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Installation Manual MDKAU

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 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.

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

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. They are highly explosive.
- Keep the genset, drip pan and compartment clean. Oily rags can catch fire. Gear stowed in the compartment can restrict cooling.
- 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.
- 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 multi-class ABC fire extinguishers handy. 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 federal codes and regulations.

GENERATOR VOLTAGE IS DEADLY

- Generator electrical output connections must be made by a trained and experienced electrician in accordance with applicable codes.
- The genset must not be connected to shore power or to any other source of electrical power. Back-feed to shore power can cause electric shock resulting in severe personal injury or death and damage to equipment. 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, stand on a dry wooden platform or rubber insulating mat and use tools with insulated handles.

ENGINE EXHAUST IS DEADLY

- Never sleep in the boat while the genset is running unless the boat is equipped with properly working carbon monoxide detectors.
- 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.
- Inspect for exhaust leaks every startup and after every eight hours of operation.
- For more information about carbon monoxide see American Boat and Yacht Council (ABYC) publication TH-22—*Educational Information About Carbon Monoxide*.

DIESEL FUEL IS COMBUSTIBLE

- Do not smoke or turn electrical switches ON or OFF where fuel fumes are present or in areas sharing ventilation with fuel tanks or equipment. Keep flames, sparks, pilot lights, arc-producing equipment and all other sources of ignition well away.
- Fuel lines must be secured, free of leaks and separated or shielded from electrical wiring.

BATTERY GAS IS EXPLOSIVE

- Wear safety glasses while servicing batteries and do not smoke.
- 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 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, and other moving parts.

FLAMMABLE VAPOR ENVIRONMENT

Flammable vapor can cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury or death. ***Do not operate a diesel-powered genset in a flammable vapor environment created by fuel spill, leak, etc.*** The owners and operators of the genset are solely responsible for operating the genset safely.

POST THESE SUGGESTIONS IN POTENTIAL HAZARD AREAS OF THE BOAT

Specifications

| | | |
|---|------------------------|--|
| GENERATOR: Two-Bearing, 2-Pole Rotating Field, Microprocessor Regulated. See Genset Nameplate for Rating | | |
| FUEL CONSUMPTION: | | |
| 60 Hz: | Full Load Half Load | 0.60 gph (2.3 liter/hr) 0.35 gph (1.3 liter/hr) |
| 50 Hz: | Full Load Half Load | 0.50 gph (1.9 liter/hr) 0.29 gph (1.1 liter/hr) |
| Engine/Generator Speed: | 60 Hz 50 Hz | 2900/3600 rpm 2400/3000 rpm |
| ENGINE: 4-Stroke Cycle, Indirect Injection Diesel, Water Cooled, Microprocessor Governed (Isochronous) | | |
| Number of Cylinders | | 2 |
| Bore | | 2.52 inch (64 mm) |
| Stroke | | 2.45 inch (62.2 mm) |
| Displacement | | 24.41 inch ³ (400 cm ³) |
| Compression Ratio | | 23:1 |
| Firing Order (Clockwise Rotation) | | 1-2 |
| Fuel Injection Timing | | 18° – 20° BTDC |
| Fuel Injection Pressure | | 1991 psi (13.73 MPa) |
| Valve Lash (cold) | | 0.0059 – 0.0073 inch (0.145 – 0.185 mm) |
| Engine Oil Capacity | | 2.2 quart (2.1 liter) |
| Engine Oil Drain Connection | | 3/8 NPT |
| Coolant Capacity | | 2.2 quart (2.1 liter) |
| Coolant Flow: | 60 Hz 50 Hz | 3.5 gpm (13 liter/min) 3.0 gpm (16 liter/min) |
| Raw Water Flow: | 60 Hz 50 Hz | 5.0 gpm (19 liter/min) 4.0 gpm (15 liter/min) |
| Maximum Raw Water Pump Lift | | 4 feet (1.2 m) with 5/8 inch ID hose |
| Raw Water Inlet Connection | | 5/8 inch (15.9 mm) ID Hose |
| Maximum Fuel Pump Lift | | 4 feet (1.2 m) with 3/8 inch ID fuel line |
| Recommended Fuel Line Size | | 3/8 inch (9 mm) ID |
| Fuel Supply Connection | | 1/8 NPT female |
| Fuel Return Connection | | 1/8 NPT female |
| Maximum Exhaust Back Pressure | | 3 inch (76 mm) Hg |
| Wet Exhaust Outlet Connection | | 2.0 inch (50.8 mm) ID Hose |
| Combustion Air | | 18 cfm (30 m ³ /hr) |
| Generator Cooling Air | | 60-80 cfm (100-135 m ³ /hr) |
| BATTERIES: | | |
| Nominal Battery Voltage | | 12 volts |
| Minimum CCA Rating | | 360 amps |
| Battery Charging Output | | 10 amps |
| SIZE, WEIGHT, NOISE: | | |
| Size: L x W x H | | 26 x 20.1 x 20.6 inch (662 x 511 x 524 mm) |
| Weight (dry) | | 350 lbs (159 kg) |
| Noise: | 60 Hz 50 Hz | 71 dB(A) 68 dB(A) |

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
- Preventing the migration of exhaust gases and fuel vapors into the living quarters
- Fuel connections
- Batteries
- Electrical connections
- Bonding for electrical grounding
- Accessibility for operation and maintenance
- Noise and vibration.

See the genset 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*,
American 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 21) 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 gensets.*

Location and Mounting

LIFTING THE GENSET

The genset weighs 350 pounds (159 kg). Use both lifting eyes, which are accessible by removing the top access door (Page 21), and proper equipment for safe handling.

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 of the boat. 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 not “ignition protected” and therefore not permitted under USCG regulation 33CFR183 to be located in a gasoline fuel environment. If the boat has gasoline-fueled propulsion engines, the genset must 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, 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 and front should have at least 1 inch (25 mm) of clearance for air flow. The top must have at least 2 inches (51 mm) of clearance to unlatch the access door. The right side must have enough clearance to remove the side panel for adjusting the V-belt, replacing the pump impeller and servicing the heat exchanger.

