Installation

Marine Generator Sets

Models:

3.5EFOZ/4EOZ, 4EFOZ/5EOZ
6.5EFOZ/8EOZ, 8.5EFOZ, 9EFOZ/10EOZ
11EFOZ/13EOZ, 11.5EFOZ/14EOZ
13EFOZ/15.5EOZ, 16EFOZ/20EOZ
17.5EFOZ/20EOZ, 19EFOZ/23EOZ
20EFOZ/24EOZ, 23EFOZ/28EOZ
27EFOZ/32EOZ, 33EFOZ/40EOZ
40EFOZ/50EOZ, 55EFOZ/65EOZ
70EFOZ/80EOZ, 80EFOZ/99EOZ
100EFOZ/125EOZ, 125EFOZ/150EOZ

ISO 9001
KOHLER POWER SYSTEMS
NATIONALLY REGISTERED

KOHLER®
POWER SYSTEMS

TP-6069 6/03d

Table of Contents

IMPORTANT SAFETY INSTRUCTIONS. Electromechanical equipment, including generator sets, transfer switches, switchgear, and accessories, can cause bodily harm and pose life-threatening danger when improperly installed, operated, or maintained. To prevent accidents be aware of potential dangers and act safely. Read and follow all safety precautions and instructions. SAVE THESE INSTRUCTIONS.

This manual has several types of safety precautions and instructions: Danger, Warning, Caution, and Notice.

DANGER

Danger indicates the presence of a hazard that ***will cause severe personal injury, death***, or ***substantial property damage***.

WARNING

Warning indicates the presence of a hazard that ***can cause severe personal injury, death,*** or ***substantial property damage***.

CAUTION

Caution indicates the presence of a hazard that ***will*** or ***can cause minor personal injury*** or ***property damage***.

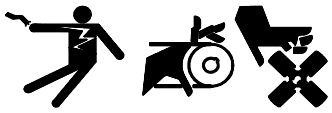
NOTICE

Notice communicates installation, operation, or maintenance information that is safety related but not hazard related.

Safety decals affixed to the equipment in prominent places alert the operator or service technician to potential hazards and explain how to act safely. The decals are shown throughout this publication to improve operator recognition. Replace missing or damaged decals.

Accidental Starting

WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or equipment connected to the set, disable the generator set as follows: (1) Place the generator set start/stop switch in the STOP position. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or equipment connected to the set, disable the generator set as follows: (1) Press the generator set on/off button to shut down the generator set. All indicator lamps dim. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.

Battery

WARNING

Sulfuric acid in batteries.
Can cause severe injury or death.

Wear protective goggles and clothing. Battery acid may cause blindness and burn skin.

Battery electrolyte is a diluted sulfuric acid. Battery acid can cause severe injury or death. Battery acid can cause blindness and burn skin. Always wear splashproof safety goggles, rubber gloves, and boots when servicing the battery. Do not open a sealed battery or mutilate the battery case. If battery acid splashes in the eyes or on the skin, immediately flush the affected area for 15 minutes with large quantities of clean water. Seek immediate medical aid in the case of eye contact. Never add acid to a battery after placing the battery in service, as this may result in hazardous spattering of battery acid.

Battery acid cleanup. Battery acid can cause severe injury or death. Battery acid is electrically conductive and corrosive. Add 500 g (1 lb.) of bicarbonate of soda (baking soda) to a container with 4 L (1 gal.) of water and mix the neutralizing solution. Pour the neutralizing solution on the spilled battery acid and continue to add the neutralizing solution to the spilled battery acid until all evidence of a chemical reaction (foaming) has ceased. Flush the resulting liquid with water and dry the area.

Battery gases. Explosion can cause severe injury or death. Battery gases can cause an explosion. Do not smoke or permit flames or sparks to occur near a battery at any time, particularly when it is charging. Do not dispose of a battery in a fire. To prevent burns and sparks that could cause an explosion, avoid touching the battery terminals with tools or other metal objects. Remove all jewelry before servicing the equipment. Discharge static electricity from your body before touching batteries by first touching a grounded metal surface away from the battery. To avoid sparks, do not disturb the battery charger connections while the battery is charging. Always turn the battery charger off before disconnecting the battery connections. Ventilate the compartments containing batteries to prevent accumulation of explosive gases.

Battery short circuits. Explosion can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage. Disconnect the battery before generator set installation or maintenance. Remove all jewelry before servicing the equipment. Use tools with insulated handles. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery. Never connect the negative (-) battery cable to the positive (+) connection terminal of the starter solenoid. Do not test the battery condition by shorting the terminals together.

Engine Backfire/Flash Fire

⚠ WARNING

Fire.
Can cause severe injury or death.

Do not smoke or permit flames or sparks near fuels or the fuel system.

Servicing the fuel system. A flash fire can cause severe injury or death. Do not smoke or permit flames or sparks near the carburetor, fuel line, fuel filter, fuel pump, or other potential sources of spilled fuels or fuel vapors. Catch fuels in an approved container when removing the fuel line or carburetor.

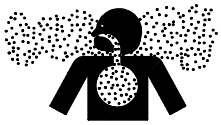
Servicing the air cleaner. A sudden backfire can cause severe injury or death. Do not operate the generator set with the air cleaner/silencer removed.

Combustible materials. A sudden flash fire can cause severe injury or death. Do not smoke or permit flames or sparks near the fuel system. Keep the compartment and the generator set clean and free of debris to minimize the risk of fire. Wipe up spilled fuels and engine oil.

Combustible materials. A fire can cause severe injury or death. Generator set engine fuels and fuel vapors are flammable and explosive. Handle these materials carefully to minimize the risk of fire or explosion. Equip the compartment or nearby area with a fully charged fire extinguisher. Select a fire extinguisher rated ABC or BC for electrical fires or as recommended by the local fire code or an authorized agency. Train all personnel on fire extinguisher operation and fire prevention procedures.

Exhaust System

⚠ WARNING



Carbon monoxide.
Can cause severe nausea, fainting, or death.

The exhaust system must be leakproof and routinely inspected.

Carbon monoxide symptoms. Carbon monoxide can cause severe nausea, fainting, or death. Carbon monoxide is a poisonous gas present in exhaust gases. Carbon monoxide poisoning symptoms include but are not limited to the following:

- Light-headedness, dizziness
- Physical fatigue, weakness in joints and muscles
- Sleepiness, mental fatigue, inability to concentrate or speak clearly, blurred vision
- Stomachache, vomiting, nausea

If experiencing any of these symptoms and carbon monoxide poisoning is possible, seek fresh air immediately and remain active. Do not sit, lie down, or fall asleep. Alert others to the possibility of carbon monoxide poisoning. Seek medical attention if the condition of affected persons does not improve within minutes of breathing fresh air.

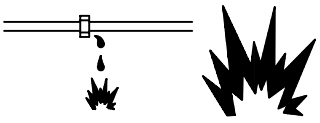
Copper tubing exhaust systems. Carbon monoxide can cause severe nausea, fainting, or death. Do not use copper tubing in diesel exhaust systems. Sulfur in diesel exhaust causes rapid deterioration of copper tubing exhaust systems, resulting in exhaust/water leakage.

Inspecting the exhaust system. Carbon monoxide can cause severe nausea, fainting, or death. For the safety of the craft's occupants, install a carbon monoxide detector. Consult the boat builder or dealer for approved detector location and installation. Inspect the detector before each generator set use. In addition to routine exhaust system inspection, test the carbon monoxide detector per the manufacturer's instructions and keep the detector operational at all times.

Operating the generator set. Carbon monoxide can cause severe nausea, fainting, or death. Carbon monoxide is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. Use the following precautions when installing and operating the generator set. Do not install the exhaust outlet where exhaust can be drawn in through portholes, vents, or air conditioners. If the generator set exhaust discharge outlet is near the waterline, water could enter the exhaust discharge outlet and close or restrict the flow of exhaust. Never operate the generator set without a functioning carbon monoxide detector. Be especially careful if operating the generator set when moored or anchored under calm conditions because gases may accumulate. If operating the generator set dockside, moor the craft so that the exhaust discharges on the lee side (the side sheltered from the wind). Always be aware of others, making sure your exhaust is directed away from other boats and buildings. Avoid overloading the craft.

Fuel System

⚠ WARNING



Explosive fuel vapors.
Can cause severe injury or death.

Use extreme care when handling, storing, and using fuels.

The fuel system. Explosive fuel vapors can cause severe injury or death. Vaporized fuels are highly explosive. Use extreme care when handling and storing fuels. Store fuels in a well-ventilated area away from spark-producing equipment and out of the reach of children. Never add fuel to the tank while the engine is running because spilled fuel may ignite on contact with hot parts or from sparks. Do not smoke or permit flames or sparks to occur near sources of spilled fuel or fuel vapors. Keep the fuel lines and connections tight and in good condition. Do not replace flexible fuel lines with rigid lines. Use flexible sections to avoid fuel line breakage caused by vibration. Do not operate the generator set in the presence of fuel leaks, fuel accumulation, or sparks. Repair fuel systems before resuming generator set operation.

Draining the fuel system. Explosive fuel vapors can cause severe injury or death. Spilled fuel can cause an explosion. Use a container to catch fuel when draining the fuel system. Wipe up spilled fuel after draining the system.

Installing the fuel system. Explosive fuel vapors can cause severe injury or death. Fuel leakage can cause an explosion. Do not modify the tank or the propulsion engine fuel system. Equip the craft with a tank that allows one of the two pickup arrangements described in the installation section. The tank and installation must conform to USCG Regulations.

Pipe sealant. Explosive fuel vapors can cause severe injury or death. Fuel leakage can cause an explosion. Use pipe sealant on all threaded fittings to prevent fuel leakage. Use pipe sealant that resists gasoline, grease, lubrication oil, common bilge solvents, salt deposits, and water.

Ignition-protected equipment. Explosive fuel vapors can cause severe injury or death. Gasoline vapors can cause an explosion. USCG Regulation 33CFR183 requires that all electrical devices (ship-to-shore transfer switch, remote start panel, etc.) must be ignition protected when used in a gasoline and gaseous-fueled environment. The electrical devices listed above are not ignition protected and are not certified to operate in a gasoline and gaseous-fueled environment such as an engine room or near fuel tanks. Acceptable locations are the wheelhouse and other living areas sheltered from rain and water splash.

Hazardous Noise

⚠ CAUTION

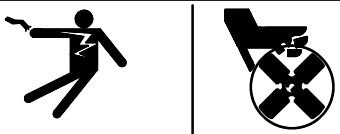
Hazardous noise.
Can cause hearing loss.

Never operate the generator set without a muffler or with a faulty exhaust system.

Engine noise. Hazardous noise can cause hearing loss. Generator sets not equipped with sound enclosures can produce noise levels greater than 105 dBA. Prolonged exposure to noise levels greater than 85 dBA can cause permanent hearing loss. Wear hearing protection when near an operating generator set.

Hazardous Voltage/ Electrical Shock

⚠ WARNING



Hazardous voltage. Moving rotor.
Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

⚠ CAUTION

Welding the generator set.
Can cause severe electrical equipment damage.

Never weld components of the generator set without first disconnecting the battery, controller wiring harness, and engine electronic control module (ECM).

Grounding electrical equipment. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Open the main circuit breakers of all power sources before servicing the equipment. Configure the installation to electrically ground the generator set, transfer switch, and related equipment and electrical circuits to comply with applicable codes and standards. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

Disconnecting the electrical load. Hazardous voltage can cause severe injury or death. Disconnect the generator set from the load by opening the line circuit breaker or by disconnecting the generator set output leads from the transfer switch and heavily taping the ends of the leads. High voltage transferred to the load during testing may cause personal injury and equipment damage. Do not use the safeguard circuit breaker in place of the line circuit breaker. The safeguard circuit breaker does not disconnect the generator set from the load.

Welding the generator set. Can cause severe electrical equipment damage. Before welding the generator set perform the following steps: (1) Remove the battery cables, negative (–) lead first. (2) Disconnect all engine electronic control module (ECM) connectors. (3) Disconnect all generator set controller and voltage regulator circuit board connectors. (4) Disconnect the engine battery-charging alternator connections. (5) Attach the weld ground connection close to the weld location.

Short circuits. Hazardous voltage/current can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage**.** Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.

Testing the voltage regulator. Hazardous voltage can cause severe injury or death. High voltage is present at the voltage regulator heat sink. To prevent electrical shock do not touch the voltage regulator heat sink when testing the voltage regulator. *(PowerBoost™, PowerBoost™ III, and PowerBoost™ V voltage regulator models only)*

Electrical backfeed to the utility. Hazardous backfeed voltage can cause severe injury or death. Connect the generator set to the building/marina electrical system only through an approved device and after the building/marina main switch is opened. Backfeed connections can cause severe injury or death to utility personnel working on power lines and/or personnel near the work area. Some states and localities prohibit unauthorized connection to the utility electrical system. Install a ship-to-shore transfer switch to prevent interconnection of the generator set power and shore power.

Testing live electrical circuits. Hazardous voltage or current can cause severe injury or death. Have trained and qualified personnel take diagnostic measurements of live circuits. Use adequately rated test equipment with electrically insulated probes and follow the instructions of the test equipment manufacturer when performing voltage tests. Observe the following precautions when performing voltage tests: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Do not touch the enclosure or components inside the enclosure. (4) Be prepared for the system to operate automatically. *(600 volts and under)*

Hot Parts

⚠ WARNING

Hot coolant and steam.
Can cause severe injury or death.

Before removing the pressure cap, stop the generator set and allow it to cool. Then loosen the pressure cap to relieve pressure.

⚠ WARNING

Hot engine and exhaust system.
Can cause severe injury or death.

Do not work on the generator set until it cools.

Checking the coolant level. Hot coolant can cause severe injury or death. Allow the engine to cool. Release pressure from the cooling system before removing the pressure cap. To release pressure, cover the pressure cap with a thick cloth and then slowly turn the cap counterclockwise to the first stop. Remove the cap after pressure has been completely released and the engine has cooled. Check the coolant level at the tank if the generator set has a coolant recovery tank.

Servicing the exhaust system. Hot parts can cause severe injury or death. Do not touch hot engine parts. The engine and exhaust system components become extremely hot during operation.

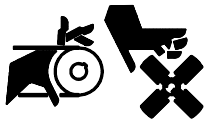
Moving Parts

⚠ WARNING

Hazardous voltage. Moving rotor. Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

⚠ WARNING



Rotating parts.
Can cause severe injury or death.

Operate the generator set only when all guards, screens, and covers are in place.

⚠ WARNING

Airborne particles.
Can cause severe injury or blindness.

Wear protective goggles and clothing when using power tools, hand tools, or compressed air.

Tightening the hardware. Flying projectiles can cause severe injury or death. Loose hardware can cause the hardware or pulley to release from the generator set engine and can cause personal injury. Retorque all crankshaft and rotor hardware after servicing. Do not loosen the crankshaft hardware or rotor thrubolt when making adjustments or servicing the generator set. Rotate the crankshaft manually in a clockwise direction only. Turning the crankshaft bolt or rotor thrubolt counterclockwise can loosen the hardware.

Servicing the generator set when it is operating. Exposed moving parts can cause severe injury or death. Keep hands, feet, hair, clothing, and test leads away from the belts and pulleys when the generator set is running. Replace guards, screens, and covers before operating the generator set.

Sound shield removal. Exposed moving parts can cause severe injury or death. The generator set must be operating in order to perform some scheduled maintenance procedures. Be especially careful if the sound shield has been removed, leaving the belts and pulleys exposed. *(Sound-shield-equipped models only)*

Notice

NOTICE

This generator set has been rewired from its nameplate voltage to

246242

NOTICE

Voltage reconnection. Affix a notice to the generator set after reconnecting the set to a voltage different from the voltage on the nameplate. Order voltage reconnection decal 246242 from an authorized service distributor/dealer.

NOTICE

Hardware damage. The engine and generator set may use both American Standard and metric hardware. Use the correct size tools to prevent rounding of the bolt heads and nuts.

NOTICE

When replacing hardware, do not substitute with inferior grade hardware. Screws and nuts are available in different hardness ratings. To indicate hardness, American Standard hardware uses a series of markings, and metric hardware uses a numeric system. Check the markings on the bolt heads and nuts for identification.

NOTICE

Electrostatic discharge damage. Electrostatic discharge (ESD) damages electronic circuit boards. Prevent electrostatic discharge damage by wearing an approved grounding wrist strap when handling electronic circuit boards or integrated circuits. An approved grounding wrist strap provides a high resistance (about 1 megohm), *not a direct short*, to ground.

NOTICE

Fuse replacement. Replace fuses with fuses of the same ampere rating and type (for example: 3AB or 314, ceramic). Do not substitute clear glass-type fuses for ceramic fuses. Refer to the wiring diagram when the ampere rating is unknown or questionable.

NOTICE

Saltwater damage. Saltwater quickly deteriorates metals. Wipe up saltwater on and around the generator set and remove salt deposits from metal surfaces.

Notes

Information in this publication represents data available at the time of print. Kohler Co. reserves the right to change this publication and the products represented without notice and without any obligation or liability whatsoever.

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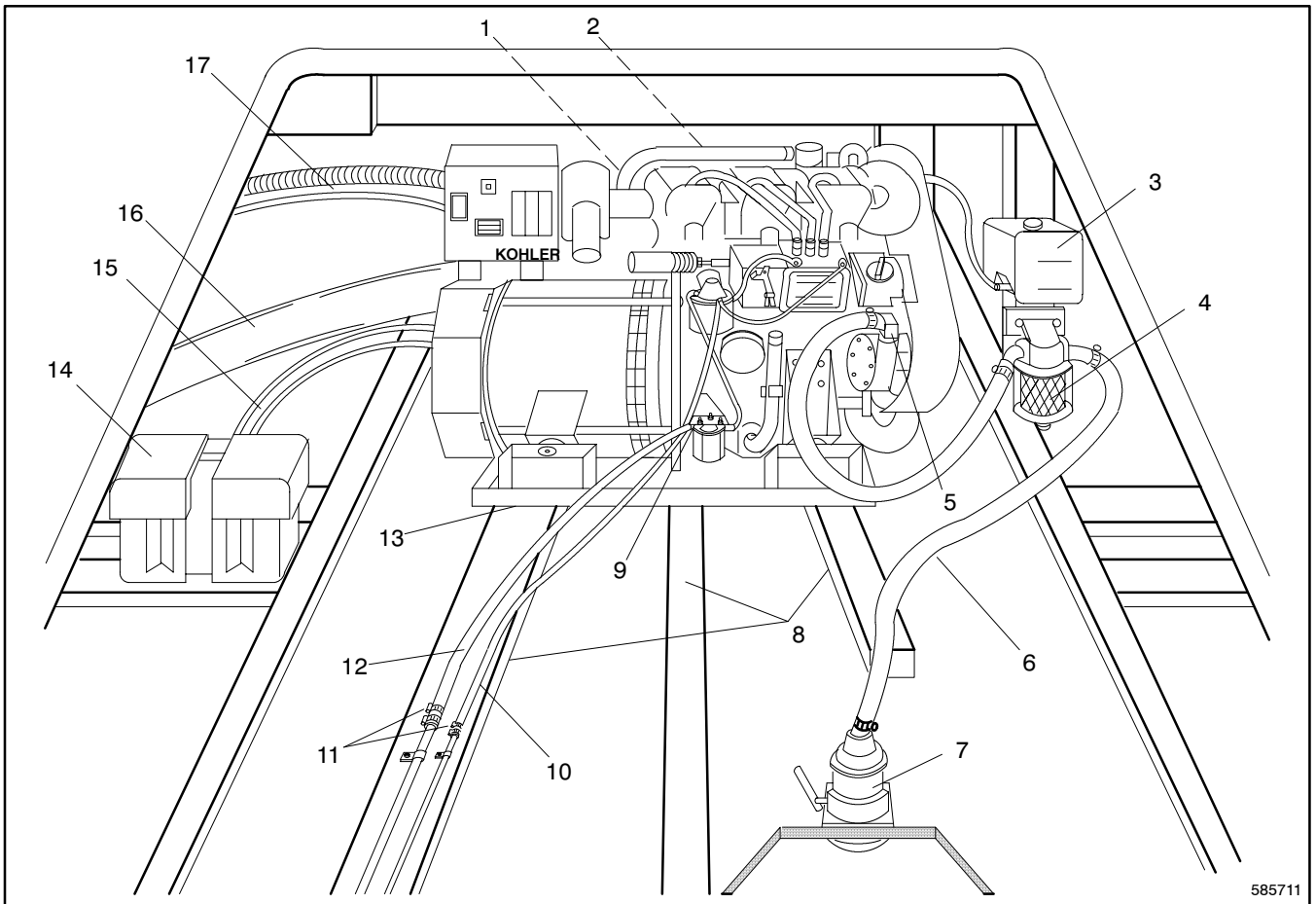
The safe and successful operation of a marine power system depends primarily on the installation. See Figure 1-1. Use this manual as a guide to install the marine generator set. For operating instructions, refer to the operation manual.

Marine generator set installations must comply with all applicable regulations and standards.

Use the specification sheets as a guide in planning your installation. Use current dimension drawings and wiring diagrams.



1. Exhaust mixer elbow (exhaust/water outlet) (not shown)
2. Heat exchanger (not shown)
3. Coolant recovery tank (located on the unit on some models)
4. Seawater strainer *
5. Seawater pump (seawater inlet)
6. Seawater line *
7. Seacock *
8. Craft stringers
9. Fuel feed pump (fuel inlet) *
10. Fuel return line *
11. Hose clamps
12. Fuel supply line *
13. Mounting tray (mounting skid on 33–150 kW models)
14. Battery/battery storage box
15. Battery cables
16. Exhaust hose or exhaust line *
17. Electrical leads (AC output leads/remote start panel leads)

* Indicated components must conform to USCG regulations.

Figure 1-1 Typical Generator Set Location and Mounting

Note: See text for complete explanation of installation requirements.

Note: Use two hose clamps on each end of all flexible exhaust hose connections.

Notes

2.1 General Considerations

The key to installation is location. Before making final plans for locating a generator set, consider the following.

Installation Location Considerations

1. Choose a location that allows adequate space for cooling and exhaust system installation, fuel system installation, ventilation, and service access to the generator set (engine and generator).
2. Use craft stringers or other available structural members capable of supporting the generator set's weight.
3. Seal the generator set compartment from the cabin to prevent exhaust gases and fuel vapors from entering the cabin.

See the current generator set specification sheet or Section 7 of this manual for generator set dimensions and weights. See Figure 1-1 for a typical installation.

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2.2 Location

Locate the generator set to allow easy service access to the generator set's engine, controller, cooling, and fuel system components. The engine compartment is often the ideal location for the generator set if the propulsion engine(s) does not obstruct access to the generator set and controller.

Marine Generator Set Installations in European Union Member Countries

This generator set is specifically intended and approved for installation below the deck in the engine compartment. Installation above the deck and/or outdoors would constitute a violation of European Union Directive 2000/14/EC noise emission standard.

Allow clearance for vibration and cooling during operation. Allow a minimum of 38 mm (1.5 in.) clearance on all sides (top, front, rear, and sides) of a generator set without an optional sound shield. Refer to the instruction sheet for minimum clearances for sound-shielded units. Also, allow space for the power takeoff (PTO) option, if equipped.

Diesel generator sets are not ignition-protected. USCG Regulation 183.410 requires ignition-protected devices only in gasoline/gaseous-fueled environments.

2.3 Mounting

Mount the generator set as high as possible to avoid contact with bilge splash and lower-lying vapors and to allow for downward pitch of the exhaust line toward the exhaust outlet.

Craft stringers generally provide the best generator set support. Ensure that the structural members can support the generator set's weight and withstand its vibration.

The generator set includes vibration mounts and a mounting tray or skid. If desired, install additional vibration isolating pads underneath the generator set's base.

Use the four mounting holes in the mounting tray to mount the generator set securely to the craft.

For angular operating limits, consult the operation manual.

Notes

3.1 Ventilation

Engine combustion, generator cooling, and expulsion of flammable and lethal fumes require ventilation. Provide ventilation compliant with USCG Regulations governing sizing of vents and other considerations.

As a rule, size each inlet- and outlet-vent area to a minimum of 13 sq. cm/30.5 cm (2 sq. in. per ft.) of the craft's beam. Should this rule conflict with USCG Regulations, follow USCG Regulations. For applications with screened inlets, double the size (4 sq. in. per ft.) of the hull/deck openings. Extend the vent ducts to bilges to expel heavier-than-air fumes.

For generator sets mounted in the engine compartment, increase the air flow to allow for the generator set's requirements. Install optional detection devices to cause alarm, warning, or engine shutdown should dangerous fumes accumulate in the compartment.

See the generator set specification sheet that shipped with the generator set for air requirements. The air intake silencer/cleaner provides combustion air to the engine. Do not compromise the recommended minimum clearance of 38 mm (1.5 in.) between a duct opening and enclosure wall. The engine/generator performance will decline if you compromise these guidelines. See Figure 3-1 for allowable intake restriction.

Note: ISO 3046 derates apply. See Appendix C.

Model	Allowable Intake Restriction
3.5EFOZ/4EOZ	200 mm H_2O (1.96 kPa or less)
4–125EFOZ/5–150EOZ	635 mm H_2O (6.23 kPa or less)

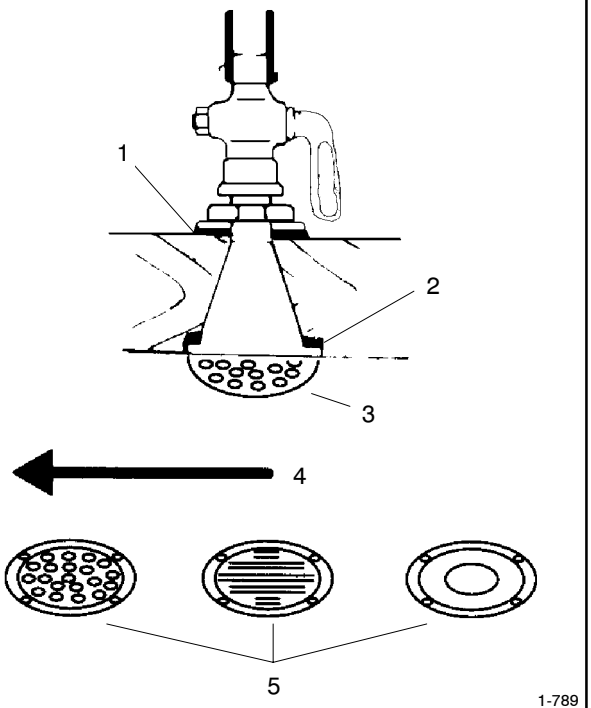
Figure 3-1 Combustion Air Intake Restriction

3.2 Cooling System Components

The marine generator set's cooling system requires the following components.

3.2.1 Intake Through-Hull Strainer (Seacock Cover)

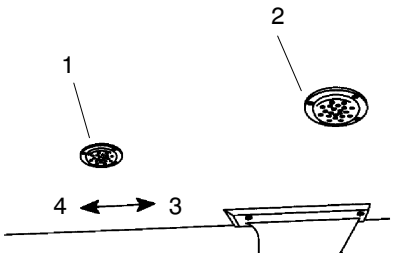
Install a screened-intake, through-hull strainer to prevent entry of foreign objects. Use perforated, slotted-hole, or unrestricted-hole design strainers. See Figure 3-2 for examples of typical strainers. The inner diameter of the strainer opening must be equal to or greater than the inner diameter of the water-line hose to the seawater pump.



1. Inside packing
2. Outside packing
3. Seacock cover
4. Direction of vessel movement
5. Typical intake through-hull strainers

Figure 3-2 Seacock Installation

Do not align the strainer (in relation to the craft's direction of travel) with any other through-hull intakes. See Figure 3-3. Flush mount the recommended through-hull strainer. Install slotted-hole-design strainers with the slots parallel to the direction of the vessel's movement.



Note: Position the intakes in relation to the vessel's travel so neither is in the wake of the other.

1. Generator set intake
2. Main engine intake
3. Aft (rearward)
4. Fore (forward)

Figure 3-3 Intake Strainer

Do not use a speed scoop or cup design intake through-hull strainer because it can cause a ramming effect and force water upward, past the seawater pump, and into the engine cylinders when the vessel is moving and the generator set is shut down.

Do not use hulls incorporating sea chests or other designs that provide a positive pressure to the raw water pump for the intake through-hull strainers. Positive pressure forces water past the raw water pump and into the engine. A sea chest is a concave molded-in-the-hull chamber that aligns to the vessel's direction of travel. A sea chest configuration applies positive pressure similar to a scoop-type through-hull strainer.

3.2.2 Seacock

Mount the seacock to the hull, assemble it to the intake, and ensure that it is accessible for operation. Figure 3-2 shows a typical installation.

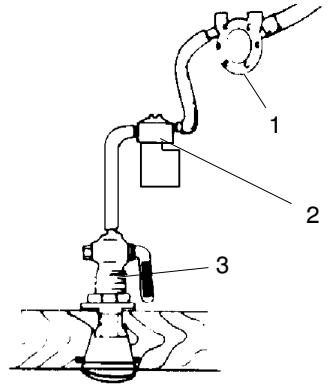
Avoid overcaulking the seacock. Excess caulk reduces water flow and, in some cases, develops a barrier that can force water upward, past the seawater pump, and into the engine cylinders when the vessel is moving and the generator set is shut down.

3.2.3 Seawater Strainer

Mount the seawater strainer to the seacock or permanent structure at a point not higher than the seawater pump. Ensure that the strainer is accessible for service. See Figure 3-4 for a typical installation.

Some seawater strainers include a seacock and an intake through-hull strainer.

Maximum seawater inlet pressure at the seawater pump is 34.5 kPa (5 psi). Excessive pressure will cause water ingestion.



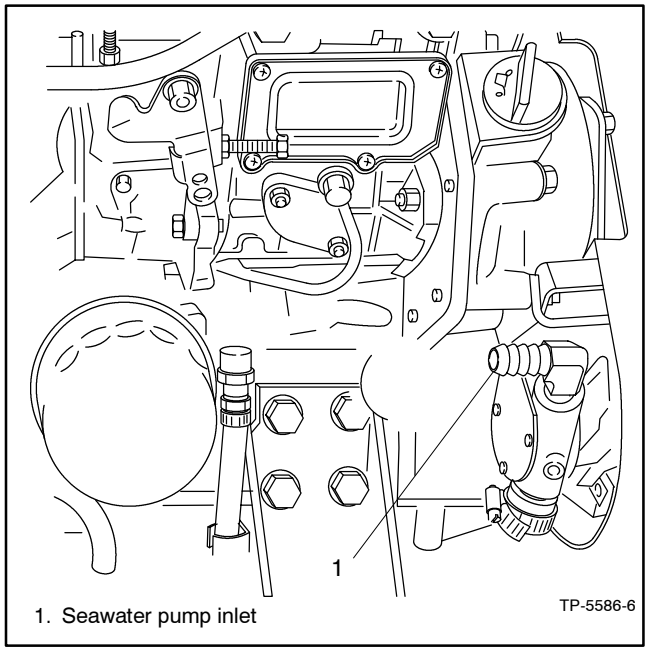
1. Seawater pump
2. Seawater strainer
3. Seacock

Figure 3-4 Seawater Strainer

3.2.4 Water Lines

Water lines from the seacock to the engine-driven seawater pump are usually constructed of flexible hose. Connect a flexible section of hose to the seawater pump to allow the generator set to vibrate during operation. Support a nonflexible water line within 102 mm (4 in.) of its connection to the flexible section.

Keep the seawater hose as straight and short as possible. If the hose is too long, usually over 4.6 m (15 ft.), water draw problems may occur. See Section 7 for the inlet water line hose size and the seawater connection to the seawater pump inlet. Avoid running the inlet pipe above the generator. See Figure 3-5 for the seawater hose connection to the seawater pump inlet.



1. Seawater pump inlet

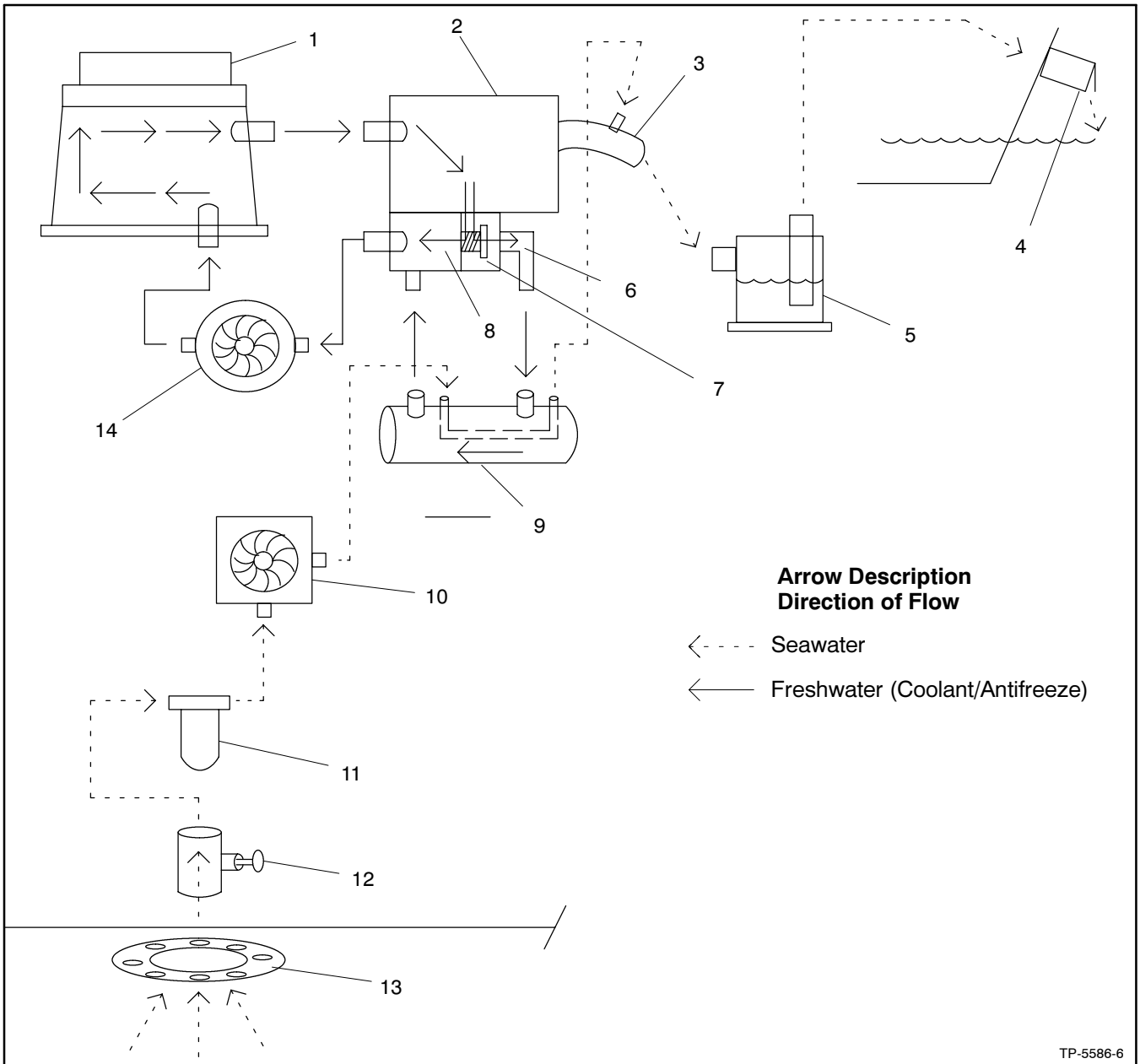
Figure 3-5 Seawater Inlet Connection, Typical

3.2.5 Closed Heat Exchanger (4–125EFOZ/5–150EOZ Models)

A closed heat exchanger is the best cooling method for most applications. See Figure 3-6 or Figure 3-7 for a typical installation. Provide space to access the water-cooled exhaust manifold pressure cap.

