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Installation Manual

MGKBC, MGKBD

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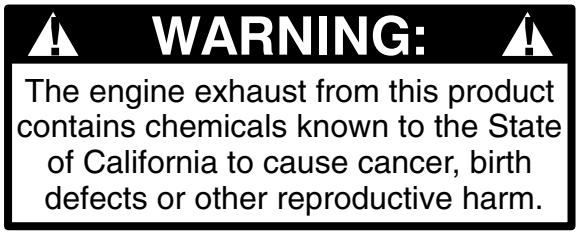

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Safety Precautions

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

Thoroughly read the OPERATOR'S MANUAL before operating the genset. Safe operation and top performance can only be attained when equipment is operated and maintained properly.

The following symbols in this manual alert you to potential hazards to operators, service personnel and equipment.

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

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

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

GENERAL PRECAUTIONS

- Keep children away from the genset.
- Do not step on the genset when entering or leaving the generator room. Parts can bend or break leading to electrical shorts or to fuel, coolant or exhaust leaks.
- To prevent accidental or remote starting while working on the genset, disconnect the negative (**–**) battery cable at the battery.
- Let the engine cool down before removing the coolant pressure cap or opening the coolant drain. Hot coolant under pressure can spray and cause severe burns.
- Do not use evaporative starting fluids such as ether. They are highly explosive.
- Keep the genset, drip pan and compartment clean. Oily rags can catch fire. Gear stowed in the compartment can cause the genset to overheat.
- Make sure all fasteners are secure and properly torqued.
- Do not work on the genset when mentally or physically fatigued or after having consumed alcohol or drugs.
- You must be trained and experienced to make 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 U. S. state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale, or contact used oil or its vapors.
- Benzene and lead in some gasolines have been identified by some U. S. state and federal agencies as causing cancer or reproductive toxicity. Do not to ingest, inhale or contact gasoline or its vapors.
- Ethylene glycol, used as engine antifreeze, is toxic to humans and animals. Clean up spills and dispose of used engine coolant in accordance with local environmental regulations.
- Keep USCG Approved multi-class ABC fire extinguishers on the boat. Class A fires involve ordinary combustible materials such as wood and cloth; Class B fires, combustible and flammable liquid fuels and gaseous fuels; Class C fires, live electrical equipment. (ref. NFPA No. 10)
- Genset installation and operation must comply with all applicable local, state and national codes and regulations.

POST THESE SUGGESTIONS IN POTENTIAL HAZARD AREAS OF THE BOAT

GENERATOR VOLTAGE IS DEADLY

- Generator electrical output connections must be made by a trained and experienced electrician in accordance with applicable codes.
- When the boat has provisions for connection to shore power, the genset must be connected to the boat electrical system through an approved transfer switch to prevent backfeed. Backfeed can lead to electric shock resulting in severe personal injury or death.
- Use caution when working on live electrical equipment. Remove jewelry, make sure clothing and shoes are dry, stand on a dry wooden platform or rubber insulating mat and use tools with insulated handles.

ENGINE EXHAUST IS DEADLY

- Never sleep in a boat while the genset is running unless the cabin is equipped with a properly working carbon monoxide detector-alarm.
- Inspect for exhaust leaks at every startup and after every eight hours of operation.
- The exhaust system must be installed in accordance with the genset Installation Manual.
- When modifying or repairing the boat, care must be taken to maintain sealing of the living quarters from spaces where exhaust gas can accumulate.
- The ventilation exhaust blowers must be kept in good working order to prevent the accumulations of engine exhaust.
- For more information about the hazards of carbon monoxide see American Boat and Yacht Council (ABYC) publication TH-22—*Educational Information About Carbon Monoxide.*

GASOLINE IS FLAMMABLE AND EXPLOSIVE

- Do not smoke where fuel vapors are present or in areas sharing ventilation with fuel tanks, engines and other such equipment. Keep flames, sparks, pilot lights, electrical switches, arc-producing equipment and all other sources of ignition well away.
- All electrical devices, such as switches, circuit breakers, meters and control panels used in areas where gasoline vapors can accumulate must be *Ignition Protected.*
- No substitutes are permitted for the parts listed in the *Critical Parts Index* of the genset Parts Catalog. They must be purchased from Onan and be installed in accordance with the genset Service Manual by those who are trained and experienced in marine gasoline genset service.
- Fuel lines must be secure, free of leaks and separated or shielded from electrical wiring.
- When modifying or repairing the boat, care must be taken to maintain sealing of the living quarters from spaces where gasoline vapors can accumulate.
- The ventilation exhaust blowers must be kept in good working order to prevent the accumulations of gasoline vapors.

BATTERY GAS IS EXPLOSIVE

- Do not smoke near batteries.
- Wear safety glasses while servicing batteries.
- To reduce arcing when disconnecting or reconnecting battery cables, always disconnect the negative (**–**) battery cable first and reconnect it last.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Do not wear jewelry or loose clothing 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, and other moving parts.

POST THESE SUGGESTIONS IN POTENTIAL HAZARD AREAS OF THE BOAT

The Hazards of Carbon Monoxide

Most people know not to run a car in the garage. Many people know about the threat of carbon monoxide poisoning in the house. But few people are aware that this invisible killer is even more insidious aboard a boat.

Engine-driven generators can produce harmful levels of carbon monoxide that can injure or kill you. The nature of boating is such that you can be harmed by this poisonous gas despite good generator set maintenance and proper ventilation.

WHAT IS CARBON MONOXIDE POISONING?

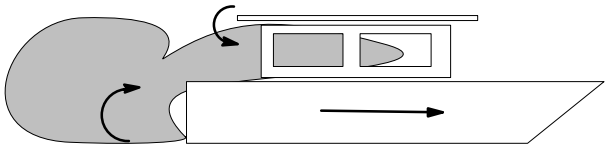
Carbon Monoxide (CO) is an odorless and colorless gas. You cannot see it or smell it. Red blood cells, however, have a greater affinity for CO than for Oxygen. Therefore, exposure even to low levels of CO for a prolonged period can lead to asphyxiation (lack of oxygen) resulting in death. Mild effects of CO poisoning include eye irritation, dizziness, headaches, fatigue and the inability to think clearly. More extreme symptoms include vomiting, seizures and collapse.

WHAT ARE THE SPECIAL RISKS OF CO ON BOATS?

Depending on air temperature and wind, CO can accumulate between hulls, under an overhanging deck or rear swimming platform and in and around the boat. A swimmer can be exposed to lethal levels of CO when the genset is running. Passengers on deck and in the living quarters can also be exposed, especially when the boat is docked, beached or tied to a neighboring boat.

The risk of exposure to CO can be multiplied greatly by the “station wagon” effect, obstructions that block exhaust dissipation, and infiltration from neighboring boats. To protect against all three situations, Onan recommends that reliable CO detector-alarms be installed on your boat.

- ***The Station Wagon Effect –*** A boat pushes aside the air through which it is moving, causing a zone of low pressure in the back of the boat and cabins into which exhaust gases can be drawn (see figure). A breeze across an anchored boat can have the same effect. Opening doors and windows so that air can flow through the boat can reduce the effect.



- ***Obstructions –*** Anchoring near a large object such as a boat house or sea wall or in a confined space such as a canyon can cause exhaust gases to accumulate in and around the boat despite good generator set maintenance and proper ventilation. Don’t run the generator set when anchored in such places.
- ***Exhaust from Neighboring Boats –*** When boats are anchored in close quarters exhaust from neighboring boats can accumulate in and around yours.

ONLY YOU CAN PROTECT YOURSELF FROM CO POISONING!

- Watch constantly for swimmers when the generator set is running.
- Make sure exhaust cannot get under the deck, between hulls or enter the living quarters through a window, vent or door.
- Make sure all CO detectors are working.
- Pay attention to the signs of CO poisoning.
- Check the exhaust system for corrosion, obstruction and leaks each time you start the generator set and every eight hours if you run it continuously.

