

Operator's Manual

MDKAV, MDKAW

MDKAZ, MDKBD

MDKBE, MDKBF

MDKBG

California

Proposition 65 Warning

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

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Safety Precautions

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

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

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

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

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

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

GENERAL PRECAUTIONS

- Keep children away from the genset.
- Do not use evaporative starting fluids. They are highly explosive.
- Do not step on the genset when entering or leaving the generator room. Parts can bend or break leading to electrical shorts or to fuel, coolant or exhaust leaks.
- To prevent accidental or remote starting while working on the genset, disconnect the negative (-) battery cable at the battery.
- Let the engine cool down before removing the coolant pressure cap or opening the coolant drain. Hot coolant under pressure can spray and cause severe burns.
- Keep the genset, drip pan and compartment clean. Oily rags can catch fire. Gear stowed in the compartment can restrict cooling.

- Make sure all fasteners are secure and properly torqued.
- Do not work on the genset when mentally or physically fatigued or after having consumed alcohol or drugs.
- You must be trained and experienced to make adjustments while the genset is running—hot, moving or electrically live parts can cause severe personal injury or death.
- Used engine oil has been identified by some U. S. state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale, or contact used oil or its vapors.
- Ethylene glycol, used as engine antifreeze, is toxic to humans and animals. Clean up spills and dispose of used engine coolant in accordance with local environmental regulations.
- Keep multi-class ABC fire extinguishers handy. Class A fires involve ordinary combustible materials such as wood and cloth; Class B fires, combustible and flammable liquid fuels and gaseous fuels; Class C fires, live electrical equipment. (ref. NFPA No. 10)
- Genset installation and operation must comply with all applicable local, state and federal codes and regulations.

GENERATOR VOLTAGE IS DEADLY

- Generator electrical output connections must be made by a trained and experienced electrician in accordance with applicable codes.
- The genset must not be connected to shore power or to any other source of electrical power. Back-feed to shore power can cause electric shock resulting in severe personal injury or death and damage to equipment. An approved switching device must be used to prevent interconnections.
- Use caution when working on live electrical equipment. Remove jewelry, make sure clothing and shoes are dry, stand on a dry wooden platform or rubber insulating mat and use tools with insulated handles.

ENGINE EXHAUST IS DEADLY

- Never sleep in the boat while the genset is running unless the boat is equipped with properly working carbon monoxide detectors.
- The exhaust system must be installed in accordance with the genset Installation Manual and be free of leaks.
- Make sure the bilge is adequately ventilated with a power exhauster.
- Inspect for exhaust leaks every startup and after every eight hours of operation.
- For more information about carbon monoxide see American Boat and Yacht Council (ABYC) publication TH-22—*Educational Information About Carbon Monoxide*.

DIESEL FUEL IS COMBUSTIBLE

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

BATTERY GAS IS EXPLOSIVE

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

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

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

FLAMMABLE VAPOR CAN CAUSE A DIESEL ENGINE TO OVERSPEED

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

POST THESE SUGGESTIONS IN POTENTIAL HAZARD AREAS OF THE BOAT

Introduction

ABOUT THIS MANUAL

This is the operator's manual for the generator sets (gensets) listed on the front cover. Each operator should study this manual carefully and observe all of its instructions and safety precautions. Keep this manual handy for ready reference.

Operation, Periodic Maintenance and Troubleshooting provide the instructions necessary for operating the genset and maintaining good performance. The owner is responsible for performing maintenance in accordance with the PERIODIC MAINTENANCE SCHEDULE (Page 12). *Emissions* (Page 34) includes information regarding compliance with emissions regulations.

⚠WARNING *This genset is not a life support system. It can stop without warning. Children, persons with physical or mental limitations, and pets could suffer severe personal injury or death. A personal attendant, redundant power or an alarm system must be used if genset operation is critical.*

MODEL IDENTIFICATION

When contacting an Onan® dealer for parts, service or product information (see *How to Obtain Service*, Page 35), be ready to provide the model and serial numbers on the genset nameplate. Figure 1 illustrates the nameplate and its location. The numbers in the gray boxes are typical model and serial numbers. Every character in these numbers is significant. (The last character of the model number is the specification letter, which is important for obtaining the right parts.) Record the model and serial numbers in the boxes in Figure 1 so that they are easy to find when you need them.

Genuine Onan replacement parts are recommended for best performance and safety.

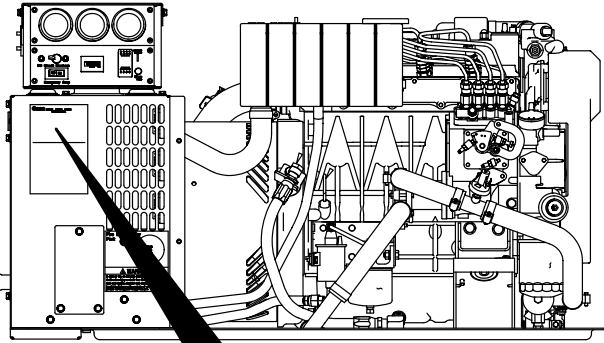



Diagram of a generator set with a nameplate. A black arrow points from the nameplate to the table below.

IMPORTANT ENGINE INFORMATION		
		
CUMMINS POWER GENERATION 1400 73rd Ave. NE Minneapolis, MN 55432		
Model No:	13.5MDKAZ-1955A	Made in U.S.A.
S/N:	E000 123456	PH:
AC Volts:	kVA:	kW:
Amps:	Pf:	RPM:
Fuel:	Hz:	Bat:
Options:	Wiring	Diagram:
Insulation - NEMA Class F Ambient 40°C		

RECORD NUMBERS HERE

MODEL NUMBER:
SERIAL NUMBER:

FIGURE 1. TYPICAL NAMEPLATE

FUEL RECOMMENDATIONS

High quality fuel is necessary for good performance and long engine life. Use No. 2 diesel fuel (American Society for Testing and Materials [ASTM] Grade 2-D). The Cetane number should not be less than 45 and sulfur content not more than 0.5 percent (by weight). Where fuel is exposed to cold ambient temperatures, use fuel that has a cloud point (temperature at which wax crystals begin to form) at least 10° F (6° C) degrees below the lowest expected fuel temperature.

⚠ WARNING *Diesel fuel is combustible and can cause severe personal injury or death. Do not smoke near fuel tanks or fuel-burning equipment or in areas sharing ventilation with such equipment. Keep flames, sparks, pilot flames, electrical arcs and switches and all other sources of ignition well away. Keep a multi-class ABC fire extinguisher handy.*

ENGINE OIL RECOMMENDATIONS

Use API (American Petroleum Institute) performance Class **CH-4** engine oil or better. Also look for the SAE (Society of Automotive Engineers) viscosity grade. Referring to Figure 2, choose the viscosity grade appropriate for the ambient temperatures expected until the next scheduled oil change. Multi-grade oils such as SAE 15W-40 are recommended for year-round use.

Synthetic motor oil is not recommended.

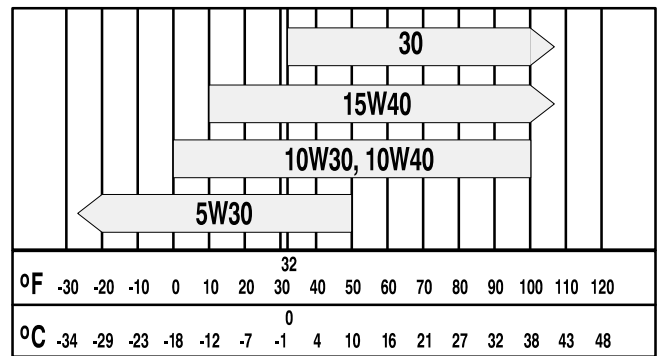


FIGURE 2. SAE VISCOSITY GRADE vs. AMBIENT TEMPERATURE

STARTING BATTERIES

The genset requires a 12 or 24 volt battery(ies) to power its control and starting circuits. Reliable genset starting and starter service life depend upon adequate battery system capacity and maintenance. See *Specifications* (Page 32) for battery requirements and *Periodic Maintenance* (Page 17) for battery care.

FIRE EXTINGUISHER PORT

The genset enclosure has a fire extinguisher port accessible by breaking through the circle on the warning label located as shown in Figure 3. ***Make sure that the nozzle of the fire extinguisher that will be used in the event of fire is smaller than the circle so that it will fit through the port.*** The fire extinguisher must be of the gaseous type.

In the event of fire:

1. DO NOT open the genset enclosure.
2. Shut down engines, generators and blowers.
3. Break through the circle on the label with the nozzle and discharge the full contents of the fire extinguisher.

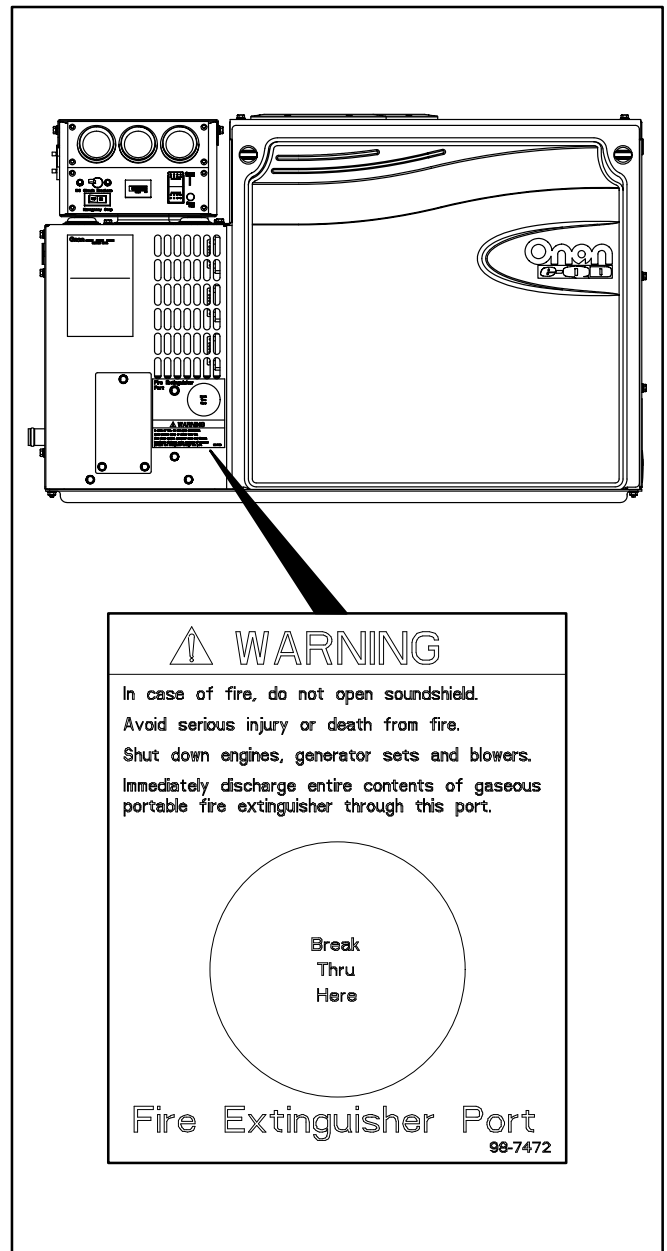


FIGURE 3. FIRE EXTINGUISHER PORT

GENSET CONTROL PANEL

The control panel (Figure 4) is located in the front, upper left hand corner of the genset.

Control Switch - This switch is used to prime the fuel system, start and stop the genset and display the shutdown codes.

- Hold the switch in its **START** position to pre-heat, crank and start the genset. (Preheat is the period of time prior to engine cranking when the glow plugs preheat the combustion chambers. The time is automatically varied by the genset controller on the basis of engine temperature.)
- Press the switch to its **STOP/PRIME** position to stop the genset.
- Hold the switch in its **STOP/PRIME** position to prime the fuel system (starts in 2 seconds).
- See *Troubleshooting* (Page 24) about displaying the shutdown codes.

Status Indicator Lamps- There are two LED (light emitting diode) lamps in the control switch. The *amber* status lamp lights during priming, blinks rapidly during pre-heat and cranking and goes out when the engine is up to speed. If the genset shuts down abnormally, this lamp will slowly blink a code to indicate the cause of shutdown. See *Troubleshooting* (Page 24). The *green* status lamp lights after the

starter disconnects and the engine is up to speed and stays on while the genset runs.

Emergency Stop Switch - In an emergency push **OFF**. Push **ON** after all necessary repairs to the genset and connected equipment have been made.

