Cummins Onan

Operator Manual

Marine Generator Set

MDKBK (Spec E-G)
MDKBL (Spec E-G)
MDKBM (Spec E-G)
MDKBN (Spec E-G)
MDKBP (Spec D-E)
MDKBR (Spec D-E)
MDKBT (Spec A-C)
MDKBU (Spec A-C)
MDKBV (Spec A-B)

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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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1 Safety Precautions

1.1 Overview

Thoroughly read the Operator Manual before operating the generator set. It contains important instructions that should be followed during operation and maintenance. Safe operation and top performance can only be achieved when equipment is properly operated and maintained. The owners and operators of the generator set are solely responsible for its safe operation.

Generator set operation, maintenance, and installation must comply with all applicable local, state, and federal codes and regulations. Electricity, fuel, exhaust, moving parts, and batteries present hazards which can result in severe personal injury or death. Only trained and experienced personnel with knowledge of fuels, electricity, and machinery hazards shall perform generator set installation or adjustment procedures. Also, only trained and experienced personnel with knowledge of fuels, electricity, and machinery hazards shall remove, dismantle, or dispose of the generator set.

SAVE THESE INSTRUCTIONS.

⚠ WARNING

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

⚠ WARNING

This generator set is not be the main source of power for communication and steering systems. It can stop without warning.

1.2 Precaution Symbols

The following symbols used in this manual alert you to potential hazards to operator, maintenance personnel, and equipment.

⚠ DANGER

Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE

Indicates information considered important, but not hazard-related (e.g., messages relating to property damage).

1.3 General Safety Precautions

⚠ WARNING

Hot, moving, and electrically live parts can cause severe personal injury or death. Keep children away from the generator set.

⚠ WARNING

Hot, moving, and electrically live parts can cause severe personal injury or death. Only trained and experienced personnel should make adjustments while the generator set is running.

⚠ WARNING

Operation of equipment is unsafe when mentally or physically fatigued. Do not operate equipment in this condition, or after consuming any alcohol or drug.

⚠ WARNING

Maintaining or installing a generator set can cause severe personal injury. Wear personal protective equipment such as safety glasses, protective gloves, hard hats, steel-toed boots, and protective clothing when working on equipment.

⚠ WARNING

Moving parts can cause severe personal injury or death and hot exhaust parts can cause severe burns. Make sure all protective guards are properly in place before starting the generator set.

⚠ WARNING

Running the generator set without the cover or service door can cause severe personal injury or equipment damage. Do not operate the generator set with the cover or service doors removed.

⚠ WARNING

Coolants under pressure can cause severe scalding. Do not open a radiator or heat exchanger pressure cap while the engine is running. Let the engine cool down before removing the coolant pressure cap. Turn the cap slowly and do not open it fully until the pressure has been relieved.

⚠ WARNING

Hot metal parts can cause severe burns. Avoid contact with the radiator, turbo charger, and exhaust system.

⚠ WARNING

Flammable liquids can cause fire or explosion. Do not store fuel, cleaners, oil, etc. near the generator set.

⚠ WARNING

Starting fluids, such as ether, can cause explosion and generator set engine damage. Do not use.

⚠ WARNING

Ethylene glycol, used as engine coolant, is toxic to humans and animals. Clean up coolant spills and dispose of used antifreeze in accordance with local environmental regulations.

⚠ WARNING

Used engine oils have been identified by some state and federal agencies to cause cancer or reproductive toxicity. Do not ingest, breathe the fumes, or contact used oil when checking or changing engine oil.

⚠ WARNING

Inhalation of carbon monoxide can cause severe personal injury or death. Test and confirm that all carbon monoxide detectors are working in accordance with the manufacturer's instructions or owner's manual prior to every startup, and after 8 hours of running.

⚠ WARNING

Substances in exhaust gases have been identified by some state and federal agencies to cause cancer or reproductive toxicity. Do not breath in or come into contact with exhaust gases.

⚠ CAUTION

To prevent accidental or remote starting while working on the generator set, disconnect the negative (–) battery cable at the battery using an insulated wrench.

⚠ CAUTION

Unsecured or loose fasteners can cause equipment damage. Make sure all fasteners are secure and properly torqued.

⚠ CAUTION

Oily rags and other material can cause fire and restrict cooling. Keep the generator set, drip pan, and compartment clean.

⚠ CAUTION

Accumulated grease and oil can cause overheating and engine damage presenting a potential fire hazard. Keep the generator set clean and repair any oil leaks promptly.

NOTICE

Keep multi-class ABC fire extinguishers handy. Class A fires involve ordinary combustible materials such as wood and cloth. Class B fires involve combustible and flammable liquid fuels and gaseous fuels. Class C fires involve live electrical equipment. (Refer to NFPA No. 10 in applicable region.)

1.4 Electrical Shocks and Arc Flashes Can Cause Severe Personal Injury or Death

- Only qualified service personnel certified and authorized to work on power circuits should work on exposed energized power circuits.
- All relevant service material must be available for any electrical work performed by certified service personnel.
- Exposure to energized power circuits with potentials of 50 VAC or 75 VDC or higher poses a significant risk of electrical shock and electrical arc flash.
- Refer to standard NFPA 70E, or equivalent safety standards in corresponding regions, for details of the dangers involved and for safety requirements.

1.5 Generator Voltage Is Deadly

- Generator electrical output connections must be made by a trained and experienced electrician in accordance with applicable codes.
- Use caution when working on live electrical equipment. Remove all jewelry, make sure clothing and shoes are dry, stand on a dry wooden platform or rubber insulating mat, and use tools with insulated handles.

1.6 Engine Exhaust Is Deadly

- Properly working carbon monoxide detectors must be located in all living areas of the boat.
- Never occupy the boat while the generator set is running unless the boat is equipped with properly working marine carbon monoxide detectors.
- The exhaust system must be installed in accordance with the generator set Installation Manual and be free of leaks.
- Prior to every startup and after every eight hours of running, all carbon monixide detectors must be tested and confirmed to be working in accordance with the manufacture's instructions or owner's manual.
- Make sure the bilge is adequately ventilated with a power exhauster or blower.
- Inspect for exhaust leaks at 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.*

1.7 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.

1.8 Battery Gas is Explosive

- Wear splash-proof safety glasses.
- Do not smoke or permit flames or sparks to occur near the battery at any time or anywhere near the generator set.
- To reduce arcing when disconnecting or reconnecting battery cables, always disconnect the negative (–) battery cable first and reconnect it last.

1.9 Moving Parts Can Cause Severe Personal Injury Or Death

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

1.10 Flammable Vapor Can Cause a Diesel Engine to Overspeed

⚠ WARNING

Flammable vapor can cause an engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury, and death. Do not operate a diesel- or gasoline-powered generator set where a flammable vapor environment can be created by fuel spill, leak, etc.

The owners and operators of the generator set are solely responsible for operating the generator set safely.

1.11 Hazards of Carbon Monoxide

⚠ WARNING

Engine-driven generators can produce harmful levels of carbon monoxide causing nausea, fainting, or death. It is possible to be harmed by this poisonous gas despite good generator set maintenance and proper ventilation.

1.11.1 Carbon Monoxide Poisoning

Carbon Monoxide (CO) is an odorless, colorless, tasteless, and non-irritating gas. You cannot see it or smell it. Exposure, even to low levels of CO, for a prolonged period can lead to asphyxiation (lack of oxygen) resulting in death.

Mild effects of CO poisoning include:

- eye irritation
- dizziness
- sleepiness

- headaches
- fatigue
- inability to think clearly

More extreme symptoms include:

- vomiting
- seizures
- collapse

1.11.2 Special Risks of CO on Boats

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

The risk of exposure to CO can be multiplied greatly by the "station wagon" effect, obstructions that block exhaust dissipation, and infiltration from neighboring boats. To protect against all three situations, it is recommended that reliable and approved marine CO detector alarms be installed on your boat.

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

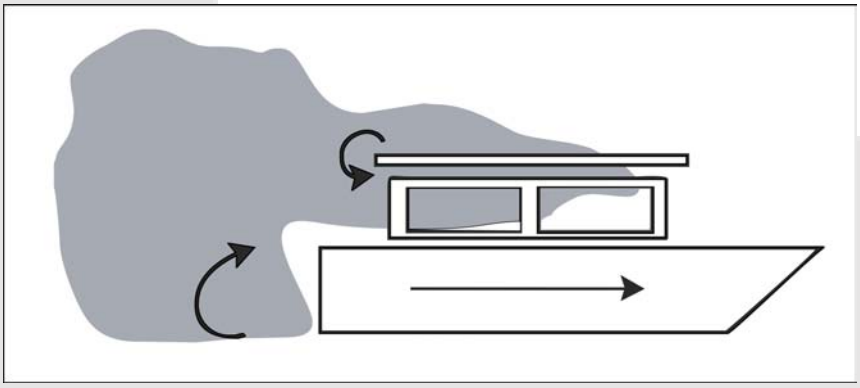


FIGURE 1. STATION WAGON EFFECT

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

1.11.3 Protection From CO Poisoning

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

1.12 Substances Hazardous to Health

Generator sets use substances, and emit and create wastes, that can cause health risks. Generator set operators must use appropriate personal protective equipment (such as clothing, gloves, protective glasses, goggles, and respiration equipment) when lungs, eyes, or skin are exposed to fuel, oil, coolant, wet batteries, grease, cleaning agents, or other substances. Use appropriate containers for transport, storage, and disposal of waste substances. Follow local regulations for disposal and recycling.

1.12.1 Antifreeze (Fleetguard - ES Compleat and EG Premix)

This antifreeze is also known as an ethylene glycol based coolant, summer coolant, coolant additive. It is a purple-colored viscous liquid with a mild chemical odor, is soluble in water, and is harmful under certain conditions. It contains ethylene glycol and diethylene glycol. Ethylene glycol is a potentially hazardous constituent.

The substance has a boiling point of 107 °C (224.6 °F) and a flash point of 121 °C (249.8 °F).

It is used as an engine coolant additive and can be found in engine cooling systems and heat exchangers. Installers, operators, and maintainers are likely to encounter this substance.

1.12.1.1 Hazardous Reactions

Ethylene glycol is combustible when exposed to heat or flame and can react vigorously with oxidants.

- It is a moderate explosive hazard in the form of vapor when exposed to heat or flame. Hazardous products resulting from combustion or decomposition include carbon monoxide, carbon dioxide, and acrid smoke. Self-contained breathing apparatus must be worn in the event of fume build up.
- It is incompatible with sulfuric acid, nitric acid, caustics, and aliphatic amines. Avoid any strong oxidizing agents.
- It may cause neurological signs and symptoms, kidney damage, and is a skin and eye irritant.
- It is very toxic in particulate form upon inhalation.
- It is harmful if swallowed. A lethal dose for humans is reported to be 100 ml.

1.12.1.2 Protective Measures

Refrain from eating, drinking, or smoking when using the product. Adopt a high standard of personal hygiene. In case of skin contact, wash immediately with soap and water.

Ensure good ventilation and avoid heat sources. Avoid breathing mist. If there is a risk of vapor or particulate, use a suitable organic vapor mask.

Eye protection, gloves, overalls, and an impervious apron should be worn. Avoid contamination inside the gloves. If overalls become contaminated, discontinue use and clean thoroughly.

1.12.1.3 Storage and Transport

Store and transport only in correctly marked containers. Keep containers closed when not in use. Keep cool, out of sunlight, and away from naked flames and strong acids. Do not freeze. Store well away from food-stuffs and drinking water. Take special care to avoid discharge into drains, sewers, and water-course.

Contain leaks and spills with sand, earth, or non-combustible absorbent material to prevent entry of substance into drains (sewage systems), water-courses, and land. Eliminate all ignition sources. Use a plastic shovel to transfer to a suitable container. Dispose of unwanted or absorbed substance through an authorized contractor to a licensed site.

1.12.1.4 Emergency Action

- Fire - Fire fighters are to use self contained breathing apparatus. Keep fire-exposed containers cool. Prevent run-off from entering waterways, drains, and drinking water supplies. Extinguishing media: CO_2, alcohol resistant foam, dry powder, or water spray.
- Ingestion - Toxic by ingestion. If swallowed, contact a doctor or poison control center. Induce vomiting only under the advice of a doctor or poison control center. Delayed treatment may result in fatality.
- Inhalation (of vapor) - Remove from further exposure. In case of irritation to lungs or throat, seek medical advice.
- Aspiration (inhalation of liquid) - Obtain immediate medical assistance.
- Eyes - Flush copiously with water or preferably eye-wash solution for at least five minutes. Seek medical advice.
- Skin - Wash thoroughly with soap and water and seek medical attention if irritation develops. Change clothing if necessary and wash clothing before re-use.
- Spillage - Soak up using an absorbent material and dispose of as directed under Storage and Transport.

1.12.2 Gas Oil

This product is also known as red diesel, fuel oil, and type A1 or A2. It can be pale red or clear liquid with a characteristic mild odor. It contains catalytically cracked oil, petroleum distillates, quinizarin, and gas oil maker dye red. The catalytically cracked oil and petroleum distillates are potentially hazardous constituents.

The substance has an initial boiling point of 180 °C (345 °F), a flash point greater than 56 °C (132.8 °F), a vapor pressure less than 0.7 mm Hg at 20 °C (68 °F), and has negligible solubility in water.

It is used as a fuel for off-road diesel powered vehicles and stationary engines and can be found in fuel tanks, pipes, and injection systems. The substance should not be used for any other purpose without contacting the manufacturer or supplier. Installers, operators, and maintainers are likely to encounter this substance.

1.12.2.1 Hazardous Reactions

This liquid is flammable. Avoid smoking, heat sources - such as welding and naked flames - sparks, and static electricity build-up. Thermal decomposition products are hazardous, containing CO_x, NO_x, and SO_x compounds.

The vapor is explosive. High vapor concentrations can cause respiratory irritation, dizziness, nausea, and loss of consciousness. Excessive and prolonged exposure to the mist can cause chronic inflammatory reaction of the lungs and a form of pulmonary fibrosis.

Avoid strong oxidizing agents such as chlorates which may be used in agriculture.

Gas oil is slightly irritating to the skin and has a de-fatting action. Toxicity following single exposure to a high level of gas oil is of low importance. Prolonged, repeated skin contact may de-fat the skin resulting in possible skin irritation and dermatitis. In some cases warty, cancerous growths have occurred.

1.12.2.2 Protective Measures

Ensure good ventilation and avoid heat sources. Observance of good housekeeping rules will ensure general safety. Do not smoke. Avoid breathing mist.

When working on or testing injection equipment, special care is required to avoid perforation of skin by high pressure fuel. Use eye protection in the event of suspected high pressure leak.

Adopt a high standard of personal hygiene. In the case of skin contact, wash well with soap and water.

Use gloves, overalls, and eye protection if there is a risk of splashing. Use oil-impervious gloves and avoid contamination inside the gloves. If overalls become contaminated, discontinue use and clean thoroughly. Contaminated clothing should be removed, soaked with water, and laundered before re-use.

No special respiratory precautions are necessary in normal use.

Do not use as a solvent for removing dirt and grease, etc, from skin.

1.12.2.3 Storage and Transport

Store and transport only in correctly marked containers. Keep containers closed when not in use. Keep cool, out of sunlight, and away from naked flames. Electrical continuity is required between the transport and storage vessels during product transfer.

Contain leak or spill with sand, earth, or other suitable material, and prevent entry of substance into drainage (sewage system), water-courses, and land. Dispose of unwanted or absorbed substance through an authorized contractor to a licensed site.

Inform fire and local authorities should the product reach waterways, drains, etc.

1.12.2.4 Emergency Action

- Fire - Avoid making sparks. Fire fighters are to use self-contained breathing apparatus. Keep fire-exposed containers cool, using water fog or spray. Prevent run-off from entering waterways, drains, and drinking water supplies.
  - Extinguishing media for large fire: Foam or water fog. Never use water jet.
  - Extinguishing media for small fire: Foam or dry powder, AAAF, CO_2, sand, earth.
- Ingestion - Do not induce vomiting. Wash mouth out with water and send to hospital immediately.
- Inhalation (of vapor) - Remove from further exposure. Obtain medical assistance immediately.
- Aspiration (inhalation of liquid) - If, following ingestion of gas oil, vomiting occurs, there is danger of aspiration into the lungs. This would cause intense local irritation and chemical pneumonities that can be fatal. Obtain immediate medical assistance.
- Eyes - Irrigate copiously with water or preferably eye-wash solution for at least five minutes. If irritation persists seek medical advice.
- Skin - Wash thoroughly with soap and water. Change clothing if necessary. If high pressure injection has occurred prompt surgical attention is required.
- Spillage - Absorb using sand, earth, or other suitable material. Dispose of unwanted or absorbed flammable material as directed under Storage and Transport.

1.12.3 Lubricant Oil - Premium Blue E 15W40

Also known as oil, lube oil, sump oil. New oil is a dark, viscous liquid with a slight characteristic odor. The base oil contains distillates (petroleum) and solvent-dewaxed heavy paraffinic. It is not classified as dangerous according to Directive 1999/45/EC and its amendments, and is not classified according to the EU regulations.

It has a boiling point greater than 150° C (302 °F), and a flash point Open Cup of 220° C (438 °F) (Cleveland) and is insoluble in cold water.

It is used in engine lubricant oil systems, sump pan and filters, make-up tanks, and piping systems as a lubrication oil for use in a wide range of diesel engines operating under severe conditions. Installers, operators, and maintainers are likely to encounter this product.

1.12.3.1 Hazardous Reactions

This product is stable, although slightly re-active, with oxidizing agents. Results of decomposition are carbon oxides (CO, CO_2) and water.

Although harmful if ingested (swallowed) or aspirated (breathed in), repeated or prolonged exposure is not known to aggravate medical conditions.

Used oil may contain harmful combustion by-products and un-burnt fuel that will cause skin reactions as detailed for fuel. Particular care must be taken if oil from a severely overheated engine is handled. Use impervious gloves, lab coat, and safety glasses. Do not breathe vapor or spray.

1.12.3.2 Protective Measures

Ensure good ventilation and avoid heat sources.

Adopt a high standard of personal hygiene. In case of skin contact, wash thoroughly with soap and water.

Use safety glasses, impervious gloves, and lab coat. Avoid contamination inside the gloves. If overalls become contaminated, discontinue use and clean thoroughly.

No special respiratory precautions are necessary in normal use. Do not breathe vapor or spray when handling hot materials.

1.12.3.3 Storage and Transport

Store and transport only in correctly marked containers. Keep containers tightly sealed when not in use. Keep in cool, well ventilated area, out of sunlight and away from naked flames. Store well away from food-stuffs and drinking water.

Wear splash goggles, full suit, boots, and gloves. Absorb leaks or spills with an inert material and dispose of unwanted or absorbed substance through an authorized contractor to a licensed site. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

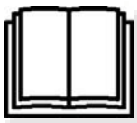
1.12.3.4 Emergency Action

- Fire - Fire-fighters are to use self contained breathing apparatus and full turnout gear. Keep fire-exposed containers cool.
    - Extinguishing media for large fire: Use water spray, fog or foam. Do not use water jet.
    - Extinguishing media for small fire: Use dry chemical powder or $CO_{2.}$
- Ingestion - Do not induce vomiting. Obtain medical advice immediately.
- Inhalation (of vapor) - Remove from further exposure. Obtain medical attention.
- Aspiration (inhalation of liquid) - Obtain immediate medical assistance.
- Eyes - Flush copiously with water or preferably eye-wash solution for at least fifteen minutes. Obtain medical advice.
- Skin - Wash thoroughly with soap and water. Obtain medical advice if irritation develops. Change clothing if necessary and wash before re-use.
- Spillage - Absorb with an inert material and dispose of as directed under Storage and Transport.