POST THESE SUGGESTIONS IN POTENTIAL HAZARD AREAS OF THE BOAT

Specifications

		MGKBC	MGKBD
GENERATOR: Two-Bearing, 2-Pole Rotating Field, Microprocessor Regulated. See Genset Nameplate for Rating			
FUEL CONSUMPTION:			
60 Hz:	Full Load Half Load	1.59 gph (6.0 liter/hr) 0.95 gph (3.6 liter/hr)	1.4 gph (5.3 liter/hr) 0.77 gph (2.9 liter/hr)
50 Hz:	Full Load Half Load	1.4 gph (5.3 liter/hr) 0.77 gph (2.9 liter/hr)	– –
Engine/Generator Speed:	60 Hz 50 Hz	2900/3600 rpm 2400/3000 rpm	2400/3600 rpm –
ENGINE: 4-Stroke Cycle, Spark-Ignited, Water Cooled, Microprocessor Governed (Isochronous)			
Number of Cylinders		3	3
Bore		2.68 inch (68 mm)	2.68 inch (68 mm)
Stroke		2.68 inch (68 mm)	2.68 inch (68 mm)
Displacement		45.2 inch^3 (740 cm^3)	45.2 inch^3 (740 cm^3)
Compression Ratio		9.2:1	9.2:1
Firing Order (Clockwise Rotation)		1-2-3	1-2-3
Ignition Timing		18° BTDC	18° BTDC
Spark Plug Gap		0.039 – 0.043 inch (1.0 – 1.1 mm)	0.039 – 0.043 inch (1.0 – 1.1 mm)
Valve Lash (cold)		0.0059 – 0.0073 inch (0.145 – 0.185 mm)	0.0059 – 0.0073 inch (0.145 – 0.185 mm)
Engine Oil Capacity		2.0 quart (1.9 liter)	2.0 quart (1.9 liter)
Engine Oil Drain Connection		3/8 NPT	3/8 NPT
Coolant Capacity		3.3 quart (3.1 liter)	3.3 quart (3.1 liter)
Coolant Flow:	60 Hz 50 Hz	3.5 gpm (13 liter/min) 3.0 gpm (16 liter/min)	3.5 gpm (13 liter/min) –
Raw Water Flow:	60 Hz 50 Hz	5.0 gpm (19 liter/min) 4.0 gpm (15 liter/min)	5.0 gpm (19 liter/min) –
Maximum Raw Water Pump Lift		4 feet (1.2 m) with 5/8 inch ID hose	4 feet (1.2 m) with 5/8 inch ID hose
Raw Water Inlet Connection		5/8 inch (15.9 mm) ID Hose	5/8 inch (15.9 mm) ID Hose
Maximum Fuel Pump Lift		4 feet (1.2 m) with 1/4 inch ID fuel line	4 feet (1.2 m) with 1/4 inch ID fuel line
Required Fuel Line Size		1/4 inch (6.4 mm) ID	1/4 inch (6.4 mm) ID
Fuel Supply Connection		1/8 NPT female	1/8 NPT female
Wet Exhaust Outlet Connection		2.0 inch (50.8 mm) ID Hose	2.0 inch (50.8 mm) ID Hose
Maximum Exhaust Back Pressure		3 inch (76 mm) Hg	3 inch (76 mm) Hg
Combustion Air Flow:	60 Hz 50 Hz	32 cfm (0.91 m^3/min) 26.7 cfm (0.76 m^3/min)	26.7 cfm (0.76 m^3/min) –
Generator Cooling Air:	60 Hz 50 Hz	100 cfm (2.83 m^3/min) 80 cfm (2.26 m^3/min)	100 cfm (2.83 m^3/min) –
BATTERIES:			
Nominal Battery Voltage		12 volts	12 volts
Minimum CCA Rating		360 amps	360 amps
Battery Charging Output (Optional)		3 amps	3 amps
SIZE, WEIGHT, NOISE:			
Size: L x W x H		26.6 x 23 x 21.1 inch (676 x 583 x 535 mm)	26.6 x 23 x 21.1 inch (676 x 583 x 535 mm)
Weight (dry)		425 lbs (193 kg)	425 lbs (193 kg)
Noise (Full Load @ 1 m):	60 Hz 50 Hz	71 dB(A) 69 dB(A)	69 dB(A) –

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Introduction

This genset is suitable for installation in accordance with USCG Pleasure Craft Regulations and ISO Small Craft Standards.

A generator set (genset) must be installed properly to attain 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 particular concerns of the installation.

Decisions you have to make will concern:

- Location and mounting
- Engine exhaust discharge and silencing
- Engine cooling
- Genset compartment ventilation
- Selection of *Ignition Protected* devices for areas where gasoline vapors can accumulate
- Preventing the migration of exhaust gases and gasoline vapors into the living quarters
- Fuel connections
- Batteries
- Electrical connections
- Bonding for grounding
- Accessibility for operation and maintenance
- Noise and vibration.

See the Operator's Manual for operation and maintenance and the Service Manual for service.

Note: Manuals are updated from time-to-time to reflect changes in the equipment and its specifications. For this reason, only the copy of the installation manual supplied with the genset should be used as a guide for the installation.

STANDARDS FOR SAFETY

You must find out which standards for safety are applicable. Compliance with United States Coast Guard (USCG) regulations is mandatory for boats in U. S. waters. The American Boat and Yacht Council (ABYC) and the National Fire Protection Association (NFPA) are typical of agencies that publish safety standards for the construction and installation of marine equipment. It is suggested that you obtain the following standards:

- USCG regulations are under Titles 33 and 46 of the Code of Federal Regulations (CFR),

  U.S. Government Printing Office
  Washington, D.C. 20404.

- NFPA No. 302, *Pleasure and Commercial Motor Craft,*

  National Fire Protection Association
  Batterymarch Park
  Quincy, MA 02269

- *Standards and Recommended Practices For Small Craft,*

  *A*merican Boat and Yacht Council, Inc.
  P.O. Box 747
  Millersville, MD 21108

Particular attention should be paid to ABYC P-1, *Installation of Exhaust Systems for Propulsion and Auxiliary Machinery;* ABYC E-8, *Alternating Current (AC) Electrical Systems on Boats;* and ABYC E-9, *Direct Current (DC) Electrical Systems on Boats*.

OUTLINE DRAWINGS

See OUTLINE DRAWING (Page 23) for installation details: mounting bolt hole locations, connection points (fuel, battery, raw water, exhaust, remote control and AC output), sizes and types of fittings, weight, overall dimensions, etc. See your Onan® dealer to obtain a large-scale copy of the drawing.

⚠WARNING ***Improper installation can result in severe personal injury or death and damage to equipment. The installer must be trained and experienced in the installation of marine gasoline gensets.***

Location and Mounting

LIFTING THE GENSET

The genset weighs 425 pounds (193 kg) and has two lifting eyes accessible through the round covers in the top panel (Page 23). Use proper equipment for safe handling. Use both lifting eyes.

Save the four steel clamps that secured the genset to the shipping skid if they are to be used for securing the genset to the floor or frame. See MOUNTING THE GENSET.

LOCATING THE GENSET

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

The genset is *ignition protected* and therefore permitted under USCG regulation 33CFR183 to be located in a gasoline fuel environment.

Because of noise, vibration, exhaust and vapors, the generator compartment should be located as far from the living quarters as practical.

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. The left side must have at least 1 inch (25 mm) of clearance for inlet air flow. The top must have at least 2 inches (51 mm) of clearance for removal. The right side must have at least 2 inches (51 mm) of clearance for removing the side panel, which must be remove to adjust the V-belt, replace the raw water pump impeller, service the heat exchanger and replace the fuel pump. At least 1 inch (25 mm) of clearance is required in front of the outlet air grille on the right side.

There must be access for:

- Starting and stopping the genset
- Resetting the line circuit breakers
- Checking, filling and draining engine oil
- Changing the engine oil filter
- Checking, filling and draining engine coolant
- Replacing raw water and exhaust hoses
- Replacing the raw water pump impeller
- Adjusting the V-belt
- Replacing the fuel pump
- Inspecting the drive belt system and generator bearing at the back of the genset
- Making fuel connections
- Making battery and ground connections
- Making AC connections
- Making remote control connections

MOUNTING THE GENSET

The genset has integral vibration isolators. The supporting structure underneath should be level and able to support the weight of the genset. Floor or frame stiffness should be greatest under the vibration isolators. Secure the genset to the floor or frame in one of the following ways:

- By bolting it with three (3) bolts through the bolt holes in the drip pan (Page 23).
- By clamping it with the four (4) steel clamps that secured it to the shipping skid: one at each corner (Page 23). A clamp can be on either side of a corner.
- By bolting it through the front bolt hole in the drip pan and clamping each rear corner with a steel clamp.

To reduce noise, plug the unused clamp openings in the drip pan with the four rubber plugs shipped in the literature packet.

Ventilation

⚠WARNING ***EXHAUST GAS IS DEADLY—GASOLINE VAPORS ARE EXPLOSIVE! Failure to provide proper ventilation can result in asphyxiation, fire and explosion. The ventilation system must meet applicable standards and regulations, including those of the USCG, ABYC and NFPA.***

VENTILATION EXHAUST SYSTEM

The USCG requires the genset be open to the atmosphere or be ventilated by an exhaust blower system to prevent dangerous concentrations of gasoline vapors and exhaust.

Exhaust Blower System Capacity

Each exhaust blower or combination of blowers must be rated at an air flow capacity not less than that computed by the formulas in Table 1.

TABLE 1. EXHAUST BLOWER CAPACITIES (USCG)

NET COMPARTMENT VOLUME (V) (Cubic Feet)	MINIMUM BLOWER RATING (CFM)	MINIMUM SYSTEM OUTPUT (CFM)
Smaller than 34	50	20
Between 34 and 100	V x 1.5	V x 0.6
Larger than 100	(V ÷ 2) + 100	(V x 0.2) + 40
V = Net volume of genset compartment and compartments open thereto. CFM = Cubic Feet per Minute.		

Warning Labels

To remind the boat operator to turn on the ventilation exhaust system before starting the genset, a label must be affixed next to each genset starting switch, to the effect that:

⚠WARNING ***Gasoline vapors can explode. Before starting the genset, operate the exhaust blower for 4 minutes and check the genset compartment and bilge for gasoline vapors.***

Ventilation Ducts

Ventilating air should enter near the bottom of the compartment at the left side, near the air inlet (Page 23), and exit near the top at the right side. This will promote natural convective air flow, good air exchange and fresh air for combustion and generator cooling when the exhaust blower system is not running.

Ventilation Air Inlets

The free-air area of a ventilation air inlet should be at least twice that of the duct. Use 40 in^2 (258 cm^2) as the basis for calculating inlet and outlet air duct sizes and areas for screens and louvers. Do not use flush air inlets or louvered transom outlets, which are easily blocked. Means must be provided to keep out sea spray.

Ventilation for Cooling

Ventilation is also necessary for genset cooling, especially just after the boat has been 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 and other construction materials.

CARBON MONOXIDE

CO Detector-Alarms

Carbon monoxide (CO) detector-alarms, listed for marine applications, must be installed in the living quarters of the boat. 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.

Openings and Feed-Through Holes in Decks and Bulkheads

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

Plumbing Fixtures

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

IGNITION PROTECTION

The genset is *ignition protected* and therefore permitted under USCG regulation 33CFR183 to be located in a gasoline fuel environment.

All electrical devices, such as switches, circuit breakers, meters and control panels used in areas where gasoline vapors can accumulate must be *Ignition Protected.*

Fuel Supply

⚠WARNING ***Gasoline is highly flammable and explosive and can cause severe personal injury or death. Fuel tank construction, location, installation, bonding for grounding, ventilation, piping, inspection and leak testing must be in accordance with applicable standards and regulations, including those of the USCG, ABYC, and NFPA.***

Fuel

See the Operator's Manual for recommended fuel.