DC Circuit Breaker - This circuit breaker protects the DC control circuits of the genset from short circuits. Push the handle left to reset after all necessary repairs have been made to the genset.

Hour Meter - The hour meter records genset operating time in hours. It cannot be reset.

Engine Gauges (Optional)- These gauges monitor engine oil pressure, coolant temperature and battery voltage. They have green, yellow and red LEDs. GREEN indicates normal operation. YELLOW and RED warn of abnormal engine conditions requiring maintenance or service. RED is more severe than YELLOW. See *Periodic Maintenance* (Page 12).

Line Circuit Breakers - See Page 9.

REMOTE CONTROL PANEL

The boat probably has one or two remote control panels for starting and operating the genset. The gauges on Onan-supplied remote panels are like the ones on the genset.

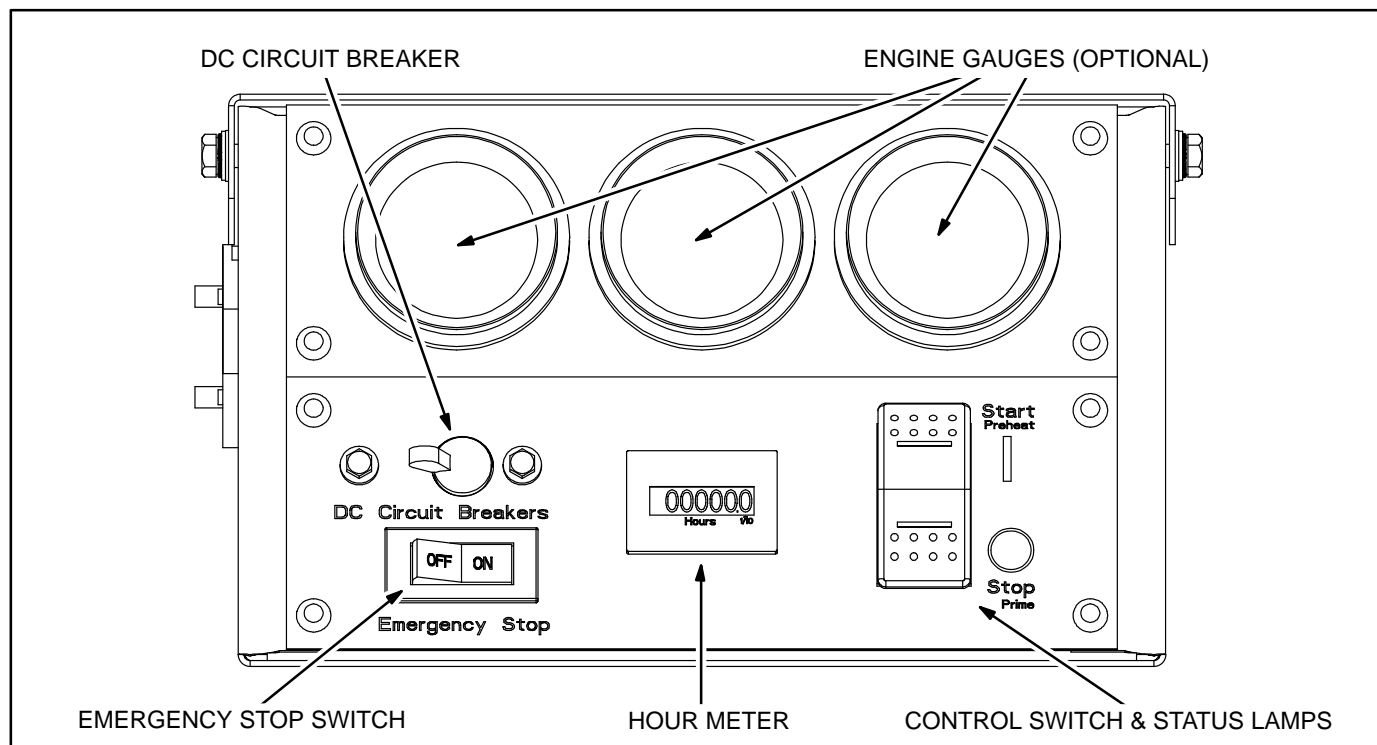


FIGURE 4. GENSET CONTROL PANEL

Operation

⚠ WARNING EXHAUST GAS IS DEADLY!

Engine exhaust contains carbon monoxide, a poisonous, odorless and colorless gas that can cause unconsciousness and death. Symptoms of carbon monoxide poisoning include:

- *Dizziness*
- *Throbbing in Temples*
- *Nausea*
- *Muscular Twitching*
- *Headache*
- *Vomiting*
- *Weakness*
- *Trouble Thinking Clearly*
- *Sleepiness*

GET EVERYONE OUT INTO FRESH AIR IMMEDIATELY IF ANYONE EXPERIENCES ANY OF THESE SYMPTOMS. Seek medical attention if symptoms persist. Never sleep in the boat when the genset is running unless the cabin has a working carbon monoxide detector.

Look over the entire exhaust system and listen for leaks every time you start up the genset and after every eight hours of operation. Shut down the genset immediately if there is a leak. Do not run the genset until the leak has been repaired. The exhaust system must be installed in accordance with the genset Installation Manual.

PRE-START CHECKS

Conduct general inspections (Page 13) before the first start of the day and after every eight hours of operation. Keep a log of maintenance and the hours run (Page 36) and perform any maintenance that may be due. Perform maintenance required to return the genset to service if the boat has been in storage (Page 11). Before each start:

1. Make sure all CO detectors on board are working properly.
2. Check for swimmers that might be exposed to the engine exhaust.
3. Turn off air conditioners and other large appliances.

PRIMING THE FUEL SYSTEM

If the genset ran out of fuel, prime the fuel system by holding the control switch at **STOP/PRIME** for 30 seconds. (The *amber* status lamp will light.)

STARTING THE GENSET

1. Push and hold the control switch at **START** until the genset starts. The *amber* status lamp will blink rapidly. The *amber* status lamp will go out and the *green* status lamp will light after the starter has disconnected and the engine is up to speed. (Depending on how cold the engine is, preheat can take up to 15 seconds before cranking starts.)

2. For longer engine life, let the engine warm up for two minutes before turning on air conditioners and other large appliances.
3. Check for water, coolant, fuel and exhaust leaks. Stop the genset immediately if there is a leak. Repair fuel leaks immediately.
4. Monitor the engine gauges if so equipped. Perform maintenance or service as necessary if a gauge indicates an abnormal engine condition. See *Periodic Maintenance* (Page 12).
5. **If the genset fails to start**, cranking will discontinue in 20 to 60 seconds, depending on how cold the engine is, and the *amber* status lamp will blink Shutdown Code No. 4 (Page 26). See *Troubleshooting* (Page 24) if the genset does not start after two or three tries.

⚠ CAUTION *Do not continue cranking and risk burning out the starter or flooding the engine (exhaust flow during cranking is too low to expel water from the exhaust system). Find out why the genset does not start and make necessary repairs.*

6. **If the genset shuts down**, the *amber* status lamp will blink one of the shutdown codes. See *Troubleshooting* (Page 24).

STOPPING THE GENSET

Turn off air conditioners and other large appliances and let the genset run for two minutes to cool down. Then touch the Control Switch to **STOP**.

EMERGENCY STOP

Push the **EMERGENCY STOP SWITCH** to **OFF** (Page 7). After all necessary repairs have been made, push the switch to **ON** so that the genset can be operated.

RESETTING CIRCUIT BREAKERS

If a circuit breaker in the main power distribution panel of the boat or on the genset (Figure 5) trips, either a circuit shorted or too many appliances were running. Note that the genset may continue to run after a circuit breaker trips.

If a circuit breaker trips, disconnect or turn off all connected loads and reset the circuit breaker. (Push the circuit breaker to **OFF** to reset it and then to **ON** to reconnect the circuit.) If the circuit breaker trips right away, either the electrical distribution system has a short circuit or the circuit breaker is faulty. Call a qualified electrician.

If the circuit breaker does not trip, reconnect or turn on appliances one by one up to a total load that does not exceed genset or circuit breaker rating. If a circuit breaker trips right away when an appliance is connected, that appliance probably has a short.

Electrical appliances and tools must be used and maintained properly and be properly grounded to cause the line circuit breakers to trip when short circuits occur.

⚠WARNING *Short circuits in electrical appliances and tools can cause fire and electrical shock leading to severe personal injury or death. Read and follow the equipment and tool manufacturer's instructions and warnings regarding use, maintenance and proper grounding.*

CONNECTING SHORE POWER

If the boat has provisions for connecting shore power, it must also have an approved device to keep the genset and shore power from being interconnected.

⚠WARNING *Backfeed to shore power can cause electric shock resulting in severe personal injury or death and damage to equipment. The boat must have an approved device to prevent the genset from being interconnected with shore power.*

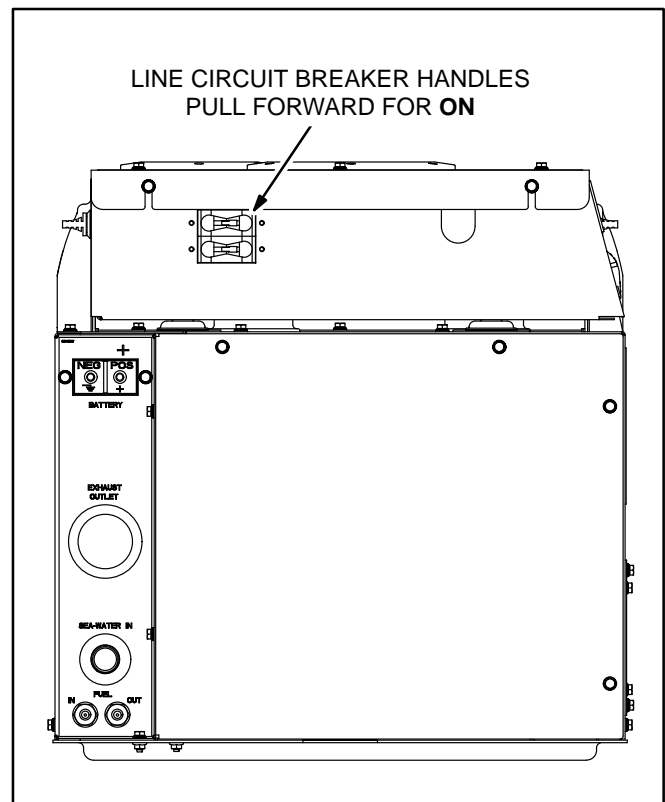


FIGURE 5. LINE CIRCUIT BREAKER

LOADING THE GENSET

The genset can power AC motors, air conditioners, AC/DC converters and other appliances. How much appliance load* can be powered depends upon the genset power rating. The genset will shut down or its circuit breakers will trip if the sum of the loads exceeds genset power.

To avoid overloading the genset and causing shut-downs, compare the sum of the loads of the appliances that are likely to be used at the same time with the power rating of the genset. Use Table 1 or the ratings on the appliances themselves to obtain the individual appliance loads. If the appliance is marked in amps and volts only, multiply the amps times the volts to obtain the appliance load (watts). ***It may be necessary to run fewer appliances at the same time—the sum of the loads must not be greater than genset rating.***

Note that the genset may shut down due to overload—even though the sum of the loads is less than genset rating—when a large motor or air conditioner is started or cycles on. The reason for this is that motor startup load is much larger than running load. ***It may be necessary to run fewer appliances when large motors and air conditioners are running or cycling on and off.***

A genset equipped with an hydraulic pump can be loaded with hydraulic as well as electrical loads at the same time. ***It may be necessary to run fewer electrical loads—or none at all—while powering hydraulic loads.***

The genset is rated at standard barometric pressure, humidity and temperature (ref. ISO 3046). Either low barometric pressure (high altitude) or high ambient temperature will decrease engine power. ***It may be necessary to run fewer appliances under such conditions.***

TABLE 1. TYPICAL APPLIANCE LOADS

Appliance	Load (watts)
Air Conditioner	1400-2000
Battery Charger	Up to 3000
DC Converter	300-700
Refrigerator	600-1000
Microwave Oven	1000-1500
Electric Frying Pan or Wok	1000-1500
Electric Stove Element	350-1000
Electric Water Heater	1000-1500
Electric Iron	500-1200
Electric Hair Dryer	800-1500
Coffee Percolator	550-750
Television	200-600
Radio	50-200
Electric Drill	250-750
Electric Broom	200-500
Electric Blanket	50-200

* Appliance load and genset power are measured in terms of watts (W) or kilowatts (kW), where 1 kilowatt (kW) = 1000 watts (W).