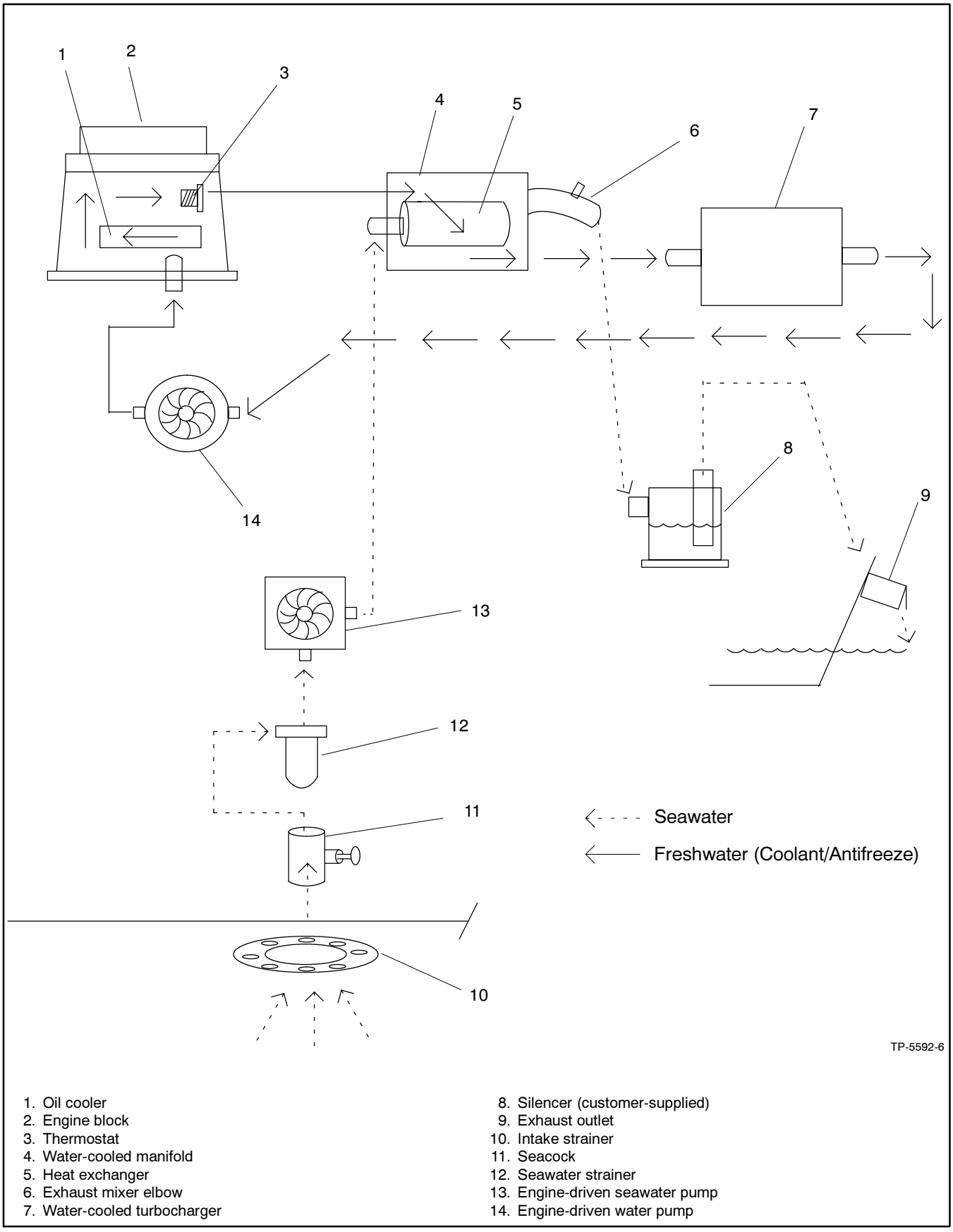
3.2.6 Direct Water Cooled (3.5EFOZ/4EOZ Models)

In a direct seawater cooling system, the impeller pump circulates the seawater around the cylinder and through the cylinder head. A thermostat controls the cooling water circuit temperature. Consult Figure 3-8 and the engine operation manual for the cooling water circuit diagrams.



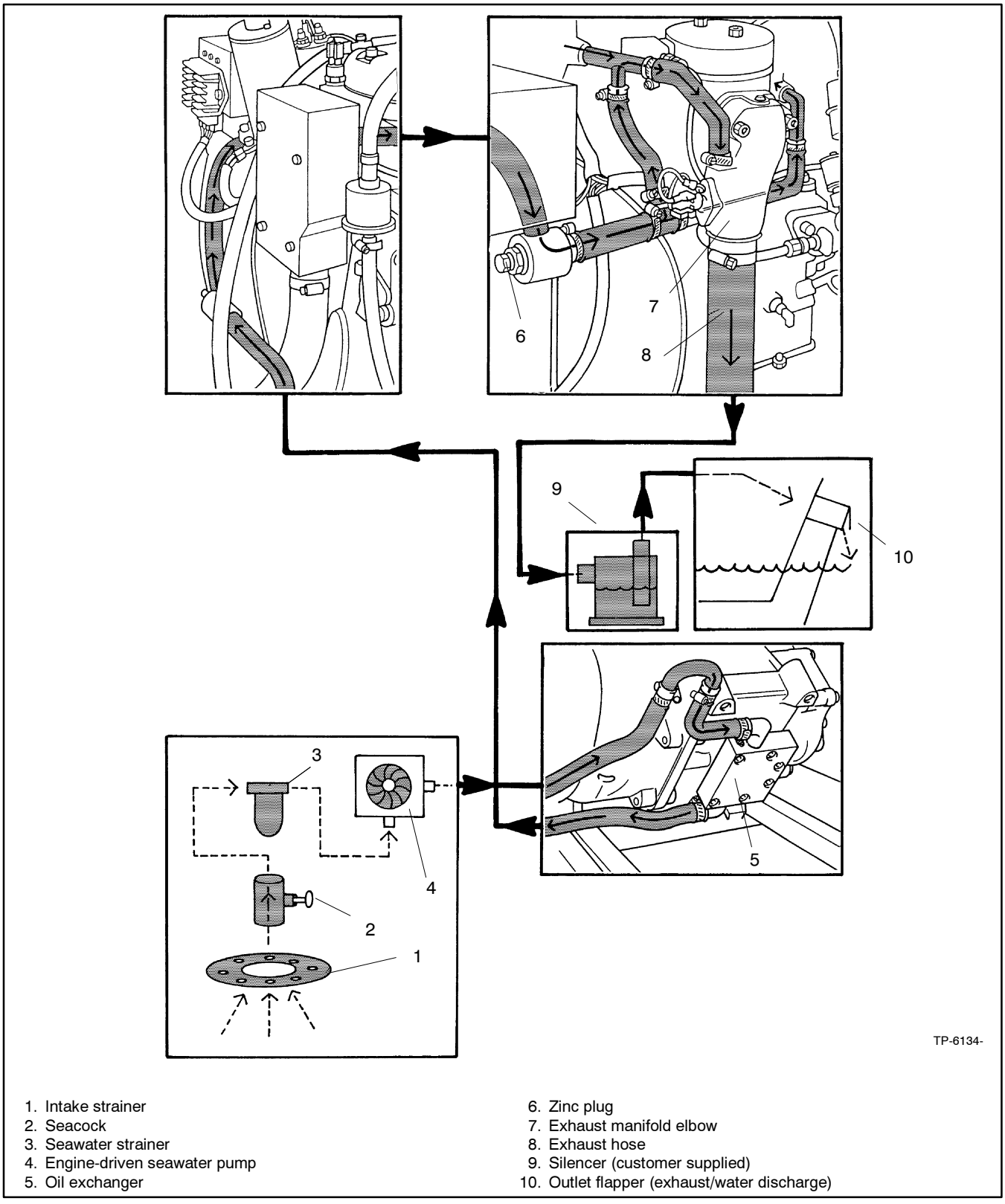
1. Engine block
2. Exhaust manifold
3. Exhaust mixer elbow
4. Outlet flapper (exhaust/water discharge)
5. Silencer (customer supplied)
6. Thermostat open
7. Thermostat
8. Thermostat closed
9. Heat exchanger
10. Engine-driven seawater pump
11. Seawater strainer
12. Seacock
13. Intake strainer
14. Engine-driven water pump

Figure 3-6 Typical Closed/Heat Exchanger Cooling System (4/6.5/8.5/9/23/27EFOZ and 5/8/10/28/32EOZ Models)



1. Oil cooler
2. Engine block
3. Thermostat
4. Water-cooled manifold
5. Heat exchanger
6. Exhaust mixer elbow
7. Water-cooled turbocharger
8. Silencer (customer-supplied)
9. Exhaust outlet
10. Intake strainer
11. Seacock
12. Seawater strainer
13. Engine-driven seawater pump
14. Engine-driven water pump

Figure 3-7 Typical Closed/Heat Exchanger Cooling System (11–20EFOZ,13–24EOZ, 33–125EFOZ and 40–150EOZ Models)

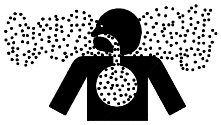


1. Intake strainer
2. Seacock
3. Seawater strainer
4. Engine-driven seawater pump
5. Oil exchanger
6. Zinc plug
7. Exhaust manifold elbow
8. Exhaust hose
9. Silencer (customer supplied)
10. Outlet flapper (exhaust/water discharge)

Figure 3-8 Direct Water-Cooled Cooling System (3.5EFOZ and 4EOZ Models)

Notes

⚠ WARNING



Carbon monoxide.
Can cause severe nausea, fainting, or death.

The exhaust system must be leakproof and routinely inspected.

Carbon monoxide symptoms. Carbon monoxide can cause severe nausea, fainting, or death. Carbon monoxide is a poisonous gas present in exhaust gases. Carbon monoxide poisoning symptoms include but are not limited to the following:

- Light-headedness, dizziness
- Physical fatigue, weakness in joints and muscles
- Sleepiness, mental fatigue, inability to concentrate or speak clearly, blurred vision
- Stomachache, vomiting, nausea

If experiencing any of these symptoms and carbon monoxide poisoning is possible, seek fresh air immediately and remain active. Do not sit, lie down, or fall asleep. Alert others to the possibility of carbon monoxide poisoning. Seek medical attention if the condition of affected persons does not improve within minutes of breathing fresh air.

Inspecting the exhaust system. Carbon monoxide can cause severe nausea, fainting, or death. For the safety of the craft's occupants, install a carbon monoxide detector. Consult the boat builder or dealer for approved detector location and installation. Inspect the detector before each generator set use. In addition to routine exhaust system inspection, test the carbon monoxide detector per the manufacturer's instructions and keep the detector operational at all times.

Operating the generator set. Carbon monoxide can cause severe nausea, fainting, or death. Carbon monoxide is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. Use the following precautions when installing and operating the generator set. Do not install the exhaust outlet where exhaust can be drawn in through portholes, vents, or air conditioners. If the generator set exhaust discharge outlet is near the waterline, water could enter the exhaust discharge outlet and close or restrict the flow of exhaust. Never operate the generator set without a functioning carbon monoxide detector. Be especially careful if operating the generator set when moored or anchored under calm conditions because gases may accumulate. If operating the generator set dockside, moor the craft so that the exhaust discharges on the lee side (the side sheltered from the wind). Always be aware of others, making sure your exhaust is directed away from other boats and buildings. Avoid overloading the craft.

4.1 Types

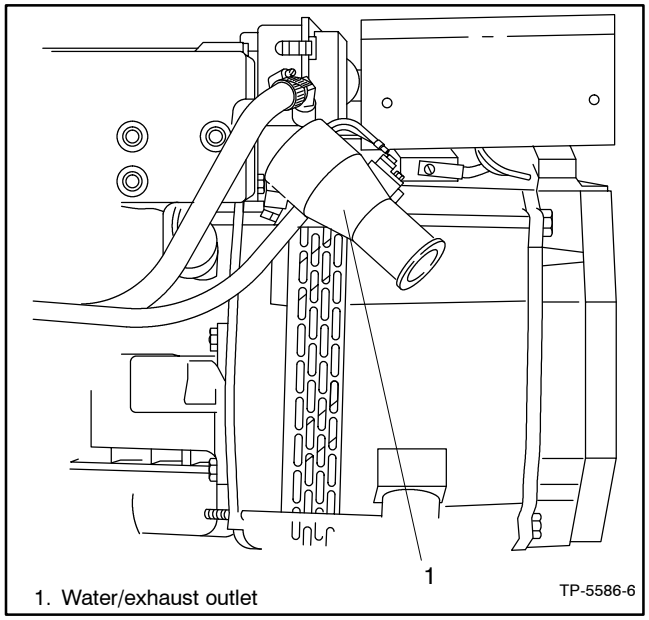
Kohler® generator sets covered in this manual use either wet or dry exhaust systems. Dry exhaust systems are common in commercial applications. See the engine manual for specifications.

4.2 Exhaust Lines

Use water-cooled exhaust lines in all marine installations. Keep the lines as short and straight as possible. NFPA 302 Fire Protection Standard for Pleasure and Commercial Motor Craft, Clause 4-3, recommends using two corrosion-resistant hose clamps with a minimum width of 13 mm (1/2 in.) on each end of the flexible exhaust hose connections. Kohler Co. requires a downward pitch of at least 13 mm per 30.5 cm (1/2 in. per running foot). Use a flexible exhaust hose that conforms to UL Standard 1129 for the engine's wet exhaust components between the mixer elbow and the exhaust outlet.

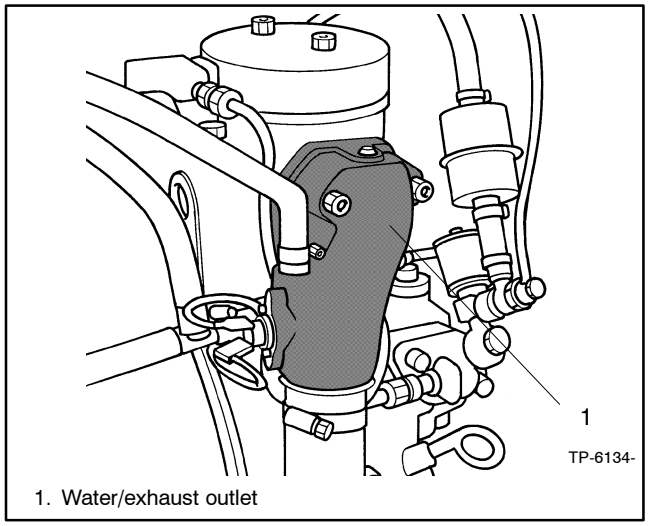
4.3 Exhaust System Location, Mounting, and Installation

Mount the silencer independently to eliminate stress on the exhaust system and the exhaust manifold/mixer elbow. See Section 7 for the mixer elbow water line hose size. See Figure 4-1 for the exhaust connection to the mixer elbow. Provide an adequate hose length from the exhaust mixer to the silencer to allow for generator set movement.



1. Water/exhaust outlet

Figure 4-1 Mixer Elbow/Exhaust Connection, Typical



1. Water/exhaust outlet

Figure 4-2 Mixer Elbow/Exhaust Connection, 3.5EFOZ/4EOZ Model Only

Locate the exhaust outlet at least 10 cm (4 in.) above the waterline when the craft is loaded to maximum capacity. Install an exhaust port with the flap at the exhaust (transom) outlet to prevent water backup in following seas or when moving astern (backward). A lift in the exhaust piping before the piping exits the craft prevents backwash. See Figure 4-4, item 1. Support the exhaust lines to prevent the formation of water pockets.

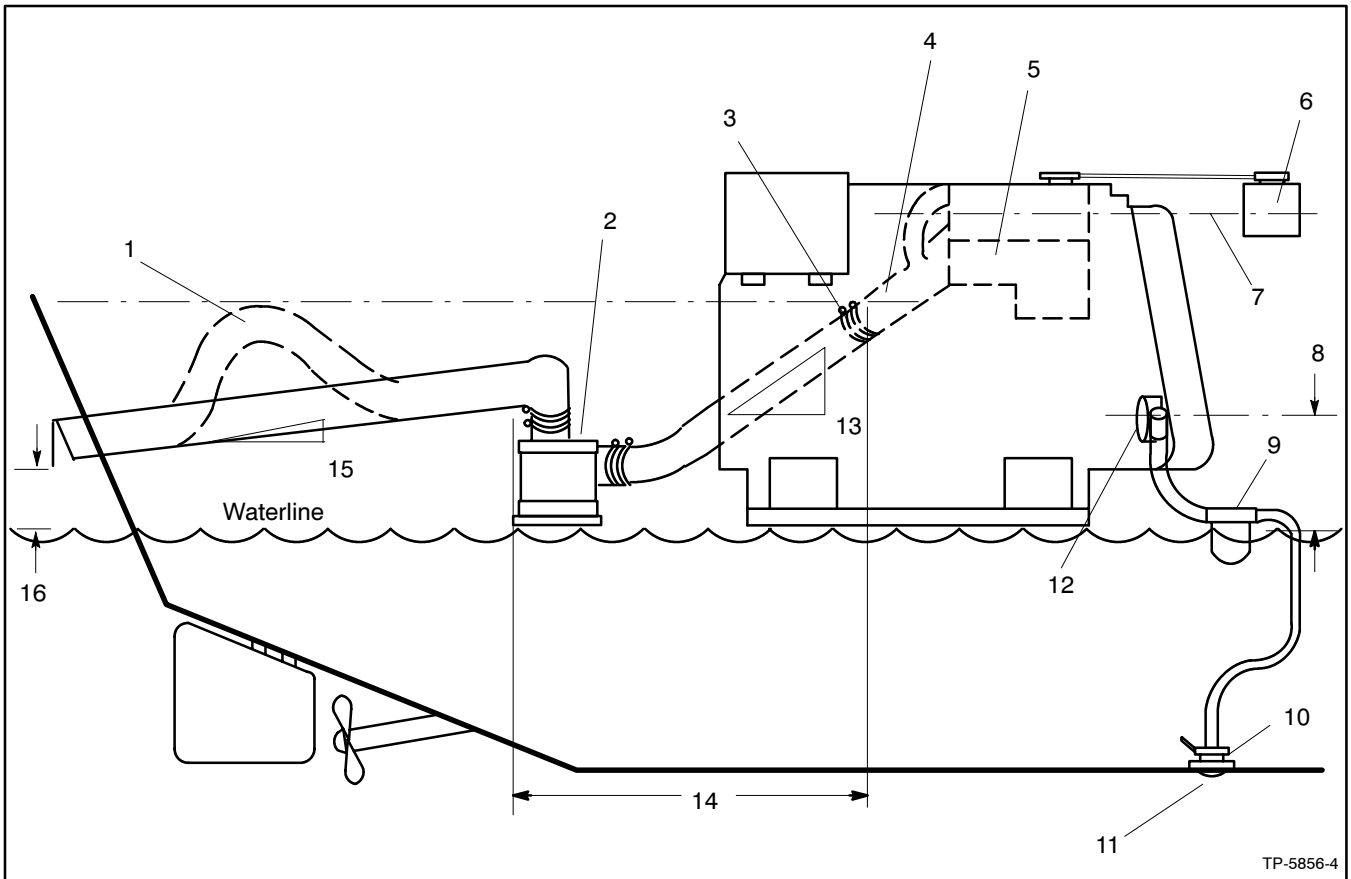
Exhaust system installation guidelines for various generator set locations follow. Information and illustrations of stern- (rear) exhaust installations also apply to side-exhaust installations. Where exhaust lines require passage through bulkheads, use port (left)- or starboard (right)- side exhaust outlets, also in applications in which long exhaust lines to the transom (rear) could cause excessive back pressure. See Figure 4-3 for allowable back pressures. Should any information regarding installation conflict with USCG Regulations, follow USCG Regulations.

Model	Allowable Exhaust Back Pressure, ≤ kPa (mm H_2O)
4/8.5/9/23/27EFOZ and 5/10/28/32EOZ	9.81 (1000)
6.5EFOZ and 8EOZ	11.77 (1200)
11/16/17.5EFOZ and 13/20EOZ	6.37 (650)
3.5/11.5/13/19/20EFOZ and 4/14/15.5/23/24EOZ	4.90 (500)
33/40/55/70/80/100/125EFOZ and 40/50/65/80/99/125/150EOZ	7.47 (762)

Figure 4-3 Allowable Exhaust Back Pressures

4.3.1 Above-Waterline Installation

Install a customer-supplied silencer with the silencer's outlet at a maximum of 3 m (10 horizontal ft.) from the center of the engine's exhaust outlet. See Figure 4-4. Mount a typical silencer with the inlet and outlet horizontal and with the drain plug down. Use an exhaust hose pitch of at least 13 mm per 30.5 cm (0.5 in. per running foot). Some silencers require two support brackets or hanger straps for installation to stringers or other suitable structure. Follow the instructions provided with the silencer. Install any lift (see Figure 4-4, item 1) in the exhaust line below the engine exhaust manifold outlet.



1. Slight lift improves silencing and prevents water backwash into the silencer (keep below the level of the exhaust manifold outlet)
2. Silencer (customer-supplied)
3. Exhaust manifold outlet
4. Exhaust mixer elbow
5. Heat exchanger (locations vary by model)
6. Coolant recovery tank (located on the unit on some models)
7. Locate the coolant recovery tank at the same height as the heat exchanger
8. Maximum seawater pump lift of 1 m (3 ft.)
9. Seawater strainer
10. Seacock
11. Intake strainer
12. Engine-driven seawater pump
13. Minimum exhaust hose pitch of 1.3 cm per 30.5 cm (0.5 in. per ft.)
14. Maximum distance between silencer and exhaust mixer elbow of 3 m (10 ft.)
15. Minimum exhaust hose pitch of 1.3 cm per 30.5 cm (0.5 in. per ft.)
16. Minimum exhaust outlet distance above waterline of 10 cm (4 in.). Note: Vessel fully loaded.

Note: Data applies to both rear- and side-exhaust installations.

Note: Use two hose clamps on each end of all flexible exhaust hose connections.

Note: Read the text for complete explanation of dimensions and other installation considerations.

Figure 4-4 Typical Above-Waterline Installation

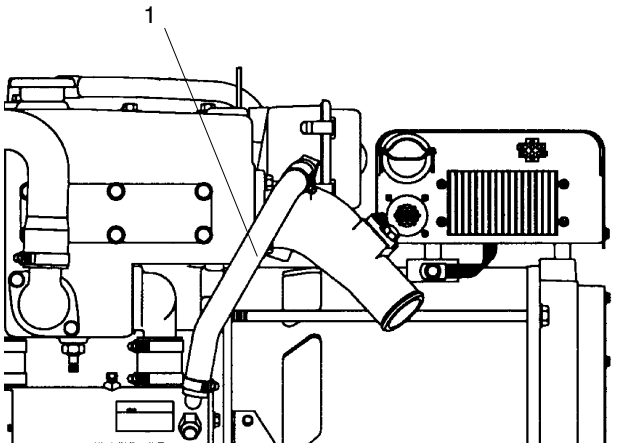
4.3.2 Mid/Below-Waterline Installation

Follow USCG Regulations for installing an antisiphon provision to prevent raw water entry into the engine. Use the siphon break if the exhaust manifold outlet is located less than 23 cm (9 in.) above the waterline when the craft is loaded to maximum capacity. Install the siphon break at least 31 cm (1 ft.) above the waterline using the instructions provided with the siphon break kit.

Note: An improperly installed siphon break will cause engine damage and may void the warranty.

Install the siphon break above the highest point in the exhaust line between the heat exchanger and the exhaust mixer. See Figure 4-5 for the siphon break connection. Support the siphon break and hoses to maintain their position and function. Allow a slight offset to clear the stringers or other permanent structures. Protect the siphon break air inlet from dirt and debris.

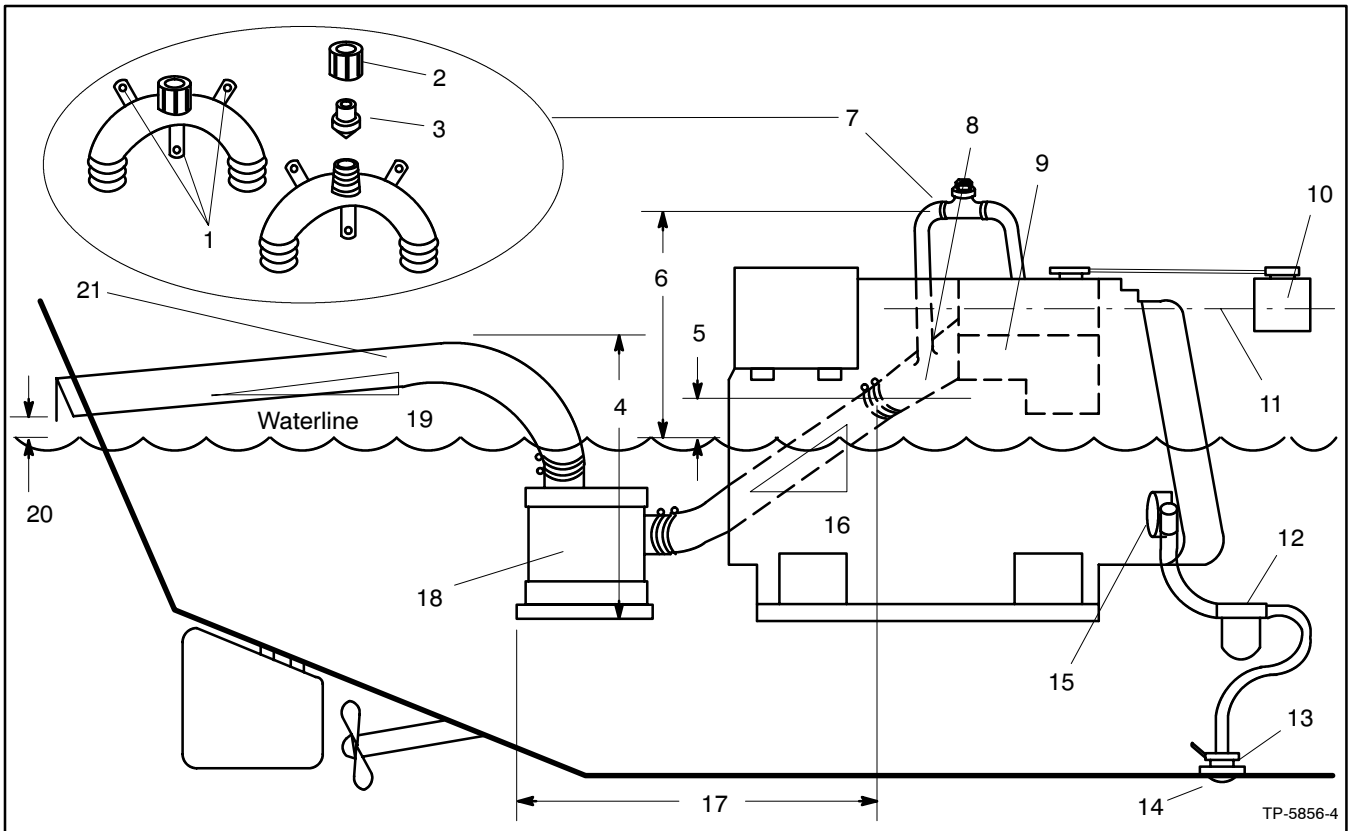
Note: To prevent water leakage on the generator set, do not mount the siphon break directly over the generator set.



1. Cut hose and connect siphon break and hardware

Figure 4-5 Siphon Break Connection (4EFOZ/5EOZ model shown)

Mount a typical silencer's base no more than 1.2 m (4 ft.) below the highest point in the exhaust line. Attach a separate wood mounting base to the hull stringers or other suitable structures. Use the silencer manufacturer's recommendation for securing the silencer to the hull. Mount the silencer with the outlet not more than 3 m (10 horizontal ft.) from the engine's exhaust manifold outlet. Use a USCG-type certified marine exhaust hose.



1. Mounting base
2. Retaining cap
3. Reed valve assembly
4. Maximum silencer vertical lift of 1.2 m (4 ft.)
5. Exhaust mixer elbow distance above waterline; if less than 23 cm (9 in.), a siphon break is required
6. Minimum siphon break distance above waterline of 30.5 cm (1 ft.)
7. Siphon break
8. Exhaust mixer elbow
9. Heat exchanger (locations vary by model)
10. Coolant recovery tank (located on the unit on some models)
11. Indicates the coolant recovery tank is at the same height as the heat exchanger
12. Seawater strainer
13. Seacock
14. Intake strainer
15. Engine-driven seawater pump
16. Minimum exhaust hose pitch of 1.3 cm per 30.5 cm (0.5 in. per ft.)
17. Maximum distance between silencer and exhaust mixer elbow of 3 m (10 ft.)
18. Silencer (customer-supplied)
19. Minimum exhaust hose pitch of 1.3 cm per 30.5 cm (0.5 in. per ft.)
20. Minimum exhaust outlet distance above waterline of 10 cm (4 in.)
21. Exhaust hose (see Figure 4-7 for hose sizes)

Note: Read the text for complete explanation of dimensions and other installation considerations.

Note: Use two hose clamps on each end of all flexible exhaust hose connections.

Note: Data applies to both rear- and side-exhaust installations.

Figure 4-6 Typical Mid and Below Waterline Installation

Models without Sound Shield	Models with Sound Shield	Exhaust Hose Diameter mm (in.)
3.5/4/6.5/8.5/9EFOZ 4/5/8/10EOZ	4/6.5/8.5/9/11/11.5/13/16/17.5/19/20EFOZ 5/8/10/13/14/15.5/20/23/24EOZ	51 (2.0)
11/11.5/13/16/17.5/19/20/23/27EFOZ 13/14/15.5/20/23/24/28/32EOZ	27EFOZ 32EOZ	76 (3.0)
33EFOZ 40EOZ	33EFOZ 40EOZ	89 (3.5)
40/55/70/80/100/125EFOZ 50/65/80/99/125/150EOZ	40/55/70/80/100/125EFOZ 50/65/80/99/125/150EOZ	102 (4.0)

Figure 4-7 Exhaust Hose Sizes

Notes

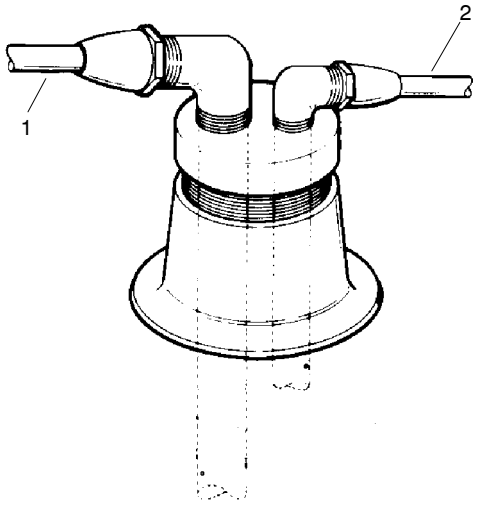
⚠ WARNING

Explosive fuel vapors.
Can cause severe injury or death.

Use extreme care when handling, storing, and using fuels.

Installing the fuel system. Explosive fuel vapors can cause severe injury or death. Fuel leakage can cause an explosion. Do not modify the tank or the propulsion engine fuel system. Equip the craft with a tank that allows one of the two pickup arrangements described in the installation section. The tank and installation must conform to USCG Regulations.

Note: Fuel system installations must conform to USCG Regulations.



1. Fuel line to propulsion engine
2. Fuel line to generator set

Figure 5-1 Multiple Dip Tube Arrangement

m:is:102:001

5.1 Fuel Tank

Most marine generator sets draw fuel from the same fuel tank as the craft's propulsion engine(s). If the tank's fuel pickup opening allows a multiple dip tube, use a multiple dip tube arrangement. See Figure 5-1. The multiple dip tube arrangement incorporates a shorter dip tube for the generator set and a longer dip tube for the propulsion engine. With this arrangement, the generator set runs out of fuel before the propulsion engine during a low fuel supply situation. Equip the fuel system with a fuel/water separator to remove any accumulated dirt and water.

5.2 Fuel Lines

Locate the fuel return line as far as practical from the fuel pickup to allow the tank fuel to cool the return fuel before delivery back to the fuel injectors. Incoming fuel cools the injectors to achieve maximum engine efficiency.

Note: Do not tee into the main propulsion engine's fuel line.

Under no circumstances should the propulsion engine and generator set share pickup or return lines (through a tee arrangement) that would allow the larger engine to starve fuel from the smaller engine. It is possible that the operation of either engine could completely drain the fuel line of the other engine and make starting difficult.

Use a flexible hose section to connect the metallic line from the fuel tank to the engine's fuel pump inlet connection point. Also, use a flexible hose section to connect the metallic line from the fuel tank to the fuel return connection point. The flexible section allows the generator set to vibrate during operation.

Model	Fuel Line ID Size mm (in.)
3.5EFOZ and 4EOZ	6.4 (1/4)
4–125EFOZ and 5–150EOZ	9.7 (3/8)

Figure 5-2 Fuel Line ID Size

See Figure 5-2 for the ID size of the customer-supplied fuel line that connects to the fuel pump and fuel return. Route the fuel lines from the fuel tank in a gradual incline to the engine—do not exceed the height of the generator set and do not route fuel lines above the generator set. Comply with USCG Regulation 46CFR182.20 regarding fuel lines and supports.

See Section 7 for fuel feed pump inlet connection and fuel return line connection.

5.3 Fuel Filters

Conform to USCG Regulations regarding inline fuel filters or strainers.

5.4 Fuel Pump Lift

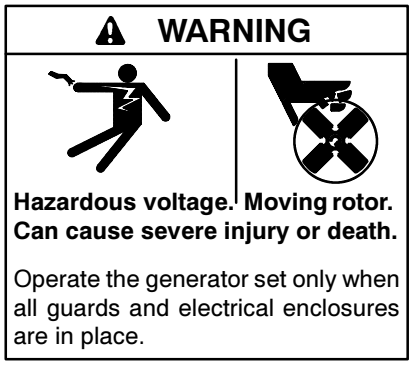
See Figure 5-3 for fuel pump lift capabilities.

Model	Fuel Pump Lift m (ft.)
3.5/4/6.5/8.5/9/11/11.5/13/16/17.5/19/20/23/ 27EFOZ and 4/5/8/10/13/14/15.5/20/23/24/28/32EOZ	1.2 (4)
33/40/55/70/80/100/125EFOZ and 40/50/65/80/99/125/150EOZ	0.9 (3)

Figure 5-3 Fuel Pump Lift

5.5 Fuel Consumption

Consult the current generator set specification sheets for generator set fuel consumption rates.



Electrical backfeed to the utility. Hazardous backfeed voltage can cause severe injury or death. Connect the generator set to the building/marina electrical system only through an approved device and after the building/marina main switch is opened. Backfeed connections can cause severe injury or death to utility personnel working on power lines and/or personnel near the work area. Some states and localities prohibit unauthorized connection to the utility electrical system. Install a ship-to-shore transfer switch to prevent interconnection of the generator set power and shore power.

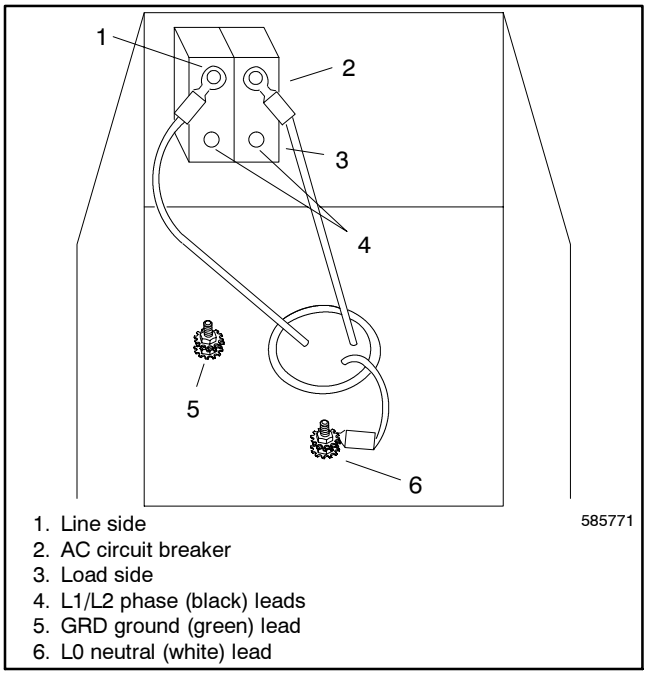


Figure 6-1 AC Voltage Connections in Controller Box (5–32EOZ Models, Typical)

6.1 AC Voltage Connections

Make AC connections to the generator set inside the controller box (4–27EFOZ and 5–32EOZ models) or inside the junction box (33–125EFOZ and 40–150EOZ models). Typically, the generator set connects to a ship-to-shore transfer switch that allows the use of shore/utility power when docked or generator set power when docked or at sea. The wiring then connects to a main circuit breaker box (panel board) that distributes branch circuits throughout the craft. See Figure 6-1 for AC voltage connections to the generator set. See Section 8 for reconnection of the generator set.

6.2 Circuit Protection

The AC circuit breakers (optional) protect the wiring from the AC circuit breakers to the vessel's distribution panel. AC circuit breakers trip when they detect a fault in the output circuit.

After correcting the fault, reset the AC circuit breaker(s) by placing them in the ON position. Restart the unit. Do not start the unit under load. See Figure 6-2 or Figure 6-3 for AC circuit breaker ratings. The unit's voltage configuration determines the circuit breaker selection.

Note: Circuit breaker ampere rating and availability are subject to change.

6.2.1 Circuit Breaker Considerations

Mounting location. Mount the circuit breakers in the generator set's controller (4–27EFOZ and 5–32EOZ models) or the generator set's junction box (33–125EFOZ and 40–150EOZ models). See Section 6.2.2 or Section 6.2.3.

Note: 3.5EFOZ and 4EOZ models already have circuit breakers installed.

Sizing. Use the generator set voltage/frequency configuration to determine the circuit breaker amperage. If the generator set voltage configuration changes, change the circuit breaker to provide optimum protection.

For circuit breaker application and selection information, contact an authorized distributor/dealer.

Have a qualified electrician or technician install circuit breakers and reconnect the generator set. Comply with all governing standards and codes.

