

INSTALLATION INSTRUCTIONS

Original Issue Date: **11/18**

Model: **32-40EKOZD and 28-35EFKOZD**

Market: **Marine**

Subject: **Keel Cooling Conversion Kits, GM102146-KP1/-KP2 and GM118540-KP1/-KP2**

1 Introduction

Install this kit to convert a unit from heat-exchanger cooled to a keel-cooled type.

Read the entire procedure including safety precautions before beginning installation. Perform the steps in the order shown.

Kit No.	Engine Group No.	Applicable Models
GM102146-KP1	GM101305-GA1	32EKOZD/28EFKOZD
	GM101305-GA2	
	GM101305-GA3	
	GM101305-GA4	
GM118540-KP1	GM118203-GA1	
	GM118203-GA2	
	GM118203-GA3	
	GM118203-GA4	
GM102146-KP2	GM101305-GA1	40EKOZD/35EFKOZD
	GM101305-GA2	
	GM101305-GA3	
	GM101305-GA4	
GM118540-KP2	GM118203-GA1	
	GM118203-GA2	
	GM118203-GA3	
	GM118203-GA4	

Figure 1 Kit Selection

NOTICE

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

2 Safety Precautions

Observe the following safety precautions while installing the kit.

⚠ 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) Press the generator set off/reset button to shut down the generator set. (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.

 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. Fill system before starting unit.

 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 is an odorless, colorless, tasteless, nonirritating gas that can cause death if inhaled for even a short time. 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.

 DANGER	Hazardous voltage. Moving parts. Will cause severe injury or death.
 	Operate the generator set only when all guards and electrical enclosures are in place.

Short circuits. Hazardous voltage/current will 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.

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

3 Cooling System Installation

3.1 Requirements - Keel Cooling System

3.1.1 Cooling System

Location

Keep piping length and number of bends to a minimum for the plumbing between the generator and keel cooler. These factors directly impact whether the cooling system performs within the published pressure drop limits.

Follow the keel cooler manufacturer's installation requirements.

3.1.2 Engine Inlet/Outlet Piping

Maximum allowable pressure loss is not to exceed the published limits for pressure loss external of the engine. See Figure 10 and Figure 11. Consider the following factors when designing and constructing the cooling system:

- Total linear length.
- Number of bends.
- Flow restriction through keel cooler and any inline valves.
- Size of piping.

See Figure 2 for recommended minimum cooling system piping size:

Generator Model	Minimum Diameter*
32-40EKOZD and 28-35EFKOZD	1.375 in.

*These are recommendations only. It is required in all cases that the maximum external pressure drop limit for the engine is not exceeded. In order to meet published limits, it may be necessary to increase pipe size diameter as pipe length increases between the generator set and keel cooler.

Figure 2 Recommended Minimum Pipe Size

Routing of Piping

Keep pipe routing as short and straight as possible, minimizing the number of bends and overall length to keep the coolant flow restriction to a minimum.

Maintain an upward slope of piping from keel cooler to the generator, with a minimum pitch of 1.3 cm rise per 30.5 cm length (0.5 in. rise per 1ft. length). Avoid high points. An upward slope should exist all the way to the expansion tank, the highest point in the system, to prevent air locks from occurring.

Note:

For proper venting instructions, see the **Vent and Fill/Make-Up Line Requirements Section**.

Use flexible connectors, such as hose or flexible pipe, between the engine and keel cooler piping to isolate vibration. Engine connections are not intended to support the weight of the piping. Piping system should be designed not to be supported by the connections to the generator's engine.

Note:

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

Plumb piping to proper generator and keel cooler connections.

Generator Connections

- Flow is not bi-directional flow from the engine. Ensure piping layout addresses flow direction appropriately.
- Identify designated coolant inlet and outlet locations.

Keel Cooler Connections

- Some keel coolers are designed for bi-directional flow. In this case, the inlet and outlet can be reversed. But, some keel coolers use enhanced internal surfaces or turbulator inserts for premium efficient cooling performance. These types of keel cooler features may not support bi-directional coolant flow and it is critical to use the inlet and outlet as the manufacturer has designated.
- Follow the keel cooler manufacturer's installation requirements. Contact the manufacturer to confirm, if necessary.

3.1.3 Remote Auxiliary Expansion Tank (Customer Provided)

The expansion tank must be located at an elevation higher than other components in the cooling system. Locating the expansion tank at the highest point in the cooling system helps to ensure proper deaeration of the system.

Volume of tank is to be at minimum 20% of the total coolant volume. Typically, total coolant volume is the combined volume of the engine, keel cooler, and piping (including vent and fill/make-up lines). The plastic overflow bottle included with the generator will most certainly be undersized for the total system volume with the keel cooler. Remove the plastic overflow bottle if it is undersized.

