do not connect the battery cables at the battery until it is time to start up the genset.

⚠WARNING *Accidental starting of the genset can cause severe personal injury or death. Do not connect the starting battery until it is time to start up the genset.*

Battery

See *Specifications* for minimum battery requirements.

Battery Recharging

The genset is equipped with an engine-driven battery charging alternator. See *Specifications* for the battery charging rate.

Battery Location and Mounting

Locate the battery where spills and leaks will not drip acid on fuel lines, wiring and other equipment and where ventilation is adequate to prevent the accumulation of explosive gases. Secure the battery so that it cannot shift and guard the positive (+) terminal against accidental contact.

⚠WARNING *Arcing can ignite the explosive hydrogen gas given off by the battery, causing severe personal injury. The battery compartment must be ventilated and isolated from spark-producing equipment.*

Battery Cables

Size battery cables according to Table 2. Total cable length is the sum of the lengths of the positive (+)

and negative (-) cables. In other words, total cable length will be approximately twice the distance between the battery and the genset.

TABLE 2. BATTERY CABLE SIZES

TOTAL CABLE LENGTH, FEET (METRES)	CABLE SIZE, AWG
8 (2.4)	2
10 (3)	1
14 (4.2)	0
18 (5.4)	00

Do not run the battery cables and fuel lines together.

⚠WARNING *Sparks can ignite fuel leading to severe personal injury or death. Do not run battery cables and fuel lines together. Separate cables and fuel lines with conduit or tubing if run through the same opening. Do not tie together.*

Connect the cables from the battery to the genset as shown in Figure 13.

Grounding Cable Connections

The genset must be bonded to the common grounding bus of the vessel in accordance with applicable regulations. See Figure 13.

In multiple-engine installations regulations may require cables (sized for the largest engine cranking circuit) to be connected between engines (negative [-] side) to prevent cranking currents from flowing through fuel lines and interconnected control wiring in the event corrosion or poor connections degrade the normal grounding paths.

⚠WARNING *Faulty bonding of the genset to the common grounding bus of the vessel or to other engines can result in severe personal injury or death. Genset bonding must comply with applicable regulations.*