NO-LOAD OPERATION

Keep no-load operation to a minimum. During no-load operation cylinder temperatures drop to the point where fuel does not burn completely, causing fuel wetting and white smoke. It is best to run the genset at 1/4 to 3/4 load (Page 10).

NEW OR RE-BUILT ENGINE CARE

Change the oil and oil filter after the first 50 hours of operation with a new or re-built engine (Page 14).

EXERCISING THE GENSET

Exercise the genset at least 1 hour every month if use is infrequent. Run the genset at 1/4 to 3/4 load (Page 10). A single exercise period is better than several shorter periods. Exercising a genset drives off moisture, re-lubricates the engine, uses up fuel before it becomes stale and removes oxides from electrical contacts and generator slip rings. The result is better starting, more reliable operation and longer engine life.

COLD TEMPERATURE OPERATION

Do not let raw water freeze in the heat exchanger (Page 22) during cold weather when the genset is not operating. Freezing water can damage the raw water tubes in the heat exchanger. Engine coolant, but not raw water, is protected from freezing. Drain the heat exchanger if there is a danger of freezing.

STORING THE GENSET

Proper storage is essential for preserving top genset performance and reliability when the genset will be idle for more than 120 days.

Storing the Genset

1. Change the engine oil (Page 14) and attach a tag indicating viscosity grade (Page 5).
2. Disconnect the battery cables (negative [-] first) from the battery (Page 17). Follow the manufacturer's recommendations when storing the battery.

⚠WARNING *Hot coolant is under pressure and can cause severe burns when loosening the pressure cap. Let the engine cool before loosening the pressure cap.*

3. Check coolant level and add as necessary (Page 18). Test the coolant mixture if freezing temperatures are possible and change if necessary.
4. If freezing temperatures are expected, drain the heat exchanger (Page 22), hoses and muffler to prevent damage from freezing water.
5. Clean and lightly oil parts that can rust.

Returning the Genset to Service

1. Check the oil tag on the genset and change the oil (Page 14) if the viscosity is not appropriate for the temperatures expected (Page 5).
2. Reconnect the battery cables (negative [-] last) (Page 17).
3. Replace the raw water pump impeller if it was installed more than a year ago (Page 23).
4. Perform the maintenance required (Page 12), conduct the pre-start checks (Page 8) and prime the fuel system (Page 8).
5. Start and run the genset (Page 8).

Periodic Maintenance

Periodic maintenance is essential for good performance and long genset life. Use Table 2 as a guide for normal periodic maintenance and record maintenance performed on Page 36.

Maintenance, replacement or repair of emission control devices and systems may be performed by any engine repair establishment or individual. How-

ever, warranty work must be completed by an authorized Onan dealer.

⚠ WARNING *Accidental or remote starting can cause severe personal injury or death. Disconnect the negative (-) cable at the battery to prevent starting while working on the genset.*

TABLE 2. PERIODIC MAINTENANCE SCHEDULE

PROCEDURE	FREQUENCY								Page
	After first 50 Hrs	Every Day/ 8 Hrs	Every Month/ 100 Hrs	Every Year/ 200 Hrs	Every Year/ 500 Hrs	Every 800 Hrs	Every 2 years	Every 5 years/ 2000 Hrs	
General Inspection ¹		x							13
Check Engine Oil Level		x							14
Check Battery			x ²						17
Check V-Belt Tension			x ³						22
Drain Fuel Filter			x						16
Check Siphon Break			x						21
Change Oil & Oil Filter	x			x					14
Change Fuel Filter					x				16
Replace Raw Water Impeller					x				23
Replace Zinc Anode					x				18
Adjust Valve Lash						x ⁴			-
Change Coolant, Pressure Cap & Thermostat							x		18
Check Generator Bearing								x ⁴	-
¹ - Includes Oil Level, Coolant Level, Fuel System, Exhaust System and Battery Checks. ² - See battery manufacturer's recommendations. ³ - Check for slippage, cracking and wear. ⁴ - Must be performed by a trained and experienced mechanic (authorized Onan dealer) in accordance with the genset Service Manuals.									

GENERAL INSPECTION

Inspect the genset before the first start of the day and after every eight hours of operation.

Oil Level

Check engine oil level (Page 14).

Exhaust System

Inspect the exhaust system for leaks and loose hose clamps at the exhaust manifold, exhaust elbow, muffler, water separator and hull fittings. Replace damaged sections of exhaust hose.

Check that all CO monitors are working properly.

⚠WARNING ***EXHAUST GAS IS DEADLY! Do not operate the genset until all exhaust leaks have been repaired.***

Fuel System

Check for leaks at hose, tube and pipe fittings in the fuel supply and return systems while the genset is running and while it is stopped. Check flexible fuel hose for cuts, cracks, abrasions and loose hose clamps. Make sure fuel lines do not rub against other parts. Replace worn or damaged fuel line parts before leaks occur. Replace hose with with USCG TYPE A1 or ISO 7840-A1 fuel hose.

⚠WARNING ***Fuel leaks can lead to fire. Repair leaks immediately. Do not run the genset if it causes fuel to leak.***

Prime the fuel system (Page 8) if the genset ran out of fuel.

Coolant Level Check

Keep the level of coolant in the recovery tank between COLD and HOT. The recovery tank is de-

signed to maintain coolant level; not to fill the system. If the tank is empty, check for and repair any coolant leaks and refill the system through the fill neck on the engine (Filling the System, Page 18). Then refill the recovery tank up to the COLD mark. Use the recommended mixture of antifreeze (Page 18).

Raw Water System

Clean out the sea water strainer if necessary and make sure the sea cock is open for genset operation. Also, when a water/exhaust separator is provided (see Installation Manual), open the sea cock for the water drain hose.

Check for and replace hoses that leak or are damaged.

Battery Connections

Check the battery terminals and keep them clean and tight (Page 17). Loose or corroded terminals have high electrical resistance, which can cause hard starting and short starter life.

Mechanical

Look for mechanical damage. Start the genset and look and listen for any unusual noises and vibrations.

Check the genset mounting bolts to make sure they are secure.

Check to see that the genset air inlet and outlet openings are not clogged with debris or blocked. Keep the genset and generator compartment clean.

Monitor the engine gauges, if so equipped, whenever the genset is running.

CHECKING ENGINE OIL LEVEL

⚠ WARNING *Crankcase pressure can blow out hot engine oil causing severe burns. Always stop the genset before removing the oil dipstick or fill cap.*

Shut off the genset before checking engine oil level and remove the access door if the genset has an enclosure.

1. Remove, wipe off and reinsert the oil level dipstick (Figure 6 or 7). Remove the dipstick again and check the oil level.
2. Add or drain oil as necessary. See ENGINE OIL RECOMMENDATIONS (Page 5). Keep the oil level between the high and low marks on the end of the dipstick. It is not necessary to add oil between oil changes if the oil has not dropped more than 1/3 of the way between the high and low marks. A full quart (0.9 liter) can be added if the oil level is at the lower mark.

⚠ CAUTION *Too much oil can cause high oil consumption. Too little oil can cause severe engine damage. Keep the oil level between the high and low marks on the dipstick.*

3. Secure the access door if the genset has an enclosure.

CHANGING ENGINE OIL AND FILTER

See Table 2 for scheduled oil change.

1. Run the genset under load until it is up to operating temperature, stop it and disconnect the negative (-) battery cable at the battery.

⚠ WARNING *Accidental or remote starting can cause severe personal injury or death. Disconnect the negative (-) cable at the battery to prevent the engine from starting.*

2. Remove the access door if the genset has an enclosure. Unscrew the plug on the end of the drain hose (Figure 6), if provided, and drain the oil into a suitable container. (Two wrenches are necessary to keep from twisting the hose when loosening and tightening the plug.) If an oil pump-out system is installed, follow the instructions provided.
3. Secure the oil drain plug in the end of the hose and secure the hose in its hanger.
4. Spin off the old oil filter (Figure 6 or 7) and wipe off the filter mounting surface. (A filter wrench is available from Onan.) Remove the old gasket if it does not come off with the filter.
5. Apply a film of oil to the filter gasket and partly fill the filter with oil so that it reaches engine parts sooner at startup. Spin the new filter on by hand until the gasket just touches the mounting pad and tighten 3/4 turn.
6. Refill with the proper type (Page 5) and amount (Page 32) of engine oil and check the level (see CHECKING ENGINE OIL LEVEL).
7. Secure the access door if the genset has an enclosure.
8. Dispose of the used oil and oil filter in accordance with local environmental regulations.

⚠ WARNING *U. S. state and federal agencies have determined that contact with used engine oil can cause cancer or reproductive toxicity. Avoid skin contact and breathing of vapors. Use rubber gloves and wash exposed skin.*

