Operator Manual

Cummins **Onan**

Performance you rely on.™

Marine Generator Set

MDKUB (Spec E–J)
MDKWB (Spec E–J)

English – Original Instructions 11–2009 981–0151 (Issue 3)

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.

⚠ WARNING ⚠

Do not use this genset on a boat
Such use may violate U. S. Coast Guard regulations and can result in severe personal injury or death from fire, electrocution, or carbon monoxide poisoning

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SAFETY PRECAUTIONS

Thoroughly read the OPERATOR MANUAL before operating the generator set. Safe operation and top performance can only be obtained when equipment is operated and maintained properly.

Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards shall remove dismantle and dispose of the generator set. See service manual.

Some generator set installation procedures present hazards that can result in severe personal injury or death. Only trained and experienced personnel with knowledge of fuels, electricity, and machinery hazards should perform generator set installation procedures.

The following symbols in this manual alert you to potential hazards to the operator, service person and equipment.

⚠ DANGER ***Used to alerts you to a lethal hazard against which you must take steps to prevent severe personal injury or death, as when you are in the vicinity of High Voltage equipement.***

⚠WARNING ***Used to alert you to a hazard or unsafe practice that can result in severe personal injury or death.***

⚠ CAUTION ***Used to alert you to a hazard or unsafe practice that can result in personal injury or equipment damage.***

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

ENGINE EXHAUST IS DEADLY

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

GENERATOR VOLTAGE IS DEADLY

- Generator electrical output connections must be made by a trained and experienced electrician in accordance with applicable codes.

⚠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.***

- Use caution when working on live electrical equipment. Remove jewelry, make sure clothing and shoes are dry, stand on a dry wooden platform or rubber insulating mat and use tools with insulated handles.

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.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

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

BATTERY GAS IS EXPLOSIVE

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

FLAMMABLE VAPOR CAN CAUSE A DIESEL ENGINE TO OVERSPEED

⚠WARNING ***Do not operate a diesel-powered generator set where a flammable vapor environment can be created by fuel spill, leak, etc.***

Flammable vapor can cause a diesel engine to overspeed and become difficult to stop, resulting in possible fire, explosion, severe personal injury and death.The owners and operators of the generator set are solely responsible for operating the generator set safely.

GENERAL PRECAUTIONS

- Keep children away from the generator set.
- Do not use evaporative starting fluids. They are highly explosive.
- Do not step on the generator set when entering or leaving the generator room. Parts can bend or break leading to electrical shorts or to fuel, coolant or exhaust leaks.
- To prevent accidental or remote starting while working on the generator set, disconnect the negative (–) battery cable at the battery.
- Let the engine cool down before removing the coolant pressure cap or opening the coolant drain. Hot coolant under pressure can spray and cause severe burns.
- Keep the generator set, drip pan and compartment clean. Oily rags can catch fire. Gear stowed in the compartment can restrict cooling.
- Make sure all fasteners are secure and properly torqued.
- Do not work on the generator set when mentally or physically fatigued or after having consumed alcohol or drugs.
- Used engine oil has been identified by some U. S. state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale, or contact used oil or its vapors.
- Ethylene glycol, used as engine coolant, is toxic to humans and animals. Clean up spills and dispose of used engine coolant in accordance with local environmental regulations.
- Keep multi-purpose fire extinguishers handy. Mulit–purpose fire extinguishers are used for fires that involve ordinary combustible materials such as wood and cloth; combustible and flammable liquid fuels and gasous fuels; live electrical equipment. (North Americal or US: Ref. NFPA No. 10)
- Generator set installation and operation must comply with all applicable local, state and federal codes and regulations.
- Generator sets with a sound sheild shall not be run with the service doors removed/missing.
- Engine components can be hot and cause servere burns. Hot coolant under pressure can spray and cause servere burns.
- Use personal protective equipment when performing periodic maintenance on the generator set such as gloves, safety glasses, etc.

THE HAZARDS OF CARBON MONOXIDE

Engine–driven generators can produce harmful levels of carbon monoxide that can injure or kill you. The nature of boating is such that you can be harmed by this poisonous gas despite good generator set maintenance and proper ventilation.

ONLY YOU CAN PROTECT YOURSELF FROM CO POISONING!

- Watch constantly 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 and audible alarms 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.

M-10

SUBSTANCE 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 exposed to fuel, oil, coolant, wet batteries, grease, cleaning agents, or other substances exposed to lungs, eyes, or skin. use appropriate containers for transport, storage, and disposal of waste substances. Follow local regulations for disposal and recycling.

ANTIFREEZE (FLEETGUARD – ES COMPLEAT/EG PREMIX)

This antifreeze is also know as an ethylene glycol based coolant; summer coolant; coolant additive. It is purple coloured, viscous liquid, with a mild chemical odour, is soluble in water and harmful. It contains ethylene glycol, and diethylene glycol. Ethylene glycol is a potentially hazardous constituent.

The substance has a boiling point of 107° C, and a flash point of 121° C.

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

HAZARDOUS REACTIONS

Ethylene glycol is combustible when exposed to heat or flame and can react vigorously with oxidants. Moderate explosive hazard in form of vapour 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.

Avoid strong oxidizing agents – incompatible with sulfuric acid, nitric acid, caustics and aliphatic amines.

It may cause neurological signs and symptoms, and kidney damage. It is also a skin and eye irritant.

Very toxic in particulate form upon inhalation. Harmful if swallowed, lethal dose for humans reported to be 100ml.

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 vapour, or particulate, use a suitable organic vapour mask.

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

STORAGE/TRANSPORT

Store and transport only in correctly marked containers. Keep containers closed when not in use. Keep cool, out of sunlight, away for 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–courses.

Contain leak/spill with sand, earth or non–combustible, absorbent material to prevent entry of substance into drainage/sewerage system, water–courses and land. Eliminate all ignition sources, use plastic shovel to transfer to suitable container and dispose of unwanted or absorbed substance through and authorised contractor to a licensed site.

EMERGENCY ACTION

- Fire
  Extinguishing media: CO_2, alcohol resistant foam, dry powder, or water spray.
  Fire fighters to use self contained breathing apparatus. Keep fire exposed containers cool. Prevent run–off from entering waterways, drains and drinking water supplies.
- ngestion
  Toxic by ingestion. If swallowed induce vomiting only under the advice of a Doctor or poison control centre. Delayed treatment may result in fatality.
- Inhalation (of vapour)
  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 before re–use.
- Spillage
  Soak–up using an absorbent material and dispose of this as directed under Storage/Transport (Section 5.1.3)

GAS OIL

This product is also known as Red Diesel, Fuel Oil, and type A1 or A2. It can be pale red or a clear liquid with a characteristic mild odour. 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, a flash point greater than 56°C, and a vapour pressure less than 0.7mm Hg at 20°C 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.

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 vapour is explosive. High vapour 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 form of pulmonary fibrosis.

Avoid strong oxidising agents, e.g. chlorates which may be use in agriculture.

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

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 glove and overalls, and eye protection goggles 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/grease etc, from skin.

STORAGE/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/spill with sand, earth or other suitable material, and prevent entry of substance into drainage/sewerage system, water–courses and land. Dispose of unwanted or absorbed substance through an authorised contractor to a licensed site.

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

EMERGENCY ACTION

- Fire
  Extinguishing media:
  Large fire – Foam/water fog. Never use water jet.

Small fire – foam/dry powder, AAAF, CO_2, sand, earth.
Avoid making sparks. Fire fighters to use self–contained breathing apparatus. Keep fire exposed containers cool, using water fog/spray. Prevent run–off from entering waterway, drains and drinking water supplies.

- Ingestion
  Do not induce vomiting. Wash the mouth out with water, and send to hospital immediately.
- Inhalation (of vapour)
  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 pneumonitis 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/ Transport (Section 5.7.3).

LUBRICATION OIL – PREMIUM BLUE E 15W40

Also known as oil, lube oil, sump oil, new oil is dark, viscous liquid with a slight, characteristic odour. The base oil contains: distillates (petroleum), 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, a flash point Open Cup of 220°C (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 wide range of diesel engines operating under severe conditions. Installers, operators and maintainers are likely to encounter this product.

HAZARDOUS REACTIONS

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

Although harmful if 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 unburnt fuel that will cause skin reactions as detailed for fuel. Particular care must be taken if oil form a severely overheated engine is handled – use impervious gloves, lab coat and safety glasses.

Do not breathe vapour/spray.

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 n normal use. Do no breathe vapour/spray when handling hot materials.

STORAGE/TRANSPORT

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

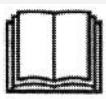
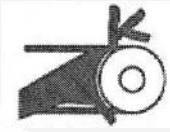
Wear splash goggles, full suit, boots and gloves. Absorb leak/spill with an inert material and dispose of unwanted or absorbed substance through an authorised contractor to a licensed site. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

EMERGENCY ACTION

- Fire
  Extinguishing media:
  Large fire – Use water spray, fog or foam. Do not use water jet.
  Small fire – Use dry chemical powder or CO_2
  Fire–fighters to use self contained breathing apparatus and full turnout gear. Keep fire exposed containers cool.
- Ingestion
  Do not induce vomiting, Obtain medical advice immediately.
- Inhalation (of vapour)
  Remove from further exposure. Obtain medical attention.

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

Introduction

ABOUT THIS MANUAL

This is the Operator Manual for the generator 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 close at hand for reference.

⚠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, redudant power or alram system must be used if generator set operation is critical.***

⚠WARNING ***This generator set is not "ignition protected" and shall not be sued in flammable vapor environment.***

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

Operation, Periodice Maintenance and Troubleshooting provide the instructions necessary for operating the generator set and maintaining it at top performance. The owner is responsible for performing maintenance in accordance with the PERIODIC MAINTENANCE SCHEDULE (p. 4–1). This manual also includes generator set specifications, information on how to obtain service, and information regarding compliance with emissions regulations.

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

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

MODEL IDENTIFICATION

Be ready to provide the generator set model and serial numbers on the nameplate when contacting Cummins Onan for parts, service and product information. Figure 1 illustrates the nameplate and its location on the side of the control box. Every charactor in these numbers is significant. (The last character of the model number is the specification letter, which is important for obtaining the right parts.) Record the generator set model and serial numbers on the lines designed in the figure so that they are easy to find when you need them.

⚠WARNING ***Improper service or replacement of parts can lead to servere personal injury or death and to damage to equipment and property. Service must be qualified to perform electrical and mechanical service.***

FEATURE AND COMPONENT LOCATIONS

The standard control panel and the routine maintenance items are shown in Figure 2.

