



Service Manual

Cummins **Onan**

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Marine Generator Set

MDKBJ (Spec A-C)
MDKBW (Spec A-B)

California

Proposition 65 Warning

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

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1 Safety Precautions

1.1 Overview

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

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

SAVE THESE INSTRUCTIONS.



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



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

1.2 Precaution Symbols

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



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



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



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



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

1.3 General Safety Precautions



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



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

**WARNING: Operation of equipment.**

Is unsafe when mentally or physically fatigued.

Do not operate equipment in this condition, or after consuming any alcohol or drug.

**WARNING: Maintaining or installing a generator set.**

Can cause severe personal injury.

Wear personal protective equipment such as safety glasses, protective gloves, hard hats, steel-toed boots, and protective clothing when working on equipment.

**WARNING: Moving parts.**

Can cause severe personal injury or death.

Make sure all protective guards are properly in place before starting the generator set.

**WARNING: Running the generator set without the cover or service door can cause severe personal injury or equipment damage. Do not operate the generator set with the cover or service doors removed.****WARNING: Coolant under pressure.**

Hot coolants under pressure can cause severe scalding.

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

**WARNING: Hot metal parts.**

Can cause severe burns.

Avoid contact with the radiator, turbo charger, and exhaust system.

**WARNING: Flammable liquids.**

Can cause fire or explosion.

Do not store fuel, cleaners, oil, etc. near the generator set.

**WARNING: Starting fluids, such as ether.**

Can cause explosion and generator set engine damage.

Do not use.

**WARNING: Ethylene glycol.**

Used as engine coolant, is toxic to humans and animals.

Clean up coolant spills and dispose of used antifreeze in accordance with local environmental regulations.

**WARNING: Used engine oils.**

Have been identified by some state and federal agencies to cause cancer or reproductive toxicity.

Do not ingest, breathe the fumes, or contact used oil when checking or changing engine oil. Wear protective gloves.



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



WARNING: *Substances in exhaust gases.*

Have been identified by some state and federal agencies to cause cancer or reproductive toxicity.

Do not breathe in or come into contact with exhaust gases.



DANGER: *Accidental or remote starting.*

Accidental starting of the generator set while working on it can cause severe personal injury or death

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



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



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



CAUTION: *Accumulated grease and oil.*

Can cause overheating and engine damage presenting a potential fire hazard.

Keep the generator set clean and make sure oil leaks are repaired promptly.



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

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



WARNING: *Energized circuits.*

Any work with exposed energized circuits with potentials of 50 Volts AC or 75 Volts DC or higher poses a significant risk of electrical shock and electrical arc flash. These silent hazards can cause severe injuries or death.

Refer to standard NFPA 70E or equivalent safety standards in corresponding regions for details of the dangers involved and for the safety requirements.

Guidelines to follow when working on de-energized electrical systems:

- Use proper PPE. Do not wear jewelry and make sure that any conductive items are removed from pockets as these items can fall into equipment and the resulting short circuit can cause shock or burning. Refer to standard NFPA 70E for PPE standards.
- De-energize and lockout/tagout electrical systems prior to working on them. Lockout/Tagout is intended to prevent injury due to unexpected start-up of equipment or the release of stored energy. Please refer to lockout/tagout procedures for more information.

- De-energize and lockout/tagout all circuits and devices before removing any protective shields or making any measurements on electrical equipment.
- Follow all applicable regional electrical and safety codes.

Guidelines to follow when working on energized electrical systems:



NOTE: It is the policy of Cummins Inc. to perform all electrical work in a de-energized state. However, employees or suppliers may be permitted to occasionally perform work on energized electrical equipment only when qualified and authorized to do so and when troubleshooting, or if de-energizing the equipment would create a greater risk or make the task impossible and all other alternatives have been exhausted.



NOTE: Exposed energized electrical work is only allowed as per the relevant procedures and must be undertaken by a Cummins authorized person with any appropriate energized work permit for the work to be performed while using proper PPE, tools and equipment.

- Do not tamper with or bypass interlocks unless you are authorized to do so.
- Make sure that an accompanying person who can undertake a rescue is nearby.

1.5 Generator Voltage Is Deadly

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

1.6 Engine Exhaust Is Deadly

- Properly working carbon monoxide detectors must be located in all living areas of the boat.
- Never occupy the boat while the generator set is running unless the boat is equipped with properly working marine carbon monoxide detectors.
- The exhaust system must be installed in accordance with the generator set Installation Manual and be free of leaks.
- Prior to every startup and after every eight hours of running, all carbon monoxide detectors must be tested and confirmed to be working in accordance with the manufacture's instructions or owner's manual.
- Make sure the bilge is adequately ventilated with a power exhauster or blower.
- Inspect for exhaust leaks at every startup and after every eight hours of operation.
- For more information about carbon monoxide see American Boat and Yacht Council (ABYC) publication TH-22—*Educational Information About Carbon Monoxide*.

1.7 Diesel Fuel is Combustible

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

1.8 Battery Gas is Explosive

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

1.9 Moving Parts Can Cause Severe Personal Injury Or Death

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

1.10 Flammable Vapor Can Cause a Diesel Engine to Overspeed



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

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

1.11 Hazards of Carbon Monoxide



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

1.11.1 Carbon Monoxide Poisoning

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

Mild effects of CO poisoning include:

- eye irritation
- dizziness
- sleepiness
- headaches
- fatigue
- inability to think clearly

More extreme symptoms include:

- vomiting
- seizures
- collapse

1.11.2 Special Risks of CO on Boats

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

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

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

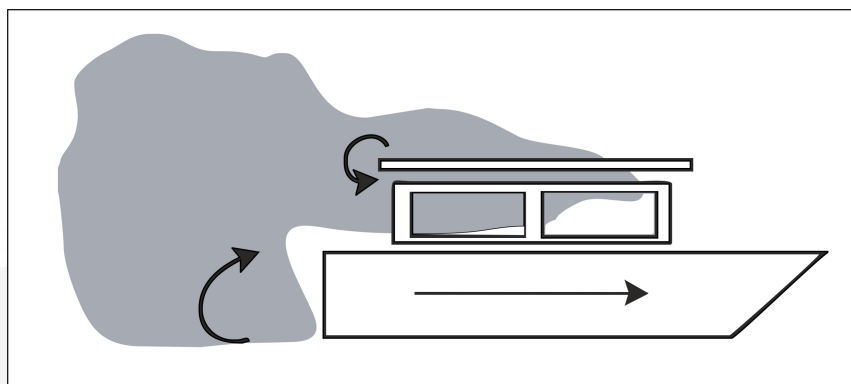


FIGURE 1. STATION WAGON EFFECT

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

1.11.3 Protection From CO Poisoning

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

1.12 Substances Hazardous to Health

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

1.12.1 Antifreeze (Fleetguard - ES Compleat and EG Premix)

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

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

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

1.12.1.1 Hazardous Reactions

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

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

1.12.1.2 Protective Measures

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

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

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

1.12.1.3 Storage and Transport

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

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

1.12.1.4 Emergency Action

- Fire - Fire fighters are to use self contained breathing apparatus. Keep fire-exposed containers cool. Prevent run-off from entering waterways, drains, and drinking water supplies. Extinguishing media: CO₂, alcohol resistant foam, dry powder, or water spray.
- Ingestion - Toxic by ingestion. If swallowed, contact a doctor or poison control center. Induce vomiting only under the advice of a doctor or poison control center. Delayed treatment may result in fatality.
- Inhalation (of vapor) - Remove from further exposure. In case of irritation to lungs or throat, seek medical advice.
- Aspiration (inhalation of liquid) - Obtain immediate medical assistance.
- Eyes - Flush copiously with water or preferably eye-wash solution for at least five minutes. Seek medical advice.
- Skin - Wash thoroughly with soap and water and seek medical attention if irritation develops. Change clothing if necessary and wash clothing before re-use.
- Spillage - Soak up using an absorbent material and dispose of as directed under Storage and Transport.

1.12.2 Gas Oil

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

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

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

1.12.2.1 Hazardous Reactions

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

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

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

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

1.12.2.2 Protective Measures

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

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

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

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

No special respiratory precautions are necessary in normal use.

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

1.12.2.3 Storage and Transport

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

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

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

1.12.2.4 Emergency Action

- Fire - Avoid making sparks. Fire fighters are to use self-contained breathing apparatus. Keep fire-exposed containers cool, using water fog or spray. Prevent run-off from entering waterways, drains, and drinking water supplies.
 - Extinguishing media for large fire: Foam or water fog. Never use water jet.
 - Extinguishing media for small fire: Foam or dry powder, AAF, CO₂, sand, earth.
- Ingestion - Do not induce vomiting. Wash mouth out with water and send to hospital immediately.
- Inhalation (of vapor) - Remove from further exposure. Obtain medical assistance immediately.
- Aspiration (inhalation of liquid) - If, following ingestion of gas oil, vomiting occurs, there is danger of aspiration into the lungs. This would cause intense local irritation and chemical 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 and Transport.

1.12.3 Lubricant Oil - Premium Blue E 15W40

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

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

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

1.12.3.1 Hazardous Reactions

This product is stable, although slightly re-active, with oxidizing agents. Results of decomposition are carbon oxides (CO, CO₂) and water.

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

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

1.12.3.2 Protective Measures

Ensure good ventilation and avoid heat sources.

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

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

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

1.12.3.3 Storage and Transport

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

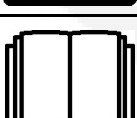
Wear splash goggles, full suit, boots, and gloves. Absorb leaks or spills with an inert material and dispose of unwanted or absorbed substance through an authorized contractor to a licensed site. Finish cleaning by spreading water on the contaminated surface and allow to evacuate through the sanitary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

1.12.3.4 Emergency Action

- Fire - Fire-fighters are to use self contained breathing apparatus and full turnout gear. Keep fire-exposed containers cool.
 - Extinguishing media for large fire: Use water spray, fog or foam. Do not use water jet.
 - Extinguishing media for small fire: Use dry chemical powder or CO₂.
- Ingestion - Do not induce vomiting. Obtain medical advice immediately.
- Inhalation (of vapor) - Remove from further exposure. Obtain medical attention.
- Aspiration (inhalation of liquid) - Obtain immediate medical assistance.
- Eyes - Flush copiously with water or preferably eye-wash solution for at least fifteen minutes. Obtain medical advice.
- Skin - Wash thoroughly with soap and water. Obtain medical advice if irritation develops. Change clothing if necessary and wash before re-use.
- Spillage - Absorb with an inert material and dispose of as directed under Storage and Transport.

1.13 Generator Set Warning Labels

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

	Caution or Warning. Indicates a risk of personal injury.
	Caution or Warning of Temperature Hazard. Indicates a risk of personal injury from high temperature.
	Caution or Warning of High Voltage Hazard. Indicates a risk of personal injury from electric shock or electrocution.
	Caution or Warning of Engine Coolant Pressure Hazard. Indicates a risk of personal injury from hot pressurized engine coolant.
	Caution or Warning. Indicates to read Operator Manual for additional information.
	Caution or Warning of No Step. Indicates a risk of personal injury or equipment damage from stepping on equipment.

	Caution or Warning of Combustion or Explosion Hazard. Indicates a risk of personal injury from explosion.
	Caution or Warning of Belt and Rotating Part Hazard. Indicates a risk of personal injury from entanglement in moving parts.
	Caution or Warning of Chemical (ingestion or burn) Hazard. Indicates a risk of personal injury or asphyxiation from poisonous fumes or toxic gases.
	Caution or Warning of High Voltage or Current Source Hazard. Indicates a risk of personal injury from electrical shock or electrocution.
	Caution or Warning of Fan and Rotating Part Hazard. Indicates a risk of personal injury from entanglement in moving parts.

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2 Introduction



WARNING: *Hazardous voltage.*

Can cause severe personal injury or death and equipment damage.

Generator electrical output connections must be made by a trained and experienced electrician in accordance with the installation instructions and all applicable codes.



WARNING: *Electrical generating equipment.*

Can cause severe personal injury or death.

Generator sets must be installed, certified, and operated by trained and experienced person in accordance with the installation instructions and all applicable codes.

2.1 About This Manual

This is the Service Manual for the generator set or sets listed on the front cover.

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

This manual includes generator set specifications, troubleshooting resolutions for all fault codes, maintenance schedule, service and maintenance procedures for the generator set control, engine, accessories, and generator as well as adjusting the AC output voltage and changing the generator set frequency .

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

2.1.1 Warning - Generator Set Not Ignition Protected



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



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

2.2 Related Literature

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



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

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

- Health and Safety Manual (0908-0110)

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

- Operator Manual (A029Z105)
- Installation Manual (A029Z106)
- Service Manual for (A029Z107)
- Parts Manual (A029Z108)
- Engine Service Manual for Marine QD (0981-0550)
- Specification and Data Sheet (A1556) (For engineering data specific to the generator set)
- Recommended Spares List (RSL) (A034C235)
- Standard Repair Times - EZ Family (A029Z109)
- Warranty Manual (F1117-0002)
- Global Commercial Warranty Statement (A028U870)

2.3 Model Identification

The generator set model name is found on the nameplate, which is mounted on the service side of the generator set. See figure below. Every character is significant (the last character of the model number is the specification letter, which is important for obtaining the right parts).



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

2.3.1 Nameplate Location

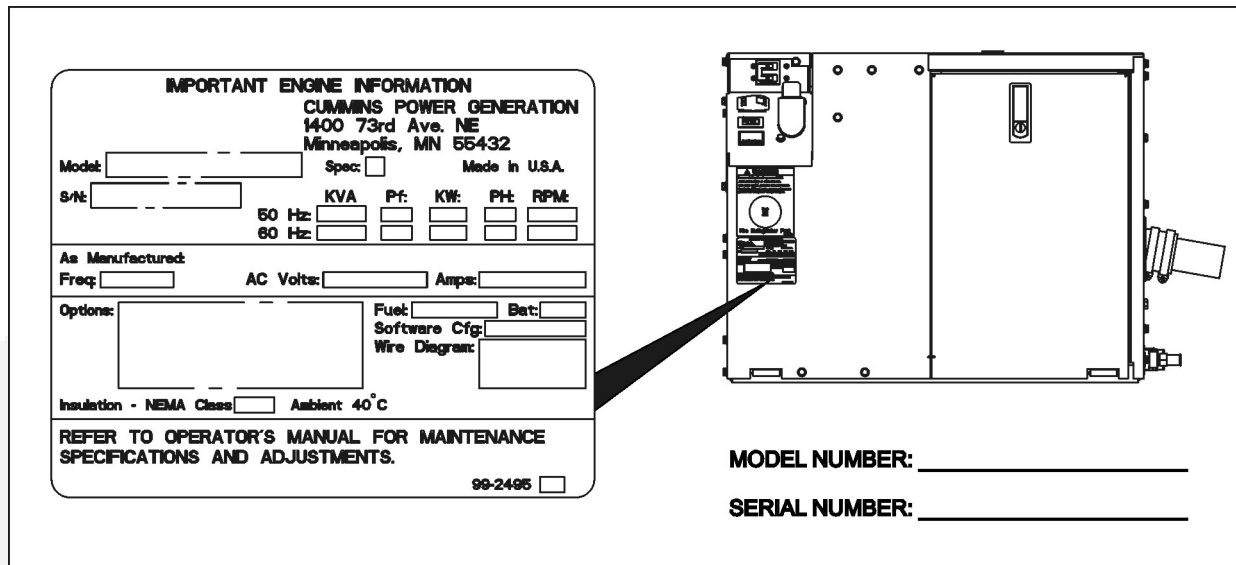


FIGURE 2. NAMEPLATE LOCATION

2.4 Emissions Label

The emissions label states compliance with applicable engine emissions regulations for US EPA certified models (17 MDKDP, 21.5 MDKDR, and 29 MDKDS). Refer also to the Federal Emissions Design And Defect Limited Warranty For C.I. Engine (Diesels) publication that was shipped in the same package as the Operator Manual.



NOTE: The emissions warranty statement is for EPA certified only products.

2.4.1 Emissions Label Location

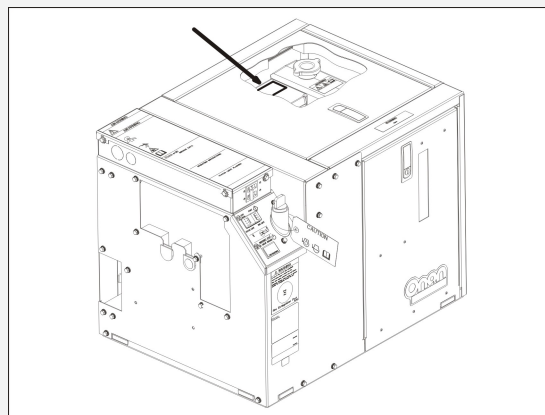


FIGURE 3. EMISSIONS LABEL LOCATION

2.5 Noise

Generator sets emit noise. As noise level and time of exposure increase, risk of hearing damage increases. [Chapter 10 on page 101](#) includes specific noise level information for these generator sets. Use personal hearing protection appropriate for your exposure to generator set noise.

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

2.6 Electromagnetic Compatibility Compliance

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

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

2.7 Build Standards

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

Standard	Title
BS EN 1037:1995+A1:2008	Safety of machinery - Prevention of unexpected start up.
BS EN ISO 14121-1:2007	Safety of machinery. Risk assessment principles.
BS EN ISO 13857:2008	Safety of machinery. Safety distances to prevent hazard zones being reached by upper and lower limbs.
BS EN 349:1993+A1:2008	Safety of machinery - Minimum gaps to avoid crushing parts on the human body.
BS EN 547-1:1996+A1:2008	Safety of machinery - Human body dimensions - Part 1: Principles for determining the dimensions required for openings for whole body access into machinery.
BS EN 547-2:1996+A1:2008	Safety of machinery - Human body dimensions - Part 2: Principles for determining the dimensions required for access openings.
BS EN 547-3:1996+A1:2008	Safety of machinery - Human body dimensions - Part 3: Anthropomorphic data.
BS EN 60204-1:2006+A1:2009	Safety of machinery. Electrical equipment of machines. General requirements.
BS EN 614-1:2006+A1:2009	Safety of machinery. Ergonomic design principles. Terminology and general principles.
BS EN 953:1997+A1:2009	Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards.
BS EN ISO 12100-1:2003+A1:2009	Safety of machinery. Basic concepts, general principles for design. Basic terminology, methodology
BS EN ISO 12100-2:2003+A1:2009	Safety of machinery. Basic concepts, general principles for design. Technical principles

Standard	Title
BS EN ISO 13732-1:2008	Ergonomics of the thermal environment. Methods for the assessment of human responses to contact with surfaces. Hot surfaces
BS EN ISO 13849-1:2008	Safety of machinery - Safety-related parts of control systems
BS EN ISO 13850:2006	Safety of machinery - Emergency stop. Principles for design.
BS EN 61310-1:2008	Safety of machinery - Indication, marking and actuation - Part 1: Requirements for visual, auditory and tactile signals.
BS EN 61310-2:2008	Safety of machinery - Indication, marking and actuation - Part 2: Requirements for marking.
BS EN 61000-6-1:2007	Electromagnetic compatibility (EMC). Generic standards. Immunity standard for residential, commercial and light-industrial environments.
BS EN 61000-6-3:2007	Electromagnetic compatibility (EMC). Generic standards. Emission standard for residential, commercial and light-industrial environments.
BS EN 1299:1997+A1:2008	Mechanical vibration and shock - Vibration isolation of machines - Information for the application of source isolation
BS EN 1679-1:1998	Reciprocating internal combustion engines - Safety - Part 1: Compression ignition engines
BS EN 12601:2001	Reciprocating internal combustion engine driven generating sets - Safety

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3 Maintenance

3.1 Periodic Maintenance

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

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

To help keep generator set maintenance regular and provide a basis for warranty claims, record maintenance performed, see [Chapter 11 on page 105](#).

3.1.1 Periodic Maintenance Schedule

Maintenance Operation	Maintenance Frequency							
	After first 50 Hrs	Every Day or 8 Hrs	Every Month or 100 Hrs	Every Year or 200 Hrs	Every Year or 500 Hrs	Every 800 Hrs	Every 2 Years	Every 5 Years or 2000 Hrs
General Inspection		X ¹						
Check Engine Oil Level		X						
Drain Water from Fuel Filter			X					
Inspect Battery and Battery Connections			X ²					
Check V-belt			X ³					
Inspect Siphon Break			X					
Change Engine Oil and Oil Filter	X			X				
Replace Fuel Filter					X			
Replace Raw Water Impeller					X ⁴			
Adjust Engine Valve Laah						X ⁴		
Replace Coolant, Pressure Cap, and Thermostat							X ⁴	
Inspect Generator Bearing								X ⁴
1 - Includes inspection of Oil Level, Coolant Level, Fuel System, Exhaust System, and Batteries and Battery Connections. 2 - See battery manufacturer's recommendations. 3 - Check for slippage, cracking, and wear. 4 - Must be performed by a qualified mechanic (authorized Cummins Onan dealer).								

3.2 General Inspection

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

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

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

3.2.1 Service Point Locations

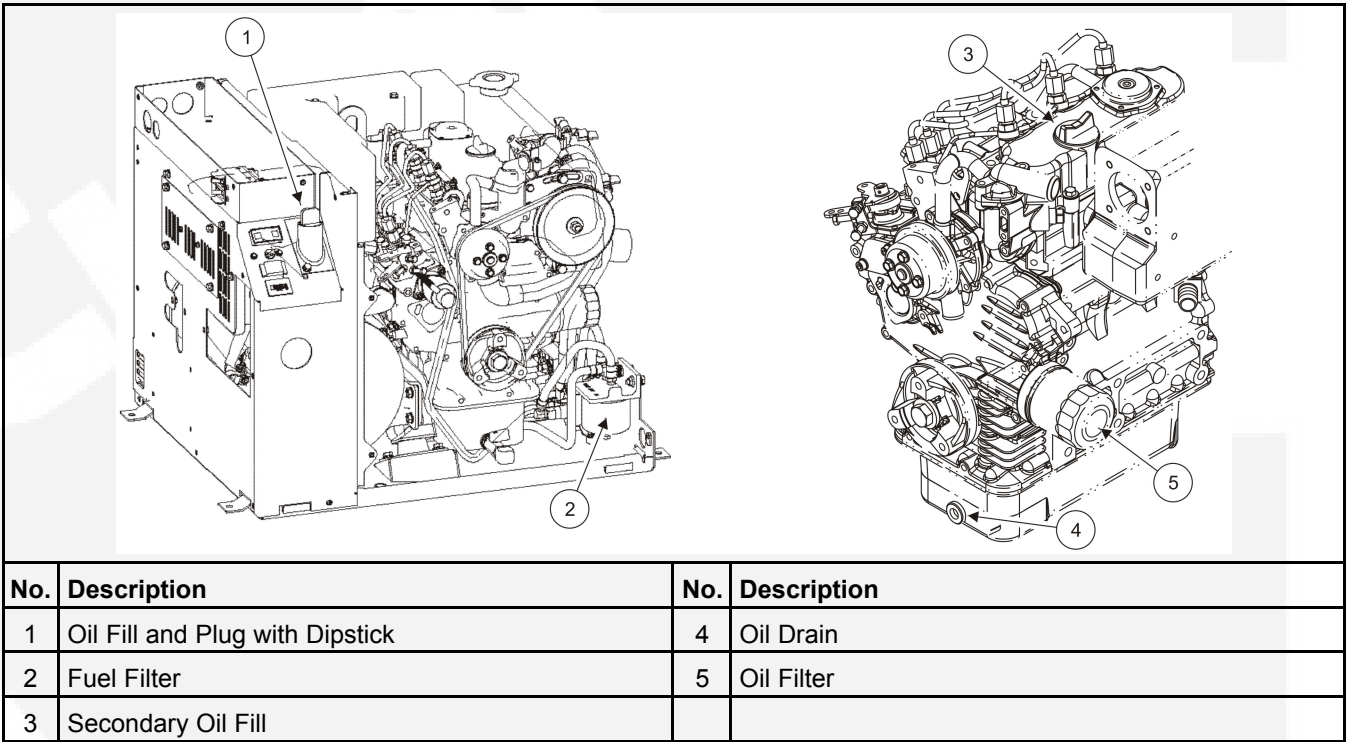


FIGURE 4. OIL AND FUEL SERVICE POINT LOCATIONS

3.2.2 Battery Connections



WARNING: *Flames, sparks, or arcing at battery terminals, light switches, or other equipment can ignite battery gas, causing severe personal injury. Ventilate the battery area before working on or near a battery, wear safety glasses, and do not smoke. Turn work light on or off away from the battery. When performing maintenance procedures or when servicing a battery, stop the generator set and disconnect the charger before disconnecting battery cables. Using an insulated wrench, disconnect the negative (–) cable first and reconnect it last.*

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

3.2.3 Oil Level



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



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



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



CAUTION: *Too little oil can cause severe engine damage. Too much oil can cause high oil consumption. Keep the oil level between the high and low beads (or markings) on the dipstick.*

1. Shut off the generator set.
2. Pull the oil fill plug and dipstick out of the oil fill neck. The plug may be difficult to pull straight out - tilt the plug in its socket while pulling out.
3. Wipe off the dipstick and thread it back into the fill neck. Seat the plug, which snaps into its socket.
4. Remove the plug and dipstick again and check the oil level on the dipstick. Replace and seat the oil fill plug.
5. Add or drain oil as necessary if the oil level is not within the bead markings (FULL or ADD markings). See [Section 3.4 on page 26](#) for oil recommendations.