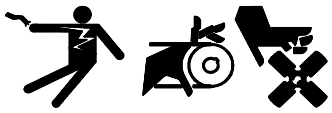
Amps	Max. Voltage	Number of Poles	Model(s)
20	250	1	4EFOZ
	600	3	8.5/11.5EFOZ, 14EOZ
22	250	2	4EFOZ, 5EOZ
25	250	2	5EOZ
30	250	1	6.5EFOZ
		2	6.5EFOZ
	600	3	11.5/17.5/20EFOZ, 14/20/24EOZ—3 phase
33	250	2	8EOZ
35	250	1	4EFOZ
		2	8EOZ
40	250	1	5EOZ
	600	3	11.5EFOZ, 14/20/24EOZ—3 phase
42	250	1	9EFOZ
		2	9EFOZ, 8/10EOZ
50	240	1	11/13EFOZ
		2	11/11.5/17.5EFOZ
	250	2	9EFOZ, 10EOZ
	480	3	20/23/27EFOZ, 20/28/32EOZ—3 phase
55	250	1	5EOZ
60	240	1	13EFOZ
		2	11/13EFOZ, 13/14EOZ
	250	1	6.5EFOZ
	600	3	17.5/20EFOZ, 20/24/28/32EOZ—3 phase
70	240	1	16EFOZ
		2	13/20EFOZ, 15.5EOZ
	250	1	6.5EFOZ, 8EOZ
	600	3	20/24EOZ—3 phase
80	240	1	16/19EFOZ
		2	16EFOZ, 20EOZ—1 phase, 20/24EOZ—3 phase
	250	1	8EOZ
	480	3	23EFOZ—3 phase
85	250	1	9EFOZ, 10EOZ
90	240	1	19EFOZ
		2	19EFOZ—1 phase 20/23EOZ
	480	3	27EFOZ—3 phase
100	240	2	23EOZ
	480	3	23/27EFOZ, 28/32EOZ—3 phase
125	600	2	23/27EFOZ, 28EOZ— 1 phase, 27EFOZ—3 phase
		3	23/27EFOZ, 28/32EOZ—3 phase
150	600	2	28/32EOZ—1 phase, 32EOZ— 3 phase
175	600	2	32EOZ—1 phase

Figure 6-2 AC Circuit Breaker Ratings (4-27EFOZ and 5-32EOZ Models), Listed By Amps

Amps	Max. Voltage	Number of Poles	Type	Model(s)
60	600	3	UL/IEC	33EFOZ, 40EOZ
70	600	3	UL/IEC	40EFOZ, 40EOZ
80	480	3	UL/IEC	40EFOZ, 50EOZ
100	480	3	UL/IEC	55EFOZ, 50/65EOZ
100-125	600	3	IEC	33/55EFOZ, 40/65EOZ
100-125	600	3	IEC	70EFOZ, 80EOZ
125	600	3	UL	33/55EFOZ, 40/65EOZ
125	600	3	UL	70EFOZ, 80EOZ
128-160	600	3	IEC	33/40EFOZ, 40/50EOZ
128-160	600	3	IEC	70/80EFOZ, 80/99EOZ
150	600	3	UL	33/40EFOZ, 40/50EOZ
150	600	3	UL	70/80EFOZ, 80/99EOZ
160-400	600	3	UL	70/80/100EFOZ, 80/99/125/150EOZ
160-400	600	3	IEC	70/80/100/125EFOZ, 80/99/125/150EOZ
200	600	3	UL	40/55EFOZ, 50/65EOZ
200	600	3	UL	100EFOZ, 99/125EOZ
200-250	600	3	IEC	40/55EFOZ, 50/65EOZ
200-250	600	3	IEC	70/100/125EFOZ, 80/125/150EOZ
240-600	600	3	UL	125EFOZ, 125/150EOZ
250	600	3	UL	55EFOZ, 65EOZ
250	600	3	UL	70/125EFOZ, 80/125/150EOZ
250-630	600	3	IEC	125EFOZ, 125/150EOZ

Figure 6-3 AC Circuit Breaker Ratings (33-150 kW Models), Listed By Amps

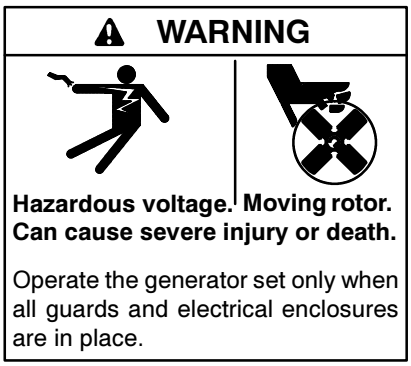
⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or equipment connected to the set, disable the generator set as follows: (1) Place the generator set start/stop switch in the STOP position. (2) Disconnect the power to the battery charger, if equipped. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent the starting of the generator set by the remote start/stop switch.



Grounding electrical equipment. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Open the main circuit breakers of all power sources before servicing the equipment. Configure the installation to electrically ground the generator set, transfer switch, and related equipment and electrical circuits to comply with applicable codes and standards. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

Short circuits. Hazardous voltage/current can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage**.** Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.

Electrical backfeed to the utility. Hazardous backfeed voltage can cause severe injury or death. Connect the generator set to the building/marina electrical system only through an approved device and after the building/marina main switch is opened. Backfeed connections can cause severe injury or death to utility personnel working on power lines and/or personnel near the work area. Some states and localities prohibit unauthorized connection to the utility electrical system. Install a ship-to-shore transfer switch to prevent interconnection of the generator set power and shore power.

6.2.2 Circuit Breaker Installation (4-27EFOZ and 5-32EOZ Models)

1. Place the generator set start/stop switch in the STOP position.

2. Disconnect the generator set engine starting battery, negative (-) lead first.

3. Remove the controller cover screws and remove the access cover.

4. Remove the screws and nuts to remove the circuit breaker cover plate. Save the mounting hardware.

5. Install the circuit breaker from the inside of the cutout panel and mount it using existing screws removed in step 4. Position the circuit breaker with the ON in the normal upright position or to the left side. Cover the cutout opening, if applicable, with the circuit breaker cover plate. Use existing screws to mount the cover plate.

6. See Section 8 for voltage reconnection.

   Note: Kohler® marine diesel generator sets are fully frequency adjustable and voltage reconnectable. To determine reconnection options, check the model's specification sheet.

7. Install insulation boots over stator lead terminals if the kit includes insulation boots.

   Note: See Section 8 for wiring instructions.

8. Make the recommended connections for the following four reconnection systems using circuit breakers:

   Two-pole circuit breaker with a single-voltage system (example: 120-volt, 3-wire). Attach stator leads marked 2 and 4 to the side of the circuit breaker marked LINE. Install the jumper lead across the LINE side of circuit breaker terminals (see Section 8). Attach stator leads 1 and 3 to L0.

   Single-pole circuit breaker with a 120-volt, 2-wire, single-voltage system. Attach stator leads marked 2 and 4 to the side of the circuit breaker marked LINE (see Section 8). Attach stator leads 1 and 3 to L0.

   Two-pole circuit breaker with a dual-voltage system (example: 120/240-volt, 3-wire). Attach stator leads marked 1 and 4 to the side of the circuit breaker marked LINE. Do not use a jumper lead (see Section 8). Attach stator leads 2 and 3 to L0.

   Single-pole circuit breaker with a 240-volt, 2-wire, single-voltage system. Attach the stator lead marked 2 to the side of the circuit breaker marked LINE (see Section 8). Bolt together leads 1 and 4 and tape to insulate from ground. Attach the stator lead marked 3 to L0.

9. Connect the stator lead(s) used for neutral connection to the L0 stud. See the illustrations in Section 8.

10. Connect the side of the circuit breaker marked LOAD to the ship-to-shore switch or craft wiring. Attach insulation boots to the black leads if the kit includes insulation boots. With a single-pole circuit breaker use one black lead (L1). With a two-pole circuit breaker use two black leads, L1 and L2. Connect the neutral (white) lead to the L0 stud. Connect the equipment ground (green) lead to GRD stud.

    Note: Wire material. Use stranded copper for all wiring. Use wire gauges and insulation, conductor temperature ratings, sheath stripping, conductor support and protection, conductor terminals and splices, and overcurrent protection (circuit breakers, fuses) that conform to standards and codes.

    Note: Follow USCG Regulations CFR33, Part 183 (Pleasurecraft) and CFR46 (Commercial Craft) for marine applications.

    Note: Wire protection. Use rubber grommets and cable ties as necessary to protect and secure wiring from sharp objects, the exhaust system, and any moving parts.

11. Replace the controller cover or circuit breaker box access panel.

12. Reconnect the generator set engine starting battery, negative (-) lead last.

13. Make voltage or frequency adjustments according to Section 8.

    Note: Voltage/frequency adjustable. Some four-lead generator sets are not voltage/frequency adjustable. To determine adjustment possibilities, check the model's specification sheet or service manual. If you are reconnecting the generator set from a single-voltage to a dual-voltage configuration (example: from 120-volt to 120/240-volt) or a dual voltage to a single voltage (example: from 120/240-volt to 120-volt) with the same primary voltage, do not adjust the voltage/frequency adjustment. Adjust the voltage/frequency for frequency changes or setting changes of the primary voltage (example: from 120-volt to 100-volt). Refer to the model's specification sheet for reconnection capability.

6.2.3 Circuit Breaker Installation (33-125EFOZ and 40-150EOZ Models)

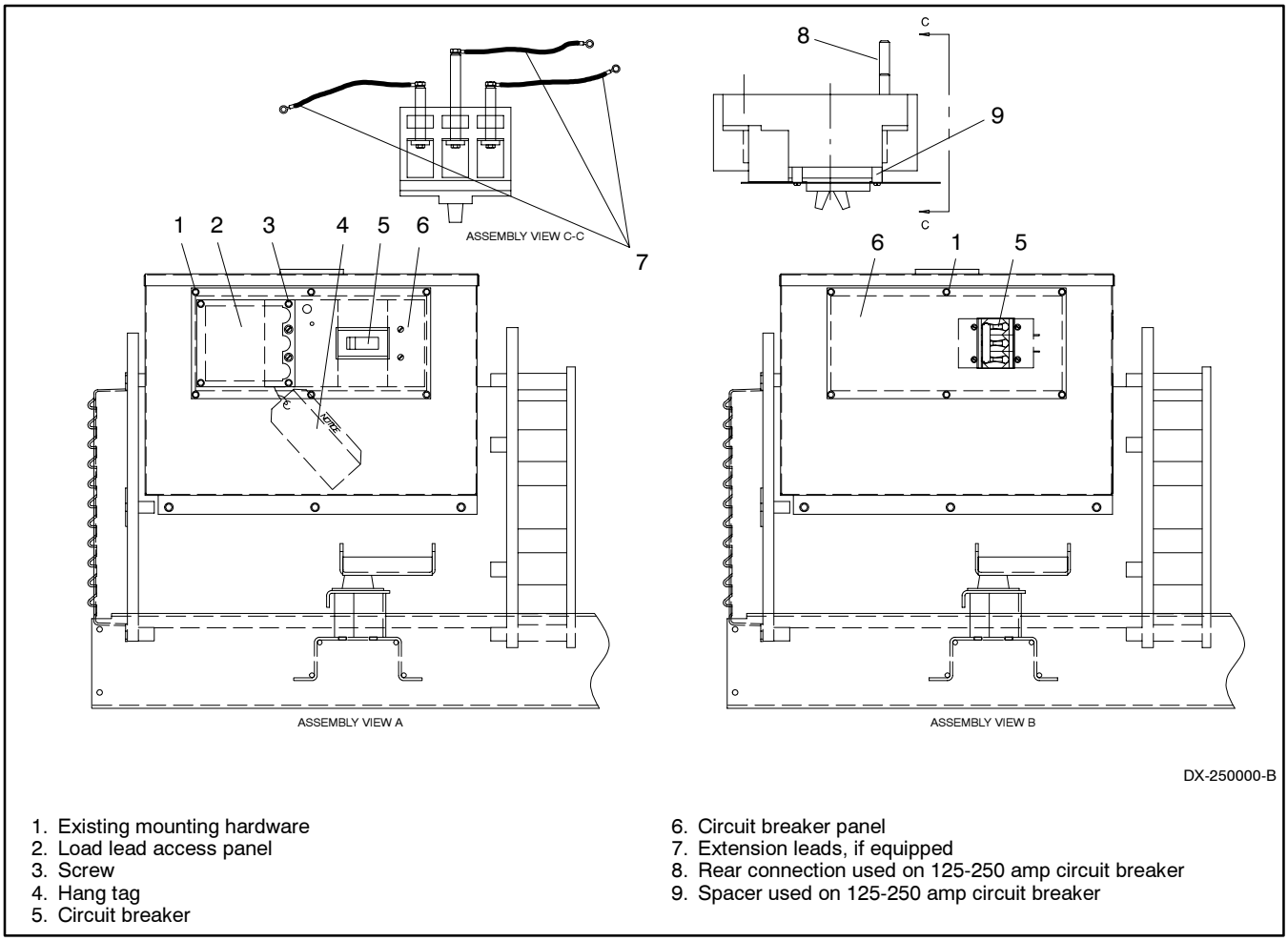
1. Place the generator set master switch in the OFF position.
2. Disconnect the generator set engine starting battery, negative (-) lead first.
3. Remove the six screws from the right side junction box panel and remove the panel.
4. Install the circuit breaker on the new panel with the screws and washers. Position the ON side of the circuit breaker toward the rear of the junction box. See Figure 6-4.
5. Attach stator leads L1, L2, and L3 to the extension leads (if supplied) or to the line side of the circuit breaker. See Figure 8-5.

    Note: Insulate leads with electrical tape after connecting extension leads to stator leads.

6. Connect the neutral connection stator leads to the L0 stud.

    Note: Verify that terminal positions and previously made line lead connections allow room for load connections to load studs.

7. Connect the load side of the circuit breaker to customer-supplied craft wiring. Connect the neutral lead to the L0 stud. See Figure 8-5.
8. Attach the new panel to the junction box using the original six screws. See Figure 6-4.
9. Check that the generator set master switch is in the OFF position. Reconnect the generator set engine starting battery, negative (-) lead last.



1. Existing mounting hardware
2. Load lead access panel
3. Screw
4. Hang tag
5. Circuit breaker
6. Circuit breaker panel
7. Extension leads, if equipped
8. Rear connection used on 125-250 amp circuit breaker
9. Spacer used on 125-250 amp circuit breaker

Figure 6-4 Circuit Breaker Mounting

6.3 Installation In Steel or Aluminum Vessels

Installation of a generator set in a vessel constructed of a material capable of conducting current (e.g., steel or aluminum) is subject to considerations not normally encountered in fiberglass or wood vessels. These differences include equipment grounding, grounding of neutral conductors, ground-fault protection, and isolation of galvanic currents.

The scope of these topics is too extensive to be fully discussed here. Consult your local marine authority for more information.

Before installing the generator set, check the available wiring diagrams in the operation manual to become familiar with the electrical system.

6.4 Installation Regulations

The U.S. Coast Guard governs generator set installation in U.S. pleasurecraft and commercial vessels. Refer to the applicable regulations below:

U.S. Pleasurecraft Installation Regulations

Title 33CFR, Chapter I, U.S. Coast Guard, Part 183

1. Subpart I—Electrical Equipment
2. Subpart J—Fuel Systems

U.S. Commercial Vessel Installation Regulations

Title 46CFR, Chapter I, U.S. Coast Guard

1. Part 111—Electrical Systems
2. Part 182—Machinery Installation

m:sc:001:001

6.5 Battery

Batteries and their installation must conform to USCG Regulations 183.420 (a) through (g). Provide generator sets with batteries separate from the propulsion engine's whenever possible. The starting/charging systems of both the generator set and the engine must have a common negative (-) ground.

USCG Regulation 183.415, Grounding, requires connection of a common conductor to each grounded cranking-motor circuit. Size the conductor to match the larger of the engine's two battery cables. Figure 6-5 lists cable sizes for generator set battery connections at various ambient temperatures. Connecting a common conductor to each grounded cranking motor circuit prevents the starting motor current from using alternative electrical paths should the cranking motor ground circuit be restricted or open because of oxidation or loose hardware. Alternative electrical paths include metallic fuel lines that can pose a fire hazard. See Figure 6-7 and Section 7 for battery connections to the generator set.

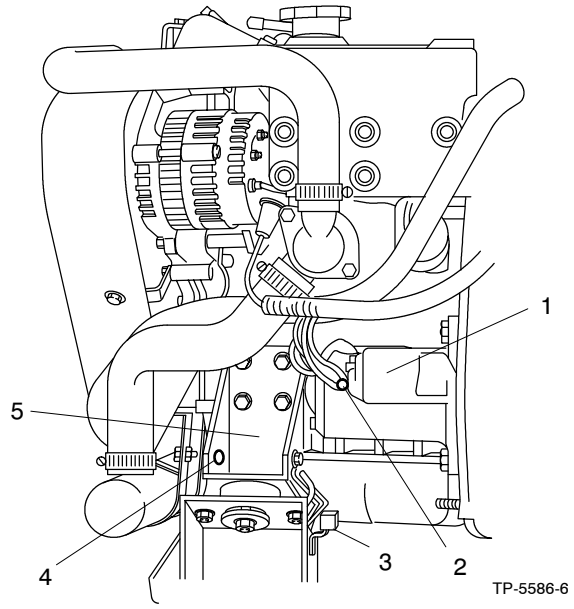
Distance between Generator Set and Battery m (ft.)		Cable Size (AWG)		
		At –18°C (0°F)	At 0°C (32°F)	At 24°C (75°F)
12.2	(40)	00	0	1
9.1	(30)	0	1	2
7.6	(25)	1	2	4
6.1	(20)	2	2	6
4.6	(15)	2	4	6
3.0	(10)	4	6	8
1.5	(5)	6	6	8
0.8	(2.5)	8	8	8

Figure 6-5 Battery Cable Sizes

Kohler Co. recommends using one 12-volt or 24-volt battery (as the spec requires) to start the generator. See Figure 6-6 for minimum cold cranking amps (CCA) recommendations.

12-Volt Starting Battery Size CCA at -18°C (0°F) or 100 Amp. Hr.	
Models	**CCA**
3.5–20EFOZ and 4-24EOZ	500
23/27/100/125EFOZ and 28/32/125/150EOZ	800
33-80EFOZ and 40-99EOZ	640

Figure 6-6 Battery Recommendations



1. Starter solenoid
2. Battery positive (+) connection
3. Equipment ground
4. Battery negative (-) connection
5. Engine block mount

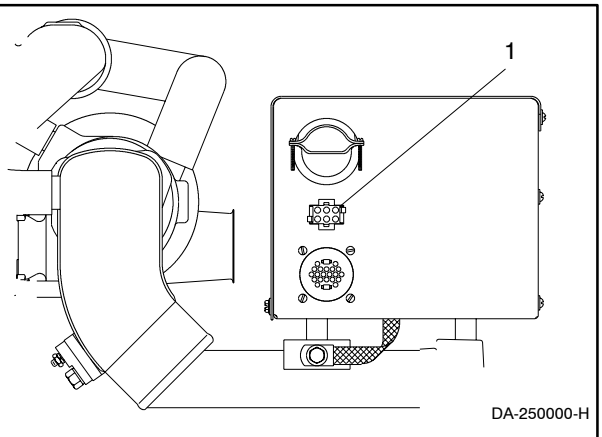
Figure 6-7 Battery Connections (5EOZ/4EFOZ model shown)

6.6 Wiring

Use only stranded copper wire. Conform to USCG Regulations 183.425 through 183.460 for wire gauges and insulation, conductor temperature ratings, sheath stripping, conductor support and protection, conductor terminals and splices, and over-current protection (circuit breakers, fuses). Use rubber grommets and cable ties as necessary to protect and secure the wire from sharp objects, the exhaust system, and moving parts.

6.7 Remote Start Switch Connection

Kohler Co. offers several remote panels for connection to the generator set. Contact your local Kohler® distributor/dealer for detailed descriptions. See Figure 6-8 for remote start panel connection to the generator set controller. Kohler Co. also offers a wiring harness with a connector keyed to the controller box connector. The other end of this harness has pigtails that the installer can use to connect to a customer-supplied start/stop switch or separate lights and hourmeter. Consult wiring diagrams and instruction sheets for connection information/details.



1. Controller remote connector

Figure 6-8 Controller Remote Connector, Typical

Note: Gauge senders. Gauge senders are available for most generator sets. If using customer-supplied gauges, be sure they are compatible with generator set senders. Contact an authorized Kohler® service distributor/dealer. Gauges and senders are available as service items from an authorized Kohler® service distributor/dealer.

33–150 kW Models: Various wiring harnesses, Y-connectors, pigtail harnesses, remote control panels, and remote annunciator panels (Decision-Maker™ 3+ only) are available. See Figure 6-9 and Figure 6-10 for wiring options.

3.5EFOZ/4EOZ Models: See Figure 7-3 for the optional remote panel wiring.

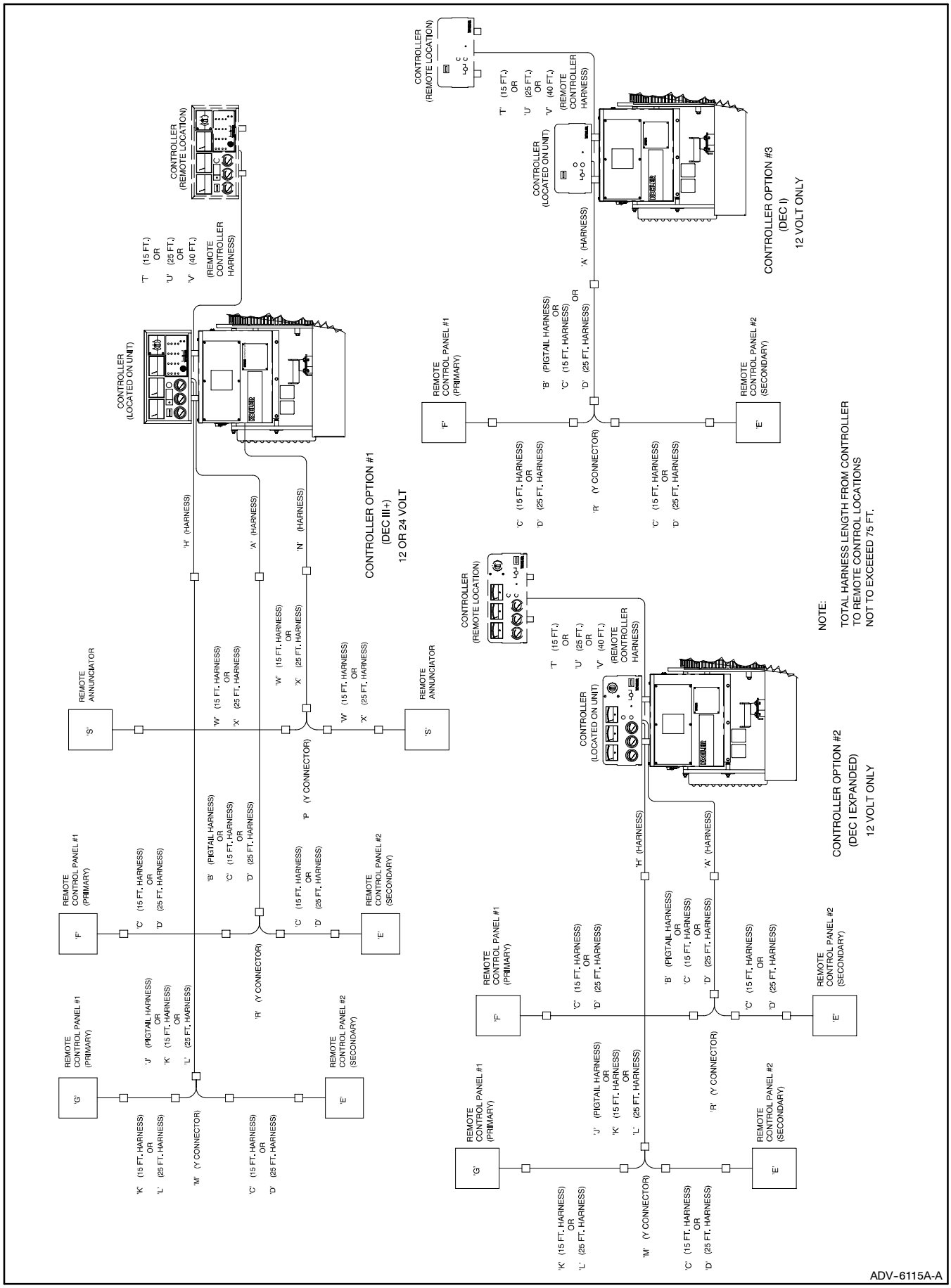


Figure 6-9 Remote Controller and Harness Options (33–150 kW Models)

COMMON TO ALL MODELS			
CONTROLLER	DEC I	DEC I EXPANDED	DEC III+
WIRING HARNESS 'A'	PA–344491/344491	PA–344491/344491	PA–344491/344491
PIGTAIL HARNESS 'B'	PA–249941	PA–249941	PA–249941
15 FT. WIRING HARNESS 'C'	PA–249334	PA–249334	PA–249334
25 FT. WIRING HARNESS 'D'	PA–249336	PA–249336	PA–249336
WIRING HARNESS 'H'	NOT AVAILABLE	PA–344493/344493	PA–344493/344493
PIGTAIL HARNESS 'J'	NOT AVAILABLE	PA–344414	PA–344414
15 FT. WIRING HARNESS 'K'	NOT AVAILABLE	PA–344415	PA–344415
25 FT. WIRING HARNESS 'L'	NOT AVAILABLE	PA–344416	PA–344416
Y CONNECTOR HARNESS 'M'	NOT AVAILABLE	PA–344417	PA–344417
WIRING HARNESS 'N'	NOT AVAILABLE	NOT AVAILABLE	PA–344492/344492
Y CONNECTOR HARNESS 'P'	NOT AVAILABLE	NOT AVAILABLE	PA–344437
Y CONNECTOR HARNESS 'R'	PA–344388	PA–344388	PA–344388
REMOTE ANNUNCIATOR 'S'	NOT AVAILABLE	NOT AVAILABLE	PA–344432
15 FT. REMOTE CONTROLLER HARNESS 'T'	PAA–344422	PAA–344422	PAA–344422
25 FT. REMOTE CONTROLLER HARNESS 'U'	PAA–344423	PAA–344423	PAA–344423
40 FT. REMOTE CONTROLLER HARNESS 'V'	PAA–344505	PAA–344505	PAA–344505
15 FT. WIRING HARNESS 'W'	NOT AVAILABLE	NOT AVAILABLE	PA–344501
25 FT. WIRING HARNESS 'X'	NOT AVAILABLE	NOT AVAILABLE	PA–344502

CONTROLLER KIT OPTION MATRIX																
MODEL		40COZ & 33CFOZ 40EOZ & 38EFOZ			50 & 60COZ, 40 & 50CFOZ 50, 65 & 80EOZ, 40, 55 & 70EFOZ			99EOZ 80EFOZ			125EOZ 100EFOZ			150EOZ 125EFOZ		
CONTROLLER		DEC I	DEC I EXPANDED	DEC III+	DEC I	DEC I EXPANDED	DEC III+	DEC I	DEC I EXPANDED	DEC III+	DEC I	DEC I EXPANDED	DEC III+	DEC I	DEC I EXPANDED	DEC III+
REMOTE PANEL 'E'	BASIC START/STOP 12 VOLT/24 VOLT	PA–344396/ PA–344401	PA–344396/ PA–344401	PA–344396/ PA–344401	PA–344396/ PA–344401	PA–344396 PA–344401	PA–344396/ PA–344401	PA–344396/ PA–344401	PA–344396/ PA–344401	PA–344396/ PA–344401	PA–344396/ PA–344401	PA–344396/ PA–344401	PA–344396/ PA–344401	PA–344396/ PA–344401	PA–344396/ PA–344401	PA–344396/ PA–344401
REMOTE PANEL 'F'	4 METER 12 VOLT/24 VOLT	PA–344397/ PA–344402	PA–344397/ PA–344402	PA–344397/ PA–344402	PA–344397/ PA–344402	PA–344397 PA–344402	PA–344397/ PA–344402	PA–344397/ PA–344402	PA–344397/ PA–344402	PA–344397/ PA–344402	PA–344397/ PA–344402	PA–344397/ PA–344402	PA–344397/ PA–344402	PA–344397/ PA–344402	PA–344397/ PA–344402	PA–344397/ PA–344402
REMOTE PANEL 'G'	FULL FEATURE 12 VOLT/24 VOLT	NOT AVAILABLE	PA–344406/ PA–344407	PA–344406/ PA–344407	NOT AVAILABLE	PA–344412 PA–344413	PA–344412/ PA–344413	NOT AVAILABLE	GM17007–KP1/ GM17008–KP1	GM17007–KP1/ GM17008–KP1	NOT AVAILABLE	GM16681–KP1/ GM16682–KP1	GM16681–KP1/ GM16682–KP1	NOT AVAILABLE	GM16683–KP1/ GM16684–KP1	GM16683–KP1/ GM16684–KP1

Figure 6-10 Remote Controller and Harness Options (33–150 kW Models)

Notes

Section 7 Installation Drawings

Use the drawings in this section for installation purposes. Consult the supplier and verify that the drawings are the most current for your specifications. Installation drawings show exhaust outlet locations, fuel inlet and return connections, siphon break locations, and battery connections. See Figure 7-1 for installation drawing identification.

Model No.	Drawing	Page
3.5EFOZ and 4EOZ	ADV-6652A-B	30
with remote options	ADV-6652B-B	31
4EFOZ and 5EOZ	ADV-5850A-H	32
with sound shield	ADV-5850B-H	33
6.5EFOZ and 8EOZ	ADV-6284A-J	34
with sound shield	ADV-6284B-J	35
8.5/9EFOZ and 10EOZ	ADV-6026A-K	36
with sound shield	ADV-6026B-K	37
11EFOZ and 13EOZ	ADV-6512A-D	38
with sound shield	ADV-6512B-D	39
11.5/13EFOZ and 14/15.5EOZ	ADV-6513A-C	40
with sound shield	ADV-6513B-C	41
16/17.5EFOZ and 20EOZ	ADV-6481A-D	42
with sound shield	ADV-6481B-D	43
19/20EFOZ and 23/24EOZ	ADV-6494A-C	44
with sound shield	ADV-6494B-C	45
23/27EFOZ and 28/32EOZ	ADV-6285A-F	46
with sound shield	ADV-6285B-F	47
33EFOZ and 40EOZ	ADV-6581A-E	48
with fuel/water separator and dry exhaust elbow	ADV-6581B-E	49
with sound shield	ADV-6581C-E	50
with electric clutch	ADV-6581D-E	51
40EFOZ and 50EOZ	ADV-6582A-E	52
with fuel/water separator and dry exhaust elbow	ADV-6582B-E	53
with sound shield	ADV-6582C-E	54
with electric clutch	ADV-6582D-E	55
55EFOZ and 65EOZ	ADV-6583A-E	56
with fuel/water separator and dry exhaust elbow	ADV-6583B-E	57
with sound shield	ADV-6583C-E	58
with electric clutch	ADV-6583D-E	59
70/80EFOZ and 80/99EOZ	ADV-6603A-D	60
with fuel/water separator and dry exhaust elbow	ADV-6603B-D	61
with sound shield	ADV-6603C-D	62
with electric clutch	ADV-6603D-D	63
100/125EFOZ and 125/150EOZ	ADV-6594A-D	64
with sound shield	ADV-6594B-D	65
with dry exhaust elbow	ADV-6594C-D	66

