Service Manual

Generator Set

QSK95 Engine with the PowerCommand® 3.3 Control and S9 Alternator

C3000 D6 (Spec A-B)
C3000 D6e (Spec A-B)
C3250 D6 (Spec A-B)
C3250 D6e (Spec A-B)
C3500 D5 (Spec A-B)
C3500 D5e (Spec A-B)
C3500 D6 (Spec A-B)
C3500 D6e (Spec A-B)
C3750 D5 (Spec A-B)
C3750 D5e (Spec A-B)

English
Original Instructions
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1 IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS. This manual contains important instructions that should be followed during installation and maintenance of the generator set and batteries.

Safe and efficient operation can be achieved only if the equipment is properly operated and maintained. Many accidents are caused by failure to follow fundamental rules and precautions.

1.1 Warning, Caution, and Note Styles Used in This Manual

The following safety styles and symbols found throughout this manual indicate potentially hazardous conditions to the operator, service personnel, or equipment.

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

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

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

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

1.2 General Information

This manual should form part of the documentation package supplied by Cummins with specific generator sets. In the event that this manual has been supplied in isolation, contact your authorized distributor.

NOTICE
It is in the operator's interest to read and understand all warnings and cautions contained within the documentation relevant to the generator set, its operation and daily maintenance.

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1.2.1 Safety Precautions

1.2.1.1 General Safety Precautions

⚠ WARNING

Hot Pressurized Liquid

Contact with hot liquid can cause severe burns.

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

⚠ WARNING

Moving Parts

Moving parts can cause severe personal injury.

Use extreme caution around moving parts. All guards must be properly fastened to prevent unintended contact.

⚠ WARNING

Toxic Hazard

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 and face guard.

⚠ WARNING

Electrical Generating Equipment

Incorrect operation can cause severe personal injury or death.

Do not operate equipment when fatigued, or after consuming any alcohol or drug.

⚠ WARNING

Toxic Gases

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.

⚠ WARNING

Combustible Liquid

Ignition of combustible liquids is a fire or explosion hazard which can cause severe burns or death.

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

⚠ WARNING

High Noise Level

Generator sets in operation emit noise, which can cause hearing damage.

Wear appropriate ear protection at all times.

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⚠ WARNING

Hot Surfaces

Contact with hot surfaces can cause severe burns.

The unit is to be installed so that the risk of hot surface contact by people is minimized. Wear appropriate PPE when working on hot equipment and avoid contact with hot surfaces.

⚠ WARNING

Electrical Generating Equipment

Incorrect operation and maintenance can result in severe personal injury or death.

Make sure that only suitably trained and experienced service personnel perform electrical and/or mechanical service.

⚠ WARNING

Toxic Hazard

Ethylene glycol, used as an engine coolant, is toxic to humans and animals.

Wear appropriate PPE. Clean up coolant spills and dispose of used coolant in accordance with local environmental regulations.

⚠ WARNING

Combustible Liquid

Ignition of combustible liquids is a fire or explosion hazard which can cause severe burns or death.

Do not use combustible liquids like ether.

⚠ WARNING

Automated Machinery

Accidental or remote starting of the generator set can cause severe personal injury or death.

Isolate all auxiliary supplies and use an insulated wrench to disconnect the starting battery cables (negative [–] first).

⚠ WARNING

Fire Hazard

Materials drawn into the generator set are a fire hazard. Fire can cause severe burns or death.

Make sure the generator set is mounted in a manner to prevent combustible materials from accumulating under the unit.

⚠ WARNING

Fire Hazard

Accumulated grease and oil are a fire hazard. Fire can cause severe burns or death.

Keep the generator set and the surrounding area clean and free from obstructions. Repair oil leaks promptly.

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⚠ WARNING

Fall Hazard

Falls can result in severe personal injury or death.

Make sure that suitable equipment for performing tasks at height are used in accordance with local guidelines and legislation.

⚠ WARNING

Fire Hazard

Materials drawn into the generator set are a fire hazard. Fire can cause severe burns or death.

Keep the generator set and the surrounding area clean and free from obstructions.

⚠ WARNING

Pressurized System

Pressurized systems can rupture/leak which can result in severe personal injury or death.

Use appropriate lock out/tag out safety procedures to isolate from all energy sources before performing any service tasks. Use PPE.

⚠ WARNING

Confined Areas

Confined spaces or areas with restricted access or potential to entrap can cause severe personal injury or death.

Use appropriate lock out/tag out safety procedures to isolate from all energy sources. Use PPE. Follow site specific lone worker protocols/permits to work.

⚠ CAUTION

Manual Handling Heavy Objects

Handling heavy objects can cause severe personal injury.

Use appropriate lifting equipment and perform tasks with two people where doing so would make completion of the task safe.

⚠ CAUTION

Power Tools and Hand Tools

Tools can cause cuts, abrasions, bruising, puncture injuries.

Only trained and experienced personnel should use power tools and hand tools. Use PPE.

⚠ CAUTION

Sharp Edges and Sharp Points

Projecting corners/parts may cause cuts, abrasions and other personal injury.

Use PPE. Be aware of sharp edges and corners/sharp points. Cover/protect them.

NOTICE

Keep multi-type ABC fire extinguishers close by. 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 the applicable region.)

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NOTICE

Before performing maintenance and service procedures on enclosed generator sets, make sure the service access doors are secured open.

NOTICE

Stepping on the generator set can cause parts to bend or break, leading to electrical shorts, or to fuel leaks, coolant leaks, or exhaust leaks. Do not step on the generator set when entering or leaving the generator set room.

1.3 Generator Set Safety Code

Before operating the generator set, read the manuals and become familiar with them and the equipment. Safe and efficient operation can be achieved only if the equipment is properly operated and maintained. Many accidents are caused by failure to follow fundamental rules and precautions.

⚠ WARNING

Electrical Generating Equipment

Incorrect operation and maintenance can result in severe personal injury or death.

Read and follow all Safety Precautions, Warnings, and Cautions throughout this manual and the documentation supplied with the generator set.

1.3.1 Moving Parts Can Cause Severe Personal Injury or Death

- Keep hands, clothing, and jewelry away from moving parts. Do not wear loose clothing or jewelry in the vicinity of moving parts or while working on electrical equipment. Loose clothing and jewelry can become caught in moving parts.
- Before starting work on the generator set, disconnect the battery charger from its AC source, then disconnect the starting batteries using an insulated wrench, negative (**–**) cable first. This will prevent accidental starting.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps; keep guards in position over fans, drive belts, etc.
- If any adjustments must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

1.3.2 Moving the Generator Set

⚠ WARNING

Heavy Load

Incorrect lifting or repositioning can cause severe personal injury or death.

Make sure that only suitably trained and experienced personnel transport and handle generator sets and associated components.

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⚠ WARNING

Heavy Load

Incorrect lifting or repositioning can cause severe personal injury or death.

Do not lift the generator set by attaching to the engine or alternator lifting points. Do not stand under or near the generator set when lifting.

⚠ WARNING

Mechanical Hazard

Failed components may be ejected or operate incorrectly which can cause severe personal injury or death.

Do not climb the generator set; this may damage critical parts.

NOTICE

Make sure that any shipping brackets supplied with the generator set are fitted, before moving the generator set. Failure to install the shipping brackets before moving may result in damage to the generator set.

NOTICE

Access or service doors must be closed and locked before repositioning, and they must remain locked during transportation and siting.

It is essential that there are sufficient trained and experienced personnel in attendance to make sure the lifting and transportation of the generator set is undertaken in a safe and appropriate manner, and in accordance to local guidelines and legislation.

Before lifting the generator set, lifting points, angle of slings, mass, access to intended site, and the distance of movement should all be taken into account when organizing a suitable crane/hoist. Consult the generator set information supplied with the generator set for details of dimensions and mass.

- Make sure the fuel tank is empty.
- Make sure that the crane operating area is able to support the mass of the crane and the generator set.
- Make sure the equipment used for lifting is adequate to support the weight of the generator set.
- Attach the lifting device to the lifting points only using suitable shackles, chains, and spreader bars.
- Slowly tighten the slings. Inspect the lifting attachments before commencing a full lift to make sure they are attached correctly.
- Hoist the generator set slowly using the indicated lifting points only.
- Guide the generator set with ropes at a safe distance to prevent uncontrolled rotation when positioning the generator set.
- Move the generator set to the desired location and place in position, bringing the set down slowly.
- Loosen the slings; unhook and remove the shackles.

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1.3.3 Generator Set Operating Areas

⚠ WARNING

Ejected Debris

Debris ejected during destructive failure can cause serious injury or death by impact, severing or stabbing.

Do not to stand alongside the engine or alternator while the generator set is running.

- Operators must not stand alongside the engine or alternator while the generator set is running, unless the risks of doing so have been assessed and adequate mitigation steps have been taken.
- If there are operation/maintenance procedures that require spending time alongside the generator set when it is running, take every precaution to perform these tasks safely. Keep time spent performing these tasks to a minimum.
- Be aware of the product environment. Other equipment may be in operation or energized in the surrounding area.

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

⚠ WARNING

Electric Shock Hazard

Voltages and currents present an electrical shock hazard that can cause severe burns or death.

Contact with exposed energized circuits with potentials of 50 Volts AC or 75 Volts DC or higher can cause electrical shock and electrical arc flash. Refer to standard NFPA 70E or equivalent safety standards in corresponding regions for details of the dangers involved and for 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 *Locking the Generator Set Out of Service* section 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:

NOTICE

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.

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NOTICE

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.

In summary:

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

1.4.1 AC Supply and Isolation

NOTICE

Local electrical codes and regulations (for example, *BS EN 12601:2010 Reciprocating internal combustion engine driven generating sets)* may require the installation of a disconnect means for the generator set, either on the generator set or where the generator set conductors enter a facility.

NOTICE

The AC supply must have the correct over current and earth fault protection according to local electrical codes and regulations. This equipment must be earthed (grounded).

It is the sole responsibility of the customer to provide AC power conductors for connection to load devices and the means to isolate the AC input to the terminal box; these must comply with local electrical codes and regulations. Refer to the wiring diagram supplied with the generator set.

The disconnecting device is not provided as part of the generator set, and Cummins accepts no responsibility for providing the means of isolation.

1.4.2 AC Disconnect Sources

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

The equipment may have more than one source of electrical energy. Disconnecting one source without disconnecting the others presents a shock hazard. Before starting work, disconnect the equipment, and verify that all sources of electrical energy have been removed.

1.4.3 Medium Voltage Equipment (601 V to 15 kV - U.S. and Canada)

- Medium voltage acts differently than low voltage. Special equipment and training is required to work on or around medium voltage equipment. Operation and maintenance must be done only by persons trained and experienced to work on such devices. Improper use or procedures will result in severe personal injury or death.

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- Do not work on energized equipment. Unauthorized personnel must not be permitted near energized equipment. Due to the nature of medium voltage electrical equipment, induced voltage remains even after the equipment is disconnected from the power source. Plan the time for maintenance with authorized personnel so that the equipment can be de-energized and safely grounded.

1.5 Fuel and Fumes Are Flammable

Fire, explosion, and personal injury or death can result from improper practices.

- Do not fill fuel tanks while the engine is running unless the tanks are outside the engine compartment. Fuel contact with hot engine or exhaust is a potential fire hazard.
- Do not permit any flame, cigarette, pilot light, spark, arcing equipment, or other ignition source near the generator set or fuel tank.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible line. Do not use copper piping on flexible lines as copper will become brittle if continuously vibrated or repeatedly bent.
- Make sure all fuel supplies have a positive (+) shutoff valve.
- Make sure the battery area has been well-ventilated prior to servicing near it. Lead-acid batteries emit a highly explosive hydrogen gas that can be ignited by arcing, sparking, smoking, etc.

1.5.1 Spillage

Any spillage that occurs during fueling, oil top-off, or oil change must be cleaned up before starting the generator set.

1.5.2 Fluid Containment

NOTICE
Where spillage containment is not part of a Cummins supply, it is the responsibility of the installer to provide the necessary containment to prevent contamination of the environment, especially water courses and sources.

Fluid containment is incorporated into the base of the generator set, it must be inspected at regular intervals. Any liquid present should be drained out and disposed of in accordance with local health and safety regulations. Failure to perform this action may result in spillage of liquids which could contaminate the surrounding area.

Any other fluid containment area must also be checked and emptied, as described above.

1.5.3 Do Not Operate in Flammable and Explosive Environments

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 generator set where a flammable vapor environment can be created, unless the generator set is equipped with an automatic safety device to block the air intake and stop the engine. The owners and operators of the generator set are solely responsible for operating the generator set safely. Contact your authorized Cummins distributor for more information.

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1.6 Exhaust Gases Are Deadly

- Provide an adequate exhaust system to properly expel discharged gases away from enclosed or sheltered areas, and areas where individuals are likely to congregate. Visually and audibly inspect the exhaust system daily for leaks per the maintenance schedule. Make sure that exhaust manifolds are secured and not warped. Do not use exhaust gases to heat a compartment.
- Make sure the unit is well ventilated.

1.6.1 Exhaust Precautions

⚠ WARNING

Hot Exhaust Gases

Contact with hot exhaust gases can cause severe burns.

Wear personal protective equipment when working on equipment.

⚠ WARNING

Hot Surfaces

Contact with hot surfaces can cause severe burns.

The unit is to be installed so that the risk of hot surface contact by people is minimized. Wear appropriate PPE when working on hot equipment and avoid contact with hot surfaces.

⚠ WARNING

Toxic Gases

Inhalation of exhaust gases can cause asphyxiation and death.

Pipe exhaust gas outside and away from windows, doors, or other inlets to buildings. Do not allow exhaust gas to accumulate in habitable areas.

⚠ WARNING

Fire Hazard

Contaminated insulation is a fire hazard. Fire can cause severe burns or death.

Remove any contaminated insulation and dispose of it in accordance with local regulations.

The exhaust outlet may be sited at the top or bottom of the generator set. Make sure that the exhaust outlet is not obstructed. Personnel using this equipment must be made aware of the exhaust position. Position the exhaust away from flammable materials - in the case of exhaust outlets at the bottom, make sure that vegetation is removed from the vicinity of the exhaust.

The exhaust pipes may have some insulating covers fitted. If these covers become contaminated they must be replaced before the generator set is run.

To minimize the risk of fire, make sure the following steps are observed:

- Make sure that the engine is allowed to cool thoroughly before performing maintenance or operation tasks.
- Clean the exhaust pipe thoroughly.

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1.7 Decommissioning and Disassembly

NOTICE
Decommissioning and disassembly of the generator set at the end of its working life must comply with local guidelines and legislation for disposal/recycling of components and contaminated fluids. This procedure must only be carried out by suitably trained and experienced service personnel. For more information contact your authorized distributor.

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2 Introduction

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Make sure that only a trained and experienced electrician makes generator set electrical output connections, in accordance with the installation instructions and all applicable codes.

⚠ WARNING

Electrical Generating Equipment

Faulty electrical generating equipment can cause severe personal injury or death.

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

2.1 About This Manual

This manual provides troubleshooting and repair information for the Generator Sets listed on the front cover. Additional Engine and alternator service and maintenance instructions are contained within the applicable engine and alternator service manuals. Operating and basic maintenance instructions are in the applicable Generator Set Operator Manual.

The information contained within the manual is based on information available at the time of going to print. In line with Cummins Inc. 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://quickserve.cummins.com**).

This manual contains basic (generic) wiring diagrams and schematics that are included to help in troubleshooting. The wiring diagrams and schematics that are maintained with the unit should be updated when modifications are made to the unit.

Read **Chapter 1 on page 1** and carefully observe all instructions and precautions in this manual.

2.2 Test Equipment

To perform the test procedures in this manual, the following test equipment must be available:

- True RMS meter for accurate measurement of small AC and DC voltages.
- Grounding wrist strap to prevent circuit board damage due to electrostatic discharge (ESD).
- Battery Hydrometer
- Jumper Leads
- Tachometer or Frequency Meter
- Wheatstone Bridge or Digital Ohmmeter
- Variac
- Load Test Panel
- Megger or Insulation Resistance Meter
- PCC Service Tool Kit (Harness Tool and Sensor Tool)

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- InPower Service Tool (PC based Generator Set Service Tool)
- RS232, USB, RS485 or ethernet interface can be used for direct cable connection to a PC.

2.3 Schedule of Abbreviations

This list is not exhaustive. For example, it does not identify units of measure or acronyms that appear only in parameters, event/fault names, or part/accessory names.

ABBR.	DESCRIPTION	ABBR.	DESCRIPTION
AC	Alternating Current	LTS	Long Term Storage
AMF	Automatic Mains Failure	LVRT	Low Voltage Ride Through
AMP	AMP, Inc., part of Tyco Electronics	MCB	Main Generator set Circuit Breaker
ANSI	American National Standards Institute	MFM	Multifunction Monitor
ASOV	Automatic Shut Off Valve	Mil Std	Military Standard
ASTM	American Society for Testing and Materials (ASTM International)	MLD	Masterless Load Demand
ATS	Automatic Transfer Switch	MRS	Manual Remote Start
AVR	Automatic Voltage Regulator	NC	Normally Closed
AWG	American Wire Gauge	NC	Not Connected
CAN	Controlled Area Network	NFPA	National Fire Protection Agency
CB	Circuit Breaker	NO	Normally Open
CE	Conformité Européenne	NWF	Network Failure
CFM	Cubic Feet per Minute	OEM	Original Equipment Manufacturer
CGT	Cummins Generator Technologies	OOR	Out of Range
CMM	Cubic Meters per Minute	OORH / ORH	Out of Range High
CT	Current Transformer	OORL / ORL	Out of Range Low
D-AVR	Digital Automatic Voltage Regulator	PB	Push Button
DC	Direct Current	PCC	PowerCommand® Control
DPF	Diesel Particulate Filter	PGN	Parameter Group Number
ECM	Engine Control Module	PI	Proportional/Integral
ECS	Engine Control System	PID	Proportional / Integral / Derivative
EMI	Electromagnetic interference	PLC	Programmable Logic Controller
EN	European Standard	PMG	Permanent Magnet Generator
EPS	Engine Protection System	PPE	Personal Protective Equipment
E-Stop	Emergency Stop	PT	Potential Transformer
FAE	Full Authority Electronic	PTC	Power Transfer Control

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ABBR.	DESCRIPTION	ABBR.	DESCRIPTION
FMI	Failure Mode Identifier	PWM	Pulse-width Modulation
FRT	Fault Ride Through	RFI	Radio Frequency Interference
FSO	Fuel Shutoff	RH	Relative Humidity
Genset	Generator Set	RMS	Root Mean Square
GCB	Generator set Circuit Breaker	RTU	Remote Terminal Unit
GCP	Generator Control Panel	SAE	Society of Automotive Engineers
GND	Ground	LED	Light-emitting Diode
LCT	Low Coolant Temperature	SPN	Suspect Parameter Number
HMI	Human-machine Interface	SWL	Safe Working Load
IC	Integrated Circuit	SW_B+	Switched B+
ISO	International Organization for Standardization	UL	Underwriters Laboratories
LBNG	Lean-burn Natural Gas	UPS	Uninterruptible Power Supply
LCD	Liquid Crystal Display	VPS	Valve Proving System

2.4 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 for C3000 series (A043F055)
- Operator Manual for C3000 series with S9 (A072S094)
- Installation Manual for C3000 series (A043F056)
- Installation Manual for C3000 series with S9 (A072S093)
- Service Manual for C3000 series with P80 (A043F057)
- Service Manual for C3000 series with DIG142 (A048U572)
- Service Manual for C3000 series with S9 (A072S095)
- Controller Service Manual for PowerCommand 3.3 (0900-0670)
- Engine Operation & Maintenance Manual for QSK95 (4358520)

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- Engine Service Manual for QSK95 (4358519)
- Alternator Service Manual for P80 (A040J851)
- Alternator Service Manual for DIG142 (A046V044)
- Alternator Service manual for S9 (A062L877)
- *Specification* and *Data Sheet* (For engineering data specific to the generator set)
- Application Manual T-030, *Liquid Cooled Generator Sets* (For application information)
- Parts Manual for C3000 series with P80 or DIG142 (A043F058)
- Universal Annunciator Owner Manual (0900-0301)
- Recommended Spares List (RSL) for C3000 D6 with P80 alternator (A049P902)
- Recommended Spares List (RSL) for C3000 D6e with P80 alternator (A049P904)
- Recommended Spares List (RSL) for C3250 D6 with P80 alternator (A049P905)
- Recommended Spares List (RSL) for C3250 D6e with P80 alternator (A049P906)
- Recommended Spares List (RSL) for C3500 D5 with P80 alternator (A049P908)
- Recommended Spares List (RSL) for C3500 D5e with P80 alternator (A049P909)
- Recommended Spares List (RSL) for C3500 D6 with P80 alternator (A051G104)
- Recommended Spares List (RSL) for C3500 D6e with P80 alternator (A051G105)
- Recommended Spares List (RSL) for C3750 D5 with P80 alternator (A051G106)
- Recommended Spares List (RSL) for C3750 D5e with P80 alternator (A051G107)
- Recommended Spares List (RSL) for C3000 D6 with DIG142 alternator (A051V940)
- Recommended Spares List (RSL) for C3000 D6e with DIG142 alternator (A051V941)
- Recommended Spares List (RSL) for C3250 D6 with DIG142 alternator (A051V942)
- Recommended Spares List (RSL) for C3250 D6e with DIG142 alternator (A051V943)
- Recommended Spares List (RSL) for C3500 D5 with DIG142 alternator (A051V944)
- Recommended Spares List (RSL) for C3500 D5e with DIG142 alternator (A051V945)
- Recommended Spares List (RSL) for C3500 D6 with DIG142 alternator (A051V946)
- Recommended Spares List (RSL) for C3500 D6e with DIG142 alternator (A051V947)
- Recommended Spares List (RSL) for C3750 D5 with DIG142 alternator (A051V948)
- Recommended Spares List (RSL) for C3750 D5e with DIG142 alternator (A051V950)
- Standard Repair Times - HH Family (A049P911)
- Service Tool Manual (A043D529)
- Fuels for Cummins Engines Service Bulletin (3379001)
- Warranty Administration Manual (4021290)
- Global Commercial Warranty Statement (A028U870)

2.5 After Sales Services

Cummins offers a full range of maintenance and warranty services.

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2.5.1 Maintenance

⚠ WARNING

Electrical Generating Equipment

Incorrect operation and maintenance can result in severe personal injury or death.

Make sure that only suitably trained and experienced service personnel perform electrical and/or mechanical service.

For expert generator set service at regular intervals, contact your local distributor. Each local distributor offers a complete maintenance contract package covering all items subject to routine maintenance, including a detailed report on the condition of the generator set. In addition, this can be linked to a 24-hour call-out arrangement, providing year-round assistance if necessary. Specialist engineers are available to maintain optimum performance levels from generator sets. Maintenance tasks should only be undertaken by trained and experienced technicians provided by your authorized distributor.

2.5.2 Warranty

For details of the warranty coverage for your generator set, refer to the Global Commercial Warranty Statement listed in the Related Literature section.

In the event of a breakdown, prompt assistance can normally be given by factory trained service technicians with resources to undertake all minor and many major repairs to equipment on site.

Extended warranty coverage is also available.

For further warranty details, contact your authorized service provider.

NOTICE

Damage caused by failure to follow the manufacturer's recommendations will not be covered by warranty. Contact your authorized service provider.

2.5.2.1 Warranty Limitations

For details of the warranty limitations for your generator set, refer to the warranty statement applicable to the generator set.

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3 Specifications

3.1 Generator Set Specifications

TABLE 1. C3000 D6 AND C3000 D6E SPECIFICATIONS

MODELS	C3000 D6	C3000 D6e
Engine Cummins Diesel Series	QSK95-G2	QSK95-G9
Generator kVA/kW Rating	See generator set nameplate for rating information.	
Engine Fuel Connection Inlet/Outlet Thread Size	Refer to generator set outline drawing supplied	
Maximum Weight	36390 kg (80226 lb)	36390 kg (80226 lb)
Fuel Max. Fuel Inlet Restriction (Prime) Max. Fuel Inlet Restriction (Standby) Max. Fuel Return Restriction Fuel Pump Flow Rate	 16.9 kPa (5 inHg) 30.5 kPa (9 inHg) 34 kPa (10 inHg) 1602 L/hr (423 gal/hr)	 16.9 kPa (5 inHg) 30.5 kPa (9 inHg) 34 kPa (10 inHg) 1602 L/hr (423 gal/hr)
Exhaust Outlet Size Max. Allowable Back Pressure Exhaust Flow at Rated Load Exhaust Temperature	**1800 RPM** DIN 350 mm, ASME B16.5 14 in 7 kPa (28 inH_2O) 628 m^3/min (22170 cfm) at SBY 815 °F (435 °C)	**1800 RPM** DIN 350 mm, ASME B16.5 14 in 7 kPa (28 inH_2O) 645 m^3/min (22780 cfm) at SBY 830 °F (443 °C)
Electrical System Starting Voltage Battery Group Number CCA (minimum) Cold Soak @ 0 °F (-18 °C)	 24 Volts DC 8D 1400 A at -18 °C to 1730 A at 0 °C (0 °F to 32 °F)	
Total Battery Quantity (Recommended) Engine Starter- Air Motor Configuration: Engine Starter- Standard 3- Starter configuration: Engine Starter- Redundant Start Configuration:	 2 batteries 6 batteries 8 batteries	
Lubricating System Oil Capacity with Filters	647.3 L (684 qt)	647.3 L (684 qt)

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TABLE 2. C3250 D6 AND C3250 D6E SPECIFICATIONS

MODELS	C3250 D6	C3250 D6e
Engine		
Cummins Diesel Series	QSK95-G2	QSK95-G9
Generator kVA/kW Rating	See generator set nameplate for rating information.	
Engine Fuel Connection		
Inlet/Outlet Thread Size	Refer to generator set outline drawing supplied	
Maximum Weight	36390 kg (80226 lb)	36390 kg (80226 lb)
Fuel		
Max. Fuel Inlet Restriction (Prime)	16.9 kPa (5 inHg)	16.9 kPa (5 inHg)
Max. Fuel Inlet Restriction (Standby)	30.5 kPa (9 inHg)	30.5 kPa (9 inHg)
Max. Fuel Return Restriction	34 kPa (10 inHg)	34 kPa (10 inHg)
Fuel Pump Flow Rate	1602 L/hr (423 gal/hr)	1602 L/hr (423 gal/hr)
Exhaust	**1800 RPM**	**1800 RPM**
Outlet Size	DIN 350 mm, ASME B16.5 14 in	DIN 350 mm, ASME B16.5 14 in
Max. Allowable Back Pressure	7 kPa (28 inH_2O)	7 kPa (28 inH_2O)
Exhaust Flow at Rated Load	666 m^3/min (23530 cfm) at SBY	677 m^3/min (23910 cfm) at SBY
Exhaust Temperature	863 °F (462 °C)	872 °F (467 °C)
Electrical System		
Starting Voltage	24 Volts DC	
Battery Group Number	8D	
CCA (minimum)	1400 A at -18 °C to 1730 A at 0 °C (0 °F to 32 °F)	
Cold Soak @ 0 °F (-18 °C)		
Total Battery Quantity (Recommended)		
Engine Starter- Air Motor Configuration:	2 batteries	
Engine Starter- Standard 3- Starter Configuration:	6 batteries	
Engine Starter- Redundant Start Configuration:	8 batteries	
Lubricating System		
Oil Capacity with Filters	647.3 L (684 qt)	647.3 L (684 qt)

TABLE 3. C3500 D6 AND C3500 D6E SPECIFICATIONS

MODELS	C3500 D6	C3500 D6e
Engine		
Cummins Diesel Series	QSK95-G2	QSK95-G9
Generator kVA/kW Rating	See generator set nameplate for rating information.	
Engine Fuel Connection		
Inlet/Outlet Thread Size	Refer to generator set outline drawing supplied	

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MODELS	C3500 D6	C3500 D6e
Maximum Weight	36390 kg (80226 lb)	36390 kg (80226 lb)
Fuel		
Max. Fuel Inlet Restriction (Prime)	16.9 kPa (5 inHg)	16.9 kPa (5 inHg)
Max. Fuel Inlet Restriction (Standby)	30.5 kPa (9 inHg)	30.5 kPa (9 inHg)
Max. Fuel Return Restriction	34 kPa (10 inHg)	34 kPa (10 inHg)
Fuel Pump Flow Rate	1602 L/hr (423 gal/hr)	1602 L/hr (423 gal/hr)
Exhaust	**1800 RPM**	**1800 RPM**
Outlet Size	DIN 350 mm, ASME B16.5 14 in	DIN 350 mm, ASME B16.5 14 in
Max. Allowable Back Pressure	7 kPa (28 inH_2O)	7 kPa (28 inH_2O)
Exhaust Flow at Rated Load	705 m^3/min (23530 cfm) at SBY	677 m^3/min (23910 cfm) at SBY
Exhaust Temperature	910 °F (488 °C)	914 °F (490 °C)
Electrical System		
Starting Voltage	24 Volts DC	
Battery Group Number	8D	
CCA (minimum)	1425 A at -18 °C to 1730 A at 0 °C (0 °F to 32 °F)	
Cold Soak @ 0 °F (-18 °C)		
Total Battery Quantity (Recommended)		
Engine Starter- Air Motor Configuration:	2 batteries	
Engine Starter- Standard 3- Starter Configuration:	6 batteries	
Engine Starter- Redundant Start Configuration:	8 batteries	
Lubricating System		
Oil Capacity with Filters	647.3 L (684 qt)	647.3 L (684 qt)

TABLE 4. C3500 D5 AND C3500 D5E SPECIFICATIONS

MODELS	C3500 D5	C3500 D5e
Engine		
Cummins Diesel Series	QSK95-G4	QSK95-G10
Generator kVA/kW Rating	See generator set nameplate for rating information.	
Engine Fuel Connection		
Inlet/Outlet Thread Size	Refer to generator set outline drawing supplied	
Maximum Weight	36390 kg (80226 lb)	36390 kg (80226 lb)
Fuel		
Max. Fuel Inlet Restriction (Prime)	16.9 kPa (5 inHg)	16.9 kPa (5 inHg)
Max. Fuel Inlet Restriction (Standby)	30.5 kPa (9 inHg)	30.5 kPa (9 inHg)
Max. Fuel Return Restriction	34 kPa (10 inHg)	34 kPa (10 inHg)
Fuel Pump Flow Rate	1392 L/hr (368 gal/hr)	1428 L/hr (377 gal/hr)

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MODELS	C3500 D5	C3500 D5e
Exhaust	**1500 RPM**	**1500 RPM**
Outlet Size	DIN 350 mm, ASME B16.5 14 in	DIN 350 mm, ASME B16.5 14 in
Max. Allowable Back Pressure	7 kPa (28 inH_2O)	7 kPa (28 inH_2O)
Exhaust Flow at Rated Load	526 m^3/min (18580 cfm) at SBY	562 m^3/min (19860 cfm) at SBY
Exhaust Temperature	749 °F (398 °C)	771 °F (411 °C)
Electrical System		
Starting Voltage	24 Volts DC	
Battery Group Number	8D	
CCA (minimum)	1425 A at -18 °C to 1730 A at 0 °C (0 °F to 32 °F)	
Cold Soak @ 0 °F (-18 °C)		
Total Battery Quantity (Recommended)		
Engine Starter- Air Motor Configuration:	2 batteries	
Engine Starter- Standard 3- Starter Configuration:	6 batteries	
Engine Starter- Redundant Start Configuration:	8 batteries	
Lubricating System		
Oil Capacity with Filters	647.3 L (684 qt)	647.3 L (684 qt)

TABLE 5. C3750 D5 AND C3750 D5E SPECIFICATIONS

MODELS	C3750 D5	C3750 D5e
Engine		
Cummins Diesel Series	QSK95-G4	QSK95-G10
Generator kVA/kW Rating	See generator set nameplate for rating information.	
Engine Fuel Connection		
Inlet/Outlet Thread Size	Refer to generator set outline drawing supplied	
Maximum Weight	36390 kg (80226 lb)	36390 kg (80226 lb)
Fuel		
Max. Fuel Inlet Restriction (Prime)	16.9 kPa (5 inHg)	16.9 kPa (5 inHg)
Max. Fuel Inlet Restriction (Standby)	30.5 kPa (9 inHg)	30.5 kPa (9 inHg)
Max. Fuel Return Restriction	34 kPa (10 inHg)	34 kPa (10 inHg)
Fuel Pump Flow Rate	1392 L/hr (368 gal/hr)	1428 L/hr (377 gal/hr)
Exhaust		
	1500 RPM	**1500 RPM**
Outlet Size	DIN 350 mm, ASME B16.5 14 in	DIN 350 mm, ASME B16.5 14 in
Max. Allowable Back Pressure	7 kPa (28 inH_2O)	7 kPa (28 inH_2O)
Exhaust Flow at Rated Load	550 m^3/min (19420 cfm) at SBY	588 m^3/min (20780 cfm) at SBY
Exhaust Temperature	762 °F (406 °C)	795 °F (424 °C)

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MODELS	C3750 D5	C3750 D5e
Electrical System		
Starting Voltage	24 Volts DC	
Battery Group Number	8D	
CCA (minimum)	1425 A at -18 °C to 1730 A at 0 °C (0 °F to 32 °F)	
Cold Soak @ 0 °F (-18 °C)		
Total Battery Quantity (Recommended)		
Engine Starter- Air Motor Configuration:	2 batteries	
Engine Starter- Standard 3- Starter Configuration:	6 batteries	
Engine Starter- Redundant Start Configuration:	8 batteries	
Lubricating System		
Oil Capacity with Filters	647.3 L (684 qt)	647.3 L (684 qt)

3.2 Coolant Capacity

TABLE 6. COOLING SYSTEM CAPACITY WITH STANDARD RADIATOR

Radiator Part Number	Radiator Size	Generator Hz	Radiator Capacity – Liters (US Gal)
A048D623	94 ft^2	60	1208 (319)
A048D645	94 ft^2	50	1208 (319)
A048D652	84 ft^2	50	1166 (308)
A052D767	84 ft^2	60	1166 (308)
A052D765	84 ft^2	50	1166 (308)
A049E410	84 ft^2	60	1166 (308)
A065K735	94 ft^2	60	1208 (319)
A065K736	84 ft^2	60	1166 (308)
A065K741	84 ft^2	50	1166 (308)
A065K742	84 ft^2	60	1166 (308)
A065K746	84 ft^2	50	1166 (308)
A063X313	61 ft^2	60	1238 (327)
A063X314	61 ft^2	50	1238 (327)
A053J805	84 ft^2	50	1166 (308)
A054B569	84 ft^2	50	1166 (308)
A072Y755	84 ft^2	50	1166 (308)
A065H332	61 ft^2	50	1238 (327)

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Radiator Part Number	Radiator Size	Generator Hz	Radiator Capacity – Liters (US Gal)
A078R238	84 ft^2	60	1166 (308)
A078R241	84 ft^2	60	1166 (308)
A078T815	84 ft^2	60	1166 (308)
A078T816	84 ft^2	60	1166 (308)
A078T818	84 ft^2	60	1166 (308)
A078T819	84 ft^2	60	1166 (308)
A079Y009	84 ft^2	60	1208 (319)
A079Y010	84 ft^2	60	1166 (308)
A079Y011	94 ft^2	60	1166 (308)
A079Y012	84 ft^2	60	1166 (308)
A079Y013	84 ft^2	60	1166 (308)
A079Y014	84 ft^2	50	1166 (308)
A079Y015	84 ft^2	50	1166 (308)
A079Y016	61 ft^2	60	1238 (327)
A079Y017	61 ft^2	50	1238 (327)
A078L535	84 ft^2	50	1010 (267)
A078L534	84 ft^2	50	1010 (267)
A076E016	61 ft^2	50	931 (246)
A079P132	84 ft^2	50	1010 (267)
A079P131	84 ft^2	50	1010 (267)
A079P108	61 ft^2	50	931 (246)
A076E017	94 ft^2	60	1138 (301)
A078M281	84 ft^2	60	1117 (295)
A078M282	84 ft^2	60	1117 (295)
A076E020	61 ft^2	60	965 (255)
A080G170	94 ft^2	60	1138 (301)
A080G171	84 ft^2	60	1117 (295)
A080G172	84 ft^2	60	1117 (295)
A080G173	61 ft^2	60	965 (255)

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3.3 Derating Factors

The following is an example of environmental conditions that must be met to ensure proper generator set operation. Operation outside of these conditions may require derates to be applied. Derate information for each generator set can be found in the GenSize and generator set data sheet areas of https://powersuite.cummins.com.

TABLE 7. C3000 D6E - EXAMPLE DERATING FACTORS

Application	Derating Factor
Data Center Continuous	Generator set power available up to 2529 m (8297 ft) at 40 °C (104 °F), and up to 2132 m (6995 ft) at 50 °C (122 °F). Above these conditions derate by an additional 3.7% per 305 m (1000 ft) and 4% per 10 °C (18 °F).
Continuous	Generator set power available up to 1628 m (5341 ft) at 40 °C (104 °F), and up to 885 m (2094 ft) at 50 °C (122 °F). Above these conditions derate by an additional 3.4% per 305 m (1000 ft) and 6.0% per 10 °C (18 °F).
Prime	Generator set power available up to 2051 m (6729 ft) at 40 °C (104 °F), and up to 1644 m (5394 ft) at 50 °C (122 °F). Above these conditions derate by an additional 3.4% per 305 m (1000 ft) and 8.0% per 10 °C (18 °F).
Standby	Generator set power available up to 1917 m (6289 ft) at 40 °C (104 °F), and up to 1410 m 4626 ft) at 50 °C (122 °F). Above these conditions derate by an additional 3.6% per 305 m (1000 ft) and 4.0% per 10 °C (18 °F).

3.4 Engine Fuel Consumption

TABLE 8. FUEL CONSUMPTION - L/HR (GAL/HR) AT 1500 RPM (50 HZ) (SPEC A)

Model	C3500 D5	C3500 D5e	C3500 D5e	C3750 D5	C3750 D5e
Engine	**QSK95 G4**	**QSK95 G5**	**QSK95 G10**	**QSK95 G4**	**QSK95 G10**
Engine Performance Data at 50Hz (Standby/Full Load)	662 (175)	700 (185)	685 (181)	704 (186)	731 (193)
Engine Performance Data at 50Hz (Maximum)	1392.9 (368)	1445.9 (382)	1392.9 (368)	1392.9 (368)	1392.9 (368)
Refer to Data Sheets for other applications. In line with the CPG policy of continuous improvement, these figures are subject to change.					

TABLE 9. FUEL CONSUMPTION - L/HR (GAL/HR) AT 1800 RPM (60 HZ) (SPEC A)

Model	C3000 D6	C3000 D6e	C3250 D6	C3250 D6e	C3500 D6	C3500 D6e
Engine	**QSK95 G2**	**QSK95 G9**	**QSK95 G2**	**QSK95 G9**	**QSK95 G2**	**QSK95 G9**
Engine Performance Data at 60Hz (Standby/Full Load)	753 (199)	768 (203)	821 (217)	836 (221)	878 (232)	893 (236)

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Model	C3000 D6	C3000 D6e	C3250 D6	C3250 D6e	C3500 D6	C3500 D6e
Engine	**QSK95 G2**	**QSK95 G9**	**QSK95 G2**	**QSK95 G9**	**QSK95 G2**	**QSK95 G9**
Engine Performance Data at 60Hz (Maximum)	1601.1 (423)	1601.1 (423)	1601.1 (423)	1601.1 (423)	1601.1 (423)	1601.1 (423)
Refer to Data Sheets for other applications. In line with the CPG policy of continuous improvement, these figures are subject to change.						

TABLE 10. FUEL CONSUMPTION - L/HR (GAL/HR) AT 1500 RPM (50 HZ) (SPEC B)

Model	C3500 D5	C3500 D5e	C3500 D5e	C3750 D5	C3750 D5e
Engine	**QSK95 G4**	**QSK95 G5**	**QSK95 G10**	**QSK95 G4**	**QSK95 G10**
Engine Performance Data at 50Hz (Standby/Full Load)	667 (176)	722 (191)	688 (182)	722 (191)	741 (196)
Engine Performance Data at 50Hz (Maximum)	1387 (366)	1402 (370)	1413 (373)	1387 (366)	1413 (373)
Refer to Data Sheets for other applications. In line with the CPG policy of continuous improvement, these figures are subject to change.					

TABLE 11. FUEL CONSUMPTION - L/HR (GAL/HR) AT 1800 RPM (60 HZ) (SPEC B)

Model	C3000 D6	C3000 D6e	C3250 D6	C3250 D6e	C3500 D6	C3500 D6e
Engine	**QSK95 G2**	**QSK95 G9**	**QSK95 G2**	**QSK95 G9**	**QSK95 G2**	**QSK95 G9**
Engine Performance Data at 60Hz (Standby/Full Load)	768 (203)	776 (205)	826 (218)	839 (222)	899 (238)	908 (240)
Engine Performance Data at 60Hz (Maximum)	1584 (418)	1594 (421)	1584 (418)	1594 (421)	1584 (418)	1594 (421)
Refer to Data Sheets for other applications. In line with the CPG policy of continuous improvement, these figures are subject to change.						

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4 Periodic Maintenance

The periodic maintenance procedures should be performed at whichever interval occurs first. At each scheduled maintenance interval, perform all previous maintenance checks that are due for scheduled maintenance.

The tabular data that follows gives the recommended service intervals for a generator set on Standby service. If the generator set will be subjected to Prime usage or extreme operating conditions, the service intervals should be reduced accordingly.

Some of the factors that can affect the maintenance schedule are:

- Use for continuous duty (prime power)
- Extremes in ambient temperature
- Exposure to elements
- Exposure to salt water
- Exposure to windblown dust or sand
- Poor quality of fuel

Consult with an authorized distributor if the generator set will be subjected to any extreme operating conditions and determine if extra protection or a reduction in service intervals is needed. Use the running time meter to keep an accurate log of all service performed for warranty support. Perform all service at the time period indicated, or after the number of operating hours indicated, whichever comes first.

NOTICE

Only authorized and competent personnel who are familiar with the equipment and its operation should carry out maintenance.

NOTICE

Before carrying out any maintenance work, lock the generator set out of service for safe working.

NOTICE

Always disconnect a battery charger from its AC source before disconnecting the battery cables. Failure to do so can result in voltage spikes high enough to damage the DC control circuits of the generator set.

⚠ WARNING

Fall Hazard

Falls can result in severe personal injury or death. Make sure that suitable equipment for performing tasks at height are used in accordance with local guidelines and legislation.

⚠ CAUTION

Sharp Edges and Sharp Points

Projecting corners/parts may cause cuts, abrasions and other personal injury.

Use PPE. Be aware of sharp edges and corners/sharp points. Cover/protect them.

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⚠ CAUTION

Rotating parts can cause severe injury. Do not operate without guards in place.

⚠ WARNING

Moving Parts
Moving parts can cause severe personal injury.
Use extreme caution around moving parts. All guards must be properly fastened to prevent unintended contact.

⚠ WARNING

Automated Machinery
Accidental or remote starting of the generator set can cause severe personal injury or death. Make sure that the generator set cannot be started accidentally or remotely before starting work on the generator.

⚠ WARNING

Moving Parts
Moving parts can cause severe personal injury.
Use extreme caution around moving parts. All guards must be properly fastened to prevent unintended contact.

⚠ WARNING

Moving Parts
Moving parts can cause severe personal injury.
Use extreme caution around moving parts. All guards must be properly fastened to prevent unintended contact.

4.1 Periodic Maintenance Schedule

TABLE 12. AIR INTAKE MAINTENANCE

MAINTENANCE ITEMS Perform maintenance tasks as specified using Daily or Hourly periods - whichever occurs first	Daily 8 Hours	6 Months 250 Hours	6 Months 500 Hours	3 Years 500 Hours	Monthly 1000 Hours	12 Months 1000	3 Years 1500 Hours	2 Years 2000 Hours	2 Years 6000 Hours
Task	**Operator Task**	**Service Technician Task**							
Check air cleaner restriction indicator	■								

MAINTENANCE ITEMS Perform maintenance tasks as specified using Daily or Hourly periods - whichever occurs first	Daily 8 Hours	6 Months 250 Hours	6 Months 500 Hours	3 Years 500 Hours	Monthly 1000 Hours	12 Months 1000	3 Years 1500 Hours	2 Years 2000 Hours	2 Years 6000 Hours
Task	**Operator Task**	**Service Technician Task**							
Check air intake system for leaks: Visually inspect the air intake system for signs of wear or damage. Check audibly when the generator set is running. To replace, contact your authorized distributor.	■								
Check the Dust Ejector Valve (DEV) Tube.			■						
Replace Air Filter Elements - Normal Duty						■[1]			
Replace Primary Air Filter Elements - Heavy Duty						■[1]			
Replace Secondary Air Filter Elements - Heavy Duty								■	
[1] Use this replacement interval or as shown by the air restriction indicator.									

TABLE 13. CONTROL MAINTENANCE

MAINTENANCE ITEMS Perform maintenance tasks as specified using Daily or Hourly periods – whichever occurs first	Daily 8 Hours	6 Months 250 Hours	6 Months 500 Hours	1 Month 1000 Hours	12 Months 1000 Hours	3 Years 1500 Hours	12 Months 8000 Hours
Task	**Operator Task**	**Service Technician Task**					
Check operation of Control Panel: Check display (the system will perform a control panel test on initial activation). To replace, contact your authorized distributor.	■						
Check for active fault codes.	■						
Extract capture file from the control using InPower or Guidanz service tool.					■[1,2]		
Check operation of Emergency Stop Button: With the generator set running, press the Emergency Stop button. Check all systems, before resetting the fault.					■		
Check control wire harnesses and connections.					■		
Update to latest version of software.							■

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MAINTENANCE ITEMS Perform maintenance tasks as specified using Daily or Hourly periods – whichever occurs first	Daily 8 Hours	6 Months 250 Hours	6 Months 500 Hours	1 Month 1000 Hours	12 Months 1000 Hours	3 Years 1500 Hours	12 Months 8000 Hours
Task	Operator Task	Service Technician Task					

[1] Service personnel to extract a capture file every time a parameter is changed in the control.
[2] Service personnel to extract a capture file annually irrespective of changes made to control parameters.

TABLE 14. COOLING MAINTENANCE

MAINTENANCE ITEMS Perform maintenance tasks as specified using Daily or Hourly periods – whichever occurs first	Daily 8 Hours	6 Months 250 Hours	12 Months 500 Hours	6 Months 500 Hours	1 Month 1000 Hours	2 Years 6000 Hours	12 Months 8000 Hours	10000 Hours	2 Years 10000 Hours	3 Years	5 Years 30000 Hours
Task	Operator Task	Service Technician Task									
Check coolant level of radiator: If low, top up to coolant system specifications level, with Cummins recommended coolant mix.	■										
Check radiator air flow: Visually inspect the radiator through the guarding for blockage, build up of debris, signs of wear or damage. To clean or replace, contact your authorized distributor.	■										
Change coolant filter.										■[4]	
Clean radiator matrix.		■[1]									

MAINTENANCE ITEMS Perform maintenance tasks as specified using Daily or Hourly periods – whichever occurs first	Daily 8 Hours	6 Months 250 Hours	12 Months 500 Hours	6 Months 500 Hours	1 Month 1000 Hours	2 Years 6000 Hours	12 Months 8000 Hours	10000 Hours	2 Years 10000 Hours	3 Years	5 Years 30000 Hours
Task	**Operator Task**	**Service Technician Task**									
Check cooling fan blades: Visually inspect the fan blades through the guarding for signs of wear or damage. To replace, contact your authorized distributor.				■[2]							
Replace Fan Drive Bearing Grease				■[3]							
Replace Fan Drive Coupling U-Joint Grease (if equipped with u-joint style fan drive coupling)			■[3]								
Inspect Fan Drive Coupling U-Joint (if equipped with u-joint style fan drive coupling)				■[6]							
Check radiator piping and radiator hoses for leaks, wear, and cracks: Visually check for leaks, worn or damages hoses. To replace, contact your authorized distributor.					■[2]						
Check anti-freeze and DCA concentration.				■[5]							
Inspect Centraflex universal joint for wear and cracks.					■						

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MAINTENANCE ITEMS Perform maintenance tasks as specified using Daily or Hourly periods – whichever occurs first	Daily 8 Hours	6 Months 250 Hours	12 Months 500 Hours	6 Months 500 Hours	1 Month 1000 Hours	2 Years 6000 Hours	12 Months 8000 Hours	10000 Hours	2 Years 10000 Hours	3 Years	5 Years 30000 Hours
Task	**Operator Task**	**Service Technician Task**									
Check drive belt tension.					■						
Check coolant heater.					■						
Check belt driven fan hub.						■					
Check drive belt for wear and cracks.						■					
Check coolant heater electrical wiring connections for wear and exessive heat. Tighten, repair, or replace connections as necessary.							■				
Remove and clean coolant heater heating element and tank.							■				
Replace fan drive assembly belts.								■			
Replace coolant heater thermostat.										■	
Replace contactor										■	

1 – Cleaning schedule may be reduced depending on operating conditions/environment. Contact your authorized distributor.

2 – Operator Task

3 – Regreasing schedule may be increased due to operating or environmental conditions. Contact your authorized distributor.

4 – 3 Years or 500 Hours

5 – 6 Months or 4000 Hours

6 – Fan drive coupling u-joint replacement required at 2500 Hours

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TABLE 15. ENGINE MAINTENANCE

MAINTENANCE ITEMS Perform maintenance tasks as specified using Daily or Hourly periods - whichever occurs first	Daily 8 Hours	6 Months 500 Hours	3 Years 500 Hours	3 Years 1500 Hours	3000 Hours	1 Year 4000 Hours	10000 Hours	2 Years 12000 Hours	24000 Hours
Task	**Operator Task**	**Service Technician Task**							
Check air cleaner restriction.	■								
Check coolant level.	■								
Check engine oil level: If low, add recommended oil to engine specifications level.	■								
Drain water from fuel system primary filter/water separator: Drain one cup, or more, of fuel to remove water and sediment. See procedure in this chapter.	■								
Check air intake piping.	■								
Check fuel lines and hoses: Visually check for leaks, or warn or damaged hoses. To replace, contact your authorized distributor.	■								
Check crankcase breather tube/collector: Check for condensed oil. Drain and dispose of in accordance with local legislation.	■								
Replace stage 1 and stage 2 fuel filters			■						
Replace lubricating oil and filters			■[2]						
Replace fuel pump drive lubricating oil filter			■						
Replace Eliminator™ filter centrifuge				■					
Replace crankcase breather filter element					■				
Check charging alternator drive belt			■						
Check supplemental coolant additive (SCA)						■[1]			
Replace charging alternator drive belt							■		
Check batteries							■		
Replace injectors							■		
Check turbocharger								■	

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MAINTENANCE ITEMS Perform maintenance tasks as specified using Daily or Hourly periods - whichever occurs first	Daily 8 Hours	6 Months 500 Hours	3 Years 500 Hours	3 Years 1500 Hours	3000 Hours	1 Year 4000 Hours	10000 Hours	2 Years 12000 Hours	24000 Hours
Task	**Operator Task**	**Service Technician Task**							
Replace vibration dampers[3]									■

■1 – 1 year or 4000 Hours, refer to Cummins service bulletin 3666132-07.

■2 – Oil change interval may differ depending on oil grade and fuel sulfur content. Refer to Cummins Service Bulletins 3810340 and 3379001.

■3 – 24,000 Hours

TABLE 16. EXHAUST MAINTENANCE

MAINTENANCE ITEMS Perform maintenance tasks as specified using Daily or Hourly periods – whichever occurs first	Daily 8 Hours	6 Months 250 Hours	6 Months 500 Hours	3 Years 500 Hours	1 Month 1000 Hours	12 Months 1000 Hours	3 Years 1500 Hours
Task	**Operator Task**	**Service Technician Task**					
Check all exhaust components, and hardware (fittings, clamps, fasteners, etc.): Visually inspect the exhaust system for signs of wear, damage, or leaks. Check audibly when the generator set is running. To replace, contact your authorized distributor.	■						
Drain exhaust condensation trap: Drain condensation into a suitable container. Dispose of fluids in accordance with local legislation.					■		

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4.1.6 Alternator Service Schedule

TABLE 17. ALTERNATOR SERVICE SCHEDULE

System	SERVICE ACTIVITY X = required * = if necessary	Alternator running	TYPE				SERVICE LEVEL								
			Inspect	Test	Clean	Refill/Replace	Commission	Post Commission	250 hrs / 0.5 year	Level 1	1000 hrs / 1 year	Level 2	10,000 hrs / 2 years	Level 3	30,000 hrs / 5 years
Alternator	Alternator rating		X				X								
	Bedplate arrangement		X				X								
	Coupling arrangement		X				X					*		X	
	Environmental conditions and cleanliness		X				X	X		X		X		X	
	Ambient temperature (inside & outside)			X			X	X		X		X		X	
	Complete machine - damage, loose parts & earth bonds		X				X	X		X		X		X	
	Guards, screens, warning and safety labels		X				X	X		X		X		X	
	Maintenance access		X				X								
	Electrical nominal operating conditions & excitation	X		X			X	X		X		X		X	
	Vibration	X		X			X	X		X		X		X	
Windings	Condition of windings		X				X	X		X		X		X	
	Insulation resistance of all windings (PI test for MV/HV)			X			X	*		*		X		X	
	Insulation resistance of rotor, exciter and PMG			X				X		X					
	Temperature sensors	X		X			X	X		X		X		X	
	Customer settings for temperature sensors		X				X								

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System	SERVICE ACTIVITY X = required * = if necessary	Alternator running	TYPE				SERVICE LEVEL								
			Inspect	Test	Clean	Refill/Replace	Commission	Post Commission	250 hrs / 0.5 year	Level 1	1000 hrs / 1 year	Level 2	10,000 hrs / 2 years	Level 3	30,000 hrs / 5 years
Bearings	Condition of bearings		X				X							X	
	Grease exhaust & trap				X			every 3000 to 3500 hours / 6 months							
	Re-grease bearing(s) (A to H core length)	X				X		every 3000 to 3500 hours / 6 months							
	Replace re-greasable bearing(s)					X						*		X	
	Temperature sensors	X		X			X	X		X		X		X	
	Customer settings for temperature sensors		X				X								
Terminal Box	All alternator/customer connections and cabling		X				X	X		X		X		X	
Controls & Auxiliaries	Initial AVR & PFC set up	X		X			X								
	AVR & PFC settings	X		X				X		X		X		X	
	Customer connection of auxiliaries			X			X			X		X		X	
	Function of auxiliaries			X			X	X		X		X		X	
	Synchronization settings		X				X								
	Synchronization	X		X			X	X		X		X		X	
	Anti condensation heater					X						*		X	
Rectifier	Diodes and varistors		X				X	X		X		X			
	Diodes and varistors					X								X	
Cooling	Air inlet temperature	X		X			X	X		X		X		X	
	Air flow (rate & direction)	X	X				X								
	Condition of fan		X				X	X		X		X		X	
	Condition of air filter (where fitted)			X			X	X		X		X		X	
	Air filters (where fitted)				X	X				*		*		*	

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TABLE 18. GENERATOR SET MAINTENANCE

MAINTENANCE ITEMS Perform maintenance tasks as specified using Daily or Hourly periods – whichever occurs first	Daily 8 Hours	1 Month 1000 Hours	12 Months 1000 Hours	12 Months 8000 Hours	25000 Hours
Task	**Operator Task**	**Service Technician Task**			
Check fuel level in tank: If low, add fuel (A full tank reduces condensation.)	■				
Check generator set, general inspection: Visually check, walk around inspection of generator set. Make sure no inlets/outlets are covered/restricted, service access doors are operational and safety systems are in place and operational. To replace damaged parts, contact your authorized distributor.	■				
Check batteries: Check connections are secure and battery area is free from tools and other items.	■				
Check oil make-up system	■				
Check battery charger operation.		■			
Verify battery charger alarms, loss of AC power, and battery temperature sensor.		■			
Check battery electrolyte level (not applicable for sealed batteries).		■			
Check electrical connections (battery, starter motor and alternator connections).			■		
Check for torque marks on terminals (DC control box, starters, charging alternator).			■		
Check for insulation degradation near terminals. Replace or repair wire as necessary.			■		
Check the DC control box functionality.			■		
Check grounding. Clean as necessary.			■		
Do battery load test.				■	
Replace engine foot mounting slip joint washers.					■

4.2 Generator Set Long Term Storage

4.2.1 Required Materials

- Moisture indicating silica desiccant gel packs
- Heavy paper or plastic and tape
- Corrosion inhibiting plastic such as Zerust

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NOTICE

Never use diesel fuel containing bio components for internal preservation of the fuel system for engine storage. Fuel degradation may cause damage and lead to malfunction of fuel system components.

4.2.2 Procedure

⚠ WARNING

Hot Pressurized Liquid

Contact with hot liquid can cause severe burns.

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

⚠ WARNING

Moving Parts

Moving parts can cause severe personal injury.

Use extreme caution around moving parts. All guards must be properly fastened to prevent unintended contact.

⚠ WARNING

High Noise Level

Generator sets in operation emit noise, which can cause hearing damage.

Wear appropriate ear protection at all times.

⚠ WARNING

Hot Surfaces

Contact with hot surfaces can cause severe burns.

Wear appropriate PPE when working on hot equipment and avoid physical contact with hot surfaces.

NOTICE

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

NOTICE

Failure to follow these instructions may invalidate the warranty and may result in reduced reliability. Please contact your local factory representative for more details.

1. Change the engine lubricating oil.
2. Replace the engine lubricating oil filters.
3. Replace the fuel filters.

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4. Verify the fuel supply contains less than 5% bio components.
5. Follow the proper starting procedure to start the generator set.
6. Bring the generator set to rated speed with no load.
7. Operate the generator set until the coolant temperature reaches 160 °F (70 °C).
8. Follow the proper procedure to turn off the generator set.
9. Follow the necessary lock-out-tag-out procedures to ensure the generator set does not start.
10. Replace the engine lubricating oil filters.
11. Replace the fuel filters.
12. Apply a lightweight lubricant or rust preventative to machined surfaces that are not painted.
13. Apply a lightweight lubricant or rust preventative to any internal cast surfaces, such as coolant inlet and outlet connections, that are visible and not painted.
14. Remove any external drive belts to prevent localized stretching and deformation.
15. The cooling system does not need to be drained if it meets Cummins coolant specifications for anti-freeze with anti-corrosion inhibitor.

NOTICE
Check coolant quality annually during storage.

16. Cover all of the engine and component openings with clean care caps or heavy paper and tape to prevent dirt and moisture from entering the engine.
17. Cover the entire generator set with plastic.
18. Place a warning tag on the generator set stating "**Do NOT Operate**."
19. Store the generator set in a clean, dry, vibration free and climate controlled area.

NOTICE
Recommended storage temperature is between -12 ˚C (10 ˚F) and 49 ˚C (120 ˚F), with relative humidity less than 60%.

20. Place silicon gel packs in the following areas.
    - Generator control panel
    - Intake manifold
    - Exhaust manifold

4.2.3 Additional Steps

NOTICE
For two bearing alternators, decouple the alternator from the engine. For single bearing machines, do not decouple.

NOTICE
Do not rotate the engine during long term storage.

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NOTICE

If the two bearing alternator is decoupled, rotate only the alternator 6 complete revolutions every 4 weeks. For single bearing machines, do not rotate.

- Cummins Inc. **STRONGLY** suggests to leave the alternator anti-condensation heaters in operation. If power to the heaters is unavailable, then place multiple silica desiccant gel packs in the core of the alternator at both ends of the rotor and in the terminal box.
- Place multiple silica desiccant gel packs on the outside of the generator set at, or near the following areas:
  - Intake/exhaust manifolds
  - Generator set control panel
  - ECM's
  - Alternator entrance box

NOTICE

The amount of silica desiccant gel packs required and the replacement interval for the silica gel packs will vary based on manufacturer and the environment the generator is exposed to. Follow manufacturer guidelines for replacement intervals and to determine the amount needed. Moisture indicating gel packs will better determine when the replacements need to occur. Inspect the silica gel packs once a month.

- If necessary, disconnect the generator set batteries. Follow the manufacturer's storage procedures to store the batteries.
- Cover all openings with heavy paper or plastic and tape to prevent dirt and moisture from entering the engine/alternator.
- Place a warning tag on the generator set stating there are silica desiccant gel packs at the locations placed.
- Wrap the generator set in a corrosion inhibiting plastic such as Zerust.

4.2.4 Returning the Generator Set to Service

1. Remove the protective paper and plastic coverings.
2. Remove all silica desiccant gel packs.
3. Follow the table below for both sealed and re-greaseable bearings:

TABLE 19. BEARING STORAGE

Bearing Type	Not Rotated during Storage	Rotated during Storage
Sealed Bearing(s)	If stored less than 12 months, put the alternator into service. If stored more than 12 months, replace the bearing(s) then put the alternator into service.	If stored less than 24 months, put the alternator into service. If stored more than 24 months, replace the bearing(s) then put the alternator into service.

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Re-greasable Bearing(s)	If stored less than 12 months, put the alternator into service. If stored more than 12 months, replace the bearing(s) then put the alternator into service.	If stored less than 6 months, put the alternator into service. If stored between 6 and 24 months, re-grease the bearing(s) during the first run then put the alternator into service. If stored more than 24 months, replace the bearing(s) then put the alternator into service.

4. For two bearing machines, recouple the alternator to the engine if necessary.
5. For the alternator, carry out the "pre-running" checks as detailed in the specific alternator model service manual to determine the condition of the windings.
6. If necessary fill or flush/fill the cooling system:
   - If the generator set has been in storage for less than 24 months and if the cooling system was drained, fill the cooling system with new coolant.
   - If the generator set has been in storage for 24 months or more, the cooling system must be drained and flushed with a suitable solvent or a hot, lightweight mineral oil.
   - If the generator set has been in storage for less than 24 months and the cooling system has an extended life coolant with a rust inhibitor, then drain and fill the cooling system with new coolant.
7. Fill and install new oil, fuel and coolant filters.
8. Fill the oil pan sump.
9. If necessary, re-connect the generator set batteries.
10. Prime the lubricating oil system using the Pre-lubricating Oil Pump.
    a. Complete a pre-lubricating oil system cycle.
    b. Rotate the crankshaft 240 degrees.
    c. Complete a pre-lubricating oil system cycle.
    d. Rotate the crankshaft 300 degrees.
    e. Complete a pre-lubricating oil system cycle.
    f. Rotate the crankshaft 240 degrees.
    g. Complete a pre-lubricating oil system cycle.
11. Reinstall any belts that were removed.

NOTICE

The engine may run unstable until the fuel system is completely primed, or until the preservative fluid is completely flushed out of the fuel system.

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5 Troubleshooting

5.1 Troubleshooting - General

5.1.1 Control System

The generator set control system continuously monitors engine sensors for abnormal conditions, such as low oil pressure and high coolant temperature. If any of these conditions occur, the control will light a yellow Warning lamp or a red Shutdown lamp and will display a message on the graphical display panel. In the event of an engine shutdown fault (red Shutdown LED), the control will stop the engine immediately.

5.1.2 Safety Considerations

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Make sure that only personnel who are trained and qualified to work on this equipment are allowed to operate the generator set and perform maintenance on it.

⚠ WARNING

Combustible Gases

Ignition of battery gases is a fire and explosion hazard which can cause severe personal injury or death.

Do not smoke, or switch the trouble light ON or OFF near a battery. Touch a grounded metal surface first before touching batteries to discharge static electricity. Stop the generator set and disconnect the battery charger before disconnecting battery cables. Using an insulated wrench, disconnect the negative (–) cable first and reconnect it last.

⚠ WARNING

Automated Machinery

Accidental or remote starting of the generator set can cause severe personal injury or death.

Isolate all auxiliary supplies and use an insulated wrench to disconnect the starting battery cables (negative [–] first).

Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform service procedures. Review the safety precautions in the Important Safety Instructions section.

High voltages are present when the generator set is running. Do not open the generator set output box while the generator set is running.

NOTICE

Disconnect the battery charger from the AC source before disconnecting the battery cables. Otherwise, disconnecting cables can result in voltage spikes damaging to DC control circuits of the generator set.

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When troubleshooting a generator set that is shut down, make certain the generator set cannot be accidentally restarted as follows:

1. Make sure the generator set is in the Off mode.
2. Turn off or remove AC power from the battery charger.
3. Turn the battery isolator to the Off position.
4. Using an insulated wrench, remove the negative (**–**) battery cable from the generator set starting battery.

5.1.3 InPower Service Tool

The InPower™ service tool can be used in troubleshooting to perform tests, verify control inputs and outputs, and test protective functions. Refer to the InPower User's Guide, provided with the InPower software for test procedures.

InPower, when used improperly, can cause symptoms like warnings and shutdowns that appear to be a defective base board. When these problems occur, always verify that a self-test or fault simulation (override) have not been left enabled with InPower. If you do not have InPower, or the enabled fault simulation(s) cannot be found using InPower, disconnect battery power to disable the test or override condition.

Make sure that parameter adjustments and time delays, related to the fault condition, have been appropriately set for the application. It may be necessary to write the initial capture file to the device or update the calibration file.

Updating a calibration file requires the InPower Pro version. Confirm that the installed calibration part number matches the serial plate information.

NOTICE
Using the wrong calibration file can result in equipment damage. Do not swap base boards from another generator set model.

Some features are not available until the hardware for that feature is installed and InPower Pro is used to update (enable) that feature. Confirm that the feature is installed and enabled prior to troubleshooting the base board for symptoms related to a feature.

5.1.4 Network Applications and Customer Inputs

In applications with networks and remote customer inputs, the generator set may start unexpectedly or fail to crank as a result of these inputs. These symptoms may appear to be caused by the base board or control module. Verify that the remote input is not causing the symptom or isolate the control from these inputs before troubleshooting the control.

5.1.5 Test Equipment

To perform the test procedures in this manual, the following test equipment must be available:

- True RMS digital multi-meter for accurate measurement of resistance, AC voltage (0-1000 VAC), and DC voltage.
- Current probe(s).
- Battery hydrometer.
- Jumper leads.
- Tachometer.

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- Megger or insulation resistance meter.
- InPower service tool (PC-based service tool)
- InSite Tool
- Newest InPower InCal files (calibration for control) from the InCal web site (**power.cummins.com** under “Services", “Software Updates", “InCal Quick Links").
- PC-based service tool connector (Cummins Part number 0541-1199).
- Inline 6 / Inline 7 adapter or newer (Cummins Part numbers 2892092/5299899).
- Inline 6 / Inline 7 drivers (available via kit or online at **cummins.com/parts-and-service/electronic-service-tools/inline**).
- Basic electrical test lead set, with very small probe tips. Fluke test leads “TL80A" (part number 0541-1627) are recommended.
- 316289800 - Pressure/Temperature sensor breakout cable
- 382477400 - Pressure sensor breakout cable
- 382477600 - Pressure sensor breakout cable
- 316475200 - DanfossTM pressure sensor breakout cable TM pressure sensor breakout cable
- 382275800 - Male Deutsch/AMP/Metri-Pack test lead
- 382291700 - Female Deutsch/AMP/Metri-Pack test lead
- 382481200 - Deutsch socket pin test lead
- 382481100 - Deutsch pin test lead

5.1.6 Voltage/Continuity Testing

For voltage and continuity tests described in the troubleshooting section, it may be necessary to remove a plug to complete the test.

The following corrective actions will mention when it is necessary to remove a plug for testing. In other cases, the plug must not be removed for testing. When plug removal is not mentioned, testing must be performed by inserting a narrow meter probe into the back of the plug.

5.1.7 CT Ratio Calculator

InPower has a built-in CT ratio calculator which allow you to determine the required CT size and CT ratio.

The following generator set information is required to calculate the CT ratio:

- Generator set power ratings
- Frequency range
- Nominal frequency
- Nominal voltage Limits
- Secondary CT ratio value

Follow these steps to use the CT ratio calculator in InPower.

1. Connect to the PCC and highlight any of the folders under the PCC connection (such as Advanced Status). Right click on the folder, and click on Genset OEM Setup...

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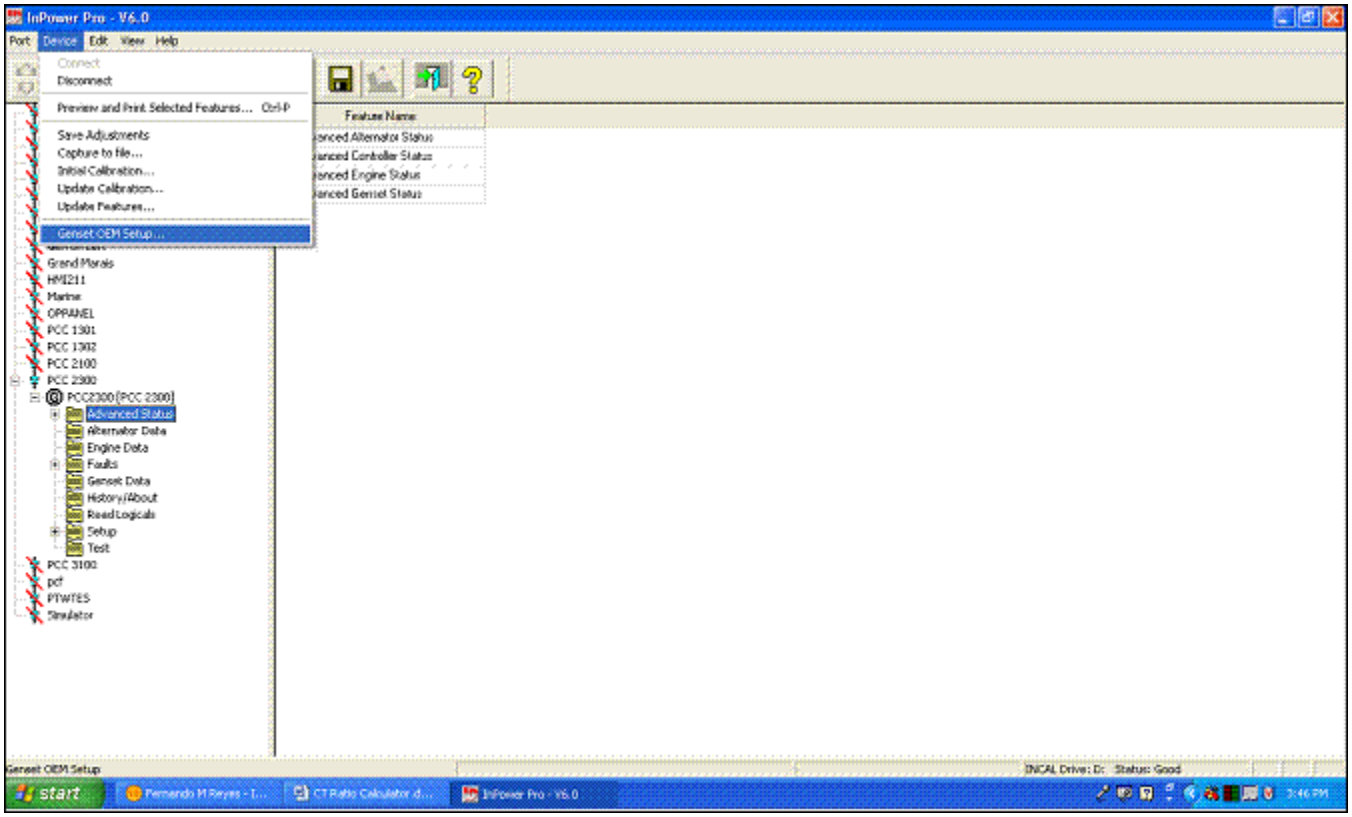


FIGURE 1. INPOWER - GENSET OEM SETUP SELECTION

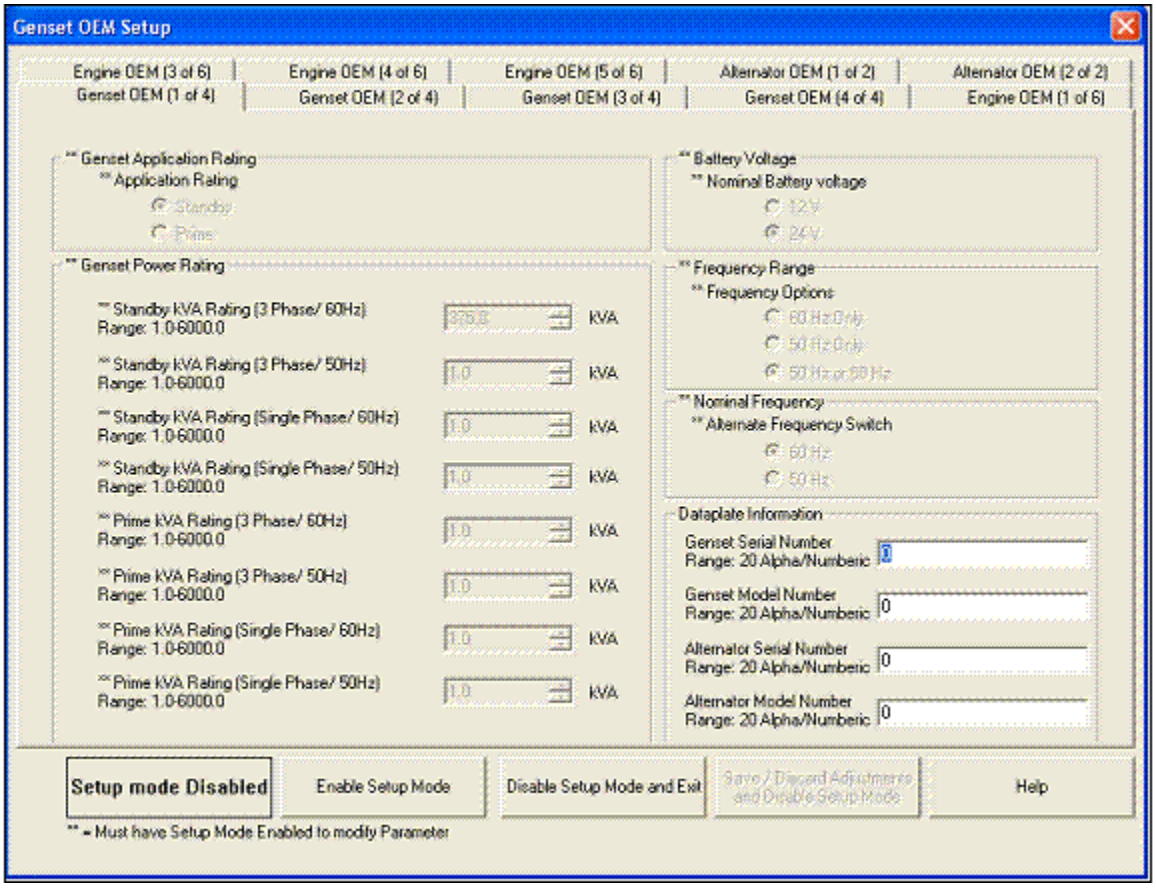


FIGURE 2. GENSET OEM SETUP WINDOW

2. Click on Enable Setup Mode in order to enable the menu.
3. Enter the generator set information under Genset Power Ratings, Frequency Range, and Nominal Frequency.
4. Click on Save/Discard Adjustments and Disable Setup Mode in order to save the generator set settings. This step is required.

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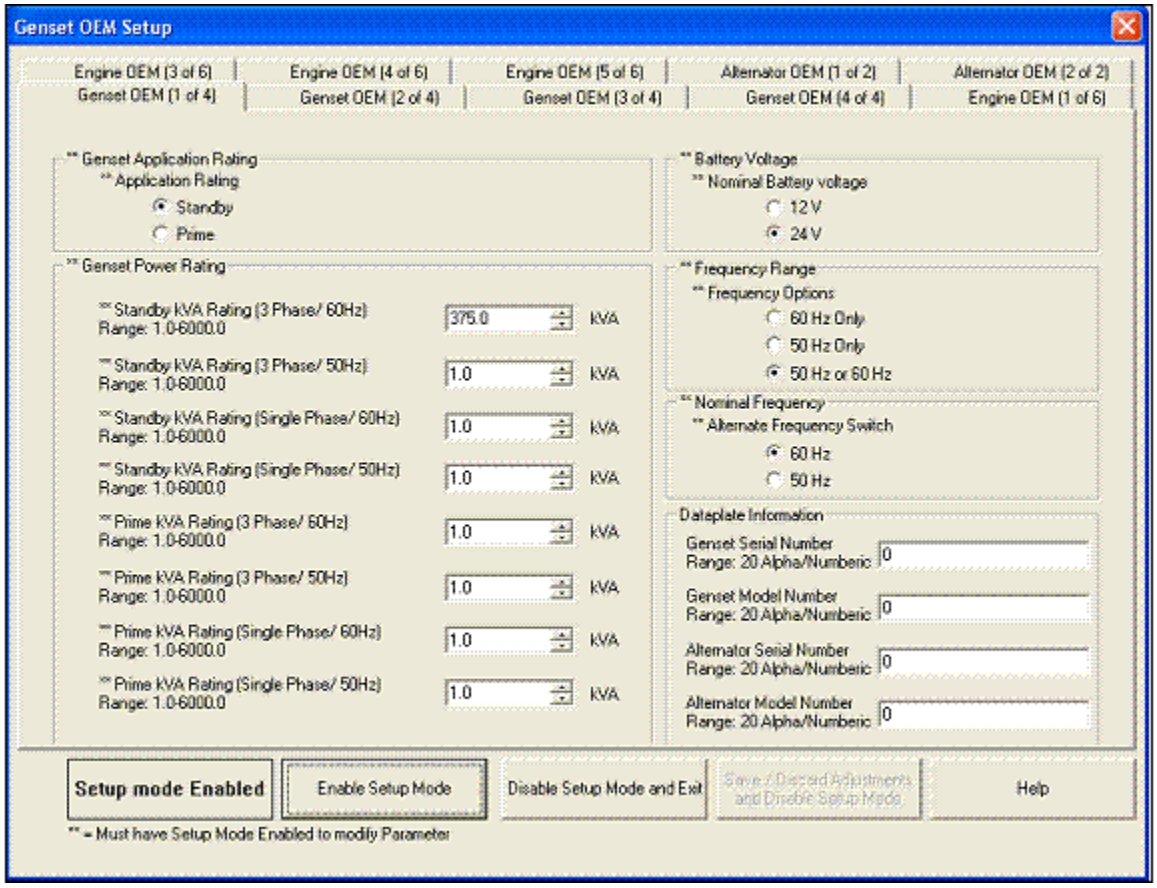


FIGURE 3. GENSET OEM SETUP WINDOW - ENABLE SETUP MODE

5. Open the Genset OEM Setup again.
6. Click on the Alternator OEM (1 of 2) tab to display the settings below.

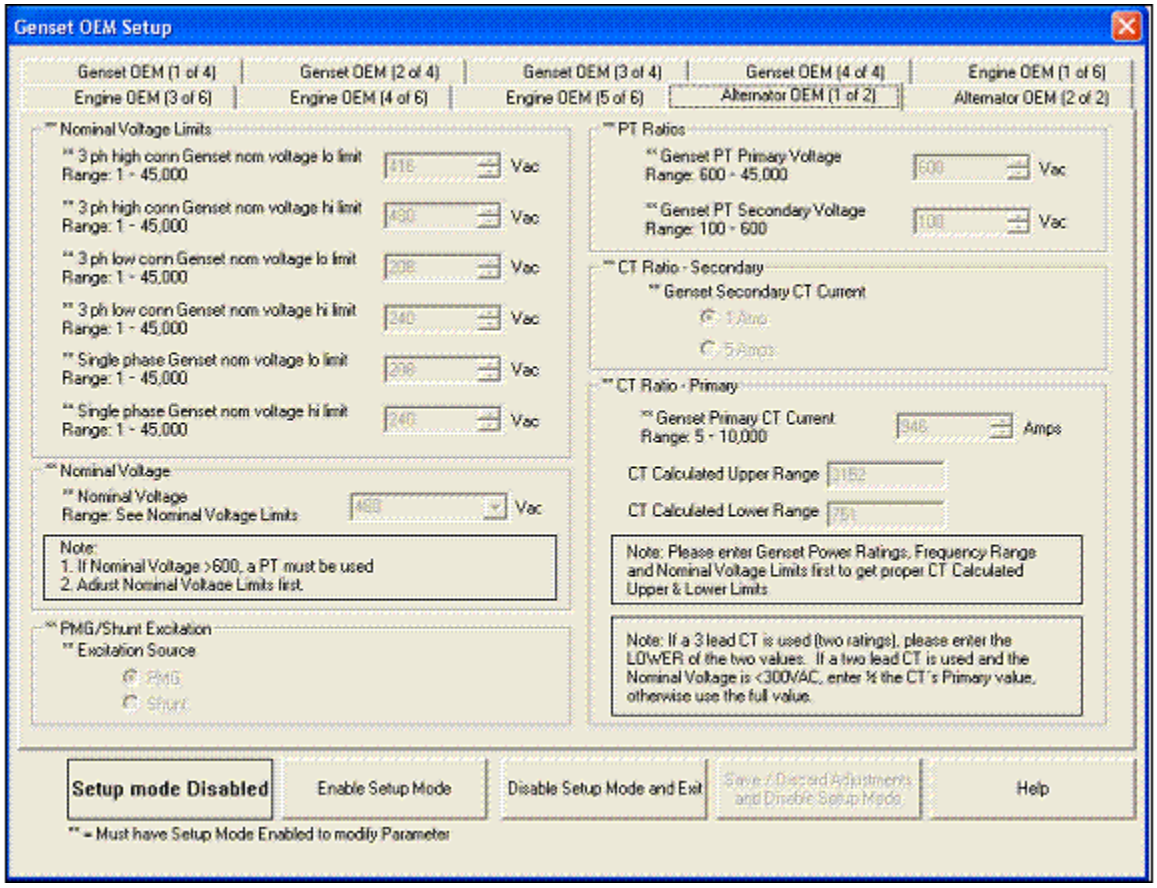


FIGURE 4. GENSET OEM SETUP WINDOW - OEM (1 OF 2)

7. Click on Enable Setup Mode in order to enable the menu.
8. Enter the generator set information under Nominal Voltage Limits and CT Ratio –Secondary. After all the information is entered, InPower will calculate the required Genset Primary CT Ratio limits. The primary CT Ratio needs to be between the CT Calculated Upper Range and the CT Calculated Lower Range.

   The CTs and the CT ratio setting in the PCC require a primary CT ratio between the CT Calculated Upper Range and the CT Calculated Lower Range.

   The alternator CT ratio is required to have a secondary CT Ratio equal to the setting under the CT Ratio – Secondary.

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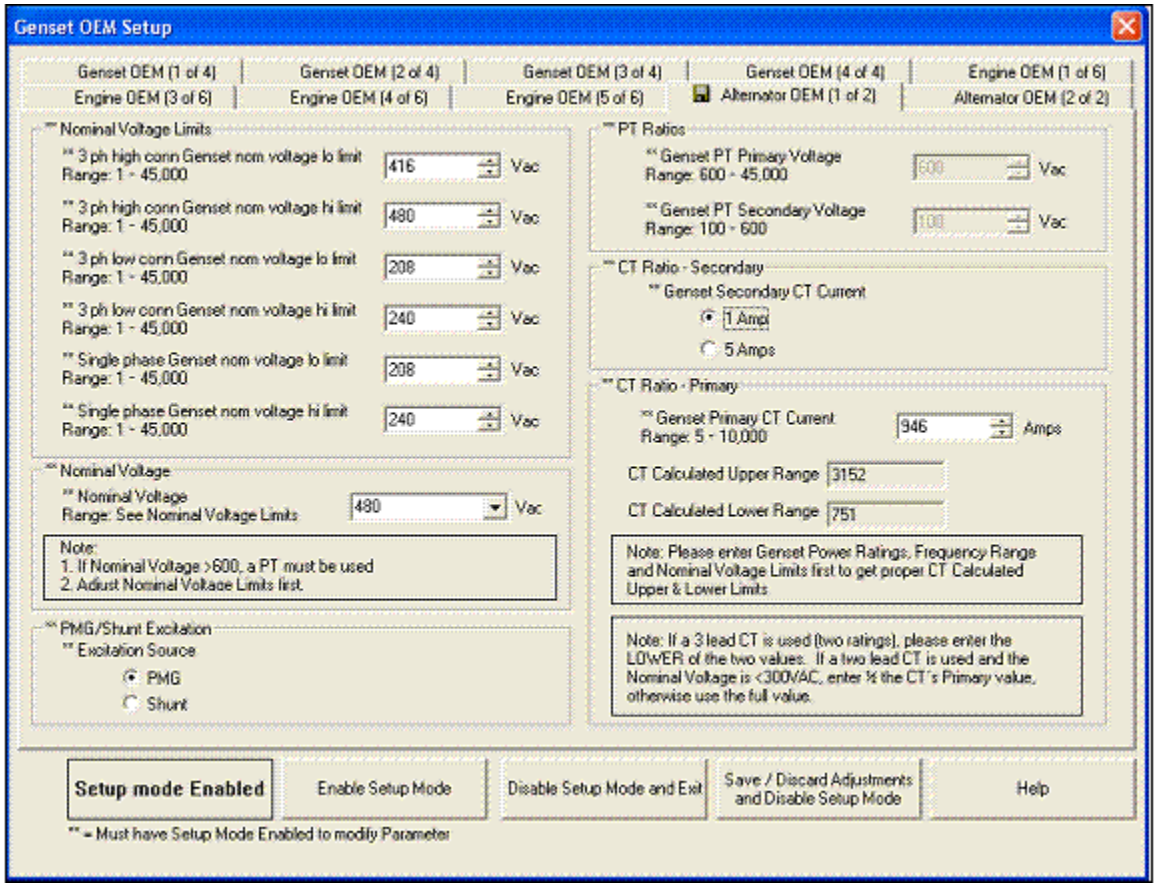


FIGURE 5. OEM (1 OF 2) NOMINAL VOLTAGES

9. To exit the setup mode and save changes, click on Save / Discard Adjustments and Disable Setup Mode.

   To exit the setup mode without saving changes, click on Disable Setup Mode and Exit. Then, click on Discard when the Save Adjustments Screen pops up.

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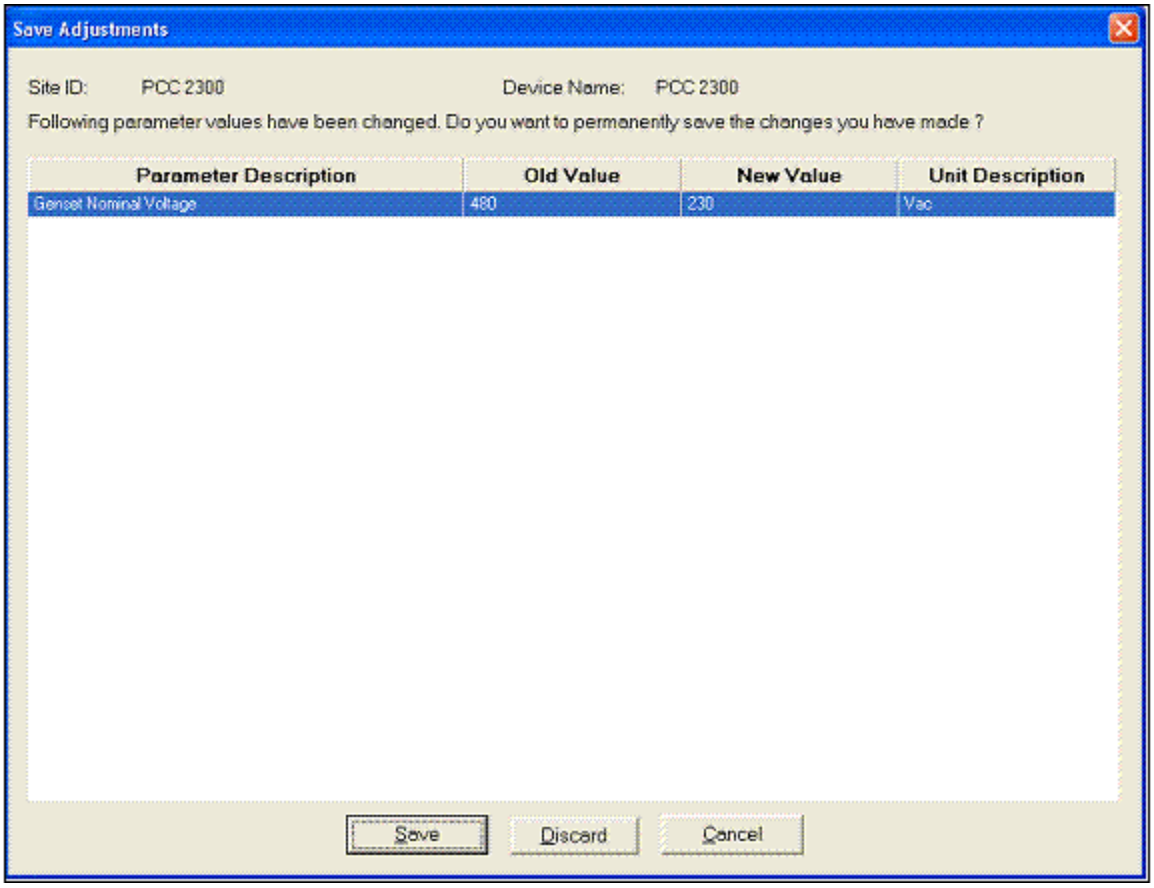


FIGURE 6. SAVE ADJUSTMENTS WINDOW

5.1.8 Reading Fault Codes

When a fault occurs, the graphical display on the HMI will display the fault code/message.

After the fault is acknowledged and corrected, the recorded fault will be deleted from the control panel memory, but will remain in a data log to maintain a fault code history. The InPower service tool is required to view this data log.

5.1.9 Troubleshooting Procedures

The following list of troubleshooting procedures are a guide to help you evaluate problems with the generator set. You can save time if you read through the manual ahead of time and understand the system.

NOTICE

Always set the generator set to off mode before disconnecting or connecting harness connectors. Otherwise, disconnecting the harness connectors can result in voltage spikes high enough to damage the DC control circuits of the set.

NOTICE

Electrostatic discharge will damage circuit boards. Always wear a wrist strap when handling circuit boards or when disconnecting or connecting harness connectors. See the *Circuit Board Removal/Replacement* procedure in the controller Service Manual.

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NOTICE

The troubleshooting procedures for ECM-related faults and engine-related faults are in the engine service manual.

NOTICE

Each fault code “warning" can be changed to a “shutdown" using InPower. Default settings are used in this manual. It is recommended that all changes to settings be recorded at each site to aid in the troubleshooting of the generator set.

If you are troubleshooting a fault that does not appear in the graphical display, look at the SA field in the Faults screens to identify the source of the fault. If this field is blank, the PCC is the source of this fault.

Try to think through the problem. Go over what was done during the last service call. The problem could be as simple as a loose wire, an opened fuse, or a tripped circuit breaker.

This section contains the following information:

- How to troubleshoot a local/remote failure to crank problem when the control panel does not indicate any fault condition.
- How to troubleshoot engine problems that are not within the detectable range of the PC control.
- How to troubleshoot a Check Engine lamp fault for generator sets that contain the low emissions option.
- Descriptions of each status, warning, and shutdown code; warning and shutdown limits where applicable; and basic corrective actions, such as checking fluid levels, control reset functions, battery connections, etc.
- Detailed troubleshooting procedures. In the following list of troubleshooting procedures, the fault codes are arranged in numeric order.

5.1.10 Fault Reset Signal

This signal may come from any of these sources:

- PCC Fault Reset connection (typically, the Reset button on the Operator Panel)
- Reset button on the Operator Panel
- Modbus networks
- PC-based service tool, such as InPower

This signal becomes active for one second when any of these sources changes from inactive to active. Then, the signal remains inactive until any of these sources changes from inactive to active again.

5.1.11 Delayed Shutdown

The PCC provides advance warning of an impending shutdown if all of these conditions are met:

- *Delayed Shutdown Enable* is set to Enable.
- The ECM is set to enable Battle Short mode (Core 2 ECMs only).
- A non-critical shutdown fault occurs, and there are no critical shutdown faults.

When these conditions are met, the PCC generates warning fault 1124 (Delayed Shutdown) and waits *Delayed Shutdown Time Delay* before it initiates the stop sequence.

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5.2 Troubleshooting Fault Codes

5.2.1 Types of Events/Faults

The PCC generates these types of events/faults.

5.2.2 Event/Fault List Definition

Faults and events that appear in the table that do not have a troubleshooting procedure in this manual are engine driven faults/events. To troubleshoot these faults, consult the engine Service manual, engine Troubleshooting and Repair manual, and/or QuickServe OnLine.

5.2.3 Events

The PCC generates events to notify external devices when certain conditions are met. The PCC may send notifications any of these ways:

- Configurable outputs.
- PCCNet devices (For example, events might control a LED or a configurable output on a PCCNet device.)

It is up to the external devices to respond to an event when they are notified about one. Events do not appear in any screen in the Operator Panel.

5.2.4 Warning Faults

The PCC generates warning faults to warn the operator when unsafe conditions are occurring.

When the PCC generates a warning fault, the warning fault becomes active. However, active warning faults have no effect on generator set operation. The generator set can start, continue running, and stop as usual.

Active warning faults appear in the Warning Faults screen. In addition, the PCC provides these indications as long as there is an active warning fault:

- The Warning LED on the Operator Panel is on.
- Event 1540 (Common Warning) is active.
- Event 1483 (Common Alarm) is active.

Follow these steps to clear a warning fault.

1. Correct the condition(s) that caused the fault.
2. Activate the fault reset signal.

Faults that have been cleared appear in the Fault History screen.

5.2.5 Derate Events

Derate events are warning faults in which the PCC also requests a reduction in the kW output level of the generator set.

If a derate event is active, *Derate Request* (This Parameter is not available in the Operator Panel, refer to parameters table) is the percentage of the current kW output level the PCC would like to have removed. Each derate event has this percentage associated with it. If two or more derate events are active at the same time, the PCC considers only the maximum percentage requested by each derate event. The PCC does not add the percentages together. For example, if one derate event requests a 10% reduction and a second derate event requests a 20% reduction, *Derate Request (This Parameter is not available in the Operator Panel, refer to parameters table)* is 20%, not 30%.

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The PCC is running in Load Govern paralleling state, the PCC requests that *Genset % Standby Total kW* be no more than 100% - *Derate Request (This Parameter is not available in the Operator Panel, refer to parameters table)*. This becomes a limitation for *Load Govern kW Target*.

If the PCC is not running in Load Govern paralleling state, the PCC generates warning fault 1464 (Load Dump Fault). If *Load Dump*/*Configurable Output #11 Output Function Pointer* is set to Default, the Load Dump connection is active. The PCC does not do anything else to reduce the kW output level. It is up to external devices to reduce the load.

If *LBNG Genset Enable* is set to Enable, the PCC recognizes derate requests from the engine control module (ECM) only if all of these conditions are met.

- *LBNG Derate Enable* is set to Enable.
- The AUX101's Derate Authorization connection is active.

5.2.6 Shutdown Faults

The PCC generates shutdown faults to prevent damage to the generator set. The PCC shuts down the generator set immediately.

When the PCC generates a shutdown fault, the shutdown fault becomes active. The PCC initiates a Shutdown Without Cooldown sequence.

Active shutdown faults appear in the Shutdown Faults screen. In addition, the PCC provides these indications as long as there is an active shutdown fault:

- The Shutdown LED on the Operator Panel is on.
- Event 1541 (Common Shutdown) is active.
- Event 1483 (Common Alarm) is active.

You cannot start the generator set until you clear the shutdown fault. Follow these steps to clear a shutdown fault.

1. Correct the condition(s) that caused the fault.
2. Make sure the emergency stop buttons are inactive, and change the PCC to Off mode.

NOTICE
If Remote Fault Reset Enabled is set to Enable, you can also clear shutdown faults in Auto mode. In this case, change the PCC to Auto mode , and make sure the exercise signal and the remote start signal are inactive. The PCC generates event 2941 (Remote Shutdown Fault Reset Occurrence) when shutdown faults are reset in Auto mode.

3. Activate the fault reset signal.

Faults that have been cleared appear in the Fault History screen.

5.2.6.1 Shutdown with Cooldown Faults

Shutdown with cooldown faults are shutdown faults in which the PCC has time to cool down the generator set.

When the PCC generates a shutdown with cooldown fault, the shutdown with cooldown fault becomes active. If the PCC is running in Load Govern paralleling state, it initiates a Manual Stop sequence and starts running the load govern kW ramp unload process. If the PCC is not running in Load Govern paralleling state, it initiates a Controlled Shutdown sequence. When the stop sequence has finished, the PCC generates shutdown fault 1336 (Cooldown Complete).

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If a shutdown with cooldown fault is active and the engine speed is greater than zero, warning fault 1132 (Controlled Shutdown) is active. You can assign this event/fault to a configurable output, so that the PCC notifies an external device that is going to shut down the generator set.

In other ways, shutdown with cooldown faults are the same as shutdown faults.

5.2.6.2 Critical Shutdown Faults vs. Non-critical Shutdown Faults

The PCC always shuts down the generator set when a critical shutdown fault is generated. Non-critical shutdown faults do not prevent the PCC from starting or running the generator set when Battle Short mode is active. The PCC also responds to critical shutdown faults and non-critical shutdown faults differently if Delayed Shutdown is set up.

NOTICE
This discussion applies to shutdown with cooldown faults as well as shutdown faults.

The table below identifies the critical shutdown faults.

TABLE 20. CRITICAL SHUTDOWN FAULTS

Event/Fault Code	Description
115	Eng Crank Sensor Error
234	Crankshaft Speed High
236	Both Engine Speed Signals Lost
359	Fail To Start
781	CAN Data Link Failure
1245	Engine Shutdown Fault
1247	Unannounced Engine Shutdown
1336	Cooldown Complete
1433	Local Emergency Stop
1434	Remote Emergency Stop
1438	Fail To Crank
1992	Crankshaft Sensor High
2335	AC Voltage Sensing Lost (Excitation Fault)
2914	Genset AC Meter Failed

All other shutdown faults are non-critical shutdown faults. The PCC still provides the usual indications that a shutdown fault has occurred, even if it overrides a non-critical shutdown fault.

5.2.7 Fault Codes - PowerCommand 3.3

TABLE 21. FAULT CODES

Code	Lamp	Displayed Message
111	Shutdown	Internal ECM Failure

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Code	Lamp	Displayed Message
115	Shutdown	Eng Crank Sensor Error
121	Warning	Engine Magnetic Crankshaft Speed or Position Lost One of Two Signals
122	Warning	Manifold 1 Press High
123	Warning	Manifold 1 Press Low
124	Warning	Manifold 1 Press High
135	Warning	High Oil Rifle 1 Pressure
137	Warning	Oil Inlet Pressure Low Error
141	Warning	Low Oil Rifle 1 Pressure
142	Warning	Oil Overpressure
143	Warning	Low Oil Rifle Pressure
144	Warning	High Coolant 1 Temp
145	Warning	Low Coolant 1 Temp
146	Derate	Pre-High Engine Coolant Temperature
151	Shutdown	High Coolant Temp
153	Warning	High Intake Manf 1 Temp
154	Warning	Low Intake Manf 1 Temp
155	Shutdown	High Intake Manf 1 Temp
156	Warning	Intake Manifold Temp 2 OOR High
157	Warning	Intake Manifold Temp 2 OOR Low
158	Shutdown	Intake Manifold Temp 2 High
159	Warning	Intake Manifold Temp 3 OOR High
161	Warning	Intake Manifold Temp 3 OOR Low
162	Shutdown	Intake Manifold Temp 3 High
163	Warning	Intake Manifold Temp 4 OOR High
164	Warning	Intake Manifold Temp 4 OOR Low
165	Shutdown	Intake Manifold Temp 4 High
175	Shutdown	Throttle Control OOR High
176	Shutdown	Throttle Control OOR Low
177	Shutdown	Throttle Control Out of Adjustment
187	Warning	Sensor Supply 2 Low
189	Shutdown	HT Coolant Temperature Cause Unknown
195	Warning	High Coolant 1 Level
196	Warning	Low Coolant 1 Level
197	Warning	Low Coolant Level

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Code	Lamp	Displayed Message
212	Warning	High Oil 1 Temperature
213	Warning	Low Oil 1 Temperature
214	Shutdown	High Oil 1 Temp
219	Warning	Eng Oil Level Remote Reservoir: Least Severe Level
221	Warning	Air Pressure Sensor High
222	Warning	Air Pressure Sensor Low
223	Warning	Oil Burn Valve Sol Low
224	Warning	Oil Burn Valve Sol High
227	Warning	Sensor Supply 2 Low
228	Shutdown	Low Coolant Pressure
229	Warning	HT Coolant Pressure Incorrect
231	Warning	High Coolant Pressure
232	Warning	Low Coolant Pressure
233	Warning	HT Coolant Pressure Moderate Low
234	Shutdown	Crankshaft Speed High
235	Shutdown	Low Coolant Level
236	Shutdown	Both Engine Speed Signals Lost
238	Warning	Sensor Supply 3 Low
239	Warning	Main Supply High
244	Warning	Red Stop Lamp Driver OOR Low
245	Warning	Fan Control Low
246	Warning	Exhaust Gas Temp Sensor 1 OOR High
247	Warning	Exhaust Gas Temp Sensor 1 OOR Low
248	Shutdown	Exhaust Gas Temp Sensor 1 High
253	Shutdown	Oil Level Low
254	Shutdown	FSO PWM High Control Error
255	Warning	FSO PWM Low Control Error
259	Warning	Engine Fuel Shutoff Valve Stuck Open
261	Warning	High Fuel Temperature
263	Warning	High Fuel 1 Temperature
265	Warning	Low Fuel 1 Temperature
266	Shutdown	High Fuel Temperature
271	Warning	Low Fuel Pump Press
272	Warning	High Fuel Pump Press

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Code	Lamp	Displayed Message
277	Warning	Fuel Control Valve Out of Adjustment
281	Warning	Cylinder Press Imbalance
284	Warning	Eng Speed/Position Sensor: Voltage Below Normal
285	Warning	CAN Mux PGN Rate Error
286	Warning	CAN Mux Calibration Error
287	Warning	CAN Mux Accel Data Error
295	Warning	Key On Air Pressure Error
311	Warning	ACT1 FF Shorted HS TO LS Error
312	Warning	ACT5 Shorted HS TO LS Error
313	Warning	ACT3 RF Shorted HS TO LS Error
314	Warning	ACT6 Shorted HS TO LS Error
315	Warning	ACT2 FT Shorted HS TO LS_Error
319	Warning	RTC PWR Intr: Data Erratic Intermittent or Wrong
321	Warning	ACT4 RT Shorted HS TO LS Error
322	Warning	Inj 1 Solenoid Low Curr
323	Warning	Inj 5 Solenoid Low Curr
324	Warning	Inj 3 Solenoid Low Curr
325	Warning	Inj 6 Solenoid Low Curr
331	Warning	Inj 2 Solenoid Low Curr
332	Warning	Inj 4 Solenoid Low Curr
334	Warning	HT Coolant Temperature Incorrect
341	Warning	Engine Control Module Data Lost
342	Shutdown	Calibration Code Fail
343	Warning	ECM Hardware Failure
346	Warning	Powerdown Data Lost
351	Warning	Injector Supply Failure
352	Warning	Sensor Supply 1 Low
354	Warning	Manifold Absolute Pressure 1 High
355	Warning	Manifold Absolute Pressure 1 Low
359	Shutdown	Fail to Start
378	Warning	Elect Fuel Inj Cntrl Valve Ckt: Curr Below Normal
379	Warning	Elect Fuel Inj Cntrl Valve Ckt: Curr Above Normal
386	Warning	Sensor Supply 1 High
394	Warning	Eng Timing Actuator Driver: Curr Below Normal

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Code	Lamp	Displayed Message
395	Warning	Eng Timing Actuator Driver: Curr Above Normal
396	Warning	Fuel Cntl Valve Solenoid Driver 2 Sensor Ckt: OC
397	Warning	Fuel Cntl Valve Solenoid Driver 2 -
398	Warning	Eng Timing Actuator Driver 2 Circuit: OC
399	Warning	Eng Timing Actuator Driver 2: Grounded Ckt
412	Event	J1708 Link Cannot Transmit
414	Event	J1708 Link Not Fast Enough
415	Shutdown	Low Oil Rifle Press
418	Warning	High H2O in Fuel
419	Warning	Intake Manifold Pres Bank Imbalance: Data Erratic
421	Warning	High Oil Temperature
422	Warning	Coolant Level Data Error
425	Warning	Oil Temperature Error
426	Event	SAE J1939 Datalink - Data Erratic, Intermittent, or Incorrect
427	Warning	CAN Data Link Degraded
428	Warning	Water In Fuel Indicator Sensor: Volt Above Normal
429	Warning	Water In Fuel Indicator Sensor: Volt Below Normal
433	Warning	Intake Manifold Press Sensor Ckt: Data Erratic
435	Warning	Oil Pressure Switch Error
441	Warning	Low Battery 1 Voltage
442	Warning	High Battery 1 Voltage
449	Shutdown	Inj Metering 1 Press High
451	Warning	Inj Metering 1 Press High
452	Warning	Inj Metering 1 Press Low
453	Warning	Gas Mass Flow High
454	Warning	Gas Mass Flow Low
458	Shutdown	Spark Timing B Error
459	Shutdown	Spark Timing A Error
461	Shutdown	Spark Reference B Error
462	Shutdown	Spark Reference A Error
471	Warning	Sump Oil Level Warning
477	Warning	Isolated Battery Voltage Low
478	Warning	Isolated Battery Voltage High
479	Warning	Exhaust Gas Temperature Data Incorrect

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Code	Lamp	Displayed Message
482	Warning	Fuel Press Low: Valid But Below Normal: Mod Severe
483	Warning	IMR 2 Pressure Sensor Circuit Shorted to High
484	Warning	IMR 2 Pressure Sensor Circuit Shorted to Low
488	Derate	High Intake Manf 1 Temp
496	Warning	Eng Speed Sensor 2 Supply Volt: Root Cause Unknown
512	Warning	Throttle Position 1 Feedback OOR High
513	Warning	Throttle Position 1 Feedback OOR Low
515	Warning	Sensor Supply 6 Circuit OORH
516	Warning	Sensor Supply 6 Circuit OORL
521	Warning	Geartrain Oil Temp OOR Hi
522	Warning	Geartrain Oil Temp OOR Lo
546	Warning	Fuel Delivery Press High
547	Warning	Fuel Delivery Press Low
553	Warning	APC Pressure High
554	Warning	APC Pressure Error
555	Warning	Crankcase Pressure High: Above Normal
556	Shutdown	Crankcase Pressure High
557	Shutdown	Fuel Control Valve 2 OOR High
558	Warning	Fuel Control Valve 2 OOR Low
559	Warning	Inj Metering 1 Press Low
561	Shutdown	Heavy Knock Error 1 (A1)
562	Shutdown	Heavy Knock Error 2 (B1)
563	Shutdown	Heavy Knock Error 3 (A2)
564	Shutdown	Heavy Knock Error 4 (B2)
565	Shutdown	Heavy Knock Error 5 (A3)
566	Shutdown	Heavy Knock Error 6 (B3)
567	Shutdown	Heavy Knock Error 7 (A4)
568	Shutdown	Heavy Knock Error 8 (B4)
569	Shutdown	Heavy Knock Error 9 (A5)
571	Warning	Knock Cylinder 1 (A1) OOR Low
572	Warning	Knock Cylinder 2 (B1) OOR Low
573	Warning	Knock Cylinder 3 (A2) OOR Low
574	Warning	Knock Cylinder 4 (B2) OOR Low
575	Warning	Knock Cylinder 5 (A3) OOR Low

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Code	Lamp	Displayed Message
576	Warning	Knock Cylinder 6 (B3) OOR Low
577	Warning	Knock Cylinder 7 (A4) OOR Low
578	Warning	Knock Cylinder 8 (B4) OOR Low
579	Warning	Knock Cylinder 9 (A5) OOR Low
581	Warning	Fuel Pump Intake Pressure Sensor OOR Hi
582	Warning	Fuel Pump Intake Pressure Sensor OOR Lo
583	Warning	Low Fuel Pump Intake Pressure
584	Warning	High Side DRV3 High Control Error
585	Warning	High Side DRV3 Low Control Error
591	Warning	Exhaust Backpressure High
592	Warning	Exhaust Backpressure Low
595	Warning	Turbo 1 Overspeed Warning Erro
611	Warning	Engine Hot Shut Down
618	Warning	Turbo 1 Inlet Pressure High
619	Warning	Turbo 2 Inlet Pressure High
621	None	Exh Gas Temp Cyl 1 Deviation Low: Below Normal
622	None	Exh Gas Temp Cyl 3 Deviation Low: Below Normal
623	None	Exh Gas Temp Cyl 5 Deviation Low: Below Normal
624	None	Exh Gas Temp Cyl 7 Deviation Low: Below Normal
625	None	Exh Gas Temp Cyl 9 Deviation Low: Below Normal
626	None	Exh Gas Temp Cyl 11 Deviation Low: Below Normal
627	None	Exh Gas Temp Cyl 13 Deviation Low: Below Normal
628	None	Exh Gas Temp Cyl 15 Deviation Low: Below Normal
631	None	Exh Gas Temp Cyl 2 Deviation Low: Below Normal
632	None	Exh Gas Temp Cyl 4 Deviation Low: Below Normal
633	None	Exh Gas Temp Cyl 6 Deviation Low: Below Normal
634	None	Exh Gas Temp Cyl 8 Deviation Low: Below Normal
635	None	Exh Gas Temp Cyl 10 Deviation Low: Below Normal
636	None	Exh Gas Temp Cyl 12 Deviation Low: Below Normal
637	None	Exh Gas Temp Cyl 14 Deviation Low: Below Normal
638	None	Exh Gas Temp Cyl 16 Deviation Low: Below Normal
641	Shutdown	Exhaust Temperature 1 (A1) High
642	Shutdown	Exhaust Temperature 3 (A2) High
643	Shutdown	Exhaust Temperature 5 (A3) High

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Code	Lamp	Displayed Message
644	Shutdown	Exhaust Temperature 7 (A4) High
645	Shutdown	Exhaust Temperature 9 (A5) High
646	Shutdown	Exhaust Temperature 11 (A6) High
647	Shutdown	Exhaust Temperature 13 (A7) High
648	Shutdown	Exhaust Temperature 15 (A8) High
649	None	Engine Oil Change Needed
651	Shutdown	Exhaust Temperature 17 (A9) High
652	Shutdown	Exhaust Temperature 2 (B1) High
653	Shutdown	Exhaust Temperature 4 (B2) High
654	Shutdown	Exhaust Temperature 6 (B3) High
655	Shutdown	Exhaust Temperature 8 (B4) High
656	Shutdown	Exhaust Temperature 10 (B5) High
657	Shutdown	Exhaust Temperature 12 (B6) High
658	Shutdown	Exhaust Temperature 14 (B7) High
671	Warning	Exhaust Gas Temperature Cylinder 1 (A1) OOR Low
672	Warning	Exhaust Gas Temperature Cylinder 3 (A2) OOR Low
673	Warning	Exhaust Gas Temperature Cylinder 5 (A3) OOR Low
674	Warning	Exhaust Gas Temperature Cylinder 7 (A4) OOR Low
675	Warning	Exhaust Gas Temperature Cylinder 9 (A5) OOR Low
676	Warning	Exhaust Gas Temperature Cylinder 11 (A6) OOR Low
677	Warning	Exhaust Gas Temperature Cylinder 13 (A7) OOR Low
678	Warning	Exhaust Gas Temperature Cylinder 15 (A8) OOR Low
683	Warning	Turbo 2 Speed Moderate High
684	Warning	Turbo 2 Speed Moderate Low
685	Warning	Turbo 2 Speed Incorrect
686	Warning	Turbo 1 Speed Incorrect
687	Warning	Turbo 1 Speed Low
689	Warning	Crankshaft Speed Error
691	Warning	Turbocharger 1 Comp Intake Temp:Volt Above Normal
692	Warning	Turbocharger 1 Comp Intake Temp:Volt Below Normal
697	Warning	ECM Temperature High
698	Warning	ECM Temperature Low
721	Warning	Exhaust Gas Temperature 2 (B1) OOR Low
722	Warning	Exhaust Gas Temperature 4 (B2) OOR Low

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Code	Lamp	Displayed Message
723	Warning	Exhaust Gas Temperature 6 (B3) OOR Low
724	Warning	Exhaust Gas Temperature 8 (B4) OOR Low
725	Warning	Exhaust Gas Temperature 10 (B5) OOR Low
726	Warning	Exhaust Gas Temperature 12 (B6) OOR Low
727	Warning	Exhaust Gas Temperature 14 (B7) OOR Low
728	Warning	Exhaust Gas Temperature 16 (B8) OOR Low
731	Warning	Crankshaft Mech Misalign
736	Warning	Starter Air Pressure OOR Low
737	Warning	Starter Air Pressure OOR High
738	Warning	Starter Air Pressure Underpressure Error
741	Warning	Air Filter Restriction Pressure High Error
742	Warning	Air Filter Restriction Pressure Low Error
743	Warning	Turbocharger 1 Compressor Intake Pressure Error
751	Warning	Gas Mass Flow In Range Error
752	Warning	Exhaust Gas Oxygen In Range Error
755	Warning	Injector Metering Rail 1 Pressure System Error
757	Warning	All Persistent Data Lost Error
778	Warning	EPS Backup Lost Sync Error
781	Shutdown	CAN Data Link Failure
782	Warning	SAE J1939 Data Link 2 Engine Network No Data Received – Condition Exists
783	Shutdown	Intake Manf 1 Rate Error
831	Warning	Spark Plug 1 (A1) OOR Low
832	Warning	Spark Plug 2 (B1) OOR Low
833	Warning	Spark Plug 3 (A2) OOR Low
834	Warning	Spark Plug 4 (B2) OOR Low
835	Warning	Spark Plug 5 (A3) OOR Low
836	Warning	Spark Plug 6 (B3) OOR Low
837	Warning	Spark Plug 7 (A4) OOR Low
838	Warning	Spark Plug 8 (B4) OOR Low
839	Warning	Spark Plug 9 (A5) OOR Low
841	Warning	Spark Plug 10 (B5) OOR Low
842	Warning	Spark Plug 11 (A6) OOR Low
843	Warning	Spark Plug 12 (B6) OOR Low
844	Warning	Spark Plug 13 (A7) OOR Low

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Code	Lamp	Displayed Message
845	Warning	Spark Plug 14 (B7) OOR Low
846	Warning	Spark Plug 15 (A8) OOR Low
847	Warning	Spark Plug 16 (B8) OOR Low
848	Warning	Spark Plug 17 (A9) OOR Low
849	Warning	Spark Plug 18 (B9) OOR Low
891	Warning	Spark Plug 1 (A1) Root Cause Unknown
893	Warning	Spark Plug 3 (A2) Root Cause Unknown
894	Warning	Spark Plug 4 (B2) Root Cause Unknown
895	Warning	Spark Plug 5 (A3) Root Cause Unknown
896	Warning	Spark Plug 6 (B3) Root Cause Unknown
897	Warning	Spark Plug 7 (A4) Root Cause Unknown
898	Warning	Spark Plug 8 (B4) Root Cause Unknown
899	Warning	Spark Plug 9 (A5) Root Cause Unknown
911	Warning	Spark Plug 10 (B5) Root Cause Unknown
912	Warning	Spark Plug 11 (A6) Root Cause Unknown
913	Warning	Spark Plug 12 (B6) Root Cause Unknown
914	Warning	Spark Plug 13 (A7) Root Cause Unknown
915	Warning	Spark Plug 14 (B7) Root Cause Unknown
916	Warning	Spark Plug 15 (A8) Root Cause Unknown
917	Warning	Spark Plug 16 (B8) Root Cause Unknown
918	Warning	Spark Plug 17 (A9) Root Cause Unknown
919	Warning	Spark Plug 18 (B9) Root Cause Unknown
982	Warning	Spark Plug 2 (B1) Root Cause Unknown
1117	Warning	Power Lost With Ignition On
1121	Warning	Fail To Disconnect
1122	Event	Rated To Idle Delay
1124	Warning	Delayed Shutdown
1128	Warning	Mixer Inlet Humidity Sensor:Volt Above Normal
1129	Warning	Mixer Inlet Humidity Sensor:Volt Below Normal
1131	Warning	Battle Short Active
1132	Warning	Controlled Shutdown
1139	Warning	UFD Injector 1 Error
1141	Warning	UFD Injector 2 Error
1142	Warning	UFD Injector 3 Error

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Code	Lamp	Displayed Message
1143	Warning	UFD Injector 4 Error
1144	Warning	UFD Injector 5 Error
1145	Warning	UFD Injector 6 Error
1213	Shutdown	Compressor Overboost Error
1219	Warning	Utility Breaker Tripped
1223	Warning	Utility Frequency
1224	Warning	Genset Overvoltage
1225	Warning	Genset Undervoltage
1226	Warning	Genset Frequency
1243	Derate	Engine Derated
1244	Shutdown	Engine Normal Shutdown
1245	Shutdown	Engine Shutdown Fault
1246	Warning	Unknown Engine Fault
1247	Shutdown	Unannounced Engine Shutdown
1248	Warning	Engine Warning
1256	Warning	Ctrl Mod ID In State Error
1257	Shutdown	Ctrl Mod ID In State Fail
1274	Shutdown	Heavy Knock Error 10 (B5)
1275	Warning	Knock Cylinder 10 (B5) OOR Low
1276	Warning	Knock Cylinder 10 (B5) OOR High
1277	Warning	Knock Cylinder 11 (A6) OOR Low
1278	Warning	Knock Cylinder 11 (A6) OOR High
1279	Warning	Knock 12 (B6) High
1281	Shutdown	Heavy Knock Error 12 (B6)
1282	Warning	Knock Cylinder 12 (B6) OOR Low
1283	Warning	Knock Cylinder 12 (B6) OOR High
1284	Warning	Knock 13 (B7) High
1285	Shutdown	Continuous Light Knock Error 13 (A7)
1286	Shutdown	Heavy Knock Error 13 (A7)
1287	Warning	Knock Cylinder 13 (A7) OOR Low
1288	Warning	Knock Cylinder 13 (A7) OOR High
1289	Warning	Knock 14 (B7) High Warning
1291	Shutdown	Heavy Knock Error 14 (B7)
1292	Warning	Knock Cylinder 14 (B7) OOR Low

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Code	Lamp	Displayed Message
1293	Warning	Knock Cylinder 14 (B7) OOR High
1294	Warning	Knock 15 (A8) High Warning
1295	Shutdown	Continuous Light Knock Error 15 (A8)
1296	Shutdown	Heavy Knock Error 15 (A8)
1297	Warning	Knock Cylinder 15 (A8) OOR Low
1298	Warning	Knock Cylinder 15 (A8) OOR High
1299	Warning	Knock 16 (B8) High Warning
1311	Shutdown	Heavy Knock Error 16 (B8)
1312	Event	Configurable Input # 2
1317	Event	Configurable Input # 13
1318	Event	Configurable Input # 14
1322	Warning	kW Load Setpoint OOR High
1323	Warning	kW Load Setpoint OOR Low
1324	Warning	kVAR Load Setpoint OOR High
1325	Warning	kVAR Load Setpoint OOR Low
1328	Warning	Genset Breaker Tripped
1336	Shutdown	Cooldown Complete
1338	Warning	Knock Cylinder 18 (B9) OOR Low
1339	Warning	Knock Cylinder 18 (B9) OOR High
1352	Warning	Knock 20 (B10) High Warning
1353	Shutdown	Continuous Light Knock Error 20 (B10)
1354	Shutdown	Heavy Knock Error 20 (B10)
1355	Warning	Knock Cylinder 20 (B10) OOR Low
1356	Warning	Knock Cylinder 20 (B10) OOR High
1357	Warning	Oil Remote Level Low
1362	Warning	Oil Filter Restriction Error
1363	Warning	Intake Manf 1 Press Low
1367	Event	High Prefilter Oil Press
1368	Event	Low Prefilter Oil Press
1369	None	Aux Temp 1 Sensor OORH
1373	None	Start Enable Device 1: Cause Unknown
1376	Warning	Camshaft Speed Error
1377	None	Post Oil Filter Pressure OORH
1378	None	Post Oil Filter Pressure OORL

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Code	Lamp	Displayed Message
1379	None	Low Fuel Pump Intake Pressure - None severity
1383	None	Intake Manifold 1 Pressure OORH
1384	None	Intake Manifold 1 Pressure OORL
1385	None	Intake Manifold 2 Pressure OORH
1386	None	Intake Manifold 2 Pressure OORL
1389	None	High Fuel Pump Intake Pressure
1411	Warning	High Out Freq Adjust Pot
1412	Warning	High Droop Adjust Pot
1416	Warning	Fail To Shutdown
1417	Warning	Power Down Failure
1418	Warning	High Gain Adjust Pot
1427	Warning	Overspeed Relay Error
1428	Warning	LOP Relay Error
1429	Warning	HET Relay Error
1431	Warning	Pre-LOP Relay Error
1432	Warning	Pre-HET Relay Error
1433	Shutdown	Local Emergency Stop
1434	Shutdown	Remote Emergency Stop
1435	Warning	Low Coolant Temperature
1438	Shutdown	Fail To Crank
1439	Warning	Low Day Tank Fuel Switch
1441	Warning	Low Fuel Level
1442	Shutdown	Weak Battery
1443	Shutdown	Dead Battery
1444	Warning	Overload
1445	Shutdown	Short Circuit
1446	Shutdown	High AC Voltage
1447	Shutdown	Low AC Voltage
1448	Shutdown	Under Frequency
1449	Warning	Over Frequency
1451	Warning	Gen/Bus Voltages Out of Calibration
1452	Warning	Genset Breaker Fail To Close
1453	Warning	Genset Breaker Fail To Open
1454	Warning	Genset Breaker Position Contact

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Code	Lamp	Displayed Message
1455	Warning	Utility Breaker Position Contact
1456	Warning	Bus Out Of Synchronizer Range
1457	Warning	Fail To Synchronize
1458	Warning	Sync Phase Rotation Mismatch Overfrequency
1459	Shutdown	Reverse Power
1461	Shutdown	Loss of Field (Reverse kVAR)
1463	Event	Not In Auto
1464	Warning	Load Dump Fault
1465	Event	Ready To Load
1469	Shutdown	Speed/Hz Mismatch
1471	Warning	Over Current
1472	Shutdown	Over Current
1474	Shutdown	ECM Software Mismatch
1475	Warning	First Start Backup
1483	Event	Common Alarm
1517	Shutdown	Failed Module Shutdown
1518	Warning	Failed Module Warning
1519	Warning	At Least One Module Has: Least Severe Fault
1521	Warning	Exhaust Gas Temperature 3 (A2) OOR High
1522	Warning	Exhaust Gas Temperature 5 (A3) OOR High
1523	Warning	Exhaust Gas Temperature 7 (A4) OOR High
1524	Warning	Exhaust Gas Temperature 9 (A5) OOR High
1525	Warning	Exhaust Gas Temperature 11 (A6) OOR High
1526	Warning	Exhaust Gas Temperature 13 (A7) OOR High
1527	Warning	Exhaust Gas Temperature 15 (A8) OOR High
1528	Warning	Exhaust Gas Temperature 17 (A9) OOR High
1529	Warning	Exhaust Gas Temperature 2 (B1) OOR High
1531	Warning	Exhaust Gas Temperature 6 (B3) OOR High
1532	Warning	Exhaust Gas Temperature 8 (B4) OOR High
1533	Warning	Exhaust Gas Temperature 10 (B5) OOR High
1534	Warning	Exhaust Gas Temperature 12 (B6) OOR High
1535	Warning	Exhaust Gas Temperature 14 (B7) OOR High
1536	Warning	Exhaust Gas Temperature 16 (B8) OOR High
1537	Warning	Exhaust Gas Temperature 18 (B9) OOR High

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Code	Lamp	Displayed Message
1540	Event	Common Warning
1541	Event	Common Shutdown
1545	Warning	EPS Backup Channel Lost
1546	Warning	EPS Main Channel Lost
1548	Warning	Inj 7 Solenoid Low Curr
1549	Warning	Inj 8 Solenoid Low Curr
1551	Warning	Inj 7 Solenoid Low Curr
1552	Warning	Inj 7 Solenoid Low Curr
1553	Warning	Inj 7 Solenoid Low Curr
1554	Warning	Inj 7 Solenoid Low Curr
1555	Warning	Inj 7 Solenoid Low Curr
1556	Warning	Inj 7 Solenoid Low Curr
1557	Warning	Inj 7 Solenoid Low Curr
1572	Shutdown	Continuous Light Knock Error 19 (A10)
1573	Event	Configurable Input #1
1574	Shutdown	Heavy Knock Error 19 (A10)
1575	Warning	Knock Cylinder 19 (A10) OOR Low
1576	Warning	Knock Cylinder 19 (A10) OOR High
1579	Shutdown	Continuous Light Knock Error 12 (B6)
1581	Shutdown	Continuous Light Knock Error 14 (B7)
1582	Shutdown	Continuous Light Knock Error 16 (B8)
1583	Shutdown	Heavy Knock Error 16 (B8)
1584	Warning	Knock Cylinder 16 (B8) OOR Low
1585	Warning	Knock Cylinder 16 (B8) OOR High
1586	Warning	Knock 17 (A9) High Warning
1587	Shutdown	Continuous Light Knock Error 17 (A9)
1588	Shutdown	Heavy Knock Error 17 (A9)
1589	Warning	Knock Cylinder 17 (A9) OOR Low
1591	Warning	Knock Cylinder 17 (A9) OOR High
1592	Warning	Knock 18 (B9) High Warning
1593	Shutdown	Continuous Light Knock Error 18 (B9)
1594	Warning	Knock 19 (A10) High Warning
1596	None	Aux Temp 1 Sensor OORL
1597	Event	ECM Device/Component

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Code	Lamp	Displayed Message
1618	Warning	Exhaust Gas Temperature, Cylinder 1 (A1) OOR High
1619	Warning	Exhaust Gas Temperature, Cylinder 4 (B2) OOR High
1622	Warning	Inj 9 Solenoid Low Curr
1636	Warning	Intake Manifold Pressure 2 OOR High
1637	Warning	Intake Manifold Pressure 2 OOR Low
1664	Warning	Exh Aft Oxidation Catalyst Missing
1665	Warning	Aftertreatment Exhaust Gas Temp1:Volt Below Normal
1666	Warning	Aftertreatment Ext Gas Temp 1:Volt Above Normal
1668	Warning	AT1 DEF Tank Level Sensor OOR Low
1669	Warning	AT1 DEF Tank Level Sensor OOR High
1673	Warning	AT1 Diesel Exhaust Fluid Tank Level Low
1674	Warning	Aftertreatment Exhaust Gas Temp2:Volt Below Normal
1675	Warning	Aftertreatment Exhaust Gas Temp2:Volt Above Normal
1677	Warning	AT1 DEF Tank Temperature Sensor OOR Low
1678	Warning	AT1 DEF Tank Temperature Sensor OOR High
1679	Warning	AT1 Diesel Exhaust Fluid Tank Temperature Error
1682	Warning	AT1 DEF Dosing Unit Input Lines condition
1683	Warning	AT1 Diesel Exhaust Fluid Tank Heater OOR High
1684	Warning	AT1 Diesel Exhaust Fluid Tank Heater OOR Low
1685	Warning	AT Diesel Exhaust Fluid Quality Sensor OOR Low
1686	Warning	AT Diesel Exhaust Fluid Quality Sensor OOR High
1689	Warning	Real Time Clock Power
1691	Warning	Aft Oxidation Catalyst Efficiency: Below Normal
1695	Warning	Sensor Supply 5 High
1696	Warning	Sensor Supply 5 Low
1712	Warning	AT1 Diesel Exhaust Fluid Tank Heater Low
1713	Warning	AT1 Diesel Exhaust Fluid Tank Heater High
1714	Warning	Aftertreatment Diesel Exhaust Fluid Quality Error
1715	Warning	AT Diesel Exhaust Fluid Quality Root unknown
1737	Shutdown	CAN Throttle Internal Failure Error
1738	Warning	CAN Throttle Internal Fault Error
1739	Warning	Engine Throttle Control Condition Exists
1741	Warning	CAN Throttle High Temp Warning Error
1742	Warning	CAN Throttle Temperature Limiting Error

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Code	Lamp	Displayed Message
1743	Shutdown	Throttle Control 2 OOR High
1744	Shutdown	Throttle Control 2 OOR Low
1745	Shutdown	Throttle Control 2 Incorrect
1746	Shutdown	Throttle Control 2 Out of Adjustment
1747	Shutdown	Throttle Control 2 Bad Device
1748	Warning	Throttle Control 2 Root Unknown
1749	Warning	Throttle Control 2 Condition Exists
1751	Warning	Throttle Control 2 Warning High
1752	Warning	Throttle Control 2 Moderate High
1753	Warning	Fuel Shutoff 2 OOR High
1754	Warning	Fuel Temperature 2 OOR High
1755	Warning	Fuel Temperature 2 OOR Low
1756	Warning	Gas Flow 2 OOR High
1757	Warning	Gas Flow 2 OOR Low
1758	Warning	Gas Flow 2 Incorrect Data
1759	Shutdown	FCV 2 Positive Feedback Incorrect
1761	Shutdown	FCV Actuator Error
1765	Warning	Engine Gas Control Valve Inlet Pressure 2 OOR High
1766	Warning	Engine Gas Control Valve Inlet Pressure 2 OOR Low
1767	Warning	Engine Gas Control Valve Outlet Pressure 2 OOR High
1768	Warning	Engine Gas Control Valve Outlet Pressure 2 OOR Low
1769	Warning	Engine Emergency Shutdown Indication OOR High
1771	Warning	Engine Emergency Shutdown Indication OOR Low
1772	Warning	Engine Derate Request OOR High
1773	Warning	Engine Derate Request OOR Low
1774	Warning	Oil Priming Pump OOR High
1775	Warning	Oil Priming Pump OOR Low
1778	Warning	Engine Heater Control Driver High Error
1779	Warning	Engine Heater Control Driver Low Error
1781	Warning	Shutdown Request OOR High
1782	Warning	Shutdown Request OOR Low
1783	Warning	Coolant Pump Control Driver High Error
1784	Warning	Coolant Pump Control Driver Low Error
1785	Warning	Oil Priming Pump Manual Override Input On

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Code	Lamp	Displayed Message
1786	Warning	Oil Priming Pump Stuck On Error
1787	Warning	Post Lube Oil Priming Error
1788	Warning	Maintenance Lube Oil Priming Error
1789	Shutdown	Pre-start Lube Oil Priming Error
1791	Shutdown	Failure To Meet Load Speed Error
1792	Warning	Idle when Circuit Breaker Closed
1794	Shutdown	Fire Detected
1795	Warning	Compressor Bypass Position High Error
1796	Warning	Compressor Bypass Position Low Error
1797	Warning	Compressor Bypass Control OOR High
1798	Warning	Compressor Bypass Control OOR Low
1799	Warning	Circuit Breaker Position Error Status
1811	Warning	High Side Driver 2 High Control Error (VPS)
1812	Warning	High Side Driver 2 Low Control Error (VPS)
1813	Warning	Valve Proving System Test Failed Warning Error
1814	Shutdown	Valve Proving System Test Failed Shutdown Error
1815	Warning	RLY14 High Control Error
1816	Warning	Oil Pre-heater Control OOR Low
1817	Warning	Oil Pre-heater Tripped Error
1818	Warning	Oil Pre-heater Not Warming Error
1819	Warning	Common AC Aux Circuit Breaker Tripped
1821	Shutdown	Minimum FSO Speed Error
1822	Shutdown	LT Coolant Level Low Shutdown Error
1823	Warning	LT Coolant Level Low Warning Error
1824	Warning	Idle Rated Trans Oil Temperature Low Error
1825	Warning	Dirty Oil Level Error
1826	Shutdown	ECM Software Incompatible
1827	Warning	Fuel Inlet Pressure High Error
1828	Warning	Fuel Inlet Pressure Low Error
1829	Shutdown	Vent Gas Valve Error
1831	Shutdown	Upstream FSO Valve Error
1832	Shutdown	Downstream FSO Valve Error
1833	Warning	Engine Heater Trip Error
1834	Warning	Coolant Pump Trip Error

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Code	Lamp	Displayed Message
1835	Warning	Oil Priming Pump Tripped Error
1836	Shutdown	LCP (LT) Low Serious Error
1837	Shutdown	Permanent FS Cam Sync Lost Error
1838	Shutdown	Partial Engine Overload Shutdown Error
1839	Warning	Fuel Supply Pressure High Error
1841	Warning	Fuel Supply Pressure Low Error
1842	Warning	Radiator Fan Trip Error
1843	Warning	Crankcase Press High
1844	Warning	Crankcase Press Low
1845	Warning	H2O In Fuel Sens High
1846	Warning	H2O In Fuel Sens Low
1847	Shutdown	Eng Coolant Temp - Shutdown w/Cool
1852	Warning	Pre-High H2O In Fuel
1853	Event	Annunciator Input 1 Fault
1854	Event	Annunciator Input 2 Fault
1855	Event	Annunciator Input 3 Fault
1858	Warning	Exhaust After Inlet O2 OOR High
1859	Warning	Exhaust After Inlet O2 OOR Low
1861	Warning	Exhaust After Inlet O2 Incorrect
1862	Warning	Exhaust After Outlet O2 OOR High
1863	Warning	Exhaust After Outlet O2 OOR Low
1864	Warning	Exhaust After Outlet O2 Incorrect
1866	Warning	EGR DP Autozero Error
1867	Warning	Exhaust Gas Recirculation Temperature Error
1879	Warning	Aft Particulate Filter Pressure OORH
1881	Warning	Aft Particulate Filter Pressure OORL
1883	Warning	Aft Particulate Filter Pressure: Incorrect
1885	Warning	Aftertreatment 1Intake NoxSensor:Volt Below Normal
1887	Warning	AT1 Outlet NOx Sensor Circuit OOR Low
1891	Warning	Change Oil
1893	Warning	CAN EGR Valve Comm
1894	Warning	CAN VGT Comm Error
1895	Warning	EGA DL Mismatch Error
1896	Warning	EGR DL Valve Stuck

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Code	Lamp	Displayed Message
1898	Warning	VGT Actuator Controller Out of Calibration
1899	Warning	Low EGR Dif Pressure
1911	Warning	Inj Metering 1 Press High
1912	Warning	Utility Loss Of Phase
1913	Warning	Genset Loss Of Phase
1914	Warning	Utility Phase Rotation
1915	Warning	Genset Phase Rotation
1916	Event	Sync Check OK
1917	Warning	Fuel Level High
1918	Shutdown	Fuel Level Low
1921	Warning	Aftertreatment DPF Differential Pressure
1922	Shutdown	Aftertreatment DPF Differential Pressure Severe
1933	Warning	High EGR Data Link Volt
1934	Warning	Low EGR Data Link Volt
1935	Warning	EGR DL Cmd Source Err
1938	Warning	ECU Power Output Volt: Below Normal
1942	Warning	THD AZ Error
1943	Event	CBR Density Derate Error ID
1944	Warning	HMI 113 Out Config Error
1961	Warning	High EGR DL EDU Temp
1962	Warning	VGT Actuator Driver Temperature: Above Normal
1965	Warning	Aftertreatment Ext Gas Temp1:Data Above Normal
1966	Shutdown	Aftertmt Ext Gas Temp1:Above Normal-Most Severe
1968	Warning	Aftertmt Ext Gas Temp2:Above Normal-Severe
1969	Shutdown	Aftertmt Ext Gas Temp2:Above Normal-Most Severe
1974	Warning	Crankcase Press High
1978	Warning	Speed Bias OOR High
1979	Warning	Speed Bias OOR Low
1982	Shutdown	Catalyst Over Temp:Data Above Normal - Most Severe
1983	Warning	Catalyst Over Temperature Data Above Normal Severe
1984	Warning	Int Man 2 Tmp Moderate High
1985	Warning	Int Man 3 Temperature Moderate High
1986	Warning	Int Man 4 Temperature Moderate High
1992	Shutdown	Crankcase Sensor High

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Code	Lamp	Displayed Message
1993	Warning	Aft Particulate Filter Missing
1999	Warning	Maximum Parallel Time
2111	Warning	Coolant Inlet Temperature (LT) High Error
2112	Warning	Coolant Inlet Temperature (LT) Low Error
2113	Warning	CIT (LT) High Warning Error
2114	Shutdown	CIT (LT) High Serious Error
2115	Warning	LT Coolant Pressure High Error
2116	Warning	LT Coolant Pressure Low Error
2117	Warning	LCP (LT) Low Warning Error
2118	Warning	Low Fuel Pressure
2121	Warning	Exhaust Temperature 1 (A1) High Warning Error
2122	Warning	Exhaust Temperature 3 (A2) High Warning Error
2123	Warning	Exhaust Temperature 5 (A3) High Warning Error
2124	Warning	Exhaust Temperature 7 (A4) High Warning Error
2125	Warning	Exhaust Temperature 9 (A5) High Warning Error
2126	Warning	Exhaust Temperature 11 (A6) High Warning Error
2127	Warning	Exhaust Temperature 13 (A7) High Warning Error
2128	Warning	Exhaust Temperature 15 (A8) High Warning Error
2129	Warning	Exhaust Temperature 17 (A9) High Warning Error
2131	Warning	Exhaust Temperature 2 (B1) High Warning Error
2132	Warning	Exhaust Temperature 4 (B2) High Warning Error
2133	Warning	Exhaust Temperature 6 (B3) High Warning Error
2134	Warning	Exhaust Temperature 8 (B4) High Warning Error
2135	Warning	Exhaust Temperature 10 (B5) High Warning Error
2136	Warning	Exhaust Temperature 12 (B6) High Warning Error
2137	Warning	Exhaust Temperature 14 (B7) High Warning Error
2138	Warning	Exhaust Temperature 16 (B8) High Warning Error
2139	Warning	Exhaust Temperature 18 (B9) High Warning Error
2141	Warning	Start Air Pressure High Error
2142	Warning	Start Air Pressure Low Error
2143	Warning	SAP Overpressure Error
2144	Shutdown	Exhaust Temperature 16 (B8) High Serious Error
2145	Shutdown	Exhaust Temperature 18 (B9) High Serious Error
2146	Warning	EGT 17 (A9) OOR Low

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Code	Lamp	Displayed Message
2147	Warning	EGT 18 (B9) OOR Low
2154	Warning	Oil Filter Outlet Pressure High Error
2155	Warning	Oil Filter Outlet Pressure Low Error
2157	Shutdown	Int Man 2 Temp Abnormal Rate
2158	Shutdown	Int Man 3 Tmp Abnormal Rate
2159	Shutdown	Int Man 4 Tmp Abnormal Rate
2184	Warning	Fuel Injection Control Valve Root Cause Unknown
2185	Warning	Sensor Supply 4 High
2186	Warning	Sensor Supply 4 Low
2188	Warning	Exhaust O2 OOR High
2191	Warning	ST Throttle Pressure Error Status
2192	Warning	Exhaust O2 OOR Low
2193	Warning	HT Coolant Level Moderate High
2198	Warning	VGT Actuator Driver Circuit: Unknown Cause
2215	Warning	Fuel Pump Press Low
2217	Warning	RAM Image Word Error
2219	Warning	Exhaust O2 Moderate High
2221	Warning	Exhaust O2 Moderate Low
2231	Warning	Knock Cylinder 1 (A1) OOR High
2232	Warning	Knock Cylinder 2 (B1) OOR High
2233	Warning	Knock Cylinder 3 (A2) OOR High
2234	Warning	Knock Cylinder 4 (B2) OOR High
2235	Warning	Knock Cylinder 5 (A3) OOR High
2236	Warning	Knock Cylinder 6 (B3) OOR High
2237	Warning	Knock Cylinder 7 (A4) OOR High
2238	Warning	Knock Cylinder 8 (B4) OOR High
2239	Warning	Knock Cylinder 9 (A5) OOR High
2249	Warning	APC 2 Pressure Low
2261	Warning	Fuel Pump Press High
2262	Warning	Fuel Pump Press Low
2265	Warning	High Fuel Lift Pump Volt
2266	Warning	Low Fuel Lift Pump Volt
2272	Warning	EGR DL POS Sensor Error
2273	Warning	EGR Delta P OOR High Error

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Code	Lamp	Displayed Message
2274	Warning	EGR Delta P OOR Low Error
2279	Warning	Knock 11 (A6) High Warning
2281	Shutdown	Knock 11 (A6) Moderate Warning
2282	Shutdown	Knock 11 (A6) Critical Warning
2288	None	Turbo Charger 1 Speed: Above Normal
2292	Warning	APC Flow high
2293	Warning	APC Flow Low
2298	Warning	Fuel Shutoff 2 OOR Low
2311	Warning	EFI Control Valve Fail
2313	Warning	Fuel Control Valve Error
2315	Warning	Red Lamp OOR High
2316	Warning	Amber Lamp OOR High
2317	Warning	Amber Lamp OOR Low
2328	Event	Utility Available
2331	Warning	Utility Undervoltage
2332	Event	Utility Connected
2333	Event	Genset Connected
2335	Shutdown	AC Voltage Sensing Lost (Excitation Fault)
2336	Shutdown	Checksum Fault
2342	Warning	Too Long In Idle
2343	None	Fuel Filter Press Hi Above Normal
2346	Event	CBR TFC Derate Error ID
2349	Warning	EGR DL Motor Open Error
2351	Warning	EGR DL Motor Short Error
2353	Warning	EGR Valve Control Circuit: Current OORH
2357	Warning	EGR DL Motor Lock Error
2358	Warning	Utility Overvoltage
2359	Warning	EGR Delta P IR High Error
2372	Warning	Fuel Filter Pressure: Above Normal
2373	Warning	Exhaust Pressure: OORH
2374	Warning	Exhaust Pressure: OORL
2375	Warning	EGR Orifice TMPTR OOR High Error
2376	Warning	EGR Orifice TMPTR OOR Low Error
2377	Warning	High Fan Control Voltage

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Code	Lamp	Displayed Message
2387	Warning	VGT Actuator: Mechanical Sys Not Responding
2396	Warning	Utility Breaker Fail To Close
2397	Warning	Utility Breaker Fail To Open
2412	Shutdown w/Cooldown	Fan Speed Error
2427	Warning	Fuel Outlet Pressure High Error
2428	Warning	Fuel Outlet Pressure Low Error
2431	Warning	Knock 1 (A1) High Warning
2432	Warning	Knock 2 (B1) High Warning
2433	Warning	Knock 3 (A2) High Warning
2434	Warning	Knock 4 (B2) High Warning
2435	Warning	Knock 5 (A3) High Warning
2436	Warning	Knock 6 (B3) High Warning
2437	Warning	Knock 7 (A4) High Warning
2438	Warning	Knock 8 (B4) High Warning
2439	Warning	Knock 9 (A5) High Warning
2441	Warning	Knock 10 (B5) High Warning
2442	Warning	Inj Solenoid Driver 1 Calib Error
2443	Warning	Inj Solenoid Driver 2 Calib Error
2444	Warning	Inj Solenoid Driver 3 Calib Error
2445	Warning	Inj Solenoid Driver 4 Calib Error
2446	Warning	Inj Solenoid Driver 5 Calib Error
2447	Warning	Inj Solenoid Driver 6 Calib Error
2448	Warning	Coolant Level Moderately Low
2449	Shutdown	VGT Actuator Controller: Out of Calibration
2453	Warning	Total Real Power Circuit OOR High
2454	Warning	Total Real Power Circuit OORL
2455	Warning	Speed Bias Low Error
2456	Warning	Speed Bias High Error
2457	Shutdown	Max Total Misfire Error
2458	Warning	Cylinder 2 (B1) Total Misfire Error
2459	Warning	Cylinder 4 (B2) Total Misfire Error
2461	Warning	Cylinder 6 (B3) Total Misfire Error
2462	Warning	Cylinder 8 (B4) Total Misfire Error

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Code	Lamp	Displayed Message
2463	Warning	Cylinder 10 (B5) Total Misfire Error
2464	Warning	Cylinder 12 (B6) Total Misfire Error
2465	Warning	Cylinder 14 (B7) Total Misfire Error
2466	Warning	Cylinder 16 (B8) Total Misfire Error
2467	Warning	Cylinder 18 (B9) Total Misfire Error
2469	Warning	Cylinder 1 (A1) Total Misfire Error
2471	Warning	Cylinder 3 (A2) Total Misfire Error
2472	Warning	Cylinder 5 (A3) Total Misfire Error
2473	Warning	Cylinder 7 (A4) Total Misfire Error
2475	Warning	Cylinder 9 (A5) Total Misfire Error
2476	Warning	Cylinder 11 (A6) Total Misfire Error
2477	Warning	Cylinder 13 (A7) Total Misfire Error
2478	Warning	Cylinder 15 (A8) Total Misfire Error
2479	Warning	Cylinder 17 (A9) Total Misfire Error
2482	Shutdown	Start Before Ready Error
2483	Shutdown	Continuous Starter Failure Error
2484	Shutdown	Exhaust Temperature 1 (A1) Abnormal Rate
2485	Shutdown	Exhaust Temperature 3 (A2) Abnormal Rate
2486	Shutdown	Exhaust Temperature 5 (A3) Abnormal Rate
2487	Shutdown	Exhaust Temperature 7 (A4) Abnormal Rate
2488	Shutdown	Exhaust Temperature 9 (A5) Abnormal Rate
2489	Shutdown	Exhaust Temperature 11 (A6) Abnormal Rate
2491	Shutdown	Exhaust Temperature 13 (A7) Abnormal Rate
2492	Shutdown	Exhaust Temperature 15 (A8) Abnormal Rate
2493	Shutdown	Exhaust Temperature 17 (A9) Abnormal Rate
2494	Shutdown	Exhaust Temperature 2 (B1) Abnormal Rate
2495	Shutdown	Exhaust Temperature 4 (B2) Abnormal Rate
2496	Shutdown	Exhaust Temperature 6 (B3) Abnormal Rate
2497	Shutdown	Exhaust Temperature 8 (B4) Abnormal Rate
2498	Shutdown	Exhaust Temperature 10 (B5) Abnormal Rate
2499	Shutdown	Exhaust Temperature 12 (B6) Abnormal Rate
2511	Shutdown	Exhaust Temperature 14 (B7) Abnormal Rate
2512	Shutdown	Exhaust Temperature 16 (B8) Abnormal Rate
2513	Shutdown	Exhaust Temperature 18 (B9) Abnormal Rate

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Code	Lamp	Displayed Message
2514	Shutdown	Exhaust Temperature 19 (A10) Abnormal Rate
2515	Shutdown	Exhaust Temperature 20 (B10) Abnormal Rate
2517	Warning	Compressor Outlet Pressure High Error
2518	Warning	Compressor Outlet Pressure Low Error
2521	Shutdown	Bank ID Error
2522	Shutdown	Continuous Light Knock Error 1 (A1)
2523	Shutdown	Continuous Light Knock Error 2 (B1)
2524	Shutdown	Continuous Light Knock Error 3 (A2)
2525	Shutdown	Continuous Light Knock Error 4 (B2)
2526	Shutdown	Continuous Light Knock Error 5 (A3)
2527	Shutdown	Continuous Light Knock Error 6 (B3)
2528	Shutdown	Continuous Light Knock Error 7 (A3)
2529	Shutdown	Continuous Light Knock Error 8 (B4)
2531	Shutdown	Continuous Light Knock Error 9 (A5)
2532	Shutdown	Continuous Light Knock Error 10 (B5)
2539	Warning	High Voltage Bias
2541	Warning	Low Voltage Bias
2544	Shutdown w/Cooldown	ECM Overtemp Error
2545	Warning	Keysw Reset Required
2553	Warning	Engine Oil Level Low Warning Error
2554	Warning	Exhaust Gar Pressure: Incorrect
2555	Warning	Low GHC 1 Voltage
2556	Warning	High GHC 1 Voltage
2557	Warning	Auxiliary PWM Driver 1 Circuit OOR High
2558	Warning	Auxiliary PWM Driver 1 Circuit OOR Low
2562	Shutdown	High Geartrain Oil Temperature
2567	Warning	DG Air Compressor Trip Error
2568	Shutdown	Gas Supply Pressure Critical High
2569	Shutdown	Gas Supply Pressure Critical Low
2586	Event	Spark Plug 1 (A1) High Warning
2587	Event	Spark Plug 2 (B1) High Warning
2588	Event	Spark Plug 3 (A2) High Warning
2589	Event	Spark Plug 4 (BS) High Warning

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Code	Lamp	Displayed Message
2591	Event	Spark Plug 5 (A3) High Warning
2592	Event	Spark Plug 6 (B3) High Warning
2593	Event	Spark Plug 1 (A1) Low Warning
2594	Event	Spark Plug 2 (B1) Low Warning
2595	Event	Spark Plug 3 (A2) Low Warning
2596	Event	Spark Plug 4 (B2) Low Warning
2597	Event	Spark Plug 5 (A3) Low Warning
2598	Event	Spark Plug 6 (B3) Low Warning
2619	Warning	Aux101 0 Input 1 Fault
2621	Warning	Aux101 0 Input 2 Fault
2622	Warning	Aux101 0 Input 3 Fault
2623	Warning	Aux101 0 Input 4 Fault
2624	Warning	Aux101 0 Input 5 Fault
2625	Warning	Aux101 0 Input 6 Fault
2626	Warning	Aux101 0 Input 7 Fault
2627	Warning	Aux101 0 Input 8 Fault
2628	Warning	Aux102 0 Expansion Input 9 Fault
2629	Warning	Aux102 0 Expansion Input 10 Fault
2631	Warning	Aux102 0 Expansion Input 11 Fault
2632	Warning	Aux102 0 Expansion Input 12 Fault
2634	Shutdown	VGT Actuator Controller: Bad Device/Component
2635	Shutdown	VGT Actuator Driver Condition Exists
2636	Shutdown	VGT Actuator Circuit: Abnormal Update Rate
2637	None	Aft Catalyst Face Plugged: Reason Unknown
2639	None	Aftertreatment DPF Differential Press Least Severe
2643	Warning	Throttle Position 2 Feedback OOR High
2644	Warning	Throttle Position 2 Feedback OOR Low
2646	Warning	HT Coolant Temperature Condition Exists
2651	None	Exhaust Gas Temperature Right Manifold: OORH
2652	None	Exhaust Gas Temperature Right Manifold: OORL
2653	Warning	Exhaust St 2 Temp High
2654	Shutdown	Exhaust Stack Temp Right Bank Above Sh Threshold
2655	None	Exhaust Gas Temperature Left Manifold: OORH
2656	None	Exhaust Gas Temperature Left Manifold: OORL

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Code	Lamp	Displayed Message
2657	Warning	Exhaust St 1 Temp High
2658	Shutdown	Exhaust Stack Temp Left Bank Above Sh Threshold
2661	Shutdown	At Least One Unacknowledged Most Severe Fault 0 Condition Exists
2662	Warning	At Least One acknowledged: Most Severe Fault
2677	Shutdown	Fail To Stop
2678	Warning	Charging Alternator Fail
2724	Warning	Gas Supply Pressure Moderate High
2725	Warning	Gas Supply Pressure Moderate Low
2727	Warning	Critical CEN Not Accessible Error
2737	Shutdown	Exhaust Gas Temperature Critical High
2738	Warning	Ether INJ Low CTRL Error
2739	Warning	Ether INJ High CTRL Error
2752	Shutdown	Throttle Actuator - Shorted High
2753	Shutdown	Exhaust Gas Recirculation Temp: Above Normal
2754	Warning	Diesel Particulate Filter Int Press: Above Normal
2765	None	Engine Inj Bank 1 Barcode: Out Of Calibration
2766	Shutdown	Bank A CCD Failed Error
2767	Shutdown	Bank B CCD Failed Error
2768	Shutdown	CAN Parent Communication Incorrect
2769	Shutdown	CAN Child Communication Incorrect
2771	Warning	Aftertreatment 1 Outlet NOx Sensor Abnormal
2774	Warning	EGR DP Clogged Tubes Error
2777	None	Particulate Trap Regen Inhibit: Condition Exists
2779	Event	Utility Unloaded Event
2789	Warning	COT Low Error
2793	Shutdown	COT Low Serious Error
2794	Warning	Ignition Shutdown Relay OOR High
2795	Warning	Ignition Shutdown Relay OOR Low
2796	Warning	Partial Engine Overload Warning Error
2797	Warning	Inlet Gas Diff Pressure OOR High
2798	Warning	Inlet Gas Diff Pressure OOR Low
2799	Shutdown	IMOP Compressor Outlet Pressure Delta Error
2811	Shutdown	IMOP Compressor Outlet Pressure Maximum Error
2812	Shutdown	Throttle Control Actuator Error

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Code	Lamp	Displayed Message
2814	Shutdown	Genset CT Ratio Low
2815	Warning	Genset CT Ratio High
2816	Shutdown	Genset PT Ratio Low
2817	Warning	Genset PT Ratio High
2818	Shutdown	Bus PT Ratio Low
2819	Warning	Bus PT Ratio High
2821	Warning	Utility PT Ratio Low
2822	Warning	Utility PT Ratio High
2837	Warning	Exhaust Temperature 1 (A1) Deviation Error
2838	Warning	Exhaust Temperature 3 (A2) Deviation Error
2839	Warning	Exhaust Temperature 5 (A3) Deviation Error
2841	Warning	Exhaust Temperature 7 (A4) Deviation Error
2842	Warning	Exhaust Temperature 9 (A5) Deviation Error
2843	Warning	Exhaust Temperature 11 (A6) Deviation Error
2844	Warning	Exhaust Temperature 13 (A7) Deviation Error
2845	Warning	Exhaust Temperature 15 (A8) Deviation Error
2846	Warning	Exhaust Temperature 17 (A9) Deviation Error
2847	Warning	Exhaust Temperature 2 (B1) Deviation Error
2848	Warning	Exhaust Temperature 4 (B2) Deviation Error
2849	Warning	Exhaust Temperature 6 (B3) Deviation Error
2851	Warning	Exhaust Temperature 8 (B4) Deviation Error
2852	Warning	Exhaust Temperature 10 (B5) Deviation Error
2853	Warning	Exhaust Temperature 12 (B6) Deviation Error
2854	Warning	Exhaust Temperature 14 (B7) Deviation Error
2855	Warning	Exhaust Temperature 16 (B8) Deviation Error
2856	Warning	Exhaust Temperature 18 (B9) Deviation Error
2857	Shutdown	Turbo 1 Overspeed Critical Error
2858	Shutdown	Turbo 2 Overspeed Critical Error
2859	Warning	Alt Heater ctrl OOR High
2861	Warning	Alt Heater ctrl OOR Low
2862	Warning	Gen Alternator 1st Start Cond Exists
2863	Shutdown	Genset to Engine Com Incorrect
2864	Shutdown	FSO NON High Control Error
2866	Warning	FCV Position High Error

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Code	Lamp	Displayed Message
2867	Warning	FCV Position Low Error
2868	Warning	Engine Heater Over-Temperature Alarm Error
2869	Warning	HT Cool Temp Driver OOR High
2871	Warning	HT Cool Temp Driver OOR Low
2872	Warning	HT Cool Temp Driver Cond Exists
2873	Warning	LT Cool Temp Driver OOR High
2874	Warning	LT Cool Temp Driver OOR Low
2875	Warning	LT Cool Temp Driver Cond Exists
2876	Shutdown	Comp Surge Shutdown Error
2877	Warning	Comp Surge Derate Error
2882	Warning	Aux101 1 Input 1 Fault
2883	Warning	Aux101 1 Input 2 Fault
2884	Warning	Aux101 1 Input 3 Fault
2885	Warning	Aux101 1 Input 4 Fault
2886	Warning	Aux101 1 Input 5 Fault
2887	Warning	Aux101 1 Input 6 Fault
2888	Warning	Aux101 1 Input 7 Fault
2889	Warning	Aux101 1 Input 8 Fault
2891	Warning	Aux102 1 Expansion Input 9 Fault
2892	Warning	Aux102 1 Expansion Input 10 Fault
2893	Warning	Aux102 1 Expansion Input 11 Fault
2894	Warning	Aux102 1 Expansion Input 12 Fault
2895	Warning	PCCNet Device Failed
2896	Shutdown	Critical PCCNet Dev Fail
2912	Shutdown	Voltage Reconnection Switch Operated
2913	Warning	Reconnection Switch Operated
2914	Shutdown	Genset AC Meter Failed
2915	Warning	Gen Bus AC Meter Failed
2916	Warning	Utility AC Meter Failed
2917	Warning	Gen Bus Voltage OOR Hi
2918	Warning	Utility Voltage OOR Hi
2919	Warning	Utility Current OOR Hi
2921	Warning	Gen Bus Current OOR Hi
2922	Warning	High Genset Neutral Curr

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Code	Lamp	Displayed Message
2923	Warning	Gen Bus kW OOR Hi
2924	Warning	Gen Bus kVAR OOR Hi
2925	Warning	Gen Bus kVA OOR Hi
2926	Warning	Utility kW OOR Hi
2927	Warning	Utility kVAR OOR Hi
2928	Warning	Utility kVA OOR Hi
2931	Shutdown	Aux101 Device ID Fault
2932	Warning	Aux101 Oil Temperature OOR Hi
2933	Warning	Aux101 Oil Temperature OOR Low
2934	Warning	High Ambient Temp
2935	Warning	Low Ambient Temp
2936	Warning	Fuel Level High
2937	Warning	Fuel Level Low
2938	Warning	Earth/Ground Fault
2939	Warning	Modbus Failure
2941	Event	Remote Shutdown Fault Reset Occurrence
2942	Warning	Shutdown Override Fail
2943	Warning	Manual Sw Config Fail
2944	Warning	Auto Switch Config Fail
2945	Warning	Rupture Basin Switch
2946	Warning	Exhaust St 2 Temp Low
2947	Warning	Exhaust St 1 Temp Low
2948	Warning	Exhaust St 2 Temp High
2949	Warning	Exhaust St 1 Temp High
2951	Warning	Alternator 1 Temp High
2952	Warning	Alternator 1 Temp Low
2953	Warning	Alternator 1 Temp High
2954	Warning	Alternator 2 Temp High
2955	Warning	Alternator 2 Temp Low
2956	Warning	Alternator 2 Temp High
2957	Warning	Alternator 3 Temp High
2958	Warning	Alternator 3 Temp Low
2959	Warning	Alternator 3 Temp High
2961	Event	EGR Torque Derate Error

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Code	Lamp	Displayed Message
2962	Warning	EGR RPM Derate Error
2963	Event	HT Coolant Temperature Warning High
2964	Warning	Pre-high Intake Manifold Temperature
2965	Event	Genset Available
2971	Event	Test/Exercise Fault
2972	Shutdown	Field Overload
2973	Warning	Charge Press IR Error
2976	Warning	AT1 Diesel Exhaust Fluid Dosing Unit Temp. Error
2977	Warning	Low Coolant Level 2 Sw
2978	Warning	Low Intake Manf 1 Temp
2979	Warning	High Alternator Temp Sw
2981	Warning	High Drive Bearing Temp
2982	Warning	Low Drive Bearing Temp
2983	Warning	High Drive Bearing Temp
2984	Warning	High Free Bearing Temp
2985	Warning	Low Free Bearing Temp
2986	Warning	High Free Bearing Temp
2992	Warning	High Intake Manf 1 Temp
2993	Warning	Battery Charger Sw Fail
2994	Shutdown	MC68302 Error
2995	Shutdown	Int Man Pressure 1 Critical High
2996	Shutdown	Int Man Pressure 1 Moderate High
2997	Shutdown	Exhaust O2 Critical Low
2998	Warning	Engine Torque Limit Feature Special Instructions
3111	Shutdown	Excessive Mech Vibration 1 (A1)
3112	Shutdown	Excessive Mech Vibration 2 (B1)
3113	Shutdown	Excessive Mech Vibration 3 (A2)
3114	Shutdown	Excessive Mech Vibration 4 (B2)
3115	Shutdown	Excessive Mech Vibration 5 (A3)
3116	Shutdown	Excessive Mech Vibration 6 (B3)
3117	Shutdown	Excessive Mech Vibration 7 (A4)
3118	Shutdown	Excessive Mech Vibration 8 (B4)
3119	Shutdown	Excessive Mech Vibration 9 (A5)
3121	Shutdown	Excessive Mech Vibration 10 (B5)

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Code	Lamp	Displayed Message
3122	Shutdown	Excessive Mech Vibration 11 (A6)
3123	Shutdown	Excessive Mech Vibration 12 (B6)
3124	Shutdown	Excessive Mech Vibration 13 (A7)
3125	Shutdown	Excessive Mech Vibration 14 (B7)
3126	Shutdown	Excessive Mech Vibration 15 (A8)
3127	Shutdown	Excessive Mech Vibration 16 (B8)
3128	Shutdown	Excessive Mech Vibration 17 (A9)
3129	Shutdown	Excessive Mech Vibration 18 (B9)
3131	Shutdown	Secondary Engine Overspeed
3133	Warning	Aftertreatment Particulate Filter Outlet Pressure OOR High
3134	Warning	Aft Particulate Filter Outlet Pressure: OORL
3135	Warning	Aft Particulate Filter Pressure: Data Eratic
3139	Warning	ASO Solenoid out of range high
3142	Warning	AT1 SCR Intake Temp. Sensor Circuit OOR High
3143	Warning	AT1 SCR Intake Temp. Sensor Circuit OOR Low
3144	Warning	AT1 SCR Intake Temperature Sensor Error
3146	Warning	AT1 SCR Outlet Temp. Sensor Circuit OOR High
3147	Warning	AT1 SCR Outlet Temp. Sensor Circuit OOR Low
3148	Warning	AT1 SCR Outlet Temperature Sensor Error
3151	Warning	AT1 SCR Catalyst System Missing Condition
3165	Shutdown	Aftertreatment 1 SCR Outlet Temperature High
3173	Warning	AT1 Warm Up DOCE Low
3226	Event	Base Load
3227	Event	Peak Shave
3228	Warning	Aftertreatment Intake Nox Sensor: Data Incorrect *
3229	Shutdown	AT1 SCR Intake Temp. High - Most Severe Level
3231	Shutdown w/Cooldown	AT1 SCR Intake Temp. High - Moderate Severe Level
3232	Warning	Aftertreatment Intake Nox Sensor:Abrnormal Update *
3235	Shutdown w/Cooldown	AT1 SCR Outlet Temperature High
3237	Warning	AT1 DEF Line Heater 1 Circuit OOR High
3238	Warning	AT1 DEF Line Heater 1 Circuit OOR Low
3239	Warning	AT1 DEF Line Heater 2 Circuit OOR High
3241	Warning	AT1 DEF Line Heater 2 Circuit OOR Low

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Code	Lamp	Displayed Message
3242	Warning	AT1 DEF Tank Heater Mechanical System Error
3245	Warning	Aft Particulate Filter System: Not Responding *
3251	Shutdown	Aft Catalyst Intake Temp:Data Valid:Above Normal *
3253	Shutdown	Particulate Filter Int Temp: Above Normal Mod Sev *
3254	Warning	Particulate Filter Int Temp: Above Normal *
3255	Shutdown	Particulate Filter Out Temp: Above Normal Mod Sev
3256	Warning	Particulate Filter Outlet Temp: Above Normal
3258	Warning	AT1 DEF Line Heater 1 Open Circuit
3261	Warning	AT1 DEF Line Heater 2 Open Circuit
3262	Event	Spark Plug 7 (A4) High Warning
3263	Event	Spark Plug 7 (A4) Low Warning
3264	Event	Spark Plug 8 (B4) High Warning
3265	Event	Spark Plug 8 (B4) Low Warning
3266	Event	Spark Plug 9 (A5) High Warning
3267	Event	Spark Plug 9 (A5) Low Warning
3268	Event	Spark Plug 10 (B5) High Warning
3269	Event	Spark Plug 10 (B5) Low Warning
3271	Event	Spark Plug 11 (A6) High Warning
3272	Event	Spark Plug 11 (A6) Low Warning
3273	Event	Spark Plug 12 (B6) High Warning
3274	Event	Spark Plug 12 (B6) Low Warning
3275	Event	Spark Plug 13 (A7) High Warning
3276	Event	Spark Plug 13 (A7) Low Warning
3277	Event	Spark Plug 14 (B7) High Warning
3278	Event	Spark Plug 14 (B7) Low Warning
3279	Event	Spark Plug 15 (A8) High Warning
3281	Event	Spark Plug 15 (A8) Low Warning
3282	Event	Spark Plug 16 (B8) High Warning
3283	Event	Spark Plug 16 (B8) Low Warning
3284	Event	Spark Plug 17 (A9) High Warning
3285	Event	Spark Plug 17 (A9) Low Warning
3286	Event	Spark Plug 18 (B9) High Warning
3287	Event	Spark Plug 18 (B9) Low Warning
3288	Warning	Exhaust Aftertreatment Outlet Oxygen Relay OOR High

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Code	Lamp	Displayed Message
3289	Warning	Exhaust Aftertreatment Outlet Oxygen Relay OOR Low
3291	Warning	Exhaust Aftertreatment Inlet Oxygen Relay OOR High
3292	Warning	Exhaust Aftertreatment Inlet Oxygen Relay OOR Low
3293	Warning	Exhaust Oxygen Relay OOR High
3294	Warning	Exhaust Oxygen Relay OOR Low
3311	Shutdown	Particulate Filter Int Temp: Above Normal Severe
3312	Shutdown	Paticulate Filter Out Temp: Above Normal Severe
3313	Warning	Aft Catalyst Intake Temperature: Below Normal
3314	Warning	Aft Catalyst Intake Temperature: Above Normal
3315	Warning	Aft Catalyst Intake Temperature: Incorrect
3316	Warning	Aft Particulate Filter Intake Temperature: OORL
3317	Warning	Aft Particulate Filter Intake Temperature: OORH
3318	Warning	Af Particulate Filter Intake Temp: Data Incorrect
3319	Warning	Aft Particulate Filter Outlet Temp Circuit: OORH
3321	Warning	Aft Particulate Filter Outlet Temp Circuit: OORL
3322	Warning	Aft Particulate Filter Outlet Temp: Data Incorrect
3325	Warning	Aft Catalyst Intake Temp Swapped: Out Of Cal
3329	None	J1939 Network 2 Data Incorrect
3331	None	J1939 Network 3 Data Incorrect
3341	Warning	Engine Air Filter Differential Pressure High
3362	Warning	Power Conservation Control OOR High
3363	Warning	Power Conservation Control OOR Low
3364	Warning	Power Conservation Control Cond Exists
3365	Warning	External Air Pressure Low Warning Error
3384	Warning	Manifold Absolute Pressure 2 High Error
3391	Warning	Manifold Absolute Pressure 2 Low Error
3392	Shutdown	Int Man Pressure 2 Critical High
3393	Warning	Int Man Pressure 2 Moderate High
3396	Warning	DPF 1 Conditions Not Met for Active Regeneration
3397	Shutdown	Low Gearbox Oil Pressure – Condition Exists
3398	Shutdown	High Gearbox Oil Pressure – Condition Exists
3399	Shutdown	Differential Fault – Condition Exists
3411	Warning	DC Power Supply Fault – Condition Exists
3412	Warning	GIB Isolator Open Fault – Condition Exists

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Code	Lamp	Displayed Message
3413	Warning	Radiator Fan Trip Fault – Condition Exists
3414	Warning	Ventilator Fan Trip Fault – Condition Exists
3415	Warning	Louvres Closed Fault – Condition Exists
3416	Warning	Start System Fault – Condition Exists
3417	Warning	Alternator Heater Trip Fault – Condition Exists
3422	Warning	AT DEF Line Heater 3 Circuit OOR High
3423	Warning	AT DEF Line Heater 3 Circuit OOR Low
3425	Warning	AT DEF Line Heater 3 Open Circuit
3457	Warning	Loss of Bus Voltage Sensing
3458	Warning	Knock Engine Derate
3475	Warning	Engine Electronic Fuel Valve #2 OOR High
3476	Warning	Engine Electronic Fuel Valve #2 OOR Low
3477	Warning	Fuel Actuator 2 Control Valve: Out of Adjustment
3478	Warning	Engine Charge Air Cooler Outlet Temperature Error
3479	Shutdown	Start-Inhibit Warning Fault Event
3481	Event	Start-Inhibit Warning Fault Event
3482	Shutdown	Start-Inhibit Shutdown Fault
3483	Shutdown	High Alternator Temperature 1 Shutdown Fault
3484	Shutdown	High Alternator Temperature 2 Shutdown Fault
3485	Shutdown	High Alternator Temperature 3 Shutdown Fault
3486	Shutdown	High Drive End Bearing Temperature Shutdown Fault
3487	Shutdown	High Non-Drive End Bearing Temp Shutdown Fault
3489	Warning	Compressor Bypass Actuator Error
3491	Shutdown	Oil Filter Restriction High
3497	Warning	Low AT1 Diesel Exhaust Fluid Tank Level
3498	Warning	AT1 DEF Tank Level Low
3499	Shutdown	Throttle Actuator 2- Special Instruction
3511	Shutdown	Throttle Actuator 2- Shorted High
3512	Shutdown	Throttle Actuator 2- Shorted Low
3513	Warning	Negative Sequence Overcurrent
3514	Shutdown	Throttle Actuator - Shorted Low
3515	Shutdown	Throttle Actuator - Special Instruction
3521	Warning	Throttle Actuator - Temperature Low
3522	Warning	Throttle Actuator 2- Temperature Low

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Code	Lamp	Displayed Message
3539	Warning	Intake Throttle Sensor Circuit shorted to High
3541	Warning	Intake Throttle Sensor Circuit shorted to Low
3543	Warning	NOx limits exceeded - Cond Exists
3545	Warning	Aftertreatment 1 Outlet NOx Sensor - Abnormal
3547	Warning	Aftertreatment Diesel Exhaust Fluid Tank Empty
3555	Warning	Engine Wait to Start Lamp - Abnormal
3558	Warning	AT1 Diesel Exhaust Fluid Dosing Unit OOR High
3559	Warning	AT1 Diesel Exhaust Fluid Dosing Unit OOR Low
3562	Warning	AT DEF Line Heater Relay OOR High
3563	Warning	AT DEF Line Heater Relay OOR Low
3565	Warning	AT1 DEF Dosing Valve 1 OOR High
3567	Warning	AT DEF Dosing Valve Open Circuit
3568	Warning	AT DEF Dosing Valve Mechanical system Error
3571	Warning	AT1 Diesel Exhaust Fluid Pressure Sensor OOR High
3572	Warning	AT1 Diesel Exhaust Fluid Pressure Sensor OOR Low
3574	Warning	AT1 Diesel Exhaust Fluid Pressure Sensor Low
3575	Warning	AT1 Diesel Exhaust Fluid Pressure Sensor High
3577	Warning	AT Diesel Exhaust Fluid Return Valve OOR High
3578	Warning	AT Diesel Exhaust Fluid Return Valve OOR Low
3582	Warning	AT SCR Catalyst Conversion Efficiency Low
3583	Warning	AT1 Outlet NOx Sensor Heater - Abnormal
3584	Shutdown	Engine Derate: Special
3585	Warning	Generator Total Real Power: Root Cause Unkwn
3586	Warning	Generator Total Real Power: Data Incorrect
3587	Warning	Methane Percent Signal:Below Normal-Least Severe
3588	Shutdown	Methane Percent Signal:Below Normal-Most Severe
3589	Warning	Methane Percent Signal: Data Incorrect
3591	Shutdown	Methane Percent Signal: Special
3592	Warning	Methane Percent Signal: Current Above Normal
3593	Warning	Methane Percent Signal: Current Below Normal
3594	Warning	Eng Emissions Closed Loop Fueling Adj:Cond Exists
3595	Shutdown	Eng Emission Closed Loop Fuel Adj:Root Cause Unkwn
3596	Warning	AT1 Diesel Exhaust Fluid Pressure Sensor Error
3599	Warning	Ground Current OOR Warning

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Code	Lamp	Displayed Message
3611	Warning	Custom Overcurrent Fault
3614	Warning	Coolant Level Sensor Received N/W Data in Error
3629	Warning	Device Calibration Update Recommended
3631	Shutdown	Device Calibration Update Required
3633	Warning	Engine Fan Clutch 2 Control Circuit OOR High
3634	Warning	Engine Fan Clutch 2 Control Circuit OOR Low
3641	Shutdown	Start Enable Line 1 Disabled
3642	Shutdown	Start Enable Line 2 Disabled
3643	Shutdown	Start Enable Line 3 is Disabled
3644	Shutdown	Intake Manifold Temperature: Special
3645	Shutdown	Intake Manifold 2 Temperature: Special
3646	Shutdown	Intake Manifold 3 Temperature: Special
3647	Shutdown	Intake Manifold 4 Temperature: Special
3649	Warning	AT1 Intake NOx Sensor Heater - Abnormal
3664	Shutdown	Genset Config Mismatch
3681	Warning	AT1 Outlet NOx Sensor Power Supply Error
3682	Warning	Aftertmt Intake Nox:Power Supply Data Incorrect
3694	Warning	Gain Adjust Potentiometer Circuit: OORL
3695	Warning	Frequency Adjust Potentiometer Circuit: OORL
3696	Warning	Droop Adjust Potentiometer Circuit: OORL
3697	Shutdown	RAM Refresh Error
3717	Warning	AT1 Outlet NOx Sensor - Out of Calibration
3718	Warning	Aftertreatment Intake Nox Sensor:Out of Cal
3724	Warning	Battery 1 Voltage: Below Normal
3725	Warning	Aftertreatment 1 Intake NOx Sensor - Abnormal
3727	None	Common Rail Fuel Press Relief Valve: Not Resp
3728	Shutdown	Engine Throttle Control Actuator: Network Error
3741	Warning	Common Rail Fuel Pressure: Above Normal
3748	Warning	AT1 Intake NOx Sensor - Data not Rational
3749	Warning	AT1 Outlet NOx Sensor - Data not Rational
3753	None	Diesel Particulate Filter Active Regen Inhibited
3846	Warning	Fuel Actuator Ctrl:Data Above Normal-least severe
3847	Warning	Fuel Actuator Ctrl:Data Below Normal-Least Severe
3848	Shutdown	Fuel Actuator Control: Special

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Code	Lamp	Displayed Message
3849	Shutdown	Fuel Actuator Control: Bad Device
3851	Shutdown	Fuel Actuator Control: Network Error
3852	Warning	Fuel Act2Ctrl Valve:Data Above Normal-Least Severe
3853	Warning	Fuel Act2Ctrl Valve:Data Below Normal-Least Severe
3854	Shutdown	Fuel Actuator 2 Control Valve: Special
3855	Shutdown	Fuel Actuator 2 Control Valve: Bad Device
3856	Shutdown	Fuel Actuator 2 Control Valve: Network Error
3857	Warning	Fuel Actuator 2 Control Valve: Root Cause Unkwn
3858	Warning	Eng Turbochrg Compressor:Above Normal-Least Severe
3859	Warning	Eng Turbochrg Compressor:Below Normal-Least Severe
3861	Warning	Engine Turbocharger Compressor:Root Cause Unkwn
3862	Warning	Eng Turbocharg Compressor Bypass Actuator:Special
3863	Shutdown	Eng Turbochrg Compressor Bypass Actuator:Bad Comp
3864	Warning	Engine TurboChgr Comp Bypass Actuator: N/W error
3866	Warning	AT DEF Quality low Warning
3867	Warning	AT DEF Quality Low - Moderately Severe level
3868	Warning	AT Diesel Exhaust Fluid Quality Error
3869	Warning	LVRT Device Error
3871	Warning	LVRT Engine Governing Message Lost Error
3872	Warning	LVRT Count Warning Error
3873	Shutdown	LVRT Count Serious Error
3874	Warning	LVRT Stuck On Error
3875	Warning	LVRT Detection Error
3876	Warning	AT DEF Quality Sensor Mech system Error
3878	Warning	AT Diesel Exhaust Fluid Quality Sensor Data error
3917	Warning	Engine Turbocharger Lube Oil Pressure low Warning
3918	Warning	Engine Turbocharger Wastegate Actuator Cal Error
3931	Shutdown	Engine Protection System Approaching Shutdown
4135	Warning	Inducement Approaching: Performance is Active
4152	Warning	AT SCR Temperature Sensor Module - Abnormal
4155	Warning	AT1 DEF Dosing Unit Heater Relay OOR High
4156	Warning	AT1 DEF Dosing Unit Heater Relay OOR Low
4157	Warning	AT DEF Return Valve Mechanical system Error
4159	Warning	AT SCR Temperature Sensor Module - Bad Device

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Code	Lamp	Displayed Message
4164	Warning	AT SCR Temperature Sensor Module OOR High
4165	Warning	AT SCR Temperature Sensor Module OOR Low
4166	Warning	AT SCR Temperature Sensor Module High
4168	Warning	AT1 DEF Dosing Unit Heater OOR High
4169	Warning	AT1 DEF Dosing Unit Heater OOR Low
4171	Warning	Selective Catalytic Reduction Temperature Low
4241	Warning	AT DEF Quality - Received Network Data Error
4243	Warning	AT1 Diesel Exhaust Fluid Temperature 2 - Abnormal
4249	Warning	AT1 DEF Dosing Temperature - Abnormal
4252	None	Engine Wait to Start Lamp - Condition Exists
4261	Warning	AT SCR Temp Sensor Module - Root Cause Unknown
4262	Warning	HPCR Fuel Pressure Relief Valve OOR High
4263	Warning	HPCR Fuel Pressure Relief Valve OOR Low
4265	Warning	High Press Common Rail Fuel Press Relief Valve Err
4277	Warning	AT Diesel Exhaust Fluid Quality - Abnormal
4285	Shutdown	LVRT Shutdown Fault
4293	Warning	Engine Brake Active Lamp OOR High
4294	Warning	Engine Brake Active Lamp OOR Low
4358	Shutdown	Setup Mode Shutdown
4437	None	J1939 Network 4 Data Incorrect
4517	Warning	Vehicle Identification Number - Out of Calibration
4572	Warning	AT1 DEF Tank Temperature - Abnormal
4585	Shutdown	AT1 SCR Catalyst System - Special Instructions
4615	Shutdown	Fuel Delivery Pressure Above Normal
4636	Warning	Throttle Delta Pressure Incorrect
4642	Shutdown	Water In Fuel Above Normal
4643	Warning	Inj Solenoid Driver 7 Calib Error
4644	Warning	Injector Solenoid Driver 8 Calib Error
4645	Warning	Injector Solenoid Driver 9 Calib Error
4646	Warning	Injector Solenoid Driver 10 Calib Error
4647	Warning	Injector Solenoid Driver 11 Calib Error
4648	Warning	Injector Solenoid Driver 12 Calib Error
4649	Warning	Injector Solenoid Driver 13 Calib Error
4651	Warning	Injector Solenoid Driver 14 Calib Error

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Code	Lamp	Displayed Message
4652	Warning	Injector Solenoid Driver 15 Calib Error
4653	Warning	Injector Solenoid Driver 16 Calib Error
4658	Warning	AT SCR Actual Dosing Reagent Quantity Low
4677	Warning	AT1 DEF Tank Level Abnormal Update Rate
4686	Warning	Connector Cap Not Present
4688	Warning	Water in Fuel Indicator 2 Sensor OOR Hi
4689	Warning	Water in Fuel Indicator 2 Sensor OOR Lo
4696	Warning	Crankcase Pressure 2 OOR High
4697	Warning	Crankcase Pressure 2 OORL
4698	None	Crankcase Pressure 2 Above Normal
4699	Warning	Crankcase Pressure 2 Moderate Hi
4711	None	Crankcase Pressure 2 Below Normal
4731	Warning	AT1 DEF Tank Temp Sensor Out of Calibration
4732	Warning	AT1 DEF Tank Level Sensor Out of Calibration
4739	Warning	AT1 DEF Tank Level Sensor - Root Cause Unknown
4741	Warning	AT DEF Quality Sensor Open Circuit
4742	Warning	AT DEF Quality Sensor Short Circuit
4743	Warning	AT1 DEF Temperature 2 Sensor Open Circuit
4744	Warning	AT1 DEF Temperature 2 Sensor Short Circuit
4745	Warning	AT1 DEF Temperature 2 - Root Cause Unknown
4747	Warning	AT Intake Oxygen Sensor Data not Rational - High
4748	Warning	AT Intake Oxygen Sensor Data not Rational - Low
4749	Warning	AT Outlet Oxygen Sensor Data not Rational - High
4751	Warning	AT Outlet Oxygen Sensor Data not Rational - Low
4761	Shutdown	Genset Voltage Sensing MCB Protection
4766	Warning	Customer Gas Valve Close Warning
4767	Shutdown	Customer Gas Valve Close Shutdown
4768	Warning	AT1 DEF Property - Root Cause Unknown
4769	Warning	AT1 DEF Tank Level Sensor Abnormal Rate Change
4789	Warning	Fan Speed High - Most Severe Level
4791	Warning	Fan Speed Low - Most Severe Level
4842	None	Aftertreatment Diesel Exhaust Fluid Quality High
4867	Warning	HPCR Fuel Pressure Relief Valve - Condition Exists
4872	Warning	System Network Failure

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Code	Lamp	Displayed Message
4873	Warning	Genset Failed to Come Online
4874	Warning	Load Demand Version Incompatibility
4875	Event	Genset Ineligible For Load Demand
4876	Warning	Genset Lost On System Network
4877	Warning	System Settings Not Synchronized
4878	Warning	Check System Network Installation
4879	Warning	Load Demand Setup Error
4881	Warning	System Genset ID Conflict
4882	Warning	Genset Bus Overload
4883	Warning	Prelube Cycle Failed
4884	Warning	Prelube Pump Stuck ON
4885	Shutdown	Fuel Supply Pump Not Responding
4886	Warning	Fuel Pump Voltage Moderate Low
4887	Shutdown	Fuel Supply Voltage Below Normal
4888	Shutdown	Fuel Supply Temperature: Moderate High
4889	Shutdown	Fuel Supply Temperature Critical High
4891	Warning	Fuel Supply Pump Root Unknown Cause
4893	Warning	Fuel Filter Press Moderate High
4894	Warning	Fuel Supply Pump Calib Error
4927	Warning	Fuel Valve 1 Bad Device
4928	Warning	Fuel Valve 1 Power Supply Data Incorrect
4929	Warning	Fuel Valve 1 Power Supply OOR High
4931	Warning	Fuel Valve 1 Power Supply OOR Low
4932	Event	Fuel Valve 1 Temp Above Normal
4933	Event	Fuel Valve 1 Position Data Error
4934	Warning	Fuel Valve 1 Voltage OOR High
4935	Warning	Fuel Valve 1 Voltage OOR Low
4936	Warning	Fuel Valve 1 Unknown Cause
4937	Warning	Fuel Valve 1 Calib Error
4941	Warning	Starter Control Voltage OOR High
4942	Warning	Starter Control Voltage OOR Low
4943	Warning	Failed To Crank Condition Exists
4944	Warning	Failed To Start Condition Exists
4945	Warning	Uncommanded Crank Cond Exists

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Code	Lamp	Displayed Message
4946	Event	Engine Crank Without Prelube Condition Exists
4958	Warning	Fuel Valve 1 Data Incorrect
4959	Event	Fuel Valve 1 Condition Exists
4961	Event	Fuel Valve 1 Update Rate Error
4982	Warning	Fuel Supply Pump Update Rate Error
5119	Warning	Fuel Pump Oil Pressure Sensor OOR High
5121	Warning	Fuel Pump Oil Pressure Sensor OOR Low
5122	Warning	Fuel Pump Oil Pressure Sensor Data Incorrect
5123	Warning	Injector Solenoid 19 Low Current
5124	Warning	Injector Solenoid 20 Low Current
5135	Shutdown	Genset Overload
5145	Warning	Load Demand Genset Bus Failure
5148	Warning	Allow Start Override Active Condition Exists
5149	Warning	Prelube Cycle failed during Non-Emergency Start
5151	Warning	Intake air restriction indicator 1 active
5152	Warning	Intake air restriction indicator 2 active
5153	Warning	Intake air restriction indicator 3 active
5154	Warning	Intake air restriction indicator 4 active
5155	Warning	Low Battery 1 Voltage
5156	Warning	Low Battery 2 Voltage
5157	Warning	Low Battery 3 Voltage
5158	Warning	Low Battery 4 Voltage
5159	Warning	Weak Battery 1
5161	Warning	Weak Battery 2
5162	Warning	Weak Battery 3
5163	Warning	Weak Battery 4
5164	Warning	Battery Charger 2 Failed Fault
5165	Warning	Battery Charger 3 Failed Fault
5166	Warning	Battery Charger 4 Failed Fault
5176	Warning	AT1 DEF Tank Level2 Abnormal Update Rate
5178	Warning	Crankcase Pressure 2 Data Incorrect
5182	Warning	AUX101 0 Input 1 Fault
5247	Warning	AT1 SCR Intake Temp. High Warning
5283	Warning	High Battery 1 Voltage

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Code	Lamp	Displayed Message
5284	Warning	High Battery 2 Voltage
5285	Warning	High Battery 3 Voltage
5286	Warning	High Battery 4 Voltage
5287	Warning	Starter Air Supply Pressure Low
5288	Warning	Starter Air Tank Volume Low
5377	Warning	AUX101-3 Communication Lost Fault
5378	Warning	AUX101-4 Communication Lost Fault
5397	Shutdown	L-N Short Circuit Shutdown
5398	Shutdown	L-L Short Circuit Shutdown
5399	Event	AmpSentry Maintenance Mode Active
5442	Shutdown	Low Geartrain Oill Level
5443	Warning	Geartrain Oil Level OOR Hi
5444	Warning	Geartrain Oil Level OOR Lo
5531	Shutdown	Cam Position Frequency Mismatch
5655	Warning	AT1 SCR Conversion Efficiency
5689	Warning	AT1 Outlet NOx Sensor Error
5838	Warning	AT1 Outlet NOx Sensor Abnormal Rate of Change
5864	Warning	AT1 DEF Pump Command OOR High
5865	Warning	AT1 DEF Pump Command OOR Low
5866	Warning	AT DEF Dosing Unit Relay Feedback OOR High
5867	Warning	AT DEF Dosing Unit Relay Feedback OOR Low
5887	None	AT1 SCR System Hydrocarbon High
5888	Warning	AT1 SCR System Hydrocarbon High Warning
5889	Shutdown	AT1 SCR System Hydrocarbon High Shutdown
5935	Warning	AT1 DEF Pressure Mechanical System Error
5936	Warning	AT1 DEF Pressure High Warning
5946	Warning	High Geartrain Oil Temperature
5947	Warning	High Geartrain Oil Level
6256	None	Battery 1 Voltage High
6257	None	Battery 1 Voltage Low
6258	None	Electric Lift Pump for Eng Fuel Supply OOR High
6259	None	Electric Lift Pump for Eng Fuel Supply OOR Low
6263	None	Fan Control Circuit OOR High
6264	None	Fan Control Circuit OOR Low

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Code	Lamp	Displayed Message
6336	None	Crankcase Breather Filter Heater OOR High
6337	None	Crankcase Breather Filter Heater OOR Low
6464	None	AT1 Out Nox Sens Error
6467	None	Fan Speed High
6468	None	Fan Speed Low
6475	None	AT1 DEF Tank Heater Mechanical Error
6476	None	AT1 DEF Tank Heater Low
6477	None	AT1 DEF Line Heater Relay OOR High
6478	None	AT1 DEF Line Heater Relay OOR Low
6479	None	AT1 DEF Tank Heater OOR High
6481	None	AT1 DEF Tank Heater OOR Low
6522	None	Coolant Level Sensor 1 OOR Low
6523	None	Coolant Level Sensor 1 OOR High
6524	None	Engine Oil Temperature Sensor 1 OOR High
6525	None	Engine Oil Temperature Sensor 1 OOR Low
6526	None	AT1 DEF Tank Level Out of Calibration Error
6531	None	AT1 DEF Line Heater1 OOR High
6532	None	AT1 DEF Line Heater1 OOR Low
6533	None	AT1 DEF Line Heater2 OOR High
6534	None	AT1 DEF Line Heater2 OOR Low
6535	None	AT1 DEF Line Heater3 OOR High
6536	None	AT1 DEF Line Heater3 OOR Low
6595	None	Engine Speed Root Cause Unknown
6619	None	AT1 DEF Temperature 2 Abnormal Update Rate
6692	None	AT1 SCR System Soot High
6693	Warning	AT1 SCR System Soot High Warning
6694	Shutdown	AT1 SCR System Soot High Shutdown
6752	None	AT DEF Quality Low
7135	Warning	Engine Turbocharger Speed High Warning
7243	Warning	Failed Normal Start Attempt
7268	None	AT1 SCR System Cleaning Incomplete Error
7269	Warning	AT1 SCR System Cleaning Incomplete Error Warning
7697	Shutdown	Bank Cut-Off FSO Failure
7823	Warning	Cylinder Cut-Off System failure

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Code	Lamp	Displayed Message
7824	Warning	Cylinder Cut-Off System State and Feedback Mismatch
7825	Shutdown	Generator Total Real Power Sensing Failure
8632	Warning	Charging Alternator Fuse Failure
9945	Warning	Injector 6 Circuit 2 Error
9946	Warning	Injector 5 Circuit 2 Error
9947	Warning	Injector 4 Circuit 2 Error
9948	Warning	Injector 3 Circuit 2 Error
9949	Warning	Injector 2 Circuit 2 Error
9951	Warning	Injector 1 Circuit 2 Error
9971	Event	ECM Derate Fault
9973	Event	Watchdog Reset Occurrence
13266	Warning	Engine Crankcase Pressure 2: Data Valid: Below Normal: Mod Severe

5.3 Alternator Performance Troubleshooting

5.3.1 No Voltage (No Load)

5.3.1.1 Voltmeter Faulty

Check and verify voltage at generator output terminals with a multimeter.

5.3.1.2 Loose, Broken, or Corroded Connections

Check all connections, repair and replace where necessary.

5.3.1.3 Insulation Failure to Earth (Ground) on Permanent Magnet Stator

Disconnect leads 06, 08, and 10 in the terminal box and use insulation test meter to measure the resistance value of the insulation to earth (ground).

5.3.1.4 Main Rectifier Diodes Short Circuit

Use a multimeter to test diodes on the main rotating rectifier assembly.

5.3.1.5 Faulty Permanent Magnet Generator, Stator or Rotor

1. Disconnect the permanent magnet generator leads from automatic voltage regulator terminals 06, 08, and 10 in the terminal box.
2. With the generator set running at the correct speed, use a multimeter to check voltage across the leads.
   - For 50 Hz, voltage should be approximately 170 to 195 VAC.
   - For 60 Hz, voltage should be approximately 204 to 234 VAC.

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5.3.1.6 Automatic Voltage Regulator High Excitation Protection Circuit Activated, Collapsing Output Voltage

Automatic voltage regulator protection circuit is factory set to trip at +70 VDC across automatic voltage regulator output, X+ (F1) and XX- (F2) at terminal box leads 13 and 14, after pre-set time delay.

1. Shut down the alternator, start and run alternator up again. If the voltage builds up normally but collapses again, the protection circuit has operated.
2. Run alternator again and check the excitation voltage across automatic voltage regulator output. If greater than 70 VDC, the protection circuit is operating correctly.

5.3.1.7 Open Circuit in Exciter Stator Windings

Remove external leads from generator. Check the resistance value of the exciter stator across these two leads with a multimeter. Refer to **Section 6.3 on page 373** for the specific alternator for specific alternator model and the corresponding resistance value.

5.3.1.8 Faulty Automatic Voltage Regulator (PCC3300) or Power Stage (AUX 103)

1. Replace AUX 103 board and re-test.
2. If not resolve replace the PCC 3300 control board and re-test.

5.3.1.9 Winding Fault, Open Circuit, or Short Circuit

1. Remove external leads from the alternator.
2. Use appropriate metering equipment (Wheatstone bridge or Kelvin bridge). Measure the low resistance winding of the main rotor and stator, and the exciter rotor.

5.3.2 Low Voltage (No Load)

5.3.2.1 Engine Speed Low, Under Frequency Roll-off

Under frequency roll-off protection is activated, indicating low engine speed.

1. Adjust or correct engine speed to an acceptable nominal.

5.3.2.2 Voltage Sensing is Faulty

Use a multimeter to check and verify voltage at generator output terminals.

5.3.2.3 Automatic Voltage Regulator Voltage Adjustment Trim Is Configured Incorrectly

Use the InPower service tool to adjust nominal voltage parameter to the appropriate value for the application level.

5.3.2.4 Faulty Automatic Voltage Regulator (PCC3300) or Power Stage (AUX 103)

1. Replace AUX 103 board and re-test.
2. If not resolve replace the PCC 3300 control board and re-test.

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5.3.3 High Voltage (No Load)

5.3.3.1 Automatic Voltage Regulator Voltage Adjustment Trim Is Configured Incorrectly

Use the InPower service tool to adjust nominal voltage parameter to the appropriate value for the application level.

5.3.3.2 Low Sensing Supply From Main Stator

1. Check sensing supply at all of leads of the alternator.

   Open circuit or low sensing signal will cause the automatic voltage regulator to produce high excitation, this will produce a high output voltage.

5.3.3.3 Faulty Automatic Voltage Regulator (PCC3300) or Power Stage (AUX 103)

1. Replace AUX 103 board and re-test.
2. If not resolve replace the PCC 3300 control board and re-test.

5.3.4 Unstable Voltage (No Load)

5.3.4.1 Engine Speed Hunting (Unstable)

1. Check with a frequency meter or tachometer for speed variations due to hunting, or cyclic irregularities in the engine.

   This may improve as load is applied.

5.3.4.2 Automatic Voltage Regulator Parameters Configured Incorrectly

1. Use the InPower servce tool to adjust automatic voltage regulator gain and/or damping trims to the appropriate value(s).
2. Check again when loaded.

5.3.4.3 Loose or Corroded Connections

1. Check push on terminals on automatic voltage regulator. Repair or replace as necessary.
2. Check auxiliary terminals for loose connections. Repair or replace as necessary.

5.3.4.4 Intermittent Earth (Ground) on Machine

Use insulation test meter to test all the alternator windings. Low insulation resistance can affect the automatic voltage regulator.

5.3.5 Unbalanced Voltage (No Load)

5.3.5.1 Fault in the Main Stator Winding

1. Disconnect all external leads to the alternator and re-test.
2. Separately excite alternator by connecting DC battery supply to the exciter stator leads X+ (F1) and XX- (F2) at the terminal box leads 13 and 14.

NOTICE
Hot Surfaces

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A shorted winding will get very hot and may cause burns if touched.

Do not touch the winding.

- A winding short will get hot, and engine will sound slightly loaded.

3. Measure the winding resistance and the winding insulation resistance to check for a winding short.

5.3.6 Unbalanced Voltage (with Load)

5.3.6.1 Fault in the Main Stator Winding

1. Disconnect all external leads to the alternator and re-test.
2. Separately excite alternator by connecting DC battery supply to the exciter stator leads X+ (F1) and XX- (F2) at the terminal box leads 13 and 14.

NOTICE
Hot Surfaces

A shorted winding will get very hot and may cause burns if touched.

Do not touch the winding.

- A winding short will get hot, and engine will sound slightly loaded.

3. Measure the winding resistance and the winding insulation resistance to check for a winding short.

5.3.7 Unstable Voltage (with Load)

5.3.7.1 Engine Governing Hunting (Unstable)

Check with frequency meter or tachometer for engine governor hunting, or cyclic irregularities in the engine.

5.3.7.2 Non-linear Loads Causing Interaction Between Dynamic Closed Loop Control Systems

The interaction of the alternator and the engine closed loop systems controls the load. Instability is caused by oversensitive control settings.

1. Adjust automatic voltage regulator to high gain (stability) and load drive system to low gain.
2. Increase engine speed droop to stabilize engine.
3. Contact factory for further advice regarding non-linear loads

5.3.7.3 Fluctuations in Load Current (Motor Starting or Reciprocating Loads)

Check the load current on a stable supply (for example mains or separately excite the machine). A variable DC supply is required for on load separate excitation tests.

5.3.7.4 Automatic Voltage Regulator Voltage Adjustment Trim Is Configured Incorrectly

Use the InPower service tool to adjust nominal voltage parameter to the appropriate value for the application level.

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5.3.8 Poor Voltage Regulation (with Load)

5.3.8.1 Large Speed Droop on Engine

Check that the speed droop from no load to full load is no greater than 4%.

5.3.8.2 Unbalanced Load

Check voltage and load current on all phases. If unbalanced, redistribute the load more evenly across the phases.

5.3.8.3 Automatic Voltage Regulator Voltage Adjustment Trim Is Configured Incorrectly

Use the InPower service tool to adjust nominal voltage parameter to the appropriate value for the application level.

5.3.8.4 Voltage Drop Between Alternator and Load Caused by Losses in Supply Cable Power Losses

Check the voltage at both ends of the cable run at full load. Large differences in voltages indicate a large voltage drop along the cable. A larger diameter cable is required in severe cases.

This will be worse during current surges such as a motor starting.

5.3.8.5 Fault on Main Rectifier or Excitation Winding

Check the no load excitation voltage across automatic voltage regulator X+ (F1) and XX- (F2) at the terminal box leads 13 and 14. Voltage should be no higher than 12 VDC.

5.3.8.6 Under Frequency Roll-off Protection Activated

Under frequency roll-off protection is activated, indicating low engine speed. Adjust or correct engine speed to an acceptable nominal.

5.3.9 Poor Response to Load Surges or Motor Starting (with Load)

5.3.9.1 Engine Performance

Check performance of the engine during application of load.

5.3.9.2 Load Current Surges Significantly Exceed the Full Load of the Alternator

1. Check surges with clip-on ammeter.
2. Check with factory for advice on voltage dips for motor starting.

5.3.9.3 Under Frequency Roll-off Protection on Automatic Voltage Regulator Operational

Check engine speed dip on load application. Low engine speed will activate under frequency roll-off protection circuit.

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5.3.9.4 Voltage Drop Between Alternator and Load Caused by Losses in Supply Cable Power Losses

Check the voltage at both ends of the cable run at full load. Large differences in voltages indicate a large voltage drop along the cable. A larger diameter cable is required in severe cases.

This will be worse during current surges such as a motor starting.

5.3.9.5 Automatic Voltage Regulator Stability Controls Incorrectly Set

Set automatic voltage regulator gain and/or damping trims to the appropriate value(s). Check again when loaded.

5.3.9.6 Fault on Main Rectifier or Excitation Winding

Check the no load excitation voltage across automatic voltage regulator X+ (F1) and XX- (F2) at the terminal box leads 13 and 14. Voltage should be no higher than 12 VDC.

5.3.9.7 Faulty Automatic Voltage Regulator (PCC3300) or Power Stage (AUX 103)

1. Replace AUX 103 board and re-test.
2. If not resolve replace the PCC 3300 control board and re-test.

5.3.10 Voltage Collapses (with Load)

5.3.10.1 Protection Circuit in Automatic Voltage Regulator Activated

Protection circuit in automatic voltage regulator activated, due to high excitation condition across automatic voltage regulator output, X+ (F1) and XX- (F2) at the terminal box leads 13 and 14.

Automatic voltage regulator protection circuit is factory set to trip at +70 VDC across automatic voltage regulator output X+ (F1) and XX- (F2) at the terminal box leads 13 and 14, after pre-set time delay.

1. Shut down and restart the alternator. If the voltage builds up normally but collapses again, the protection circuit has operated.
2. With alternator running, check the excitation voltage across automatic voltage regulator output X+ (F1) and XX- (F2) at the terminal box leads 13 and 14. If greater than 70 VDC, the protection circuit is operating correctly.
3. Check load current for overload condition.

5.3.10.2 Protection Circuit in Automatic Voltage Regulator Operated Due to Fault in Alternator Windings or Diodes

1. Shut down and restart the alternator. If voltage returns as normal, but collapses again when loaded, protection circuit is activated due to high excitation.
2. Remove external leads from the alternator.
3. Use appropriate metering equipment (Wheatstone bridge or Kelvin bridge). Measure the low resistance winding of the main rotor and stator, and the exciter rotor.
4. Check exciter stator for a short circuit.
5. Check diodes.
6. Use a multimeter to test diodes on the main rotating rectifier assembly.

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5.3.10.3 Malfunction of Protection Circuit in Automatic Voltage Regulator

1. Replace AUX 103 board and re-test.
2. If not resolve, replace the PCC 3300 control board and re-test when loaded.

5.3.10.4 Severe Overload or Short Circuit Across Phases

Check load current with clip-on ammeter.

5.3.11 High Voltage (with Load)

5.3.11.1 Unbalanced Load

Check voltage and load current on all phases. If unbalanced, redistribute the load more evenly across the phases.

5.3.11.2 Leading Power Factor

Check for capacitive (leading) power factor load (for example kVA correction fluorescent lights). A leading power factor load will give abnormally low DC excitation volts across X+ (F1) and XX-(F2).

1. Apply motor (lagging) power factor load, or switch off capacitors.

5.3.11.3 Malfunction of Protection Circuit in Automatic Voltage Regulator

1. Replace AUX 103 board and re-test.
2. If not resolve, replace the PCC 3300 control board and re-test when loaded.

5.3.12 Low Voltage (with Load)

5.3.12.1 Engine Speed Droop Greater than 4%

1. Check engine speed at no load and full load. Engine speed droop should be within +4% and -1% of normal speed.
2. Reset as necessary.

5.3.12.2 Under Frequency Roll-off Protection Circuit Operational

Under frequency roll-off protection is activated, indicating low engine speed. Adjust or correct engine speed to an acceptable nominal.

5.3.12.3 Faulty Permanent Magnet Generator, Stator or Rotor

1. Disconnect the permanent magnet generator leads from automatic voltage regulator terminals 06, 08, and 10 in the terminal box.
2. With the generator set running at the correct speed, use a multimeter to check voltage across the leads.
   - For 50 Hz, voltage should be approximately 170 to 195 VAC.
   - For 60 Hz, voltage should be approximately 204 to 234 VAC.

5.3.12.4 Malfunction of Protection Circuit in Automatic Voltage Regulator

1. Replace AUX 103 board and re-test.
2. If not resolve, replace the PCC 3300 control board and re-test when loaded.

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5.3.12.5 Fault on Winding or Rotating Diodes

Any fault in this area will appear as high excitation voltage across X+ (F1) and XX- (F2) at the terminal box leads 13 and 14.

1. Remove external leads from the alternator.
2. Use appropriate metering equipment (Wheatstone bridge or Kelvin bridge). Measure the low resistance winding of the main rotor and stator, and the exciter rotor.
3. Check the exciter stator for a short circuit.
4. Check diodes.
5. Use a multimeter to test diodes on the main rotating rectifier assembly.

5.3.12.6 Voltage Drop Between Alternator and Load Caused by Losses in Supply Cable Power Losses

Check the voltage at both ends of the cable run at full load. Large differences in voltages indicate a large voltage drop along the cable. A larger diameter cable is required in severe cases.

This will be worse during current surges such as a motor starting.

5.4 Battle Short Procedures

5.4.1 Battle Short Mode

⚠ WARNING

Automated Machinery

Battle Short mode overrides some parameters of generator set control. Unmonitored generator sets can cause a fire or electrical hazard, resulting in severe personal injury or death.

Make sure that the operation of the set is supervised during Battle Short operation.

Battle Short mode is used to satisfy local code requirements. While Battle Short mode is active, the PCC ignores non-critical shutdown faults and non-critical shutdown with cooldown faults. It does not initiate a stop sequence and continues to run the generator set until Battle Short Mode is inactive. Otherwise, generator set operation remains the same.

Battle Short mode must be set up at the factory or by an authorized service representative. Contact your local distributor for assistance.

Battle Short mode is active only when all of these conditions are met:

- *Battle Short Enable* is set to Enable.
- The ECM is set to enable Battle Short mode (Core 2 ECMs only).
- The Battle Short Switch or *Battle Short Switch (Modbus)* is active. (*Battle Short Switch (Modbus*) is not available in the Operator Panel.)

The PCC generates warning fault 2942 (Shutdown Override Fail) if the Battle Short Switch is active but any of the other conditions are not met.

Battle Short mode is not a distinct mode of operation . The PCC is still in Off mode, Manual mode, or Auto mode while Battle Short mode is active. The PCC still follows the appropriate sequence of operation to start the generator set and to stop the generator set.

The PCC generates warning fault 1131 (Battle Short Active) as long as Battle Short mode is active.

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While Battle Short mode is active, the PCC ignores most shutdown faults and only initiates a Shutdown Without Cooldown sequence if a critical shutdown fault occurs.

When the PCC overrides a shutdown fault, it generates warning fault 1416 (Fail To Shutdown) after *Fail To Shutdown Delay* as long as Battle Short mode remains active. It also turns on the Shutdown LED.

NOTICE

The faults that are overridden in Battle Short mode can affect generator set performance and might cause permanent engine, alternator, or connected equipment damage. All shutdown faults, including those overridden in Battle Short mode, must be acted upon immediately to ensure the safety and well-being of the operator and the generator set.

NOTICE

Any damage caused to the generator set as a direct result of running in Battle Short mode is not covered by the warranty.

5.5 Engine Performance Troubleshooting

5.5.1 Engine Does Not Crank in Manual Mode (No Fault Message)

Control has not received or recognized a manual start signal.

A. Check Power to Control

No power is supplied to the control. (The Control Alive indicator on the base board is not flashing).

1. Poor battery cable connections. Clean the battery cable terminals and tighten all connections using an insulated wrench.
2. Remove F4 and check continuity. If open, replace the fuse with one of the same type and amp rating (5 Amps).
   a. If F4 is OK, remove connector P7 and check for B+ at P7-1 through P7-4 and GND at P7-5 through P7-8.
   b. If B+ or ground missing, isolate to the harness and the TB BAT terminal mounted on the engine block.
   c. If B+ and ground check OK, the base board may be defective. Cycle power to the base board by reconnecting P7.

B. Check Control Caliabration

The base board is not properly calibrated or the calibration is corrupt. (The Control Alive indicator flashes every ½ second.)

1. Confirm that the installed calibration part number matches the serial plate information. Re-enter a calibration file if necessary. (When properly installed, the Control Alive indicator flashes once every second.)

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C. Check the Emergency Stop Switch

The Emergency Stop switch or wiring is defective.

1. With the Emergency Stop push button not activated, remove connector P1 and check for continuity between P1-1 (ESTOP-NC1) and P1-2 (ESTOP-NC2). (If the circuit is open, the control will detect a local E-Stop condition but will not display the E-Stop condition.) If the circuit is open, isolate to the Emergency Stop switch and wiring.
2. If there is continuity, go to the next step.

D. Check the Manual Input

The Manual input is not getting from the Manual select switch (S12) to the base board indicating that S12, the base board, or the harness is defective.

1. With S12 in the Manual position, remove connector P1 from the base board and check for continuity from P1-6 (MAN) to P1-9 (GND). If there is no continuity, isolate the switch and wiring.
2. If there is continuity, go to the next step.

E. Check the Manual Run/Stop Button

The Manual Run/Stop button, harness, or the base board is defective.

1. Remove connector P3 from the base board and check for continuity from P3-9 (MAN RUN/STOP) to P3-10 (GND). If there is no continuity when pressing the Manual Run/Stop button, replace the front membrane panel.

5.5.2 Engine Does Not Crank in Remote Mode (No Fault Message)

Control has not received or recognized a remote start signal.

A. Check the Remote Start Switch

The remote start switch or customer wiring is faulty.

1. Reset the control. Attempt to start and check for ground at TB1-1.
    a. If ground is not present, isolate to the remote switch or customer wiring. Repair as necessary.
    b. If ground is present, go to next step.

B. Check the Auto Mode Input

The Auto mode input is not getting from the Auto select switch (S12) to the base board, indicating that the S12 switch or the harness is defective.

1. With S12 in the Auto position, remove connector P1 from the base board and check for continuity from P1-5 (Auto) to P1-9 (GND).
2. If no continuity exists, isolate to the switch or the wiring harness.

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5.5.3 Engine is Difficult to Start or Does Not Start (Exhaust Smoke)

A. Check for Engine Faults

With the InPower or INSITE service tool(s) check for the presence of the active or inactive fault codes that might influence the engine performance.

1. With InPower go to **Faults > Active Faults** or **Faults > Fault History**.
2. If fault codes are present refer to the appropriate Fault Code Troubleshooting section of the engine manual to troubleshoot by the fault code.

B. Check Battery Voltage

1. Check low, interrupted, or open battery voltage.
2. Check battery connections, unswitched battery supply, and fuses.
3. Refer to procedures in the engine troubleshooting and repair manual.
4. Refer to procedures for fault codes 441 and 1442.

C. Check Parameters with INSITE

1. Use the INSITE service tool verify that engine idle speed is not set too low. Increase the idle speed if necessary.
2. Use InPower to check the starter disconnect speed. Verify that the RPM matches the Engine Requirements (Default = 450RPM).

D. Check ECM Calibration

With the INSITE service tool verify the calibration in the ECM. If the calibration in the ECM does not match the latest calibration on QSOL, update the ECM to the latest calibration

E. Check Starting Procedure

Verify the correct starting procedure. Refer to procedure in the engine troubleshooting and repair manual.

F. Check Coolant Heater and Coolant Temperature

1. Visually inspect the coolant heater for proper operating conditions. Replace as necessary.
2. Check the coolant temperature on the HMI display. Engine Coolant temperature should be >100 °F.

G. Check Fuel System

1. Inspect fuel lines, fuel connections and fuel filters for leaks.
    a. Repair if leaks found.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
2. Open the fuel tank cap and verify the fuel level is not below the pickup tube in the tank.
    a. Add fuel to the fuel tank if the fuel level is found to be low.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

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3. Manual fuel shutoff valve is closed.
    a. Check the OEM fuel shutoff valves.
    b. Verify that the fuel tanks are open.
4. Fuel shutoff valve solenoid or circuit is malfunctioning.
    a. Check the fuel shutoff valve solenoid and circuit.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
5. Check for air in the fuel system.
    a. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
6. Check for the fuel inlet restriction.
    a. Check the fuel inlet lines for restriction.
    b. Check for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.
    c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
7. Check for fuel drain line restriction.
    a. Check the fuel drain lines for restriction.
    b. Clear or replace the fuel lines, check valves, or tank vents as necessary.
    c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
8. Fuel system restriction is above specification.
    a. Check all fuel system lines for restrictions or debris.
    b. Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
    c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
9. Check the fuel supply pump (FSP).
    a. Refer to procedures in the engine troubshooting and repair manual to check the fuel supply pump.
    b. Replace the pump if necessary.

H. Check Air Intake and Exhaust

1. Check the air intake system for restriction.
    a. Clean or replace the air filter and inlet piping as necessary.
    b. Refer to procedures for fault codes 5151 and 5154.
    c. Refer to the procedure in the enngine troubleshooting and repair manual.
2. Check the exhaust system for restrictions.
    a. Refer to the procedure in the enngine troubleshooting and repair manual.

I. Check Sensors

1. Fuel system pressure sensors (fueling/timing) are malfunctioning.
    a. Check the fuel system pressure sensors (fueling/timing).
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

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2. Intake manifold pressure sensor is malfunctioning.
    a. Check the intake manifold pressure sensor.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
3. Ambient air pressure sensor is malfunctioning.
    a. Check the ambient air pressure sensor.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
4. Crankshaft and/or camshaft speed/position sensor(s) reading incorrectly.
    a. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

J. Check Other Issues

1. Engine parasitics are excessive.
    a. Check engine-driven units for correct operation.
    b. Check the cooling fan for correct operation and cycle time.
    c. Refer to the OEM specifications.
2. Overhead adjustments are not correct.
    a. Adjust the overhead settings.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
3. Base engine problem.
    a. Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
4. Injector O-rings are damaged or missing.
    a. Remove and check the injectors.
    b. Replace the injector O-rings.
    c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

5.5.4 Engine is Difficult to Start or Does Not Start (No Exhaust Smoke)

A. Check for Engine Faults

With the InPower or INSITE service tool(s) check for the presence of the active or inactive fault codes that might influence the engine performance.

1. With InPower go to **Faults > Active Faults** or **Faults > Fault History**.
2. If fault codes are present refer to the appropriate Fault Code Troubleshooting section of the engine manual to troubleshoot by the fault code.

B. Check Battery Voltage

1. Check low, interrupted, or open battery voltage.
2. Check battery connections, unswitched battery supply, and fuses.
3. Refer to procedures in the engine troubleshooting and repair manual.

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4. Refer to procedures for fault codes 441 and 1442.

C. Check Emergency Stop/Remote Emergency Stop

Check that the emergency stop and remote emergency stop is not energized.

D. Check Parameters with INSITE

1. Use the INSITE service tool verify that engine idle speed is not set too low. Increase the idle speed if necessary.
2. Use InPower to check the starter disconnect speed. Verify that the RPM matches the Engine Requirements (Default = 450RPM).

E. Check ECM Calibration

With the INSITE service tool verify the calibration in the ECM. If the calibration in the ECM does not match the latest calibration on QSOL, update the ECM to the latest calibration

F. Check Starting Procedure

Verify the correct starting procedure. Refer to procedure in the engine troubleshooting and repair manual.

G. Check Coolant Heater and Coolant Temperature

1. Visually inspect the coolant heater for proper operating conditions. Replace as necessary.
2. Check the coolant temperature on the HMI display. Engine Coolant temperature should be >100 °F.

H. Check Fuel System

1. Inspect fuel lines, fuel connections and fuel filters for leaks.
    a. Repair if leaks found.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
2. Open the fuel tank cap and verify the fuel level is not below the pickup tube in the tank.
    a. Add fuel to the fuel tank if the fuel level is found to be low.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
3. Manual fuel shutoff valve is closed.
    a. Check the OEM fuel shutoff valves.
    b. Verify that the fuel tanks are open.
4. Fuel shutoff valve solenoid or circuit is malfunctioning.
    a. Check the fuel shutoff valve solenoid and circuit.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
5. Check for air in the fuel system.
    a. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
6. Check for the fuel inlet restriction.
    a. Check the fuel inlet lines for restriction.

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b. Check for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.

c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

7. Check for fuel drain line restriction.

a. Check the fuel drain lines for restriction.

b. Clear or replace the fuel lines, check valves, or tank vents as necessary.

c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

8. Fuel system restriction is above specification.

a. Check all fuel system lines for restrictions or debris.

b. Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.

c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

9. Check the fuel supply pump (FSP).

a. Refer to procedures in the engine troubshooting and repair manual to check the fuel supply pump.

b. Replace the pump if necessary.

I. Check Air Intake and Exhaust

1. Check the air intake system for restriction.

a. Clean or replace the air filter and inlet piping as necessary.

b. Refer to procedures for fault codes 5151 and 5154.

c. Refer to the procedure in the enngine troubleshooting and repair manual.

2. Check the exhaust system for restrictions.

a. Refer to the procedure in the enngine troubleshooting and repair manual.

J. Check Sensors

1. Fuel system pressure sensors (fueling/timing) are malfunctioning.

a. Check the fuel system pressure sensors (fueling/timing).

b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

2. Intake manifold pressure sensor is malfunctioning.

a. Check the intake manifold pressure sensor.

b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

3. Ambient air pressure sensor is malfunctioning.

a. Check the ambient air pressure sensor.

b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4. Crankshaft and/or camshaft speed/position sensor(s) reading incorrectly.

a. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

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K. Check Other Issues

1. Engine parasitics are excessive.
    a. Check engine-driven units for correct operation.
    b. Check the cooling fan for correct operation and cycle time.
    c. Refer to the OEM specifications.
2. Overhead adjustments are not correct.
    a. Adjust the overhead settings.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
3. Base engine problem.
    a. Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
4. Injector O-rings are damaged or missing.
    a. Remove and check the injectors.
    b. Replace the injector O-rings.
    c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

5.5.5 Engine Experiences Low Power, Poor Acceleration, or Poor Response

A. Check for Engine Faults

With the InPower or INSITE service tool(s) check for the presence of the active or inactive fault codes that might influence the engine performance.

1. With InPower go to **Faults > Active Faults** or **Faults > Fault History**.
2. If fault codes are present refer to the appropriate Fault Code Troubleshooting section of the engine manual to troubleshoot by the fault code.

B. Check ECM Calibration

With the INSITE service tool verify the calibration in the ECM. If the calibration in the ECM does not match the latest calibration on QSOL, update the ECM to the latest calibration

C. Check for Excessive Load

Ensure that the load on the generator set does not exceed the generator set KW rating. Revisit the generator set sizing process to ensure that the generator set is correctly sized for the application, especially if new loads have been introduced into the system. Refer to the T−030 manual for proper generator set sizing and application.

D. Check Fuel System

1. Inspect fuel lines, fuel connections, and fuel filters for leaks.
    a. Repair if leaks found.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

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2. Fuel grade is not correct for the application; fuel quality is poor or presence of water in the fuel.
    a. Operate the engine from a tank of high-quality fuel.
    b. Refer to Fuel for Cummins Engines, Bulletin 3379001.
3. Check for air in the fuel system.
    a. Refer to procedure in the troubleshooting and repai manual for the specific engine.
4. Check for fuel inlet restriction.
    a. Check the fuel inlet lines for restriction.
    b. Look for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.
    c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
5. Check for fuel drain line restriction.
    a. Check the fuel drain lines for restriction.
    b. Clear or replace the fuel lines, check valves, or tank vents as necessary.
    c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
6. Fuel system restriction is above specification.
    a. Check all fuel system lines for restrictions or debris.
    b. Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
    c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
7. Fuel supply pump (FSP) malfunctioning.
    a. Check fuel supply pump output pressure
    b. Replace the fuel supply pump if necessary.
    c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
8. Fuel pump overflow valve is malfunctioning.
    a. Check the overflow valve.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
9. Fuel lift pump is malfunctioning.
    a. Check the fuel lift pump for correct operation.
    b. Check the pump output pressure.
    c. Replace the fuel lift pump if necessary.
    d. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
10. Fuel injection pump is malfunctioning.
    a. Remove and test the fuel injection pump.
    b. Replace the pump if necessary.
    c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
11. Check for injector malfunction.
    a. Perform the cylinder performance test.
    b. Replace injectors as necessary.

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c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

E. Check Air Intake and Exhaust

1. Check the air intake system for restriction.
   a. Clean or replace the air filter and inlet piping as necessary.
   b. Refer to the procedure in the enngine troubleshooting and repair manual.
2. Monitor the turbocharger boost pressure with an INSITE electronic service tool. Refer to the procedure in the engine troubleshooting and repair manual.
3. Check the exhaust system for restrictions.
   a. Refer to the procedure in the enngine troubleshooting and repair manual.

F. Check Sensors

1. Coolant temperature sensor is malfunctioning.
   a. Use InPower or INSITE service tool to check the coolant temperature sensor.
   b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
2. Intake manifold pressure sensor is malfunctioning.
   a. Check the intake manifold pressure sensor.
   b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
3. Ambient air pressure sensor is malfunctioning.
   a. Check the ambient air pressure sensor.
   b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

G. Check Other Issues

1. Engine is operating above recommended altitude.
   a. Engine power decreases above recommended altitude. Refer to the Engine Data Sheet for specifications.
2. Engine parasitics are excessive.
   a. Check engine-driven units for correct operation.
   b. Check the cooling fan for correct operation and cycle time.
   c. Refer to the OEM specifications.

5.5.6 Engine Runs Rough or Misfires

A. Check for Engine Faults

With the InPower or INSITE service tool(s) check for the presence of the active or inactive fault codes that might influence the engine performance.

1. With InPower go to **Faults > Active Faults** or **Faults > Fault History**.
2. If fault codes are present refer to the appropriate Fault Code Troubleshooting section of the engine manual to troubleshoot by the fault code.

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B. Check Parameters with INSITE

1. Use the INSITE service tool verify that engine idle speed is not set too low. Increase the idle speed if necessary.
2. Use InPower to check the starter disconnect speed. Verify that the RPM matches the Engine Requirements (Default = 450RPM).

C. Check ECM Calibration

With the INSITE service tool verify the calibration in the ECM. If the calibration in the ECM does not match the latest calibration on QSOL, update the ECM to the latest calibration

D. Check Air Intake and Exhaust

1. Check the air intake system for restriction.
    a. Clean or replace the air filter and inlet piping as necessary.
    b. Refer to the procedure in the enngine troubleshooting and repair manual.
2. Monitor the turbocharger boost pressure with an INSITE electronic service tool. Refer to the procedure in the engine troubleshooting and repair manual.
3. Check the exhaust system for restrictions.
    a. Refer to the procedure in the enngine troubleshooting and repair manual.

E. Check Fuel System

1. Inspect fuel lines, fuel connections, and fuel filters for leaks.
    a. Repair if leaks found.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
2. Fuel grade is not correct for the application; fuel quality is poor or presence of water in the fuel.
    a. Operate the engine from a tank of high-quality fuel.
    b. Refer to Fuel for Cummins Engines, Bulletin 3379001.
3. Check for air in the fuel system.
    a. Refer to procedure in the troubleshooting and repai manual for the specific engine.
4. Check for fuel inlet restriction.
    a. Check the fuel inlet lines for restriction.
    b. Look for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.
    c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
5. Check for fuel drain line restriction.
    a. Check the fuel drain lines for restriction.
    b. Clear or replace the fuel lines, check valves, or tank vents as necessary.
    c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
6. Fuel system restriction is above specification.
    a. Check all fuel system lines for restrictions or debris.
    b. Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.

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c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

7. Fuel supply pump (FSP) malfunctioning.
   a. Check fuel supply pump output pressure
   b. Replace the fuel supply pump if necessary.
   c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
8. Fuel pump overflow valve is malfunctioning.
   a. Check the overflow valve.
   b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
9. Fuel lift pump is malfunctioning.
   a. Check the fuel lift pump for correct operation.
   b. Check the pump output pressure.
   c. Replace the fuel lift pump if necessary.
   d. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
10. Fuel injection pump is malfunctioning.
    a. Remove and test the fuel injection pump.
    b. Replace the pump if necessary.
    c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
11. Check for injector malfunction.
    a. Perform the cylinder performance test.
    b. Replace injectors as necessary.
    c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

F. Check Sensors

1. Crankshaft and/or camshaft speed/position sensor(s) reading incorrectly. Refer to the troubleshooting procedure in the troubleshooting and repair manual for specific engine.
2. Fuel system pressure sensors (fueling/timing) are malfunctioning. Check the fuel system pressure sensors (fueling/timing).
3. Coolant temperature sensor is malfunctioning.
   a. Use InPower or INSITE service tool to check the coolant temperature sensor.
   b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
4. Intake manifold pressure sensor is malfunctioning.
   a. Check the intake manifold pressure sensor.
   b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
5. Ambient air pressure sensor is malfunctioning.
   a. Check the ambient air pressure sensor.
   b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

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G. Check Other Issues

1. Engine parasitics are excessive.
   a. Check engine-driven units for correct operation.
   b. Check the cooling fan for correct operation and cycle time.
   c. Refer to the OEM specifications.
2. Engine mounts are worn, damaged, loose, or not correct.
   a. Verify the condition of the engine mounts.
   b. Refer to procedures in the engine troubleshooting and repair manual.
3. Overhead adjustments are not correct.
   a. Adjust the overhead settings.
   b. Refer to procedures in the engine troubleshooting and repair manual.
4. Base engine problem.
   a. Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
   b. Refer to procedures in the engine troubleshooting and repair manual.

5.5.7 Engine Shuts Off Unexpectedly or Dies During Deceleration

A. Check for Engine Faults

With the InPower or INSITE service tool(s) check for the presence of the active or inactive fault codes that might influence the engine performance.

1. With InPower go to **Faults > Active Faults** or **Faults > Fault History**.
2. If fault codes are present refer to the appropriate Fault Code Troubleshooting section of the engine manual to troubleshoot by the fault code.

B. Check ECM Calibration

With the INSITE service tool verify the calibration in the ECM. If the calibration in the ECM does not match the latest calibration on QSOL, update the ECM to the latest calibration

C. Check Emergency Stop/Remote Emergency Stop

Check that the emergency stop and remote emergency stop is not energized.

D. Check Fuel System

1. Open the fuel tank cap and verify the fuel level is not below the pickup tube in the tank. Add fuel to the fuel tank if the fuel level is found to be low.
2. Make sure that the manual fuel shutoff valve is open.
3. Fuel shutoff valve solenoid or circuit is malfunctioning.
   a. Check the fuel shutoff valve solenoid and circuit.
4. Check for the air in the fuel system. Refer to the engine troubleshooting and repair manual.

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5. Check for fuel inlet restriction.
    a. Check the fuel inlet lines for restriction.
    b. Look for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.
    c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.
6. Check for fuel drain line restriction.
    a. Check the fuel drain lines for restriction.
    b. Clear or replace the fuel lines, check valves, or tank vents as necessary.
    c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.
7. Fuel supply pump (FSP) malfunctioning.
    a. Check fuel supply pump output pressure
    b. Replace the fuel supply pump if necessary.
    c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.
8. Fuel system restriction is above specification.
    a. Check all fuel system lines for restrictions or debris.
    b. Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
    c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.

E. Check ECM

1. Battery voltage supply to the electronic control module (ECM) has been lost.
    a. Check the ECM battery connections. Refer to the engine operation and maintenance manual.
    b. Check the unswitched battery supply circuit in the DC Distribution box.
2. Electronic control module (ECM) ground is not correct.
    a. Check the ECM for correct placement of star washers.
3. Electronic control module (ECM) is malfunctioning.

F. Check PowerCommand Control

1. Lost J1939 CAN link to the ECMs.
    a. Verify that fault codes 427 and 781 are not active.
    b. Check the J1939 harnesses from the control to the ECM.
2. Control lost power.
    a. Check the battery connections to the control.
    b. Verify that the circuit breakers have not tripped in the DC Distribution box.
3. Loss of start signal which causes the generator set to shutdown. Verify that the start signal has not been removed from the Customer control system.
    a. Verify that the start signal has not been removed from the control.
4. PowerCommand Control malfunctioning.

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G. Check Other Issues

1. Base engine problem.
    a. Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
    b. Refer to procedures in the engine troubleshooting and repair manual.

5.5.8 Engine Speed Surges at High or Low Idle

A. Check for Engine Faults

With the InPower or INSITE service tool(s) check for the presence of the active or inactive fault codes that might influence the engine performance.

1. With InPower go to **Faults > Active Faults** or **Faults > Fault History**.
2. If fault codes are present refer to the appropriate Fault Code Troubleshooting section of the engine manual to troubleshoot by the fault code.

B. Check Parameters with INSITE

1. Use the INSITE service tool verify that engine idle speed is not set too low. Increase the idle speed if necessary.
2. Use InPower to check the starter disconnect speed. Verify that the RPM matches the Engine Requirements (Default = 450RPM).

C. Check AVR Gain Settings

Use InPower to verify the AVR gain settings.

D. Check ECM Calibration

With the INSITE service tool verify the calibration in the ECM. If the calibration in the ECM does not match the latest calibration on QSOL, update the ECM to the latest calibration

E. Check Fuel System

1. Open the fuel tank cap and verify the fuel level is not below the pickup tube in the tank. Add fuel to the fuel tank if the fuel level is found to be low.
2. Check for the air in the fuel system. Refer to the engine troubleshooting and repair manual.
3. Check for fuel inlet restriction.
    a. Check the fuel inlet lines for restriction.
    b. Look for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.
    c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.
4. Check for fuel drain line restriction.
    a. Check the fuel drain lines for restriction.
    b. Clear or replace the fuel lines, check valves, or tank vents as necessary.
    c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.
5. Fuel supply pump (FSP) malfunctioning.
    a. Check fuel supply pump output pressure

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b. Replace the fuel supply pump if necessary.

c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.

6. Fuel system restriction is above specification.
   a. Check all fuel system lines for restrictions or debris.
   b. Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
   c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.
7. Check for injector malfunction.
   a. Perform the cylinder performance test.
   b. Replace injectors as necessary.
   c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.
8. Fuel pump overflow valve is malfunctioning.
   a. Check the overflow valve.
   b. Refer to the procedures in the troubleshooting and repair manual for the specific engine.
9. Fuel injection pump is malfunctioning.
   a. Remove and test the fuel injection pump.
   b. Replace the pump if necessary.
   c. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

F. Check Sensors

1. Fuel system pressure sensors (fueling/timing) are malfunctioning.
   a. Check the fuel system pressure sensors (fueling/timing).
   b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
2. Intake manifold pressure sensor is malfunctioning.
   a. Check the intake manifold pressure sensor.
   b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
3. Ambient air pressure sensor is malfunctioning.
   a. Check the ambient air pressure sensor.
   b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
4. Crankshaft and/or camshaft speed/position sensor(s) reading incorrectly.
   a. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

G. Check Other Issues

1. Engine parasitics are excessive.
   a. Check engine-driven units for correct operation.
   b. Check the cooling fan for correct operation and cycle time.
   c. Refer to the OEM specifications.

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2. Base engine problem.
    a. Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
    b. Refer to procedures in the engine troubleshooting and repair manual.
3. Alternator malfunctioning.
    a. Temporarily disconnect the alternator and test-run the engine.
    b. Replace the alternator if necessary.

5.5.9 Engine Speed Surges Under Load or in Operating Range

A. Check for Engine Faults

With the InPower or INSITE service tool(s) check for the presence of the active or inactive fault codes that might influence the engine performance.

1. With InPower go to **Faults > Active Faults** or **Faults > Fault History**.
2. If fault codes are present refer to the appropriate Fault Code Troubleshooting section of the engine manual to troubleshoot by the fault code.

B. Check ECM Calibration

With the INSITE service tool verify the calibration in the ECM. If the calibration in the ECM does not match the latest calibration on QSOL, update the ECM to the latest calibration

C. Check Parameters with INSITE

1. Use the INSITE service tool verify that engine idle speed is not set too low. Increase the idle speed if necessary.
2. Use InPower to check the starter disconnect speed. Verify that the RPM matches the Engine Requirements (Default = 450RPM).

D. Check AVR Gain Settings

Use InPower to verify the AVR gain settings.

E. Check Generator Set Paralling Control

Generator paralleling controls are sending inconsistent or incorrect commands to the engine electronic control system. Verify that the generator paralleling controls are functioning correctly. Refer to the paralleling controls user manual for specifications.

F. Check Fuel System

1. Fuel grade is not correct for the application; fuel quality is poor or presence of water in the fuel.
    a. Operate the engine from a tank of high-quality fuel.
    b. Refer to Fuel for Cummins Engines, Bulletin 3379001.
2. Check for air in the fuel system.
    a. Refer to procedure in the troubleshooting and repai manual for the specific engine.
3. Check for fuel inlet restriction.
    a. Check the fuel inlet lines for restriction.

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b. Look for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.

c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.

4. Check for fuel drain line restriction.

   a. Check the fuel drain lines for restriction.

   b. Clear or replace the fuel lines, check valves, or tank vents as necessary.

   c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.

5. Fuel system restriction is above specification.

   a. Check all fuel system lines for restrictions or debris.

   b. Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.

   c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.

6. Fuel supply pump (FSP) malfunctioning.

   a. Check fuel supply pump output pressure

   b. Replace the fuel supply pump if necessary.

   c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.

7. Fuel injection pump is malfunctioning.

   a. Remove and test the fuel injection pump.

   b. Replace the pump if necessary.

   c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.

G. Check Sensors

1. Fuel system pressure sensors (fueling/timing) are malfunctioning.

   a. Check the fuel system pressure sensors (fueling/timing).

   b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

2. Intake manifold pressure sensor is malfunctioning.

   a. Check the intake manifold pressure sensor.

   b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

3. Ambient air pressure sensor is malfunctioning.

   a. Check the ambient air pressure sensor.

   b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

4. Crankshaft and/or camshaft speed/position sensor(s) reading incorrectly.

   a. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

H. Check Other Issues

1. Moisture in the wiring harness connectors.

   a. Dry the connectors with Cummins electronic cleaner, Part Number 3824510.

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2. Base engine problem.
    a. Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
    b. Refer to procedures in the engine troubleshooting and repair manual.
3. Alternator malfunctioning.
    a. Temporarily disconnect the alternator and test-run the engine.
    b. Replace the alternator if necessary.

5.5.10 Engine Starts But Will Not Keep Running

A. Check for Engine Faults

With the InPower or INSITE service tool(s) check for the presence of the active or inactive fault codes that might influence the engine performance.

1. With InPower go to **Faults > Active Faults** or **Faults > Fault History**.
2. If fault codes are present refer to the appropriate Fault Code Troubleshooting section of the engine manual to troubleshoot by the fault code.

B. Check ECM Calibration

With the INSITE service tool verify the calibration in the ECM. If the calibration in the ECM does not match the latest calibration on QSOL, update the ECM to the latest calibration

C. Check Parameters with INSITE

1. Use the INSITE service tool verify that engine idle speed is not set too low. Increase the idle speed if necessary.
2. Use InPower to check the starter disconnect speed. Verify that the RPM matches the Engine Requirements (Default = 450RPM).

D. Check Battery Voltage

1. Check low, interrupted, or open battery voltage.
2. Check battery connections, unswitched battery supply, and fuses.
3. Refer to procedures in the engine troubleshooting and repair manual.
4. Refer to procedures for fault codes 441 and 1442.

E. Check Run/Stop Circuit

Run/Stop circuit is malfunctioning. Check the generator Run/Stop circuit.

F. Check Fuel System

1. Open the fuel tank cap and verify the fuel level is not below the pickup tube in the tank. Add fuel to the fuel tank if the fuel level is found to be low.
2. Fuel grade is not correct for the application; fuel quality is poor or presence of water in the fuel.
    a. Fuel grade is not correct for the application; fuel quality is poor or presence of water in the fuel.
    b. Refer to Fuel for Cummins Engines, Bulletin 3379001.

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3. Fuel system restriction is above specification.
    a. Check all fuel system lines for restrictions or debris.
    b. Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
    c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.

G. Check Other Issues

1. Engine parasitics are excessive.
    a. Check engine-driven units for correct operation.
    b. Check the cooling fan for correct operation and cycle time.
    c. Refer to the OEM specifications.
2. Base engine problem.
    a. Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
    b. Refer to procedures in the engine troubleshooting and repair manual.

5.5.11 Poor Engine Transient Response

A. Check for Engine Faults

With the InPower or INSITE service tool(s) check for the presence of the active or inactive fault codes that might influence the engine performance.

1. With InPower go to **Faults > Active Faults** or **Faults > Fault History**.
2. If fault codes are present refer to the appropriate Fault Code Troubleshooting section of the engine manual to troubleshoot by the fault code.

B. Check Parameters with INSITE

1. Use the INSITE service tool verify that engine idle speed is not set too low. Increase the idle speed if necessary.
2. Use InPower to check the starter disconnect speed. Verify that the RPM matches the Engine Requirements (Default = 450RPM).

C. Check ECM Calibration

With the INSITE service tool verify the calibration in the ECM. If the calibration in the ECM does not match the latest calibration on QSOL, update the ECM to the latest calibration

D. Check for Excessive Load

Ensure that the load on the generator set does not exceed the generator set KW rating. Revisit the generator set sizing process to ensure that the generator set is correctly sized for the application, especially if new loads have been introduced into the system. Refer to the T−030 manual for proper generator set sizing and application.

E. Check Fuel System

1. Inspect fuel lines, fuel connections and fuel filters for leaks. Repair if leaks found.

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2. Fuel grade is not correct for the application; fuel quality is poor or presence of water in the fuel.
    a. Operate the engine from a tank of high-quality fuel.
    b. Refer to Fuel for Cummins Engines, Bulletin 3379001.
3. Check for air in the fuel system.
    a. Refer to procedure in the troubleshooting and repai manual for the specific engine.
4. Check for fuel inlet restriction.
    a. Check the fuel inlet lines for restriction.
    b. Look for plugged fuel filters, a restricted lift pump bypass check valve, pinched fuel lines, or a restricted stand pipe in the fuel tank.
    c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.
5. Check for fuel drain line restriction.
    a. Check the fuel drain lines for restriction.
    b. Clear or replace the fuel lines, check valves, or tank vents as necessary.
    c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.
6. Fuel system restriction is above specification.
    a. Check all fuel system lines for restrictions or debris.
    b. Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
    c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.
7. Low or no fuel pressure at the fuel filters (primary pressure).
    a. Use an electronic service tool to measure the fuel pressure at the fuel filter.
    b. Refer to the procedures in the troubleshooting and repair manual for the specific engine.
8. Fuel supply pump (FSP) malfunctioning.
    a. Check fuel supply pump output pressure
    b. Replace the fuel supply pump if necessary.
    c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.
9. Fuel injection is malfunctioning.
    a. Perform the cylinder performance test.
    b. Replace injectors as necessary.
    c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.

F. Check Air Intake and Exhaust

1. Check air intake and exhaust for leaks.
    a. Refer to the procedure in the enngine troubleshooting and repair manual.
2. Check the air intake system for restriction.
    a. Clean or replace the air filter and inlet piping as necessary.
    b. Refer to the procedure in the enngine troubleshooting and repair manual.
3. Check the exhaust system for restrictions.
    a. Refer to the procedure in the enngine troubleshooting and repair manual.

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4. Monitor the turbocharger boost pressure with an INSITE electronic service tool. Refer to the procedure in the engine troubleshooting and repair manual.

G. Check Sensors

1. Fuel system pressure sensors (fueling/timing) are malfunctioning.
    a. Check the fuel system pressure sensors (fueling/timing).
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
2. Intake manifold pressure sensor is malfunctioning.
    a. Check the intake manifold pressure sensor.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
3. Coolant temperature sensor is malfunctioning.
    a. Use InPower or INSITE service tool to check the coolant temperature sensor.
4. Ambient air pressure sensor is malfunctioning.
    a. Check the ambient air pressure sensor.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
5. Intake manifold pressure sensor is malfunctioning.
    a. Check the intake manifold pressure sensor.

H. Check Other Issues

1. Engine is operating above recommended altitude.
    a. Engine power decreases above recommended altitude. Refer to the Engine Data Sheet for specifications.
2. Engine parasitics are excessive.
    a. Check engine-driven units for correct operation.
    b. Check the cooling fan for correct operation and cycle time.
    c. Refer to the OEM specifications.
3. Overhead adjustments are not correct.
    a. Adjust the overhead settings.
    b. Refer to the procedure in the engine troubleshooting and repair manual.
4. Base engine problem.
    a. Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
    b. Refer to the procedures in the engine troubleshooting and repair manual.

5.5.12 Engine Will Not Reach Rated Speed (RPM)

A. Check for Engine Faults

With the InPower or INSITE service tool(s) check for the presence of the active or inactive fault codes that might influence the engine performance.

1. With InPower go to **Faults > Active Faults** or **Faults > Fault History**.

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2. If fault codes are present refer to the appropriate Fault Code Troubleshooting section of the engine manual to troubleshoot by the fault code.

B. Check Parameters with INSITE

1. Use the INSITE service tool verify that engine idle speed is not set too low. Increase the idle speed if necessary.
2. Use InPower to check the starter disconnect speed. Verify that the RPM matches the Engine Requirements (Default = 450RPM).

C. Check ECM Calibration

With the INSITE service tool verify the calibration in the ECM. If the calibration in the ECM does not match the latest calibration on QSOL, update the ECM to the latest calibration

D. Check for Excessive Load

Ensure that the load on the generator set does not exceed the generator set KW rating. Revisit the generator set sizing process to ensure that the generator set is correctly sized for the application, especially if new loads have been introduced into the system. Refer to the T−030 manual for proper generator set sizing and application.

E. Check Air Intake and Exhaust

1. Check the air intake system for restriction.
    a. Clean or replace the air filter and inlet piping as necessary.
    b. Refer to procedures for fault codes 5151 and 5154.
    c. Refer to the procedure in the enngine troubleshooting and repair manual.
2. Check the exhaust system for restrictions.
    a. Refer to the procedure in the enngine troubleshooting and repair manual.

F. Check Fuel System

1. Fuel grade is not correct for the application; fuel quality is poor or presence of water in the fuel.
    a. Operate the engine from a tank of high-quality fuel.
    b. Refer to Fuel for Cummins Engines, Bulletin 3379001.
2. Check for air in the fuel system.
    a. Refer to procedure in the troubleshooting and repai manual for the specific engine.
3. Fuel system restriction is above specification.
    a. Check all fuel system lines for restrictions or debris.
    b. Clear or replace the fuel lines, fuel tubes, fuel manifold, check valves, tank vents, actuator screens, and cylinder head drillings as necessary.
    c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.
4. Fuel supply pump (FSP) malfunctioning.
    a. Check fuel supply pump output pressure
    b. Replace the fuel supply pump if necessary.
    c. Refer to the procedures in the troubleshooting and repair manual for the specific engine.

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G. Check Sensors

1. Crankshaft and/or camshaft speed/position sensor(s) reading incorrectly. Refer to the troubleshooting procedure in the troubleshooting and repair manual for specific engine.
2. Fuel system pressure sensors (fueling/timing) are malfunctioning. Check the fuel system pressure sensors (fueling/timing).
3. Intake manifold pressure sensor is malfunctioning.
    a. Check the intake manifold pressure sensor.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.
4. Ambient air pressure sensor is malfunctioning.
    a. Check the ambient air pressure sensor.
    b. Refer to the procedure(s) in the troubleshooting and repair manual for the specific engine.

H. Check Other Issues

1. Engine is operating above recommended altitude.
    a. Engine power decreases above recommended altitude. Refer to the Engine Data Sheet for specifications.
2. Engine parasitics are excessive.
    a. Check engine-driven units for correct operation.
    b. Check the cooling fan for correct operation and cycle time.
    c. Refer to the OEM specifications.
3. Overhead adjustments are not correct.
    a. Adjust the overhead settings.
    b. Refer to the procedure in the engine troubleshooting and repair manual.
4. Base engine problem.
    a. Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
    b. Refer to the procedures in the engine troubleshooting and repair manual.
5. Injector o-rings are damaged or missing.
    a. Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
    b. Refer to the procedures in the engine troubleshooting and repair manual.

5.5.13 Engine Will Not Shut Off

A. Check Run/Stop Circuit

Run/Stop circuit is malfunctioning. Check the generator Run/Stop circuit.

1. Run/Stop circuit is malfunctioning. Check the Remote start signal and verify that it has been removed.
2. Check the e-stop function. Verify that the E-stop (remote and Local) are functioning correctly.
3. Engine is running on fumes drawn into the air intake.
    a. Check the air intake ducts. Locate and isolate the source of the fumes.

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b. Repair as necessary.

4. Refer to Engine Service manual for more troubleshooting of the Engine symptom: Engine will not shut off.
   a. Fuel shutoff valve solenoid or circuit is malfunctioning. Check the fuel shutoff valve solenoid and circuit.
   b. Check for injector malfunction. Perform the cylinder performance test. Replace injectors as necessary.
   c. Turbocharger oil seal is leaking. Check the turbocharger for oil seals and for leaks.

B. Check Other Issues

1. Base engine problem.
   a. Check the engine for high crankcase pressure, low compression, damaged pistons, camshaft, and other parts.
   b. Refer to the procedures in the troubleshooting and repair manual for the specific engine.

5.5.14 Fuel Consumption is Excessive

Refer to the engine service manual for troubleshooting.

5.5.15 Fuel in the Coolant

Refer to the engine service manual for troubleshooting.

5.5.16 Fuel in the Lubricating Oil

Refer to the engine service manual for troubleshooting.

5.5.17 Excessive Smoke - Black

A. Check Air Intake

1. Check the air intake system for restriction.
   a. Clean or replace the air filter and inlet piping as necessary.
   b. Refer to procedures for fault codes 5151 through 5154.
   c. Refer to the procedure in the enngine troubleshooting and repair manual.

5.5.18 Excessive Smoke - White

A. Check Coolant Heater

1. Check the circuit breaker for the coolant heater. Reset the circuit braker if it is tripped.
2. Check the functions of the coolant heater. Replace components as necessary.
3. Refer to engine service manual for further troubleshooting.

5.5.19 Engine Noise Is Excessive

A. Check Lubrication System

Check the functions of the oil make-up system (if applicable). Replace as necessary.

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5.6 Troubleshooting - PowerCommand 3.3

5.6.1 No Code - The Operator Panel Is Unavailable After Changing the PCCNet Network

The Operator Panel was working until a PCCNet device was added or removed from the PCCNet network.

A. Bad Installation of PCCNet Device

1. Check the installation of the PCCNet device, in particular the connection at TB1. J25 and TB1 share the same electrical connection. If the PCCNet device is installed incorrectly, the Operator Panel on J25 stops working. Make sure the PCCNet device is connected correctly and is functioning properly.

5.6.2 Fault Code 118 - Fuel Pressure OOR High (Warning)

Fuel pressure sensor signal is out of range – shorted high.

A. Faulty Fuel Pressure Sensor Connections

1. Inspect the fuel pressure sensor and the engine harness connector pins.
    a. Disconnect the engine harness connector from the fuel pressure sensor.
    b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.

B. Faulty Fuel Pressure Sensor (Active Sensor)

1. Check the fuel pressure sensor supply voltage.
    a. Disconnect the engine harness connector from the fuel pressure sensor.
    b. Install the pressure sensor breakout cable between the sensor and the sensor harness connector.
    c. Measure the supply voltage by connecting the breakout cable's supply and return connectors to the multimeter. If the reading is between 4.75 and 5.25 VDC, then the supply voltage is correct.
2. Check the fuel pressure sensor signal (sense) voltage.
    a. Disconnect the engine harness connector from the fuel pressure sensor
    b. Install the pressure sensor breakout cable between the sensor and the sensor harness connector.
    c. Measure the signal voltage by connecting the breakout cable's signal and return connectors to the multimeter. If the reading is between 0.46 and 4.56 V, then the signal voltage is correct. If not, sensor is faulty.

C. Faulty Engine Harness

1. Inspect the engine harness and the connector pins.
    a. Disconnect the engine harness connector from the extension harness.
    b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.

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c. Inspect for evidence of moisture in or on the connector.

d. Inspect for missing or damaged connector seal.

e. Inspect for dirt or debris in or on the connector pin.

2. Check for a short circuit from pin to pin on the crankshaft speed sensor conductors.

   a. Disconnect the engine harness from the extension harness.

   b. Disconnect the engine harness connector from the crankshaft speed sensor.

   c. Disconnect the engine harness from all sensors that have a shared supply or return with the crankshaft speed sensor.

   d. Measure the resistance from the crankshaft speed 5 VDC supply pin on the engine harness inline connector to all other pins in the engine harness inline connector.

   e. Measure the resistance from the crankshaft speed return pin on the engine harness inline connector to all other pins in the engine harness inline connector.

   f. Measure the resistance from the crank shaft speed signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.

   g. If all measurements are greater than 100k ohms, then the resistance is correct.

3. Check for a short circuit to engine block ground on the crankshaft speed sensor conductors.

   a. Disconnect the extension harness from the control.

   b. Disconnect the extension harness from the engine harness.

   c. Measure the resistance from the crankshaft speed signal pin on the extension harness connector to the engine block ground.

   d. Measure the resistance from the crankshaft speed 5 VDC pin on the extension harness connector to the engine block ground.

   e. If the measurement is more than 100k ohms, then the resistance is correct.

4. Check for an open circuit on the crankshaft speed sensor conductors.

   a. Disconnect the engine harness connector from the extension harness.

   b. Disconnect the engine harness from the crankshaft speed sensor.

   c. Measure the resistance from the crankshaft speed return pin on the engine harness inline connector to the crankshaft speed return pin on the engine harness sensor connector.

   d. If the measurement is less than 10 ohms, then the resistance is correct.

5. Check for a short circuit from pin to pin on the camshaft position sensor conductors.

   a. Disconnect the engine harness from the extension harness.

   b. Disconnect the engine harness connector from the camshaft position sensor.

   c. Disconnect the engine harness from all sensors that have a shared supply or return with the camshaft position sensor.

   d. Measure the resistance from the camshaft position 5 VDC supply pin on the engine harness inline connector to all other pins in the engine harness inline connector.

   e. Measure the resistance from the camshaft position return pin on the engine harness inline connector to all other pins in the engine harness inline connector.

   f. Measure the resistance from the camshaft position signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.

   g. If all measurements are greater than 100k ohms, then the resistance is correct.

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6. Check for a short circuit to engine block ground on the camshaft position sensor conductors.
    a. Disconnect the extension harness from the control.
    b. Disconnect the extension harness from the engine harness.
    c. Measure the resistance from the camshaft position signal pin on the extension harness connector to the engine block ground.
    d. Measure the resistance from the camshaft position 5 VDC pin on the extension harness connector to the engine block ground.
    e. If the measurement is more than 100k ohms, then the resistance is correct.
7. Check for an open circuit on the camshaft position sensor conductors.
    a. Disconnect the engine harness connector from the extension harness.
    b. Disconnect the engine harness from the camshaft position sensor.
    c. Measure the resistance from the camshaft position return pin on the engine harness inline connector to the camshaft position return pin on the engine harness sensor connector.
    d. If the measurement is less than 10 ohms, then the resistance is correct.

D. Faulty Extension Harness

1. Inspect the extension harness and control pins.
    a. Disconnect the extension harness connector from the control.
    b. Inspect for corroded, bent broken, pushed back, expanded, or loose pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.
2. Check for a short circuit from pin to pin on the crankshaft speed sensor conductors.
    a. Disconnect the extension harness connector from the control.
    b. Disconnect the extension harness from the engine harness.
    c. Measure the resistance from the crankshaft speed sensor 5 VDC supply pin on the extension harness connector to all other pins in the extension harness connector.
    d. Measure the resistance from the crankshaft speed return pin on the extension harness connector to all other pins in the extension harness connector.
    e. Measure the resistance from the crankshaft speed signal pin on the extension harness connector to all other pins in the extension harness connector.
    f. If all measurements are greater than 100k ohms, then the resistance is correct.
3. Check for a short circuit to engine block ground on the crankshaft speed sensor conductors.
    a. Disconnect the extension harness from the control.
    b. Disconnect the extension harness from the engine harness.
    c. Measure the resistance from the crankshaft speed signal pin on the extension harness connector to the engine block ground.
    d. Measure the resistance from the crankshaft speed 5 VDC pin on the extension harness connector to the engine block ground.
    e. If the measurement is more than 100k ohms, then the resistance is correct.

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4. Check for an open circuit on the crankshaft speed sensor conductors.
    a. Disconnect the extension harness from the control.
    b. Disconnect the extension harness from the engine harness.
    c. Measure the resistance from the crankshaft speed return pin on the engine harness inline connector to the crankshaft speed return pin on the engine harness sensor connector.
    d. If the measurement is less than 10 ohms, then the resistance is correct.
5. Check for a short circuit from pin to pin on the camshaft position sensor conductors.
    a. Disconnect the extension harness connector from the control.
    b. Disconnect the extension harness from the engine harness.
    c. Measure the resistance from the camshaft position sensor 5 VDC supply pin on the extension harness connector to all other pins in the extension harness connector.
    d. Measure the resistance from the camshaft position return pin on the extension harness connector to all other pins in the extension harness connector.
    e. Measure the resistance from the camshaft position signal pin on the extension harness connector to all other pins in the extension harness connector.
    f. If all measurements are greater than 100k ohms, then the resistance is correct.
6. Check for a short circuit to engine block ground on the camshaft position sensor conductors.
    a. Disconnect the extension harness from the control.
    b. Disconnect the extension harness from the engine harness.
    c. Measure the resistance from the camshaft position signal pin on the extension harness connector to the engine block ground.
    d. Measure the resistance from the camshaft position 5 VDC pin on the extension harness connector to the engine block ground.
    e. If the measurement is more than 100k ohms, then the resistance is correct.
7. Check for an open circuit on the camshaft position sensor conductors.
    a. Disconnect the extension harness from the control.
    b. Disconnect the extension harness from the engine harness.
    c. Measure the resistance from the camshaft position return pin on the engine harness inline connector to the camshaft position return pin on the engine harness sensor connector.
    d. If the measurement is less than 10 ohms, then the resistance is correct.

E. Verify the calibrations in the ECM and the PowerCommand controls

1. Using the display or the InPower Service tool, verify the calibration in the PCC.
    a. If the calibration in the PCC matches the latest calibration on the InCal website, then the calibration is correct. If it does not, update the calibration to the latest.
2. Using the InSite Service tool, verify the calibration in the ECM.
    a. If the calibration in the ECM matches the latest calibration on QSOL, then the calibration is correct. If it does not, update the ECM to the latest calibration.

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5.6.3 Fault Code 119 - Fuel Pressure Sensor OOR Low (Warning)

Fuel pressure sensor signal is out of range – shorted high.

A. Faulty Fuel Pressure Sensor Connections

1. Inspect the fuel pressure sensor and the engine harness connector pins.
    a. Disconnect the engine harness connector from the fuel pressure sensor.
    b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.

B. Faulty Fuel Pressure Sensor (Active Sensor)

1. Check the fuel pressure sensor supply voltage.
    a. Disconnect the engine harness connector from the fuel pressure sensor.
    b. Install the pressure sensor breakout cable between the sensor and the sensor harness connector.
    c. Measure the supply voltage by connecting the breakout cable's supply and return connectors to the multimeter. If the reading is between 4.75 and 5.25 VDC, then the supply voltage is correct.
2. Check the fuel pressure sensor signal (sense) voltage.
    a. Disconnect the engine harness connector from the fuel pressure sensor
    b. Install the pressure sensor breakout cable between the sensor and the sensor harness connector.
    c. Measure the signal voltage by connecting the breakout cable's signal and return connectors to the multimeter. If the reading is between 0.46 and 4.56 V, then the signal voltage is correct. If not, sensor is faulty.

C. Faulty Engine Harness

1. Inspect the engine harness and the connector pins.
    a. Disconnect the engine harness connector from the extension harness.
    b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seal.
    e. Inspect for dirt or debris in or on the connector pin.
2. Check for a short circuit from pin to pin on the crankshaft speed sensor conductors.
    a. Disconnect the engine harness from the extension harness.
    b. Disconnect the engine harness connector from the crankshaft speed sensor.
    c. Disconnect the engine harness from all sensors that have a shared supply or return with the crankshaft speed sensor.

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d. Measure the resistance from the crankshaft speed 5 VDC supply pin on the engine harness inline connector to all other pins in the engine harness inline connector.

e. Measure the resistance from the crankshaft speed return pin on the engine harness inline connector to all other pins in the engine harness inline connector.

f. Measure the resistance from the crank shaft speed signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.

g. If all measurements are greater than 100k ohms, then the resistance is correct.

3. Check for a short circuit to engine block ground on the crankshaft speed sensor conductors.

a. Disconnect the extension harness from the control.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the crankshaft speed signal pin on the extension harness connector to the engine block ground.

d. Measure the resistance from the crankshaft speed 5 VDC pin on the extension harness connector to the engine block ground.

e. If the measurement is more than 100k ohms, then the resistance is correct.

4. Check for an open circuit on the crankshaft speed sensor conductors.

a. Disconnect the engine harness connector from the extension harness.

b. Disconnect the engine harness from the crankshaft speed sensor.

c. Measure the resistance from the crankshaft speed return pin on the engine harness inline connector to the crankshaft speed return pin on the engine harness sensor connector.

d. If the measurement is less than 10 ohms, then the resistance is correct.

5. Check for a short circuit from pin to pin on the camshaft position sensor conductors.

a. Disconnect the engine harness from the extension harness.

b. Disconnect the engine harness connector from the camshaft position sensor.

c. Disconnect the engine harness from all sensors that have a shared supply or return with the camshaft position sensor.

d. Measure the resistance from the camshaft position 5 VDC supply pin on the engine harness inline connector to all other pins in the engine harness inline connector.

e. Measure the resistance from the camshaft position return pin on the engine harness inline connector to all other pins in the engine harness inline connector.

f. Measure the resistance from the camshaft position signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.

g. If all measurements are greater than 100k ohms, then the resistance is correct.

6. Check for a short circuit to engine block ground on the camshaft position sensor conductors.

a. Disconnect the extension harness from the control.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the camshaft position signal pin on the extension harness connector to the engine block ground.

d. Measure the resistance from the camshaft position 5 VDC pin on the extension harness connector to the engine block ground.

e. If the measurement is more than 100k ohms, then the resistance is correct.

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7. Check for an open circuit on the camshaft position sensor conductors.
    a. Disconnect the engine harness connector from the extension harness.
    b. Disconnect the engine harness from the camshaft position sensor.
    c. Measure the resistance from the camshaft position return pin on the engine harness inline connector to the camshaft position return pin on the engine harness sensor connector.
    d. If the measurement is less than 10 ohms, then the resistance is correct.

D. Faulty Extension Harness

1. Inspect the extension harness and control pins.
    a. Disconnect the extension harness connector from the control.
    b. Inspect for corroded, bent broken, pushed back, expanded, or loose pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.
2. Check for a short circuit from pin to pin on the crankshaft speed sensor conductors.
    a. Disconnect the extension harness connector from the control.
    b. Disconnect the extension harness from the engine harness.
    c. Measure the resistance from the crankshaft speed sensor 5 VDC supply pin on the extension harness connector to all other pins in the extension harness connector.
    d. Measure the resistance from the crankshaft speed return pin on the extension harness connector to all other pins in the extension harness connector.
    e. Measure the resistance from the crankshaft speed signal pin on the extension harness connector to all other pins in the extension harness connector.
    f. If all measurements are greater than 100k ohms, then the resistance is correct.
3. Check for a short circuit to engine block ground on the crankshaft speed sensor conductors.
    a. Disconnect the extension harness from the control.
    b. Disconnect the extension harness from the engine harness.
    c. Measure the resistance from the crankshaft speed signal pin on the extension harness connector to the engine block ground.
    d. Measure the resistance from the crankshaft speed 5 VDC pin on the extension harness connector to the engine block ground.
    e. If the measurement is more than 100k ohms, then the resistance is correct.
4. Check for an open circuit on the crankshaft speed sensor conductors.
    a. Disconnect the extension harness from the control.
    b. Disconnect the extension harness from the engine harness.
    c. Measure the resistance from the crankshaft speed return pin on the engine harness inline connector to the crankshaft speed return pin on the engine harness sensor connector.
    d. If the measurement is less than 10 ohms, then the resistance is correct.
5. Check for a short circuit from pin to pin on the camshaft position sensor conductors.
    a. Disconnect the extension harness connector from the control.

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b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the camshaft position sensor 5 VDC supply pin on the extension harness connector to all other pins in the extension harness connector.

d. Measure the resistance from the camshaft position return pin on the extension harness connector to all other pins in the extension harness connector.

e. Measure the resistance from the camshaft position signal pin on the extension harness connector to all other pins in the extension harness connector.

f. If all measurements are greater than 100k ohms, then the resistance is correct.

6. Check for a short circuit to engine block ground on the camshaft position sensor conductors.

   a. Disconnect the extension harness from the control.

   b. Disconnect the extension harness from the engine harness.

   c. Measure the resistance from the camshaft position signal pin on the extension harness connector to the engine block ground.

   d. Measure the resistance from the camshaft position 5 VDC pin on the extension harness connector to the engine block ground.

   e. If the measurement is more than 100k ohms, then the resistance is correct.

7. Check for an open circuit on the camshaft position sensor conductors.

   a. Disconnect the extension harness from the control.

   b. Disconnect the extension harness from the engine harness.

   c. Measure the resistance from the camshaft position return pin on the engine harness inline connector to the camshaft position return pin on the engine harness sensor connector.

   d. If the measurement is less than 10 ohms, then the resistance is correct.

E. Verify the calibrations in the ECM and the PowerCommand controls

1. Using the display or the InPower Service tool, verify the calibration in the PCC.

   a. If the calibration in the PCC matches the latest calibration on the InCal website, then the calibration is correct. If it does not, update the calibration to the latest.

2. Using the InSite Service tool, verify the calibration in the ECM.

   a. If the calibration in the ECM matches the latest calibration on QSOL, then the calibration is correct. If it does not, update the ECM to the latest calibration.

5.6.4 Fault Code 121 - Loss of Speed Sense (Shutdown)

No engine speed signal detected from one of two signals: engine crankshaft speed or engine camshaft position.

Possible Causes:

1. Faulty crankshaft speed sensor connections
2. Faulty crankshaft speed sensor
3. Faulty camshaft position sensor connections
4. Faulty camshaft position sensor
5. Faulty engine harness
6. Faulty extension harness

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7. Damaged crankshaft target wheel
8. Verify the calibrations in the ECM and the PowerCommand controls

A. Faulty Crankshaft Speed Sensor Connections

1. Inspect the crankshaft speed sensor and the engine harness connector pins.
    a. Disconnect the engine harness connector from the crankshaft speed sensor.
    b. Inspect for corroded, bent broken, pushed back, expanded, or loose pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.

B. Faulty Crankshaft Speed Sensor

1. Check the crankshaft speed sensor supply voltage.
    a. Disconnect the engine harness connector from the crankshaft speed sensor.
    b. Install the speed sensor breakout cable between the sensor and the sensor harness connector.
    c. Measure the supply voltage by connecting the breakout cable's supply and return connectors to the multimeter. If the reading is between 4.75 and 5.25 VDC, then the supply voltage is correct.
2. Check the crankshaft speed sensor signal (sense) voltage.
    a. Disconnect the engine harness connector from the camshaft position sensor.
    b. Install the pressure sensor breakout cable between the sensor and the sensor harness connector.
    c. Measure the signal voltage by connecting the breakout cable's signal and return connectors to the multimeter. If the reading is between 0.46 and 4.56 VDC, then the signal voltage is correct. If not, sensor is faulty.

C. Faulty Camshaft Position Sensor Connections

1. Inspect the camshaft position sensor and the engine harness connector pins
    a. Disconnect the engine harness connector from the camshaft position sensor.
    b. Inspect for corroded, bent broken, pushed back, expanded, or loose pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.

D. Faulty Camshaft Position Sensor

1. Check the camshaft position sensor supply voltage.
    a. Disconnect the engine harness connector from the camshaft position sensor.
    b. Install the speed sensor breakout cable between the sensor and the sensor harness connector.

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c. Measure the supply voltage by connecting the breakout cable's supply and return connectors to the multimeter. If the reading is between 4.75 and 5.25 VDC, then the supply voltage is correct.

2. Check the camshaft position sensor signal (sense) voltage.
   a. Disconnect the engine harness connector from the camshaft position sensor.
   b. Install the pressure sensor breakout cable between the sensor and the sensor harness connector.
   c. Measure the signal voltage by connecting the breakout cable's signal and return connectors to the multimeter. If the reading is between 0.46 and 4.56 VDC, then the signal voltage is correct. If not, sensor is faulty.

E. Faulty Engine Harness

1. Inspect the engine harness and the connector pins.
   a. Disconnect the engine harness connector from the extension harness.
   b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seal.
   e. Inspect for dirt or debris in or on the connector pin.
2. Check for a short circuit from pin to pin on the crankshaft speed sensor conductors.
   a. Disconnect the engine harness from the extension harness.
   b. Disconnect the engine harness connector from the crankshaft speed sensor.
   c. Disconnect the engine harness from all sensors that have a shared supply or return with the crankshaft speed sensor.
   d. Measure the resistance from the crankshaft speed 5 VDC supply pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   e. Measure the resistance from the crankshaft speed return pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   f. Measure the resistance from the crank shaft speed signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   g. If all measurements are greater than 100k ohms, then the resistance is correct.
3. Check for a short circuit to engine block ground on the crankshaft speed sensor conductors.
   a. Disconnect the extension harness from the control.
   b. Disconnect the extension harness from the engine harness.
   c. Measure the resistance from the crankshaft speed signal pin on the extension harness connector to the engine block ground.
   d. Measure the resistance from the crankshaft speed 5 VDC pin on the extension harness connector to the engine block ground.
   e. If the measurement is more than 100k ohms, then the resistance is correct.
4. Check for an open circuit on the crankshaft speed sensor conductors.
   a. Disconnect the engine harness connector from the extension harness.
   b. Disconnect the engine harness from the crankshaft speed sensor.

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c. Measure the resistance from the crankshaft speed return pin on the engine harness inline connector to the crankshaft speed return pin on the engine harness sensor connector.

d. If the measurement is less than 10 ohms, then the resistance is correct.

5. Check for a short circuit from pin to pin on the camshaft position sensor conductors.

a. Disconnect the engine harness from the extension harness.

b. Disconnect the engine harness connector from the camshaft position sensor.

c. Disconnect the engine harness from all sensors that have a shared supply or return with the camshaft position sensor.

d. Measure the resistance from the camshaft position 5 VDC supply pin on the engine harness inline connector to all other pins in the engine harness inline connector.

e. Measure the resistance from the camshaft position return pin on the engine harness inline connector to all other pins in the engine harness inline connector.

f. Measure the resistance from the camshaft position signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.

g. If all measurements are greater than 100k ohms, then the resistance is correct.

6. Check for a short circuit to engine block ground on the camshaft position sensor conductors.

a. Disconnect the extension harness from the control.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the camshaft position signal pin on the extension harness connector to the engine block ground.

d. Measure the resistance from the camshaft position 5 VDC pin on the extension harness connector to the engine block ground.

e. If the measurement is more than 100k ohms, then the resistance is correct.

7. Check for an open circuit on the camshaft position sensor conductors.

a. Disconnect the engine harness connector from the extension harness.

b. Disconnect the engine harness from the camshaft position sensor.

c. Measure the resistance from the camshaft position return pin on the engine harness inline connector to the camshaft position return pin on the engine harness sensor connector.

d. If the measurement is less than 10 ohms, then the resistance is correct.

F. Faulty Extension Harness

1. Inspect the extension harness and control pins.

a. Disconnect the extension harness connector from the control.

b. Inspect for corroded, bent broken, pushed back, expanded, or loose pins.

c. Inspect for evidence of moisture in or on the connector.

d. Inspect for missing or damaged connector seals.

e. Inspect for dirt or debris in or on the connector pins.

2. Check for a short circuit from pin to pin on the crankshaft speed sensor conductors.

a. Disconnect the extension harness connector from the control.

b. Disconnect the extension harness from the engine harness.

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c. Measure the resistance from the crankshaft speed sensor 5 VDC supply pin on the extension harness connector to all other pins in the extension harness connector.

d. Measure the resistance from the crankshaft speed return pin on the extension harness connector to all other pins in the extension harness connector.

e. Measure the resistance from the crankshaft speed signal pin on the extension harness connector to all other pins in the extension harness connector.

f. If all measurements are greater than 100k ohms, then the resistance is correct.

3. Check for a short circuit to engine block ground on the crankshaft speed sensor conductors.

a. Disconnect the extension harness from the control.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the crankshaft speed signal pin on the extension harness connector to the engine block ground.

d. Measure the resistance from the crankshaft speed 5 VDC pin on the extension harness connector to the engine block ground.

e. If the measurement is more than 100k ohms, then the resistance is correct.

4. Check for an open circuit on the crankshaft speed sensor conductors.

a. Disconnect the extension harness from the control.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the crankshaft speed return pin on the engine harness inline connector to the crankshaft speed return pin on the engine harness sensor connector.

d. If the measurement is less than 10 ohms, then the resistance is correct.

5. Check for a short circuit from pin to pin on the camshaft position sensor conductors.

a. Disconnect the extension harness connector from the control.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the camshaft position sensor 5 VDC supply pin on the extension harness connector to all other pins in the extension harness connector.

d. Measure the resistance from the camshaft position return pin on the extension harness connector to all other pins in the extension harness connector.

e. Measure the resistance from the camshaft position signal pin on the extension harness connector to all other pins in the extension harness connector.

f. If all measurements are greater than 100k ohms, then the resistance is correct.

6. Check for a short circuit to engine block ground on the camshaft position sensor conductors.

a. Disconnect the extension harness from the control.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the camshaft position signal pin on the extension harness connector to the engine block ground.

d. Measure the resistance from the camshaft position 5 VDC pin on the extension harness connector to the engine block ground.

e. If the measurement is more than 100k ohms, then the resistance is correct.

7. Check for an open circuit on the camshaft position sensor conductors.

a. Disconnect the extension harness from the control.

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b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the camshaft position return pin on the engine harness inline connector to the camshaft position return pin on the engine harness sensor connector.

d. If the measurement is less than 10 ohms, then the resistance is correct.

G. Damaged Crankshaft Target Wheel

1. Visually inspect the crankshaft target wheel.
   a. Inspect for damaged, malformed, missing or broken target wheel teeth.
   b. Inspect for evidence of corrosion or other materials on or around the target wheel teeth.
   c. Inspect for dirt or debris on the target wheel teeth.

H. Verify the calibrations in the ECM and the PowerCommand controls

1. Using the display or the InPower Service tool, verify the calibration in the PCC.
   a. If the calibration in the PCC matches the latest calibration on the InCal website, then the calibration is correct. If it does not, update the calibration to the latest.
2. Using the InSite Service tool, verify the calibration in the ECM.
   a. If the calibration in the ECM matches the latest calibration on QSOL, then the calibration is correct. If it does not, update the ECM to the latest calibration.