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

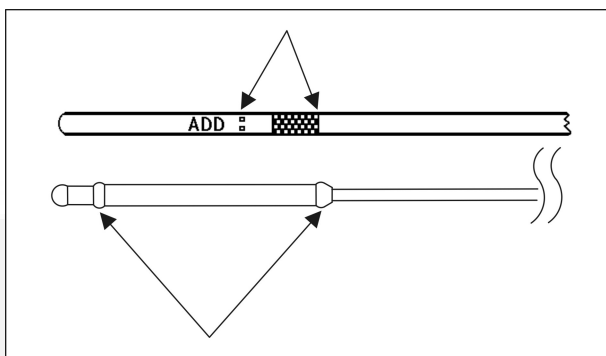


FIGURE 5. OIL LEVEL DIPSTICK ADD/FULL MARKINGS

3.2.4 Fuel System Leaks



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

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

3.2.5 Coolant Level

The recovery tank is designed to maintain coolant level, not to fill the system. Keep the level of coolant in the recovery tank between **COLD** and **HOT**. See [Section 3.6.5 on page 34](#) for coolant specifications. Also see [Section 3.6.7 on page 35](#) for detailed instructions on refilling the cooling system.

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

3.2.6 Raw Water System

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

3.2.7 Exhaust System



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

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

3.2.8 Mechanical System

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

3.3 Maintaining the Battery



WARNING: *Flames, sparks, or arcing at battery terminals, light switches, or other equipment can ignite battery gas, causing severe personal injury. Ventilate the battery area before working on or near a battery, wear safety glasses, and do not smoke. Turn work light on or off away from the battery. When performing maintenance procedures or when servicing a battery, stop the generator set and disconnect the charger before disconnecting battery cables. Using an insulated wrench, disconnect the negative (–) cable first and reconnect it last.*

Refer to [Section 3.1 on page 21](#) for the battery maintenance schedule and follow the battery manufacturer's instructions. Have the battery charging system serviced if DC system voltage is consistently low or high.

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

1. Keep the battery case and terminals clean and dry.
2. Keep the battery terminals tight.
3. Remove battery cables with a battery terminal puller.

- 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.

3.4 Maintaining the Lubrication System

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

3.4.1 Oil Recommendations



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

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

3.4.1.1 Oil Viscosity vs. Ambient Temperature

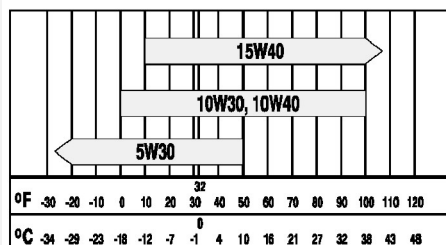


FIGURE 6. OIL VISCOSITY VS. AMBIENT TEMPERATURE

3.4.2 Changing Engine Oil and Filter



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



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



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

Refer to [Chapter 3 on page 21](#) for the engine oil change schedule.

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

2. For generator sets with sound shield, remove service door.
3. Remove oil fill plug and open the drain valve. The drain valve has a 3/8 NPT outlet for connecting a hose fitting to facilitate oil drainage.



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



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



NOTE: Dispose of oil in accordance with local requirements.

4. Drain used oil into a suitable container.
5. Close the oil drain valve.
6. Remove the old oil filter or filters using a suitable filter wrench (available from Cummins Onan) and appropriately discard the filter or filters.
7. Remove the old gasket if it does not come off with the filter. Wipe the sealing surface clean.
8. Apply a film of oil to the new filter gasket and partly fill the new filter with oil so that it reaches engine parts sooner at startup.
9. Spin the filter on by hand until the gasket just touches the mounting pad and tighten 3/4 of a turn.
10. Refill the engine with the proper type and amount of engine oil. See previous section for oil recommendations and [Chapter 10 on page 101](#) for oil capacity.



CAUTION: *Too little oil can cause severe engine damage. Too much oil can cause high oil consumption. Keep the oil level between the high and low beads (or markings) on the dipstick.*



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

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

3.5 Maintaining the Fuel System

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

3.5.1 Fuel Recommendations



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

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

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

3.5.1.1 Bio-Diesel Fuels B5-B20

B5 bio-diesel fuel that meets industry specifications and quality is suitable for use with this generator set.

See the Specifications Table [Chapter 10 on page 101](#) for model and spec compatability of bio-diesel blends up to B20.

Before using bio-diesel fuel blends ensure the following:

- The vehicle propulsion engine is capable of using B20 when sharing the same fuel tank.
- The OEM has installed a B20 compatible fuel line from fuel tank to generator set.
- The OEM has installed a water separator in the fuel line just before the generator set.

Approved Bio-Diesel Fuel:

- Bio-diesel meeting either ASTM D6751 or EN14214. Fuel meeting either ASTM D6751 or EN14214 can be blended with an acceptable diesel fuel meeting ASTM D975, meeting ASTM D975 up to 20 percent volume concentration (B20).

Blended bio-diesels fuels should be bought pre-blended and not made by customers.

Bio-Diesel Properties:

- Bio-diesel has poor oxidation stability which can accelerate fuel oxidation. Fuel oxidation will reduce generator performance. This effect is accelerated at increased ambient temperatures.
- Bio-diesel properties change at low ambient temperatures (below 235 °F/-55 °C). Necessary precautions must be taken when operating the generator with bio-diesel blends in low ambient temperatures, such as a fuel heater, hose insulation, or additional anti-gel fuel additives.
- Bio-diesel fuel blends are an excellent medium for microbial growth. Microbes cause fuel system corrosion and premature filter plugging. The effectiveness of all commercially available conventional anti-microbial additives, when used in bio-diesel, is not known. Consult your fuel and additive supplier for assistance.

- It is highly recommended that specific market applications are avoided or exercised with extra care due to some of the properties of bio-diesel fuel blends such as cold weather operation, long term storage, material incompatibilities and other effects on engine operating characteristics. Such applications that should use standard fuels include applications that will experience seasonal usage, storage for periods exceeding 60 days, and extreme temperatures or humidity.

Storage Requirements:

If using bio-diesel for seasonal applications (stored more than 90 days), the generator must be purged before storage by running the engine on pure diesel fuel meeting ASTM D975 for a minimum of 30 minutes.

Warranty Coverage:

Cummins Onan Warranty covers failures that are a direct result of defects in material or factory workmanship. Generator damage, service issues and/or performance issues determined by Cummins Onan to be caused by bio-diesel fuel blends not meeting the specifications outlined in the applicable Installation, Operator, and Service Manuals are not considered to be defects in material or workmanship and may affect your generator's warranty.

3.5.2 Draining the Fuel Filter

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

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

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

3.5.3 Replacing Fuel Filter



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



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



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

See [Section 3.1 on page 21](#) for scheduled fuel filter replacement. Replace the fuel filters if the engine lacks power. The generator set may have a primary and a secondary fuel filter. The primary filter has a water separator and sensor. Check for up-stream filters which may also need to be replaced.

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

3.5.4 Priming the Fuel System



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



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

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

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

3.6 Maintaining the Cooling System

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

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

3.6.1 Cooling System

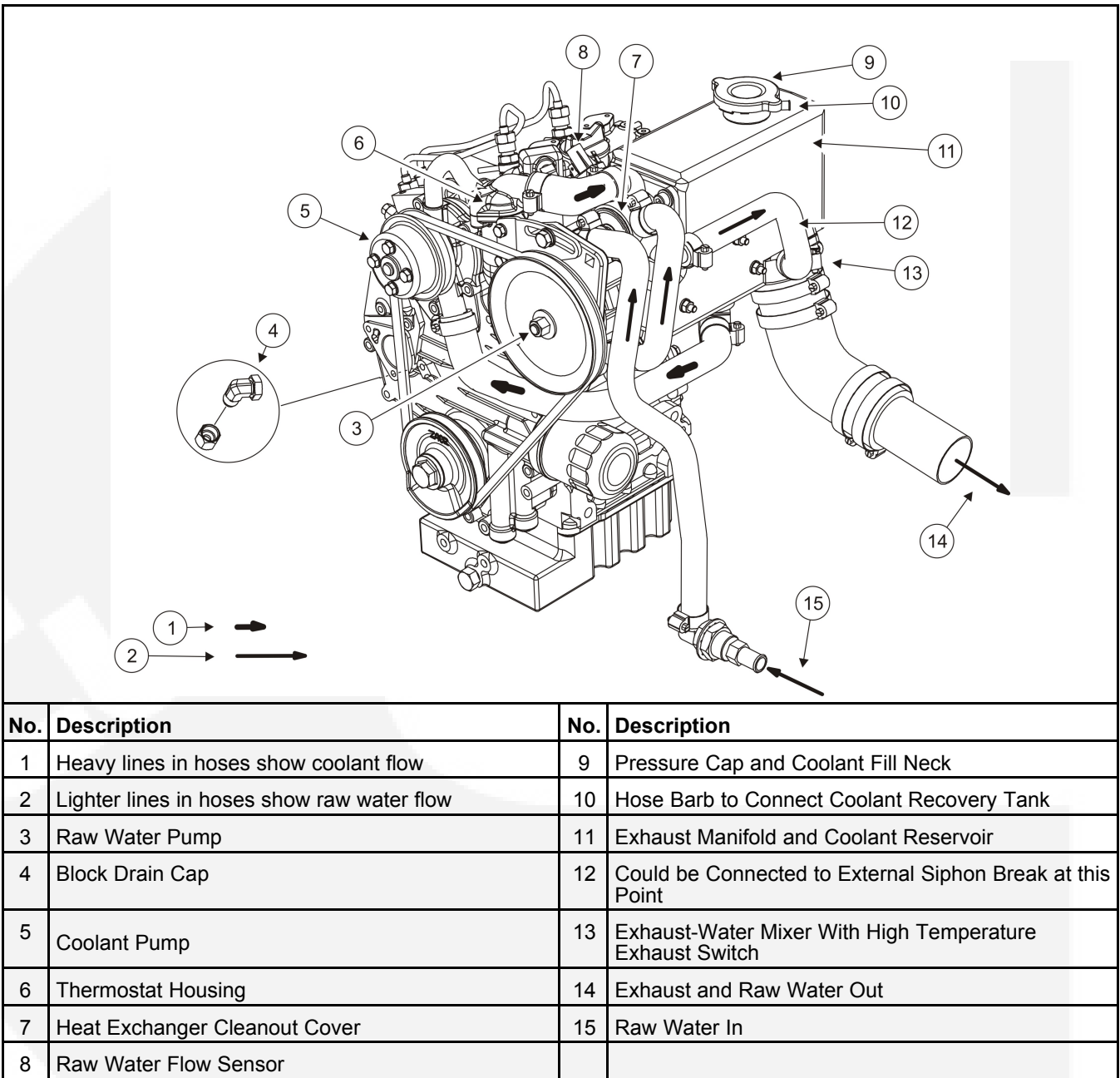


FIGURE 7. COOLING SYSTEM

3.6.2 Pressure Cap



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

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

3.6.3 Coolant Hoses

Check for and replace hoses that leak or are damaged.

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

3.6.4 Siphon Break



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

A siphon break is installed when the exhaust-water mixer is less than 6 inches above the water line. Replace the siphon break if it is encrusted with deposits, which indicates leakage. If it is of the bleed-vent type, check that the vent hose is connected to a through-hull fitting. Check for normal water flow whenever the engine is running. See the Installation Manual for more information regarding siphon breaks.

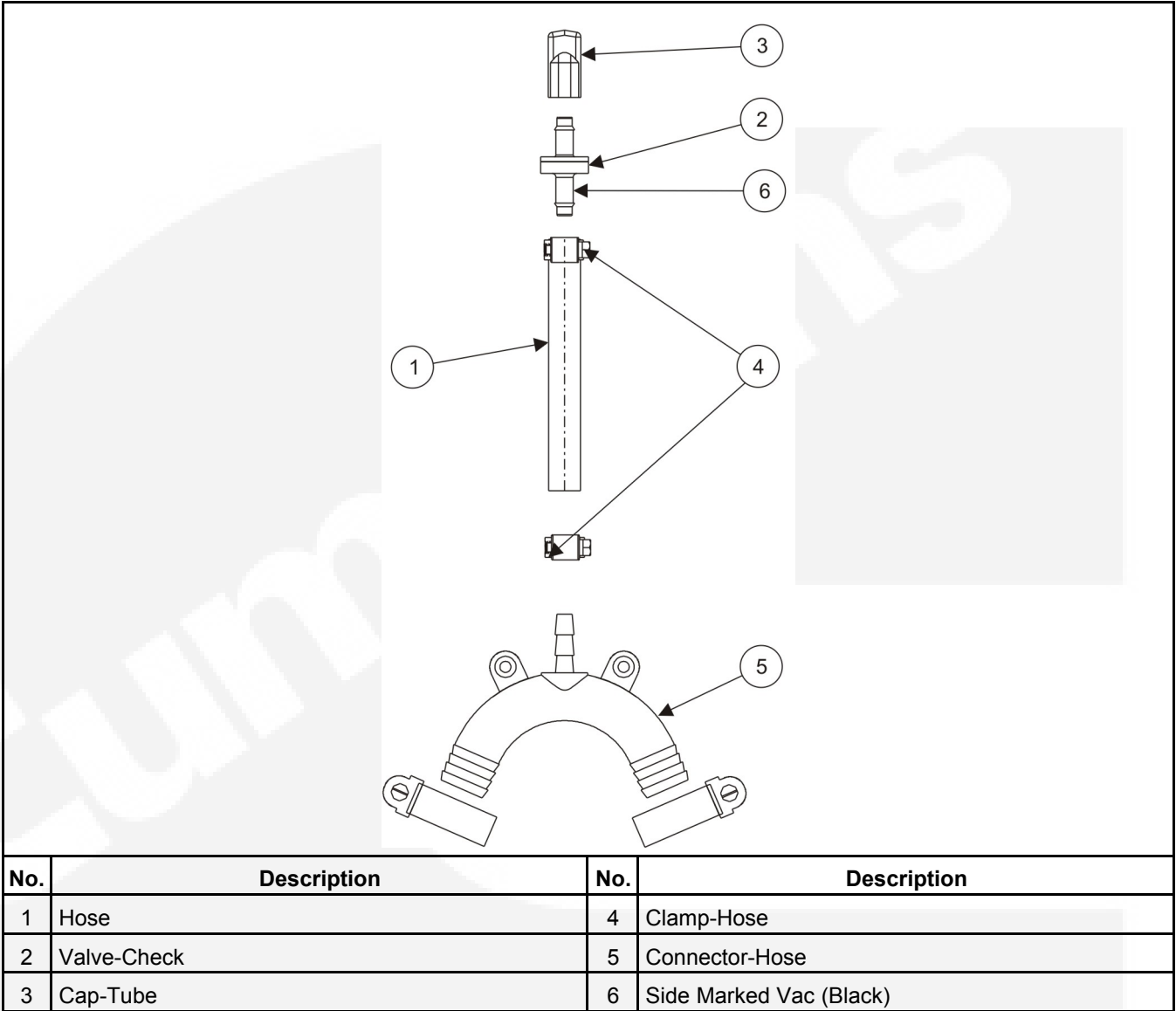


FIGURE 8. SIPHON BREAK

3.6.5 Coolant Recommendations

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

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

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

See [Chapter 10 on page 101](#) regarding coolant capacity.



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

3.6.6 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.

3.6.7 Refilling Cooling System



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

See [Section 3.6.5 on page 34](#) for coolant specifications. See [Chapter 10 on page 101](#) for coolant capacity.

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



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

3.6.8 Draining and Cleaning Cooling System



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



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

Have towels and containers ready to clean, collect and properly dispose of the coolant.

1. Use an insulated wrench to disconnect the negative (-) cable at the battery to prevent the engine from starting, let the engine cool, remove the front access door, top of the enclosure and coolant pressure cap.
2. Drain the exhaust manifold/coolant reservoir by disconnecting the hose at the coolant pump inlet and twisting it down into a container.

3. Drain the block by removing the cap on the drain fitting on the left side of the block. 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 that is large enough to fit over the socket but shorter than the extension. The hose will catch the coolant as the cap is being unscrewed.
4. Use radiator cleaning chemicals to clean and flush the cooling system before refilling with fresh coolant. Follow the cleaner manufacturer's instructions.



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

3.6.9 Heat Exchanger



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



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



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

See [Section 3.1 on page 21](#) for scheduled maintenance. Clean the raw water tubes if the engine keeps shutting down (Code No. 1) or the engine gauge or digital display indicates abnormally high engine temperatures. Drain the heat exchanger if there is a danger of freezing when the generator set is not running or is in storage. Freezing water can damage the raw water tubes in the heat exchanger. Engine coolant is protected from freezing, water is not.

3.6.9.1 Heat Exchanger

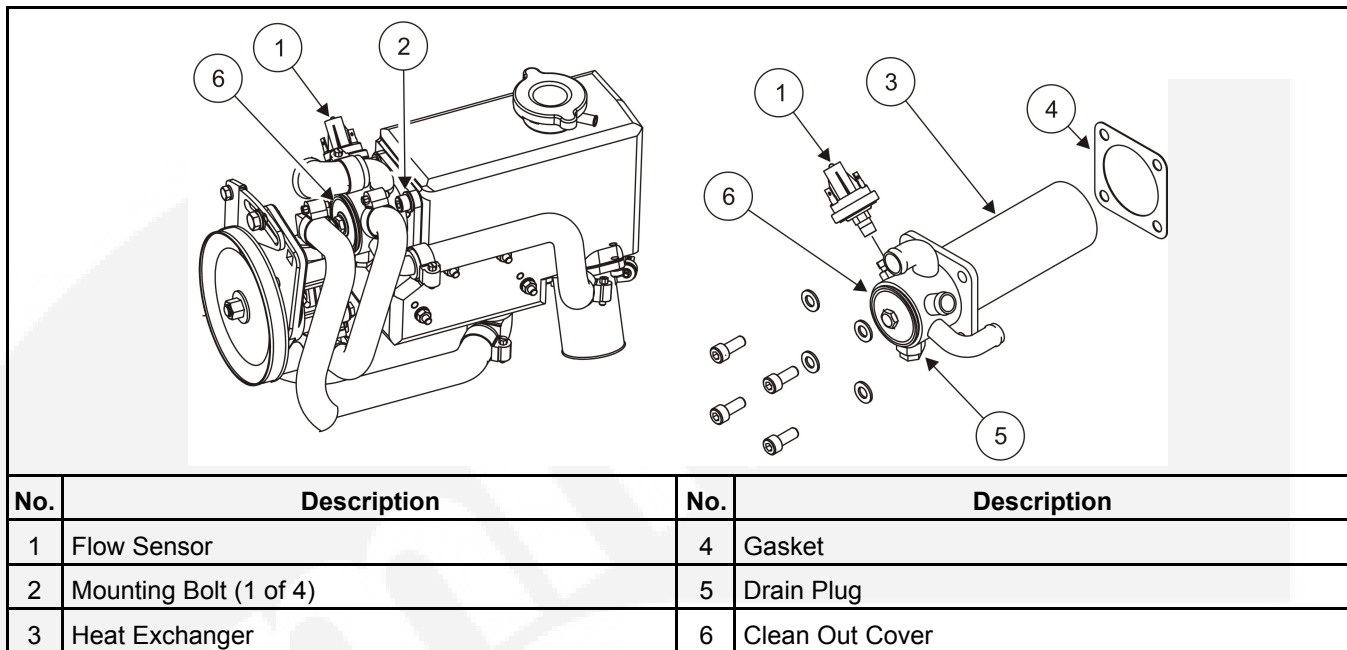


FIGURE 9. HEAT EXCHANGER

3.6.10 Removing and Installing the Heat Exchanger

Removal

1. Disconnect the two leads at the flow sensor.
2. Remove the sensor.
3. Disconnect the three hoses. (To work the coolant hose elbow off the fitting on the heat exchanger, it will be necessary to loosen the hose clamps on both ends.)
4. Remove the four mounting bolts.
5. Remove the heat exchanger.

Installation

1. Clean the mating gasket faces taking special care not to scratch the face on the aluminum manifold.
2. Replace the old gasket with a new one.
3. Torque the mounting bolts to 19 lb-ft (26 N-m).
4. Install the flow sensor using pipe thread sealant.
5. Reconnect the two leads in the harness.
6. Reconnect the hoses and reassemble all the parts that were disassembled for access.

3.6.11 Draining and Cleaning the Heat Exchanger

1. Disconnect the negative (-) cable at the battery to prevent the engine from starting, let the engine cool, and close the sea cock.

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



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

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

3.6.12 Replacing the Thermostat



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



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

See the [Section 3.1 on page 21](#) section for scheduled replacement.

1. Use an insulated wrench to disconnect the negative battery cable at the battery to prevent the engine from starting. Let the engine cool and remove the front access door.
2. Remove the pressure cap.
3. Drain the cooling system following procedure in previous section - Draining and Cleaning the Cooling System.
4. Remove the two thermostat housing bolts and pull off the housing, thermostat, and gasket. The hose does not need to come off.
5. Clean off the gasket area and install the new thermostat and gasket. Apply Three Bond 1215 liquid sealant or equivalent to the top side of the gasket.
6. Replenish any lost coolant (refer to the previous section - Refilling the Cooling System), secure the pressure cap, secure the top of the enclosure and access door, and reconnect the negative battery cable.

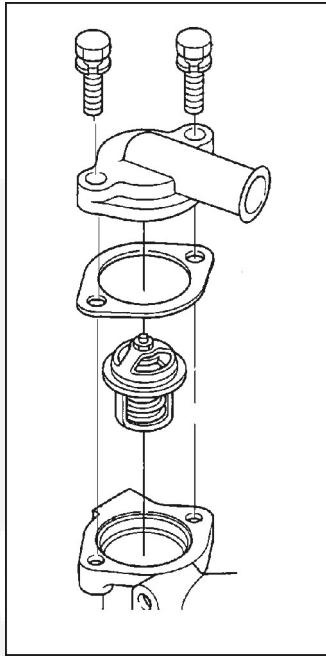


FIGURE 10. TYPICAL THERMOSTAT AND HOUSING

3.6.13 Replacing Raw Water Pump Impeller



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



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

See [Section 3.1 on page 21](#) for scheduled replacement. Avoid spilling raw water on the electrical components below the pump. Have towels and containers ready in case of water spillage.

1. Close the sea-cock.
2. Disconnect the negative (-) cable at the battery to prevent the engine from starting.
3. Remove the front access door, top of enclosure, and if work space is limited, the end panel if set is in an enclosure.
4. Remove the belt guard.
5. Loosen the hose clamps and disconnect the hoses.
6. Remove the two pump mounting bolts and belt, pull out the pump.
7. Remove the 4 pump cover screws.
8. Remove the impeller and O-ring. An impeller removal tool may be necessary to pull the impeller off the shaft.
9. Inspect impeller for broken vanes. Check for and clean out pieces that may have lodged in the heat exchanger.