1.13 Generator Set Warning Labels

Warning signs are provided on the generator set at or near the point of risk. To avoid injury, always take the necessary precautions as indicated on the sample signs shown below.

	Caution or Warning. Indicates a risk of personal injury.
	Caution or Warning of Temperature Hazard. Indicates a risk of personal injury from high temperature.

	Caution or Warning of High Voltage Hazard. Indicates a risk of personal injury from electric shock or electrocution.
	Caution or Warning of Engine Coolant Pressure Hazard. Indicates a risk of personal injury from hot pressurized engine coolant.
	Caution or Warning. Indicates to read Operator Manual for additional information.
	Caution or Warning of No Step. Indicates a risk of personal injury or equipment damage from stepping on equipment.
	Caution or Warning of Combustion or Explosion Hazard. Indicates a risk of personal injury from explosion.
	Caution or Warning of Belt and Rotating Part Hazard. Indicates a risk of personal injury from entanglement in moving parts.
	Caution or Warning of Chemical (ingestion or burn) Hazard. Indicates a risk of personal injury or asphyxiation from poisonous fumes or toxic gases.
	Caution or Warning of High Voltage or Current Source Hazard. Indicates a risk of personal injury from electrical shock or electrocution.
	Caution or Warning of Fan and Rotating Part Hazard. Indicates a risk of personal injury from entanglement in moving parts.

2 Introduction

⚠ WARNING

Improperly connected generator electrical output connections can cause equipment damage, severe personal injury or death and therefore must be made by a trained and experienced electrician in accordance with the installation instructions and all applicable codes.

⚠ WARNING

Improper installations can cause equipment damage, severe personal injury or death and therefore all installations must be conducted by a trained and experienced person in accordance with the installation instructions and all applicable codes.

2.1 About this Manual

This is the Operator Manual for the generator set or sets listed on the front cover. Each operator should study this manual carefully and observe all of its instructions and safety precautions. Keep this manual readily available for reference.

The information contained within the manual is based on information available at the time of going to print. In line with Cummins Power Generation policy of continuous development and improvement, information may change at any time without notice. The users should therefore make sure that before commencing any work, they have the latest information available. The latest version of this manual is available on QuickServe Online (https://qsol.cummins.com/info/index.html).

The Operation, Maintenance, and Troubleshooting Chapters of this manual provide instructions necessary for operating the generator set and maintaining it at top performance. The owner is responsible for performing maintenance in accordance with the information provided in **Section 5.1 on page 33**.

This manual also includes generator set specifications and information on how to obtain service, emissions regulation compliance, and model identification.

See the Parts Manual for part identification numbers and required quantities. Genuine Cummins Onan replacement parts are recommended for best results.

2.1.1 Warning - Generator Set Not Ignition Protected

⚠ WARNING

The generator set or sets included in this manual are not ignition protected and shall not be used in a flammable vapor environment.

⚠ WARNING

Within the Parts Manual, MC parts are marine critical and must comply with boating safety ignition protection, backfire, fire resistance, exhaust system integrity, or other requirements established by regulatory agencies, such as the U.S. Coast Guard, ABYC, and ISO. When marine critical parts are replaced for any reason, use Cummins Onan parts that are identified with the part numbers in the appropriate Parts Manual.

2.2 Related Literature

Before any attempt is made to operate the generator set, the operator should take time to read all of the manuals supplied with the generator set, and to familiarize themselves with the warnings and operating procedures.

⚠ CAUTION

A generator set must be operated and maintained properly if you are to expect safe and reliable operation. The Operator manual includes a maintenance schedule and a troubleshooting guide.

The Health and Safety manual must be read in conjunction with this manual for the safe operation of the generator set:

- Health and Safety Manual (0908-0110)

The relevant manuals appropriate to your generator set are also available, the documents below are in English:

- Operator Manual (0981-0181)
- Installation Manual (0981-0648)
- Service Manual for (0981-0543)
- Parts Manual MDKBK (0981-0279); MDKBL, MDKBM, MDKBN (0981-0280); MDKBP, MDKBR, MDKBU (0981-0288); MDKBT and MDKBV (0981-0284)
- Service Manual for Kubota 03-M-E3B and E3BG and 03-M DI-E3B (0981-0551)
- Specification and Data Sheet (MDKBK A1477, MDKBL A1476, MDKBM A1478, MDKBN A1479, MDKBP A1480, MDKBR A1481, MDKBT A1494, MDKBU A1488, MDKBV A1537) (For engineering data specific to the generator set)
- Standard Repair Times - BT Family (0900-0625)
- Warranty Manual (F1117-0002)
- Global Commercial Warranty Statement (A028U870)

2.3 Model Identification

Each generator set is provided with a nameplate that contains the model and serial numbers. This information is needed when contacting Cummins Onan for parts, service, and product information.

Every character of the model number is significant. The last character of the model number is the specification letter which is important for obtaining the correct parts.

Record the generator set model and serial numbers in the figure below to have them available if needed.

2.3.1 Nameplate Location

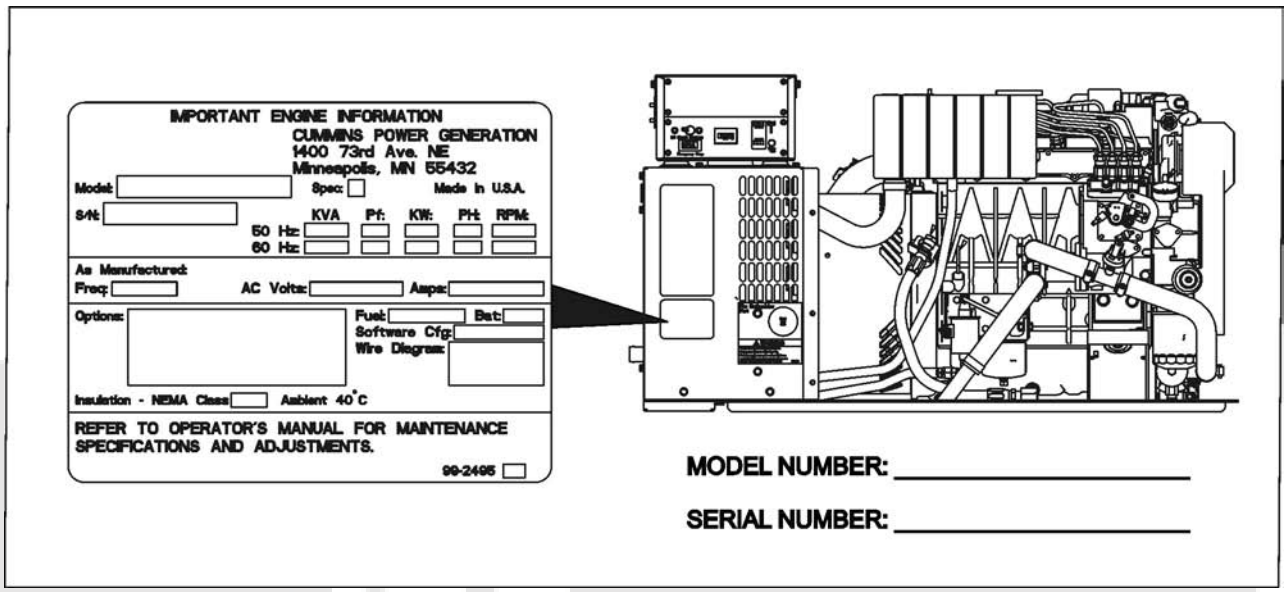


FIGURE 2. NAMEPLATE LOCATION

2.4 How to Obtain Service

For generator set parts, service, and literature, contact the nearest authorized Cummins Onan distributor. You may go to the Internet site ***www.cumminsonan.com*** for information on contacting our distributors worldwide.

2.4.1 In North America

Call +01 800 8886626 for the nearest Cummins Onan distributor in the United States or Canada. Press 1 (option 1) to be automatically connected.

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

2.4.2 Outside North America

Call Cummins Power Generation at +01 763 5745000 from 7:30 AM to 4:00 PM (Central Standard Time), Monday through Friday, or fax +01 763 5287229.

2.4.3 Information To Have Available

- model number
- serial number
- date of purchase
- nature of the problem (see **Chapter 6 on page 59**)

2.5 Emissions Label

The emissions label states compliance with applicable engine emissions regulations. Refer also to the Federal Emissions Design And Defect Limited Warranty For C.I. Engine (Diesels) publication that was shipped in the same package as the Operator Manual.

2.5.1 Typical Emissions Label Location

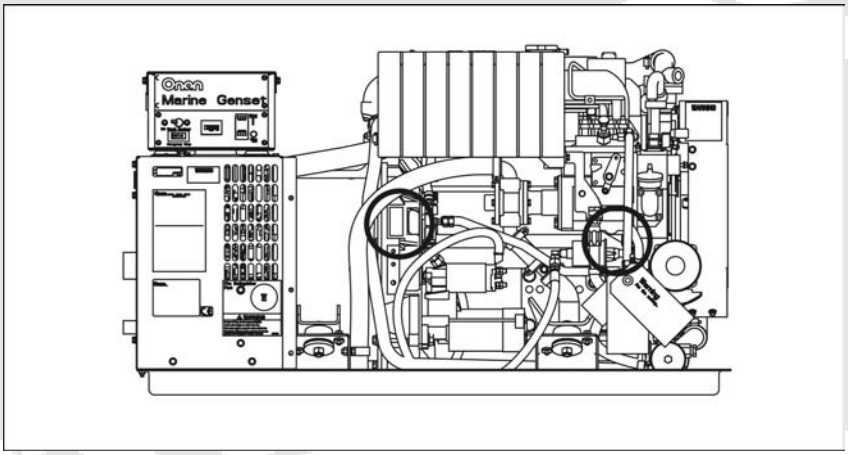


FIGURE 3. TYPICAL EMISSIONS LABEL LOCATIONS

2.6 Noise

Generator sets emit noise. As noise level and time of exposure increase, risk of hearing damage increases. **Chapter 7 on page 71** includes specific noise level information for these generator sets. Use personal hearing protection appropriate for your exposure to generator set noise.

When used in countries where compliance to the EU Noise directive is required: This generator set has not been evaluated and is not marked for use in open air. Install the generator set in accordance with the Installation Manual. Obey local noise restrictions when you operate the generator set.

2.7 Electromagnetic Compatibility Compliance

Generator sets emit and receive electromagnetic (radio frequency) energy. If the generator set affects operation of nearby devices, or nearby devices affect generator set operation, increase the distance between them.

When used in countries where compliance to the EMC directive is required: This generator set has been evaluated for use in the residential, commercial, and light industrial environments.

2.8 Build Standards

The generator set and its control system have been designed, constructed and tested generally in accordance with the following Standards where applicable.

Standard	Title
BS EN 1037:1995+a1:2008	Safety of machinery - Prevention of unexpected start up.
BS EN ISO 14121-1:2007	Safety of machinery. Risk assessment principles.
BS EN ISO 13857:2008	Safety of machinery. Safety distances to prevent hazard zones being reached by upper and lower limbs.
BS EN 349:1993+A1:2008	Safety of machinery - Minimum gaps to avoid crushing parts on the human body.
BS EN 547-1:1996+A1:2008	Safety of machinery - Human body dimensions - Part 1: Principles for determining the dimensions required for openings for whole body access into machinery.
BS EN 547-2:1996+A1:2008	Safety of machinery - Human body dimensions - Part 2: Principles for determining the dimensions required for access openings.
BS EN 547-3:1996+A1:2008	Safety of machinery - Human body dimensions - Part 3: Anthropomorphic data.
BS EN 60204-1:2006+A1:2009	Safety of machinery. Electrical equipment of machines. General requirements.
BS EN 614-1:2006+A1:2009	Safety of machinery. Ergonomic design principles. Terminology and general principles.
BS EN 953:1997+A1:2009	Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards.
BS EN ISO 12100-1:2003+A1:2009	Safety of machinery. Basic concepts, general principles for design. Basic terminology, methodology
BS EN ISO 12100-2:2003+A1:2009	Safety of machinery. Basic concepts, general principles for design. Technical principles
BS EN ISO 13732-1:2008	Ergonomics of the thermal environment. Methods for the assessment of human responses to contact with surfaces. Hot surfaces
BS EN ISO 13849-1:2008	Safety of machinery - Safety-related parts of control systems
BS EN ISO 13850:2006	Safety of machinery - Emergency stop. Principles for design.
BS EN 61310-1:2008	Safety of machinery - Indication, marking and actuation - Part 1:Requirements for visual, auditory and tactile signals.
BS EN 61310-2:2008	Safety of machinery - Indication, marking and actuation - Part 2: Requirements for marking.
BS EN 61000-6-1:2007	Electromagnetic compatibility (EMC). Generic standards. Immunity standard for residential, commercial and light-industrial environments.
BS EN 61000-6-3:2007	Electromagnetic compatibility (EMC). Generic standards. Emission standard for residential, commercial and light-industrial environments.
BS EN 1299:1997+A1:2008	Mechanical vibration and shock - Vibration isolation of machines - Information for the application of source isolation
BS EN 1679-1:1998	Reciprocating internal combustion engines - Safety - Part 1: Compression ignition engines
BS EN 12601:2001	Reciprocating internal combustion engine driven generating sets - Safety

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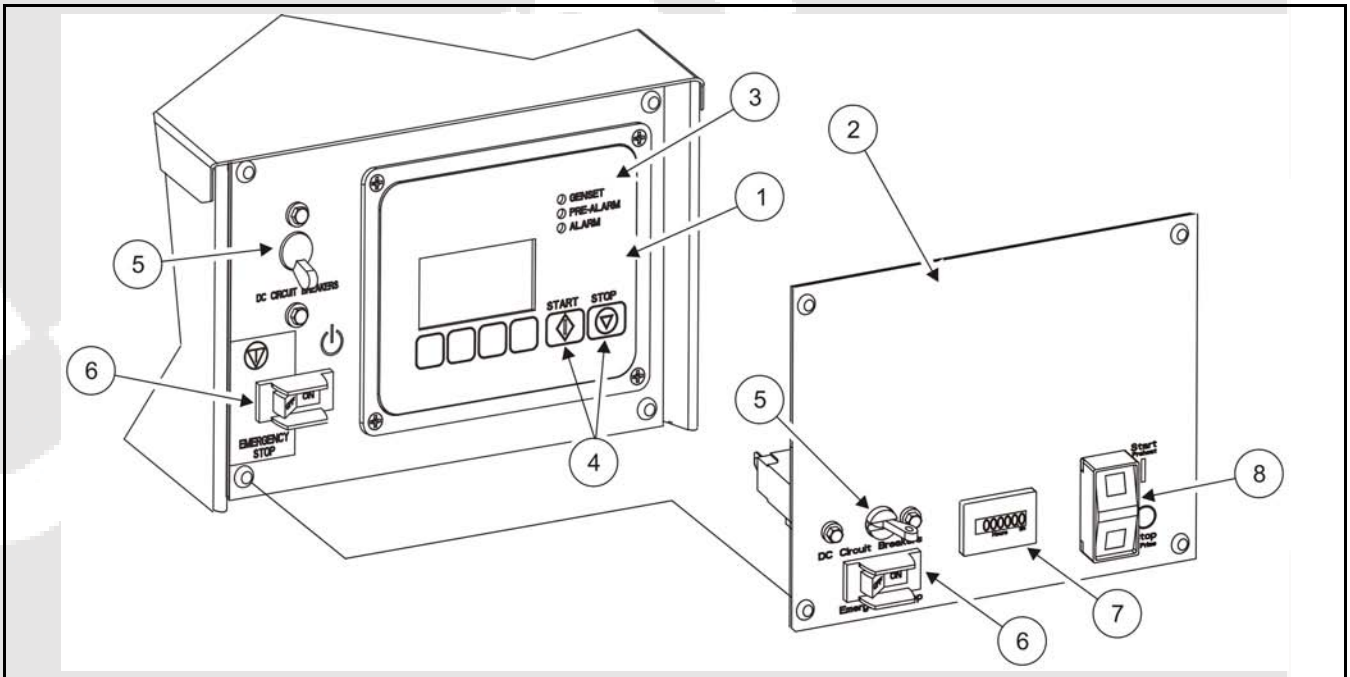
3 Control Panel

3.1 Local Control Panel

The generator set control panel has either a control switch with status lamps or a Cummins Onan Digital Display. A generator set equipped for operation in parallel with other generator sets may have a **Single/Parallel** operation selector switch. It may also have a manual voltage regulator. If the generator set has a housing, the front panel will need to be removed to access the selector switches and manual voltage adjusting knob.

3.1.1 Local Control Panel Components



No.	Description	No.	Description
1	Digital Display Panel (Optional)	5	DC Circuit Breaker
2	Control Switch Panel (Standard)	6	Emergency Stop Switch
3	Status Lamps	7	Hour Meter
4	Start and Stop Buttons	8	Control Switch and Status Lamps

FIGURE 4. LOCAL CONTROL PANEL COMPONENTS

3.1.2 Control Switch and Status Lamps

The control switch is used to start and stop the generator set and prime fuel.

- When starting the generator set, the amber status lamp flashes rapidly during preheat and cranking and goes out when the engine is up to speed. The green status lamp lights after starting and stays on while the generator set is running. (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 generator set controller on the basis of engine temperature.) See **Section 4.4 on page 27** for more information.
- When stopping the generator set, all status lamps will go out. See **Section 4.5 on page 28** for more information.
- The amber status lamp lights and stays on during priming. See Priming the Fuel System in the Operation Chapter for more information.
- If the generator set shuts down abnormally, the amber lamp will slowly blink a numerical code to indicate the cause of the shutdown. See **Chapter 6 on page 59** for more information on fault codes and status lamp blink codes.

3.1.3 Digital Display Panel

The local control panel may have a digital display panel instead of a control switch. See **Section 3.3 on page 21** for more information on the digital display panel.

3.1.4 Emergency Stop Switch

This is a circuit breaker that protects the generator set control circuits from shorts to ground. In an emergency, the switch is pushed to off. It is pushed to on after all necessary repairs to the generator set and connected equipment have been made.

3.1.5 DC Circuit Breaker

The circuit breaker protects the DC control circuits of the generator set from short circuits. It must be reset after all necessary repairs have been made to the generator set.

3.1.6 Line Circuit Breaker

The line circuit breaker protects the AC power leads connected to the generator set from overloads and equipment short circuits. It may be located on the side of the generator set instead of with the local control panel.

3.1.7 Hour Meter

The hour meter records total runnning time of the generator set. It cannot be reset.

3.2 Remote Control Panels

The boat may be equipped with one or more remote control panels for generator set control and monitoring. A remote control panel may consist of a control switch and status lamp or it may be a Cummins Onan Digital Display panel.

3.2.1 Boat Monitoring System

Generator set operation may be monitored by an integrated monitoring system using an SAE J1939 or SmartCraft™ network protocol. (SmartCraft is a trademark of the Brunswick Corporation.)

3.3 Cummins Onan Digital Display Panel

The Cummins Onan digital display panel (see figure below) has an LCD screen with 4 navigation buttons, 3 status lamps, a start button, and a stop button.

The digital display communicates with the generator set controller. All connected display panels will turn on automatically when the generator set is started at any station. They will all turn off 5 minutes after the generator set has received a normal command to stop. If a fault occurs, they will stay on until the fault is cleared. See **Section 4.2 on page 23**.