NOISE

Generator sets emit noise. As noise level and time of exposure increase, risk of hearing damage increases. The Specifications page n the Operator manual states noise level for this generator set. Select and use personal hearing protection appropriate for your exposure to generator set noise.

Note for use 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.

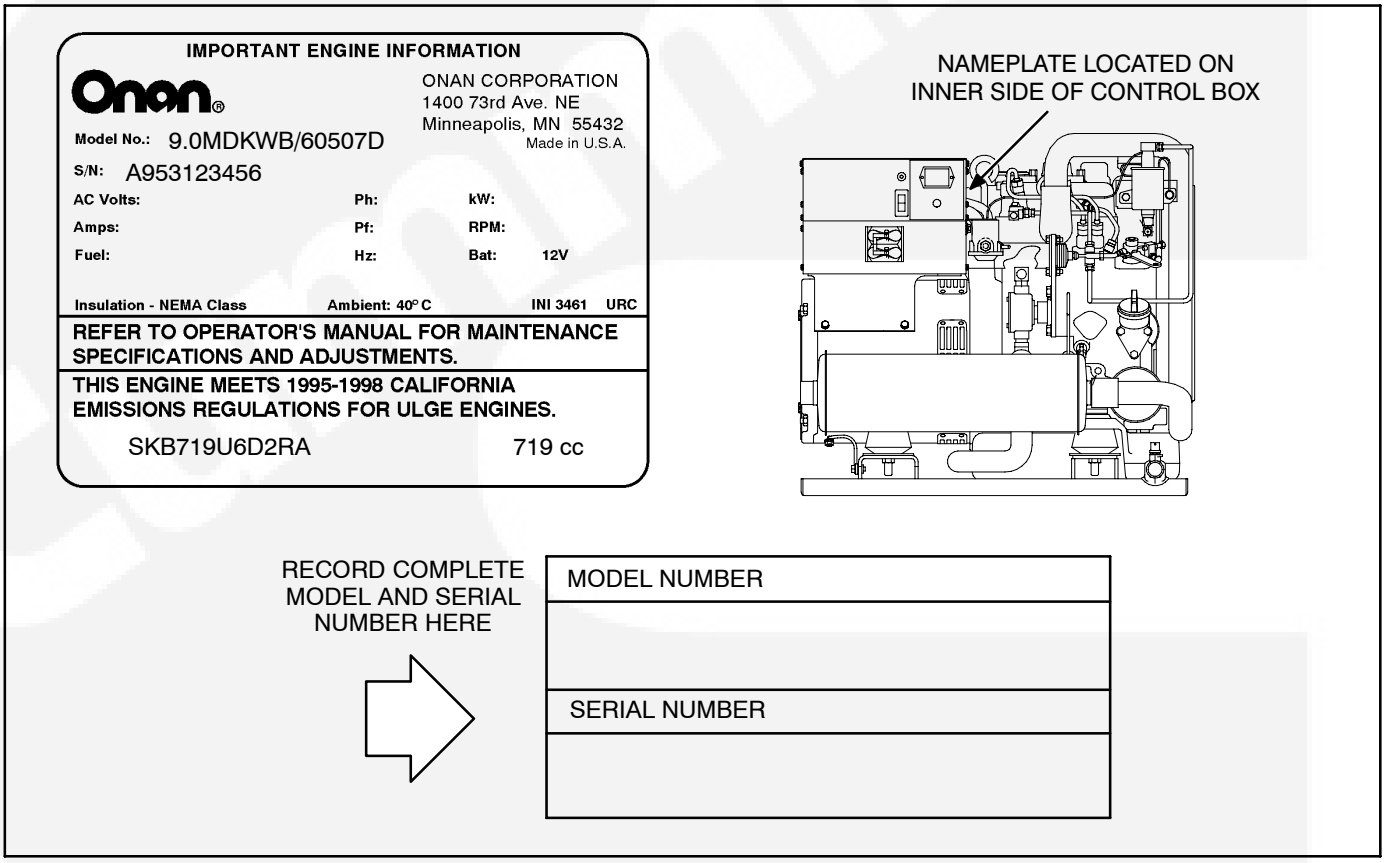


FIGURE 1. MODEL IDENTIFICATION

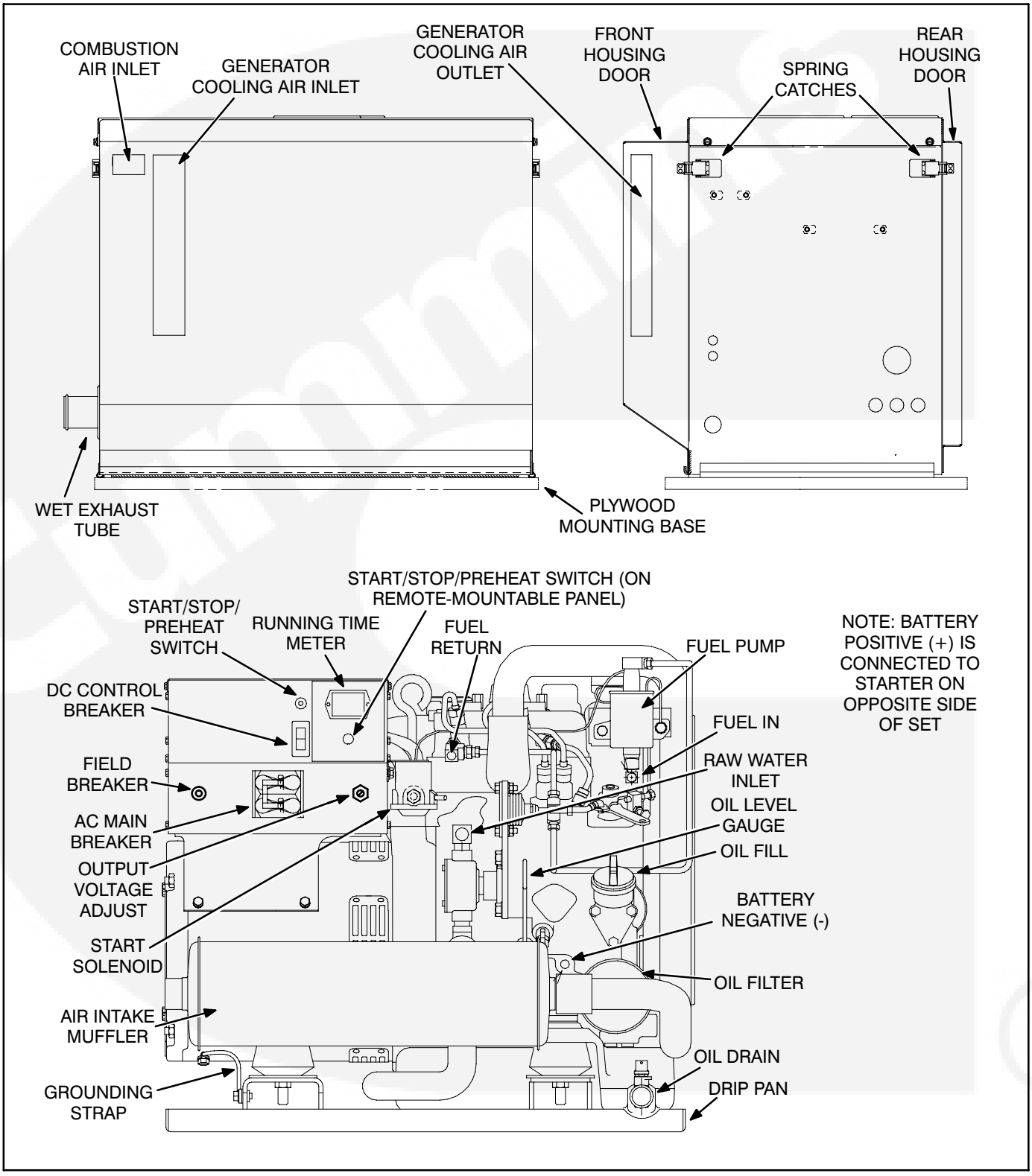


FIGURE 2. GENERATOR SET COMPONENT LOCATIONS (MDKUB SHOWN)

Controls and Circuit Breakers

The set controls and circuit breakers are located on the front of the generator set, behind the front housing panel. See Figure 4.

The genset control panel is held on the set by two screws. This panel may be removed, unplugged and remounted anywhere on the vessel with the aid of a remote wiring harness. A blanking plate is used to cover the opening in the control box. See the Installation Manual, publication 981-0602.

Remote (Detachable) Control Panel

Start/Stop/Preheat Switch: Starts and stops the generator set. Operates the engine cylinder preheaters.

Running Time Meter: A meter that displays the number of hours the generator set runs.

Set-Mounted Controls and Breakers

Start/Stop/Preheat Switch: Starts and stops the generator set. Operates the engine cylinder preheaters.

Voltage Adjustment Pot: A potentiometer that is used to adjust the set output voltage (qualified technicians only).

Field Breaker: A breaker which trips when the generator field overloads.

DC Control Breaker: A 15 ampere DC breaker that protects the control box and remote wiring from short circuits or overload. Also serves as an emergency stop switch.

Line Circuit Breaker: A dual circuit breaker that protects the set from a short circuit or other overload. It is mounted on the side of the AC control box.