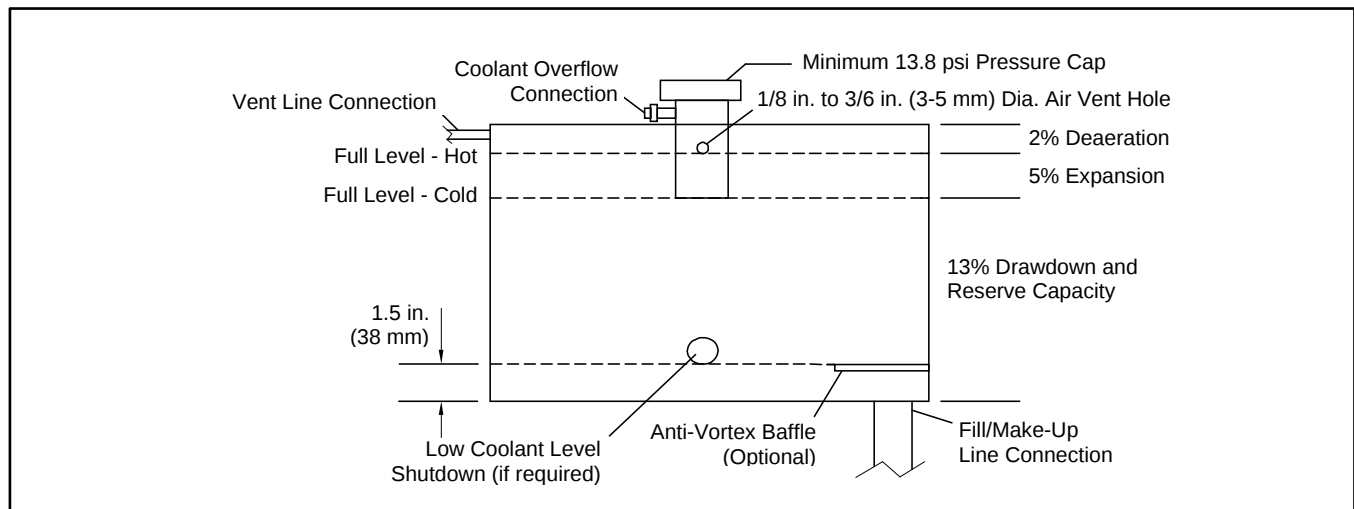


Figure 3 Expansion Tank Concept Drawing

To prevent vortex phenomena above fill/make-up outlet in the expansion tank, include a provision for an optional anti-vortex baffle. Locate the anti-vortex baffle 38 mm (1.5 in.) from the bottom of the tank. See Figure 3.

Sight Glass (Optional)

Note:

A sight glass is recommended but is not required.

- Including a sight glass provides a visual reference of the current coolant level for the operator.
- Including a sight glass can be a visual aid when filling the system with coolant. Observing the expansion tank fill with coolant provides advance indication when the system is almost full of coolant so as not to overfill/overflow.
- Select a sight glass that is robust, appropriate for the application, and meets any applicable regulations/standards. Some sight glasses are made of plastic or glass and some are encapsulated so they can't shatter if unintentionally bumped. Select one appropriate for the location, application, and use.

Filler Neck (Optional)

- Design a filler neck into the tank in order to indicate when a complete refill of the system has occurred. When filling at a 3 gpm rate, the moment the coolant level hits the bottom of the filler neck, the coolant will "burp" up the neck indicating that initial fill is complete.
- Determine the level within the tank where a space equal to 7% of the total system volume is above that level to determine the length of the filler neck. This establishes the Full Level-Cold and is the length to design the filler neck to extend into the tank.

- If a filler neck is used, provide an air vent hole with a 3-5 mm (1/8-3/16 in.) diameter to vent to the pressure cap. To determine the location of the hole from the top of the tank, determine the level within the tank where a space equal to 2% of the total system volume is above that level. This establishes the Full Level-Hot and is the location to position the single air vent hole.
- Design the top of the filler neck to accept a pressure cap of appropriate rating. See Figure 4.
- A filler neck is not required, but use caution when filling to the proper cold fill line as one can easily fill to the top. If coolant is filled too high, the space for fluid expansion is reduced and is no longer adequately sized. When the generator set operates, coolant may spill out past the pressure cap.
- Some filler necks are designed with a small diameter barbed tube. This is an optional overflow tube. Any coolant that expands out of the tank can be sent to a remote overflow bottle via a plastic tube.

Vent Line Connections

- Vent line connections are a means to connect each vent line (required under the **Vent and Fill/Make-Up Line Requirements Section**) to the expansion tank. A dedicated connection is required per vent line. If multiple vent lines are required, the number of connections must match.
- Vent lines must be plumbed to deaeration zone within 13 mm (0.5 in.) of the top of the expansion tank. This is accomplished in one of two ways:
 - Connection on the vertical tank wall above the Fill Level-Hot.
 - Connection to the bottom of the tank with an integral stand pipe internal to the tank that projects above the Fill Level-Hot.

The size of the connections should match the size of the vent line selected to meet the requirements listed under the **Vent and Fill/Make-Up Line Requirements Section**.

Fill/Make-Up Line Connection

- Fill/make-up line connection is required to connect the bottom of the expansion tank to the returning coolant flow from the keel cooler.
- The size of the connection should match the size of the fill/make-up line selected to meet the requirements listed under the **Vent and Fill/Make-Up Line Requirements Section**.

Low Coolant Level Indicators (Optional)

- When required, additional connections can be designed into an expansion tank for low coolant level warnings or shutdowns.
- For a protective shutdown under a low coolant level condition, locate the bottom of the connection for the shutdown sensor 38 mm (1.5 in.) or greater above the bottom of the tank.
- For a low coolant level warning indication, locate the warning sensor somewhere between the Full Level-Cold and the shutdown sensor (if one is being utilized) or 38 mm (1.5 in.) from the bottom of the tank.
- Install per level indicator manufacturer's instructions.

Pressure Cap

- Never run the engine without a pressure cap. The pressure cap maintains pressure in the system to prevent the coolant from boiling or from evaporating. The cap also maintains the coolant cleanliness by preventing contamination.
- The expansion tank cap should be an open-cap style. Open-cap styles allow venting when the pressure rating is exceeded and allow air to be drawn into the expansion tank when the coolant contracts and the system is under slight vacuum.
- Minimum pressure cap rating is shown in Figure 4.