5.6.5 Fault Code 135 - Oil Pressure Sensor OOR High

Engine oil pressure sensor signal is out of range – shorted high.

NOTICE
This warning will only occur if the generator set is equipped with an oil pressure sensor.

Refer to the engine service manual for troubleshooting.

5.6.6 Fault Code 141 - Oil Pressure Sensor OOR Low

Engine oil pressure sensor signal is out of range – shorted low.

NOTICE
This warning will only occur if the generator set is equipped with an oil pressure sensor.

Refer to the engine service manual for troubleshooting.

5.6.7 Fault Code 143 - Engine Oil Pressure Low (Warning)

Engine oil pressure is below the low oil pressure warning threshold.

Refer to the engine service manual for troubleshooting.

5.6.8 Fault Code 144 - Engine Coolant Temperature OOR High

Engine coolant temperature signal voltage is out of range - shorted high

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NOTICE
Part number 382275800 - Male Deutsch/AMP/Metri-Pack test lead **Part number 382291700 - Female Deutsch/AMP/Metri-Pack test lead**

Refer to the engine service manual for troubleshooting.

5.6.9 Fault Code 145 - Engine Coolant Temperature OOR High (Warning)

Engine coolant temperature signal voltage is out of range – shorted high.

Refer to the engine service manual for troubleshooting.

5.6.10 Fault Code 146 - Engine Coolant Temperature Above Normal (Warning)

Engine coolant temperature has exceeded the warning level and duration parameters set in the ECM or control.

Refer to the engine service manual for troubleshooting.

5.6.11 Fault Code 151 - Engine Coolant Temperature High (Shutdown)

Engine coolant temperature has exceeded the alarm (shutdown) threshold for high coolant temperature.

Refer to the engine service manual for troubleshooting.

5.6.12 Fault Code 153 - Intake Manifold Temperature OOR High (Warning)

Engine intake manifold temperature sensor signal is out of range – shorted high.

NOTICE
Part Number 3822758 - Male Deutsch/AMP/Metri-Pack test lead **Part Number 3822917 - Female Deutsch/AMP/Metri-Pack test lead**

A. Faulty Intake Manifold Temperature Sensor Connections

1. Inspect the intake manifold temperature sensor and the harness connector pins.
   a. Disconnect the engine harness connector from the intake manifold temperature sensor.
   b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.

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B. Faulty Intake Manifold Temperature Sensor

1. Check the resistance of the sensor.
    a. Disconnect the engine harness connector from the intake manifold temperature sensor.
    b. Measure the resistance between the intake manifold temperature signal pin and the intake manifold temperature return pin.
    c. Refer to the troubleshooting and repair manual for the specific engine platform for intake manifold temperature ranges.
2. Check for a short circuit to engine block ground.
    a. Disconnect the engine harness connector from the intake manifold temperature sensor.
    b. Measure the resistance from one of the pins of the intake manifold temperature sensor connector to engine block ground. If the resistance is more than 100k Ohms, the sensor is operating correctly.

C. Faulty Engine Harness

1. Inspect the engine harness and the extension harness connector pins.
    a. Disconnect the engine harness from the extension harness.
    b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.
2. Check for a short circuit from pin to pin.
    a. Disconnect the engine harness connector from the extension harness.
    b. Disconnect the engine harness from the intake manifold temperature sensor.
    c. Disconnect the engine harness from all sensors that have a shared return with the intake manifold temperature sensor.
    d. Measure the resistance from the intake manifold temperature return pin on the engine harness inline connector to all other pins in the engine harness inline connector.
    e. Measure the resistance from the intake manifold temperature signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
    f. If all measurements are greater than 100k Ohms, then the resistance is correct.
3. Check for an open circuit.
    a. Disconnect the engine harness connector from the extension harness.
    b. Disconnect the engine harness from the intake manifold
    c. Measure the resistance from the intake manifold temperature return pin on the engine harness inline connector to the intake manifold temperature return pin at the engine harness sensor connector.
    d. Measure the resistance from the intake manifold temperature signal pin on the engine harness inline connector to the intake manifold temperature signal pin at then engine harness sensor connector.
    e. If the measurement is less than 10 Ohms, then the resistance is correct.

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D. Faulty Extension Harness

1. Inspect the engine harness and the extension harness connector pins.
   a. Disconnect the engine harness from the extension harness.
   b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.
2. Check for a short circuit from pin to pin.
   a. Disconnect the engine harness connector from the extension harness.
   b. Disconnect the engine harness from the intake manifold temperature sensor.
   c. Disconnect the engine harness from all sensors that have a shared return with the intake manifold temperature sensor.
   d. Measure the resistance from the intake manifold temperature return pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   e. Measure the resistance from the intake manifold temperature signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   f. If all measurements are greater than 100k Ohms, then the resistance is correct.
3. Check for an open circuit.
   a. Disconnect the engine harness connector from the extension harness.
   b. Disconnect the engine harness from the intake manifold
   c. Measure the resistance from the intake manifold temperature return pin on the engine harness inline connector to the intake manifold temperature return pin at the engine harness sensor connector.
   d. Measure the resistance from the intake manifold temperature signal pin on the engine harness inline connector to the intake manifold temperature signal pin at then engine harness sensor connector.
   e. If the measurement is less than 10 ohms, then the resistance is correct.

5.6.13 Fault Code 154 - Intake Manifold Temperature OOR Low (Warning)

Engine intake manifold temperature sensor signal is out of range – shorted low.

NOTICE
Part Number 3822758 - Male Deutsch/AMP/Metri-Pack test lead **Part Number 3822917 - Female Deutsch/AMP/Metri-Pack test lead**

A. Faulty Intake Manifold Temperature Sensor Connections

1. Inspect the intake manifold temperature sensor and the harness connector pins.
   a. Disconnect the engine harness connector from the intake manifold temperature sensor.
   b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.

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c. Inspect for evidence of moisture in or on the connector.

d. Inspect for missing or damaged connector seals.

e. Inspect for dirt or debris in or on the connector pins.

B. Faulty Intake Manifold Temperature Sensor

1. Check the resistance of the sensor.
   a. Disconnect the engine harness connector from the intake manifold temperature sensor.
   b. Measure the resistance between the intake manifold temperature signal pin and the intake manifold temperature return pin.
   c. Refer to the troubleshooting and repair manual for the specific engine platform for intake manifold temperature ranges.
2. Check for a short circuit to engine block ground.
   a. Disconnect the engine harness connector from the intake manifold temperature sensor.
   b. Measure the resistance from one of the pins of the intake manifold temperature sensor connector to engine block ground. If the resistance is more than 100k Ohms, the sensor is operating correctly.

C. Faulty Engine Harness

1. Inspect the engine harness and the extension harness connector pins.
   a. Disconnect the engine harness from the extension harness.
   b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.
2. Check for a short circuit from pin to pin.
   a. Disconnect the engine harness connector from the extension harness.
   b. Disconnect the engine harness from the intake manifold temperature sensor.
   c. Disconnect the engine harness from all sensors that have a shared return with the intake manifold temperature sensor.
   d. Measure the resistance from the intake manifold temperature return pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   e. Measure the resistance from the intake manifold temperature signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   f. If all measurements are greater than 100k Ohms, then the resistance is correct.
3. Check for an open circuit.
   a. Disconnect the engine harness connector from the extension harness.
   b. Disconnect the engine harness from the intake manifold
   c. Measure the resistance from the intake manifold temperature return pin on the engine harness inline connector to the intake manifold temperature return pin at the engine harness sensor connector.

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d. Measure the resistance from the intake manifold temperature signal pin on the engine harness inline connector to the intake manifold temperature signal pin at then engine harness sensor connector.

e. If the measurement is less than 10 Ohms, then the resistance is correct.

D. Faulty Extension Harness-Intake Manifold Sensor

1. Inspect the extension harness and the control connector pins.
   a. Disconnect the extension harness connector from the control.
   b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.
2. Check for a short circuit to engine block ground.
   a. Disconnect the extension harness from the engine harness.
   b. Measure the resistance from the intake manifold temperature signal pin on the extension harness connector to engine block ground.
   c. Measure the resistance from the intake manifold temperature return pin on the extension harness connector to engine block ground.
   d. If all measurements are greater than 100k ohms, then the resistance is correct.
3. Check for an open circuit.
   a. Disconnect the extension harness connector from the control.
   b. Disconnect the extension harness from the engine harness.
   c. Measure the resistance from the intake manifold temperature return pin on the extension harness connector to the intake manifold temperature return pin on the extension harness inline connection.
   d. If the measurement is less than 10 ohms, then the resistance is correct.

5.6.14 Fault Code 155 - Intake Manifold Temperature High (Shutdown)

Engine intake manifold temperature has the shutdown level and duration parameters set in the ECM or control.

A. High Ambient Temperature

1. Using a thermocouple, verify the air temperature entering the intake louver of the generator set.
2. Reduce loads or recirculation of discharge air to the generator set with an elevated ambient temperature.

B. Radiator Blocked

1. Inspect for dirt, debris or obstructions.
2. Remove blockage or winterfront as applicable.

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C. Louvers Are Closed Or Damaged

1. Inspect the louvers for proper operation.
2. Repair or replace the louvers if damaged.
3. Check the louver motor for proper operation.
4. If the louver motor is operational, verify the louver shutterstat is operational.

D. Charge Air Cooler Fins or Radiator Fins are Damaged or Obstructed

1. Inspect for dirt, debris or obstructions.
2. Clean if necessary.

E. Fan Belt Is Broken Or Loose

1. Inspect belt(s) for damage, wear, and proper tension.
2. Inspect pulleys and belt tensioner for damage or wear.
3. Repair or replace if damaged or worn.

F. Fan Drive Or Fan Controls Are Malfunctioning

1. Inspect pulleys and belt tensioner for damage or wear.
2. Repair or replace if damaged or worn.

G. Inaccurate Coolant Temperature Sensor

1. Using a thermocouple or similar device, measure the coolant temperature near the sensor and compare it to the coolant temperature displayed.
2. Verify the temperature sensor resistance and compare it to the specifications in the engine manual.
3. Verify continuity from the temperature sensor wire pin to the engine ECM pin. The harness resistance should be less than 5 Ohms.
4. Repair or replace faulty components or wiring.

H. Fault Simulation Feature Is Enabled

1. Connect InPower.
2. Verify that the fault simulation is not enabled for the engine speed sensor by connecting to the PCC via InPower.
3. If the fault simulation is disabled, there is no problem.

I. Incorrect Threshold Setting

1. Connect to the engine ECM using the service tool. Verify fault threshold settings and compare them to the specifications in the engine manual.
2. Verify that the calibration numbers and revisions are correct for the ECM and PCC.
3. Recalibrate the engine ECM to reset the threshold settings.

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5.6.15 Fault Code 195 - Coolant Level Sensor OOR High (Warning)

Coolant level sensor signal is out of range – shorted high.

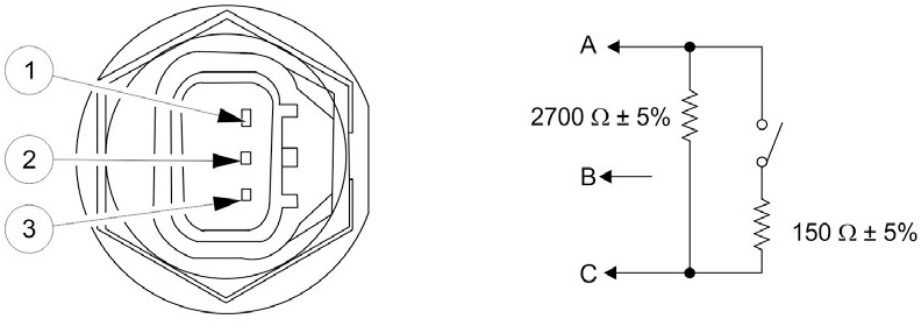
NOTICE
Part Number 3822758 - Male Deutsch/AMP/Metri-Pack test lead
Part Number 3822917 - Female Deutsch/AMP/Metri-Pack test lead

A. Faulty Coolant Temperature Sensor Connections

1. Inspect the coolant temperature sensor and the engine harness connector pins.
   a. Disconnect the engine harness connector from the coolant temperature sensor.
   b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.

B. Faulty Coolant Level Sensor

1. Check the sensor.
   a. Disconnect the engine harness connector from the coolant level sensor.
   b. Measure the resistance between the coolant level sensor signal pin and the coolant level sensor return pin. Resistance should be 142 Ω ± 5% (in coolant) or 2700 Ω ± 5% (in air).
      i. If resistance is not correct, replace sensor.
   c. Measure the voltage between the coolant level sensor signal pin and the coolant level sensor return pin. Voltage should be lower than 2.00 VDC.
      i. If voltage is more than above specification, replace sensor.



No.	Description	No.	Description
1	Pin A - Power	3	Pin C - Signal Return
2	Pin B - Not used		

FIGURE 7. COOLANT LEVEL SENSOR SCHEMATIC

C. Faulty Engine Harness-Coolant Level Sensor

1. Inspect the engine harness and the connector pins.
    a. Disconnect the engine harness connector from the extension harness.
    b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pin.
2. Check for a short circuit from pin to pin.
    a. Disconnect the engine harness from the extension harness.
    b. Disconnect the engine harness connector from the coolant level sensor.
    c. Measure the resistance from the coolant level sensor supply pin on the engine harness inline connector to all other pins in the engine harness inline connector.
    d. Measure the resistance from the coolant level sensor pin on the engine harness inline connector to all other pins in the engine harness inline connector.
    e. Measure the resistance from the coolant level sensor signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
    f. If all measurements are greater than 100k ohms, then the resistance is correct.
3. Check for an open circuit.
    a. Disconnect the engine harness from the extension harness.
    b. Disconnect the engine harness connector from the coolant level sensor.
    c. Measure the resistance from the coolant level sensor return pin on the engine harness inline connector to the coolant level sensor return pin on the engine harness sensor connector.
    d. If the measurement is less than 10 ohms, then the resistance is correct.

D. Faulty Extension Harness-Coolant Level Sensor

1. Inspect the extension harness and the extension harness connector pins.
    a. Disconnect the extension harness connector from the control.
    b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.
2. Check for an open circuit.
    a. Disconnect the extension harness connector from the control.
    b. Disconnect the extension harness from the engine harness.
    c. Measure the resistance from the coolant level sensor return pin on the engine harness inline connector to the coolant level sensor return pin at the engine harness sensor connector.
    d. Measure the resistance from the coolant level sensor signal pin on the engine harness inline connector to coolant level sensor signal pin at then engine harness sensor connector.

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e. If the measurement is less than 10 ohms, then the resistance is correct.

3. Check for a short circuit from pin to pin.
   a. Disconnect the extension harness connector from the control.
   b. Disconnect the extension harness from the engine harness.
   c. Disconnect the engine harness from all sensors that have a shared return with the coolant level sensor. Measure the resistance from the intake manifold temperature return pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   d. Measure the resistance from the coolant level sensor signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   e. If all measurements are greater than 100k Ohms, then the resistance is correct.

5.6.16 Fault Code 196 - Coolant Level Sensor OOR Low (Warning)

Coolant level sensor signal is out of range – shorted high.

NOTICE
Part Number 3822758 - Male Deutsch/AMP/Metri-Pack test lead **Part Number 3822917 - Female Deutsch/AMP/Metri-Pack test lead**

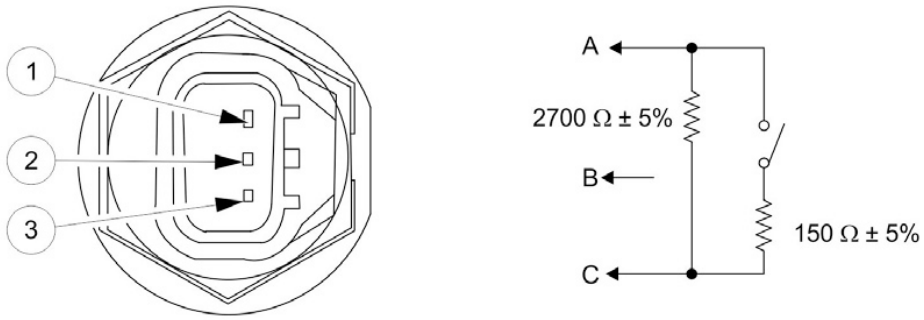
A. Faulty Coolant Temperature Sensor Connections

1. Inspect the coolant temperature sensor and the engine harness connector pins.
   a. Disconnect the engine harness connector from the coolant temperature sensor.
   b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.

B. Faulty Coolant Level Sensor

1. Check the sensor.
   a. Disconnect the engine harness connector from the coolant level sensor.
   b. Measure the resistance between the coolant level sensor signal pin and the coolant level sensor return pin. Resistance should be 142 Ω ± 5% (in coolant) or 2700 Ω ± 5% (in air).
      i. If resistance is not correct, replace sensor.
   c. Measure the voltage between the coolant level sensor signal pin and the coolant level sensor return pin. Voltage should be lower than 2.00 VDC.
      i. If voltage is more than above specification, replace sensor.

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No.	Description	No.	Description
1	Pin A - Power	3	Pin C - Signal Return
2	Pin B - Not used		

FIGURE 8. COOLANT LEVEL SENSOR SCHEMATIC

C. Faulty Engine Harness-Coolant Level Sensor

1. Inspect the engine harness and the connector pins.
   a. Disconnect the engine harness connector from the extension harness.
   b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pin.
2. Check for a short circuit from pin to pin.
   a. Disconnect the engine harness from the extension harness.
   b. Disconnect the engine harness connector from the coolant level sensor.
   c. Measure the resistance from the coolant level sensor supply pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   d. Measure the resistance from the coolant level sensor pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   e. Measure the resistance from the coolant level sensor signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   f. If all measurements are greater than 100k ohms, then the resistance is correct.
3. Check for an open circuit.
   a. Disconnect the engine harness from the extension harness.
   b. Disconnect the engine harness connector from the coolant level sensor.
   c. Measure the resistance from the coolant level sensor return pin on the engine harness inline connector to the coolant level sensor return pin on the engine harness sensor connector.
   d. If the measurement is less than 10 ohms, then the resistance is correct.

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D. Faulty Extension Harness-Coolant Level Sensor

1. Inspect the extension harness and the extension harness connector pins.
    a. Disconnect the extension harness connector from the control.
    b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.
2. Check for an open circuit.
    a. Disconnect the extension harness connector from the control.
    b. Disconnect the extension harness from the engine harness.
    c. Measure the resistance from the coolant level sensor return pin on the engine harness inline connector to the coolant level sensor return pin at the engine harness sensor connector.
    d. Measure the resistance from the coolant level sensor signal pin on the engine harness inline connector to coolant level sensor signal pin at then engine harness sensor connector.
    e. If the measurement is less than 10 ohms, then the resistance is correct.
3. Check for a short circuit from pin to pin.
    a. Disconnect the extension harness connector from the control.
    b. Disconnect the extension harness from the engine harness.
    c. Disconnect the engine harness from all sensors that have a shared return with the coolant level sensor. Measure the resistance from the intake manifold temperature return pin on the engine harness inline connector to all other pins in the engine harness inline connector.
    d. Measure the resistance from the coolant level sensor signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
    e. If all measurements are greater than 100k Ohms, then the resistance is correct.

5.6.17 Fault Code 197 - Coolant Level Low (Warning)

Coolant level sensor signal is showing a low coolant level for greater 10 seconds.

A. Check Coolant Level

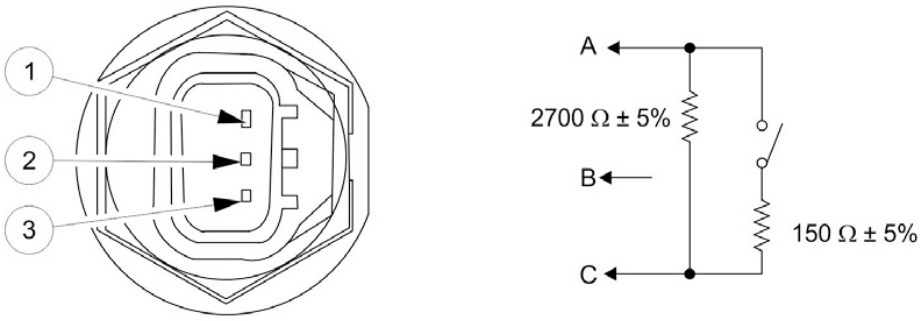
1. If the generator set is powering critical loads and cannot be shut down, wait until next shutdown period, then complete the following steps:
2. Allow engine to cool completely.
3. Inspect the engine, cooling system and surrounding area for external coolant leaks.
    a. Repair as required.
    b. If internal coolant loss is suspected, refer to the Engine Service Manual.
4. Inspect the coolant level, using the sight glass (if applicable) or by removing the radiator cap.
    a. Allow engine to cool.
    b. Slowly remove the radiator cap to allow for pressure to be released,

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5. If coolant level is below X in (X cm) from the top of the radiator, add manufacturer's prescribed amount of coolant.
    a. Refer to Section X, for cooling system maintenance procedures.
6. Clear the warning by pressing the Reset button on the Operator Panel.

B. Faulty Coolant Level Sensor

1. Check the sensor.
    a. Disconnect the engine harness connector from the coolant level sensor.
    b. Measure the resistance between the coolant level sensor signal pin and the coolant level sensor return pin. Resistance should be 142 Ω ± 5% (in coolant) or 2700 Ω ± 5% (in air).
        i. If resistance is not correct, replace sensor.
    c. Measure the voltage between the coolant level sensor signal pin and the coolant level sensor return pin. Voltage should be lower than 2.00 VDC.
        i. If voltage is more than above specification, replace sensor.



No.	Description	No.	Description
1	Pin A - Power	3	Pin C - Signal Return
2	Pin B - Not used		

FIGURE 9. COOLANT LEVEL SENSOR SCHEMATIC

C. Faulty Engine Harness-Coolant Level Sensor

1. Inspect the engine harness and the connector pins.
    a. Disconnect the engine harness connector from the extension harness.
    b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pin.
2. Check for a short circuit from pin to pin.
    a. Disconnect the engine harness from the extension harness.
    b. Disconnect the engine harness connector from the coolant level sensor.

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c. Measure the resistance from the coolant level sensor supply pin on the engine harness inline connector to all other pins in the engine harness inline connector.

d. Measure the resistance from the coolant level sensor pin on the engine harness inline connector to all other pins in the engine harness inline connector.

e. Measure the resistance from the coolant level sensor signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.

f. If all measurements are greater than 100k ohms, then the resistance is correct.

3. Check for an open circuit.

a. Disconnect the engine harness from the extension harness.

b. Disconnect the engine harness connector from the coolant level sensor.

c. Measure the resistance from the coolant level sensor return pin on the engine harness inline connector to the coolant level sensor return pin on the engine harness sensor connector.

d. If the measurement is less than 10 ohms, then the resistance is correct.

D. Faulty Extension Harness-Coolant Level Sensor

1. Inspect the extension harness and the extension harness connector pins.

a. Disconnect the extension harness connector from the control.

b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.

c. Inspect for evidence of moisture in or on the connector.

d. Inspect for missing or damaged connector seals.

e. Inspect for dirt or debris in or on the connector pins.

2. Check for an open circuit.

a. Disconnect the extension harness connector from the control.

b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the coolant level sensor return pin on the engine harness inline connector to the coolant level sensor return pin at the engine harness sensor connector.

d. Measure the resistance from the coolant level sensor signal pin on the engine harness inline connector to coolant level sensor signal pin at then engine harness sensor connector.

e. If the measurement is less than 10 ohms, then the resistance is correct.

3. Check for a short circuit from pin to pin.

a. Disconnect the extension harness connector from the control.

b. Disconnect the extension harness from the engine harness.

c. Disconnect the engine harness from all sensors that have a shared return with the coolant level sensor. Measure the resistance from the intake manifold temperature return pin on the engine harness inline connector to all other pins in the engine harness inline connector.

d. Measure the resistance from the coolant level sensor signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.

e. If all measurements are greater than 100k Ohms, then the resistance is correct.

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E. Check PCCNet Annunciator

1. Check the wiring on the back of the PCCNet Annunciator. Make sure that an open circuit or short circuit does not exist in the wiring.
2. Refer to the PCCNet Annunciator Operator Manual to verify that the Annunciator is configured correctly; since inputs can be configured to Active Open or Active Closed.
3. Use the following table to determine proper wiring connections:

TABLE 22. CONNECTIONS

Pin	Description
CTB5-4	Input
CTB10-2	Ground

5.6.18 Fault Code 212 - Engine Oil Temperature OOR High

Engine oil temperature is out of range - shorted high.

NOTICE
Part number 382275800 - Male Deutsch/AMP/Metri-Pack test lead **Part number 382291700 - Female Deutsch/AMP/Metri-Pack test lead**

A. Engine Oil Temperature Sensor Connections

1. Inspect the engine oil temperature sensor and the harness connector pins.
   a. Disconnect the engine harness connector from the engine oil temperature sensor.
   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.

B. Faulty Engine Oil Temperature Sensor

1. Check the resistance of the sensor.
   a. Disconnect the engine harness connector from the engine oil temperature sensor.
   b. Measure the resistance between the engine oil temperature signal pin and the engine oil temperature return pin.
   c. Refer to the troubleshooting and repair manual for the specific engine platform for engine oil temperature ranges.

C. Faulty Engine Harness Oil Temperature Sensor

1. Inspect the engine harness and the extension harness connector pins.
   a. Disconnect the engine harness connector from the extension harness.
   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.

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d. Inspect for missing or damaged connector seals.

e. Inspect for dirt or debris in or on the connector pins.

Check for a short circuit from pin-to-pin.

a. Disconnect the engine harness connector from the extension harness.

b. Disconnect the engine harness from the engine oil temperature sensor.

c. Disconnect the engine harness from all sensors that have a shared return with the engine oil temperature sensor.

d. Measure the resistance from the engine oil temperature return pin on the engine harness inline connector to all other pins in the engine harness inline connector.

e. Measure the resistance from the engine oil temperature signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.

f. If all measurements are greater than 100K ohms, then the resistance is correct.

Check for an open circuit.

a. Disconnect the engine harness connector from the extension harness.

b. Disconnect the engine harness from the engine oil temperature sensor.

c. Measure the resistance from the engine oil temperature return pin on the engine harness inline connector to the engine oil temperature return pin at the engine harness sensor connector.

d. Measure the resistance from the engine oil temperature signal pin on the engine harness inline connector to the engine oil temperature signal pin at the engine harness sensor connector.

e. If all measurements are less than 10 ohms, then the resistance is correct.

D. Faulty Extension Harness Oil Temperature Sensor

1. Inspect the extension harness and the AUX 105 connector pins.

   a. Disconnect the extension harness connector from the AUX 105.

   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.

   c. Inspect for evidence of moisture in or on the connector.

   d. Inspect for missing or damaged connector seals.

   e. Inspect for dirt or debris in or on the connector pins.

   Check for an open circuit.

   a. Disconnect the extension harness connector from the AUX 105.

   b. Disconnect the extension harness from the engine harness.

   c. Measure the resistance from the engine oil temperature return pin on the extension harness connector to the engine oil temperature return pin at the extension harness inline connector.

   d. Measure the resistance from the engine oil temperature signal pin on the extension harness connector to the engine oil temperature signal pin at the extension harness inline connector.

   e. If all measurements are less than 10 ohms, then the resistance is correct.

   Check for a short circuit from pin-to-pin.

   a. Disconnect the extension harness from the AUX 105.

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b. Disconnect the extension harness from the engine harness.

c. Measure the resistance from the engine oil temperature return pin on the extension harness connector to all other pins in the extension harness connector.

d. Measure the resistance from the engine oil temperature signal pin on the extension harness connector to all other pins in the extension harness connector.

e. If all measurements are greater than 100K ohms, then the resistance is correct.

5.6.19 Fault Code 213 - Engine Oil Temperature OOR Low

Logic:

Engine oil temperature is out of range - shorted low.

NOTICE
Part number 382275800 - Male Deutsch/AMP/Metri-Pack test lead **Part number 382291700 - Female Deutsch/AMP/Metri-Pack test lead**

A. Engine Oil Temperature Sensor Connections

1. Inspect the engine oil temperature sensor and the harness connector pins.
   a. Disconnect the engine harness connector from the engine oil temperature sensor.
   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.

B. Faulty Engine Oil Temperature Sensor

1. Check the resistance of the sensor.
   a. Disconnect the engine harness connector from the engine oil temperature sensor.
   b. Measure the resistance between the engine oil temperature signal pin and the engine oil temperature return pin.
   c. Refer to the troubleshooting and repair manual for the specific engine platform for engine oil temperature ranges.

C. Faulty Engine Harness Oil Temperature Sensor

1. Inspect the engine harness and the extension harness connector pins.
   a. Disconnect the engine harness connector from the extension harness.
   b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.

   Check for a short circuit from pin-to-pin.
   a. Disconnect the engine harness connector from the extension harness.

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b. Disconnect the engine harness from the engine oil temperature sensor.

c. Disconnect the engine harness from all sensors that have a shared return with the engine oil temperature sensor.

d. Measure the resistance from the engine oil temperature return pin on the engine harness inline connector to all other pins in the engine harness inline connector.

e. Measure the resistance from the engine oil temperature signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.

f. If all measurements are greater than 100K ohms, then the resistance is correct.

Check for an open circuit.

a. Disconnect the engine harness connector from the extension harness.

b. Disconnect the engine harness from the engine oil temperature sensor.

c. Measure the resistance from the engine oil temperature return pin on the engine harness inline connector to the engine oil temperature return pin at the engine harness sensor connector.

d. Measure the resistance from the engine oil temperature signal pin on the engine harness inline connector to the engine oil temperature signal pin at the engine harness sensor connector.

e. If all measurements are less than 10 ohms, then the resistance is correct.

5.6.20 Fault Code 214 - Engine Oil Temperature High - Critical

Engine oil temperature has exceeded the alarm (shutdown) threshold for high engine oil temperature.

A. Inaccurate Engine Temperature Sensor

1. Verify the sensor accuracy with a thermocouple or similar temperature probe.
   a. Connect the temperature probe to the engine near the engine oil temperature sensor.
   b. Connect InPower.
   c. Compare the engine oil temperature reading from the service tool to the reading from the temperature sensor. If the two readings are reasonably close, then the sensor is reading correctly.

B. Fault Simulation Feature Is Enabled

1. Verify that the fault simulation feature is not enabled.
   a. Connect InPower.
   b. Verify that the fault simulation is NOT enabled for the engine oil temperature sensor by connecting to the PCC via InPower. If fault simulation is disabled, there is no problem.

C. Incorrect Threshold Setting

1. Check threshold settings.
   a. Connect InPower.
   b. Verify that the fault threshold is set correctly for the normal operating range for the engine oil temperature sensor. Refer to the engine manual for correct threshold values, and make the appropriate changes using InPower.

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5.6.21 Fault Code 228 - Coolant Pressure Below Normal – Most Severe

Engine Coolant pressure is below the normal threshold value. Refer to Engine Sensor Threshold table.

Refer to the engine service manual for troubleshooting.

5.6.22 Fault Code 234 - Engine Speed High (Shutdown)

Engine speed signals indicate an engine speed greater than shutdown threshold.

Refer to the engine service manual for troubleshooting.

5.6.23 Fault Code 235 - Low Coolant Level

Low Coolant Level input is active and the threshold response is set to “Shutdown".

A. Check Coolant Level

1. If the generator set is powering critical loads and cannot be shut down, wait until next shutdown period, then complete the following steps:
2. Allow engine to cool completely.
3. Inspect the engine, cooling system and surrounding area for external coolant leaks.
    a. Repair as required.
    b. If internal coolant loss is suspected, refer to the Engine Service Manual.
4. Inspect the coolant level, using the sight glass (if applicable) or by removing the radiator cap.
    a. Allow engine to cool.
    b. Slowly remove the radiator cap to allow for pressure to be released,
5. If coolant level is below X in (X cm) from the top of the radiator, add manufacturer's prescribed amount of coolant.
    a. Refer to Section X, for cooling system maintenance procedures.
6. Clear the warning by pressing the Reset button on the Operator Panel.

B. Faulty Sensor Or Wiring.

1. Disconnect the signal leads at the sensor, so the sensor is no longer connected to the control; then reset the control by pressing the Reset button. If event/fault code 197 clears and does not reappear, then replace the low coolant level sensor.
2. If event/fault code 197 reappears, check for a short in the wiring between the low coolant level sensor and the input to the control (at J20-17: Input and J20-5: Ground). A ground input into J20-17 will activate the alarm at the control.

C. PCCNet Annunciator

1. If a PCCNet Annunciator is not used, go to step 4. If a PCCNet Annunciator is used, check the wiring on the back of the PCCNet Annunciator at TB1-6 to the Low Coolant Level sender. Ensure that an open circuit or short circuit does not exist in the wiring.
2. Refer to the PCCNet Annunciator Operator's Manual to ensure that the Annunciator is configured correctly; since inputs can be configured to Active Open or Active Closed. Then check the input on the back of the PCCNet Annunciator at TB1 – 6 and ensure that the input signal into the PCCNet Annunciator is properly configured.

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5.6.24 Fault Code 236 - Engine Speed/Position Sensor Circuit

Engine speed/position sensor signal is not detected.

If the generator set stalls after starting, this is not a control issue.

NOTICE
Part number 382275800 - Male Deutsch/AMP/Metri-Pack test lead **Part number 382291700 - Female Deutsch/AMP/Metri-Pack test lead**

A. Inaccurate Engine Speed/Position Sensor

1. Check the sensor gap.
    a. Measure the sensor gap.
    b. Refer to the engine manual for appropriate gap size, and adjust as necessary.

B. Faulty Engine Speed Sensor Connections

1. Inspect the engine speed sensor and the harness connector pins.
    a. Disconnect the engine harness connector from the engine speed sensor.
    b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.

C. Faulty Engine Harness Engine Speed Position Sensor

1. Inspect the engine harness and the extension harness connector pins.
    a. Disconnect the engine harness connector from the extension harness.
    b. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.
2. Check for a short circuit from pin-to-pin.
    a. Disconnect the engine harness connector from the extension harness.
    b. Disconnect the engine harness from the engine speed sensor.
    c. Disconnect the engine harness from all sensors that have a shared return with the engine speed sensor.
    d. Measure the resistance from the engine speed return pin on the engine harness inline connector to all other pins in the engine harness inline connector.
    e. Measure the resistance from the engine speed signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
    f. If all measurements are greater than 100K ohms, then the resistance is correct.

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3. Check for an open circuit.
    a. Disconnect the engine harness connector from the extension harness.
    b. Disconnect the engine harness from the engine speed sensor.
    c. Measure the resistance from the engine speed return pin on the engine harness inline connector to the engine speed return pin at the engine harness sensor connector.
    d. Measure the resistance from the engine speed signal pin on the engine harness inline connector to the engine speed signal pin at the engine harness sensor connector.
    e. If all measurements are less than 10 ohms, then the resistance is correct.

D. Faulty Engine Speed Sensor

1. Inspect the engine speed sensor.
    a. Disconnect the engine speed/position sensor from the engine and engine harness.
    b. Inspect the sensor for bent, corroded, or loose pins.
    c. Inspect the sensor for structural deficiencies.

5.6.25 Fault Code 359 - Fail To Start

Engine has failed to start after the last crank cycle.

A. DC Breaker Tripped

1. Open the DC distribution box.
2. Check the circuit breakers.
    a. Verify that none of the circuit breakers have tripped.
    b. Make sure that the fuse for the pre-lube pump has not opened.

B. Pre-lube Cycle Failed

1. Use InPower to make sure that the Pre-lube pump functioned according to specification.
    a. For Rapid Emergency start, concurrent pre-lube is enabled.
    b. For Non-emergency start, Start after pre-lube is enabled.

C. Starter Malfunction

1. Check connections to the starter.
2. Check Diodes (DS2).

D. Software Calibration

1. Make sure that the “start inhibit” function is not enabled.
2. Make sure that the proper application of starter function is set.

5.6.26 Fault Code 381 – Start-Inhibit Warning Fault Event

This is an event. No action required.

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5.6.27 Fault Code 415 - Engine Oil Pressure Low (Shutdown)

Logic:

Voltage signal indicates oil pressure has dropped below the shutdown threshold. Refer to Engine Sensor Threshold table.

Refer to the engine service manual for troubleshooting.

5.6.28 Fault Code 421 - Engine Oil Temperature High (Warning)

The control has detected the engine oil temperature has exceeded the warning threshold.

A. High Ambient Temperature

1. Using a thermocouple, verify the air temperature entering the intake louver of the generator set.
2. Reduce loads or recirculation of discharge air to the generator set with an elevated ambient temperature.

B. Radiator Blocked

1. Inspect for dirt, debris or obstructions.
2. Remove blockage or winterfront as applicable.

C. Louvers Are Closed Or Damaged

1. Inspect the louvers for proper operation.
2. Repair or replace the louvers if damaged.
3. Check the louver motor for proper operation.
4. If the louver motor is operational, verify the louver shutterstat is operational.

D. Charge Air Cooler Fins or Radiator Fins are Damaged or Obstructed

1. Inspect for dirt, debris or obstructions.
2. Clean if necessary.

E. Coolant Level Is Below Specification

1. Inspect the engine, cooling system, and surrounding area for external coolant leaks.
2. Repair as required.
3. Verify that the coolant level is correct via the sight glass.
4. Add coolant as necessary.

F. Fan Shroud Is Damaged Or Air Recirculation Baffles Are Damaged

1. Inspect shroud and baffles for damage and clearance.
2. Repair or replace if damaged.

G. Fan Belt Is Broken Or Loose

1. Inspect belt(s) for damage, wear, and proper tension.

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2. Inspect pulleys and belt tensioner for damage or wear.
3. Repair or replace if damaged or worn.

H. Fan Drive Or Fan Controls Are Malfunctioning

1. Inspect pulleys and belt tensioner for damage or wear.
2. Repair or replace if damaged or worn.

I. Thermostat Is Faulty

1. Remove thermostat and inspect/test for proper operation.
2. Replace if damaged or malfunctioning.

J. Cooling System Hose Is Collapsed, Restricted Or Leaking

1. Inspect upper and lower radiator hoses for collapse, distortion, or fluid leaks.
2. Replace if damaged or worn.

K. Intake Manifold Air Temperature Is Above Specification

1. Use a thermocouple to verify manifold air temperature.
2. Repair or replace faulty after cooler components.

L. Water Pump Is Malfunctioning

1. Inspect water pump for proper operation.
2. Replace if damaged or worn.

M. Oil Pressure Sensor Is Inaccurate Or Blocked

1. Connect a mechanical oil pressure gauge of known quality and calibration to the engine at one of the plugs on top of the oil filter head.
2. Connect InPower.
3. While the engine is stopped, compare the oil pressure reading on the service tool to the reading on the mechanical oil pressure gauge.
4. Proceed only if engine troubleshooting has been completed. Do not attempt to start the engine if there is any doubt about the oil pressure.
5. Start the generator set.
6. Compare the oil pressure reading on the service tool to the reading on the mechanical oil pressure gauge.
7. Refer to the troubleshooting and repair manual for the specific engine platform for oil pressure ranges.

N. Fault Simulation Feature Is Enabled

1. Connect InPower.
2. Verify that the fault simulation is not enabled for the engine speed sensor by connecting to the PCC via InPower.
3. If the fault simulation is disabled, there is no problem.

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5.6.29 Fault Code 426 - J1939 Data Link Cannot Transmit

Communication between the ECM and another device on the SAE J1939 data link has been lost.

Possible Causes:

1. Communication error
2. Faulty engine harness

A. Communication Error

1. Check for ECM communication with InSite.
    a. Connect the INLINE data link adapter to SAE J1939 data link diagnostic connector.
    b. Attempt to communicate with the ECM using InSite.

B. Faulty Engine Harness - General

1. Inspect the engine harness and the connector pins.
    a. Disconnect the engine harness connector from the extension harness.
    b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pin.
    f. Disconnect harness from ECM and sensor.
    g. Measure the resistance in each pin from ECM to sensor. Resistance should be 5 ohms or less.
    h. Repair or replace harness as necessary.

5.6.30 Fault Code 427 - CAN Data Link Degraded

Communication between the engine control (ECM) and the generator set control is severed.

A. The Engine ECM Has Lost Power Or Failed

1. Emergency (E-Stop) button is a closed relay when it is pulled out (not active), and open relay when depressed (active). The E-Stop button on the Operator Panel disables power to the engine ECM when it is depressed (active); CAN-LINK communication will cease when power to the ECM is lost. Ensure that the E-Stop is not active on the control. Follow the procedure below:
    a. Reset the Local/Remote Emergency Stop.
        i. Pull-out (not active) the Local/Remote Emergency Stop button.
        ii. Press the Off button on the Operator Panel.
        iii. Press the Reset button.
        iv. Select Manual or Auto as required.
2. Ensure that the emergency stop button is functioning correctly, measure the outputs of the E-Stop (Normally Open and Normally Closed contacts) and ensure that the outputs switch state correctly when engaged and disengaged, replace the switch if faulty.
3. Check the wiring from the base board.

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4. Keyswitch control relay is a normally open relay. Ensure that B+ is available at the relay input, then measure the voltage output. If there is a B+ at both the input and output of the Keyswitch control relay, the relay is not faulty. If B+ is noted at the input but not at the output of the Keyswitch control relay, replace the relay.
5. Connect to the engine ECM with InPower and/or Insite, to verify that the ECM is functioning properly and is communicating with the CAN-LINK network. Refer to the engine service manual for ECM troubleshooting procedures, if the ECM is faulty, replace.

B. The CAN Datalink Has Failed

1. There is a defective datalink harness connection, or open circuit; inspect the Datalink harness and connector pins from J11-20 to J1939+ and from J11-19 to J1039-; also check the shield ground connection at J11-17.
2. Check the terminating resistors. With connector J11 disconnected from the base board and the engine datalink connection disconnected from the ECM control, measure resistance between pins J11-19 and J11-20 (60 ohms is satisfactory). If the resistance is not 60 ohms, check the terminating resistors. Each of the two terminating resistors should be 120 ohms, replace if not 120 ohms.

5.6.31 Fault Code 441 - Low Battery Voltage

Logic:

Low battery voltage set point reached (Default = 24 Vdc) for the “Low Battery Voltage Set time” (Default = 60 s)

A. Check Battery Cable Connections

1. Inspect for:
   - Corroded or loose connections (clean and tighten as necessary)
   - Damaged battery cables and connectors (repair and replace as necessary)
   - A good connection at the starter solenoid terminals
2. If necessary, disconnect the cables and properly reconnect them.

B. Check Battery Ground

1. Measure the resistance from the negative (-) battery terminal to the engine block ground. If the resistance is less than 5 ohms, then there is proper grounding. If the resistance is greater than 5 ohms, repair the battery ground connection.
2. Check ground connection at the 3300 board (P20-2,4,7,12). Measure resistance from the 3300 board to the negative (-) battery terminal and from the 3300 board to the engine block ground. If the resistance is less than 5 ohms, then there is proper grounding. If the resistance is greater than 5 ohms, repair the battery ground connection.

C. Check Battery Voltage (24 VDC)

1. Measure the battery voltage from the positive (+) terminal to the negative (-) terminal with the batteries connected to the battery charger. If the voltage is between 24 and 28 VDC, then the voltage is within normal range.
2. Replenish the electrolyte level if low and recharge the battery (if applicable).
3. If the battery cannot hold adequate voltage, replace the battery.

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D. Check the Battery Charger

If the battery system voltage is less than the normal voltage range:

1. Disconnect the battery (+) and (-) leads from the battery charger and measure the battery charger output voltage.
2. If the voltage is not greater than 24 volts, troubleshoot the battery charger according to the manufacturer's service manual.

E. Load Test the Battery

Disconnect all battery cables and perform battery load test using a battery load tester according to the manufacturer recommendations.

F. Check Specific Gravity (If Applicable)

Check the battery specific gravity. Refer to battery OEM manual for details.

G. Check Add-on or Accessory Wiring

Check all add-on and accessory wiring connected to the battery positive (+) terminal.

1. Check for damaged insulation.
2. Check for short to the engine block.

H. Check Charging Alternator (24 VDC)

1. Temporarily disconnect the alternator and test-run the engine.
2. Check the wiring of the alternator for open circuits.
3. If the wiring is satisfactory, measure the charging voltage of the alternator while the engine is running. The voltage should be +24 to +28 VDC.
4. If the charging voltage is not correct, check the following connections:
   - Check the alternator reference diodes in the DC box (DB+ S1, S2, and S3) for proper operation and correct wiring.
   - Check the charging alternator output diodes in the DC box (DCA S1, S2, and S3) for proper operation and correct wiring.
5. Refer to the engine service manuals, replace battery charging alternator as necessary.

I. Check Battery Voltage Setting (24 VDC)

Verify that the battery voltage matches calibration. Use InPower to check Nominal Battery Voltage setting. (Default = 24 Vdc).

5.6.32 Fault Code 442 - High Battery Voltage

Logic:

High Battery voltage threshold reached (Default = 32 Vdc) for “High battery voltage set time” (Default = 60 s)

A. Check Battery Voltage Setting (24 VDC)

Verify that the battery voltage matches calibration. Use InPower to check Nominal Battery Voltage setting. (Default = 24 Vdc).

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B. Check Battery Charging Rate

1. Make sure that the battery charger is charging the battery at an acceptable rate and not overcharging the battery. Adjust the charge rate of the battery charger if the charge rate is above the recommendation of the manufacturer.
2. Replace the battery charger if faulty.
3. Refer to the battery charger manual, if available.

C. Check Charging Alternator (24 VDC)

1. Temporarily disconnect the alternator and test-run the engine.
2. Check the wiring of the alternator for open circuits.
3. If the wiring is satisfactory, measure the charging voltage of the alternator while the engine is running. The voltage should be +24 to +28 VDC.
4. If the charging voltage is not correct, replace the alternator. Refer to the engine service manuals.

D. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 23. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
PCC Voltage Setting to Match Actual Battery Voltage	**Setup > OEM Setup > OEM Engine Setup > Nominal Battery Voltage**	Refer to the battery manufacturer's manual.
High Battery Voltage Threshold Setting to be above the Actual Battery Voltage		

5.6.33 Fault Code 488 - Intake Manifold Temperature High (Warning)

Engine intake manifold temperature has exceeded the warning level and duration parameters set in the ECM or control.

A. High Ambient Temperature

1. Using a thermocouple, verify the air temperature entering the intake louver of the generator set.
2. Reduce loads or recirculation of discharge air to the generator set with an elevated ambient temperature.

B. Radiator Blocked

1. Inspect for dirt, debris or obstructions.
2. Remove blockage or winterfront as applicable.

C. Louvers Are Closed Or Damaged

1. Inspect the louvers for proper operation.

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2. Repair or replace the louvers if damaged.
3. Check the louver motor for proper operation.
4. If the louver motor is operational, verify the louver shutterstat is operational.

D. Charge Air Cooler Fins or Radiator Fins are Damaged or Obstructed

1. Inspect for dirt, debris or obstructions.
2. Clean if necessary.

E. Fan Belt Is Broken Or Loose

1. Inspect belt(s) for damage, wear, and proper tension.
2. Inspect pulleys and belt tensioner for damage or wear.
3. Repair or replace if damaged or worn.

F. Fan Drive Or Fan Controls Are Malfunctioning

1. Inspect pulleys and belt tensioner for damage or wear.
2. Repair or replace if damaged or worn.

G. Inaccurate Coolant Temperature Sensor

1. Using a thermocouple or similar device, measure the coolant temperature near the sensor and compare it to the coolant temperature displayed.
2. Verify the temperature sensor resistance and compare it to the specifications in the engine manual.
3. Verify continuity from the temperature sensor wire pin to the engine ECM pin. The harness resistance should be less than 5 Ohms.
4. Repair or replace faulty components or wiring.

H. Fault Simulation Feature Is Enabled

1. Connect InPower.
2. Verify that the fault simulation is not enabled for the engine speed sensor by connecting to the PCC via InPower.
3. If the fault simulation is disabled, there is no problem.

I. Incorrect Threshold Setting

1. Connect to the engine ECM using the service tool. Verify fault threshold settings and compare them to the specifications in the engine manual.
2. Verify that the calibration numbers and revisions are correct for the ECM and PCC.
3. Recalibrate the engine ECM to reset the threshold settings.

5.6.34 Fault Code 611 - Engine Hot Shut Down

Engine shutdown hot without a proper cooldown run period.

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A. Critical Shutdown Fault

1. A critical shutdown fault (e.g., overspeed) has caused the engine to shut down immediately without allowing the engine to complete the proper cooldown process. Troubleshoot the other shutdown fault(s) that are causing the generator set to shut down.

B. Emergency Shutdown

1. An Emergency Stop command has immediately shutdown the engine, which has bypassed the proper cooldown process for the engine.

C. Incorrect Shutdown of Generator Set

1. The generator set has been shut down without allowing the proper cooldown process for the engine (control switched to OFF manually by user/operator).

5.6.35 Fault Code 781 - ECM CAN Datalink Has Failed

Communication between the engine control module (ECM) and the generator set control is severed.

A. The Engine ECM Has Lost Power Or Failed

1. Emergency (E-Stop) button is a closed relay when it is pulled out (not active), and open relay when depressed (active). The E-Stop button on the Operator Panel disables power to the engine ECM when it is depressed (active); CAN-LINK communication will cease when power to the ECM is lost. Ensure that the E-Stop is not active on the control. Follow the procedure below:
    a. Reset the Local/Remote Emergency Stop.
        i. Pull-out (not active) the Local/Remote Emergency Stop button.
        ii. Press the Off button on the Operator Panel.
        iii. Press the Reset button.
        iv. Select Manual or Auto as required.
2. Ensure that the emergency stop button is functioning correctly, measure the outputs of the E-Stop (Normally Open and Normally Closed contacts) and ensure that the outputs switch state correctly when engaged and disengaged, replace the switch if faulty.
3. Check the wiring from the base board.
4. Keyswitch control relay is a normally open relay. Ensure that B+ is available at the relay input, then measure the voltage output. If there is a B+ at both the input and output of the Keyswitch control relay, the relay is not faulty. If B+ is noted at the input but not at the output of the Keyswitch control relay, replace the relay.
5. Connect to the engine ECM with InPower and/or Insite, to verify that the ECM is functioning properly and is communicating with the CAN-LINK network. Refer to the engine service manual for ECM troubleshooting procedures, if the ECM is faulty, replace.

B. The CAN Datalink Has Failed

1. There is a defective datalink harness connection, or open circuit; inspect the Datalink harness and connector pins from J11-20 to J1939+ and from J11-19 to J1039-; also check the shield ground connection at J11-17.

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2. Check the terminating resistors. With connector J11 disconnected from the base board and the engine datalink connection disconnected from the ECM control, measure resistance between pins J11-19 and J11-20 (60 ohms is satisfactory). If the resistance is not 60 ohms, check the terminating resistors. Each of the two terminating resistors should be 120 ohms, replace if not 120 ohms.

5.6.36 Fault Code 1117 - ECM Power Lost (Warning)

Indicates that "Keyswitch" to the ECM was NOT removed for 90 seconds before removing battery power to the ECM (removing connectors or battery cable).

A. ECM Power Lost (Warning)

1. To reset, press the Off button, press E-Stop, wait 90 seconds; then remove E-Stop and select the desired operating mode (manual or remote).

   This Fault Code may cause an increment of 30 minutes to be added to engine hours value due to ECM data save loss.

5.6.37 Fault Code 1121 - Fail To Disconnect

If the “Fail To Disconnect Enable" parameter is set to enable, and the Genset CB and Utility CB Fail to Open Faults are both active, the generator set control will display event/fault code 1121.

In case of recurrent warnings during start, verify battery voltage and state of health. Replace battery if necessary.

A. Event/Fault Code 1221 is Mapped to a Configurable Output and Event/Fault Code 1453 and Event/Fault Code 2397 are Active

1. Event/fault code 1221 can be mapped to send an external notification through a configurable customer output relay on the base board to an external device that the Genset CB and Utility CB have failed to open. This fault will become active if the “Fail To Disconnect Enable" parameter is set to enable, event/fault code 1221 is mapped to a configurable output, and if event/fault code 1453 and event/fault code 2397 are active. Troubleshoot event/fault code 1453 and event/fault code 2397 to resolve this issue.

   To disable event/fault code 1221 go to **Setup > Paralleling Setup > Power Transfer Control > Fail to Disc En** on the display and set the “Fail To Disconnect Enable" parameter to Disable, then determine which configurable output is set to activate when event/fault code 1221 is active and go to: **Setup > Configurable I/O** on the display and remove the mapping of event/fault code 1221 to that output.

5.6.38 Fault Code 1122 - Delayed Rated To Idle Transition

If the "Rated to Idle Transition Delay" is greater than zero, event/fault code 1122 will become active when the generator set transitions from rated to idle.

A. Event/Fault Code 1122 is Set to Warning or Shutdown and the Generator Set is Transitioning From Rated to Idle Mode.

1. This event/fault code can be mapped to a configurable customer output relay in order to send external notification via the relay on the base board to users so that proper action can be taken in the time given before the generator set transitions to idle. This fault can be disabled by setting the "Rated to Idle Transition Delay" to 0 seconds. To access the setup menu through the Operator Panel, go to **Setup > Genset Setup > Rated to Idle Delay** and set appropriately.

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5.6.39 Fault Code 1123 - Shutdown After Battle Short (Shutdown)

A shutdown fault occurred while the Battle Short mode was enabled. Check fault history for faults that may have been bypassed.

5.6.40 Fault Code 1124 - Delayed Shutdown

Provides advance warning of an impending generator set shutdown to loads which cannot handle sudden losses of power.

A. A Shutdown Fault

1. Event/fault code 1124 is activated as a result of another non-critical shutdown fault. Troubleshoot the other non-critical shutdown fault(s) that is(are) causing the generator set to shutdown. This event/fault code was designed to send an external notification through a configurable customer output relay on the base board to loads which cannot handle a sudden loss of power. The generator set base board will send a signal to critical loads and will wait for the amount of time in the “Delayed Shutdown Time" parameter before shutting down the generator set. Go to **Setup > Genset Setup > Delayed shutdown delay** from the operator panel and set appropriately.

5.6.41 Fault Code 1131 - Battle Short Active

Battle Short has been enabled.

A. Battle Short Enabled

1. Disable Battle Short.
    a. The purpose of this fault is to provide a record in the fault history and fault occurrence list that the Battle Short feature is activate. The Battle Short fault becomes active when all of the following are true:
        - The Battle Short parameter is Enabled.
        - One of the configurable inputs on the base board is configured for Battle Short.
        - The configurable input configured for Battle Short becomes Active.

5.6.42 Fault Code 1132 - Controlled Shutdown

A fault set to Shutdown with Cooldown is active and has put the generator set in a controlled shutdown.

A. A Fault Set to Shutdown With Cooldown is Active

1. Event/fault code 1132 is activated by another active event/fault that is set to "Shutdown with Cooldown". Troubleshoot the other shutdown fault(s) that are causing the generator set to shutdown. A controlled shutdown of the system allows first for loads to be transferred or ramped off, and then for a proper cooldown of the generator set to take place before shutting down. Go to **Setup > Genset Setup > Ctrld Shutdown Advance** from the Operator Panel in order to appropriately set the Controlled Shutdown Advanced Notice Delay.

5.6.43 Fault Code 2112 - AUX 101 Coolant Inlet Temperature OOR (Warning)

Coolant temperature sensor voltage is out of range.

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A. Faulty Coolant Temperature Sensor Connections

1. Inspect the coolant temperature sensor and the engine harness connector pins.
    a. Disconnect the engine harness connector from the coolant temperature sensor.
    b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.

B. Faulty Coolant Temperature Sensor

1. Check the resistance of the sensor
2. Disconnect the engine harness connector from the coolant temperature sensor.
3. Measure the resistance between the coolant temperature sensor signal pin and the coolant temperature sensor return pin.

C. Improper Wiring

1. Check wiring. Ensure wiring from the coolant temperature sensor is connected to the correct Aux 101 input.
2. Check wires for breaks or abrasions.
3. Check wires for moisture and debris at connection points.

D. Verify Controller Calibrations

1. Using the display or the InPower Service tool, verify the calibration in the PCC control.
    a. If the calibration in the PCC control matches the latest calibration on the InCal website, then the calibration is correct. If it does not, update the calibration to the latest.
2. Using the InSite Service tool, verify the calibration in the ECM.
    a. If the calibration in the ECM matches the latest calibration on QSOL, then the calibration is correct. If it does not, update the ECM to the latest calibration.

5.6.44 Fault Code 1219 - Utility CB Tripped

The Utility CB has tripped.

A. Overload, Short Circuit, or Ground Fault

1. Check the load of the application, load cables, and the ground fault relay if available. Repair if necessary.

B. Incorrectly Wired or Short Circuit

1. Verify the wiring from the Utility CB to the Utility CB Tripped status input on the base board. The Utility CB Tripped status input is a Normally Open contact at TB10-5 and TB10-1 (B+ Return). Ensure that the connection from the Utility CB to TB10-5 on the base board is not shorted to ground.

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C. CB Trip Solenoid is Incorrectly Configured or Faulty

1. Utility CB Trip settings are configured to trip at a low over-current threshold. Check other settings on the Utility CB that might cause it to trip since circuit breakers can have multiple trip settings. Configure the Utility CB Trip Solenoid to trip at adequate trip settings for the application; refer to the CB Service Manual.
2. Faulty Trip solenoid, refer to the CB Service Manual for troubleshooting instructions.

D. Faulty Utility CB

1. Refer to the Utility CB Service Manual.

5.6.45 Fault Code 1223 - Utility Frequency Error

In Power Transfer Control (PTC) Operation, if the “Utility Frequency Sensor Enable" parameter is enabled and the utility frequency exceeds the “Utility Frequency Upper Drop-Out Threshold", or is below the “Utility Frequency Lower Drop-Out Threshold", or is Out of Range Low, for the “Utility Frequency Drop-Out Delay", fault code 1223 will become active.

A. Utility Frequency Drop-out Thresholds are Incorrectly Set

1. This fault will become active when the Utility Frequency goes above or below the drop-out thresholds. Drop-out threshold are dependent of the following parameters:
   - Utility Center Frequency.
   - Utility Frequency Pick-Up Bandwidth.
   - Utility Frequency Drop-Out Bandwidth.

   To Modify the preceding parameters, on the display go to: **Setup > Paralleling Setup > Power Transfer Control > Center Frequency** or **Pick-Up BW** or **Drop-out BW** or **Drop-Out Delay** and set appropriately. Refer to the PTC section for setup information and instructions.
2. To disable this function, set the “Utility Frequency Sensor Enable" parameter to disable. On the display go to: **Setup > Paralleling Setup > Power Transfer Control > Enable** and set appropriately. Refer to the PTC section for more information.

B. The Frequency of the Utility is Not Stable

1. The frequency of the utility is unstable, check with your utility company.

5.6.46 Fault Code 1224 - High Genset Voltage

In Power Transfer Control (PTC) Operation, if the “Genset Overvoltage Sensor Enable" parameter is set to enable, and the generator set voltage goes above the “Genset Overvoltage Drop-Out Threshold", for the “Genset Overvoltage Drop-Out Delay" time, fault code 1224 will become active.

A. Generator Set High AC Voltage Fault

1. If the High AC Voltage fault is active on the display, refer to the troubleshooting procedures for High AC Voltage, fault code 1446.

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B. Genset Overvoltage Drop-out Thresholds are Incorrectly Set

1. This fault will become active when the generator set voltage goes above the “Genset Overvoltage Drop-Out Threshold" for the “Genset Overvoltage Drop-Out Delay" time. The genset overvoltage drop-out threshold is dependent of the following parameters:
   - Genset Overvoltage Drop-out percentage.
   - Genset Overvoltage Drop-out Delay.

     To modify the preceding parameters, on the display go to: **Setup > Paralleling Setup > Power Transfer Control > Drop out** or **Drop-Out Delay** and set appropriately. Refer to the PTC section for setup information and instructions.
2. To disable this function, set the “Genset Overvoltage Sensor Enable" parameter to disable. On the display, go to: **Setup > Paralleling Setup > Power Transfer Control > Enable** and set appropriately. Refer to the PTC section for more information.

5.6.47 Fault Code 1225 - Low Genset Voltage

In Power Transfer Control (PTC) Operation, if the generator set voltage drops below the “Genset Undervoltage Drop-Out Threshold", for the “Genset Undervoltage Drop-Out Delay" time, fault code 1225 will become active.

A. Genset Low AC Voltage Fault

1. If the Low AC Voltage fault is active on the display, refer to the troubleshooting procedures for Low AC Voltage, fault code 1447.

B. Genset Undervoltage Drop-out Thresholds are Incorrectly Set

1. This fault will become active when the generator set voltage drops below the “Genset Undervoltage Drop-Out Threshold" for the “Genset Undervoltage Drop-Out Delay" time. The genset Undervoltage drop-out threshold is dependent of the following parameters:
   - Genset Undervoltage Drop-out percentage.
   - Genset Undervoltage Drop-out Delay.

     To modify the preceding parameters, on the display go to: **Setup > Paralleling Setup > Power Transfer Control > Drop out** or **Drop-Out Delay** and set appropriately. Refer to the PTC section for setup information and instructions.

5.6.48 Fault Code 1226 - Genset Frequency Error

In Power Transfer Control (PTC) Operation, if the “Genset Frequency Sensor Enable" parameter is enabled and the generator set frequency exceeds the “Genset Frequency Upper Drop-Out Threshold", or is below the “Genset Frequency Lower Drop-Out Threshold", or is Out of Range Low, for the “Genset Frequency Drop-Out Delay", fault code 1226 will become active.

A. Genset Frequency Drop-out Thresholds are Incorrectly Set

1. This fault will become active when the generator set frequency goes above or below the drop-out thresholds. Drop-out threshold are dependent on the following parameters:
   - Genset Center Frequency.
   - Genset Frequency Pick-Up Bandwidth.
   - Genset Frequency Drop-Out Bandwidth.

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To modify the preceding parameters, on the display go to: **Setup > Paralleling Setup > Power Transfer Control > Center Frequency** or **Pick-Up BW** or **Drop-out BW** or **Drop-Out Delay** and set appropriately. Refer to the PTC section for setup information and instructions.

B. The Frequency of the Generator Set is Not Stable

1. If the generator set frequency is not stable or the generator set is hunting/oscillating while it is running, refer to the troubleshooting procedures for fault codes 1448 and 1449.

5.6.49 Fault Code 1243 - Engine Derated

Event/fault code 1243 will become active if the engine has gone into a derate mode to protect itself from a shutdown, and if there are no other active derate events on the PCC.

A. A Derate Condition Has Been Initiated by The Engine ECM

1. Event/fault code 1243 is activated by another active engine fault. Determine the fault(s) that caused the engine to derate by checking the operator panel or using InPower or InSite to connect to the ECM. Troubleshoot the event/fault(s) and resolve the issue(s) (Reference the Engine Service Manual). After the issue is resolved, press the Reset button on the generator set control to allow the generator set to return to a normal mode of operation. If the issue is not resolved when the Reset button is pressed, the engine will stay in derated mode.

5.6.50 Fault Code 1244 - Engine Normal Shutdown

A normal shutdown request has been received by the engine and no active shutdown with cooldown faults exist.

A. Description

1. The generator set is going through a normal shutdown and there are no active shutdown faults in the ECM for at least 2 seconds.
2. No action required.

5.6.51 Fault Code 1245 - Engine Shutdown Fault

Engine shutdown fault has occurred in the engine ECM.

A. Description

1. Event/fault code 1245 is activated by another active shutdown fault in the ECM.
2. Connect to the Engine ECM with InPower or InSite to determine the actual shutdown fault that is generating event/fault code 1245.
3. Troubleshoot the shutdown fault(s) (Refer to Engine Service Manual).

5.6.52 Fault Code 1246 - Unknown Engine Fault

An unrecognized engine fault has been received over the datalink.

A. Description

1. The generator set control has received an unknown event/fault code from the ECM.
2. Connect directly to the Engine ECM with InPower or InSite to determine the actual warning or shutdown fault that is generating event/fault code 1246.

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3. Troubleshoot the fault(s) that are causing the generator set to display event/fault code 1246 (Reference the Engine Service Manual).

5.6.53 Fault Code 1247 - Engine Shutdown – Unannounced

An engine shutdown condition has been activated by the ECM and the Common Shutdown command is inactive. This fault code can be set to active or inactive.

A. Description

1. Event/fault code 1247 is activated by another active shutdown fault in the ECM.
2. Connect to the Engine ECM with InPower or INSITE to determine the actual shutdown fault that is generating event/fault code 1247.
3. Troubleshoot the faults that are causing the generator set to display fault code 1247 (Reference the Engine Service Manual).

5.6.54 Fault Code 1248 - Engine Warning

An engine warning fault has occurred in the engine ECM, and there are no active warning faults on the PCC.

A. Description

1. Event/fault code 1248 is activated by another active warning fault in the ECM.
2. Connect to the Engine ECM with InPower or INSITE to determine the actual shutdown fault that is generating event/fault code 1248.
3. Troubleshoot the faults that are causing the generator set to display fault code 1248 (Reference the Engine Service Manual).

5.6.55 Fault Code 1311 and 1312 - Customer Input #1 and #2 (Warning or Shutdown)

The nature of the fault is an optional customer selection. Example inputs: Low Fuel Day Tank, Water In Fuel, Ground Fault, Low Starting Hydraulic Pressure, Low Starting Air Pressure, etc.

Each of the fault functions can be programmed (using the InPower service tool), as follows:

- Enable/disable input (Default: enable)
- Status, Warning, or Shutdown (Default: #1-None, #2 and #3-Warning)
- Active closed or open (Default: closed [ground])
- Change the display name using up to 19 characters (Default: #1- Customer Fault 1, #2-Ground Fault, #3-Low Fuel)

A. Disconnect The Signal Lead From TB1 And Reset The Control.

1. CONFIG INPUT 1 - TB1-12
2. CONFIG INPUT 2 - TB1-14
3. If the message goes away, the external wiring has a short circuit. Grounding of either input activates fault.

5.6.56 Fault Code 1312 - Customer Input 2

This fault is an optional customer selection.

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A. Check Condition for Configurable Input

1. Check the condition for which the input has been configured.
   - Example: if the input was configured to become active when the fuel level is low, check the fuel level and add fuel if needed.
2. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault.
3. If the fault does not clear, continue troubleshooting.

B. Check Active State Selection Parameter

With InPower or through the Operator Panel check the switch input setting (active closed or active open) for the Configurable Input. Ensure that the switch input setting is correctly set.

Configurable Input	Parameter	Setting	Connections	Action
2	Input Function Pointer	Default	Connected (Shorted): TB1-14 (input 2) TB1-15 (ground)	Code 1312 Active
2	Active State Selection	Active Closed		
2	Input Function Pointer	Default	Open Circuit: TB1-15 (ground) TB1-14 (input 2)	Code 1312 Active
2	Active State Selection	Active Open		

C. Check Wiring

Check for incorrect wiring, open circuits, or short circuits.

5.6.57 Fault Code 1313, 1314, 1315, 1316 - Network Fault 1–4

Indicates network input (1–4) is in an active state. Each of the fault functions can be programmed (using the service tool), as follows:

- Status, Warning, or Shutdown
- Change display name, using up to 19 characters

A. Identify Network Fault

Identify and troubleshoot the active network fault.

B. Check the Harnesses

1. Check the harnesses and connections points for:
   - Corroded pins
   - Bent or broken pins
   - Pushed back or expanded pins
   - Evidence of moisture in or on the connector
   - Missing or damaged connector seals
   - Dirt or debris in or on the connector pin
2. Check the pin-to-pin connections. If no short or open circuit is found, check all connections to the pins.

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5.6.58 Fault Code 1317 Customer Input 13

This fault is an optional customer selection.

A. Check Condition for Configurable Input

1. Check the condition for which the input has been configured.
   - Example: if the input was configured to become active when the fuel level is low, check the fuel level and add fuel if needed.
2. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault.
3. If the fault does not clear, continue troubleshooting.

B. Check Active State Selection Parameter

With InPower or through the Operator Panel check the switch input setting (active closed or active open) for the Configurable Input. Ensure that the switch input setting is correctly set.

Configurable Input	Parameter	Setting	Connections	Action
13	Input Function Pointer	Default	Connected (Shorted): TB8-7 (CTB-25) (input13) TB8-12 (CTB-20) (ground)	Code 1317 Active
13	Active State Selection	Active Closed		
13	Input Function Pointer	Default	Connected (Shorted): TB8-7 (CTB-25) (input13) TB8-12 (CTB-20) (ground)	Code 1317 Active
13	Active State Selection	Active Open		

C. Check Wiring

Check for incorrect wiring, open circuits, or short circuits.

5.6.59 Fault Code 1318 Customer Input 14

This fault is an optional customer selection.

A. Check Condition for Configurable Input

1. Check the condition for which the input has been configured.
   - Example: if the input was configured to become active when the fuel level is low, check the fuel level and add fuel if needed.
2. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault.
3. If the fault does not clear, continue troubleshooting.

B. Check Active State Selection Parameter

With InPower or through the Operator Panel check the switch input setting (active closed or active open) for the Configurable Input. Ensure that the switch input setting is correctly set.

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Configurable Input	Parameter	Setting	Connections	Action
14	Input Function Pointer	Default	Connected (Shorted): TB8-8 (CTB-24) (input13) TB8-13 (CTB-19) (ground)	Code 1318 Active
14	Active State Selection	Active Closed		
14	Input Function Pointer	Default	Connected (Shorted): TB8-8 (CTB-24) (input13) TB8-13 (CTB-19) (ground)	Code 1318 Active
14	Active State Selection	Active Open		

C. Check Wiring

Check for incorrect wiring, open circuits, or short circuits.

5.6.60 Fault Code 1322 - kW Setpoint OOR Hi

If the “KW Load Setpoint OOR Check Enable" is enabled and the “KW Load Setpoint OOR High Limit" has been exceeded for the time that is registered in the “KW Load Setpoint OOR Time" the generator set control will display event/fault code 1322.

A. Wiring Issue kW Setpoint

1. Ensure that the KW Load Setpoint analog input (configurable analog Input #1) is not shorted high or disconnected. On the control, the KW Load Setpoint analog input is located at:

   TB9 – 1 Sense

   TB9 – 2 Return

B. Load Govern KW Setpoint RC Enable is Incorrectly Set

1. The "Load Govern KW Setpoint RC Enable" limits the KW Load Govern voltage input from 0 - 5 volts, when set to "Enable" (at TB9-1 and TB9-2); if the voltage input into the KW Load Govern input exceeds 5 VDC, the generator set control locks the KW output to zero since the control logic states that the voltage input is out of range, and displays event/fault code 1322. When the "Load Govern KW Setpoint RC Enable" parameter is set to "Disable" a greater input voltage than 5 VDC is recognized; a 24 VDC input is treated as a 5 VDC input. To change the "Load Govern KW Setpoint RC Enable" parameter appropriately for the application, on the display go to: **Setup > Paralleling Setup > Basic > Load Govern KW Setpoint RC Enable** and set appropriately.

5.6.61 Fault Code 1323 - kW Setpoint OOR Lo

If the “KW Load Setpoint OOR Check Enable" is enabled and the KW Load Setpoint analog input is below the “KW Load Setpoint OOR Low Limit" for the time that is registered in the “KW Load Setpoint OOR Time" the generator set control will display event/fault code 1323.

A. Wiring Issue kW Setpoint

1. Ensure that the KW Load Setpoint analog input (configurable analog Input #1) is not shorted high or disconnected. On the control, the KW Load Setpoint analog input is located at:

   TB9 – 1 Sense

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TB9 – 2 Return

B. KW Load Setpoint Input Voltage is too Low

1. If the voltage input at TB9-1 and TB9-2 is below the “KW Load Setpoint OOR Low Limit", the control will register that input as shorted low. Ensure that the voltage input at TB9-1 and TB9-2 is greater than “KW Load Setpoint OOR Low Limit". To verify the voltage value of the “KW Load Setpoint OOR Low Limit" check the parameter section.

5.6.62 Fault Code 1324 - kVAR Setpoint OOR Hi

If the “KVAR Load Setpoint OOR Check Enable" is enabled and the KVAR Load Setpoint analog input exceeds the “KVAR Load Setpoint OOR High Limit" parameter for the time that is registered in the “KVAR Load Setpoint OOR Time"; the generator set control will display event/fault code 1324.

A. Wiring Issue KVAR

1. Ensure that the KVAR Load Setpoint analog input (configurable analog Input #2) is not shorted high or disconnected. On the control, the voltage bias analog input is located at:

   TB9 – 3 Sense

   TB9 – 2 Return

B. Load Govern KVAR Setpoint RC Enable is Incorrectly Set

1. The "Load Govern KVAR Setpoint RC Enable" limits the KVAR Load Govern voltage input from 0 - 5 volts, when set to "Enable" (at TB9-3 and TB9-2); if the voltage input into the KVAR Load Govern input exceeds 5 VDC, the generator set control locks the KVAR output to zero since the control logic states that the voltage input is out of range, and displays event/fault code 1324. When the "Load Govern KVAR Setpoint RC Enable" parameter is set to "Disable" a greater input voltage than 5 VDC is recognized; a 24 VDC input is treated as a 5 VDC input. To change the "Load Govern KVAR Setpoint RC Enable" parameter appropriately for the application, on the display go to: **Setup > Paralleling Setup > Basic > Load Govern KVAR Setpoint RC Enable** and set appropriately.

5.6.63 Fault Code 1325 - kVAR Setpoint OOR Lo

If the “KVAR Load Setpoint OOR Check Enable" is enabled and the KVAR Load Setpoint analog input is below the “KVAR Load Setpoint OOR Low Limit" for the time that is registered in the “KVAR Load Setpoint OOR Time", the generator set control will display event/fault code 1325.

A. Wiring Issue KVAR

1. Ensure that the KVAR Load Setpoint analog input (configurable analog Input #2) is not shorted high or disconnected. On the control, the voltage bias analog input is located at:

   TB9 – 3 Sense

   TB9 – 2 Return

B. KVAR Load Setpoint Input Voltage Is Too Low

1. If the voltage input at TB9-3 and TB9-2 is below the “KVAR Load Setpoint OOR Low Limit", the control will register that input as shorted low. Ensure that the voltage input at TB9-3 and TB9-2 is greater than “KVAR Load Setpoint OOR Low Limit". To verify the voltage value of the “KVAR Load Setpoint OOR Low Limit" check the parameter section.

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5.6.64 Fault Code 1328 - Genset CB Tripped

The Genset CB has tripped.

A. Correct Any Active Genset Faults

1. Check for active generator set faults on the display (especially Overload, Short Circuit, or Ground Faults); then correct these faults.

B. Incorrectly Wired or Short Circuit

1. Verify the wiring from the Genset CB to the Genset CB Tripped status input on the base board. The Genset CB Tripped status input is a Normally Open contact at TB10-10 and TB10-2 (B+ Return). Ensure that the connection from the Genset CB to TB10-10 on the base board is not shorted to ground.

C. CB Trip Solenoid is Incorrectly Configured or Faulty

1. Genset CB Trip settings are configured to trip at a low over-current threshold. Check other settings on the Genset CB that might cause it to trip since circuit breakers can have multiple trip settings. Configure the Genset CB Trip Solenoid to trip at adequate trip settings for the application; refer to the CB Service Manual.
2. Faulty Trip solenoid, refer to the CB Service Manual for troubleshooting instructions.

D. Faulty Genset CB

1. Refer to the appropriate circuit breaker service manual.

5.6.65 Fault Code 1334 - Crit Scaler OR

An incorrect feature or calibration was entered into the control.

Refer to the engine service manual for troubleshooting.

5.6.66 Fault Code 1336 - Cooldown Completed

Provides a record in the fault history that the engine cooldown period has been completed successfully during a Shutdown with Cooldown condition and fault code 1336 (shutdown) active. No action required.

5.6.67 Fault Code 1369 - Aux Temp 1 Sensor OOR High

Auxiliary Temperature 1 Sensor is above normal operating voltage.

Refer to the engine service manual for troubleshooting.

5.6.68 Fault Code 1416 - Fail To Shutdown

To provide a record in the fault history that generator set shutdown faults were bypassed while the control was in Battle Short mode.

A. A Shutdown Fault was Bypassed While the Battle Short Feature was Enabled on the Control

1. Event/fault code 1416 is activated because of an active “Shutdown fault" while the control is operating in battle-short mode. Troubleshoot the other shutdown fault(s) that are causing the generator set to display event/fault code 1416.

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5.6.69 Fault Code 1417 - Power Down Failure

The PCC has failed to go to sleep.

A. Faulty Base Board

1. Remove power (B+) from the PCC for 5−10 seconds and reconnect B+ to the PCC. If the PCC fails to go to sleep after power is cycled from the PCC and the PCC shows event/fault code 1417 again, replace the base board.

5.6.70 Fault Code 1433 - Local E-Stop

The Local Emergency Stop has been activated.

A. The Local Emergency Stop Button Has Been Activated

1. Pull the Local Emergency stop button out.
2. Press the Off button.
3. Press the Reset button.
4. Select Manual or Auto as required.

B. Faulty Connection Or Faulty Emergency Stop Switch

1. Check the Emergency Stop button, and verify that it is working properly. The Emergency Stop button is a closed relay when it is pulled out (not active), and open relay when depressed (active).
2. Verify that the connection/wiring from the Local Emergency Stop switch to the control for an open circuit condition. A ground connection to the Local E−Stop control input (J25 – 2 Input; J25 – 6 Ground) disables the emergency stop alarm. An open circuit should activate the Emergency stop alarm.

   J25 – 2 Input

   J25 – 6 Ground

5.6.71 Fault Code 1434 - Remote E-Stop

The Remote Emergency Stop has been activated.

A. The Remote Emergency Stop Button Has Been Activated

1. Reset the Remote Emergency Stop:
   a. Pull the Remote Emergency stop button out.
   b. Press the Off button.
   c. Press the Reset button.
   d. Select Manual or Auto as required.
2. If the Remote Emergency Stop is not used:
   a. Install a jumper between the following:

      TB1 – 16 Input

      TB1 – 15 Ground

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b. Reset the Remote Emergency Stop:

i. Pull the Remote Emergency stop button out.

ii. Press the Off button.

iii. Press the Reset button.

iv. Select Manual or Auto as required.

B. Faulty Connection Or Faulty Emergency Stop Switch

1. Check the Emergency Stop button, and verify that it is working properly. The Emergency Stop button is a closed relay when it is pulled out (not active), and open relay when depressed (active).
2. Verify that the connection/wiring from the Remote Emergency Stop switch to the PCC for an open circuit condition. A ground connection to the Remote E−Stop control input (TB1 – 16 Input; TB1 – 15 Ground) disables the emergency stop alarm. An open circuit should activate the Emergency stop alarm.

   TB1 – 16 Input

   TB1 – 15 Ground

5.6.72 Fault Code 1435 - Low Coolant Temperature

Engine coolant temperature is below the low coolant temperature warning threshold.

A. Check Coolant Level

1. If the generator set is powering critical loads and cannot be shut down, wait until next shutdown period, then complete the following steps:
2. Allow engine to cool completely.
3. Inspect the engine, cooling system and surrounding area for external coolant leaks.
   a. Repair as required.
   b. If internal coolant loss is suspected, refer to the Engine Service Manual.
4. Inspect the coolant level, using the sight glass (if applicable) or by removing the radiator cap.
   a. Allow engine to cool.
   b. Slowly remove the radiator cap to allow for pressure to be released,
5. If coolant level is below the manufacturer's specified amount, add prescribed amount of coolant.
6. Clear the warning by pressing the Reset button on the operator panel.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 24. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
LCT Warning Threshold	**Setup->Genset Setup**	Default = 70 F
LCT Warning Set time	**Setup->Genset Setup**	Default = 1 minute

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C. Check PCCNet Annunciator

1. Check the wiring on the back of the PCCNet Annunciator. Make sure that an open circuit or short circuit does not exist in the wiring.
2. Refer to the PCCNet Annunciator Operator Manual to verify that the Annunciator is configured correctly; since inputs can be configured to Active Open or Active Closed.
3. Use the following table to determine proper wiring connections:

TABLE 25. CONNECTIONS

Pin	Description
CTB5-4	Input
CTB10-2	Ground

D. Check Coolant Heaters

1. Ensure that the coolant heaters are connected properly to a power supply.
2. Check for open circuits in the wiring to the coolant heaters.
3. Ensure that the power supply of the coolant heaters is working properly. Verify breaker position in the AC Distribution box.
4. Verify breaker position in the AC Distribution box.
5. Measure the temperature of the coolant heaters using a proper temperature measuring device.
6. If the ambient temperature is above 40 °F (4.4 °C), the measured temperature of the coolant heaters should be above or close to 90 °F (32 °C) (dependent on ambient temperature). If the temperature of the coolant heaters is close to the ambient temperature and the ambient temperature is 40 °F (4.4 °C) or more, troubleshoot the coolant heater.

E. Check for Low Ambient Temperature

If the coolant heaters are working properly and the radiator has enough coolant, but the ambient temperature around the generator set is less than 40 °F (4.4 °C); the coolant heaters might not have the capability to keep the coolant temperature above 70 °F (21 °C). This could be an application issue and will need to be further investigated.

F. Low Ambient Temperature

1. If the coolant heaters are working properly and the radiator has enough coolant, but the ambient temperature around the generator set is less than 3.5 °C (40 °F), the coolant heaters might not have the capability to keep the coolant temperature above 21 °C (70 °F). This could be an application issue and will need to be further investigated.

5.6.73 Fault Code 1438 - Fail to Crank (Shutdown)

The engine failed to crank after the generator control received a start signal.

A. Check for Low or Weak Battery Voltage

1. During cranking if the battery voltage goes below the engine ECM minimum operating voltage, the ECM will reset and event/fault code 1438 will become active.
2. Troubleshoot fault codes 441 and 1442.

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B. Check Supply Fuse

1. Verify the switched B+ supply fuse on the PCC 3300 control (F5C) is in place and functional.
2. Replace fuse as necessary.

C. Failed Starter

1. Press the Reset/Fault Acknowledge button on the display.
2. Attempt to start the generator and test for B+ at the starter supply lug.
3. If B+ is present at the starter supply lug, the starter could be defective. Test the starter according to the appropriate engine service manual and replace if faulty.
4. If B+ is not present at the starter, check the emergency stop switch and switch connections.

D. Check Starter Solenoid

1. Reset the PCC by pressing the Fault Reset button on the operator panel.
2. Check wiring for continuity between relay K4-4 to DC Distribution box Crank1, 2, and 3.
3. Check Continuity from Crank1, 2, and 3 terminals on the DC Distribution box to each respective starter solenoid (pin 2).
4. If B+ is not present in one or both of the above described cases, the starter solenoid is defective.

E. Check Starter Relay

1. Check wiring for continuity between K4-5 on the starter relay and J20-13 control board terminal. Resistance should be less than 5Ω.
2. Check wiring for continuity between K4-6 on the starter relay and J20-15 control board terminal. Resistance should be less than 5Ω.
3. Check for B+ at K4-1 on the starter relay. If voltage is not present, verify 20 Amp fuse is in place and functional.
4. Attempt to start the generator set and test for B+ at K4-5 of the starter relay.
5. Check wiring for continuity between K4-6 on the starter relay and ground. Resistance should be less than 5Ω.
6. Attempt to start the generator set and test for B+ at K4-4 on the starter relay. If B+ is not present, the starter relay is defective.

F. Engine Or Rotor Is Locked Or Binding

1. Verify that the generator can rotate freely by barring the engine over by hand. If generator cannot be turned over, identify the source of bind and repair as necessary.

G. Failed Emergency Stop Switch Or Wiring

1. Push emergency stop button in, remove the configurable leads from TB1–15 and TB1–16 and check for continuity between these two leads.
2. If the circuit is open, isolate to the emergency stop switch and wiring.
3. Push emergency stop button in and remove P25 from the base board. Check for continuity between J25–2 and J25–6.
4. Repair or replace the emergency stop switch or the wiring as necessary.

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H. Check Air Supply (Air Start Only)

1. Check that all valves controlling the air supply to the starter are completely open and functioning properly.
2. Check that the line supply pressure is according to generator set specifications.
3. During crank attempts, verify line pressure does not drop below the minimum required for cranking.

I. Check Rotating Mechanisms (Air Start Only)

1. Properly lock-out the generator set to prevent accidental starting during this diagnosis.
2. Check for machine rotation by physically barring the engine.
3. If the machine rotates without significant effort, the fail to crank issue lies with another component.
4. If the machine rotated with significant effort or does not rotate at all, contact your service provider for further investigation. Do not attempt to force the machine to rotate with tremendous effort as you may propagate the issue.

5.6.74 Fault Code 1439 - Low Day Tank Fuel

Indicates day tank fuel supply is running low.

A. Check Fuel Sender Wiring

Check the wiring for improper wiring, a short or open circuit from the fuel sensor to the discrete configurable input on the base board that was configured for the “Low Day Tank Fuel Level". If a short or open circuit or improper wiring is found, correct the wiring.

B. Check Fuel Sender

Measure the resistance of the fuel sender at the day tank. If the sender is reading incorrectly (Shorted or Open Circuit), replace the fuel sender.

C. Check Configurable Input Active State Selection

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1. With InPower or through the operator panel, check the switch input setting (active closed or active open) for the configurable input that was configured to “Low Fuel in Day Tank Switch". Ensure that the switch input setting is correctly set. If the “Configurable Input Function Pointer" parameter is set to “Low Fuel in Day Tank Switch" and the “Configurable Input Active State Selection" parameter is set to “active closed", event/fault code 1439 will become active when the configurable input that was configured to “Low Fuel in Day Tank Switch" is connected to ground.
    a. Ensure that the switch input setting is correctly set.
    b. If the “Configurable Input Function Pointer" parameter is set to “Low Fuel in Day Tank Switch" and the “Configurable Input Active State Selection" parameter is set to “active closed", event/fault code 1439 will become active when the configurable input that was configured to “Low Fuel in Day Tank Switch" is connected to ground.
2. If the “Configurable Input Function Pointer" parameter is set to “Low Fuel in Day Tank Switch" and the “Configurable Input Active State Selection" parameter is set to “active open", event/fault code 1439 will become active when the configurable input that was configured to “Low Fuel in Day Tank Switch" is an open circuit.

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3. To access the input configuration on the operator panel go to **Setup > Configurable I/O >** and set the “Configurable Input Active State Selection" parameter appropriately for the configurable input that was configured to “Low Fuel in Day Tank Switch".

5.6.75 Fault Code 1441 - Low Fuel Level

The "Fuel level % (AUX 101)" input has gone below the "Low Fuel Level Threshold (AUX 101)" setting for the time in the "Low Fuel Level Time (AUX 101)" setting.

A. Fuel Sender Incorrectly Wired

1. Check the wiring of the fuel sensor.
    a. Ensure that the sender is correctly wired to the base board. Check the wiring for a short circuit from the fuel sensor to the input on the base board that is configured for the “Fuel Level". If a short circuit is found, correct the wiring.

B. Faulty Fuel Sender

1. Measure the resistance between the fuel level signal pin and the fuel level return pin. The resistance should be between 600 Ohms to 2500 Ohms when the tank is full. Replace the sender if the resistance value is below the recommended threshold when the fuel tank is full.

C. The Low Fuel Set/Clear Time Parameter is Configured Incorrectly

1. Check the low fuel level setup parameter. To access the input configuration on the operator panel go to **Setup > Genset Setup** and set the "Low Fuel Set/Clear Time" parameter appropriately for the application.

5.6.76 Fault Code 1442 - Weak Battery

This fault occurs when the engine is starting (cranking) and the voltage of the battery drops below the Week Battery Voltage Threshold (Default = 14.4 Vdc) for the time set in the Weak Battery Voltage Set time (Default = 2s).

A. Check Battery Voltage (24 VDC)

1. Measure the battery voltage from the positive (+) terminal to the negative (-) terminal. If the voltage is between 17.3 and 34.7 V, then the voltage is within normal range.
2. Recharge the battery.
3. If the battery cannot hold adequate voltage, replace the battery.

B. Check Battery Cable Connections

1. Inspect for:
    - Corroded or loose connections (clean and tighten as necessary)
    - Damaged battery cables and connectors (repair and replace as necessary)
    - A good connection at the starter solenoid terminals
2. If necessary, disconnect the cables and properly reconnect them.

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C. Check Battery Voltage Setting (24VDC)

Verify that the battery voltage matches calibration. Use InPower to check Weak Battery setting. (Default = 24Vdc).

TABLE 26. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Weak Battery	**Setup > OEM Setup > OEM Engine Setup > FAE > Weak Battery**	Refer to the battery manufacturer's manual.

D. Check Battery Charging Rate

1. Make sure that the battery charger is charging the battery at an acceptable rate and not overcharging the battery. Adjust the charge rate of the battery charger if the charge rate is above the recommendation of the manufacturer.
2. Replace the battery charger if faulty.
3. Refer to the battery charger manual, if available.

E. Load Test the Battery

Disconnect all battery cables and perform battery load test using a battery load tester according to the manufacturer recommendations.

F. Check Charging Alternator (24 VDC)

1. Temporarily disconnect the alternator and test-run the engine.
2. Check the wiring of the alternator for open circuits.
3. If the wiring is satisfactory, measure the charging voltage of the alternator while the engine is running. The voltage should be +24 to +28 VDC.
4. If the charging voltage is not correct, check the following connections:
   - Check the alternator reference diodes in the DC box (DB+ S1, S2, and S3) for proper operation and correct wiring.
   - Check the charging alternator output diodes in the DC box (DCA S1, S2, and S3) for proper operation and correct wiring.
5. Refer to the engine service manuals, replace battery charging alternator as necessary.

G. Check Battery Harness

1. Measure the battery voltage at the battery terminals and at the control board (CTB-4, CTB-5, and CTB-6). Refer to the following table for wiring connections.
2. If the voltage is not the same at the battery terminals as it is at the base board input, check the harness and replace if necessary.

TABLE 27. CONNECTIONS

B+ (positive) Input	B- (negative) Input
J20-9 (CTB-4)	J20-2 CTB-7

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B+ (positive) Input	B- (negative) Input
J20-10 (CTB-5)	J20-4 CTB-8
J20-20 (CTB-6)	J20-7 CTB-9
J20-21	J20-12

5.6.77 Fault Code 1443 - Dead Battery

During cranking, the battery voltage drops below the operating voltage of the control, which resets the control. After the control has reset three consecutive times, event/fault code 1443 will become active.

A. Check Battery Voltage (24 VDC)

1. Measure the battery voltage from the positive (+) terminal to the negative (-) terminal. If the voltage is between 17.3 and 34.7 V, then the voltage is within normal range.
2. Recharge the battery.
3. If the battery cannot hold adequate voltage, replace the battery.

B. Check Battery Cable Connections

1. Inspect for:
   - Corroded or loose connections (clean and tighten as necessary)
   - Damaged battery cables and connectors (repair and replace as necessary)
   - A good connection at the starter solenoid terminals
2. If necessary, disconnect the cables and properly reconnect them.

C. Load Test the Battery

Disconnect all battery cables and perform battery load test using a battery load tester according to the manufacturer recommendations.

D. Check Battery Charging Rate

1. Make sure that the battery charger is charging the battery at an acceptable rate and not overcharging the battery. Adjust the charge rate of the battery charger if the charge rate is above the recommendation of the manufacturer.
2. Replace the battery charger if faulty.
3. Refer to the battery charger manual, if available.

E. Check Charging Alternator (24 VDC)

1. Temporarily disconnect the alternator and test-run the engine.
2. Check the wiring of the alternator for open circuits.
3. If the wiring is satisfactory, measure the charging voltage of the alternator while the engine is running. The voltage should be +24 to +28 VDC.

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4. If the charging voltage is not correct, check the following connections:
   - Check the alternator reference diodes in the DC box (DB+ S1, S2, and S3) for proper operation and correct wiring.
   - Check the charging alternator output diodes in the DC box (DCA S1, S2, and S3) for proper operation and correct wiring.
5. Refer to the engine service manuals, replace battery charging alternator as necessary.

F. Check Battery Harness

1. Measure the battery voltage at the battery terminals and at the control board (CTB-4, CTB-5, and CTB-6). Refer to the following table for wiring connections.
2. If the voltage is not the same at the battery terminals as it is at the base board input, check the harness and replace if necessary.

TABLE 28. CONNECTIONS

B+ (positive) Input	B- (negative) Input
J20-9 (CTB-4)	J20-2 CTB-7
J20-10 (CTB-5)	J20-4 CTB-8
J20-20 (CTB-6)	J20-7 CTB-9
J20-21	J20-12

5.6.78 Fault Code 1444 - kW Overload

The "Overload Threshold" has been exceeded for the time that is registered in the "Overload Set Time" parameter.

A. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 29. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Overload Threshold	**Setup->Genset Setup**	Default value is 105%
High AC Voltage Trip	**Setup > OEM Setup > OEM ALT Setup > High AC Voltage**	Default = “Inverse Time”
High AC Voltage Threshold	**Setup > OEM Setup > OEM ALT Setup > High AC Voltage Threshold**	Default = 110%
High AC Voltage Fault Simulation	**Tests > Protection Verification > Alternator Protection > Overvoltage**	Disabled

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Setting	Menu Navigation	Parameter
Current Transformer Ratio	**Setup > OEM Setup > OEM Alt Setup > Genset CT Ratio**	Set appropriately for the application. Use the CT ratio calculator in InPower to determine the correct CT ratio

B. Check Load and Load Cables

1. An overload condition has occurred. With the generator set being turned off, visually inspect the load and load cables for damage and/or short circuit. Repair if necessary.
2. Make sure that new loads have not been added to the generator set. Revisit the generator set sizing process to make sure that the generator set is correctly sized for the application (reference the T-030 manual).

C. Check Current Transformer Size

Make sure the current transformer size is correct. Replace current transformer if necessary.

D. Check Current Transformer Connections and Current

1. Verify the CT connections are correct from the CTs to the input of the control board.
2. Verify CTs are correct ratio for the application.
3. Check the current going into the CT input on the control board (use a current probe to check the secondary output of the CT).
   - This should be the value that the control secondary is calibrated with (e.g. if the control is calibrated with a CT ratio of 1000:5, the current input into the base board should not be more than 5 A).
4. Replace the control board if necessary.

5.6.79 Fault Code 1445 - Short Circuit

The generator output current has exceeded 175% of rated current.

NOTICE
This fault remains active and cannot be reset until the Alternator Overheat Integral time has expired (which takes up to five minutes). The Alternator Overheat Integral time allows the alternator to cool down before allowing a restart.

A. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 30. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Nominal Voltage	**Setup > Genset setup > Genset Nominal Voltage**	Set appropriately for the application.

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Setting	Menu Navigation	Parameter
Current Transformer Ratio	**Setup > OEM Setup > OEM Alt Setup > Genset Primary CT Current** and **Setup > OEM Setup > OEM Alt Setup > Genset CT Secondary Current**	Set appropriately for the application. Use the CT ratio calculator in InPower to determine the correct CT ratio.

B. Check Load and Load Cables

1. An overload condition has occurred. With the generator set being turned off, visually inspect the load and load cables for damage and/or short circuit. Repair if necessary.
2. Make sure that new loads have not been added to the generator set. Revisit the generator set sizing process to make sure that the generator set is correctly sized for the application (reference the T-030 manual).

C. Check Current Transformer Size

Make sure the current transformer size is correct. Replace current transformer if necessary.

D. Check Current Transformer Connections and Current

1. Verify the CT connections are correct from the CTs to the input of the control board.
2. Verify CTs are correct ratio for the application.
3. Check the current going into the CT input on the control board (use a current probe to check the secondary output of the CT).
   - This should be the value that the control secondary is calibrated with (e.g. if the control is calibrated with a CT ratio of 1000:5, the current input into the base board should not be more than 5 A).
4. Replace the control board if necessary.

5.6.80 Fault Code 1446 - High AC Voltage

One or more of the phase voltages has exceeded the high AC voltage threshold (Default = 110%) over the High AC Voltage Delay (Default = 10s).

A. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 31. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
High AC Voltage Trip	**Setup > OEM Setup > OEM ALT Setup > High AC Voltage**	Default = “Inverse Time”
High AC Voltage Threshold	**Setup > OEM Setup > OEM ALT Setup > High AC Voltage Threshold**	Default = 110%

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Setting	Menu Navigation	Parameter
Potential Transformer Ratio	**Setup > OEM Setup > OEM Alt Setup > Genset PT Ratio Primary** **Setup > OEM Setup > OEM Alt Setup > Genset PT Ratio Secondary**	Set appropriately for the application.

B. Check Potential Transformer Connections and Voltage

1. Verify the PT connections are correct from the alternator to the PT and the PT to the control board.
   - If the wires are incorrectly connected or there is an open circuit, correct the wiring issue.
   - If the voltage input is less than 600 VAC, a PT is not required.
2. Check the PT settings through InPower (**Genset PT Primary Voltage**, **Genset PT Secondary Voltage**, **Genset Nominal Voltage**).

C. Check Potential Transformer Voltage Input and Output

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Make sure that only personnel who are trained and qualified to work on this equipment are allowed to operate the generator set and perform maintenance on it.

Use a calibrated voltage meter, measure the voltage input and output of the potential transformer. The input and output should be proportional, if they are not, replace the potential transformer.

NOTICE

Example: Inputs: L1 = 4160, L2 = 5460, L3 = 4160; Outputs: L1 = 120, L2 =120, L3 = 120.

D. Check Potential Transformer Size

1. Use the following equation to determine if the correct potential transformer (PT) for the application is installed.

   (Generator Set Nominal Voltage / Generator Set PT Primary Voltage) x Generator Set PT Secondary Voltage
   - If the value is greater than 600 VAC, the PT ratio is too small.
   - If the value is less than 1/2 the nominal voltage (Nominal Voltage x .5), the PT ratio is too large.
2. Check the voltage input into the control board. Refer to the control settings table.

E. Check AUX 103/106

Use InPower to check the AUX 103/106 as follows:

- If the AVR (Automatic Voltage Regulation) or PWM (Pulse Width Modulation) is continuously high, replace the control board.
- If the AUX 103/106 is continuously high, replace the AUX 103/106.

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F. Check PMG

1. Start the generator set and run at rated speed.
2. Measure the voltages at the defined locations below, the values should be balanced and within the acceptable value rage.
   a. If voltages are unbalanced or out of range:
      i. Stop the generator set.
      ii. Remove PMG cover.
      iii. Disconnect the multi-pin plug in the PMG output leads.
      iv. Check the leads for continuity.
      v. Check the PMG stator resistances between output leads. These should be balanced and within ± 10% of 2.3 Ω.
   b. If the voltages are balanced but low, and the PMG stator winding resistances are correct, replace the PMG rotor.

TABLE 32. ACCEPTABLE VALUES (AUX 103)

Measure	Location	Operating Condition	Acceptable Value
AVR(AUX 103Input	P19-1 (B+)	No load	17-30 VDC
AVR (AUX 103) Input	P19-8 (B-)	No load	17-30 VDC
PWM (pulse width modulation)	P19-2 (AVR PWM +)	Generator set on	< 2.0 VDC
PWM (pulse width modulation)	P19-9 (AVR PWM -)	Generator set on	< 2.0 VDC
Output	P18-1	Running at rated speed	50 Hz Genset: 170-180 V 60 Hz Genset: 200-216 V
Output	P18-2	Running at rated speed	
Output	P18-3	Running at rated speed	
AVR Output	P17-1	Generator set on	≥ 300 VDC
AVR Output	P17-2	Generator set on	

TABLE 33. ACCEPTABLE VALUES (AUX 106)

Measure	Location	Operating Condition	Acceptable Value
AVR(AUX 106) Input	P19-1 (B+)	No load	17-30 VDC
AVR(AUX 106) Input	J17-2 (-)	No load	17-30 VDC
PWM (pulse width modulation)	J19-2 (AVR PWM +)	Generator set on.	< 2.0 VDC

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Measure	Location	Operating Condition	Acceptable Value
PWM (pulse width modulation)	J19-9 (AVR PWM -)	Generator set on.	< 2.0 VDC
Output	P18-1	Running at rated speed	50 Hz Genset: 170-180 V 60 Hz Genset: 200-216 V
Output	P18-2	Running at rated speed	60 Hz Genset: 200-216 V
Output	P18-3	Running at rated speed	≥ 300 VDC
AVR Output	P17-1	Generator set on.	
AVR Output	P17-2	Generator set on.	

5.6.81 Fault Code 1447 - Low AC Voltage

Voltage has decreased below the Low AC Voltage Threshold (Default = 85%) for the time that is registered in the Low AC Voltage Delay parameter (Default = 10s).

A. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 34. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Low AC Voltage Threshold	**Setup > OEM Setup > OEM ALT** **Setup > Low AC Voltage Threshold**	Default = 85%
Potential Transformer Ratio	**Setup > OEM Setup > OEM Alt** **Setup > Genset PT Ratio Primary** **Setup > OEM Setup > OEM Alt** **Setup >** **Genset PT Ratio Secondary**	Set appropriately for the application.

B. Check Potential Transformer Connections and Voltage

1. Verify the PT connections are correct from the alternator to the PT and the PT to the control board.
   - If the wires are incorrectly connected or there is an open circuit, correct the wiring issue.
   - If the voltage input is less than 600 VAC, a PT is not required.
2. Check the PT settings through InPower (**Genset PT Primary Voltage**, **Genset PT Secondary Voltage**, **Genset Nominal Voltage**).

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C. Check Potential Transformer Voltage Input and Output

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Make sure that only personnel who are trained and qualified to work on this equipment are allowed to operate the generator set and perform maintenance on it.

Use a calibrated voltage meter, measure the voltage input and output of the potential transformer. The input and output should be proportional, if they are not, replace the potential transformer.

NOTICE

Example: Inputs: L1 = 4160, L2 = 5460, L3 = 4160; Outputs: L1 = 120, L2 =120, L3 = 120.

D. Check Potential Transformer Size

1. Use the following equation to determine if the correct potential transformer (PT) for the application is installed.

   (Generator Set Nominal Voltage / Generator Set PT Primary Voltage) x Generator Set PT Secondary Voltage

   - If the value is greater than 600 VAC, the PT ratio is too small.
   - If the value is less than 1/2 the nominal voltage (Nominal Voltage x .5), the PT ratio is too large.
2. Check the voltage input into the control board. Refer to the control settings table.

E. Check Power Supply to AVR (AUX103/106)

1. Check the power supply to the AVR. If the AVR has no power, you will need to troubleshoot the power supply connections.
2. Replace any fuses with open circuits.
3. Check the power supply at the following locations:

F. Check AVR Output

1. Measure the output of the AVR (Automatic Voltage Regulation) at the following connection locations. The output should fall within the specified ranges.
   - If the voltage is constantly zero, or less than specified then the AVR portion, the

     PCC is faulty.
2. Double-check the results.
   a. Disconnect the connections from the AVR board (the AVR board should no longer be connected to the field wires).
   b. Place a power supply with the same VDC as the acceptable range to the field wires.
   c. If the generator set produces adequate voltage (nominal voltage or greater) the AVR portion of the control board is faulty. Replace the control board.

Insert the body content of the topic

TABLE 35. CONNECTIONS

Pin	Description
P19-1	Power supply from PCC 3300
P19-8	Power supply from PCC 3300
P18-1	Power from PMG
P18-2	
P18-3	

G. Check AUX 103/106

Use InPower to check the AUX 103/106 as follows:

- If the AVR (Automatic Voltage Regulation) or PWM (Pulse Width Modulation) is continuously high, replace the control board.
- If the AUX 103/106 is continuously high, replace the AUX 103/106.

H. Check PMG

1. Start the generator set and run at rated speed.
2. Measure the voltages at the defined locations below, the values should be balanced and within the acceptable value rage.
   a. If voltages are unbalanced or out of range:
      i. Stop the generator set.
      ii. Remove PMG cover.
      iii. Disconnect the multi-pin plug in the PMG output leads.
      iv. Check the leads for continuity.
      v. Check the PMG stator resistances between output leads. These should be balanced and within ± 10% of 2.3 Ω.
   b. If the voltages are balanced but low, and the PMG stator winding resistances are correct, replace the PMG rotor.

TABLE 36. ACCEPTABLE VALUES (AUX 103)

Measure	Location	Operating Condition	Acceptable Value
AVR(AUX 103Input	P19-1 (B+)	No load	17-30 VDC
AVR (AUX 103) Input	P19-8 (B-)	No load	17-30 VDC
PWM (pulse width modulation)	P19-2 (AVR PWM +)	Generator set on	< 2.0 VDC
PWM (pulse width modulation)	P19-9 (AVR PWM -)	Generator set on	< 2.0 VDC

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Measure	Location	Operating Condition	Acceptable Value
Output	P18-1	Running at rated speed	50 Hz Genset: 170-180 V 60 Hz Genset: 200-216 V
Output	P18-2	Running at rated speed	
Output	P18-3	Running at rated speed	
AVR Output	P17-1	Generator set on	≥ 300 VDC
AVR Output	P17-2	Generator set on	

TABLE 37. ACCEPTABLE VALUES (AUX 106)

Measure	Location	Operating Condition	Acceptable Value
AVR(AUX 106) Input	P19-1 (B+)	No load	17-30 VDC
AVR(AUX 106) Input	J17-2 (-)	No load	17-30 VDC
PWM (pulse width modulation)	J19-2 (AVR PWM +)	Generator set on.	< 2.0 VDC
PWM (pulse width modulation)	J19-9 (AVR PWM -)	Generator set on.	< 2.0 VDC
Output	P18-1	Running at rated speed	50 Hz Genset: 170-180 V 60 Hz Genset: 200-216 V
Output	P18-2	Running at rated speed	60 Hz Genset: 200-216 V
Output	P18-3	Running at rated speed	≥ 300 VDC
AVR Output	P17-1	Generator set on.	
AVR Output	P17-2	Generator set on.	

I. Check Rotating Rectifier Assembly

1. Disconnect the specified leads from the AVR or transformer control rectifier bridge.
2. Connect the specified power supply to the leads.
3. Start the generator set and run at rated speed.
4. Measure the voltages at the main output terminals.
5. If voltages are balanced but below the voltage range, there is a fault in the rotating diode assembly or the main excitation windings.
6. Check the diodes on the main rectifier assembly with a multimeter.
    a. Disconnect the flexible leads from each diode at the terminal end.
    b. Check the forward and reverse resistance.
        - A healthy diode will indicate a very high resistance (infinity) in the reverse direction, and a low resistance in the forward direction.
        - A faulty diode will give a full deflection reading or an infinity reading in both directions with the test meter on the 10,000 ohms scale.

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- On an electronic digital meter a healthy diode will give a low reading in one direction, and a high reading in the other.

c. Replace diodes as necessary.

TABLE 38. CONNECTIONS

Location	Description
P17-1 (+)	Leads
P17-2 (-)	
P18-1	Main output terminals Acceptable Voltage Ranges: 50 Hz generators: 170-180 V 60 Hz generators: 200-216 V
P18-2	
P18-3	

5.6.82 Fault Code 1448 - Underfrequency

The frequency has dropped below the underfrequency threshold (Default = 6Hz) for the time set in the underfrequency delay parameter (default = 10s).

A. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 39. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Underfrequency Threshold	**Setup > OEM Setup > OEM ALT Setup > Underfrequency Threshold**	Default = 6Hz
Adjustable Freq/Speed Gain	**Setup > OEM Setup >OEM Engine Setup > Adjustable Freq/Speed Gain**	To calculate the frequency to speed gain ratio use the following equation: 120 / Number of poles of the alternator.
Frequency to Speed Gain Select	**Setup > OEM Setup >OEM Engine Setup > Frequency to Speed Gain Select**	To calculate the frequency to speed gain ratio use the following equation: 120 / Number of poles of the alternator.

B. Check for Overload

The load on the generator set should not exceed the generator set KW rating. Revisit the generator set sizing process to ensure that the generator set is correctly sized for the application, especially if new loads have been introduced into the system (reference the T-030 manual).

Underfrequency shutdowns can be caused by the load as follows:

- The generator set produces correct frequency with no load.
- The generator set shuts down on underfrequency when the generator set picks up certain loads.

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The following examples have a considerable and different influence on a generator set and may require starting these loads when there is a minimum load on the generator set.

- Motors
- Uninterruptible Power Supply (UPS)
- Variable Frequency Drive (VFD)
- Medical Diagnostic Imaging Equipment
- Fire Pumps
- Certain types of lighting

C. Check that Engine Operates Correctly

1. Check fuel connections.
2. Check fuel level.
3. Check electronic ffuel transfer pump (EFTP) breaker in the DC distribution box.
4. Refer to the engine service manual.

5.6.83 Fault Code 1449 - Overfrequency

Frequency has gone above the overfrequency threshold (Default = 6 Hz) fro the time that is registered in the overfrequency delay parameter (Default = 10s).

A. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 40. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
OEM Alternator Setup	**Setup > OEM Setup > OEM Alternator Setup**	Disable
Overfrequency Threshold	**Setup > OEM Setup > OEM ALT Setup > Overfrequency Threshold**	Default = 6Hz Set to parameter appropriately for the application.
Adjustable Freq/Speed Gain	**Setup > OEM Setup >OEM Engine Setup > Adjustable Freq/Speed Gain**	To calculate the frequency to speed gain ratio use the following equation: 120 / Number of poles of the alternator.
Frequency to Speed Gain Select	**Setup > OEM Setup >OEM Engine Setup > Frequency to Speed Gain Select**	To calculate the frequency to speed gain ratio use the following equation: 120 / Number of poles of the alternator.

B. Check for Overload

The load on the generator set should not exceed the generator set KW rating. Revisit the generator set sizing process to ensure that the generator set is correctly sized for the application, especially if new loads have been introduced into the system (reference the T-030 manual).

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Underfrequency shutdowns can be caused by the load as follows:

- The generator set produces correct frequency with no load.
- The generator set shuts down on underfrequency when the generator set picks up certain loads.

The following examples have a considerable and different influence on a generator set and may require starting these loads when there is a minimum load on the generator set.

- Motors
- Uninterruptible Power Supply (UPS)
- Variable Frequency Drive (VFD)
- Medical Diagnostic Imaging Equipment
- Fire Pumps
- Certain types of lighting

C. Check for Large Cycling Loads

1. Verify that the load is within proper operating range (ex. motor starts). Verify for the condition by disconnecting the load and restarting the generator set.
2. Stager large loads.

D. Check that Engine Operates Correctly

Refer to the engine service manual for troubleshooting.

5.6.84 Fault Code 1451 - Genset/Bus V Mismatch

Five seconds after the Genset circuit breaker (CB) closes, the base board continuously verifies whether the generator set and bus voltages are within 5% of each other; if the difference between the generator set and bus voltage is greater than 5%, event/fault code 1451 becomes active.

A. The Generator Set and Bus Voltages Are Not Properly Set Up or Calibrated

1. Calibrate the generator set and bus voltage (all phases) in order to improve the voltage match performance, as well as the metering accuracy. Refer to the calibration section.
2. If the voltage is greater than 600 VAC, ensure that the PT ratio is correctly set. To change the Utility PT ratio parameter appropriately for the application, go to: **Setup > Paralleling Setup > Power Transfer Control > PT Primary or PT Secondary** and set appropriately. To change the Genset PT ratio parameter appropriately for the application, go to: **Setup > OEM Setup > OEM Alt Setup > PT Primary or PT Secondary** and set appropriately.

5.6.85 Fault Code 1452 - Genset CB Fail To Close

The base board sends the Genset CB a close command, but Genset circuit breaker (CB) has failed to close for the time that is registered in the "Gen CB Fail to Close Time Delay" parameter.

A. Incorrectly Wired Genset CB Close Command

Check the wiring from the Genset CB Close command output on the base board to the generator circuit breaker.

- The Genset CB Close command output on the base board is a NO Relay at TB5-1 and TB5-2 (Common). When the relay on the base board is closed, the Genset breaker should be closed.

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- The output of TB5-1 (CTB39) and TB5-2 (CTB40) should match the status of the Genset CB Close command.

  Go to **Advanced Status > Advanced Controller Status > Genset CB Close Command**, and ensure that the status of the Genset CB Close command matches the output.

B. Incorrectly Selected Genset CB Position Contacts and/or Incorrectly Wired Status Feedback

1. The CB position sensing can be set up as single or dual sensing in the base board.

   Go to **Setup > Paralleling Setup > Basic > Genset Breaker Position Contacts**, and check if the base board is set up as single or dual sensing.

2. The CB Status Feedback on InPower should match the status of the CB position.

   Go to **Paralleling Status > Paralleling Status-Isolated Bus > Genset CB Position Status**, and ensure that the status of the CB position matches the connection. If it does not, check the wiring of the CB position status from the generator circuit breaker to the base board.

   - If the CB position sensing is set up as single, verify the following connection:
     - CB A (NO)
       - Status at TB10-7 (CTB-42)
       - Return at TB10-2 (CTB-48)
   - If the CB position sensing is set up as dual, verify the following connection:
     - CB A (NO)
       - Status at TB10-7 (CTB-42)
       - Return at TB10-2 (CTB-48)
     - CB B (NC)
       - Status at TB10-8 (CTB-41)
       - Return at TB10-2 (CTB-48)

NOTICE
The input status at CB A (NO) and CB B (NC) should be opposite; one input is open while the other is closed. If they are the same, check the wiring between the Genset circuit breaker and the CB status input on the base board.

C. Faulty Genset Circuit Breaker

Refer to the appropriate circuit breaker service manual.

5.6.86 Fault Code 1453 - Genset CB Fail To Open

The base board sends the Genset circuit breaker (CB) an open command, but the Genset CB has failed to open for the time that is registered in the "Gen CB Fail to Open Time Delay" parameter.

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A. Incorrectly Wired Genset CB Open Command

Check the wiring from the Genset CB Open Command output on the base board to the generator circuit breaker.

- The Genset CB Open Command output on the base board is a NC Relay at TB5-5 and TB5-4 (Common). When the relay on the base board is open, the Genset Breaker should be open.
- The output of TB5-5 (CTB42) and TB5-4 (CTB41) should match the status of the Genset CB Open command.

  Go to **Advanced Status > Advanced Controller Status > Genset CB Open Command**, and ensure that the status of Genset CB Open Command matches the output.

B. Incorrectly Selected Genset CB Position Contacts and/or Incorrectly Wired Status Feedback

1. The CB position sensing can be set up as single or dual sensing in the base board.

   Go to **Setup > Paralleling Setup > Basic > Genset Breaker Position Contacts**, and check if the base board is set up as single or dual sensing.

2. The CB Status Feedback on InPower should match the status of the CB position.

   Go to **Paralleling Status > Paralleling Status-Isolated Bus > Genset CB Position Status**, and ensure that the status of the CB position matches the connection. If it does not, check the wiring of the CB position status from the generator circuit breaker to the base board.

   - If the CB position sensing is set up as single, verify the following connection:
     - CB A (NO)
       - Status at TB10-7 (CTB-42)
       - Return at TB10-2 (CTB-48)
   - If the CB position sensing is set up as dual, verify the following connection:
     - CB A (NO)
       - Status at TB10-7 (CTB-42)
       - Return at TB10-2 (CTB-48)
     - CB B (NC)
       - Status at TB10-8 (CTB-41)
       - Return at TB10-2 (CTB-48)

NOTICE
The input status at CB A (NO) and CB B (NC) should be opposite; one input is open while the other is closed. If they are the same, check the wiring between the Genset circuit breaker and the CB status input on the base board.

C. Faulty Genset Circuit Breaker

Refer to the appropriate circuit breaker service manual.

5.6.87 Fault Code 1454 - Genset CB Pos Error

A mismatch in the generator set position status exists.

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A. Mismatch In The Genset Position Sensing

1. Verify the wiring of the CB position status from the generator set breaker to the base board. The CB position sensing can be set up as single or dual sensing in the base board; check the display if the base board is setup as single or dual sensing. To access the CB position sensing, go to: **Setup > Paralleling Setup > Basic > Genset Breaker Position Contacts**.
2. When the Genset Breaker Position contact is set to Single, the base board monitors current going through the Genset CB (Amps going through the CB means it is closed) and CB A position status to determine the position of the Genset CB. If there is a mismatch between the current-based breaker position and CB A position sensing, fault code 1454 will occur. Verify the connection at CB A (NO) status at TB10-7 and the Return at TB10-2, and ensure that an open/short circuit does not exist.
3. If the CB position sensing is set up as dual, verify the connection at CB A (NO) status at TB10-7 and the Return at TB10-2 and also verify the connection at CB B (NC) status at TB10-8 and TB10-2 (Return). The input status at CB A (NO) and CB B (NC) should be opposite; one input will be open while the other is closed, if they are the same, check the wiring between the Genset breaker and the CB status input on the base board. Ensure that the connections on the base board are correctly connected and that a short and/or open circuit does not exist. The physical connection to the base board should match the status of the CB position; go to: **Setup > Paralleling Status-Isolated Bus > Genset CB Position Status**, and ensure that the status of the CB position matches the connection.

B. Faulty Genset CB

1. Refer to the appropriate circuit breaker service manual.

5.6.88 Fault Code 1455 - Utility CB Pos Error

A mismatch in the Utility position status exists.

A. Utility Single Mode Verify Switch is Inactive

1. Event/fault code 1455 will become active, if the generator set is set up to operate in the following generator set application types; Utility Single, Utility Multiple, or PTC, and the Utility Single Mode Verify Switch is not active, The base board will not close the Utility breaker until the Utility Single Mode Verify Switch input is activated. This procedure is to ensure that the whole system has been rechecked before allowing the base board to close the Utility Breaker. To activate the Utility Single Mode Verify Switch, make a connection between TB10-12 (Single Mode Verify Input) and TB10-16 (Return); then press the fault reset button on the display to clear the fault.

B. Mismatch In The Utility Position Sensing

1. Verify the wiring of the CB position status from the Utility breaker to the base board. The CB position sensing can be set up as single or dual sensing in the base board; check the display if the base board is setup as single or dual sensing. To access the CB position sensing, go to: **Setup > Paralleling Setup > Basic > Utility Breaker Position Contacts**.
2. When the Utility Breaker Position contact is set to Single, the base board monitors current going through the Utility CB (Amps going through the CB means it is closed) and CB A position status to determine the position of the Utility CB. If there is a mismatch between the current-based breaker position and CB A position sensing, fault code 1455 will occur. Verify the connection at CB A (NO) status at TB10-3 and the Return at TB10-1, and ensure that an open/short circuit does not exist.

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3. If the CB position sensing is set up as dual, verify the connection at CB A (NO) status at TB10-3 and the Return at TB10-1 and also verify the connection at CB B (NC) status at TB10-4 and TB10-1 (Return). The input status at CB A (NO) and CB B (NC) should be opposite; one input will be open while the other is closed, if they are the same check the wiring between the Utility breaker and the CB status input on the base board. Ensure that the connections on the base board are correctly connected and that a short and/or open circuit does not exist. The physical connection to the base board should match the status of the CB position; go to: **Paralleling Status > Paralleling Status-PTC > Utility CB Position Status**, and ensure that the status of the CB position matches the connection.

C. Faulty Utility CB

1. Refer to the Utility CB Service Manual.

5.6.89 Fault Code 1456 - Bus Out Of Sync Range

The Synchronizer cannot be enabled because the Bus Voltage and/or Frequency are not within 60 – 110% of nominal.

A. System Bus Voltage Cables Are Incorrectly Wired or Open Circuit To The Paralleling Breaker

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Make sure that only personnel who are trained and qualified to work on this equipment are allowed to operate the generator set and perform maintenance on it.

1. The system bus has lost a phase, using a phase rotation meter or a synchronizing light; verify that the phase rotation of the system bus at the paralleling breaker is correct; in synchronization with the generator set phase rotation. For proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation check shows that a phase is missing, check for blown fuses, and an open circuit at the system bus voltage cables connected to the paralleling breaker.

B. System Bus Voltage Sensing Connections Are Incorrectly Wired At The Base Board

1. If the nominal voltage is 600 VAC or lower, ensure that the voltage sensing connections are correct.
   - Measure the phase rotation and voltage input into the base board from the System bus at: L1, TB7-1; L2, TB7-2; and L3, TB7-3. The voltage should match nominal voltage, and the phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation and/or voltage are not correct, re-check the wiring.
2. If the nominal voltage is over 600 VAC, check the voltage sensing connections from the base board to the PT and the PT to the System bus.
   - Measure the phase rotation and voltage input into the base board from the PT (Potential Transformer) at: L1, TB7-1; L2, TB7-2; and L3, TB7-3. The voltage should match nominal voltage, and the phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation and/or voltage are not correct, re-check the wiring from the base board to the PT.

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- Measure the phase rotation and voltage input into the TB8 - 5 and TB8 – 1

C. Faulty PT

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Make sure that only personnel who are trained and qualified to work on this equipment are allowed to operate the generator set and perform maintenance on it.

1. Ensure that the control is set up with the correct PT ratio (primary vs. secondary). Reference event/fault code 2816 for troubleshooting information on the PT ratio. To access the PT Ratio configuration menu on the operator panel go to **Setup > OEM Setup > OEM ALT Setup > PT Primary or PT Sec** and set the PT ratio appropriately for the application.
2. With a calibrated voltage meter, measure the voltage output of the PT. The output of the PT should match the ratio of the PT; ex. Outputs: L1=120, L2=120, L3=120. If the outputs of the PT are incorrect, replace the PT once the generator set has been properly grounded by a qualified electrician.

5.6.90 Fault Code 1457 - Fail To Synchronize

Synchronizer has not met the synch check conditions within the “Fail To Synchronize Time" parameter

A. Improper Adjustment of Bus or Generator Set Voltage

1. Ensure that that the base board is calibrated correctly by checking that the generator set is operating at proper voltage and frequency. With a calibrated Frequency and Voltage meter, measure the frequency and voltage output of the generator set at the alternator; while thru the display, ensuring that the base board is displaying the same voltage and frequency that is shown on the meter. (Go to the Servicing the Generator section in the manual)
2. Ensure that that the base board is calibrated correctly by checking the System bus voltage and frequency. With a calibrated Frequency and Voltage meter, measure the frequency and voltage of the System bus; while thru the display, ensuring that the base board is displaying the same voltage and frequency that is shown on the meter.

   To view and adjust the bus voltage, go to: **Setup > Calibration >** find **Genset Bus L12 Voltage Calibration, Genset Bus L23 Voltage Calibration**, and **Genset Bus L31 Voltage Calibration**, and if appropriate, change the Bus Voltage to reflect the voltage shown on the meter.

   To view and adjust the generator set frequency, go to: **Setup > Adjust > Frequency Adjust** and if appropriate, adjust the generator set frequency to reflect the frequency shown on the bus meter.

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B. Faulty PT

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Make sure that only personnel who are trained and qualified to work on this equipment are allowed to operate the generator set and perform maintenance on it.

1. Ensure that the control is set up with the correct PT ratio (primary vs. secondary). Reference event/fault code 2816 for troubleshooting information on the PT ratio. To access the PT Ratio configuration menu on the operator panel go to **Setup > OEM Setup > OEM ALT Setup > PT Primary or PT Sec** and set the PT ratio appropriately for the application.
2. With a calibrated voltage meter, measure the voltage output of the PT. The output of the PT should match the ratio of the PT; ex. Outputs: L1=120, L2=120, L3=120. If the outputs of the PT are incorrect, replace the PT once the generator set has been properly grounded by a qualified electrician.

C. Permissive Window Parameters are Set Too Tight

1. The synch check function monitors the generator set and bus voltage, frequency, and phase rotation, to determine whether the two sources can be paralleled. The difference in voltage, frequency, and phase rotation between the generator set and system bus must be smaller than the Permissive parameter windows. Set the following parameters appropriately for the application:
   - Permissive Frequency Window
   - Permissive Voltage Window
   - Permissive Window Time
   - Permissive Phase Window

   To access the Permissive Parameters Window setup menu from the display, refer to the parameter section for the default value, and limits.
2. Synchronizer has failed to synchronize the Generator set to the System bus within the “Fail To Synchronize Time" parameter. To increase the “Fail To Synchronize Time" parameter from the display, go to: Setup > Paralleling Setup > Basic > Sync Time and change the “Fail To Synchronize Time" parameter of the control appropriately. Refer to the parameter section for the default value, and limits.

5.6.91 Fault Code 1458 - Sync Ph Rot Mismatch

Mismatch in phase rotation between the generator set output and the system bus.

A. Generator Set Or System Bus Voltage Cables Are Incorrectly Wired To The Paralleling Breaker

1. If the nominal voltage is over 600 VAC, check the voltage sensing connections from the base board to the PT and the PT to the System bus.

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⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Make sure that only personnel who are trained and qualified to work on this equipment are allowed to operate the generator set and perform maintenance on it.

- Measure the phase rotation at the input of the PT (Potential Transformer) from the system bus. The phase rotation at the input of the PT should match the phase rotation at the input of the base board. The phase rotation (“L1 – L2 –L3") at the input of the PT should be the same as the phase rotation at the input of the base board at L1, TB7-1; L2, TB7-2; L3, TB7-3; if the phase rotation does not match, correct the wiring from the System bus to the PT and/or from the PT the base board.
- Measure the phase rotation at the input of the PT (Potential Transformer) from the generator set. The phase rotation at the input of the PT should match the phase rotation at the input of the base board. The phase rotation (“L1 – L2 –L3") at the input of the PT should be the same as the phase rotation at the input of the base board at J22-1; L2, J22-2; L3, J22-3; if the phase rotation does not match, correct the wiring from the Generator set to the PT and/or from the PT the base board.

B. Generator Set or System Bus Voltage Sensing Connections Are Incorrectly Wired at The Control Board

Mismatch in phase rotation between the generator set output and the system bus.

1. If the nominal voltage is 600 VAC or lower, ensure that the voltage sensing connections are correct.
   - Measure the phase rotation at base board from the system bus at: L1, TB7-1; L2, TB7-2; L3, TB7-3. The phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation is not correct, re-check the wiring.
   - Measure the phase rotation at base board from the Generator set at: L1, J22-1; L2, J22-2; L3, J22-3. The phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation is not correct, re-check the wiring.
2. If the nominal voltage is over 600 VAC, check the voltage sensing connections from the control board to the PT and the PT to the System bus.

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Make sure that only personnel who are trained and qualified to work on this equipment are allowed to operate the generator set and perform maintenance on it.

- Measure the phase rotation at the input of the PT (Potential Transformer) from the system bus. The phase rotation at the input of the PT should match the phase rotation at the input of the control board. The phase rotation (“L1 - L2 - L3") at the input of the PT should be the same as the phase rotation at the input of the control board at L1, TB7-1; L2, TB7-2; L3, TB7-3. If the phase rotation does not match, correct the writing from the System bus to the PT and/or from the PT to the control board.

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- Measure the phase rotation at the input of the PT (Potential Transformer) from the generator set. The phase rotation at the input of the PT should match the phase rotation at the input of the control board. The phase rotation (“L1 – L2 –L3") at the input of the PT should be the same as the phase rotation at the input of the control board at J22-1; L2, J22-2; L3, J22-3; if the phase rotation does not match, correct the wiring from the Generator set to the PT and/or from the PT the control board.

5.6.92 Fault Code 1459 - Reverse Power

The “Reverse KW threshold" has been exceeded for the time that is registered in the “Reverse KW time delay" setting.

A. Check Fault Simulation

- Check with InPower
  1. Connect InPower.
  2. Verify that the fault simulation for this fault is disabled.
- Check without Inpower
  1. Enage the Emergency Stop button and wait 30 seconds.
  2. Disconnect or disable the battery charger.
  3. Disconnect the battery (disconnect negative cable first).
  4. Leave the controller without power for one minute.
  5. Do the next steps in the order shown.
     a. Reconnect the battery.
     b. Connect or enable the battery charger.
     c. Disengage out the E-Stop button.
     d. Reset the control.

B. Check Voltage Sensing Inputs

1. Ensure all values are within the acceptable range.
2. If using a PT, also check the inputs and outputs of the PT.

TABLE 41. ACCEPTABLE VALUES

Check	Acceptable Value
Sensor gap	Refer to the appropriate engine service manual.
Phases: L1-L2 L2-L3 L3-L1	120°
Utility voltage sensing locations: L1: TB7-1 L2: TB7-2 L3: TB7-3	No open circuits Correct voltage Correct phase angle

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Check	Acceptable Value
Generator set voltage sensing locations: L1: J22-1 L2: J22-2 L3: J22-3	No open circuits Voltage should be equal to nominal voltage Correct phase angle Phase rotation: L1 - L2 - L3
Phase rotation and voltage into the base board from the utility bus: L1: TB7-1 L2: TB7-2 L3: TB7-3	Voltage should be equal to nominal voltage Phase rotation: L1 - L2 - L3
Phase rotation and voltage into the base board from the potential transformer: L1: TB7-1 L2: TB7-2 L3: TB7-3 L4: TB7-4	Voltage should be equal to nominal voltage Phase rotation: L1 - L2 - L3
Phase rotation and voltage into the potential transformer from the utility bus:	Voltage should be equal to nominal voltage Phase rotation: L1 - L2 - L3
Phase rotation and voltage into the base board from the generator set: L1: J22-1 L2: J22-2 L3: J22-3	Voltage should be equal to nominal voltage Phase rotation: L1 - L2 - L3
Phase rotation and voltage into the base board from the potential transformer: L1: J22-1 L2: J22-2 L3: J22-3 L4: J22-4	Voltage should be equal to nominal voltage Phase rotation: L1 - L2 - L3
Phase rotation and voltage into the potential transformer from the generator set:	Voltage should be equal to generator set voltage Phase rotation: L1 - L2 - L3

C. Check Alternator Output Frequency

If the engine starts and idles, and does not display a fault, there may be a frequency mismatch.

1. Use a digital multimeter to measure generator output frequency. with a digital multimeter and compare to the frequency on the PCC display
2. Compare to the measured frequency to the frequency shown on the PCC display.
3. If the frequency does not match, multiply the value by 30 and compare this number to the RPM value on the PCC display.
4. If the RPM values are not the same, inspect the crankshaft position sensor and harness as in previous steps.

D. Check Air Intake

1. Inspect air filter for dirt or other obstructions. Replace air filter as needed.

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2. Inspect air intake tract for dirt or other obstructions. Clean and remove obstructions as necessary.

E. Check Output Leads

1. Check output lead connections.
   - Inspect alternator and the output leads.
   - Check for a short circuit from post to post.

F. CTs are Incorrectly Connected or Installed

1. If event/fault code 1459 becomes active as soon as the generator set picks up load, check the generator set operator panel under the **Alternator Data** menu and view the **L1 KW, L2 KW, and L3 KW** parameters when the generator set picks up load (right before the generator set shuts down). If L1 KW, L2 KW, or L3 KW is a negative value, it is likely that the CT connected to the negative KW value has an incorrect orientation or is connected backwards. Verify the CT orientation and CT wiring at L1: J12-1 and J12-4, L2: J12-2 and J12-5, L3: J12-3 and J12-6, correct if miswired.

G. kW load Share Lines

1. Make sure the kW load share lines are wired correctly.

   Negative: TB9-7 to TB9-7

   Positive: TB9-8 to TB9-8

   Shield: TB9-9 to TB9-9

2. Disconnect the kW load share lines wires, including the shield. Check the continuity of each kW load share line. The resistance should be less than 10 ohms.

5.6.93 Fault Code 1461 - Loss of Field

The “Reverse KVAR threshold" has been exceeded for the time that is registered in the “Reverse KVAR time delay" setting.

A. Improper Voltage Calibration Of The Generator Set

1. If the generator set is not operating in droop paralleling mode, go to the Load Sharing Lines Incorrectly Connected step.
2. Using a volt-meter, measure the AC voltage of the Electric Bus that the generator set is paralleled to (voltage of the Genset Bus or the Utility). Then measure the output voltage of the generator set and ensure that the generator set output voltage is +3 VAC/-0 VAC that of the source which the generator set is paralleled to. Event/fault code 1461 is a result of the generator set not matching or exceeding the voltage of the electric bus, which causes the generator set to import current from the electric bus (Reverse KVAR).

   To access the voltage calibration configuration menu on the display, go to: **Setup > Adjust > Voltage Adjust** and increase the generator set output voltage.

B. Load Sharing Lines Incorrectly Connected

1. Ensure that the orientation of the load sharing connections is correct, and that the shield is only grounded at one point. Check for damaged or disconnected wires at TB9-8, KW+ ; TB9-7, KW- ; TB9-10, KVAR+ ; TB9-11, KVAR- ; TB9-9, Shield (shield should be grounded at only one generator set). Correct connections if faulty.

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C. Improperly Set Leading Power Factor

1. If loss of excitation occurs when the generator set is lightly loaded, a leading power factor may be the cause. Leading Power factor can be caused by operation of filters and power factor correction capacitors when the KW load level on the generator set is low. Motors, Uninterruptible Power Supply (UPS), Variable Frequency Drive (VFD), Medical Diagnostic Imagining Equipment, Fire Pumps and certain types of lighting have a considerable and different influence on a generator and can also cause a leading power factor. Leading power factor loads can cause the generator set to lose control of the output voltage of the generator set. To access the Power Factor menu on the operator panel, go to **Alternator Data** and view the value of L1 PF, L2 PF, L3 PF, and Total PF, right before the generator set shuts down on event/fault code 1461. Revisit the generator set sizing process if the power factor is leading to ensure that the generator set is correctly sized for the application, especially if new loads have been introduced into the system (reference the T-030 manual).

NOTICE
Increasing the KVAR threshold or time delay may have adverse effects on the alternator. Always check the capability of the alternator.

D. kVAR Load Share Lines

1. Make sure the kVAR load share lines are wired correctly.

   Negative: TB9-11 to TB9-11

   Shield: TB9-9 to TB9-9

   Positive: TB9-10 to TB9-10

2. Disconnect the kVAR load share lines wires, including the shield. Check the continuity of the each kVAR load share line. The resistance should be less than 10 ohms.

5.6.94 Fault Code 1463 - Not In Auto

This is an event. No action required.

5.6.95 Fault Code 1464 - Load Dump

If the "Load Dump" parameter is enabled and the generator set KW output exceeds the "Overload Threshold" for the "Overload Set Time" or the output frequency of the generator set drops below the "Under-frequency Offset" for the "Under-frequency Set Time"; the generator set will dump its electrical load.

A. Active Fault Code Is Set To Derate

1. Event/fault code 1464 can be activated as a result of another active fault that is set to "Derate". Troubleshoot the other active fault(s) that are set to Derate.

B. The Under-frequency Offset Is Set To Low

1. To access the Under-frequency Offset configuration menu on the operator panel go to **Setup > Genset Setup** and set the "Under-frequency Offset" parameter appropriately for the application. Refer to the parameter list to see the default value for "Under-frequency Offset".

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C. The Overload Set Time or Under-frequency Set Time Is Set Too Low

1. To access the "Overload Set Time" and "Under-frequency Set Time" configuration menu on the operator panel go to **Setup > Genset Setup** and set the "Overload Set Time" and "Under-frequency Set Time" Parameters appropriately for the application. Refer to the parameter list to see the default values for "Overload Set Time" and "Under-frequency Set Time".

D. Incorrect CTs or CT Connections

1. Check the CTs, CT Connections, and CT ratio. For installation instructions, refer to the section on Current Transformer Installation or reference event/fault code 2814 and event/fault code 2815.

5.6.96 Fault Code 1465 - Ready to Load

This is an event. No action required.

5.6.97 Fault Code 1469 - Speed/Hz Mismatch

Engine speed and generator set output frequency do not match.

A. Check Engine Speed Data

1. Connect to the ECM with INSITE.
2. Verify proper operating RPM; 1500 for 50Hz or 1800 for 60Hz.
3. Compare with reading on PCC display and InPower.

B. Check Alternator Output Frequency

If the engine starts and idles, and does not display a fault, there may be a frequency mismatch.

1. Use a digital multimeter to measure generator output frequency. with a digital multimeter and compare to the frequency on the PCC display
2. Compare to the measured frequency to the frequency shown on the PCC display.
3. If the frequency does not match, multiply the value by 30 and compare this number to the RPM value on the PCC display.
4. If the RPM values are not the same, inspect the crankshaft position sensor and harness as in previous steps.

C. Check Customer Loads

1. Shutdown or disconnect the customer loads individually.
2. Open main generator breaker.
3. Start the generator set, verify if the fault reappears
4. Verify if the fault reappears.
5. Close main generator breaker.
6. If generator set is stable, add each load individually until either the unit shuts down or all loads are connected.
7. If unit shuts down, have the suspect customer load investigated.

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D. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 42. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Engine Overspeed Sensor	**Setup > OEM Setup > OEM Engine Setup > HMECM > Overspeed**	Refer to the appropriate engine service manual.
Fault Simulation	**Test > Protection Verification > Speed override for HM Genset**	Enabled/Disabled
Fuel Type	**Setup > OEM Setup > OEM Engine Setup > HMECMàFuel System**	Fuel source setting should match the fuel type being used by the generator set.

E. Verify Alternator

1. Use the system record to verify whether the unit has had an alternator/stator replacement.
2. Use generator Bill Of Materials to verify alternator/stator part number is correct.

F. Check the Sensor

Check the sensor to make sure it adheres to the following acceptable values.

TABLE 43. ACCEPTABLE VALUES

Check	Acceptable Values
Supply voltage	4.75 to 5.25 VDC
Signal (sense) voltage	0.46 to 4.56 V
Switch	Normally open/closed
Sensor resistance	Refer to the appropriate engine service manual.
Service tool reading vs. sensor reading	If the two are reasonably close, the sensor is functioning properly.
Sensor gap	Refer to the appropriate engine service manual.

G. Check the Harnesses

1. Check the harnesses and connections points for:
   - Corroded pins
   - Bent or broken pins
   - Pushed back or expanded pins
   - Evidence of moisture in or on the connector
   - Missing or damaged connector seals

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- Dirt or debris in or on the connector pin

2. Check the pin-to-pin connections. If no short or open circuit is found, check all connections to the pins.

5.6.98 Fault Code 1471 - High AC Current (Warning)

The generator output current has exceeded at least 110% of rated current for greater than 60 seconds.

A. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 44. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Overload Threshold	**Setup->Genset Setup**	Default value is 105%
High AC Voltage Trip	**Setup > OEM Setup > OEM ALT Setup > High AC Voltage**	Default = “Inverse Time”
High AC Voltage Threshold	**Setup > OEM Setup > OEM ALT Setup > High AC Voltage Threshold**	Default = 110%
High AC Voltage Fault Simulation	**Tests > Protection Verification > Alternator Protection > Overvoltage**	Disabled
Current Transformer Ratio	**Setup > OEM Setup > OEM Alt Setup > Genset CT Ratio**	Set appropriately for the application. Use the CT ratio calculator in InPower to determine the correct CT ratio

B. Check Load and Load Cables

1. An overload condition has occurred. With the generator set being turned off, visually inspect the load and load cables for damage and/or short circuit. Repair if necessary.
2. Make sure that new loads have not been added to the generator set. Revisit the generator set sizing process to make sure that the generator set is correctly sized for the application (reference the T-030 manual).

C. Incorrect CT Ratio Setup Or Feature Code

1. The control uses voltage, kW, and the CT ratio in order to determine if the CT ratio is correct for the operation of the generator set. Use the CT ratio calculator in InPower to determine the correct CT ratio for this generator set. Then enter the correct CT ratio via InPower or through the operator panel. To access the Genset CT ratio configuration menu on the operator panel, go to **Setup > OEM Setup > OEM Alt Setup > Genset CT Ratio** and set the “Genset CT Ratio primary" and “Genset CT Ratio secondary" parameters appropriately for the application.

D. The CTs Are Incorrectly Sized

1. Change the CTs to the correct size.

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E. Incorrect Voltage Or kW Rating Setup

1. The PCC uses voltage, kW, and the CT ratio in order to determine if the CT ratio is correct for the operation of the generator set. If the voltage or kW setup is incorrect, event/fault code 2814 can become active. Use the CT calculator in InPower to determine the correct voltage and kW rating for this generator set. To access the generator set voltage and kW rating setup on the Operator Panel, go to **Setup > OEM Setup > OEM Alt Setup > Genset Nominal Voltage** and **Setup > OEM Setup > OEM Genset Setup** and set the parameters appropriately for the application.

5.6.99 Fault Code 1472 - High AC Current (Shutdown)

The generator output current has exceeded at least 150% of rated current.

A. Check Load and Load Cables

1. An overload condition has occurred. With the generator set being turned off, visually inspect the load and load cables for damage and/or short circuit. Repair if necessary.
2. Make sure that new loads have not been added to the generator set. Revisit the generator set sizing process to make sure that the generator set is correctly sized for the application (reference the T-030 manual).

B. Incorrect CT Ratio Setup Or Feature Code

1. The control uses voltage, kW, and the CT ratio in order to determine if the CT ratio is correct for the operation of the generator set. Use the CT ratio calculator in InPower to determine the correct CT ratio for this generator set. Then enter the correct CT ratio via InPower or through the operator panel. To access the Genset CT ratio configuration menu on the operator panel, go to **Setup > OEM Setup > OEM Alt Setup > Genset CT Ratio** and set the “Genset CT Ratio primary" and “Genset CT Ratio secondary" parameters appropriately for the application.

C. The CTs Are Incorrectly Sized

1. Change the CTs to the correct size.

D. Incorrect Voltage Or kW Rating Setup

1. The PCC uses voltage, kW, and the CT ratio in order to determine if the CT ratio is correct for the operation of the generator set. If the voltage or kW setup is incorrect, event/fault code 2814 can become active. Use the CT calculator in InPower to determine the correct voltage and kW rating for this generator set. To access the generator set voltage and kW rating setup on the Operator Panel, go to **Setup > OEM Setup > OEM Alt Setup > Genset Nominal Voltage** and **Setup > OEM Setup > OEM Genset Setup** and set the parameters appropriately for the application.

5.6.100 Fault Code 1475 - First Start Backup Fail

Generator set has not received permission to close the Genset CB to a dead bus from the First Start Input within the “First Start Back up time" parameter.

A. Wiring Issue At the First Start Arbitration Input

1. The First Start Arbitration input is incorrectly wired between generator sets or an open circuit exists at the First Start Arbitration input. Check the wiring at TB3-11 (First Start Arbitration) and TB3-12 (Return) between this and all generator sets that are interconnected, and ensure that the wiring is correct.

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5.6.101 Fault Code 1483 - Common Alarm

The control has detected a warning fault and/or shutdown fault.

A. A Warning Fault and/or Shutdown Fault is Active

1. This fault is activated as a result of another warning or shutdown fault. Troubleshoot the other fault(s) that are causing the generator set to generate this event/fault code.

5.6.102 Fault Code 1540 - Common Warning

The control has detected a warning fault.

A. Active Warning Fault

1. This fault is activated as a result of another warning fault. Troubleshoot the other warning fault(s) that are causing the generator set to generate a warning fault.

5.6.103 Fault Code 1541 - Common Shutdown

The control has detected a shutdown fault.

A. Active Shutdown Fault

1. This fault is activated as a result of another shutdown fault. Troubleshoot the other shutdown fault(s) that are causing the generator set to shut down.

5.6.104 Fault Code 1573 - Config Input #1 Fault

Configurable input #1 fault is active.

A. Condition for Which Configurable Input #1 is Configured for Service

1. Check the condition for which "Configurable Input #1" has been configured; ex. if "Configurable Input #1" was configured to become active when the fuel level is low, check the fuel level and add fuel if needed. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to the next step.

B. Configurable Input #1 Active State Selection Parameter is Configured Incorrectly.

1. With InPower or through the operator panel check the switch input setting (active closed or active open) for Configurable Input #1. Ensure that the switch input setting is correctly set. If "Configurable Input #1 Input Function Pointer" parameter is set to default and if "Configurable Input #1 Active State Selection" parameter is set to "active closed", input 1 (event/fault code 1573) will become active when TB1-12 (input 1) and TB1-13 (ground) are connected (shorted) together.

   If "Configurable Input #1 Input Function Pointer" parameter is set to default and if "Configurable Input #1 Active State Selection" parameter is set to "active open", input 1 (event/fault code 1573) will become active when there is an open circuit between TB1-12 (input 1) and TB1-13 (ground).

   To access the input configuration on the operator panel go to **Setup > Configurable I/O > Config Input #1 Menu > Active** and set this parameter appropriately for the application.

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C. Incorrectly Wired; or Open Circuit or Short Circuit in the Wiring

1. Check the wiring at TB1-12 (input 1) and TB1-13 (ground) for an open circuit, short circuit, or a miswired condition.

5.6.105 Fault Code 1596 – Aux Temp 1 Sensor OOR Low

Auxilary temperature 1 sensor is below normal operating voltage.

Refer to the engine service manual for troubleshooting.

5.6.106 Fault Code 1689 - Reset Real Time Clock

Power to the Real Time Clock (RTC) chip on the base board has been lost and the clock is no longer accurate.

A. Battery Power Has Been Lost

1. The RTC chip requires little, but constant, power to keep the control's internal clock accurate. It has an internal capacitor that keeps the RTC operating for up to 1 hour when the battery is disconnected or dead. If battery power is lost for over 1 hour, the RTC will stop functioning. When battery power is supplied to the control again, the control will display event/fault code 1689, because the RTC is no longer accurate. If the fault clears after being acknowledged, then the control is OK. To set the real time clock, on the operator panel go to **Setup > Clock Setup** and set the RTC clock appropriately.

5.6.107 Fault Code 1847 - Engine Coolant Temperature High (Shutdown with Cooldown)

Exhaust gas temperature sensor signal is out of range – shorted high.

Possible Causes:

1. Inaccurate engine temperature sensor
2. Fault simulation feature is enabled
3. Threshold setting too low

A. Fault Simulation Feature Is Enabled

1. Connect InPower.
2. Verify that the fault simulation is not enabled for the engine speed sensor by connecting to the PCC via InPower.
3. If the fault simulation is disabled, there is no problem.

B. Threshold Setting Too Low

1. Use the service tool to connect to the engine ECM and verify fault threshold settings for the sensor and compare to the specifications called out in the engine manual.
2. Verify ECM and PCC calibration number and revision is correct.
3. Recalibrate the engine ECM to reset the threshold settings.

5.6.108 Fault Code 1853 - Annunciator Input 1 Fault

Customer fault 1 (input 1, LED 1) on the Universal Annunciator is active.

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A. Condition for which Annunciator Input #1 is Configured for is Active

Check the condition for which "Annunciator Input #1" has been configured for; ex. if "Annunciator Input #1" was configured to become active when the fuel level is low, check the fuel level and add fuel if needed. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to next step.

B. Incorrectly Configured or Wiring Issue

1. Customer input 1 on the Universal Annunciator can be configured to conform to different applications. Below are two configurations that have an impact on how input 1 becomes active.

TABLE 45. CONTROL SETTINGS

Configurable Parameter	Option 1 (Default)	Option 2
Negative or Positive Input 1 Activation	Negative Input (ground input)	Positive Input (B+ input)
Inverting Active Hardware Signals	Do Not Invert	Invert

Negative or positive Input 1 activation: Allows the user to activate with a negative (ground) or positive (B+) input; the default setting is a negative (ground) input.

Inverting active hardware signals: Input 1 has the capability to be inverted. If annunciator input 1 is set to inverted, then an active hardware signal will be considered inactive and an inactive signal will be considered active, default is set to non-inverted.

When set to default, event/fault code 1853 (customer input 1) becomes active when there is a ground input at TB1-1 on the back of the Universal Annunciator.

Ensure that the Universal Annunciator is correctly configured; for setup and configuration instructions, refer to the Universal Annunciator operator's manual (P/N 0900-0301).

2. Check the wiring at TB1-1 and ensure that customer input 1 is not wired incorrectly. Depending on the configuration of the annunciator in step 1, ensure that there is not a short or open circuit at the TB1-1 connection.
3. Check the sender, relay, or device that is activating Input 1 on the Universal Annunciator, replace if faulty.

C. Faulty Annunciator

If the wiring and configuration is satisfactory, replace the Universal Annunciator.

5.6.109 Fault Code 1854 - Annunciator Input 2 Fault

Customer fault 2 (input 2, LED 2) on the Universal Annunciator is active.

A. Condition for which Annunciator Input #2 is Configured for is Active

Check the condition for which "Annunciator Input #2" has been configured for; ex. if "Annunciator Input #2" was configured to become active when the fuel level is low, check the fuel level and add fuel if needed. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to next step.

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B. Incorrectly Configured or Wiring Issue

1. Customer input 2 on the Universal Annunciator can be configured to conform to different applications. Below are two configurations that have an impact on how input 2 becomes active.

TABLE 46. CONTROL SETTINGS

Configurable Parameter	Option 1 (Default)	Option 2
Negative or Positive Input 2 Activation	Negative Input (ground input)	Positive Input (B+ input)
Inverting Active Hardware Signals	Do Not Invert	Invert

Negative or positive Input 2 activation: Allows the user to activate with a negative (ground) or positive (B+) input; the default setting is a negative (ground) input.

Inverting active hardware signals: Input 2 has the capability to be inverted. If annunciator input 2 is set to inverted, then an active hardware signal will be considered inactive and an inactive signal will be considered active, default is set to non-inverted.

When set to default, event/fault code 1854 (customer input 2) becomes active when there is a ground input at TB1-2 on the back of the Universal Annunciator.

Ensure that the Universal Annunciator is correctly configured; for setup and configuration instructions, refer to the Universal Annunciator operator's manual (P/N 0900-0301).

2. Check the wiring at TB1-2 and ensure that customer input 2 is not wired incorrectly. Depending on the configuration of the annunciator in step 1, ensure that there is not a short or open circuit at the TB1-2 connection.
3. Check the sender, relay, or device that is activating Input 2 on the Universal Annunciator, replace if faulty.

C. Faulty Annunciator

If the wiring and configuration is satisfactory, replace the Universal Annunciator.

5.6.110 Fault Code 1855 - Annunciator Input 3 Fault

Customer fault 3 (input 3, LED 3) on the Universal Annunciator is active.

A. Condition for which Annunciator Input #3 is Configured for is Active

Check the condition for which "Annunciator Input #3" has been configured for; ex. if "Annunciator Input #3" was configured to become active when the fuel level is low, check the fuel level and add fuel if needed. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to next step.

B. Incorrectly Configured or Wiring Issue

1. Customer input 3 on the Universal Annunciator can be configured to conform to different applications. Below are two configurations that have an impact on how input 3 becomes active.

TABLE 47. CONTROL SETTINGS

Configurable Parameter	Option 1 (Default)	Option 2
Negative or Positive Input 3 Activation	Negative Input (ground input)	Positive Input (B+ input)

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Configurable Parameter	Option 1 (Default)	Option 2
Inverting Active Hardware Signals	Do Not Invert	Invert

Negative or positive Input 3 activation: Allows the user to activate with a negative (ground) or positive (B+) input; the default setting is a negative (ground) input.

Inverting active hardware signals: Input 3 has the capability to be inverted. If annunciator input 3 is set to inverted, then an active hardware signal will be considered inactive and an inactive signal will be considered active, default is set to non-inverted.

When set to default, event/fault code 1855 (customer input 3) becomes active when there is a ground input at TB1-3 on the back of the Universal Annunciator.

Ensure that the Universal Annunciator is correctly configured; for setup and configuration instructions, refer to the Universal Annunciator operator's manual (P/N 0900-0301).

2. Check the wiring at TB1-3 and ensure that customer input 3 is not wired incorrectly. Depending on the configuration of the annunciator in step 1, ensure that there is not a short or open circuit at the TB1-3 connection.
3. Check the sender, relay, or device that is activating Input 3 on the Universal Annunciator, replace if faulty.

C. Faulty Annunciator

If the wiring and configuration is satisfactory, replace the Universal Annunciator.

5.6.111 Fault Code 1912 - Utility Loss Of Phase

In Power Transfer Control (PTC) Operation, if the phase angle between phases drops below 90 degrees or exceeds 150 degrees, for the “Utility Loss of Phase Drop-Out Delay" time parameter, fault code 1912 will become active.

A. Open Circuit At The Utility Voltage Sensing Inputs

1. The phase angle between phases L1-L2, L2-L3, and L3-L1 should be 120 degrees. At least one connection point that is used to calculate phase angle has been lost. Check the voltage sensing connections at L1: TB7-1; L2: TB7-2, L3: TB7-3 for an open circuit, and ensure that voltage and phase angle is correct. If using a PT also check the inputs and outputs of the PT.

B. Utility Voltage or Frequency is Unstable

1. Check with your utility company.

5.6.112 Fault Code 1913 - Genset Loss Of Phase

In Power Transfer Control (PTC) Operation, if the phase angle between phases drops below 90 degrees or exceeds 150 degrees, for the “Genset Loss of Phase Drop-Out Delay" time parameter, fault code 1913 will become active.

A. Correct Any Active Generator Set Faults

1. Correct any active generator set faults on the display, especially faults that might cause the engine to hunt/oscillate.

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B. Open circuit at the generator set voltage sensing inputs

1. The phase angle between phases L1-L2, L2-L3, and L3-L1 should be 120 degrees. At least one connection point that is used to calculate phase angle has been lost. Check the voltage sensing connections at L1, J22-1; L2, J22-2; L3, J22-3 for an open circuit, and ensure that voltage and phase angle is correct. If using a PT, also check the inputs and outputs of the PT.

5.6.113 Fault Code 1914 - Utility Ph Rotation Error

Utility Phase rotation is incorrect.

A. Utility Voltage Sensing Connections are Incorrectly Wired at the Base Board

1. If the nominal voltage is 600 VAC or lower, ensure that the voltage sensing connections are correct.
   - Measure the phase rotation and voltage input into the base board from the Utility bus at: L1, TB7-1; L2, TB7-2; L3, TB7-3. The voltage should match nominal voltage, and the phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation and/or voltage are not correct, re-check the wiring.
2. If the nominal voltage is over 600 VAC, measure the voltage sensing connections from the base board to the PT and the PT to the Utility bus.

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Make sure that only personnel who are trained and qualified to work on this equipment are allowed to operate the generator set and perform maintenance on it.

- Measure the phase rotation and voltage input into the base board from the PT (Potential Transformer) at: L1, TB7-1; L2, TB7-2; L3, TB7-3, L4, TB7-4. The voltage should match nominal voltage, and the phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation and/or voltage are not correct, re-check the wiring from the base board to the PT and correct if necessary.
- Measure the phase rotation and voltage input into the PT (Potential Transformer) from the Utility bus. The voltage into the PT should match the Utility bus voltage, and the phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation and/or voltage are not correct, re-check the wiring from the PT to the Utility bus and correct if necessary.

5.6.114 Fault Code 1915 - Genset Phase Rotation

Generator set phase rotation is incorrect.

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A. Genset Voltage Sensing Connections are Incorrectly Wired at the Base Board

1. If the nominal voltage is 600 VAC or lower, ensure that the voltage sensing connections are correct.
   - Measure the phase rotation and voltage input into the base board from the Generator set at: L1, J22-1; L2, J22-2; L3, J22-3. The voltage should match nominal voltage, and the phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation and/or voltage are not correct, re-check the wiring.
2. If the nominal voltage is over 600 VAC, measure the voltage sensing connections from the base board to the PT and the PT to the Generator set.

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Make sure that only personnel who are trained and qualified to work on this equipment are allowed to operate the generator set and perform maintenance on it.

- Measure the phase rotation and voltage input into the base board from the PT (Potential Transformer) at: L1, J22-1; L2, J22-2; L3, J22-3. The voltage should match nominal voltage, and the phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation and/or voltage are not correct, re-check the wiring from the base board to the PT and correct if necessary.
- Measure the phase rotation and voltage input into the PT (Potential Transformer) from the Generator set. The voltage into the PT should match the Generator set voltage, and the phase rotation should be “L1 – L2 –L3", for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation and/or voltage are not correct, re-check the wiring from the PT to the Generator set and correct if necessary.

5.6.115 Fault Code 1916 – Sync Check OK

Generator set has compared Generator output voltage to system bus voltage. “Permissive Close Allowed” should be “Allowed”.

This is an event. No action required.

5.6.116 Fault Code 1917 – Fuel Level High

This fault occurs if the Input voltage coming in from the customer supplied fuel level sensor has indicated a high fuel level condition.

A. Check Fuel Level

Check fuel level in customer supplied fuel tank.

- If fuel level is high, troubleshoot and repair as necessary.
- If fuel level is within an acceptable range, troubleshoot the customer supplied sensor and connections to the AUX 101-0 or AUX 101-1.

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B. Verify Customer Input Settings

Verify the customer input settings are correct for the application.

- If the High Fuel Level input is not applicable, ensure the feature is not enabled in the control using InPower service tool.

C. Check the Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the output from the sensor
    - If the readings mismatch, troubleshoot the harness.
    - If the readings match, check the sensor calibration

D. Check Control Settings

1. Use InPower to check the trim values for the Fuel Level sensor OOR High Limit and Fuel Level Sensor Time delay (**Setup > Genset Setup**).
2. Troubleshoot the AUX 101.

5.6.117 Fault Code 1918 – Fuel Level Low

This fault occurs if the Input voltage coming in from the customer supplied fuel level sensor has indicated a low fuel level condition.

A. Check Fuel Level

Check fuel level in customer supplied fuel tank.

- If fuel level is low, troubleshoot and repair as necessary.
- If fuel level is within an acceptable range, troubleshoot the customer supplied sensor and connections to the AUX 101-0 or AUX 101-1.

B. Verify Customer Input Settings

Verify the customer input settings are correct for the application.

- If the Low Fuel Level input is not applicable, ensure the feature is not enabled in the control using InPower service tool.

C. Check the Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the output from the sensor
    - If the readings mismatch, troubleshoot the harness.
    - If the readings match, check the sensor calibration

D. Check Control Settings

1. Use InPower to check the trim values for the Fuel Level sensor OOR Low Limit and Fuel Level Sensor Time delay (**Setup > Genset Setup**).
2. Troubleshoot the AUX 101.

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5.6.118 Fault Code 1944 – HMI 113 Out Config Error

PCCNet Annunciator (HMI 113) output relays are being activated by more than one source.

A. Check PCCNet Annunciator Connections

Only one control system through the PCCNet should be connected to the HMI113 / Annunciator.

- Make sure that multiple controls are not connected to a single annunciator.

B. Replace Annunciator

If the previous steps are satisfactory, then replace the annunciator.

5.6.119 Fault Code 1992 - Engine Crankshaft Speed Above Rated Speed (Warning)

Engine speed signals indicate an engine speed 15% greater than rated.

A. Fault Simulation Feature Is Enabled

1. Connect InPower.
2. Verify that the fault simulation is not enabled for the engine speed sensor by connecting to the PCC via InPower.
3. If the fault simulation is disabled, there is no problem.

B. Incorrect Threshold Setting

1. Connect to the engine ECM using the service tool. Verify fault threshold settings and compare them to the specifications in the engine manual.
2. Verify that the calibration numbers and revisions are correct for the ECM and PCC.
3. Recalibrate the engine ECM to reset the threshold settings.

C. Incorrect Fuel Type Setting

1. Connect InPower
2. Verify the fuel source set with InPower is the same fuel used by the generator.

D. Faulty Engine Speed Sensor Connections

1. Inspect the engine speed sensor and the harness connector pins.
2. Disconnect the engine harness connector from the engine speed sensor.
3. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
4. Inspect for evidence of moisture in or on the connector.
5. Inspect for missing or damaged connector seals.
6. Inspect for dirt or debris in or on the connector pins.

E. Faulty Engine Harness - General

1. Inspect the engine harness and the connector pins.
    a. Disconnect the engine harness connector from the extension harness.

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b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.

c. Inspect for evidence of moisture in or on the connector.

d. Inspect for missing or damaged connector seals.

e. Inspect for dirt or debris in or on the connector pin.

f. Disconnect harness from ECM and sensor.

g. Measure the resistance in each pin from ECM to sensor. Resistance should be 5 ohms or less.

h. Repair or replace harness as necessary.

F. Faulty Engine Speed Position Sensor

1. Inspect the engine speed sensor.
2. Disconnect the engine speed/position sensor from the engine and engine harness.
3. Inspect sensor for bent, corroded or loose pins.
4. Inspect the sensor for structural deficiencies.
5. Check the crankshaft speed sensor supply voltage.
6. Disconnect the engine harness connector from the crankshaft speed sensor.
7. Install the speed sensor breakout cable between the sensor and the sensor harness connector.
8. Measure the supply voltage by connecting the breakout cable's supply and return connectors to the multimeter. If the reading is between 4.75 and 5.25 VDC, then the supply voltage is correct.
9. Check the crankshaft speed sensor signal (sense) voltage.
10. Disconnect the engine harness connector from the camshaft position sensor.
11. Install the speed/position sensor breakout cable between the sensor and the sensor harness connector.
12. Measure the signal voltage by connecting the breakout cable's signal and return connectors to the multimeter. If the reading is between 0.46 and 4.56 VDC, then the signal voltage is correct. If not, sensor is faulty.

5.6.120 Fault Code 1999 - Maximum Parallel Time

In Power Transfer Control (PTC) Operation, if the generator set remains paralleled to the utility for a time that is longer than the "Maximum Parallel Time" parameter, fault code 1999 will become active.

A. Check Maximum Parallel Time Parameter

"Maximum Parallel Time" parameter is set too low.

- Fault code 1999 becomes active when the generator set remains paralleled to the utility for a time that is longer than the "Maximum Parallel Time" parameter. Check the setting of the Maximum Parallel Time parameter and ensure that it is set to an appropriate value for the application. To modify the "Maximum Parallel Time" parameter on the display, go to: **Setup > Paralleling Setup > Power Transfer Control > Max Parallel** and set appropriately for the application.

5.6.121 Fault Code 2193 – HT Cool Level Moderate Hi

The coolant level is above the threshold values.

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Refer to the engine service manual for troubleshooting.

5.6.122 Fault Code 2321 – Sever Engine Overspeed

A sever engine overspeed condition exists.

A. Check Generator Set Frequency

If there is a load dump while the generator set is running at high load and the generator set frequency is higher than normal but lower than the high frequency threshold, the engine has a high probability of overspeed.

- Make sure that the generator set is running at normal frequency.

B. Check for Engine Internal Overspeed Condition

Refer to the engine service manual for troubleshooting.

5.6.123 Fault Code 2323–2326 Network Fault 5–8

Indicates network input (5–8) is in an active state.

A. Identify Network

Identify Network with which the PCC has lost communication. Locate the device with the red network status LED to identify the affected device.

B. Check the Harnesses

1. Check the harnesses and connections points for:
   - Corroded pins
   - Bent or broken pins
   - Pushed back or expanded pins
   - Evidence of moisture in or on the connector
   - Missing or damaged connector seals
   - Dirt or debris in or on the connector pin
2. Check the pin-to-pin connections. If no short or open circuit is found, check all connections to the pins.

5.6.124 Fault Code 2327 - PTC Fault

The PTC module or the communication link to the PTC module is not working properly when

PTC is enabled.

A. Check PTC Power

1. Check for blinking light on the PTC module to indicate that it has power.
2. If off, check for B+ between TB3-3 and TB3-4.
3. Check PTC status voltage between TB3-5 and TB3-6 (0.2 VDC).
4. Check to make sure cable ground shield, on the cable from the PTC module is properly grounded at the generator set control.

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5. Remove power from the control for 5 seconds, then reapply power. Confirm that the fault clears.

B. Check the Harnesses

1. Check the harnesses and connections points for:
   - Corroded pins
   - Bent or broken pins
   - Pushed back or expanded pins
   - Evidence of moisture in or on the connector
   - Missing or damaged connector seals
   - Dirt or debris in or on the connector pin
2. Check the pin-to-pin connections. If no short or open circuit is found, check all connections to the pins.

5.6.125 Fault Code 2328 – Utility Available

This is an event. No action required.

5.6.126 Fault Code 2329 - Low S1 Frequency

Low utility (S1) frequency.

A. Check S1 AC Inputs

Check S1 AC inputs and wiring to PTC at TB5.

B. Check the Harnesses

1. Check the harnesses and connections points for:
   - Corroded pins
   - Bent or broken pins
   - Pushed back or expanded pins
   - Evidence of moisture in or on the connector
   - Missing or damaged connector seals
   - Dirt or debris in or on the connector pin
2. Check the pin-to-pin connections. If no short or open circuit is found, check all connections to the pins.

C. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

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TABLE 48. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Center Frequency Threshold	**Setup > Paralleling Setup > Power Transfer Control > Center Frequency**	Refer to the Power Transfer Control (Paralleling/PTC Setup) section of the Controller Service Manual.
Pick-Up Bandwidth Threshold	**Setup > Paralleling Setup > Power Transfer Control > Pick-Up BW**	
Drop-Out Bandwidth Threshold	**Setup > Paralleling Setup > Power Transfer Control > Drop-Out BW**	
Drop-Out Delay Threshold	**Setup > Paralleling Setup > Power Transfer Control > Drop-Out Delay**	
Utility Frequency Sensor Enable	**Setup > Paralleling Setup > Power Transfer Control > Enable**	

5.6.127 Fault Code 2331 - Low Utility Voltage

In Power Transfer Control (PTC) Operation, if the utility voltage is below the “Utility Undervoltage Drop-Out Threshold", for the “Utility Undervoltage Drop-Out Delay", fault code 2331 will become active.

A. Utility Undervoltage Drop-out Thresholds are Incorrectly Set

1. This fault will become active when the Utility voltage goes below the “Utility undervoltage drop-out threshold" for the “Utility Undervoltage Drop-Out Delay". Utility undervoltage drop-out threshold is dependent of the following parameters:
   - Utility Undervoltage Drop-out percentage.
   - Utility Undervoltage Drop-out Delay.

   To Modify the preceding parameters, on the display go to: **Setup > Paralleling Setup > Power Transfer Control > Drop out or Drop-Out Delay** and set appropriately. Refer the PTC section for setup information and instructions.

B. The Voltage of the Utility is Low and/or Unstable

1. The voltage of the utility is low and/or unstable, check with your utility company.

5.6.128 Fault Code 2332 – Utility Connected

This is an event. No action required.

5.6.129 Fault Code 2333 – Genset Connected

This is an event. No action required.

5.6.130 Fault Code 2335 - Excitation Fault

The control has detected the simultaneous loss of all phases of sensing.

A. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

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TABLE 49. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Lost AC Voltage Threshold	**Setup > OEM Setup > OEM ALT Setup > Lost AC Voltage Threshold**	Set appropriately for the application.

B. Check Connections

Use the following table to make sure that the appropriate connections have been properly made for the application.

TABLE 50. CONNECTIONS

Location	Action
L1: J22-1	Check for voltage and current available at these connections while the generator set is running.
L2: J22-2	
L3: J22-3	
L4: J22-4	
L1: J12-1, J12-4	
L2: J12-2, J12-5	
L3: J12-3, J12-6	
Input of PT (when applicable)	
Output of PT (when applicable)	

5.6.131 Fault Code 2336 - Checksum Fault

Integrity check has found corrupted memory block(s) in the PCC.

A. PCC Has Corrupted Memory Block(s)

1. The PCC has corrupted memory block(s), this is indicated by all of the LEDs on the base board flashing. Perform an initial calibration on the base board with the newest Incal files. If the Incal update does not resolve the issue, then replace the base board.

5.6.132 Fault Code 2337 - PWR Tran Disabled

The PTC module is available, but the PTC feature is not enabled.

5.6.133 Fault Code 2338 - PWR Tran Failure

The PTC module is available, but the PTC feature is not enabled.

A. Check PTC Power

1. Check for blinking light on the PTC module to indicate that it has power.
2. If off, check for B+ between TB3-3 and TB3-4.
3. Check PTC status voltage between TB3-5 and TB3-6 (0.2 VDC).

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4. Check to make sure cable ground shield, on the cable from the PTC module is properly grounded at the generator set control.
5. Remove power from the control for 5 seconds, then reapply power. Confirm that the fault clears.

B. Check the Harnesses

1. Check the harnesses and connections points for:
   - Corroded pins
   - Bent or broken pins
   - Pushed back or expanded pins
   - Evidence of moisture in or on the connector
   - Missing or damaged connector seals
   - Dirt or debris in or on the connector pin
2. Check the pin-to-pin connections. If no short or open circuit is found, check all connections to the pins.

5.6.134 Fault Code 2339 - PWR Down Enabled

The Power Down Module (sleep) function is enabled, but either the PTC module or the network board is active.

5.6.135 Fault Code 2341 - High Control Temp

Control temperature is above normal (158 °F (70 °C)) for a time greater than the control temperature set time.

A. Check for High Ambient Temperature

1. Using thermocouple, verify air temperature entering intake louver of generator.
2. Reduce loads or recirculation of discharge air to generator in elevated ambient.

5.6.136 Fault Code 2342 - Too Long In Idle

The engine has been running at Low Speed Idle for a time longer than the "Max Idle Time" parameter.

A. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 51. CONTROL SETTINGS (WARMUP/COOLDOWN TIME)

Setting	Menu Navigation	Parameter
Idle Warmup Time	**Setup > Genset Setup > Idle Warmup Time**	Set appropriately for the application.
Idle Cooldown Time	**Setup > Genset Setup > Idle Cooldown Time**	Set appropriately for the application.

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TABLE 52. CONTROL SETTINGS (IDLE TIME)

Setting	Menu Navigation	Parameter
Max Idle Time	**Setup > Genset Setup > Max Idle Time**	Set appropriately for the application.

TABLE 53. CONTROL SETTINGS (COOLANT TEMP)

Setting	Menu Navigation	Parameter
Idle Warmup Coolant Temp	**Setup > Genset Setup > Idle Warmup Coolant Temp**	Set appropriately for the application.

5.6.137 Fault Code 2358 - High Utility Voltage

In Power Transfer Control (PTC) Operation, if the “Utility Overvoltage Sensor Enable" parameter is set to enable, and the utility voltage goes above the “Utility Overvoltage Drop-Out Threshold", for the “Utility Overvoltage Drop-Out Delay" time, fault code 2358 will become active.

A. Utility Overvoltage Drop-out Thresholds are Incorrectly Set

1. Utility Overvoltage drop-out thresholds are incorrectly set.
    a. This fault will become active when the Utility voltage goes above the “Utility Overvoltage Drop-Out Threshold" for the “Utility Overvoltage Drop-Out Delay" time. The utility overvoltage drop-out threshold is dependent of the following parameters:
        - Utility Overvoltage Drop-out percentage.
        - Utility Overvoltage Drop-out Delay.

        To Modify the preceding parameters, on the display go to: **Setup > Paralleling Setup > Power Transfer Control > Drop out or Drop-Out Delay** and set appropriately. Refer the PTC section for setup information and instructions.

        i. To disable this function, set the “Utility Overvoltage Sensor Enable" parameter to disable. On the display go to: **Setup > Paralleling Setup > Power Transfer Control > Enable** and set appropriately. Refer the PTC section for more information.

B. The Voltage of the Utility is Not Stable

1. The voltage of the utility is very high and/or unstable, check with your utility company.

5.6.138 Fault Code 2396 - Utility CB Fail To Close

Utility circuit breaker (CB) has failed to close for the time that is registered in the “Util CB Fail to Close Time Delay" parameter.

A. Check Control Board to Utility Circuit Breaker Wiring

1. Check the wiring from the control output on the control board.
2. Check the wiring from the control board to the utility breaker; check for a short circuit.
3. Check that the output of the control board matches the parameter of the control setting shown below.

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B. Check Connections

Use the following table to make sure that the appropriate connections have been properly made for the application.

TABLE 54. CONNECTIONS

Control Output	Base Board Connection	Breaker Connection
Circuit Breaker Close Control	TB5-6 (CTB39-2) and TB 5-7 (CTB40-2)	Utility breaker

C. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 55. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Utility CB Close Command	**Advanced Status > Advanced Controller Status > Utility CB Close Command**	Ensure that the CB Close Position Command matches the output.
Utility Breaker Position Contacts	**Setup > Paralleling Setup > Basic > Utility Breaker Position Contacts**	One of the following scenarios will occur. If circuit breaker (CB) position sensing is set up as single: Verify the connection at CB A (NO) status at TB10- 3 (CTB43-4) and the return at TB10-1 (CTB46-4). If the CB position sensing is set up as dual: Verify the connection at CB A (NO) status at TB 10-3 (CTB43-4) and the return at TB10-1 (CTB46-4). Also verify the connection at CB B (NC) status at TB10-4 (CTB44-4) and TB 10-1 (CTB46-4) (return). The input status at CB A (NO) and CB B (NC) should be opposite. If they are the same, check the wiring between the utility breaker and the CB status input on the base board

D. Check Utility Circuit Breaker

5.6.139 Fault Code 2397 - Utility CB Fail To Open

Utility circuit breaker (CB) has failed to open for the time that is registered in the “Utility CB Fail to Open Time Delay" parameter.

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A. Check Connections

Use the following table to make sure that the appropriate connections have been properly made for the application.

TABLE 56. CONNECTIONS

Control Output	Base Board Connection	Breaker Connection
Circuit Breaker Open Control	TB5-8 (CTB41-2) and TB 5-9 (CTB42-2)	Utility breaker

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 57. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Utility CB Open Command	**Advanced Status > Advanced Controller Status > Utility CB Open Command**	Ensure that the Utility CB Open Command matches the output.
Utility Breaker Position Contacts	**Setup > Paralleling Setup > Basic > Utility Breaker Position Contacts**	One of the following scenarios will occur. If circuit breaker (CB) position sensing is set up as single: Verify the connection at CB A (NO) status at TB10-3 (CTB43-4) and the return at TB10-1 (CTB46-4). If the CB position sensing is set up as dual: Verify the connection at CB A (NO) status at TB 10-3 (CTB43-4) and the return at TB10-1 (CTB46-4). Also verify the connection at CB B (NC) status at TB10-4 (CTB44-4) and TB 10-1 (CTB46-4) (return). The input status at CB A (NO) and CB B (NC) should be opposite. If they are the same, check the wiring.

C. Check Utility Circuit Breaker

5.6.140 Fault Code 2398 - AUX 101 Ambient Temperature OOR (Warning)

Ambient temperature sensor voltage is out of range.

A. Faulty Ambient Temperature Sensor Connections

1. Inspect the ambient temperature sensor and the engine harness connector pins.
    a. Disconnect the engine harness connector from the ambient temperature sensor.
    b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
    c. Inspect for evidence of moisture in or on the connector.
    d. Inspect for missing or damaged connector seals.
    e. Inspect for dirt or debris in or on the connector pins.

B. Faulty Ambient Temperature Sensor

1. Check the resistance of the sensor.
    a. Disconnect the engine harness connector from the ambient temperature sensor.
    b. Measure the resistance between the ambient temperature sensor signal pin and the ambient temperature sensor return pin.

C. Improper Wiring

1. Check wiring. Ensure wiring from the coolant temperature sensor is connected to the correct Aux 101 input.
2. Check wires for breaks or abrasions.
3. Check wires for moisture and debris at connection points.

D. Verify Controller Calibrations

1. Using the display or the InPower Service tool, verify the calibration in the PCC control.
    a. If the calibration in the PCC control matches the latest calibration on the InCal website, then the calibration is correct. If it does not, update the calibration to the latest.
2. Using the InSite Service tool, verify the calibration in the ECM.
    a. If the calibration in the ECM matches the latest calibration on QSOL, then the calibration is correct. If it does not, update the ECM to the latest calibration.

5.6.141 Fault Code 2539 – Voltage Bias OOR High

This fault will occur when the peak value of the voltage bias is reached for a continuous period of time. These values are set depending on the application.

Default values are:

- Voltage Bias OOR High Limit = 5 V
- Voltage Bias OOR Time = 1 s

A. Check Analog Inputs

1. Use a digital multimeter to check the voltage value at the analog inputs.
    - CTB46-2 (Input)
    - CTB45-2 (Return)
2. If value is higher than specified, troubleshoot at the input side.

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B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 58. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Voltage Bias time limit	**Setup > Paralleling setup > Voltage Bias OOR**	Set appropriately for the application

5.6.142 Fault Code 2541 – Voltage Bias OOR Low

This fault will occur when the bottom value of the voltage bias is reached for a continuous period of time. These values are set depending on the application.

Default values are:

- Voltage Bias OOR High Limit = -5 V
- Voltage Bias OOR Time = 1 s

A. Check Analog Inputs

1. Use a digital multimeter to check the voltage value at the analog inputs.
   - CTB46-2 (Input)
   - CTB45-2 (Return)
2. If value is higher than specified, troubleshoot at the input side.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 59. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Voltage Bias time limit	**Setup > Paralleling setup > Voltage Bias OOR**	Set appropriately for the application

5.6.143 Fault Code 2544 - Over Temperature

Charger is overheating

A. Charger’s Ambient Temperature Is Too High

1. Move the charger to a cooler location.
   - The charger will automatically begin charging again after the internal temp lowers.

B. Charger’s Internal Cooling Fan Is Blocked, Failed, Or Air Inlets Are Covered

1. Verify that the charger’s air inlets on the side of the charger are not blocked and nothing is interfering with fan rotation.

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5.6.144 Fault Code 2545 - Keyswitch Reset Required (Warning)

CAN datalink communication has been lost between the generator set control and ECM, therefore event/fault code 2545 becomes active if event/fault code 781 “CAN Data Link Failure" is also active at the ECM.

A. CAN Datalink Failure

1. Reset the Keyswitch manually.
    a. Put the generator set control in the OFF position and press the Reset button on the operator panel. This action will clear any shutdown faults and resets the Keyswitch.
    b. Enable the Keyswitch through the operator panel. Go to **Setup > Adjust > Keyswitch Override Enable**, set to Enable.
2. Reset the ECM and PCC controls
    a. Push the Emergency Stop button in.
    b. Wait 30 seconds.
    c. Disconnect the battery terminals from the battery.
    d. Wait 10-15 seconds.
    e. Reconnect the battery cables to the battery terminals correctly.
    f. Pull the Emergency Stop button out.
    g. Press the Fault Reset button.
3. Check the relay that is proving power to the Keyswitch. This relay is normally open, and if faulty, replace.
4. Check the terminating resistors. With connectors J11 and J26 removed, measure resistance between pins J11-19 and J11-20 (60 ohms, is satisfactory).
5. Reference the troubleshooting procedure for event/fault code 781 in the engine service manual.

B. Faulty ECM

1. After ensuring that the ECM has an adequate B+ supply, connect to the ECM with InPower or Insite in order to determine if it is functioning correctly and can communicate with the PCC controller. Replace the controller if communication to it with InPower is not possible.

5.6.145 Fault Code 2621 thru 2627, 2882 thru 2889 and 5182 - Aux 101 Input Fault

These Faults are triggered if the AUX 101 devices connected through the PCC Net are configured to be Active-Open or Active-Closed.

TABLE 60. FAULT CODES

Input	Fault Code	
	AUX101 Device 0	AUX101 Device 1
1	5182	2882
2	2621	2883
3	2622	2884

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Input	Fault Code	
	AUX101 Device 0	AUX101 Device 1
4	2623	2885
5	2624	2886
6	2625	2887
7	2626	2888
8	2627	2889

NOTICE
These Fault codes are only applicable to the AUX 101s connected through the PCC Net and not the AUX 101 connected through the CAN Link (OEM Devices).

A. Check Customer Connections

Check customer connections that are connected through the input.

B. Check the Harness

Verify continuity of the wiring harness from customer side to the AUX 101.

C. Check Control Settings

1. Check the settings for the AUX 101 board. Confirm and validate the correct settings for the Customer Inputs.
2. Using InPower, go to **Setup > AUX 101 Setup** to calibrate the AUX 101 inputs and outputs.

5.6.146 Fault Code 2628 – AUX 102 Input #9 Fault

Discrete input #9 fault is active.

A. Condition For Which Discrete Input #9 Is Configured Is Active

1. Check the condition for which "Discrete Input #9" has been configured. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to next step.

B. Discrete Input #9 Active State Selection Parameter Is Configured Incorrectly

1. With InPower or through the Operator Panel check the switch input setting (active closed or active open) for Discrete Input #9. Ensure that the switch input setting is correctly set. If “Discrete Input #9 Sensor Type" parameter is set to active low, an active high will invert the logic, causing this fault code to go active.

C. Incorrectly Wired; Or Open Circuit Or Short Circuit In The Wiring

1. Check the wiring at J4-1 (switch input 1) and J4-2 (reference input) for an open circuit, short circuit, or a miswired condition.

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5.6.147 Fault Code 2629 – AUX 102 Input #10 Fault

Discrete input #10 fault is active.

A. Condition For Which Discrete Input #10 Is Configured Is Active

1. Check the condition for which "Discrete Input #10" has been configured. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to next step.

B. Discrete Input #10 Active State Selection parameter is configured incorrectly

1. With InPower or through the Operator Panel check the switch input setting (active closed or active open) for Discrete Input #10. Ensure that the switch input setting is correctly set. If “Discrete Input #10 Sensor Type" parameter is set to active low, an active high will invert the logic, causing this fault code to go active.

C. Incorrectly Wired; Or Open Circuit Or Short Circuit In The Wiring

1. Check the wiring at J4-3 (switch input 1) and J4-4 (reference input) for an open circuit, short circuit, or a miswired condition.

5.6.148 Fault Code 2632 – AUX 102 Input #12 Fault

Discrete input #12 fault is active.

A. Condition for which Discrete Input #12 is Configured is Active

1. Check the condition for which "Discrete Input #12" has been configured. After the issue is resolved, press the Reset button on the Operator Panel in order to clear the fault, if the fault does not clear go to next step.

B. Discrete Input #12 Active State Selection Parameter Is Configured Incorrectly

1. Check the wiring at J4-7 (switch input 1) and J4-8 (reference input) for an open circuit, short circuit, or a miswired condition.

C. Faulty Switch Unit

1. Visually inspect the switch for proper operation, intended range of movement, and functionality. If any defects or a physical damage are detected the switch unit should be replaced.
2. Measure the resistance of the switch, if the switch is reading incorrectly (shorted or open circuit), replace the switch (< 10 ohms for closed; > 100 Kohms for open).

D. Faulty Switch Connector(s)

1. Check the switch unit’s connection at the plug for an adequate connection, short circuit, open circuit, or a wiring mismatch at the switch connector end.
2. Inspect the switch and the harness connector pins for:
    a. Bent or broken pins, pushed back, or expanded pins.
    b. Evidence of moisture or corrosion in or on the connector.

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c. Missing or damaged connector seals.

d. Dirt or debris in or on the connector pins.

E. Incorrectly Wired; Or Open Circuit Or Short Circuit In The Wiring

1. Check the wiring at J4-7 (switch input 1) and J4-8 (reference input) for an open circuit, short circuit, or a miswired condition

5.6.149 Fault Code 2661 - One or More Unacknowledged Engine Fault Codes

Logic:

Fault code 2661 (unacknowledged engine fault): One or more unacknowledged Engine Shutdown Faults are active.

Diagnoses and Repair: Troubleshoot Engine Fault Codes.

5.6.150 Fault Code 2662 - At Least One ACK:Mod Severe Fault

Logic:

Fault code 2662: One or more acknowledged Engine Shutdown Faults are active.

Diagnoses and Repair: Troubleshoot Engine Fault Codes.

NOTICE
For PCC software version 3.280 and later, FC 2662 is no longer active. FC 2662 has been replaced with FC 6598 which has similar logic. Please see the troubleshooting for FC 6598 for additional information.

5.6.151 Fault Code 2677 – Fail Stop

This is an event. No action required.

5.6.152 Fault Code 2678 - Charging Alternator Fail

Battery charging alternator is not functioning correctly or is sensing too high of external battery voltage.

A. Monitor Charging Alternator Output

If output value falls below acceptable range (output < Battery voltage - .7 V), troubleshoot the alternator per the Engine Service Manual.

1. Check for voltage across battery charging alternator terminals with engine off. Voltage should be approximately equal to the battery voltage minus 0.7V.
2. If voltage is not present, check Alternator Reference supply wiring, diodes, and fuse in the DC distribution box.

B. Check Charging Alternator Reference Wires

1. Check charging alternator output with clamp ammeter at rated engine RPM.

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2. If no output current is measured, the input voltage to the charging alternator may be higher than the alternator's internal voltage setpoint (nominal 28V) for longer than the Charging Alternator Fault Delay (nominal 120 seconds). To resolve, consider increasing Charging Alternator Fault Delay to the max value of 300 seconds or reducing the external charger voltage setpoint.

C. Check the Harnesses

1. Check the harnesses and connections points for:
   - Corroded pins
   - Bent or broken pins
   - Pushed back or expanded pins
   - Evidence of moisture in or on the connector
   - Missing or damaged connector seals
   - Dirt or debris in or on the connector pin
2. Check the pin-to-pin connections. If no short or open circuit is found, check all connections to the pins.

5.6.153 Fault Code 2693 - Speed Bias OOR (Warning)

Indicates The Speed Bias Circuit Output Is Out Of Range (OOR), High Or Low.

A. Sensor/wiring is defective

1. Check wiring. Ensure speed bias OOR wiring is connected to the correct Aux 101 input.
2. Check wires for breaks or abrasions.
3. Check wires for moisture and debris at connection points.

5.6.154 Fault Code 2694 - Alternator RTD OOR (Warning)

Indicates the RTD circuit output is out of range (OOR), high or low.

A. Sensor/Wiring is Defective

1. Sensor/wiring is defective
   a. Check wiring. Ensure alternator RDT OOR wiring is connected to the correct Aux 101 input.
   b. Check wires for breaks or abrasions.
   c. Check wires for moisture and debris at connection points.

5.6.155 Fault Code 2696 - Alternator RTD Temperature High (Warning)

Indicates that the alternator temperature is above normal and has reached the shutdown trip point.

A. RTD Sensor Wiring Is Defective

1. Check wiring. Ensure alternator RDT temperature wiring is connected to the correct Aux 101 input.
2. Check wires for breaks or abrasions.

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3. Check wires for moisture and debris at connection points.

5.6.156 Fault Code 2729 - IO Module Lost (Warning)

Indicates an intermittent data link between the I/O module and the PCC control (Aux 101 I/O Module option) and no input fault levels were set to Shutdown.

A. Incorrect Wiring

1. Connection between AUX 101 and PCC board is incorrect. Ensure proper wiring.
    a. PCC board TB1-1 – PCC Net A (+) to AUX 101 J1-3
    b. PCC board TB1-2 – PCC Net B (-) to AUX 101 J1-4
    c. PCC board TB1-3 – B+ Return to AUX 101 J14-2
    d. PCC board TB1-5 – Customer Fused B+ to AUX 101 J14-1
    e. PCC board TB15-5 – System Wake-up to AUX 101 J1-5

B. I/O Settings Misconfigured

1. If no AUX 101 is connected to PCC3300, connect to InPower. Under Adjustments > System I/O Adjustment > Output Relays ensure System IO Board Enable is disabled.
2. If no AUX 101 is connected to PCC3300, connect to InPower. Under Adjustments > System I/O Adjustment > ensure no inputs or outputs are configured as enabled.

5.6.157 Fault Code 2731 - IO Module Lost (Shutdown)

Indicates an intermittent data link between the I/O module and the PC Control (Aux 101 I/O Module option) and at least one input fault level was set to Shutdown.

A. Incorrect Wiring

1. Connection between AUX 101 and PCC board is incorrect. Ensure proper wiring.
    a. PCC board TB1-1 – PCC Net A (+) to AUX 101 J1-3
    b. PCC board TB1-2 – PCC Net B (-) to AUX 101 J1-4
    c. PCC board TB1-3 – B+ Return to AUX 101 J14-2
    d. PCC board TB1-5 – Customer Fused B+ to AUX 101 J14-1
    e. PCC board TB15-5 – System Wake-up to AUX 101 J1-5

B. I/O Settings Misconfigured

1. If no AUX 101 is connected to PCC3300, connect to InPower. Under Adjustments > System I/O Adjustment > Output Relays ensure System IO Board Enable is disabled.
2. If no AUX 101 is connected to PCC3300, connect to InPower. Under Adjustments > System I/O Adjustment > ensure no inputs or outputs are configured as enabled.

5.6.158 Fault Code 2779 – Utility Unloaded

This is an event. No action required.

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5.6.159 Fault Code 2814 - Genset CT Ratio Low

The genset CT ratio (primary vs. secondary) is too small for the control to function properly for the voltage and KW rating of this generator set.

A. Incorrect CT Ratio Setup Or Feature Code

1. The control uses voltage, kW, and the CT ratio in order to determine if the CT ratio is correct for the operation of the generator set. Use the CT ratio calculator in InPower to determine the correct CT ratio for this generator set. Then enter the correct CT ratio via InPower or through the operator panel. To access the Genset CT ratio configuration menu on the operator panel, go to **Setup > OEM Setup > OEM Alt Setup > Genset CT Ratio** and set the “Genset CT Ratio primary" and “Genset CT Ratio secondary" parameters appropriately for the application.

B. The CTs Are Incorrectly Sized

1. Change the CTs to the correct size.

C. Incorrect Voltage Or kW Rating Setup

1. The PCC uses voltage, kW, and the CT ratio in order to determine if the CT ratio is correct for the operation of the generator set. If the voltage or kW setup is incorrect, event/fault code 2814 can become active. Use the CT calculator in InPower to determine the correct voltage and kW rating for this generator set. To access the generator set voltage and kW rating setup on the Operator Panel, go to **Setup > OEM Setup > OEM Alt Setup > Genset Nominal Voltage** and **Setup > OEM Setup > OEM Genset Setup** and set the parameters appropriately for the application.

5.6.160 Fault Code 2815 - Genset CT Ratio High

The ratio of the genset CT is too large for this generator set. The genset CT ratio (primary vs. secondary) is too large for the control to calculate current accurately at the voltage and KW ratings for this generator set.

A. The Control Is Set Up With The Incorrect CT Ratio or Feature Code

1. The control uses voltage, kW, and the CT ratio in order to determine if the CT ratio is correct for the operation of the generator set. Use the CT ratio calculator in InPower to determine the correct CT ratio for this generator set. Then enter the correct CT ratio via InPower or through the operator panel. To access the Genset CT ratio configuration menu on the operator panel go to Setup > OEM Setup > OEM Alt Setup > and set the “Genset CT Ratio primary" and “Genset CT Ratio secondary" parameters appropriately for the application.

B. The CTs Are Incorrectly Sized

1. Change the CTs to the correct size.

C. Incorrect Voltage Or kW Rating Setup

1. The PCC uses voltage, kW, and the CT ratio in order to determine if the CT ratio is correct for the operation of the generator set. If the voltage or kW setup is incorrect, event/fault code 2815 can become active. Use the CT calculator in InPower to determine the correct voltage and kW rating for this generator set. To access the generator set voltage and kW rating setup on the Operator Panel, go to **Setup > OEM Setup > OEM Alt Setup > Genset Nominal Voltage** and Setup > OEM Setup > OEM Genset Setup and set the parameters appropriately for the application.

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5.6.161 Fault Code 2816 - Genset PT Ratio Low

The genset PT ratio is too small for the generator set rating. The genset PT ratio (primary vs. secondary) is too small and will cause high voltage readings.

A. The Control Is Set Up With The Incorrect CT Ratio or Feature Code

1. The control uses voltage, kW, and the CT ratio in order to determine if the CT ratio is correct for the operation of the generator set. Use the CT ratio calculator in InPower to determine the correct CT ratio for this generator set. Then enter the correct CT ratio via InPower or through the operator panel. To access the Genset CT ratio configuration menu on the operator panel go to Setup > OEM Setup > OEM Alt Setup > and set the “Genset CT Ratio primary" and “Genset CT Ratio secondary" parameters appropriately for the application.

B. The PTs Are Incorrectly Sized Ratio Low

1. Use the following equation to determine if the correct PT for the application is installed: (Genset Nominal Voltage / Genset PT Primary voltage) * Genset PT Secondary voltage > 600 VAC, your PT ratio is too small.
2. Check the voltage input into the control board. When the generator set is running, the voltage input between L1 and L2 (J22-1 and J22-2) or L2 and L3 (J22-2 and J22-3) should not be more than 600 VAC.

5.6.162 Fault Code 2817 - Genset PT Ratio High

The genset PT ratio is too large, which causes an inaccurate reading of nominal voltage during normal operation; when the genset PT is used (above 600 VAC).

A. The Control Is Set Up With The Incorrect PT Ratio

1. The control uses nominal voltage and the PT ratio in order to determine if the PT ratio is correct for the operation of the generator set. Voltage input into the control board should exceed 50% of the nominal voltage to allow the control to obtain an accurate voltage reading, whether an external PT is used or not. Use the following equation to determine if you have the correct PT ratio: If (Genset Nominal Voltage / Genset PT Primary voltage) * Genset PT Secondary voltage < (Nominal voltage *.5), the PT ratio is too large.

   Then configure the control with the correct PT ratio. To access the genset PT ratio configuration menu on the operator panel, go to **Setup > OEM Setup > OEM Alt Setup >** and set the “Genset PT Ratio primary" and “Genset PT Ratio secondary" parameters appropriately for the application.

B. The PTs Are Incorrectly Sized Ratio High

1. Use the following equation to determine if you have the correct PT for the application: (Genset Nominal Voltage / Genset PT Primary voltage) * Genset PT Secondary voltage < (Nominal voltage *.5), your PT ratio is too large.

   B. Check the voltage input into the control board. When the generator set is running, the voltage input between L1 and L2 (J22-1 and J22-2) or L2 and L3 (J22-2 and J22-3) should be greater than (Genset Bus Nominal Voltage *.5) VAC.

5.6.163 Fault Code 2818 - Bus PT Ratio Low

The Genset Bus PT ratio is too small for the Genset Bus rating. The Bus PT ratio (primary vs. secondary) is too small and will cause high voltage readings

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A. The Control Is SetUp With The Incorrect PT Ratio

1. The control uses nominal voltage and the PT ratio in order to determine if the PT ratio is correct for proper operation of the bus. Voltage input into the control board should not exceed 600 VAC, whether an external PT is used or not. Use the following equation to determine if you have the correct PT Ratio: If (Genset Bus Nominal Voltage / Genset Bus PT Primary voltage) * Genset Bus PT Secondary voltage > 600 VAC, your PT Ratio is too small.
2. Then configure the control with the correct PT Ratio. To access the Bus PT ratio configuration menu on the display go to: **Setup > Paralleling Setup > Basic > PT Primary and PT Secondary** and set the “Genset Bus PT Primary Voltage" and “Genset Bus PT Secondary Voltage" parameters appropriately for the application.

B. The PTs Are Incorrectly Sized Bus PT Ratio Low

1. Use the following equation to determine if the correct PT for the application is installed: If (Genset Bus Nominal Voltage / Genset Bus PT Primary voltage) * Genset Bus PT Secondary voltage > 600 VAC, your PT Ratio is too small.
2. Check the voltage input into the control board between L1 & L2 or L2 & L3 the voltage reading should not be more that 600 VAC.

5.6.164 Fault Code 2819 - Bus PT Ratio High

The Genset Bus PT ratio is too large, which causes an inaccurate reading of Genset Bus Nominal voltage during normal operation; when the Genset PT is used (above 600 VAC)

A. The Control Is Set Up With The Incorrect Genset Bus PT Ratio

1. The control uses Genset Bus Nominal voltage and the PT ratio in order to determine if the PT ratio is correct for the operation of the generator set. Voltage input into the control board should exceed 50% of the Genset Bus Nominal voltage (up to 600 VAC), to allow the control to obtain an accurate voltage reading, whether an external PT is used or not. Use the following equation to determine if you have the correct PT Ratio: If (Genset Bus Nominal Voltage / Genset Bus PT Primary voltage) * Genset Bus PT Secondary voltage < (Genset Bus Nominal voltage *.5), the PT Ratio is too large.
2. Then configure the control with the correct PT Ratio. To access the Genset Bus PT ratio configuration menu on the display go to: **Setup > Paralleling Setup > Basic > PT Primary and PT Secondary** and set the "Genset Bus PT Primary Voltage" and "Genset Bus PT Secondary Voltage" parameters appropriately for the application.

B. The PT's Are Incorrectly Sized Bus PT Ratio High

1. Use the following equation to determine if you have the correct PT for the application: If (Genset Bus Nominal Voltage / Genset Bus PT Primary voltage) * Genset Bus PT Secondary voltage < (Genset Bus Nominal voltage *.5), the PT Ratio is too large.
2. Check the voltage input into the control board between L1 & L2 or L2 & L3 the voltage should be greater than (Genset Bus Nominal Voltage *.5) VAC.

5.6.165 Fault Code 2821 - Utility PT Ratio Low

The Utility PT ratio is too small for the Utility rating. The Utility PT ratio (primary vs. secondary) is too small and will cause high voltage readings.

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A. The Control Is SetUp With The Incorrect PT Ratio

1. The control uses nominal utility voltage and the PT ratio in order to determine if the PT ratio is correct for proper operation of the utility. Voltage input into the control board should not exceed 600 VAC, whether an external PT is used or not. Use the following equation to determine if you have the correct PT Ratio: If (Utility Nominal Voltage / Utility PT Primary voltage) * Utility PT Secondary voltage > 600 VAC, your PT Ratio is too small.
2. Then configure the control with the correct PT Ratio. To access the utility PT ratio configuration menu on the display go to: **Setup > Paralleling Setup > Basic > PT Primary and PT Secondary** and set the “Utility PT Primary Voltage" and “Utility PT Secondary Voltage" parameters appropriately for the application.

B. The PTs are Incorrectly Sized Utility PT Ratio Low

1. Use the following equation to determine if the correct PT for the application is installed: If (Utility Nominal Voltage / Utility PT Primary voltage) * Utility PT Secondary voltage > 600 VAC, your PT Ratio is too small.
2. Check the voltage input into the control board between L1 & L2 (J22-1 & J22-2) or L2 & L3 (J22-2 & J22-3) the voltage reading should not be more that 600 VAC.

5.6.166 Fault Code 2822 - Utility PT Ratio High

The Utility PT ratio is too large, which causes an inaccurate reading of Utility Nominal voltage during normal operation; when the Genset PT is used (above 600 VAC)

A. The control is set up with the incorrect Utility PT Ratio

1. The control uses Utility Nominal voltage and the PT ratio in order to determine if the PT ratio is correct for the operation of the generator set. Voltage input into the control board should exceed 50% of the Utility Nominal voltage (up to 600 VAC), to allow the control to obtain an accurate voltage reading, whether an external PT is used or not. Use the following equation to determine if you have the correct PT Ratio: If (Utility Nominal Voltage / Utility PT Primary voltage) * Utility PT Secondary voltage < (Utility Nominal voltage *.5), the PT Ratio is too large.

   Then configure the control with the correct PT Ratio. To access the Utility PT ratio configuration menu on the display go to: **Setup > Paralleling Setup > Basic > PT Primary and PT Secondary** and set the “Utility PT Primary Voltage" and “Utility PT Secondary Voltage" parameters appropriately for the application.

B. The PTs are Incorrectly Sized Utility PT Ratio High

1. Use the following equation to determine if you have the correct PT for the application: If (Utility Nominal Voltage / Utility PT Primary voltage) * Utility PT Secondary voltage < (Utility Nominal voltage *.5), the PT Ratio is too large.
2. Check the voltage input into the control board between L1 & L2 (J22-1 & J22-2) or L2 & L3 (J22-2 & J22-3) the voltage should be greater than (Utility Nominal Voltage *.5) VAC.

5.6.167 Fault Code 2891 - AUX 102 (1) Input #1 Fault

NOTICE
AUX 102 Input #1 may be referred to as Input #9 in some cases.

AUX 102 1 Discrete input #1 fault is active.

A. Condition For Which Discrete Input #1 Is Configured For Is Active

1. Verify the condition for which Discrete Input #1 has been configured. After the issue is resolved press the Reset button on the operator panel in order to clear the fault.
    a. If the fault does not clear go to the Aux 102 1 Discrete Input #1 active state selection parameter is configured incorrectly step below.

B. Aux 102 1 Discrete Input #1 Active State Selection Parameter Is Configured Incorrectly

1. With the InPower service tool or through the operator panel verify the switch input setting (active closed or active open) for Discrete Input #1. Go to: **Setup > Aux 101 Setup.**
    a. Verify that the switch input setting is set correctly.
    b. If Aux 102 1 Discrete Input #1 Sensor Type parameter is set to active close, an active open will invert the logic, causing this fault code to go active.

C. Faulty Switch Unit

1. Visually inspect the switch for proper operation, intended range of movement, and functionality. If any defects or a physical damage are detected the switch unit should be replaced.
2. Measure the resistance of the switch, if the switch is reading incorrectly (shorted or open circuit), replace the switch (< 10 ohms for closed; > 100 Kohms for open).

D. Faulty Switch Connector(s)

1. Check the switch unit's connection at the plug for an adequate connection, short circuit, open circuit, or a wiring mismatch at the switch connector end.
2. Inspect the switch and the harness connector pins for:
    a. Bent or broken pins, pushed back, or expanded pins.
    b. Evidence of moisture or corrosion in or on the connector.
    c. Missing or damaged connector seals.
    d. Dirt or debris in or on the connector pins.

E. Wiring Harness Incorrectly Wired, Open Circuit, Or Short Circuit To The AUX 101 Board

1. Check the wiring at J4-2 (reference input) and J4-1 (switch input) for an open circuit, short circuit, or a miss wired condition at the AUX 102 input side.
2. Verify the wiring harness running from the switch plug to the AUX 102 board for shorted low condition at the J4-1 (switch input) side for an active closed parameter fault setting activation.
    a. With the switch disconnected measure the resistance from the J4-1 input pin to the engine block ground; value should be more than 100k ohms.
3. Disconnect the wiring harness.
    a. Test the resistance of the wiring between the switch's output leads (input and return) and input leads at the base board; value should be less than 10 ohms.
    b. Test the resistance from the switch's output leads (input and return) to all other pins in the harness connector; value should be greater than 100k ohms.

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5.6.168 Fault Code 2892 - AUX 102 (1) Input #2 Fault

AUX 102 1 Discrete input #2 fault is active.

NOTICE
AUX 102 Input #2 may be referred to as Input #10 in some cases.

A. Condition For Which Discrete Input #2 Is Configured For Is Active

1. Verify the condition for which Discrete Input #2 has been configured. After the issue is resolved press the Reset button on the operator panel in order to clear the fault.
    a. If the fault does not clear go to the Aux 102 1 Discrete Input #2 active state selection parameter is configured incorrectly step below.

B. Aux 102 1 Discrete Input #2 Active State Selection Parameter Is Configured Incorrectly

1. With the InPower service tool or through the operator panel verify the switch input setting (active closed or active open) for Discrete Input #2. Go to: **Setup > Aux 101 Setup.**
    a. Verify that the switch input setting is set correctly.
    b. If Aux 102 1 Discrete Input #2 Sensor Type parameter is set to active close, an active open will invert the logic, causing this fault code to go active.

C. Faulty Switch Unit

1. Visually inspect the switch for proper operation, intended range of movement, and functionality. If any defects or a physical damage are detected the switch unit should be replaced.
2. Measure the resistance of the switch, if the switch is reading incorrectly (shorted or open circuit), replace the switch (< 10 ohms for closed; > 100 Kohms for open).

D. Faulty Switch Connector(s)

1. Check the switch unit’s connection at the plug for an adequate connection, short circuit, open circuit, or a wiring mismatch at the switch connector end.
2. Inspect the switch and the harness connector pins for:
    a. Bent or broken pins, pushed back, or expanded pins.
    b. Evidence of moisture or corrosion in or on the connector.
    c. Missing or damaged connector seals.
    d. Dirt or debris in or on the connector pins.

E. Wiring Harness Incorrectly Wired, Open Circuit, Or Short Circuit To The AUX 101 Board

1. Check the wiring at J4-4 (reference input) and J4-3 (switch input) for an open circuit, short circuit, or a miss wired condition at the AUX 102 input side.

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2. Verify the wiring harness running from the switch plug to the AUX 102 board for shorted low condition at the J4-3 (switch input) side for an active closed parameter fault setting activation.
    a. With the switch disconnected measure the resistance from the J4-3 input pin to the engine block ground; value should be more than 100k ohms.
3. Disconnect the wiring harness.
    a. Test the resistance of the wiring between the switch's output leads (input and return) and input leads at the base board; value should be less than 10 ohms.
    b. Test the resistance from the switch's output leads (input and return) to all other pins in the harness connector; value should be greater than 100k ohms.

5.6.169 Fault Code 2893 - AUX 102 (1) Input #3 Fault

AUX 102 1 Discrete input #3 fault is active.

NOTICE
AUX 102 Input #3 may be referred to as Input #11 in some cases.

A. Condition For Which Discrete Input #3 Is Configured For Is Active

1. Verify the condition for which Discrete Input #3 has been configured. After the issue is resolved press the Reset button on the operator panel in order to clear the fault.
    a. If the fault does not clear go to the Aux 102 1 Discrete Input #3 active state selection parameter is configured incorrectly step below.

B. Aux 102 1 Discrete Input #3 Active State Selection Parameter Is Configured Incorrectly

1. With the InPower service tool or through the operator panel verify the switch input setting (active closed or active open) for Discrete Input #3. Go to: **Setup > Aux 101 Setup.**
    a. Verify that the switch input setting is set correctly.
    b. If Aux 102 1 Discrete Input #3 Sensor Type parameter is set to active close, an active open will invert the logic, causing this fault code to go active.

C. Faulty Switch Unit

1. Visually inspect the switch for proper operation, intended range of movement, and functionality. If any defects or a physical damage are detected the switch unit should be replaced.
2. Measure the resistance of the switch, if the switch is reading incorrectly (shorted or open circuit), replace the switch (< 10 ohms for closed; > 100 Kohms for open).

D. Faulty Switch Connector(s)

1. Check the switch unit's connection at the plug for an adequate connection, short circuit, open circuit, or a wiring mismatch at the switch connector end.
2. Inspect the switch and the harness connector pins for:
    a. Bent or broken pins, pushed back, or expanded pins.
    b. Evidence of moisture or corrosion in or on the connector.

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c. Missing or damaged connector seals.

d. Dirt or debris in or on the connector pins.

E. Wiring Harness Incorrectly Wired, Open Circuit, Or Short Circuit To The AUX 101 Board

1. Check the wiring at J4-6 (reference input) and J4-5 (switch input) for an open circuit, short circuit, or a miss wired condition at the AUX 102 input side.
2. Verify the wiring harness running from the switch plug to the AUX 102 board for shorted low condition at the J4-5 (switch input) side for an active closed parameter fault setting activation.
   a. With the switch disconnected measure the resistance from the J4-5 input pin to the engine block ground; value should be more than 100k ohms.
3. Disconnect the wiring harness.
   a. Test the resistance of the wiring between the switch's output leads (input and return) and input leads at the base board; value should be less than 10 ohms.
   b. Test the resistance from the switch's output leads (input and return) to all other pins in the harness connector; value should be greater than 100k ohms.

5.6.170 Fault Code 2894 - AUX 102 (1) Input #4 Fault

AUX 102 1 Discrete input #4 fault is active.

NOTICE
AUX 102 Input #4 may be referred to as Input #12 in some cases.

A. Condition for which Discrete Input #4 is Configured for is Active

1. Verify the condition for which Discrete Input #4 has been configured. After the issue is resolved press the Reset button on the operator panel in order to clear the fault.
   a. If the fault does not clear go to the Aux 102 1 Discrete Input #4 active state selection parameter is configured incorrectly step below.

B. Aux102_ 1 Discrete Input #4 Active State Selection Parameter Is Configured Incorrectly

1. With the InPower service tool or through the operator panel verify the switch input setting (active closed or active open) for Discrete Input #4. Go to: **Setup > Aux 101 Setup.**
   a. Verify that the switch input setting is set correctly.
   b. If Aux 102 1 Discrete Input #4 Sensor Type parameter is set to active close, an active open will invert the logic, causing this fault code to go active.

C. Faulty Switch Unit

1. Visually inspect the switch for proper operation, intended range of movement, and functionality. If any defects or a physical damage are detected the switch unit should be replaced.
2. Measure the resistance of the switch, if the switch is reading incorrectly (shorted or open circuit), replace the switch (< 10 ohms for closed; > 100 Kohms for open).

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D. Faulty Switch Connector(s)

1. Check the switch unit's connection at the plug for an adequate connection, short circuit, open circuit, or a wiring mismatch at the switch connector end.
2. Inspect the switch and the harness connector pins for:
    a. Bent or broken pins, pushed back, or expanded pins.
    b. Evidence of moisture or corrosion in or on the connector.
    c. Missing or damaged connector seals.
    d. Dirt or debris in or on the connector pins.

E. Wiring Harness Incorrectly Wired Open Circuit Or Short Circuit to the AUX 101 Board

1. Check the wiring at J4-8 (reference input) and J4-7 (switch input) for an open circuit, short circuit, or a miss wired condition at the AUX 102 input side.
2. Verify the wiring harness running from the switch plug to the AUX 102 board for shorted low condition at the J4-7 (switch input) side for an active closed parameter fault setting activation.
    a. With the switch disconnected measure the resistance from the J4-7 input pin to the engine block ground; value should be more than 100k ohms.
3. Disconnect the wiring harness.
    a. Test the resistance of the wiring between the switch's output leads (input and return) and input leads at the base board; value should be less than 10 ohms.
    b. Test the resistance from the switch's output leads (input and return) to all other pins in the harness connector; value should be greater than 100k ohms.

5.6.171 Fault Code 2895 - PCCnet Device Failed

A non-critical PCCNet device has failed.

A. PCCNet Communication Has Been Lost Or PCCNet Device Is Faulty

1. If a PCCNet device has lost network communication, the network status light for that device will turn RED. Locate the device with the red network status LED to identify the affected device.
2. Ensure that the network device has sufficient voltage (12-24 V), as measured at the input of the device, not at the source or battery. Also verify that the device is awake and has a heartbeat. A heartbeat is a LED on the PCCNet device that blinks every 1 second to inform the operator that the device is functioning.
3. Check the network cable connections of the device(s) and ensure that there are no open or short circuits. The PCCNet network devices are polarity sensitive. For example: Control (RS485+) to Annunciator (RS485+) and Control (RS485-) to Annunciator (RS485-). If the connections are incorrect, the devices will not properly communicate over the network. Ensure that the shield is grounded at one point ONLY. Refer to the respective PCCNet device manual for line limitations and cable requirements.
4. If previous steps are satisfactory, replace the network device.

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5. If replaced device is still exhibiting network issues, this can be due to a grounding loop or ground referencing for remotely mounted and powered network, incorrect network wire, or a noise (EMI) issue. As a test, connect the PCCNet device close (2-5 FT) to the base board, using the power supply from the base board (TB1-5, B+ and TB1-3 ground) and use the required network wire. If the network device functions appropriately, correct the grounding issue, EMI issue, or replace the network wire with the required network wire.

5.6.172 Fault Code 2896 - Critical PCCnet Device Fail

A critical PCCNet device has failed and has caused the generator set to shut down.

A. PCCNet Communication Has Been Lost Or PCCNet Device Is Faulty

1. If a PCCNet device has lost network communication, the network status light for that device will turn RED. Locate the device with the red network status LED to identify the affected device.
2. Ensure that the network device has sufficient voltage (12-24 V), as measured at the input of the device, not at the source or battery. Also verify that the device is awake and has a heartbeat. A heartbeat is a LED on the PCCNet device that blinks every 1 second to inform the operator that the device is functioning.
3. Check the network cable connections of the device(s) and ensure that there are no open or short circuits. The PCCNet network devices are polarity sensitive. For example: Control (RS485+) to Annunciator (RS485+) and Control (RS485-) to Annunciator (RS485-). If the connections are incorrect, the devices will not properly communicate over the network. Ensure that the shield is grounded at one point ONLY. Refer to the respective PCCNet device manual for line limitations and cable requirements.
4. If previous steps are satisfactory, replace the network device.
5. If replaced device is still exhibiting network issues, this can be due to a grounding loop or ground referencing for remotely mounted and powered network, incorrect network wire, or a noise (EMI) issue. As a test, connect the PCCNet device close (2-5 FT) to the base board, using the power supply from the base board (TB1-5, B+ and TB1-3 ground) and use the required network wire. If the network device functions appropriately, correct the grounding issue, EMI issue, or replace the network wire with the required network wire.

5.6.173 Fault Code 2897 - Factory Memory Block Corrupt

Control has detected a corrupted memory block.

A. Control Has Detected A Corrupted Memory Block

1. Contact factory for support.

5.6.174 Fault Code 2898 - Periodic or Fault Memory Block Corrupt

Control has detected a corrupted memory block.

A. Control Has Detected A Corrupted Memory Block

1. Contact factory for support.

5.6.175 Fault Code 2899 - User Memory Block Corrupt

Control has detected a corrupted memory block.

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A. Control Has Detected A Corrupted Memory Block

1. Contact factory for support.

5.6.176 Fault Code 2911 - Trim Memory Block Corrupt

Control has detected a corrupted memory block.

A. Control Has Detected A Corrupted Memory Block

1. Contact factory for support.

5.6.177 Fault Code 2914 - Genset AC Meter Failed

Metering chip has failed and can no longer accurately monitor generator set current and voltage.

A. An Over-Voltage/-Current Condition Has Damaged The Metering Chip

1. Measure the voltage (L1: J22 -1; L2: J22 -2, L3: J22-3, L4: J22-4) and current (L1: J12-1, J12-4; L2: J12-2, J12-5; L3: J12-3, J12-6;) input into the control. Voltage input into the board should not exceed 600 VAC, (damage to board occurs at 750 VAC). Current input into the board should not exceed 5 Amps. If a short circuit or an over-voltage/-current issue exists, correct the problem(s).

5.6.178 Fault Code 2915 - Gen Bus AC Meter Failed

Metering chip has failed and can no longer accurately monitor generator set bus current and voltage.

A. An Over-Voltage/-Current Condition Has Damaged The Metering Chip

1. Measure the voltage using a volt-meter at L1: TB7-1; L2: TB7-2, L3: TB7-3, L4: TB7-4; and the current using a current probe at CT1, CT2, and CT3. Voltage input into the board should not exceed 600 VAC, (damage to board occurs at 750 VAC). Current input into the board should not exceed 5 Amps. If a short circuit or over-voltage/-current condition exists, correct the problem.

5.6.179 Fault Code 2916 - Utility AC Meter Failed

Metering chip has failed and can no longer accurately monitor utility current and voltage.

A. An Over-Voltage/-Current Condition Has Damaged The Metering Chip

1. Measure the voltage using a volt-meter at L1: TB7-1; L2: TB7-2, L3: TB7-3, L4: TB7-4; and the current using a current probe at CT1, CT2, and CT3. Voltage input into the board should not exceed 600 VAC, (damage to board occurs at 750 VAC). Current input into the board should not exceed 5 Amps. If a short circuit or over-voltage/-current condition exists, correct the problem.

5.6.180 Fault Code 2917 - Gen Bus Voltage OOR Hi

If the Paralleling Application parameter is set to “Genset Bus", and the Genset Bus Voltage sensing input into the base board exceeds 1020 VAC for the time that is registered in the “Genset Bus Voltage OOR Delay"; the generator set control will display event/fault code 2917.

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A. The Control Is Set Up With The Incorrect Genset Bus PT Ratio or The PT's Are Incorrectly Sized.

1. Refer to event/fault code 2819.

B. The voltage of the Genset Bus is too high and/or unstable.

1. Ensure that the voltage of the Genset Bus is at nominal or stable; high generator set bus voltage can also damage the base board.

5.6.181 Fault Code 2918 - Utility Voltage OOR Hi

If the Paralleling Application parameter is set to “Utility", and the Utility Voltage sensing input into the base board exceeds 1020 VAC for the time that is registered in the “Utility Voltage OOR Delay; the generator set control will display event/fault code 2918.

A. The Control Is Set Up With The Incorrect Genset Bus PT Ratio 0r The PT's Are Incorrectly Sized.

1. Refer to event/fault code 2819.

B. The Voltage Of The Genset Bus Is Too High And Or Unstable

1. Check with your utility company.

5.6.182 Fault Code 2919 - Utility Current OOR Hi

If the Paralleling Application parameter is set to “Utility", and the Utility Current sensing input into the base board exceeds 140% for the time that is registered in the “Utility Current OOR Delay; the generator set control will display event/fault code 2919.

A. The Control Is Set Up With The Incorrect Utility CT Ratio Or The CT's Are Incorrectly Sized

1. If this fault becomes active during the commissioning processes, verify the sizing of the CT's and the setup of the Utility CT Ratio. The Utility secondary CT ratio can be set to 1 or 5 Amps; Fault code 2919 will become active when the Utility secondary CT current going into the base board is 1.4 amps or 7 amps. Ensure that the Maximum Utility primary CT current, Full Load Amps (FLA) of the building/application is correct.
    a. Use the following equation to determine the FLA.
        - FLA (one phase) = Maximum KW / Voltage
        - FLA (three phases) = Maximum KW / Voltage * (1.732)
        - Primary CT : Secondary CT = (FLA * 1.1) : (1 or 5 Amps).

          Ex. The maximum building load is 100KW, at 480 VAC, three phase.

          FLA = 100000 / 480*1.73 = 120.42

          The Utility primary CT size and CT Ratio should be at least 121 * (1.1) = 133 (1.1 is used as a buffer)

          Primary CT: Secondary CT = 133 : (1 or 5 Amps).
2. To change the Utility CT Primary Current and Utility CT Secondary Current ratio parameter appropriately for the application, go to: **Setup > Paralleling Setup > Basic > CT Primary or CT Secondary** and set appropriately.

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B. Check For A Short Circuit

1. Check for a short circuit.

C. The Voltage Of The Genset Bus Is Too High And Or Unstable

1. Check with your utility company.

5.6.183 Fault Code 2921 - Gen Bus Current OOR Hi

If the Paralleling Application parameter is set to “Genset bus", and the Genset bus Current sensing input into the base board exceeds 140% for the time that is registered in the “Genset bus Current OOR Delay; the generator set control will display event/fault code 2921.

A. The Control Is Set Up With The Incorrect Utility CT Ratio Or The CT's Are Incorrectly Sized

1. If this fault becomes active during the commissioning processes, verify the sizing of the CT's and the setup of the Utility CT Ratio. The Utility secondary CT ratio can be set to 1 or 5 Amps; Fault code 2919 will become active when the Utility secondary CT current going into the base board is 1.4 amps or 7 amps. Ensure that the Maximum Utility primary CT current, Full Load Amps (FLA) of the building/application is correct.
   a. Use the following equation to determine the FLA.
      - FLA (one phase) = Maximum KW / Voltage
      - FLA (three phases) = Maximum KW / Voltage * (1.732)
      - Primary CT : Secondary CT = (FLA * 1.1) : (1 or 5 Amps).

        Ex. The maximum building load is 100KW, at 480 VAC, three phase.

        FLA = 100000 / 480*1.73 = 120.42

        The Utility primary CT size and CT Ratio should be at least 121 * (1.1) = 133 (1.1 is used as a buffer)

        Primary CT: Secondary CT = 133 : (1 or 5 Amps).
2. To change the Utility CT Primary Current and Utility CT Secondary Current ratio parameter appropriately for the application, go to: **Setup > Paralleling Setup > Basic > CT Primary or CT Secondary** and set appropriately.

B. The Current Of The Utility Is Too High And Or Unstable

1. Ensure that the current of the Genset Bus is at nominal or stable; high generator set bus current can also damage the base board.

5.6.184 Fault Code 2922 - Genset Neutral Curr OOR Hi

The Genset Neutral current is above the “Genset Neutral Current Calibration" parameter for the time in the “Genset Neutral Current OOR Delay" time parameter.

A. CT Ratio Is Too Small Or The CTs Are Not Sized Correctly For The Genset Voltage And kW Rating

1. Please see event/fault code 2814.

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B. Genset Neutral Current Is Above The Genset Neutral Current Calibration Parameter

1. Measure the Genset Neutral current input into the control board with a current probe at J22-4. The maximum value of current going into the control CTs should not be more than the value of the “Genset CT Secondary Current" value that the control is calibrated for. For example, if secondary setting in the control is 1 Amp, current going into the control should not be more than 1 Amp.

   To access the Genset CT Secondary Current configuration menu on the operator panel, go to **Setup > OEM Setup > OEM Alt Setup > Genset CT Secondary Current**, and set the parameter appropriately for the application.

C. Faulty CT

1. If the above is satisfactory, check the CT and replace if faulty.

5.6.185 Fault Code 2923 - Gen Bus kW OOR Hi

If the Paralleling Application parameter is set to “Genset Bus", and the Genset Bus KW exceeds 32,767 KW or is below -32768 KW for the time that is registered in the “Genset Bus KW OOR Delay; the generator set control will display event/fault code 2923.

A. Incorrect Application Or Setup GenBus kWOORHi

1. Generator set is being used in an incorrect application in which the power monitoring is out of range. Ex. If there are 25 paralleled generator sets operating at 2 MW and 13.8 KV, the generator set will not be able to monitor power above 32.767 MW and will display event/fault code 2923. This application will require external switchgear to monitor power.
2. Genset Bus CT Ratio is incorrectly set, refer to event/fault code 2921.
3. Genset Bus PT Ratio is incorrectly set, refer to event/fault code 2917.

5.6.186 Fault Code 2924 - Gen Bus kVAR OOR Hi

If the Paralleling Application parameter is set to “Genset Bus", and the Genset Bus KVAR exceeds 32,767 KVAR or is below -32768 KVAR for the time that is registered in the “Genset Bus KVAR OOR Delay; the generator set control will display event/fault code 2924.

A. Incorrect Application Or Setup GenBus kVAR OORHi

1. Generator set is being used in an incorrect application in which the power monitoring is out of range. Ex. If there are 25 paralleled generator sets operating at 2 MVAR and 13.8 KV, the generator set will not be able to monitor power above 32.767 MVAR and will display event/fault code 2924. This application will require external switchgear to monitor power.
2. Genset Bus CT Ratio is incorrectly set, refer to event/fault code 2921.
3. Genset Bus PT Ratio is incorrectly set, refer to event/fault code 2917.

5.6.187 Fault Code 2925 - Gen Bus kVA OOR Hi

If the Paralleling Application parameter is set to “Genset Bus", and the Genset Bus KVA exceeds 65,535 KVA for the time that is registered in the “Genset Bus KVA OOR Delay; the generator set control will display event/fault code 2925.

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A. Incorrect Application Or Setup - Gen Bus kVA OOR Hi

1. Generator set is being used in an incorrect application in which the power monitoring is out of range. Ex. If there are 35 paralleled generator sets operating at 2 MVA and 25 KV, the generator set will not be able to monitor power above 65.535 MVA and will display event/fault code 2925. This application will require external switchgear to monitor power.
2. Genset Bus CT Ratio is incorrectly set, refer to event/fault code 2921.
3. Genset Bus PT Ratio is incorrectly set, refer to event/fault code 2917.

5.6.188 Fault Code 2926 - Utility kW OOR Hi

If the Paralleling Application parameter is set to “Utility", and the Utility KW exceeds 32,767 KW or is below -32768 KW for the time that is registered in the “Utility KW OOR Delay; the generator set control will display event/fault code 2926.

A. Incorrect Application Or Setup Utility kWOORHi

1. Generator set is being used in an incorrect application in which the power monitoring is out of range. Ex. If the Utility power is 40 MW, the generator set will not be able to monitor power above 32.767 MW and will display event/fault code 2926. This application will require external switchgear to monitor power.
2. Utility CT Ratio is incorrectly set, refer to event/fault code 2919.
3. Utility PT Ratio is incorrectly set, refer to event/fault code 2918.

5.6.189 Fault Code 2927 - Utility kVAR OOR Hi

If the Paralleling Application parameter is set to “Utility", and the Utility KVAR exceeds 32,767 KVAR or is below -32768 KVAR for the time that is registered in the “Utility KVAR OOR Delay; the generator set control will display event/fault code 2927.

A. Incorrect Application Or Set up kVAR

1. Generator set is being used in an incorrect application in which the power monitoring is out of range. Ex. If the Utility power is 40 MVAR, the generator set will not be able to monitor power above 32.767 MVAR and will display event/fault code 2927. This application will require external switchgear to monitor power.
2. Utility CT Ratio is incorrectly set, refer to event/fault code 2919.
3. Utility PT Ratio is incorrectly set, refer to event/fault code 2918.

5.6.190 Fault Code 2928 - Utility kVA OOR Hi

If the Paralleling Application parameter is set to “Utility", and the Utility KVA exceeds 65,535 KVA for the time that is registered in the “Utility KVA OOR Delay; the generator set control will display event/fault code 2928.

A. Code 2928 - Utility kVA OOR Hi

1. Generator set is being used in an incorrect application in which the power monitoring is out of range. Ex. If the Utility power is 70 MVAR, the generator set will not be able to monitor power above 65.535 MVA and will display event/fault code 2928. This application will require external switchgear to monitor power.
2. Utility CT Ratio is incorrectly set, refer to event/fault code 2919.
3. Utility PT Ratio is incorrectly set, refer to event/fault code 2918.

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5.6.191 Fault Code 2931 – AUX 101 Device ID Error

This fault is active if there are AUX 101 with a 2 or 3 that are sensed in the PCC network or if both AUX 101 have ‘0’ or ‘1’ ID.

NOTICE
Device ID with 3 or 4 can exist through the CAN Link (J1939) but not through the PCC net.

A. Check Aux 101 Calibration

1. Check the LED on the AUX 101 boards. Ensure that there is only one AUX 101-3 and one AUX 101-4 respectively. If there are two, follow the procedure outlined below to change the board ID numbers.
    a. Press and hold S1 for at least five seconds. On the AUX 101 device number indicator, a small dot should appear next to the current device number.
    b. Press and release S1 until the desired number is displayed.
    c. Wait five seconds. After five seconds of inactivity, the new device number is set, and the small dot should disappear.
    d. Disconnect and reconnect J14 to cycle power to the AUX 101.
2. Connect to the AUX 101 board through InPower (Use site AUX101_LBNG) and verify that it has the latest calibration programmed into the board.

5.6.192 Fault Code 2932 - Aux 101 Oil Temp Sensor High

This fault will occur if the Input voltage coming in from the Oil Temperature sensor has reached its high Out of Range limit for the set time.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 61. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
AUX 101 Oil/Ambient/Intake Manifold Temp OOR High Limit	**Setup > Genset Setup**	Default = 4.8 V
AUX 101 Oil/Ambient/Intake Manifold Temp OOR Time	**Setup > Genset Setup**	Default = 2 s

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5.6.193 Fault Code 2933 – Aux 101 Oil Temp Sen Lo

This fault will occur if the Input voltage coming in from the Oil Temperature sensor has reached its lower Out of Range limit for the set time.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 62. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
AUX 101 Oil/Ambient/Intake Manifold Temp OOR Low Limit	**Setup > Genset Setup**	Default = 0.2 V
AUX 101 Oil/Ambient/Intake Manifold Temp OOR Time	**Setup > Genset Setup**	Default = 2 s

5.6.194 Fault Code 2934 – Ambient Temp Sen Hi

This fault will occur if the Input voltage coming in from the Ambient Temperature sensor has reached its high Out of Range limit for the set time.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 63. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
AUX 101 Oil/Ambient/Intake Manifold Temp OOR High Limit	**Setup > Genset Setup**	Default = 4.8 V
AUX 101 Oil/Ambient/Intake Manifold Temp OOR Time	**Setup > Genset Setup**	Default = 2 s

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5.6.195 Fault Code 2935 – Ambient Temp Sen Lo

This fault will occur if the Input voltage coming in from the Ambient Temperature sensor has reached its lower Out of Range limit for the set time.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 64. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
AUX 101 Oil/Ambient/Intake Manifold OOR High Limit	**Setup > Genset Setup**	Default = 0.2 V
AUX 101 Oil/Ambient/Intake Manifold OOR Time	**Setup > Genset Setup**	Default = 2 s

5.6.196 Fault Code 2936 – Fuel Level Sens Hi

This fault will occur if the Input voltage coming in from the Fuel Level sensor has reached its high Out of Range limit for the set time.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 65. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
AUX 101 Fuel Level OOR High Limit	**Setup > Genset Setup**	Default = 4.8 V
AUX 101 Fuel Level OOR Time	**Setup > Genset Setup**	Default = 2 s

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5.6.197 Fault Code 2937 – Fuel Level Sens Lo

This fault will occur if the Input voltage coming in from the Fuel level sensor has reached its lower Out of Range limit for the set time.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 66. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
AUX 101 Fuel Level OOR Low Limit	**Setup > Genset Setup**	Default = 0.2 V
AUX 101 Fuel Level OOR Time	**Setup > Genset Setup**	Default = 2 s

5.6.198 Fault Code 2938 - Earth/Ground Fault

Short to ground in the external wiring.

A. Configurable Input Active State Selection Parameter Is Incorrectly Configured For Ground Fault

1. Through the operator panel, check the switch input setting (active closed or open) for the Configurable Input setup for Ground Fault. Ensure that the switch input setting is correctly set. If "Configurable Input Function Pointer" parameter is set to Ground Fault and if "Configurable Input Active State Selection" parameter is set to "active closed", event/fault code 2938 will become active when the input is a ground input.
2. If "Configurable Input Function Pointer" parameter is set to Ground Fault and if "Configurable Input Active State Selection" parameter is set to "active open", event/fault code 2938 will become active when the input is an open circuit.
3. To access the input configuration on the operator panel go to **Setup > Configurable I/O > Config Input Menu > Active** and set the "Configurable Input Active State Selection" parameter appropriately for the application.

B. Incorrectly Wired Open Or Short Circuit In The Wiring

1. Depending on the "Configurable Input Active State Selection" parameter setting, check the wiring for an open/short circuit, or mis-wired condition from the generator set (L1, J22-1; L2, J22-2; L3, J2-3; LN, J22-4) to the Ground Fault Alarm Relay (Input 6 and 8), correct if faulty.

C. Faulty Ground Fault Alarm Relay

1. Ensure that the input voltage to the Ground Fault Alarm Relay is 24 VDC, at input 1 and 2.

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2. Verify that the Trip Current and Time Delay settings on the Ground Fault Alarm Relay are set appropriately for the application.
3. If the previous steps are satisfactory, replace the Ground Fault Alarm Relay.

(refer to instruction sheet C648a).

5.6.199 Fault Code 2939 - MODBUS Failure

If any of the Modbus parameters are Active, and the Modbus device stops communicating with the base board for a time period longer than in the “Modbus Failure Time Delay", event/fault code 2939 becomes active.

A. Active Modbus Fault Or Wiring Issue

1. Check the following parameters for an “Active" Modbus state. If any of the below listed Modbus parameters are Active and have stopped communicating with the base board for a time period longer than in the “Modbus Failure Time Delay", event/fault code 2939 becomes active. Communication with these items will need to be restored.
   - Exercise Switch
   - Remote Start Switch
   - Load Demand Stop
   - Start Type
   - Fault Reset
   - Battle Short Switch
   - Genset CB Inhibit Switch
   - Utility CB Inhibit Switch
   - Synch Enable Switch
   - Ramp Load Unload Switch
   - Speed Droop Enable Switch
   - Voltage Droop Enable Switch
   - Genset CB Tripped Switch
   - Utility CB Tripped Switch
   - Extended Parallel Switch
   - PTC Mode Switch
2. Check the Modbus connection from the parameters listed above to that base board connection at TB15-3 (RS485+) and TB15-4 (RS485-) for open/short circuits or miswiring. There should be a 120 Ohm terminating resistor at each end of the Modbus network (a resistor at the control TB15-3 (RS485+) and TB15-4 (RS485-) and at the last device of the Modbus network). Also ensure that the shield is grounded at TB15-1. the shield should be grounded at ONLY this point.

B. Faulty Modbus Device

1. Check the Modbus device that is transmitting information to the base board. If this device is faulty and/or has stopped communicating with the base board, event/fault code 2939 becomes Active. If the external Modbus device is faulty then repair or replace.

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5.6.200 Fault Code 2941 – Remote Fault Reset

This is an event. No action required.

5.6.201 Fault Code 2942 - Shutdown Override Fail

The generator set has failed to transition to Battle Short mode or Delayed Shutdown mode.

A. Battle Short Or Delayed Shutdown Is Not Enabled In The Genset Control

1. Through the operator panel, verify that the “Battle Short" parameter is set to enable. To access the “Battle Short" configuration menu on the operator panel go to **Setup > OEM Setup > OEM Genset Setup > Battle Short** and set the parameter to enable, if the battle short mode is required by the customer.
2. Ensure that one of the configurable inputs is set up to activate Battle Short mode (e.g., Configurable Input #1 = Battle Short). Battle Short may now be enabled by activating the configurable input that was set up for Battle Short (e.g., Enable Configurable Input #1 with a ground input).
3. Through the operator panel, verify that the “Delayed Shutdown" parameter is set to enable. To access the “Delayed Shutdown" configuration menu on the operator panel go to **Setup > OEM Setup > OEM Genset Setup > Delayed Shutdown** and set the parameter to enable, if the Delayed Shutdown mode is required by the customer.

B. Battle Short Is Not Enabled In The Engine Control Module (ECM)

1. Connect to the ECM with InSite or InPower and enable the Battle Short parameter in the ECM. Under “Engine Protection", set “Shutdown Manual Override" to “Enable".

5.6.202 Fault Code 2943 - Manual Sw Config Fail

Event/fault code 2943 is activated when the control receives an active Manual input from both the operator panel and the PCCNet network at the same time for two seconds or more.

A. Two Manual Command Inputs That Are Active At The Same Time_Manual

1. Ensure there is only one Manual switch input to the control that is active, either through the operator panel or PCCNet Network (PCCNet DIM) but not both at the same time.

5.6.203 Fault Code 2944 - Auto Switch Config Fail

Event/fault code 2944 is activated when the control receives an active Auto input from both the operator panel and the PCCNet network at the same time for two seconds or more.

A. Two Auto Command Inputs That Are Active At The Same Time

1. Ensure there is only one Auto switch input to the control that is active, either through the operator panel or through PCCNet Network (PCCNet DIM) but not both at the same time

5.6.204 Fault Code 2945 - Rupture Basin

Main fuel tank is leaking into the rupture basin.

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A. Check Main Fuel Tank for Leaks

Make sure there is no fuel leaking into the rupture basin.

B. Rupture Basin/Configurable Input #12 Active State Selection Parameter Is Incorrectly Configured

1. Through the operator panel check the switch input setting (active closed or open) for the Rupture Basin/Configurable Input #12 Active State Selection. Ensure that the switch input setting is correctly set. If "Rupture Basin/Configurable Input #12 Function Pointer" parameter is set to Default and if "Rupture Basin/Configurable Input #12 Active State Selection" parameter is set to "active closed", event/fault code 2945 will become active when the input is a ground input.
2. If ""Rupture Basin/Configurable Input #12 Function Pointer" parameter is set to Default and if "Rupture Basin/Configurable Input #12 Active State Selection" parameter is set to "active open", event/fault code 2945 will become active when the input is an open circuit.
3. To access the input configuration on the operator panel go to **Setup > Configurable I/O > Rupture Basin/Configurable Input #12 Active State Selection** and set the "Rupture Basin/Configurable Input #12 Active State Selection" parameter appropriately for the application.

C. Incorrectly Wired; Open Or Short Circuit In The Wiring

1. Depending on the "Rupture Basin/Configurable Input #12 Active State Selection" parameter setting, check the wiring at for an open/short circuit, or miswired condition, from the rupture basin sender to the base board at J20-19 and J20-8; correct if wiring is faulty.

D. Faulty Sender

1. Measure the rupture basin sender for an open or short circuit reading, replace if faulty.

5.6.205 Fault Code 2946 – Exh Stk 2 Temp Sens Lo

This fault will occur if the Input voltage coming in from the Exhaust Stack temperature sensor number 2 has reached its lower Out of Range limit for the set time.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 67. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
AUX 101 Exhaust Stack Temp OOR Low Limit	**Setup > Genset Setup**	Default = 0.2 V

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Setting	Menu Navigation	Parameter
AUX 101 Exhaust Stack Temp OOR Time	**Setup > Genset Setup**	Default = 2 s

5.6.206 Fault Code 2947 – Exh Stk 1 Temp Sens Lo

This fault will occur if the Input voltage coming in from the Exhaust Stack temperature sensor number 1 has reached its lower Out of Range limit for the set time.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 68. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
AUX 101 Exhaust Stack Temp OOR Low Limit	**Setup > Genset Setup**	Default = 0.2 V
AUX 101 Exhaust Stack Temp OOR Time	**Setup > Genset Setup**	Default = 2 s

5.6.207 Fault Code 2948 – High Exh Stk 2 Temp

This fault will occur if the Input voltage coming in from the Exhaust Stack temperature sensor number 2 has reached its high Out of Range limit for the set time.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

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TABLE 69. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
AUX 101 Exhaust Stack Temp OOR High Limit	**Setup > Genset Setup**	Default = 4.8 V
AUX 101 Exhaust Stack Temp OOR Time	**Setup > Genset Setup**	Default = 2 s

5.6.208 Fault Code 2949 – High Exh Stk 1 Temp

This fault will occur if the Input voltage coming in from the Exhaust Stack temperature sensor number 1 has reached its high Out of Range limit for the set time.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 70. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
AUX 101 Exhaust Stack Temp OOR High Limit	**Setup > Genset Setup**	Default = 4.8 V
AUX 101 Exhaust Stack Temp OOR Time	**Setup > Genset Setup**	Default = 2 s

5.6.209 Fault Code 2951 – Alternator 1 Temp Sen Hi

This fault will occur if the Input voltage coming in from the Alternator 1 Temperature sensor has reached its high Out of Range limit for the set time.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

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TABLE 71. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Alternator 1 Temperature OOR High Limit	**Setup > Genset Setup**	Default = 4.8 V
Alternator 1 Temperature OOR Time	**Setup > Genset Setup**	Default = 2 s

5.6.210 Fault Code 2952 – Alternator 1 Temp Sen Lo

This fault will occur if the Input voltage coming in from the Alternator 1 Temperature sensor has reached its lower Out of Range limit for the set time.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 72. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Alternator 1 Temperature OOR Low Limit	**Setup > Genset Setup**	Default = 0.2 V
Alternator 1 Temperature OOR Time	**Setup > Genset Setup**	Default = 2 s

5.6.211 Fault Code 2953 – High Alternator 1 Temp

This Fault is triggered when the Alternator 1 main stator winding reaches its high temperature threshold value for a set period of time.

A. Check Alternator Temperature

1. Use an infrared temperature gun or thermal image gun to verify temperature of the winding with respect to the HMI of the control.
2. If higher than expected, follow troubleshooting procedure for the alternator main stator winding.

B. Check Generator Set Ventilation

1. Check functionality of the louvers.
2. Check for restriction or blockage at the inlet air of the alternator.

C. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.

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2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

D. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 73. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
High Alternator Temperature 1 Threshold	**Setup > Genset Setup**	Default = 300 °F
High Alternator Temperature 1 Time	**Setup > Genset Setup**	Default = 5 s

5.6.212 Fault Code 2954 – Alternator 2 Temp Sen Hi

This fault will occur if the Input voltage coming in from the Alternator 2 Temperature sensor has reached its high Out of Range limit for the set time.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 74. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Alternator 2 Temperature OOR High Limit	**Setup > Genset Setup**	Default = 4.8 V
Alternator 2 Temperature OOR Time	**Setup > Genset Setup**	Default = 2 s

5.6.213 Fault Code 2955 – Alternator 2 Temp Sen Lo

This fault will occur if the Input voltage coming in from the Alternator 2 Temperature sensor has reached its lower Out of Range limit for the set time.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.

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4. If the readings match, check the sensor calibration.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 75. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Alternator 2 Temperature OOR Low Limit	**Setup > Genset Setup**	Default = 0.2 V
Alternator 2 Temperature OOR Time	**Setup > Genset Setup**	Default = 2 s

5.6.214 Fault Code 2956 – High Alternator 2 Temp

This Fault is triggered when the Alternator 2 main stator winding reaches its high temperature threshold value for a set period of time.

A. Check Alternator Temperature

1. Use an infrared temperature gun or thermal image gun to verify temperature of the winding with respect to the HMI of the control.
2. If higher than expected, follow troubleshooting procedure for the alternator main stator winding.

B. Check Generator Set Ventilation

1. Check functionality of the louvers.
2. Check for restriction or blockage at the inlet air of the alternator.

C. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

D. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 76. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
High Alternator Temperature 2 Threshold	**Setup > Genset Setup**	Default = 300 °F
High Alternator Temperature 2 Time	**Setup > Genset Setup**	Default = 5 s

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5.6.215 Fault Code 2957 – Alternator 3 Temp Sen Hi

This fault will occur if the Input voltage coming in from the Alternator 3 Temperature sensor has reached its high Out of Range limit for the set time.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 77. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Alternator 3 Temperature OOR High Limit	**Setup > Genset Setup**	Default = 4.8 V
Alternator 3 Temperature OOR Time	**Setup > Genset Setup**	Default = 2 s

5.6.216 Fault Code 2958 – Alternator 3 Temp Sen Lo

This fault will occur if the Input voltage coming in from the Alternator 3 Temperature sensor has reached its lower Out of Range limit for the set time.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

B. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 78. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Alternator 3 Temperature OOR Low Limit	**Setup > Genset Setup**	Default = 0.2 V
Alternator 3 Temperature OOR Time	**Setup > Genset Setup**	Default = 2 s

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5.6.217 Fault Code 2959 – High Alternator 3 Temp

This fault is triggered when the Alternator 3 main stator winding reaches its high temperature threshold value for a set period of time.

A. Check Alternator Temperature

1. Use an infrared temperature gun or thermal image gun to verify temperature of the winding with respect to the HMI of the control.
2. If higher than expected, follow troubleshooting procedure for the alternator main stator winding.

B. Check Generator Set Ventilation

1. Check functionality of the louvers.
2. Check for restriction or blockage at the inlet air of the alternator.

C. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

D. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 79. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
High Alternator Temperature 3 Threshold	**Setup > Genset Setup**	Default = 300 °F
High Alternator Temperature 3 Time	**Setup > Genset Setup**	Default = 5 s

5.6.218 Fault Code 2965 – Genset Available

This is an event. No action required.

5.6.219 Fault Code 2966 - PTC Timeout

PTC module is not responding. PTC status may be okay, but the PTC module is no longer communicating.

A. Check PTC Power

1. Check for blinking light on the PTC module to indicate that it has power.
2. If off, check for B+ between TB3-3 and TB3-4.
3. Check PTC status voltage between TB3-5 and TB3-6 (0.2 VDC).
4. Check to make sure cable ground shield, on the cable from the PTC module is properly grounded at the generator set control.

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5. Remove power from the control for 5 seconds, then reapply power. Confirm that the fault clears.

B. Check the Harnesses

1. Check the harnesses and connections points for:
   - Corroded pins
   - Bent or broken pins
   - Pushed back or expanded pins
   - Evidence of moisture in or on the connector
   - Missing or damaged connector seals
   - Dirt or debris in or on the connector pin
2. Check the pin-to-pin connections. If no short or open circuit is found, check all connections to the pins.

5.6.220 Fault Code 2967 - Governor Fault

Governor hardware drive circuitry contains a fault condition.

5.6.221 Fault Code 2968 - AVR Fault

Control does not recognize AVR output within the set time delay.

5.6.222 Fault Code 2971 – Test/Exercise Active

This is an event. No action required.

5.6.223 Fault Code 2972 - Field Overload

If the time that the field AVR duty cycle is operating at maximum output (60% duty cycle) is longer than the time in the Maximum Field Time parameter, event/fault code 2972 becomes active.

A. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 80. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Max Field Time	**Setup > OEM Setup > OEM Alt Setup > Max Field Time**	Set appropriately for the application. (Default = 15s) Make sure the Max Field Time is not set to 0.

B. Check AVR Output

1. Measure the output of the AVR (Automatic Voltage Regulation) at the following connection locations. The output should fall within the specified ranges.
   - If the voltage is constantly zero, or less than specified then the AVR portion, the PCC is faulty.

2. Double-check the results.
   a. Disconnect the connections from the AVR board (the AVR board should no longer be connected to the field wires).
   b. Place a power supply with the same VDC as the acceptable range to the field wires.
   c. If the generator set produces adequate voltage (nominal voltage or greater) the AVR portion of the control board is faulty. Replace the control board.

TABLE 81. CONNECTIONS

Check	Connections	Parameter
Voltage Input	L1 (J22-1), Fuses (F11)	Acceptable value: Must be greater than zero. Must be ≥ nominal voltage.
	L2 (J22-2), Fuses (F12)	
	L3 (J22-3), Fuses (F13)	
	LN (J22-4)	

NOTICE

If the voltage does not fall within the acceptable range, check the wiring from the alternator to the base board for an open or short circuit.

C. Check AUX 103/106

Use InPower to check the AUX 103/106 as follows:

- If the AVR (Automatic Voltage Regulation) or PWM (Pulse Width Modulation) is continuously high, replace the control board.
- If the AUX 103/106 is continuously high, replace the AUX 103/106.

TABLE 82. ACCEPTABLE VALUES (AUX 103)

Measure	Location	Operating Condition	Acceptable Value
AVR(AUX 103Input	P19-1 (B+)	No load	17-30 VDC
AVR (AUX 103) Input	P19-8 (B-)	No load	17-30 VDC
PWM (pulse width modulation)	P19-2 (AVR PWM +)	Generator set on	< 2.0 VDC
PWM (pulse width modulation)	P19-9 (AVR PWM -)	Generator set on	< 2.0 VDC
Output	P18-1	Running at rated speed	50 Hz Genset: 170-180 V 60 Hz Genset: 200-216 V
Output	P18-2	Running at rated speed	
Output	P18-3	Running at rated speed	
AVR Output	P17-1	Generator set on	≥ 300 VDC
AVR Output	P17-2	Generator set on	

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TABLE 83. ACCEPTABLE VALUES (AUX 106)

Measure	Location	Operating Condition	Acceptable Value
AVR(AUX 106) Input	P19-1 (B+)	No load	17-30 VDC
AVR(AUX 106) Input	J17-2 (-)	No load	17-30 VDC
PWM (pulse width modulation)	J19-2 (AVR PWM +)	Generator set on.	< 2.0 VDC
PWM (pulse width modulation)	J19-9 (AVR PWM -)	Generator set on.	< 2.0 VDC
Output	P18-1	Running at rated speed	50 Hz Genset: 170-180 V 60 Hz Genset: 200-216 V
Output	P18-2	Running at rated speed	60 Hz Genset: 200-216 V
Output	P18-3	Running at rated speed	≥ 300 VDC
AVR Output	P17-1	Generator set on.	
AVR Output	P17-2	Generator set on.	

D. Check Connections

1. Check the connections from the alternator to the potential transformer (PT) and from the PT to the control board.
2. If there is voltage going into the PT, but not coming out of it, replace the PT.

E. Check for Proper Application

It may be an application issue if the generator set runs adequately with no load or some load, but as soon as additional load is applied, it shuts down on "Field Overload". Make sure the generator set is properly loaded and not undersized.

5.6.224 Fault Code 2977 - Low Coolant Level 2

Low Coolant Level switch #2 indicates that the coolant level is low in the second radiator.

Possible Causes:

1. Low Coolant.
2. Coolant sender incorrectly wired.
3. Faulty coolant level sender.
4. The "Configurable Input Active State Selection" parameter is configured incorrectly.
5. Faulty Extension Harness Coolant Level Sensor.

A. Low Coolant

1. Stop the engine and allow the engine to cool down.

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2. Visually inspect that engine coolant is at the appropriate level through the sight glass or expansion tank.
3. Remove radiator cap and check that coolant is up to the required level.
4. If coolant is below 1 in. (2.54 cm) from the top of the radiator add manufacturer's prescribed coolant.

B. Cooling System Hose Is Collapsed, Restricted Or Leaking

1. Inspect upper and lower radiator hoses for collapse, distortion, or fluid leaks.
2. Replace if damaged or worn.

C. Coolant Sender Incorrectly Wired

1. Check for improper wiring, such as a short or open circuit from the coolant sensor to the discrete configurable input on the base board that was configured for the "Low Coolant Level 2 Switch". If a short/open circuit or improper wiring is found, correct the wiring.

D. Configurable Input Active State Selection parameter is configured incorrectly

1. Through the operator panel, check the switch input setting (active closed or active open) for the Configurable Input that was configured to "Low Coolant Level 2 Switch". Ensure the setting is correct. If the "Configurable Input Function Pointer" parameter is set to "Low Coolant Level 2 Switch" and the "Configurable Input Active State Selection" parameter is set to "active closed", event/fault code 2977 will become active when the Configurable Input that was configured to "Low Coolant Level 2 Switch" is connected to ground.

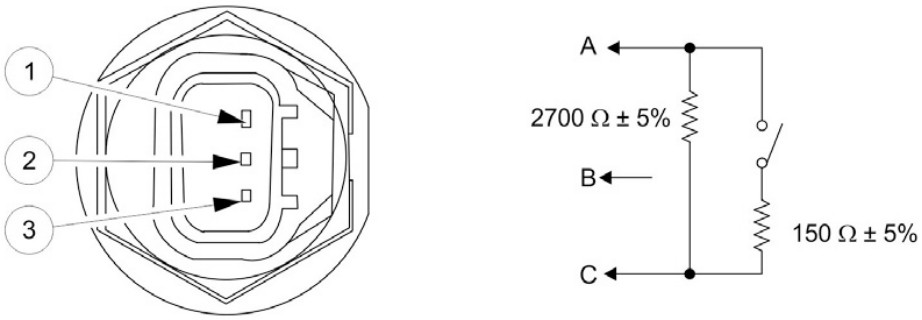
   If the "Configurable Input Function Pointer" parameter is set to "Low Coolant Level 2 Switch" and the "Configurable Input Active State Selection" parameter is set to "active open", event/fault code 2977 will become active when the Configurable Input that was configured to "Low Coolant Level 2 Switch" is an open circuit.

   To access the input configuration on the operator panel go to **Setup > Configurable I/O >** and set the "Configurable Input Active State Selection" parameter appropriately for the Configurable Input that was configured to "Low Coolant Level 2 Switch".

E. Faulty Coolant Level Sensor

1. Check the sensor.
   a. Disconnect the engine harness connector from the coolant level sensor.
   b. Measure the resistance between the coolant level sensor signal pin and the coolant level sensor return pin. Resistance should be 142 Ω ± 5% (in coolant) or 2700 Ω ± 5% (in air).
      i. If resistance is not correct, replace sensor.
   c. Measure the voltage between the coolant level sensor signal pin and the coolant level sensor return pin. Voltage should be lower than 2.00 VDC.
      i. If voltage is more than above specification, replace sensor.

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No.	Description	No.	Description
1	Pin A - Power	3	Pin C - Signal Return
2	Pin B - Not used		

FIGURE 10. COOLANT LEVEL SENSOR SCHEMATIC

F. Faulty Extension Harness-Coolant Level Sensor

1. Inspect the extension harness and the extension harness connector pins.
   a. Disconnect the extension harness connector from the control.
   b. Inspect for corroded pins, bent or broken pins, pushed back or expanded pins.
   c. Inspect for evidence of moisture in or on the connector.
   d. Inspect for missing or damaged connector seals.
   e. Inspect for dirt or debris in or on the connector pins.
2. Check for an open circuit.
   a. Disconnect the extension harness connector from the control.
   b. Disconnect the extension harness from the engine harness.
   c. Measure the resistance from the coolant level sensor return pin on the engine harness inline connector to the coolant level sensor return pin at the engine harness sensor connector.
   d. Measure the resistance from the coolant level sensor signal pin on the engine harness inline connector to coolant level sensor signal pin at then engine harness sensor connector.
   e. If the measurement is less than 10 ohms, then the resistance is correct.
3. Check for a short circuit from pin to pin.
   a. Disconnect the extension harness connector from the control.
   b. Disconnect the extension harness from the engine harness.
   c. Disconnect the engine harness from all sensors that have a shared return with the coolant level sensor. Measure the resistance from the intake manifold temperature return pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   d. Measure the resistance from the coolant level sensor signal pin on the engine harness inline connector to all other pins in the engine harness inline connector.
   e. If all measurements are greater than 100k Ohms, then the resistance is correct.

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5.6.225 Fault Code 2978 – Int Manf 1 Temp Sen Lo

Intake Manifold Temp 1 feature is enabled in the AUX 101 and the Intake Manifold temperature has dropped below the acceptable value range.

A. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

B. Check Harness

Verify continuity of the wiring harness from customer side to the AUX 101.

C. Check Input Trigger

1. Check customer connections into the AUX 101 inputs.
2. If feature is not being used, disable the input.

D. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 84. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
OOR Low Limit	**Setup > Genset Setup**	Default = 0.2 V
OOR Time	**Setup > Genset Setup**	Devault = 2 s

5.6.226 Fault Code 2979 - High Alternator Temp

Indicates that the alternator temperature is high.

A. Alternator Temperature Sender Incorrectly Wired

1. Check for improper wiring or a short/open circuit from the alternator temperature sender to the discrete configurable input on the base board that was configured for the "High Alternator Temp Switch". If a short/open circuit or improper wiring is found, correct the wiring.

B. Faulty Alternator Temperature Sender

1. Measure the resistance between the alternator temperature signal pin and return pin. The resistance should be between 530 Ohms to 2214 Ohms. Replace the sender if the resistance value is out of specification.

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C. Configurable Input Active State Selection parameter is configured incorrectly

1. Through the operator panel, check the switch input setting (active closed or open) for the Configurable Input that was configured to "High Alternator Temp Switch". Ensure the setting is correct. If the "Configurable Input Function Pointer" parameter is set to "High Alternator Temp Switch" and the "Configurable Input Active State Selection" parameter is set to "active closed", event/fault code 2979 will become active when the Configurable Input that was configured to "High Alternator Temp Switch" is connected to ground.

   If the "Configurable Input Function Pointer" parameter is set to "High Alternator Temp Switch" and the "Configurable Input Active State Selection" parameter is set to "active open", event/fault code 2979 will become active when the Configurable Input that was configured to "High Alternator Temp Switch" is an open circuit.

   To access the input configuration on the operator panel go to **Setup > Configurable I/O >** and set the "Configurable Input Active State Selection" parameter appropriately for the Configurable Input that was configured to "High Alternator Temp Switch".

5.6.227 Fault Code 2981 – Drv Bearing Temp Sen Hi

This fault is set to occur if the Drive end Bearing temperature sensor is Out of Range and the temperature at the bearing is greater than 506 °F continuously for a set period of time.

A. Check Bearing Temperature

1. Check the temperature at the drive end bearing.
2. If higher than recommended, follow troubleshooting procedure for Fault Code 2983.

B. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

C. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 85. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Drive End Bearing OOR High Limit	**Setup > Genset Setup**	Default = 4.8 V
Drive End bearing Temperature OOR Time	**Setup > Genset Setup**	Default = 2 s

5.6.228 Fault Code 2982 –Drv Bearing Temp Sen Lo

This fault is set to occur if the Drive end bearing temperature sensor is Out of Range and the temperature at the bearing is less than 0 °F continuously for a set period of time.

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A. Check Bearing Temperature

1. Check the temperature at the drive end bearing.
2. If lower than recommended, follow troubleshooting procedure for the alternator bearing.

B. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

C. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 86. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Drive End Bearing OOR Low Limit	**Setup > Genset Setup**	Default = 0.2 V
Drive End bearing Temperature OOR Time	**Setup > Genset Setup**	Default = 2 s

5.6.229 Fault Code 2983 – High Drive Bearing Temp

This fault becomes active if the drive end bearing temperature is above the set threshold value over a given period of time.

A. Check Bearing Temperature

Use secondary equipment like infrared temperature gun or thermal imaging camera to read the bearing temperature.

B. Check Generator Set Ventilation

1. Check functionality of the louvers.
2. Check for restriction or blockage at the inlet air of the alternator.

C. Check Bearing Grease

1. Check maintenance log, ensure greasing procedure is followed to regrease the bearing.
2. Make sure that the correct grease is used.
3. Visually inspect for excessive grease loss.

D. Check Alternator to Engine Alignment

Check the alignment between the engine and the alternator bell housing.

E. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.

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2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

F. Check Setup or Application

Verify that the threshold values used are within the parameters of the alternator being used.

G. Replace Bearing as Necessary

5.6.230 Fault Code 2984 – NonDrv Bearing Sens Hi

This fault is set to occur if the non-drive end bearing temperature sensor is Out of Range and the temperature at the bearing is greater than 506 °F continuously for a set period of time.

A. Check Bearing Temperature

1. Check the temperature at the non-drive end bearing.
2. If higher than recommended, follow troubleshooting procedure for Fault Code 2986.

B. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

C. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 87. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Non-Drive End Bearing Temperature OOR High Limit	**Setup > Genset Setup**	Default = 4.80 V
Non-Drive End Bearing Temperature OOR Time	**Setup > Genset Setup**	Default = 2 s

C.2. Check Bearing Temperature

1. Check the temperature at the non-drive end bearing.
2. If lower than recommended, follow troubleshooting procedure for the alternator bearing.

5.6.231 Fault Code 2985 – NonDrv Bearing Sens Lo

This fault is set to occur if the non-drive end bearing temperature sensor is Out of Range and the temperature at the bearing is less than 0 °F continuously for a set period of time.

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A. Check Bearing Temperature

1. Check the temperature at the non-drive end bearing.
2. If lower than recommended, follow troubleshooting procedure for the alternator bearing.

B. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

C. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 88. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Non-Drive End Bearing Temperature OOR Low Limit	**Setup > Genset Setup**	Default = 0.2 V
Non-Drive End Bearing Temperature OOR Time	**Setup > Genset Setup**	Default = 2 s

5.6.232 Fault Code 2986 – High NonDrv Bearing Temp

This fault becomes active if the non-drive end bearing temperature is above the set threshold value over a given period of time.

A. Check Bearing Temperature

Use secondary equipment like infrared temperature gun or thermal imaging camera to read the bearing temperature.

B. Check Generator Set Ventilation

1. Check functionality of the louvers.
2. Check for restriction or blockage at the inlet air of the alternator.

C. Check Bearing Grease

1. Check maintenance log, ensure greasing procedure is followed to regrease the bearing.
2. Make sure that the correct grease is used.
3. Visually inspect for excessive grease loss.

D. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.

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4. If the readings match, check the sensor calibration.

E. Check Setup or Application

Verify that the threshold values used are within the parameters of the alternator being used.

F. Replace Bearing as Necessary

5.6.233 Fault Code 2993 – Battery Charger Failed

Indicates that the battery charger has failed.

A. Check Output of Battery Charger

Check the output voltage of the battery charger. If the battery charger is overcharging or not charging the batteries at all, then repair or replace the battery charger.

B. Check Battery Charger Wiring

Check for improper wiring, a short circuit, or an open circuit from the battery charger switch to the discrete configurable input on the control board that was configured for the "Battery Charger Switch Fail". If a short circuit, open circuit, or improper wiring is found, correct the wiring.

C. Check Switch

Measure the resistance of the battery charger switch. If the switch is shorted or open circuit, replace the switch.

D. Check Configurable Input Active State Selection Parameter

Through the operator panel, check the switch input setting (active closed or active open) for the Configurable Input that was configured to "Battery Charger Switch Fail". Ensure that the switch input setting is correctly set.

- If the "Configurable Input Function Pointer" parameter is set to "Battery Charger Switch Fail" and the "Configurable Input Active State Selection" parameter is set to "active closed" event/fault code 2993 becomes active when the Configurable Input that was configured to "Battery Charger Switch Fail" is connected to ground.
- If the "Configurable Input Function Pointer" parameter is set to "Battery Charger Switch Fail" and the "Configurable Input Active State Selection" parameter is set to "active open", event/fault code 2993 becomes active when the Configurable Input that was configured to "Battery Charger Switch Fail" is an open circuit.

To access the input configuration on the operator panel go to **Setup > Configurable I/O >** and set the "Configurable Input Active State Selection" parameter appropriately for the Configurable Input that was configured to "Battery Charger Switch Fail".

5.6.234 Fault Code 3226 – Base Load

This is an event. No action required.

5.6.235 Fault Code 3227 – Peak Shave

This is an event. No action required.

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5.6.236 Fault Code 3397 - Low GB Oil Pressure

⚠ WARNING

Hot Oil

Contact with hot oil can cause severe burns.

Avoid direct contact with hot oil. Allow the engine to cool down before carrying out any maintenance.

Immediate genset shutdown due to AUX101 sensed gearbox oil pressure activated switch circuit state is active and the genset's average engine speed is greater than the Gearbox Engine Speed Threshold for the duration of the Gearbox Dwell Time.

A. Gearbox Oil Supply is Low

1. Check and top-up the gearbox oil supply so-as to maintain an adequate quantity of oil to allow the oil pump to maintain system pressure above the pressure switch active threshold. Refer to the genset maintenance guide to ensure the gearbox oil level is properly maintained.

B. Gearbox Oil Is Leaking

1. Conduct a thorough assessment of the gearbox's exterior oil circuit to identify the source of pressure vent that's resulting in lubrication system pressure below the pressure switch active threshold. Sealing the leaks should restore pressure above the switch's active threshold.
    a. Leaking at the threaded joint. Ensure the joint's assembly torque is per genset spec. Disassemble and check thread and sealing interface condition and cleanliness if assembly torque was per spec and leaking persists.
    b. Leaking between gasketed surfaces. Ensure clamp force application to the gasketed surface is properly applied. Disassemble and clean sealing surfaces of oil film and debris and replace the gaskets if leaking persists.
2. Leaking as the result of a fatigued component. Assess and remedy the source of fatigue induction if the source appears abnormal. Replace fatigued component with new.

C. Inadequate Gearbox Dwell Time

1. Via InPower, verify/adjust Gearbox Dwell Time (default = 5 seconds) to allow the pressure switch to attain an inactive and stable state before the engine speed is greater than the Gearbox Engine Speed Threshold. Note that a high Gearbox Dwell Time may improperly disguise low speed gearbox mechanical issues.

D. Gearbox Engine Speed Threshold Set Low

1. Via InPower, verify/adjust Gearbox Engine Speed Threshold (default = 600 RPM) to provide sufficient gearbox oil pump speed and corresponding pressure switch to attain an inactive and stable state. Note that a high Gearbox Engine Speed Threshold may disguise low speed gearbox mechanical issues.

E. Faulty Gearbox Oil Pressure Switch Wiring

1. Wiring to pressure switch shorted together mimicking a pressure switch closure; repair.

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F. Inadequate Gearbox Oil Flow

1. Pressure drop across gearbox oil filter resulting in system pressure, post filter, below the inactive threshold of the pressure switch.
    a. Refer to the genset maintenance logs to ensure the gearbox oil filter is properly maintained.
    b. Inspect filter for irregular contamination (e.g. excessive metal or debris). Continue internal investigation if irregular contamination is found and filter was properly maintained.
    c. Clean/replace filter and oil.
    d. Clean/replace filter and oil if the filter was not properly maintained.
2. Pressure drop across gearbox oil heat exchanger (HEX) resulting in system pressure, post HEX, below the inactive threshold of the pressure switch.
    a. Check this genset's maintenance logs to determine when the last gearbox oil HEX cleaning was conducted.
    b. Inspect HEX for irregular contamination (e.g. excessive metal or debris). Continue internal investigation if irregular contamination is found and HEX was properly maintained.
    c. Clean/replace filter and oil and HEX, if HEX was not properly maintained.
3. The gearbox's oil pump is worn or faulty and generating insufficient pressure to render the pressure switch inactive.
    a. Check pump internal clearances and repair/replace as necessary.
4. Check line and transfer passages for contamination; clear and replace as needed.

G. Faulty Gearbox Oil Pressure Bypass

1. Gearbox oil pump pressure bypass is stuck open and oil is bypassing the pressure switch rendering it active. Inspect the pressure bypass and clean/replace as necessary.

H. Faulty Gearbox Oil Pressure Switch

1. Verify pressure switch state (active and inactive).
    a. Disconnect electrical leads from pressure switch (pressure switch must remain installed in original lubrication pressure sensing location).
    b. Attach DVOM test leads to pressure switch terminals to measure electrical resistance.
    c. Prepare DVOM to measure electrical resistance.
    d. Prepare DVOM to measure electrical resistance.
    e. Install physical pressure driven gauge to lubrication system pressure if a gauge isn't already fitted. Note gauge maximum pressure must be greater than lubrication system maximum pressure.
    f. Measure and note resting pressure.
    g. Drive gearbox oil pump to operating speed (e.g. start genset).
    h. Verify operating lubrication pressure (must be greater than pressure switch inactive threshold).
    i. Replace switch if active resistance = inactive resistance.

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I. Faulty AUX101-Gearbox Oil Pressure Switch

1. AUX101 isn't communicating gearbox oil pressure switch state properly and/or is falsely presenting gearbox oil pressure switch state as active to PCC. Check wiring and connections to AUX101 or refer to AUX101 troubleshooting with respect to the temperature switch interface.

5.6.237 Fault Code 3398 - High GB Oil Temperature

⚠ WARNING

Hot Oil

Contact with hot oil can cause severe burns.

Avoid direct contact with hot oil. Allow the engine to cool down before carrying out any maintenance.

Controlled genset shutdown due to AUX101 sensed gearbox oil temperature activated switch circuit stat is active and the genset's average engine speed is greater than the Gearbox Engine Speed Threshold.

A. Gearbox Oil Supply is Incorrect

1. Gearbox oil supply contains an inadequate quantity of oil, limiting time required to radiate heat before being employed again, resulting in an oil temperature greater than the temperature switch's active threshold. Check and top-up oil as needed. Refer to the genset maintenance guide to ensure the gearbox oil level is properly maintained.
2. Gearbox oil supply contains too much oil which is producing surface friction/drag between the gears and oil as well as potential oil cavitations. The gearbox input energy lost due to friction is converted to heat in both the oil and the gears, resulting in an oil temperature greater than the temperature switched active threshold. Check and remove oil as needed.
3. Check for external influences that may have increased the gearbox's oil level (e.g. rain water ingress). Refer to the genset maintenance guide to ensure the gearbox oil level is properly maintained.

B. Incorrect Gearbox Oil.

1. Gearbox oil has poor heat radiation properties or modified circuit flow allowing the oil temperature to exceed the temperature switch's active threshold. Conduct an oil sample analysis and/or change. Refer to the genset maintenance guide to ensure the proper gearbox oil is employed.

C. External Thermal Influence

1. An external heat source near the gearbox oil or oil temperature sensor and is driving the oil temperature beyond the temperature switch's active threshold. Reroute or protect the gearbox from said heat source.

D. Faulty Gearbox Oil Temperature Switch or Wiring

1. Verify temperature switch state (active and inactive).
    a. Disconnect electrical leads from temperature switch.
    b. Attach DVOM test leads to temperature switch terminals to measure electrical resistance.
    c. Prepare the DVOM to measure electrical resistance.
    d. Measure and note switch resting resistance (cold) = inactive resistance.

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e. Induce heat approximately equal to gearbox lubrication operating temperature into temperature switch sensor (heat source must be capable of heating switch beyond inactive threshold). Induce heat with care so-as to not exceed switch surface contamination or component flash or metal temperature.

f. Measure and note switch resistance (hot) = active resistance.

g. Replace switch if active resistance = inactive resistance.

2. Wiring to the temperature switch shorted together mimicking a temperature switch closure; repair.

E. Inadequate Gearbox Oil Flow

1. See Code 3397, step 6 for troubleshooting as oil volumetric flow is inadequate and subject to prolonged employment allowing time for heat ingress beyond the oil's capability to radiate before re-employment and driving temperature above the temperature switch active threshold.

F. Gearbox Internal Clearance Incorrect.

1. Clearance between gearbox gears is too small resulting in hydraulic heating of the oil; adjust clearance.
2. Clearance between gearbox gears is too large resulting in impact loading which also hydraulically heats the oil; adjust the clearance.

G. Faulty AUX101-Gearbox

1. AUX101 isn't communicating gearbox oil temperature switch state properly and/or is falsely presenting state to PCC. Check wiring and connections to AUX101 or refer to AUX101 troubleshooting with respect to the temperature switch interface.

5.6.238 Fault Code 3399 - Differential Fault

⚠ WARNING

Electrical Explosion

CTs powered without load are susceptible to explosion, which can cause personal injury.

Do not power the current transformers (CTs) without load.

A. Faulty, Improperly Wired or Improperly Sized Current Differential CT or Protection Relay

1. Secure all CT and relay connections to mitigate any intermittent current imbalances resulting from poor connection that may trip the protection relay.
2. Verify clearance between CT phases, ground and secondary conductors (one inch/kV + one inch). Ensure the secondary conductors are not parallel or in close proximity to primary conductors to prevent secondary circuit current induction and corresponding protection relay trip. Reroute as needed.
3. Verify the CT primary and secondary circuits are properly sized for the genset and protection relay, replace as needed. Note, all CTs must perform identically with respect to the differential protection relay sensitivity unless percent differential relays are employed.