Figure 7-1 Installation Drawings

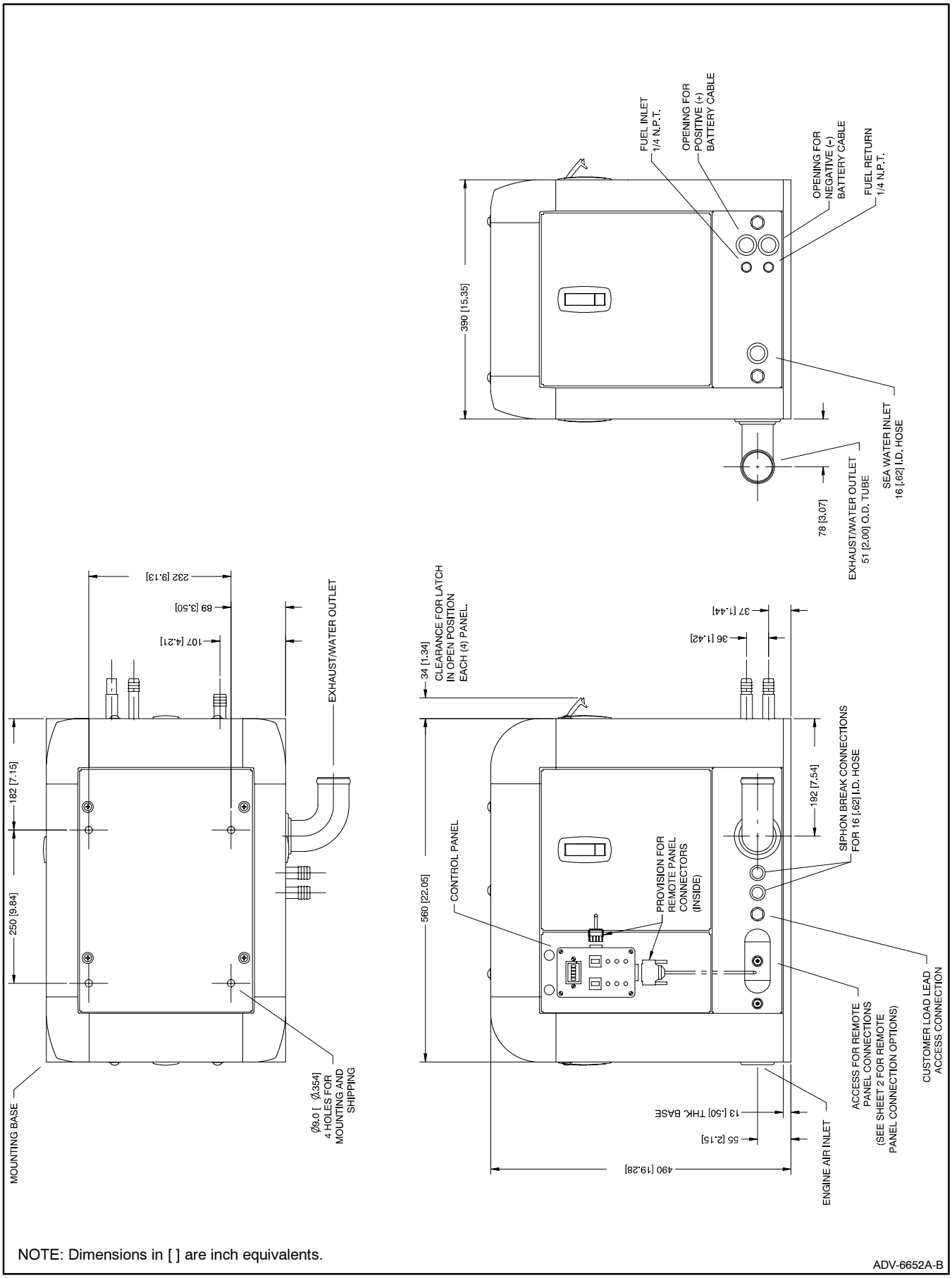


Figure 7-2 Dimension Drawing, 3.5EFOZ/4EOZ

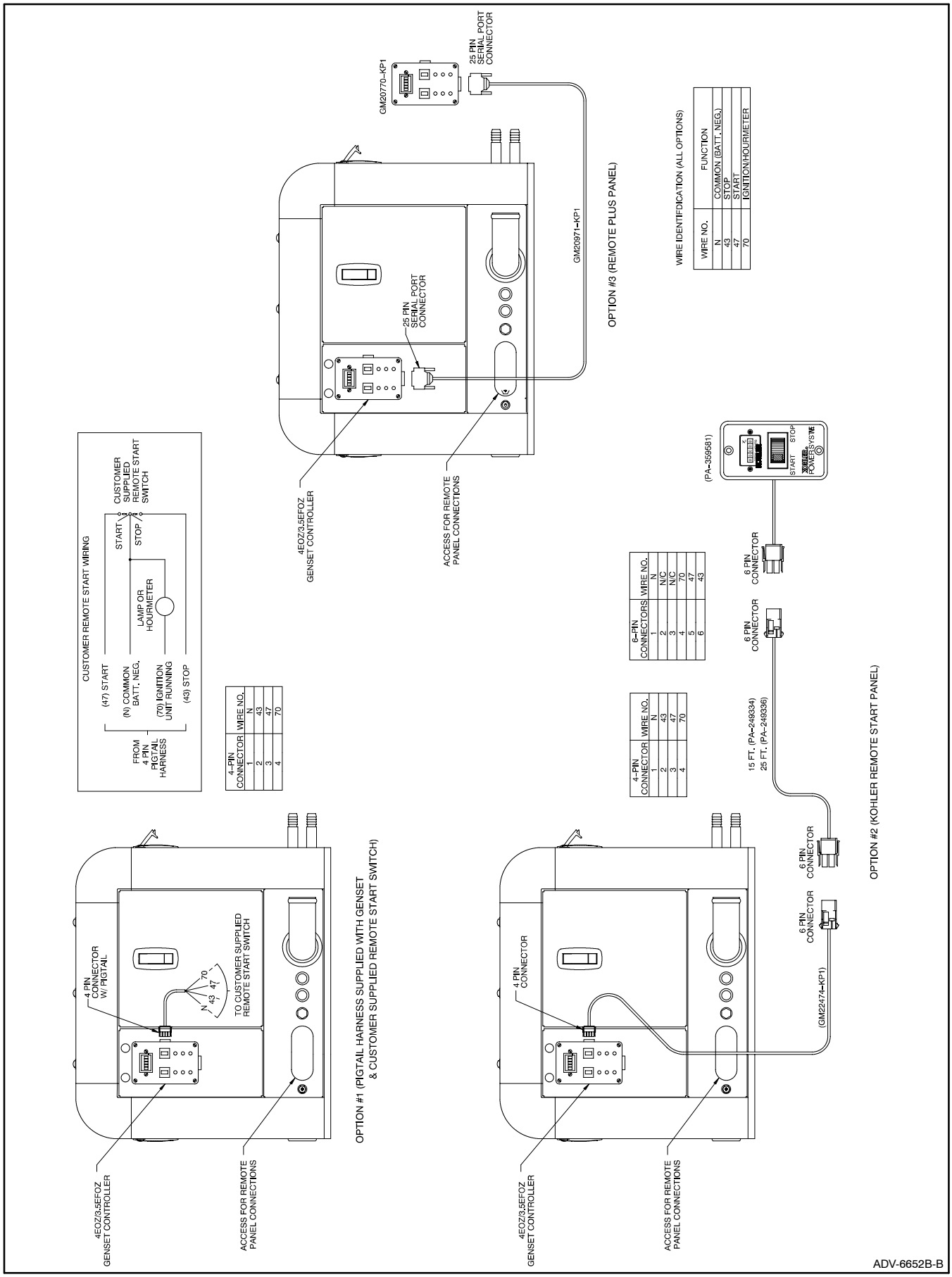


Figure 7-3 Remote Options, 3.5EFOZ/4EOZ

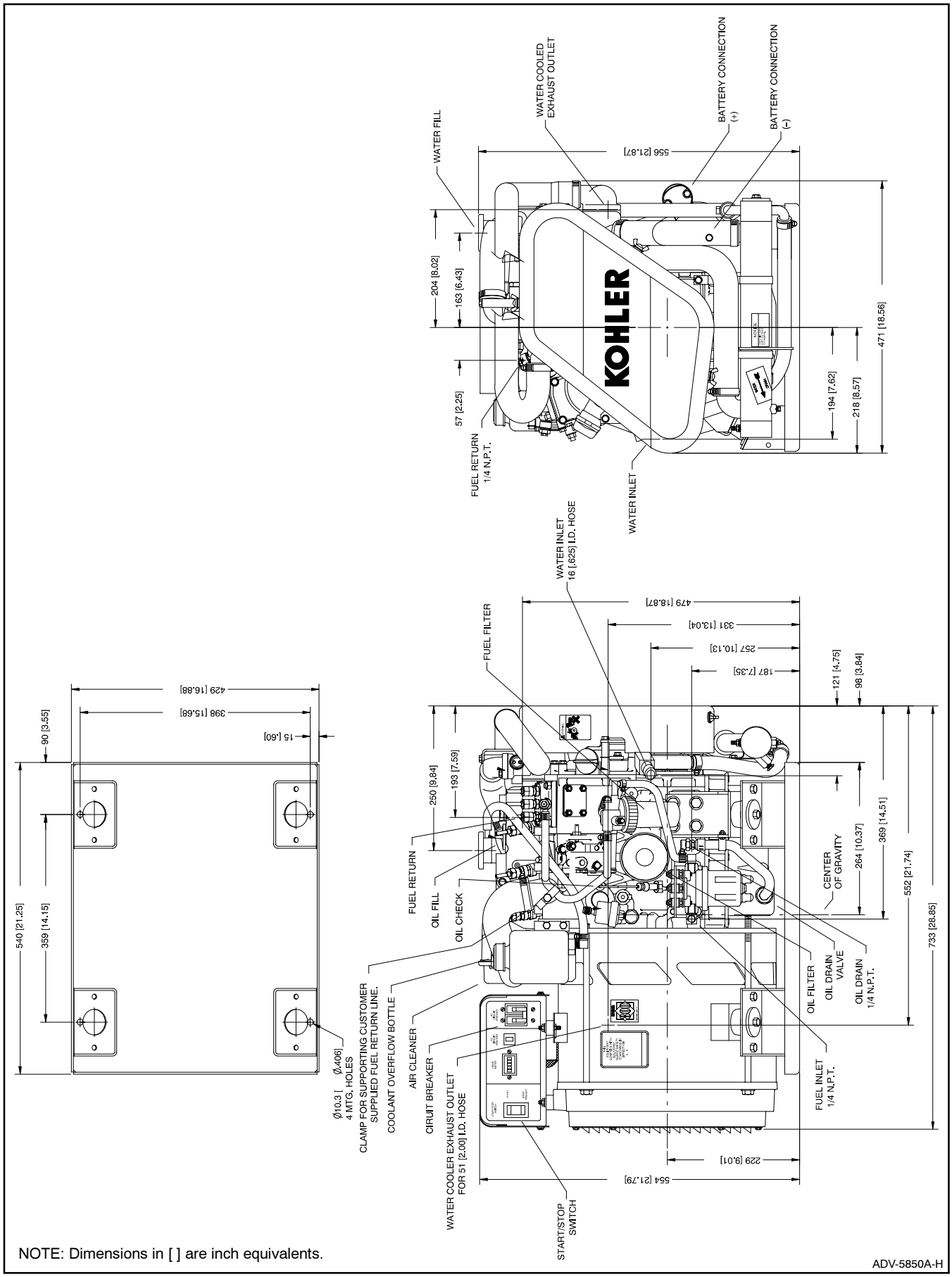


Figure 7-4 Dimension Drawing, 4EFOZ/5EOZ

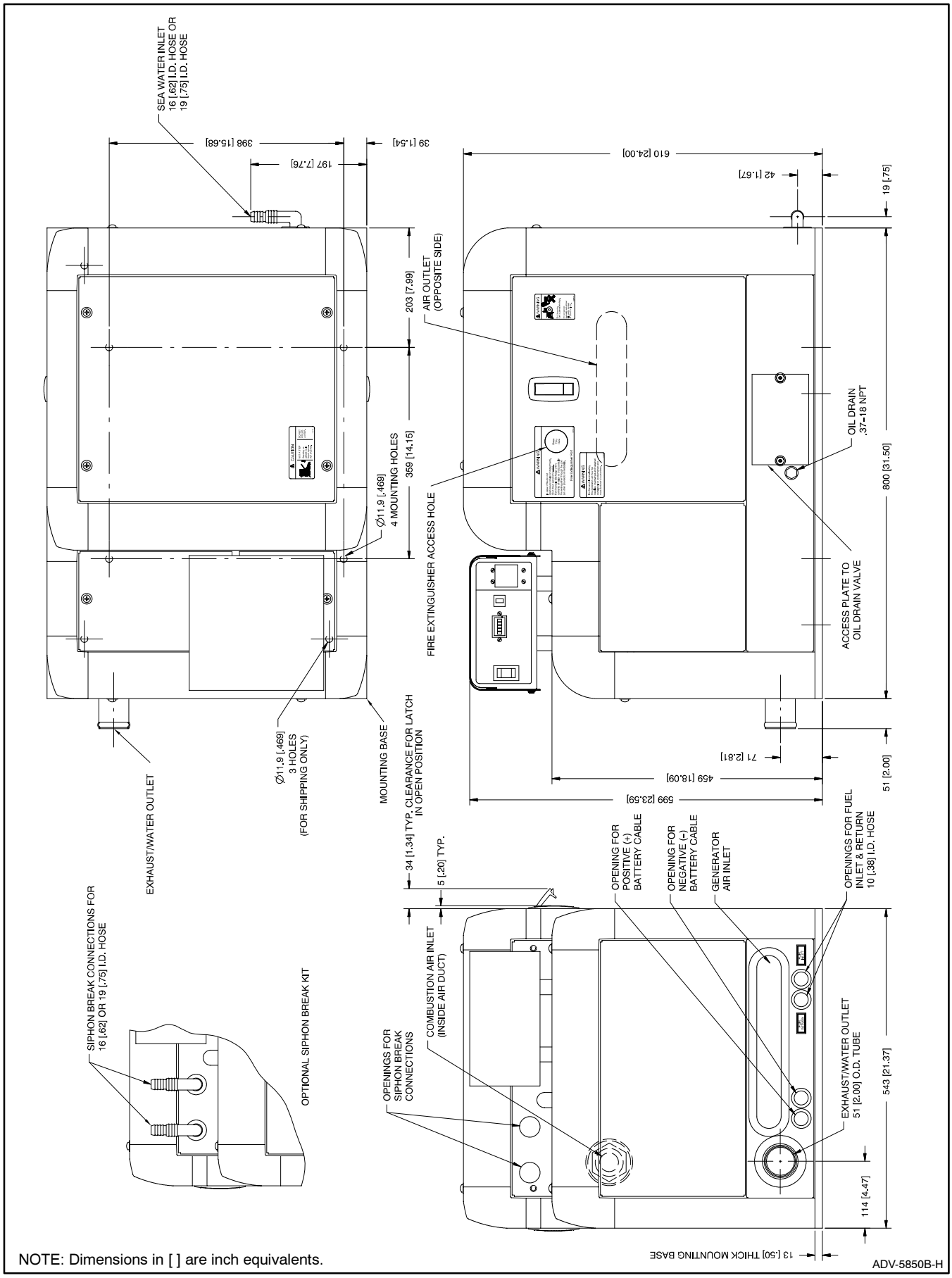
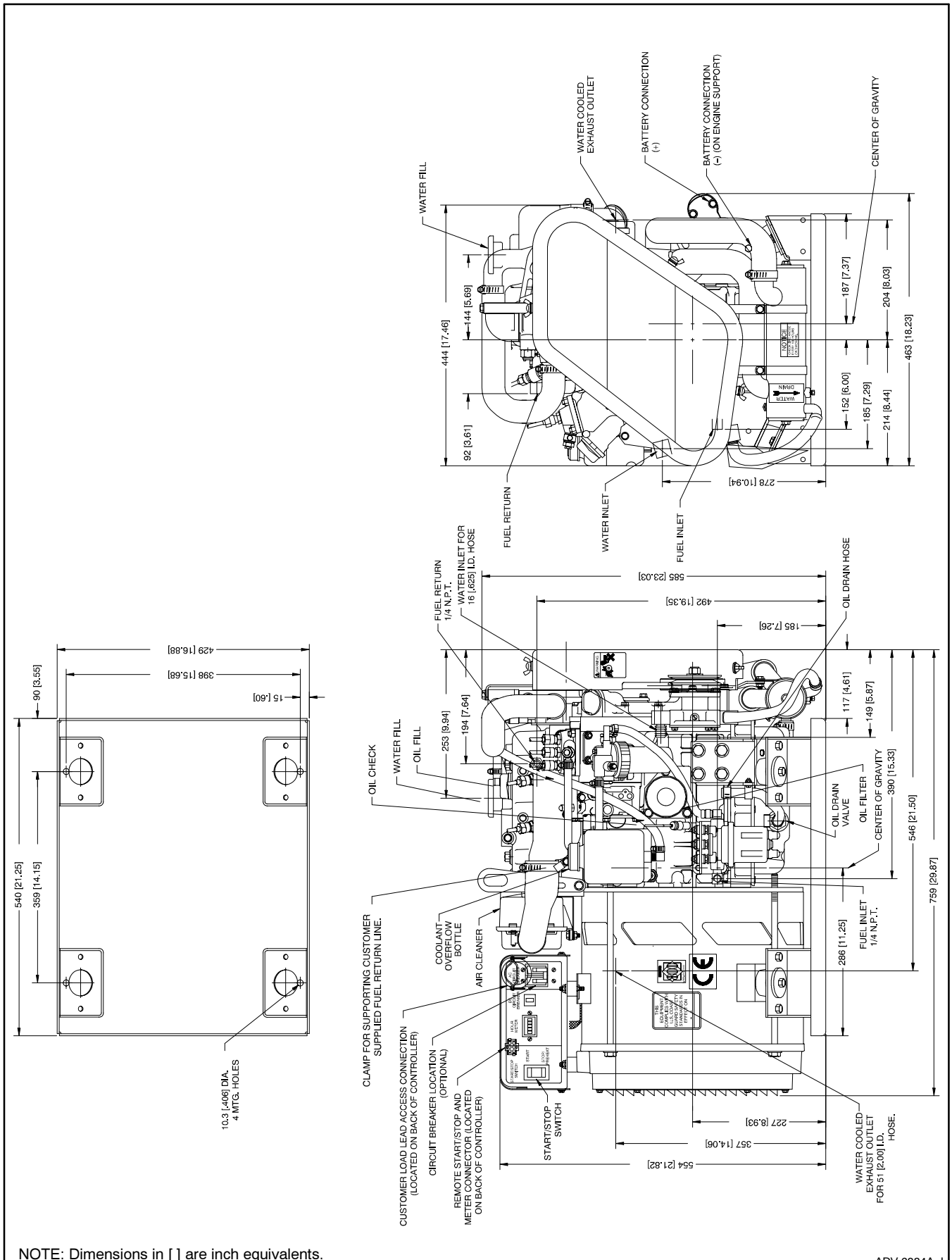


Figure 7-5 Dimension Drawing, 4EFOZ/5EOZ with Sound Shield



NOTE: Dimensions in [ ] are inch equivalents.