Generator Models	Pressure Cap Rating
32-40EKOZD and 28-35EFKOZD	13.8 psi

Figure 4 Pressure Cap Rating

- The expansion tank must be located at an elevation higher than other components in the cooling system. Locating the expansion tank at the highest point in the cooling system helps to ensure proper deaeration of the system.

3.1.4 Vent and Fill/Make-Up Line Requirements

Vent Line

- A vent line is required to be routed from the engine water manifold to the expansion tank.
 - The installer is responsible for removing the existing filler neck and pressure cap from the engine.

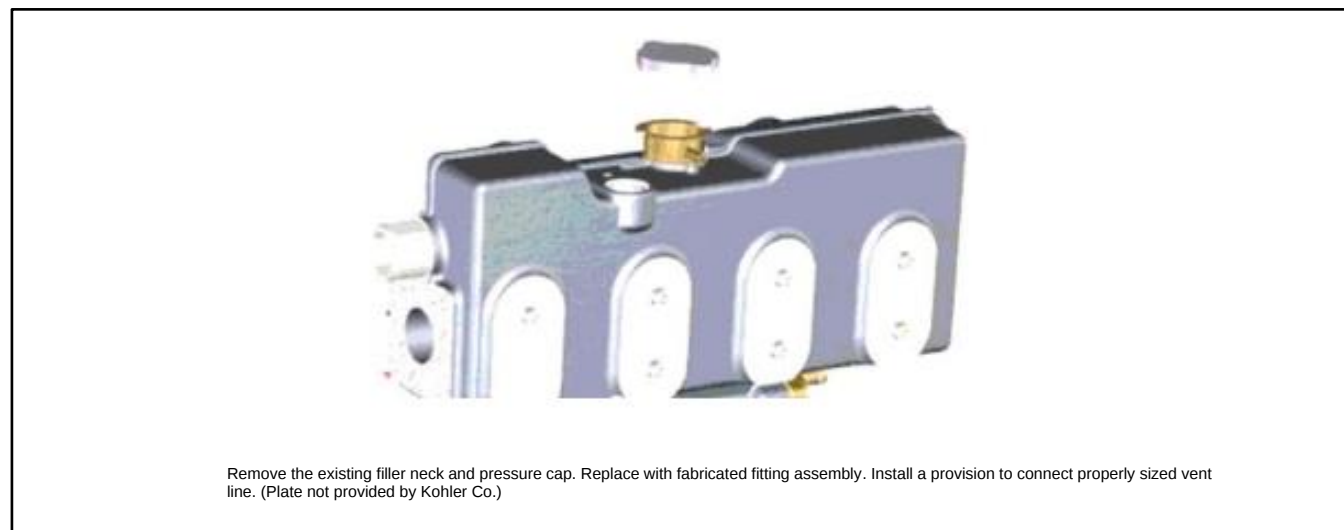


Figure 5 Engine Vent Location-Water Manifold

- Kohler Co. does not provide the mating transition piece to connect the vent line to the engine. It is the responsibility of the installer to provide, install, and connect the properly sized vent hose.
- A single fill/vent line located between the expansion tank and the engine can be used if:
 - The keel cooler is located below the engine connection points.
 - The coolant piping has continuous upward slope from the keel cooler connections to the engine connections. There should be no local high points in the piping. See Figure 6.
 - If double circuit keel cooling is used, each circuit must have a separate independent fill/vent line.
- Multiple vent lines with a separate fill/make-up line:
 - If a single fill/vent line located between the expansion tank and the engine cannot be used, separate vent lines and a dedicated fill/make-up line are required. See Figure 7.
 - Multiple vent lines can be used on single circuit keel coolers as well as a double circuit keel cooling system, vent lines can not cross circuits as both circuits are piped/plumbed separate from each other.
- Vent lines should continuously run uphill from the high points in the system (engine water manifold and piping) to the expansion tank.
- Vent lines should not be connected to each other. Each vent line should enter the expansion tank separately to prevent cross flow of coolant and air.
- Vent lines should be no larger than 6 mm (1/4 in.) diameter to prevent excessive bypass flow. If three or more vent lines are required, do not exceed 3 mm (1/8 in.) diameter.
- The purpose of the fill/make-up line is to:
 - Provide an initial fill of the coolant system.
 - Maintain the proper coolant level in the system after the initial fill.
 - Supply deaerated coolant back to the engine during operation.
- Minimum size of fill/make-up line should be 19 mm (3/4 in.) diameter.
- The fill/make-up line should be connected to the coolant piping that is returning coolant from the keel cooler to the suction side of the engine pump (water pump inlet).

- The fill/make-up line should slope continuously downward between the expansion tank and the connection to the coolant piping.
- The fill line should provide a complete fill at a minimum 3 gpm fill rate. Completely purge or bleed the system of air at the initial fill.