Fuel Inlet Fitting

A 1/8 NPT fuel inlet fitting is mounted on the drip pan on the right side (Page 23).

Fuel Lines and Hoses

Use USCG TYPE A1 fuel hose. Fuel lines and hoses must have an inside diameter of 1/4 inch (6.4 mm).

Do not connect the genset to a shared fuel distribution manifold. The genset fuel pump might not be able to prime the fuel manifold nor overcome the draw of a propulsion engine fuel system.

Use non-conductive fuel lines for connections at the genset to prevent the fuel lines from carrying cranking currents back through the fuel tank. Fuel tanks are required to be bonded to the common negative (**–**) grounding system of the boat.

⚠WARNING ***Fuel lines must not carry cranking currents, which can cause fire resulting in severe personal injury or death. Use non-conductive fuel lines for connections at the genset.***

Fuel Filter

A fuel filter is installed at the inlet to the carburetor. An external in-line fuel filter is provided in the literature packet. The filter must be readily accessible for regular replacement and be install as close as possible to the genset.

Fuel Pickup

Provide a separate pickup tube in the fuel tank for the genset. The inside diameter should be 1/4 inch (6.35 mm). It must not be greater than 3/8 inch (9 mm). In a common fuel supply tank, the genset pickup tube should be shorter than those for the propulsion engines so that the genset cannot empty the fuel tank.

Maximum Fuel Pump Lift

The genset fuel inlet fitting must not be more than 48 inches (122 cm) higher than the bottom of the fuel pickup tube. The suction required at the genset fuel inlet to overcome lift and line flow resistance (including fittings, filters and valves) must not exceed 3 inches Hg (10 kPa).

Fuel Anti-Siphon Device

If any part of the fuel line is routed below the top of the fuel tank, a fuel anti-siphon device must be installed at the tank fitting to prevent accidental discharge of gasoline.

Check Valve-Type Anti-Siphon Devices: A fuel check valve used as an anti-siphon device must not require a pull-off vacuum of more than 1.6 inches Hg (5.5 kPa).

Solenoid-Type Anti-Siphon Devices: The genset wiring harness has leads with quick-connect terminals labeled **SWB+** and **CUSTOMER GND** (Page 21) that can be connected to power a pilot relay for a fuel solenoid stop valve at the fuel tank fitting. They are accessible by removing the access cover on the left end of the genset (Page 23). The total load on **SWB+** must not exceed 0.5 amps.

Note: The genset leaves the factory with SWB+ jumpered to two other connectors, ESTOP and CO. When making connections for a fuel solenoid pilot relay, SWB+ must continue to be jumpered to ESTOP and CO unless they are connected to normally closed external shutdown devices (Page 18), otherwise the genset will not run.

Engine Cooling

COOLING SYSTEM OVERVIEW

Refer to Figure 1. 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. The exhaust manifold also serves as the engine coolant reservoir.

The heat exchanger is mounted inside the exhaust manifold. Raw water (the flotation water) is pumped through tubes in the heat exchanger to cool the engine coolant and then is passed through a hose into the exhaust-water mixer to cool the exhaust gases. The raw water is expelled from the boat along with the exhaust gases. The V-belt drives the coolant and the raw water pumps.

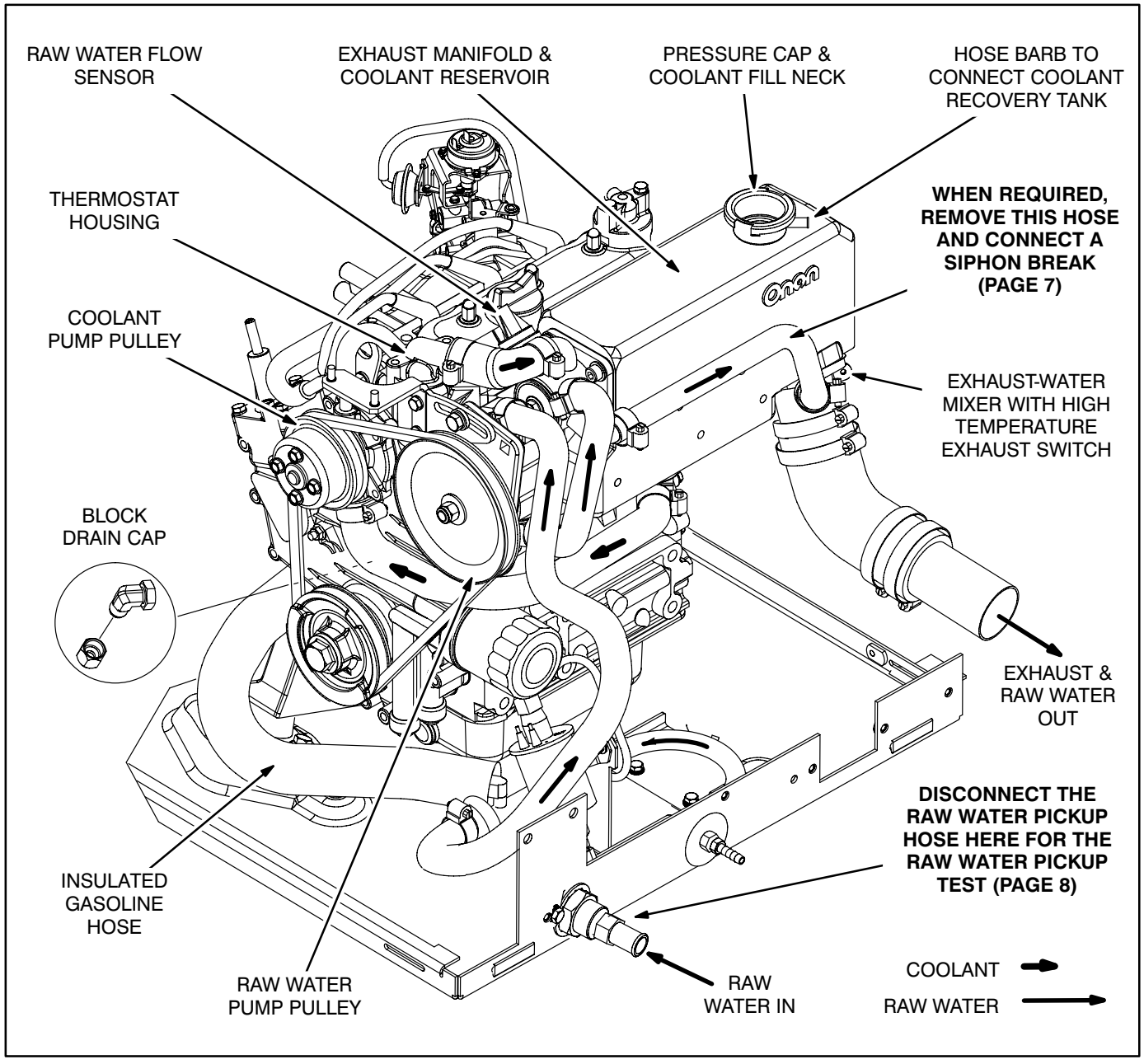


FIGURE 1. ENGINE COOLING SYSTEM

SYSTEM COMPONENTS

Raw Water Pump

The raw water pump can work against a maximum lift (suction) of 48 inches (122 cm) WC to deliver the required flow of cooling water. Lift is a combination of the actual vertical lift and the resistance to flow cause by the hose, strainer, sea cock and through-hull fitting.

The pump impeller must be wetted with water to establish initial pump lubrication and suction. See the Operator's Manual.

Raw Water Hose

The 5/8 inch (15.9 mm) hose barb for raw water pickup is mounted on the drip pan on the right side (Page 23). Use SAE 20R3 or equivalent hose to supply raw water to the genset. The hose must be able to resist a slight vacuum.

Sea Water Strainer

The sea water strainer should have a 5/8 inch (15.9 mm) inlet. It should be located below the level of the raw water pump (Page 23) and as close as possible to the genset. The basket must be removeable for cleaning.

Sea Cock

Install a bronze, full-flow sea cock on the through-hull fitting.

Through-Hull Fitting and Strainer

The through-hull fitting should have a 5/8 inch (15.9 mm) inlet and be as close to the genset as possible. If the strainer has slotted openings, the slots must be parallel to the keel for best flow when the boat is under way. Also, stagger the through-hull fittings along the keel so that downstream fittings are not starved.

⚠ CAUTION ***Do not use a scoop-type through-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.***

Siphon Break

Conduct the RAW WATER PICKUP TEST to determine whether a siphon break is required to prevent the engine from being flooded with floatation water. Siphon Break Kit 541-0876 is available if a siphon break is required. Carefully follow the instructions in the kit. The hoses in the kit replace the hose between the engine heat exchanger and exhaust-water mixer (Figure 1). The end panel of the genset has knockouts for the hoses to pass through (Page 23). The kit has the hole grommets. Figures 4 and 5 illustrate typical siphon break installations.

⚠ CAUTION ***Engine damage due to flooding as a result of failing to install a required siphon break is not covered by Warranty.***

Coolant Recovery Tank

The genset is shipped with a coolant recovery tank kit. Follow the instructions in the kit. *The tank must be accessible for daily inspection and refilling.* Clamp the recovery hose to the hose barb on the coolant fill neck (Figure 1). Route the tank recovery and overflow hoses through the holes in the end of the enclosure (Page 23). Make sure the overflow hose terminates in the drip pan where it will not splash coolant on electrical components. Fill the tank in accordance with the Operator's Manual.

Initial Coolant Fill

The genset is normally shipped from the factory with coolant, unless prohibited by shipping regulations. Fill the system, if necessary, in accordance with the Operator's Manual.

