# Operator Manual

Cummins **Onan**

**Performance you rely on.™**

## Generator Set

MDKBH (Spec A–D)

English – Original Instructions 2–2010 981–0180 (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.**

# Table of Contents


| SECTION | PAGE |
|---|---|
| Table of Contents | i |
| SAFETY PRECAUTIONS | iii |
| 1. INTRODUCTION | 1-1 |
| About this Manual | 1-1 |
| Model Identification | 1-1 |
| How to Obtain Service | 1-2 |
| Emissions Label | 1-2 |
| noise | 1-2 |
| electromagnetic compatibility | 1-3 |
| build standards | 1-3 |
| 2. OPERATOR CONTROL PANELS | 2-1 |
| Local Control | 2-1 |
| Remote Control | 2-1 |
| Operator Panel | 2-2 |
| 3. OPERATION | 3-1 |
| Fuel | 3-1 |
| Engine Oil | 3-1 |
| Engine Coolant | 3-2 |
| Batteries | 3-2 |
| Fire Extinguisher Port | 3-2 |
| Pre-Start Checks | 3-3 |
| Priming the Fuel System | 3-3 |
| Starting the Generator Set | 3-3 |
| Stopping the Generator Set | 3-3 |
| Emergency Stop | 3-4 |
| Loading the Generator Set | 3-4 |
| No-Load Operation | 3-4 |
| Connecting to Shore Power | 3-4 |
| Resetting Line Circuit Breakers | 3-5 |

Cold Temperature Operation . . . . . 3-5
Care of New or Re-Built Engine . . . . . 3-5
Exercising the Generator Set . . . . . 3-5
Storing the Generator Set . . . . . 3-6
4. PERIODIC MAINTENANCE . . . . . 4-1
Periodic Maintenance Schedule . . . . . 4-1
General Inspection . . . . . 4-2
Maintaining the Battery and Battery Connections . . . . . 4-3
Checking Engine Oil Level . . . . . 4-4
Changing Engine Oil and Filter . . . . . 4-5
Draining/Replacing the Fuel Filter . . . . . 4-6
Maintaining the Engine Cooling System . . . . . 4-7
5. TROUBLESHOOTING . . . . . 5-1
Troubleshooting with Operator Panel . . . . . 5-1
Troubleshooting with Status Lamp . . . . . 5-1
6. SPECIFICATIONS . . . . . 6-1
7. MAINTENANCE RECORD . . . . . 7-1

# 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 presend hazards that can result in severe personal injury or death. Only trained and experienced personnel with knowledge of fuels, electricity and machinery hazard 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** ***alerts you to an immediate hazard that will result in severe personal injury or death.***

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

**⚠ CAUTION** ***alerts 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.

## 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.
- 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.
- 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.
- Used engine oil has been identified by some U. S. state and federal agencies as causing cancer or reproductive toxicity. Do not ingest, inhale, or contact used oil or its vapors.
- Ethylene glycol, used as engine antifreeze, is toxic to humans and animals. Clean up spills and dispose of used engine coolant in accordance with local environmental regulations.
- Keep multi–purpose fire extinguishers handy. Multi–purpose fires 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 America: 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 shield shall not be run with the service doors removed/missing.
- Engine components can be hot and cause severe burns. Hot coolant under pressure can spray and cause severe burns.
- Use personal protective equipment when maintaining or installing the generator set such as gloves, saftey glasses, etc.

## THE HAZARDS OF CARBON MONOXIDE

Engine–driven generators can produce harmful level of carbon monoxide that can injuire or kill you.

The nature of boating is such that you can be harmed by this poisonous gas despite good geneartor 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.

### 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.

### 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.*

### 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.

### GASOLINE IS FLAMMABLE AND EXPLOSIVE

- Because this generator set is an *Ignition Protected* device, no substitutes are permitted for the parts listed in the *Critical Parts Index* of the generator set Parts Catalog. They must be purchased from Onan and be installed in accordance with the generator set Service Manual by those who are trained and experienced in marine generator set service.

### BATTERY GAS IS EXPLOSIVE

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

### MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

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

### FLAMMABLE VAPOR CAN CAUSE A DIESEL ENGINE TO OVERSPEED

**⚠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.

## SUBSTANCE HAZARDS TO HEATLH

Generator sets use substance, and emit and create wastes that can cause health ricks. 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 containters 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 known 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 gylcol, and diethylene glycol. Ethylene glycol is a potentially hazardous consituent.

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 the engine cooling systems, and heat exchangers. Installers, operators and maintainers ar 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 sufuric acid, nitric acid, caustics and aliphatic amines.

It may cause neurological signs and sysmptoms, 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 ther is a risk of vapour, or particulate, use a suitable organic vapour mask.

Eye protection, gloves, overalls, impervious apron should be used. Avoid contaminated, discontinue use and clean throughly.

## 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 sue self contained breathing apparatus. Keep fire exposed containers cool. Prevent run–off from entering waterways, drains and drinking water supplies.
- Ingestion
  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 irriatation to lungs or throat, seek medical advice.

- Aspriation (inhalation of liquid)
  Obtain immediate medical assistance.
- Eyes
  Flush copiously with water or preferable eye–wash solution for at least fifteen 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.

## 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 a 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.

## 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 in 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 au-

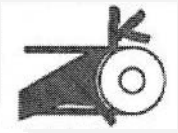
thorised contractor to a licensed site. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary system.

## 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.
- Inhalation (of vapour)
  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 this as directed under Storage/Transport.
- Ingestion
  Do not induce vomiting, Obtain medical advice immediately.

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

# 1. 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 handy for ready reference.

*Operation, Periodic 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.

**⚠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.***

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

**⚠WARNING** ***Because this generator set is an Ignition Protected Device, no substitutes are permitted for the parts listed in the Critical Parts Index of the generator set Parts Catalog. They must be purchased from Onan and be installed in accordance with the generator set Service Manual by those who are trained and experienced in marine generator set service.***

## MODEL IDENTIFICATION

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

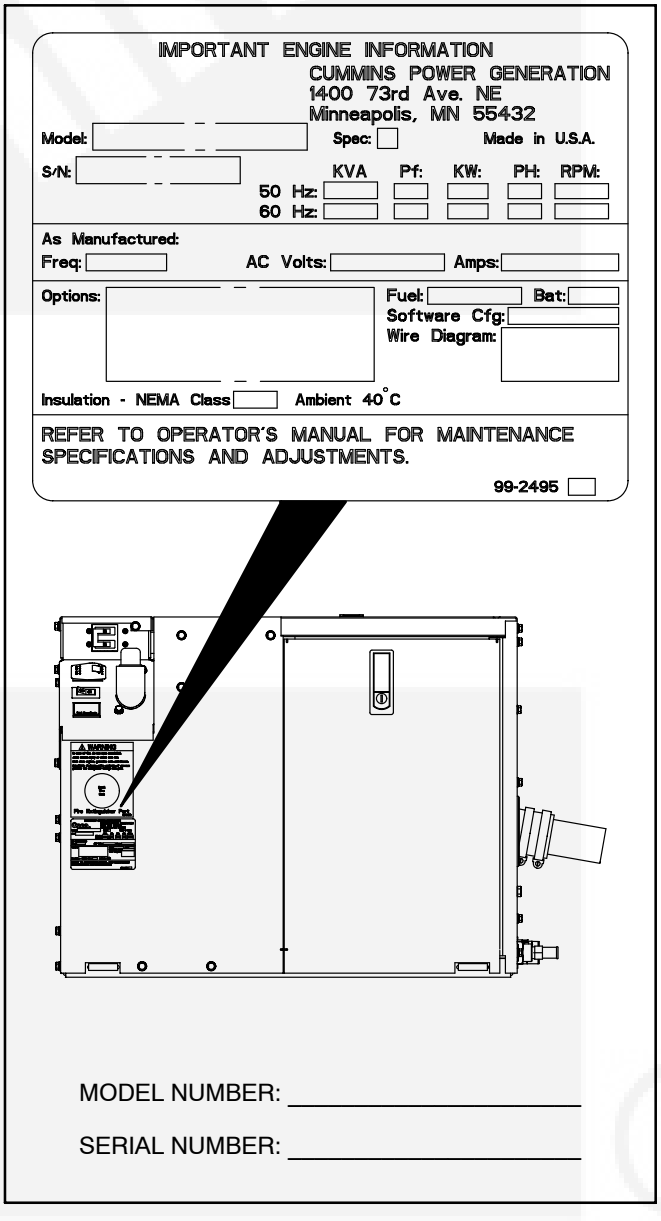



**FIGURE 1-1. TYPICAL NAMEPLATE**

## 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-ONAN 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 5. Troubleshooting).*

## EMISSIONS LABEL

The label that states compliance with applicable engine emissions regulations is located as shown on the engine (Figure 1-2). 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 Manual.

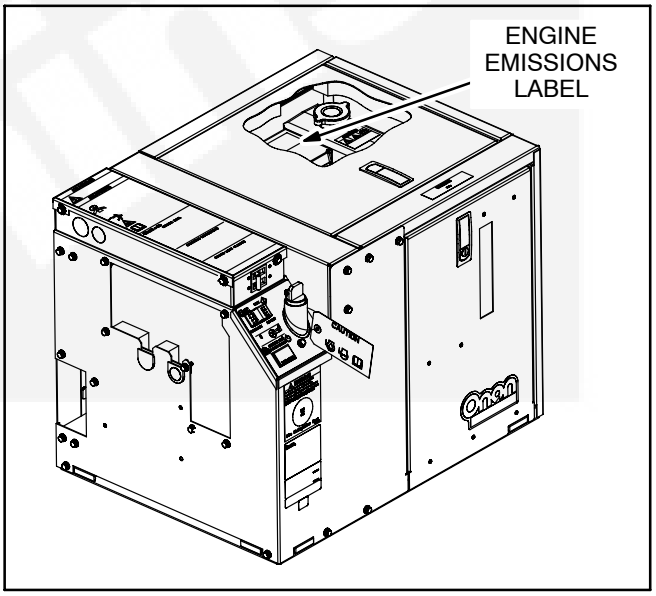



**FIGURE 1-2. EMISSIONS LABEL**

## NOISE

Generator sets emit noise. As noise level and time of exposure increase, risk of hearing damage increases. The Specifications page in 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 where you operate the generator set.