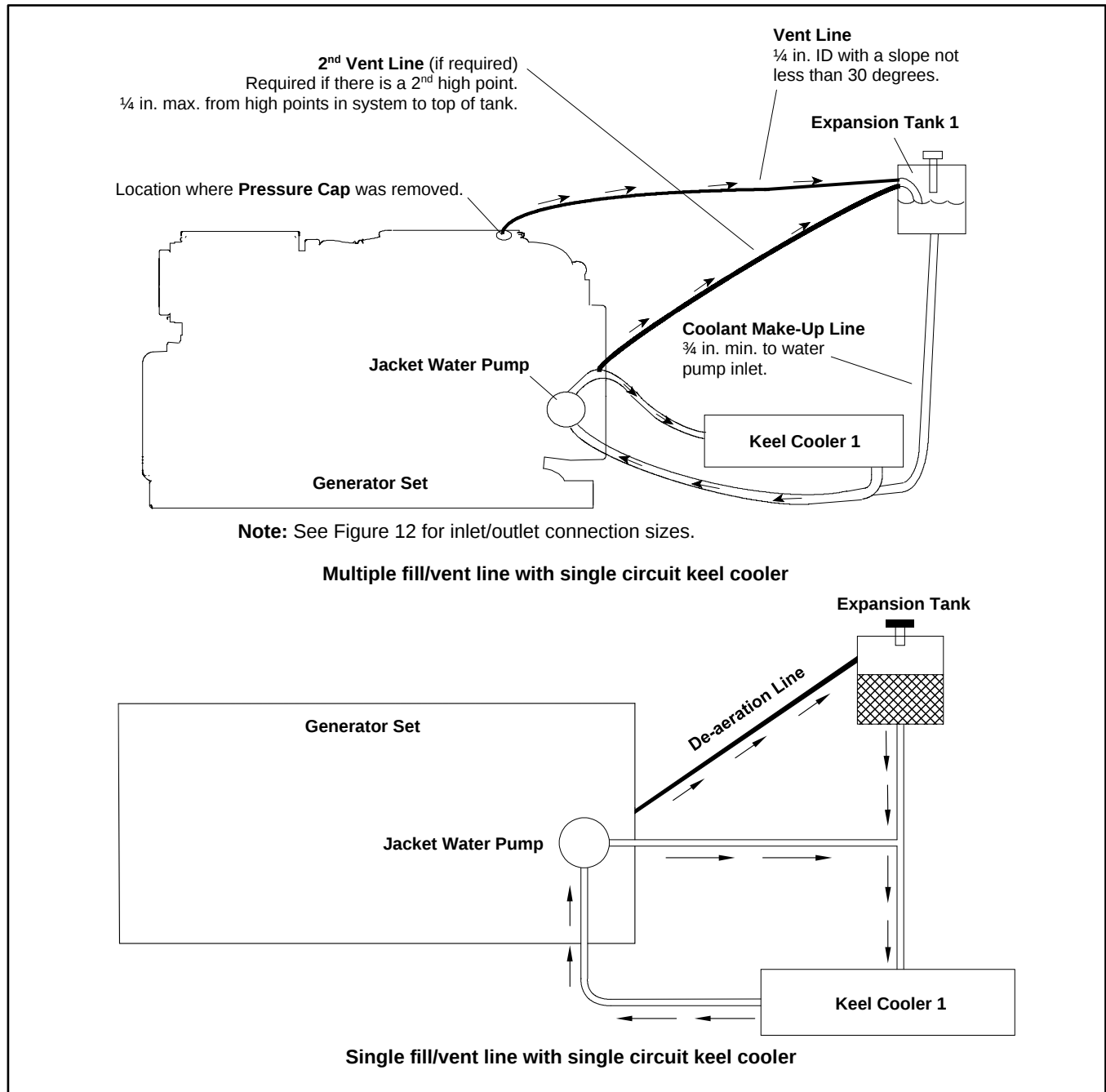
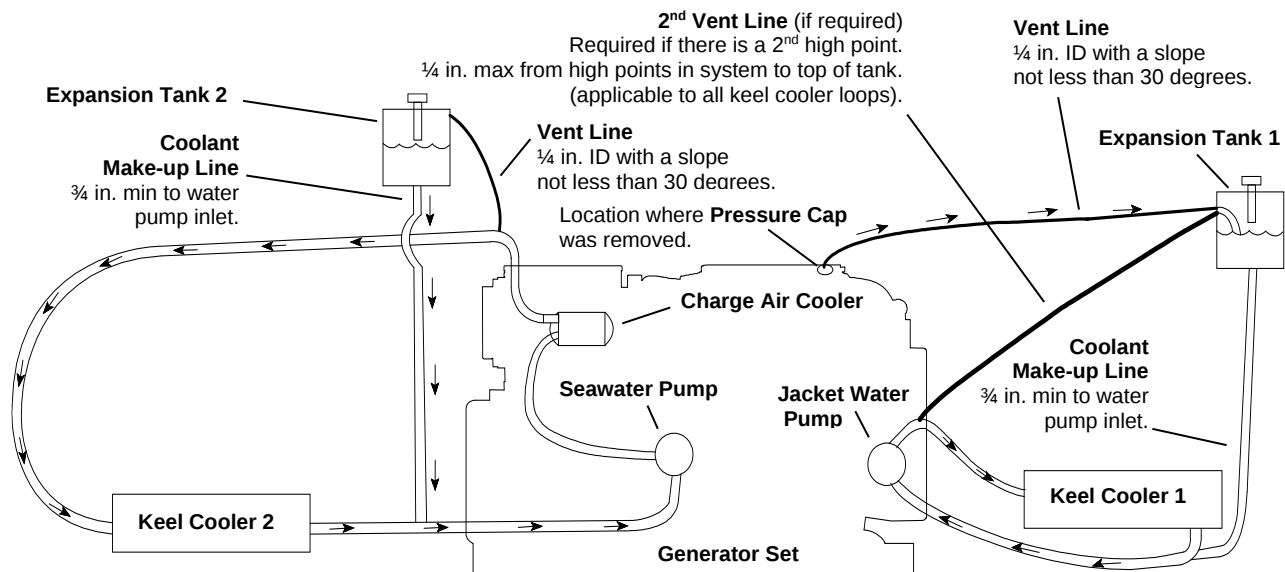