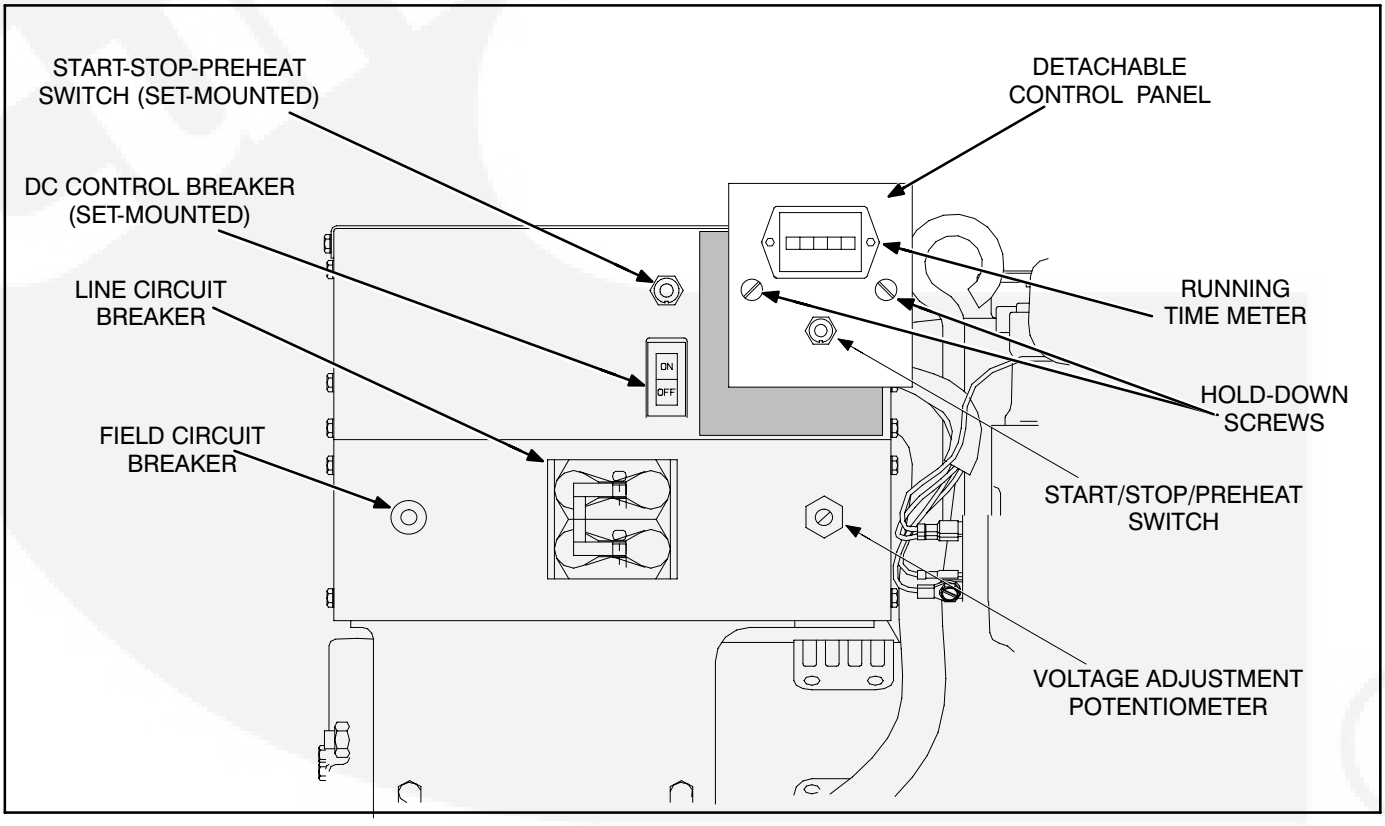


FIGURE 3. REMOTE CONTROL PANEL

Optional Control/Meter Panel

An optional control panel includes a start/stop/pre-heat switch, running time meter, and gauges that monitor oil pressure, coolant temperature, and DC battery voltage. The Starting and Stopping section of this manual describes these meters and what they should show during set operation.

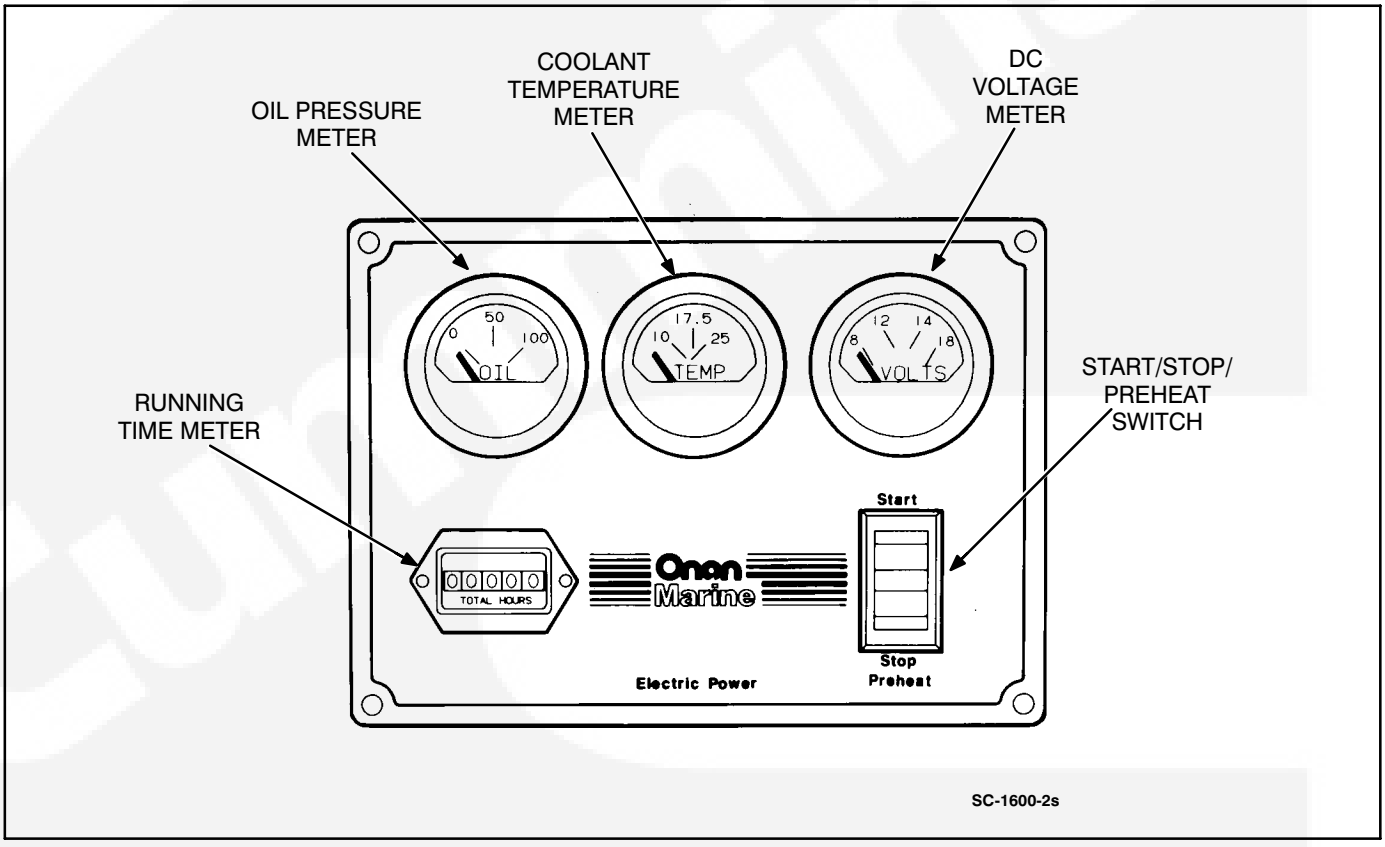


FIGURE 4. OPTIONAL CONTROL PANEL (W/METERS)

Pre-Start Checks

GENERAL

Read through this entire section before attempting to start the genset. It is essential for safe operation that the operator be completely familiar with the set.

ENGINE OIL

Check the engine oil level before each start. When the generator set is new, the engine must be filled with oil before the initial start.

- MDKUB oil capacity: 3.78 liters (4 quarts)
- MDKWB oil capacity: 4.73 liters (5 quarts)

If adding oil between changes, use the same brand because different brands might not be compatible when mixed. Be careful not to overfill the crankcase because the oil will foam, resulting in engine shutdown.

Oil Recommendations

Use premium quality motor oil. Look for the API (American Petroleum Institute) classification and use Class CD or better oil (CD, CE). Also look for the SAE (Society of Automotive Engineers) viscosity grade. Referring to Table 1, choose the viscosity grade appropriate for the ambient temperatures expected during the period of time until the next scheduled oil change.

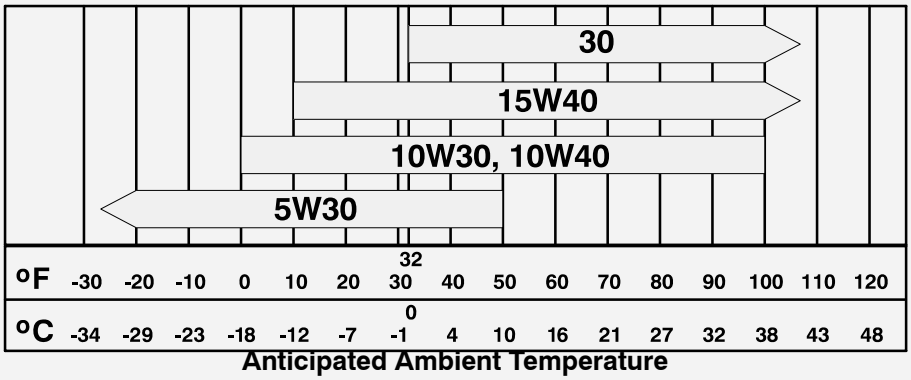
Checking Engine Oil Level

⚠ CAUTION ***Do not operate the engine with the oil below the ADD mark or above the FULL mark. Overfilling can cause foaming or aeration of the oil, while operation below the ADD mark might cause loss of oil pressure.***

Check the engine oil level at the intervals shown in Table 2, later in this manual. The oil dipstick and fill are located on the side of the engine (see Figure 5). The dipstick is stamped with FULL and ADD to indicate the oil level in the crankcase. For an accurate reading, shut off the engine and wait 10 minutes before checking the level. This lets oil in the upper part of the engine drain into the crankcase.

Keep the oil level near as possible to the FULL mark on the dipstick. Remove the oil fill cap and add the same type of oil when necessary.

TABLE 1. OIL VISCOSITY VS. TEMPERATURE



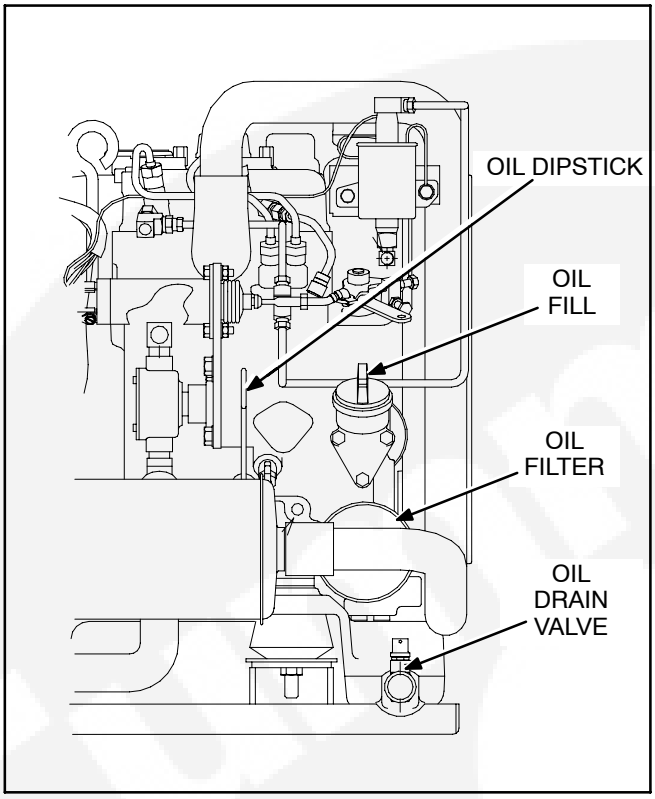


FIGURE 5. ENGINE OIL

COOLANT

The coolant level should be near the fill mark on the coolant overflow bottle fill cap. Do not check while the coolant is hot.