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 the genset 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 21).
- By clamping it with the four (4) steel clamps that secured it to the shipping skid: one at each corner (Page 21). 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—FUEL 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

Ventilation Capacity

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 boats.

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 |

Ventilation Ducts

Ventilating air should enter near the bottom of the compartment at the left side, near the air inlet (Page 21), 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 in² (258 cm²) 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 the living quarters are sealed off from the engine room.

Openings and Feed-Through Holes in Decks and Bulkheads

All openings and feed-through holes for wiring, conduit, pipe and hose in decks and bulkheads must be sealed to prevent exhaust gases and fuel 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.

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 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 Filter

The genset is equipped with a water separator type of fuel filter accessible for periodic draining of water and sediment and replacement. The fuel supply system should also be equipped with a fuel filter and water separator ahead of the connections at the genset. *Keep out dirt and debris when making fuel connections.*

Fuel Fittings

Two 1/8 NPT fittings for supply and return fuel connections are mounted on the drip pan on the right side (Page 21). Barbed hose fittings for 5/16 inch (8 mm) fuel hose are available.

Fuel Lines and Hoses

Use USCG TYPE A1 or ISO 7840-A1 fuel hose. Fuel lines and hoses should have inside diameters of 5/16 to 3/8 inch (8 to 9 mm). Larger diameter fuel lines take longer to prime and they drain down more easily, allowing air to enter. Smaller diameter fuel lines restrict flow and thereby can affect engine performance.

Do not connect the genset to a shared fuel distribution manifold. The genset fuel pump might not be able to prime the fuel manifold or 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 Pickup

Provide a separate pickup tube in the fuel tank for the genset. The inside diameter should not be greater than a 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. Make sure the fuel tanks are large enough to cool returning fuel.

Maximum Fuel Pump Lift

The fuel lift pump mounted in the genset can handle up to 4 feet (1.2 m) of fuel suction head (combination of lift height and line friction) in 3/8 inch fuel line.

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. The sulfur in diesel fuel attacks galvanized (zinc) coatings causing debris that can clog fuel filters, pumps and injectors.*

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 is then 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.

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 gen-set the Operator's Manual.

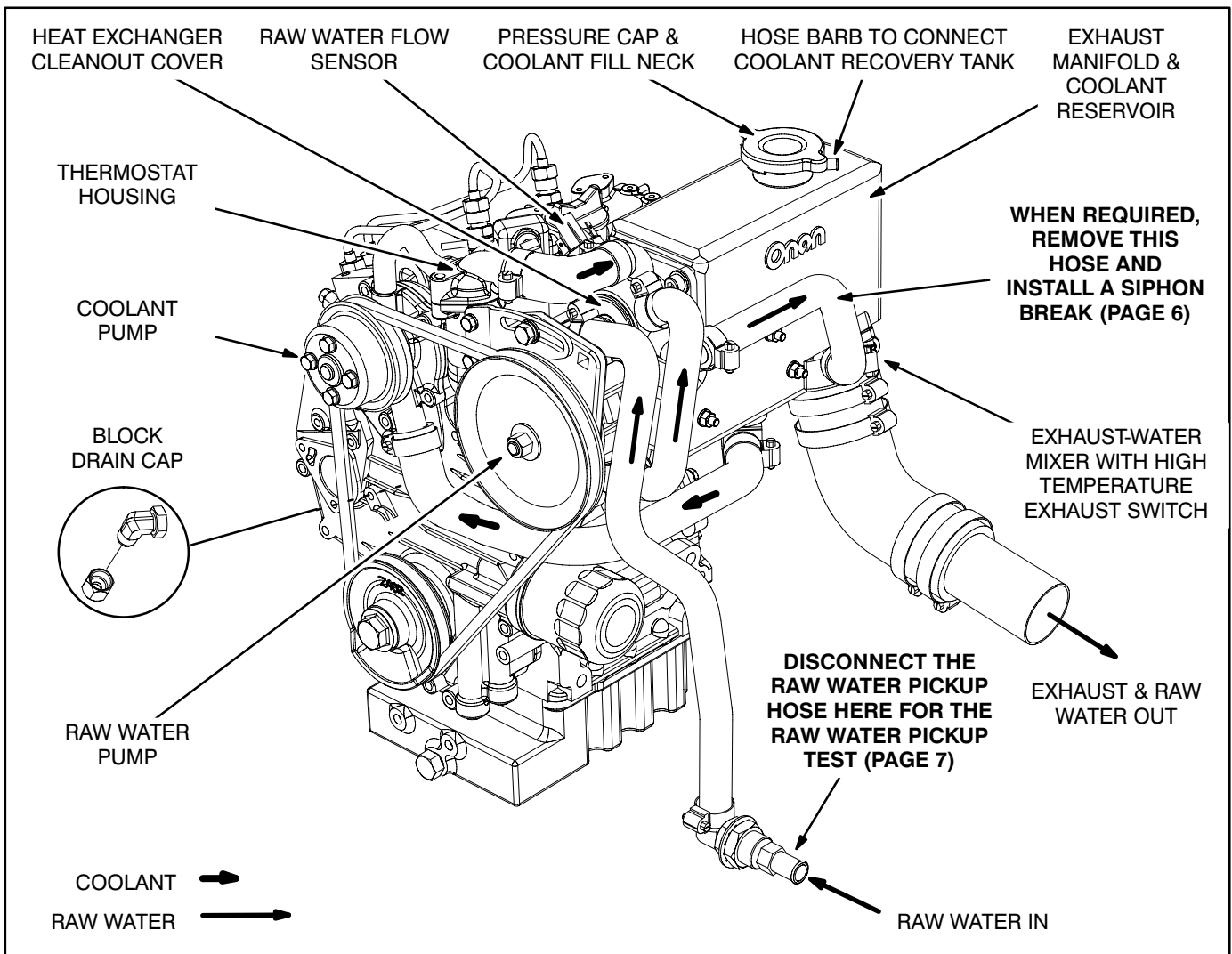


FIGURE 1. ENGINE COOLING SYSTEM

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 21). 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 21) and as close as possible to the genset. The basket must be removable 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 21). 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 21). 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 the 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 21) 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 5) 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 21).
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 (Figures 2 and 4). When an elbow is used, the base of the muffler should not be more than 48 inches (1.2 meter) below the elbow (Figures 3 and 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 (Figures 2 and 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.