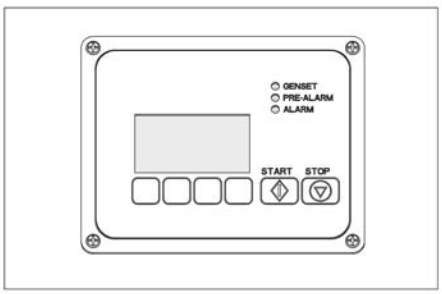


FIGURE 5. CUMMINS ONAN DIGITAL DISPLAY

3.3.1 Start Button

When pushed, the **Start** button starts the generator set. When starting the generator set, the **Generator** status lamp on the digital display will blink while the engine is preheating and cranking and stay on while the generator set is running. Status on the digital display will change from *Starting* to *Running*. See **Section 4.4 on page 27** for more information.

3.3.2 Stop Button

When pushed, the **Stop** button shuts down the generator set. After stopping the generator set, the **Generator** status lamp will go out. Status on the digital display will change from *Running* to *Stopped.* See **Section 4.5 on page 28** for more information.

3.3.3 Prime using Stop Button

The **STOP** button is used to prime the generator set. The **Generator** status lamp will blink while priming and the status on the digital display will change from **Stopped** to **Priming**. See Priming the Fuel System in the Operation Chapter for when and how to prime.

3.3.4 Generator Status Lamp (green)

The **Generator** status lamp blinks while the engine is cranking or the fuel system is being primed. It stays on while the generator set is running.

3.3.5 Pre-alarm Status Lamp (amber)

The **Pre-alarm** status lamp lights and stays on while an engine pre-alarm condition exists. It blinks rapidly while the generator set is running in fault bypass mode, if so equipped.

3.3.6 Alarm Status Lamp (red)

The **Alarm** status lamp blinks during a fault shutdown.

3.3.7 Generator Set Status

Generator set status is displayed on either three or four digital display status screens depending on model configuration. See **Section 4.2 on page 23** for more information.

4 Operation

4.1 Pre-Start Checks

⚠ WARNING

Exhaust gas is deadly. All engine exhaust contains carbon monoxide - an odorless, colorless, poisonous gas that can cause unconsciousness and death. Symptoms of carbon monoxide poisoning include: dizziness, nausea, sleepiness, headache, vomiting, weakness, and inability to think coherently.

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 generator set 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 the generator set and after every eight hours of operation. Shut down the generator set immediately if there is a leak. Do not run the generator set until the leak has been repaired. The exhaust system must be installed in accordance with the generator set Installation Manual.

Before each start:

1. Before the first start of the day and after every eight hours of operation, inspect the generator set as instructed in **Section 5.2 on page 34**. Keep a log of maintenance (**Chapter 8 on page 79**) and the hours run and perform any maintenance that may be due (**Section 5.1 on page 33**). See **Section 5.9 on page 58** if the boat has been in storage.
2. Make sure all CO detectors on board are working properly.
3. Disconnect all electrical loads and disengage the Power Takeoff (PTO), if so equipped.
4. Check for swimmers that might be exposed to the engine exhaust.

4.2 Digital Display

Touch any button to turn on the digital display panel. The main status screen (**GEN STATUS Pg1**) will show the word **Priming**, **Starting**, **Running**, **Stopped**, **Volt Adj**, or **Fault Override** depending on the operating status of the generator set.

Use the double arrows to navigate through the screens, or touch any one of the **SETUP**, **FAULT**, or **SCREEN** buttons for more options.

Additional status screen information includes:

- AC output voltage
- AC frequency
- engine coolant temperature
- engine oil pressure
- starting battery voltage
- total hours of generator set running time.

A fourth screen, if so equipped, shows:

- percentage of full load in 10% increments as a bar graph

- engine RPM
- engine air intake manifold temperature
- fuel temperature
- fuel rate of consumption.

NOTICE

The total time on the master hour meter prevails if the total time on the digital display is different. See the Service Manual for more information on resetting the hour meter.

4.2.1 Generator Set Status Screens

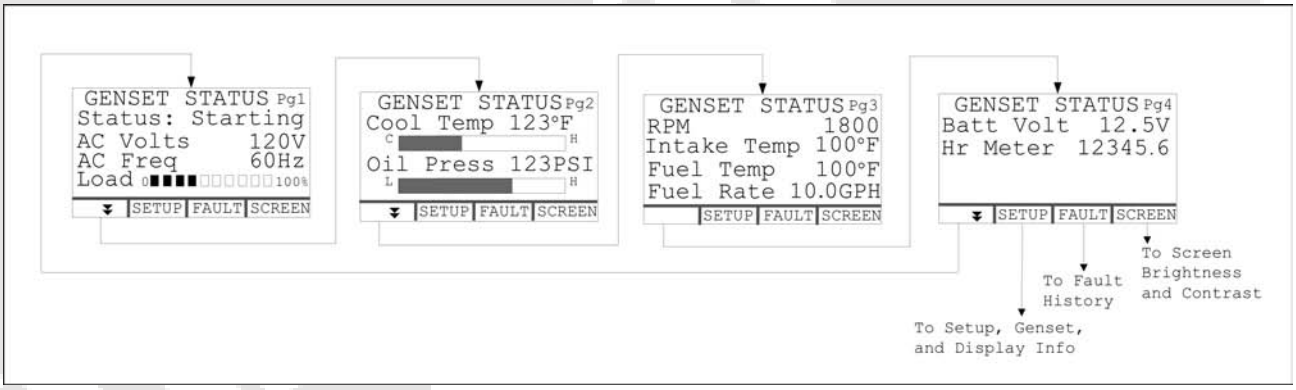


FIGURE 6. GENERATOR SET STATUS SCREENS

4.2.2 Fault Screen

If a fault shutdown occurs, the alarm status lamp will blink, and the screen will display a description of the fault, the numeric fault code, and the hour the fault occurred in total generator set running time (see figure below). Refer to **Section 6.4 on page 60** to diagnose and correct the problem.

The screen will display the fault indefinitely until any button is touched to clear the fault. The digital display will turn off in 5 minutes after the fault has been cleared.

Press **BACK** to return to **GEN STATUS**.

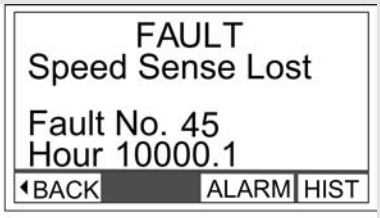


FIGURE 7. DIGITAL DISPLAY FAULT SCREEN

4.2.3 Fault History

To display any of the last five faults, press **FAULT** on any **GEN STATUS** screen and **HIST** on the **FAULT** screen (see figure below).

The **FAULT HISTORY** screen displays a description of the fault, the numeric fault code, and the hour the fault occurred in total generator set running time. Press the double arrows to toggle between the last 5 faults. If there are no faults, the **FAULT HISTORY** screen will display **No Stored Faults**.

Press **BACK** to return to **GEN STATUS**.

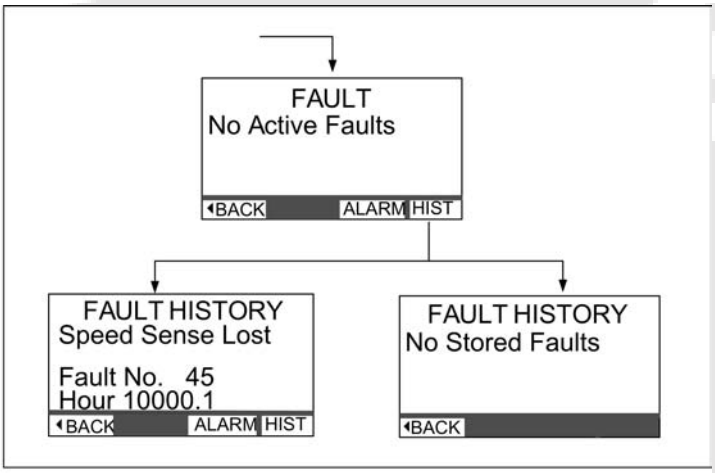


FIGURE 8. FAULT HISTORY

4.2.4 Engine Pre-Alarms

The **PRE-ALARM** status lamp will blink when the engine oil pressure or engine temperature approaches its engine shutdown limit. The screen will display **Low Oil Pressure** or **High Engine Temperature** (see figure below).

Press **BACK** to return to **GEN STATUS** in order to monitor engine temperature and oil pressure. Service the generator set as required.

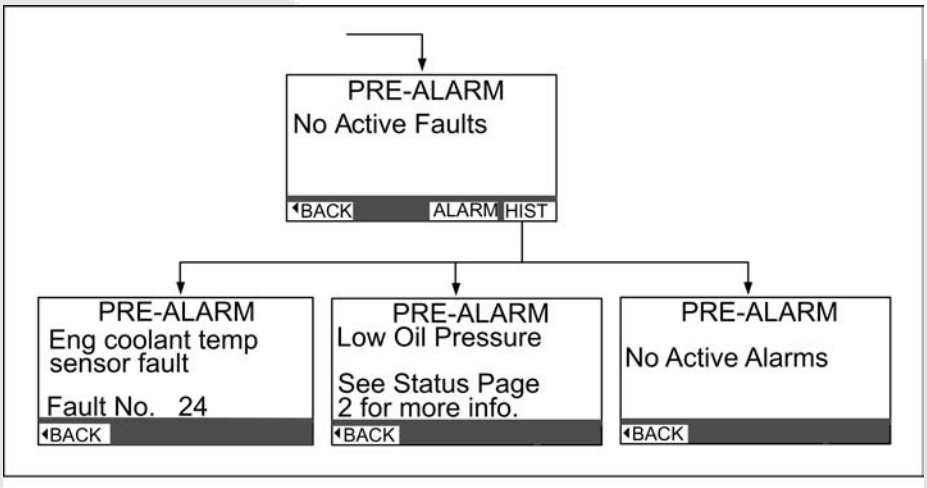


FIGURE 9. ENGINE PRE-ALARMS

4.2.5 Brightness and Contrast

To adjust the brightness or contrast of the digital display screen, press **SCREEN** on any **GEN STATUS** screen, then **NEXT** to toggle between Brightness and Contrast (see figure below). Press the right or left arrow to increase or decrease brightness or contrast.

Press **BACK** to save the settings and return to **GEN STATUS**.

NOTICE
These settings apply only to the control panel that the change was made on, not to any remote panels. Any other panels will need to be changed locally.

FIGURE 10. SCREEN BRIGHTNESS AND CONTRAST

4.2.6 Display Setup

The **SETUP** screen allows for setting units of measure and voltmeter calibration, and gives general information about the generator and display (**Figure 11 on page 27**). Press **SETUP** on any **GEN STATUS** screen then the up or down arrow to toggle through the options: **DISPLAY SETUP**, **GENSET INFO**, or **DISPLAY INFO**. Press **ENTER** when the desired option is highlighted.

To select the units of measure for the **GEN STATUS** screens, press **NEXT** on the **DISPLAY SETUP** screen to highlight **UNITS** and then the up or down arrow to select **SAE** or **METRIC**. Press **BACK** to save the selection and return to **GEN STATUS**.

To calibrate the digital display voltmeter, press **NEXT** on the **DISPLAY SETUP** screen to highlight **AC Voltmeter Calibration** and then press the up or down arrow to increase or decrease the voltage displayed so that it matches that of an accurate AC voltmeter (line-to-line or line-to-neutral, as desired). Press **BACK** to save the selection and return to **GEN STATUS**.

NOTICE
This procedure does not change AC output voltage.

⚠ WARNING
Many troubleshooting procedures or replacement of parts present hazards that can result in equipment damage and severe personal injury or death. Have a trained and experienced person adjust AC output voltage, if necessary, before calibrating the digital display voltmeter.

4.2.7 Generator Set and Digital Display Information

Press **SETUP** on any **GEN STATUS** screen. Press the up or down arrow on the **SETUP** screen to select **GENSET INFO** or **DISPLAY INFO** and press **ENTER** (see figure below). This information may be requested by the service technician. Keep pressing **BACK** to get back to **GEN STATUS**.

GENSET INFO and **DISPLAY INFO** screens show software part numbers and version detail information that may be requested by a service technician. Press **BACK** to return to **GEN STATUS**.

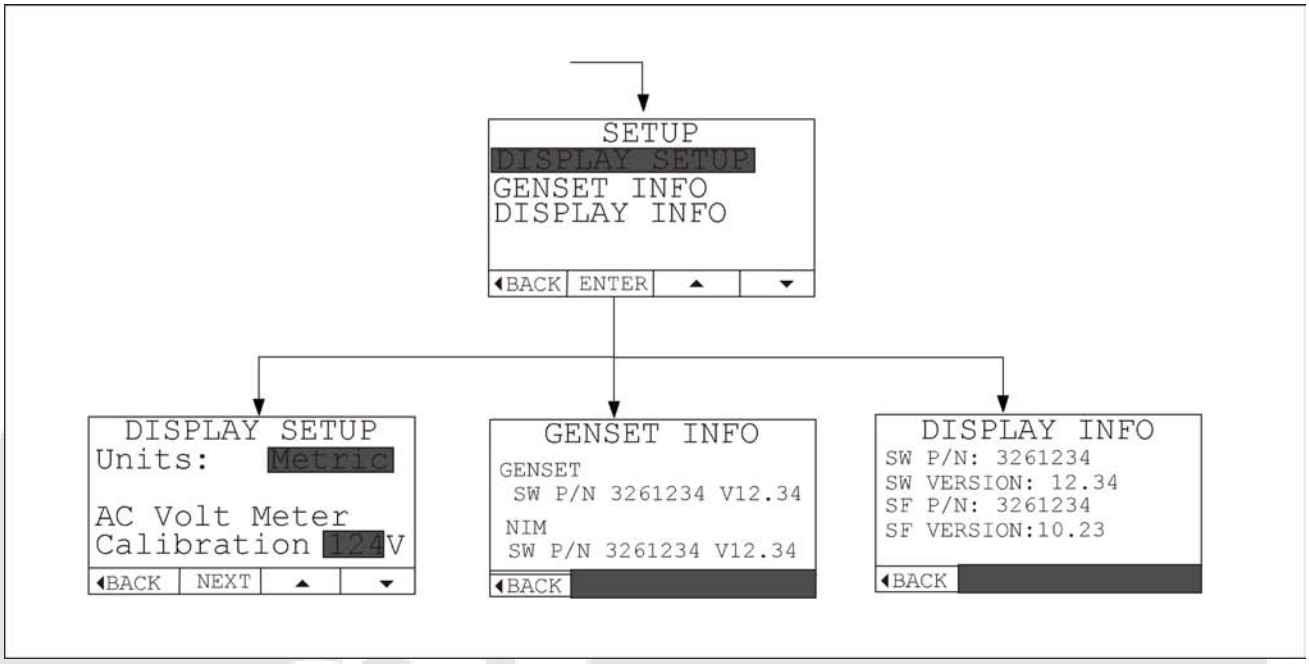


FIGURE 11. DISPLAY SETUP, GENSET INFO, DISPLAY INFO

4.3 Priming the Fuel System

⚠ 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 multiclass fire extinguisher handy.

⚠ WARNING

Engine components (drains, filters, hoses, etc.) can be hot and cause severe burns, lacerations of the skin, and liquid splash. Use personal protective equipment when working with or around hazardous materials. Examples of personal protective equipment include (but are not limited to) safety glasses, protective gloves, hard hats, steel toed boots, and protective clothing.

The fuel system should be primed after fuel filters are replaced or after the generator set runs out of fuel.

Push and hold **STOP (prime)** on the control switch or push and hold **STOP (prime)** on the digital display for at least 30 seconds. The **Generator** status lamp will blink while priming and the status on the digital display will change from **Stopped** to **Priming**.

4.4 Starting the Generator Set

The generator set can be started and stopped from the generator set control panel or remote control panel.

1. Visually check for water, coolant, fuel, and exhaust leaks. Stop the generator set immediately if there is a leak. Repair fuel leaks immediately.

2. Push and hold start on the control switch or digital display until the generator set starts. The generator set status lamp blinks when the engine is cranking and comes on and stays on when the generator set starts and runs. Status on the digital display changes from **Starting** to **Running**.
3. For longer engine life, let the engine warm up for two minutes before connecting air conditioners and other large electrical loads or engaging the PTO, if so equipped.
4. Monitor the generator set status using the digital display. Perform maintenance or service as necessary if the display indicates a pre-alarm condition (**Chapter 5 on page 33**).
5. If the generator set fails to start, cranking will discontinue in 20 to 60 seconds, depending on engine temperature. The digital display and/or control switch status lamp will indicate Fault Code No. 4. See **Section 6.4 on page 60** if the generator set does not start after several tries.

⚠ WARNING

Excessive cranking can burn out the starter or flood the engine (exhaust flow during cranking is too low to expel water from a wet exhaust system). Find out why the generator set does not start and make necessary repairs.

6. If the generator set shuts down, the digital display and/or control switch status lamp will indicate the numeric fault code. See **Section 6.4 on page 60**.

4.5 Stopping the Generator Set

Disconnect all electrical loads and disengage the PTO, if so equipped, to let the generator set run without load and cool down. After 2 minutes push and release stop on the digital display or control switch. The generator set status lamps will go out.

⚠ CAUTION

Afterboil can force large amounts of coolant through the pressure cap and coolant recovery tank. Always let the engine cool down before stopping the generator set. Check for loss of coolant after every emergency stop or fault shutdown. Refill and clean up as necessary.

4.6 Emergency Stop

In case of emergency, push the emergency stop switch to off. After all necessary repairs have been made, push the switch to on so that the generator set can be operated. See **Section 3.1 on page 19** for an illustrated location of the emergency stop switch.

4.7 Loading the Generator Set

The power rating (kW) on the generator set nameplate determines how much electrical load (motors, fans, pumps, heaters, air conditioners, appliances) the generator set can power. The generator set will shut down or its line circuit breakers will trip if the sum of the loads exceeds the generator set power rating.

NOTICE
It may be necessary to run fewer electrical loads and appliances at the same time - the sum of the loads must not be greater than the generator set power rating.

To avoid shutdowns due to generator set overload, use the electrical ratings on the nameplates of equipment to compare the sum of the electrical loads that are likely to be used at the same time to the generator set power rating. Refer to **Table 1** below for typical appliance ratings.

- If the equipment is marked in amps and volts only, multiply the amps times the volts to obtain the load in watts.
- Divide watts by 1000 to obtain load in terms of kilowatts.

The generator set may shut down due to overload when a large motor or air conditioner is started or cycles off and then on again, even though the sum of the electrical loads is less than the generator set power rating. The reason for this is that a motor's startup load is much greater than its running load.

On generator sets so equipped, the PTO can take most, if not all, of the power available from the engine. The boat builder may have made provisions to automatically disconnect all or most electrical loads when the PTO is engaged.

NOTICE
When PTO (if so equipped) is engaged, it may be necessary to run fewer electrical loads and appliances - or none at all.

The generator set is rated at standard barometric pressure, humidity, and temperature (reference ISO 3046). Low barometric pressure (high altitude) or high ambient temperature will decrease engine power.

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

Appliance	Load (watts)
Electric Broom	200-500
Electric Blanket	50-200

4.8 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 generator set at 1/4 to 3/4 load.

4.9 Exercising the Generator Set

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

4.10 Resetting Line Circuit Breakers

If a generator set line circuit breaker trips or a circuit breaker in the power distribution panel trips, either a short circuit has occurred or too many loads were connected.

NOTICE
The generator set will continue to run if its circuit breaker trips.