B. Line Load Imbalance

1. Verify and adjust so all loads are properly applied and balanced to below the differential current relay active threshold.

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C. Faulty Current Differential CT

1. Differential CT primary or secondary internal failure has delivered an inaccurate current to the protection relay rendering it active. Employ a DVOM and test leads to measure the following with the genset not producing voltage:
    a. Measure winding, winding-to-winding and winding-to-ground or CT case electrical resistance to establish any shorting.
2. Differential CT primary or secondary internal failure has delivered an inaccurate current to the protection relay rendering it active. Employ a CT tester or A/C current clamp (not in-line) to validate CT performance. Replace CT if damaged or suspect.

D. Faulty Current Differential Protection Relay

1. Differential protection relay internal failure rendering it active when all CT input is balanced.
    a. Disconnect all connections to protection relay.
    b. Measure the resistance between the CT secondary line relay inputs. All groups of line inputs should be similar, else: replace relay.
2. For further assessment, conduct the following if active with relay closed.
    a. Disconnect all connections to protection relay.
    b. Measure the resistance between the relay active output terminals. If resistance is relatively low, replace relay.
3. For further assessment, conduct the following if active with relay open.
    a. Disconnect all connections to protection relay.
    b. Measure the resistance between the relay active output terminals. If resistance is relatively low, relay is OK. Verify by applying a test current to any set of CT secondary line relay inputs, simulating a common input voltage, and measure relay resistance which should be OL or relatively high.

E. Faulty Alternator Winding Insulation or Short.

1. A faulty alternator winding insulation or short has resulted in higher current on a winding, rendering the protection relay active.
    a. A faulty alternator winding insulation or short has resulted in higher current on a winding, rendering the protection relay active.
    b. Visually investigate load lines for wear and shorting, replace and support as necessary.
    c. Conduct an insulation resistance test for all alternator lines, repair as necessary.

F. Faulty AUX101- Differential

1. AUX101 isn't communicating differential current protection relay state properly and/or is falsely presenting protection relay state as active to PCC. Check wiring and connections to AUX101 or refer to AUX101 troubleshooting with respect to the protection relay times.

5.6.239 Fault Code 3411 - DC Power Supply Fault

NOTICE
Due to AUX101 sensed DC power supply unit (PSU) state is below inactive threshold lower limit for the duration of DC PSU Dwell Time.

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A. Inadequate DC PSU Dwell Time

1. Via InPower, verify and adjust DC PSU Dwell Time (default = 5 seconds) to permit surge power recovery or battery charger engagement to attain voltage within inactive threshold limits. Note that a high DC PSU Dwell Time may mask DC power supply issues.

B. Faulty or Poor DC Power Supply

1. Check source state of charge and physical condition as faulty or poor component state has resulted in voltage below AUX101 inactive threshold lower limit. Clean and replace as necessary.

C. Faulty DC Power Supply to AUX101 Wiring

1. Check for continuity in powered mode, between DC PSU and AUX101 (including but not limited to fuses and key switches) as failed component resulted in voltage below AUX101 inactive threshold lower limit. Repair as necessary.

D. Faulty AUX 101 - DCPCU

1. AUX101 isn't communicating DC PSU properly and/or is falsely presenting DC PSU state as below inactive threshold lower limit to PCC. Check wiring and connections to AUX101 or refer to AUX101 troubleshooting with respect to DC PSU.

5.6.240 Fault Code 3412 - GIB Isolator Open Fault

NOTICE
Due to AUX101 sensed generator interface box (GIB) isolator switch state is active (open).

A. GIB Isolator Switch is Open

1. Close the GIB doors to engage the switch body with switch mechanism and rotate the switch until aligned with the closed symbol to change the switch state to inactive (closed).

B. Faulty GIB Isolator Switch or Wiring

1. Check all wiring and measure switch state resistances to ensure proper contact as failed component or wiring to AUX101 is mimicking an active isolator switch. Repair as necessary.

C. Faulty AUX 101- GIB

1. AUX101 isn't communicating GIB isolator switch state properly and/or is falsely presenting switch state as active to PCC. Check wiring and connections to AUX101 or refer to AUX101 troubleshooting with respect to GIB isolator switch state.

5.6.241 Fault Code 3413 - Radiator Fan Trip

⚠ **WARNING**
Moving Parts ***Moving parts can cause severe personal injury.*** ***To prevent personal injury, turn off and remove power while troubleshooting.***

NOTICE

Due to AUX101 sensed active radiator fan circuit protection state during fan run command active from PCC.

A. Inadequate Circuit Protection - Fan

1. Check fan wiring and circuit protection device(s) are sized to suit circuit's current capability as faulty component resulted in active circuit protection. Replace as necessary.

B. Faulty Fan Motor or Wiring

1. Check the wiring for loose connections, short circuits or stuck motors resulting in active circuit protection. Replace and repair as necessary.

C. Faulty Aux 101 - Fan

1. AUX101 isn't communicating radiator fan circuit protection state properly and/or is falsely presenting circuit protection state as active to PCC. Check wiring and connections to AUX101 or refer to AUX101 troubleshooting with respect to fan circuit protection.

5.6.242 Fault Code 3414 - Ventilator Fan Trip

⚠ WARNING

Moving Parts

Moving parts can cause severe personal injury.

To prevent personal injury, turn off and remove power while troubleshooting.

NOTICE

Due to AUX101 sensed active ventilator fan circuit protection state during fan run command active from PCC.

NOTICE

Ventilator fans are site-specific, not genset-specific; be sure to refer to plant wiring diagrams when available.

A. Inadequate Circuit Protection

1. Check fan wiring and circuit protection device(s) are sized to suit circuit's current capability as faulty component resulted in active circuit protection. Replace as necessary.

B. Faulty Ventilator Motor or Wiring

1. Check the wiring for loose connections, short circuits, or stuck motors resulting in active circuit protection. Replace and repair as necessary.

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C. Faulty Aux 101 - Ventilator Fan Trip

1. AUX101 isn't communicating ventilator fan circuit protection state properly and/or is falsely representing circuit protection state as active to the control module. Check wiring and connections to AUX101 or refer to AUX101 troubleshooting with respect to ventilator circuit protection.

5.6.243 Fault Code 3415 - Louvre Closed

NOTICE
Due to AUX101 sensed active ventilation louvre closed switch state for the duration of the Louvre Closed Dwell Time.

A. Louvre Didn't Open

1. Clear obstruction and/or fix damaged louvre and movement driving mechanisms to ensure unrestricted movement beyond the louvre position switch inactive threshold.
2. Verify wiring and connections between louvre motor control relay and louvre motor are proper to enable movement beyond the louvre position switch inactive threshold; Repair as needed.

B. Faulty Louvre Position Switch Or Wiring

1. Check wiring between AUX101 and louvre position switch for short circuits that may mimic position below switch inactive threshold. Replace and/or repair as needed.
2. Correspond switch active/inactive states with louvre position via resistance measurement across switch terminals.
    a. Disconnect all connections to louvre position switch.
    b. Attach DVOM test leads to louvre position switch terminals to measure electrical resistance.
    c. Prepare DVOM to measure electrical resistance.
    d. Measure and note switch resting resistance (louvre closed) = active resistance.
    e. Open louvre beyond louvre position switch inactive threshold.
    f. Measure and note switch resistance (louvre open) = inactive resistance.
    g. Replace switch if active resistance = inactive resistance.

C. Inadequate Louvre Closed Dwell Time

1. Via InPower, verify/adjust Louvre Closed Dwell Time (default - 100 seconds) so-as to permit position switch to attain inactive and stable state. Mind time required for complete louvre opening. Note that a high Louvre Closed Dwell Time may mask louvre mechanism issues.

D. Faulty AUX 101

1. AUX101 isn't communicating Louvre position switch state properly and/or is falsely representing state to the control module. Check wiring and connections to AUX101 or refer to AUX101 troubleshooting with respect to louvre closed protection.

5.6.244 Fault Code 3416 - Start System

See the troubleshooting procedures for fault code 359 or 1438.

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5.6.245 Fault Code 3417 - Alternator Heater Trip

NOTICE
Due to AUX101 sensed active alternator heater circuit protection state during alternator heater control active from PCC.

A. Inadequate Circuit Protection

1. Check heater wiring, heater relays and circuit protection device(s) are sized to suit circuit's current capability as faulty component resulted in current greater than heater circuit protection active threshold. Replace as necessary.

B. Faulty Alternator Heater or Wiring

1. Check the following circuits, repair as needed:
    a. AUX101 to alternator heater relay input for loose connections and short circuit between wires as fault will result in failure to deliver the electrical current required to close the alternator heater relay switch and mimic alternator heater current greater than circuit protection active threshold.
    b. AUX101 to alternator heater relay sense for loose connections and short circuit between wires as fault will result in failure to report alternator heater circuit current and mimic alternator heater current greater than circuit protection active threshold.
    c. Alternator heather circuit protection to alternator heater relay for short to ground as fault will result in alternator heater current greater than circuit protection active threshold.

C. Faulty Alternator heater Relay

1. Check that the alternator heater relay for closure when AUX 101 input is applied by measuring resistance of relay's high current circuit; replace if open as fault will mimic circuit protection active.

D. Faulty AUX101

1. AUX101 isn't communicating alternator heater circuit current properly and/or is falsely representing state to the control module. Check wiring and connections to AUX101 or refer to AUX101 troubleshooting with respect to alternator heater circuit protection.

5.6.246 Fault Code 3457 - Loss of Bus Voltage Sensing

An open circuit condition exists in all 3 phases of the bus voltage sensing in Isolated Bus or Utility Multiple applications.

A. Genset Bus Voltage Sensing Connections Are Open Circuit Or Incorrectly Wired At The Base Board

1. The purpose of this event/fault code is to prevent the generator set circuit breaker from closing to a live bus, but it appears to the controller to be dead. Check and ensure that the following are OK: TB7 is securely connected to the base board, bus fuses have been closed after troubleshooting/maintenance procedures, blown bus fuses have been checked and replaced as needed, and if applicable, disconnected medium voltage set of PTs have been reconnected.

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2. If the nominal voltage is 600 VAC or lower, ensure that the voltage sensing connections are correct.
    a. Measure the phase rotation, frequency, and voltage input into the base board from the Genset bus at: L1, TB7-1; L2, TB7-2; and L3, TB7-3. The voltage and frequency should match the Genset bus nominal voltage and frequency. The phase rotation should be "L1-L2-L3" at TB7-1, TB7-2, and TB7-3 on the base board; for proper phase rotation measurement procedures, refer to the phase rotation meter instructions. If the phase rotation, voltage and/or frequency are not correct, re-check the wiring.
3. If the nominal voltage is over 600 VAC, check the voltage sensing connections from the base board to the PT and the PT to the Genset bus.
    a. Measure the phase rotation, frequency, and voltage input into the base board from the PT (Potential Transformer) at: L1, TB7-1; L2, TB7-2; and L3, TB7-3. The voltage input into the base board should match the secondary voltage of the PT (for example, if the PT ratio is 13,800:240, the voltage measured at the base board should be 240 VAC). The phase rotation at TB7-1, TB7-2, and TB7-3 should be "L1-L2-L3" for proper phase rotation measurement procedures; refer to the phase rotation meter instructions. The frequency should match the Genset bus nominal frequency. If the phase rotation, frequency, and/or voltage are not correct at the base board, correct the wiring from the base board to the PT.

B. kW Load Share And kVAR Lines Are Switched

1. Ensure kW load share line on genset 1 is connected to kW load share line on genset 2 and kVAR load share is connected to kVAR it will cause this fault code.

C. Faulty PT

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Make sure that only personnel who are trained and qualified to work on this equipment are allowed to operate the generator set and perform maintenance on it.

1. Ensure that the control is set up with the correct PT ratio (primary vs. secondary). Reference event/fault code 2816 for troubleshooting information on the PT ratio. To access the PT Ratio configuration menu on the operator panel go to **Setup > OEM Setup > OEM ALT Setup > PT Primary or PT Sec** and set the PT ratio appropriately for the application.
2. With a calibrated voltage meter, measure the voltage output of the PT. The output of the PT should match the ratio of the PT; ex. Outputs: L1=120, L2=120, L3=120. If the outputs of the PT are incorrect, replace the PT once the generator set has been properly grounded by a qualified electrician.

5.6.247 Fault Code 3482 – Off Load Running Fault

This fault code becomes active when the generator set has been called to go off load for too long. This leads to a shutdown.

A. Verify Off Load Running

1. Check the generator set history and verify the off load running.
2. Check external connections to the generator set.

B. Check Trims

Check the following trims:

- Off Load Running Fault Enable
- Off Load Running Engine RPM Threshold
- Off Load Running % kW Threshold
- Off Load Running Dwell time Threshold
- Off Load Running Test Override Time

5.6.248 Fault Code 3483 – High Alternator 1 Temp Shutdown

This fault is set to active if the alternator 1 temperature reaches a set threshold value for a given period of time.

A. Check Alternator Temperature

1. Use an infrared temperature gun or thermal image gun to verify temperature of the winding with respect to the HMI of the control.
2. If higher than expected, follow troubleshooting procedure for the alternator main stator winding.

B. Check Generator Set Ventilation

1. Check functionality of the louvers.
2. Check for restriction or blockage at the inlet air of the alternator.

C. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

D. Check Setup or Application

Check the trim values for the High Alternator 1 Shutdown Temperature threshold and High Alternator 1 Shutdown Temperature time.

5.6.249 Fault Code 3484 – High Alternator 2 Temp Shutdown

This fault is set to active if the alternator 2 temperature reaches a set threshold value for a given period of time.

A. Check Alternator Temperature

1. Use an infrared temperature gun or thermal image gun to verify temperature of the winding with respect to the HMI of the control.
2. If higher than expected, follow troubleshooting procedure for the alternator main stator winding.

B. Check Generator Set Ventilation

1. Check functionality of the louvers.

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2. Check for restriction or blockage at the inlet air of the alternator.

C. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

D. Check Setup or Application

Check the trim values for the High Alternator 2 Shutdown Temperature threshold and High Alternator 2 Shutdown Temperature time.

5.6.250 Fault Code 3485 – High Alternator 3 Temp Shutdown

This fault is set to active if the alternator 3 temperature reaches a set threshold value for a given period of time.

A. Check Alternator Temperature

1. Use an infrared temperature gun or thermal image gun to verify temperature of the winding with respect to the HMI of the control.
2. If higher than expected, follow troubleshooting procedure for the alternator main stator winding.

B. Check Generator Set Ventilation

1. Check functionality of the louvers.
2. Check for restriction or blockage at the inlet air of the alternator.

C. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

D. Check Setup or Application

Check the trim values for the High Alternator 3 Shutdown Temperature threshold and High Alternator 3 Shutdown Temperature time.

5.6.251 Fault Code 3486 – High Drive Bearing Temp Shutdown

This fault becomes active if the drive end bearing temperature is above the set threshold value over a given period of time.

A. Check Bearing Temperature

Use secondary equipment like infrared temperature gun or thermal imaging camera to read the bearing temperature.

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B. Check Generator Set Ventilation

1. Check functionality of the louvers.
2. Check for restriction or blockage at the inlet air of the alternator.

C. Check Bearing Grease

1. Check maintenance log, ensure greasing procedure is followed to regrease the bearing.
2. Make sure that the correct grease is used.
3. Visually inspect for excessive grease loss.

D. Check Alternator to Engine Alignment

Check the alignment between the engine and the alternator bell housing.

E. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.
2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

F. Check Setup or Application

Verify that the threshold values used are within the parameters of the alternator being used.

G. Replace Bearing as Necessary

5.6.252 Fault Code 3487 –High NonDrv Bearing Temp Shutdown

This fault becomes active if the drive end bearing temperature is above the set threshold value over a given period of time.

A. Check Bearing Temperature

Use secondary equipment like infrared temperature gun or thermal imaging camera to read the bearing temperature.

B. Check Generator Set Ventilation

1. Check functionality of the louvers.
2. Check for restriction or blockage at the inlet air of the alternator.

C. Check Bearing Grease

1. Check maintenance log, ensure greasing procedure is followed to regrease the bearing.
2. Make sure that the correct grease is used.
3. Visually inspect for excessive grease loss.

D. Check Sensor

1. Use a digital multimeter to check the Voltage at the AUX 101 input.

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2. Check the Output from the sensor.If mismatch, Troubleshoot the harness
3. If the readings do not match, troubleshoot the harness.
4. If the readings match, check the sensor calibration.

E. Check Setup or Application

Verify that the threshold values used are within the parameters of the alternator being used.

F. Replace Bearing as Necessary

5.6.253 Fault Code 3513 – NegSeq Overcurrent

This fault is triggered when the load current or load power factor are not equal in all the three phases.

A. Check Phase Wiring for Generator Set Control and Metering

1. Check all CT wiring is going to the correct location in the alternator terminal box.
2. Check connections for the CT wiring are from pin 40-45 on the terminal block inside the alternator terminal box.
3. Verify all voltage sensing wires are going to the correct locations.
4. Check that connections for the voltage sensing wires are pins 13, 14, 70, 67, 64, 74, 61, and 56 on the terminal block inside the alternator terminal box.

B. Check Control Threshold Values

Make sure that the following settings under **Setup > OEM Setup > OEM ALT Setup** are correct:

- Genset Neg Seq Overcurrent Protection Enable (Default=Enabled)
- Genset Neg Seq Overcurrent Protection K Factor (Default=20)
- Genset Neg Seq Overcurrent Protection Reset Time (Default=360)
- Genset Neg Seq Overcurrent Protection Threshold (Default=12.00)

C. Check for Short

1. Check generator set main output leads for any signs of shorting.
2. Repair short as necessary.

5.6.254 Fault Code 3599 – Ground Current OOR Hi

The Ground Current has reached its upper limit over a set period of time.

A. Check Calibration

Verify that the set value for the ground current is within acceptable limits.

B. Check Ground

Check all ground points and validate ground connections.

5.6.255 Fault Code 3611 –Custom Overcurrent Fault

This fault is generated due to a customer defining a custom time for Over Current protection in addition to the normal overcurrent protection faults that exist in the AmpSentry.

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A. Check Control Settings

Use InPower and the following table to make sure the control settings are appropriate for the application.

TABLE 89. CONTROL SETTINGS

Setting	Menu Navigation	Parameter
Overload Threshold	**Setup->Genset Setup**	Default value is 105%
High AC Voltage Trip	**Setup > OEM Setup > OEM ALT Setup > High AC Voltage**	Default = “Inverse Time”
High AC Voltage Threshold	**Setup > OEM Setup > OEM ALT Setup > High AC Voltage Threshold**	Default = 110%
High AC Voltage Fault Simulation	**Tests > Protection Verification > Alternator Protection > Overvoltage**	Disabled
Current Transformer Ratio	**Setup > OEM Setup > OEM Alt Setup > Genset CT Ratio**	Set appropriately for the application. Use the CT ratio calculator in InPower to determine the correct CT ratio

B. Check Load and Load Cables

1. An overload condition has occurred. With the generator set being turned off, visually inspect the load and load cables for damage and/or short circuit. Repair if necessary.
2. Make sure that new loads have not been added to the generator set. Revisit the generator set sizing process to make sure that the generator set is correctly sized for the application (reference the T-030 manual).

C. Check Current Transformer Size

Make sure the current transformer size is correct. Replace current transformer if necessary.

D. Check Calibration

Check the custom calibration of the following parameters:

- Custom Overcurrent Threshold
- Custom Overcurrent Time Characteristic

Verify the correct calibration.

5.6.256 Fault Code 3629 - Device Calibration Update Recommended

The PCC may have setup parameters that the AUX 105 does not have.

A. Incorrect Calibration File in the PCC

1. Verify the calibration files for the PCC.
   a. Connect InPower to the PCC.
   b. Download the latest calibration to the PCC.

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B. Incorrect Calibration File in AUX 105

1. Verify the calibration files for the AUX 105.
    a. Connect InPower to the AUX 105.
    b. Download the latest calibration to the AUX 105.

5.6.257 Fault Code 3631 - Device Calibration Update Required

The AUX 105 did not receive a setup parameter from the PCC.

A. Verify Calibration Files for the PCC

1. Connect InPower to the PCC.
2. Download the latest calibration to the PCC.

B. VerifyC alibration Files for the Aux 105

1. Connect InPower to the AUX 105.
2. Download the latest calibration to the AUX 105.

5.6.258 Fault Code 4358 – Setup Mode Shutdown

The Fault goes active if the control is in set up mode and a run command is sent to the control.

A. Control in Setup Mode

1. Make sure that the control is not in setup mode before running the generator set.
    a. Make sure that the Setup Mode Enable = Disable. In InPower go to **Setup > Adjust > Setup Mode Enable.**

5.6.259 Fault Code 4872 - System Network Failure

The generator set has lost network communications with all generator sets on the s-CAN network.

MLD Response:

When this fault is present all generator sets will start and connect to the bus, but will not operate load demand. The Load Demand State will change to Halted. If three or more generator sets exist on the network, the other generator sets in the system rather than the generator set with this warning will have Generator Set Lost on System Network (4876). If only two generator sets exist on the network, both will show this warning.

A. Incorrectly wired connections on the s-CAN network

Make sure that s-CAN network wires are securely landed in TB3 and have no external damage.

Verify that:

1. s-CAN shield ground is landed securely in TB3-1.
2. s-CAN isolated ground is landed securely in TB3-2.
3. s-CAN L is landed securely in TB3-3.
4. s-CAN H is landed securely in TB3-4.

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B. Improper Installation Of The S-CAN Network

1. If using local termination resistors in the board, verify that only the termination resistors of the generator sets that are at both ends of the system are on, the termination resistors of the rest of the boards should be off.
2. Verify the interconnection harness (s-CAN cable) of the s-CAN bus to make sure there is no interruption of the s-CAN signal to the generator set that is affected.
3. If using external terminator resistors, disconnect power from the PCC 3300 board and measure ohms between TB3-3 and TB3-4, should get 55 to 65 ohms indicating that a 120 ohm resistor is on each end of the system.
4. If using local termination resistors in the board, isolate the board from the network and measure the resistance between TB3-3 and TB3-4. The resistance should be between 110 and 130 ohms.
5. Verify that the cable used for s-CAN network meets the J1939-11 standards (type Belden 3106A) or equivalent.
6. Verify that the total length of the s-CAN bus is no longer than 200 meter.
7. Refer to (CAN Network Troubleshooting Recommendations) for additional details on how troubleshoot CAN network.

NOTICE
If an external termination resistor is being used, the switch activated termination resistor on the PCC3300MLD control should be turned Off. The combination of active switch-activated and external termination resistors must be 2

5.6.260 Fault Code 4873 - Generator Set Failed to Come Online

A generator set running on MLD mode failed to come online within the load demand generator set failed delay period.

MLD Response:

If available, another generator set will start up to replace the generator set that failed to come online.

A. The generator set that failed to come online has an active shutdown that prevented the generator set from starting, or the generator set is having trouble starting (low battery, out of fuel, and etc.)

1. Locate the generator set that Failed to come online (Indicated as Failed on the Load Demand System Status Screen) and troubleshoot any active fault on the generator set by referring to the specific troubleshooting procedure for the active fault. Check for any problems that might prevent the generator set for starting (low battery, out of fuel, etc.).

NOTICE
If the generator set is eventually able to come online, it will no longer appear as failed on the Paralleling Status (8/9) screen.

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B. The Generator Sets On The S-CAN Network Have Different Settings

1. Verify system settings are In sync by using Inpower service tool or by setting (Sync System Settings) to Yes in HMI paralleling setup screen 7 of 9. (See Masterless Load Demand Status Screen).

C. The Time Delay (LD Time Delay) Is Set Too Short

1. Verify that the load demand generator set fail Delay (LD Gen Fail Delay) is not set lower than the time the generator set takes to normally come online, depending on what type of generator set on the system; the time required for a generator set to come online will vary. Increase this time delay as required.

D. The Expected-To-Come-Online Generator Set Has Trouble Synchronizing To The Bus

1. If the generator set that fails to synchronize to the system has an active fault code 1457 Fail To Synchronize, reference fault code 1457 to troubleshoot the fault

E. The Generator Set CB Inhibit Signal To The Generator Set Is Active Which Prevents The Breaker From Closing

1. If any of the configurable inputs on the PCC are set to a Generator Set CB inhibit, verify that those configurable inputs are not active

NOTICE
The default input for generator set CB inhibit is TB10-11.

5.6.261 Fault Code 4874 - Load Demand Software Version Incompatibility

There is an incompatibility in MLD versions, between two or more generator sets on the s-CAN network.

NOTICE
MLD does not require all generator sets to have the same software version to operate. This fault is independent of software version; however the two may be linked.

MLD Response:

All generator sets will start up but Load Demand State (LD State) will indicate the generator set as halted, MLD no longer operates.

NOTICE
MLD does not require all generator sets to have the same software version to operate.

A. Generator Sets In The MLD System Have Different MLD Versions That Are Incompatible

1. Perform an update calibration on each generator set in the network to the latest released calibration, starting at the generator set with the oldest software version until the issue is resolved.

5.6.262 Fault Code 4875 - Generator Set Ineligible for Load Demand

A networked generator set on the s-CAN Network has transitioned to Ineligible.

NOTICE
By default the response of this fault is set to None. The fault response for this fault must be set to warning for this fault to be declared.

MLD Response:

If a generator set becomes ineligible for load demand the MLD system bus will bring the next priority generator set online. When the ineligible generator set is again eligible, the MLD system will again utilize that generator set based on its assigned priority and start and stop generator set as required.

A. Generator Set Not In Auto

Find the generator set with LD State status set to Ineligible, HMI320 Paralleling Status menu and verify that all conditions for a generator set to be eligible for use in load demand are met.

1. Make sure that the generator set is running in Auto mode by setting the control switch position to Auto.

B. Load Demand Generator Set Enable (trim) Set To Disable

Find the generator set with LD State status set to Ineligible, HMI320 Paralleling Status menu and verify that all conditions for a generator set to be eligible for use in load demand are met.

1. Verify with InPower or through the HMI paralleling/Basic setup 9/9 menu that the LD Gen Enable trim is set to Enable.

C. The Generator Set Does Not Have A Remote Start Command

Find the generator set with LD State status set to Ineligible, HMI320 Paralleling Status menu and verify that all conditions for a generator set to be eligible for use in load demand are met.

1. Verify if the generator set is getting a remote start command via wired input, system remote start, or through a Modbus command. The Remote Start LED on the HMI320 will be on or blinking when a valid Remote Start command exists.

D. Inadequate Generator Set Application

1. Make sure that the Generator Set Application type is set to Isolated Bus.

E. Active Shutdown Fault

1. This fault is activated as a result of another shutdown fault. Troubleshoot the other shutdown fault(s) that are causing the generator set to shut down.

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F. Load Demand Stop Input Is Active

Find the generator set with LD State status set to Ineligible, HMI320 Paralleling Status menu and verify that all conditions for a generator set to be eligible for use in load demand are met.

NOTICE
The default input for Load Demand Stop is Configurable Input 31.

1. Verify that the Load Demand Stop Input/Modbus command is Inactive.

G. Generator Set Circuit Breaker Inhibit Command Is Active

Find the generator set with LD State status set to Ineligible, HMI320 Paralleling Status menu and verify that all conditions for a generator set to be eligible for use in load demand are met.

NOTICE
The default input for generator set CB inhibit is TB10-11.

1. If any of the configurable inputs on the PCC are set to a Generator Set CB inhibit, verify that those configurable inputs are not active.

5.6.263 Fault Code 4876 - Generator Set Lost on System Network

Network communications have been lost to one or more generator sets, but the network is still active (two or more generator sets are still communicating). This fault can only occur if three or more generator sets exist on the s-CAN network.

NOTICE
If only one generator set lost communications with all generator sets on the network, that generator set will indicate a System Network Failure (4872) warning, while the rest of the generator sets indicate a Generator Set Lost on System Network (4876) fault.

NOTICE
If a break occurs between two groups of communication generator sets, each group may continue to communicate within their group. In this scenario the disconnected groups of networked generator sets will indicate all generator sets of the disconnected group as Lost.

MLD Response:

All generator sets will start. The Load Demand state will change to halted. The generator set(s) that is/are no longer communicating on the network will be indicated as Lost.

A. Incorrectly Wired Connections On The s-CAN Network

1. Make sure that s-CAN network wires are securely landed in TB3 and have no external damage.

   Verify that:

1. s-CAN shield ground is landed securely in TB3-1.
2. s-CAN isolated ground is landed securely in TB3-2.
3. s-CAN L is landed securely in TB3-3.
4. s-CAN H is landed securely in TB3-4.

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B. Improper Installation Of The s-CAN Network

NOTICE

If an external termination resistor is being used, the switch activated termination resistor on the PCC3300MLD control should be turned Off. The combination of active switch-activated and external termination resistors must be 2.

1. Verify a proper installation of the s-CAN communication cable.
    a. If using local termination resistors in the board, verify that only the termination resistors of the generator sets that are at both ends of the system are on, the termination resistors of the rest of the boards should be off.
    b. Verify the interconnection harness (s-CAN cable) of the s-CAN bus to make sure there is no interruption of the s-CAN signal to the generator set that is affected.
    c. If using external terminator resistors, disconnect power from the PCC 3300 board and measure ohms between TB3-3 and TB3-4, should get 55 to 65 ohms indicating that a 120 ohm resistor is on each end of the system.
    d. If using local termination resistors in the board, isolate the board from the network and measure the resistance between TB3-3 and TB3-4. The resistance should be between 110 and 130 ohms.
    e. Verify that the cable used for s-CAN network meets the J1939-11 standards (type Belden 3106A) or equivalent.
    f. Verify that the total length of the s-CAN bus is no longer than 200 meter.
    g. Refer to *[CAN Network Troubleshooting Recommendation]* for additional details on how troubleshoot CAN network.

C. Power Is Lost To One Or More Generator Sets On The s-CAN Network

1. Verify that all generator sets on the network have adequate battery voltage, HMI320s are communicating and displaying information, and LEDs on the PCC3300 are active.

D. An Improper Update Calibration Was Performed On The Generator Set And It Is No Longer Functioning

NOTICE

See *[MLD Service Procedures]* for information on how to remove and return a generator set to the network.

1. Verify that the generator set control functions (generator set starts and stops, and HMI320 is showing valid information). Perform an update or initial calibration if required.

5.6.263.1 Fault Code 4877 - System Settings Not Synchronized

There is a discrepancy between system settings on the system network (s-CAN). A Synchronize System Settings (Sync System Settings) operation from a generator set controller with the desired settings is needed to clear the fault.

MLD Response:

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The MLD system will decide which generator set to turn on and off based on the system settings in the 'acting master'. This will be the generator set with the lowest priority communicating to network. Operation of the system may not be consistent when viewed from all HMI screens.

A. An Updated Calibration

1. Go to a generator set with the desired settings and Synchronize (broadcast) system setting from that generator set. The synchronization can be done through the HMI Paralleling/Basic Setup menu (7/9) or by using the service tool.

B. System Settings Status (System Settings Status) is set to Out of Sync

1. Go to a generator set with the desired settings and Synchronize (broadcast) system setting from that generator set. The synchronization can be done through the HMI Paralleling/Basic Setup menu (7/9) or by using the service tool.

C. A New Generator Set Was Added To The s-CAN Network

1. Go to a generator set with the desired settings and Synchronize (broadcast) system setting from that generator set. The synchronization can be done through the HMI Paralleling/Basic Setup menu (7/9) or by using the service tool.

D. System Settings Were Modified While The Generator Set Was Running And, The Control Has Lost Power Or Battery Was Disconnected While Running.

1. Go to a generator set with the desired settings and Synchronize (broadcast) system setting from that generator set. The synchronization can be done through the HMI Paralleling/Basic Setup menu (7/9) or by using the service tool.

5.6.264 Fault Code 4877 – System Settings Not Synchronized

There is a discrepancy between system settings on the system network (s-CAN). A Synchronize System Settings (Sync System Settings) operation from a generator set controller with the desired settings is needed to clear the fault.

MLD Response:

The MLD system will decide which generator set to turn on and off based on the system settings in the 'acting master'. This will be the generator set with the lowest priority communicating to network. Operation of the system may not be consistent when viewed from all HMI screens.

A. Diagnosis and Repair

Go to a generator set with the desired settings and Synchronize (broadcast) system setting from that generator set. The synchronization can be done through the HMI Paralleling/Basic Setup menu (7/9) or by using the service tool.

5.6.265 Fault Code 4878 - Check System Network Installation

Switch S1 is switched On in more than two controls in the s-CAN Network, or the s-CAN Network Datalink status has been active for at least 20 seconds and a degraded system network connection has been detected by the controller due to errors in communication detected on the s-CAN network.

MLD Response:

The MLD system will continue to run with this warning active. MLD data updates may be delayed.

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This warning provides early detection of potential issues on the s-CAN bus. If uncorrected, this fault may progress into more serious network failure (i.e. code 4872 or code 4876).

A. Incorrectly Wired Connections On The s-CAN Network

1. Make sure that s-CAN network wires are securely landed in TB3 and have no external damage.

   Verify that:

1. s-CAN shield ground is landed securely in TB3-1.
2. s-CAN isolated ground is landed securely in TB3-2.
3. s-CAN L is landed securely in TB3-3.
4. s-CAN H is landed securely in TB3-4.

B. Improper Installation Of The s-CAN Network

NOTICE
If an external termination resistor is being used, the switch activated termination resistor on the PCC3300MLD control should be turned Off. The combination of active switch-activated and external termination resistors must be 2.

1. Verify a proper installation of the s-CAN communication cable.
   a. If using local termination resistors in the board, verify that only the termination resistors of the generator sets that are at both ends of the system are on, the termination resistors of the rest of the boards should be off.
   b. Verify the interconnection harness (s-CAN cable) of the s-CAN bus to make sure there is no interruption of the s-CAN signal to the generator set that is affected.
   c. If using external terminator resistors, disconnect power from the PCC 3300 board and measure ohms between TB3-3 and TB3-4, should get 55 to 65 ohms indicating that a 120 ohm resistor is on each end of the system.
   d. If using local termination resistors in the board, isolate the board from the network and measure the resistance between TB3-3 and TB3-4. The resistance should be between 110 and 130 ohms.
   e. Verify that the cable used for s-CAN network meets the J1939-11 standards (type Belden 3106A) or equivalent.
   f. Verify that the total length of the s-CAN bus is no longer than 200 meter.
   g. Refer to *[CAN Network Troubleshooting Recommendation]* for additional details on how troubleshoot CAN network.

5.6.266 Fault Code 4879 - Load Demand Setup Error

An improper %kW or kW setup condition exists with regard to Load Demand Settings.

MLD Response:

All generator sets will turn on.

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A. Improper Setup of Load Demand Settings

1. Verify that Load demand settings are set correctly:
    a. Verify system settings are In sync through the HMI Paralleling/Basic Setup Menu (7/9) or using the service tool.
    b. From the HMI Paralleling/Basic Setup Menu (7/9) or from the service tool, determine the setting of the Load Demand Threshold Method (Threshold Method):
        - If the Load Demand Threshold Method (Threshold Method) is %kW, make sure the Load Demand Start Threshold (%kW) (Start Thresh %kW) is greater than the Load Demand Stop Threshold (%kW) (Stop Thresh %kW) by at least 5%.
        - If the Load Demand Threshold Method (Threshold Method) is kW, make sure Load Demand Stop Threshold (kW) (Stop Thresh kW) is greater than Load Demand Start Threshold (kW) (Start Thresh kW).
    c. After the changes are made, set Synchronize System Settings (Sync System Settings) to Yes, to propagate settings to all generator sets in the network.

5.6.267 Fault Code 4881 – System Genset ID Conflict

Two or more generator sets in the s-CAN network have the same generator set identification (Genset ID).

MLD Response:

All generator sets will start. The Load Demand State (LD State) will change to Halted.

A. Diagnosis and Repair

Make sure each generator set in the network has a unique generator set identification (Genset ID) assigned to it. Genset ID is a local setting, and must be changed/set on each generator set. After the changes are made, set Synchronize System Settings (Sync System Settings) to Yes to propagate settings to all generator sets in the network.

5.6.268 Fault Code 4882 – Genset Bus Overload

The generator set AC bus became overloaded while running in MLD mode. A single overloaded generator set will trigger this fault.

MLD Response:

All generator sets will start up.

If bus overload leads to a bus failure, all generator sets will attempt to start or restart.

MLD operation will resume once all generator sets are online and the Load Demand Initial Delay (LD Initial Delay) has expired.

A. Diagnosis and Repair

1. Verify that Load demand settings are set correctly:
    a. Verify system settings are In sync through the HMI Paralleling/Basic Setup Menu (7/9) or using the service tool.
    b. From the HMI Paralleling/Basic Setup Menu (7/9) or from the service tool, determine the setting of the Load Demand Threshold Method (Threshold Method):
        - If the Load Demand Threshold Method (Threshold Method) is %kW, make sure the Load Demand Start Threshold (%kW) (Start Thresh %kW) is greater than the Load Demand Stop Threshold (%kW) (Stop Thresh %kW) by at least 5%.

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- If the Load Demand Threshold Method (Threshold Method) is kW, make sure Load Demand Stop Threshold (kW) (Stop Thresh kW) is greater than Load Demand Start Threshold (kW) (Start Thresh kW).

c. After the changes are made, set Synchronize System Settings (Sync System Settings) to Yes, to propagate settings to all generator sets in the network.

2. Verify that the load requested is within the generator sets network capacity. Utilize the spare capacity request feature when enabling large power consuming loads.
3. Load Demand settings are not properly configured to respond to changes in load on the system leading to a generator set bus overload.
   - Load Demand start delay timers are set incorrectly (too long).
   - Load Demand Stop delay timers are set incorrectly (too short).
   - Load Demand Stop threshold is set incorrectly (too low).

   Verify each Load Demand parameter is correctly set to meet the needs of the system.
4. Determine if System remote start is being used. If this is set to enable and there is a network failure on the s-CAN network, all generator sets in the network will shutdown as they will lose their remote start command.
5. Locate the generator set that failed to come online or stopped due to a shutdown and troubleshoot any active fault on the generator set by referring to the specific troubleshooting procedure for the active fault.
6. Troubleshoot active Fault Codes 1464 - Load Dump, 1444 - kW Overload, and 1448 - Underfrequency.
7. Make sure that load share lines and KVAR lines are connected properly as following:
   a. Ensure kW load share line on generator set is connected to kW load share line on the next generator set on the bus on all generator sets on the network.
   b. Ensure that KVAR load share line on generator set is connected to KVAR load share line on the next generator set on the bus on all generator sets on the network.
   c. Ensure that kW load share lines and KVAR load share lines have are not shorted or opened
   d. Make sure that load sharing parameters are correctly configured.
   e. Troubleshoot and active Fault Code - Reverse Power.
8. Verify that the synchronizer is performing correctly. Troubleshoot and active Fault Code 1457 - Fail To Synchronize.
9. Evaluate the following time delay settings and consider reducing them:
   - Idle warm-up time
   - Time delay to start
   - Start to rated ramp time
   - Rated to idle ramp time
   - Idle to rated ramp time
   - Load share ramp time

5.6.269 Fault Code 5134 - Unknown Shutdown at Idle

Engine speed remains zero when the controller mode is idle.

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A. Incorrect PCC reference to engine speed

Check for PCC reference to engine speed while cranking.

1. Connect with InPower.
2. Check if **Alternate Frequency Switch**, **Frequency Adjust**, and **Frequency to Speed Gain Select** are set up properly.
3. If ECM CAN Enable is set to Enable, the PCC sends the speed bias reference to the ECM. The speed bias reference is the percent difference between the speed reference and the base speed (Alternate Frequency Switch multiplied by Frequency to Speed Gain Select).

B. Engine Fault Code active

1. Using InSite, connect to the engine ECM. Check for active or inactive fault codes.
2. Diagnose and repair any engine fault codes. Refer to the engine service manual.
3. Clear all engine fault codes. Cycle power to the control.

C. Faulty engine speed/position sensor

Inspect the engine speed/position sensor.

1. Disconnect the engine speed/position sensor from the engine and engine harness.
2. Inspect sensor for bent, corroded, or loose pins.
3. Inspect the sensor for structural deficiencies.

D. Faulty engine speed sensor connection

Inspect the engine speed sensor and the harness connector pins.

1. Disconnect the engine harness connector from the engine speed sensor.
2. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
3. Inspect for evidence of moisture in or on the connector.
4. Inspect for missing or damaged connector seals.
5. Inspect for dirt or debris in or on the connector pins.

E. Faulty engine harness

Inspect the engine harness and the connector pins.

1. Disconnect the engine harness connector from the extension harness.
2. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
3. Inspect for evidence of moisture in or on the connector.
4. Inspect for missing or damaged connector seals.
5. Inspect for dirt or debris in or on the connector pins.

F. Faulty extension harness

Inspect the extension harness and the AUX105 connector pins.

1. Disconnect the extension harness connector from the AUX105.
2. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
3. Inspect for evidence of moisture in or on the connector.

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4. Inspect for missing or damaged connector seals.
5. Inspect for dirt or debris in or on the connector pins.

5.6.270 Fault Code 5135 – Genset Overload

The generator set will go into “Genset Overload” shutdown when the Input “Genset % Application total KW” reaches its Overload Shutdown Threshold for Overload Shutdown Set time.

A. Check Overload to Generator Set

1. Inspect output wires to ensure that a short did not cause the overload.
2. Check the load history and verify if the overload was caused by extra load added to the generator set.
3. Verify functionality of other generator sets and utilitiesy paralleled with the overloaded generator set (if applicable).

B. Check Settings and Calibration

1. Verify that the proper Threshold values are being used for the proper application.
2. To access the settings in InPower go to **Setup > Genset Setup**.

5.6.271 Fault Code 5145 - Load Demand Generator Set Bus Failure

The generator set AC bus fails while Load Demand is running (AC Bus < 20% of Nominal).

MLD Response:

All generator sets will restart.

MLD operation will resume once all generator sets are online and the initial Load Demand Start Delay Timer (Start Dly Tmr) has expired.

A. System Load Exceeded System Capacity

1. If fault code 4882 - Generator Set Bus Overload is active, refer to *[Fault Code 4882 - Diagnosis and Repair]* for troubleshooting the fault.

B. One Or More Online Generator Sets Had A Shut Down Failure

1. Locate the generator set that failed to come online (Indicated as Failed on the Load Demand System Status Screen) and troubleshoot any active fault on the generator set by referring to the specific troubleshooting procedure for the active fault.

C. System Remote Start Is Set To Enable, And The Generator Set With The Single Remote Start Input Is Removed Or Lost On The s-CAN Network

1. Determine if System remote start is being used. If this is set to enable and there is a network failure on the s-CAN network, all generator sets in the network will shutdown as they will lose their remote start command. Refer to *[System Remote Start]* and *[Load Demand System Settings]* for additional details on the system remote start feature, see *[Fault Code 4872 - System Network Failure]*, *[Fault Code 4876 - Generator Set Lost on System Network]*, or *[Fault Code 4878 - Check System Network Installation]* for information on how to diagnose and repair s-CAN network failures.

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D. Load Demand Settings Are Not Properly Configured To Respond To Changes In Load On The System Leading To A Generator Set Bus Overload

1. Load Demand start delay timers are set incorrectly (too long).
2. Load Demand Stop delay timers are set incorrectly (too short).
3. Load Demand Stop threshold is set incorrectly (too low).

Verify each Load Demand parameter is correctly set to meet the needs of the system.

E. Low load And MLD Settings Result In The System Having Only One Generator Set Online Followed By A Generator Set Shutdown. (Loss of remote start, generator set fault, etc.)

1. Set the Load Demand Stop Threshold (kW) (Stop Thresh kW) to a value greater than the rating of a single generator set to ensure system redundancy.

5.6.272 Fault Code 5149 – PreLube Cycle Failed during Non-Emergency Start

The Pre-lube pump failed to cycle during a non-emergency start condition.

NOTICE
The engine will not start under non-emergency condition if the pre-lube pump has not cycled.

A. Check ECM

Troubleshoot according to ECM Fault 4883 – Oil Priming State in the engine service manual.

B. Check Pre-lube Pump Operation

1. Check the Pre-lube pump fuse located in the DC Distribution box.
2. Visually inspect wires and ensure there is good connection to the pump.
3. Verify K02-2 has B+ voltage.
4. Check continuity from K02-4 to pin 2 of the engine harness pre-lube control plug.
5. Check continuity from K02-3 to pin 1 of the engine harness's pre-lube control plug.
6. Verify continuity from K02-1 to DC pre-lube pump (+) terminal.
7. Make sure that proper grounding from DC pre-lube pump.

5.6.273 Fault Code 5151 – Intake Air Restriction Indicator 1 Active

If the switch pertaining to the Intake Air restriction indicator 1 is enabled, this warning fault is triggered.

A. Check Air Filter Element

1. Visually inspect the air filter element.
2. Follow air filter removal procedure to replace if needed.

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B. Reset Air Restriction Indicator

Press the button on the air restriction indicator that says “Push to Reset” to reset the switch to default position.

C. Check Air Restriction Indicator

1. Verify plumbing connections from filter to the air restriction indicator.
2. Check reset functionality of the indicator.
3. Visually inspect the indicator for cracks and dirt.

D. Check Wiring

1. Check continuity of the wiring harness in AUX 101(4).
   - Signal: P11(4)-2
   - Ground P11(4)-1
2. Replace as necessary.

5.6.274 Fault Code 5152 – Intake Air Restriction Indicator 2 Active

If the switch pertaining to the Intake Air restriction indicator 2 is enabled, this warning fault is triggered.

A. Check Air Filter Element

1. Visually inspect the air filter element.
2. Follow air filter removal procedure to replace if needed.

B. Reset Air Restriction Indicator

Press the button on the air restriction indicator that says “Push to Reset” to reset the switch to default position.

C. Check Air Restriction Indicator

1. Verify plumbing connections from filter to the air restriction indicator.
2. Check reset functionality of the indicator.
3. Visually inspect the indicator for cracks and dirt.

D. Check Wiring

1. Check continuity of the wiring harness in AUX 101(4).
   - Signal: P11(4)-4
   - Ground P11(4)-3
2. Replace as necessary.

5.6.275 Fault Code 5153 – Intake Air Restriction Indicator 3 Active

If the switch pertaining to the Intake Air restriction indicator 3 is enabled, this warning fault is triggered.

A. Check Air Filter Element

1. Visually inspect the air filter element.

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2. Follow air filter removal procedure to replace if needed.

B. Reset Air Restriction Indicator

Press the button on the air restriction indicator that says “Push to Reset” to reset the switch to default position.

C. Check Air Restriction Indicator

1. Verify plumbing connections from filter to the air restriction indicator.
2. Check reset functionality of the indicator.
3. Visually inspect the indicator for cracks and dirt.

D. Check Wiring

1. Check continuity of the wiring harness in AUX 101(4).
    - Signal: P11(4)-10
    - Ground P11(4)-9
2. Replace as necessary.

5.6.276 Fault Code 5154 – Intake Air Restriction Indicator 4 Active

If the switch pertaining to the Intake Air restriction indicator 4 is enabled, this warning fault is triggered.

A. Check Air Filter Element

1. Visually inspect the air filter element.
2. Follow air filter removal procedure to replace if needed.

B. Reset Air Restriction Indicator

Press the button on the air restriction indicator that says “Push to Reset” to reset the switch to default position.

C. Check Air Restriction Indicator

1. Verify plumbing connections from filter to the air restriction indicator.
2. Check reset functionality of the indicator.
3. Visually inspect the indicator for cracks and dirt.

D. Check Wiring

1. Check continuity of the wiring harness in AUX 101(4).
    - Signal: P11(4)-12
    - Ground P11(4)-11
2. Replace as necessary.

5.6.277 Fault Code 5155 – Low Battery 1 Voltage

This fault code becomes active when “Low battery voltage” is detected on battery 1 through the OEM AUX 101.

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A. Diagnosis and Repair

1. Refer to troubleshooting for Fault Code 441.
2. Inputs for the battery voltage are:
    - AUX 101 (3) – Input 7
    - J43-13 = Battery Return

5.6.278 Fault Code 5156 – Low Battery 2 Voltage

This fault code becomes active when “Low battery voltage” is detected on battery 2 through the OEM AUX 101.

A. Diagnosis and Repair

1. Refer to troubleshooting for Fault Code 441.
2. Inputs for the battery voltage are:
    - AUX 101 (3) – Inputs 8
    - J43-13 = Battery Return

5.6.279 Fault Code 5157 – Low Battery 3 Voltage

This fault code becomes active when “Low battery voltage” is detected on battery 3 through the OEM AUX 101.

A. Diagnosis and Repair

1. Refer to troubleshooting for Fault Code 441.
2. Inputs for the battery voltage are:
    - AUX 101 (4) – Input 7
    - J43-13 = Battery Return

5.6.280 Fault Code 5158 – Low Battery 4 Voltage

This fault code becomes active when “Low battery voltage” is detected on battery 4 through the OEM AUX 101.

A. Diagnosis and Repair

1. Refer to troubleshooting for Fault Code 441.
2. Inputs for the battery voltage are:
    - AUX 101 (4) – Input 8
    - J43-13 = Battery Return

5.6.281 Fault Code 5159 – Weak Battery 1 Voltage

This fault code becomes active when “Weak battery voltage” is detected on battery 1 through the OEM AUX 101.

A. Diagnosis and Repair

1. Refer to troubleshooting for Fault Code 1442.

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2. Inputs for the battery voltage are:
    - AUX 101 (3) – Input 7
    - J43-13 = Battery Return

5.6.282 Fault Code 5160 – Weak Battery 2 Voltage

This fault code becomes active when “Weak battery voltage” is detected on battery 2 through the OEM AUX 101.

A. Diagnosis and Repair

1. Refer to troubleshooting for Fault Code 1442.
2. Inputs for the battery voltage are:
    - AUX 101 (3) – Input 8
    - J43-13 = Battery Return

5.6.283 Fault Code 5161 – Weak Battery 3 Voltage

This fault code becomes active when “Weak battery voltage” is detected on battery 3 through the OEM AUX 101.

A. Diagnosis and Repair

1. Refer to troubleshooting for Fault Code 1442.
2. Inputs for the battery voltage are:
    - AUX 101 (4) – Input 7
    - J43-13 = Battery Return

5.6.284 Fault Code 5162 – Weak Battery 4 Voltage

This fault code becomes active when “Weak battery voltage” is detected on battery 4 through the OEM AUX 101.

A. Diagnosis and Repair

1. Refer to troubleshooting for Fault Code 1442.
2. Inputs for the battery voltage are:
    - AUX 101 (4) – Input 8
    - J43-13 = Battery Return

5.6.285 Fault Code 5164 – Battery Charger 2 Failed Fault

If the switch pertaining to the battery charger 2 is enabled, this warning fault is triggered.

A. Check the Battery Charger

If the battery system voltage is less than the normal voltage range:

1. Disconnect the battery (+) and (-) leads from the battery charger and measure the battery charger output voltage.

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2. If the voltage is not greater than 24 volts, troubleshoot the battery charger according to the manufacturer's service manual.

B. Check Wiring

1. Check continuity of the wiring harness. (Cummins recommended location is AUX 101-1, Input 4).
2. Replace as necessary.

5.6.286 Fault Code 5165 – Battery Charger 3 Failed Fault

If the switch pertaining to the battery charger 3 is enabled, this warning fault is triggered.

A. Check the Battery Charger

If the battery system voltage is less than the normal voltage range:

1. Disconnect the battery (+) and (-) leads from the battery charger and measure the battery charger output voltage.
2. If the voltage is not greater than 24 volts, troubleshoot the battery charger according to the manufacturer's service manual.

B. Check Wiring

1. Check continuity of the wiring harness. (Cummins recommended location is AUX 101-1, Input 5).
2. Replace as necessary.

5.6.287 Fault Code 5166 – Battery Charger 4 Failed Fault

If the switch pertaining to the battery charger 4 is enabled, this warning fault is triggered.

A. Check the Battery Charger

If the battery system voltage is less than the normal voltage range:

1. Disconnect the battery (+) and (-) leads from the battery charger and measure the battery charger output voltage.
2. If the voltage is not greater than 24 volts, troubleshoot the battery charger according to the manufacturer's service manual.

B. Check Wiring

1. Check continuity of the wiring harness. (Cummins recommended location is AUX 101-1, Input 6).
2. Replace as necessary.

5.6.288 Fault Code 5283 – High Battery 1 Voltage

This fault code becomes active when “High battery voltage” is detected on battery 1 through the OEM AUX 101.

A. Diagnosis and Repair

1. Refer to troubleshooting for Fault Code 442.

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2. Inputs for the battery voltage are:
    - AUX 101 (3) – Input 7
    - J43-13 = Battery Return

5.6.289 Fault Code 5284 – High Battery 2 Voltage

This fault code becomes active when “High battery voltage” is detected on battery 2 through the OEM AUX 101.

A. Diagnosis and Repair

1. Refer to troubleshooting for Fault Code 442.
2. Inputs for the battery voltage are:
    - AUX 101 (3) – Input 8
    - J43-13 = Battery Return

5.6.290 Fault Code 5285 – High Battery 3 Voltage

This fault code becomes active when “High battery voltage” is detected on battery 3 through the OEM AUX 101.

A. Diagnosis and Repair

1. Refer to troubleshooting for Fault Code 442.
2. Inputs for the battery voltage are:
    - AUX 101 (4) – Input 7
    - J43-13 = Battery Return

5.6.291 Fault Code 5286 – High Battery 4 Voltage

This fault code becomes active when “High battery voltage” is detected on battery 4 through the OEM AUX 101.

A. Diagnosis and Repair

1. Refer to troubleshooting for Fault Code 442.
2. Inputs for the battery voltage are:
    - AUX 101 (4) – Input 8
    - J43-13 = Battery Return

5.6.292 Fault Code 5377 – AUX 101-3 Communication Lost Fault

The OEM AUX 101-3 has lost communication through the CAN link.

A. Check Aux 101 Board

There are two different kinds of AUX 101 boards. One for Customer connections through the PCCnet (AUX 101-0 and AUX 101-1) and one for OEM connections through the J1939. Refer to the parts manual and ensure that the right part number is used for the AUX101-3 or AUX101-4 OEM AUX 101.

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B. Check Aux 101 Calibration

1. Check the LED on the AUX 101 boards. Ensure that there is only one AUX 101-3 and one AUX 101-4 respectively. If there are two, follow the procedure outlined below to change the board ID numbers.
    a. Press and hold S1 for at least five seconds. On the AUX 101 device number indicator, a small dot should appear next to the current device number.
    b. Press and release S1 until the desired number is displayed.
    c. Wait five seconds. After five seconds of inactivity, the new device number is set, and the small dot should disappear.
    d. Disconnect and reconnect J14 to cycle power to the AUX 101.
2. Connect to the AUX 101 board through InPower (Use site AUX101_LBNG) and verify that it has the latest calibration programmed into the board.

C. Check Wiring

Check the communication lines between the AUX 101 boards and the J1939 CAN link.

1. Ensure battery power is disconnected.
2. Disconnect P10(3)-1 and 2. Check the resistance.
3. Check the resistance. Make sure it is 60Ω.

5.6.293 Fault Code 5378 – AUX 101-4 Communication Lost Fault

The OEM AUX 101-4 has lost communication through the CAN link.

A. Check Aux 101 Board

There are two different kinds of AUX 101 boards. One for Customer connections through the PCCnet (AUX 101-0 and AUX 101-1) and one for OEM connections through the J1939. Refer to the parts manual and ensure that the right part number is used for the AUX101-3 or AUX101-4 OEM AUX 101.

B. Check Aux 101 Calibration

1. Check the LED on the AUX 101 boards. Ensure that there is only one AUX 101-3 and one AUX 101-4 respectively. If there are two, follow the procedure outlined below to change the board ID numbers.
    a. Press and hold S1 for at least five seconds. On the AUX 101 device number indicator, a small dot should appear next to the current device number.
    b. Press and release S1 until the desired number is displayed.
    c. Wait five seconds. After five seconds of inactivity, the new device number is set, and the small dot should disappear.
    d. Disconnect and reconnect J14 to cycle power to the AUX 101.
2. Connect to the AUX 101 board through InPower (Use site AUX101_LBNG) and verify that it has the latest calibration programmed into the board.

C. Check Wiring

Check the communication lines between the AUX 101 boards and the J1939 CAN link.

1. Ensure battery power is disconnected.

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2. Disconnect P10(4)-1 and 2. Check the resistance.
3. Check the resistance. Make sure it is 60Ω.

5.6.294 Fault Code 5397 – L-N Short Circuit Shutdown

The generator set control has sensed a L-N short in one of the phases.

A. Check for Short from Line to Neutral

1. Inspect all main generator output cables. Verify that there are no shorts or damage.
2. Check the entrance box. Verify all the cable connections and wires for the alternator output are adequate.

B. Check Calibration

Verify that the LN short circuit time delay is correct (Default = 1.5s).

C. Check for CT Malfunction

1. Check wiring from CT to control.
2. Inspect the CT for any damage, or wear and tear.
3. Check for continuity on the CT.

5.6.295 Fault Code 5398 – L-L Short Circuit Shutdown

The generator set control has sensed a L-L short in one of the phases.

A. Check for Short from Line to Line

1. Inspect all main generator output cables. Verify that there are no shorts or damage.
2. Check the entrance box. Verify all the cable connections and wires for the alternator output are adequate.

B. Check Calibration

Verify that the LL short circuit time delay is correct (Default = 4.5s).

C. Check for CT Malfunction

1. Check wiring from CT to control.
2. Inspect the CT for any damage, or wear and tear.
3. Check for continuity on the CT.

5.6.296 Fault Code 5399 – Amp Sentry Maintenance mode Active

This is an event. No action required.

5.6.297 Fault Code 5637 - Unknown Shutdown at Start Up (Shutdown)

Generator set is stuck in below mentioned states for a period defined by parameter 'State Monitor Timer'.

- Disengage Starter

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- Pre-ramp
- Ramp

A. Incorrect PCC reference to engine speed

Check for PCC reference to engine speed while cranking.

1. Connect with InPower.
2. Check if **Alternate Frequency Switch**, **Frequency Adjust**, and **Frequency to Speed Gain Select** are set up properly.
3. If ECM CAN Enable is set to Enable, the PCC sends the speed bias reference to the ECM. The speed bias reference is the percent difference between the speed reference and the base speed (Alternate Frequency Switch multiplied by Frequency to Speed Gain Select).

B. Engine Fault Code active

1. Using InSite, connect to the engine ECM. Check for active or inactive fault codes.
2. Diagnose and repair any engine fault codes. Refer to the engine service manual.
3. Clear all engine fault codes. Cycle power to the control.

C. Faulty engine speed/position sensor

Inspect the engine speed/position sensor.

1. Disconnect the engine speed/position sensor from the engine and engine harness.
2. Inspect sensor for bent, corroded, or loose pins.
3. Inspect the sensor for structural deficiencies.

D. Faulty engine speed sensor connection

Inspect the engine speed sensor and the harness connector pins.

1. Disconnect the engine harness connector from the engine speed sensor.
2. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
3. Inspect for evidence of moisture in or on the connector.
4. Inspect for missing or damaged connector seals.
5. Inspect for dirt or debris in or on the connector pins.

E. Faulty engine harness

Inspect the engine harness and the connector pins.

1. Disconnect the engine harness connector from the extension harness.
2. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
3. Inspect for evidence of moisture in or on the connector.
4. Inspect for missing or damaged connector seals.
5. Inspect for dirt or debris in or on the connector pins.

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F. Faulty extension harness

Inspect the extension harness and the AUX105 connector pins.

1. Disconnect the extension harness connector from the AUX105.
2. Inspect for corroded pins, bent pins, broken pins, pushed-back pins, or expanded pins.
3. Inspect for evidence of moisture in or on the connector.
4. Inspect for missing or damaged connector seals.
5. Inspect for dirt or debris in or on the connector pins.

5.6.298 Fault Code 6487 - Nominal Voltage Setup OOR

If voltage limits under OEM alternator setup is not in the correct order and if nominal voltage is not between certain voltage limits, the generator set control will display event/fault code 6487.

1. Voltage limits under OEM alternator setup is not in the correct order.
2. Nominal voltage is not between certain voltage limits.

A. Gather Setup Information

1. Use InPower to check and record the following:
   - Under **Setup > Genset Setup**, check and record that the **Single/3 Phase Connection** is **Single Phase** or **Three Phase**.
   - Under **Setup > OEM Setup > OEM Alt. Reconnection Setup**, record the **Nominal Voltage**.

B. Check Single Phase Parameters

1. If the **Single/3 Phase Connection** is **Single Phase**, use InPower to check and record the following:
   - Under **Setup > OEM Setup > Alternator OEM**, record the value shown for **Single phase Genset nom voltage high limit** (HL).
   - Under **Setup > OEM Setup > Alternator OEM**, record the value shown for **Nominal Voltage** (NV).
   - Under **Setup > OEM Setup > Alternator OEM**, record the value shown for **Single phase Genset nom voltage low limit** (LL)
2. Compare the recorded values. Relationships should be as follows:

   HL >= NV >= LL
3. If the relationships are not as stated, make changes to the **Single phase Genset nom voltage high limit** or **Single phase Genset nom voltage low limit**.

C. Check Three Phase Parameters

If the value of **Single/3 Phase Connection** is **Three Phase**:

1. Use InPower to check and record the following:
   - Under **Setup > OEM Setup > Alternator OEM**, record the value shown for **3ph high connection Genset nom voltage high limit (HNH).**
   - Under **Setup > OEM Setup > Alternator OEM**, record the value shown for **3ph high connection Genset nom voltage low limit (HNL).**

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- Under **Setup > OEM Setup > Alternator OEM**, record the value shown for **3ph low connection Genset nom voltage high limit (LNH).**
- Under **Setup > OEM Setup > Alternator OEM**, record the value shown for **3ph low connection Genset nom voltage low limit (LNL).**

2. Compare the recorded values. Relationships should be as follows:

   HNH >= HNL >= LNH >= LNL

3. If the relationships are not as stated, make changes to the **3ph high connection Genset nom voltage high limit** (HNH), **3ph high connection Genset nom voltage low limit** (HNL), **3ph low connection Genset nom voltage high limit** (LNH), or **3ph low connection Genset nom voltage low limit** (LNL)**.**
4. Determine the values to be adjusted.
   a. Check and record the following:
      - Under **Setup > OEM Setup > Alternator OEM**, record the value shown for **3ph high connection Genset nom voltage low limit** (HNL).
      - Under **Setup > OEM Setup > Alternator OEM**, record the value shown for **3ph low connection Genset nom voltage high limit** (LNH).
      - Under **Setup > OEM Setup > Alternator OEM**, record the value shown for **Nominal Voltage** (NV).
   b. Subtract the value recorded for NV from the value recorded for HNL. Record the result as HL (HNL - NV = HL).
   c. Subtract the value recorded for NV from the value recorded for LNH. Record the result as LL (LNH - NV = LL).
   d. Compare the values calculated for HL and LL:
      - If HL < LL, make changes to the **3ph high connection Genset nom voltage high limit** or **3ph high connection Genset nom voltage low limit** to get the following relationship:

        HNH >= NV >= HNL
      - If HL > LL, make changes to the **3ph low connection Genset nom voltage high limit** or **3ph low connection Genset nom voltage low limit** to get the following relationship:

        LNH >= NV >= LNL

5.6.299 Fault Code 6598 - At Least One ACK:Mod Severe Fault

Fault code 6598 (acknowledged engine fault): One or more acknowledged Engine Shutdown Faults are active.

5.6.300 Fault Code 6875 - Under Excitation

AVR PWM Duty Cycle is lower than Under Excitation AVR Duty Cycle minimum Threshold (Default: 0.5%) for more than Under Excitation Threshold Time (Default: 1 second).

A. Calibration is Out Of Date

Update per the latest calibration to prevent nuisance faults.

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B. Voltage Sensing Error

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Make sure that only personnel who are trained and qualified to work on this equipment are allowed to operate the generator set and perform maintenance on it.

1. Check Potential Transformer (PT) Voltage Input and Output.

   With a calibrated voltage meter, measure the voltage input and output of the PT. The input and output of the PT should be proportional; ex. Inputs: L1 = 13,800, L2 = 13,800, L3 = 13,800; Outputs: L1 = 240, L2 = 240, L3 = 240. If the inputs and outputs of the PT are not proportional, replace the PT.

2. Check PT Size.

   Use the following equation to determine if the correct PT for the application is installed:

   (Generator Set Nominal Voltage / Generator Set PT Primary Voltage) x Generator Set PT Secondary Voltage

   - If the value is greater than 600 VAC, the PT ratio is too small.
   - If the value is less than 1/2 the nominal voltage (Nominal Voltage x .5), the PT ratio is too large.

3. Check the voltage input into the control board.

C. Faulty AVR Board

Replace AVR board if necessary.

D. Faulty Control Board

Replace the control board if necessary.

5.6.301 Fault Code 7548 - Engine Friction Baseline – Data Valid But Below Normal Operating Range (Least Severe Level)

Engine warning fault has occurred in the engine ECM. This fault code is related to the Engine Friction Monitoring prognostic based on the relationship of the ECM commanded torque to the alternator feedback torque.

Refer to the engine service manual for troubleshooting.

5.6.302 Fault Code 7549 - Engine Friction Baseline – Data Valid But Below Normal Operating Range (Moderately Severe Level)

Engine warning fault has occurred in the engine ECM. This fault code is related to the Engine Friction Monitoring prognostic based on the relationship of the ECM commanded torque to the alternator feedback torque.

Refer to the engine service manual for troubleshooting.

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5.6.303 Fault Code 7551 - Engine Friction Baseline – Data Valid But Above Normal Operating Range (Least Severe Level)

Engine warning fault has occurred in the engine ECM. This fault code is related to the Engine Friction Monitoring prognostic based on the relationship of the ECM commanded torque to the alternator feedback torque.

Refer to the engine service manual for troubleshooting.

5.6.304 Fault Code 7552 - Engine Friction Baseline – Data Valid But Above Normal Operating Range (Moderately Severe Level)

Engine warning fault has occurred in the engine ECM. This fault code is related to the Engine Friction Monitoring prognostic based on the relationship of the ECM commanded torque to the alternator feedback torque.

Refer to the engine service manual for troubleshooting.

5.6.305 Fault Code 7553 - Engine Friction Deviation – Data Valid But Above Normal Operating Range (Moderately Severe Level)

Engine warning fault has occurred in the engine ECM. This fault code is related to the Engine Friction Monitoring prognostic based on the relationship of the ECM commanded torque to the alternator feedback torque.

Refer to the engine service manual for troubleshooting.

5.6.306 Fault Code 7554 - Engine Friction Deviation – Data Valid But Above Normal Operating Range (Most Severe Level)

Engine shutdown fault has occurred in the engine ECM. This fault code is related to the Engine Friction Monitoring prognostic based on the relationship of the ECM commanded torque to the alternator feedback torque.

Please note that if engine friction monitor baseline was not reset from engine using Calterm/InSite after last major service event, the engine will be locked out and cannot start. PowerGen tools like InPower cannot reset this fault code. Refer to Engine Service manual for further troubleshooting.

Also note that some undetected generator set conditions could potentially trigger this shutdown fault code. This is because those generator set conditions can result in an alternator feedback torque (kW) error which is quickly changing with respect to ECM's learned torque ratio, thereby affecting the relationship upon which the ECM prognostic relies. Examples of generator set conditions are as follows:

A. Voltage Sensing Error

⚠ WARNING

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Make sure that only personnel who are trained and qualified to work on this equipment are allowed to operate the generator set and perform maintenance on it.

1. Check Potential Transformer (PT) Voltage Input and Output

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With a calibrated voltage meter, measure the voltage input and output of the PT. The input and output of the PT should be proportional; ex. Inputs: L1 = 13,800, L2 = 13,800, L3 = 13,800; Outputs: L1 = 240, L2 = 240, L3 = 240. If the inputs and outputs of the PT are not proportional, replace the PT.

2. Check PT Size

   Use the following equation to determine if the correct PT for the application is installed:

   (Generator Set Nominal Voltage / Generator Set PT Primary Voltage) x Generator Set PT Secondary Voltage

   - If the value is greater than 600 VAC, the PT ratio is too small.
   - If the value is less than 1/2 the nominal voltage (Nominal Voltage x .5), the PT ratio is too large.

3. Check the voltage input into the control board.

B. Current Sensing Error

1. Check the Current Transformers (CTs).
   - Verify the CT polarity is correct.
   - Verify the CT connections from the CTs to the input of the control board are correct.
   - Verify CTs have the correct ratio for the application.
2. Check the current going into the CT input on the control board (use a current probe to check the secondary output of the CT).
   - This should be the value with which the secondary is calibrated (e.g. if the control is calibrated with a CT ratio of 1000:5, the current input into the base board should not be more than 5 A).
3. For installation instructions, refer to the Current Transformer Installation section or reference event/fault codes 2814 and 2815.

C. Metering Calibration Adjustment (V, Frequency, A)

1. Calibrate the generator set and bus voltage (all phases) in order to improve the voltage match performance as well as the metering accuracy. Ensure that that the base board is calibrated correctly by checking that the generator set is operating at proper voltage and frequency. With a calibrated Frequency and Voltage meter, measure the frequency and voltage output of the generator set at the alternator; while through the display, ensure that the base board displays the same voltage and frequency shown on the meter.

   To view and adjust the voltage, go to: **Setup > Calibration** and if appropriate, change the voltage to reflect the voltage shown on the meter.

   To view and adjust the frequency, go to: **Setup > Adjust > Frequency Adjust** and if appropriate, change the frequency to reflect the frequency shown on the meter.

2. If paralleling, use a volt-meter to measure the AC voltage of the electric bus to which the generator set is paralleled (voltage of the Genset Bus or the Utility). Then, measure the output voltage of the generator set and ensure that the generator set output voltage is +3 VAC/-0 VAC that of the source to which the generator set is paralleled. Event/fault code 1461 is a result of the generator set not matching or exceeding the voltage of the electric bus, which causes the generator set to import current from the electric bus (Reverse KVAR).

   To access the voltage calibration configuration menu on the display, go to: **Setup > Calibration** and increase the generator set output voltage.

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3. Measure the generator set current input into the control board with a current probe at J22. The maximum value of current going into the control CTs should not be more than the value of the Genset CT Secondary Current value for which the control is calibrated. For example, if secondary setting in the control is 1 Amp, current going into the control should not be more than 1 Amp.

   To access the Genset CT Secondary Current configuration menu on the operator panel, go to: **Setup > OEM Setup > OEM Alt Setup** and set the Genset CT Secondary Current parameter appropriately for the application.

D. Faulty Control Board

Replace the control board if necessary.

5.6.307 Fault Code 7555 - Alternator Feedback Power – Special Instructions

Engine shutdown fault has occurred in the engine ECM. This fault code is related to the Engine Friction Monitoring prognostic based on the relationship of the ECM commanded torque to the alternator feedback torque.

Refer to the engine service manual for troubleshooting.

5.6.308 Fault Code 7558 - Engine Friction Deviation – Condition Exists

Engine warning fault has occurred in the engine ECM. This fault code is related to the Engine Friction Monitoring prognostic based on the relationship of the ECM commanded torque to the alternator feedback torque.

Refer to the engine service manual for troubleshooting.

5.6.309 Fault Code 7697 - Bank Cut-Off FSO Failure - Condition Exists

When engine is running on both banks and one of the fuel rail pressure switch starts malfunctioning.

1. Faulty or incorrect configurable output of PCC hardware.
2. Faulty relays.
3. Stuck Fuel Shut-Off (FSO) actuator.
4. Faulty fuel rail pressure switch of Bank A or Bank B.
5. Wiring connection from PCC to relay, FSO, and fuel rail pressure switch.

A. Faulty or Incorrect Configurable Output of PCC Hardware

1. Check if the configurable output is working properly using overrides for the assigned configurable output. If it works with overrides, the issue is with the hardware pins on the PCC. Repair the pins as necessary or use any other configurable output.
2. Check the PCC wiring diagram or service manual and verify if configurable outputs have been configured correctly to the respective pins on the PCC board. If not, configure per the wiring diagram.

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B. Faulty Relays

Check if any of the relays driven by configurable outputs are malfunctioning. Test the de-energized and energized conditions of the relay contacts. Check the resistance between each pole of the relay and the corresponding NC and NO contacts for that pole.

- All NC contacts should read 0 ohms to the corresponding pole.
- All NO contacts should read infinite resistance to the corresponding pole.

Replace the relay if not working.

C. Stuck Fuel Shut-Off (FSO) Actuator

1. Check the wiring harness for damage, short, or abrasions. Repair as necessary.
2. Check for corded, bent, broken, pushed back, expanded, or loose pins.
3. Check that the fuel shut-off valve is not stuck mechanically. Tap lightly with a plastic or rubber mallet to dislodge a stuck actuator. Replace if faulty.
4. Refer to the Engine service manual for additional checks on FSO.

D. Faulty Switch

1. Using a multimeter, check the continuity between the fuel pressure switch terminals while the switch is in the closed position. If the multimeter shows infinite resistance, it means the switch is stuck in the open position. Replace the switch.
2. Using a multimeter, check the continuity between the fuel pressure switch terminals while the switch is in the open position. If the multimeter shows 0 ohm, it means the switch is stuck in the closed position. Replace the switch.

E. Wiring Connection

Check the wiring connection from the PCC hardware pin to the relay, FSO, and the fuel rail pressure switch feedback wire for any damage, short, or abrasions. Repair as necessary.

5.6.310 Fault Code 7823 - Cylinder Cut-Off System Failure – Condition Exists

CCS failure condition when one bank is active but fuel rail pressure feedback is received from both banks.

1. Faulty fuel rail pressure switch of Bank A or Bank B.
2. Stuck Fuel Shut-Off (FSO) actuator.

A. Faulty Switch

1. Using a multimeter, check the continuity between the fuel pressure switch terminals while the switch is in the closed position. If the multimeter shows infinite resistance, it means the switch is stuck in the open position. Replace the switch.
2. Using a multimeter, check the continuity between the fuel pressure switch terminals while the switch is in the open position. If the multimeter shows 0 ohm, it means the switch is stuck in the closed position. Replace the switch.

B. Stuck Fuel Shut-Off (FSO) Actuator

1. Check the wiring harness for damage, short, or abrasions. Repair as necessary.
2. Check for corded, bent, broken, pushed back, expanded, or loose pins.

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3. Check that the fuel shut-off valve is not stuck mechanically. Tap lightly with a plastic or rubber mallet to dislodge a stuck actuator. Replace if faulty.
4. Refer to the Engine service manual for additional checks on FSO.

5.6.311 Fault Code 7824 - Cylinder Cut-Off System State and Feedback Mismatch - Condition Exists

Cylinder Cut-Off System state and fuel rail pressure switch feedback mismatch.

1. Reverse connection of fuel rail pressure switch for Bank A and Bank B.

A. Reverse Connection

When the generator set is running, check the condition where Bank A is active but feedback is received from Bank B or vice versa.

For example, when CCS state shows “A Bank Active”, the status of “CCS BankB Pressure Switch” will display “Active”. This means that connections have been reversed.

To check these parameters in Inpower, go to **Setup > Cylinder Cutoff System**, and monitor the parameters.

To change the configurable input settings, go to **Setup > Configurable I/O**, and set the configurable inputs for Bank A and Bank B appropriately.

5.6.312 Fault Code 7825 - Generator Total Real Power Sensing Failure – Condition Exists

Indicates failure in generator set total real power sensing.

1. J12 connector on PCC 3300 board is loose or damaged.
2. Any connection(s) of CT wire removed/damaged.
3. Faulty CT.

A. Loose or Damaged J12 Connector on PCC 3300 Board

1. Check if the J12 connector is fitted properly on the PCC. If it is not, fix the connections.
2. Check the J12 connector for any damage, short, or abrasions. Repair as necessary.

B. Any Removed/Damaged CT Wire Connection(s)

Check the wiring harness for damage, short, or abrasions. Repair as necessary.

C. Faulty CT

Check if there is any physical damage in the CT or if any of its connections are open. Repair or rectify as applicable.

5.6.313 Fault Code 8632 - DC Box F18 Fuse Blown - Condition Exists

F18 Fuse signal voltage is out of range - open circuit (only applicable for generator sets with QSK95 engine).

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A. Battery Banks Voltage Imbalance Due to Faulty Starter or Faulty Battery

1. Disconnect the battery banks from the generator set unit.
2. Disconnect the battery banks from the battery charger (if applicable).
3. Measure the voltage of the battery with a voltmeter.
   - Battery voltage should be 12 VDC or greater in a 12 VDC system, or 24 VDC or greater in a 24 VDC system.
   - If the battery voltage is low, check the electrolyte level in the battery.
   - Replenish the electrolyte level if low and recharge the battery; the specific gravity for a fully charged lead acid battery is approximately 1260 at 27°C (80°F).
4. If the battery cannot hold adequate voltage, then replace the battery.
5. If the battery is good, check the battery charger status (reference the battery charger manual).
6. Check the starter functionality.

B. Faulty F18 Fuse

1. Inspect the F18 fuse inside the generator set DC box.
2. Check the F18 fuse status.
3. Replace the fuse if it is blown.
4. If the fuse is okay, follow Faulty Relay Diagnosis and Repair instruction.

C. Faulty K22 Relay

1. Inspect the K22 relay inside the generator set DC box.
2. If the K22 relay indicator light is on, replace it with a new K22 relay.
3. If the K22 relay indicator light is off, then check the connection on the K22 relay coil.

D. Improper Connection on Power Harness to Charging Alternator or Battery Banks

1. Visually inspect the power harness connection on the charging alternator and battery banks, and take corrective action if required.
2. Refer to the wiring diagram.

5.6.314 Fault Code 9971 – ECM Derate Fault

This is an event. No action required.

6 Generator Set Subsystems

6.1 System Overview

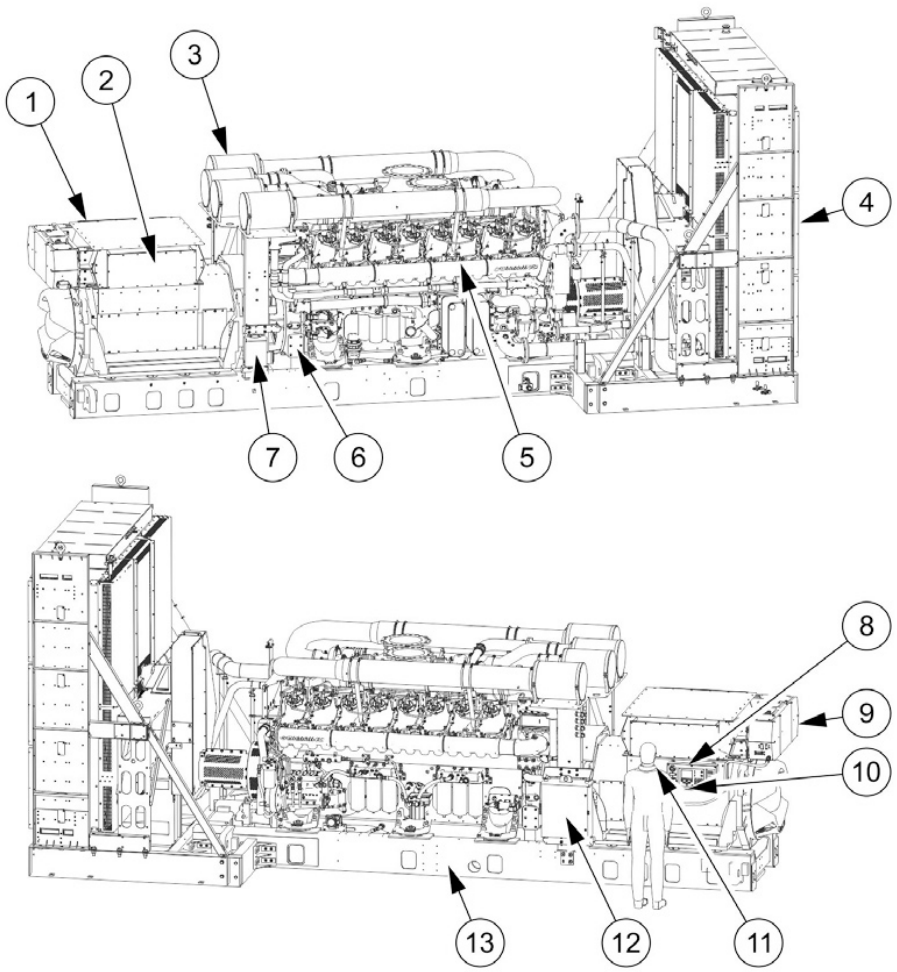
This section provides an overview of the generator set.

6.1.1 Generator Set Components

The main components of a typical generator set with a QSK95 engine are shown below, and referred to within this section.

There are various options listed although they may not be available for all models.

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No.	Description	No.	Description
1	Alternator	9	Control Box
2	Terminal Box	10	HMI
3	Air Filter (X4)	11	Nameplate (not shown)
4	Radiator	12	DC Distribution Panel
5	Engine	13	Skid
6	Coolant Heater (location only, device not shown)		(Not indicated)
7	AC Distribution Panel		Alarm Module
8	Control Panel		Battery (X3) or (X4)

FIGURE 11. TYPICAL GENERATOR SET

6.1.2 Locking the Generator Set Out of Service

Before any work is carried out for maintenance, etc., the generator set must be immobilized. Even if the generator set is put out of service by pressing the **Off** switch on the operator panel, the generator set cannot be considered safe to work on until the engine is properly immobilized, as detailed in the following procedures.

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NOTICE

Refer also to the engine specific Operator Manual. This manual contains specific equipment instructions that may differ from the standard generator set.

6.1.2.1 Immobilizing for Safe Working

1. Notify the site supervisor, and/or the customer representative to ensure that all affected personnel are notified. Follow any site specific Lock Out/Tag Out requirements.
2. Press the Off mode button on the operator panel to shut down the engine.
3. After the engine has stopped press the Emergency Stop button.
   - This will prevent the starting of the generator set regardless of the start signal source and will therefore provide an additional safety step for immobilizing the generator set.

NOTICE

When the E-stop button is pressed, the Operator Panel will indicate the Shutdown condition by illuminating the red Shutdown status LED  and displaying a message on the graphical LCD display.

NOTICE

This fault will affect the Fault History memory bank.

4. Wait 60 seconds for the engine control module (ECM) to power down.
5. Insert a lock on the Emergency Stop button.
6. Disconnect the generator set from the distribution system.
7. Lock out the circuit breaker. Attach a "**Do Not Operate**" or similar warning tag to the circuit breaker.
   - Refer to the electrical diagram.
   - Verify that all points of possible reverse power flow have been locked out.
8. Turn Off and lock out all battery charger and breakers.
9. Open the Single Phase AC distribution panel (if equipped). Turn Off the main circuit breaker and insert a lock to prevent operation.

NOTICE

If maintenance is to be performed on any generator mounted AC distribution panels, lock out the customer supply circuit breaker to the affected AC distribution panel.

10. Disconnect any external AC devices that are not connect through the AC distribution panel.
11. Close the fuel supply valve to the engine and attach a "**Do Not Operate**" or similar warning tags.
12. Disconnect the battery cables to each of the starters.
    - Disconnect the negative (-) cables first, using an insulated wrench. Attach a "**Do Not Operate**" or similar warning tag.
13. Fit warning notices at each of the above points to indicated **Maintenance in Progress - Plant Immobilized for Safe Working**.

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6.1.2.2 Returning the Generator Set to Operation

Upon successful completion of service procedure, follow the steps below to remove the locks and tags and reconnect power to the generator set.

1. Notify the site supervisor, and/or the customer representative to ensure that all affected personnel are notified. Follow any site specific Lock Out/Tag Out procedure requirements.
2. Open the Single phase AC distribution panel (if equipped), remove the lock and switch the main circuit breaker to the ON position.
3. Remove locks and close breakers for the battery chargers. Turn on the battery chargers.
4. Reconnect the generator set to the distribution system. Remove the locks and close the output circuit breaker.

NOTICE
If the maintenance was performed on the generator set mounted AC distribution panels, remove the locks and close the customer supply circuit breaker to the AC distribution panels.

5. Open the fuel supply to the engine.
6. Remove the maintenance tags and reconnect the battery cables. Connect the positive (+) leads first, using an insulated wrench.
7. Remove the lock from the Emergency Stop button. Reset the Emergency Stop button and reset the control panel.
8. Run the generator set to verify proper operation.
9. Return the generator set control to the appropriate mode of operation.

6.2 Engine

6.2.1 Engine Specifications

TABLE 90. ENGINE SPECIFICATIONS

Item	Data
Engine Type	Four Cycle, 60 degree V, 16 cylinder
Displacement	5816 in^3 (95.3 L)
Fuel System	Cummins MCRS
Aspiration	Turbocharged and Low Temperature Aftercooled
Weight (maximum)	Dry 12,817 kg (28,257 lb) Wet 13,705 kg (30,214 lb)
Size	
Height	2,361 mm (93 in)
Width	1,732 mm(68 in)
Depth	3,654 mm (144 in)

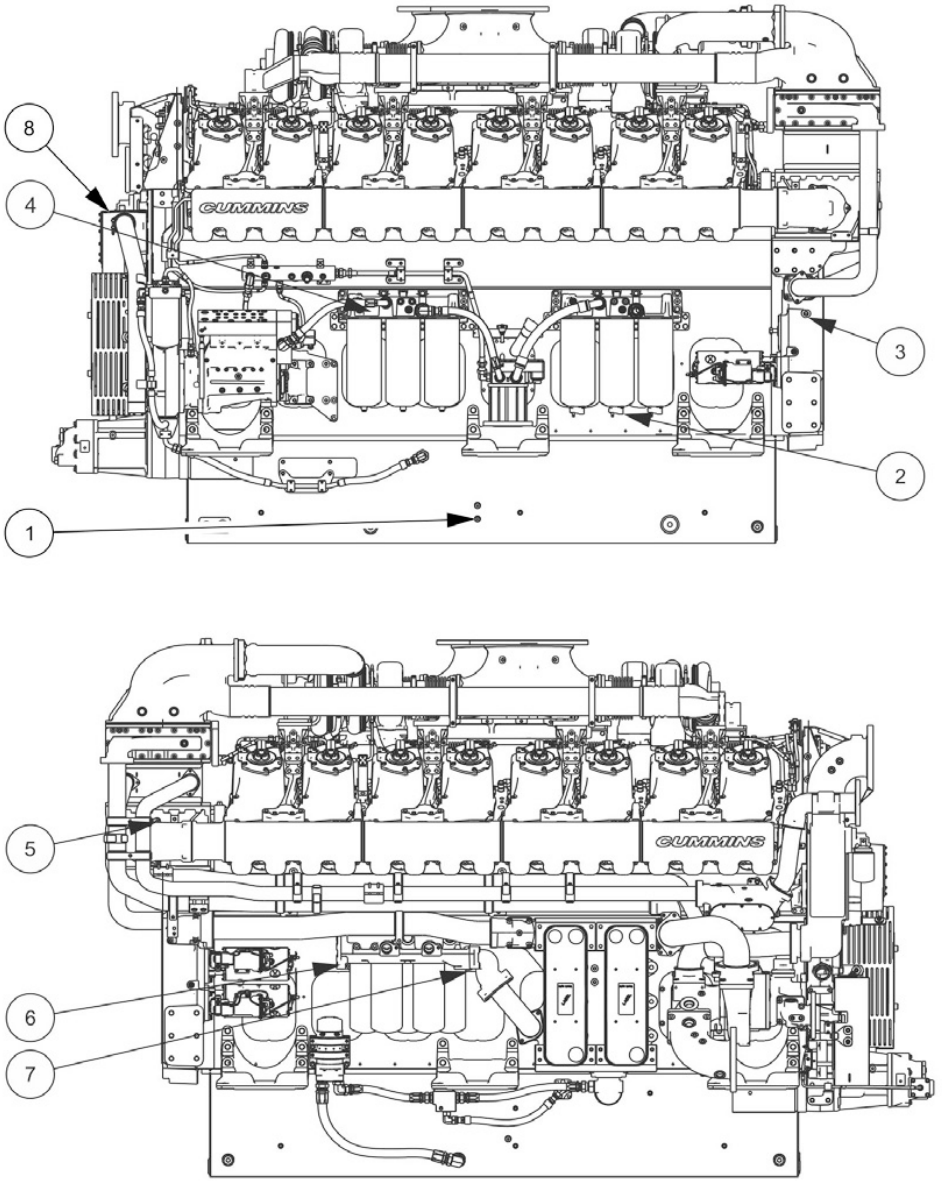
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6.2.2 Engine Sensors

Figure 12 shows the locations of the engine sensors.

The low coolant level sensor is not shown in Figure 12; this sensor is located near the top of the radiator.

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No.	Description	No.	Description
1	Oil Temperature	2	Water in Fuel
3	Crankshaft Position	4	Fuel Supply Pressure
5	TMAP	6	Post Filter Oil Pressure
7	Pre-Filter Oil Pressure	8	Camshaft Position

FIGURE 12. ENGINE SENSOR LOCATIONS

6.2.2.1 Oil Pressure Sensor

The oil pressure sensor measures the engine oil pressure at the outlet of the oil filter head. When engine oil pressure falls below the ECM threshold, the ECM fault code will become active and display on the PCC.

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TABLE 91. OIL PRESSURE SENSOR INFO

Sensor Type	Ratiometric
Measuring Range	0-120 psia

For more information regarding the oil pressure sensor, refer to the engine service manual.

6.2.2.2 Intake Manifold Temperature and Pressure Sensor (TMAP)

The intake manifold temperature and pressure (TMAP) sensor is a thermistor device, which uses changes in resistance dependant on the temperature and pressure.

TABLE 92. TMAP SENSOR INFO

Temperature Measuring Range	-40 °C to 150 °C
Pressure Measuring Range	6.5 to 75 psia

Temperature		RESISTANCE (OHMS)			
°C	°F	R NOM	TOL. (±%)	R MIN	R MAX
-40	-40	44373	7.03	41255	47492
-30	-22	25572	6.40	23935	27209
-20	=4	15141	5.82	14260	16022
-10	14	9202	5.29	8716	9689
0	32	5774	4.78	5497	6050
10	50	3714	4.33	3553	3875
20	68	2448	3.92	2353	2544
25	77	2014	3.72	1940	2089
30	86	1671	3.53	1613	1730
40	104	1150	3.13	1114	1186
50	122	816.7	2.77	794	839.3
60	140	583.1	2.45	568.9	597.3
70	158	426.7	2.13	417.6	435.8
80	176	315.8	1.84	310	321.6
90	194	238.1	1.55	234.4	241.8
100	212	182.8	1.26	180.4	185.1
110	230	141.2	0.99	139.8	142.6
120	248	110.3	1.36	108.9	111.8
130	266	87.4	1.60	86	88.8

FIGURE 13. INTAKE MANIFOLD TEMPERATURE RESISTANCE READINGS

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6.2.2.3 Crankshaft Position Sensor (CKP)

The crankshaft position sensor (CKP) is used to determine engine RPM and crankshaft position. The CKP functions similar to a traditional magnetic pickup sensor. The CKP is located next to the trigger wheel mounted on the end of the crankshaft. By magnetically locating specific flywheel locations on each revolution, the ECM can determine the position of the crankshaft and engine speed.

TABLE 93. CRANKSHAFT POSITION SENSOR INFO

Digital Output	0-5 V
Range	0-3500 rpm

6.2.2.4 Camshaft Position Sensor (CMP)

The Camshaft Position Sensor (CMP) is used to determine when cylinder 1 reaches its compression stroke. The ECM uses this information to control fuel delivery to the proper cylinder.

TABLE 94. CAMSHAFT POSITION SENSOR INFO

Digital Output	0-5 V
Range	0-2250 rpm

6.2.3 Engine Control Module (ECM)

The Engine Control Module (ECM) monitors signal inputs from engine sensors to control the fuel metering and speed of the engine (see figure below). The ECM also provides diagnostic control over the engine and fuel system. The Generator Set Control Module controls the starting and stopping sequence of the engine through the ECM.

In the event of an engine fault, the ECM provides a signal output, via the CAN datalink, to the Generator Set Control Module. If the ECM triggers an engine shutdown, the Generator Set Control Module displays an engine shutdown or service fault. The Generator Set Control Module will display an additional fault to determine the root cause of the engine shutdown. If no additional fault is displayed in the Generator Set Control Module, the engine fault code can be determined by connecting to the ECM with the INSITE service tool.

The wiring harness and INSITE software required to perform engine diagnostics are available from your authorized distributor.

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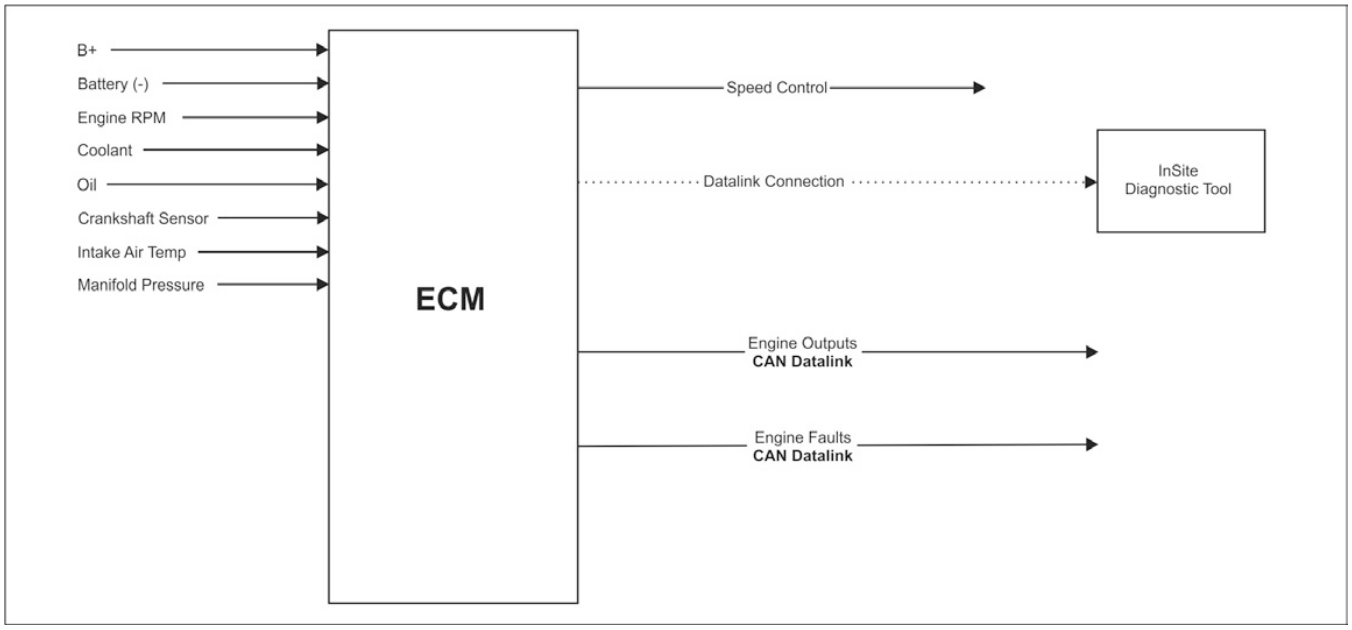


FIGURE 14. ECM INPUT AND OUTPUT

6.2.3.1 ECM Cooling

The ECMs are fitted with cooling plates to prevent overheating. The LTA coolant circuit passes through these plates.

6.2.3.2 Keyswitch Control

The Keyswitch input to the ECM remains active during all controller modes other than when the Sleep Mode is active or the Emergency Stop is engaged. The PCC sends a start signal to the ECM via the Keyswitch Relay and the Start Relay. When the PCC detects a start command, both relays become charged, sending the start signal to the ECM, causing the engine to crank.

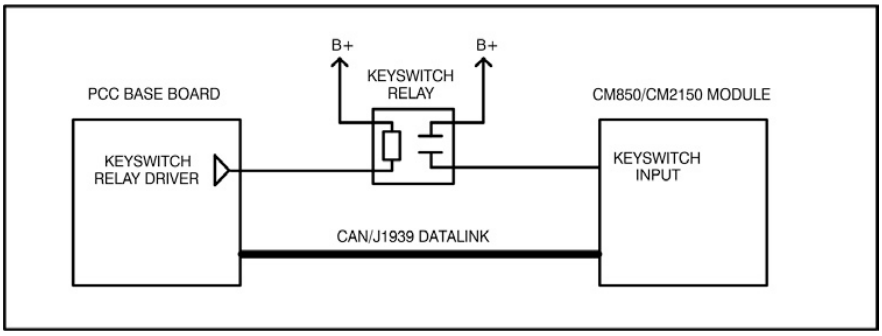


FIGURE 15. CONTROL SYSTEM BLOCK DIAGRAM

6.2.3.3 Reprogram ECM

ECM calibrations can be performed using the INSITE™ electronic service tool. Contact your local Cummins Distributor for information on how to procure and use this service tool.

NOTICE
Due to the number of various engine control module (ECM) configurations, this procedure has been written to be common. For more information regarding your specific engine configuration, refer to your engine service manual.

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NOTICE

More than one ECM may be installed. Each ECM must be programmed separately.

Initial Check

NOTICE

If the tool will not communicate with the keyswitch in the ON position, cycle the keyswitch and try again.

The ECM calibration process occurs with the keyswitch turned **ON**. Always follow the instructions on the service tool screens.

Preparatory Steps

Connect the INSITE™ electronic service tool to the service tool datalink, which is located on the engine.

- See the help section within INSITE™ for detailed ECM calibration procedures.

After an ECM is replaced or calibrated, the actual engine hours/distance must be entered correctly into the ECM.

- Record the values of ECM distance Offset, ECM Time Offset, Engine Distance Offset, and Engine Time Offset prior to replacement of calibration of the ECM. These parameters can be found in the Trip Information section of Features and Parameters.

Following the calibration download, if new fault codes or fault conditions exist, perform the following inspection steps in order to understand if the calibration is working correctly and is the appropriate calibration for the application.

- If it is suspected that the calibration is not working correctly, make sure that the appropriate calibration was loaded for the engine, equipment, and application.

  NOTICE

  For applications with multiple ECMs, it may be required for each ECM to be recalibrated to ensure proper communication is established between them. For more information refer to your engine service manual or local Cummins distributor.

- If no issues are found, no further action is required.

Inspect

Establish if the suspected feature creating the problem is operating correctly. Reference the relevant "Electronic Controlled Fuel System" of your specific engine operation and maintenance manual or in INSITE™ "Fault Information System" for further information.

NOTICE

To access INSITE™ electronic service tool "Adjustable Engine Features" section, either select Help->Contents from the menu bar, or press F1 with an individual feature within the Features and Parameters section in INSITE™ electronic service tool highlighted.

Review the INSITE™ help files "Adjustable Engine Features" section to determine if the suspected error is due to an incorrectly set adjustable engine feature.

Use QuickServe™ Online to inspect the calibration revision history.

1. Log into QuickServe™ Online.
2. Select "My Applications".

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3. Select "ECM Calibration Revisions".
4. Enter the calibration code and select "Search".
5. Review the calibration revision information.

NOTICE

The calibration revision history provides information relating to the changes made to a calibration each time a new revision is released. This information can be used to establish if there is a commonality between changes made to the calibration and the symptoms being observed. The calibration revision history can also be downloaded in Excel format by selecting "Spreadsheet" in the record filter box.

NOTICE

The greater the number of parameters, the slower the rate at which they can be logged. Therefore, only log the minimum number of parameters if sample rate is important.

If no issue can be identified using the steps listed above, the following information should be collected to allow the issue to enter the technical escalation chain:

1. Engine specifics, including but not limited to:
   - Engine Serial Number (ESN)
   - Application
   - Rating
   - Engine Hours
   - Maintenance History
2. ECM codes (the codes before and after, including revision numbers)
3. ECM images (before and after calibration downloads)
4. Data logs (utilize existing, pre-defined parameter groups, found in INSITE™ electronic service tool, or use the relevant wiring diagram to identify if multiple circuits utilize a common supply or ground, or monitor parameters which logically would be linked - i.e. User Fueling State, Engine Speed, Commanded Fuel Rail Pressure, Measured Fuel Rail Pressure, etc.).

6.2.3.4 Viewing Engine Faults

The engine electronic control module (ECM) can display and record certain detectable engine fault conditions. These failures are displayed as fault codes, which makes troubleshooting easier. The fault codes generated by the engine are retained in the ECM.

ECM fault information can be viewed on the PCC HMI or using the INSITE™ electronic service tool. The electronic service tool is available from your local Cummins distributor.

All fault codes recorded will either be active or inactive. Active fault codes are presently active on the engine. Active fault codes can be read using the PCC HMI, InPower™ electronic service tool or INSITE™ electronic service tool. Inactive fault codes were active at one time, but are not active at the moment. Inactive fault codes can only be viewed using the InPower™ or INSITE™ electronic service tools.

When an engine diagnostic fault code is recorded in the ECM, ECM input and output data is recorded from all sensors and switches. Snapshot data allows the relationships between ECM inputs and outputs to be viewed and used during troubleshooting. Fault code snapshot data can only be viewed with the INSITE™ electronic service tool.

For more information on how to use the INSITE™ electronic service tool to view ECM faults, refer to your specific engine service manual.

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6.2.4 Rigging Instructions

⚠ WARNING

Incorrect engine installation.
This can result in severe personal injury, death, and/or equipment damage.
Personnel must be trained and experienced in rigging and hoisting.

⚠ WARNING

Improper lifting.
This can result in severe personal injury or death.
Do not stand under or near the engine when lifting. Failing to follow these instructions can result in load rotating without warning.

1. Consult the outline drawing for weight and center-of-gravity information.
2. Use a cross wise pattern to check the torque on the four engine lifting eyes is 281 Nm (161 ft-lb) (**Figure 30 on page 358**).
3. Attach cables from the lifting lugs to a spreader bar. Never make the spreader bar cable attachment points wider than the attachment points on the skid or the bars. Make sure cables do not touch any other part of the generator set other than the skid. Approximate engine wet weight is 13,283 kg (29,284 lb). Approximate engine dry weight is 12,784 kg (28,184 lb).

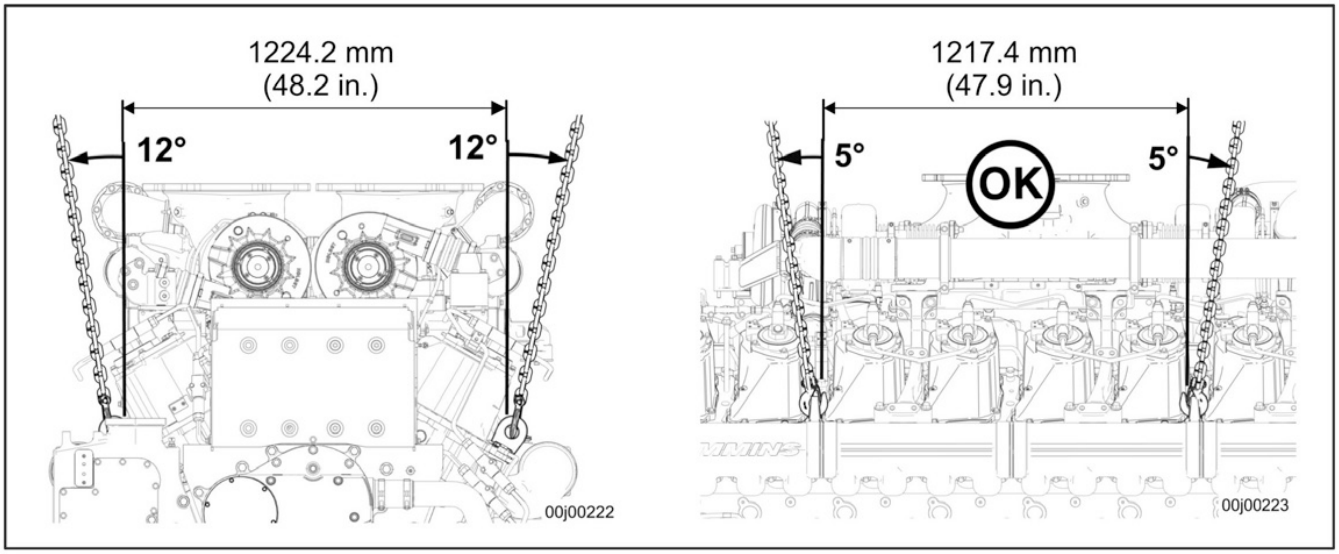


FIGURE 16. ENGINE RIGGING

6.2.5 Engine Removal and Installation

6.2.5.1 Personal Protective Equipment

Wear the following personal protective equipment (PPE):

- Hearing protection
- Steel toe shoes
- Face shield

- Leather gloves
- All site mandatory PPE

6.2.5.2 Tools

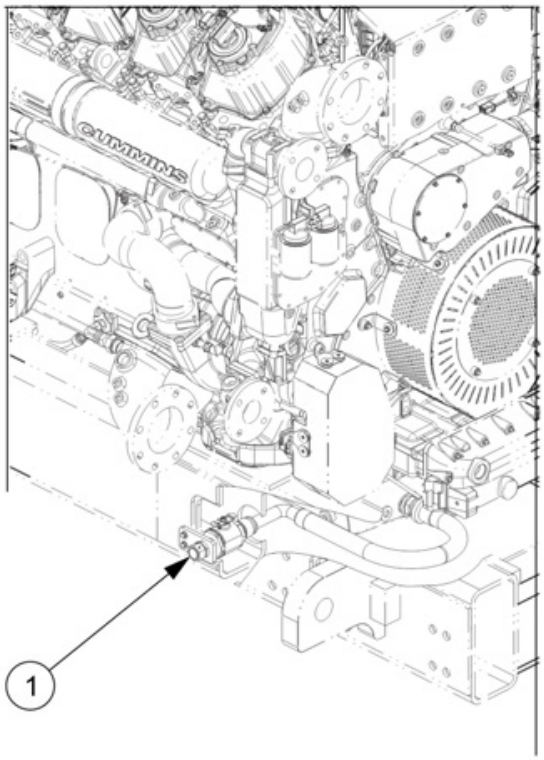
- RT-03 Torque Tool (A050L948)
- Engine Foot Alignment Tool (A046G299)

6.2.5.3 Parts

- Slip joint kit (A050R936)

6.2.5.4 Remove Engine

1. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See Section 6.1.2 on page 334.
2. Drain the generator set cooling system from the lowest point available. Store or dispose of the coolant according to local regulations.
3. Drain the engine oil. Dispose of the oil according to local regulations.

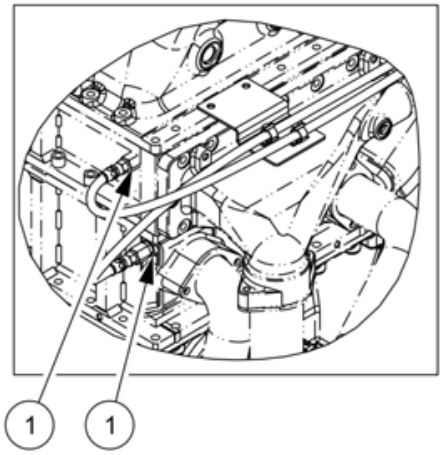


No.	Description	No.	Description
1	Oil drain		

FIGURE 17. OIL DRAIN

4. Remove the HT, LT, and aftercooler vent lines.

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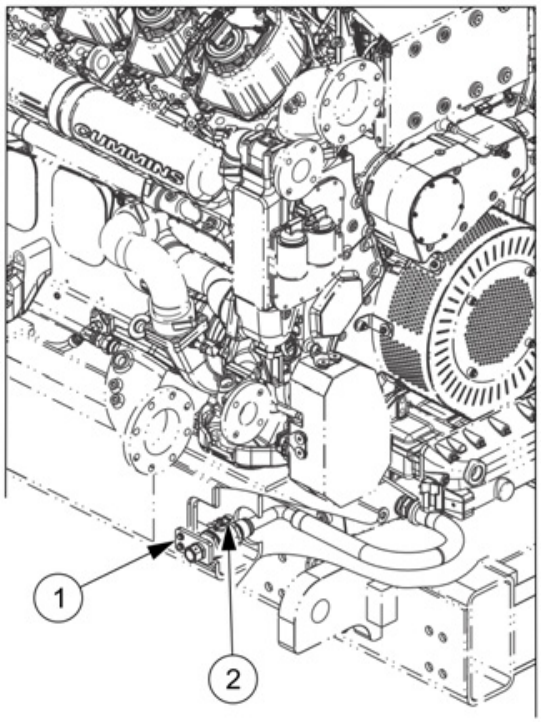


No.	Description	No.	Description
1	Aftercooler vent lines		

FIGURE 18. AFTERCOOLER VENT LINES

5. Remove the HT inlet and outlet coolant piping.
6. Remove the LT inlet and outlet coolant piping.
7. If equipped, remove the coolant heater.
8. Remove the oil maintainer system.
9. Remove any customer connections to the engine breather hose.
10. Remove the oil drain cap and jam nut that secure the oil drain valve to the mounting bracket.
11. Remove the oil drain valve handle and oil drain mounting bracket.

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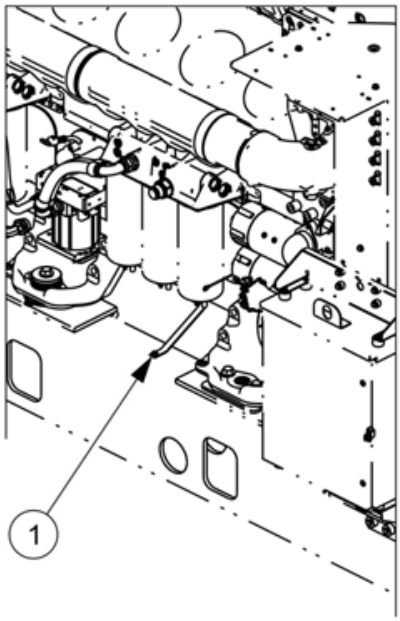


No.	Description	No.	Description
1	Mounting bracket	2	Oil drain valve handle

FIGURE 19. MOUNTING BRACKET AND OIL DRAIN VALVE VALVE HANDLE

12. If using a Cummins supplied, generator set mounted coolant system, remove the fan drive shaft.
13. If using the Cummins low coolant level sensor, disconnect the sensor from the engine harness.
14. Remove the two engine ground straps (one one each bank).

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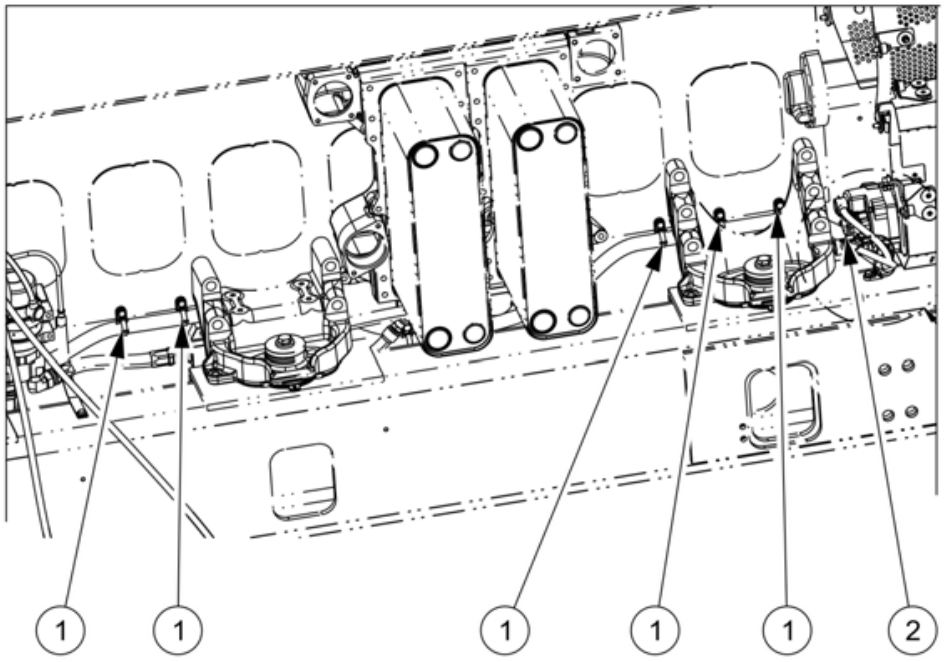


No.	Description	No.	Description
1	Ground strap		

FIGURE 20. GROUND STRAP

15. Remove the DC harness connections at the battery charging alternator.
16. Remove the clips and cable ties that secure the DC harness to the engine block.

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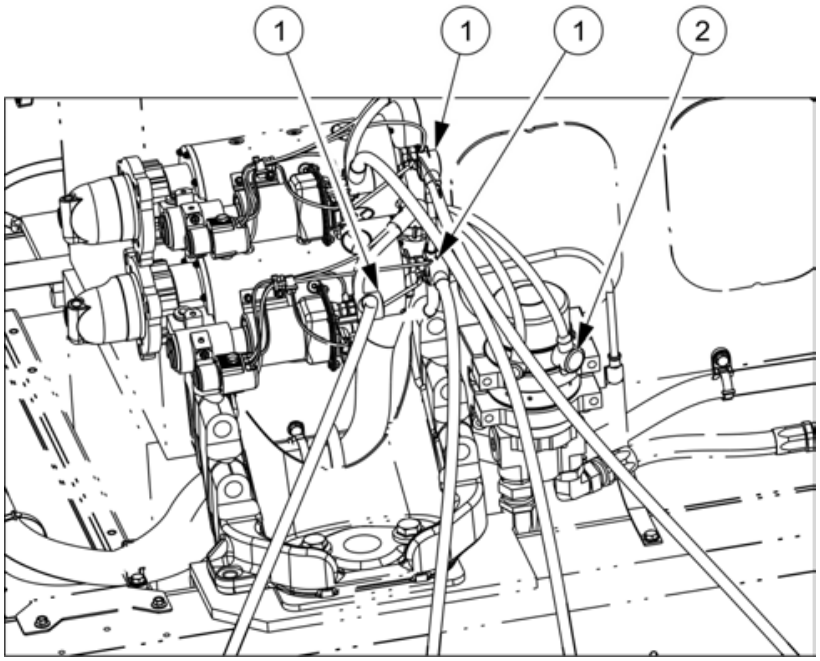


No.	Description	No.	Description
1	Clip and cable tie	2	Charging alternator connection

FIGURE 21. DC HARNESS CLIPS

17. Remove the DC harness connections on the two right bank starters and the pre-lube pump.

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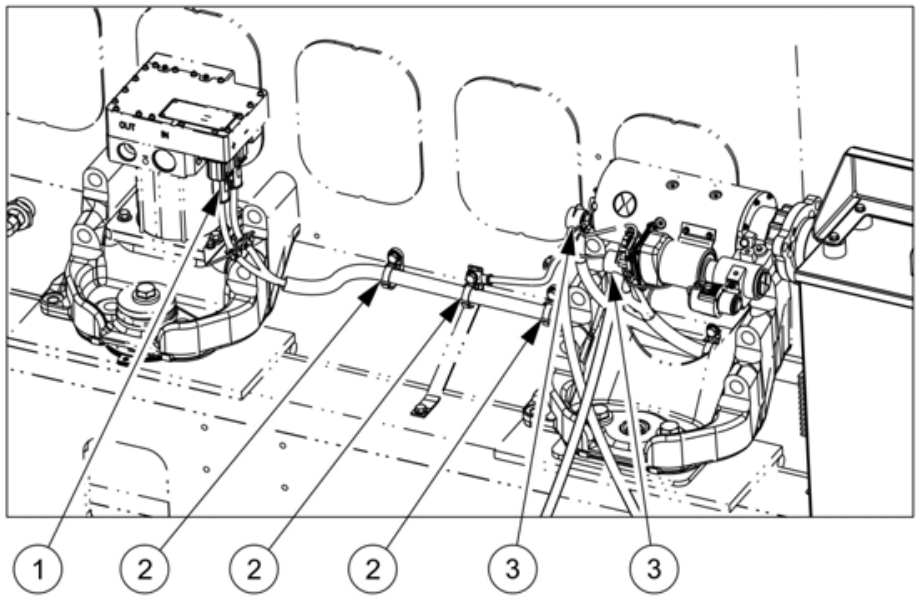


No.	Description	No.	Description
1	Starter connections	2	Pre-lube pump connections

FIGURE 22. DC HARNESS CONNECTIONS TO RIGHT BANK STARTERS AND PRE-LUBE PUMP

18. Remove the clips and cable ties that secure the DC Harness from the right bank starters to the engine block.
19. Remove the DC harness connections at the fuel supply pump (FSP).
20. Remove the DC harness connection at the left bank starter.
21. Remove the clips and cable ties that secure the DC harness from the FSP and the left bank starter to the engine block.

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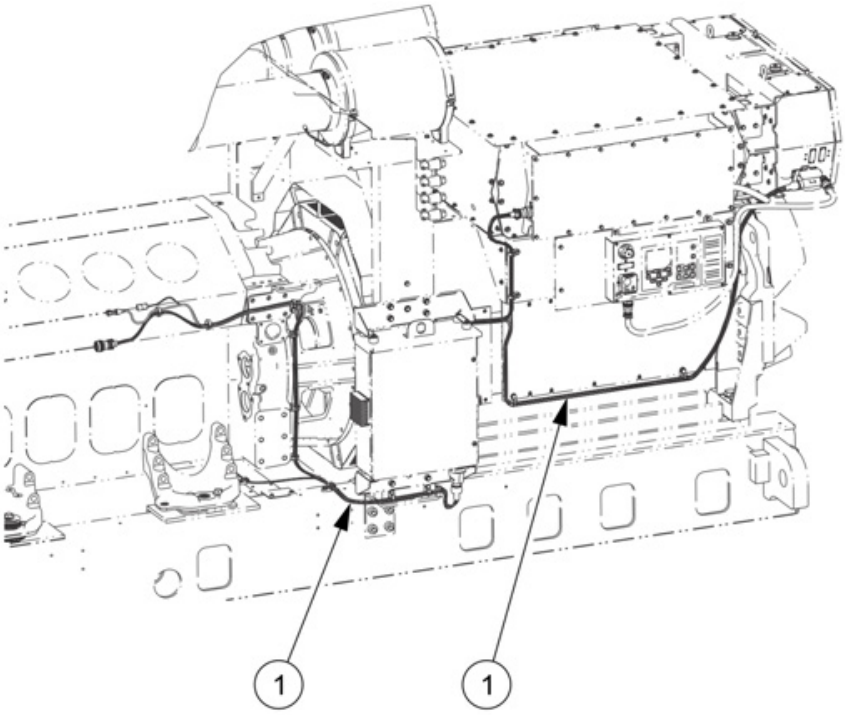


No.	Description	No.	Description
1	Fuel supply pump	3	Starter Connection
2	Clips and cable tie		

FIGURE 23. DC HARNESS CONNECTIONS TO FUEL SUPPLY PUMP

22. Disconnect the generator set harness on the left bank of the engine.
23. Remove the cable ties that secure the generator set harness to the engine block.

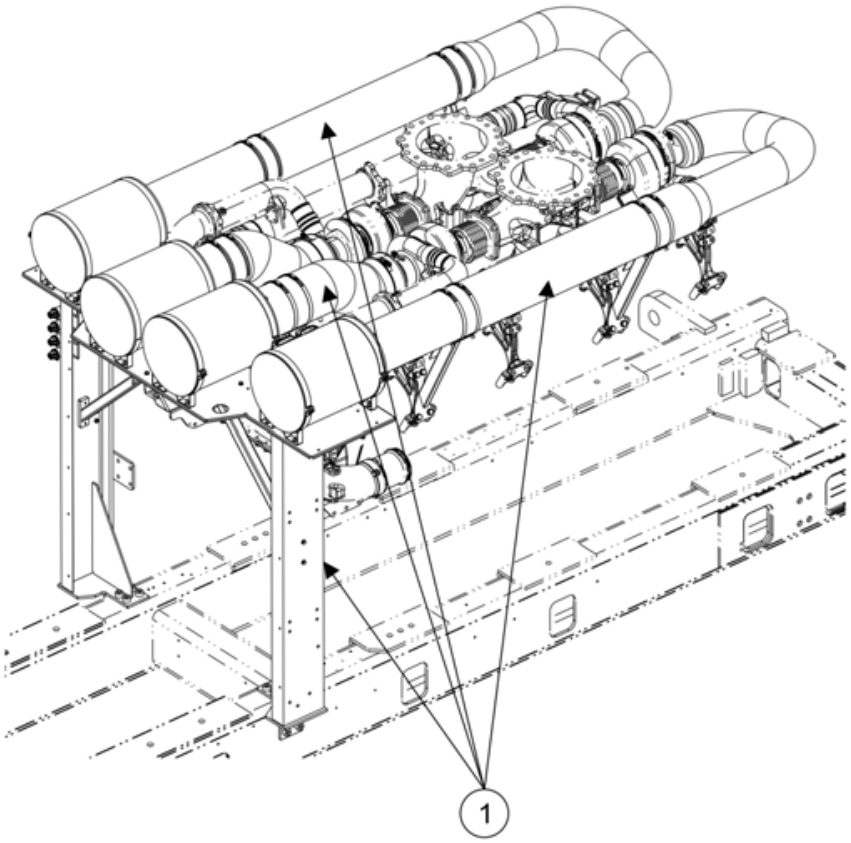
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No.	Description	No.	Description
1	Generator set harness		

FIGURE 24. GENERATOR SET HARNESS - ENGINE LEFT BANK

24. Remove the air cleaner assemblies.

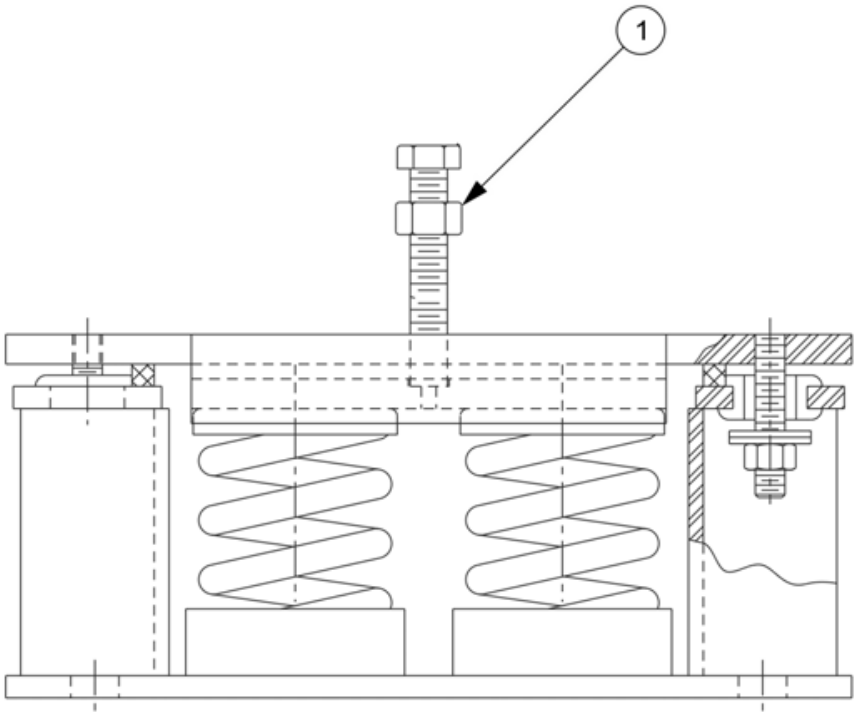


No.	Description	No.	Description
1	Air induction system		

FIGURE 25. AIR INDUCTION SYSTEM

25. Remove engine exhaust connections.
26. Remove the mounting hardware for the generator set vibration isolators.
27. Loosen the vibration isolator adjustment bolt jam nut.

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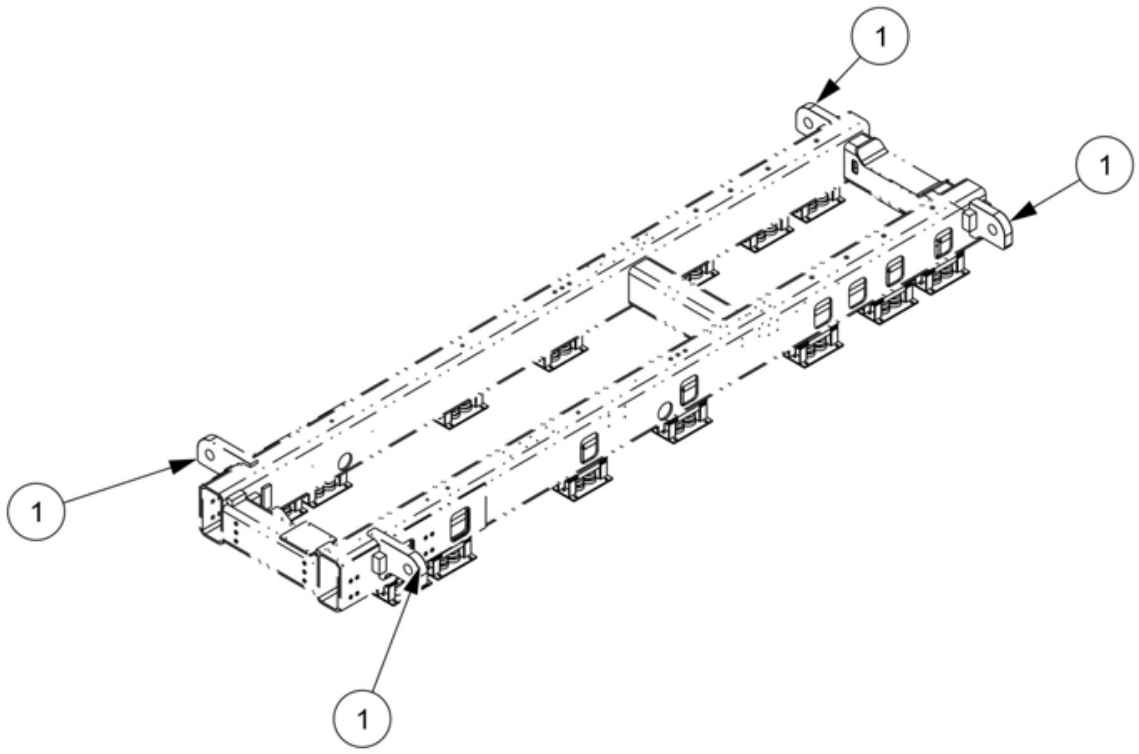


No.	Description	No.	Description
1	Adjustment bolt jam nut		

FIGURE 26. VIBRATION ISOLATOR

28. Connect to the generator set lifting eyes to appropriately sized shackles, spreader bars, slings, and a crane.

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No.	Description	No.	Description
1	Lifting eyes		

FIGURE 27. LIFTING EYES

29. Lift the generator set and remove the vibration isolators.
30. Place three blocks under each side of the generator set skid below the engine. Place a slightly smaller block under the right front corner of the generator set skid to make sure the skid does not tip during alternator removal.
31. Place two blocks at the back of the skid below the alternator.

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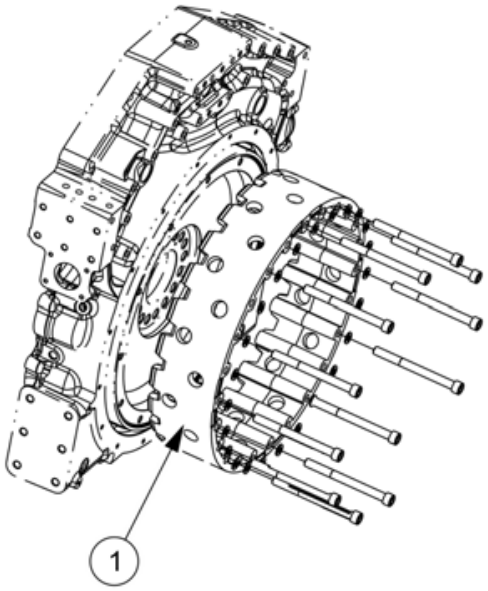


No.	Description	No.	Description
1	Leveling blocks		

FIGURE 28. LEVELING BLOCKS

32. Lower the generator set onto the blocks.
33. Remove the lifting equipment from the generator set.
34. Remove the alternator. Refer to Section 6.3.1.12 on page 391.
35. Remove the aluminum ring that couples the alternator coupling to the engine flywheel.

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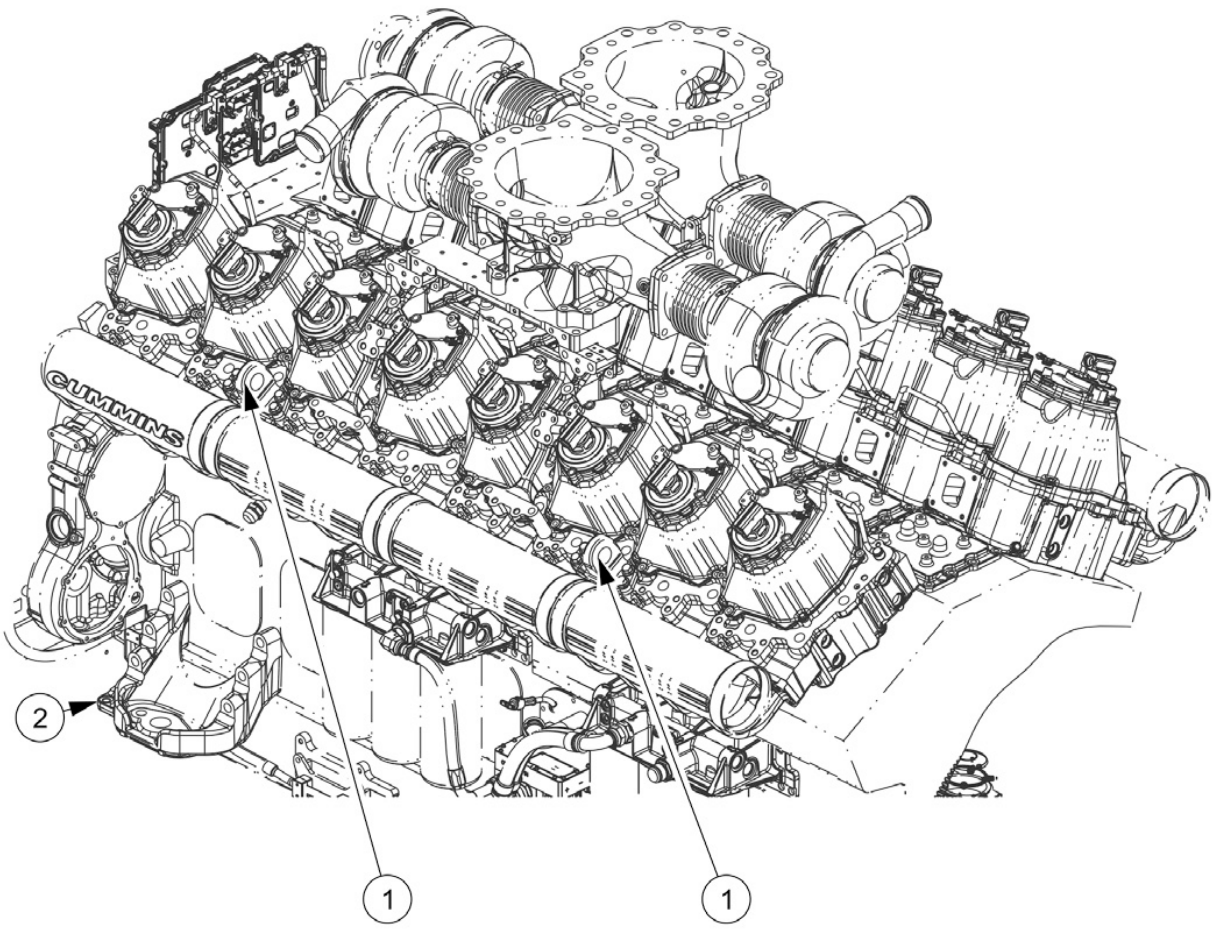


No.	Description	No.	Description
1	Aluminum ring		

FIGURE 29. ALUMINUM RING

36. Use a cross wise pattern to check that the torque on the four engine lifting eyes is 281 Nm (161 ft-lb).

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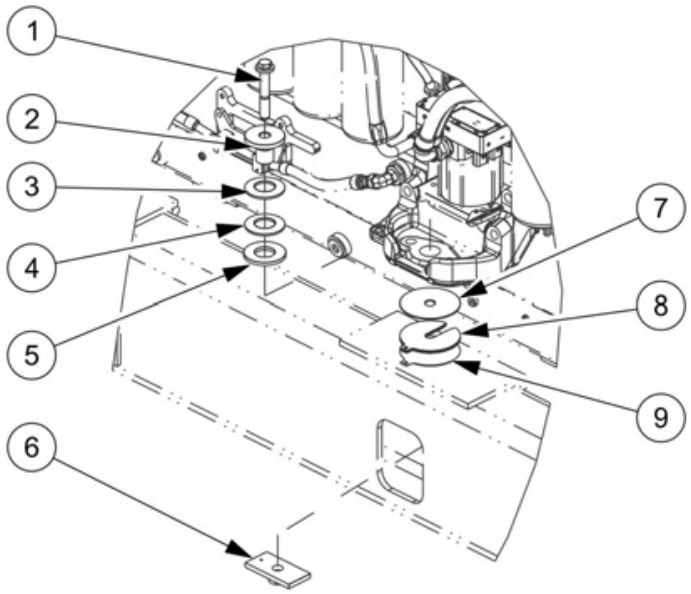


No.	Description	No.	Description
1	Engine lifting eyes		

FIGURE 30. ENGINE LIFTING EYES

37. Install rigging and lifting equipment capable of lifting the engine. The engine weight is 29,262 lb (13,273 kg).
38. Remove the eight engine mounting bolts.
39. Remove the slip joint hardware from the front four engine feet. Mark the location from which each set of slip joint hardware was removed. Keep the parts together.

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No.	Description	No.	Description
1	Screw	6	Bracket
2	Spacer	7	Plate spacer
3	Washer	8	Shim
4	Washer	9	Mounting spacer
5	Plate spacer		

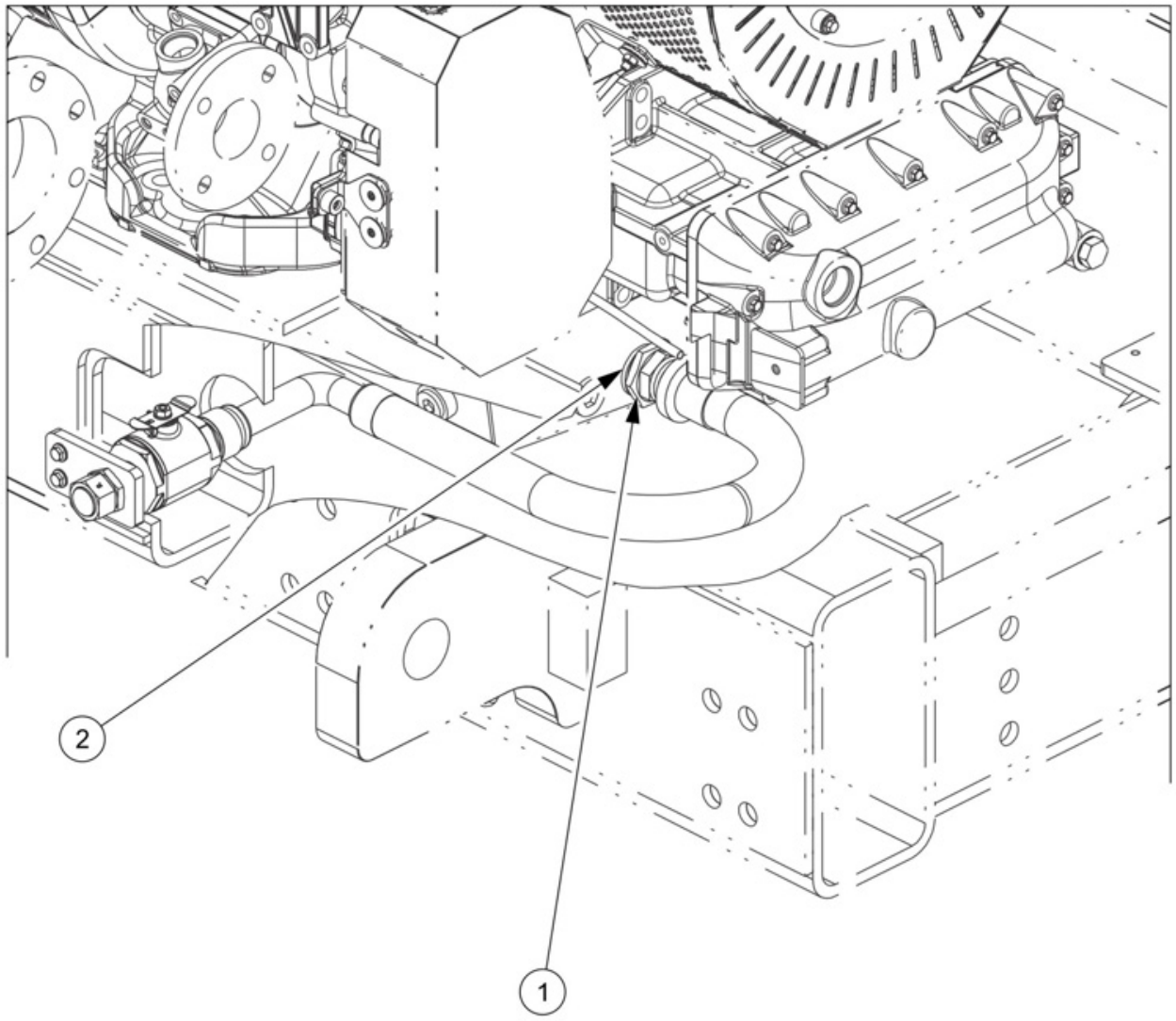
FIGURE 31. SLIP JOINT HARDWARE

40. Slowly lift the engine off of the generator set skid. Make sure to feed the oil drain line through the hole in the generator set skid.
41. Place the engine on a stable surface capable of supporting the engine weight.
42. Remove the oil drain hose and fitting from the oil pan. Have a catch pan under the oil drain fitting to collect oil from the oil pan. The oil pan can hold approximately 38 L (10 gal) of oil.
43. Remove rigging from the engine.

6.2.5.5 Install Engine

1. Install the oil drain fitting and the oil drain hose on the engine oil pan.
    a. Oil will be present in the oil pan. Have a suitable container to collect oil from the oil pan. The oil pan can have approximately 38 L (10 gal) of oil.
    b. Torque the oil drain fitting to 525 Nm (387 ft-lb).
    c. Torque the oil drain hose to 185 Nm (136 ft-lb).

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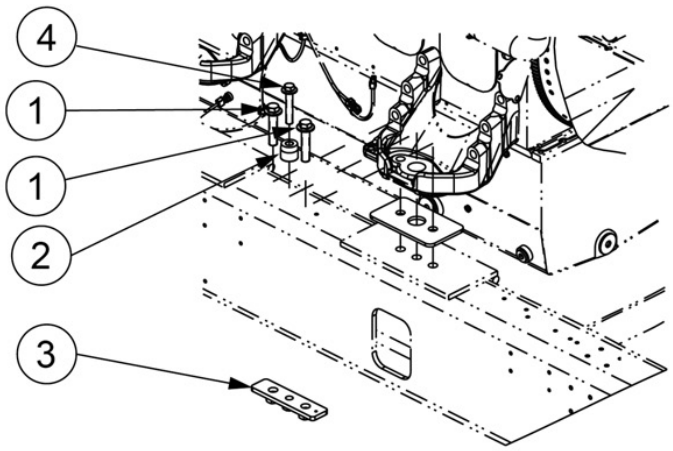


No.	Description	No.	Description
1	Oil drain hose	2	Oil drain fitting

FIGURE 32. OIL DRAIN HOSE AND FITTING

2. Prepare the generator set skid:
   a. Install the alignment pin on the left rear engine foot mounting spot.
   b. Loosely install two hex bolts to prevent the nut plate from rotating.
   c. Torque M20 flange head capscrew to 518 Nm (382 ft-lb). If using socket head capscrew torque to 618 Nm (455 ft-lb).

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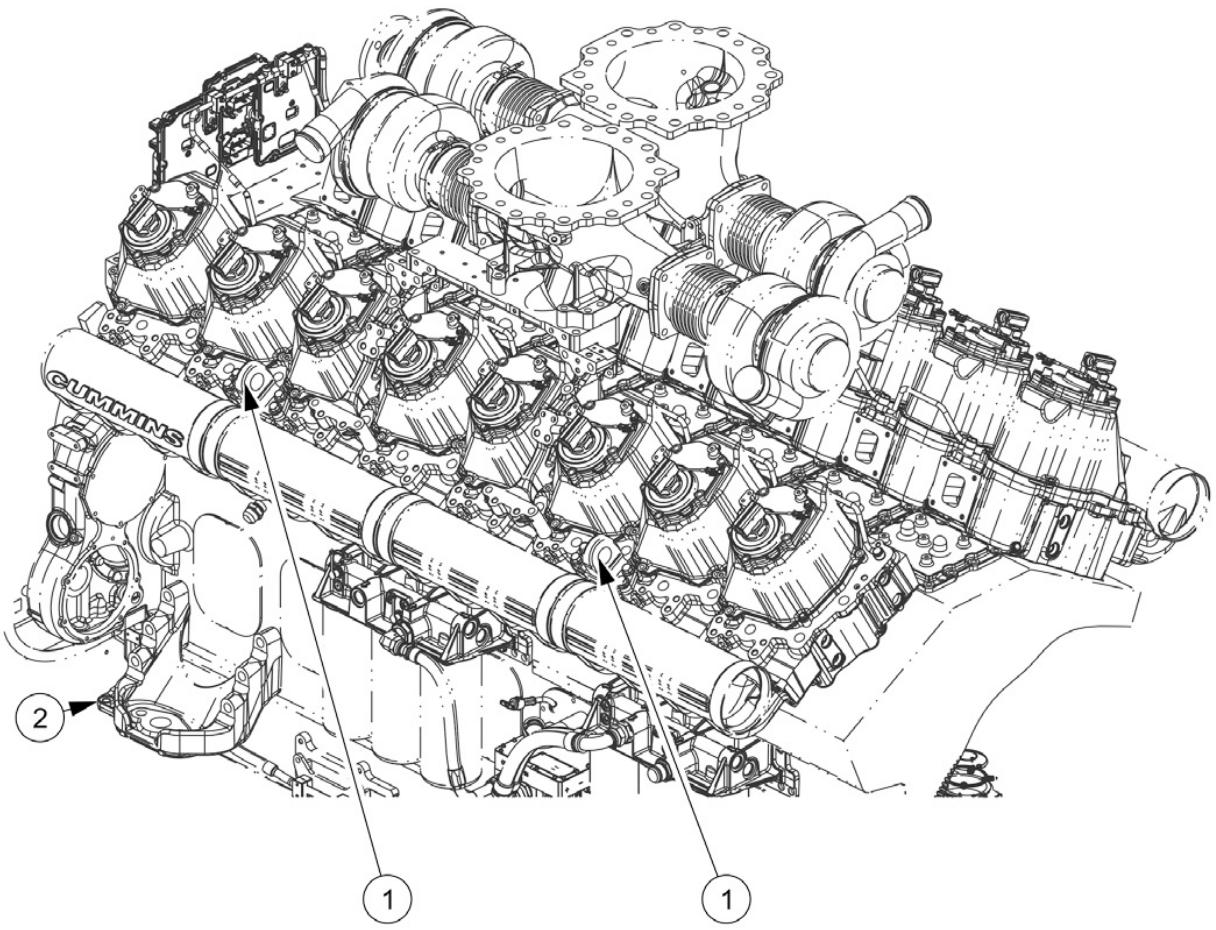


No.	Description	No.	Description
1	M24 capscrews	3	Nut Plate
2	Alignment Pin	4	M20 flange head or socket head capscrew

FIGURE 33. ALIGNMENT PIN AND HEX BOLTS

3. Use a cross wise pattern to check that the torque on the four engine lifting eyes is 281 Nm (161 ft-lb).

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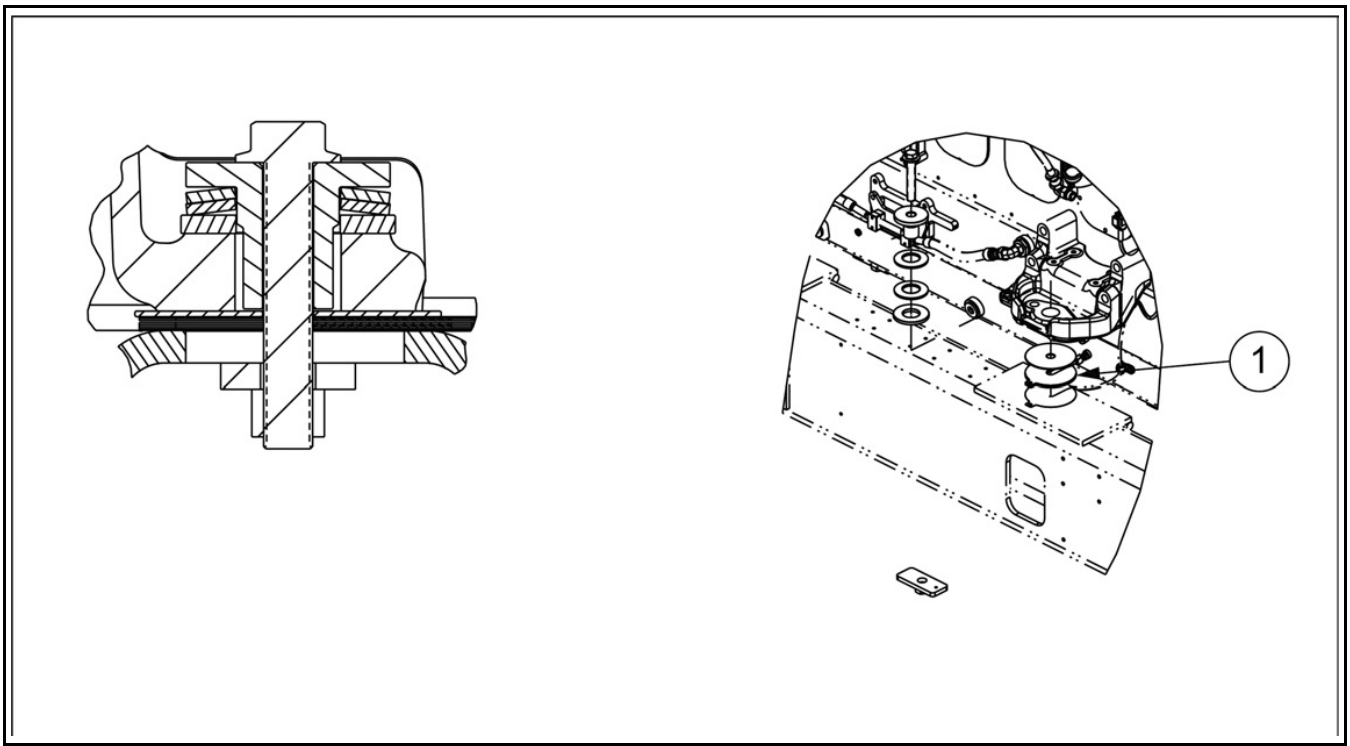


No.	Description	No.	Description
1	Engine lifting eyes	2	Alignment pin location

FIGURE 34. ENGINE LIFTING EYES

4. Remove the hardware that secures the engine to the shipping skid.
5. Slowly lift the engine off of the shipping skid.
6. Clean the unpainted surfaces of the engine mounting feet with degreaser.
7. Install the engine alignment pin into the left front engine foot.
8. Place the engine mounting spacer plates at the front left and two rear mounting locations.
9. Slowly lift the engine and position it over the generator set skid.
10. Lower the engine onto the generator set skid. Make sure to keep the left front alignment pin centered with the hole in the skid.
11. Loosely install the four rear engine foot mounting bolts.
12. Loosely install the left front engine foot slip joint assembly.
13. Loosely install the three remaining engine foot slip joint assemblies.
14. Shim to fit the right bank front and middle engine feet, and the left bank middle engine foot. Place the shims between the engine spacer plate and the generator set skid.

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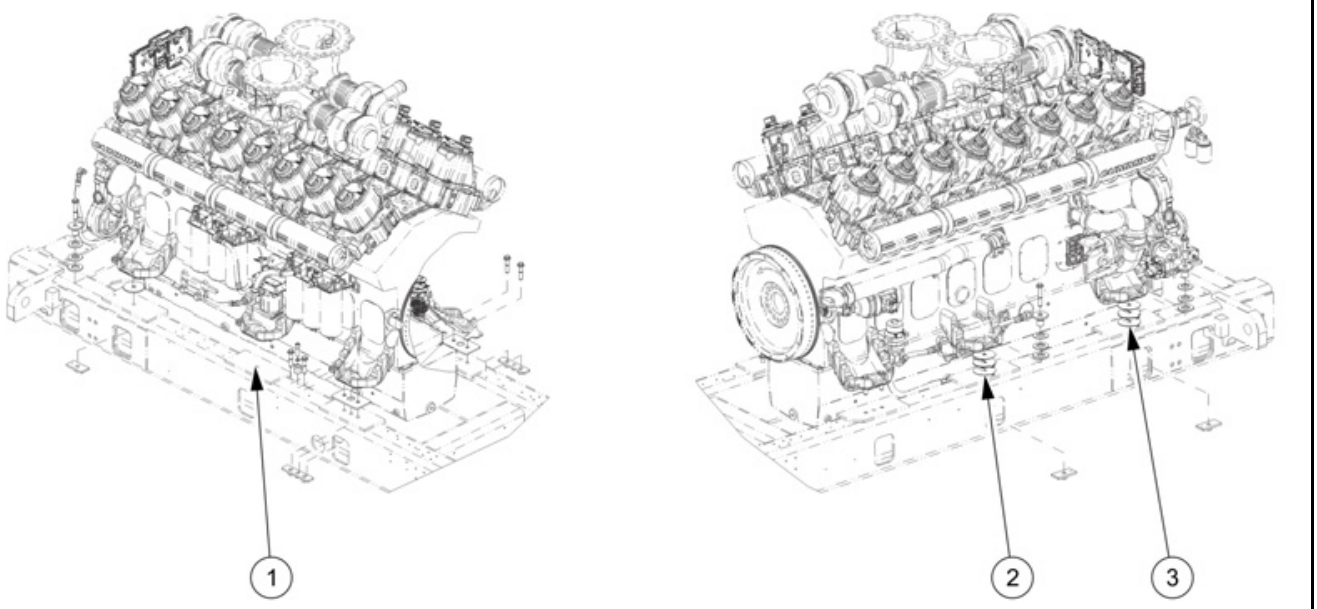


No.	Description	No.	Description
1	Shim		

FIGURE 35. SHIMS

15. Lift the engine just enough to install the red shims in the quantities and locations shown in **Figure 36**.

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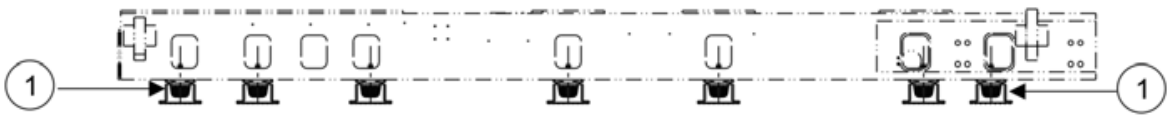
No.	Description	No.	Description
1	Left center, quantity 1	3	Right front, quantity 5
2	Right center, quantity 4		

FIGURE 36. RED SHIM LOCATIONS AND QUANTITIES

16. Torque the M24 flange head capscrews to 1050 Nm (774 ft-lb).
17. Remove engine alignment pin from left front engine foot.
18. Install the oil drain valve support bracket and the oil drain valve handle. Torque the oil drain plug to 125 Nm (28.1 ft-lb). Torque the oil drain valve support bracket to 55 Nm (40 ft-lb).
19. Install the oil maintainer system.
20. Clean the engine flywheel.
21. Install the flywheel coupler adaptor (aluminum ring). Torque the flywheel coupler adaptor to 245 NM (180 ft-lb).
22. Install the alternator.
23. Install the air cleaner assembly.
24. Install the clips and cable ties that secure the generator set harness to the engine block.
25. Connect the generator set harness to the left bank of the engine.
26. Install the clips and cable ties that secure the DC harness from the left bank starter to the engine block (**Figure 23 on page 351**).
27. Install the DC harness connections on the left bank starter (**Figure 23 on page 351**).
28. Install the clips and cable ties that secure the DC harness from the fuel supply pump to the engine block (**Figure 23 on page 351**).
29. Install the DC harness connections to the fuel supply pump (**Figure 23 on page 351**).
30. Install the clips and cable ties that secure the DC harness from the right bank starters to the engine block (**Figure 22 on page 350**).

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31. Install the DC harness connections to the two right bank starters (**Figure 22 on page 350**).
32. Install the clips and cable ties that secure the DC harness from the charging alternator to the engine block (**Figure 21 on page 349**).
33. Install the DC harness connections on the battery charging alternator (**Figure 21 on page 349**).
34. Install two engine ground straps (one on each bank) (**Figure 20 on page 348**)
35. If equipped, install the generator set coolant heater.
36. If the generator set has the Cummins low coolant level sensor, connect the sensor to the engine harness.
37. If the generator set has a Cummins supplied mounted coolant system, install the fan drive shaft.
38. Install the LT inlet and outlet coolant piping.
39. Install the HT inlet and outlet coolant piping.
40. Install the HT and LT aftercooler vent lines (**Figure 18 on page 346**).
41. Fill the engine with Cummins approved engine oil.
42. Fill the generator set with Cummins approved coolant.
43. Connect to the generator set lifting eyes to appropriately sized shackles, spreader bars, slings, and a crane.
44. Lift the generator set off of the blocks. Remove the blocks.
45. Align the generator set with the vibration isolators under the generator set skid.

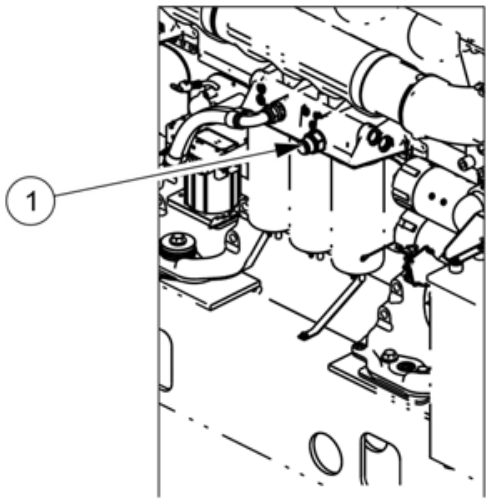


No.	Description	No.	Description
1	Vibration isolators		

FIGURE 37. VIBRATION ISOLATOR LOCATIONS

46. Install the vibration isolators.
47. Install any customer connections to the engine breather hose.
48. Install the customer engine exhaust connections.
49. Connect the fuel supply and return lines.

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No.	Description	No.	Description
1	Fuel supply connection		

FIGURE 38. FUEL SUPPLY CONNECTION

50. Connect the generator set batteries.
51. Test run the generator set.
    a. Check for leaks and proper operation.
    b. Correct any issues found.
52. Return the generator set to normal operation.

6.2.6 Replace Engine Slip Joints

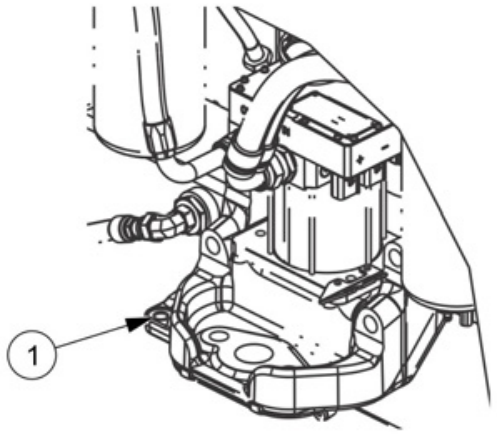
6.2.6.1 Required Tools and Parts

1. Required Tools
   - Hydraulic torque wrench (A050L948)
2. Required Parts
   - Slip joint kit (A050R936)

6.2.6.2 Procedure

1. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See Section 6.1.2.
2. Apply anti-seize lubricant to engine and alternator jacking bolts.
3. Install engine jacking bolts in all six engine feet.

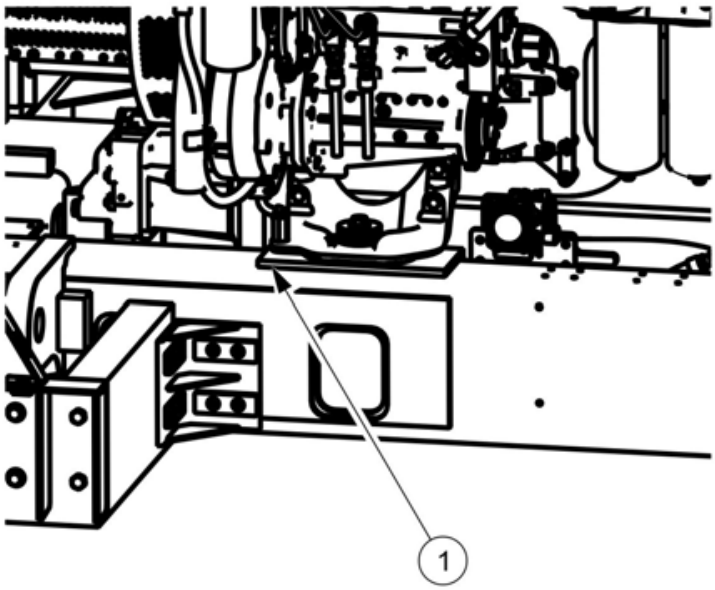
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No.	Description	No.	Description
1	Engine jacking bolt location		

FIGURE 39. ENGINE JACKING BOLT LOCATION

4. Place a 3/8 inch (10 mm) steel plate over the engine alignment pn hole before installing the left front foot jacking bolt.

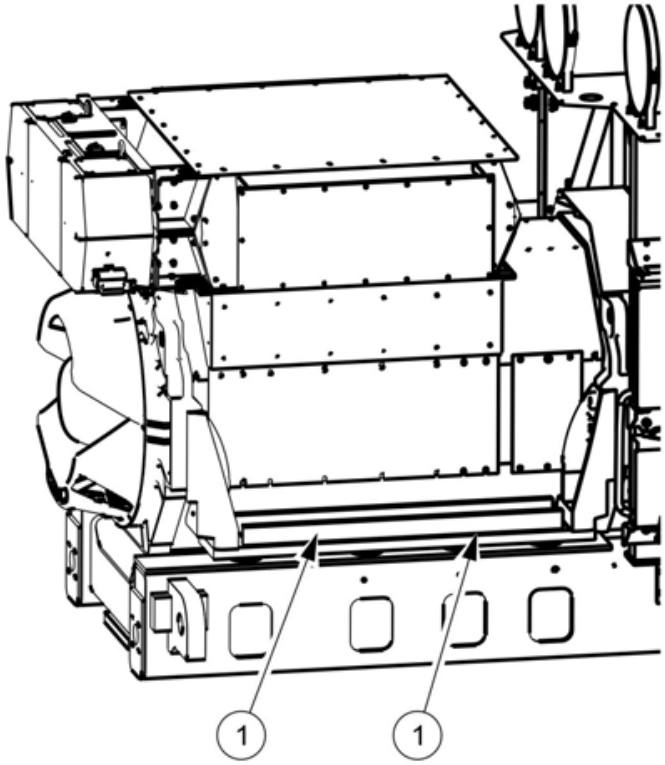


No.	Description	No.	Description
1	Steel plate		

FIGURE 40. STEEL PLATE

5. Install the alternator jacking bolts in the four alternator jacking bolt locations.

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No.	Description	No.	Description
1	Alternator jacking bolt locations (left side)		

FIGURE 41. ALTERNATOR JACKING BOLTS

6. Remove and discard the engine mounting bolts and nut plates.
7. Remove and discard the alternator mounting bolts and nut plates.
8. Tighten all jacking bolts until they come in contact with the generator set skid.
9. Mark the heads of all the jacking bolts to monitor bolt rotation.
10. Turn the left bank rear engine foot jacking bolt 1/2 turn clockwise (number 1 in **Figure 42**).

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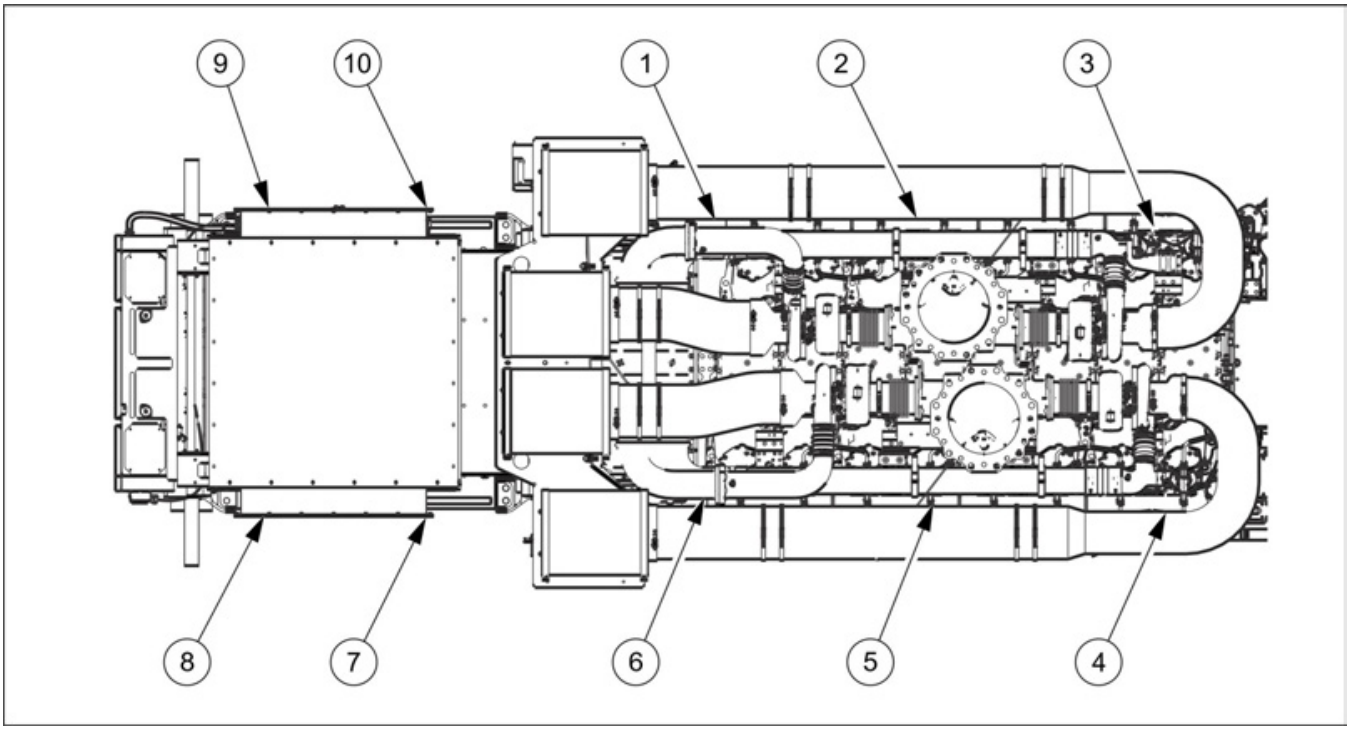


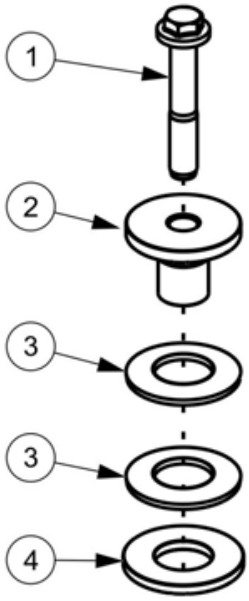
FIGURE 42. JACKING BOLT SEQUENCE

11. Turn the left bank middle engine foot jacking bolt 1/2 turn clockwise (number 2 in **Figure 42**).
12. Continue turning the jacking bolts 1/2 turn in the sequence shown in **Figure 42** until the generator set is slightly raised above the mounting surface (approximately 1/2 mm).
13. Remove and replace the slip joint hardware at the two middle and two front engine mounting locations.

NOTICE

Do not remove or add shims under the engine mounting feet. Only change the shims if a new engine or generator set skid is being used.

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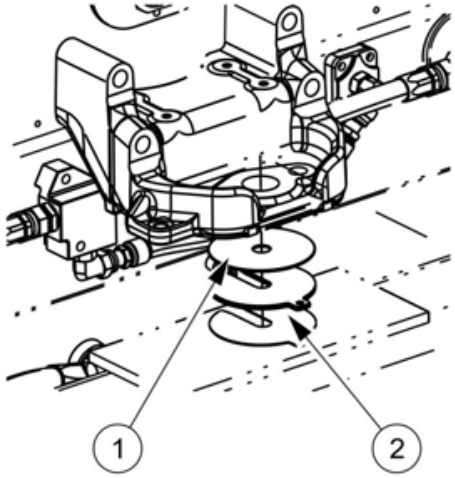


No.	Description	No.	Description
1	Mounting bolt	3	Bevel washers
2	T spacer	4	Upper slip joint plate

FIGURE 43. SLIP JOINT HARDWARE

14. Make sure that the "Top" indication on the bevel washer faces up.
15. Make sure that the lower slip joint plate is in contact with the engine foot.

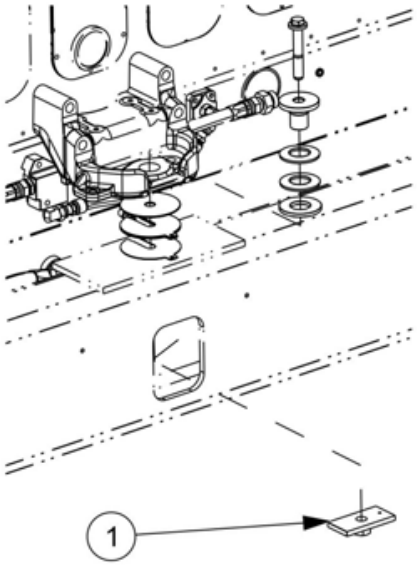
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No.	Description	No.	Description
1	Lower slip joint plate	2	Shims

FIGURE 44. LOWER SLIP JOINT PLATE

16. Remove the left rear engine alignment pin. Discard the bolt.
17. Remove and replace all engine and alternator mounting nut plates.
18. Loosely install new generator set mounting bolts and nut plates.

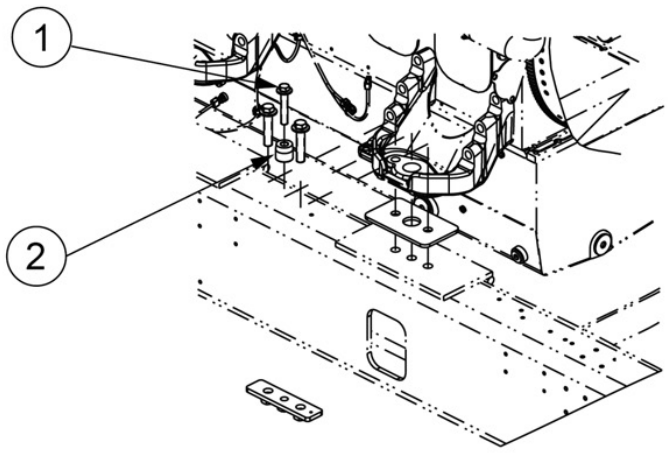


No.	Description	No.	Description
1	Nut plate		

FIGURE 45. NUT PLATE

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19. Use a new capscrew and nut plate to install the left rear engine alingment pin. Torque M20 flange head capscrew to 518 Nm (382 ft-lb). If using socket head capscrew torque to 618 Nm (455 ft-lb).



No.	Description	No.	Description
1	M20 flange head or socket head capscrew	2	Alignment pin

FIGURE 46. ALIGNMENT PIN

20. Turn the left rear engine foot jacking bolt 1/2 turn counter-clockwise (number 1 in Figure 42).
21. Turn the left bank middle engine foot jacking bolt 1/2 turn counter-clockwise (number 2 in Figure 42).
22. Continue turning the jacking bolts 1/2 turn counter-clockwise in the sequence shown in Figure 42 until the generator set is lowered onto the mounting surface.
23. Remove all jacking bolts.

NOTICE

If jacking bolts are in good condition, they can be retained for reuse. Discard any jacking bolts that have damage.

24. Tighten all generator set mounting hardware.
    - Torque hardware to 1050 Nm (774.4 ft-lb)
25. Return the generator set to normal operation.

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6.3 Alternator

6.3.1 S9 Alternators

6.3.1.1 General Description

S9 alternators are of brushless rotating field design, available in the following ranges:

- Low Voltage (LV) up to 1000 V, 50 Hz (1500 RPM, 4 pole) and 1000 V, 60 Hz (1800 RPM, 4 pole).
- Medium Voltage (MV) up to 3.3 kV, 50 Hz (1500 RPM, 4 pole) and 4.16 kV, 60 Hz (1800 RPM, 4 pole).
- High Voltage (HV) up to 13.8 kV, 50 Hz (1500 RPM, 4 pole) and 13.8 kV, 60 Hz (1800 RPM, 4 pole).

S9 alternators have an excitation system that uses various AVRs powered by a Permanent Magnet Generator (PMG).

6.3.1.2 Environment

The alternators are protected to IP23 as standard. IP23 is not adequate protection for use outdoors without additional measures.

TABLE 95. ENVIRONMENTAL SPECIFICATION

Ambient Temperature	-15 °C to 50 °C (5 °F to 122 °F)
Relative Humidity	< 70%
Altitude	< 1000 m (3280 ft)

The alternator has been designed for the environment shown in the table. The alternator can operate outside these conditions if it is rated accordingly; the nameplate gives details. If the operating environment is changed after purchase, refer to the factory for a revised alternator rating.

6.3.1.3 Air Flow

TABLE 96. S9 LV, MV, HV MINIMUM AIR FLOW AND MAXIMUM PRESSURE DIFFERENCE

Alternator model and frequency	Minimum Air flow, m^3/s (ft^3/min)		Maximum intake to outlet pressure difference, mm (in) water gauge
	50 Hz	60 Hz	
S9 (All Variants)	2.78 (5890)	3.33 (7056)	13 (0.5)

Make sure that the air inlets and outlets are not obstructed when the alternator is running.

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6.3.1.4 Airborne Contaminants

⚠ CAUTION

Dust & Airborne Particles/Fumes

Dust and other airborne particles and fumes can cause minor or moderate injury by irritating the lungs and eyes. Prolonged or repetitive exposure can cause serious medical conditions. To prevent injury:

- ***Use mechanical vacuum extraction to remove dust and airborne particles or fumes.***
- ***Ventilate the area fully.***
- ***Always wear the appropriate personal protective equipment. Refer to Safety Precautions Chapter.***

NOTICE

Contaminants such as salt, oil, exhaust fumes, chemicals, dust, and sand will reduce the effectiveness of the insulation and the life of the windings. Consider using air filters and an enclosure to protect the alternator.

6.3.1.5 Air Filters

Air filters trap airborne particulates above 5 microns. The filters must be cleaned or replaced regularly, depending on site conditions. Check the filters frequently to establish an appropriate service interval.

Alternators with factory-fitted filters are rated to account for the reduced flow rate of cooling air. If filters are retrofitted, the alternator rating must be reduced by 5%.

Air filters do not remove water. Keep the filters dry with additional protection. Wet filters further restrict airflow, causing the alternator to overheat and leading to premature failure of the insulation.

6.3.1.6 Humid Conditions

The water carrying capacity of air depends on temperature. If the air temperature falls below its saturation point, dew may form on the windings, reducing the electrical resistance of the insulation. In humid conditions, additional protection may be required even if the alternator is fitted inside an enclosure. Anti-condensation heaters are supplied on request.

6.3.1.7 Anti-Condensation Heaters

⚠ DANGER

Live Electrical Conductors

Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before working on live conductors:

- ***Shut down and isolate the alternator from all energy sources.***
- ***Remove or isolate stored energy.***
- ***Test isolated parts for electrical isolation using a suitable voltage tester.***
- ***Use lock out/tag out safety procedures.***

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⚠ WARNING

Condensed Water

Operating an alternator with condensed water in the windings can cause serious injury by electric shock, burns or exposure to flying debris and particles. To prevent injury and before operating the alternator:

- ***Use anti-condensation heaters (if fitted) to prevent condensation accumulating.***
- ***Check for condensed water.***
- ***If condensed water is present, drain/remove the water, dry and inspect the alternator. Refer to the Maintenance and Servicing Chapter.***

⚠ WARNING

Hot Surfaces and Fire

Contact with hot surfaces can cause serious injury and death by burns. A risk of fire exists where hot surfaces are contacted by combustible items. To prevent injury, death or risk of fire:

- ***Avoid contact with hot surfaces.***
- ***Always wear the appropriate personal protective equipment, refer to: Safety Precaution Chapter.***
- ***Make sure combustible materials or flammable substances are not stored close to or contact the anti-condensation heater (if fitted).***
- ***Make sure combustible materials or flammable substances are not stored close to the alternator or prime mover, including the ventilation and exhaust system(s) where applicable.***

Power to the anti-condensation heater is supplied from a separate source. Anti-condensation heaters increase the air temperature around the windings to prevent condensation in humid conditions when the alternator is not operating. Best practice is to energize the heaters automatically when the alternator is off.

6.3.1.8 Enclosures

⚠ WARNING

Enclosures

Alternators may be installed within an enclosure for environmental protection, noise reduction or transportation reasons. Before entering the enclosure to prevent injury or death, personnel must:

- ***Know the related hazards / risks.***
- ***Have a safe access route in to and out of the enclosure, have sufficient ventilation and obey the alternator hazard zones.***
- ***Wear the appropriate protective equipment.***

Additionally when working with Medium or High Voltage alternators:

- ***Enter the enclosure when the alternator is operating, only if absolutely necessary.***
- ***To minimize risks to personnel use remote diagnostic, monitoring and measuring systems.***

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⚠ WARNING

Water ingress during the rainy season could lead to electric shock near the alternator and other electrical components.

- Fit an enclosure to protect the alternator from adverse environmental conditions.
- Make sure that air entering the alternator is of adequate flow rate, free from moisture and contaminants and below the maximum ambient temperature on the rating plate.
- The airflow should be modeled to identify and prevent hot air from re-circulating within the enclosure.
- Make sure there is sufficient access around the alternator for safe maintenance.

6.3.1.9 Vibration

The alternators are designed to withstand the vibration levels encountered on generator sets built to meet the requirements of ISO 8528-9 and BS 5000-3. (Where ISO 8528 is taken to be broad band measurements and BS5000 refers to the predominant frequency of any vibrations on the generator set).

NOTICE

Exceeding either of the above specifications will have a detrimental effect on the life of the bearings and other components and may invalidate the alternator warranty.

NOTICE

The terminal box is designed to support the fitted busbars or terminals, transformers, load cables and auxiliary terminal box. Additional mass could cause excessive vibration and lead to failure of the terminal box enclosure and mounting. Refer to the Installation Manual to connect the load cables to the terminal box. Contact STAMFORD | AvK™ customer services before fixing any additional mass to the terminal box.

6.3.1.9.1 Definition of BS5000–3

Alternators shall be capable of continuously withstanding linear vibration levels with amplitudes of 0.25 mm between 5 Hz and 8 Hz, and velocities of 9.0 mm/s RMS between 8 Hz and 200 Hz, when measured at any point directly on the carcass or main frame of the machine. These limits refer only to the predominant frequency of vibration of any complex waveform.

6.3.1.9.2 Definition of ISO 8528-9

ISO 8528-9 refers to a broad band of frequencies, the broad band is taken to be between 10 Hz and 1000 Hz. The table below is an extract from ISO 8528-9 (Table C.1, value 1). This simplified table lists the vibration limits by kVA and speed for acceptable operation of standard generator set designs.

6.3.1.9.3 Vibration Frequencies

The main vibration frequencies produced by the alternator are as follows:

- 4-pole 1500 RPM 25 Hz
- 4-pole 1800 RPM 30 Hz

Vibrations induced in the alternator by the engine are complex. It is the responsibility of the generator set designer to ensure that the alignment and stiffness of the bedplate and mountings do not allow vibration to exceed BS5000 part 3 and ISO 8528 part 9 limits.

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6.3.1.9.4 Linear Vibration Limits

TABLE 97. S9 VIBRATION LEVEL MEASUREMENTS

Linear Vibration Levels As Measured On The Alternator - S9			
Engine Speed RPM (min^{-1})	**Power Output S (kVA)**	**Vibration Displacement RMS (mm)**	**Vibration Velocity RMS (mm/s)**
1 300 ≤n_r ≤2 000	>250	0.32	20
The broad band is taken as 10 Hz - 1000 Hz			

6.3.1.9.5 Linear Vibration Monitoring

We recommend using vibration analyzing equipment to measure vibration at the positions shown below. Best practice is for the generator set builder or during early stages of commissioning, take initial vibration readings as a reference. Periodically monitor vibration, according to the recommended service schedule to detect a deteriorating trend. If the vibration values change from the base line or go above the limits specified in ISO 8528-9, the generator set builder should be informed.

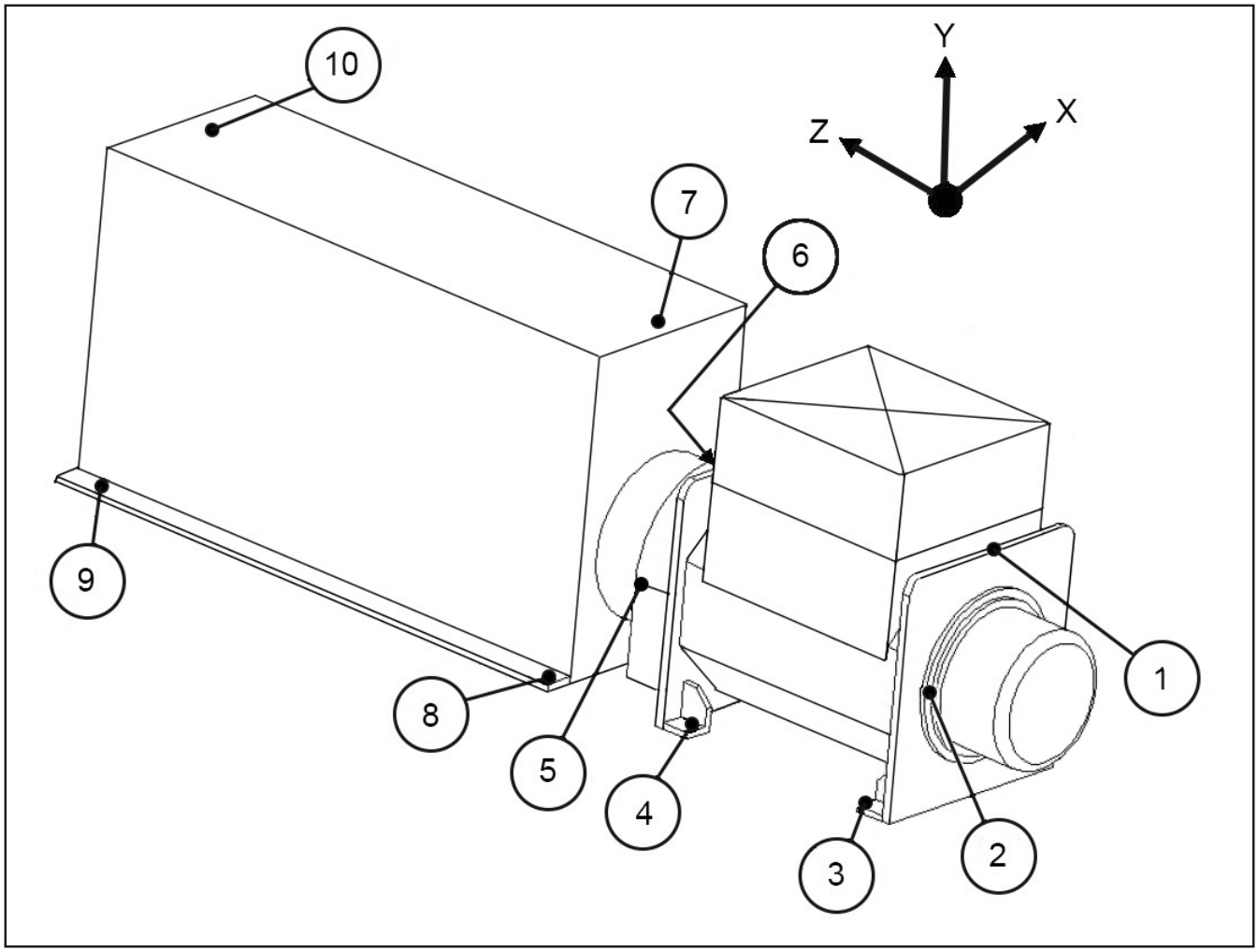


FIGURE 47. VIBRATION MEASUREMENT POSITIONS

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6.3.1.9.6 Excessive Vibration

⚠ WARNING

Exposure to Ejected Debris and Particles

Ejected debris and particles can cause serious injury or death by impact, severing or puncturing. Exposure to mechanically driven release of debris and particles exists in all directions (horizontally and vertically) in the areas surrounding the alternator air outlet(s), air inlets(s) and the open shaft end (also commonly known as the Drive End (DE)). To prevent injury or death:

- ***Keep away from the air inlet(s) and air outlet(s) when the alternator is operating.***
- ***Do not position operator controls near the air inlet(s) or air outlet(s).***
- ***Do not cause overheating by running the alternator outside rating plate parameters.***
- ***Do not overload the alternator.***
- ***Do not operate an alternator displaying excessive vibration.***
- ***Do not synchronize parallel alternators outside the specified parameters.***

If the measured vibration of the generator set is not within the limits:

1. Consult with the generator set manufacturer to reduce vibration to an acceptable level.
2. Contact STAMFORD | AvK™ customer services **www.stamford-avk.com** to assess the impact on bearing and alternator life expectancy.

6.3.1.10 Bearings

6.3.1.10.1 Re-greasable Bearings

Each bearing housing is connected by a grease pipe to an external grease nipple. A label gives the grease type and quantity, and frequency for re-greasing. The recommended grease is a high specification synthetic compound that must not be mixed with grease of a different specification. Refer to the Service and Maintenance chapter for detailed instructions.

6.3.1.10.2 Bearing Life

Factors that reduce bearing life or lead to bearing failure include:

- Adverse operating conditions and environment.
- Stress caused by misalignment of the generator set.
- Vibration from the engine that exceeds the limits in BS 5000-3 and ISO 8528-9.
- Long periods (including transportation) when the alternator is stationary and subjected to vibration can cause false brinelling wear (flats on the balls and grooves on the races).
- Humid or wet conditions that cause corrosion and deterioration of the grease by emulsification.

6.3.1.10.3 Health Monitoring of the Bearings

We recommend that the user checks the bearing condition using vibration monitoring equipment. Best practice is to take initial readings as a reference and periodically monitor the bearings to detect a deteriorating trend. It will then be possible to plan a bearing change at an appropriate generator set or engine service interval.

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6.3.1.10.4 Bearing 'Service Life' Expectancy

Bearing manufacturers recognize that the service life of bearings depends on factors that are outside their control. Rather than quote a service life, practicable replacement intervals are based on the L10 life of the bearing, the type of grease, and the recommendations of the bearing and grease manufacturers.

For general purpose applications, if the correct maintenance is carried out, vibration levels do not exceed the levels stated in ISO 8528-9 and BS5000-3, and the ambient temperature does not exceed 50 °C, plan to replace the bearings within 30,000 hours of operation.

If in doubt regarding any aspect of bearing life of a STAMFORD | AvK™ alternator, contact the nearest authorized supplier of the alternator or STAMFORD | AvK™ customer services **www.stamford-avk.com**.

6.3.1.10.5 Replace Bearings

To replace the bearings, do the following procedure:

1. Refer to: **Remove Non-Drive End** section to access NDE bearing.
2. If the DE bearing is to be replaced, refer to: **Remove Drive End** section to access DE bearing.
3. Assemble and fit the new NDE bearing (and DE bearing, as required) onto the rotor shaft, referring to: **Assemble Bearing** section.
4. If the DE bearing has been replaced, refer to: **Assemble Drive End** section to refit DE components.
5. Refer to: **Assemble Non-Drive End** section to refit NDE components.

6.3.1.10.5.1 Requirements

TABLE 98. RE-GREASABLE BEARING REPLACEMENT REQUIREMENTS

Requirement	Description
Personal Protective Equipment (PPE)	• Wear appropriate protective equipment as directed by site rules and risk assessment requirements. • Wear heat-resistant gloves for handling heated parts.
Consumables	• Lint-free cleaning cloths • Thin disposable gloves • Washing fluid • Large plastic bags for storing parts • White anti-static assembly surface • Wooden bearers
Parts	• NDE bearing • DE bearing (if fitted) • CGT-recommended grease • CGT-recommended anti-fretting paste • O-rings (if fitted) • Wavy washer • Grease flinger

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Requirement	Description
Tools	• Grease gun (calibrated for volume or mass) • Washing bowl and brush • Induction heater (with protective sleeve on bar) • Torque wrench • Bearing removal tooling • Rotor support packing (nylon strips 4 mm x 60 mm x core length) • Hydraulic cylinder jack and pump • NDE bracket lifting tool • M10 x 120 guide studs x 2 • M12 x 100 bolt x 2 (G-H cores only) • M16 x 100 bolt x 2

6.3.1.10.5.2 Remove Non-Drive End

NOTICE
Delicate exciter leads and temperature sensor leads may be fixed to the inside of the NDE bracket. Note the routing of leads and locations of all fasteners. Detach the leads carefully and keep all fasteners for re-use during assembly. Take care not to damage the leads when removing and storing the NDE bracket.

1. Turn off the anti-condensation heaters and isolate from supply.
2. Clean thoroughly with lint free cloths all tools to be used on greased parts.
3. Remove the air inlet cover or air filter components (if fitted).
4. Remove the grease trap assembly.
5. Remove the fixing bracket for the permanent magnet generator (PMG) control cable.
6. Unplug the PMG control cable.
7. Remove the air inlet mesh.
8. Disconnect the grease pipe.
9. Disconnect the heaters.
10. Disconnect the RTD sensor for bearing temperature.
11. Remove the PMG stator and PMG rotor together as an assembly.
12. Remove the NDE bearing cap assembly.
13. Put the PMG assembly and NDE bearing cap parts into separate plastic bags. Seal the bags to protect the parts from debris.
14. Turn the main rotor so that the NDE keyway is at the top of the rotor shaft. In this position, the lowest rotor pole is vertical and will support the rotor weight when the bearing is removed. If the rotor cannot be turned and no rotor pole is vertical, fit two rotor support packing pieces (see next step) to support the lower two poles.

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15. For alternators with a DE bearing, insert a rotor support packing piece into the air gap between the lowest rotor pole and the stator, along the full length of the rotor pole. When the NDE bearing is removed, the packing will keep the rotor near-horizontal to reduce non-radial loading on the other bearing.
16. Withdraw the NDE bearing cartridge fasteners by 10 mm.
17. Support the NDE bracket with a crane and sling, also supporting the NDE bearing assembly and rotor.
18. Remove the NDE bracket fasteners.
19. Use the NDE bracket removal tool to release the NDE bracket from the landing bars – approximately 10 mm movement.
20. Remove the NDE bearing cartridge fasteners.
21. Supported by the crane sling, carefully slide the NDE bracket along the rotor shaft and away from the alternator, without damaging the exciter stator windings on the exciter rotor.
22. Set aside the NDE bracket flat on the floor on wooden bearers, with the exciter stator face up, and remove the crane sling.

6.3.1.10.5.3 Remove Drive End

1. Remove NDE components first and fit rotor support packing piece(s), see **Remove Non-Drive End** section.
2. Remove the upper and lower air outlet screen covers.
3. Disconnect the alternator from the prime mover.
4. Disconnect the grease tube.
5. Disconnect the RTD sensor for bearing temperature.
6. Remove fasteners from DE bearing cartridge.
7. Remove fasteners from DE bearing bracket.
8. Fit M12 x 100 mm bolts to the bearing cartridge jacking holes (G & H cores only)
9. Use a crane sling to lift the rotor at the drive end a small amount, to support its weight.
10. Fit M16 x 100 mm bolts to the jacking holes of the DE bracket (all cores).
11. Gently lower the rotor onto the the support packing and remove the crane sling.
12. Remove the DE bearing bracket along the rotor shaft and away from the alternator.

6.3.1.10.5.4 Assemble Bearing

TABLE 99. S9 HV INITIAL GREASING: GREASE QUANTITY

Quantity of recommended grease										
Bearing Type	**Cartridge**		**Bearing**		**Bearing Cap Inner**		**Bearing Cap Outer**		**TOTAL**	
	Vol (cm^3)	**Mass (g)**	**Vol (cm^3)**	**Mass (g)**	**Vol (cm^3)**	**Mass (g)**	**Vol (cm^3)**	**Mass (g)**	**Vol (cm^3)**	**Mass (g)**
Drive End (S9 Core length A, B, C, D)	126	121	252	242	N/A	N/A	126	121	504	484

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Quantity of recommended grease										
Drive End (S9 Core length E, F)	180	173	360	346	N/A	N/A	180	173	720	692
Drive End (S9 Core length G, H)	N/A	N/A	188	180	94	90	94	90	376	360
Non-drive End (S9 Core length A, B, C, D, E, F)	157	151	314	302	N/A	N/A	157	151	628	604
Non-drive End (S9 Core length G, H)	182	175	364	350	N/A	N/A	182	175	728	700

1. Remove the wavy washer (NDE only)
2. Expand the grease flinger by local heating with a blowtorch flame.
3. Remove the grease flinger.
4. Remove the circlip (NDE only, if fitted) from the main rotor shaft groove.
5. Remove the bearing cartridge from the main rotor shaft.
6. Use the bearing extraction puller tool to remove the old bearing from the cartridge.
7. Prepare for assembly, by cleaning:
    a. Wipe clean the anti-static assembly surface, using solvent on lint free cloth.
    b. Wash the bearing cartridge, wavy washer and the bearing cap and inspect for contamination.
    c. Wipe off excess washing fluid with a lint free cloth and place all components on the clean anti-static assembly surface.
    d. Thoroughly clean the external surface of the grease gun nozzle using a lint free cloth.
8. Prepare the bearing:
    a. Remove the bearing from its packaging.
    b. Wipe off the preservative oil with a lint free cloth from the surface of the inner and outer rings.
    c. Place the bearing on the clean anti-static assembly surface, with the bearing type identification markings face down.
9. Grease and assemble the bearing components:
    a. Fit a new O ring in the groove in the bearing housing (NDE only), if fitted.
    b. Apply the specified quantity of grease to the back face of the bearing cartridge.
    c. Apply a small amount of grease to the grooved sealing surface in the cartridge.
    d. Without rubbing in, use a lint free cloth to smear anti-fretting paste in a thin coherent layer to the bearing housing circumference.
    e. Apply half the specified quantity of grease to the upper face of the bearing (without the bearing designation markings).
    f. Press the grease into the bearing, ensuring good penetration into the raceways and between the balls.

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g. Assemble the bearing into the bearing cartridge, greased side first, by pressing **ONLY** on the bearing outer race. Ensure the bearing outer race contacts the location shoulder.

h. Apply the remaining half of the specified quantity of grease to the exposed side of the bearing.

i. Press the grease into the bearing, ensuring good penetration into the raceways and between the balls.

j. Apply the specified quantity of grease to the inside face of the bearing cap.

k. Fill the grease exhaust slot, with grease.

l. Apply a small amount of grease to the grooved sealing surface in the bearing cap.

m. Fill the grease pipe and grease nipple with grease.

10. Fit the bearing components:

a. Expand the bearing and cartridge assembly by heating to between 100 and 110 ºC in the induction heater.

b. Slide the bearing and cartridge assembly over the rotor shaft, pushing it firmly against the seating shoulder.

c. Oscillate the assembly (including inner race) 45 degrees in both directions, to ensure bearing is seated. Hold the bearing in place until it cools and contracts onto the rotor shaft.

d. Refit the circlip (NDE only, if fitted) into the main rotor shaft groove.

e. Expand the grease flinger by heating to 100 °C in the induction heater.

f. Slide the grease flinger over the rotor shaft and push it firmly against the bearing assembly. Hold the flinger in place while it cools and contracts onto the rotor shaft.

g. Fit the wavy washer (NDE only).

h. Wait for the bearing and cartridge assembly and flinger to cool to ambient temperature.

6.3.1.10.5.5 Assemble Drive End

1. Insert two guide studs into the DE bearing cartridge. Slide the DE bearing bracket onto the rotor shaft and locate over the DE bearing assembly.
2. Use a crane sling to lift the rotor and DE bearing bracket at the drive end a small amount, to support the weight.
3. Fit the DE bearing bracket onto the frame using the correct hardware and ensure the machined faces are flush. Remove the two guide studs and replace with the remaining two bolts and washers. Apply the correct torque to all fasteners.
4. Reconnect the grease pipe.
5. Reconnect the RTD sensor (if fitted).
6. Recouple the alternator to the prime mover.

6.3.1.10.5.6 Assemble Non-Drive End

NOTICE
Route the delicate exciter leads and temperature sensor leads carefully, and fix securely to the inside of the NDE bracket. Take care not to damage the leads when fitting the NDE bracket.

1. Lift the NDE bracket with a crane and sling.
2. Fit the NDE bearing cap to the NDE bracket.
3. Insert two guide studs into the NDE bearing cartridge.

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4. Rotate the NDE cartridge to orientate the grease port and RTD leads for connection.
5. Slide the NDE bracket up to the landing bars, using the studs to align the threaded fastener holes of the NDE bearing cap and cartridge.
6. Fix the NDE bearing cap to the NDE bearing cartridge, removing the alignment studs. Do not fully tighten the fasteners.
7. Gently lift the NDE bracket with a crane and sling, also supporting the NDE bearing assembly and rotor, to align the fasteners with the landing bars.
8. Remove the rotor support packing piece(s).
9. Refit the shims in their original positions. Fix the NDE bracket and fully tighten the NDE bearing cap fasteners. Make sure the bearing and bracket are secure.
10. Gently lower the crane sling to add the full rotor weight onto the bearing and remove the sling.
11. Remove the alternator frame supports.
12. Turn the rotor by hand to check bearing alignment and free rotation.
13. Fix the PMG rotor and the PMG stator.
14. Reconnect the control cable plug.
15. Reconnect the grease pipe.
16. Reconnect the RTD sensor.
17. Fix the PMG control cable fixing bracket.
18. Fix the NDE bearing cap assembly.
19. Fix the air inlet mesh and screen and air inlet cover or air filter components (if fitted).
20. Refit the grease trap assembly.
21. Reconnect the supply to the anti-condensation heaters.

6.3.1.10.6 Standby Applications

Run alternators in standby applications at no load for a minimum of 10 minutes every week. For alternators fitted with re-greasable bearings, re-grease the bearings every 6 months, regardless of the number of accumulated running hours.

6.3.1.11 Installation into the Generator Set

6.3.1.11.1 Alternator Dimensions

Dimensions are included in the data sheet specific to the alternator model. Refer to the rating plate to identify the alternator model.

NOTICE
Data sheets are available from www.stamford-avk.com

6.3.1.11.2 Lifting the Alternator

⚠ DANGER

Falling Mechanical Parts

Falling mechanical parts can cause serious injury or death by impact, crushing, severing or trapping. To prevent injury or death and before lifting:

- ***Check the capacity, condition and attachment of lifting equipment.***
- ***Check the capacity, condition and attachment of accessories for lifting.***
- ***Check the capacity, condition and attachment of lifting point(s) on the load.***
- ***Check the mass, integrity and stability of the load.***
- ***If available: Install drive end and non-drive end transit fittings to prevent movement and damage to bearings.***
- ***Keep the alternator horizontal when lifting.***
- ***Do not use alternator lifting points for lifting a complete generator set.***
- ***Do not use cooler lifting points for lifting the alternator or a complete generator set.***
- ***Do not remove the lifting label attached to one of the lifting points.***

Lift the alternator by shackles attached to the lifting points (lugs or eyes) provided. A label attached to a lifting point shows the correct lifting arrangement. Use chains of sufficient length, and a spreader bar if necessary, to make sure that the chains are vertical when lifting. Make sure that the capacity of the lifting equipment is sufficient for the alternator mass shown on the label attached to the alternator.

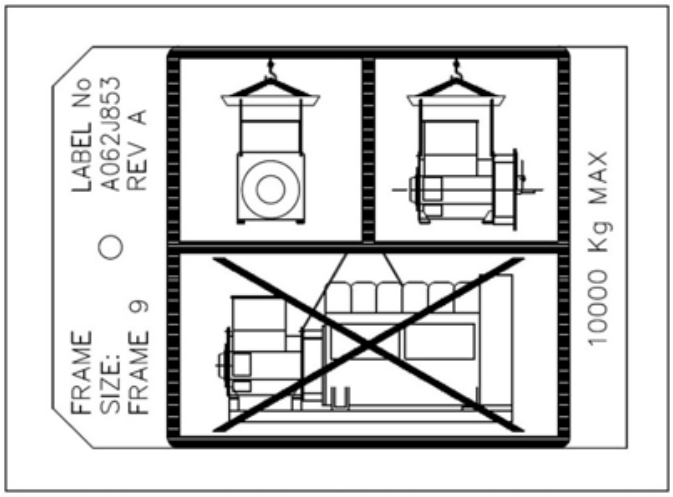


FIGURE 48. EXAMPLE LIFTING LABEL

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6.3.1.11.3 Storage

⚠ WARNING

Condensed Water

Operating an alternator with condensed water in the windings can cause serious injury by electric shock, burns or exposure to flying debris and particles. To prevent injury and before operating the alternator:

- ***Use anti-condensation heaters (if fitted) to prevent condensation accumulating.***
- ***Check for condensed water.***
- ***If condensed water is present, drain/remove the water, dry and inspect the alternator. Refer to the Maintenance and Servicing Chapter.***

⚠ WARNING

Hot Surfaces and Fire

Contact with hot surfaces can cause serious injury and death by burns. A risk of fire exists where hot surfaces are contacted by combustible items. To prevent injury, death or risk of fire:

- ***Avoid contact with hot surfaces.***
- ***Always wear the appropriate personal protective equipment, refer to: Safety Precaution Chapter.***
- ***Make sure combustible materials or flammable substances are not stored close to or contact the anti-condensation heater (if fitted).***
- ***Make sure combustible materials or flammable substances are not stored close to the alternator or prime mover, including the ventilation and exhaust system(s) where applicable.***

If the alternator will not be used immediately, it must be stored in a clean, dry, vibration-free environment. We recommend the use of anti-condensation heaters, when available.

If the alternator can be rotated, turn the rotor a minimum of 6 revolutions every month during storage.

6.3.1.11.3.1 After Storage

After a period of storage, do the pre-running checks to determine the condition of the windings. If the windings are damp or the insulation resistance is low, refer to alternator insulation drying procedure: Section 6.3.1.12.11.7 on page 463.

Before putting the alternator into service, refer to the following table.

TABLE 100. BEARING STORAGE

Bearing Type	Not Rotated during Storage	Rotated during Storage
Sealed Bearing(s)	If stored less than 12 months, put the alternator into service. If stored more than 12 months, replace the bearing(s), then put the alternator into service.	If stored less than 24 months, put the alternator into service. If stored more than 24 months, replace the bearing(s), then put the alternator into service.

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Re-greasable Bearing(s)	If stored less than 6 months, put the alternator into service. If stored between 6 and 12 months, re-grease the bearings(s) during the first run, then put the alternator into service. If stored more than 12 months, replace the bearing(s), then put the alternator into service.	If stored less than 6 months, put the alternator into service. If stored between 6 and 24 months, re-grease the bearing(s) during the first run, then put the alternator into service. If stored more than 24 months, replace the bearing(s), then put the alternator into service.

6.3.1.11.3.2 Long-term Storage

When an alternator is stationary, in storage or otherwise, it may be subjected to environmental factors, such as vibration, humidity, temperature and airborne contaminant particles, that could degrade the bearing arrangements.

Contact STAMFORD | AvK™ customer services www.stamford-avk.com for advice in advance if the alternator will be stationary for long periods.

6.3.1.11.4 Generator Set Coupling

⚠ WARNING

Coupling an Alternator

Moving mechanical parts during coupling can cause serious injury by crushing, severing or trapping. When coupling the alternator to a prime-mover or when installing large components, to prevent injury:

- ***Personnel must keep limbs and body parts away from coupling surfaces during coupling and/or installing operations.***

NOTICE

Do not attempt to rotate the alternator rotor by levering against the vanes of the cooling fan. The fan is not designed to withstand such forces and will be damaged.

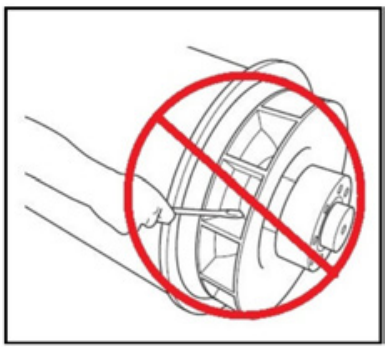


FIGURE 49. DO NOT ROTATE WITH A LEVER

Efficient operation and long component life depend on minimizing mechanical stresses on the alternator. When coupled in a generator set, misalignment and vibration interactions with the prime mover engine can cause mechanical stress.

A coupling mass greater than 150 kg will reduce bearing life significantly. Refer to the factory for further information.

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Generator sets need a substantial flat continuous bedplate to suit the installation site floor loading, with engine and alternator mounting pads to make a firm base for accurate alignment. The height of all mounting pads must be within 0.25 mm for skid mounting, 3 mm for non-adjustable anti-vibration mounts (AVM) or 10 mm for adjustable height AVMs. Use shims or adjust alignment elements to achieve level. The rotational axes of alternator rotor and engine output shaft must be coaxial (radial alignment) and perpendicular to the same plane (angular alignment). The axial alignment of the alternator and engine coupling must be within 0.5 mm, to allow for thermal expansion without unwanted axial force on the bearings at operating temperature.

Vibration can occur by flexing of the coupling. The alternator is designed for a maximum bending moment not exceeding 275 kgm (2000 lbs ft). Check the maximum bending moment of the engine flange with the engine manufacturer.

Torsional vibrations occur in all engine-driven shaft systems and may be large enough to cause damage at critical speeds. The generator set builder must consider the effect of torsional vibration on the alternator shaft and couplings, referring to the torsional drawings supplied for shaft dimensions and rotor inertia.

Close-coupling of alternator and engine can increase the rigidity of the generator set. Both one and two bearing alternators can be close-coupled. The generator set builder must supply guarding for open-coupled applications.

To prevent rust during transit and storage, the alternator frame spigot, rotor coupling plates and shaft extension have been treated with a rust preventative coating. Remove this before coupling the generator set.

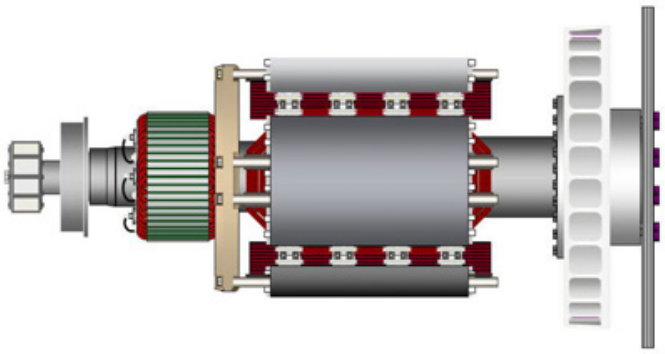


FIGURE 50. ONE BEARING ALTERNATOR ROTOR SHOWING COUPLING DISCS BOLTED TO DRIVE END COUPLING HUB (AT RIGHT)

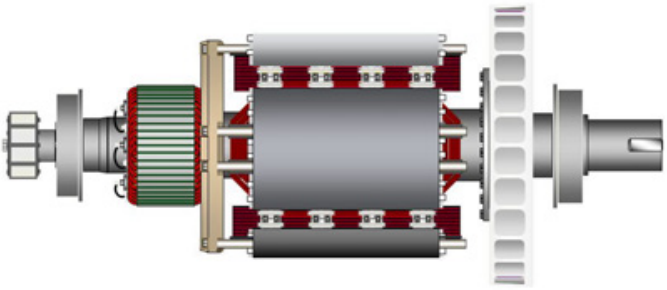


FIGURE 51. TWO BEARING ALTERNATOR ROTOR SHOWING SHAFT WITH KEYWAY FOR FLEXIBLE COUPLING (AT RIGHT)

6.3.1.11.5 Two Bearing Alternators

A flexible coupling, designed to suit the specific engine/alternator combination, is recommended to minimize torsional vibration effects.

If a close coupling adaptor is used the alignment of machined faces must be checked by offering the alternator up to the engine. Shim the alternator feet if necessary.

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6.3.1.11.6 Pre-Running Checks

Before starting the generator set, test the insulation resistance of windings and check that all connections are tight and in the correct location. Make sure the alternator air path is clear of obstructions. Replace all covers.

6.3.1.11.7 Direction of Rotation

As standard, alternator rotation is clockwise, as viewed from the drive end (unless counter-clockwise rotation is specified when ordering). The fan must be changed if the direction of rotation is changed, speak to STAMFORD® or AvK® customer services **www.stamford-avk.com**.

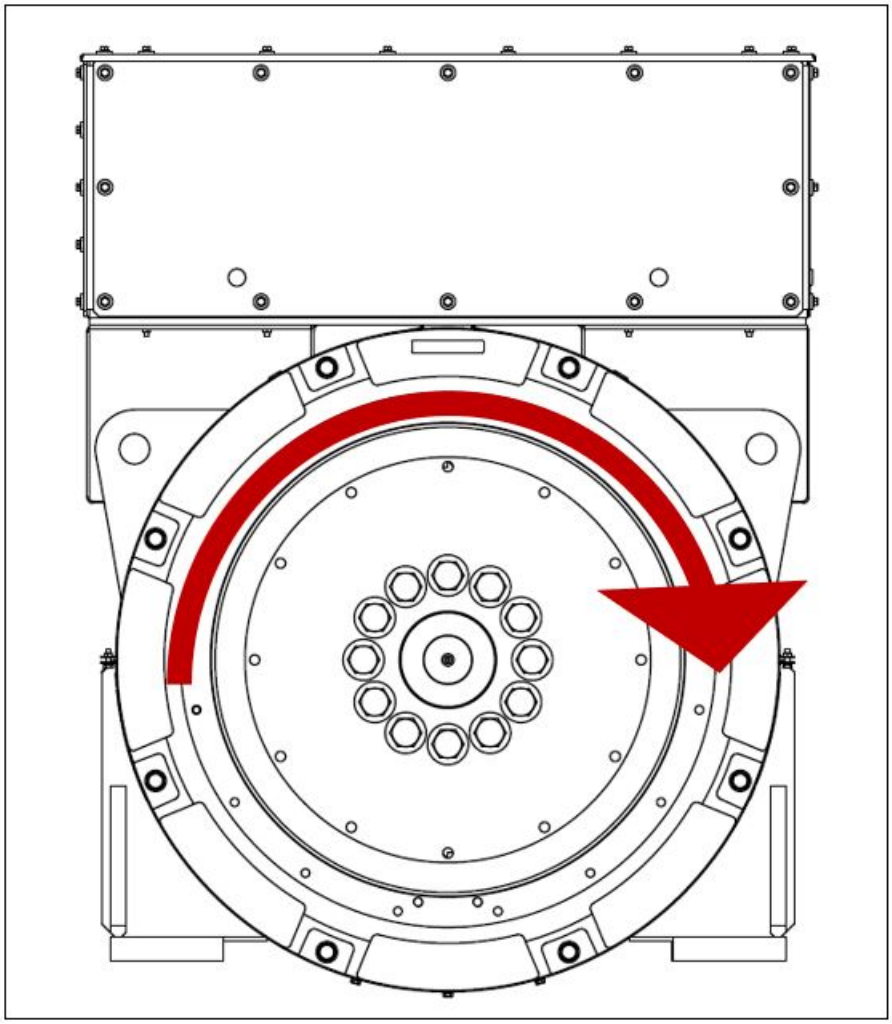


FIGURE 52. DIRECTION OF ROTATION

6.3.1.11.8 Phase Rotation

Main stator output is connected for a phase sequence of U V W when the alternator runs clockwise, as viewed from the drive end. If the phase rotation must be reversed, the customer must re-connect the output cables in the terminal box. Contact STAMFORD | AvK™ customer services **www.stamford-avk.com** for a circuit diagram of 'reverse phase connections'.

6.3.1.11.9 Voltage and Frequency

Check that the voltage and frequency shown on the alternator rating plate meet the requirements of the generator set application. Refer to detailed instructions in the AVR manual for adjustments.

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6.3.1.11.10 AVR Settings

The AVR is factory set for initial running tests. Check that the AVR settings are compatible with your required output. Refer to detailed instructions in the AVR manual for on- and off-load adjustments.

6.3.1.11.11 Electrical Connections

⚠ WARNING

Incorrect Electrical Installation and System Protection

Incorrect electrical installation and / or system protection can cause serious injury or death by electric shock and burns. To prevent injury or death and before starting work, personnel:

- ***Have completed related, applicable and approved training.***
- ***Know the equipment, understand the task(s) and procedure(s).***
- ***Know related hazards / risks.***
- ***Know and obey site / location specific emergency procedures and applicable laws and regulations.***

The terminal box is designed to support the fitted busbars or terminals, transformers, load cables and auxiliary terminal box. Additional mass can cause excessive vibration and lead to failure of the terminal box enclosure and mountings. Contact STAMFORD | AvK™ customer services **www.stamford-avk.com** before fixing any additional mass to the terminal box. Panels must be removed to be drilled or cut, to prevent swarf entering the terminal box or alternator.

Fault current curves and alternator reactance values are available on request from the factory so that the system designer can calculate the necessary fault protection and/or discrimination.

The installer must check that the alternator frame is bonded to the generator set bedplate, and must bond to site earth. If anti-vibration mounts are fitted between the alternator frame and its bedplate, a suitably-rated earth conductor must bridge across the anti-vibration mount.

Refer to wiring diagrams for electrical connection of the load cables. Electrical connections are made in the terminal box, constructed with removable panels to suit site-specific cable entry and glanding. Route single core cables through the insulated or non-magnetic gland plates supplied. Panels must be removed to be drilled or cut to prevent swarf entering the terminal box or alternator. After wiring, inspect the terminal box, remove all debris using a vacuum cleaner if necessary and check that no internal components are damaged or disturbed.

As standard, the alternator neutral is not bonded to the alternator frame. If required, neutral may be connected to the earth terminal in the terminal box, by a conductor of at least one half of the sectional area of a phase lead.

Load cables must be supported appropriately to avoid a tight radius at the point of entry into the terminal box, clamped at the terminal box gland, and allow at least ±25 mm movement by the alternator set on its anti-vibration mountings, without causing excessive stress to the cables and alternator load terminals.

The palm (flattened part) of load cable lugs must be clamped in direct contact with the main stator load output terminals so that the whole palm area conducts the output current. Using a torque wrench on the uppermost nut and a spanner positioned on the nut below, apply equal reverse leverage to avoid damaging the insulation post. The tightening torque of M12 fasteners is 70 Nm (51.6 ft-lb) (main nut) and 45 Nm (33.2 ft-lb) (lock nut) on insulated terminals.

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FIGURE 53. CORRECT CABLE CLAMPING (MULTIPLE CABLES)

6.3.1.11.12 Grid Connection: Voltage Surges and Micro-Interruptions

Consideration should be given to any transient voltages loads generated by connected loads and/or distribution system which could damage the alternator components.

According to the specifics of the application and installation the points below must be considered:

- Loads with characteristics that result in large load step changes.
- Load control by switchgear and power control by any method likely to generate transient voltage spikes.
- Distribution systems susceptible to external influences, such as lightning strikes.
- Applications involving parallel operation to a mains supply, where the risk of a mains disturbance in the form of a micro-interruption could occur.

If the alternator is at risk from voltage surges or micro-interruptions, it is recommended that the installation includes adequate protection of the generation system to meet regulations and installation requirements. It is recommended to seek guidance from specialist protection system designers and associated professional bodies.

6.3.1.11.13 Varying Load

Under certain conditions, load variations can reduce alternator life.

Identify any possible risk, especially the following:

- Large capacitive loads (for example Power Factor Correction equipment) can affect alternator stability and cause pole slip.
- Stepped grid voltage variation (for example Tap Changing).

If the alternator is at risk from varying load, include adequate protection into the generator set system by under-excitation protection.

6.3.1.12 Service and Maintenance

6.3.1.12.1 Alternator Removal and Installation

6.3.1.12.1.1 Parts Identification

Refer to Section 6.3.1.13 for an exploded view of components and for fastener information.

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6.3.1.12.1.2 Lifting the Alternator

⚠ DANGER

Falling Mechanical Parts

Falling mechanical parts can cause serious injury or death by impact, crushing, severing or trapping. To prevent injury or death and before lifting:

- ***Check the capacity, condition and attachment of lifting equipment.***
- ***Check the capacity, condition and attachment of accessories for lifting.***
- ***Check the capacity, condition and attachment of lifting point(s) on the load.***
- ***Check the mass, integrity and stability of the load.***
- ***If available: Install drive end and non-drive end transit fittings to prevent movement and damage to bearings.***
- ***Keep the alternator horizontal when lifting.***
- ***Do not use alternator lifting points for lifting a complete generator set.***
- ***Do not use cooler lifting points for lifting the alternator or a complete generator set.***
- ***Do not remove the lifting label attached to one of the lifting points.***

NOTICE

A shock load detector fitted on the DE bracket activates if the alternator is subjected to a 15 g acceleration. If the detector has been activated, the alternator must be inspected for damage by CGT. As a minimum, the bearings must be replaced.

Lift the alternator by shackles attached to the lifting points (lugs or eyes) provided. A label attached to a lifting point shows the correct lifting arrangement. Use chains of sufficient length, and a spreader bar if necessary, to make sure that the chains are vertical when lifting. Make sure that the capacity of the lifting equipment is sufficient for the alternator mass shown on the label.

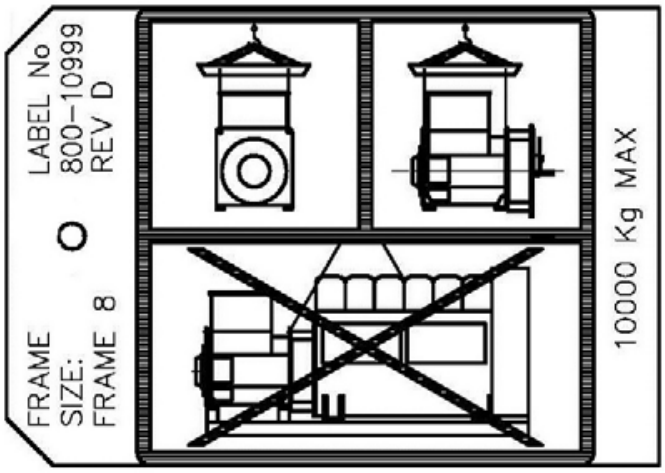


FIGURE 54. LIFTING LABEL

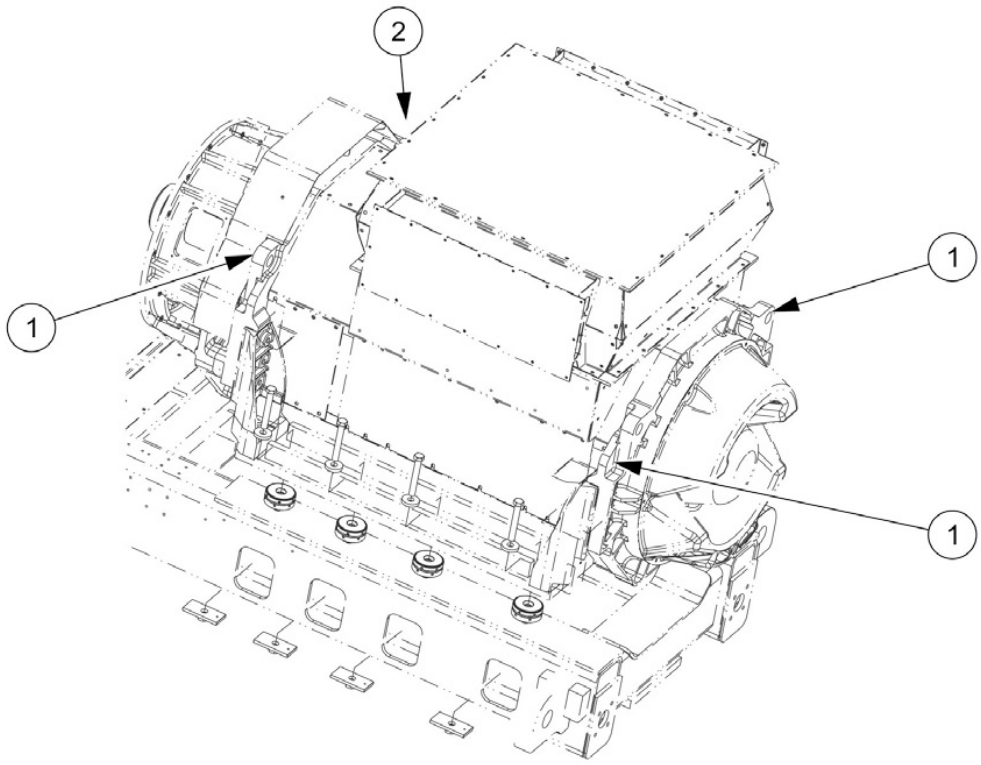
6.3.1.12.1.3 Personal Protective Equipment (PPE)

Wear hearing protection, face shield, steal toed shoes and leather gloves. Wear all site mandatory PPE.

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6.3.1.12.1.4 Remove Alternator

1. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See Section 6.1.2.
2. Block chassis to prevent chassis from sagging when the generator set center of gravity shifts during the alternator pullback. Snug two jack stands under the skid and under the lifting eyes on the non drive end side. Be careful not to load the isolators.
3. Disconnect all harnesses between the engine and the alternator.
4. Disconnect the customer load cables and remove from the entrance box.
5. Disconnect and remove any additional hardware and piping that could interfere with the alternator movement during pullback.
6. Connect to the alternator appropriately sized shackles, spreader bars, slings, and a crane rated to at least twice the alternator weight. Remove the slack from the slings without lifting the alternator.

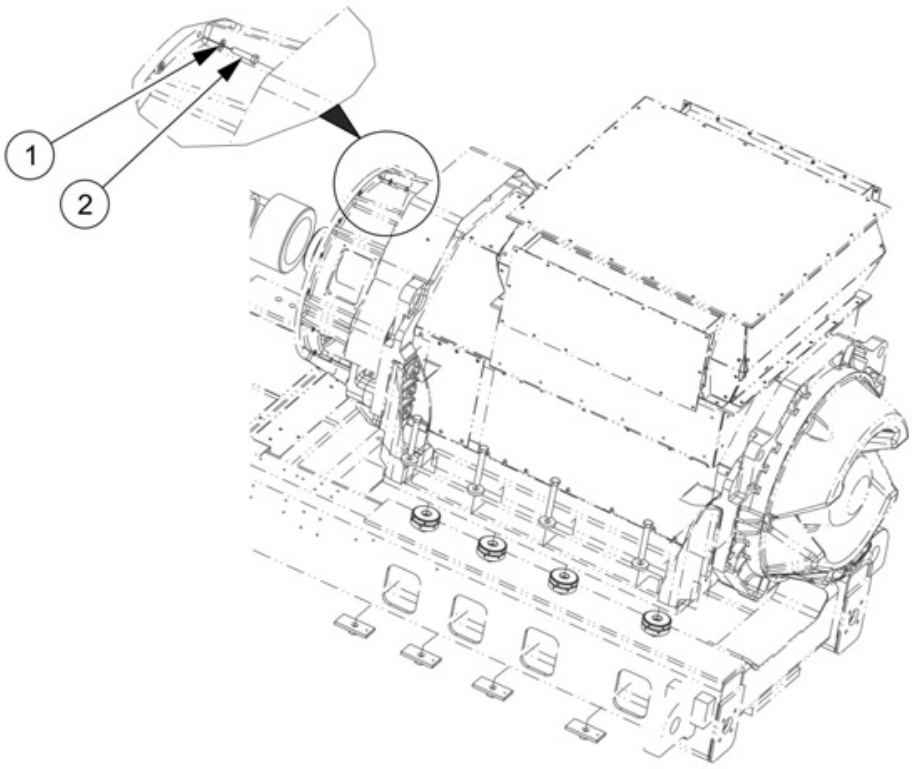


No.	Description	No.	Description
1	Lifting point	2	Lifting point (not shown)

FIGURE 55. ALTERNATOR LIFTING POINTS

7. Remove the 16 mounting bolts for the alternator bell housing and the flywheel housing.

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No.	Description	No.	Description
1	Bolt	2	Washer

FIGURE 56. ALTERNATOR HOUSING BOLTS

8. Remove the alternator to chassis mounting bolts.
9. Use the crane to gently remove the alternator weight off the alternator shims.
10. Use a paint pen to draw a line over the two halves of the alternator shims, this serves as reference for realignment. Label the alternator shims 1 to 8 or (left, right, front back etc.) to identify the location on the alternator foot.
11. Remove the alternator shims. Do not twist and change the alternator shim height.

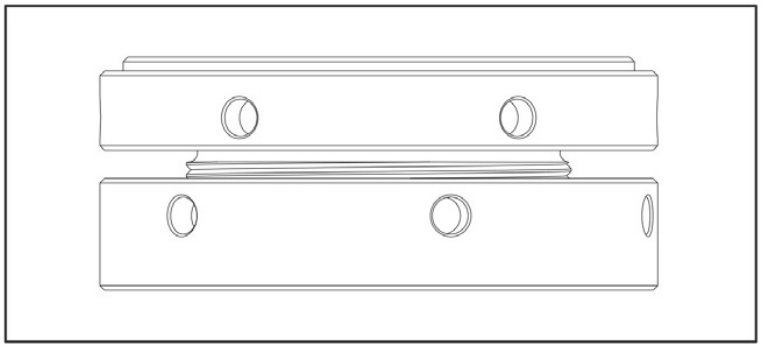


FIGURE 57. ALTERNATOR SHIM

12. Three people are required for this step.

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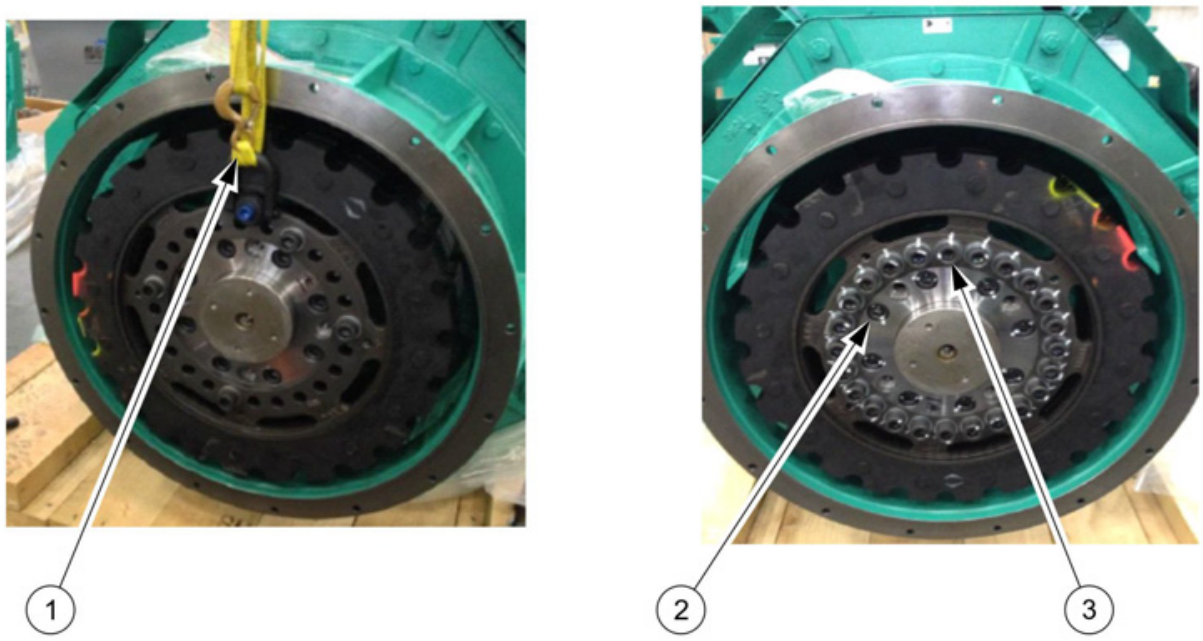
Use two pry bars on each side of the alternator, separate the alternator and flywheel housing while gently operating the crane to pull the alternator toward the non drive end.

13. When the alternator coupling is free from the bell housing, lift the alternator off and away from the generator set. Place the alternator on blocks so that it does not rest on the ground.

6.3.1.12.1.5 Drive Coupling A041A904, A041A908, A043U417 Removal and Installation

6.3.1.12.1.5.1 Remove Drive Coupling from Alternator

1. Support the weight of the rubber element with suitable rigging equipment Rubber element weight is 68 kg (150 lb).
2. Remove the 24 bolts on the rubber element with a 19 mm hex key.
3. Support the weight of the coupler with suitable rigging equipment Coupling hub weight is 136 kg (300 lb). Drive ring weight is 27 kg (60 lb).
4. Remove the eight hub bolts with a 19 mm hex key.

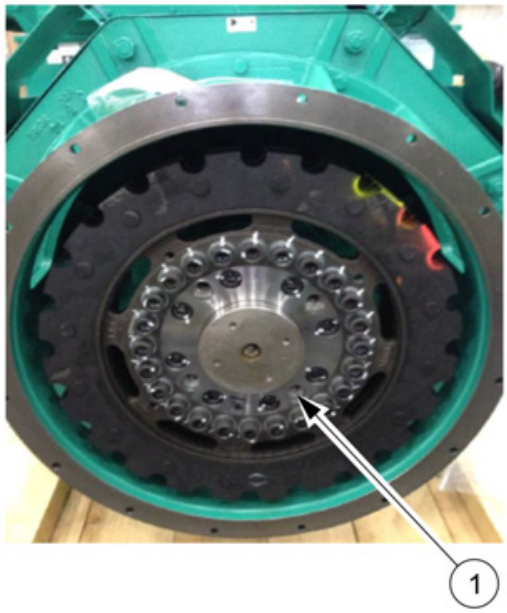


No.	Description	No.	Description
1	Rigging equipment	2	Eight M24 bolts
3	24 M24 bolts		

FIGURE 58. RIGGING EQUIPMENT AND BOLTS

5. Separate the hub inner and outer rings. Insert two M24 coupling bolts into two adjacent jacking holes and alternately torque until the outer ring is released.

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No.	Description	No.	Description
1	Jacking hole		

FIGURE 59. JACKING HOLE

6.3.1.12.1.5.2 Install Drive Coupling on Alternator

Required tools and disposables:

- Hoist
- Coupling Install Tool (A050N812)
- Clamp assembly (A051D415)
- Torque wrench
- Degreaser
- Molykote/lithium based graphite

1. Degrease the spacer. Put the spacer on alternator shaft.
2. Slide the spacer on the rotor shaft until it meets the step on the shaft.
3. Degrease and debur the alternator shaft.
4. Degrease and debur inner diameter of the hub.

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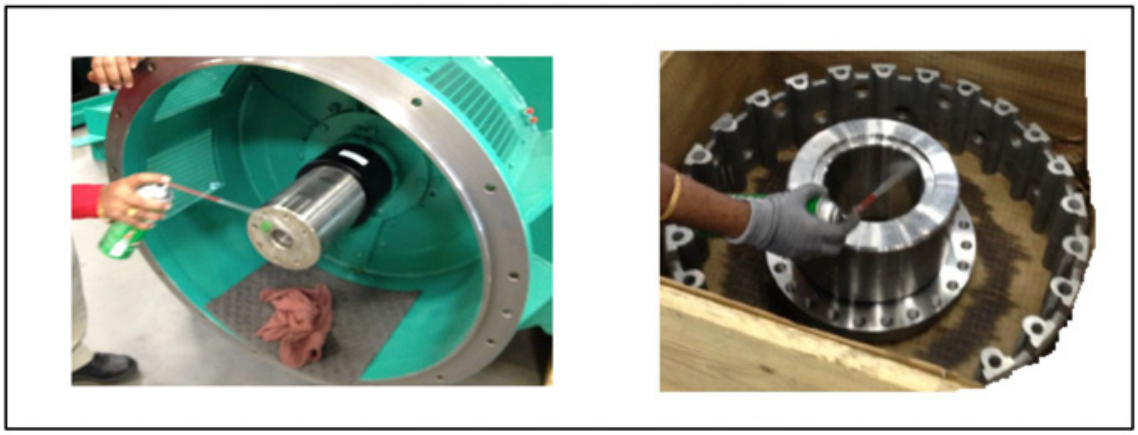


FIGURE 60. DEGREASE AND DEBUR

5. Use level spirit (as shown) to make sure that alternator shaft (axis) is horizontal.

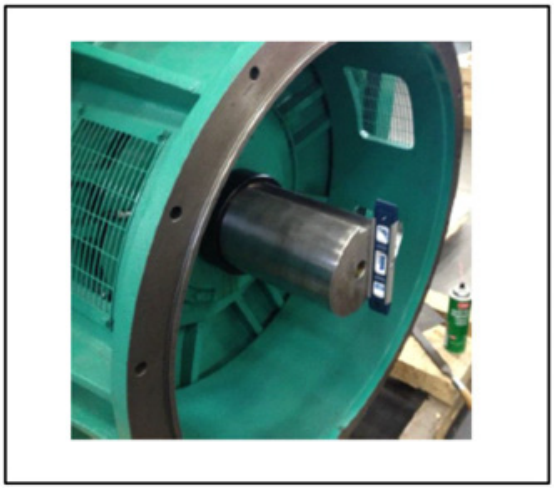


FIGURE 61. CHECK HORIZONTAL

6. Make sure that there is no lubricant or oil between the hub and the shaft.
7. Apply a thin film of molykote/lithium based graphite on the inner diameter of the hub outer ring and on the tapered side of the hub.

NOTICE
There should not be lubricant or oil between the hub and the rotor shaft.

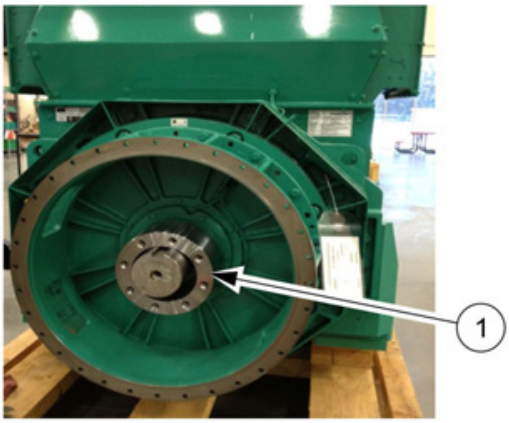
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FIGURE 62. LUBRICATE INNER DIAMETER OF THE HUB OUTER RING

8. Install the hub outer ring on the shaft.

NOTICE
For a new installation the outer ring comes attached to the hub. Do not disassemble, install as one part.

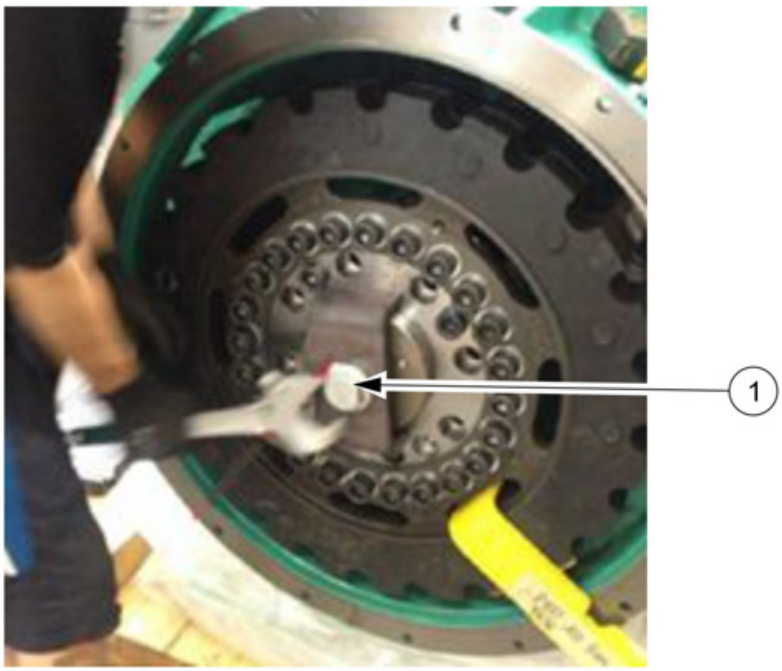


No.	Description	No.	Description
1	Outer ring		

FIGURE 63. HUB OUTER RING

9. Use a hoist and the coupling install tool to install the hub. Slide the hub on the alternator shaft. Make sure that there is roughly the same amount around the alternator shaft and the inner hub.
10. Loosely install two bolts in the outer and inner ring to be sure that the bolt holes align.
11. Install the clamp assembly at the end of the rotor shaft. Torque M24 bolt to 340 Nm (250.8 ft-lb). This ensures the spacer does not become loose.

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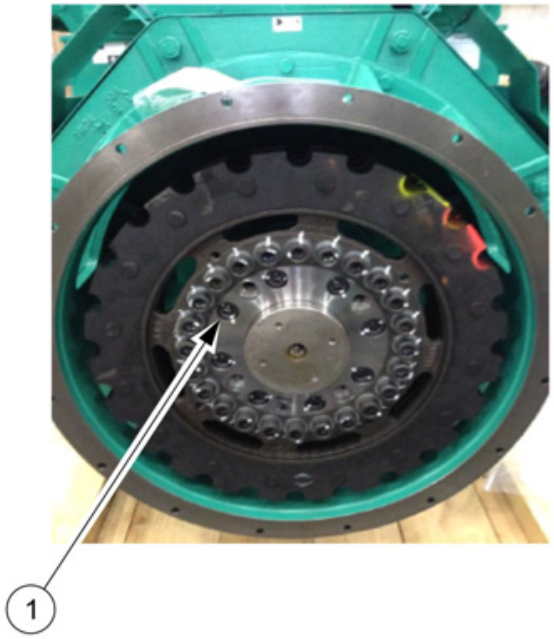


No.	Description	No.	Description
1	Clamp assembly		

FIGURE 64. CLAMP ASSEMBLY

12. Remove the two bolts from the outer and inner ring.
13. Apply anti seize and torque the M24 bolts coupling bolts in a crosswise pattern as follows:
    a. Snug the bolts.
    b. Torque to 340 Nm (250.8 ft-lb) (40%).
    c. Torque to 510 Nm (376.1 ft-lb) (60%).
    d. Torque to 850 Nm (626.9 ft-lb) (100%).

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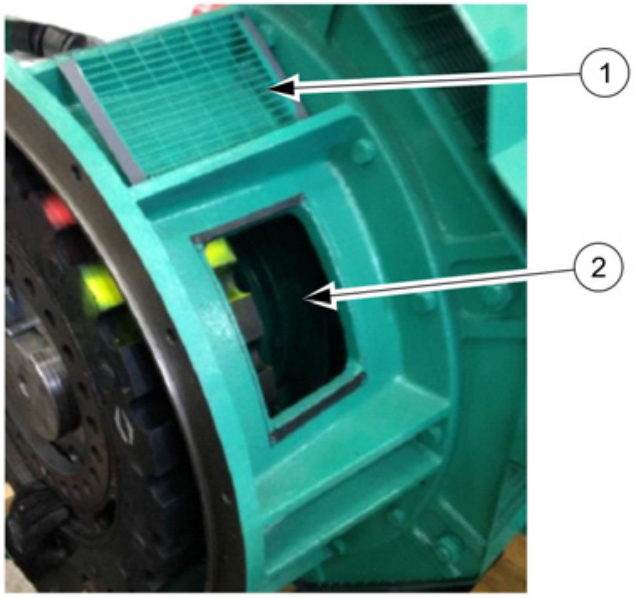


No.	Description	No.	Description
1	Bolt		

FIGURE 65. HUB BOLTS

14. Remove one alternator bell housing mesh to check that the spacer does not move. If it moves remove the bolts and repeat the torque sequence in the previous step.

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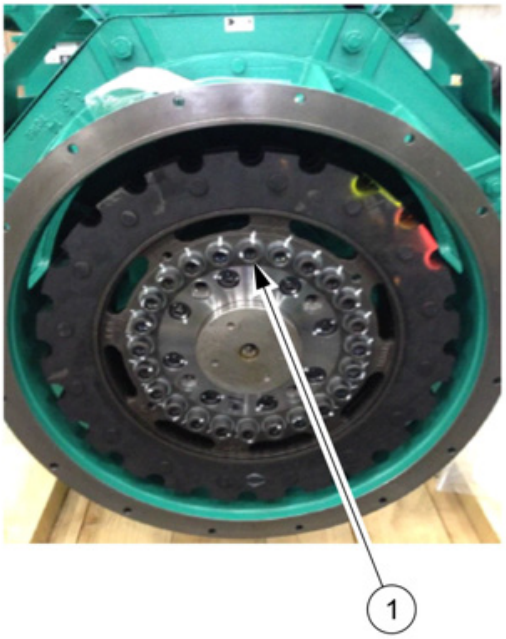


No.	Description	No.	Description
1	Mesh	2	Spacer

FIGURE 66. MESH AND SPACER

15. Install the rubber element. Apply anti seize and torque the M24 bolts coupling bolts in a crosswise pattern as follows:
    a. Snug the bolts.
    b. Torque to 340 Nm (250.8 ft-lb) (40%).
    c. Torque to 510 Nm (376.1 ft-lb) (60%).
    d. Torque to 850 Nm (626.9 ft-lb) (100%).

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No.	Description	No.	Description
1	Bolt		

FIGURE 67. RUBBER ELEMENT BOLTS

16. Repeat torque step until all bolts remain at 850 Nm (626.9 ft-lb) torque.
17. Remove one alternator bell housing mesh to check that the spacer again Figure 67 to make sure it does not move.
18. Re-install the bell housing mesh.
19. Remove the clamp assembly from the rotor shaft.

6.3.1.12.1.6 Drive Coupling A071V012, A072Z117, A072Z118 Removal and Installation

6.3.1.12.1.6.1 Remove Drive Coupling from Alternator

1. Remove one alternator bell housing mesh and insert a pry bar to counter-hold the coupler element.
2. Loosen the 15 bolts from the locking assembly.

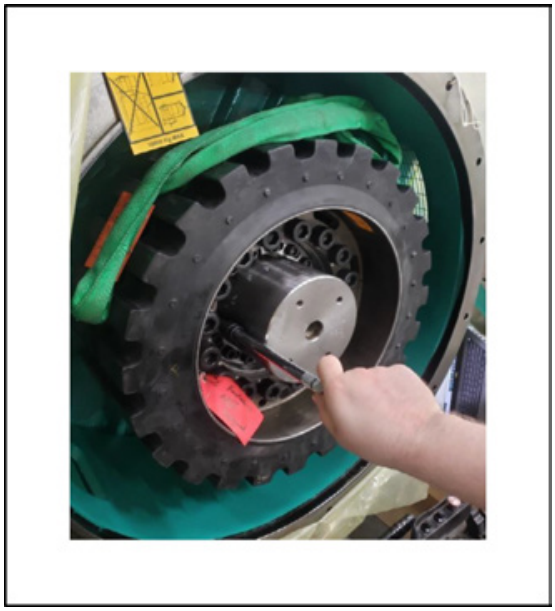


FIGURE 68. LOCKING CAPSCREWS

3. Remove 4 capscrews and insert in to the jacking holes of the locking ring assembly.

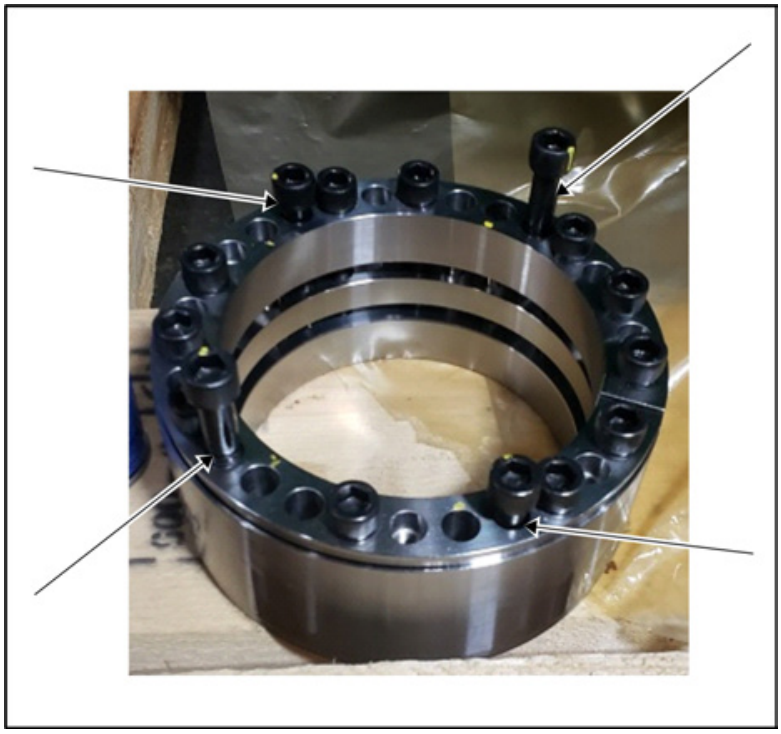


FIGURE 69. JACKING CAPSCREWS

4. Slightly tighten the jacking capscrews to loosen the locking ring assembly hold on the alternator shaft. Remove the locking assembly from the alternator shaft and place it on a clean, dry surface.
5. Use a lifting strap wrapped around the coupling element to support the coupling.

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FIGURE 70. LIFTING STRAP

6. Use a pry bar to gently remove the coupling element from the alternator shaft.
7. Place the coupling element on a clean. dry surface.

6.3.1.12.1.6.2 Install Drive Coupling on Alternator

Required tools and disposables:

- Hoist
- Lifting Strap
- 3-In-One Multipurpose Oil
- Torque wrench
- Pry-bar

1. Clean and oil the alternator shaft.
2. Slide the spacer on the rotor shaft until it meets the step on the shaft.

NOTICE
Coupling A072Z117 does not use a spacer.

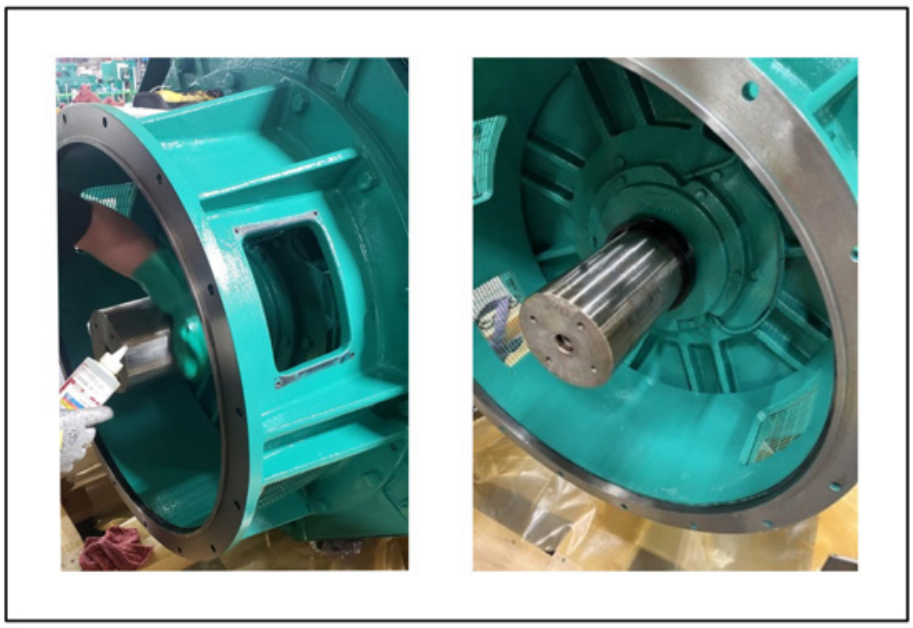


FIGURE 71. CLEAN AND INSTALL SPACER

3. Thread M12 lifting eyes in to the lifting holes of the inner coupling element. Minimum thread engagement is 76 mm (3 in).

⚠ WARNING

The object or component weighs more than 23 kg (50 lb). Seek appropriate lifting device or assistance.

4. Use a hoist and lifting strap to remove the inner coupling element from the shipping container. Place the coupling on the floor and remove the lifting device.

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FIGURE 72. LIFTING DEVICE

5. Remove the locking ring assembly by lifting the two long capscrews proturding from the jacking holes.

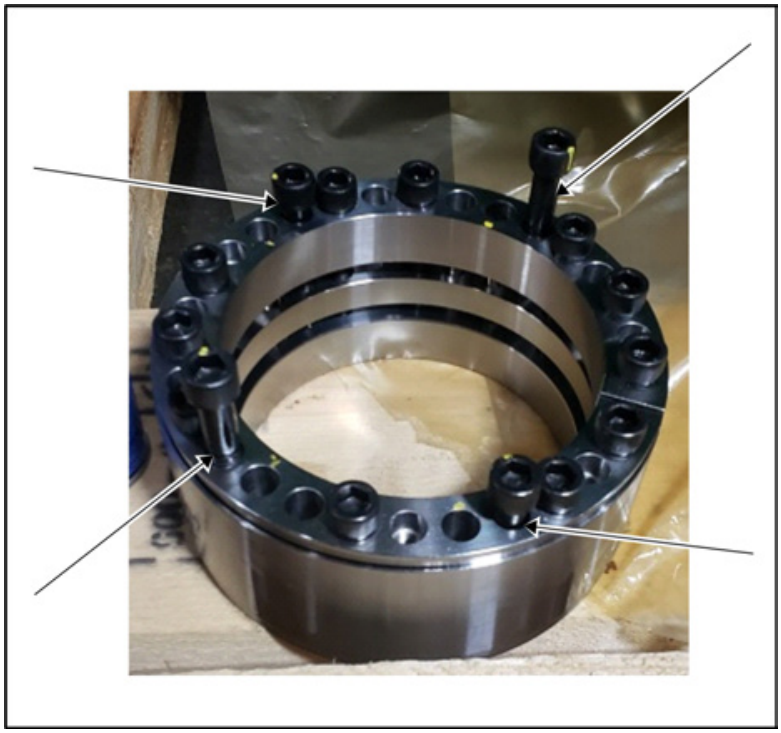


FIGURE 73. JACKING CAPSCREWS

6. Place the locking ring assemebly on a clean, dry surface.

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NOTICE

Orientation and order of the components of the locking ring assembly are critical to the installation and performance of the device. If the locking ring assembly is disassembled, used a marker to record position and orientation.

⚠ WARNING

The object or component weighs more than 23 kg (50 lb). Seek appropriate lifting device or assistance.

7. Use a lifting strap around the circumference of the coupling element and a hoist to position the inner coupling element to the alternator shaft.



FIGURE 74. COUPLING INSTALLATION

8. Slide the coupling on the shaft until the inner face meets the spacer.

NOTICE

If the coupling element binds on the shaft, adjust with a rubber mallet. Maintain enough hoist cable slack to support the coupling element while also minimizing binding from oblique angle lifting forces.

9. Remove one alternator bell housing mesh to check the depth of coupling element. The coupling element will be fully seated when the spacer is no longer able to be rotated.

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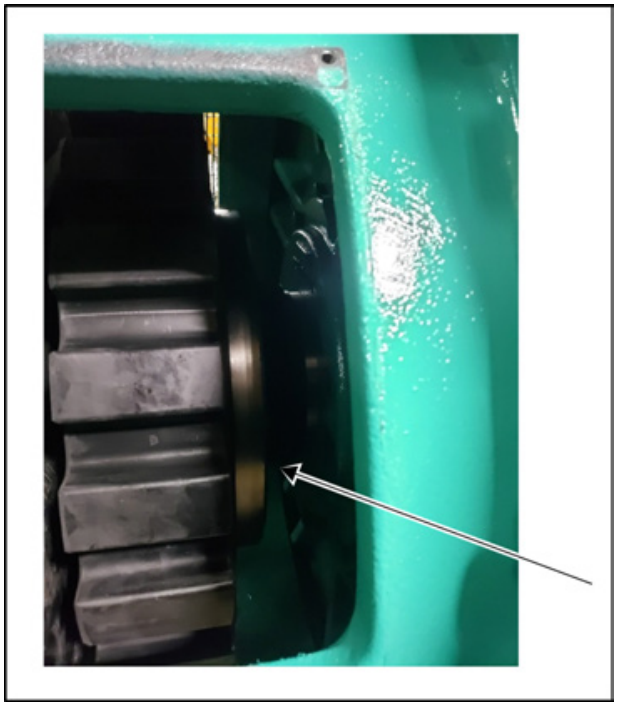
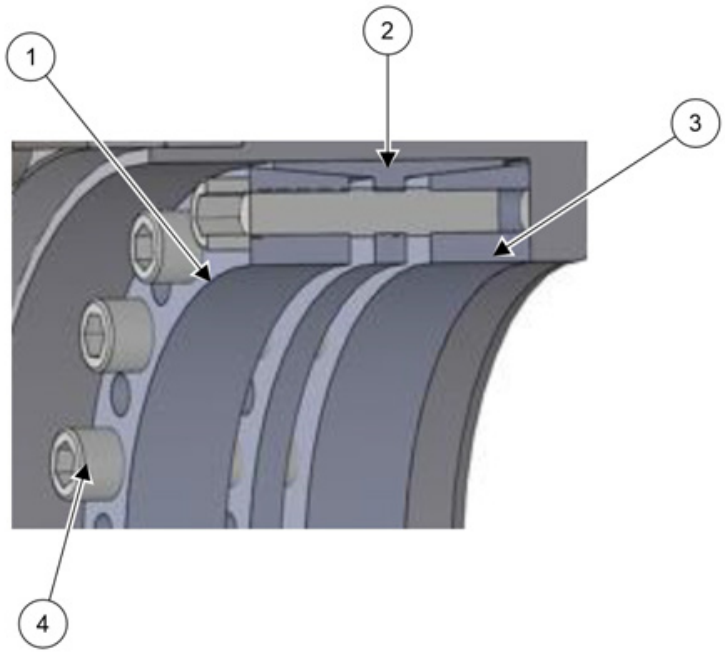


FIGURE 75. COUPLING INSTALLED

10. Install the locking ring assembly to the alternator shaft. Push on the capscrews threaded in to the jacking hole positions, this will push with the rear thrust ring and prevent binding.

NOTICE
If the locking ring assembly binds, loosen all capscrews except the capscrews in the jacking positions. Verify all threads retain engagement. Slightly tighten the jacking capscrews to spread the front and rear thrust rings apart.



No.	Description	No.	Description
1	Front Thrust Ring	3	Rear Thrust Ring
2	Outer Ring	4	Capscrew

FIGURE 76. LOCKING RING ASSEMBLY DETAIL

11. Fully seat the locking ring to the coupling element. Remove the capscrews from the jacking positions and thread them in to the locking ring fastening holes.

NOTICE

A screwdriver tip inserted in the ends of the thrust rings may be used to slightly spread the thrust ring to start the locking assembly on the alternator shaft.

NOTICE

Do not insert a screwdriver tip in to the circumference of any component of the locking ring assembly. Damage will occur to the thrust rings or outer ring as a result.

12. Remove the sling from the coupling element.
13. If the alternator shaft has a keyway, position the slot of the locking ring assembly 180° opposed from the keyway.
14. Use a pry-bar to counter-hold the coupling element.
15. Follow the torque sequence and steps.
    a. Snug the bolts by hand.
    b. Torque to 100 Nm (73.8 ft-lb).
    c. Torque to 190 Nm (140.1 ft-lb).
    d. Torque to 240 Nm (177 ft-lb).

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e. Torque to 252 Nm (185 ft-lb).

f. Overcheck in sequence at 240 Nm (177 ft-lb).

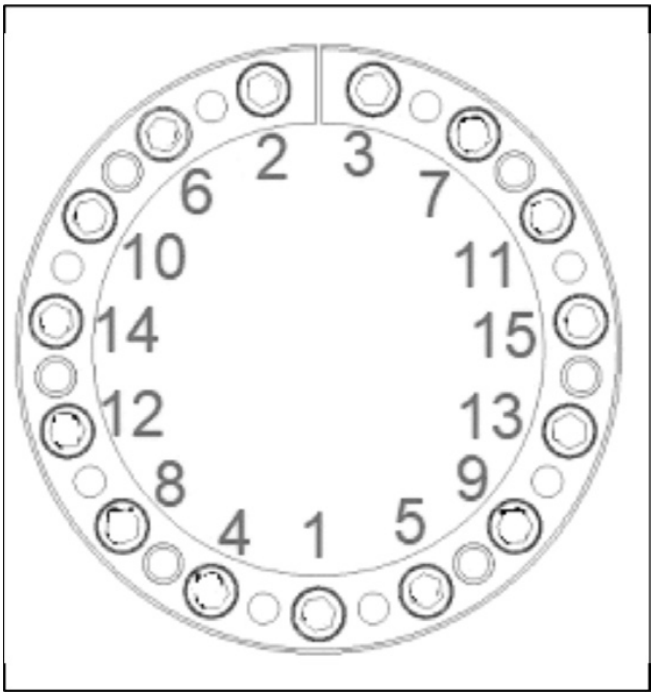


FIGURE 77. LOCKING RING ASSEMBLY TORQUE SEQUENCE BOLTS

16. Install the alternator bell housing mesh.

6.3.1.12.1.6.3 Remove Drive Ring from Engine

Required tools and disposables:

- Hoist
- Lifting Strap
- Torque wrench
- M18 x 2.5 thread guide pin

1. Attach a lifting eye through one lifting hole of the drive ring.

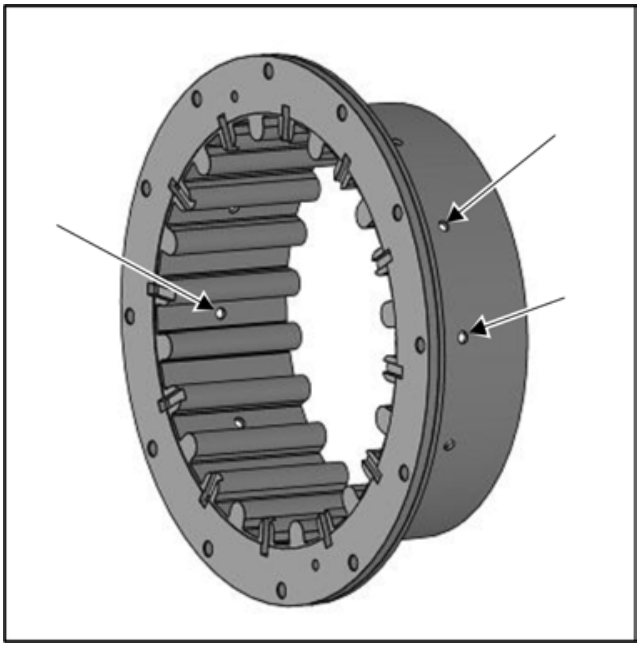


FIGURE 78. DRIVE RING LIFTING HOLES

2.

⚠ WARNING

The object or component weighs more than 23 kg (50 lb). Seek appropriate lifting device or assistance.

Use a hoist and a lifting strap through a rigging shackle on the lifting eye to support the drive ring.

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FIGURE 79. DRIVE RING SUPPORT

3. Remove qty. 12 capscrews from the engine flywheel.

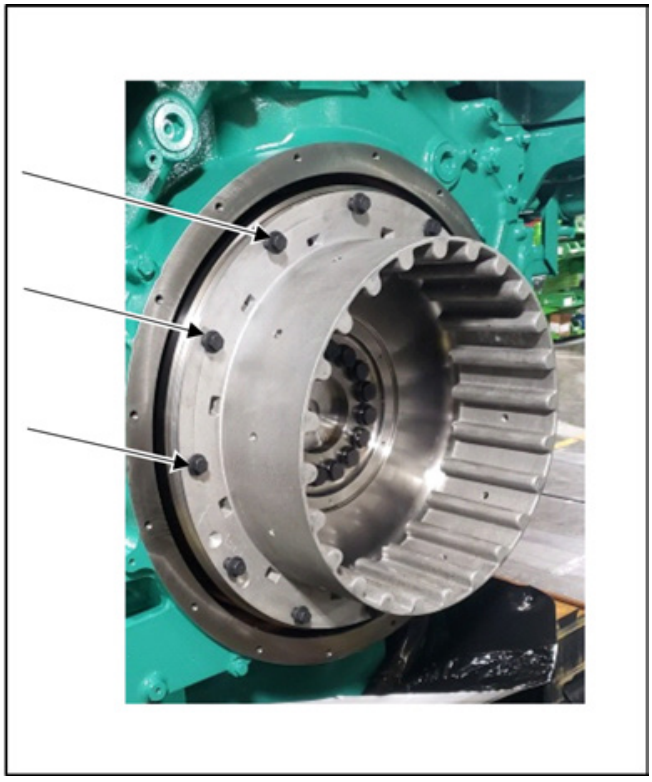


FIGURE 80. DRIVE RING REMOVAL

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4. Remove the drive ring and place on a clean, dry surface.

6.3.1.12.1.6.4 Install Drive Ring on Engine

Required tools and disposables:

- Hoist
- Lifting Strap
- Torque wrench
- M18 x 2.5 thread guide pin

1. Thread the guide pin in to engine flywheel at the highest point.



FIGURE 81. DRIVE RING GUIDE PIN

2. Attach a lifting eye through one lifting hole of the drive ring.

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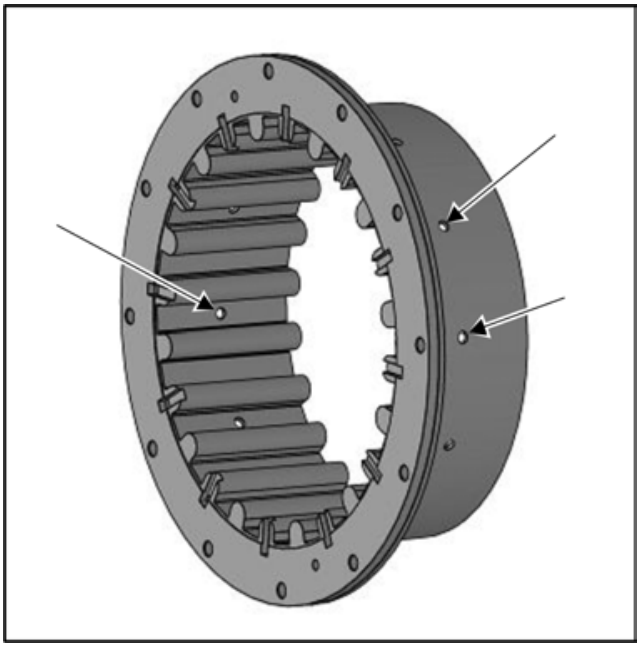


FIGURE 82. DRIVE RING LIFTING HOLE

3.

⚠ WARNING

The object or component weighs more than 23 kg (50 lb). Seek appropriate lifting device or assistance.

Use a hoist and a lifting strap through a rigging shackle on the lifting eye to support the drive ring.

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FIGURE 83. DRIVE RING SUPPORT

4. Align the drive ring to the engine flywheel and hand thread qty. 11 M18 x 2.5 capscrews in to the engine flywheel.



FIGURE 84. DRIVE RING INSTALLATION

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5. Remove the guide pin once all 11 capscrews are hand tight and hand thread the last M18 x 2.5 capscrew.
6. Torque the capscrews in sequence. Torque to 245 Nm (180.7 ft-lb).

NOTICE
Mark each capscrew with a pint marker when torqued.

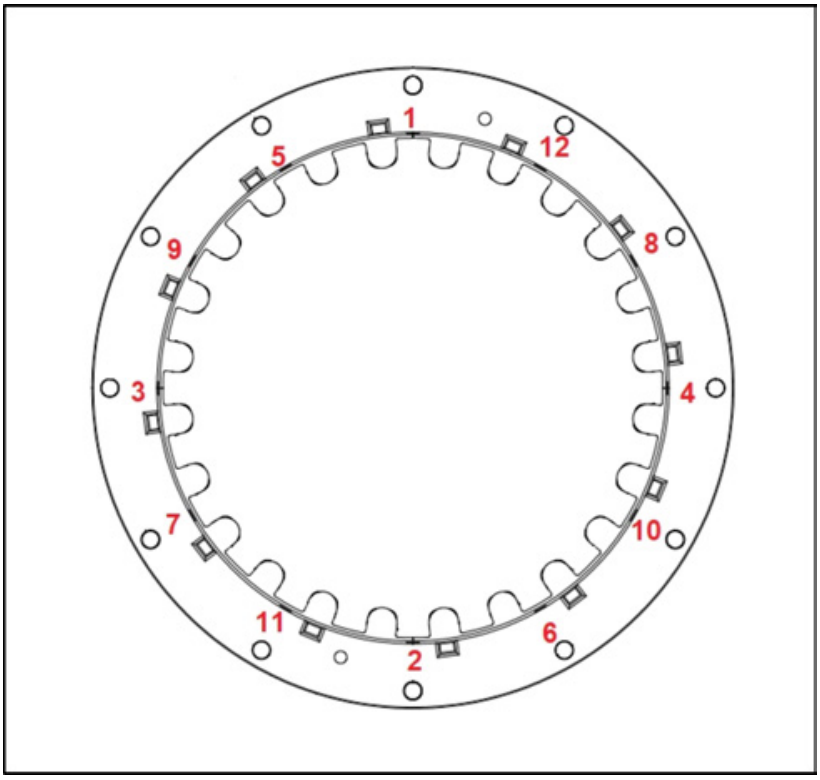
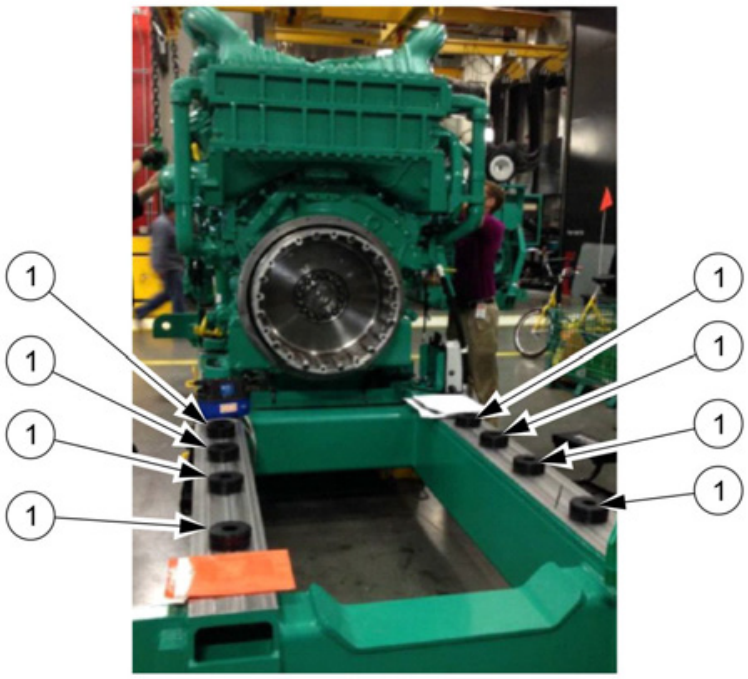


FIGURE 85. DRIVE RING CAPSCREW TORQUE SEQUENCE

6.3.1.12.1.7 Install Alternator

1. Use an alternating pattern to torque the drive ring onto engine on the flywheel end to torque 245 ± 25 Nm (180.7 ± 18.4 ft-lb).
2. Prepare the skid. Clean the skid surface. Stage the alternator shims as shown below. Make sure the holes in the alternator foot railing and the alternator shim pads are aligned.

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No.	Description	No.	Description
1	Alternator shim		

FIGURE 86. ALTERNATOR SHIM PLACEMENT

3. Lift the alternator (**Figure 55**).
4. Spray anti rust solution onto the rubber element and outer ring on the alternator.
5. Align the holes on the alternator bell housing with corresponding holes on engine flywheel housing.
6. Hand tighten the 16 mounting bolts for the alternator bell housing and the flywheel housing (**Figure 56**).
7. Check that the holes in the foot railing of the alternator and the alternator shim machined pads are aligned. The holes in the foot railing of the alternator and the alternator shim machined pads must be aligned. If realignment is necessary, repeat steps 5 and 6.
8. Snug up all the alternator shims to bottom of the alternator feet.
9. Install the alternator bell housing and the flywheel housing 16 mounting bolts. Torque to 126 ± 25 Nm (92.9 ± 18.4 ft-lb) in alternate pattern.
10. Remove load from the hoist.
11. Remove the 16 mounting bolts from the flywheel housing and the alternator.
12. Use a feeler gauge and document the gap between the flywheel housing and the alternator at 3, 6, 9 and 12 o'clock positions. If the gap is greater than 0.1 mm, adjust alternator shims with spherical washer facing up to reduce the gap between the alternator and flywheel housing to less than or equal to 0.1 mm.

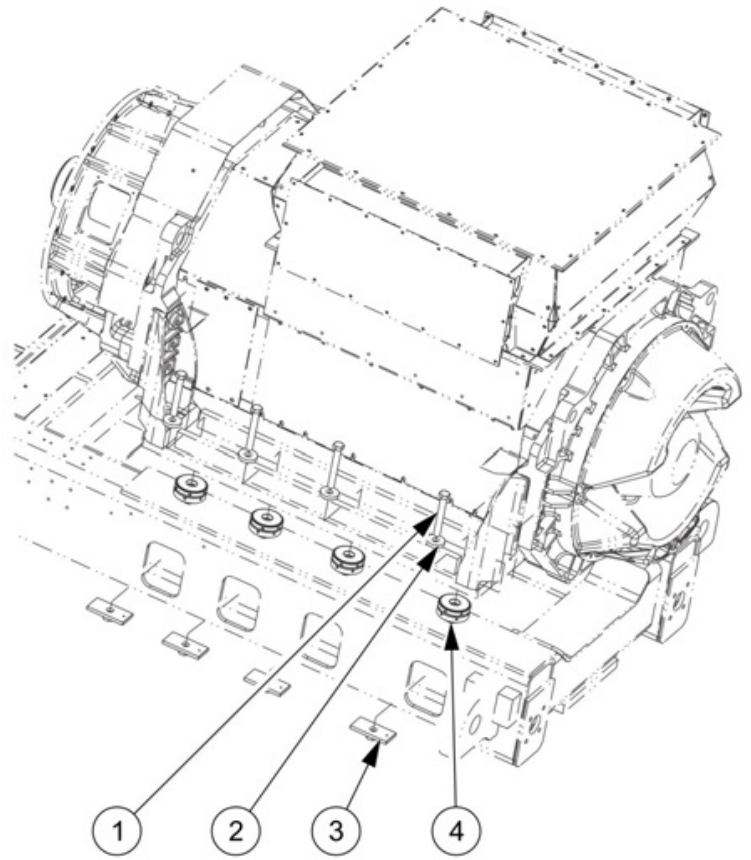
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FIGURE 87. MEASURE GAP

13. If the gap is less than 0.1 mm, torque the 16 mounting bolts of the bell housing and flywheel housing to 126 ± 25 Nm (92.9 ± 18.4 ft-lb) in alternating pattern. After torqueing, mark each bolt with a paint pen.
14. Put new hex bolts and flat washers through the foot railing holes and run it through nut plate. Torque the bolts to 1050 ± 50 Nm (774.4 ± 36.9 ft-lb). Mark each bolt with a paint pen after torqueing. Do not re-use the old bolt or washer.