## ELECTROMAGNETIC COMPATIBILITY

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

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

## BUILD STANDARDS

The generator set and its control system have been designed, constructed and tested generally in accordance with the following Standards where applicable refer to Table 1–1.

**TABLE 1-1. BUILD STANDARS**

| | |
|---|---|
| BS EN 1037:1995+A1:2008 | Safety of machinery – Prevent 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 distance 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 of 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 – Saftey – Part 1: Compression ignition engines |
| BS EN 12601:2001 | Reciprocating internal combustion engine driven generating sets – Safety |

# 2. Operator Control Panels

## LOCAL CONTROL

Refer to Figure 2-1.

### Control Switch

***Starting:*** *Push* and *Hold* **START** to preheat, crank and start the generator set. The *green* status lamp comes on when 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.)

***Stopping:*** *Push* and *Release* **STOP (Prime)** to stop the generator set.

***Priming:*** *Push* and *Hold* **STOP (Prime** to prime the fuel system (amber lamp comes on in 2 seconds to indicate priming).

### Status Lamps

The control switch has two status lamps. The *amber* status lamp comes on during priming, blinks rapidly during cranking and goes out when the engine is up to speed. If the generator set shuts down abnormally, this lamp will slowly blink a numerical code to indicate the cause of shutdown. See *Troubleshooting* (Section 5). The *green* status lamp comes on to indicate that the generator set is running.

### Emergency Stop Switch

In an emergency push the switch to **OFF**. Push it to **ON** after all necessary repairs to the generator set and connected equipment have been made.

### Line Circuit Breaker

The line circuit breaker protects the AC power leads connected to the generator set from overloads and equipment short circuits.

### Hour Meter

The hour meter records generator set operating time in hours. It cannot be reset.

## REMOTE CONTROL

### Remote Control Stations

The boat may be equipped with one or more remote control stations having a remote Operator Panel (p. 2-2) or a control switch with status lamps.

### Boat Monitoring System

The boat may be equipped to monitor generator set operation on an integrated monitoring system using an SAE J1939 or SmartCraft™ network protocol.

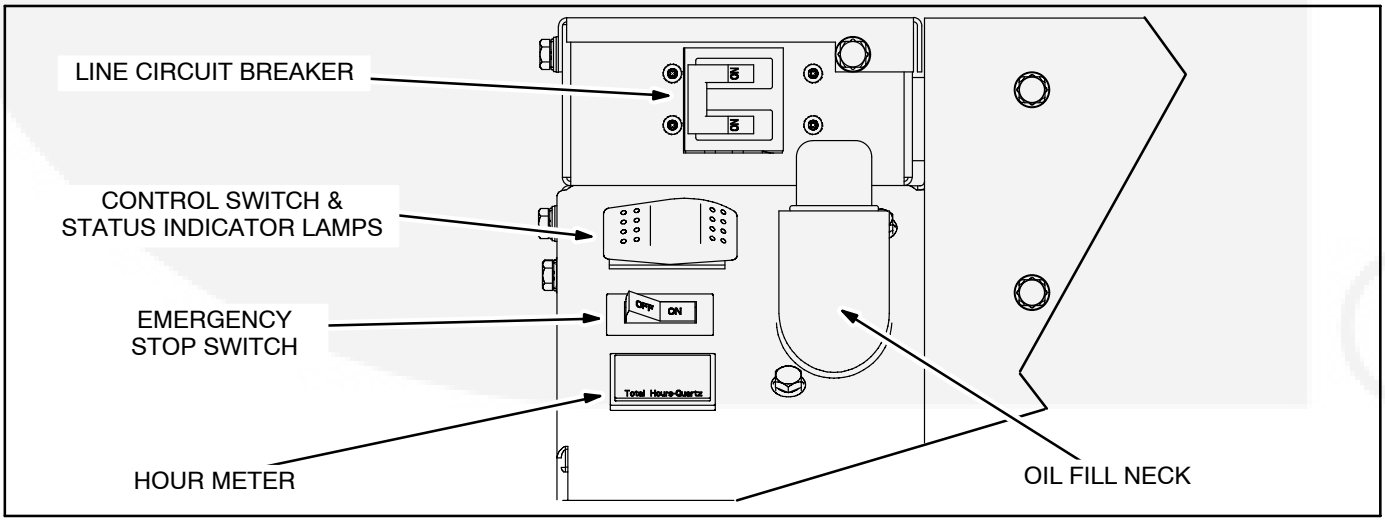



**FIGURE 2-1. LOCAL CONTROL PANEL**

SmartCraft is a trademark of the Brunswick Corporation.

## OPERATOR PANEL

The remote Operator Panel has an LCD screen with 4 navigation buttons, 3 status lamps, a START button and a STOP button (Figure 2-2).

### Turning On the Display

Touch any button to turn on the Display, which will initialize and attempt to establish communications with the generator set controller. All connected Operator 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. They will stay on indefinitely until a fault shutdown is cleared by touching any button on any Operator Panel.

### Start Button

***Starting the Generator Set:*** *Push* and *Hold* **START** until the generator set starts. The GENSET status lamp blinks while the engine is cranking. It comes on when the generator set starts and stays on while it runs. The status displayed on the LCD changes from *Starting* to *Running* (Figure 2-3). See STARTING THE GENSET (p. 3-3).

### Stop Button

***Stopping the Generator Set:*** *Push* and *Release* **STOP**. The GENSET status lamp will go out. The status displayed on the LCD will change from *Running* to *Stopped* (Figure 2-3). See STOPPING THE GENSET (p. 3-3).

***Priming the Fuel System:*** *Push* and *Hold* **STOP**. The GENSET status lamp will blink. The status displayed on the LCD will change to *Priming* in 2 seconds (Figure 2-3). See PRIMING THE FUEL SYSTEM (p. 3-3).

### Genset Status Lamps

**GENSET –** This status lamp (green) blinks while the engine is cranking or the fuel system is being primed. It stays on while the generator set is running.

**PRE-ALARM –** This status lamp (amber) comes on when an engine Pre-Alarm condition exists (p. 2-5).

**ALARM –** This status lamp (red) blinks during fault shutdown (p. 2-4).

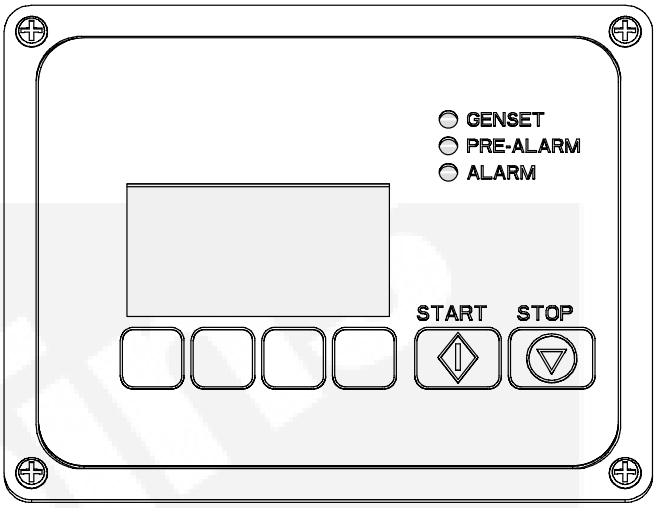



**FIGURE 2-2. REMOTE OPERATOR PANEL**

## Genset Status Screens

Generator set status is displayed on 3 screen pages (Figure 2-3). GEN STATUS PG1 appears when the Display is turned on. Press the double arrows [⏬] to toggle between the 3 screen pages.

The *Status* line on PG1 will display the word *Priming*, *Starting*, *Running, Stopped* or *Volt Adj.* The rest of the lines on the 3 status screen pages display AC output voltage, AC frequency, engine coolant temperature, engine oil pressure, starting battery voltage and total generator set running time.

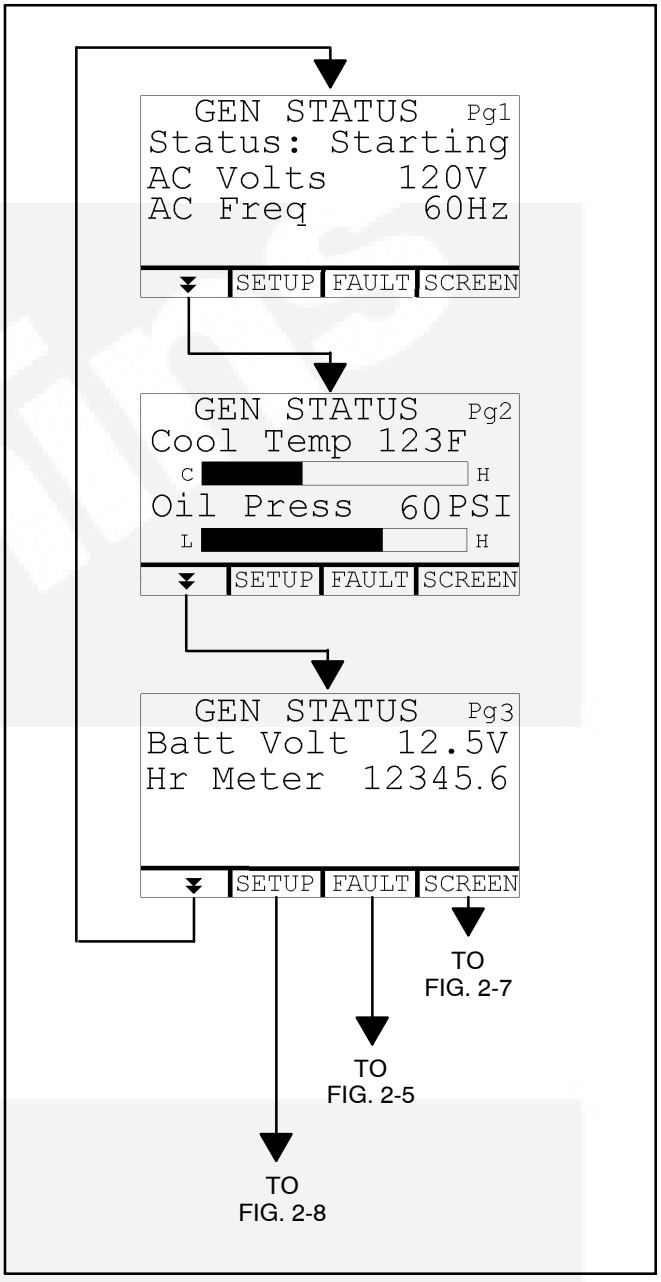



**FIGURE 2-3. TYPICAL GENERATOR SET STATUS SCREENS**

## Fault Screens

If a fault shutdown occurs the ALARM status lamp will blink and the LCD screen will display the Fault Number, a description of the Fault and the hour in total generator set running time when the Fault occurred (Figure 2-4). Refer to TABLE 5-1. TROUBLESHOOTING GENSET FAULTS to diagnose and correct the problem.