WARNING ***The sudden release of hot pressurized coolant can result in serious personal injury. Remove the expansion tank pressure cap slowly after the engine has cooled.***

EXHAUST

Thoroughly inspect the exhaust system for leaks or corrosion. Have any problems repaired before operating the generator set.

WARNING ***Exhaust gas presents the hazard of severe personal injury or death. Make certain that all exhaust components are operational and that there are no exhaust leaks.***

FUEL CHECK

Carefully inspect the fuel system for leaks or corrosion. Have any problems repaired immediately.

⚠WARNING ***Fuel presents the hazard of fire or explosion which can cause severe personal injury or death. Do not permit any flame, spark, pilot light, cigarette, or other ignition source near the fuel system.***

Use the best fuel available. Fuel quality is important for dependable performance and satisfactory engine life. Regularly check the fuel filter according to the Maintenance Schedule in this manual. Replace if necessary.

⚠WARNING ***Ignition of fuel can cause serious personal injury or death by fire or explosion. Do not permit any flame, cigarette, pilot light, spark or other igniter near the fuel system.***

Fuel Recommendation

Use ASTM 2-D (No. 2 Diesel) or ASTM 1-D (No. 1 Diesel) fuel with a minimum Cetane number of 45. Number 2 diesel fuel gives the best economy and performance under most conditions. Use number 1 diesel fuel when ambient temperatures are below 32° F (0° C), and during long periods of light engine load.

Use low sulfur content fuel which has a cloud point at least 10 degrees below the lowest expected fuel temperature. (Cloud point is the temperature at which wax crystals begin to form in diesel fuel.)

RAW WATER PUMP PRIMING

Before beginning operation (initial start-up), the raw (sea) water pump should be primed. The priming water provides an impeller surface lubricant until flotation water is pulled into the pump.

To prime the pump, close the sea cock and remove the hose from the water filter outlet. Fill the hose and pump with clean water. Replace the hose and open the sea cock. Check pump operation on start-up by observing water discharge from the exhaust outlet.

GENERAL INSPECTION

Check the generator set for damaged or loose parts. Make sure the air inlet and outlet areas are not blocked. Investigate any abnormal operating noises. Make sure that the generator set is securely mounted.

Starting and Stopping

⚠WARNING

EXHAUST GAS IS DEADLY!

Exhaust gases contain carbon monoxide, an odorless and colorless gas. Carbon monoxide is poisonous and can cause unconsciousness and death. Symptoms of carbon monoxide poisoning can include:

- ***Dizziness***
- ***Nausea***
- ***Headache***
- ***Weakness and Sleepiness***
- ***Throbbing in Temples***
- ***Muscular Twitching***
- ***Vomiting***
- ***Inability to Think Coherently***

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET OUT INTO THE FRESH AIR IMMEDIATELY. If symptoms persist, seek medical attention. Shut down the unit and do not operate until it has been inspected and repaired.

Never sleep in the vessel with the generator set running unless the vessel interior is equipped with an operating carbon monoxide detector. Protection against carbon monoxide inhalation also includes proper exhaust system installation and visual and audible inspection of the complete exhaust system at the start of each generator set operation.

STARTING

Starting at Set

1. Hold the starting switch to the STOP/PREHEAT position for 10 to 30 seconds, depending on the temperature (see Table 2).

   ⚠CAUTION ***Preheat time longer than 30 seconds may damage glow plugs.***

TABLE 2. PREHEAT TIME vs. TEMPERATURE

Ambient Temperature	Preheat Time
Above 86° F (30° C)	10 seconds
Between 50° to 86° F (10° to 30° C)	15 seconds
Between 32° to 50° F (0° to 10° C)	20 seconds
Below 32° F (0° C)	30 seconds

2. Release the switch, then move it to the START position. The starter will crank and after a few seconds the engine should start. The starter will automatically disconnect when the generator AC voltage builds up.

3. If the engine does not start after cranking 30 seconds, release the switch. Wait two minutes, then repeat Step 1 (preheat).

   ⚠CAUTION ***Excessive cranking can overheat the starter, damaging it. Do not engage the starter longer than 30 seconds without allowing two minutes for cooling.***

4. If the engine does not start on the second try:

   - Check the fuel supply.
   - Make sure the fuel system has been primed.

   With an empty tank, the fuel system may need priming before the set can start. See *Fuel System* in the *Maintenance* Section.

Starting at Remote Panel

The same procedures and cautions for normal starting apply to remote starting.

Starting at Remote (Meter) Panel

If the optional remote panel with meters has been installed, monitor the oil pressure, water temperature, and set DC voltage while the set is being started, and after it has run for roughly a minute. Note the following:

- ***Oil Pressure Gauge:*** The oil pressure should be in the range of 28 to 64 psi (294 to 543 kPa) when the engine is at operating temperature.
- ***Coolant Temperature Gauge:*** The coolant temperature should be in the range of 165° to 195° F (74° to 91° C) depending on the load and ambient temperature.
- ***DC Voltmeter:*** Normal battery voltage should be 12.5 to 15 volts. Actual voltage depends on the battery state-of-charge and condition.

STOPPING

Before Stopping

Run the genset at no load three to five minutes before stopping. This lets the lubricating oil and engine coolant carry heat away from the combustion chamber and bearings.

⚠ CAUTION ***Failure to allow running time for engine cooling without load can cause engine damage. Make sure the generator set runs unloaded at least three minutes.***

⚠ CAUTION ***"After Boil" 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 of fault shutdown. Refill and clean up as necessary.***

To Stop: Push the switch to STOP, and hold it there until the engine stops.

Wattage Requirements

AC WATTAGE CAPACITY

The AC power output from the generator will power appliances and other equipment. (The wattage requirement of appliances and electrical equipment may be referred to as “electrical load”.)

AC line circuit breakers mounted on the set protect the generator from an overloaded output, which occurs when too much load is applied at once, or if there is a short circuit in the system.

Connecting a Load

To determine the maximum amount of electrical load that can be applied, follow these steps:

1. Determine the maximum load (wattage) supplied by the genset/vehicle circuit, by multiplying the circuit breaker size by the AC output voltage:

   2 x 45 (amps) x 120 (volts) = 10800 watts
   or
   2 x 22.5 (amps) x 240 (volts) = 10800 watts

2. Check the wattage requirement of each appliance to be connected (see Table 3). The appliance nameplate should list the wattage of each item.

3. Add the wattages of all the items to be powered at the same time. Make sure that the total wattage does not exceed the limit of the circuit breaker.

   Example:

Air Conditioner	1800 watts
Converter	500 watts
Coffee Percolator	600 watts
Television	300 watts
Total	3200 watts

4. Start the generator set and let it warm up a few minutes before applying electrical load.

Make sure that each appliance and tool is properly grounded and in good working condition before using it.

⚠WARNING ***Electrical shock can cause severe personal injury or death. Appliances should be in good working condition and be properly grounded to provide additional protection from electrical shock.***

TABLE 2. APPROXIMATE POWER DRAW OF COMMON APPLIANCES

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

Motorized Appliances

Motorized appliances consume more power during startup than they do when running at normal speed. (Some motors draw as much as three times their operating power during startup.) If you plan to use a motorized appliance, turn it on **before** starting other appliances. When the motor is running at normal speed, more appliances may be added.

Circuit Breakers

Circuit breakers on the electrical distribution panel or on the genset will open if their current ratings are exceeded. This may be caused either by running too many appliances at once, or by a short circuit.

The genset will continue to run after a breaker trips. Turn off all appliances and other loads, then reset

the breaker. If it trips again, a short circuit is indicated. Turn off the set and contact a qualified technician for assistance.

If the breaker does not trip, turn on only as many appliances as the breaker size allows (see *Connecting A Load* in this section). If the breaker trips again, a defective appliance or circuit breaker is indicated.

Connection to Shore Power

Connect the Boat to shore power (power from an outside source such as a plug-in outlet) **only** through an approved device, to protect against the possibility of generator power and shore power being connected. Consult the Installation Manual (publication 981-0601) for information on isolating the genset from shore power.

⚠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.***

DC POWER

A 10-amp belt-driven alternator on the engine supplies DC power to recharge the starting battery for the set.

Operating Recommendations

BREAK-IN PROCEDURE

Drain the crankcase oil after the first 35 hours of operation. See the *Maintenance* section of this manual for the procedure.

NO-LOAD OPERATION

Hold no-load operation to a minimum. With no load, combustion chamber temperatures drop so low that fuel does not burn completely. This creates carbon deposits which clog injectors, glaze cylinders and cause piston rings and valves to stick. If it is necessary to run the engine for long periods, **connect an electrical load to the generator output.**

EXERCISE PERIOD

Infrequent use can result in difficult starting and moisture condensation problems. This moisture is a result of the engine not being run long enough to reach normal operating temperature. In extreme cases, water may be deposited in the oil. If this happens, severe engine damage can result. To prevent this possibility, run the generator set under load at least one hour per week.

Exercising for one long period each week is better than several shorter periods of operation. Do NOT operate the set for long periods at no load.

Maintenance Schedule

Following the maintenance schedule and using the generator set properly will result in longer genset life, better performance, and safer operation. Perform each maintenance procedure at the time period indicated or after the number of operating hours indicated, whichever comes first. Refer to the *Maintenance Procedures* section for instructions.

Consult an Onan service center if the generator set will be subjected to extremely hot or dusty conditions; a more frequent maintenance schedule may be necessary. Use the running time meter to keep an accurate log of all service and maintenance for warranty support (see the *Maintenance Record* section).

⚠WARNING ***Accidental or remote starting can cause servere personal injury or death. Disconnect the negative (–) cable at the battery to prevent starting while working on the generator set.***

TABLE 2. PERIODIC MAINTENANCE SCHEDULE

	SERVICE TIME				
SERVICE THESE ITEMS	**Daily or after 8 hours**	**Monthly or after 100 hours**	**6 Months or after 250 hours**	**Yearly or after 500 hours**	**PAGE**
Inspect Set	x[1]				14
Check Oil Level	x				5
Check Coolant Level	x				6
Check Fuel Level	x				7, 19
Check Battery Specific Gravity		x			22
Check Pump Belt Tension		x[6]			–
Change Crankcase Oil and Filter			x[2,3,5]		15
Drain Water/Sediment From Fuel Filter		x			20
Change Fuel Filter			x		20, 21
Flush/Clean Cooling System				x	17
Check Genset Brushes			x[6]	x	–

1 - Check for oil, fuel, cooling and exhaust system leaks. Check exhaust system audibly and visually with genset running and repair any leaks immediately.
2 - Perform after first 35 hours of operation on new genset.
3 - Perform more often in extremely dusty conditions.
4 - Visually check belts for evidence of slippage.
5 - Yearly if operated less than 250 hours.
6 - To be performed by authorized service technician.