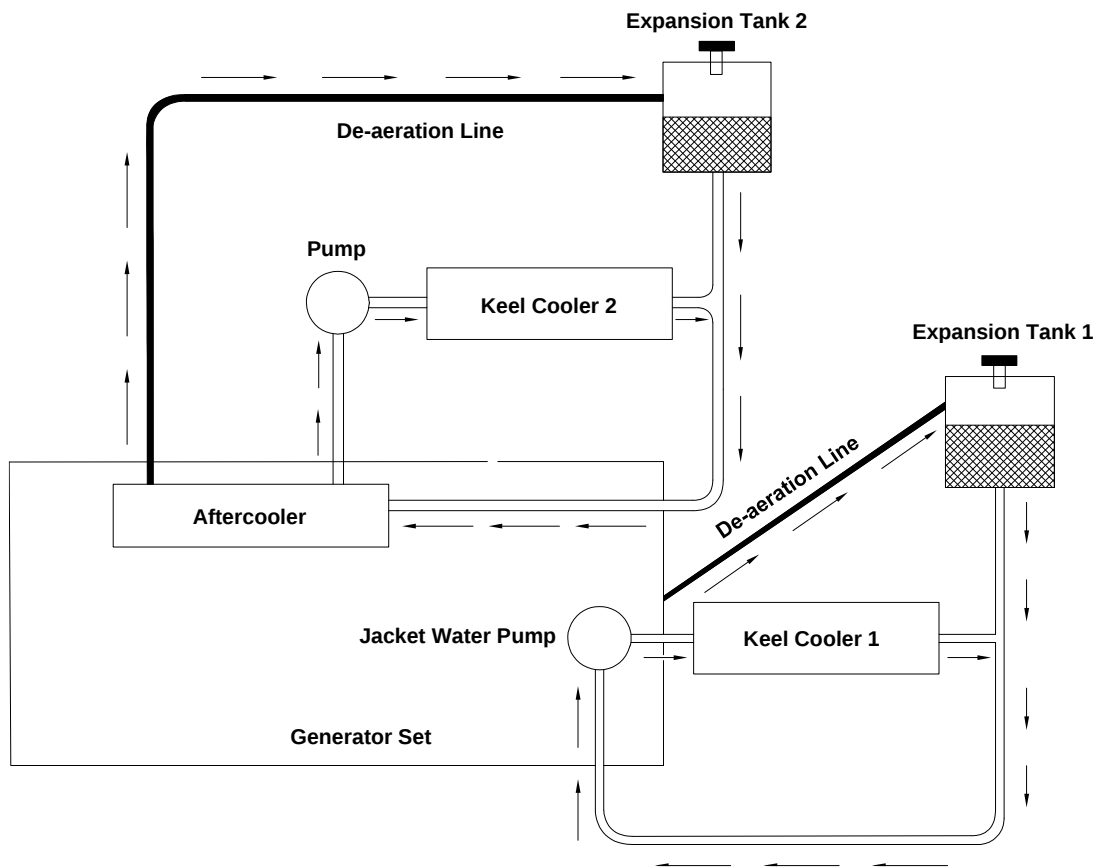