The *e*-Series Digital Display will display the fault indefinitely. Touch any button to clear the fault. The display will turn off in 5 minutes after the fault has been cleared.

Press [◂BACK] to go back to the GEN STATUS screen.

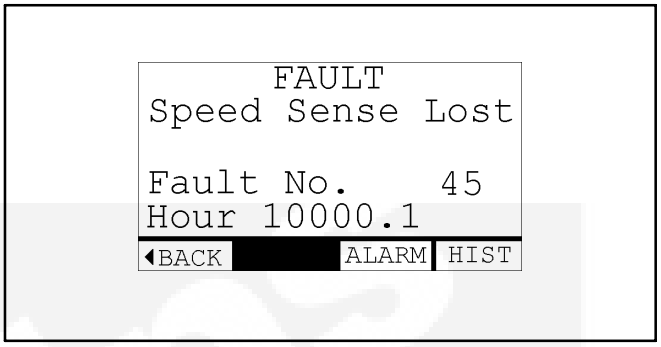



**FIGURE 2-4. TYPICAL FAULT SCREEN**

## Displaying Last 5 Faults

To display any of the last five faults, press the FAULT button on any GEN STATUS screen. Then press the HIST button on the FAULT screen (Figure 2-5).

The FAULT HISTORY screen will display the last Fault Number, a description of the Fault and the hour in total generator set running time when the fault occurred. 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 go back to GEN STATUS.

## Engine Pre-Alarm Screens

The PRE-ALARM status lamp will start to blink when engine oil pressure or temperature approaches its limit for engine shutdown. The Display will display *Low Oil Pressure* or *High Engine Temperature* on the PRE-ALARM screen (Figure 2-6).

Press [◂BACK] to go back to GEN STATUS to monitor the engine temperature or oil pressure.

Service the generator set as required.

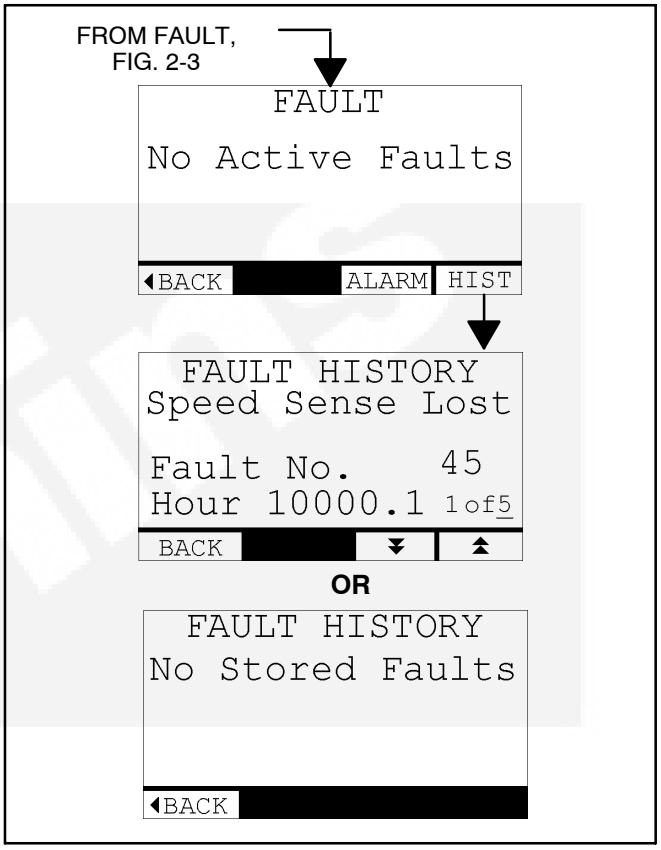



**FIGURE 2-5. FAULT HISTORY**

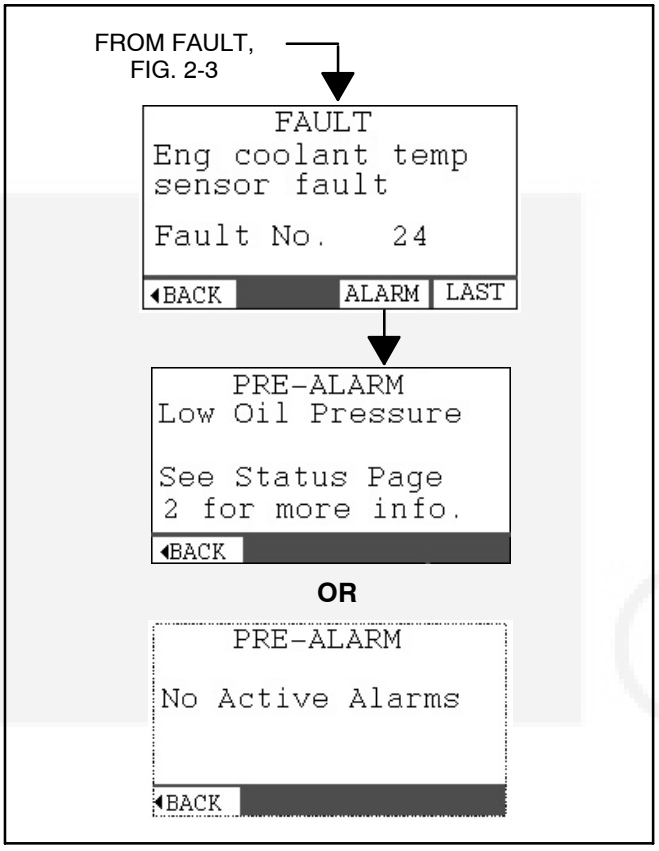



**FIGURE 2-6. ENGINE PRE-ALARMS**

## Screen Brightness and Contrast

To adjust the brightness and contrast of the LCD screen and status lamps, go to the SCREEN ADJUST screen by pressing SCREEN on any GEN STATUS screen. Press NEXT to select *Brightness* or *Contrast*. Increase or decrease the selected item by pressing the increase-decrease buttons [◀ ▶]. See Figure 2-7. ("Contrast" applies only to the LCD screen.)

Press [◀BACK] to save the settings and go back to GEN STATUS.

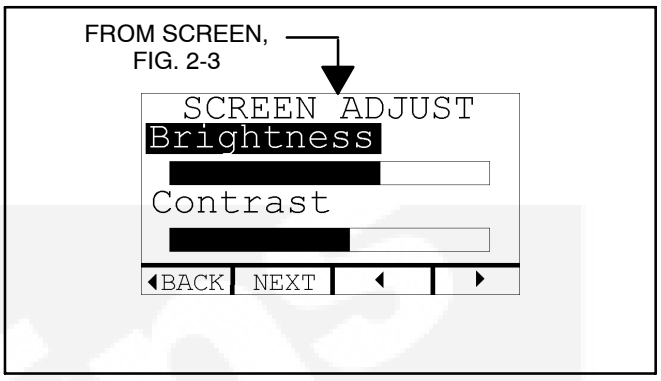



**FIGURE 2-7. SCREEN BRIGHTNESS & CONTRAST**

## Display Setup

Go to the SETUP screen by pressing SETUP on any GEN STATUS screen. Press the up-down arrows [▼ ▲] to select *Display Setup* and press ENTER. See Figure 2-8.

***Units:*** To change the units of measure on the GEN STATUS screens, press NEXT to select Units. Then press the up-down arrows [▼ ▲] to toggle between Metric and SAE units.

Press [◀BACK] to save the selection and go back to GEN STATUS.

***AC Voltmeter Calibration:*** To calibrate the Display Voltmeter, press NEXT to select AC Voltmeter Calibration. Then press the up-down arrows [▼ ▲] to increase or decrease the voltage displayed to correspond to an accurate AC output voltmeter (line-to-line or line-to-neutral, as desired).

Press [◀BACK] to save the selection and go back to GEN STATUS.

**Note: This procedure does not change AC output voltage. Have a trained and experienced person adjust AC output voltage, if necessary, before calibrating the Display Voltmeter.**

## Generator Set and Display Information

Go to the SETUP screen by pressing SETUP on any GEN STATUS screen. Press the up-down arrows [▼ ▲] to select *Genset Info* or *Display Info* and press ENTER. See Figure 2-8. This information may be requested by the service technician.

Keep pressing [◀BACK] to get back to GEN STATUS.

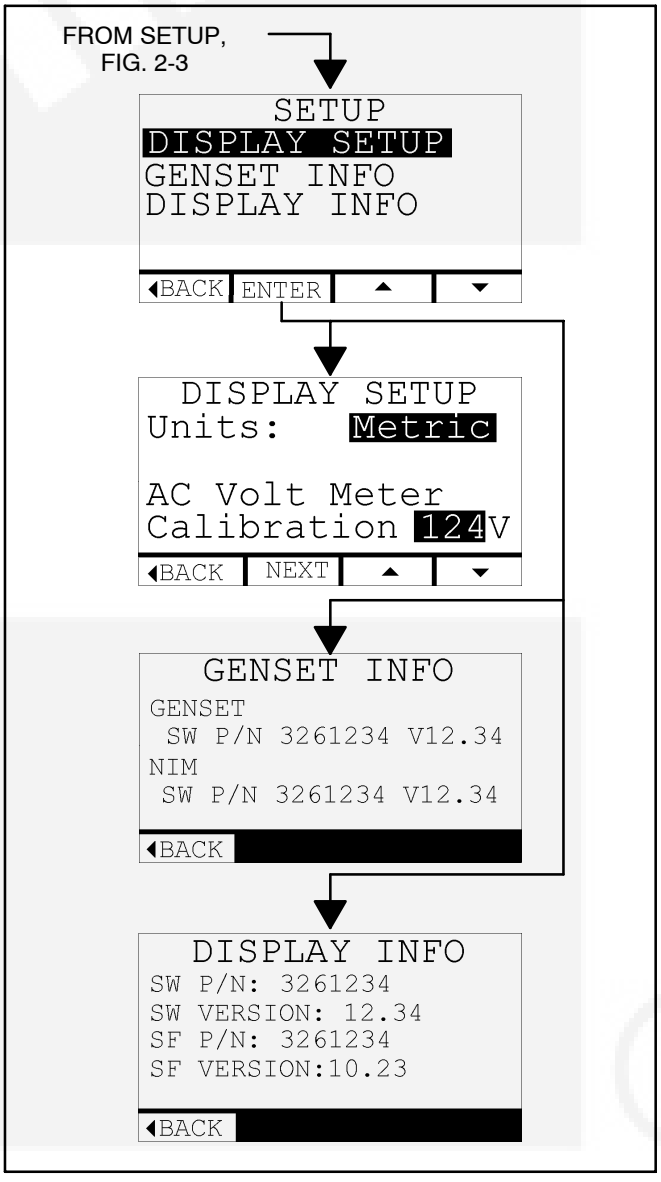



**FIGURE 2-8. SETUP, GENSET & DISPLAY INFO**

# 3. Operation

## FUEL

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

High quality Grade 2-D diesel fuel is necessary for good performance and long engine life. Diesel fuels specified by EN 590 or ASTM D975 are recommended. Use Grade 1-D diesel fuel if the fuel tank is exposed to temperatures below 40° F (5° C).