If a circuit breaker trips:

1. Disconnect or turn off as many electrical loads and appliances as possible.
2. Reset the circuit breaker.
3. If the circuit breaker trips right away either the appliance (or electrical load) has a short or the circuit breaker is faulty. Call a qualified electrician.

NOTICE
It may be necessary to push the circuit breaker OFF to reset it and ON to reconnect the circuit.

4. If the circuit breaker does not trip right away, reconnect loads one-by-one making sure not to overload the generator set or cause a circuit breaker to trip. If a circuit breaker trips right away when an appliance is connected, that appliance or circuit probably has a short.

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

Electric appliances and tools must be used and maintained in accordance with their manufacturer's instructions and safety precautions. They must be properly grounded to reduce the risk of electric shock and fire.

⚠ WARNING

Short circuits in electrical equipment can cause fire and electrical shock leading to severe personal injury or death. Electrical equipment and its grounding must be maintained properly to protect against short circuits.

4.11 Connecting to Shore Power

When provisions have been made for connecting shore power, the boat must have an approved device to keep the generator set and shore power from being interconnected.

⚠ WARNING

Interconnecting the generator set and shore power can lead to electrocution of utility line workers, equipment damage, and fire. Use an approved switching device to prevent interconnections.

4.12 Care of New or Re-Built Engine

Avoid no-load operation as much as possible during break-in. Change the oil and oil filter after the first 50 hours of operation. See **Section 5.4.1 on page 40** for information on oil recommendations.

4.13 Batteries

The generator set requires a 12 volt battery to power its control and starting circuits. Reliable generator set starting and starter service life depend upon adequate battery system capacity and maintenance. See **Chapter 5 on page 33** for battery care and **Chapter 7 on page 71** for battery requirements.

4.14 Fire Extinguisher

⚠ CAUTION

Improper nozzle size can result in spray misdirection. Make sure that the nozzle of your fire extinguisher is smaller than the circle found on the enclosure warning label so that it will fit through the port. The fire extinguisher must be of the gaseous type.

The boat must have a fire extinguisher readily available for putting out a fire in the generator set. It must be approved for liquid fuel and electrical equipment.

A generator set with an enclosure has a fire extinguisher port accessible by breaking through the circle on the warning label located on the service side of the enclosure (see below). The fire extinguisher must be of the gaseous type.

In the event of fire:

1. Do not open the generator set 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.

4.14.1 Fire Extinguisher Port Label Location

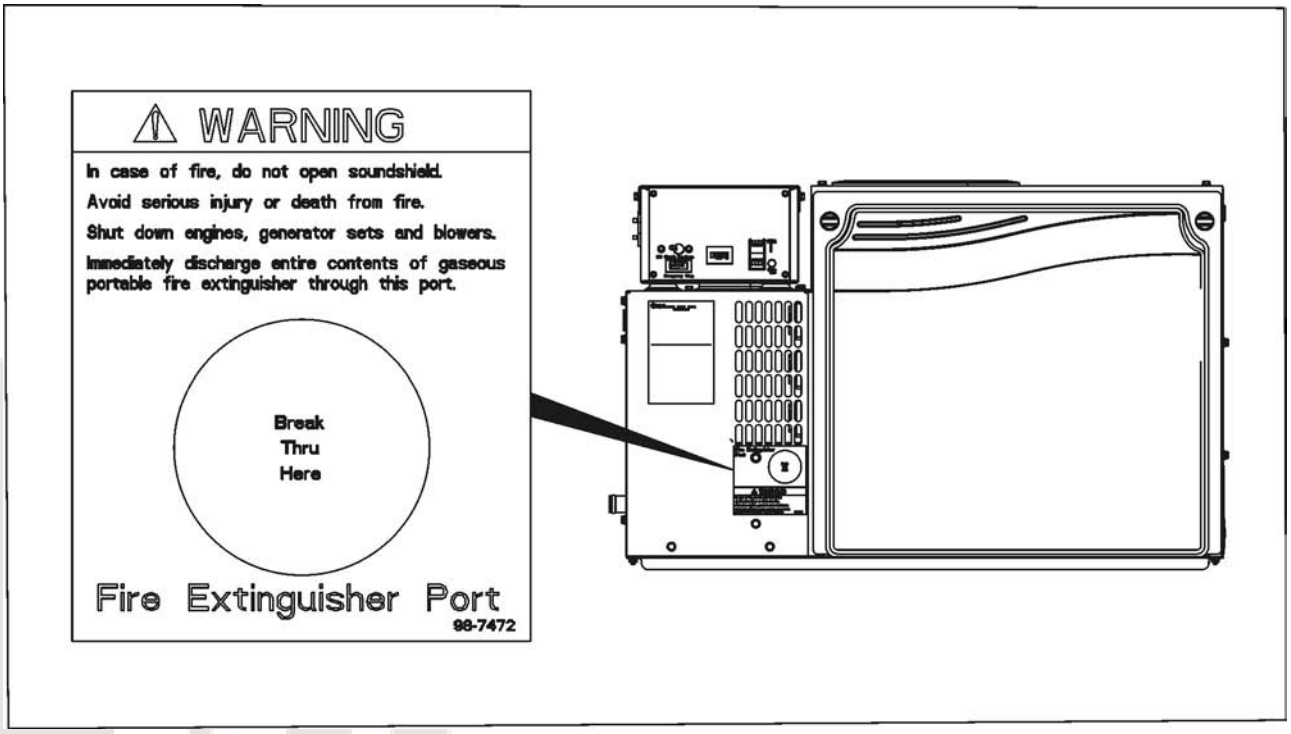


FIGURE 12. FIRE EXTINGUISHER PORT LABEL LOCATION

5 Maintenance

5.1 Periodic Maintenance

Periodic maintenance is essential for top performance and long generator set life. Use the Periodic Maintenance Schedule below as a guide for normal periodic maintenance.

Maintenance, replacement, or repair of emission control devices and systems may be performed by any engine repair establishment or individual. However, warranty work must be completed by an authorized Cummins Onan service representative.

To help keep generator set maintenance regular and provide a basis for warranty claims, record maintenance performed, see **Chapter 8 on page 79**.

5.1.1 Periodic Maintenance Schedule

TABLE 2. PERIODIC MAINTENANCE SCHEDULE

MAINTENANCE OPERATION	MAINTENANCE FREQUENCY									
	After First 50 Hrs	Every Day/8 Hrs	Every Month/100 Hrs	Every Year/ 200 Hrs	Every Year/ 350 Hrs	Every Year/ 500 Hrs	Every 800 hrs	Every 2 Years	Every 5 Years /2000 Hrs	
General Inspection[1]		x								
Check Engine Oil Level		x								
Drain Water From Fuel Filter			x							
Check Battery and Battery Connections[2]			x							
Check V-Belt Tension[3]			x							
Check Siphon Break			x							
Change Oil and Filter - All except MDKBT and MDKBU[5]	x			x						
Change Oil and Filter - Only MDKBT and MDKBU[5]	x				x					
Change Fuel Filter						x				
Inspect Zinc Anode						x				
Replace Raw Water Pump Impeller						x				
Adjust Valve Lash[4]							x			
Replace Coolant, Pressure Cap, and Thermostat								x		
Inspect Generator Bearing[4]									x	

1 - Includes inspection of Oil Level, Coolant Level, Fuel System, Exhaust System, Batteries and Battery Connections. 2 - See battery manufacturer's recommendations. 3 - Check for slippage, cracking, and wear. 4 - Must be performed by a qualified mechanic (authorized Cummins Onan Dealer). 5 - Perform twice as often when using high sulfur fuel. See Engine Oil Recommendations in the Maintenance chapter.	

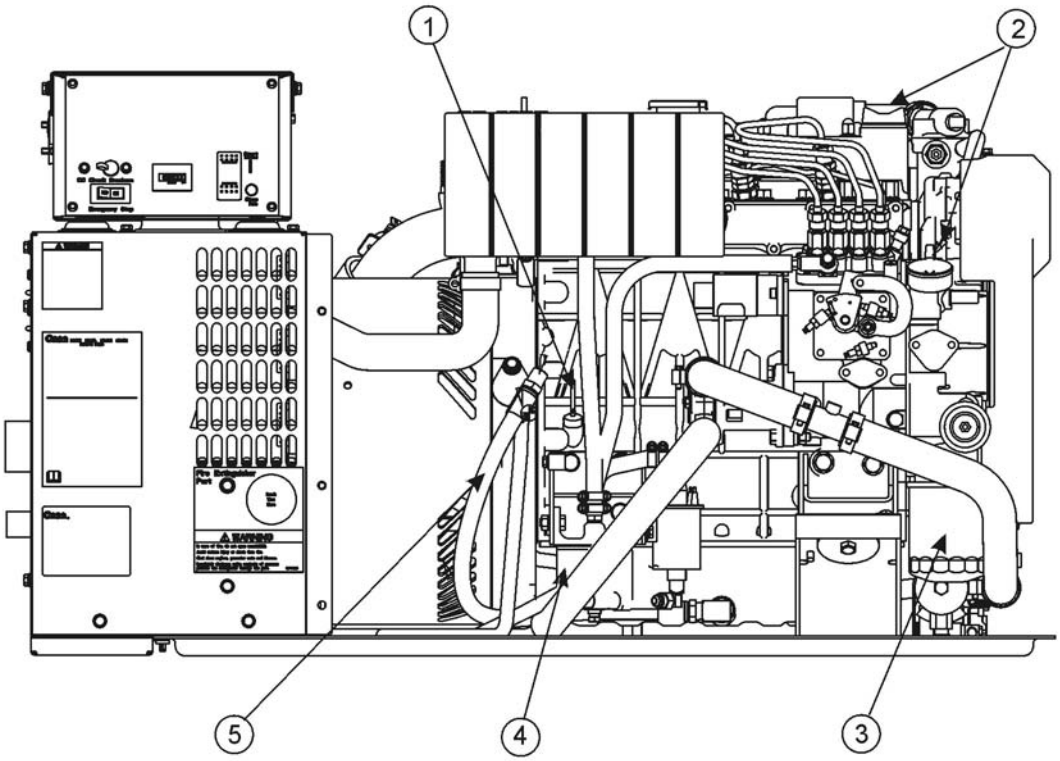
5.2 General Inspection

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

- Battery Connections
- Oil Level
- Fuel System
- Coolant Level
- Raw Water System
- Exhaust System
- Mechanical System

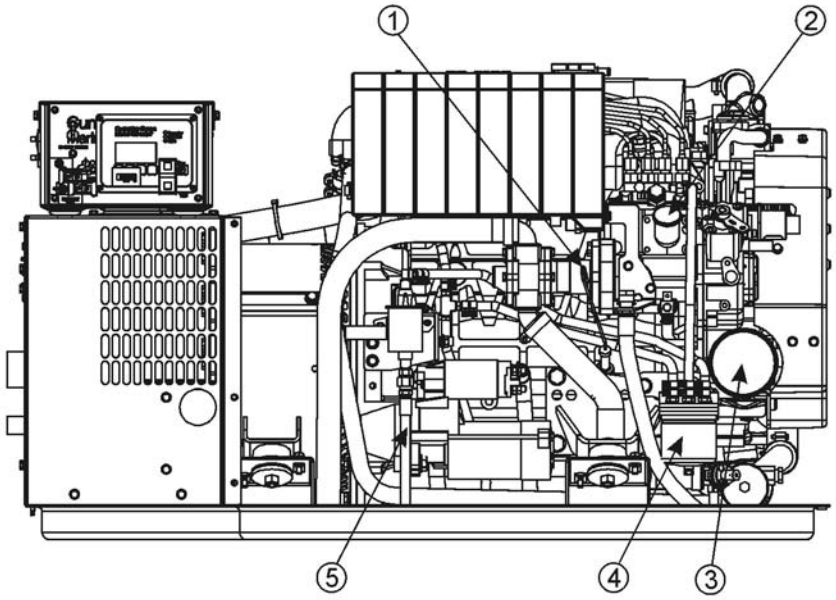
Review the following figure for assistance in locating various service points.

5.2.1 Service Point Locations



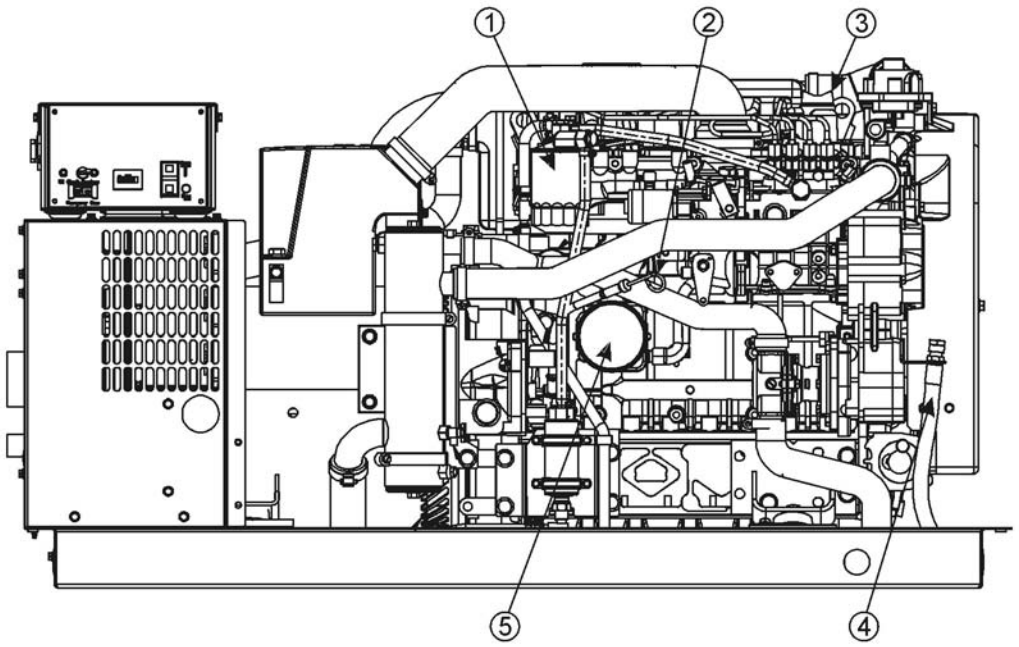
No.	Description	No.	Description
1	Oil Dipstick	4	Fuel Filter and Water Separator
2	Oil Fill	5	Oil Drain Hose
3	Oil Filter		

FIGURE 13. OIL AND FUEL SERVICE POINTS - MDKBK, MDKBL, MDKBM, MDKBN



No.	Description	No.	Description
1	Oil Dipstick	4	Fuel Filter and Water Separator
2	Oil Fill	5	Oil Drain Hose
3	Oil Filter		

FIGURE 14. OIL AND FUEL SERVICE POINTS - MDKBP, MDKBR, MDKBV



No.	Description	No.	Description
1	Fuel Filter	4	Oil Drain Hose
2	Oil Dipstick	5	Oil Filter
3	Oil Fill		

FIGURE 15. OIL AND FUEL SERVICE POINTS - MDKBT, MDKBU

5.2.2 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 a battery, wear safety glasses, and do not smoke. Turn work light on or off away from the battery. When performing maintenance procedures or when servicing a battery, stop the generator set and disconnect the charger before disconnecting battery cables. Using an insulated wrench, disconnect the negative (–) cable first and reconnect it last.

Check the battery terminals for clean, tight connections. Loose or corroded connections have high electrical resistance which makes starting harder.

5.2.3 Oil Level

⚠ WARNING

Engine components (drains, filters, hoses, etc.) can be hot and cause severe burns, lacerations of the skin, and liquid splash. Use personal protective equipment when working with or around hazardous materials. Examples of personal protective equipment include (but are not limited to) safety glasses, protective gloves, hard hats, steel toed boots, and protective clothing.

⚠ WARNING

Crankcase pressure can blow hot engine oil out the fill opening causing, severe burns. Always stop the generator set before removing the oil fill cap.

⚠ WARNING

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.

⚠ CAUTION

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

1. Shut off the generator set.
2. Pull the oil fill plug and dipstick out of the oil fill neck. The plug may be difficult to pull straight out - tilt the plug in its socket while pulling out.
3. Wipe off the dipstick and thread it back into the fill neck. Seat the plug, which snaps into its socket.
4. Remove the plug and dipstick again and check the oil level on the dipstick. Replace and seat the oil fill plug.
5. Add or drain oil as necessary if the oil level is not within the bead markings (FULL or ADD markings). See **Section 5.4 on page 40** for oil recommendations.

NOTICE

It is not necessary to add oil between oil changes unless the oil level has dropped more than 1/3 of the way between the high and low beads. A full quart (0.9 liter) can be added if the oil level is at the lower bead.

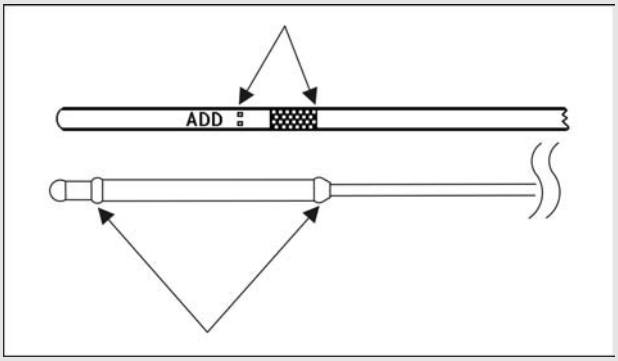


FIGURE 16. OIL LEVEL DIPSTICK ADD/FULL MARKINGS

5.2.4 Fuel System Leaks

⚠ WARNING

Fuel leaks can lead to fire. Repair leaks immediately. Do not run the generator set if it causes fuel to leak.

1. Check for leaks at hose, tube, and pipe fittings in the fuel supply and return systems while the generator set is running and while it is stopped.
2. Check flexible fuel hoses for cuts, cracks, abrasions, and loose hose clamps.
3. Make sure fuel lines do not rub against other parts.
4. Replace worn or damaged fuel line parts before leaks occur. Replace hose with a high pressure fuel injection system USCG TYPE A1 or ISO 7840-A1 fuel hose.
5. Prime the fuel system if the generator set ran out of fuel.

5.2.5 Coolant Level

The recovery tank is designed to maintain coolant level, not to fill the system. Keep the level of coolant in the recovery tank between **COLD** and **HOT**. See **Section 5.6.7 on page 49** for coolant specifications. Also see **Section 5.6.9 on page 50** for detailed instructions on refilling the cooling system.

1. Check coolant level in the recovery tank and, if necessary, refill the recovery tank to **COLD** when the engine is cold or to **HOT** when it is at normal running temperature. Use the recommended antifreeze mixture.
2. If the tank is empty, check for and repair any coolant leaks and refill the system through the fill neck on the engine. Use the recommended antifreeze mixture.

5.2.6 Raw Water System

1. Clean out the sea water strainer, if necessary.
2. Make sure the sea-cock is open for generator set operation.
3. When a water/exhaust separator is provided, open the sea-cock for the water drain hose.
4. Check for hoses that leak or are damaged. Have a qualified service person replace any leaking or damaged hoses.

5.2.7 Exhaust System

⚠ WARNING

Exhaust gas is deadly. Do not operate the generator set until all exhaust leaks have been repaired.

1. Check that all CO monitors are working properly.
2. Inspect the exhaust system for leaks and loose hose clamps on:
   - exhaust manifold
   - exhaust elbow
   - muffler
   - water separator
   - hull fittings
3. Replace any damaged sections of exhaust hose.

5.2.8 Mechanical System

1. Monitor generator set status using the digital display.
2. Visually check the generator set for mechanical damage.
3. For generator sets with sound shield, install service doors before running the generator set, then listen for unusual noises when the generator set is running.
4. Check the generator set mounting bolts.
5. Check to see that the generator set air inlet and outlet openings are not clogged with debris or blocked.
6. Keep the generator set compartment clean.