10. Install the new impeller - for easier installation, twist the impeller counter-clockwise (the way it normally turns on its own) while squeezing it into the housing.
11. To provide initial lubrication and better pump suction before water reaches the pump, wet the inside of the pump and impeller with water, soap solution, or a silicone lubricant and secure the O-ring and cover.



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

12. Remount the pump, reconnect the hoses, adjust V-belt tension, and secure the belt guard, the top of the enclosure, and the front access door.
13. If the sea water strainer is above the water line, fill it for faster prime and secure its cover.
14. Open the sea-cock, reconnect the battery cables, negative [-] last, and start the generator set. The generator set will shut down within 8 seconds if there is no raw water flow, and the amber status lamp will blink shutdown Code No. 7. If it shuts down, remove any blockage and restart the generator set.

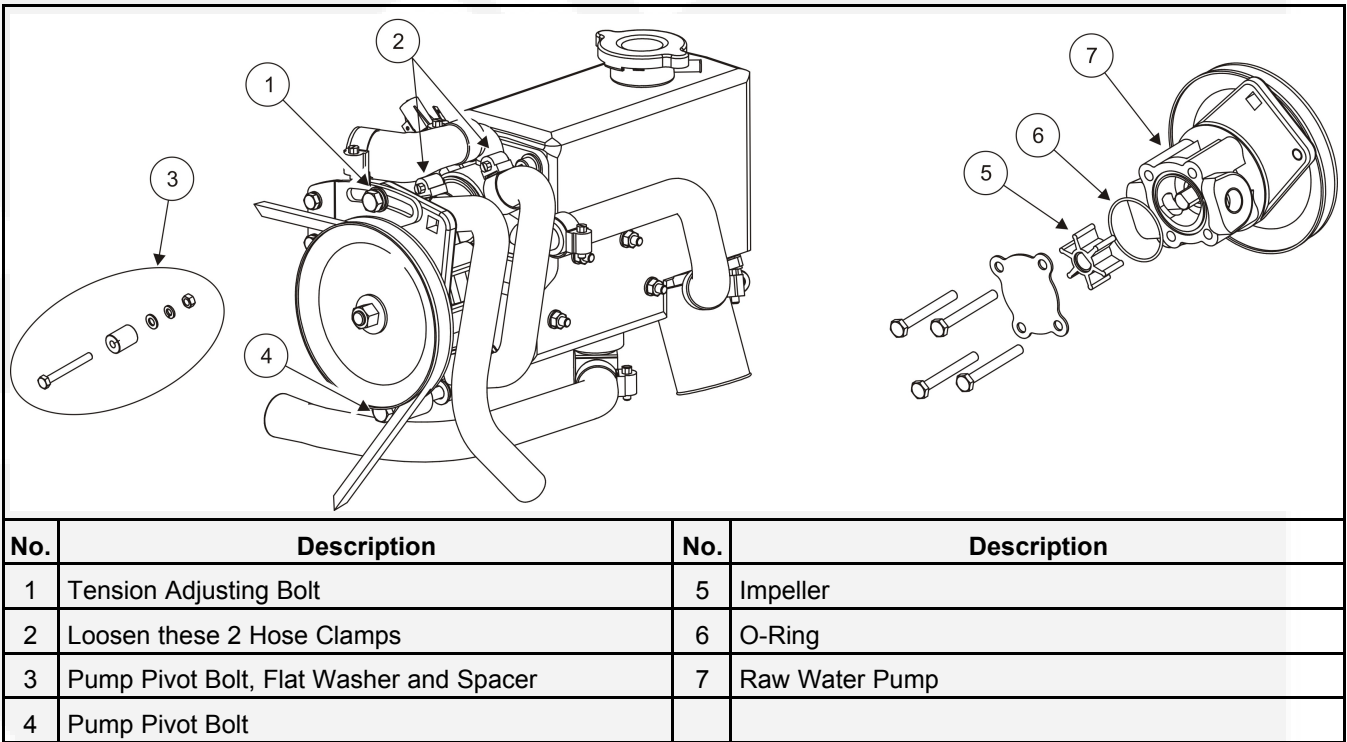


FIGURE 11. REMOVING RAW WATER PUMP

3.6.14 Adjusting V-Belt Tension



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

1. Use an insulated wrench to disconnect the negative (-) cable at the battery to prevent the engine from starting.

- 2. Remove the belt guard or enclosure top panel and access doors, if so equipped. If work space is limited, remove the end panel to be able to hold the nut on the pump pivot bolt with an open-end wrench while loosening the bolt.
- 3. Loosen both bolts so that the pump can pivot.
- 4. Pivot the pump out to tighten belt tension. Hold tension by tightening the tension adjusting bolt. Check tension by applying 10 kg (20 pounds) to the middle of the pulley span. Belt tension is correct when deflection is 10 mm (0.4 inch)
- 5. Tighten the bolts, secure the belt guard or enclosure, and reconnect the negative battery cable.

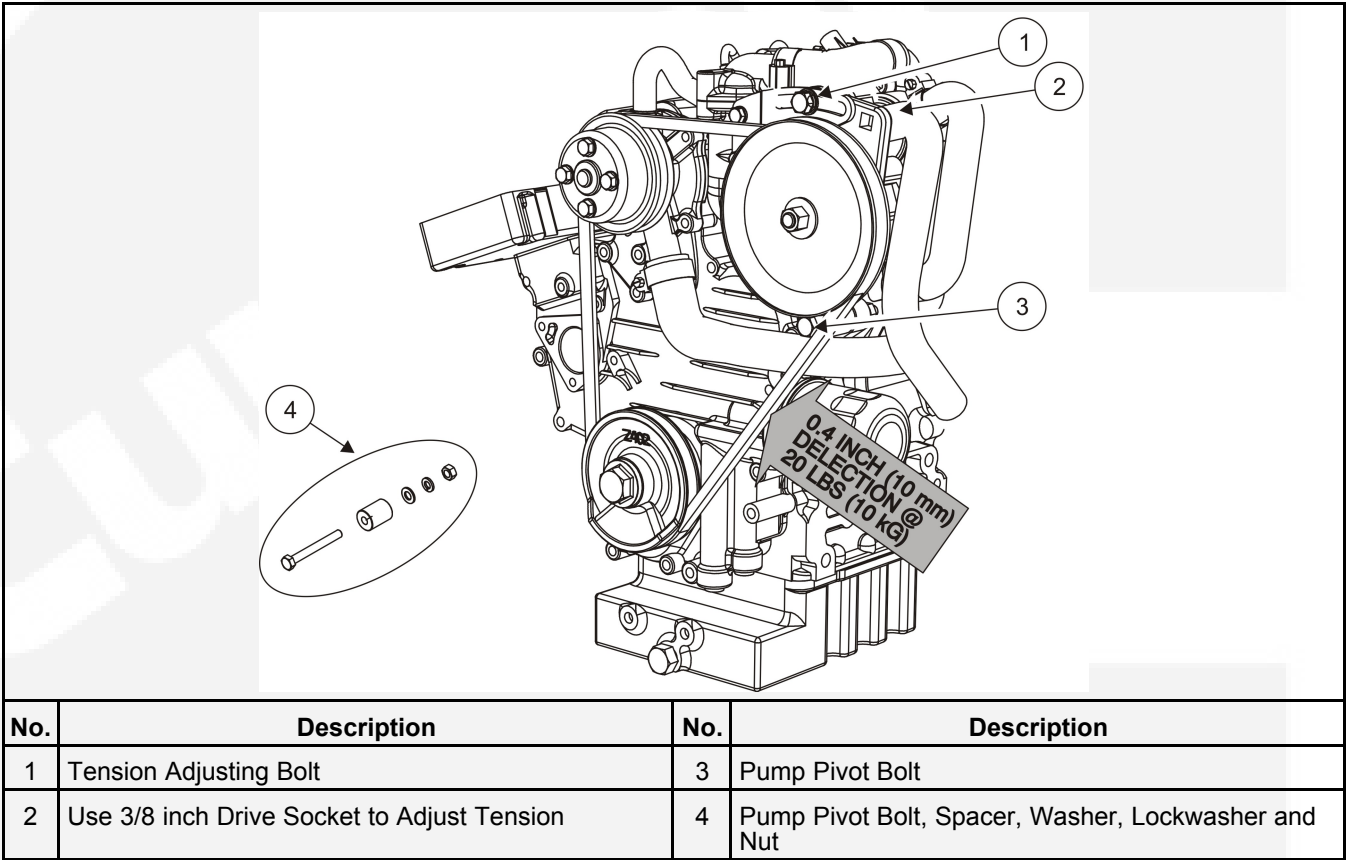


FIGURE 12. ADJUSTING V-BELT TENSION

3.6.15 Replacing V-Belt When PTO Equipped

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

3.7 Storing the Generator Set

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

1. Turn off the generator set line circuit breaker or AC distribution panel.
2. Change the engine oil and filter and attach a tag indicating oil viscosity.
3. Crank the engine several revolutions by pressing the start switch momentarily but do not let it start. This will fill the oil passages with the new oil.
4. Use an insulated wrench to disconnect the battery cables, negative [-] cable first, from the starting battery and store the battery according to the battery manufacturer's recommendations. Check coolant level and add as necessary. Test the coolant mixture if freezing temperatures are possible and change if necessary.
5. Drain the heat exchanger and muffler if freezing temperatures are expected.
6. Disengage the PTO clutch, if so equipped.
7. Clean and lightly oil parts that can rust.

3.8 Cold Temperature Storage

Freezing water can damage the heat exchanger and exhaust cooler. Drain these of any water before freezing temperatures begin. See [Section 3.7 on page 42](#).

3.9 Returning the Generator Set to Service

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

4 Generator Set Control

4.1 Overview



WARNING: *Accidental or remote starting can cause severe personal injury or death. Before removing an access door or belt guard, use an insulated wrench to disconnect the negative (–) cable at the battery to prevent the engine from starting.*

The control board has a microprocessor controller that provides all the control, monitoring, and diagnostic functions required to operate the generator set.

Up to three Cummins Onan Digital Displays may be connected to the generator set for operator control and monitoring.

An optional Network Interface Module (NIM) is available for mounting in the control box. It is equipped with a connector for external SAE J1939 data link connections to an integrated boat monitoring system.

Refer to [Appendix A on page 107](#) and [Appendix C on page 117](#) for more information on control board wiring and harnesses.

4.2 Controller

4.2.1 Major Functions of Generator Set Controller

4.2.1.1 Initialization

Control initialization consists of checking memory (RAM, ROM, EEPROM) and generator set configuration.

4.2.1.2 Fuel Prime

Press and hold the control switch at **STOP (Prime)** for more than 3 seconds to cause fuel pump (E5) to prime the fuel system.

4.2.1.3 Start

Press and hold the control switch at **START (Preheat)** until the generator set starts. The controller:

1. Enables the status lamp (amber) to blink rapidly.
2. Enables some fault detection.
3. Energizes fuel lift pump (E5).
4. Energizes the glow plugs during pre-heat and cranking. The duration of pre-heat prior to cranking is engine temperature dependent, but not to exceed 15 seconds.
5. Enables cranking. The maximum allowed duration of cranking is 20 to 60 seconds, depending on engine temperature.
6. Enables field flash if no frequency pulses are present (F1-F2).
7. Energizes governor actuator (A12) (full rack).

8. Disconnects the starter (B1) at 800 RPM.
9. When operating speed is reached:
 - a. Enables output voltage.
 - b. Turns off field flash.
 - c. Switches amber status lamp to green run lamp.
 - d. Enables Switched B+ (J7).
 - e. Enables complete fault detection.

4.2.1.4 Stop

Touch the control switch to **STOP (Prime)**. The controller:

1. Disables output voltage.
2. De-energizes the fuel lift pump and governor actuator.
3. Turns off the status lamp.
4. Writes session data (number of cranks, minutes of operation, last fault, etc.) to non-volatile memory (NVM).
5. Removes processor power when idle 5 minutes.



NOTE: Stop takes precedence over Start if both are present due to a faulty switch or other cause.

4.2.1.5 Fuel Control

The controller positions the fuel rack to maintain nominal frequency as load varies by sending a pulse-width-modulated (PWM) square-wave signal to governor actuator A12. It determines frequency by sensing the frequency of the quadrature winding output. When the actuator is not energized, its spring-loaded plunger holds the fuel rack in the no-fuel position.

4.2.1.6 Voltage Control

The controller maintains nominal AC output voltage during steady state operation by varying field current as load varies. In response to transient loads it lowers the voltage set-point to allow engine recovery. Field power (DC) is supplied by the quadrature windings (Q1-Q2) (AC) through the controller.

4.2.1.7 Voltage Adjustment

See [Chapter 8 on page 85](#).

4.2.1.8 Adjusting Frequency

See [Chapter 7 on page 81](#).

4.2.1.9 Fault Monitoring, Shutdown and Diagnostics

See the Troubleshooting Chapter of this manual ([Chapter 9 on page 87](#)).

4.2.2 Control Block Diagram

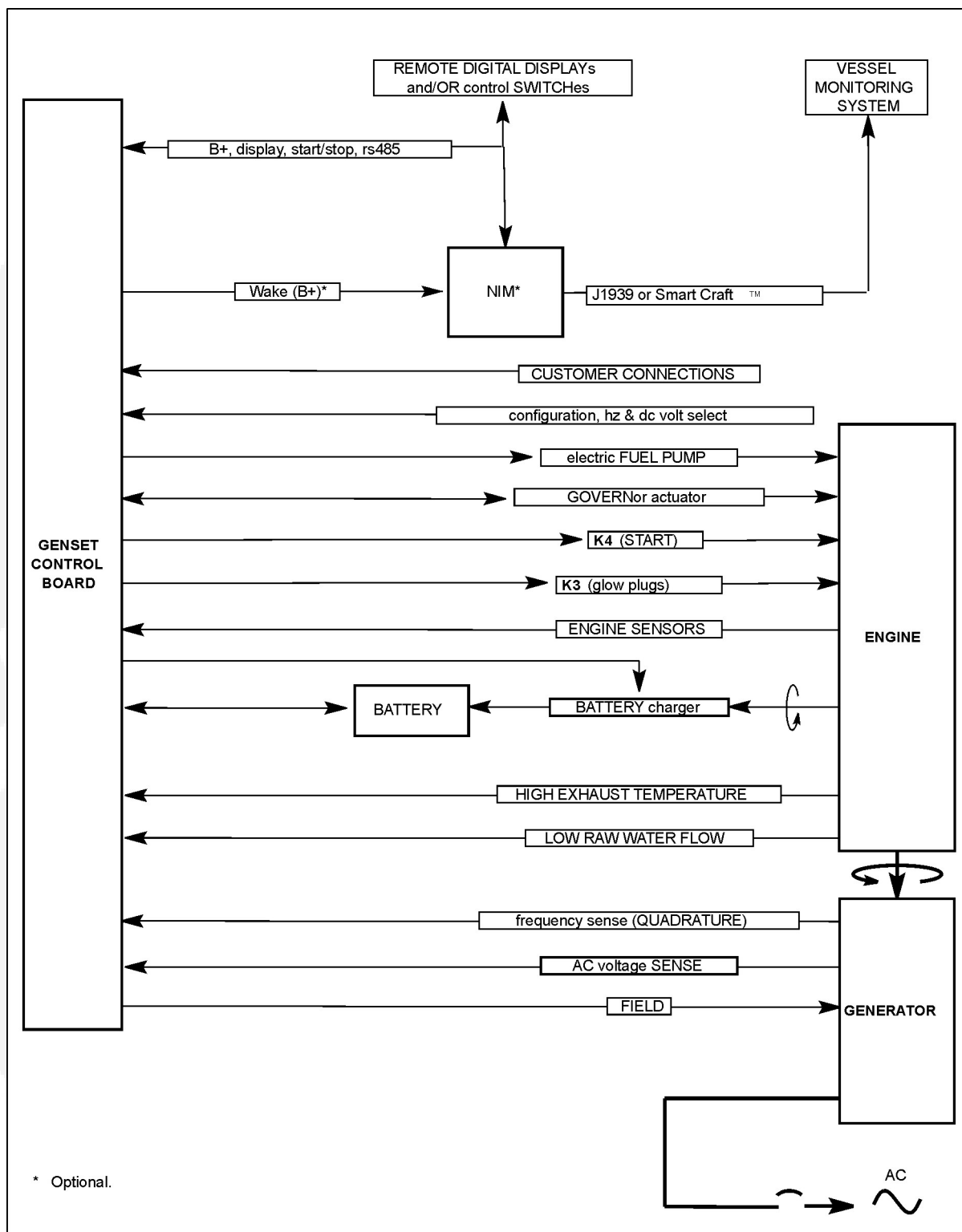


FIGURE 13. CONTROL BLOCK DIAGRAM

4.2.3 Connectors

All connections to the controller are through connectors P1/J1 (black), P2/J2 (gray) and P3/J3 (green). When removing a connector from the controller, squeeze the locking tabs on the sides while pulling out. When reinstalling a plug, make sure the seal is in place and that the locking tabs snap into position.



CAUTION: *Makeshift meter test probes used for testing control board connections during troubleshooting can damage pin sockets by spreading or dislodging the contact wiper arms, resulting in an open or intermittent electrical connection. Use a mating pin (Cummins Onan PN 323-1491) or a test probe that is 0.045 inches in diameter. Replace damaged pin sockets (Cummins Onan PN 323-1492). Make sure the pin sockets are fully seated and cannot be pulled out.*

4.2.4 Removal/Replacement



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

The control board is secured to the access cover by 2 screws. The cover is secured by 4 screws to the enclosure end panel. Remove the 4 cover screws and withdraw the control board with the cover. To remove the control board, first disconnect the 3 connectors (P1, P2 and P3) by squeezing the locking tabs on the sides of the connectors while pulling out.

When reinstalling a connector plug, make sure the seal is in place and that the locking tabs snap into position.

4.2.4.1 Generator Controller Mounting

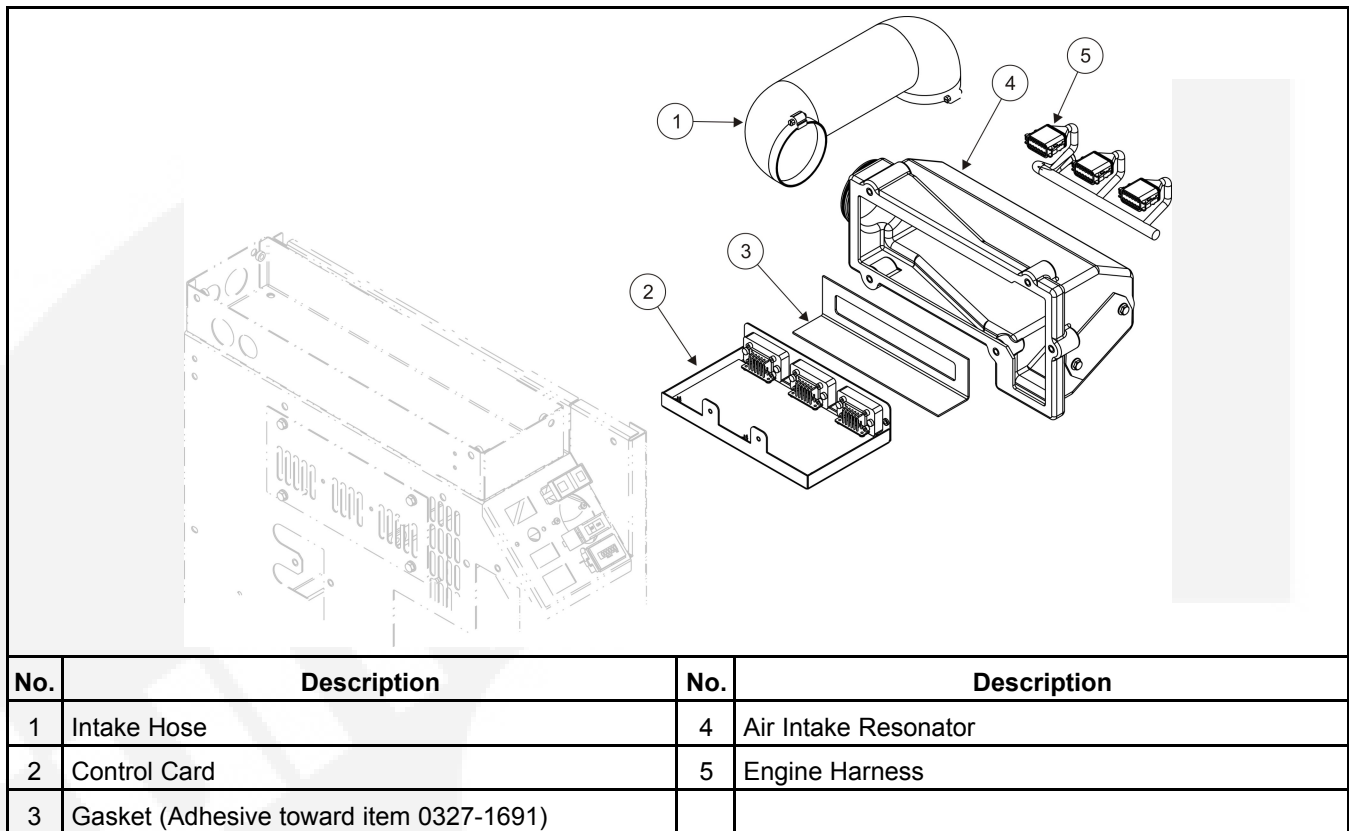


FIGURE 14. GENERATOR CONTROLLER MOUNTING

4.2.5 Configuring Generator Set Controller Using Digital Display

A replacement controller must be configured to the generator set configuration (1-phase or 3-phase). An INVALID GENSET CONFIGURATION - CODE NO.37 shutdown will occur at startup if not configured properly. Also, the digital display hour meter should be set to match the master hour meter.

Setting Configuration:

1. Stop the generator set and press STOP 6 times to display the configuration screen.
2. Press NEXT to select Genset Config.
3. Press the up-down arrows to select the configuration number marked on the generator set nameplate, or see table below.
4. Press BACK to save the selection and get back to GEN STATUS.

Setting Digital Display Hour Meter:

1. Press NEXT to select Set Hour Meter.
2. Press the up-down arrows to match the number or hours on the master hour meter.
3. Press BACK to save the selection and get back to GEN STATUS.

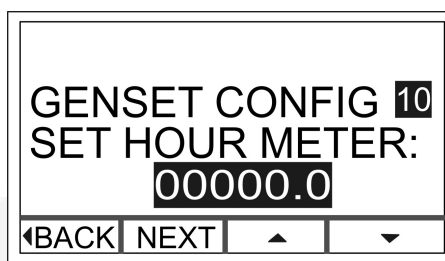


FIGURE 15. CONFIGURING CONTROLLER AND SETTING HOUR METER

4.2.5.1 Generator Set Configuration Codes

TABLE 1. GENERATOR SET CONFIGURATION CODES

Generator Set Model	Code Number
MDKBJ	51
MDKBW	51

4.2.6 Configuring Generator Set Controller Using Control Switch

1. Remove the insulating connectors from wiring harness connectors CONFIG 1 and CONFIG 2 in the control box and connect them together. This places the control in configuration mode. (In configuration mode the control will not start, prime, or display faults.)
2. The status lamp on the control switch will blink the numeric configuration code, a two-digit number. See above table for appropriate code number.
3. Press START or STOP to increase or decrease the code number. For example, the lamp should blink as follows when configured for a 1-Phase, Model MDKDR generator set (15): blink — pause — blink-blink-blink-blink-blink — long pause — repeat code
4. When configured properly, disconnect CONFIG 1 from CONFIG 2 and re-install the insulating connectors that were removed from each connector.

4.3 Control Switch Schematic

The control switch, when located on the generator, is mounted on the control panel. Unsnap the connector for access to its terminals. See [Appendix A on page 107](#) for connections.

Referring to the figure below, replace the switch if:

- **START** does not close terminals 2 and 3,
- **STOP** does not close terminals 1 and 2,
- Green does not light when 12 VDC is applied across terminals 7 (–) and 8 (+),
- Amber does not light when 12 VDC is applied across terminals 7 (–) and 6 (+).