The Cetane number should not be less than 45 and sulfur content not more than 0.5 percent (by weight). Where fuel is exposed to cold ambient temperatures, use fuel that has a cloud point (temperature at which wax crystals begin to form) at least 10° F (6° C) degrees below the lowest expected fuel temperature.

Fuel lubricity should 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.

## ENGINE OIL

Use API (American Petroleum Institute) Service Category **CI-4** engine oil or better. Also look for the SAE (Society of Automotive Engineers) viscosity grade. Referring to Figure 3-1, choose the viscosity grade appropriate for the ambient temperatures expected until the next scheduled oil change. Multi-grade oils such as SAE 15W-40 are recommended for year-round use.

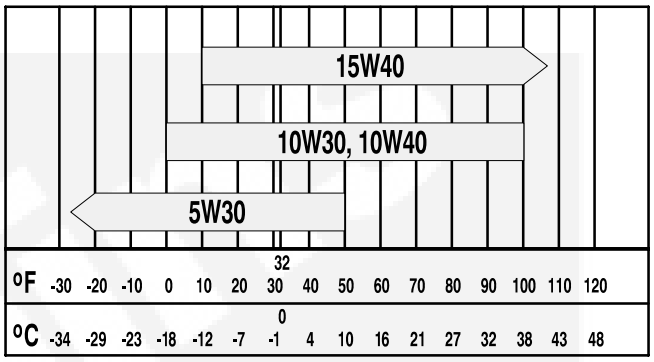



**FIGURE 3-1. OIL VISCOSITY GRADE VS. AMBIENT TEMPERATURE**

## ENGINE COOLANT

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

Use the best quality ethylene glycol antifreeze solution available. It should be fully formulated with rust inhibitors and coolant stabilizers. A 50/50 mixture of water and ethylene glycol is recommended to provide protection from freezing down to -34° F (-37° C).

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

See *Specifications* (Section 6) regarding coolant capacity.

## BATTERIES

Reliable generator set starting and starter service life depend upon adequate battery system capacity and maintenance. See MAINTAINING THE BATTERY AND BATTERY CONNECTIONS (p. 4-3) and *Specifications* (Section 6).

## FIRE EXTINGUISHER PORT

The boat must have a fire extinguisher readily available for putting out a fire in the genset. It must be approved for both 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 as shown in Figure 3-2.

**⚠CAUTION** ***Make sure that the nozzle of the fire extinguisher that will be used in the event of fire is smaller than the circle so that it will fit through the port. The fire extinguisher must be of the gaseous type.***

In the event of fire:

1. DO NOT open the 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.

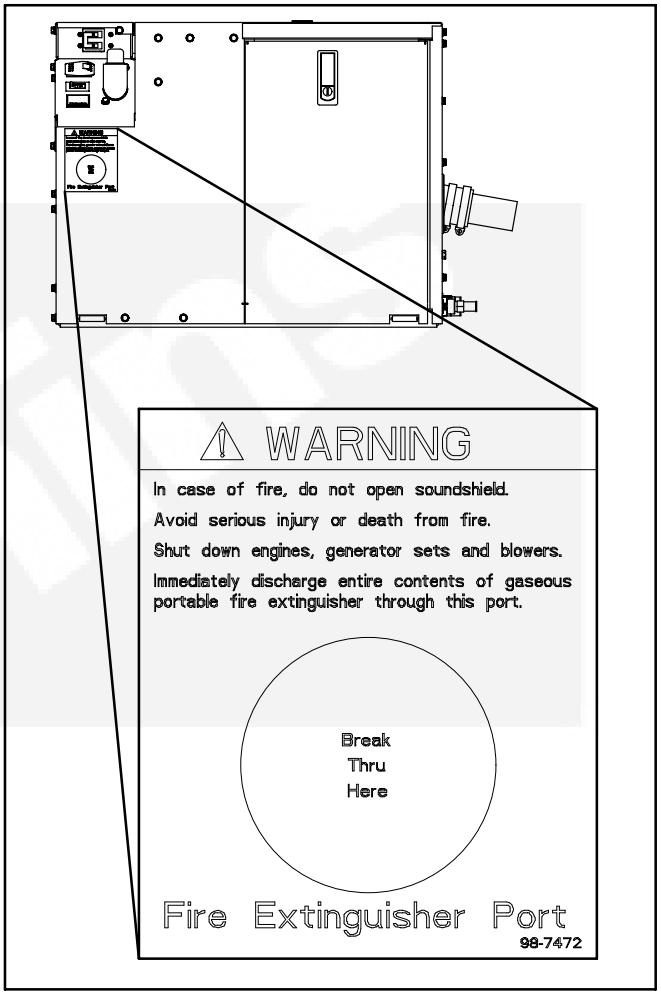



**FIGURE 3-2. FIRE EXTINGUISHER PORT**

**⚠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***
- ***Headache***
- ***Nausea***
- ***Vomiting***
- ***Weakness***
- ***Sleepiness***
- ***Inability to Think Clearly***

***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 up 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.***

## PRE-START CHECKS

Before the first start of the day and after every eight hours of operation, inspect the generator set as instructed under GENERAL INSPECTION (p. 4-2). Keep a log of maintenance and the hours run and perform any maintenance that may be due. See Returning the generator set to Service (p. 3-6) if the boat has been in storage. Before each start:

1. Make sure all CO detectors on board are working properly.
2. Check for swimmers that might be exposed to the engine exhaust.
3. Disconnect all electrical loads.

## PRIMING THE FUEL SYSTEM

The fuel system should be primed after replacing the fuel filter or running the generator set out of fuel. To prime the fuel system, *Push* and *Hold* **STOP** on the *e*-Series Digital Display or **STOP (Prime)** on the control switch for at least 30 seconds.

## STARTING THE GENERATOR SET

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

1. Visually inspect for water, coolant, fuel and exhaust leaks. Do not start the generator set if there is a leak. Repair fuel leaks immediately.
2. *Push* and *Hold* **START** on the *e*-Series Digital Display or control switch 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. The status displayed on the *e*-Series Digital Display changes from *Starting* to *Running* (Figure 2-3).
3. For longer engine life, let the engine warm up for two minutes before connecting air conditioners and other large electrical loads.
4. Monitor generator set status using the *e*-Series Digital Display (p. 2-3), if so equipped. Perform maintenance or service as necessary if the Display indicates a **Pre-Alarm** condition (p. 2-2).
5. ***If the generator set fails to start***, cranking will discontinue in 20 to 60 seconds, depending on engine temperature. The *e*-Series Digital Display and/or control switch status lamp will indicate Fault Code No. 4. See *Troubleshooting* (Section 5) if the generator set does not start after several tries.

   **⚠CAUTION** ***Do not continue cranking and risk burning out the starter or flooding the engine (exhaust flow during cranking is too low to expel water from 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 *e*-Series Digital Display and/or control switch status lamp will indicate the numeric fault code. See *Troubleshooting* (Section 5).

## STOPPING THE GENERATOR SET

Disconnect all electrical loads to let the generator set run without load and cool down. After 2 minutes *Push* and *Release* **STOP** on the *e*-Series Digital Display or control switch. The generator set status lamps will go out.

**⚠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.***

## EMERGENCY STOP

Push the **EMERGENCY STOP SWITCH** to **OFF** (p. 2-1). After all necessary repairs have been made, push the switch to **ON** so that the generator set can be operated.

## LOADING THE GENERATOR SET

How much equipment load can be powered depends upon the generator set power rating. The generator set will shut down or its AC output circuit breakers will trip if the sum of the loads exceeds generator set power or circuit breaker rating.

To avoid overloading the generator set and causing shutdowns, compare the sum of the loads of the appliances that are likely to be used at the same time with the power rating of the generator set. Use Table 3-1 or the ratings on the appliances themselves to obtain the individual appliance loads. If the appliance is marked in amps and volts only, multiply the amps times the volts to obtain the appliance load (watts). ***It may be necessary to run fewer appliances at the same time—the sum of the loads must not be greater than generator set rating.***

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 loads is less than generator set rating. The reason for this is that a motor's startup load is much larger than its running load. ***It may be necessary to run fewer loads when large motors and air conditioners are cycling on and off.***

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

**TABLE 3-1. TYPICAL APPLIANCE LOADS**

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

## 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.

## 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.***

## RESETTING LINE CIRCUIT BREAKERS

If the generator set line circuit breaker trips (p. 2-1), or a circuit breaker in the power distribution panel of the boat, either a circuit shorted or too many loads were connected. Note that the generator set will continue to run after a line circuit breaker trips.

If a circuit breaker trips, disconnect or turn off as many loads as possible and reset the circuit breaker. If the circuit breaker trips right away, either the electrical distribution system has a short or the circuit breaker is faulty. Call a qualified electrician.

If the circuit breaker does not trip, reconnect loads one-by-one up to a total load that does not overload the generator set or cause the circuit breaker to trip. The circuit probably has a short if the circuit breaker trips right away when it is connected.