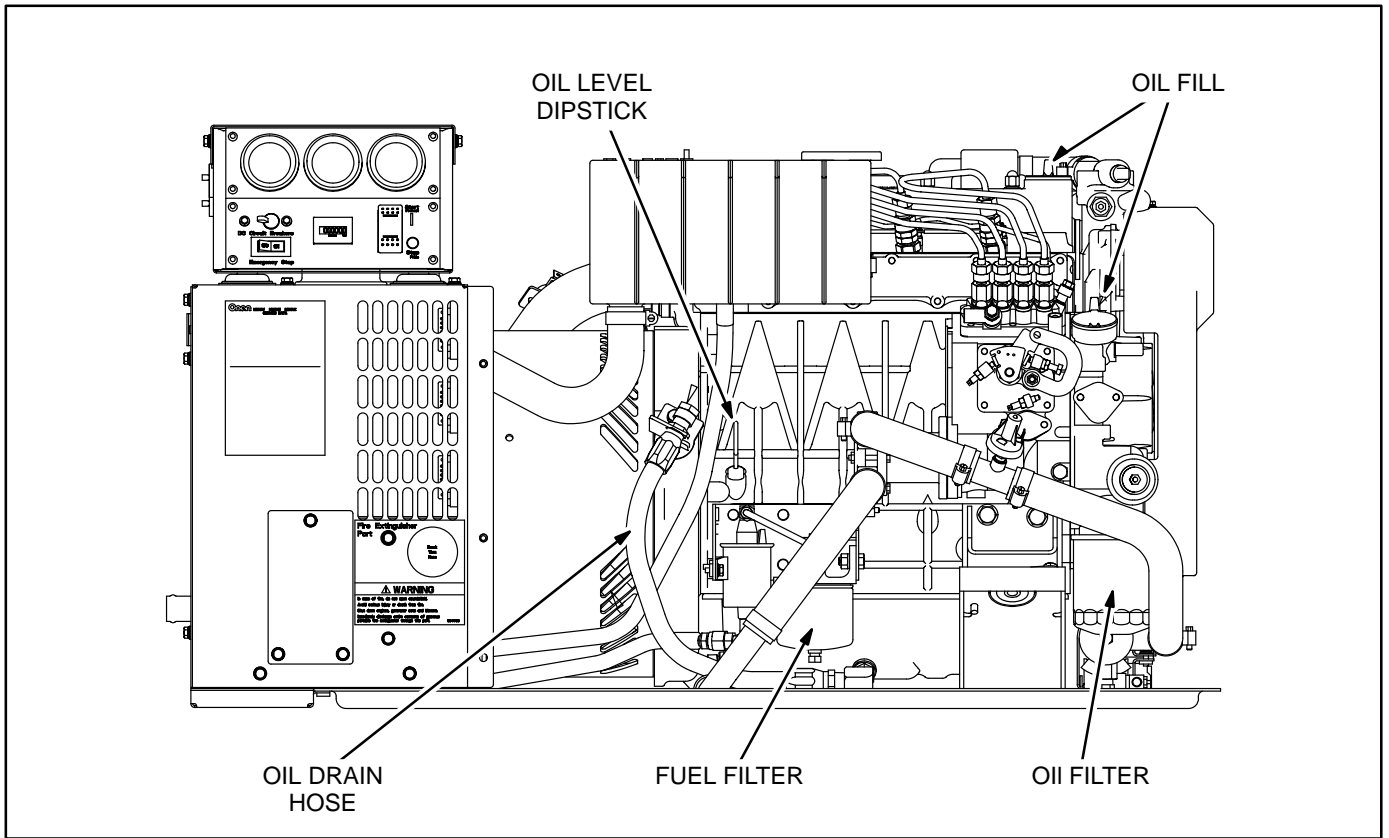


FIGURE 6. OIL AND FUEL SERVICE POINTS—MDKAV, MDKBG, MDKAW, MDKAZ

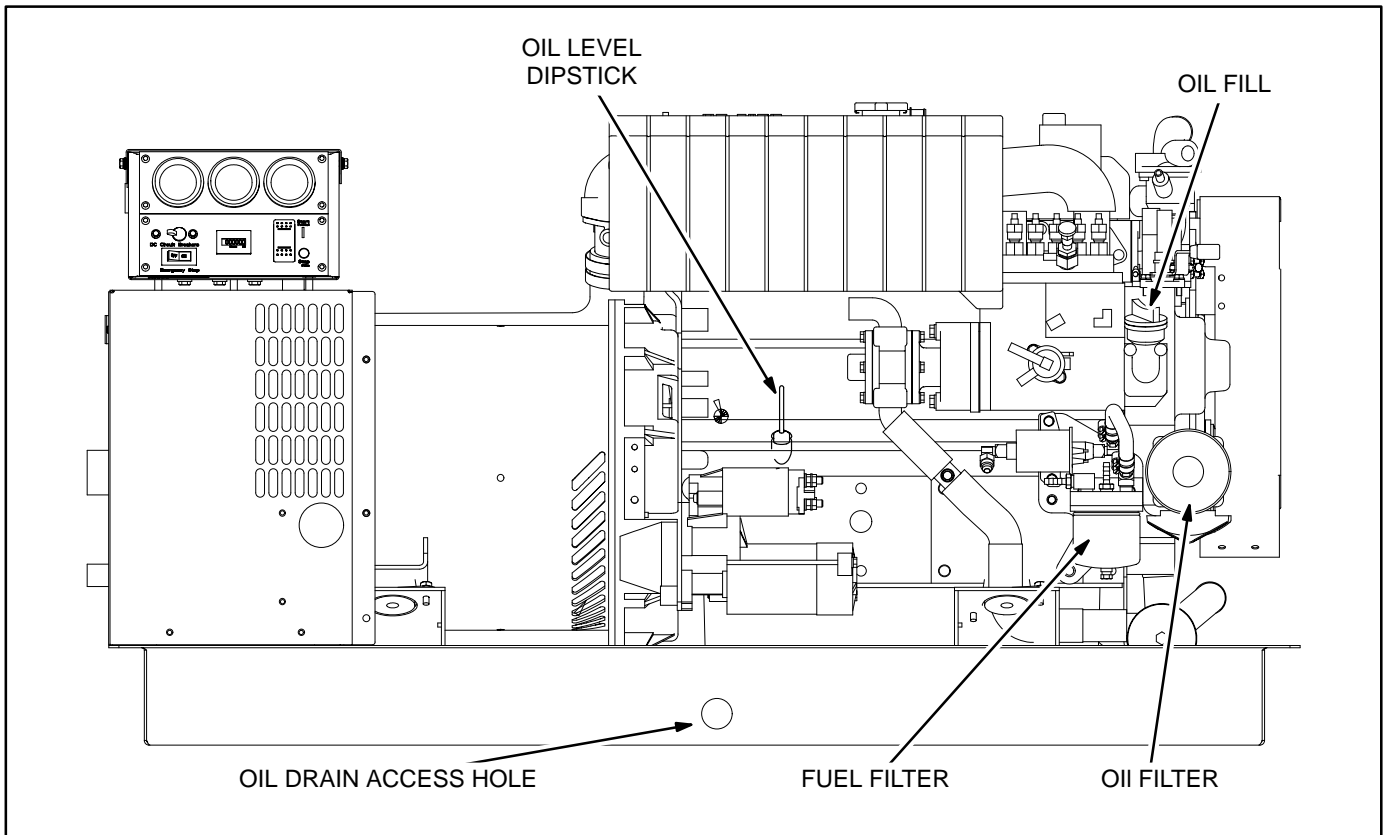


FIGURE 7. OIL AND FUEL SERVICE POINTS—MDKBD, MDKBE, MDKBF

DRAINING / CHANGING FUEL FILTER

⚠WARNING *Diesel fuel is combustible and can cause severe personal injury or death. Do not smoke near fuel tanks or fuel-burning equipment or in areas sharing ventilation with such equipment. Keep flames, sparks, pilot flames, electrical arcs and switches and all other sources of ignition well away. Keep a multi-class ABC fire extinguisher handy.*

Fuel Handling Precautions: Keep dirt, water and other contaminants from entering the fuel system and corroding or clogging fuel injection components. The genset has a water separator type of fuel filter (Figure 6 or 7). The fuel supply system should also have a water separator and filter.

Humid air condenses on the walls of fuel tanks and is the primary source of water in fuel. Water clogs fuel passages by freezing and causes corrosion by forming sulfuric acid with the sulfur in the fuel. Keeping fuel tanks full reduces condensation by reducing the area on which condensation can take place.

⚠WARNING *Accidental or remote starting can cause severe personal injury or death. Disconnect the negative (-) cable at the battery to prevent the engine from starting.*

Draining Water and Sediment: Drain water and sediment more often than scheduled (Table 2) if fuel quality is poor or condensation cannot be avoided.

1. Disconnect the negative (-) cable at the battery to prevent the engine from starting and close

the fuel supply valve, if provided, to prevent loss of prime.

2. Remove the access door if the genset has an enclosure. Drain the filter (about 1/2 cup [120 ml]) into a suitable container by removing the drain plug (bottom of filter).
3. Re-install the drain plug and dispose of the drain-off in accordance with local environmental regulations.
4. Secure the access door if the genset has an enclosure.

Changing Fuel Filter: See Table 2 for scheduled filter change. Change the filter if the engine lacks power.

1. Disconnect the negative (-) cable at the battery to prevent the engine from starting and close the fuel supply valve, if provided, to prevent loss of prime.
2. Remove the access door if the genset has an enclosure. Spin off the old filter and dispose of it in accordance with local environmental regulations.
3. Clean the contact surface on the filter base, lubricate the new filter gasket and spin the new filter on hand tight.
4. Prime the engine for at least 30 seconds (Page 8) to fill the new filter. Run the genset and check for leaks. Tighten the filter by hand, if necessary.
5. Secure the maintenance access door if the genset has an enclosure.

MAINTAINING BATTERY AND BATTERY CONNECTIONS

⚠ WARNING *Flames, sparks or arcing at battery terminals, light switches or other equipment can ignite battery gas causing severe personal injury — Ventilate the battery area before working on or near the battery — Wear safety glasses — Do not smoke — Switch a work lamp ON and OFF away from the battery — Do not disconnect the battery cables while the genset is running or a battery charger is on — Always disconnect the negative (-) cable first and reconnect it last.*

See Table 2 for scheduled maintenance. Follow the battery manufacturer's instructions. Have the battery charging system serviced if DC system voltage is consistently low or high. Always:

1. Keep the battery case, terminals and cables clean and dry and the terminals tight at the battery and at the genset (Figure 8).
2. Remove battery cables with a battery terminal puller.
3. Make sure which terminal is positive (+) and which is negative (-) before making battery connections. Always remove the negative (-) cable first and reconnecting it last to reduce arcing.
4. Follow the manufacturer's recommendations when storing the battery. Disconnect the battery so that it does not discharge through the genset control during storage.

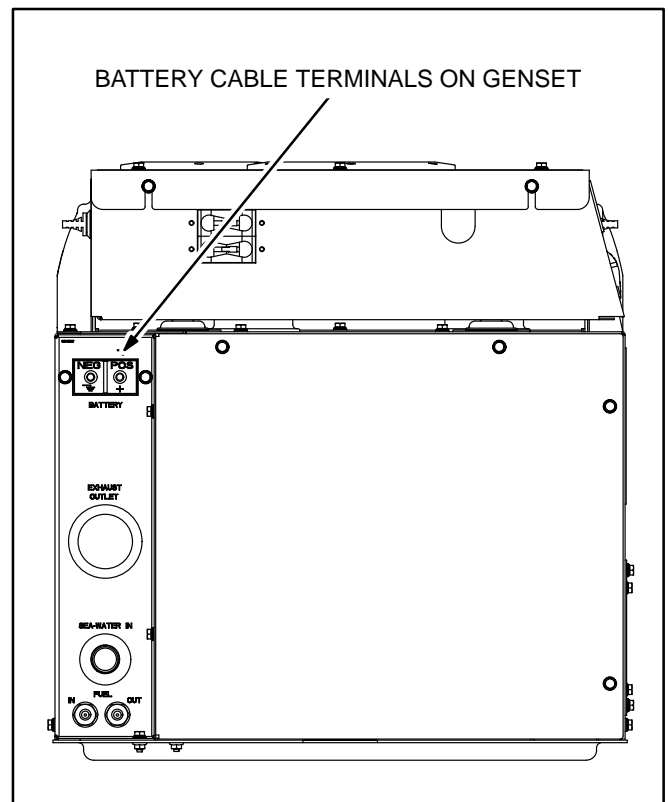


FIGURE 8. BATTERY CABLE TERMINALS

ENGINE COOLING SYSTEM

Cooling System Overview

The engine is cooled by a pressurized, closed-loop liquid cooling system (Figure 9 or 10). Coolant is pumped through passages in the engine block, head and exhaust manifold by a belt-driven pump and is cooled in a heat exchanger mounted on the base pan or in a keel cooler. The exhaust manifold also serves as the engine coolant reservoir.

If the genset has a heat exchanger and/or exhaust-water mixer, the engine is equipped with a gear-driven raw water pump. The raw water cools the heat exchanger and/or exhaust gases and exits the boat through the exhaust system.

Recommended Coolant Mixture

Use the best quality ethylene glycol antifreeze solution available. It should be fully formulated with rust inhibitors and coolant stabilizers. Use fresh water that is low in minerals and corrosive chemicals. Distilled water is best. Unless prohibited by shipping regulations, the genset is shipped with the recommended 50/50 mixture of water and ethylene glycol, which is good for -34° F (-37° C). See Page 32 regarding coolant capacity.

⚠ WARNING *Ethylene glycol antifreeze is considered toxic. Dispose of it according to local regulations for hazardous substances.*

Replenishing Normal Coolant Loss

Keep the level of coolant in the coolant recovery tank between COLD and HOT. The recovery tank is designed to maintain coolant level; not to fill the system. If the tank is empty, check for and repair any coolant leaks and refill the system through the fill neck on the engine. Then refill the recovery tank up to the COLD mark. Use the recommended coolant mixture.

Changing Coolant

See Table 2 for scheduled maintenance.

Draining the System: Have towels and containers ready to wipe up, collect and properly dispose of the coolant.

1. Disconnect the negative (-) cable at the battery to prevent the engine from starting, let the engine cool and remove the front and back access doors if the genset has an enclosure.

⚠ WARNING *Accidental or remote starting can cause severe personal injury or death. Disconnect the negative (-) cable from the battery to prevent the engine from starting.*

⚠ WARNING *Hot coolant is under pressure and can cause severe burns when loosening the pressure cap. Let the engine cool before loosening the pressure cap.*

2. Remove the coolant pressure cap.
3. Open the block and heat exchanger drain cocks (Figure 9 or 10) and collect the used coolant in containers for proper disposal. See the manufacturer's instructions regarding how to drain a keel cooler, if the boat is so equipped.

Coolant Hoses: Check for and replace hoses that leak or are damaged.

Pressure Cap: See Table 2 for scheduled replacement. The pressure cap is necessary for optimal engine cooling and reduced coolant loss.

Cleaning and Flushing the System: Use radiator cleaning chemicals to clean and flush the cooling system before refilling with fresh coolant. Follow the cleaner manufacturer's instructions.

⚠ CAUTION *Filling a hot engine with cold water can cause cracks in the manifold, head and block. Follow the manufacturer's instructions for cleaning and flushing.*

Filling the System: Close the block and heat exchanger drain cocks and fill the system through the engine fill neck. The system will fill only as fast as the air can escape. Fill to the bottom of the fill neck. Start and run the engine for a couple of minutes to dislodge air pockets and shut it down. Add as much coolant as necessary and secure the pressure cap. Then refill the recovery tank up to the COLD mark.

⚠ CAUTION *Low coolant level can cause severe engine damage. Make sure the system is full.*

Secure the access door if the genset has an enclosure.