ADV-6284A-J

Figure 7-6 Dimension Drawing, 6.5EFOZ/8EOZ

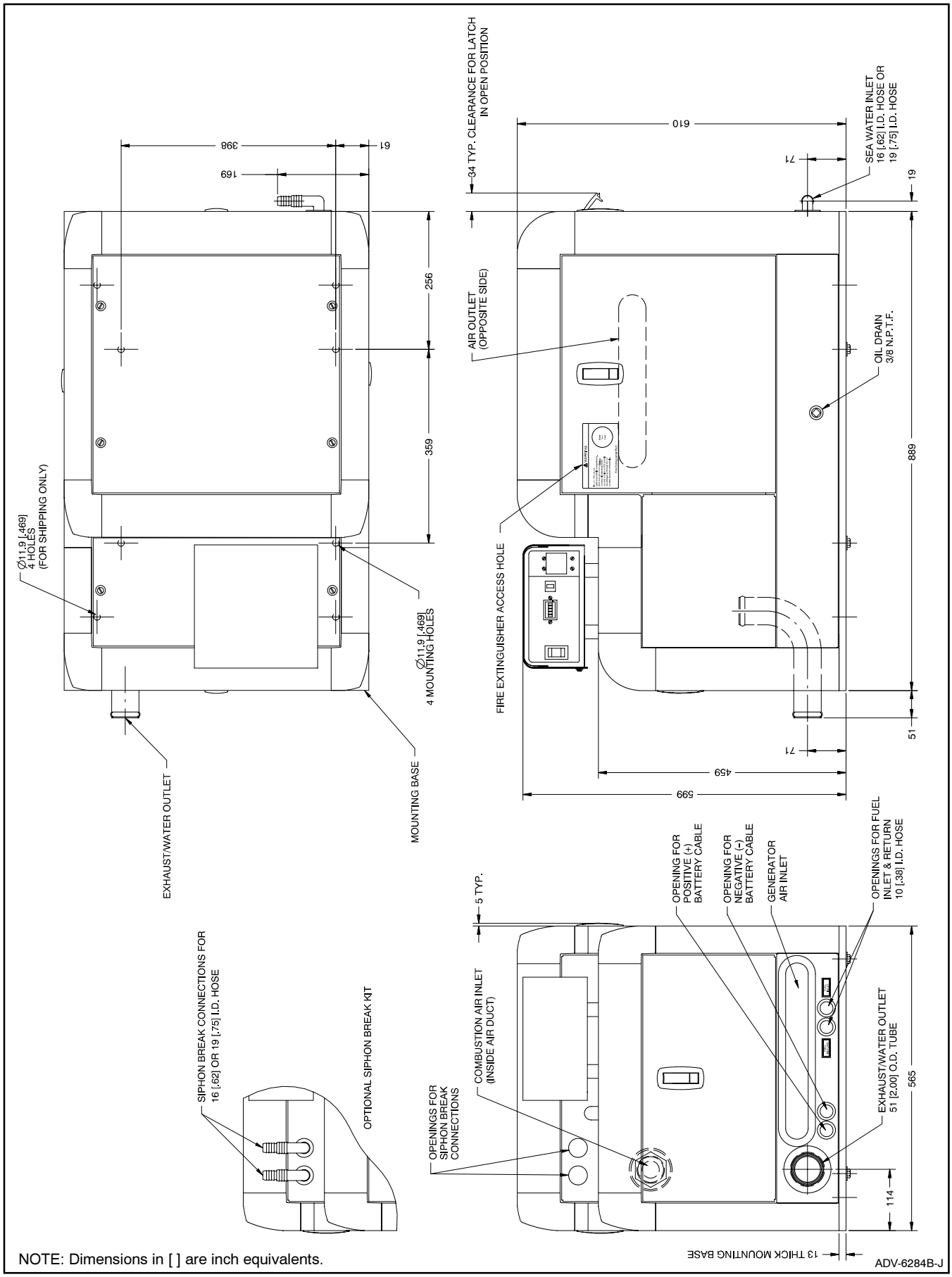


Figure 7-7 Dimension Drawing, 6.5EFOZ/8EOZ with Sound Shield

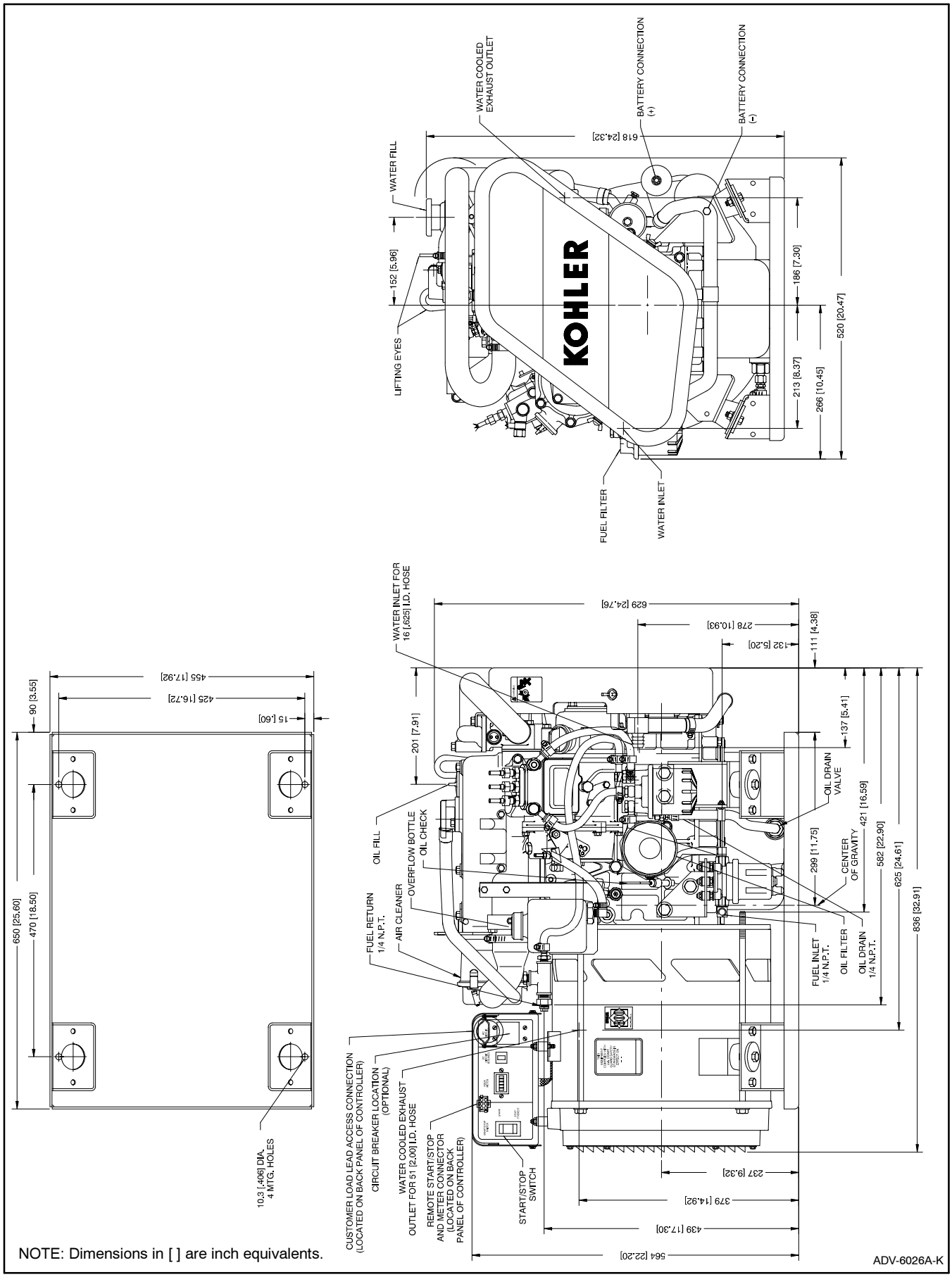


Figure 7-8 Dimension Drawing, 8.5/9EFOZ and 10EOZ

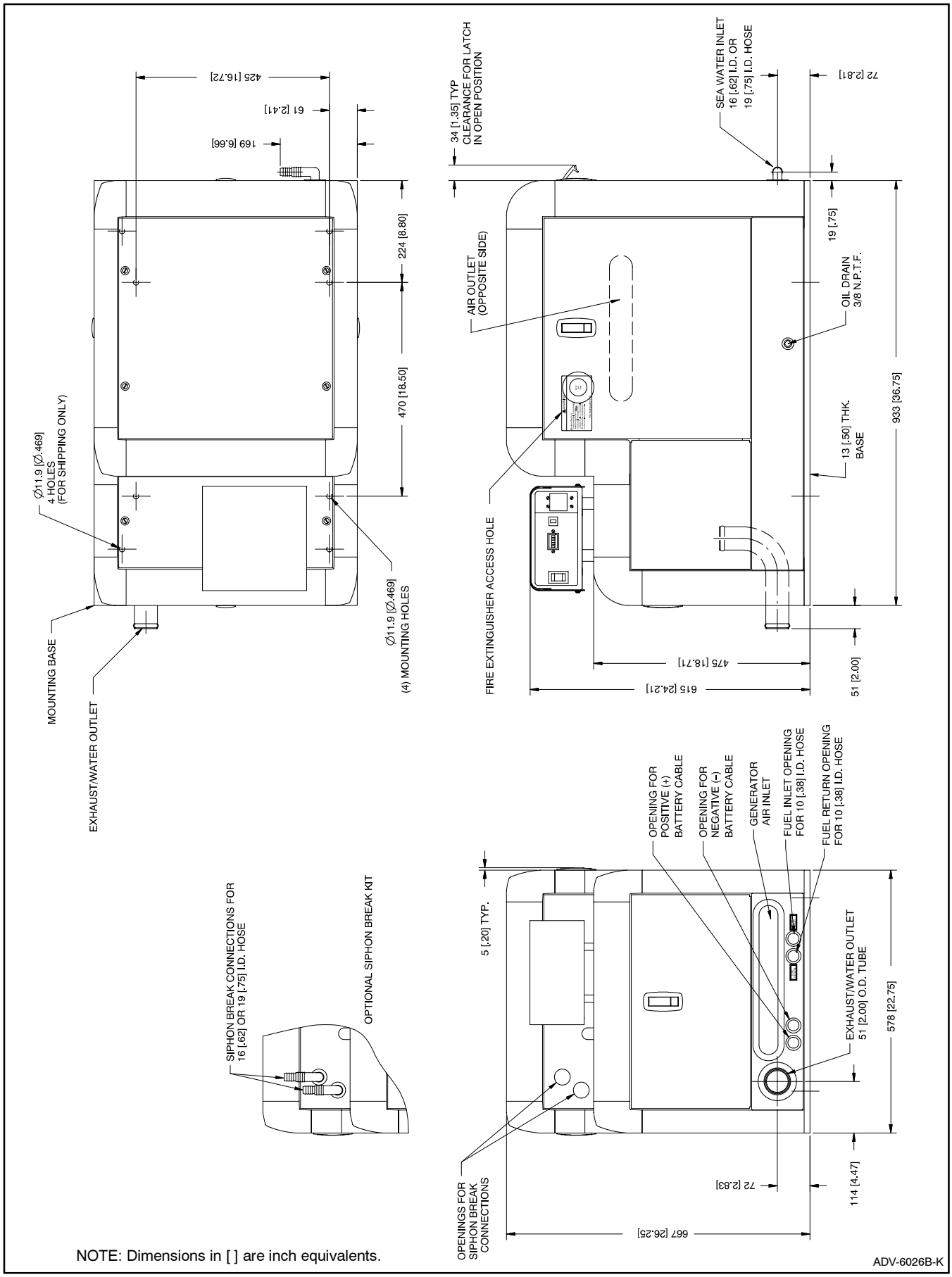


Figure 7-9 Dimension Drawing, 8.5/9EFOZ and 10EOZ with Sound Shield

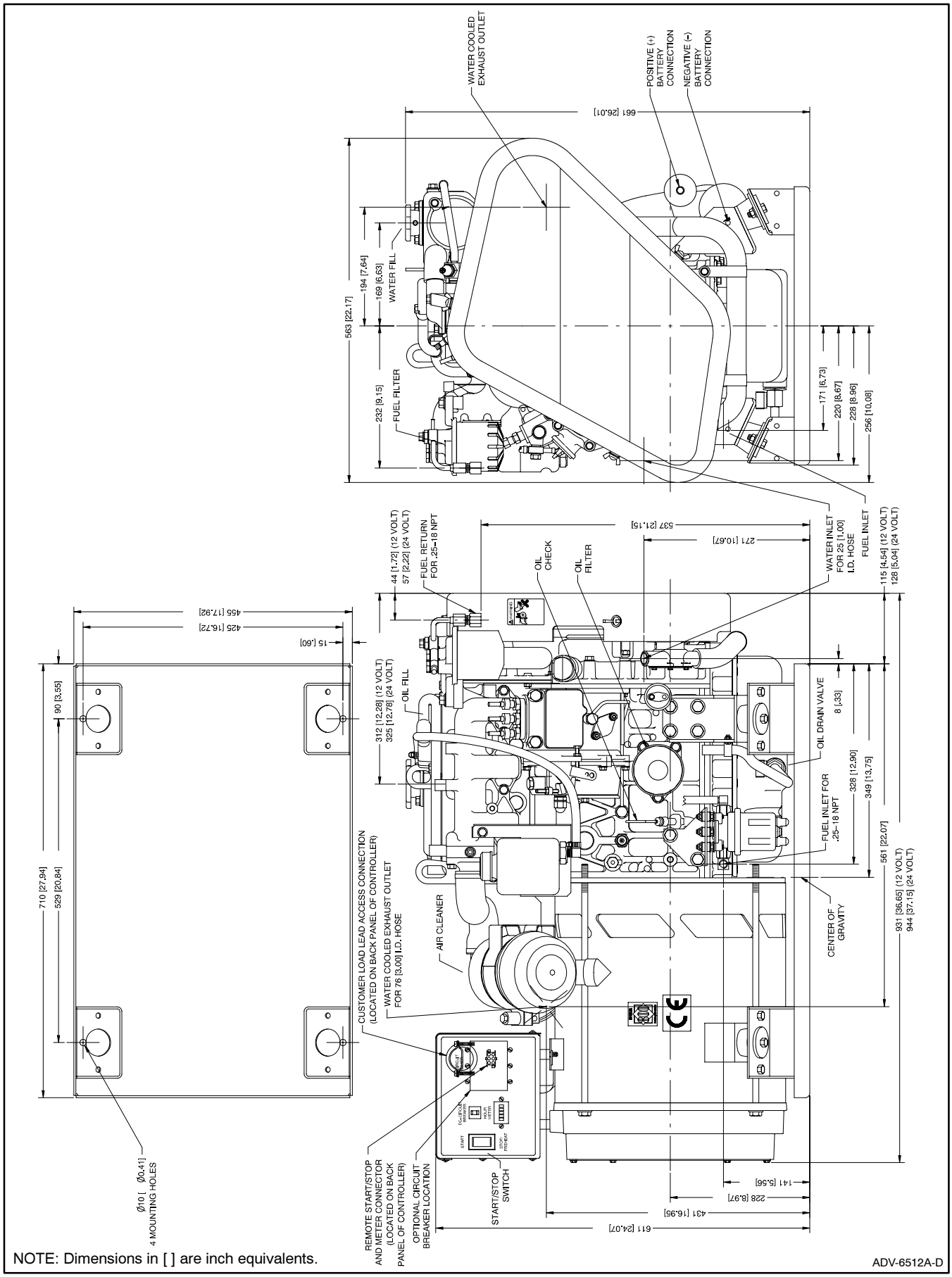


Figure 7-10 Dimension Drawing, 11EFOZ/13EOZ

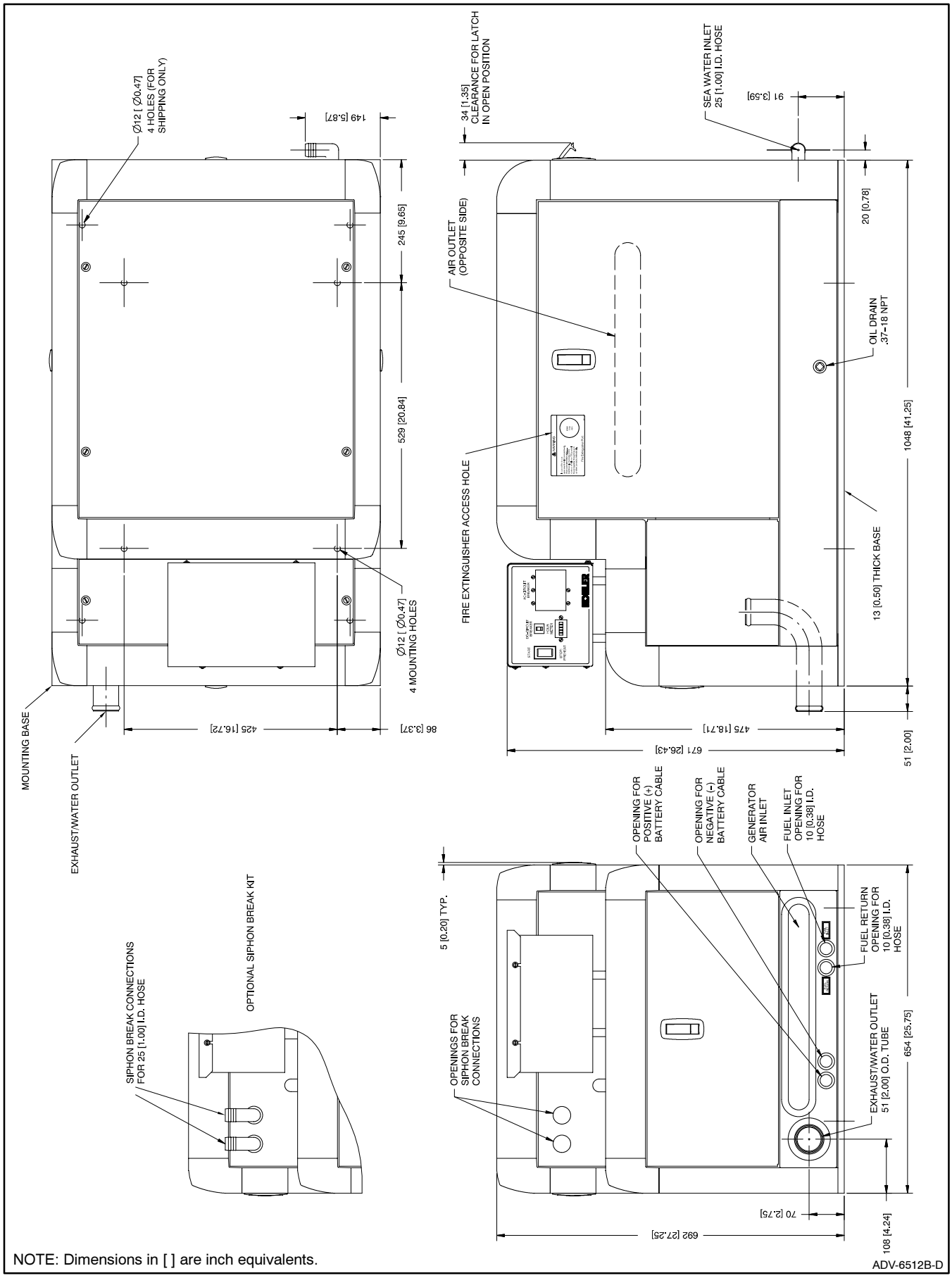


Figure 7-11 Dimension Drawing, 11EFOZ/13EOZ with Sound Shield

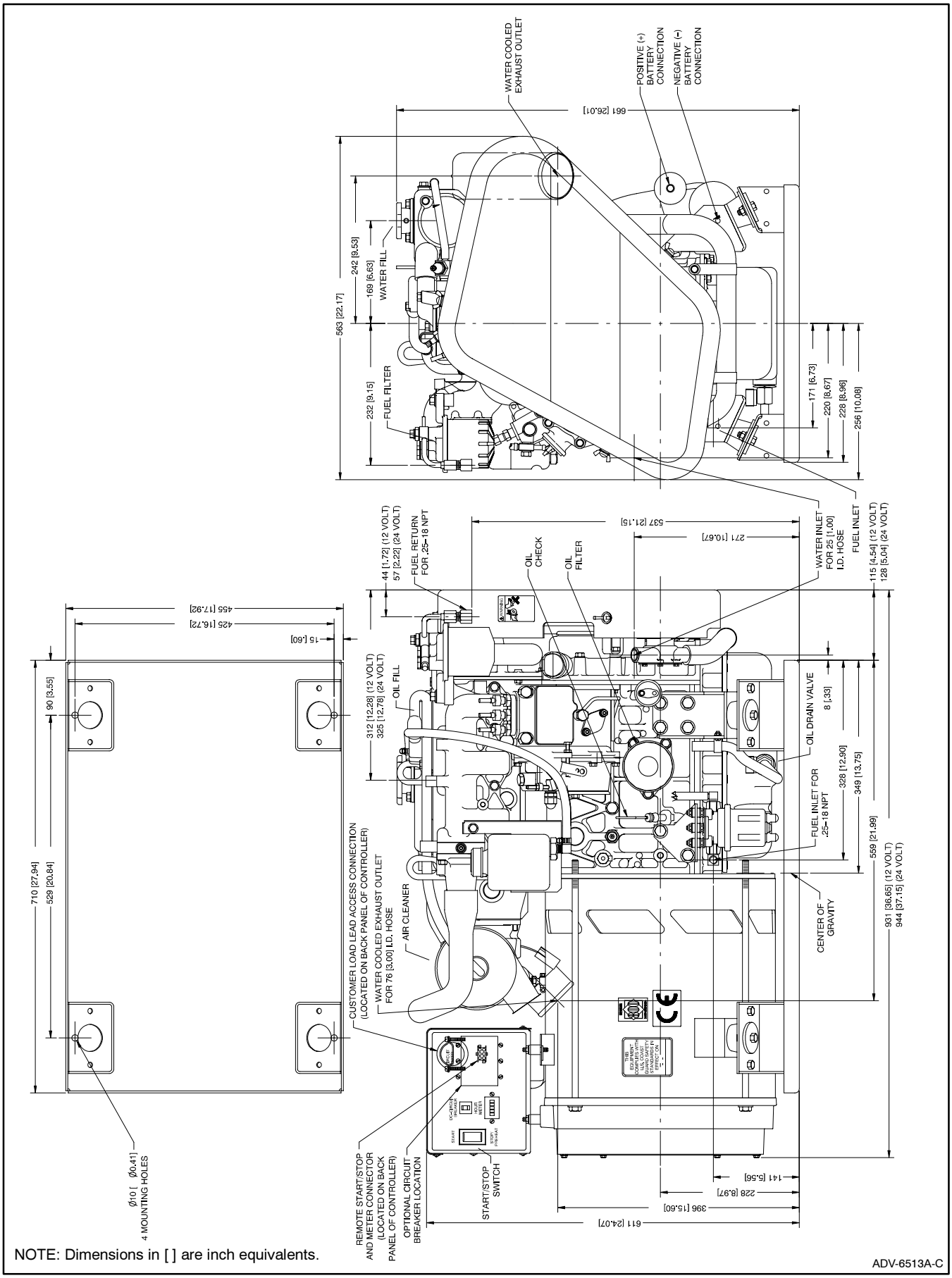


Figure 7-12 Dimension Drawing, 11.5/13EFOZ and 14/15.5EOZ

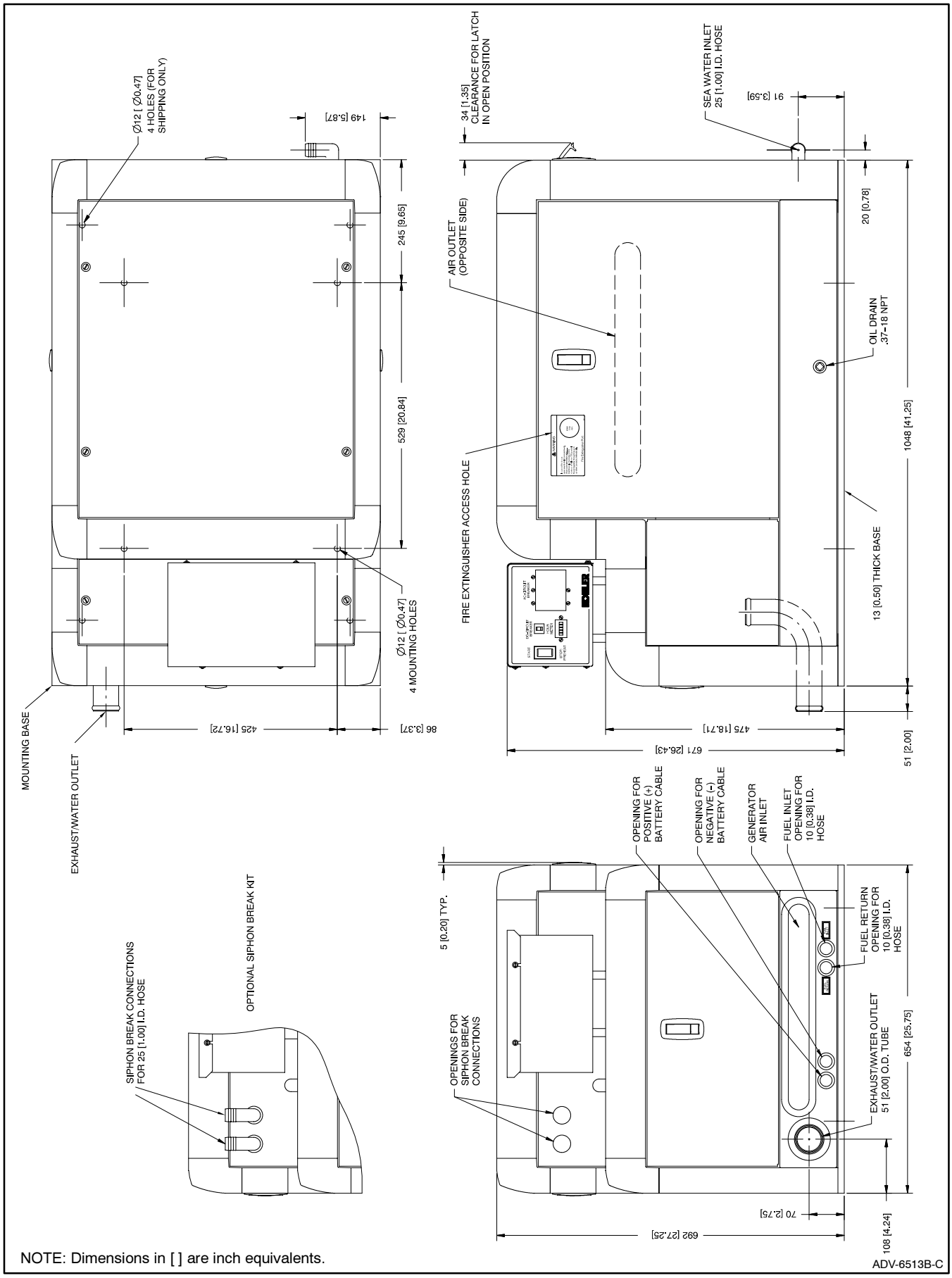


Figure 7-13 Dimension Drawing, 11.5/13EFOZ and 14/15.5EOZ with Sound Shield

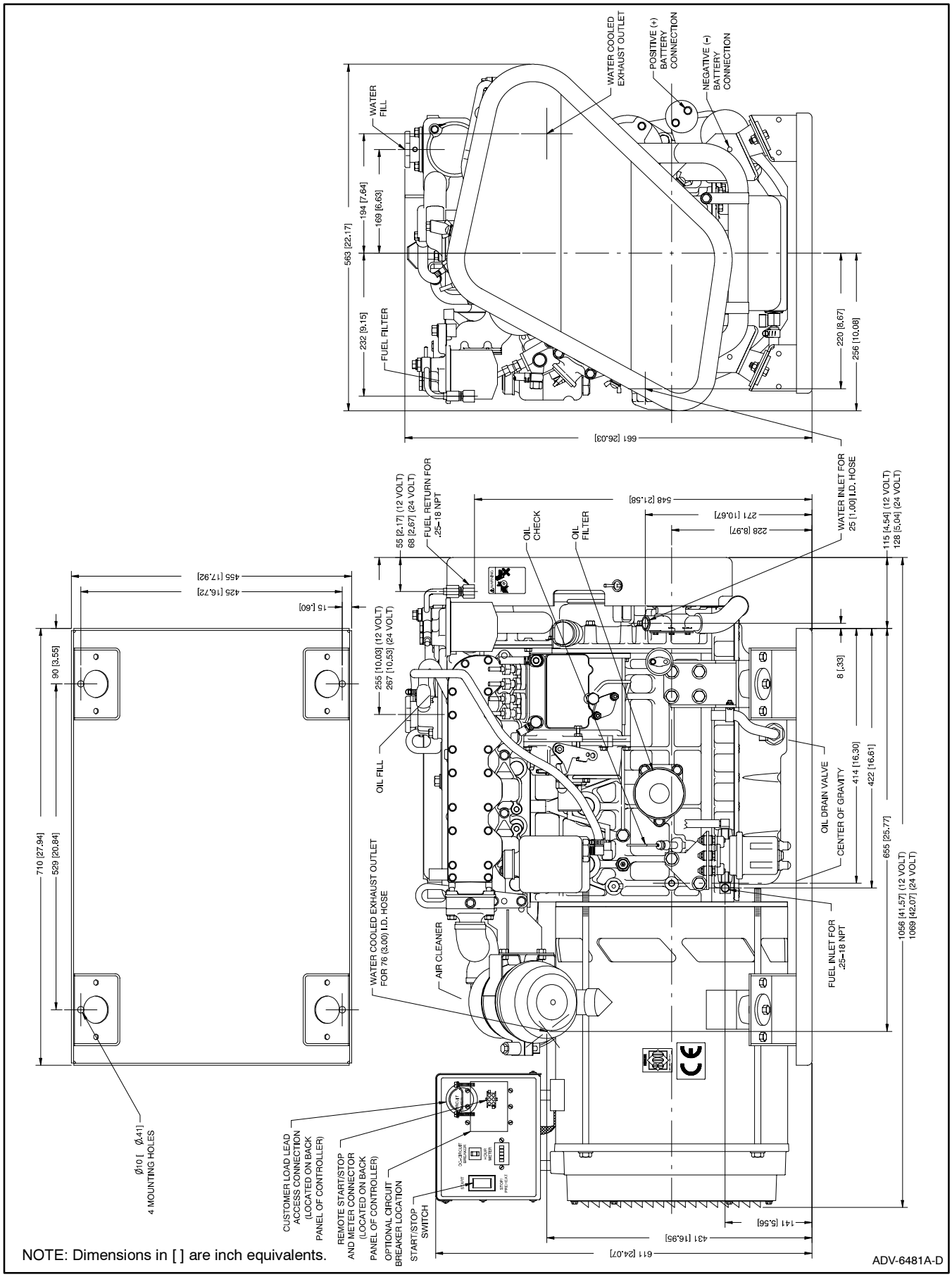


Figure 7-14 Dimension Drawing, 16/17.5EFOZ and 20EOZ

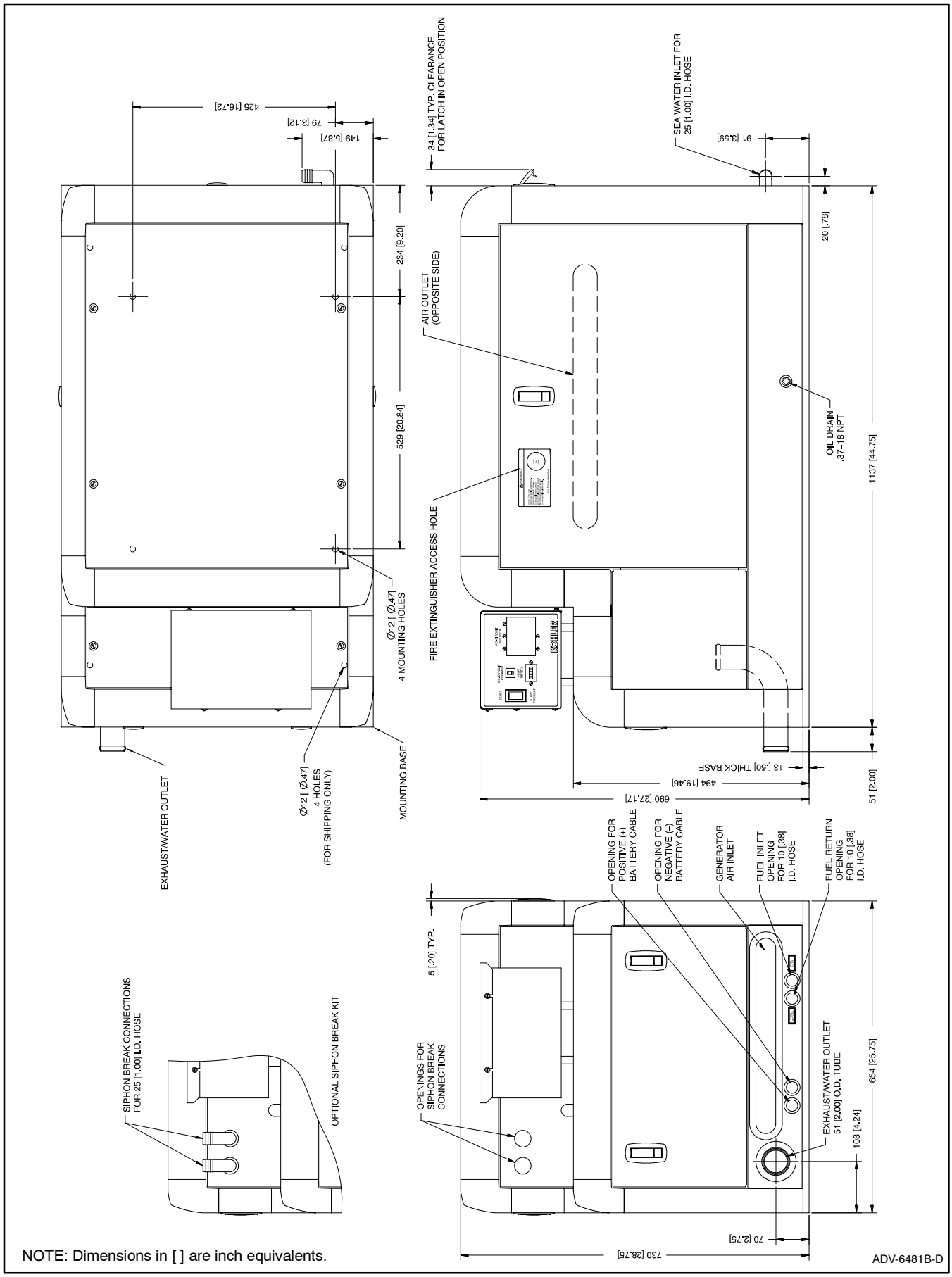


Figure 7-15 Dimension Drawing, 16/17.5EFOZ and 20EOZ with Sound Shield

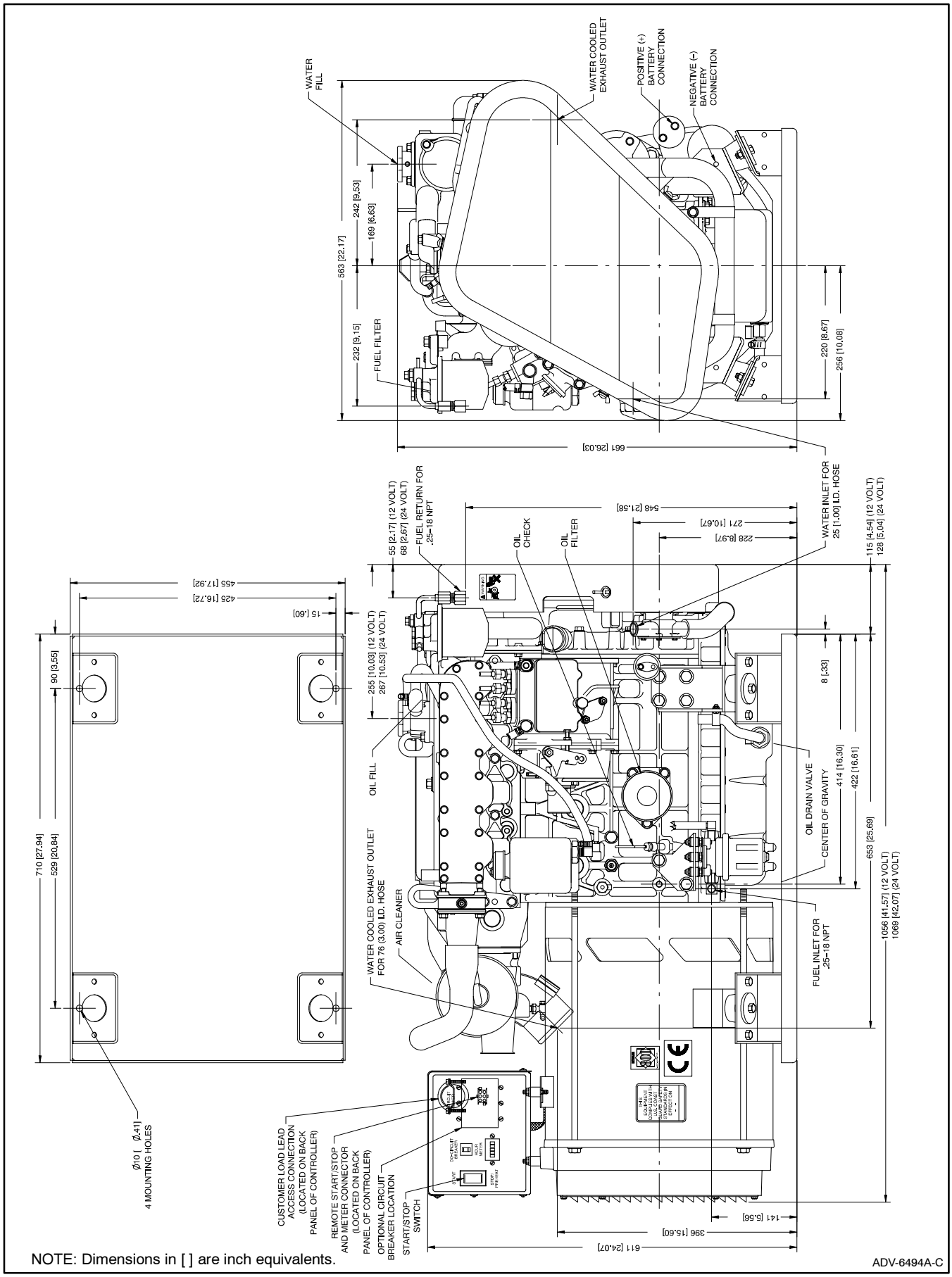


Figure 7-16 Dimension Drawing, 19/20EFOZ and 23/24EOZ

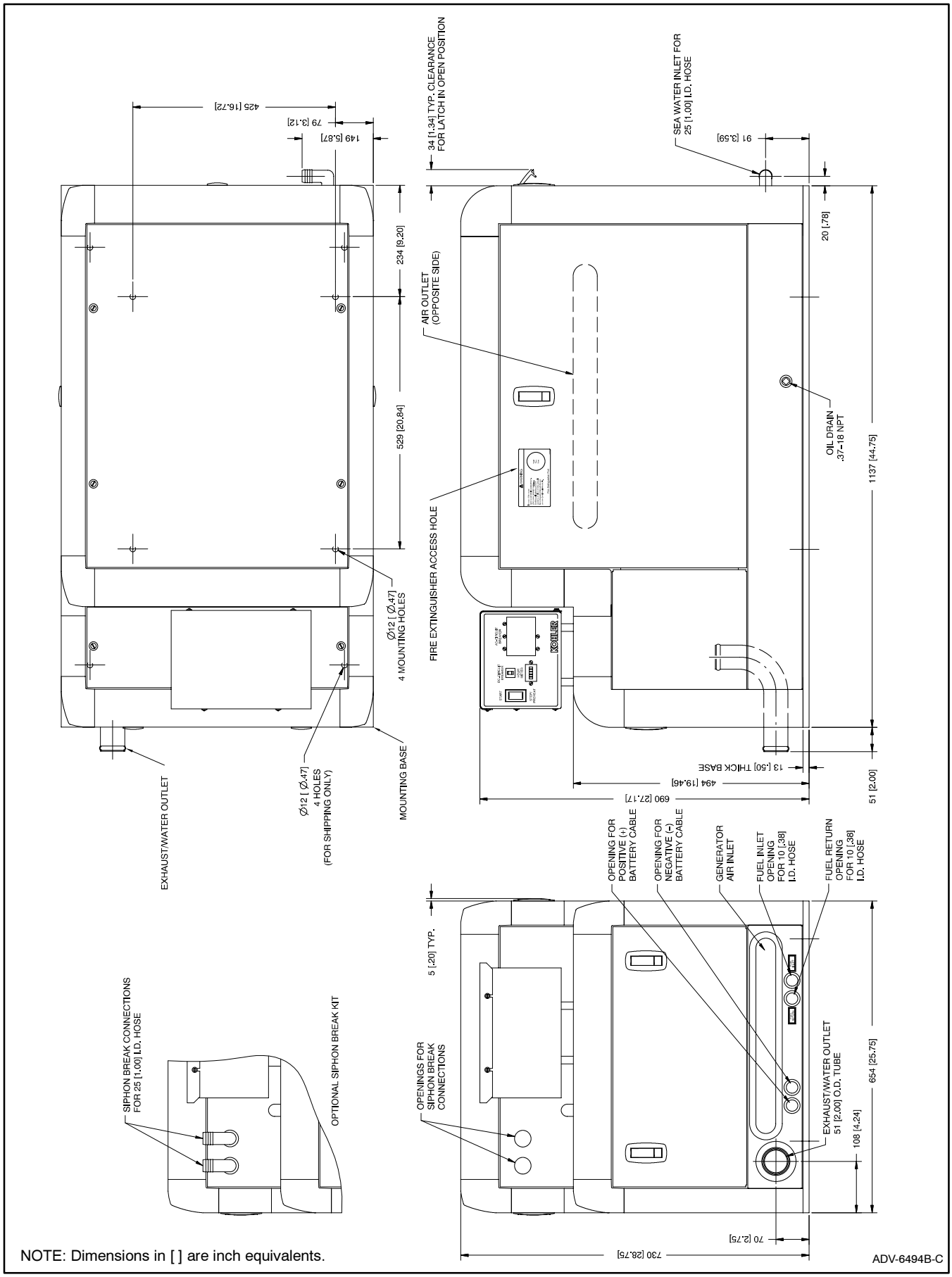


Figure 7-17 Dimension Drawing, 19/20EFOZ and 23/24EOZ with Sound Shield

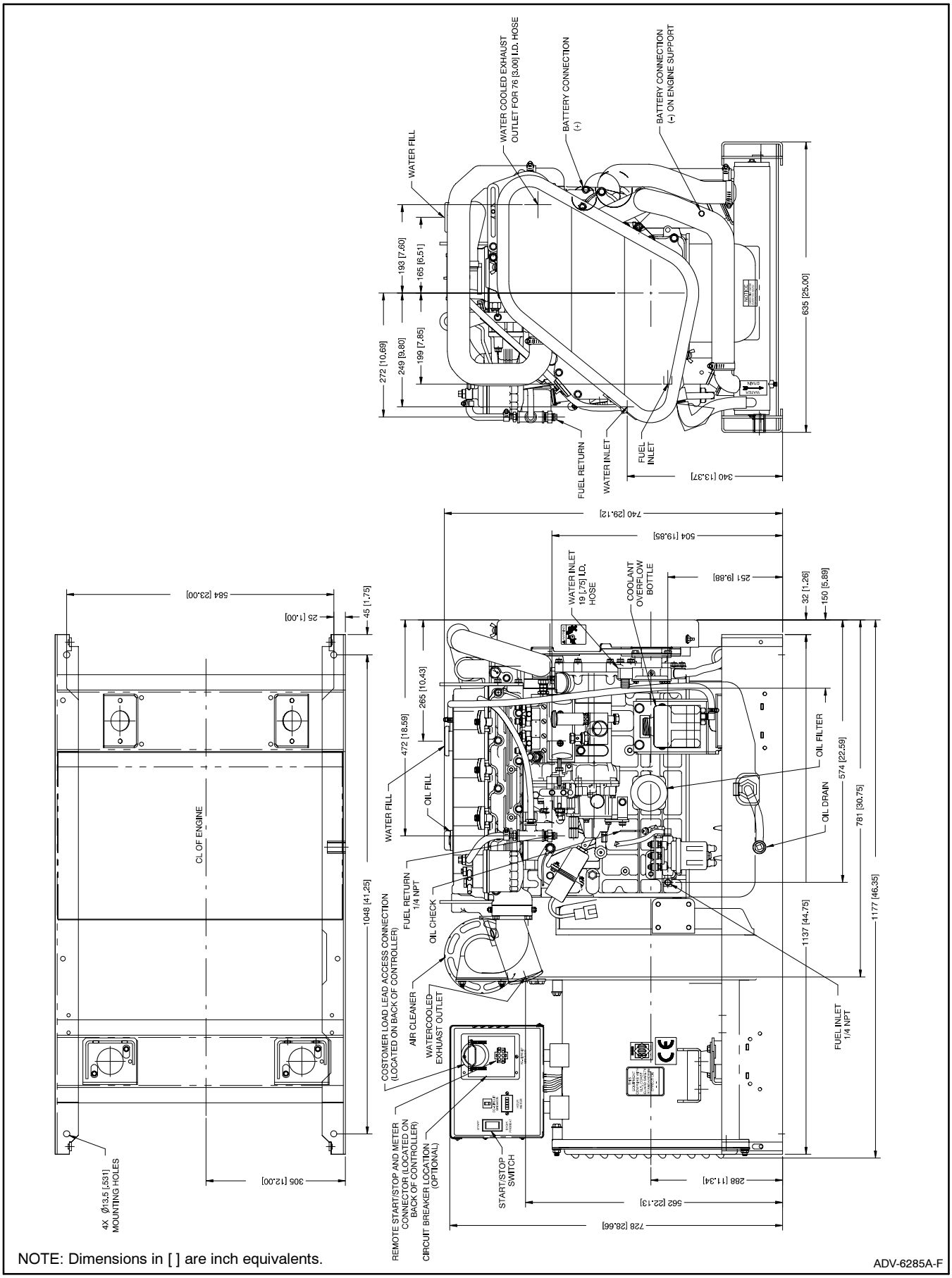


Figure 7-18 Dimension Drawing, 23/27EFOZ and 28/32EOZ

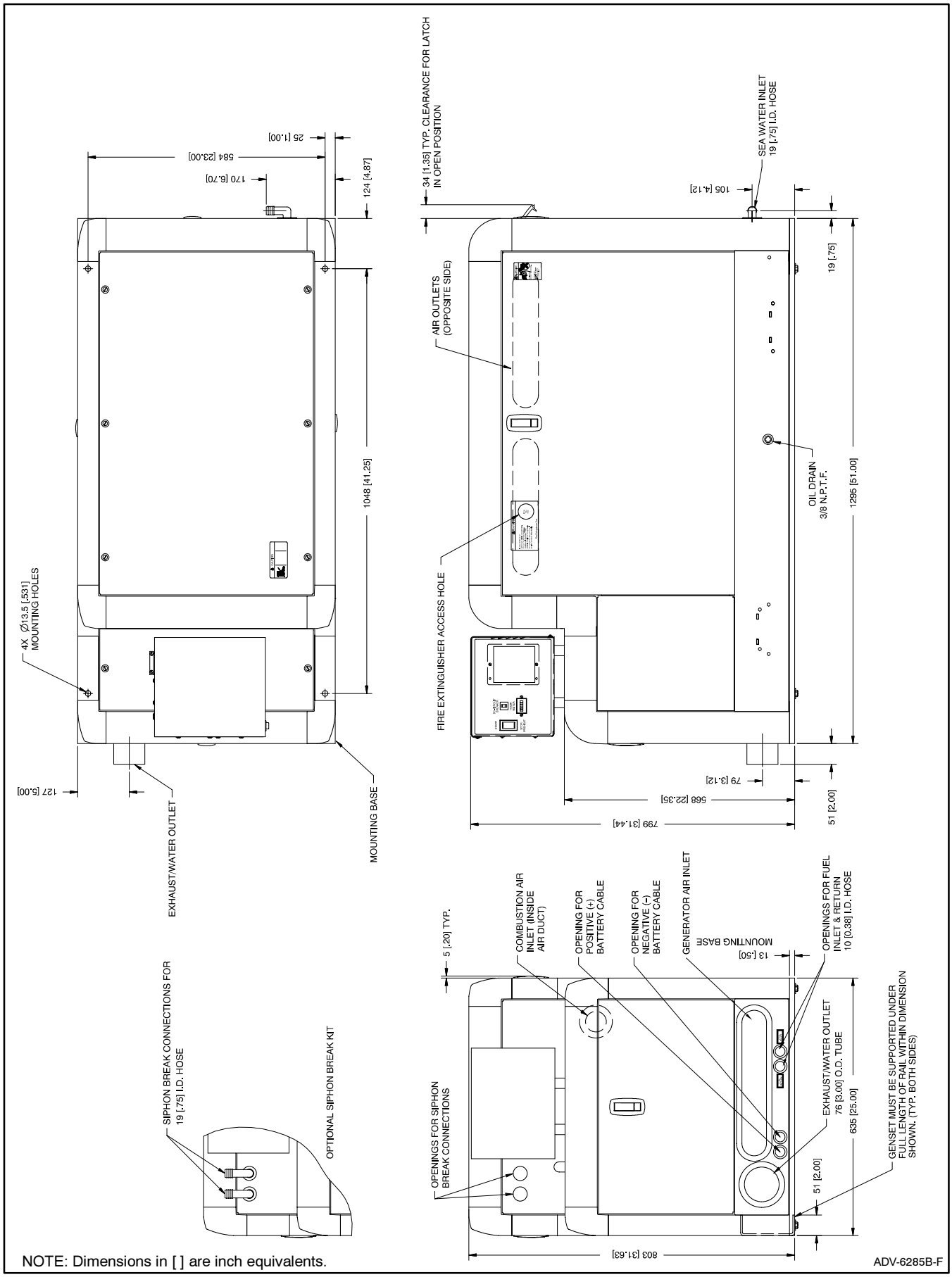


Figure 7-19 Dimension Drawing, 23/27EFOZ and 28/32EOZ with Sound Shield

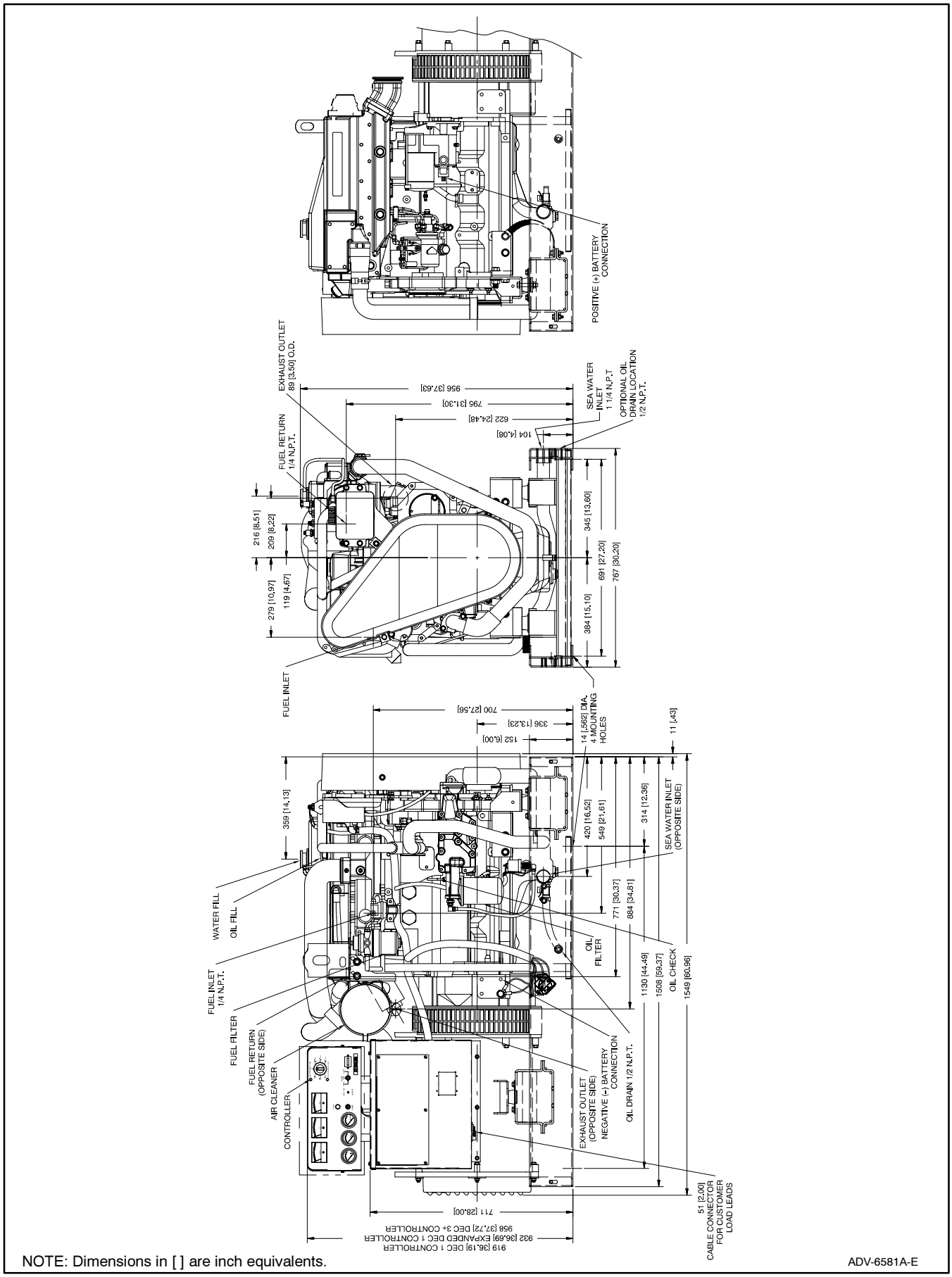


Figure 7-20 Dimension Drawing, 33EFOZ/40EOZ

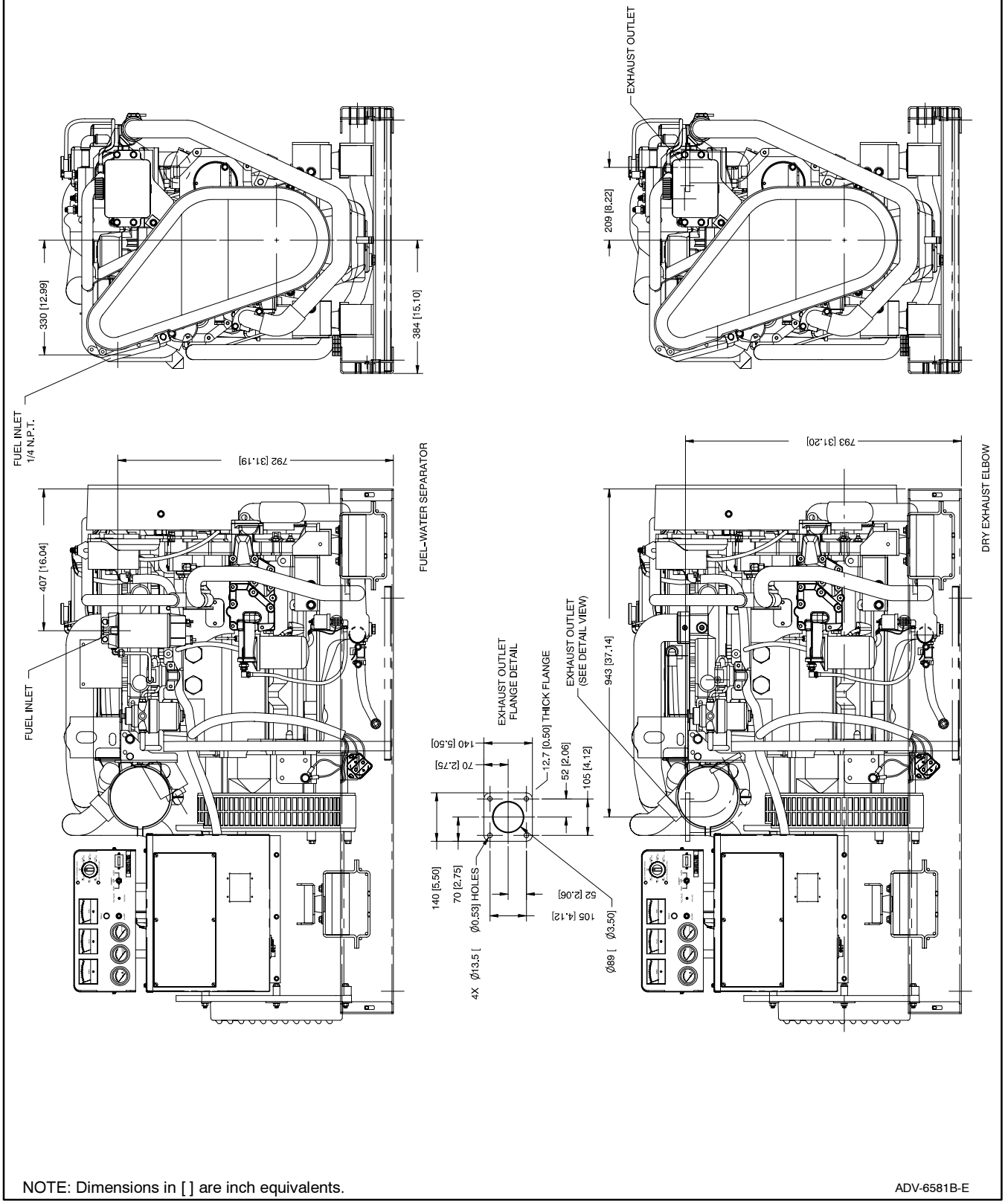


Figure 7-21 Dimension Drawing, 33EFOZ/40EOZ with Fuel/Water Separator and Dry Exhaust Elbow

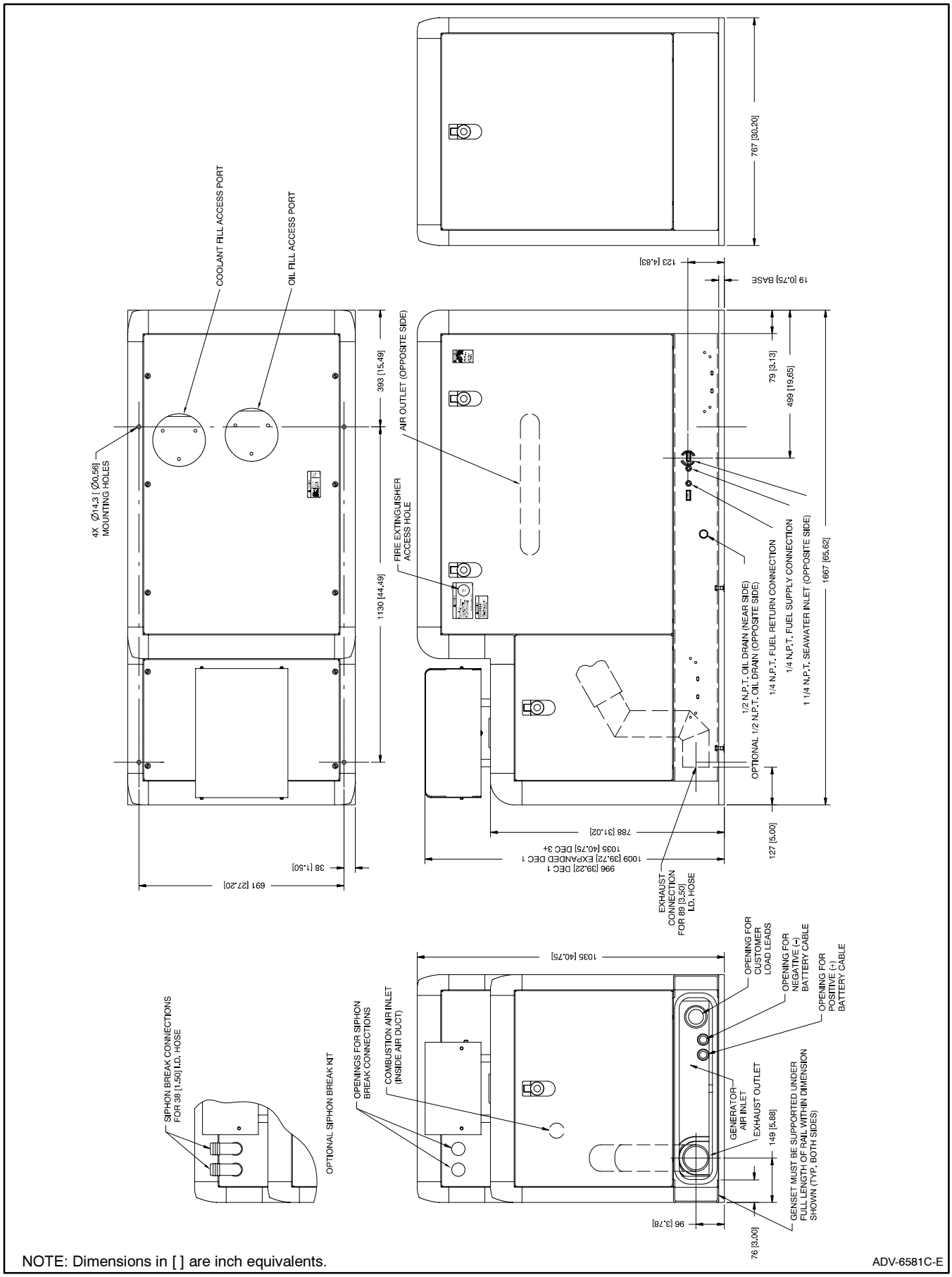
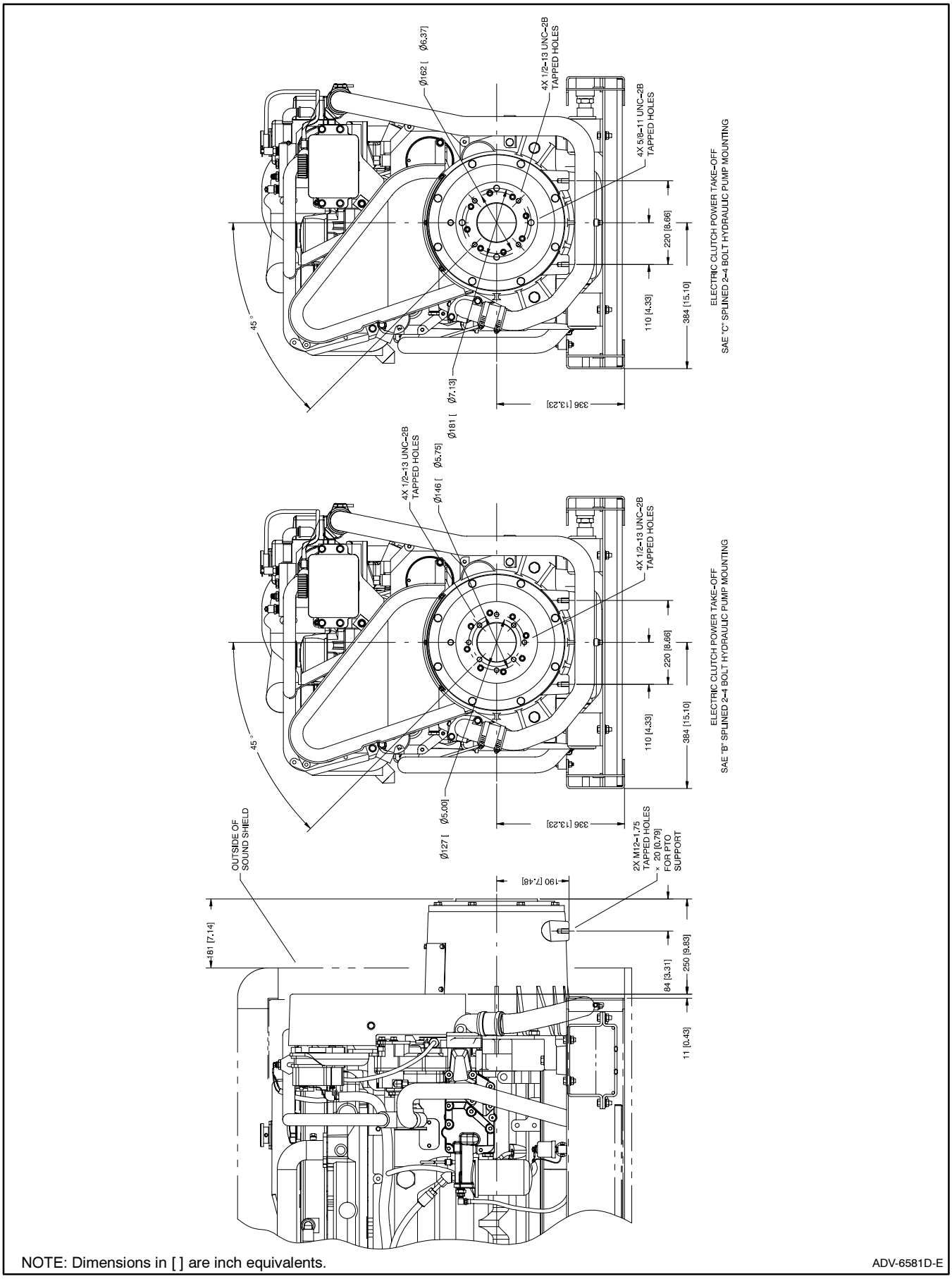