Maintenance Procedures

INTRODUCTION

The procedures described in this section are limited to those that can be performed by the knowledgeable genset operator. If there is any doubt as to the correct performance of a procedure, consult your Onan distributor. **Certain procedures on the Maintenance Schedule (brush replacement, etc.) should only be performed by a qualified service technician.**

GENERATOR SET INSPECTION

Inspect the generator set daily or after every eight hours of operation, whichever comes first. Check the exhaust, fuel, and DC electrical systems as described below. Also check the mechanical condition of the set.

Engine Gauges (Remote Installation)

Check these gauges while the set is running.

Oil Pressure Gauge: Oil pressure should be 28 to 64 psi (294 to 543 kPa) when the engine is at operating temperature.

Coolant Temperature Gauge: Coolant temperature should be 165° to 195° F (74° to 91° C), depending on load and ambient temperature.

DC Voltmeter: Battery voltage during operation should be 12.5 to 15 volts on a 12-volt system.

Exhaust System

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

Check that all CO monitors are working properly.

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

Fuel System

Check for leaks at hose, tube and pipe fittings in the fuel supply and return systems while the generator set is stopped. Check flexible fuel hose for cute, cracks, abrastions and loose hose clamps. Make sure fuel lines do not rub against other parts. Replace worn or damaged fuel line parts before leaks occur. Replace hose with a USCG TYPE A1 or ISO 7840–A1 fuel hose.

Prime the fuel system if the generator set ran out of fuel.

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

MAINTAINING THE BATTERY AND BATTERY CONNECTIONS

⚠WARNING ***Arcing at the battery terminals or in light switches or other equipment, and flames or sparks, can ignite battery gas causing severe personal injury–Ventilate battery area before working on or near battery–Wear safety glasses–Do not smoke–Switch work light ON or OFF away from battery–Stop generator set and disconnect charger before disconnecting battery cables–Disconnect negative (–) cable first and reconnect last.***

Refer to Table x–x for scheduled battery maintenance, and follow the battery manufacture'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.

Always:

1. Keep the battery case and terminals clean and dry and the terminals tight.

2. Remove battery cables with a battery terminal puller.

3. Make sure which terminals is positive (+) and which is negative (–) before making battery connec-

tions, always removing the negative (–) cable first and reconnecting it last to reduce arcing.

Coolant Level

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. 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. See Refilling the Cooling System . Use the recommended antifreeze mixture.

Raw Water System

Clean out the sea water strainer if necessary and make sure the sea valve is open for generator set operation. Also, when a water/exhaust separator is provided, open the sea valve for the water drain hose.

Mechanical

Visually inspect genset for mechanical damage. For generator sets with a sound shield, install service doors before running the generator set to listen for unusual noises. Check the generator set mounting bolt. Check to see that the generator set air inlet and outlet openings are not clogged with debris or blocked. Keep the generator set compartment clean.

OIL AND FILTER CHANGE

The engine oil was drained from the crankcase before shipment. **Before the initial start, fill the lubrication system with the recommended oil.** See the *Specifications* section for oil capacity.

Change the oil and filter at the intervals listed in Table 1. Use oil that meets the API classification and SAE viscosity grade indicated in the previous section.

Engine Oil Change

Run the engine until thoroughly warm. Stop the engine, open the drain valve (Figure 6) and drain the oil into a container. When completely drained, close the valve and refill the crankcase with new oil.

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

***WARNING** Engine components (drains, filters, hoses, etc) will be hot and can cause servere burns. The use of protective gloves is recommended.*

***WARNING** State or federal agencies have determined that prolonged contact with used engine oil can cause cancer or reproductive toxicity. When adding, changing or working with used oil, take care not to breathe, ingest or come into excessive contact with these substances. Wash hands after use. Wear protective clothing and equipment. Provide adequate ventilation.*

Oil Filter Change

Spin off the oil filter and discard it. Thoroughly clean the filter mounting surface. Apply a thin film of oil to the filter gasket, and spin the filter on until the gasket just touches the mounting pad. Then turn an additional 3/4 turn. Do not over-tighten the filter.

Add the quantity of oil listed in the Specifications section of this manual to the crankcase, start the set and check for leakage around the filter gasket. Tighten the filter only enough to eliminate leaks. Shut off the set, recheck the oil level and add additional oil if necessary.

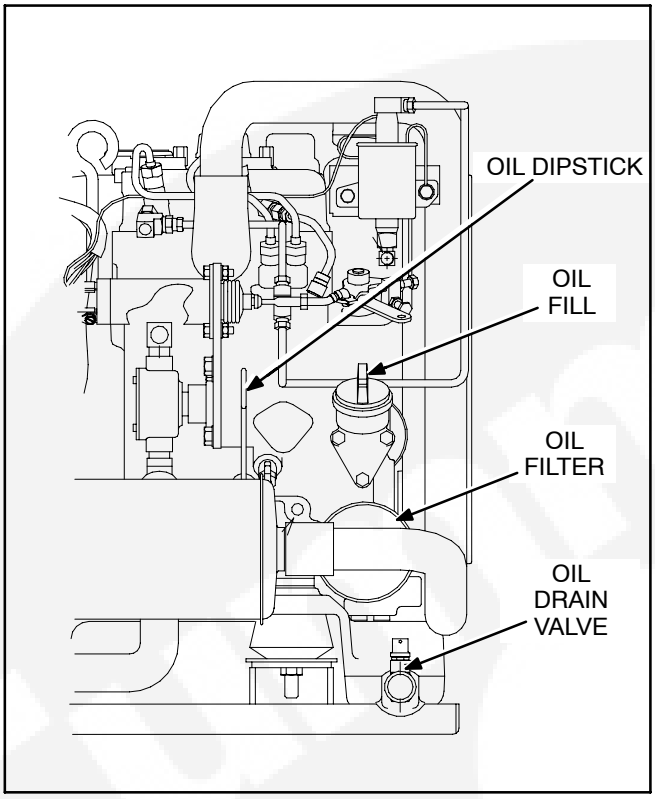


FIGURE 6. ENGINE OIL

COOLING SYSTEM

The cooling system is drained before the set is shipped. **It must be refilled before the genset is operated.** Cooling system capacity is listed in the *Specifications* section.

Coolant Requirements

Engine coolant must inhibit corrosion and protect against freezing. A 50/50 mixture of ethylene glycol anti-freeze and water is recommended for normal operation and storage. Use only a reliable brand of anti-freeze that contains a rust and corrosion inhibitor. **The anti-freeze should not contain a stop-leak additive.**

Do not exceed a 50/50 mixture of ethylene glycol and water. A higher proportion of ethylene glycol will alter the heat transfer properties of the coolant. A 50/50 mixture will provide freeze protection to -34° F (-37° C).

Water used for engine coolant should be clean, low in minerals, and free of corrosive chemicals. Use distilled or soft water if available. Avoid the use of well water, which may contain minerals which can clog the heat exchanger core and reduce cooling efficiency.

Filling the Cooling System

⚠WARNING ***Let the engine cool down before removing the coolant pressure cap or opening the coolant drain. Hot coolant under pressure can spray and cause severe burns.***

⚠WARNING ***Accidental or remote starting can cause servere personal injury or death. Disconnect the negative (–) calbe from the battery to prevent the engine from starting.***

⚠WARNING ***Engine components (drains, filters, hoses, etc) will be hot and can cause severe burns. The use of protective gloves is recommended.***

Verify that all drain cocks are closed and all hose clamps are secure. Remove the cooling system pressure cap and slowly fill the cooling system with the coolant mixture.

⚠ CAUTION ***Exceeding the recommended fill rate can cause incomplete filling of the engine block, leading to engine damage during warm-up. Always follow the recommended fill procedure.***

Fill the recovery tank with coolant mixture to the FULL mark. Operate the genset until normal operating temperature is maintained (about 15 minutes of operation). Shut down the genset and let cool. Add coolant to recovery tank until coolant level stabilizes at the Full mark - this may require several operation cycles.

⚠WARNING ***Contact with hot coolant can result in serious burns. Do not bleed hot, pressurized coolant from a closed cooling system.***

⚠ CAUTION ***The high engine temperature cutoff will shut down the engine in a overheat condition only if the coolant level is sufficiently high to physically contact the shutdown switch. Loss of coolant will allow engine to overheat without protection of shutdown device, thereby causing severe damage to the engine. It is therefore imperative that adequate engine coolant levels be maintained for operational integrity of the cooling system and engine coolant overheat shutdown protection.***

⚠ WARNING ***Let the engine cool down before removing the coolant pressure cap or opening the coolant drain. Hot coolant under pressure can spray and cause severe burns.***

⚠ WARNING ***Accidental or remote starting can cause servere personal injury or death. Disconnect the negative (–) calbe from the battery to prevent the engine from starting.***

⚠ WARNING ***Engine components (drains, filters, hoses, etc) will be hot and can cause severe burns. The use of protective gloves is recommended.***