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

**⚠WARNING** ***Short circuits in electrical 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.***

## COLD TEMPERATURE OPERATION

Drain the heat exchanger (See Service Manual) and muffler before cold weather sets in if the generator set is not being used. Freezing water can damage the muffler and the raw water tubes in the heat exchanger.

## 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 (p. 4-5).

## 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, more reliable operation and longer engine life.

## STORING THE GENERATOR SET

Proper storage is essential for preserving top generator set performance and reliability when the generator set cannot be exercised regularly and will be idle for more than 120 days.

### Storing the Generator Set

1. Turn off the generator set line circuit breaker (p. 2-1).
2. Change the engine oil and filter and attach a tag indicating oil viscosity. See ENGINE OIL RECOMMENDATIONS (p. 3-1).
3. Crank the engine several revolutions but do not let it start. This will fill the oil passages with the new oil.
4. Disconnect the battery cables (negative [–] cable first) from the starting battery and store the battery according to the battery manufacturer's recommendations. See MAINTAINING THE BATTERY AND BATTERY CONNECTIONS (p. 4-3).
5. Check coolant level and add as necessary (p. 4-7). Test the coolant mixture if freezing temperatures are possible and change if necessary.

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

6. Drain the heat exchanger and muffler if freezing temperatures are expected.
7. Clean and lightly oil parts that can rust.

### 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. See ENGINE OIL RECOMMENDATIONS (p. 3-1).
2. Reconnect the starting battery (negative [–] cable last). See MAINTAINING THE BATTERY AND BATTERY CONNECTIONS (p. 4-3).
3. Perform the maintenance required (p. 4-1), conduct the pre-start checks and prime the fuel system.
4. Start and run the generator set.
5. Turn on the generator set line circuit breaker (p. 2-1) when ready to power loads.

# 4. Periodic Maintenance

## PERIODIC MAINTENANCE SCHEDULE

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

Periodic maintenance is essential for top performance and long generator set life. Use Table 4-1 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 Onan service representative.

To help you keep generator set maintenance regular and provide a basis for warranty claims, record maintenance performed in *Maintenance Record* (p. 7-1).

**TABLE 4-1. PERIODIC MAINTENANCE SCHEDULE**

| | After First 50 Hrs | Every Day / 8 Hrs | Every Month/ 100 Hrs | Every Year/ 200 Hrs | Every Year/ 500 Hrs | Every 800 Hrs | Every 2 Years | Every 5 Years/ 2000 Hrs | Page |
|---|---|---|---|---|---|---|---|---|---|
| General Inspection | | x[1] | | | | | | | 4-2 |
| Check Engine Oil Level | | x | | | | | | | 4-4 |
| Check Battery | | | x[2] | | | | | | 4-3 |
| Check V-Belt Tension | | | x[5] | | | | | | – |
| Drain Fuel Filters | | | x | | | | | | 4-6 |
| Check Siphon Break | | | x | | | | | | 4-10 |
| Change Oil/Oil Filter | x | | | x | | | | | 4-5 |
| Check Brushes/Slip Rings | | | | x[5] | | | | | 4-5 |
| Replace Fuel Filters | | | | | x | | | | 4-6 |
| Replace Pump Impeller | | | | | x[5] | | | | – |
| Adjust Engine Valve Lash | | | | | | x[5] | | | – |
| Replace Coolant, Pressure Cap & Thermostat | | | | | | | x[4] | | 4-7 |
| Check Generator Bearings, Drive Belt, Belt Tensioner & Drive Coupling | | | | | | | | x[5] | – |

1. Includes inspection of Oil Level, Coolant Level, Fuel System, Exhaust System, Batteries and Sea Water Strainer.
2. See battery manufacturer's recommendations.
3. Check for slippage, cracking and wear (pump drive belt only).
4. There is no zinc anode to replace.
5. Must be performed by a trained and experienced mechanic (Onan Distributor/Dealer) in accordance with the engine and generator set Service Manuals.

## GENERAL INSPECTION

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

### Oil Level

Check engine oil level (p. 4-4).

### Exhaust System

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

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.

### Fuel System

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

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. Check flexible fuel hose for cuts, cracks, abrasions and loose hose clamps. Make sure fuel lines do not rub against other parts. Replace worn or damaged fuel line parts before leaks occur. Replace hose with with USCG TYPE A1 or ISO 7840-A1 fuel hose.

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

### Coolant Level

Check coolant level in the recovery tank and, if necessary, refill 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 (p. 4-8). Use the recommended antifreeze mixture (p. 3-2).

### Raw Water System

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

Check for hoses that leak or are damaged. Have a qualified service person replace any leaking or damaged hoses.

### Battery Connections

See MAINTAINING THE BATTERY AND BATTERY CONNECTIONS.

### Mechanical

Monitor generator set status using the *e*-Series Digital Display (p. 2-3).

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 noise. Check the generator set mounting bolts. 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.

## MAINTAINING THE BATTERY AND BATTERY CONNECTIONS

**⚠WARNING** ***Arcing at 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 4-1 for scheduled battery maintenance, 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. Always:

1. Keep the battery case and terminals clean and dry and the terminals tight.
2. Use a battery terminal puller if the battery has terminal posts.
3. 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.

## CHECKING ENGINE OIL LEVEL

**⚠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.***

**⚠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 plug.***

1. Pull the plug and dipstick out of the oil fill neck (Figure 4-1). The plug may be difficult to pull straight out. It is easier if you tilt the plug in its socket while pulling out. Wipe off the dipstick and thread it back into the fill neck and seat the plug, which snaps into its socket. Remove the plug and dipstick again and check the oil level on the dip stick.
2. Add or drain oil as necessary. See ENGINE OIL RECOMMENDATIONS (Page 3-1). Keep the oil level between the high and low beads on the end of the dipstick, as shown. It is not necessary to add oil between oil changes if the oil has not dropped more than 1/3 of the way between the high and low beads.

   **⚠CAUTION** ***Too little oil can cause severe engine damage. Too much oil can cause high oil consumption.***
3. Secure the oil fill plug, which snaps into its socket.

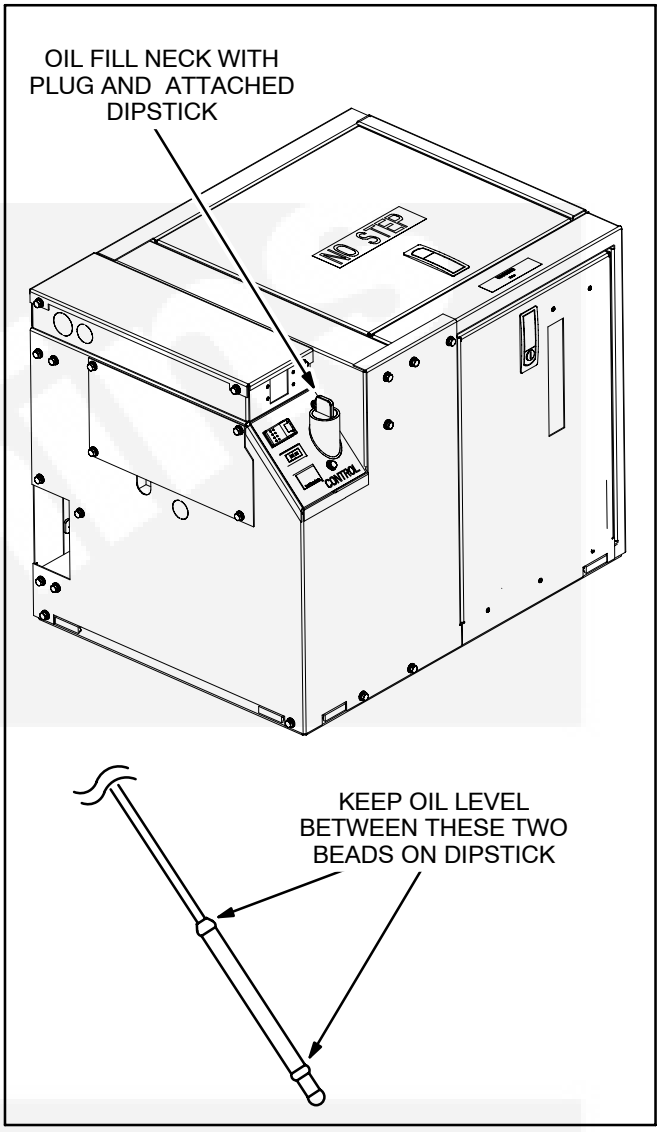



**FIGURE 4-1. OIL FILL NECK AND DIPSTICK**

## CHANGING ENGINE OIL AND FILTER

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

**⚠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.***

**⚠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 plug.***

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

Refer to Table 4-1 for scheduled engine oil change.

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. Remove the oil fill plug (Figure 4-1), open the front access door and drain the engine oil into a container by opening the drain valve (Figure 4-2). (The drain valve has a 3/8 NPT outlet for connecting a hose fitting to facilitate oil draining.) If an oil pump-out system is installed, follow the instructions provided.
3. *Close the oil drain valve.*
4. Spin off the old oil filter with a filter wrench and wipe off the filter mounting surface. (A filter wrench is available from Onan.) Remove the old gasket if it does not come off with the filter.
5. Apply a film of oil to the filter gasket and partly fill the filter with oil so that it reaches engine parts sooner at startup. Spin the new filter on by hand until the gasket just touches the mounting pad and tighten 3/4 turn.
6. Refill the engine with the proper type and amount of engine oil. See ENGINE OIL RECOMMENDATIONS (p. 3-1) and *Specifications* (Section 6). Check the oil level and add or drain oil as necessary.

   **⚠CAUTION** ***Too little oil can cause severe engine damage. Too much oil can cause high oil consumption.***
7. Close the access door and dispose of the used oil and oil filter according to local environmental regulations.