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No.	Description	No.	Description
1	Bolt	3	Nut plate
2	Washer	4	alternator shim

FIGURE 88. HEX BOLT AND NUT PLATE

6.3.1.12.2 Alternator Decouple and Recouple

6.3.1.12.2.1 Personal Protective Equipment

Wear the following personal protective equipment (PPE):

- Hearing protection
- Steel toe shoes
- Face shield
- Leather gloves
- All site mandatory PPE

6.3.1.12.2.2 Consumables

- Lint-free cloths
- Thin disposable gloves
- Anti seize compound

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6.3.1.12.2.3 Parts

- Alternator feet mounting bolts

6.3.1.12.2.4 Tools

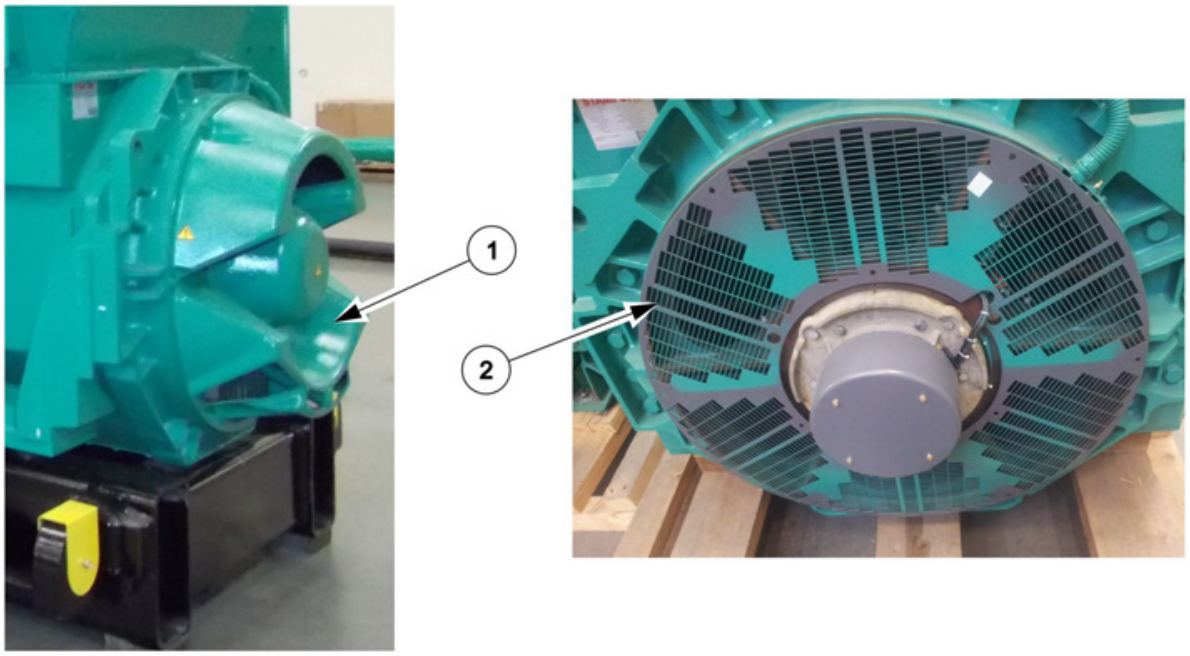
- 1/2" socket set (SAE/Metric)
- Torque wrench
- Jacks
- Alternator pullback service kits
  - A050R999

6.3.1.12.2.5 Decouple the Alternator from the Engine

6.3.1.12.2.5.1 Procedure

1. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See **Section 6.1.2**.
2. Block the chassis to prevent chassis from sagging when the generator set center of gravity shifts during the alternator pullback. Snug two jack stands under the skid non drive end lifting eyes. Be careful not to load the isolators.
3. Disconnect all harnesses between the engine and the alternator.
4. Disconnect the customer load cables and remove from the entrance box.
5. Disconnect and remove any additional hardware and piping that could interfere with the alternator movement during pullback.
6. Remove the alternator NDE cover (9 bolts) and mesh.

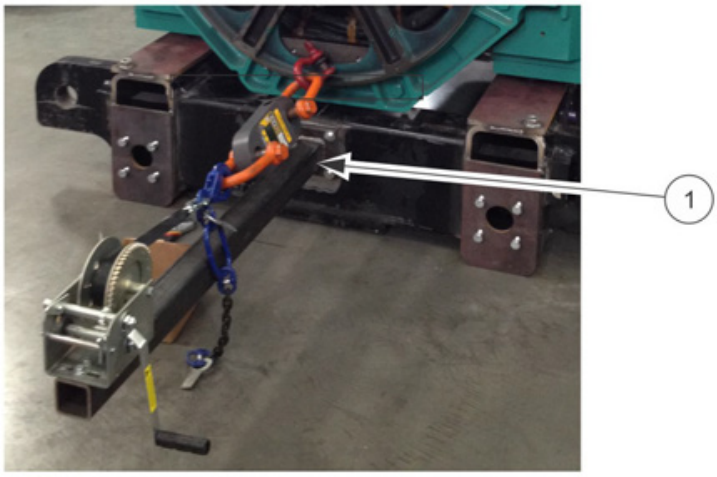
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No.	Description	No.	Description
1	Cover	2	Mesh

FIGURE 89. ALTERNATOR NDE COVER AND MESH

7. Install the winch support tube on the chassis NDE cross member with 4 bolts. Torque the bolts to 91 ± 9 Nm (67 ± 7 ft-lb).

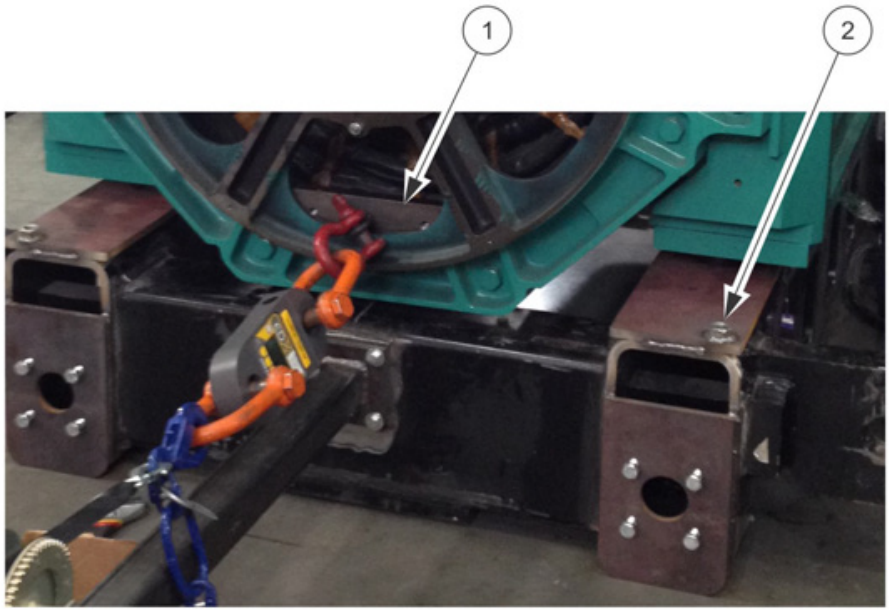


No.	Description	No.	Description
1	Winch support tube		

FIGURE 90. WINCH SUPPORT TUBE

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8. Install the Stop bolts at the end of chassis
9. Install the pulling bracket at 6 o-clock behind the NDE bracket with the eyelid pointing toward you.

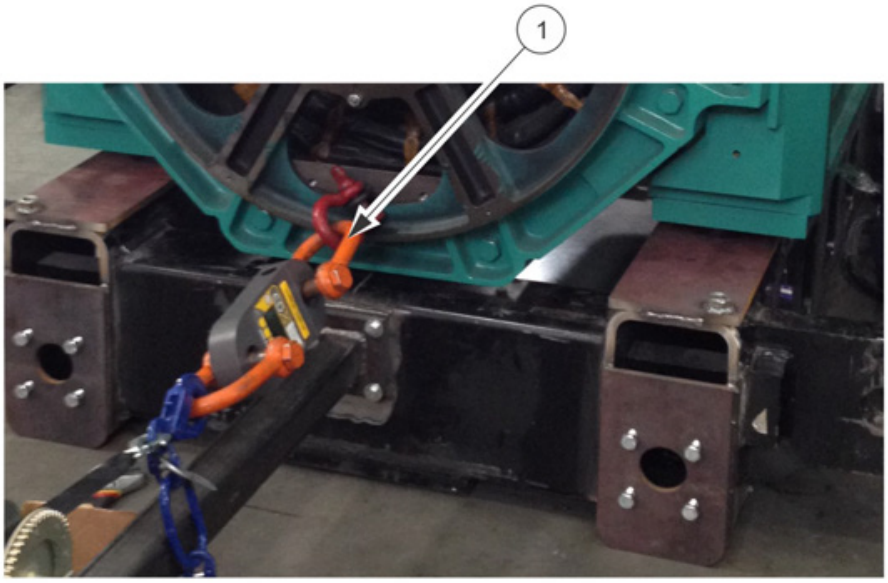


No.	Description	No.	Description
1	Pull back brace	2	Stop bolt

FIGURE 91. PULL BACK BRACE AND STOP BOLT

10. Hook the winch strap to the pulling bracket eyelid.

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No.	Description	No.	Description
1	Winch strap connection		

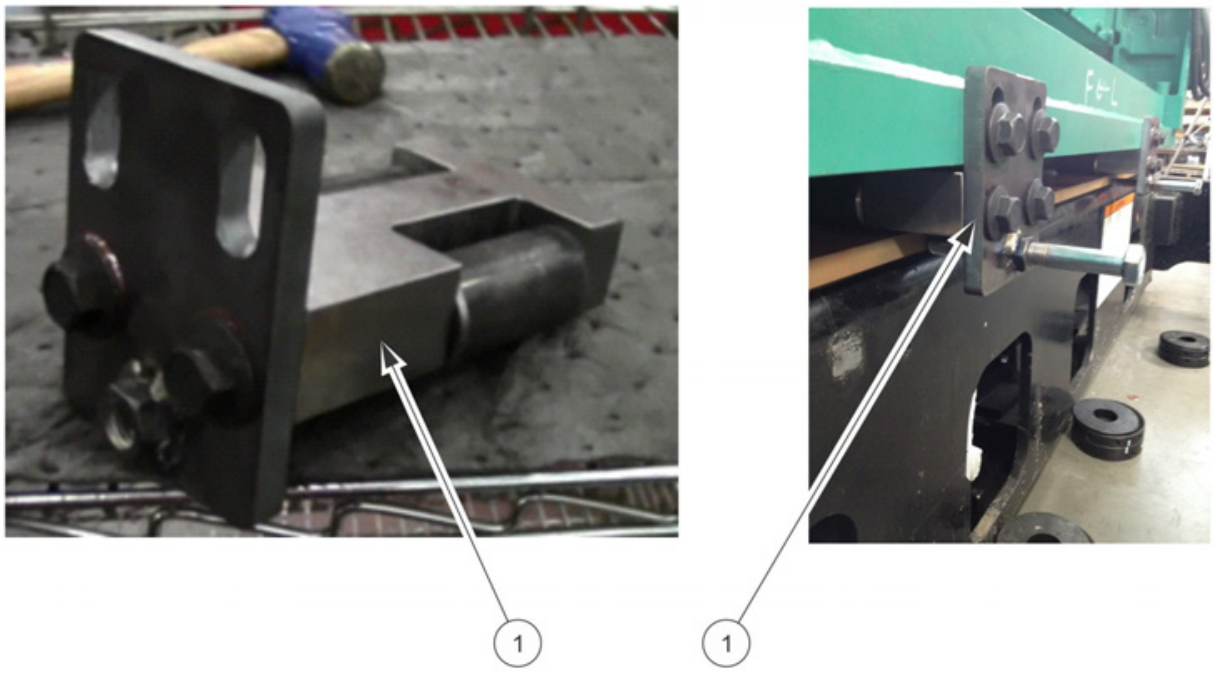
FIGURE 92. WINCH STRAP CONNECTION

11. Remove the 16 mounting bolts for the alternator bell housing and flywheel housing. The bottom two bolts are hard to reach. Stand on the right to remove left side bolt and on the left to remove the right side using a 19 mm socket with a ½ inch driver. Stand on the right to remove left side bolt and on the left to remove the right side using a 19 mm socket with a ½ inch driver

    The bottom two bolts are hard to reach. Stand on the right to remove left side bolt and on the left side to remove the right side. Using a 19 mm socket with a ½ inch driver.

12. Remove the alternator jacking bolts.
13. Apply anti seize compound to the roller assembly mounting bolts. Install the four roller assemblies, two on each side of the alternator. Torque bolts to 198 ± 20 Nm (146 ± 15 ft-lb).

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No.	Description	No.	Description
1	Roller assembly		

FIGURE 93. ROLLER ASSEMBLY

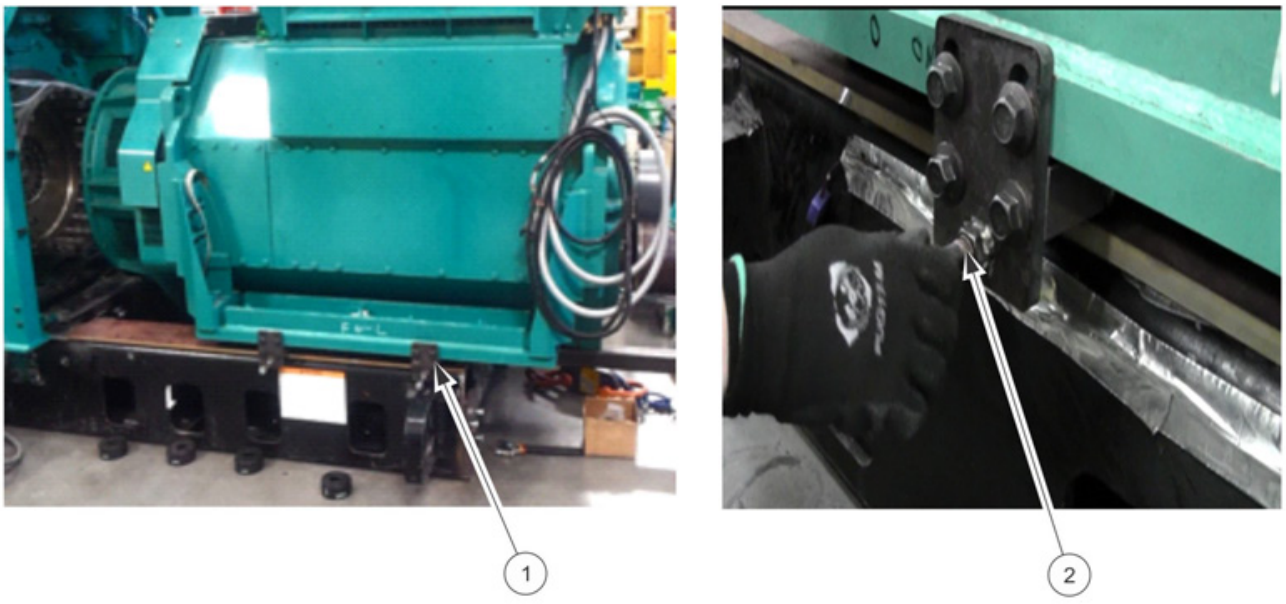
14. Remove the alternator to chassis mounting bolts.
15. Apply anti seize compound to the Jacking bolts and install the jacking bolts. Torque each jacking bolt just enough (approximately 90 Nm (66.3 ft-lb)) to relieve pressure from the alternator shims so they can be removed.
16. Use a paint pen to draw a line over the two halves of the alternator shims. This provides a reference for realignment. Label the alternator shims 1 to 8 or (left, right, front back etc.) to identify their location on the alternator foot.

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FIGURE 94. MARKED ALTERNATOR SHIM

17. Remove the alternator shims. Do Not Twist and Change the height of the alternator shims.
18. Review the winch latch mechanism for proper engagement.
19. Operate the winch lever clockwise to begin pulling the alternator toward you.
20. When the alternator has reached the maximum pullback distance, the roller assembly touches the stop bolt, lock the alternator in place. Insert the locking bolts into the alternator foot rail and skid and tighten the nuts.

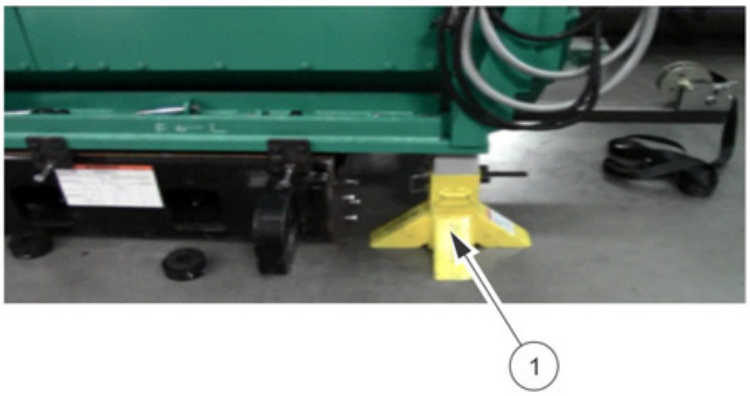


No.	Description	No.	Description
1	Roller assembly	2	Locking bolt

FIGURE 95. ROLLER ASSEMBLY AND LOCKING BOLT

21. Insert two jack stands under the alternator foot as an additional precaution.

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No.	Description	No.	Description
1	Jack stand		

FIGURE 96. JACK STAND

6.3.1.12.2.6 Couple the Alternator to the Engine

6.3.1.12.2.6.1 Procedure

1. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See **Section 6.1.2**.
2. Install the pulley assembly on the skid cross-member on the DE side. Torque 4 mounting bolt to 91 ± 9 Nm (67 ± 7 ft-lb).



No.	Description	No.	Description
1	Pully assembly		

FIGURE 97. DE PULLY ASSEMBLY

3. Unhook the winch strap from the pulling bracket. Run the strap under the alternator, through the bottom of the pulley, and back to the strap to hock on the NDE pulling bracket.

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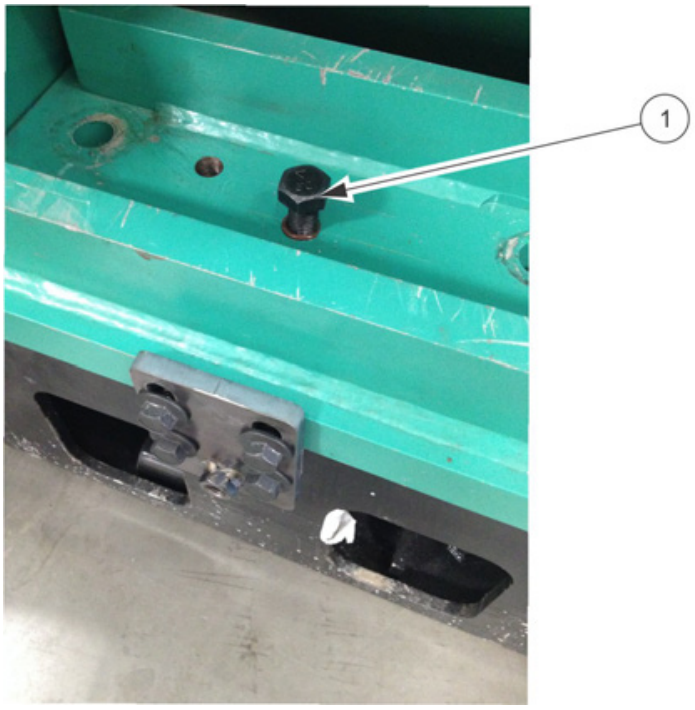


No.	Description	No.	Description
1	Wench strap	2	Connection to pulling bracket

FIGURE 98. WINCH STRAP ROUTING

4. Unlock the alternator. Remove the locking bolts from the alternator foot.
5. Wear a face shield and leather gloves.
6. Operate the winch lever clockwise to begin pulling the alternator until the bell housing comes in contact with the engine flywheel housing.
7. Install the alternator bell housing and the flywheel housing with 16 mounting bolts. Torque the bolts to 126 ± 25 Nm (92.9 ± 18.4 ft-lb) in alternating pattern.
8. Carefully inspect the alternator shims to ensure the marks on the two halves are aligned. Install the alternator shims to the correct location as previously marked. Do not twist or change the height of the alternator shims.
9. Ensure the holes in the alternator foot railing and the alternator shim machined pads are aligned.
10. Loosen the jacking bolts to lower the alternator until the alternator shims are snug to the bottom of the alternator feet.

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No.	Description	No.	Description
1	Jacking bolt		

FIGURE 99. JACKING BOLTS

11. Torque the 16 mounting bolts on the alternator bell housing and flywheel housing to 126 ± 25 Nm (92.9 ± 18.4 ft-lb) in alternating pattern.
12. Loosen the four jacking bolts so that the entire alternator weight is supported by the alternator shims.
13. Remove the 16 mounting bolts from the flywheel housing and the alternator.
14. Use a feeler gage and document the gap between the flywheel and bell housing at 3, 6, 9, and 12 o'clock positions.

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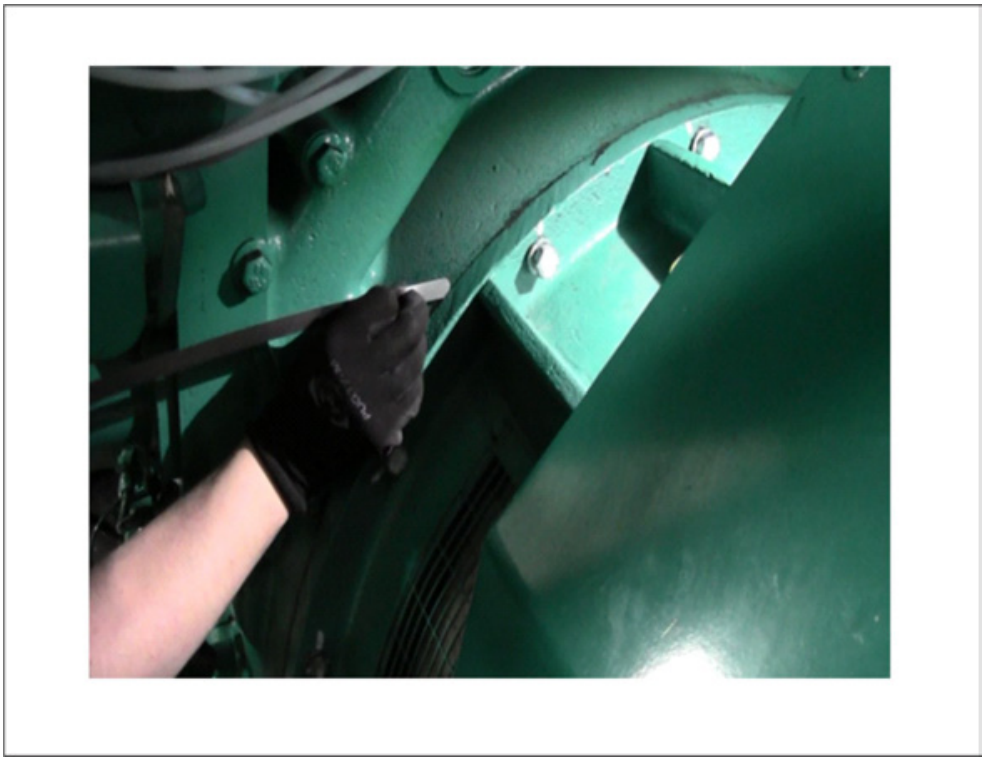


FIGURE 100. GAP MEASUREMENT

15. If the gap is greater than 0.1 mm, adjust the alternator shims with washer facing up to reduce the gap between the flywheel and bell housing to less than 0.1 mm.
16. When the gap is less than 0.1 mm, torque the 16 mounting bolts of the bell housing and flywheel housing to 126 ± 25 Nm (92.9 ± 18.4 ft-lb) in alternating pattern.
17. Install new alternator feet mounting bolts and torque to 1050 ± 50 Nm (774.4 ± 36.9 ft-lb).
18. Remove the winch strap from the pulling bracket eyelid.
19. Remove the pulling bracket from the alternator NDE.
20. Remove the winch strap from the DE pulley and completely remove it from the bottom of the alternator.
21. Disconnect the pulley assembly.
22. Remove the winch support assembly from the skid.

6.3.1.12.3 Recommended Service Schedule

Refer to: Safety Precautions in **Section 1.2.1 on page 2** before starting any service and maintenance activity.

Refer to: Parts Identification in **Section 6.3.1.13 on page 464** for an exploded view of components and fastener information.

The recommended service schedule shows the recommended service activities in table rows, grouped by alternator subsystem. Columns of the table show the types of service activity, whether the alternator must be running, and the service levels. Service frequency is given in running hours or time interval, whichever is sooner. A cross (X) in the cells where a row intersects the columns shows a service activity type and when it is required. An asterisk (*) shows a service activity done only when necessary.

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All service levels in the recommended service schedule can be purchased directly from STAMFORD | AvK™ customer services **www.stamford-avk.com**.

1. Proper service and repair are vital to the reliable operation of your alternator and the safety of anyone coming into contact with the alternator.
2. These service activities are intended to maximize the life of the alternator but shall not vary, extend or change the terms of the manufacturer's standard warranty or your obligations in that warranty.
3. Each service interval is a guide only, and developed on the basis that the alternator was installed and is operated in accordance with the manufacturer's guidelines. If the alternator is located and/or operated in adverse or unusual environmental conditions, the service intervals may need to be more frequent. The alternator should be continually monitored between services to identify any potential failure modes, signs of misuse, or excessive wear and tear.

6.3.1.12.3.1 Alternator Service Schedule

TABLE 101. ALTERNATOR SERVICE SCHEDULE

System	SERVICE ACTIVITY X = required * = if necessary	Alternator running	TYPE				SERVICE LEVEL								
			Inspect	Test	Clean	Refill/Replace	Commission	Post Commission	250 hrs / 0.5 year	Level 1	1000 hrs / 1 year	Level 2	10,000 hrs / 2 years	Level 3	30,000 hrs / 5 years
Alternator	Alternator rating		X				X								
	Bedplate arrangement		X				X								
	Coupling arrangement		X				X					*		X	
	Environmental conditions and cleanliness		X				X	X		X		X		X	
	Ambient temperature (inside & outside)			X			X	X		X		X		X	
	Complete machine - damage, loose parts & earth bonds		X				X	X		X		X		X	
	Guards, screens, warning and safety labels		X				X	X		X		X		X	
	Maintenance access		X				X								
	Electrical nominal operating conditions & excitation	X		X			X	X		X		X		X	
	Vibration	X		X			X	X		X		X		X	

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System	SERVICE ACTIVITY X = required * = if necessary	Alternator running	TYPE				SERVICE LEVEL								
			Inspect	Test	Clean	Refill/Replace	Commission	Post Commission	250 hrs / 0.5 year	Level 1	1000 hrs / 1 year	Level 2	10,000 hrs / 2 years	Level 3	30,000 hrs / 5 years
Windings	Condition of windings		X				X	X		X		X		X	
	Insulation resistance of all windings (PI test for MV/HV)			X			X	*		*		X		X	
	Insulation resistance of rotor, exciter and PMG			X				X		X					
	Temperature sensors	X		X			X	X		X		X		X	
	Customer settings for temperature sensors		X				X								
Bearings	Condition of bearings		X				X							X	
	Grease exhaust & trap				X			every 3000 to 3500 hours / 6 months							
	Re-grease bearing(s) (A to H core length)	X				X		every 3000 to 3500 hours / 6 months							
	Replace re-greasable bearing(s)					X						*		X	
	Temperature sensors	X		X			X	X		X		X		X	
	Customer settings for temperature sensors		X				X								
Terminal Box	All alternator/customer connections and cabling		X				X	X		X		X		X	
Controls & Auxiliaries	Initial AVR & PFC set up	X		X			X								
	AVR & PFC settings	X		X				X		X		X		X	
	Customer connection of auxiliaries			X			X			X		X		X	
	Function of auxiliaries			X			X	X		X		X		X	
	Synchronization settings		X				X								
	Synchronization	X		X			X	X		X		X		X	
	Anti condensation heater					X						*		X	
Rectifier	Diodes and varistors		X				X	X		X		X			
	Diodes and varistors					X								X	

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System	SERVICE ACTIVITY X = required * = if necessary	Alternator running	TYPE				SERVICE LEVEL								
			Inspect	Test	Clean	Refill/Replace	Commission	Post Commission	250 hrs / 0.5 year	Level 1	1000 hrs / 1 year	Level 2	10,000 hrs / 2 years	Level 3	30,000 hrs / 5 years
Cooling	Air inlet temperature	X		X			X	X		X		X		X	
	Air flow (rate & direction)	X	X				X								
	Condition of fan		X				X	X		X		X		X	
	Condition of air filter (where fitted)			X			X	X		X		X		X	
	Air filters (where fitted)				X	X				*		*		*	

6.3.1.12.4 Bearings

6.3.1.12.4.1 Introduction

NOTICE

Do not overfill a bearing with grease, the bearing can be damaged.

Do not mix lubricant types.

Change gloves to handle different lubricant

Assemble bearings in static and dust-free conditions, wearing lint free gloves.

To prevent damage or contamination, store removed parts and tools in static and dust-free conditions.

Do not reuse bearings. Bearings are damaged by the axial force needed to remove it from the rotor shaft.

Do not press fit bearing. Bearings are damaged if the insertion force is applied through the bearing balls.

Do not try to turn the rotor by levering against the cooling fan vanes. The fan will be damaged.

The alternator rotor is supported by a bearing at the non-drive end (NDE) and by either a bearing or a coupling to the prime mover at the drive end (DE).

- Lubricate each re-greasable bearing according to the recommended service schedule with the correct quantity and type of grease, also shown on a label fitted at the grease nipple.

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6.3.1.12.4.2 Safety

⚠ DANGER

Rotating Mechanical Parts

Rotating mechanical parts can cause serious injury or death by crushing, severing or trapping. To prevent injury:

- ***Before operating the alternator: The rotating coupling between the alternator and prime mover must be covered by a guard or cover.***
- ***Before attempting service or maintenance tasks or removing covers from rotating parts: Shut down and isolate the generator set from all energy sources, isolate stored energy and use lock out/tag out safety procedures.***

⚠ WARNING

Hot Surfaces and Fire

Contact with hot surfaces can cause serious injury and death by burns. A risk of fire exists where hot surfaces are contacted by combustible items. To prevent injury, death or risk of fire:

- ***Avoid contact with hot surfaces.***
- ***Always wear the appropriate personal protective equipment, refer to: Safety Precaution Chapter.***
- ***Make sure combustible materials or flammable substances are not stored close to or contact the anti-condensation heater (if fitted).***
- ***Make sure combustible materials or flammable substances are not stored close to the alternator or prime mover, including the ventilation and exhaust system(s) where applicable.***

⚠ WARNING

Exposure to Ejected Debris and Particles

Ejected debris and particles can cause serious injury or death by impact, severing or puncturing. Exposure to mechanically driven release of debris and particles exists in all directions (horizontally and vertically) in the areas surrounding the alternator air outlet(s), air inlets(s) and the open shaft end (also commonly known as the Drive End (DE)). To prevent injury or death:

- ***Keep away from the air inlet(s) and air outlet(s) when the alternator is operating.***
- ***Do not position operator controls near the air inlet(s) or air outlet(s).***
- ***Do not cause overheating by running the alternator outside rating plate parameters.***
- ***Do not overload the alternator.***
- ***Do not operate an alternator displaying excessive vibration.***
- ***Do not synchronize parallel alternators outside the specified parameters.***

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⚠ CAUTION
Hazardous Substances ***Hazardous substances can cause minor or moderate injury. Prolonged or repetitive exposure to hazardous substances can cause serious medical conditions. To prevent injury:*** • ***Always read and obey the instructions provided by the product manufacturer.*** • ***Use, handle and store substances as specified by the product manufacturer.*** • ***Always wear appropriate personal protective equipment, refer to Safety Precautions Chapter.***

6.3.1.12.4.3 Re-Grease Bearings

6.3.1.12.4.3.1 Requirements

TABLE 102. RE-GREASING: EQUIPMENT REQUIREMENTS

Requirement	Description
Personal Protective Equipment (PPE)	• Wear appropriate protective equipment as directed by site rules and risk assessment requirements.
Consumables	• Lint-free cleaning cloths • Thin disposable gloves
Parts	• CGT recommended grease
Tools	• Grease gun (calibrated for volume or mass)

6.3.1.12.4.3.2 Re-grease Method

TABLE 103. REGREASING: GREASE QUANTITY

Bearing Type	Quantity of recommended grease	
	Volume (cm^3)	Mass (g)
Drive End (S9 Core length A, B, C, D)	126	121
Drive End (S9 Core length E, F)	180	173
Drive End (S9 Core length G, H)	94	90
Non-Drive End (S9 A, B, C, D, E, F)	157	151
Non-Drive End (S9 G, H)	182	175

1. For each bearing, identify grease nipple, re-greasing label and bearing type.
2. Make sure the new grease is not contaminated. It must be a uniform whitish-beige colour of stiff consistency throughout.
3. Clean the grease gun nozzle and grease nipple.
4. Clean the grease exhaust.

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5. Where an air filter is fitted, with the alternator stopped, remove the NDE cover and air filter and clean the exhausted grease trap. Afterwards, replace the air filter and reinstall the NDE cover.
6. With the alternator running, fit the grease gun to the grease nipple and add the correct quantity of grease.
7. Run the alternator for at least 60 minutes, off-load.
8. Remove the grease trap, clean the grease exhaust and re-fit.
9. Inspect the colour and consistency of grease expelled from the exhaust and compare with new grease - whitish-beige of stiff consistency.
10. Replace the bearing if the expelled grease is severely discoloured or absent.

NOTICE
If the exhaust grease trap overflows, the stator and rotor windings would be contaminated. Make sure trap is emptied when re-greasing.

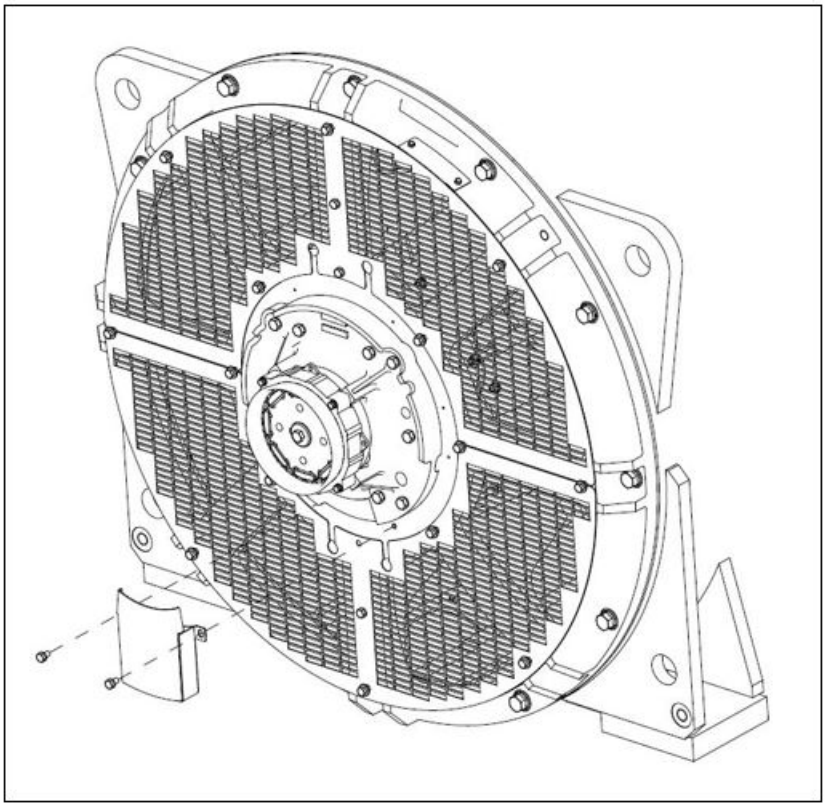


FIGURE 101. GREASE TRAP S9

6.3.1.12.5 Controls

6.3.1.12.5.1 Introduction

An operating alternator is a harsh environment for control components. Heat and vibration can cause electrical connections to loosen and cables to fail. Routine inspection and test can identify an issue before it becomes a failure that incurs unplanned downtime.

6.3.1.12.5.2 Safety

⚠ DANGER

Live Electrical Conductors

Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before working on live conductors:

- ***Shut down and isolate the alternator from all energy sources.***
- ***Remove or isolate stored energy.***
- ***Test isolated parts for electrical isolation using a suitable voltage tester.***
- ***Use lock out/tag out safety procedures.***

⚠ WARNING

Hot Surfaces and Fire

Contact with hot surfaces can cause serious injury and death by burns. A risk of fire exists where hot surfaces are contacted by combustible items. To prevent injury, death or risk of fire:

- ***Avoid contact with hot surfaces.***
- ***Always wear the appropriate personal protective equipment, refer to: Safety Precaution Chapter.***
- ***Make sure combustible materials or flammable substances are not stored close to or contact the anti-condensation heater (if fitted).***
- ***Make sure combustible materials or flammable substances are not stored close to the alternator or prime mover, including the ventilation and exhaust system(s) where applicable.***

⚠ WARNING

Incorrect Electrical Installation and System Protection

Incorrect electrical installation and / or system protection can cause serious injury or death by electric shock and burns. To prevent injury or death and before starting work, personnel:

- ***Have completed related, applicable and approved training.***
- ***Know the equipment, understand the task(s) and procedure(s).***
- ***Know related hazards / risks.***
- ***Know and obey site / location specific emergency procedures and applicable laws and regulations.***

6.3.1.12.5.3 Connection Test Requirements

TABLE 104. CONNECTION TEST REQUIREMENTS

Requirements	Description
Personal Protective Equipment (PPE)	• Wear appropriate protective equipment as directed by site rules and risk assessment requirements.
Consumables	• None

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Requirements	Description
Parts	• None
Tools	• Insulation test meter • Multimeter • Torque wrench

6.3.1.12.5.4 Inspect and Test

1. Remove the terminal box lid
2. Check the tightness of fasteners securing the load cables.
3. Check that cables are firmly clamped at the terminal box gland, and allow ±25 mm movement by an alternator on anti-vibration mounts.
4. Check that all cables are anchored and unstressed within the terminal box.
5. Check all cables for signs of damage caused by vibration, including insulation wear and wire strand breaks.
6. Check that all AVR accessories and current transformers are correctly fitted, and cables pass centrally through current transformers.
7. If an anti-condensation heater is fitted:
   a. Isolate the supply and measure electrical resistance of the heater element(s). Replace heater element if open circuit.
   b. Connect together both ends of the heater leads.
   c. Apply the test voltage between the winding and earth.
   d. Measure the insulation resistance after 1 minute (IR 1min).
   e. Discharge the voltage.
   f. If the measured insulation resistance is less than the minimum acceptable value, replace the heater element(s), refer to: **Table 105 on page 438** for values.
8. Test the supply voltage to the anti-condensation heaters (if fitted). 100 VAC to 277 VAC should be present across each heater element when the alternator is stopped. Refer to the wiring diagram for heater connections.
9. Check that AVR and AVR accessories within the terminal box are clean, securely fitted on anti-vibration mounts, and the cable connectors are firmly attached to the terminals. AVR and AVR accessories do not need further routine servicing.
10. For parallel operation, check that alternator frequency signal cables to the synchronization equipment are securely connected.
11. Refit the terminal box lid.

TABLE 105. TEST VOLTAGE AND MINIMUM ACCEPTABLE INSULATION RESISTANCE FOR NEW AND IN-SERVICE ANTI-CONDENSATION HEATERS

	Test Voltage (V)	Minimum Insulation Resistance at 1 minute (MΩ)	
		New	In-service

Anti-condensation heater	500	10	1

6.3.1.12.6 Cooling System

6.3.1.12.6.1 Introduction

The alternators are designed to meet standards supporting EU Directives and UK Statutory Instruments, and are rated for the effect of operating temperature on winding insulation.

BS EN 60085 (≡ IEC 60085) Electrical insulation – Thermal Evaluation and Designation classifies insulation capability by the maximum operating temperature for a reasonable design and service life. When considering thermal design life, thermal conditioning of insulation system components and their combination are predominantly influenced by the level of thermal stress applied to the system. Additional, single or a combination of factors such as mechanical, electrical and environmental stress, may cause degradation over time, but these are considered secondary when considering thermal degradation of an insulation system.

If the operating environment differs from the values shown on the rating plate, rated output must be reduced by

- 3% for class H utilization for every 5 °C that the temperature of the ambient air entering the cooling fan exceeds 40 °C, up to a maximum of 60 °C
- 3.5% for class F utilization for every 5 °C that the temperature of the ambient air entering the cooling fan exceeds 40 °C, up to a maximum of 60 °C
- 4.5% for class B utilization for every 5 °C that the temperature of the ambient air entering the cooling fan exceeds 40 °C, up to a maximum of 60 °C
- 3% for every 500 m increase in altitude above 1000 m, up to 4000 m*, due to the reduced thermal capacity of lower density air, and
- 5% if air filters are fitted due to restricted air flow.

NOTICE

The values above are cumulative dependent on environmental conditions.

Efficient cooling depends on maintaining the condition of the cooling fan, air filters and gaskets.

* The following changes to the insulation system of medium and high voltage alternators, must be applied to minimize the adverse effects of operating at higher altitudes, to ensure normal operational life expectancy. The changes are calculated according to the specific alternator design and Pashen's Curve.

- Up to 1500 m elevation: No change to insulation system required
- 1500 - 3000 m elevation: Requires a change to the insulation system design to meet altitude operational requirements. Maximum system voltage (Un) designs up to 11 kV. This design upgrade is factory manufactured only.
- 3000 - 4000 m elevation: Requires a change to the insulation system design to meet altitude operational requirements. Maximum system voltage (Un) designs up to 6.6 kV. This design upgrade is factory manufactured only.

NOTICE

For alternators with nominal design voltage above 1.1 kV, thermal derate due to the change in insulation system design to meet higher altitude operational conditions above 1000 MASL cannot be assumed based on standard derate factors. Advice must be obtained from Cummins Generator Technologies, as special considerations are required to allow for increased insulation systems thermal transfer capabilities.

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6.3.1.12.6.2 Safety

⚠ DANGER

Rotating Mechanical Parts

Rotating mechanical parts can cause serious injury or death by crushing, severing or trapping. To prevent injury:

- ***Before operating the alternator: The rotating coupling between the alternator and prime mover must be covered by a guard or cover.***
- ***Before attempting service or maintenance tasks or removing covers from rotating parts: Shut down and isolate the generator set from all energy sources, isolate stored energy and use lock out/tag out safety procedures.***

⚠ WARNING

Hot Surfaces and Fire

Contact with hot surfaces can cause serious injury and death by burns. A risk of fire exists where hot surfaces are contacted by combustible items. To prevent injury, death or risk of fire:

- ***Avoid contact with hot surfaces.***
- ***Always wear the appropriate personal protective equipment, refer to: Safety Precaution Chapter.***
- ***Make sure combustible materials or flammable substances are not stored close to or contact the anti-condensation heater (if fitted).***
- ***Make sure combustible materials or flammable substances are not stored close to the alternator or prime mover, including the ventilation and exhaust system(s) where applicable.***

⚠ CAUTION

Dust & Airborne Particles/Fumes

Dust and other airborne particles and fumes can cause minor or moderate injury by irritating the lungs and eyes. Prolonged or repetitive exposure can cause serious medical conditions. To prevent injury:

- ***Use mechanical vacuum extraction to remove dust and airborne particles or fumes.***
- ***Ventilate the area fully.***
- ***Always wear the appropriate personal protective equipment. Refer to Safety Precautions Chapter.***

NOTICE

Do not attempt to rotate the alternator rotor by levering against the vanes of the cooling fan. The fan is not designed to withstand such forces and could be damaged.

NOTICE

Filters are designed to remove dust, not moisture. Wet filter elements can cause reduced air flow and overheating. Do not allow filter elements to get wet.

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6.3.1.12.6.3 Cooling System Test Requirements

TABLE 106. COOLING SYSTEM TEST REQUIREMENTS

Requirements	Description
Personal Protective Equipment (PPE)	• Wear appropriate protective equipment as directed by site rules and risk assessment requirements.
Consumables	• Lint-free cleaning cloths • Thin disposable gloves
Parts	• Air filters (if fitted) • Air filter sealing gaskets (if fitted)
Tools	• Applicable hand tools

6.3.1.12.6.4 Inspect and Clean

1. Inspect the fan for damaged vanes and cracks.
2. Remove air filters (at the fan and terminal box, if fitted) from their frames.
3. Wash and dry the air filters and gaskets to remove contaminant particles.
4. Inspect the filters and gaskets for damage and replace, as necessary.
5. Install the filters and gaskets.
6. Reinstate the generator set for running.
7. Make sure the air inlets and outlets are not blocked.

6.3.1.12.7 Coupling

6.3.1.12.7.1 Introduction

Efficient operation and long component life rely on minimizing mechanical stresses on the alternator. When coupled in a generator set, misalignment and vibration interactions with the prime mover engine can cause mechanical stress.

The rotational axes of alternator rotor and engine output shaft must be coaxial (radial and angular alignment).

Torsional vibration can cause damage to internal combustion engine shaft-driven systems, if not controlled. The generator set manufacturer is responsible for assessing the effect of torsional vibration on the alternator. Rotor dimensions, inertia, and coupling details are available on request.

6.3.1.12.7.2 Safety

NOTICE
Do not attempt to rotate the alternator rotor by levering against the vanes of the cooling fan. The fan is not designed to withstand such forces and can be damaged.

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⚠ WARNING

Coupling an Alternator

Moving mechanical parts during coupling can cause serious injury by crushing, severing or trapping. When coupling the alternator to a prime-mover or when installing large components, to prevent injury:

- ***Personnel must keep limbs and body parts away from coupling surfaces during coupling and/or installing operations.***

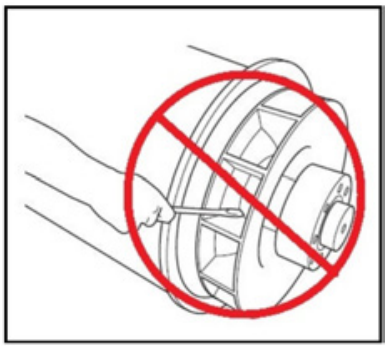


FIGURE 102. DO NOT ROTATE THE ALTERNATOR ROTOR WITH A LEVER

6.3.1.12.7.3 Coupling Test Requirements

TABLE 107. COUPLING TEST REQUIREMENTS

Requirements	Description
Personal Protective Equipment (PPE)	• Wear appropriate protective equipment as directed by site rules and risk assessment requirements.
Consumables	• None
Parts	• None
Tools	• Dial gauge • Torque wrench

6.3.1.12.7.4 Inspect Mounting Points

1. Check the generator set bedplate and mounting pads are in good condition, not cracked.
2. Check that rubber in anti-vibration mounts has not perished.
3. Check vibration monitoring historical records for a trend of increasing vibration.

6.3.1.12.7.4.1 One Bearing Coupling

1. Remove the DE adaptor screen and cover to access the coupling.
2. Check that the coupling discs are not damaged, cracked or distorted, and the coupling disc holes are not elongated. If any are damaged, replace the complete set of discs.
3. Check tightness of bolts fixing the coupling discs to the engine flywheel. Tighten in the sequence shown for alternator coupling in the Installation chapter, to the torque recommended by the engine manufacturer.

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4. Replace the DE adaptor screen and drip proof cover.

6.3.1.12.8 Rectifier System

6.3.1.12.8.1 Introduction

The rectifier converts alternating current (AC) induced in the exciter rotor windings into direct current (DC) to magnetize the main rotor poles. The rectifier comprises two semicircular annular positive and negative plates, each with three diodes. In addition to connecting to the main rotor, the DC output of the rectifier also connects to a matched pair of varistors (one at each end of the plates) and two pairs of resistors, if fitted (mounted into holes in the exciter rotor). These additional components protect the rectifier from voltage spikes and surge voltages that may be present on the rotor under various loading conditions of the alternator.

Diodes provide a low resistance to current in one direction only: Positive current will flow from anode to cathode, or another way of viewing it is that negative current will flow from cathode to anode.

The exciter rotor windings are connected to 3 diode anodes to form the positive plate and to 3 diode cathodes to form the negative plate to give full wave rectification from AC to DC. The rectifier is mounted on, and rotates with, the exciter rotor at the non-drive end (NDE).

6.3.1.12.8.2 Safety

⚠ DANGER

Live Electrical Conductors

Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before working on live conductors:

- ***Shut down and isolate the alternator from all energy sources.***
- ***Remove or isolate stored energy.***
- ***Test isolated parts for electrical isolation using a suitable voltage tester.***
- ***Use lock out/tag out safety procedures.***

⚠ DANGER

Rotating Mechanical Parts

Rotating mechanical parts can cause serious injury or death by crushing, severing or trapping. To prevent injury:

- ***Before operating the alternator: The rotating coupling between the alternator and prime mover must be covered by a guard or cover.***
- ***Before attempting service or maintenance tasks or removing covers from rotating parts: Shut down and isolate the generator set from all energy sources, isolate stored energy and use lock out/tag out safety procedures.***

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⚠ WARNING

Incorrect Electrical Installation and System Protection

Incorrect electrical installation and / or system protection can cause serious injury or death by electric shock and burns. To prevent injury or death and before starting work, personnel:

- ***Have completed related, applicable and approved training.***
- ***Know the equipment, understand the task(s) and procedure(s).***
- ***Know related hazards / risks.***
- ***Know and obey site / location specific emergency procedures and applicable laws and regulations.***

6.3.1.12.8.3 Requirements

TABLE 108. RECTIFIER SYSTEM: TEST AND REPLACE COMPONENT REQUIREMENTS

Personal Protective Equipment (PPE)	• Wear appropriate protective equipment as directed by site rules and risk assessment requirements.
Consumables	• Dow Corning Silicone heat sink compound type 340 or similar. • Duralco 4461N Amber Electrically Resistant Epoxy [Part: 030-02668]. If Resistors are fitted. • Vidaflex 942 Acrylic 3mm sleeving [Part: 030-01548]. If Resistors are fitted. • Vidaflex 942 Acrylic 5mm sleeving [Part: 030-01550]. If Resistors are fitted. • Sumitube B2 Polyolefin heat shrink 9.5mm tubing [Part: 030-04179]. If Resistors are fitted.
Parts	• Kit of three Anode lead Diodes and three Cathode lead Diodes (all from the same manufacturer). • Kit of two metal-oxide Varistors (same type, same manufacturer, same voltage grading: A, B, C, D, E, F). • Kit of four Snubber Resistors (same type, same manufacturer). If fitted.
Tools	• Multimeter. • Insulation tester. • Torque wrench. • Resistor removal tool. If Resistors are fitted. • Hammer. If Resistors are fitted. • Round file. If Resistors are fitted.

6.3.1.12.8.4 Test and Replace Varistors

1. Inspect both varistors.
2. Record varistor as faulty if there are signs of overheating (discoloration, blisters, melting) or disintegration. Check for loose connectors vs. varistor body.

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3. Disconnect the varistor leads.
4. A serviceable varistor will read open circuit in both directions using a multimeter (set in the Ohms (Ω) range). A faulty varistor can read short circuit in both directions and/or it may be physically damaged.
5. If either varistor is faulty, replace both varistors with a matched pair (same type, same manufacturer and same voltage grading: A, B, C, D, E, F) and replace all diodes.
6. Reconnect and check that all leads are secure, washers fitted and fasteners tight.

6.3.1.12.8.5 Test and Replace Diodes

NOTICE
Do not tighten a diode above the stated torque. The diode will be damaged.

1. Disconnect the lead of one diode where it joins the windings at the insulated terminal post. Store fastener and washers.
2. Measure the voltage drop across the diode in the forward direction, using the diode test function of a multimeter.
3. Measure the resistance across the diode in the reverse direction, using the 1000 VDC test voltage of an insulation tester.
4. Diode is faulty if the voltage drop in the forward direction is outside the range 0.3–0.9 VDC, or the resistance is below 20 MΩ in the reverse direction.
5. Repeat the tests for the five remaining diodes.
6. If any diode is faulty, replace the full set of six diodes (same type, same manufacturer):
    a. Remove diode(s).
    b. Apply a small amount of heat sink compound **only** to the base of the replacement diode(s), not the threads.
    c. Check polarity of diode(s).
    d. Screw each replacement diode into a threaded hole in the rectifier plate.
    e. Apply 2.6–3.1 Nm (23–27.4 in-lb) torque to give good mechanical, electrical and thermal contact.
    f. Replace both varistors with a matched pair (same type, same manufacturer and same voltage grading: A, B, C, D, E, F)
7. Reconnect and check that all leads are secure, washers fitted and fasteners tight.

6.3.1.12.8.6 Test and Replace Resistors - If Fitted

1. Inspect the visible ends of all four resistors.
2. Resistor is faulty if there are any signs of discoloration or overheating.
3. Break the electrical circuit by removing fasteners from one resistor of each pair. Store fasteners and washers.
4. Measure the total resistance of both resistor pairs, using the ohms range of a digital multimeter.
5. Resistors are faulty if the total resistance of a resistor pair is outside the range 160 Ω ± 10 %.
6. If resistors are faulty, replace all four resistors:
    a. Remove the fasteners from the existing resistors.
    b. Label and disconnect the six exciter rotor winding leads at the insulated terminal posts.

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c. Label and disconnect the two main rotor winding leads at the terminals on the rectifier plate.

d. Disconnect a lead from both varistors to allow the rectifier plates to be removed separately.

e. Note the rotational position of the rectifier plates. Use a 5 mm Allen key to remove four M6 x 120 fasteners and both plates (complete with diodes) from the exciter rotor.

f. Cut the leads and connecting the bases of both resistor pairs.

g. Remove each resistor:

   i. Resistors may disintegrate during removal. Position covers and vacuum extraction to collect any ceramic fragments.

   ii. At the NDE, align the cylindrical removal tool squarely over the threaded terminal and onto the ceramic body of the resistor.

   iii. Strike the free end of the tool sharply with a hammer to break the glue seal and then drive the resistor out of the hole towards the drive end.

h. Use a round file to remove resin from the rotor core holes. Clean with a lint-free cloth.

i. Loose fit a replacement resistor into each cleaned hole to check that all resin has been removed.

j. Apply 2 gm of epoxy and insert a replacement resistor into a rotor core hole, threaded post towards the rectifier plate position. Rotate the resistor to coat its surface evenly. Position the resistor so its base protrudes 3 mm from the core.

k. Repeat with the remaining three replacement resistors.

l. Leave the epoxy to cure.

m. Fit a nut and a spring and flat washer on the M6 threaded post of each resistor.

n. Refit the complete rectifier assembly onto the exciter rotor.

o. Apply thread lock and fit a flat washer and stover nut on the M6 threaded post of each resistor. Ensure good electrical contact with the rectifier plate.

p. Refer to the images and the steps below to finish and secure the resistor leads.

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TABLE 109. RESISTOR LEAD CONNECTIONS





q. Sleeve each resistor lead with 3 x 130 mm Vidaflex 942.

r. Sleeve two of the resistor leads (which are electrically connected through the rectifier plate) with 5 x 70 mm Vidaflex 942 and 9.5 x 100 mm heat shrink tubing (030-04179).

s. Connect by a crimped ferrule (003-09103) with the remaining resistor leads (electrically connected on the other rectifier plate) as shown.

t. Slide the 5 x 70 mm Vidaflex 942 and 9.5 x 100 mm heat shrink tubing over the ferrule and shrink the tube by heating.

u. Secure both lead assemblies to the inside of the exciter rotor windings with seven heat-stabilized cable ties (052-45017). Position the cable tie heads to the inside.

7. Replace both varistors with a matching pair (same type, same manufacturer and same voltage grading: A, B, C, D, E, F) (see below).
8. Replace all diodes (see below).
9. Reconnect and check that all leads are secure, washers fitted and fasteners tight.

6.3.1.12.9 Permanent Magnet Generator (PMG)

⚠ WARNING

Strong Magnetic Field

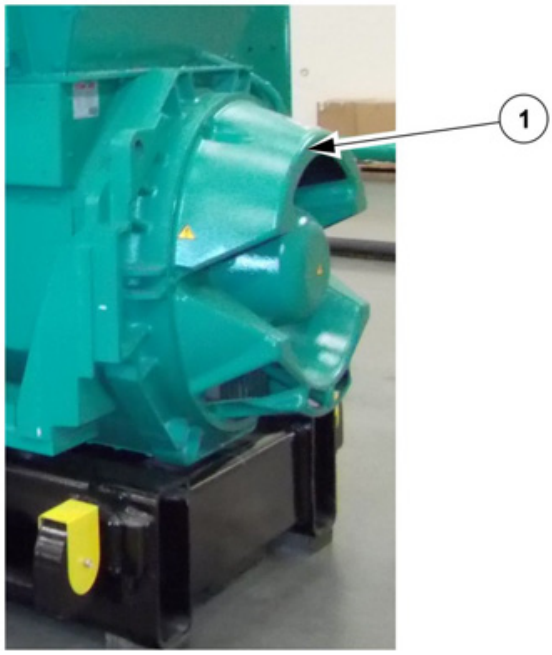
The PMG has a strong magnetic field that could interfere with an implanted medical device, such as an implated heart pace maker.

Do not go near the PMG if you have an implanted medical device.

6.3.1.12.9.1 PMG Removal

1. Make sure all sources of energy are isolated. Lock the generator set out of service. See **Section 6.1.2**.
2. Remove the air inlet cover (1, **Figure 103**) and air filter components (if fitted).

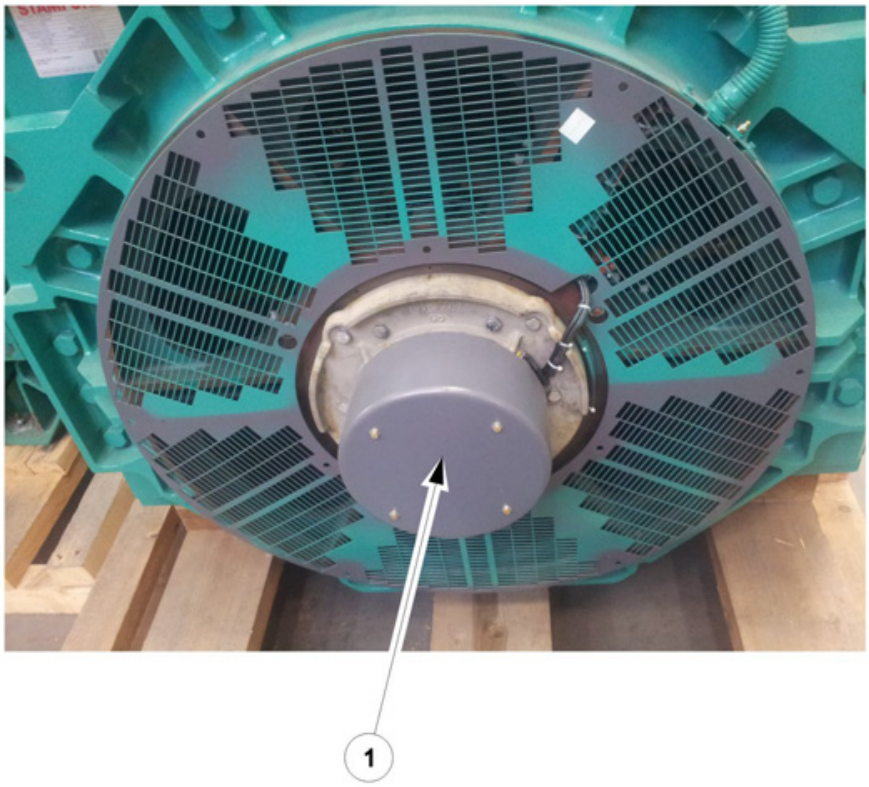
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No.	Description	No.	Description
1	Air inlet cover		

FIGURE 103. AIR INLET COVER

3. Remove the PMG access cover (1, Figure 104).

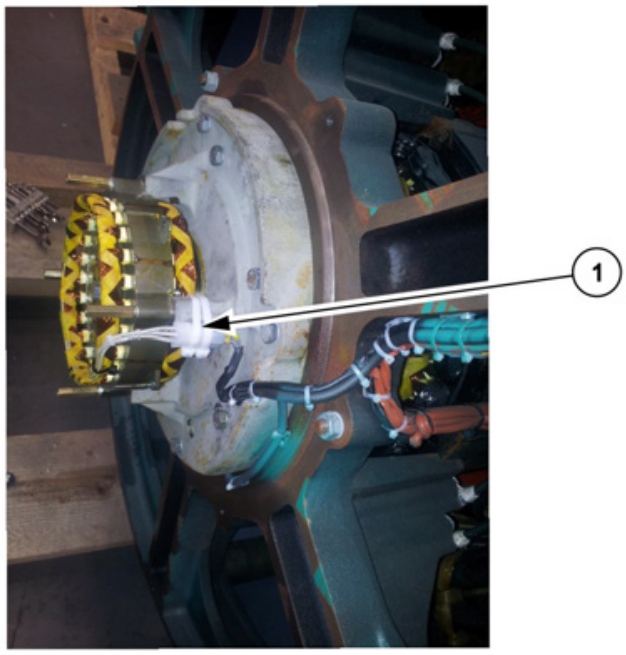


No.	Description	No.	Description
1	PMG access cover		

FIGURE 104. ACCESS COVER AND AIR INLET COVER

4. Disconnect the control cable plug (1, **Figure 105**) from the PMG.

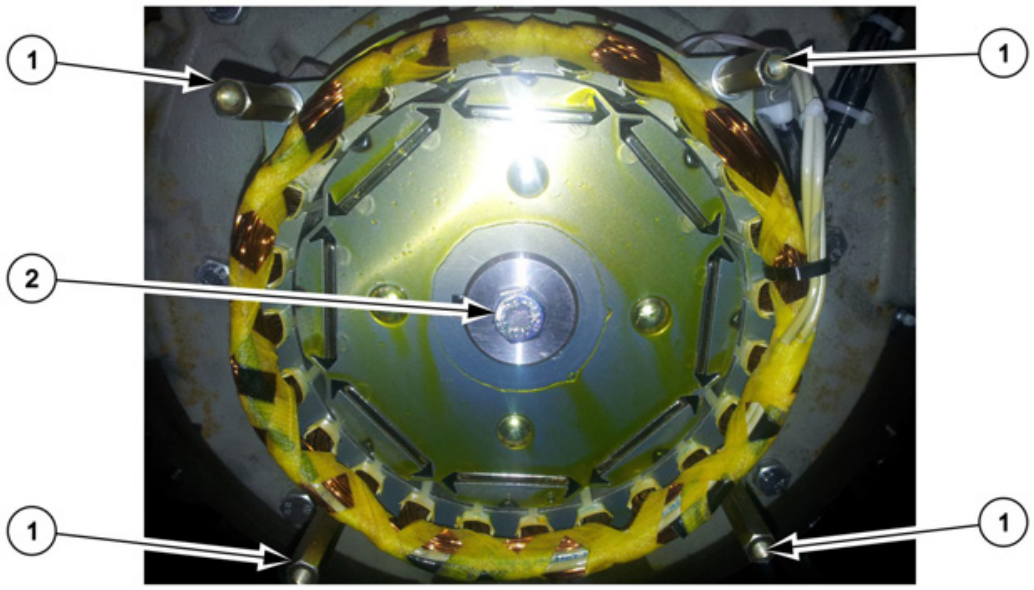
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No.	Description	No.	Description
1	Control cable		

FIGURE 105. PMG CONTROL CABLE

5. Remove four bolts (1, **Figure 106**) from the PMG stator.
6. Remove one bolt (2, **Figure 106**) from the PMG rotor.



No.	Description	No.	Description
1	PMG stator bolt	2	PMG rotor bolt

FIGURE 106. STATOR AND ROTOR BOLTS

7. Pull the PMG rotor and stator assembly from the alternator shaft. A quick, strong pull is required to overcome the magnetic attraction between the PMG and the alternator shaft.

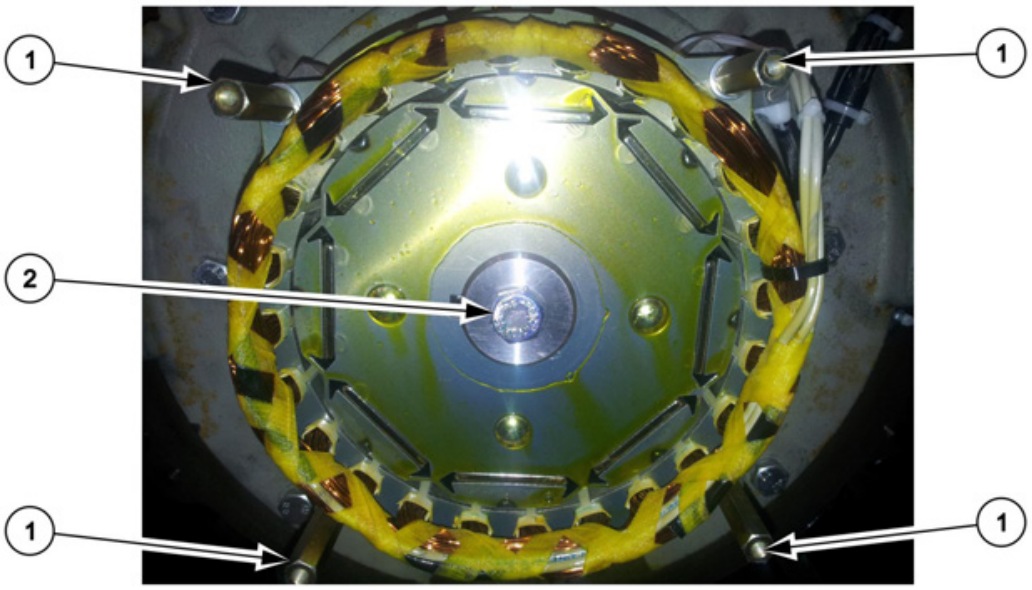
6.3.1.12.9.2 PMG Installation

1. Make sure all sources of energy are isolated. Lock the generator set out of service. See Section 6.1.2.

> **⚠ CAUTION**
>
> ***Strong Magnetic Force***
>
> ***Fingers can be damaged when the magnetic force pulls the PMG onto the alternator shaft. Keep fingers clear of the area between the alternator shaft and the PMG.***

2. Guide the PMG rotor and stator assembly onto the alternator shaft. Keep fingers clear of the area between the alternator shaft and the PMG.
3. Attach one bolt (2, Figure 107) to secure the PMG rotor. Torque the bolt to 45 Nm (33.2 ft-lb).

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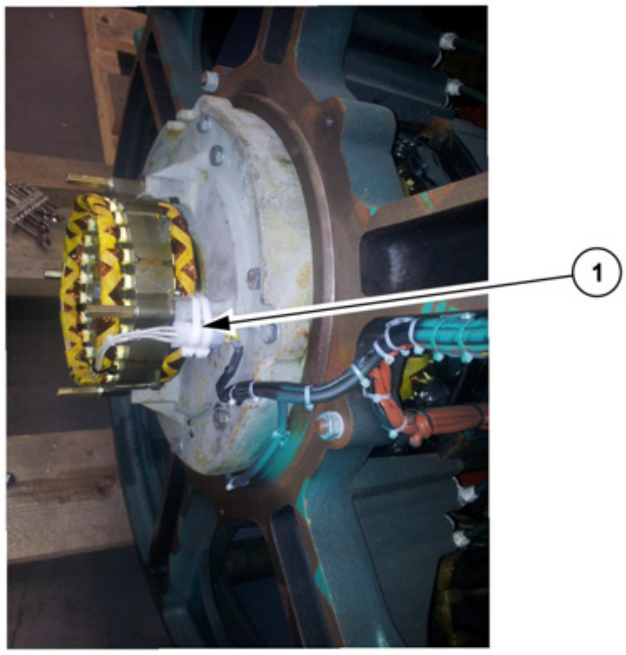


No.	Description	No.	Description
1	PMG stator bolt	2	PMG rotor bolt

FIGURE 107. STATOR AND ROTOR BOLTS

4. Attach four bolts (1, **Figure 107**) to secure the PMG stator. Torque the bolts to 9.4 Nm (6.9 ft-lb).
5. Connect the control cable plug (1, **Figure 108**) to the PMG.

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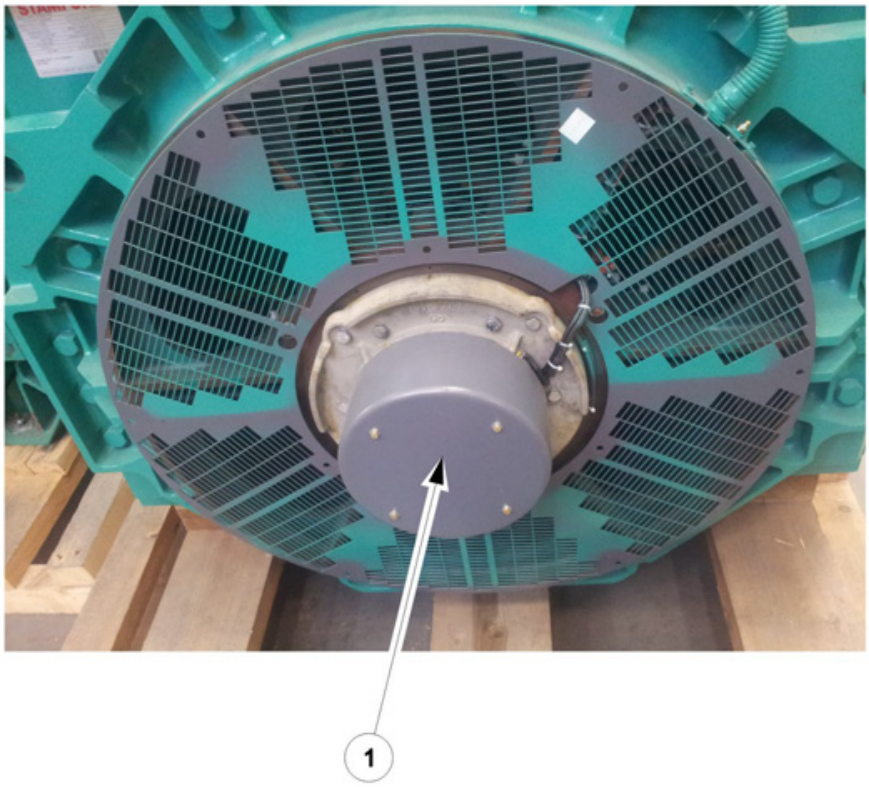


No.	Description	No.	Description
1	Control cable		

FIGURE 108. PMG CONTROL CABLE

6. Attach the PMG access cover (1, Figure 109).

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No.	Description	No.	Description
1	PMG access cover		

FIGURE 109. ACCESS COVER AND AIR INLET COVER

7. Attach the air inlet cover (2, Figure 110) and air filter components (if fitted).



No.	Description	No.	Description
1	Air inlet cover		

FIGURE 110. ACCESS COVER AND AIR INLET COVER

6.3.1.12.10 Temperature Sensors

6.3.1.12.10.1 Introduction

The alternators are designed to meet standards supporting EU Safety Directives, and recommended operating temperatures. Temperature sensors (where fitted) detect abnormal overheating of the main stator windings and bearing(s). Sensors are of Resistance Temperature Detector (RTD) type, with three wires terminated at a terminal block in the auxiliary terminal box. The resistance of Platinum (PT100) RTD sensors increases linearly with temperature.

TABLE 110. RESISTANCE (Ω) OF PT100 SENSOR BETWEEN 40 TO 180 °C

Temperature (°C)		+1 °C	+ 2 °C	+3 °C	+ 4 °C	+ 5 °C	+ 6 °C	+ 7 °C	+ 8 °C	+ 9 °C
40.00	115.54	115.93	116.31	116.70	117.08	117.47	117.86	118.24	118.63	119.01
50.00	119.40	119.78	120.17	120.55	120.94	121.32	121.71	122.09	122.47	122.86
60.00	123.24	123.63	124.01	124.39	124.78	125.16	125.54	125.93	126.31	126.69
70.00	127.08	127.46	127.84	128.22	128.61	128.99	129.37	129.75	130.13	130.52
80.00	130.90	131.28	131.66	132.04	132.42	132.80	133.18	133.57	133.95	134.33
90.00	134.71	135.09	135.47	135.85	136.23	136.61	136.99	137.37	137.75	138.13

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Temperature (°C)		+1 °C	+ 2 °C	+3 °C	+ 4 °C	+ 5 °C	+ 6 °C	+ 7 °C	+ 8 °C	+ 9 °C
100.00	138.51	138.88	139.26	139.64	140.02	140.40	140.78	141.16	141.54	141.91
110.00	142.29	142.67	143.05	143.43	143.80	144.18	144.56	144.94	145.31	145.69
120.00	146.07	146.44	146.82	147.20	147.57	147.95	148.33	148.70	149.08	149.46
130.00	149.83	150.21	150.58	150.96	151.33	151.71	152.08	152.46	152.83	153.21
140.00	153.58	153.96	154.33	154.71	155.08	155.46	155.83	156.20	156.58	156.95
150.00	157.33	157.70	158.07	158.45	158.82	159.19	159.56	159.94	160.31	160.68
160.00	161.05	161.43	161.80	162.17	162.54	162.91	163.29	163.66	164.03	164.40
170.00	164.77	165.14	165.51	165.89	166.26	166.63	167.00	167.37	167.74	168.11
180.00	168.48	-	-	-	-	-	-	-	-	-

Customer-supplied external equipment may be connected to monitor the sensors and generate signals to raise an alarm and to shut down the generator set.

BS EN 60085 (≡ IEC 60085) Electrical insulation – Thermal Evaluation and Designation classifies insulation of windings by the maximum operating temperature for a reasonable service life. To avoid damage to windings, signals should be set, appropriate to the insulation class shown on the alternator rating plate.

TABLE 111. ALARM AND SHUTDOWN TEMPERATURE SETTINGS FOR WINDINGS

Windings insulation	Max. Continuous temperature (°C)	Alarm temperature (°C)	Shutdown temperature (°C)
Class B	130	120	140
Class F	155	145	165
Class H	180	170	190

To detect overheating of bearings, control signals should be set according to the following table.

TABLE 112. ALARM AND SHUTDOWN TEMPERATURE SETTINGS FOR BEARINGS

Bearings	Alarm temperature (°C)	Shutdown temperature (°C)
Drive end bearing	45 + maximum ambient	50 + maximum ambient
Non-drive end bearing	40 + maximum ambient	45 + maximum ambient

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6.3.1.12.10.2 Safety

⚠ DANGER

Live Electrical Conductors

Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before working on live conductors:

- ***Shut down and isolate the alternator from all energy sources.***
- ***Remove or isolate stored energy.***
- ***Test isolated parts for electrical isolation using a suitable voltage tester.***
- ***Use lock out/tag out safety procedures.***

⚠ WARNING

Hot Surfaces and Fire

Contact with hot surfaces can cause serious injury and death by burns. A risk of fire exists where hot surfaces are contacted by combustible items. To prevent injury, death or risk of fire:

- ***Avoid contact with hot surfaces.***
- ***Always wear the appropriate personal protective equipment, refer to: Safety Precaution Chapter.***
- ***Make sure combustible materials or flammable substances are not stored close to or contact the anti-condensation heater (if fitted).***
- ***Make sure combustible materials or flammable substances are not stored close to the alternator or prime mover, including the ventilation and exhaust system(s) where applicable.***

6.3.1.12.10.3 Test RTD Temperature Sensors

1. Remove the auxiliary terminal box lid.
2. Identify the sensor leads at the terminal block and where each sensor is fitted.
3. Measure the resistance between the white and each red wire of one sensor.
4. Calculate the sensor temperature from the measured resistance.
5. Compare calculated temperature with temperature indicated by external monitoring equipment (if available).
6. Compare alarm and shutdown signal settings (if available) with recommended settings.
7. Repeat steps 3 to 7 for each sensor.
8. Refit the auxiliary terminal box lid.
9. Replace any faulty sensors.
10. Note: Main stator RTDs are not replaceable. Bearing RTDs are replaceable.

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6.3.1.12.11 Windings

6.3.1.12.11.1 High Voltage Test

NOTICE

Windings have been tested at high voltage during manufacture. Repeated high voltage tests may degrade the insulation and reduce operating life. If a further test is required at installation for customer acceptance, it must be done at a reduced voltage, V = 0.8 x (2 x Rated Voltage + 1000). Once in service, any further tests for maintenance purposes must be done after passing visual checks and insulation resistance tests, and at a reduced voltage, V = (1.5 x Rated Voltage).

Repeated high-voltage resistance tests can damage the alternator insulation. Before carrying out high-voltage tests, contact STAMFORD | AvK™ customer services at **www.stamford-avk.com**.

6.3.1.12.11.2 Introduction

NOTICE

Disconnect all control wiring and customer load leads from alternator winding connections before conducting these tests.

NOTICE

The Automatic Voltage Regulator (AVR) contains electronic components which would be damaged by high voltage applied during insulation resistance tests. The AVR must be disconnected before doing any insulation resistance test. Temperature sensors must be grounded to earth before doing any insulation resistance test.

Damp or dirty windings have a lower electrical resistance and could be damaged by insulation resistance tests at high voltage. If in doubt, test the resistance at low voltage (500 V) first.

Alternator performance depends on good electrical insulation of the windings. Electrical, mechanical and thermal stresses, and chemical and environmental contamination, cause the insulation to degrade. Various diagnostic tests indicate the condition of insulation by charging or discharging a test voltage on isolated windings, measuring current flow, and calculating the electrical resistance by Ohm's law.

When a DC test voltage is first applied, three currents can flow:

- **Capacitive Current:** To charge the winding to the test voltage (decays to zero in seconds),
- **Polarizing Current:** To align the insulation molecules to the applied electric field (decays to near-zero in ten minutes), and
- **Leakage Current:** Discharge to earth where the insulation resistance is lowered by moisture and contamination (increases to a constant in seconds).

For an insulation resistance test, a single measurement is made one minute after a DC test voltage is applied, when capacitive current has ended. For the polarization index test, a second measurement is made after ten minutes. An acceptable result is where the second insulation resistance measurement is at least double the first, because the polarization current has decayed. In poor insulation, where leakage current dominates, the two values are similar. A dedicated Insulation Tester takes accurate, reliable measurements and may automate some tests.

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6.3.1.12.11.3 Safety

⚠ DANGER

Live Electrical Conductors

Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before working on live conductors:

- ***Shut down and isolate the alternator from all energy sources.***
- ***Remove or isolate stored energy.***
- ***Test isolated parts for electrical isolation using a suitable voltage tester.***
- ***Use lock out/tag out safety procedures.***

⚠ DANGER

Testing Live Electrical Conductors

Live electrical conductors can cause serious injury or death by electric shock and burns. To prevent injury and before testing on or near live electrical conductors:

- ***Take applicable precautions to prevent contact with live conductors, refer to: Safety Precautions Chapter.***
- ***Test on or near live conductors, only if absolutely necessary.***
- ***Only trained personnel may test on or near live electrical conductors.***
- ***Do not test on or near live electrical conductors alone: Another competent person must be present, trained to isolate energy sources and take action in an emergency.***

⚠ WARNING

Condensed Water

Operating an alternator with condensed water in the windings can cause serious injury by electric shock, burns or exposure to flying debris and particles. To prevent injury and before operating the alternator:

- ***Use anti-condensation heaters (if fitted) to prevent condensation accumulating.***
- ***Check for condensed water.***
- ***If condensed water is present, drain/remove the water, dry and inspect the alternator. Refer to the Maintenance and Servicing Chapter.***

⚠ WARNING

Exposure to Particles and Fumes from an Alternator.

Particles and fumes can be released in all directions (horizontally and vertically) from where alternator ventilation is installed. To avoid injury:

- ***Avoid the areas around ventilation openings, air intake(s) and air outlet(s) when the alternator is operating.***
- ***Use the correct personal protective equipment when working around an alternator.***

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⚠ WARNING

Live Electrical Conductors

Live electrical conductors at the winding terminals can cause serious injury or death by electric shock or burns. After an insulation resistance test, to prevent injury or death:

- ***Discharge the windings immediately after the test has concluded by shorting to a suitable earth. The windings must discharge for the greater of:***
  1. ***A length of time equal to the duration of the test.***
     or
  2. ***5 minutes.***

⚠ WARNING

Incorrect Electrical Installation and System Protection

Incorrect electrical installation and / or system protection can cause serious injury or death by electric shock and burns. To prevent injury or death and before starting work, personnel:

- ***Have completed related, applicable and approved training.***
- ***Know the equipment, understand the task(s) and procedure(s).***
- ***Know related hazards / risks.***
- ***Know and obey site / location specific emergency procedures and applicable laws and regulations.***

6.3.1.12.11.4 Requirements

TABLE 113. WINDING TEST REQUIREMENTS

Requirement	Description
Personal Protective Equipment (PPE)	• Wear appropriate protective equipment as directed by site rules and risk assessment requirements.
Consumables	• None
Parts	• None
Tools	• Insulation test meter • Multimeter • Milliohm meter or micro ohmmeter • Clamp ammeter • Infrared thermometer • Earth rod

6.3.1.12.11.5 Test the Electrical Resistance of Windings

1. Stop the alternator.
2. Verify the electrical resistance of the exciter field (stator) winding:
   a. Disconnect the exciter field leads F1 and F2 from the AVR.

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b. Measure and record the electrical resistance between F1 and F2 leads with a multimeter.

c. Reconnect the exciter field leads F1 and F2.

d. Make sure the fasteners are secure.

3. Verify the electrical resistance of the exciter armature (rotor) winding:

a. Mark the leads attached to diodes on one of the two rectifier plates.

b. Disconnect all exciter rotor leads from all diodes at the rectifier.

c. Measure and record the electrical resistance between pairs of marked leads (between phase windings). A specialist micro ohmmeter must be used.

d. Reconnect all exciter rotor leads to the diodes.

e. Make sure the fasteners are secure.

4. Verify the electrical resistance of the main field (rotor) winding:

a. Disconnect the two main rotor DC leads from the rectifier plates.

b. Measure and record the electrical resistance between the main rotor leads. A specialist micro ohmmeter must be used.

c. Reconnect the two main rotor DC leads to the rectifier plates.

d. Make sure the fasteners are secure.

5. Verify the electrical resistance of the main armature (stator) winding:

a. Disconnect the leads of the main stator from the output terminals.

b. Measure and record the electrical resistance between U1 and U2 leads and between U5 and U6 (if present). A specialist micro ohmmeter must be used.

c. Measure and record the electrical resistance between V1 and V2 leads and between V5 and V6 (if present). A specialist micro ohmmeter must be used.

d. Measure and record the electrical resistance between W1 and W2 leads and between W5 and W6 (if present). A specialist micro ohmmeter must be used.

e. Reconnect the leads to the output terminals, as before.

f. Make sure the fasteners are secure.

6. Verify the electrical resistance of the PMG armature (stator) winding:

a. Disconnect the three PMG output leads P2, P3 and P4 from the AVR.

b. Measure and record the electrical resistance between pairs of the PMG output leads, with a multimeter.

c. Reconnect the three PMG output leads P2, P3 and P4 to the AVR.

d. Make sure the fasteners are secure.

7. Refer to the winding resistance table in: **Section 6.3.1.14 on page 467** to verify the measured resistances of all windings agree with the reference values.

6.3.1.12.11.6 Test the Insulation Resistance of Windings

NOTICE
The alternator must not be put into service until the minimum insulation resistance is achieved.

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TABLE 114. TEST VOLTAGE AND MINIMUM ACCEPTABLE INSULATION RESISTANCE FOR NEW AND IN-SERVICE ALTERNATORS

	Test Voltage (V)	Minimum Insulation Resistance at 1 minute (IR_{1min}) (MΩ)		Minimum Polarisation Index (PI = (IR_{10min}) / (IR_{1min}))
		New	In-service	
Medium voltage (MV) stator, 1 to 4.16 kV (each phase)	2500	100	50	2
High Voltage (HV) stator, 4.16 to 13.8 kV (each phase)	5000	300	150	2
PMG stator	500	5	3	N/A
Exciter stator	500	10	5	N/A
Exciter rotor, rectifier & main rotor combined	1000	200	100	N/A

1. Inspect the windings for mechanical damage or discoloration from overheating. Clean the insulation if there is hygroscopic dust and dirt contamination.
2. For Medium Voltage (MV) and High Voltage (HV) main stators:
   a. Separate the three neutral leads.
   b. Connect together both ends of each phase winding (if possible).
   c. Ground two phases to earth.
   d. Apply the test voltage from the table between the non-grounded phase and earth.
   e. Measure the insulation resistance after 1 minute (IR_{1min}).
   f. Measure the insulation resistance after 10 minutes (IR_{10min}).
   g. Discharge the test voltage with an earth rod for five minutes.
   h. Calculate the polarization index (PI = (IR_{10min}) / (IR_{1min}))
   i. Test the other two phases in turn.
   j. If the equivalent insulation resistance or polarization index is less than the minimum acceptable values, dry the insulation, then repeat the method.
   k. Remove the connections made for testing and reconnect the neutral leads. Refer to the Electrical Connections chapter for the correct torque settings.
3. For PMG and exciter stators, and combined exciter and main rotors:
   a. Connect together both ends of the winding (if possible).
   b. Apply the test voltage from the table between the winding and earth.
   c. Measure the insulation resistance after 1 minute (IR_{1min}).
   d. Discharge the test voltage with an earth rod for five minutes.
   e. If the measured insulation resistance is less than the minimum acceptable value, dry the insulation, then repeat the method.
   f. Repeat the method for each winding.
   g. Remove the connections made for testing.

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6.3.1.12.11.7 Dry the Insulation

Use the methods below to dry the insulation of the main stator windings. To prevent damage as water vapor is expelled from the insulation, make sure the winding temperature does not increase faster than 5 ºC per hour or exceed 90 ºC.

Plot the insulation resistance graph to show when drying is complete.

6.3.1.12.11.7.1 Dry with Ambient Air

In many cases, the alternator can be dried sufficiently using its own cooling system. Disconnect the cables from the X+ (F1) and XX- (F2) terminals of the AVR so there is no excitation voltage supply to the exciter stator. Run the generator set in this de-excited state. Air must flow freely through the alternator to remove the moisture. Operate the anti-condensation heater (if fitted) to assist the drying effect of the air flow.

After drying is complete, re-connect the cables between the exciter stator and AVR. If the generator set is not put into service immediately, turn on the anti-condensation heater (if fitted) and retest the insulation resistance before use.

6.3.1.12.11.7.2 Dry with Hot Air

Direct the hot air from one or two 1 to 3 kW electrical fan heaters into the alternator air inlet. Make sure each heat source at least 300 mm away from the windings to avoid scorching or over-heating damage to the insulation. Air must flow freely through the alternator to remove the moisture.

After drying, remove the fan heaters and re-commission as appropriate.

If the generator set is not put into service immediately, turn on the anti-condensation heaters (where fitted) and retest the insulation resistance before use.

6.3.1.12.11.7.3 Plot Insulation Resistance (IR) Graph

Whichever method is used to dry out the alternator, measure the insulation resistance and temperature (if sensors fitted) of the main stator windings every 15 to 30 minutes. Plot a graph of insulation resistance, IR (y axis) against time, t (x axis).

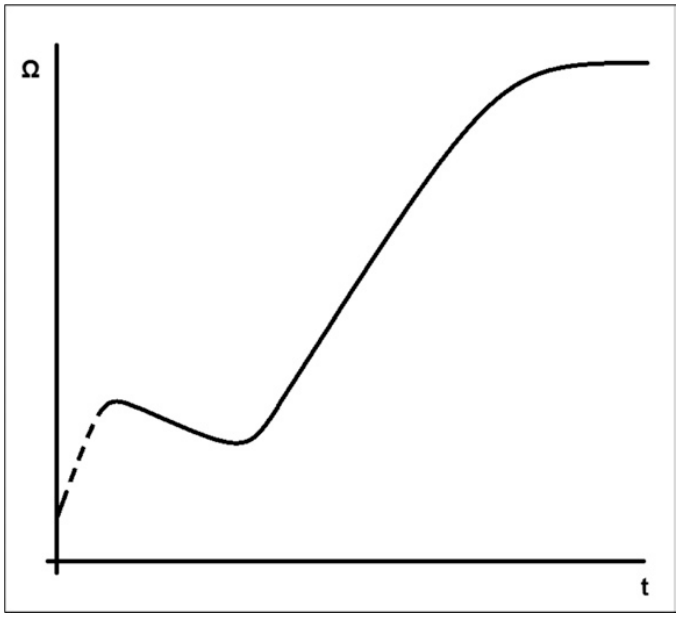


FIGURE 111. INSULATION RESISTANCE GRAPH

A typical curve shows an initial increase in resistance, a fall and then a gradual rise to a steady state. If the windings are only slightly damp the dotted portion of the curve may not appear. Continue drying for another hour after steady state is reached.

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NOTICE

The alternator must not be put into service until the minimum insulation resistance is achieved.

6.3.1.13 Parts Identification

6.3.1.13.1 S9 Two Bearing Alternator

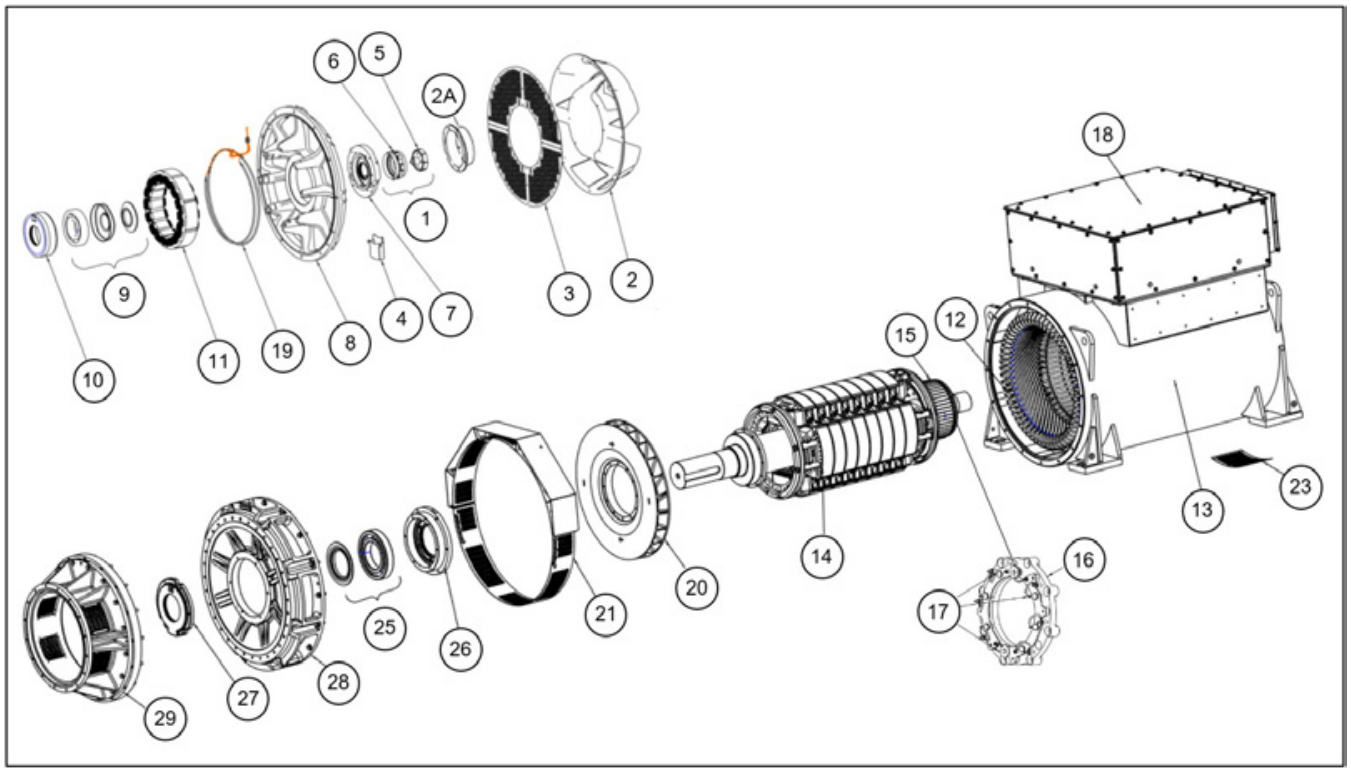


FIGURE 112. S9 TWO BEARING ALTERNATOR

6.3.1.13.2 S9 Medium and High Voltage Parts and Fasteners

TABLE 115. S9 PARTS AND FASTENERS

Reference	Component	Fastener	Quantity	Torque (Nm)
1	Complete PMG parts	-	-	-
2	Air Inlet Cover	M8 x 20	14	10
2A	PMG Cover	M5 x 12	4	5
3	Air Inlet Screen (axial)	M8 x 14	3	25
4	Grease Trap	M8 x 14	2	25
5	PMG Rotor	M10 x 100	1	48
6	PMG Stator	M6 Threaded Pillars	4	10
7	NDE Bearing Cap (A-F cores) NDE Bearing Cap (G-H cores)	M10 x 55 M12 x 55	4 7	48 84

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Reference	Component	Fastener	Quantity	Torque (Nm)
8	NDE Bracket (mass 177 kg)	M16 x 60	12	206
9	NDE Bearing	-	-	-
10	NDE Bearing Cartridge (A-F cores) NDE Bearing Cartridge (G-H cores)	M10 x 55 M10 x 50	4 6	48 48
11	Exciter Stator (A-F cores) Exciter Stator (G-H cores)	M8 x 120 M8 x 150	8 8	25 25
12	Main Stator	-	-	-
13	Main Frame	-	-	-
14	Main Rotor	-	-	-
15	Exciter Rotor	-	-	-
16	Rectifier Assembly	M8 Stover Nut	8	20
17	Diode/Varistor	-	-	2.6 - 3.1
18	Terminal Box	-	-	-
19	Anti-condensation Heaters	M6 x 20	8	10
20	Fan	M10 x 110	12	45
21/21a	DE Air Outlet Screen	M8 x 25	4	25
22	DE Adapter (One Bearing)	M16x 55	16	206
23	NDE Air Inlet Screen (Radial)	M8 x 14	6	25
24	DE Coupling Discs (One Bearing) SAE18 DE Coupling Discs (One Bearing) SAE21	M30 x 90 M30 x 70	12 12	1350 1350
25	DE Bearing (Two Bearing)	-	-	-
26	DE Bearing Cartridge (Two Bearing A-D cores) DE Bearing Cartridge (Two Bearing E-F cores) DE Bearing Cartridge (Two Bearing G-H cores)	M10 x 75 M12 x 90 M12 x 75	6 6 6	48 84 84
27	DE Bearing Cap (Two Bearing A-D cores) DE Bearing Cap (Two Bearing E-F cores) DE Bearing Cap (Two Bearing G-H cores)	M10 x 45 M10 x 45 M12 x 120	6 6 4	48 48 48
28	DE Bracket (Two Bearing)	M16 x 55	16	206
29	DE Adapter (Two Bearing)	M16 x 60	16	206

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6.3.1.13.3 S9 Medium and High Voltage Terminal Box Parts and Fasteners

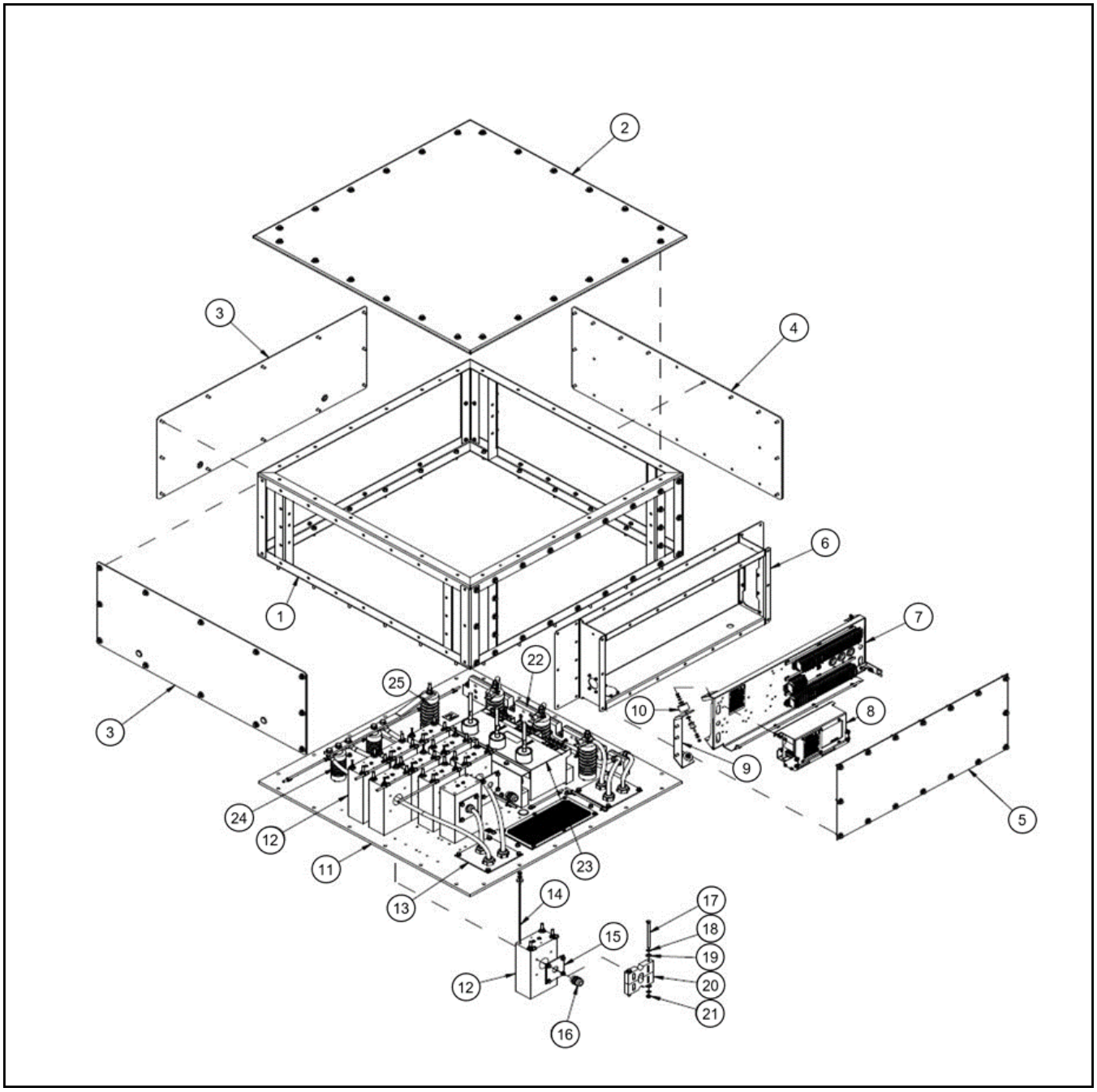


FIGURE 113. MEDIUM AND HIGH VOLTAGE TERMINAL BOX PARTS AND FASTENERS

TABLE 116. PARTS AND FASTENERS: S9 MV/HV TERMINAL BOX

Reference	Component	Fastener	Torque (Nm)
1	Terminal Box Frame	M8 x 35	25
2	Terminal Box Lid	M8 x 25	25
3	Terminal Box Panel	M8 x 25	25

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Reference	Component	Fastener	Torque (Nm)
4	Gland Plate	M8 x 25	25
5	Auxiliary Terminal Box Cover	M8 x 25	25
6	Auxiliary Terminal Box	M8 x 25	25
7	Auxiliary Terminal Box Panel	M6	10
8	Automatic Voltage Regulator (AVR)	M6 x 16	10
9	Anti-Vibration Mount (AVM) Fixing Bracket	M8 x 25	25
10	AVM	M6	10
11	Terminal Box Base Plate	M8 x 35	25
12	Current Transformer (CT)	-	-
13	Gland Plate	M6 x 16	10
14	CT Stud	-	-
15	Gland Plate	M8 x 16	15
16	Cable Gland	-	-
17	Cable Clamp Bolt	M8 x 030	15
18	Washer, Belleville		-
19	Washer, Flat		-
20	Cable Clamp	-	-
21	Nut	M8	15
22	Cable Support	M8 x 70	15
23	Voltage Transformer (VT)	M8	15
24	Post Insulator to Base Plate	M12	90
25	Post Insulator to Base Plate	M12	90

6.3.1.14 Technical Data

NOTICE
Compare measurements with the technical data sheet and the test certificate supplied with the alternator.

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6.3.1.14.1 S9 Medium and High Voltage Winding Resistances

TABLE 117. S9 WINDING RESISTANCES (5/6 PITCH)

Alternator	Resistance of windings at 22 °C (measured values should be within 10%)								
	Main Stator (lead-lead) (Ohms)					Exciter Stator (Ohms)	Exciter Rotor, L-L (Ohms)	Main Rotor (Ohms)	PMG Stator, L-L (Ohms)
	51 (U1-U2) (V1-V2) (W1-W2)	61 (U1-U2) (V1-V2) (W1-W2)	63 (U1-U2) (V1-V2) (W1-W2)	83 (U1-U2) (V1-V2) (W1-W2)	91 (U1-U2) (V1-V2) (W1-W2)				
S9-A4	0.052	0.272	0.168	0.828	0.8940	9.8	0.028	0.48	3.8
S9-B4	0.0378	0.191	0.14	0.618	0.711	9.8	0.028	0.5	3.8
S9-C4	0.038	0.144	0.108	0.504	0.596	9.8	0.028	0.53	3.8
S9-D4	0.03	0.129	0.0905	0.409	0.497	9.8	0.028	0.57	3.8
S9-E4	0.0247	0.1005	0.078	0.342	0.408	11.2	0.032	0.63	3.8
S9-F4	0.02	0.082	0.061	0.284	0.336	11.2	0.032	0.69	3.8
S9-G4	0.0172	0.0624	0.048	0.206	0.253	11.2	0.032	0.76	3.8
S9-H4	0.0132	0.058	0.042	0.188	0.218	11.2	0.032	0.81	3.8

TABLE 118. S9 WINDING RESISTANCES (2/3 PITCH)

Alternator	Resistance of windings at 22 °C (measured values should be within 10%)								
	Main Stator (lead-lead) (Ohms)					Exciter Stator (Ohms)	Exciter Rotor, L-L (Ohms)	Main Rotor (Ohms)	PMG Stator, L-L (Ohms)
	851 (U1-U2) (V1-V2) (W1-W2)	961 (U1-U2) (V1-V2) (W1-W2)	963 (U1-U2) (V1-V2) (W1-W2)	983 (U1-U2) (V1-V2) (W1-W2)	991 (U1-U2) (V1-V2) (W1-W2)				
S9-A4	0.0618	0.329	0.191	1.139	1.318	9.8	0.028	0.48	3.8
S9-B4	0.048	0.251	0.154	0.761	0.822	9.8	0.028	0.5	3.8
S9-C4	0.0366	0.196	0.132	0.598	0.687	9.8	0.028	0.53	3.8
S9-D4	0.037	0.143	0.111	0.505	0.577	9.8	0.028	0.57	3.8
S9-E4	0.0304	0.147	0.094	0.418	0.498	11.2	0.032	0.63	3.8
S9-F4	0.024	0.1	0.078	0.348	0.408	11.2	0.032	0.69	3.8
S9-G4	0.0205	0.0827	0.062	0.289	0.336	11.2	0.032	0.76	3.8

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Alternator	Resistance of windings at 22 °C (measured values should be within 10%)								
	Main Stator (lead-lead) (Ohms)					Exciter Stator (Ohms)	Exciter Rotor, L-L (Ohms)	Main Rotor (Ohms)	PMG Stator, L-L (Ohms)
	851 (U1-U2) (V1-V2) (W1-W2)	961 (U1-U2) (V1-V2) (W1-W2)	963 (U1-U2) (V1-V2) (W1-W2)	983 (U1-U2) (V1-V2) (W1-W2)	991 (U1-U2) (V1-V2) (W1-W2)				
S9-H4	0.0172	0.066	0.047	0.208	0.252	11.2	0.032	0.81	3.8

6.4 Chassis

6.4.1 Skid Mounted Fuse and Relay Box

⚠ WARNING

Automated Machinery

Accidental or remote starting of the generator set can cause severe personal injury or death.

Isolate all auxiliary supplies and use an insulated wrench to disconnect the starting battery cables (negative [–] first).

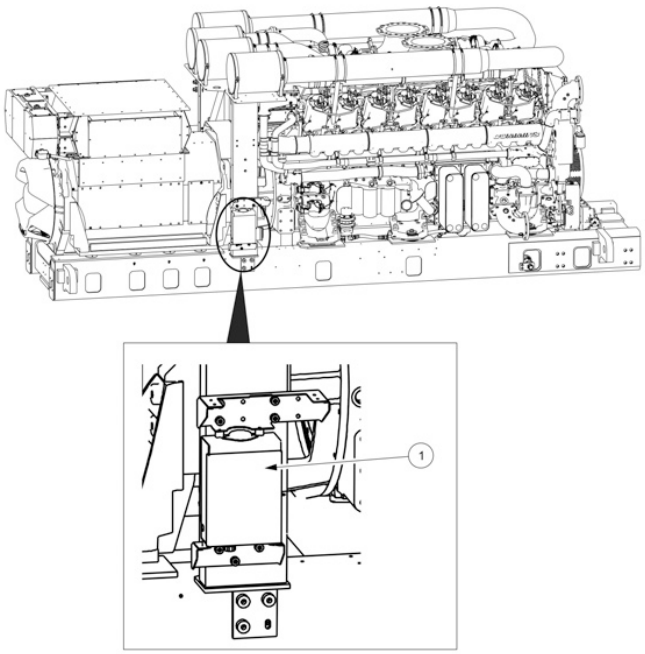
NOTICE

Use of an incorrect fuse or relay can damage the generator set. Use replacement fuses and relays of the correct amperage.

6.4.1.1 AC Distribution Panel

The following distribution panel is a generator set factory option.

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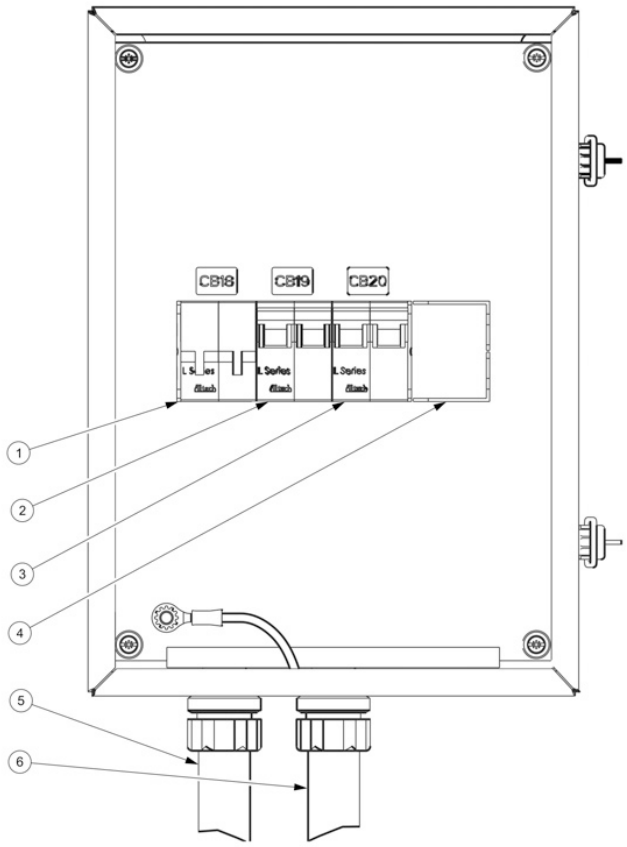
No.	Description
1	Single Phase (120/240 VAC) AC Distribution Panel

FIGURE 114. AC DISTRIBUTION PANEL LOCATION

The AC distribution panels provide a centralized power source for generator set single phase (120/240 VAC) accessories. The configuration of this panel depends on the factory supplied options shipped with the generator set.

Previously, different breaker ratings were used for items #1-3 in Figure 93. (40A, 20A, and 5A)

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Note: Panel door removed for clarity

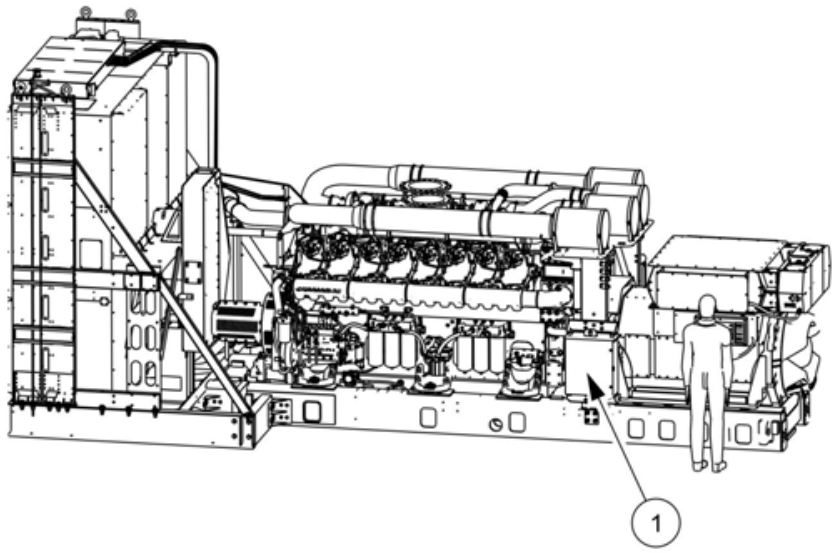
No.	Description	No.	Description
1	20 A Main Circuit Breaker (CB18)	4	Knockout for 15 A Customer Supplied Circuit Breaker (if equipped)
2	15 A Alternator Heater Circuit Breaker (CB19)	5	Control Box Heater AC Supply (if equipped)
3	1 A Control Box Heater Circuit Breaker (CB20)	6	Alternator Heater AC Supply (if equipped)

FIGURE 115. AC DISTRIBUTION PANEL FEATURES

6.4.1.2 DC Distribution Panels

The DC electrical distribution panel provides a single point of contact for all DC powered generator set mounted components.

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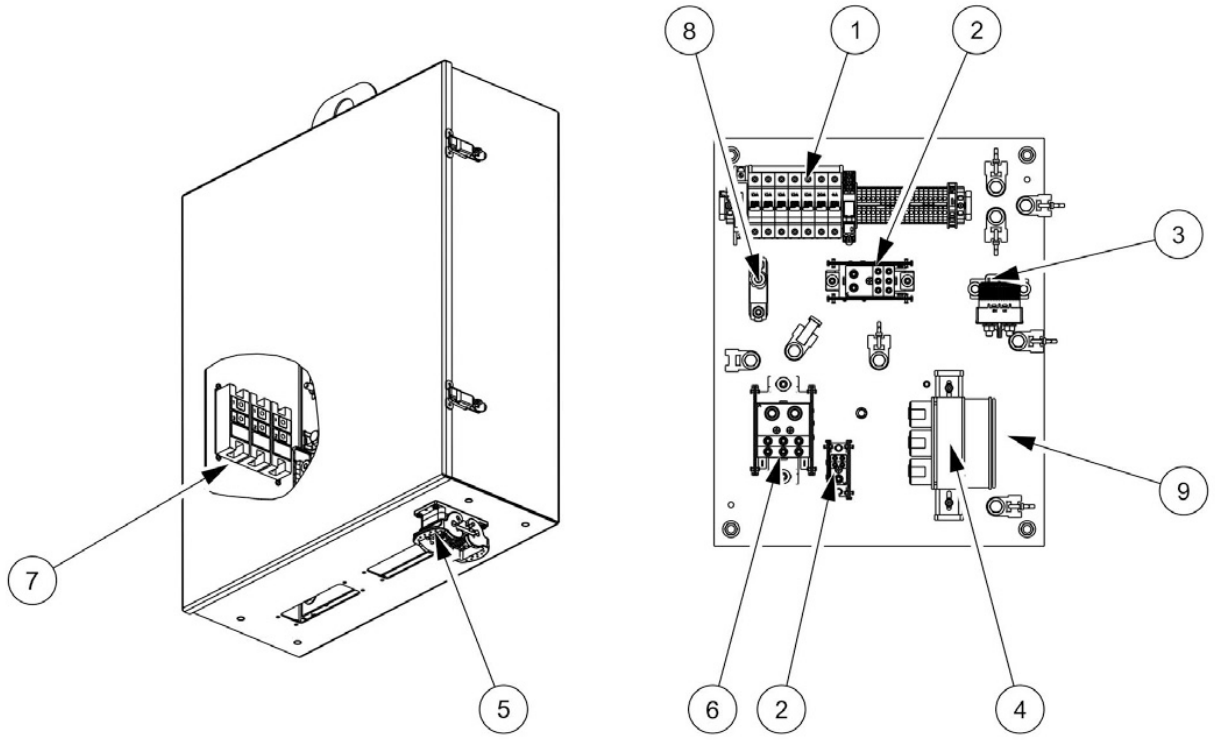


No.	Description	No.	Description
1	DC distribution panel		

FIGURE 116. DC DISTRIBUTION PANEL LOCATION

The DC breakers are located inside the box to allow for faster electrical fault reset, versus replacing fuses. The DC breakers allow the service technician to disconnect power to individual electrical components during service events.

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No.	Description	No.	Description
1	Circuit breakers	6	Power Supply, B-
2	Power supply, B+	7	Diodes, DCAS
3	Relay, Pre-lube	8	Fuse, 300 A
4	Diodes, DS	9	Diodes, Voltage Regulator (not shown)
5	Connector		

FIGURE 117. DC DISTRIBUTION PANEL FEATURES (SPEC A)

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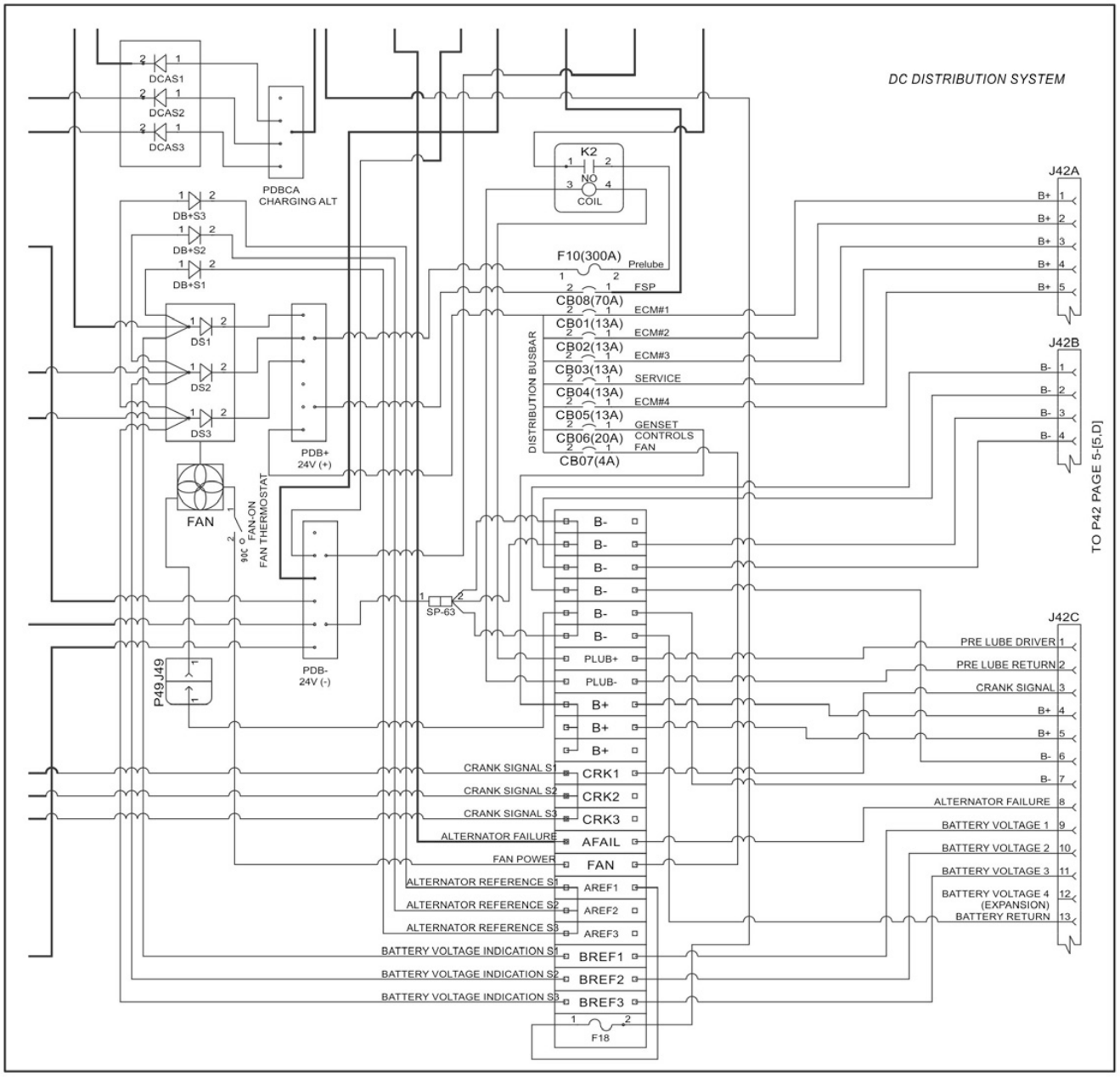
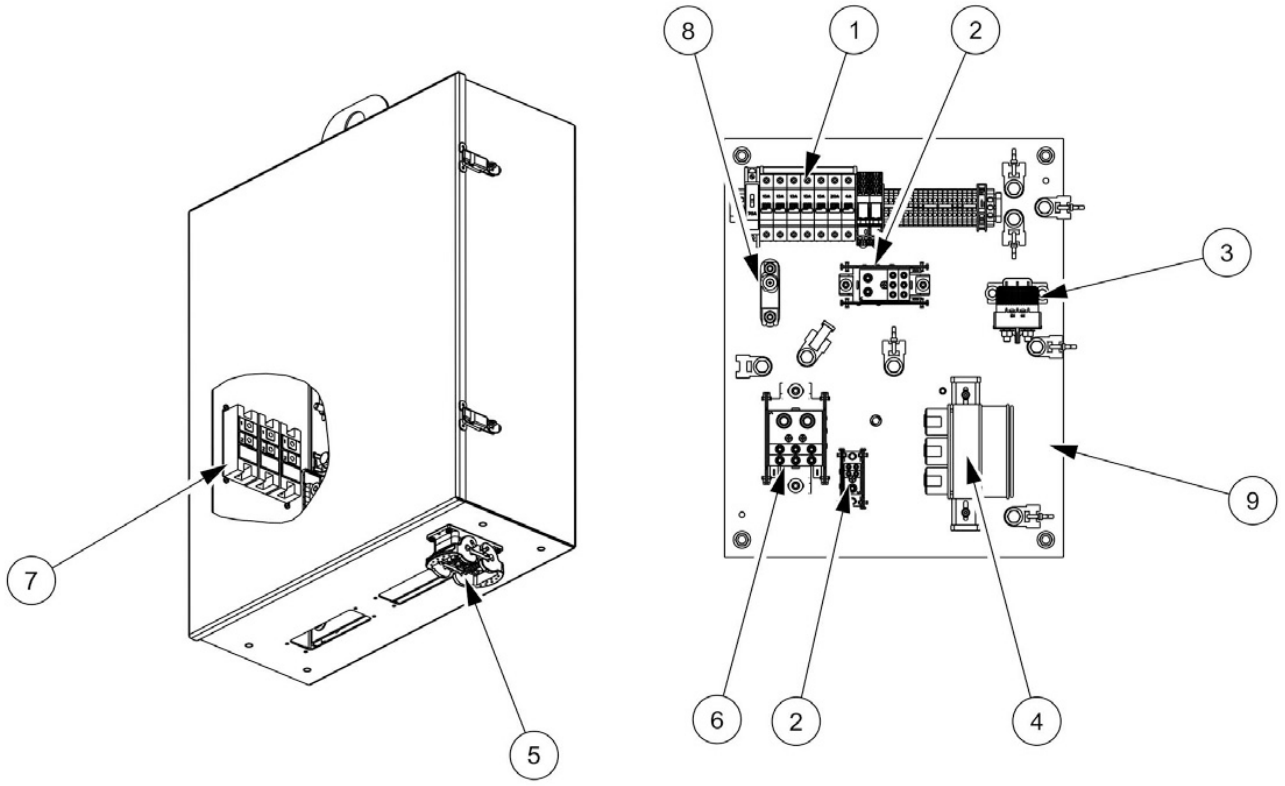


FIGURE 118. DC DISTRIBUTION BOX SCHEMATIC DIAGRAM (SPEC A)



No.	Description	No.	Description
1	Circuit breakers	6	Power Supply, B-
2	Power supply, B+	7	Diodes, DCAS
3	Relay, Pre-lube	8	Fuse, 175 A
4	Diodes, DS	9	Diodes, Voltage Regulator (not shown)
5	Connector		

FIGURE 119. DC DISTRIBUTION PANEL FEATURES (SPEC B)

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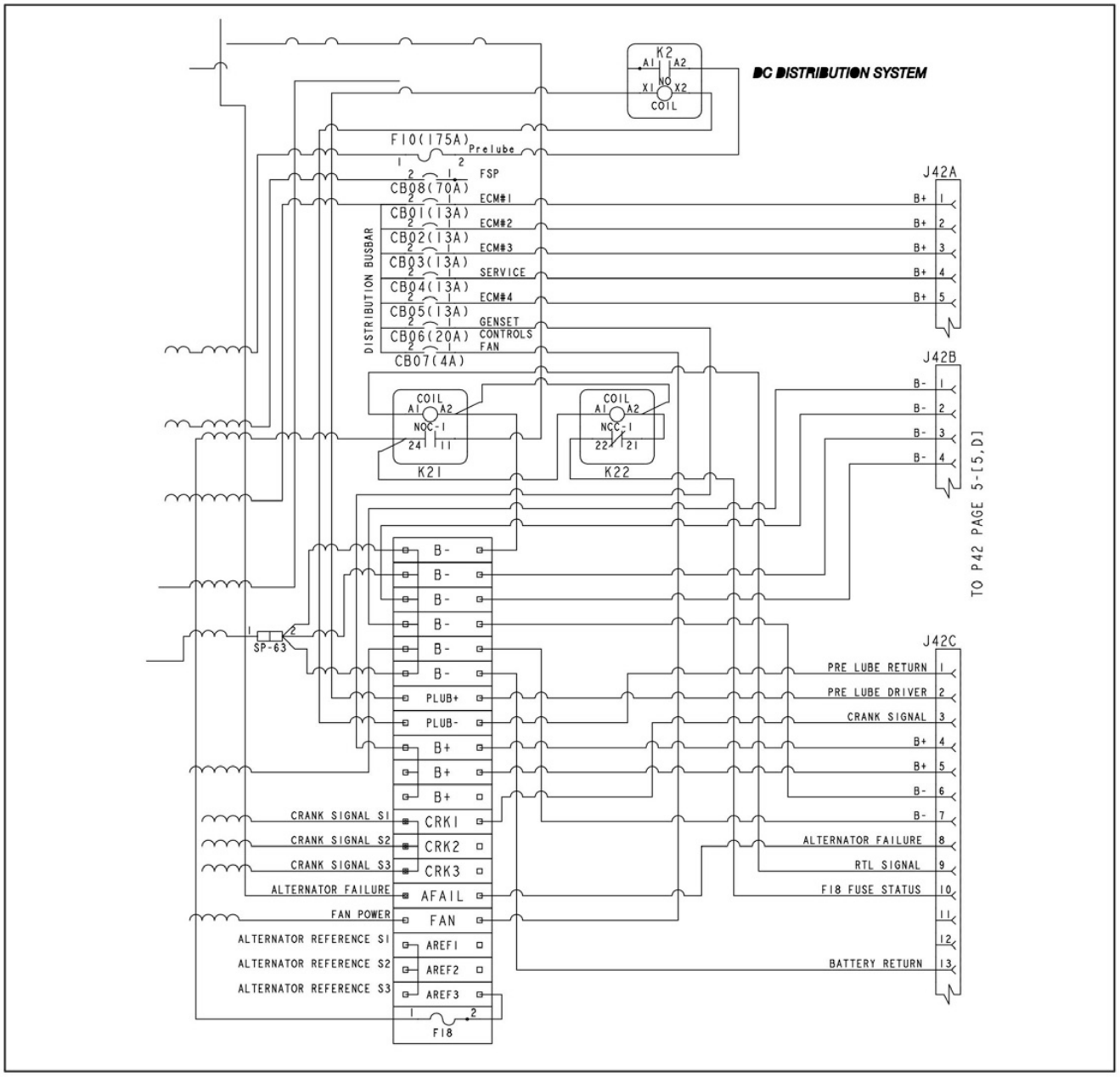


FIGURE 120. DC DISTRIBUTION BOX SCHEMATIC DIAGRAM (SPEC B)

6.4.2 Fuel Information Needed for Service Issue

When servicing is needed on a failed fuel tank, the following questions must be answered and conveyed via the submission of the Technical Support Request form (TSR).

1. Is there an actual confirmed leak?
    - Has the rupture basin alarm gone off?
    - What Fault Code(s) are present?
    - Is the sensor functioning properly?
    - Is there visible fuel in the basin or outside the tank (i.e. is there an EPA concern)?

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- If so, what is the leak rate?
- Is the fluid fuel and NOT water?
- What is the level of the fuel, in inches, in the tank and basin? A dipstick may be required to obtain an accurate reading.
- Can the leak locale be identified?

⚠ CAUTION

High Pressure

Excessive pressurization can rupture tanks or basins which can result in severe personal injury or death.

Remove all liquids before pressure testing. Do not exceed 2 psig when testing a tank or basin.

- Has the tank been previously repaired?
- Is there evidence of physical damage that may be contributing to the leak?
- Pictures may convey a great deal of information and should be considered.

2. What are the Cummins and manufacturer's details associated with the tank? Include the following in the Issue:
   - Cummins part number.
   - Manufacturer's part number, model, serial number and date of manufacture.
3. What time frame is required for the needed repair or replacement (i.e. how sensitive of an issue is this with the client and do they have any flexibility in the repair timing)?
   - If replacement, has there been an order placed for a new tank?
   - If ordered, is it categorized as machine down?
   - If not, then please update the order accordingly.
   - If an order has been placed, the Issue is to reflect this data (order number) as well.

6.4.2.1 Obtaining Information Needed for Fuel Tank Service Issues

⚠ CAUTION

High Pressure

Excessive pressurization can rupture tanks or basins which can result in severe personal injury or death.

Remove all liquids before pressure testing. Do not exceed 2 psig when testing a tank or basin.

NOTICE

Third party tank certifications do not allow anyone other than the manufacturer to make structural modifications to the tank (Cutting, Welding, Drilling, etc.). Any structural modification made by any other party, except UA, would void the certification. Accessories and tank maintenance can be completed by Cummins or the end user.

NOTICE

Before refueling the fuel tank after cleaning, make sure all drain plugs are properly fitted to prevent leaks or operational issues.

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To aid in identifying/isolating the leak or obtaining some of the information needed for Fuel Tank Service Issues:

1. Seal all penetrations/fittings with plugs except for one.
2. For the remaining penetration, fit up a regulated pressure source with a calibrated pressure gauge and a pressure relief valve (set to no more than 2.5 psig).
3. Pressurize the tank or basin to 2 psig and observe for the following:
   - For secondary tank (basin) work, spray all exterior weld seams with a soap water solution. Observe the pressure gauge for no change in a 30 minute period and visually observe the exterior seams for bubbling. Results are to be conveyed in the Issue details.
   - For the primary fuel tank, spray all exterior weld seams with a soap water solution. Observe the pressure gauge for no change in a 30 minute period and visually inspect the interior of the basin to the maximum extent possible. Results are to be conveyed in the Issue details.

NOTICE
For further questions or concerns regarding the information stated above, please contact (in the following order):

1. Your local Service Manager
2. Cummins Field Service Engineer (CFSE) or counterpart
3. Inside the U.S. and Canada: The Cummins Distributor Technical Support Line at 1-800-CUMMINS™ (1-800-286-6467)

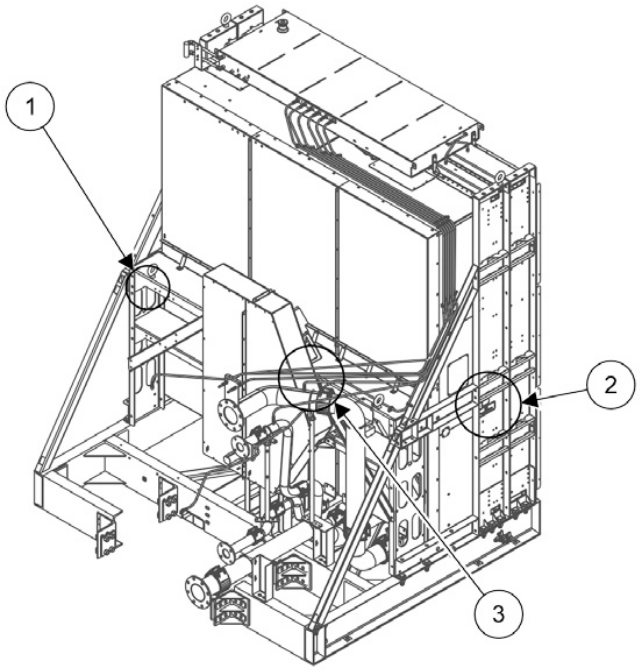
   Outside the U.S. and Canada: Refer to **www.cummins.com/support** and select Sales and Service Locator, or send an email to ask.powergen@cummins.com.

6.5 Cooling System

6.5.1 Radiator Identification

Several types of radiators are used depending on the generator set configuration. The radiator part number is printed on the radiator data plate and can be found in one of the indicated locations.

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No.	Description	No.	Description
1	Near Left Rear Lifting Eye	3	On Right Side of Belt Guarding
2	On Right Side Core Support		

FIGURE 121. RADIATOR DATA PLATE LOCATIONS

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TABLE 119. RADIATOR PART NUMBER AND SERVICE CHAPTER REFERENCE

Model	Radiator Chapter
A048D623	Section 6.5.4 on page 508
A048D645	
A048D652	
A052D767	
A052D765	
A049E410	
A065K735	
A065K736	
A065K741	
A065K742	
A065K746	
A063X313	
A063X314	
A053J805	
A054B569	
A072Y755	
A065H332	
A078R238	
A078R241	
A078T815	
A078T816	
A078T818	
A078T819	
A079Y009	
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A079Y011	
A079Y012	
A079Y013	
A079Y014	
A079Y015	
A079Y016	
A079Y017	

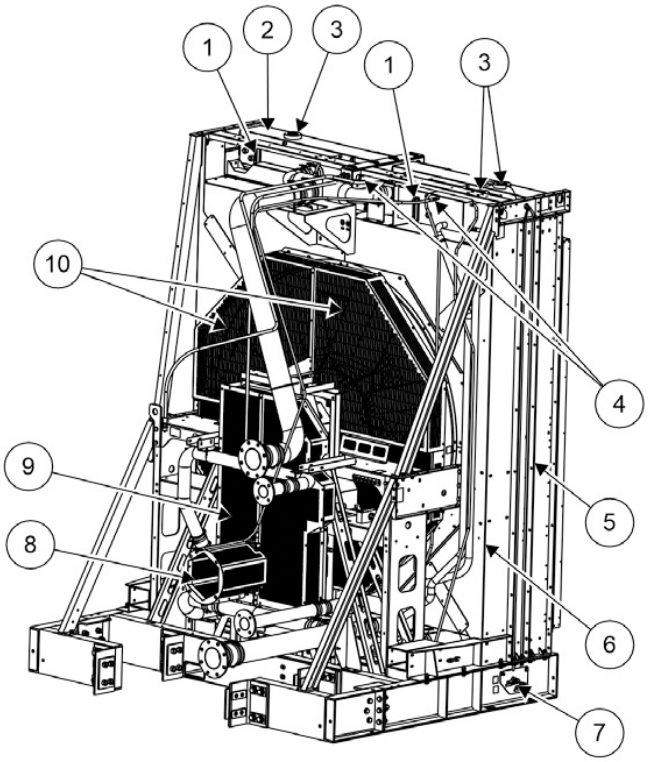
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Model	Radiator Chapter
A078L535	Section 6.5.5 on page 586
A078L534	
A076E016	
A079P132	
A079P131	
A079P108	
A076E017	Section 6.5.6 on page 640
A078M281	
A078M282	
A076E020	
A080G170	
A080G171	
A080G172	
A080G173	

6.5.2 Cooling System Components

There are multiple models of radiator available. The main variations are shown below.

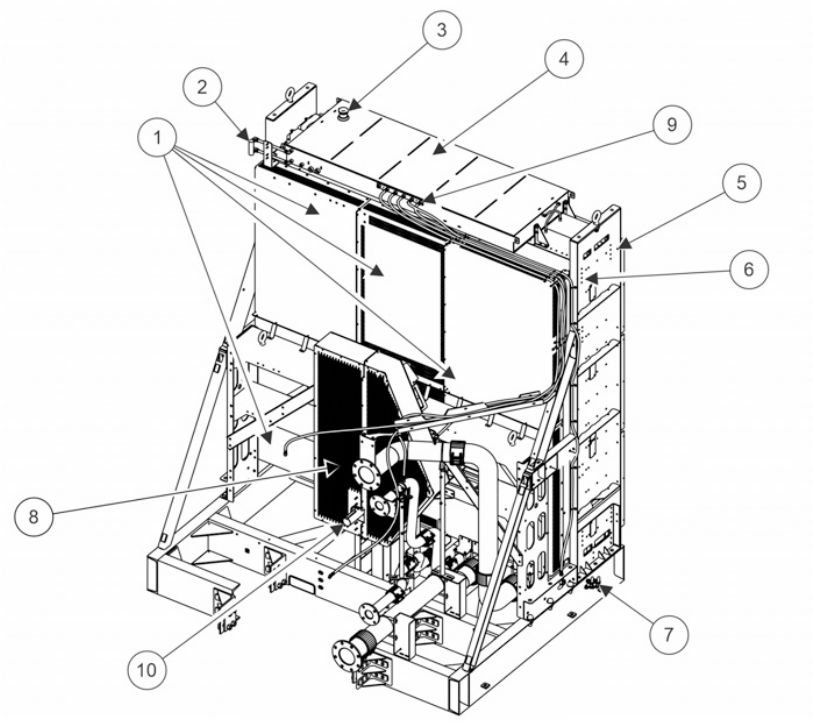
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No.	Description	No.	Description
1	Sight Glass	6	Radiator - LT Core
2	Expansion Tank	7	Coolant Drains
3	Coolant Fill	8	Drive Shaft
4	Vent Ports	9	Drive Guard
5	Radiator - HT Core	10	Fan Guard

FIGURE 122. COOLING SYSTEM (VARIATION 1 OF 3)

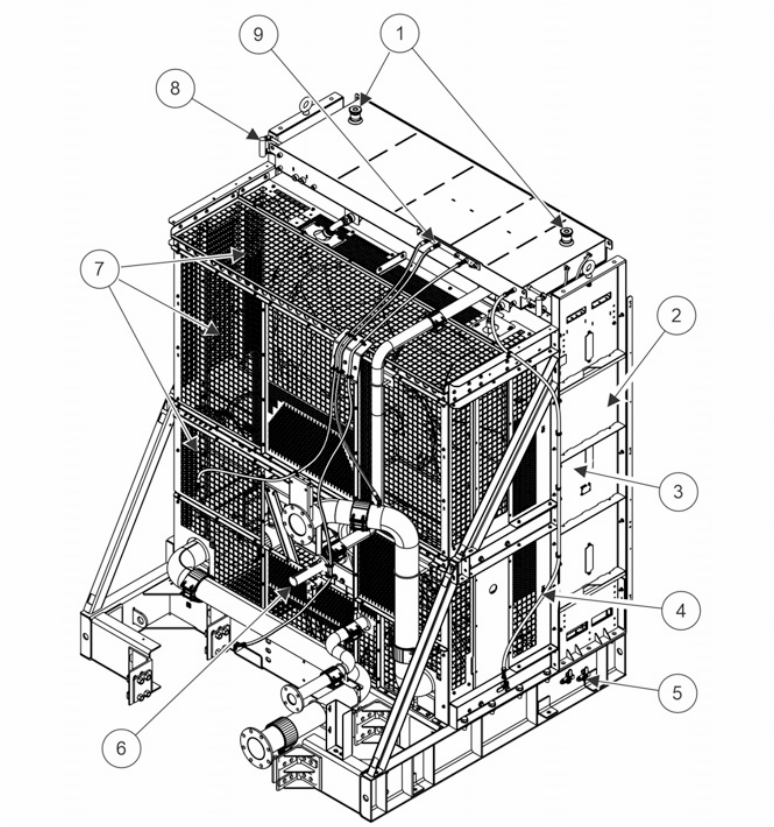
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No.	Description	No.	Description
1	Fan Guard (one not shown)	6	Radiator - LT Core
2	Sight Glass	7	Coolant Drains
3	Coolant Fill	8	Drive Guard
4	Expansion Tank	9	Vent Ports
5	Radiator - HT Core	10	Drive Shaft

FIGURE 123. COOLING SYSTEM (VARIATION 2 OF 3)

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No.	Description	No.	Description
1	Coolant Fill	6	Drive Shaft
2	Radiator - HT Core	7	Fan Guards
3	Radiator - LT Core	8	Sight Glass
4	Vent Hose	9	Vent Ports
5	Coolant Drains		

FIGURE 124. COOLING SYSTEM (VARIATION 3 OF 3)

6.5.2.1 Radiator Pressure Cap

The radiator pressure cap forms an integral part of the cooling system and should not be overlooked when diagnosing low or high coolant temperatures. A damaged pressure cap can increase the pressure in the cooling system, which can raise the point at which the coolant starts to boil and form steam pockets.

If the radiator pressure cap becomes damaged, it could cause:

- Overheating due to the valve not lifting off its seat
- Damage to the coolant hoses due to excessive pressure
- Loss of coolant due to the valve not being closed
- Collapse of the expansion tank if the vacuum seal is faulty
- Engine not reaching its operating temperature

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6.5.2.1.1 Radiator Pressure Cap Testing

⚠ WARNING

Hot Pressurized Liquid

Contact with hot liquid can cause severe burns.

Make sure the radiator cap is properly secured before operating the generator set.

NOTICE

Do not attempt to remove a radiator pressure cap while the generator set is running, or is stationary but hot. Always allow it to cool before releasing the pressure and removing the cap.

NOTICE

To test the operation of the radiator pressure cap a suitable cooling system pressure tester is required with a radiator pressure cap adaptor.

1. Examine the pressure cap for damage to the seals and springs. Replace the radiator cap if necessary.

   NOTICE

   The operating pressure should be stamped on the radiator cap, if unreadable refer to Section 6.5.4.1 on page 508

2. Test the radiator pressure cap in accordance with the instructions provided with the cooling system pressure tester.
   - If the pressure releases before reaching the correct pressure, or the cap does not hold pressure, the cap is faulty.

6.5.2.2 Coolant Heater

Coolant heaters are designed to allow the generator set to start and pick up load within 8.5 seconds in a 4.4 °C (40 °F) environment. In colder ambient temperature environments the starting time may be longer.

6.5.2.2.1 Coolant Heater Specifications

The coolant heater is designed to allow the generator set to perform an emergency start and pick up load within 10 seconds in a 40 °F (4.4 °C) environment. In colder ambient temperature environments the starting time may be longer.

The coolant heater is a forced circulation heater featuring a pump, heating element, and thermostatic control system. An internal thermostat controls the operation of the heating element. The circulation pump continues operation even when the heating element is turned off. This maintains a uniform coolant temperature in the engine. A 24 V signal is used to turn off the coolant heater during generator set operation.

⚠ CAUTION

The coolant heater must not be operated while the cooling system is empty or damage to the heater will occur.

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⚠ CAUTION

The Emergency Start sequence wears out the engine sooner than the Non-emergency Start sequence. If it is not necessary to start the generator set as quickly as possible (for example, when exercising or servicing the generator set), the Non-emergency Start sequence is preferred. In some applications use of the Emergency Start sequence is required.

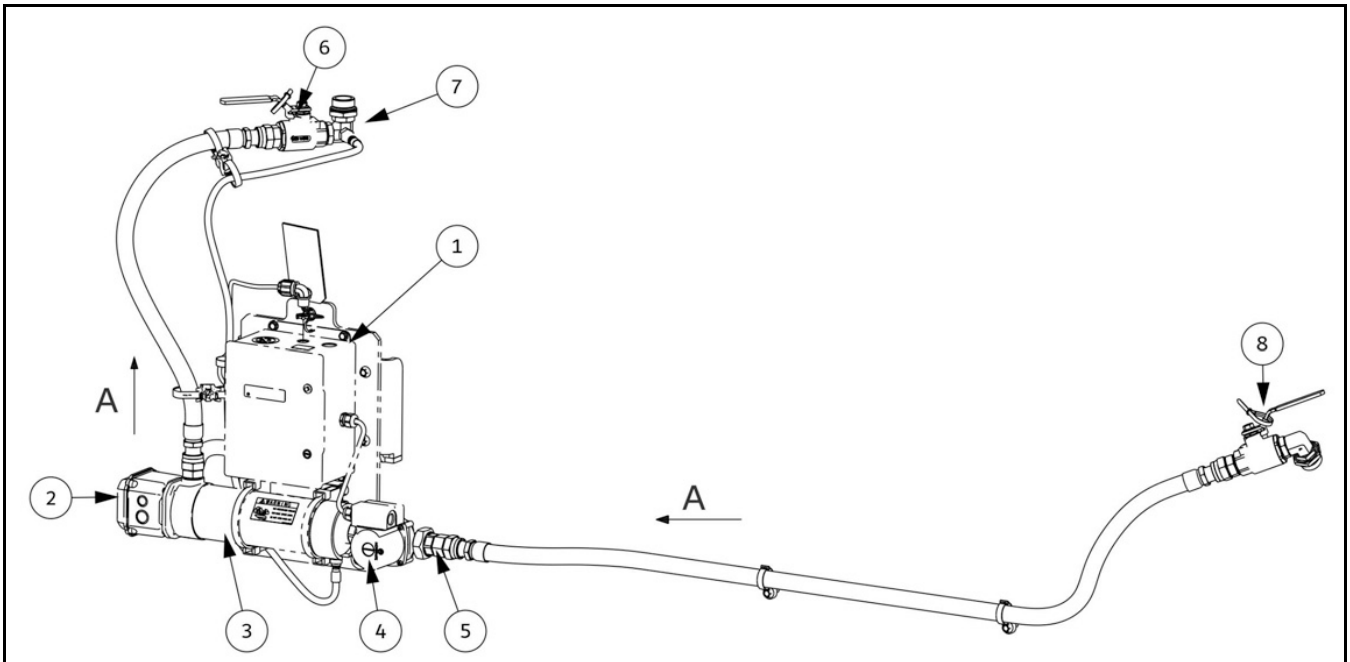
NOTICE

Activation of the generator set Emergency Stop switch will not isolate AC power supplied to generator set accessories. To properly isolate AC power to the generator set accessories, refer to Section 6.1.2.

TABLE 120. COOLANT HEATER SPECIFICATIONS

Heater Element Rating	12 kW
Thermostat Operating Range	100-130 °F (38-54 °C)
Total Dry Weight	75 lbs (34 kgs)
Configurations	
60Hz	480 V
50Hz	400 V

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No.	Description	No.	Description
A	Direction of Coolant Flow	5	Check Valve
1	Control Panel	6	Outlet Isolation Valve
2	Thermostat Housing	7	Pressure Relief Valve
3	Tank	8	Inlet Isolation Valve
4	Pump Motor		

FIGURE 125. COOLANT HEATER SYSTEM OVERVIEW

The coolant heater circuit is equipped with isolation valves on the inlet and outlet. The isolation valves must be in the open position, in line with the coolant hose, while the generator set is in operation. In the event that these valves are closed during coolant heater operation, the pressure relief valve will provide protection against over pressurizing the system.

6.5.2.2.2 Coolant Heater Pump Inspection

The coolant heater pump contains a small slotted access port located on the end of the motor drum.

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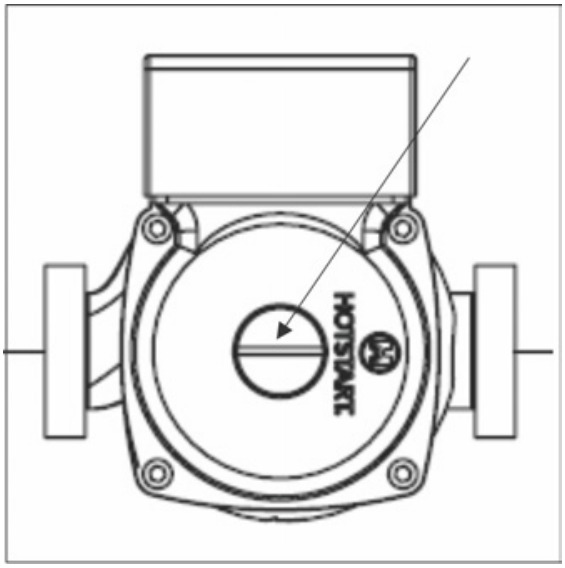


FIGURE 126. COOLANT HEATER PUMP ACCESS PORT

This access port is used to troubleshoot in the event that it is suspected the pump has seized or the impeller is plugged with material, resulting in no pump rotation.

NOTICE
This access port can only be removed when the AC power supply has been isolated to remove power from the pump.

Inspect

The slotted access port can be removed using a standard flat screwdriver. This will expose the end of the pump motor shaft, that sits inside of the ceramic sleeve bearing. A small amount of fluid is expected to be present when the access port is removed.

Visually inspect for any signs of abnormal wear. If seizure or impeller blockage is suspected, use a standard flat screwdriver to manually turn the end of the shaft to feel for resistance.

6.5.2.2.3 Coolant Heater Removal

6.5.2.2.3.1 Required Tools

The following tools are required to complete this installation.

- 1-5/8” crowfoot wrench
- 1-1/2” crowfoot wrench
- 13 mm socket
- 15 mm combination wrench
- Torque wrench (20 - 100 Nm)
- Torque wrench (40 - 200 Nm)

6.5.2.2.3.2 Procedure

1. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See Section 6.1.2.
2. Cut zip ties, slide the locking portion up, and close both 1/4 turn ball valves to isolate the coolant heater from the generator set coolant circuit.

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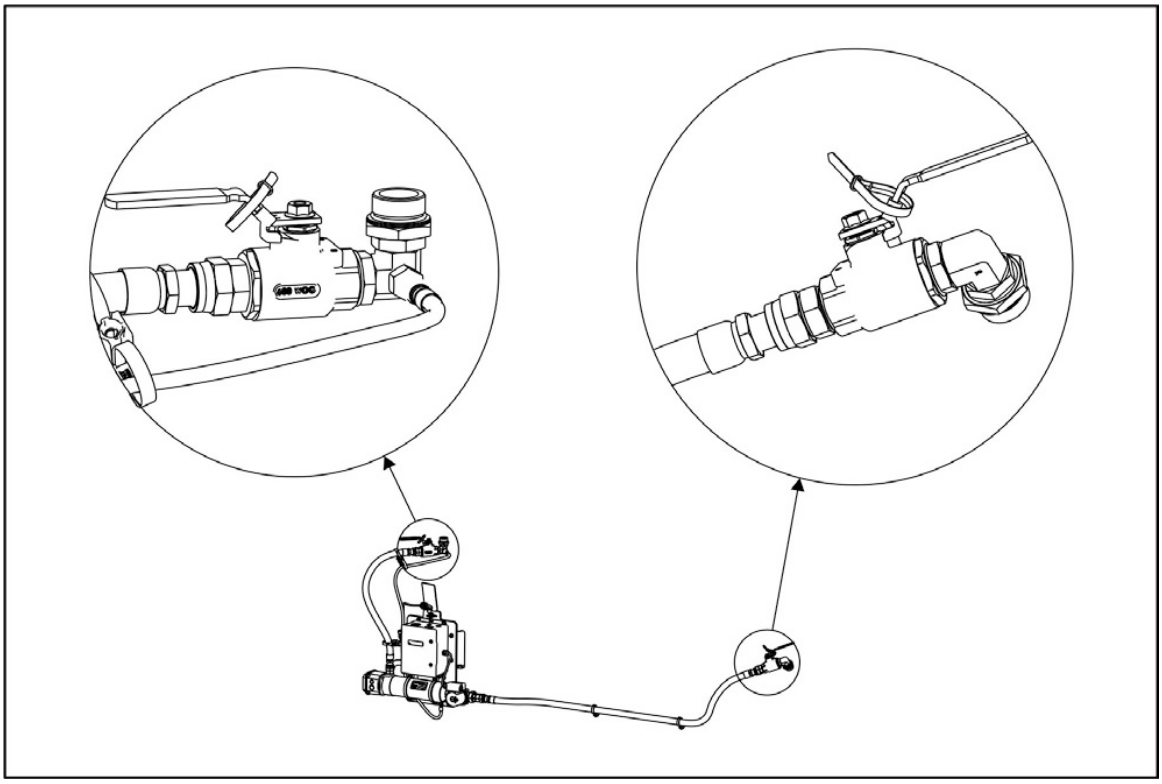


FIGURE 127. BALL VALVES

3. Place a bucket under the coolant heater pump and inlet hose connection.
4. Remove the inlet hose and hose fitting from the coolant heater assembly.

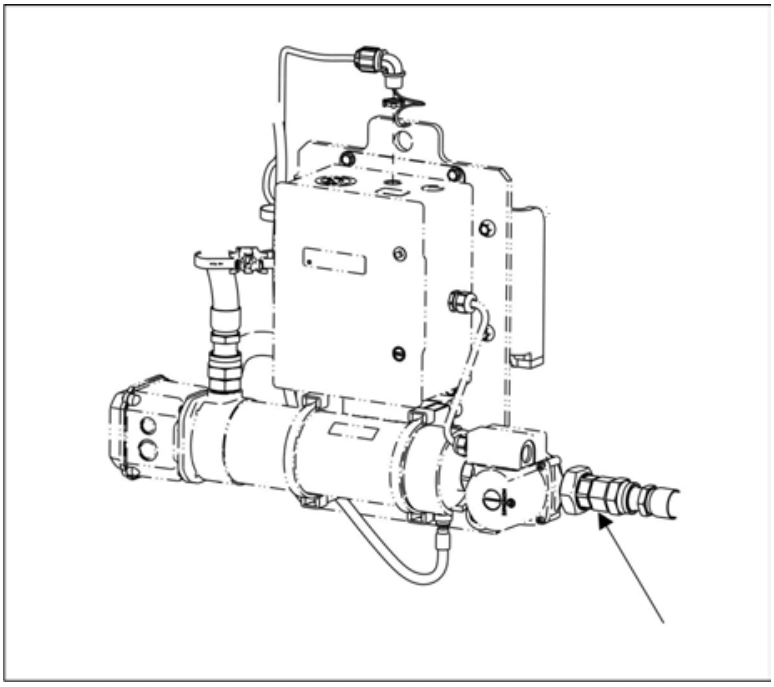


FIGURE 128. INLET HOSE

5. Loosen inlet hose connection to drain coolant into the bucket. Dispose of the coolant in accordance with local regulations.

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6. Remove the inlet hose and hose fitting from the coolant heater assembly.
7. Remove the outlet hose and hose fitting from the coolant heater assembly.

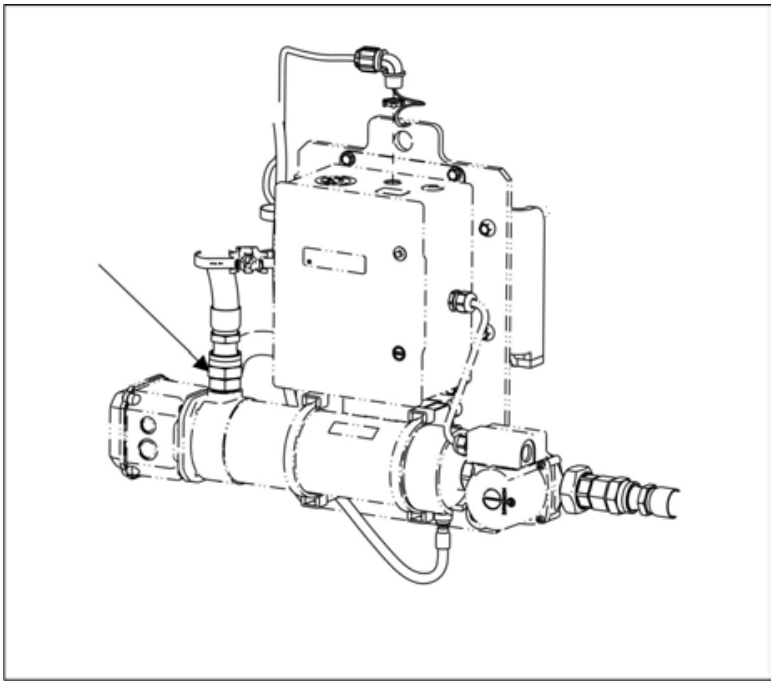


FIGURE 129. OUTLET HOSE

8. At the coolant heater outlet engine connection point, remove the pressure relief hose.

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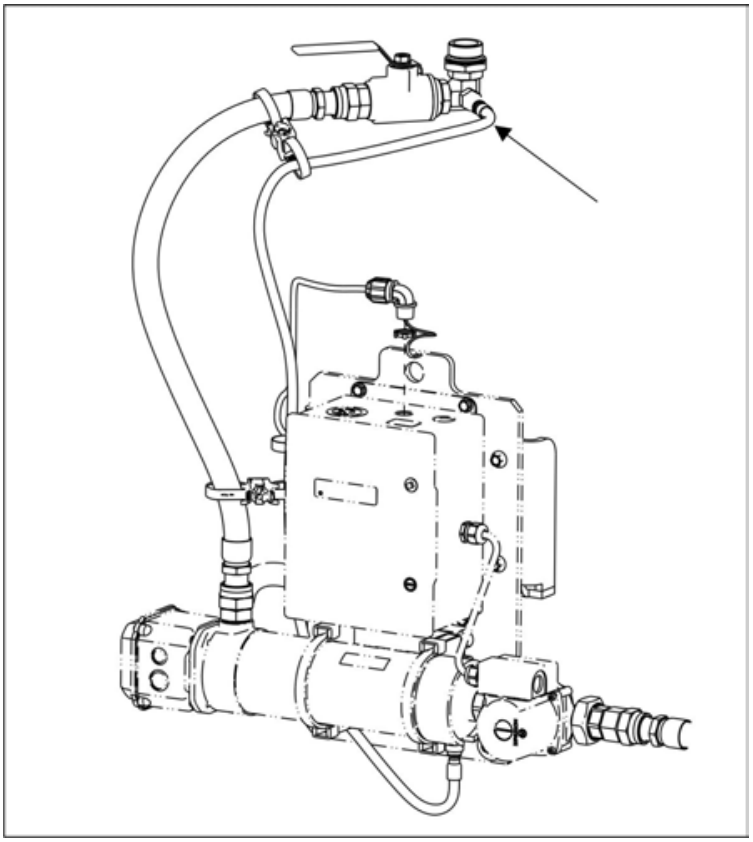
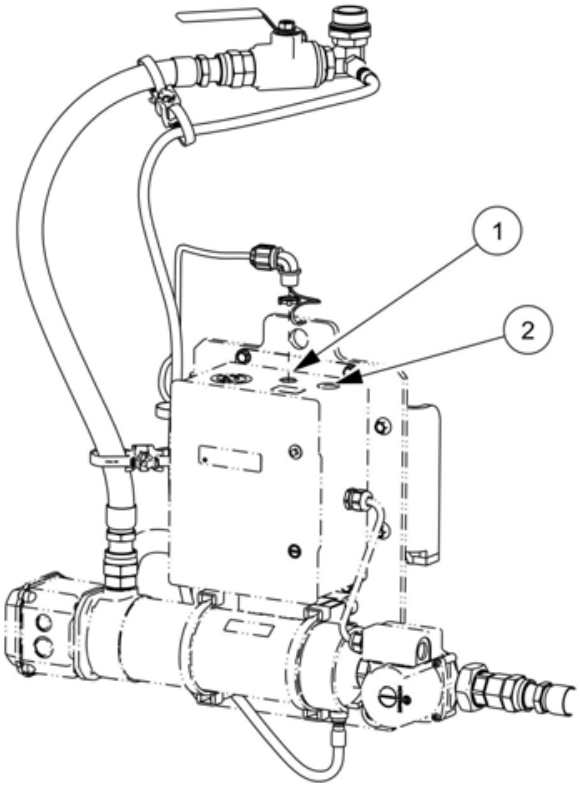


FIGURE 130. PRESSURE RELIEF HOSE

9. Remove the AC power wires from the coolant heater control box and disconnect the coolant heater control harness.

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No.	Description	No.	Description
1	Coolant heater control harness	2	AC power wires

FIGURE 131. COOLANT HEATER CONTROL HARNESS

10. Remove two mounting bolts, washers, and rubber isolators that attach the coolant heater assembly to the side of the generator set skid.

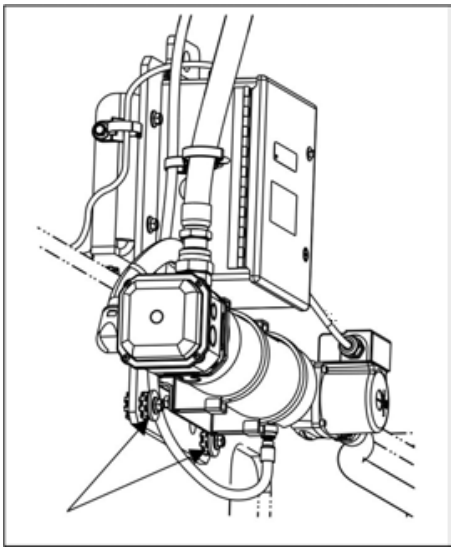


FIGURE 132. COOLANT HEATER AND SKID MOUNTING HARDWARE

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11. Attach a lifting device to coolant heater assembly. The weight of the coolant heater assembly is 93 lb (42 kg).

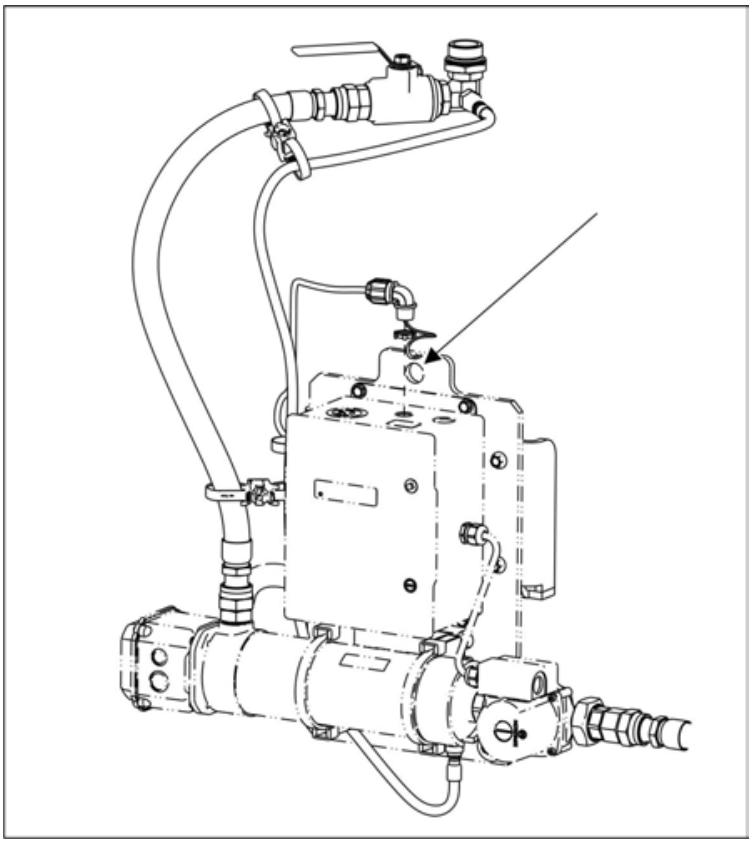


FIGURE 133. LIFTING POINT

12. Remove four sets of mounting hardware attaching the coolant heater assembly to the coolant heater mounting bracket.

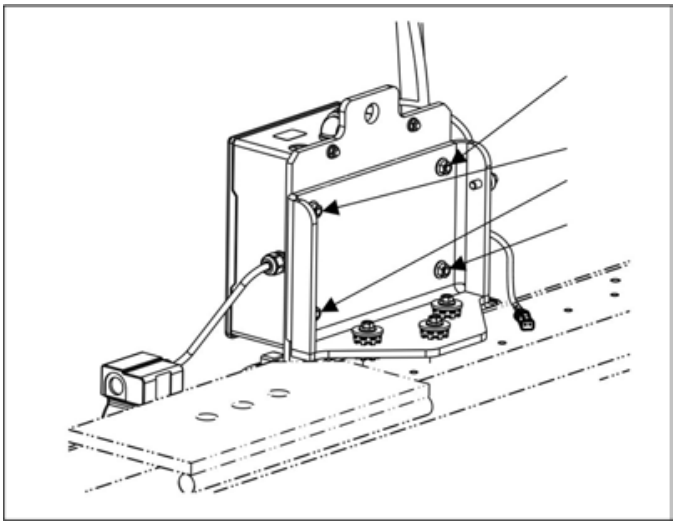


FIGURE 134. COOLANT HEATER ASSEMBLY TO MOUNTING BRACKET HARDWARE

13. Remove coolant heater assembly from the generator set.

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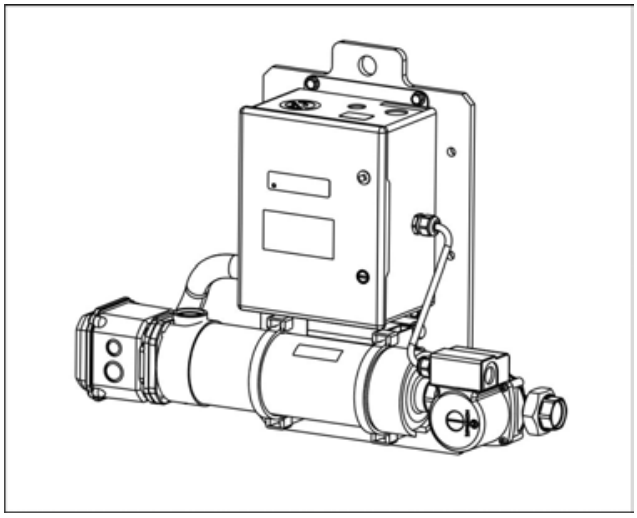


FIGURE 135. REMOVE COOLANT HEATER

6.5.2.2.4 Coolant Heater Installation

6.5.2.2.4.1 Required Tools

The following tools are required to complete this installation.

- 1-5/8” crowfoot wrench
- 1-1/2” crowfoot wrench
- 13 mm socket
- 15 mm combination wrench
- Torque wrench (20 - 100 Nm)
- Torque wrench (40 - 200 Nm)

6.5.2.2.4.2 Procedure

1. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See **Section 6.1.2**.
2. Attach a lifting device to coolant heater assembly. The weight of the coolant heater assembly is 93 lb (42 kg).

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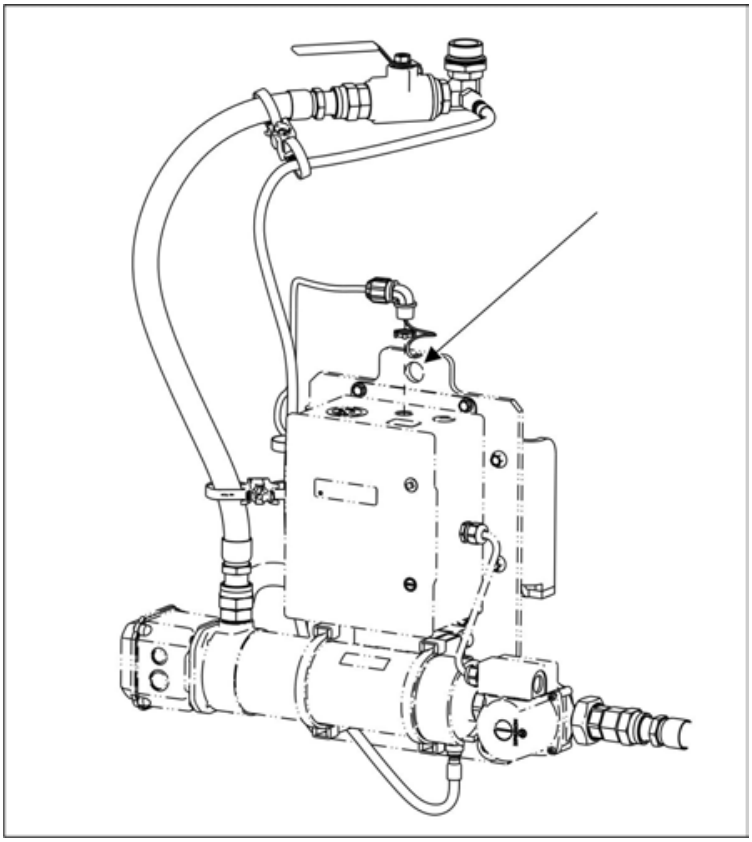


FIGURE 136. LIFTING POINT

3. Install the pieces of the two large vibration isolators into the bottom two coolant heater mounting locations, between the coolant heater back plate and generator set skid.

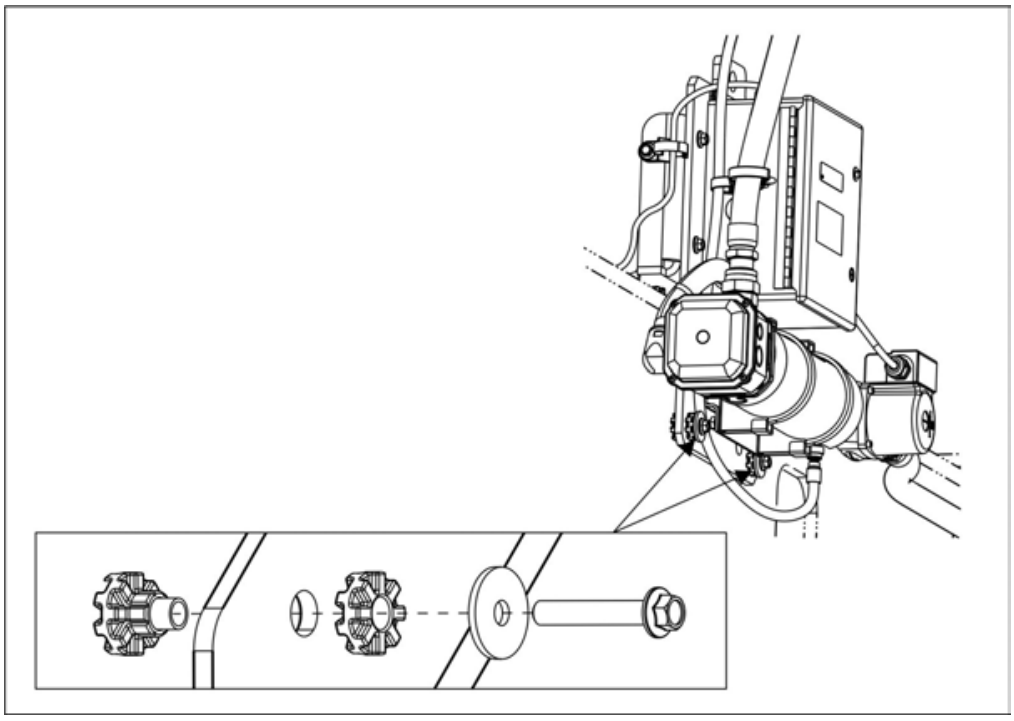


FIGURE 137. VIBRATION ISOLATORS

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4. Loosely install the upper four mounting bolts and nuts.

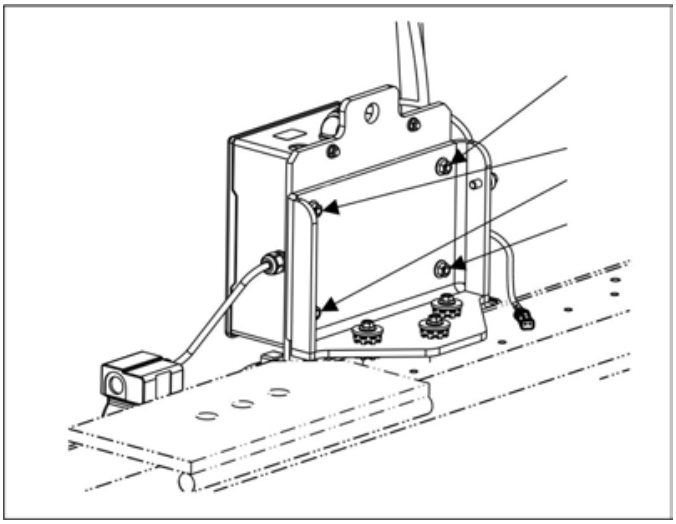


FIGURE 138. MOUNTING HARDWARE

5. Install the two bolts, flat washers, and rubber isolators that attach the coolant heater assembly to the generator set skid.

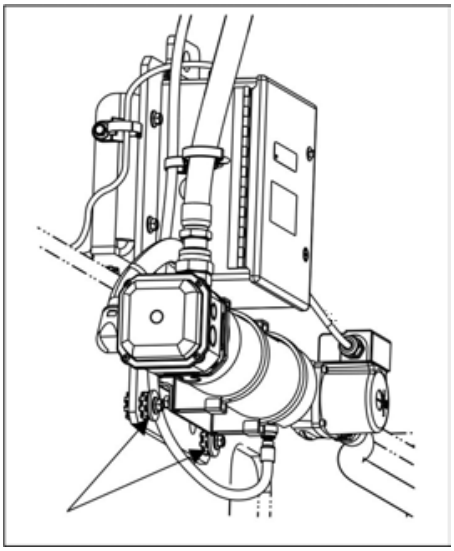


FIGURE 139. COOLANT HEATER AND SKID MOUNTING HARDWARE

6. Torque the 6 sets of mounting hardware.
    - Coolant heater assembly to coolant heater bracket (four sets) to 52 Nm (38.3 ft-lb)
    - Coolant heater assembly to generator set skid (two sets) to 30 Nm (22.1 ft-lb)
7. Install coolant heater outlet hose fitting and hose.

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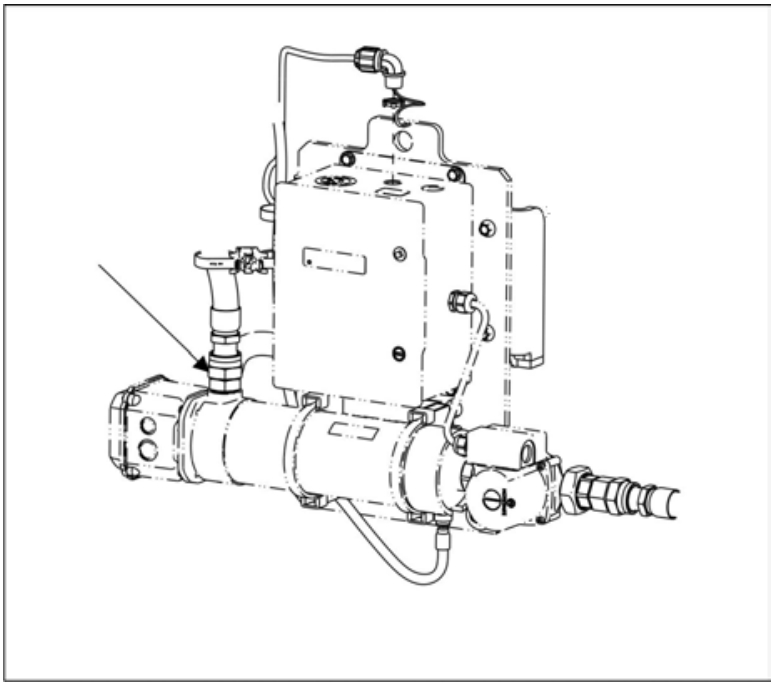


FIGURE 140. OUTLET HOSE

a. Lubricate o-rings with a light coat of oil. Do not lubricate the threads.

b. Torque fitting to 174 Nm (128.3 ft-lb).

c. Torque hose to 125 Nm (92.2 ft-lb).

8. Install the pressure relief hose.

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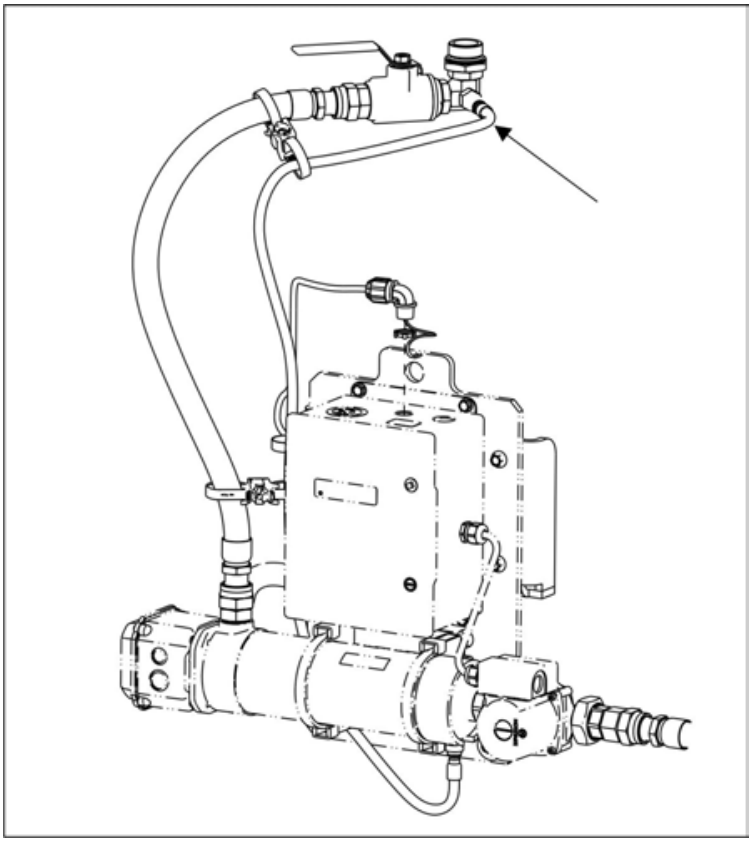


FIGURE 141. PRESSURE RELIEF HOSE

a. Apply thread sealant to pressure relief system pipe threads.

b. Torque hose connector to 25 Nm (18.4 ft-lb).

9. Install coolant heater inlet hose fitting and hose.

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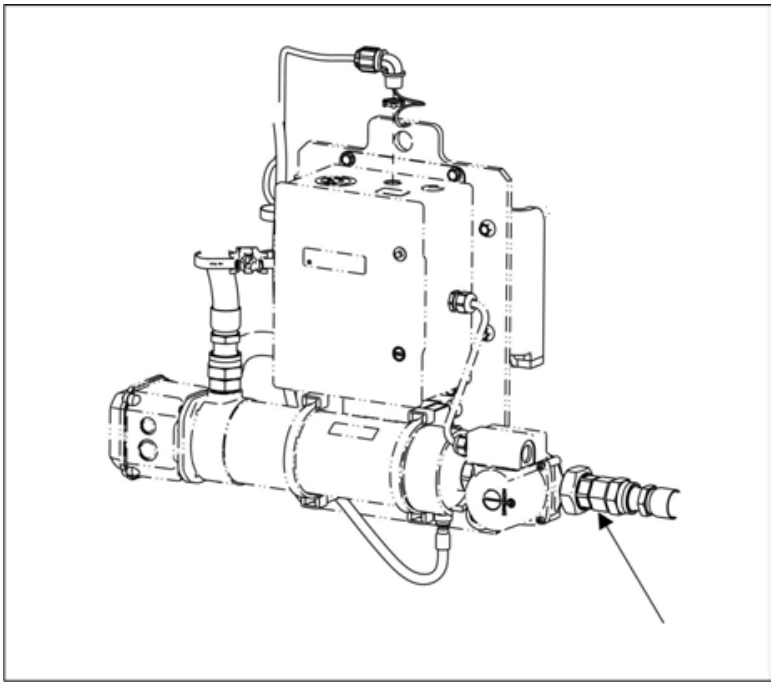


FIGURE 142. INLET HOSE

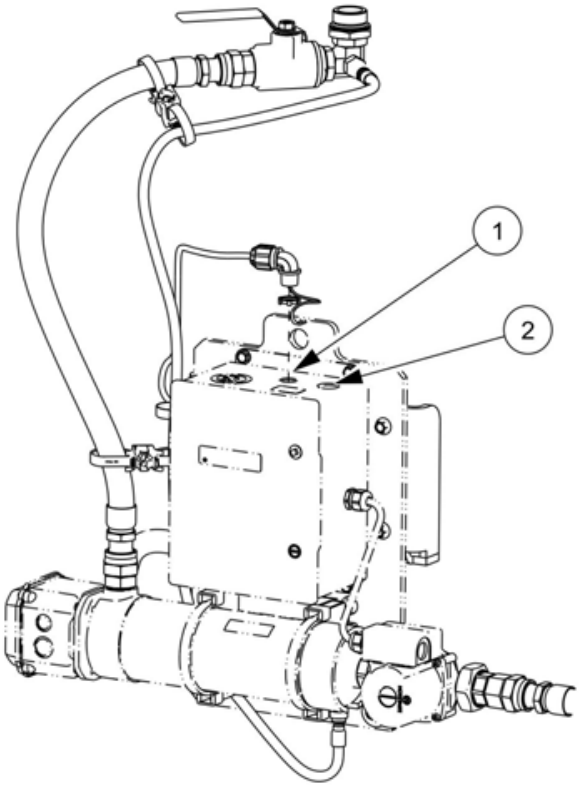
a. Lubricate o-rings with a light coat of oil. Do not lubricate threads.

b. Torque fitting to 174 Nm (128.3 ft-lb).

c. Torque hose to 125 Nm (92.2 ft-lb).

10. Install AC power wires and connect coolant heater control harness. It is required to use the top entry for the AC power wires (**Figure 143 on page 500**). Make sure the wires are routed and secured away from the transformer and enclosure door latches.

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No.	Description	No.	Description
1	Coolant heater control harness	2	AC power wires

FIGURE 143. COOLANT HEATER CONTROL HARNESS

- Connect A1 and A2 to coolant heater control.
- Connect L1, L2, and L3 to AC power.

11. Open 1/4 turn ball valves on coolant heater inlet and outlet hoses.
12. Secure the locking collar with a zip tie.

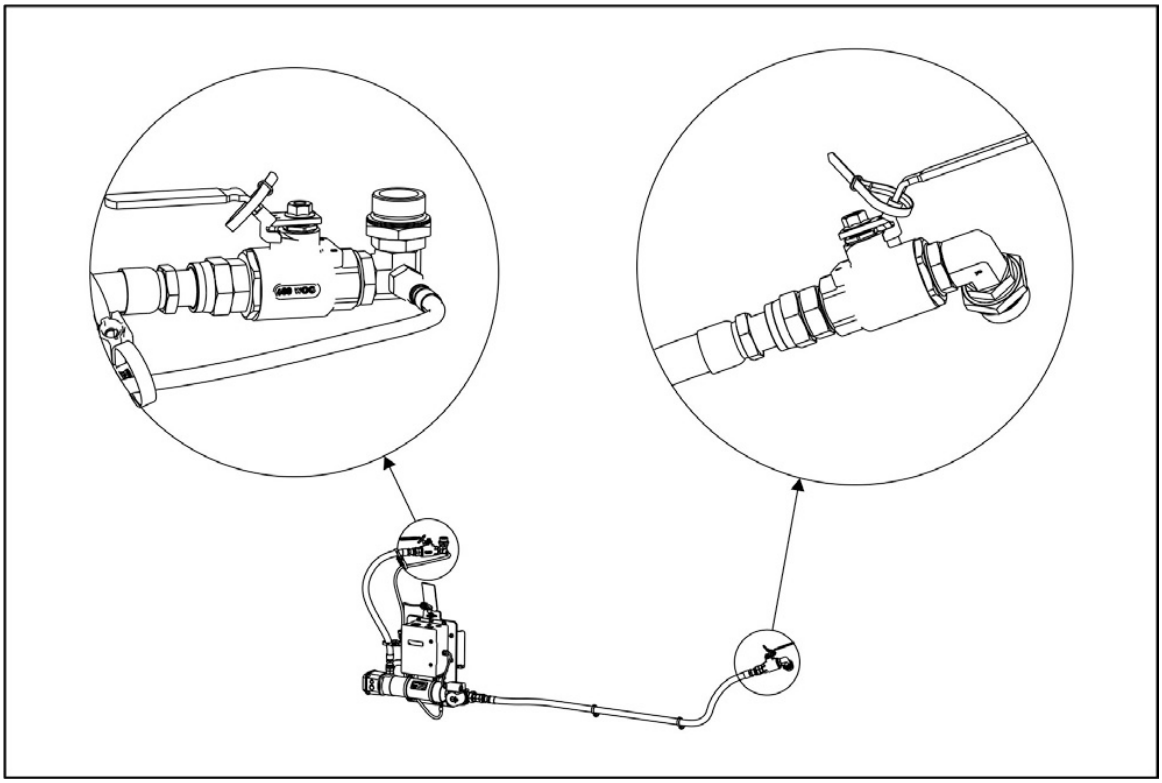


FIGURE 144. BALL VALVES

13. Reconnect all sources of potential energy. Remove the lock-out of the generator set. Verify coolant heater operation.

6.5.2.2.5 Coolant Heater Element Resistance Test

Tools Required

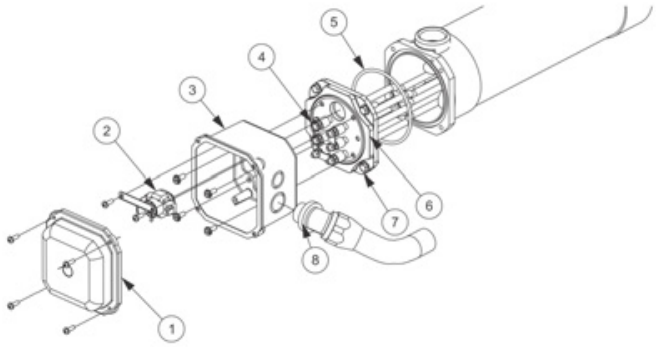
- Electrical Meter
- Small Screwdriver

Preparation Steps

NOTICE
When servicing a generator set that is shutdown, make certain the generator set cannot be accidentally restarted. This includes, but is not limited to, these steps.

1. Put the PCC in Off Mode.
2. Push the Emergency Stop button, and wait 30 seconds.
3. Disable the air starter (if equipped).
4. Display a suitable "Maintenance in Progress" sign prominently.
5. Follow the appropriate lockout/tagout procedures for the equipment, refer to Section 6.1.2.

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No.	Description	No.	Description
1	Cover	5	Element Assembly O-ring
2	Thermostat	6	Element Assembly
3	Element Wiring Enclosure	7	Element Assembly Mounting Screws (4)
4	Cup Washers at Wiring Connection Points	8	Conduit Connector

FIGURE 145. COOLANT HEATER ELEMENT

Testing Coolant Heater Element Resistance

The numbers in parenthesis () correspond to the part call out numbers in **Figure 145** .

1. Remove coolant heater element cover by removing 4 screws.
2. Remove the two bus bars between the heater element connections (1) (2).

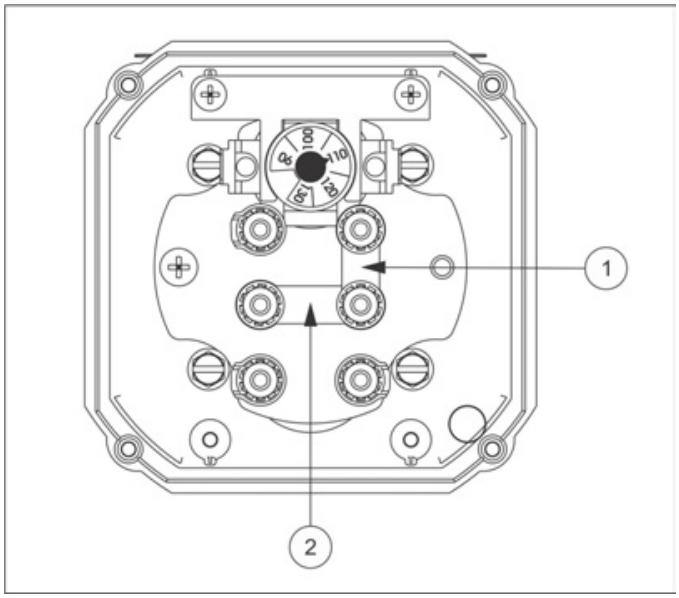


FIGURE 146. COOLANT HEATER ELEMENT BUS BARS

3. Using an electrical meter, check the resistance of each heater element (A) (B) (C).

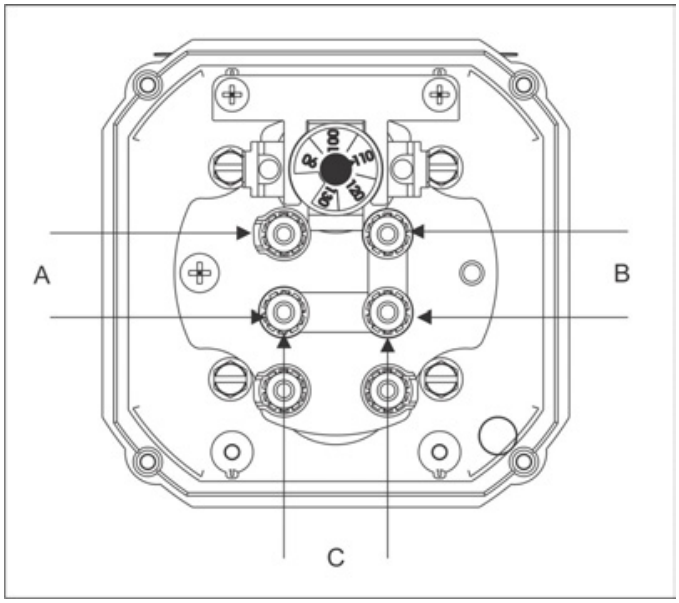


FIGURE 147. COOLANT HEATER ELEMENT TEST POINTS

- Refer to the table for each element resistance readings.
- If heater resistance test indicates an open circuit, replace the burned out heater element.

TABLE 121. RESISTANCE TABLE

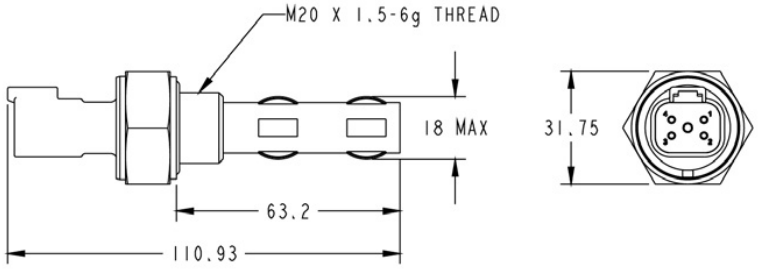
Voltage	Minimum	Maximum
400 V	18.2 Ohms	21.2 Ohms
440 V	12.5 Ohms	14.6 Ohms

6.5.2.3 Coolant Sensors

The sensors in this chapter relate to those with a CPG part number. For further information regarding the sensors fitted to the engine refer to the engine service manual, see Related Literature in the **Chapter 2**.

6.5.2.3.1 Sensor Specifications

TABLE 122. COOLANT LEVEL SENSOR SPECIFICATIONS

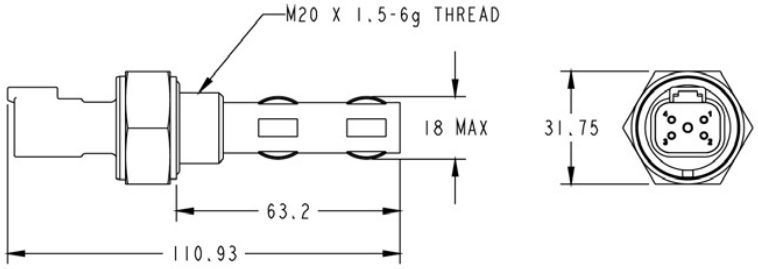
Physical Dimensions		
Operation Specifications		
	Supply Voltage	0-5 VDC

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Install Torque	20 Nm (14.7 ft-lb)

6.5.2.3.2 Sensor Specifications

TABLE 123. COOLANT LEVEL SENSOR SPECIFICATIONS

Physical Dimensions		
Operation Specifications		
	Supply Voltage	0-5 VDC
Install Torque	20 Nm (14.7 ft-lb)	

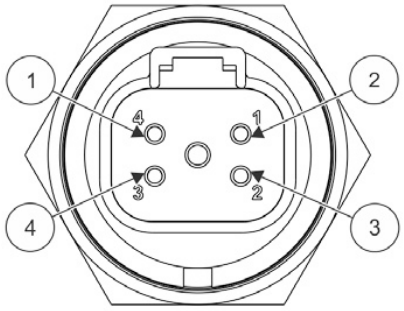
6.5.2.3.3 Sensor Testing

The low coolant level sensor must be tested only when certain conditions are present. Before testing the sensor, be sure that the following conditions are met:

- The generator set control must be powered on.
- Sensor should be connected to the control as stated in the wiring diagram.

Test the sensor. If it does not give results within the Acceptable Values ranges, the sensor is faulty.

TABLE 124. SENSOR PINS



Pin	Pin Connections
1	Ground
2	Power
3	Signal Return
4	Not Used

TABLE 125. PIN CONNECTIONS

Check	Pin Connections	Acceptable Values
Supply Voltage		0-5 VDC
Signal (Sense) Voltage		In Coolant - 1.2 V In Air - 3.75 V
Resistance	A - C Normal Coolant Level	135-150 Ohm
	A - C Low Coolant Level	2565-2835 Ohm

1. Inspect the sensor and engine harness connector pins. Repair or replace as necessary.
2. Disconnect the low coolant level sensor leads from the engine harness.
3. Using a suitable multimeter check for a short circuit from pin A to pin C.
4. Using a suitable multimeter check for a open circuit from pin A to pin C.

6.5.2.4 Engine Thermostat

The thermostat forms an integral part of the cooling system and should not be overlooked when diagnosing low or high coolant temperatures.

If the engine thermostat fails, it could cause:

- Overheating due to the valve not lifting off its seat
- Engine not reaching its operating temperature

For further information refer to the Engine Service Manual

6.5.2.5 Zinc Anode

The set mounted cooling system is equipped with a zinc anode to prevent corrosion within the coolant passages. The anode should be check regularly, per the generator set maintenance intervals.

The zinc anode rode should be replaced when 80% of the anode is depleted.



FIGURE 148. ZINC ANODE

Zinc Anode Inspection and Replacement

⚠ WARNING

Hot Pressurized Liquid

Contact with hot liquid can cause severe burns.

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

1. Drain cooling system so the coolant level is below the level of the zinc anode location.
2. Remove plug from radiator.

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3. Inspect zinc anode rod for degradation.
    - If anode rod is depleted 80% or more, replace the anode rod.
    - If anode rod condition is still acceptable for use, go to **Step 4** of **Replace Anode Rod**.

Replace Anode Rod

1. Unthread the anode rod from the brass plug.
2. Apply anti-seize compound to the threads of the new anode rod.
3. Thread the new rod into the brass plug.
4. Apply pipe thread sealing tape or sealing compound to the threads of the brass plug.
5. Insert the brass plug into the radiator location.
    - Do not over tighten the brass plug.
6. Refill the cooling system to the proper operating level.
7. Verify there are no leaks around the brass plug or any other locations.

6.5.3 Remote Radiator Installation

Special requirements apply if your generator set includes a remote radiator. For more information, refer to Section 6.5.3.1 on page 506.

6.5.3.1 Remote Radiator Cooling

The remote radiator cooling substitutes a remote mounted radiator and an electrically driven fan in place of generator set mounted components. Removal of the radiator and the fan from the generator set reduces noise levels without forcing dependence on a continuous cooling water supply (necessary with heat exchanger cooling). The remote radiator installation must be completely protected against freezing.

Remote radiator plumbing will vary with installation. Follow recommendations given in Application Manual T-030. See product for friction head and static head limits.

NOTICE
Before filling the cooling system, make sure all hardware is tight. This includes hose clamps, cap screws, fittings, and connections. Use flexible coolant lines with heat exchanger or remote mounted radiator.

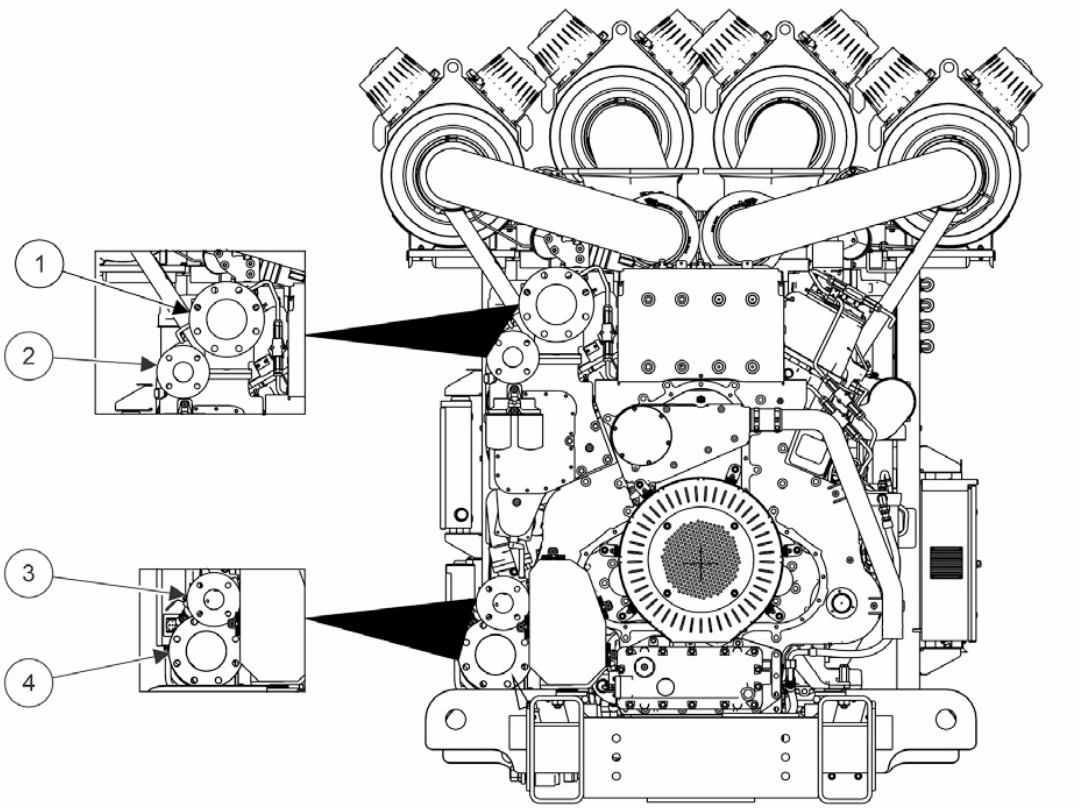
NOTICE
All customer connections must be fully supported where they interface with flexible coolant flange. The support must be located within 100 mm from the flexible flange connection.

6.5.3.2 Remote Radiator Installation

Installations set up for remote radiator cooling may or may not include flanges. Refer to Appendix A on page 813 for outline drawings showing remote radiator installations.

A low coolant level sender and a wiring harness are supplied with the generator set. Once the low coolant level sender is installed, refer to Appendix B for information on connecting the wiring harness.

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No.	Description	No.	Description
1	HT outlet	3	LT inlet
2	LT outlet	4	HT inlet

FIGURE 149. REMOTE RADIATOR COOLING COMPONENTS (INCLUDES FLANGES)

Table 126 shows specifications for the coolant piping.

NOTICE
Engine flanges will be damaged if raised face flanges are used for coolant connections. Use flat face style flanges.

TABLE 126. COOLANT PIPING SPECIFICATIONS

Connection	Maximum Bending Moment (Nm)	Maximum Bending Moment (ft-lb)	Maximum Length of Unsupported Schedule 40 Pipe with water (ft (mm))
LT inlet	55.73	41.10	2.79 (850.4)
LT outlet	38.00	28.00	2.30 (701)
HT inlet	76.67	56.50	1.90 (579)

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Connection	Maximum Bending Moment (Nm)	Maximum Bending Moment (ft-lb)	Maximum Length of Unsupported Schedule 40 Pipe with water (ft (mm))
HT outlet	73.33	54.10	1.87 (570)

6.5.4 Radiator Service – A048D623, A048D645, A048D652, A049E410, A052D765, A052D767, A053J805, A054B569, A063X313, A063X314, A065H332, A065K735, A065K736, A065K741, A065K742, A065K746, A072Y755, A076E016, A078L534, A078L535, A078R238, A078R241, A078T815, A078T816, A078T818, A078T819, A079P108, A079P131, A079P132, A079Y009, A079Y010, A079Y011, A079Y012, A079Y013, A079Y014, A079Y015, A079Y016, A079Y017

6.5.4.1 Specifications

TABLE 127. SPECIFICATIONS

Item	Data
Cooling System Capacity	
Capacity Standard Radiator Only	For fill volumes, refer to Section 3.2 on page 23
Capacity Engine Only	
Total Capacity (Engine and Standard Radiator)	
Coolant flow rate	For 50 °C, 94 ft² radiator: HT section 2523 lpm (667 gpm) LT section 500 lpm (132 gpm) For 40 °C, 84 ft² radiator: HT section 3218 lpm (850 gpm) LT section 681 lpm (180 gpm) For 60 Hz, 61 ft² radiator: HT section 2915 lpm (770 gpm) LT section 651 lpm (172 gpm) For 50 Hz, 61 ft² radiator: HT section 2442 lpm (645 gpm) LT section 541 lpm (143 gpm)
Expected pressure drop	For 60 Hz: 12 psi For 50 Hz: 8.5 psi
Radiator Pressure cap	
Operating Pressure	1.03 Bar (15 PSI)
Operating Temperature (maximum)	50 °C (122 °F)
Thermostat	

Item	Data
Operating temperature	HT thermostat opens @ 82.2 °C (180 °F) LT thermostat opens @ 46.1 °C (115 °F)
Set Mounted Cooling System	
Radiator Assembly Dry Weight	94 ft^2 5130 kg (11310 lb) 84 ft^2 4581 kg (10100 lb) 61 $ft^2$4456 kg (9824 lb)
Radiator Size	
Height	94 ft^2 3752 mm (147.7 in) 84 ft^2 3767 mm (148.3 in) 61 ft^2 2610 mm (102.8 in)
Width	94 ft^2 3172 mm(124.9 in) 84 ft^2 3029 mm (119.3 in) 61 ft^2 3355 mm (132.1 in)
Depth	94 ft^2 2591 mm (102 in) 84 ft^2 2305 mm (90.7 in) 61 ft^2 2347 mm (92.4 in)

6.5.4.2 Radiator Rigging Instructions

⚠ WARNING

Heavy Load

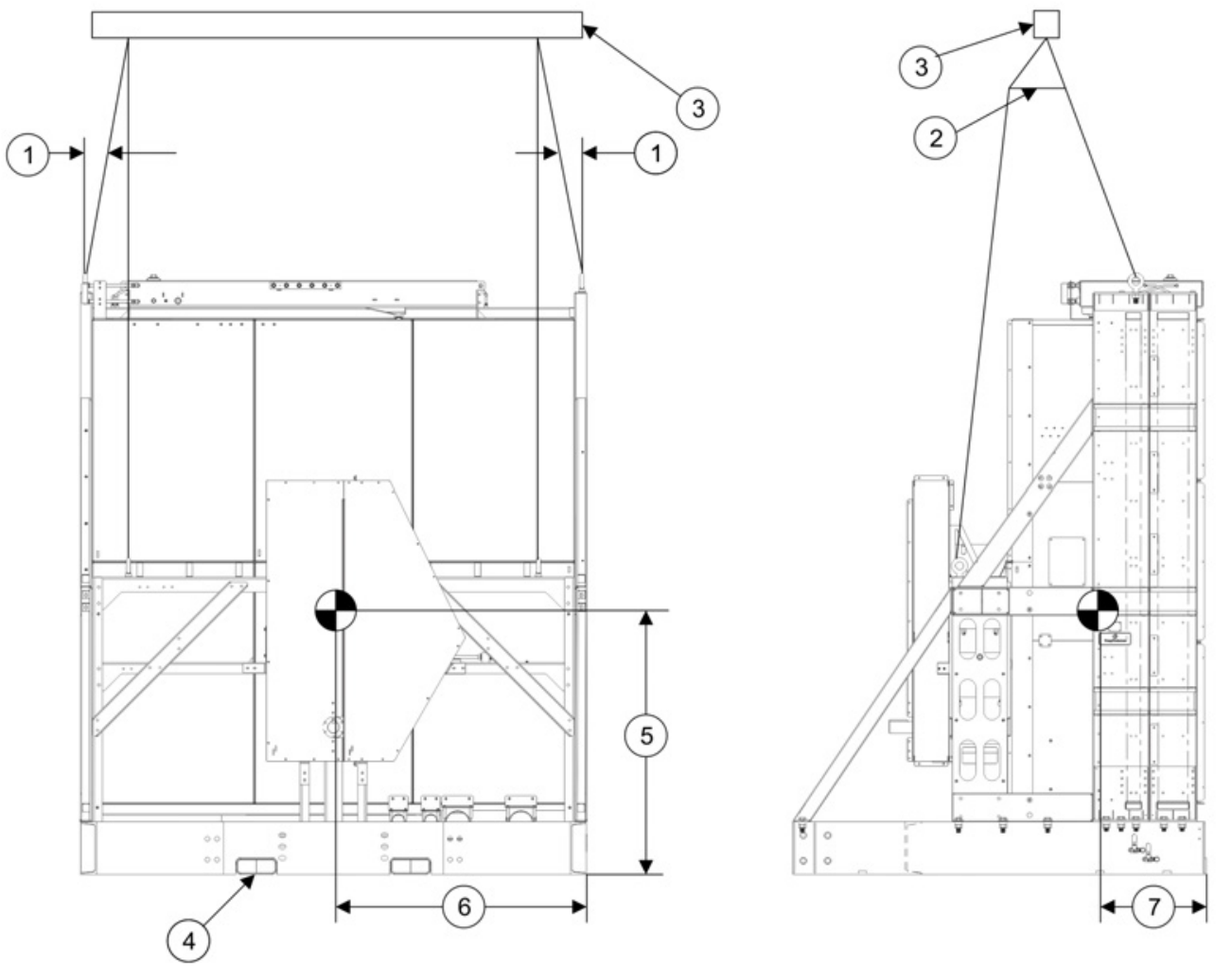
Incorrect lifting or repositioning can cause severe personal injury or death.

Make sure that only suitably trained or experienced personnel transport and handle radiator and associated components.

NOTICE

Do not lift the generator set with the radiator installed. Damage can occur.

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Item	Description	Item	Description
1	Angle 10° maximum	5	61 ft² radiator - 1542 mm (60.71 in) 84 ft² radiator - 1574 mm (61.97 in) 94 ft² radiator - 1535 mm (60.43 in)
2	Spreader bar to avoid damage to the fan guard	6	61 ft² radiator - 1300 mm (51.18 in) 84 ft² radiator - 1500 mm (59.06 in) 94 ft² radiator - 1566 mm (61.65 in)
3	Lifting beam	7	61 ft² radiator - 591 mm* (23.27 in) 84 ft² radiator - 634 mm (24.96 in) 94 ft² radiator - 686 mm (27.01 in)
4	Fork tube (quantity 2) 254 mm X 102 mm (10.0 in X 4.0 in)		Dry weight: 61 ft² radiator - 4456 kg (9,824 lb) 84 ft² radiator - 4581 kg (10,100 lb) 94 ft² radiator - 5130 kg (11,310 lb)

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Cables must not exceed a 45° angle from vertical in any direction.
*Measured from the duct flange, which is the furthest rearward part.

FIGURE 150. RADIATOR RIGGING

6.5.4.3 Cooling System Maintenance

This section provides information on cleaning the radiator and updated information regarding bearings that has been provided by our supplier to enable efficient and prolonged life of the equipment.

NOTICE

The following information regarding the correct choice and fitting of hose clamps has also been provided by our supplier to assist and guide the user.

6.5.4.3.1 Hose Clamp Installation

This section provides general installation guidelines for the correct positioning, orientation and torque figures required when fitting hose clamps. Recommended hose and clamp combinations are also included.

6.5.4.3.1.1 Pipe Couplings

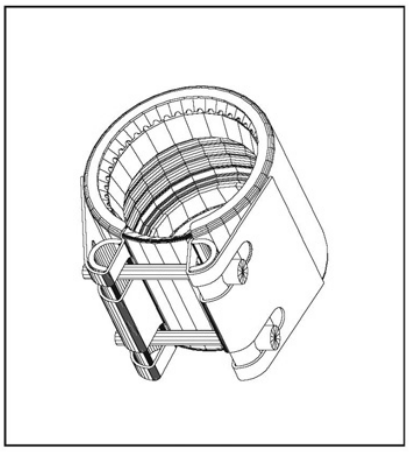


FIGURE 151. PIPE COUPLING

Installation

1. Make sure the pipe ends are clean.
2. Pipes must be properly supported. Couplers do not act as supports for pipes.
3. Center the coupler over the pipe connections.
   - Do not exceed the maximum allowed gap between pipe ends.

NOTICE

To ensure coupler is properly centered on the gap between pipe ends, it is recommended to mark the coupler location on the pipes accordingly prior to tightening the bolts. This mark will act as a guide during installation.

4. Apply anti-seize lubricant compound to the coupler bolt threads.

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5. Using a torque wrench, tighten the coupler bolts in an alternating sequence to the torque value printed on the coupling.
    - Make sure that all bolts have been properly torqued.
    - After coupling has been properly torqued, do not re-torque.

NOTICE
Do not attempt to move coupler after tightening.

Removal

1. Make sure fluids have been properly drained from the system.
2. Loosen the pipe coupler bolts.
3. Carefully pry up and tap the casing to release the grip ring and gasket from the pipe surface.
4. Slide the coupler to the side to remove from the pipe.

6.5.4.3.2 Cleaning

6.5.4.3.2.1 General Cleaning

The Cleaning Of Radiator Cores Using Pressurized Water Equipment:

NOTICE
In specific dust laden environments, this procedure should not be used as the initial cleaning operation; it should follow Cleaning - Dust Laden Environments.

On enclosed generator sets with removable end panel(s), remove the end panel(s) to assist in the cleaning of the radiator.

Inspect the exterior of the radiator for obstructions. During the service life of a radiator, a build up of foreign matter can obstruct the flow of air through the radiator cores, reducing the cooling capability. To ensure the continued efficiency of the radiator, the core will require cleaning.

For thorough cleaning, pressure wash in the opposite direction to the airflow. A suitable proprietary degreasing additive (as recommended by the manufacturer of the pressure washer) should be applied via the pressure washer but this must not contain ammonia as it will corrode the core.

The recommended equipment for cleaning a radiator core is an industrial pressure washer, but it must be used in the correct manner as misuse can reduce the performance of the core. Protect the generator set from any over spray during this procedure.

To be effective, it is recommended that a hot water washer be used.

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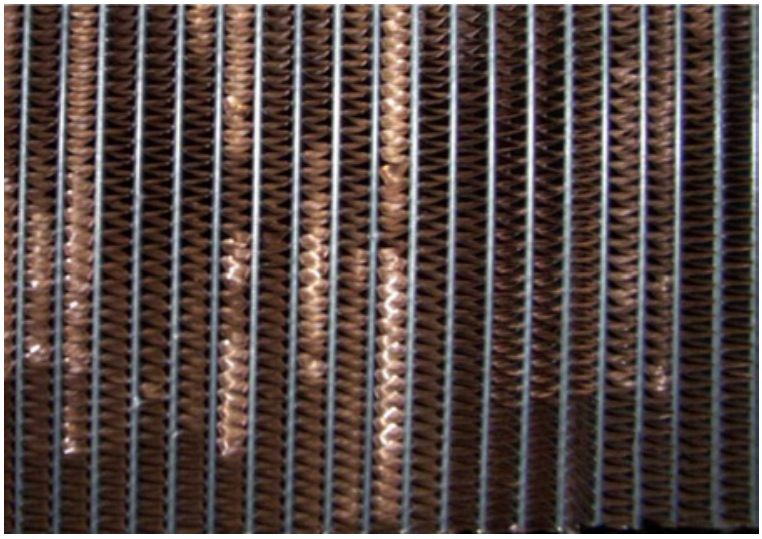


FIGURE 152. FINS DAMAGED BY PRESSURE WASHING AT ACUTE ANGLES TO CORE FACE

NOTICE
With the pressures involved it is important that the distance between the core face and the nozzle is a minimum of 100 mm (3.93 inches); any closer and damage may occur.

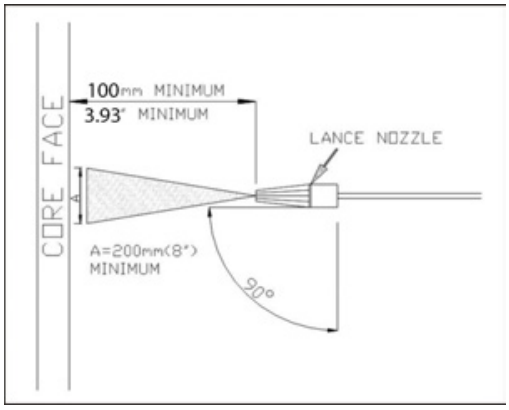


FIGURE 153. PRESSURE WASHER NOZZLE POSITIONING

NOTICE
Most Industrial pressure washers work at pressures of around 1500 psi to 2000 psi (103 bar to137.89 bar). It is very important that, when washing a core in this way, the lance must be kept at a right angle to the core

NOTICE
If your pressure washer works above 2000 psi, then the gap between the nozzle and the core face must be increased or fin damage will occur.

NOTICE
Always follow pressure washer Manufacturer's Health and Safety Guidelines.

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Replace the end panel(s) where necessary.

6.5.4.3.2.2 Dust Laden Environments

Specific Instructions for the Cleaning of Radiator Cores Used in an Environment Subjected to Crushed Aggregate or Ceramic Dust Contamination

On enclosed generator sets with removable end panel(s), remove the end panel(s) to assist in the cleaning of the radiator.

Inspect the exterior of the radiator for obstructions. During the service life of a radiator, a buildup of foreign matter can obstruct the flow of air through the radiator cores, reducing cooling capability. To maintain the efficiency of the radiator, the core will require cleaning.

Unless the radiator can be dismantled and the core treated in a professional caustic immersion cleaning system, the radiator should not be “wet” cleaned. This is because of the tendency of this type of contamination to coalesce and become extremely difficult to remove.

The correct procedure is to regularly blow through the entire core area with low pressure compressed air (against the direction of cooling airflow). It is very important to ensure that resultant debris blown from the core is subsequently removed and disposed of before engine start-up. An industrial vacuum cleaner will achieve this requirement. In most installations, it will be necessary to remove cowls and guarding.

To prevent damage to fins and resultant loss of cooling, it is important to ensure that the air gun used is maintained at right angles to the core face.

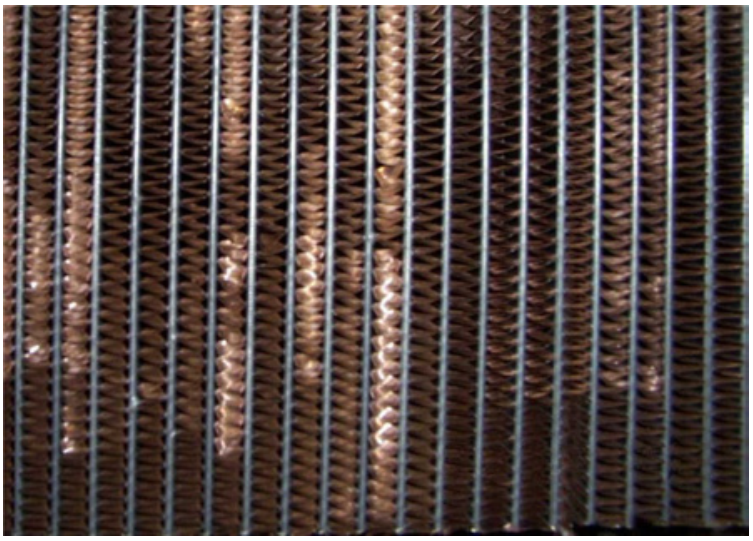


FIGURE 154. FINS DAMAGED BY COMPRESSED AIR AT ACUTE ANGLES TO CORE FACE

After this procedure has been effectively carried out with only the lightest of dust remaining, follow it immediately (if necessary) by cleaning the radiator cores using pressurized water equipment.

Replace the end panel(s) where necessary.

NOTICE
It is vitally important that the core is thoroughly dried before start-up.

6.5.4.3.3 Fan Drive Bearings

6.5.4.3.3.1 Bearing Health Check

The following information is relevant to both Interference Fit and Non-Interference Fit bearings.

Determine if there are any sounds emanating from the shaft/bearing assembly which may be indicative of failure, or imminent failure.

6.5.4.3.3.2 Fan Drive Bearing Locations

Placeholder for image depicting Fan Drive Bearing Locations.

FIGURE 155. FAN DRIVE BEARING LOCATIONS

6.5.4.3.3.3 Bearing and Grease Change

The fan drive and design has been changed to improve serviceability of the bearing set-up, both in terms of greasing and fitting.

For detailed procedure applicable to this radiator, see **Section 6.5.4.7.2 on page 582**

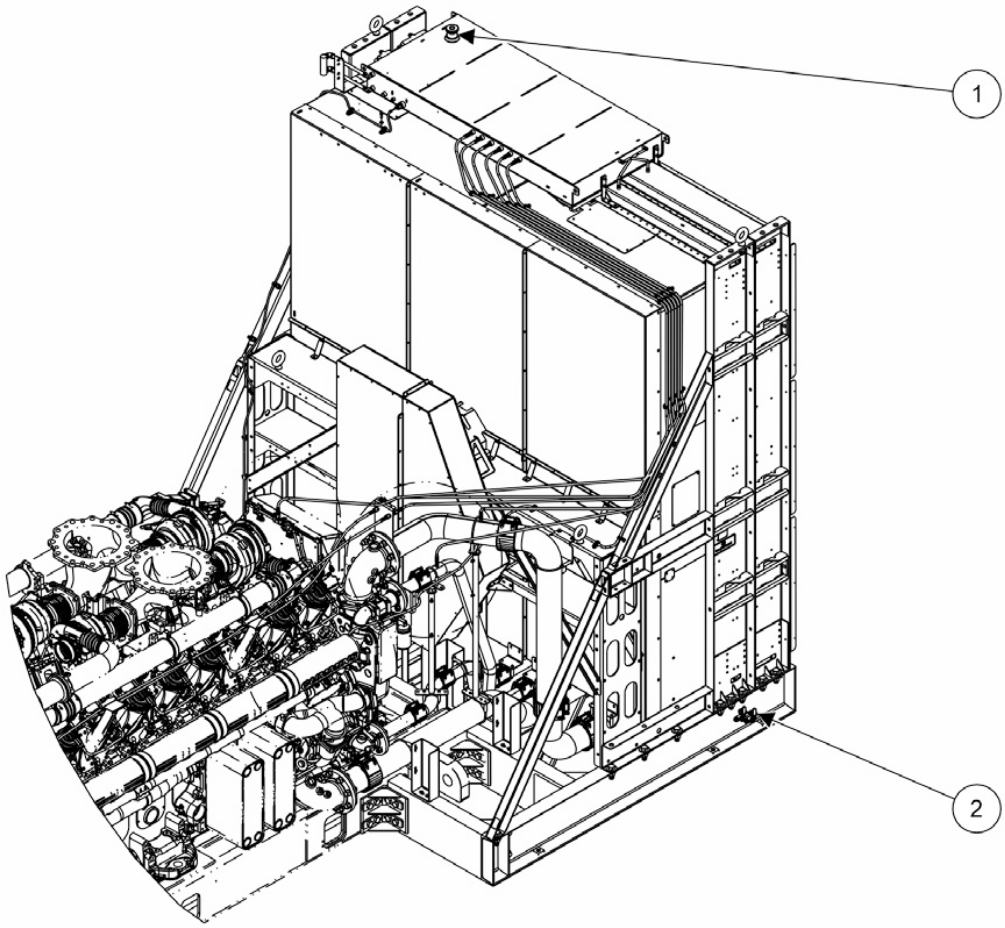
6.5.4.4 Radiator Removal - Open Set

6.5.4.4.1 Remove Radiator Fan Drive Shaft

Remove the radiator fan drive shaft according to **Section 6.5.7.1 on page 685**.

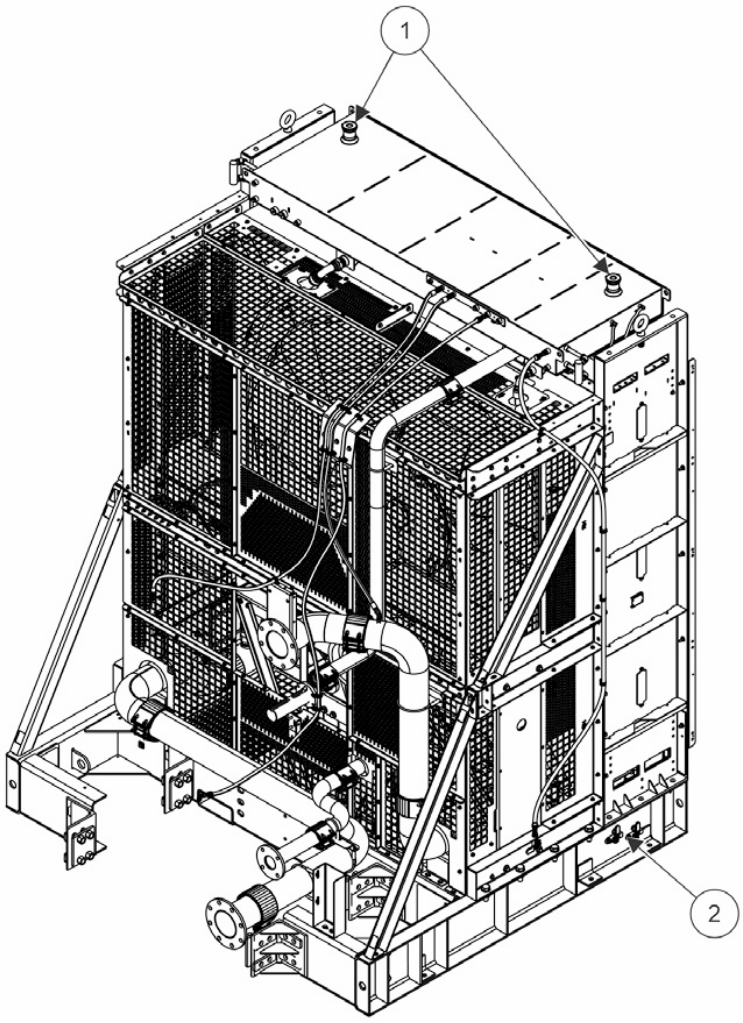
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6.5.4.4.2 Remove Coolant



No.	Description	No.	Description
1	Fill neck	2	Drain valves

FIGURE 156. RADIATOR FILL NECK AND DRAIN VALVE LOCATIONS (84 SQ FT AND 94 SQ FT)



No.	Description	No.	Description
1	Fill Necks	2	Drain Valves

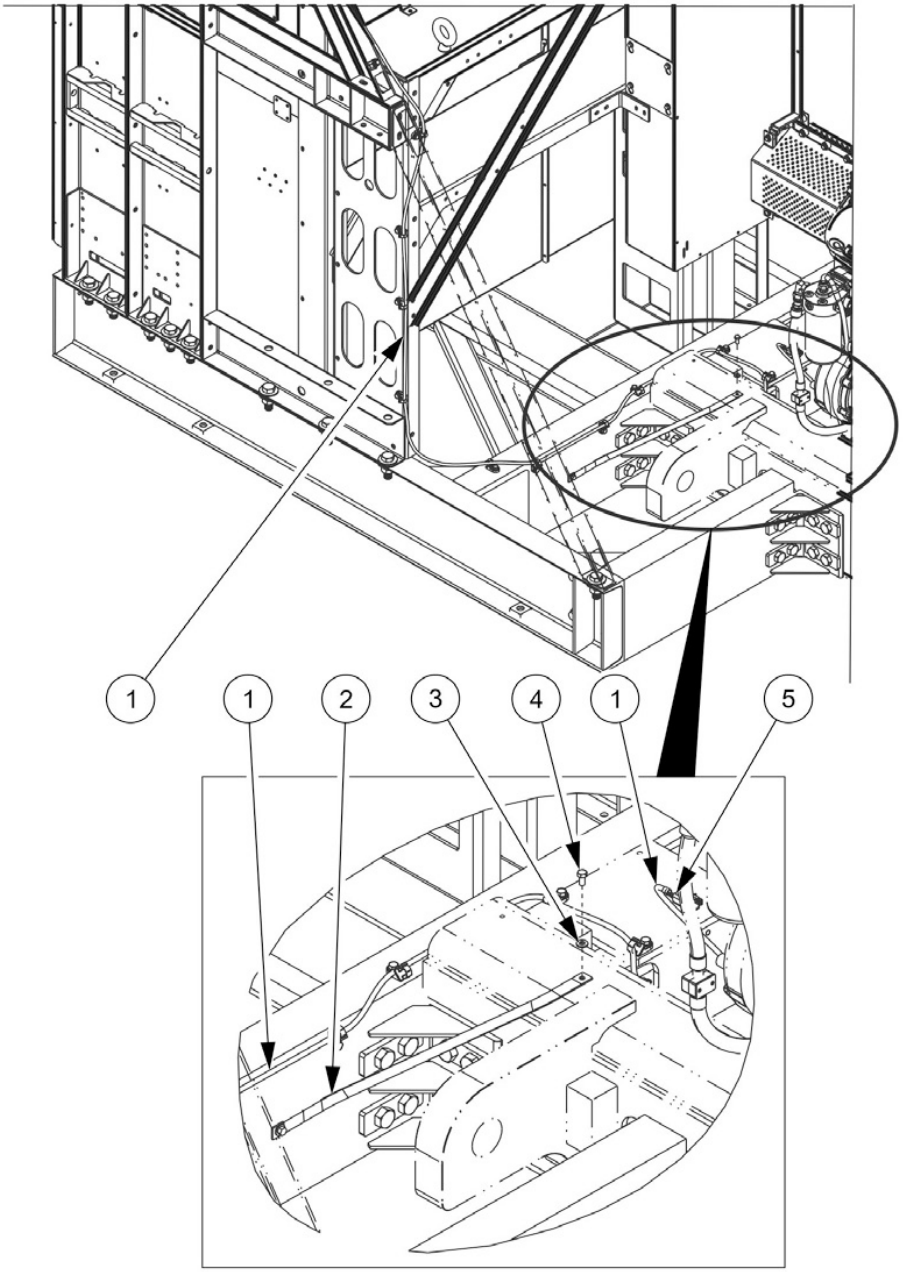
FIGURE 157. RADIATOR FILL LOCATIONS (61 SQ FT)

1. Remove the radiator pressure cap on the fill neck.
2. Connect a drain hose from the drain valves to a suitable container.
3. Open the drain valves to drain coolant to the container.
4. Dispose of the coolant in accordance with local regulations.

6.5.4.4.3 Remove Low Coolant Level Sensor Harness from Engine Harness

NOTICE
Numbers in parenthesis refer to Figure 158 unless specified otherwise.

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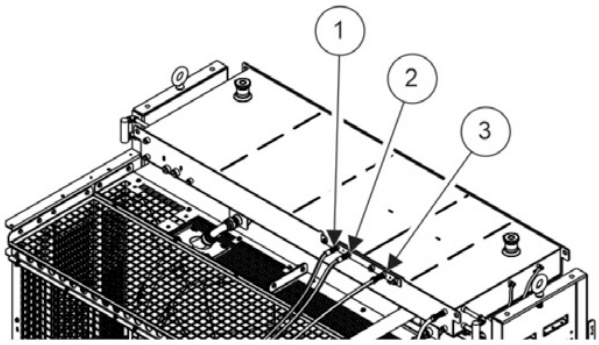
No.	Description	No.	Description
1	Low coolant level sensor harness	4	Bolt
2	Ground strap	5	P1
3	Washer		

FIGURE 158. LOW COOLANT LEVEL SENSOR HARNESS CONNECTION TO ENGINE HARNESS

1. Remove the radiator ground strap (2).
2. Disconnect the low coolant level sensor harness (1) from the engine harness (5).

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6.5.4.4.4 Remove Vent Lines (61 Sq Ft Radiator)

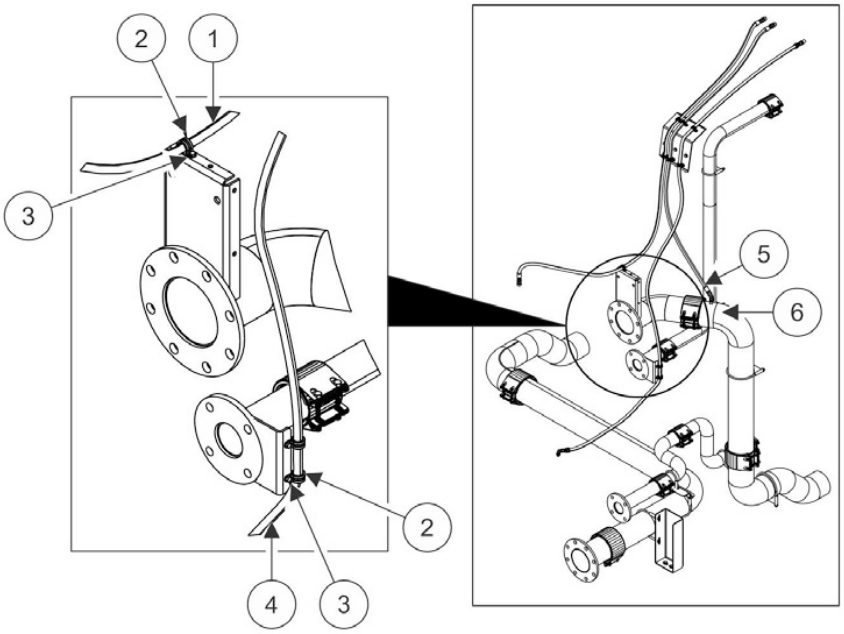


No.	Description	No.	Description
1	HT Engine Vent Line	3	LT Engine Vent Line
2	HT Outlet Tube Vent Line		

FIGURE 159. RADIATOR VENT LINES

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6.5.4.4.4.1 Remove Vent Lines on Outlet Tubes and Vent Line Support Brackets



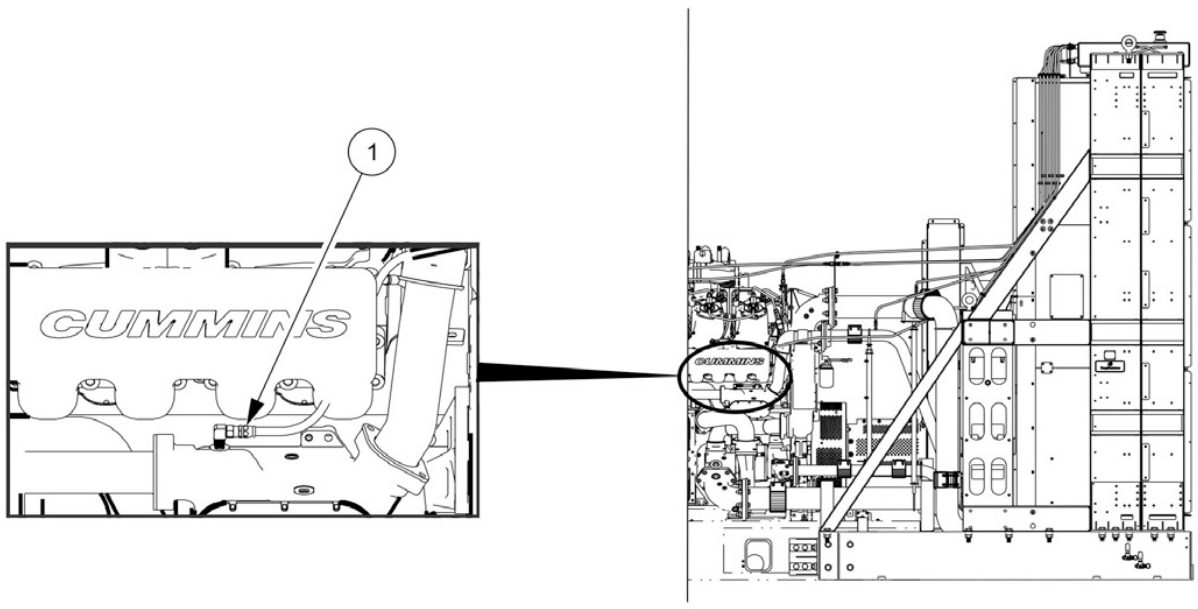
No.	Description	No.	Description
1	HT Engine Vent Line	4	LT Engine Vent Line
2	Hose Clip	5	HT Outlet Tube Vent Line
3	Bolt	6	HT Outlet Tube

FIGURE 160. VENT LINES ON OUTLET TUBES AND VENT LINE SUPPORT BRACKETS

1. Label vent line locations.
2. Remove one bolt (3) and one hose clip (2) securing the HT vent line (1) to the HT vent line support bracket.
3. Remove the HT outlet tube vent line (5) from the HT outlet tube (6).
4. Remove two bolts (3) and two hose clips (2) securing the LT engine vent line (4) to the LT engine vent line bracket.

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6.5.4.4.4.2 Remove LT Engine Vent Line



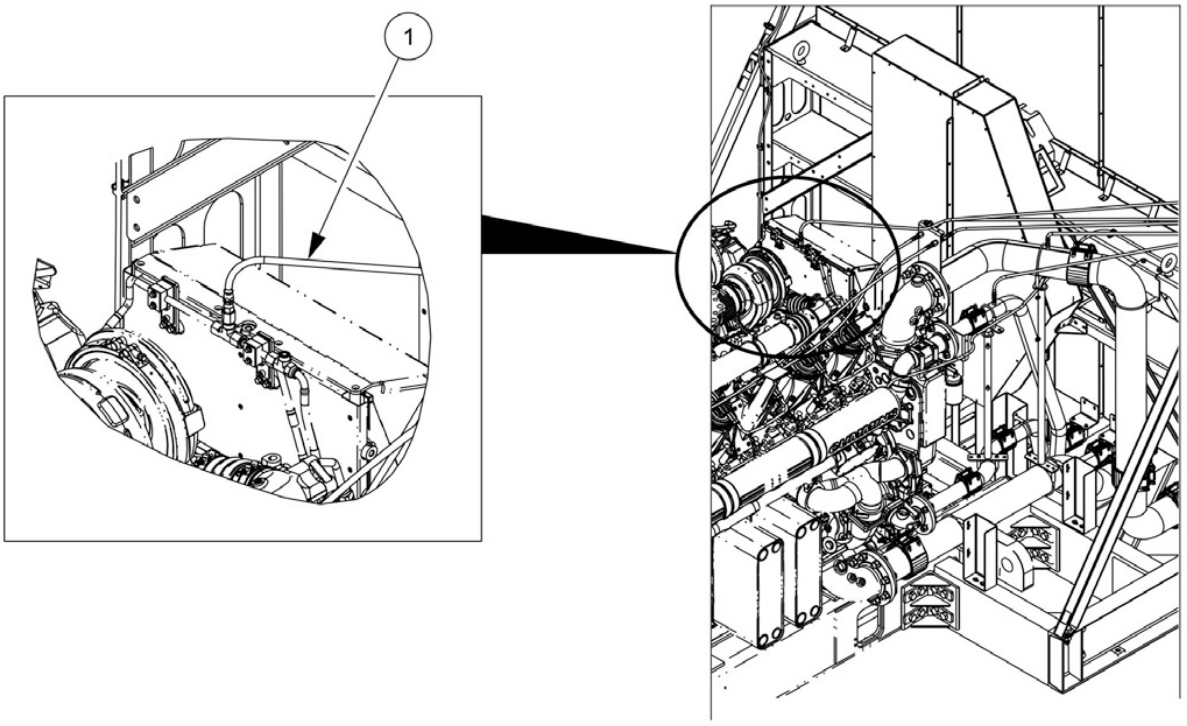
No.	Description
1	Vent Line

FIGURE 161. LT ENGINE VENT LINE

1. Label Vent line locations.
2. Remove LT vent line (1) from LT thermostat vent line fitting.

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6.5.4.4.4.3 Remove HT Engine Vent Line

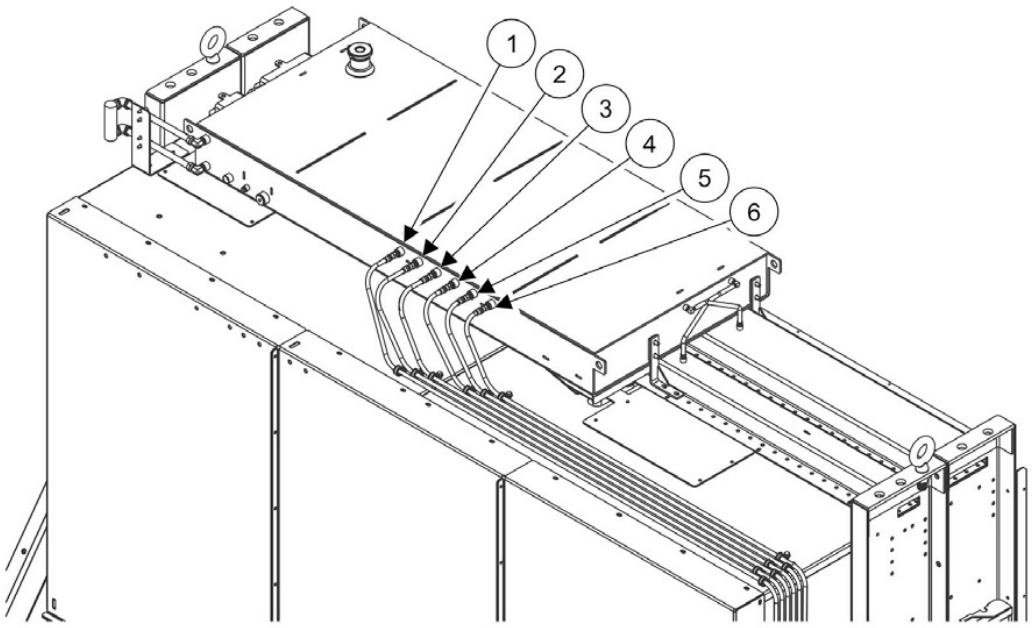


No.	Description
1	Vent Line

FIGURE 162. HT ENGINE VENT LINE

1. Label vent line locations.
2. Remove HT vent line (1) from HT vent line fitting.

6.5.4.4.5 Remove Vent Lines (84 Sq Ft and 94 Sq Ft Radiator)



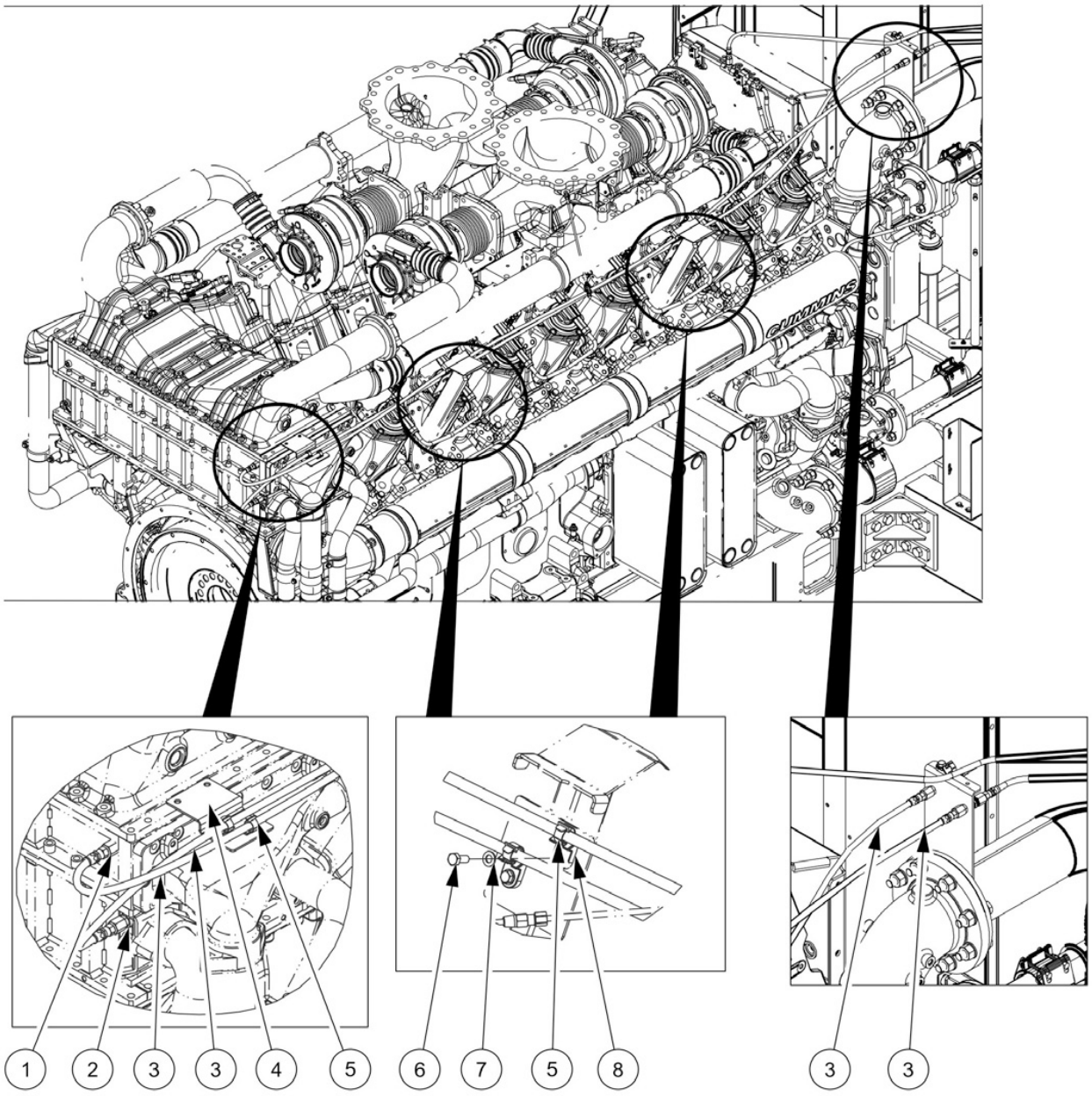
No.	Description
1	Vent lines

FIGURE 163. RADIATOR VENT LINES

6.5.4.4.5.1 Remove HT and LT Aftercooler Vent Lines

NOTICE
Numbers in parenthesis refer to Figure 164 unless otherwise specified.

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No.	Description	No.	Description
1	HT aftercooler vent	5	Cable tie
2	LT aftercooler vent	6	Screw
3	Vent Line	7	Washer
4	Bracket	8	Cable clamp

FIGURE 164. HT AND LT AFTERCOOLER VENT LINES (SPEC A ONLY)

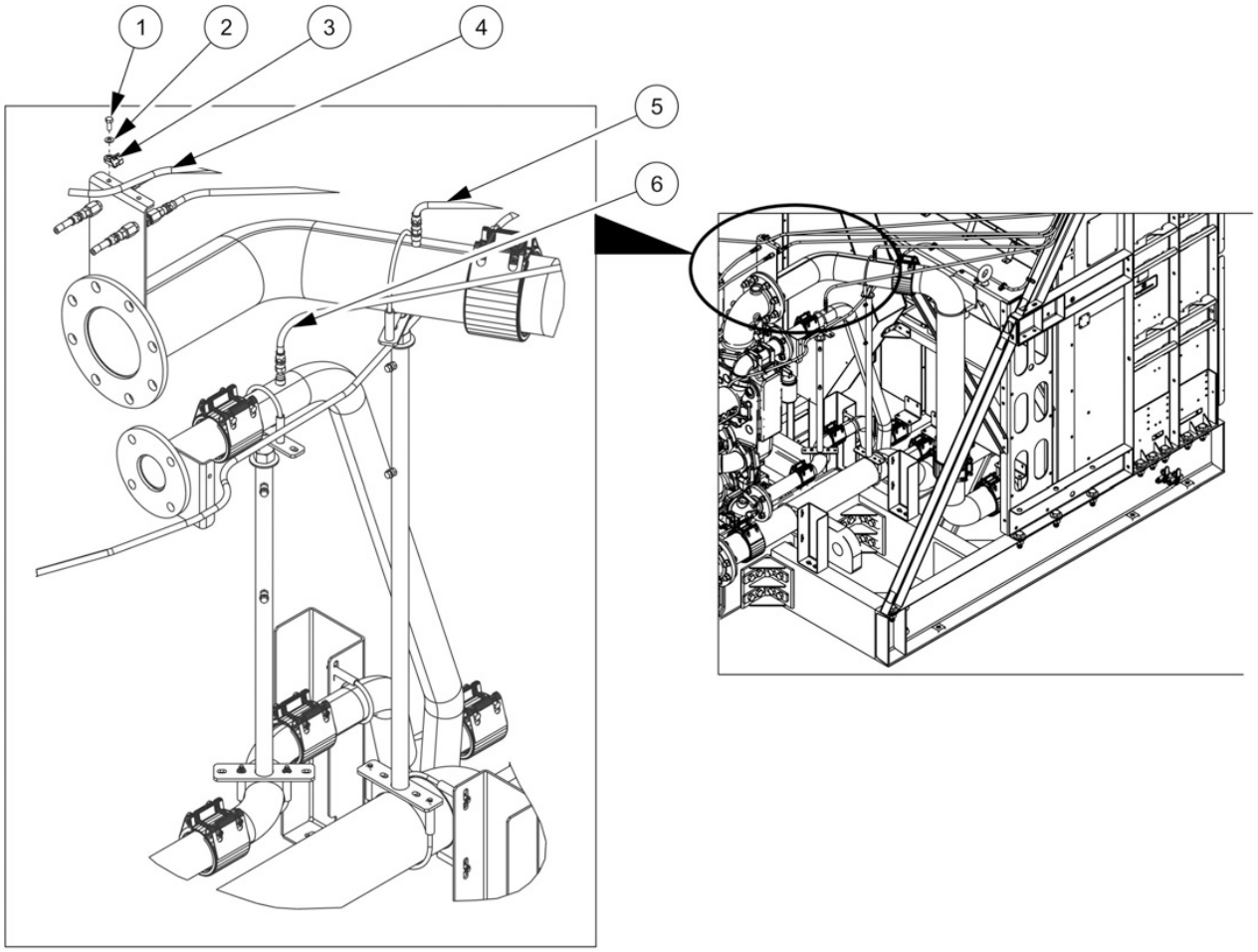
1. Label vent line locations.
2. Remove vent lines (3) from vent line support bracket.

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6.5.4.4.5.2 Remove Vent Lines from Outlet Tubes and HT Vent Line Support Bracket

NOTICE

Numbers in parenthesis refer to Figure 165 unless otherwise specified.



No.	Description	No.	Description
1	Screw	4	Vent Line
2	Washer	5	Vent Line
3	Cable clamp and cable tie	6	Vent Line

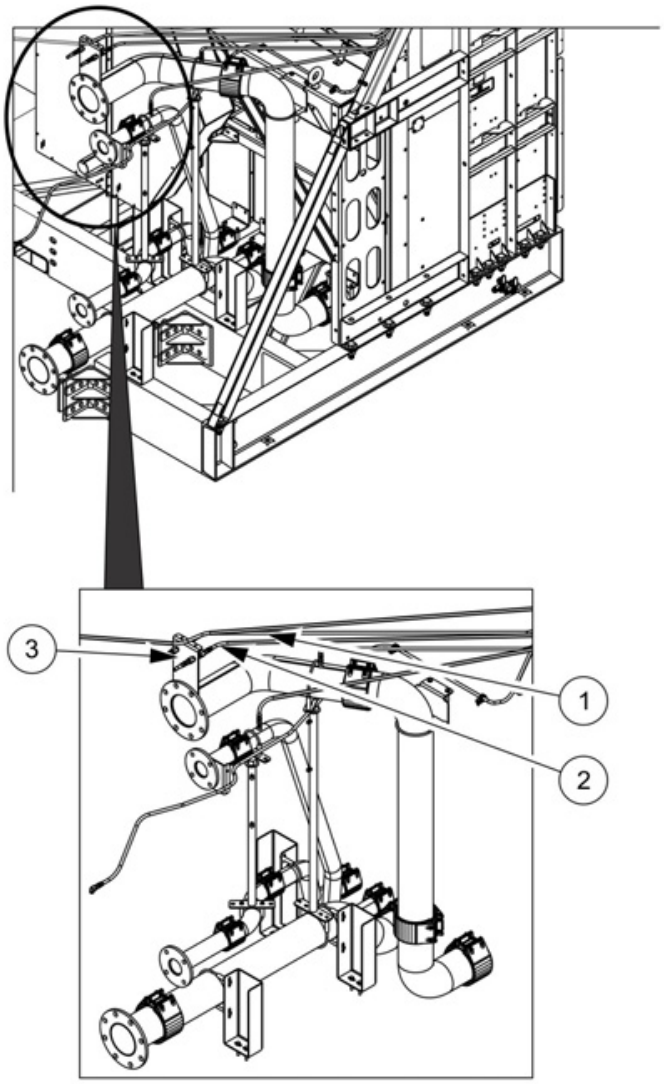
FIGURE 165. VENT LINES ON OUTLET TUBES AND HT VENT LINE SUPPORT BRACKET

1. Label vent line locations.
2. Remove vent line (6) from the LT outlet tube.
3. Remove vent line (5) from the HT outlet tube.
4. Remove vent line (4) from vent line support bracket.

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6.5.4.4.5.3 Remove Vent Lines from HT Vent Line Support Bracket

NOTICE
Numbers in parenthesis refer to Figure 166 unless specified otherwise.



No.	Description	No.	Description
1	Vent Line	3	HT vent line support bracket
2	Vent Line		

FIGURE 166. VENT LINES ON HT VENT LINE SUPPORT BRACKET

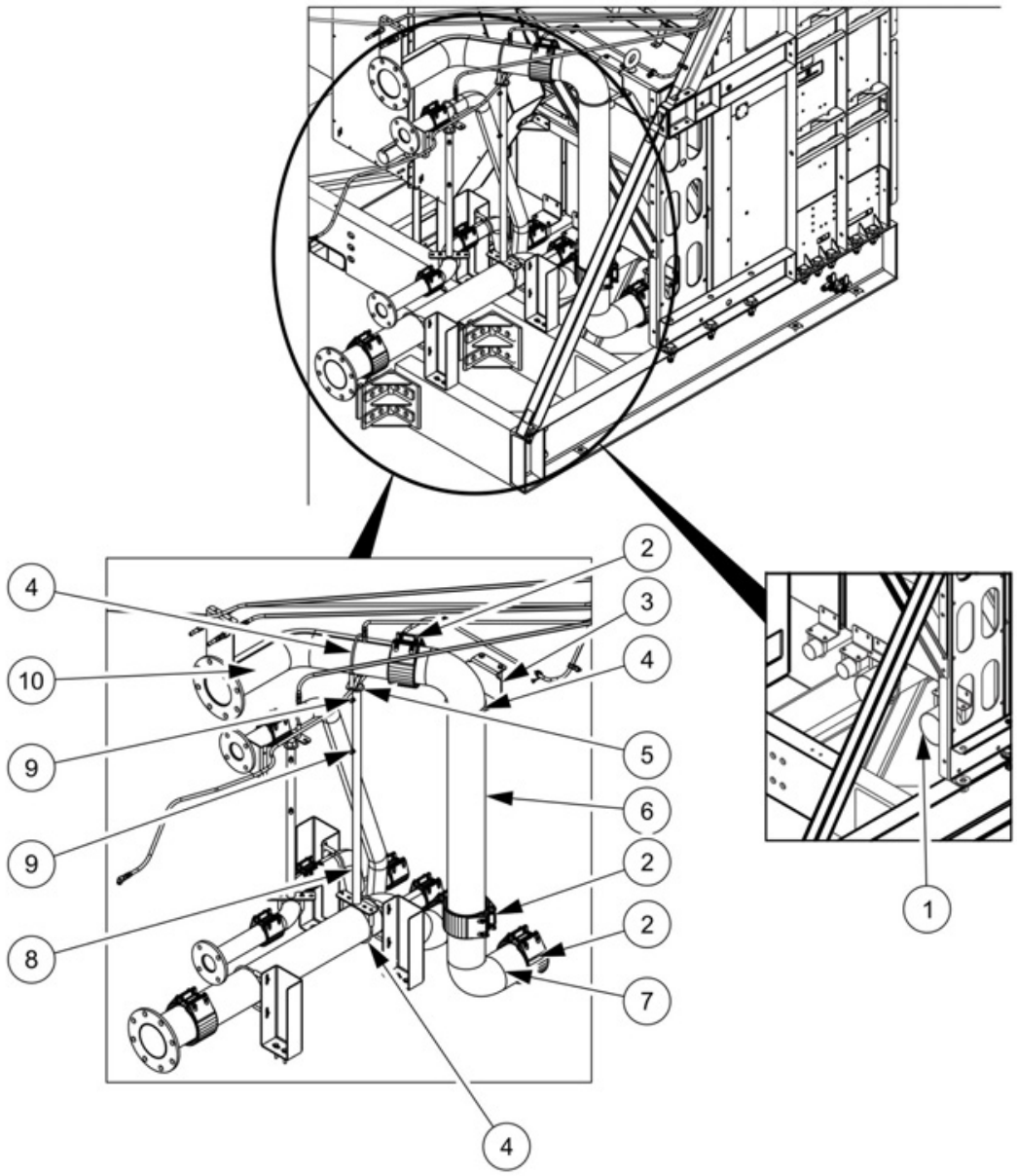
1. Label vent line locations.
2. Remove vent lines (1 and 2) from the HT vent line support bracket.

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6.5.4.4.6 Remove HT Outlet Tubing

NOTICE
Numbers in parenthesis refer to Figure 167 unless specified otherwise.

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No.	Description	No.	Description
1	Radiator HT Outlet	6	HT outlet tube
2	Pipe coupler	7	HT radiator outlet tube
3	HT outlet tube support	8	Tube support
4	U-bolt	9	Lock bolt
5	Adjustment screw	10	HT engine outlet tube

FIGURE 167. HT OUTLET TUBING

1. Remove HT outlet tube support bracket (3).
2. Remove U-bolts (3 and 4).

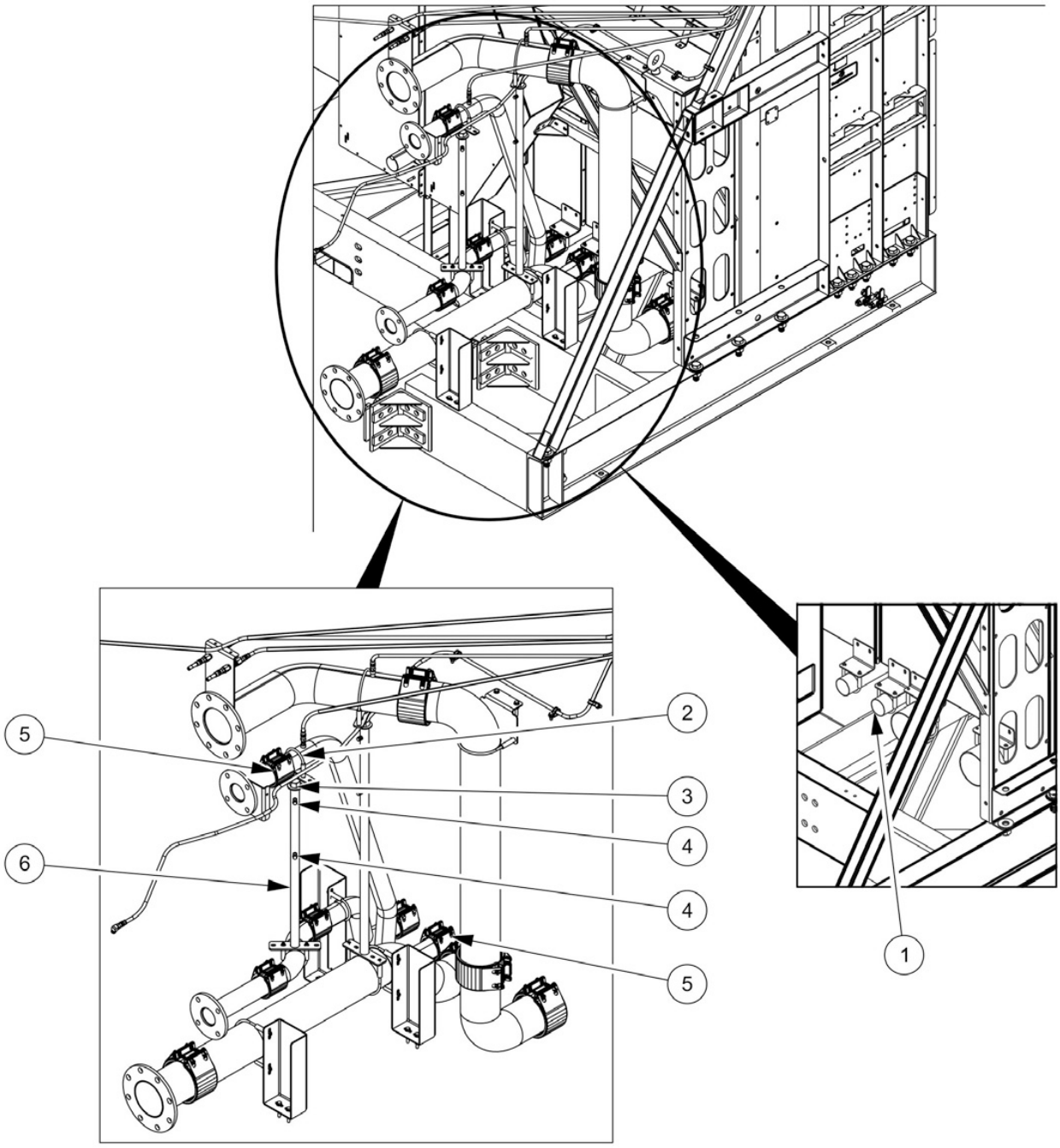
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3. Loosen bolts on pipe couplers (2) that attach to HT engine outlet tube (10) and HT radiator outlet tube (7).
4. Slide pipe couplers (2) onto HT engine outlet tube (10).
5. Remove the engine outlet tube (10).
6. Loosen bolts on pipe coupler (2) that attaches HT radiator outlet tube (7) and radiator connection point (1).
7. Remove HT radiator outlet tube (7).

6.5.4.4.7 Remove LT Outlet Tubing

NOTICE
Numbers in parenthesis refer to Figure 168 unless specified otherwise.

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No.	Description	No.	Description
1	Radiator LT Outlet	4	Lock bolt
2	U-bolt	5	Pipe coupler
3	Adjustment screw	6	Tube support

FIGURE 168. LT OUTLET TUBING

1. Remove U-bolt (2) from LT outlet tube support (6).

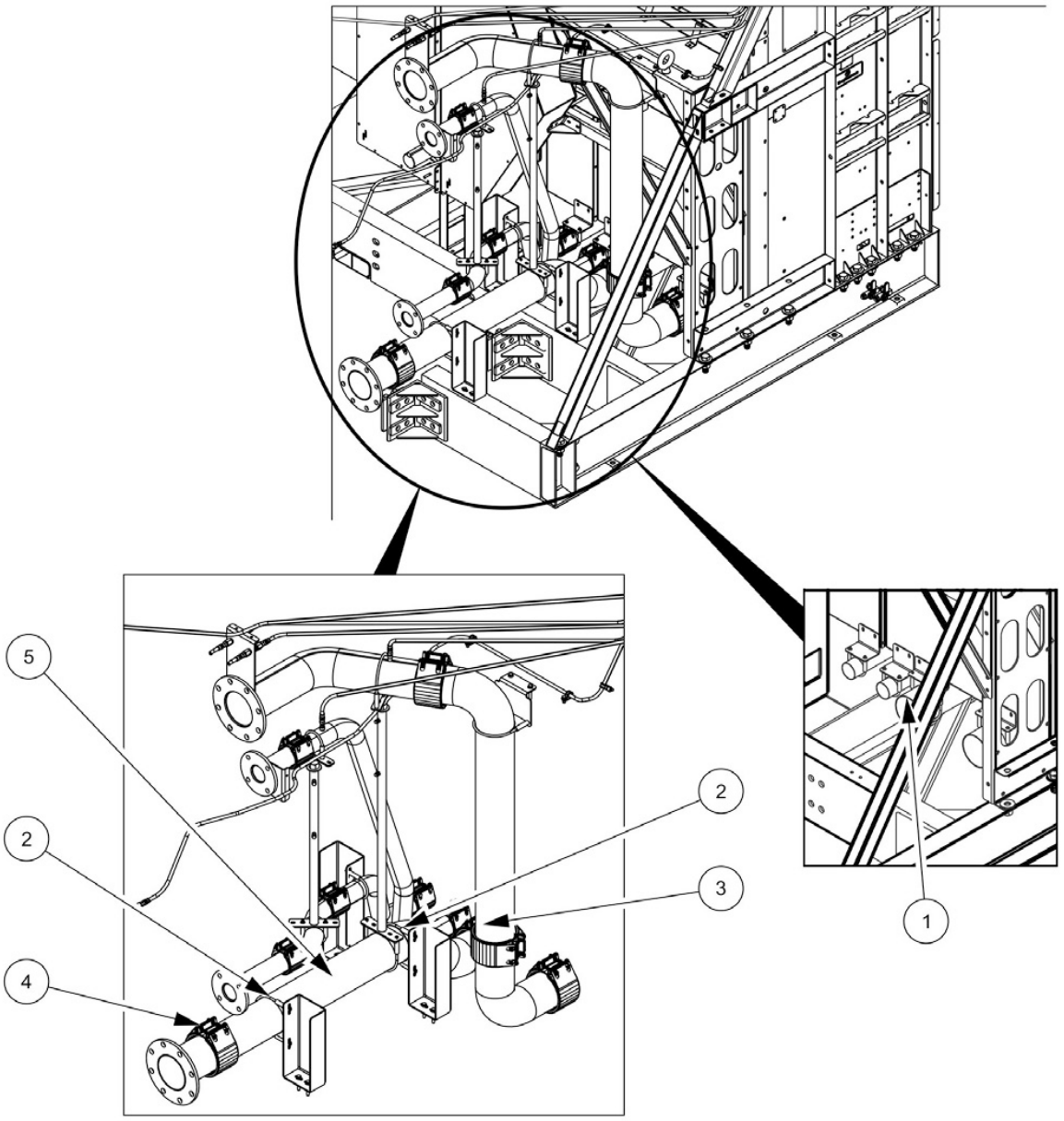
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2. Loosen bolts on pipe couplers (5).
3. Slide pipe couplers (5) onto LT outlet tube.
4. Remove LT outlet tube.

6.5.4.4.8 Remove HT Inlet Tube

NOTICE
Numbers in parenthesis that follow refer to Figure 169 unless specified otherwise.

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No.	Description	No	Description
1	Radiator HT Inlet	4	Pipe coupler
2	U-bolt	5	HT inlet tube
3	Pipe coupler (behind outlet tube)		

FIGURE 169. HT INLET TUBE

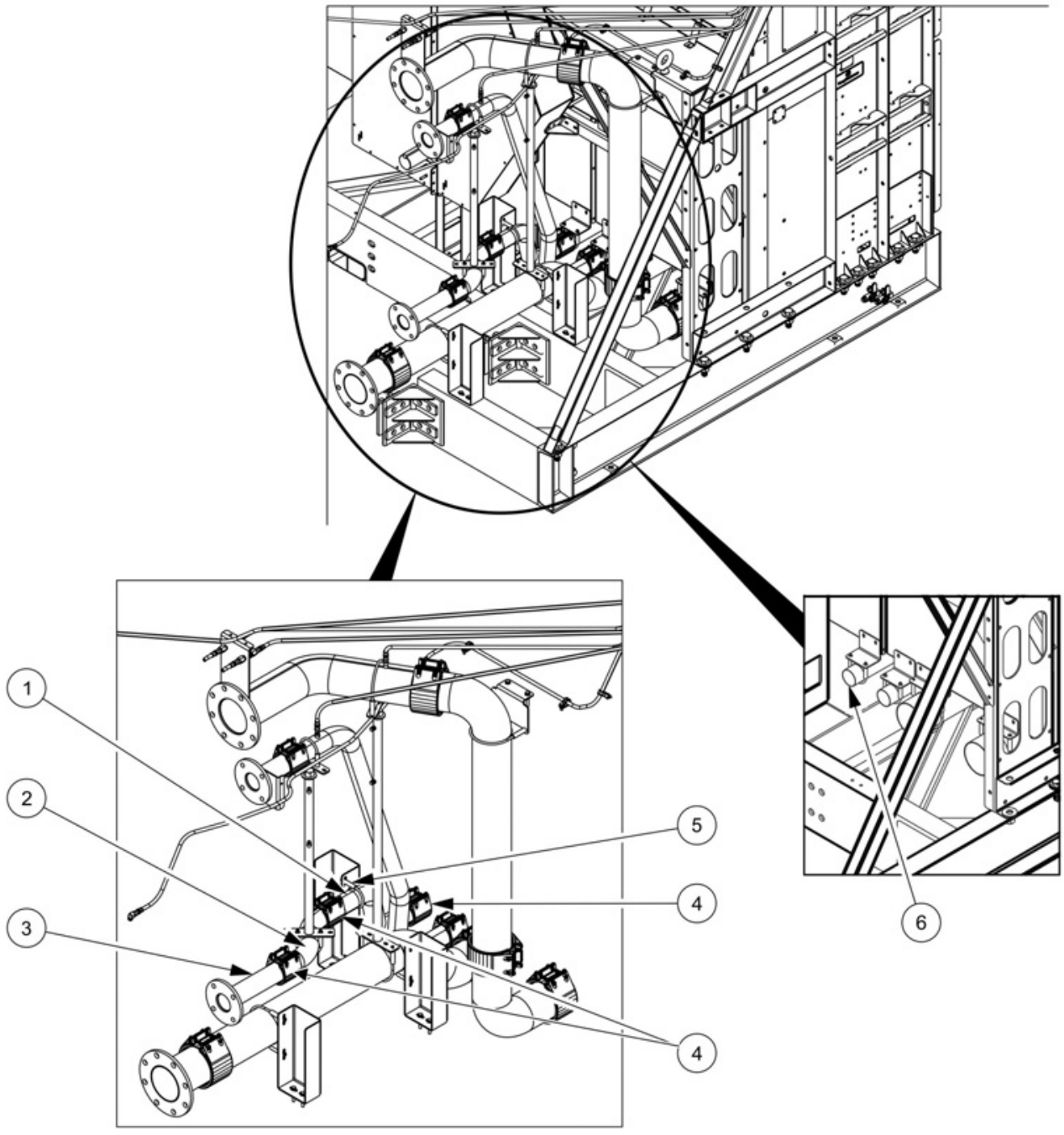
1. Remove U-bolts (2).
2. Loosen bolts on pipe couplers (3 and 4).
3. Slide pipe couplers (3 and 4) onto HT inlet tube (5).
4. Remove HT inlet tube (5).

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6.5.4.4.9 Remove LT Inlet Pipe from Radiator

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No.	Description	No.	Description
1	Radiator tube	4	Pipe coupler
2	S-bend tube	5	U-bolt
3	Engine tube	6	Radiator LT outlet

FIGURE 170. LT INLET PIPE

1. Remove U-bolt (5).

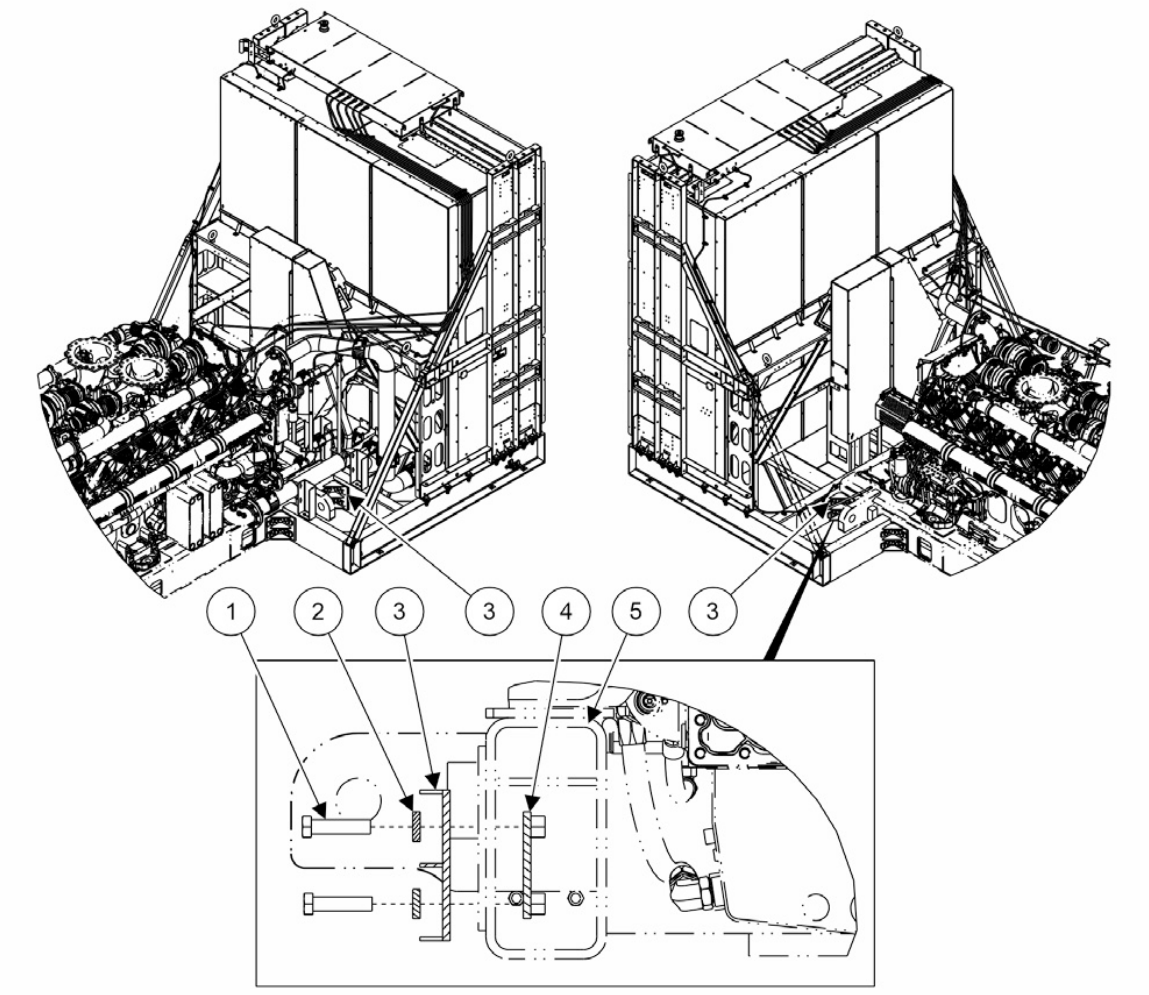
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2. Loosen bolts on pipe couplers (4).
3. Slide pipe couplers (4) onto radiator tube (1) and S-bend tube (2).
4. Remove radiator tube (1) and S-bend tube (2).

6.5.4.4.10 Remove Front Radiator L-brackets on Generator Set Skid

NOTICE
Numbers in parenthesis refer to Figure 171 unless otherwise specified.

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No.	Description	No.	Description
1	Bolt	4	Nut plate
2	Washer plate	5	Generator set skid
3	L-bracket		

FIGURE 171. FRONT LEFT AND RIGHT RADIATOR L-BRACKETS

1. Remove two L-brackets (3) on the generator set skid (5) at the front right and left radiator mounting locations. Use four bolts (1), two washer plates (2), and one nut plate (4) for each L-bracket (3).

6.5.4.5 Radiator Installation - Open Set

6.5.4.5.1 Required Tools, Parts, and Consumables

The following tools are required to complete this installation.