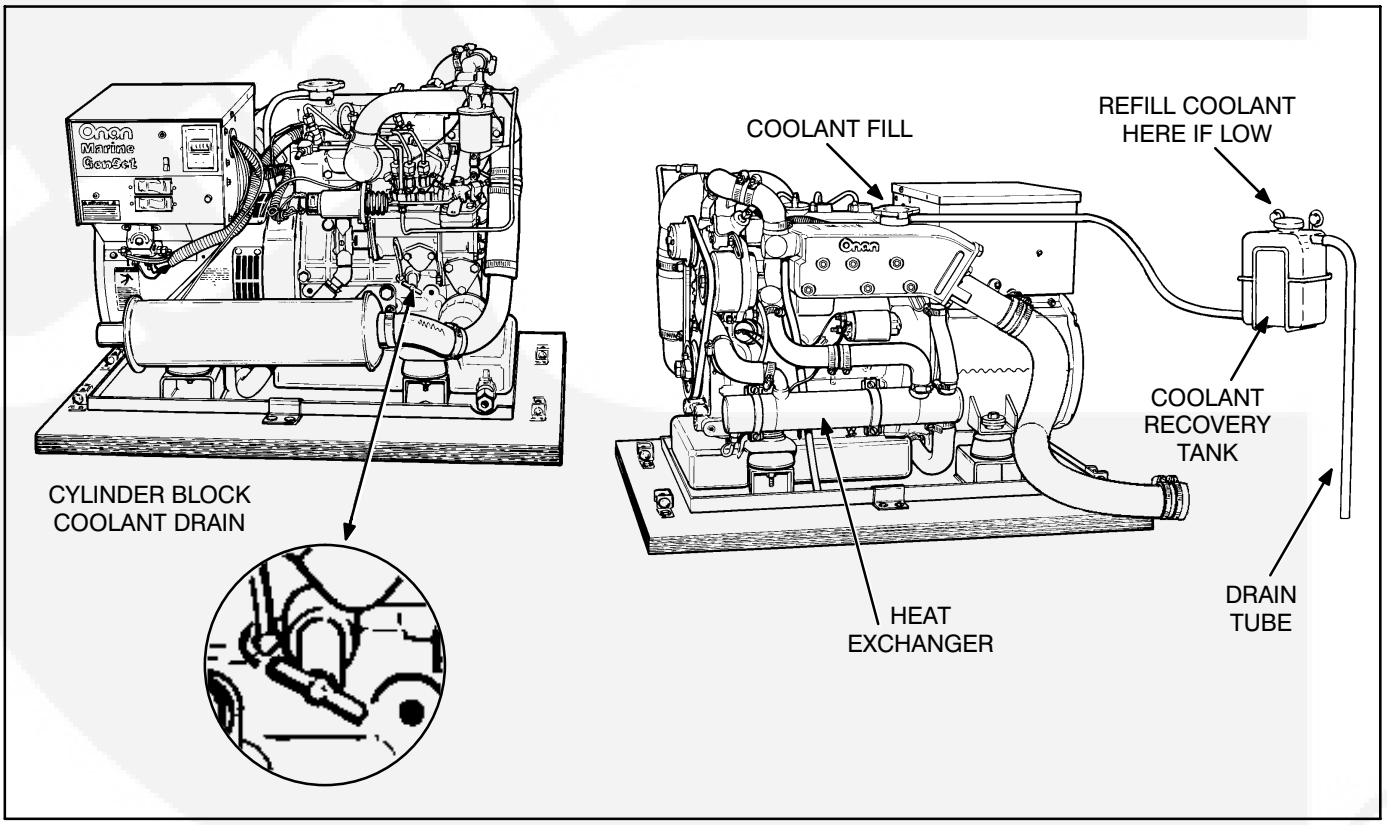


FIGURE 7. GENSET COOLING SYSTEM

Pressure Cap

⚠WARNING ***Let the engine cool down before removing the coolant pressure cap or opening the coolant drain. Hot coolant under pressure can spray and cause severe burns.***

Closed cooling systems use a pressure cap to increase the boiling point of the coolant and allow higher operating temperatures. Replace the pressure cap every two years, or sooner if it malfunctions. The cap is rated at 7 psi (48 kPa).

Siphon Break Valve

A siphon break valve should be installed on gensets if the exhaust injection elbow is at or below load water line. When properly installed, it helps prevent sea water siphoning into the engine and compartment when the genset shuts down.

The siphon break valve is normally trouble-free. However, when used in contaminated waters or salt water for example, some corrosion may appear. The valve can be checked for free movement after unscrewing the top cover. If the valve sticks or the seat shows wear, the valve must be replaced (see Parts Manual). The siphon valve is not part of the generator set; however, Onan provides a siphon valve kit.

FUEL SYSTEM

Use the best fuel available. Fuel quality is important for dependable performance and satisfactory engine life.

⚠WARNING ***Ignition of fuel can cause serious personal injury or death by fire or explosion. Do not permit any flame, cigarette, pilot light, spark or other igniter near the fuel system.***

Fuel Recommendation

Use ASTM 2-D (no. 2 Diesel) or ASTM 1-D (No. 1 Diesel) fuel with a minimum Cetane number of 45. Number 2 diesel fuel gives the best economy and performance under most conditions. Use number 1 diesel fuel when ambient temperatures are below 32° F (0° C), and during long periods of light engine load.

Use low sulfur content fuel which has a cloud point at least 10 degrees below the lowest expected fuel temperature. (Cloud point is the temperature at which wax crystals begin to form in diesel fuel.)

Fuel Handling Precautions

Prevent dirt, water or other contaminants from entering the fuel system. Filter or strain the fuel as the tank is filled.

⚠CAUTION ***Due to the precise tolerances of diesel injection systems, dirt or water in the system will cause severe damage to both the injection pump and the injection nozzles. It is extremely important the fuel be kept clean and water free.***

Condensation (water) can cause clogging of fuel filters as well as freezing problems. Water mixing with the sulfur in the fuel forms acid which can corrode and damage engine parts.

Low fuel in the tank promotes condensation. In warm weather, the fuel tank cools at night quicker than the fuel. If the fuel level is low, the upper portion of the tank will cool more rapidly, forming condensation. In cold weather, the warm fuel returning from the injectors heats the fuel in the supply tank. If the fuel is low, condensation may form on the upper part of the tank. **To avoid condensation, fill the fuel tank every time the genset is used.**

Priming the Fuel System

The fuel system must be primed before initial start-up or after the engine has run out of fuel. Figure 9 illustrates the fuel system.

Low Pressure Fuel System: The electric fuel pump, fuel filter and injection pump inlet comprise the low pressure fuel system. To prime these components (remove the trapped air), follow the same procedure as when the fuel filter is replaced (following section).

Be sure to check the fuel level in the tank and that the shutoff valve is open.

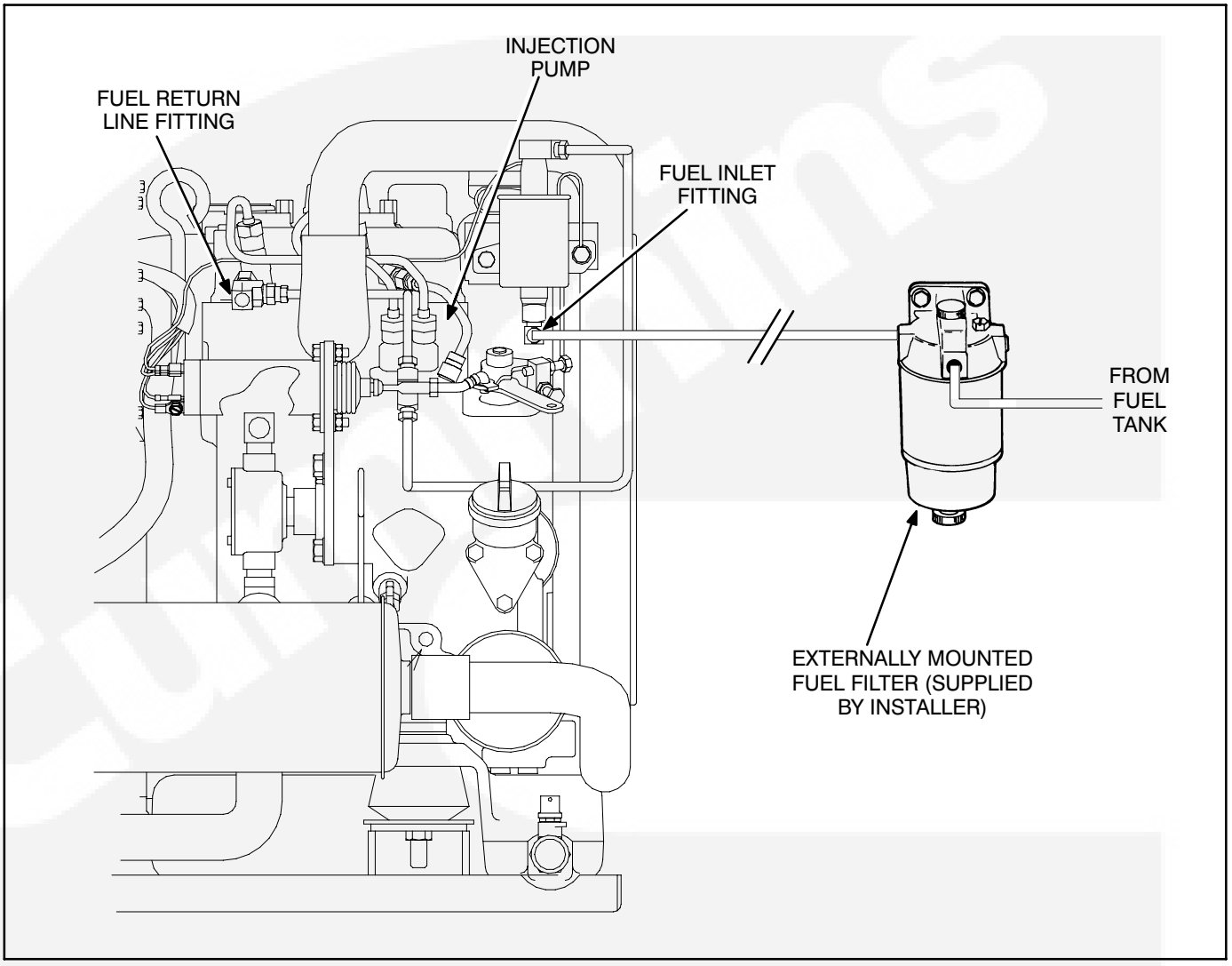


FIGURE 9. INJECTION PUMP FUEL SYSTEM

Fuel Filter

The filter replacement interval will vary according to the fuel quality and cleanliness. Using the wrong fuel, or dirty fuel, will shorten service life of the filter.

⚠ CAUTION ***Dirt or water in the system will cause severe damage to both the injection pump and the injection nozzles. It is extremely important that the fuel be kept clean and free of water.***

Draining Water/Sediment From Filter: Refer to Table 1 for the recommended time interval. Drain about 1/4 cup of fuel as follows:

1. Open the drain valve and bleed plug on the fuel filter assembly (Figure 10). Collect fuel in a suitable container and dispose of properly.
2. Tighten drain valve.
3. Bleed air from the filter housing by performing Steps 8 through 10 in the next paragraph.

Replacing Filter Element: Refer to Table 1 for the recommended filter change interval. However, if the engine shows signs of fuel starvation (reduced power or surging), change the fuel filter. Use the following procedure to replace.

1. Loosen the drain valve and bleed screws. Collect fuel in a suitable container and dispose of

properly. Remove the bleed plug. See Figure 4-5.