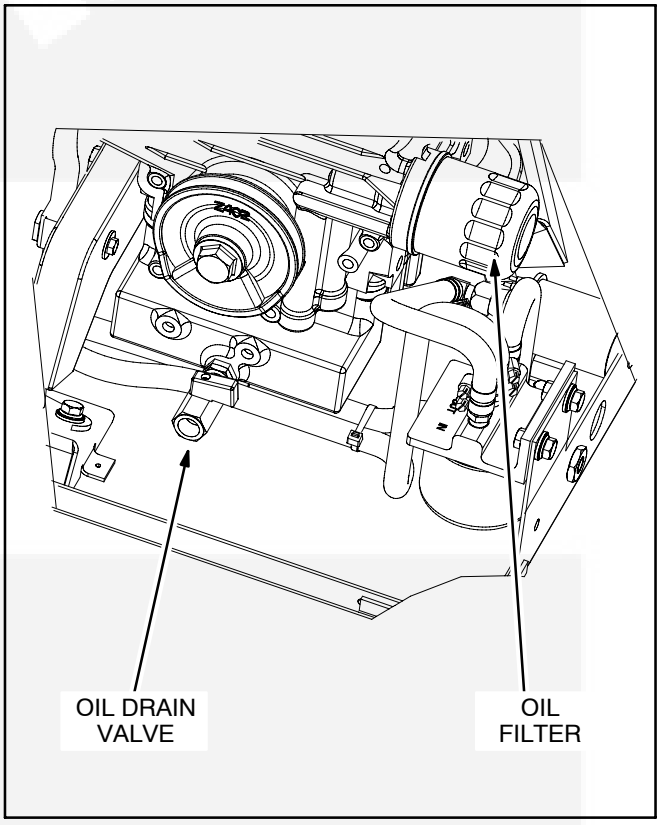



**FIGURE 4-2. OIL FILTER AND DRAIN VALVE**

## DRAINING/REPLACING THE FUEL FILTER

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

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

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

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

The generator set has a water-separator fuel filter (Figure 4-3). Check for other up-stream filters which may also need to be drained or replaced.

### Draining Water and Sediment

Drain water and sediment more often than scheduled (Table 4-1) if fuel quality is poor or condensation cannot be avoided.

1. Disconnect the negative (–) cable at the battery to prevent the engine from starting and close any fuel supply and return valves.
2. Open the front access door and drain the filter (about 1/2 cup [120 ml]) into a suitable container by removing the drain plug (bottom of filter).
3. *Re-install the drain plug* and dispose of the drain-off in accordance with local environmental regulations.

### Replacing Fuel Filter

See Table 4-1 for scheduled filter change. Change the filter if the engine lacks power.

1. Disconnect the negative (–) cable at the battery to prevent the engine from starting and close any fuel supply and return valves.
2. Open the front access door and spin off the old filter with a filter wrench and dispose of it in accordance with local environmental regulations.
3. Clean the contact surface on the filter base, lubricate the new filter gasket and spin the new filter on hand tight.
4. Prime the engine for at least 30 seconds (Page 3-3) to fill the new filter. Run the generator set and check for leaks. Tighten the filter by hand, if necessary.

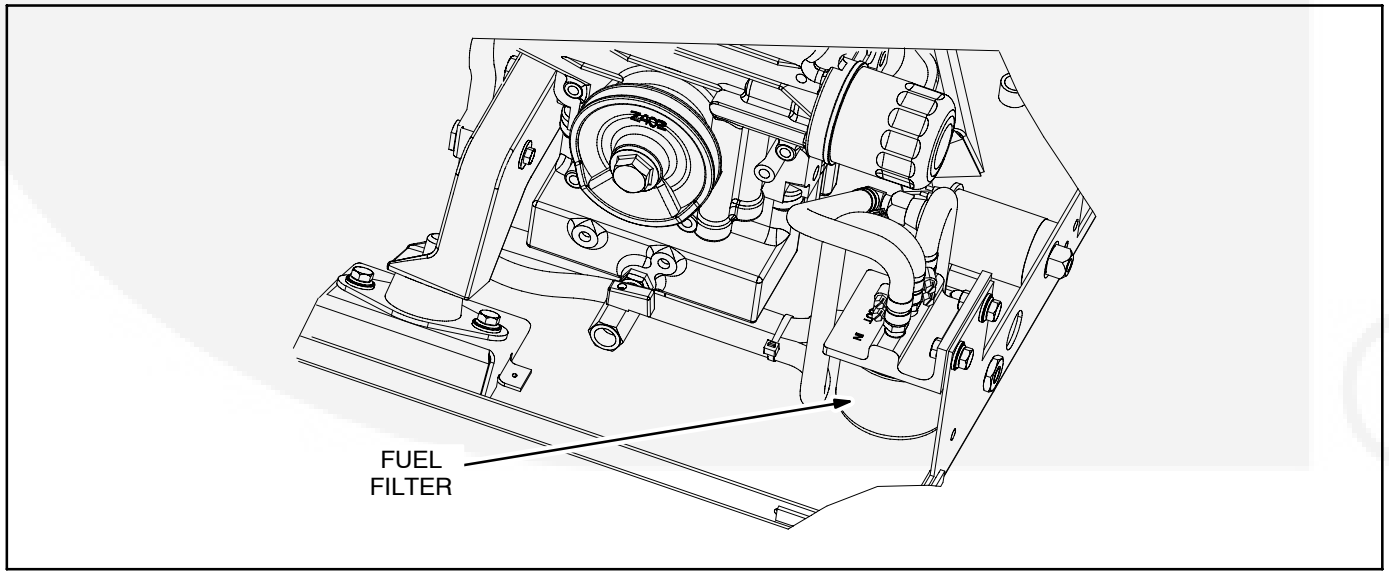



**FIGURE 4-3. FUEL FILTER**

## MAINTAINING THE ENGINE COOLING SYSTEM

Refer to Table 4-1 for scheduled maintenance.

### Cooling System Overview

The engine is cooled by a pressurized, closed-loop liquid cooling system in which coolant is pumped through passages in the engine block, head and exhaust manifold (Figure 4-4). The exhaust manifold also serves as the engine coolant reservoir.

The heat exchanger is mounted inside the exhaust manifold. Raw water (the 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. The V-belt drives the coolant and the raw water pumps.

### Recommended Coolant Mixture

See ENGINE COOLANT (p. 3-2) for recommendations.

### 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.

### 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 caus severe burns. Wear safety glasses.***

Replace the pressure cap every two years (seals deteriorate and leak). Proper cooling system pressure (10 psi) is essential for optimal engine cooling and minimal coolant loss.

### Coolant Hoses

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

Check for hoses that leak or are damaged. Have a qualified service person replace any leaking or damaged hoses.

### Draining and Cleaning Cooling System

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

**⚠WARNING** ***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. Wear safety glases.***

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

1. Have towels and containers ready to wipe up, collect and properly dispose of the coolant.
2. Disconnect the negative (–) cable at the battery to prevent the engine from starting, let the engine cool and remove the front and top access doors and the coolant pressure cap.
3. Drain the exhaust manifold/coolant reservoir by disconnecting the hose at the coolant pump inlet (Figure 4-4) and twisting it down into a container.
4. Drain the block by removing the cap on the drain fitting on the left side of the block (Figure 4-4). Use an 11/16 inch socket on a swivel and 12 to 18 inch extension. To catch the coolant and direct it into a container, insert the socket and extension through a piece of hose large enough to fit over the socket but shorter than the extension. The hose will catch the coolant as the cap is being unscrewed.
5. Use radiator cleaning chemicals to clean and flush the cooling system before refilling with fresh coolant. Follow the cleaner manufacturer's instructions.

## Refilling Cooling System

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

**⚠ CAUTION** ***Filling a hot engine with cold water can cause cracks in the manifold, head and block.***

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

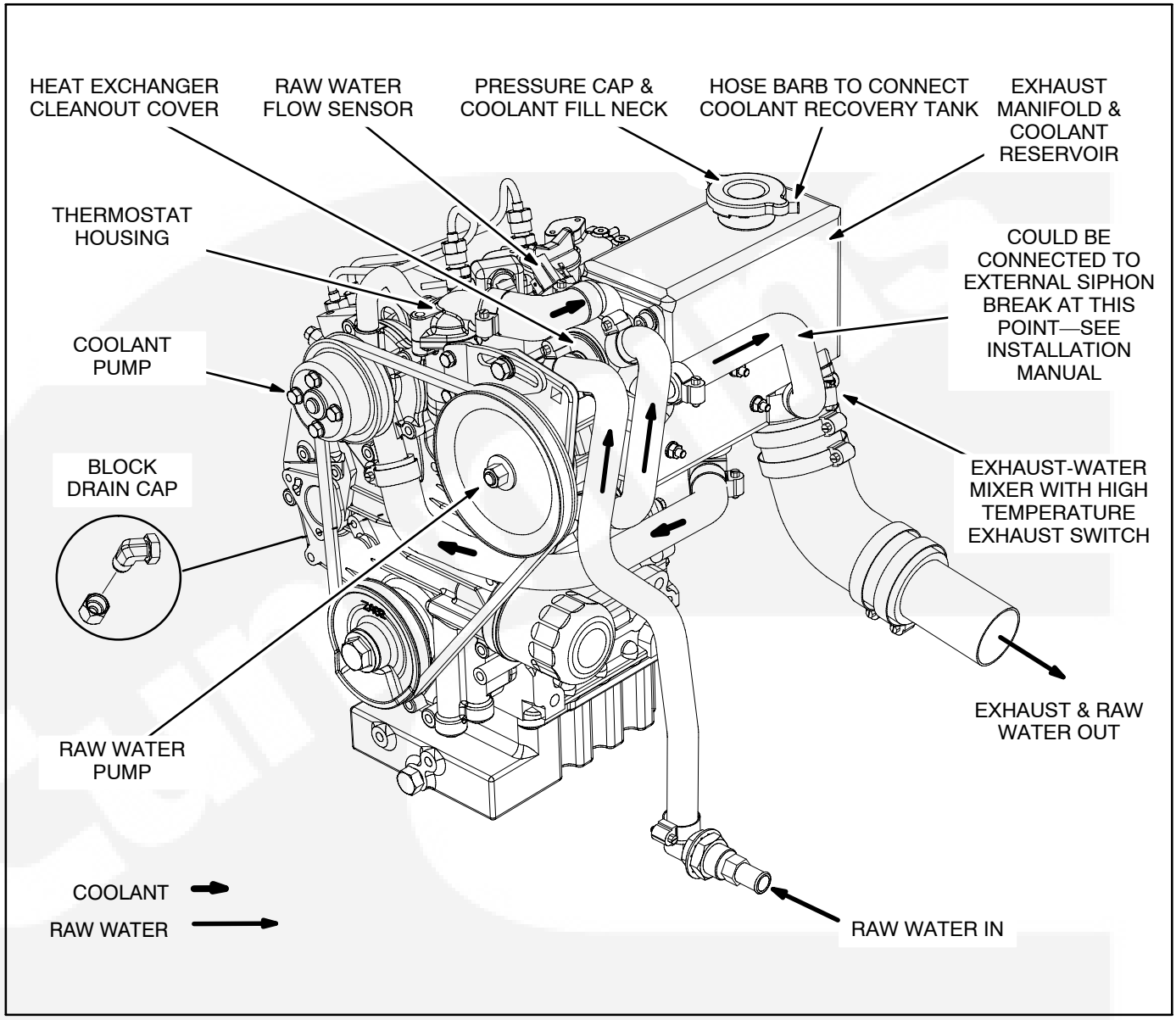



**FIGURE 4-4. ENGINE COOLING SYSTEM**

## Replacing the Thermostat

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

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

See Table 4-1 for scheduled replacement. Referring to Figure 4-5, replace the thermostat as follows:

1. Disconnect the negative (–) cable at the battery to prevent the engine from starting, let the engine cool and remove the top access door and pressure cap.
2. Remove the two thermostat housing bolts and pull off the housing, thermostat and gasket. The hose does not need to come off.
3. 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.
4. Replenish any lost coolant, secure the pressure cap, secure the access door and reconnect the battery cables (negative [–] last).