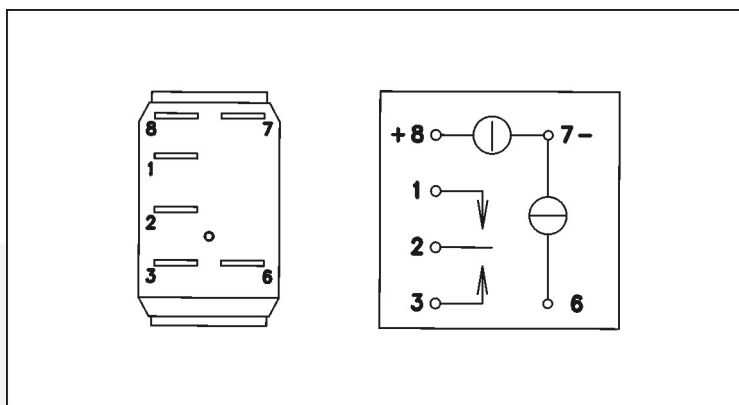


FIGURE 16. CONTROL SWITCH SCHEMATIC AND TERMINALS

4.4 Control Relays

To test a relay, apply 12 VDC (or 24 VDC if applicable) across terminals 85-86 (see figure below). Replace the relay if 30-86 (NO) does not close or 30-87a (NC) does not open, or either does not return to its normal position when power is removed.

See the drawings in [Appendix A on page 107](#) for relay function.

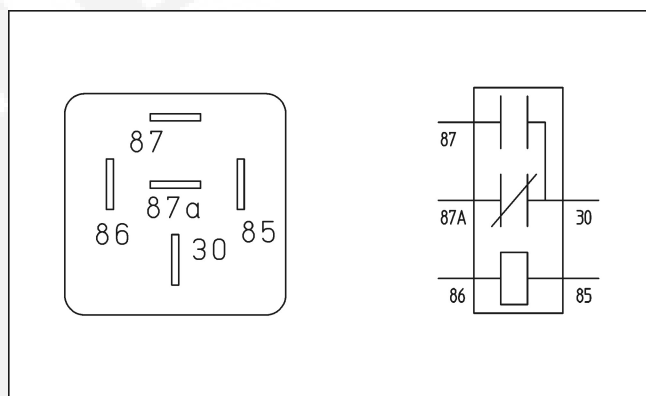


FIGURE 17. CONTROL RELAY TERMINALS AND SCHEMATIC

4.5 Master Hour Meter (M11)

See Operator Manual for instructions on how to reset the hour meter on the digital display to match the master hour meter when replacing the generator set controller.

4.5.1 Master Hour Meter (M11)

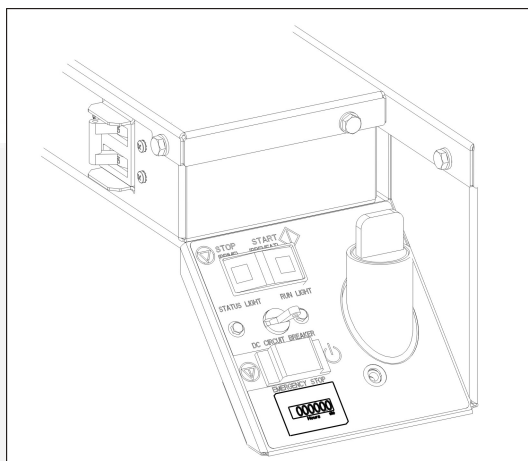


FIGURE 18. MASTER HOUR METER MOUNTED ON LOCAL CONTROL PANEL

4.6 Emergency Stop Switch/Circuit Breaker

The switch/circuit breaker is mounted on the control panel. Disconnect the leads and check electrical continuity across the two terminals. Replace the circuit breaker if it does not reset, turn on, or turn off. For easier access to the switch terminals, push out the four plastic buttons that secure the panel and pull the panel with switch forward.

4.7 Line Circuit Breaker

The circuit breaker is mounted on the side of the generator set. Disconnect the leads and check electrical continuity across the two terminals. Replace the circuit breaker if it does not reset, turn on, or turn off.

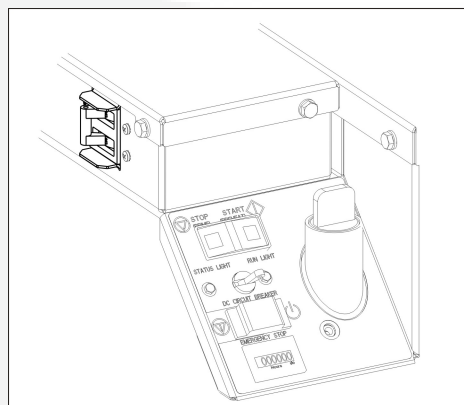


FIGURE 19. LINE CIRCUIT BREAKER LOCATION

FIGURE 20.

4.8 Engine Oil Pressure Sensor (E1)

In isolated ground applications the sensor has two terminals. Use thread sealant and engage at least two full threads when installing. Replace the sensor if resistance is not between 227 and 257 ohms when the engine is stopped (0 psi). See [Appendix A on page 107](#) for connections.

4.8.1 Oil Pressure Sensor (E1)

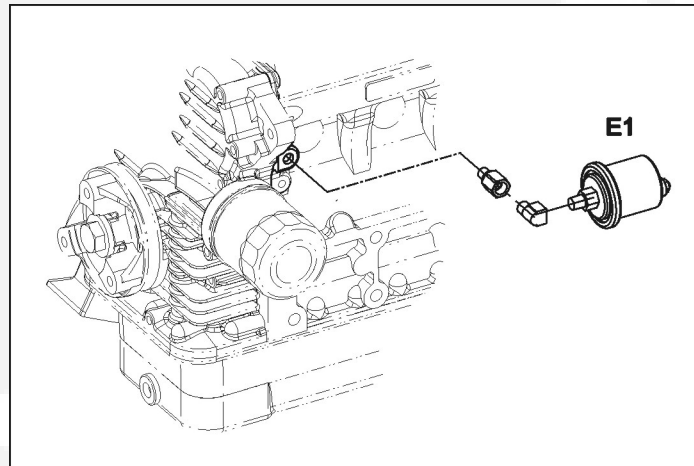


FIGURE 21. OIL PRESSURE SENSOR

4.9 Coolant Temperature Sender (E2)

In isolated ground applications the sender has two terminals. Use thread sealant and engage at least two full threads when installing. Replace the sender if resistance is not approximately 800 ohms at room temperature or does not decrease rapidly when immersed in boiling water. See [Appendix A on page 107](#) for connections.

4.9.1 Coolant Temperature Sender (E2)

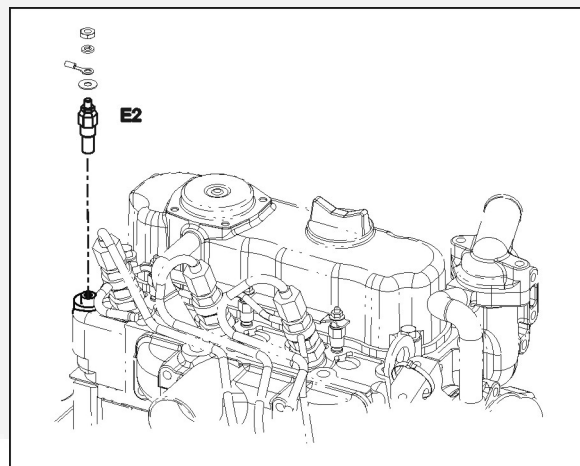


FIGURE 22. COOLANT TEMPERATURE SENDER

4.10 High Exhaust Temperature Switch (S5)

The high exhaust temperature switch is provided on models with wet exhaust and is a normally-closed switch. It is secured to the side of the water/exhaust mixer. See [Appendix A on page 107](#) for connections.

4.10.1 High Exhaust Temperature Switch (S5)

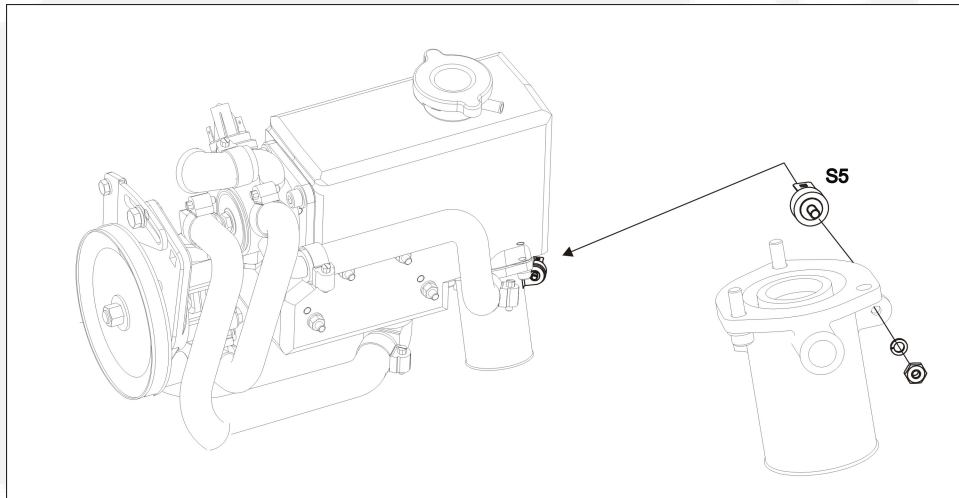


FIGURE 23. HIGH EXHAUST TEMPERATURE SWITCH

4.11 Raw Water Flow Switch (S6)

This switch is provided on models having a heat exchanger. The raw water flow switch is threaded into the heat exchanger. It is a normally-closed switch. Use thread sealant and engage at least two full threads when installing.

Check continuity across the switch terminals while blowing into it (1 psi). Replace the switch if it does not open and close.

See [Appendix A on page 107](#) for connections.

4.11.1 Raw Water Flow Switch (S6)

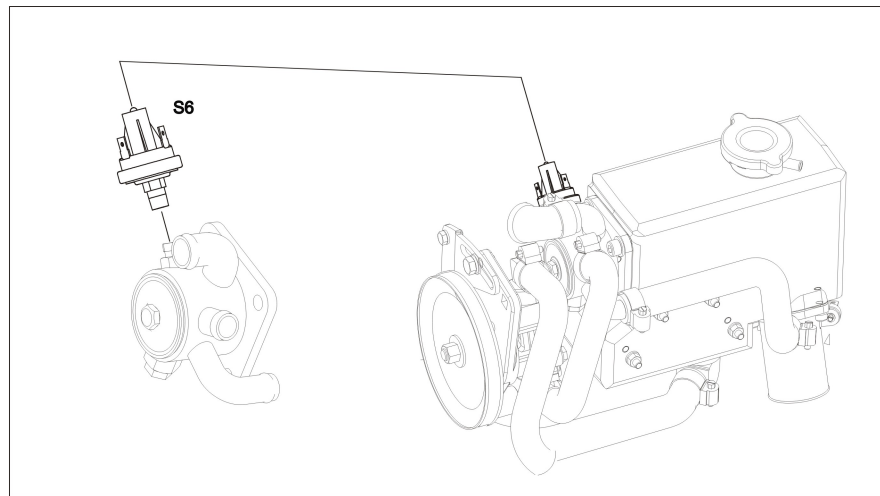


FIGURE 24. RAW WATER FLOW SWITCH

4.12 Battery Charging Regulator (A1)

The regulator and heat sink are mounted on the generator air intake duct. It is accessible by removing the front access door.

To test the battery charging regulator:

1. Disconnect any external battery chargers,
2. Start the generator set and check DC voltage across the battery terminals on the generator set,
3. Replace the regulator if the battery charge windings are good but DC voltage does not increase to 12.5 volts, while the generator set is running.

4.13 Glow Plug Relay (K3)

The glow plug relay is mounted in its wiring socket inside the generator set control box.

To test the relay:

1. Remove the relay from the socket.
2. Apply battery voltage (12 VDC) across terminals 85-86.
3. Replace the relay if the contacts across terminals 30-87 do not close.

4.14 Starter Relay (K4)

The starter relay is mounted in its wiring socket on the controller mounting bracket.

To test the relay:

- Remove the relay from the socket.
- Apply battery voltage (12 VDC) across terminals 85-86.

- Replace the relay if the contacts across terminals 30-87 do not close.

4.15 Governor Actuator (A12)

The generator set controller modulates the pulse width of the current it sends to governor actuator (A12), which positions the engine fuel rack accordingly.

If troubleshooting indicates that the actuator might be malfunctioning, disconnect its two leads and remove the actuator. Replace the actuator if the plunger does not move smoothly when pushed in or the internal spring does not return it smoothly. If the plunger moves smoothly without binding, apply battery voltage (12 or 24 volts, depending on the generator set) and observe the plunger. Replace the actuator if the plunger does not pull in all the way and stay in while power is applied.

Reinstall the actuator with a new flange gasket. Torque the two mounting screws to 9.5-12.2 Nm (7-9 ft-lb).

4.15.1 Governor Actuator

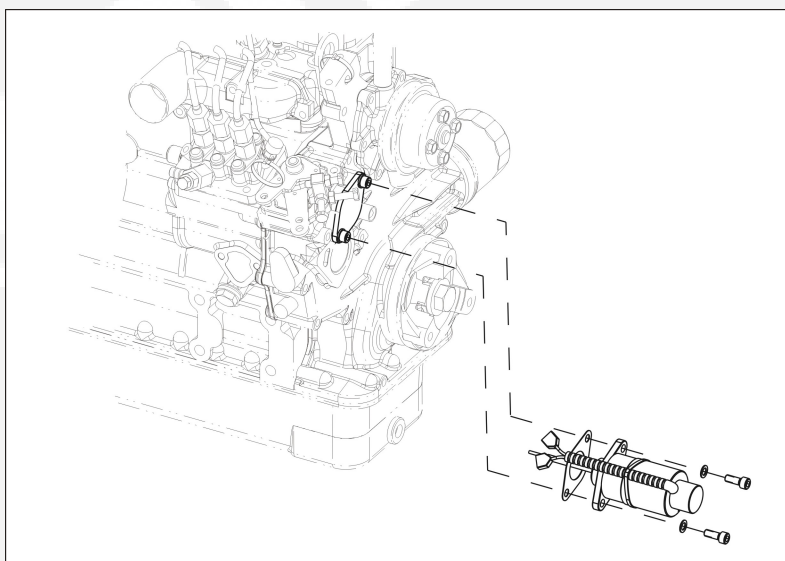


FIGURE 25. GOVERNOR ACTUATOR

4.16 External Shutdown Devices

4.16.1 External Shutdown Device Connectors

The generator set wiring harness has leads with quick-connect terminals labeled **SWB+**, **ESTOP**, and **CO** for connecting external shutdown devices. They are accessible by removing the access cover on the left end of the generator set.

- **ESTOP** can be connected to have a fire suppression or other emergency system shut down the generator set.
- **CO** can be connected to have a CO detector shut down the generator set.

4.16.2 External Shutdown Devices

The generator set will stop running if the circuit is opened between **SWB+** and either of the other two connectors, **ESTOP** or **CO**. Therefore use normally-closed (NC) shutdown devices.



NOTE: The total load on **SWB+** must not exceed 0.5 amps.

4.16.3 Factory Jumpers

The generator set leaves the factory with **SWB+** jumpered to the other two connectors, **ESTOP** and **CO**.



NOTE: Generator set will not run if jumpers are not connected. Leave the jumpers connected when no external shutdown devices are to be connected.

4.16.4 Shutdown Indication

If shutdown occurs due to either device, **Code No. 5: Warning-Shutdown due to Vessel CO** or **Code No. 61: Emergency Shutdown** will be displayed. All of the status indicator lights in the control circuit will also blink the fault code.

See [Chapter 9 on page 87](#) of this manual for more information on what to do when codes are triggered.

4.17 Fuel Anti-Siphon Device

If any part of the fuel line is routed below the top of the fuel tank, a fuel anti-siphon device must be installed at the tank fitting to prevent accidental discharge of fuel.

4.17.1 Check Valve-Type Anti-Siphon Devices

A fuel check valve used as an anti-siphon device must not require a pull-off vacuum of more than 1.6 inches Hg (5.5 kPa or 0.8 psi).

4.17.2 Solenoid-Type Anti-Siphon Devices

The generator set wiring harness has leads with quick-connect terminals labeled **SWB+** and **CUSTOMER GND** that can be connected to power a pilot relay for a fuel solenoid stop valve at the fuel tank fitting. They are accessible by removing the access cover on the left end of the generator set. The total load on **SWB+** must not exceed 0.5 amps.



NOTE: The generator set leaves the factory with **SWB+** jumpered to two other connectors, **ESTOP** and **CO**. When making connections for a fuel solenoid pilot relay, **SWB+** must continue to be jumpered to **ESTOP** and **CO** unless they are connected to normally closed external shutdown devices, otherwise the generator set will not run.

4.18 Network Interface Module (NIM)

The optional NIM board has an open 12-pin connector socket for external network connections that mates with a Deutsch® 12-pin sealed connector plug, part number DT06-12S. See illustration below for NIM board mounting location.

See [Appendix A on page 107](#) for connection information.



NOTE: For more information on SAE 1939 applications see your Cummins Onan distributor. Cummins Onan publication D-3315, *Supported Messages on SAE J1939*, must be used in designing the interface for monitoring generator set status and diagnostics.



NOTE: For more information on SmartCraft™ applications see your Cummins MerCruiser Distributor.

4.18.1 NIM Mounting Location

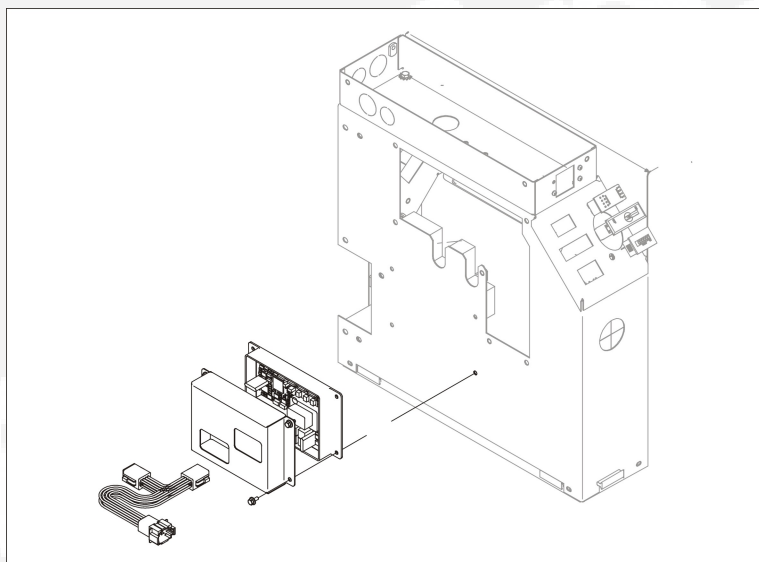


FIGURE 26. NIM MOUNTING LOCATION

4.18.2 NIM Configuration Jumpers

The NIM board has 5 jumpers to configure the board for the specific application, as shown below.

1. Jumper W1 has no function at this time.
2. Jumper W2 will be cut when the generator set is ordered for an SAE J1939 or NMEA 2000™ network application. The jumper must remain uncut when the generator set is ordered for a SmartCraft™ network application.
3. Jumpers W3 and W4 are used to assign the network addresses of the generator sets in a multiple-generator set installation. To assign an address, cut the jumpers as shown below.

TABLE 2. J1939 ADDRESSES

Jumper W3	Jumper W4	Address
Not Cut	Not Cut	234
Not Cut	Cut	158
Cut	Not Cut	179
Cut	Cut	203

4. Cut Jumper W5 if the bus termination resistor on this NIM board is not required to terminate the network bus. (The jumper is cut on a SmartCraft™ board.)

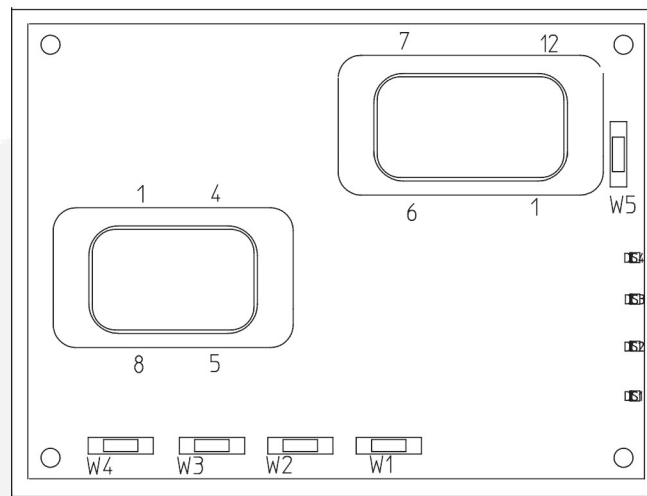


FIGURE 27. NIM CONFIGURATION JUMPERS

4.18.3 Troubleshooting LEDs

1. The NIM must be awake to communicate. To wake up the NIM, press the start switch on the generator set. The NIM will always be awake when the generator set is running. If there is no communication activity, it will turn itself off in 5 to 10 minutes after the generator set stops.
2. LED indicator light DS2 blinks very fast when communicating with the generator set. If it does not, check that the Y-harness is connected to 8-pin connector J10 on the NIM and generator set remote connector J4 inside the control junction box. See [Appendix A on page 107](#).
3. LED indicator light DS4 blinks approximately once a second when communicating with the network. If it does not, check that the network harness is connected to 12-pin connector J11 on the NIM. If it still does not communicate, troubleshoot the network harness.
4. LED indicator lights DS1 and DS3 are not used at this time.

4.18.4 Troubleshooting Network

1. Make sure the NIM has been configured properly with its jumpers.
2. Disconnect the network harness at 12-pin connector J11 on the NIM and measure resistance across pins 4 and 5 in the mating network harness connector. The resistance should be 60 ohms, indicating that there is a terminating resistor at each end of the network and that the wiring is intact.
3. Make sure that CAN HI (or CAN +) matches CAN HI on the display and rest of the network.

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5 Engine and Accessories

5.1 Major Engine Service



WARNING: *Accidental or remote starting can cause severe personal injury or death. Before removing an access door or belt guard, use an insulated wrench to disconnect the negative (-) cable at the battery to prevent the engine from starting.*

Refer to the Engine Workshop Manual for major engine service. See the Specifications Section ([Chapter 10 on page 101](#)) in this manual to identify the engine model number for the generator set.

When remounting the engine torque the vibration isolator through bolts to 37-44.7 Nm (27-33 ft-lb).

5.1.1 Fuel Injection Timing Marks

The fuel injection timing marks line up at 21 degrees BTDC (see figure below). They are visible when the back or side panel is removed.

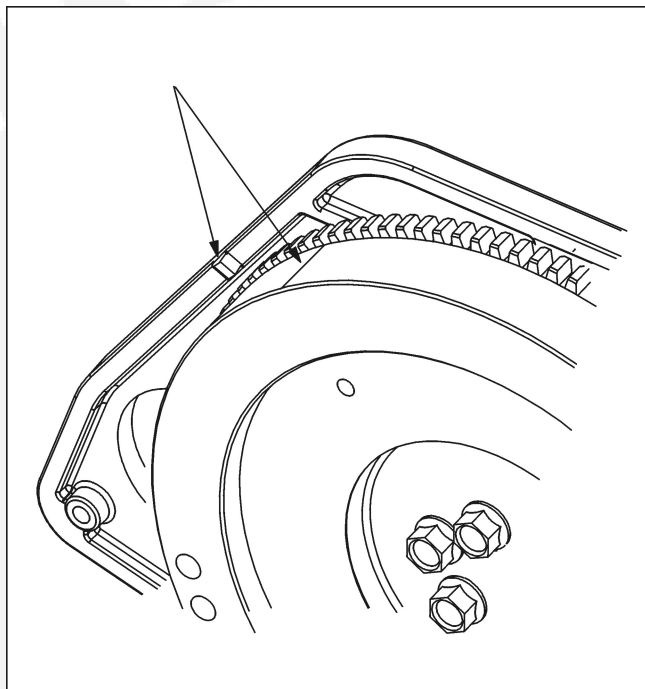


FIGURE 28. FUEL INJECTION TIMING MARKS

5.1.2 Adjusting Valve Lash



NOTE: Do not use the fuel injection timing marks when adjusting the valve lash. Using them could lead to mis-adjustments.