⚠ CAUTION ***Engine damage due to running the engine without coolant is not covered by Warranty.***

RAW WATER PICKUP TEST

Objective

The objective is to determine the elevation of the water line relative to the genset under all anticipated uses and speeds of the boat.

Method

When the boat is ready for its sea trials and loaded to its maximum rated capacity:

1. Close the sea cock and disconnect the raw water pickup hose from the genset (Figure 1). Alternatively, connect a clear plastic hose to the strainer or sea cock.
2. Raise the end of the hose above expected water level and open the sea cock. *The water line is at the level visible in a clear plastic hose or where water just begins to spill as the end of the hose is lowered.* While the boat is still docked, mark the level on the genset enclosure.
3. Operate the boat through its speed range, forward and reverse. While the boat is operating, have someone monitor the water level in the hose and mark the highest level on the genset.

Requirement

A siphon break must be installed if the engine exhaust-water mixer (Page 23) is not at least 6 inches (152 mm) above both water lines (docked and moving).

Note: If the water line when the boat is moving is much higher than when the boat is docked, the difference could be due to the through-hull fitting or its location. If the through-hull fitting is of the forward-facing scoop-type designed to create ram pressure, replace it with a flush-type fitting. Another possibility might be to move the fitting to a location where the dynamic hull pressure is less.

Engine Exhaust

SYSTEM COMPONENTS

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

Figures 2 and 3 illustrate typical exhaust systems where the exhaust-water mixer is above the load water line and Figures 4 and 5 where it is below. See *Engine Cooling* (Page 6) regarding raw water connections. The installation must comply with applicable standards and regulations, including those of the USCG and ABYC.

Mufflers, water separators, resonators and siphon breaks are available as kits from Onan. Muffler kits include a strainer for the through-hull fitting.

Fitting and Hose Diameters

No fitting or hose section in the exhaust system may have a smaller inside diameter than the genset exhaust outlet. Exhaust back pressure must be measured if the total run of the exhaust system is more than 20 feet (6 meters). Use larger diameter hose if back pressure exceeds 3 inches Hg (10 kPa).

Exhaust Hose

Use hose that has been approved for wet exhaust systems. Approved hose and stainless steel elbows are available from Onan. Horizontal runs of 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*.

Hose Clamps

Use two 1/2 inch (12.7 mm) wide stainless steel hose clamps to clamp each end of each hose.

Muffler

Install the muffler as close a practical to the engine, observing the following:

1. The length of hose between the genset and the muffler should be 1 to 5.5 feet (30 to 170 cm).
2. The muffler inlet must be more than 1 foot (30 cm) below the exhaust-water mixer (Page 23).
3. The muffler outlet hose must rise straight up from the muffler into a water separator (Figures 2 and 4) or elbow that turns sharply down (Figures 3 and 5).
4. When a water separator is use, the base of the muffler should not be more than 54 inches (1.4 meter) below the top of the water separator (Figure 2 or 4). When an elbow is used, the base of the muffler should not be more than 48 inches (1.2 meter) below the elbow (Figure 3 or 5).
5. The muffler must be mounted such that air can circulate underneath to prevent condensation and mold.

Exhaust Water Separator

When an exhaust water separator is used (Figure 2 or 4), *the muffler outlet and water separator inlet diameters must be the same size.* The water separator should be installed directly above the muffler to maintain a vertical lift. The through-hull fitting for the drain hose should be below the load water line and must have a sea cock. An EXHAUST WATER SEPARATOR BACKFLOW TEST must be conducted during the sea trials to determine that there is no backflow that could flood the engine.

Exhaust Through-Hull Fitting

The exhaust through-hull fitting must be above the load water line under all anticipated uses and speeds of the boat. To reduce wave wash-in when a water separator is used (Figure 2 or 4), the top of the water separator must be at least 18 inches (450 mm) *above the load water line*. When an elbow is used at the top of the muffler outlet hose, the elbow must be at least 12 inches (305 mm) above the through-hull fitting (Figure 3 or 5).

⚠ CAUTION ***Backflow can cause major engine damage if the cylinders become flooded. The sea trials must verify that there is no backflow through either the exhaust hull fitting or the water separator drain hose fitting.***

Other Engine Exhaust Systems

Do not “T” into any other engine exhaust system. Run the genset exhaust piping all the way to the hull and terminate it flush with or extended slightly from the outside of the hull.

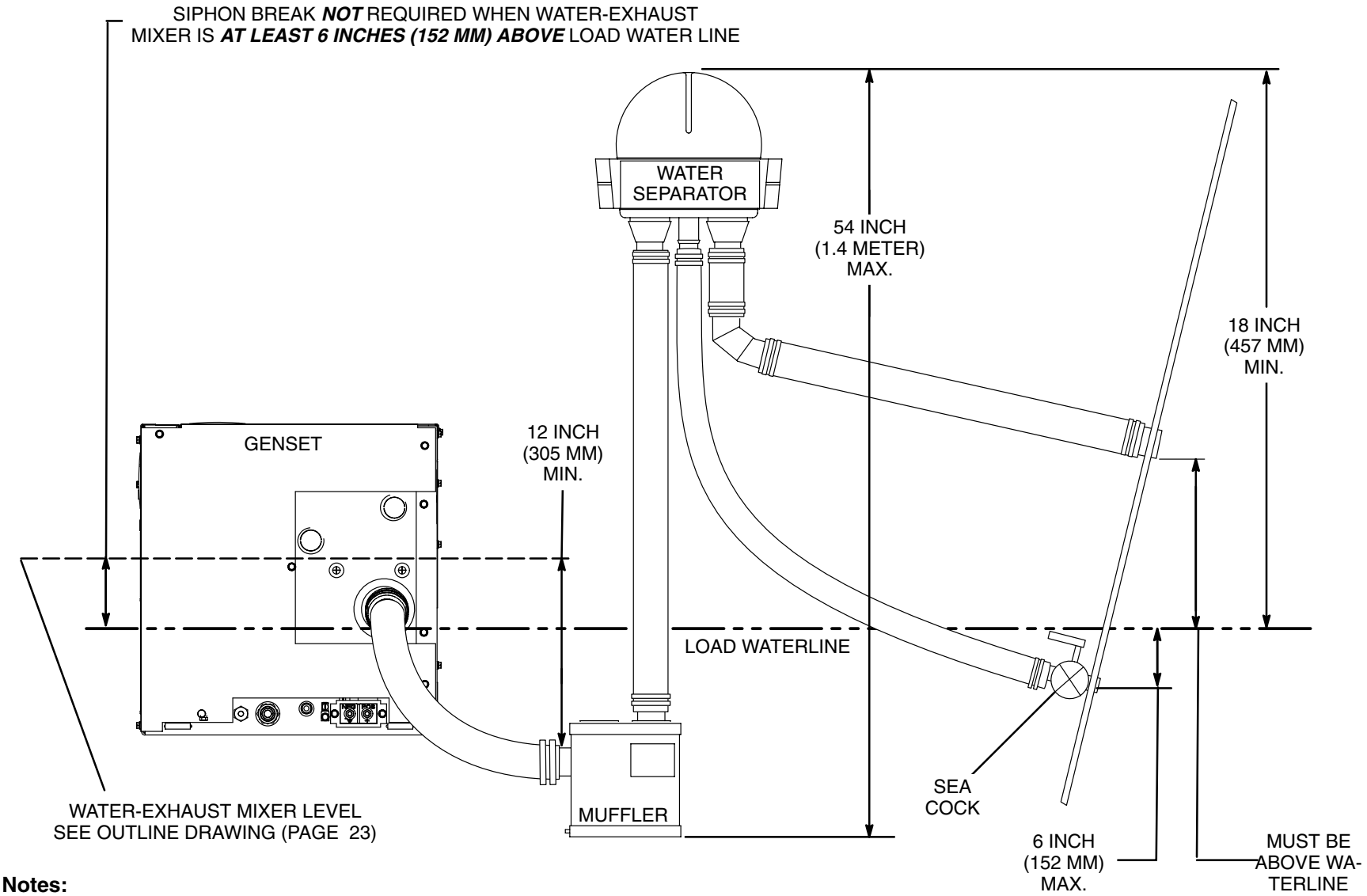
⚠ CAUTION ***Corrosive exhaust vapors can migrate through a shared exhaust system and cause damage to idle engines. Provide a separate exhaust system for each engine.***

EXHAUST WATER SEPARATOR BACKFLOW TEST

Objective: To determine that there is no backflow through the exhaust water separator under any operating condition (Figure 2 or 4).

Method: Conduct this test during the sea trials in conjunction with the RAW WATER PICKUP TEST. Prepare by closing the drain hose sea cock and disconnecting the hose from the water separator. Conduct the test by opening the sea cock while keeping the hose raised to its fitting on the water separator.

Requirement: There must not be any back flow while operating the boat throughout its speed range. If there is, relocate the through-hull fitting.