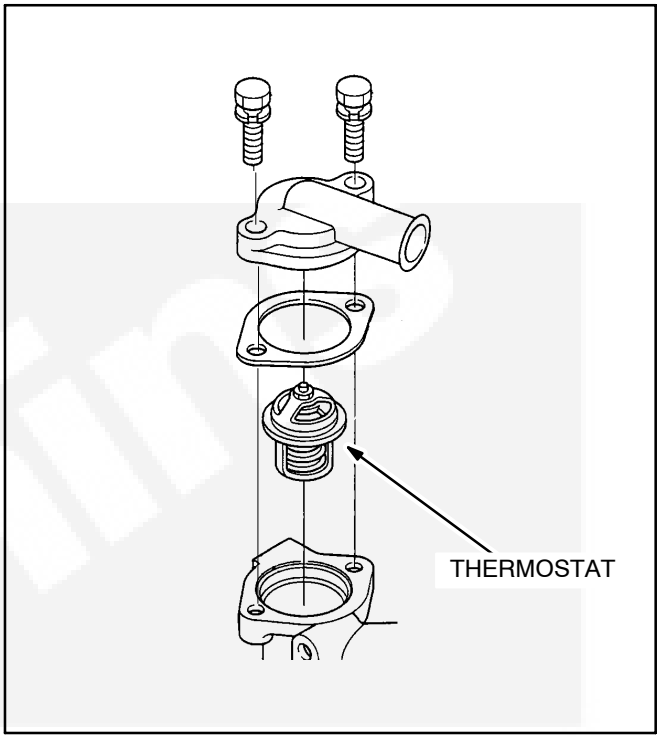



**FIGURE 4-5. TYPICAL THERMOSTAT**

## Siphon Break

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

See Table 4-1 for scheduled maintenance. A siphon break is installed when the exhaust-water mixer is below the water line. If of a spring-loaded valve design, check for free movement of the plunger. Replace the device if the plunger does not move freely or the body is encrusted with deposits from leakage past the valve seat. If of the bleed-vent type, check that the vent hose is properly connected on both ends. If the vent is connected to a through-hull fitting, check for normal water flow whenever the engine is running. See the Installation Manual for more information regarding siphon break installation.

# 5. Troubleshooting

To troubleshoot the generator set use TABLE 5-1. TROUBLESHOOTING GENERATOR SET FAULTS in conjunction with the *e*-Series Digital Display or blinking of the control switch status lamp. Perform the step-by-step corrective actions suggested. If you are still unable to resolve the problem, contact an authorized Onan service representative. See *How to Obtain Service* (p. 1-2).

**Note: Many generator set shutdowns can be avoided by performing periodic maintenance on schedule (TABLE 4-1. PERIODIC MAINTENANCE 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 dip 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.**

## Break-Out Tool 420–0624

Break-out tool 420–0624 for use in conjunction with an accurate digital multi-meter is available for preforming stator winding output tests while running the generator set. The tool is plugged into the generator set wiring harness in place of the generator set control. Follow the tool instructions.

## TROUBLESHOOTING WITH OPERATOR PANEL

If a fault shutdown occurs the ALARM status lamp on the *e*-Series Digital Display will blink and the LCD screen will display the Fault Number, a description of the Fault and the hour in total generator set running time when the Fault occurred (Figure 2-4).

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

See Page 2-5 to display any of the **last five faults** in fault history.

## TROUBLESHOOTING WITH STATUS LAMP

If a fault shutdown occurs, the amber status lamp on the control switch will repeatedly blink sets of **3**, **4**, **5** or **7** blinks.

- **One blink** indicates shutdown due to high engine temperature.
- **Two blinks** indicate shutdown due to low oil pressure.
- **Three blinks** indicate a service fault. Press **Stop** once to cause the two-digit shutdown code to blink. (Pressing **Stop** again will stop the blinking.) The two-digit code consists of 1 to 7 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, **Shut-Down Code No. 36** appears as:

  **blink – blink – blink — *pause* — blink – blink – blink – blink – blink – blink — *long pause* — repeat**.
- **Four blinks** indicate shutdown due to a failure to start within the time allowed for cranking.
- **Five blinks** indicate shutdown due to high levels of Carbon Monoxide (CO) in the vessel.
- **Seven blinks** indicate shutdown due to a loss of raw water flow for engine and exhaust cooling.

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

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

**TABLE 5-1. 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 Safety Precautions.***

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

## NO RESPONSE AT OPERATOR PANEL OR CONTROL SWITCH

**Possible Cause:** Faulty switch, poor or missing connections, dead battery

**Corrective Action:**

1. Push the Emergency Stop Breaker **ON** if tripped.
2. Try the Operator Panel or control switch on the generator set (local) if there is no response at a remote Operator Panel or control switch, and vice versa..
3. If none of the Operator Panels or control switches works, service as necessary by cleaning and tightening battery connections, recharging or replacing the battery or replacing damaged battery cables (p. 4-3).

## THE STARTER ENGAGES AND DISENGAGES

**Possible Cause:** Low cranking voltage

**Corrective Action:**

1. Push the generator set line circuit breaker OFF.
2. Service the battery as necessary by cleaning and tightening connections, recharging or replacing the battery or replacing damaged battery cables (p. 4-3).

## THE STARTING BATTERIES DO NOT MAINTAIN A CHARGE

**Possible Cause:** Marginal battery, battery connections or charging system

**Corrective Action:**

1. Service the battery as necessary by cleaning and tightening connections, recharging or replacing the battery or replacing damaged battery cables (p. 4-3).
2. Check for and disconnect parasitic battery loads.

## NO AC POWER WHEN GENERATOR SET IS RUNNING

**Possible Cause:** A Circuit Breaker is OFF, tripped or malfunctioning or the generator is not connected properly

**Corrective Action:**

1. Reset or turn ON the generator set circuit breaker if OFF or tripped.
2. Reset or turn ON any other circuit breaker in the AC power supply system if OFF or tripped.

**TABLE 5-1. TROUBLESHOOTING GENERATOR SET FAULTS (CONT.)**

**⚠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 Safety Precautions.***

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

## HIGH ENGINE TEMPERATURE—CODE NO. 1

**Control Logic:** Engine coolant temperature exceed design limit

**Corrective Action:**

1. Open the sea valve.
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 engine coolant level, add coolant as necessary and check for and repair leaks (p. 4-7).
4. Check for and reconnect or replace any disconnected, kinked or leaking raw water hoses.
5. Check the bottom of the hull for any blockage at the through-hull fitting.
6. Drain and clean the cooling system to remove fouling (p. 4-7).
7. Replace the coolant thermostat, which might not be opening fully (p. 4-10).

## LOW OIL PRESSURE—CODE NO. 2

**Control Logic:** Low oil pressure

**Corrective Action:** Check engine oil level, add or drain oil as necessary and repair any leaks (p. 4-4).

## SERVICE CHECK—CODE NO. 3

**Control Logic:** A fault with a 2-Digit Fault Code Number occurred

**Corrective Action:** Check the 2-Digit fault code by *Pushing* and *Releasing* **Stop**. The 2-Digit fault will be one of the following in this table. (Does not apply to *e*-Series Digital Display.)

**TABLE 5-1. TROUBLESHOOTING GENERATOR SET FAULTS (CONT.)**

**⚠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 Safety Precautions.***

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

## OVERCRANK—CODE NO. 4

**Control Logic:** Cranking time exceeded 20 to 60 seconds, depending on ambient temperature

**Corrective Action:**

1. Push the generator set line circuit breaker OFF.
2. Check the fuel tank and fill as necessary. (Note: The arrangement of pickup tubes in the fuel supply tank probably is such that the generator set will run out of fuel before the propulsion engines.)
3. Remove combustion air or exhaust system blockages.
4. Open any closed fuel supply and return valves.
5. Prime the engine fuel system for at least 30 seconds (p. 3-3).
6. Service the battery as necessary by cleaning and tightening connections, recharging or replacing the battery or replacing damaged battery cables (p. 4-3).
7. Check all fuel filters and fittings for fuel and air leaks, tighten as necessary and reprime.
8. Replace the fuel filters and reprime (p. 4-6).
9. Change the engine oil to oil of the proper viscosity for the ambient temperature. High oil viscosity can slow down cranking speed.

## WARNING—SHUTDOWN DUE TO VESSEL CO—CODE NO. 5

**Control Logic:** Dangerous levels of Carbon Monoxide in Vessel

**Corrective Action:** Get everyone out into fresh air immediately and seek medical attention.

## LOSS OF RAW WATER FLOW—CODE NO. 7

**Control Logic:** Insufficient raw water flow through the heat exchanger to cool the engine

**Corrective Action:**

1. Open the sea valve.
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 and reconnect or replace any disconnected, kinked or leaking raw water hoses.
4. Check the bottom of the hull for any blockage at the through-hull fitting.