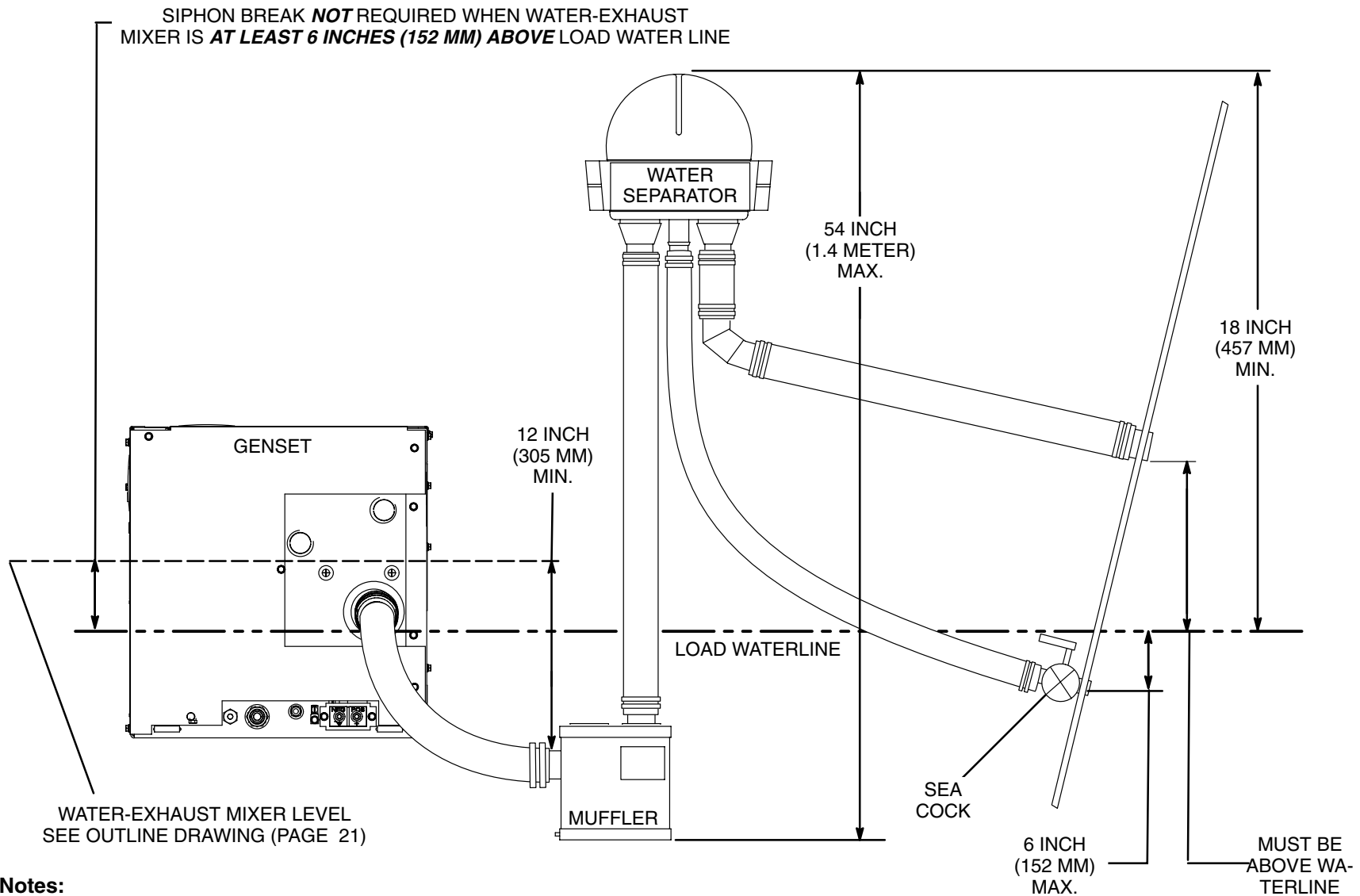
⚠ CAUTION *Corrosive exhaust vapors can migrate through a shared exhaust system and cause damage to idle engines. Provide a separate exhaust system for each engine.*