The valve lash should be adjusted when both valves are closed at TDC for the cylinder power stroke (every other revolution).

To locate this position for either cylinder:

1. Rotate the engine clockwise (looking from the front) until the intake valve push rod just stops moving down (valve closed) (see figure below).
2. Turn the engine one half turn more and adjust lash to 0.145 - 0.185 mm (0.0059-0.0073 inch) for both valves (intake and exhaust).
3. Repeat this procedure for the other cylinder.

The rocker arm cover is accessible through the top access opening.

To get the rocker arm cover off:

1. Remove the screw that secures the intake resonator to the cover.
2. Tilt the resonator out of the way.
3. Remove the glow plugs.

5.1.2.1 Rocker Arms and Push Rods

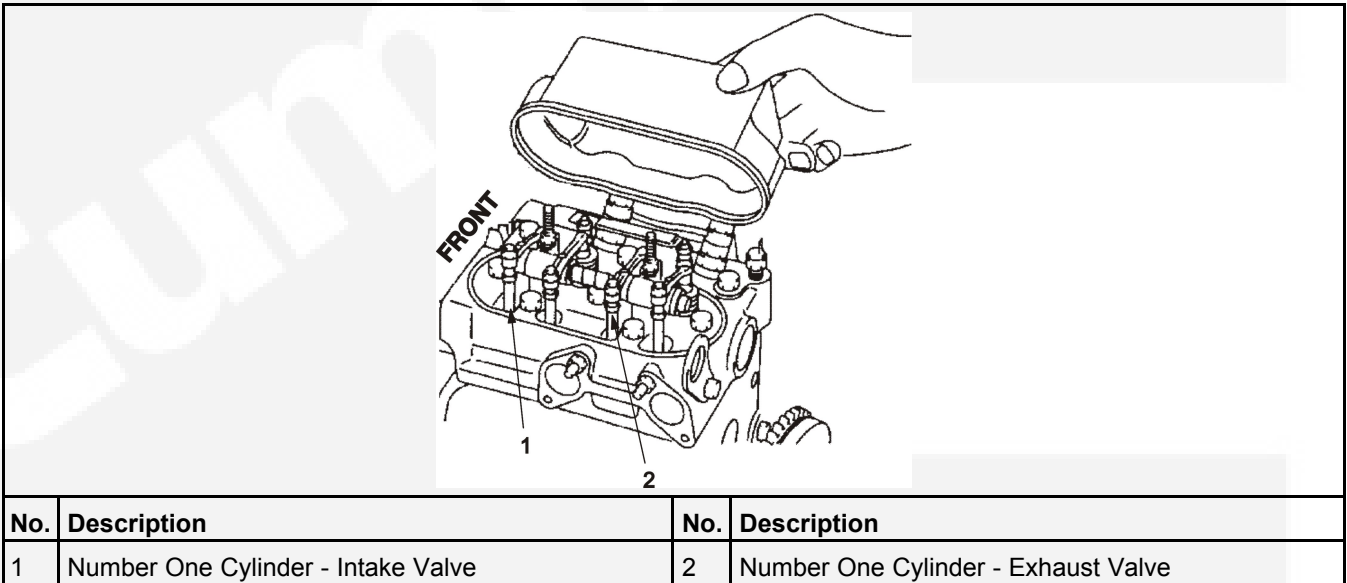


FIGURE 29. ROCKER ARMS AND PUSH RODS

5.2 Intake Resonator



WARNING: *Accidental or remote starting can cause severe personal injury or death. Before removing an access door or belt guard, use an insulated wrench to disconnect the negative (-) cable at the battery to prevent the engine from starting.*

Remove the top access door and the control access panel on the left side for access.

Before installing the second resonator chamber, make sure that:

- The brush block leads are connected.
- The fuel lines are connected at the fuel injector.
- The oil fill hose is connected at the engine fill tube.

- The controller connectors are connected.
- Any adjustments to the governor actuator have been completed.

When reassembling, make sure the tails on the hose clamps will not touch the insulation on the access door.

5.2.1 Intake Resonator Assembly

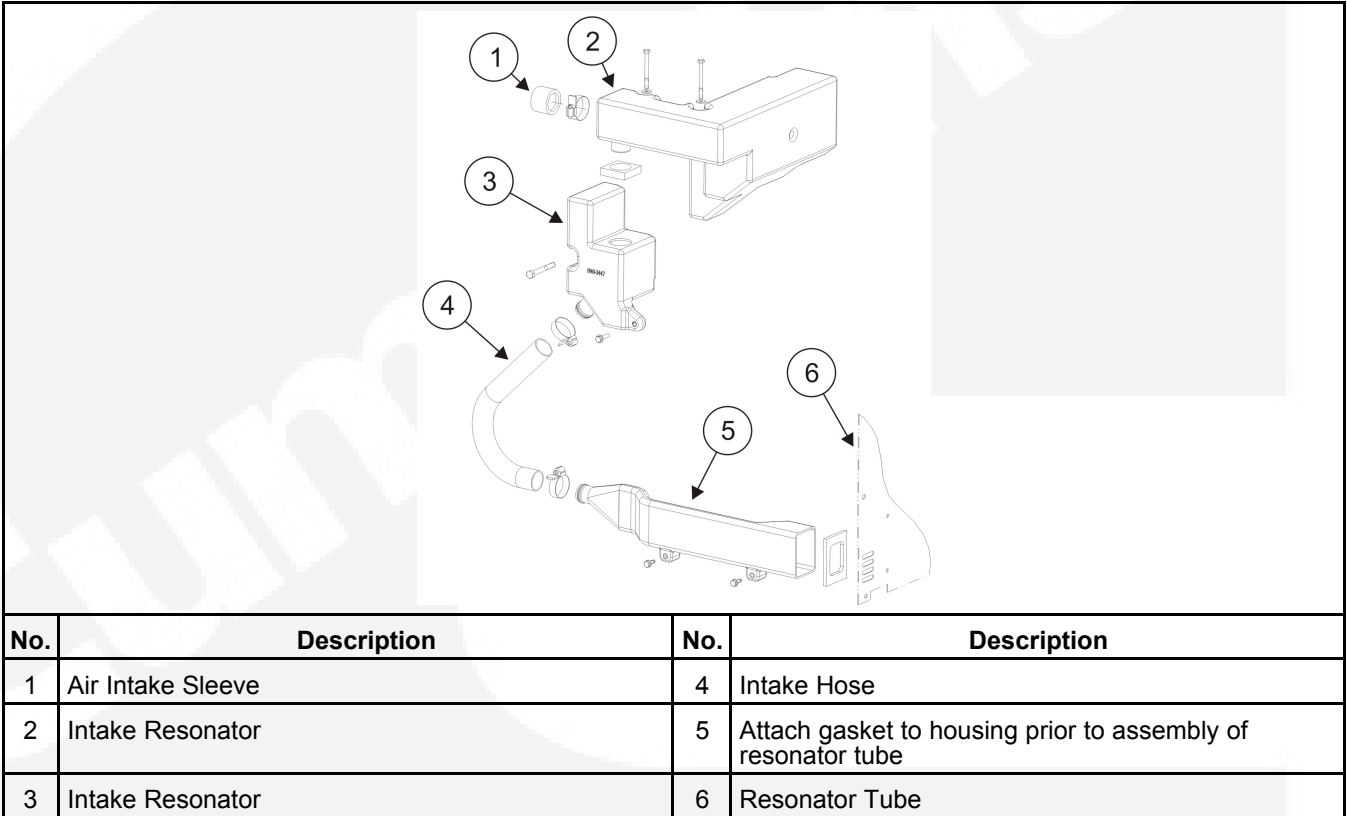


FIGURE 30. INTAKE RESONATOR ASSEMBLY

5.3 Exhaust Manifold



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

- Remove the top and front access doors and the right side panel to access the exhaust manifold.
- When reassembling, use new manifold and mixer gaskets.
- Torque the 4 manifold nuts and the 3 mixer bolts to 11 Nm (8 ft-lb).

5.3.1 Exhaust Manifold

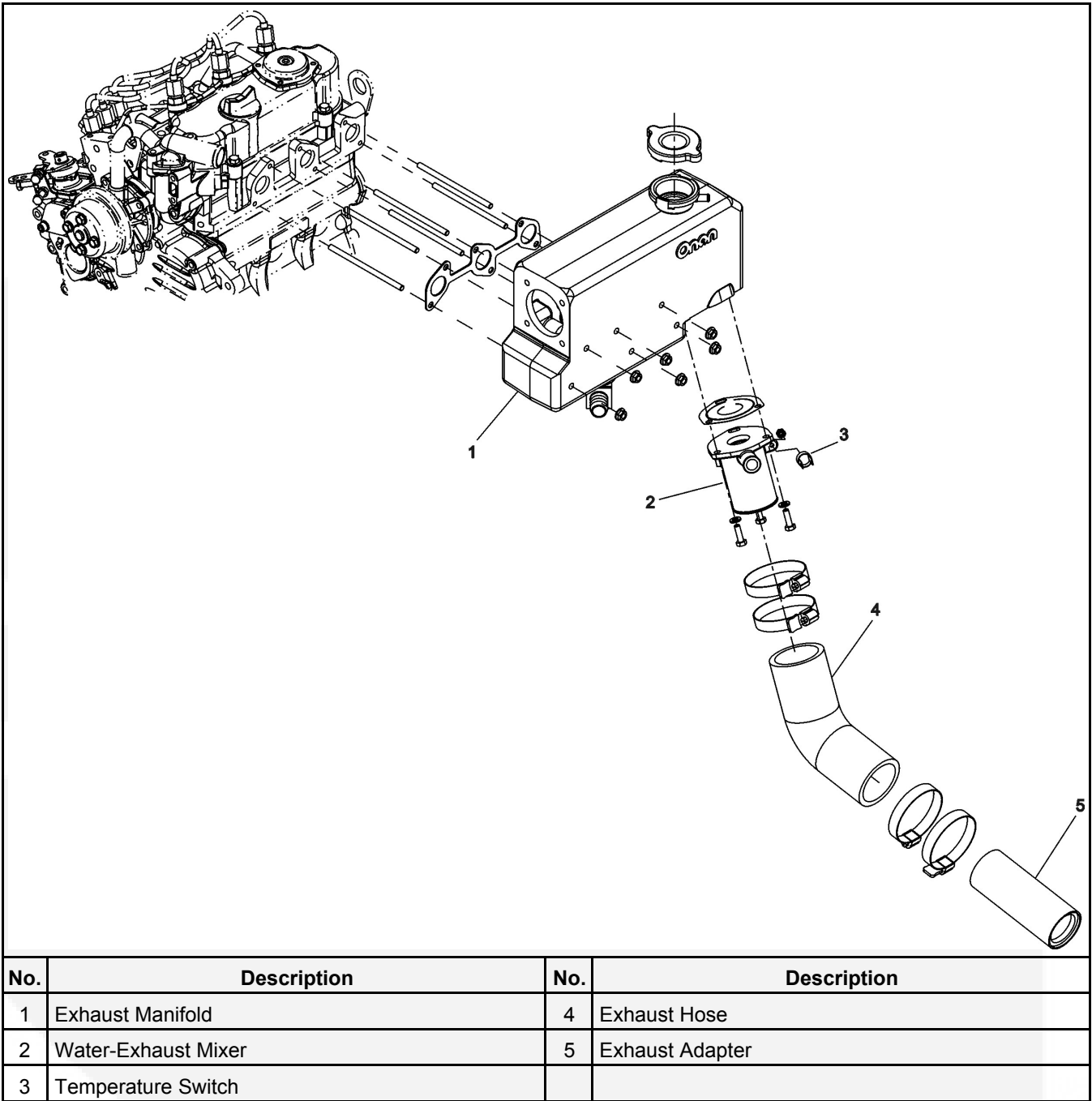


FIGURE 31. EXHAUST MANIFOLD ASSEMBLY

5.4 Fuel System



WARNING: Accidental or remote starting can cause severe personal injury or death. Before removing a panel or access door, 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 fire extinguisher handy.

The figure below illustrates the fuel system and glow plug location.

See the Engine Workshop Manual for fuel injection system service.

5.4.1 Fuel System

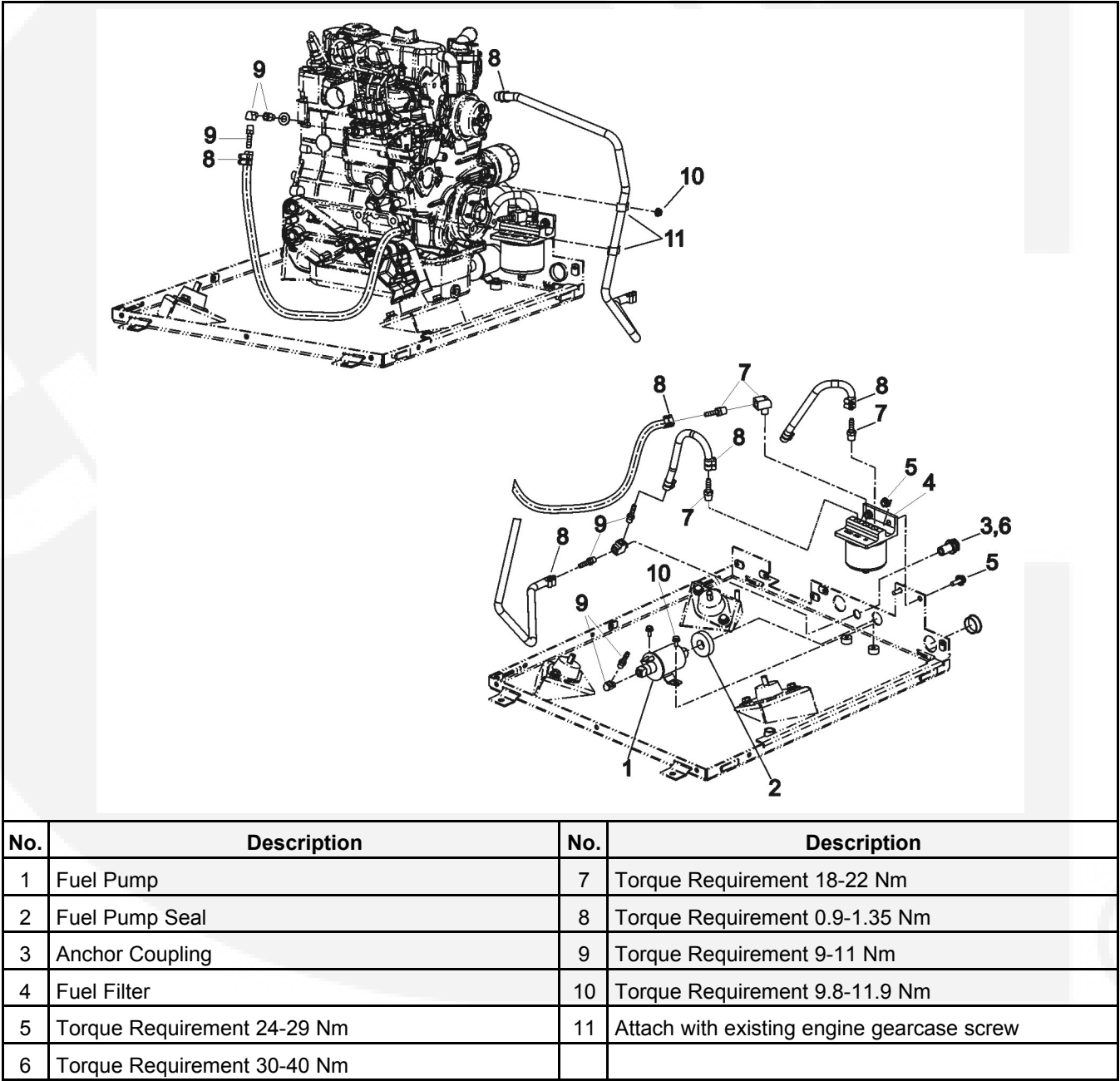


FIGURE 32. FUEL SYSTEM

5.4.2 Fuel Filter

For fuel filter maintenance, see [Section 3.5 on page 27](#).

5.4.3 Fuel Pump Test

A quick test to determine if the fuel pump is weak is to pinch the fuel bypass hose with rubber-tipped vise grips. If an engine that fails to start, starts and runs with bypass flow cut off, fuel delivery to the engine is weak. Service all fuel filters in the system and repair any restrictions to fuel flow. If fuel delivery is still weak, test the fuel lift pump.

To test fuel lift pump delivery:

1. Disconnect the fuel return hose from the line to the supply tank and point the end into a container of known volume, such as a 1 or 2 liter (quart) bottle.
2. Prime the generator set by pushing the Start/Stop switch to STOP (Prime) and hold it there for the duration of the test. It should not take longer than 1-1/2 minutes to fill a 1 liter container (2/3 liter per minute).
3. If flow is less than specified above, service all of the fuel filters in the system and repair any restrictions to fuel flow. If fuel delivery is still weak, replace the fuel lift pump.

5.4.4 Fuel Pump Removal and Installation

Remove the right side panel for access.

Alternatively, if the starter has been removed from the front, the fuel pump can also be removed from the front.

5.4.5 Fuel Fittings

The connections for fuel supply and return are pipe threaded fittings. Use liquid-type pipe thread sealant listed as suitable for diesel fuel. Apply the sealant sparingly to the male threads only.



CAUTION: *Excess liquid-type pipe thread sealant or pieces of Teflon-type pipe thread sealant can plug the engine fuel system. Apply liquid-type pipe thread sealant sparingly to the male threads only. Do not use Teflon tape.*

5.4.6 Fuel Hose

Replace worn or damaged fuel hoses with USCG TYPE A1 or ISO 7840-A1 fuel hose. The hoses must be long enough to be clamped and routed under the oil pan without rubbing on the oil pan.

If so equipped, the second intake resonator chamber must be removed to connect and disconnect the supply hose at the fuel injector.

5.4.7 Glow Plugs

Refer to the Engine Workshop Manual when replacing the glow plugs. See [Section 5.4 on page 62](#) for glow plug location illustration.



NOTE: **If a glow plug does not come out after unscrewing it, or the end has broken off, it will be necessary to remove the engine head. Glow plugs can swell if preheat voltage is greater than 14 volts, such as when a battery booster is used for starting.**

Inspect the glow plugs as follows.

1. Check for B+ at the glow plug terminals during cranking. If there is no B+, remove the glow plug relay K3 from its socket, test for proper operation ([Section 4.13 on page 53](#)), and replace if necessary.
2. Check for B+ at relay socket terminal 30 for continuity between terminal 87 and the glow plugs, and for continuity between terminal 86 and B- (ground).
3. Clean and tighten connections and replace wiring as necessary.
4. Check for B+ at relay socket terminal 85 while cranking. If there is no B+, disconnect connector P1 (black) from the generator set controller and check for a missing, bent or corroded Pin 1 and for faulty wire and repair as necessary.
5. Remove the glow plug bus bar and check for electrical continuity between each glow plug terminal and B- (ground).
6. Replace any open glow plug.

5.5 Starter



WARNING: *Accidental or remote starting can cause severe personal injury or death. Before removing an access door or belt guard, use an insulated wrench to disconnect the negative (-) cable at the battery to prevent the engine from starting.*

The starter motor is bolted to the flywheel housing. For access, remove the right side enclosure panel. See the Engine Workshop Manual for service or replacement. Parts are available for rebuilding the starter. Torque the mounting bolts to 39 Nm (29 ft-lb).

5.5.1 Negative Ground Connection

1. Install the starter motor.
2. Check to sure that the engine block is grounded properly, depending on whether standard or isolated ground connections are required.
3. Install the star washer between the engine block and cables.
4. Torque the bolt to 55 Nm (41 ft-lb).

5.5.2 Ground Isolation Relay (K9)

This relay is accessible after the starter or side panel has been removed.

When required, the generator set is equipped with isolation relay K9 to isolate the negative (-) battery terminal from the vessel grounding system while the generator set is running. (The engine block is connected to battery negative [-] during starting.) Replace the relay if its contacts do not close when 12 VDC voltage is applied to the coil terminals.

5.5.3 Starter Motor Mounting and Connections

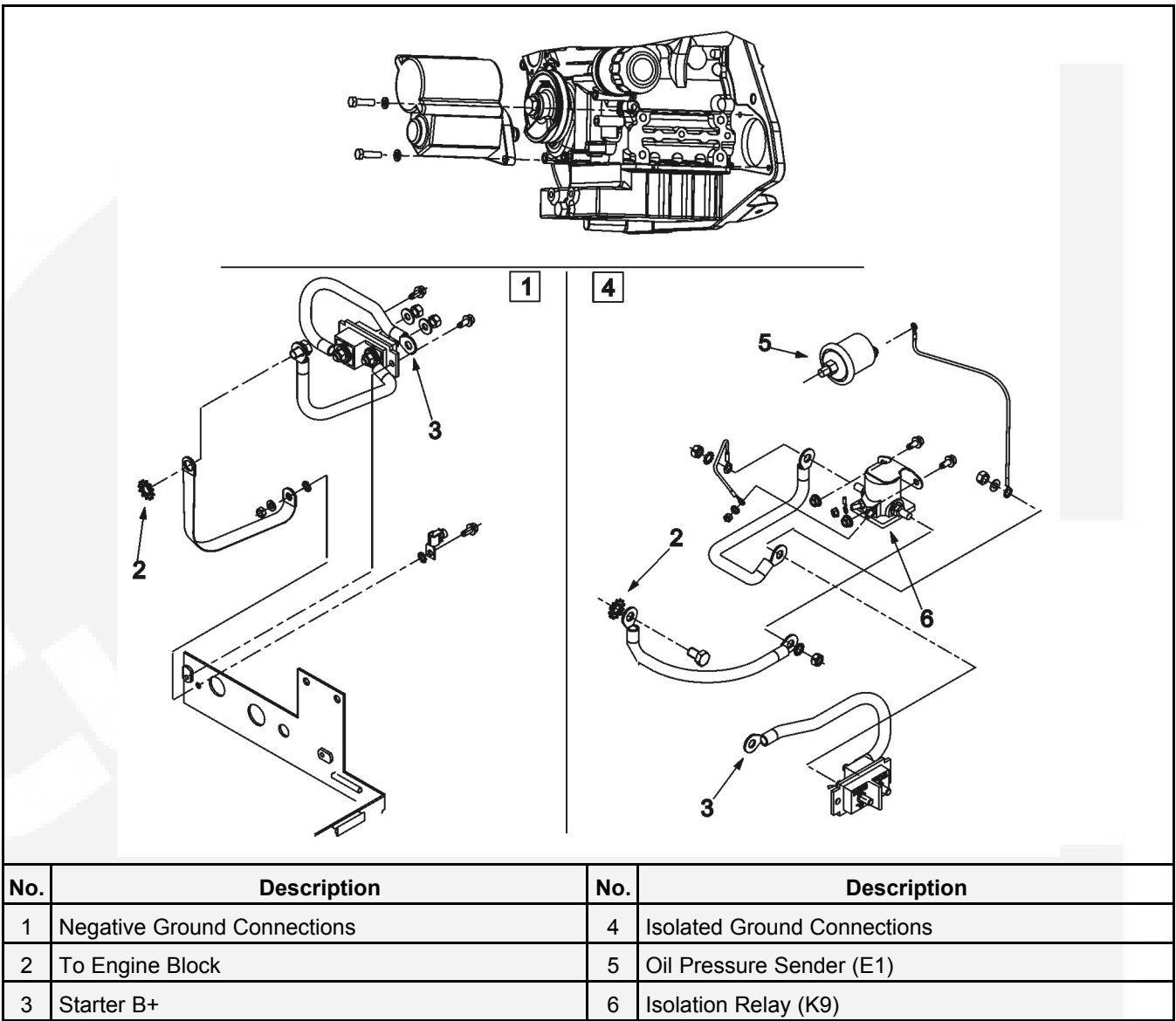


FIGURE 33. STARTER MOTOR MOUNTING AND CONNECTIONS

5.6 Raw Water Pump

The engine is equipped with a raw water pump only on models with wet exhaust or wet exhaust and heat exchanger.

See Replacing the Raw Water Pump Impeller Section in the Maintenance Chapter for instructions on how to replace the impeller. Kits are available for servicing the raw water pump. Follow the instructions in the kit.