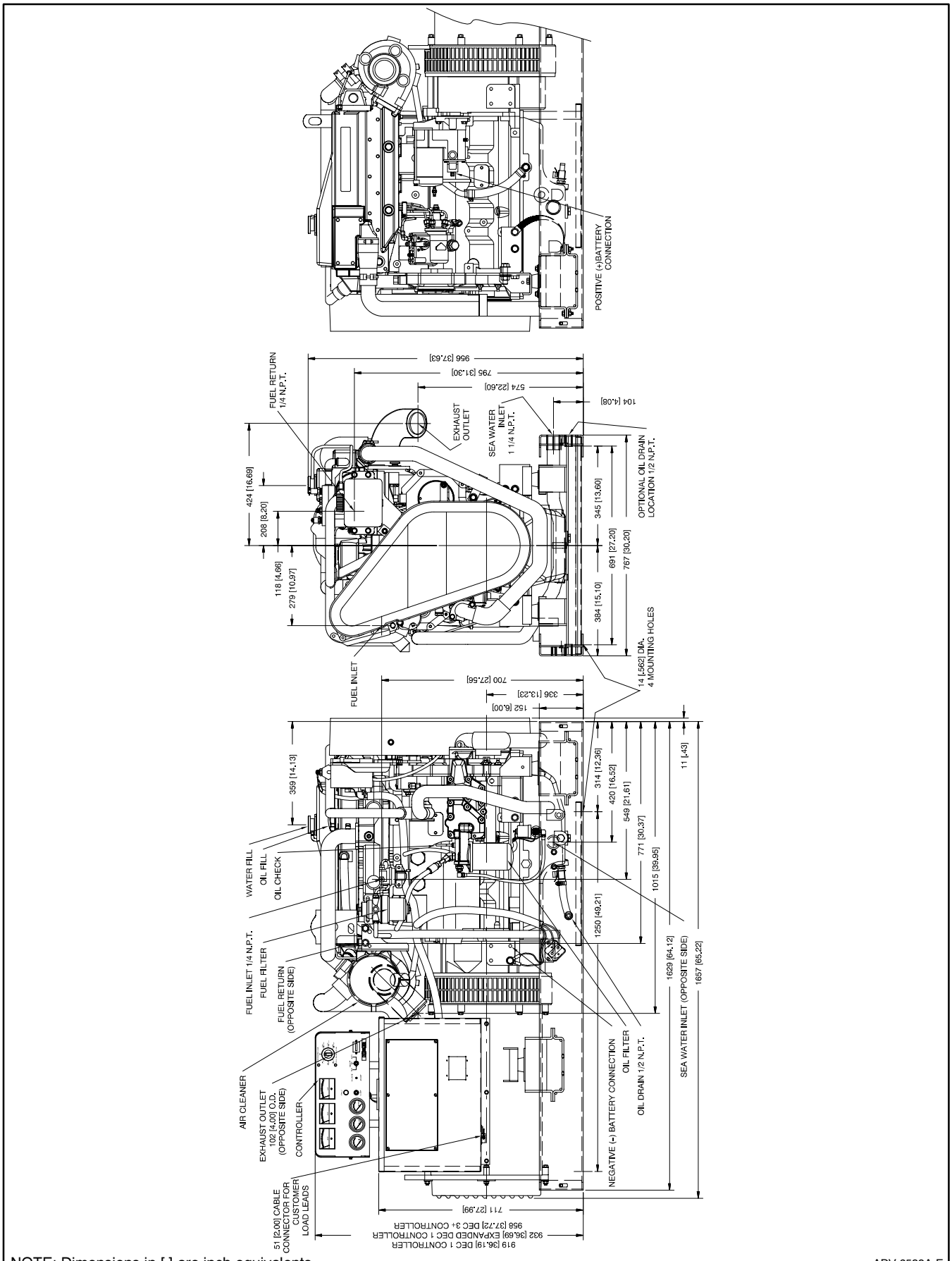
Figure 7-22 Dimension Drawing, 33EFOZ/40EOZ with Sound Shield



NOTE: Dimensions in [ ] are inch equivalents.

ADV-6581D-E

Figure 7-23 Dimension Drawing, 33EFOZ/40EOZ with Electric Clutch



NOTE: Dimensions in [ ] are inch equivalents.

ADV-6582A-E

Figure 7-24 Dimension Drawing, 40EFOZ/50EOZ

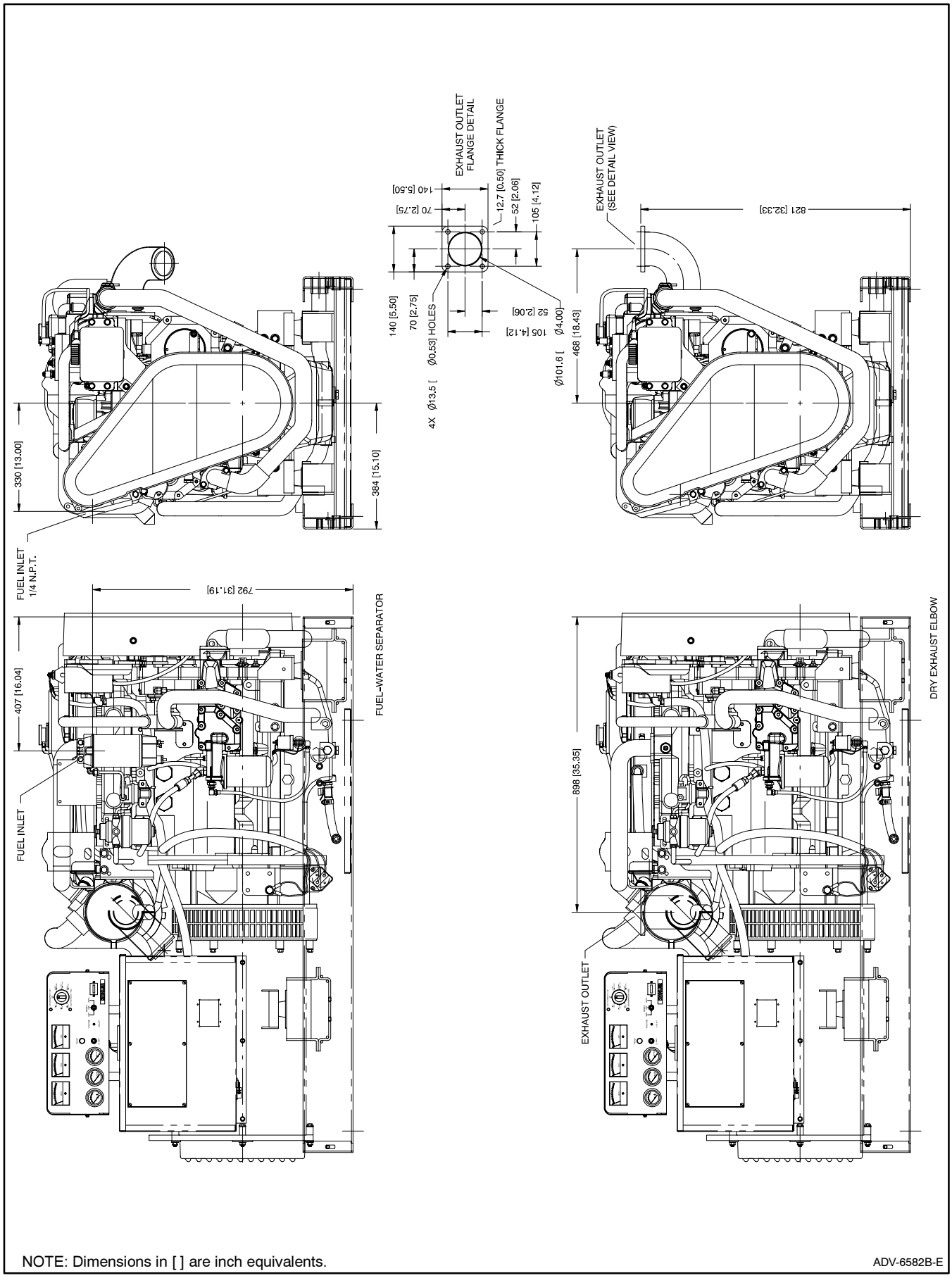


Figure 7-25 Dimension Drawing, 40EFOZ/50EOZ with Fuel/Water Separator and Dry Exhaust Elbow

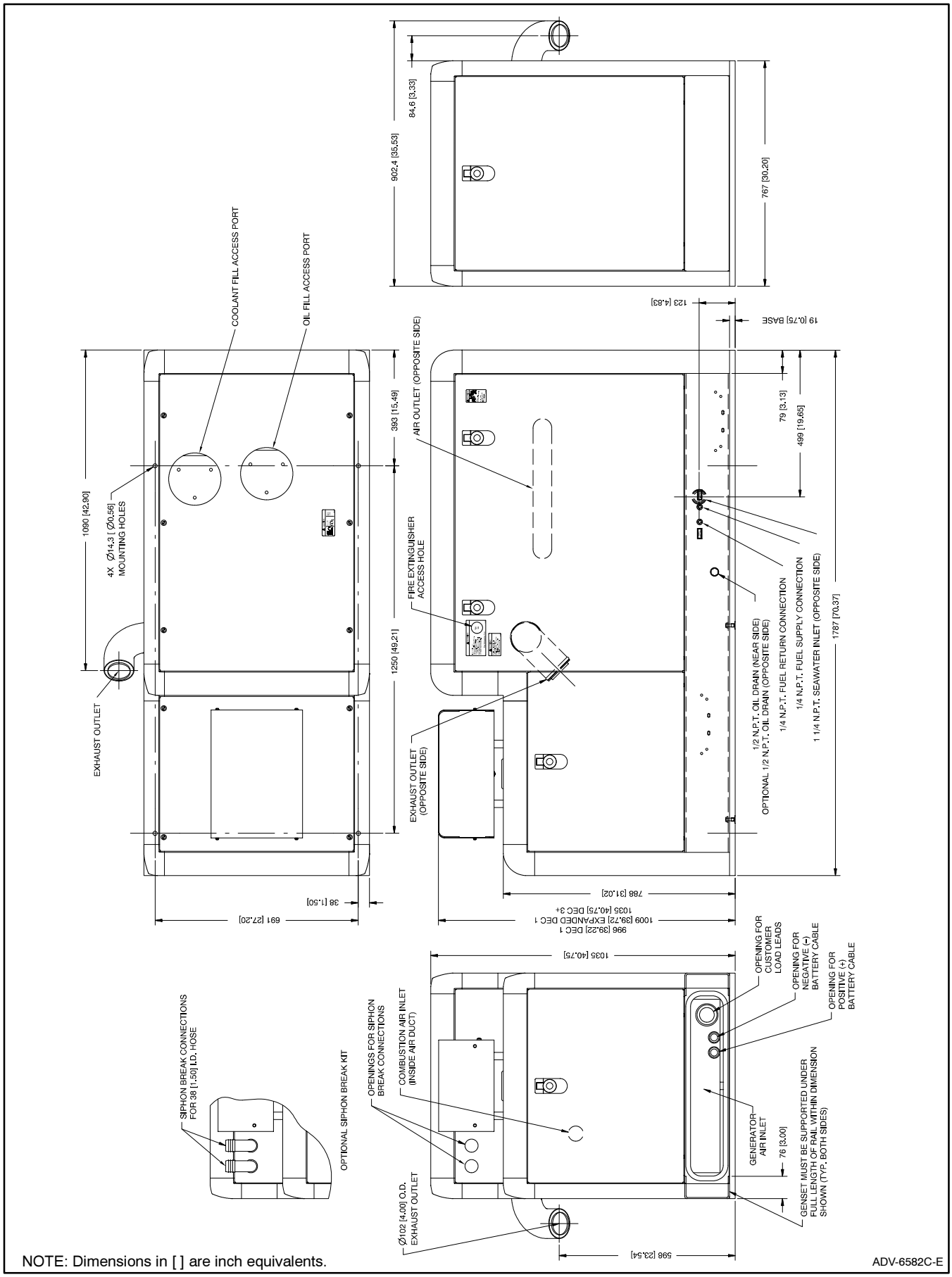
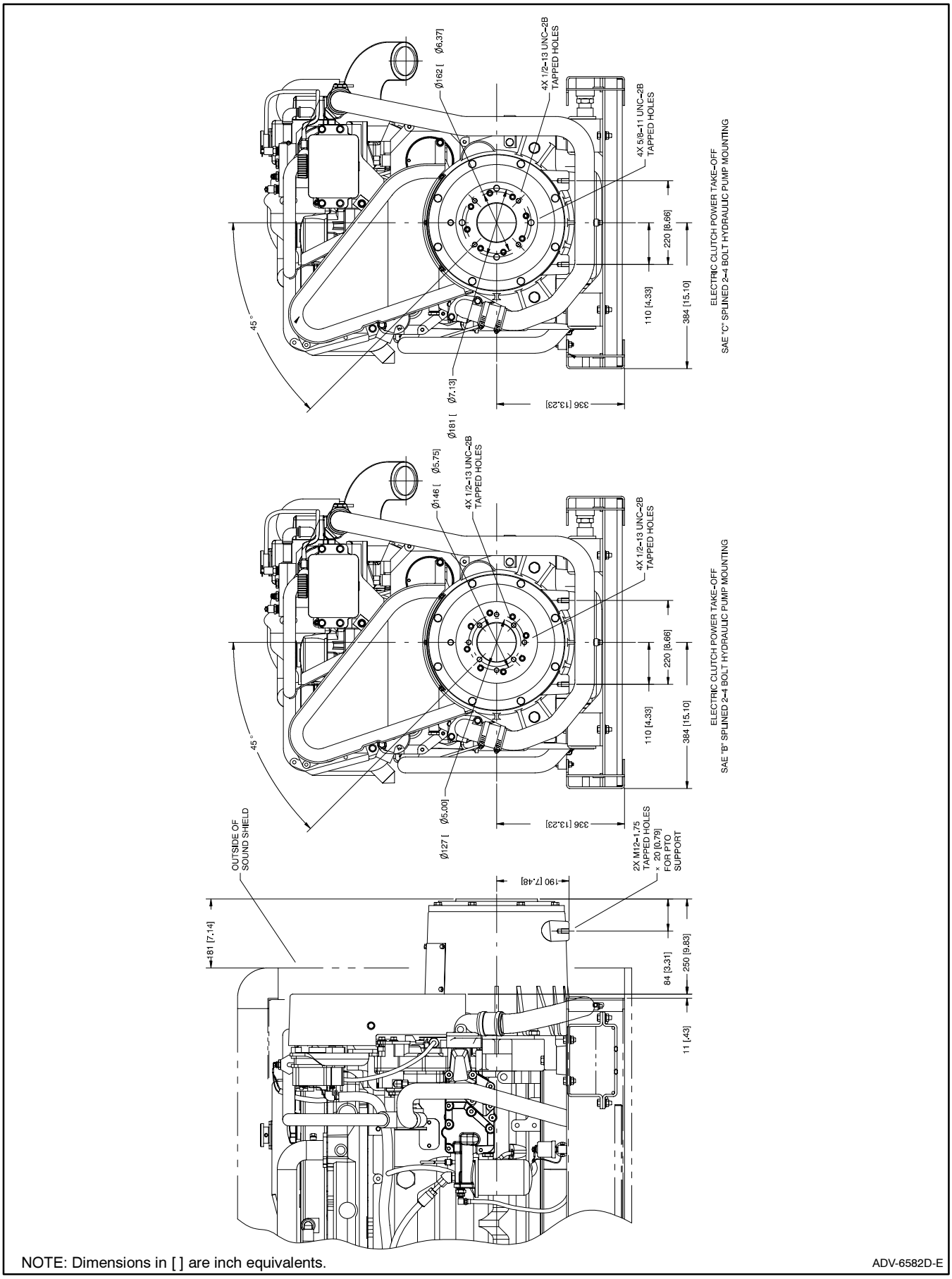


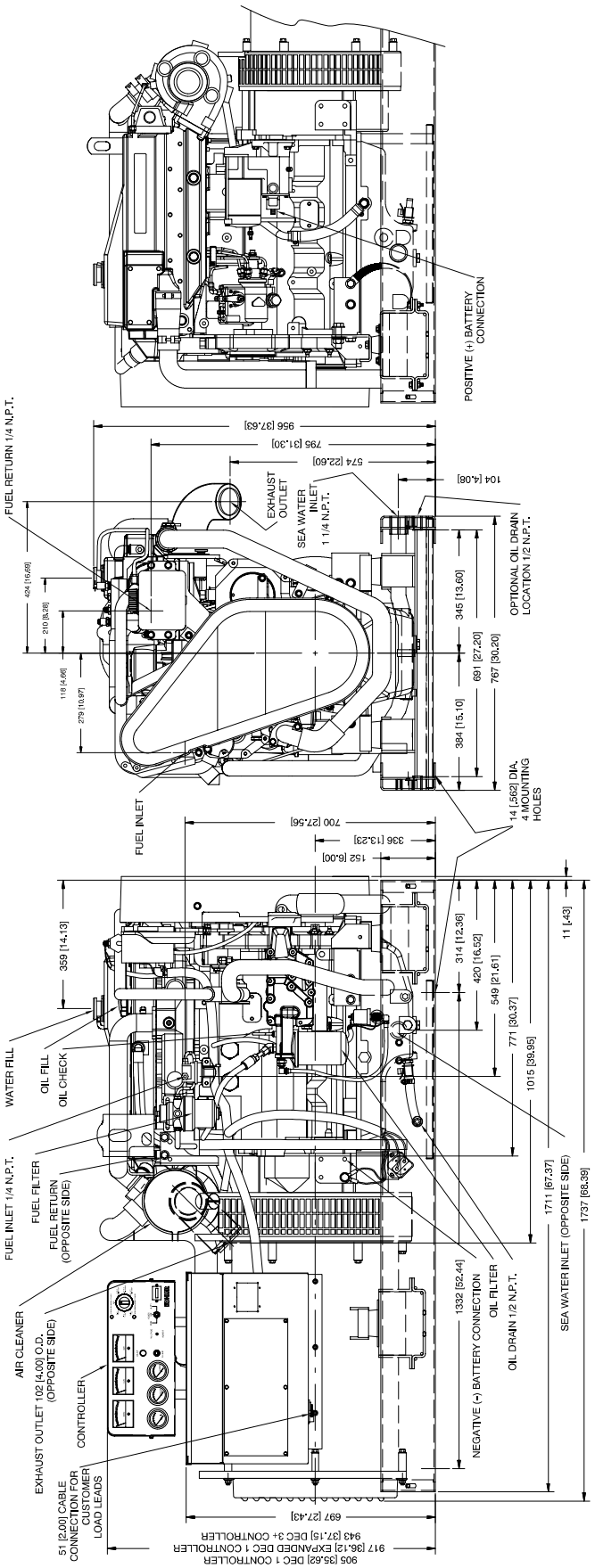
Figure 7-26 Dimension Drawing, 40EFOZ/50EOZ with Sound Shield



NOTE: Dimensions in [ ] are inch equivalents.

ADV-6582D-E

Figure 7-27 Dimension Drawing, 40EFOZ/50EOZ with Electric Clutch



NOTE: Dimensions in [ ] are inch equivalents.

ADV-6583A-E

Figure 7-28 Dimension Drawing, 55EFOZ/65EOZ

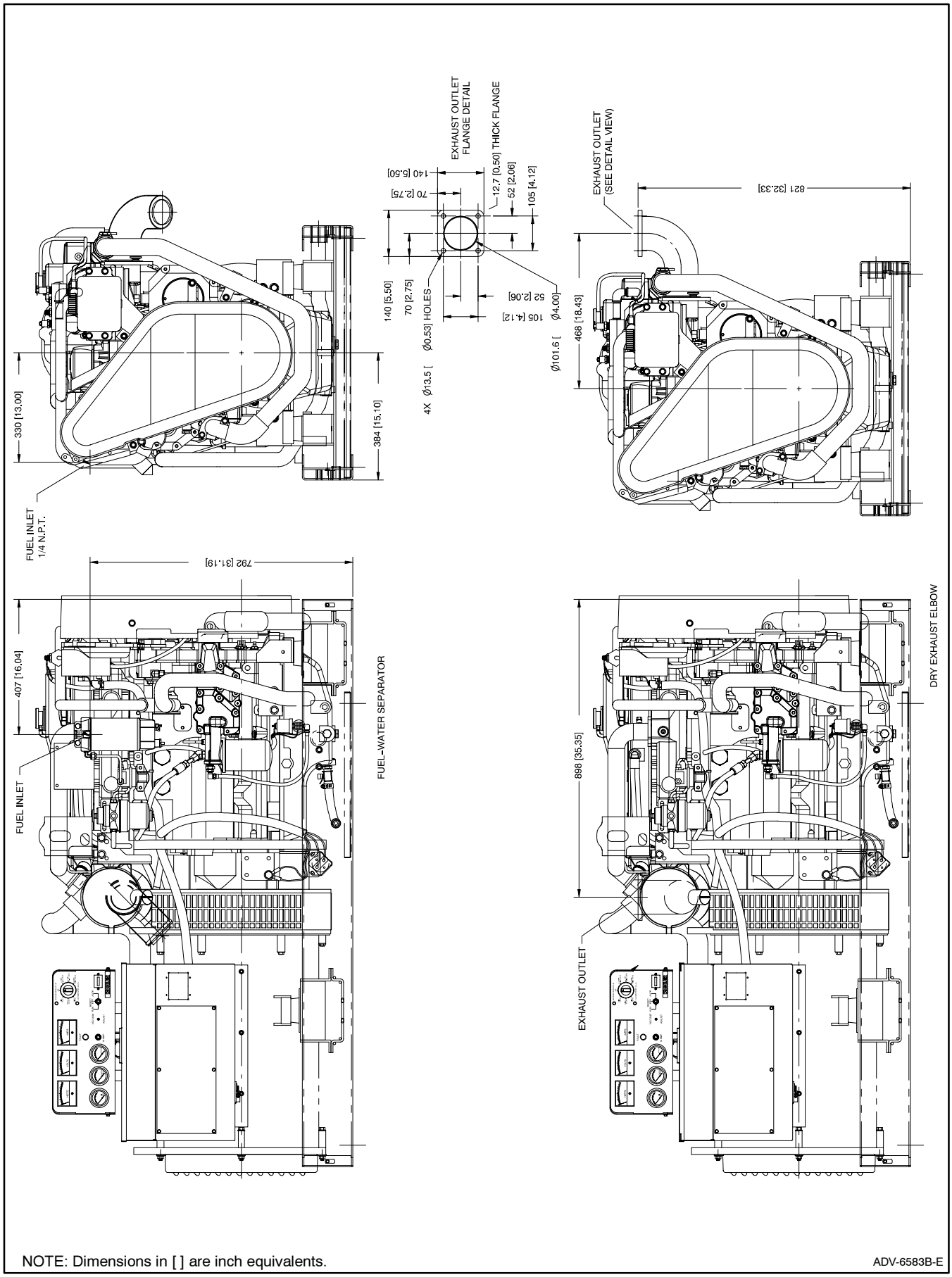


Figure 7-29 Dimension Drawing, 55EFOZ/65EOZ with Fuel/Water Separator and Dry Exhaust Elbow

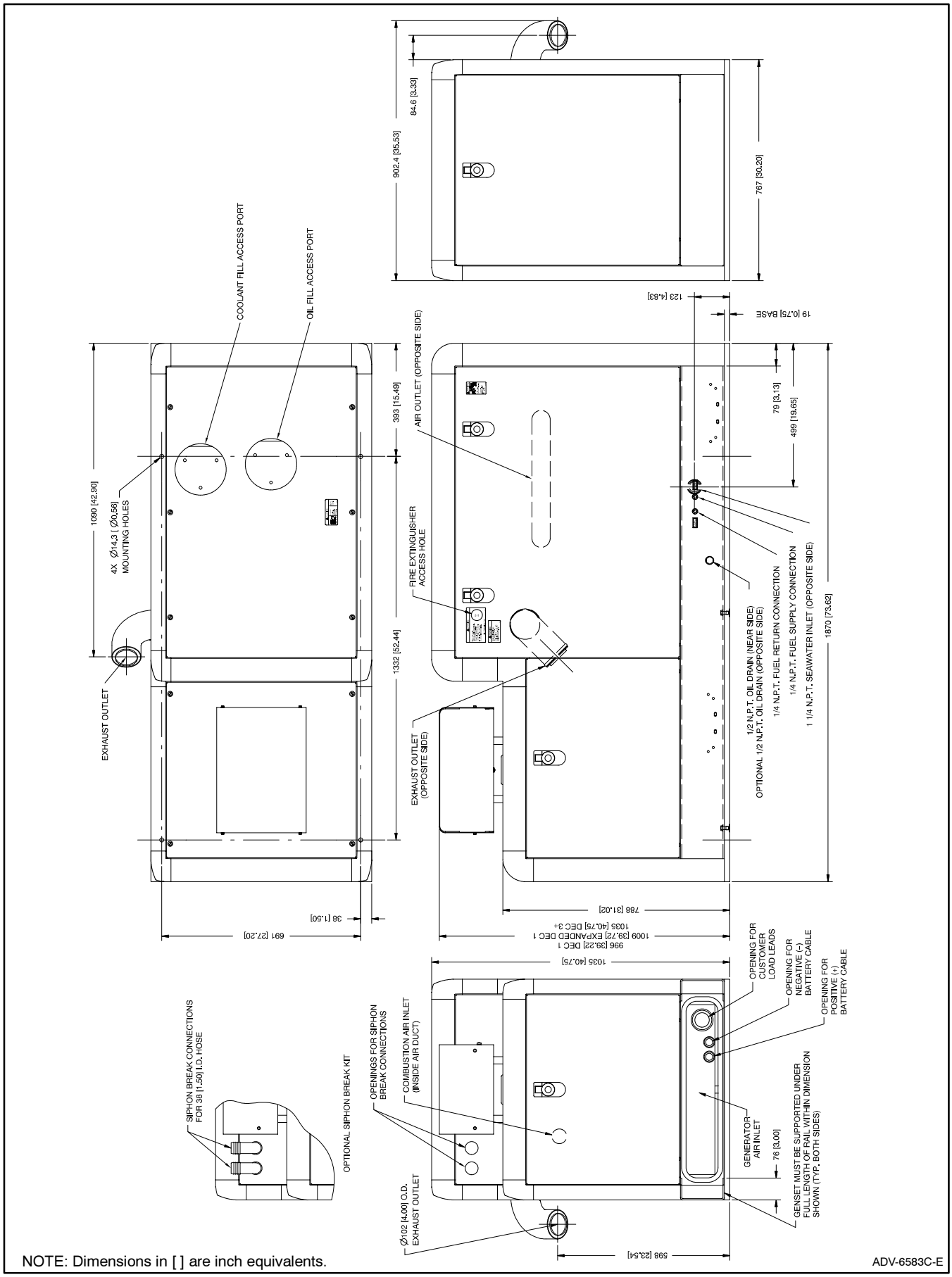
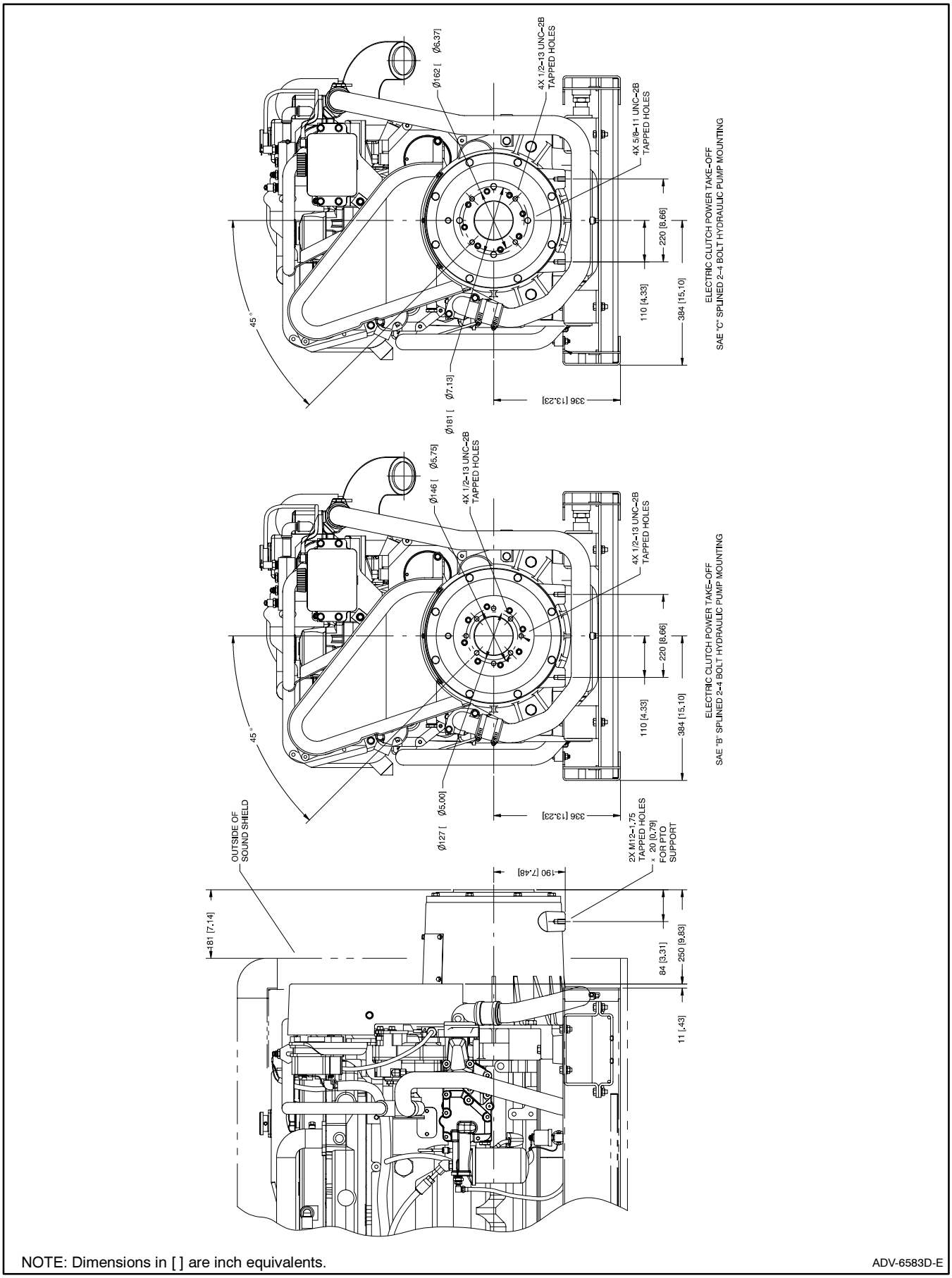


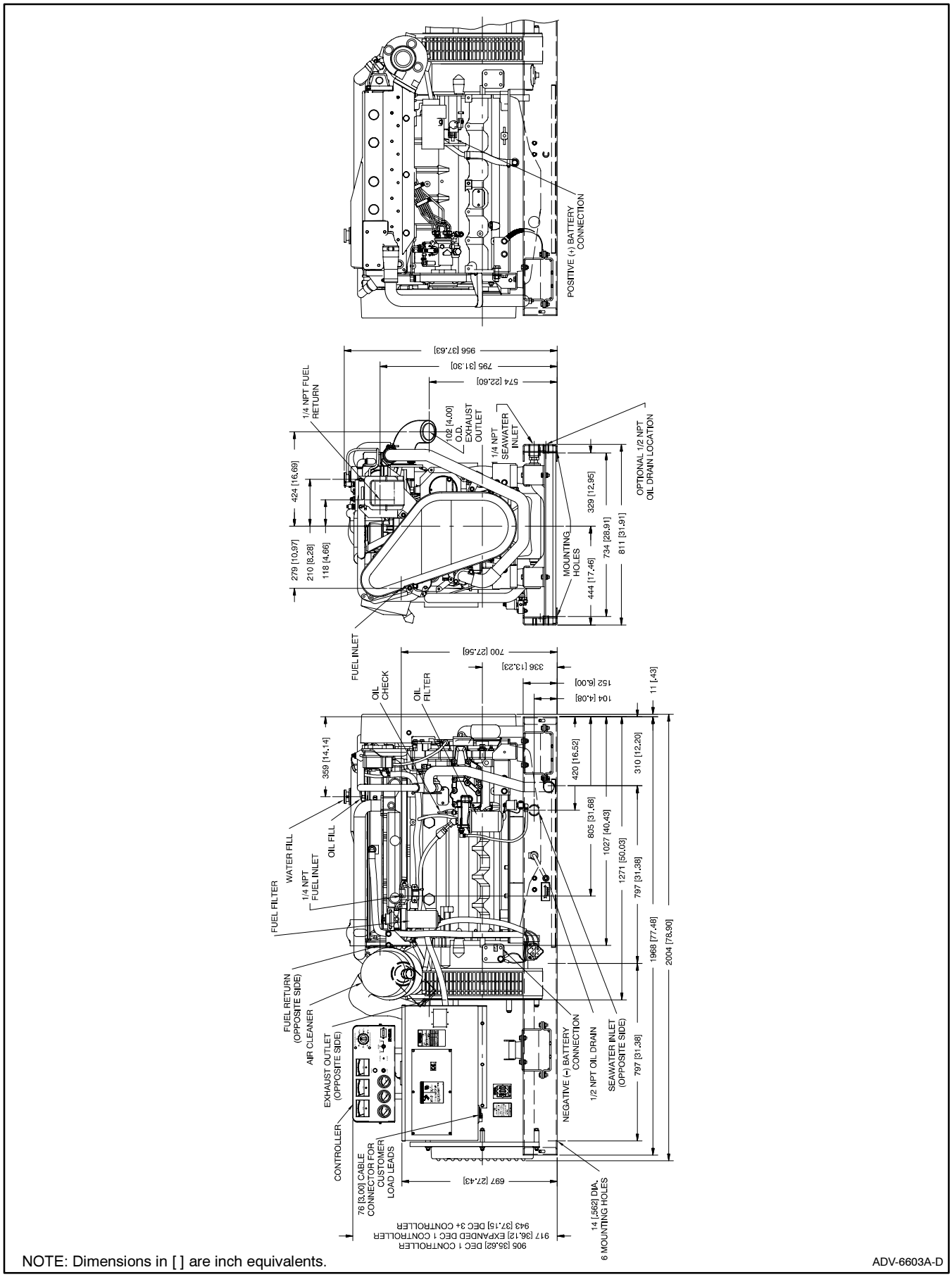
Figure 7-30 Dimension Drawing, 55EFOZ/65EOZ with Sound Shield



NOTE: Dimensions in [ ] are inch equivalents.