5.3 Maintaining the Battery

⚠ 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 a battery, wear safety glasses, and do not smoke. Turn work light on or off away from the battery. When performing maintenance procedures or when servicing a battery, stop the generator set and disconnect the charger before disconnecting battery cables. Using an insulated wrench, disconnect the negative (–) cable first and reconnect it last.

Refer to **Section 5.1 on page 33** for the battery maintenance schedule and follow the battery manufacturer's instructions. Have the battery charging system serviced if DC system voltage is consistently low or high.

Check the battery terminals for clean, tight connections. Loose or corroded connections have high electrical resistance which makes starting harder.

1. Keep the battery case and terminals clean and dry.
2. Keep the battery terminals tight.
3. Remove battery cables with a battery terminal puller.
4. Make sure which terminal is positive (+) and which is negative (–) before making battery connections, always removing the negative (–) cable first and reconnecting it last to reduce arcing.

5.4 Maintaining the Lubrication System

Keep dirt, water, and other contaminants from entering the lubrication system and corroding or clogging lubrication components.

5.4.1 Oil Recommendations

⚠ CAUTION

Using normally specified CH-4 or equivalent oils will not allow a new or rebuilt engine to break-in properly.

- Use API (American Petroleum Institute) Service Category CH-4 engine oil or better after the first 100 hours of engine break-in.
- Look for the SAE (Society of Automotive Engineers) viscosity grade. Choose the viscosity grade appropriate for the ambient temperatures expected until the next scheduled oil change. See figure below.
- Multi-grade oils such as SAE 15W-40 are recommended for year-round use.

5.4.1.1 Oil Viscosity vs. Ambient Temperature

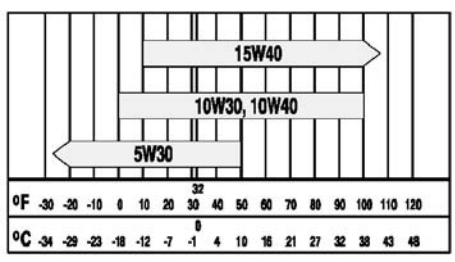


FIGURE 17. OIL VISCOSITY VS. AMBIENT TEMPERATURE

5.4.2 Changing Engine Oil and Filter

⚠ WARNING

Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, or before working on the generator set, use an insulated wrench to disconnect the negative (-) cable from the battery to prevent accidental starting.

⚠ WARNING

Engine components (drains, filters, hoses, etc.) can be hot and cause severe burns, lacerations of the skin, and liquid splash. Use personal protective equipment when working with or around hazardous materials. Examples of personal protective equipment include (but are not limited to) safety glasses, protective gloves, hard hats, steel toed boots, and protective clothing.

⚠ WARNING

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.

Refer to **Chapter 5 on page 33** for the engine oil change schedule.

1. Run the generator set under load until it is up to operating temperature, stop it, and disconnect the negative (–) battery cable at the battery.
2. For generator sets with sound shield, remove service door.
3. Remove oil fill plug and open the drain valve. The drain valve has a 3/8 NPT outlet for connecting a hose fitting to facilitate oil drainage.

⚠ WARNING

Crankcase pressure can blow hot engine oil out the fill opening causing, severe burns. Always stop the generator set before removing the oil fill cap.

NOTICE

If an oil pump-out system is installed, follow the instructions provided with the pump.

NOTICE

Dispose of oil in accordance with local requirements.

4. Drain used oil into a suitable container.
5. Close the oil drain valve.
6. Remove the old oil filter or filters using a suitable filter wrench (available from Cummins Onan) and appropriately discard the filter or filters.
7. Remove the old gasket if it does not come off with the filter. Wipe the sealing surface clean.
8. Apply a film of oil to the new filter gasket and partly fill the new filter with oil so that it reaches engine parts sooner at startup.
9. Spin the filter on by hand until the gasket just touches the mounting pad and tighten 3/4 of a turn.
10. Refill the engine with the proper type and amount of engine oil. See previous section for oil recommendations and **Chapter 7 on page 71** for oil capacity.

⚠ CAUTION

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

NOTICE

Do not fill the oil through the oil check port (where the dipstick is located) as oil will backup in the tube.

11. Check the oil level and add or drain oil as necessary.
12. Reinstall service doors on generator sets that have a sound shield.
13. Reconnect the negative battery cable.
14. Run the generator for a few minutes, shut it down, and recheck for proper oil level and leaks.
15. Dispose of the used oil and oil filter in accordance with local environmental regulations.

5.5 Maintaining the Fuel System

Keep dirt, water, and other contaminants from entering the fuel system and corroding or clogging fuel system components.

5.5.1 Fuel Recommendations

⚠ 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 multiclass fire extinguisher handy.

High quality Grade 2-D diesel fuel is necessary for good performance and long engine life. Use Grade 1-D diesel fuel where ambient temperatures are below 5 °C (40 °F). Where fuel is exposed to cold ambient temperature, use fuel that has a cloud point (temperature at which wax crystals begin to form) at least 6 Celsius (10 Fahrenheit) degrees below the lowest expected fuel temperature.

- Diesel fuels specified by EN 590 or ASTM D975 are recommended.
- The Cetane number should not be less than 45 and sulfur content not more than 0.5% by weight.
- The specifications for the type and sulfur content (ppm, % weight) of the diesel fuel used must comply with all emissions regulations applicable where the generator set is to be operated.
- Diesel fuel must meet the ASTM D975 standard for lubricity and pass a minimum load level of 3100 grams as measured by ASTM D6078, or maximum scar diameter of 0.45 mm as measured by ASTM D6079 or ISO 12156-1.
- B5 bio-diesel fuel that meets industry specifications and quality is suitable for use with this generator set.

5.5.2 Draining the Fuel Filter

The generator set may have a water-separator fuel filter. Check for other up-stream filters which may also need to be drained or replaced. Drain water and sediment more often than scheduled if fuel quality is poor, condensation cannot be avoided, or when a warning is being displayed for **WATER IN FUEL**.

Have towels and containers ready to clean, collect, and properly dispose of spilled or dripping fuel.

1. Using an insulated wrench, disconnect the negative (–) cable at the battery to prevent the engine from starting.
2. Open the front access door.
3. Remove drain plug on bottom of filter to drain water and sediment into a suitable container, about 120 ml (1/2 cup).
4. Re-install drain plug.
5. Replace the front access door.
6. Connect negative (–) batty cable.
7. Dispose of the drain-off in accordance with local environmental regulations.

5.5.3 Replacing Fuel Filter

⚠ WARNING

Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, or before working on the generator set, use an insulated wrench to disconnect the negative (-) cable from the battery to prevent accidental starting.

⚠ WARNING

Engine components (drains, filters, hoses, etc.) can be hot and cause severe burns, lacerations of the skin, and liquid splash. Use personal protective equipment when working with or around hazardous materials. Examples of personal protective equipment include (but are not limited to) safety glasses, protective gloves, hard hats, steel toed boots, and protective clothing.

⚠ 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 multiclass fire extinguisher handy.

See **Section 5.1 on page 33** for scheduled fuel filter replacement. Replace the fuel filters if the engine lacks power. The generator set may have a primary and a secondary fuel filter. The primary filter has a water separator and sensor. Check for up-stream filters which may also need to be replaced.

1. Using an insulated wrench, disconnect the negative (–) cable at the battery to prevent the engine from starting.
2. Open the front access door (if applicable).
3. Close any fuel supply and return valves.
4. Spin off the old filter with a filter wrench.
5. Dispose of old filter in accordance with local environmental regulations.
6. Clean the contact surface on the filter base, lubricate the new filter gasket, and hand tighten the new filter.
7. Open any fuel supply and return valves.
8. Close the front access door, if applicable.
9. Prime the engine for at least 30 seconds to fill the new filter. Check for leaks as the generator set runs for several minutes.
10. Retighten the filter by hand, if necessary.
11. Connect the negative (–) cable at the battery.

5.5.4 Priming the Fuel System

⚠ 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 multiclass fire extinguisher handy.

⚠ WARNING

Engine components (drains, filters, hoses, etc.) can be hot and cause severe burns, lacerations of the skin, and liquid splash. Use personal protective equipment when working with or around hazardous materials. Examples of personal protective equipment include (but are not limited to) safety glasses, protective gloves, hard hats, steel toed boots, and protective clothing.

The fuel system should be primed after fuel filters are replaced or after the generator set runs out of fuel.

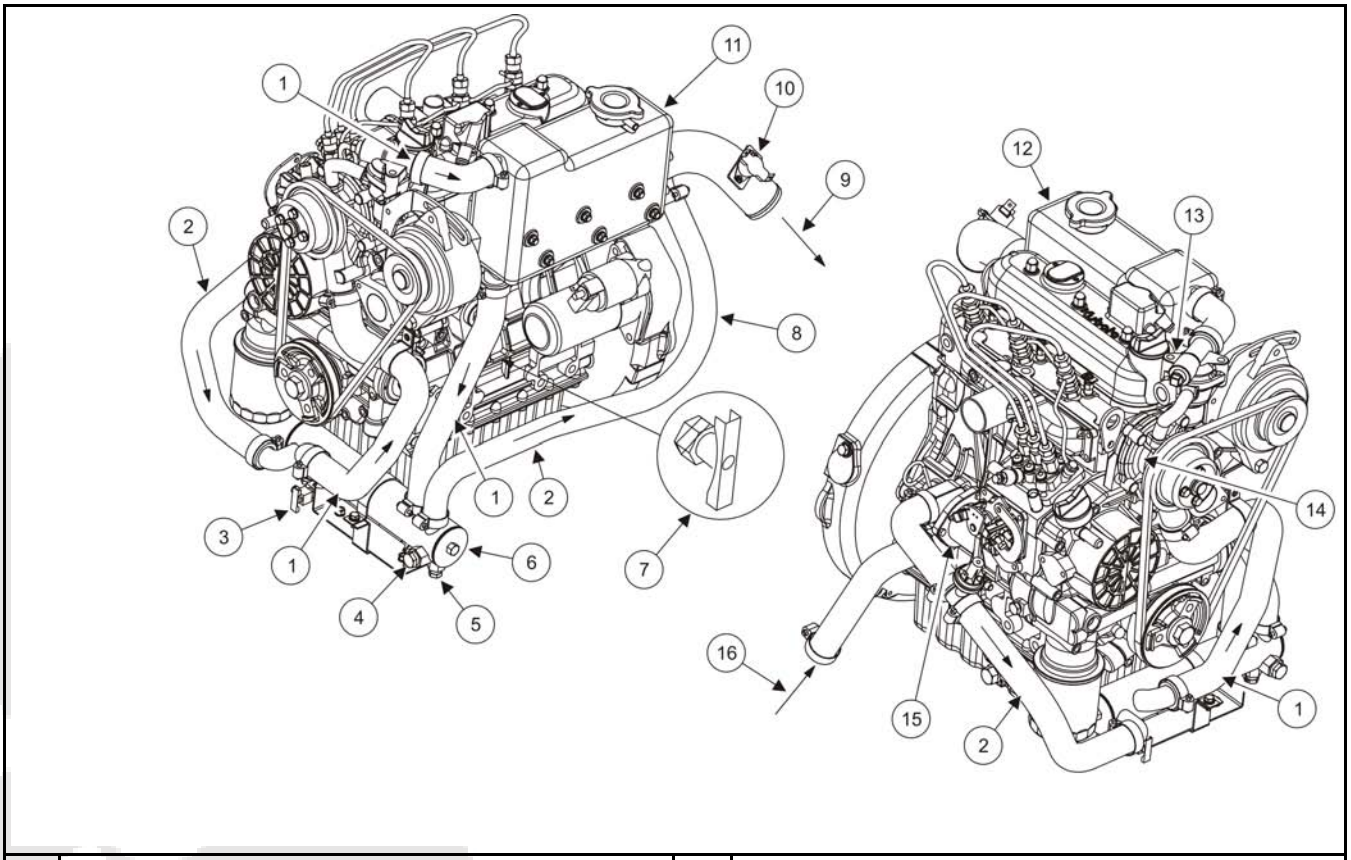
Push and hold **STOP (prime)** on the control switch or push and hold **STOP (prime)** on the digital display for at least 30 seconds. The **Generator** status lamp will blink while priming and the status on the digital display will change from **Stopped** to **Priming**.

5.6 Maintaining the Cooling System

The engine is cooled by a pressurized, closed-loop liquid system. Coolant is pumped through passages in the engine block, head, and exhaust manifold. The exhaust manifold also serves as the engine coolant reservoir.

Raw water (flotation water) is pumped through tubes in the heat exchanger to cool the engine coolant. The raw water then passes through a hose into the exhaust-water mixer where it cools the exhaust gases and is expelled.

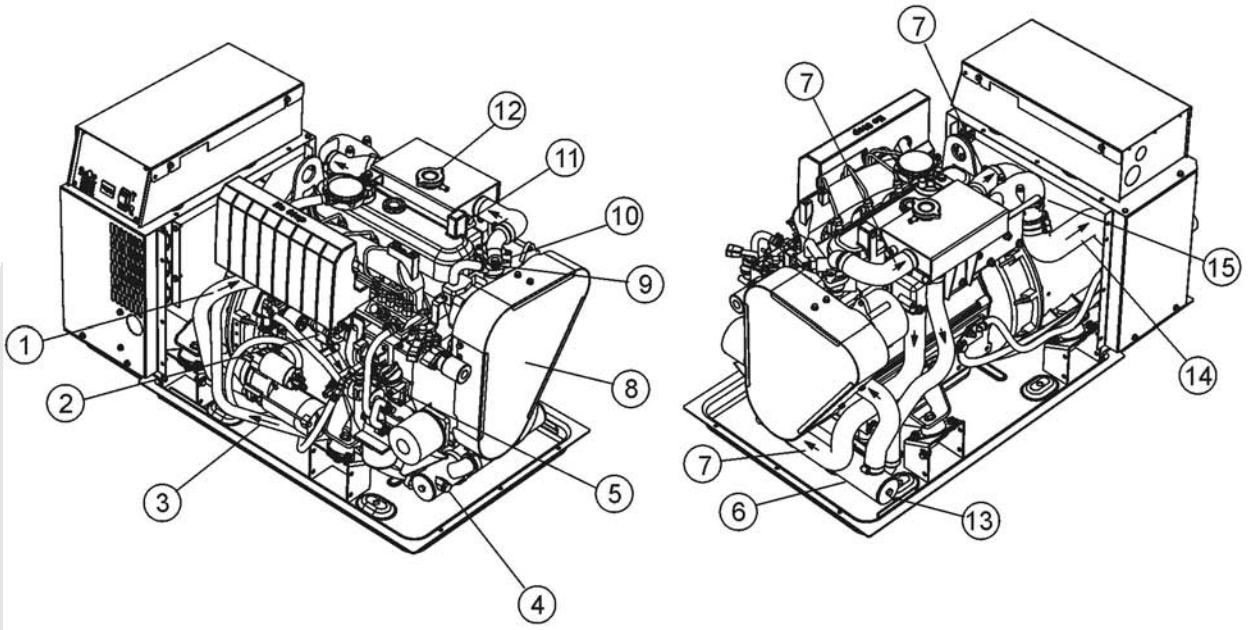
5.6.1 Cooling System



No.	Description	No.	Description
1	Coolant Flow	9	Exhaust and Raw Water out to Bulkhead Fitting on Right or Left Side
2	Raw Water Flow	10	Exhaust-Water Mixer with High Temperature Exhaust Switch
3	Coolant Drain Valve	11	Exhaust Manifold and Coolant Reservoir with Pressure Cap and Coolant Fill Neck. Fill neck has hose barb for connecting coolant recovery tank.
4	Zinc Anode	12	Optional Low Coolant Level Sensor Location
5	Raw Water Drain Plug (both ends)	13	Coolant Thermostat
6	Heat Exchanger and Cleanout Covers (both ends)	14	Coolant Pump
7	Block Drain Valve	15	Raw Water Pump
8	Raw Water Hose to Exhaust-Water Mixer - when required, replace with Siphon Break and Connecting Hoses	16	Raw Water in from Bulkhead Fitting on Right or Left Side

FIGURE 18. MDKBK, MDKBL, MDBKM, AND MDKBN

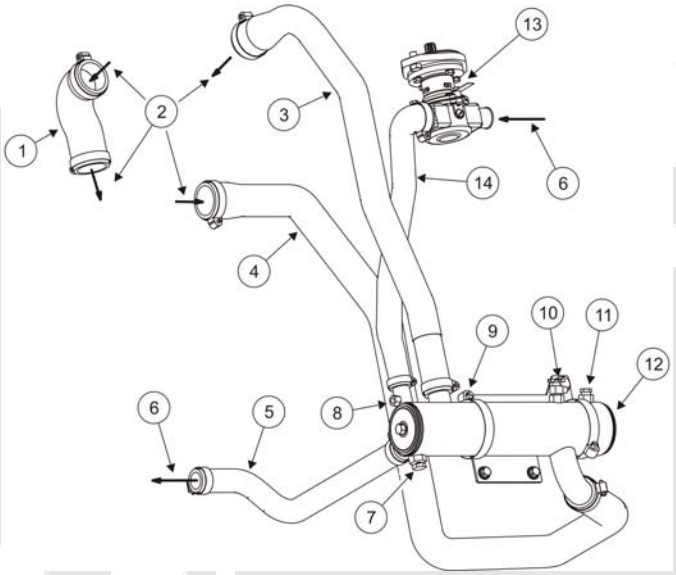
5.6.2 Cooling System



No.	Description	No.	Description
1	Raw Water to Pump from Bulkhead Fitting on Right or Left Side	9	Coolant Temperature Sensor
2	Raw Water Pump	10	Coolant Thermostat Housing
3	Raw Water Hose to Exhaust-Water Mixer - When required, replace with siphon break and connecting hoses	11	Location, Optional Low Coolant Sensor
4	Heat Exchanger with Zinc Anode and Clean Out Covers (both ends)	12	Coolant Reservoir with Pressure Cap and Coolant Fill Neck - Fill Neck has Hose Barb for Connecting Coolant Recovery Tank
5	Location, Block Drain Valve (Coolant)	13	Raw Water Cleanout Cover (Both Ends - Make Sure to Reconnect Ground Strap on This End with Cover Screw)
6	Coolant Drain Valve Raw Water Plugs (Underneath)	14	Exhaust and Raw Water Out to Bulkhead Fitting on Right or Left Side
7	Coolant Flow	15	Exhaust-Water Mixer with High Temperature Exhaust Switch
8	Coolant Pump Pulley		

FIGURE 19. MDKBP, MDKBR, AND MDBKV

5.6.3 Cooling System



No.	Description	No.	Description
1	Hose, Thermostat to Coolant Reservoir	8	Raw Water Flow Switch
2	Coolant Flow	9	Heat Exchanger Mounting Straps (2) Torque to 11 Nm (8 ft-lb)
3	Hose, Heat Exchanger to Coolant Pump	10	Coolant Drain Valve
4	Hose, Coolant Reservoir to Heat Exchanger	11	Raw Water Drain Plug
5	Hose, Raw Water to Exhaust-Water Mixer - Replace hose with siphon break and connecting hoses when required - For dry exhaust replace with hose to hull fitting.	12	Heat Exchanger with Cleanout Covers (both ends)
6	Raw Water Flow	13	Raw Water Pump
7	Zinc Anode	14	Hose, Raw Water Pump to Heat Exchanger

FIGURE 20. MDKBT AND MDKBU

5.6.4 Pressure Cap

⚠ WARNING

Hot coolant is under pressure and can spray, causing severe burns when loosening the pressure cap or opening the coolant drain. Let the engine cool before loosening the pressure cap. Wear safety glasses.