**TABLE 5-1. TROUBLESHOOTING GENERATOR SET FAULTS (CONT.)**

**⚠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 Safety Precautions.***

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

## HIGH AC VOLTAGE—CODE NO. 12

**Control Logic:** After voltage regulation was enabled Output Voltage jumped to more than 125percent of rated for 75 milliseconds or to more than 115percent of rated for 3 seconds

**Corrective Action:**

1. 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.
2. Check all fuel filters and fittings for fuel and air leaks, tighten as necessary and reprime. (Air bubbles can disrupt frequency.)

## LOW AC VOLTAGE—CODE NO. 13

**Control Logic:** After voltage regulation was enabled Output Voltage fell to less than 90percent of rated for 5 seconds

**Corrective Action:**

1. Push the generator set line circuit breaker **OFF**. If the generator set now runs and voltage and frequency are normal, reduce the number of electrical loads.
2. Check the fuel tank and fill as necessary. (Note: The arrangement of pickup tubes in the fuel supply tank probably is such that the generator set will 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 (p. 3-3).
5. Check all fuel filters and fittings for fuel and air leaks, tighten as necessary and reprime. (Air bubbles can disrupt frequency.)
6. Replace the fuel filters and reprime (p. 4-6).

## HIGH AC FREQUENCY—CODE NO. 14

**Control Logic:** After the starter was engaged Frequency jumped to more than 70 Hz for 40 milliseconds or to more than 2percent over nominal for 6 seconds

**Corrective Action:**

1. Check for a tripped generator set circuit breaker, reset it if necessary, and run with fewer connected loads. (A breaker tripping under load can cause generator set frequency to overshoot.)
2. Check all fuel filters and fittings for fuel and air leaks, tighten as necessary and reprime. (Air bubbles can disrupt frequency.)

**TABLE 5-1. TROUBLESHOOTING GENERATOR SET FAULTS (CONT.)**

**⚠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 Safety Precautions.***

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

## LOW AC FREQUENCY—CODE NO. 15

**Control Logic:** During normal operation Frequency fell to less than 90percent of nominal for more than 8 seconds

**Corrective Action:**

1. Push the generator set line circuit breaker OFF. If the generator set now runs, reduce the number of loads, especially those with high motor starting loads such as air conditioners.
2. Check the fuel tank and fill as necessary. (Note: The arrangement of pickup tubes in the fuel supply tank probably is such that the generator set will 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 (p. 3-3).
5. Check all fuel filters and fittings for fuel and air leaks, tighten as necessary and reprime. (Air bubbles can disrupt frequency.)
6. Replace the fuel filters and reprime (p. 4-6).

## GOVERNOR OVERLOAD—CODE NO. 22

**Control Logic:** Maximum allowable time at full-duty cycle was exceeded

**Corrective Action:**

1. Reduce the number of appliances running at the same time, especially those with high motor starting loads such as air conditioners.
2. Check the fuel tank and fill as necessary. (Note: The arrangement of pickup tubes in the fuel supply tank probably is such that the generator set will 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 (p. 3-3).
5. Check all fuel filters and fittings for fuel and air leaks, tighten as necessary and reprime.
6. Replace the fuel filters and reprime (p. 4-6).

## FAULTY OIL PRESSURE SENDER—CODE NO. 23

**Control Logic:** Controller sensed grounded sender

**Corrective Action:** See an authorized Onan service representative.

**TABLE 5-1. TROUBLESHOOTING GENERATOR SET FAULTS (CONT.)**

**⚠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 Safety Precautions.***

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

## FAULTY TEMPERATURE SENDER—CODE NO. 24

**Control Logic:** Controller sensed open sender

**Corrective Action:** See an authorized Onan service representative.

## LOSS OF AC VOLTAGE SENSE—CODE NO. 27

**Control 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

**Corrective Action:** See an authorized Onan service representative.

## HIGH BATTERY VOLTAGE—CODE NO. 29

**Control Logic:** During startup the generator set Controller sensed that battery system voltage was greater than 19.2 volts

**Corrective Action:**

1. Check battery bank connections and reconnect if necessary for 12 volts.
2. Select a lower battery booster charge rate.

## CONTROL CARD FAILURE–EE—CODE NO. 35

**Control Logic:** During startup the generator set Controller detected a EE memory error

**Corrective Action:** See an authorized Onan service representative.

**TABLE 5-1. TROUBLESHOOTING GENERATOR SET FAULTS (CONT.)**

**⚠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 Safety Precautions.***

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

## UNKNOWN SHUTDOWN—CODE NO. 36

**Control 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

**Corrective Action:**

1. Check for mechanical damage and service as necessary.
2. Reduce the number of appliances running at the same time, especially those with high motor starting loads such as air conditioners.
3. Check fuel level and refill as necessary. (Note: 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 (p. 3-3).
6. Check all fuel filters and fittings for fuel and air leaks, tighten as necessary and reprime.
7. Replace the fuel filters and reprime (p. 4-6).

## INVALID GENSET CONFIGURATION—CODE NO. 37

**Control Logic:** The generator set Controller is not configured properly for the generator set

**Corrective Action:** See an authorized Onan service representative.

## FIELD OVERLOAD—CODE NO. 38

**Control Logic:** High field voltage induced by high rotor temperature or low power factor loads

**Corrective Action:**

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

## GENERATOR ROTOR FAULT—CODE NO. 41

**Control Logic:** F+ grounded

**Corrective Action:** See an authorized Onan service representative.

**TABLE 5-1. TROUBLESHOOTING GENERATOR SET FAULTS (CONT.)**

**⚠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 Safety Precautions.***

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

## CONTROL CARD FAILURE–RAM—CODE NO. 43

**Control Logic:** During startup the generator set Controller detected a RAM memory error

**Corrective Action:** See an authorized Onan service representative.

## SPEED SENSE LOST—CODE NO. 45

**Control Logic:** After start disconnect the generator set Controller lost speed sense [quadrature zero crossings] for 0.25 seconds

**Corrective Action:** See an authorized Onan service representative.

## FIELD SENSE LOST–RAM—CODE NO. 48

**Control Logic:** Controller unable to sense field voltage

**Corrective Action:** See an authorized Onan service representative.

## OVERPRIME—CODE NO. 57

**Control Logic:** A local or remote control switch was held in the Prime position for more than 5 minutes

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

TABLE 5-1. TROUBLESHOOTING GENERATOR SET FAULTS (CONT.)

**⚠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 Safety Precautions.***

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

## HIGH EXHAUST TEMPERATURE—CODE NO. 58

**Control Logic:** Exhaust temperature exceeded design limits due to lack of water delivered to the exhaust/water mixer

**Corrective Action:**

1. Open the sea valve.
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 and reconnect or replace any disconnected, kinked or leaking raw water hoses.
4. Inspect the siphon break (if provided) for proper operation.

## EXTERNAL SHUTDOWN—CODE NO. 61

**Control Logic:** The generator set was shut down by a fire suppression system or other external control

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

# 6. Specifications

| | | |
|---|---|---|
| **GENERATOR:** 2-Bearing, 2-Pole Rotating Field, Microprocessor Regulated. Rating on Generator Set Nameplate | | |
| **FUEL CONSUMPTION:** | | |
| 60 Hz: | Full Load<br>Half Load | 0.55 gph (2.1 liter/hr)<br>0.35 gph (1.3 liter/hr) |
| 50 Hz: | Full Load<br>Half Load | 0.44 gph (1.7 liter/hr)<br>0.28 gph (1.0 liter/hr) |
| Engine/Generator Speed: | 60 Hz<br>50 Hz | 2900/3600 rpm<br>2400/3000 rpm |
| **ENGINE:** 4-Stroke Cycle, Indirect Injection Diesel, Water Cooled, Microprocessor Governed (Isochronous) | | |
| Number of Cylinders | | 2 |
| Bore | | 2.64 inch (67 mm) |
| Stroke | | 2.68 inch (68 mm) |
| Displacement | | 29.23 $inch^3$ (479 $cm^3$) |
| Compression Ratio | | 23.5:1 |
| Firing Order (Clockwise Rotation) | | 1-2 |
| Fuel Injection Timing | | 18.25° – 19.75° BTDC |
| Fuel Injection Pressure | | 1991 psi (13.73 MPa) |
| Valve Lash (cold) | | 0.0059 – 0.0073 INCH (0.145 – 0.185 MM) |
| Engine Oil Capacity | | 2.2 quart (2.1 liter) |
| Engine Oil Drain Connection | | 3/8 NPT |
| Coolant Capacity | | 2.2 quart (2.1 liter) |
| Coolant Flow: | 60 Hz<br>50 Hz | 3.5 gpm (13 liter/min)<br>3.0 gpm (16 liter/min) |
| Raw Water Flow: | 60 Hz<br>50 Hz | 5.0 gpm (19 liter/min)<br>4.0 gpm (15 liter/min) |
| Maximum Raw Water Pump Lift | | 4 feet (1.2 m) with 5/8 inch ID hose |
| Raw Water Inlet Connection | | 5/8 inch (15.9 mm) ID Hose |
| Maximum Fuel Pump Lift | | 4 feet (1.2 m) with 3/8 inch ID fuel line |
| Recommended Fuel Line Size | | 3/8 inch (9 mm) ID |
| Fuel Supply Connection | | 1/8 NPT female |
| Fuel Return Connection | | 1/8 NPT female |
| Maximum Exhaust Back Pressure | | 3 INCH (76 MM) HG |
| Wet Exhaust Outlet Connection | | 2.0 INCH (50.8 MM) ID HOSE |
| Combustion Air | | 18 CFM (30 $M^3$/HR) |
| Generator Cooling Air | | 60-80 CFM (100-135 $M^3$/HR) |
| **BATTERIES:** | | |
| Nominal Battery Voltage | | 12 volts |
| Minimum CCA Rating | | 360 amps |
| Battery Charging Output | | Trickle (3 amps) |
| **SIZE, WEIGHT, NOISE:** | | |
| Size: L x W x H | | 26 x 20.1 x 20.6 inch (662 x 511 x 524 mm) |
| Weight (dry) | | 365 lbs (166 kg) |
| Noise: | 60 Hz<br>50 Hz | 71 dB(A)<br>68 dB(A) |

# 7. Maintenance Record

Record all periodic and unscheduled maintenance and service. See *Periodic Maintenance* (Section 4).

| DATE | HOUR METER READING | MAINTENANCE OR SERVICE PERFORMED |
|---|---|---|
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Record the name, address, and phone number of your authorized Cummins Onan service center.

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Cummins **Onan**

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