ADV-6583D-E

Figure 7-31 Dimension Drawing, 55EFOZ/65EOZ with Electric Clutch



NOTE: Dimensions in [ ] are inch equivalents.

ADV-6603A-D

Figure 7-32 Dimension Drawing, 70/80EFOZ and 80/99EOZ

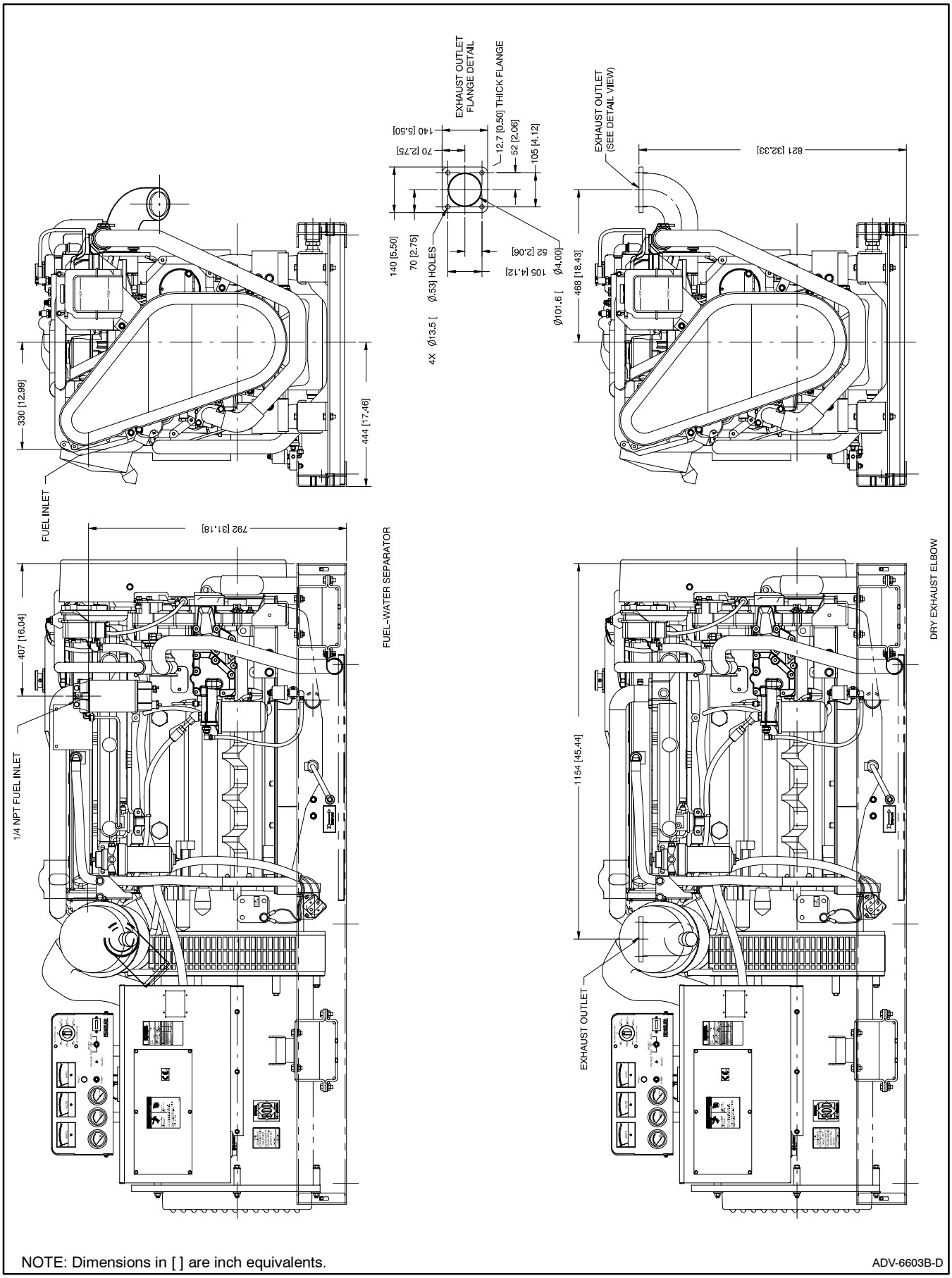


Figure 7-33 Dimension Drawing, 70/80EFOZ and 80/99EOZ with Fuel/Water Separator and Dry Exhaust Elbow

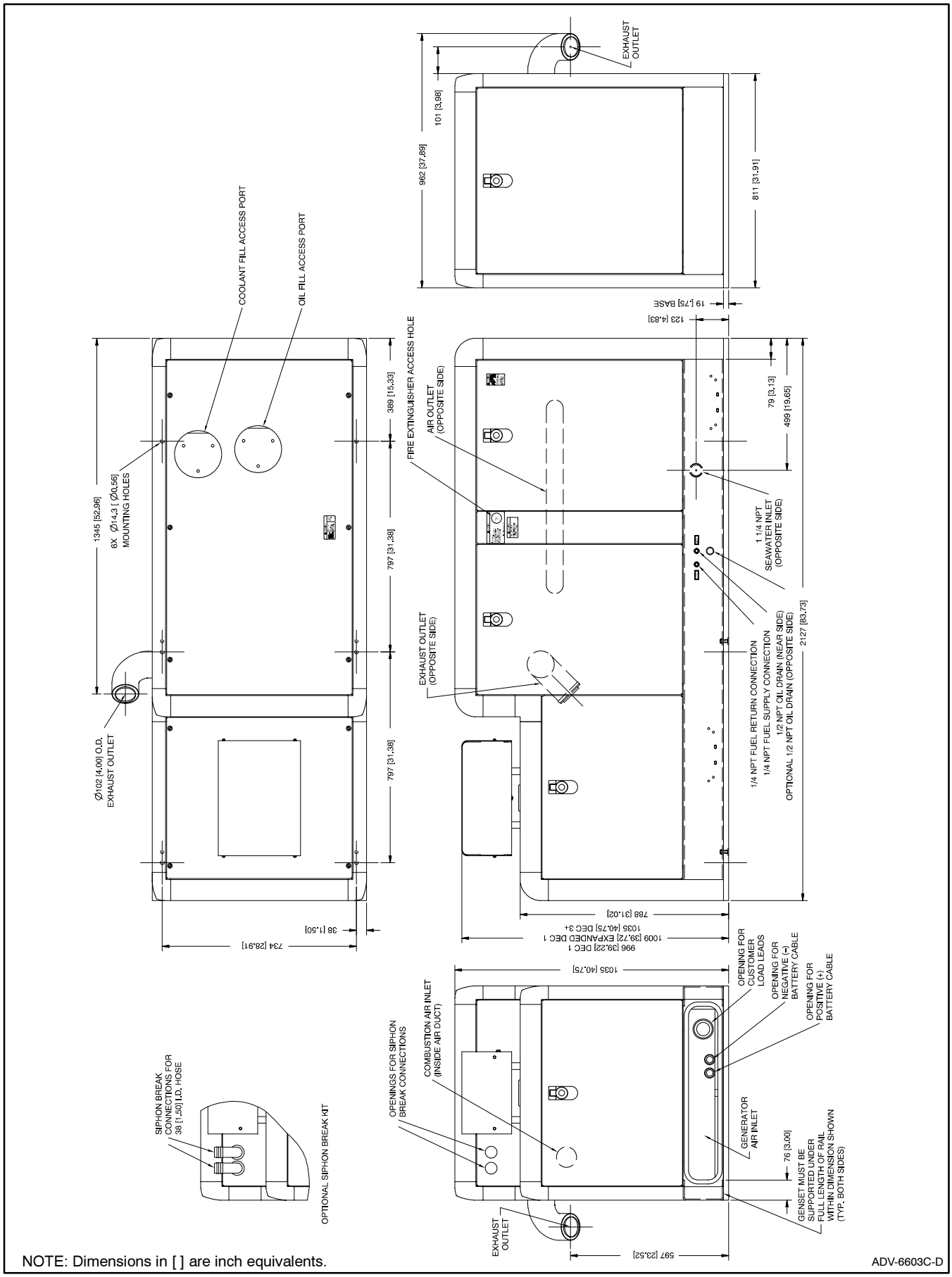
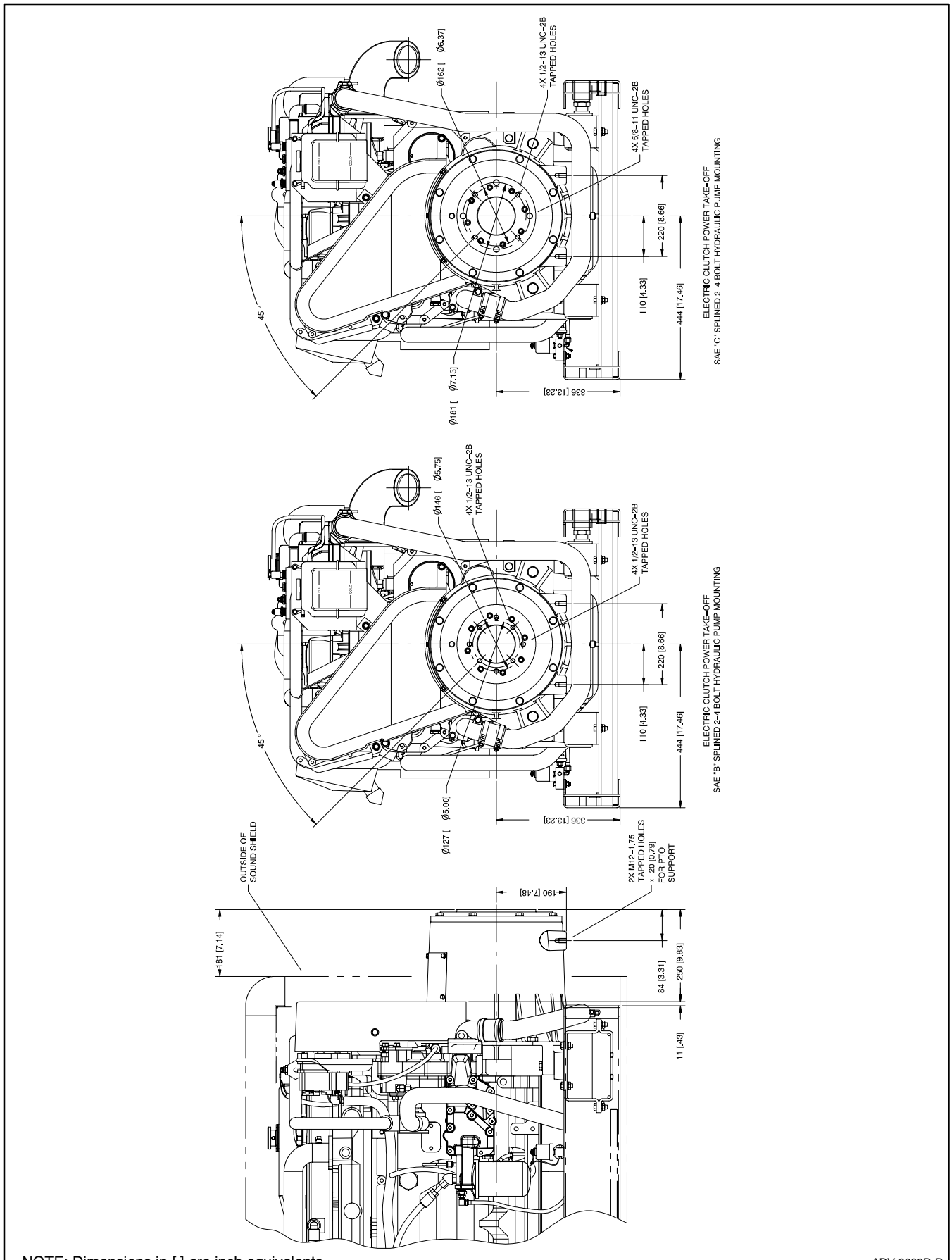


Figure 7-34 Dimension Drawing, 70/80EFOZ and 80/99EOZ with Sound Shield



NOTE: Dimensions in [ ] are inch equivalents.

ADV-6603D-D

Figure 7-35 Dimension Drawing, 70/80EFOZ and 80/99EOZ with Electric Clutch

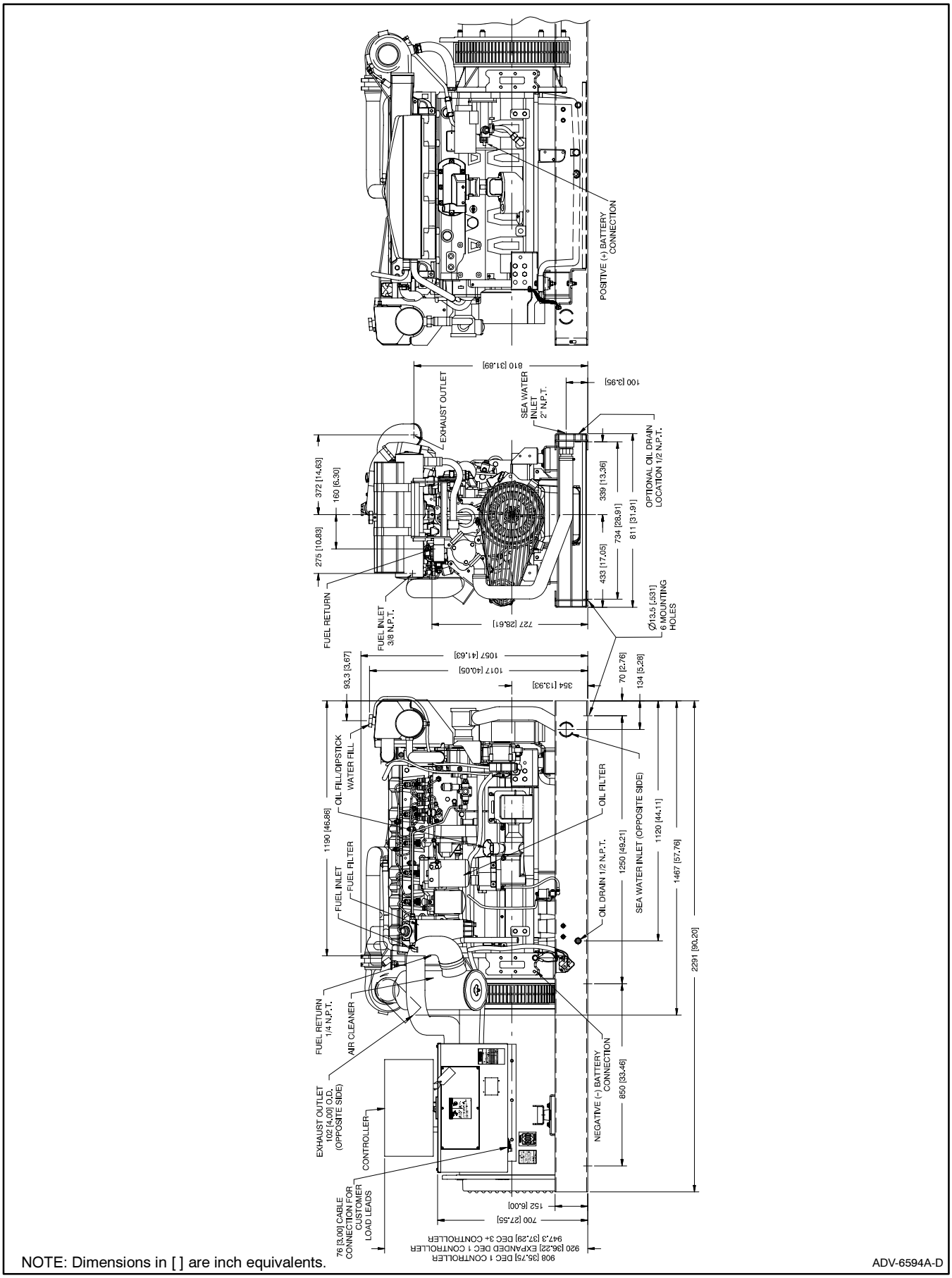


Figure 7-36 Dimension Drawing, 100/125EFOZ and 125/150EOZ

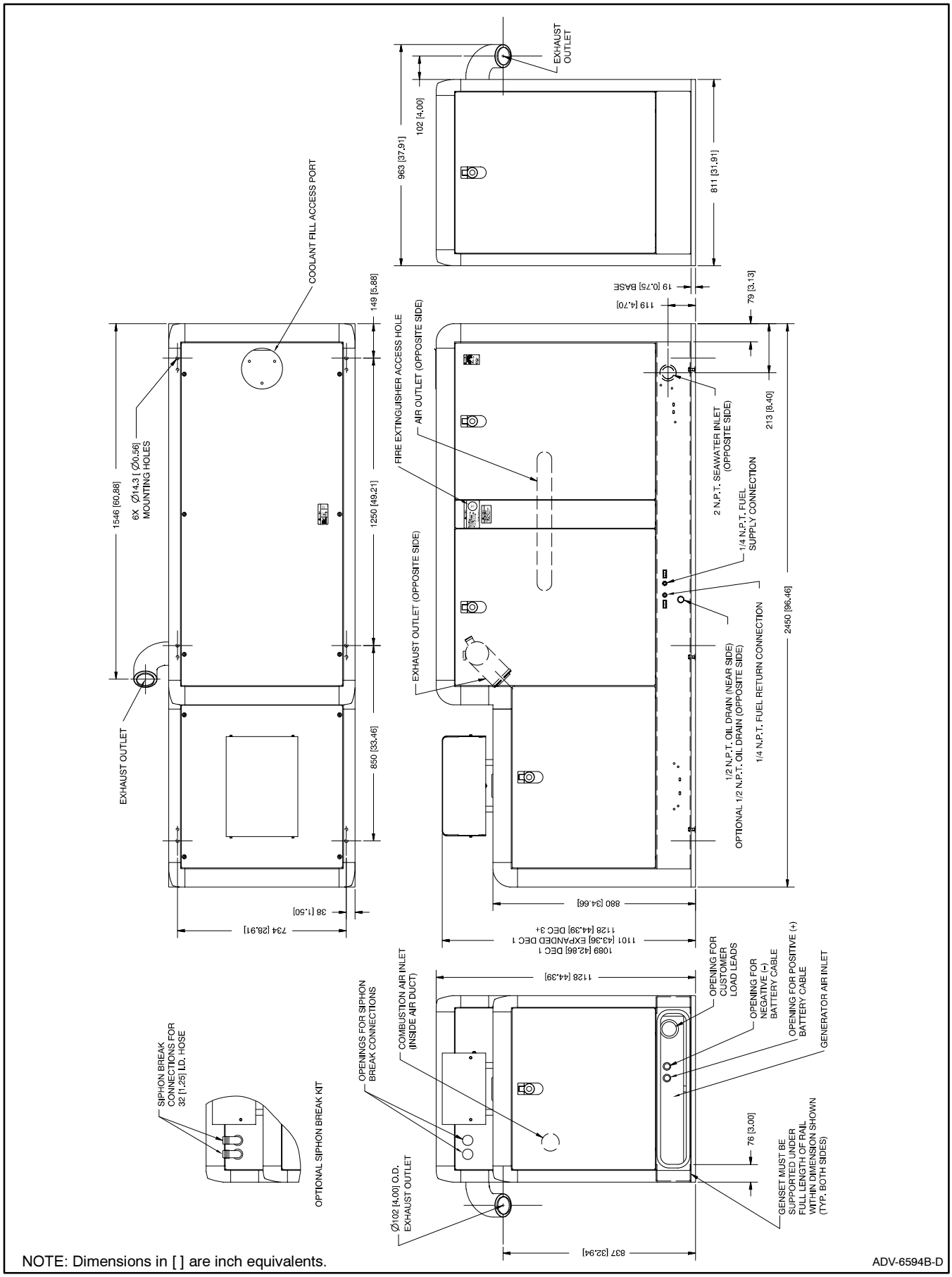


Figure 7-37 Dimension Drawing, 100/125EFOZ and 125/150EOZ with Sound Shield

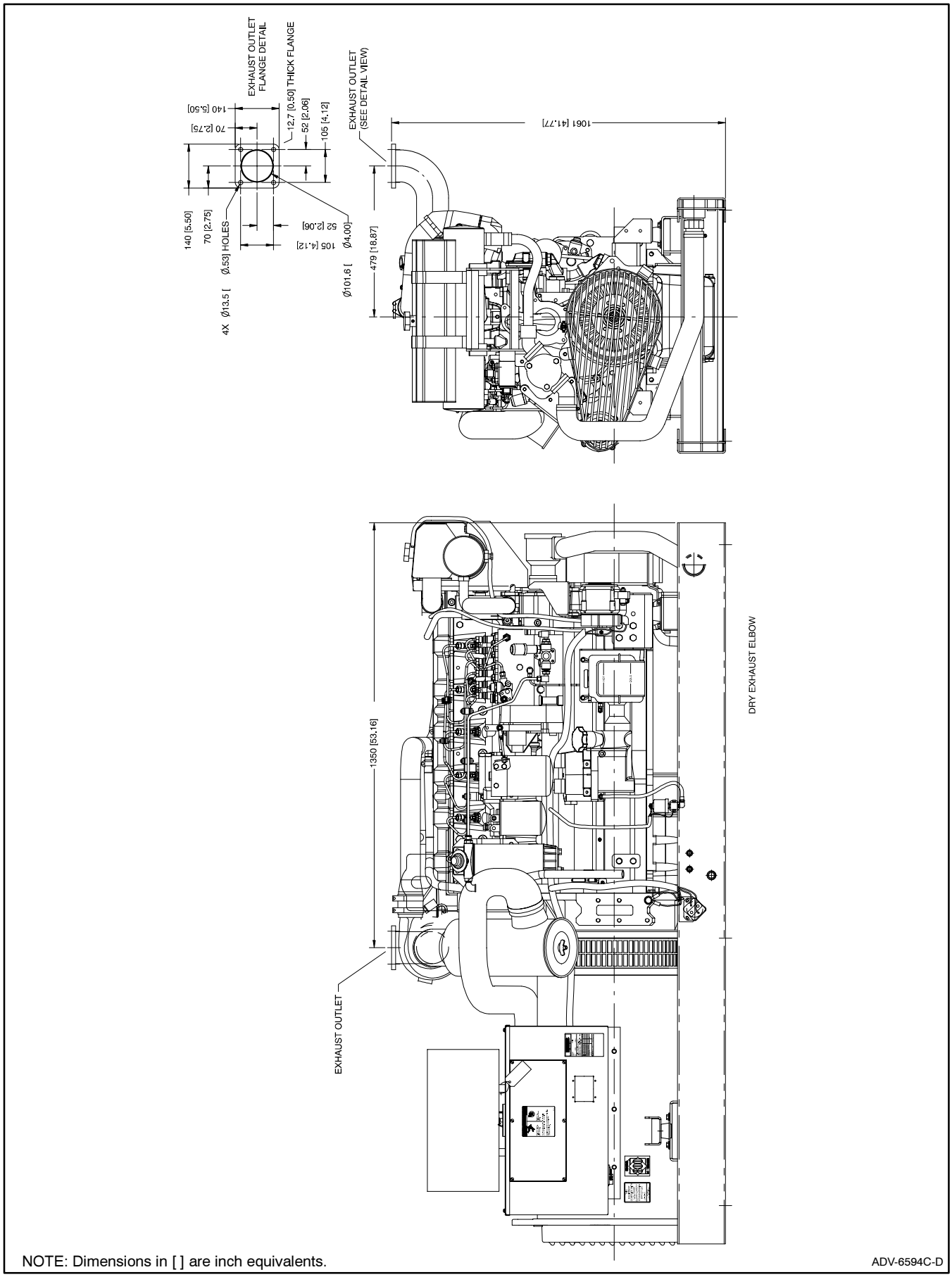


Figure 7-38 Dimension Drawing, 100/125EFOZ and 125/150EOZ with Dry Exhaust Elbow

8.1 Four-Lead Reconnection

The following information illustrates the reconnection of four-lead generator sets. In all cases, conform to the National Electrical Code (NEC).

NOTICE

Voltage reconnection. Affix a notice to the generator set after reconnecting the set to a voltage different from the voltage on the nameplate. Order voltage reconnection decal 246242 from an authorized service distributor/dealer.

8.1.1 100–120-Volt Configurations

If the installation requires a factory two-pole circuit breaker, do not connect the load-side terminals of the circuit breaker together; see Figure 8-1. If the installation requires a 100–120-volt, 2-wire system, use a single-pole circuit breaker. See Figure 8-2. When connecting stator phase leads together, size the output lead (L1) to handle the amperage. Use a jumper lead on the *line* side of the circuit breaker to balance the load of the generator set.

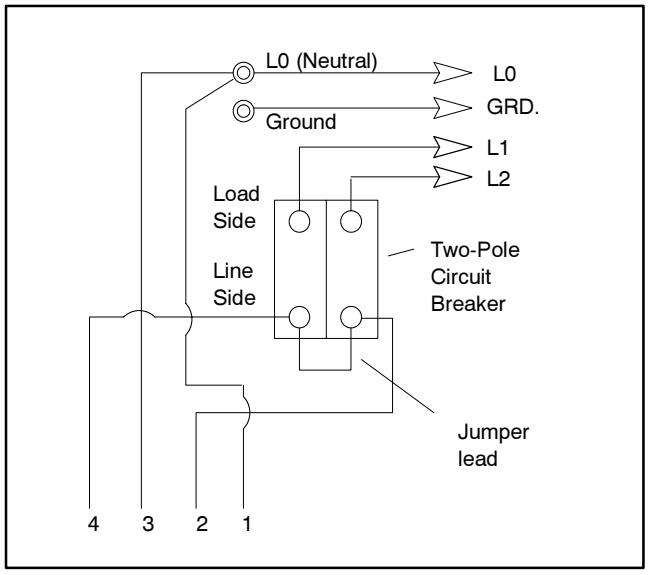
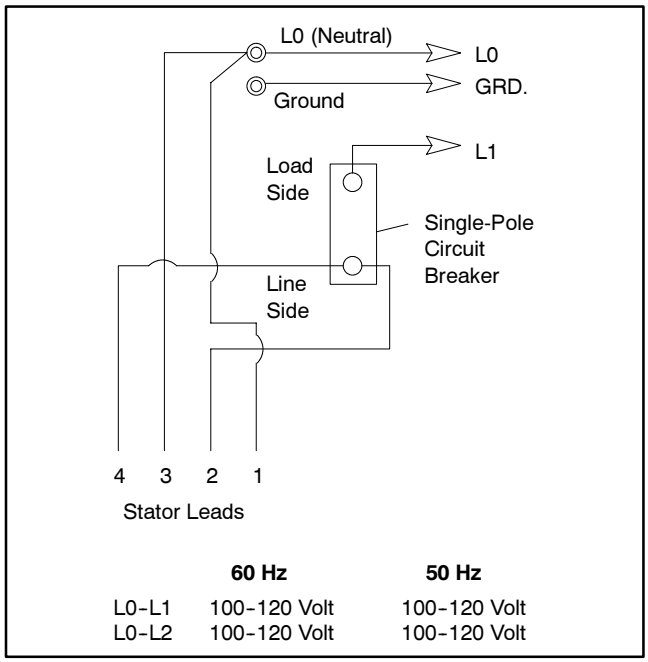


Figure 8-1 100–120-Volt, 3-Wire Configuration

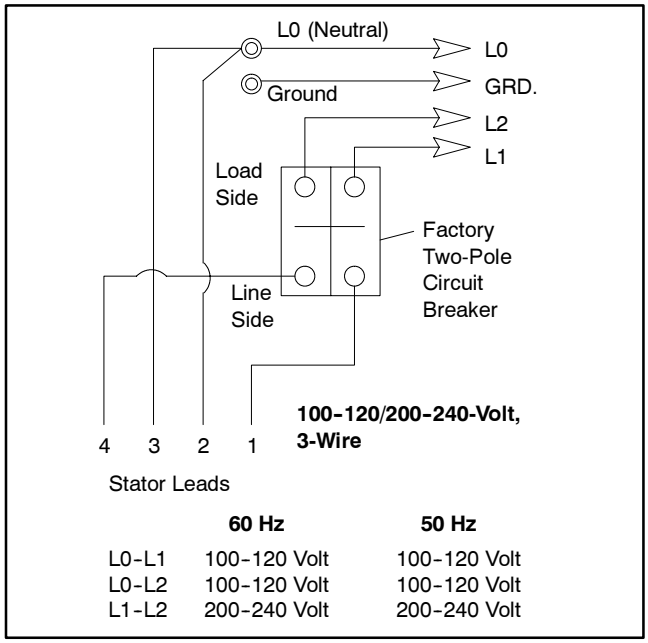
8.1.2 100–120/200–240-Volt Configurations

The 100–120/200–240-volt configuration does not use a jumper lead. If the unit was originally wired for straight 100–120 volt, 3-wire, remove the jumper lead (see Figure 8-1 for location). Select a two-pole circuit breaker. Application of two single-pole circuit breakers does not conform to NEC requirements for supplying a 200–240-volt load, even if the breakers are mechanically attached together. Leads L1 and L2 are for different phases; *never* connect them together.



	60 Hz	50 Hz
L0–L1	100–120 Volt	100–120 Volt
L0–L2	100–120 Volt	100–120 Volt

Figure 8-2 100–120-Volt, 2-Wire Configuration



	60 Hz	50 Hz
L0–L1	100–120 Volt	100–120 Volt
L0–L2	100–120 Volt	100–120 Volt
L1–L2	200–240 Volt	200–240 Volt

Figure 8-3 100–120/200–240-Volt, 3-Wire Configuration

8.1.3 200–240-Volt Configurations

The 200–240-volt configuration does not use a jumper lead. If the unit was originally wired for straight 100–120 volt, 3-wire, remove the jumper lead (see Figure 8-1 for location).

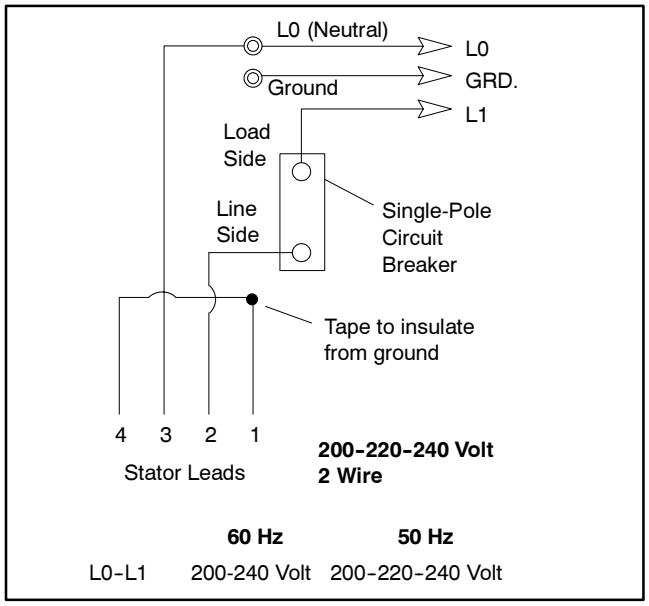


Figure 8-4 200–220–240-Volt, 2-Wire Configuration

8.2 Twelve-Lead Reconnection

The reconnection procedure details voltage reconnections only. If the generator set requires frequency changes, adjust the governor and voltage regulator. See the generator set service manual for information regarding frequency adjustment.

The following information illustrates the reconnection of twelve-lead generator sets. In all cases, conform to the National Electrical Code (NEC).

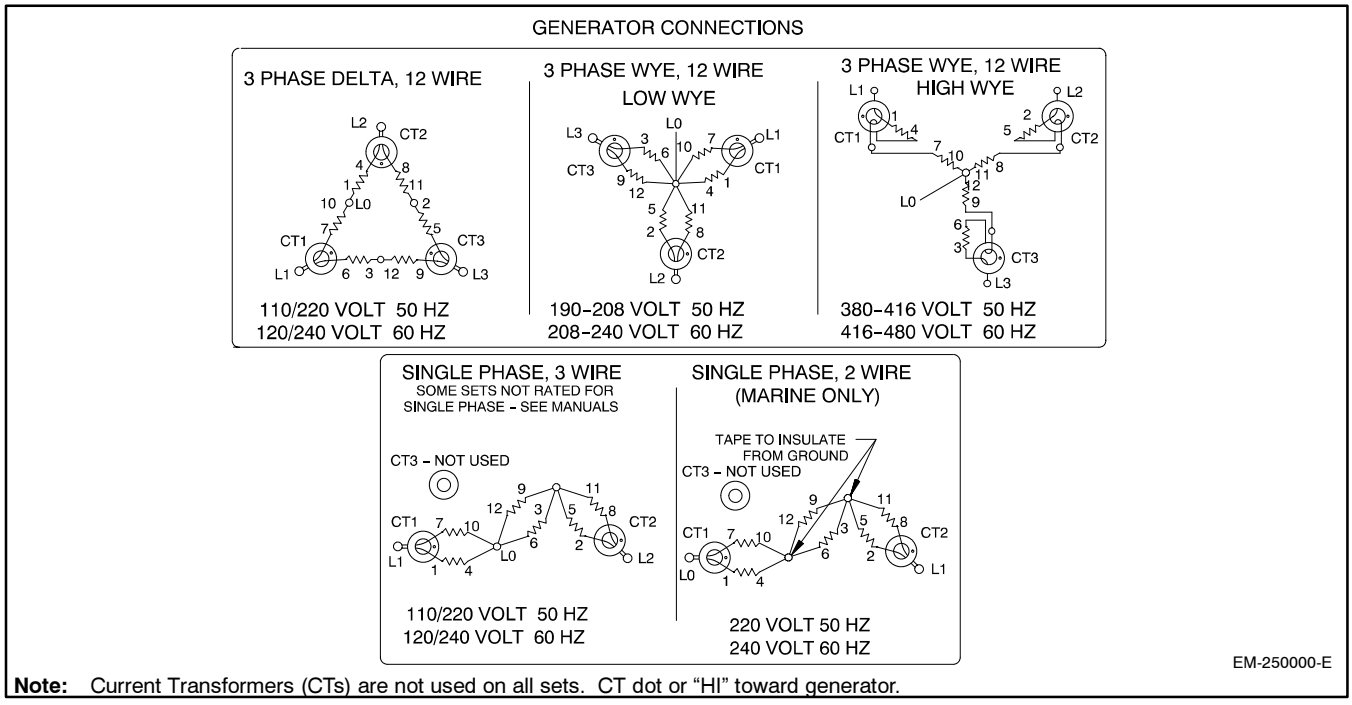
Reconnect the stator leads of the generator set to change output phase or voltage. Refer to the following procedure and connection schematics. Follow all safety precautions at the front of this manual and in the text during the reconnection procedure.

NOTICE

Voltage reconnection. Affix a notice to the generator set after reconnecting the set to a voltage different from the voltage on the nameplate. Order voltage reconnection decal 246242 from an authorized service distributor/dealer.

Twelve-Lead Reconnection Procedure

1. Place the generator start/stop switch in the STOP position.
2. Disconnect generator set engine starting battery, negative (–) lead first.
3. Disconnect power to battery charger, if equipped.
4. Use Figure 8-5 to determine the generator set voltage configuration. Note the original voltage and reconnect the generator set as needed. Route leads through current transformers (CTs) and connect the leads according to the diagram for the desired phase and voltage.



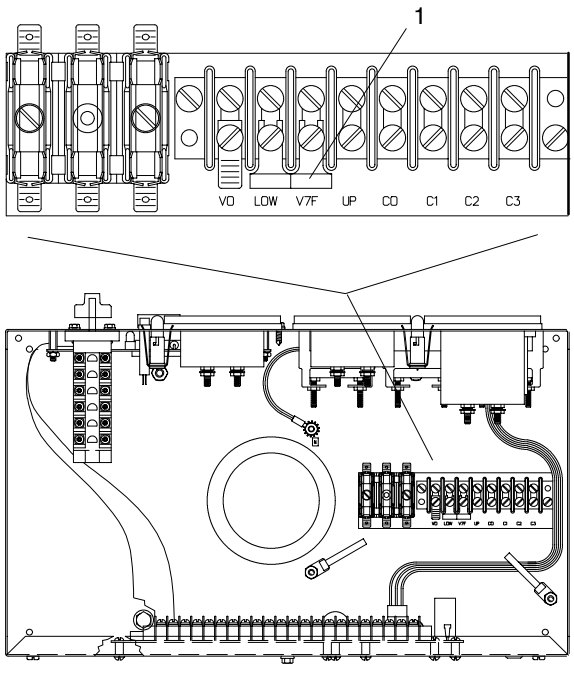
Note: Current Transformers (CTs) are not used on all sets. CT dot or "HI" toward generator.

Figure 8-5 Generator Reconnection

Note: Position the current transformers with the dot or HI side CT marking toward the generator set.

Note: Only generator sets equipped with AC meter controllers and/or safeguard circuit breakers require CTs.

5. If the controller has meters, remove the controller cover and reposition the meter scale lamp jumper (see Figure 8-6) matching the position of the desired voltage (shown in Figure 8-5).