Replace the pressure cap every two years (seals deteriorate and leak). Proper cooling system pressure (7 psi) is essential for optimal engine cooling and minimal coolant loss.

5.6.5 Coolant Hoses

Check for and replace hoses that leak or are damaged.

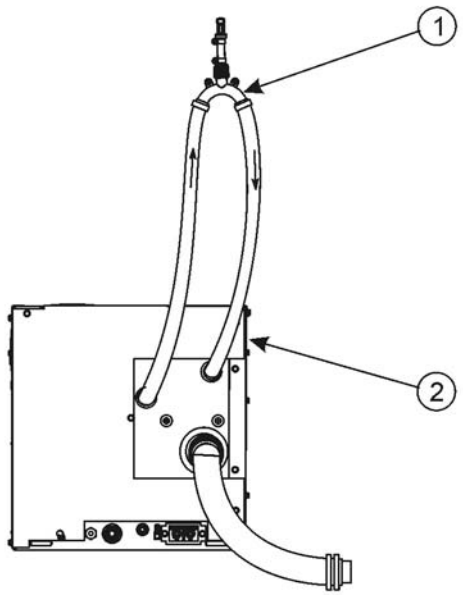
Make sure the two hoses from the recovery tank are routed through the two holes in the right side of the generator set enclosure (if applicable), that the coolant recovery hose is connected to the fill neck on the engine, and that the overflow hose terminates in the drip pan where it will not splash coolant on electrical components.

5.6.6 Siphon Break

⚠ WARNING

Bypassing a siphon break or failing to maintain it can lead to engine flooding and damage to the engine that is not covered under warranty.

A siphon break is installed when the exhaust-water mixer is less than 6 inches above the water line. Replace the siphon break if it is encrusted with deposits, which indicates leakage. If it is of the bleed-vent type, check that the vent hose 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.



No.	Description	No.	Description
1	Siphon Break Valve	2	Generator Set

FIGURE 21. SIPHON BREAK

5.6.7 Coolant Recommendations

Use a high quality, fully formulated, ethylene glycol coolant with rust inhibitors and coolant stabilizers that meets ASTM D6210 Standard Specification for Fully-Formulated Glycol Base Engine Coolant for Heavy-Duty Engines. This will provide corrosion protection, foam control, liner-pitting protection, and scale/deposit control.

Unless prohibited by shipping regulations, the generator set is shipped with the recommended 50/50 mixture of water and ethylene glycol which provides protection to -37 °C (-34 °F). In warmer climates and sea water environments, a 60/40 mixture of water/ethylene glycol is recommended.

Use fresh water that is low in minerals and corrosive chemicals for the coolant mixture. Distilled water is best.

See **Chapter 7 on page 71** regarding coolant capacity.

⚠ WARNING

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

5.6.8 Replenishing Normal Coolant Loss

Check coolant level in the recovery tank before the first startup of each day and, if necessary, refill to COLD when the engine is cold or to HOT when it is running. 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.

Make sure the two hoses from the recovery tank are routed through the two holes in the right end of the generator set enclosure, that the coolant recovery hose is connected to the fill neck on the engine, and that the overflow hose terminates in the drip pan where it will not splash coolant on electrical components.

5.6.9 Refilling Cooling System

⚠ 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.

See **Section 5.6.7 on page 49** for coolant specifications. See **Chapter 7 on page 71** for coolant capacity.

1. Close the block and heat exchanger drain valves (or check to be sure they are closed), reconnect the pump inlet hose (or check to be sure it is connected), 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.
2. Start and run the engine for a couple of minutes to dislodge air pockets then shut it down.
3. Check the coolant level, add as much coolant as necessary, and secure the pressure cap.
4. Refill the recovery tank up to the COLD mark.
5. On sets with an enclosure, secure the top and front access doors. and use an insulated wrench to reconnect the battery cables, negative [-] last, when done.

⚠ CAUTION

Low coolant level can cause severe engine damage. Be sure the system is full.

5.6.10 Draining and Cleaning Cooling System

⚠ WARNING

Hot coolant is under pressure and can spray, causing severe burns when loosening the pressure cap or opening the coolant drain. Let the engine cool before loosening the pressure cap. Wear safety glasses.

⚠ WARNING

Engine components (drains, filters, hoses, etc.) can be hot and cause severe burns, lacerations of the skin, and liquid splash. Use personal protective equipment when working with or around hazardous materials. Examples of personal protective equipment include (but are not limited to) safety glasses, protective gloves, hard hats, steel toed boots, and protective clothing.

1. Have towels and containers ready to clean, collect and properly dispose of the coolant.
2. Use an insulated wrench to disconnect the negative (-) cable at the battery to prevent the engine from starting, let the engine cool, remove the front access door, top of the enclosure and coolant pressure cap.
3. Remove the pressure cap.
4. Open the drain valves. Drain the coolant into suitable containers for disposal in accordance with the local regulations for hazardous substances.
5. Drain or flush a keel cooler in accordance with the manufacturer's instructions.
6. 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.

5.6.11 Heat Exchanger

⚠ WARNING

Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, or before working on the generator set, use an insulated wrench to disconnect the negative (-) cable from the battery to prevent accidental starting.

⚠ WARNING

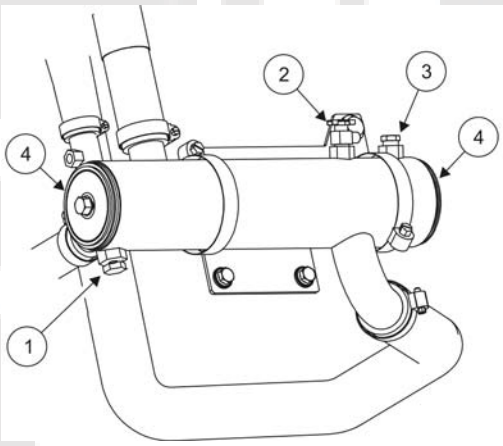
Engine components (drains, filters, hoses, etc.) can be hot and cause severe burns, lacerations of the skin, and liquid splash. Use personal protective equipment when working with or around hazardous materials. Examples of personal protective equipment include (but are not limited to) safety glasses, protective gloves, hard hats, steel toed boots, and protective clothing.

⚠ WARNING

Ethylene glycol is considered toxic. Do not use it to protect the raw water passages in the heat exchanger from freezing. It will be expelled into the environment when the generator set is started.

See **Section 5.1 on page 33** for scheduled maintenance. Clean the raw water tubes if the engine keeps shutting down (Code No. 1) or the engine gauge or digital display indicates abnormally high engine temperatures. Drain the heat exchanger if there is a danger of freezing when the generator set is not running or is in storage. Freezing water can damage the raw water tubes in the heat exchanger. Engine coolant is protected from freezing, water is not.

5.6.11.1 Heat Exchanger



No.	Description	No.	Description
1	Zinc Anode	3	Raw Water Drain Plug
2	Coolant Drain Valve	4	Clean Out Cover (both ends)

FIGURE 22. HEAT EXCHANGER

5.6.11.2 Removing and Installing the Heat Exchanger

Removal

1. Disconnect the four hoses. (To work the coolant hose elbow off the fitting on the heat exchanger, it will be necessary to loosen the hose clamps on both ends.)
2. Remove the screw and mounting straps.
3. Remove the heat exchanger.

Installation

1. Reconnect hoses.
2. Place heat exchanger in mounting bracket.
3. Install mounting strap and secure with screw.

5.6.11.3 Draining and Cleaning the Heat Exchanger

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 front access door, belt guard, top of the enclosure, and end panel, if so equipped.
3. Have towels and containers ready to prevent spilling raw water on the electrical components below the heat exchanger.
4. Remove the water pump. This will make it easier to clean the tubes.
5. Remove the drain plug or clean-out cover.
6. Clean and flush the tubes. The drain plug must be removed to get all the water out of the tubes. Do not use metal rods to clean the tubes. The tubes are made of relatively soft copper alloy and can be easily damaged.

NOTICE
Have the heat exchanger cleaned at a radiator shop if there is hard scale in the tubes.

7. Use thread sealant on the drain plug and a new clean-out cover gasket if the old one is torn or otherwise damaged.
8. Reassemble all the parts that were disassembled for access.

5.6.12 Zinc Anode

Replace the zinc anode as recommended in Chapter 5 on page 33. 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. See Section 5.6.11 on page 51 for location of zinc anode.

5.6.13 Replacing the Thermostat

⚠ WARNING
Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, or before working on the generator set, use an insulated wrench to disconnect the negative (-) cable from the battery to prevent accidental starting.

⚠ WARNING
Hot coolant is under pressure and can spray, causing severe burns when loosening the pressure cap or opening the coolant drain. Let the engine cool before loosening the pressure cap. Wear safety glasses.

See the Section 5.1 on page 33 section for scheduled replacement.

1. Use an insulated wrench to disconnect the negative battery cable at the battery to prevent the engine from starting. Let the engine cool and remove the front access door.
2. Remove the pressure cap.
3. Drain the cooling system following procedure in previous section - Draining and Cleaning the Cooling System.
4. Remove the two thermostat housing bolts and pull off the housing, thermostat, and gasket. The hose does not need to come off.

5. 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.
6. Replenish any lost coolant (refer to the previous section - Refilling the Cooling System), secure the pressure cap, secure the top of the enclosure and access door, and reconnect the negative battery cable.

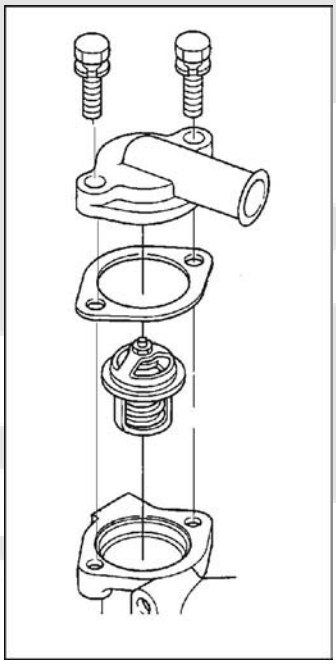


FIGURE 23. TYPICAL THERMOSTAT AND HOUSING

5.6.14 Replacing Raw Water Pump Impeller

⚠ WARNING

Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, or before working on the generator set, use an insulated wrench to disconnect the negative (-) cable from the battery to prevent accidental starting.

⚠ WARNING

Engine components (drains, filters, hoses, etc.) can be hot and cause severe burns, lacerations of the skin, and liquid splash. Use personal protective equipment when working with or around hazardous materials. Examples of personal protective equipment include (but are not limited to) safety glasses, protective gloves, hard hats, steel toed boots, and protective clothing.

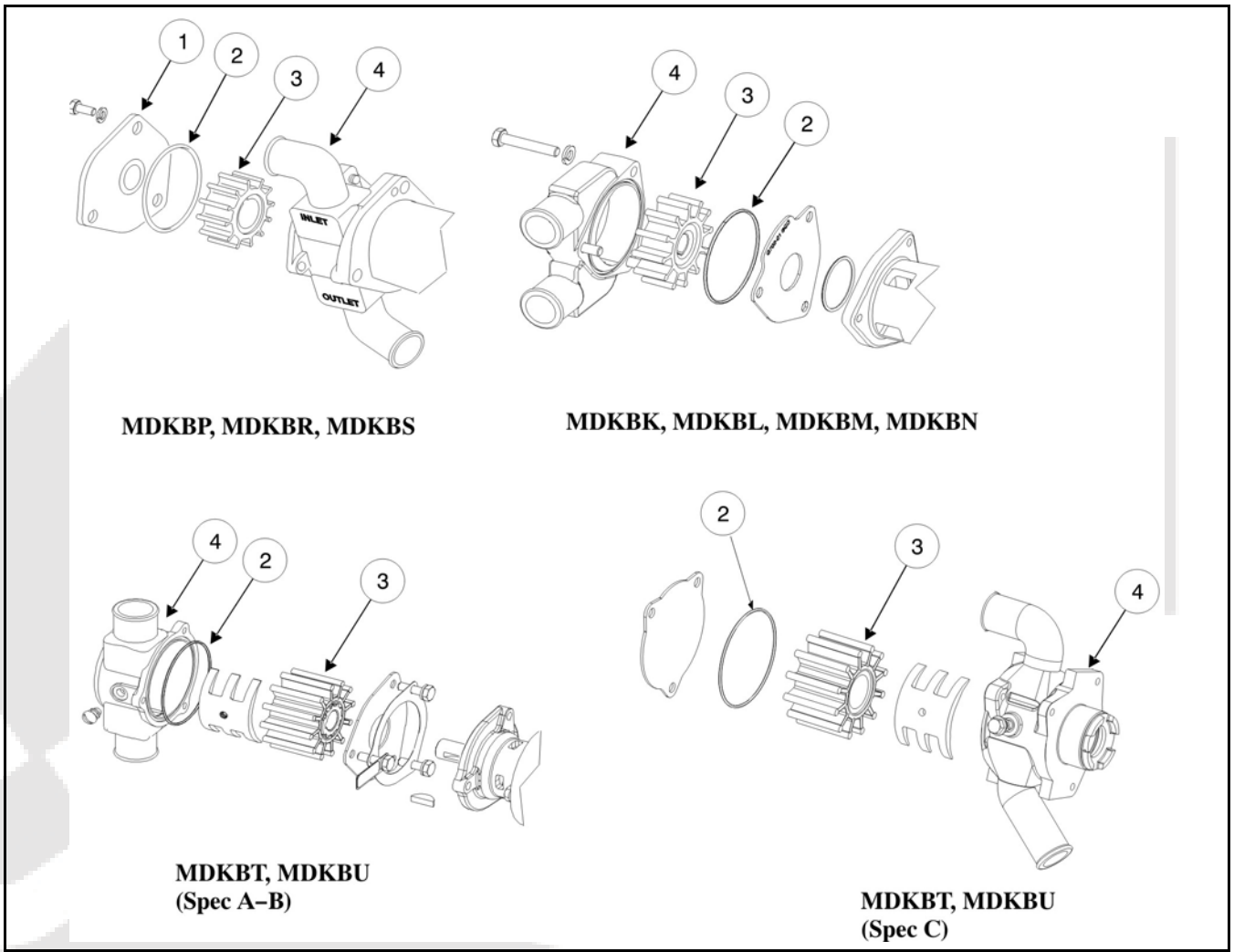
See **Section 5.1 on page 33** for scheduled replacement. Avoid spilling raw water on the electrical components below the pump. Have towels and containers ready in case of water spillage.

1. Close the sea-cock.
2. Disconnect the negative (-) cable at the battery to prevent the engine from starting.
3. Loosen the three screws on the end of the pump body to remove the pump body or impeller cover, depending on construction (see below).

4. Remove the impeller and O-ring. An impeller removal tool may be necessary to pull the impeller off the shaft.
5. Inspect impeller for broken vanes. Check for and clean out pieces that may have lodged in the heat exchanger.
6. Install the new impeller - for easier installation, twist the impeller the way it normally turns on its own while squeezing it into the housing.
7. 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.

8. Secure the cover or pump body and O-ring.
9. If the sea water strainer is above the water line, fill it for faster priming at startup.
10. Open the sea-cock, reconnect the negative battery cable and start the generator set. The generator set will shut down within a few seconds if there is no raw water flow, and the amber status lamp will blink shutdown Code No. 7. If it shuts down, remove any blockage and restart the generator set.



No.	Description	No.	Description
1	Cover	3	Impeller
2	O-Ring	4	Raw Water Pump

FIGURE 24. REPLACING THE RAW WATER PUMP IMPELLER

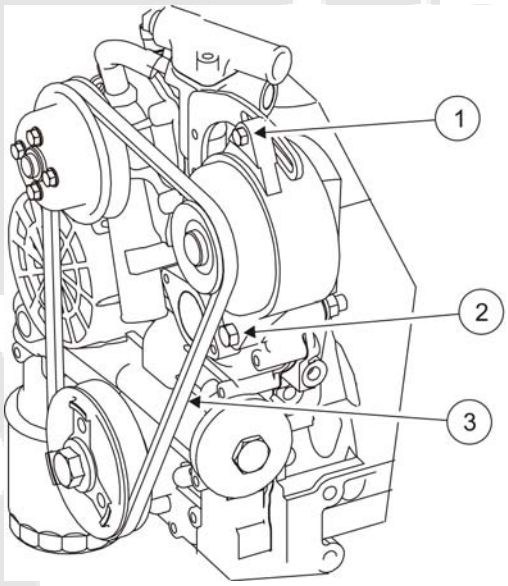
5.6.15 Adjusting V-Belt Tension

⚠ WARNING

Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, or before working on the generator set, use an insulated wrench to disconnect the negative (-) cable from the battery to prevent accidental starting.

1. Use an insulated wrench to disconnect the negative (–) cable at the battery to prevent the engine from starting.
2. Remove the belt guard or enclosure top panel and access doors.
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 then check tension by applying 10 kg (20 pounds) to the middle of the pulley span. Belt tension is correct when deflection is 10 mm (3/8 inch).
5. Tighten the alternator bolts when tension is correct.
6. Tighten the bolts, secure the belt guard or enclosure and reconnect the negative battery cable.



No.	Description	No.	Description
1	Tension Adjusting Bolt	3	V-Belt
2	Alternator Pivot Bolt		

FIGURE 25. ADJUSTING V-BELT TENSION

5.6.16 Replacing V-Belt When PTO Equipped

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

5.7 Storing the Generator Set

When the generator set cannot be exercised regularly and (or) will be idle for more than 120 days, proper storage is essential in preserving top performance and reliability.

1. Turn off the generator set line circuit breaker or AC distribution panel.
2. Change the engine oil and filter and attach a tag indicating oil viscosity.
3. Crank the engine several revolutions by pressing the start switch momentarily but do not let it start. This will fill the oil passages with the new oil.

4. Use an insulated wrench to disconnect the battery cables, negative [-] cable first, from the starting battery and store the battery according to the battery manufacturer's recommendations. Check coolant level and add as necessary. Test the coolant mixture if freezing temperatures are possible and change if necessary.
5. Drain the heat exchanger and muffler if freezing temperatures are expected.
6. Disengage the PTO clutch, if so equipped.
7. Loosen or remove the serpentine belt, if so equipped. See the Service Manual.
8. Clean and lightly oil parts that can rust.

5.8 Cold Temperature Storage

Freezing water can damage the heat exchanger and exhaust cooler. Drain these of any water before freezing temperatures begin. See **Section 5.7 on page 57**.

5.9 Returning the Generator Set to Service

1. Check the oil tag on the generator set and change the oil if the viscosity indicated is not appropriate for the temperatures expected.
2. Use an insulated wrench to reconnect the starting battery, negative [-] cable last.
3. Replace the raw water pump impeller if it is over one year old.
4. Service the air filter element if it is dirty.
5. Reinstall the serpentine belt if so equipped (see Service Manual).
6. Engage the PTO clutch, if so equipped.
7. Perform required maintenance.
8. After connecting the battery complete the pre-start checks and prime the fuel system.
9. Start and run the generator set.
10. Turn on the generator set line circuit breaker or distribution panel when ready to power loads.

6 Troubleshooting

6.1 Overview

To troubleshoot the generator set, use the blinking control switch status lamp or the digital display fault code in conjunction with the following list of fault codes (listed in order by fault code number). Perform the step-by-step corrective actions suggested in this section. If you are still unable to resolve the problem, contact an authorized Cummins Onan service representative. See **Section 2.4 on page 15**.