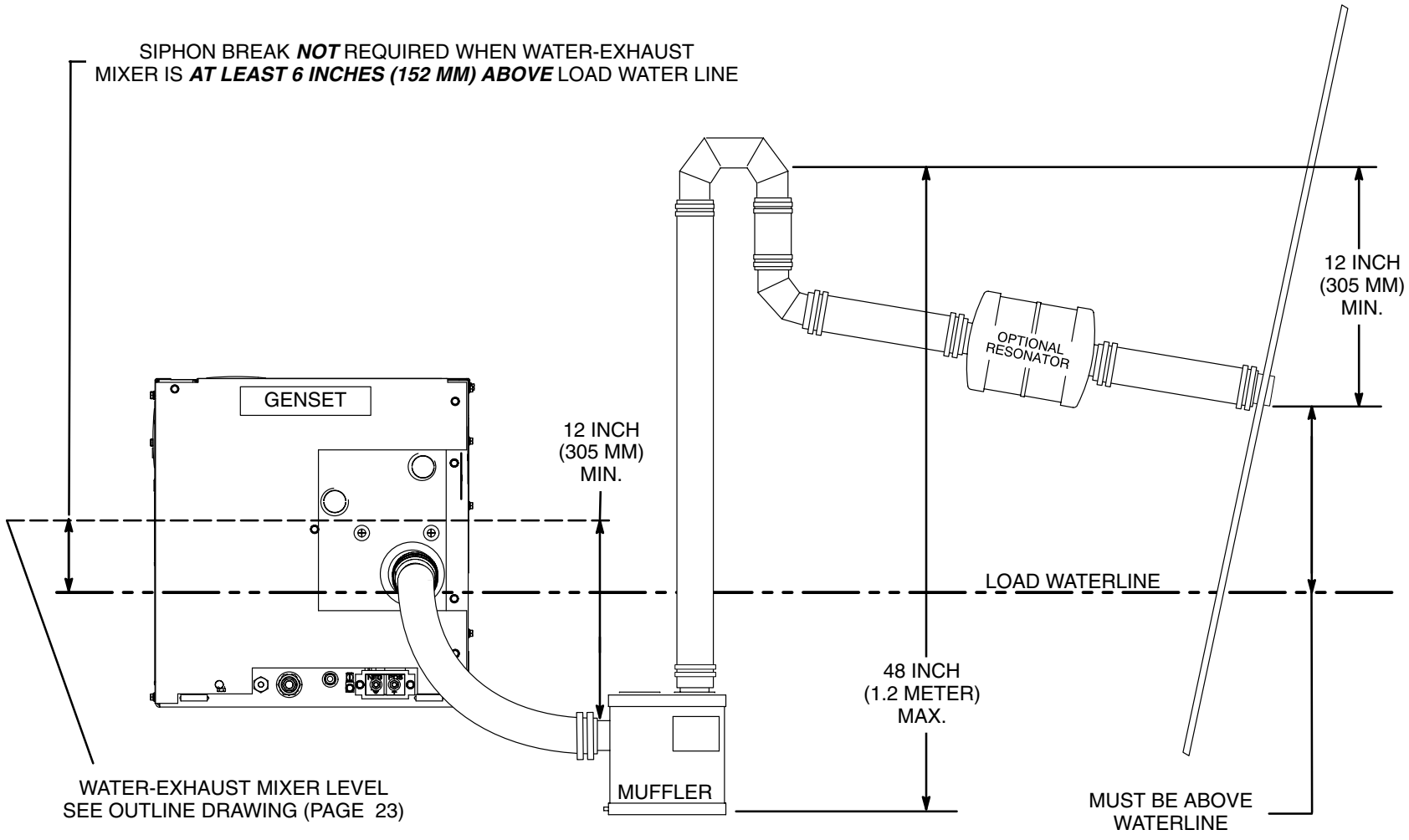


Notes:

1. All exhaust hose and pipe must slope, without sagging, at least 1/2 inch per foot (42 mm/meter).

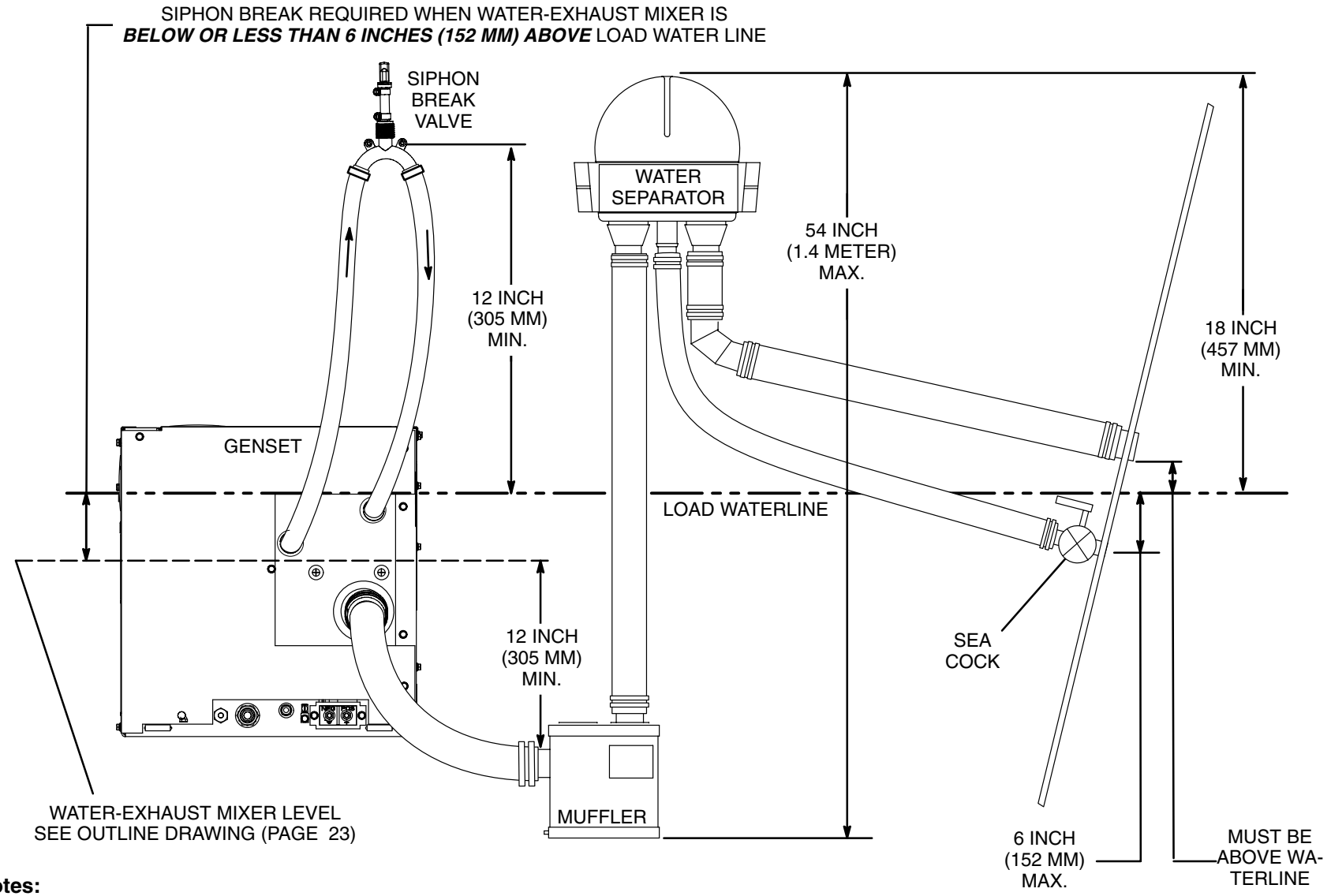
2. The operator will not be able to look for water discharge from the hull to tell whether engine/exhaust cooling water is flowing. However, the genset will shutdown if water stops flowing (Code No. 7). See *Troubleshooting* in the Operator's Manual.

FIGURE 2. TYPICAL INSTALLATION ABOVE LOAD WATERLINE—WITH MUFFLER AND WATER SEPARATOR



Note: All exhaust hose and pipe must slope, without sagging, at least 1/2 inch per foot (42 mm/meter).

FIGURE 3. TYPICAL INSTALLATION ABOVE LOAD WATERLINE—WITH MUFFLER AND RESONATOR

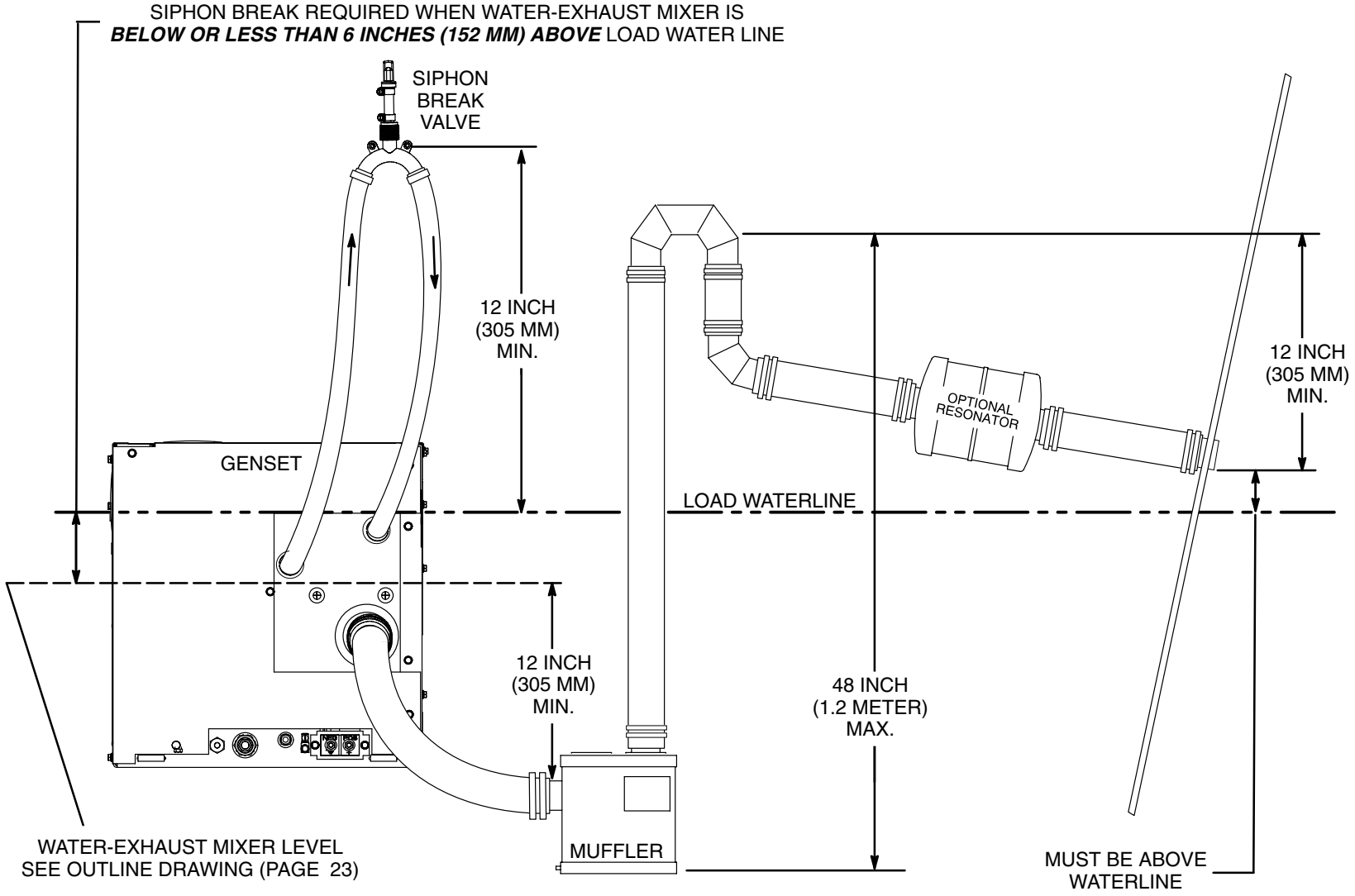


Notes:

1. All exhaust hose and pipe must slope, without sagging, at least 1/2 inch per foot (42 mm/meter).

2. The operator will not be able to look for water discharge from the hull to tell whether engine/exhaust cooling water is flowing. However, the genset will shutdown if water stops flowing (Code No. 7). See *Troubleshooting* in the Operator's Manual.

FIGURE 4. TYPICAL INSTALLATION BELOW LOAD WATERLINE—WITH A SIPHON BREAK, MUFFLER AND WATER SEPARATOR



Note: All exhaust hose and pipe must slope, without sagging, at least 1/2 inch per foot (42 mm/meter).

FIGURE 5. TYPICAL INSTALLATION BELOW LOAD WATERLINE—WITH A SIPHON BREAK, MUFFLER AND RESONATOR

Electrical Connections

⚠WARNING ***Accidental or remote starting can cause severe personal injury or death. To prevent accidental starting, disconnect the negative (–) battery cable from the battery before working on the genset.***

⚠WARNING ***HAZARDOUS VOLTAGE! Touching uninsulated live parts inside the genset and connected equipment 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 ***Improper wiring can cause fire or electric shock resulting in severe personal injury or death.***

GENERATOR

Wiring Methods

All wiring methods, connections, wire ampacities, equipment grounding and materials must be inspected and comply with applicable regulations. Use flexible conduit and stranded conductors for connections to take up the movement and vibration of the genset. See Page 23 for the location of the AC power output box and its conduit knockouts.

Note: All feed-through holes in decks and bulkheads for wiring must be sealed to prevent exhaust gases and flammable vapors from entering the rest of the boat. Wiring conduit must be sealed inside as well as outside

Generator Connections / Reconnections

Make generator connections and reconnections as required (Page 22).

Note 1: When reconnecting the generator for a different output voltage, make sure the line circuit breakers are suitable for the new output. Replace them if necessary with ones of appropriate rating.

Note 2: See Page 19 if it is necessary to change frequency or to readjust voltage.

Grounding

The genset, power supply wiring and all connected electrical equipment must be bonded to the common grounding system of the boat in accordance with applicable regulations.

⚠WARNING ***Faulty grounding of electrical equipment can lead to fire or electric shock resulting in severe personal injury or death.***

Transfer Switch

When the boat has provisions for connection to shore power, the genset must be connected to the boat electrical system through an approved transfer switch to prevent backfeed.

⚠WARNING ***Backfeed to shore power can lead to electric shock resulting in severe personal injury or death. Prevent backfeed by connecting the genset to the boat electrical system through an approved transfer switch.***

Load Balancing

Loads should be balanced as closely as possible across the generator phases.

REMOTE CONTROL

Remote Control Connector

The sealed 8-pin Deutsch® connector for remote connections is stowed inside the genset. Remove the access cover on the left end of the enclosure. Remove and discard the solid rubber slot plug (not the one with the round plastic insert). See Page 23. Pull the connector out, fit the wire grommet into the slot and secure the access cover. Remove the protective cap over the connector pins and join the connector and its mate from the *e-Series Digital Display* and/or remote switch and meters.

Onan e-Series Digital Display

Up to three (3) Onan *e-Series Digital Displays* may be connected for remote control and monitoring of the genset. *The e-Series Digital Display is not ignition protected and must therefore be installed in spaces isolated from gasoline fuel sources.* Follow the installation instructions in the Display kit.

Remote Switch and Meters

Onan Remote Control Panel Kits: Remote control panels with a control switch or a control switch with DC voltmeter or hour meter are available as kits. Follow the installation instructions in the kit. *These panels are not ignition protected and must therefore be installed in spaces isolated from gasoline fuel sources.*

Non-Onan Remote Control Panels: Use Figure 6 as a guide for wiring a remote switch and meters to mate with the genset remote connector. Start-Stop switches must be momentary contact in both positions. *The panel must be installed in spaces isolated from gasoline fuel sources unless all of its components are ignition protected devices.*

Remote Control Wiring Harnesses

Onan Harnesses: Eight-conductor plug-in wiring harnesses of various length are available for connecting *e-Series Digital Displays* and/or a remote switch and meters.

Non-Onan Harnesses: Use 16 AWG wiring. For harnesses 45 to 150 feet (14 to 46 meters) long, use 14 AWG wiring at connector pins 2, 3 and 4.

Harnesses for *e-Series Digital Displays* must have eight (8) conductors.

Harnesses for remote switches and meters only must have at least six (6) conductors (connector pins 7 and 8 are not used). See Figure 6.

Note 1: All feed-through holes in decks and bulkheads for wiring must be sealed to prevent exhaust gases and flammable vapors from entering the rest of the boat. Wiring conduit must be sealed inside as well as outside.

Note 2: Do not route remote control wiring near AC wiring. AC can induce false signals that can cause erratic operation of the genset.

Warning Labels

Each Onan kit for an *e-Series Digital Display* or remote control panel includes the following label:

⚠WARNING ***Gasoline vapors can explode. Before starting the genset, operate the exhaust blower for 4 minutes and check the genset compartment and bilge for gasoline vapors.***

This label or equivalent must be affixed next to each *e-Series Digital Display* or genset start switch and be visible when starting the genset at that station.

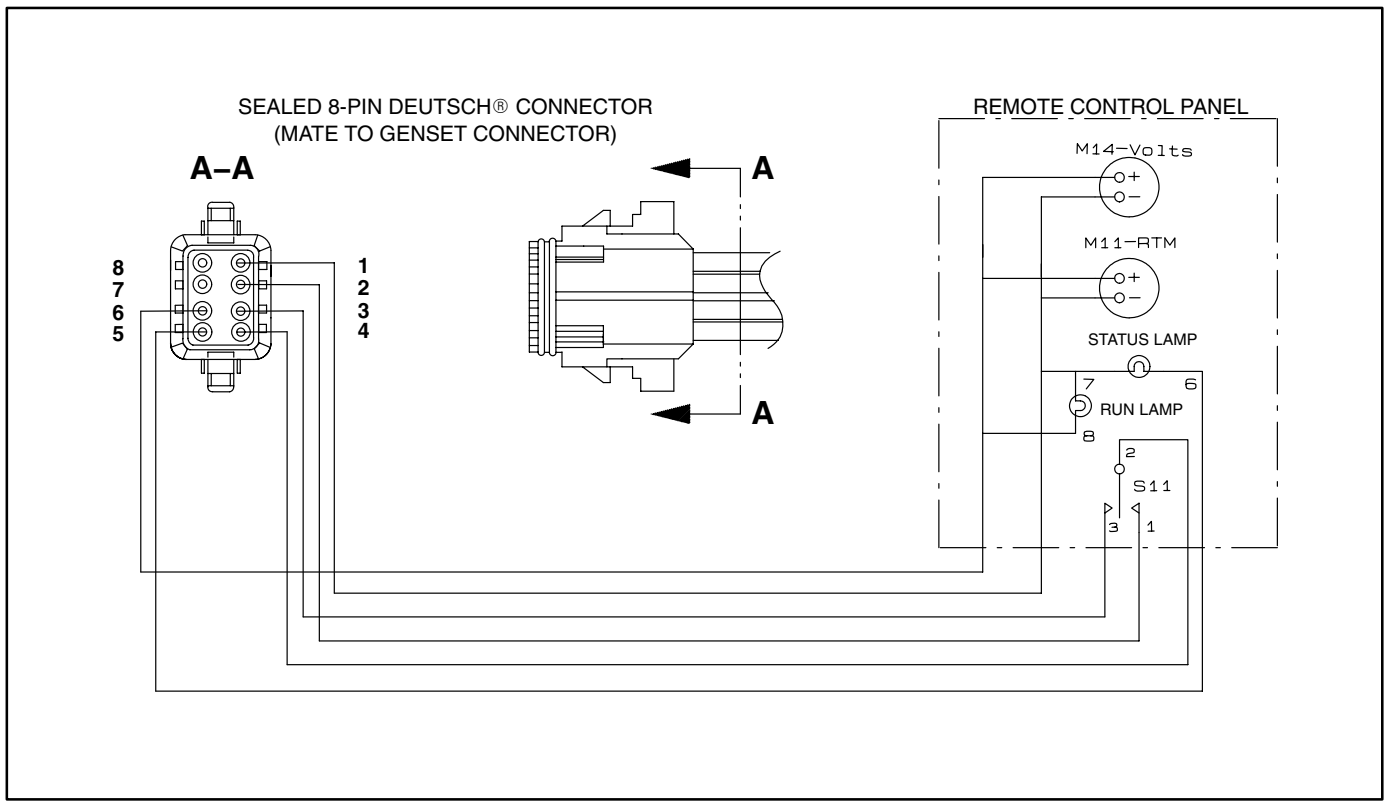


FIGURE 6. CONNECTIONS BETWEEN REMOTE PANEL AND ITS 8-PIN CONNECTOR

BATTERIES

The genset control and cranking circuits are negative (–) grounded and require a 12 volt battery. A kit is available for isolated DC ground systems.