- Tape measure
- Level
- Torque Wrenches
  - 40-200 in-lb, 3/8 inch drive

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    - 15-75 ft-lb, 3/8 inch drive
    - 50-250 ft-lb, 1/2 inch drive
    - 120-600 ft-lb, 3/4 inch drive
- Toe Jacks, Fork Lift, or Overhead Crane capable of lifting generator set
    - If using overhead crane, appropriately sized rigging equipment
- Pipe wrench, 24 inch
- Hex socket
    - 6 mm
    - 8 mm
    - 17 mm
    - 5/16 inch
- Paint marker
- Socket
    - 36 mm
    - 1/2 inch
    - 15/16 inch
    - 1 1/8 inch
- Deep socket
    - 9/16 inch
    - 15 mm
- Combination wrench
    - 1 1/16 inch
    - 1 1/4 inch
- 3/4 inch drive extension, 8 inch
- Belt tension tool (A050L945)
- Standard 6 inch (150 mm) Vernier calipers
- Steel bar (A059R243)
- Clamp (A001G779)
- Clean rags
- Molykote (MoS")
- ½ inch internal to 3/8 inch external square drive adapter
- 3/8 inch drive, 12 point, 21 mm torque adapter with 2 inch offset
- Jeweler files, or 150 grit or finer emery cloth

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6.5.4.5.2 Safety Precautions

⚠ WARNING

Automated Machinery

Accidental or remote starting of the generator set can cause severe personal injury or death.

Isolate all auxiliary supplies and use an insulated wrench to disconnect the starting battery cables (negative [–] first).

⚠ WARNING

Electrical Generating Equipment

Incorrect operation and maintenance can result in severe personal injury or death.

Make sure that only suitably trained and experienced service personnel perform electrical and/or mechanical service.

⚠ WARNING

Combustible Gases

Ignition of battery gases is a fire and explosion hazard which can cause severe personal injury or death.

Using an insulated wrench, disconnect the negative (–) cable first and reconnect it last. Make certain hydrogen from the battery, engine fuel, and other explosive fumes are fully dissipated. This is especially important if the battery has been connected to a battery charger.

⚠ WARNING

Combustible Gases

Ignition of battery gases is a fire and explosion hazard which can cause severe personal injury or death.

Do not smoke, or switch the trouble light ON or OFF near a battery. Touch a grounded metal surface first before touching batteries to discharge static electricity. Stop the generator set and disconnect the battery charger before disconnecting battery cables. Using an insulated wrench, disconnect the negative (–) cable first and reconnect it last.

⚠ WARNING

Electric Shock Hazard

Voltages and currents present an electrical shock hazard that can cause severe burns or death.

Make sure that only service personnel who are trained and experienced perform electrical and mechanical component installations. Follow all local requirements when working on electrical equipment. Isolate all forms of electrical energy before working on the generator set.

⚠ CAUTION

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Disconnect the battery charger before isolating the battery.

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⚠ CAUTION
Sharp Edges ***Sharp edges/burrs on housing parts can cause cuts and puncture wounds.*** ***When handling housing parts, use appropriate PPE.***

Read these instructions completely and become familiar with safety warnings, cautions, and procedures before starting the installation.

The installer must be familiar with the techniques of working on heavy machinery. A hoist must be available which can support the weight of the radiator, with an appropriate lifting strength margin.

Turn off or remove AC power from the battery charger and then use an insulated wrench to remove the negative (**–**) battery cable from the set starting battery. This prevents the generator set from starting while working on it and to avoid circuit board damage, caused by voltage spikes when removing and replacing circuit board connectors.

6.5.4.5.3 Preparing for the Installation

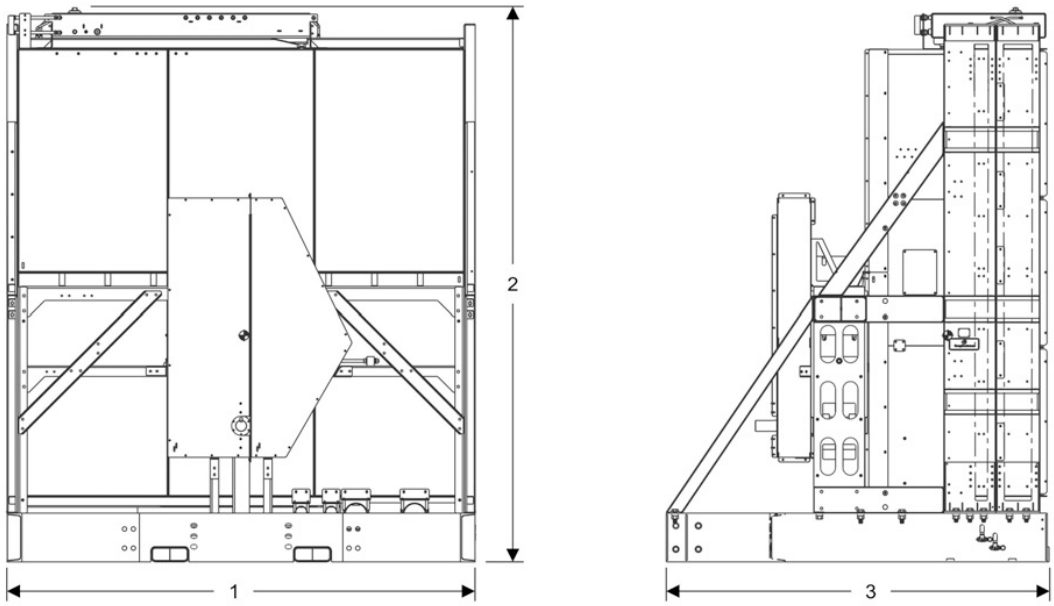
When installing the generator set, make sure to consider what is needed to install the cooling system.

1. Make sure to have all of the necessary tools and any additional items needed to complete the installation.

   The following items must be supplied by the customer to complete the installation.

   - Cable ties to be used when installing the vent lines
   - Coolant mixture:
     - For 94 ft^2 radiators: fully formulated, a 50% EG coolant mixture.
     - For 84 ft^2 radiators: fully formulated, a 50% EG coolant mixture.
     - For 61 ft^2 radiators: fully formulated, a 50% EG coolant mixture.
     - For fill volumes, refer to **Section 3.2**.
   - High strength tread locking compound (Loctite 277 or equivalent)
   - Anti-seize (Loctite C5-A or equivalent)
   - Thread sealant (Loctite 592 or equivalent)
   - Dielectric grease (Loctite 8423 or equivalent)
2. Apply the appropriate Hot Surface Warning Labels, included in the radiator kit, to the applicable parts as required per local codes and standards.
3. Make sure to have allowed enough space to install the radiator. Basic radiator dimensions are shown in **Figure 172**.

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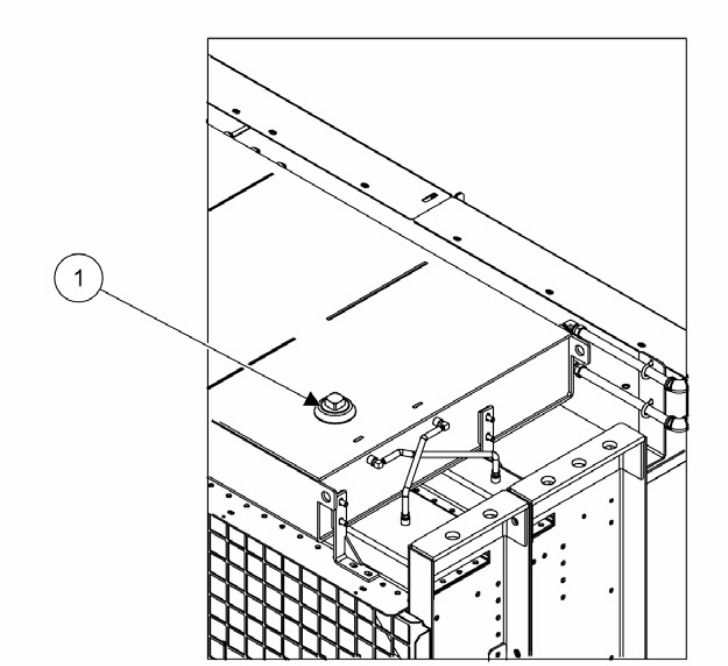


No.	Description	No.	Description
84 ft² High Ambient Radiator			
1	3029 mm (119.26 in)	3	2305 mm (90.75 in)
2	3767 mm (148.3 in)		
94 ft² Enhanced High Ambient Radiator			
1	3172 mm (124.9 in)	3	2591 mm (102 in)
2	3752 mm (147.7 in)		
61 ft² Radiator			
1	2610 mm (102.8 in)	3	2347 mm (92.4 in)
2	3355 mm (132 in)		

FIGURE 172. RADIATOR DIMENSIONS

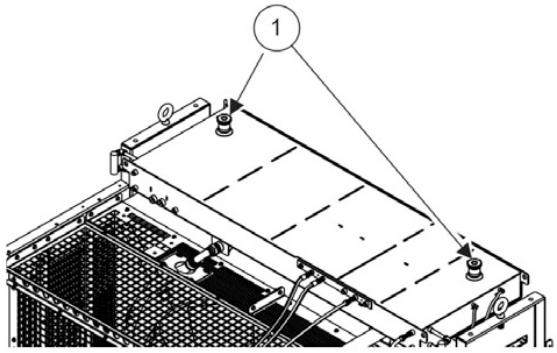
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6.5.4.5.4 Install Fill Neck



No.	Description	No.	Description
1	Fill neck plug		

FIGURE 173. FILL NECK PLUG LOCATION (84 AND 94 SQ FT RADIATORS)



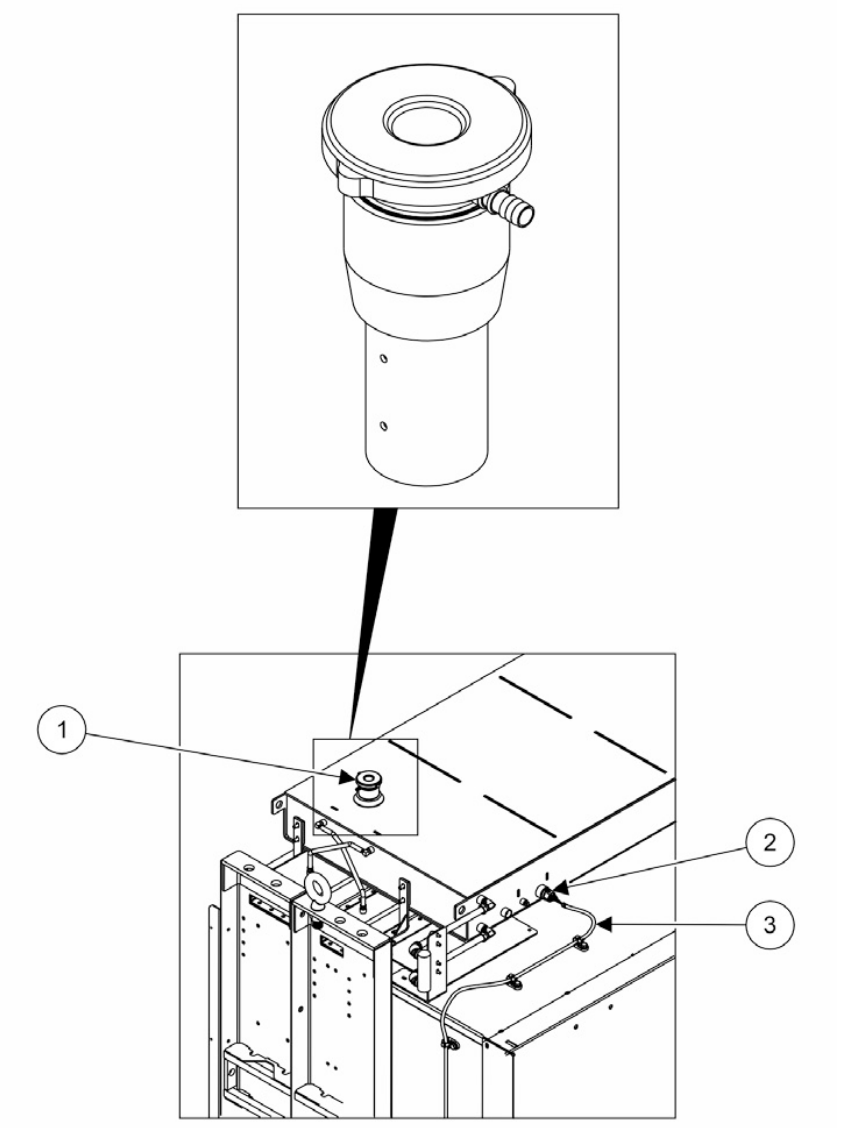
No.	Description	No.	Description
1	Fill neck plugs		

FIGURE 174. FILL NECK PLUG LOCATIONS (61 SQ FT RADIATOR)

1. Remove and dispose of the fill neck plug (1).
2. Apply thread sealant to the threads of the radiator fill neck (1, Figure 175). Make sure that the sealant covers the entire circumference of the fill neck threads.

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3. Install the radiator fill neck into the radiator expansion tank. Make sure that the barbed fitting for the coolant overflow line points toward the left side (outboard) of the radiator when the fill neck is tightened.
4. Attach the coolant overflow line to the fill neck.
5. Route the overflow line down the left side of the radiator.
6. Secure the overflow line with cable ties.



No.	Description	No.	Description
1	Fill neck	3	Low coolant level harness
2	Low coolant level sensor		

FIGURE 175. FILL NECK AND LOW COOLANT LEVEL SENSOR

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6.5.4.5.5 Attach the Low Coolant Level Sensor

NOTICE

Numbers in parenthesis refer to Figure 175.

⚠ CAUTION

Equipment Damage

Power tools can damage the low coolant level sensor.

After installing by hand, use a manual torque wrench to complete the installation of the sensor

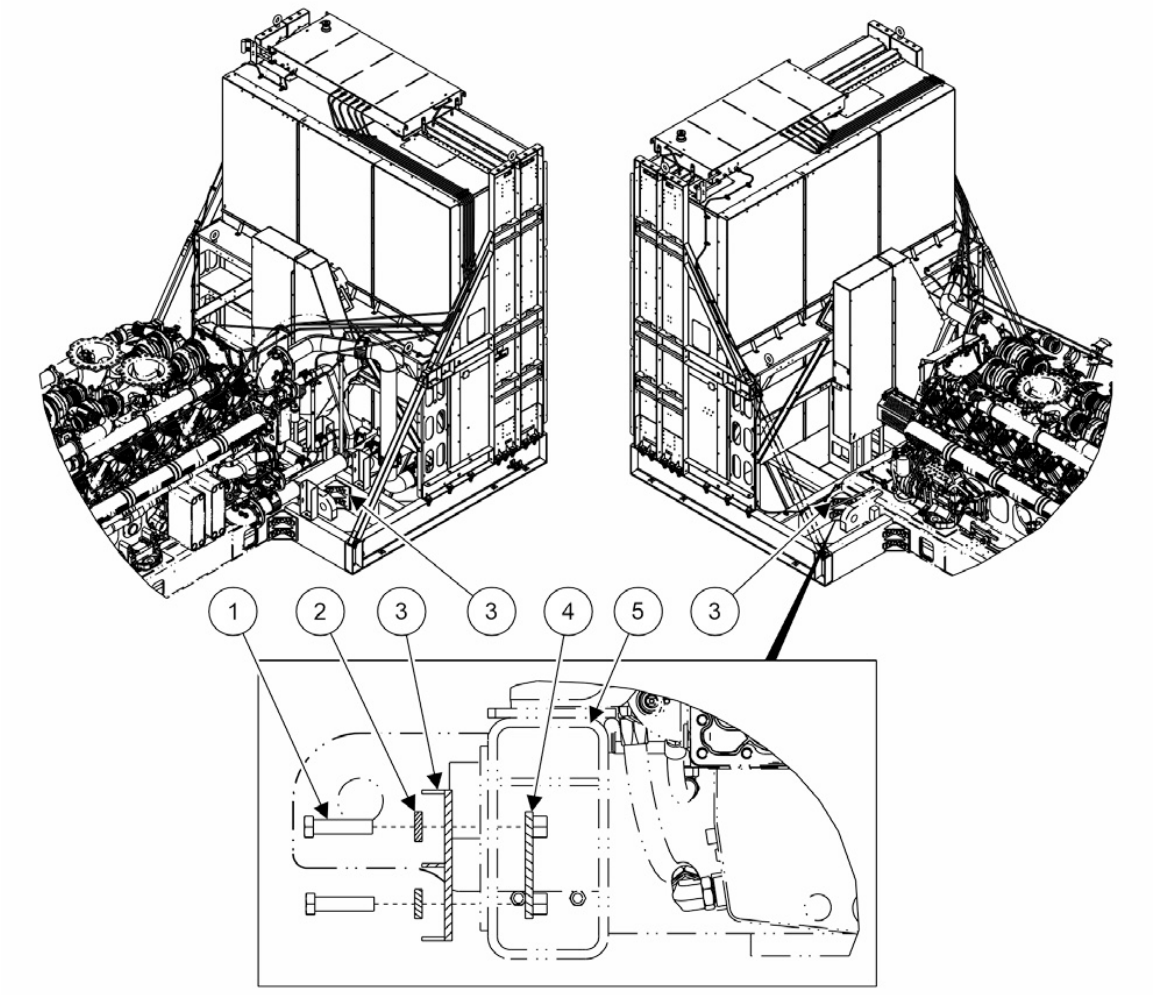
1. Remove and dispose of the internal hex plug in the radiator expansion tank.
2. Install the low coolant level sensor (2) by hand to be sure the sensor does not get damaged.
3. When the low coolant level sensor (2) is hand tight, use a manual torque wrench to tighten the sensor to 20 Nm (15 ft-lb).
4. Install the low coolant level harness (3) and retaining clips. Route the harness down the left side of the radiator.
5. Tighten retaining clip bolts to 52 Nm (38 ft-lb).

6.5.4.5.6 Install Front Radiator L-brackets on Generator Set Skid

NOTICE

Numbers in parenthesis refer to Figure 176 unless otherwise specified.

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No.	Description	No.	Description
1	Bolt – M24 x 100 mm	4	Nut plate
2	Washer plate	5	Generator set skid
3	L-bracket		

FIGURE 176. FRONT LEFT AND RIGHT RADIATOR L-BRACKETS

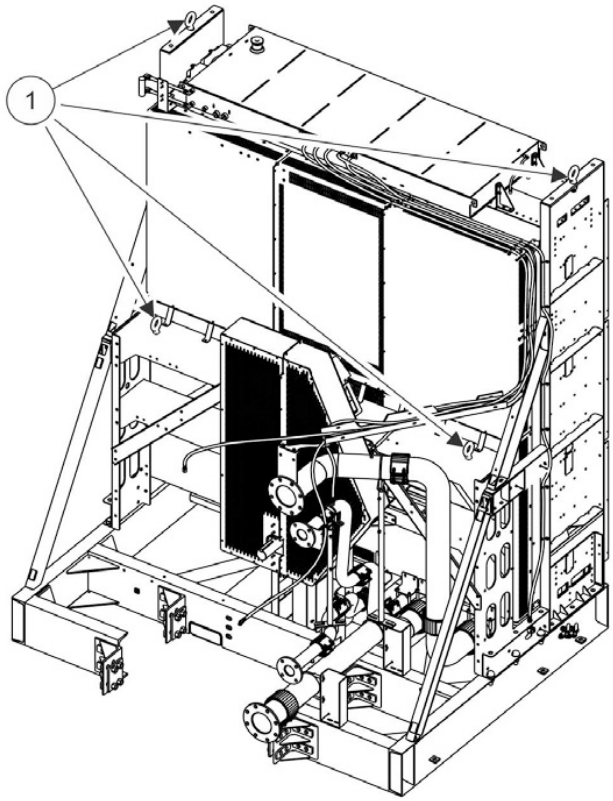
1. Apply anti-seize compound to threads of bolts (1).
2. Loosely install two L-brackets (3) on the generator set skid (5) at the front right and left radiator mounting locations. Use four bolts (1), two washer plates (2), and one nut plate (4) for each L-bracket (3).

6.5.4.5.7 Position the Radiator to the Generator Set

Do the following if using an overhead crane to position the radiator.

1. Connect lifting equipment to the four radiator lifting eye bolts (1, **Figure 177**). A spreader bar is required to allow for a vertical lift on the eye bolts.
2. Position the radiator to the generator set.

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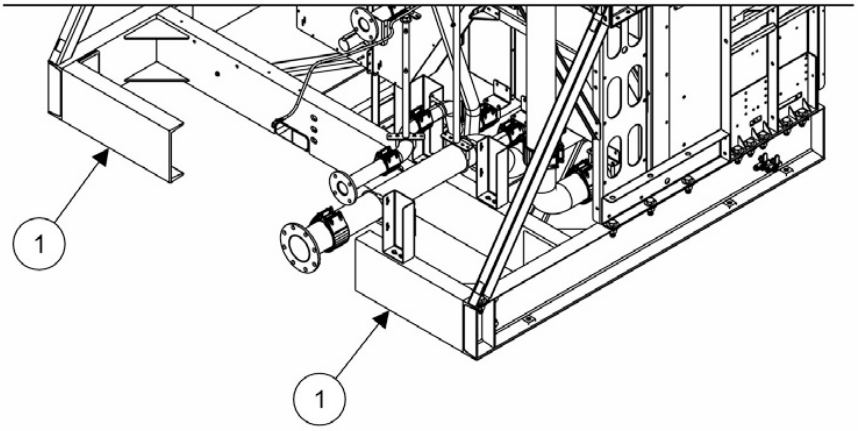
No.	Description	No.	Description
1	Lifting eye bolt		

FIGURE 177. RADIATOR EYE BOLTS

Do the following if using a fork lift or other method to position the radiator.

1. Remove the cross beams (1, **Figure 178**) from the radiator skid if necessary for access to fork lift pickets or allow for clearance of the generator set front lifting eyes.
2. Position the radiator to the generator set.
3. After the radiator has been positioned, reinstall the cross beams (1, **Figure 178**). Torque the cross beam bolts to 610 Nm (450 ft-lb).

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No.	Description	No.	Description
1	Cross beam		

FIGURE 178. CROSS BEAMS ON RADIATOR SKID

6.5.4.5.8 Install Vibration Isolators

The vibration isolators need to be installed following the installation guidelines from the manufacturer. The vibration isolator must be installed (1, **Figure 292**) so that it is in the locked shipping position. The vibration isolator must not provide any spring isolation (solid block) to allow for proper radiator alignment.

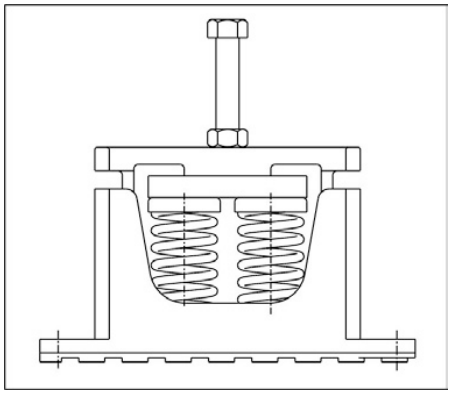


FIGURE 179. VIBRATION ISOLATOR

1. Lift the radiator and place it in its final location on the locked vibration isolators. Make sure the holes in the radiator skid are centered to the vibration isolator attachment bolt location.
2. Lift the generator set and bring it into alignment with the radiator skid.
3. Place the generator set on the locked vibration isolators. Make sure the holes in the generator set skid are centered to the vibration isolator attachment bolt location.
4. Make sure the generator set and radiator are against each other (no gaps) at the chassis front cross member and the radiator cross frame.
5. Left to right measurements between the radiator frame and chassis are helpful for placement but are not final measurements for alignment.
6. When the generator set and radiator appear to be aligned and ready to be bolted together, proceed to Fan Drive Alignment.

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6.5.4.5.9 Fan Drive Alignment

6.5.4.5.9.1 Fan Drive Alignment

The following gives the procedure to align the radiator to the generator set. **This video** shows the procedure.

1. Remove engine vibration damper center cover.

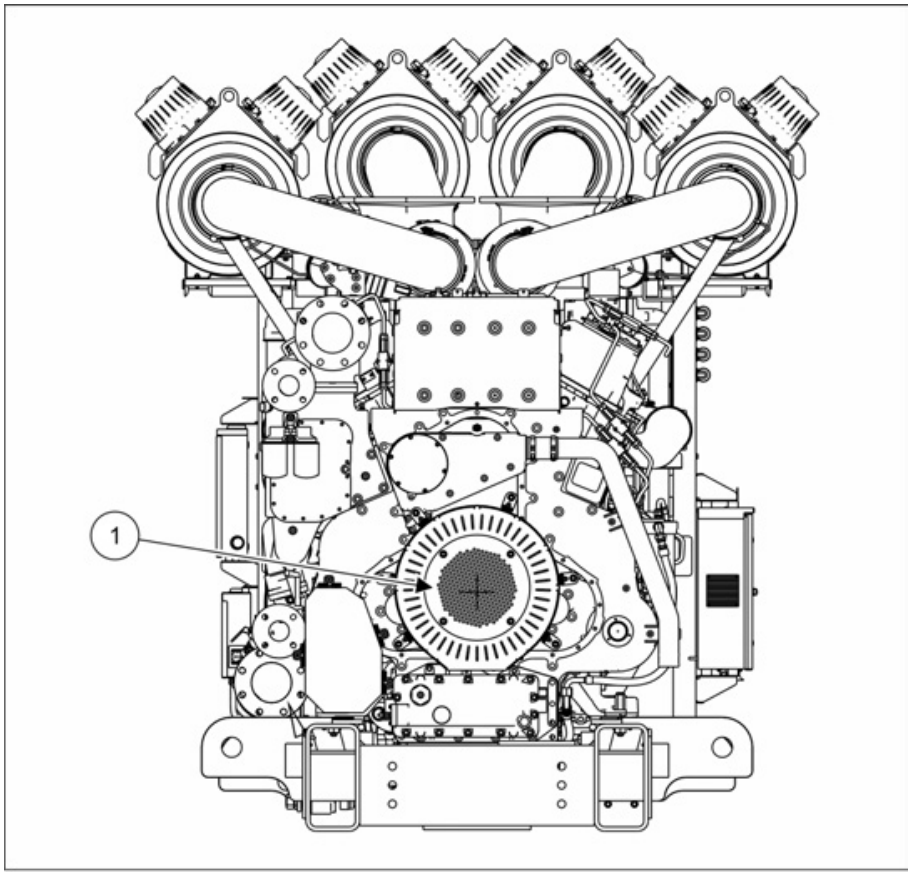


FIGURE 180. ENGINE DAMPENER CENTER COVER

2. Clean the mounting surface for the engine vibration dampener with degreaser.
3. Clean the fan drive input shaft with degreaser.
4. Install the fan drive alignment bar from the radiator installation kit in the radiator fan drive input shaft keyway.

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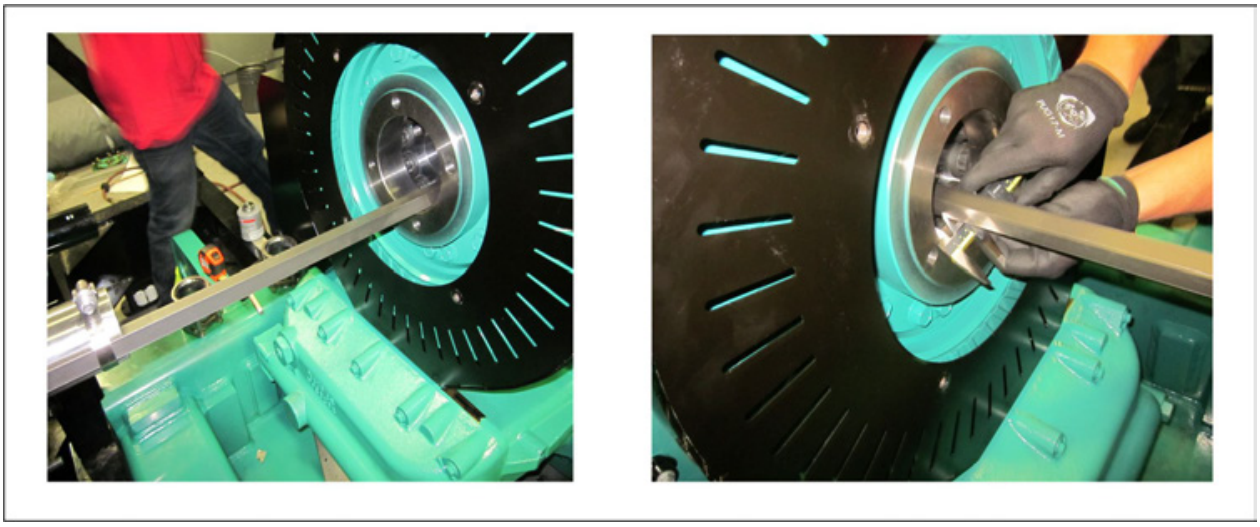


FIGURE 181. FAN DRIVE ALIGNMENT

5. The radiator end of the square bar must fit snugly into the fan shaft key way. Clamp into place with hose clamp around the radiator fan drive input shaft.
6. The other end of the bar fits inside the center bore of the vibration dampener.
7. Carefully rotate the fan shaft by hand. The bar should never contact the inside bore of the damper. Contact with the inside bore indicates gross misalignment.
8. When the bar rotates freely inside the damper bore, measure and record the distance from the bar to the outer diameter of the damper bore at the 12:00 and 6:00 o'clock positions (vertical), and at the 3:00 and 9:00 o'clock positions (horizontal). The difference between the two vertical measurements and the two horizontal measurements cannot be greater than 12.5 mm (1/2 inch).

TABLE 128. EXAMPLE MEASUREMENTS

	Measurement	Position	Status
	17	3:00	
	19	9:00	
Difference	2		Good
	10	12:00	
	28	6:00	
Difference	18		Needs vertical adjustment

9. Options for Horizontal adjustment are:
   - Move the radiator or generator set.
   - Move the fan belt drive input shaft bearing assemblies right or left (±3 mm of adjustment).

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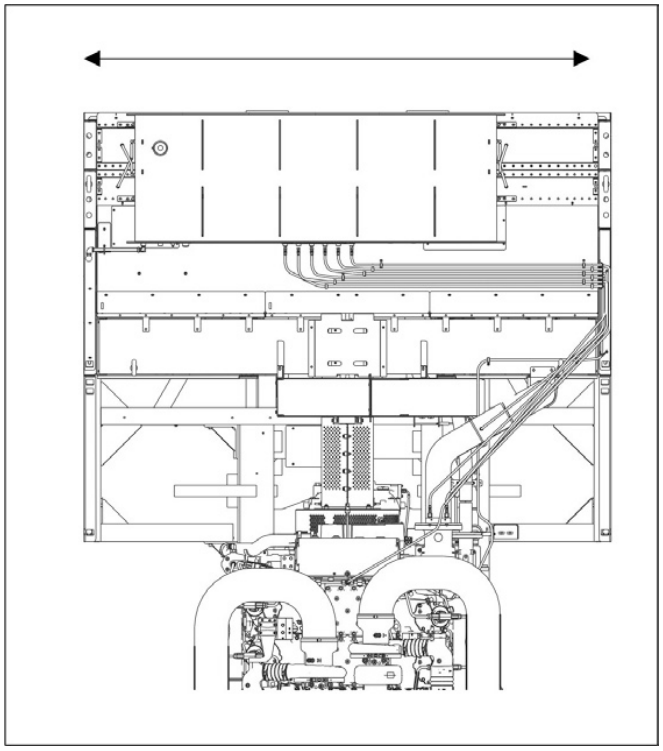


FIGURE 182. HORIZONTAL ADJUSTMENT

10. Options for vertical adjustment are:
    - Place shims under the generator set or radiator vibration isolators.
    - Add or remove shims under the fan belt drive input shaft bearings (±3 mm of adjustment).

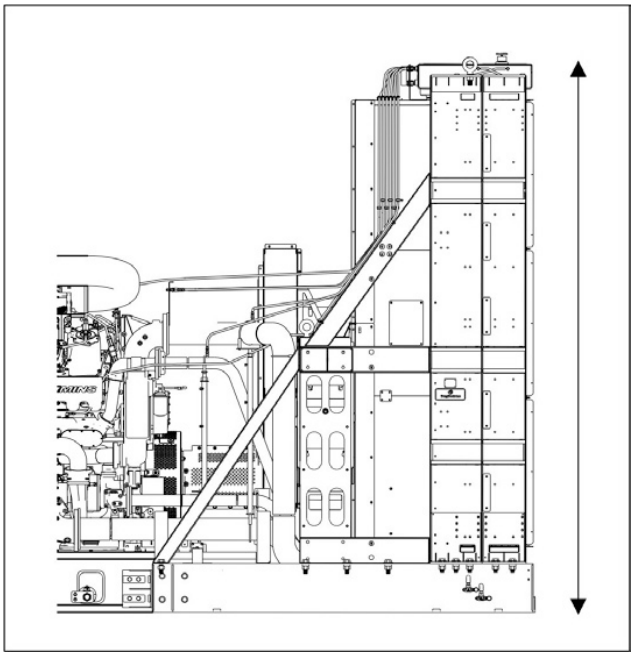


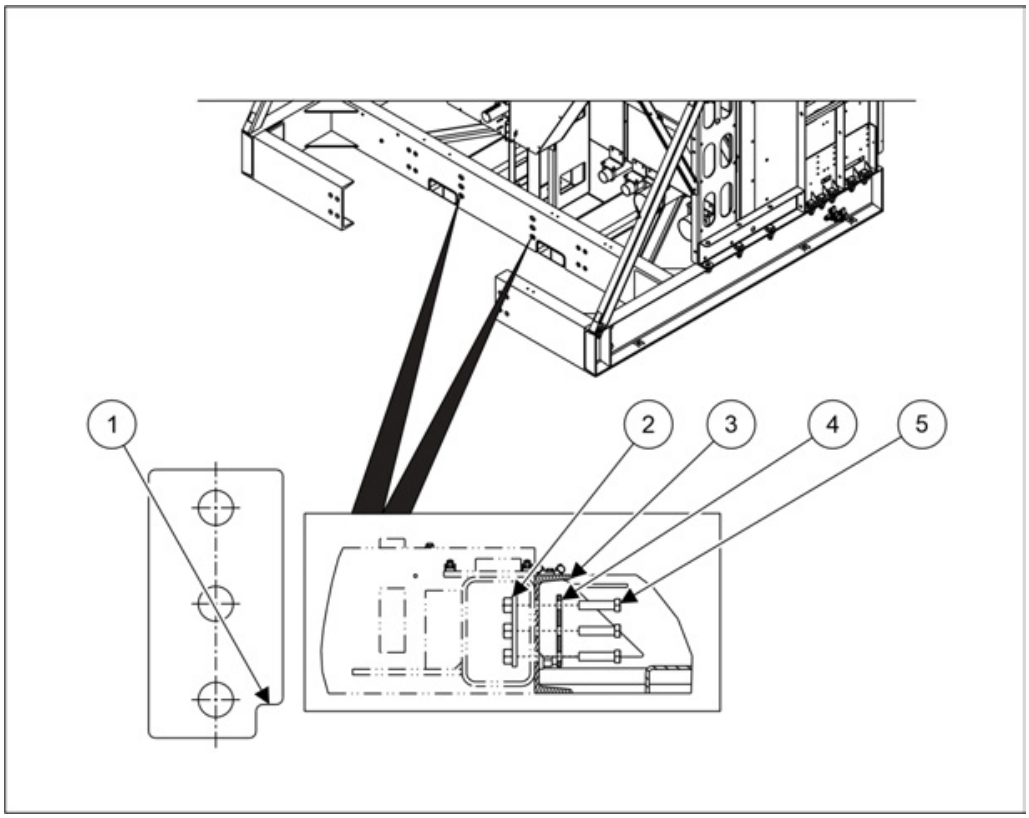
FIGURE 183. VERTICAL ADJUSTMENT

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6.5.4.5.10 Install Front Middle Clamping Plates

NOTICE

Numbers in parenthesis refer to Figure 245 unless otherwise specified.



No.	Description	No.	Description
1	Notch in washer plate	4	Washer plate
2	Nut plate	5	Bolt – M24 x 100 mm
3	Clamping plate		

FIGURE 184. FRONT MIDDLE CLAMPING PLATE

1. Apply anti-seize compound to mounting bolt (5) threads.
2. Loosely install each clamping plate (3) to the front radiator mounts with one nut plate (2), one washer plate (4), and three bolts (5).

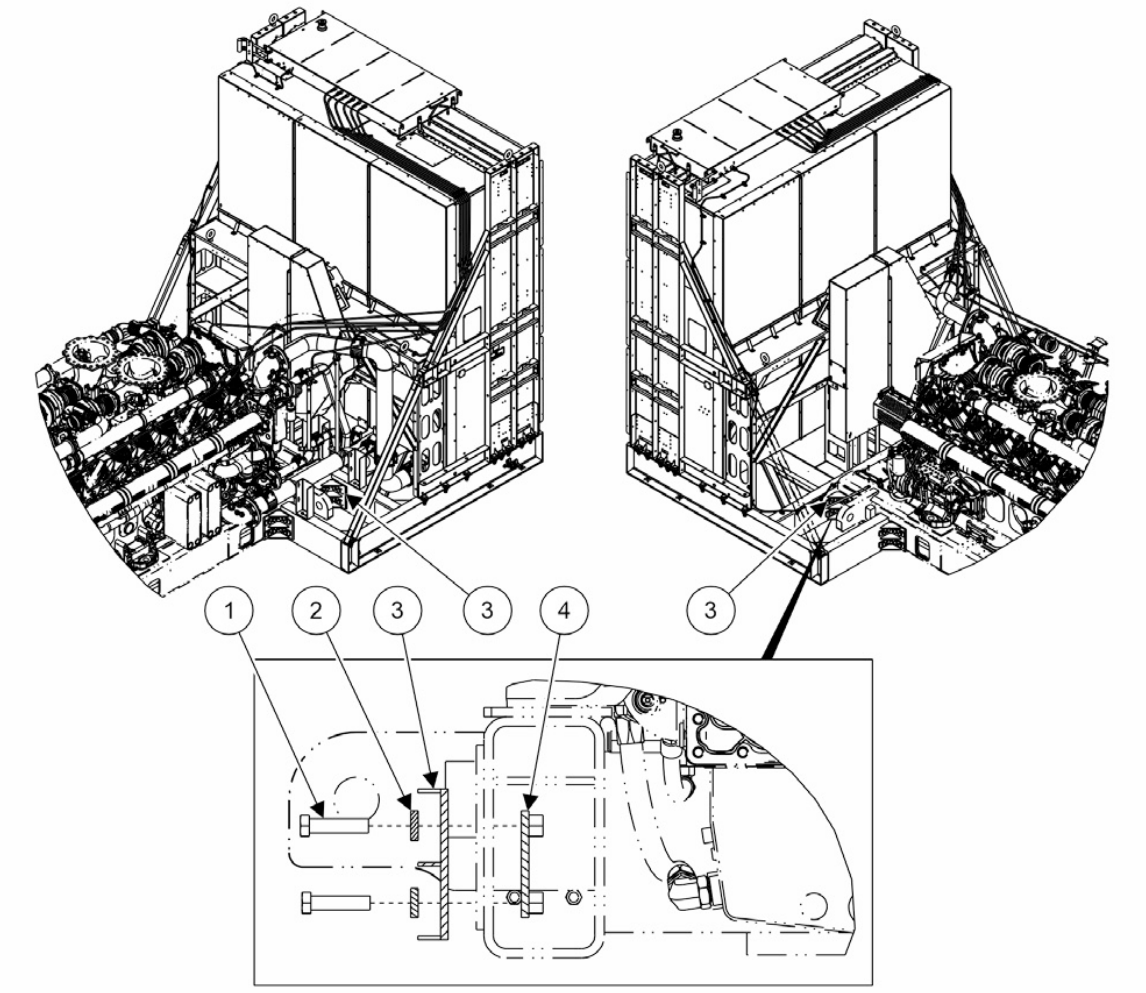
NOTICE

The notch in the washer plate faces down and toward the fork tubes in the radiator skid.

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6.5.4.5.11 Install Front Radiator L-brackets Remaining Hardware

NOTICE
Numbers in parenthesis refer to Figure 246 unless otherwise specified.



No.	Description	No.	Description
1	Bolt – M24 x 100 mm	3	L-bracket
2	Washer plate	4	Nut plate

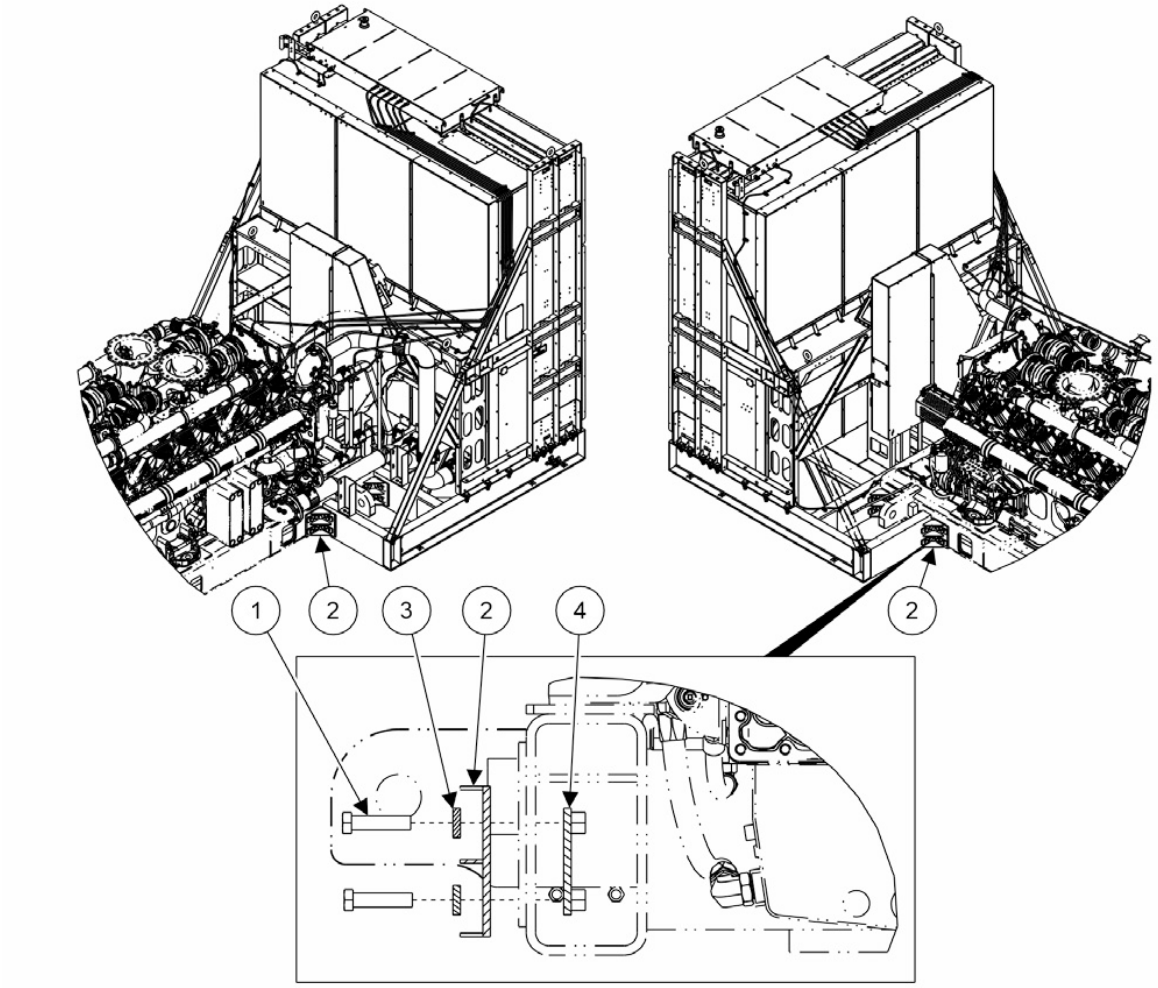
FIGURE 185. FRONT LEFT AND RIGHT RADIATOR L-BRACKETS REMAINING HARDWARE

1. Apply anti-seize compound to threads of bolts (1).
2. Loosely install each L-bracket to radiator skid with remaining washer plates (2), nut plates (4), and bolts (1).

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6.5.4.5.12 Install Rear L-brackets

NOTICE
Numbers in parenthesis refer to Figure 247 unless otherwise specified.



No.	Description	No.	Description
1	Bolt – M24 x 100 mm	3	Washer
2	L-bracket	4	Nut plate

FIGURE 186. REAR L-BRACKETS

1. Apply anti-seize compound to mounting bolt threads.
2. Loosely install each L-bracket (2) to generator set and radiator skid with two nut plates (4), four washers (3), and eight bolts (1).

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6.5.4.5.13 Tighten and Torque L-bracket bolts

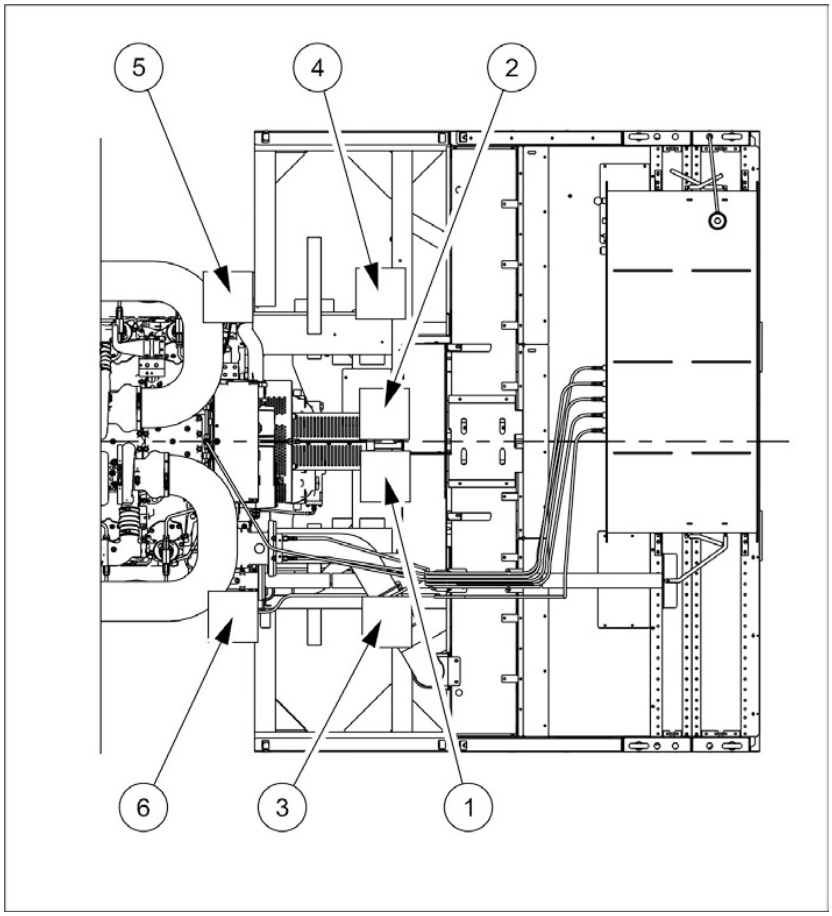


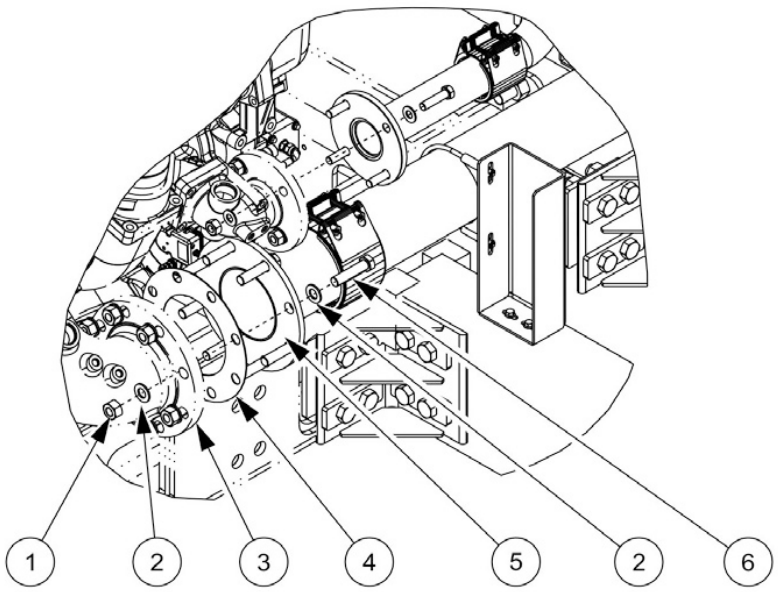
FIGURE 187. L-BRACKET LOCATIONS

1. Tighten the 6 M24 bolts at the front middle locations (locations 1 and 2 in **Figure 248**).
2. Tighten the 16 M24 bolts at the front left and right locations (locations 3 and 4 in **Figure 248**).
3. Tighten the 16 M24 bolts at the rear left and right locations (locations 5 and 6 in **Figure 248**).
4. Torque the 6 M24 bolts at the front middle locations (locations 1 and 2 in **Figure 248**) to 552 Nm (407 ft-lb).
5. Torque the 16 M24 bolts at the front left and right locations (locations 3 and 4 in **Figure 248**) to 552 Nm (407 ft-lb).
6. Torque the 16 M24 bolts at the rear left and right locations (locations 5 and 6 in **Figure 248**) to 522 Nm (407 ft-lb).
7. The radiator lifting equipment may be removed as long as the radiator is properly supported on isolators at the same height as the generator set skid.

6.5.4.5.14 Install HT Inlet Coolant Flange

NOTICE
Numbers in parenthesis refer to Figure 188 unless specified otherwise.

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No.	Description	No.	Description
1	Nut – ⅝ inch	4	Gasket
2	Washer – ⅝ inch	5	HT inlet pipe
3	HT inlet flange	6	Bolt – ⅝ x 2½ inch

FIGURE 188. HT INLET COOLANT FLANGE

1. Apply anti-seize lubricant to bolt (6) threads.
2. Install HT inlet pipe (5) to HT inlet flange (3) with flange gasket (4), bolts – ⅝ x 2½ inch (6), washers – ⅝ inch (2), and nuts – ⅝ inch (1).
3. Torque the bolts and nuts to 311 Nm (229 ft-lb) using the following torque sequence.
   a. Torque position 1, then position 5 shown in **Figure 189**.
   b. Torque position 8, then position 3 shown in **Figure 189**.
   c. Torque position 6, then position 2 shown in **Figure 189**.
   d. Torque position 7, then position 4 shown in **Figure 189**.

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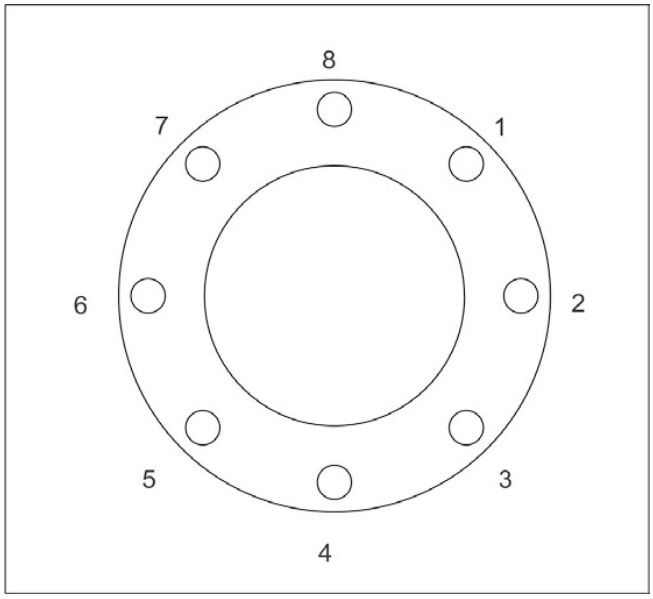
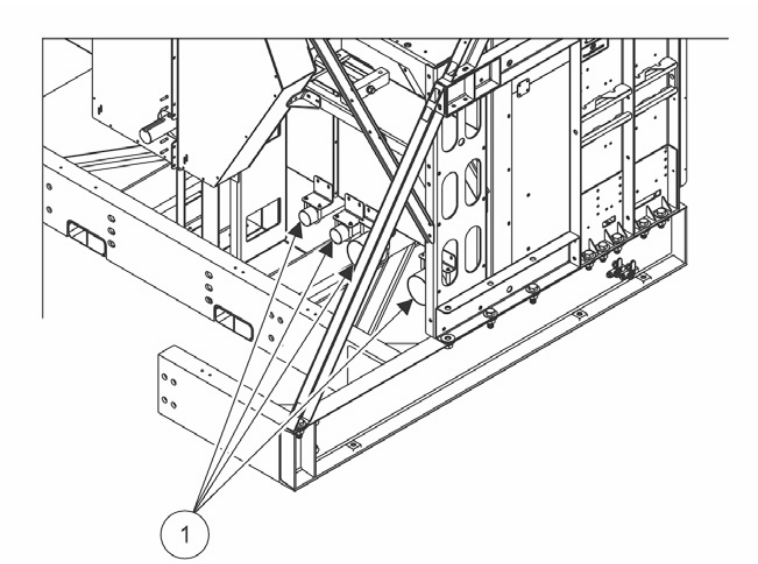


FIGURE 189. HT FLANGE TORQUE SEQUENC NUMBERS

6.5.4.5.15 Remove Radiator Shipping Plugs and Install LT and HT Inlet Pipe Support Brackets

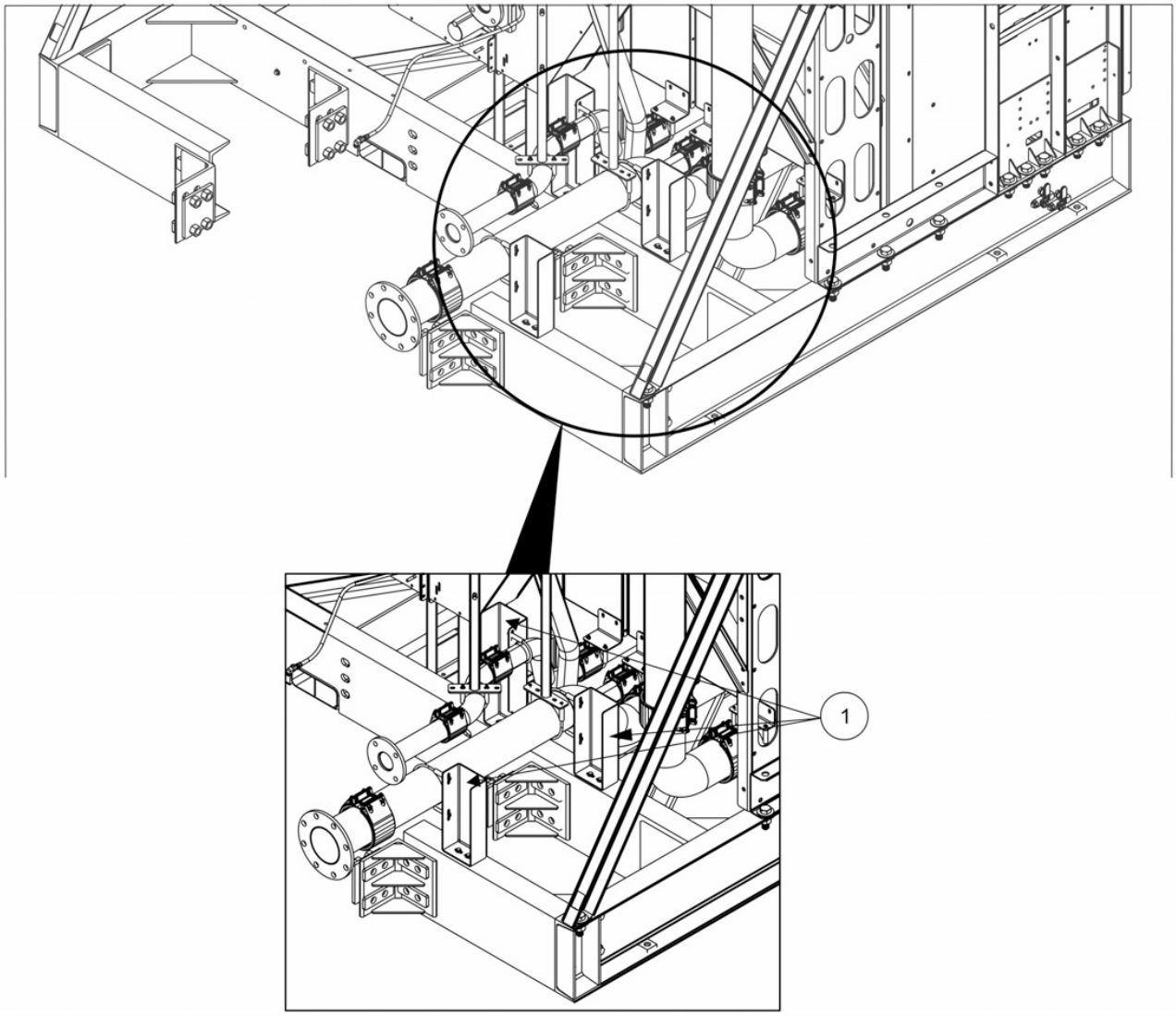


No.	Description
1	Shipping plug

FIGURE 190. RADIATOR SHIPPING PLUG LOCATIONS

1. Remove shipping plugs (1, **Figure 251**).
2. Clean coolant pipe connections at radiator.
3. Install LT and HT inlet pipe support brackets on radiator skid (1, **Figure 252**).

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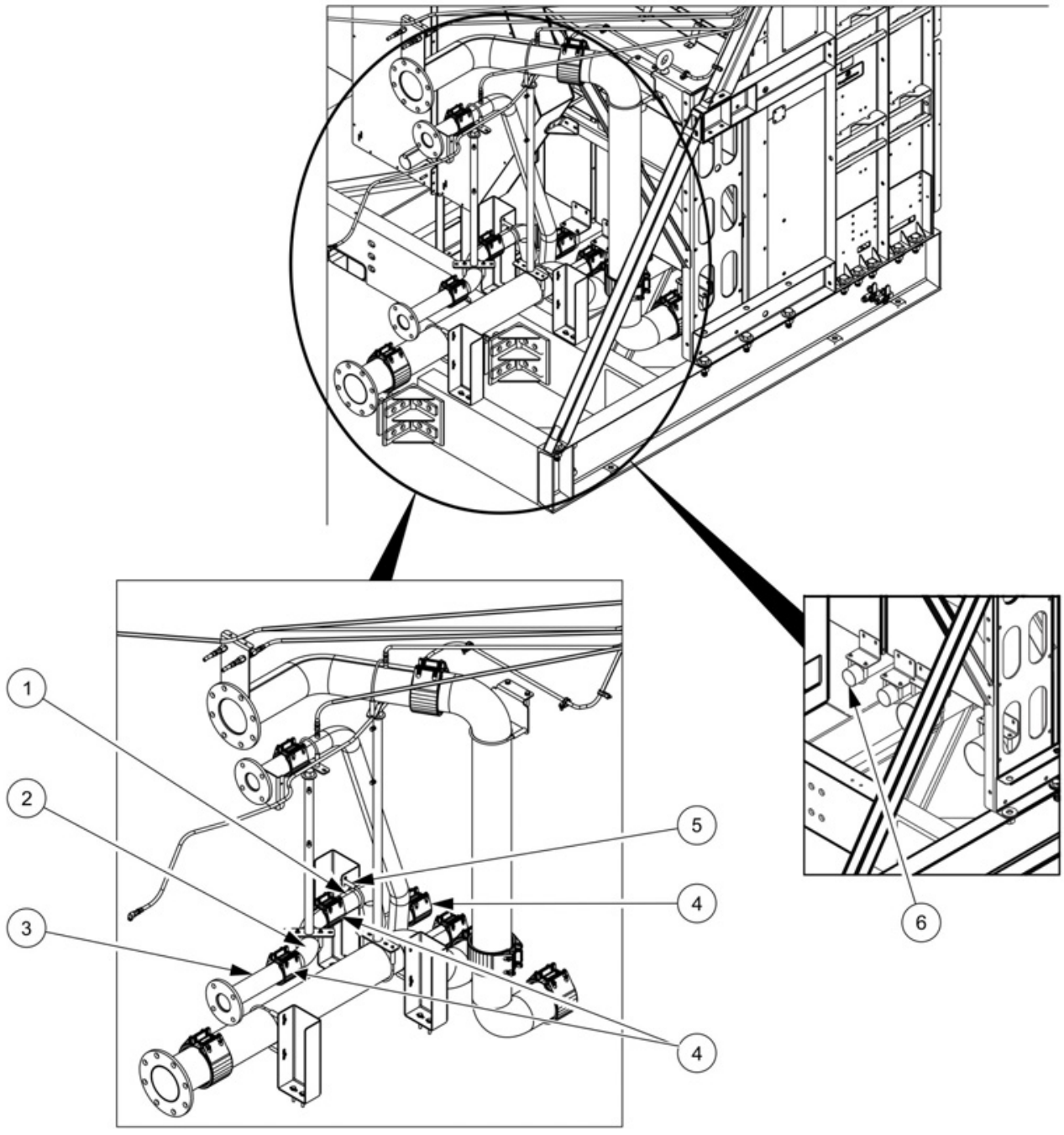


No.	Description
1	Support bracket

FIGURE 191. LT AND HT INLET PIPE SUPPORT BRACKETS

6.5.4.5.16 Install LT Inlet Pipe on Radiator

NOTICE
Numbers in parenthesis refer to Figure 192 unless specified otherwise.



No.	Description	No.	Description
1	Radiator tube	4	Pipe coupler
2	S-bend tube	5	U-bolt
3	Engine tube	6	Radiator LT outlet

FIGURE 192. LT INLET PIPE INSTALLATION

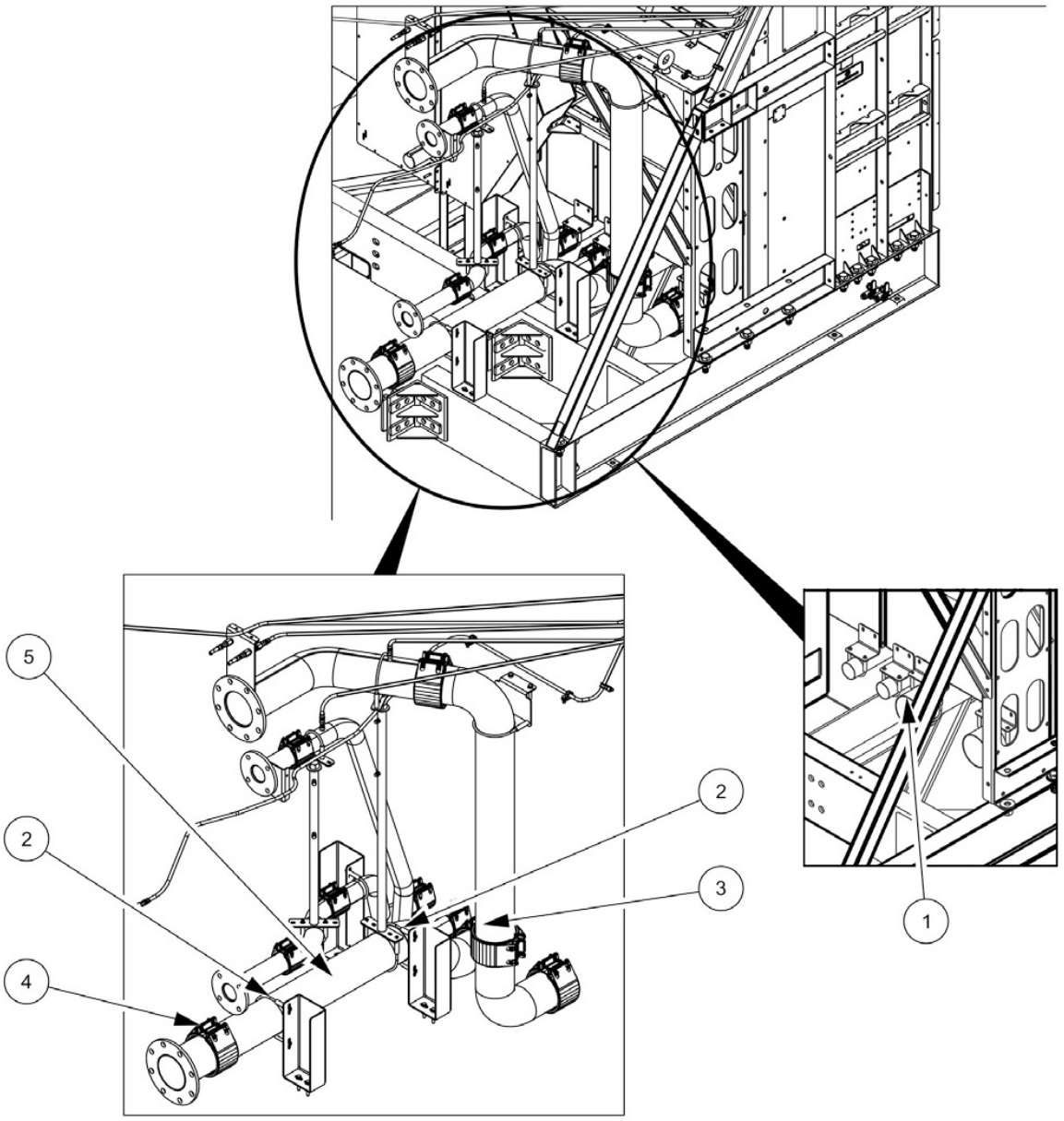
1. Apply anti-seize lubricant to pipe coupler (4) bolts.

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2. Center pipe coupler (4) over the gap in the tubing. Use a paint marker to mark the coupling location on the tube before installation.
3. Loosely tighten the pipe coupler (4) at the radiator connection point (6).
4. Apply thread locking compound to U-bolt (5) threads. Use the U-bolt (5) to loosely attach tube to support bracket.
5. Slide pipe coupler (4) onto the smaller S-bend tube (2). Align the S-bend tube (2) to the engine tube (3) and the radiator tube (1).
6. Center pipe couplers (4) over the gap in the tubes (1, 2, and 3). Make sure the tubes are vertically and horizontally aligned.
7. Use a two step, alternating torque sequence to tighten the pipe couplers.
    a. First, use alternating sequence to torque the pipe couplers to 6 Nm (4.4 ft-lb).
    b. Second, use alternating sequence to torque the pipe couplers to 13 Nm (9.6 ft-lb).
8. Torque the U-bolt (5) that attaches the radiator tube (1) to the tube support bracket to 50 Nm (37 ft-lb).

6.5.4.5.17 Install HT Inlet Tube

NOTICE
Numbers in parenthesis that follow refer to Figure 193 unless specified otherwise.



No.	Description	No	Description
1	Radiator HT Inlet	4	Pipe coupler
2	U-bolt	5	HT inlet tube
3	Pipe coupler (behind outlet tube)		

FIGURE 193. HT INLET TUBE INSTALLATION

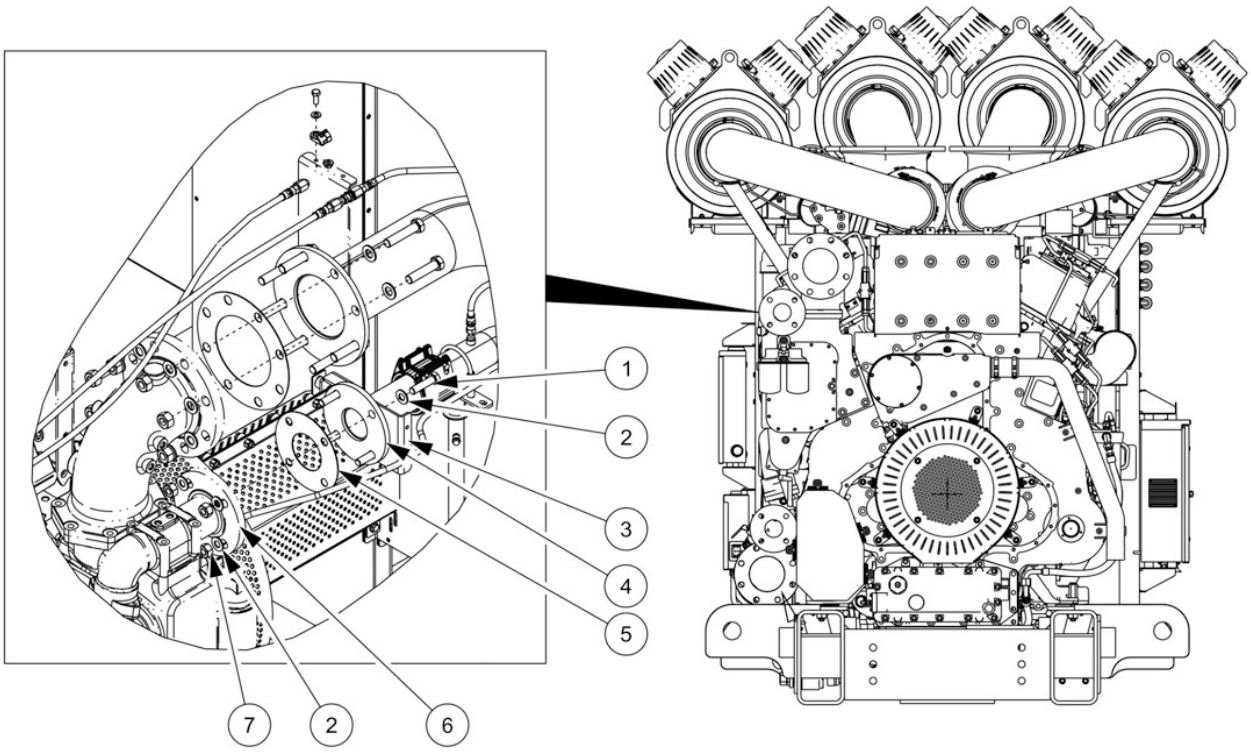
1. Apply anti-seize lubricant to pipe coupler (3 and 4) bolts.
2. Slide pipe couplers (3 and 4) onto HT inlet tube (5).
3. Place the HT inlet tube (5) between the engine connection tube and the radiator connection point (1).
4. Center pipe couplings (3 and 4) over the gaps in the inlet tube (5). Make sure the tubes are aligned vertically and horizontally.

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5. Apply thread locking compound to U-bolt (2) threads. Loosely install two U-bolts (2) that attach the HT inlet tube (5) to the support brackets.
6. Use a two-step, alternating torque sequence to tighten the pipe couplers.
   a. First, use alternating sequence to torque the pipe couplers to 10 Nm (4.4 ft-lb).
   b. Second, use alternating sequence to torque the pipe couplers to 21 Nm (9.6 ft-lb).
7. Torque the U-bolt (2) that attaches the HT inlet tube to the tube support bracket to 50 Nm (37 ft-lb).

6.5.4.5.18 Install LT Outlet Coolant Flange

NOTICE
Numbers in parenthesis refer to Figure 194 unless specified otherwise.



No.	Description	No.	Description
1	Bolt – ⅝ inch x 2½ inch	5	Gasket
2	Washer – ⅝ inch	6	LT inlet flange
3	Vent line support bracket	7	Nut – ⅝ inch
4	LT outlet pipe		

FIGURE 194. LT OUTLET COOLANT FLANGE

1. Apply anti-seize lubricant to bolt (1) threads.

2. Install LT outlet pipe (4) to LT outlet flange (6) with flange gasket (5), bolts – ⅝ x 2½ inch (1), washers – ⅝ inch (2), and nuts – ⅝ inch (7).
3. Torque the bolts and nuts to 175 Nm (129 ft-lb) using the following torque sequence.
   a. Torque position 1, then position 3 shown in **Figure 195**.
   b. Torque position 2, then position 4 shown in **Figure 195**.

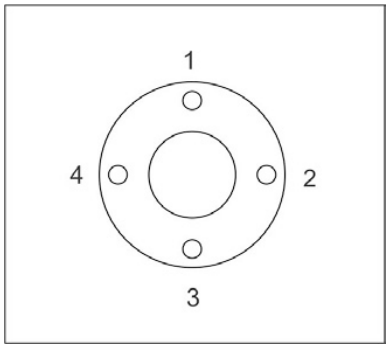
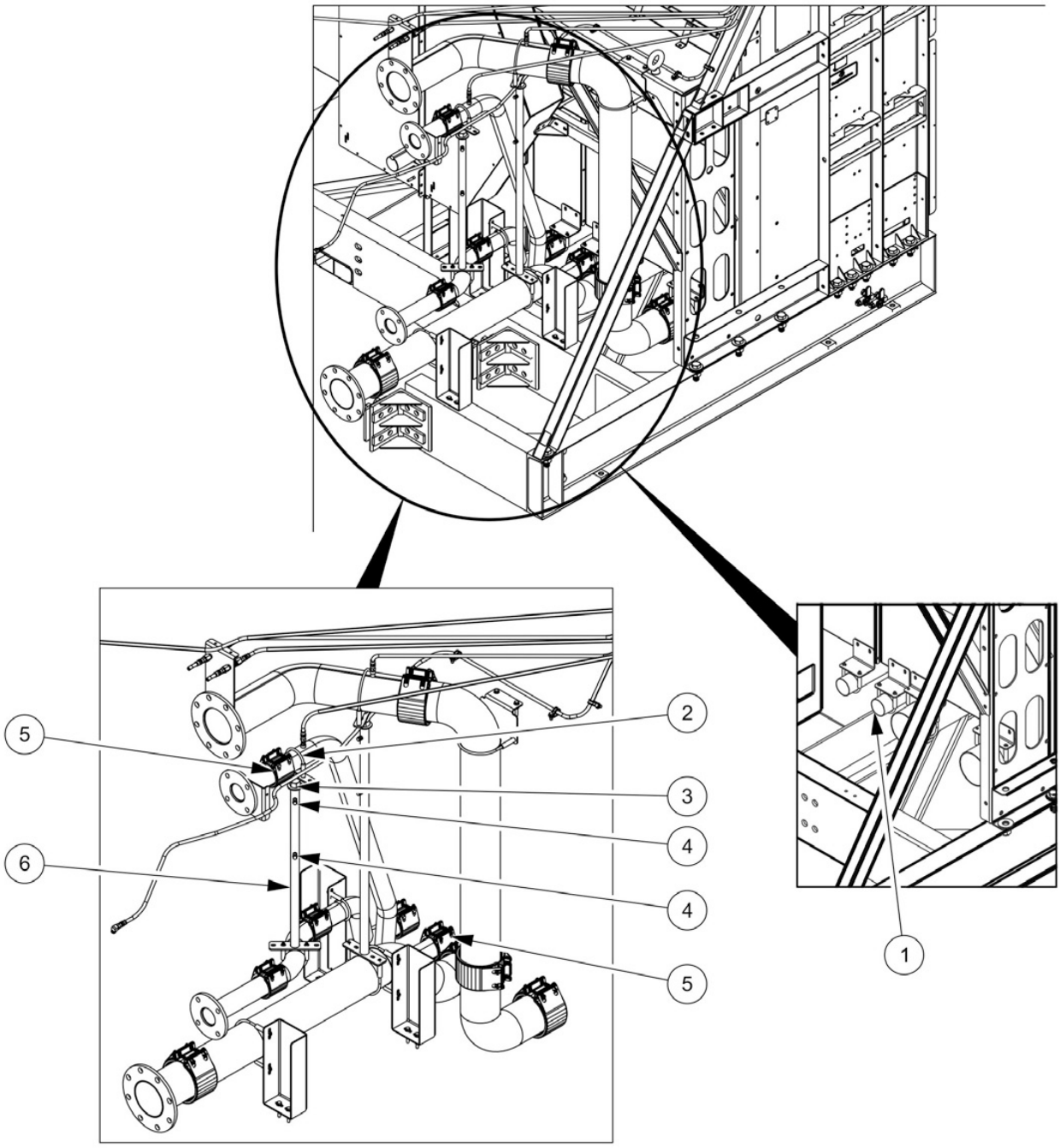


FIGURE 195. LT FLANGE TORQUE SEQUENCE NUMBERS

6.5.4.5.19 Install LT Outlet Tubing

NOTICE
Numbers in parenthesis refer to Figure 196 unless specified otherwise.

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No.	Description	No.	Description
1	Radiator LT Inlet	4	Lock bolt
2	U-bolt	5	Pipe coupler
3	Adjustment screw	6	Tube support

FIGURE 196. LT OUTLET TUBING INSTALLATION

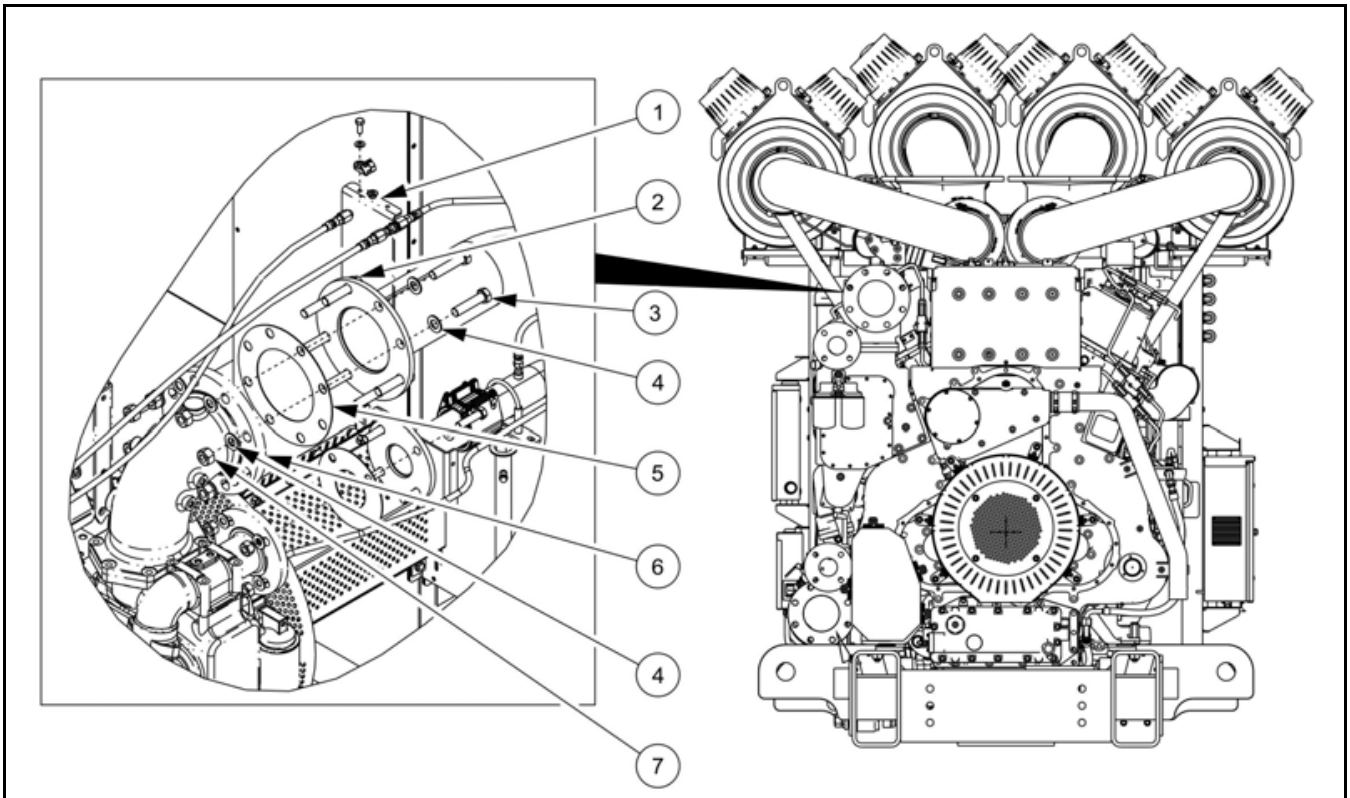
1. Apply anti-seize lubricant to pipe coupler (5) bolts.

2. Slide pipe couplers (5) onto LT outlet tube. Use a paint marker to mark centered coupling location on the tube before installation.
3. Place the LT outlet tube between the engine connection tube and the radiator connection point (1).
4. Center the pipe couplers over the gaps in the tubes. Make sure that the tubes are aligned both vertically and horizontally.
5. Loosely attach the pipe coupler (5) at the radiator connection point (1).
6. Apply thread locking compound to U-bolt (2) threads. Use U-bolts (2) and the support brace to install the LT outlet tube support (6).
7. Use two lock bolts (4) and the adjustment screw (3) to adjust the height of the LT outlet tube support (6).
8. Check the pipe couplers (5) for proper tube alignment and coupler placement.
9. Use a two-step, alternating torque sequence to tighten the pipe couplers.
    a. First, use alternating sequence to torque the pipe couplers to 6 Nm (4.4 ft-lb).
    b. Second, use alternating sequence to torque the pipe couplers to 13 Nm (9.5 ft-lb).
10. Apply a thread locking compound to the lock bolts (4).
11. Torque the lock bolts (4) to 40 Nm (30 ft-lb).
12. Torque U-bolts (2) to 50 Nm (37 ft-lb).

6.5.4.5.20 Install HT Outlet Coolant Flange

NOTICE
Numbers in parenthesis refer to Figure 197 unless specified otherwise.

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No.	Description	No.	Description
1	Vent line support bracket	5	Gasket
2	Bolt – ¾ X 3½ inch	6	HT inlet flange
3	Bolt – ¾ X 3¼ inch	7	Nut – ¾ inch
4	Washer – ¾ inch		

FIGURE 197. HT OUTLET COOLANT FLANGE

1. Apply anti-seize lubricant to bolt (7) threads.
2. Install HT outlet pipe and vent line support bracket (1) to HT outlet flange (6) with flange gasket (5), bolts (2 and 3), washers (4), and nuts (7). Use the ¾ inch X 3½ inch bolts (2) to attach the vent line support bracket (1).
3. Torque the bolts and nuts to 311 Nm (229 ft-lb) using the following torque sequence.
   a. Torque position 1, then position 5 shown in **Figure 198**.
   b. Torque position 8, then position 3 shown in **Figure 198**.
   c. Torque position 6, then position 2 shown in **Figure 198**.
   d. Torque position 7, then position 4 shown in **Figure 198**.

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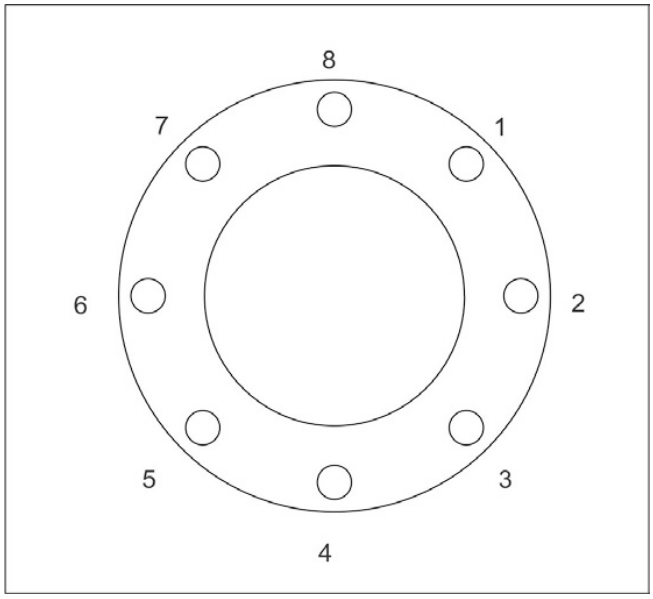
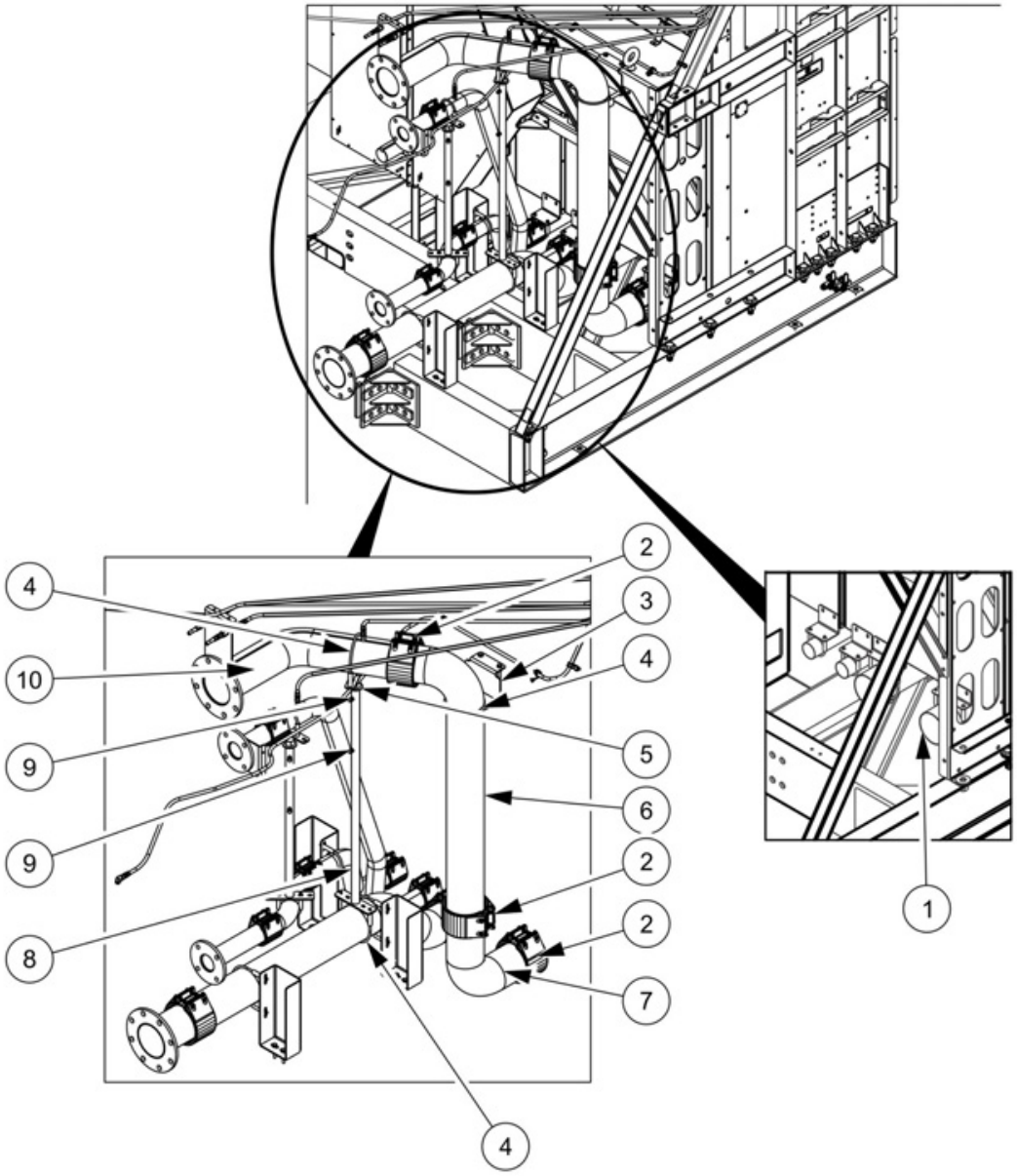


FIGURE 198. HT FLANGE TORQUE SEQUENCE NUMBERS

6.5.4.5.21 Install HT Outlet Tubing

NOTICE
Numbers in parenthesis refer to Figure 199 unless specified otherwise.

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No.	Description	No.	Description
1	Radiator HT Outlet	6	HT outlet tube
2	Pipe coupler	7	HT radiator outlet tube
3	HT outlet tube support (94 ft^2 radiator only)	8	Tube support
4	U-bolt	9	Lock bolt
5	Adjustment screw	10	HT engine outlet tube

FIGURE 199. HT OUTLET TUBING INSTALLATION

1. Install HT outlet tube support bracket (3) with two bolts, two flange nuts, and two washers.
2. Apply anti-seize lubricant to pipe coupler (2) bolts.

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3. Slide pipe coupler (2) onto HT radiator outlet tube (7). Use a paint marker to mark centered coupling location on the tube before installation.
4. Place the HT radiator outlet tube (7) on the radiator connection point (1).
5. Center the pipe coupler (2) over the gap in the tube. Make sure that the tubes are aligned both vertically and horizontally.
6. Loosely attach the pipe coupler (2) at the radiator connection point (1).
7. Slide one pipe coupler (2) onto the HT engine outlet tube (10) and one pipe coupler (2) onto the HT radiator outlet tube (7).
8. Align HT outlet tube (6) to HT engine outlet tube (10) and HT radiator outlet tube (7).
9. Center pipe couplers (2) over the gaps in the tubes. Make sure the tubes are aligned both vertically and horizontally.
10. Loosely tighten pipe coupler bolts.
11. Apply thread locking compound to U-bolt (4) threads. Loosely install U-bolt on HT outlet tube support bracket (3).
12. Apply thread locking compound to U-bolt (4) threads. Use U-bolts (4) and the support brace to install the HT outlet tube support (3).
13. Use two lock bolts (9) and the adjustment screw (5) to adjust the height of the HT outlet tube support (6).
14. Check the pipe couplers (2) for proper tube alignment and coupler placement.
15. Use a two-step, alternating torque sequence to tighten the pipe couplers.
    a. First, use alternating sequence to torque the pipe couplers to 10 Nm (7.4 ft-lb).
    b. Second, use alternating sequence to torque the pipe couplers to 21 Nm (15.5 ft-lb).
16. Apply a thread locking compound to the lock bolts (9).
17. Torque the lock bolts (9) to 40 Nm (30 ft-lb).
18. Torque U-bolts (4) to 50 Nm (37 ft-lb).

6.5.4.5.22 Install Vent Lines (61 Sq Ft Radiator)

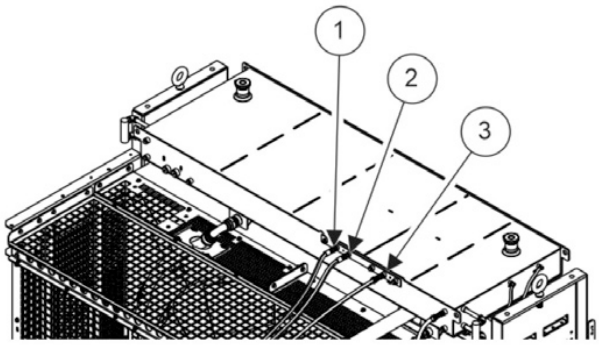
The vent lines come installed on the radiator expansion tank (**Figure 200**). All the vent lines are bundled together and secured to the radiator.

1. Separate the vent lines and identify each line by part number.

All vent lines must be secured to the generator set using clips and cable ties.

All vent lines must be either vertical or inclined between the engine and radiator. No sags are permitted.

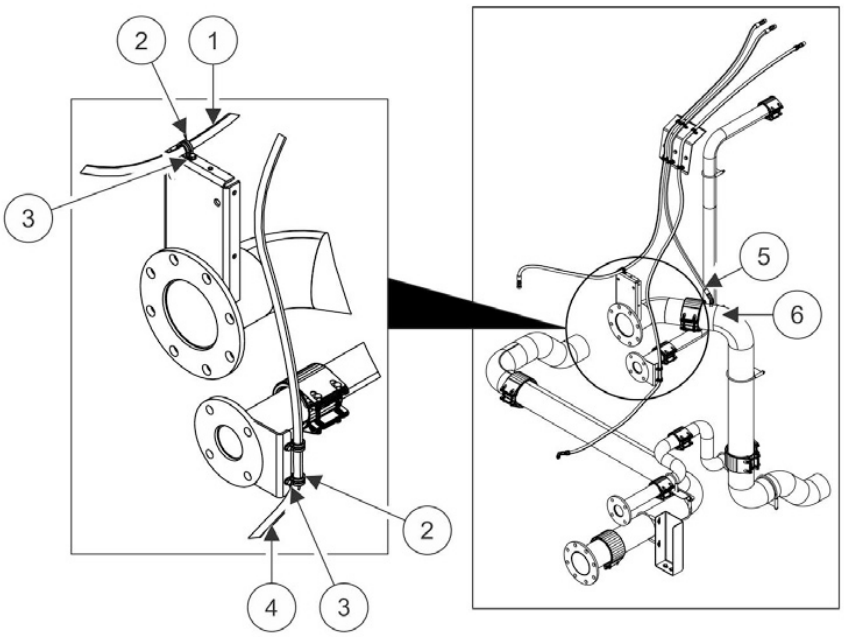
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No.	Description	No.	Description
1	HT Engine Vent Line	3	LT Engine Vent Line
2	HT Outlet Tube Vent Line		

FIGURE 200. RADIATOR VENT LINES

6.5.4.5.22.1 Install Vent Lines on Outlet Tubes and Vent Line Support Brackets



No.	Description	No.	Description
1	HT Engine Vent Line	4	LT Engine Vent Line
2	Hose Clip	5	HT Outlet Tube Vent Line
3	Bolt	6	HT Outlet Tube

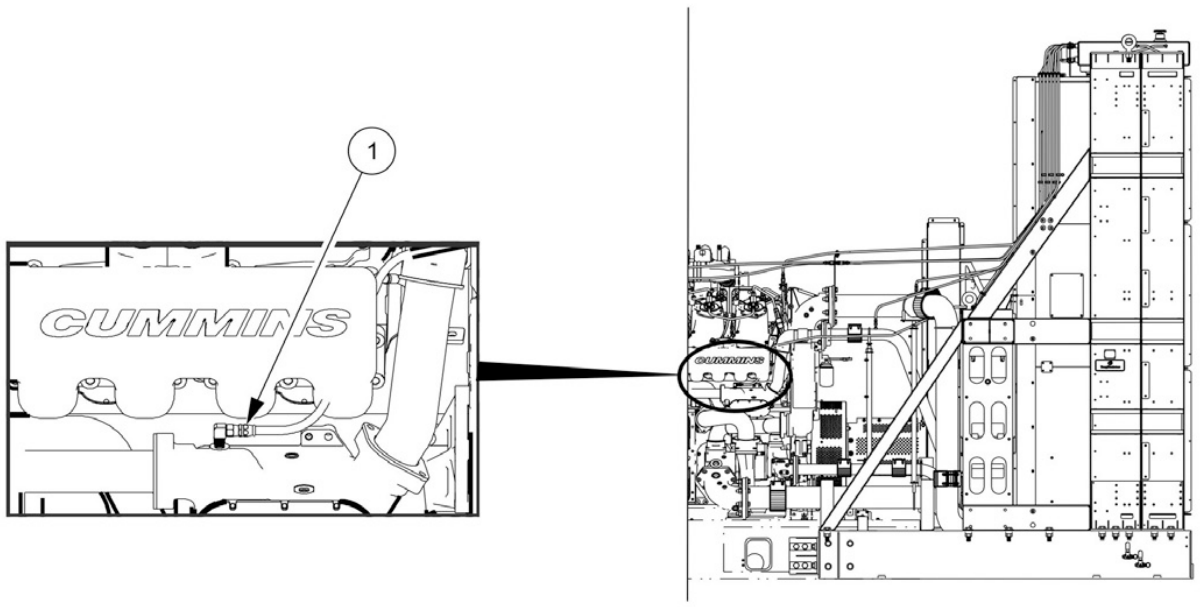
FIGURE 201. VENT LINES ON OUTLET TUBES AND VENT LINE SUPPORT BRACKETS

1. Install the HT engine vent line (1) onto the HT vent line support bracket with one bolt (1) and one hose clip (3).

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2. Install the HT outlet tube vent line (5) onto the HT outlet tube (6).
3. Install the LT engine vent line (4) onto the LT vent line support bracket using two bolts (3) and two hose clips (2).
4. Torque the vent lines to 20 Nm (9 ft-lb).

6.5.4.5.22.2 Install LT Engine Vent Line



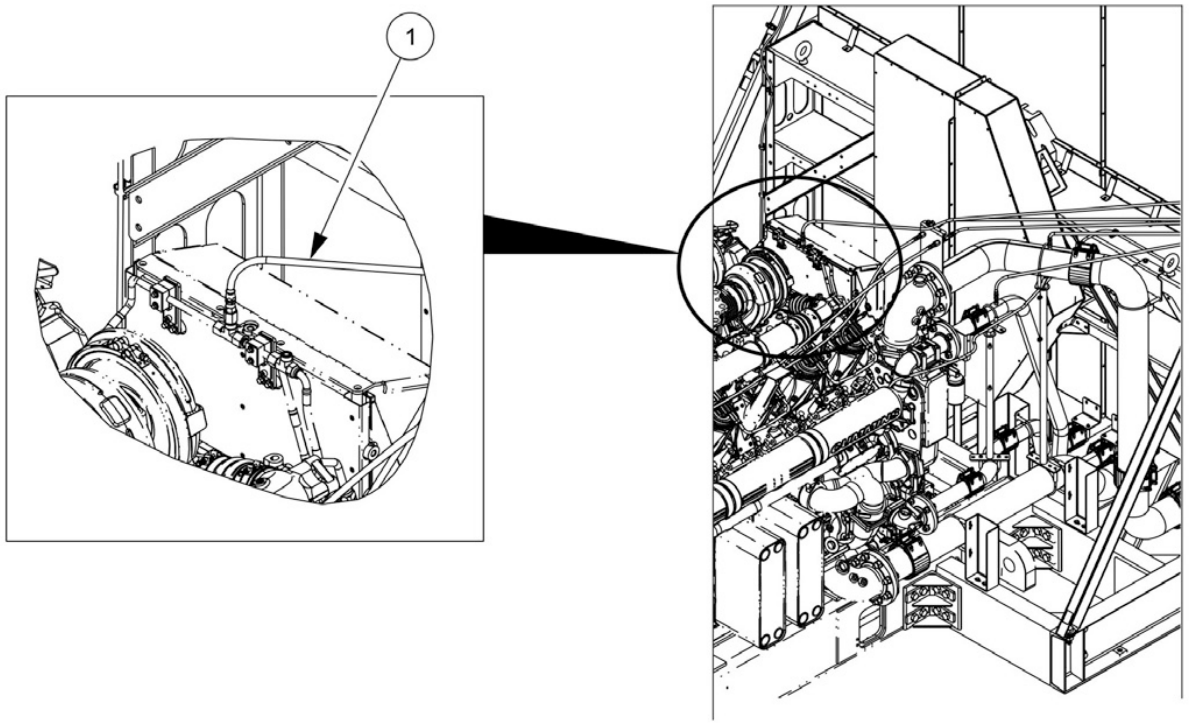
No.	Description
1	Vent Line

FIGURE 202. LT ENGINE VENT LINE

1. Remove the M14 plug in the LT thermostat housing.
2. Install the LT engine vent line fitting.
3. Install the LT engine vent line (1).
4. Torque the vent line to 27 Nm (20 ft-lb).

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6.5.4.5.22.3 Install HT Engine Vent Line



No.	Description
1	Vent Line

FIGURE 203. HT ENGINE VENT LINE

1. Remove any shipping plugs.
2. Install vent line (1).
3. Torque vent line to 52 Nm (38 ft-lb).

6.5.4.5.23 Install Vent Lines (84 and 94 Sq Ft Radiator)

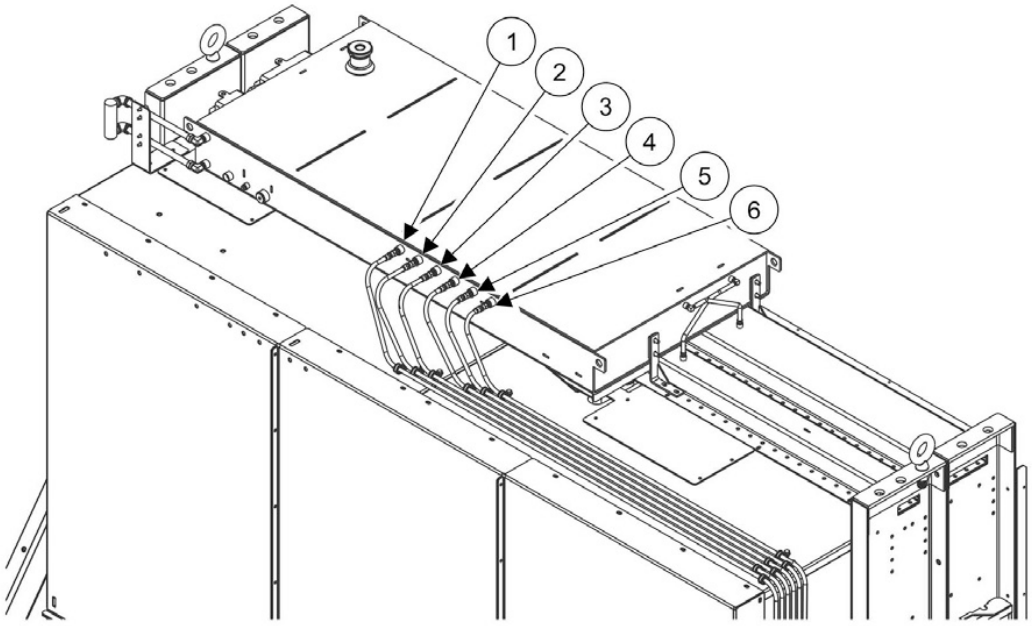
The vent lines come installed on the radiator expansion tank (**Figure 204**). All the vent lines are bundled together and secured to the radiator.

1. Separate the vent lines and identify each line by part number.

All vent lines must be secured to the generator set using clips and cable ties.

All vent lines must be either vertical or inclined between the engine and radiator. No sags are permitted.

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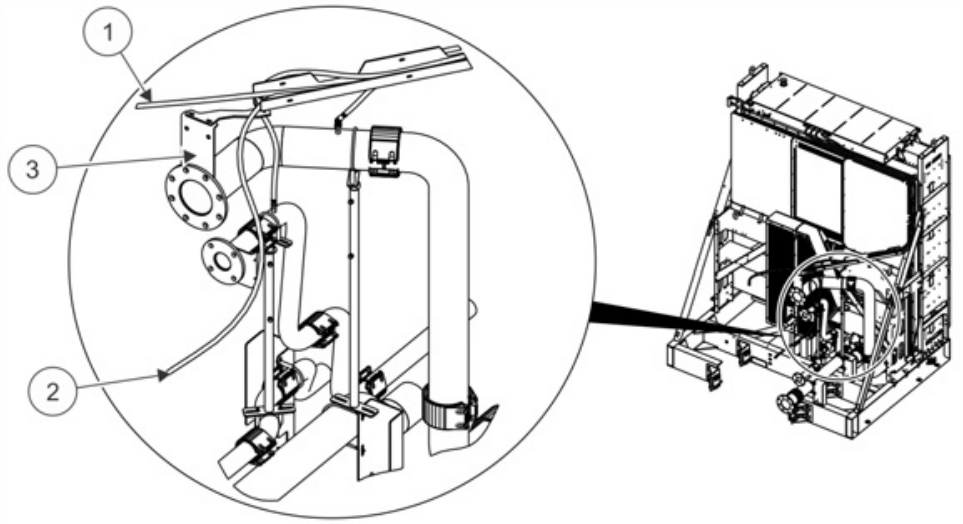
No.	Description	No.	Description
1	LT Outlet Tube 84 sq ft²: 4605 mm (181.30 in) 94 sq ft²: 5118 mm (201.50 in)	4	HT Engine Vent Line 84 sq ft²: 5071 mm (199.65 in) 94 sq ft²: 5499 mm (216.50 in)
2	HT Outlet Tube 84 sq ft²: 4512 mm (177.64 in) 94 sq ft²: 5029 mm (198 in)	5	LT Engine Vent Line 84 sq ft²: 5193 mm (204.45 in) 94 sq ft²: 6161 mm (242.56 in)
3	LT Aftercooler Vent Line 84 sq ft²: 4229 mm (166.50 in) 94 sq ft²: 4515 mm (177.76 in)	6	HT Aftercooler Vent Line 84 sq ft²: 3978 mm (156.61 in) 94 sq ft²: 4425 mm (174.21 in)

FIGURE 204. RADIATOR VENT LINES

6.5.4.5.23.1 Install Vent Lines on HT Vent Line Support Bracket (Spec A Only)

NOTICE
Numbers in parenthesis refer to Figure 205 unless specified otherwise.

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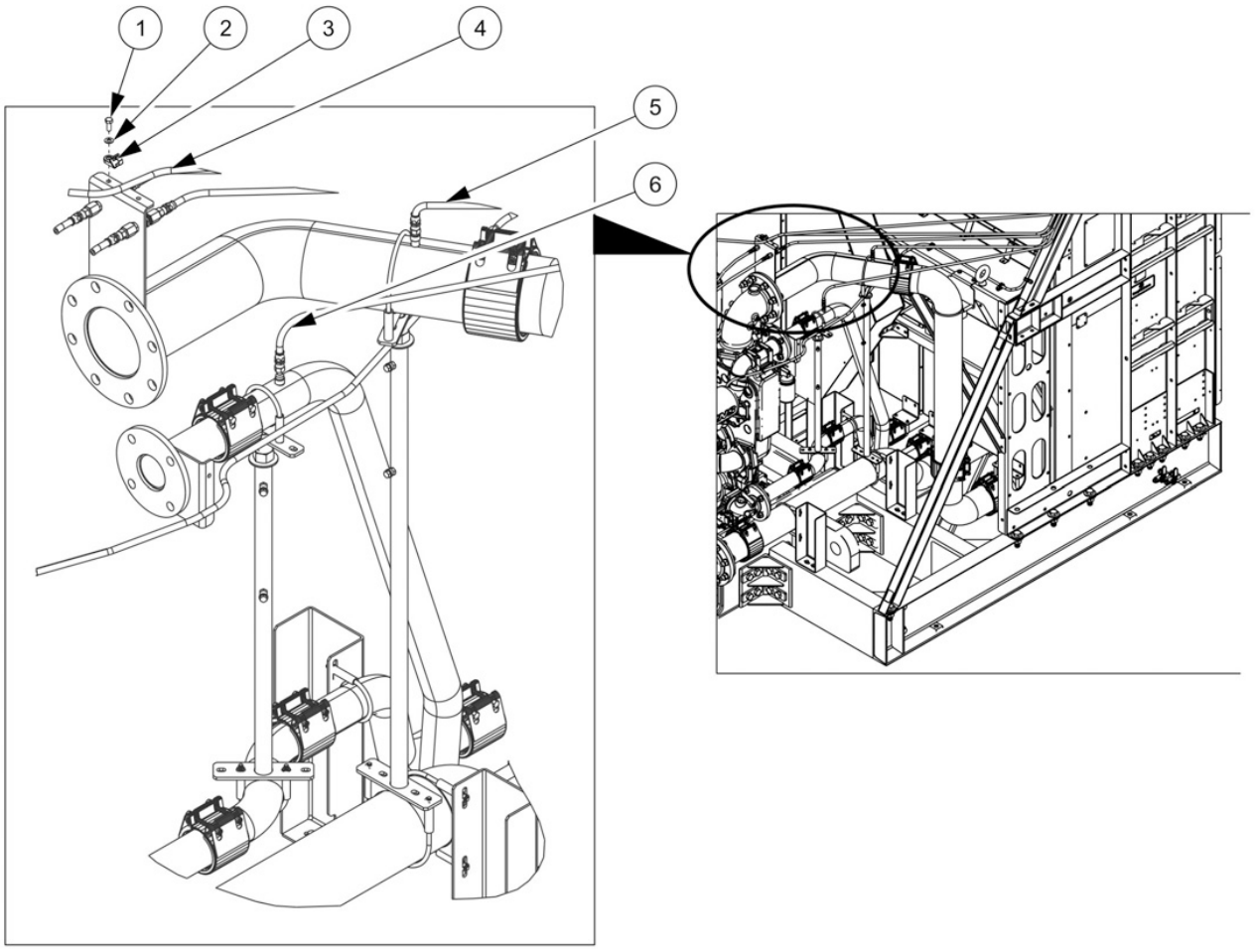
No.	Description	No.	Description
1	HT Vent Line 84 sq ft²: 4229 mm (166.50 in) 94 sq ft²: 4515 mm (177.76 in)	3	HT vent line support bracket
2	LT Vent Line 84 sq ft²: 3978 mm (156.61 in) 94 sq ft²: 4425 mm (174.21 in)		

FIGURE 205. VENT LINES ON HT VENT LINE SUPPORT BRACKET

1. Install vent lines (1 and 2) on the HT vent line support bracket. Use Loctite 592 or similar thread sealant on all threads.
2. Torque the vent lines to 12 Nm (9 ft-lb).

6.5.4.5.23.2 Install Vent Lines on Outlet Tubes and HT Vent Line Support Bracket

NOTICE
Numbers in parenthesis refer to Figure 206 unless otherwise specified.



No.	Description	No.	Description
1	Screw	4	Vent Line 84 sq ft²: 5071 mm (199.65 in) 94 sq ft²: 5499 mm (216.50 in)
2	Washer	5	Vent Line 84 sq ft²: 4512 mm (177.64 in) 94 sq ft²: 5029 mm (198 in)
3	Cable clamp and cable tie	6	Vent Line 84 sq ft²: 4605 mm (181.30 in) 94 sq ft²: 5118 mm (201.50 in)

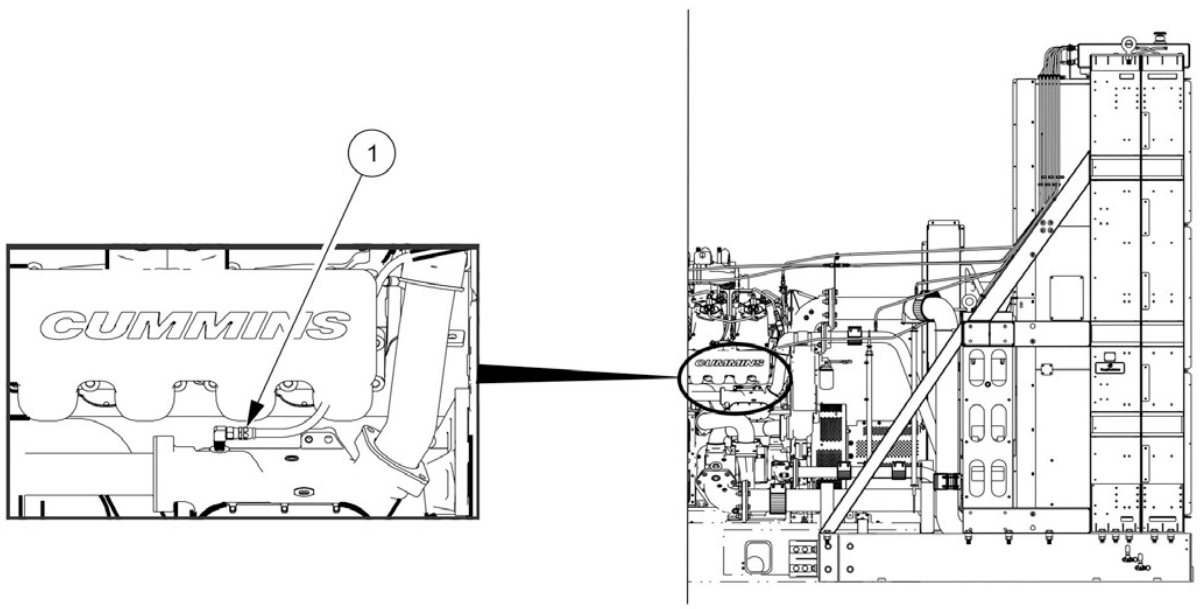
FIGURE 206. VENT LINES ON OUTLET TUBES AND HT VENT LINE SUPPORT BRACKET

1. Install vent line (4) on vent line support bracket with one screw (1), one washer (2), one cable clamp (3), and a cable tie.
2. Install vent line (5) on the HT outlet tube.
3. Install vent line (6) on the LT outlet tube.
4. Torque vent lines to 20 Nm (9 ft-lb).

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6.5.4.5.23.3 Install LT Engine Vent Line

NOTICE
Numbers in parenthesis refer to Figure 207 unless specified otherwise.



No.	Description
1	Vent Line 84 sq ft²: 5193 mm (204.45 in) 94 sq ft²: 6161 mm (242.56 in)

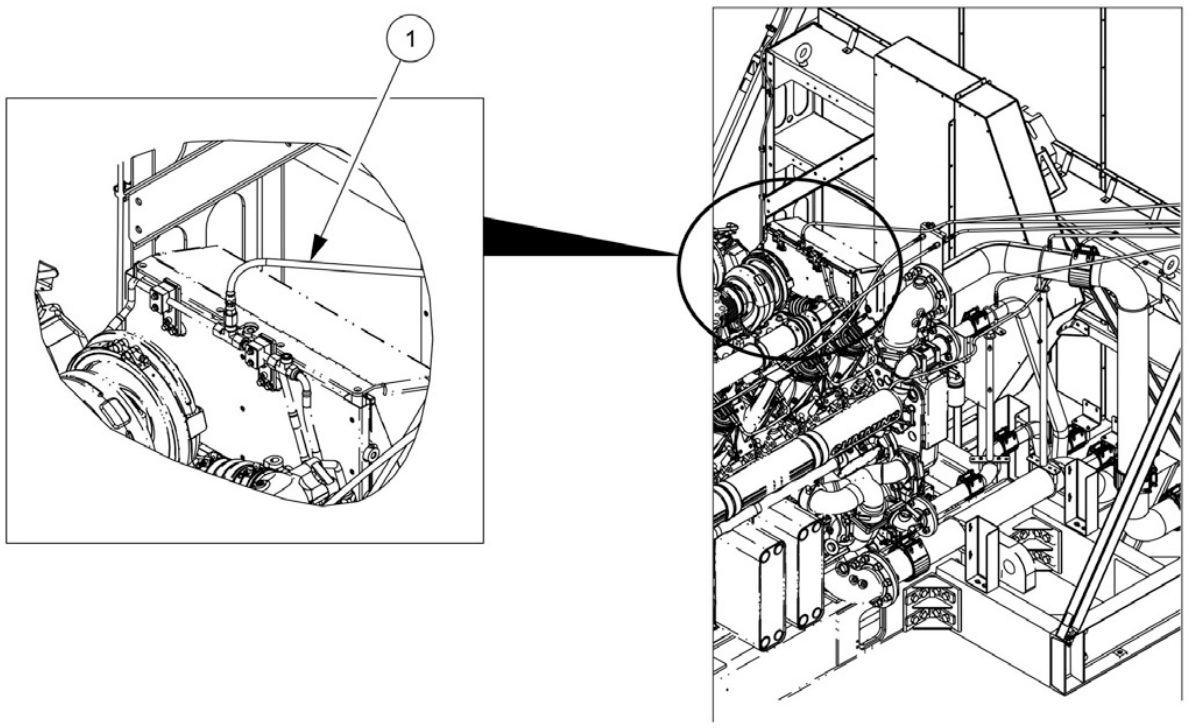
FIGURE 207. LT ENGINE VENT LINE

1. Remove the M14 plug in the LT thermostat housing.
2. Install the LT engine vent line fitting.
3. Install the LT engine vent line (1).
4. Torque the vent line to 27 Nm (20 ft-lb).

6.5.4.5.23.4 Install HT Engine Vent Line

NOTICE
Numbers in parenthesis refer to Figure 208 unless specified otherwise.

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No.	Description
1	Vent Line 84 sq ft²: 5071 mm (199.65 in) 94 sq ft²: 5499 mm (216.50 in)

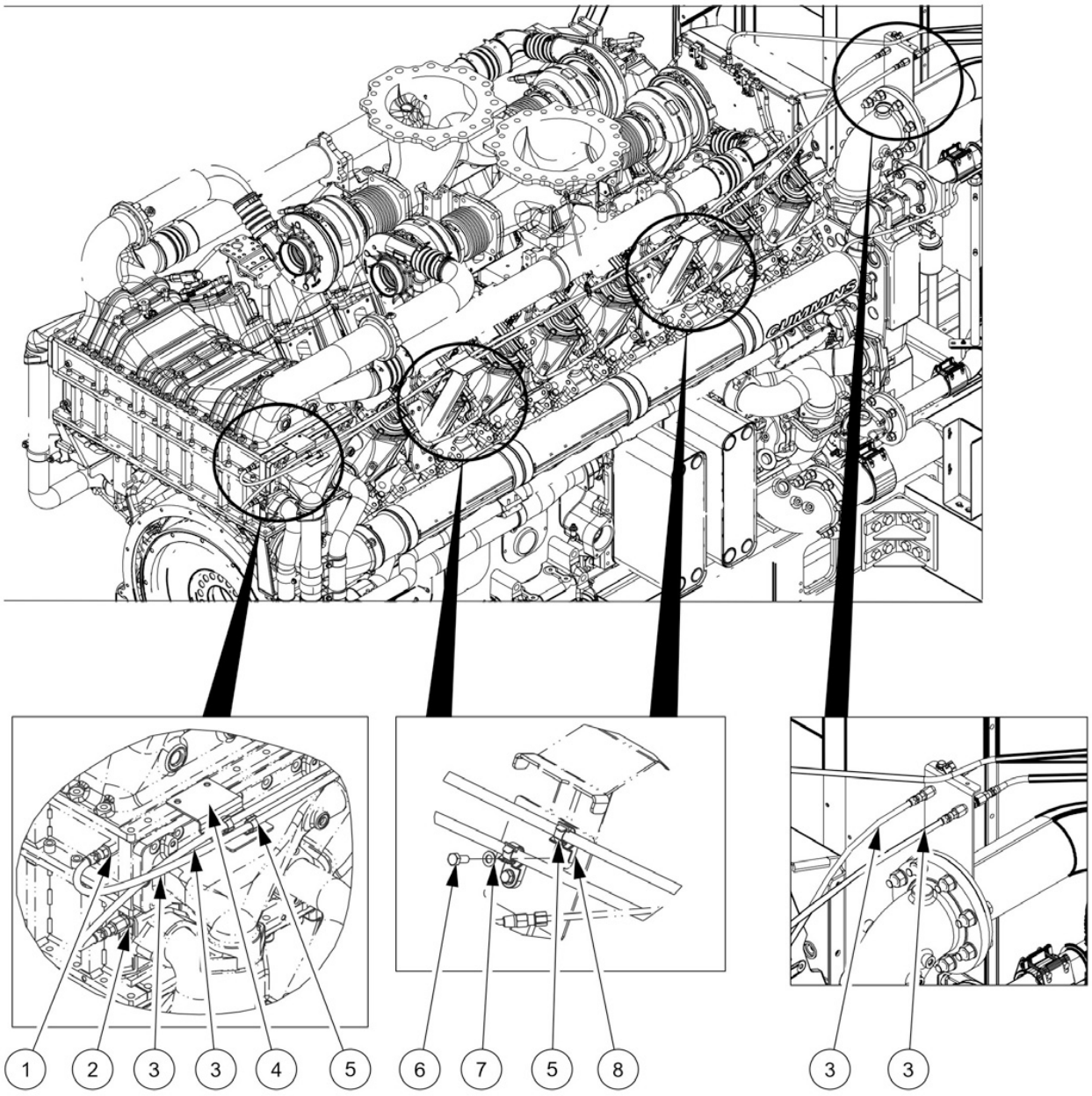
FIGURE 208. HT ENGINE VENT LINE

1. Remove any shipping plugs.
2. Install vent line (1).
3. Torque vent line to 52 Nm (38 ft-lb).

6.5.4.5.23.5 Install HT and LT Aftercooler Vent Lines (Spec A Only)

NOTICE
Numbers in parenthesis refer to Figure 209 unless otherwise specified.

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No.	Description	No.	Description
1	HT aftercooler vent	5	Cable tie
2	LT aftercooler vent	6	Screw
3	Vent Line	7	Washer
4	Bracket	8	Cable clamp

FIGURE 209. HT AND LT AFTERCOOLER VENT LINES

1. Install aftercooler vent line support bracket (4) and attachment clips.
2. Torque support bracket (4) to 52 Nm (38 ft-lb).
3. Torque attachment clips to 27 Nm (20 ft-lb).

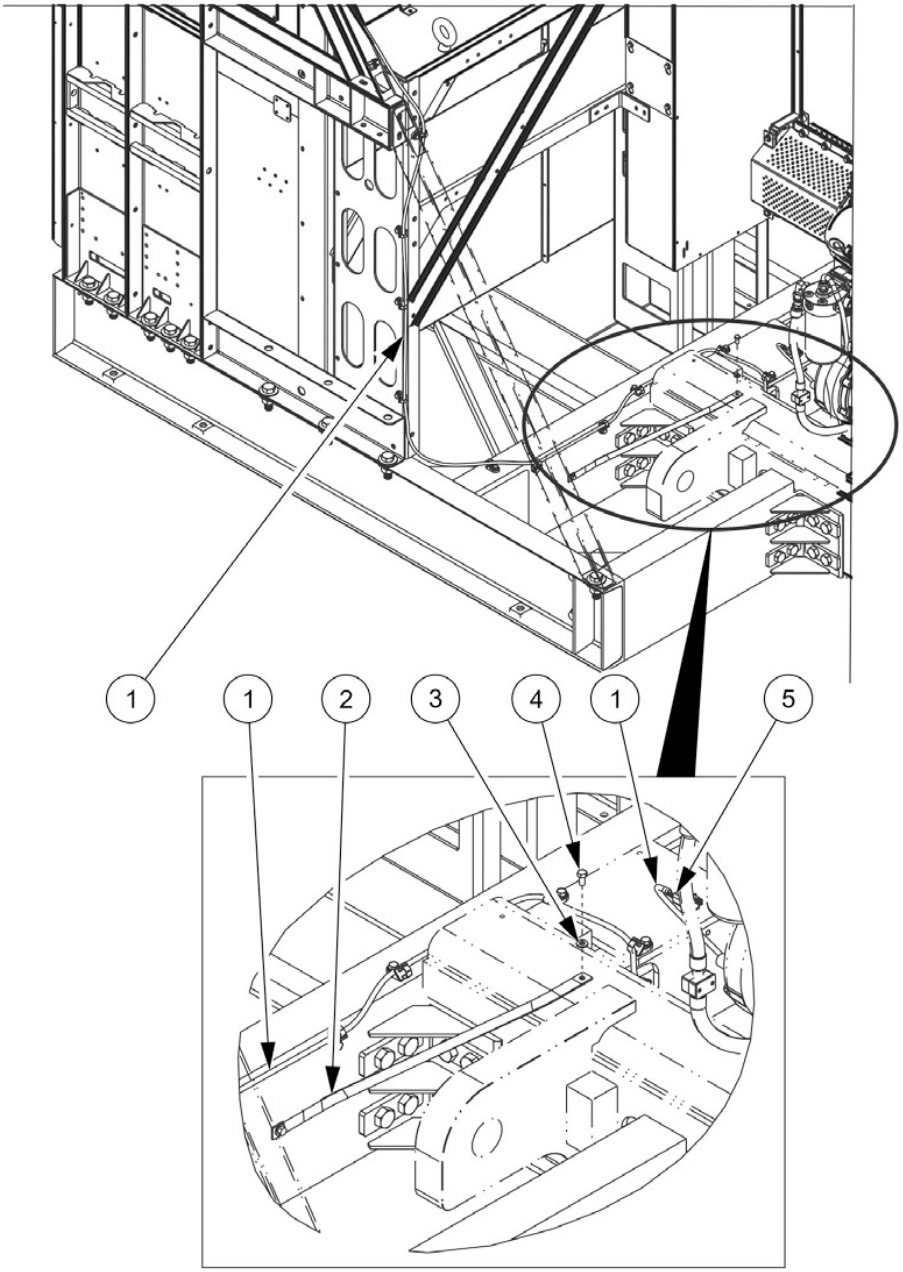
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4. Remove M14 plugs in HT and LT aftercooler.
5. Install HT and LT aftercooler vent line fittings.
6. Install HT and LT aftercooler vent lines (3).
7. Run vent lines (3) along the right bank of the engine. Attach the vent lines (3) to the air cleaner support brackets with cable ties (5).
8. Install vent lines (3) on vent line support bracket.

6.5.4.5.24 Complete Installation of Low Coolant Level Sensor Harness

NOTICE
Numbers in parenthesis refer to Figure 210 unless specified otherwise.

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No.	Description	No.	Description
1	Low coolant level sensor harness	4	Bolt
2	Ground strap	5	P1 connector on engine harness
3	Washer		

FIGURE 210. LOW COOLANT LEVEL SENSOR HARNESS CONNECTION TO ENGINE HARNESS

1. Connect the low coolant level sensor harness (1) to the engine harness (5).
2. Install the radiator ground strap (2).
    a. Apply dielectric grease to the ground strap mounting locations.

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b. Install the ground strap (2) with existing hardware.

c. Install the ground strap (2) to the generator set skid with one bolt (4) and one washer (3).

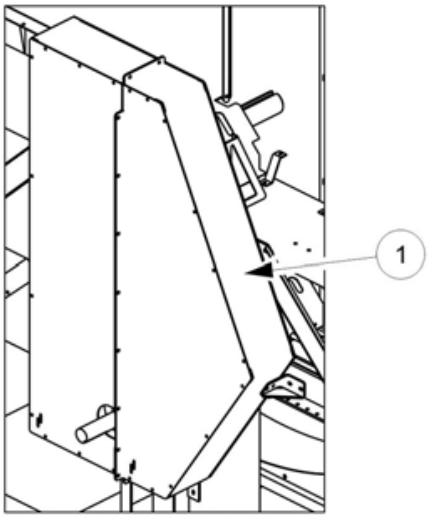
d. Torque bolts to 52 Nm (38 ft-lb).

6.5.4.5.25 Install Radiator Fan Drive Shaft

Install the radiator fan drive shaft according to Section 6.5.7 on page 685.

6.5.4.6 Fan Drive Belt Replacement

1. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See Section 6.1.2 on page 334.
2. Remove the fan drive shaft according to Section 6.5.7.1 on page 685.
3. Remove the radiator belt guard.

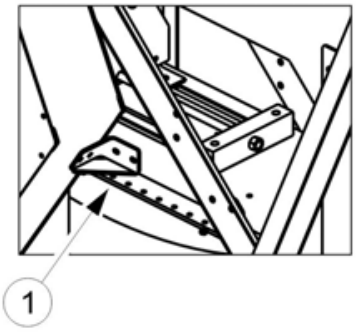


No.	Description	No.	Description
1	Radiator belt guard		

FIGURE 211. RADIATOR BELT GUARD

4. Loosen four tensioner 5/8" locking bolts and nuts located under the radiator support cross member.

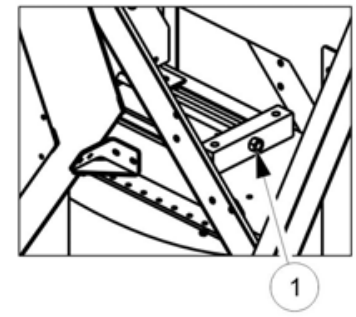
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No.	Description	No.	Description
1	Tensioner locking bolts under radiator support cross member		

FIGURE 212. TENSIONER LOCKING BOLT LOCATION

5. Turn the tensioner adjustment screw counterclockwise to loosen the fan drive belts.



No.	Description	No.	Description
1	Tensioner adjustment screw		

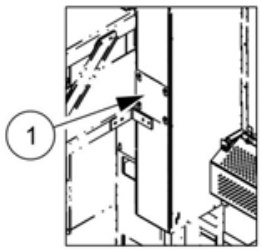
FIGURE 213. TENSIONER ADJUSTMENT SCREW

6. Remove all fan drive belts.
7. Install new fan drive belts.

NOTICE
The fan drive belts should be a matched set.

8. Remove the fan drive belt inspection cover.

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No.	Description	No.	Description
1	Fan drive belt inspection cover		

FIGURE 214. FAN DRIVE BELT INSPECTION COVER

9. Use a belt tension tool to set the belt tension for the new belts.
10. Turn the tensioner adjustment screw clockwise to increase fan drive belt tension.
    - Belt span

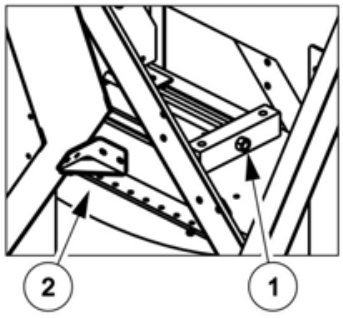
      40.5 inches (1028.7 mm)
    - New belt deflection force

      60 Hz - 21.4 lb (9.71 kg)

      50 Hz - 22.1 lb (10.02 kg)
    - Used belt deflection force

      60 Hz - 14.3 lb (6.48 kg)

      50 Hz - 14.7 lb (6.67 kg)



No.	Description	No.	Description
1	Tensioner adjustment screw	2	Tensioner locking bolts under radiator support cross member

FIGURE 215. TENSIONER ADJUSTMENT SCREW AND LOCKING BOLTS

11. Torque the four tensioner locking bolts underneath the radiator support cross member to 290 Nm (215 ft-lb).
12. Install the fan drive belt inspection cover.
13. Install the radiator belt guard.
14. Install the fan drive shaft according to **Section 6.5.7.2 on page 694**.
15. Test run the generator set. Check for proper operation of the fan drive shaft and fan drive belts.

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6.5.4.7 Grease Fan Bearings

Fan bearings should be greased immediately with initial installation of radiator, then at regular intervals following the maintenance schedule. When operating in hot, dirty, or wet environments, the bearing re-grease interval will need to be increased. The timing can vary from daily to weekly. historical experience with bearings operating under the specific conditions will help determine the correct interval. Contact your authorized distributor for assistance.

6.5.4.7.1 Tools and Consumables

- Grease gun (flexible hose recommended)
- 9/16 inch socket
- Fan drive bearing grease (Mobil One Synthetic, part number A049B381)

6.5.4.7.2 Procedure

⚠ WARNING

Moving Parts
Moving parts can cause severe personal injury.
Use extreme caution around moving parts. All guards must be properly fastened to prevent unintended contact.

⚠ WARNING

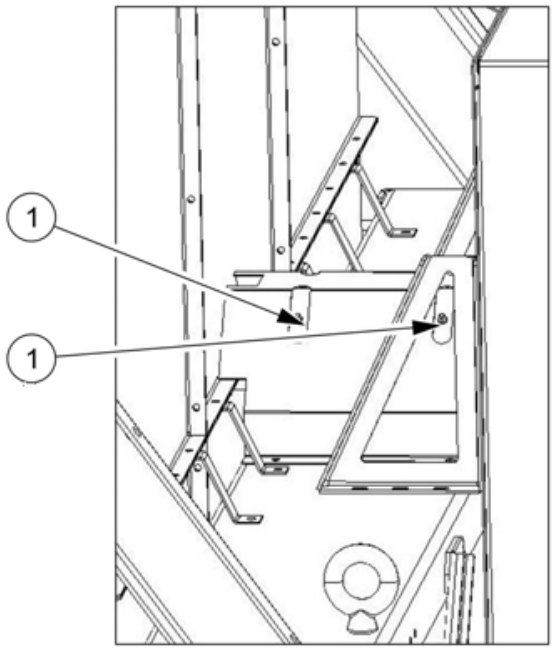
Automated Machinery
Accidental or remote starting of the generator set can cause severe personal injury or death.
Make sure that the generator set cannot be started accidentally or remotely before starting work on the generator.

⚠ CAUTION

Sharp Edges and Sharp Points Projecting corners/parts may cause cuts, abrasions and other personal injury.
Use PPE. Be aware of sharp edges and corners/sharp points. Cover/protect them.

1. Locate the fan shaft grease fittings. The grease fittings are accessible through slots in the bearing guard.

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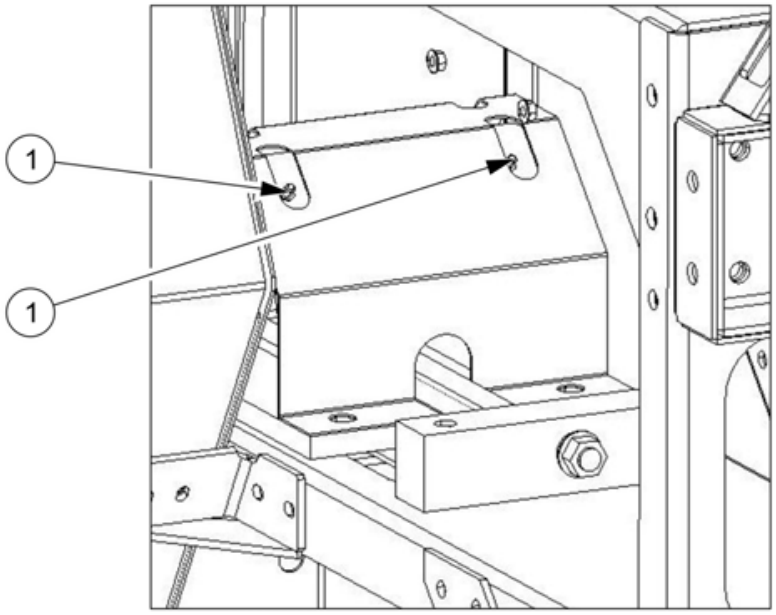


No.	Description	No.	Description
1	Fan shaft grease fitting		

FIGURE 216. FAN SHAFT GREASE FITTINGS

2. Wipe the grease fittings clean of any foreign material.
3. Put the grease gun onto the grease fitting. Make sure the grease gun nozzle is fully engaged on the grease fitting.
4. Pump about 0.42 oz of grease into each grease fitting.
5. Locate the idler shaft grease fittings. The grease fittings are accessible through the slots in the bearing guard.

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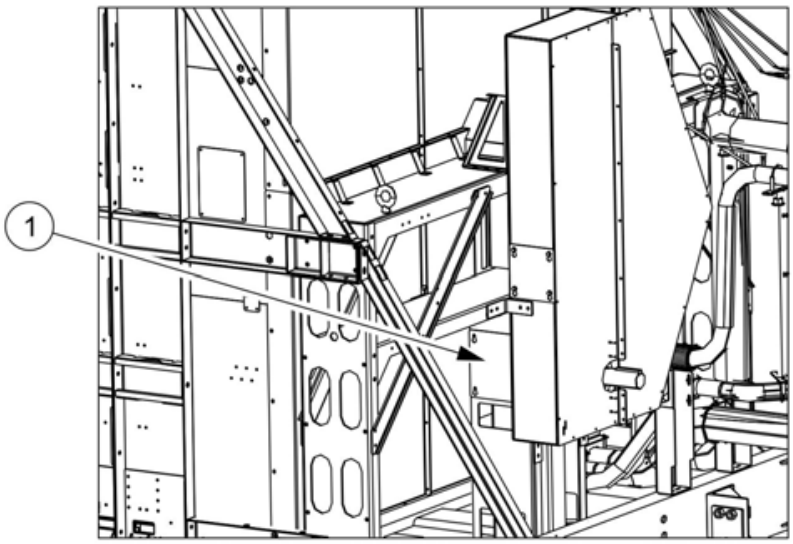


No.	Description	No.	Description
1	Idler shaft grease fitting		

FIGURE 217. IDLER SHAFT GREASE FITTINGS

6. Wipe the grease fittings clean of any foreign material.
7. Put the grease gun onto the grease fitting. Make sure the grease gun nozzle is fully engaged on the grease fitting.
8. Pump about 0.28 oz of grease into each grease fitting.
9. Remove the inspection cover.

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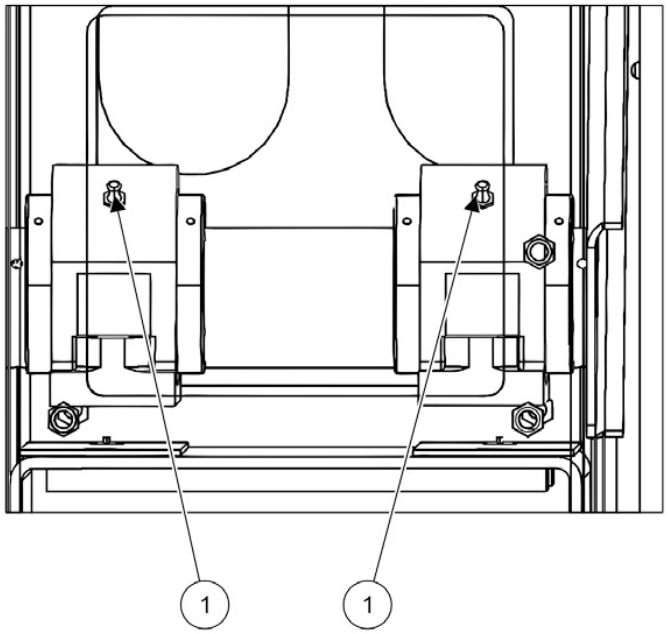


No.	Description	No.	Description
1	Inspection cover		

FIGURE 218. INSPECTION COVER

10. Locate the input shaft grease fittings. The grease fittings are accessible through the slots in the bearing guard.

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No.	Description	No.	Description
1	Input shaft grease fitting		

FIGURE 219. IDLER SHAFT GREASE FITTINGS

11. Wipe the grease fittings clean of any foreign material.
12. Put the grease gun onto the fitting. Make sure the grease gun nozzle is fully engaged on the grease fitting.
13. Pump about 0.63 oz of grease into each grease fitting.
14. Use a baring device to turn the engine 3 full turns. Take note of fan blade location for counting.
15. Pump about 0.42 oz of grease into each fan shaft grease fitting.
16. Pump about 0.28 oz of grease into each idler shaft grease fitting.
17. Pump about 0.63 oz of grease into each input shaft grease fitting.
18. Install the inspection cover. Tighten the four bolts

6.5.5 Radiator Service – A076E016, A078L534, A078L535, A079P108, A079P131, A079P132

6.5.5.1 Specifications

TABLE 129. SPECIFICATIONS

Item	Data
Cooling System Capacity	

Item	Data
Capacity Standard Radiator Only	For fill volumes, refer to Section 3.2 on page 23
Capacity Engine Only	
Total Capacity (Engine and Standard Radiator)	
Coolant flow rate	For 50 °C, 84 ft² radiator: HT section 2478 lpm (655 gpm) LT section 685 lpm (181 gpm) For 40 °C, 84 ft² radiator: HT section 2478 lpm (655 gpm) LT section 685 lpm (181 gpm) For 40 °C, 61 ft² radiator: HT section 2518 lpm (665 gpm) LT section 668 lpm (176 gpm)
Expected pressure drop	For 60 Hz: 12 psi For 50 Hz: 8.5 psi
Radiator Pressure cap	
Operating Pressure	1.03 Bar (15 PSI)
Operating Temperature (maximum)	50 °C (122 °F)
Thermostat	
Operating temperature	HT thermostat opens @ 82.2 °C (180 °F) LT thermostat opens @ 46.1 °C (115 °F)
Set Mounted Cooling System	
Radiator Assembly Dry Weight	84 ft² 5000 kg (11023 lb) 61 ft²4620 kg (10185 lb)
Radiator Size	
Height	84 ft² 3759.2 mm (148 in) 61 ft² 3371 mm (132.7 in)
Width	84 ft² 3022.6 mm (119 in) 61 ft² 2616.2 mm (103 in)
Depth	84 ft² 2336.8 mm (92 in) 61 ft² 2336.8 mm (92 in)

6.5.5.2 Radiator Rigging Instructions

⚠ WARNING

Heavy Load

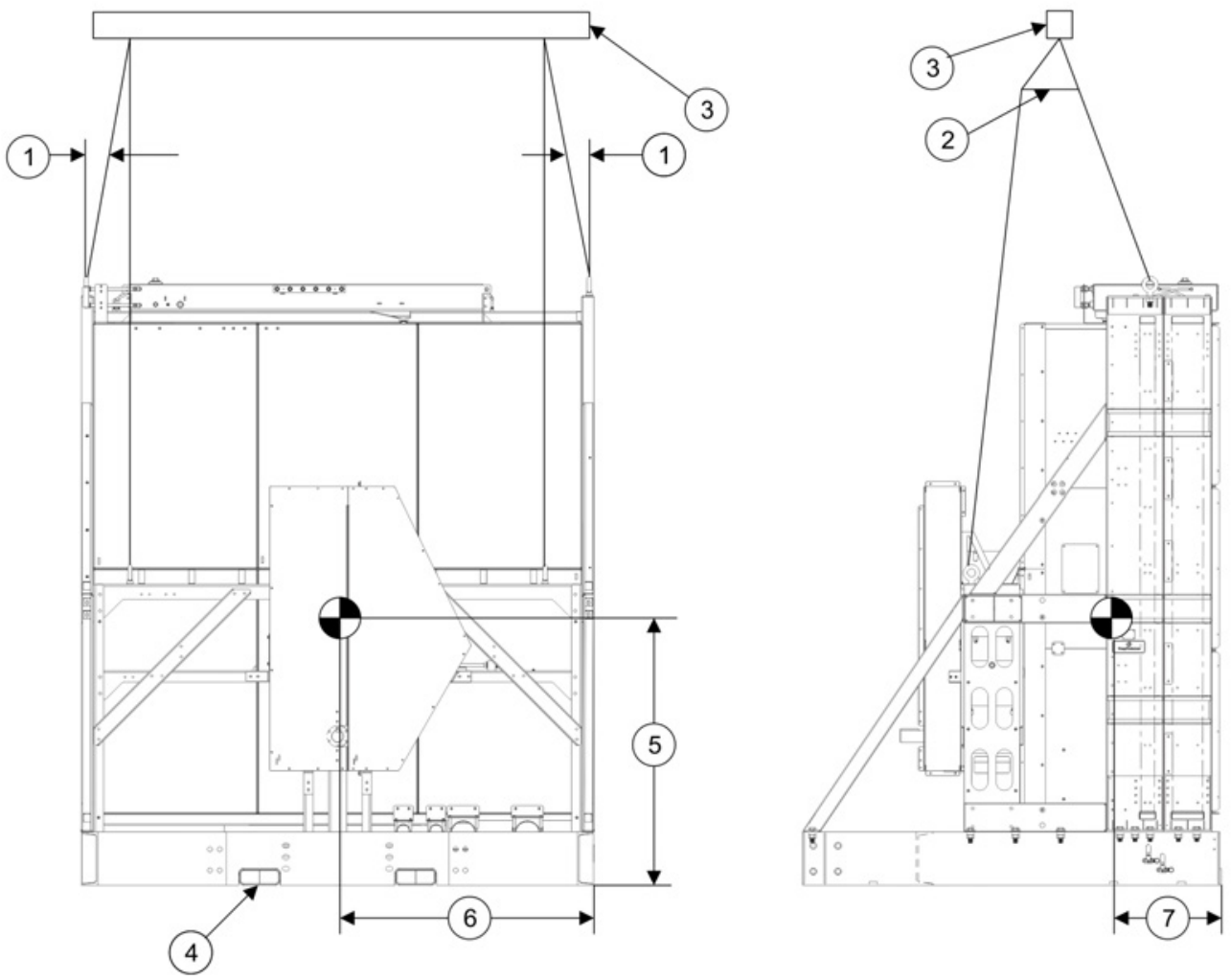
Incorrect lifting or repositioning can cause severe personal injury or death.

Make sure that only suitably trained or experienced personnel transport and handle radiator and associated components.

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NOTICE
Do not lift the generator set with the radiator installed. Damage can occur.

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Item	Description	Item	Description
1	Angle 10° maximum	5	61 ft² radiator - 1271 mm (50.03 in) 84 ft² radiator - 1472 mm (57.95 in)
2	Spreader bar to avoid damage to the fan guard	6	61 ft² radiator - 1285 mm (50.59 in) 84 ft² radiator - 1500 mm (59.06 in)
3	Lifting beam	7	61 ft² radiator - 848 mm (33.38 in) 84 ft² radiator - 768 mm (30.23 in)
4	Fork tube (quantity 2) 254 mm X 102 mm (10.0 in X 4.0 in)		Dry weight: 61 ft² radiator - 4620 kg (10185.3 lb) 84 ft² radiator - 4836 kg (10,660 lb)
Cables must not exceed a 45° angle from vertical in any direction.			

FIGURE 220. RADIATOR RIGGING

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6.5.5.3 Cooling System Maintenance

This section provides information on cleaning the radiator and updated information regarding bearings that has been provided by our supplier to enable efficient and prolonged life of the equipment.

NOTICE
The following information regarding the correct choice and fitting of hose clamps has also been provided by our supplier to assist and guide the user.

6.5.5.3.1 Hose Clamp Installation

This section provides general installation guidelines for the correct positioning, orientation and torque figures required when fitting hose clamps. Recommended hose and clamp combinations are also included.

6.5.5.3.1.1 Hose Clamps

Installation

1. Make sure the pipe ends are clean.
2. Pipes must be properly supported. Hoses do not act as supports for pipes.
3. Center the hose over the pipe connections.
   - Do not exceed the maximum allowed gap between pipe ends.

NOTICE
To ensure hose is properly centered on the gap between pipe ends, it is recommended to mark the hose location on the pipes accordingly prior to tightening the hose clamps. This mark will act as a guide during installation.

4. Tighten the hose clamp bolts.

NOTICE
Do not attempt to move hose after tightening.

Removal

1. Make sure fluids have been properly drained from the system.
2. Loosen the hose clamp bolts.
3. Carefully use a hose pick to release the hose from the pipe surface.
4. Slide the hose to remove from the pipe.

6.5.5.3.2 Cleaning

6.5.5.3.2.1 General Cleaning

The Cleaning Of Radiator Cores Using Pressurized Water Equipment:

NOTICE
In specific dust laden environments, this procedure should not be used as the initial cleaning operation; it should follow Cleaning - Dust Laden Environments.

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On enclosed generator sets with removable end panel(s), remove the end panel(s) to assist in the cleaning of the radiator.

Inspect the exterior of the radiator for obstructions. During the service life of a radiator, a build up of foreign matter can obstruct the flow of air through the radiator cores, reducing the cooling capability. To ensure the continued efficiency of the radiator, the core will require cleaning.

For thorough cleaning, pressure wash in the opposite direction to the airflow. A suitable proprietary degreasing additive (as recommended by the manufacturer of the pressure washer) should be applied via the pressure washer but this must not contain ammonia as it will corrode the core.

The recommended equipment for cleaning a radiator core is an industrial pressure washer, but it must be used in the correct manner as misuse can reduce the performance of the core. Protect the generator set from any over spray during this procedure.

To be effective, it is recommended that a hot water washer be used.

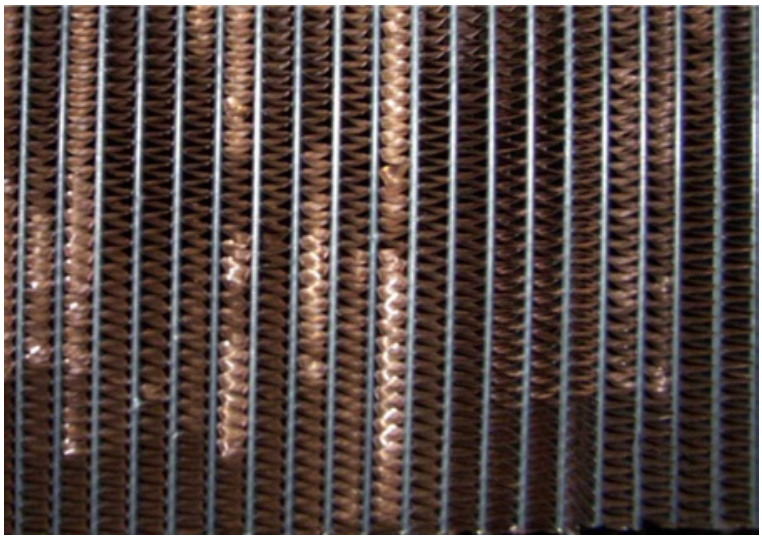


FIGURE 221. FINS DAMAGED BY PRESSURE WASHING AT ACUTE ANGLES TO CORE FACE

NOTICE
With the pressures involved it is important that the distance between the core face and the nozzle is a minimum of 100 mm (3.93 inches); any closer and damage may occur.

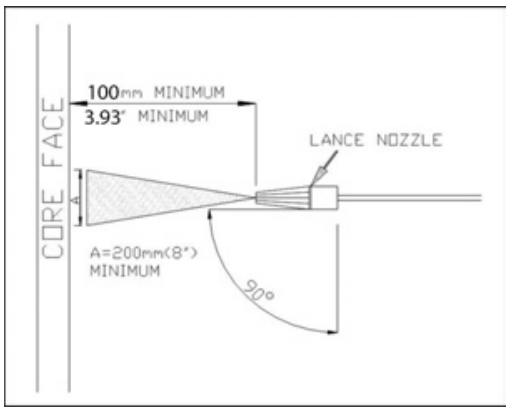


FIGURE 222. PRESSURE WASHER NOZZLE POSITIONING

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NOTICE

Most Industrial pressure washers work at pressures of around 1500 psi to 2000 psi (103 bar to137.89 bar). It is very important that, when washing a core in this way, the lance must be kept at a right angle to the core

NOTICE

If your pressure washer works above 2000 psi, then the gap between the nozzle and the core face must be increased or fin damage will occur.

NOTICE

Always follow pressure washer Manufacturer's Health and Safety Guidelines.

Replace the end panel(s) where necessary.

6.5.5.3.2.2 Dust Laden Environments

Specific Instructions for the Cleaning of Radiator Cores Used in an Environment Subjected to Crushed Aggregate or Ceramic Dust Contamination

On enclosed generator sets with removable end panel(s), remove the end panel(s) to assist in the cleaning of the radiator.

Inspect the exterior of the radiator for obstructions. During the service life of a radiator, a buildup of foreign matter can obstruct the flow of air through the radiator cores, reducing cooling capability. To maintain the efficiency of the radiator, the core will require cleaning.

Unless the radiator can be dismantled and the core treated in a professional caustic immersion cleaning system, the radiator should not be "wet" cleaned. This is because of the tendency of this type of contamination to coalesce and become extremely difficult to remove.

The correct procedure is to regularly blow through the entire core area with low pressure compressed air (against the direction of cooling airflow). It is very important to ensure that resultant debris blown from the core is subsequently removed and disposed of before engine start-up. An industrial vacuum cleaner will achieve this requirement. In most installations, it will be necessary to remove cowls and guarding.

To prevent damage to fins and resultant loss of cooling, it is important to ensure that the air gun used is maintained at right angles to the core face.

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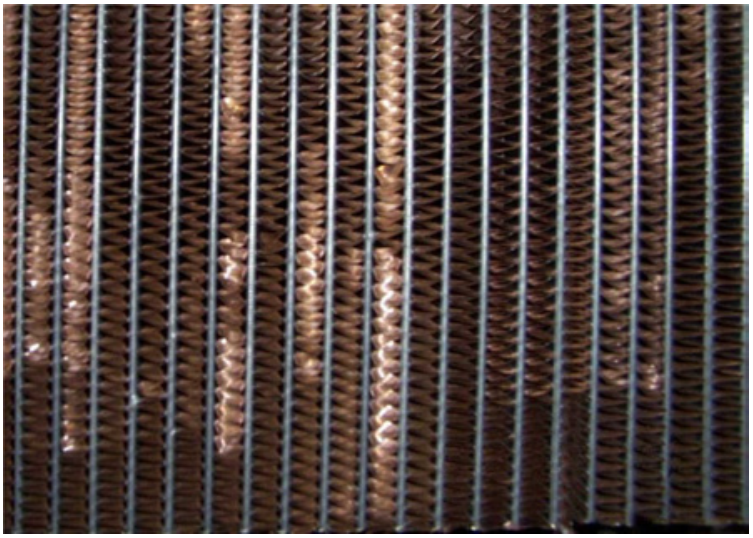


FIGURE 223. FINS DAMAGED BY COMPRESSED AIR AT ACUTE ANGLES TO CORE FACE

After this procedure has been effectively carried out with only the lightest of dust remaining, follow it immediately (if necessary) by cleaning the radiator cores using pressurized water equipment.

Replace the end panel(s) where necessary.

NOTICE
It is vitally important that the core is thoroughly dried before start-up.

6.5.5.3.3 Fan Drive Bearings

6.5.5.3.3.1 Bearing Health Check

The following information is relevant to both Interference Fit and Non-Interference Fit bearings.

Determine if there are any sounds emanating from the shaft/bearing assembly which may be indicative of failure, or imminent failure.

6.5.5.3.3.2 Fan Drive Bearing Locations

Placeholder for image depicting Fan Drive Bearing Locations.

FIGURE 224. FAN DRIVE BEARING LOCATIONS

6.5.5.3.3.3 Bearing and Grease Change

The fan drive and design has been changed to improve serviceability of the bearing set-up, both in terms of greasing and fitting.

For detailed procedure applicable to this radiator, see Section 6.5.5.7 on page 638

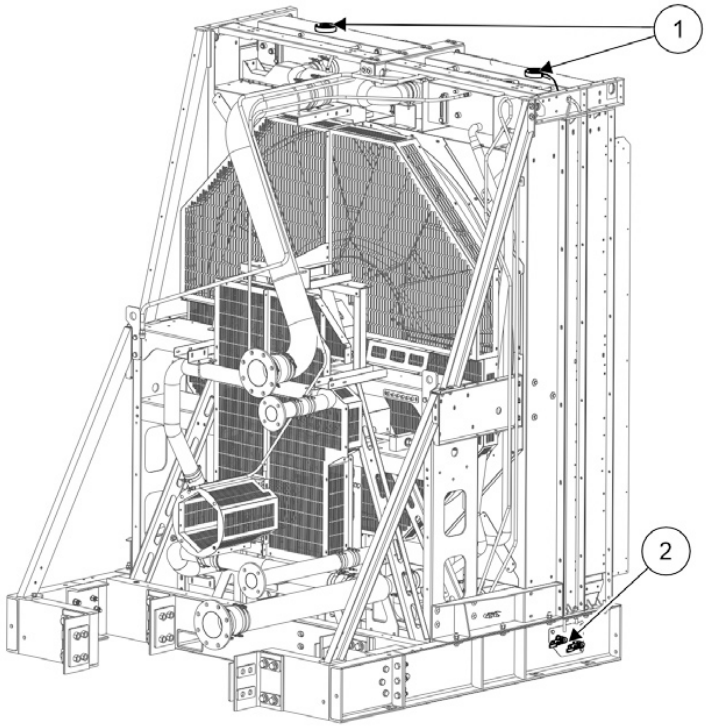
6.5.5.4 Radiator Removal - Open Set

6.5.5.4.1 Remove Radiator Fan Drive Shaft

Remove the radiator fan drive shaft according to Section 6.5.7.1 on page 685.

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6.5.5.4.2 Remove Coolant



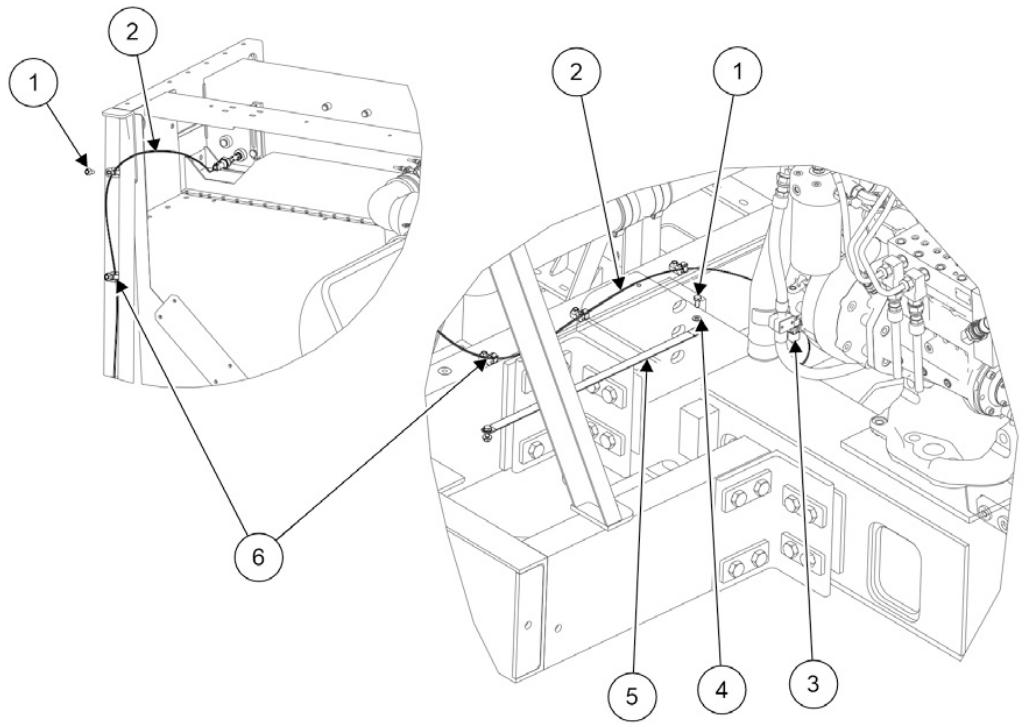
No.	Description	No.	Description
1	Fill Necks	2	Drain Valves

FIGURE 225. RADIATOR FILL LOCATIONS

1. Remove the radiator pressure cap on the fill neck.
2. Connect a drain hose from the drain valves to a suitable container.
3. Open the drain valves to drain coolant to the container.
4. Dispose of the coolant in accordance with local regulations.

6.5.5.4.3 Remove Low Coolant Level Sensor Harness from Engine Harness

NOTICE
Numbers in parenthesis refer to Figure 226 unless specified otherwise.



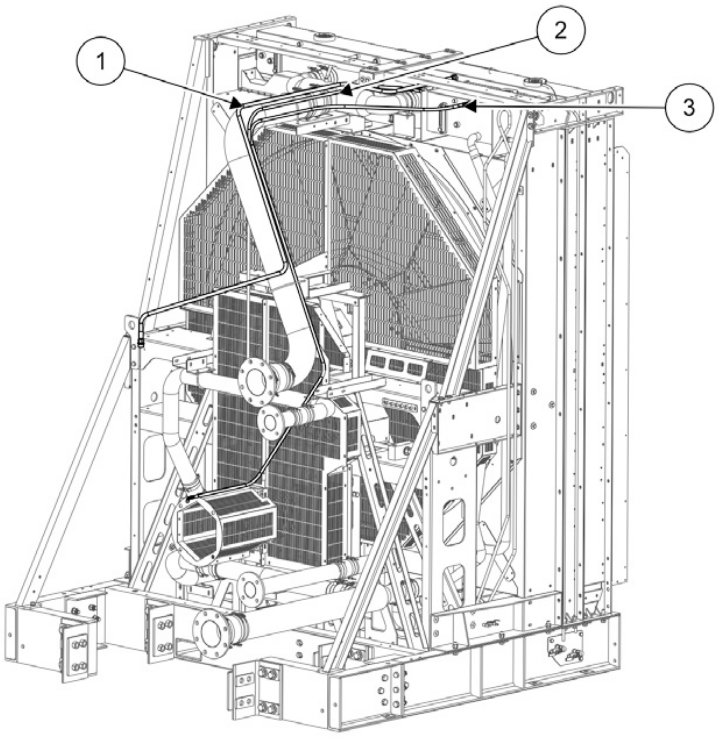
No.	Description	No.	Description
1	Bolt	4	Washer
2	Low coolant level sensor harness	5	Ground strap
3	Engine P1 connector	6	Cable clamp

FIGURE 226. LOW COOLANT LEVEL SENSOR HARNESS CONNECTION TO ENGINE HARNESS

1. Remove the radiator ground strap (5).
2. Disconnect the low coolant level sensor harness (2) from the engine harness (3).

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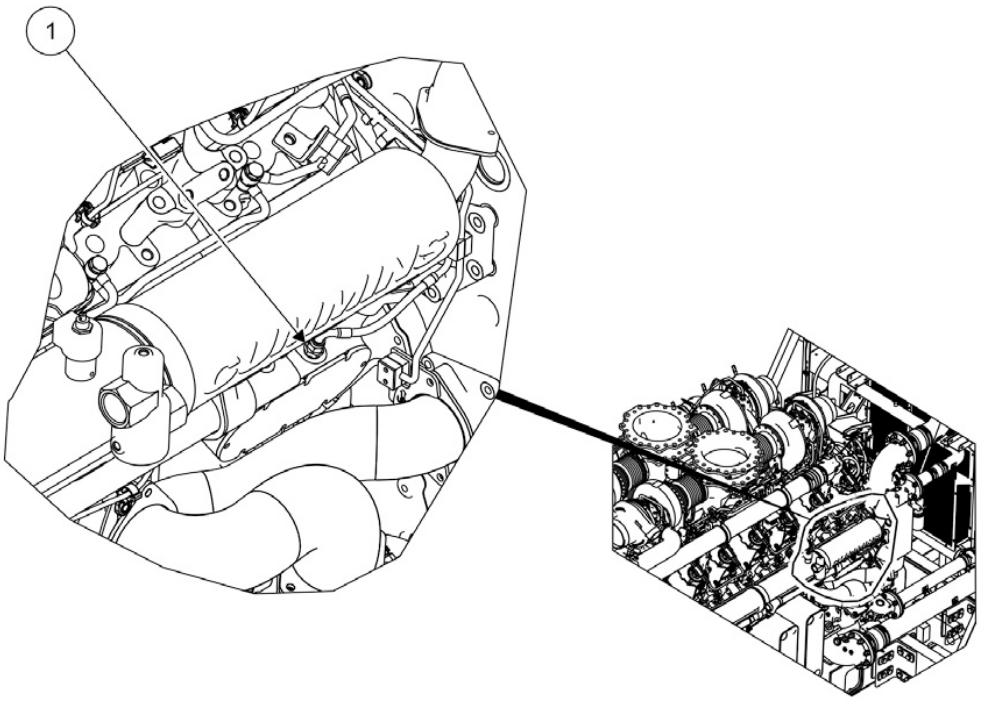
6.5.5.4.4 Remove Vent Lines



No.	Description	No.	Description
1	LT Engine Vent Line	3	HT Engine Vent Line
2	LT Engine Outlet Tube Vent Line		

FIGURE 227. RADIATOR VENT LINES

6.5.5.4.4.1 Remove LT Engine Vent Line



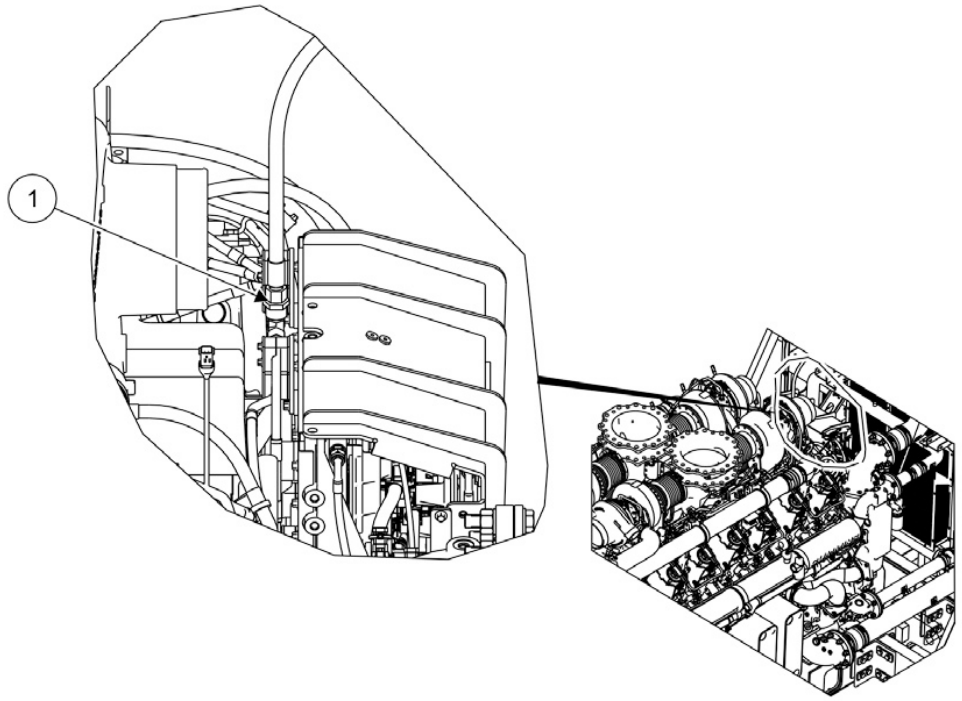
No.	Description
1	Vent Line

FIGURE 228. LT ENGINE VENT LINE

1. Label Vent line locations.
2. Remove LT vent line (1) from LT thermostat vent line fitting.

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6.5.5.4.4.2 Remove HT Engine Vent Line



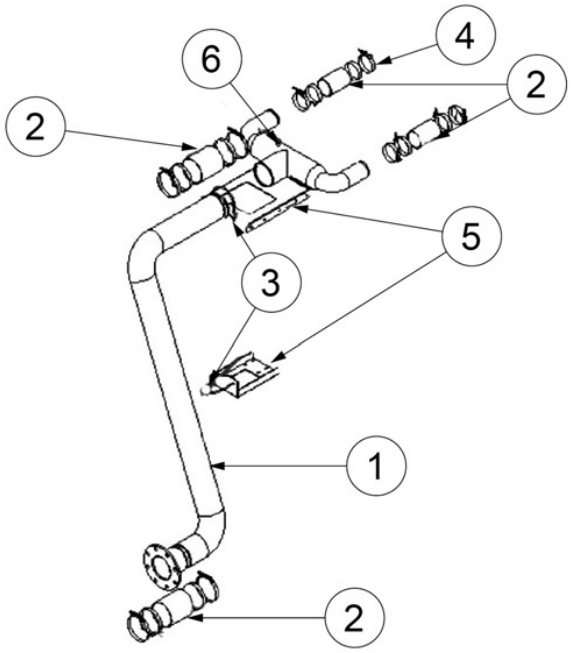
No.	Description
1	Vent Line

FIGURE 229. HT ENGINE VENT LINE

1. Label vent line locations.
2. Remove HT vent line (1) from HT vent line fitting.

6.5.5.4.5 Remove HT Outlet Tubing

NOTICE
Numbers in parenthesis refer to Figure 230 unless specified otherwise.



No.	Description	No.	Description
1	Radiator HT Outlet	4	Clamp
2	High temperature hose	5	Support bracket
3	U-bolt	6	C-bend Pipe

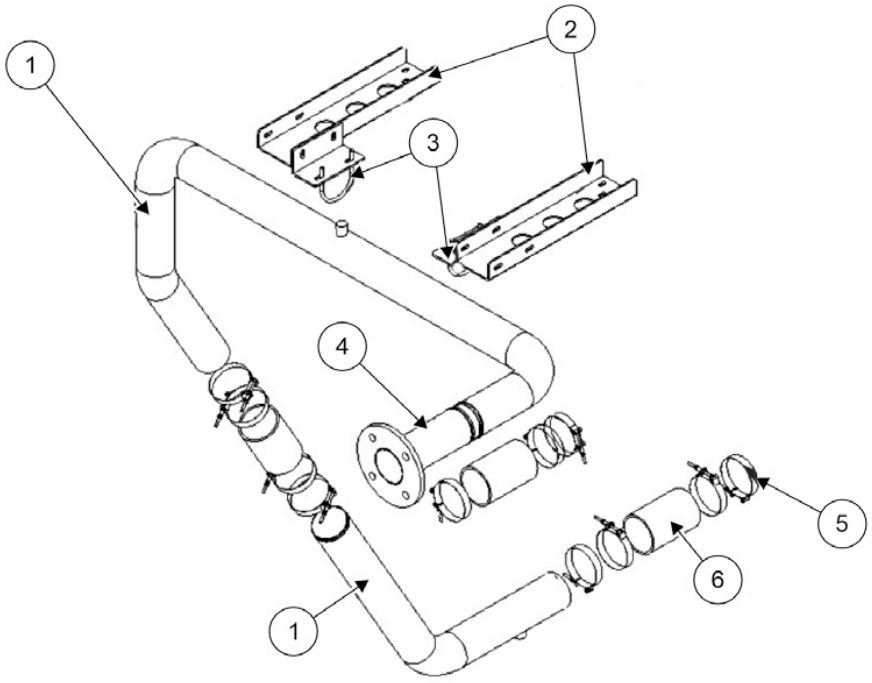
FIGURE 230. HT OUTLET TUBING INSTALLATION

1. Remove HT outlet tube support bracket (5).
2. Remove U-bolts (3).
3. Loosen clamps (4) that attach the high temperature hoses (2) to the C-bend pipe (6).
4. Remove the C-bend pipe (6).
5. Remove the bolts on pipe flange of the radiator HT outlet pipe (1).
6. Remove the HT radiator outlet (1).

6.5.5.4.6 Remove LT Outlet Tubing

NOTICE
Numbers in parenthesis refer to Figure 231 unless specified otherwise.

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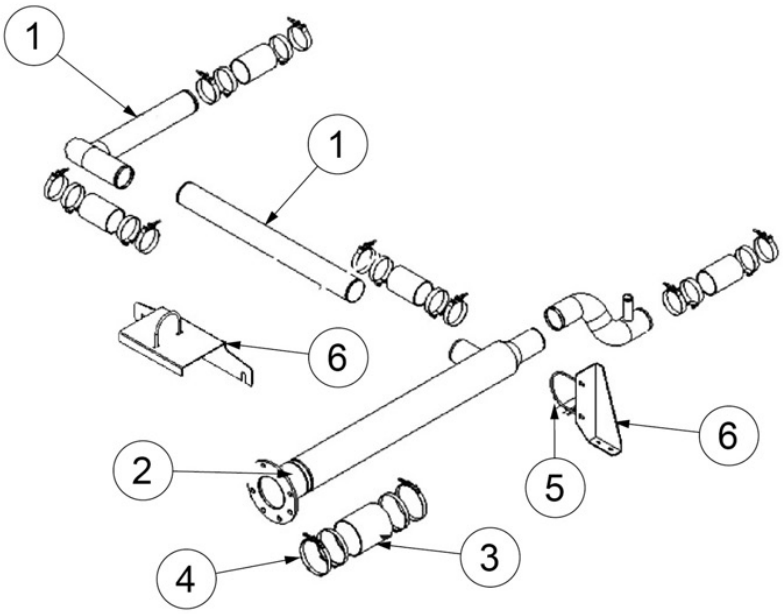
No.	Description	No.	Description
1	LT Outlet Tube	4	DIN Connection
2	Support Bracket	5	Clamp
3	U-Bolt	6	High Temperature Hose

FIGURE 231. LT OUTLET TUBING INSTALLATION

1. Remove U-bolt (3) from LT outlet tube support (2).
2. Loosen bolts on hose clamps (5).
3. Remove high temperature hoses (6) from LT outlet tube.
4. Remove LT outlet tube (1).

6.5.5.4.7 Remove HT Inlet Tube

NOTICE
Numbers in parenthesis that follow refer to Figure 232 unless specified otherwise.



No.	Description	No	Description
1	Engine HT Inlet	4	Clamp
2	DIN pipe	5	U-bolt
3	High Temperature Hose	6	Support Bracket

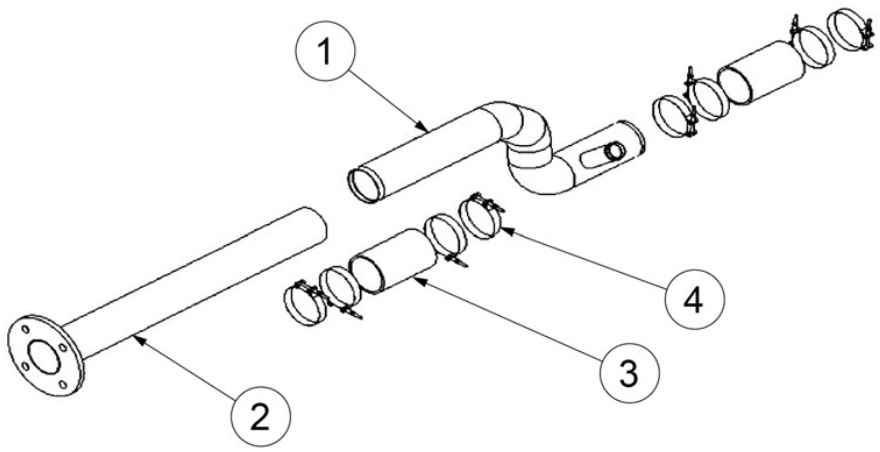
FIGURE 232. HT INLET TUBE REMOVAL

1. Remove U-bolts (5).
2. Loosen bolts on pipe clamps (4).
3. Slide high temperature hose (3) and pipe clamps (4) off of the HT inlet tube (1).
4. Remove HT inlet tube (1).

6.5.5.4.8 Remove LT Inlet Pipe from Radiator

NOTICE
Numbers in parenthesis refer to Figure 233 unless specified otherwise.

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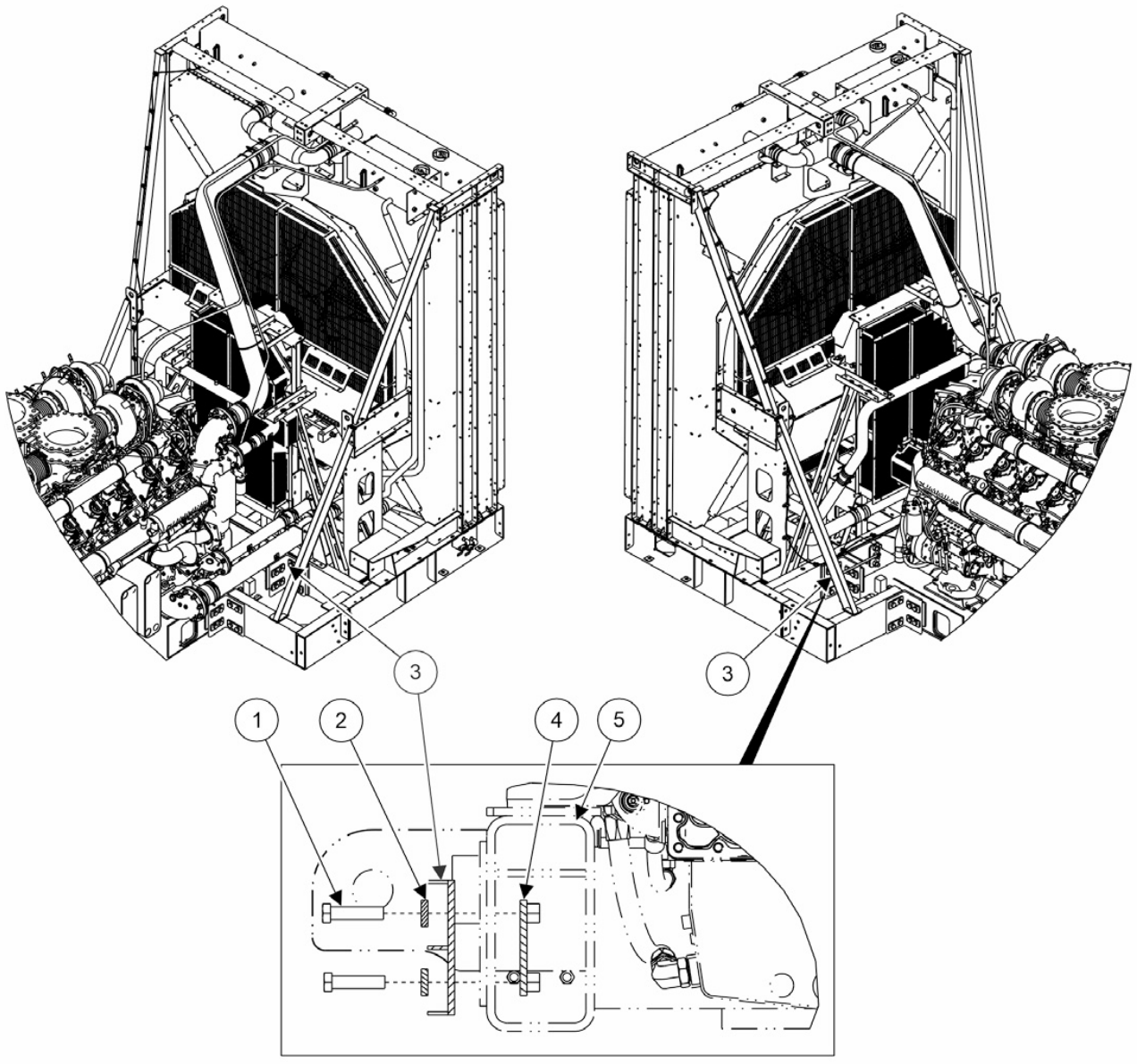
No.	Description	No.	Description
1	LT Inlet Tube	3	High Temperature Hoses
2	DIN Pipe	4	Clamp

FIGURE 233. LT INLET PIPE REMOVAL

1. Loosen bolts on pipe clamps (4).
2. Slide high temperature hoses (3) off of the radiator tube (2) and S-bend tube (1).
3. Remove radiator tube (2) and S-bend tube (1).

6.5.5.4.9 Remove Front Radiator L-brackets on Generator Set Skid

NOTICE
Numbers in parenthesis refer to Figure 234 unless otherwise specified.



No.	Description	No.	Description
1	Bolt	4	Nut plate
2	Washer plate	5	Generator set skid
3	L-bracket		

FIGURE 234. FRONT LEFT AND RIGHT RADIATOR L-BRACKETS

1. Remove two L-brackets (3) on the generator set skid (5) at the front right and left radiator mounting locations. Use four bolts (1), two washer plates (2), and one nut plate (4) for each L-bracket (3).

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6.5.5.5 Radiator Installation - Open Set

6.5.5.5.1 Required Tools, Parts, and Consumables

The following tools are required to complete this installation.

- Tape measure
- Level
- Torque Wrenches
  - 40-200 in-lb, 3/8 inch drive
  - 15-75 ft-lb, 3/8 inch drive
  - 50-250 ft-lb, 1/2 inch drive
  - 120-600 ft-lb, 3/4 inch drive
- Toe Jacks, Fork Lift, or Overhead Crane capable of lifting generator set
  - If using overhead crane, appropriately sized rigging equipment
- Pipe wrench, 24 inch
- Hex socket
  - 6 mm
  - 8 mm
  - 17 mm
  - 5/16 inch
- Paint marker
- Socket
  - 36 mm
  - 1/2 inch
  - 15/16 inch
  - 1 1/8 inch
- Deep socket
  - 9/16 inch
  - 15 mm
- Combination wrench
  - 1 1/16 inch
  - 1 1/4 inch
- 3/4 inch drive extension, 8 inch
- Belt tension tool (A050L945)
- Standard 6 inch (150 mm) Vernier calipers
- Steel bar (A059R243)
- Clamp (A001G779)
- Clean rags
- Molykote (MoS")

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- Water based rubber assembly lubricant
- ½ inch internal to 3/8 inch external square drive adapter
- 3/8 inch drive, 12 point, 21 mm torque adapter with 2 inch offset
- Jeweler files, or 150 grit or finer emery cloth

6.5.5.5.2 Safety Precautions

⚠ WARNING

Automated Machinery

Accidental or remote starting of the generator set can cause severe personal injury or death.

Isolate all auxiliary supplies and use an insulated wrench to disconnect the starting battery cables (negative [–] first).

⚠ WARNING

Electrical Generating Equipment

Incorrect operation and maintenance can result in severe personal injury or death.

Make sure that only suitably trained and experienced service personnel perform electrical and/or mechanical service.

⚠ WARNING

Combustible Gases

Ignition of battery gases is a fire and explosion hazard which can cause severe personal injury or death.

Using an insulated wrench, disconnect the negative (–) cable first and reconnect it last. Make certain hydrogen from the battery, engine fuel, and other explosive fumes are fully dissipated. This is especially important if the battery has been connected to a battery charger.

⚠ WARNING

Combustible Gases

Ignition of battery gases is a fire and explosion hazard which can cause severe personal injury or death.

Do not smoke, or switch the trouble light ON or OFF near a battery. Touch a grounded metal surface first before touching batteries to discharge static electricity. Stop the generator set and disconnect the battery charger before disconnecting battery cables. Using an insulated wrench, disconnect the negative (–) cable first and reconnect it last.

⚠ WARNING

Electric Shock Hazard

Voltages and currents present an electrical shock hazard that can cause severe burns or death.

Make sure that only service personnel who are trained and experienced perform electrical and mechanical component installations. Follow all local requirements when working on electrical equipment. Isolate all forms of electrical energy before working on the generator set.

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⚠ CAUTION

Hazardous Voltage
Contact with high voltages can cause severe electrical shock, burns, or death.
Disconnect the battery charger before isolating the battery.

⚠ CAUTION

Sharp Edges
Sharp edges/burrs on housing parts can cause cuts and puncture wounds.
When handling housing parts, use appropriate PPE.

Read these instructions completely and become familiar with safety warnings, cautions, and procedures before starting the installation.

The installer must be familiar with the techniques of working on heavy machinery. A hoist must be available which can support the weight of the radiator, with an appropriate lifting strength margin.

Turn off or remove AC power from the battery charger and then use an insulated wrench to remove the negative (**–**) battery cable from the set starting battery. This prevents the generator set from starting while working on it and to avoid circuit board damage, caused by voltage spikes when removing and replacing circuit board connectors.

6.5.5.5.3 Preparing for the Installation

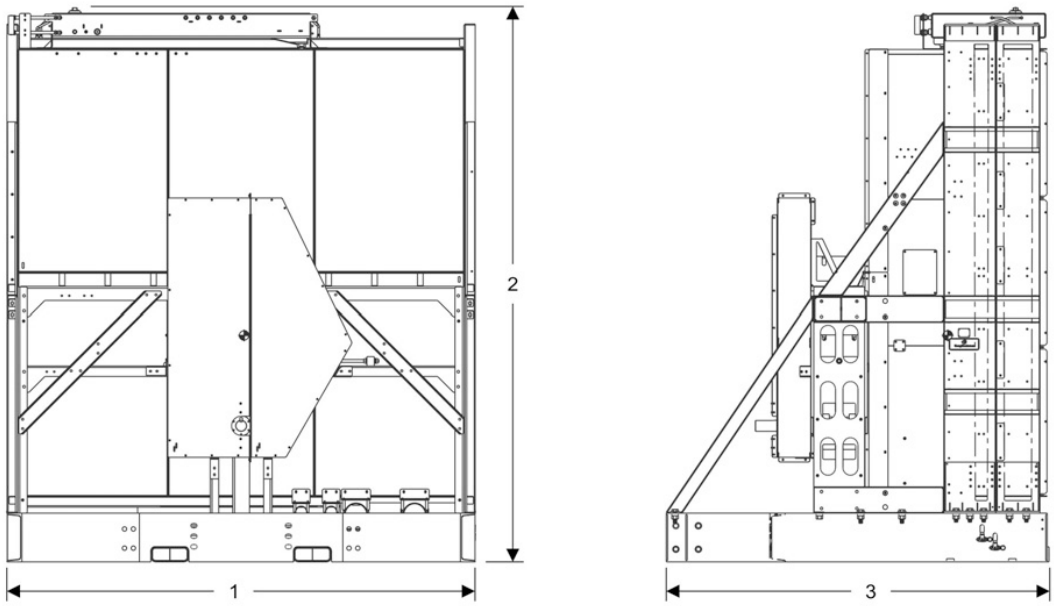
When installing the generator set, make sure to consider what is needed to install the cooling system.

1. Make sure to have all of the necessary tools and any additional items needed to complete the installation.

   The following items must be supplied by the customer to complete the installation.

   - Cable ties to be used when installing the vent lines
   - Coolant mixture:
     - For 84 ft^2 radiators: fully formulated, a 50% EG coolant mixture.
     - For 61 ft^2 radiators: fully formulated, a 50% EG coolant mixture.
     - For fill volumes, refer to **Section 3.2**.
   - High strength tread locking compound (Loctite 277 or equivalent)
   - Anti-seize (Loctite C5-A or equivalent)
   - Thread sealant (Loctite 592 or equivalent)
   - Dielectric grease (Loctite 8423 or equivalent)
2. Apply the appropriate Hot Surface Warning Labels, included in the radiator kit, to the applicable parts as required per local codes and standards.
3. Make sure to have allowed enough space to install the radiator. Basic radiator dimensions are shown in **Figure 235**.

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No.	Description	No.	Description
84 ft² High Ambient Radiator			
1	3022.6 mm (119 in)	3	2336.8 mm (92 in)
2	3759.2 mm (148 in)		
61 ft² Radiator			
1	2616.2 mm (103 in)	3	2336.8 mm (92 in)
2	3371 mm (132.7 in)		

FIGURE 235. RADIATOR DIMENSIONS

6.5.5.5.4 Attach the Low Coolant Level Sensor

⚠ CAUTION

Equipment Damage

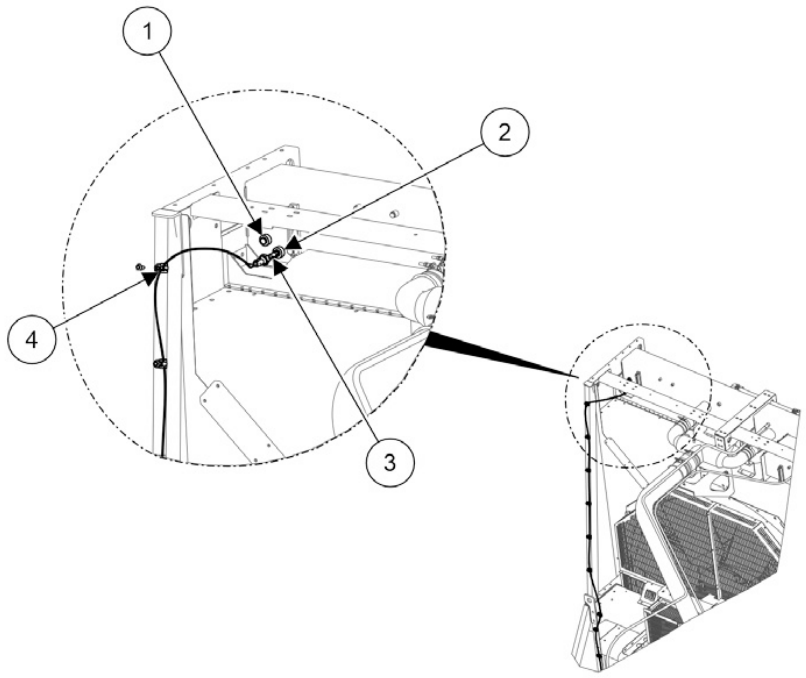
Power tools can damage the low coolant level sensor.

After installing by hand, use a manual torque wrench to complete the installation of the sensor

NOTICE

Numbers in parenthesis refer to components identified in the figure below.

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Item	Description	Item	Description
1	Low Coolant Level Warning Port	3	Low Coolant Level Sensor
2	Low Coolant Level Shutdown Port	4	Low Coolant Level Harness

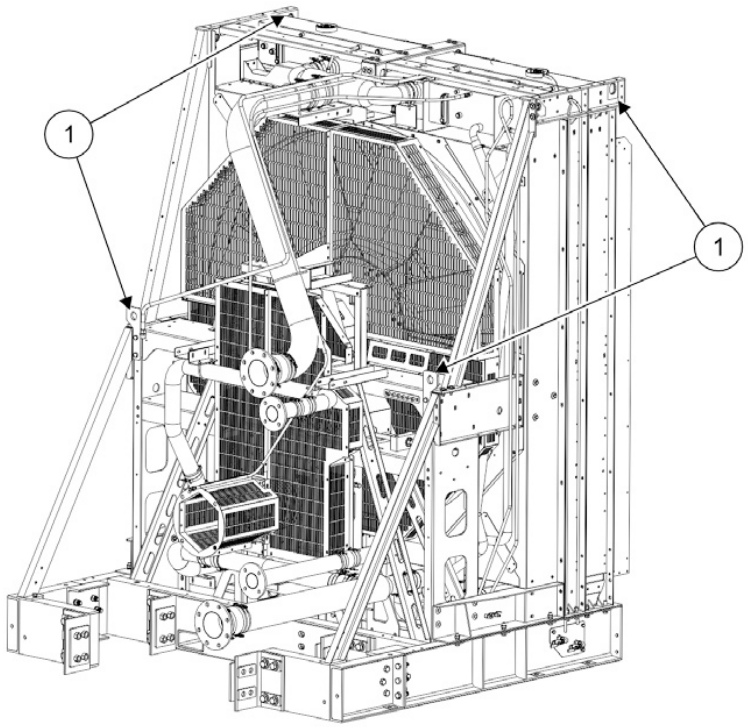
FIGURE 236. COOLANT LEVEL SENSOR

1. Remove and dispose of the internal hex plug in the radiator expansion tank.
2. Install the low coolant level sensor (3) by hand to be sure the sensor does not get damaged.
3. When the low coolant level sensor (3) is hand tight, use a manual torque wrench to tighten the sensor to 20 Nm (15 ft-lb).
4. Install the low coolant level harness (4) and retaining clips. Route the harness down the left side of the radiator.
5. Tighten retaining clip bolts to 52 Nm (38 ft-lb).

6.5.5.5.5 Position the Radiator to the Generator Set

Do the following if using an overhead crane to position the radiator.

1. Connect lifting equipment to the four radiator lifting eye bolts (1, **Figure 237**). A spreader bar is required to allow for a vertical lift on the eye bolts.
2. Position the radiator to the generator set.



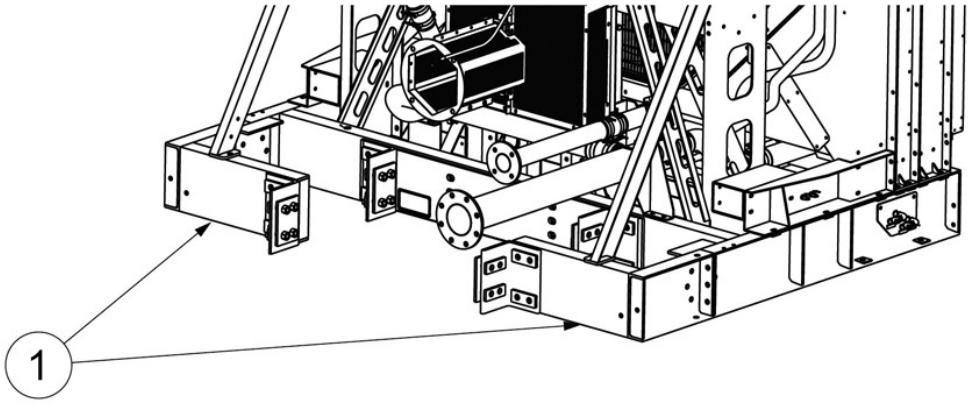
No.	Description	No.	Description
1	Lifting eye bolt		

FIGURE 237. RADIATOR EYE BOLTS

Do the following if using a fork lift or other method to position the radiator.

1. Remove the cross beams (1, **Figure 238**) from the radiator skid if necessary for access to fork lift pickets or allow for clearance of the generator set front lifting eyes.
2. Position the radiator to the generator set.
3. After the radiator has been positioned, reinstall the cross beams (1, **Figure 238**).
    a. Apply anti-seize compound 0524-0076 to the nut engagement threads of the cross beam bolts.
    b. Torque the cross beam bolts to 732 Nm (540 ft-lb).

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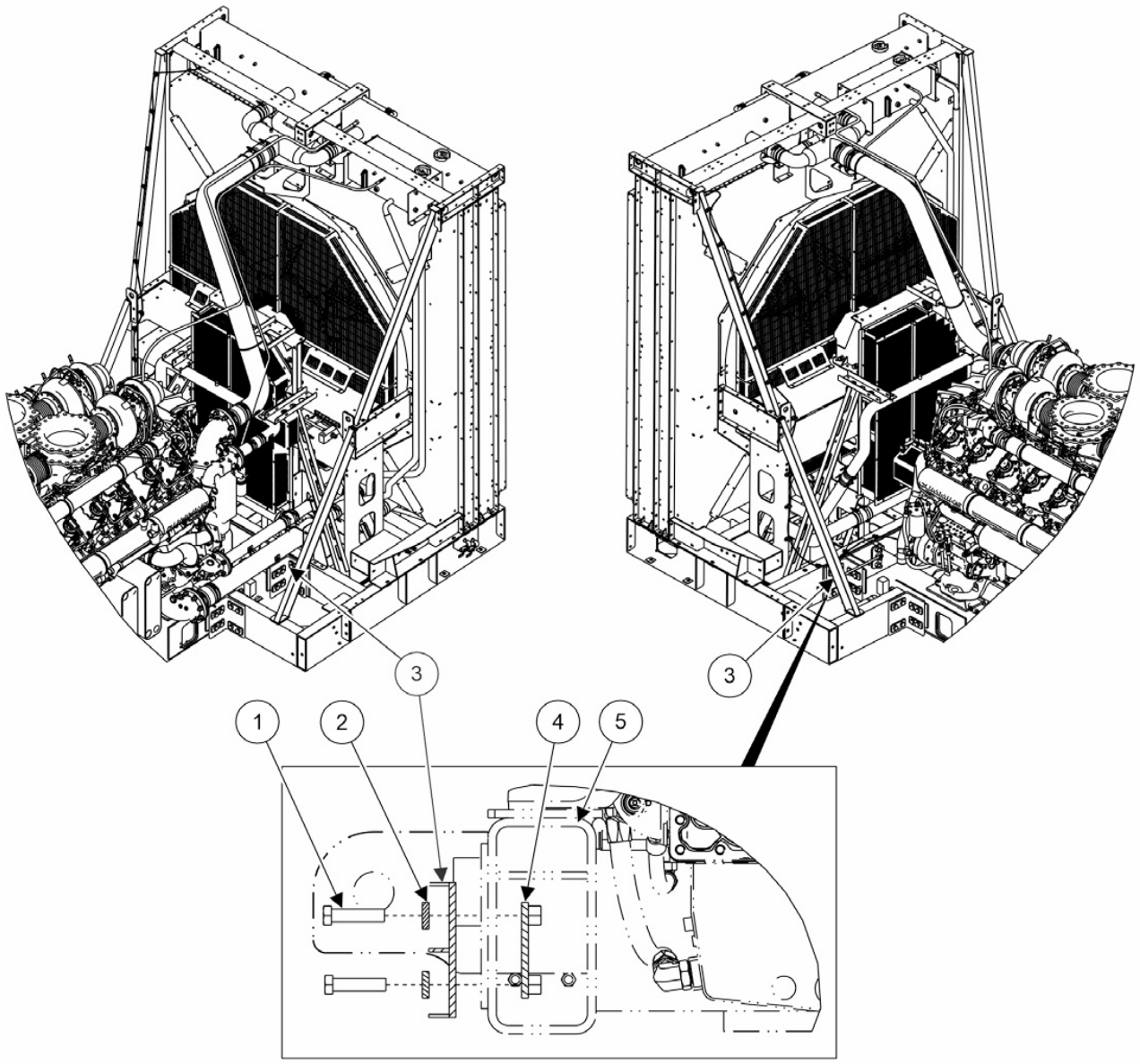


No.	Description	No.	Description
1	Cross beam		

FIGURE 238. CROSS BEAMS ON RADIATOR SKID

6.5.5.5.6 Install Front Radiator L-brackets on Generator Set Skid

NOTICE
Numbers in parenthesis refer to Figure 239 unless otherwise specified.



No.	Description	No.	Description
1	Bolt	4	Nut plate
2	Washer plate	5	Generator set skid
3	L-bracket		

FIGURE 239. FRONT LEFT AND RIGHT RADIATOR L-BRACKETS

1. Apply anti-seize compound to threads of bolts (1).
2. Loosely install two L-brackets (3) on the generator set skid (5) at the front right and left radiator mounting locations. Use four bolts (1), two washer plates (2), and one nut plate (4) for each L-bracket (3).

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6.5.5.5.7 Install Vibration Isolators

The vibration isolators need to be installed following the installation guidelines from the manufacturer. The vibration isolator must be installed (1, **Figure 292**) so that it is in the locked shipping position. The vibration isolator must not provide any spring isolation (solid block) to allow for proper radiator alignment.

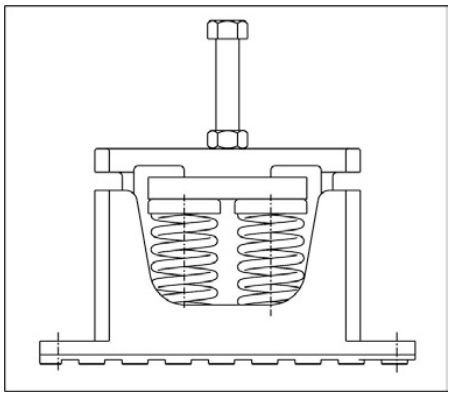


FIGURE 240. VIBRATION ISOLATOR

1. Lift the radiator and place it in its final location on the locked vibration isolators. Make sure the holes in the radiator skid are centered to the vibration isolator attachment bolt location.
2. Lift the generator set and bring it into alignment with the radiator skid.
3. Place the generator set on the locked vibration isolators. Make sure the holes in the generator set skid are centered to the vibration isolator attachment bolt location.
4. Make sure the generator set and radiator are against each other (no gaps) at the chassis front cross member and the radiator cross frame.
5. Left to right measurements between the radiator frame and chassis are helpful for placement but are not final measurements for alignment.
6. When the generator set and radiator appear to be aligned and ready to be bolted together, proceed to Fan Drive Alignment.

6.5.5.5.8 Fan Drive Alignment

The following gives the procedure to align the radiator to the generator set. **This video** shows the procedure.

1. Remove engine vibration damper center cover.

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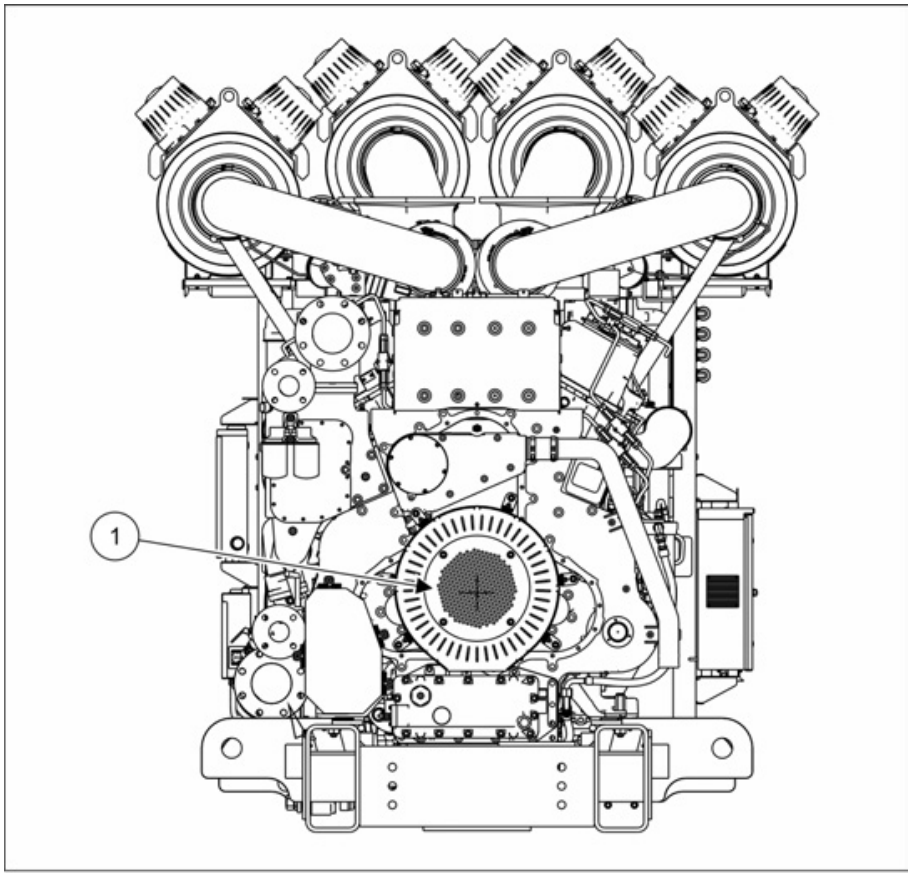


FIGURE 241. ENGINE DAMPENER CENTER COVER

2. Clean the mounting surface for the engine vibration dampener with degreaser.
3. Clean the fan drive input shaft with degreaser.
4. Install the fan drive alignment bar from the radiator installation kit in the radiator fan drive input shaft keyway.

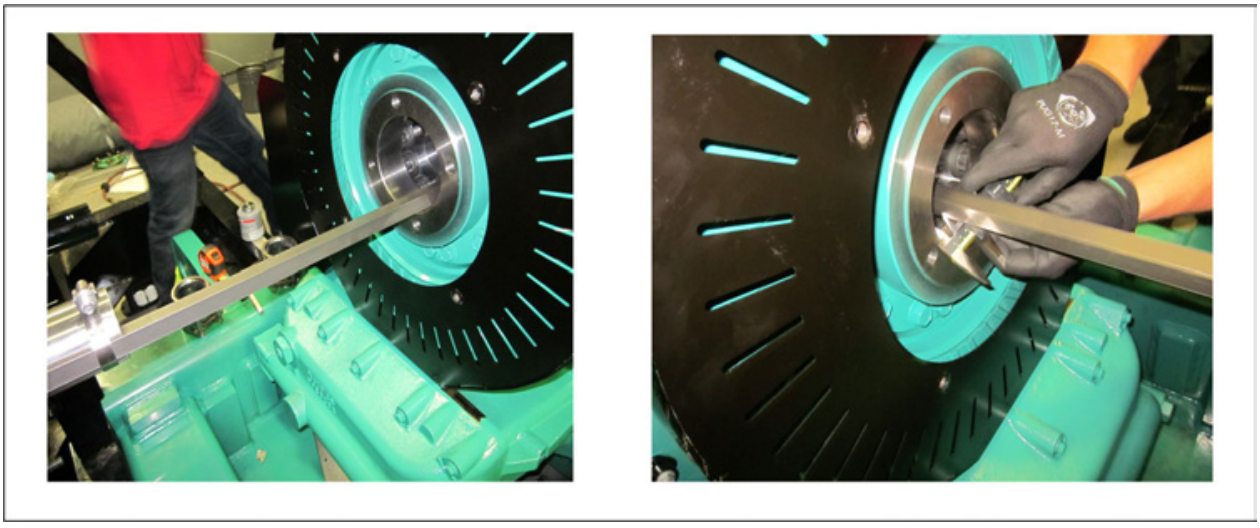


FIGURE 242. FAN DRIVE ALIGNMENT

5. The radiator end of the square bar must fit snugly into the fan shaft key way. Clamp into place with hose clamp around the radiator fan drive input shaft.

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6. The other end of the bar fits inside the center bore of the vibration dampener.
7. Carefully rotate the fan shaft by hand. The bar should never contact the inside bore of the damper. Contact with the inside bore indicates gross misalignment.
8. When the bar rotates freely inside the damper bore, measure and record the distance from the bar to the outer diameter of the damper bore at the 12:00 and 6:00 o'clock positions (vertical), and at the 3:00 and 9:00 o'clock positions (horizontal). The difference between the two vertical measurements and the two horizontal measurements cannot be greater than 12.5 mm (1/2 inch).

TABLE 130. EXAMPLE MEASUREMENTS

	Measurement	Position	Status
	17	3:00	
	19	9:00	
Difference	2		Good
	10	12:00	
	28	6:00	
Difference	18		Needs vertical adjustment

9. Options for Horizontal adjustment are:
   - Move the radiator or generator set.
   - Move the fan belt drive input shaft bearing assemblies right or left (±4 mm of adjustment).

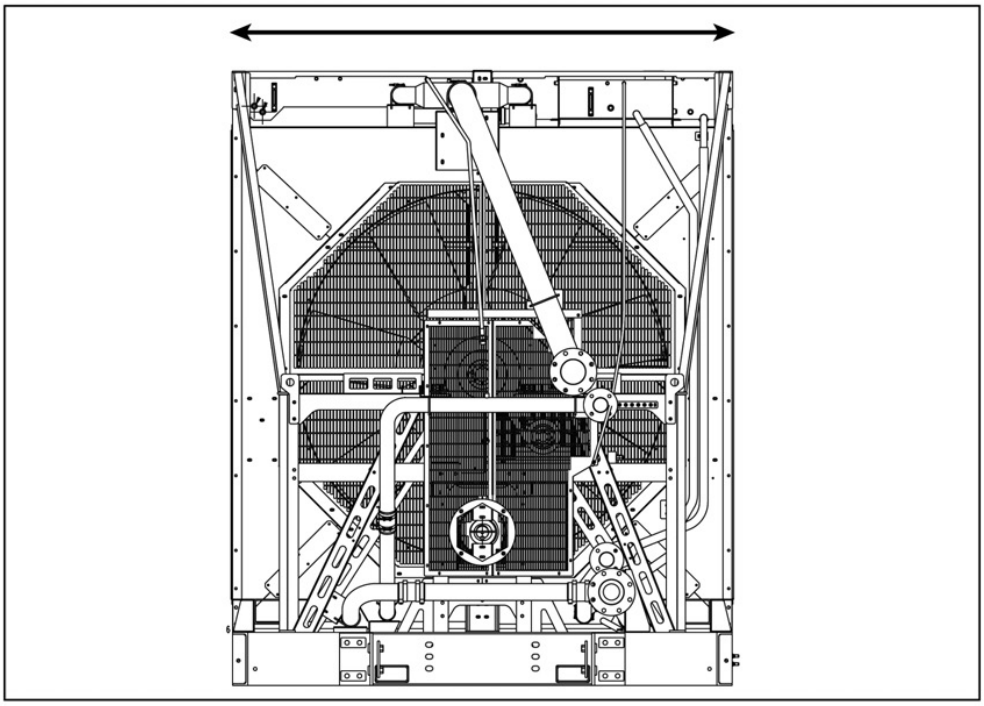


FIGURE 243. HORIZONTAL ADJUSTMENT

10. Options for vertical adjustment are:
    - Place shims under the generator set or radiator vibration isolators.
    - Add or remove shims under the fan belt drive input shaft bearings (±4 mm of adjustment).

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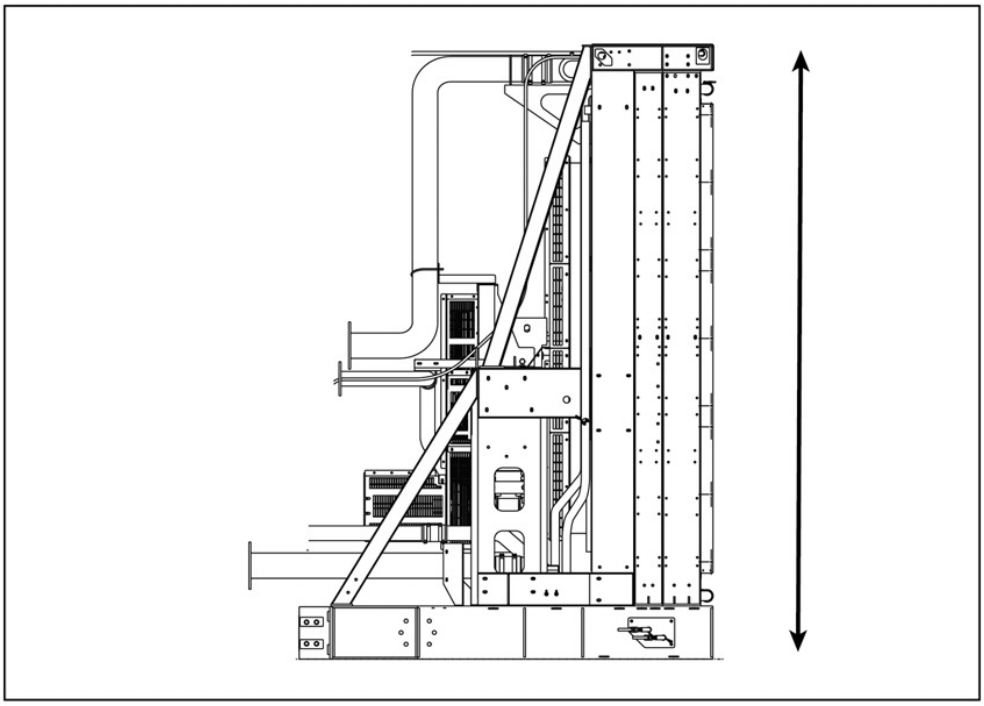
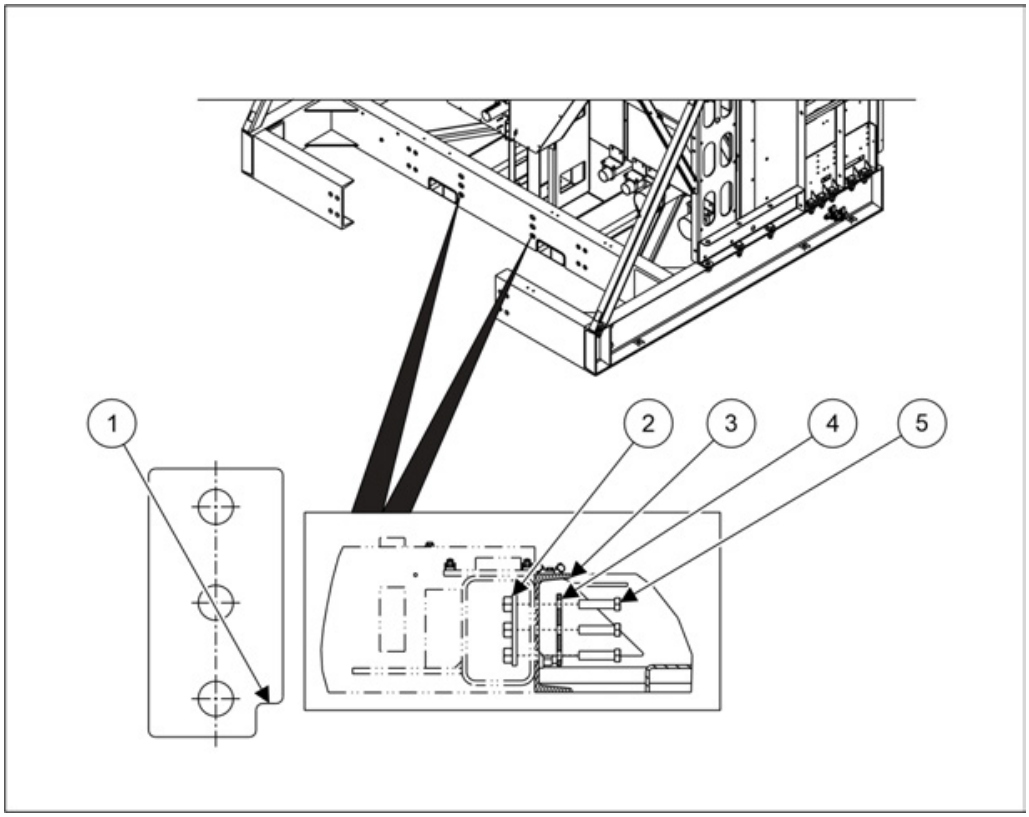


FIGURE 244. VERTICAL ADJUSTMENT

6.5.5.5.9 Install Front Middle Clamping Plates

NOTICE
Numbers in parenthesis refer to Figure 245 unless otherwise specified.

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No.	Description	No.	Description
1	Notch in washer plate	4	Washer plate
2	Nut plate	5	Bolt – M24 x 100 mm
3	Clamping plate		

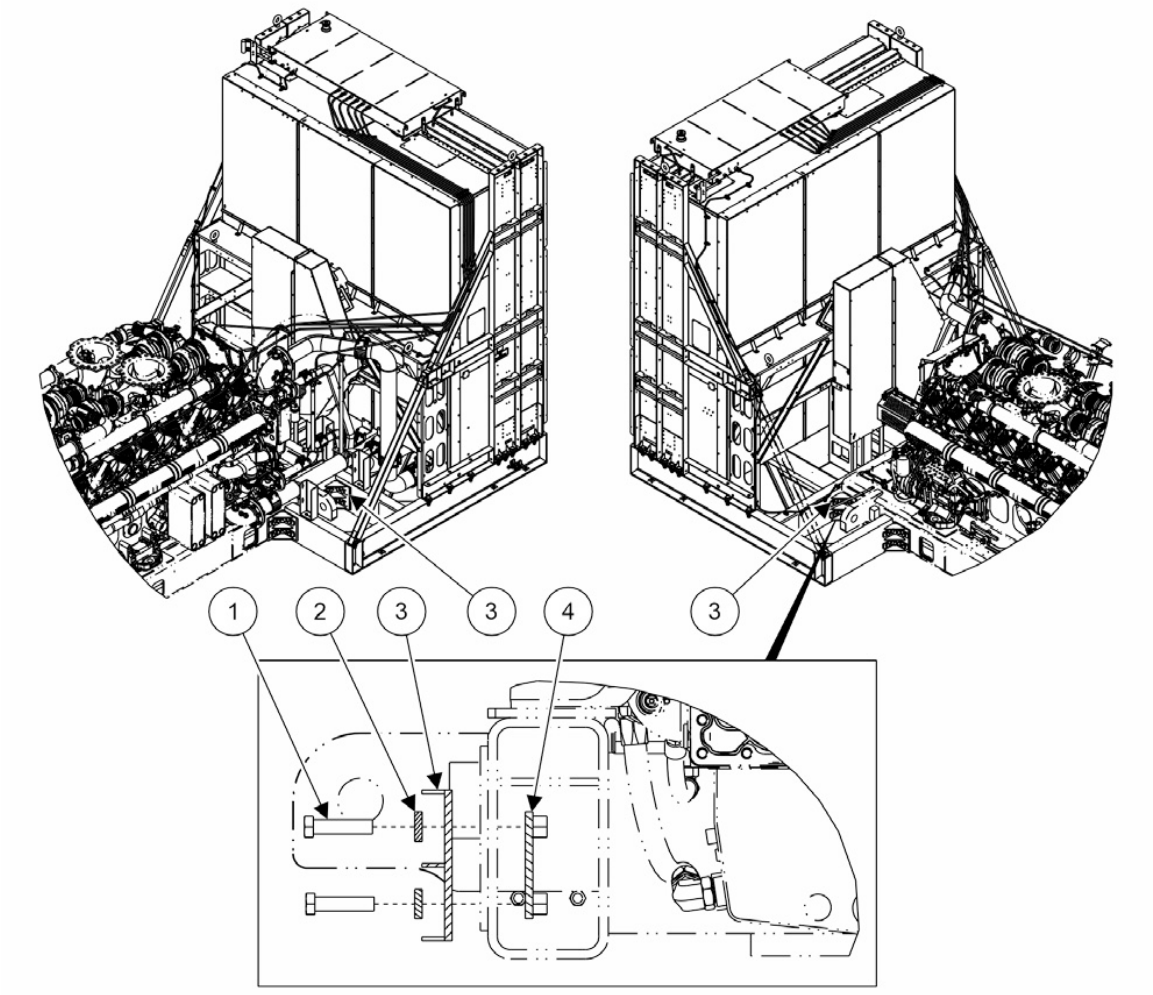
FIGURE 245. FRONT MIDDLE CLAMPING PLATE

1. Apply anti-seize compound to mounting bolt (5) threads.
2. Loosely install each clamping plate (3) to the front radiator mounts with one nut plate (2), one washer plate (4), and three bolts (5).

NOTICE
The notch in the washer plate faces down and toward the fork tubes in the radiator skid.

6.5.5.5.10 Install Front Radiator L-brackets Remaining Hardware

NOTICE
Numbers in parenthesis refer to Figure 246 unless otherwise specified.



No.	Description	No.	Description
1	Bolt – M24 x 100 mm	3	L-bracket
2	Washer plate	4	Nut plate

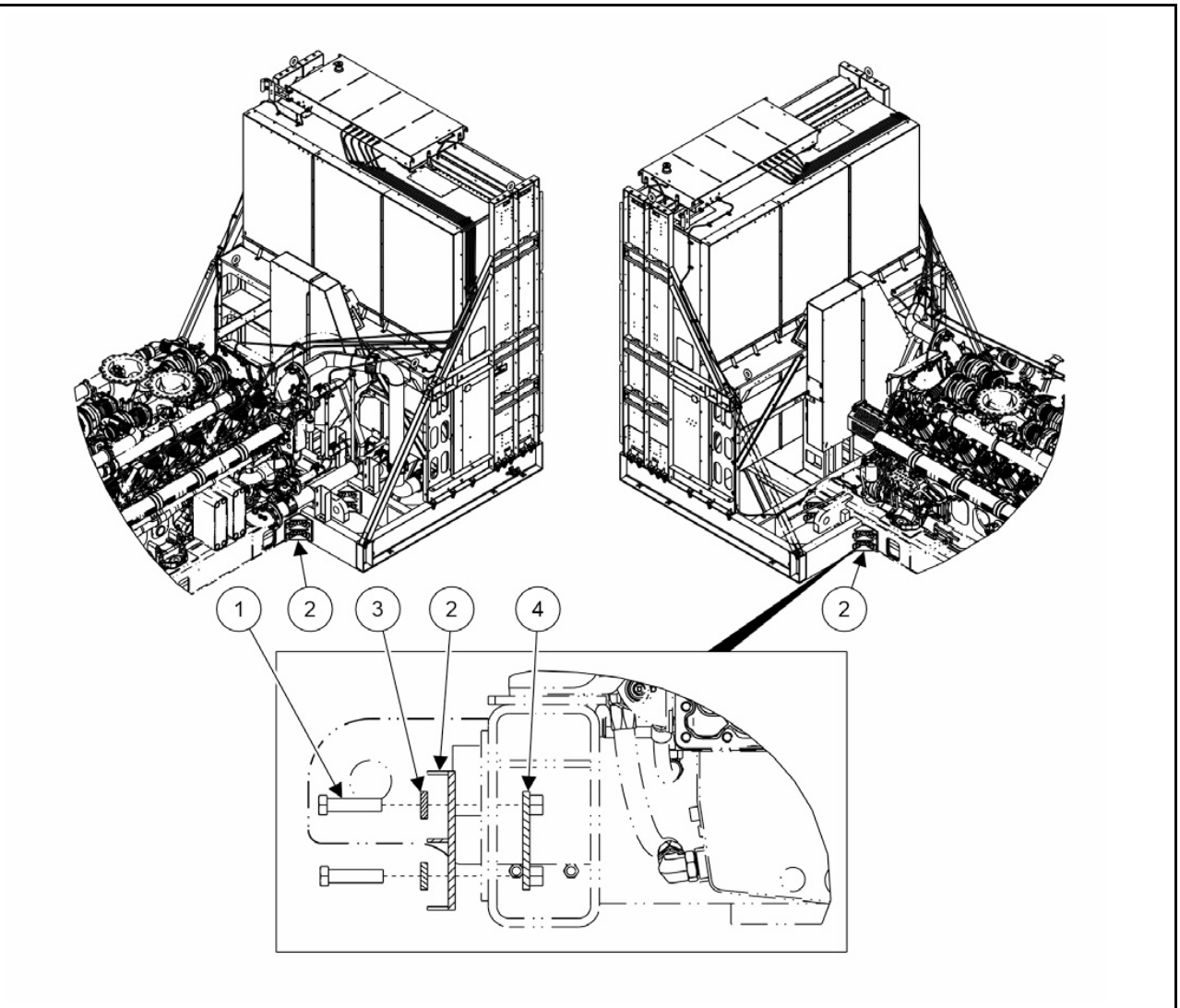
FIGURE 246. FRONT LEFT AND RIGHT RADIATOR L-BRACKETS REMAINING HARDWARE

1. Apply anti-seize compound to threads of bolts (1).
2. Loosely install each L-bracket to radiator skid with remaining washer plates (2), nut plates (4), and bolts (1).

6.5.5.5.11 Install Rear L-brackets

NOTICE
Numbers in parenthesis refer to Figure 247 unless otherwise specified.

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No.	Description	No.	Description
1	Bolt – M24 x 100 mm	3	Washer
2	L-bracket	4	Nut plate

FIGURE 247. REAR L-BRACKETS

1. Apply anti-seize compound to mounting bolt threads.
2. Loosely install each L-bracket (2) to generator set and radiator skid with two nut plates (4), four washers (3), and eight bolts (1).

6.5.5.5.12 Tighten and Torque L-bracket bolts

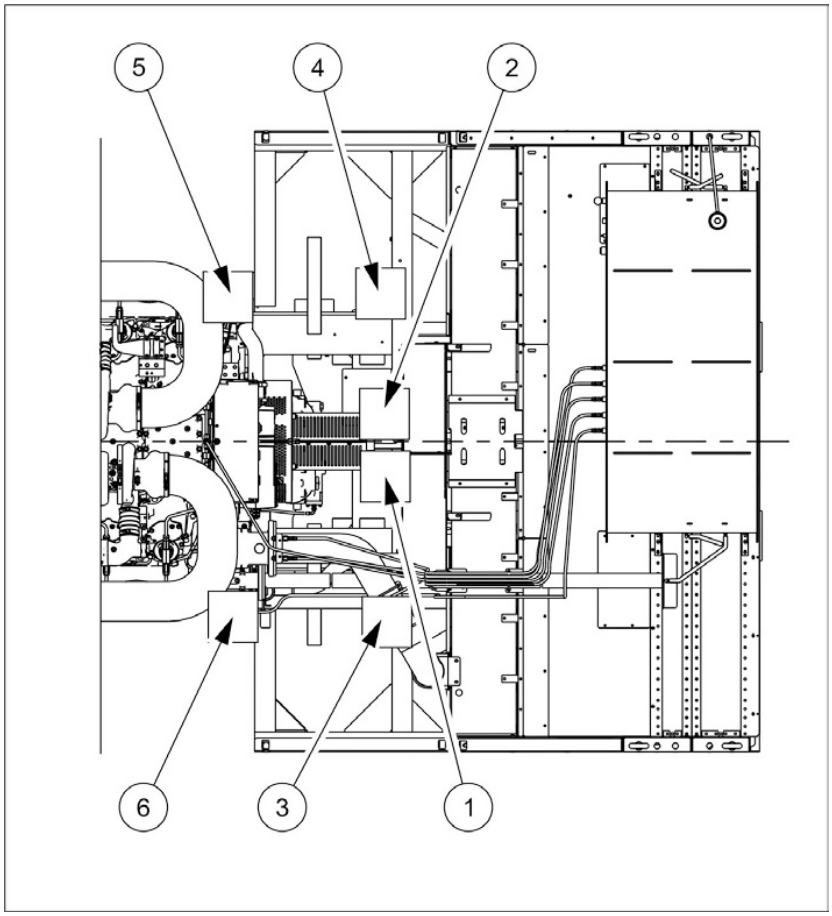


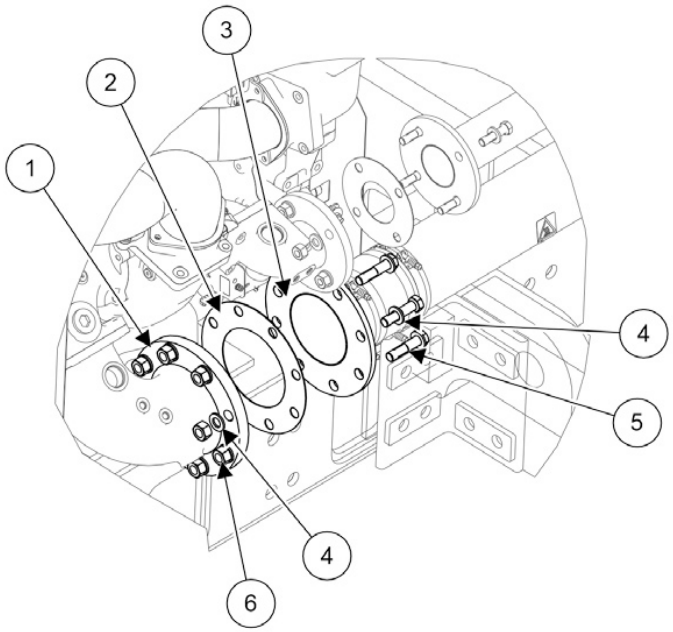
FIGURE 248. L-BRACKET LOCATIONS

1. Tighten the 6 M24 bolts at the front middle locations (locations 1 and 2 in **Figure 248**).
2. Tighten the 16 M24 bolts at the front left and right locations (locations 3 and 4 in **Figure 248**).
3. Tighten the 16 M24 bolts at the rear left and right locations (locations 5 and 6 in **Figure 248**).
4. Torque the 6 M24 bolts at the front middle locations (locations 1 and 2 in **Figure 248**) to 552 Nm (407 ft-lb).
5. Torque the 16 M24 bolts at the front left and right locations (locations 3 and 4 in **Figure 248**) to 552 Nm (407 ft-lb).
6. Torque the 16 M24 bolts at the rear left and right locations (locations 5 and 6 in **Figure 248**) to 522 Nm (407 ft-lb).
7. The radiator lifting equipment may be removed as long as the radiator is properly supported on isolators at the same height as the generator set skid.

6.5.5.5.13 Install HT Inlet Coolant Flange

NOTICE
Numbers in parenthesis refer to Figure 249 unless specified otherwise.

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No.	Description	No.	Description
1	HT inlet flange	4	Washer
2	Gasket	5	Bolt
3	HT inlet pipe	6	Nut

FIGURE 249. HT INLET COOLANT FLANGE

1. Apply anti-seize lubricant to bolt (5) threads.
2. Install HT inlet pipe (3) to HT inlet flange (1) with flange gasket (2), bolts (5), washers (4), and nuts (6).
3. Torque the bolts and nuts to 311 Nm (229 ft-lb) using the following torque sequence.
   a. Torque position 1, then position 5 shown in **Figure 250**.
   b. Torque position 8, then position 3 shown in **Figure 250**.
   c. Torque position 6, then position 2 shown in **Figure 250**.
   d. Torque position 7, then position 4 shown in **Figure 250**.

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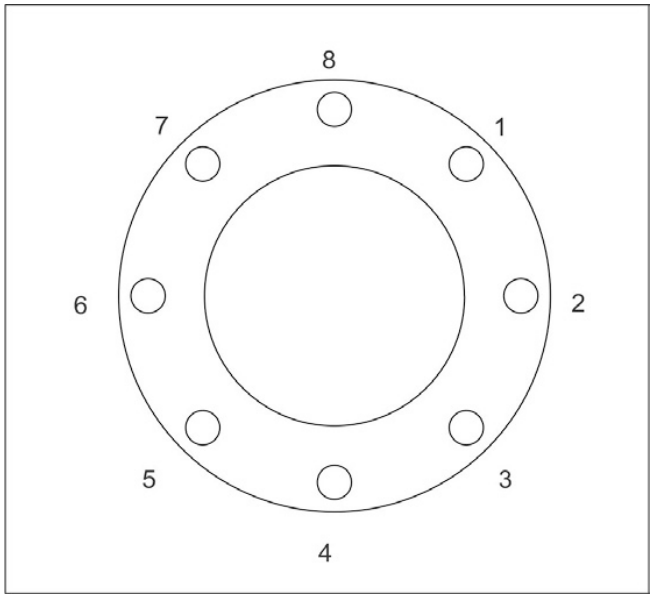
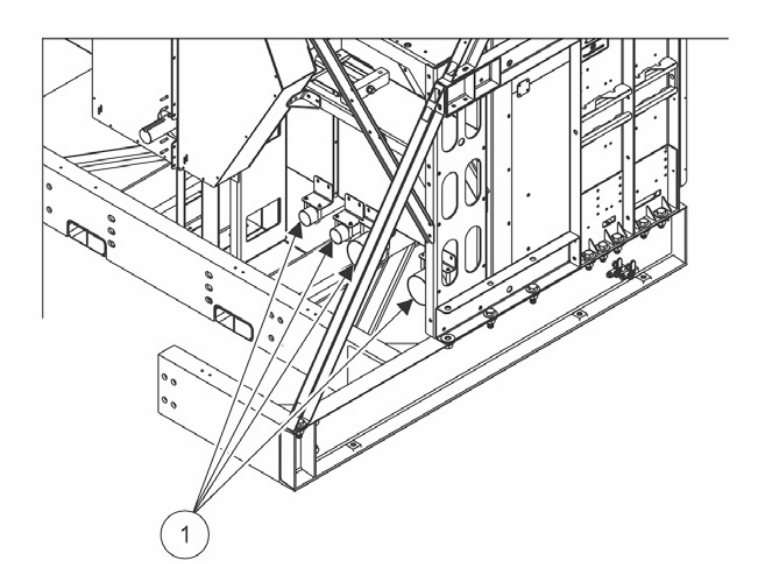


FIGURE 250. HT FLANGE TORQUE SEQUENCE NUMBERS

6.5.5.5.14 Remove Radiator Shipping Plugs and Install LT and HT Inlet Pipe Support Brackets

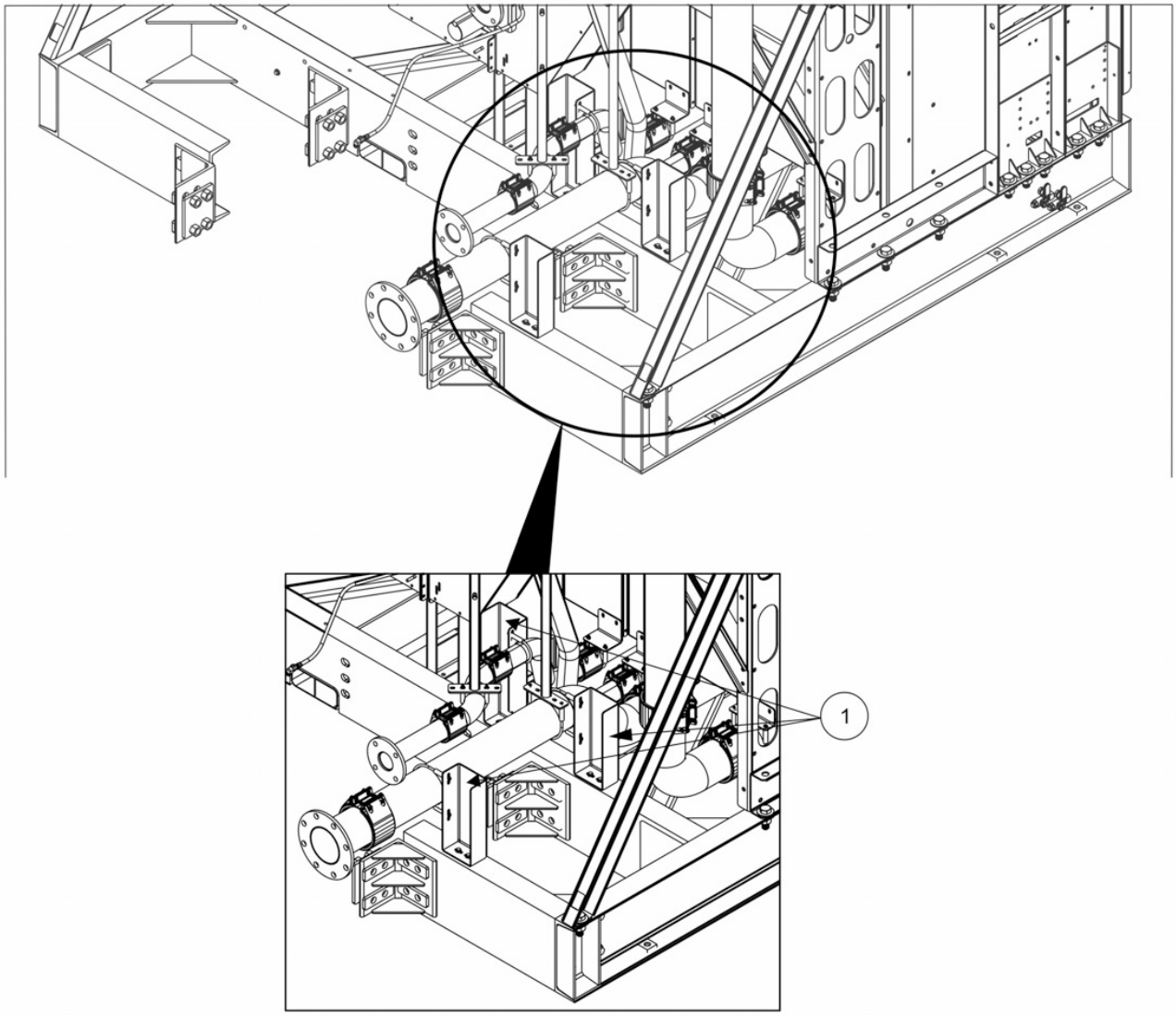


No.	Description
1	Shipping plug

FIGURE 251. RADIATOR SHIPPING PLUG LOCATIONS

1. Remove shipping plugs (1, **Figure 251**).
2. Clean coolant pipe connections at radiator.
3. Install LT and HT inlet pipe support brackets on radiator skid (1, **Figure 252**).

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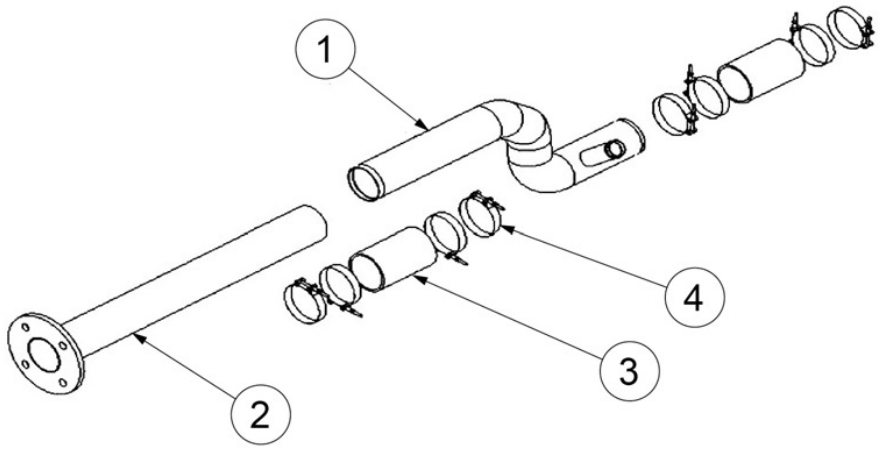


No.	Description
1	Support bracket

FIGURE 252. LT AND HT INLET PIPE SUPPORT BRACKETS

6.5.5.5.15 Install LT Inlet Pipe on Radiator

NOTICE
Numbers in parenthesis refer to Figure 253 unless specified otherwise.



No.	Description	No.	Description
1	LT Inlet Tube	3	High Temperature Hoses
2	DIN Pipe	4	Clamp

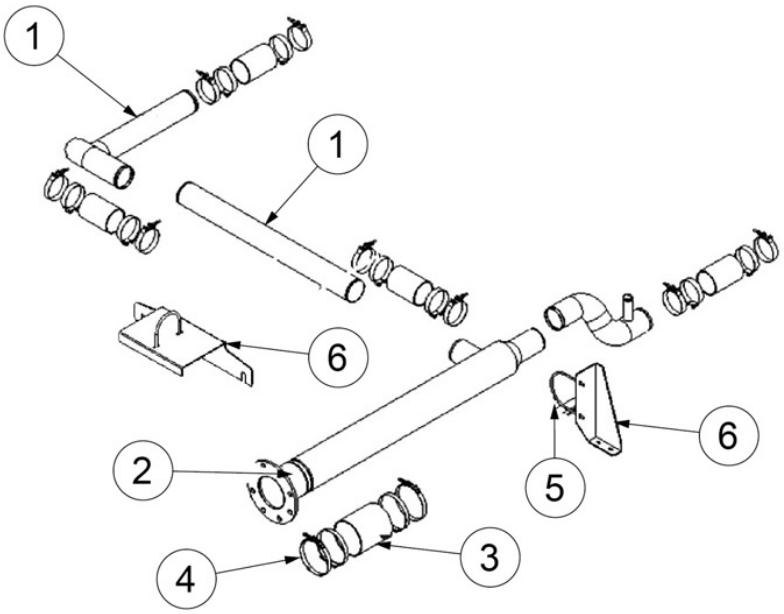
FIGURE 253. LT INLET PIPE INSTALLATION

1. Inspect the pipe before installation for any damage.
2. Center LT S-pipe (2) with radiator hose (3). Loosely tighten the pipe (2) at the radiator connection point.
3. Apply water based rubber assembly lubricant inside both ends of all hoses (3).
4. Connect and align the DIN pipe (2) to the engine tube (1) with the high temp hose (3) and clamp (4).
5. Make sure the tubes are vertically and horizontally aligned with engine flange.
6. Use a torque wrench to tighten the flange, hose and clamps. (4)
   a. First, use alternating sequence to torque DIN flange to 175 Nm (129 ft-lb).
   b. Second, torque the hose clamps (4) to 11 Nm (8.1 ft-lb).
7. Torque the U-bolt (5) that attaches the radiator tube (1) to the tube support bracket to 25 Nm (18 ft-lb).

6.5.5.5.16 Install HT Inlet Tube

NOTICE
Numbers in parenthesis that follow refer to Figure 254 unless specified otherwise.

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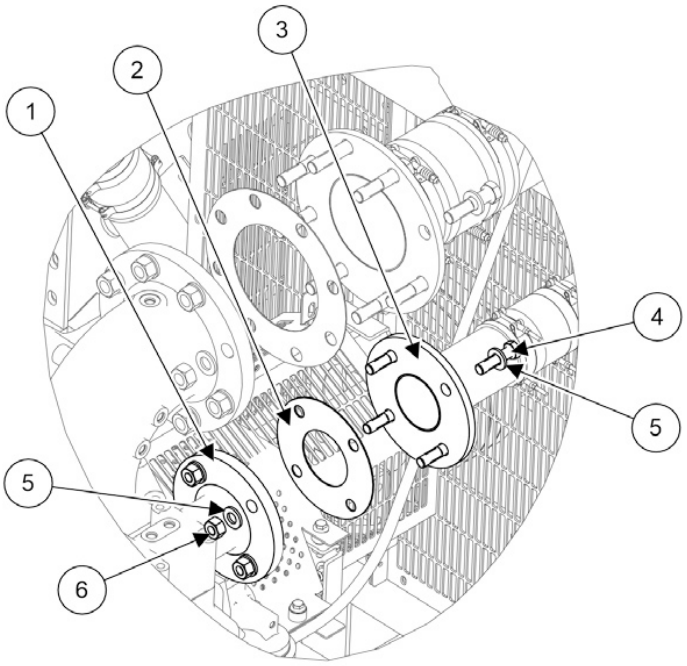
No.	Description	No	Description
1	Engine HT Inlet	4	Clamp
2	DIN pipe	5	U-bolt
3	High Temperature Hose	6	Support Bracket

FIGURE 254. HT INLET TUBE INSTALLATION

1. Inspect the pipes before installation, for any damage.
2. Apply water based rubber assembly lubricant inside both ends of all hoses (3).
3. Connect the high temperature hose (3) at radiator end on both sides and hand tighten the clamps (4) on both sides at the bottom tank.
4. Connect the DIN pipe (2) and align with both high temperature hoses (3) and hand tighten with the clamp (4).
5. Torque DIN pipe to the high temperature hose (3) and align the clamp (4) in proper direction.
6. Apply thread locking compound to U-bolt (5) threads. Loosely install two U-bolts (5) that attach the HT inlet tube (1) to the support brackets (6).
7. Use an alternating sequence to torque the DIN flange to 311 Nm (229 ft-lb).
   a. Use a torque wrench to torque hoses clamps (4) to 11Nm (8 ft-lb).
   b. Torque the U-bolt (2) that attaches the HT inlet tube (1) to the tube support bracket to 25 Nm (18 ft-lb).

6.5.5.5.17 Install LT Outlet Coolant Flange

NOTICE
Numbers in parenthesis refer to Figure 255 unless specified otherwise.



No.	Description	No.	Description
1	LT outlet pipe	4	Bolt
2	Gasket	5	Washer
3	LT outlet flange	6	Nut

FIGURE 255. LT OUTLET COOLANT FLANGE

1. Apply anti-seize lubricant to bolt (4) threads.
2. Install LT outlet pipe (1) to LT outlet flange (3) with flange gasket (2), bolts (4), washers (5), and nuts (6).
3. Torque the bolts and nuts to 175 Nm (129 ft-lb) using the following torque sequence.
   a. Torque position 1, then position 3 shown in **Figure 256**.
   b. Torque position 2, then position 4 shown in **Figure 256**.

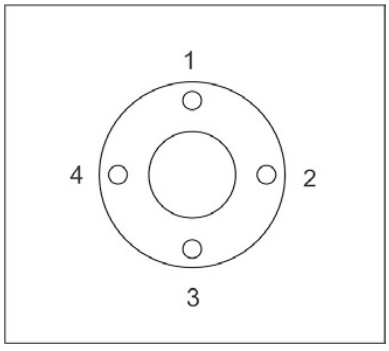
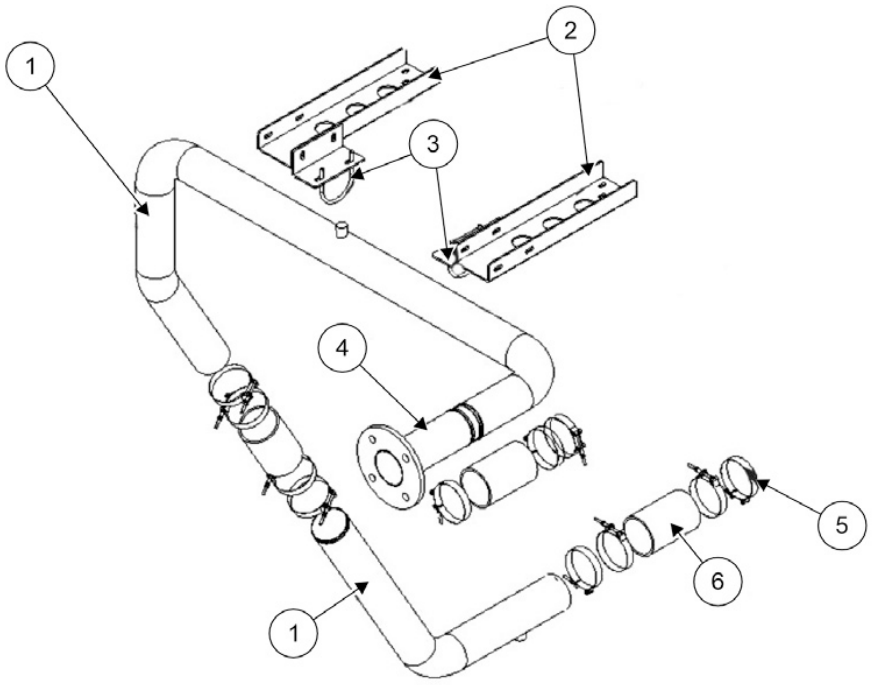


FIGURE 256. LT FLANGE TORQUE SEQUENCE NUMBERS

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6.5.5.5.18 Install LT Outlet Tubing

NOTICE
Numbers in parenthesis refer to Figure 257 unless specified otherwise.



No.	Description	No.	Description
1	LT Outlet Tube	4	DIN Connection
2	Support Bracket	5	Clamp
3	U-Bolt	6	High Temperature Hose

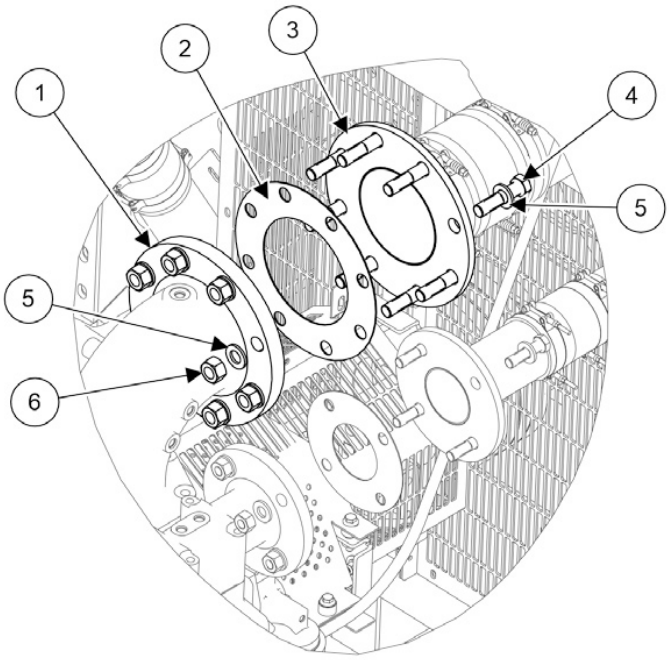
FIGURE 257. LT OUTLET TUBING INSTALLATION

1. Apply water based rubber assembly lubricant inside both ends of all hoses (6).
2. Connect the LT high temperature hose (6) at radiator and hand tighten the clamp (5).
3. Place the S-bend tube between the DIN Connection tube (4) and the radiator connection. Align the S-bend in proper direction and hand tighten the clamp (5).
4. Align the clamp (5) in proper direction and torque both clamps.
5. Apply thread lock to U-bolt (3) threads. Use U-bolts and fix S-bend to the support bracket (2) on the radiator.
6. Torque the U-bolt (3) that attaches the LT outlet tube (1) to the support bracket (2) to 25 Nm (18 ft-lb).
7. Use two step torque wrench and torque the clamp.
8. Torque all the high temperature hose (6) clamps (5) to 11 Nm (8.11 ft-lb).

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6.5.5.5.19 Install HT Outlet Coolant Flange

NOTICE
Numbers in parenthesis refer to Figure 258 unless specified otherwise.



No.	Description	No.	Description
1	HT Inlet Flange	4	Bolt, 3/4 inch - 10 X 3.5 inch
2	Gasket	5	Washer
3	HT Outlet Pipe	6	Nut

FIGURE 258. HT OUTLET COOLANT FLANGE

1. Apply anti-seize lubricant to bolt (4) threads.
2. Install HT outlet pipe (3) to HT inlet flange (1) with flange gasket (2), bolts (4), washers (5), and nuts (6).
3. Torque the bolts and nuts to 311 Nm (229 ft-lb) using the following torque sequence.
   a. Torque position 1, then position 5 shown in **Figure 259**.
   b. Torque position 8, then position 3 shown in **Figure 259**.
   c. Torque position 6, then position 2 shown in **Figure 259**.
   d. Torque position 7, then position 4 shown in **Figure 259**.

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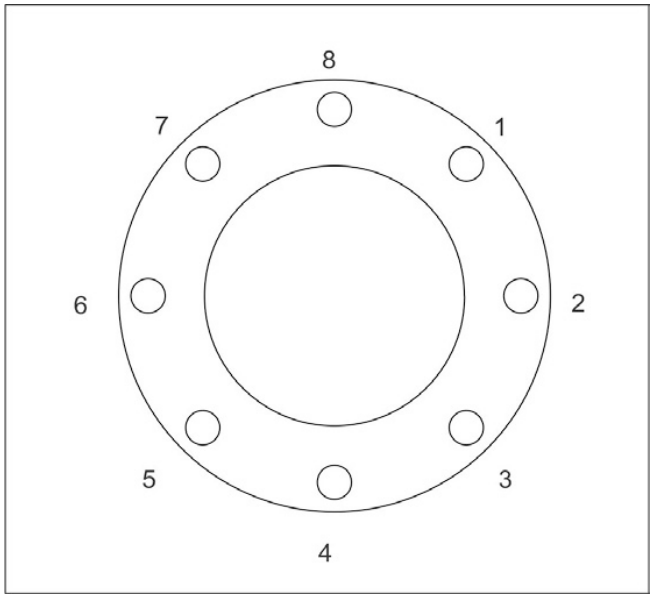
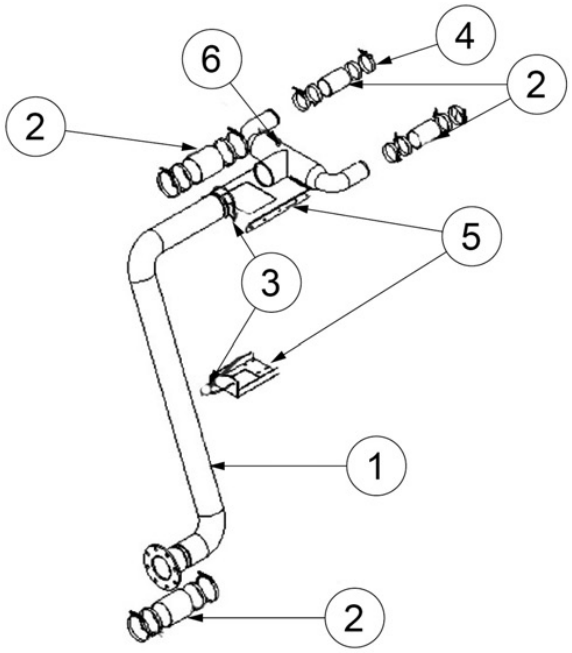


FIGURE 259. HT FLANGE TORQUE SEQUENCE NUMBERS

6.5.5.5.20 Install HT Outlet Tubing

NOTICE
Numbers in parenthesis refer to Figure 260 unless specified otherwise.



No.	Description	No.	Description
1	Radiator HT Outlet	4	Clamp
2	High temperature hose	5	Support bracket
3	U-bolt	6	C-bend Pipe

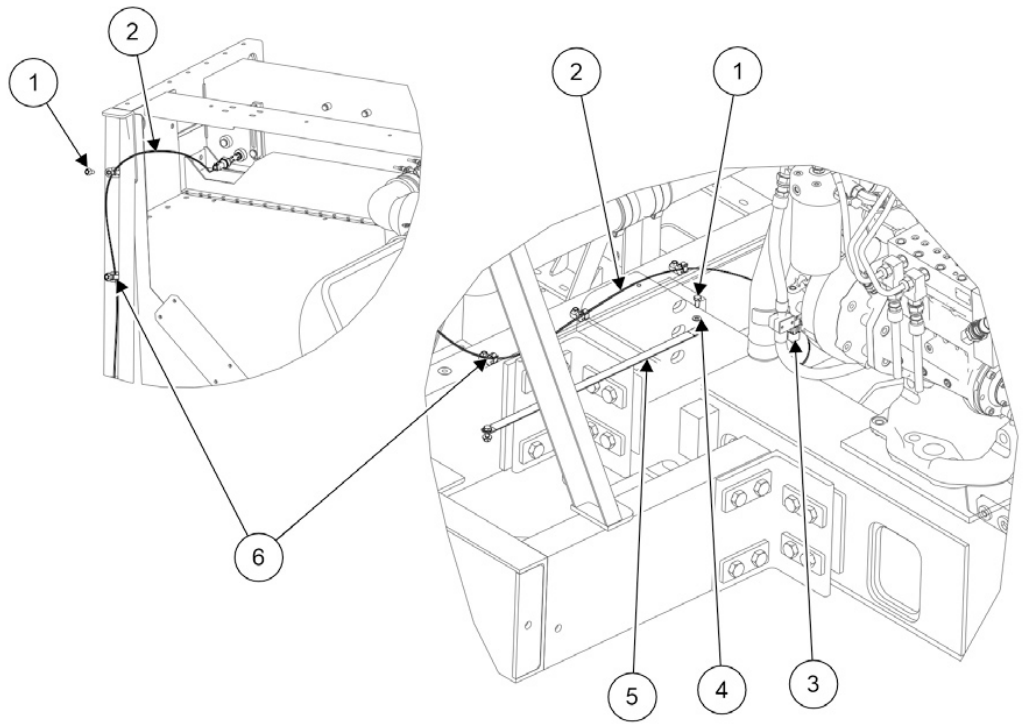
FIGURE 260. HT OUTLET TUBING INSTALLATION

1. Apply water based rubber assembly lubricant inside both ends of all hoses (2).
2. Connect the HT C-bend pipe (6) with high temperature hose (2) at both ends of the radiator and hand tighten the clamp (4).
3. Place the S-bend tube between the DIN Connection tube and the radiator connection. Align the S-bend in proper direction and hand tighten.
4. Connect the outlet tube (1) in left side end with the high temperature hose (2). Align in proper direction and hand tighten the clamp (4) on both ends.
5. Fix the straight pipe (1) between right side hose and left side and hand tighten the clamp (4).
6. Apply thread locking compound to U-bolt (3) threads. Use U-bolts and fix the HT pipe on radiator with support bracket (5).
7. Torque the U-bolt (4) that attaches the HT outlet tube (1) to the tube support bracket (5) to 25 Nm (18 ft-lb).
8. Use two step torque wrench and torque all hose clamps 11 Nm (8 ft-lb).

6.5.5.5.21 Complete Installation of Low Coolant Level Sensor Harness

NOTICE
Numbers in parenthesis refer to Figure 261 unless specified otherwise.

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No.	Description	No.	Description
1	Hex Screw	4	Washer
2	Low coolant level sensor harness	5	Ground strap
3	P1 connector on engine harness	6	Cable Clamp

FIGURE 261. LOW COOLANT LEVEL SENSOR HARNESS CONNECTION TO ENGINE HARNESS

1. Connect the low coolant level sensor harness (2) to the engine harness (3).
2. Install the radiator ground strap (5).
    a. Apply dielectric grease to the ground strap mounting locations.
    b. Install the ground strap (5) with existing hardware.
    c. Install the ground strap (5) to the generator set skid with one hex screw (1) and one washer (4).
    d. Torque bolts to 52 Nm (38 ft-lb).
3. Route wiring harness along radiator frame and secure with cable clamps.

6.5.5.5.22 Install Vent Lines

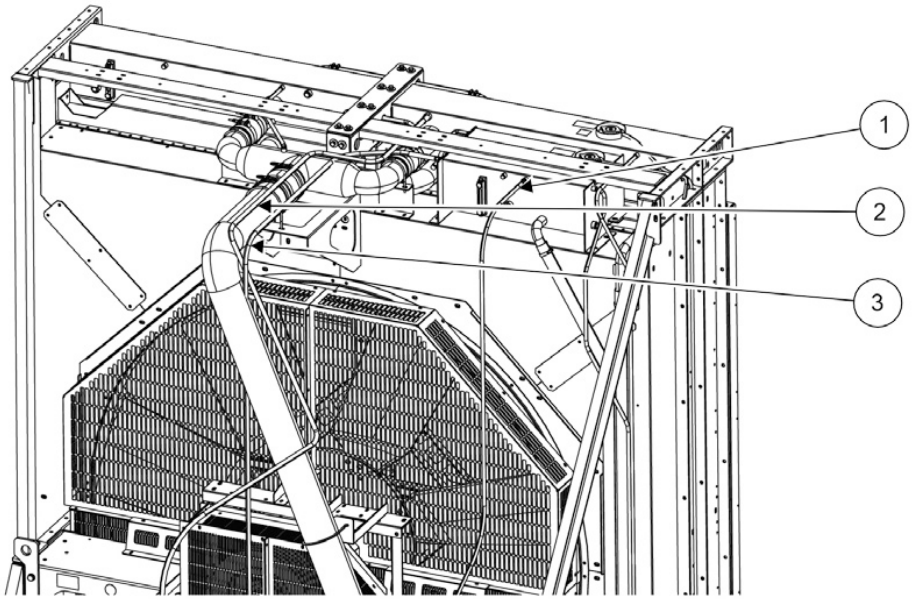
The vent lines are shipped loose in a kit that is required to be installed on to the radiator expansion tank.

1. Separate the vent lines and identify each line by part number.

All vent lines must be secured to the generator set using clips and cable ties.

All vent lines must be either vertical or inclined between the engine and radiator. No sags are permitted.

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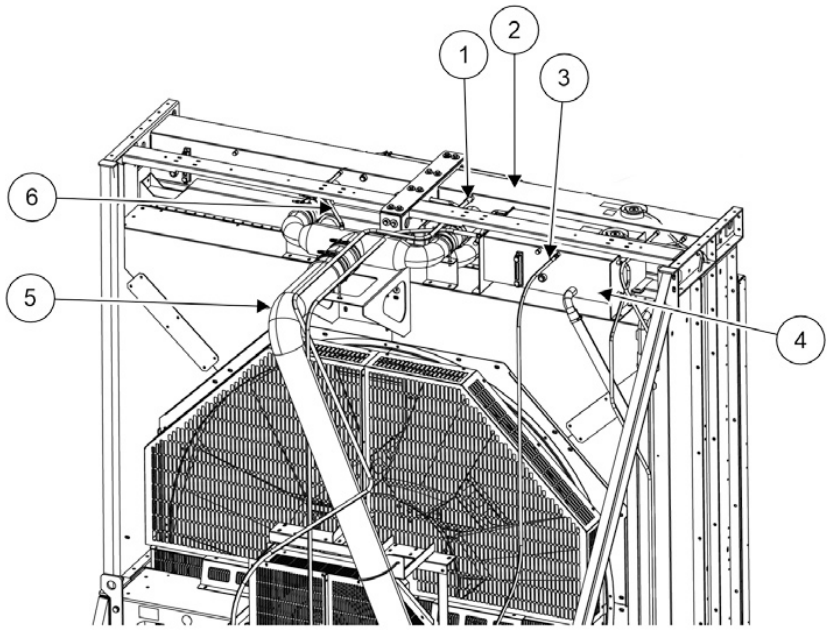


No.	Description	No.	Description
1	LT Engine Vent Line (3700 mm or 3900 mm - ¼ in. NPT)	3	LT Engine Outlet Tube Vent Line (2750 mm or 4100 mm - ¼ in. NPT)
2	HT Engine Vent Line (3400 mm or 3600 mm - ½ in. NPT)		

FIGURE 262. RADIATOR VENT LINES

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6.5.5.5.22.1 Install Vent Lines on HT and LT Top Tank



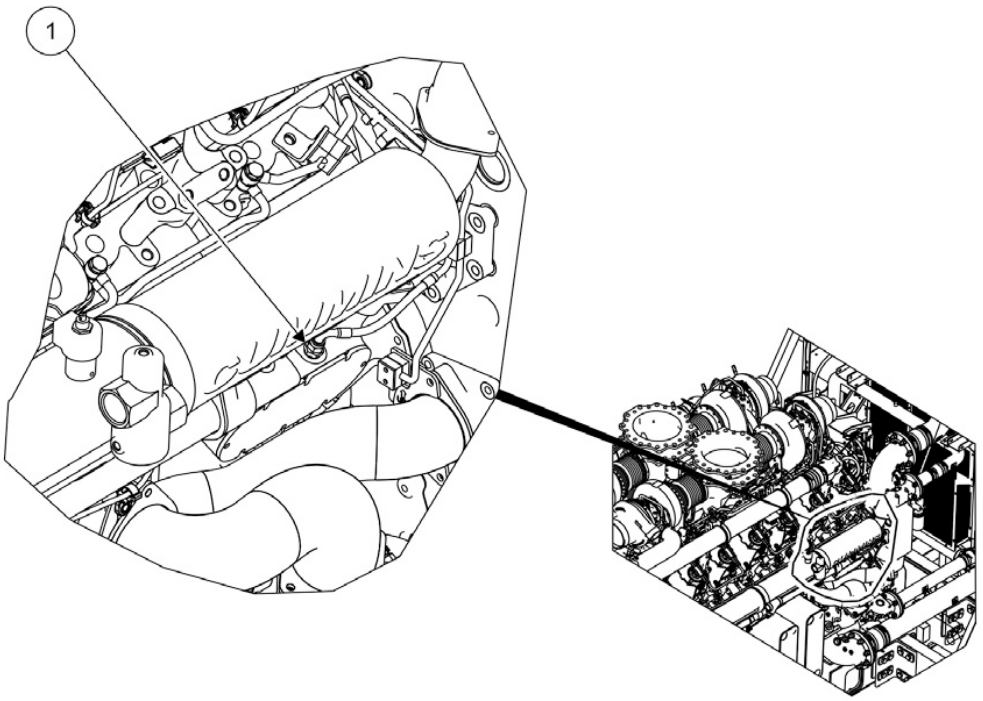
No.	Description	No.	Description
1	HT Engine Vent Line	4	LT Top Tank
2	HT Top Tank	5	HT Outlet Tube
3	LT Engine Vent Line	6	HT Outlet Tube Vent Line

FIGURE 263. VENT LINES ON OUTLET TUBES AND VENT LINE A076E016

1. Install the HT engine vent line (1) on radiator HT top tank (2) and route the vent line to the HT outlet tube (5) with the help of cable tie as shown.
2. Install the LT engine vent line (3) to LT top tank (4) and route the vent line from fan guard to LT DIN pipe support bracket with DIN pipe.
3. Install the HT outlet tube vent line (6) on radiator HT top tank and connect with HT C-pipe connection.
4. Torque the vent lines to 20 Nm (9 ft-lb).

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6.5.5.5.22.1.1 Install LT Engine Vent Line



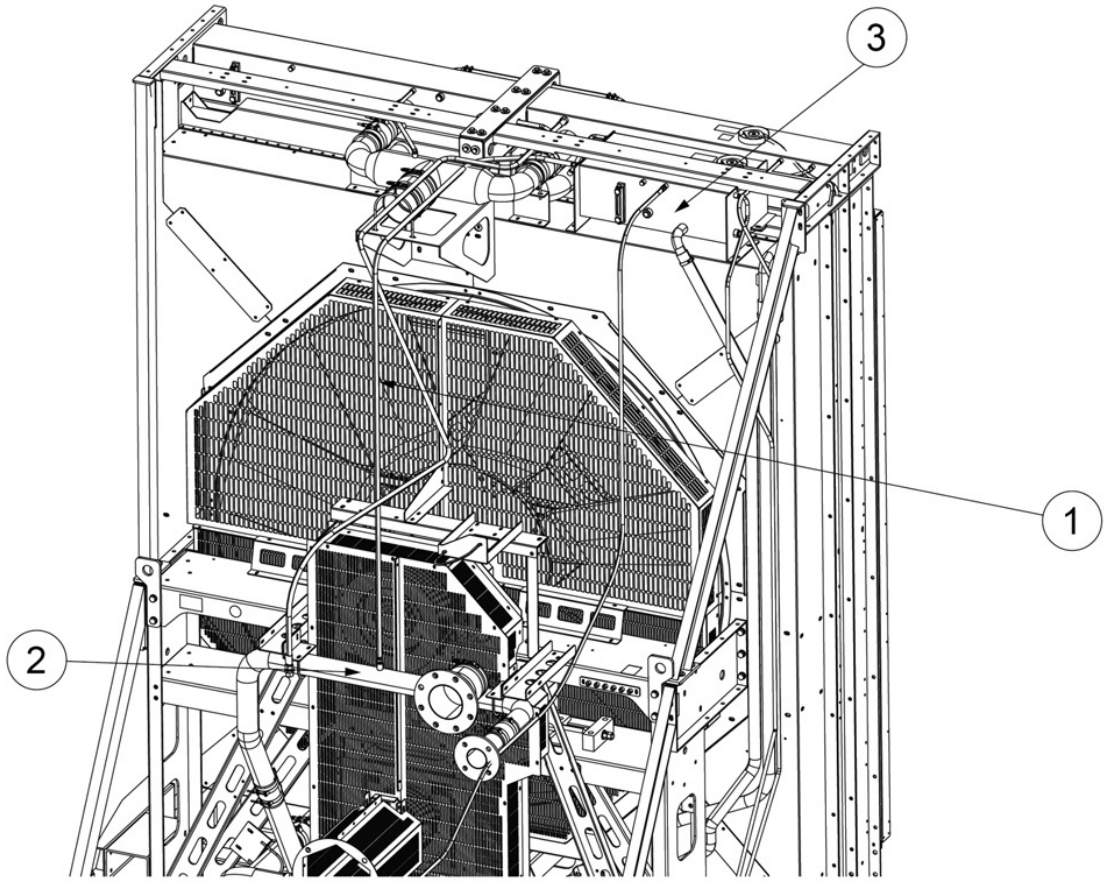
No.	Description
1	Vent Line

FIGURE 264. LT ENGINE VENT LINE

1. Remove the M14 plug in the LT thermostat housing.
2. Install the LT engine vent line fitting.
3. Install the LT engine vent line (1).
4. Torque the vent line to 27 Nm (20 ft-lb).

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6.5.5.5.22.1.2 Install LT Vent Line on LT Engine Outlet Pipe



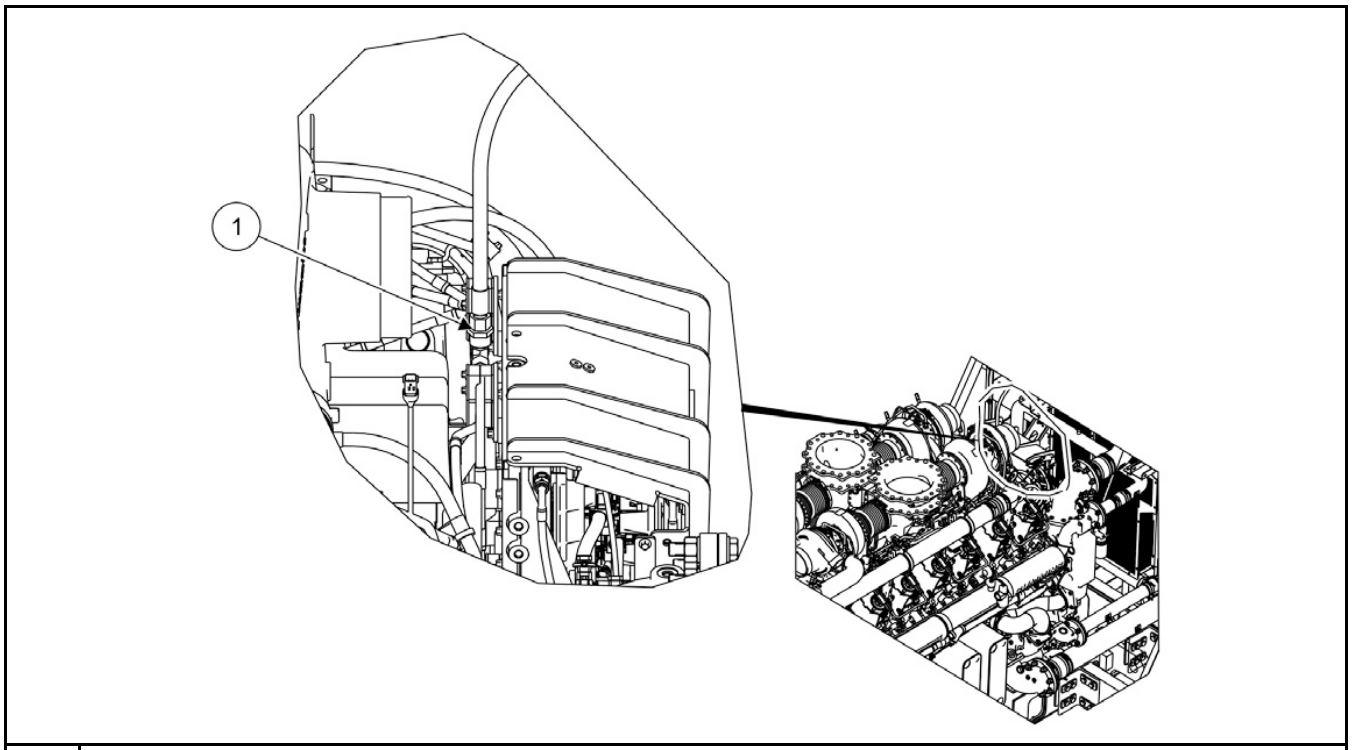
No.	Description	No.	Description
1	LT Tube Vent Line	3	LT Top Tank
2	LT Engine Outlet Tube		

FIGURE 265. LT VENT LINES ON LT ENGINE OUTLET PIPE

1. Remove the plug from LT engine outlet tube (2) and from LT top tank (3).
2. Install the LT tube vent line (1) fitting.
3. Install the LT tube vent line (1) to LT top tank and to the LT engine outlet tube (2).
4. Use two step torque range to Torque the vent line to 27 Nm (20 ft-lb).

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6.5.5.5.22.1.3 Install HT Engine Vent Line



No.	Description
1	Vent Line

FIGURE 266. HT ENGINE VENT LINE

1. Remove any shipping plugs.
2. Install vent line (1).
3. Torque vent line to 52 Nm (38 ft-lb).

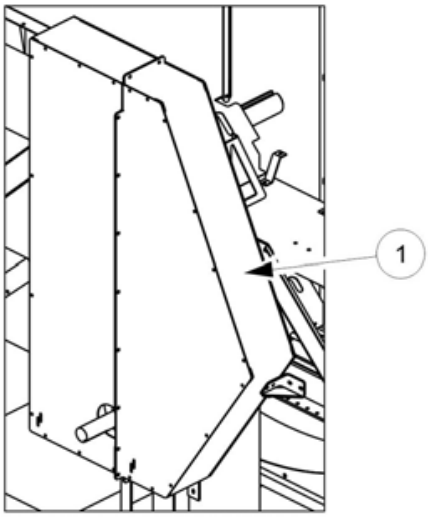
6.5.5.5.23 Install Radiator Fan Drive Shaft

Install the radiator fan drive shaft according to **Section 6.5.7 on page 685**.

6.5.5.6 Fan Drive Belt Replacement

1. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See **Section 6.1.2 on page 334**.
2. Remove the fan drive shaft according to **Section 6.5.7.1 on page 685**.
3. Remove the radiator belt guard.