EXHAUST WATER SEPARATOR BACKFLOW TEST

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

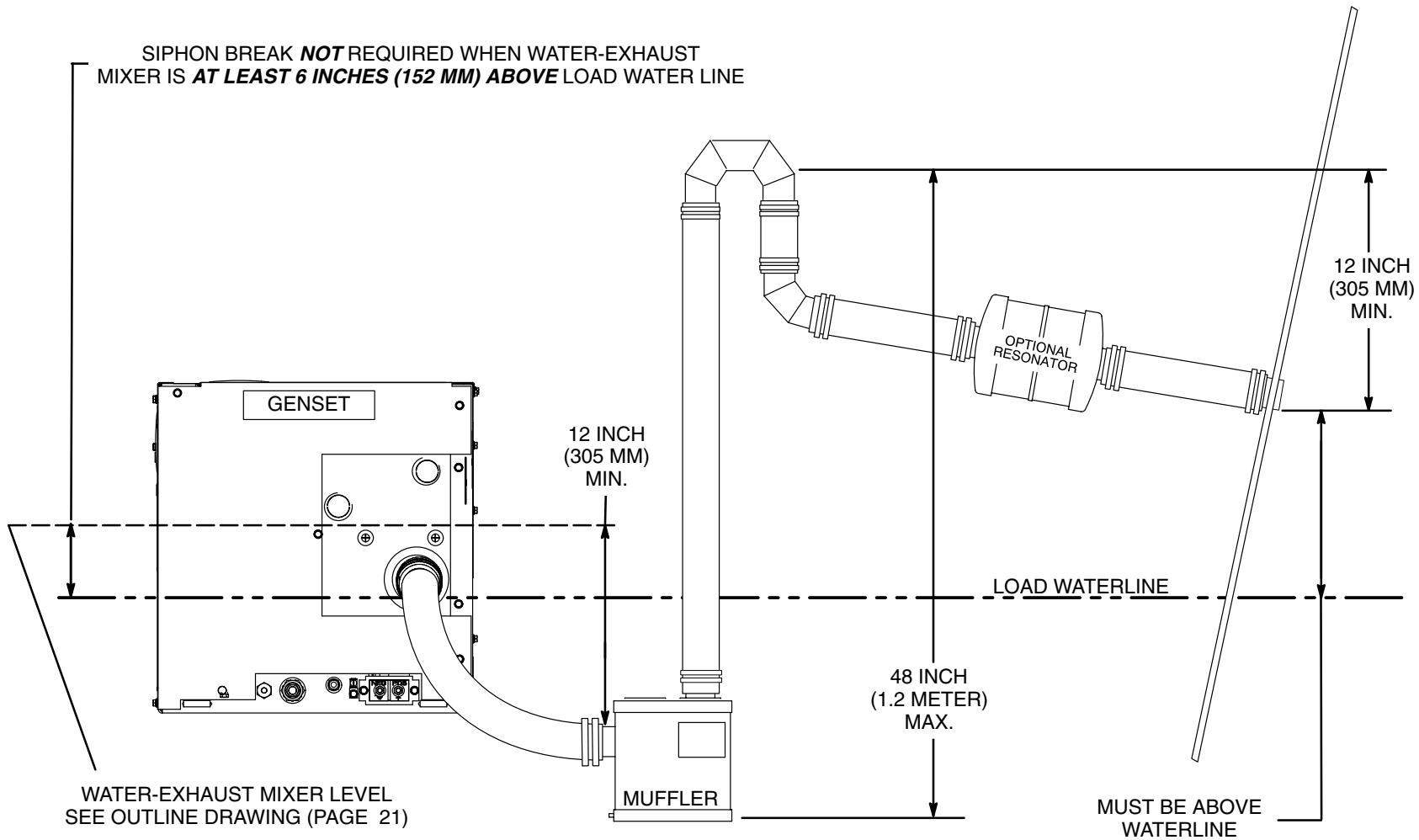
Method: Conduct this test during the sea trials in conjunction with the RAW WATER PICKUP TEST. Prepare by closing the drain hose sea cock and disconnecting the hose from the water separator. Conduct the test by opening the sea cock while keeping the hose raised to its fitting on the water separator.

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:**

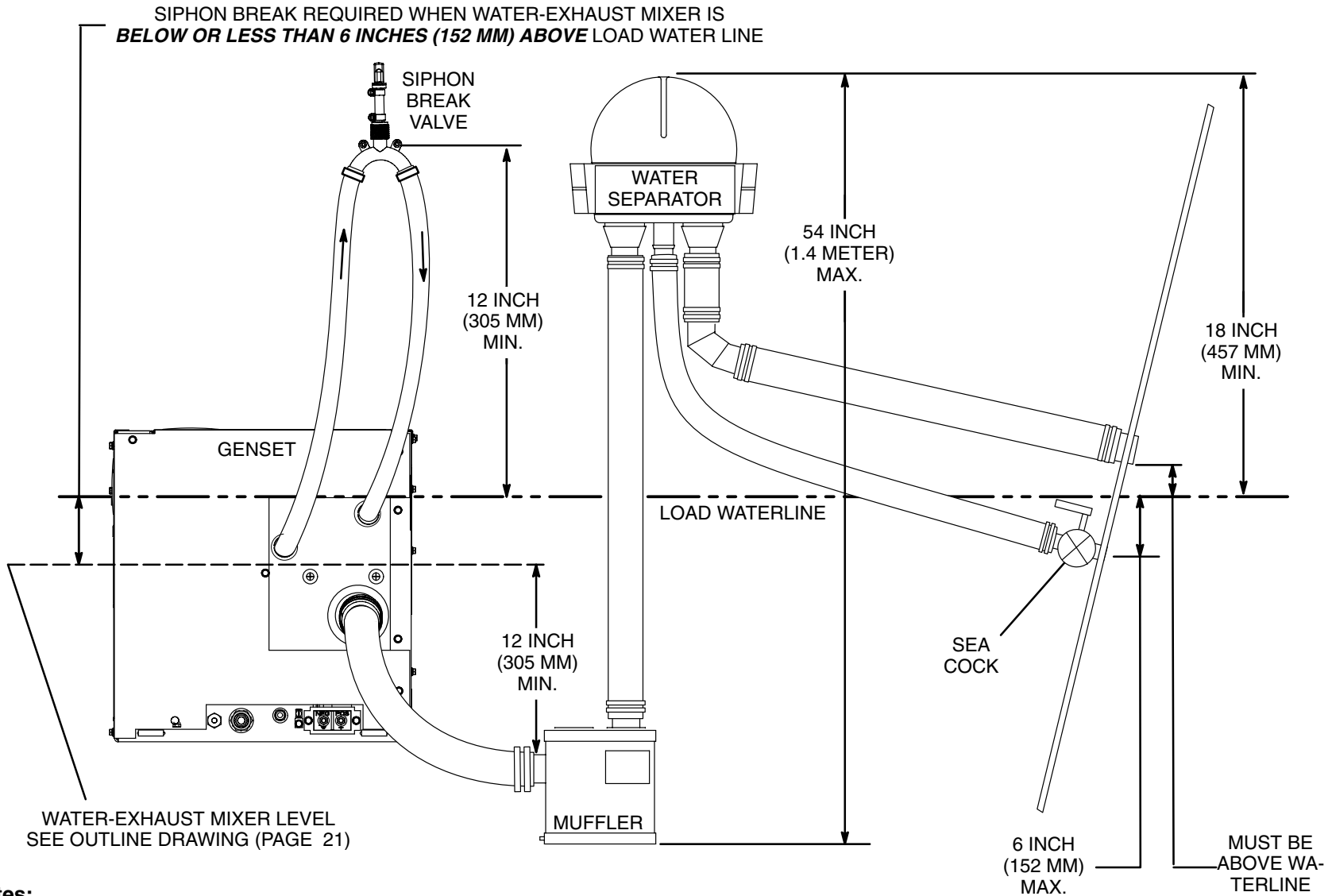
1. All exhaust hose and pipe must slope, without sagging, at least 1/2 inch per foot (42 mm/meter).
2. The operator will not be able to look for water discharge from the hull to tell whether engine/exhaust cooling water is flowing. However, the genset will shutdown if water stops flowing (Code No. 7). See *Troubleshooting* in the Operator's Manual.