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

Batteries

See *Specifications* for minimum battery requirements.

Battery Charger (Optional)

See *Specifications* for charging rate.

Disabling Battery Charger

If it is necessary to disable battery charging for the application, disconnect the leads marked **B1**, **B2** and **B+** from the quick-connect terminals on battery charging voltage regulator A1 (Page 21). The regulator is mounted below and to the left of the ignition coil. Insulate the end of each lead with several wraps of listed electrical insulating tape and tie them neatly in the wiring harness.

Battery Location and Mounting

Locate the battery where spills and leaks will not drip acid on fuel lines, wiring or other equipment and where ventilation is adequate to prevent the accumulation of explosive gases.

⚠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 (METERS)	CABLE SIZE, AWG
10 (3)	4
14 (4.3)	3
18 (5.5)	2
22 (6.7)	1
30 (9.1)	1/0

⚠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.***

Genset Battery Terminals

Connect the cables from the battery to the genset at the genset battery terminals mounted on the drip pan (Page 23).

B+ Terminal Insulating Boots

Provide insulating boots over the B+ battery cable terminals at the battery and at the genset to protected them from contact with metal objects that could short to ground.

DC GROUNDING

Common Ground

The genset must be electrically bonded to the common grounding system of the boat in accordance with applicable regulations. Connect the bonding cable to the genset bonding lug mounted on the drip pan (Page 23).

⚠WARNING ***Faulty bonding of the genset to the common grounding system of the boat can lead to fire or explosion, resulting in severe personal injury or death.***

EXTERNAL SHUTDOWN DEVICES

External Shutdown Device Connectors

The genset wiring harness has leads with quick-connect terminals labeled **SWB+**, **ESTOP** and **CO** (Figure 21) for connecting external shutdown devices. They are accessible by removing the access cover on the left end of the genset (Page 23). **ESTOP** can be connected to have a fire suppression or other emergency system shut down the genset. **CO** can be connected to have a CO detector shut down the genset.

External Shutdown Devices

The genset will stop running if the circuit is opened between **SWB+** and either of the other two connectors, **ESTOP** or **CO**. Therefore use normally closed (NC) shutdown devices. The total load on **SWB+** must not exceed 0.5 amps. See Page 5 regarding possible fuel solenoid connections at **SWB+**.

Factory Jumpers

The genset leaves the factory with **SWB+** jumpered to the other two connectors, **ESTOP** and **CO**. Leave the jumpers connected when no external shutdown devices are to be connected, otherwise the genset will not run.

Wiring Grommet and Strain Relief

Remove and discard the round plastic plug in the rubber grommet next to the access cover (Page 23). Push the external wires and conduit through the grommet before making connections. Use wire ties to provide strain relief for the external leads. Secure the access cover when connections have been made.

Shutdown Indication

If shutdown occurs due to either device, the *e-Series Digital Displays* will display, respectively, **Code No. 5: Warning—Shutdown due to Vessel CO** or **Code No. 61: Emergency Shutdown**. See *Troubleshooting* in the Operator's Manual. (All of the status indicator lights in the control circuit will also blink the fault code.)

Changing Frequency and Adjusting Voltage

CHANGING FREQUENCY

Model MGKBC gensets may be configured to operate at 60 Hz or 50 Hz. To change the operating frequency, remove the front access door and find wiring harness connectors **P5**, **P6** and **P7** (Page 21), which are located just behind the ignition coil. Connect **P5** to **P6** for **60 HZ** or **P5** to **P7** for **50 HZ**.

Note 1: When changing genset operating frequency, make sure the line circuit breakers are suitable for the new output. Replace them if necessary with ones of appropriate rating.

Note 2: Check and adjust voltage as necessary after frequency has been changed.

ADJUSTING VOLTAGE

⚠WARNING ***HAZARDOUS VOLTAGE! Touching uninsulated live parts inside the genset or connected equipment 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.***

Before adjusting voltage, make sure that proper fuel, exhaust, raw water and battery connections have been made and that the engine has the proper levels of oil and coolant. See the Operator's Manual. Complete *Installation Checks and Startup* (Page 20) as far as possible. Disconnect all generator loads and connect accurate meters to measure AC voltage and frequency.

Using Start Switch

1. Start the genset and let voltage and frequency stabilize for 5 to 10 seconds.
2. Rapidly press **START** 6 times *during the first minute after startup* to put the genset controller into *voltage adjust mode*. The amber status light will begin blinking about once every second to indicate the change to voltage adjust mode. The green status light will remain on.
3. ***To adjust voltage up***, press and quickly release **START**. Voltage will increase approximately 0.6 volts each press and release.
4. ***To adjust voltage down***, press and hold **START** for about 1 second. Voltage will decrease approximately 0.6 volts each press and release.
5. When satisfied with the adjustment, wait about 20 seconds for the amber light to stop blinking and then press **STOP** to save the adjustment.
6. Restart the genset and check voltage.

Using e-Series Digital Display

See the Operator's Manual for details regarding the *e-Series Digital Display*.

1. Start the genset and let voltage and frequency stabilize for 5 to 10 seconds.
2. Rapidly press **START** 6 times *during the first minute after startup* to put the genset controller into *voltage adjust mode*. The green status light will begin blinking about once every second and the Display will indicate a Status change from *Running* to *Volt Adj* (Figure 7).
3. ***To adjust voltage up***, press and quickly release **START**. Voltage will increase approximately 0.6 volts each press and release.
4. ***To adjust voltage down***, press and hold **START** for about 1 second. Voltage will decrease approximately 0.6 volts each press and release.
5. When satisfied with the adjustment, wait about 20 seconds for the Display to indicate a Status change from *Volt Adj* to *Running* and then press **STOP** to save the adjustment.
6. Restart the genset and check voltage.

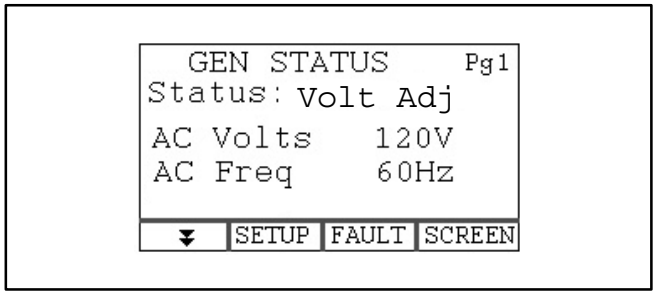
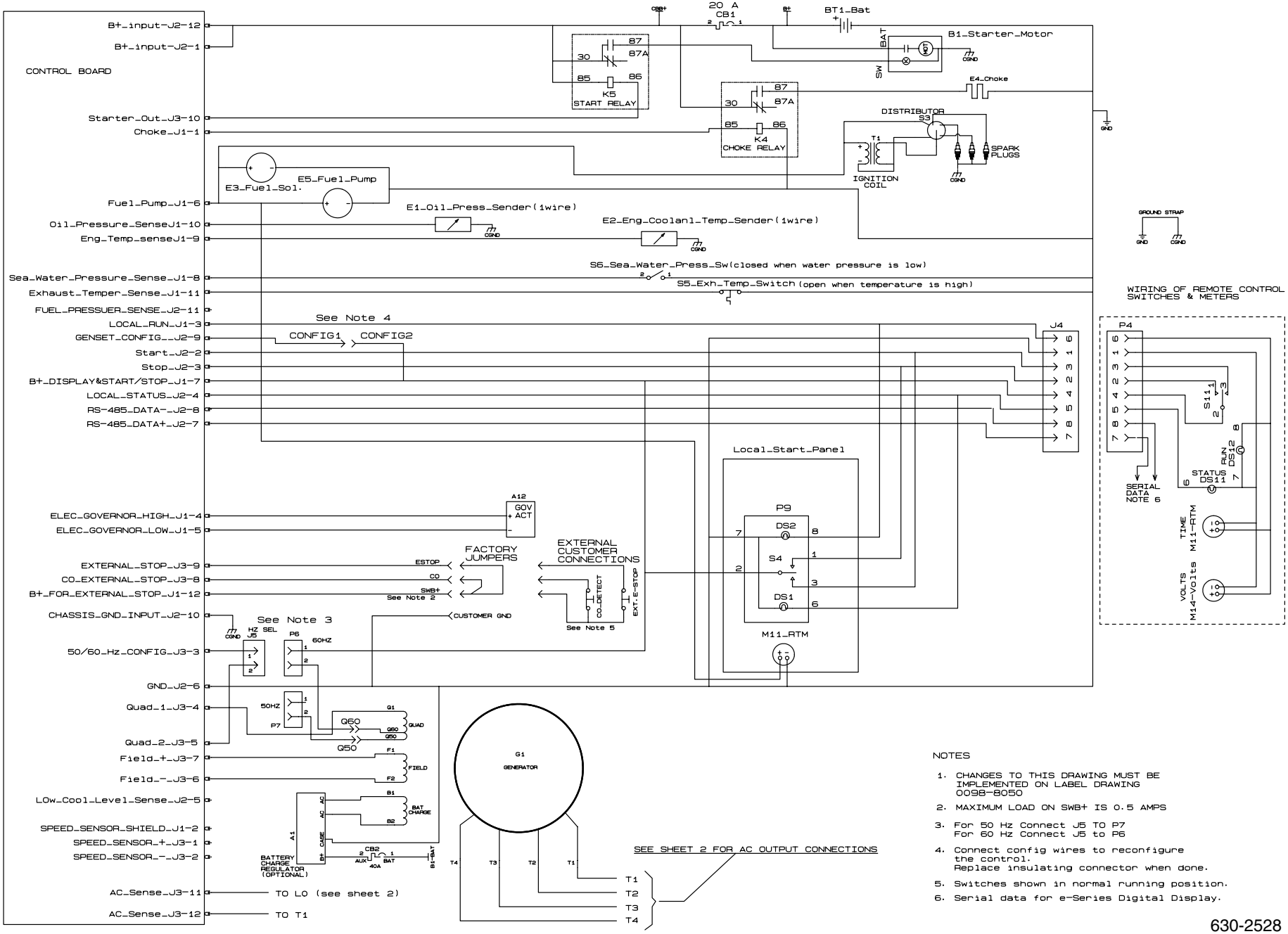


FIGURE 7. VOLTAGE ADJUSTMENT SCREEN

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 reconnections, modifications and repairs. 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 reconnections, modifications and repairs. Check off (√) each item that can be answered positively. Do not place the genset in service until each item has been checked off.