Figure 6 Single Fill/Vent Line Cooling System



Note: See Figure 12 for inlet/outlet connection sizes.

Multiple fill/vent line with double circuit keel cooler



Single fill/vent line with double circuit keel cooler

Figure 7 Multiple Vent Line Cooling System

4 Dry-Exhaust Conversion

Note:

Read and follow all safety precautions at the beginning of this publication before performing any work on the generator set.

4.1 Remove the Generator Set from Service

1. Press the generator set OFF/RESET button to shut down the generator set.
2. Disconnect the generator set engine starting battery, negative (-) lead first.

4.2 Remove the Exhaust Mixer, Heat Exchanger Bundle, and Seawater Pump Components

Note:

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.

1. Drain the engine coolant. Consult the generator operation manual, TP-7044, for procedure.
2. Remove the hoses, hose clamps, tube tee, and pressure switch as shown in Figure 8.
3. Remove the overflow bottle, bracket, flex line, clamps, and hardware as shown in Figure 8.
4. Disconnect the high exhaust temperature sender.
5. Remove and discard the hose, hose clamps, temperature sender, wet exhaust elbow, exhaust wrap, and pipe plug. Save the mounting hardware and gasket. See Figure 8.

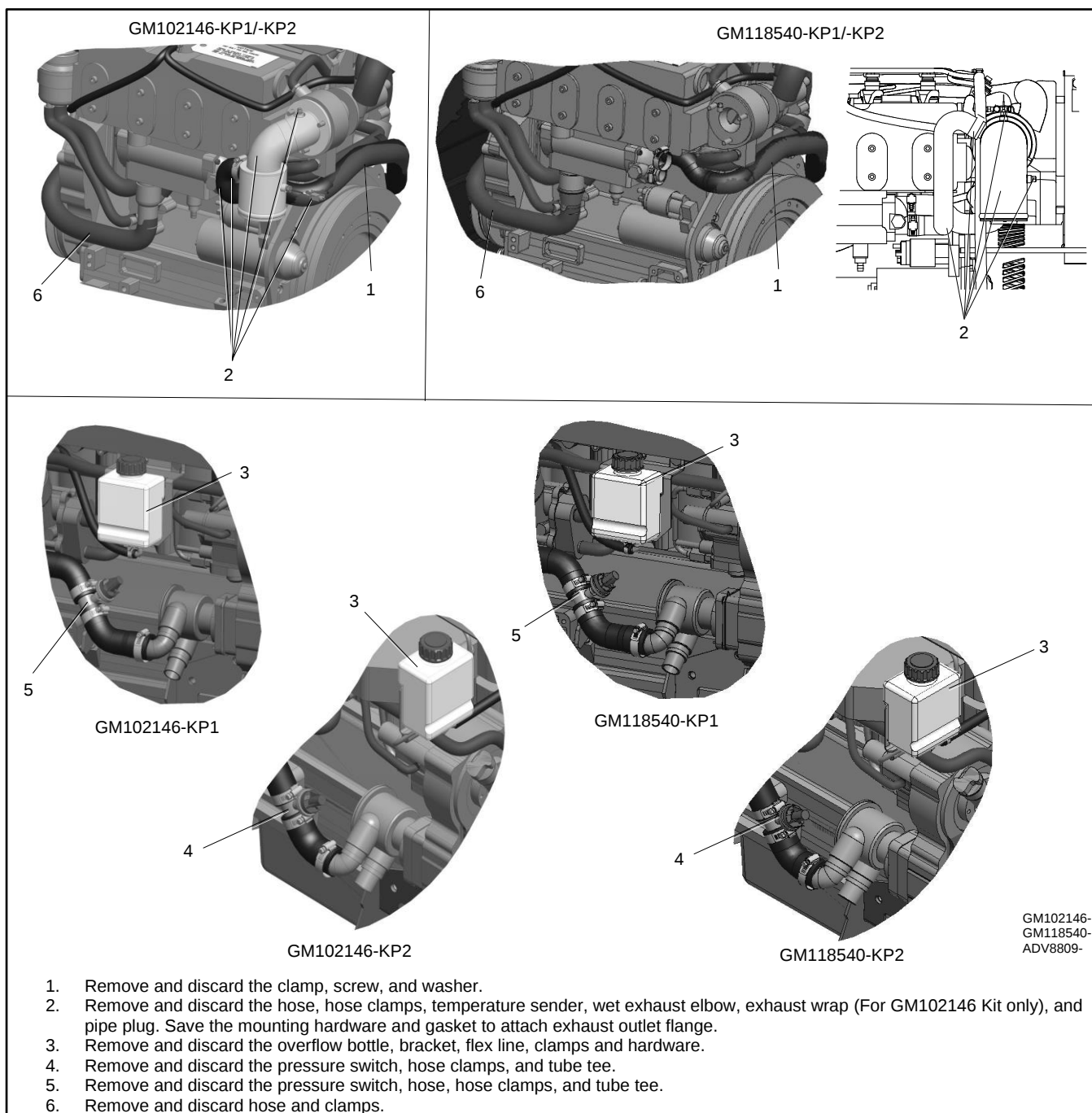


Figure 8 Exhaust Mixer Removal

6. Tape the leads (that was connected to the high exhaust temperature sender and to the sea water pressure sensor) to insulate.
7. Using SiteTech™, change the setting to the following:

	Using SiteTech™	Using Controller Display	Input Enabled Setting
Digital Input 5	Digital Input 113	Digital Input 1:5	OFF
Analog Resistive Input 4	Programmable Analog Resistive Input 103	Resistive Input 1:4	OFF

Note:

For more information on SiteTech™, see TP-6701 SiteTech™ software operation manual.

8. Attach the instruction tag (GM101817) to the pressure cap. See Figure 9.
9. Remove the front and rear heat exchanger end caps and gaskets to locate the heat exchanger bundle inside.
10. Remove and discard the heat exchanger bundle. See Figure 9.
11. Replace the front and rear heat exchanger end caps with caps (GM101323 qty. 2), existing gaskets, and screws (M912-06016-60 qty. 6). See Figure 9, item 3.

Install Dry-Exhaust Keel Cooling Kit

1. Install the new exhaust outlet flange (GM102145) reusing the existing gasket and hardware and torque to 23 Nm (17 ft. lbs.). See Figure 9, item 2. The customer must supply flexible stainless exhaust piping and fiberglass insulation to insulate exhaust heat from the generator set.

Note:

Exhaust temperatures can reach 538°C (1000°F) depending on load. Wrap the exhaust pipe to maintain a maximum of 93°C (200°F) surface temperature on the outer wrap.

2. Ensure any wiring harness is at a minimum of 76 mm (3 in.) away from the wrapped exhaust.

For GM102146-KP1 and GM118540-KP1 Only:

3. Remove and discard the seawater pump assembly, retaining ring, support flange, bushing, nut, gasket and shaft. Save the hardware.
4. Install the plate (GM102856) and gasket (GM103936) using existing hardware and torque to 25 Nm (18 ft. lbs.). See Figure 9.