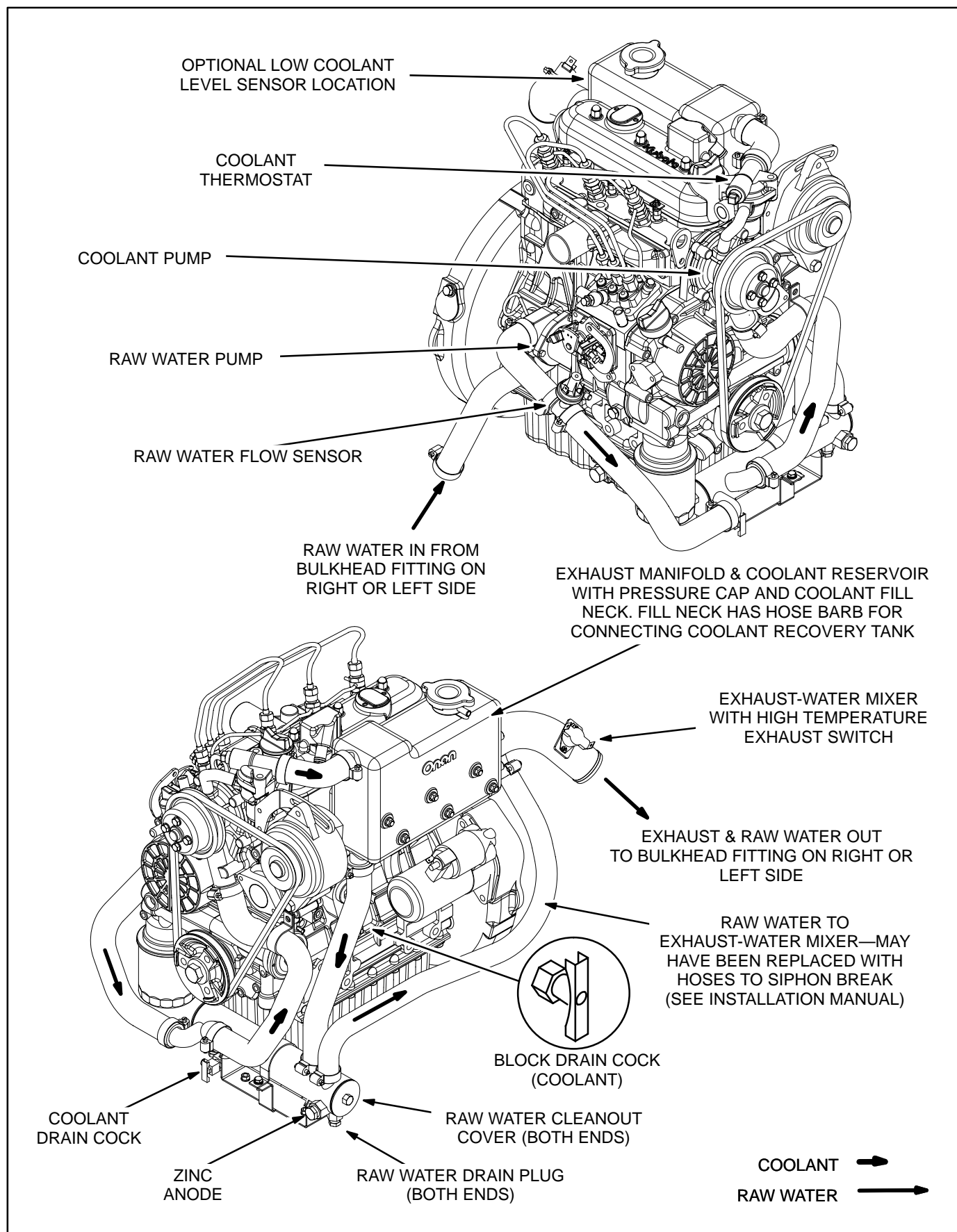


FIGURE 9. ENGINE COOLING SYSTEM—MDKAV, MDKBG, MDKAW, MDKAZ

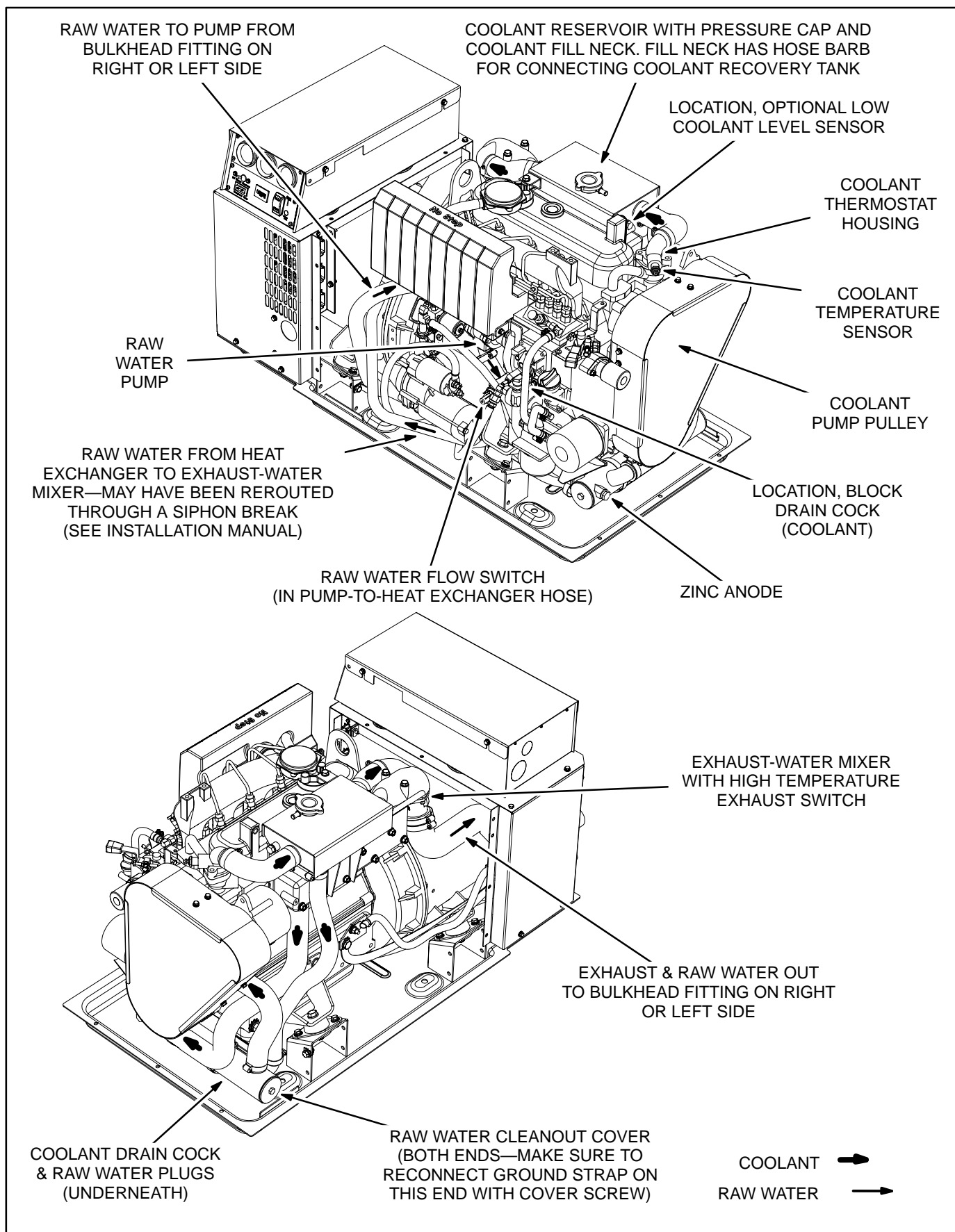


FIGURE 10. ENGINE COOLING SYSTEM—MDKBD, MDKBE, MDKBF

Siphon Break

⚠WARNING *Bypassing a siphon break or failing to maintain it can lead to engine flooding and damage to the engine not covered under Warranty.*

See Table 2 for scheduled maintenance. A siphon break is installed when the exhaust-water mixer is below the water line. If of a spring-loaded valve design, check for free movement of the plunger. Replace the device if the plunger does not move freely or the body is encrusted with deposits from leakage past the valve seat. If of the bleed-vent type, check that the vent hose is properly connected on both ends. If the vent is connected to a through-hull fitting, check for normal water flow whenever the engine is running. See the Installation Manual for more information regarding siphon breaks.

Replacing the Thermostat

See Table 2 for scheduled replacement. Referring to Figure 11, replace the thermostat as follows:

1. Disconnect the negative (-) cable at the battery to prevent the engine from starting, let the engine cool and remove the front and back access doors if the genset has an enclosure.

⚠WARNING *Accidental or remote starting can cause severe personal injury or death. Disconnect the negative (-) cable from the battery to prevent the engine from starting.*

⚠WARNING *Hot coolant is under pressure and can cause severe burns when loosening the pressure cap. Let the engine cool before loosening the pressure cap.*

2. Remove the coolant pressure cap.
3. Remove the two thermostat housing bolts and pull off the housing, thermostat and gasket. The hose does not need to come off.
4. Clean off the gasket area and install the new thermostat and gasket. Apply Three Bond 1215 liquid sealant or equivalent to the top side of the gasket.
5. Replenish any lost coolant, secure the pressure cap and any doors and panels removed and reconnect the battery cables (negative [-] last).

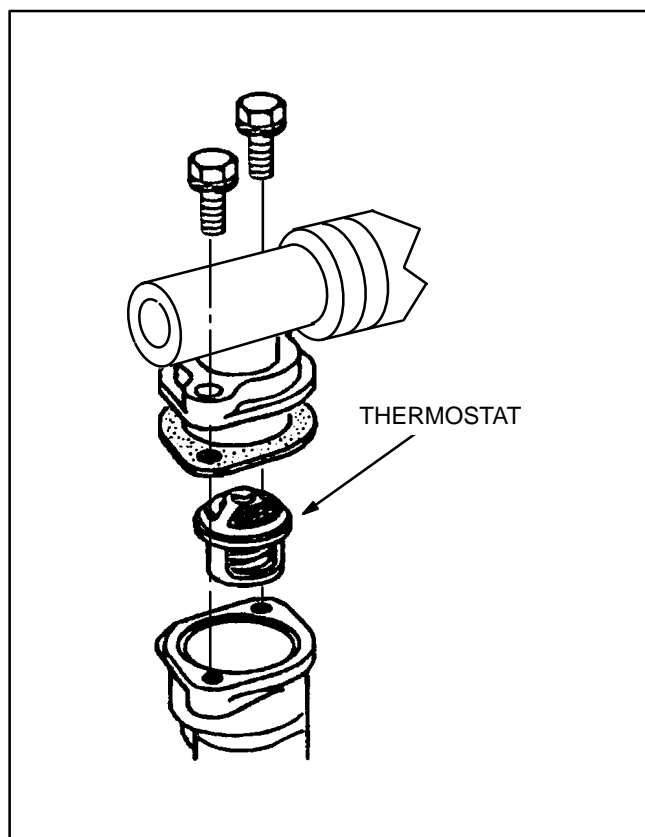


FIGURE 11. THERMOSTAT

Adjusting V-Belt Tension

Referring to Figure 12, readjust belt tension as follows:

⚠WARNING *Accidental or remote starting can cause severe personal injury or death. Disconnect the negative (-) cable at the battery to prevent the engine from starting.*

1. Disconnect the negative (-) cable at the battery to prevent the engine from starting.
2. Remove the belt guard or the access doors and top panel if the genset has an enclosure.
3. Loosen the alternator pivot bolt first and then the adjusting bracket bolt on top.
4. Pivot the alternator out to tighten belt tension. Hold tension by tightening the tension adjusting bolt and check it by applying 20 pounds (10 kg) to the middle of the pulley span. Belt tension is correct when deflection is 0.4 inch (10 mm). Tighten the alternator bolts when tension is correct.
5. Tighten the bolts, secure the belt guard or panels and doors and reconnect the battery cables (negative [-] last).

Replacing the V-Belt When PTO Equipped

A special belt replacement kit must be used when the genset is equipped with a PTO. The kit includes a tool to keep the flexible coupling from twisting during assembly/disassembly. The coupling has to be disassembled so that the belt can be looped around the crank pulley. Follow the instructions in the kit.

Heat Exchanger and Zinc Anode

Both ends of the heat exchanger (Figure 9) have raw water drain plugs and cleanout covers. Clean the raw water tubes if the engine keeps shutting down (Code No.1) or the engine gauge indicates abnormally high engine temperatures. Drain the heat exchanger if there is a danger of freezing when the genset is not running or is in storage. (Freezing water can damage the raw water tubes in the heat exchanger. Engine coolant, but not raw water, is protected from freezing.)