5.7 Battery Charging Alternator

See Adjusting V-belt Tension in the Maintenance Chapter to adjust or replace the alternator V-belt. See the Engine Workshop Manual in the Related Literature Section of the Introduction Chapter for service or replacement.

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6 Generator

6.1 Overview



WARNING: *Accidental or remote starting can cause severe personal injury or death. Before removing an access door or belt guard, use an insulated wrench to disconnect the negative (–) cable at the battery to prevent the engine from starting.*

These are 2-bearing, belt-drive, 2-pole revolving-field generators with brushes and slip rings. Output voltage is regulated by a microcontroller-based generator set controller.

The stator consists of steel laminations with three sets of windings in the lamination slots. The main windings (T1-T2-T3-T4) are for powering the connected loads, the quadrature winding (Q1-Q2) is for field excitation and the battery charge (B1-B2) winding for battery charging.

The rotor consists of a shaft with steel laminations wrapped with field windings. A molded slip ring assembly is pressed on to supply a field current to the rotor windings through the brush block assembly. The rotor shaft is supported on both ends by sealed ball bearings. The drive belt pulley and fan are center-bolted to the tapered rotor ends.

Field current passes through the brush block which has two spring-loaded carbon brushes that make contact with the rotor slip rings.

During startup, generator set controller A1 flashes the field with battery current for fast buildup of generator voltage as the engine accelerates to operating speed. During operation, the controller maintains nominal AC output voltage by varying field current in response to load. In response to transient loads, the controller lowers the voltage set-point to allow for engine recovery.



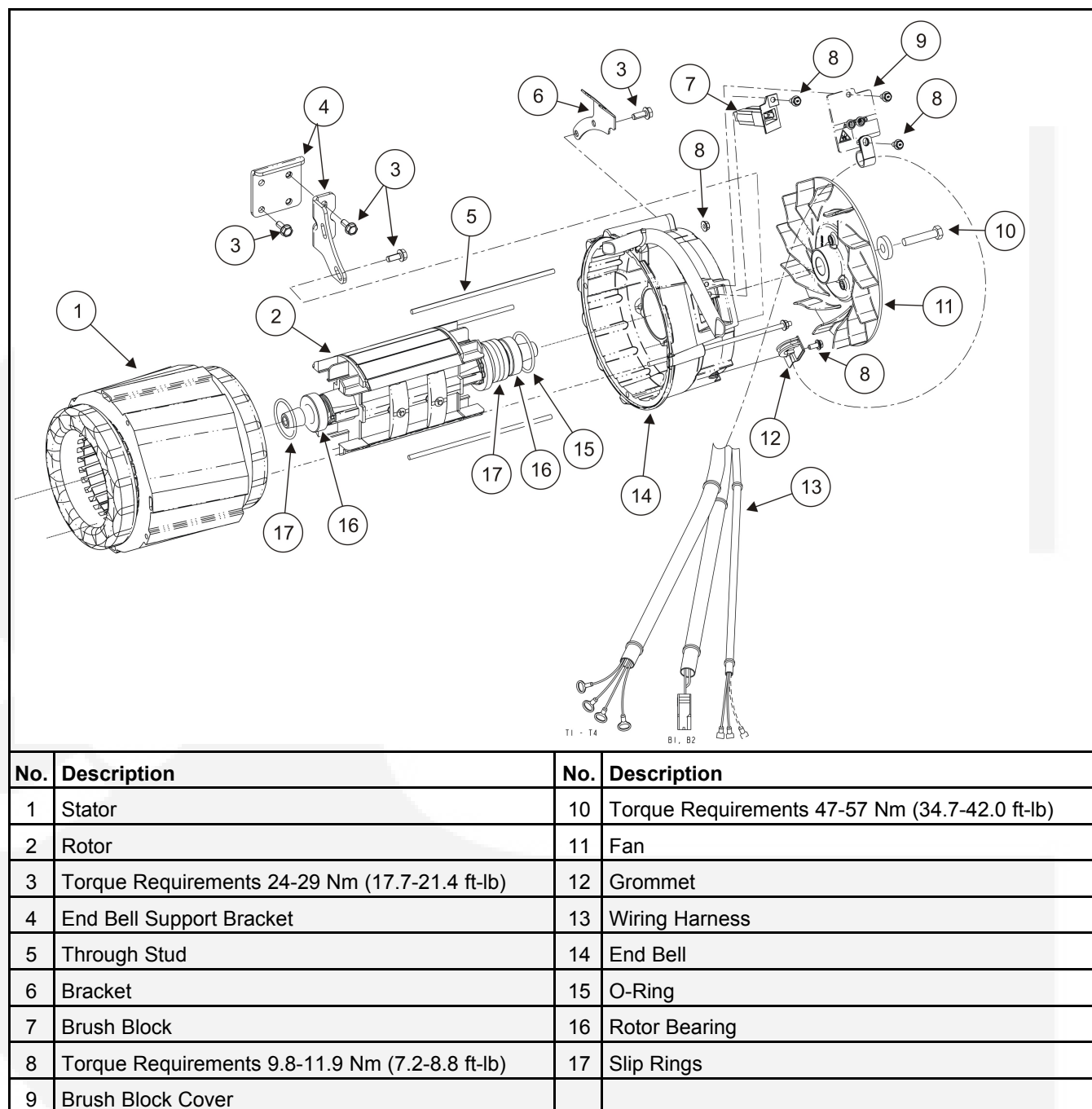


FIGURE 34. GENERATOR

6.2 Generator Winding Resistances

Winding	Resistance (OHMS) @ 25 °C (77 °F) +/- 10% 150 mm Stack
T1-T2, T3-T4	0.111
Q1-Q2	1.66
B1-B2	0.037

F1-F2	25.5
-------	------

6.3 Break-Out Tool 300-5512

Break-out tool, part of Tester Electronic UMC Service Kit 420-0624, for use in conjunction with an accurate digital multi-meter, is available for performing 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.

6.4 Inspection

Examine the bearing bore and replace the end bell if the bore is scored or otherwise damaged by the bearing.

6.5 Winding Insulation Resistance Test Procedure

A 500 VAC megger is recommended for the winding insulation resistance tests prescribed below. A test consists of applying the test potential between the winding and ground (winding laminations) for a period of 10 minutes and recording resistance at 1 minute and again at 10 minutes.

Resistance values of at least 5 megohms should be obtained for a new generator with dry windings. The polarization index should also be at least 2 (the ratio of the resistance reading at ten minutes to the reading at one minute). For a set that has been in service, the resistance reading should not be less than 1 megohm nor the polarization index less than 2.

Dry the windings if low readings are obtained or the set has been in standby for a long time in high humidity conditions and repeat the test.

6.6 Winding Resistance Test Procedure

Use a digital ohmmeter or Wheatstone bridge to measure winding resistance. The device should have a precision of at least 0.01 ohm.

6.7 Stator



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

In preparation for the following tests:

- Disconnect T1, T2, T3 and T4 from the terminals in the output box.
- Disconnect B1 and B2 from charging regulator AVR1.
- Disconnect Q1 and Q2 from the controller A1 by pulling green connector P3 (pins 4 and 5).
 - To measure resistance across the full quadrature winding (Q1-Q2), measure resistance across P3-4 and P6-2 for 60 Hz and across P3-4 and P7-2 for 50 Hz. P6-2 and P7-2 are accessible in the wiring harness behind the ignition coil.

6.7.1 Open Winding Test

Test - Measure resistance across each winding lead pair.

Action - Replace the stator if any winding is open (zero ohms).

6.7.2 Winding Resistance Test

Inspection - Verify that resistance is within proper range.

Test - Use a meter (Wheatstone Bridge) having 0.001 ohm precision to measure resistance across each winding lead pair.

Action - Replace the stator if resistance in any winding is not as specified.

Disassembly - Disconnect Q1 and Q2 from the controller A1 by pulling green connector P3 (pins 4 and 5).

Assembly - Connect Q1 and Q2 to the controller.

6.7.3 Ground Test

Inspection - Resistance between stack and each stator lead.

Test - Using a megger or the highest scale on a digital ohmmeter, measure resistance between the stack and each stator lead.

Action - Replace the stator if any winding has less than one mega ohm resistance to ground.

6.7.4 Quadrature Winding Insulation Resistance

Disassembly

Disconnect generator set control connector P3.

Test

1. Connect a megger to connector P3 pin 4 or pin 5.
2. Do the Winding Insulation Resistance Test Procedure.

6.7.5 Quadrature Winding Resistance

Test

Use a Wheatstone bridge to measure winding resistance between pins P3-4 and P3-5.

Action

Replace the stator assembly if the resistance is not as specified in the Generator Stator and Winding Resistances table in the beginning of the chapter.

6.7.6 Winding to Winding Insulation Resistance

Inspection - Check stator winding-to-winding insulation resistance between the following lead pairs as instructed under Testing Winding Insulation Resistance:

Test - Measure insulation resistance between lead pairs: T1-T3, T1-P3-4, T3-P3-4

Disassembly - Disconnect generator set control connector P3 and all main stator leads from the terminals to which they are connected.

6.7.7 Disassembly



WARNING: *Accidental or remote starting can cause severe personal injury or death. Before removing an access door or belt guard, use an insulated wrench to disconnect the negative (-) cable at the battery to prevent the engine from starting.*

1. Disconnect the generator leads inside the AC outlet box.
2. Remove the front access door, top and left end panels.
3. Remove the second intake resonator chamber.
 - Remove bolt securing it to generator.
 - Loosen clamp at intake manifold.
4. Remove the brush block.



CAUTION: *The brushes can be damaged if the brush block is not removed before removing the end bell.*

5. Remove the fan hub bolt and fan.
 - To keep the rotor from turning while loosening the fan bolt, hold the pulley bolt with a wrench
 - To pull the fan off the shaft taper, secure a three-point wheel puller to the 3 holes in the fan hub with M6 or 1/4 inch self-tapping screws.
6. Remove the end bell support bracket from the engine bracket and the end bell (4 bolts).
7. Disconnect the 8 generator leads from their connections and from the clip on the side of the generator.
8. Scribe a line across the adapter, stator laminations, and end bell to make realignment easier during reassembly.
9. Block the stator so it does not fall against the rotor.
10. Remove the 4 generator through bolts.
11. Pull the generator end bell straight out.
12. Pull the stator assembly straight out, taking care not to damage rotor or stator windings.
13. Block the rotor to support its hanging weight to prevent damage to the adapter and bearing.

6.7.8 Reassembly

Reassembly is the reverse of removal. Note the following:

1. Loosen the end bell support bracket bolts, if not already removed, so that the bracket does not interfere with proper stator and end bell alignment.
2. Align the stator and end bell using the line scribed on them during disassembly.
3. Relubricate the bearing bore in the end bell with molybdenum disulfide paste (Cummins Onan PN 524-0118 or equivalent).
4. Make sure the wave washer and O-ring are in place in the bearing bore.

5. Torque the stator through bolts and end bell bracket bolts to 11 Nm (8 ft-lb) and the fan hub bolt to 61 Nm (45 ft-lb). (To keep the rotor from turning while tightening the fan bolt, hold the pulley bolt with a wrench).
6. Reconnect the leads, tie the generator leads to the clip on the side of the generator.

6.8 Rotor

6.8.1 Rotor Field Resistance

Inspection - Examine leads and brush block for wear and damage. Check generator winding resistances.

Test - Check that resistance is as specified in the Generator Winding Resistances table at the beginning of this chapter.

Action -

1. Repair faulty field leads.
2. Measure resistance across pins 6/7 for MDKBJ and pins 7/8 for MDKBH.
3. Service the brush block and slip rings.
4. Check rotor resistance across the slip rings. Replace the rotor if resistance is not as specified.

Disassembly - Disconnect field leads F1 and F2 from the controller A1 by pulling green connector P3.

Assembly - Connect field leads F1 and F2 to the controller.

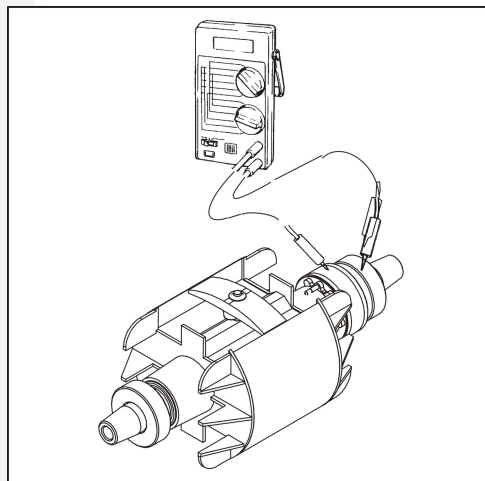


FIGURE 35. OPEN OR SHORTED ROTOR TEST

6.8.2 Ground Test

Test - Using a megger or the highest scale on a digital ohmmeter, measure resistance between the rotor and either slip ring.

Action - Replace the rotor if its winding has less than one megohm resistance to ground.

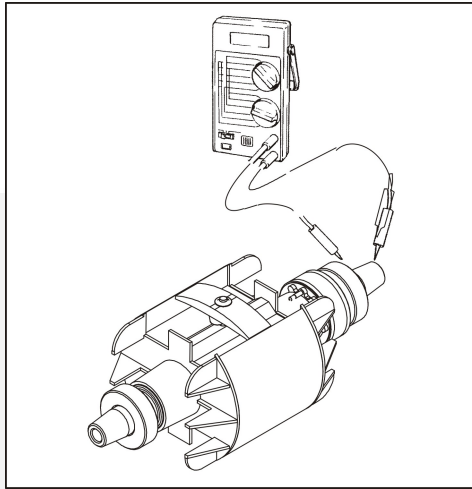


FIGURE 36. GROUNDED ROTOR TEST

6.8.3 Disassembly

1. Remove the stator.
2. Remove the drive pulley.
3. Pull the rotor straight out to the front.

6.8.4 Assembly

1. Lubricate the bearing bores in the end bell and adapter with molybdenum disulfide paste (Cummins Onan PN 524-0118 or equivalent).
2. Make sure the O-rings are in place in the bearing bore grooves in both ends.
3. Make sure the wave washer is in place in the bearing bore in the engine-generator adapter.

Install each bearing up to the shoulder on the shaft using a bench press.



CAUTION: Apply force only to the bearing inner race to avoid damage to the bearing.

6.9 Brush Block



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

Inspection - Evaluate brush length, check for binds in the brush block or other damage.

Test - Brush length should not be shorter than 11 mm (7/16 inch).

Action - Replace the brush block assembly if any damage is detected or brush length is not appropriate.

Disassembly -

1. Remove access panel on left end enclosure panel (MDKBJ) or swing out the front and left enclosure panels (MDKBH).

2. Move the second resonator chamber out of the way by removing the bolt that secures it to the generator and by loosening the clamp at the intake manifold.
3. Remove the brush block cover.
4. Disconnect the field leads from the brush block.
5. Remove the mounting screw and withdraw the brush block from the generator end bell.

Assembly - Reconnect the field leads, F- (black) to the outside terminal, and F+ (red) to the inside terminal. Make sure to replace the brush block cover, which is an integral part of the ignition protection system on applicable generator sets.

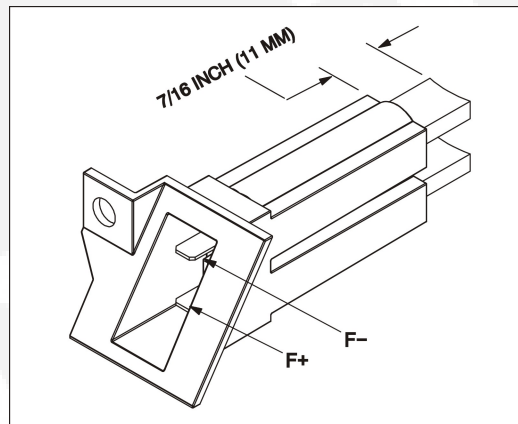


FIGURE 37. BRUSH BLOCK

6.10 Slip Rings

Inspection - Examine slip rings for grooves, pits, and other damage.

Action - Use an abrasive cleaning pad or commutator stone to remove light wear or corrosion.

Disassembly - Remove the brush block.

Assembly - Make sure to replace the brush block cover, which is an integral part of the ignition protection system on applicable generator sets.

6.11 Field Flash Test

Inspection - Voltage to the brush block terminals should be approximately equal to the battery voltage.

Test - Measure the output voltage at the brush block terminals while cranking the engine.

Action - If output voltage increases at least 1 volt while cranking, the entire field excitation system - controller, brushes, slip rings, and rotor - are probably in working order and the problem lies elsewhere. See [Chapter 9 on page 87](#).

Disassembly - Disconnect the governor actuator leads to keep the engine from starting.

Assembly - Connect the governor actuator leads.

6.12 Generator Drive

The engine drives the generator by means of a 6-rib "Poly-Vee" belt. The drive pulley is mounted on the engine flywheel by means of a flexible coupling. The generator pulley is center-bolted to the tapered end of the rotor shaft. The pulley must be removed to remove the generator rotor from the engine-generator adapter.

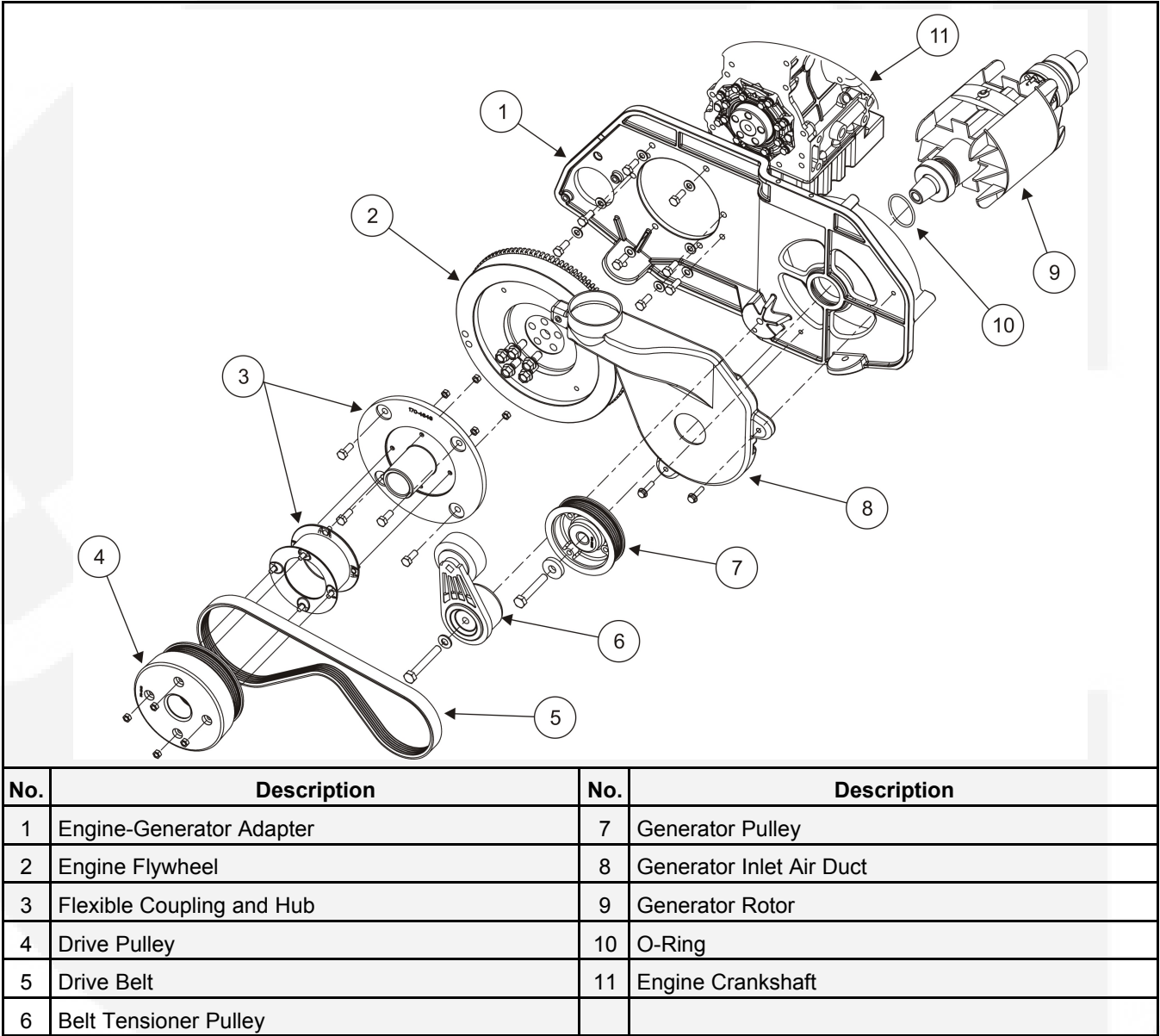


FIGURE 38. GENERATOR DRIVE

6.12.1 Belt



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

Remove the rear panel to inspect the drive and bearings.

Inspection - Examine the belt for cracks, worn spots, and other signs of deterioration.

Action - Replace the belt if necessary or if it has been in service 5 years or 2000 hours.

Disassembly - Pivot the belt tensioner away from the belt with a 3/8 inch drive and remove the belt.

6.12.2 Generator Pulley

Inspection -

1. Determine if there is any noise or grinding.
2. Check for side-to-side and up-and-down looseness of the bearing.

Test - Spin the generator pulley by hand.

Action -

- Replace the rotor assembly if it is evident that either bearing has spun on the shaft.
- Replace the end bell or adapter if it is evident that the bearing has spun in the bore.
- Replace the bearings if they have been in service 5 years or 2000 hours.
- If necessary, disassemble the generator to determine the cause of the looseness or noise.

Disassembly - Remove the belt and pulley center bolt. Use a claw-type wheel puller to break the pulley free of the generator shaft taper. To keep the rotor from turning while loosening the puller bolt, hold the fan bolt with a wrench.

Assembly - Torque the center bolt to 60 Nm (45 ft-lb) when reassembling. Make sure to install the generator inlet air duct before installing the pulley.

6.12.3 Generator Inlet Air Duct

Assembly - Torque the mounting bolts to 12 Nm (8 ft-lb). Make sure to install the air inlet duct and its air sealing gasket before installing the pulley.

6.12.4 Tensioner Pulley Assembly

Inspection - Observe and evaluate spin of bearing and pivot of idler assembly.

Test - Spin the idler pulley.

- Replace the bearing if it does not spin smoothly or is noisy.
- Replace the idler assembly if it does not pivot smoothly from one end of its travel to the other.

Assembly - Torque the center pivot bolt 60 Nm (45 ft-lb).

6.12.5 Drive Pulley and Coupling

Inspection -

1. Examine the coupling for wear and deterioration.
2. Examine the two split-sleeve bearings in the pulley hub for wear and scoring

Action - Replace if necessary.

1. Remove the drive pulley and coupling as an assembly from the flywheel.
2. If necessary, remove the 4 coupling nuts on each end to disassemble the coupling from the hub and the pulley.

Assembly - Torque the coupling nuts to 12 Nm (8 ft-lb) and the 4 hub-to-hub flywheel bolts to 29 Nm (21 ft-lb).

6.12.6 Flywheel

Disassembly - Remove the drive pulley and coupling as an assembly for access to the flywheel mounting bolts. Scribe a line across the crankshaft and flywheel to make realignment easier when reassembling.

Assembly - Torque the 5 mounting bolts to 56 Nm (42 ft-lb) when remounting the flywheel. The flywheel will only go on one way because the bolts are not quite evenly spaced. Proper alignment is necessary to preserve engine balance and timing mark.

6.12.7 Engine/Generator Adapter

Disassembly -

1. Remove the engine-generator assembly from its mounting.
2. Remove the flywheel from the engine.
3. Remove the generator from the adapter.

Assembly - Torque the 6 mounting bolts to 29 Nm (21 ft-lb) when reassembling.

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7 Changing Generator Set Frequency

7.1 As Manufactured

The generator set was set up and adjusted at the factory for the frequency and voltage stated in the *As Manufactured* block on the nameplate (see figure below). If it is necessary to reconfigure voltage and (or) frequency for the application, follow the instructions in this section.

7.2 Reconnection Label

The generator set manuals were shipped with a sheet with peel-off reconnection labels ([Figure 40](#)) to apply over the *As Manufactured* block on the generator set nameplate ([Figure 39](#)) when reconfiguring the generator set for the application. Apply the appropriate label if different from the *As Manufactured* data block.