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



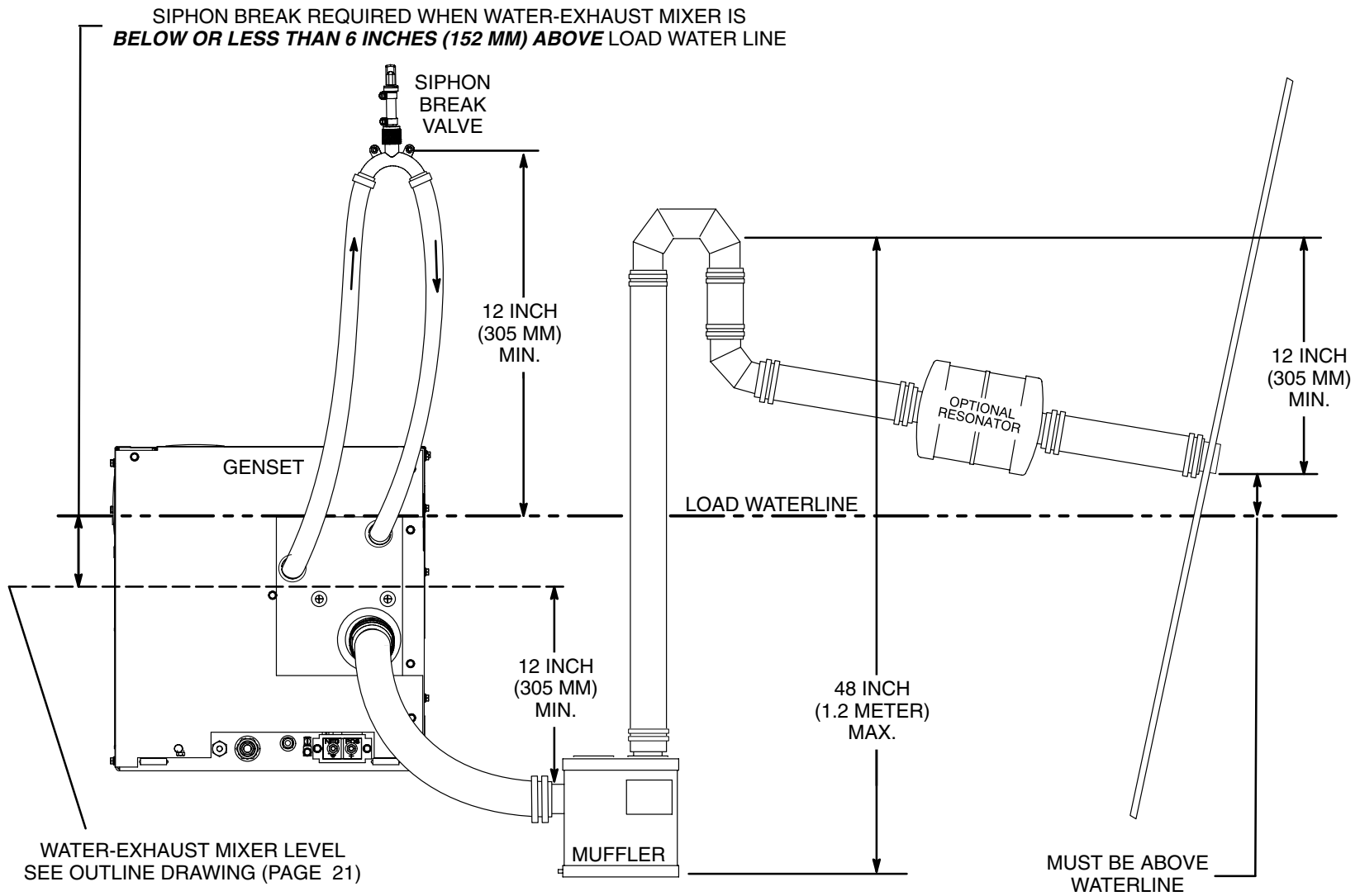
Note: All exhaust hose and pipe must slope, without sagging, at least 1/2 inch per foot (42 mm/meter).

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 21 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 (Figure 6).

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 18 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 electrical 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.*