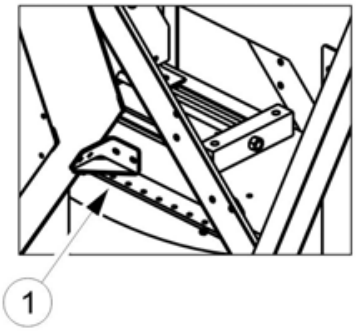
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No.	Description	No.	Description
1	Radiator belt guard		

FIGURE 267. RADIATOR BELT GUARD

4. Loosen four tensioner 5/8" locking bolts and nuts located under the radiator support cross member.

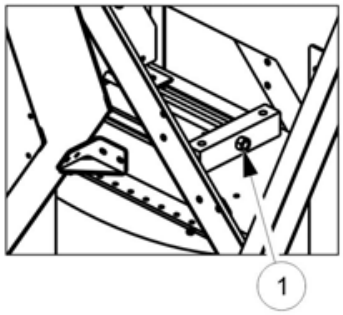


No.	Description	No.	Description
1	Tensioner locking bolts under radiator support cross member		

FIGURE 268. TENSIONER LOCKING BOLT LOCATION

5. Turn the tensioner adjustment screw counterclockwise to loosen the fan drive belts.

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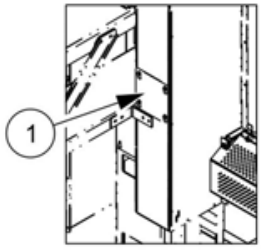
No.	Description	No.	Description
1	Tensioner adjustment screw		

FIGURE 269. TENSIONER ADJUSTMENT SCREW

6. Remove all fan drive belts.
7. Install new fan drive belts.

NOTICE
The fan drive belts should be a matched set.

8. Remove the fan drive belt inspection cover.



No.	Description	No.	Description
1	Fan drive belt inspection cover		

FIGURE 270. FAN DRIVE BELT INSPECTION COVER

9. Use a belt tension tool to set the belt tension for the new belts.
10. Turn the tensioner adjustment screw clockwise to increase fan drive belt tension.
    - Belt span

      40.5 inches (1028.7 mm)
    - New belt deflection force

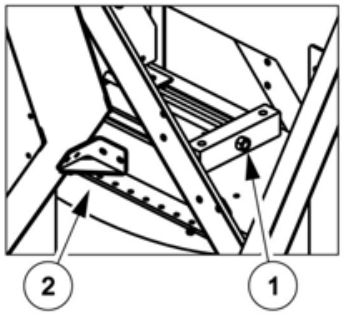
      60 Hz - 23.4 lb (10.61 kg)

      50 Hz - 23.8 lb (10.8 kg)
    - Used belt deflection force

      60 Hz - 15.6 lb (7.08 kg)

      50 Hz - 15.9 lb (7.21 kg)

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No.	Description	No.	Description
1	Tensioner adjustment screw	2	Tensioner locking bolts under radiator support cross member

FIGURE 271. TENSIONER ADJUSTMENT SCREW AND LOCKING BOLTS

11. Torque the four tensioner locking bolts underneath the radiator support cross member to 290 Nm (215 ft-lb).
12. Install the fan drive belt inspection cover.
13. Install the radiator belt guard.
14. Install the fan drive shaft according to Section 6.5.7.2 on page 694.
15. Test run the generator set. Check for proper operation of the fan drive shaft and fan drive belts.

6.5.5.7 Grease Fan Bearings

Fan bearings should be greased immediately with initial installation of radiator, then at regular intervals following the maintenance schedule. When operating in hot, dirty, or wet environments, the bearing re-grease interval will need to be increased. The timing can vary from daily to weekly. historical experience with bearings operating under the specific conditions will help determine the correct interval. Contact your authorized distributor for assistance.

6.5.5.7.1 Tools and Consumables

- Grease gun (flexible hose recommended)
- 9/16 inch socket
- Fan drive bearing grease (Mobil One Synthetic, part number A049B381)

6.5.5.7.2 Procedure

⚠ WARNING

Moving Parts
Moving parts can cause severe personal injury.
Use extreme caution around moving parts. All guards must be properly fastened to prevent unintended contact.

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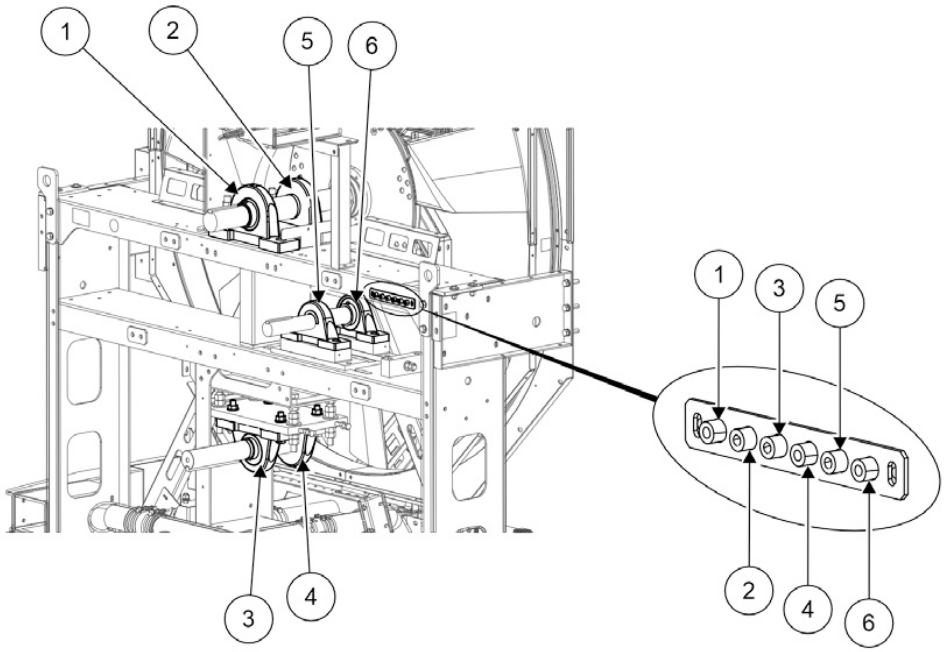
⚠ WARNING

Automated Machinery
Accidental or remote starting of the generator set can cause severe personal injury or death. Make sure that the generator set cannot be started accidentally or remotely before starting work on the generator.

⚠ CAUTION

Sharp Edges and Sharp Points Projecting corners/parts may cause cuts, abrasions and other personal injury.
Use PPE. Be aware of sharp edges and corners/sharp points. Cover/protect them.

The grease fittings shown below correspond to the indicated bearing.



No.	Description	No.	Description
1	Fan Shaft Rear Bearing	4	Drive Shaft Forward Bearing
2	Fan Shaft Forward Bearing	5	Idler Shaft Rear Bearing
3	Drive Shaft Rear Bearing	6	Idler Shaft Forward Bearing

FIGURE 272. BEARING SEATS

1. The bearing seat needs to be lubricated regularly; the locations as shown in the figure.
2. Wipe the grease fittings clean of any foreign material.
3. Put the grease gun onto the grease fitting. Make sure the grease gun nozzle is fully engaged on the grease fitting.
4. Pump about 0.52 oz of grease into each grease fitting in order from 1 through 6.

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6.5.6 Radiator Service – A076E017, A076E020, A078M281, A078M282, A080G170, A080G171, A080G172, A080G173

6.5.6.1 Specifications

TABLE 131. SPECIFICATIONS

Item	Data
Cooling System Capacity	
Capacity Standard Radiator Only	For fill volumes, refer to Section 3.2 on page 23
Capacity Engine Only	
Total Capacity (Engine and Standard Radiator)	
Coolant flow rate	For 50 °C, 94 ft^2 radiator: HT section 2909 lpm (768 gpm) LT section 757 lpm (200 gpm) For 50 °C, 84 ft^2 radiator: HT section 2593 lpm (685 gpm) LT section 767 lpm (203 gpm) For 40 °C, 84 ft^2 radiator: HT section 2593 lpm (685 gpm) LT section 767 lpm (203 gpm) For 40 °C, 61 ft^2 radiator: HT section 2513 lpm (664 gpm) LT section 764 lpm (202 gpm)
Expected pressure drop	For 60 Hz: 12 psi For 50 Hz: 8.5 psi
Radiator Pressure cap	
Operating Pressure	1.03 Bar (15 PSI)
Operating Temperature (maximum)	50 °C (122 °F)
Thermostat	
Operating temperature	HT thermostat opens @ 82.2 °C (180 °F) LT thermostat opens @ 46.1 °C (115 °F)
Set Mounted Cooling System	
Radiator Assembly Dry Weight	94 ft^2 4849 kg (10690 lb) 84 ft^2 4276 kg (9427 lb) 61 $ft^2$3715 kg (8190 lb)
Radiator Size	
Height	94 ft^2 3791 mm (149.3 in) 84 ft^2 3661 mm (144 in) 61 ft^2 3366 mm (132.5 in)

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Item	Data
Width	94 ft² 3172 mm (124.9 in) 84 ft² 3022 mm (118.9 in) 61 ft² 2610 mm (102.8 in)
Depth	94 ft² 2781 mm (109.5 in) 84 ft² 2496 mm (98.3 in) 61 ft² 2551 mm (100 in)

6.5.6.2 Radiator Rigging Instructions

⚠ WARNING

Heavy Load

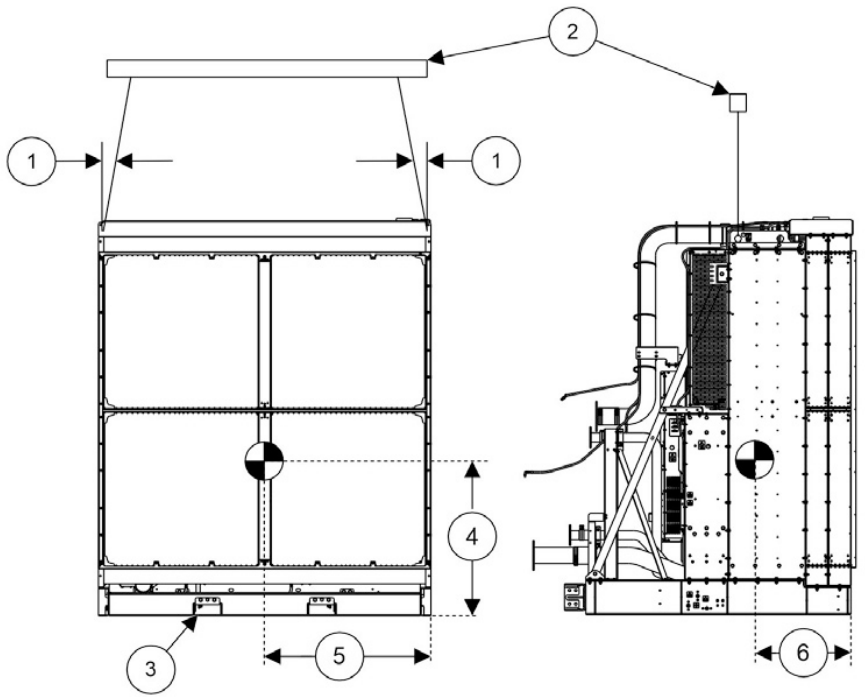
Incorrect lifting or repositioning can cause severe personal injury or death.

Make sure that only suitably trained or experienced personnel transport and handle radiator and associated components.

NOTICE

Do not lift the generator set with the radiator installed. Damage can occur.

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Item	Description	Item	Description
	Dry weight: 61 ft² radiator - 3715 kg (8190 lb) 84 ft² radiator - 4298 kg (9475 lb) 94 ft² radiator - 4849 kg (10960 lb)	4	61 ft² radiator - 1131 mm (44.53 in) 84 ft² radiator - 1555 mm (61.22 in) 94 ft² radiator - 1492 mm (58.74 in)
1	Angle 10° maximum	5	61 ft² radiator - 1348 mm (53.07 in) 84 ft² radiator - 1500 mm (59.05 in) 94 ft² radiator - 1620.52 mm (63.80 in)
2	Lifting beam	6	61 ft² radiator - 806 mm (31.73 in) 84 ft² radiator - 818.2 mm (32.21 in) 94 ft² radiator - 915.9 mm (36.06 in)
3	Fork tube (quantity 2)		
Cables must not exceed a 45° angle from vertical in any direction.			

FIGURE 273. RADIATOR RIGGING

6.5.6.3 Cooling System Maintenance

This section provides information on cleaning the radiator and updated information regarding bearings that has been provided by our supplier to enable efficient and prolonged life of the equipment.

NOTICE
The following information regarding the correct choice and fitting of hose clamps has also been provided by our supplier to assist and guide the user.

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6.5.6.3.1 Hose Clamp Installation

This section provides general installation guidelines for the correct positioning, orientation and torque figures required when fitting hose clamps. Recommended hose and clamp combinations are also included.

6.5.6.3.1.1 Hose Clamps

Installation

1. Make sure the pipe ends are clean.
2. Pipes must be properly supported. Hoses do not act as supports for pipes.
3. Center the hose over the pipe connections.
   - Do not exceed the maximum allowed gap between pipe ends.

NOTICE
To ensure hose is properly centered on the gap between pipe ends, it is recommended to mark the hose location on the pipes accordingly prior to tightening the hose clamps. This mark will act as a guide during installation.

4. Tighten the hose clamp bolts.

NOTICE
Do not attempt to move hose after tightening.

Removal

1. Make sure fluids have been properly drained from the system.
2. Loosen the hose clamp bolts.
3. Carefully use a hose pick to release the hose from the pipe surface.
4. Slide the hose to remove from the pipe.

6.5.6.3.2 Cleaning

6.5.6.3.2.1 General Cleaning

The Cleaning Of Radiator Cores Using Pressurized Water Equipment:

NOTICE
In specific dust laden environments, this procedure should not be used as the initial cleaning operation; it should follow Cleaning - Dust Laden Environments.

On enclosed generator sets with removable end panel(s), remove the end panel(s) to assist in the cleaning of the radiator.

Inspect the exterior of the radiator for obstructions. During the service life of a radiator, a build up of foreign matter can obstruct the flow of air through the radiator cores, reducing the cooling capability. To ensure the continued efficiency of the radiator, the core will require cleaning.

For thorough cleaning, pressure wash in the opposite direction to the airflow. A suitable proprietary degreasing additive (as recommended by the manufacturer of the pressure washer) should be applied via the pressure washer but this must not contain ammonia as it will corrode the core.

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The recommended equipment for cleaning a radiator core is an industrial pressure washer, but it must be used in the correct manner as misuse can reduce the performance of the core. Protect the generator set from any over spray during this procedure.

To be effective, it is recommended that a hot water washer be used.

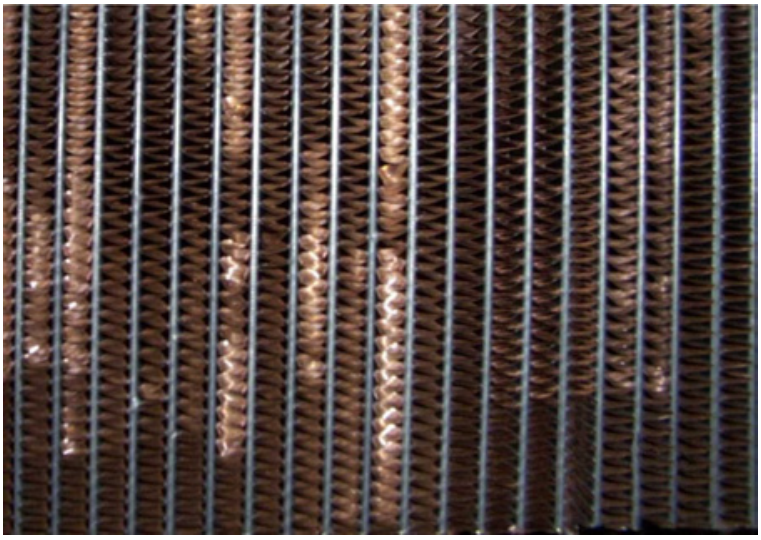


FIGURE 274. FINS DAMAGED BY PRESSURE WASHING AT ACUTE ANGLES TO CORE FACE

NOTICE
With the pressures involved it is important that the distance between the core face and the nozzle is a minimum of 100 mm (3.93 inches); any closer and damage may occur.

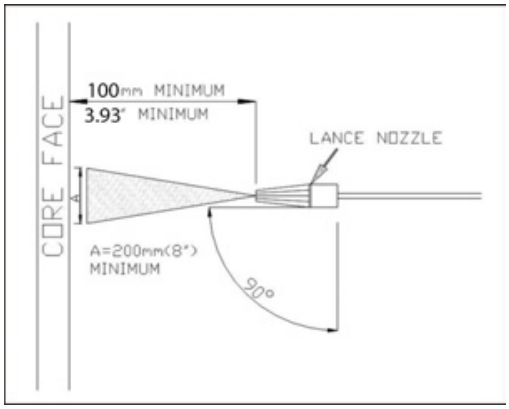


FIGURE 275. PRESSURE WASHER NOZZLE POSITIONING

NOTICE
Most Industrial pressure washers work at pressures of around 1500 psi to 2000 psi (103 bar to137.89 bar). It is very important that, when washing a core in this way, the lance must be kept at a right angle to the core

NOTICE
If your pressure washer works above 2000 psi, then the gap between the nozzle and the core face must be increased or fin damage will occur.

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NOTICE
Always follow pressure washer Manufacturer's Health and Safety Guidelines.

Replace the end panel(s) where necessary.

6.5.6.3.2.2 Dust Laden Environments

Specific Instructions for the Cleaning of Radiator Cores Used in an Environment Subjected to Crushed Aggregate or Ceramic Dust Contamination

On enclosed generator sets with removable end panel(s), remove the end panel(s) to assist in the cleaning of the radiator.

Inspect the exterior of the radiator for obstructions. During the service life of a radiator, a buildup of foreign matter can obstruct the flow of air through the radiator cores, reducing cooling capability. To maintain the efficiency of the radiator, the core will require cleaning.

Unless the radiator can be dismantled and the core treated in a professional caustic immersion cleaning system, the radiator should not be "wet" cleaned. This is because of the tendency of this type of contamination to coalesce and become extremely difficult to remove.

The correct procedure is to regularly blow through the entire core area with low pressure compressed air (against the direction of cooling airflow). It is very important to ensure that resultant debris blown from the core is subsequently removed and disposed of before engine start-up. An industrial vacuum cleaner will achieve this requirement. In most installations, it will be necessary to remove cowls and guarding.

To prevent damage to fins and resultant loss of cooling, it is important to ensure that the air gun used is maintained at right angles to the core face.

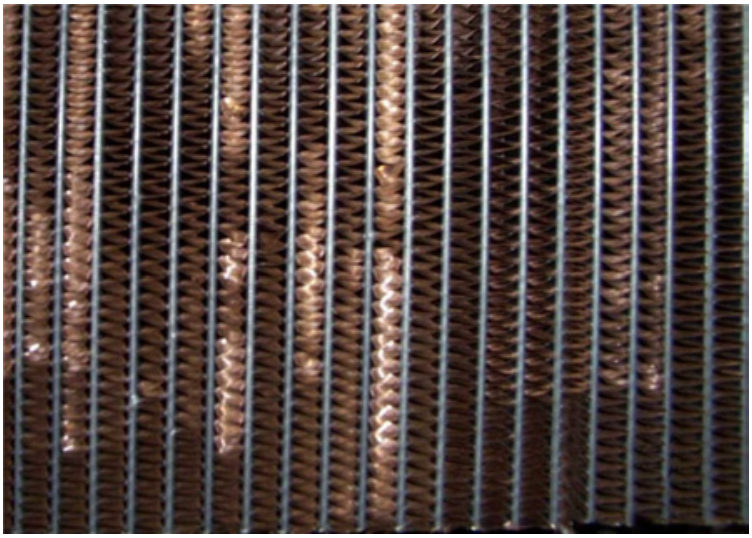


FIGURE 276. FINS DAMAGED BY COMPRESSED AIR AT ACUTE ANGLES TO CORE FACE

After this procedure has been effectively carried out with only the lightest of dust remaining, follow it immediately (if necessary) by cleaning the radiator cores using pressurized water equipment.

Replace the end panel(s) where necessary.

NOTICE
It is vitally important that the core is thoroughly dried before start-up.

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6.5.6.3.3 Fan Drive Bearings

6.5.6.3.3.1 Bearing Health Check

The following information is relevant to both Interference Fit and Non-Interference Fit bearings.

Determine if there are any sounds emanating from the shaft/bearing assembly which may be indicative of failure, or imminent failure.

6.5.6.3.3.2 Fan Drive Bearing Locations

Placeholder for image depicting Fan Drive Bearing Locations.

FIGURE 277. FAN DRIVE BEARING LOCATIONS

6.5.6.3.3.3 Bearing and Grease Change

The fan drive and design has been changed to improve serviceability of the bearing set-up, both in terms of greasing and fitting.

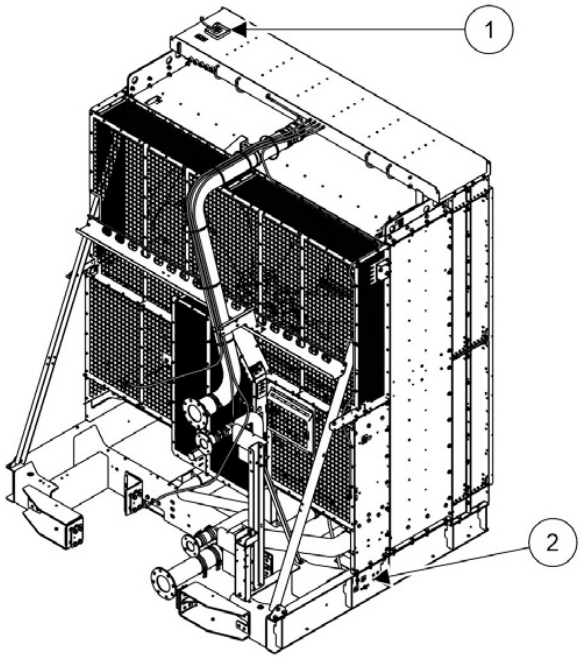
For detailed procedure applicable to this radiator, see **Section 6.5.5.7 on page 638**

6.5.6.4 Radiator Removal - Open Set

6.5.6.4.1 Remove Radiator Fan Drive Shaft

Remove the radiator fan drive shaft according to **Section 6.5.7.1 on page 685**.

6.5.6.4.2 Remove Coolant



No.	Description	No.	Description
1	Fill Necks	2	Drain Valves

FIGURE 278. RADIATOR FILL LOCATIONS

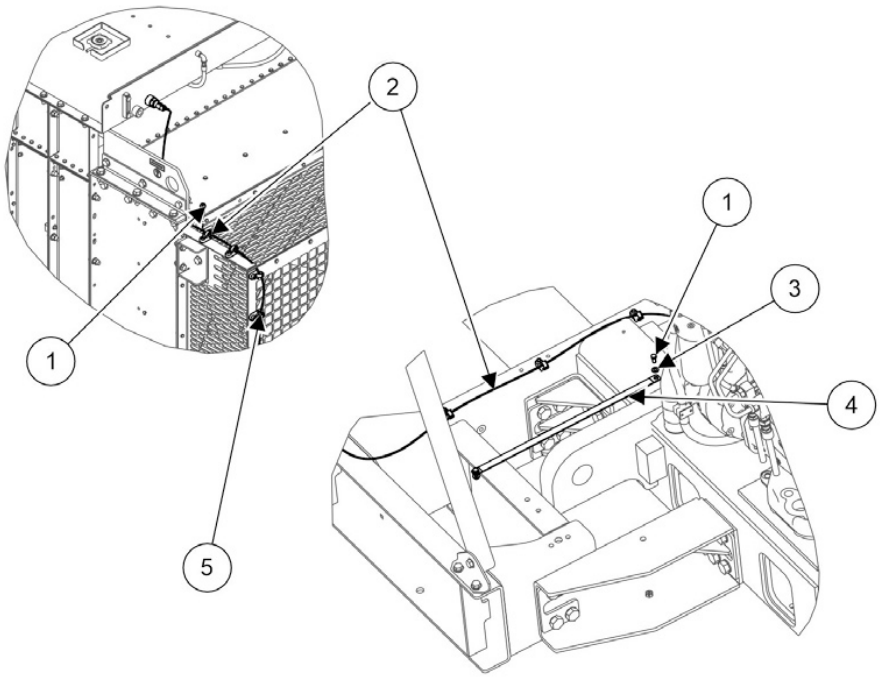
1. Remove the radiator pressure cap on the fill neck.

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2. Connect a drain hose from the drain valves to a suitable container.
3. Open the drain valves to drain coolant to the container.
4. Dispose of the coolant in accordance with local regulations.

6.5.6.4.3 Remove Low Coolant Level Sensor Harness from Engine Harness

NOTICE
Numbers in parenthesis refer to Figure 279 unless specified otherwise.



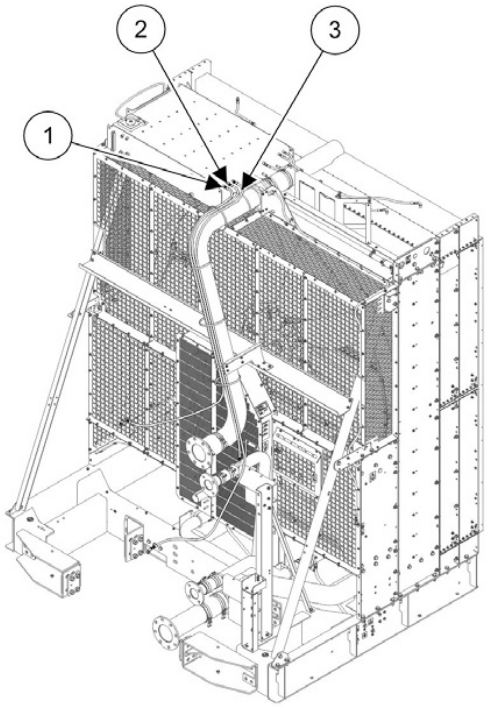
No.	Description	No.	Description
1	Bolt	4	Ground strap
2	Low coolant level sensor harness	5	Cable clamp
3	Washer		

FIGURE 279. LOW COOLANT LEVEL SENSOR HARNESS CONNECTION TO ENGINE HARNESS

1. Remove the radiator ground strap (5).
2. Disconnect the low coolant level sensor harness (2) from the engine harness (3).

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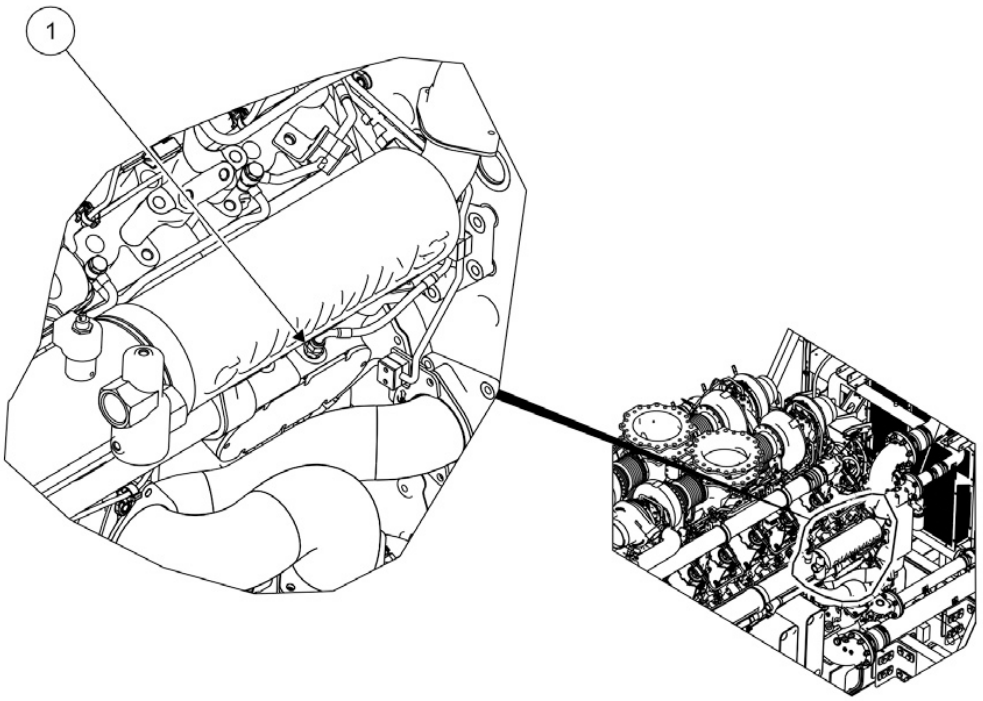
6.5.6.4.4 Remove Vent Lines



No.	Description	No.	Description
1	LT Engine Vent Line	3	HT Engine Vent Line
2	LT Engine Outlet Tube Vent Line		

FIGURE 280. RADIATOR VENT LINES

6.5.6.4.4.1 Remove LT Engine Vent Line



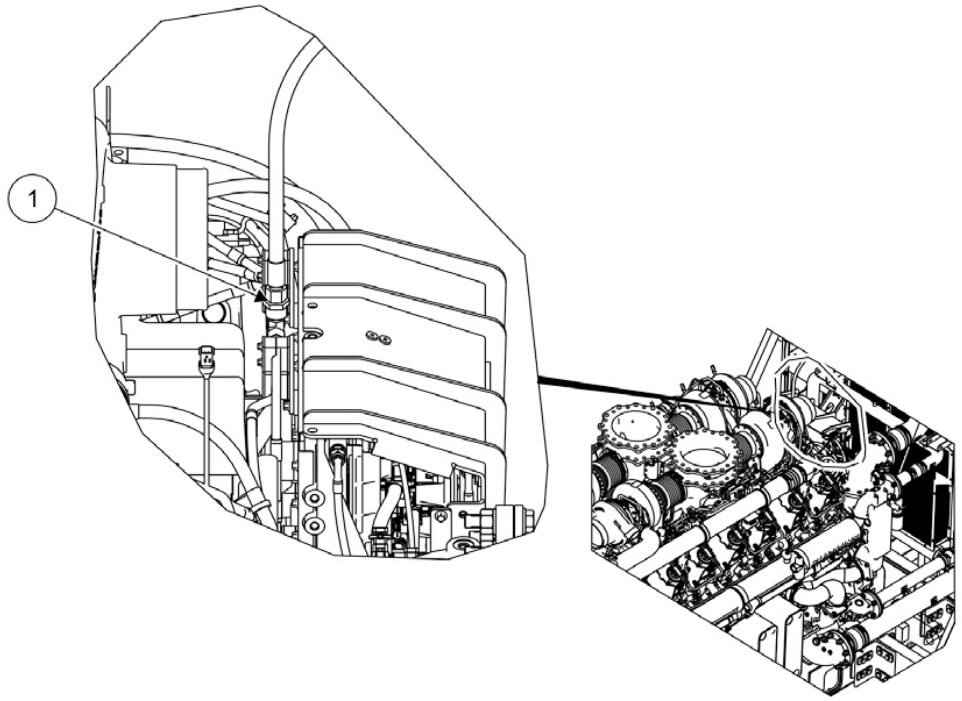
No.	Description
1	Vent Line

FIGURE 281. LT ENGINE VENT LINE

1. Label Vent line locations.
2. Remove LT vent line (1) from LT thermostat vent line fitting.

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6.5.6.4.4.2 Remove HT Engine Vent Line



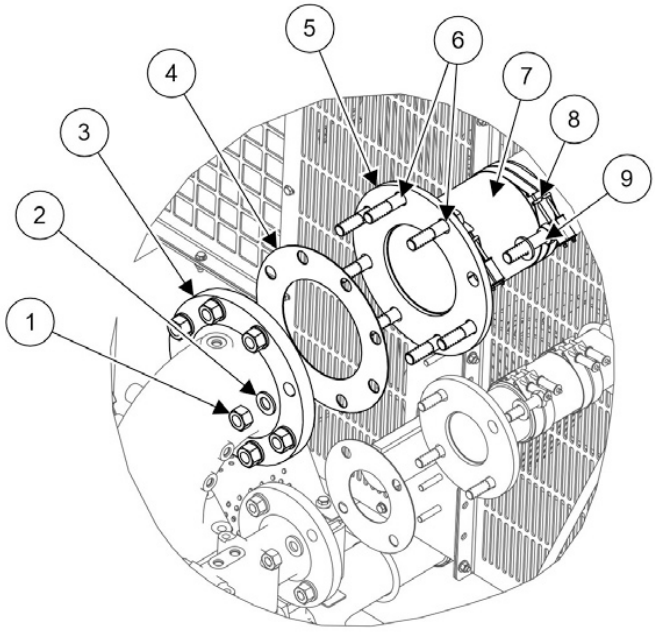
No.	Description
1	Vent Line

FIGURE 282. HT ENGINE VENT LINE

1. Label vent line locations.
2. Remove HT vent line (1) from HT vent line fitting.

6.5.6.4.5 Remove HT Outlet Coolant Flange

NOTICE
Numbers in parenthesis refer to Figure 283 unless specified otherwise.



No.	Description	No.	Description
1	Nut	6	Bolt, ¾ inch – 10 X 3.5 inch (Qty. 2)
2	Washer	7	Hose
3	HT Outlet Pipe	8	Clamp
4	Gasket	9	Bolt, ¾ inch – 10 X 3.25 inch (Qty. 6)
5	HT Outlet Flange		

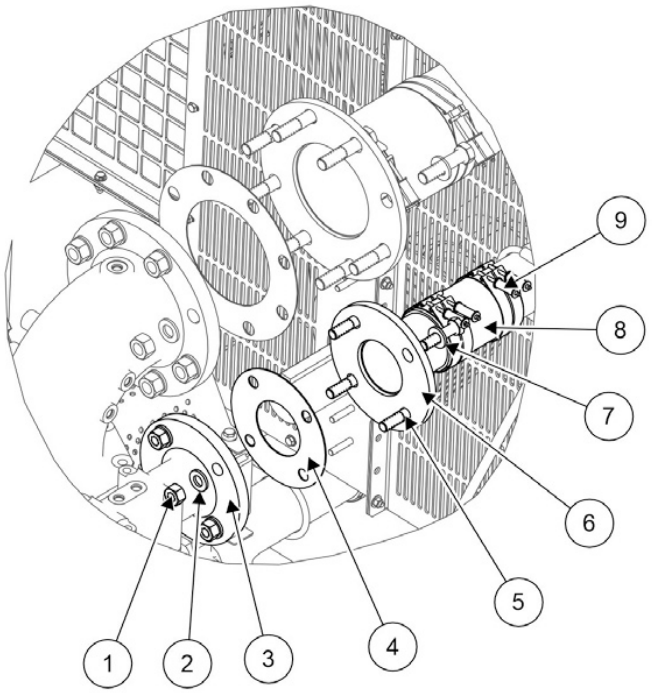
FIGURE 283. HT OUTLET COOLANT FLANGE

1. Remove the hose (8) and clamps (9) connecting the HT outlet flange (5) to the radiator pipe.
2. Remove HT outlet pipe (3) to HT outlet flange (5) and flange gasket (4), bolts (6, 9), washers (2), and nuts (1).
   - Discard the gasket.
3. Place the removed components on a clean, dry surface.

6.5.6.4.6 Remove LT Outlet Coolant Flange

NOTICE
Numbers in parenthesis refer to Figure 284 unless specified otherwise.

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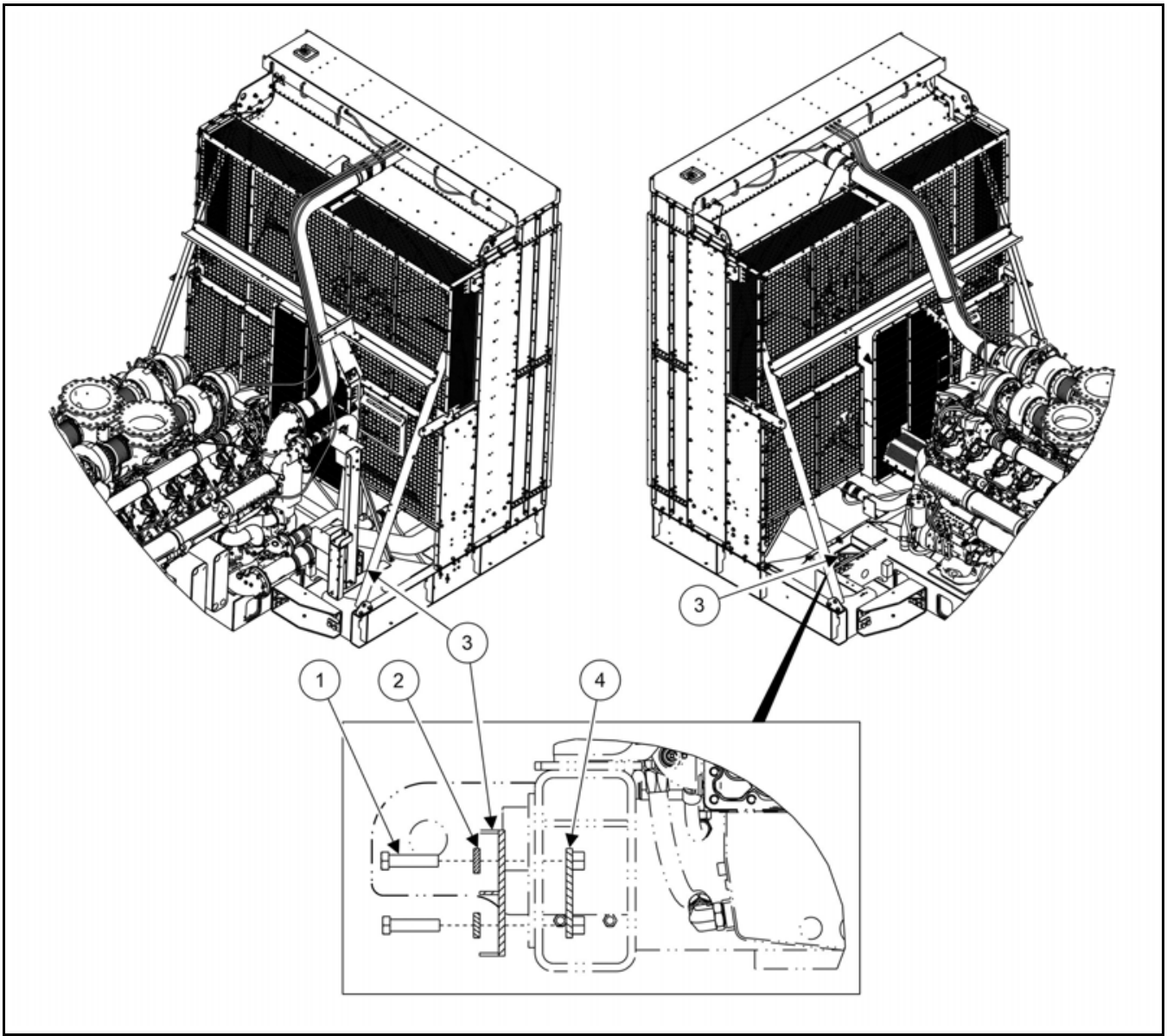
No.	Description	No.	Description
1	Nut	6	LT outlet flange
2	Washer	7	Washer
3	LT outlet pipe	8	Hose
4	Gasket	9	Clamp
5	Bolt		

FIGURE 284. LT OUTLET COOLANT FLANGE

1. Remove the hose (8) and clamps (9) connecting the LT outlet flange (6) to the radiator pipe.
2. Remove LT outlet pipe (3) to LT outlet flange (6) and flange gasket (4), bolts (5), washers (2,7), and nuts (1).
   - Discard the gasket.
3. Place the removed components on a clean, dry surface.

6.5.6.4.7 Remove Front Radiator L-brackets on Generator Set Skid

NOTICE
Numbers in parenthesis refer to Figure 285 unless otherwise specified.



No.	Description	No.	Description
1	Bolt	4	Nut plate
2	Washer plate	5	Generator set skid
3	L-bracket		

FIGURE 285. FRONT LEFT AND RIGHT RADIATOR L-BRACKETS

1. Remove two L-brackets (3) on the generator set skid (5) at the front right and left radiator mounting locations. Use four bolts (1), two washer plates (2), and one nut plate (4) for each L-bracket (3).

6.5.6.5 Radiator Installation - Open Set

6.5.6.5.1 Required Tools, Parts, and Consumables

The following tools are required to complete this installation.

- Tape measure

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- Level
- Torque Wrenches
  - 40-200 in-lb, 3/8 inch drive
  - 15-75 ft-lb, 3/8 inch drive
  - 50-250 ft-lb, 1/2 inch drive
  - 120-600 ft-lb, 3/4 inch drive
- Toe Jacks, Fork Lift, or Overhead Crane capable of lifting generator set
  - If using overhead crane, appropriately sized rigging equipment
- Pipe wrench, 24 inch
- Hex socket
  - 6 mm
  - 8 mm
  - 17 mm
  - 5/16 inch
- Paint marker
- Socket
  - 36 mm
  - 1/2 inch
  - 15/16 inch
  - 1 1/8 inch
- Deep socket
  - 9/16 inch
  - 15 mm
- Combination wrench
  - 1 1/16 inch
  - 1 1/4 inch
- 3/4 inch drive extension, 8 inch
- Belt tension tool (A050L945)
- Standard 6 inch (150 mm) Vernier calipers
- Steel bar (A059R243)
- Clamp (A001G779)
- Clean rags
- Molykote (MoS")
- Water based rubber assembly lubricant
- ½ inch internal to 3/8 inch external square drive adapter
- 3/8 inch drive, 12 point, 21 mm torque adapter with 2 inch offset
- Jeweler files, or 150 grit or finer emery cloth

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6.5.6.5.2 Safety Precautions

⚠ WARNING

Automated Machinery

Accidental or remote starting of the generator set can cause severe personal injury or death.

Isolate all auxiliary supplies and use an insulated wrench to disconnect the starting battery cables (negative [–] first).

⚠ WARNING

Electrical Generating Equipment

Incorrect operation and maintenance can result in severe personal injury or death.

Make sure that only suitably trained and experienced service personnel perform electrical and/or mechanical service.

⚠ WARNING

Combustible Gases

Ignition of battery gases is a fire and explosion hazard which can cause severe personal injury or death.

Using an insulated wrench, disconnect the negative (–) cable first and reconnect it last. Make certain hydrogen from the battery, engine fuel, and other explosive fumes are fully dissipated. This is especially important if the battery has been connected to a battery charger.

⚠ WARNING

Combustible Gases

Ignition of battery gases is a fire and explosion hazard which can cause severe personal injury or death.

Do not smoke, or switch the trouble light ON or OFF near a battery. Touch a grounded metal surface first before touching batteries to discharge static electricity. Stop the generator set and disconnect the battery charger before disconnecting battery cables. Using an insulated wrench, disconnect the negative (–) cable first and reconnect it last.

⚠ WARNING

Electric Shock Hazard

Voltages and currents present an electrical shock hazard that can cause severe burns or death.

Make sure that only service personnel who are trained and experienced perform electrical and mechanical component installations. Follow all local requirements when working on electrical equipment. Isolate all forms of electrical energy before working on the generator set.

⚠ CAUTION

Hazardous Voltage

Contact with high voltages can cause severe electrical shock, burns, or death.

Disconnect the battery charger before isolating the battery.

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⚠ CAUTION
Sharp Edges ***Sharp edges/burrs on housing parts can cause cuts and puncture wounds.*** ***When handling housing parts, use appropriate PPE.***

Read these instructions completely and become familiar with safety warnings, cautions, and procedures before starting the installation.

The installer must be familiar with the techniques of working on heavy machinery. A hoist must be available which can support the weight of the radiator, with an appropriate lifting strength margin.

Turn off or remove AC power from the battery charger and then use an insulated wrench to remove the negative (**–**) battery cable from the set starting battery. This prevents the generator set from starting while working on it and to avoid circuit board damage, caused by voltage spikes when removing and replacing circuit board connectors.

6.5.6.5.3 Preparing for the Installation

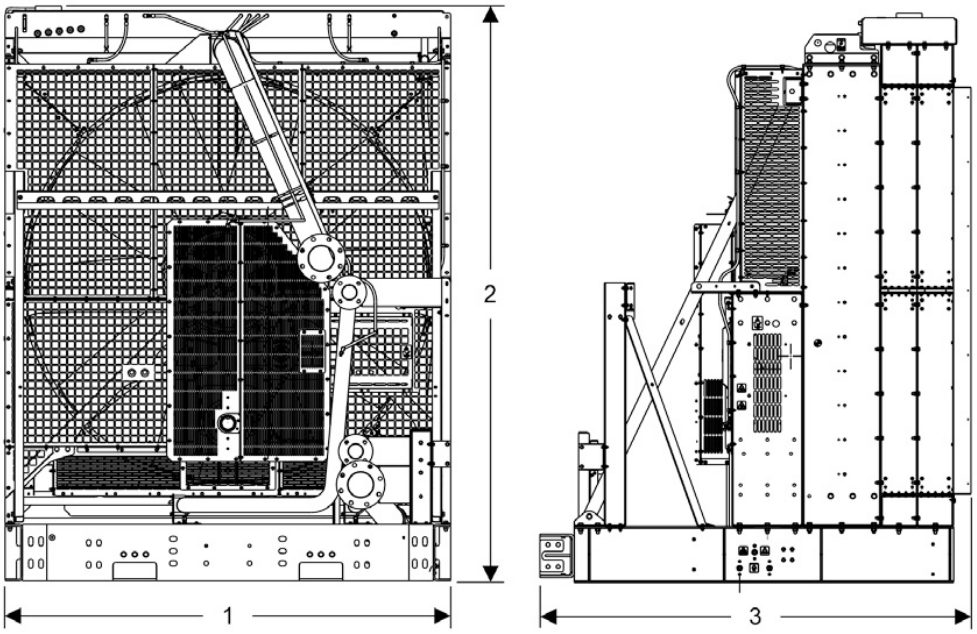
When installing the generator set, make sure to consider what is needed to install the cooling system.

1. Make sure to have all of the necessary tools and any additional items needed to complete the installation.

   The following items must be supplied by the customer to complete the installation.

   - Cable ties to be used when installing the vent lines
   - Coolant mixture:
     - For 94 ft^2 radiators: fully formulated, a 50% EG coolant mixture.
     - For 84 ft^2 radiators: fully formulated, a 50% EG coolant mixture.
     - For 61 ft^2 radiators: fully formulated, a 50% EG coolant mixture.
     - For fill volumes, refer to **Section 3.2**.
   - High strength tread locking compound (Loctite 277 or equivalent)
   - Anti-seize (Loctite C5-A or equivalent)
   - Thread sealant (Loctite 592 or equivalent)
   - Dielectric grease (Loctite 8423 or equivalent)
2. Apply the appropriate Hot Surface Warning Labels, included in the radiator kit, to the applicable parts as required per local codes and standards.
3. Make sure to have allowed enough space to install the radiator. Basic radiator dimensions are shown in **Figure 286**.

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No.	Description	No.	Description
A076E017, A080G170 - 94 ft² Radiator			
1	3172 mm (124.9 in)	3	2781 mm (109.5 in)
2	3791 mm (149.3 in)		
A078M281, A078M282, A080G171, A080G172 - 84 ft² Radiator			
1	3022 mm (119.0 in)	3	2496 mm (98.3 in)
2	3661 mm (144.2 in)		
A076E020, A080G173 - 61 ft² Radiator			
1	2607 mm (102.6 in)	3	2551 mm (100.4 in)
2	3366 mm (132.5 in)		

FIGURE 286. RADIATOR DIMENSIONS

6.5.6.5.4 Radiator Rigging Instructions

⚠ WARNING

Heavy Load

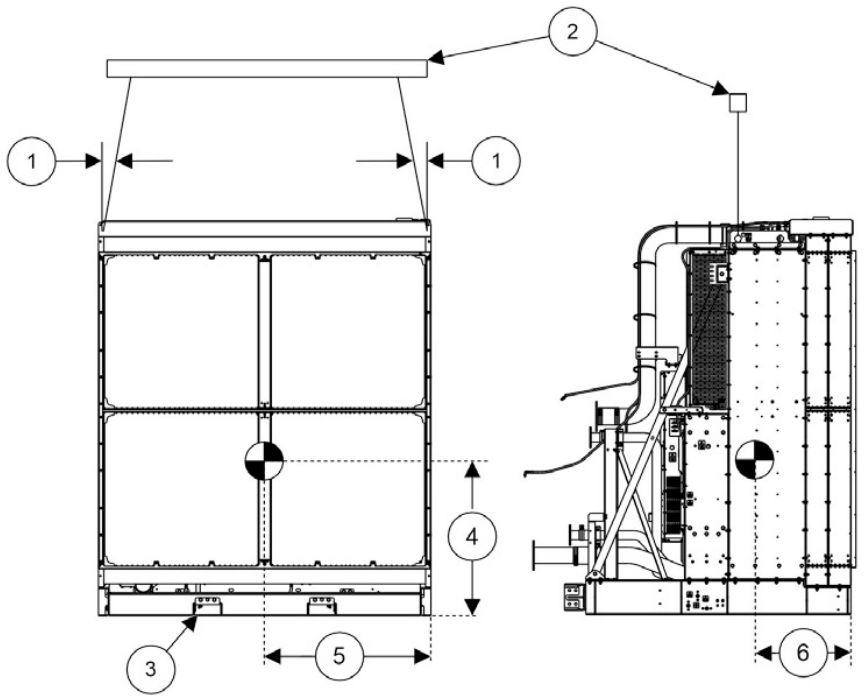
Incorrect lifting or repositioning can cause severe personal injury or death.

Make sure that only suitably trained or experienced personnel transport and handle radiator and associated components.

NOTICE

Do not lift the generator set with the radiator installed. Damage can occur.

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Item	Description	Item	Description
	Dry weight: 61 ft² radiator - 3715 kg (8190 lb) 84 ft² radiator - 4298 kg (9475 lb) 94 ft² radiator - 4849 kg (10960 lb)	4	61 ft² radiator - 1131 mm (44.53 in) 84 ft² radiator - 1555 mm (61.22 in) 94 ft² radiator - 1492 mm (58.74 in)
1	Angle 10° maximum	5	61 ft² radiator - 1348 mm (53.07 in) 84 ft² radiator - 1500 mm (59.05 in) 94 ft² radiator - 1620.52 mm (63.80 in)
2	Lifting beam	6	61 ft² radiator - 806 mm (31.73 in) 84 ft² radiator - 818.2 mm (32.21 in) 94 ft² radiator - 915.9 mm (36.06 in)
3	Fork tube (quantity 2)		
Cables must not exceed a 45° angle from vertical in any direction.			

FIGURE 287. RADIATOR RIGGING

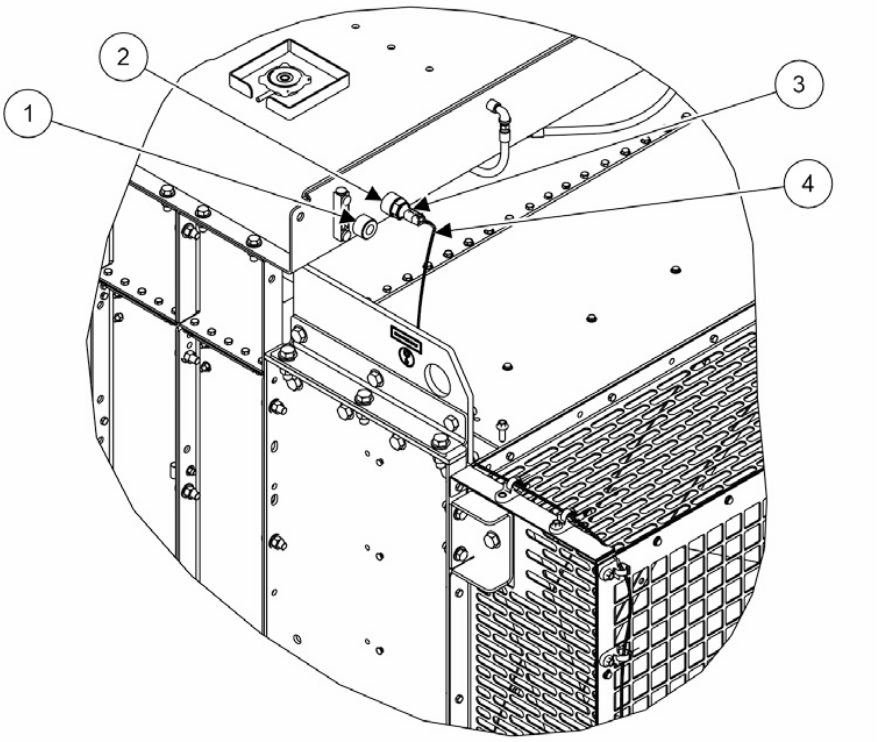
6.5.6.5.5 Attach the Low Coolant Level Sensor

⚠ CAUTION

Equipment Damage
Power tools can damage the low coolant level sensor.
After installing by hand, use a manual torque wrench to complete the installation of the sensor

NOTICE

Numbers in parenthesis refer to components identified in the figure below.



Item	Description	Item	Description
1	Low Coolant Level Shutdown Port	2	Low Coolant Level Warning Port
3	Low Coolant Level Sensor	4	Low Coolant Level Harness

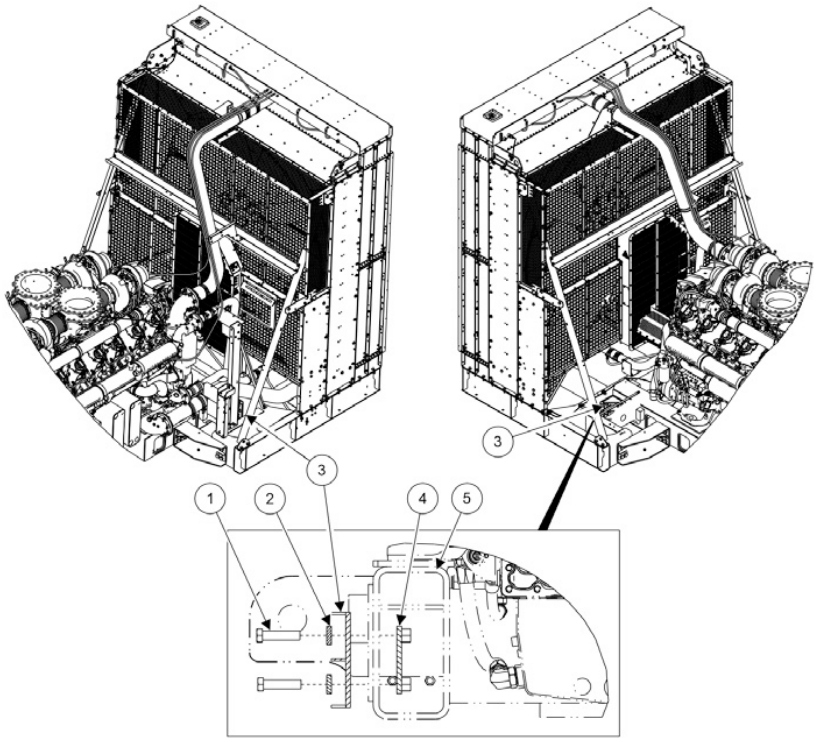
FIGURE 288. RADIATOR RIGGING

1. Remove and dispose of the internal hex plug in the radiator expansion tank.
2. Install the low coolant level sensor (1) by hand to be sure the sensor does not get damaged.
3. When the low coolant level sensor (1) is hand tight, use a manual torque wrench to tighten the sensor to 20 Nm (15 ft-lb).
4. Install the low coolant level harness (2) and retaining clips. Route the harness down the left side of the radiator.
5. Tighten retaining clip bolts to 52 Nm (38 ft-lb).

6.5.6.5.6 Install Front Radiator L-brackets on Generator Set Skid

NOTICE
Numbers in parenthesis refer to Figure 289 unless otherwise specified.

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No.	Description	No.	Description
1	Bolt	4	Nut plate
2	Washer plate	5	Generator set skid
3	L-bracket		

FIGURE 289. FRONT LEFT AND RIGHT RADIATOR L-BRACKETS

1. Apply anti-seize compound to threads of bolts (1).
2. Loosely install two L-brackets (3) on the generator set skid (5) at the front right and left radiator mounting locations. Use four bolts (1), two washer plates (2), and one nut plate (4) for each L-bracket (3).

6.5.6.5.7 Position the Radiator to the Generator Set

Do the following if using an overhead crane to position the radiator.

1. Connect lifting equipment to the four radiator lifting eye bolts (1, **Figure 290**). A spreader bar is required to allow for a vertical lift on the eye bolts.
2. Position the radiator to the generator set.

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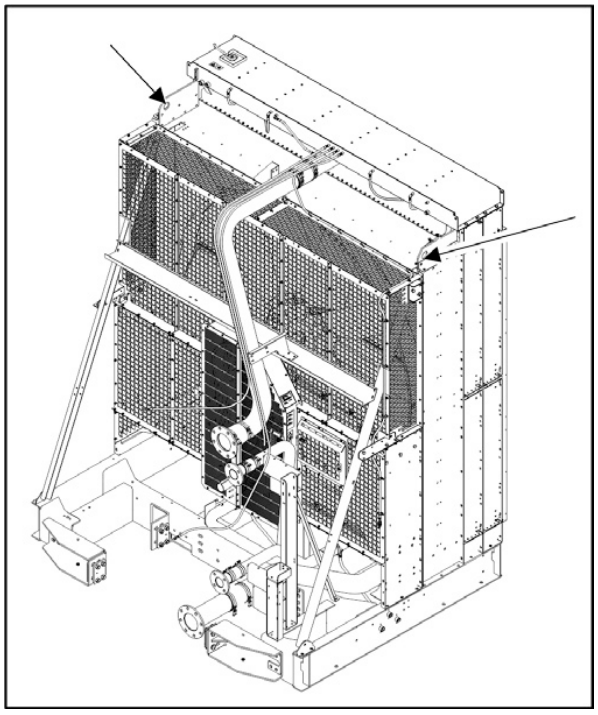


FIGURE 290. RADIATOR LIFTING EYE

Do the following if using a fork lift or other method to position the radiator.

1. Remove the cross beams (1, **Figure 291**) from the radiator skid if necessary for access to fork lift pickets or allow for clearance of the generator set front lifting eyes.
2. Position the radiator to the generator set.
3. After the radiator has been positioned, reinstall the cross beams (1, **Figure 291**).
    a. Apply anti-seize compound 0524-0076 to the nut engagement threads of the cross beam bolts.
    b. Torque the cross beam bolts to 732 Nm (540 ft-lb).

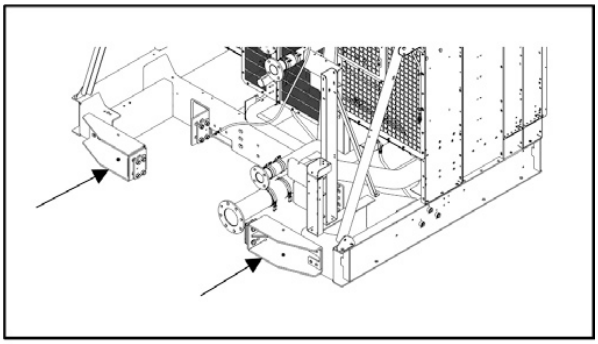


FIGURE 291. CROSS BEAMS ON RADIATOR SKID

6.5.6.5.8 Install Vibration Isolators

The vibration isolators need to be installed following the installation guidelines from the manufacturer. The vibration isolator must be installed (1, **Figure 292**) so that it is in the locked shipping position. The vibration isolator must not provide any spring isolation (solid block) to allow for proper radiator alignment.

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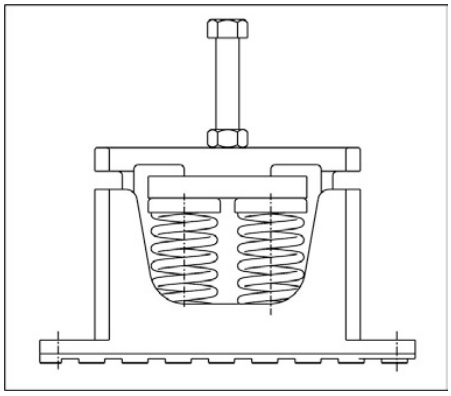


FIGURE 292. VIBRATION ISOLATOR

1. Lift the radiator and place it in its final location on the locked vibration isolators. Make sure the holes in the radiator skid are centered to the vibration isolator attachment bolt location.
2. Lift the generator set and bring it into alignment with the radiator skid.
3. Place the generator set on the locked vibration isolators. Make sure the holes in the generator set skid are centered to the vibration isolator attachment bolt location.
4. Make sure the generator set and radiator are against each other (no gaps) at the chassis front cross member and the radiator cross frame.
5. Left to right measurements between the radiator frame and chassis are helpful for placement but are not final measurements for alignment.
6. When the generator set and radiator appear to be aligned and ready to be bolted together, proceed to Fan Drive Alignment.

6.5.6.5.9 Fan Drive Alignment

The following gives the procedure to align the radiator to the generator set. **This video** shows the procedure.

1. Remove engine vibration damper center cover.

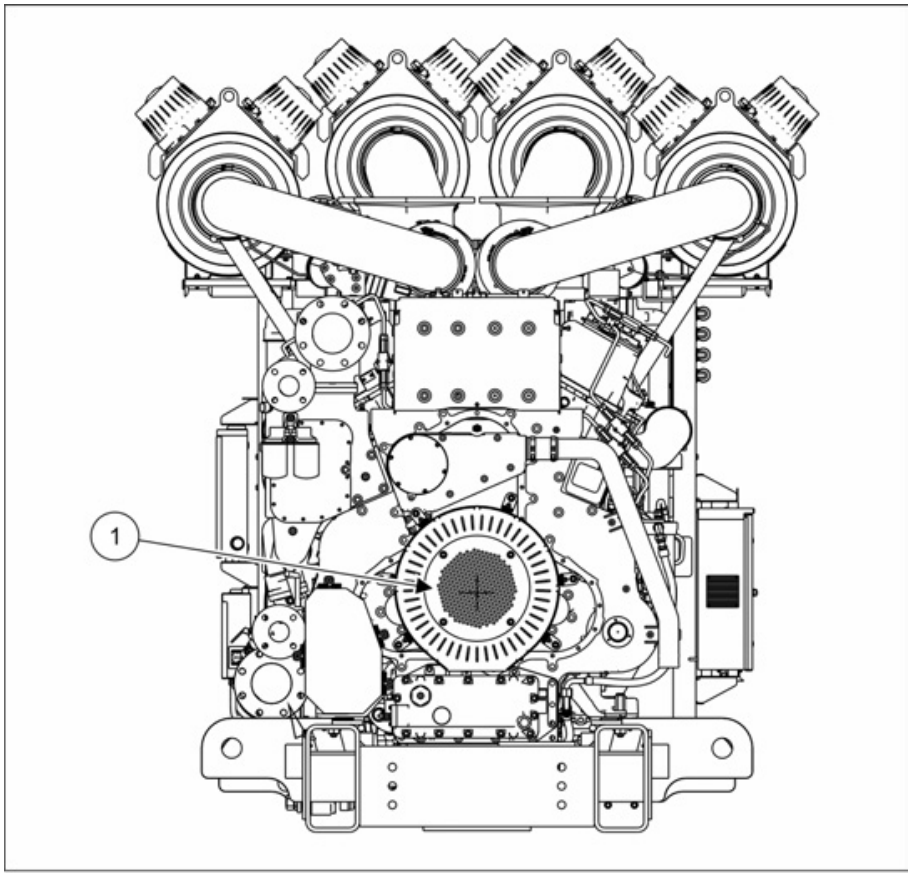


FIGURE 293. ENGINE DAMPENER CENTER COVER

2. Clean the mounting surface for the engine vibration dampener with degreaser.
3. Clean the fan drive input shaft with degreaser.
4. Install the fan drive alignment bar from the radiator installation kit in the radiator fan drive input shaft keyway.

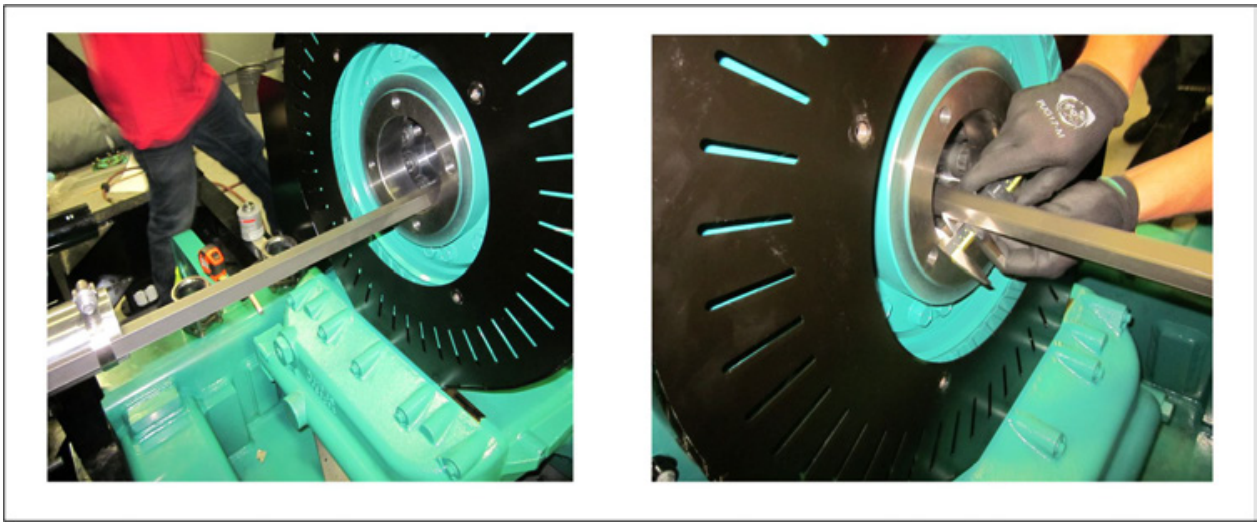


FIGURE 294. FAN DRIVE ALIGNMENT

5. The radiator end of the square bar must fit snugly into the fan shaft key way. Clamp into place with hose clamp around the radiator fan drive input shaft.

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6. The other end of the bar fits inside the center bore of the vibration dampener.
7. Carefully rotate the fan shaft by hand. The bar should never contact the inside bore of the damper. Contact with the inside bore indicates gross misalignment.
8. When the bar rotates freely inside the damper bore, measure and record the distance from the bar to the outer diameter of the damper bore at the 12:00 and 6:00 o'clock positions (vertical), and at the 3:00 and 9:00 o'clock positions (horizontal). The difference between the two vertical measurements and the two horizontal measurements cannot be greater than 12.5 mm (1/2 inch).

TABLE 132. EXAMPLE MEASUREMENTS

	Measurement	Position	Status
	17	3:00	
	19	9:00	
Difference	2		Good
	10	12:00	
	28	6:00	
Difference	18		Needs vertical adjustment

9. Options for Horizontal adjustment are:
   - Move the radiator or generator set.
   - Move the fan belt drive input shaft bearing assemblies right or left (±4 mm of adjustment).

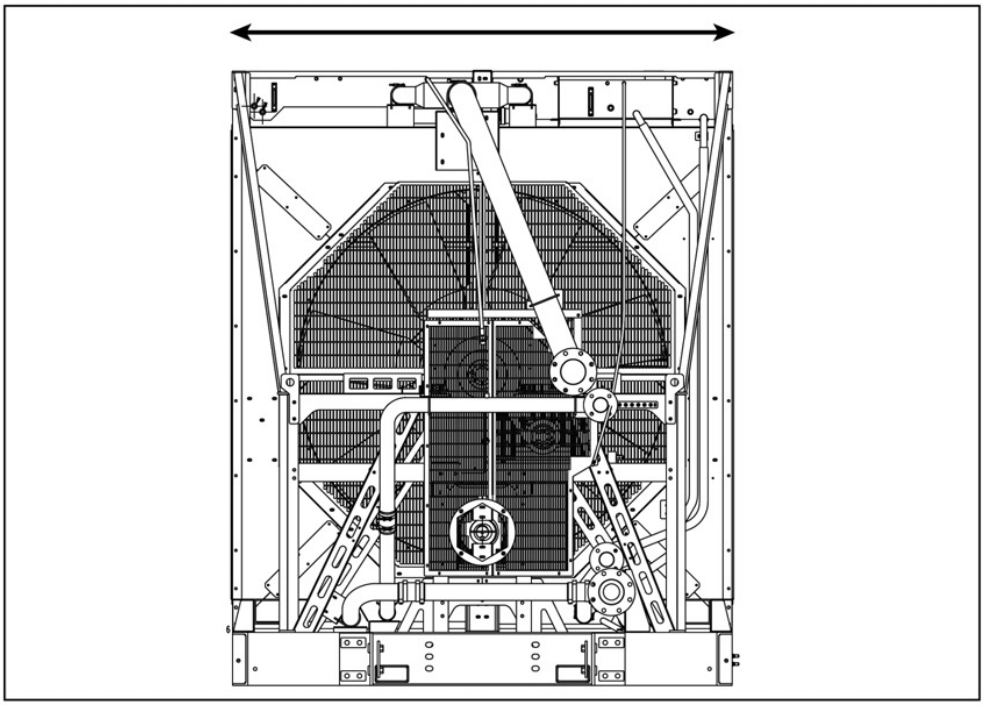


FIGURE 295. HORIZONTAL ADJUSTMENT

10. Options for vertical adjustment are:
    - Place shims under the generator set or radiator vibration isolators.
    - Add or remove shims under the fan belt drive input shaft bearings (±4 mm of adjustment).

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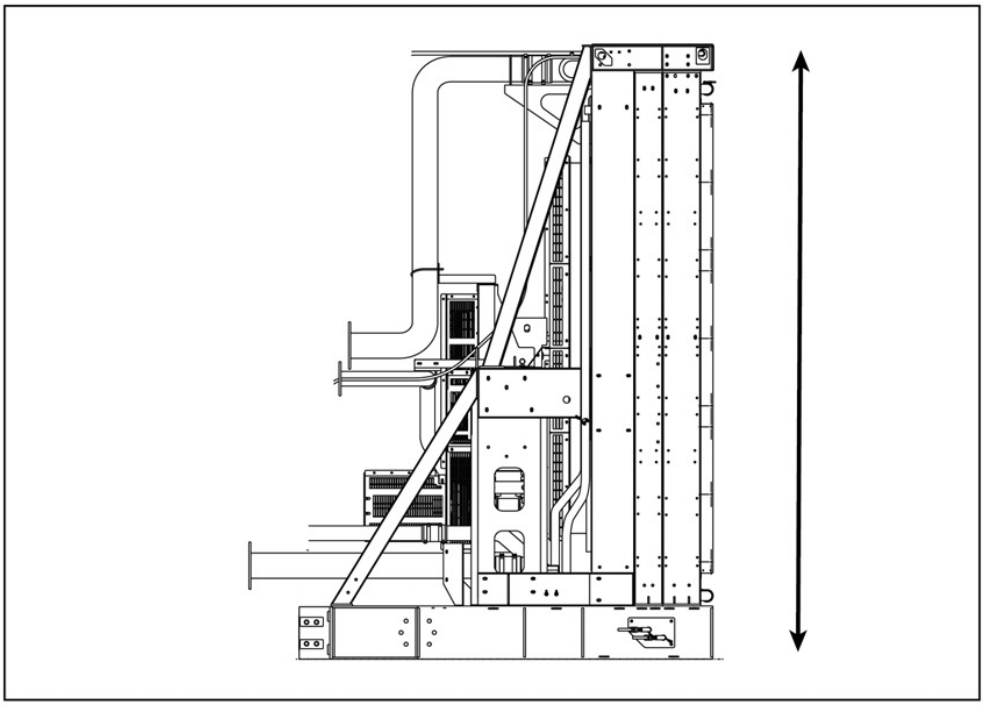
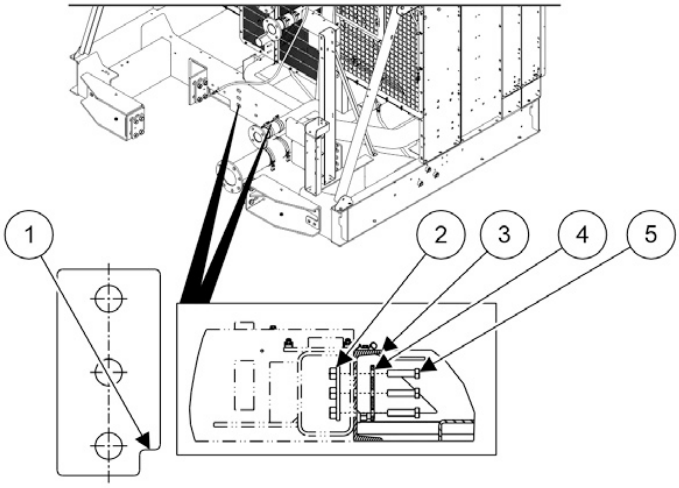


FIGURE 296. VERTICAL ADJUSTMENT

6.5.6.5.10 Install Front Middle Clamping Plates

NOTICE
Numbers in parenthesis refer to Figure 297 unless otherwise specified.

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No.	Description	No.	Description
1	Notch in washer plate	4	Washer plate
2	Nut plate	5	Bolt – M24 x 100 mm
3	Clamping plate		

FIGURE 297. FRONT MIDDLE CLAMPING PLATE

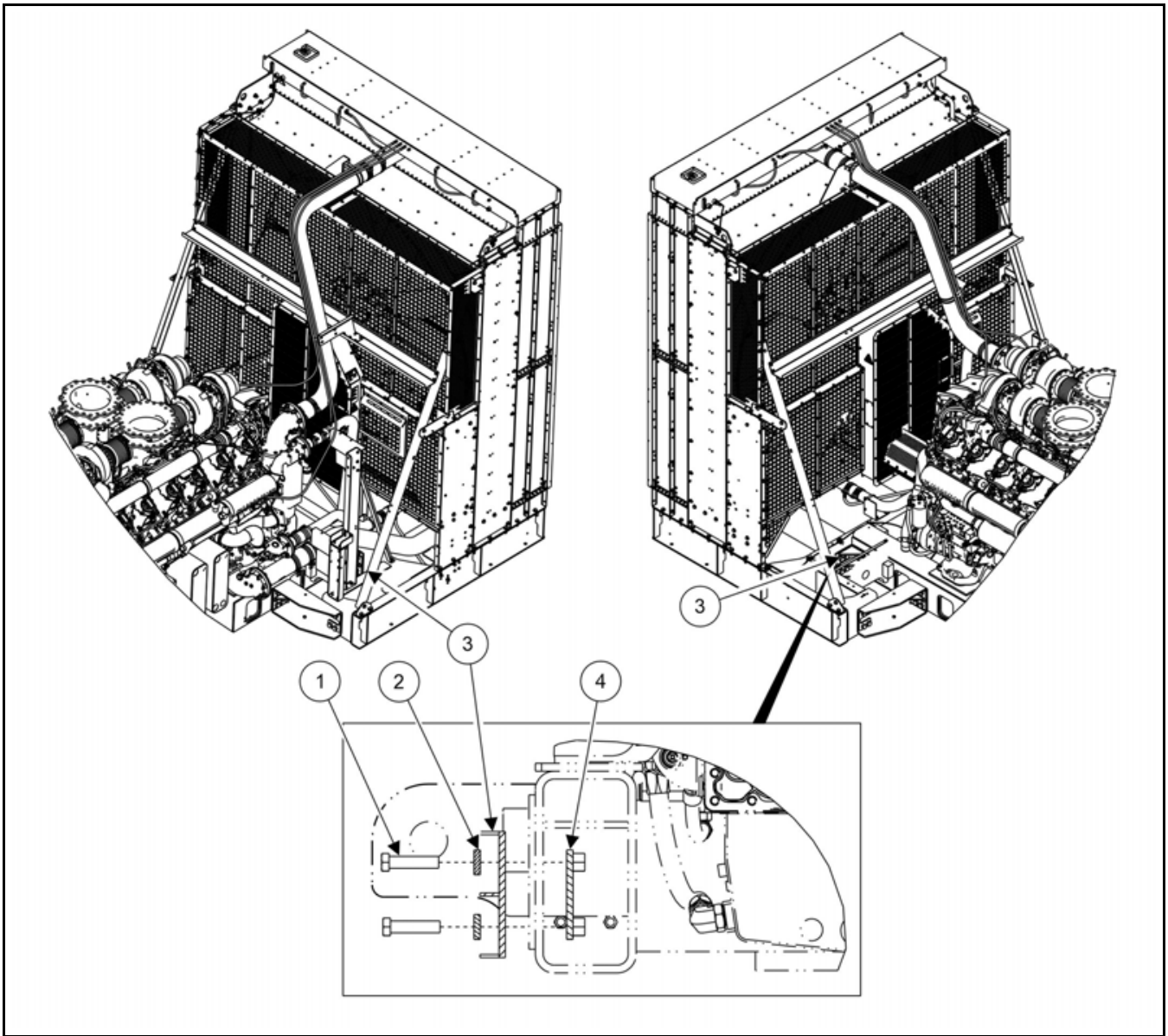
1. Apply anti-seize compound to mounting bolt (5) threads.
2. Loosely install each clamping plate (3) to the front radiator mounts with one nut plate (2), one washer plate (4), and three bolts (5).

NOTICE
The notch in the washer plate faces down and toward the fork tubes in the radiator skid.

6.5.6.5.11 Install Front Radiator L-brackets Remaining Hardware

NOTICE
Numbers in parenthesis refer to Figure 298 unless otherwise specified.

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No.	Description	No.	Description
1	Bolt – M24 x 100 mm	3	L-bracket
2	Washer plate	4	Nut plate

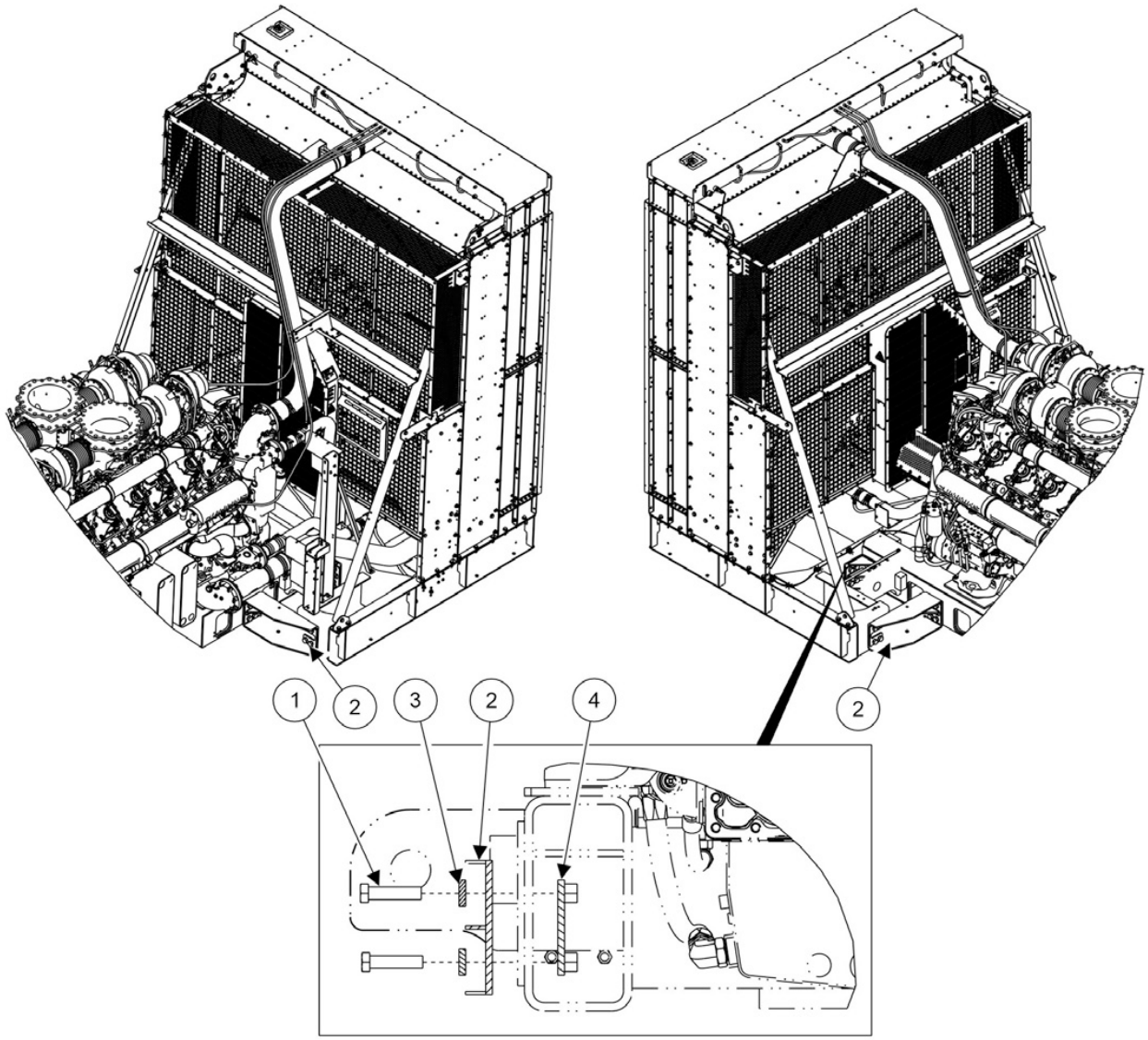
FIGURE 298. FRONT LEFT AND RIGHT RADIATOR L-BRACKETS REMAINING HARDWARE

1. Apply anti-seize compound to threads of bolts (1).
2. Loosely install each L-bracket to radiator skid with remaining washer plates (2), nut plates (4), and bolts (1).

6.5.6.5.12 Install Rear L-brackets

NOTICE
Numbers in parenthesis refer to Figure 299 unless otherwise specified.

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No.	Description	No.	Description
1	Bolt – M24 x 100 mm	3	Washer
2	L-bracket	4	Nut plate

FIGURE 299. REAR L-BRACKETS

1. Apply anti-seize compound to mounting bolt threads.
2. Loosely install each L-bracket (2) to generator set and radiator skid with two nut plates (4), four washers (3), and eight bolts (1).

6.5.6.5.13 Tighten and Torque L-bracket Bolts

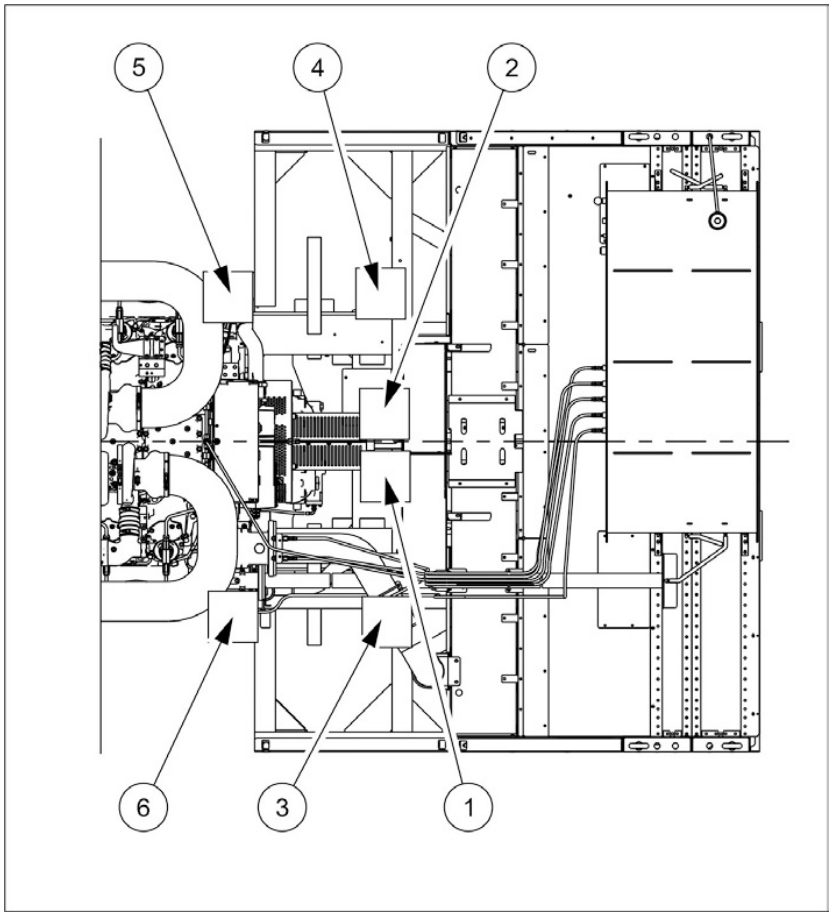


FIGURE 300. L-BRACKET LOCATIONS

1. Tighten the 6 bolts at the front middle locations (locations 1 and 2).
2. Tighten the 8 bolts at the front left and right locations (locations 3 and 4).
3. Tighten the 8 bolts at the rear left and right locations (locations 5 and 6).
4. Torque the 4 bolts at the front middle locations (locations 1 and 2) to 732 Nm (540 ft-lb).
5. Torque the 16 bolts at the front left and right locations (locations 3 and 4) to 732 Nm (540 ft-lb).
6. Torque the 16 bolts at the rear left and right locations (locations 5 and 6) to 732 Nm (540 ft-lb).
7. The radiator lifting equipment may be removed as long as the radiator is properly supported on isolators at the same height as the generator set skid.

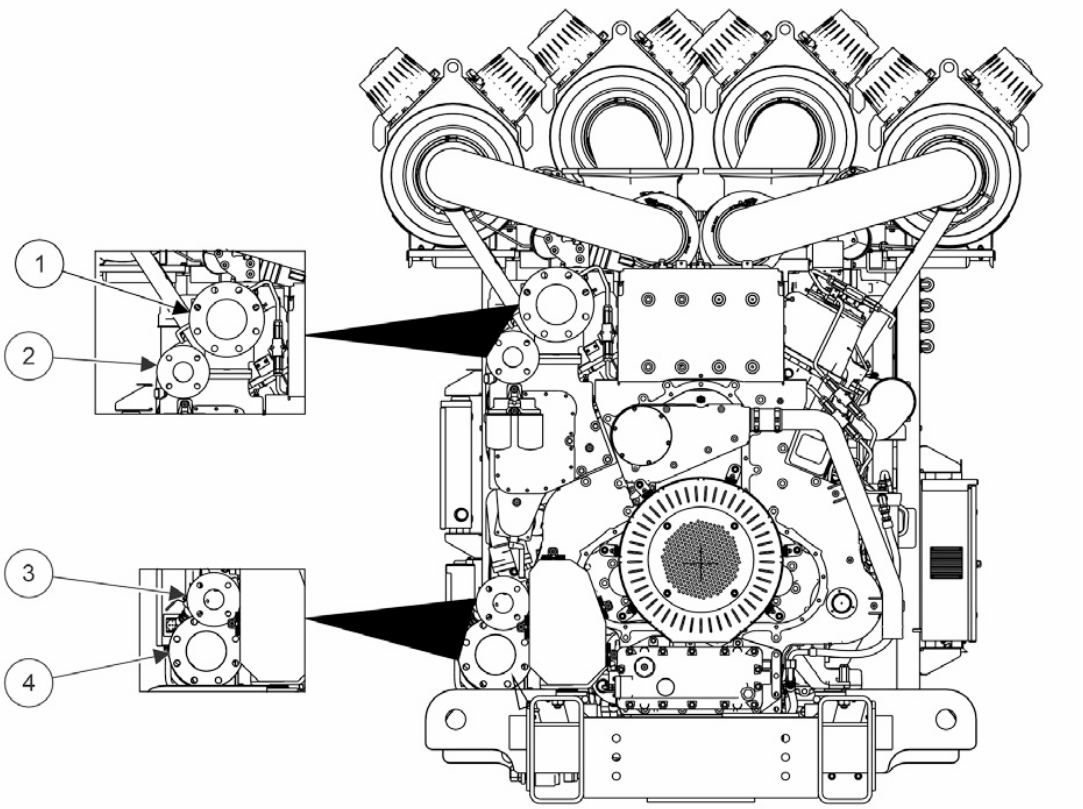
6.5.6.5.14 Remove Flange Shipping Covers

1. Remove the shipping covers from the generator set cooling system flanges.

NOTICE
There may be coolant behind the inlet flanges, use an appropriate catch pan. Dispose of coolant according to local codes.

2. Clean the generator set cooling system flanges.

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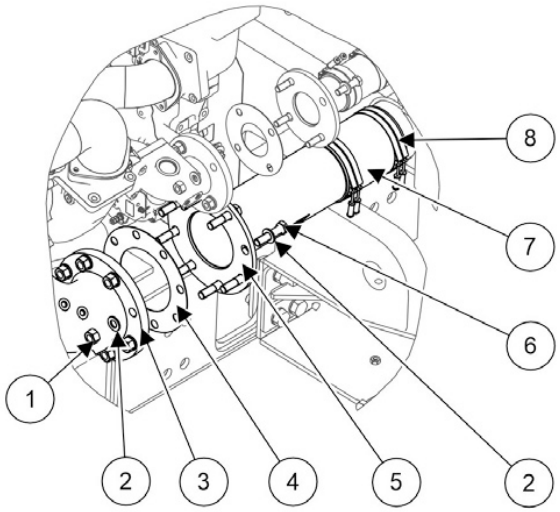


No.	Description	No.	Description
1	HT outlet	3	LT inlet
2	LT outlet	4	HT inlet

FIGURE 301. COOLING SYSTEM FLANGES

6.5.6.5.15 Install HT Inlet Coolant Flange

NOTICE
Numbers in parenthesis refer to Figure 302 unless specified otherwise.



No.	Description	No.	Description
1	Nut	5	HT inlet pipe
2	Washer	6	Bolt
3	HT inlet flange	7	Hose
4	Gasket	8	Clamp

FIGURE 302. HT INLET COOLANT FLANGE

1. Apply anti-seize lubricant to bolt (5) threads.
2. Apply water based rubber assembly lubricant inside both ends of hose (7).
3. Install HT inlet pipe (3) to HT inlet flange (1) with flange gasket (2), bolts (5), washers (4), nuts (6), hose (7) and clamps (8).
4. Torque the bolts and nuts to 311 Nm (229 ft-lb) using the following torque sequence.
   a. Torque position 1, then position 5 shown in **Figure 303**.
   b. Torque position 8, then position 3 shown in **Figure 303**.
   c. Torque position 6, then position 2 shown in **Figure 303**.
   d. Torque position 7, then position 4 shown in **Figure 303**.
5. Torque the hose clamps to 10Nm (88.5 in-lb).

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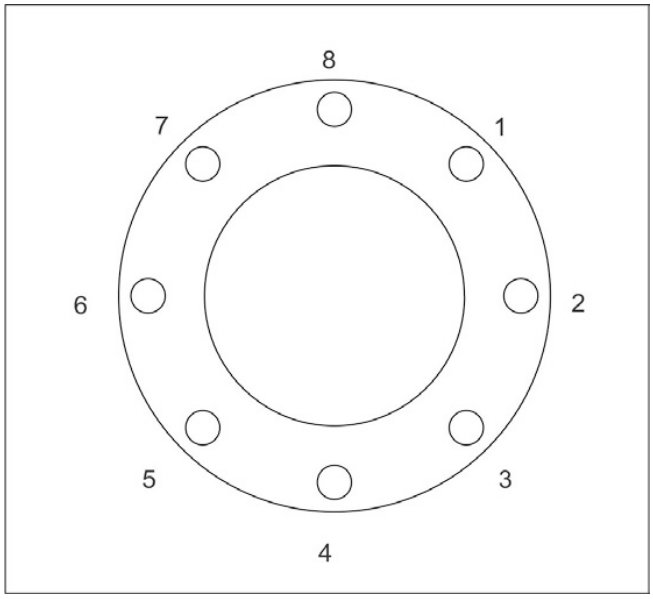
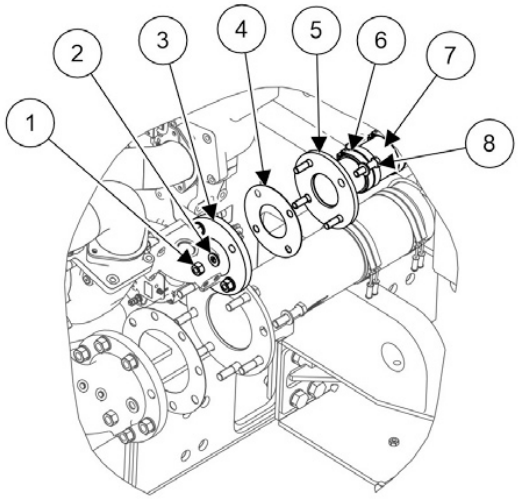


FIGURE 303. HT FLANGE TORQUE SEQUENCE NUMBERS

6.5.6.5.16 Install LT Inlet Coolant Flange

NOTICE
Numbers in parenthesis refer to Figure 304 unless specified otherwise.



No.	Description	No.	Description
1	Nut	5	LT inlet pipe
2	Washer	6	Clamp
3	LT inlet flange	7	Hose
4	Gasket	8	Bolt

FIGURE 304. LT INLET COOLANT FLANGE

1. Apply anti-seize lubricant to bolt (4) threads.
2. Apply water based rubber assembly lubricant inside both ends of hose (7).
3. Install LT inlet pipe (3) to LT inlet flange (5) with flange gasket (4), bolts (8), washers (2), nuts (1), hose (7) and clamps (6).
4. Torque the bolts and nuts to 175 Nm (129 ft-lb) using the following torque sequence.
   a. Torque position 1, then position 3 shown in **Figure 305**.
   b. Torque position 2, then position 4 shown in **Figure 305**.
5. Torque hose clamps to 10 Nm (88.5 in-lb).

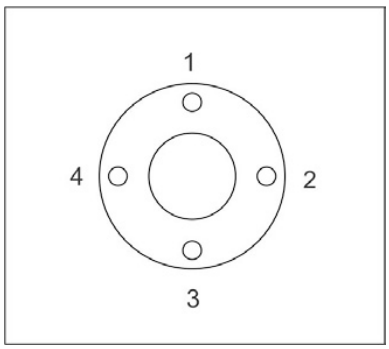
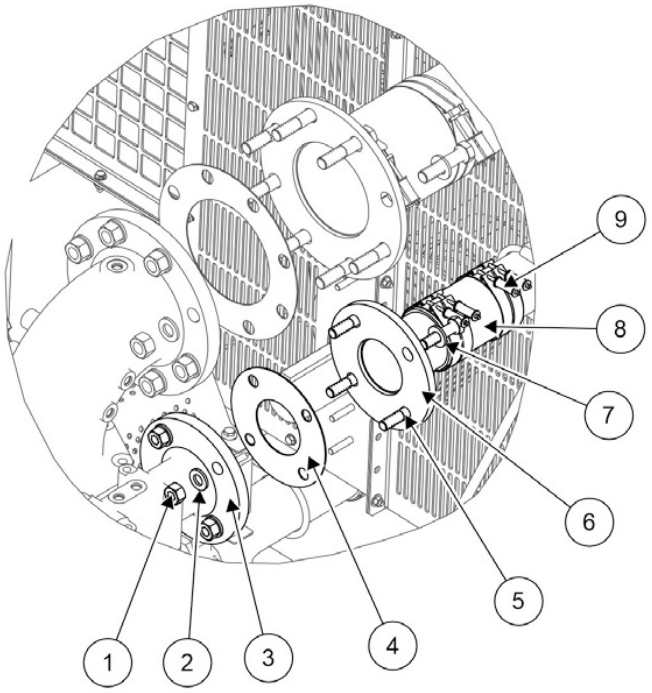


FIGURE 305. LT FLANGE TORQUE SEQUENC NUMBERS

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6.5.6.5.17 Install LT Outlet Coolant Flange

NOTICE
Numbers in parenthesis refer to Figure 306 unless specified otherwise.



No.	Description	No.	Description
1	Nut	6	LT outlet flange
2	Washer	7	Washer
3	LT outlet pipe	8	Hose
4	Gasket	9	Clamp
5	Bolt		

FIGURE 306. LT OUTLET COOLANT FLANGE

1. Apply anti-seize lubricant to bolt (5) threads.
2. Install LT outlet pipe (3) to LT outlet flange (6) with flange gasket (4), bolts (5), washers (2,7), and nuts (1).
3. Torque the bolts and nuts to 175 Nm (129 ft-lb) using the following torque sequence.
   a. Torque position 1, then position 3 shown in **Figure 307**.
   b. Torque position 2, then position 4 shown in **Figure 307**.
4. Apply water based rubber assembly lubricant inside both ends of hose (8).
5. Connect LT outlet flange (6) to radiator pipe with the hose (8) and clamps (9). Torque clamps to 10 Nm (88.5 in-lb).

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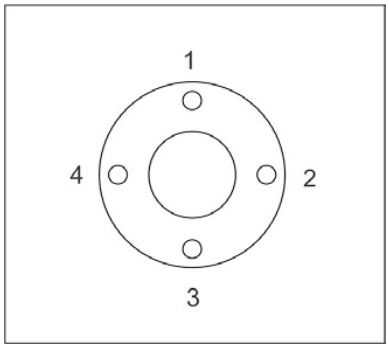
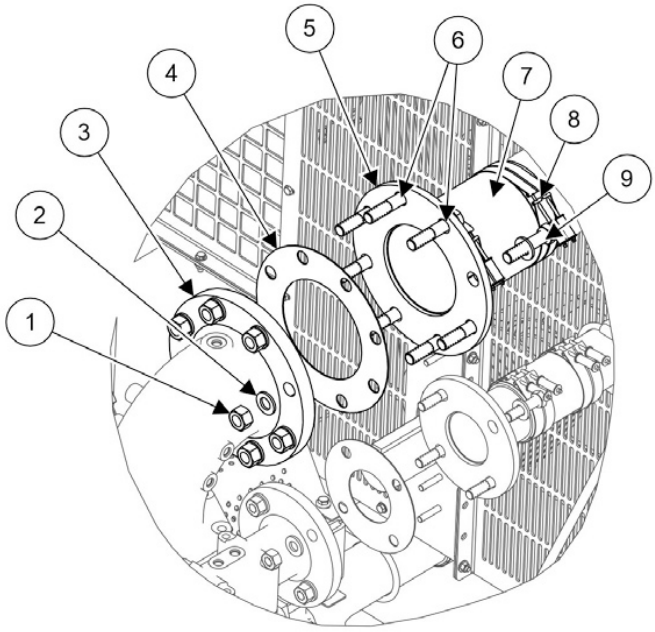


FIGURE 307. LT FLANGE TORQUE SEQUENCE NUMBERS

6.5.6.5.18 Install HT Outlet Coolant Flange

NOTICE
Numbers in parenthesis refer to Figure 308 unless specified otherwise.

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No.	Description	No.	Description
1	Nut	6	Bolt, ¾ inch – 10 X 3.5 inch (Qty. 2)
2	Washer	7	Hose
3	HT Outlet Pipe	8	Clamp
4	Gasket	9	Bolt, ¾ inch – 10 X 3.25 inch (Qty. 6)
5	HT Outlet Flange		

FIGURE 308. HT OUTLET COOLANT FLANGE

1. Apply anti–seize lubricant to bolt (6, 9) threads.
2. Install HT outlet pipe (3) to HT outlet flange (5) with flange gasket (4), bolts (6, 9), washers (2), and nuts (1).
   - The two ¾ inch – 10 x 3.5 in bolts should be used in the upper positions of the flange. A bracket will be added later.
   - The six ¾ inch – 10 x 3.25 in bolts should be used in the remaining positions of the flange.
3. Torque the bolts and nuts to 311 Nm (229 ft–lb) using the following torque sequence.
   a. Torque position 1, then position 5 shown in **Figure 309**.
   b. Torque position 8, then position 3 shown in **Figure 309**.
   c. Torque position 6, then position 2 shown in **Figure 309**.
   d. Torque position 7, then position 4 shown in **Figure 309**.
4. Apply water based rubber assembly lubricant inside both ends of hose (7).
5. Connect HT outlet flange (5) to radiator pipe with the hose (7) and clamps (8). Torque clamps to 10 Nm (88.5 in–lb)

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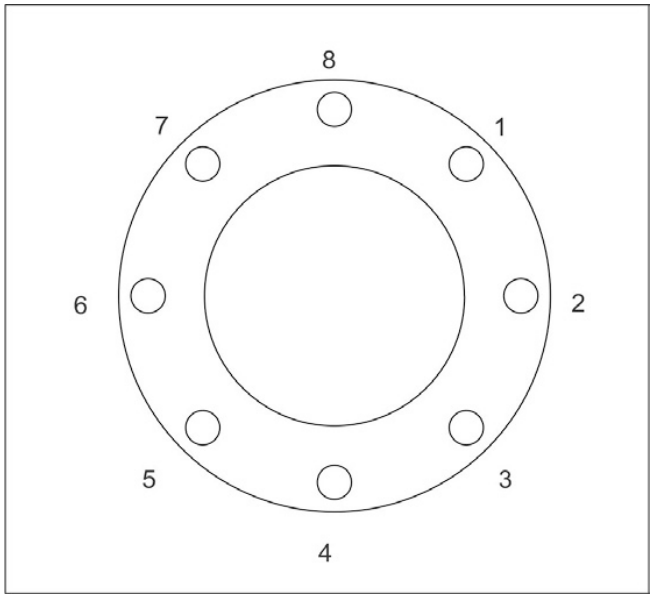
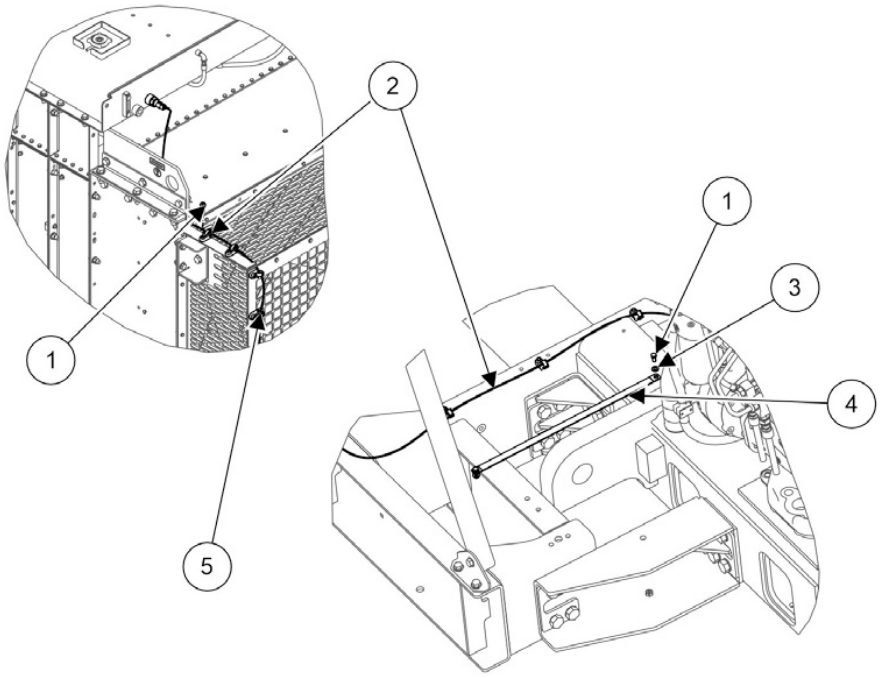


FIGURE 309. HT FLANGE TORQUE SEQUENCE NUMBERS

6.5.6.5.19 Complete Installation of Low Coolant Level Sensor Harness

NOTICE
Numbers in parenthesis refer to Figure 310 unless specified otherwise.

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No.	Description	No.	Description
1	Hex Screw	4	Ground strap
2	Low coolant level sensor harness	5	Cable Clamp
3	Washer		

FIGURE 310. LOW COOLANT LEVEL SENSOR HARNESS CONNECTION TO ENGINE HARNESS

1. Connect the low coolant level sensor harness (2) to the engine harness.
2. Install the radiator ground strap (4).
   a. Apply dielectric grease to the ground strap mounting locations.
   b. Install the ground strap (4) with existing hardware.
   c. Install the ground strap (4) to the generator set skid with one hex screw (1) and one washer (3).
   d. Torque bolts to 52 Nm (38 ft-lb).
3. Route wiring harness along radiator frame and secure with cable clamps (5).

6.5.6.5.20 Install Vent Lines

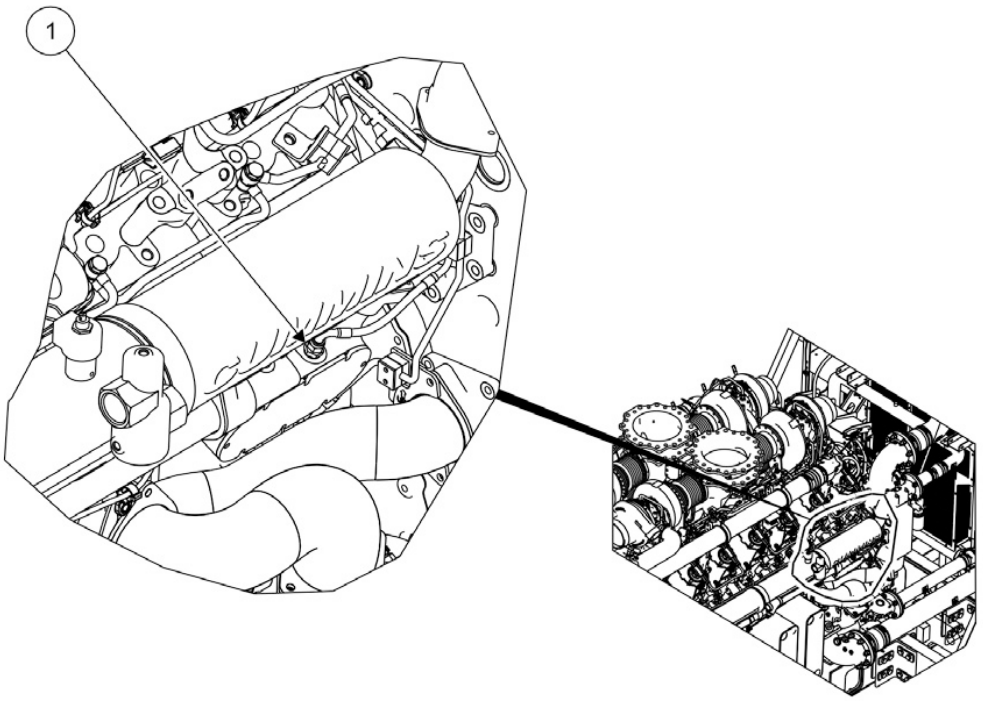
The vent lines are shipped pre-installed to the radiator expansion tank.

All vent lines must be secured to the generator set using clips and cable ties.

All vent lines must be either vertical or inclined between the engine and radiator. No sags are permitted.

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6.5.6.5.20.1 Install LT Engine Vent Line



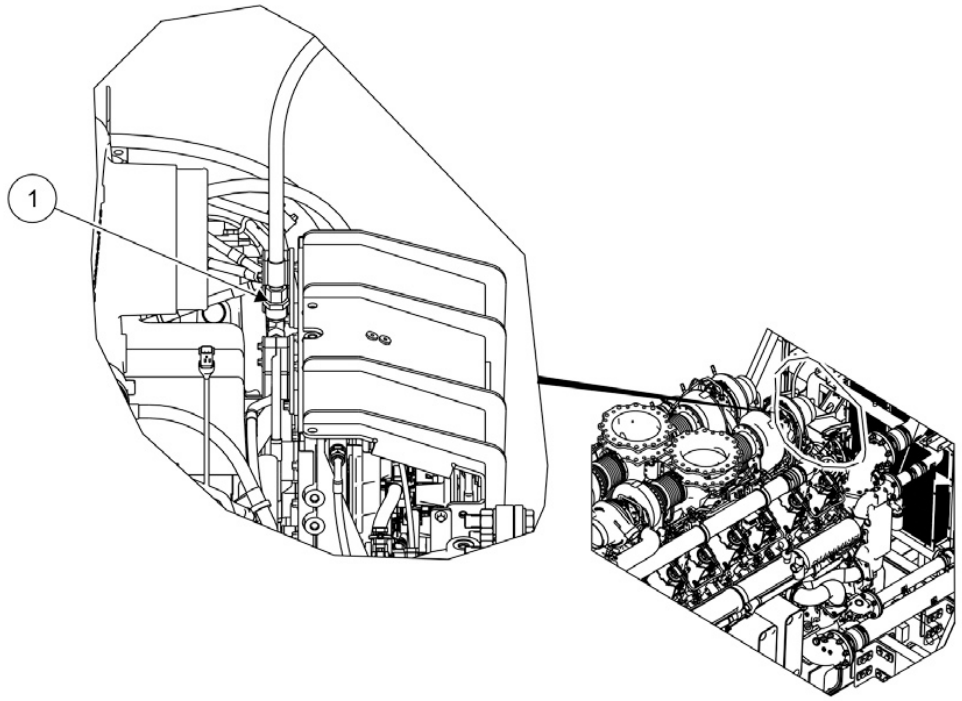
No.	Description
1	Vent Line

FIGURE 311. LT ENGINE VENT LINE

1. Remove the M14 plug in the LT thermostat housing.
2. Install the LT engine vent line fitting.
3. Install the LT engine vent line (1).
4. Torque the vent line to 27 Nm (20 ft-lb).

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6.5.6.5.20.2 Install HT Engine Vent Line



No.	Description
1	Vent Line

FIGURE 312. HT ENGINE VENT LINE

1. Remove any shipping plugs.
2. Install vent line (1).
3. Torque vent line to 52 Nm (38 ft-lb).

6.5.6.5.21 Install Radiator Fan Drive Shaft

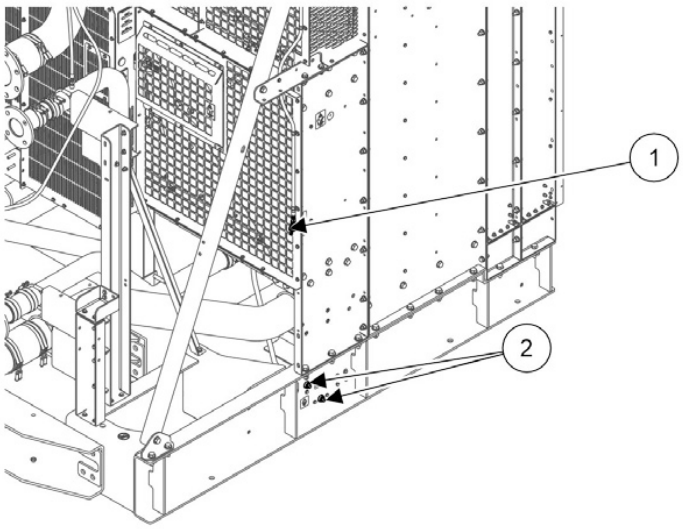
Install the radiator fan drive shaft according to **Section 6.5.7 on page 685**.

6.5.6.5.22 Fill Radiator Using Bottom Fill Option

NOTICE
Bottom fill option must be installed prior to performing this procedure.

NOTICE
If using the top fill option, make sure that fill rate should be 13 Lpm to avoid overfill of coolant in the radiator.

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No.	Description	No.	Description
1	Surge Tank Ball Valve	2	Coolant Drains

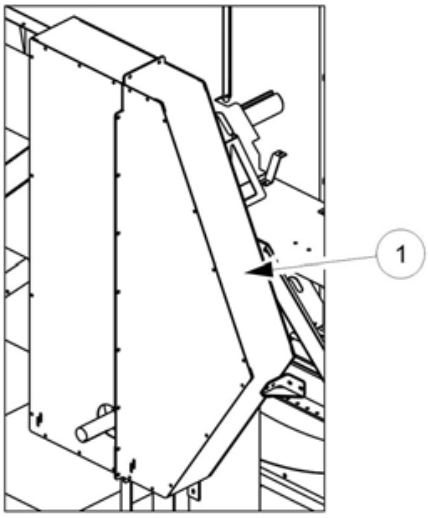
FIGURE 313. RADIATOR BOTTOM FILL COMPONENTS

1. Open the inlet isolation valve and the outlet isolation valve on the coolant heater.
2. Fill the radiator.
   - Fill rate - 5 gpm (19 Lpm)
   - For fill volumes, refer to **Section 3.2**.
3. Open the ball valve connected to the surge tank.
4. Pump in the coolant via the coolant drains. If coolant flows out of the surge tank ball valve, the coolant needs to be drained to the appropriate coolant level.
5. Check for coolant leaks during and after the radiator coolant fill.
6. Close and lock all of the ball valves.
7. Test run the generator set for 10 minutes with the coolant temperature above 82 °C (180 °F).
8. Check for coolant leaks at the generator set and the radiator.
9. Check the coolant level and top off if needed.

6.5.6.6 Fan Drive Belt Replacement

1. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See **Section 6.1.2 on page 334**.
2. Remove the fan drive shaft according to **Section 6.5.7.1 on page 685**.
3. Remove the radiator belt guard.

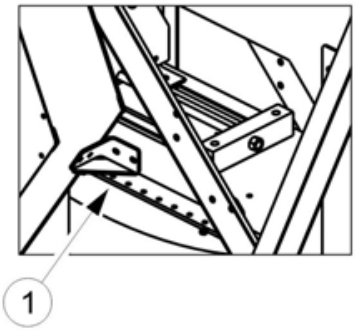
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No.	Description	No.	Description
1	Radiator belt guard		

FIGURE 314. RADIATOR BELT GUARD

4. Loosen four tensioner 5/8" locking bolts and nuts located under the radiator support cross member.

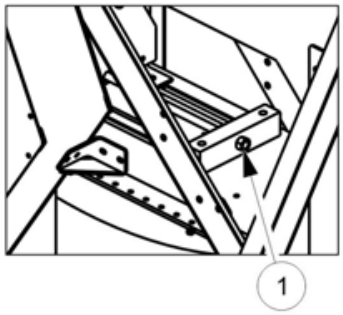


No.	Description	No.	Description
1	Tensioner locking bolts under radiator support cross member		

FIGURE 315. TENSIONER LOCKING BOLT LOCATION

5. Turn the tensioner adjustment screw counterclockwise to loosen the fan drive belts.

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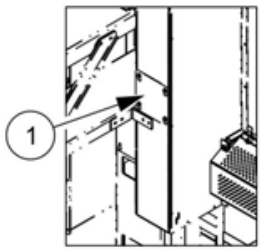
No.	Description	No.	Description
1	Tensioner adjustment screw		

FIGURE 316. TENSIONER ADJUSTMENT SCREW

6. Remove all fan drive belts.
7. Install new fan drive belts.

NOTICE
The fan drive belts should be a matched set.

8. Remove the fan drive belt inspection cover.



No.	Description	No.	Description
1	Fan drive belt inspection cover		

FIGURE 317. FAN DRIVE BELT INSPECTION COVER

9. Use a belt tension tool to set the belt tension for the new belts.
10. Turn the tensioner adjustment screw clockwise to increase fan drive belt tension.
    - Belt span

      40.5 inches (1028.7 mm)
    - New belt deflection force

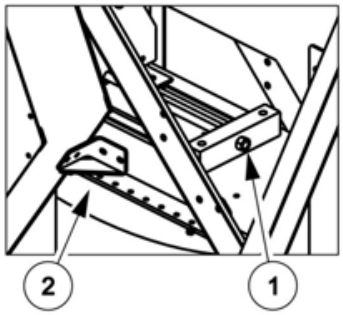
      60 Hz - 23.4 lb (10.61 kg)

      50 Hz - 23.8 lb (10.8 kg)
    - Used belt deflection force

      60 Hz - 15.6 lb (7.08 kg)

      50 Hz - 15.9 lb (7.21 kg)

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No.	Description	No.	Description
1	Tensioner adjustment screw	2	Tensioner locking bolts under radiator support cross member

FIGURE 318. TENSIONER ADJUSTMENT SCREW AND LOCKING BOLTS

11. Torque the four tensioner locking bolts underneath the radiator support cross member to 290 Nm (215 ft-lb).
12. Install the fan drive belt inspection cover.
13. Install the radiator belt guard.
14. Install the fan drive shaft according to Section 6.5.7.2 on page 694.
15. Test run the generator set. Check for proper operation of the fan drive shaft and fan drive belts.

6.5.6.7 Grease Fan Bearings

Fan bearings should be greased immediately with initial installation of radiator, then at regular intervals following the maintenance schedule. When operating in hot, dirty, or wet environments, the bearing re-grease interval will need to be increased. The timing can vary from daily to weekly. historical experience with bearings operating under the specific conditions will help determine the correct interval. Contact your authorized distributor for assistance.

6.5.6.7.1 Tools and Consumables

- Grease gun (flexible hose recommended)
- 9/16 inch socket
- Fan drive bearing grease (Mobil One Synthetic, part number A049B381)

6.5.6.7.2 Procedure

⚠ WARNING

Moving Parts
Moving parts can cause severe personal injury.
Use extreme caution around moving parts. All guards must be properly fastened to prevent unintended contact.

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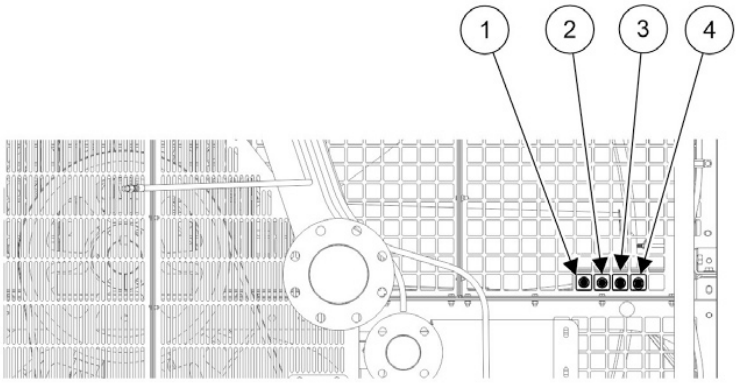
⚠ WARNING

Automated Machinery
Accidental or remote starting of the generator set can cause severe personal injury or death. Make sure that the generator set cannot be started accidentally or remotely before starting work on the generator.

⚠ CAUTION

Sharp Edges and Sharp Points Projecting corners/parts may cause cuts, abrasions and other personal injury.
Use PPE. Be aware of sharp edges and corners/sharp points. Cover/protect them.

The grease fittings shown below correspond to the indicated bearing.



No.	Description	No.	Description
1	Fan Shaft Forward Bearing	3	Auxiliary Shaft Rear Bearing
2	Fan Shaft Rear Bearing	4	Auxiliary Shaft Forward Bearing

FIGURE 319. BEARING SEATS

1. The bearing seat needs to be lubricated regularly; the locations as shown in the figure.
2. Wipe the grease fittings clean of any foreign material.
3. Put the grease gun onto the grease fitting. Make sure the grease gun nozzle is fully engaged on the grease fitting.
4. Pump 0.84 oz of grease into grease fitting 1.
5. Pump 0.76 oz of grease into grease fitting 2.
6. Pump 1.45 oz of grease into grease fitting 3 and 4.

6.5.7 Fan Drive Shaft Removal and Installation

6.5.7.1 Fan Drive Shaft Removal

6.5.7.1.1 Required Tools

The following tools are required to complete this installation.

- 15 mm deep socket

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- 17 mm hex bit socket
- 5/16" hex bit socket
- Ratcheting Socket Wrench

6.5.7.1.2 Remove Fan Drive Shaft Rubber Coupling

1. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See Section 6.1.2 on page 334.
2. Remove the fan drive shaft guard.

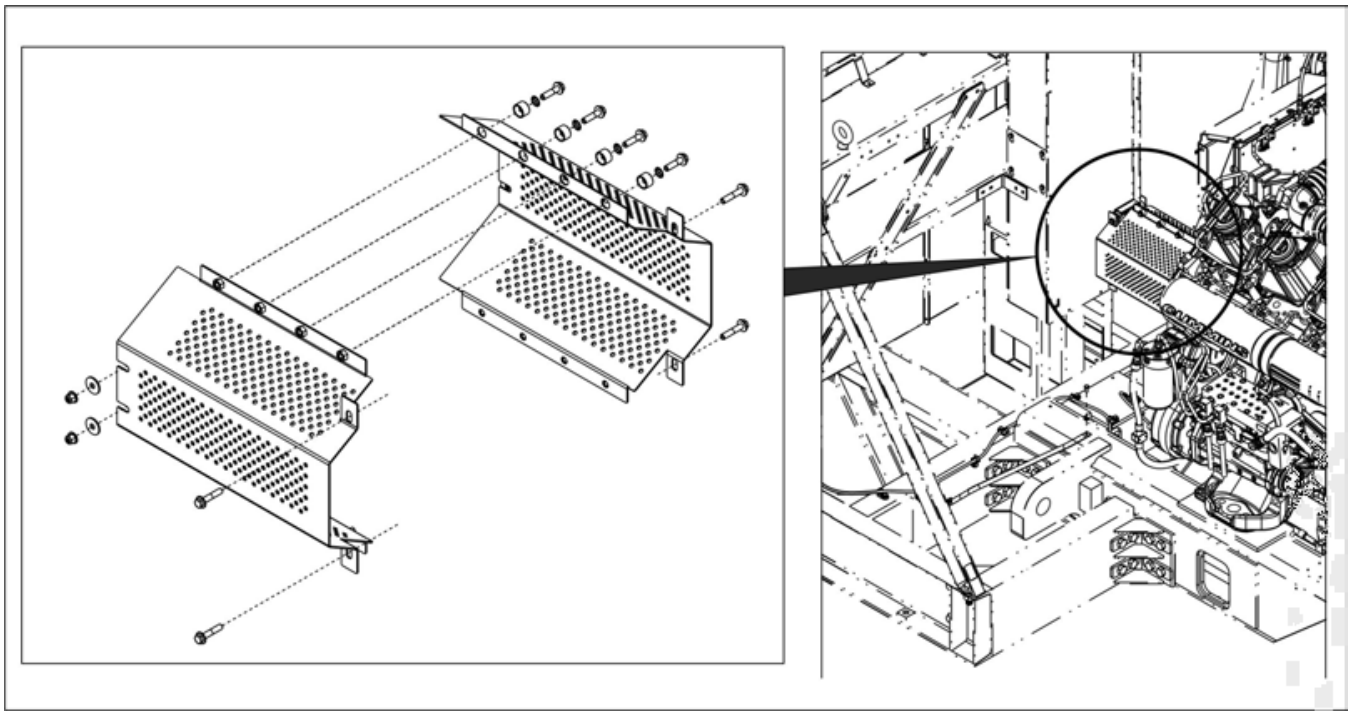


FIGURE 320. FAN DRIVE SHAFT GUARD

3. Remove the vibration dampener guard adapter ring and slide it onto the fan drive shaft.

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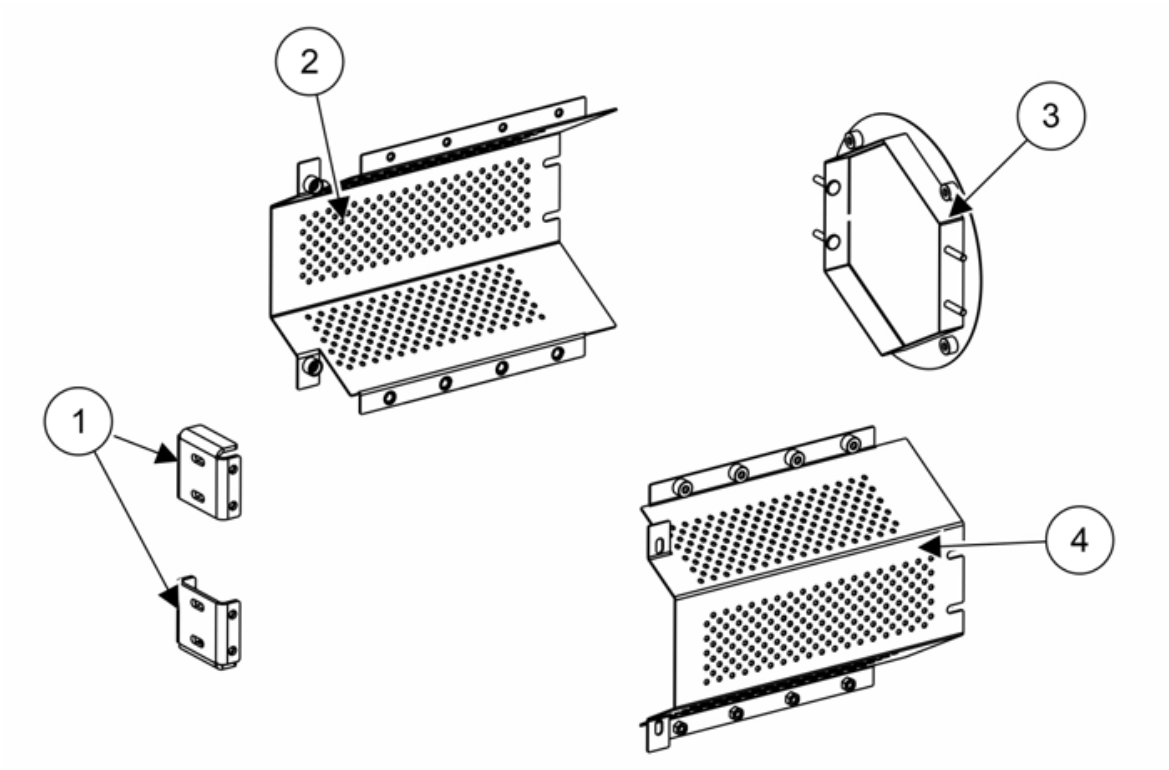


FIGURE 321. VIBRATION DAMPENER GUARD ADAPTER RING

4. Loosen six bolts that attach the rubber element to the fan drive hub.

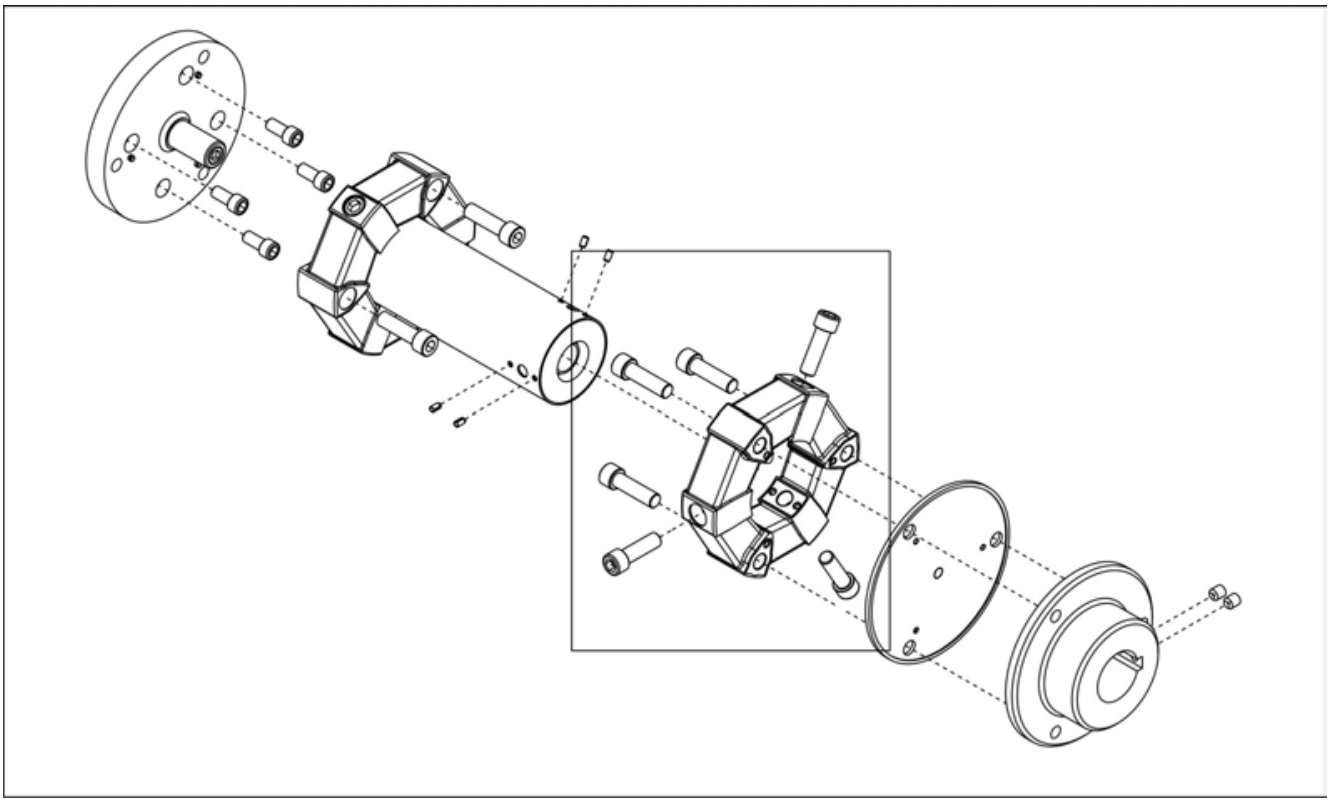


FIGURE 322. RUBBER ELEMENT TO FAN DRIVE HUB

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5. Remove six bolts that attach the rubber element to the engine vibration dampener.

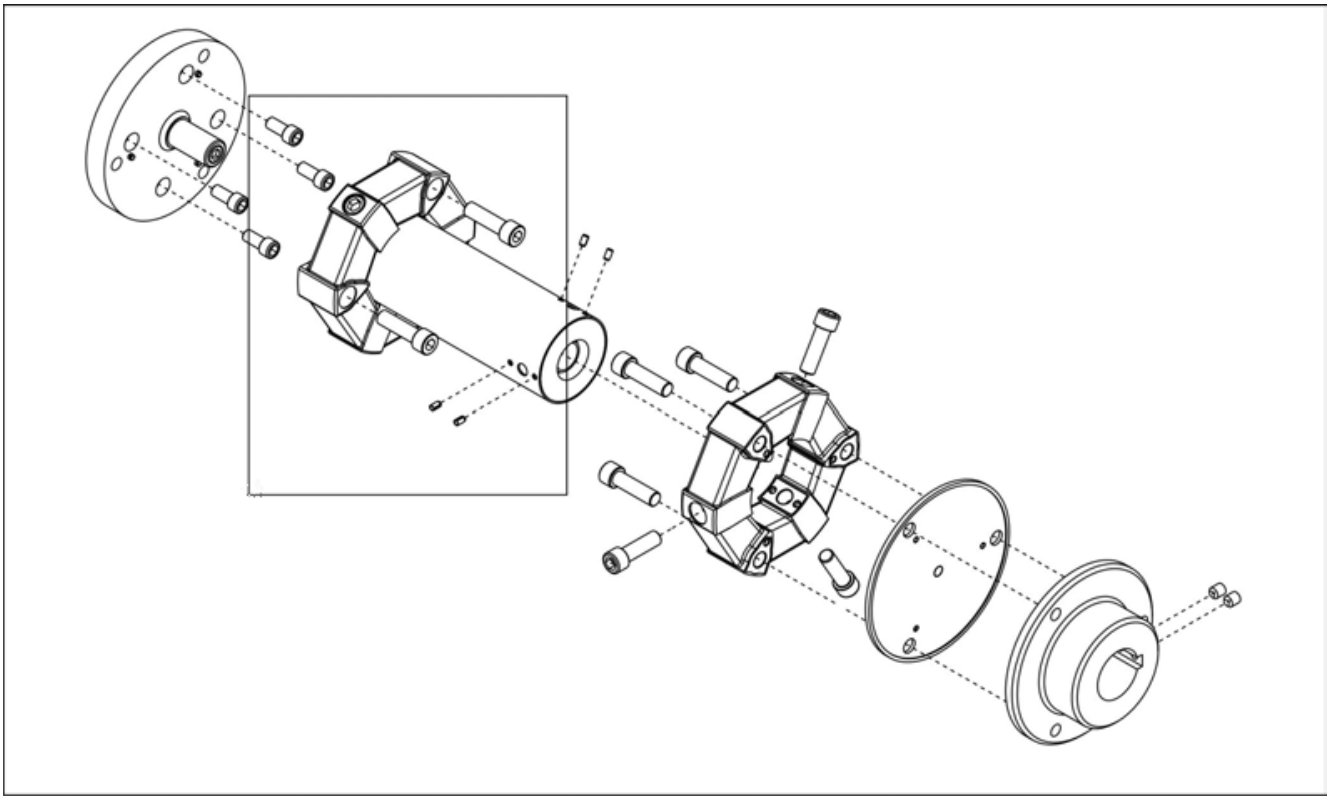


FIGURE 323. RUBBER ELEMENT TO ENGINE VIBRATION DAMPENER

6. Slide the vibration dampener side rubber element onto the fan drive shaft.
7. Support the fan drive shaft with an overhead hoist and lifting strap. The weight of the fan drive shaft assembly is 75 lbs (34 kg).
8. Remove four bolts that attach the engine bearing assembly to the engine vibration dampener.

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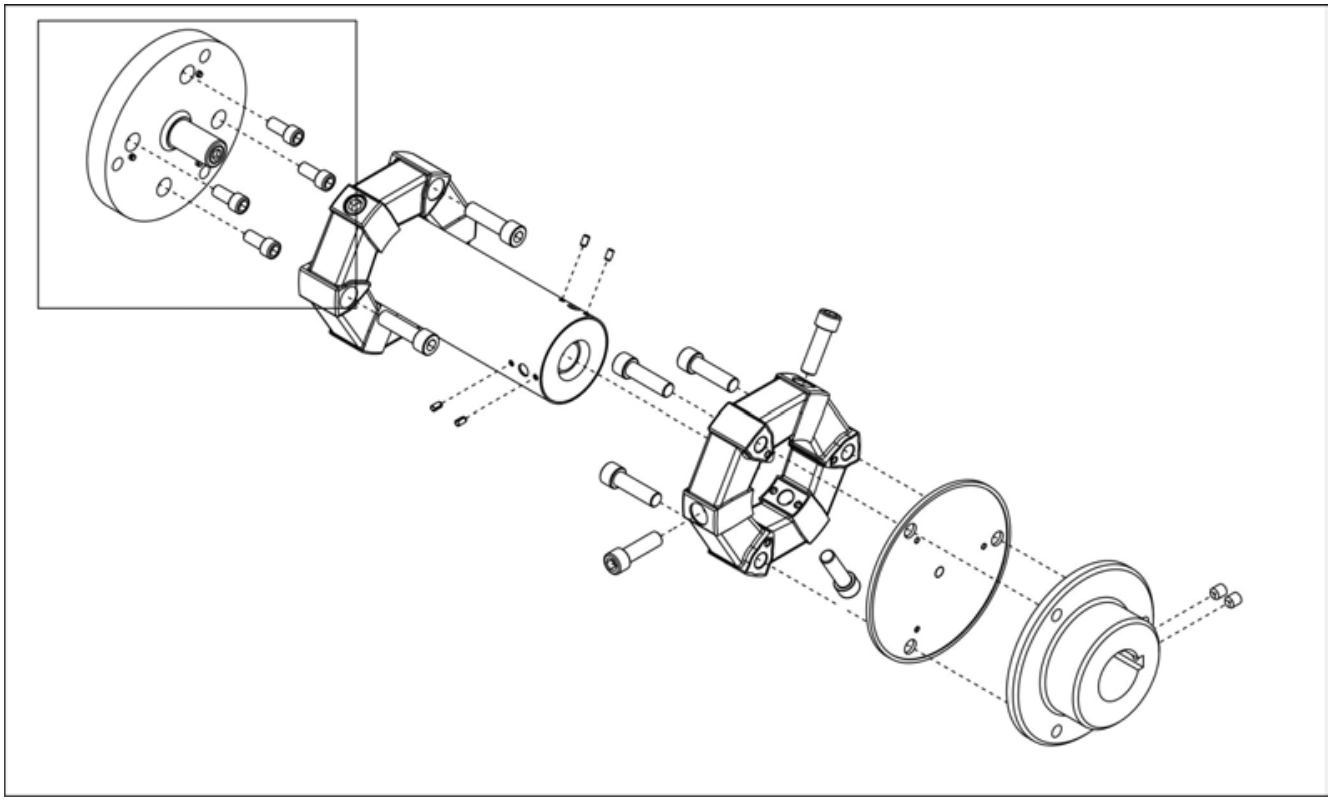


FIGURE 324. ENGINE BEARING ASSEMBLY TO ENGINE VIBRATION DAMPENER

9. Loosen two setscrews that secure the fan drive hub to the fan belt drive input shaft.

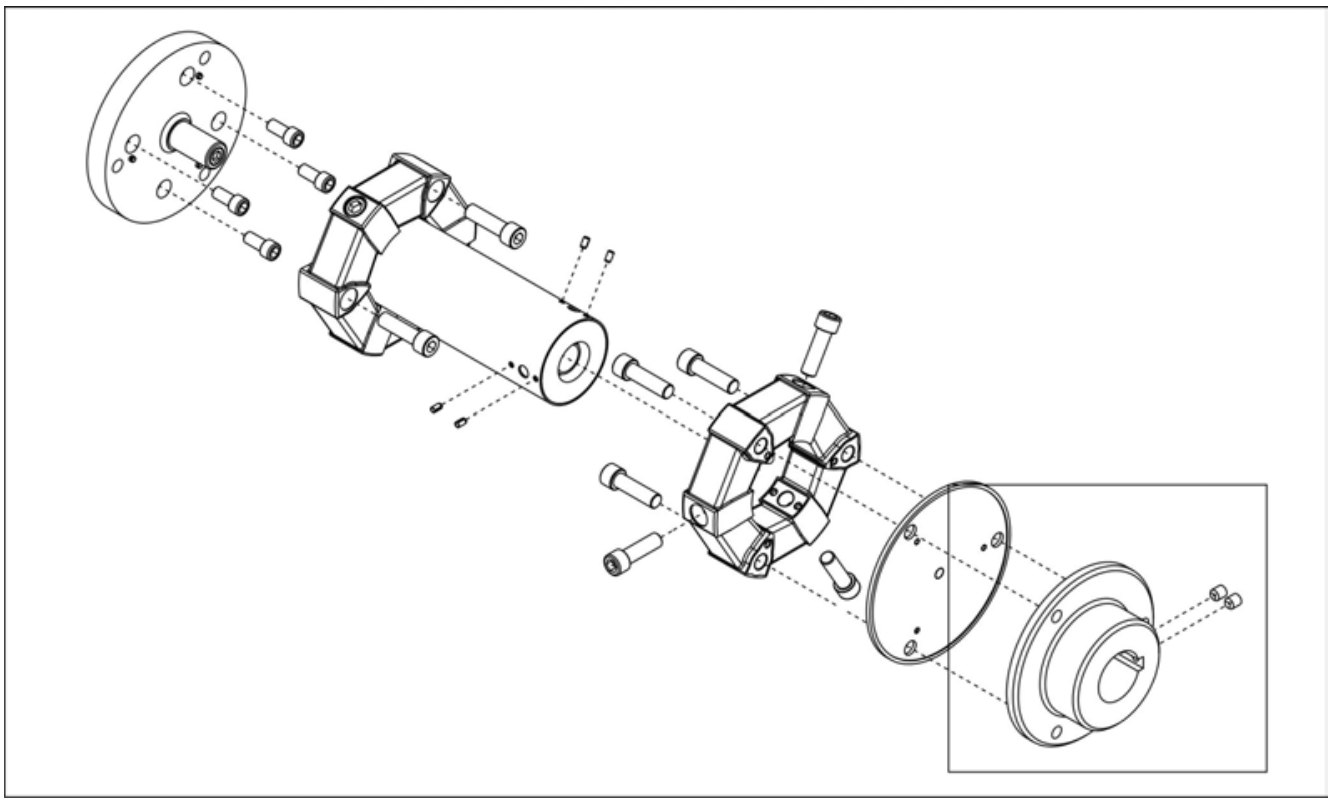


FIGURE 325. FAN DRIVE HUB TO FAN BELT DRIVE INPUT SHAFT

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10. Remove six bolts that attach the rubber element to the fan drive hub.

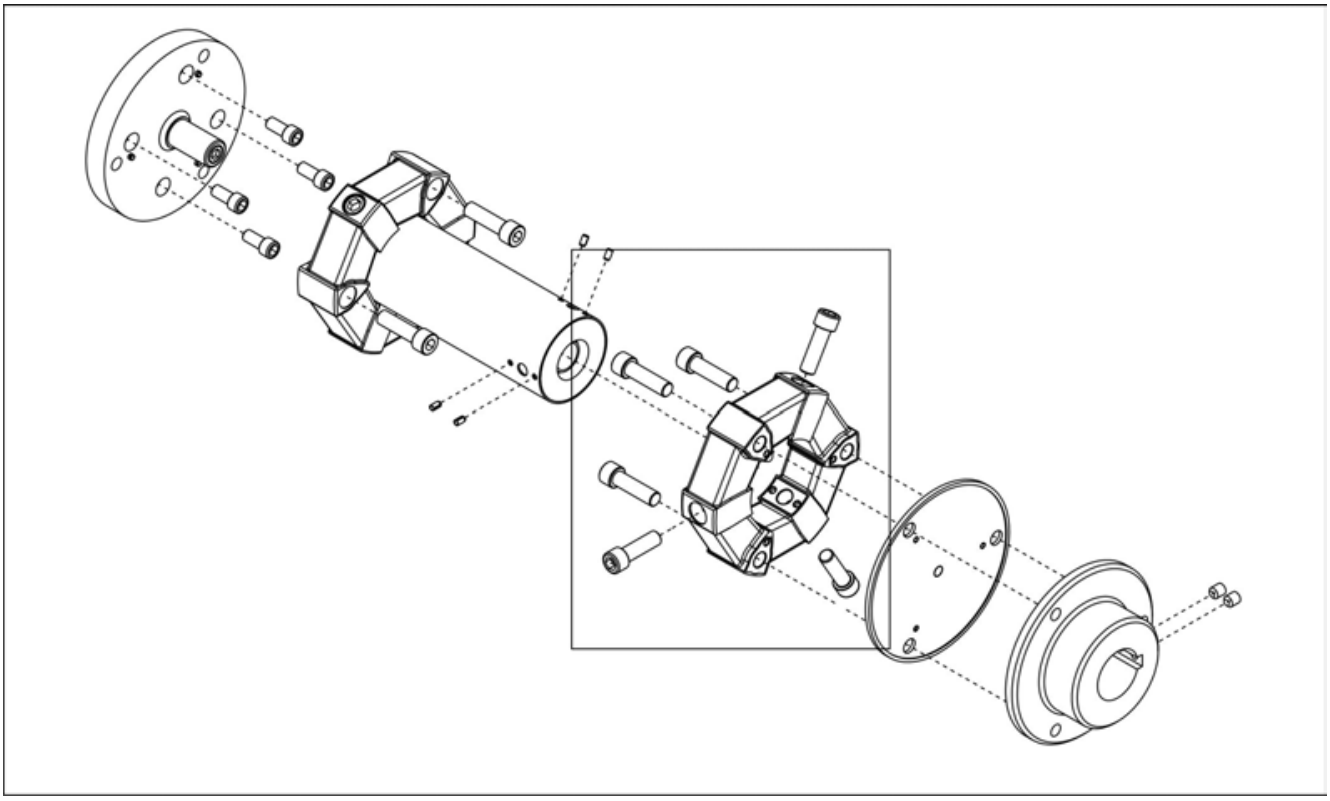


FIGURE 326. RUBBER ELEMENT TO FAN DRIVE HUB

11. Slide the fan drive hub towards the radiator.
12. Use and overhead hoist and strap to remove the entire fan drive shaft assembly.

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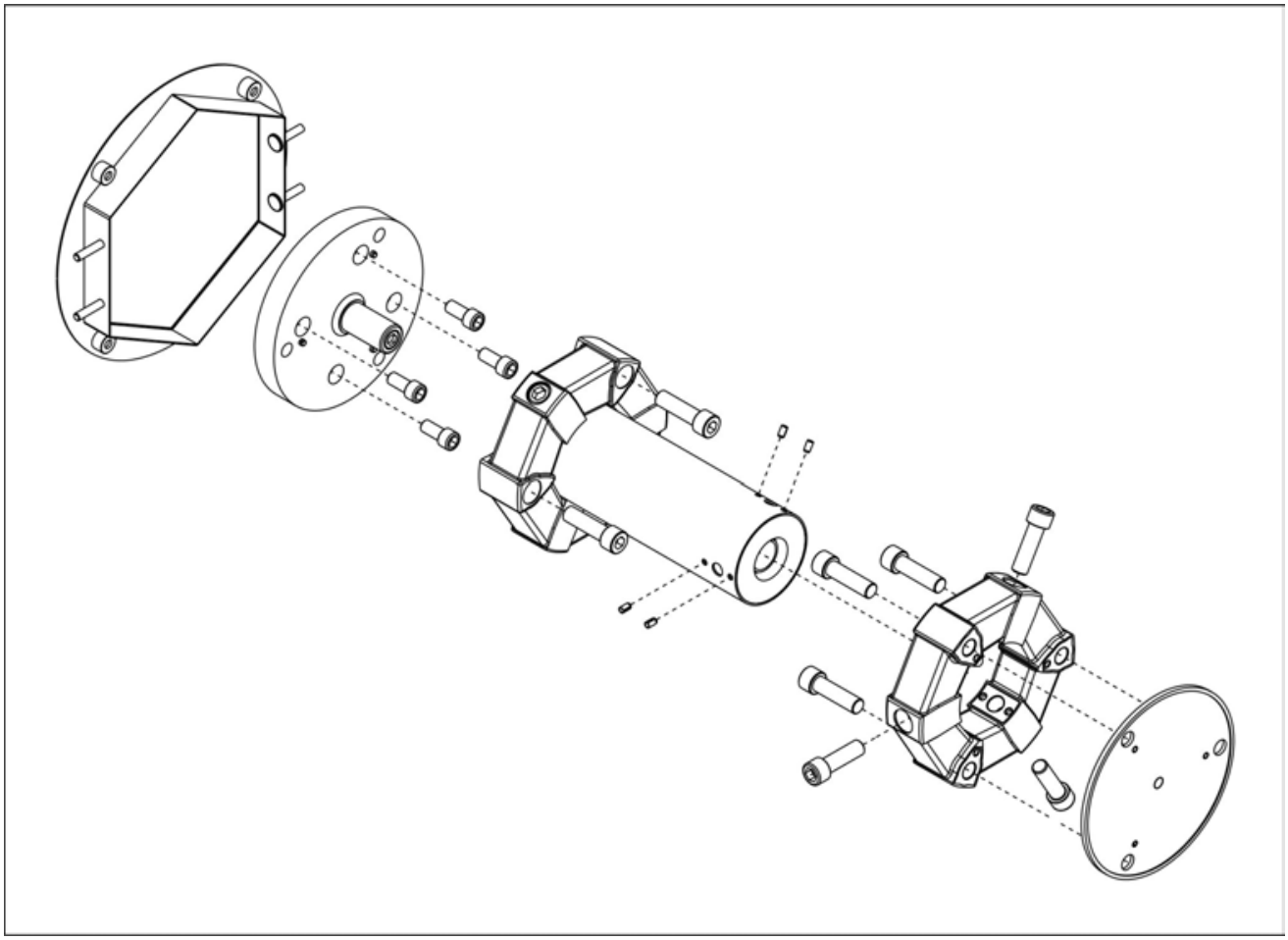


FIGURE 327. FAN DRIVE ASSEMBLY

13. Discard the 12 bolts that were used to secure the rubber elements.
14. Inspect all fan drive shaft interface surfaces for wear or damage.
15. Replace worn or damaged parts.

6.5.7.1.3 Remove Fan Drive Shaft U-joint Coupling

1. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See **Section 6.1.2 on page 334**.
2. Remove the fan drive shaft guard.

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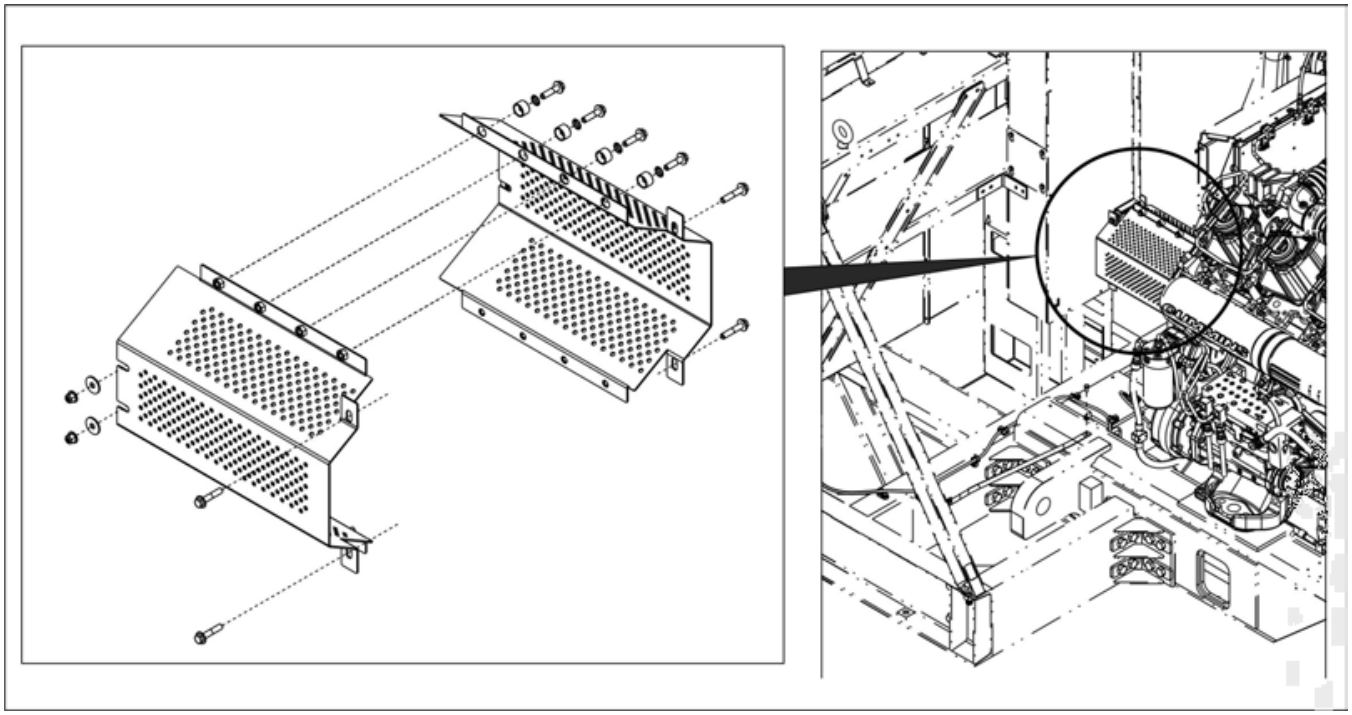


FIGURE 328. FAN DRIVE SHAFT GUARD

3. It may be necessary to remove the vibration dampener guard adapter ring and slide it onto the fan drive shaft.

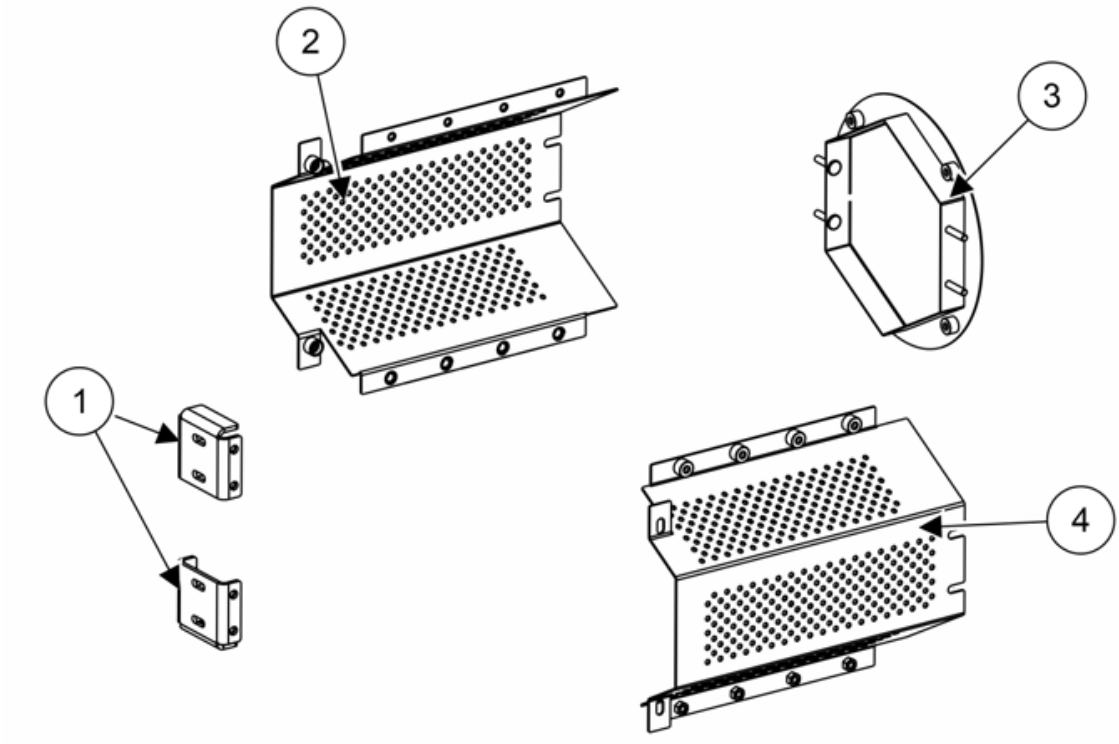


FIGURE 329. VIBRATION DAMPENER GUARD ADAPTER RING

4. Remove the 6 hex nuts that secure the driveshaft yoke to the rubber element.

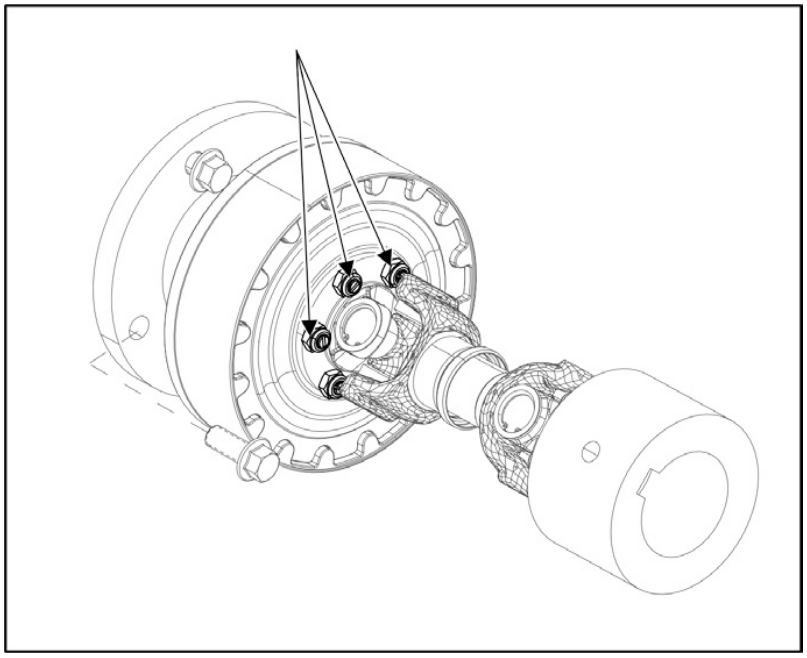


FIGURE 330. YOKE HEX NUTS

5. Loosen the four hex screws that attached the drive shaft to the vibration damper.

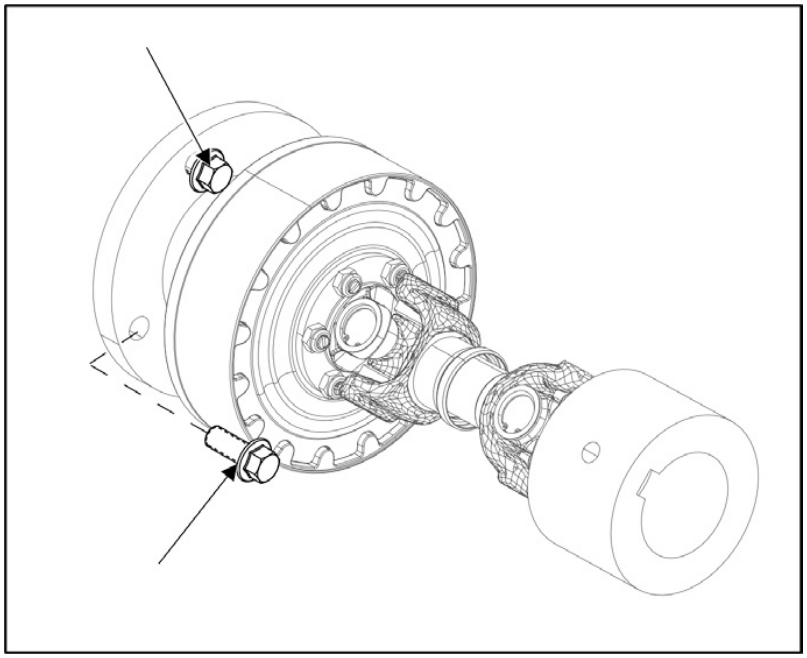


FIGURE 331. VIBRATION DAMPER SCREWS

6. Loosen the set screw holding the drive shaft to the fan drive input shaft.

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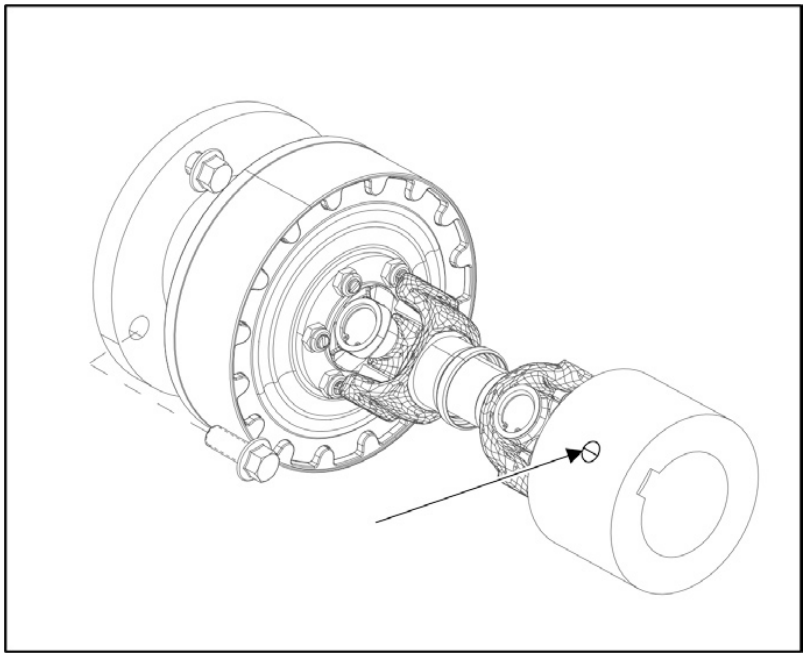


FIGURE 332. SET SCREW LOCATION

7. Slide the yoke portion of the driveshaft toward the radiator.
8. Support the rubber element and remove the 4 hex screws from the vibration damper. Discard the hex screws.
9. Remove the hub end and yoke assembly form the fan drive input shaft.
10. Inspect all fan drive shaft interface surfaces for wear or damage.
11. Replace worn or damaged parts.

6.5.7.2 Fan Drive Shaft Installation

6.5.7.2.1 Required Tools

The following tools are required to complete this installation.

- 15 mm deep socket
- 17 mm hex bit socket
- 5/16" hex bit socket
- Torque wrench (20-100 Nm)
- Torque wrench (160-800 Nm)

6.5.7.2.2 Required Parts

The following parts are required to complete this installation.

- Six M20 X 70 mm bolts (A046B433)
- Six M20 X 65 mm bolts (A046B425)

6.5.7.2.3 Install Fan Guard Adapters

1. Hang the engine vibration dampener guard adapter on the fan drive shaft. Do not install the capscrews at this time.

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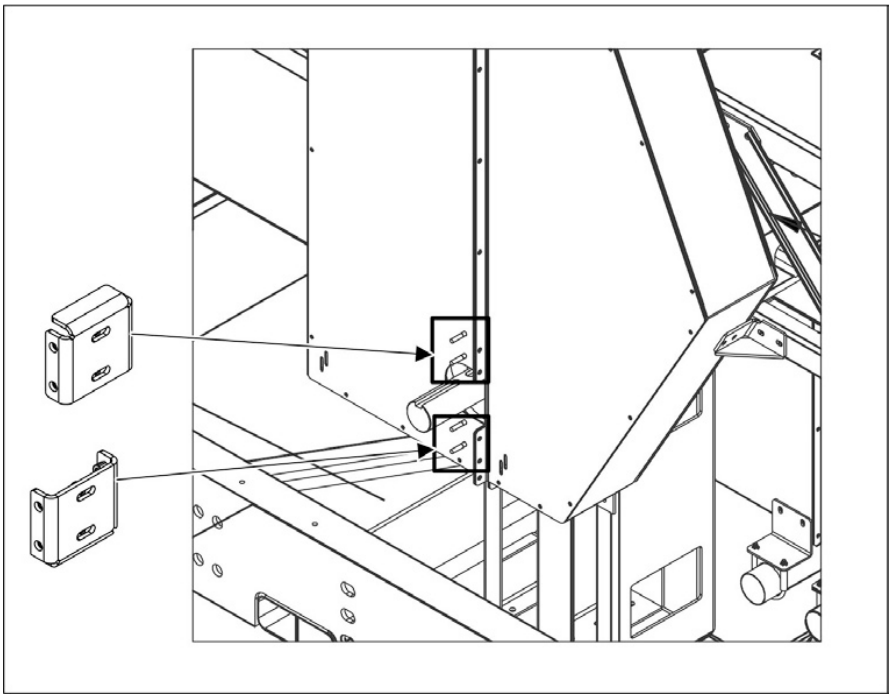


FIGURE 333. FAN DRIVE GUARD BRACKET DETAIL

2. Install radiator side guard adapter brackets. Torque bolts to 52 Nm (38 ft-lb).

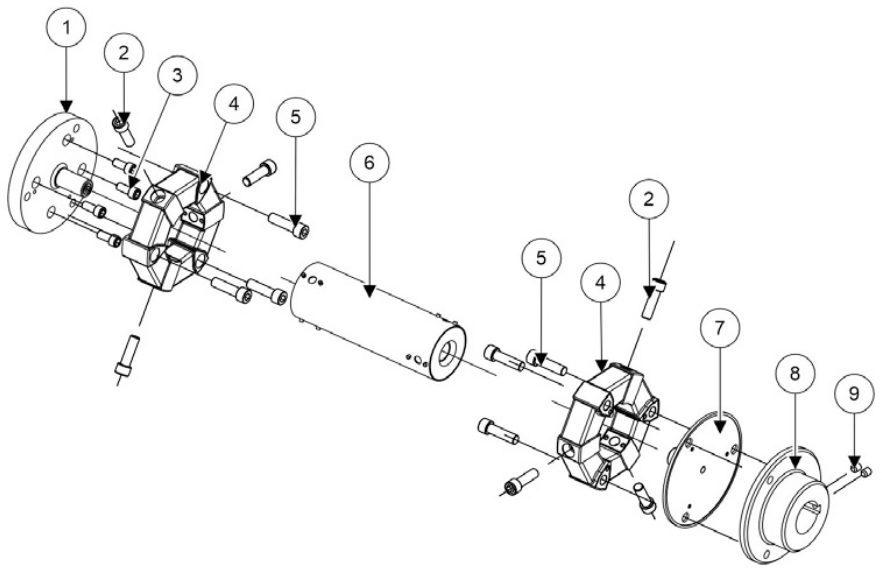
6.5.7.2.4 Install Fan Drive Shaft Rubber Coupling

1. Loosen fan drive hub set screws (9, **Figure 334**).
2. Align fan drive hub (8, **Figure 334**) with shaft key and slide the fan drive hub onto the fan shaft.

NOTICE
Do not tighten fan drive hub set screws at this time.

3. Install the engine hub assembly (1, **Figure 334**) on the engine vibration dampener using quantity 4 M16 x 35 mm socket head screws (3, **Figure 334**). Torque to 250 Nm (184 ft-lb).
4. Slide two rubber elements (4, **Figure 334**), fan hub flange (7, **Figure 334**) onto the coupling drive shaft (6, **Figure 334**).

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No.	Description	No.	Description
1	Engine Hub Assembly	6	Coupling Drive Shaft
2	M20 x 65 mm Socket Head Screw	7	Fan Hub Flange
3	M16 x 35 mm Socket Head Screw	8	Fan Drive Hub
4	Rubber Element	9	Set Screw
5	M20 x 70 mm Socket Head Screw		

FIGURE 334. RADIATOR FAN DRIVE PARTS

NOTICE
The socket head screws that attach the rubber elements to the coupling drive shaft come with a specific thread locking compound applied. Do not use other thread locking compound or damage will occur to the rubber elements.

5. Lift the coupling drive shaft with all the assembled parts and slide it on to the engine hub assembly.
6. Hand thread quantity 3 – M20 x 70 mm socket head screws (5, **Figure 334**) through the rubber element and fan hub flange into the fan hub (4, 7 and 8, **Figure 334**). Start each bolt with 2 to 3 threads of engagement.
7. Hand thread quantity 6 – M20 X 65 mm socket head screws (2, **Figure 334**) through both rubber elements into the coupling drive shaft (4 and 6, **Figure 334**). Start each bolt with 2 to 3 threads of engagement.

NOTICE
All M20 screws must be torqued in the order prescribed below. Deviation from this order could result in premature failure of or damage to the rubber element(s).

8. Use a two-step process to torque all M20 x 70 mm socket head screws.
   a. First torque step, 250 Nm (184 ft-lb).
   b. Second torque step, 500 Nm (368 ft-lb).

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9. Use a two-step process to torque all M20 x 65 mm socket head screws.
    a. First torque step, 250 Nm (184 ft-lb).
    b. Second torque step, 500 Nm (368 ft-lb).
10. Torque fan drive hub setscrews to 50 Nm (37 ft-lb).

6.5.7.2.5 Install Fan Drive Shaft U-joint Coupling

1. Clean the coupling assembly (item 1 Figure 335 on page 698) making sure the mating surfaces are free of debris, preservatives and grease.

NOTICE
Do not separate the drive shaft spline drive slip joint in any case. These components are to remain meshed together at all times.

NOTICE
A light coating of oil or rust inhibitor on all metal surfaces is acceptable. Care should be taken that the rubber element of the drive shaft does not come in contact with any chemicals.

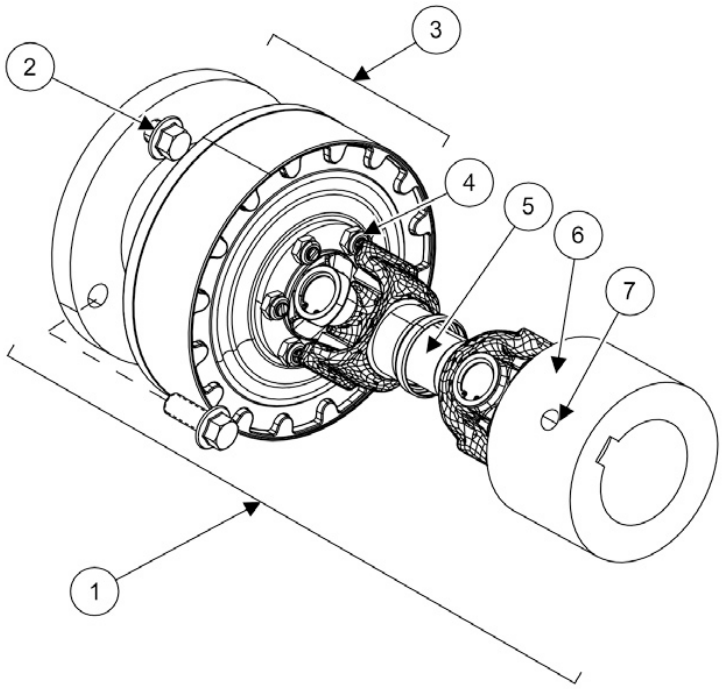
2. Slide the drive shaft and hub end assembly (item 6 Figure 335 on page 698) onto the fan input shaft.

NOTICE
The drive shaft hub end is designed with a shaft stop. Seat the hub end fully on the radiator fan drive input shaft prior to torquing the M16 set screw.

3. Install the M16 set screw (item 7 Figure 335 on page 698) to lock the hub in place over the shaft key. Torque to 150 Nm (110.5 ft-lb).
4. Use an appropriate lifting device to support the rubber element (item 3 Figure 335 on page 698) during installation. Lift the rubber element to the engine vibration damper and loosely install the M16 flange head hex screws (item 2 Figure 335 on page 698).
5. Extend the u-joint flange over the studs of the rubber element and install the hex nuts. Torque to 49 Nm (36 ft-lb) using a crow foot wrench. Perform an overcheck to verify all hex nuts are properly torqued. Scribe or mark with ink each nut upon validation of torque completion.

NOTICE
It may be necessary to start all the hex nuts on the studs prior to seating the flange.

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No.	Description	No.	Description
1	Radiator Fan Drive shaft Assembly	5	Drive Shaft and Hub End Assembly
2	M16 x 40 mm Flange Head Hex Screw	6	Hub End
3	Rubber Element End	7	Fan Hub M16 Set Screw
4	M10 Hex Nut		

FIGURE 335. RADIATOR FAN DRIVE PARTS

6. Hand-tighten all flange head hex screws for the rubber element to the vibration damper.

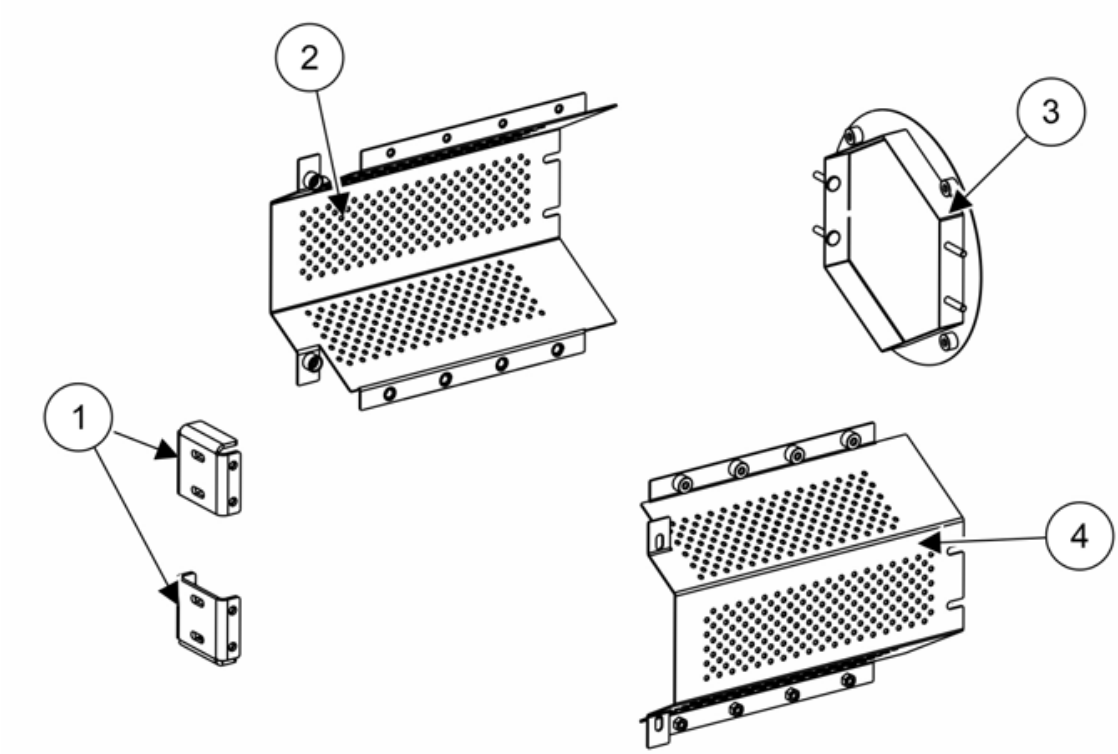
NOTICE
When using a torque adapter, always maintain a 90° angle between the torque adapter and torque wrench handle. For use of torque adapters of other lengths than the recommended, calculate the appropriate torque correction as recommended by the torque adapter manufacturer.

7. Torque flange head hex screws to 215 Nm (158.5 ft-lb) in a star pattern using a 2 in (50.8 mm) torque adapter. Perform an overcheck to verify all hex nuts are properly torqued. Scribe or mark with ink each nut upon validation of torque completion.

NOTICE
The u-joints are greased form the factory and do not require additional grease at time of installation.

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6.5.7.2.6 Install the Fan Drive Shaft Coupling Guard

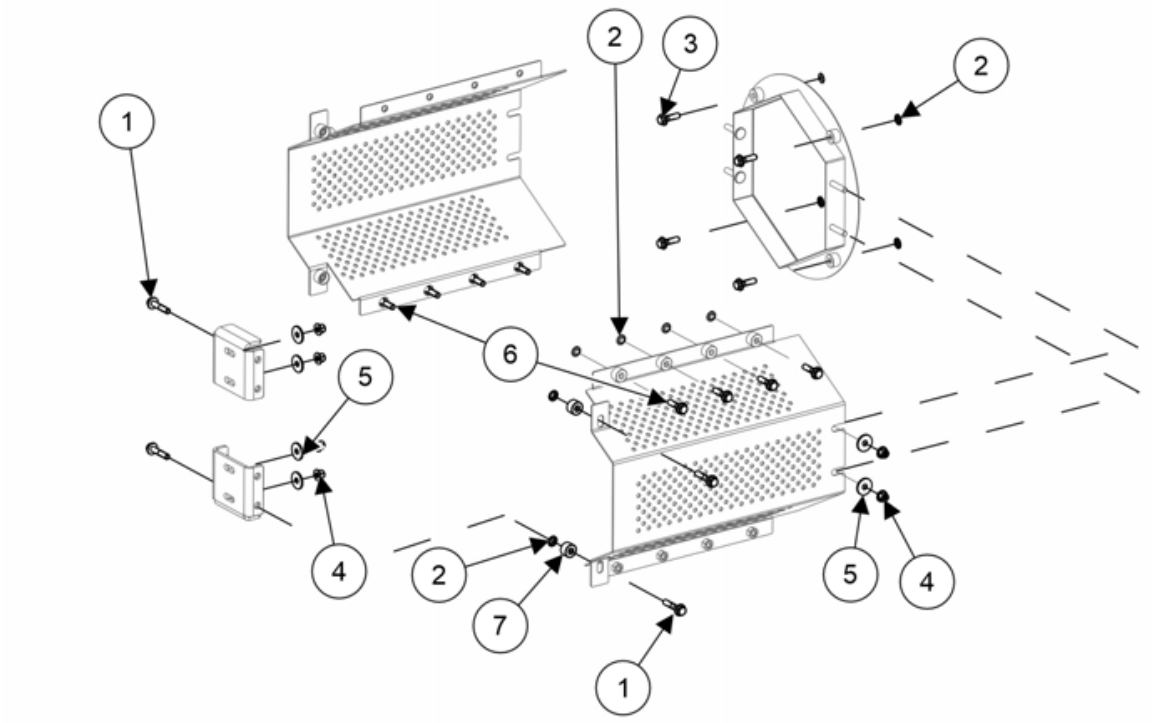


No.	Description	No.	Description
1	Radiator Guard Bracket	3	Engine Vibration Damper Guard Adapter
2	Right Side Guard	4	Left Side Guard

FIGURE 336. FAN DRIVE GUARD DETAIL

1. Install the engine vibration damper guard adapter. Torque capscrews to 52 Nm (38 ft-lb).
2. Prepare the right and left side guard brackets for installation:
   a. Using quantity 4 – insert one M10 x 50 mm hex flange head screw (1, **Figure 337**) through each of the 4 holes at the radiator end of the right and left brackets. Install one spacer (7, **Figure 337**) and one push on nut (2, **Figure 337**) after each hex flange head screw has been inserted through the guard.
   b. Using quantity 8 – insert one M10 x 40 mm hex flange head screw (6, **Figure 337 on page 700**) through each of the 4 holes along the top of the left side guard and along the bottom of the right side guard. Install one push on nut (2, **Figure 337**) after each hex flange head screw has been inserted through the guard1

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No.	Description	No.	Description
1	M10 x 50 mm Hex Flange Head Screw	5	M10 Flat Washer
2	M10 Push On Nut	6	M10 x 40 mm Hex Flange Head Screw
3	M10 x 35 mm Hex Flange Head Screw	7	Spacer
4	M10 Hex Flange Nut		

FIGURE 337. FAN DRIVE GUARD FASTENER DETAIL

3. Install the right side coupling guard to the engine vibration dampener adapter and the radiator side adapter brackets:
   a. Using quantity 2 – M10 hex flange nuts and flat washer (4 and 5, **Figure 337**) install to the studs of the engine vibration damper guard adapter. Torque to 52 Nm (38 ft-lb).
   b. Tighten the quantity 2 – M10 x 50 mm hex flange head screws (1, **Figure 337**), torque to 52 Nm (38 ft-lb).
4. Install the left side coupling guard to the engine vibration dampener adapter and the radiator side adapter brackets:
   a. Using quantity 2 – M10 hex flange nuts and flat washer (4 and 5, **Figure 337**) install to the studs of the engine vibration damper guard adapter. Torque to 52 Nm (38 ft-lb).
   b. Tighten the quantity 2 – M10 x 50 mm hex flange head screws (1, **Figure 337**), torque to 52 Nm (38 ft-lb).
5. Tighten the quantity 8 – M10 x 40 mm hex flange head screws (6, **Figure 337**), torque to 52 Nm (38 ft-lb).

6.5.8 Filling the Cooling System

After the components have been properly assembled and mounted, fill the cooling system.

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NOTICE

The cooling system must be filled before aligning the fan drive. The weight of the coolant can change alignment.

6.5.8.1 Coolant Level - Check

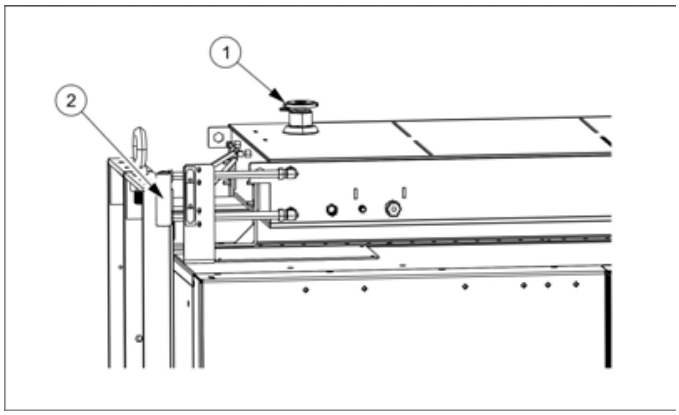


FIGURE 338. HEADER TANK

1. Observe the coolant level through the sight glass (2) at the top of the expansion tank. Coolant level should be approximately at the fill level in the sight glass.
2. Isolate the generator set to prevent accidental starting while filling the radiator.
3. Slowly remove the radiator filler cap (1).
4. Begin slowly filling the radiator with a 50/50 mixture of fully formulated coolant and DCA4 (or equivalent) until the sight glass shows the correct level.
5. Replace the radiator cap securely. Push down and twist clockwise until the cap lip hits the tank stop flange.
6. Start the generator set and check for leaks.

6.5.8.2 Cooling System Filling Procedure

⚠ WARNING

Hot Pressurized Liquid

Contact with hot liquid can cause severe burns.

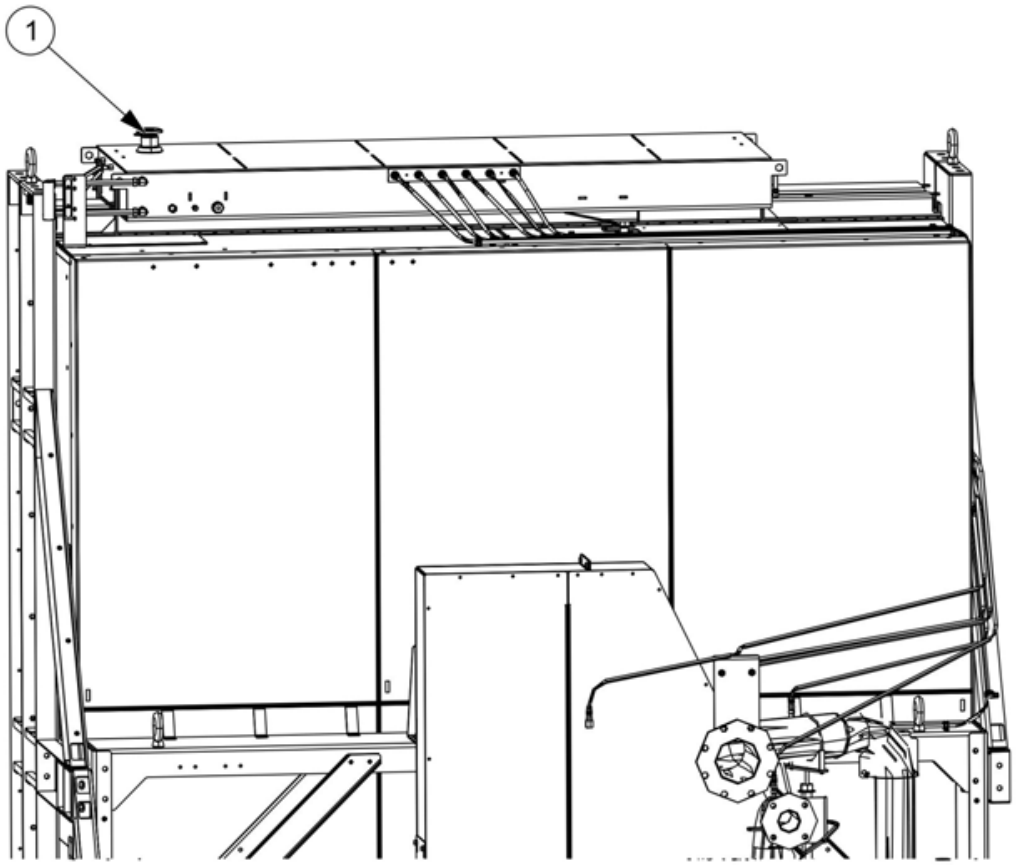
Make sure the radiator cap is properly secured before operating the generator set.

NOTICE

Failure to use the correct type of coolant, maintain the correct level, and bleed the systems of air can result in severe engine damage. Make sure the correct coolant and additive is used.

Fill the cooling system from the top at a 5 gallon per minute rate.

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No.	Description	No.	Description
1	Fill neck		

FIGURE 339. COOLING SYSTEM FILL NECK

Fill the cooling system with premixed fully formulated coolant or with a 50/50 mixture of high-quality water distilled or deionized and fully formulated concentrated antifreeze. The fully formulated coolant/antifreeze, either ethylene glycol or propylene glycol, must meet Cummins Engineering Standard 14603. Cummins Inc. recommends using Fleetguard® coolants containing DCA4. If the radiators are not filled using Fleetguard "Compleat" brand antifreeze or equivalent antifreeze, the DCA4 needs to be added to the cooling systems.

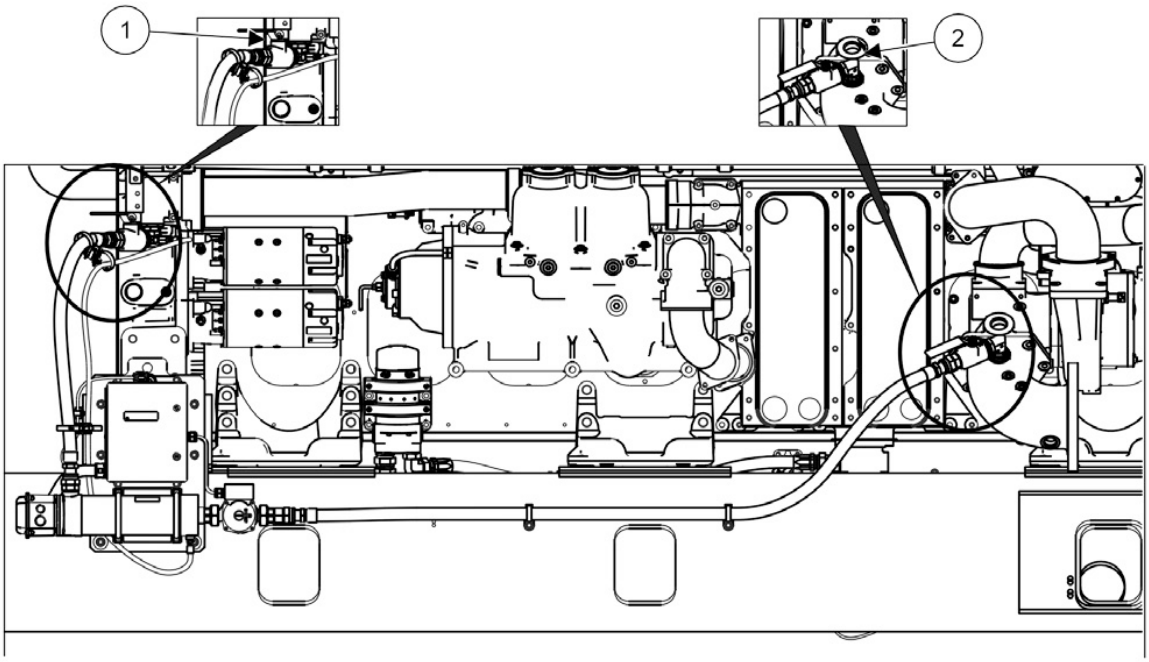
If water quality is unknown, it can be tested with the Fleetguard® Monitor C™ program or Water-Chek™ test strip.

Fill the radiator with a combination of coolant and corrosion inhibitor. Refer to the engine manufacturer's Owner's manual for recommended coolant type.

For system coolant capacity, refer to **Chapter 3**.

6.5.8.3 Fill Radiator - Top Fill Method

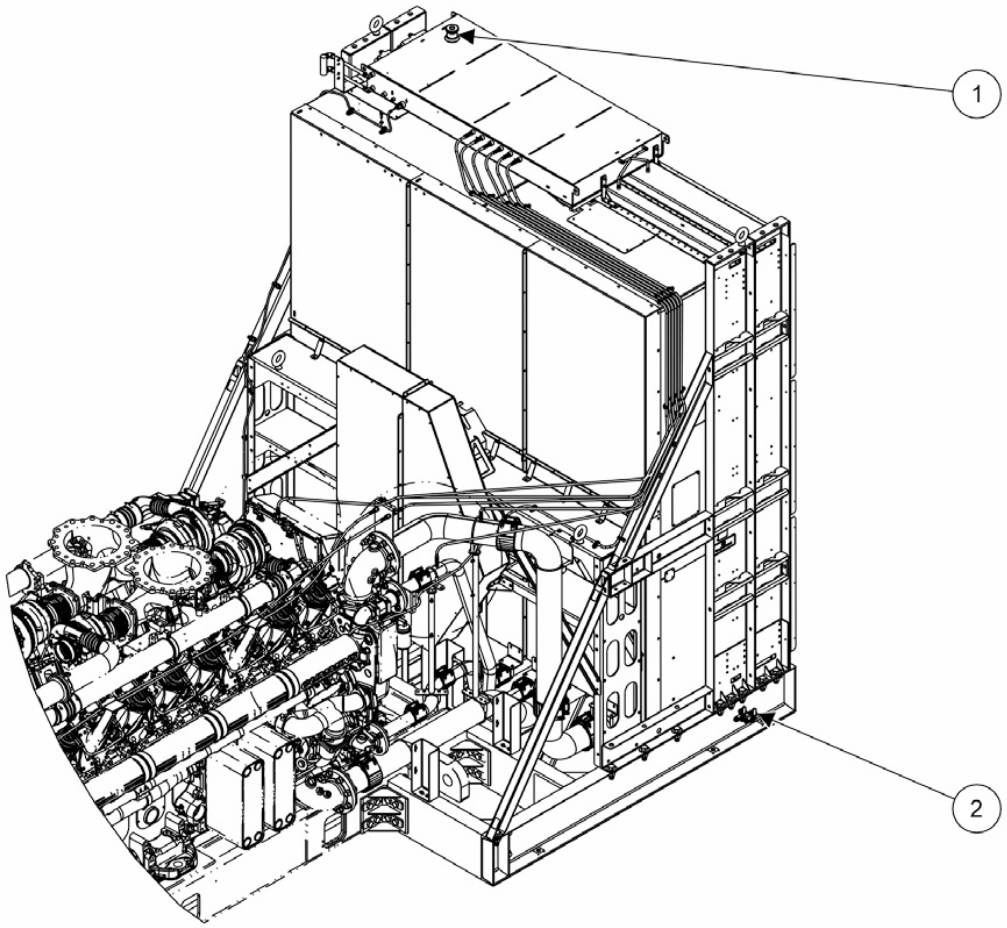
NOTICE
Cummins recommends that the bottom fill method be used top rill the radiator when possible.



No.	Description	No.	Description
1	Outlet Isolation Valve	2	Inlet Isolation Valve

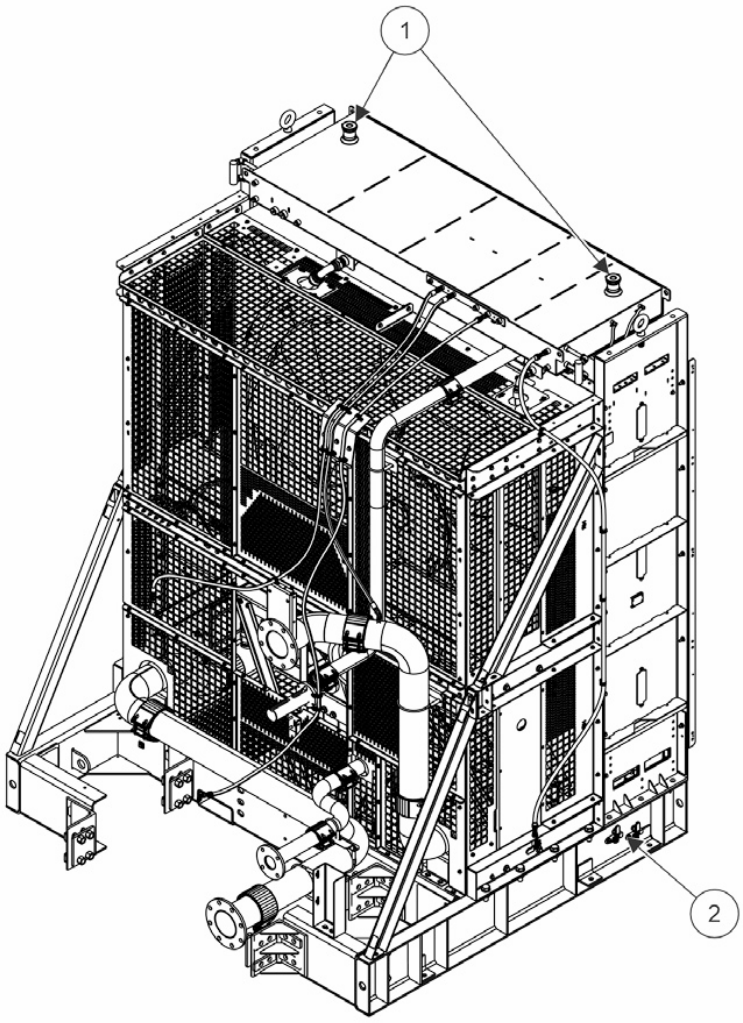
FIGURE 340. COOLANT HEATER ISOLATION VALVES

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No.	Description	No.	Description
1	Fill Neck	2	Drain Valves

FIGURE 341. RADIATOR FILL LOCATION (84 AND 94 SQ FT)



No.	Description	No.	Description
1	Fill Necks	2	Drain Valves

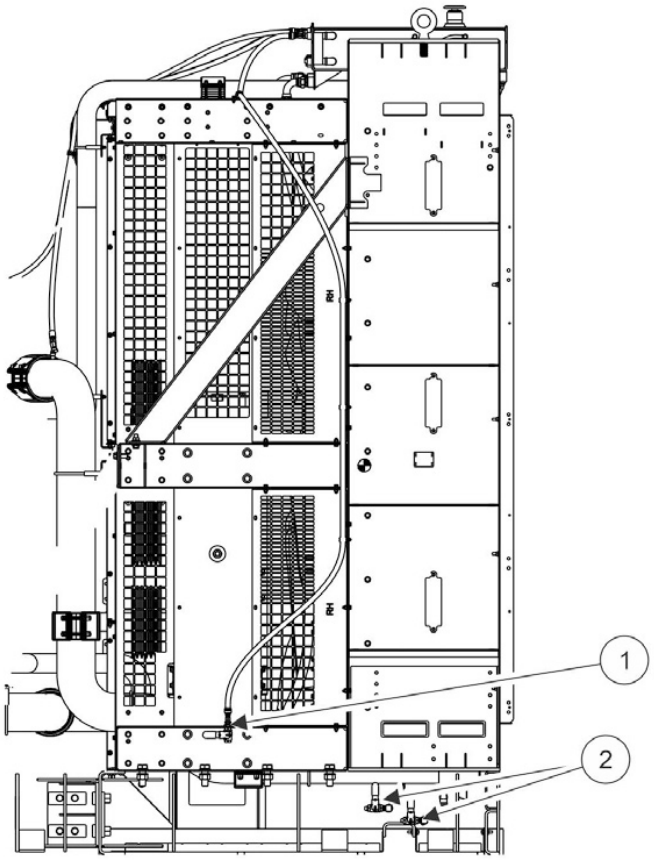
FIGURE 342. RADIATOR FILL LOCATIONS (61 SQ FT)

1. Open the inlet isolation valve and the outlet isolation valve on the coolant heater (**Figure 340**).
2. Remove the radiator pressure cap on the fill neck.
3. Fill the radiator from the fill neck (Spec A or B) or bottom fill via the drain valves (Spec B only, see **Section 6.5.8.4 on page 706**).
   - Fill rate - 5 gpm (19 Lpm)
   - For fill volumes, refer to **Section 3.2**.
4. Check for coolant leaks during and after the radiator coolant fill.
5. Install the radiator pressure cap.
6. Test run the generator set for 10 minutes with the coolant temperature above 82 °C (180 °F).
7. Check for coolant leaks at the generator set and the radiator.
8. Check the coolant level and top off if needed.

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6.5.8.4 Fill Radiator - Bottom Fill Method

NOTICE
Bottom fill option must be installed prior to performing this procedure.



No.	Description	No.	Description
1	Ball Valve Connected to Surge Tank	2	Drain Valves

FIGURE 343. RADIATOR BOTTOM FILL COMPONENTS

1. Open the inlet isolation valve and the outlet isolation valve on the coolant heater (**Figure 340**).
2. Fill the radiator.
   - Fill rate - 5 gpm (19 Lpm)
   - For fill volumes, refer to **Section 3.2**.
   a. Open the ball valve connected to the surge tank.
   b. Pump in the coolant via the drain valves. If coolant flows out of the ball valve, the coolant needs to be drained to the appropriate coolant level.
3. Check for coolant leaks during and after the radiator coolant fill.
4. Close and lock all of the ball valves.

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5. Test run the generator set for 10 minutes with the coolant temperature above 82 °C (180 °F).
6. Check for coolant leaks at the generator set and the radiator.
7. Check the coolant level and top off if needed.

6.5.8.5 Checking the Antifreeze Concentration

⚠ WARNING

Toxic Hazard

Ethylene glycol, used as an engine coolant, is toxic to humans and animals.

Wear appropriate PPE. Clean up coolant spills and dispose of used coolant in accordance with local environmental regulations.

⚠ WARNING

Hot Pressurized Liquid

Contact with hot liquid can cause severe burns.

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

NOTICE

Inaccurate coolant/antifreeze concentration may actually be harmful to your engine. make sure the antifreeze concentration is correct for the environment the generator set is being used in.

NOTICE

Both Ethylene Glycol and Propylene Glycol may be measured very accurately by refractive index, whereas a Hydrometer will only measure Ethylene Glycol.

Using a suitable antifreeze concentration tester (dependent on the type of antifreeze being used) following the instructions supplied with the tester check the concentration ratio of antifreeze to water.

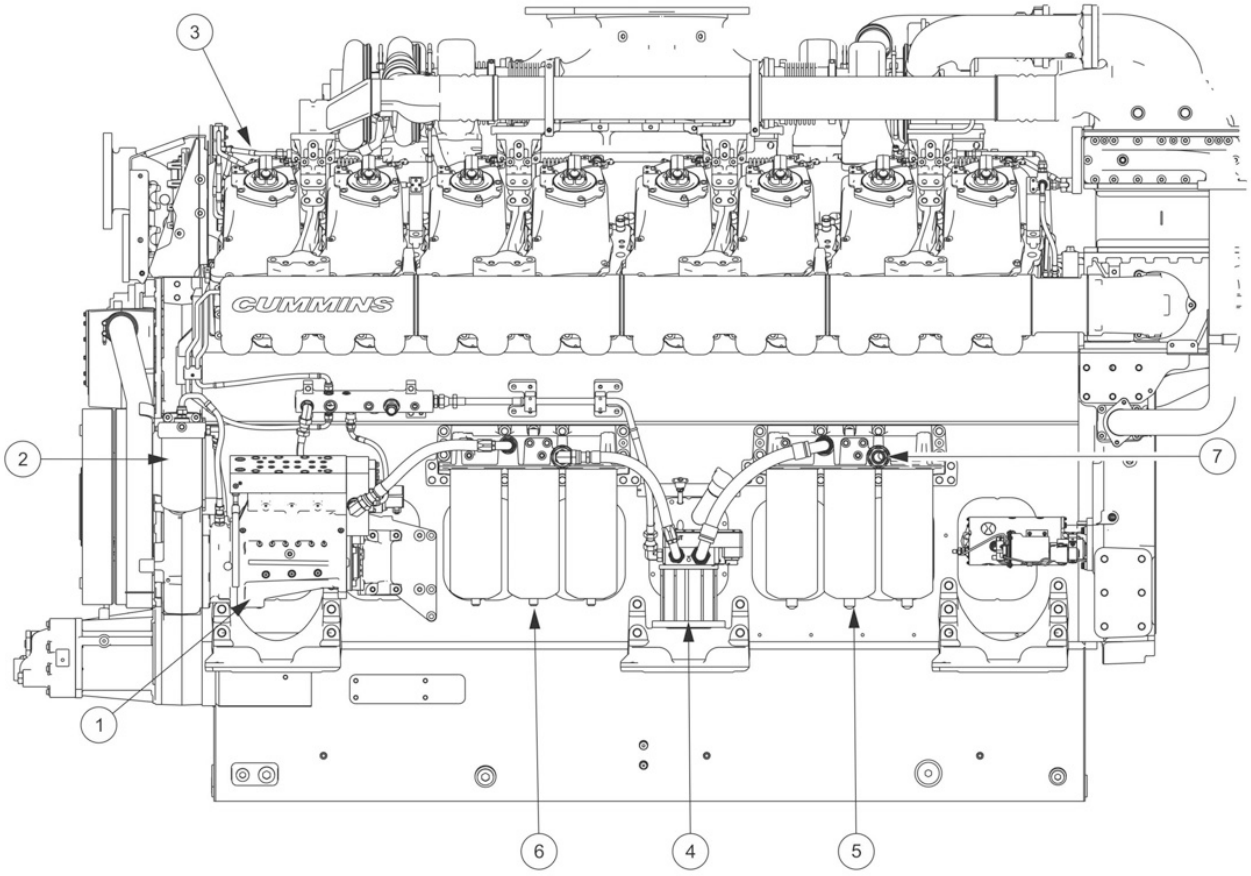
Refer to the engine service manual for the recommended type of antifreeze.

1. Low concentration of Antifreeze/CS may cause:
   - Liner or water pump impeller cavitation.
   - General Corrosion.
   - Deposits on heat transfer surfaces.
   - Plugging of the system with corrosion products.
   - Freezing and resultant overheating and cracking of blocks, etc.
2. High concentration of Antifreeze/CS may cause:
   - Water pump seal seepage.
   - Solder bloom or solder corrosion.
   - Hose and gasket seepage.
   - Plugging of the system with precipitates or gelled additive.
   - Slush formation and resultant overheating.

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6.6 Fuel System

6.6.1 Fuel System - QSK95 Engine



No.	Description	No.	Description
1	High Pressure Fuel Pump	5	Stage 1 (Primary) Fuel Filters
2	High Pressure Fuel Pump Lubrication Filter	6	Stage 2 (Secondary) Fuel Filters
3	MCRS Fuel Injectors	7	Fuel Inlet
4	Fuel Supply Pump		

FIGURE 344. FUEL SYSTEM COMPONENTS, ENGINES WITH TWO-STAGE FUEL FILTERS

6.6.2 Fuel System Specifications

Cummins Inc. recommends the use of ASTM number 2 diesel fuel. The use of number 2 diesel fuel will result in optimum engine performance.

At operating temperatures below 0 °C (32 °F), acceptable performance can be obtained by using blends of number 2D and number 1D. The use of higher concentrations of number 1D fuel can reduce fuel economy.

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The viscosity of the fuel **must** be kept above 1.3 cSt to provide adequate fuel system lubrication.

For information regarding fuel system restriction specifications, refer to **Section 3.1**.

Refer to the engine specific manual for a more detailed fuel system information and procedures.

6.6.3 Fuel System Components and Operation

6.6.3.1 High Pressure Fuel Pump

The fuel system uses a high pressure three or four piston pump, capable of producing fuel pressure up to 2750 bar (39,885 psi). The fuel pump is lubricated by engine lubricating oil, and has a wet oil sump, meaning that a volume of oil will be present in the oil pan on the bottom of the pump even when the engine is not operating. The oil drain plug is magnetic to capture any metallic debris in the oil.

Fuel enters the high pressure fuel pump through the fuel metering valve mounted on the rear of the pump. The high pressure fuel pump also has an internal pressure relief valve that will open if the pump output pressure rises above a set limit. The fuel metering valve and pressure relief valve are serviceable components. The fuel pump weighs up to 148 kg (327 lbs) and will require special lifting equipment during service.

For more information regarding the fuel pump, refer to the engine service manual.

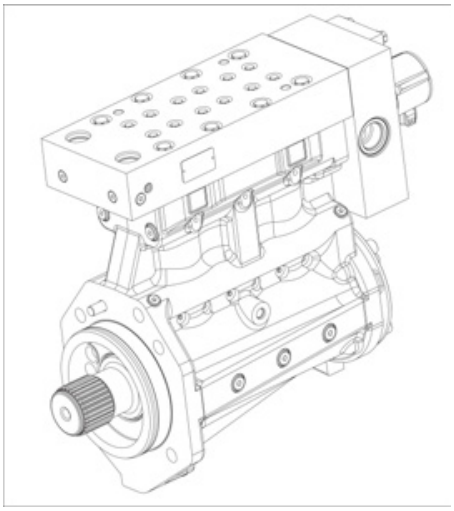
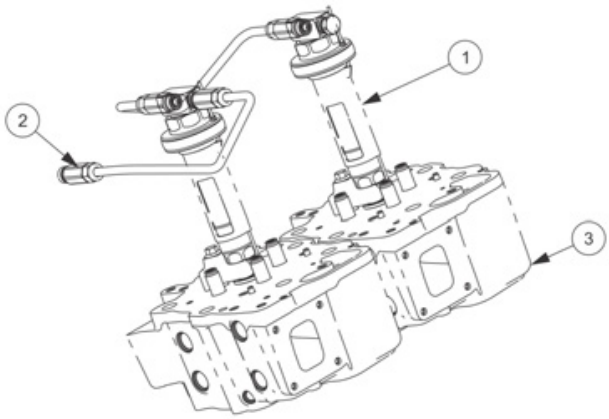


FIGURE 345. HIGH PRESSURE FUEL PUMP

6.6.3.2 Electronically Actuated Injector and Supply Lines

Electronically actuated injectors have been incorporated into the configuration for advanced fueling and timing control. The injectors are electronically actuated and controlled by the engine control modules (ECMs). The injectors are connected in parallel so that all injectors receive the same fuel pressure. Injectors are very sensitive to foreign debris.

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No.	Description	No.	Description
1	Fuel Injector	3	Cylinder Head
2	Fuel Supply Lines		

FIGURE 346. ELECTRONICALLY ACTUATED INJECTOR AND SUPPLY LINES

The injector supply lines are a double wall design, where the inner tube transports the high pressure fuel and the outer tube serves as a shield and drain path if a fuel leak occurs. The fuel is drained to the fuel pump where it exists through a check valve and drain hose.

The high pressure injector supply lines are for single use only. When the line is installed, a slight amount of material on the line is deformed to create the high pressure seal. If a line is removed, it must be replaced with a new line to ensure a proper high pressure seal is created.

For more information regarding fuel injectors and supply lines, refer to the engine service manual.

6.6.3.3 Fuel Supply Pump

The engine fuel supply pump is located on the left bank between the Stage 1 and Stage 2 fuel filters. It serves as both a priming pump during engine start-up and a transfer pump during normal engine operation. The fuel supply pump will automatically prime the fuel system when Emergency Stop is disengaged.

The fuel supply pump contains an internal computer processor that controls pump operation when commanded by the engine control modules (ECMs), and enables self-diagnostic capability. The electronic calibration of this processor can be updated if required.

The fuel supply pump contains an integrated inlet pressure sensor that is replaceable.

The fuel supply pump weighs approximately 34 kg (75 lbs) and will require special lifting equipment.

NOTICE

On engines with canister type fuel filters the fuel transfer pump is mounted to the high-pressure fuel pump. The single fuel supply pump shown is not used on engines with the canister type fuel filters.

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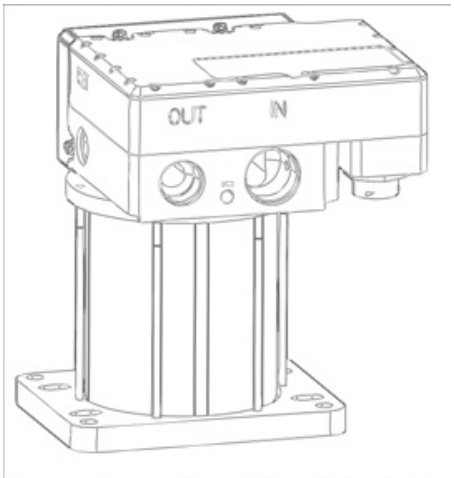


FIGURE 347. FUEL SUPPLY PUMP

6.6.3.4 Two Stage Fuel Filters

The fuel system configuration includes a fuel filter head with two stages of fuel filters (**Figure 348**).

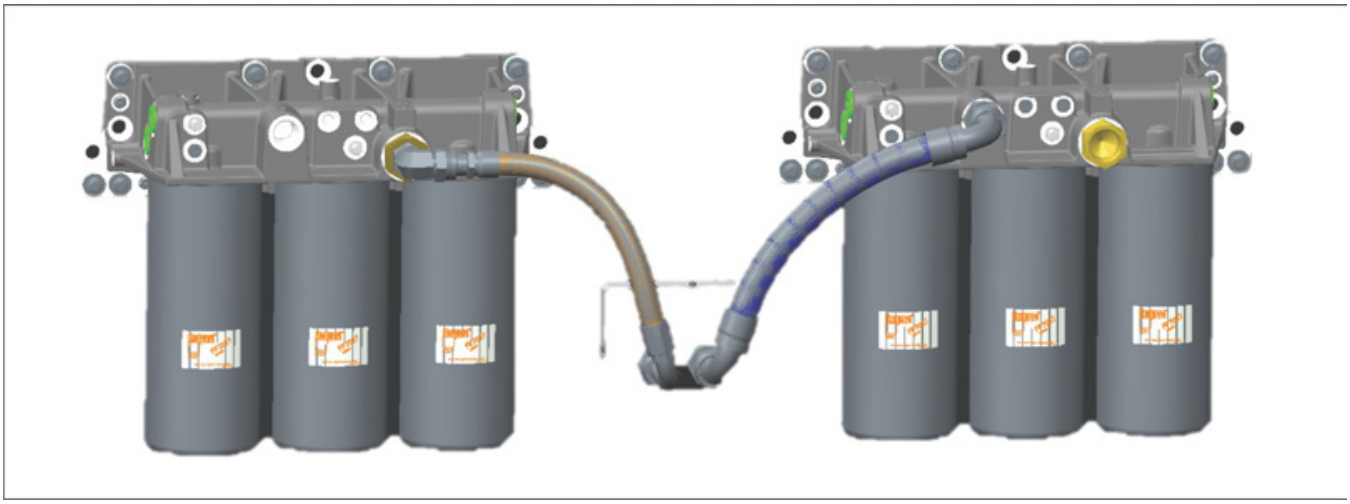


FIGURE 348. TWO STAGE FUEL FILTERS

Three fuel filters are mounted on the Stage 1 (Primary) fuel filter head on the left engine bank. The Stage 1 filters contain 5 micron NanoNet™ filtration media and also serve as fuel-water separators.

Three fuel filters are mounted on the Stage 2 (Secondary) fuel filter head on the left engine bank. The Stage 2 filters contain 3/2 micron NanoNet™ filtration media, meaning the fuel flows through a 3 micron layer and a 2 micron layer in series.

The engine fuel supply pump is used to prime the fuel system after replacing the fuel filters.

Refer to **on page 746** for fuel filter service procedures.

6.6.3.5 Duplex Fuel Filters

The fuel system may include an optional duplex fuel filter system.

The duplex fuel filter system provides a secondary set of Stage 1 fuel filters. This secondary set of filters offers the ability to continue unit operation when the primary fuel filters have surpassed their service life.

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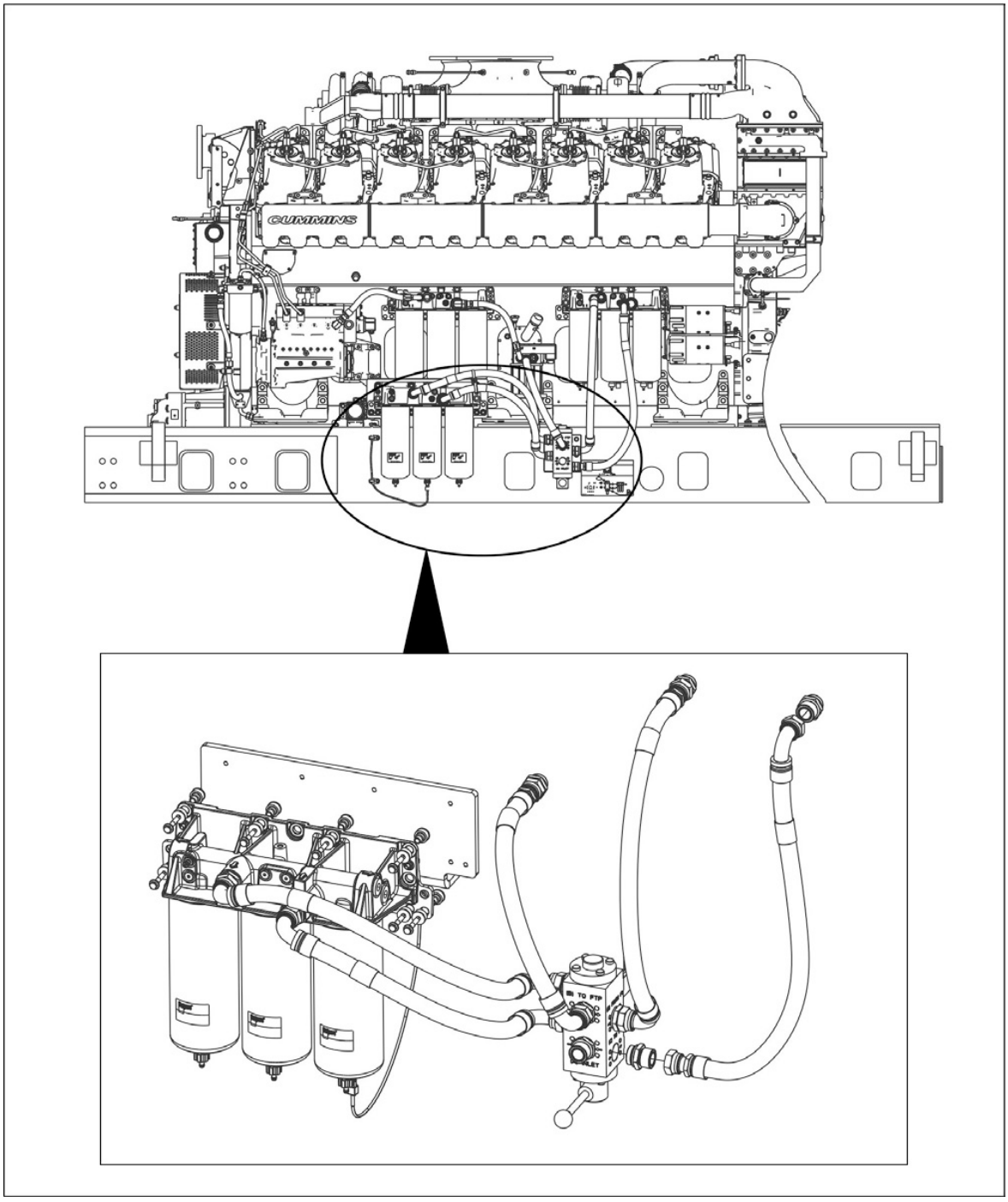


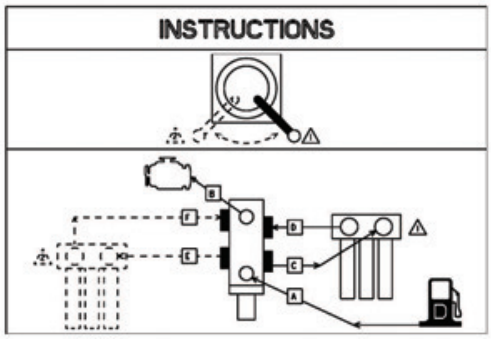
FIGURE 349. DUPLEX FUEL FILTERS

Fuel Selector Valve

A selector valve allows for quick and easy switching from the on-engine primary filters and the duplex filters.

Figure 350 shows the fuel flow through the system for both selector valve positions. Wherever possible this valve should be operated when the generator set is not running. However in an emergency situation, the valve may be operated with the engine running. Use appropriate PPE.

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No.	Description	No.	Description
1	Valve Position 1	C	From Selector Valve To On Engine Stage 1 (Primary) Fuel Filters
2	Valve Position 2	D	From On Engine Stage 1 (Primary) Fuel Filters to Selector Valve
A	From Fuel Inlet to Selector Valve	E	From Selector Valve to Off Engine Duplex Fuel Filters
B	From Selector Valve To Engine	F	From Off Engine Duplex Fuel Filters to Selector Valve

FIGURE 350. FUEL SELECTOR VALVE POSTION FLOW DIAGRAM

Refer to on page 746 for fuel filter service procedures.

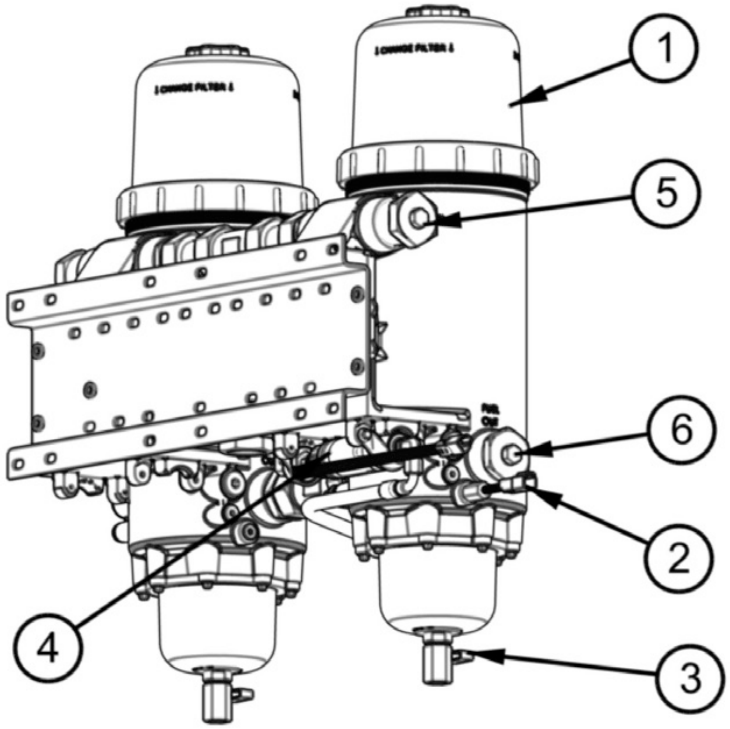
6.6.3.6 Canister Fuel Filters

The fuel system may include an optional canister fuel filter system.

The canister type fuel filters have a transparent filter cover to view the fuel level inside the filter housing, a NanoNet™ filtration media and serve as fuel-water separators. When the fuel level reaches the mark on the cover, the filter element must be replaced.

The canister type filters are mounted off the engine. The fuel priming pump is mounted with the canister type filter assembly.

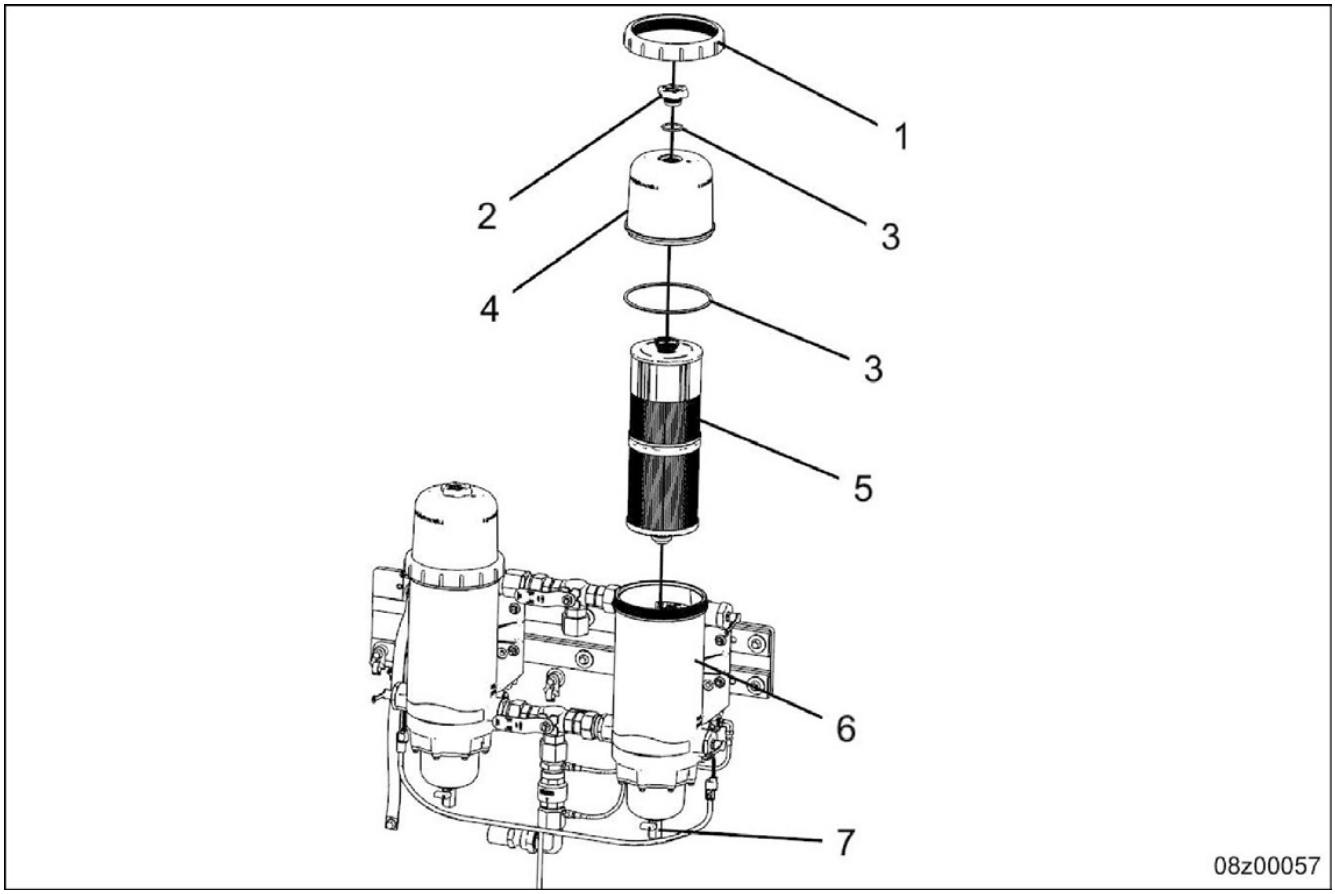
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No.	Description	No.	Description
1	Canister Type Fuel Filter	4	Lift Pump/Priming Pump
2	Water-in-fuel Sensor	5	Fuel Inlet Check Valve
3	Drain Valve	6	Fuel Outlet Check Valve

FIGURE 351. CANISTER FUEL FILTER ASSEMBLY AND PRIMING PUMP

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No.	Description	No.	Description
1	Collar	5	Fuel Filter Element
2	Vent Cap	6	Filter Housing
3	O-ring Seal	7	Drain Valve
4	Filter Cover		

FIGURE 352. CANISTER FUEL FILTER COMPONENTS

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6.6.4 Duplex Fuel Filter Assembly

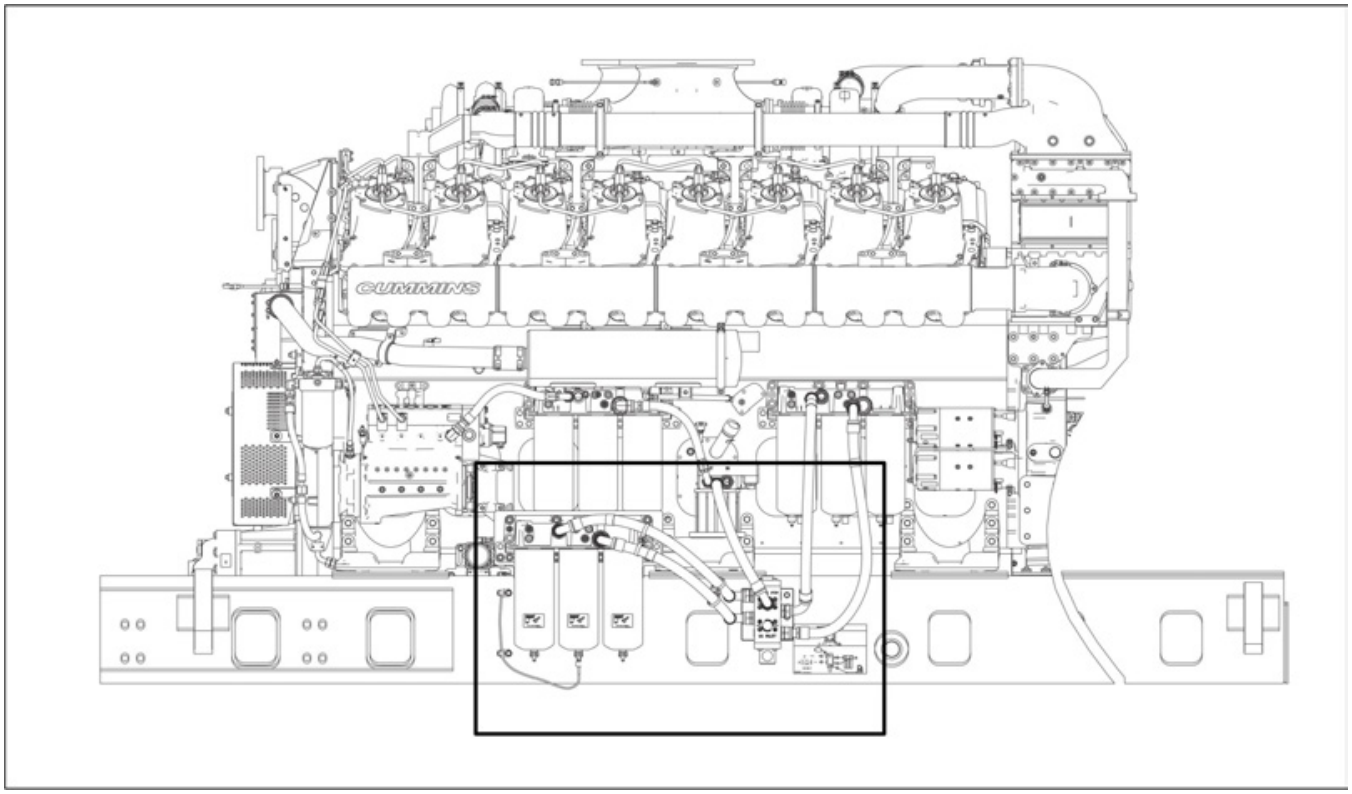


FIGURE 353. DUPLEX FUEL FILTER ASSEMBLY

6.6.4.1 Duplex Fuel Filter Removal

6.6.4.1.1 Required Tools

The following tools are required.

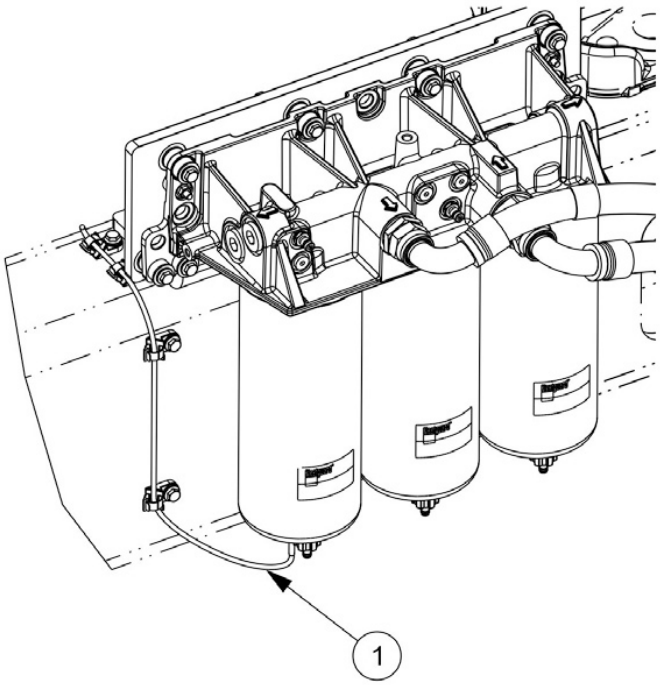
- 1-7/8” crowfoot wrench
- 2” crowfoot wrench
- Sockets
  - 13 mm
  - 16 mm
  - 17 mm
- 10" extension
- Strap wrench
- Torque wrench (20 - 100 Nm)
- Torque wrench (40 - 200 Nm)

6.6.4.1.2 Procedure

1. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See **Section 6.1.2 on page 334**.
2. Close the customer supplied fuel supply valve.

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3. Remove the water in fuel (WIF) sensor harness.



No.	Description	No.	Description
1	Water in fuel sensor harness		

FIGURE 354. WATER IN FUEL SENSOR HARNESS

4. Drain and remove all three fuel filters.
5. Remove the fuel hoses on the duplex filter head, selector valve, fuel supply pump (FSP), and engine state 1 fuel filter head.

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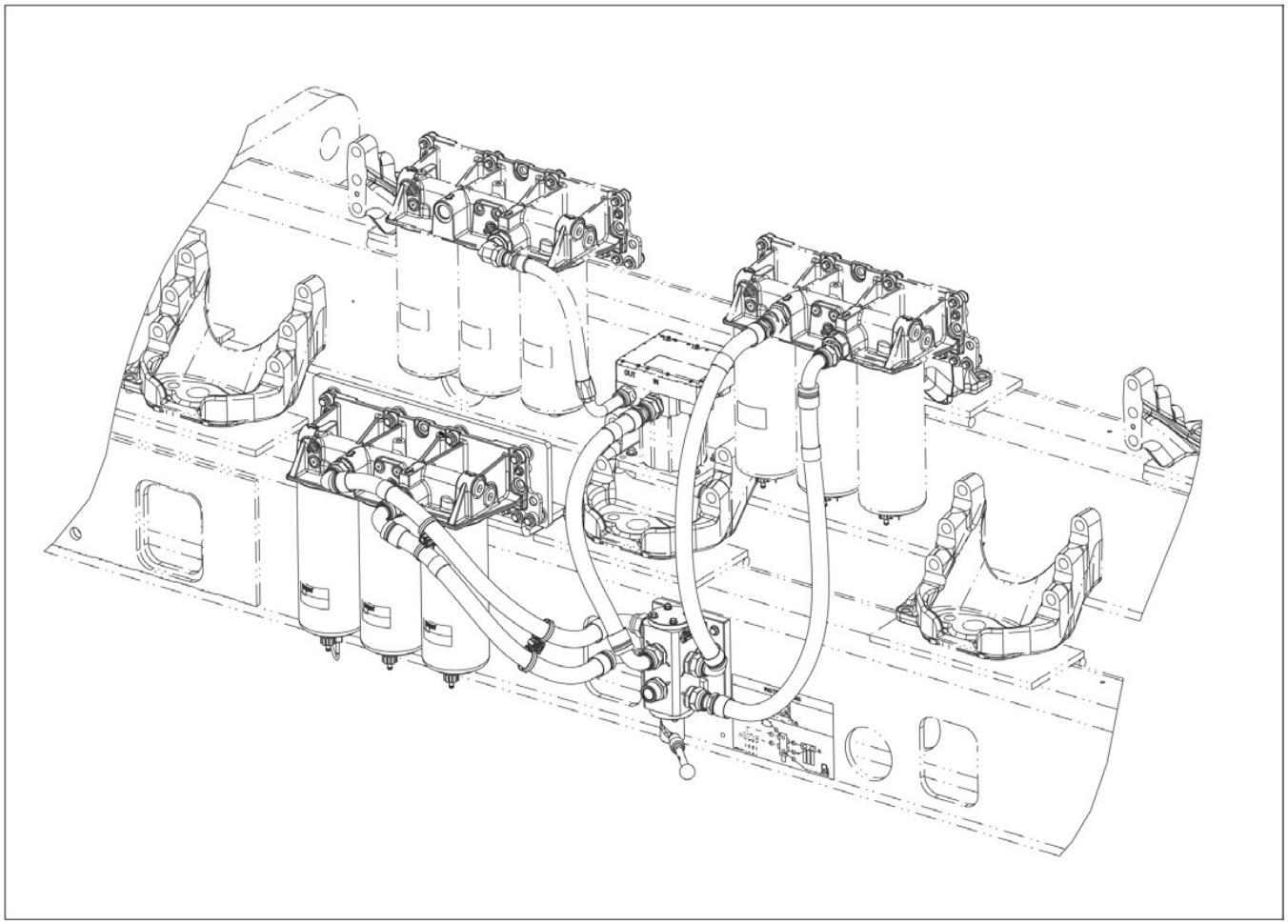


FIGURE 355. REMOVE FUEL HOSES

6. If the fuel hoses are going to be reused, cover hose ends to make sure the no dirt and debris get into the hoses.
7. Install a lifting aid on the filter head.
   - Fuel filter head weight is 97 lb (44 kg).
   - Thread pitch for lifting aid is M12 X 1.75.

NOTICE
Do not lift an assembled fuel filter head and fuel filter mounting bracket. They must be removed as separate parts.

8. Remove ten bolts and vibration isolators that attach the filter head to the mounting bracket.

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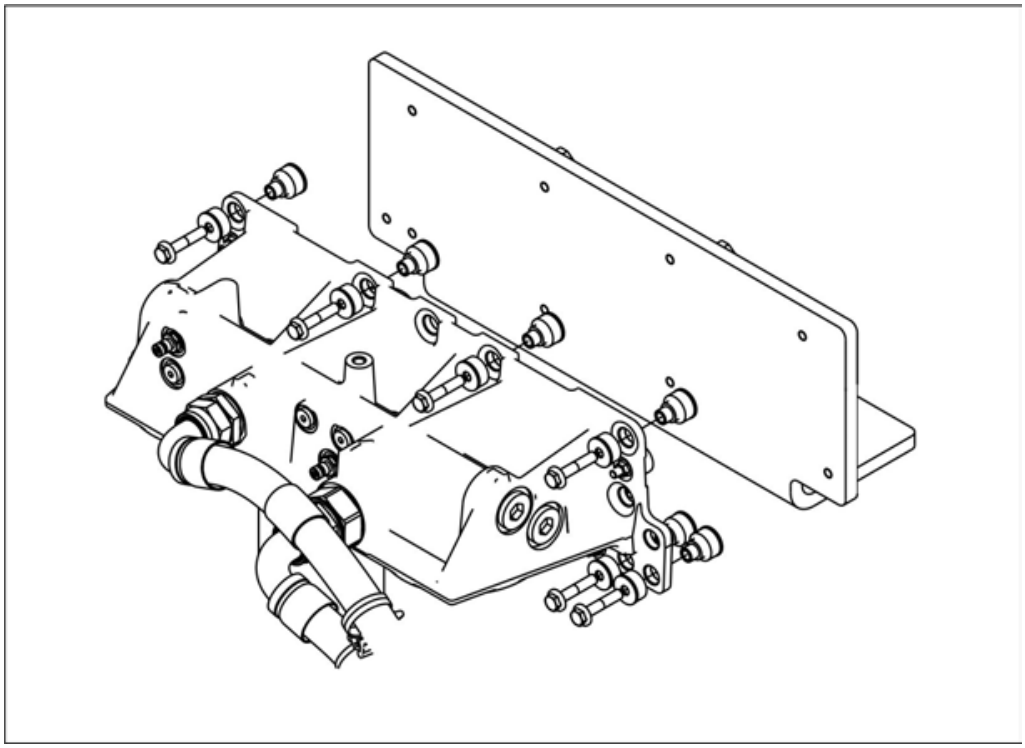


FIGURE 356. FILTER HEAD TO MOUNTING BRACKET

9. Remove eight bolts and spacers that attach the filter head bracket to the generator set skid.
    - Mounting bracket weight is 71 lb (32 kg).

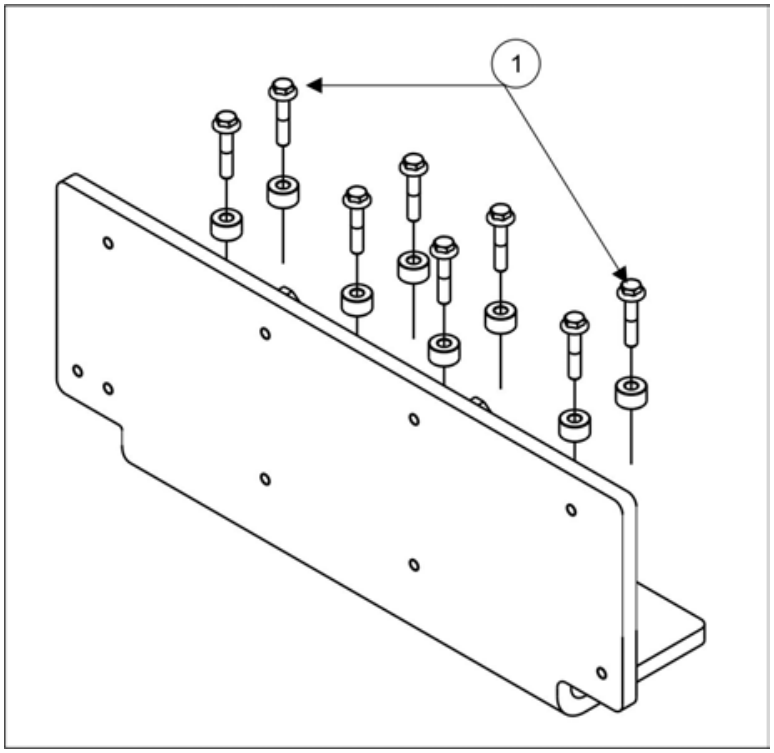
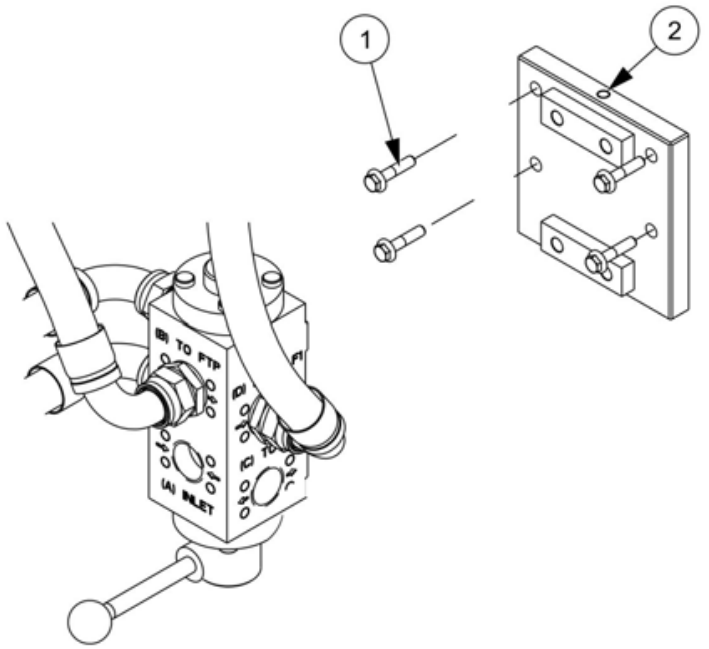


FIGURE 357. FILTER HEAD BRACKET TO GENERATOR SET SKID

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10. Install lifting aid in the valve mounting bracket.
    - Valve assembly weight is 60 lb (27 kg).
    - Lift aid thread pitch is M12 X 1.75.
11. Remove four bolts that attach the selector valve and mounting bracket to the generator set.



No.	Description	No.	Description
1	Bolts	2	Lifting aid location

FIGURE 358. SELECTOR VALVE AND MOUNTING BRACKET

12. Remove the selector valve and the mounting bracket from the generator set skid.
13. Remove four bolts that attach the selector valve to the mounting bracket.

6.6.4.2 Duplex Fuel Filter Installation

6.6.4.2.1 Required Tools

The following tools are required.

- 1-7/8” crowfoot wrench
- 2” crowfoot wrench
- Sockets
  - 13 mm
  - 16 mm
  - 17 mm
- 10" extension

- Strap wrench
- Torque wrench (20 - 100 Nm)
- Torque wrench (40 - 200 Nm)

6.6.4.2.2 Procedure

1. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See Section 6.1.2 on page 334.
2. Use the following to install clips to secure the water in fuel (WIF) sensor harness to the generator set skid rail:
   - Eight cable clips
   - Eight M10 X 1.5 X 30 flange bolts
   - Eight M10 flat washers

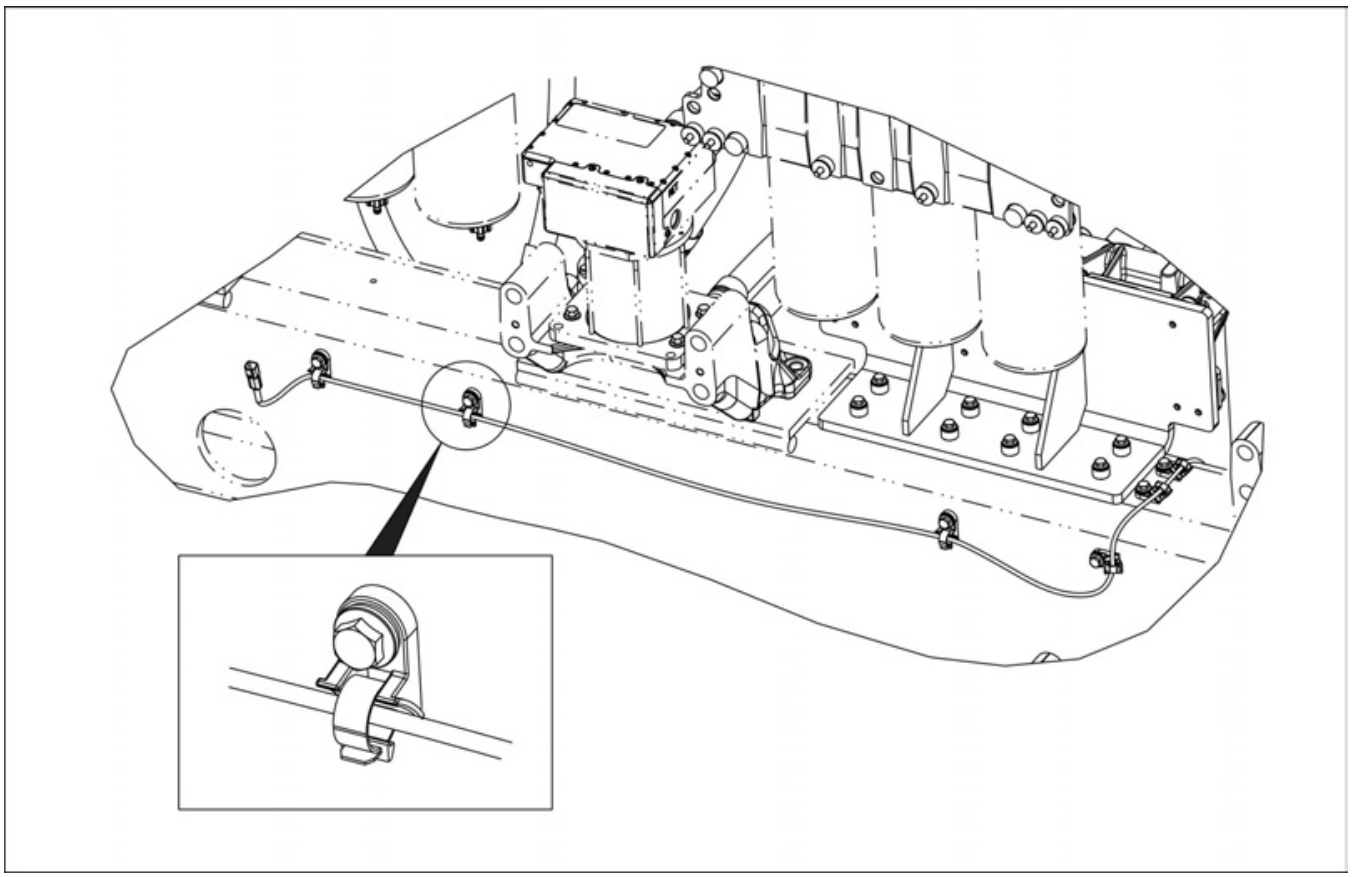


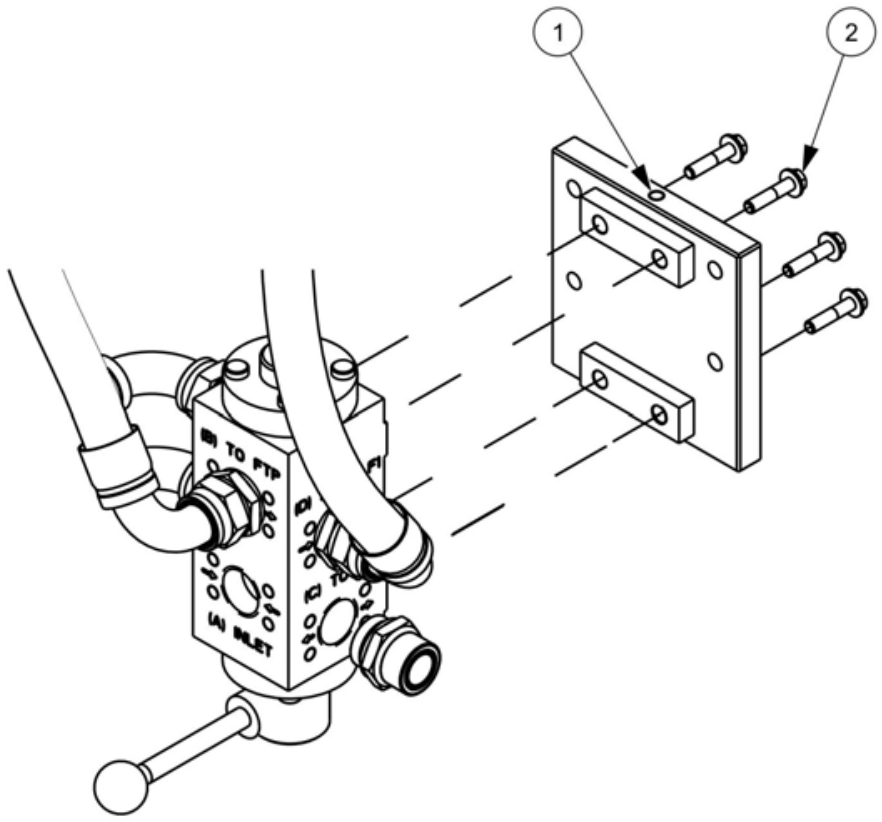
FIGURE 359. INSTALL CLIPS

NOTICE
Do not secure the water in fuel sensor harness to the clips at this time. The harness will be installed later.

3. Torque the eight flange bolts to 42 Nm.

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4. Make sure the threaded hold for the lifting aid is on the top side of the mounting bracket. Install the lifting aid on the mounting bracket.
   - Lifting aid thread pitch is M12 X 1.75
   - Valve assembly weight is 60 lb (27 kg)
5. Use the following to install the selector valve on the mounting bracket:
   - Four M12 X 1.75 X 45 flange bolts
6. Torque the four flange bolts to 80 Nm.

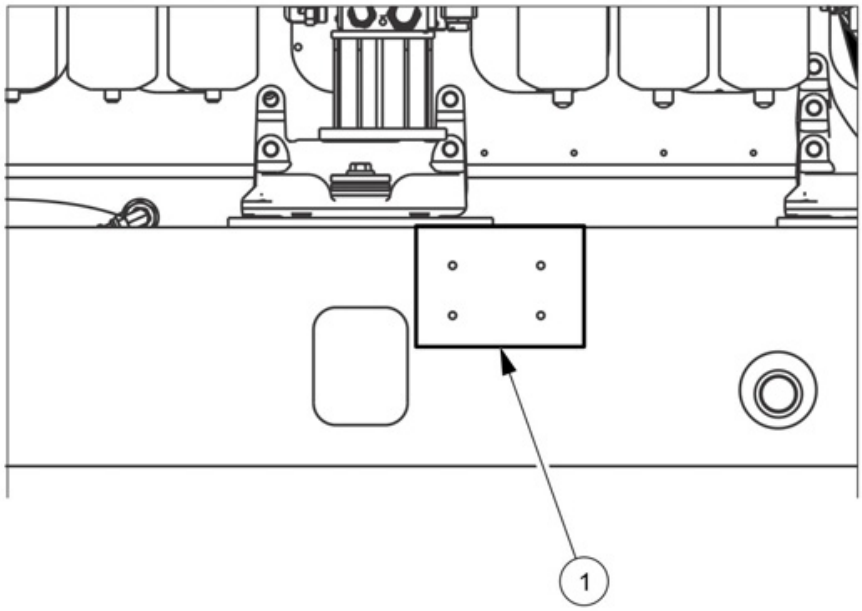


No.	Description	No.	Description
1	Lifting aid location	2	Flange bolts

FIGURE 360. SELECTOR VALVE AND MOUNTING BRACKET

7. Use the following to install selector valve and mounting bracket on generator set skid:
   - Four M12 X 1.75 X 45 flange bolts
8. Torque the four flange bolts to 80 Nm.

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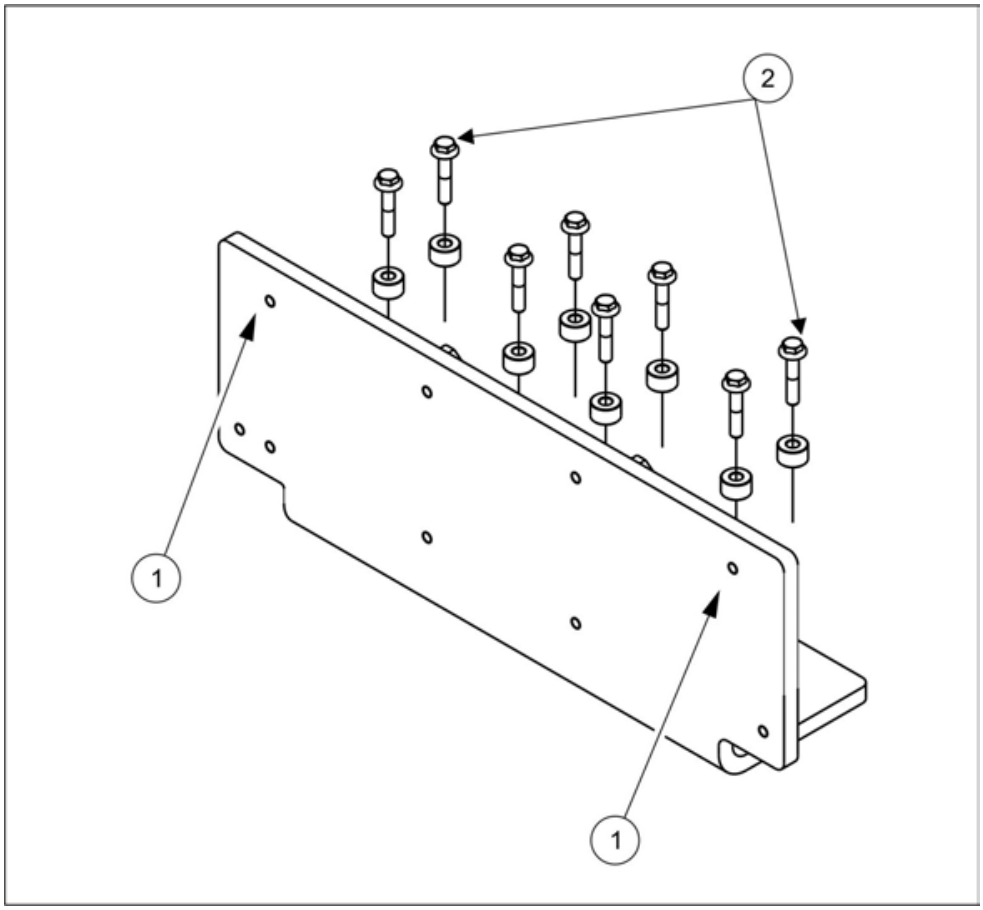


No.	Description	No.	Description
1	Selector valve location		

FIGURE 361. SELECTOR VALVE LOCATION ON GENERATOR SET SKID

9. Use the following to install the fuel filter head mounting bracket on the generator set skid:
   - Eight M10 X 1.5 X 50 flange bolts
   - Eight M10 spacers
10. The mounting bracket weight is 71 lb (32 kg).
11. Torque the flange bolts to 46 Nm.

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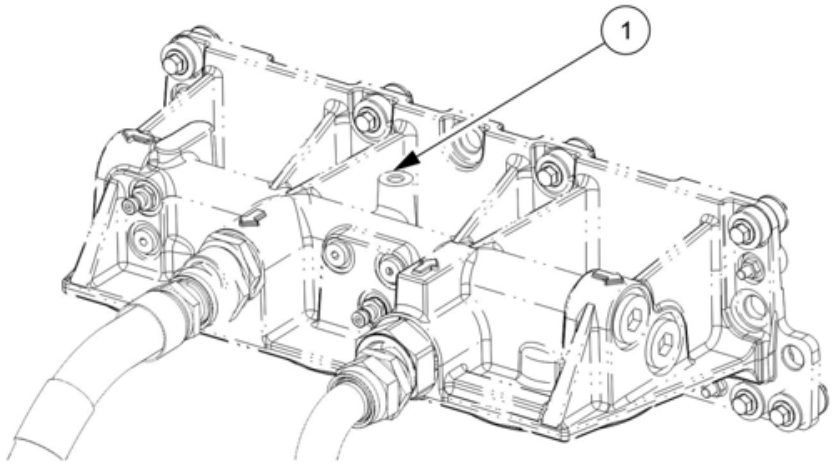


No.	Description	No.	Description
1	Location for alignment dowels	2	Flange bolts and spacers

FIGURE 362. FUEL FILTER HEAD MOUNTING BRACKET

12. Install alignment dowels in the fuel filter head mounting bracket.
13. Install a lifting aid on the fuel filter head.
    - Fuel filter head weight is 97.1 lb (44 kg).
    - Lifting aid thread pitch is M12 X 1.75.

NOTICE
Only lift the fuel filter head from the lifting aid location shown in Figure 363.



No.	Description	No.	Description
1	Lifting aid location		

FIGURE 363. FUEL FILTER HEAD LIFTING AID LOCATION

14. Use the following to install the fuel filter head on the mounting bracket.
    - Ten M10 X 1.5 X 50 flange bolts
    - Ten vibration isolators

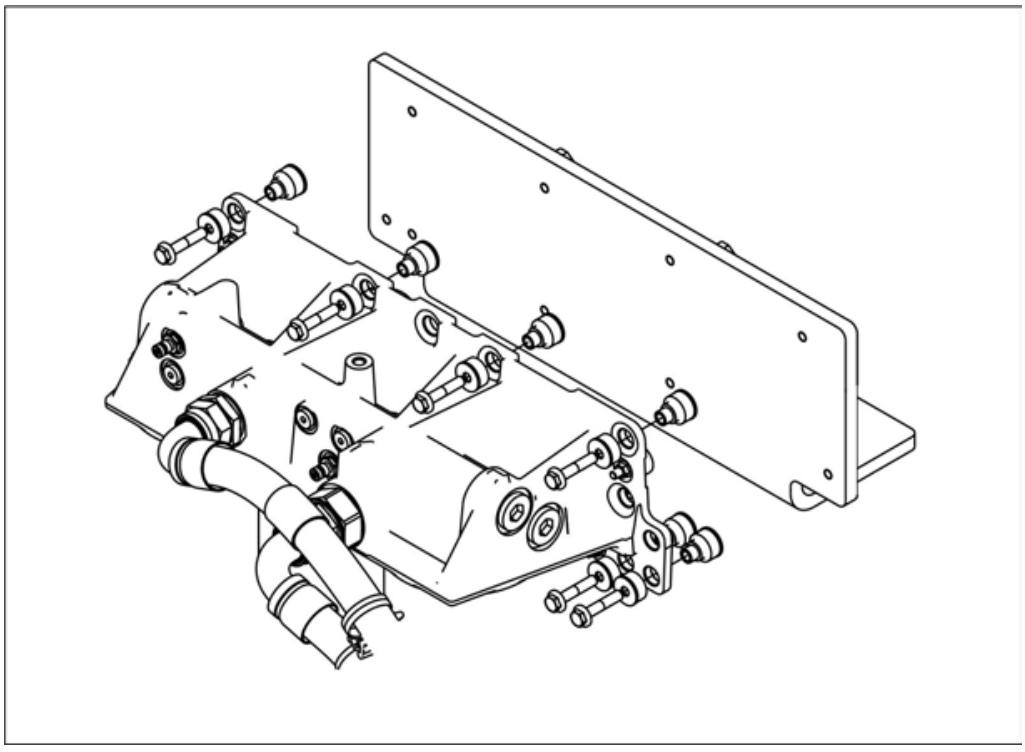


FIGURE 364. FUEL FILTER HEAD ON MOUNTING BRACKET

a. Use soapy water to lubricate isolators to aid installation.

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b. Install eight mounting bolts first.

c. Snugly tighten the eight mounting bolts.

d. Remove the alignment dowels.

e. Install two mounting bolts.

f. Torque the mounting bolts to 46 Nm in the sequence shown in **Figure 365**.

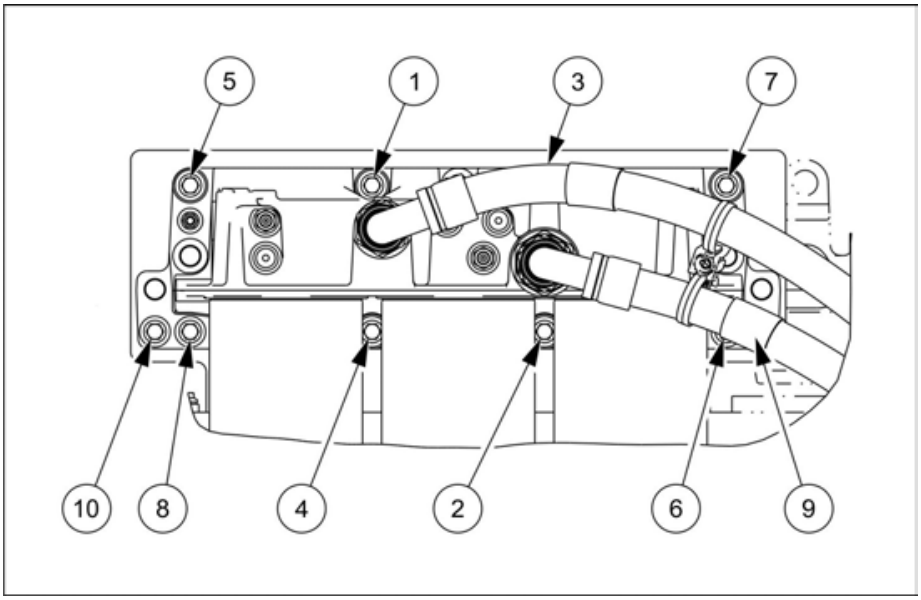
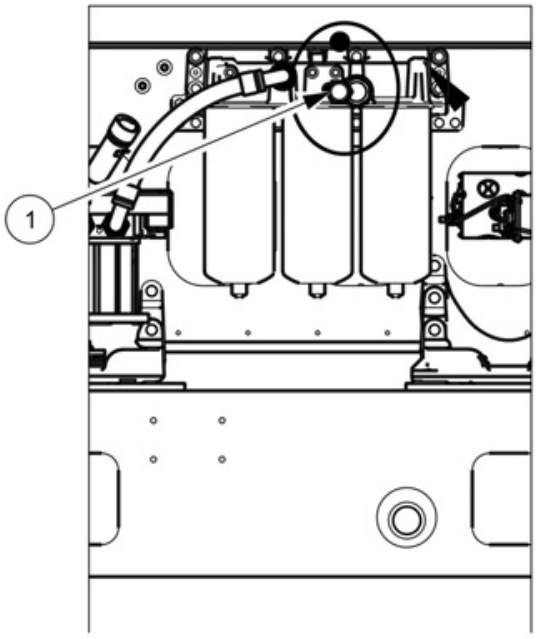


FIGURE 365. TORQUE SEQUENCE FOR FILTER HEAD

15. Remove the inlet fitting from the engine state 1 fuel filter head assembly.

NOTICE
The JIC fitting from the engine stage 1 filter head assembly can be reused and installed in the selector valve for the customer connection.



No.	Description	No.	Description
1	Inlet fitting location		

FIGURE 366. STAGE 1 INLET FITTING LOCATION

16. Install the duplex fuel hose fitting in the engine state 1 fuel filter assembly.
17. Torque the inlet fitting to 183 Nm.
18. Loosely install the fuel hoses on the duplex filter head, the selector valve, the fuel supply pump (FSP), and the engine stage 1 fuel filter head (**Figure 367**).

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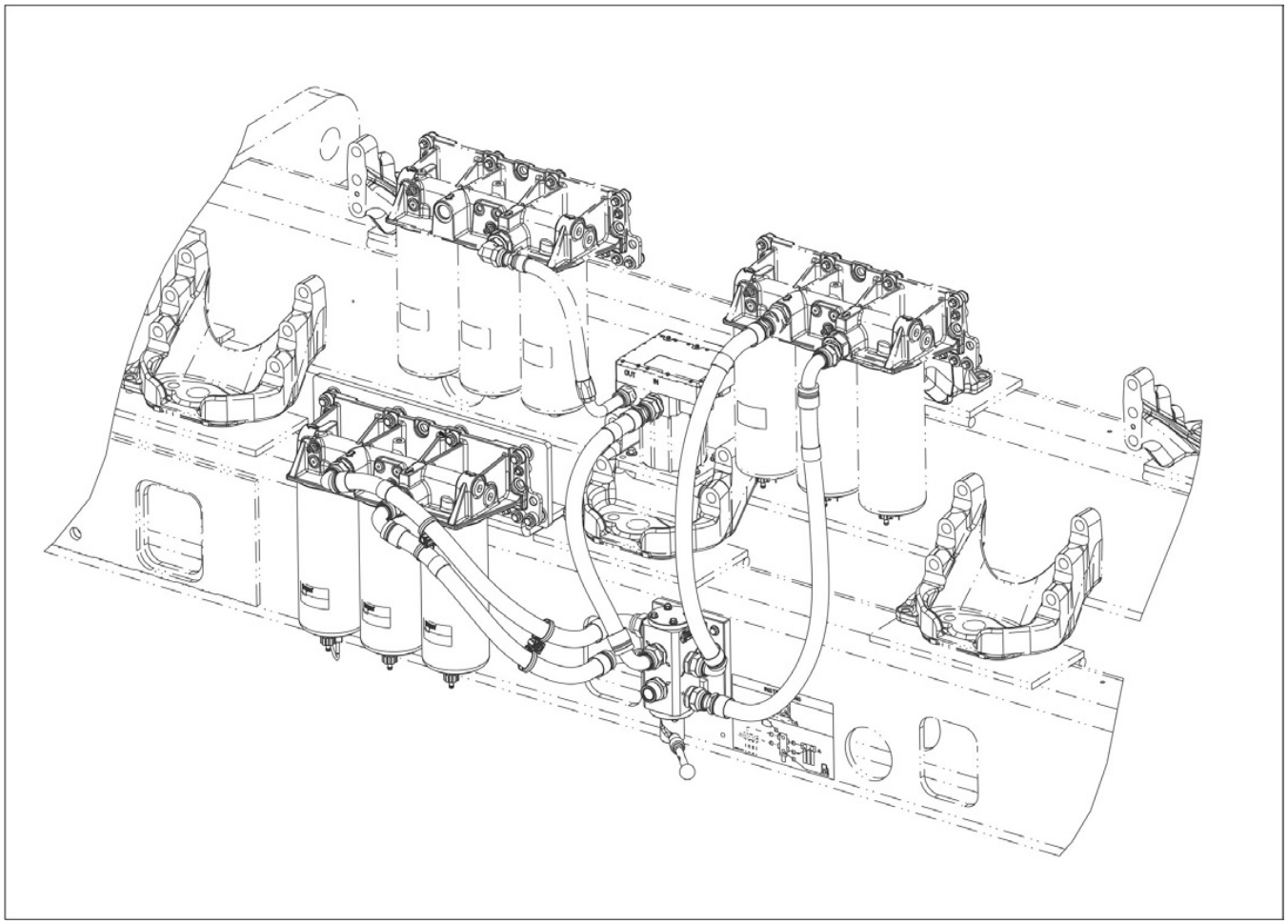
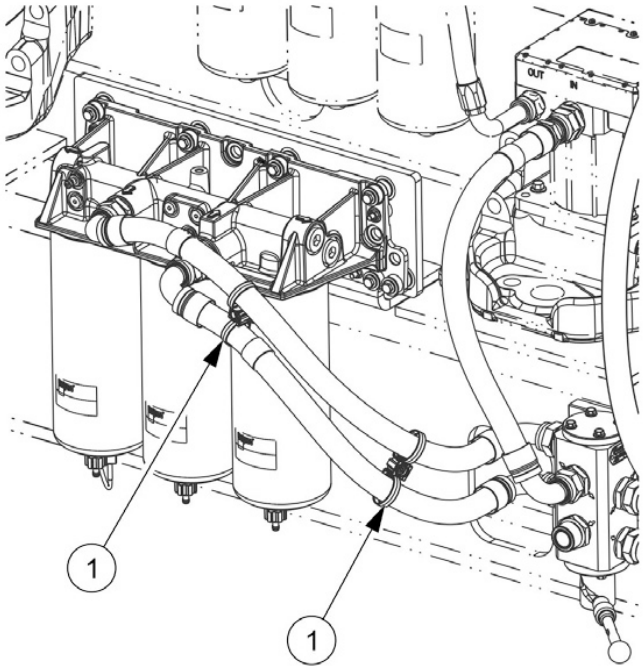


FIGURE 367. FUEL HOSE LOCATIONS

19. Install two hose spacers on the duplex filter supply supply and return hoses.

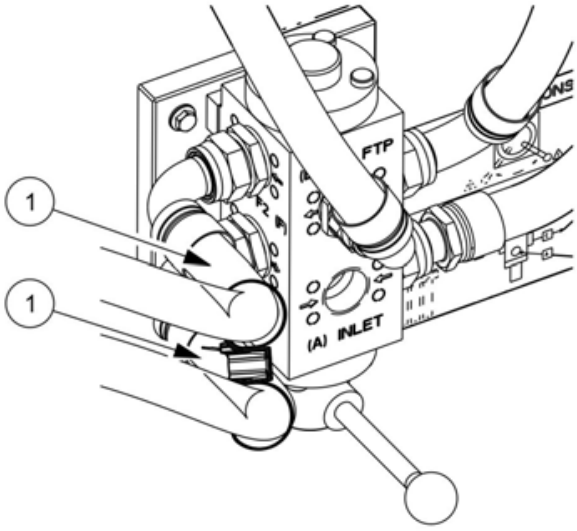


No.	Description	No.	Description
1	Fuel hose spacer		

FIGURE 368. FUEL HOSE SPACERS

20. Make sure that the fuel hoses are not touching any generator set component before and after the hoses are torqued.
21. The supply and return hoses from the duplex fuel filter head must be parallel with the ground or floor after installation of the selector valve and after the hoses are torqued.

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No.	Description	No.	Description
1	Parallel part of hoses		

FIGURE 369. PARALLEL PART OF FUEL HOSES

22. Torque the fuel hoses to 180 Nm.
23. Install three fuel filters on the duplex fuel filter head. Do not pre-fill the fuel filters with fuel before installation.

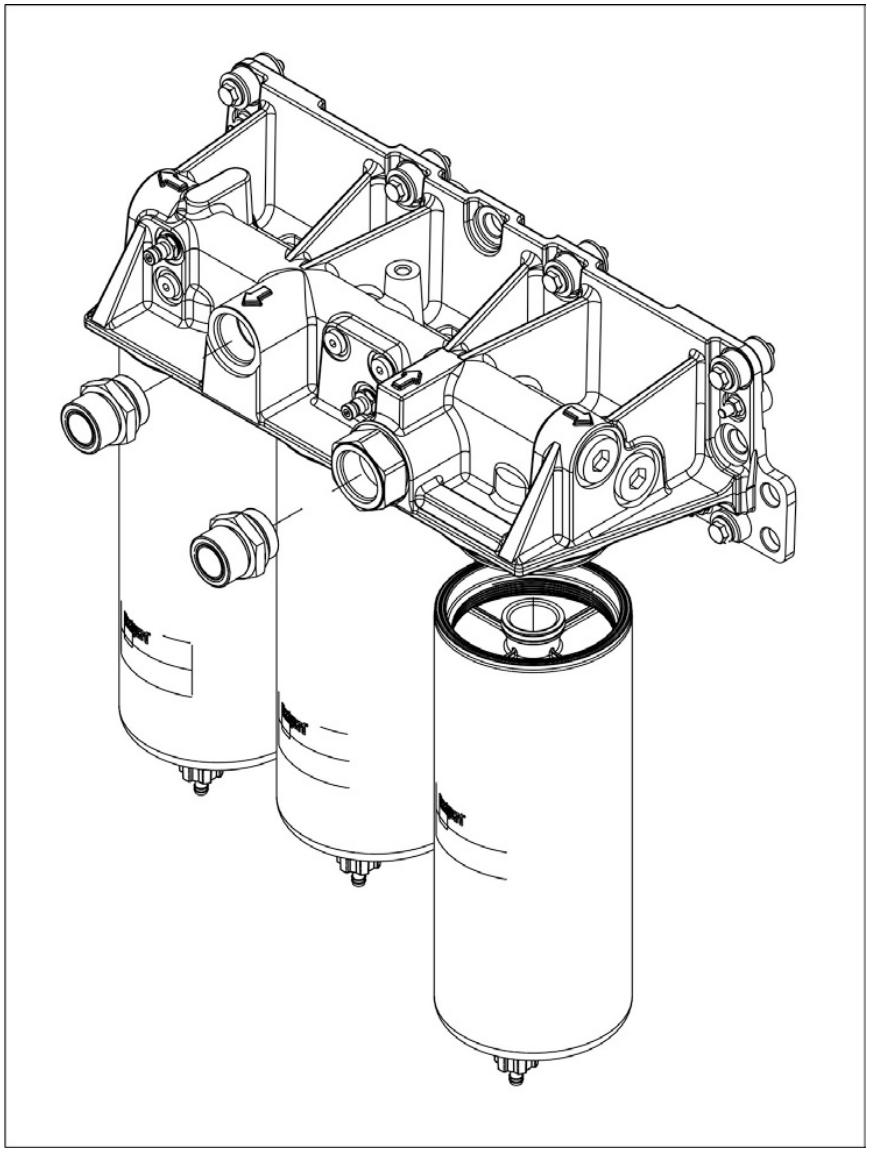


FIGURE 370. FUEL FILTERS ON DUPLEX FUEL FILTER HEAD

24. Complete installation of the water in fuel (WIF) sensor. Secure the harness to the generator set skid with cable ties connected through the clips bolted to the generator set skid rail.