Replace the zinc anode as recommended (Table 2). Use thread sealant on the zinc plug and drain plugs and replace the clean out cover gaskets if the old ones are torn or otherwise damaged.

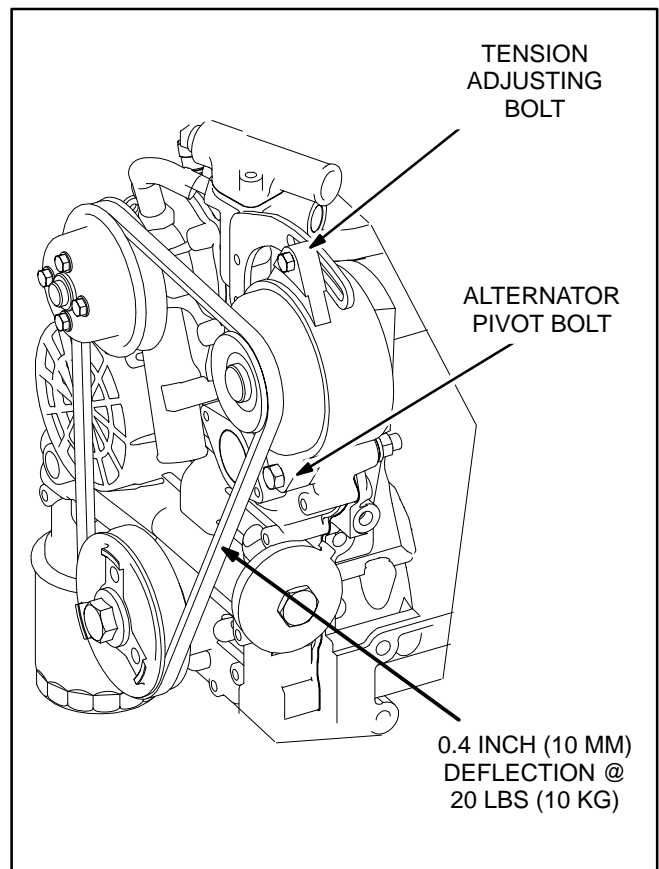


FIGURE 12. ADJUSTING V-BELT TENSION

Replacing the Raw Water Pump Impeller

See Table 2 for scheduled replacement. Have towels and containers ready and avoid spilling raw water on the electrical components below the pump. Referring to Figure 13 replace the impeller as follows:

⚠ WARNING *Accidental or remote starting can cause severe personal injury or death. Disconnect the negative (-) cable at the battery to prevent the engine from starting.*

1. Disconnect the negative (-) cable at the battery to prevent the engine from starting, let the engine cool and *close the sea cock*.
2. Remove the access door if the genset has an enclosure.
3. Remove the impeller cover and O-ring.
4. Use two pliers to grip vanes on opposite sides if the impeller is difficult to remove. *It will be necessary to check for and cleanout pieces of the impeller from the heat exchanger if vanes have broken off.*
5. Install the new impeller. It helps to twist the impeller clockwise (the way it turns) while squeezing it into the housing.
6. To provide initial lubrication and better pump suction before water reaches the pump, wet the inside of the pump and impeller with water, soap solution or a silicone lubricant and secure the O-ring and cover.

⚠ CAUTION *Do not lubricate with petroleum products like grease and oil which chemically attack impeller materials.*

7. If the sea water strainer is above the water line, fill it for faster prime and secure its cover.
8. Open the sea cock, reconnect the battery cables (negative [-] last) and start the genset. The genset will shut down within 8 seconds if there is no raw water flow and the *amber* status lamp will blink shutdown Code No. 7 (Page 27). If it shuts down, find out why, remove any blockage and restart the genset.
9. Secure the access door if the genset has an enclosure.

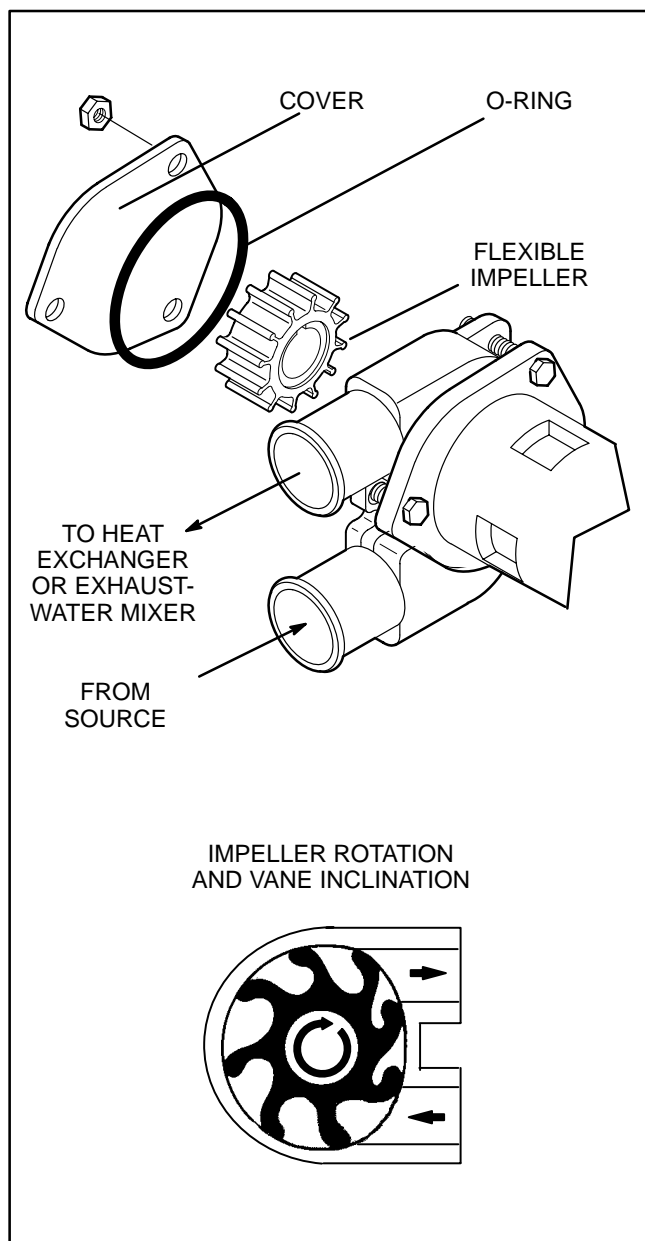


FIGURE 13. REPLACING RAW WATER IMPELLER

Troubleshooting

TABLE 3 lists the shutdown codes in numerical order along with step-by-step corrective actions. If you are unable to resolve the problem after taking the corrective actions suggested, contact an authorized Onan dealer. See *How to Obtain Service* (Page 35).

First note the following:

- Maintaining engine oil and coolant levels, cleaning the raw water strainer, keeping battery connections clean and tight, watching the fuel gauge and not overloading the genset will prevent most shutdowns.
- When the genset and propulsion engines share a common fuel tank, the fuel dip tubes are usually arranged so that the genset will run out of fuel first. Marking the genset empty point on the fuel gauge will make it easier to tell when to stop the genset before running it out of fuel.

SHUTDOWN CODES

The genset controller provides extensive diagnostics by causing the *amber* status lamp on the control switch to blink. Following a shutdown, the indicator lamp will blink 1, 2, 3, 4 or 7 times, pause, and then repeat the blinking. **The number of blinks is the shutdown code.**

- **One blink** indicates shutdown due to high engine temperature.

- **Two blinks** indicate shutdown due to low oil pressure.
- **Three blinks** indicate shutdown due to a condition normally requiring service by a trained and experienced person. Before assistance arrives, you may be asked to help by accessing the second-level, two-digit shutdown code. To do so, press **STOP** once. The two-digit code consists of 1 to 6 blinks, a brief pause, and then 1 to 9 blinks. The first set of blinks represents the tens digit and the second set of blinks the units digit of the shutdown code number. For example, **Shutdown Code No. 23** blinks as follows:

blink-blink—pause—blink-blink-blink—long pause—repeat

- **Four blinks** indicate shutdown due to a failure to start within the time allowed for cranking.
- **Seven blinks** indicate shutdown due to a loss of raw water flow for engine and exhaust cooling.

Blinking of the shutdown code continues for five minutes and stops. Pressing **STOP** three times restores blinking. (If you press **STOP** again, blinking stops entirely and you have to start over by pressing **STOP** three times.)

Note: The last shutdown logged will blink, even though the condition that caused shutdown has been serviced.

TABLE 3. TROUBLESHOOTING

⚠ WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable from the battery to prevent the engine from starting.

NO POWER—GENSET RUNNING, RUN LAMP ON

(Line circuit breaker OFF or tripped)

Corrective Action:

1. Turn on or reset the line circuit breaker on the genset (Page 9).
2. Turn on or reset the line circuit breakers on the main distribution panel in the boat.

STARTER ENGAGES-DISENGAGES

(Battery voltage dips below 6 volts while cranking—low battery charge, poor connections, long cables)

Corrective Action:

1. Clean and tighten the positive (+) and negative (-) battery cable connections at the battery and genset (Page 17).
2. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.
3. Increase battery cable size or run parallel cables.

RUN-DOWN STARTING BATTERY

(Marginal battery, connections, or charging system or, parasitic loads)

Corrective Action:

1. Clean and tighten the positive (+) and negative (-) battery cable connections at the battery and genset (Page 17).
2. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.

ENGINE CRANKS, STARTS, ACCELERATES, BUT STOPS WHEN SWITCH LET GO

(Open field or open or grounded quadrature circuit)

Corrective Action: See an authorized Onan dealer.

NO LIGHTS, NO RESPONSE

(Poor connections, faulty wiring or dead battery)

Corrective Action:

1. Try the genset Control Switch if the remote Control Switch does not work, and vice versa.
2. Clean and tighten the positive (+) and negative (-) battery cable connections at the battery and genset (Page 17).
3. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.

TABLE 3. TROUBLESHOOTING (CONT.)

⚠ WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable from the battery to prevent the engine from starting.

HIGH ENGINE TEMPERATURE—CODE NO. 1

(First-level shutdown—Engine coolant temperature exceed design limit)

Corrective Action:

1. Add coolant as necessary and repair leaks (Page 18).
2. Replace the engine thermostat, which might not be opening fully (Page 21).
3. Clean the raw water tubes in the heat exchanger, which might be clogged with scale (Page 22).
4. Flush the coolant system to remove coolant passage fouling (Page 18).

LOW OIL PRESSURE—CODE NO. 2

(First-level shutdown—Low oil pressure)

Corrective Action: Add engine oil or drain excess oil, as necessary (Page 14).

SERVICE CHECK—CODE NO. 3

(First-level shutdown—Indicates presence of second-level shutdown)

Corrective Action: Check the second-level shutdown code by pressing **STOP** once. The second-level shutdown code will have two-digits. The shutdowns are listed below in numerical order.

OVERCRANK—CODE NO. 4

(First-level shutdown—Cranking exceeded 20 to 60 seconds [temperature dependent] without start)

Corrective Action:

1. Check the fuel tank and fill as necessary. (Note: The arrangement of pickup tubes in the fuel supply tank probably is such that the genset will run out of fuel before the propulsion engines.)
2. Open any closed fuel valves.
3. Remove any blockage in the combustion air inlet (front grille) or exhaust system.
4. Tighten loose fuel line fittings so that air cannot be drawn in by genset lift pump suction.
5. Drain and/or replace the fuel filter (Page 16) and prime the fuel system (Page 8).
6. Drain and/or replace fuel supply system filters and prime the fuel system (Page 8).

TABLE 3. TROUBLESHOOTING (CONT.)

⚠ WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable from the battery to prevent the engine from starting.

LOSS OF RAW WATER FLOW—CODE NO. 7

(First-level shutdown—Low raw water pressure in heat exchanger)

Corrective Action:

1. Open the sea cock.
2. Close the sea cock and clean the sea water strainer. If the strainer is above the water line, fill it with water to assist priming. Secure the strainer cover and reopen the sea cock.
3. Reconnect or replace any disconnected or leaking raw water hoses (Page 19).
4. Remove any blockage from the strainer on the through-hull fitting on the bottom side of the hull.
5. Replace the raw water impeller (Page 23).

OVERVOLTAGE—CODE NO. 12

(Controller unable to maintain rated voltage)

Corrective Action: See an authorized Onan dealer.

UNDERVOLTAGE—CODE NO. 13

(Controller unable to maintain rated voltage)

Corrective Action: Reduce the number of connected appliances, especially when air conditioners and battery chargers are running.