- ☐ The RAW WATER PICKUP TEST was conducted during the sea trials to establish the water line and a siphon break was installed, if found necessary.
- ☐ The sea trials established that at all boat speeds enough raw water is picked up for genset engine and exhaust cooling.
- ☐ The sea trials established that there is no backflow through the exhaust through-hull fitting or water separator drain hose when the boat is under way, forward or reverse.
- ☐ Genset compartment ventilation meets regulations and the sea trials established that ventilation is sufficient to maintain acceptable genset compartment temperatures, even while "heat soaking" after returning and docking.
- ☐ All electrical devices used in spaces where gasoline vapors can accumulate are *Ignition Protected.*
- ☐ The living quarters are sealed against leaks from spaces where exhaust and gasoline vapors can accumulate.
- ☐ The genset is securely 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 entire exhaust system is accessible for inspection and replacement.
- ☐ Fuel tanks, piping, hoses and filters comply with regulations and are accessible for inspection and replacement.
- ☐ The genset is bonded to the boat grounding system in accordance with regulations.
- ☐ All grounded cranking motor circuits are connected by properly sized common bonding conductors.
- ☐ If required, the kit for isolated DC ground was installed.
- ☐ An approved transfer switch prevents interconnections between shore power and genset.
- ☐ 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 LCD control panel functions as intended and is not mounted where gasoline vapors can accumulate.
- ☐ Emergency and/or CO detection and shutdown devices have been connected and have been tested to determine that the genset shuts down as intended.
- ☐ The genset is properly sized for the application, the voltage and frequency are correct and the loads across a multi-phase generator are balanced.
- ☐ 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 raw water systems are leak-free.
- ☐ The engine has the proper levels of oil and coolant.
- ☐ The raw water pump has been primed and the sea cock is open.
- ☐ All operators have been thoroughly briefed on the Operator's Manual and its safety precautions—especially concerning the dangers of carbon monoxide and gasoline vapors—and can demonstrate how to operate, maintain and troubleshoot the genset as explained therein.

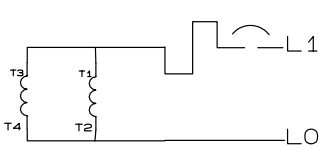
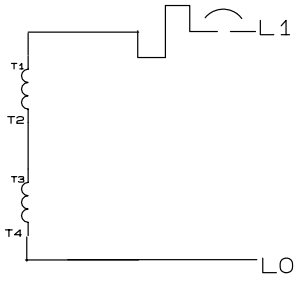
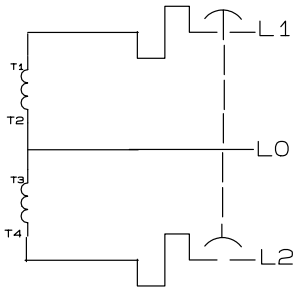
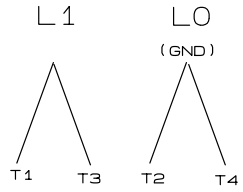
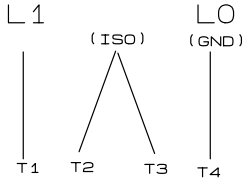
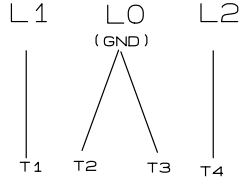
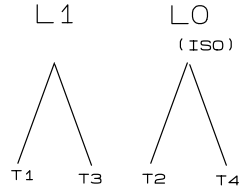
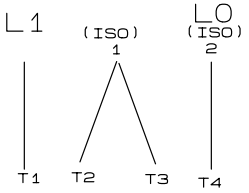
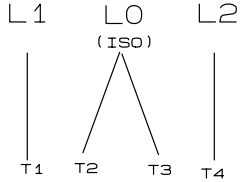


NOTES

1. CHANGES TO THIS DRAWING MUST BE IMPLEMENTED ON LABEL DRAWING 0098-8050
2. MAXIMUM LOAD ON SWB+ IS 0.5 AMPS
3. For 50 Hz Connect J5 TO P7
   For 60 Hz Connect J5 to P6
4. Connect config wires to reconfigure the control.
   Replace insulating connector when done.
5. Switches shown in normal running position.
6. Serial data for e-Series Digital Display.

630-2528

FIGURE 8 . WIRING DIAGRAM

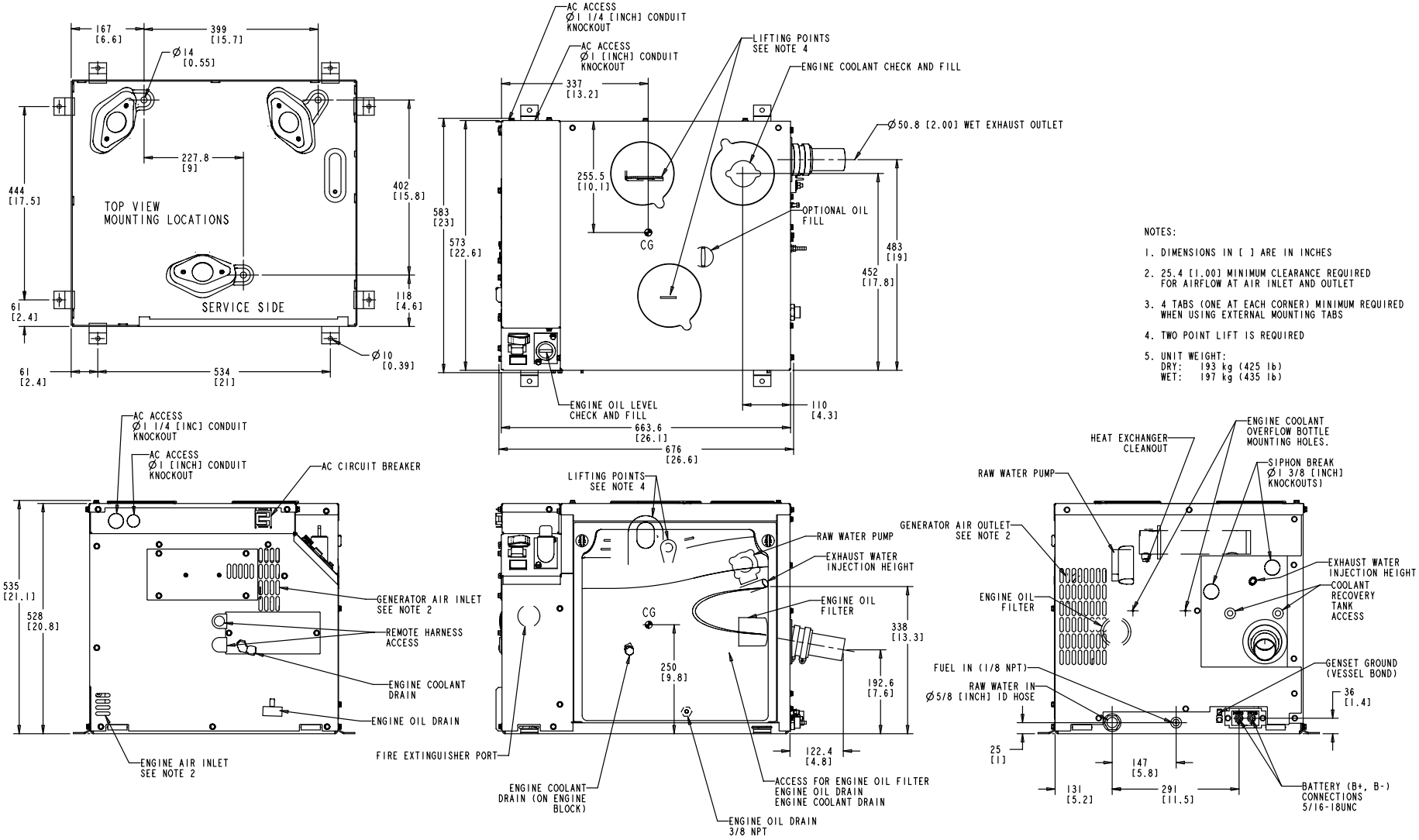
	A	B	C	HZ
VOLTAGE	120	240	120/240	60
	110 115 120	220 230 240	110/220 115/230 120/240	50
SCHEMATIC				
DIAGRAM GROUNDED NEUTRAL				
DIAGRAM ISOLADTED NEUTRAL				

NOTES:
1. (GND) INDICATES GROUND. CONNECTION SHOULD BE MADE AT THE GROUND STUD IN THE AC CONNECTION BOX.
2. (ISO) INDICATES ISOLATED. CONNECTION SHOULD BE MADE AT THE ISOLATION STANDOFF IN THE AC CONNECTION BOX.

1Ø Generator Reconnection

630-252

FIGURE 9. GENERATOR CONNECTION DIAGRAM



500-3363

FIGURE 10. OUTLINE DRAWING