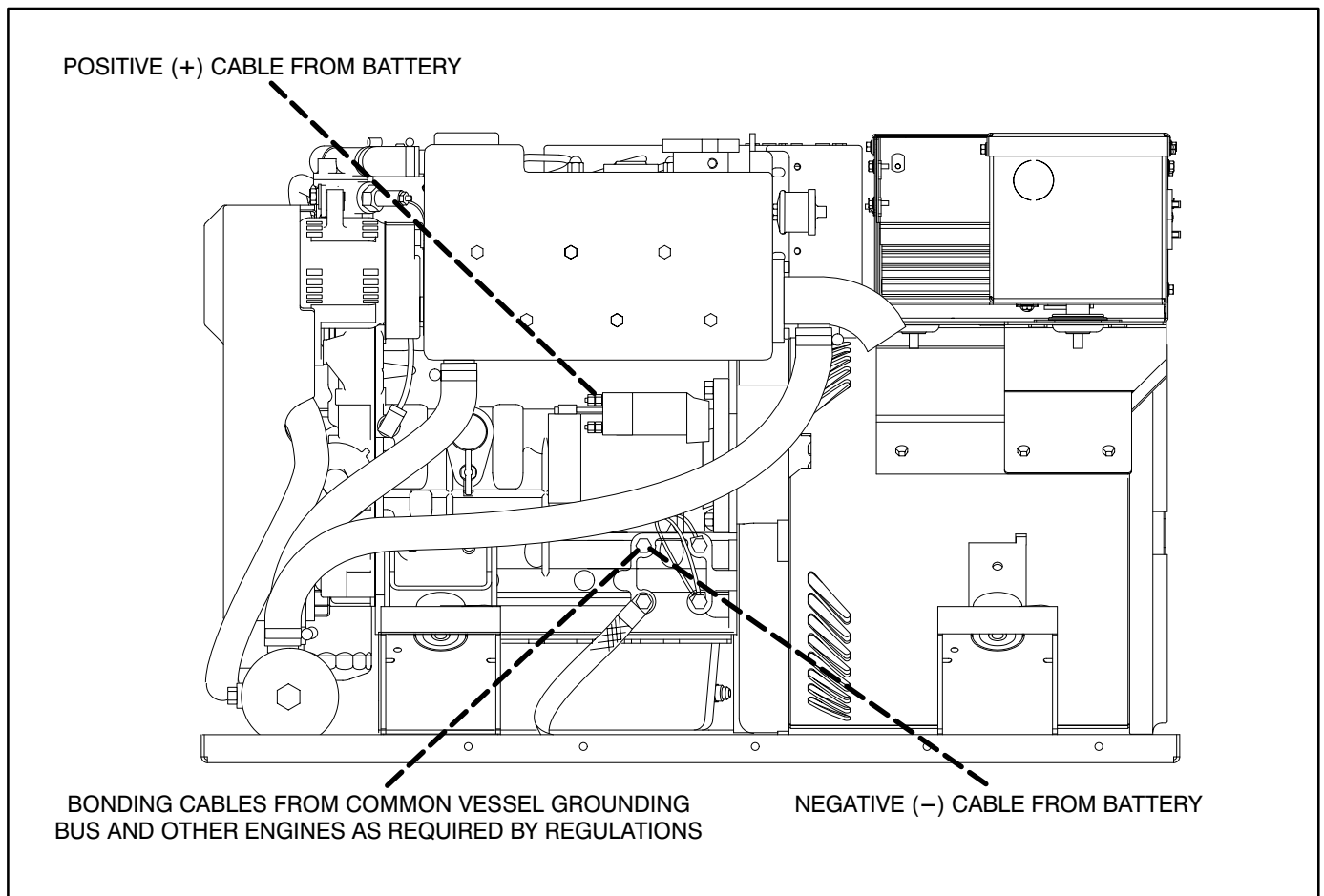


FIGURE 13. BATTERY AND GROUNDING CABLE CONNECTIONS

Voltage and Frequency Adjustments

These gensets are field adjustable for 50 Hz or 60 Hz. The generator can be reconnected and the voltage regulator readjusted for a range of outputs at either frequency. Check output voltage and frequency if generator reconnections have been made and readjust as necessary.

⚠ WARNING HAZARDOUS VOLTAGE *Touching uninsulated live parts inside the control box can result in severe personal injury or death. For your protection, stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry from your hands and use tools with insulated handles.*

VOLTAGE ADJUSTMENTS

The voltage regulator is mounted on the floor of the control box (Figure 14). Note the voltage adjustment pot and 50/60 Hz selector switch. The other adjusting pot (V/HZ break point) is factory sealed and should not be adjusted. To adjust voltage:

1. Disconnect all generator loads.
2. Check the position of the 50/60 Hz selector switch and change it if necessary.
3. Start the genset and turn the voltage adjusting pot to obtain rated output voltage.
4. Check and readjust frequency (p. 15).
5. Readjust voltage if frequency was changed.

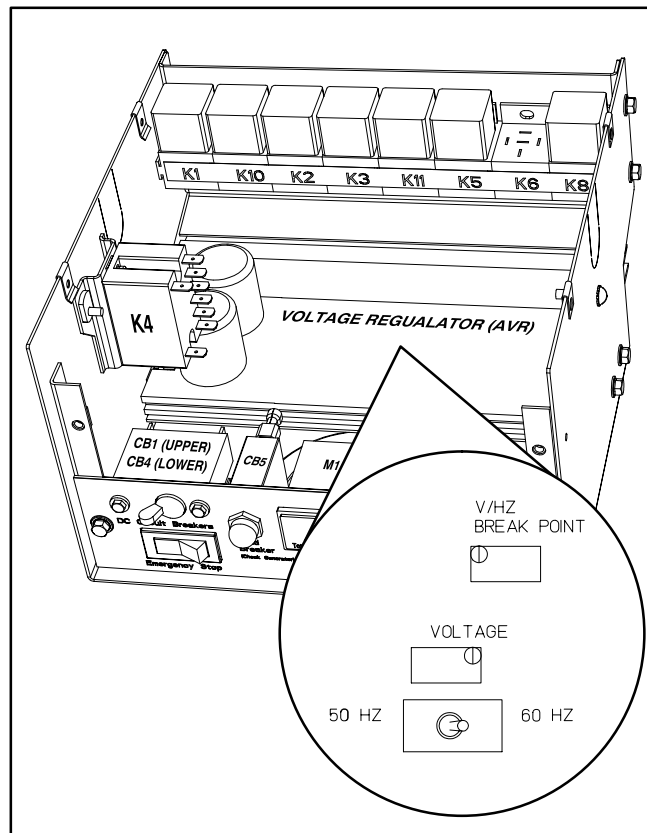


FIGURE 14. VOLTAGE ADJUSTMENTS

FREQUENCY ADJUSTMENTS

50 Hz Frequency Adjustment

1. Make sure the AVR frequency selector switch (p. 25) is set at **50 Hz**.
2. Back off screw **A** (Figure 15) to free the front (60 Hz) lever and prevent overspeed shut-down, snug screw **D** and set the locknuts.
3. Disconnect all loads and start the genset.
4. Back off screw **C**, turn screw **B** to obtain a *no-load frequency* of **52.5 Hz**, snug screw **C** and set the locknuts. There is no droop adjustment.
5. Readjust frequency and voltage (p. 25) as necessary.