1. Lamp Jumper

Figure 8-6 Meter Scale Lamp Jumper

6. The overvoltage shutdown is standard on Decision-Maker™ 3+ controllers. The **139/240-volt (low wye)** and **277/480-volt (high wye)**, 3-phase, 4-wire, 60 Hz configurations use different overvoltage shutdown settings than all other configurations. Recalibrate the overvoltage shutdown if the reconnection changes the voltage to or from one of these configurations. See Section 8.3, Decision-Maker 3+ Controller, Overvoltage Shutdown Adjustment. Do not recalibrate the overvoltage adjustment for other voltage changes.

7. If the controller has meters, set the phase selector switch to the L1-L2 position (1-phase or 3-phase configuration depending on generator set connection). Connect a voltmeter across leads L1 and L2 if the controller has no meters.

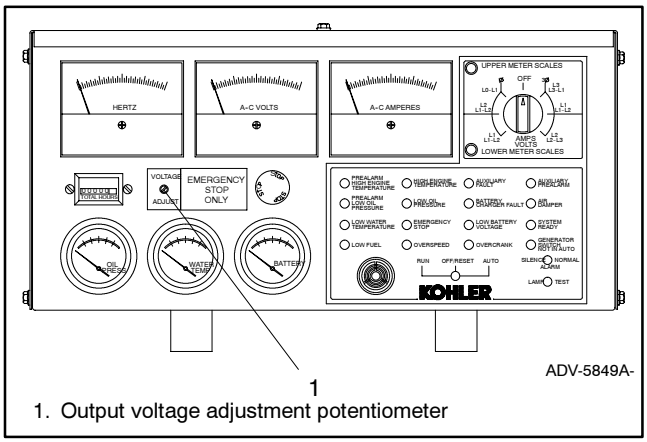
Note: Equipment damage. Verify that the voltage ratings of the transfer switch, line circuit breakers, and other accessories match the desired line voltage.

8. Reconnect the starting battery, negative (-) lead last. Place the generator set master switch in the RUN position to start the generator set. Observe the voltmeter and verify that the unit has the desired line voltage connection.

   Adjust the voltage using the voltage adjustment potentiometer on the generator controller front panel. See Figure 8-7.

9. Stop the generator set after completing the voltage adjustment.

10. Disconnect the external voltmeter if used. Replace the controller cover.



1. Output voltage adjustment potentiometer

Figure 8-7 Voltage Adjustment

This is bpid

8.3 Decision-Maker 3+ Controller, Overvoltage Shutdown Adjustment

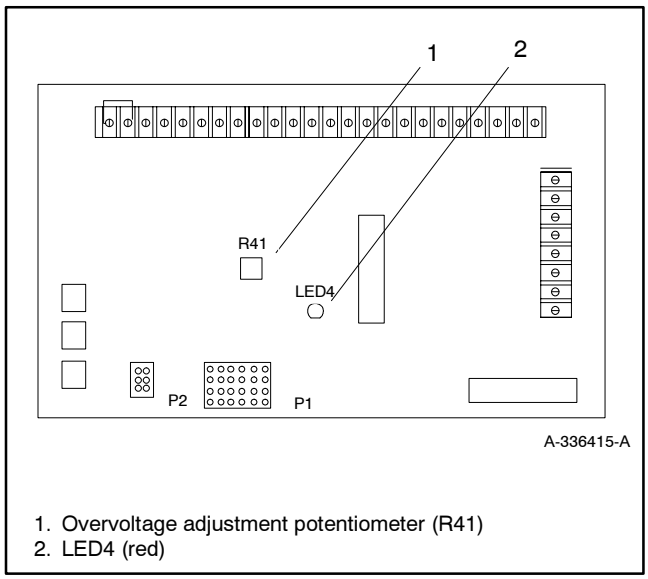
Disconnecting the electrical load. Hazardous voltage can cause severe injury or death. Disconnect the generator set from the load by opening the line circuit breaker or by disconnecting the generator set output leads from the transfer switch and heavily taping the ends of the leads. High voltage transferred to the load during testing may cause personal injury and equipment damage. Do not use the safeguard circuit breaker in place of the line circuit breaker. The safeguard circuit breaker does not disconnect the generator set from the load.

Short circuits. Hazardous voltage/current can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage**.** Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.

Overvoltage Shutdown Adjustment Procedure

1. Disconnect the generator set engine starting battery, negative (–) lead first. Disconnect power to the battery charger (if equipped).
2. With the generator set shut down, open the output line circuit breaker to disconnect the load from the generator set.
3. Remove the controller cover.
4. Wrap the shaft of an insulated-handle screwdriver with electrical tape to insulate the metal shaft. Turn the overvoltage potentiometer (R41) on the main circuit board fully clockwise. See Figure 8-8.
5. Connect a digital AC voltmeter (or other 1% minimum accuracy voltmeter) to terminals V0 and V7 on the controller terminal block. See Figure 8-6.
6. Reconnect the battery, negative (–) lead last.
7. Start the generator set by placing the generator set master switch in the RUN position.
8. Adjust the output voltage to 115% of the nominal output voltage using the voltage adjustment potentiometer. If the voltage configuration is 139/240 volts (low wye) or 277/480 volts (high wye), 3-phase, 4-wire, 60 Hz, adjust output voltage to 160 volts across terminals V0 and V7. For all other voltages, adjust the output to 140 volts across terminals V0 and V7.

   Adjust the voltage using the voltage adjustment potentiometer on the generator controller front panel. See Figure 8-7.
9. Use the insulated screwdriver to slowly rotate the overvoltage adjustment potentiometer (R41) counterclockwise until red LED4 lights. See Figure 8-8. The generator set should shut down on an overvoltage fault in approximately 2 seconds.



1. Overvoltage adjustment potentiometer (R41)
2. LED4 (red)

Figure 8-8 Overvoltage Shutdown Adjustment on Main Circuit Board

10. Turn the voltage adjustment potentiometer counterclockwise to prevent overvoltage shutdown upon restart. Restart the generator set. Slowly increase the voltage by turning the voltage adjustment potentiometer clockwise. Verify the shutdown voltage point (115% of the nominal output voltage) by observing the voltmeter and noting when LED4 lights. The generator set should shut down on overvoltage fault in approximately 2 seconds. If the shutdown voltage point is not 115% of nominal voltage, repeat the calibration output procedure; otherwise, continue to step 11.
11. Turn the voltage adjustment potentiometer counterclockwise to prevent overvoltage shutdown upon restart. Restart the generator set. Readjust the generator set output to the nominal voltage using the voltage adjustment potentiometer.
12. Stop the generator set by placing the generator set master switch in the OFF/RESET position. Seal the overvoltage adjustment potentiometer (R41) with RTV sealant or equivalent. Replace the controller cover.

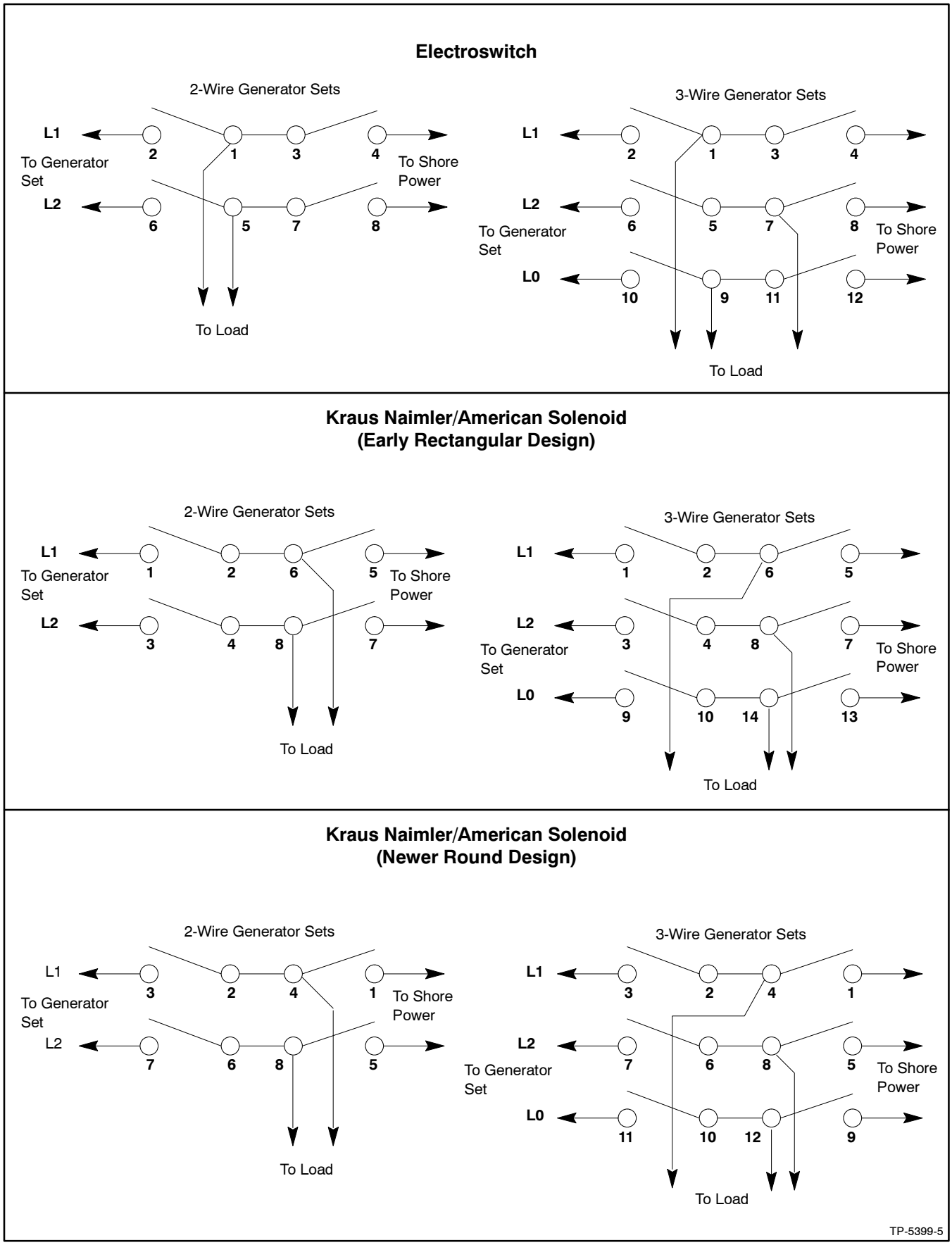


Figure 8-9 Marine Manual (Ship-to-Shore) Transfer Switch

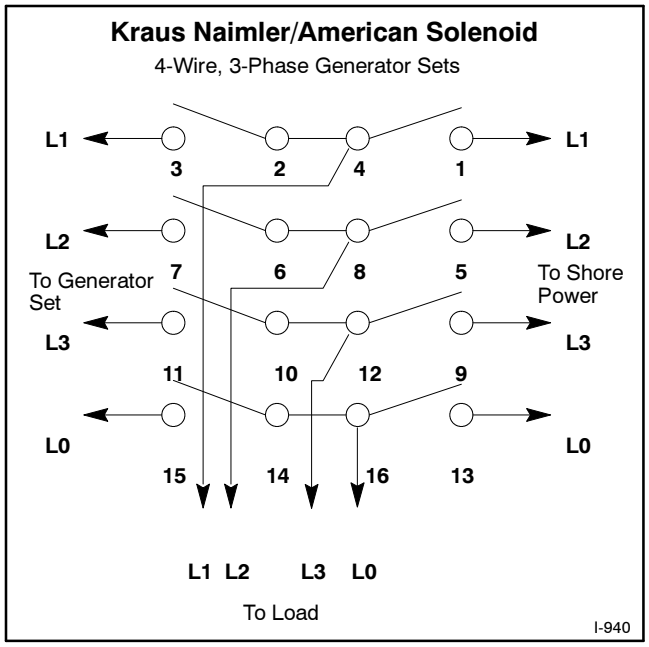


Figure 8-10 Marine Manual (Ship-to-Shore) Transfer Switch, continued

8.4 Voltage Regulator Adjustment (4-27EFOZ and 5-32EOZ Models)

⚠ WARNING

Hazardous voltage. Moving rotor. Can cause severe injury or death.

Operate the generator set only when all guards and electrical enclosures are in place.

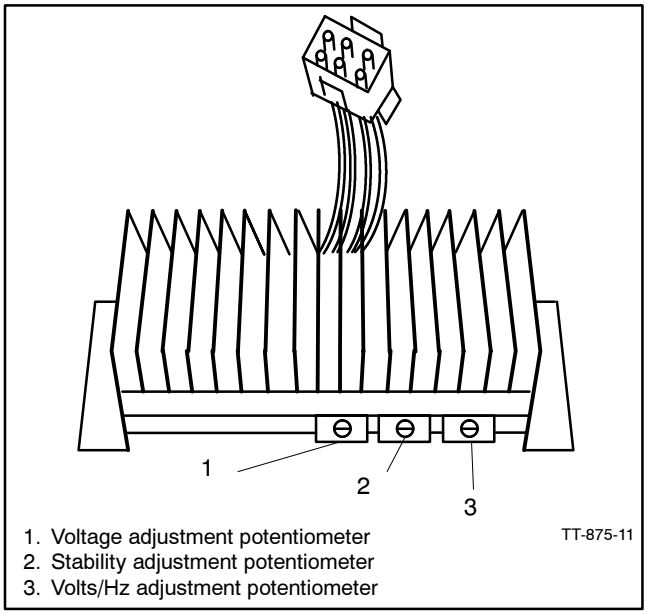
Testing the voltage regulator. Hazardous voltage can cause severe injury or death. High voltage is present at the voltage regulator heat sink. To prevent electrical shock do not touch the voltage regulator heat sink when testing the voltage regulator.
(PowerBoost™, PowerBoost™ III, and PowerBoost™ V voltage regulator models only)

The voltage regulator is typically located in the controller. Adjustments are possible without removing the voltage regulator. The voltage regulator adjustment procedure applies to both the PowerBoost™ IIIE (Figure 8-11) and PowerBoost™ V (Figure 8-12) voltage regulators.

Note: Broadrange generator sets. The following adjustment procedure is for readjustment of the voltage regulator and governor for broadrange generator sets with mechanical governors.

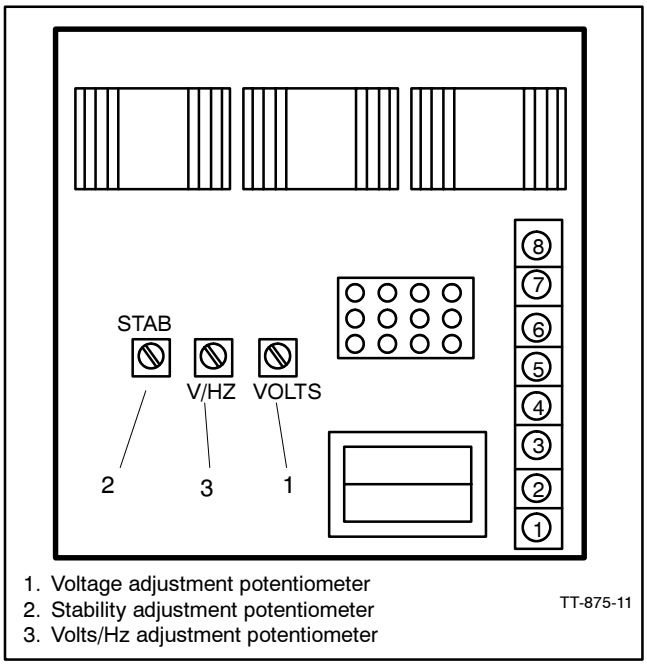
Note: Special tool. Frequency meter 50/60 Hz.

Note: Rheostat connection. Connect a customer-provided rheostat across regulator leads/terminals 33 and 66 to adjust the generator output voltage from a location remote from the generator set. The rheostat (10 kOhms, 1/2 watt minimum) provides a 5-volt adjustment range.



1. Voltage adjustment potentiometer
2. Stability adjustment potentiometer
3. Volts/Hz adjustment potentiometer

Figure 8-11 PowerBoost™ IIIE Voltage Regulator



1. Voltage adjustment potentiometer
2. Stability adjustment potentiometer
3. Volts/Hz adjustment potentiometer

Figure 8-12 PowerBoost™ V Voltage Regulator

Stabilizer Potentiometer (Pot) fine tunes the regulator circuitry to reduce light flicker.

Voltage Adjustment Pot adjusts the generator voltage output within the range of approximately 100 to 130 volts.

Volts/Hz Pot determines the engine speed (Hz) at which the generator output voltage begins to drop.

Note: The **volts/Hz** adjustment does not apply to the following models:

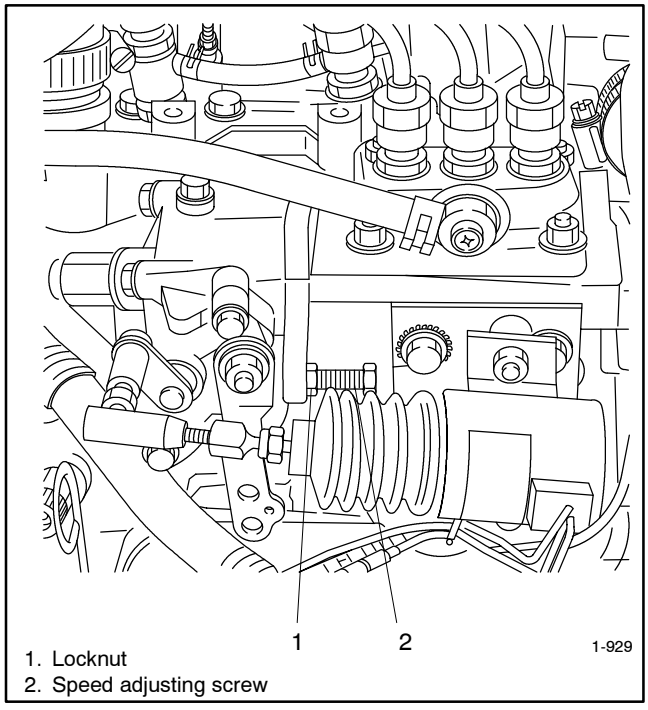
Model
4/6.5/8/8.5/9EFOZ
5/8/9/10EOZ

Note: On these models, turn the volts/Hz adjustment pot full counterclockwise to stop and seal. No further volts/Hz adjustments are required.

Note: For optimum results, apply full load for voltage regulator adjustment.

Voltage Regulator Adjustment Procedure

1. With the generator set off, turn the remote rheostat, if equipped, to the midpoint.
2. Turn the voltage, volts/Hz, and stability pots fully counterclockwise.
3. Connect the voltmeter and frequency meter to the AC circuit or an electrical outlet.
4. Start the generator set.
5. Rotate the voltage adjustment pot clockwise to increase the voltage (counterclockwise to decrease voltage) to achieve the desired output voltage.
6. Rotate the stability pot clockwise to minimize light flicker.
7. Readjust the voltage adjustment pot if necessary.
8. Adjust the engine speed to the desired cut-in frequency (factory setting 57.5–58 Hz for 60 Hz models or 47.5–48 Hz for 50 Hz models) as measured on frequency meter. To change engine speed adjust the governor arm. Loosen the locknut and turn it clockwise or counterclockwise to achieve the desired frequency. See Figure 8-13. If a second screw holds the governor arm, loosen the locknut and back out the screw.
9. If applicable, rotate the volts/Hz adjustment pot clockwise until the voltage level begins to drop (as measured on the voltmeter). When set to these specifications, the generator attempts to maintain normal output until the engine speed drops below the frequency set in step 8 as load is applied.
10. Readjust the engine speed to normal (63 Hz/ 1890 rpm for 60 Hz or 52.5 Hz/1575 rpm for 50 Hz). Tighten the locknut when the adjustments are complete. Turn the second screw, if used, to lock the governor arm in place and tighten the locknut.
11. Readjust the voltage adjustment pot if necessary.
12. Readjust the stability pot if necessary.
13. Use the remote rheostat, if equipped, to make final voltage adjustments.
14. Stop the generator set.



1. Locknut
2. Speed adjusting screw

Figure 8-13 Governor Adjustment (4EFOZ/5EOZ shown)

Notes

Appendix A Generator Selection and Wattage Requirements

Consider total wattage requirements (lights, motors, appliances) when selecting a generator set or when sizing wattage usage in which available space and construction limit the size of the generator set.

Motors

When figuring generator set capacity requirements for loads that include electric motors, consider the high current demanded by the motors during startup. The inrush or starting current is typically 2–3 times higher than that required when the motor reaches normal operating speed. Allow reserve for inrush demands plus other loads which could be on the line as the electric motor starts. Use Figure 1 as a guide when selecting generator set capacity requirements involving motor loads.

Motor HP	Starting (Inrush) Watts	Running Watts
1/4	750	330
1/3	1000	400
1/2	1500	600
3/4	2000	750
1	3300	1100
2	4000	2000
3	5000	3000

Figure 1 Motor Requirements

Lighting

To calculate lighting load, add the wattage of each generator set-operated lamp. Note that not all of the lights or lamps are on the generator set AC circuit; some are DC powered by a 12-volt battery. Make sure the calculated total wattage includes only lights actually on the generator set AC circuit.

Air Conditioners

The starting characteristics of air conditioners vary greatly; one 12,000 Btu unit has, for example, lower starting requirements than a 10,000 Btu unit of another variety. When using only one unit, there is usually no starting problem, provided the lighting and appliance load is not too high when starting the unit.

Simultaneous starting of two air conditioning units, however, can present problems if the generator set capacity is marginal. Because of the variation in starting characteristics among air conditioners, this publication makes no statements regarding multiple-motor starting capabilities of the generator set covered. Consider delayed starting or use of easy-starting devices on air conditioner units whenever simultaneously starting more than one motor.

See Figure 2 for typical air conditioner requirements. Information will vary with manufacturer.

Appliances

Generator sets often furnish AC for appliances such as TV, stereo, electric water heater, etc. With the exception of the resistance-type loads such as the water heater, requirements for appliances are usually low. Do not overlook such loads when figuring total requirements. Allow reserve capacity for anticipated appliance loads to avoid overloading a generator set.

Air Conditioner Size (Btu/Hr.)									
	7,000		9,000		12,000		16,000		24,000
Voltage	115	230	115	230	115	230	115	230	230
Full load amps	9.3	4.8	9.9	5.0	11.8	6.3	16.3	8.0	11.6
Rated load amps	7.7	4.0	7.0	3.5	8.9	4.8	13.0	6.2	10.2
Locked rotor amps	34.0	20.0	40.0	20.0	50.0	31.0	75.0	36.0	56.0
Starting (inrush) watts	3910	4600	4600	4600	5750	7130	8630	8280	12,900
Running watts	886	920	805	805	1020	1100	1500	1430	2350

Figure 2 Typical Marine Air Conditioner Requirements, 60 Hz

Appendix B Abbreviations

The following list contains abbreviations that may appear in this publication.

A, amp	ampere
ABDC	after bottom dead center
AC	alternating current
A/D	analog to digital
ADC	analog to digital converter
adj.	adjust, adjustment
ADV	advertising dimensional drawing
AHWT	anticipatory high water temperature
AISI	American Iron and Steel Institute
ALOP	anticipatory low oil pressure
alt.	alternator
Al	aluminum
ANSI	American National Standards Institute (formerly American Standards Association, ASA)
AO	anticipatory only
API	American Petroleum Institute
approx.	approximate, approximately
AR	as required, as requested
AS	as supplied, as stated, as suggested
ASE	American Society of Engineers
ASME	American Society of Mechanical Engineers
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after top dead center
ATS	automatic transfer switch
auto.	automatic
aux.	auxiliary
A/V	audiovisual
avg.	average
AVR	automatic voltage regulator
AWG	American Wire Gauge
AWM	appliance wiring material
bat.	battery
BBDC	before bottom dead center
BC	battery charger, battery charging
BCA	battery charging alternator
BCI	Battery Council International
BDC	before dead center
BHP	brake horsepower
blk.	black (paint color), block (engine)
blk. htr.	block heater
BMEP	brake mean effective pressure
bps	bits per second
br.	brass
BTDC	before top dead center
Btu	British thermal unit
Btu/min.	British thermal units per minute
C	Celsius, centigrade
cal.	calorie
CARB	California Air Resources Board
CB	circuit breaker
cc	cubic centimeter
CCA	cold cranking amps
ccw.	counterclockwise
CEC	Canadian Electrical Code
cfh	cubic feet per hour
cfm	cubic feet per minute
CG	center of gravity
CID	cubic inch displacement
CL	centerline
cm	centimeter
CMOS	complementary metal oxide substrate (semiconductor)
cogen.	cogeneration
Com	communications (port)
conn.	connection
cont.	continued
CPVC	chlorinated polyvinyl chloride
crit.	critical
CRT	cathode ray tube
CSA	Canadian Standards Association
CT	current transformer
Cu	copper
cu. in.	cubic inch
cw.	clockwise
CWC	city water-cooled
cyl.	cylinder
D/A	digital to analog
DAC	digital to analog converter
dB	decibel
dBA	decibel (A weighted)
DC	direct current
DCR	direct current resistance
deg., °	degree
dept.	department
dia.	diameter
DI/EO	dual inlet/end outlet
DIN	Deutsches Institut fur Normung e. V. (also Deutsche Industrie Normenausschuss)
DIP	dual inline package
DPDT	double-pole, double-throw
DPST	double-pole, single-throw
DS	disconnect switch
DVR	digital voltage regulator
E, emer.	emergency (power source)
EDI	electronic data interchange
EFR	emergency frequency relay
e.g.	for example (*exempli gratia)*
EG	electronic governor
EGSA	Electrical Generating Systems Association
EIA	Electronic Industries Association
EI/EO	end inlet/end outlet
EMI	electromagnetic interference
emiss.	emission
eng.	engine
EPA	Environmental Protection Agency
EPS	emergency power system
ER	emergency relay
ES	engineering special, engineered special
ESD	electrostatic discharge
est.	estimated
E-Stop	emergency stop
etc.	et cetera (and so forth)
exh.	exhaust
ext.	external
F	Fahrenheit, female
fglass.	fiberglass
FHM	flat head machine (screw)
fl. oz.	fluid ounce
flex.	flexible
freq.	frequency
FS	full scale
ft.	foot, feet
ft. lbs.	foot pounds (torque)
ft./min.	feet per minute
g	gram
ga.	gauge (meters, wire size)
gal.	gallon
gen.	generator
genset	generator set
GFI	ground fault interrupter
GND, ⏚	ground
gov.	governor
gph	gallons per hour
gpm	gallons per minute
gr.	grade, gross
GRD	equipment ground
gr. wt.	gross weight
H x W x D	height by width by depth
HC	hex cap
HCHT	high cylinder head temperature
HD	heavy duty
HET	high exhaust temperature
hex	hexagon
Hg	mercury (element)
HH	hex head
HHC	hex head cap
HP	horsepower
hr.	hour
HS	heat shrink
hsg.	housing
HVAC	heating, ventilation, and air conditioning
HWT	high water temperature
Hz	hertz (cycles per second)
IC	integrated circuit
ID	inside diameter, identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IMS	improved motor starting
in.	inch
in. H_2O	inches of water
in. Hg	inches of mercury
in. lbs.	inch pounds
Inc.	incorporated
ind.	industrial
int.	internal
int./ext.	internal/external
I/O	input/output
IP	iron pipe
ISO	International Organization for Standardization
J	joule
JIS	Japanese Industry Standard
k	kilo (1000)
K	kelvin
kA	kiloampere
KB	kilobyte (2^{10} bytes)

kg	kilogram
kg/cm^2	kilograms per square centimeter
kgm	kilogram-meter
kg/m^3	kilograms per cubic meter
kHz	kilohertz
kJ	kilojoule
km	kilometer
kOhm, kΩ	kilo-ohm
kPa	kilopascal
kph	kilometers per hour
kV	kilovolt
kVA	kilovolt ampere
kVAR	kilovolt ampere reactive
kW	kilowatt
kWh	kilowatt-hour
kWm	kilowatt mechanical
L	liter
LAN	local area network
L x W x H	length by width by height
lb.	pound, pounds
lbm/ft^3	pounds mass per cubic feet
LCB	line circuit breaker
LCD	liquid crystal display
ld. shd.	load shed
LED	light emitting diode
Lph	liters per hour
Lpm	liters per minute
LOP	low oil pressure
LP	liquefied petroleum
LPG	liquefied petroleum gas
LS	left side
L_{wa}	sound power level, A weighted
LWL	low water level
LWT	low water temperature
m	meter, milli (1/1000)
M	mega (10^6 when used with SI units), male
m^3	cubic meter
m^3/min.	cubic meters per minute
mA	milliampere
man.	manual
max.	maximum
MB	megabyte (2^{20} bytes)
MCM	one thousand circular mils
MCCB	molded-case circuit breaker
meggar	megohmmeter
MHz	megahertz
mi.	mile
mil	one one-thousandth of an inch
min.	minimum, minute
misc.	miscellaneous
MJ	megajoule
mJ	millijoule
mm	millimeter
mOhm, mΩ	milliohm
MOhm, MΩ	megohm
MOV	metal oxide varistor
MPa	megapascal
mpg	miles per gallon
mph	miles per hour
MS	military standard
m/sec.	meters per second
MTBF	mean time between failure
MTBO	mean time between overhauls
mtg.	mounting
MW	megawatt
mW	milliwatt
μF	microfarad
N, norm.	normal (power source)
NA	not available, not applicable
nat. gas	natural gas
NBS	National Bureau of Standards
NC	normally closed
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
Nm	newton meter
NO	normally open
no., nos.	number, numbers
NPS	National Pipe, Straight
NPSC	National Pipe, Straight-coupling
NPT	National Standard taper pipe thread per general use
NPTF	National Pipe, Taper-Fine
NR	not required, normal relay
ns	nanosecond
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OF	overfrequency
opt.	option, optional
OS	oversize, overspeed
OSHA	Occupational Safety and Health Administration
OV	overvoltage
oz.	ounce
p., pp.	page, pages
PC	personal computer
PCB	printed circuit board
pF	picofarad
PF	power factor
ph., ∅	phase
PHC	Phillips head crimptite (screw)
PHH	Phillips hex head (screw)
PHM	pan head machine (screw)
PLC	programmable logic control
PMG	permanent-magnet generator
pot	potentiometer, potential
ppm	parts per million
PROM	programmable read-only memory
psi	pounds per square inch
pt.	pint
PTC	positive temperature coefficient
PTO	power takeoff
PVC	polyvinyl chloride
qt.	quart
qty.	quantity
R	replacement (emergency) power source
rad.	radiator, radius
RAM	random access memory
RDO	relay driver output
ref.	reference
rem.	remote
RFI	radio frequency interference
RH	round head
RHM	round head machine (screw)
rly.	relay
rms	root mean square
rnd.	round
ROM	read only memory
rot.	rotate, rotating
rpm	revolutions per minute
RS	right side
RTV	room temperature vulcanization
SAE	Society of Automotive Engineers
scfm	standard cubic feet per minute
SCR	silicon controlled rectifier
s, sec.	second
SI	*Systeme international d'unites,* International System of Units
SI/EO	side in/end out
sil.	silencer
SN	serial number
SPDT	single-pole, double-throw
SPST	single-pole, single-throw
spec, specs	specification(s)
sq.	square
sq. cm	square centimeter
sq. in.	square inch
SS	stainless steel
std.	standard
stl.	steel
tach.	tachometer
TD	time delay
TDC	top dead center
TDEC	time delay engine cooldown
TDEN	time delay emergency to normal
TDES	time delay engine start
TDNE	time delay normal to emergency
TDOE	time delay off to emergency
TDON	time delay off to normal
temp.	temperature
term.	terminal
TIF	telephone influence factor
TIR	total indicator reading
tol.	tolerance
turbo.	turbocharger
typ.	typical (same in multiple locations)
UF	underfrequency
UHF	ultrahigh frequency
UL	Underwriter's Laboratories, Inc.
UNC	unified coarse thread (was NC)
UNF	unified fine thread (was NF)
univ.	universal
US	undersize, underspeed
UV	ultraviolet, undervoltage
V	volt
VAC	volts alternating current
VAR	voltampere reactive
VDC	volts direct current
VFD	vacuum fluorescent display
VGA	video graphics adapter
VHF	very high frequency
W	watt
WCR	withstand and closing rating
w/	with
w/o	without
wt.	weight
xfmr	transformer

Appendix C Generator Set Output Ratings Procedure

Kohler Co. develops the kilowatt output rating of a Kohler® marine generator set based upon the calculations specified in ISO 3046 and ISO 8528-1. The calculations *correct* for environmental variables encountered in a generator set installation. Figure 1 outlines the calculations. Figure 2 contains examples of how heat variables affect generator set ratings.

Generator Output $_{corrected}$ = Generator Output $_{observed}$ x Correction Factor
Output power is expected to be within ±5% of the specified rating when corrected to reference conditions. Correction factors are determined using the following formulas:
1. For naturally aspirated compression-ignition engines: C.F. = [1.175 (29.2 / Dry Barometer in. Hg)^{1} (Temperature °F + 460/537)$^{.75}$ – .175] x Alternator Efficiency $_{Reference}$ / Alternator Efficiency $_{Observed}$
2. For turbocharged compression ignition engines: C.F. = [1.175 (29.2 / Barometer $_{Observed}$ in. Hg)$^{.7}$ (Temperature °F + 460/537)^{2} – .175] x Alternator Efficiency $_{Reference}$ / Alternator Efficiency $_{Observed}$
3. For turbocharged and intercooled compression ignition engines: C.F. = [1.175 (29.2 / Barometer $_{Observed}$ in. Hg)$^{.7}$ (Temperature °F + 460/537)$^{1.2}$ – .175] x Alternator Efficiency $_{Reference}$ / Alternator Efficiency $_{Observed}$
Reference conditions: Temperature: 77°F; Pressure: 29.2 in. Hg dry barometer. Kohler sound shield increases ambient intake air approx. 12°F Approximate derates: Temperature: approximately 1% per 10°F (turbocharged engines have a greater derate); Pressure (altitude): approximately 4% per 1000 ft. (1 in. Hg)

Figure 1 Generator Output

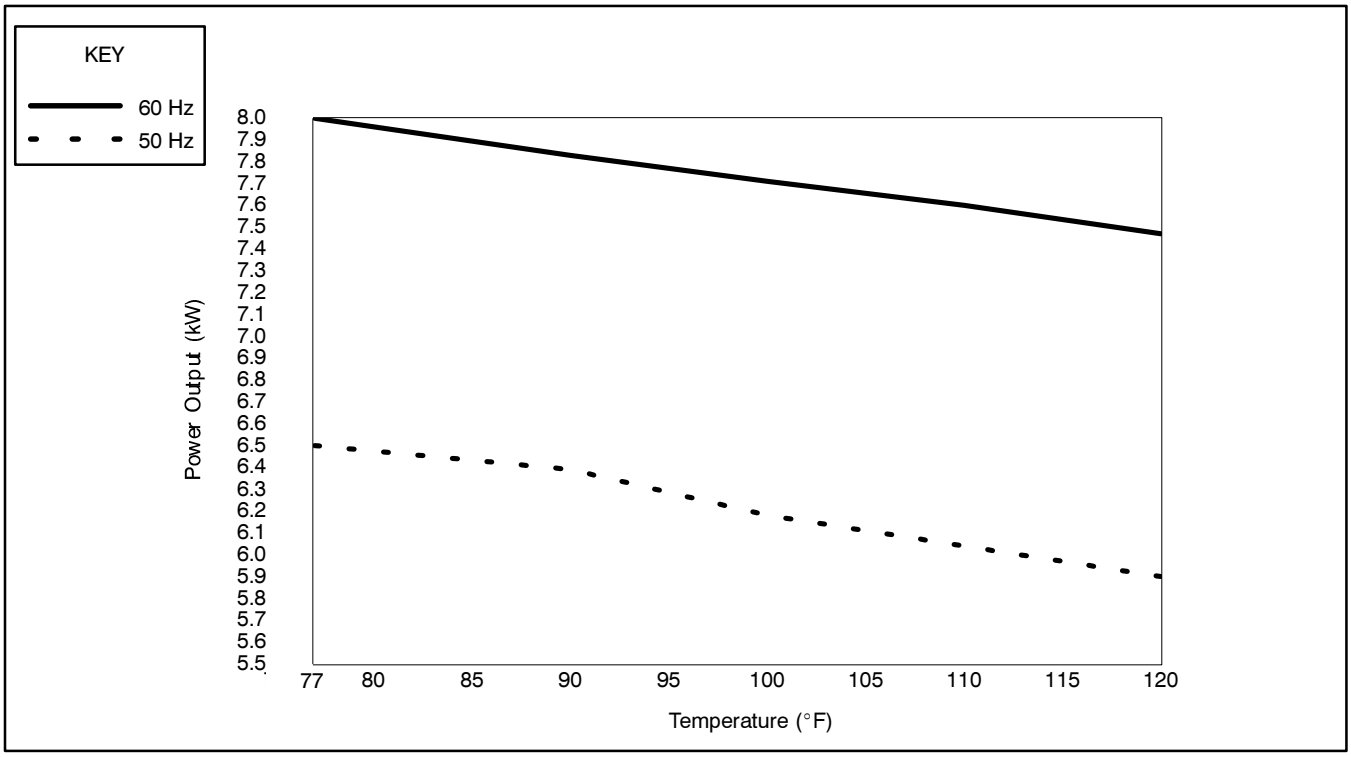


Figure 2 Example: 6.5EFOZ/8EOZ kW Derates (ISO 3046/ISO 8258-1)

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