NOTICE

Many generator set shutdowns can be avoided by performing periodic maintenance on schedule and by not running the generator set out of fuel. Note that when generator sets and propulsion engines draw from the same fuel tanks, the fuel pickup tubes are usually arranged so that the generator sets run out of fuel first. By marking the generator set empty points on the fuel gauges, it will be easier to tell when to stop the generator sets before running them out of fuel.

⚠ WARNING

Some generator set 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 generator set service. See the Safety Precautions chapter for more information on hazards.

⚠ WARNING

Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, or before working on the generator set, use an insulated wrench to disconnect the negative (-) cable from the battery to prevent accidental starting.

6.2 Troubleshooting with Digital Display

If a fault shutdown occurs the ALARM status lamp on the Digital Display will blink and the LCD screen will display the Fault Number, a description of the fault and the hour the fault occurred in total generator set running time.

The fault will be displayed until it is cleared. Touch any button to clear the fault. The display will turn off in 5 minutes after the fault has been cleared.

To display any of the last five faults, see **Section 4.2.3 on page 24**.

6.3 Troubleshooting with Status Lamp

If a fault shutdown occurs, the amber status lamp on the control switch will repeatedly flash various sets of blinks.

- A set of one blink indicates shutdown due to high engine temperature.
- A set of two blinks indicates shutdown due to low oil pressure.

- A set of three blinks indicates a service fault.
  1. Press **Stop** once to cause the two-digit shutdown code to blink.

     The two-digit code consists of two sets of blinks. The first set is 1 to 7 blinks, which represents the tens digit of the code number. There is a brief pause, then the second set of 1 to 9 blinks, which represents the units digit of the code number. This is followed by a longer pause and then repeats the process.

     For example, Low Voltage Code No. 13 appears as: blink—*pause*—blink-blink-blink—*long pause*—repeat
  2. Pressing **Stop** again will stop the blinking.
- A set of four blinks indicates shutdown due to a failure to start within the time allowed for cranking.
- A set of five blinks indicates shutdown due to high levels of Carbon Monoxide (CO) in the vessel.
- A set of seven blinks indicates shutdown due to a loss of raw water flow for engine and exhaust cooling.

Blinking continues for five minutes and stops. To restore blinking press the control switch to **STOP (Prime)** until the lamp comes on (3 to 4 seconds). Then press **STOP (Prime)** three times to restore blinking.

NOTICE
The last fault logged will blink even though the condition that caused the shutdown may have been corrected.

6.4 Troubleshooting Generator Set Faults

⚠ **WARNING**
Some generator set 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 generator set service. See the Safety Precautions chapter for more information on hazards.

⚠ **WARNING**
Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, or before working on the generator set, use an insulated wrench to disconnect the negative (-) cable from the battery to prevent accidental starting.

6.4.1 No Code - No Response at Digital Display or Control Switch

Logic:

Faulty switch, poor or missing connections, dead battery

Diagnosis and Repair:

Refer to Appendix drawings as appropriate.

1. Push the Emergency Stop to remove emergency stop mode. Push the DC Circuit Breaker **ON** if tripped.
2. Try the local digital display or control switch on the generator set if there is no response at a remote control switch, and vice versa.
3. If no control switches work, service battery connections as necessary by cleaning and tightening, recharging or replacing the battery, or replacing damaged battery cables (**Section 5.3 on page 40**).

6.4.2 No Code - Starter Engages and Disengages

Logic:

Low cranking voltage

Diagnosis and Repair:

1. De-energize the PTO clutch, if so equipped.
2. Service battery connections as necessary by cleaning and tightening, recharging or replacing the battery, or replacing damaged battery cables (**Section 5.3 on page 40**).

6.4.3 No Code - Starting Batteries do not Maintain a Charge

Logic:

Marginal battery, battery connections or charging system

Diagnosis and Repair:

Refer to Appendix drawings as appropriate.

1. Service battery connections as necessary by cleaning and tightening, recharging or replacing the battery, or replacing damaged battery cables (**Section 5.3 on page 40**).
2. Check for and disconnect parasitic battery loads.

6.4.4 No Code - No AC Power When Generator Set is Running

Logic:

A Circuit Breaker is off, tripped or malfunctioning, or the generator is not connected properly.

Diagnosis and Repair:

Refer to Appendix drawings as appropriate.

1. Reset, turn on or repair the generator set circuit breaker if off or tripped.
2. Reset, turn on or repair any other circuit breaker in the AC power supply system if off or tripped.
3. If the generator set has a manual voltage regulator, push the manual voltage selector switch to auto.

6.4.5 Code No. 1 - High Engine Temperature

Logic: Engine coolant temperature exceeds design limit.

Diagnosis and Repair:

1. Check for and clean a blocked sea water strainer. If strainer is above the water line, fill the strainer with water to assist priming.
2. Check engine coolant level and add coolant as necessary.
3. Check for disconnected, kinked, or leaking hoses and reconnect, reroute, or replace.
4. Inspect the siphon break for proper operation (**Section 5.6.6 on page 49**).
5. Check for a worn raw water impeller and replace as necessary.
6. Clean the heat exchanger.
7. Check the bottom of the hull for any blockage at the through-hull fitting.
8. Drain and clean the coolant system to remove coolant passage fouling.
9. Replace the coolant thermostat, which may not be opening fully.

6.4.6 Code No. 2 - Low Oil Pressure

Possible Cause:

Low oil pressure

Corrective Action:

Check the engine oil level and add or drain oil as necessary (**Section 5.4.2 on page 41**). Repair any oil leaks.

6.4.7 Code No. 3 - Service Check

Logic:

A fault with a 2-digit fault code number occurred.

Diagnosis and Repair:

Press the STOP switch once. The status lamp will blink the two-digit shutdown code which will be one of the codes in this section. (Does not apply to Digital Display.)

6.4.8 Code No. 4 - Overcrank

Possible Cause:

Cranking time exceeded 20 to 60 seconds, depending on engine temperature.

Diagnosis and Repair:

1. Disconnect the PTO clutch, if so equipped.
2. Check fuel level and refill as necessary.

NOTICE
The generator set fuel pickups are probably higher than the propulsion engine fuel pickups.

3. Open any closed fuel supply and return valves.

4. Prime the engine fuel system for at least 30 seconds see Priming the Fuel System in the Maintenance Chapter.
5. Service as necessary by cleaning and tightening battery connections, recharging or replacing the battery, or replacing damaged battery cables (**Section 5.3 on page 40**).
6. Remove combustion air or exhaust system blockages.
7. Check all fuel fittings for fuel and air leaks, tighten as necessary and reprime.
8. Replace fuel filters and reprime, see Draining the Fuel Filter in the Maintenance Chapter.
9. If so equipped, check the engine air filter and remove any blockage.
10. Check for contaminated fuel by connecting to a source of known fuel quality.
11. Change engine oil to oil of the proper viscosity for the ambient temperature (**Section 5.4 on page 40**). High oil viscosity can slow down cranking speed.

6.4.9 Code No. 5 - Warning Shutdown due to CO

Logic:

Dangerous levels of Carbon Monoxide in Vessel.

Diagnosis and Repair:

Get everyone out into fresh air immediately and seek medical attention.

6.4.10 Code No. 7 - Loss of Raw Water Flow

Logic:

Low raw water pressure in heat exchanger

Diagnosis and Repair:

1. Open the sea cock.
2. Check for and clean a blocked sea water strainer. If above the water line, fill the strainer with water to assist priming.
3. Check for disconnected, kinked, or leaking hoses and reconnect, reroute, or replace.
4. Check for a worn raw water impeller and replace as necessary.
5. Check the bottom of the hull for any blockage at the through-hull fitting.

6.4.11 Code No. 12 - High AC Voltage

Logic:

After voltage regulation was enabled output voltage jumped to more than 125% of rated for 75 milliseconds or to more than 115% of rated for 3 seconds

Diagnosis and Repair:

1. Does not apply when generator set has PMG excitation.
2. Check for a tripped generator set circuit breaker, reset if necessary, and run with fewer loads. (A breaker tripping under load can cause generator set voltage to overshoot.)
3. Check all fuel fittings and filters for fuel and air leaks and tighten as necessary. (Air bubbles can disrupt generator set frequency and voltage.)

4. Prime the engine fuel system for at least 30 seconds, see Priming the Fuel System in the Maintenance Chapter.
5. Push the generator set line circuit breaker **OFF**, start the generator set. If output voltage is normal, the problem is in the circuits external to the generator set. If there is no voltage, see an authorized Cummins Onan service representative.

6.4.12 Code No. 13 - Low AC Voltage

Logic:

After voltage regulation was enabled output voltage fell to less than 90% of rated for 5 seconds.

Diagnosis and Repair:

1. Does not apply when generator set has PMG excitation.
2. Push the generator set line circuit breaker to off and disconnect the PTO, if so equipped. If the generator set now runs and voltage and frequency are normal, reduce the number of electrical and mechanical (PTO) loads. If there is no voltage, contact your Cummins Onan service representative.
3. Check the fuel level and fill as necessary.

NOTICE
The generator set fuel pickups are probably higher than the propulsion engine fuel pickups

4. Remove combustion air or exhaust system blockages.
5. Prime the engine fuel system for at least 30 seconds.
6. Check all fuel fittings and filters for fuel and air leaks and tighten as necessary. (Air bubbles can disrupt generator set frequency and voltage).
7. Replace fuel filters and reprime.

6.4.13 Code No. 14 - High AC Frequency

Logic:

After the starter was engaged frequency jumped to more than 70 Hz for 40 milliseconds or to more than 2% over nominal for 6 seconds.

Diagnosis and Repair:

1. Check for a tripped generator set circuit breaker, reset if necessary, and run with fewer loads.

NOTICE
A breaker tripping under load can cause generator set frequency to overshoot.

2. Check all fuel fittings and filters for fuel and air leaks and tighten as necessary.

NOTICE
Air bubbles can disrupt frequency

6.4.14 Code No. 15 - Low AC Frequency

Logic:

During normal operation Frequency fell to less than 90% of nominal for more than 8 seconds

Diagnosis and Repair:

1. Push the generator set line circuit breaker off and disconnect the PTO clutch, if so equipped. If the generator set now runs, reduce the number of electrical and mechanical (PTO) loads, especially those with high motor starting loads, such as air conditioners.
2. Check the fuel level and fill as necessary.

NOTICE
The generator set fuel pickups are probably higher than the propulsion engine fuel pickups causing the generator to run out of fuel before the propulsion engines.

3. Remove combustion air or exhaust system blockages.
4. Prime the engine fuel system for at least 30 seconds, see Priming the Fuel System in the Maintenance Chapter.
5. Check all fuel fittings for fuel and air leaks and tighten as necessary.

NOTICE
Air bubbles can disrupt frequency and voltage.

6. Replace fuel filters and reprime, see Replacing the Fuel Filter in the Maintenance Chapter.
7. Check for contaminated fuel by connecting to a source of known fuel quality.
8. If so equipped, check the engine air filter and remove any blockage.

6.4.15 Code No. 22 - Governor Overload

Logic:

Maximum allowable time at full-duty cycle was exceeded

Diagnosis and Repair:

1. Reduce the number of appliances running, especially those with high motor starting loads such as air conditioners.
2. Check fuel level and refill as necessary.

NOTICE
The generator set fuel pickups are probably higher than the propulsion engine fuel pickups, causing the generator to run out of fuel before the propulsion engine.

3. Remove combustion air or exhaust system blockages.
4. Prime the engine fuel system for at least 30 seconds.
5. Check all fittings and fuel filters for fuel and air leaks, tighten as necessary, and reprime.

6. Replace fuel filters and reprime, see Replacing Fuel Filter in the Maintenance Chapter.
7. Check for contaminated fuel by connecting to a source of known fuel quality.

6.4.16 Code No. 23 - Faulty Oil Pressure Sender

Logic:

Controller sensed grounded sender

Diagnosis and Repair:

See an authorized Cummins Onan Service Representative.

6.4.17 Code No. 24 - Faulty Temperature Sender

Logic:

Controller sensed open sender

Diagnosis and Repair:

See an authorized Cummins Onan Service Representative.

6.4.18 Code No. 27 - Loss of AC Voltage Sense

Logic:

The generator set Controller lost VAC sensing during normal voltage regulation when the field was functioning normally and frequency was at least 40 Hz

Diagnosis and Repair:

See an authorized Cummins Onan Service Representative.

6.4.19 Code No. 29 - High Battery Voltage

Logic:

During startup the generator set controller sensed that battery system voltage was greater than 19.2 volts if 12 VDC system, or 32.2 volts if 24 volt system.

Diagnosis and Repair:

1. Check battery bank connections and reconnect if necessary for 12 volts or 24 volts, depending on generator set model.
2. Select a lower battery booster charge rate (external charging system).

6.4.20 Code No. 32 - Starting Fault

Logic:

The generator set controller could not detect cranking speed for 3 seconds.

Diagnosis and Repair:

1. Disconnect the PTO clutch, if so equipped.
2. Have the propulsion engines running while trying to start the generator set. Their charging alternators may be able to maintain a high enough battery terminal voltage to start the generator set.

3. Service the battery as necessary by cleaning and tightening connections, recharging or replacing the battery, or replacing damaged battery cables (Section 5.3 on page 40).
4. Change the engine oil to oil of the proper viscosity for the ambient temperature (Section 5.4 on page 40).

NOTICE
High oil viscosity can slow cranking speed.

6.4.21 Code No. 35 - Control Card Failure - EE

Logic:

During startup the generator set controller detected an EE memory error.

Diagnosis and Repair:

See an authorized Cummins Onan Service Representative.

6.4.22 Code No. 36 - Unknown Shutdown

Logic:

The generator set controller declared this fault because engine speed fell below 1000 RPM for 0.5 seconds, though not by generator set or engine control action.

Diagnosis and Repair:

1. Check for mechanical damage and service as necessary.
2. Push the generator set line circuit breaker to off and disconnect the PTO clutch, if so equipped. If the generator set now runs, reduce the number of electrical and mechanical (PTO) loads.
3. Check fuel level and refill as necessary.

NOTICE
The generator set fuel pickups are probably higher than the propulsion engine fuel pickups.

4. Prime the engine fuel system for at least 30 seconds, see Priming the Fuel System in the Maintenance Chapter.
5. Remove combustion air or exhaust system blockages.
6. Check all fuel fittings for fuel and air leaks, tighten as necessary.
7. Replace fuel filters and reprime, see Replacing Fuel Filter im Maintenance Chapter.
8. If so equipped, check the engine air filter and remove any blockage.

6.4.23 Code No. 37 - Invalid Generator Set Configuration

Logic:

The generator set controller is not configured properly for the generator set.

Diagnosis and Repair:

See an authorized Cummins Onan service representative.

6.4.24 Code No. 38 - Field Overload

Logic:

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

Diagnosis and Repair:

1. Remove blockages to generator air flow at the front inlet air grill.
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.

NOTICE
A locked compressor rotor can cause very low power factor.

6.4.25 Code No. 41 - Generator Rotor Fault

Logic:

F+ grounded.

Diagnosis and Repair:

See an authorized Cummins Onan Service Representative.

6.4.26 Code No. 43 - Control Card Failure - RAM

Logic:

During startup the generator set Controller detected a RAM memory error

Diagnosis and Repair:

See an authorized Cummins Onan Service Representative.

6.4.27 Code No. 45 - Speed Sense Lost

Logic:

After start disconnect the generator set controller lost speed sense for 0.25 seconds.

Diagnosis and Repair:

See an authorized Cummins Onan Service Representative.

6.4.28 Code No. 48 - Field Sense Lost - RAM

Logic:

Controller unable to sense field voltage.

Diagnosis and Repair:

See an authorized Cummins Onan Service Representative.

6.4.29 Code No. 57 - Overprime

Logic:

A local or remote control switch was held in the prime position for more than 5 minutes.

Diagnosis and Repair:

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

6.4.30 Code No. 58 - High Exhaust Temperature

Logic:

Exhaust temperature exceeded design limits due to lack of water delivered to the exhaust/water mixer.

Diagnosis and Repair:

1. Check for disconnected, kinked, or leaking water hoses and reconnect, reroute, or replace.
2. Check for and clean a blocked sea water strainer. If strainer is above the water line, fill with water to assist priming.
3. Inspect the siphon break (if provided) for proper operation.
4. If loose, reconnect terminals S5+ and S5- to high exhaust temperature switch S5.
5. Check for a worn raw water impeller and replace as necessary.
6. Clean the heat exchanger.
7. Disconnect connector P1 (black) from generator set controller and check continuity between Pin 11 and terminal S5+ and between terminal S5- and B- (ground). Repair wiring and connectors as necessary.
8. Test high exhaust temperature switch S5 and replace as necessary.
9. Replace the generator set controller.

6.4.31 Code No. 59 - Low Coolant Level

Logic:

The engine coolant level fell below the optional coolant level sensor

Diagnosis and Repair:

Add coolant as necessary and repair leaks.

6.4.32 Code No. 61 - External Shutdown

Logic:

The generator set was shut down by a fire suppression system or other external control.

Diagnosis and Repair:

Make all necessary repairs to the generator set and connected equipment. Reset the external control which shut down the generator set.