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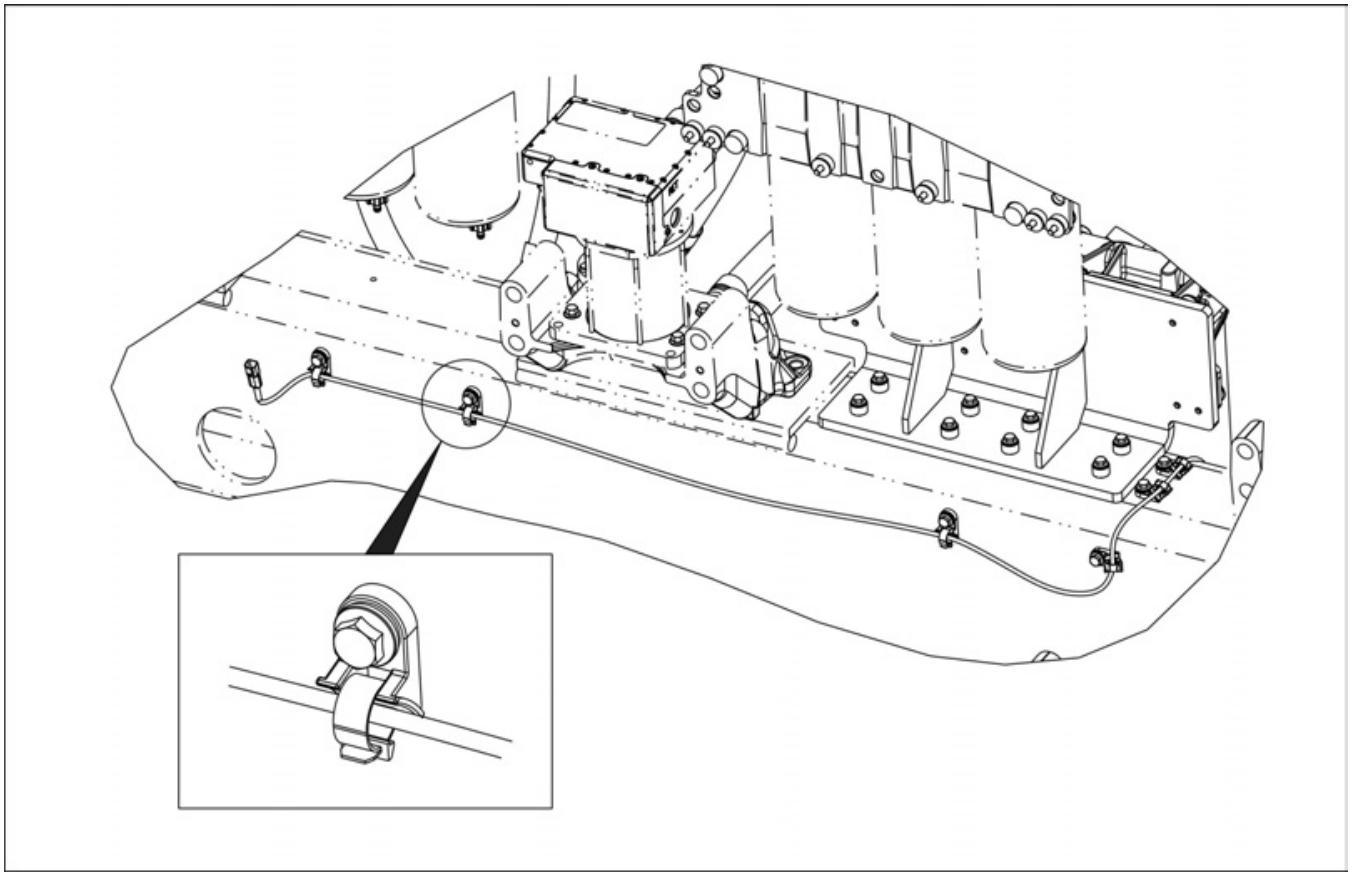
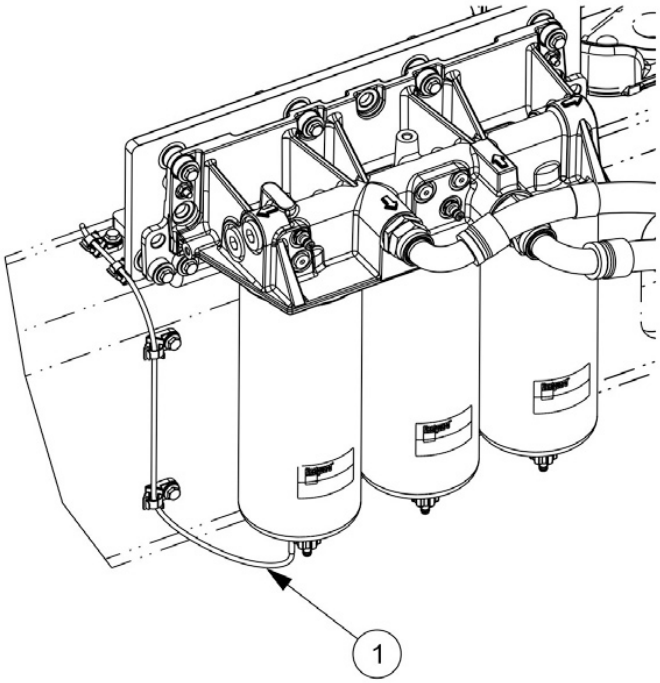


FIGURE 371. CABLE TIES AND CLIPS

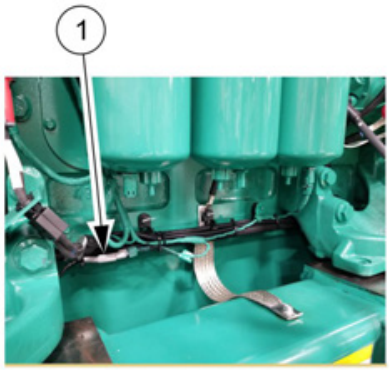
25. Connect the water in fuel sensor harness to the left filter of the duplex fuel filter assembly (**Figure 372**) and to the engine harness (**Figure 373**).

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No.	Description	No.	Description
1	Water in fuel sensor harness		

FIGURE 372. WATER IN FUEL SENSOR HARNESS CONNECTION TO FUEL FILTER

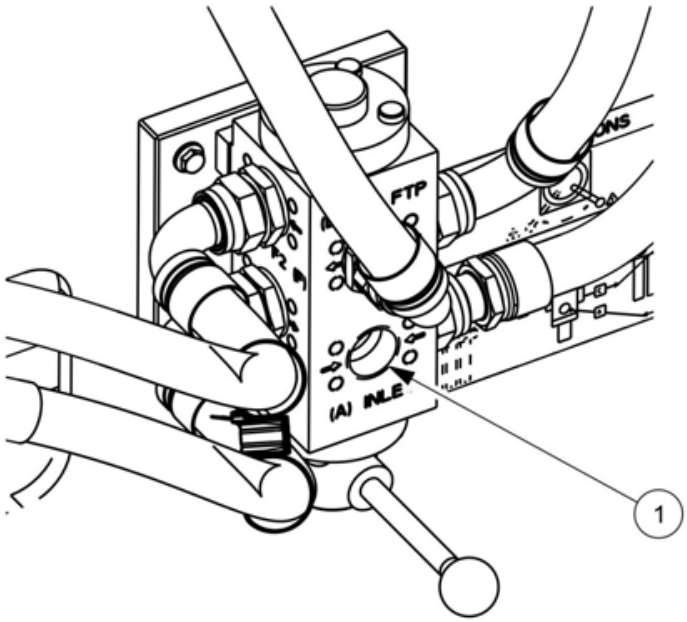


No.	Description	No.	Description
1	Water in fuel sensor harness to engine harness connection		

FIGURE 373. WATER IN FUEL SENSOR HARNESS CONNECTION TO ENGINE HARNESS

26. Connect the fuel supply line to the selector valve.

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No.	Description	No.	Description
1	Customer fuel supply connection location		

FIGURE 374. FUEL SUPPLY CONNECTION

27. Turn the selector valve to the left side position . The duplex fuel filter assembly is operational.
28. Reconnect sources of potential energy including 24 VDC.
29. Do the following to cycle the generator set keyswitch. Cycling the keyswitch runs the fuel supply pump (FSP) and primes the duplex fuel filter system.
    a. Pull the Emergency Stop switch out.
    b. Wait for two minutes.
    c. Push the Emergency Stop switch in.
    d. Wait for one minute.
    e. Pull the Emergency Stop switch out.
30. Turn the selector switch to the right side position. The stage 1 fuel filter assembly is operational. Repeat step 29.

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6.6.5 Canister Fuel Filter

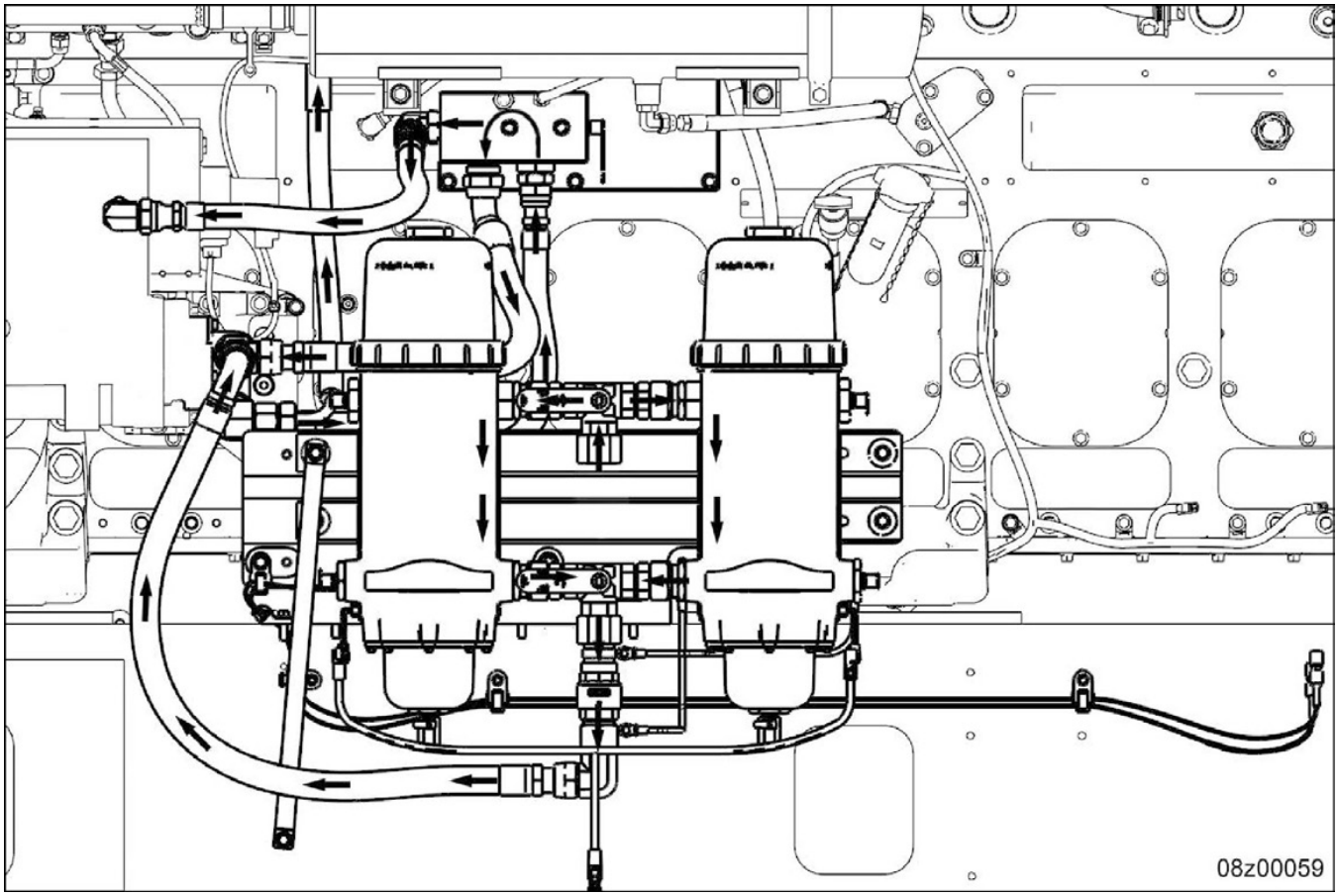


FIGURE 375. CANISTER FUEL FILTER FLOW DIAGRAM

6.6.5.1 Canister Fuel Filter Assembly Removal

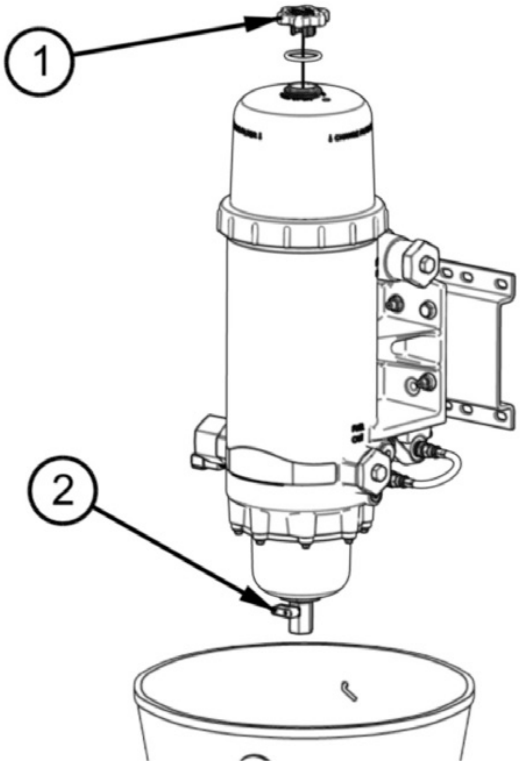
6.6.5.1.1 Required Tools

The following tools are required.

- Collar Wrench, Fleetgard Part Number SP1076
- Fuel System Clean Care Kit, Part Number 5394230
- Container suitable for fuel – approximately 28.5 L (7.5 US gal)

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6.6.5.1.2 Drain the Filter



No.	Description	No.	Description
1	Vent Cap	2	Drain Valve

FIGURE 376. DRAINING THE FILTER

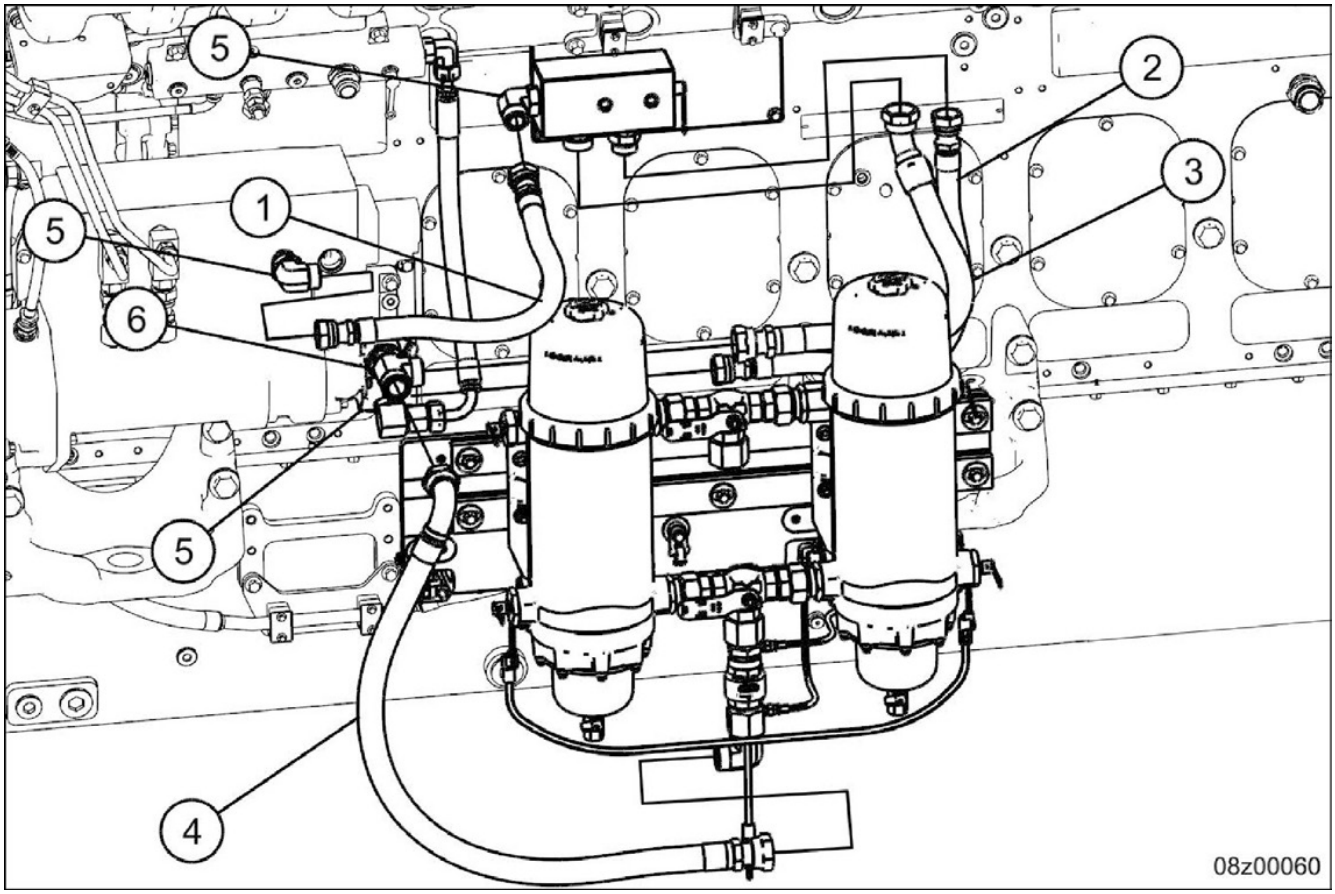
1. Shut off the engine.
2. Close the fuel supply to the filters.
3. Place suitable container under canister type fuel filter to collect fluid that will be drained.
4. Loosen vent cap (1).
5. Open drain valve (2).
6. Drain all fuel from the filter housing.

   The drained liquids must be disposed of in accordance with local environmental regulations.
7. Close drain valve.
8. Tighten vent cap by hand until a click is heard.

Repeat for each canister type fuel filter.

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6.6.5.1.3 Canister Fuel Filter Plumbing



No.	Description	No.	Description
1	Fuel Supply Line – Fuel supply manifold to high pressure fuel pump	4	Fuel Supply Line – Canister type fuel filter to Fuel Transfer Pump
2	Fuel Supply Line – Fuel Supply manifold to fuel transfer pump	5	Male union elbows
3	Fuel Supply Line – Fuel transfer pump male union tee to fuel supply manifold	6	Male union tee

FIGURE 377. CANISTER FUEL FILTER LINE DIAGRAM

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6.6.5.1.3.1 Fuel Supply Line – Remove

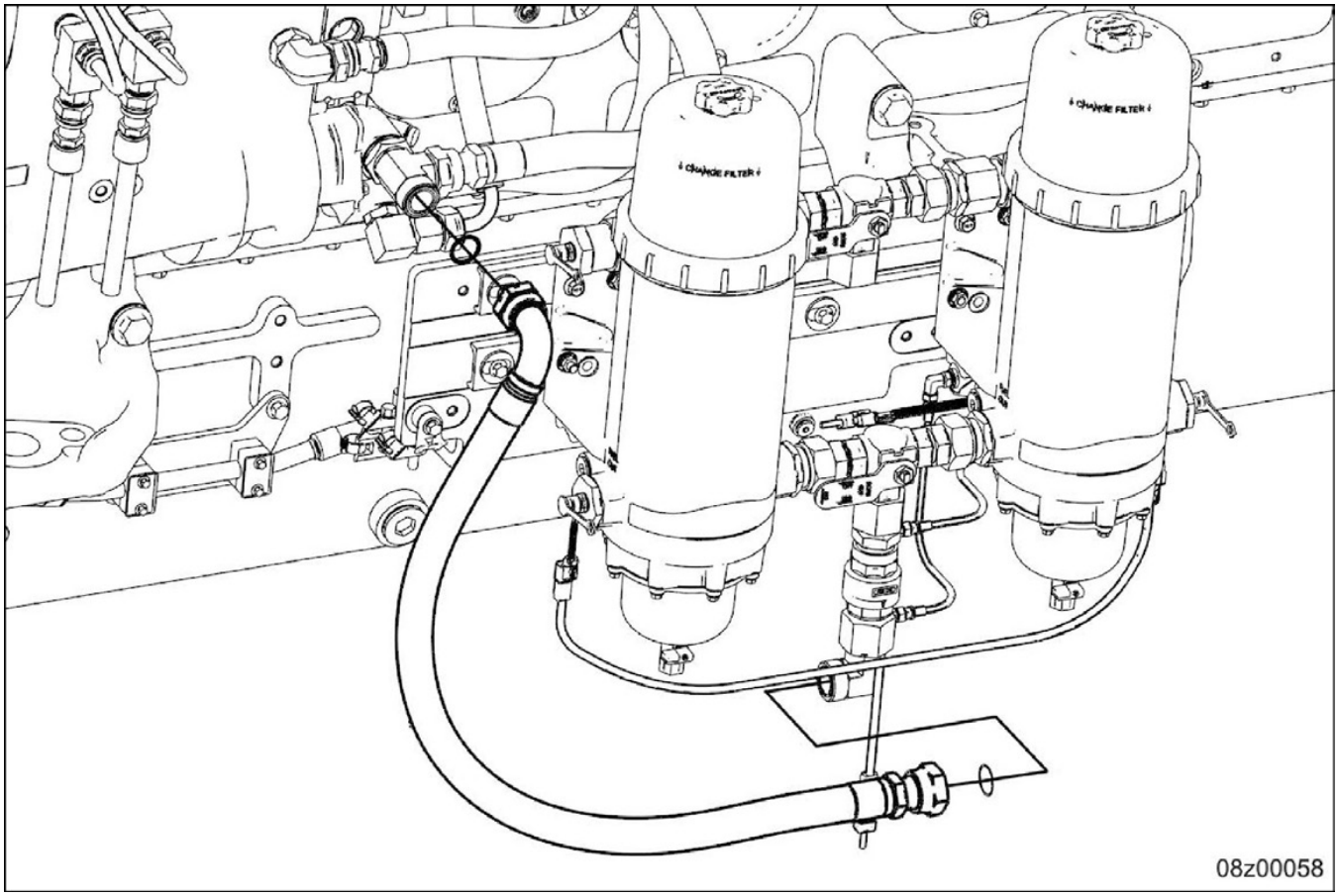


FIGURE 378. CANISTER FUEL FILTER SUPPLY LINE

Remove fuel supply line connecting the canister type fuel filter to the fuel transfer pump. When loosening fuel supply line, hold male union with a second wrench to prevent rotation.

Remove and discard o-ring seals.

Cover ends of fuel supply line using protective caps from fuel system clean care kit, Part Number 5299201.

Place fuel supply line in clean plastic bag.

6.6.5.1.4 Wiring Harnesses

6.6.5.1.4.1 Fuel Transfer Pump Wiring Harness – Remove

Disconnect the wiring harness connector from the lift pump at the base of each canister type fuel filter.

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6.6.5.1.4.2 Water–in–Fuel Sensor Wiring Harness – Remove

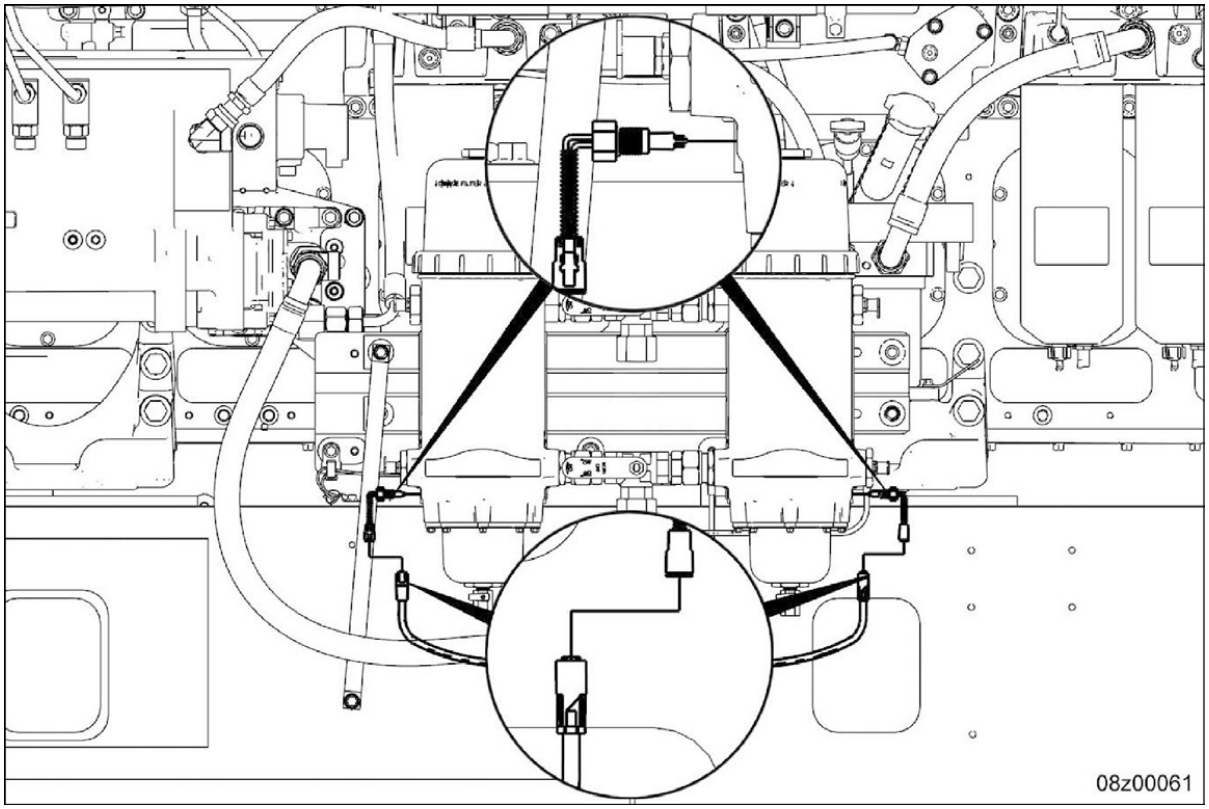


FIGURE 379. CANISTER FUEL FILTER WATER-IN-FUEL SENSORS

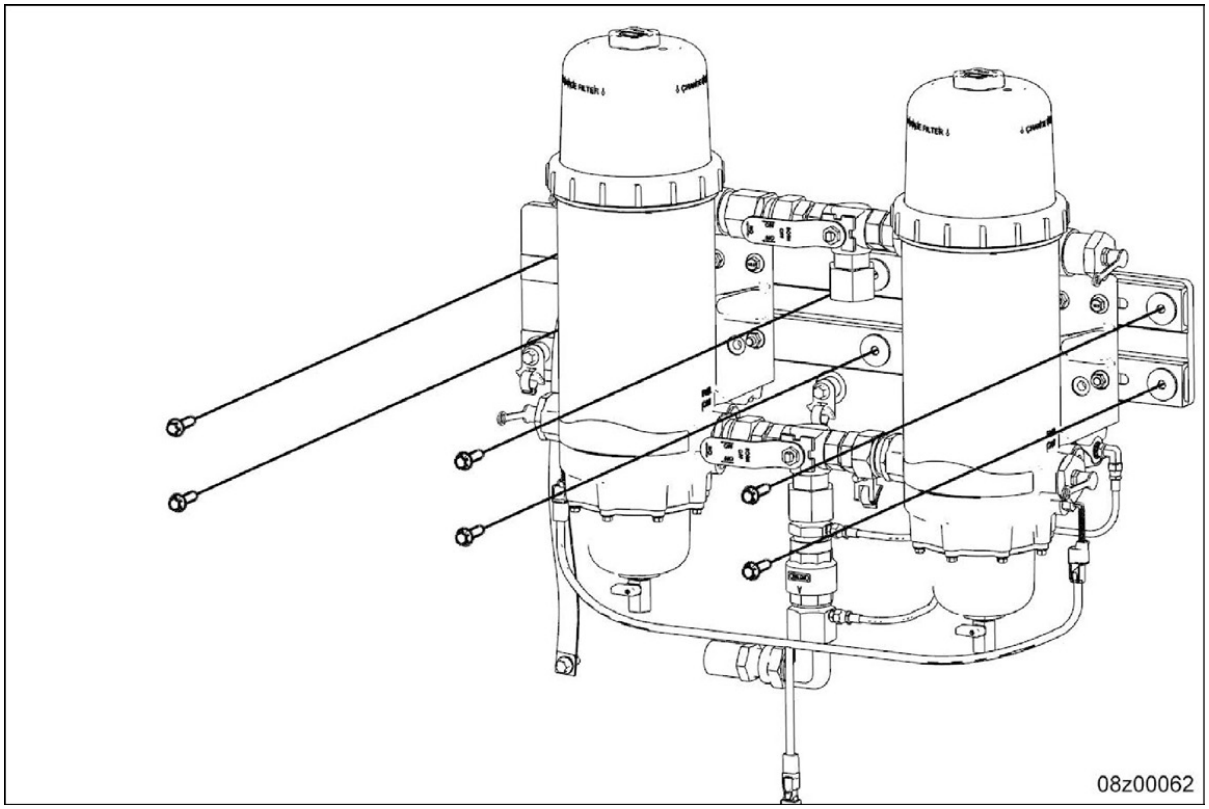
Each industrial pro fuel/water separator duplex tall housing has a water–in–fuel sensor, the engine wiring harness connects to the two sensors.

The water-in-fuel sensor is integrated into each industrial pro fuel/water separator duplex tall housing. The sensors are serviceable and can be removed for cleaning.

Disconnect the wiring harness connectors from both water–in–fuel sensors.

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6.6.5.1.5 Filter Housing – Remove



The canister fuel filter housing weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.

Remove canister type fuel filter housing. Remove six cap screws (1), from canister type fuel filter housing mounting spacer.

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6.6.5.1.6 Filter Housing Mounting Bracket– Remove

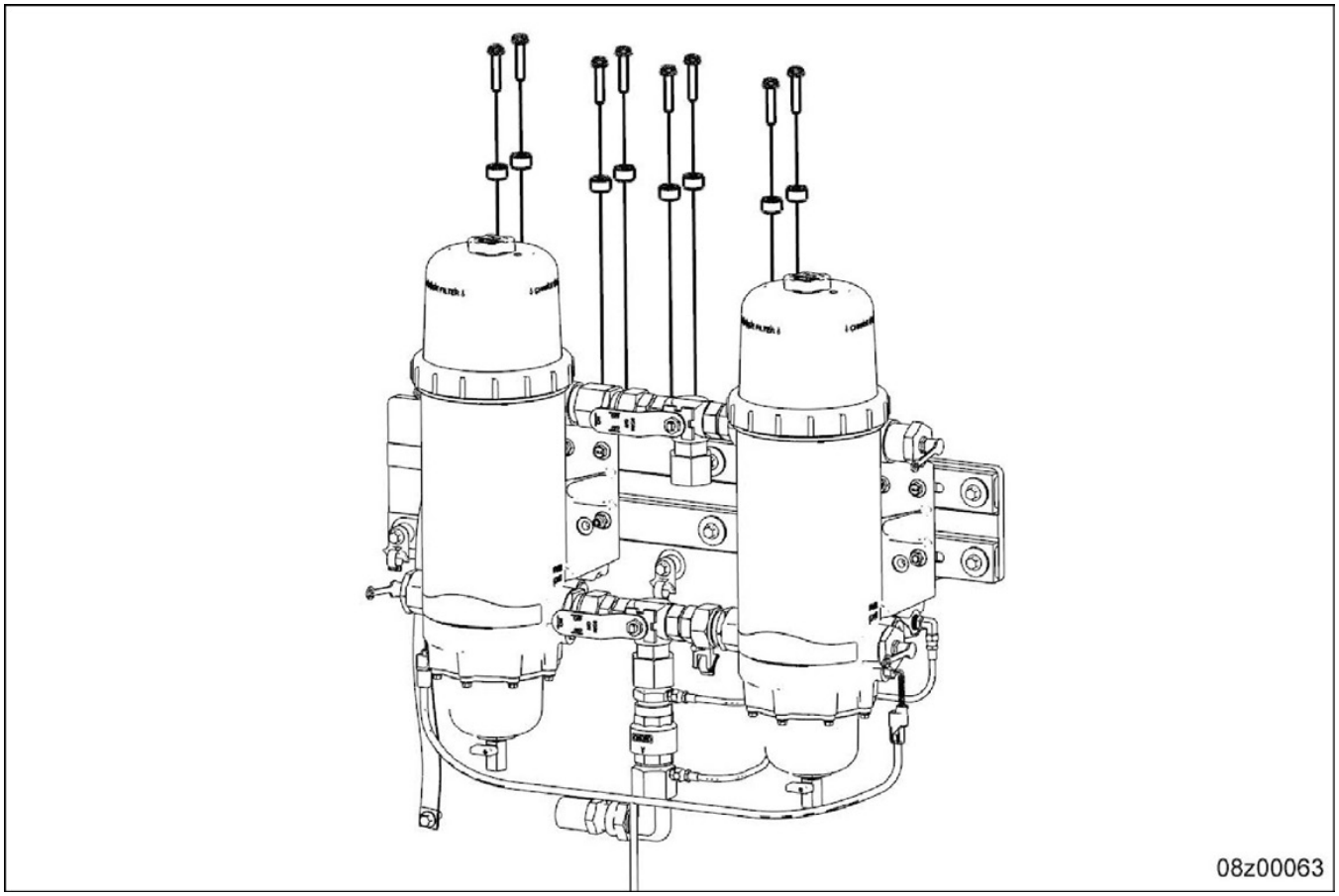


FIGURE 380. CANISTER FUEL FILTER MOUNTING BRACKET

Remove canister type fuel filter housing mounting bracket. Remove eight cap screws and spacers.

Remove filters.

Disassemble and clean filters. Section 6.6.6.2.2 on page 751

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6.6.5.2 Canister Fuel Filter Assembly Install

6.6.5.2.1 Filter Housing Mounting Bracket– Install

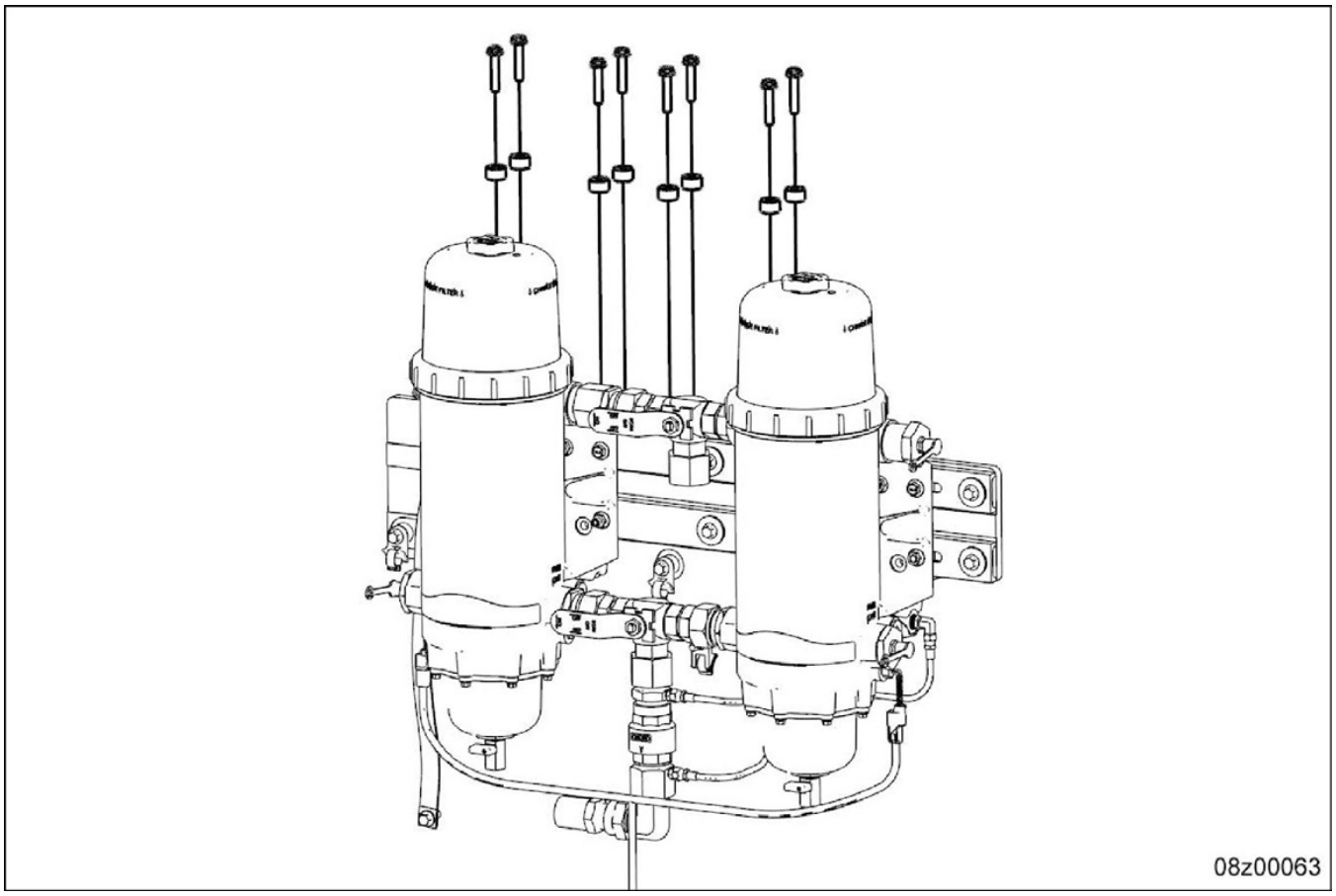


FIGURE 381. CANISTER FUEL FILTER MOUNTING BRACKET

Install the canister type fuel filter housing mounting bracket. Install eight cap screws and spacers.

Torque Value: 65 Nm (48 ft-lb)

6.6.5.2.2 Filter Housing – Install

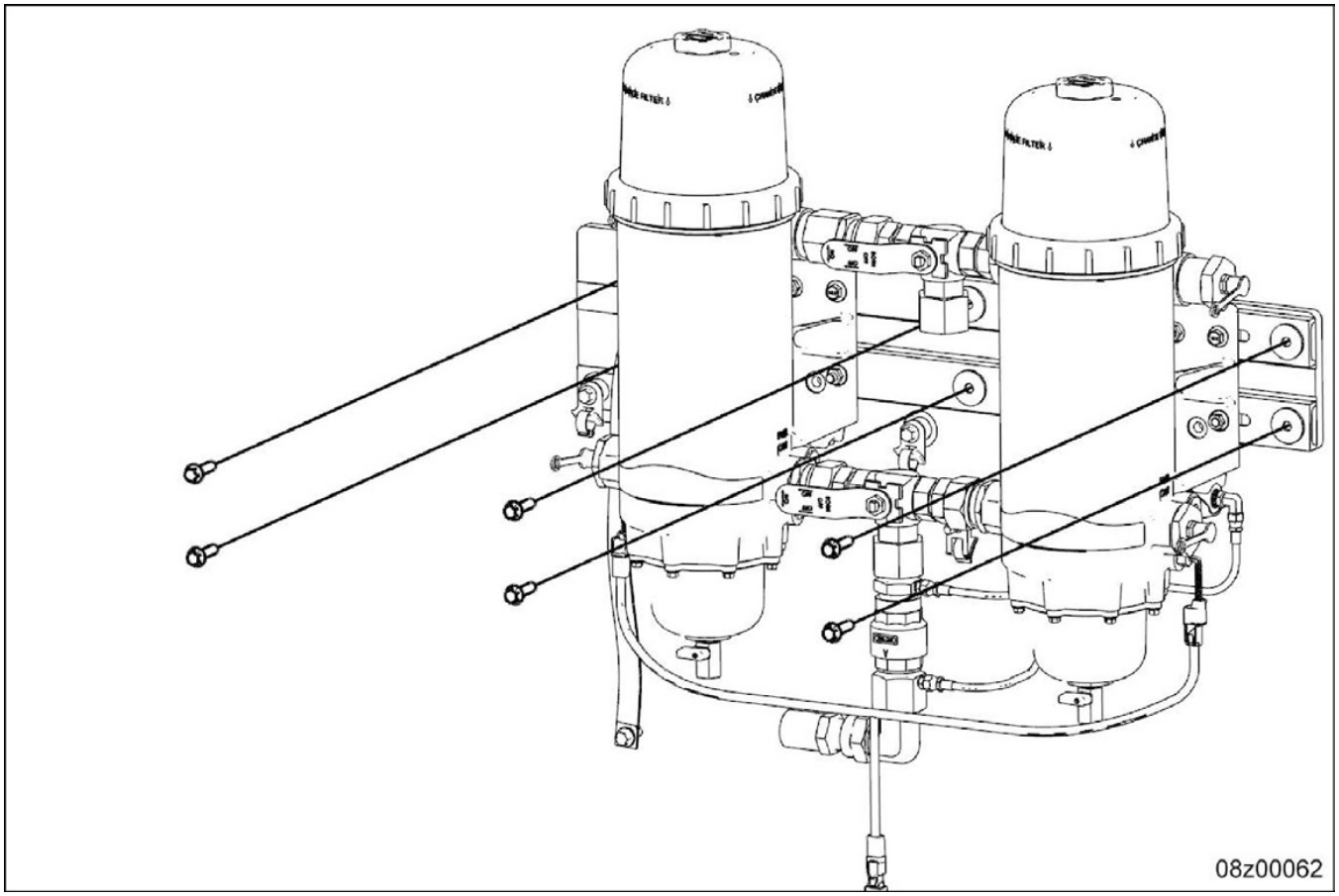


FIGURE 382. CANISTER FUEL FILTER HOUSING

The canister fuel filter housing weighs greater than 23 kg [50 lb]. To prevent serious personal injury, be sure to have assistance or use appropriate lifting equipment to lift this component or assembly.

Install the canister type fuel filter housing on the mounting bracket. Install six cap screws to canister type fuel filter housing mounting spacer.

Torque Value: 46 Nm (34 ft-lb)

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6.6.5.2.3 Wiring Harnesses

6.6.5.2.3.1 Water–in–Fuel Sensor Wiring Harness – Install

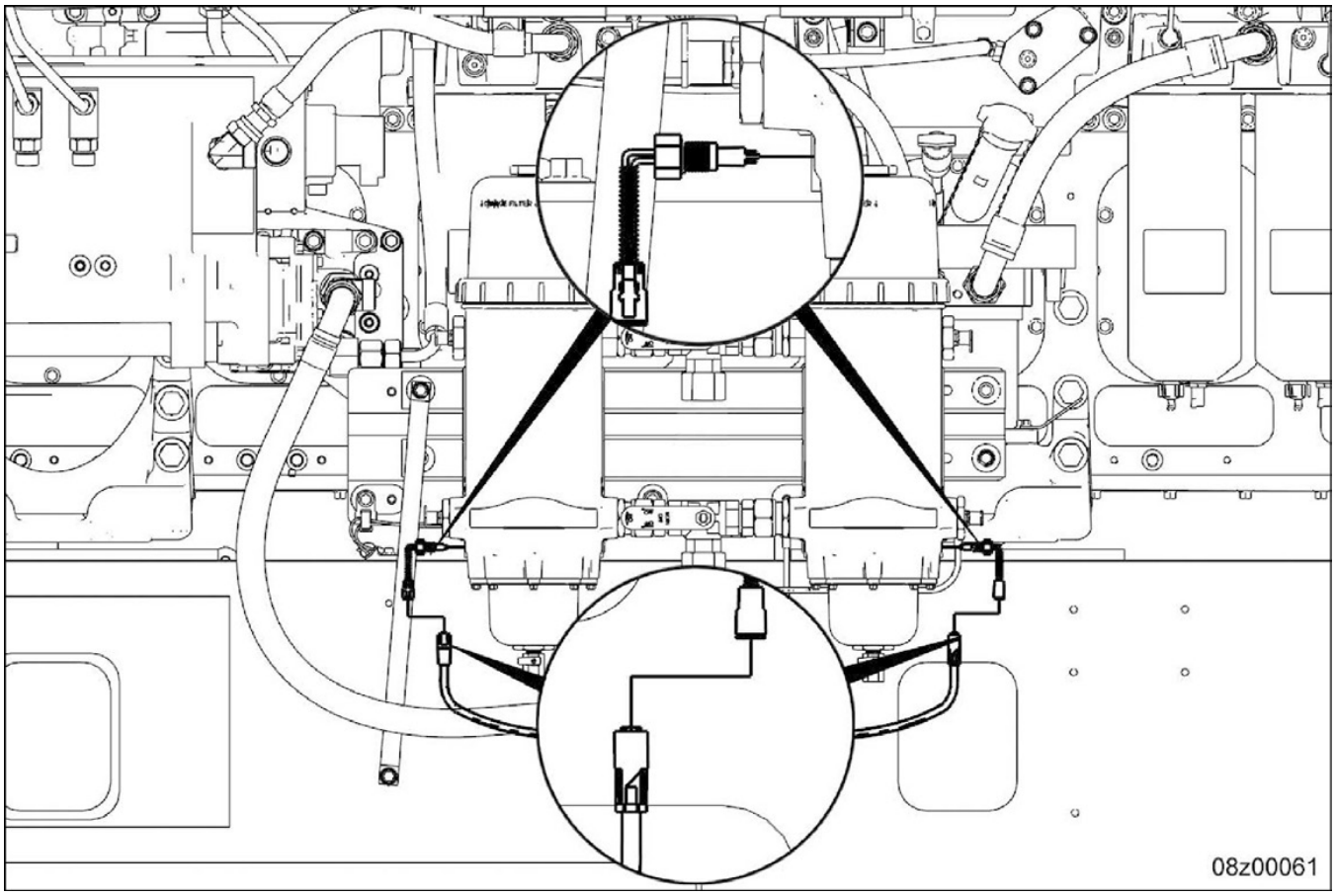


FIGURE 383. CANISTER FUEL FILTER WATER-IN-FUEL SENSORS

Connect the wiring harness connectors for the water–in–fuel sensors at the bottom of each canister.

6.6.5.2.3.2 Fuel Transfer Pump Wiring Harness – Install

Connect the wiring harness connector to the lift pump on each canister type fuel filter.

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6.6.5.2.4 Fuel Supply Line – Install

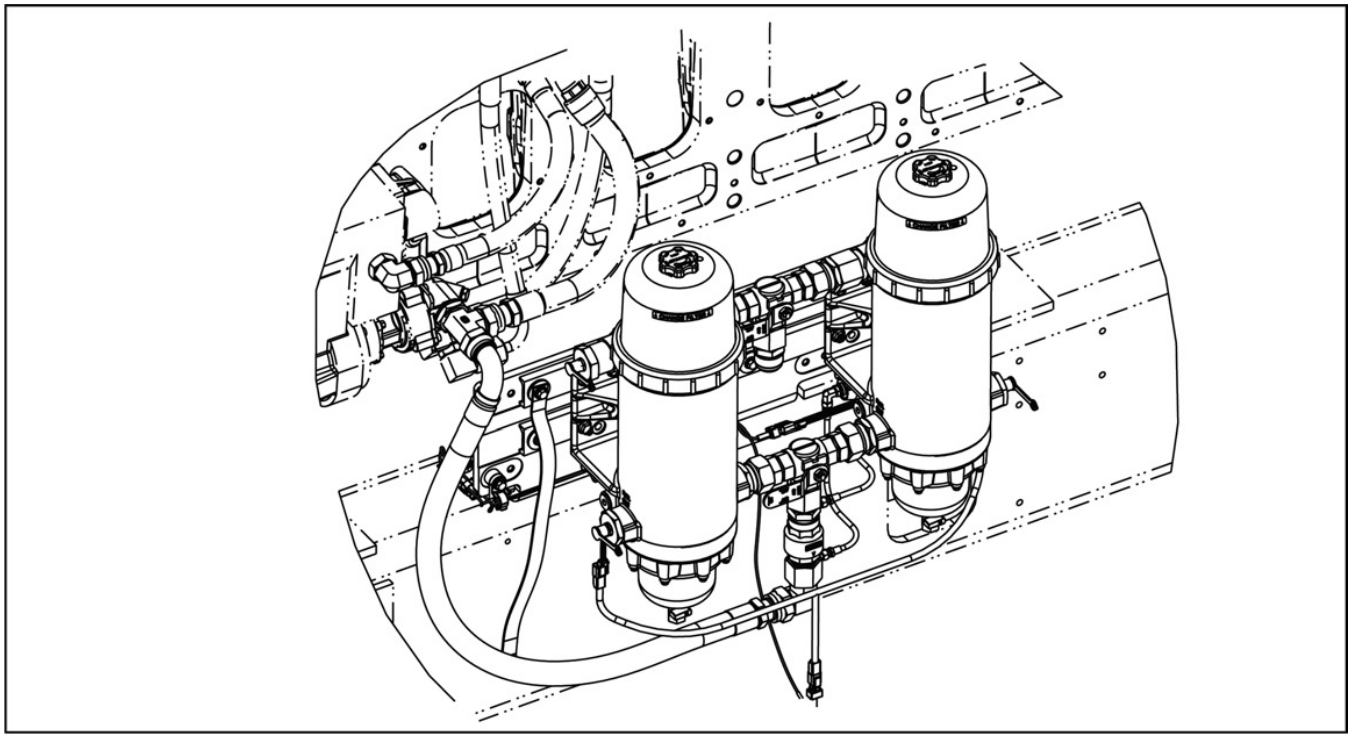


FIGURE 384. CANISTER FUEL FILTER SUPPLY LINE

Remove the protective caps.

Install new o-ring seals.

Install fuel supply line connecting the canister type fuel filter to the fuel transfer pumps. When tightening the fuel supply line, hold the male union with a second wrench to prevent rotation.

Torque Value: 205 Nm (151 ft-lb)

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6.6.5.2.5 Fill the Filter

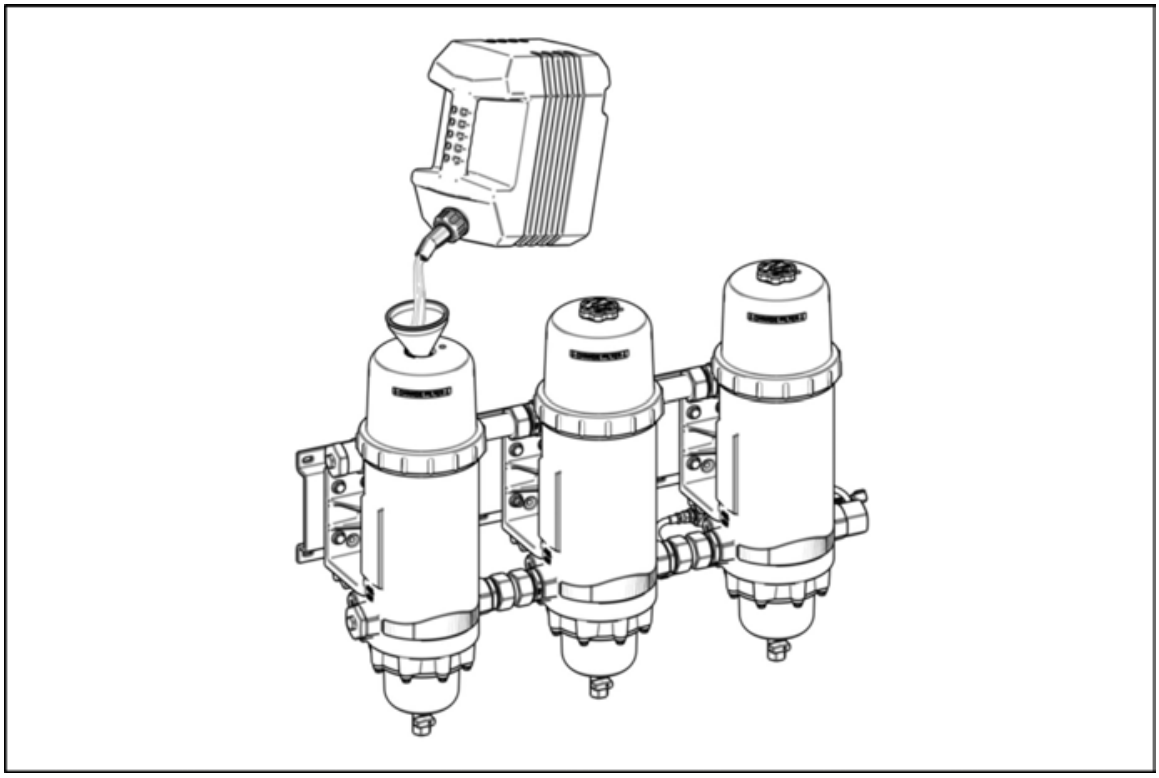


FIGURE 385. FILL CANISTER FUEL FILTER

Fill the filter housing with clean diesel fuel.

Repeat for each canister type fuel filter.

6.6.6 Fuel Filter Maintenance

6.6.6.1 Spin-on Fuel Filter

6.6.6.1.1 Fuel Filter - Drain

The Stage 1 fuel filters are also fuel-water separators. Three Stage 1 fuel filters are located on the left bank of the engine.

Refer to the engine specific manual for a more detailed procedure for draining the fuel filters.

Drain the water and sediment daily. Each filter must be drained individually.

To drain the water:

1. Shut off the engine.
2. Place a suitable container under the fuel filter.

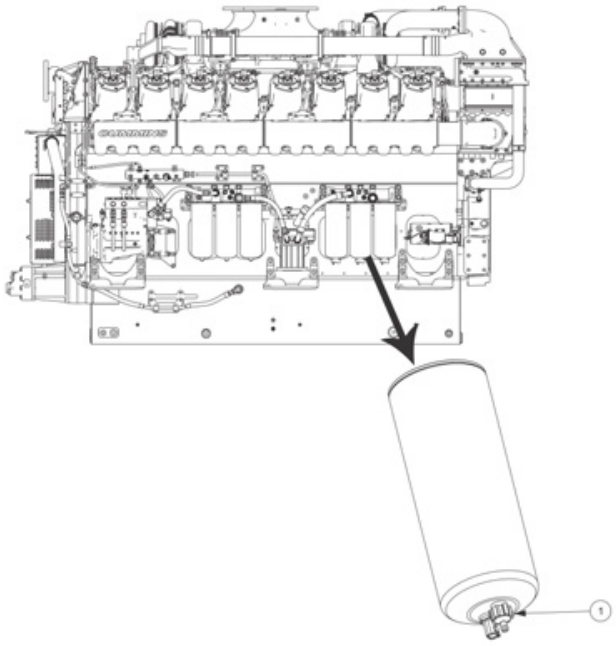
NOTICE
Stage 1 fuel filters have a combined capacity of approximately 23 L (6 US gal).

3. Open the drain valve on the bottom of the fuel filter by turning it counterclockwise until fluid begins to flow out. Accumulated water will drain first.
4. Drain the filter until clean fuel begins to flow out of the drain.

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5. Close the drain valve by lifting and turning clockwise until it is hand-tight.
6. Repeat process for all Stage 1 fuel filters.

The drained liquids must be disposed of in accordance with local environmental regulations.



No.	Description	No.	Description
1	Fuel filter drain valve		

FIGURE 386. FUEL FILTER

6.6.6.1.2 Fuel Filter Removal and Replacement

⚠ CAUTION

Benzine and lead.

Benzine and lead, found in some diesel oils, have been identified as causing cancer or reproductive toxicity.

When checking, draining, or adding diesel, take care not to ingest, breathe the fumes, or come into physical contact with the diesel.

NOTICE

Only authorized and competent personnel who are familiar with the equipment and its operation should carry out maintenance.

NOTICE

Before carrying out any maintenance, isolate all supplies to the generator set and any control panels. Render the set inoperative by disconnecting the battery.

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NOTICE

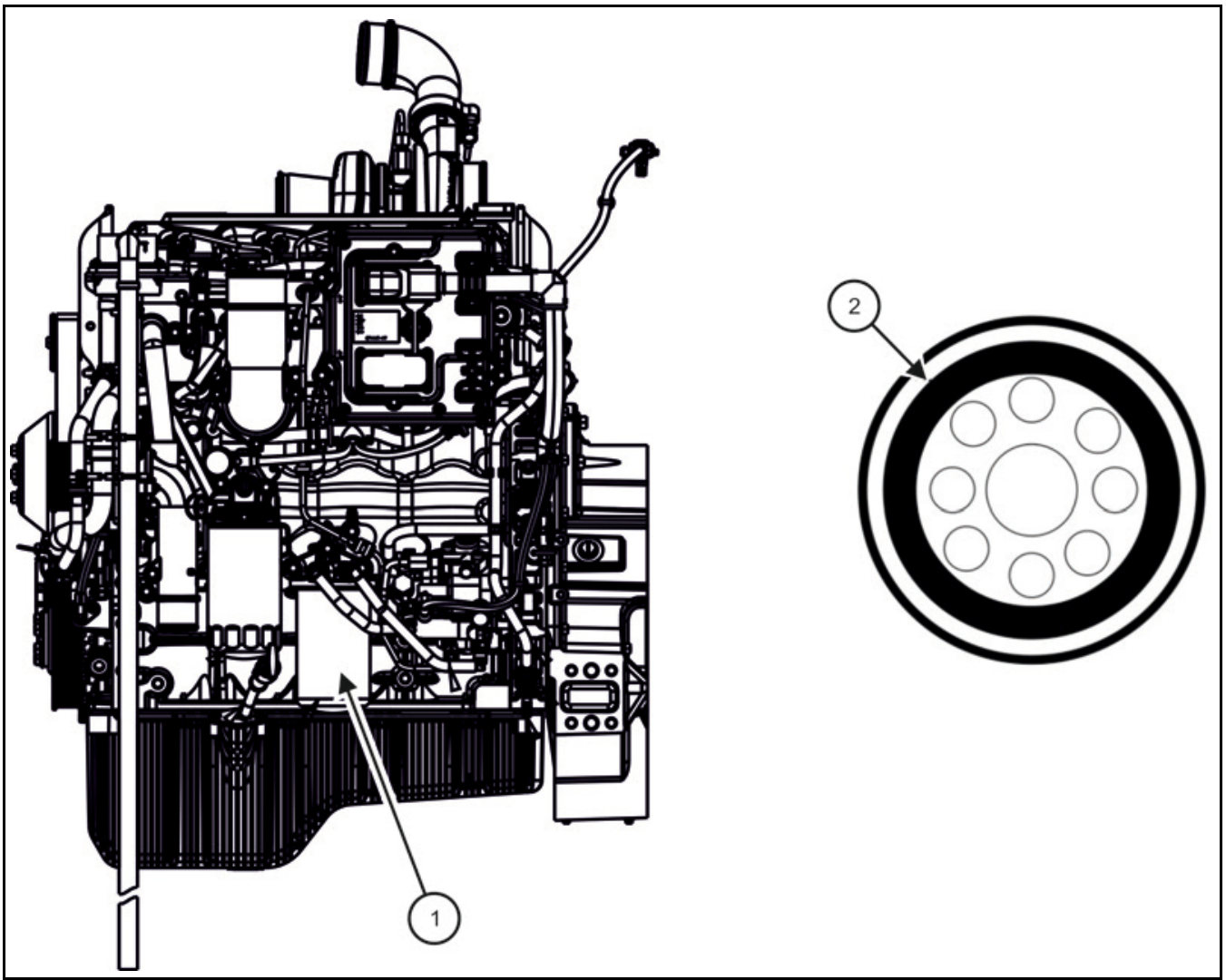
Shut down the generator set as described in the Operation and Maintenance Manual supplied with the generator set.

This procedure is to be used with spin-on-type fuel filters that do not include a separate, removable filter element. These filters are disposable and are to be removed and replaced with a new filter, instead of changing the internal element.

The following equipment is required to remove the fuel filter.

- Strap wrench
- Container to drain the remaining fuel from the filter into
- Lint-free cloth
- Clean fuel
- Disposable gloves

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No.	Description	No.	Description
1	Filter housing	#	Water drain tap and water sensor connector (If fitted)
2	O-ring seal		

FIGURE 387. FUEL FILTER

1. If the filter is fitted with one, disconnect the fuel/water sensor connector.
2. Place the lint-free cloth below the fuel filters(s).
3. Using a suitable strap wrench, release the fuel filter from the fuel filter housing.
4. Unscrew the fuel filter and empty the fuel into a suitable container.

NOTICE
Dispose of the fuel filter in accordance with local regulations.

5. Using the lint-free cloth, clean the filter housing.
6. Lubricate the O-ring seals on the new fuel filter with engine oil.

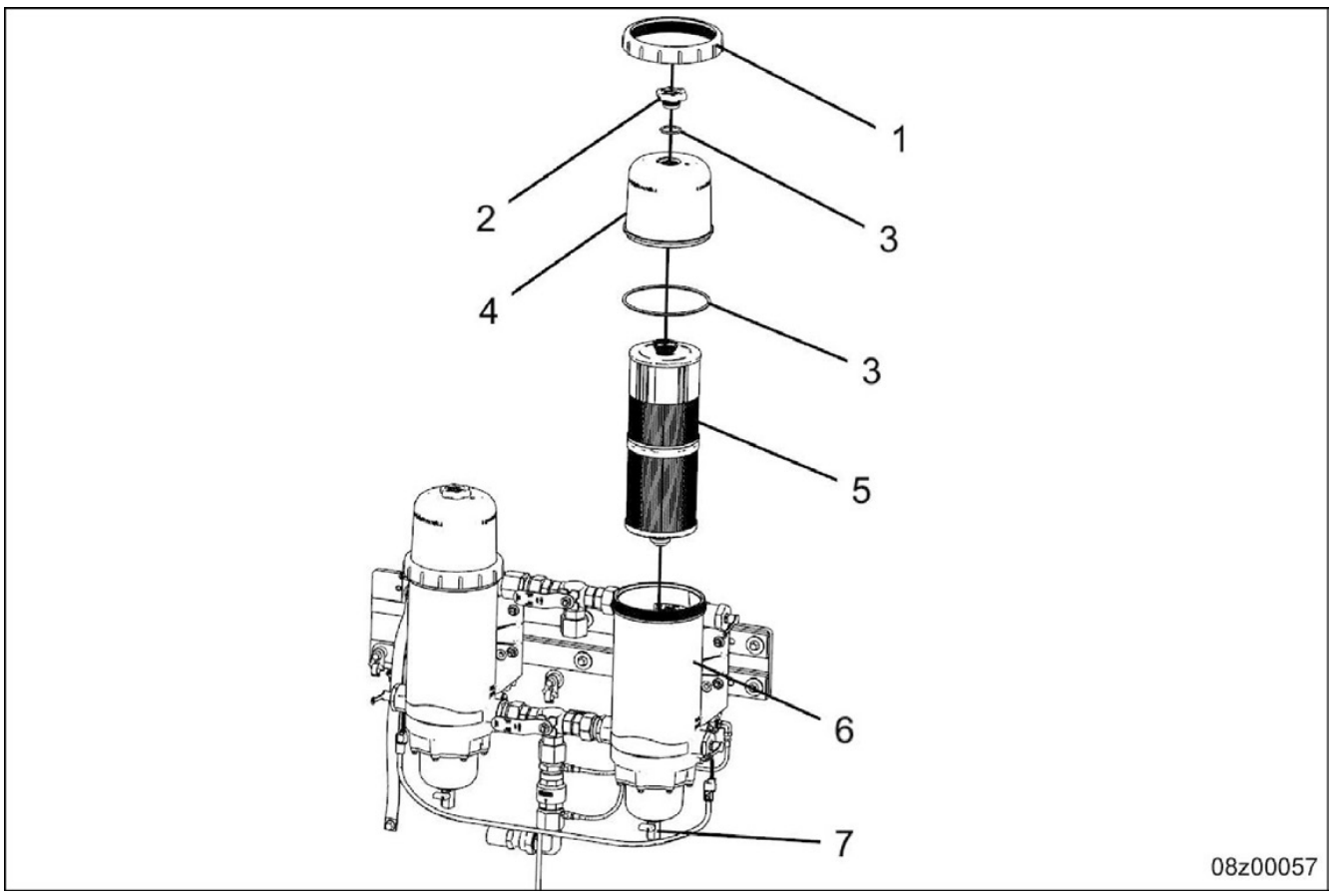
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7. Screw the fuel filter to the filter housing. Tighten by hand until the filter touches the filter head; then tighten an additional 3/4 turn.

NOTICE
Over-tightening of the fuel filter may distort the threads or damage the seal.

8. Connect the water sensor connector.
9. Wipe the fuel filter, cleaning off any spilled fuel.
10. Remove the lint-free cloth from below the fuel filter(s).
11. Start the generator set and check for leaks.

6.6.6.2 Canister Fuel Filter



No.	Description	No.	Description
1	Collar	5	Fuel Filter Element
2	Vent Cap	6	Filter Housing
3	O-ring Seal	7	Drain Valve
4	Filter Cover		

FIGURE 388. CANISTER FUEL FILTER COMPONENTS

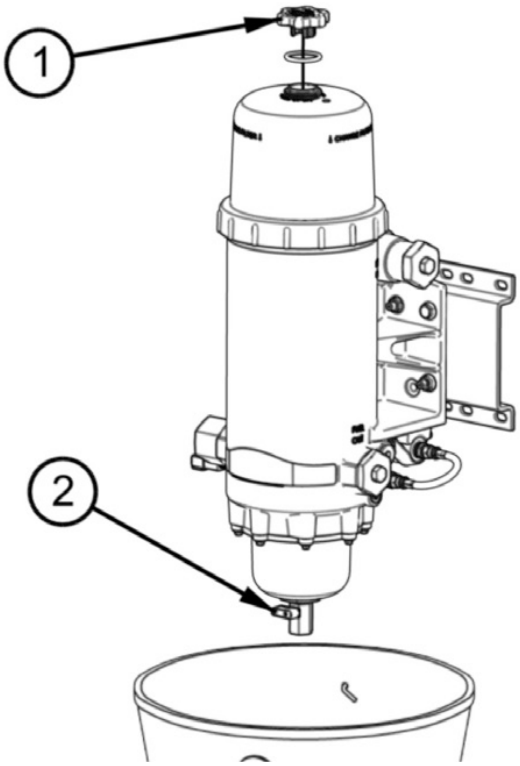
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6.6.6.2.1 Required Tools

The following tools are required.

- Collar Wrench, Fleetgard Part Number SP1076
- Fuel System Clean Care Kit, Part Number 5394230
- Container suitable for fuel – approximately 28.5 L (7.5 US gal)

6.6.6.2.2 Canister Filter Removal



No.	Description	No.	Description
1	Vent Cap	2	Drain Valve

FIGURE 389. DRAINING THE FILTER

1. Shut off the engine.
2. Close the fuel supply to the filters.
3. Place suitable container under canister type fuel filter to collect fluid that will be drained.
4. Loosen vent cap (1).
5. Open drain valve (2).
6. Drain all fuel.

   The drained liquids must be disposed of in accordance with local environmental regulations.
7. Close drain valve.
8. Tighten vent cap by hand until a click is heard.

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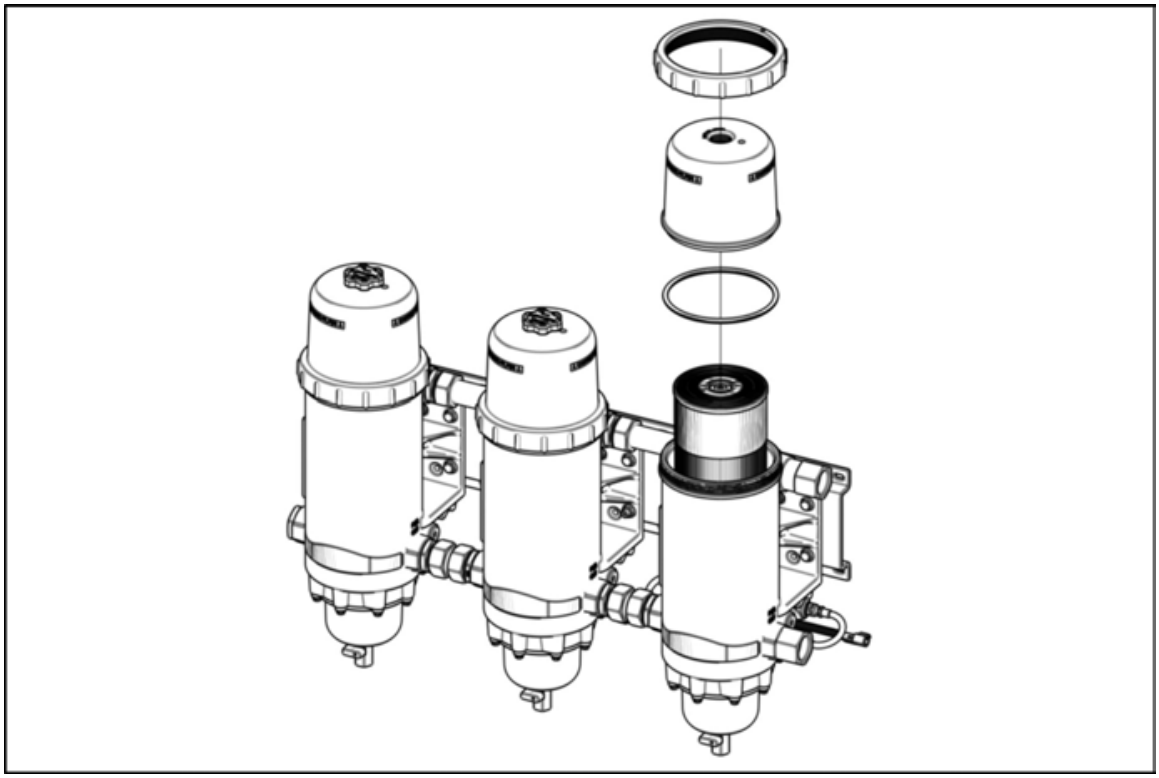


FIGURE 390. CANISTER FUEL FILTER COVER

9. Remove the collar. Use collar wrench, Part Number SP1076.
10. Remove the filter cover.
11. Remove and discard the o-ring seal.

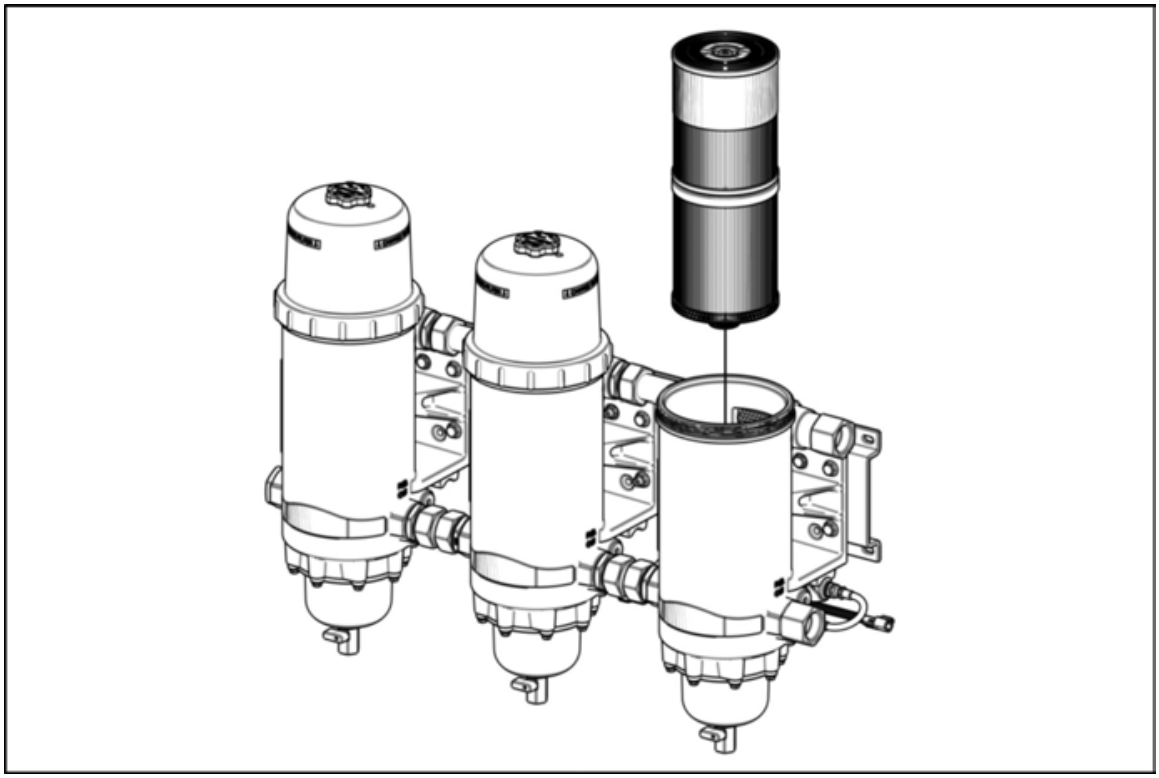


FIGURE 391. CANISTER FUEL FILTER ELEMENT

12. Remove and discard the filter element.

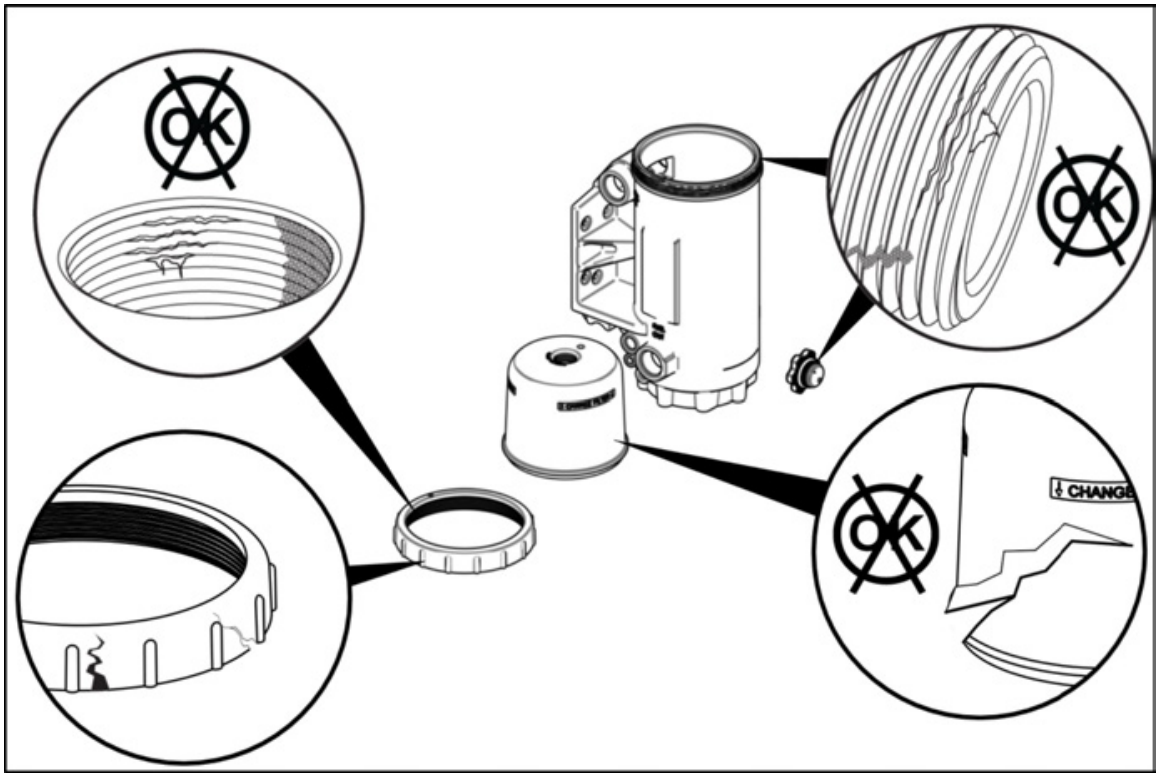


FIGURE 392. CANISTER FUEL FILTER INSPECT

13. Clean sealing surfaces of filter housing and cover. Use a clean, lint-free cloth.

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Inspect:

- Filter housing
- Filter cover
- Collar
- Vent cap

Replace damaged component if:

- Cracked
- Threads damaged
- Otherwise damaged

Repeat all steps for each Canister Filter equipped.

6.6.6.2.3 Canister Filter Replacement

NOTICE

The Fuel System is extremely sensitive to dirt and debris. All connections and ports must be cleaned and covered. Even a very small amount of debris can result in a fuel system malfunction. Damage to the engine high-pressure fuel pump and injectors can result.

The replacement fuel filter element includes a new cover o-ring and vent cap o-ring.

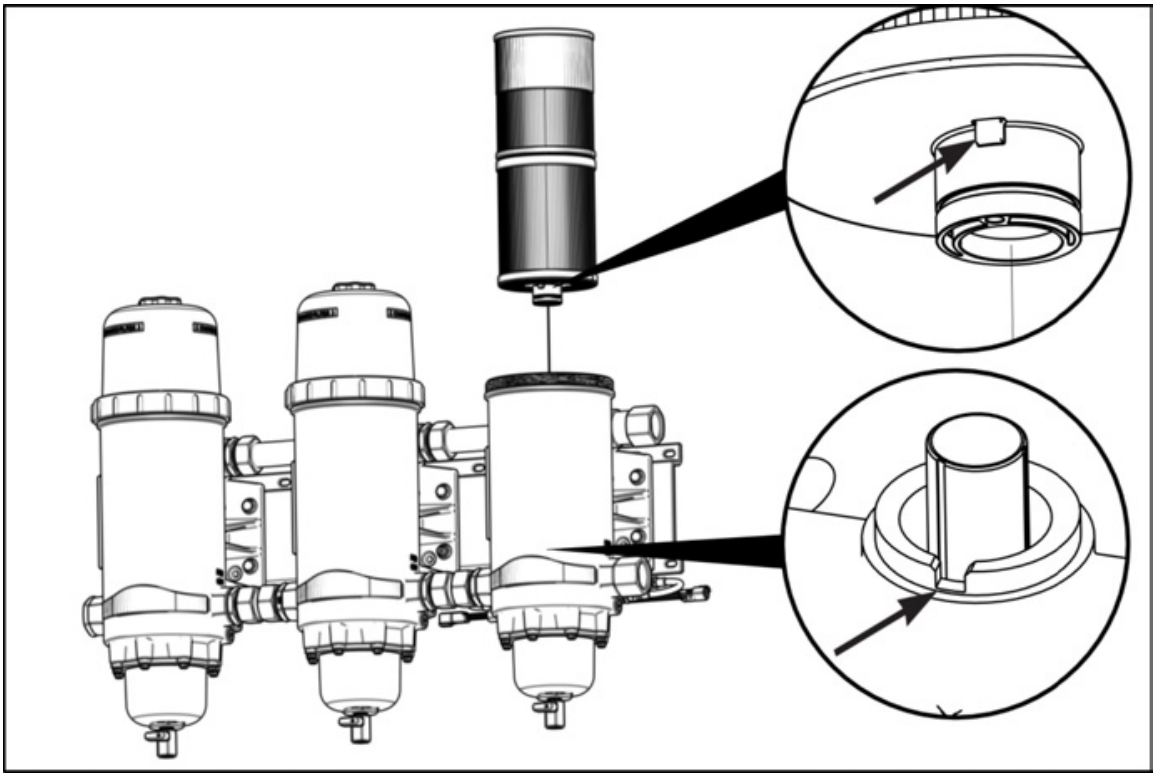


FIGURE 393. CANISTER FUEL FILTER ELEMENT KEY

1. Align key on filter element with the slot in the filter housing.
2. Press the filter element down to fully seat.

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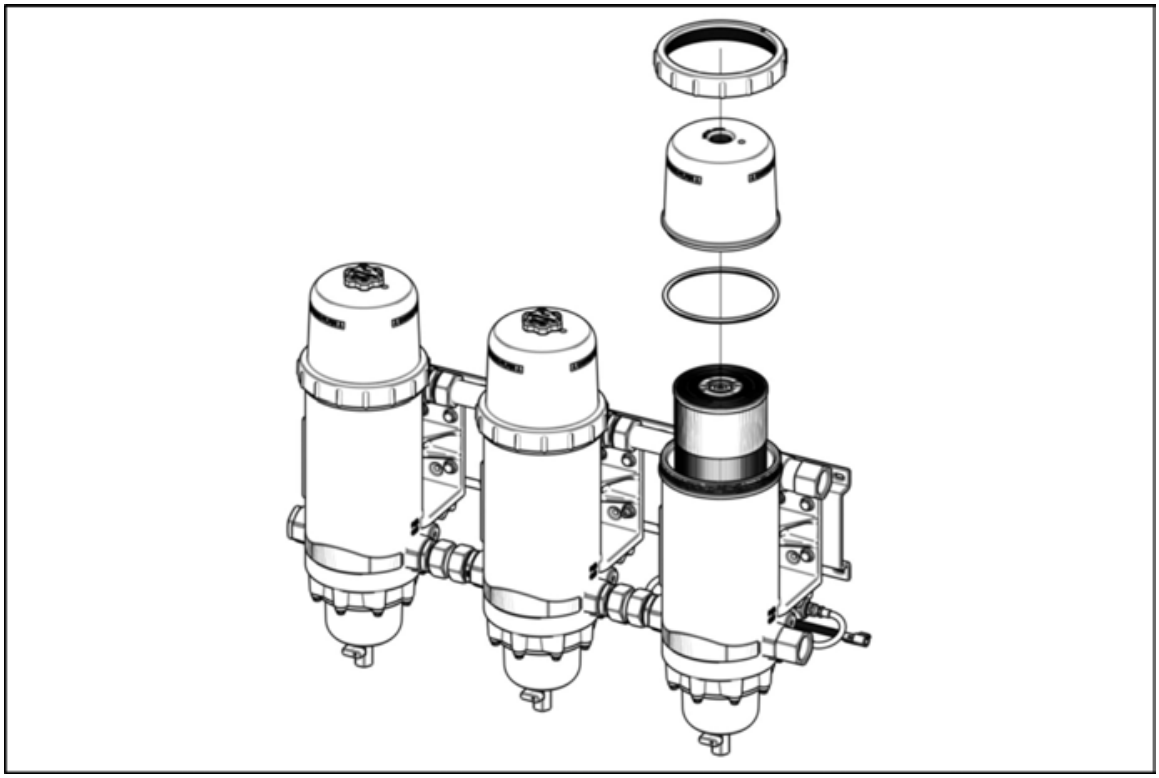


FIGURE 394. CANISTER FUEL FILTER COVER

3. Install a new cover o-ring seal.
4. Install filter cover.
5. Press down on cover while tightening collar by hand.
6. Tighten collar an additional two ribs. Use collar wrench, Part Number SP1076.

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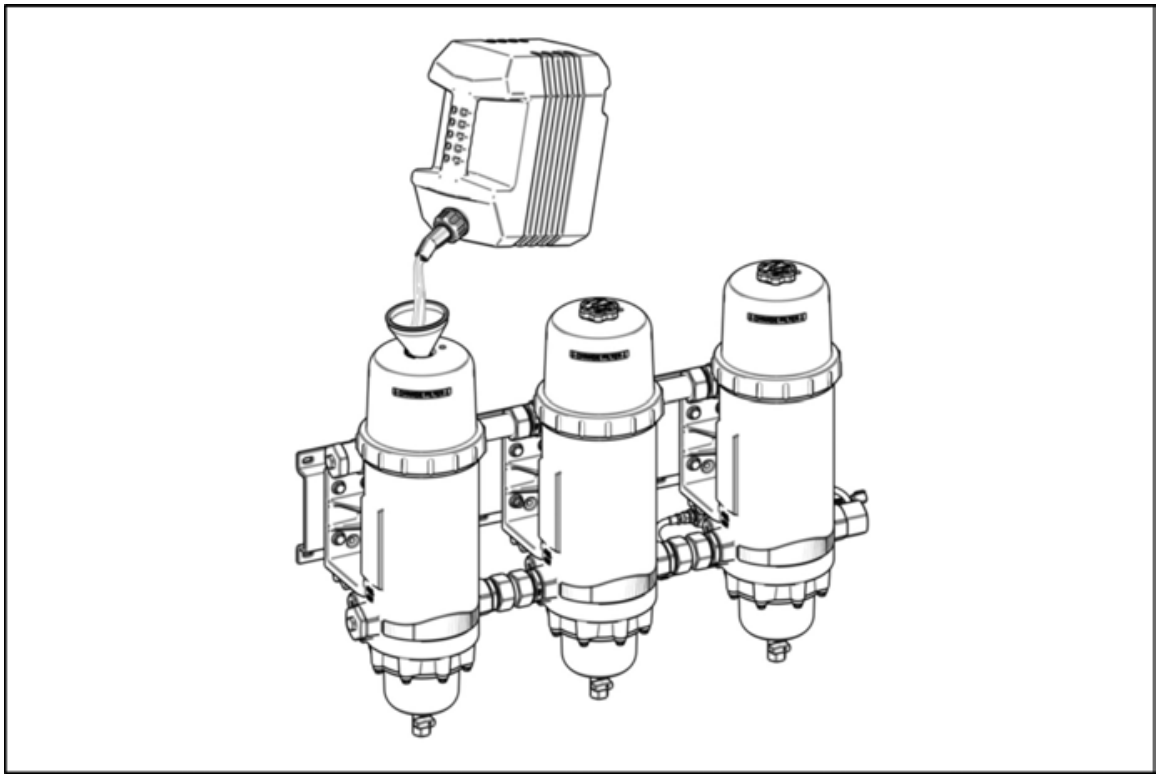


FIGURE 395. FILL CANISTER FUEL FILTER

7. Fill each filter housing with clean diesel fuel.

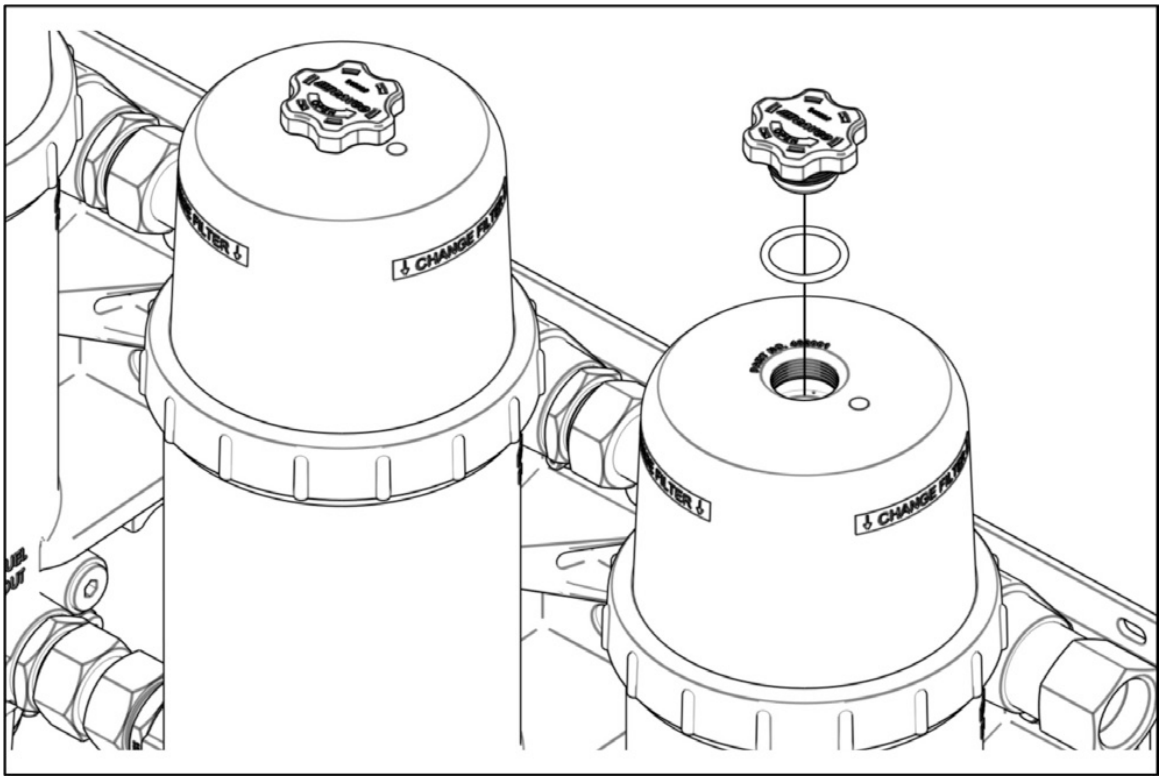


FIGURE 396. CANISTER FUEL FILTER VENT CAP

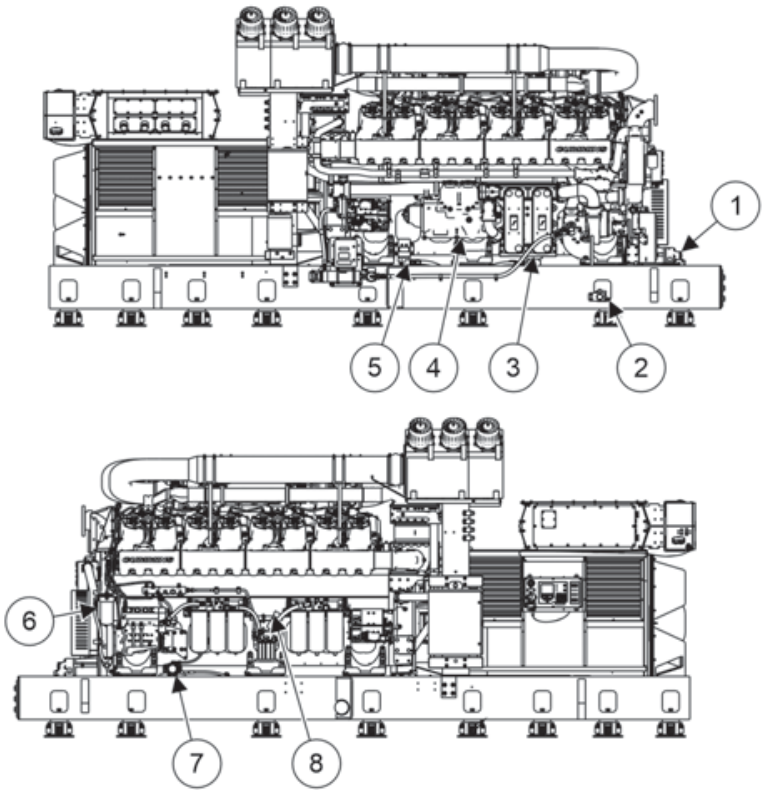
8. Install a new vent cap o-ring seal.

9. Install vent cap.
10. Tighten by hand until click is heard.

    Repeat all steps for each Canister Filter equipped.

6.7 Lubrication Support

6.7.1 Lubrication System



No.	Description	No.	Description
1	Lubrication Oil Pump	5	Pre-Lubrication Oil Pump (if equipped)
2	Oil Drain	6	Fuel Pump Drive Lubricating Oil Filter
3	Oil Cooler	7	Oil Make Up System Regulator (if equipped)
4	Lubrication Oil Filters	8	Oil Fill and Check Dipstick

FIGURE 397. C3000 SERIES LUBRICATION SYSTEM COMPONENTS

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6.7.2 Lubrication System Components and Operation

6.7.2.1 Lubrication Oil Pump

The lubricating oil pump is a positive displacement, rotary screw style pump. The oil pump is mounted at the front of the engine gear housing and driven via an idler gear by the crankshaft gear. The oil pump drive ratio is 1.4:1. The lubricating oil pump rotates counterclockwise, as viewed from the driven end of the pump. Gear train backlash and alignment are fixed and will not require adjustment.

The oil pump weighs approximately 159 kg (350 lbs) and will require proper lifting equipment.

For more information regarding the lubrication oil pump, refer to the engine service manual.

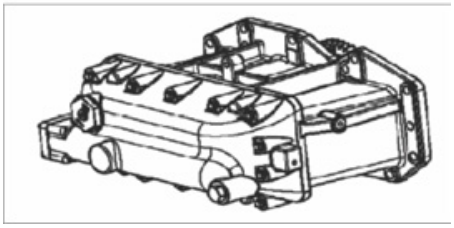


FIGURE 398. LUBRICATION OIL PUMP

6.7.2.2 Oil Cooler

For more information regarding the oil cooler, refer to the engine service manual.

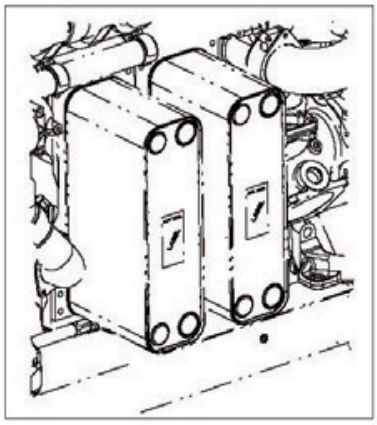


FIGURE 399. OIL COOLER

6.7.2.3 Pre-Lubrication Oil Pump

The pre-lubrication oil pump protects the engine from damage during cranking by ensuring that the engine lubricating oil circuit is pressurized prior to cranking. The pre-lubrication oil pump is mounted on the engine and controlled by the ECM.

For more information regarding the pre-lubrication oil pump, refer to the engine service manual.

6.7.2.4 Oil Maintainer System

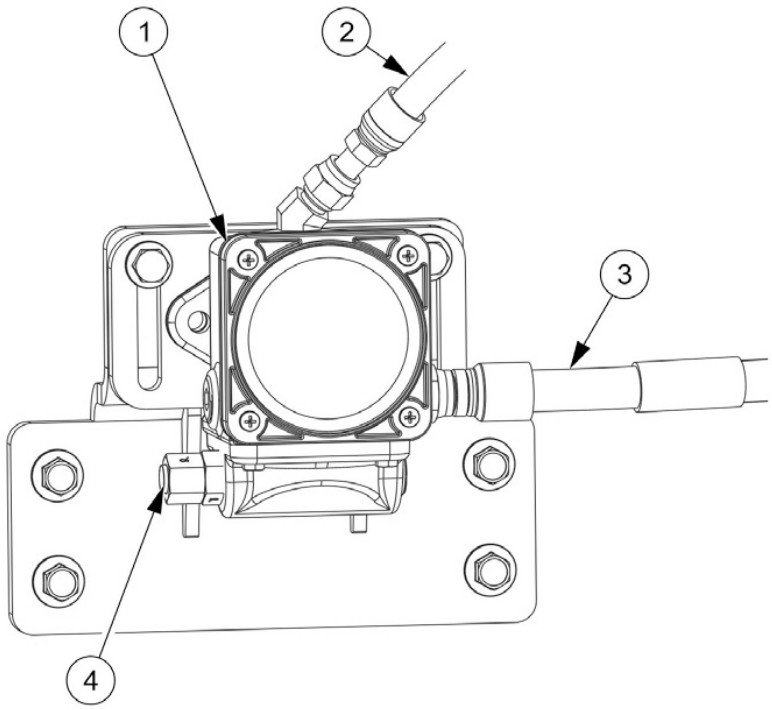
The oil maintainer system is an optional feature available of the generator set. The oil maintainer system includes an oil level regulator and connection points. An auxiliary oil tank and tank mounting hardware is provided by the end user.

The oil maintainer system ensures a proper level of engine lubricating oil.

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NOTICE

The regulator should not be used as an oil level sight glass. The oil regulator does not accurately reflect the level of oil in the engine oil pan.



No.	Description	No.	Description
1	Oil regulator	3	Supply line to the engine oil pan
2	Vent line to the engine	4	Bulk supply line connection from auxiliary oil tank

FIGURE 400. OIL MAINTAINER

6.7.3 Changing Engine Oil and Oil Filter

⚠ WARNING

Accidental or Remote Starting

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 Surfaces

Contact with hot surfaces can cause severe burns, lacerations and liquid splash.

Wear appropriate PPE when working on hot equipment and avoid contact with hot surfaces.

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⚠ WARNING

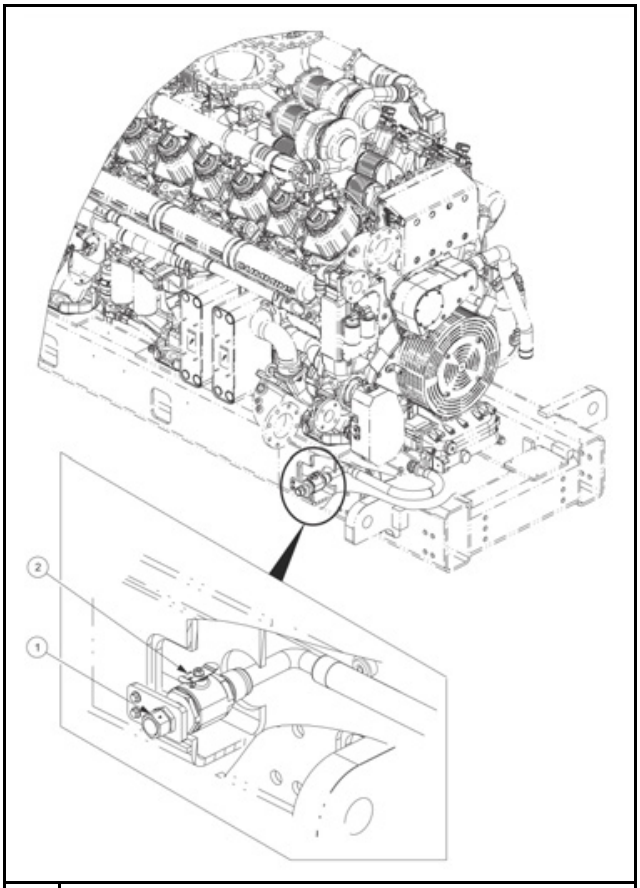
Toxic Hazard

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 **Section 4.1 on page 28** for the engine oil change schedule. Change oil more often in hot or dusty environments.

6.7.3.1 Oil Change Values and Drain Plug Location



No.	Description
1	Drain Plug
2	Drain Valve

FIGURE 401. OIL DRAIN LOCATION

TABLE 133. OIL CHANGE VALUES

Plug Torque	Oil Amount
125 +/- 15 Nm (28 +/- 3.4 ft-lb)	621 liters (164 gal)

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6.7.3.2 Engine Oil Level Check

⚠ WARNING

Hot Pressurized Liquid

Contact with hot liquid can cause severe burns.

Crankcase pressure can blow out hot oil. Do not check the oil while the generator set is operating.

⚠ CAUTION

Hazardous Liquid

Prolonged or repeated skin contact can cause severe personal injury.

Avoid prolonged or repeated skin contact. Comply with all local health and safety regulations/codes during handling or disposal.

NOTICE

Wear personal protective equipment (PPE) to reduce the possibility of the injuries. Make sure to adhere to on-site safety regulations for required PPE.

NOTICE

Safety equipment should be properly maintained. Safety equipment should be inspected regularly to make sure its integrity and functionality are intact.

NOTICE

Do not operate the engine with the oil level below the low mark or above the high mark. Overfilling can cause foaming or aeration of the oil while operation below the low mark may cause loss of oil pressure.

NOTICE

Use high-quality multi-viscosity lubricating oil such as Cummins Premium Blue® or its equivalent. Consult your authorized distributor for the correct lubricating oil specifications for your operating conditions.

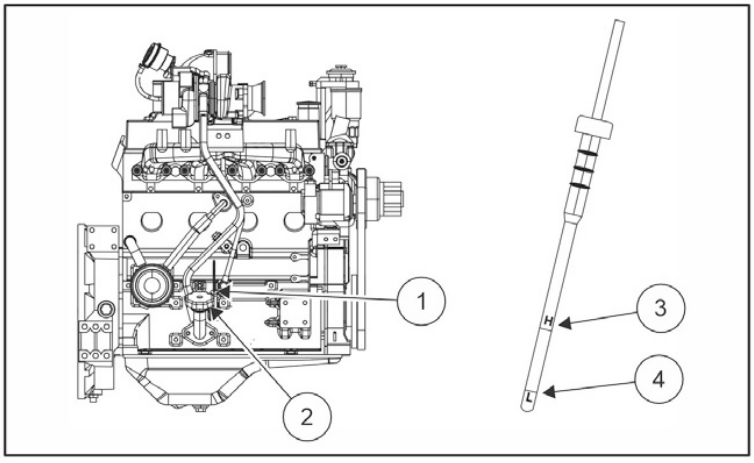


FIGURE 402. OIL LEVEL CHECK

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The engine oil level must be checked daily before starting the engine, when the generator set is not running.

Never operate the engine with the oil level below the L (Low) mark (4), or above the H (High) mark (3).

1. Remove the dipstick (1) and with a lint free cloth wipe the dipstick clean.
2. Fully replace the dipstick.
3. Remove the dipstick and check the level of oil against the High and Low marks on the dipstick.
4. Top up to the High mark (3) if necessary with the correct grade of oil for your application.
    a. Remove the filler cap (2).
    b. Place a lint free cloth beneath or around the oil filler neck to minimize spillage.
    c. Where possible use a funnel to help pour the new engine oil into the oil filler neck to the correct level.
    d. Using the dipstick check the oil level, do not overfill the system. If more oil is needed then continue to fill with oil until the correct level is reached. If the level is too high, then some of the oil will need to be drained of. Refer to the *Engine Operator and Maintenance Manual*.
    e. Replace the dipstick and oil filler cap.
    f. Remove the lint free cloth, start the engine and allow to idle for 5 minutes, switch the engine off, wait 5 minutes to allow the oil to drain back to the oil pan.
    g. Check the oil level. Repeat steps (1–5) if oil needs to be added.

Clean up any spillage and dispose of materials in accordance with local regulations.

6.7.3.3 Engine Oil Drain and Fill

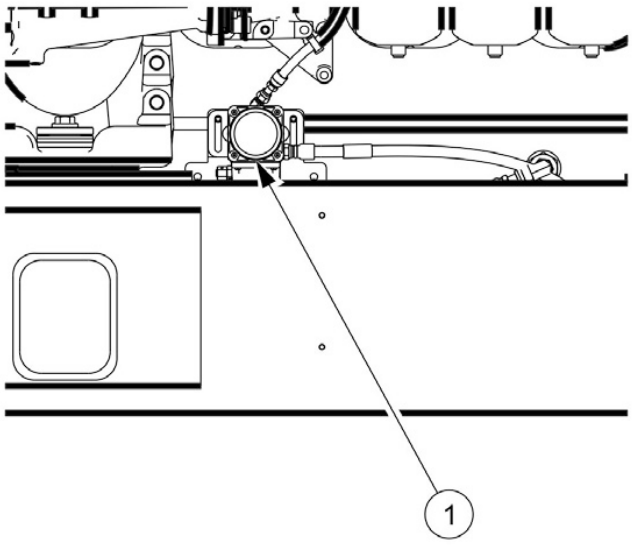
6.7.3.3.1 Required Tools and Parts

1. Required Tools
    - Torque wrench capable of 170 Nm (126 ft-lb)
    - 1 and 7/8 inch socket
    - Oil catch pan
    - Oil containers for disposal
    - Rags

6.7.3.3.2 Drain and Fill Procedure

1. Operate the generator set until the engine coolant temperature reaches 60 °C (140 °F).
2. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See **Section 6.1.2**.
3. If the generator set is equipped with an oil make up system, close the valve from the oil make up tank to the oil make up gauge on the generator set.

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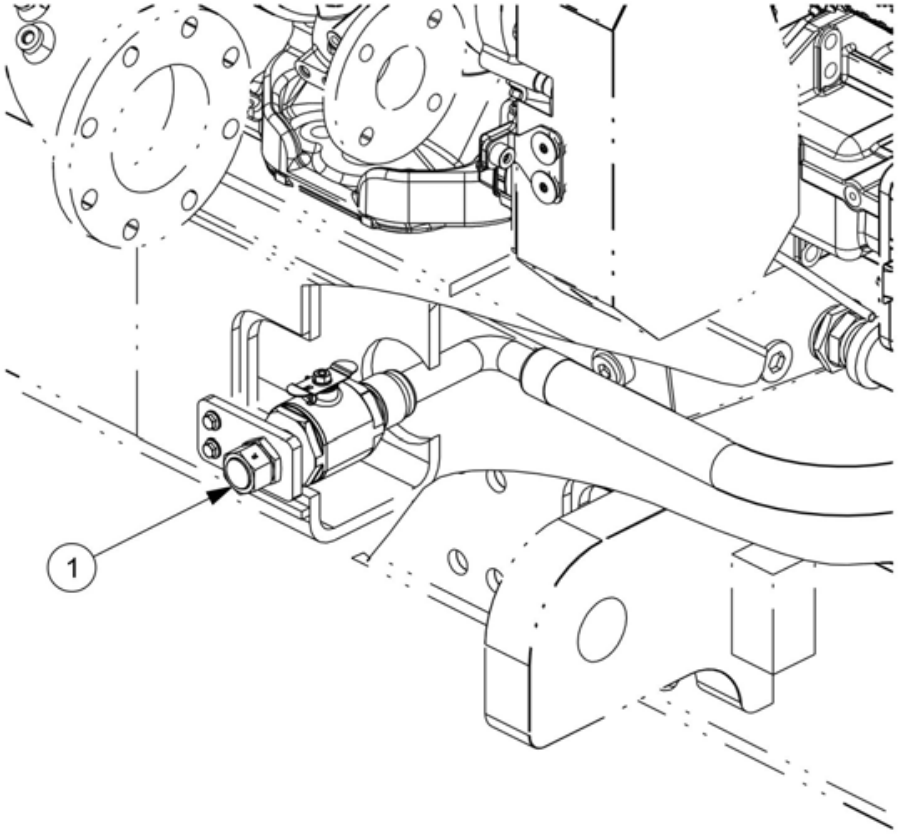


No.	Description	No.	Description
1	Oil make up system		

FIGURE 403. OIL MAKE UP SYSTEM

4. Remove cap from oil drain valve.

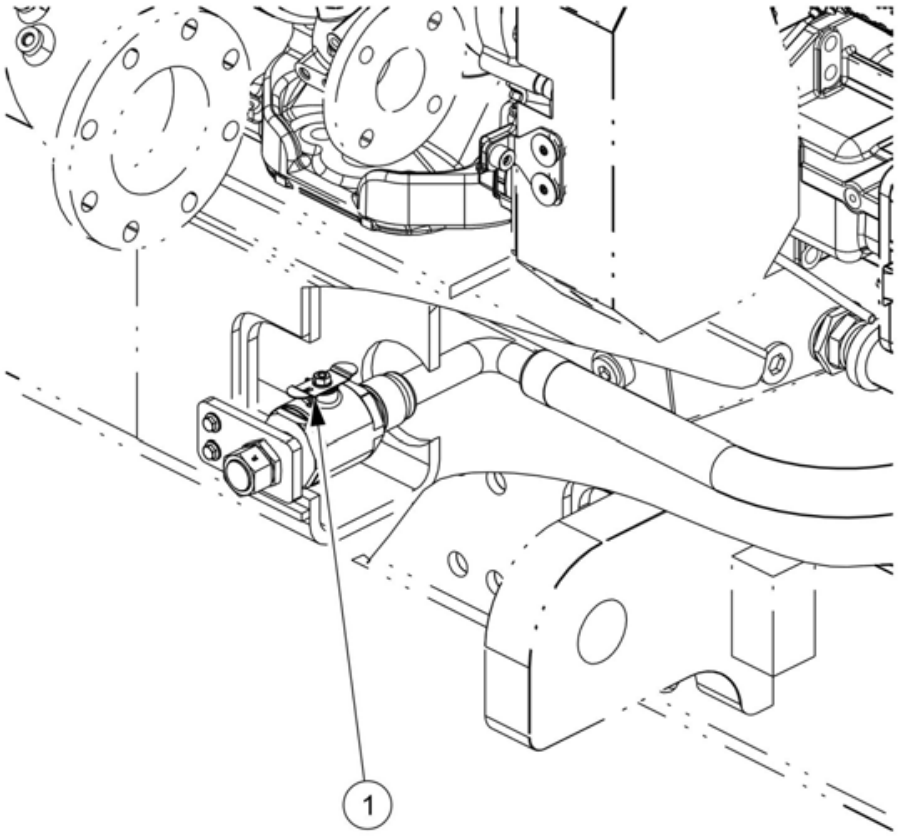
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No.	Description	No.	Description
1	Oil drain cap		

FIGURE 404. OIL DRAIN CAP

5. Place a catch pan under the oil drain valve or use an adaptor fitting to attach a hose and pump to the drain valve. Oil drain fitting size is 1-11/16 - 12 ORFS.
6. Turn the drain valve handle to open the drain valve.

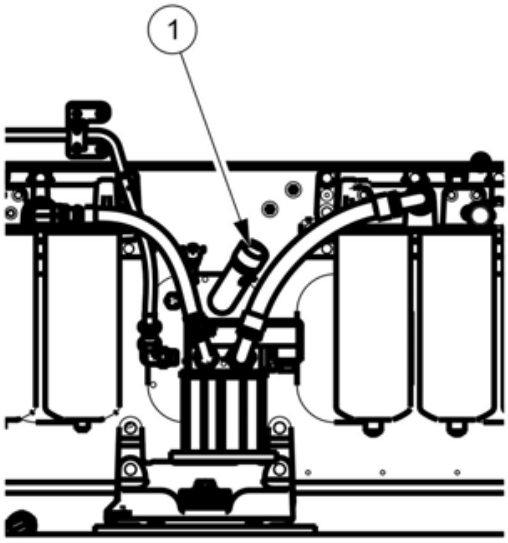


No.	Description	No.	Description
1	Oil drain valve		

FIGURE 405. OIL DRAIN VALVE

7. Drain the oil into suitable containers. Dispose of the oil according to local laws.
8. Turn the drain handle to close the valve (**Figure 405**).
9. Install the drain valve cap (**Figure 404**). Torque the cap to 125 Nm (92.2 ft-lb).
10. Remove the cap from the oil fill neck.

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No.	Description	No.	Description
1	Oil fill neck		

FIGURE 406. OIL FILL NECK

11. Fill the engine with clean engine oil.
12. Use the dipstick to check the oil level. Fill the engine until the oil level is at the static high mark on the dipstick.
13. If the generator set is equipped with an oil make up system, open the valve from the oil mack up tank.
14. Return the generator set to normal operation.
15. Run the generator set at idle and check for oil leakes.
16. Shut down the generator set and wait 5 minutes.
17. Use the dipstick to recheck the oil level.

6.7.3.4 Oil Filter Removal and Replacement

NOTICE
Only authorized and competent personnel who are familiar with the equipment and its operation should carry out maintenance.

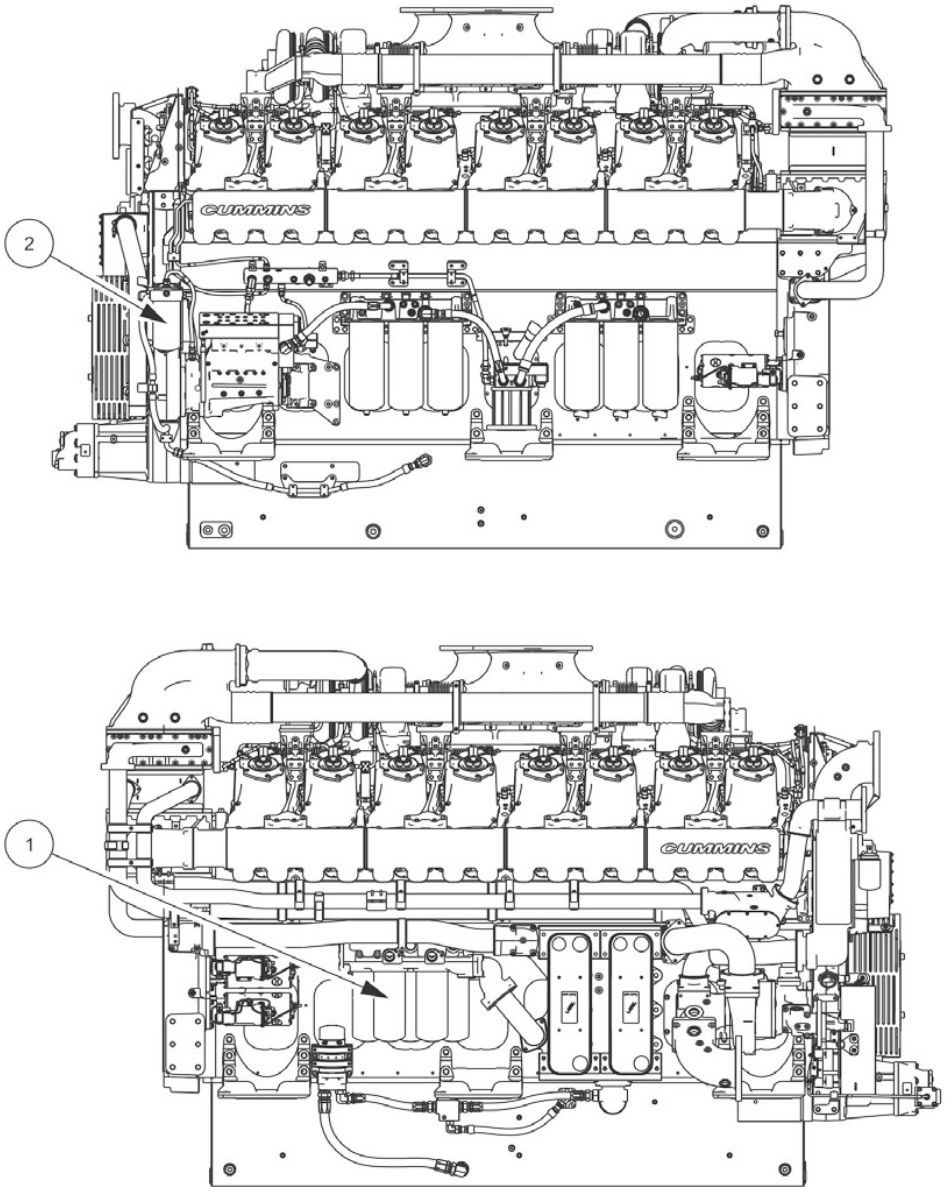
NOTICE
Before carrying out any maintenance, isolate all supplies to the generator set and any control panels. Render the set inoperative by disconnecting the battery.

NOTICE
Shut down the generator set as described in the Operation and Maintenance Manual supplied with the generator set.

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There are five full flow spin-on lubricating oil filters mounted on the right engine bank.

A dedicated full flow lubricating oil filter is used to provide added protection to critical components in the high pressure fuel pump. This filter is mounted on a dedicated filter head on the left bank side of the gear housing near the high pressure fuel pump.



No.	Description	No.	Description
1	Oil Filters	2	Fuel Pump Drive Lubricating Oil Filter

FIGURE 407. OIL FILTER LOCATIONS - QSK95

These canisters are disposable and are to be removed and replaced with a new canister, instead of cleaning the internal element.

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The following equipment is required to remove the oil filter canisters.

- Oil filter wrench
- Container to drain the remaining oil from the filter into
- Lint free cloth
- Disposable gloves

Remove Oil Filters

1. Place the container under the filter to catch any spilled oil.
2. Use the filter wrench to unscrew and remove the filter.
3. Empty any oil into a suitable container

NOTICE
Dispose of the oil filter canister in accordance with local regulations.

4. Repeat this process for each of the six oil filters.

Clean and Inspect

1. Clean the oil filter head and dedicated fuel pump oil filter head with the lint free cloth.
2. Inspect each filter head for cracks or damaged filter mounting threads. If damage is found, the damaged component must be replaced.

Install Oil Filters

1. Apply a light coat of clean engine oil to the seal surface of the filter gasket.

NOTICE
Do not prefill the oil filters.

2. Install each of the six engine oil filters.

NOTICE
Over-tightening of the oil filter canister may distort the threads or damage the filter element seal.

3. Tighten the oil filter until the seal contacts the filter head sealing surface.
4. Tighten the oil filter an additional 3/4 turn.

6.8 Air Cleaner

6.8.1 Air Cleaner Service Indicator

⚠ WARNING
Exhaust components become very hot when the generator set is in use and remain hot for a period of time after the generator set has been shut down. These components can cause severe personal injury or death from contact. Allow these components to cool completely before performing any maintenance tasks.

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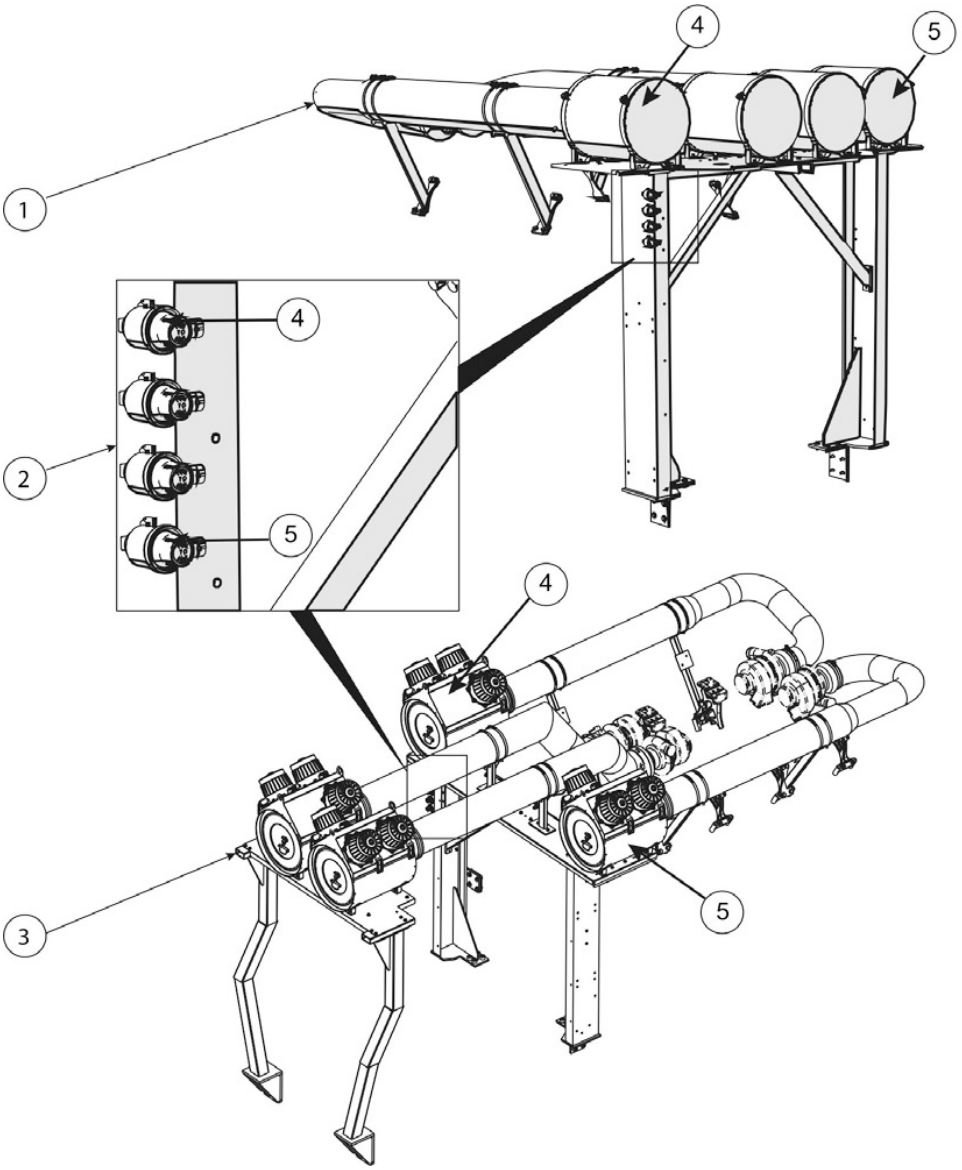
⚠ WARNING

Moving parts can cause severe personal injury or death. Use extreme caution around hot manifolds, moving parts, etc.

The air intake system utilizes air cleaner service indicators to measure the restriction or vacuum across the air cleaners. The service indicator helps maximize filter service life, prevents excess fuel usage from overly restricted filters, and saves operational costs.

The Air Cleaner Service Indicators are located on the air cleaner support stand (**Figure 408**).

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No.	Description	No.	Description
1	Normal Duty Air Cleaner	4	Left Air Cleaner and Associated Service Indicator
2	Air Cleaner Service Indicator	5	Right Air Cleaner and Associated Service Indicator
3	Heavy Duty Air Cleaner		

FIGURE 408. AIR CLEANER SERVICE INDICATOR LOCATION

The service indicators are electronically switched. In the event the air cleaners are restricted, the Air Restriction Indicator Active fault will be displayed, on the generator set graphical display.

Check the air cleaner service indicator periodically. If the gauge has crossed the red mark (1), replace the filter. Reset the indicator by pushing the reset button at the end of the service indicator.

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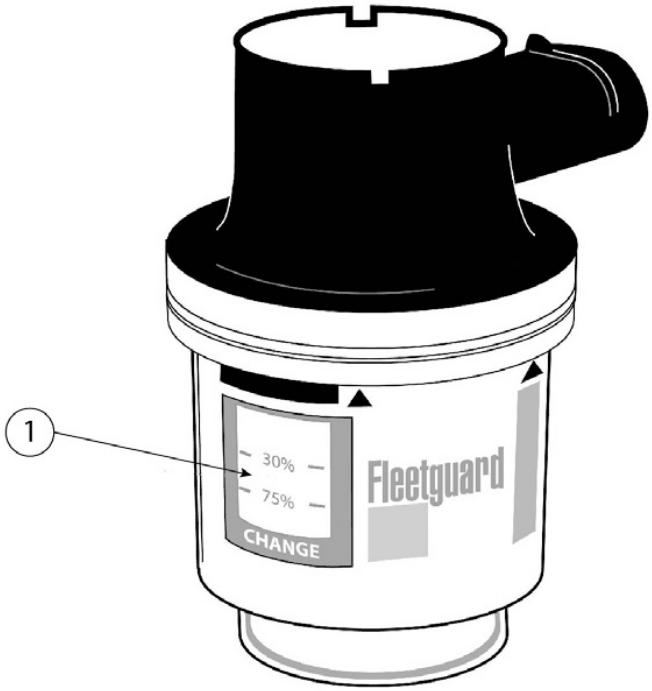


FIGURE 409. AIR CLEANER RESTRICTION INDICATOR

6.8.2 Normal Duty Air Cleaner

6.8.2.1 Air Cleaner Element Removal

⚠ CAUTION

Holes, loose-end seals, dented sealing surfaces, corrosion of pipes, and other forms of damage render the air cleaner inoperative and require immediate element replacement or engine damage can occur.

NOTICE

Cummins Inc. does not recommend cleaning paper-type air cleaner elements. Elements that have been cleaned will clog, and airflow to the engine will be restricted.

Use care when servicing components for the engine combustion air intake system. Cleanliness of air tubes downstream of the filters is important. Clean surfaces that get dusty during service. Use care to ensure proper mounting of air filter elements. Do not use any defective products. Faulty air intake filters or poor mounting can lead to significant compressor and engine damage.

1. Loosen air filter straps and band clamp, securing filter (1).
2. Slide the air filter element straight forward (over the terminal box) to remove (2).
3. Repeat steps 1-3 to remove the remaining three filter elements.

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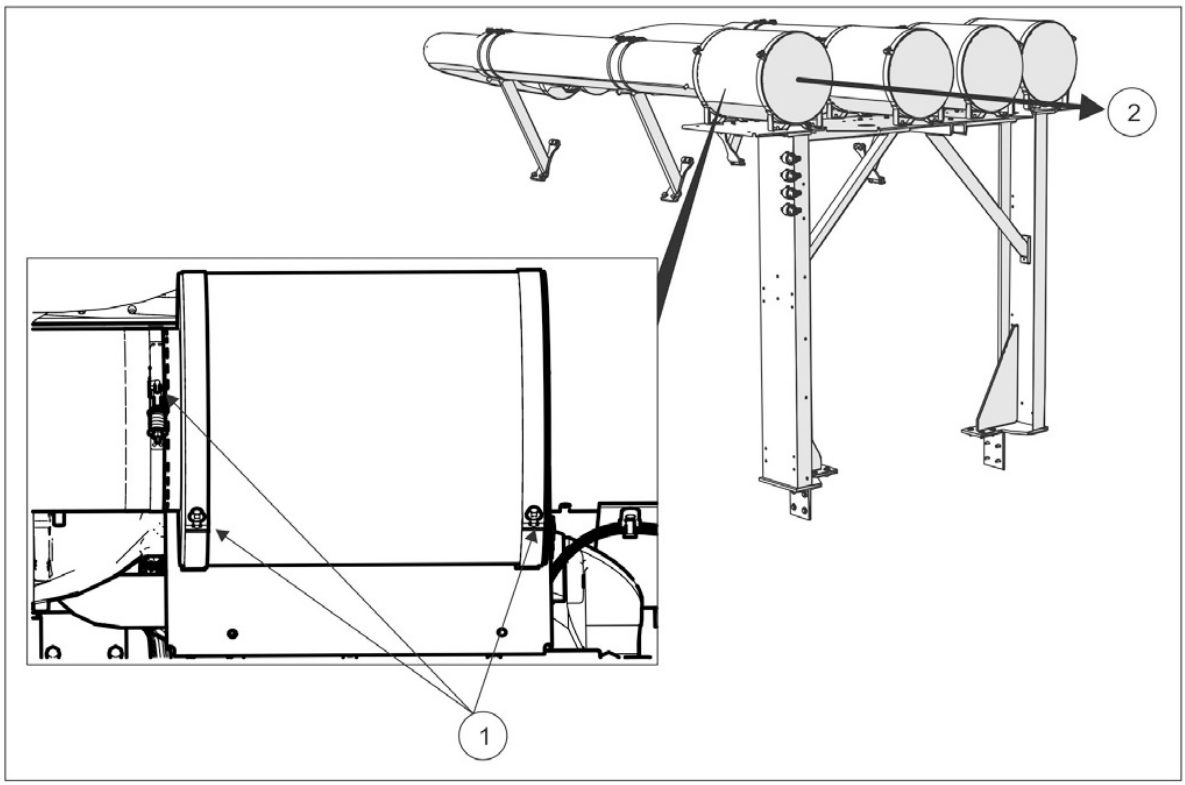


FIGURE 410. NORMAL DUTY AIR CLEANER ELEMENT REMOVAL

6.8.2.2 Air Cleaner Element Installation

1. Install the new filter by sliding it into place within the air filter straps (1).

⚠ CAUTION
Air filter straps need to be aligned with black rubber air filter element ends. Failure to properly align the air filter element could result in damage to the air filter.

2. Tighten the band clamp to secure the filter to the air induction pipe (2).
3. Tighten the two air filter straps to secure the air filter element (2). Torque to 4.5 Nm (40 in-lbs).
4. Repeat steps 1-3 to install the remaining three filter elements

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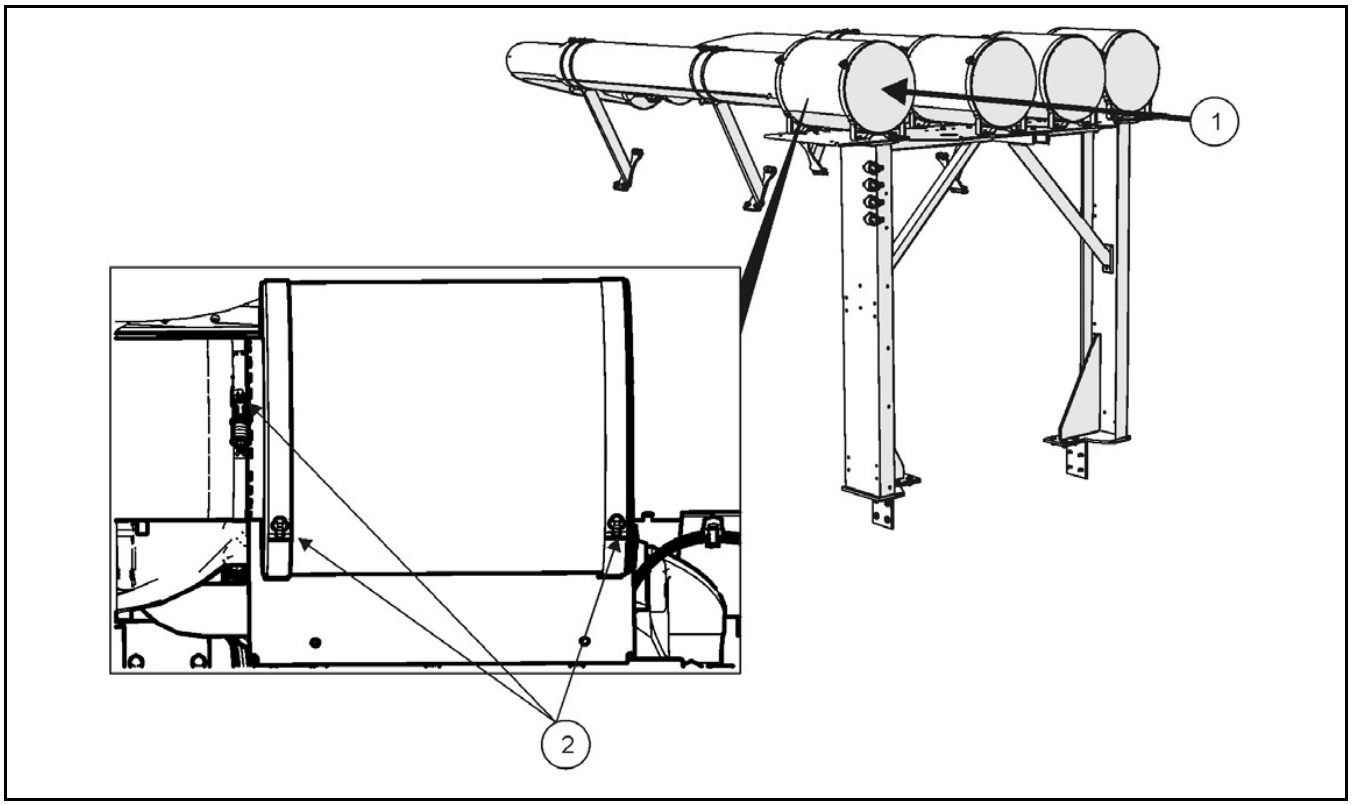


FIGURE 411. NORMAL DUTY AIR CLEANER ELEMENT INSTALLATION

6.8.3 Heavy Duty Air Cleaner

6.8.3.1 Air Cleaner Element Removal

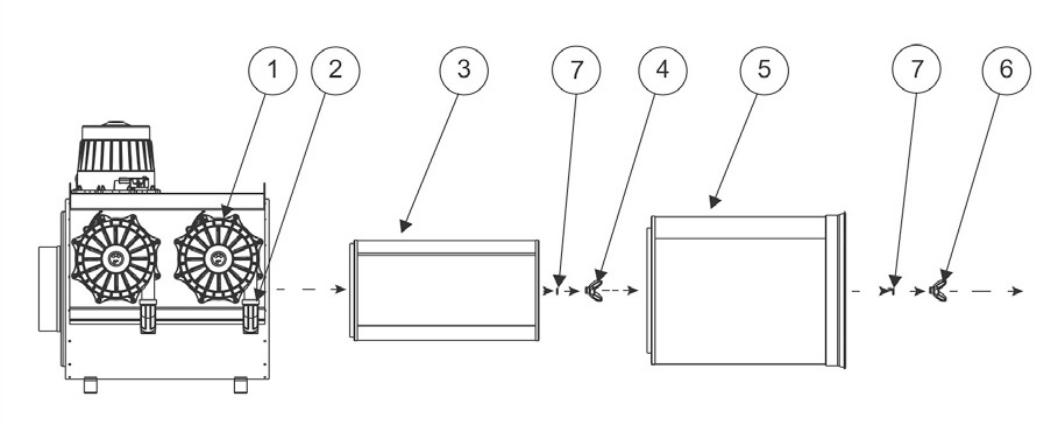
Heavy duty air cleaners combine centrifuge cleaning with element filtering before air enters the engine.

NOTICE
Cummins Inc. does not recommend cleaning paper-type air cleaner elements. Elements that have been cleaned will clog, and airflow to the engine will be restricted.

Use care when servicing components for the engine combustion air intake system. Cleanliness of air tubes downstream of the filters is important. Clean surfaces that get dusty during service. Use care to ensure proper mounting of air filter elements. Do not use any defective products. Faulty air intake filters or poor mounting can lead to significant compressor and engine damage.

1. Before disassembly, wipe dirt from the cover and the upper portion of the air cleaner.
2. Remove the wing nut (6) that secures the air cleaner primary element (5) in the air cleaner housing.
3. Remove the air cleaner primary element (5).
4. If the inner safety element (3) is being replaced based upon high intake restriction, remove the wing nut (4) and remove the air cleaner inner safety element.
5. Dispose of the dirty element(s) in accordance with local environmental agency requirements.

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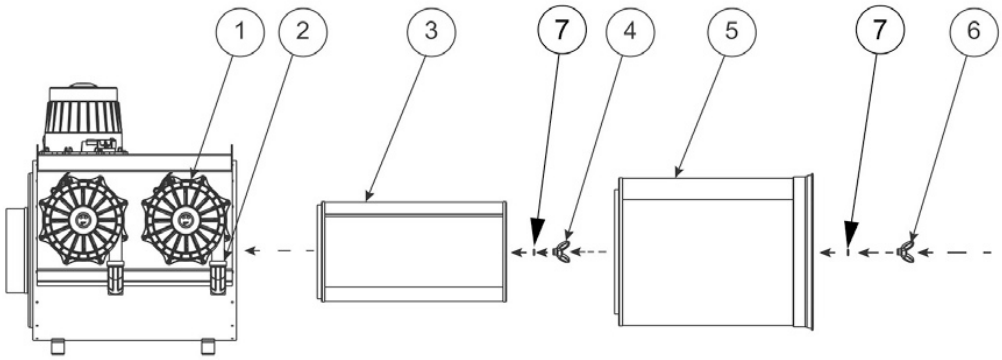
No.	Description	No.	Description
1	Pre-cleaner	5	Air Cleaner Primary Element
2	Pre-cleaner Discharge	6	Wing Nut
3	Air Cleaner Inner Safety Element	7	Conical Spring Washer
4	Wing Nut		Wing Bolt (not shown)
			Dust Shield (not shown)

FIGURE 412. HEAVY DUTY AIR CLEANER ELEMENT REMOVAL

6.8.3.2 Air Cleaner Element Installation

1. Use a lint free cloth to clean the inside of the air cleaner housing. Do as much cleaning as possible while the inner safety element (3) is installed.
2. If the air cleaner inner safety element (3) is being replaced, install the safety element and secure it with the wing nut (4). Filter seal is created by even pressure being applied to the filter outlet in the axial direction. Be sure that the filter is installed straight and centered to allow for an optimal seal.
3. Install the air cleaner primary element (5) in the air cleaner housing. Filter seal is created by even pressure being applied to the filter outlet in the axial direction. Be sure that the primary element (5) is installed straight and centered to allow for an optimal seal.
4. Tighten the wing nut (6) to secure the air cleaner primary element (5). Make sure that the conical spring washer (7) is installed under the wing nut with the rubber side toward the filter. The spring washer helps provide tension on the filter to maintain a good seal at the filter outlet.
5. Inspect the rubber boot that rests on the exterior perimeter of the primary element (5). It may move during installation. It must be flush with the filter housing to ensure a good seal.

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No.	Description	No.	Description
1	Pre-cleaner	5	Air Cleaner Primary Element
2	Dust ejector valve (DEV)	6	Wing Nut
3	Air Cleaner Inner Safety Element	7	Conical Spring Washer
4	Wing Nut		Wing Bolt (not shown)
			Dust Shield (not shown)

FIGURE 413. HEAVY DUTY AIR CLEANER ELEMENT INSTALLATION

6.8.3.3 Heavy Duty Air Cleaner Maintenance

⚠ WARNING

Fall Hazard

Falls can result in severe personal injury or death.

Make sure that suitable equipment for performing tasks at height are used in accordance with local guidelines and legislation.

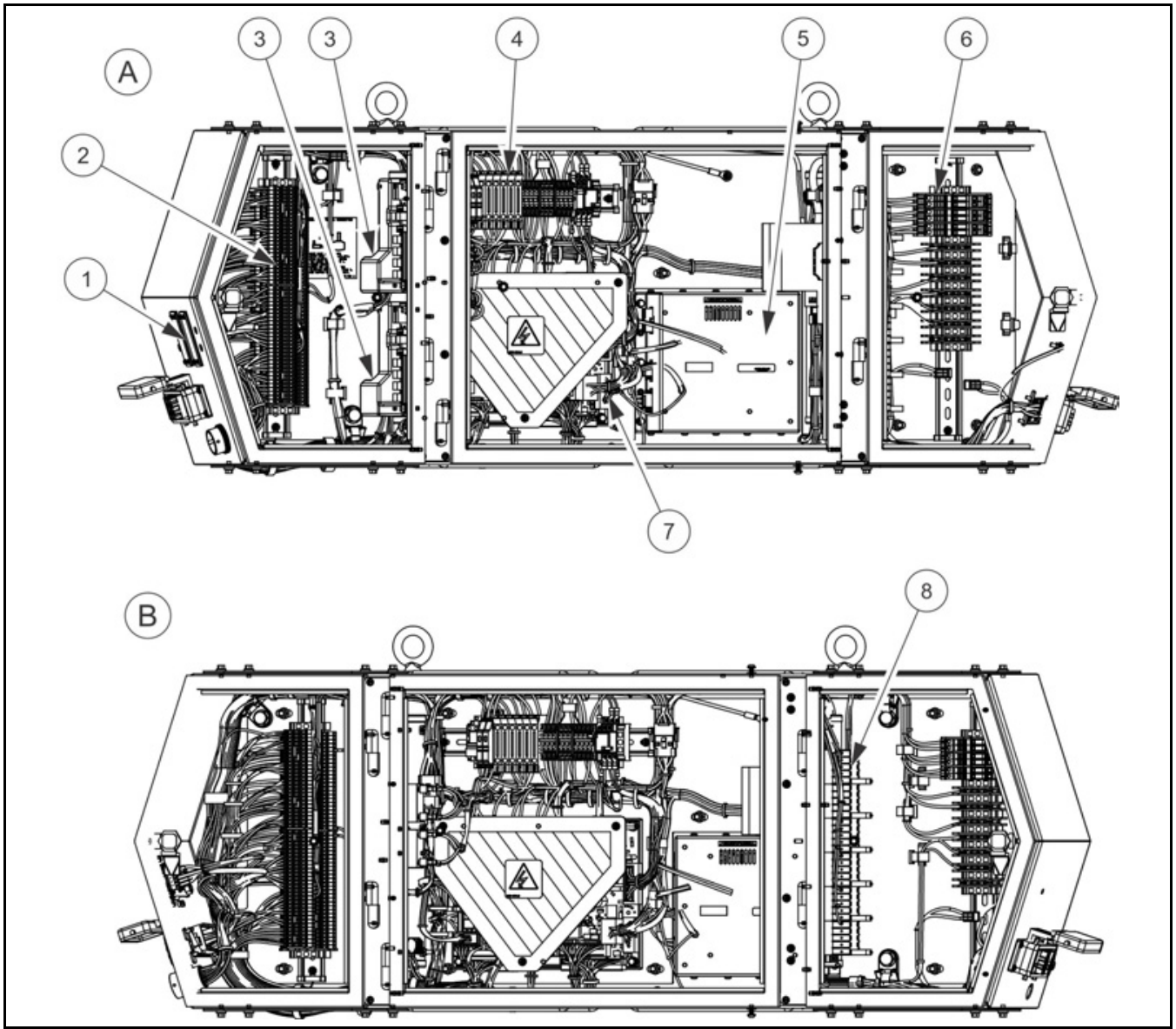
There is a dust ejector valve (DEV) on the bottom of each filter pre-cleaner that should be checked periodically to make sure it is free of dust and dirt.

When there is a filter pre-cleaner, it includes a primary and secondary element that is checked periodically to make sure they are clean. Refer to the *Periodic Maintenance Schedule* table for additional information.

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6.9 Control System

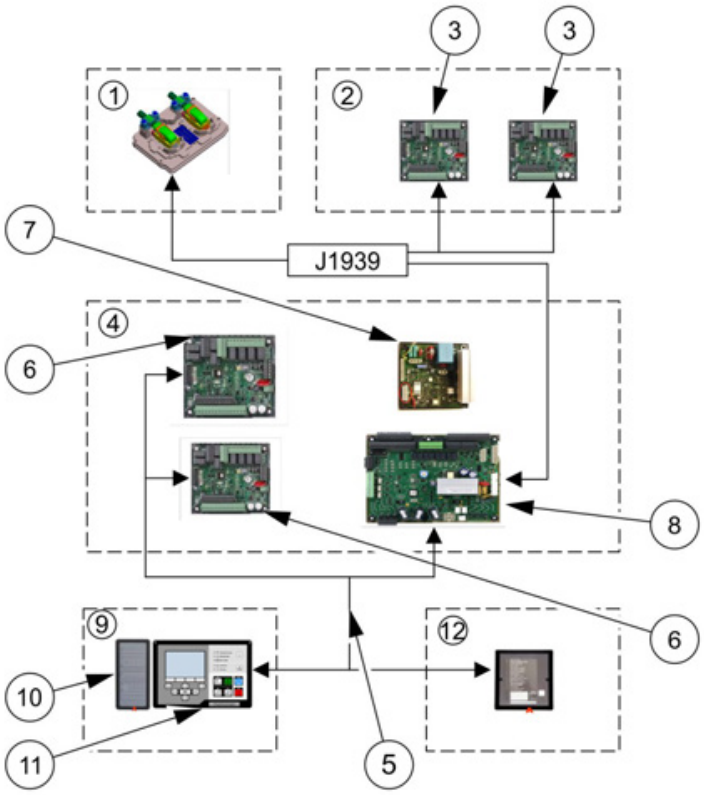
6.9.1 Component Locations



No.	Description	No.	Description
A	Viewed from left side	5	AUX 103
1	Service connection ports	6	AC customer connections
2	DC customer connections	7	PCC 3300 board
3	Customer AUX 101	B	Viewed from right side
4	Fuses	8	Customer relays

FIGURE 414. COMPONENT LOCATIONS

6.9.2 Control Box Architecture



No.	Description	No.	Description
1	Engine - Power - Key switch	7	AUX 103
2	Alternator terminal box - Exciter field - Voltage sense - PMG	8	PCC 3300
3	OEM AUX 101	9	HMI - E-stop - Alarm - HMI programming
4	Generator set control	10	Bar graph
5	PCC Net	11	HMI 320
6	Customer AUX 101	12	Other Accessories - RMS Cirrus (J14) - RS232 to 485 converter

FIGURE 415. CONTROL BOX ARCHITECTURE

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6.10 Software

6.10.1 SAE J1939 CAN (Controlled Area Network)

The following section describes the function and operation of the J1939 Controlled Area Network (CAN) datalink, as it applies to this generator set. The engine control module (ECM) communicates to the generator set controller (I.e., PCC) over this network.

CAN communications follow the SAE J1939 communication protocol standard. The CAN datalink is based on a main trunk no more than 131 feet (40 meters) long and with 30 devices that is terminated by a 120 Ohm resistor at each end. Stubs no longer than 3.3 feet (1 meter) extend from the main trunk to each module in the bus.

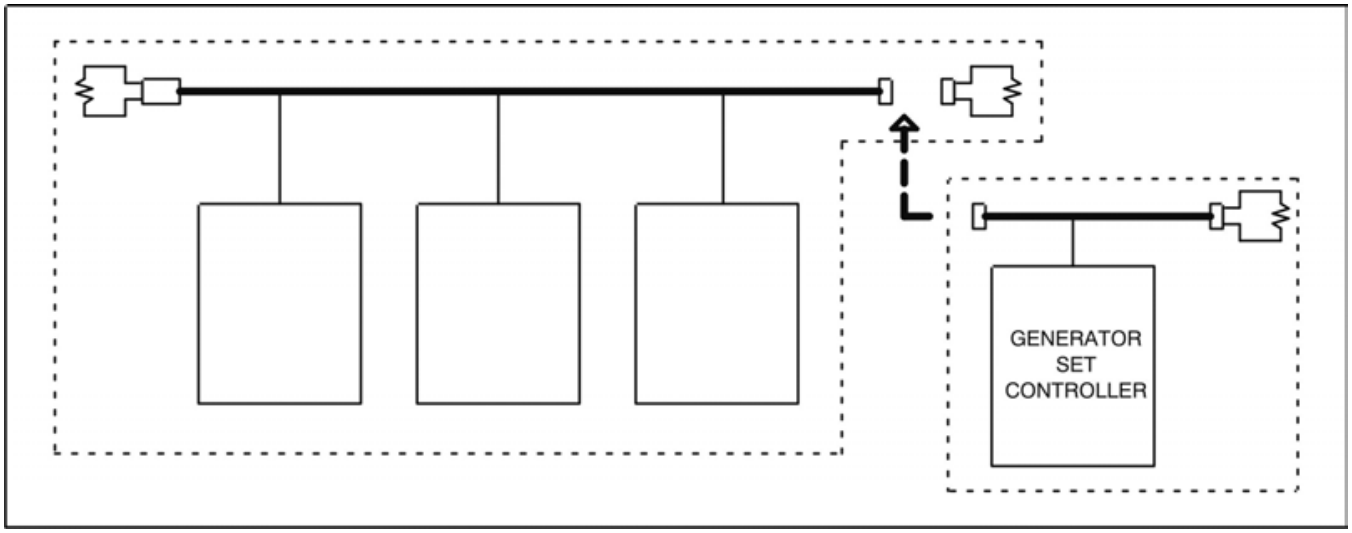


FIGURE 416. CAN DATALINK

6.10.1.1 CAN Datalink Signals

The CAN datalink carries the binary signal between the ECM (Engine Control Module) and the generator set controller. The binary signal is expressed by a change in voltage. The table below shows how the generator set controller distinguishes between the voltage signals.

TABLE 134. CAN DATALINK VOLTAGE DIFFERENTIALS

Signal	0	1
J1939 High (+)	2.5 V	3.5 V
J1939 Low (–)	2.5 V	1.5 V
Voltage Differential	0 V	2 V

The CAN datalink transmits the signal at 250 KBaud, or 250 kilobits per second. Hence, it is possible for the voltages on J1939 High (+) and J1939 Low (–) to change 250,000 times per second.

The figures below show examples of good and bad datalink signals, on a high-resolution oscilloscope. The bad signal is caused by termination problems (no termination, wrong termination, or bad termination).

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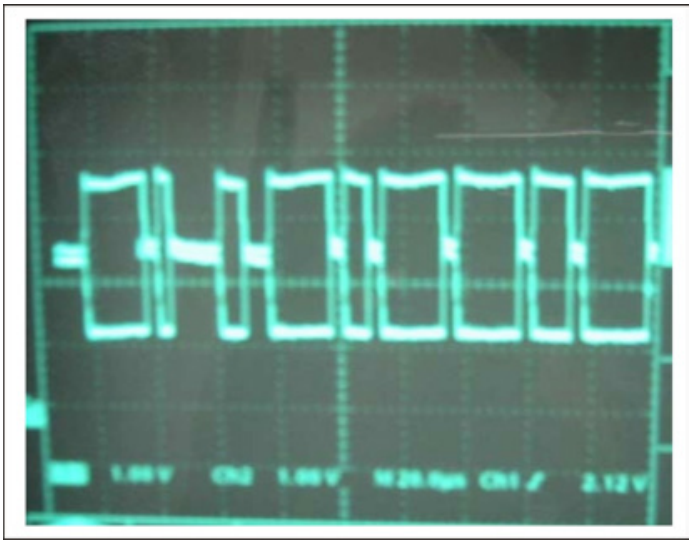


FIGURE 417. CAN DATALINK: GOOD SIGNAL



FIGURE 418. CAN DATALINK: BAD SIGNAL

6.10.1.2 J11 Connections

The CAN datalink connects to the PCC baseboard via connector J11. J11 pin connections are identified in the table below.

TABLE 135. CONNECTOR J11

Description	Pin
CAN +	20
CAN -	19
CAN Shield	17
Keyswitch +	22
Keyswitch -	21

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The PCC uses this data to display engine status (sensor, warning and shutdown conditions). The datalink must remain active at all times. If not, the PCC will detect the inactive datalink and display a datalink error shutdown condition.

6.10.1.3 J10 Connections

The CAN datalink connects to the PCC baseboard via connector J10. J10 pin connections are identified in the following table.

TABLE 136. CONNECTOR J10

Description	Pin
CAN +	1
CAN -	2
CAN Shield	3
Keyswitch +	4
Keyswitch -	5

The PCC uses this data to display engine status (sensor, warning and shutdown conditions). The datalink must remain active at all times. If not, the PCC will detect the inactive datalink and display a datalink error shutdown condition.

6.11 Terminal Box

6.11.1 Current Transformer

6.11.1.1 Current Transformer Info

The Toroidal current transformers have the line that carries the current flowing in the circuits threaded through a window or hole in the toroidal transformer.

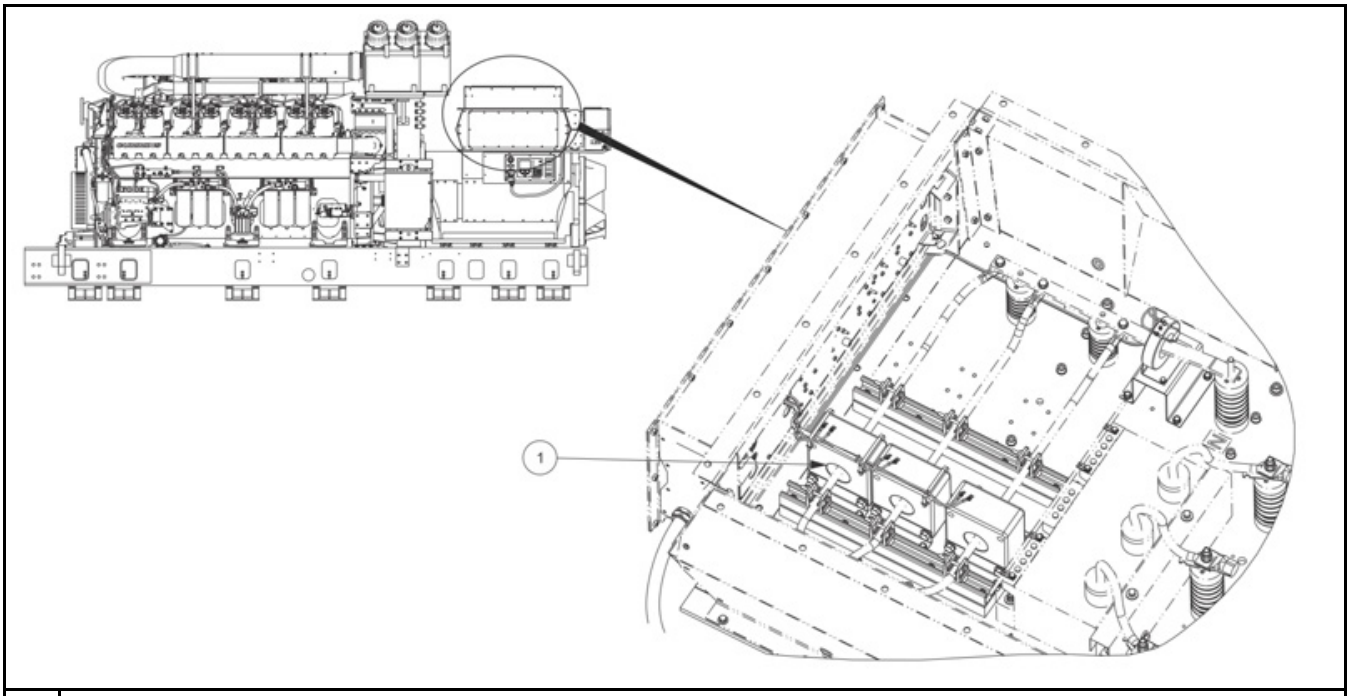
The CT has a dot on one side. This dot must be facing toward the generator reconnection terminal block (conventional current flowing into the dot).

Route the load lead through the appropriate CT.

The CTs have single pair of secondary terminals (2 studs). The CT secondary wire marked X1 is connected to terminal stud X1 of the CT. CT secondary wire marked X2 is connected to the other terminal stud.

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6.11.1.2 Metering Current Transformer Location



No.	Description
1	Metering Current Transformers

FIGURE 419. METERING CURRENT TRANSFORMERS LOCATION

6.11.1.3 Current Transformer Testing

⚠ WARNING

The current transformer must be fully De-energised before testing. Failure to discharge the current transformer may cause serious personal injury.

NOTICE

Make sure when reconnecting the leads to the current transformer that they are connected to the same terminals.

Connection between the CT terminals depends on the ratio required for the set. For half ratio 1-2 is used and for full ratio 1-3.

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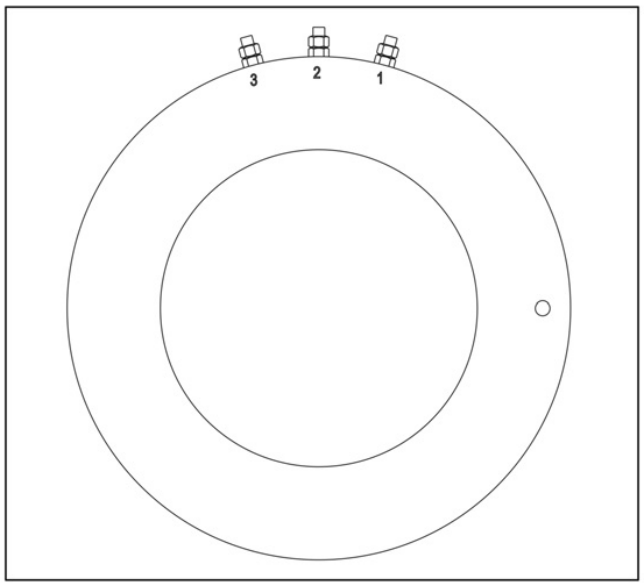


FIGURE 420. 0315-1605 CURRENT TRANSFORMER

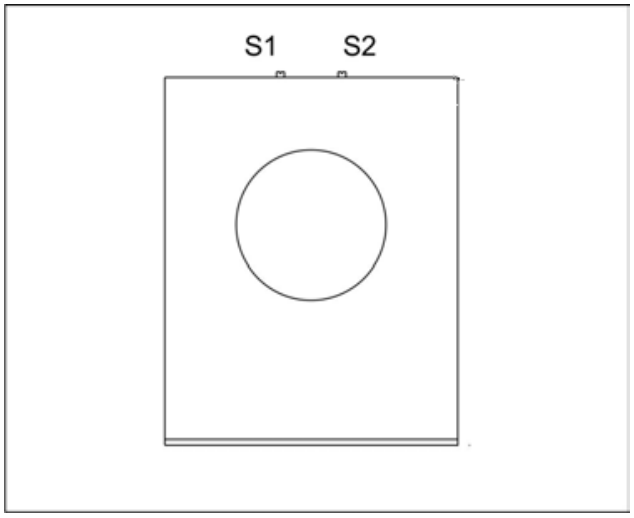


FIGURE 421. 0315-1616 CURRENT TRANSFORMER

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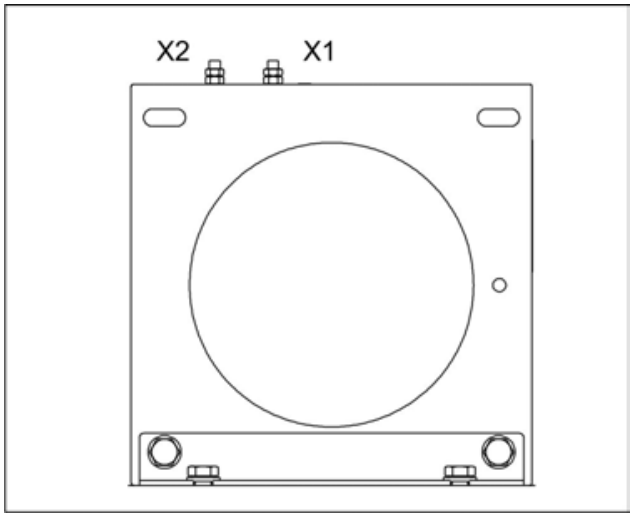


FIGURE 422. 0315-1668, 0315-1672 CURRENT TRANSFORMER

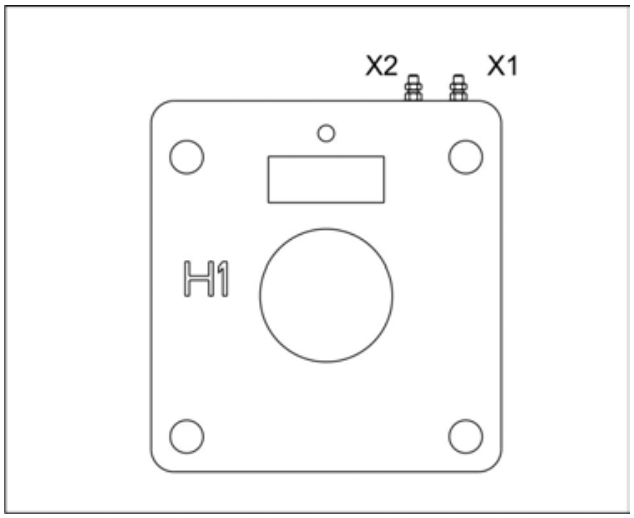


FIGURE 423. 0315-1690, 0315-1692, A049C198, A049C202 CURRENT TRANSFORMER

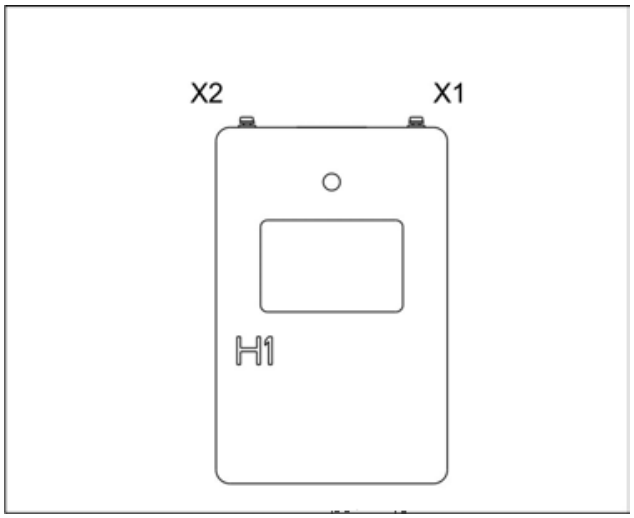


FIGURE 424. 0315-1691 CURRENT TRANSFORMER

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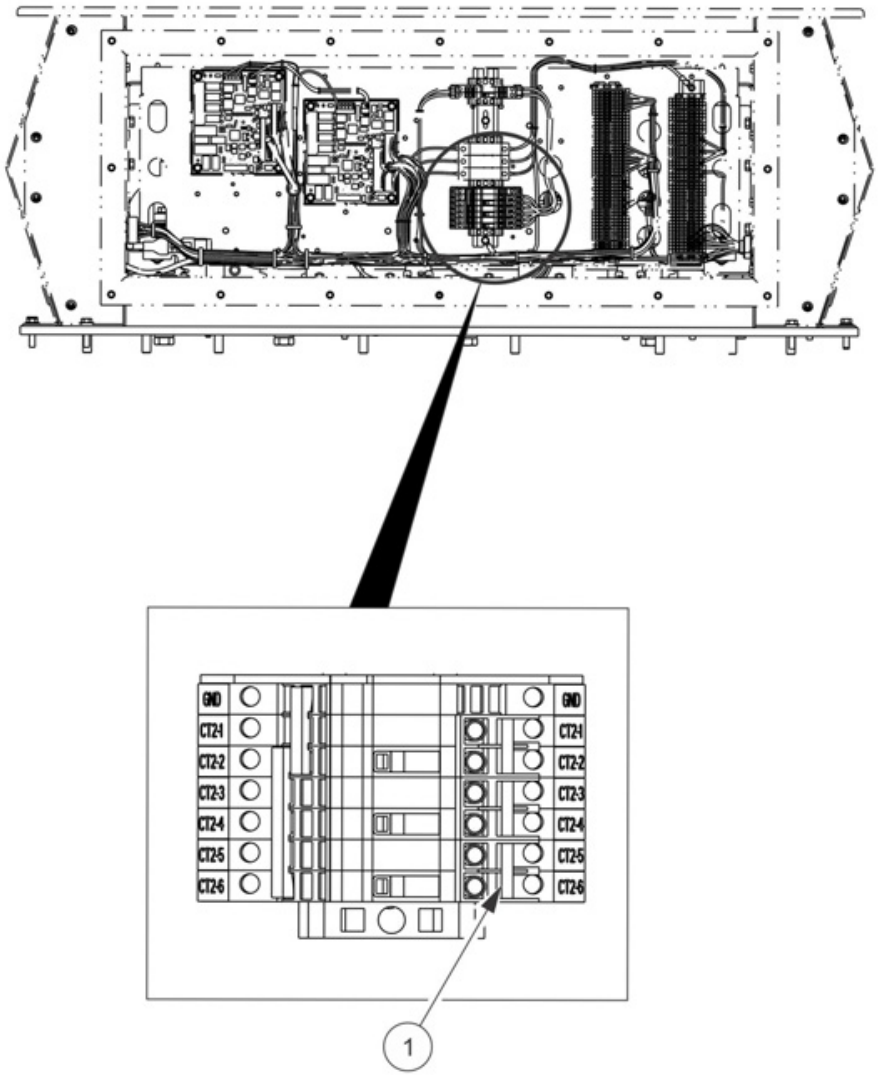
It will necessary to test all the current transformers on the circuit that is showing a fault, to isolate which current transformer is faulty.

1. Inspect the security of the current transformer and connector pins.
2. Disconnect the cables from the current transformer.
3. Using a suitable Ohm meter (multimeter) check for continuity between pin 1 to pin 2 for half ratio, from pin 1 to pin 3 for full ratio, from X1 to X2 for full ratio, or S1 to S2 for full ratio.
4. If the reading on the meter is infinity then the CT is opened circuit and needs replacing.

6.11.1.4 CT Remove and Replace - Low Voltage

1. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See **Section 6.1.2**.
2. Remove the alternator customer connection box cover. Locate the CT shorting block, and engage the actuator to short the CT.
3. Locate the shorting block for each CT. Engage the actuator to short each CT.

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No.	Description	No.	Description
1	Shorting block		

FIGURE 425. CT SHORTING BLOCK

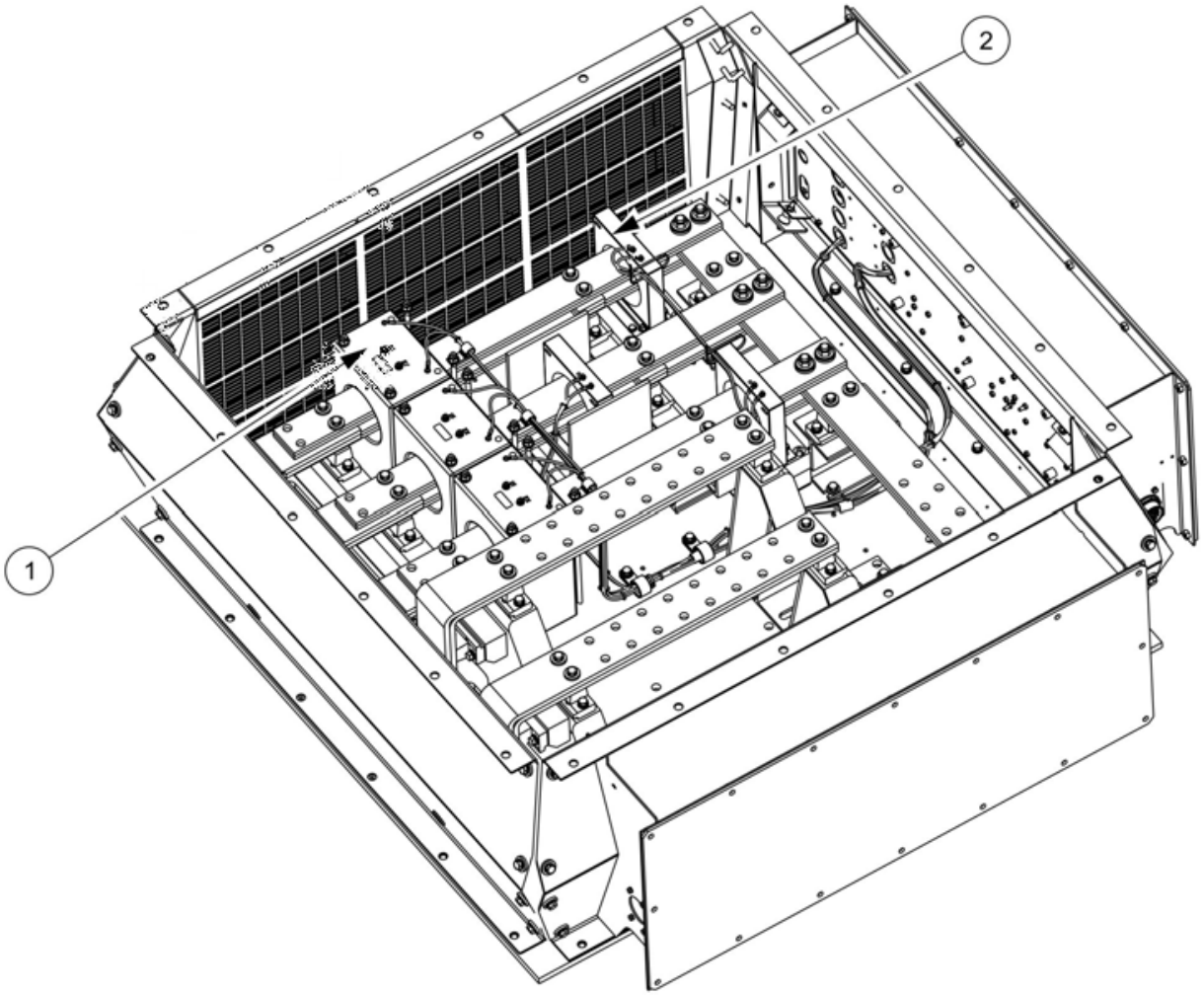
4. Remove the alternator top cover.
5. Located the CT or CTs that need to be replaced.

NOTICE
This procedure provides instructions to remove and install the current transformers on the U phase neutral bar. Instructions to remove and install the current transformers on the V phase and W phase neutral bars are similar.

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NOTICE

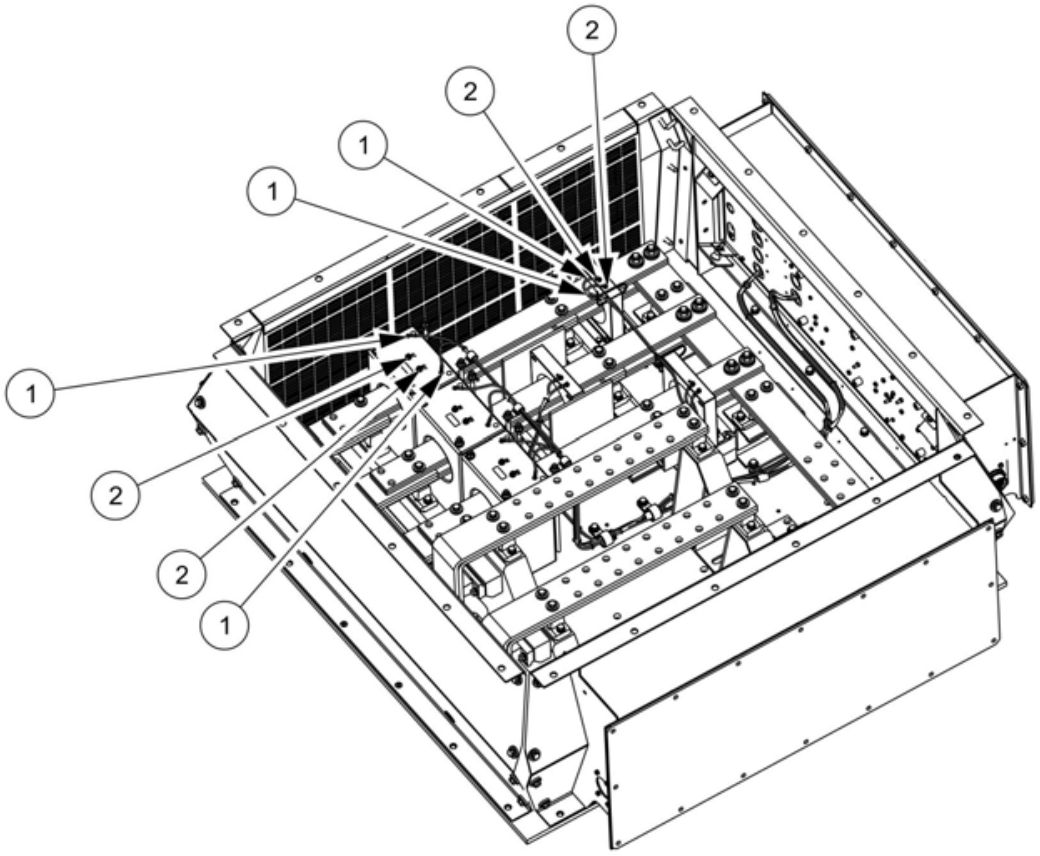
This procedure provides instructions to remove and install both the metering CT and the differential CT. The metering CT is an optional part based on cutomer needs. The differential CT is a standard part.



No.	Description	No.	Description
1	Differential CT	2	Metering CT

FIGURE 426. CT LOCATIONS

6. Take note of the signal wires and the signal wire locations, the CT should be marked with an X1 and X2. Label the wires if not already labeled.

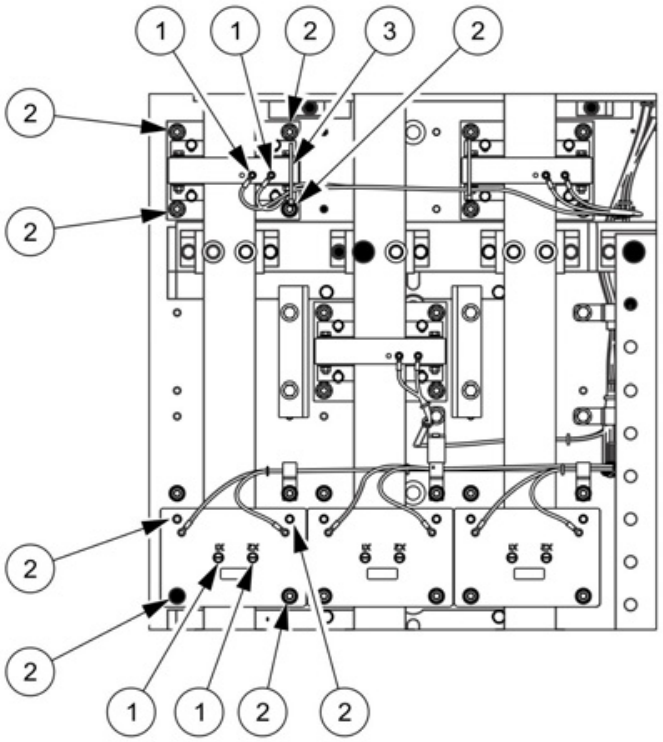


No.	Description	No.	Description
1	Signal wires	2	Connections

FIGURE 427. SIGNAL WIRES

7. Remove the two brass screws that attach the signal wires to the CT and the four bolts and locknuts that attaching the CT to the mounting brackets.

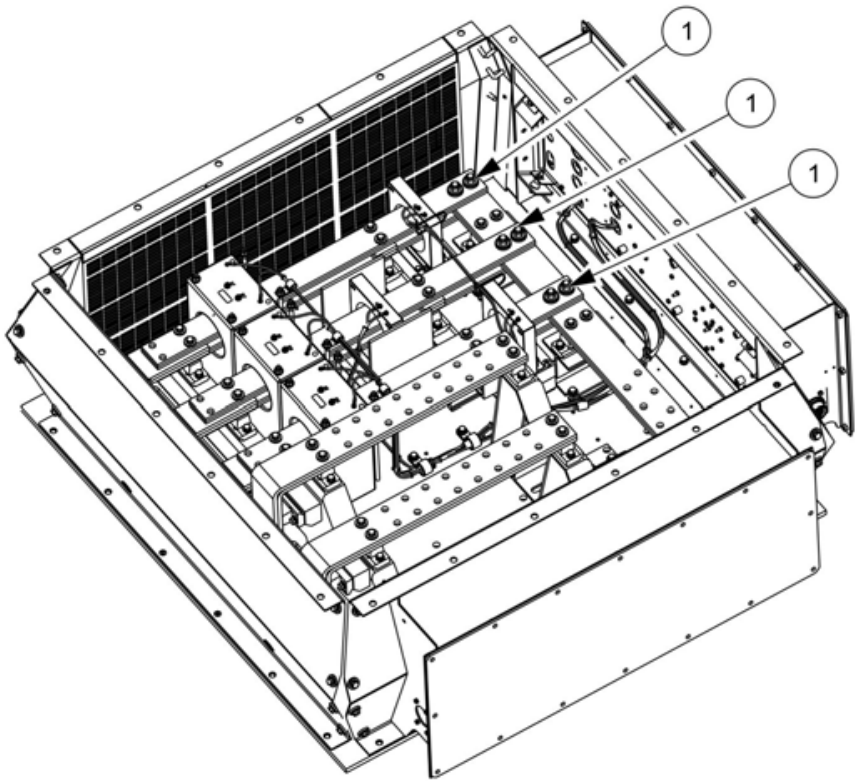
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No.	Description	No.	Description
1	Brass screws	2	Bolts and locknuts

FIGURE 428. BOLTS AND SCREWS

8. Cut and remove the wire securing zip ties attached to the CT as needed.
9. Remove the six sets of hardware connecting the alternator phase bars to the neutral bus bar.

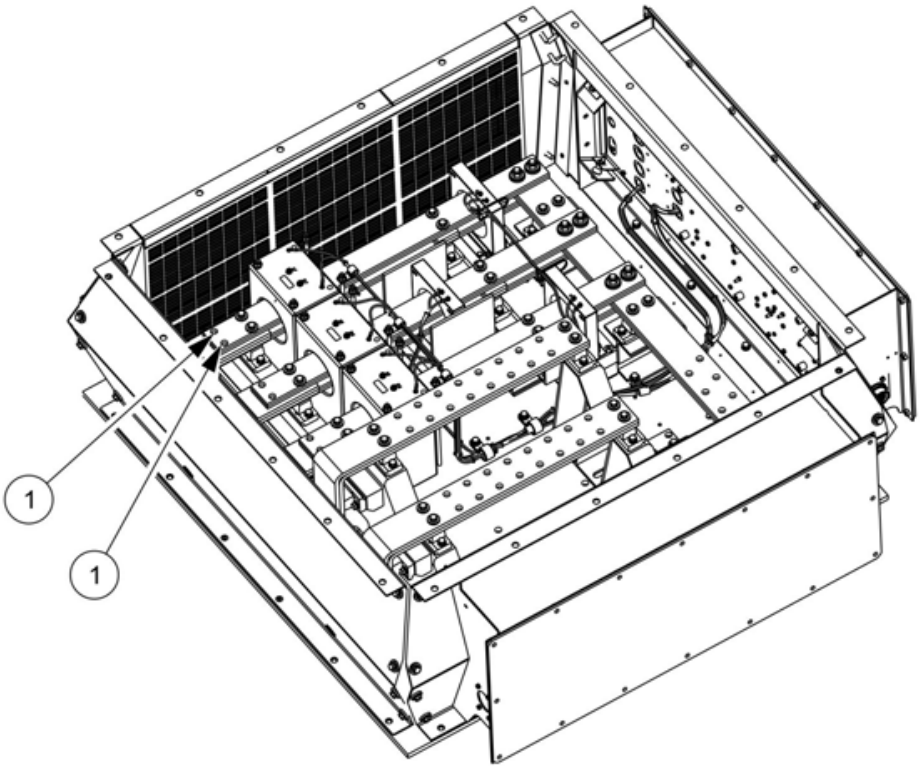


No.	Description	No.	Description
1	Attaching hardware		

FIGURE 429. NEUTRAL BUS BAR ATTACHING HARDWARE

10. Remove two sets of hardware that attach the alternator phase bus bar to the stator lead lug.

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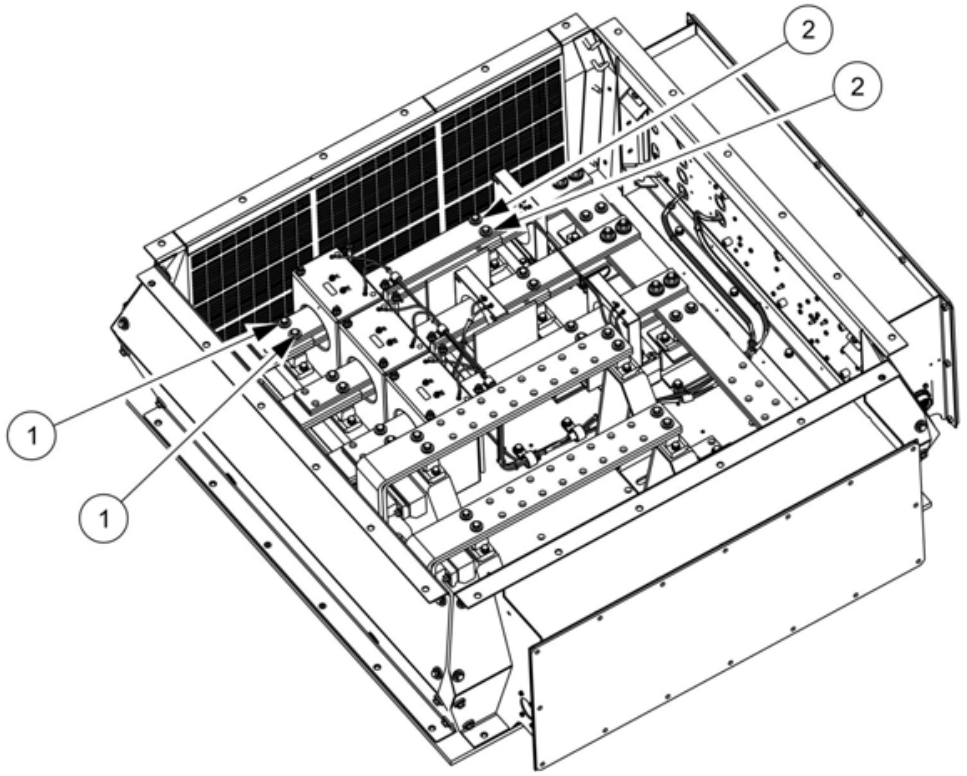


No.	Description	No.	Description
1	Attaching hardware location		

FIGURE 430. STATOR LEAD LUG ATTACHING HARDWARE

11. Remove four sets of hardware that attach the phase and neutral bus bar to the alternator.

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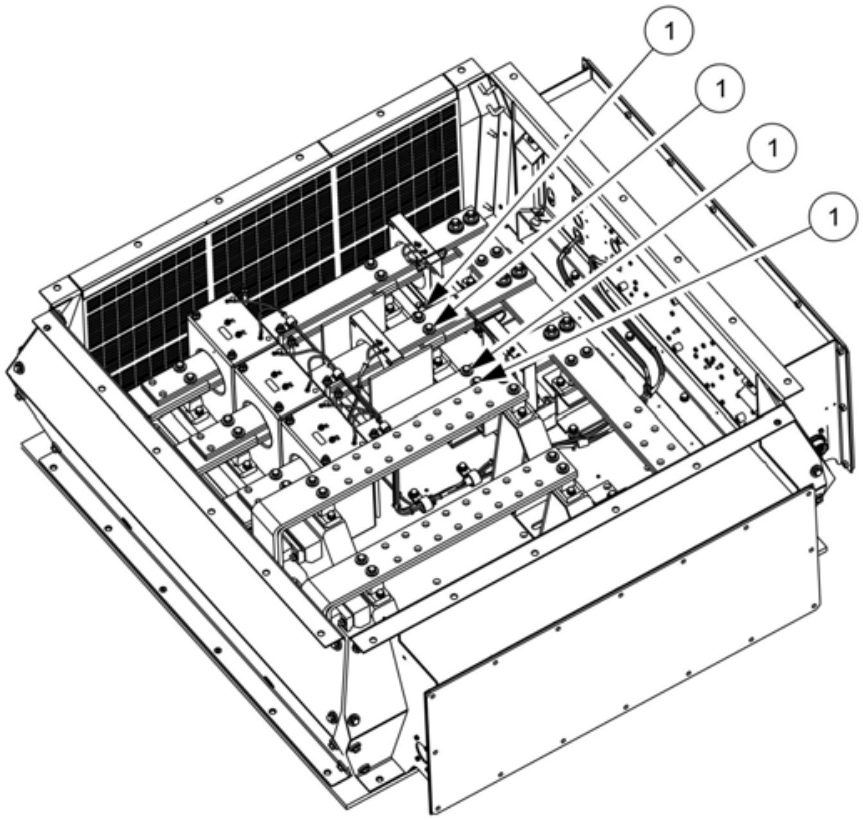


No.	Description	No.	Description
1	Attaching hardware location		

FIGURE 431. ALTERNATOR AND PHASE BUS BAR ATTACHING HARDWARE

12. Loosen four sets of hardware that hold the remaining phase bus bars to the alternator.

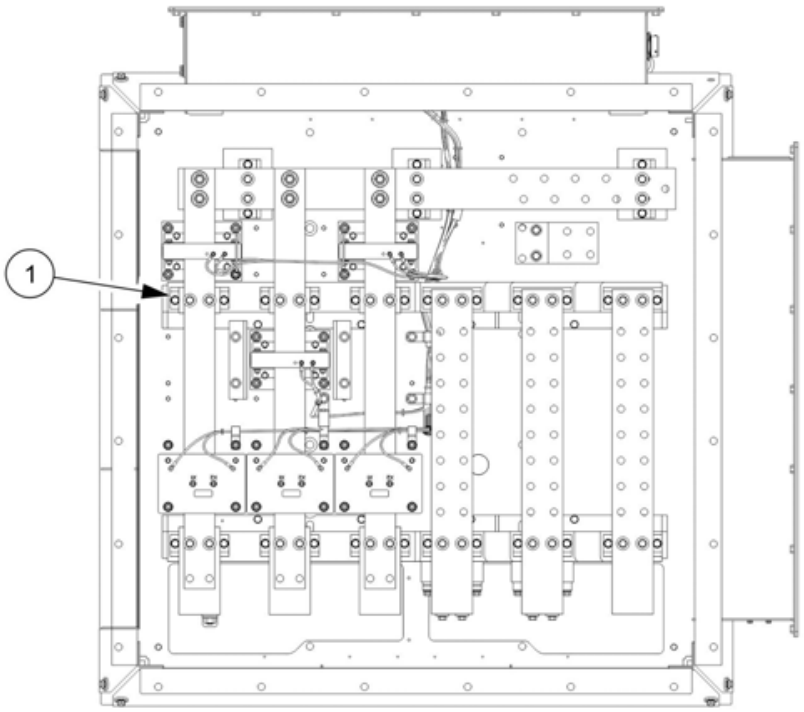
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No.	Description	No.	Description
1	Attaching hardware location		

FIGURE 432. ALTERNATOR AND REMAINING PHASE BUS BARS ATTACHING HARDWARE

13. Remove two spacers from the bus bar assembly.

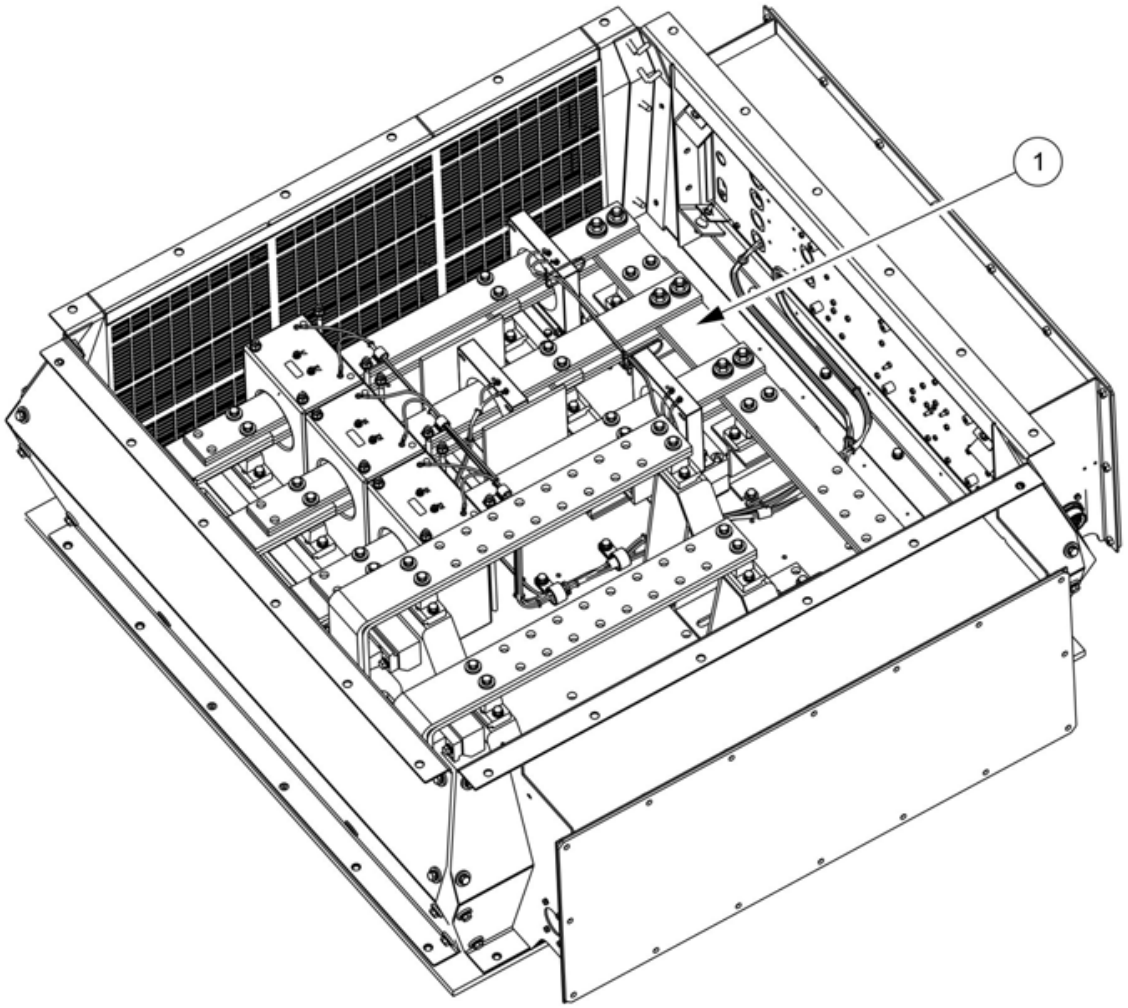


No.	Description	No.	Description
1	Location of spacers		

FIGURE 433. LOCATION OF SPACERS

14. Remove the neutral bus bar assembly.

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No.	Description	No.	Description
1	Neutral bus bar assembly		

FIGURE 434. NEUTRAL BUS BAR ASSEMBLY

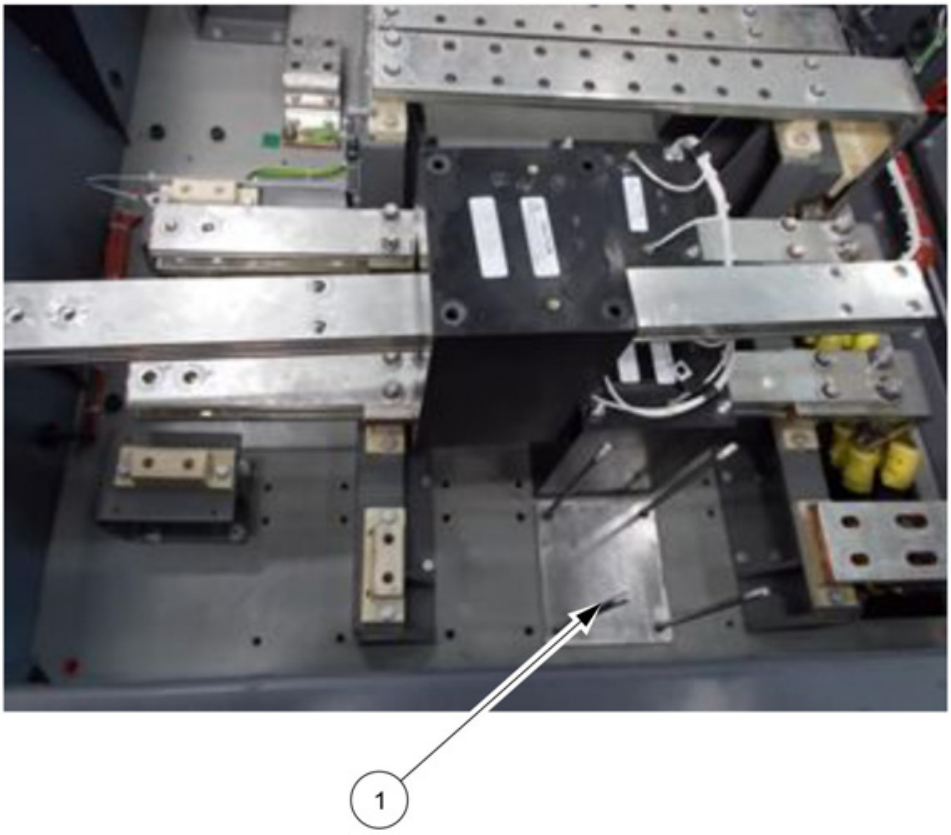
15. Move the bottom two phase bus bars around the stator lead lug so that all four bus bars are above the stator lead lug.



FIGURE 435. FOUR BUS BARS ABOVE THE STATOR LEAD LUG

16. Lift the phase bus bare up to remove the CT from the alternator mounting studs. The bus bars and the CT wight approximately 57 lbs (25.8 kg).

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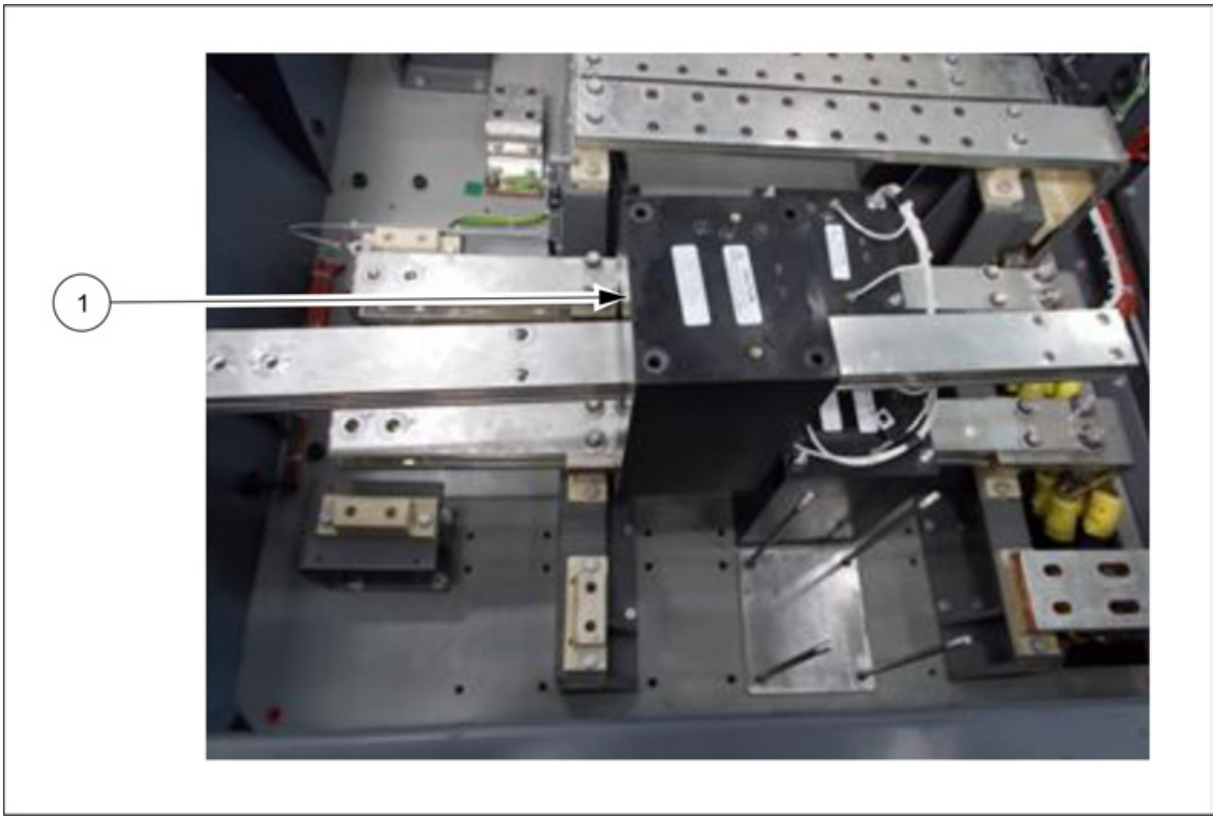


No.	Description	No.	Description
1	Mounting studs		

FIGURE 436. MOUNTING STUDS

17. Remove the CT from the bus bars.
18. Slide the replacement CT on the bus bar. Enure that the white dot on the CT faces the neutral bus bar.

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No.	Description	No.	Description
1	White dot location		

FIGURE 437. WHITE DOT LOCATION

19. Use the bus bars to lift the CT into the alternator compartment and align the CT to the mounting studs (**Figure 443**).
20. Move the bottom two phase bus bars to below the stator lead lug.

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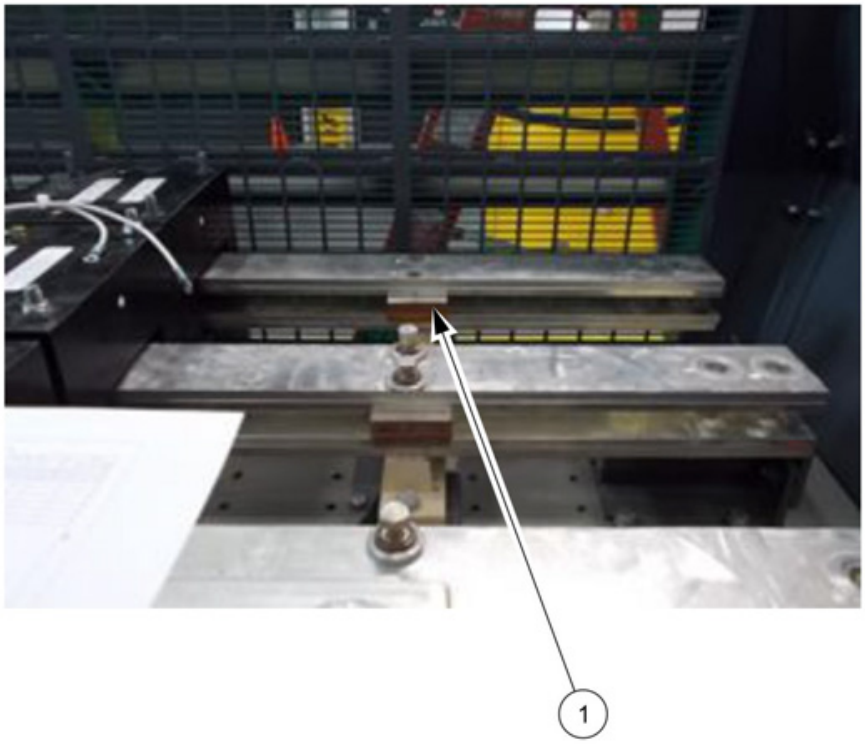


No.	Description	No.	Description
1	Top phase bus bars	2	Bottom phase bus bars

FIGURE 438. POSITIONS OF PHASE BUS BARS AND STATOR LEAD LUG

21. Install two spacers between the top two and bottom two bus bars.

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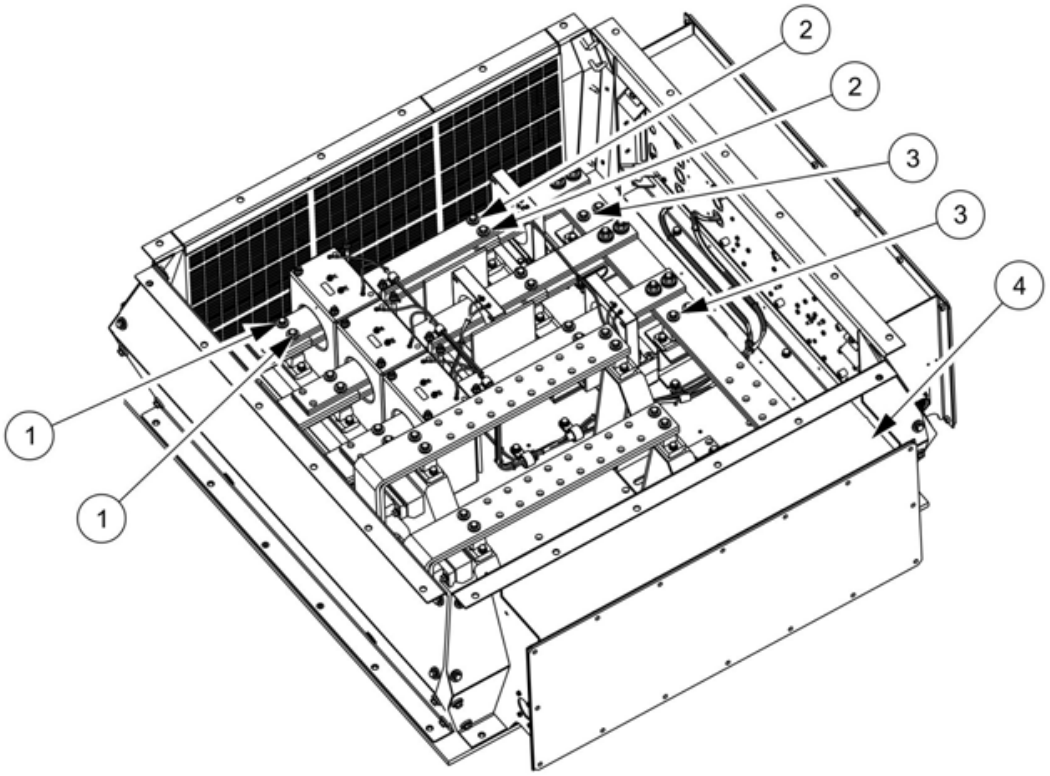


No.	Description	No.	Description
1	Spacers	2	Bottom phase bus bars

FIGURE 439. SPACERS BETWEEN BUS BARS

22. Install the neutral bus bar assembly (**Figure 443**).
23. Install, but do not tighten, ten sets of hardware that attach the neutral and phase bus bars to the alternator.

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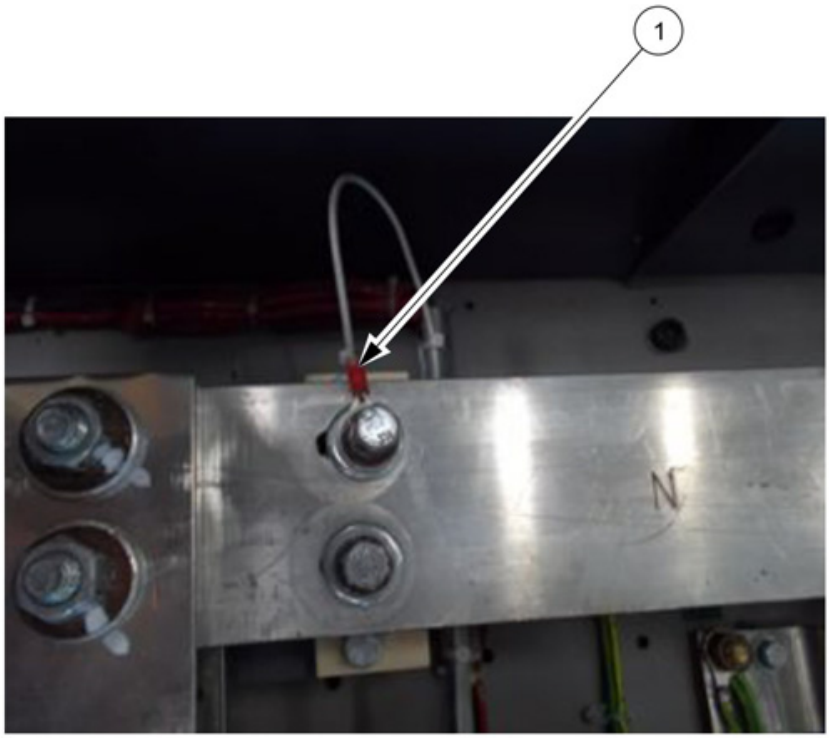


No.	Description	No.	Description
1	Mounting hardware for phase bus bar - location 1	2	Mounting hardware for phase bus bar - location 1
3	Mounting hardware for neutral bus bar (shown)	4	Mounting hardware for neutral bus bar (not shown)

FIGURE 440. HARDWARE LOCATIONS FOR NEUTRAL AND PHASE BUS BARS

24. Connect the neutral voltage sense wire to the neutral bus bar.

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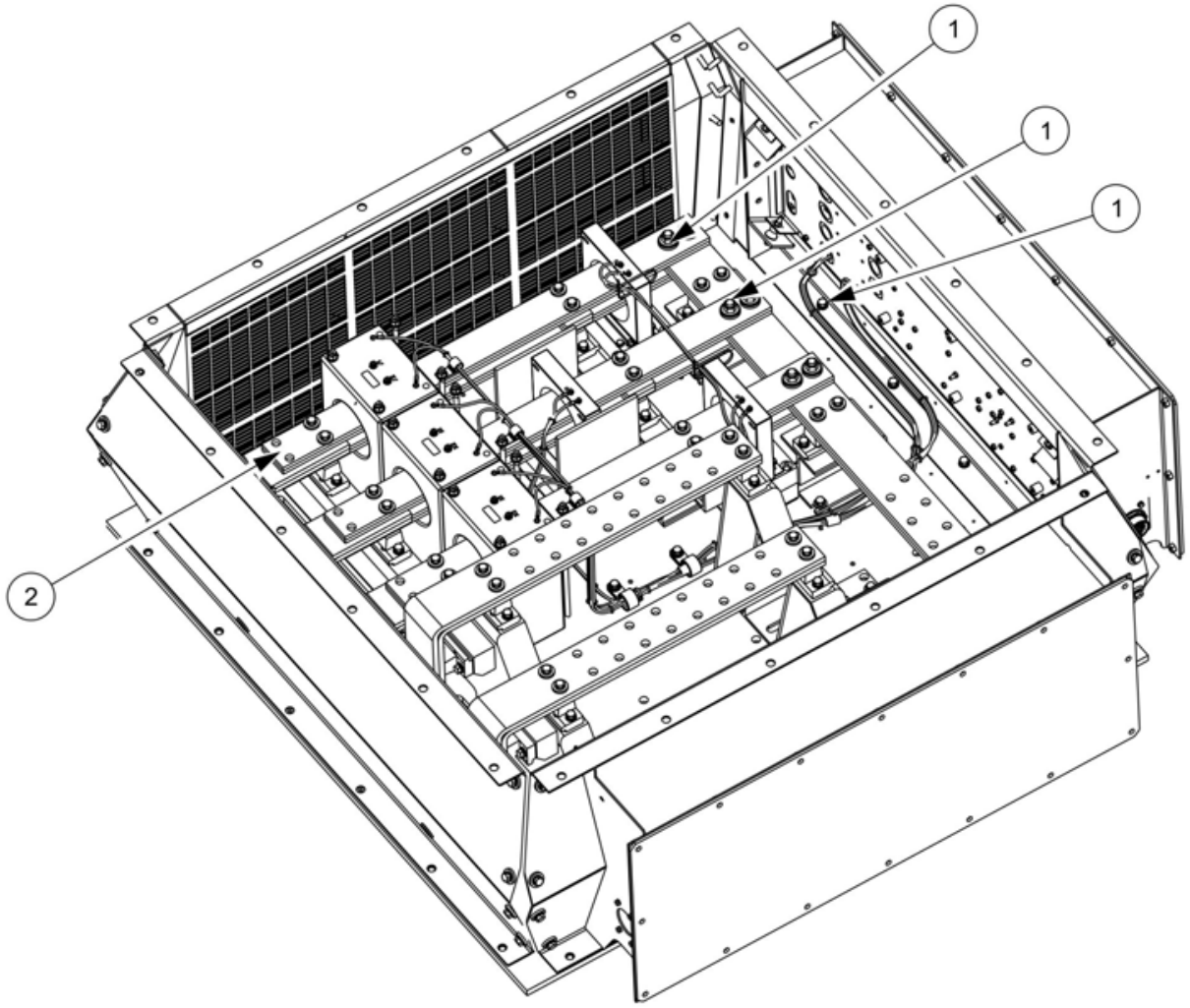


No.	Description	No.	Description
1	Neutral voltage sense wire		

FIGURE 441. NEUTRAL VOLTAGE SENSE WIRE

25. Loosely install six sets of hardware that attach the phase bus bars to the neutral bus bar and two sets of hard ware that attach the phase bus bar to the stator lead lug.

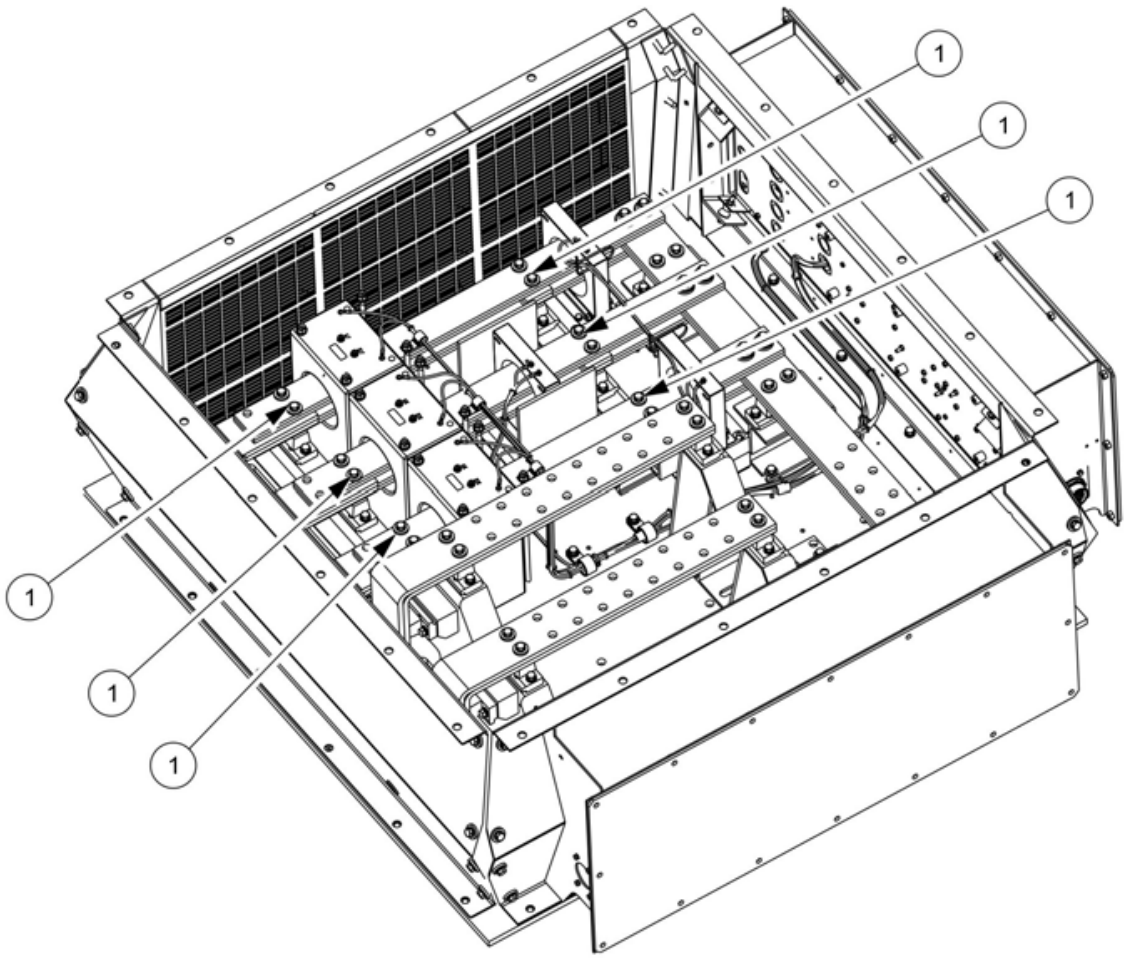
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No.	Description	No.	Description
1	Hardware locations - phase bus bar to neutral bus bar	2	Hardware locations - phase bus bar to stator lead lug

FIGURE 442. HARDWARE LOCATIONS FOR PHASE BUS BAR

26. Torque the bus bare to alternator attachment bolts to 30 Nm. Put a witness mark on the torqued hardware.



No.	Description	No.	Description
1	Hardware locations		

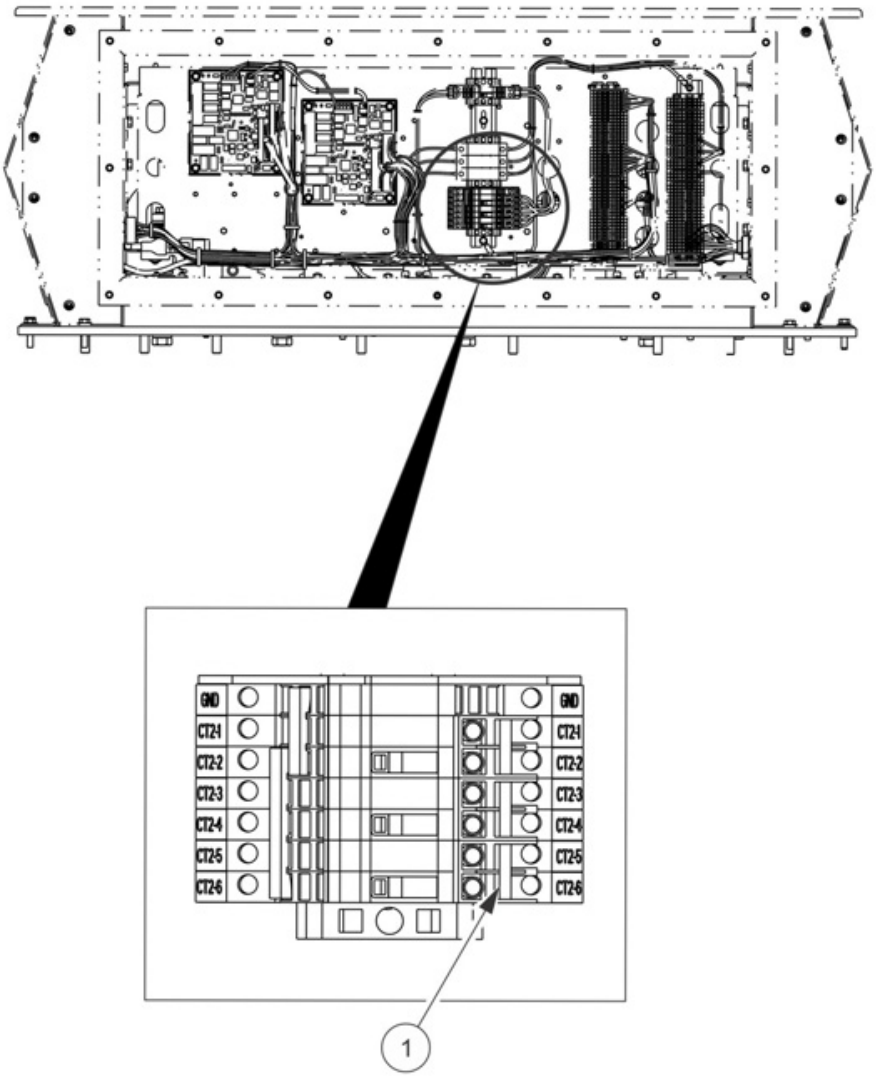
FIGURE 443. HARDWARE LOCATIONS - PHASE BUS BAR TO ALTERNATOR

27. Torque phase bus bar to neutral bus bar bolts to 45 Nm (**Figure 431**). Put a witness mark on the torqued hardware.
28. Torque the phase bus bar to stator lead lug attachment bolts to 80 Nm (**Figure 431**). Put a witness mark on the torqued hardware.
29. Reconnect the X1 and X2 signal wires. Make sure X1 and X2 go to the correct locations (**Figure 427**).
30. Install four locknuts and washers on the the CT studs. Torque the locknuts to 20 to 23 Nm.
31. Install zip ties to secure all wires.
32. Remove all tools and trash and install the alternators top cover.
33. Test run the generator set.

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6.11.1.5 CT Remove and Replace - Medium and High Voltage

1. Make sure all sources of potential energy are isolated. Lock the generator set out of service. See Section 6.1.2.
2. Remove the alternator customer connection box cover. Locate the CT shorting block, and engage the actuator to short the CT.
3. Locate the shorting block for each CT. Engage the actuator to short each CT.

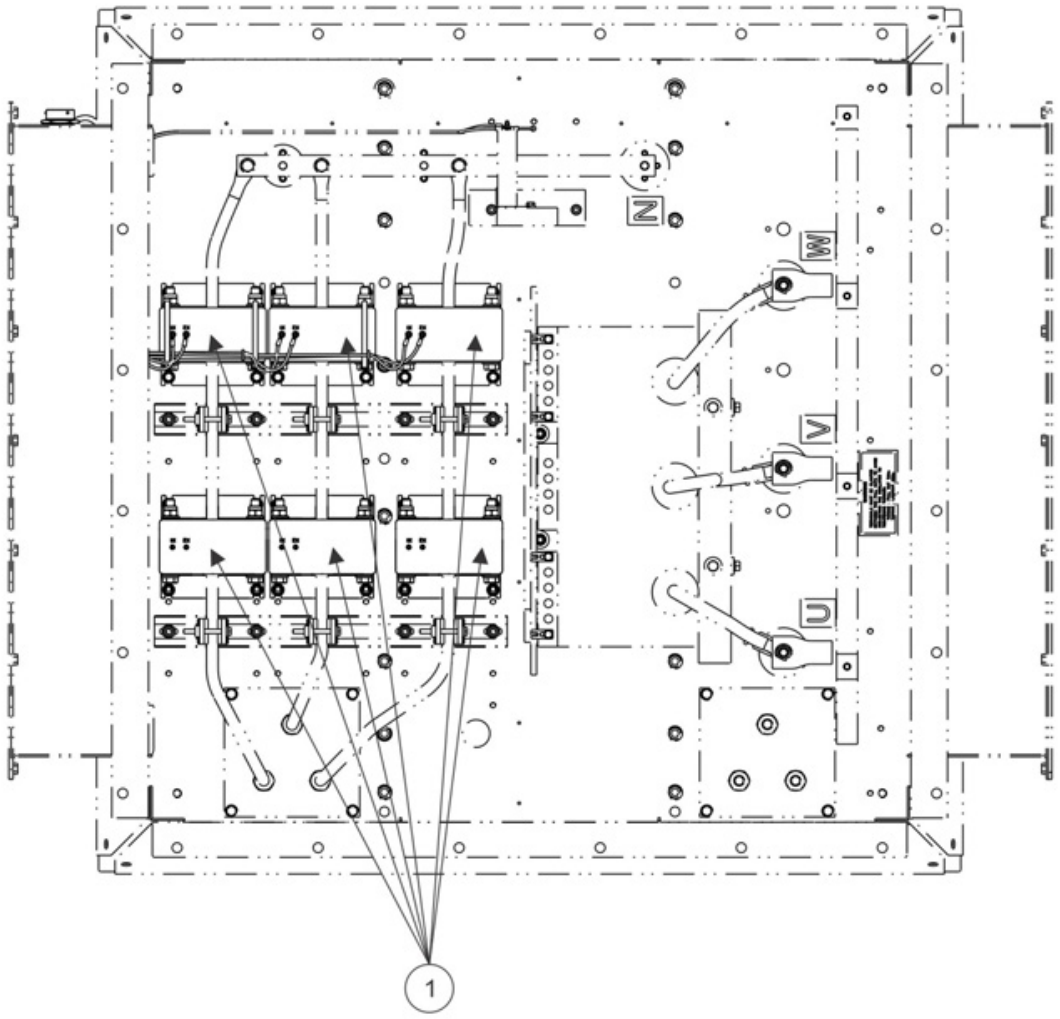


No.	Description	No.	Description
1	Shorting block		

FIGURE 444. CT SHORTING BLOCK

4. Remove the alternator top cover.
5. Located the CT or CTs that need to be replaced.

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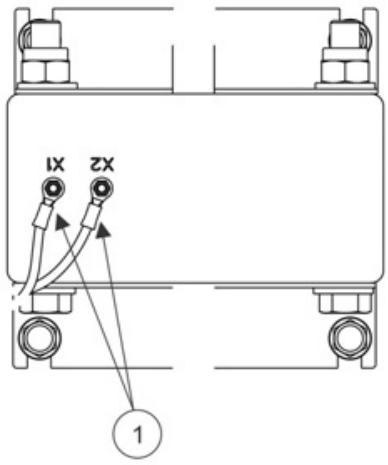


No.	Description	No.	Description
1	CT locations		

FIGURE 445. CT LOCATIONS

6. Take note of the signal wires and the signal wire locations, the CT should be marked with an X1 and X2. Label the wires if not already labeled.

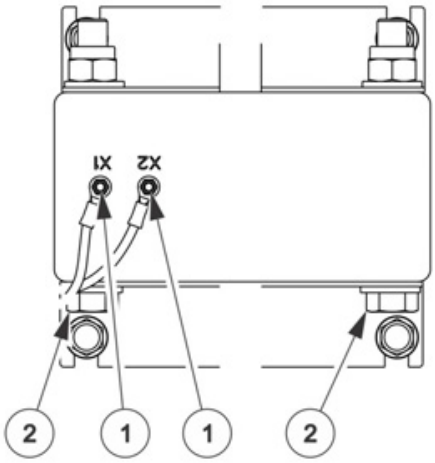
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No.	Description	No.	Description
1	Signal wires		

FIGURE 446. SIGNAL WIRES

7. Remove the 2 brass screws that attach the signal wires to the CT and the 2 bolts and locknuts that attaching the CT to the mounting brackets.

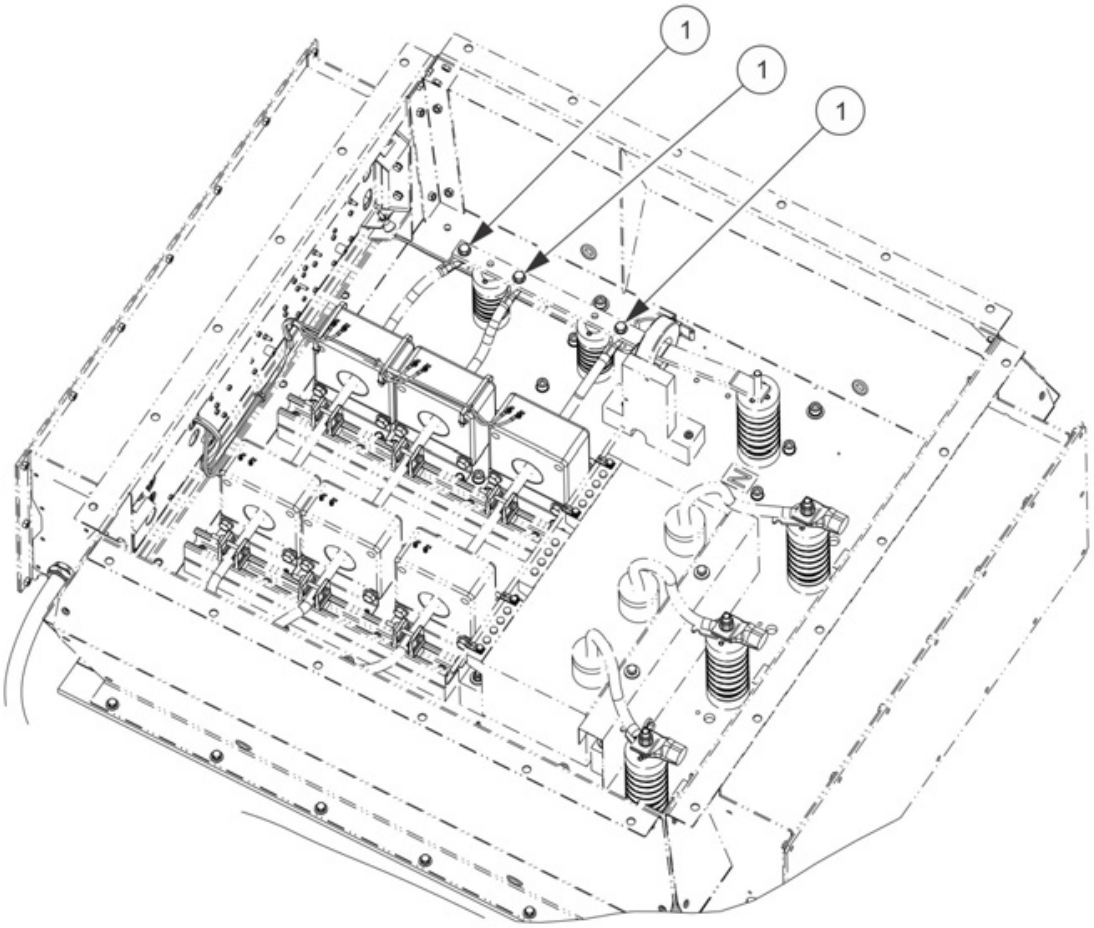


No.	Description	No.	Description
1	Brass screws	2	Bolts and locknuts

FIGURE 447. BOLTS AND SCREWS

8. Cut and remove the wire securing zip ties attached to the CT as needed.
9. Remove the hardware connecting the alternator phase cables to the neutral bus bar.

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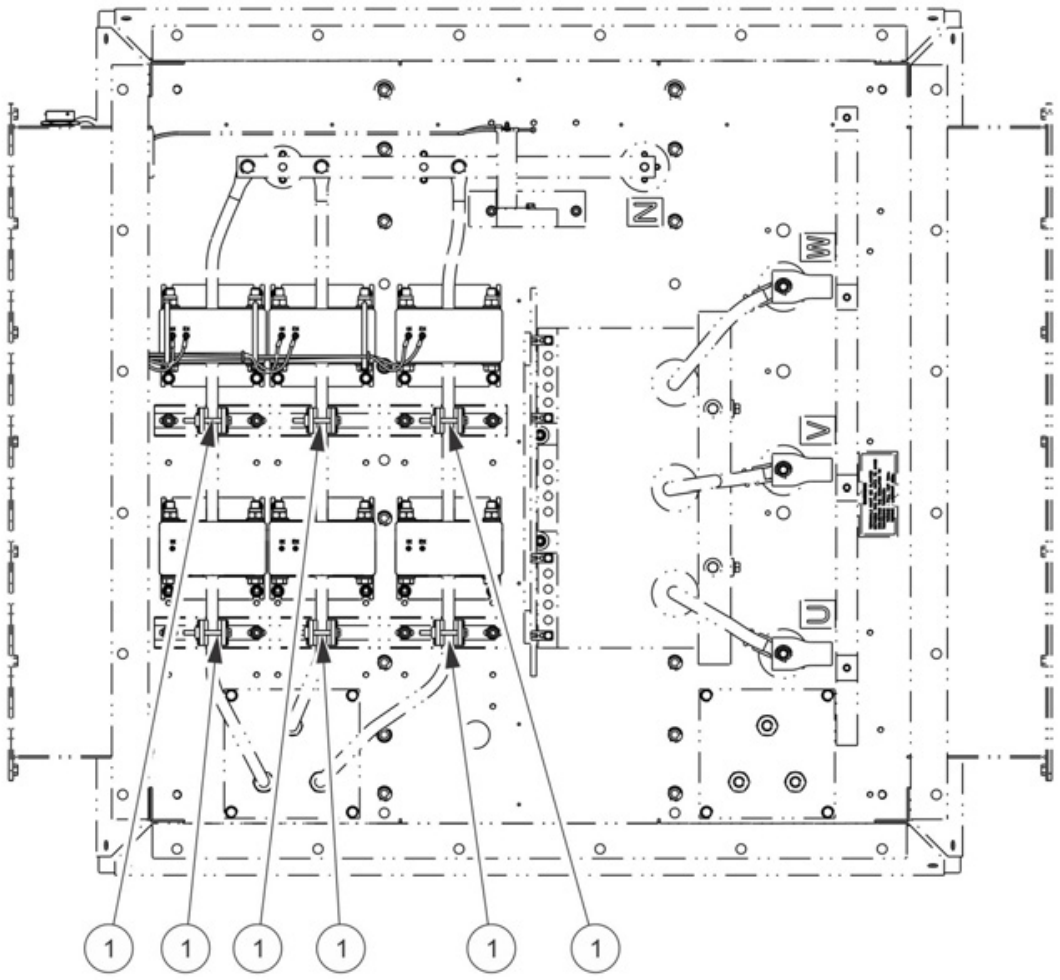


No.	Description	No.	Description
1	Phase cables		

FIGURE 448. PHASE CABLES

10. Remove the phase cable securing clamp hardware as needed. Slide the old CT out off the phase cables.

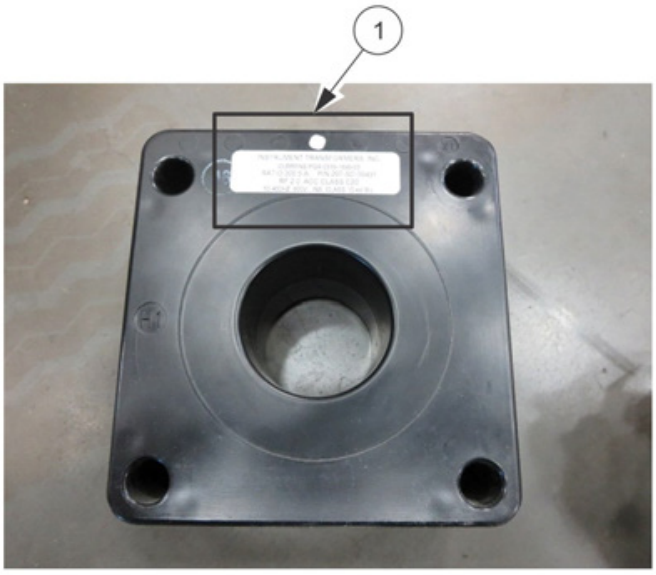
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No.	Description	No.	Description
1	Securing clamps		

FIGURE 449. PHASE CABLES

11. Ensure that the sticker and/or dot for each CT faces the neutral bar after installed.



No.	Description	No.	Description
1	Sticker and dot		

FIGURE 450. CT STICKER AND DOT

12. Slide the cable through the new CT. Install two bolts and locknuts to attach the CT to the mounting bracket.
13. Reconnect the X1 and X2 signal wires. Make sure X1 and X2 go to the correct locations (**Figure 447**).
14. Reconnect the phase cables to the neutral bar (**Figure 448**). Torque to 55 ± 4 Nm.
15. Re-install the phase cable securing clamp hardware.
16. Install zip ties to secure all wires.
17. Remove all tools and trash and install the alternators top cover.
18. At the customer connection box, slide the actuator back to disengage the CT shorting block (**Figure 444**).
19. Test run the generator set.

6.12 Generator Set Sensors

The sensors/senders in this chapter relate to those with a CPG part number. For information regarding the sensors/senders supplied as fitted by the EBU refer to the Engine Operator and Maintenance Manual see **Section 2.4**.

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6.12.1 Sensor Temperature Specifications

TABLE 137. 0193-0529-01

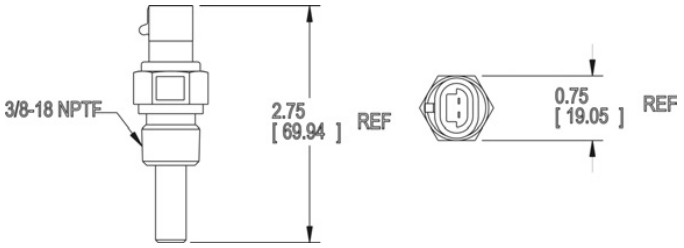
Physical Dimensions		
Operation Specifications		
	Operating Voltage	12-24 VDC
	Max Temperature	149 °C (300 °F)
	Operating Temperature	-40 °C - 129 °C (-40 °F - 265 °F)

TABLE 138. 0193-0529-02

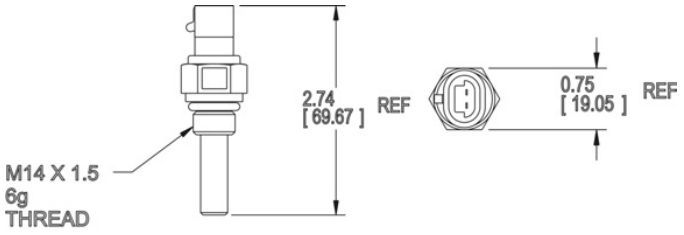
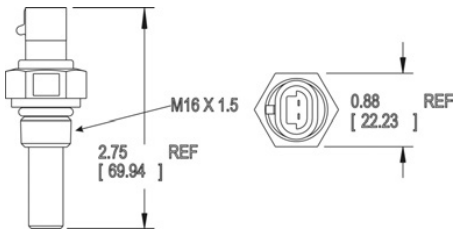
Physical Dimensions		
Operation Specifications		
	Operating Voltage	12-24 VDC
	Max Temperature	149 °C (300 °F)
	Operating Temperature	-40 °C - 129 °C (-40 °F - 265 °F)

TABLE 139. 0193-0529-03

Physical Dimensions		
Operation Specifications		
	Operating Voltage	12-24 VDC
	Max Temperature	149 °C (300 °F)
	Operating Temperature	-40 °C - 129 °C (-40 °F - 265 °F)

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7 Manufacturing Facilities

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A.1 Outline Drawing A067K080 – Normal Duty Air Cleaner with 94 Square Foot Radiator

ALTERNATOR	WINDING	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH NO RADIATOR* Kg [LBS]	GENSET WEIGHT WITH RADIATOR* Kg [LBS]	C OF G WITH RADIATOR DIM A (SHEET 2) * mm [inch]	C OF G WITH RADIATOR DIM B (SHEET 2) * mm [inch]	C OF G WITHOUT RADIATOR DIM A* mm [inch]	C OF G WITHOUT RADIATOR DIM B* mm [inch]
S9HID-G42	851	7750 [17086]	24597 [54227]	30947 [68226]	1145 [45]	3777 [148]	1038 [40]	2875 [113]
S9HID-H42	991	8200 [18078]	25047 [55219]	31397 [69218]	1142 [44]	3729 [146]	1036 [40]	2831 [111]
S9HID-G42	991	7750 [17086]	24597 [54227]	30947 [68226]	1145 [45]	3777 [148]	1038 [40]	2875 [113]
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S9HID-H42	961	8200 [18078]	25047 [55219]	31397 [69218]	1142 [44]	3729 [146]	1036 [40]	2831 [111]
S9HID-G42	983	7750 [17086]	24597 [54227]	30947 [68226]	1145 [45]	3777 [148]	1038 [40]	2875 [113]
S9HID-H42	983	8200 [18078]	25047 [55219]	31397 [69218]	1142 [44]	3729 [146]	1036 [40]	2831 [111]
S9HID-H42	851	8200 [18078]	25047 [55219]	31397 [69218]	1142 [44]	3729 [146]	1036 [40]	2831 [111]

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS WITH IMPERIAL INCH CONVERSIONS IN "[ ]".

   1.1 IN EVENT OF A DISCREPANCY BETWEEN METRIC AND IMPERIAL DIMENSIONS, THE METRIC DIMENSIONS CONTROL.

2. ALL DIMENSIONS ARE REFERENCE, UNLESS SPECIFICALLY TOLERANCED.

3. WEIGHT: REFER TO TABLE FOR STANDARD GENSET WITH E127-2 (ENHANCED HIGH AMBIENT) COOLING SYSTEM.

   *3.1 INCLUDES WEIGHT OF 606 LITERS [160 GALLONS] SUPPLIED ENGINE OIL.(530 Kg/1168 LBS)

   **3.2 INCLUDES DRY WEIGHT OF RADIATOR 5130 Kg [11310 LBS] (SHIPS LOOSE).

   **3.3 INCLUDES WEIGHT FOR 1196 LITERS [316 GALLONS] OF NON-SUPPLIED COOLANT. (1216 Kg/2780 LBS)

4. LARGEST NOMINAL DIMENSIONS:
   4.1 LENGTH 8307 [327.0]
   4.2 WIDTH 3172 [124.9] RADIATOR
   4.3 HEIGHT 3791 [149.2] TOP OF RADIATOR CAP
   4.4 DOES NOT INCLUDE THE HEIGHT OF THE VIBRATION ISOLATOR

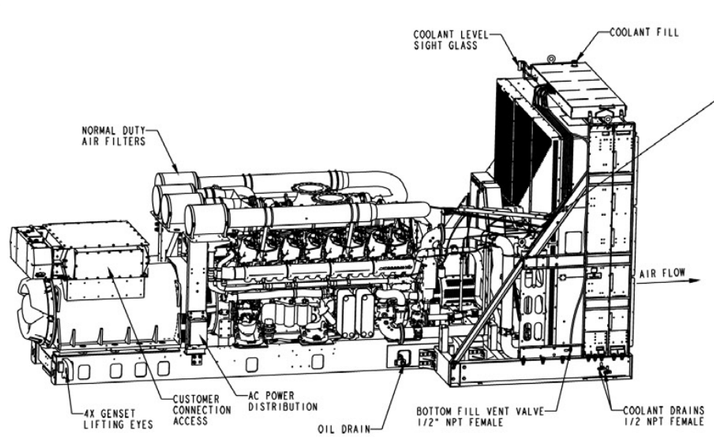
5 LIFTING INSTRUCTIONS: GENSET SHALL NOT BE LIFTED USING THE LIFTING EYES WHEN ATTACHED TO THE RADIATOR. RADIATOR AND GENSET SHALL ALWAYS BE LIFTED SEPARATELY PER INSTALLATION MANUAL AND LIFTING DIAGRAMS.

5.1 NOTE: GENSET SHALL NOT BE LIFTED USING THE LIFTING EYES WHEN ATTACHED TO THE RADIATOR. THEY ARE TO BE LIFTED SEPARATELY PER INSTALLATION MANUAL AND LIFTING DIAGRAMS

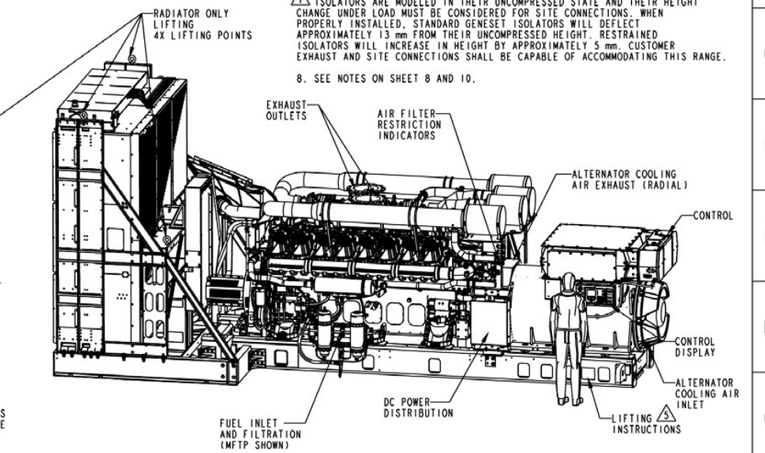
6. ALLOW 1 METER OF SPACE AROUND THE GENSET FOR SERVICE.

7 ISOLATORS ARE MODELLED IN THEIR UNCOMPRESSED STATE AND THEIR HEIGHT CHANGE UNDER LOAD MUST BE CONSIDERED FOR SITE CONNECTIONS. WHEN PROPERLY INSTALLED, STANDARD GENESET ISOLATORS WILL DEFLECT APPROXIMATELY 13 mm FROM THEIR UNCOMPRESSED HEIGHT. RESTRAINED ISOLATORS WILL INCREASE IN HEIGHT BY APPROXIMATELY 5 mm. CUSTOMER EXHAUST AND SITE CONNECTIONS SHALL BE CAPABLE OF ACCOMMODATING THIS RANGE.

8. SEE NOTES ON SHEET 8 AND 10.



RIGHT SIDE



LEFT SIDE

STANDARD GENSET CONFIGURATION
WITH S9HID-G42 ALTERNATOR AND E127-2
(ENHANCED HIGH AMBIENT) COOLING SYSTEM SHOWN

LAST DATUM LETTER USED: . | LAST REFERENCE LETTER USED: W
MODEL/PLATFORM: C325D6 | THIS PART IS SIMILAR TO: A040H712
Cummins Inc.
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: INCHES | SIZE: A1 | SCALE:0.04
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009 | THIRD ANGLE PROJECTION | CAD SYSTEM PTC® Creo® Parametric

FIGURE 451. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 94 SQUARE FOOT RADIATOR (SHEET 1 OF 10)

Copyright © 2026 Cummins Inc.

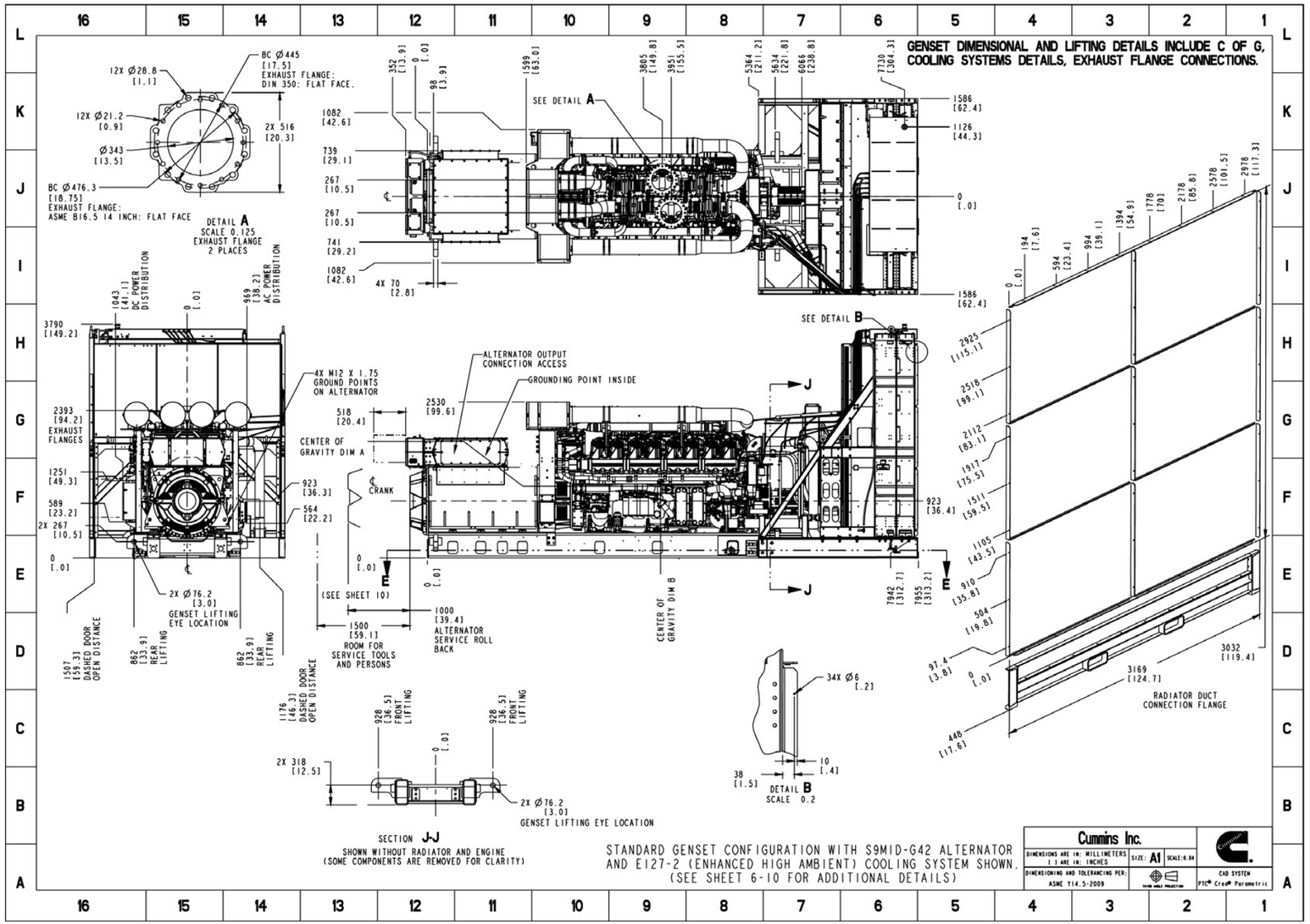


FIGURE 452. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 94 SQUARE FOOT RADIATOR (SHEET 2 OF 10)

Copyright © 2026 Cummins Inc.

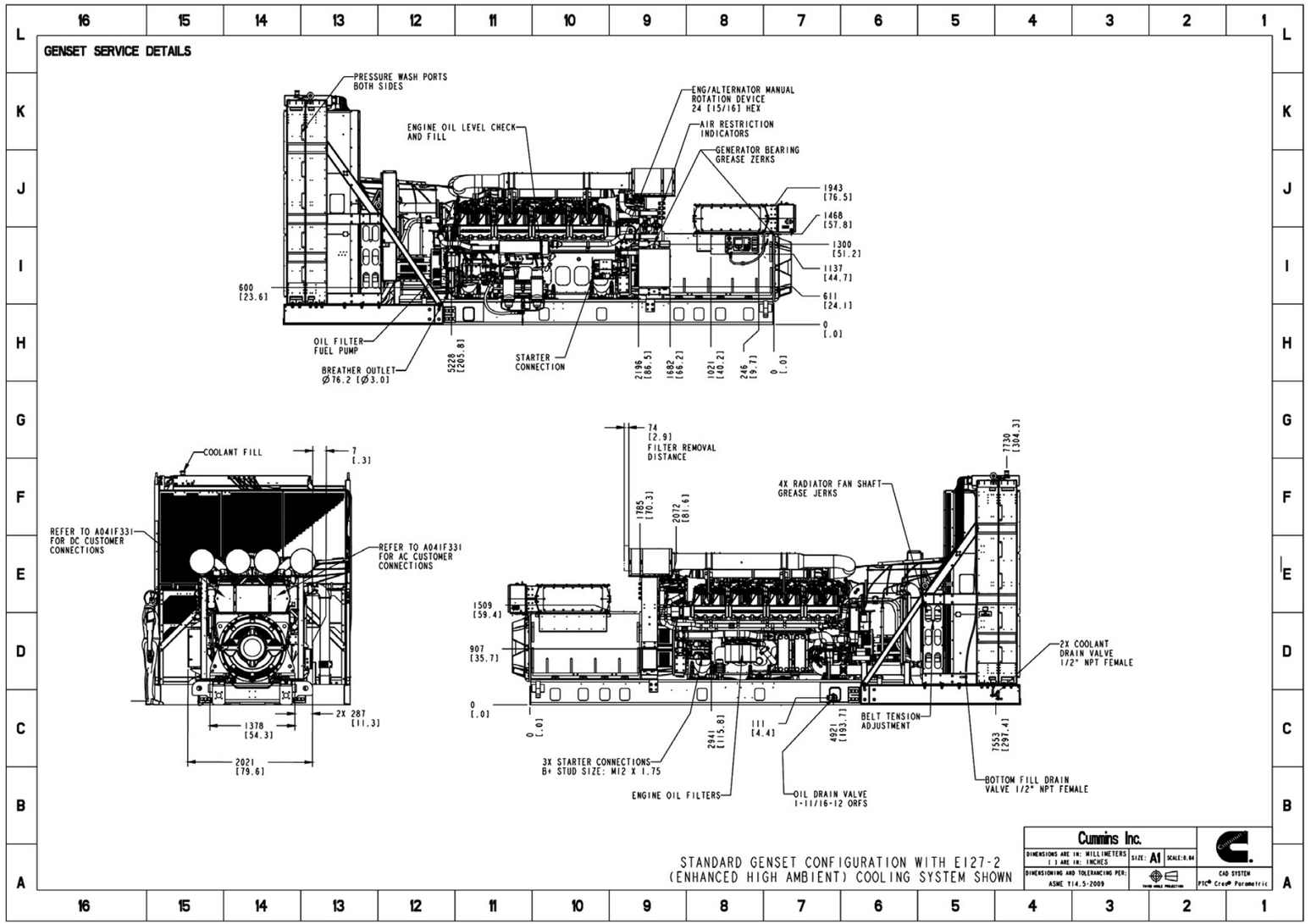


FIGURE 453. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 94 SQUARE FOOT RADIATOR (SHEET 3 OF 10)

Copyright © 2026 Cummins Inc.

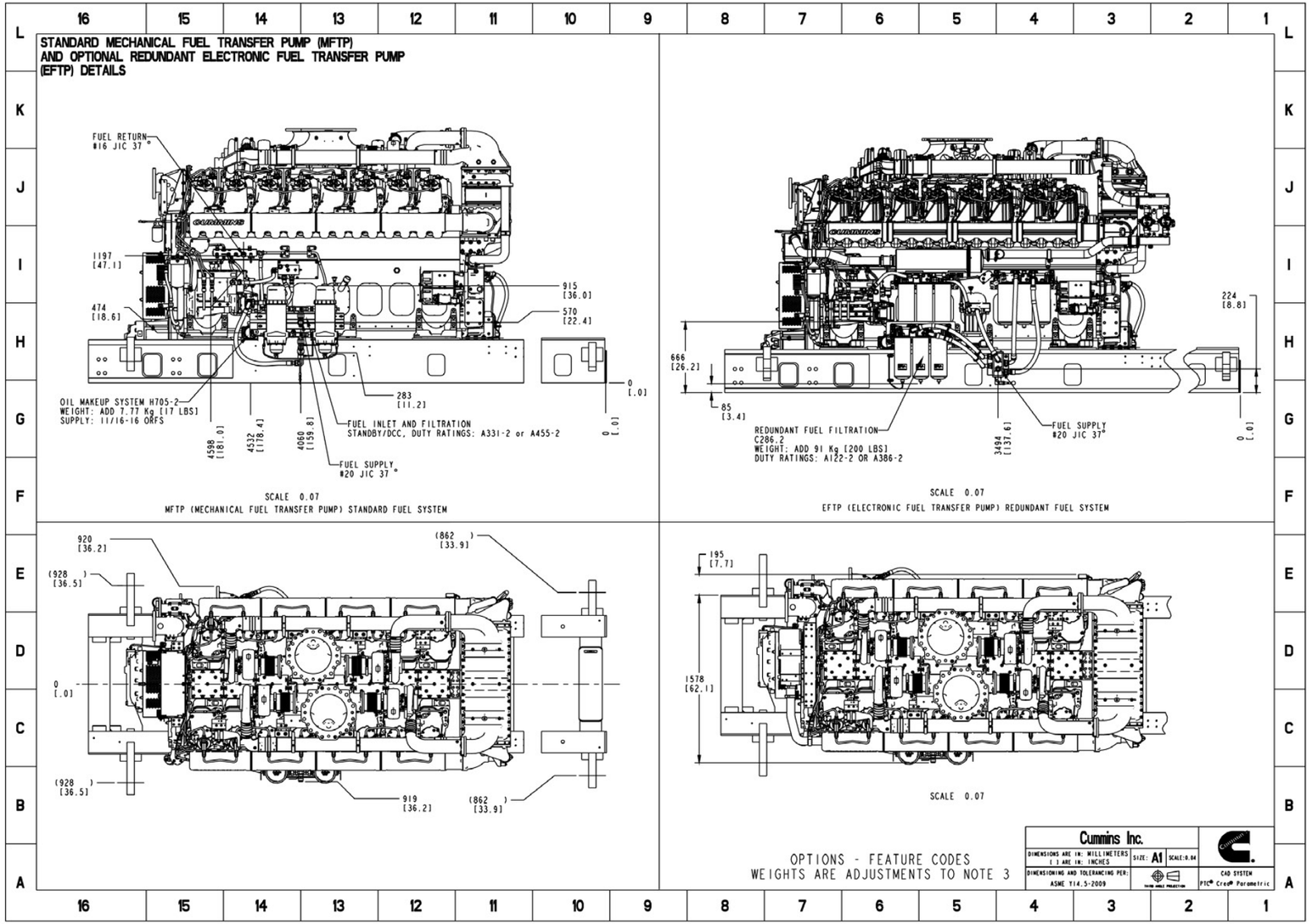


FIGURE 454. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 94 SQUARE FOOT RADIATOR (SHEET 4 OF 10)

Copyright © 2026 Cummins Inc.

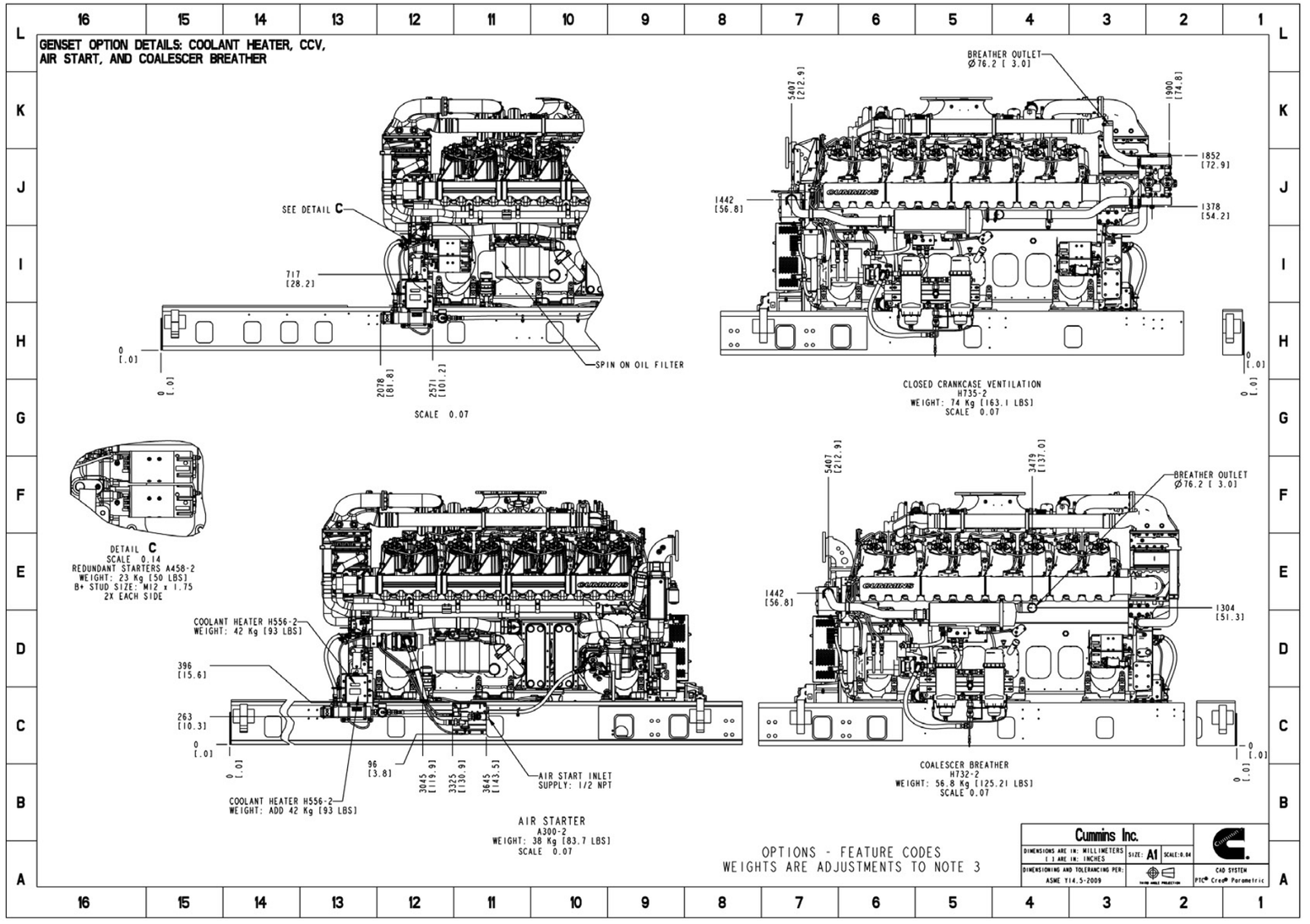


FIGURE 455. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 94 SQUARE FOOT RADIATOR (SHEET 5 OF 10)

Copyright © 2026 Cummins Inc.

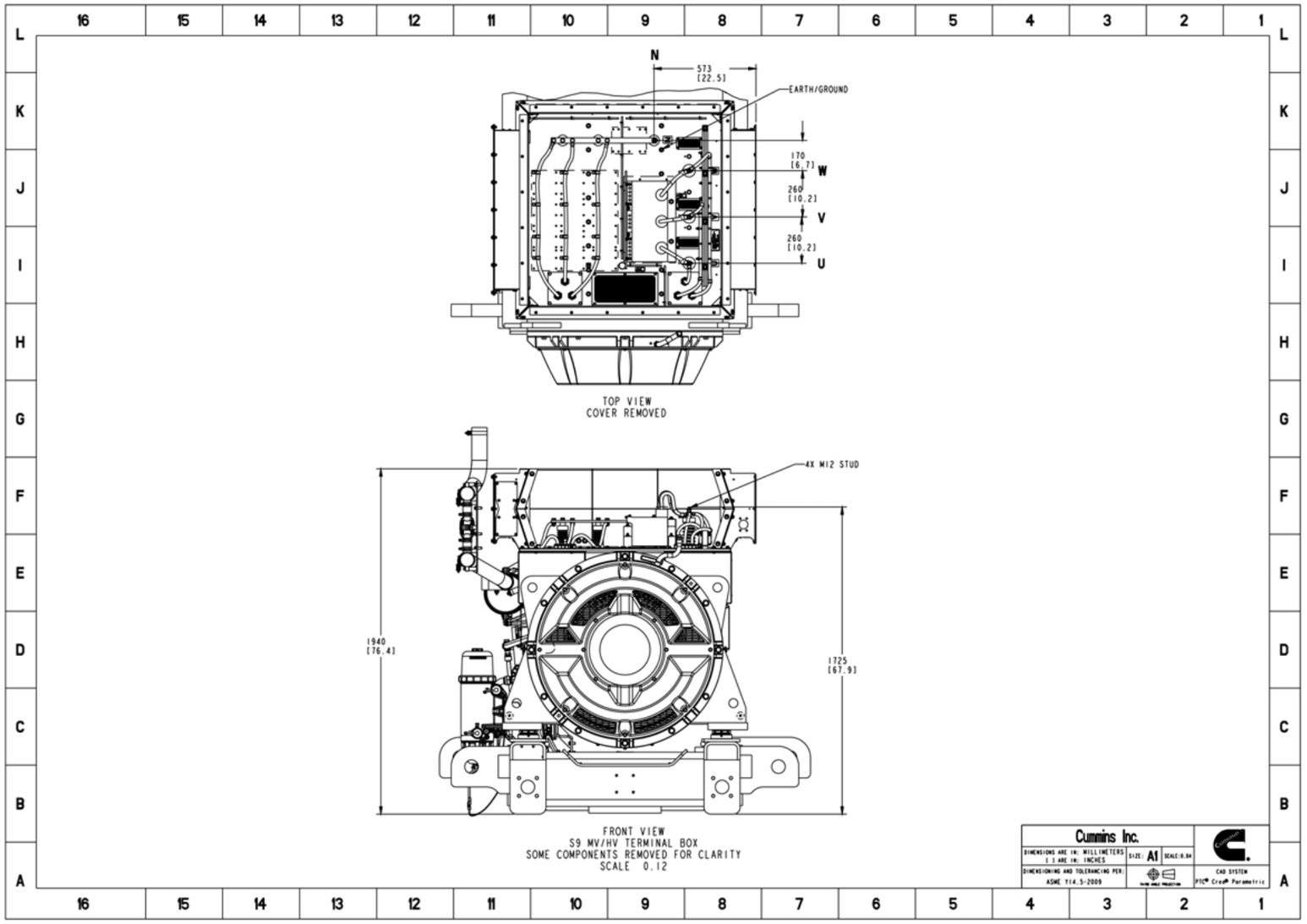


FIGURE 456. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 94 SQUARE FOOT RADIATOR (SHEET 6 OF 10)

Copyright © 2026 Cummins Inc.

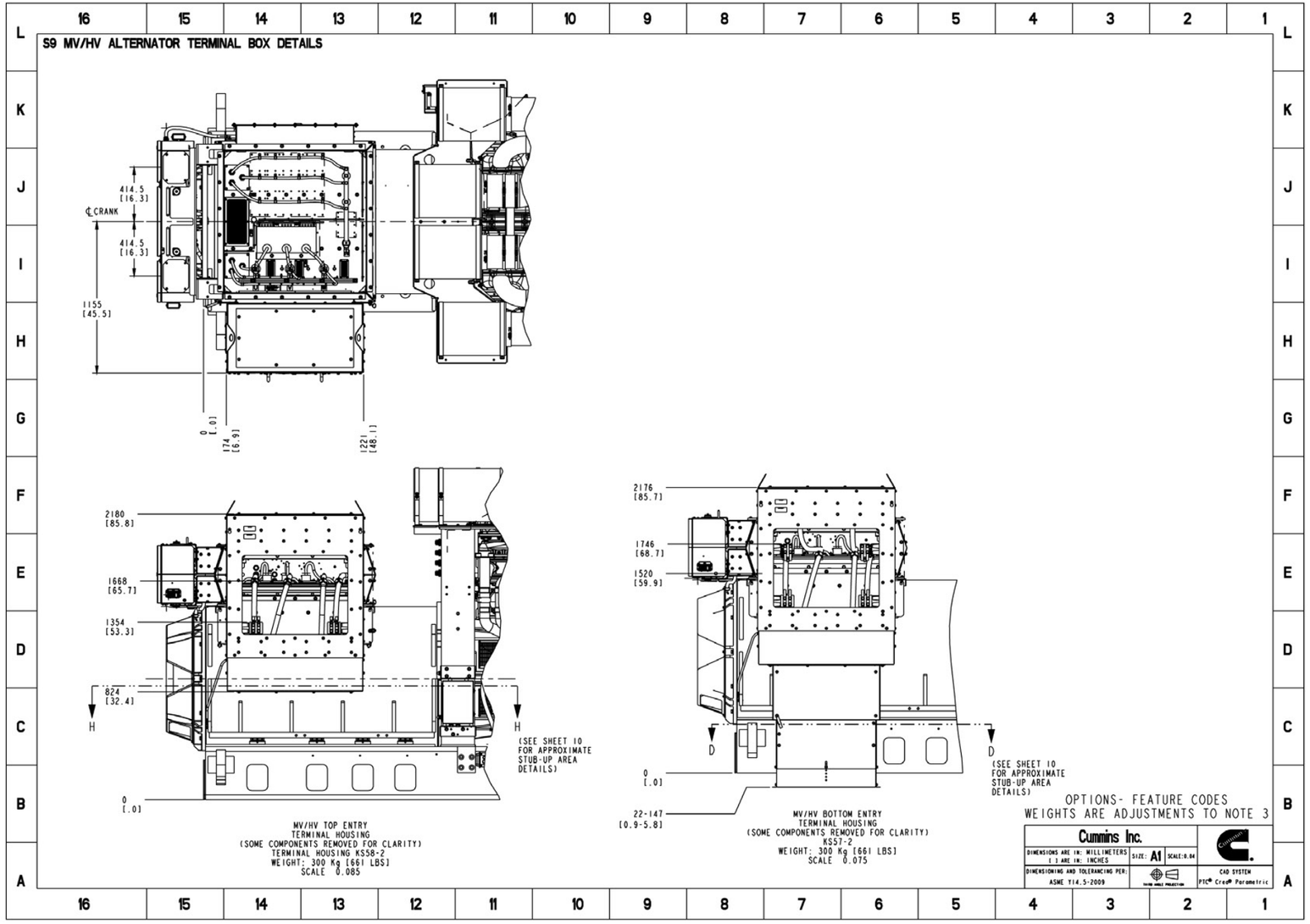


FIGURE 457. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 94 SQUARE FOOT RADIATOR (SHEET 7 OF 10)

Copyright © 2026 Cummins Inc.

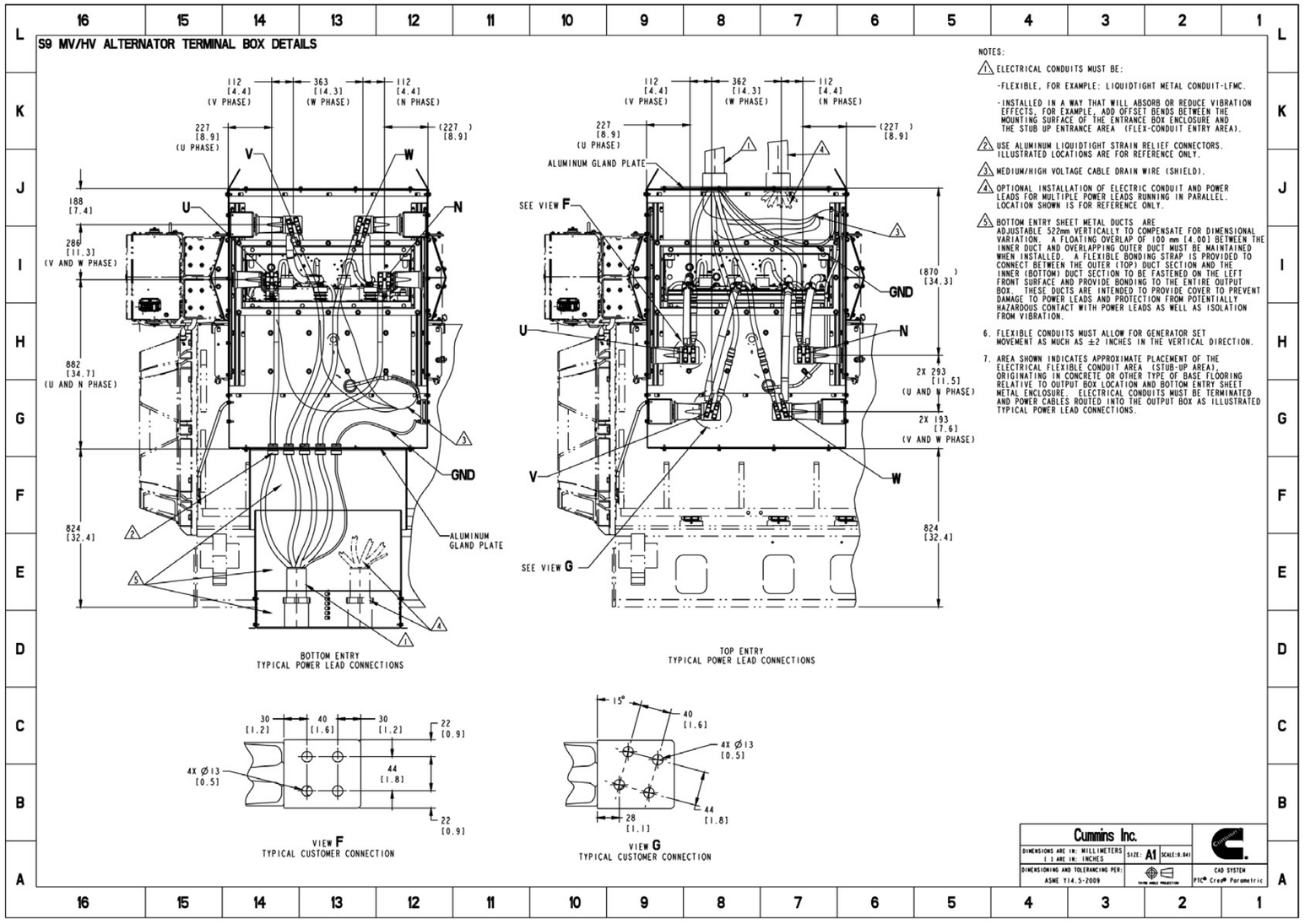


FIGURE 458. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 94 SQUARE FOOT RADIATOR (SHEET 8 OF 10)

Copyright © 2026 Cummins Inc.

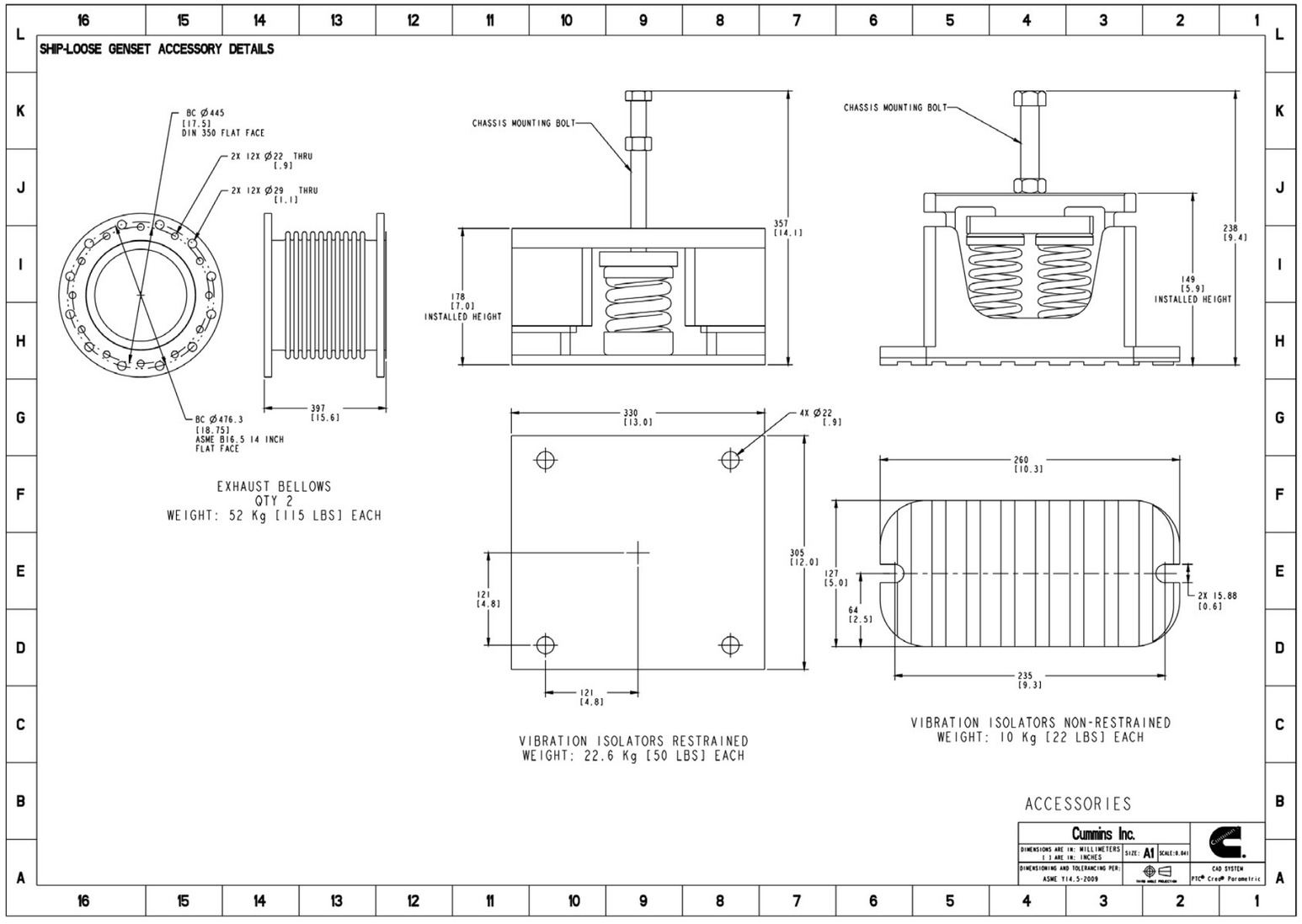


FIGURE 459. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 94 SQUARE FOOT RADIATOR (SHEET 9 OF 10)

Copyright © 2026 Cummins Inc.