IMPORTANT ENGINE INFORMATION					
CUMMINS POWER GENERATION					
1400 73rd Ave. NE					
Minneapolis, MN 55432					
Model:	Spec: ☐	Made in U.S.A.			
S/N:	KVA:	Pf:	KW:	PH:	RPM:
50 Hz:	50 Hz:	50 Hz:	50 Hz:	50 Hz:	50 Hz:
60 Hz:	60 Hz:	60 Hz:	60 Hz:	60 Hz:	60 Hz:
As Manufactured:					
Freq:	AC Volts:	Amps:			
Options:		Fuel:	Bat:		
		Software Cfg:			
		Wire Diagram:			
Insulation - NEMA Class Ambient 40 °C					
REFER TO OPERATOR'S MANUAL FOR MAINTENANCE SPECIFICATIONS AND ADJUSTMENTS.					
99-2495 ☐					

FIGURE 39. "AS MANUFACTURED" BLOCK ON NAMEPLATE

ALTERNATOR RECONNECTION LABEL

THESE LABELS ARE TO BE USED WHEN GENSET IS REWIRED.
 *TEAR-OFF LABEL SHOULD BE APPLIED OVER GENSET NAMEPLATE VOLTAGE.
 REFER TO INSTALLATION MANUAL FOR DIRECTIONS.

CAUTION: CIRCUIT BREAKER MAY NEED TO BE CHANGED.

FOR GENERATOR SET MODEL: 13.5/17 MDKBP

THIS SET HAS BEEN RECONFIGURED TO:		
Freq: 50HZ	AC Volts: 115/230V	Amps: 117.4/58.7
THIS SET HAS BEEN RECONFIGURED TO:		
Freq: 60HZ	AC Volts: 120/240V	Amps: 141.7/70.8
THIS SET HAS BEEN RECONFIGURED TO:		
Freq: 50HZ	AC Volts: 120/240V	Amps: 112.5/56.3

FOR GENERATOR SET MODEL: 17.5/21.5 MDKBR

THIS SET HAS BEEN RECONFIGURED TO:		
Freq: 50HZ	AC Volts: 115/230V	Amps: 152.2/76.1
THIS SET HAS BEEN RECONFIGURED TO:		
Freq: 60HZ	AC Volts: 120/240V	Amps: 179/89.6
THIS SET HAS BEEN RECONFIGURED TO:		
Freq: 50HZ	AC Volts: 120/240V	Amps: 145.8/72.9

FIGURE 40. TYPICAL RECONNECTION LABELS

7.3 Changing Frequency

The DC side of the generator set control box has three frequency selection jumper leads terminated in connectors **J5**, **P6**, and **P7**. If application frequency is different from "As Manufactured" frequency follow the steps below.

1. Remove the control box cover.
2. Connect **J5** to **P6** for 60 Hz.
3. Disconnect **J5** from **P7** for 50 Hz.
4. Apply the appropriate reconfiguration label.
5. Replace the control box cover.



NOTE: When changing generator set operating frequency, make sure the line circuit breakers are suitable for the new output. Replace them, if necessary, with ones of appropriate rating.



NOTE: Check and adjust voltage as necessary after the frequency has been changed.

7.4 Reconnecting Generator



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

If necessary:

1. Reconnect the generator for the application voltage in accordance with the appropriate generator connection schematic (see [Appendix A on page 107](#)).
2. Apply the appropriate reconnection label.
3. Adjust voltage, if necessary.



NOTE: It may be necessary to change circuit breakers to provide required protection or full generator set power when reconnecting the generator.

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8 Adjusting AC Output Voltage

8.1 Adjusting Voltage

Before adjusting voltage, make sure that proper fuel, exhaust, raw water, and battery connections have been made and that the engine has the proper levels of oil and coolant.

Disconnect all generator loads and connect accurate meters to measure AC voltage and frequency.



NOTE: When reconnecting the generator for a different output voltage, make sure the line circuit breakers are suitable for the new output. Replace them if necessary with ones of appropriate rating.



WARNING: *Hazardous Voltage*

Touching uninsulated live parts inside the generator set and connected equipment can result in severe personal injury or death.

For your protection, stand on a dry wooden platform or rubber insulating mat, make sure your clothing and shoes are dry, remove jewelry from your hands, and use tools with insulated handles. Secure protective covers when completing installation

8.2 Adjusting Voltage Using Digital Display

1. Start the generator set and let voltage and frequency stabilize for 5 to 10 seconds. Make sure all loads have been disconnected.
2. Rapidly press **START** 6 times during the first minute after startup to put the generator set control into voltage adjust mode. The green status lamp will blink rapidly and the display will indicate a status change from **Running** to **Volt Adj** (see Voltage Adjustment Screen figure below).
3. To adjust voltage up, press and quickly release **START**. Voltage will increase approximately 0.6 volts with each press and release.
4. To adjust voltage down, press and hold **START** for about 1 second. Voltage will decrease approximately 0.6 volts with each press and release.
5. When satisfied with the adjustment, wait about 20 seconds for the display to indicate a status change from **Volt Adj** to **Running** and then press **STOP** to stop the generator set and save the adjustment.
6. Restart the generator set and check voltage.
7. Recalibrate AC voltage on the digital display as instructed in the Operator Manual.

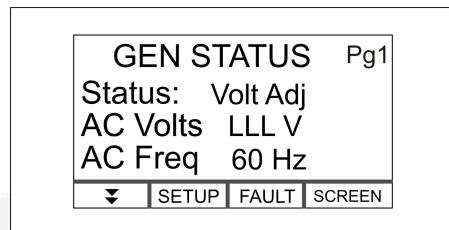


FIGURE 41. VOLTAGE ADJUSTMENT SCREEN

8.3 Adjusting Voltage Using Control Switch

1. Start the generator set and let voltage and frequency stabilize for 5 to 10 seconds. Make sure all loads have been disconnected.
2. Rapidly press **START** 6 times during the first minute after start up to put the generator set control into voltage adjust mode. The amber status lamp will begin blinking about once every second to indicate the change to voltage adjust mode. The green status lamp will remain on.
3. To adjust voltage up, press and quickly release **START**. Voltage will increase approximately 0.6 volts with each press and release.
4. To adjust voltage down, press and hold **START** for about 1 second. Voltage will decrease approximately 0.6 volts with each press and release.
5. When satisfied with the adjustment, wait about 20 seconds for the amber lamp to stop blinking and then press **STOP** to stop the generator set and save the adjustment.
6. Restart the generator set and check voltage.

9 Troubleshooting

9.1 Overview

To troubleshoot the generator set, use the blinking control switch status lamp or the digital display fault code in conjunction with the following list of fault codes (listed in order by fault code number). Perform the step-by-step corrective actions suggested in this section.



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



WARNING: Some generator set service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform generator set service. See the Safety Precautions chapter for more information on hazards.



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

9.2 Troubleshooting with Digital Display

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

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

See the Operator Manual for more information on displaying any of the last five faults.

9.3 Troubleshooting with Status Lamp

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

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

1. Press **Stop** once to cause the two-digit shutdown code to blink.

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

For example, Low Voltage Code No. 13 appears as: blink—*pause*—blink-blink-blink—*long pause*—repeat

2. Pressing **Stop** again will stop the blinking.

- A set of four blinks indicates shutdown due to a failure to start within the time allowed for cranking.
- A set of five blinks indicates shutdown due to high levels of Carbon Monoxide (CO) in the vessel.
- A set of seven blinks indicates shutdown due to a loss of raw water flow for engine and exhaust cooling.

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



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

9.4 Troubleshooting Generator Set Faults



WARNING: *Some generator set service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform generator set service. See the Safety Precautions chapter for more information on hazards.*



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

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

Logic:

Faulty switch, poor or missing connections, dead battery

Diagnosis and Repair:

Refer to Appendix drawings as appropriate.

1. Push the Emergency Stop to remove the emergency stop and/or DC Circuit Breaker **ON** if tripped.
2. Try the local digital display or control switch on the generator set if there is no response at a remote control switch, and vice versa. If at least one control switch or display works, but not the others, go to Step 7.
3. If no control switches work, service battery connections as necessary by cleaning and tightening, recharging or replacing the battery, or replacing damaged battery cables.
4. If there still is no response, disconnect the mate to connector J4 (P4, P33, or P43) in the control box. Check for battery voltage across pins J4-4 and J4-1 (B+, Display, Start/Stop, and ground). If there is voltage, go to Step 7. If there is no voltage, go to Step 5.

5. Disconnect connector P2 (grey) from the generator set controller (p. 5-1) and check for battery voltage across pin sockets P2-1 and P2-6. If there is voltage, replace the controller. If there is no voltage, go to Step 6.
6. Test the Emergency Stop Breaker (CB1) and replace if necessary (p. 9-5). If there still is no voltage, check for and repair faulty wiring and connectors between: P2-1 and CB1-1; CB1-2 and B1-BAT; and P2-6 and GND-ENG.
7. Test for and replace a faulty Display or control switch (p. 9-5) and repair faulty wiring and connectors. See the Appendix for wiring connections.

9.4.2 No Code - Starter Engages and Disengages

Logic:

Low cranking voltage

Diagnosis and Repair:

1. De-energize the PTO clutch, if so equipped.
2. Service battery connections as necessary by cleaning and tightening, recharging or replacing the battery, or replacing damaged battery cables ([Section 3.3 on page 25](#)).
3. Service the starter ([Section 5.5 on page 65](#)). For additional information, see the appropriate engine Workshop Manual. See [Chapter 5](#).

9.4.3 No Code - Starting Batteries do not Maintain a Charge

Logic:

Marginal battery, battery connections or charging system

Diagnosis and Repair:

Refer to Appendix drawings as appropriate.

1. Service battery connections as necessary by cleaning and tightening, recharging or replacing the battery, or replacing damaged battery cables.
2. Check for and disconnect parasitic battery loads.
3. Service the battery starting alternator.

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

Logic:

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

Diagnosis and Repair:

Refer to Appendix drawings as appropriate.

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

9.4.5 Code No. 1 - High Engine Temperature

Logic: Engine coolant temperature exceeds design limit.

Diagnosis and Repair:

1. Check for and clean a blocked sea water strainer. If above the water line, fill the strainer with water to assist priming.
2. Check engine coolant level and add coolant as necessary.
3. Check for disconnected, kinked, or leaking hoses and reconnect, reroute, or replace.
4. Check for and readjust a loose pump belt.
5. Inspect the siphon break for proper operation.
6. Check for a worn raw water impeller and replace as necessary.
7. Clean the heat exchanger.
8. Check the bottom of the hull for any blockage at the through-hull fitting.
9. Drain and clean the coolant system to remove coolant passage fouling.
10. Replace the coolant thermostat, which might not be opening fully.
11. Check the ring terminal on coolant sender E2. Tighten if necessary.
12. Test coolant sender E2 and replace if necessary.
13. Disconnect connector P1 (black) from the generator set controller and check for electrical continuity between Pin 9 and the ring terminal on sender E2. If it is an isolated-ground sender, also check for electrical continuity between E2-2 and B- (ground). Repair wiring and connectors as necessary.
14. Replace the generator set controller.

9.4.6 Code No. 2 - Low Oil Pressure

Possible Cause:

Low oil pressure

Corrective Action:

1. Check the engine oil level and add or drain oil as necessary. Repair any oil leaks.
2. If loose, tighten the ring terminal on oil pressure sender E1.
3. Check electrical resistance through sender E1. Replace the sender if resistance is not between 227 and 257 ohms (0 psi) when the engine is stopped.
4. Disconnect connector P1 (black) from the generator set controller and check for electrical continuity between Pin 10 and the ring terminal on sender E1. If it is an isolated-ground sender, also check for electrical continuity between E1-2 and B- (ground). Repair wiring and connectors as necessary.
5. Replace the sender with a gauge, ground the sender wire (to keep the engine running) and start the engine. Shut down the engine immediately if there is no oil pressure. Service the engine lubricating system in accordance with the Engine Workshop Manual if oil pressure is less than 98 kPa (14 PSI).
6. Replace the generator set controller.

9.4.7 Code No. 3 - Service Check

Logic:

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

Diagnosis and Repair:

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

9.4.8 Code No. 4 - Overcrank

Possible Cause:

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

Diagnosis and Repair:

1. Check fuel level and refill as necessary. (Note: The generator set fuel pickups are probably higher than the propulsion engine fuel pickups.)
2. Open any closed fuel supply and return valves.
3. Prime the engine fuel system for at least 30 seconds.
4. Service as necessary by cleaning and tightening battery connections, recharging or replacing the battery, or replacing damaged battery cables.
5. Remove combustion air or exhaust system blockages.
6. Check all fuel fittings for fuel and air leaks, tighten as necessary and reprime.
7. Replace fuel filters and reprime.
8. Check for contaminated fuel by connecting to a source of known fuel quality.
9. Change engine oil. Use oil of the proper viscosity for the ambient temperature. High oil viscosity can slow cranking speed.
10. Conduct a fuel pump test and replace if necessary.
11. Inspect and service the glow plugs as necessary.
12. Check for proper operation of the governor actuator and replace if necessary.
13. Check compression and cylinder leak down and service a worn engine. See the Engine Workshop Manual.
14. Service the fuel injectors. See the engine workshop manual.
15. Check for proper operation of the internal governor mechanism. See the Engine Workshop Manual.

9.4.9 Code No. 5 - Warning Shutdown due to CO

Logic:

Dangerous levels of Carbon Monoxide in Vessel.

Diagnosis and Repair:

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

9.4.10 Code No. 7 - Loss of Raw Water Flow

Logic:

Low raw water pressure in heat exchanger

Diagnosis and Repair:

1. Open the sea cock.
2. Check for and clean a blocked sea water strainer. If above the water line, fill the strainer with water to assist priming.
3. Check for disconnected, kinked, or leaking hoses and reconnect, reroute, or replace.
4. If loose, reconnect terminals S6+ and S6- to raw water flow switch S6.
5. Check for and readjust a loose pump belt.
6. Test raw water flow switch S6 and replace as necessary.
7. Check for a worn raw water impeller and replace as necessary.
8. Check the bottom of the hull for any blockage at the through-hull fitting.
9. Disconnect connector P1 (black) from generator set controller and check continuity between Pin 8 and terminal S6+ and between terminal S6- and B- (ground). Repair wiring and connectors as necessary.
10. Replace the generator set controller.

9.4.11 Code No. 12 - High AC Voltage

Logic:

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

Diagnosis and Repair:

1. Check for a tripped generator set circuit breaker, reset if necessary, and run with fewer loads. (A breaker tripping under load can cause generator set voltage to overshoot.)
2. Check all fuel fittings and filters for fuel and air leaks and tighten as necessary. (Air bubbles can disrupt generator set frequency/voltage.)
3. Check the brushes and slip rings, and rotor and stator windings. Service as necessary.
4. Prime the engine fuel system for at least 30 seconds.
5. Push the generator set line circuit breaker off, start the generator set, and measure output voltage. If output voltage is normal, the problem is in the circuits external to the generator set. If there is no voltage, test for grounded or shorted main, field or quadrature windings, and service as necessary.
6. Replace the generator set controller.

9.4.12 Code No. 13 - Low AC Voltage

Logic:

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

Diagnosis and Repair:

1. Push the generator set line circuit breaker to off and disconnect the PTO, if so equipped. If the generator set now runs and voltage and frequency are normal, reduce the number of electrical and mechanical (PTO) loads. If there is no voltage, test for grounded or shorted main, field or quadrature windings, and service as necessary.
2. Check the fuel level and fill as necessary. (Note: The generator set fuel pickups are probably higher than the propulsion engine fuel pickups).
3. Remove combustion air or exhaust system blockages.
4. Prime the engine fuel system for at least 30 seconds.
5. Check all fuel fittings and filters for fuel and air leaks and tighten as necessary. (Air bubbles can disrupt generator set frequency/voltage.)
6. Replace fuel filters and reprime.
7. Conduct a fuel pump test and replace if necessary
8. Replace the generator set controller.
9. Check the brushes and slip rings, rotor and stator windings, and service as necessary.
10. Check for proper operation of the governor actuator and service or replace as necessary.
11. Re-adjust high idle speed.
12. Service the fuel injectors in accordance with the Engine Workshop Manual.
13. Check fuel injection timing in accordance with the Engine Workshop Manual..
14. Check for proper operation of the internal governor mechanism in accordance with the engine Workshop Manual.
15. Service a worn engine in accordance with the Engine Workshop Manual.

9.4.13 Code No. 14 - High AC Frequency**Logic:**

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

Diagnosis and Repair:

1. Check for a tripped generator set circuit breaker, reset if necessary, and run with fewer loads. (A breaker tripping under load can cause generator set frequency to overshoot.)
2. Check all fuel fittings and filters for fuel and air leaks and tighten as necessary. (Air bubbles can disrupt frequency).
3. Check for proper operation of the governor actuator and replace if necessary.
4. Check for proper operation of the internal governor mechanism in accordance with the engine Workshop Manual.
5. Replace the generator set controller.

9.4.14 Code No. 15 - Low AC Frequency**Logic:**

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

Diagnosis and Repair:

1. Push the generator set line circuit breaker off and disconnect the PTO clutch, if so equipped. If the generator set now runs, reduce the number of electrical and mechanical (PTO) loads, especially those with high motor starting loads, such as air conditioners.
2. Check the fuel level and fill as necessary. (The generator set fuel pickups are probably higher than the propulsion engine fuel pickups causing the generator to run out of fuel before the propulsion engines).
3. Remove combustion air or exhaust system blockages.
4. Prime the engine fuel system for at least 30 seconds.
5. Check all fuel fittings for fuel and air leaks and tighten as necessary. (Air bubbles can disrupt frequency and voltage.)
6. Replace fuel filters and reprime.
7. Check for contaminated fuel by connecting to a source of known fuel quality.
8. Conduct a fuel pump test and replace if necessary.
9. Check for proper operation of the governor actuator and service or replace as necessary.
10. Re-adjust high idle speed.
11. Service the fuel injectors in accordance with the engine Workshop Manual.
12. Check fuel injection timing in accordance with the engine Workshop Manual.
13. Check for proper operation of the internal governor mechanism in accordance with the engine Workshop Manual.
14. Check compression and cylinder leak down. Service a worn engine in accordance with the engine Workshop Manual.
15. Replace the generator set controller

9.4.15 Code No. 22 - Governor Overload**Logic:**

Maximum allowable time at full-duty cycle was exceeded

Diagnosis and Repair:

1. Reduce the number of appliances running, especially those with high motor starting loads such as air conditioners.
2. Check fuel level and refill as necessary. (Note: The generator set fuel pickups are probably higher than the propulsion engine fuel pickups, causing the generator to run out of fuel before the propulsion engine.)
3. Remove combustion air or exhaust system blockages.
4. Prime the engine fuel system for at least 30 seconds.
5. Check all fittings and fuel filters for fuel and air leaks, tighten as necessary, and reprime.
6. Replace fuel filters and reprime.
7. Check for contaminated fuel by connecting to a source of known fuel quality.
8. Conduct a fuel pump test and replace if necessary.

9. Check for proper operation of the governor actuator and replace if necessary.
10. Re-adjust high idle speed.
11. Service the fuel injectors in accordance with the engine Workshop Manual.
12. Check fuel injection timing in accordance with the engine Workshop Manual.
13. Check for proper operation of the internal governor mechanism in accordance with the engine Workshop Manual.
14. Check compression and cylinder leak down. Service a worn engine in accordance with the engine Workshop Manual.
15. Replace the generator set control.

9.4.16 Code No. 23 - Faulty Oil Pressure Sender

Logic:

Controller sensed grounded sender

Diagnosis and Repair:

1. If loose, tighten the ring terminal on oil pressure sender **E1**. (This fault will occur if a loose ring terminal touches grounded metal.)
2. Disconnect connector **P1** (black) from the generator set controller and check for electrical resistance between **Pin 10** and **B-** (ground). If the resistance is less than 227 ohms (engine stopped):
 - a. Repair wiring and connectors as necessary to eliminate the ground path.
 - b. Check electrical resistance through sender **E1**. Replace the sender if resistance is not between 227 and 257 ohms (0 psi) when the engine is stopped.
3. Replace the generator set controller.

9.4.17 Code No. 24 - Faulty Temperature Sender

Logic:

Controller sensed open sender

Diagnosis and Repair:

1. If loose, tighten the ring terminal on sender **E2**. If it is an isolated-ground sender, also make sure flag terminal is connected to terminal 2 on sender.
2. Disconnect connector **P1** (black) from generator set controller and check continuity between **Pin 9** and ring terminal **E2-1**. If it is an isolated-ground sender, also check continuity between **E2-2** and **B-** (ground). Repair wiring and connectors as necessary.
3. Test sender **E2** and replace as necessary.
4. Replace the generator set controller.

9.4.18 Code No. 27 - Loss of AC Voltage Sense

Logic:

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

Diagnosis and Repair:

1. Disconnect connector P3 (green) from the generator set controller and check continuity between Pin 11 (S1) and Pin 12 (S2). If open, check for missing, bent or corroded pins and faulty wiring and repair as necessary.
2. Test and service the generator as necessary.

9.4.19 Code No. 29 - High Battery Voltage

Logic:

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

Diagnosis and Repair:

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

9.4.20 Code No. 32 - Starting Fault

Logic:

The generator set controller could not detect cranking speed [quadrature zero crossings] for 3 seconds.

Diagnosis and Repair:

1. Disconnect the PTO clutch, if so equipped.
2. Have the propulsion engines running while trying to start the generator set. Their charging alternators may be able to maintain a high enough battery terminal voltage to start the generator set.
3. Service the battery as necessary by cleaning and tightening connections, recharging or replacing the battery, or replacing damaged battery cables.
4. Change the engine oil to oil of the proper viscosity for the ambient temperature. (High oil viscosity can slow cranking speed).
5. Check for proper operation of starter relay K4 and replace if necessary.
6. Disconnect connector P3 (green) from generator set controller and measure resistance between Pin 10 and K4-86 and between K4-85 and CB2-2. If either lead is open, check for a missing, bent, or corroded pin or faulty wiring and repair as necessary.
7. Service the starter motor in accordance with the engine Workshop Manual.
8. Service the engine if the crankshaft is unusually hard to rotate manually, in accordance with the engine Workshop Manual.
9. Replace the generator set controller.

9.4.21 Code No. 35 - Control Card Failure - EE

Logic:

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

Diagnosis and Repair:

Replace the generator set controller.

9.4.22 Code No. 36 - Unknown Shutdown

Logic:

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

Diagnosis and Repair:

1. Check for mechanical damage and service as necessary.
2. Push the generator set line circuit breaker to off and disconnect the PTO clutch, if so equipped. If the generator set now runs, reduce the number of electrical and mechanical (PTO) loads.
3. Check fuel level and refill as necessary. (Note: The generator set fuel pickups are probably higher than the propulsion engine fuel pickups.)
4. Prime the engine fuel system for at least 30 seconds.
5. Remove combustion air or exhaust system blockages.
6. Check all fuel fittings for fuel and air leaks, tighten as necessary.
7. Replace fuel filters and reprime.
8. Conduct a fuel pump test and replace if necessary.
9. Disconnect connector P1 (black) from the generator set controller and measure resistance between Pin 5 and A12+ and between Pin 4 and A12-. If either lead is open, check for a missing, bent, or corroded pin, or faulty wiring. Repair as necessary.
10. Check for proper operation of the governor actuator and replace if necessary.
11. Service the brushes and slip rings as necessary and test the rotor and quadrature windings for opens and shorts. Replace a stator or rotor found to have faulty windings.
12. Check for a malfunctioning exciter or rotor, or open or grounded quadrature circuit. Service as necessary.
13. Service the fuel injectors in accordance with the engine Workshop Manual.
14. Check for proper operation of the internal governor mechanism in accordance with the engine Workshop Manual.
15. Check compression and cylinder leak down. Service a worn engine in accordance with the engine Workshop Manual.
16. Remove combustion air or exhaust system blockages.

9.4.23 Code No. 37 - Invalid Generator Set Configuration

Logic:

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

Diagnosis and Repair:

1. Make sure the ends of the two leads marked CONFIG 1 and CONFIG 2 in the control box are not connected and that they are terminated with insulated connectors.
2. Reconfigure the generator set controller.