OVERFREQUENCY—CODE NO. 14

(Engine governor unable to maintain rated frequency)

Corrective Action:

1. If the line circuit breaker or any other circuit breaker has tripped, start the genset before resetting the breaker. (Frequency can overshoot when a circuit breaker trips under load.) *If the genset continues to run*, turn off or disconnect all loads, reset the breaker and bring the loads on one at a time without overloading the genset.
2. Tighten loose fuel line fittings so that air cannot be drawn in by genset lift pump suction.
3. Prime the fuel system to remove air in the fuel lines (Page 8).

TABLE 3. TROUBLESHOOTING (CONT.)

⚠ WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable from the battery to prevent the engine from starting.

UNDERFREQUENCY—CODE NO. 15

(Engine governor unable to maintain rated frequency)

Corrective Action:

1. Reduce the number of appliances running at the same time, especially those with high motor starting loads such as air conditioners.
2. Check the fuel tank and fill as necessary. (Note: The arrangement of pickup tubes in the fuel supply tank probably is such that the genset will run out of fuel before the propulsion engines.)
3. Remove any blockage in the combustion air inlet (front grille) or exhaust system.
4. Tighten loose fuel line fittings so that air cannot be drawn in by genset lift pump suction.
5. Drain and/or replace the fuel filter (Page 16) and prime the fuel system (Page 8).
6. Drain and/or replace fuel supply system filters and prime the fuel system (Page 8).

OVER-PRIME—CODE NO. 17

(Prime mode exceed 5 minutes)

Corrective Action: Check for and remove any object that may be holding either control switch (remote or local) in the prime position.

GOVERNOR OVERLOAD—CODE NO. 22

(Maximum allowable time at full-duty cycle was exceeded)

Corrective Action:

1. Reduce the number of appliances running at the same time, especially those with high motor starting loads such as air conditioners.
2. Check the fuel tank and fill as necessary. (Note: The arrangement of pickup tubes in the fuel supply tank probably is such that the genset will run out of fuel before the propulsion engines.)
3. Remove any blockage in the combustion air inlet (front grille) or exhaust system.
4. Tighten loose fuel line fittings so that air cannot be drawn in by genset lift pump suction.
5. Drain and/or replace the fuel filter (Page 16) and prime the fuel system (Page 8).
6. Drain and/or replace fuel supply system filters and prime the fuel system (Page 8).

FAULTY OIL PRESSURE SENDER—CODE NO. 23

(Controller sensed grounded sender)

Corrective Action: See an authorized Onan dealer.

FAULTY TEMPERATURE SENDER—CODE NO. 24

(Controller sensed open sender)

Corrective Action: See an authorized Onan dealer.

TABLE 3. TROUBLESHOOTING (CONT.)

⚠ WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable from the battery to prevent the engine from starting.

LOSS OF VOLTAGE SENSE—CODE NO. 27

(Controller unable to sense output voltage)

Corrective Action: See an authorized Onan dealer.

HIGH BATTERY VOLTAGE—CODE NO. 29

(Battery system at more than 19.2 volts if 12 VDC system, or 38.4 volts if 24 volt system)

Corrective Action:

1. Check battery bank connections and reconnect if necessary to supply 12 volts or 24 volts, as appropriate.
2. Select a lower battery boost charge rate.

CONTROL CARD FAILURE—CODE NO. 35

(Microprocessor EEPROM error during self-test)

Corrective Action: See an authorized Onan dealer.

ENGINE STOPPED—CODE NO. 36

(Engine stopped without command by controller)

Corrective Action:

1. Open any closed fuel supply valves.
2. Check the fuel tank and fill as necessary. (Note: The arrangement of pickup tubes in the fuel supply tank probably is such that the genset will run out of fuel before the propulsion engines.)
3. Check for mechanical damage and service as necessary.
4. Remove any blockage in the combustion air inlet (front grille) or exhaust system.
5. Tighten loose fuel line fittings so that air cannot be drawn in by genset lift pump suction.
6. Drain and/or replace the fuel filter (Page 16) and prime the fuel system (Page 8).
7. Drain and/or replace fuel supply system filters and prime the fuel system (Page 8).

INVALID GENSET CONFIGURATION—CODE NO. 37

(Controller cannot determine genset operating parameters)

Corrective Action: See an authorized Onan dealer.

TABLE 3. TROUBLESHOOTING (CONT.)

⚠ WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable from the battery to prevent the engine from starting.

FIELD OVERLOAD—CODE NO. 38

(High field voltage induced by high rotor temperature or low power factor loads)

Corrective Action:

1. Remove blockages to generator air flow at the front inlet grill and right side, if enclosed.
2. Reduce the number of appliances running at the same time, especially those with high motor starting loads such as air conditioners.
3. Have air conditioners and other appliances checked for proper operation. (A locked compressor rotor can cause very low power factor.)

GROUNDING ROTOR—CODE NO. 41

(F+ grounded)

Corrective Action: See an authorized Onan dealer.

PROCESSOR FAILURE—CODE NO. 42

(Microprocessor ROM error during self-test)

Corrective Action: See an authorized Onan dealer.

PROCESSOR FAILURE—CODE NO. 43

(Microprocessor RAM error during self-test)

Corrective Action: See an authorized Onan dealer.

PROCESSOR FAILURE—CODE NO. 48

(Controller unable to sense field voltage)

Corrective Action: See an authorized Onan dealer.

HIGH EXHAUST TEMPERATURE—CODE NO. 58

(Exhaust temperature exceeded design limits)

Corrective Action:

1. Check for and reconnect or replace any disconnected or leaking raw water hoses (Page 19).
2. Check for and replace a worn raw water impeller (Page 23).

TABLE 3. TROUBLESHOOTING (CONT.)

⚠ WARNING *Some genset service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform genset service. See Safety Precautions.*

Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, disconnect the negative (-) cable from the battery to prevent the engine from starting.

LOW COOLANT LEVEL—CODE NO. 59

(Exhaust temperature exceeded design limits)

Corrective Action: Add coolant as necessary and repair leaks (Page 18).

EMERGENCY SHUTDOWN—CODE NO. 61

(Genset was shut down by a fire suppression system or other external control)

Corrective Action: Make all necessary repairs to the genset and connected equipment and reset the external control which shut down the genset.

Specifications

	MDKAV	MDKBG	MDKAU	MDKAZ
ALTERNATOR: Single-Bearing, Brushless 4-Pole Rotating Field with Digital Electronic Regulation. See Genset Nameplate for Rating.				
Alternator Cooling Air Flow: 60 Hz 50 Hz	275 cfm (0.85 m ³ /min) 230 cfm (0.71 m ³ /min)	275 cfm (0.85 m ³ /min) 230 cfm (0.71 m ³ /min)	275 cfm (0.85 m ³ /min) 230 cfm (0.71 m ³ /min)	275 cfm (0.85 m ³ /min) 230 cfm (0.71 m ³ /min)
FUEL CONSUMPTION:				
60 Hz: Full Load Half Load	0.8 gph (3.0 liter/hr) 0.5 gph (1.9 liter/hr)	0.8 gph (3.0 liter/hr) 0.5 gph (1.9 liter/hr)	1.0 gph (3.8 liter/hr) 0.6 gph (2.3 liter/hr)	1.2 gph (4.5 liter/hr) 0.7 gph (2.7 liter/hr)
50 Hz: Full Load Half Load	0.7 gph (2.7 liter/hr) 0.4 gph (1.5 liter/hr)	0.7 gph (2.7 liter/hr) 0.4 gph (1.5 liter/hr)	0.8 gph (3.0 liter/hr) 0.5 gph (1.9 liter/hr)	0.9 gph (3.4 liter/hr) 0.5 gph (1.9 liter/hr)
ENGINE: Kubota 4-Stroke Cycle, Indirect Injection, Water Cooled Diesel with Digital Electronic Governing				
Model	D1105	D1105	V1305	V1505
Number of Cylinders	3	3	4	4
Displacement	68.58 in ³ (1124 cm ³)	68.58 in ³ (1124 cm ³)	81.47 in ³ (1335 cm ³)	91.44 in ³ (1499 cm ³)
Bore	3.07 in (78 mm)	3.07 in (78 mm)	2.99 in (76 mm)	3.07 in (78 mm)
Stroke	3.09 in (78.4 mm)	3.09 in (78.4 mm)	2.90 in (73.6 mm)	3.09 in (78.4 mm)
Compression Ratio	22:1	22:1	22:1	22:1
Firing Order (Clockwise Rotation)	1-2-3	1-2-3	1-2-4-3	1-2-4-3
Fuel Injection Timing	15.5° - 17.5° BTDC	15.5° - 17.5° BTDC	15.5° - 17.5° BTDC	15.5° - 17.5° BTDC
Valve Lash (cold)	0.0071 - 0.0087 in (0.18 - 0.22 mm)	0.0071 - 0.0087 in (0.18 - 0.22 mm)	0.0071 - 0.0087 in (0.18 - 0.22 mm)	0.0071 - 0.0087 in (0.18 - 0.22 mm)
Lube Oil Capacity	4.2 quart (4.0 liter)	4.2 quart (4.0 liter)	4.5 quart (4.3 liter)	4.5 quart (4.3 liter)
Lube Oil Drain Connection	3/8 NPT	3/8 NPT	3/8 NPT	3/8 NPT
Coolant Capacity	4.2 quart (4.0 liter)	4.2 quart (4.0 liter)	5.3 quart (5.0 liter)	5.3 quart (5.0 liter)
Coolant Flow Rate: 60 Hz 50 Hz	5.0 gpm (18.9 liter/min) 4.2 gpm (15.9 liter/min)	5.0 gpm (18.9 liter/min) 4.2 gpm (15.9 liter/min)	5.0 gpm (18.9 liter/min) 4.2 gpm (15.9 liter/min)	5.0 gpm (18.9 liter/min) 4.2 gpm (15.9 liter/min)
Raw Water Flow Rate: 60 Hz 50 Hz	6.0 gpm (22.7 liter/min) 5.0 gpm (18.9 liter/min)	6.0 gpm (22.7 liter/min) 5.0 gpm (18.9 liter/min)	6.0 gpm (22.7 liter/min) 5.0 gpm (18.9 liter/min)	6.0 gpm (22.7 liter/min) 5.0 gpm (18.9 liter/min)
Combustion Air Flow: 60 Hz 50 Hz	30 cfm (0.85 m ³ /min) 25 cfm (0.71 m ³ /min)	30 cfm (0.85 m ³ /min) 25 cfm (0.71 m ³ /min)	36 cfm (1.02 m ³ /min) 30 cfm (0.85 m ³ /min)	41 cfm (1.16 m ³ /min) 34 cfm (0.96 m ³ /min)
Heat Rejection to Ambient: 60 Hz 50 Hz	200 Btu/min (50 kcal/min) 179 Btu/min (45 kcal/min)	200 Btu/min (50 kcal/min) 179 Btu/min (45 kcal/min)	230 Btu/min (58 kcal/min) 190 Btu/min (48 kcal/min)	280 Btu/min (71 kcal/min) 210 Btu/min (53 kcal/min)
CONNECTIONS:				
Max Fuel Pump Lift	4 ft (1.2 m)	4 ft (1.2 m)	4 ft (1.2 m)	4 ft (1.2 m)
Fuel Supply	1/4 NPT female	1/4 NPT female	1/4 NPT female	1/4 NPT female
Fuel Return	1/4 NPT female	1/4 NPT female	1/4 NPT female	1/4 NPT female
Max Raw Water Pump Lift	4 ft (1.22 m)	4 ft (1.22 m)	4 ft (1.22 m)	4 ft (1.22 m)
Raw Water Inlet	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose
Wet Exhaust Outlet	2 in (50.8 mm) ID Hose	2 in (50.8 mm) ID Hose	2 in (50.8 mm) ID Hose	2 in (50.8 mm) ID Hose
Max Exhaust Back Pressure	3 in (76 mm) Hg	3 in (76 mm) Hg	3 in (76 mm) Hg	3 in (76 mm) Hg
KEEL COOLING AND DRY EXHAUST:				
Coolant Inlet & Outlet	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose
Max Coolant Friction Head	1 psi (6.9 kPa)	1 psi (6.9 kPa)	1 psi (6.9 kPa)	1 psi (6.9 kPa)
Heat Rejection to Coolant: 60 Hz 50 Hz	950 Btu/min (239 kcal/min) 780 Btu/min (197 kcal/min)	950 Btu/min (239 kcal/min) 780 Btu/min (197 kcal/min)	1220 Btu/min (307 kcal/min) 980 Btu/min (247 kcal/min)	1420 Btu/min (358 kcal/min) 1160 Btu/min (292 kcal/min)
Dry Exhaust Outlet	1-1/4 NPT	1-1/4 NPT	1-1/4 NPT	1-1/4 NPT
Max Exhaust Back Pressure	3 in (76 mm) Hg	3 in (76 mm) Hg	3 in (76 mm) Hg	3 in (76 mm) Hg
BATTERIES:				
Nominal Battery Voltage	12 volts*	12 volts*	12 volts*	12 volts*
Min CCA Rating - SAE @ 32° F (0° C)	360 amps	360 amps	500 amps	500 amps
Battery Charging	5 amps	5 amps	5 amps	5 amps
SIZE, WEIGHT, NOISE:				
Without Enclosure Dry Weight Dimensions: L x W x H	555 lbs (252 kg) 35.9 x 22.3 x 23.0 in (911 x 566 x 585 mm)	525 lbs (238 kg) 32.4 x 18.9 x 22.1 in (479.1 x 822.6 x 560.9 mm)	640 lbs (290 kg) 40.7 x 22.3 x 23.0 in (1033 x 566 x 585 mm)	640 lbs (290 kg) 40.7 x 22.3 x 23.0 in (1033 x 566 x 585 mm)
With Enclosure Noise Dry Weight Dimensions: L x W x H	66 dB(A) @ 60HZ 600 lbs (272 kg) 35.9 x 22.3 x 23.4 in (911 x 566 x 593 mm)	-	66 dB(A) @ 60HZ 695 lbs (315 kg) 40.7 x 22.3 x 23.4 in (1033 x 566 x 593 mm)	66 dB(A) @ 60HZ 695 lbs (315 kg) 40.7 x 22.3 x 23.4 in (1033 x 566 x 593 mm)
* - 24 volts optional				