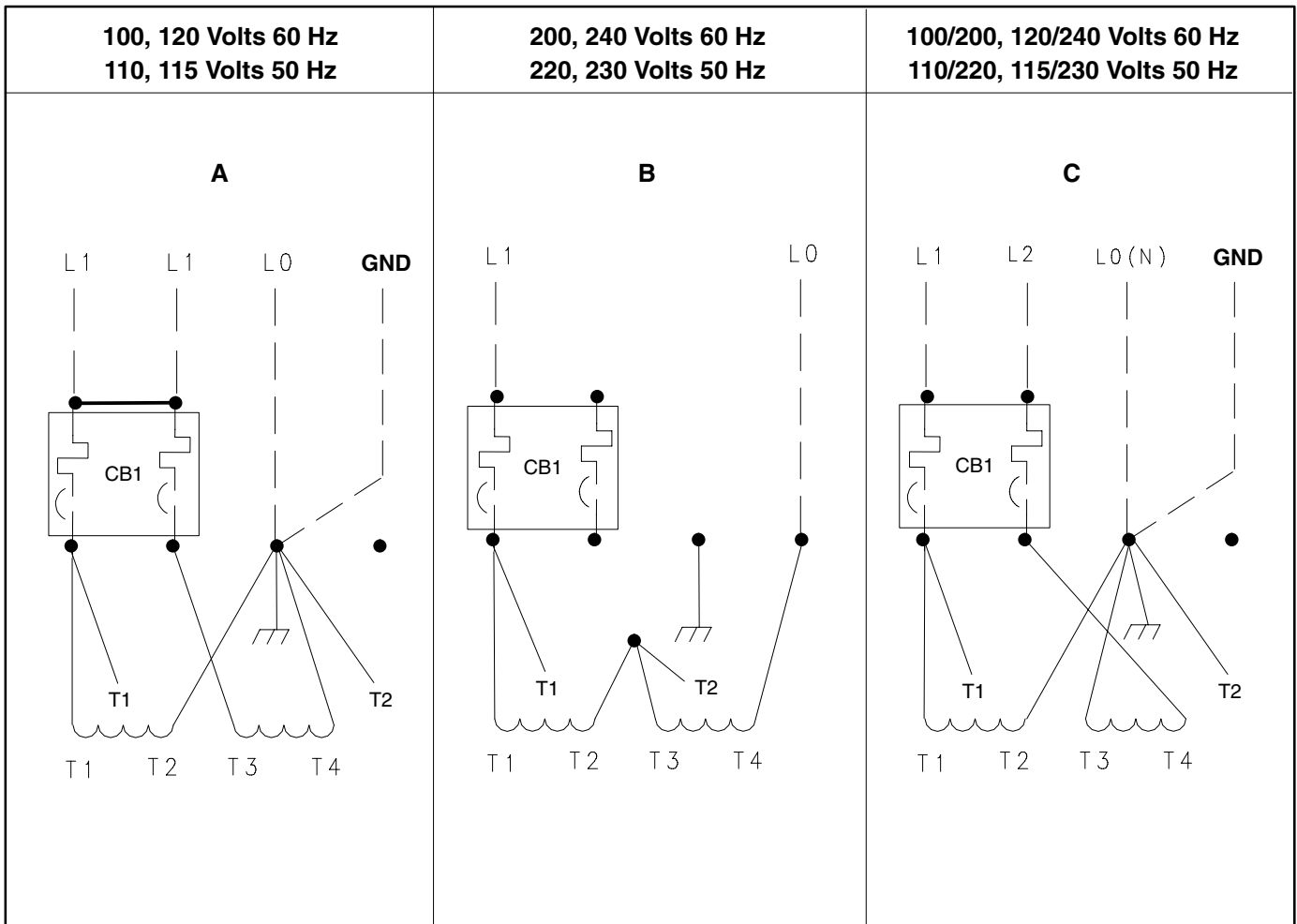
Transfer Switch

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.



A – Jumper the two load terminals of the circuit breaker so that there is no imbalance of loads between the generator windings and both windings are available for large motor and air conditioner starting. Bolt **T2/T2/T4/L0/GND** to the grounding stud in the outlet box.

B – Bolt and insulate **T2/T2/T3**. Bolt **L0/T4** to the insulated terminal in the outlet box. Generator grounding must be in accordance with codes.

C – Bolt **T2/T2/T3/L0(N)/GND** to the grounding stud in the control box unless codes require an isolated neutral (N).

Note: Always bolt the T1 voltage sense lead with the T1 winding lead and the T2 voltage sense lead with the T2 winding lead.

FIGURE 6. GENERATOR RECONNECTION DIAGRAMS

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 and remove and discard the rubber slot plug (Page 21). 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 remote control panel.

Remote Control Panels

Onan Remote Control Panel Kits: Various remote control panels are available from Onan (Marine Genset Accessories & Service Support Catalog). Follow the instructions in the kits.

Non-Onan Remote Control Panels: Use Figure 7 as a guide for wiring a remote panel to its connector. Start-Stop switches must be momentary contact in both positions.

Remote Control Wiring Harnesses

Onan Harnesses: Eight-conductor plug-in wiring harnesses of various length are available for connecting to a remote control panel. "Y" harnesses are also available for applications requiring two remote stations.

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. See Figure 7.

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.