2. Remove filter element from the head with the bowl connected.
3. Clean the bowl, O-ring and O-ring gland.
4. Lubricate the O-ring with clean diesel fuel and place it in the bowl gland.
5. Tighten the drain valve.
6. Spin the bowl onto the new element. DO NOT OVER-TIGHTEN.
7. Lubricate the element and gasket, and fill bowl and filter element with clean diesel fuel.
8. Spin the bowl and element assembly onto the head and hand tighten.
9. Disconnect the starter solenoid lead at the Faston terminal connector (this connector is on the starter solenoid). This allows the fuel pump operation without cranking the engine.
10. Depress the Start switch until fuel purges at the bleed screw and bleed plug opening.
11. Replace the bleed plug and close bleed screw. Reconnect the starter solenoid lead.

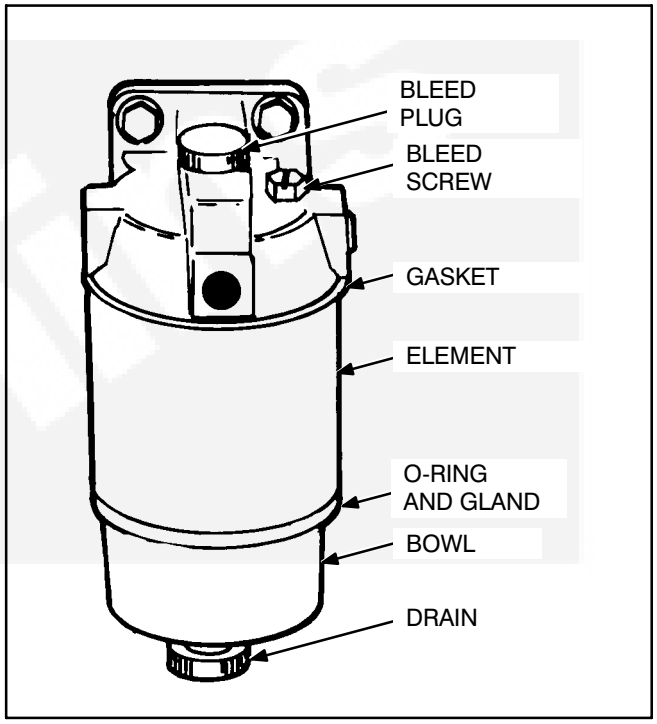


FIGURE 10. FUEL FILTER ASSEMBLY

BATTERY CARE

Service the battery at the intervals shown in the maintenance schedule. Check the electrolyte level more frequently during hot weather.

WARNING ***Batteries present the hazard of explosion that can result in severe personal injury. Do not smoke or allow any fire, flame, spark, pilot light, arc-producing equipment or other ignition sources around the battery area. Do not disconnect battery cables while the generator set is cranking or running because explosive battery gases could be ignited.***

WARNING ***Battery electrolyte can cause severe eye damage and burns to the skin. Wear goggles, rubber gloves and a protective apron when working with batteries.***

1. Keep the battery case clean and dry.
2. Make certain that the battery cable connections are clean and tight. Use a terminal puller tool to remove the battery cables.

   Remove corrosion from the battery terminal connections. Wash the terminals with an ammonia solution or a solution consisting of 1/4 pound (about 100 grams) of baking soda in 1 quart (about 1 liter) of water. Be sure the vent plugs are tight to prevent cleaning solution from entering the cells. After cleaning, flush the outside of the battery and the surrounding areas with clean water.
3. Identify the cable as positive (+) or negative (-) before making the battery connections. Always connect the negative (-) cable last, to reduce the risk of arcing.
4. Maintain the electrolyte level by adding distilled water. Fill each cell to the split-level marker in the battery. The water component of the electrolyte evaporates, but the sulfuric acid component remains. For this reason, add water, not electrolyte to the battery.
5. Use a battery hydrometer to check the specific gravity of the electrolyte in each battery cell (Figure 11). Charge the battery if the specific gravity measures less than 1.215. Do not overcharge the battery. Stop charging the battery when the electrolyte specific gravity reaches 1.260, at approximately 80° F (27° C).

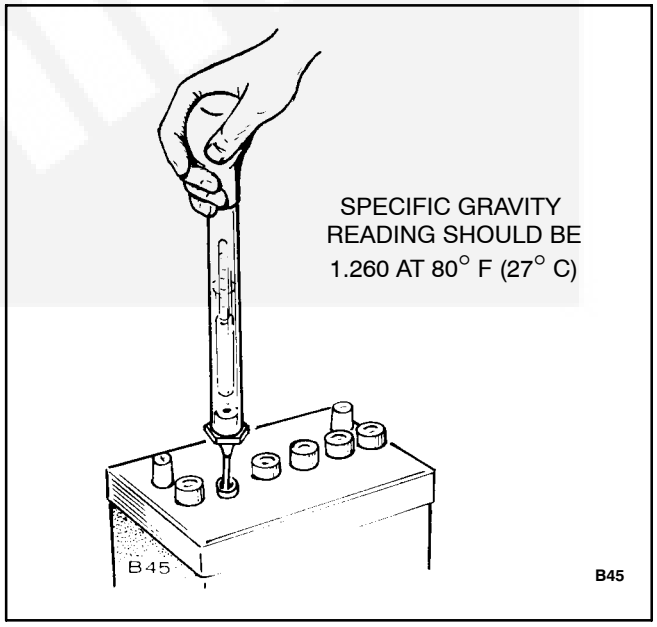


FIGURE 11. BATTERY CHECK

AC GENERATOR

Generator Brushes

The generator should be inspected for brush wear and cleaning as required per the Periodic Maintenance Schedule. This procedure should be performed by an authorized Onan service technician.

WARNING ***Accidental starting of the generator set can cause severe personal injury or death. Stop the generator set and disable by disconnecting the starting battery cables (negative [-] cable first) before inspecting the generator.***

Generator Set Storage

OUT-OF-SERVICE PROTECTION

The lubricating qualities of No. 2 diesel fuel should protect the cylinders of a diesel engine at least 30 days when the set is not being run. For storage longer than 30 days, proceed as follows:

1. Exercise the genset (see *Operation* section) until the engine is at operating temperature.

2. Shut down the genset and disconnect the battery cables (negative [-] cable first). Store the battery in a cool, dry place and connect to a trickle charger once every 30 days to maintain full charge.

   ⚠WARNING ***Battery electrolyte can cause severe eye damage and burns to the skin. Wear goggles, rubber gloves and a protective apron when working with batteries.***

   ⚠WARNING ***Engine components can be hot and cause severe burns. Hot coolant under pressure can spray and cause severe burns.***

3. Drain the crankcase oil while still warm. Replace oil filter. Refill crankcase and attach a tag indicating oil viscosity.

   ⚠WARNING ***Let the engine cool down before removing the pressure cap or opening the coolant drain. Hot coolant under pressure can spray and cause severe burns.***

4. Check the coolant level. Add more coolant if low. If freezing temperatures are possible, test the coolant mixture.

   The sea water cooling system must be drained of water, or protected with a 50-50 anti-freeze mixture as follows:

   A. Close sea cock and remove the raw water inlet hose at filter.

   B. Place end hose in a bucket of anti-freeze mixture and run engine until mixture is observed coming out of the exhaust outlet.

   C. Replace inlet hose and tighten clamp.

5. Plug exhaust outlets to prevent entrance of moisture, bugs, dirt, etc.

6. Clean and wipe the entire genset. Lightly coat parts that may rust with grease or oil.

Returning the Genset to Service

Refer to the preceding paragraphs in this *Maintenance* section for specific service procedures.

1. Remove plug from the exhaust outlet, and open the sea cock.

2. Check tag on oil base and verify that oil viscosity is still correct for existing ambient temperature.

3. Clean and check the battery. Measure the electrolyte specific gravity with a hydrometer (1.260 @ 80° F [27° C]) and verify the proper level. If the specific gravity is low, charge the battery until the value is correct. If the level is low, add distilled water and charge until the specific gravity reading is correct. DO NOT OVERCHARGE.

   ⚠WARNING ***Battery electrolyte can cause severe eye damage and burns to the skin. Wear goggles, rubber gloves and a protective apron when working with batteries.***

4. Prime the fuel system.

5. Connect the starting battery, negative (-) cable last.

6. Remove all loads before starting the genset.

7. After starting, run the generator set at no load for roughly 30 seconds. Then apply a load of at least 50 percent rated capacity.

8. Check all gauges for normal readings. Genset is ready for operation.

Troubleshooting

⚠WARNING ***Some generator set service procedures prsent 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 services. See Safety Precautions.***

DC CONTROL

The DC control has a number of sensors that continuously monitor the engine for low oil pressure, high coolant temperature and high exhaust temperature. If any of these conditions occur, the control stops the engine. See Figure 13.

If a major problem is indicated, contact an Onan dealer or distributor for help or service.