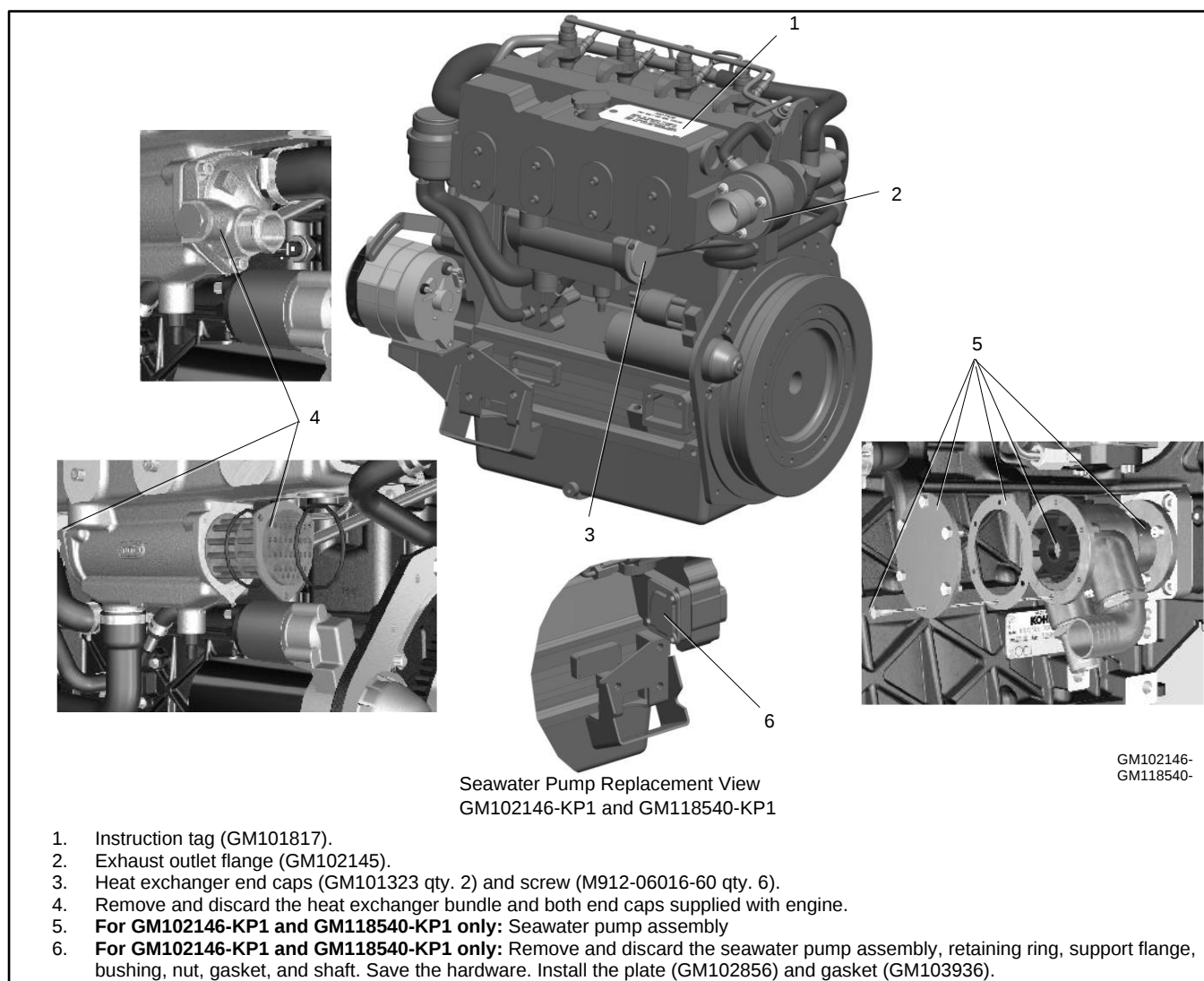


Figure 9 Kit Component Assembly

See Figure 10 and Figure 11 for engine heat rejections and engine block water flows for sizing keel coolers.

Kit Number	GM102146-KP1 and GM118540-KP1	
Cooling Circuit	Engine Jacket Water	
Models	32EKOZD 60Hz	28EFKOZD 50Hz
Heat rejected to cooling water, kJ/min (Btu/hr.)	44.9 (2553)	36.8 (2093)
Engine water pump flow, Lpm (gpm)	70 (18.5)	57 (15)
Engine coolant capacity, L (qt.), approx.	7 (7.4)	
Max. external pressure drop, kPa (psi) *	30 (4)	

*External pressure drop includes pressure loss from all piping and keel cooler. For initial layout purposes, consider allocating 1/3 of the maximum external pressure drop for all piping restriction and the remaining 2/3 for allowable keel cooler restriction.

Figure 10 Cooling System Specifications, GM102146-KP1 and GM118540-KP1

Kit Number	GM102146-KP2 and GM118540-KP2			
Cooling Circuit	Engine Jacket Water		Charge Air Cooler	
Models	40EKOZD 60Hz	35EFKOZD 50Hz	40EKOZD 60Hz	35EFKOZD 50Hz
Heat rejected to cooling water, kJ/min (Btu/hr.)	56.4 (3207)	45.2 (2570)	7.8 (443.9)	5.8 (330.1)
Engine water pump flow, Lpm (gpm)	70 (18.5)	57 (15)	89 (23.5)	78 (20.6)
Engine coolant capacity, L (qt.), approx.	7 (7.4)		N/A	
Max. external pressure drop, kPa (psi) *	30 (4)		68 (9.86)	

*External pressure drop includes pressure loss from all piping and keel cooler. For initial layout purposes, consider allocating 1/3 of the maximum external pressure drop for all piping restriction and the remaining 2/3 for allowable keel cooler restriction.

Figure 11 Cooling System Specifications, GM102146-KP2 and GM118540-KP2

5. Install the customer supplied keel cooler per the keel cooler manufacturer's instructions.
6. Fill the engine with coolant. Consult the generator operation manual, TP-7044, for procedure.

Note:

For all **Engine Jacket Water-Cooled Models** (32-40EKOZD/28-35EFKOZD): Keel cooler is sized sufficiently if (in the highest engine operating ambient condition with generator set fully loaded) the engine jacket water temperature does not exceed 110°C (230°F) and the engine outlet temperature of the cooling water does not exceed 87°C (188.6°F).