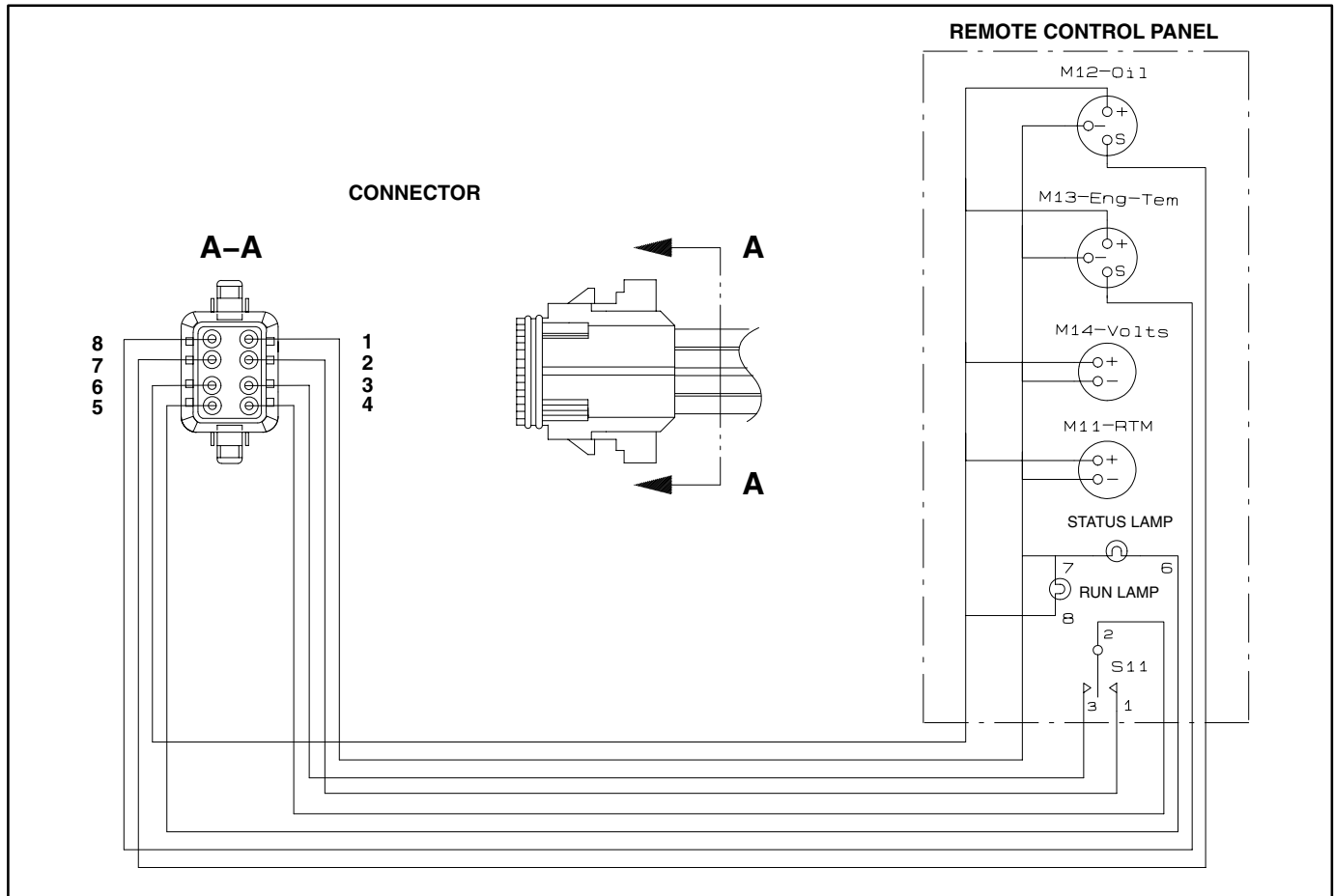


FIGURE 7. CONNECTIONS BETWEEN REMOTE PANEL AND ITS 8-PIN CONNECTOR

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 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

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 (Page 20). The regulator is mounted on the left wall inside the access opening on the left end of the genset. Insulate the end of each lead with several wraps of listed electrical insulating tape and tie them neatly into the wiring harness. Secure the access cover when done.

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 21).

B+ Terminal Insulating Boots

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

DC GROUNDING

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 21).

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

FIRE SUPPRESSION SYSTEM

The genset wiring harness has leads terminating in quick-connects **J6** and **J7** (Page 20) for connection to a fire suppression system or other control to shut down the genset in the event of a fire or other emergency. The system must close a set of contacts to cause genset shutdown. The connectors are accessible by removing the access cover on the left end of the genset. For connections, use the conduit knockout just below the access opening. Secure the access cover when connections have been made. If an emergency shutdown occurs, the status indicator light will blink **Code No. 61—Emergency Shutdown**. See *Troubleshooting* in the genset Operator's Manual.

Changing Frequency and Adjusting Voltage

CHANGING FREQUENCY

If it is necessary to change the output frequency for the application, remove the access cover on the left end of the genset. Find the leads marked **J8 HZ**, **60 HZ** and **50 HZ** in the wiring harness (Page 20). Connect **J8 HZ** to **60 HZ** or to **50 HZ**, as appropriate, and secure the access cover.

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 voltage and adjust 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 genset Operator's Manual. Complete *Installation Checks and Startup* (Page 19) as far as possible. Disconnect all generator loads and connect accurate meters to measure AC voltage and frequency. To adjust voltage:

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 recheck voltage.

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 genset 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 back-flow 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.
- The living quarters are sealed against leaks from spaces where exhaust and fuel vapors can accumulate.
- The genset is securely mounted.
- There is adequate clearance for conducting all maintenance specified in the genset 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 electrical grounding system in accordance with regulations.
- 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 control panel functions as intended.
- Emergency 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 are balanced across the phases.
- 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 and air tight.
- 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 genset Operator's Manual and its safety precautions—especially concerning the dangers of carbon monoxide gas—and can demonstrate how to operate, maintain and troubleshoot the genset as explained therein.