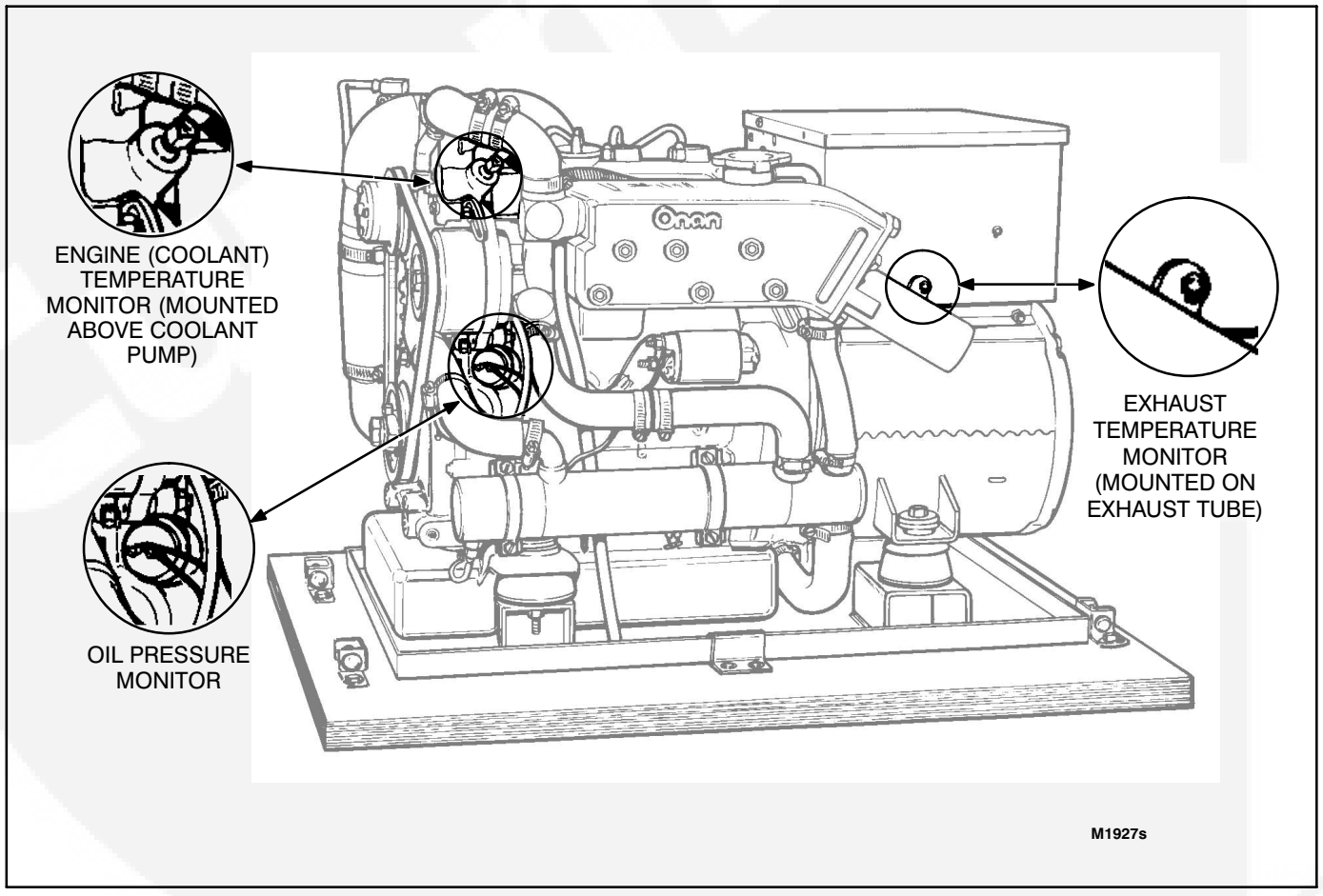


FIGURE 13. LOCATION OF ENGINE MONITORS

Low Oil Pressure

⚠WARNING ***Crankcase pressure can blow out hot oil and cause SEVERE burns. Do NOT check oil while the generator set is operating.***

Remove dipstick and check oil level. If low, add oil to bring level up to full mark. Inspect engine exterior for leaks and repair as necessary. The oil pressure switch actuates the fault circuit if pressure drops below 9 psi (62 kPa).

High Coolant Temperature

⚠WARNING ***Contact with hot coolant can result in SEVERE burns. Allow cooling system to cool before releasing pressure and removing radiator cap or release of hot coolant can result.***

If fault occurred during operation, check the set for indication of coolant temperature over 222° F (106° C). The coolant thermostat switch closes at this temperature and actuates the fault circuit.

Check the coolant level in the exhaust manifold after allowing the engine to cool down. Ensure pump belt is OK and has proper tension. The raw water flow at the exhaust outlet should be about 3 gal./min. (11.4 liter/min.). Also check cooling system cleanliness (freedom from contaminants, rust, sludge buildup, etc.).

High Exhaust Temperature

⚠WARNING ***Inhalation of exhaust gas can cause serious personal injury or death. Do not disconnect or bypass the exhaust elbow switch. Excessive heat will damage the exhaust hoses and cause exhaust gas leakage. If exhaust hose is damaged, shut off the generator set immediately and do not operate until hose is repaired.***

The high exhaust temperature switch is mounted on the exhaust elbow and closes on temperature rise above 230° F (110° C). It closes to shut down the set if raw water flow is lost. It opens again when the temperature reaches about 190° F (88° C).

AC CONTROL

The AC control consists of the line circuit breakers and the generator field breaker. The line circuit breakers are connected between the generator output and the load. Breakers are required to protect the generator from shorts or overload. They are mounted on the side of the AC control box on the set. Line circuit breakers are customer supplied on the set, and their location may vary.

The generator field breaker protects the generator rotor from overload damage.

FAULT CODE BLINKING

At fault shutdown, the status indicator light will repeatedly blink sets of 1, 2, 3 or 4 blinks.

- **One blink** indicates shutdown due to high engine coolant temperature.
- **Two blinks** indicate shutdown due to a loss of engine oil pressure.
- **Three blinks** indicate a service fault. Press **Stop** once to cause the two-digit, second-level shutdown code to blink. (Pressing **Stop** again will stop the blinking.) The two-digit code consists of 1, 2, 3, 4 or 5 blinks, a brief pause, and then 1 to 9 blinks. The first set of blinks represents the tens digit and the second set of blinks the units digit of the shutdown code number. For example, **shutdown code No. 36** appears as:

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

- **Four blinks** indicate that cranking time exceeded 35 seconds.
- *Fault Code Nos. 1, 2, 3, and 4 are first level faults. Pay close attention to the pause sequence to avoid interpreting first level faults as second-level Fault Codes Nos. 11, 22, 33, or 44.*
- *To avoid the possibility of anyone misinterpreting Code Nos. 3 and 4 as Code Nos. 33 and 44, the latter have not been assigned faults.*

RESTORING FAULT CODE BLINKING

The fault code stops blinking after five minutes. Press **Stop** three times within three seconds to restore fault code blinking.

How to Obtain Service

HOW TO OBTAIN SERVICE

For generator set parts, service, and product information (such as the Service Manual), contact the nearest authorized Cummins Onan distributor. You may go to Internet site ***www.cumminsonan.com*** for information for contacting our distributors worldwide.

In North America

Call 1-800-888-6626 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

Outside North America

Call Cummins Power Generation at 1–763–574–5000 from 7:30 AM to 4:00 PM (Central Standard Time), Monday through Friday, or fax 1–763–528–7229.

Information To Have Available

1. *Model Number, including Spec Letter, and Serial Number (Figure 1–1).*
2. *Date of purchase.*
3. *Nature of problem (Section 1–1. Troubleshooting).*

EMISSIONS LABEL

The label that states compliance with applicable engine emissions regulations is located on the engine as circled in Figure 1-1. Refer also to the FEDERAL EMISSION DESIGN AND DEFECT LIMITED WARRANTY FOR C. I. ENGINES (DIESELS) that was shipped in the same package as the Operator's Manual.

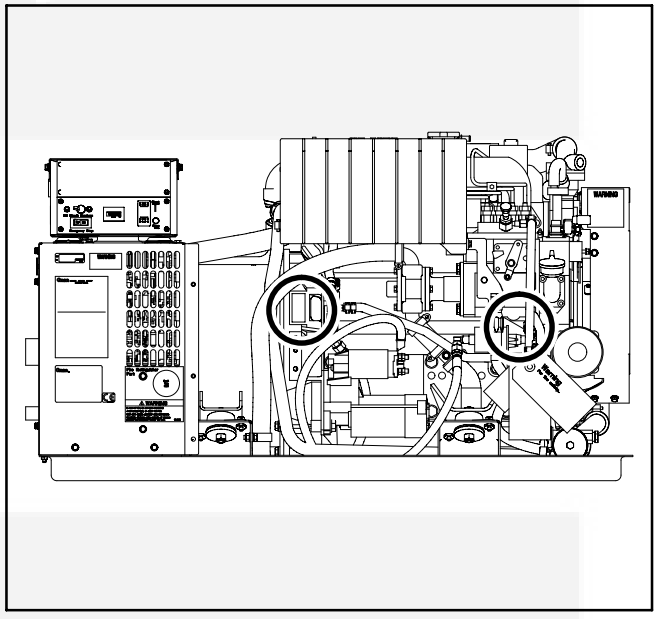


FIGURE 1-1. TYPICAL EMISSIONS LABEL LOCATIONS

Specifications

DIMENSIONS AND WEIGHT

MDKUB:	Weight (with housing)	172.4 kg (380 pounds)
	Height	595.8 mm (23.46 inches)
	Length	709.7 mm (27.94 inches)
	Width	545.4 mm (21.47 inches)
MDKWB:	Weight	204.1 kg (450 pounds)
	Height	595.8 mm (23.46 inches)
	Length	816.7 mm (32.15 inches)
	Width	545.4 mm (21.47 inches)

GENERATOR

Type: 2-pole revolving field, 4-wire reconnectible
Standby ratings: See Genset Nameplate
Frequency regulation, no load-rated load: 5 percent
Voltage regulation, no load-rated load: ±2 percent

ENGINE

Engine type:	MDKUB	Kubota Z482B, diesel, 2 cylinder, vertical in-line
	MDKWB	Kubota D722B, diesel, 3 cylinder, vertical in-line
Bore and stroke:		67 x 68 mm (2.64 x 2.68 inches)
Total displacement:	MDKUB	479 cc (29.23 cubic inches)
	MDKWB	719 cc (43.89 cubic inches)
Combustion chamber:		Spherical type
Engine speed:	60 Hz sets:	3600 rpm
	50 Hz sets:	3000 rpm
Fuel:		No. 2 diesel
Oil capacity with filter:	MDKUB	3.78 liters (4 quarts)
	MDKWB	4.73 liters (5 quarts)

Fuel consumption (No. 2 diesel fuel) liters/hour (gallons/hour) average @ half load:

MDKUB @ 60 Hz	1.75 (0.46)
MDKUB @ 50 Hz	1.4 (0.37)
MDKWB @ 60 Hz	2.5 (0.65)
MDKWB @ 50 Hz	2.0 (0.52)

Fuel consumption, (No. 2 diesel fuel) liters/hour (gallons/hour) average @ full load:

MDKUB @ 60 Hz	2.65 (0.7)
MDKUB @ 50 Hz	2.1 (0.55)
MDKWB @ 60 Hz	3.7 (0.98)
MDKWB @ 50 Hz	3.0 (0.79)

Fuel pump lift (self-priming) 1.2 meters (48 inches)
Fuel inlet 1/8-27, NPT, Female
Fuel return 1/8-27, NPT, Female
Total air per minute required (cooling and combustion): 4.25 m^3/min. (150 ft^3/min.)
Battery charge alternator maximum output (regulated) 10 amperes
Battery voltage (nominal) 12 volts
Battery recommendation minimum cranking performance @ 0° F (-18° C) 360 ampere

Coolant capacity:	MDKUB	2 liters (2.1 qt.)
	MDKWB	3.5 liters (3.7 qt.)

Maintenance Record

Keep a record of all periodic and unscheduled maintenance. Record the service date and the number of operating hours from the optional hour meter (if equipped).

DATE	HOUR METER READING	SERVICE PERFORMED / NOTES

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

Information for California Genset Users

These gensets meet the requirements of California's Exhaust Emissions Standards for 1995 and later for Utility and Lawn and Garden Equipment Engines.

As a California user of these gensets, please be aware that unauthorized modifications or replacement of fuel, exhaust, air intake, or speed control system components that affect engine emissions are prohibited. Unauthorized modification, removal or replacement of the genset label is prohibited.

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

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

TABLE 4. EMISSIONS CONTROL INFORMATION

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

Cummins **Onan**

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