	MDKBD	MDKBE	MDKBF
ALTERNATOR: Single-Bearing, Brushless 4-Pole Rotating Field with Digital Electronic Regulation. See Genset Nameplate for Rating.			
Alternator Cooling Air Flow: 60 Hz 50 Hz	275 cfm (0.85 m ³ /min) 230 cfm (0.71 m ³ /min)	275 cfm (0.85 m ³ /min) 230 cfm (0.71 m ³ /min)	275 cfm (0.85 m ³ /min) 230 cfm (0.71 m ³ /min)
FUEL CONSUMPTION:			
60 Hz: Full Load Half Load	1.3 gph (4.9 liter/hr) 0.8 gph (3.0 liter/hr)	1.9 gph (7.2 liter/hr) 1.1 gph (4.2 liter/hr)	2.5 gph (9.5 liter/hr) 1.5 gph (5.7 liter/hr)
50 Hz: Full Load Half Load	1.1 gph (4.2 liter/hr) 0.7 gph (2.7 liter/hr)	1.6 gph (6.1 liter/hr) 0.9 gph (3.4 liter/hr)	2.1 gph (8.0 liter/hr) 1.3 gph (4.9 liter/hr)
ENGINE: Kubota 4-Stroke Cycle, Indirect Injection, Water Cooled Diesel with Digital Electronic Governing			
Model	V1903B	V2203B	V2803B
Number of Cylinders	4	4	5
Displacement	113.37 in ³ (1857 cm ³)	134.07 in ³ (2197cm ³)	167.57 in ³ (2748 cm ³)
Bore	3.15 in (80 mm)	3.43 in (87 mm)	3.43 in (87 mm)
Stroke	3.64 in (92.4 mm)	3.64 in (92.4 mm)	3.64 in (92.4 mm)
Compression Ratio	23:1	23:1	23:1
Firing Order (Clockwise Rotation)	1-3-4-2	1-3-4-2	1-3-5-4-2
Fuel Injection Timing	15.5° - 17.5° BTDC	15.5° - 17.5° BTDC	15.5° - 17.5° BTDC
Valve Lash (cold)	0.0071 - 0.0087 in (0.18 - 0.22 mm)	0.0071 - 0.0087 in (0.18 - 0.22 mm)	0.0071 - 0.0087 in (0.18 - 0.22 mm)
Lube Oil Capacity	8 quart (7.6 liter)	8 quart (7.6 liter)	12.7 quart (12 liter)
Lube Oil Drain Connection	3/8 NPT	3/8 NPT	3/8 NPT
Coolant Capacity	8 quart (7.6 liter)	8 quart (7.6 liter)	8 quart (7.6 liter)
Coolant Flow Rate: 60 Hz 50 Hz	14.0 gpm (53.0 liter/min) 10.0 gpm (37.9 liter/min)	14.0 gpm (53.0 liter/min) 10.0 gpm (37.9 liter/min))	14.0 gpm (53.0 liter/min) 10.0 gpm (37.9 liter/min)
Raw Water Flow Rate: 60 Hz 50 Hz	9.0 gpm (34.1 liter/min) 7.0 gpm (26.5 liter/min)	9.0 gpm (34.1 liter/min) 7.0 gpm (26.5 liter/min)	9.0 gpm (34.1 liter/min) 7.0 gpm (26.5 liter/min)
Combustion Air Flow: 60 Hz 50 Hz	52 cfm (1.45 m ³ /min) 42 cfm (1.21 m ³ /min)	60 cfm (1.72 m ³ /min) 50 cfm (1.43 m ³ /min))	41 cfm (1.16 m ³ /min) 34 cfm (0.96 m ³ /min)
Heat Rejection to Ambient: 60 Hz 50 Hz	Btu/min (kcal/min) Btu/min (kcal/min)	Btu/min (kcal/min) Btu/min (kcal/min)	Btu/min (kcal/min) Btu/min (kcal/min)
CONNECTIONS:			
Max Fuel Pump Lift	4 ft (1.2 m)	4 ft (1.2 m)	4 ft (1.2 m)
Fuel Supply	1/4 NPT female	1/4 NPT female	1/4 NPT female
Fuel Return	1/4 NPT female	1/4 NPT female	1/4 NPT female
Max Raw Water Pump Lift	4 ft (1.22 m)	4 ft (1.22 m)	4 ft (1.22 m)
Raw Water Inlet	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose
Wet Exhaust Outlet	2 in (50.8 mm) ID Hose	2 in (50.8 mm) ID Hose	2 in (50.8 mm) ID Hose
Max Exhaust Back Pressure	3 in (76 mm) Hg	3 in (76 mm) Hg	3 in (76 mm) Hg
KEEL COOLING AND DRY EXHAUST:			
Coolant Inlet & Outlet	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose	1 in (25.4 mm) ID Hose
Max Coolant Friction Head	1 psi (6.9 kPa)	1 psi (6.9 kPa)	1 psi (6.9 kPa)
Heat Rejection to Coolant: 60 Hz 50 Hz	Btu/min (kcal/min) Btu/min (kcal/min)	Btu/min (kcal/min) Btu/min (kcal/min)	Btu/min (kcal/min) Btu/min (kcal/min)
Dry Exhaust Outlet	1-1/2 NPT	1-1/2 NPT	1-1/2 NPT
Max Exhaust Back Pressure	3 in (76 mm) Hg	3 in (76 mm) Hg	3 in (76 mm) Hg
BATTERIES:			
Nominal Battery Voltage	12 volts*	12 volts*	12 volts*
Min CCA Rating - SAE @ 32° F (0° C)	500 amps	625 amps	625 amps
Battery Charging	5 amps	5 amps	5 amps
SIZE, WEIGHT, NOISE:			
Without Enclosure Dry Weight Dimensions: L x W x H	830 lbs (377 kg) 44.4 x 23.7 x 26.1 in (1127 x 602 x 663 mm)	870 lbs (375 kg) 44.4 x 23.7 x 26.1 in (1127 x 602 x 663 mm)	1090 lbs (494 kg) 53.5 x 23.7 x 28.8 in (1358 x 602 x 732 mm)
With Enclosure Noise Dry Weight Dimensions: L x W x H	67/64 dB(A) @ 60/50 HZ 890 lbs (404 kg) 44.4 x 23.7 x 27.5 in (1127 x 602 x 698 mm)	67/64 dB(A) @ 60/50 HZ 930 lbs (422 kg) 44.4 x 23.7 x 27.5 in (1127 x 602 x 698 mm)	67/66 dB(A) @ 60/50 HZ 1175 lbs (533 kg) 53.5 x 23.7 x 30.0 in (1358 x 602 x 763 mm)
* - 24 volts optional			

Emissions

The label which states compliance with applicable EPA and California emissions regulations is located on the flywheel housing (Figure 14).

California users of this genset should be aware that unauthorized modifications or replacement of fuel, exhaust, air intake, or speed control system components that affect engine emissions are prohibited. Unauthorized modification, removal or replacement of the engine label is prohibited.

You should carefully review Operator (Owner), Installation and other manuals and information you receive with your genset. If you are unsure that the installation, use, maintenance or service of your genset is authorized, you should seek assistance from an approved Onan dealer.

California genset users may use Table 4 as an aid in locating information related to the California Air Resources Board requirements for emissions control.

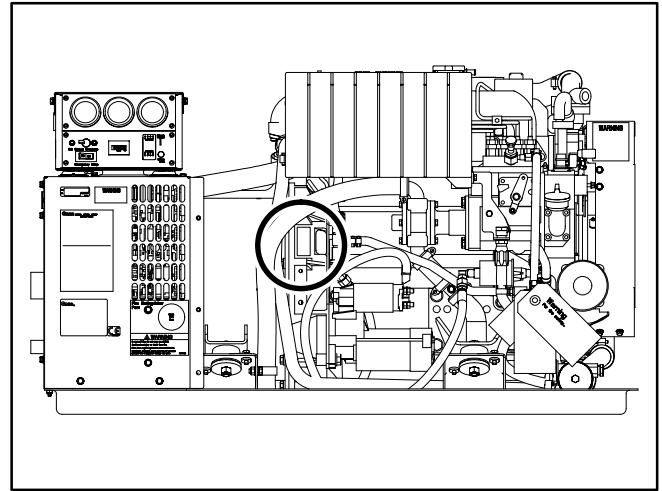


FIGURE 14. EMISSIONS LABEL

TABLE 4. EMISSIONS CONTROL INFORMATION

Emissions Warranty Information	The California emissions control warranty statement is located in the same packet of information as this manual when the genset is shipped from the factory.
Engine Fuel Requirements	The engine is certified to operate on diesel fuel. See FUEL RECOMMENDATIONS (Page 5).
Engine Lubricating Oil Requirements	See ENGINE OIL RECOMMENDATIONS (Page 5).
Engine Adjustments	High Idle Speed. This is a service procedure requiring trained personnel and proper tools. See the Service Manual.
Engine Emission Control System	The engine emission control system consists of engine design and precision manufacture. (IFI)

How to Obtain Service

When you need service, parts, or product literature (such as the Service Manual) for your genset, contact the nearest authorized distributor. Onan has factory-trained representatives to handle your needs for genset parts and service.

Call 1-800-888-ONAN to contact the nearest Cummins/Onan or Onan-only distributor in the United States or Canada. (This automated service utilizes touch-tone phones only). Select OPTION 1 (press 1) to be automatically connected to the distributor nearest to you.

If you are unable to contact a distributor using the automated service, consult the Yellow Pages. Typically, our distributors are listed under:

GENERATORS - ELECTRIC,
ENGINES - GASOLINE OR DIESEL, or
RECREATIONAL VEHICLES - EQUIPMENT,
PARTS AND SERVICE.

If you are outside North America, call Onan Corporation at 1-763-574-5000 from 7:30 AM to

4:00 PM, Central Standard Time, Monday through Friday, or fax 1-763-528-7229.

Before calling for service, have the following information available:

1. *The complete genset model number and serial number. See Model Identification (Page 4).*
2. *The date of purchase.*
3. *The nature of the problem. See Troubleshooting (Page 25).*

If you have difficulty in arranging service or resolving a problem, please contact the Service Manager at the nearest Cummins/Onan distributor for assistance.

⚠ WARNING *Improper service or replacement of parts can result in severe personal injury, death, and/or equipment damage. Service personnel must be trained and experienced in performing electrical and/or mechanical service.*

Maintenance Record

Record all periodic and unscheduled maintenance and service. See *Periodic Maintenance* (Page 12).

[illegible]

Record the name, address, and phone number of your authorized Onan service center.



Cummins Power Generation
1400 73rd Avenue N.E.
Minneapolis, MN 55432
763-574-5000
Fax: 763-528-7229

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