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7 Specifications

7.1 MDKBK, MDKBL, and MDKBM Specifications Table

TABLE 3. GENERATOR SET SPECIFICATIONS

DESCRIPTION	MDKBK	MDKBL	MDKBM
Alternator	Single-Bearing, 4-Pole Rotating Field, Brushless	Single-Bearing, 4-Pole Rotating Field, Brushless	Single-Bearing, 4-Pole Rotating Field, Brushless
Installation Drawing	0500-4753	0500-4752	0500-4754
Engine	Kubota 4-Stroke Cycle, Indirect Injection, Water Cooled Diesel with Digital Electronic Governing	Kubota 4-Stroke Cycle, Indirect Injection, Water Cooled Diesel with Digital Electronic Governing	Kubota 4-Stroke Cycle, Indirect Injection, Water Cooled Diesel with Digital Electronic Governing
Model	D1105	D1105	V1505
Rated RPM			
60 Hz	1800	1800	1800
50 Hz	1500	1500	1500
Number of Cylinders	3	3	4
Bore	78 mm (3.07 in)	78 mm (3.07 in)	78 mm (3.07 in)
Stroke	78.4 mm (3.09 in)	78.4 mm (3.09 in)	78.4 mm (3.09 in)
Displacement	1.123 L (68.53 in^3)	1.123 L (68.53 in^3)	1.498 cm^3 (91.41 in^3)
FUEL:			
BioDiesel Compatibility	N/A	N/A	N/A
Consumption - 60 Hz			
No Load	0.8 L/hr (0.2 gal/hr)	0.8 L/hr (0.2 gal/hr)	1.1 L/hr (0.3 gal/hr)
Half Load	1.9 L/hr (0.5 gal/hr)	1.9 L/hr (0.5 gal/hr)	2.6 L/hr (0.7 gal/hr)
Full Load	3.8 L/hr (1 gal/hr)	3.8 L/hr (1 gal/hr)	3.8 L/hr (1 gal/hr)
Consumption - 50 Hz			
No Load	0.8 L/hr (0.2 gal/hr)	0.8 L/hr (0.2 gal/hr)	0.8 L/hr (0.2 gal/hr)
Half Load	1.5 L/hr (0.4 gal/hr)	1.5 L/hr (0.4 gal/hr)	2.3 L/hr (0.6 gal/hr)
Full Load	3 L/hr (0.8 gal/hr)	3 L/hr (0.8 gal/hr)	3.4 L/hr (0.9 gal/hr)
Minimum Fuel Inlet Pressure	- 1.7 psi	- 1.7 psi	- 1.7 psi
Minimum Fuel Inlet Pressure with Auxiliary Pump	N/A	N/A	N/A
LUBRICATION:			
Engine Oil Capacity	4 L (4.2 qt)	4 L (4.2 qt)	4.3 L (4.5 qt)
Maximum Angularity any Direction			

DESCRIPTION	MDKBK	MDKBL	MDKBM
Continuous	10°	10°	10°
Intermittent	22.5°	22.5°	22.5°
COOLING:			
Coolant Capacity	4 L (4.2 qt)	4 L (4.2 qt)	5 L (5.3 qt)
Coolant Flow Rate			
60 Hz	18.9 L/min (5 gal/min)	18.9 L/min (5 gal/min)	18.9 L/min (5 gal/min)
50 Hz	15.9 L/min (4.2 gal/min)	15.9 L/min (4.2 gal/min)	15.9 L/min (4.2 gal/min)
Raw Water Flow Rate			
60 Hz	22.7 L/min (6 gal/min)	22.7 L/min (6 gal/min)	22.7 L/min (6 gal/min)
50 Hz	18.9 L/min (5 gal/min)	18.9 L/min (5 gal/min)	18.9 L/min (5 gal/min)
Minimum Raw Water Inlet Pressure	- 1.7 psi	- 1.7 psi	- 1.7 psi
Maximum Pressure Drop across Keel Cooler Outlet and Inlet Connection	1 psi	1 psi	1 psi
Heat Rejection to Coolant			
60 Hz	239 Kcal/min (950 BTU/min)	239 Kcal/min (950 BTU/min)	307 Kcal/min (1220 BTU/min)
50 Hz	197 Kcal/min (780 BTU/min)	197 Kcal/min (780 BTU/min)	247 Kcal/min (980 BTU/min)
Thermostat Opening Temperature	71 °C (159.8 °F)	71 °C (159.8 °F)	71 °C (159.8 °F)
Thermostat Fully Open Temperature	85 °C (185 °F)	85 °C (185 °F)	85 °C (185 °F)
Recommended Pressure Cap	48 kPA (7 psi)	N/A	48 kPA (7 psi)
GENERATOR SET AIR FLOW:			
Combustion Air Flow	0.85 m^3/min (30 ft^3/min)	0.85 m^3/min (30 ft^3/min)	1.02 m^3/min (36 ft^3/min)
Heat Rejection to Ambient			
60 Hz	50 Kcal/min (200 Btu/min)	50 Kcal/min (200 Btu/min)	58 Kcal/min (230 Btu/min)
50 Hz	45 Kcal/min (179 Btu/min)	45 Kcal/min (179 Btu/min)	48 Kcal/min (190 Btu/min)
EXHAUST:			
Maximum Exhaust Back Pressure	3 in Hg	3 in Hg	3 in Hg
Dry Exhaust Gas Flow	2.5 m^3/min (90 ft^3/min)	2.5 m^3/min (90 ft^3/min)	3.3 m^3/min (118 ft^3/min)
Dry Exhaust Temperature		N/A	
BATTERIES:			
Nominal Battery Voltage	12/24 VDC	12/24 VDC	12/24 VDC
Minimum CCA Rating - SAE @ 0 °C (32 °F) 12 VDC	360 Amps	360 Amps	500 Amps
12 Volt Net Battery Charging Output			
Negative Ground (60 Hz)	5 Amps	5 Amps	5 Amps

DESCRIPTION	MDKBK	MDKBL	MDKBM
Isolated Ground (60 Hz)	5 Amps	5 Amps	5 Amps
Negative Ground (50 Hz)	2 Amps	2 Amps	2 Amps
Isolated Ground (50 Hz)	2 Amps	2 Amps	2 Amps
24 Volt Net Battery Charging Output			
Negative Ground (60 Hz)	15 Amps	15 Amps	15 Amps
Isolated Ground (60 Hz)	N/A	N/A	N/A
Negative Ground (50 Hz)	13 Amps	13 Amps	13 Amps
Isolated Ground (50 Hz)	N/A	N/A	N/A
Starter Rolling Current			
12V	N/A	N/A	N/A
24V	N/A	N/A	N/A
Maximum Starting Current Resistance			
12V	N/A	N/A	N/A
24V	N/A	N/A	N/A
SIZE, WEIGHT, NOISE:			
Weight without Sound Shield:			
Dry Weight	252 kg (555 lb)	238 kg (525 lb)	290 kg (640 lb)
Weight with Sound Shield:			
Dry Weight	272 kg (600 lb)	N/A	315 kg (695 lb)
Sound Level with Sound Shield @ 1 meter	66/65 dB(A) @ 60/50 Hz	N/A	66/65 dB(A) @ 60/50 Hz

7.2 MDKBN, MDKBP, and MDKBR Specifications Table

TABLE 4. GENERATOR SET SPECIFICATIONS

DESCRIPTION	MDKBN	MDKBP	MDKBR
Alternator	Single-Bearing, 4-Pole Rotating Field, Brushless	Single-Bearing, 4-Pole Rotating Field, Brushless	Single-Bearing, 4-Pole Rotating Field, Brushless
Installation Drawing	0500-4754	0500-4944	0500-4944
Engine	Kubota 4-Stroke Cycle, Indirect Injection, Water Cooled Diesel with Digital Electronic Governing	Kubota 4-Stroke Cycle, Indirect Injection, Water Cooled Diesel with Digital Electronic Governing	Kubota 4-Stroke Cycle, Indirect Injection, Water Cooled Diesel with Digital Electronic Governing
Model	V1505	V2003	V2403
Rated RPM			
60 Hz	1800	1800	1800
50 Hz	1500	1500	1500

DESCRIPTION	MDKBN	MDKBP	MDKBR
Number of Cylinders	4	4	4
Bore	78 mm (3.07 in)	83 mm (3.27 in)	87 mm (3.43 in)
Stroke	78.4 mm (3.09 in)	92.4 mm (3.64 in)	102.4 mm (4.03 in)
Displacement	1.498 cm^3 (91.41 in^3)	1.999 L (121.99 in^3)	2.434 cm^3 (148.53 in^3)
FUEL:			
BioDiesel Compatibility	N/A	N/A	N/A
Consumption - 60 Hz			
No Load	1.1 L/hr (0.3 gal/hr)	1.5 L/hr (0.4 gal/hr)	1.5 L/hr (0.4 gal/hr)
Half Load	2.6 L/hr (0.7 gal/hr)	3.4 L/hr (0.9 gal/hr)	3.8 L/hr (1 gal/hr)
Full Load	4.5 L/hr (1.2 gal/hr)	6.1 L/hr (1.6 gal/hr)	7.2 L/hr (1.9 gal/hr)
Consumption - 50 Hz			
No Load	0.8 L/hr (0.2 gal/hr)	1.1 L/hr (0.3 gal/hr)	1.1 L/hr (0.3 gal/hr)
Half Load	2.3 L/hr (0.6 gal/hr)	2.6 L/hr (0.7 gal/hr)	3.4 L/hr (0.9 gal/hr)
Full Load	3.8 L/hr (1 gal/hr)	4.9 L/hr (1.3 gal/hr)	6.4 L/hr (1.7 gal/hr)
Minimum Fuel Inlet Pressure	- 1.7 psi	- 1.7 psi	- 1.7 psi
Minimum Fuel Inlet Pressure with Auxiliary Pump	N/A	N/A	N/A
LUBRICATION:			
Engine Oil Capacity	4.3 L (4.5 qt)	7.6 L (8.0 qt)	7.6 L (8.0 qt)
Maximum Angularity any Direction			
Continuous	10°	10°	10°
Intermittent	22.5°	22.5°	22.5°
COOLING:			
Coolant Capacity	5 L (5.3 qt)	7.6 L (8.0 qt)	7.6 L (8.0 qt)
Coolant Flow Rate			
60 Hz	18.9 L/min (5 gal/min)	53 L/min (14 gal/min)	53 L/min (14 gal/min)
50 Hz	15.9 L/min (4.2 gal/min)	37.9 L/min (10 gal/min)	37.9 L/min (10 gal/min)
Raw Water Flow Rate			
60 Hz	22.7 L/min (6 gal/min)	34.1 L/min (9 gal/min)	34.1 L/min (9 gal/min)
50 Hz	18.9 L/min (5 gal/min)	26.5 L/min (7 gal/min)	26.5 L/min (7 gal/min)
Minimum Raw Water Inlet Pressure	- 1.7 psi	- 1.7 psi	- 1.7 psi
Maximum Pressure Drop across Keel Cooler Outlet and Inlet Connection	1 psi	1 psi	1 psi
Heat Rejection to Coolant			
60 Hz	358 Kcal/min (1420 BTU/min)	402 Kcal/min (1590 BTU/min)	500 Kcal/min (1980 BTU/min)

DESCRIPTION	MDKBN	MDKBP	MDKBR
50 Hz	292 Kcal/min (1160 BTU/min)	379 Kcal/min (1500 BTU/min)	422 Kcal/min (1670 BTU/min)
Thermostat Opening Temperature	71 °C (159.8 °F)	71 °C (159.8 °F)	71 °C (159.8 °F)
Thermostat Fully Open Temperature	85 °C (185 °F)	85 °C (185 °F)	85 °C (185 °F)
Recommended Pressure Cap	48 kPA (7 psi)	48 kPA (7 psi)	48 kPA (7 psi)
GENERATOR SET AIR FLOW:			
Combustion Air Flow	1.16 m^3/min (41 ft^3/min)	1.45 m^3/min (52 ft^3/min)	1.72 m^3/min (60 ft^3/min)
Heat Rejection to Ambient			
60 Hz	71 Kcal/min (280 Btu/min)	88 Kcal/min (350 Btu/min)	106 Kcal/min (420 Btu/min)
50 Hz	53 Kcal/min (210 Btu/min)	72 Kcal/min (285 Btu/min)	88 Kcal/min (350 Btu/min)
EXHAUST:			
Maximum Exhaust Back Pressure	3 in Hg	3 in Hg	3 in Hg
Dry Exhaust Gas Flow	3.3 m^3/min (118 ft^3/min)	4.5 m^3/min (160 ft^3/min)	5.1 m^3/min (180 ft^3/min)
Dry Exhaust Temperature			
BATTERIES:			
Nominal Battery Voltage	12/24 VDC	12/24 VDC	12/24 VDC
Minimum CCA Rating - SAE @ 0 °C (32 °F) 12 VDC	500 Amps	500 Amps	625 Amps
12 Volt Net Battery Charging Output			
Negative Ground (60 Hz)	5 Amps	29 Amps	29 Amps
Isolated Ground (60 Hz)	5 Amps	38 Amps	38 Amps
Negative Ground (50 Hz)	2 Amps	25 Amps	25 Amps
Isolated Ground (50 Hz)	2 Amps	35 Amps	35 Amps
24 Volt Net Battery Charging Output			
Negative Ground (60 Hz)	15 Amps	14 Amps	14 Amps
Isolated Ground (60 Hz)	N/A	28 Amps	28 Amps
Negative Ground (50 Hz)	13 Amps	13 Amps	13 Amps
Isolated Ground (50 Hz)	N/A	24 Amps	24 Amps
Starter Rolling Current			
12V	N/A	N/A	N/A
24V	N/A	N/A	N/A
Maximum Starting Current Resistance			
12V	N/A	N/A	N/A
24V	N/A	N/A	N/A

DESCRIPTION	MDKBN	MDKBP	MDKBR
SIZE, WEIGHT, NOISE:			
Weight without Sound Shield:			
Dry Weight	290 kg (640 lb)	377 kg (830 lb)	375 kg (870 lb)
Weight with Sound Shield:			
Dry Weight	315 kg (695 lb)	404 kg (890 lb)	422 kg (930 lb)
Sound Level with Sound Shield @ 1 meter	66/65 dB(A) @ 60/50 Hz	67/64 dB(A) @ 60/50 Hz	67/64 dB(A) @ 60/50 Hz

7.3 MDKBT, MDKBU, and MDKBV Specifications Table

TABLE 5. GENERATOR SET SPECIFICATIONS

DESCRIPTION	MDKBT	MDKBU	MDKBV
Alternator	Single-Bearing, 4-Pole Rotating Field, Brushless	Single-Bearing, 4-Pole Rotating Field, Brushless	Single-Bearing, 4-Pole Rotating Field, Brushless
Installation Drawing	0500-4307	0500-4307	0500-4944
Engine	Kubota 4-Stroke Cycle, Indirect Injection, Water Cooled Diesel with Digital Electronic Governing	Kubota 4-Stroke Cycle, Indirect Injection, Water Cooled Diesel with Digital Electronic Governing	Kubota 4-Stroke Cycle, Indirect Injection, Water Cooled Diesel with Digital Electronic Governing
Model	V3300	V3300	V2403
Rated RPM			
60 Hz	1800	1800	1800
50 Hz	1500	1500	1500
Number of Cylinders	4	4	4
Bore	98 mm (3.86 in)	98 mm (3.86 in)	87 mm (3.43 in)
Stroke	110 mm (4.33 in)	110 mm (4.33 in)	102.4 mm (4.03 in)
Displacement	3.318 L (202.48 in^3)	3.318 L (202.48 in^3)	2.434 cm^3 (148.53 in^3)
FUEL:			
BioDiesel Compatibility	N/A	N/A	N/A
Consumption - 60 Hz			
No Load	2.3 L/hr (0.6 gal/hr)	2.3 L/hr (0.6 gal/hr)	1.5 L/hr (0.4 gal/hr)
Half Load	4.9 L/hr (1.3 gal/hr)	5.7 L/hr (1.5 gal/hr)	4.5 L/hr (1.2 gal/hr)
Full Load	9.1 L/hr (2.4 gal/hr)	11.4 L/hr (3 gal/hr)	7.6 L/hr (2 gal/hr)
Consumption - 50 Hz			
No Load	1.9 L/hr (0.5 gal/hr)	1.9 L/hr (0.5 gal/hr)	1.1 L/hr (0.3 gal/hr)
Half Load	4.2 L/hr (1.1 gal/hr)	4.5 L/hr (1.2 gal/hr)	3.8 L/hr (1 gal/hr)
Full Load	6.8 L/hr (1.8 gal/hr)	9.1 L/hr (2.4 gal/hr)	6.4 L/hr (1.7 gal/hr)
Minimum Fuel Inlet Pressure	- 1.7 psi	- 1.7 psi	- 1.7 psi

DESCRIPTION	MDKBT	MDKBU	MDKBV
Minimum Fuel Inlet Pressure with Auxiliary Pump	N/A	N/A	N/A
LUBRICATION:			
Engine Oil Capacity	10.4 L (11 qt)	10.4 L (11 qt)	7.6 L (8.0 qt)
Maximum Angularity any Direction			
Continuous	10°	10°	10°
Intermittent	22.5°	22.5°	22.5°
COOLING:			
Coolant Capacity	14 L (14.5 qt)	14 L (14.5 qt)	7.6 L (8.0 qt)
Coolant Flow Rate			
60 Hz	53 L/min (14 gal/min)	53 L/min (14 gal/min)	53 L/min (14 gal/min)
50 Hz	43.5 L/min (11.5 gal/min)	43.5 L/min (11.5 gal/min)	37.9 L/min (10 gal/min)
Raw Water Flow Rate			
60 Hz	59.1 L/min (15.6 gal/min)	59.1 L/min (15.6 gal/min)	34.1 L/min (9 gal/min
50 Hz	49.2 L/min (13 gal/min)	49.2 L/min (13 gal/min)	26.5 L/min (7 gal/min)
Minimum Raw Water Inlet Pressure	- 1.7 psi	- 1.7 psi	- 1.7 psi
Maximum Pressure Drop across Keel Cooler Outlet and Inlet Connection	1 psi	1 psi	1 psi
Heat Rejection to Coolant			
60 Hz	555 Kcal/min (2200 BTU/min)	655 Kcal/min (2600 BTU/min)	500 Kcal/min (1980 BTU/min)
50 Hz	470 Kcal/min (1870 BTU/min)	555 Kcal/min (2200 BTU/min)	422 Kcal/min (1670 BTU/min)
Thermostat Opening Temperature	76.5 °C (170 °F)	76.5 °C (170 °F)	71 °C (159.8 °F)
Thermostat Fully Open Temperature	90 °C (194 °F)	90 °C (194 °F)	85 °C (185 °F)
Recommended Pressure Cap	48 kPA (7 psi)	48 kPA (7 psi)	48 kPA (7 psi)
GENERATOR SET AIR FLOW:			
Combustion Air Flow	2.6 m^3/min (91.7 ft^3/min)	2.6 m^3/min (91.7 ft^3/min)	1.72 m^3/min (60 ft^3/min)
Heat Rejection to Ambient			
60 Hz	134 Kcal/min (532 Btu/min)	159 Kcal/min (629 Btu/min)	106 Kcal/min (420 Btu/min)
50 Hz	111 Kcal/min (441 Btu/min)	130 Kcal/min (515 Btu/min)	88 Kcal/min (350 Btu/min)
EXHAUST:			
Maximum Exhaust Back Pressure	3 in Hg	3 in Hg	3 in Hg
Dry Exhaust Gas Flow	6.8 m^3/min (240 ft^3/min)	6.8 m^3/min (240 ft^3/min)	5.1 m^3/min (180 ft^3/min)

DESCRIPTION	MDKBT	MDKBU	MDKBV
Dry Exhaust Temperature	475 °C (887 °F)	475 °C (887 °F)	
BATTERIES:			
Nominal Battery Voltage	12/24 VDC	12/24 VDC	12/24 VDC
Minimum CCA Rating - SAE @ 0 °C (32 °F) 12 VDC	625 Amps	625 Amps	625 Amps
12 Volt Net Battery Charging Output			
Negative Ground (60 Hz)	28 Amps	28 Amps	29 Amps
Isolated Ground (60 Hz)	37 Amps	37 Amps	38 Amps
Negative Ground (50 Hz)	20 Amps	20 Amps	25 Amps
Isolated Ground (50 Hz)	33 Amps	33 Amps	35 Amps
24 Volt Net Battery Charging Output			
Negative Ground (60 Hz)	21 Amps	21 Amps	14 Amps
Isolated Ground (60 Hz)	26 Amps	26 Amps	28 Amps
Negative Ground (50 Hz)	23 Amps	23 Amps	13 Amps
Isolated Ground (50 Hz)	23 Amps	23 Amps	24 Amps
Starter Rolling Current			
12V	N/A	N/A	N/A
24V	N/A	N/A	N/A
Maximum Starting Current Resistance			
12V	N/A	N/A	N/A
24V	N/A	N/A	N/A
SIZE, WEIGHT, NOISE:			
Weight without Sound Shield:			
Dry Weight	565 kg (1245 lb)	590 kg (1300 lb)	375 kg (870 lb)
Weight with Sound Shield:			
Dry Weight	601 kg (1325 lb)	626 kg (1380 lb)	422 kg (930 lb)
Sound Level with Sound Shield @ 1 meter	68/67 dB(A) @ 60/50 Hz	68/67 dB(A) @ 60/50 Hz	67/64 dB(A) @ 60/50 Hz

8 Maintenance Record

TABLE 6. MAINTENANCE RECORD

Record all periodic and unscheduled maintenance/service. See Periodic Maintenance section.		
DATE	**HOUR METER READING**	**MAINTENANCE OR SERVICE PERFORMED**
Record the name, address, and phone number of your authorized Cummins Onan service center.		

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