3. Replace the generator set controller.

9.4.24 Code No. 38 - Field Overload

Logic:

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

Diagnosis and Repair:

1. Remove blockages to generator air flow at the front inlet air grill.
2. Reduce the number of appliances running at the same time, especially those with high motor starting loads, such as air conditioners.
3. Have air conditioners and other appliances checked for proper operation. (A locked compressor rotor can cause very low power factor.)
4. Check for loose generator fan and repair or replace as necessary.
5. Test and service the generator as necessary.

9.4.25 Code No. 41 - Generator Rotor Fault

Logic:

F+ grounded.

Diagnosis and Repair:

1. Disconnect connector **P3** (green) from the generator set controller and check for continuity between Pin **P3-7** (F+) and **B-** (ground). Pin **P3-7** should not be grounded. Repair or replace wiring, brushes, slip rings, or rotor, as necessary.
2. Replace the generator set controller.

9.4.26 Code No. 43 - Control Card Failure - RAM

Logic:

During startup the generator set Controller detected a RAM memory error

Diagnosis and Repair:

Replace the generator set controller.

9.4.27 Code No. 45 - Speed Sense Lost

Logic:

After start disconnect the generator set controller lost speed sense [quadrature zero crossings] for 0.25 seconds.

Diagnosis and Repair:

1. Disconnect connector **P3** (green) from generator set controller and check for open or shorted field (P3-6 to P3-7) and quadrature (P3-4 to P3-5) windings. Service generator as necessary.
2. Replace the generator set controller.

9.4.28 Code No. 48 - Field Sense Lost - RAM

Logic:

Controller unable to sense field voltage.

Diagnosis and Repair:

See an authorized Cummins Onan service representative. (Replace the generator set controller).

9.4.29 Code No. 57 - Overprime

Logic:

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

Diagnosis and Repair:

1. Check for and remove any object that may be holding any control switch (local or remote) in the prime position.
2. Replace any control switch (S4) in the control system that does not open across terminals 1 and 2 when **Stop** is released.

9.4.30 Code No. 58 - High Exhaust Temperature

Logic:

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

Diagnosis and Repair:

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

9.4.31 Code No. 59 - Low Coolant Level

Logic:

The engine coolant level fell below the optional coolant level sensor

Diagnosis and Repair:

Add coolant as necessary and repair leaks.

9.4.32 Code No. 61 - External Shutdown

Logic:

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

Diagnosis and Repair:

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

10 Specifications

10.1 Specifications Table

TABLE 3. GENERATOR SET SPECIFICATIONS

DESCRIPTION	MDKBJ	MDKBW
Alternator	Single-Bearing, 2-Pole Rotating Field brush type	Single-Bearing, 2-Pole Rotating Field brush type
Installation Drawing	A029F006	A029F006
Engine	Kubota 4-Stroke Cycle, Indirect Injection, Water Cooled Diesel with Digital Electronic Governing	Kubota 4-Stroke Cycle, Indirect Injection, Water Cooled Diesel with Digital Electronic Governing
Model	D722	D722
Rated RPM		
60 Hz	2900	N/A
50 Hz	2400	2880
Number of Cylinders	3	3
Bore	67 mm (2.64 in)	67 mm (2.64 in)
Stroke	68 mm (2.68 in)	68 mm (2.68 in)
Displacement	0.719 L (43.88 in ³)	0.719 L (43.88 in ³)
FUEL:		
Bio-Diesel Compatibility	N/A	N/A
Consumption - 60 Hz		
No Load	1 L/hr (0.27 gal/hr)	N/A
Half Load	1.8 L/hr (0.48 gal/hr)	N/A
Full Load	2.9 L/hr (0.77 gal/hr)	N/A
Consumption - 50 Hz		
No Load	0.8 L/hr (0.21 gal/hr)	0.8 L/hr (0.21 gal/hr)
Half Load	1.5 L/hr (0.39 gal/hr)	1.85 L/hr (0.488 gal/hr)
Full Load	2.3 L/hr (0.6 gal/hr)	2.97 L/hr (0.784 gal/hr)
Minimum Fuel Inlet Pressure	- 1.7 psi	- 1.7 psi
Minimum Fuel Inlet Pressure with Auxiliary Pump	N/A	N/A
LUBRICATION:		
Engine Oil Capacity	3 L (3.2 qt)	3 L (3.2 qt)
Maximum Angularity any Direction		
Continuous	20°	20°
Intermittent	30°	30°
COOLING:		

DESCRIPTION	MDKBJ	MDKBW
Coolant Capacity	3.1 L (3.3 qt)	3.1 L (3.3 qt)
Coolant Flow Rate		
60 Hz	13 L/min (3.5 gal/min)	N/A
50 Hz	11 L/min (3 gal/min)	11 L/min (3 gal/min)
Raw Water Flow Rate		
60 Hz	19 L/min (5 gal/min)	N/A
50 Hz	15 L/min (4 gal/min)	15 L/min (4 gal/min)
Minimum Raw Water Inlet Pressure	- 1.7 psi	- 1.7 psi
Maximum Pressure Drop across Keel Cooler Outlet and Inlet Connection	N/A	N/A
Heat Rejection to Coolant		
60 Hz	N/A	N/A
50 Hz	N/A	N/A
Thermostat Opening Temperature	N/A	N/A
Thermostat Fully Open Temperature	N/A	N/A
Recommended Pressure Cap	N/A	N/A
GENERATOR SET AIR FLOW:		
Combustion Air Flow	0.75 m ³ /min (26.5 ft ³ /min)	0.75 m ³ /min (26.5 ft ³ /min)
Heat Rejection to Ambient		
60 Hz	39 Kcal/min (154 Btu/min)	N/A
50 Hz	31 Kcal/min (124 Btu/min)	31 Kcal/min (124 Btu/min)
EXHAUST:		
Maximum Exhaust Back Pressure	3 in Hg	3 in Hg
Dry Exhaust Gas Flow	N/A	N/A
Dry Exhaust Temperature	N/A	N/A
BATTERIES:		
Nominal Battery Voltage	12 VDC	12 VDC
Minimum CCA Rating - SAE @ 0 °C (32 °F) 12 VDC	450 Amps	450 Amps
Minimum CCA Rating - SAE @ 0 °C (32 °F) 24 VDC	N/A	N/A
12 Volt Net Battery Charging Output		
Negative Ground (60 Hz)	3 Amps	3 Amps
Isolated Ground (60 Hz)	3 Amps	3 Amps
Negative Ground (50 Hz)	3 Amps	3 Amps
Isolated Ground (50 Hz)	3 Amps	3 Amps
24 Volt Net Battery Charging Output		
Negative Ground (60 Hz)	N/A	N/A

DESCRIPTION	MDKBJ	MDKBW
Isolated Ground (60 Hz)	N/A	N/A
Negative Ground (50 Hz)	N/A	N/A
Isolated Ground (50 Hz)	N/A	N/A
Starter Rolling Current		
12V	N/A	N/A
24V	N/A	N/A
Maximum Starting Current Resistance		
12V	N/A	N/A
24V	N/A	N/A
SIZE, WEIGHT, NOISE:		
Weight without Sound Shield:		
Dry Weight	N/A	N/A
Weight with Sound Shield:		
Dry Weight	195 kg (429 lb)	195 kg (429 lb)
Sound Level with Sound Shield @ 1 meter	71/69 dB(A) @ 60/50 Hz	72.5 dB(A) @ 50 Hz

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11 Maintenance Record

TABLE 4. MAINTENANCE RECORD

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Appendix A. Wiring Diagrams

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Figure 43. 0630-2694 Revision G (Sheet 2)	110
Figure 44. 0630-2694 Revision G (Sheet 3)	111

The drawings included in this section are representative. For current complete information, refer to the drawing package that was shipped with the unit.



A.2 MDKBJ and MDKBW Wiring Diagram

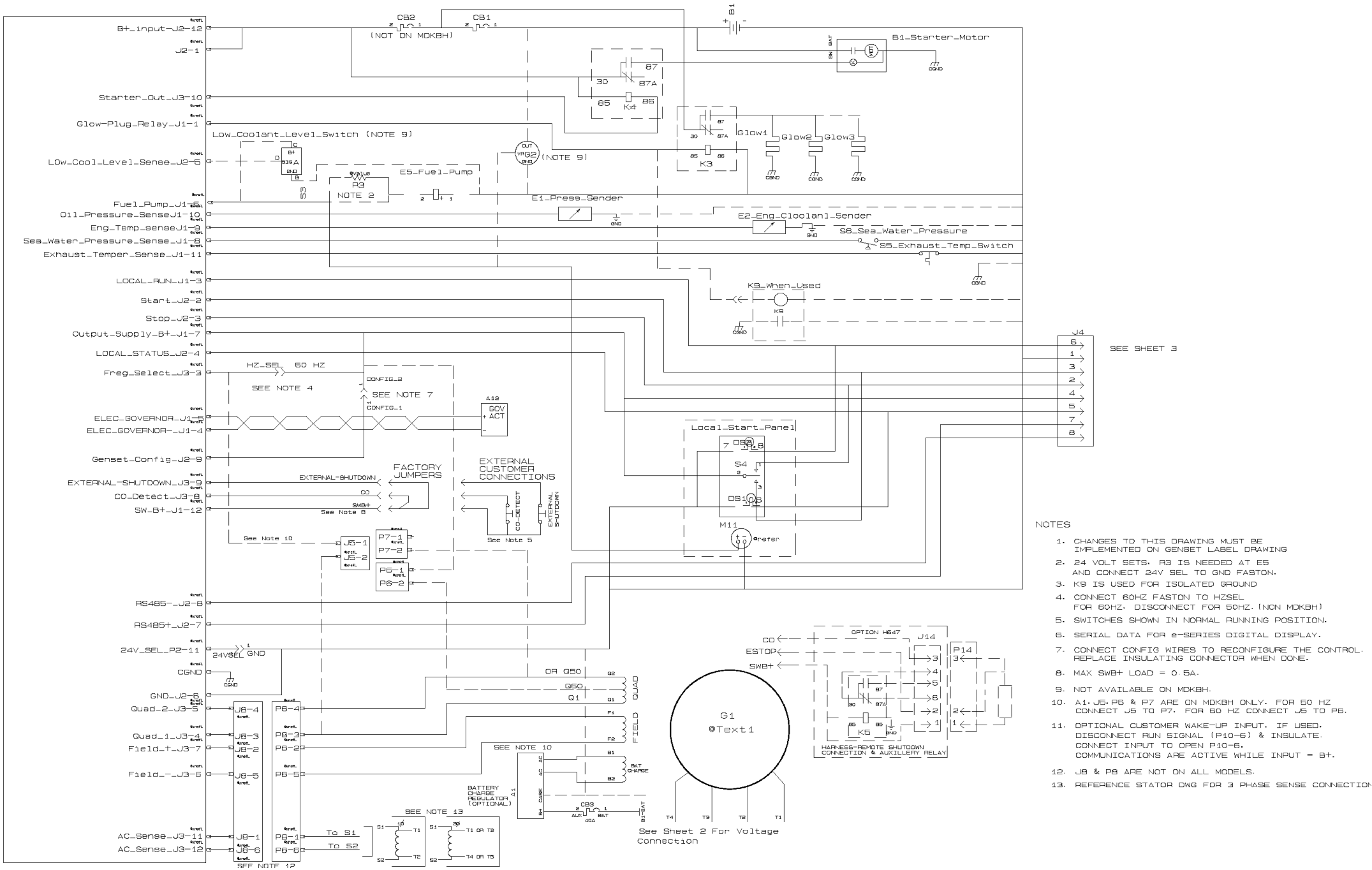
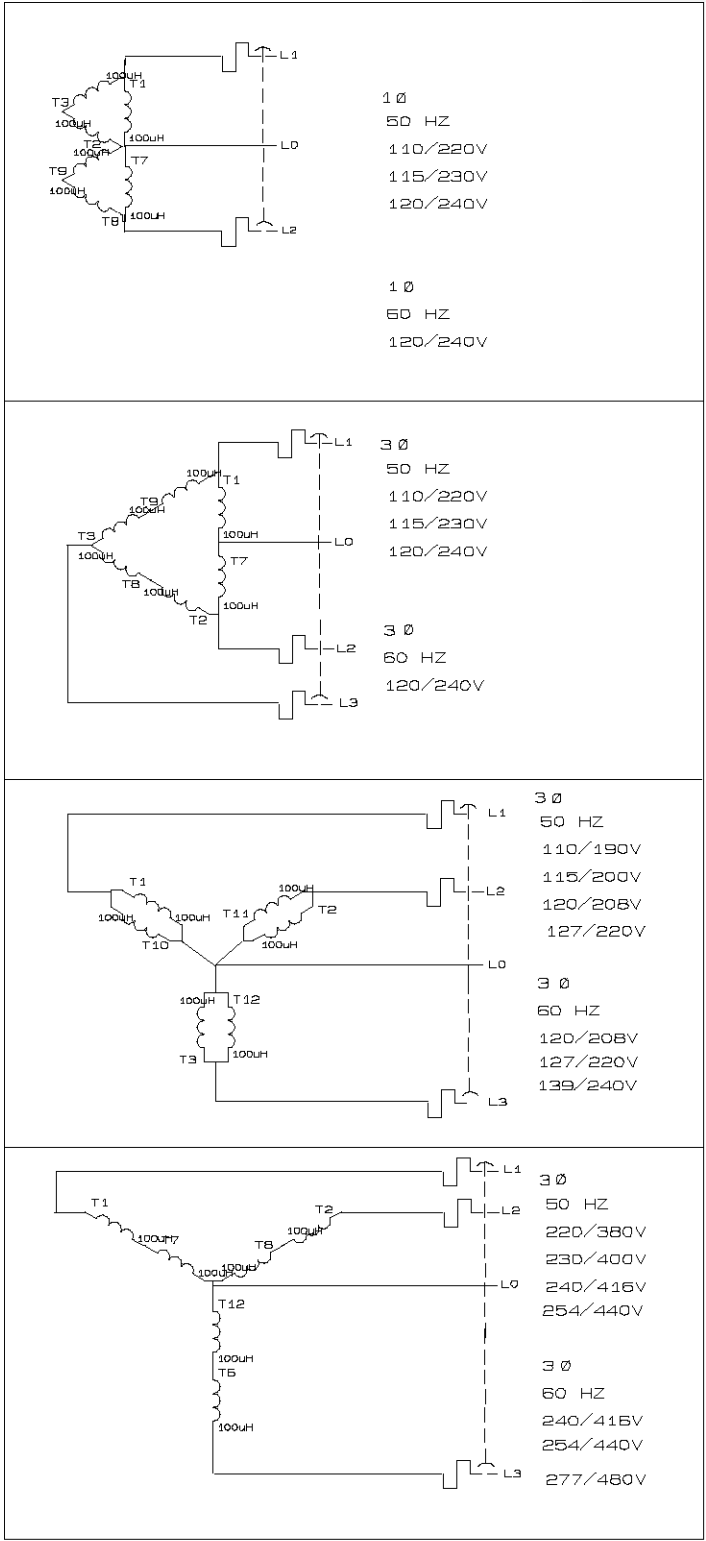


FIGURE 42. 0630-2694 REVISION G (SHEET 1)



3Ø Generator Reconnection

	A	B	C	HZ
VOLTAGE	120	240	120/240	60
	110 115 120	220 230 240	110/220 115/230 120/240	50
SCHEMATIC				
DIAGRAM GROUNDED NEUTRAL				
DIAGRAM ISOLATED NEUTRAL				

NOTES:
(GND) INDICATES GROUND. CONNECTION SHOULD BE MADE AT THE GROUND STUD IN THE CONTROL BOX. (ISO) INDICATES ISOLATED. CONNECTION SHOULD BE MADE AT THE ISOLATION STANDOFF IN THE CONTROL BOX.

1Ø Generator Reconnection

FIGURE 43. 0630-2694 REVISION G (SHEET 2)

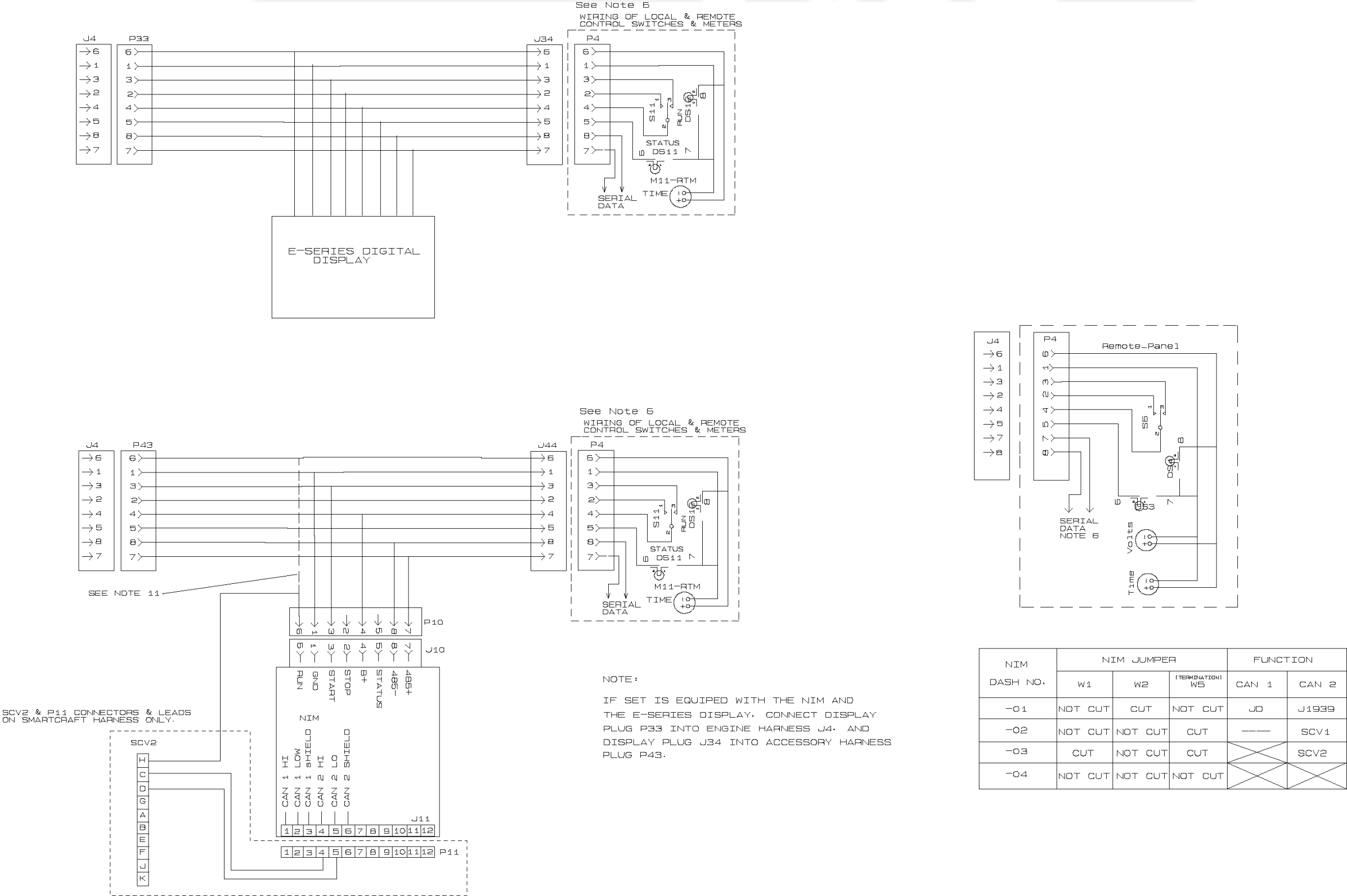


FIGURE 44. 0630-2694 REVISION G (SHEET 3)

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Appendix B. Outline Drawings

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The drawings included in this section are representative. For current complete information, refer to the drawing package that was shipped with the unit.



B.2 MDKBJ and MDKBW Outline Drawing

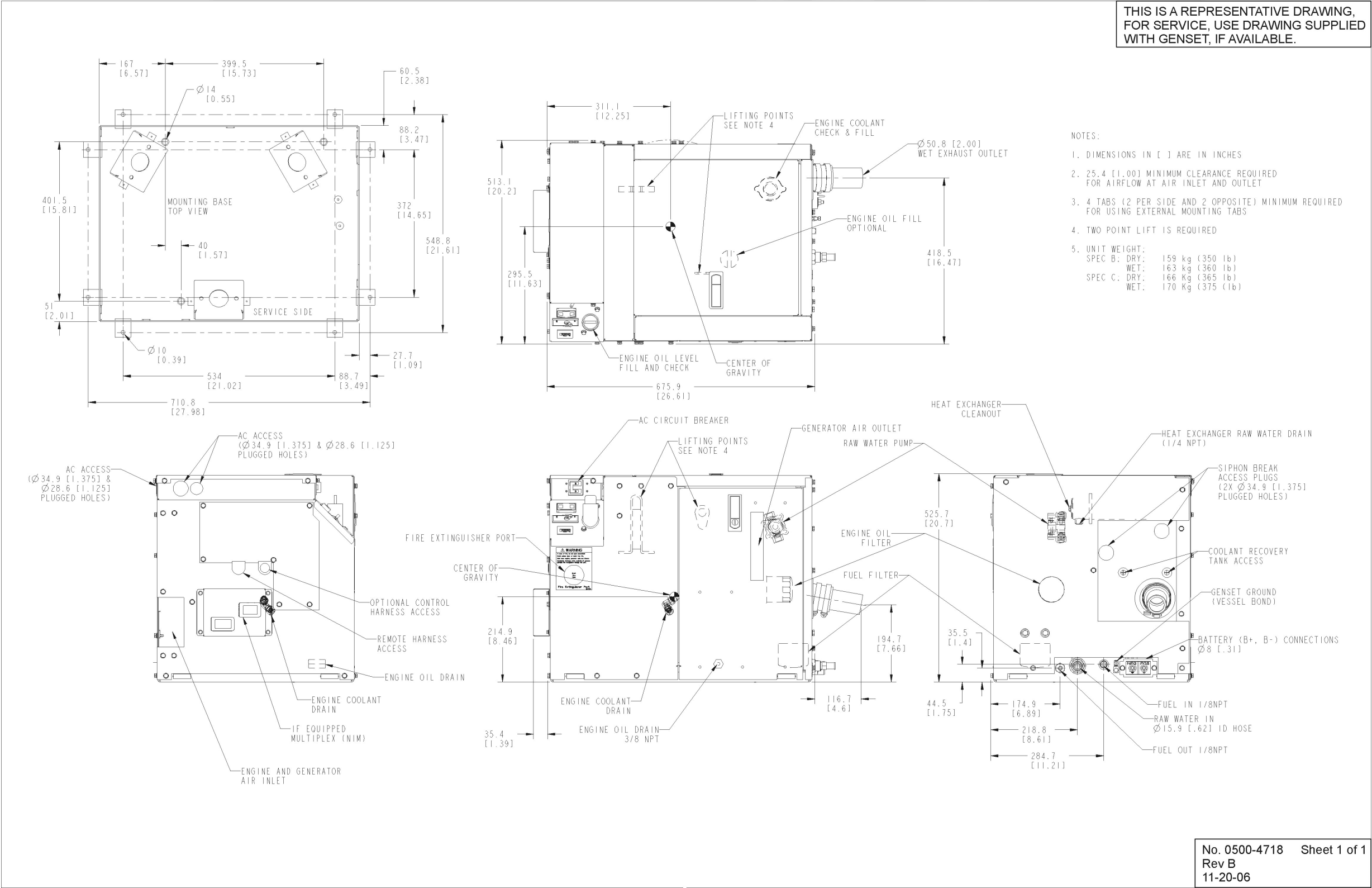


FIGURE 45. 0500-4718 REVISION B OUTLINE DRAWING

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Appendix C. Wiring Harnesses

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Figure 46. A029X224 Revision D Wiring Harness 119

The drawings included in this section are representative. For current complete information, refer to the drawing package that was shipped with the unit.



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Cummins Onan

Cummins Power Generation
1400 73rd Ave. NE
Minneapolis, MN 55432 USA
Phone 1 763 574 5000
Toll-free 1 800 888 6626
Fax 1 763 574 5298

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