60 Hz Frequency Adjustment

1. First adjust genset frequency to 50 Hz if the adjustment seal on screw **B** (Figure 15) is broken. Snug screw **C** if necessary.
2. Stop the genset, reset the AVR frequency selector switch (p. 25) to **60 Hz** and restart.
3. Back off screw **D**, turn screw **A** to obtain a *no-load frequency* of **63 Hz**, snug screw **D** and set the locknuts. There is no droop adjustment.
4. Readjust frequency and voltage (p. 25) as necessary.

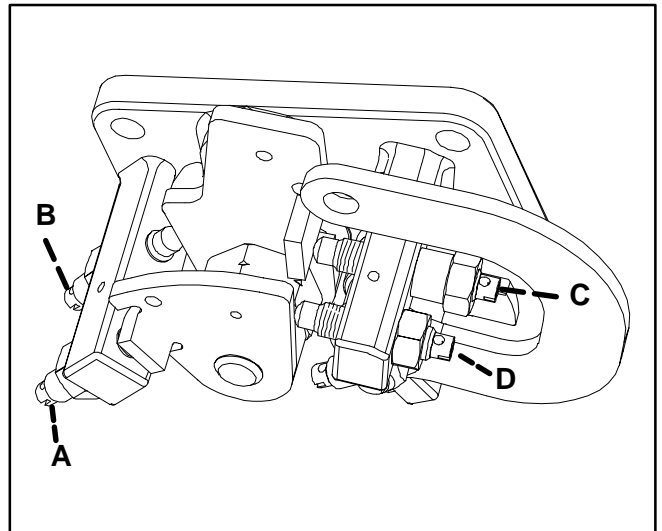


FIGURE 15. FREQUENCY ADJUSTMENT

Installation Checks and Startup

Before starting the genset, review the installation checklist below for those items that do not require the genset to be actually running. Make necessary repairs, reconnections and modifications. Then start and operate the genset in accordance with the Operator's Manual, observing all of its instructions and precautions. Continue working through the installation checklist with the genset running, making necessary repairs, reconnections and modifications. Check off (✓) each item that can be answered positively. Do not place the genset in service until every applicable item has been checked off.

- ☐ The sea trials have been conducted to establish the load water line, if a wet exhaust system is employed.
- ☐ A siphon break has been installed and is securely fastened in its upright position at least 12 inches (305 mm) above the load water line, if the exhaust outlet is less than 6 inches (151 mm) above the load water line.
- ☐ The sea trials established that the sea water inlet neither causes excessive restriction nor "ram pressure" when the vessel is under way.
- ☐ The sea trials established that there is no back-flow through the sea water exit port when the vessel is under way.
- ☐ The genset is securely and adequately mounted.
- ☐ There is adequate clearance for conducting all maintenance specified in the Operator's Manual.
- ☐ The coolant recovery tank is mounted properly and is accessible for inspection and filling.
- ☐ The engine has the proper levels of oil and coolant.
- ☐ The sea water pump has been primed and the sea cock opened.
- ☐ The entire exhaust system is accessible for inspection and replacement.
- ☐ If the genset has a dry exhaust system, approved methods and materials are used to protect combustible construction and operators from hot mufflers and piping.
- ☐ Approved flexible fuel lines are used for connections at the engine.
- ☐ Fuel tanks and piping comply with regulations.
- ☐ Generator room ventilation meets regulations.
- ☐ The genset is bonded to the vessel grounding bus in accordance with regulations.
- ☐ If required, the genset has an isolated-ground system.
- ☐ An approved transfer switch prevents interconnections with shore power.
- ☐ AC wiring methods, materials and bonding for grounding meet regulations.
- ☐ A properly sized battery has been installed, serviced and charged. The battery is securely mounted in an adequately ventilated space and the positive (+) terminal is shielded from accidental contact.
- ☐ The remote control panel functions as intended.
- ☐ Exhaust back pressure is acceptable.
- ☐ The exhaust system is leak-free and conveys all engine exhaust outside, away from windows, doors and vents.
- ☐ The fuel supply system is leak-free.
- ☐ The engine coolant and sea water systems are leak-free.
- ☐ Voltage and frequency are correct for the application, the genset is properly sized and the loads are balanced.
- ☐ All operators have been thoroughly briefed on the Operator's Manual and its safety precautions—especially concerning the danger of carbon monoxide gas—and can demonstrate how to operate, maintain and troubleshoot the genset as explained therein.



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