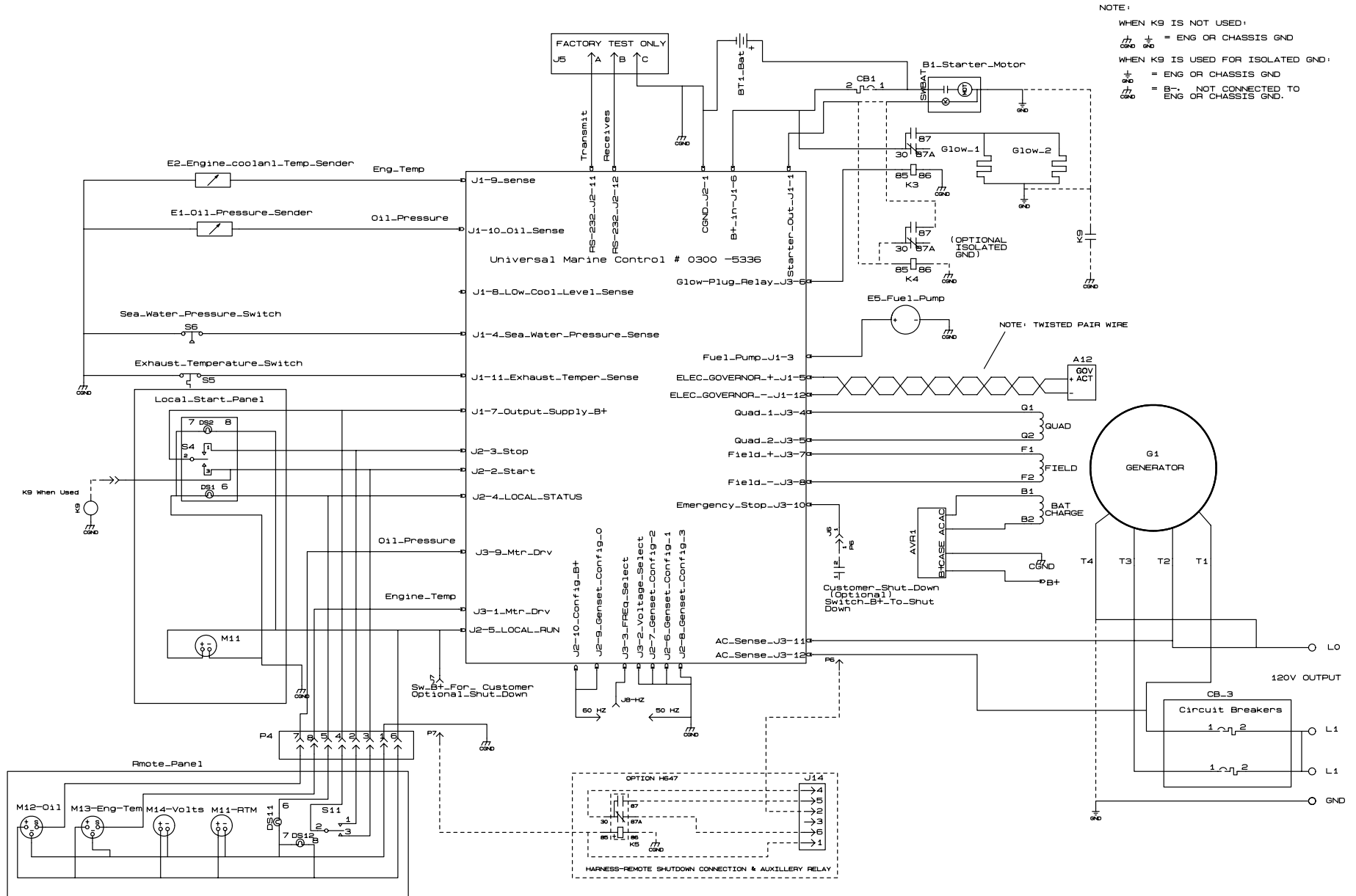
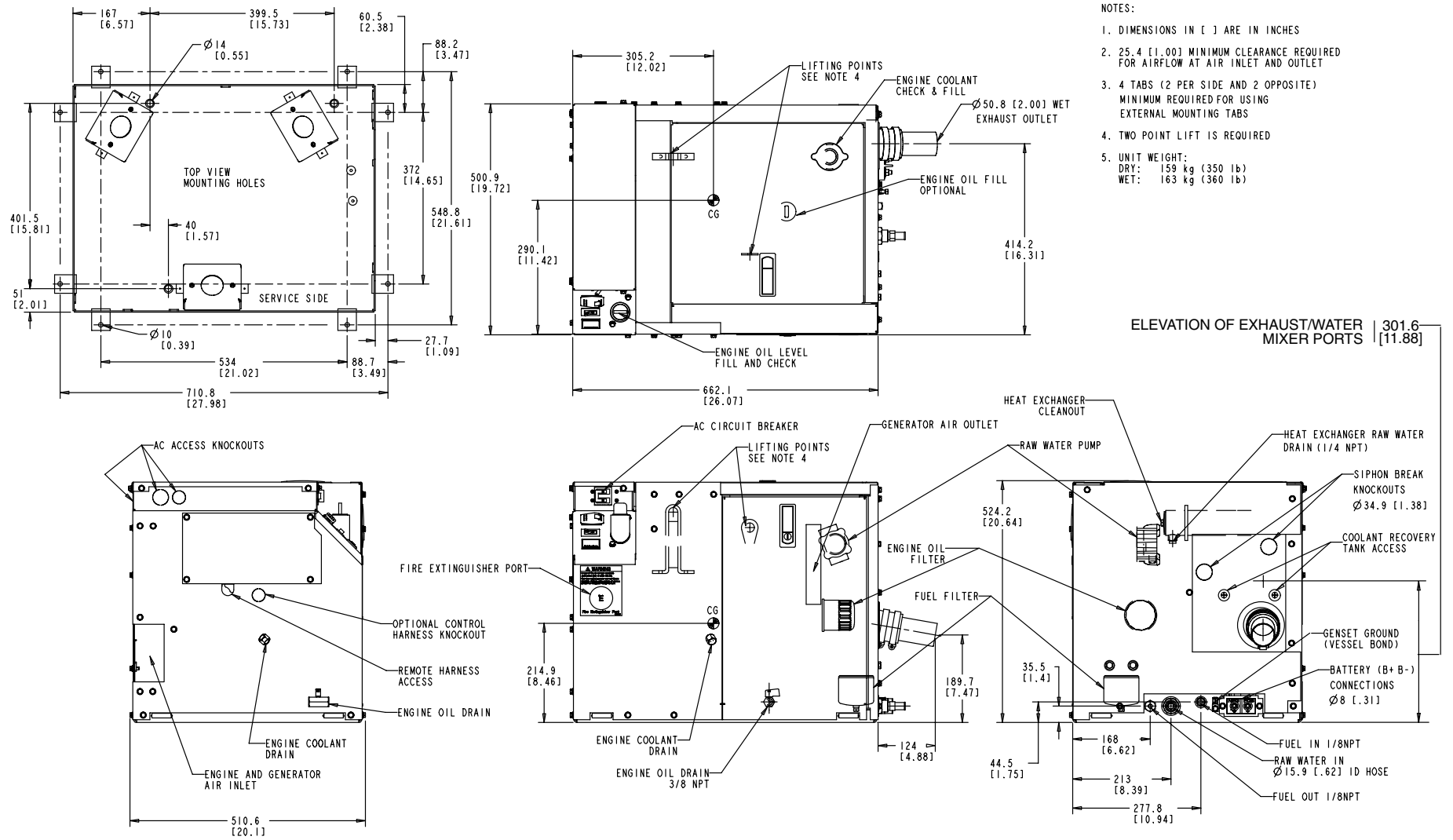


FIGURE 8 . WIRING DIAGRAM



- NOTES:
1. DIMENSIONS IN [] ARE IN INCHES
 2. 25.4 [1.00] MINIMUM CLEARANCE REQUIRED FOR AIRFLOW AT AIR INLET AND OUTLET
 3. 4 TABS (2 PER SIDE AND 2 OPPOSITE) MINIMUM REQUIRED FOR USING EXTERNAL MOUNTING TABS
 4. TWO POINT LIFT IS REQUIRED
 5. UNIT WEIGHT:
 DRY: 159 kg (350 lb)
 WET: 163 kg (360 lb)

FIGURE 9. OUTLINE DRAWING