For all **Charge Air Cooler Models** (40EKOZD/35EFKOZD): Keel cooler is sized sufficiently if (in the highest engine operating ambient condition with generator set fully loaded) the charge air cooler water inlet temperature does not exceed 27°C (81°F) and the engine outlet temperature of the cooling water does not exceed 28.3°C (83°F).

4.3 Restore the Generator Set to Service

1. Check that the generator set is OFF.
2. Reconnect the generator set engine starting battery, negative (-) lead last.

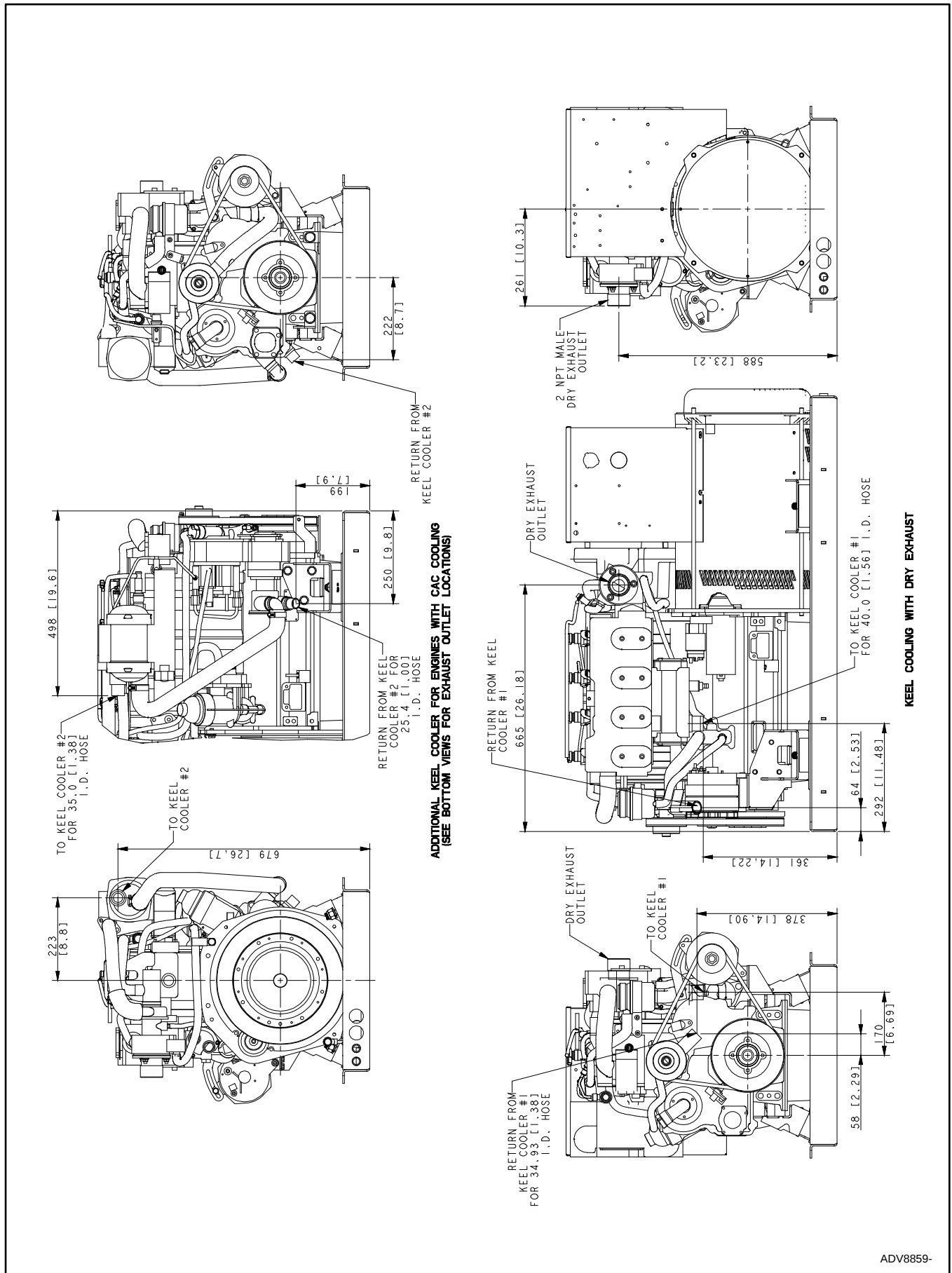


Figure 12 Dimension Print (32/40EKOZD and 28/35EKOZD)

Notes

Notes

5 Parts List

Kits: GM102146-KP1 and GM118540-KP1		
Qty.	Description	Part Number
2	Cap, heat exchanger	GM101323
1	Tag, instruction	GM101817
1	Flange, exhaust outlet	GM102145
6	Screw, socket head cap	M912-06016-60
1	Plate, PTO cover	GM102856
1	Gasket, PTO cover	GM103936

Kits: GM102146-KP2 and GM118540-KP2		
Qty.	Description	Part Number
2	Cap, heat exchanger	GM101323
1	Tag, instruction	GM101817
1	Flange, exhaust outlet	GM102145
6	Screw, socket head cap	M912-06016-60

Availability is subject to change without notice. Kohler Co. reserves the right to change the design or specifications without notice and without any obligation or liability whatsoever. Contact your local Kohler® generator set distributor for availability.

© 2018 Kohler Co. All rights reserved.