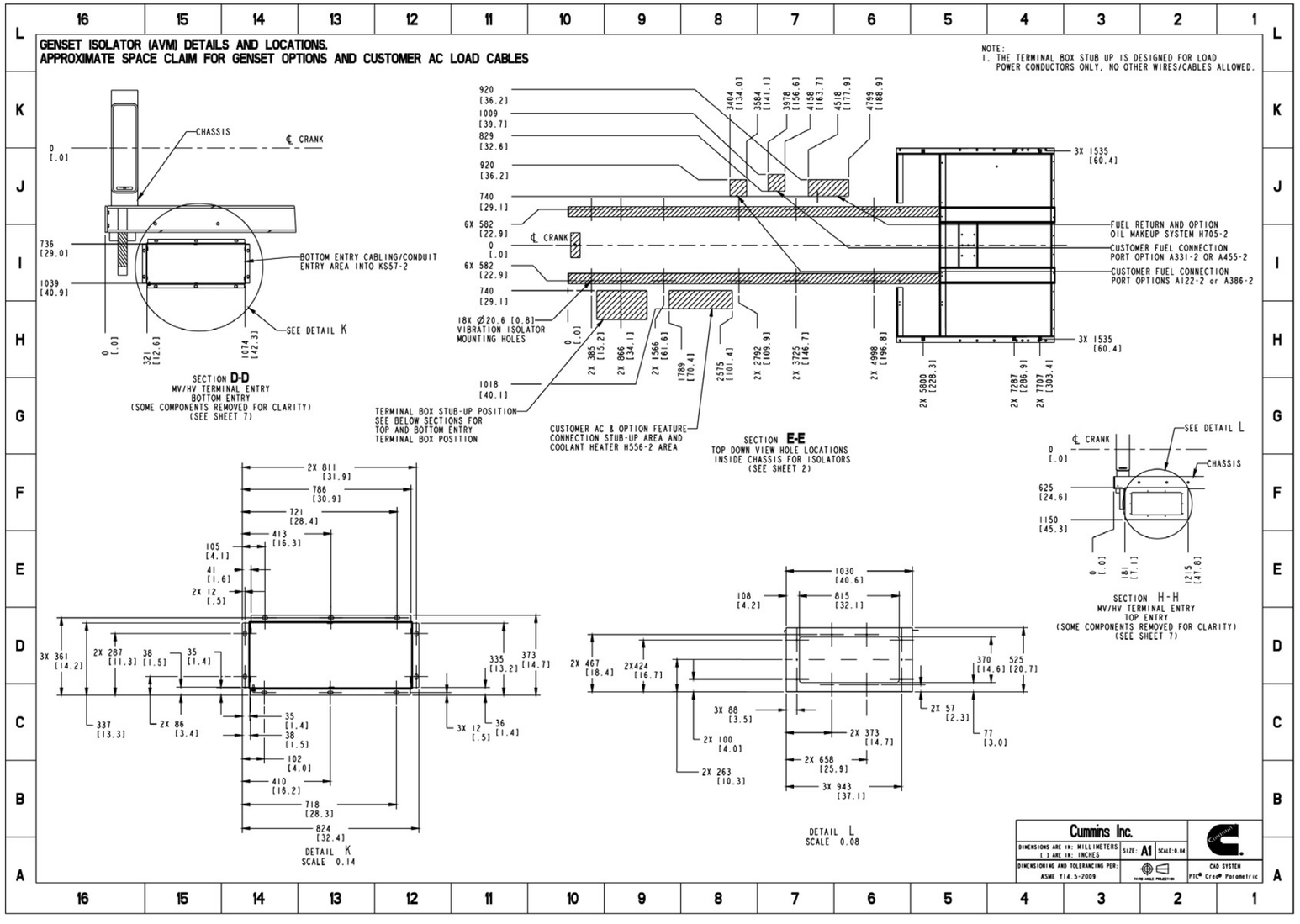


FIGURE 460. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 94 SQUARE FOOT RADIATOR (SHEET 10 OF 10)

Copyright © 2026 Cummins Inc.

A.2 Outline Drawing A067R482 – Normal Duty Air Cleaner with 84 Square Foot Radiator

ALTERNATOR	WINDING	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH NO RADIATOR* Kg [LBS]	GENSET WEIGHT WITH RADIATOR* Kg [LBS]	C OF G WITH RADIATOR DIM A (SHEET 2)* mm [inch]	C OF G WITH RADIATOR DIM B (SHEET 2)* mm [inch]	C OF G WITHOUT RADIATOR DIM A* mm [inch]	C OF G WITHOUT RADIATOR DIM B* mm [inch]
S9MID-G42	851	7750 [17086]	24597 [54227]	29797 [65691]	1122 [44]	3612 [142]	1038 [40]	2875 [113]
S9HID-H42	991	8200 [18078]	25047 [55219]	30247 [66683]	1142 [45]	3588 [141]	1064 [42]	2860 [113]
S9HID-G42	991	7750 [17086]	24597 [54227]	29797 [65691]	1145 [45]	3636 [143]	1067 [42]	2903 [114]
S9HID-G42	961	7750 [17086]	24597 [54227]	29797 [65691]	1145 [45]	3636 [143]	1067 [42]	2903 [114]
S9HID-H42	961	8200 [18078]	25047 [55219]	30247 [66683]	1142 [45]	3588 [141]	1064 [42]	2860 [113]
S9HID-G42	983	7750 [17086]	24597 [54227]	29797 [65691]	1145 [45]	3636 [143]	1067 [42]	2903 [114]
S9HID-H42	983	8200 [18078]	25047 [55219]	30247 [66683]	1142 [45]	3588 [141]	1064 [42]	2860 [113]
S9MID-H42	851	8200 [18078]	25047 [55219]	30247 [66683]	1142 [45]	3588 [141]	1064 [42]	2860 [113]

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS WITH IMPERIAL INCH CONVERSIONS IN "[ ]".

   1.1 IN EVENT OF A DISCREPANCY BETWEEN METRIC AND IMPERIAL DIMENSIONS, THE METRIC DIMENSIONS CONTROL.

2. ALL DIMENSIONS ARE REFERENCE, UNLESS SPECIFICALLY TOLERANCED.

3. WEIGHT: REFER TO TABLE FOR STANDARD GENSET WITH E127-2 E128-2 COOLING SYSTEM.

   *3.1 INCLUDES WEIGHT OF 606 LITERS [160 GALLONS] SUPPLIED ENGINE OIL.(530 Kg/1168 LBS)

   **3.2 INCLUDES DRY WEIGHT OF RADIATOR 4555 Kg [10042 LBS] (SHIPS LOOSE)

   **3.3 INCLUDES WEIGHT FOR 1120.5 LITERS [296 GALLONS] OF NON-SUPPLIED COOLANT. (1139 Kg/2511 LBS)

4. LARGEST NOMINAL DIMENSIONS:
   4.1 LENGTH 8025 [316.0]
   4.2 WIDTH 3028 [119.2] RADIATOR
   4.3 HEIGHT 3758 [148] TOP OF RADIATOR CAP
   4.4 DOES NOT INCLUDE THE HEIGHT OF THE VIBRATION ISOLATOR

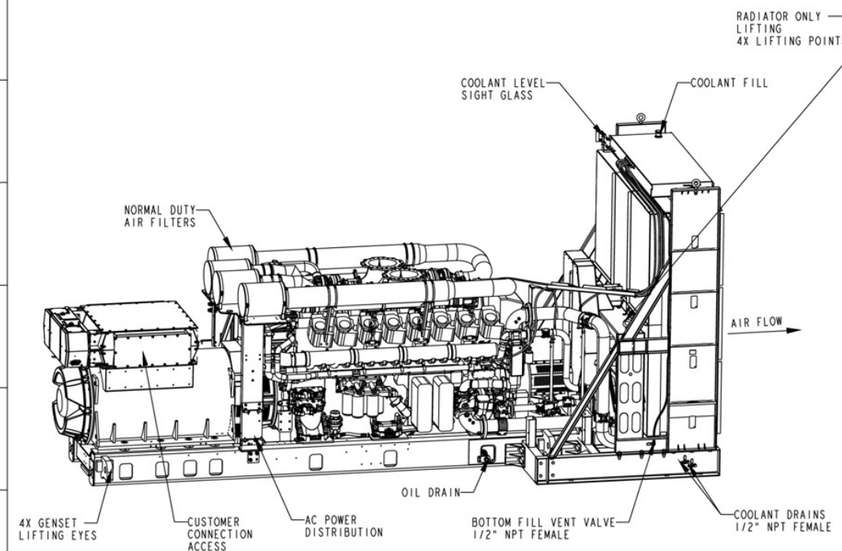
5. LIFTING INSTRUCTIONS: REFER TO GENSET INSTALLATION MANUAL AND LIFTING LABEL

   5.1 GENSET SHALL NOT BE LIFTED USING THE LIFTING EYES WHEN ATTACHED TO THE RADIATOR. RADIATOR AND GENSET SHALL ALWAYS BE LIFTED SEPARATELY PER INSTALLATION MANUAL AND LIFTING DIAGRAMS.

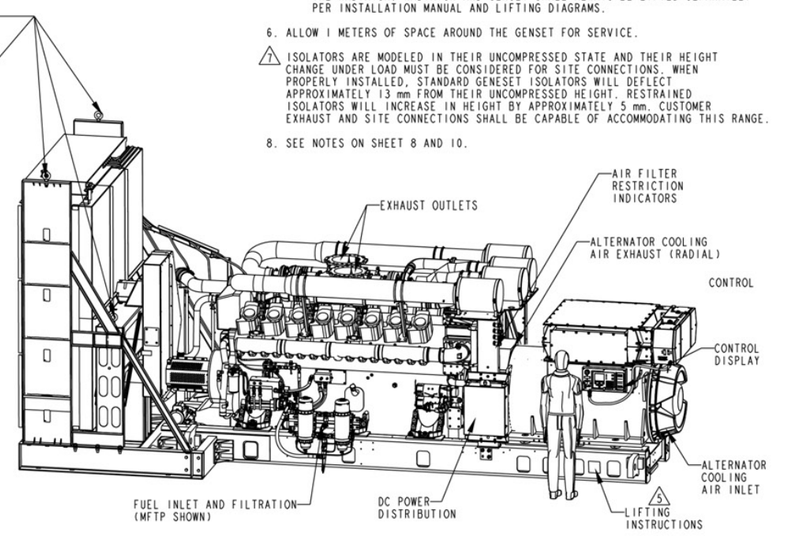
6. ALLOW 1 METERS OF SPACE AROUND THE GENSET FOR SERVICE.

7. ISOLATORS ARE MODELED IN THEIR UNCOMPRESSED STATE AND THEIR HEIGHT CHANGE UNDER LOAD MUST BE CONSIDERED FOR SITE CONNECTIONS. WHEN PROPERLY INSTALLED, STANDARD GENESET ISOLATORS WILL DEFLECT APPROXIMATELY 13 mm FROM THEIR UNCOMPRESSED HEIGHT. RESTRAINED ISOLATORS WILL INCREASE IN HEIGHT BY APPROXIMATELY 5 mm. CUSTOMER EXHAUST AND SITE CONNECTIONS SHALL BE CAPABLE OF ACCOMMODATING THIS RANGE.

8. SEE NOTES ON SHEET 8 AND 10.



RIGHT SIDE



LEFT SIDE

STANDARD GENSET CONFIGURATION
WITH S9HID-H42 ALTERNATOR AND E127-2,
E128-2 COOLING SYSTEM SHOWN

LAST DATUM LETTER USED: A	LAST REFERENCE LETTER USED: T
MODEL/PLATFORM: C325D6	THIS PART IS SIMILAR TO: A049P688
Cummins Inc.	
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: INCHES	SIZE: A1 SCALE:0.04
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009	THIRD ANGLE PROJECTION
	CAD SYSTEM PTC® Creo® Parametric

FIGURE 461. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 84 SQUARE FOOT RADIATOR (SHEET 1 OF 10)

Copyright © 2026 Cummins Inc.

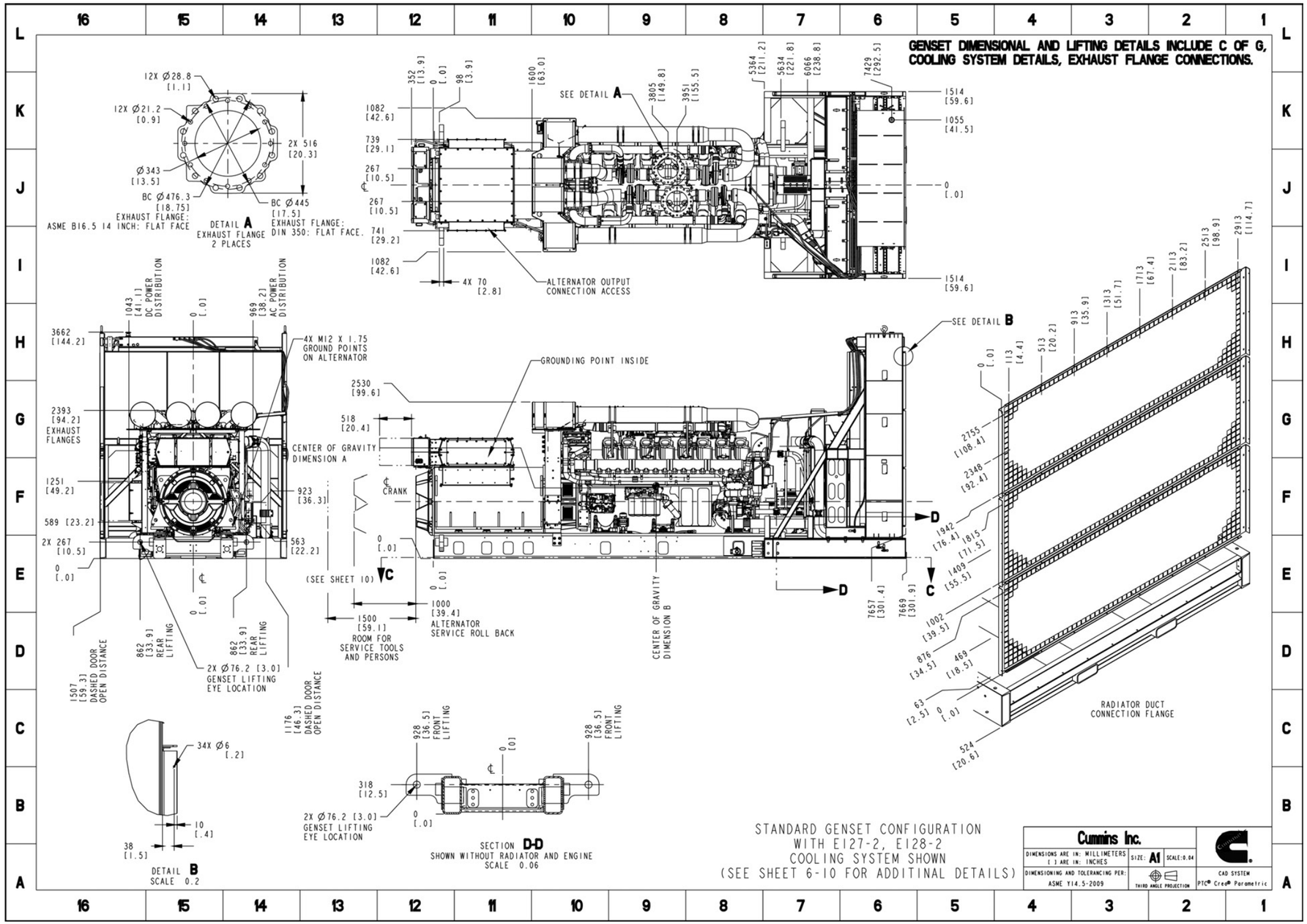


FIGURE 462. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 84 SQUARE FOOT RADIATOR (SHEET 2 OF 10)

Copyright © 2026 Cummins Inc.

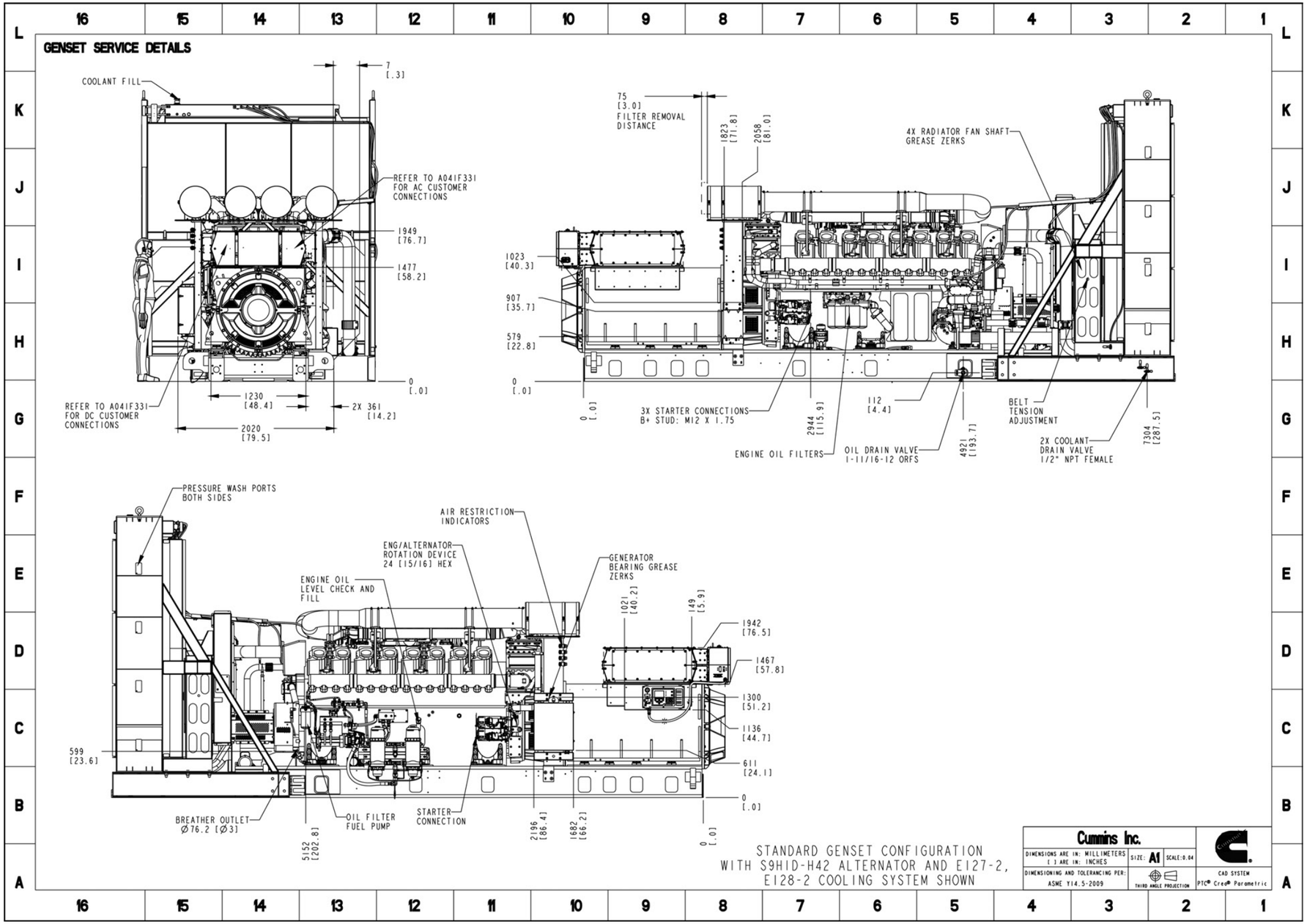


FIGURE 463. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 84 SQUARE FOOT RADIATOR (SHEET 3 OF 10)

Copyright © 2026 Cummins Inc.

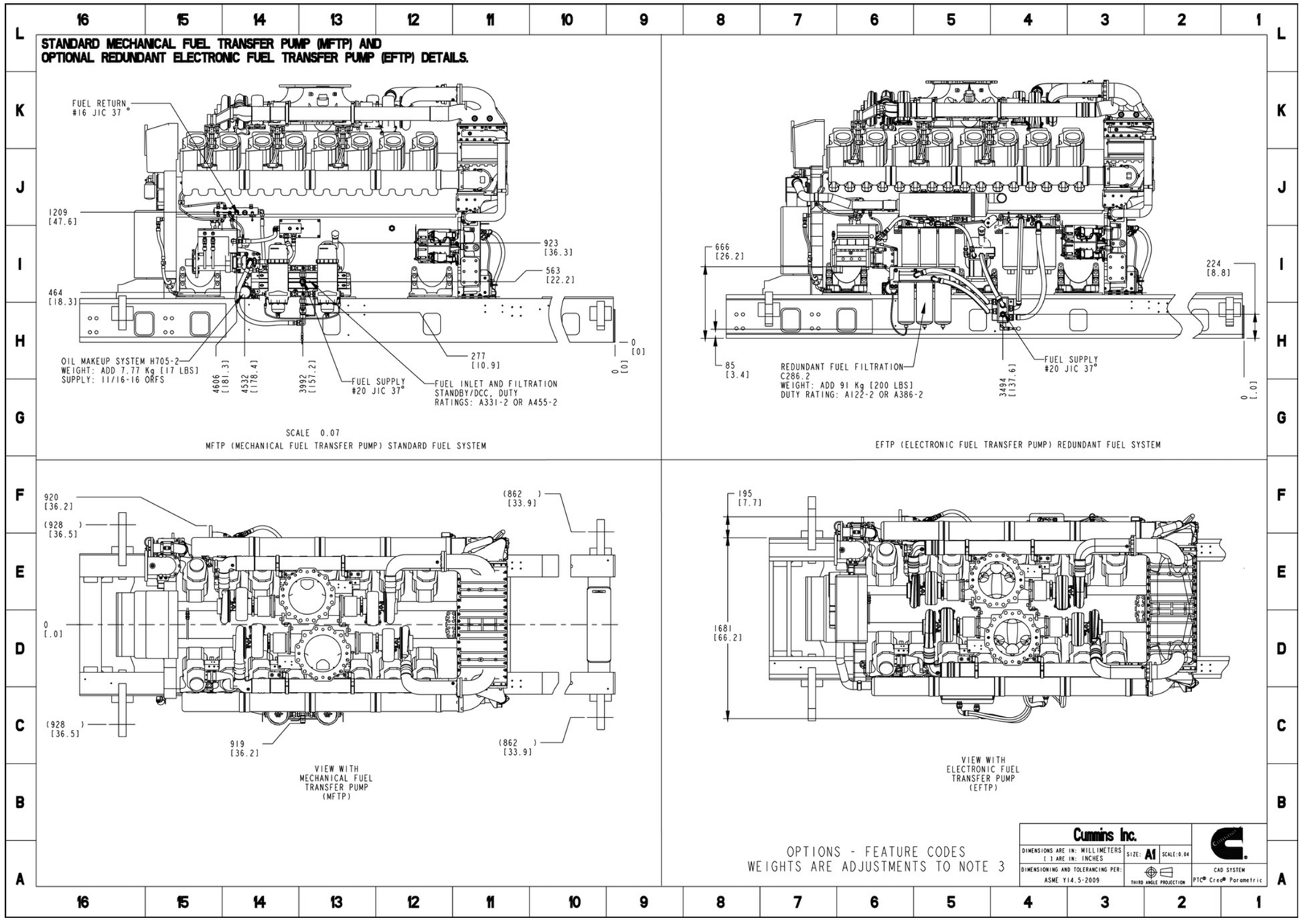


FIGURE 464. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 84 SQUARE FOOT RADIATOR (SHEET 4 OF 10)

Copyright © 2026 Cummins Inc.

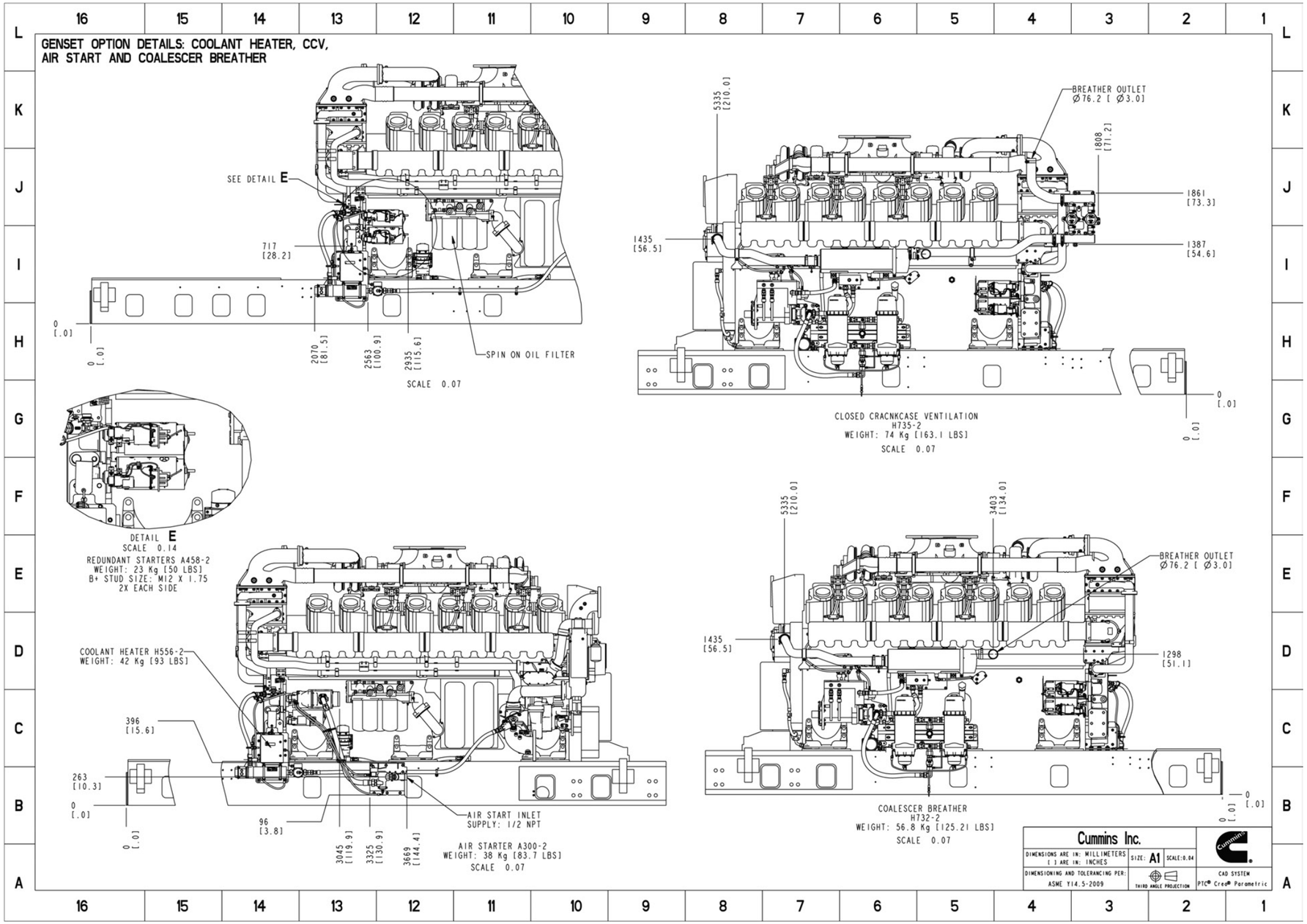


FIGURE 465. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 84 SQUARE FOOT RADIATOR (SHEET 5 OF 10)

Copyright © 2026 Cummins Inc.

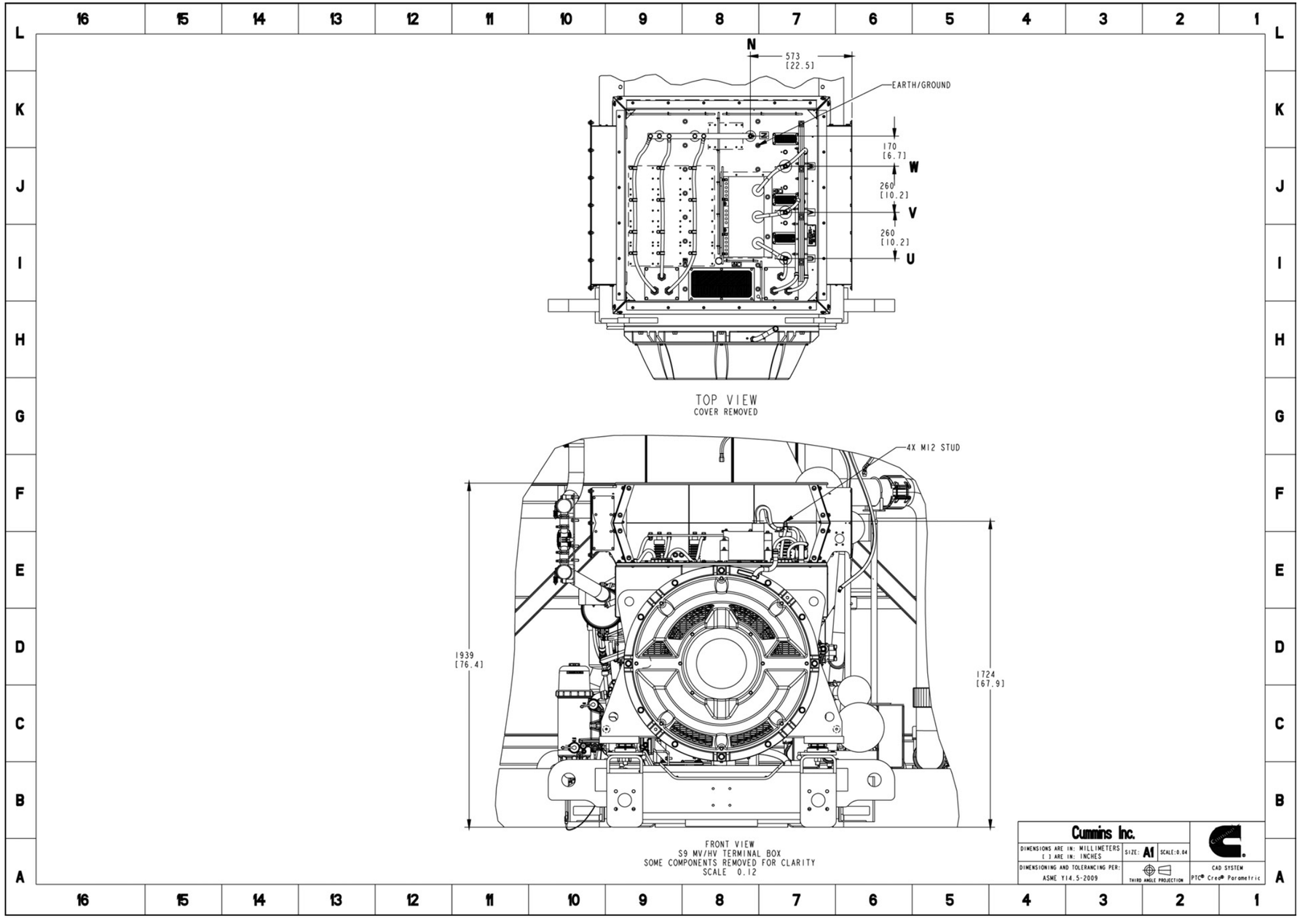


FIGURE 466. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 84 SQUARE FOOT RADIATOR (SHEET 6 OF 10)

Copyright © 2026 Cummins Inc.

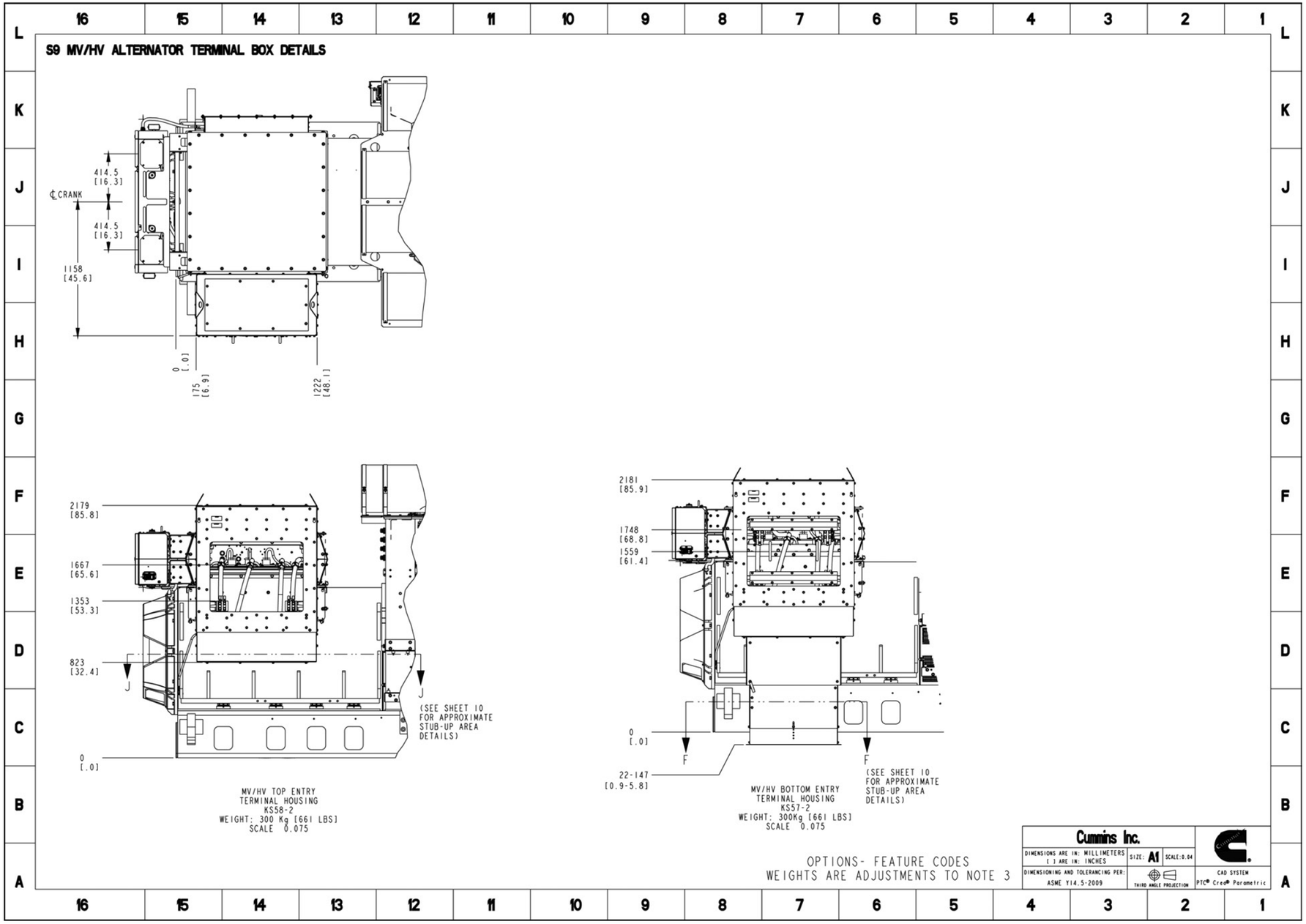


FIGURE 467. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 84 SQUARE FOOT RADIATOR (SHEET 7 OF 10)

 Copyright © 2026 Cummins Inc.

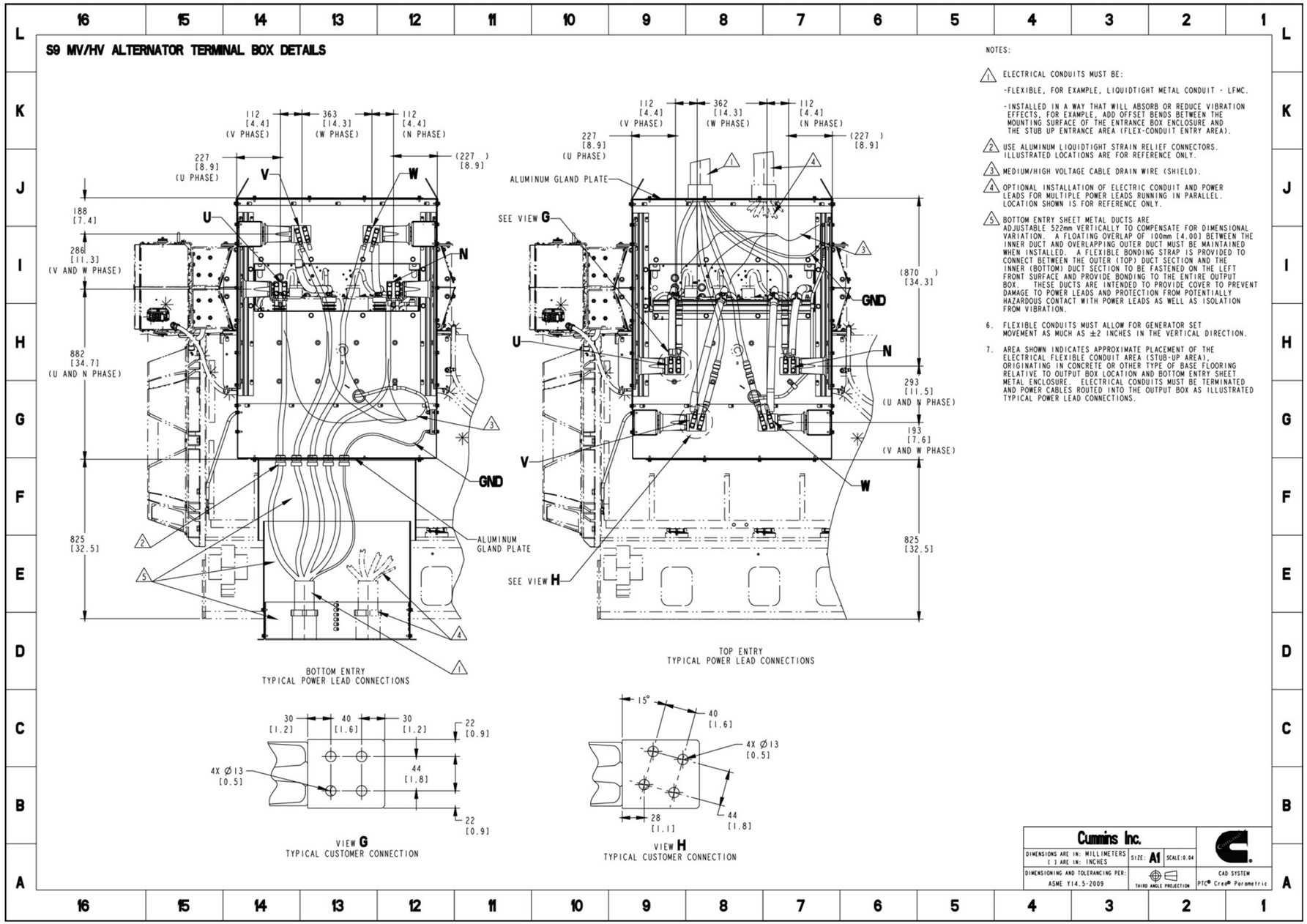


FIGURE 468. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 84 SQUARE FOOT RADIATOR (SHEET 8 OF 10)

Copyright © 2026 Cummins Inc.

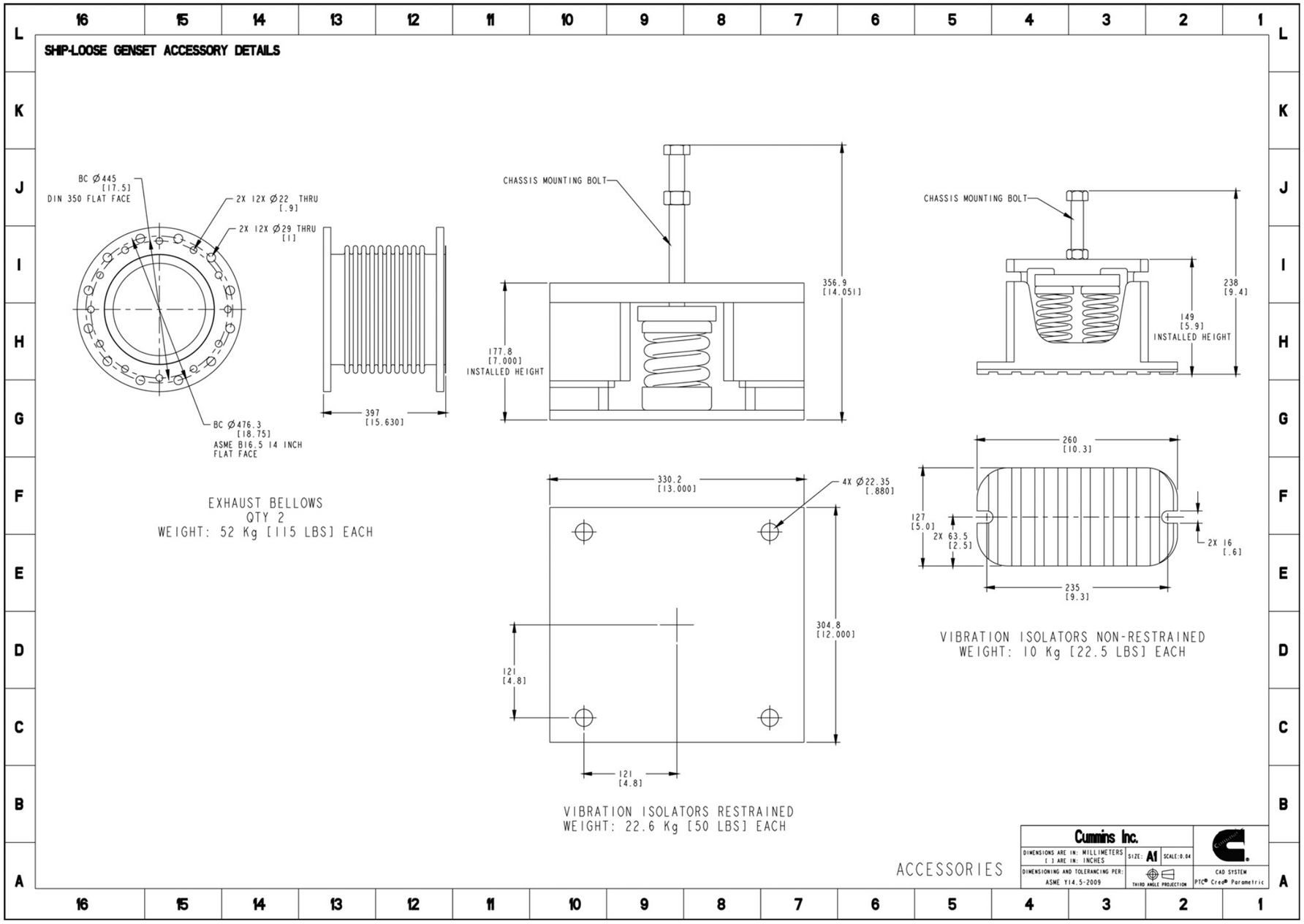


FIGURE 469. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 84 SQUARE FOOT RADIATOR (SHEET 9 OF 10)

Copyright © 2026 Cummins Inc.

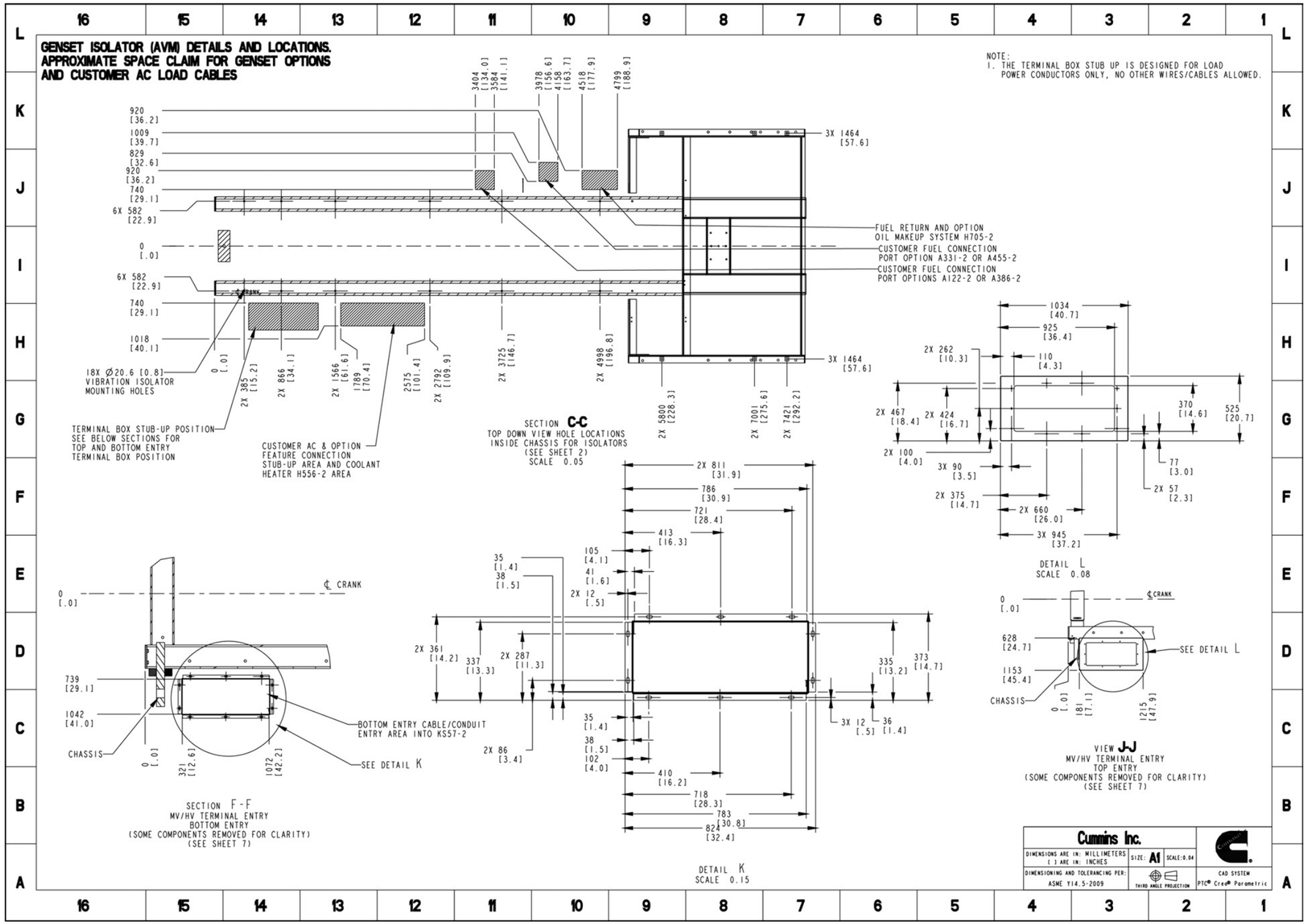


FIGURE 470. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 84 SQUARE FOOT RADIATOR (SHEET 10 OF 10)

Copyright © 2026 Cummins Inc.

A.3 Outline Drawing A068A473 – Normal Duty Air Cleaner with 61 Square Foot Radiator

ALTERNATOR	WINDING	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH NO RADIATOR* Kg [LBS]	GENSET WEIGHT WITH RADIATOR* Kg [LBS]	C OF G WITH RADIATOR DIM A (SHEET 2)* mm [inch]	C OF G WITH RADIATOR DIM B (SHEEET 2)* mm [inch]	C OF G WITHOUT RADIATOR DIM A* mm [inch]	C OF G WITHOUT RADIATOR DIM B* mm [inch]
S9MID-G42	851	7750 [17086]	24597 [54227]	30218 [66619]	1132 [44]	3671 [144]	1038 [40]	2875 [113]
S9HID-H42	991	8200 [18078]	25047 [55219]	30668 [67611]	1129 [44]	3624 [142]	1036 [40]	2831 [111]
S9HID-G42	991	7750 [17086]	24597 [54227]	30218 [66619]	1132 [44]	3671 [144]	1038 [40]	2875 [113]
S9HID-G42	961	7750 [17086]	24597 [54227]	30218 [66619]	1132 [44]	3671 [144]	1038 [40]	2875 [113]
S9HID-H42	961	8200 [18078]	25047 [55219]	30668 [67611]	1129 [44]	3624 [142]	1036 [40]	2831 [111]
S9HID-G42	983	7750 [17086]	24597 [54227]	30218 [66619]	1132 [44]	3671 [144]	1038 [40]	2875 [113]
S9HID-H42	983	8200 [18078]	25047 [55219]	30668 [67611]	1129 [44]	3624 [142]	1036 [40]	2831 [111]
S9MID-H42	851	8200 [18078]	25047 [55219]	30668 [67611]	1129 [44]	3624 [142]	1036 [40]	2831 [111]

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS WITH IMPERIAL INCH CONVERSIONS IN "[]".
   1.1 IN EVENT OF A DISCREPANCY BETWEEN METRIC AND IMPERIAL DIMENSIONS, THE METRIC DIMENSIONS CONTROL.
2. ALL DIMENSIONS ARE REFERENCE, UNLESS SPECIFICALLY TOLERANCED.
3. WEIGHT: REFER TO TABLE FOR STANDARD GENSET WITH E128-2 COOLING SYSTEM.
   *3.1 INCLUDES WEIGHT OF 606 LITERS [160 GALLONS] SUPPLIED ENGINE OIL.(530 KG/1168 LBS)
   **3.2 INCLUDES DRY WEIGHT OF RADIATOR 4657 KG [10267 LBS] (SHIPS LOOSE)
   **3.3 INCLUDES WEIGHT FOR 1238 LITERS [327 GALLONS] OF NON-SUPPLIED COOLANT. (1336 KG/2947 LBS)
4. LARGEST NOMINAL DIMENSIONS:
   4.1 LENGTH 7912 [311.5]
   4.2 WIDTH 2610 [102.7] RADIATOR
   4.3 HEIGHT 3366 [132.5] TOP OF RADIATOR CAP
   4.4 DOES NOT INCLUDE THE HEIGHT OF THE VIBRATION ISOLATOR

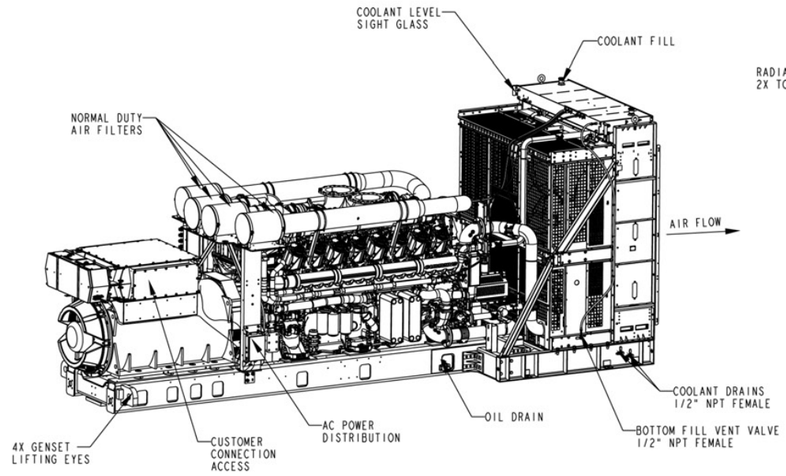
△5 LIFTING INSTRUCTIONS: REFER TO GENSET INSTALLATION MANUAL AND LIFTING LABEL

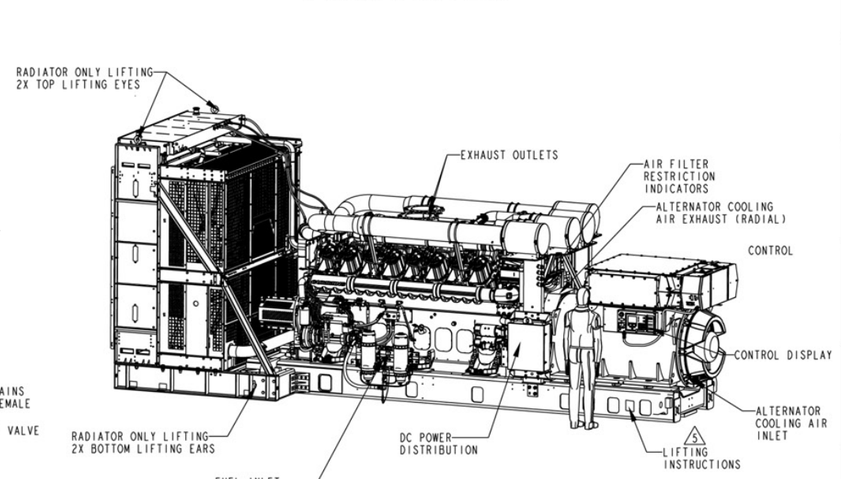
   5.1 GENSET SHALL NOT BE LIFTED USING THE LIFTING EYES WHEN ATTACHED TO THE RADIATOR. RADIATOR AND GENSET SHALL ALWAYS BE LIFTED SEPARATELY PER INSTALLATION MANUAL AND LIFTING DIAGRAMS.

6. ALLOW 1 METERS AROUND THE GENSET FOR SERVICE.

△7 ISOLATORS ARE MODELED IN THEIR UNCOMPRESSED STATE AND THEIR HEIGHT CHANGE UNDER LOAD MUST BE CONSIDERED FOR SITE CONNECTIONS. WHEN PROPERLY INSTALLED, STANDARD GENESET ISOLATORS WILL DEFLECT APPROXIMATELY 13 mm FROM THEIR UNCOMPRESSED HEIGHT. RESTRAINED ISOLATORS WILL INCREASE IN HEIGHT BY APPROXIMATELY 5 mm. CUSTOMER EXHAUST AND SITE CONNECTIONS SHALL BE CAPABLE OF ACCOMMODATING THIS RANGE..

8. SEE NOTES ON SHEET 9 AND 11.





STANDARD GENSET CONFIGURATION WITH S9HID-H42 ALTERNATOR AND E165-2 COOLING SYSTEM SHOWN

LAST DATUM LETTER USED: A	LAST REFERENCE LETTER USED: B
MODEL/PLATFORM: C325D6	THIS PART IS SIMILAR TO: A065H012
Cummins Inc.	
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: INCHES	SIZE: A1 SCALE:0.04
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009	THIRD ANGLE PROJECTION
	CAD SYSTEM PTC® Creo® Parametric

FIGURE 471. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 1 OF 11)

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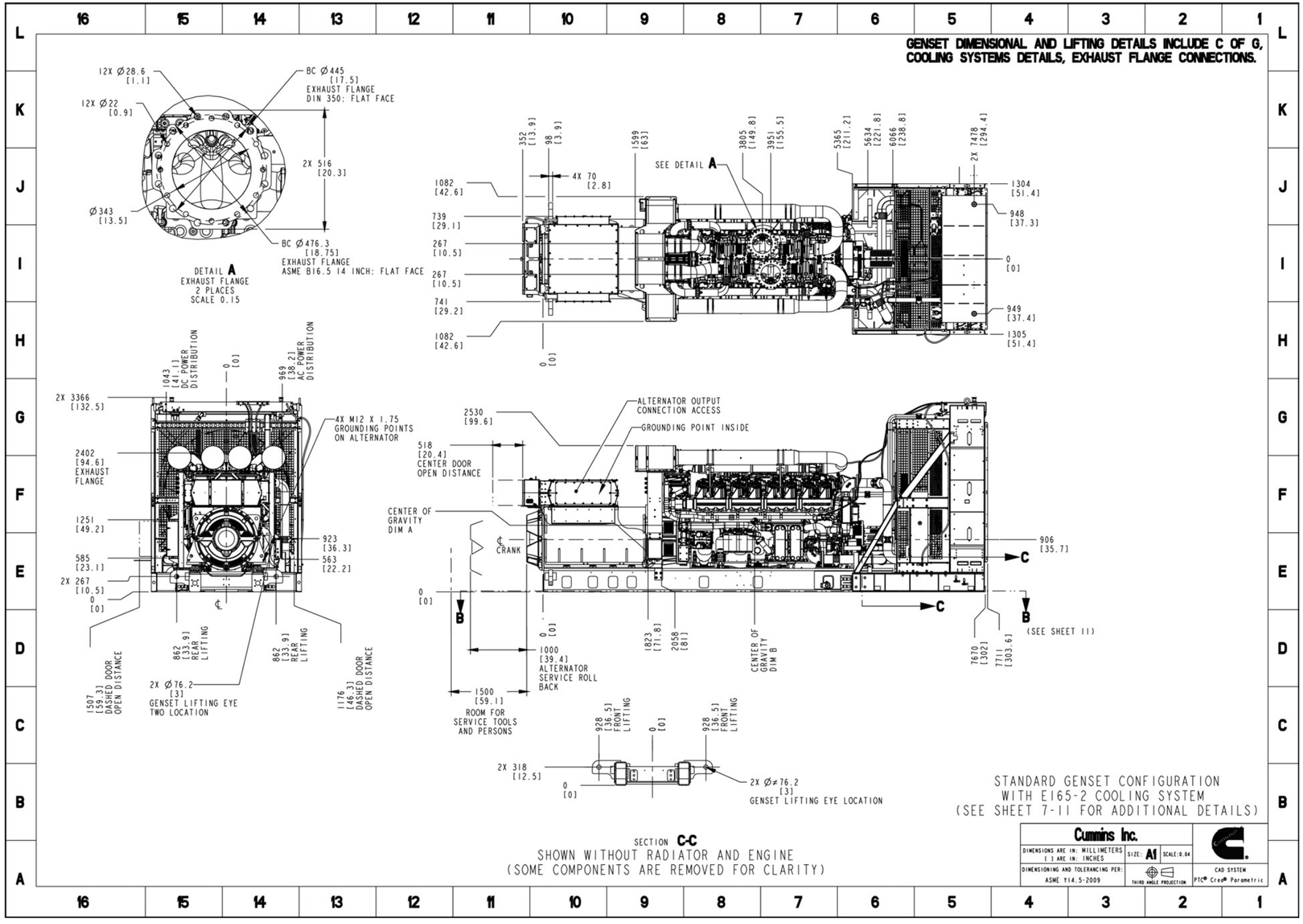


FIGURE 472. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 2 OF 11)

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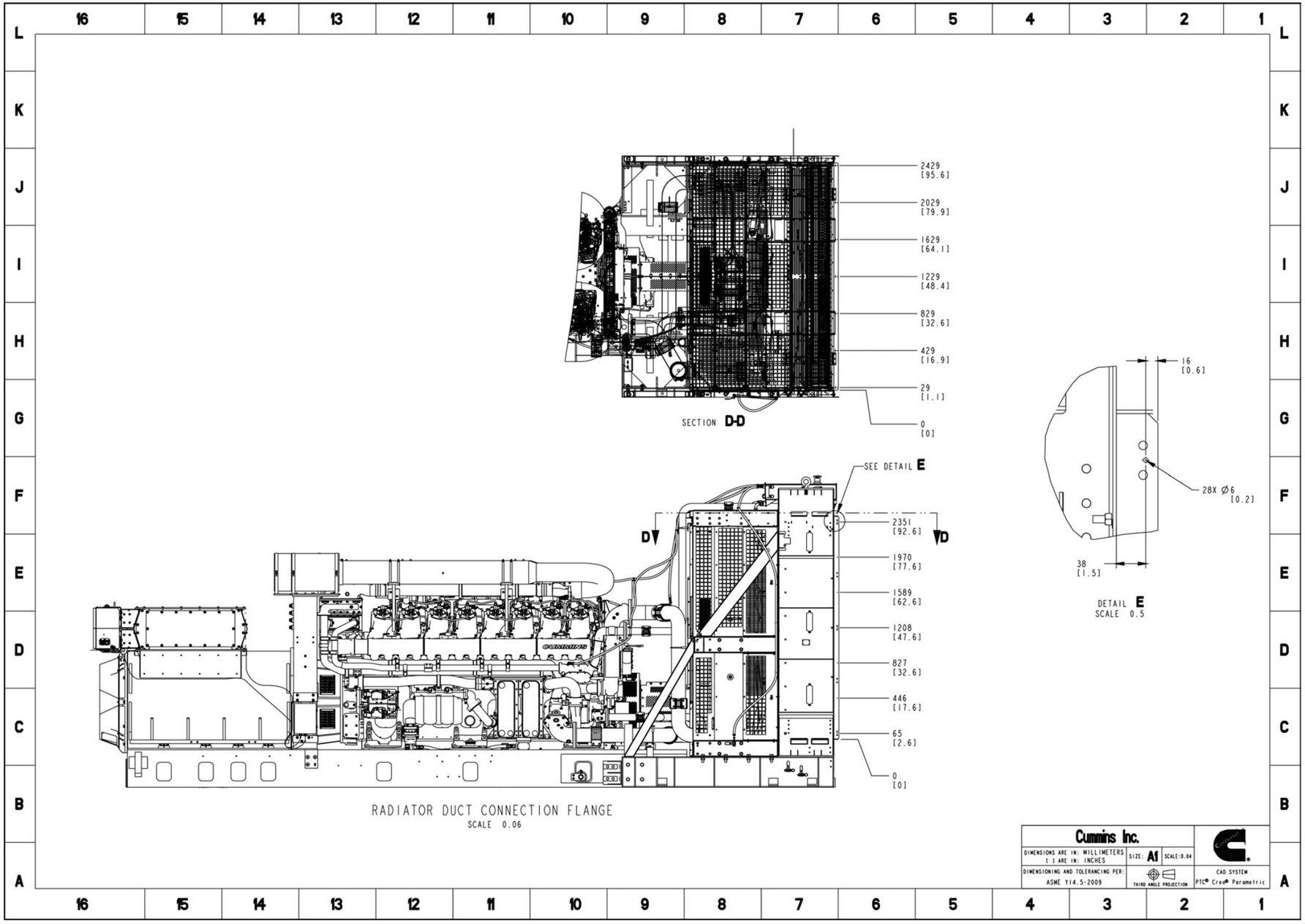


FIGURE 473. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 3 OF 11)

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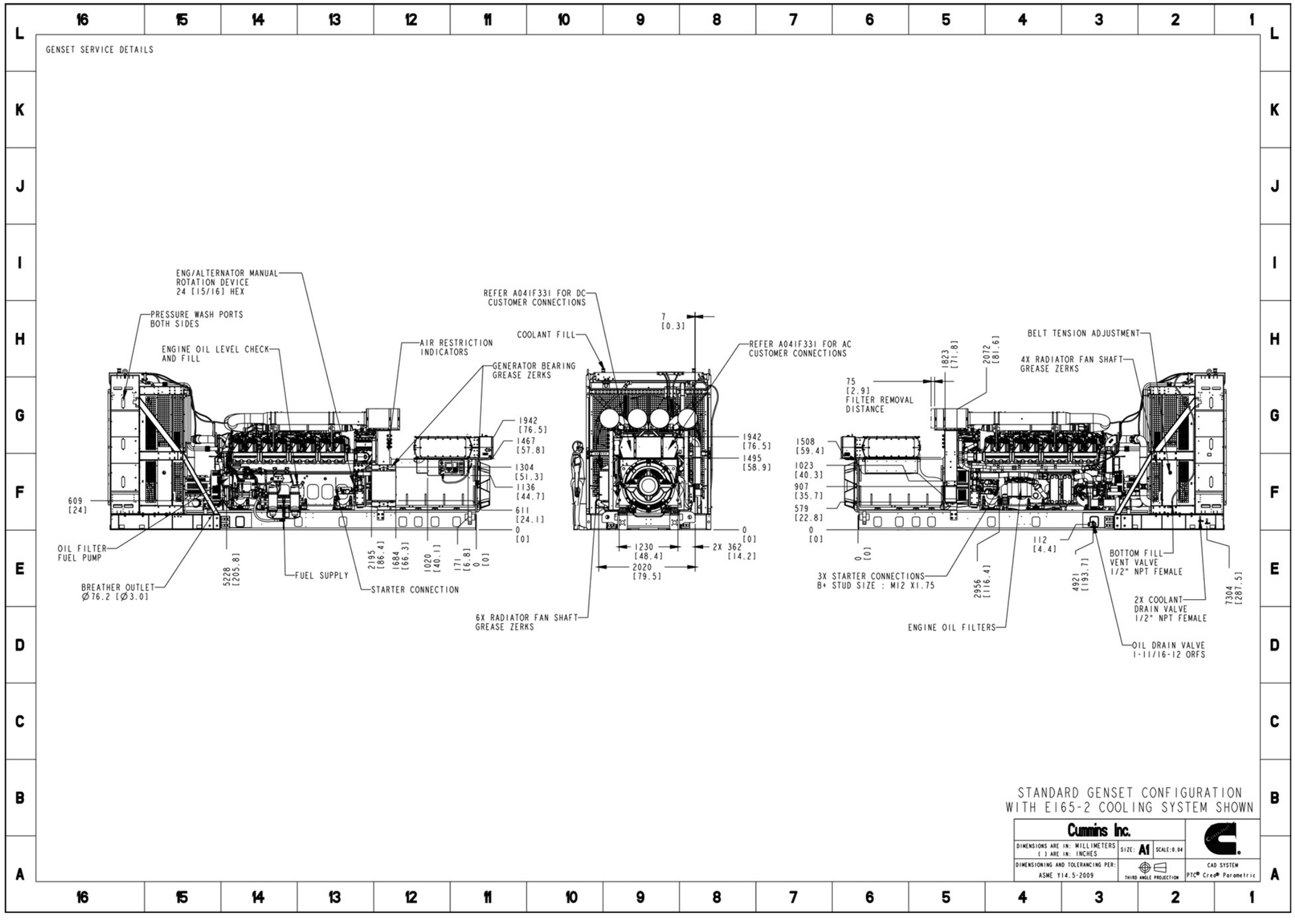


FIGURE 474. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 4 OF 11)

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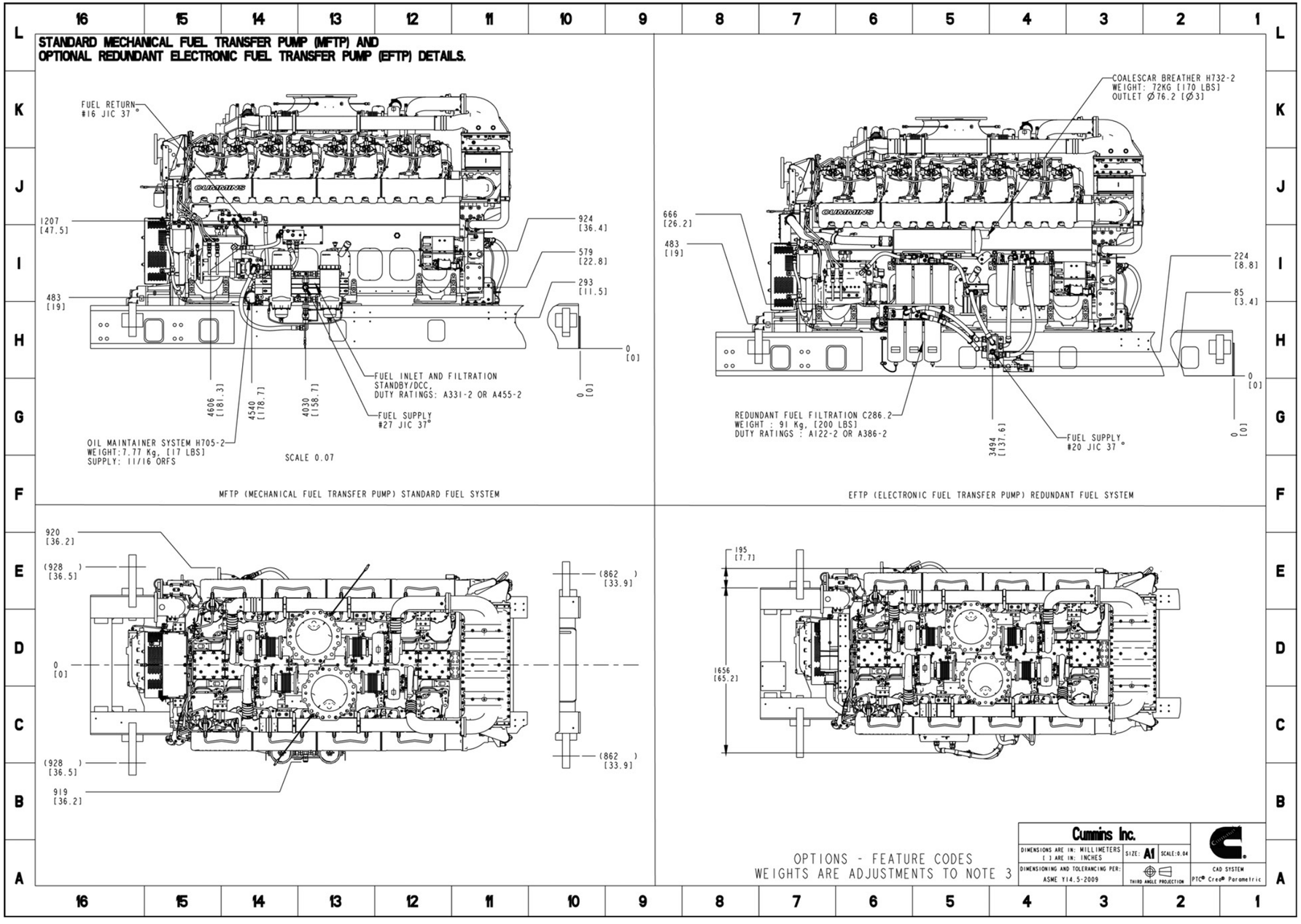


FIGURE 475. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 5 OF 11)

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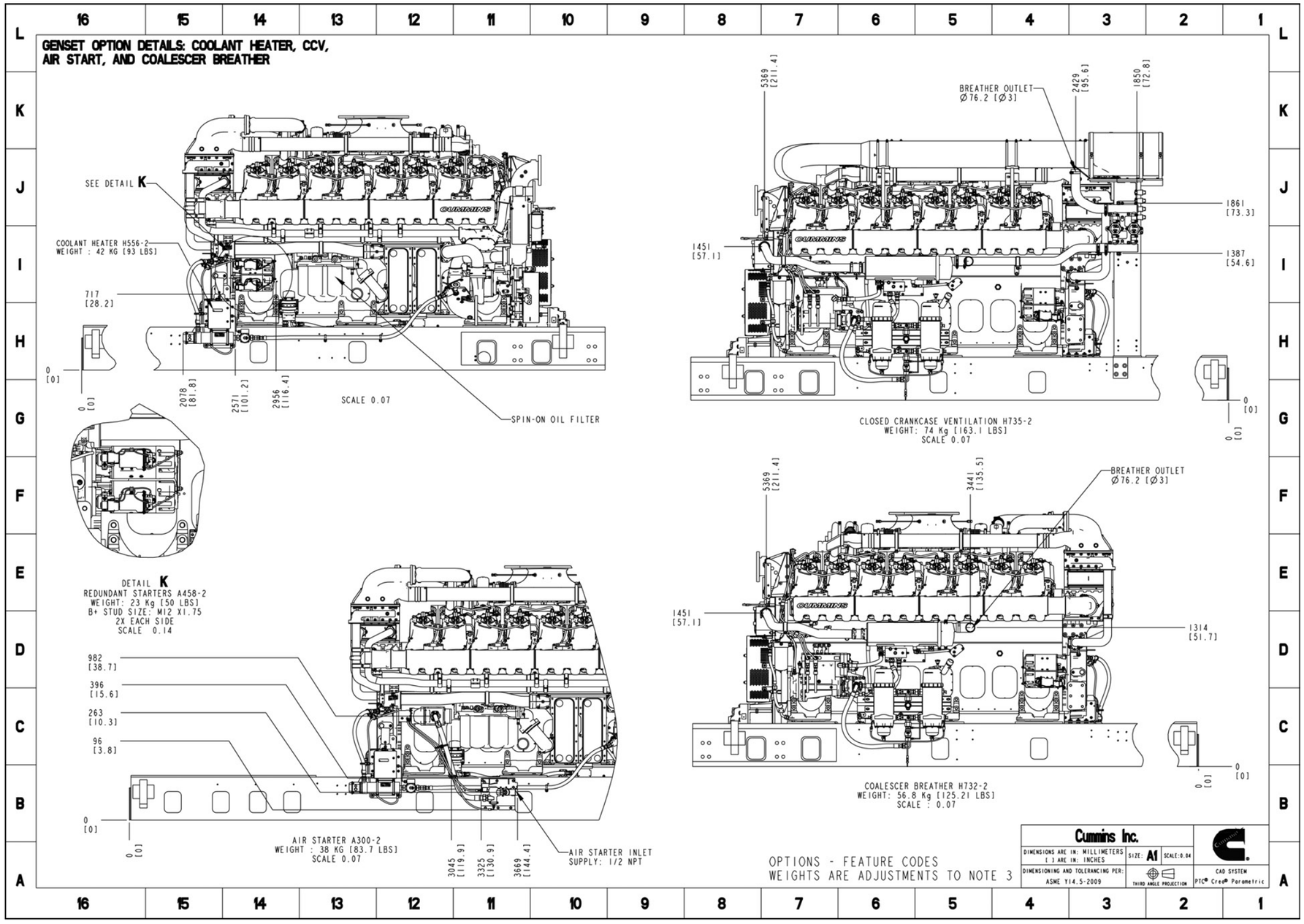


FIGURE 476. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 6 OF 11)

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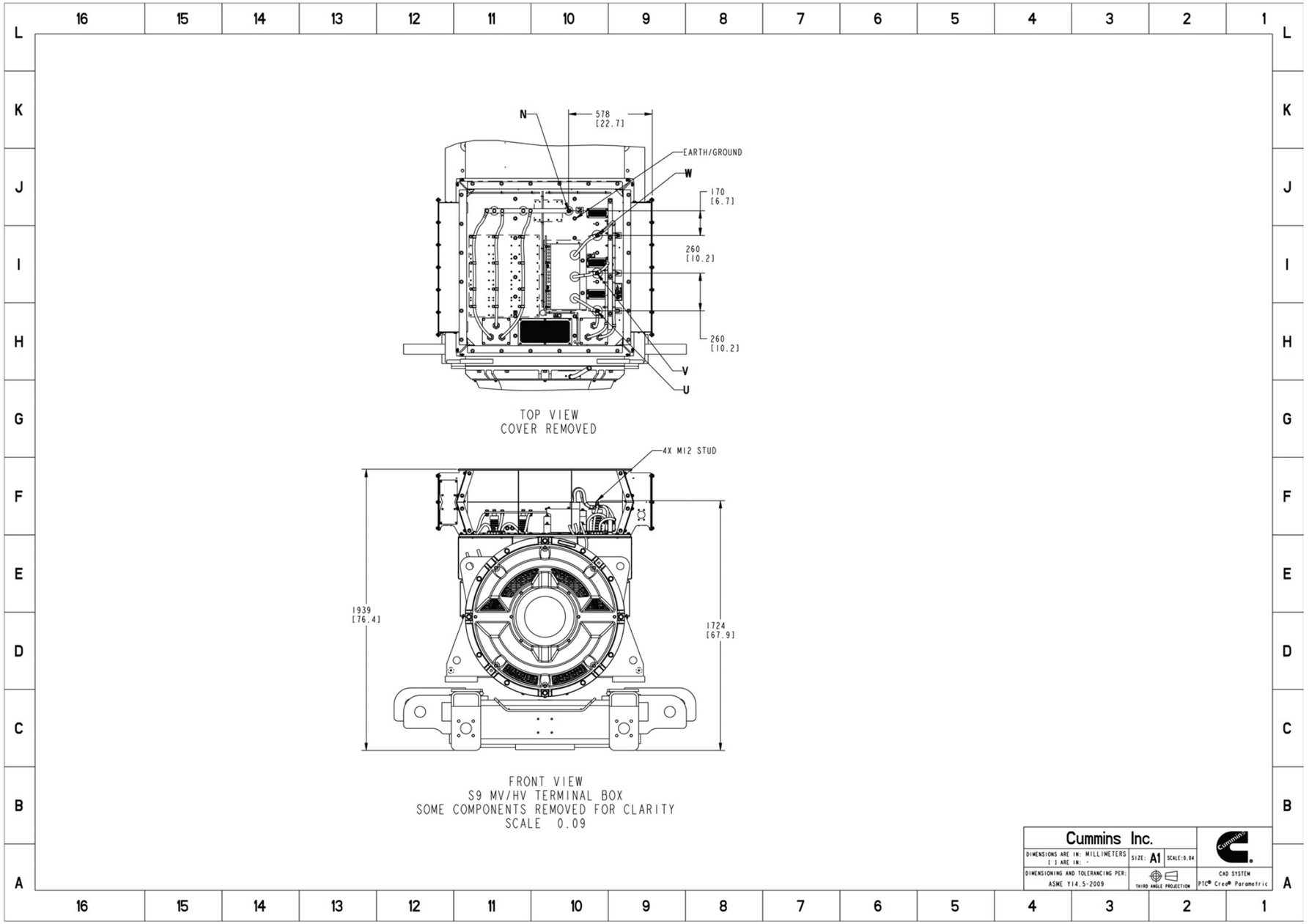


FIGURE 477. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 7 OF 11)

 Copyright © 2026 Cummins Inc.

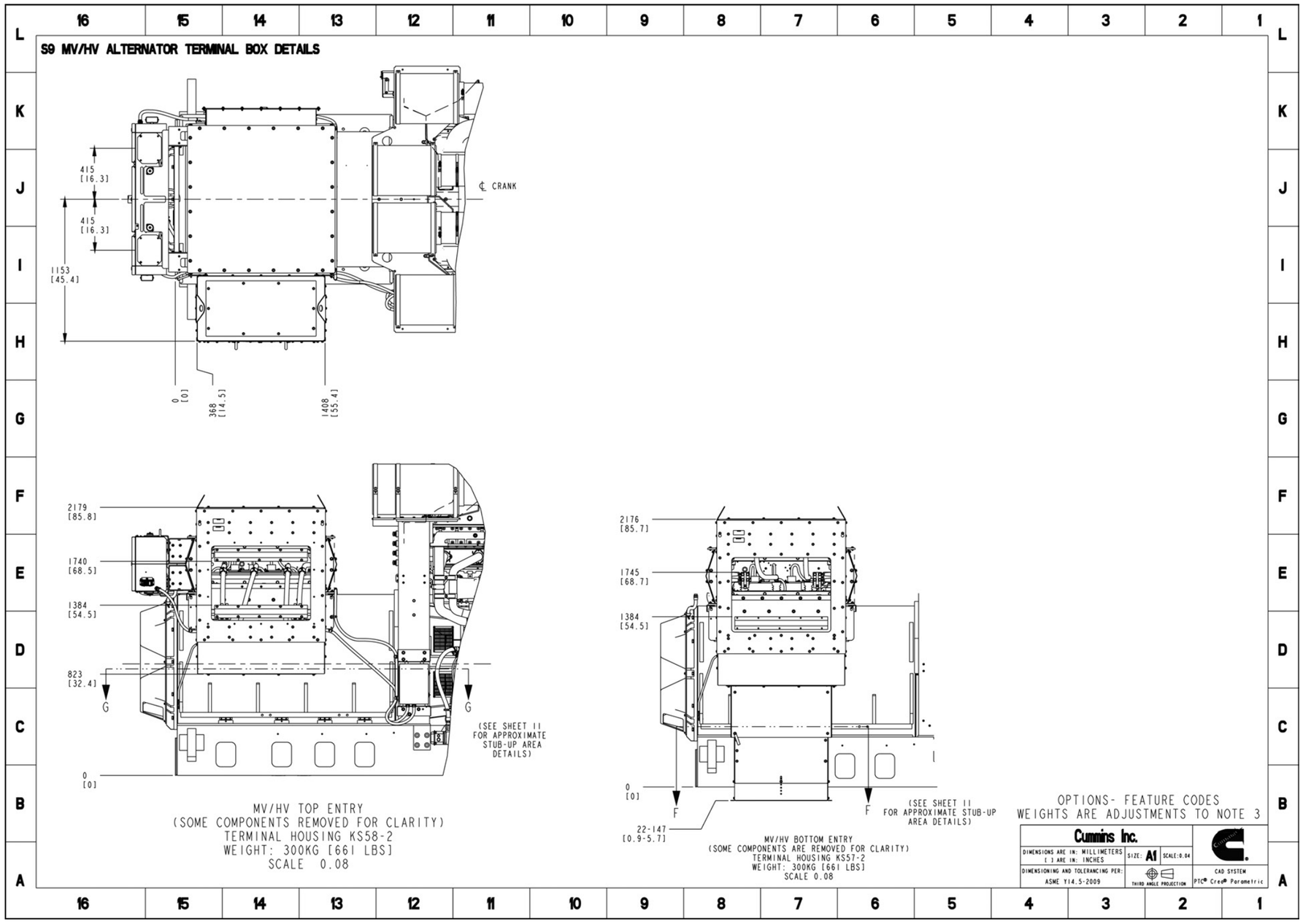


FIGURE 478. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 8 OF 11)

Copyright © 2026 Cummins Inc.

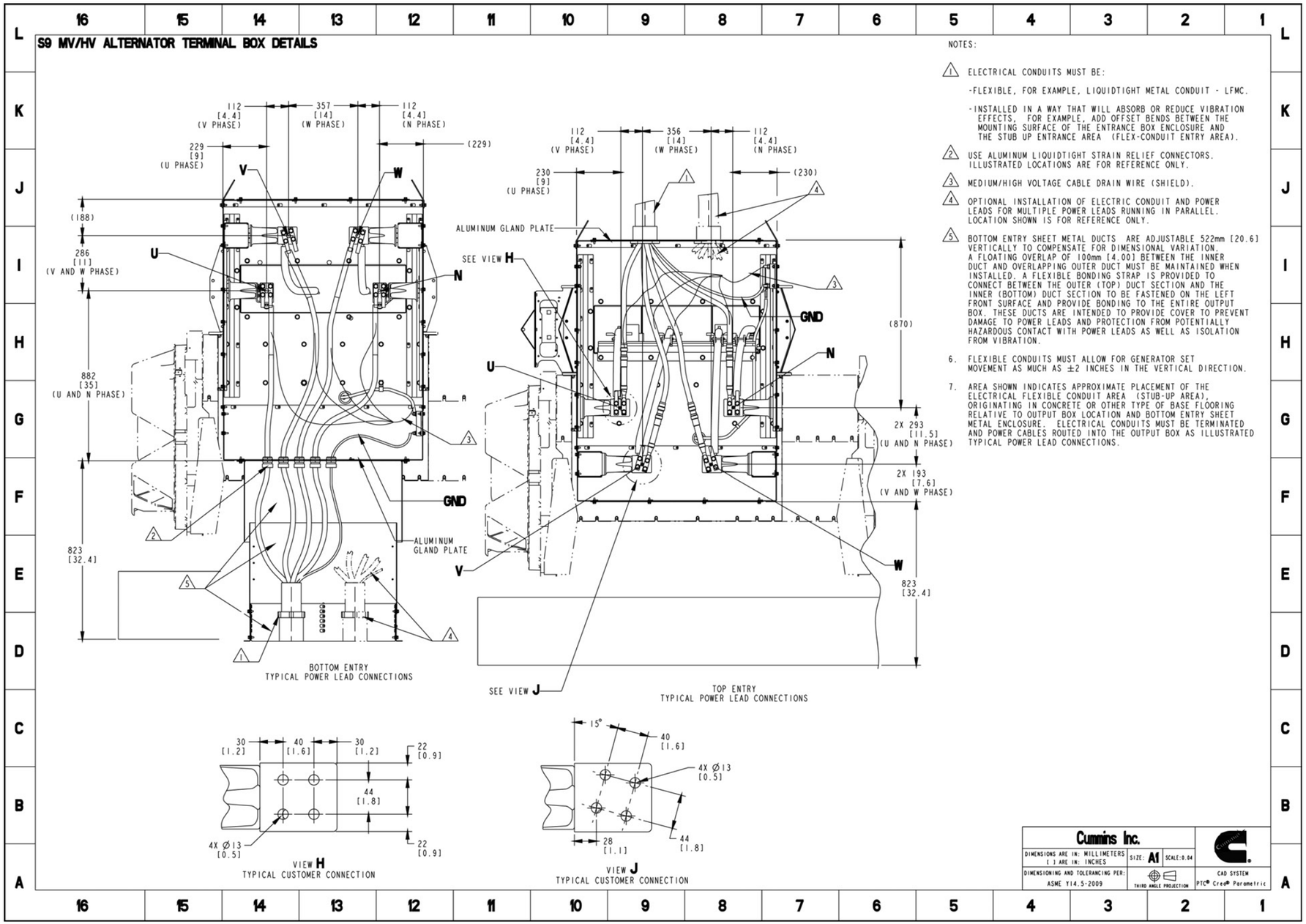


FIGURE 479. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 9 OF 11)

Copyright © 2026 Cummins Inc.

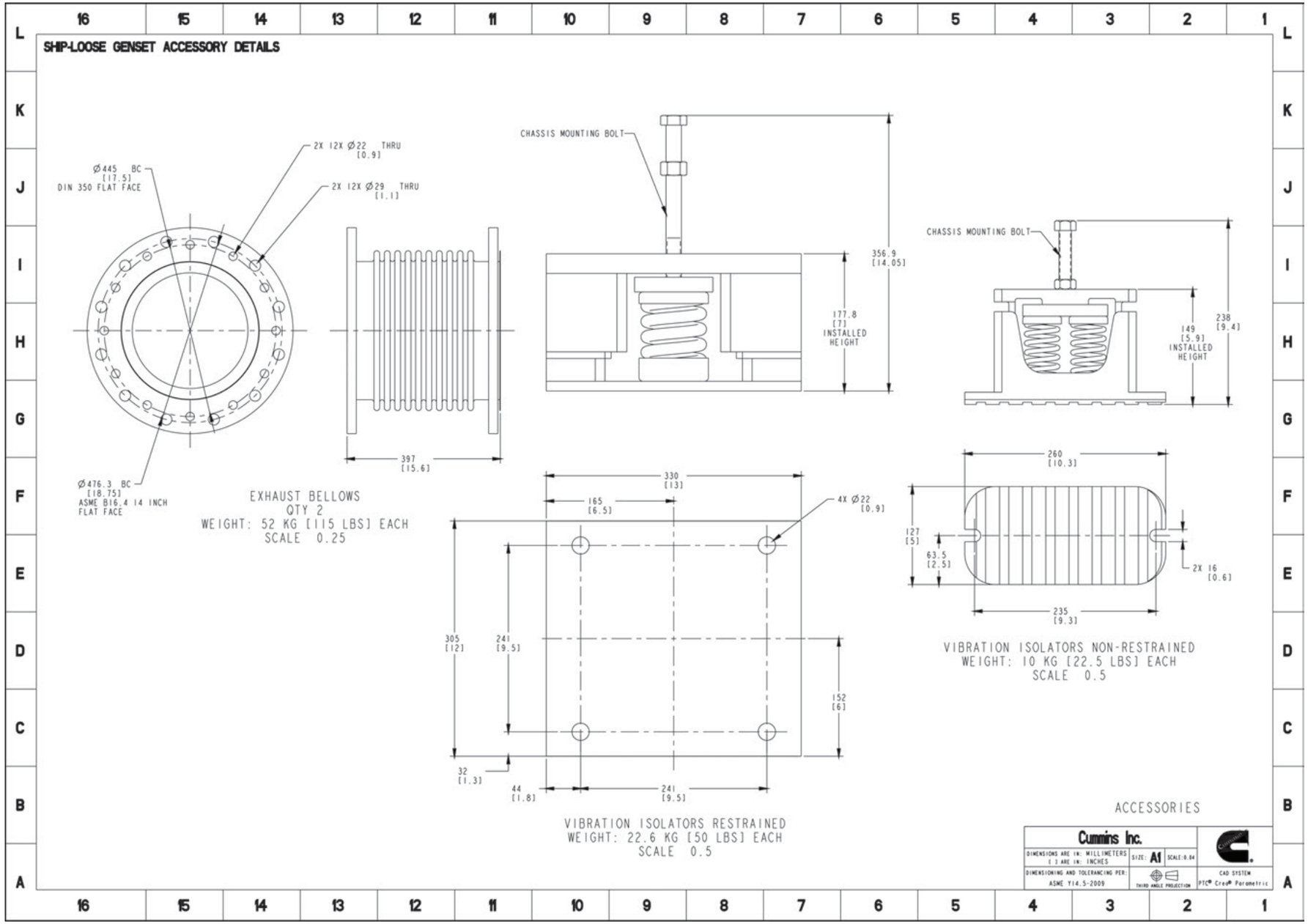


FIGURE 480. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 10 OF 11)

Copyright © 2026 Cummins Inc.

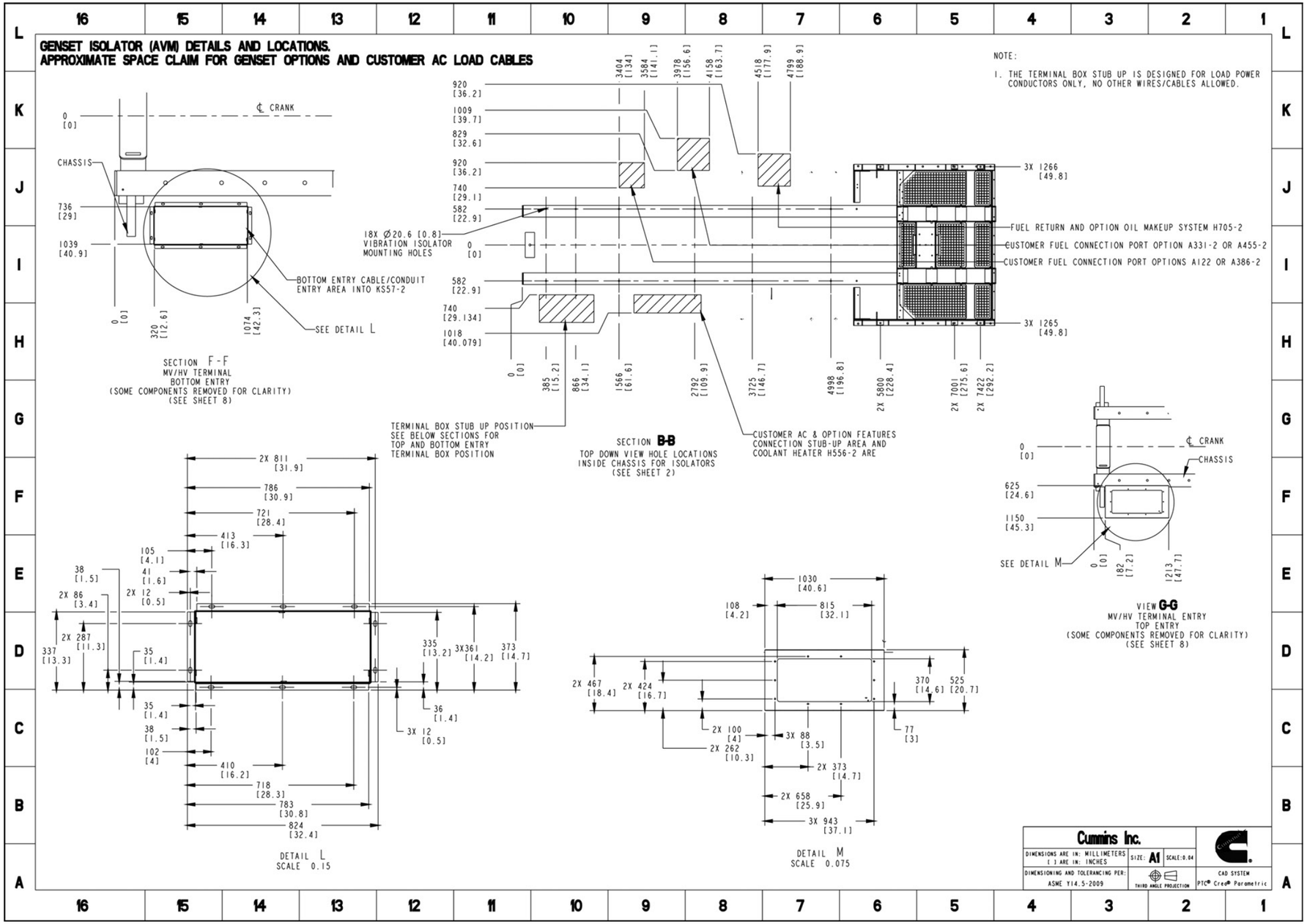


FIGURE 481. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 11 OF 11)

Copyright © 2026 Cummins Inc.

A.4 Outline Drawing A067M933 – Normal Duty Air Cleaner Without Radiator

ALTERNATOR	WINDING	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT* Kg [LBS]	C OF G DIM A* mm [Inch]	C OF G DIM B* mm [Inch]
S9MID-G42	851	7750 [17086]	24597 [54227]	1038 [40]	2875 [113]
S9HID-H42	991	8200 [18078]	25047 [55219]	1036 [40]	2831 [111]
S9HID-G42	991	7750 [17086]	24597 [54227]	1038 [40]	2875 [113]
S9HID-G42	961	7750 [17086]	24597 [54227]	1038 [40]	2875 [113]
S9HID-H42	961	8200 [18078]	25047 [55219]	1036 [40]	2831 [111]
S9HID-G42	983	7750 [17086]	24597 [54227]	1038 [40]	2875 [113]
S9HID-H42	983	8200 [18078]	25047 [55219]	1036 [40]	2831 [111]
S9MID-H42	851	8200 [18078]	25047 [55219]	1036 [40]	2831 [111]

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS WITH IMPERIAL INCH CONVERSIONS IN "[ ]".

1.1 IN EVENT OF A DISCREPANCY BETWEEN METRIC AND IMPERIAL DIMENSIONS, THE METRIC DIMENSIONS CONTROL.

2. ALL DIMENSIONS ARE REFERENCE, UNLESS SPECIFICALLY TOLERANCED.

3. WEIGHT: REFER TO TABLE FOR STANDARD GENSET

*3.1 INCLUDES WEIGHT OF 606 LITERS [160 GALLONS] SUPPLIED ENGINE OIL.(530 KG/1168 LBS)

3.2 DOES NOT INCLUDE NON- SUPPLIED 378.5 LITERS [100 GALLONS] OF ENGINE COOLANT CAPACITY

4. LARGEST NOMINAL DIMENSIONS:
4.1 LENGTH: 6422 [252.8]
4.2 WIDTH: 2164 [85.2]
4.3 HEIGHT: 2530 [99.6]
4.4 DOES NOT INCLUDE THE HEIGHT OF THE VIBRATION ISOLATOR

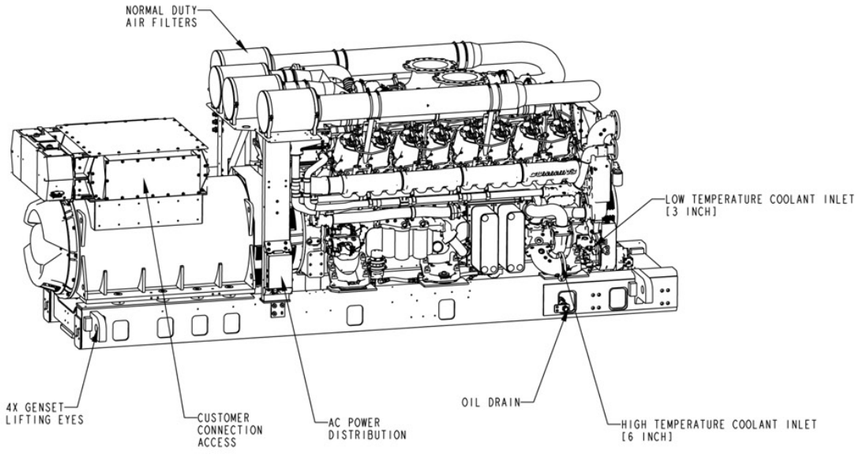
△5 LIFTING INSTRUCTIONS: REFER TO GENSET INSTALLATION MANUAL AND LIFTING LABEL.

5.1 GENSET SHALL NOT BE LIFTED USING THE LIFTING EYES WHEN ATTACHED TO THE RADIATOR. THEY ARE TO BE LIFTED SEPARATELY PER INSTALLATION MANUAL AND LIFTING DIAGRAMS.

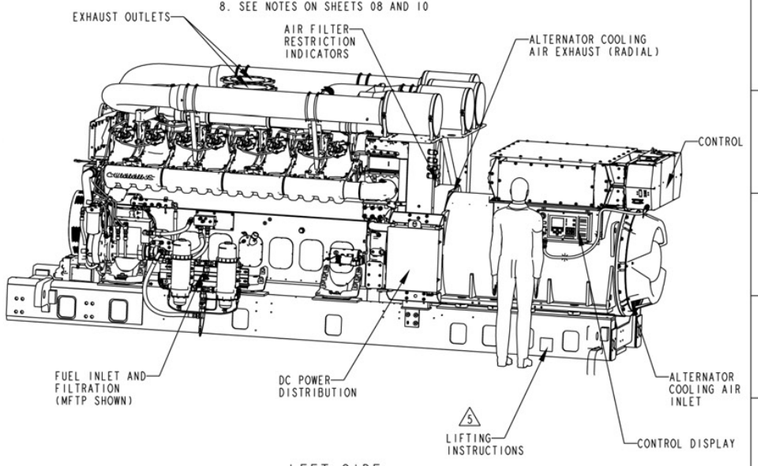
6. ALLOW 1 METER SPACE AROUND THE GENSET FOR SERVICE.

△7 ISOLATORS ARE MODELED IN THEIR UNCOMPRESSED STATE AND THEIR HEIGHT CHANGE UNDER LOAD MUST BE CONSIDERED FOR SITE CONNECTIONS. WHEN PROPERLY INSTALLED, STANDARD GENESET ISOLATORS WILL DEFLECT APPROXIMATELY 13 mm FROM THEIR UNCOMPRESSED HEIGHT. RESTRAINED ISOLATORS WILL INCREASE IN HEIGHT BY APPROXIMATELY 5 mm. CUSTOMER EXHAUST AND SITE CONNECTIONS SHALL BE CAPABLE OF ACCOMMODATING THIS RANGE.

8. SEE NOTES ON SHEETS 08 AND 10



RIGHT SIDE



LEFT SIDE

STANDARD GENSET CONFIGURATION WITH S9HID-H42 ALTERNATOR AND E127-2 (ENHANCED HIGH AMBIENT) COOLING SYSTEM SHOWN.

LAST DATUM LETTER USED: .	LAST REFERENCE LETTER USED:
MODEL/PLATFORM: C325D6	THIS PART IS SIMILAR TO: A049P662
Cummins Inc.	
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: INCHES	SIZE: A1 SCALE: 0.04
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009	THIRD ANGLE PROJECTION
	CAD SYSTEM PTC® Creo® Parametric

FIGURE 482. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 1 OF 10)

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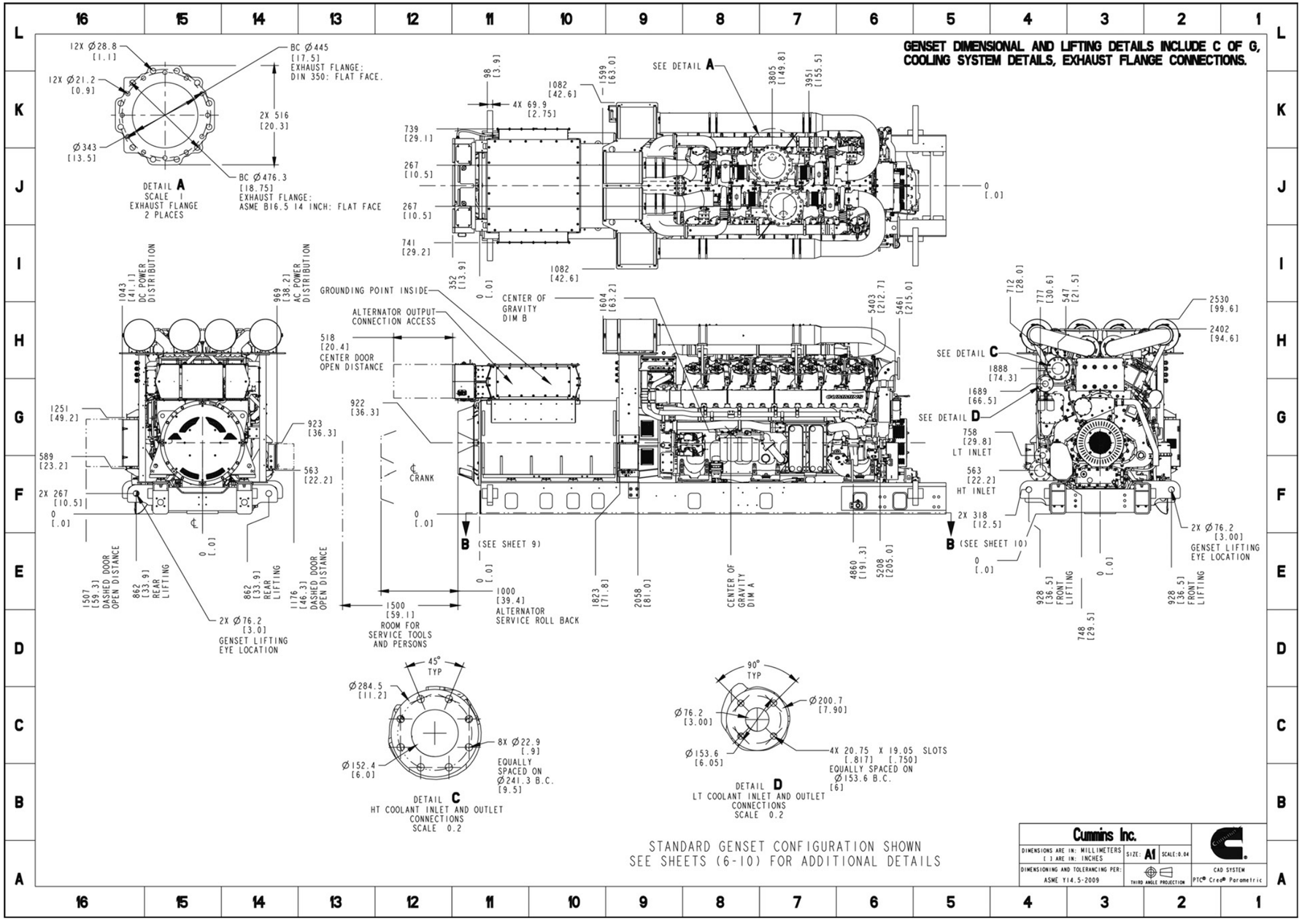


FIGURE 483. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 2 OF 10)

Copyright © 2026 Cummins Inc.

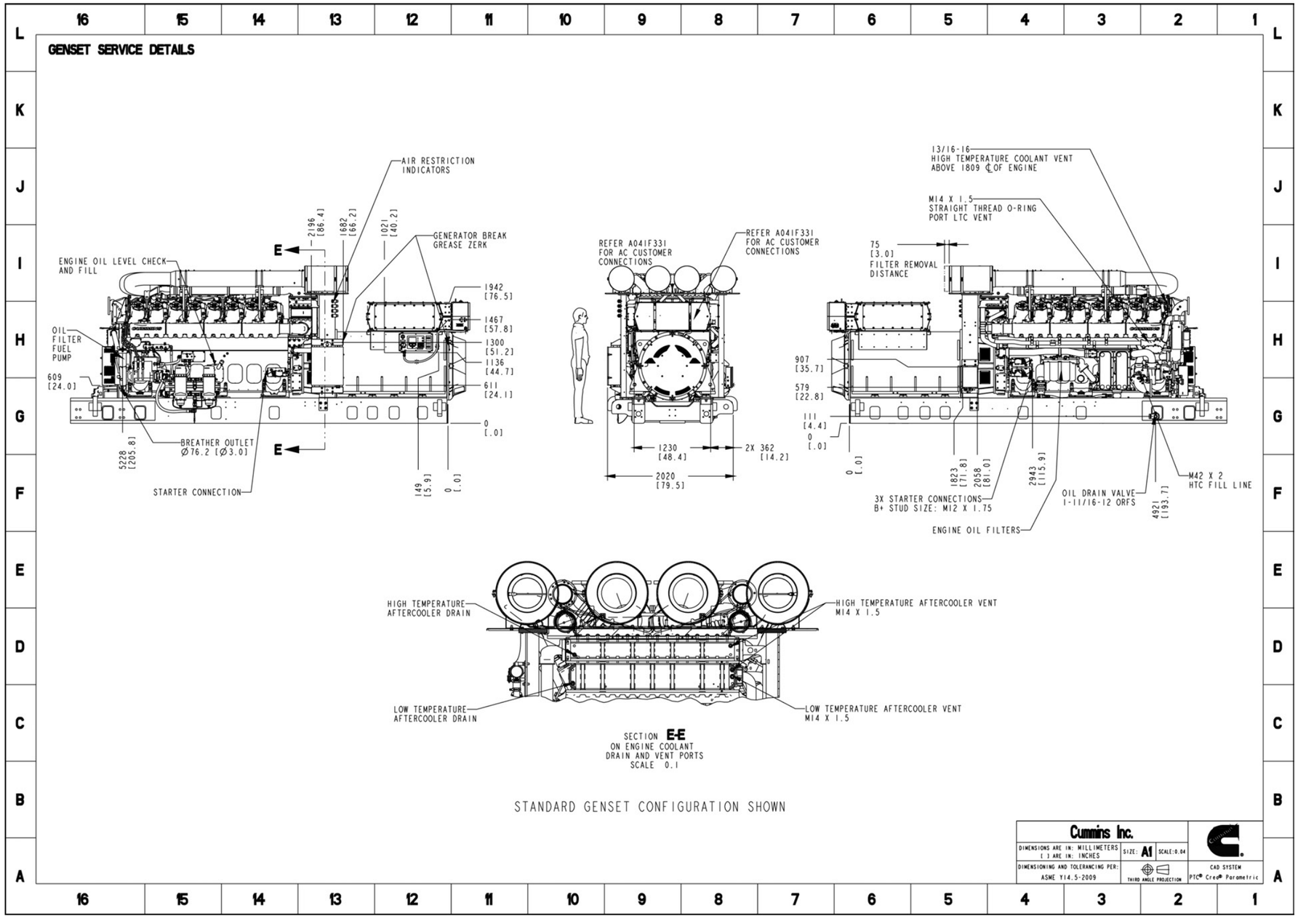


FIGURE 484. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 3 OF 10)

Copyright © 2026 Cummins Inc.

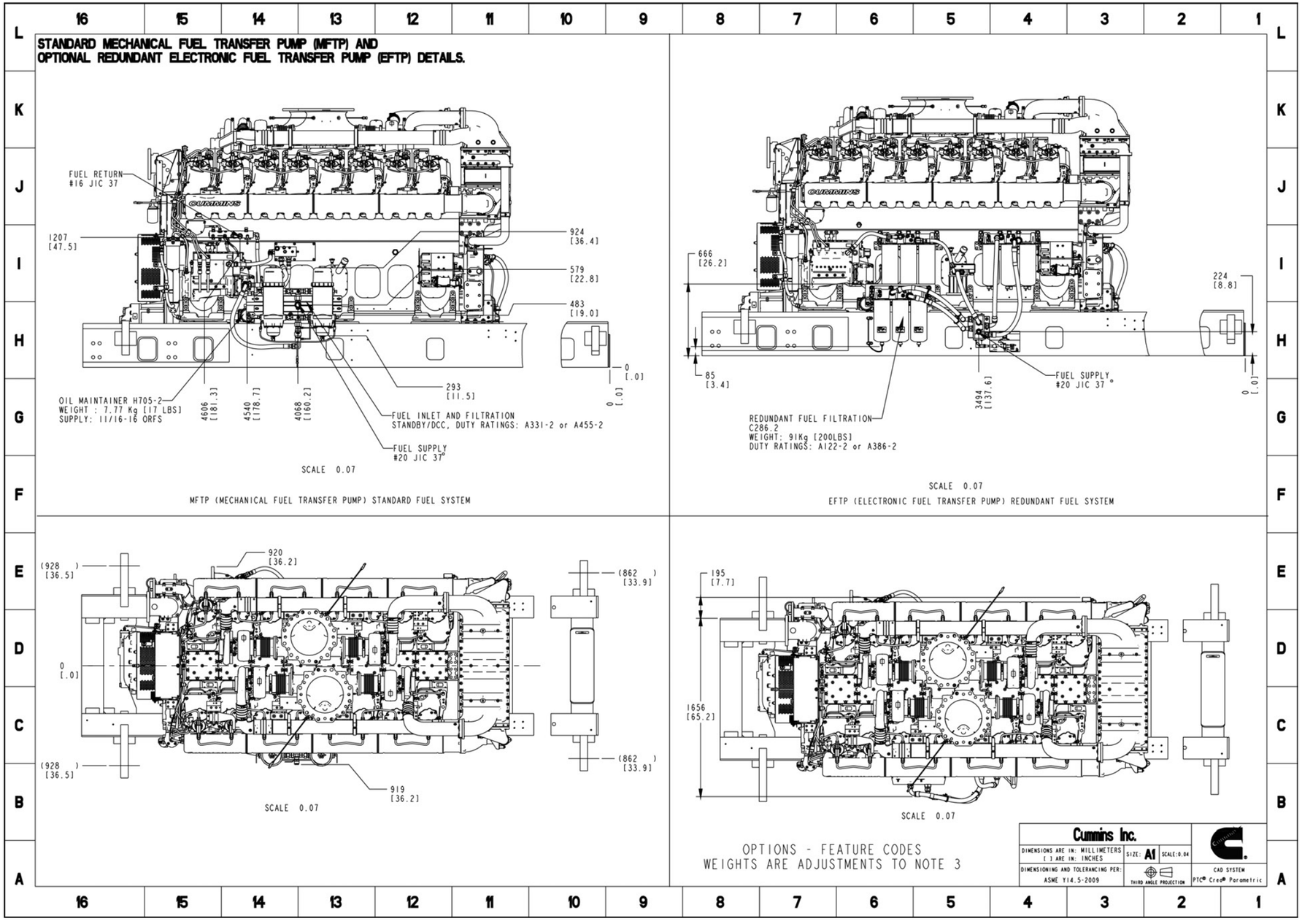


FIGURE 485. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 4 OF 10)

Copyright © 2026 Cummins Inc.

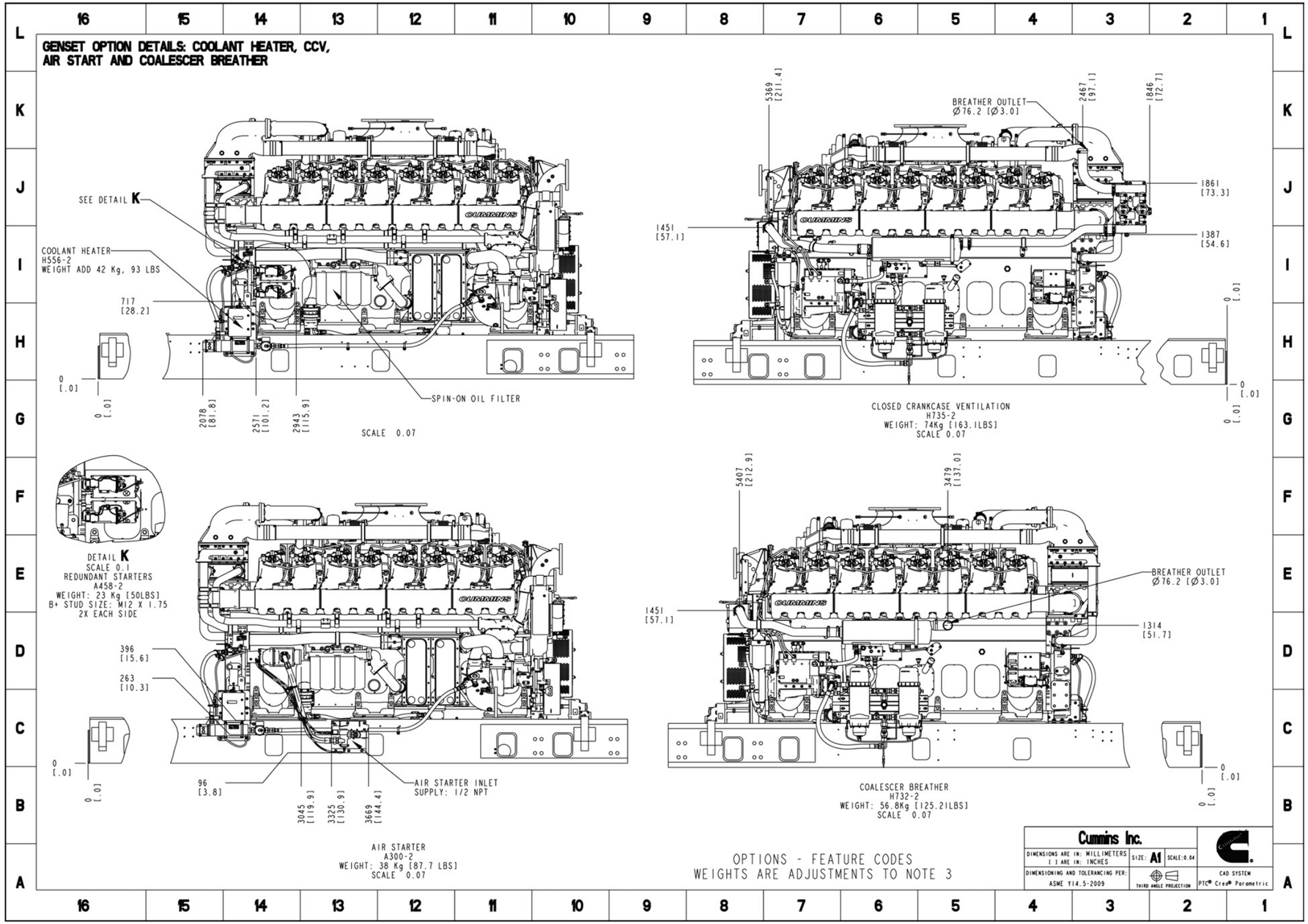


FIGURE 486. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 5 OF 10)

Copyright © 2026 Cummins Inc.

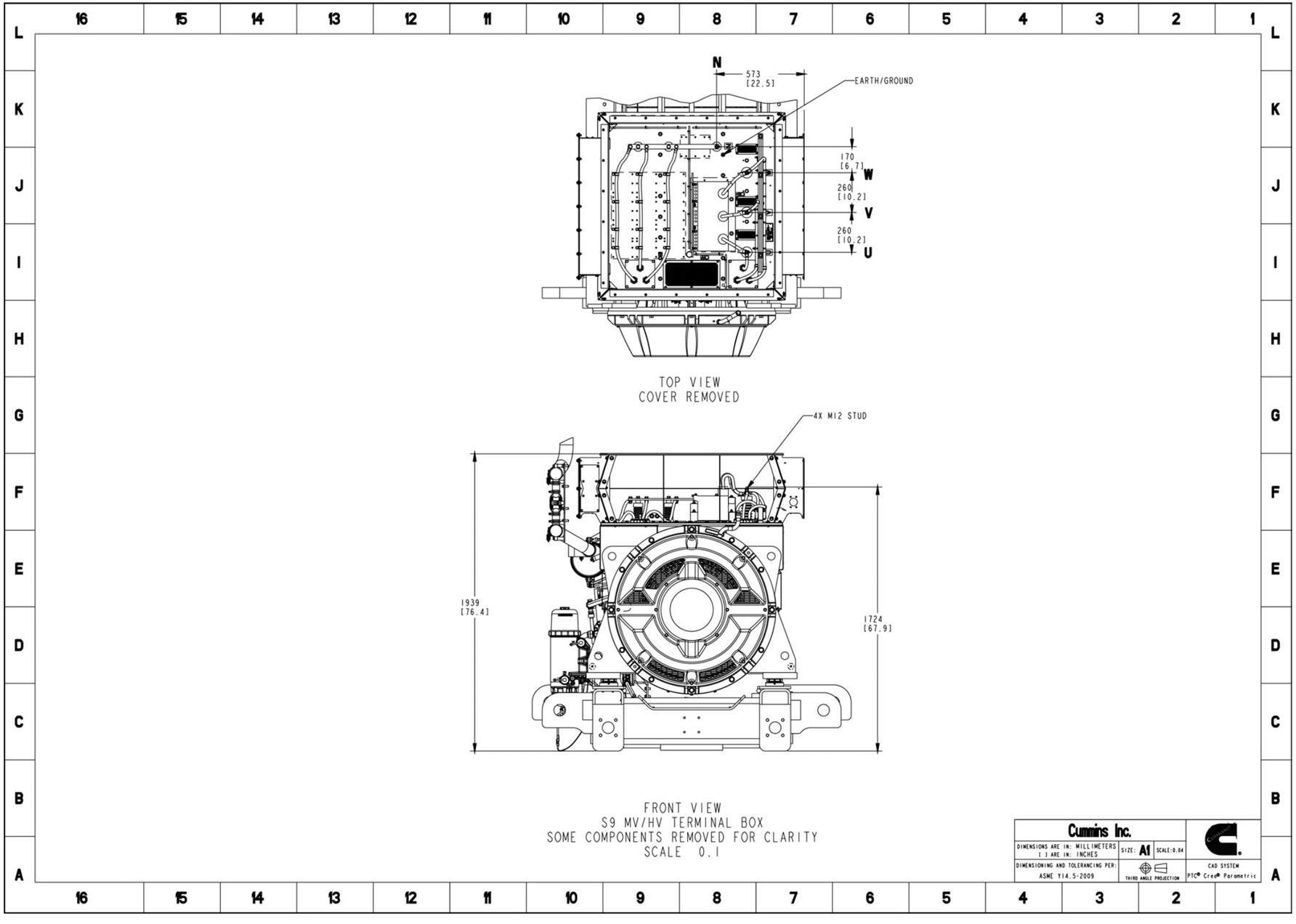


FIGURE 487. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 6 OF 10)

Copyright © 2026 Cummins Inc.

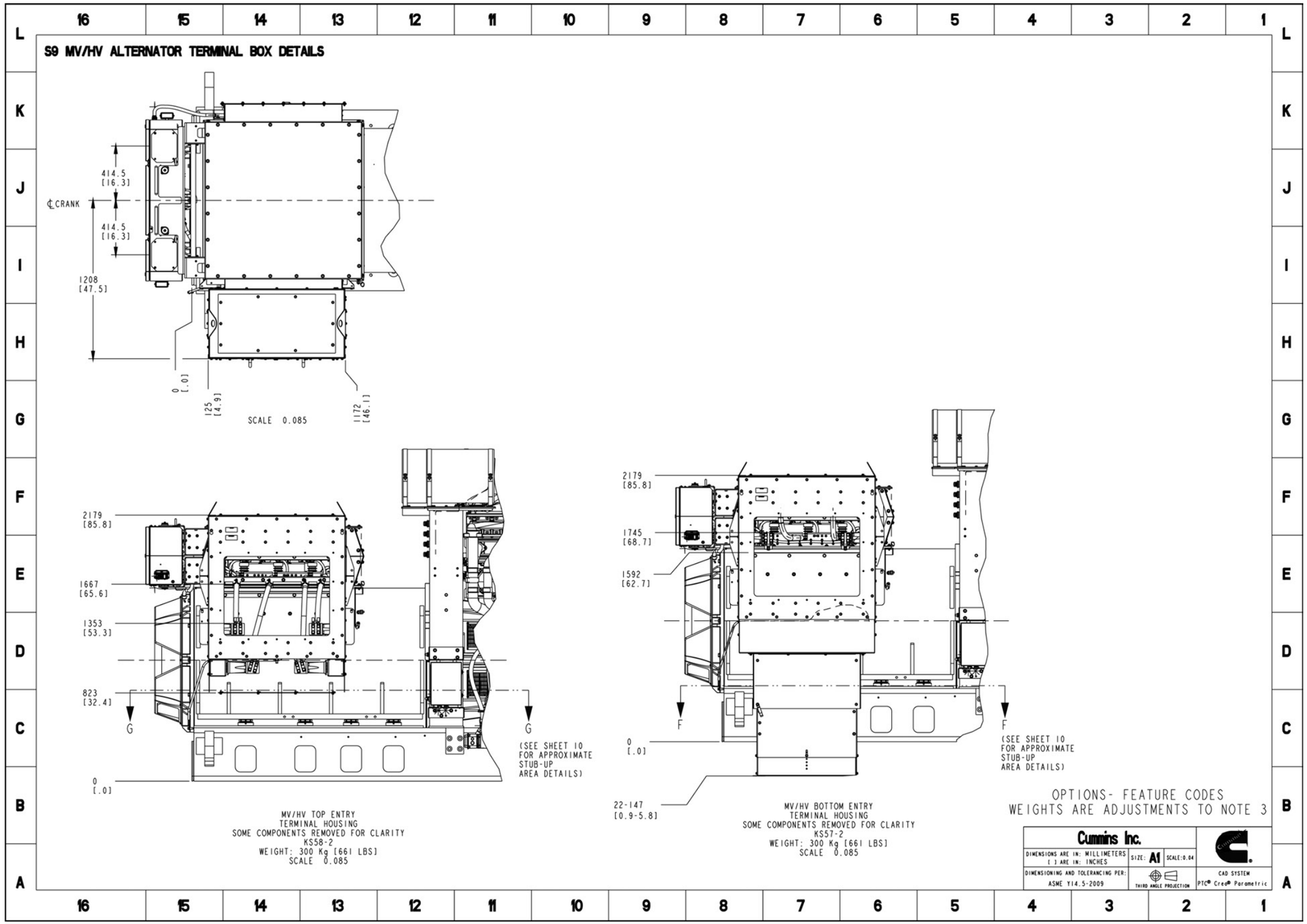


FIGURE 488. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 7 OF 10)

Copyright © 2026 Cummins Inc.

FIGURE 489. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 8 OF 10)

Copyright © 2026 Cummins Inc.

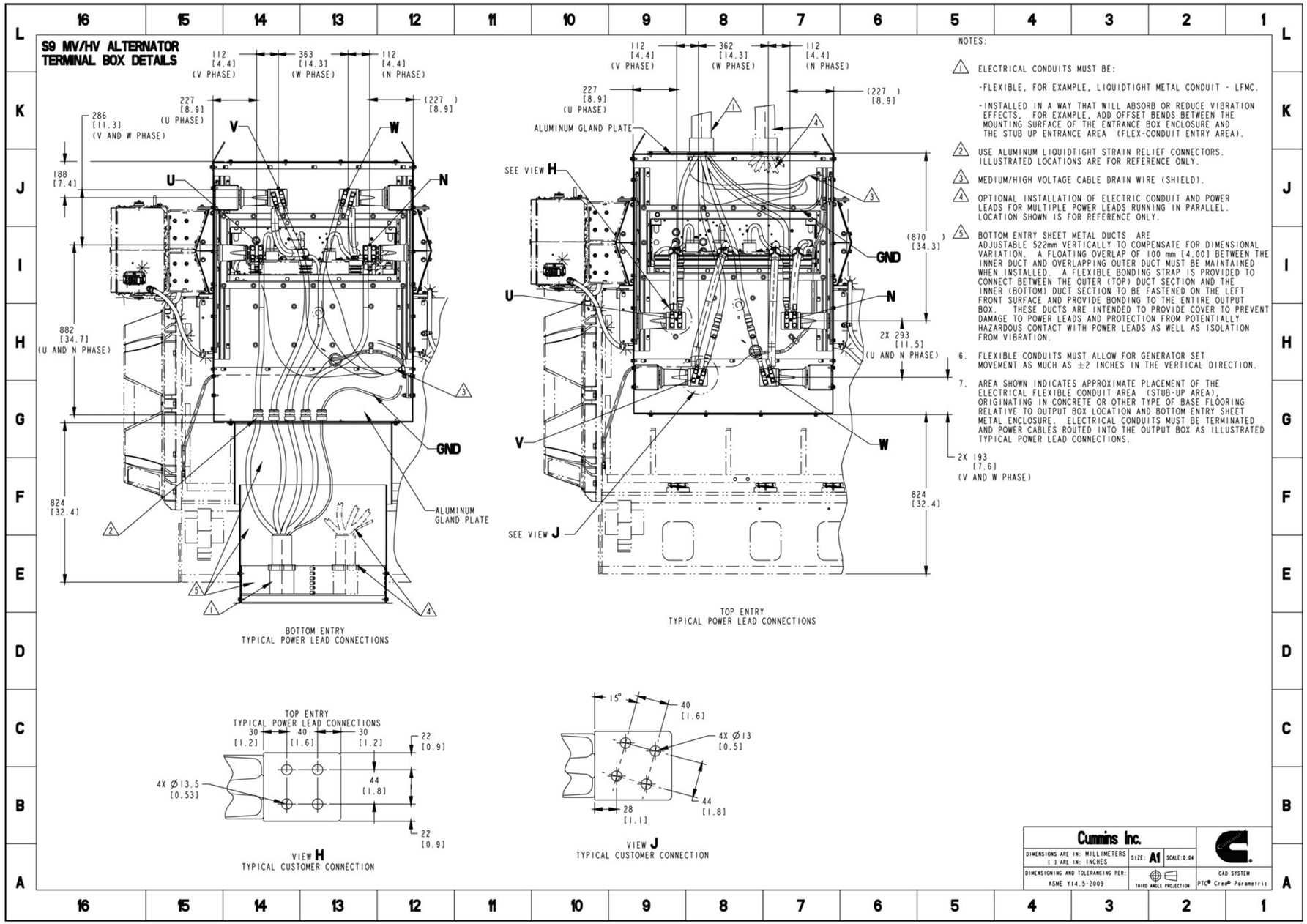


FIGURE 490. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 8 OF 10)

Copyright © 2026 Cummins Inc.

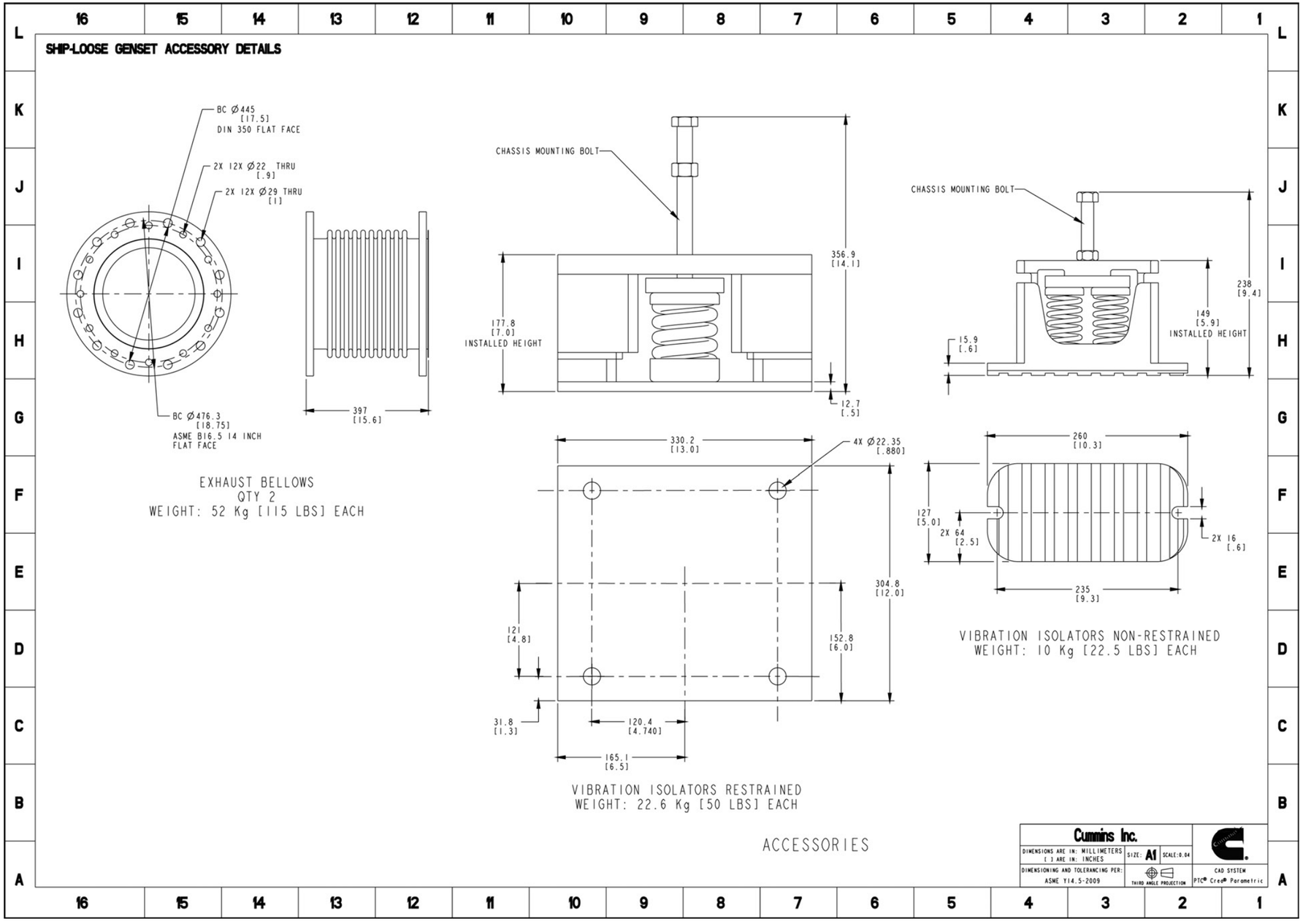


FIGURE 491. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 9 OF 10)

Copyright © 2026 Cummins Inc.

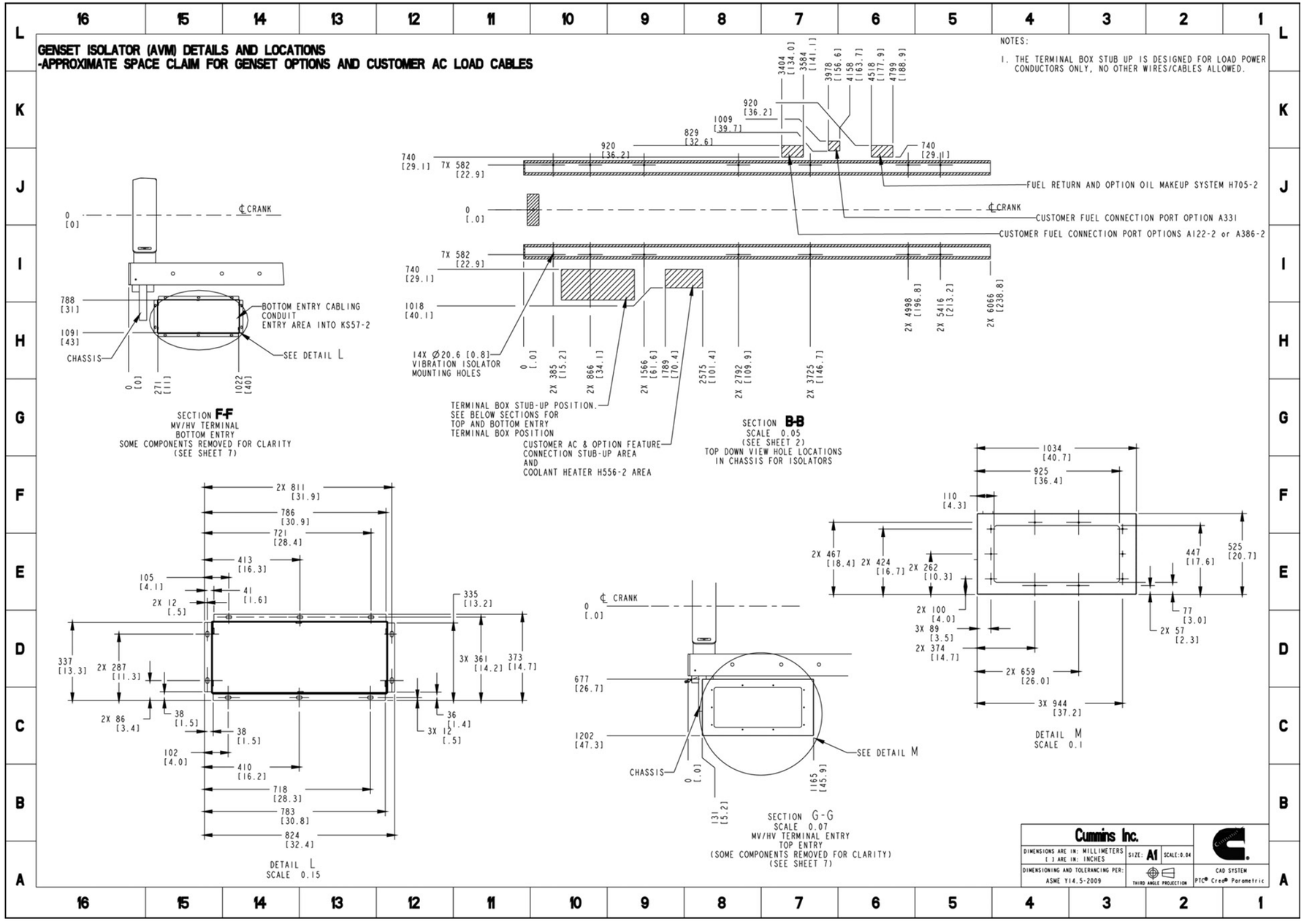


FIGURE 492. OUTLINE DRAWING – NORMAL DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 10 OF 10)

A.5 Outline Drawing A067U304 – Heavy Duty Air Cleaner and 94 Square Foot Radiator

ALTERNATOR	WINDING	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH NO RADIATOR* Kg [LBS]	GENSET WEIGHT WITH RADIATOR* Kg [LBS]	C OF G WITH RADIATOR DIM A (SHEET 2)* mm [Inch]	C OF G WITH RADIATOR DIM B (SHEET 2)* mm [Inch]	C OF G WITHOUT RADIATOR DIM A* mm [Inch]	C OF G WITHOUT RADIATOR DIM B* mm [Inch]
S9MID-G42	851	7750 [17086]	24897 [54888]	31423 [69276]	1153 [45]	3751 [147]	1049 [41]	2853 [112]
S9HID-H42	991	8200 [18078]	25347 [55881]	31873 [70268]	1149 [45]	3705 [145]	1046 [41]	2811 [110]
S9HID-G42	991	7750 [17086]	24897 [54888]	31423 [69276]	1153 [45]	3751 [147]	1049 [41]	2853 [112]
S9HID-G42	961	7750 [17086]	24897 [54888]	31423 [69276]	1153 [45]	3751 [147]	1049 [41]	2853 [112]
S9HID-H42	961	8200 [18078]	25347 [55881]	31873 [70268]	1149 [45]	3705 [145]	1046 [41]	2811 [110]
S9HID-G42	983	7750 [17086]	24897 [54888]	31423 [69276]	1153 [45]	3751 [147]	1049 [41]	2853 [112]
S9HID-H42	983	8200 [18078]	25347 [55881]	31873 [70268]	1149 [45]	3705 [145]	1046 [41]	2811 [110]
S9MID-H42	851	8200 [18078]	25347 [55881]	31873 [70268]	1149 [45]	3705 [145]	1046 [41]	2811 [110]

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS WITH IMPERIAL INCH CONVERSIONS IN "[]".
   1.1 IN EVENT OF A DISCREPANCY BETWEEN METRIC AND IMPERIAL DIMENSIONS, THE METRIC DIMENSIONS CONTROL.
2. ALL DIMENSIONS ARE REFERENCE, UNLESS SPECIFICALLY TOLERANCED.
3. WEIGHT: REFER TO TABLE FOR STANDARD GENSET WITH E127-2 (ENHANCED HIGH AMBIENT) COOLING SYSTEM.
   *3.1 INCLUDES WEIGHT OF 606 LITERS [160 GALLONS] SUPPLIED ENGINE OIL.(530 Kg/1168 LBS)
   **3.2 INCLUDES DRY WEIGHT OF RADIATOR 5130 Kg [11310 LBS] (SHIPS LOOSE)
   **3.3 INCLUDES WEIGHT FOR 1196 LITERS [316 GALLONS] OF NON-SUPPLIED COOLANT. (1216 Kg/2780 LBS)
4. LARGEST NOMINAL DIMENSIONS:
   4.1 LENGTH 8311 [327.2]
   4.2 WIDTH 3172 [124.9] RADIATOR
   4.3 HEIGHT 3791 [149.3] TOP OF RADIATOR CAP
   4.4 DOES NOT INCLUDE THE HEIGHT OF THE VIBRATION ISOLATOR

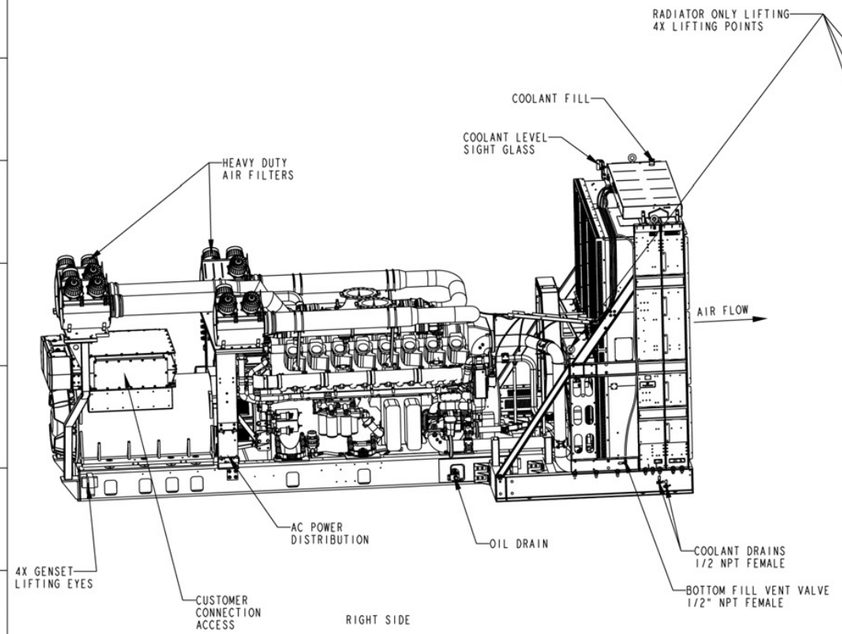
△5 LIFTING INSTRUCTIONS: REFER TO GENSET INSTALLATION MANUAL AND LIFTING LABEL

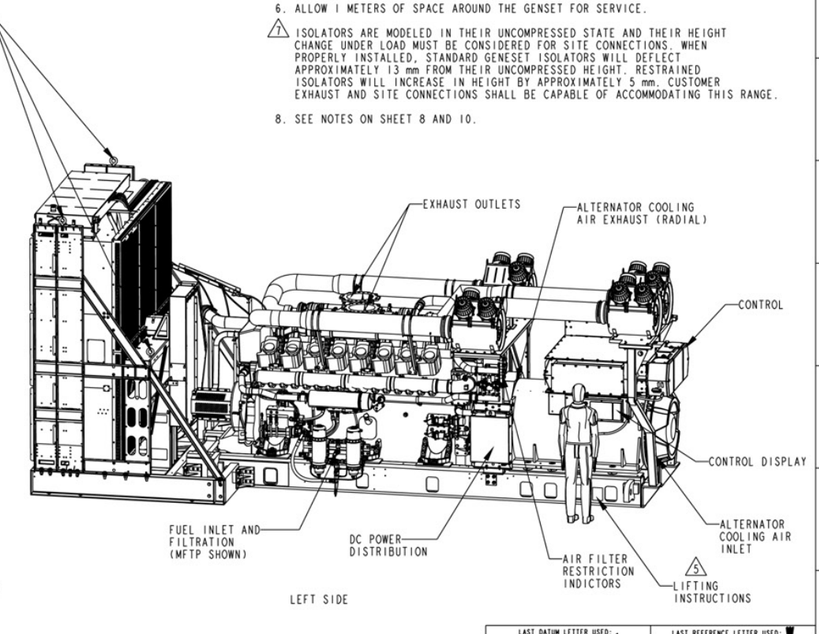
   5.1 GENSET SHALL NOT BE LIFTED USING THE LIFTING EYES WHEN ATTACHED TO THE RADIATOR. RADIATOR AND GENSET SHALL ALWAYS BE LIFTED SEPARATELY PER INSTALLATION MANUAL AND LIFTING DIAGRAMS.

6. ALLOW 1 METERS OF SPACE AROUND THE GENSET FOR SERVICE.

△7 ISOLATORS ARE MODELED IN THEIR UNCOMPRESSED STATE AND THEIR HEIGHT CHANGE UNDER LOAD MUST BE CONSIDERED FOR SITE CONNECTIONS. WHEN PROPERLY INSTALLED, STANDARD GENESET ISOLATORS WILL DEFLECT APPROXIMATELY 13 mm FROM THEIR UNCOMPRESSED HEIGHT. RESTRAINED ISOLATORS WILL INCREASE IN HEIGHT BY APPROXIMATELY 5 mm. CUSTOMER EXHAUST AND SITE CONNECTIONS SHALL BE CAPABLE OF ACCOMMODATING THIS RANGE.

8. SEE NOTES ON SHEET 8 AND 10.





STANDARD GENSET CONFIGURATION
WITH S9HID-H42 ALTERNATOR,
E127-2 (ENHANCED HIGH AMBIENT)
COOLING SYSTEM AND D036-2 SHOWN

LAST DATUM LETTER USED: ,	LAST REFERENCE LETTER USED:
MODEL/PLATFORM: C325D6	THIS PART IS SIMILAR TO: A049P692
Cummins Inc.	
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: INCHES	SIZE: A1 SCALE:0.04
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009	THIRD ANGLE PROJECTION
	CAD SYSTEM PTC® Creo® Parametric

FIGURE 493. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER AND 94 SQUARE FOOT RADIATOR (SHEET 1 OF 10)

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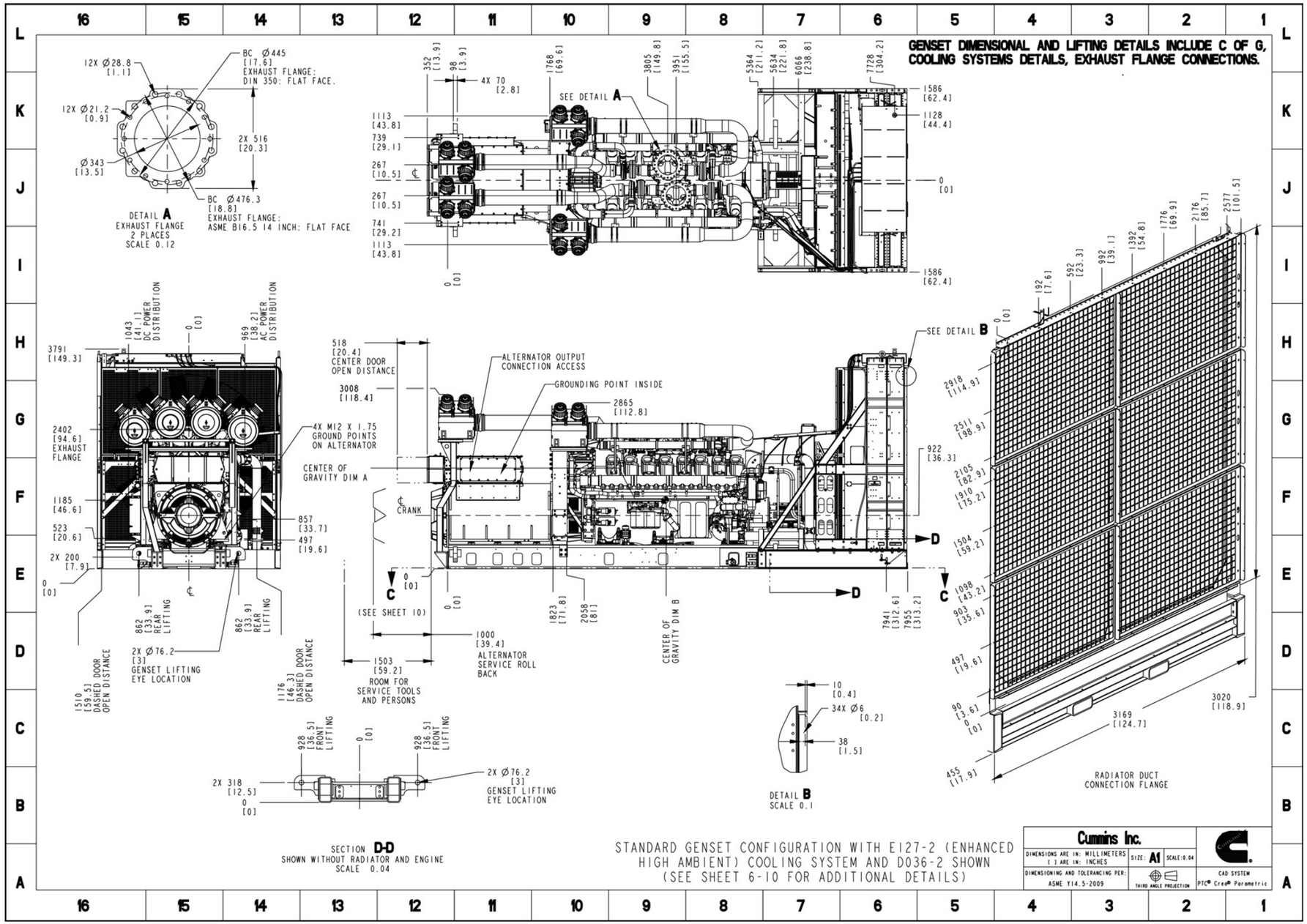


FIGURE 494. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER AND 94 SQUARE FOOT RADIATOR (SHEET 2 OF 10)

Copyright © 2026 Cummins Inc.

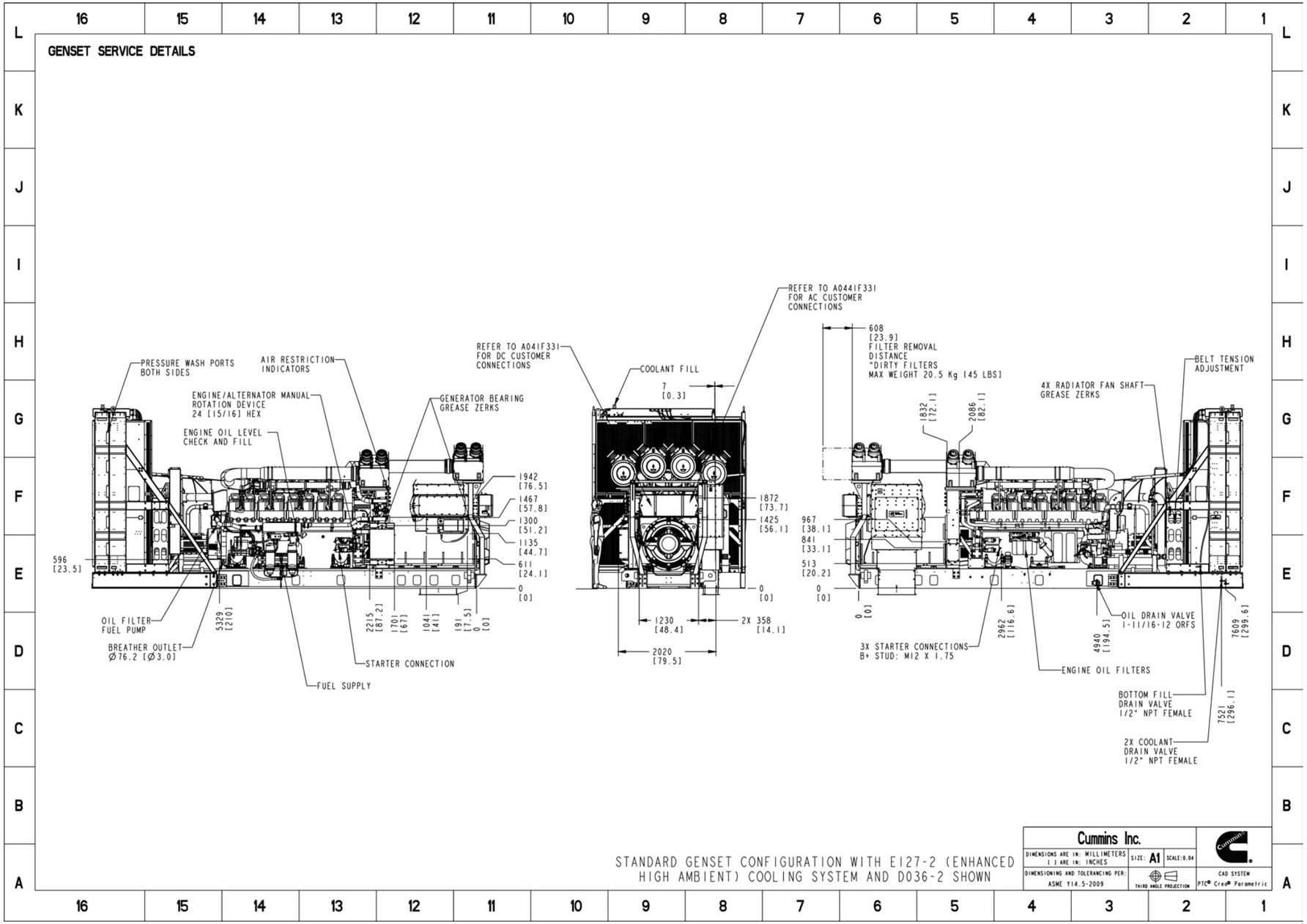


FIGURE 495. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER AND 94 SQUARE FOOT RADIATOR (SHEET 3 OF 10)

 Copyright © 2026 Cummins Inc.

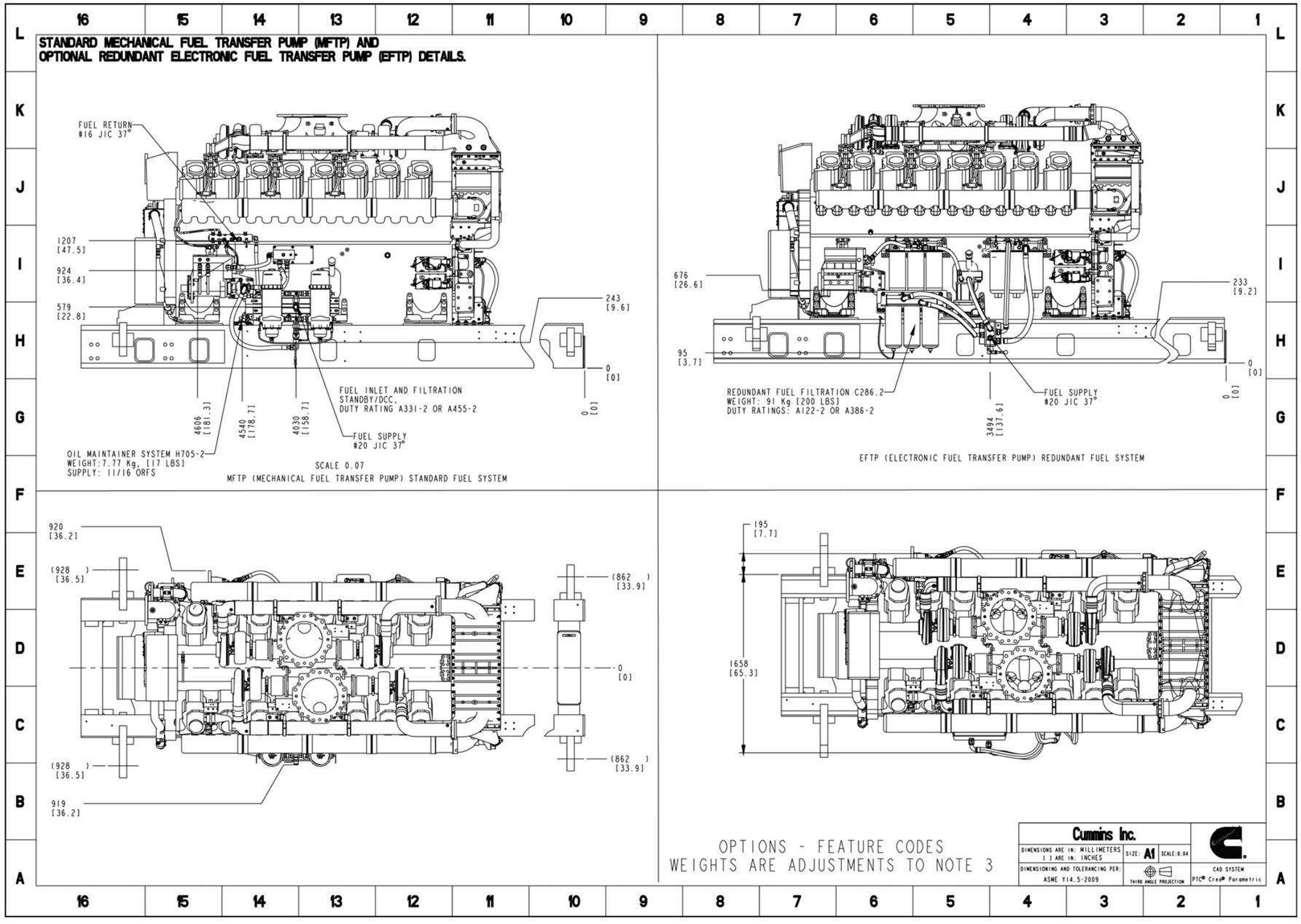


FIGURE 496. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER AND 94 SQUARE FOOT RADIATOR (SHEET 4 OF 10)

Copyright © 2026 Cummins Inc.

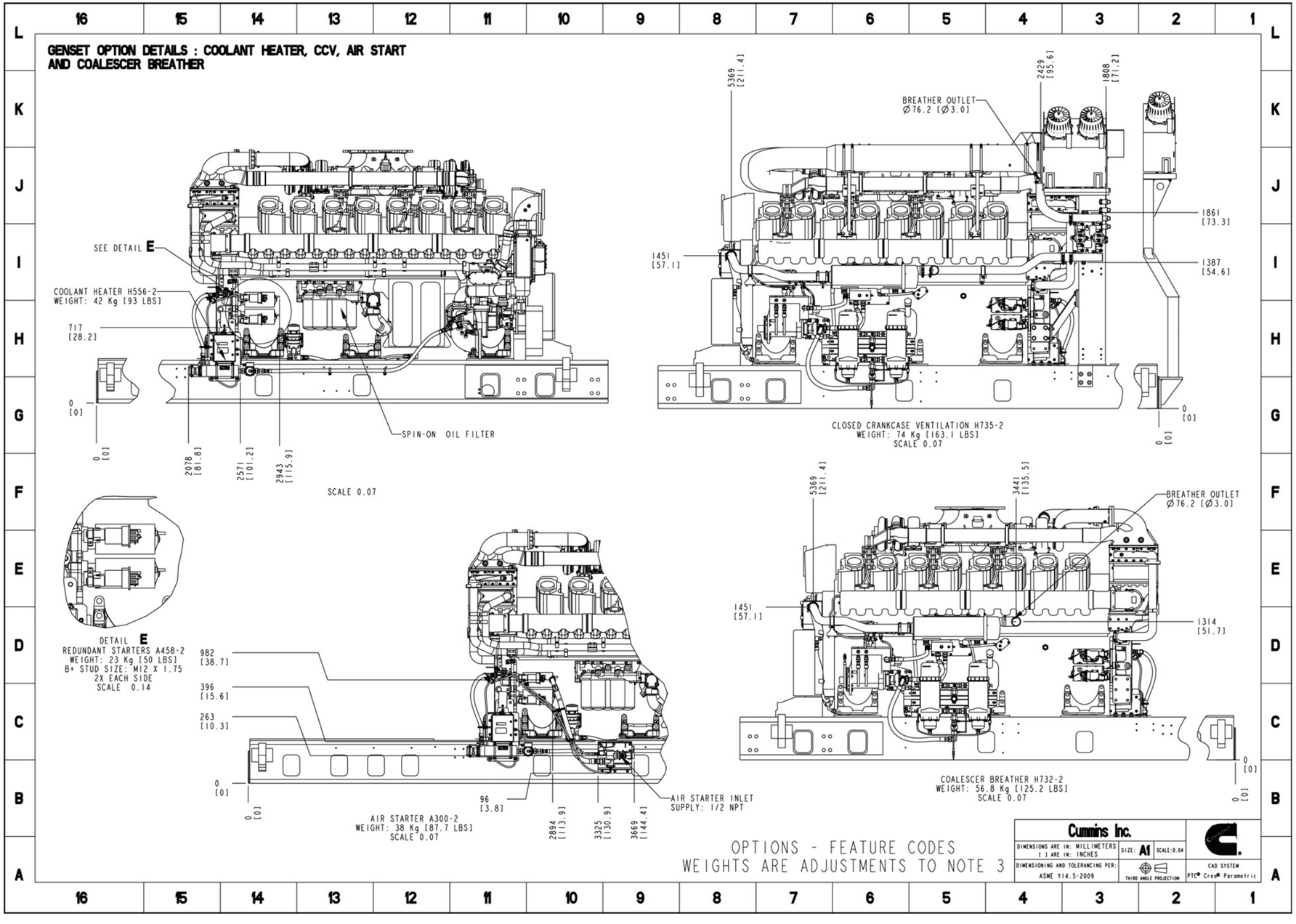


FIGURE 497. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER AND 94 SQUARE FOOT RADIATOR (SHEET 5 OF 10)

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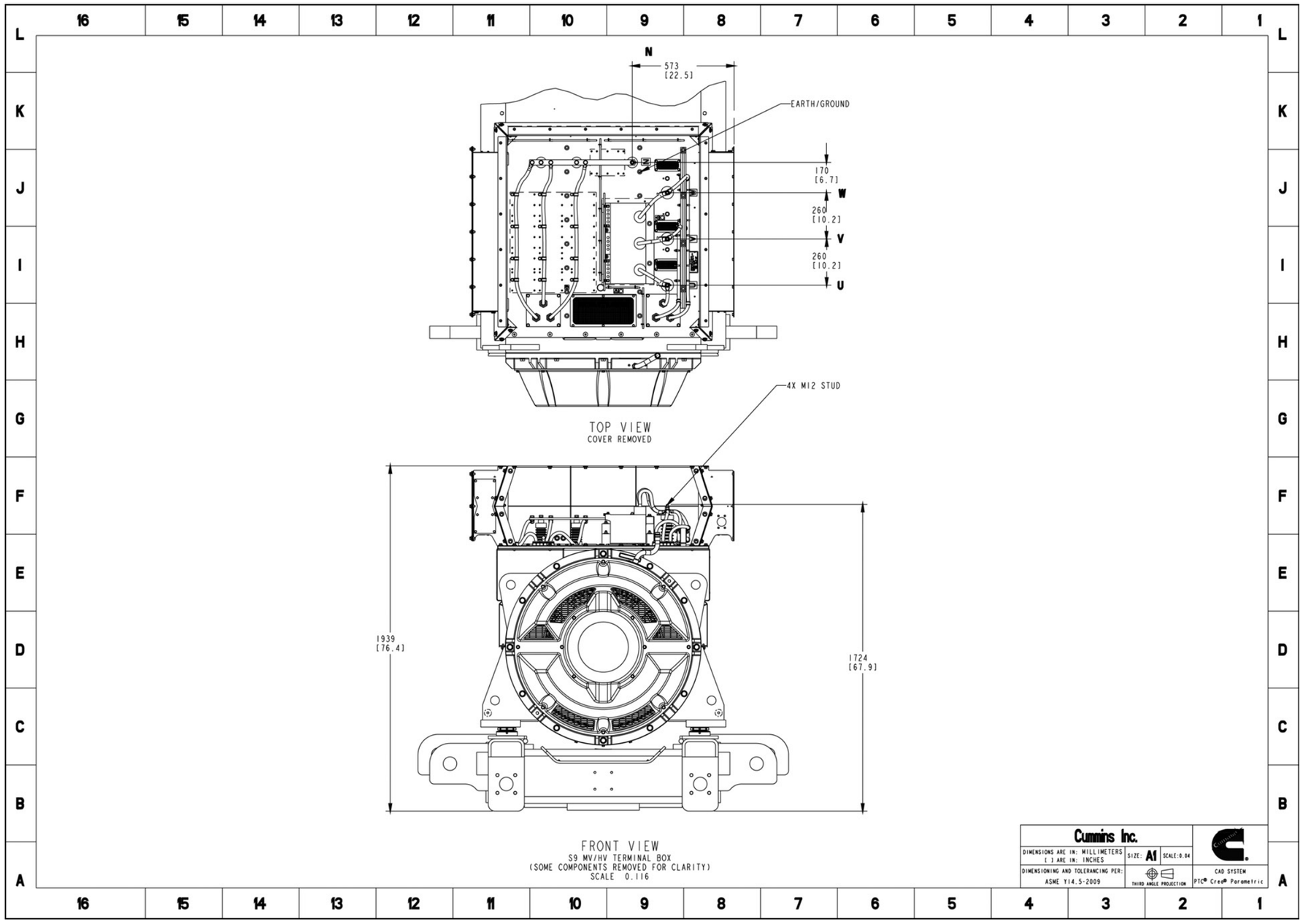


FIGURE 498. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER AND 94 SQUARE FOOT RADIATOR (SHEET 6 OF 10)

Copyright © 2026 Cummins Inc.

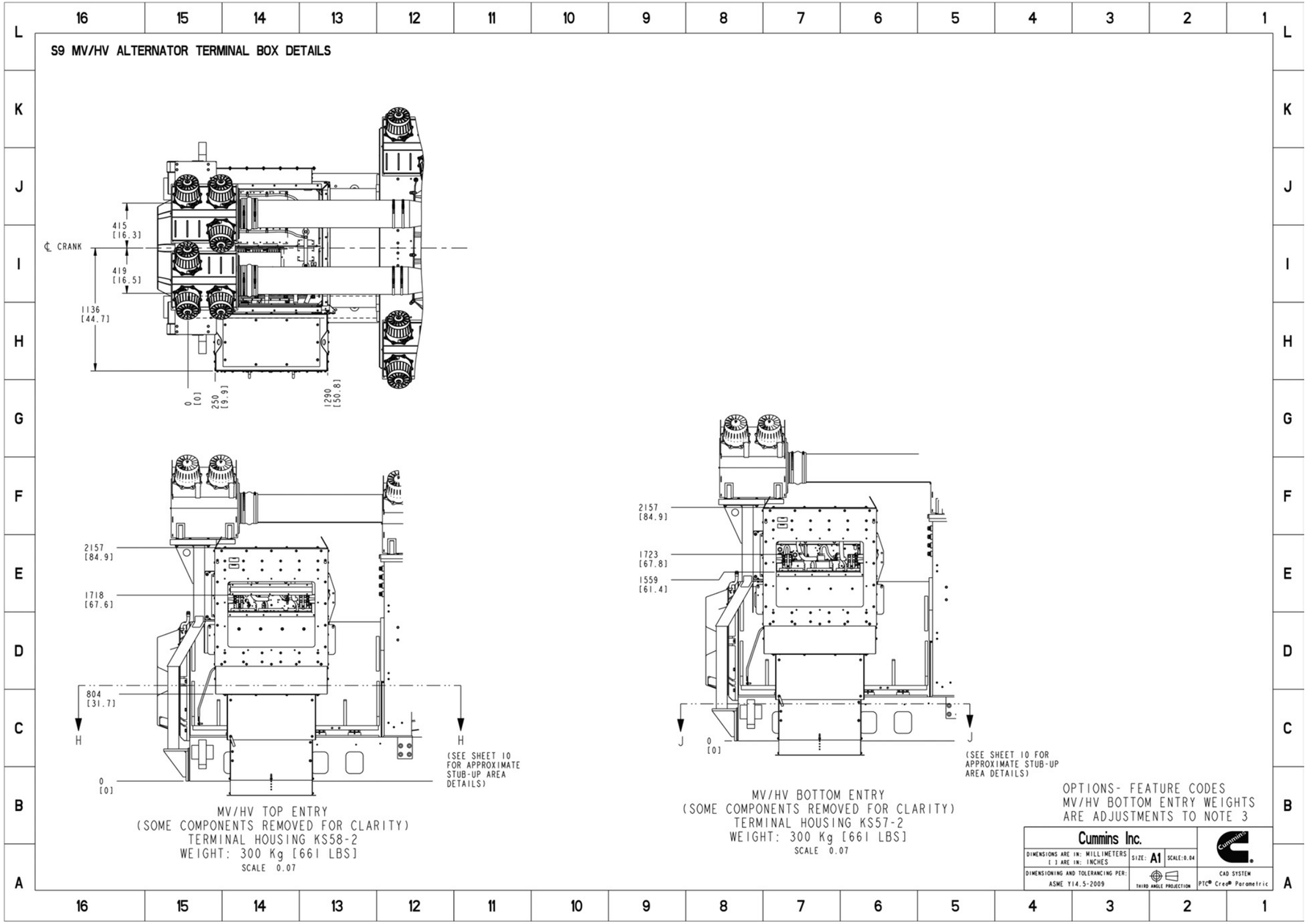


FIGURE 499. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER AND 94 SQUARE FOOT RADIATOR (SHEET 7 OF 10)

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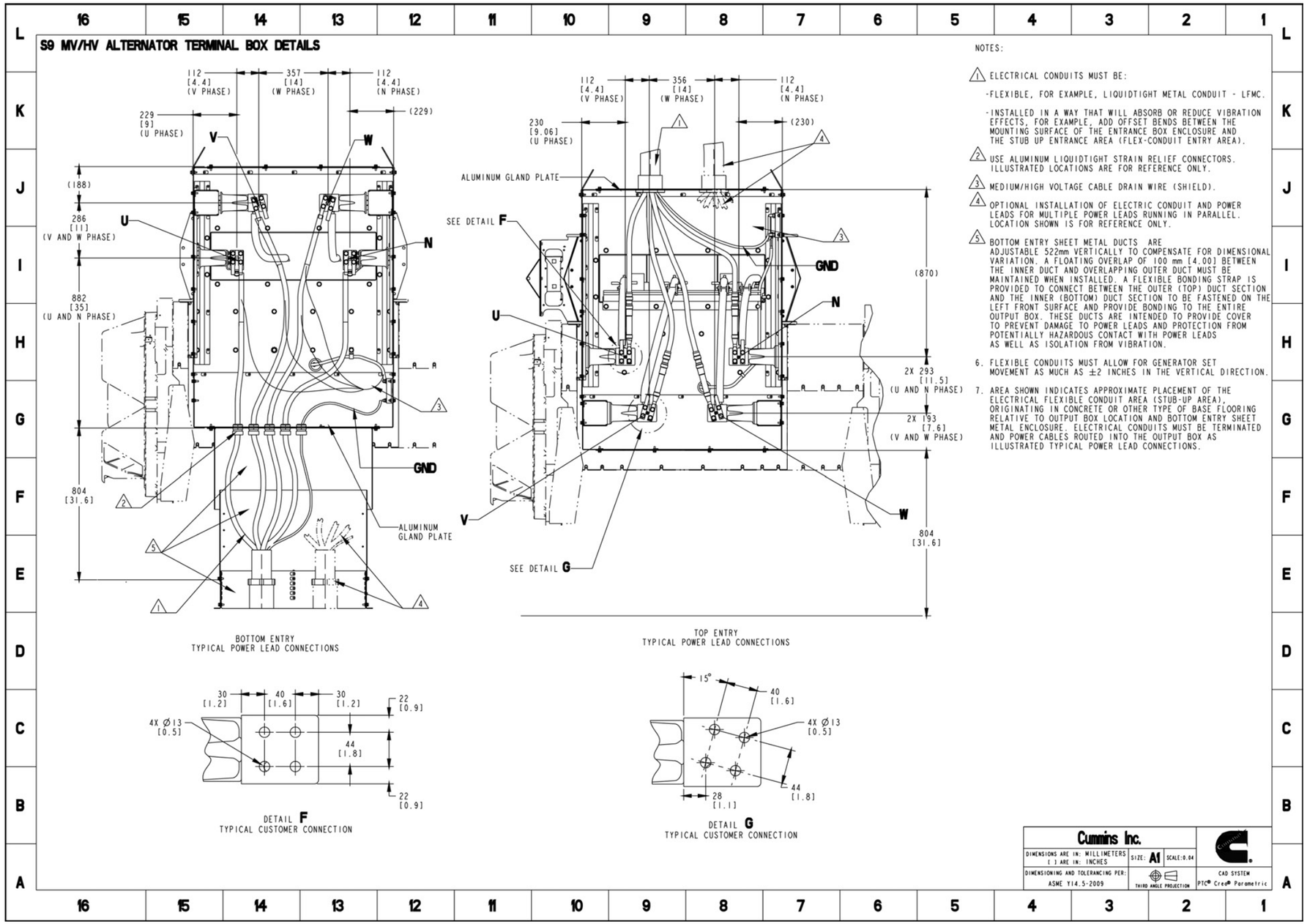


FIGURE 500. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER AND 94 SQUARE FOOT RADIATOR (SHEET 8 OF 10)

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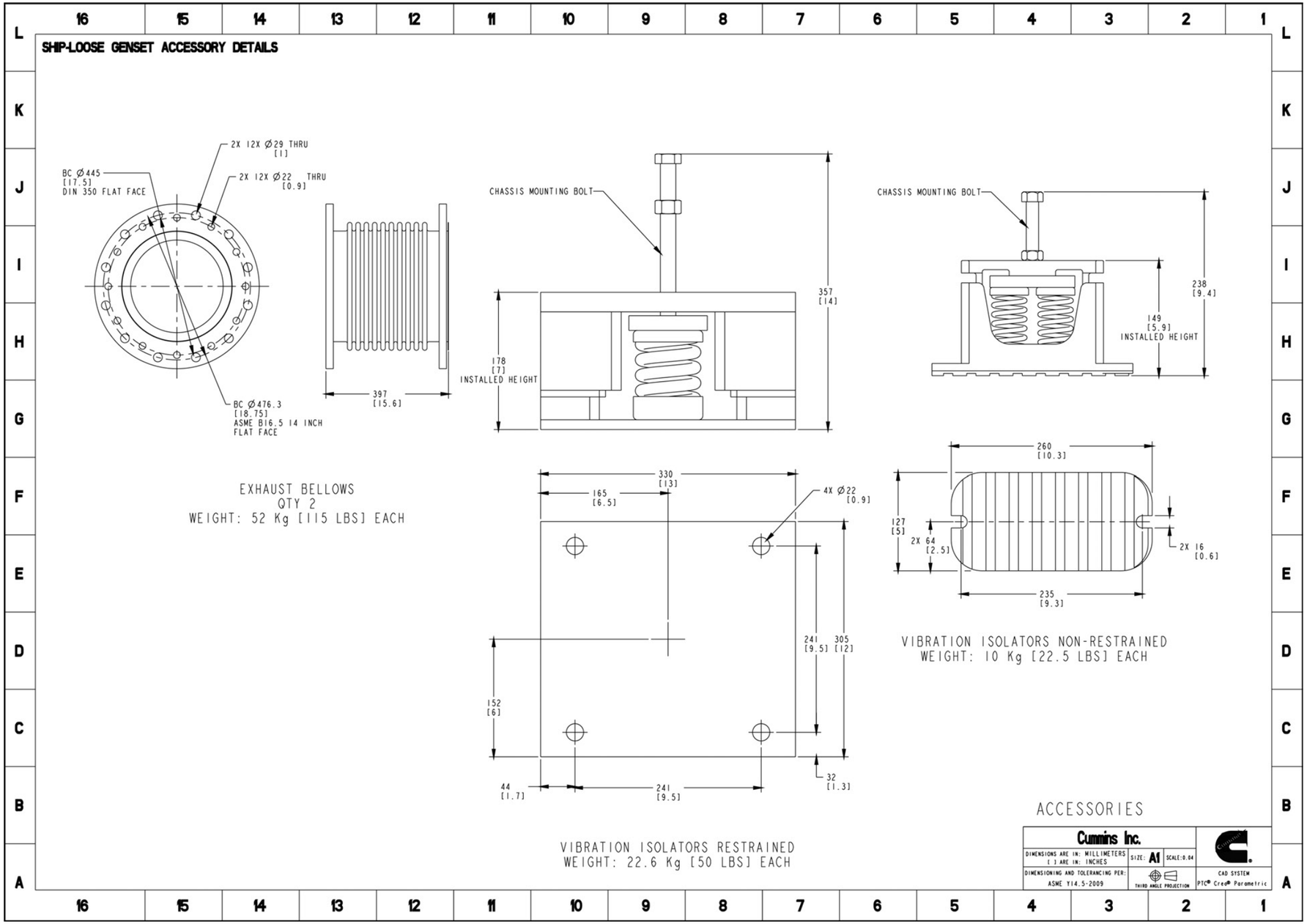


FIGURE 501. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER AND 94 SQUARE FOOT RADIATOR (SHEET 9 OF 10)

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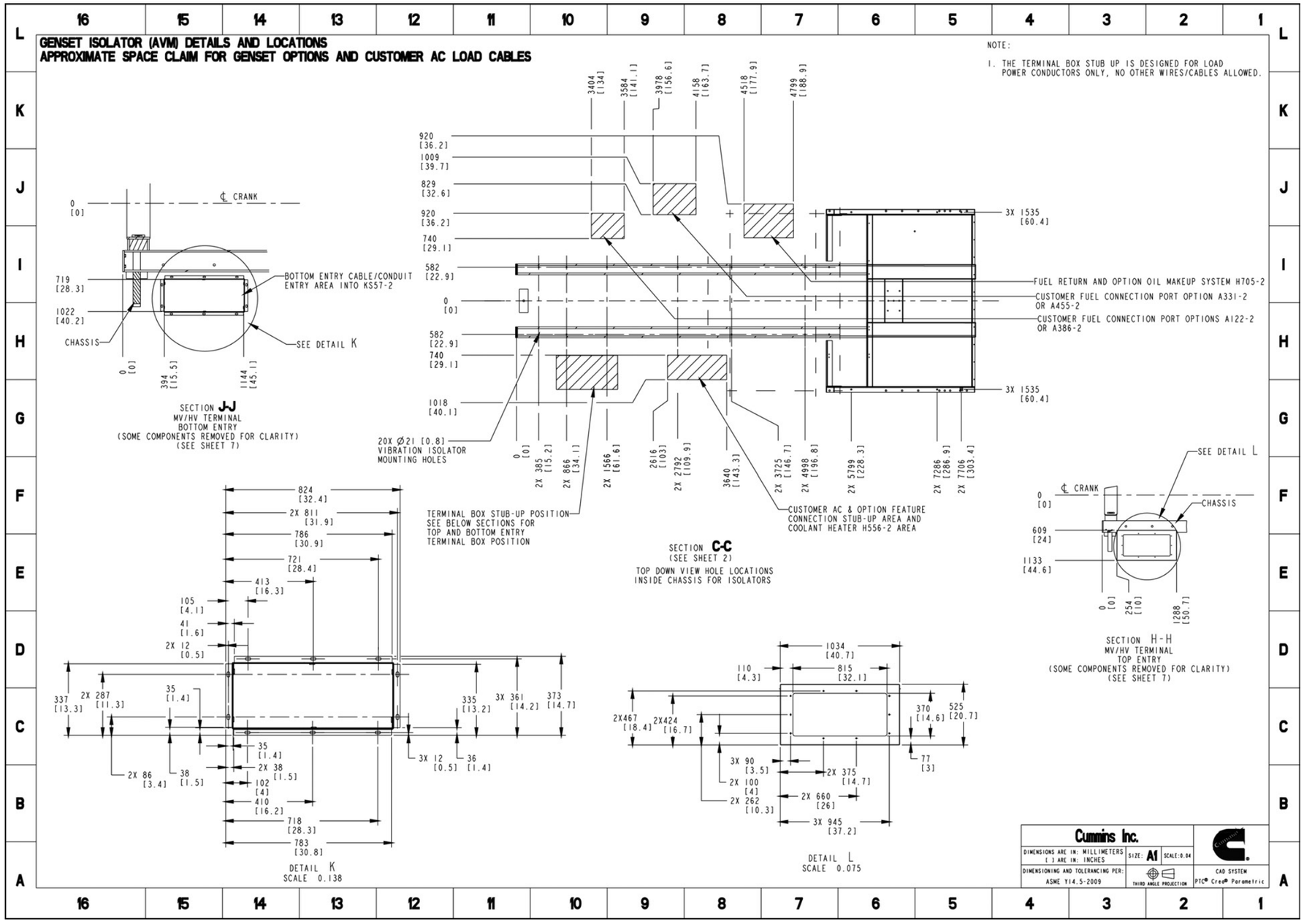


FIGURE 502. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER AND 94 SQUARE FOOT RADIATOR (SHEET 10 OF 10)

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A.6 Outline Drawing A068G150 – Heavy Duty Air Cleaner with 84 Square Radiator

ALTERNATOR	WINDING	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH NO RADIATOR* Kg [LBS]	GENSET WEIGHT WITH RADIATOR* Kg [LBS]	C OF G WITH RADIATOR DIM A (SHEET 2)* mm [inch]	C OF G WITH RADIATOR DIM B (SHEET 2)* mm [inch]	C OF G WITHOUT RADIATOR DIM A* mm [inch]	C OF G WITHOUT RADIATOR DIM B* mm [inch]
S9MID-G42	851	7750 [17086]	24897 [54888]	30097 [66352]	1130 [44]	3587 [141]	1049 [41]	2853 [112]
S9MID-H42	991	8200 [18078]	25347 [55881]	30547 [67345]	1126 [44]	3541 [139]	1046 [41]	2811 [110]
S9HID-G42	991	7750 [17086]	24897 [54888]	30097 [66352]	1130 [44]	3587 [141]	1049 [41]	2853 [112]
S9HID-G42	961	7750 [17086]	24897 [54888]	30097 [66352]	1130 [44]	3587 [141]	1049 [41]	2853 [112]
S9HID-H42	961	8200 [18078]	25347 [55881]	30547 [67345]	1126 [44]	3541 [139]	1046 [41]	2811 [110]
S9HID-G42	983	7750 [17086]	24897 [54888]	30097 [66352]	1130 [44]	3587 [141]	1049 [41]	2853 [112]
S9HID-H42	983	8200 [18078]	25347 [55881]	30547 [67345]	1126 [44]	3541 [139]	1046 [41]	2811 [110]
S9MID-H42	851	8200 [18078]	25347 [55881]	30547 [67345]	1126 [44]	3541 [139]	1046 [41]	2811 [110]

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS WITH IMPERIAL INCH CONVERSIONS IN "[ ]".

   1.1 IN EVENT OF A DISCREPANCY BETWEEN METRIC AND IMPERIAL DIMENSIONS, THE METRIC DIMENSIONS CONTROL.

2. ALL DIMENSIONS ARE REFERENCE, UNLESS SPECIFICALLY TOLERANCED.

3. WEIGHT: REFER TO TABLE FOR STANDARD GENSET WITH E127-2, E128-2 COOLING SYSTEM AND D036-2

   *3.1 INCLUDES WEIGHT OF 606 LITERS [160 GALLONS] SUPPLIED ENGINE OIL.(530 Kg/1168 LBS)

   **3.2 INCLUDES DRY WEIGHT OF RADIATOR 4555 Kg [10042 LBS] (SHIPS LOOSE)

   **3.3 INCLUDES WEIGHT FOR 1120.5 LITERS [296 GALLONS] OF NON-SUPPLIED COOLANT. (1139 Kg/2511 LBS)

4. LARGEST NOMINAL DIMENSIONS:
   4.1 LENGTH 8021 [315.8]
   4.2 WIDTH 3029 [119.3] RADIATOR
   4.3 HEIGHT 3662 [144] TOP OF RADIATOR CAP
   4.4 DOES NOT INCLUDE THE HEIGHT OF THE VIBRATION ISOLATOR

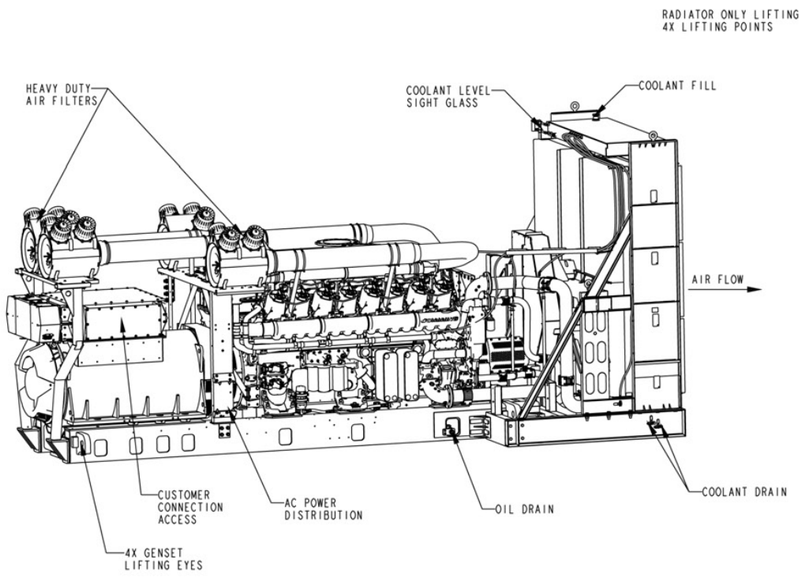
5. LIFTING INSTRUCTIONS: REFER TO GENSET INSTALLATION MANUAL AND LIFTING LABEL.

   5.1 GENSET SHALL NOT BE LIFTED USING THE LIFTING EYES WHEN ATTACHED TO THE RADIATOR. RADIATOR AND GENSET SHALL ALWAYS BE LIFTED SEPARATELY PER INSTALLATION MANUAL AND LIFTING DIAGRAMS.

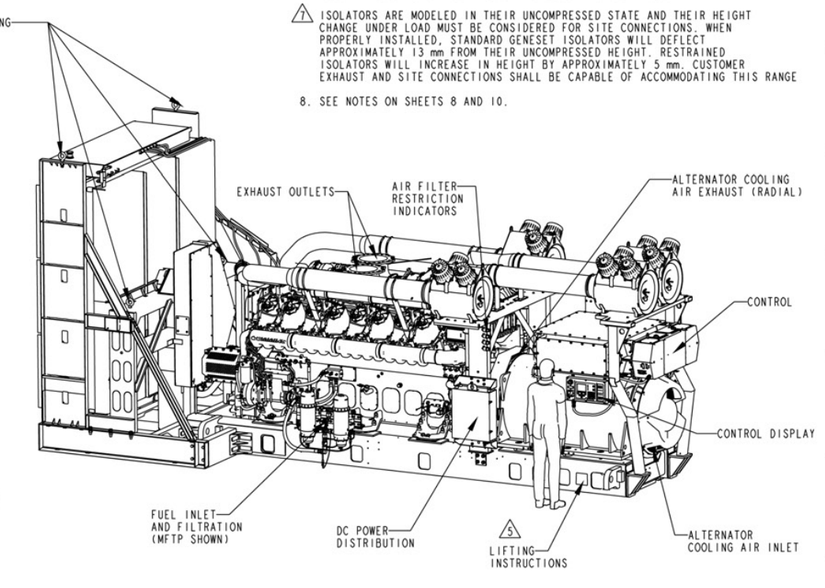
6. ALLOW 1 METER OF SPACE AROUND THE GENSET FOR SERVICE.

7. ISOLATORS ARE MODELED IN THEIR UNCOMPRESSED STATE AND THEIR HEIGHT CHANGE UNDER LOAD MUST BE CONSIDERED FOR SITE CONNECTIONS. WHEN PROPERLY INSTALLED, STANDARD GENESET ISOLATORS WILL DEFLECT APPROXIMATELY 13 mm FROM THEIR UNCOMPRESSED HEIGHT. RESTRAINED ISOLATORS WILL INCREASE IN HEIGHT BY APPROXIMATELY 5 mm. CUSTOMER EXHAUST AND SITE CONNECTIONS SHALL BE CAPABLE OF ACCOMMODATING THIS RANGE

8. SEE NOTES ON SHEETS 8 AND 10.



RIGHT SIDE



LEFT SIDE

STANDARD GENSET CONFIGURATION WITH S9HID-H42 ALTERNATOR AND E127-2 (ENHANCED HIGH AMBIENT) COOLING SYSTEM SHOWN.

LAST DATUM LETTER USED: .	LAST REFERENCE LETTER USED:
MODEL/PLATFORM: C325D6	THIS PART IS SIMILAR TO: A049P696
Cummins Inc.	
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: INCHES	SIZE: A1 SCALE:0.04
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009	THIRD ANGLE PROJECTION
	CAD SYSTEM PTC® Creo® Parametric

FIGURE 503. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 84 SQUARE RADIATOR (SHEET 1 OF 10)

Copyright © 2026 Cummins Inc.

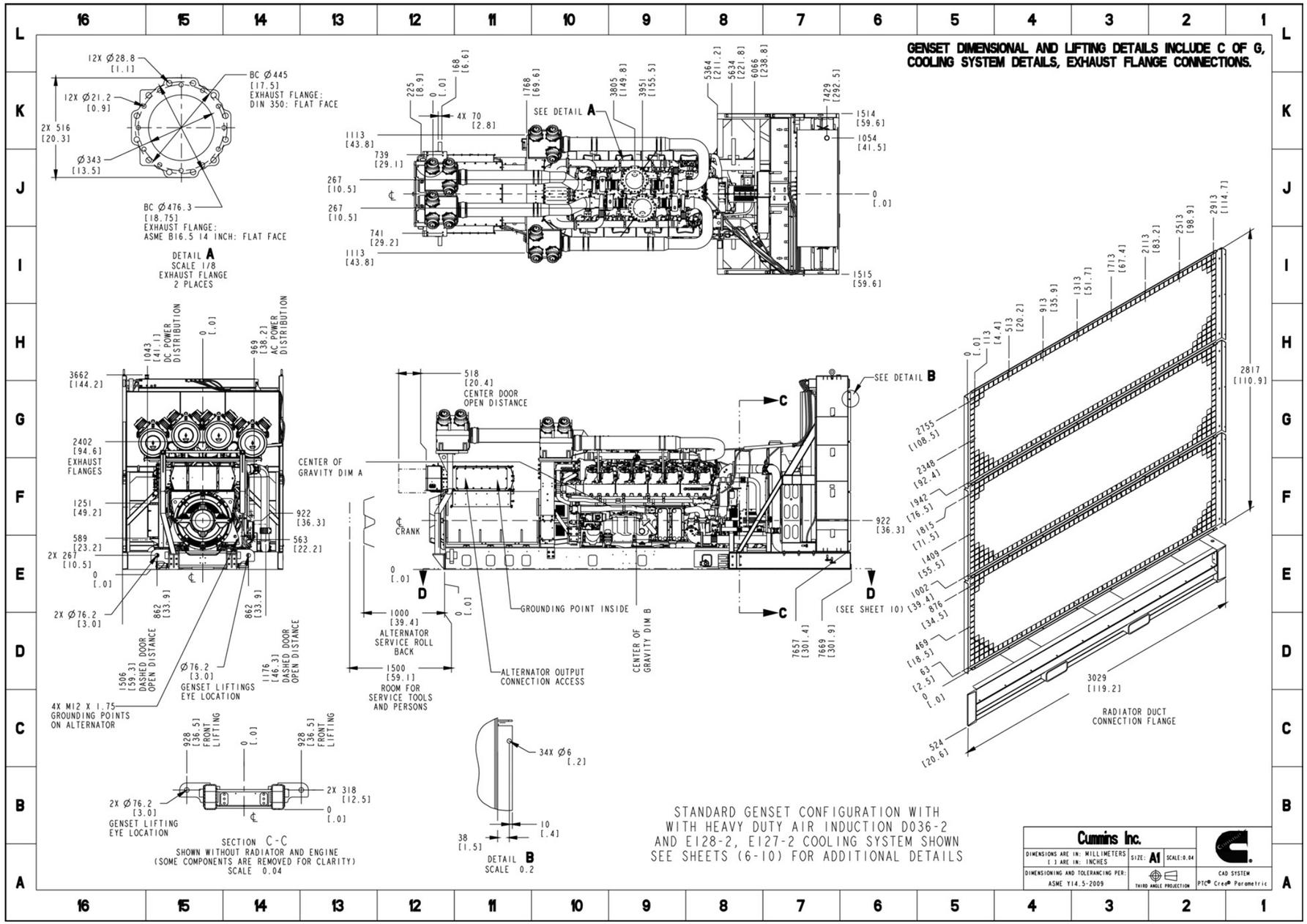


FIGURE 504. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 84 SQUARE RADIATOR (SHEET 2 OF 10)

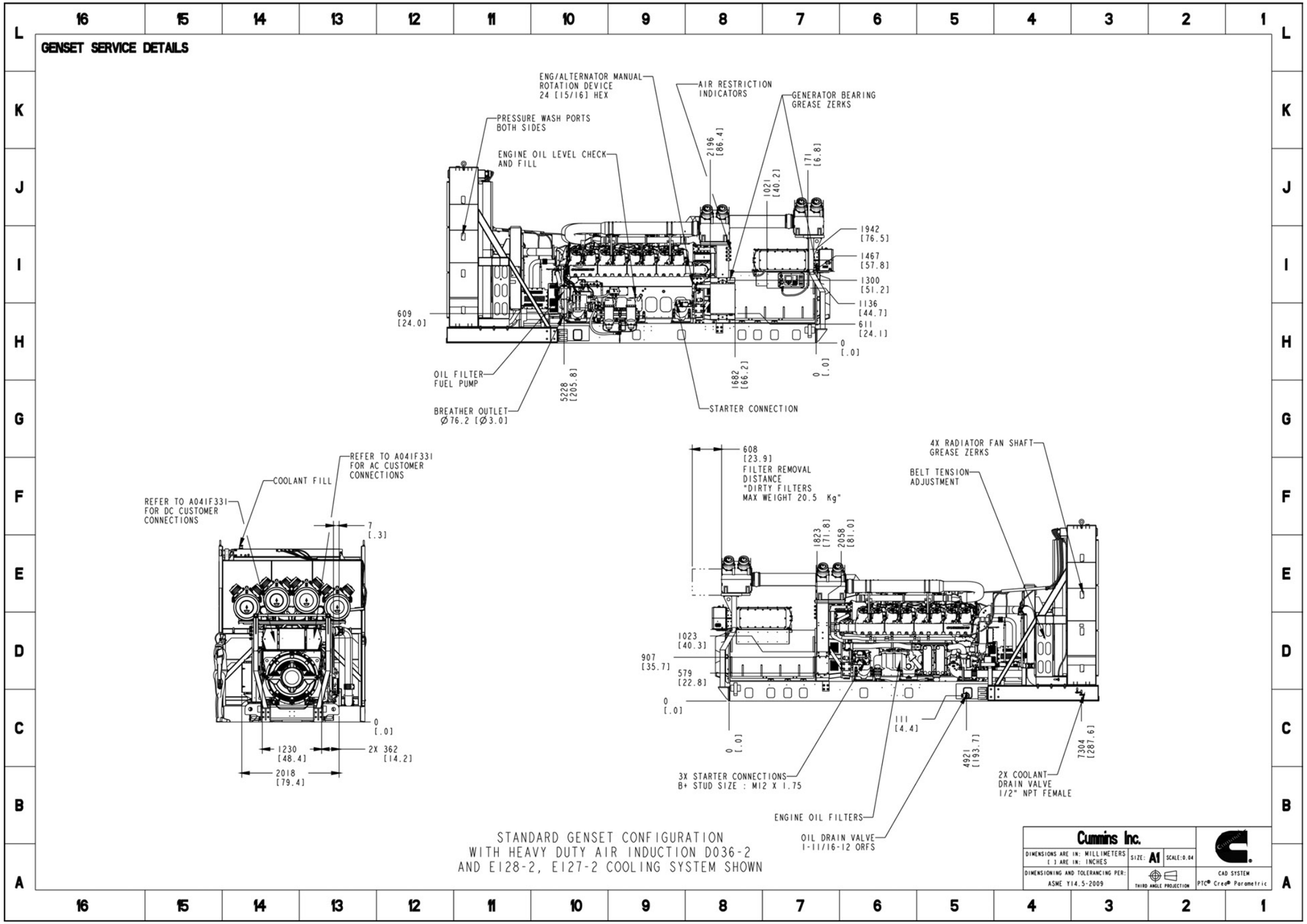


FIGURE 505. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 84 SQUARE RADIATOR (SHEET 3 OF 10)

Copyright © 2026 Cummins Inc.

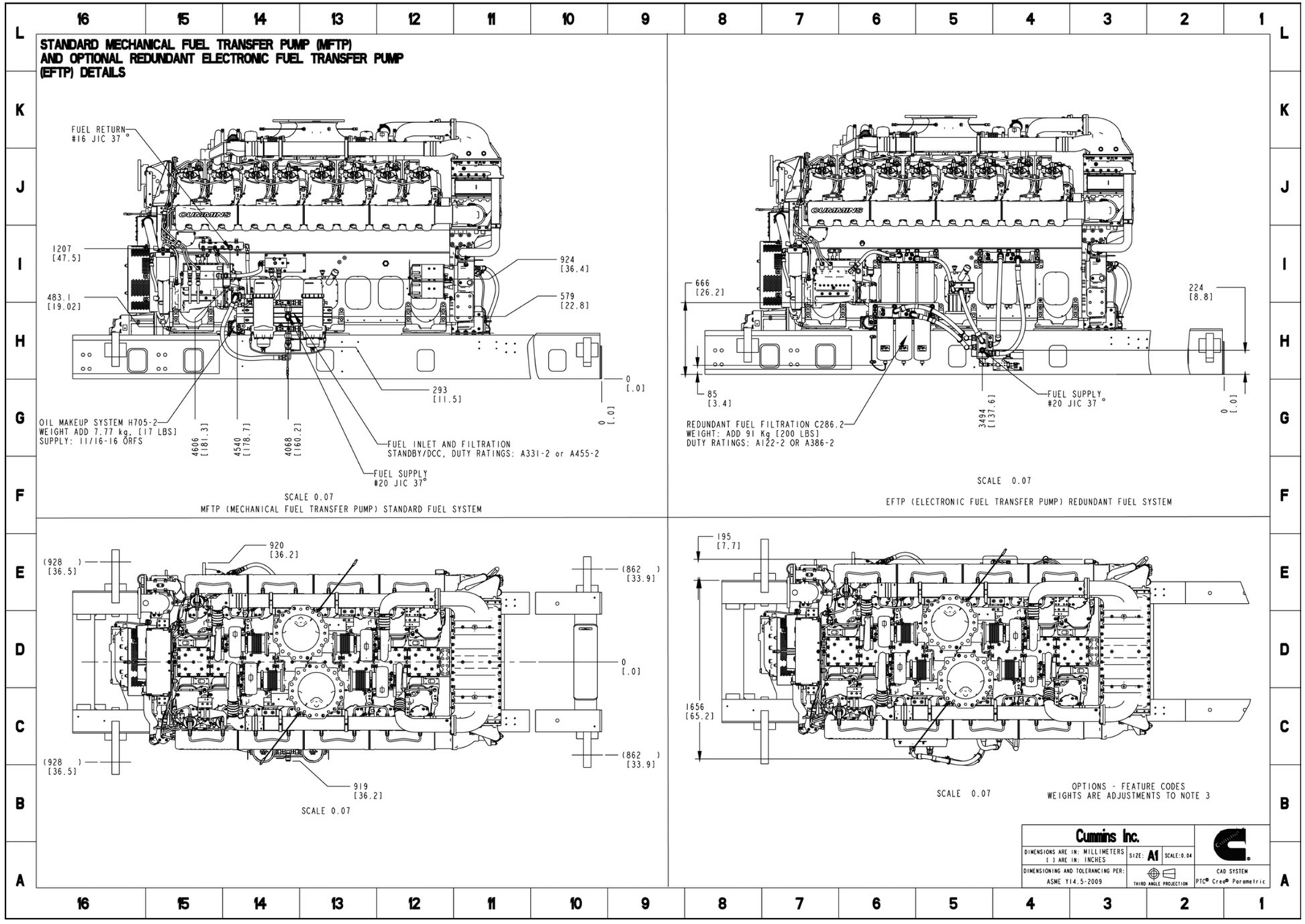


FIGURE 506. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 84 SQUARE RADIATOR (SHEET 4 OF 10)

Copyright © 2026 Cummins Inc.

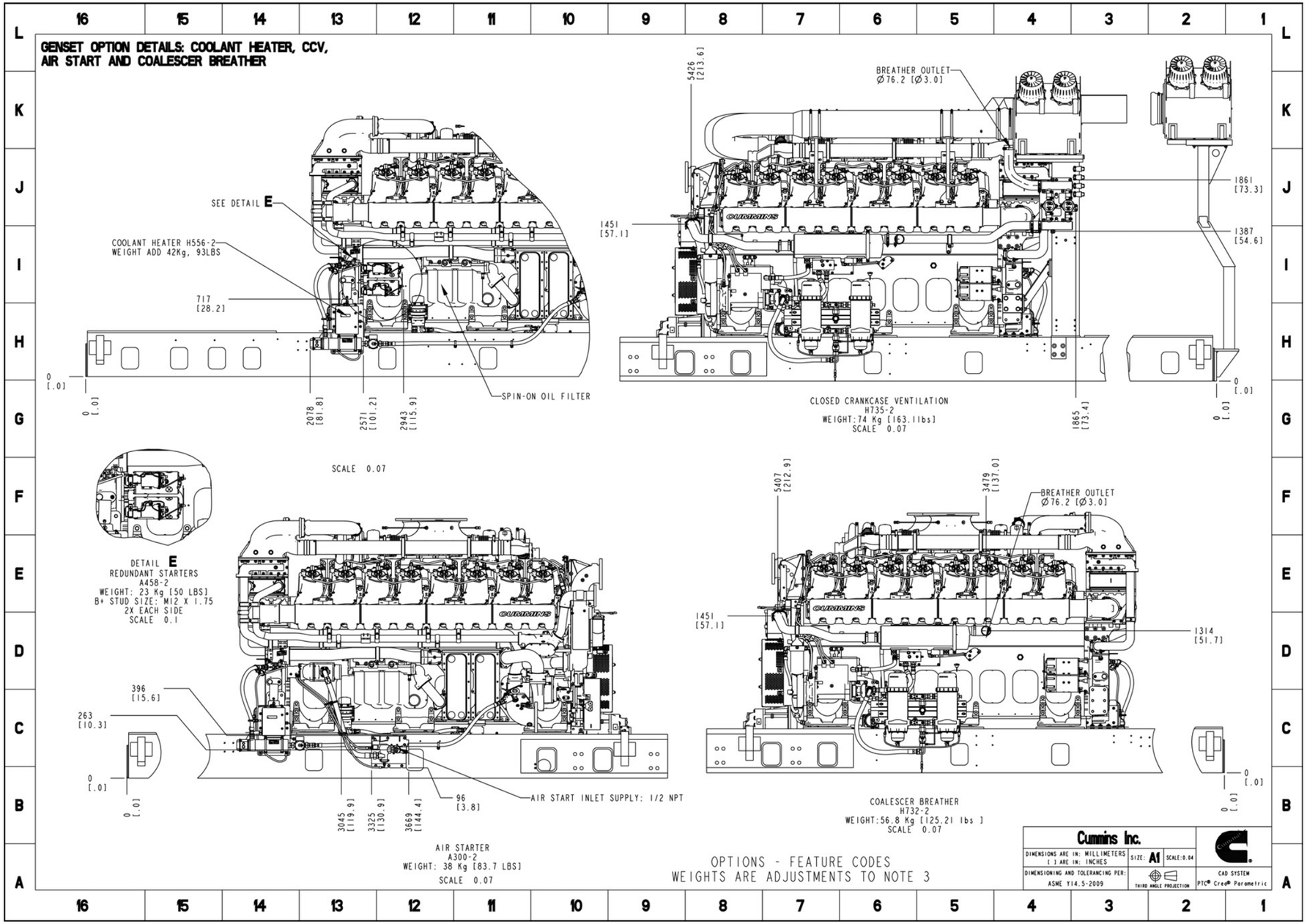


FIGURE 507. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 84 SQUARE RADIATOR (SHEET 5 OF 10)

Copyright © 2026 Cummins Inc.

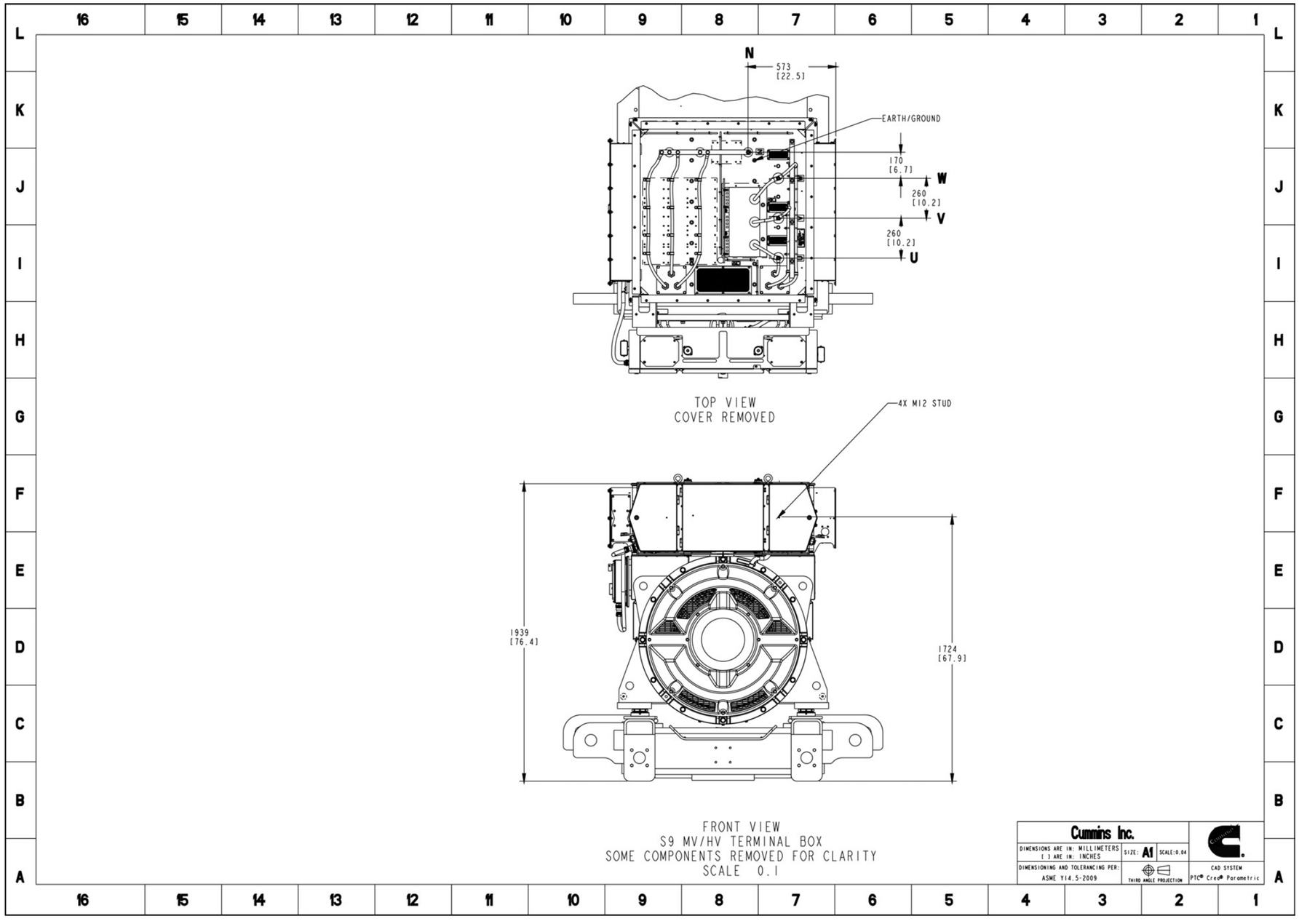
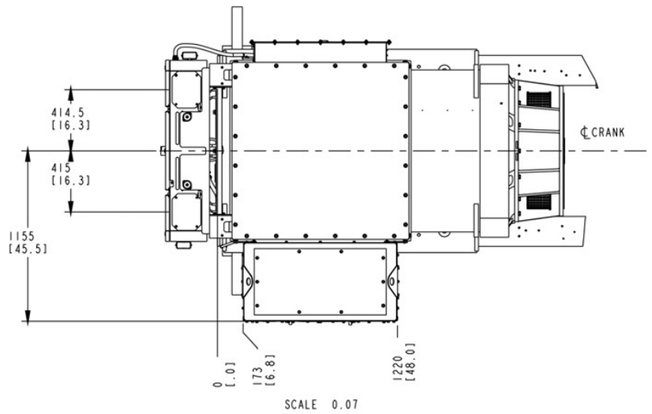


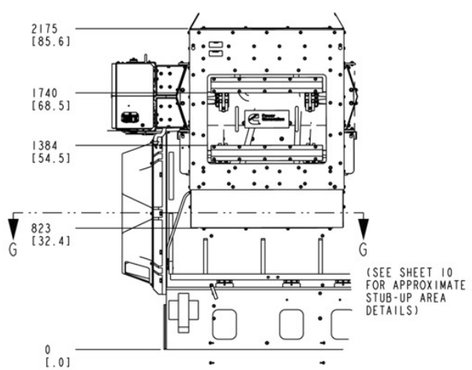
FIGURE 508. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 84 SQUARE RADIATOR (SHEET 6 OF 10)

Copyright © 2026 Cummins Inc.

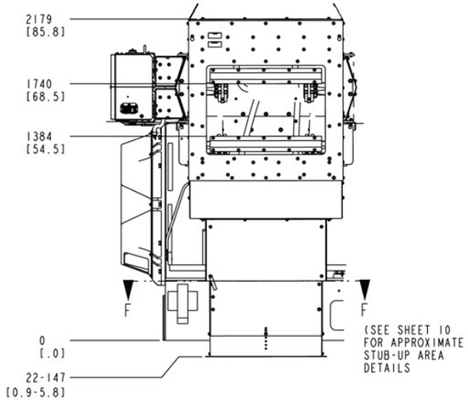
S9 MV/HV ALTERNATOR TERMINAL BOX DETAILS



SCALE 0.07



MV/HV TOP ENTRY
(SOME COMPONENTS REMOVED FOR CLARITY)
TERMINAL HOUSING
KS58-2
WEIGHT: 300 Kg [661 LBS]



MV/HV BOTTOM ENTRY
(SOME COMPONENTS REMOVED FOR CLARITY)
TERMINAL HOUSING
KS57-2
WEIGHT: 300 Kg [661 LBS]

Cummins Inc.	
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: INCHES	SIZE: A1 SCALE:0.04
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009	THIRD ANGLE PROJECTION
	CAD SYSTEM PTC® Creo® Parametric

FIGURE 509. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 84 SQUARE RADIATOR (SHEET 7 OF 10)

Copyright © 2026 Cummins Inc.

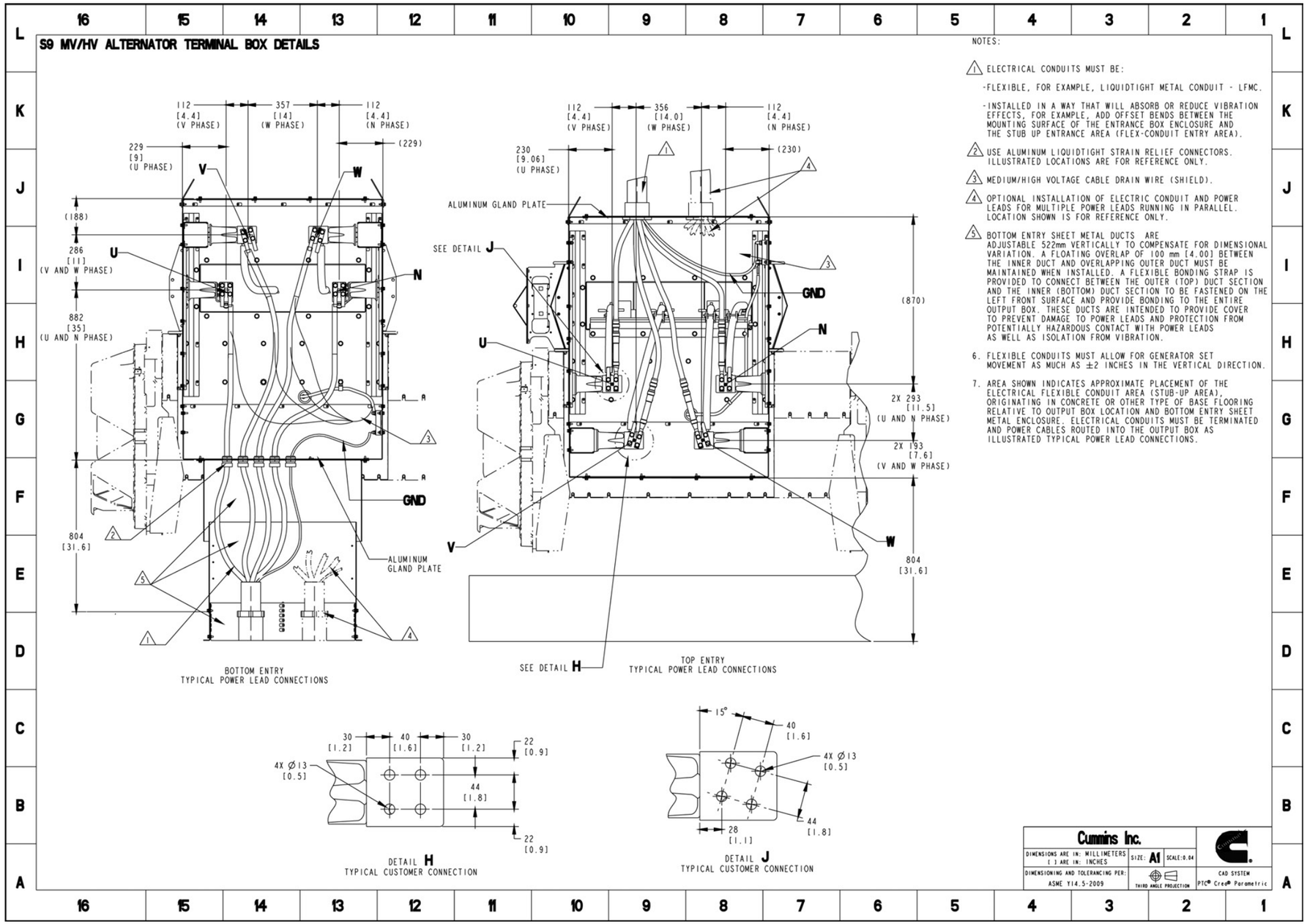


FIGURE 510. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 84 SQUARE RADIATOR (SHEET 8 OF 10)

Copyright © 2026 Cummins Inc.

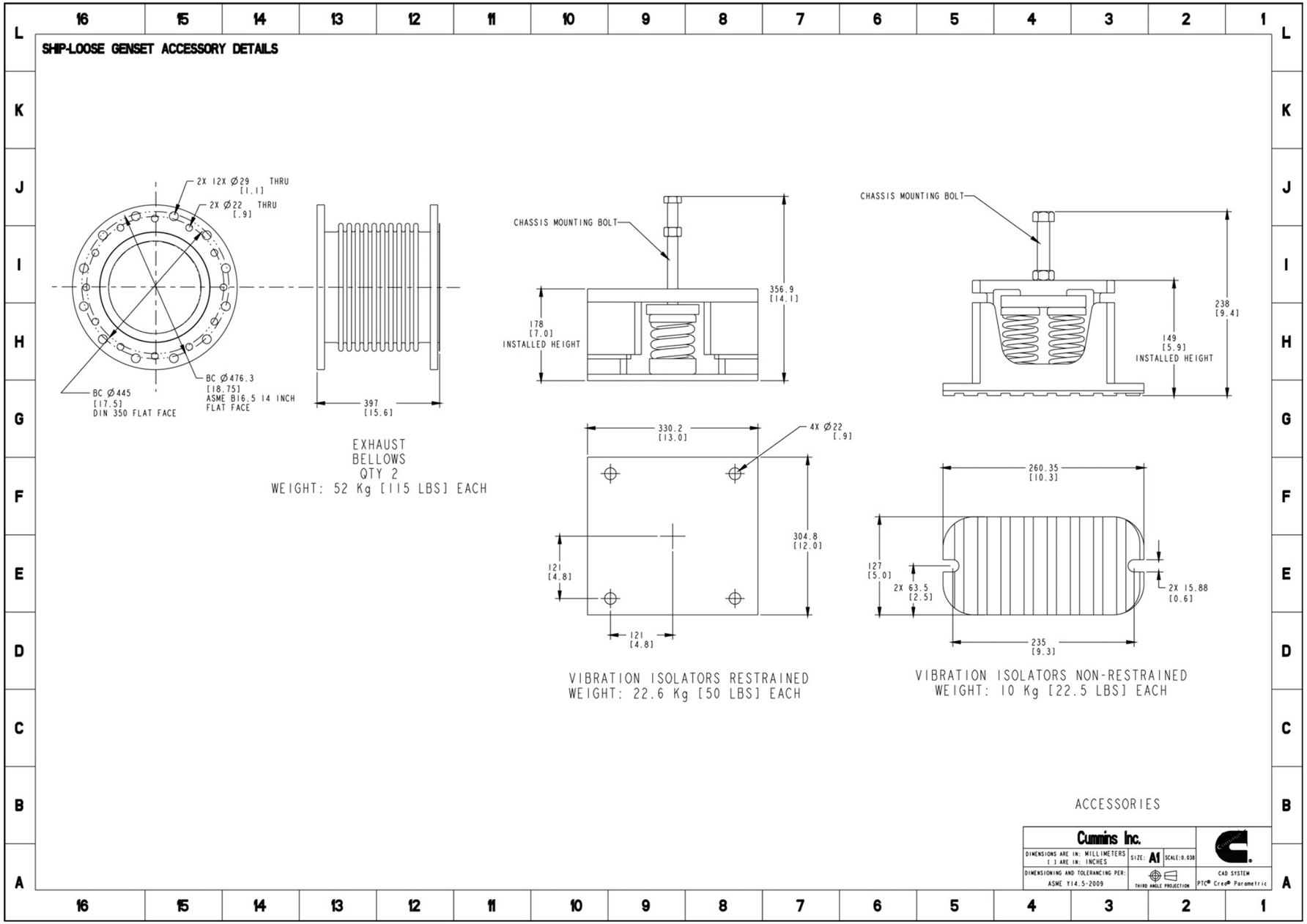


FIGURE 511. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 84 SQUARE RADIATOR (SHEET 9 OF 10)

Copyright © 2026 Cummins Inc.

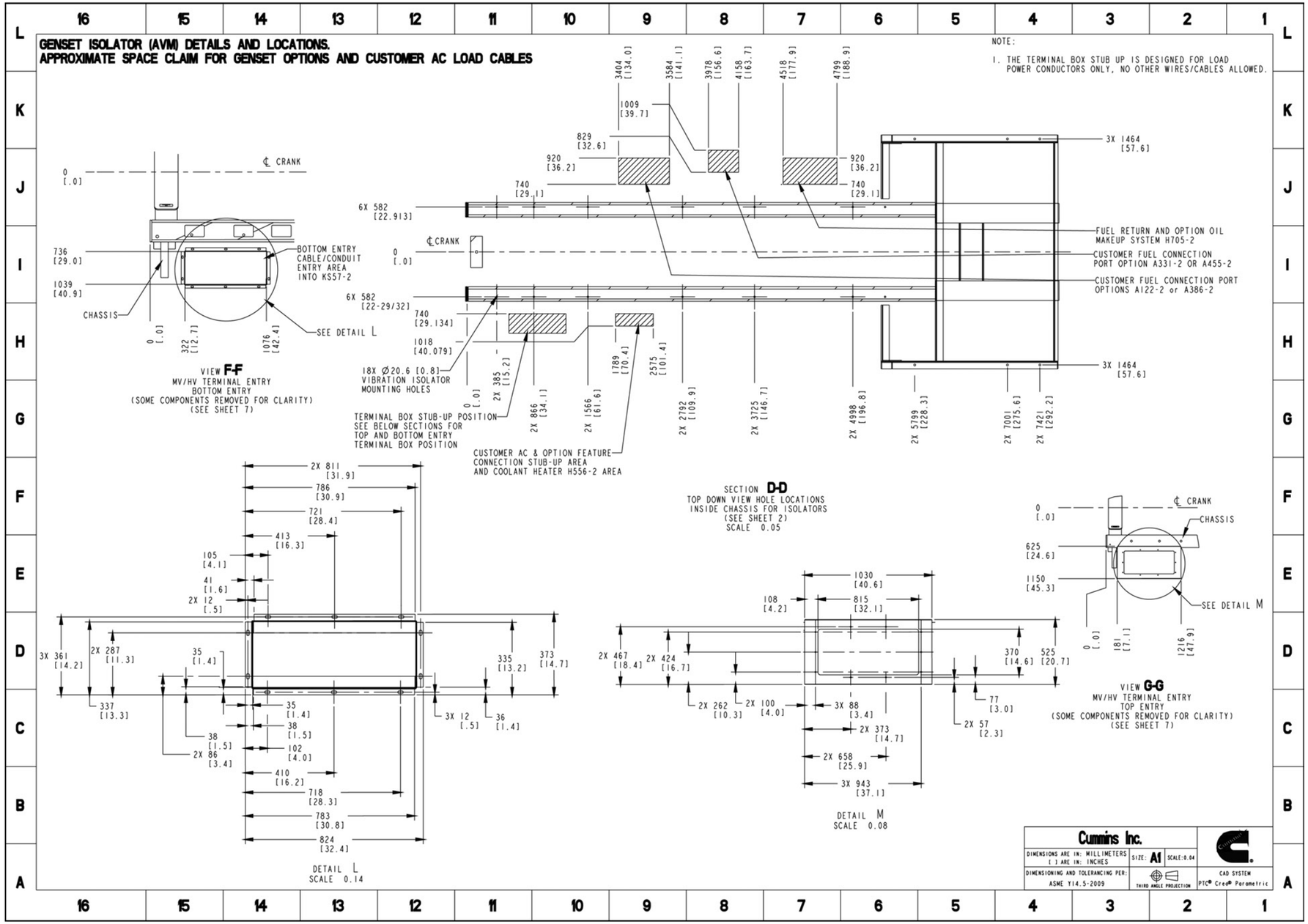


FIGURE 512. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 84 SQUARE RADIATOR (SHEET 10 OF 10)

Copyright © 2026 Cummins Inc.

A.7 Outline Drawing A068C508 – Heavy Duty Air Cleaner with 61 Square Foot Radiator

ALTERNATOR	WINDING	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH NO RADIATOR* Kg [LBS]	GENSET WEIGHT WITH RADIATOR* Kg [LBS]	C OF G WITH RADIATOR DIM A (SHEET 2)* mm [inch]	C OF G WITH RADIATOR DIM B (SHEET 2)* mm [inch]	C OF G WITHOUT RADIATOR DIM A* mm [inch]	C OF G WITHOUT RADIATOR DIM B* mm [inch]
S9MID-G42	851	7750 [17086]	24897 [54888]	30518 [67281]	1140 [44]	3646 [143]	1049 [41]	2853 [112]
S9HID-H42	991	8200 [18078]	25347 [55881]	30968 [68273]	1137 [44]	3600 [141]	1046 [41]	2811 [110]
S9HID-G42	991	7750 [17086]	24897 [54888]	30518 [67281]	1140 [44]	3646 [143]	1049 [41]	2853 [112]
S9HID-G42	961	7750 [17086]	24897 [54888]	30518 [67281]	1140 [44]	3646 [143]	1049 [41]	2853 [112]
S9HID-H42	961	8200 [18078]	25347 [55881]	30968 [68273]	1137 [44]	3600 [141]	1046 [41]	2811 [110]
S9HID-G42	983	7750 [17086]	24897 [54888]	30518 [67281]	1140 [44]	3646 [143]	1049 [41]	2853 [112]
S9HID-H42	983	8200 [18078]	25347 [55881]	30968 [68273]	1137 [44]	3600 [141]	1046 [41]	2811 [110]
S9MID-H42	851	8200 [18078]	25347 [55881]	30968 [68273]	1137 [44]	3600 [141]	1046 [41]	2811 [110]

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS WITH IMPERIAL INCH CONVERSIONS IN "[ ]".

   1.1 IN EVENT OF A DISCREPANCY BETWEEN METRIC AND IMPERIAL DIMENSIONS, THE METRIC DIMENSIONS CONTROL.

2. ALL DIMENSIONS ARE REFERENCE, UNLESS SPECIFICALLY TOLERANCED.

3. WEIGHT: REFER TO TABLE FOR STANDARD GENSET WITH E128-2 COOLING SYSTEM.

   *3.1 INCLUDES WEIGHT OF 606 LITERS [160 GALLONS] SUPPLIED ENGINE OIL.(530 Kg/1168 LBS)

   **3.2 INCLUDES DRY WEIGHT OF RADIATOR 4657 Kg [10267 LBS] (SHIPS LOOSE)

   **3.3 INCLUDES WEIGHT FOR 1238 LITERS [327 GALLONS] OF NON-SUPPLIED COOLANT.(1336 Kg/2947 LBS)

4. LARGEST NOMINAL DIMENSIONS:
   4.1 LENGTH 8063 [317.4]
   4.2 WIDTH 2610 [102.7] RADIATOR
   4.3 HEIGHT 3366 [132.5] TOP OF RADIATOR CAP
   4.4 DOES NOT INCLUDE THE HEIGHT OF THE VIBRATION ISOLATOR

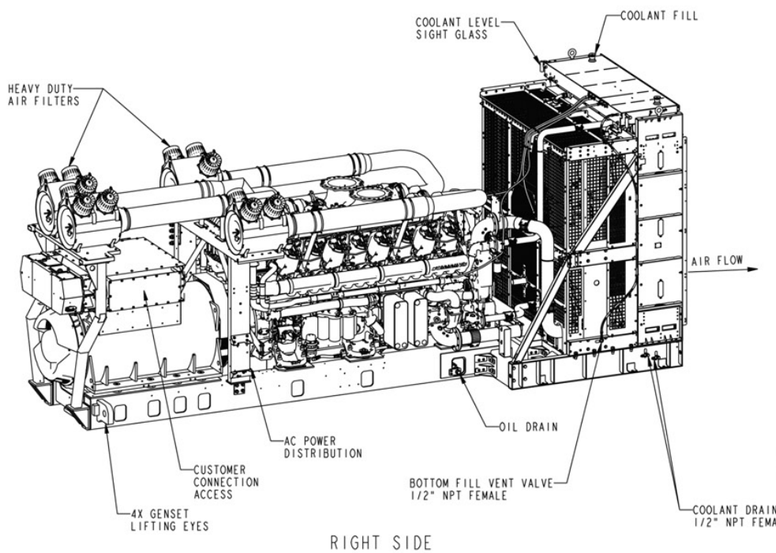
5 LIFTING INSTRUCTIONS: REFER TO GENSET INSTALLATION MANUAL AND LIFTING LABEL

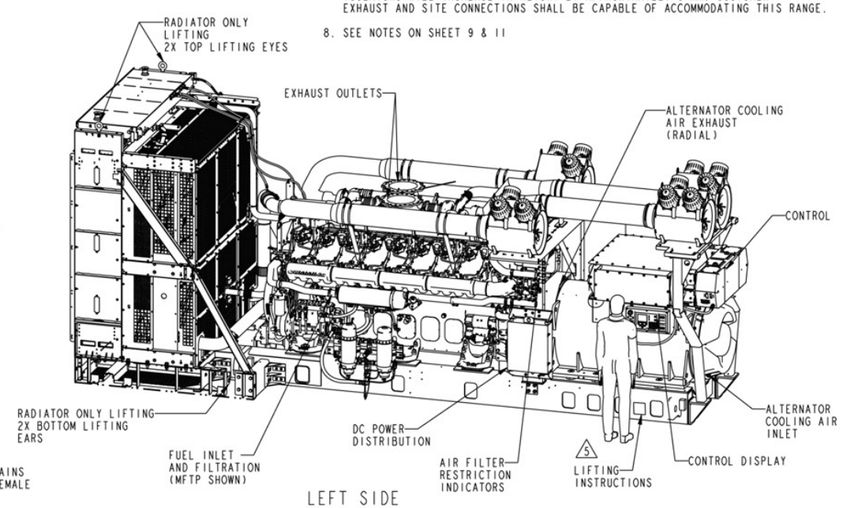
   5.1 GENSET SHALL NOT BE LIFTED USING THE LIFTING EYES WHEN ATTACHED TO THE RADIATOR. RADIATOR AND GENSET SHALL ALWAYS BE LIFTED SEPARATELY PER INSTALLATION MANUAL AND LIFTING DIAGRAMS.

6. ALLOW 1 METER OF SPACE AROUND THE GENSET FOR SERVICE.

7 ISOLATORS ARE MODELED IN THEIR UNCOMPRESSED STATE AND THEIR HEIGHT CHANGE UNDER LOAD MUST BE CONSIDERED FOR SITE CONNECTIONS. WHEN PROPERLY INSTALLED, STANDARD GENESET ISOLATORS WILL DEFLECT APPROXIMATELY 13 mm FROM THEIR UNCOMPRESSED HEIGHT. RESTRAINED ISOLATORS WILL INCREASE IN HEIGHT BY APPROXIMATELY 5 mm. CUSTOMER EXHAUST AND SITE CONNECTIONS SHALL BE CAPABLE OF ACCOMMODATING THIS RANGE.

8. SEE NOTES ON SHEET 9 & 11





STANDARD GENSET CONFIGURATION
WITH S9HID-H42 ALTERNATOR AND HEAVY DUTY AIR
INDUCTION D036-2 AND E165-2 COOLING SYSTEM SHOWN

LAST DATUM LETTER USED: .	LAST REFERENCE LETTER USED: W
MODEL/PLATFORM: C325D6	THIS PART IS SIMILAR TO: A065K152
Cummins Inc.	
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: INCHES	SIZE: A1 SCALE:0.04
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009	THIRD ANGLE PROJECTION
	CAD SYSTEM PTC® Creo® Parametric

FIGURE 513. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 1 OF 11)

Copyright © 2026 Cummins Inc.

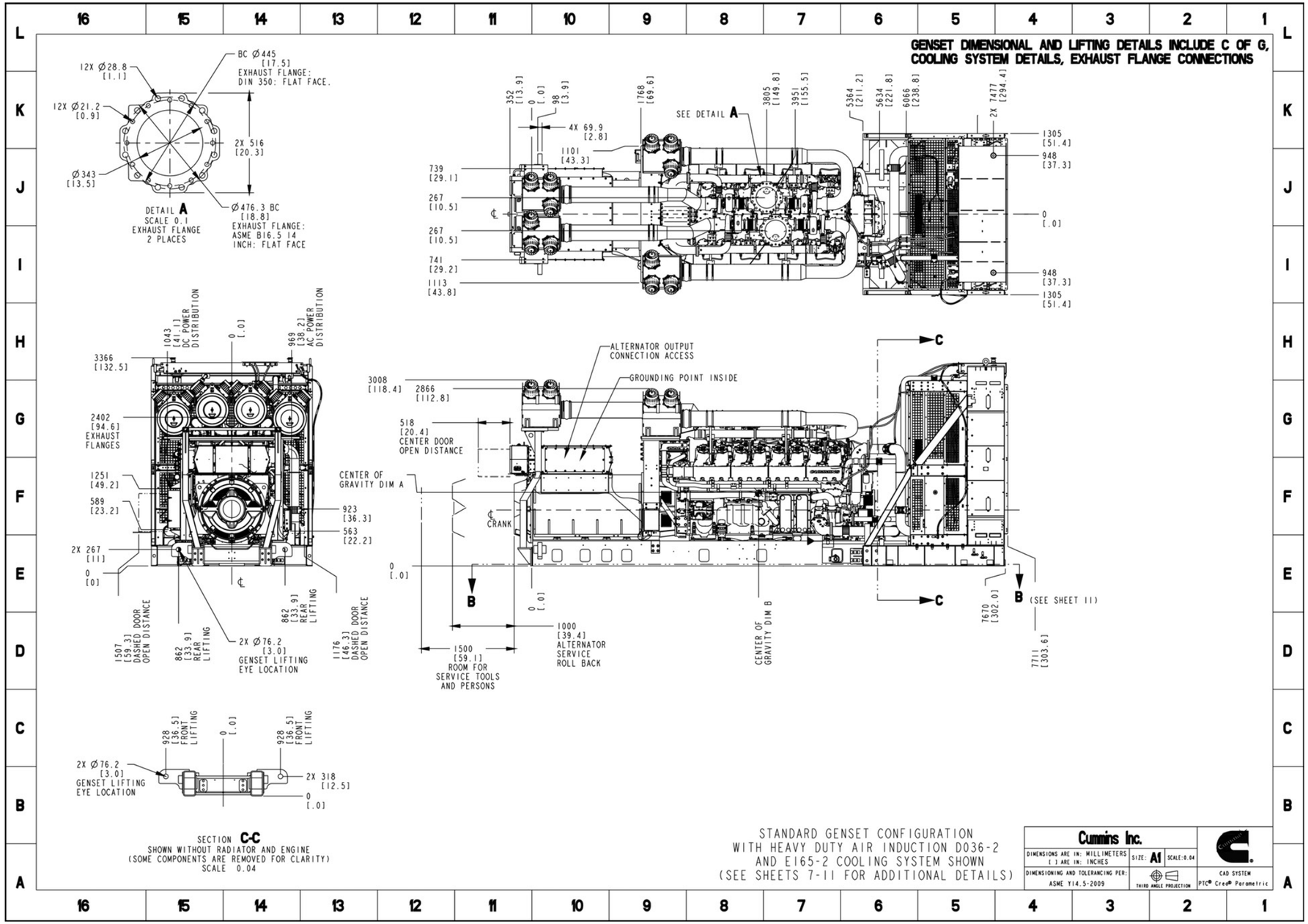


FIGURE 514. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 2 OF 11)

Copyright © 2026 Cummins Inc.

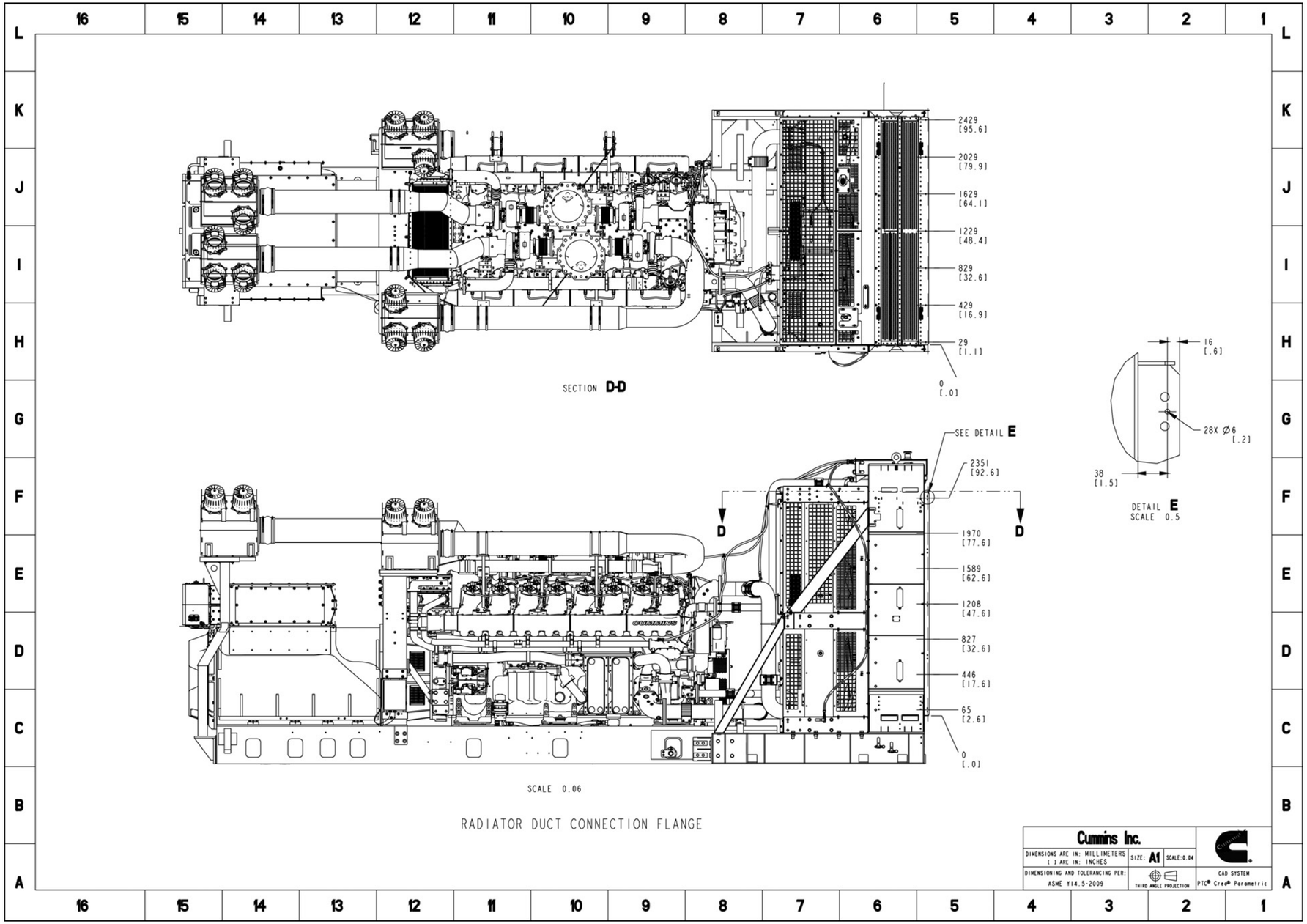


FIGURE 515. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 3 OF 11)

Copyright © 2026 Cummins Inc.

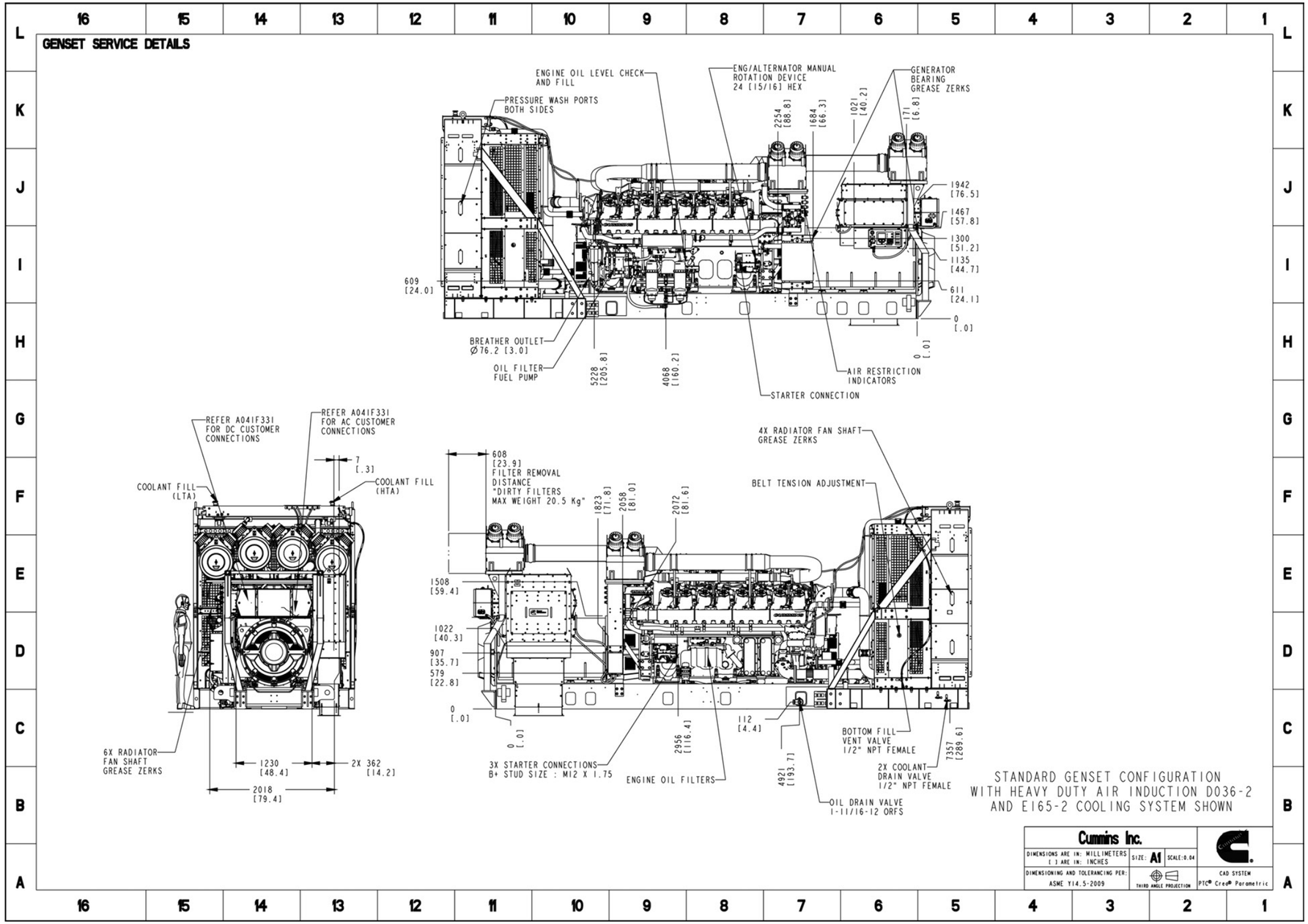


FIGURE 516. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 4 OF 11)

Copyright © 2026 Cummins Inc.

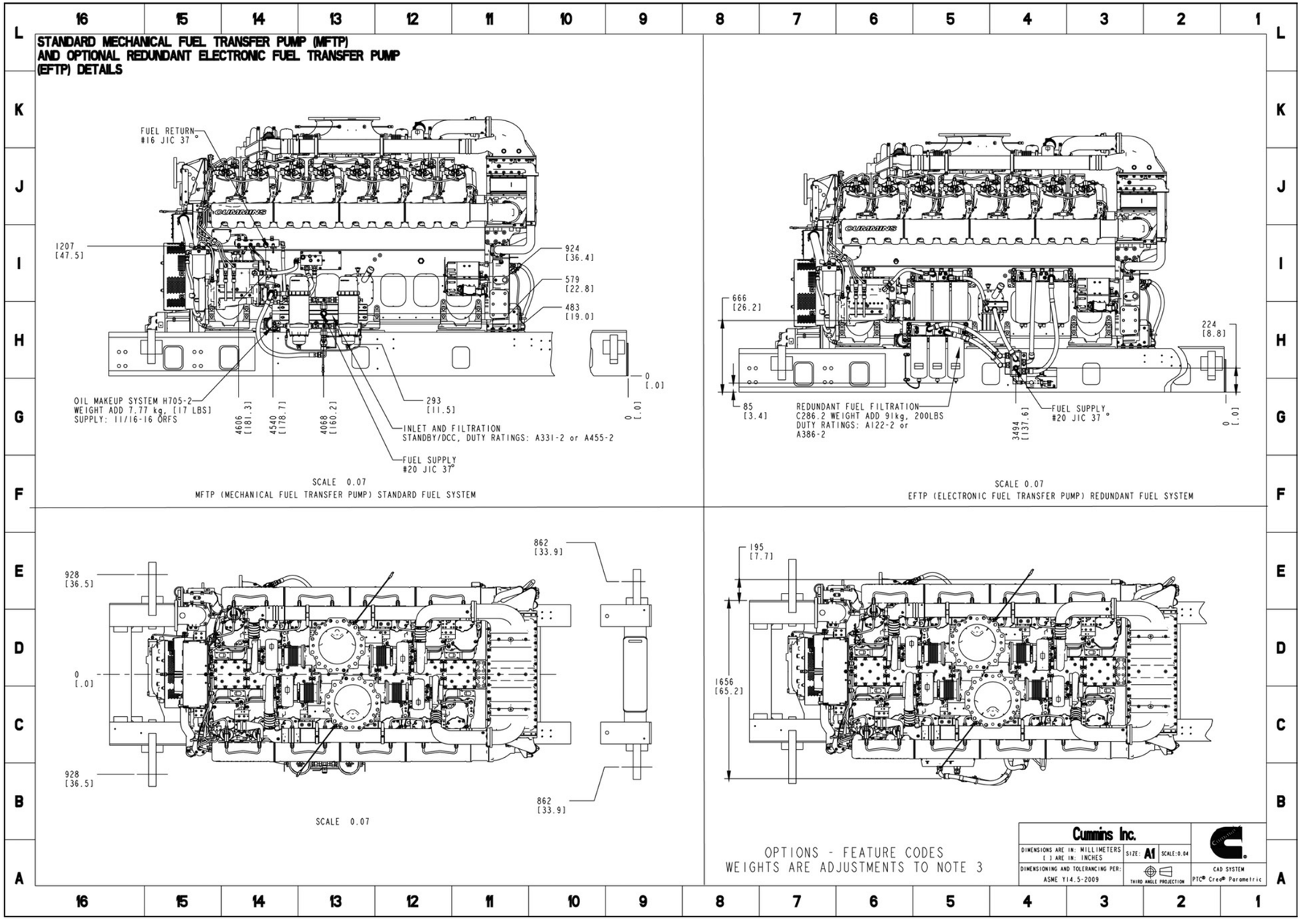


FIGURE 517. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 5 OF 11)

Copyright © 2026 Cummins Inc.

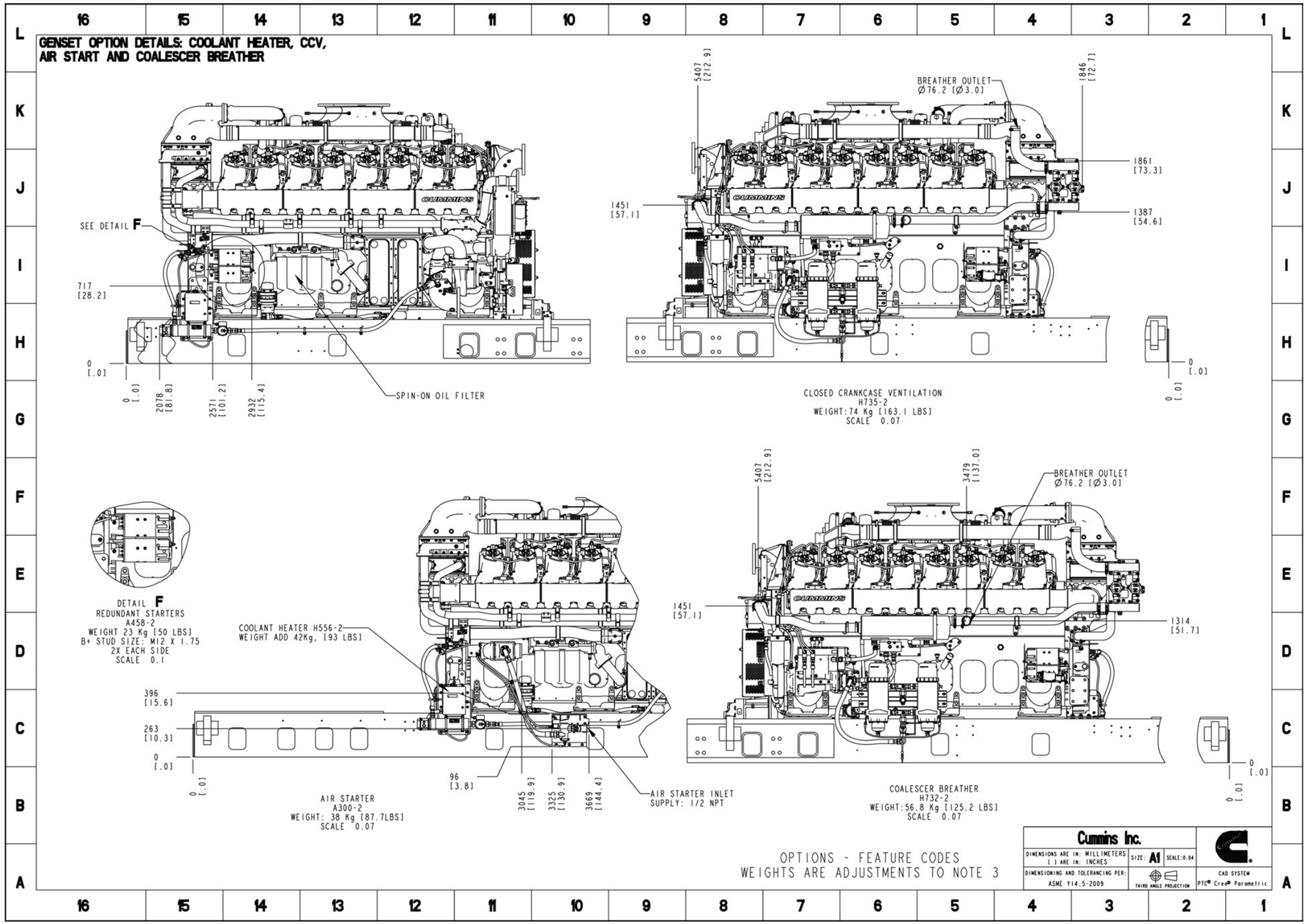


FIGURE 518. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 6 OF 11)

Copyright © 2026 Cummins Inc.

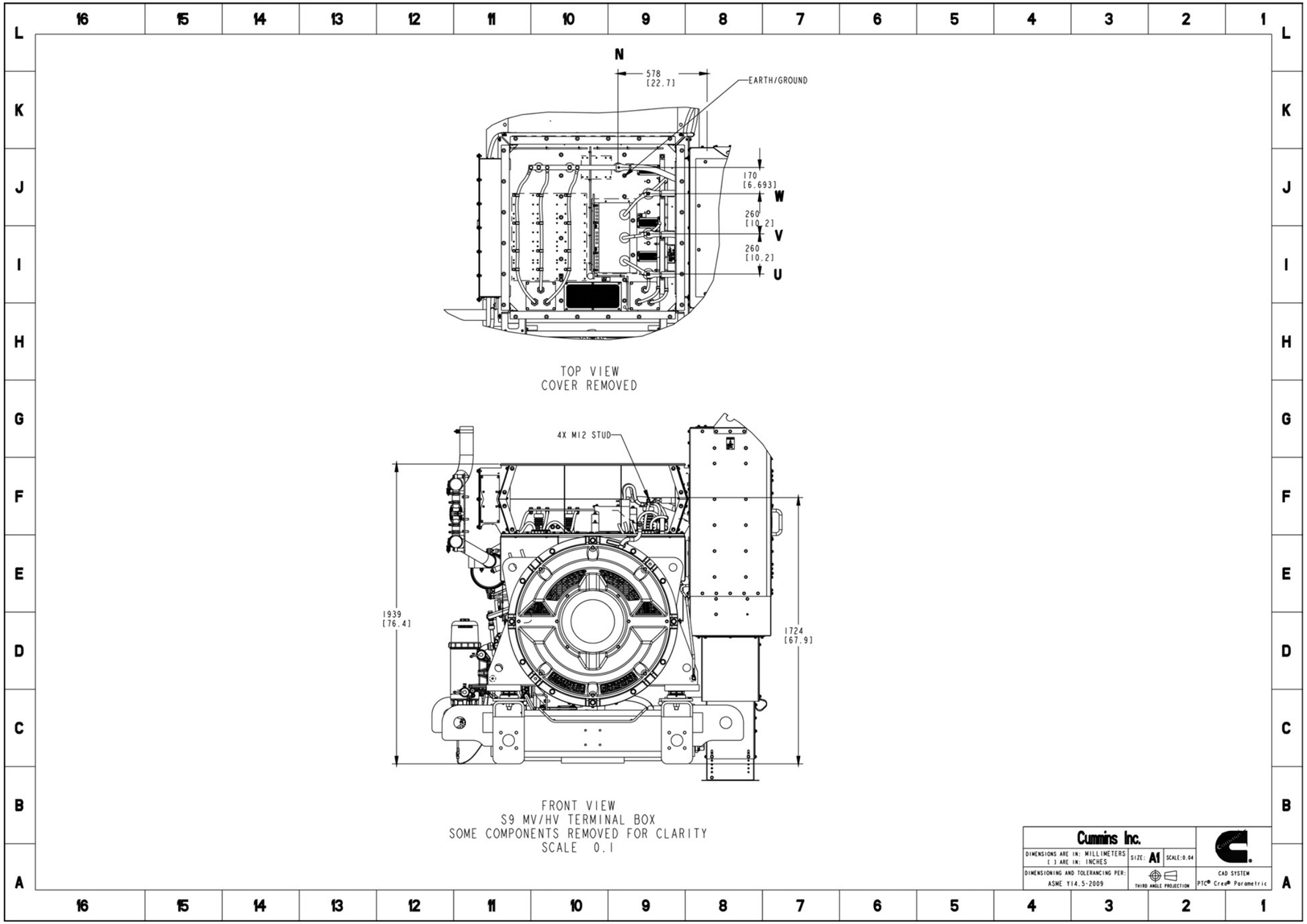


FIGURE 519. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 7 OF 11)

Copyright © 2026 Cummins Inc.

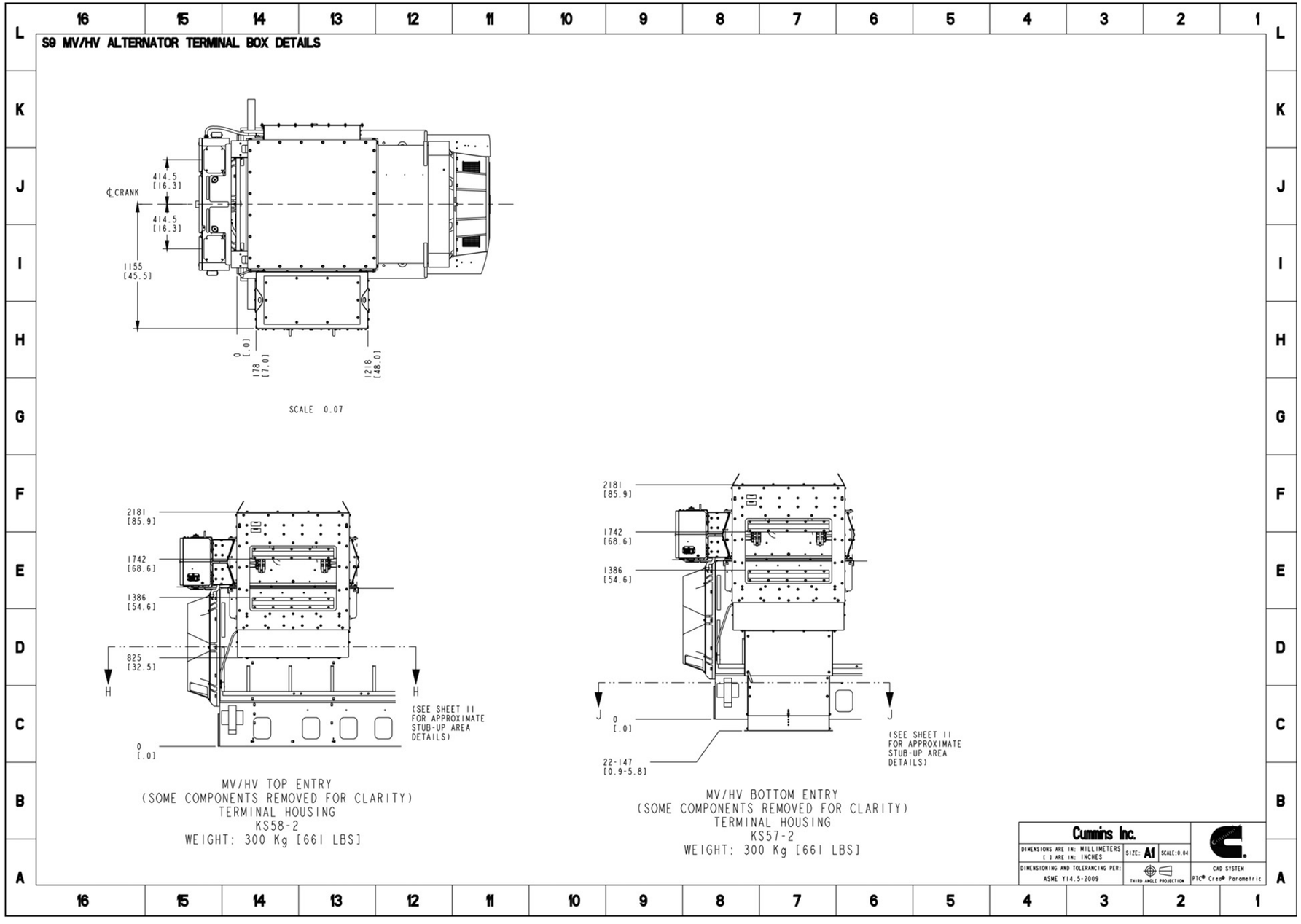


FIGURE 520. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 8 OF 11)

Copyright © 2026 Cummins Inc.

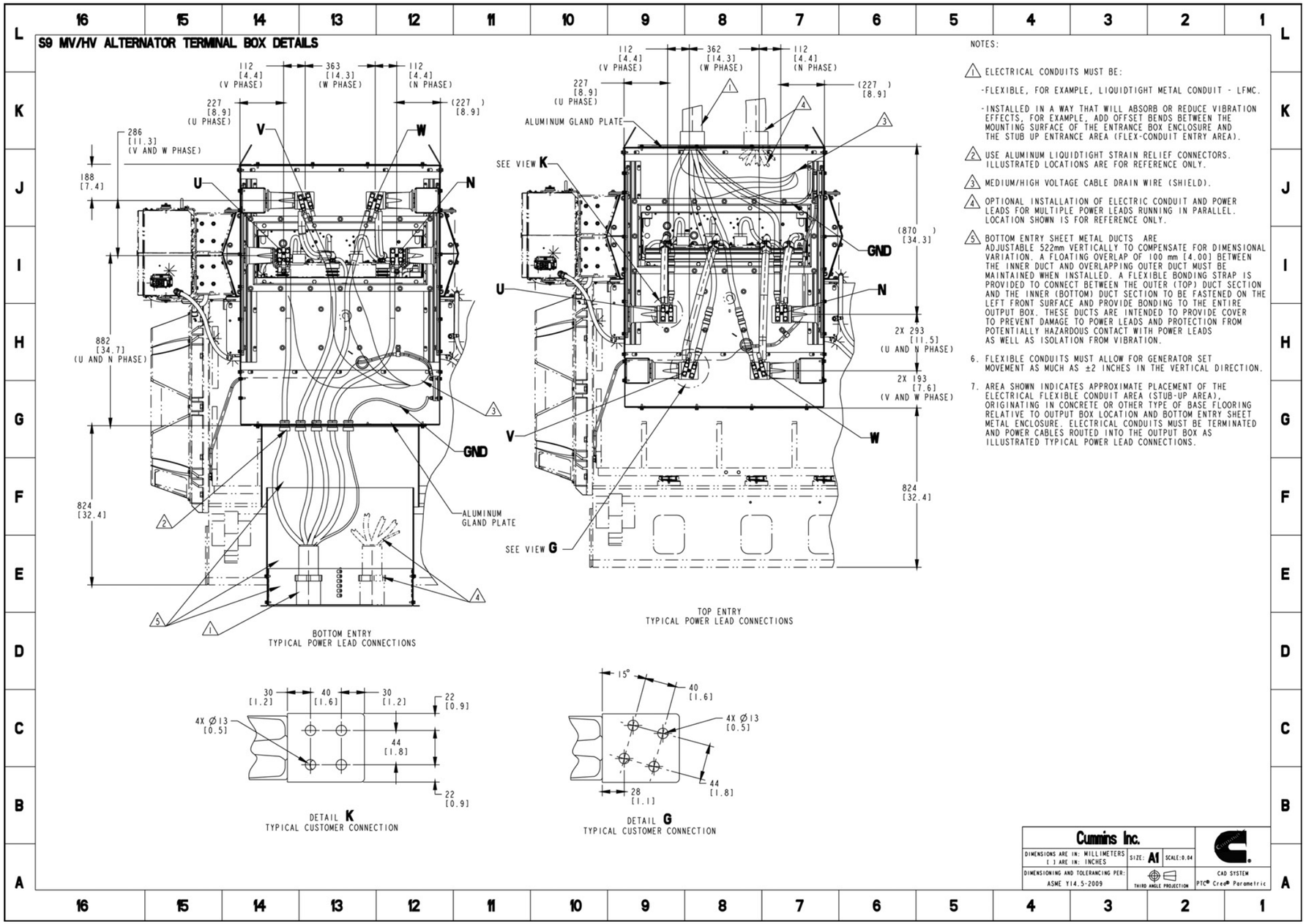


FIGURE 521. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 9 OF 11)

Copyright © 2026 Cummins Inc.

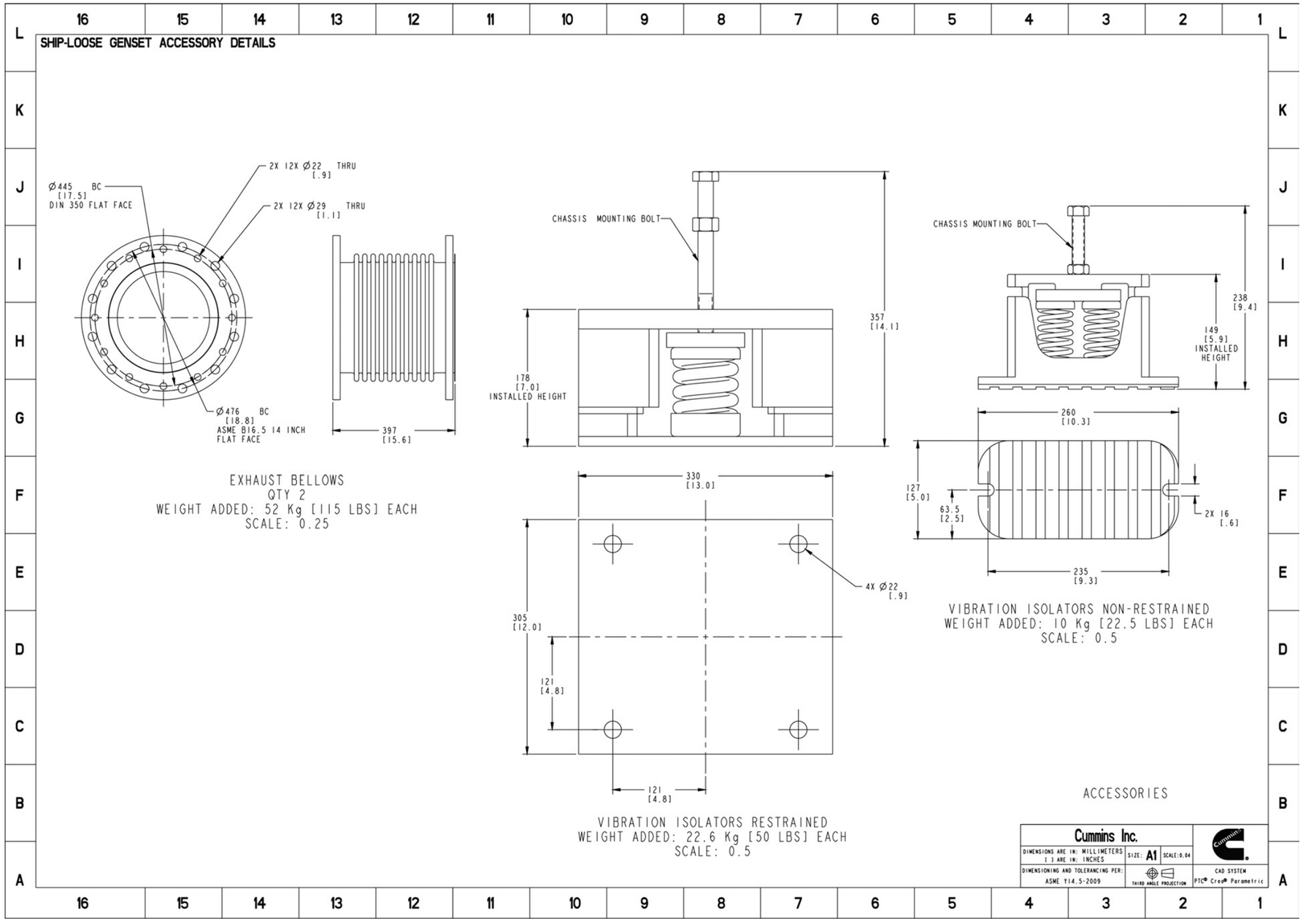


FIGURE 522. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 10 OF 11)

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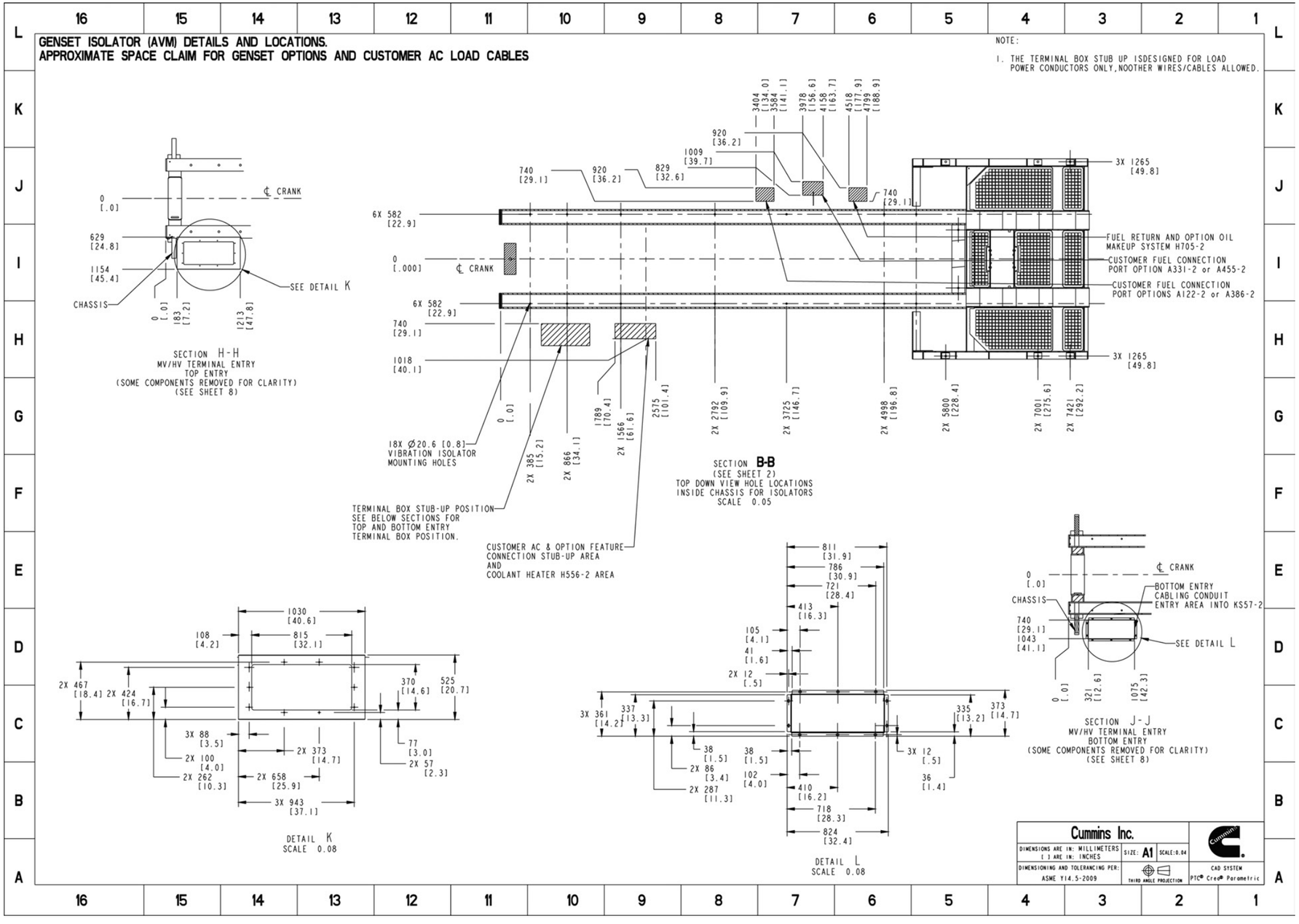


FIGURE 523. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITH 61 SQUARE FOOT RADIATOR (SHEET 11 OF 11)

 Copyright © 2026 Cummins Inc.

A.8 Outline Drawing A067S625 – Heavy Duty Air Cleaner Without Radiator

ALTERNATOR	WINDING	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT* Kg [LBS]	C OF G DIM A* (SHEET 2) mm [inch]	C OF G DIM B* (SHEET 2) mm [inch]
S9MID-G42	851	7750 [17086]	24897 [54888]	1049 [41]	2853 [112]
S9HID-H42	991	8200 [18078]	25347 [55881]	1046 [41]	2811 [110]
S9HID-G42	991	7750 [17086]	24897 [54888]	1049 [41]	2853 [112]
S9HID-G42	961	7750 [17086]	24897 [54888]	1049 [41]	2853 [112]
S9HID-H42	961	8200 [18078]	25347 [55881]	1046 [41]	2811 [110]
S9HID-G42	983	7750 [17086]	24897 [54888]	1049 [41]	2853 [112]
S9HID-H42	983	8200 [18078]	25347 [55881]	1046 [41]	2811 [110]
S9MID-H42	851	8200 [18078]	25347 [55881]	1046 [41]	2811 [110]

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS WITH IMPERIAL INCH CONVERSIONS IN "[ ]".

   1.1 IN EVENT OF A DISCREPANCY BETWEEN METRIC AND IMPERIAL DIMENSIONS, THE METRIC DIMENSIONS CONTROL.

2. ALL DIMENSIONS ARE REFERENCE, UNLESS SPECIFICALLY TOLERANCED..

3. WEIGHT: REFER TO TABLE FOR STANDARD GENSET WITH D036-2.

   *3.1 INCLUDES WEIGHT OF 606 LITERS [160 GALLONS] SUPPLIED ENGINE OIL.(530 KG/1168 LBS)

   **3.2 DOES NOT INCLUDE NON-SUPPLIED 378.5 LITERS [100 GALLONS] OF ENGINE COOLANT CAPACITY.

4. LARGEST NOMINAL DIMENSIONS:
   4.1 LENGTH: 6415 [252.6]
   4.2 WIDTH: 2594 [102.1]
   4.3 HEIGHT: 3009 [118.5]
   4.4 DOES NOT INCLUDE THE HEIGHT OF VIBRATION ISOLATOR

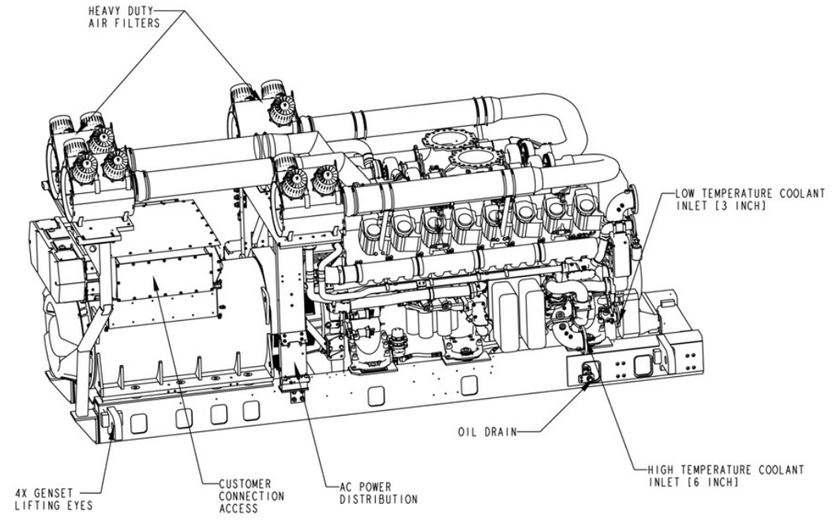
5. LIFTING INSTRUCTIONS: REFER TO GENSET INSTALLATION MANUAL AND LIFTING LABEL.

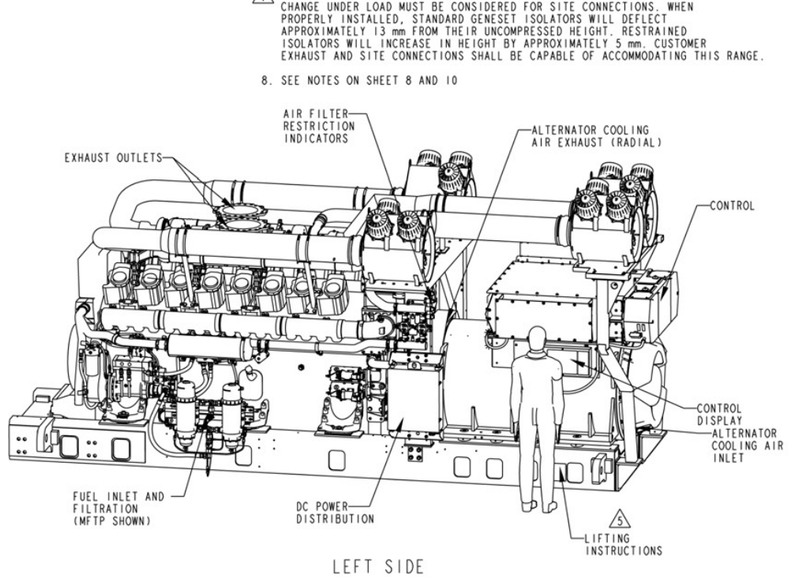
   NOTE: GENSET SHALL NOT BE LIFTED USING THE LIFTING EYES WHEN ATTACHED TO THE RADIATOR. RADIATOR AND GENSET SHALL ALWAYS BE LIFTED SEPARATELY PER INSTALLATION MANUAL AND LIFTING DIAGRAMS.

6. ALLOW 1 METER OF SPACE AROUND THE GENSET FOR SERVICE.

7. ISOLATORS ARE MODELED IN THEIR UNCOMPRESSED STATE AND THEIR HEIGHT CHANGE UNDER LOAD MUST BE CONSIDERED FOR SITE CONNECTIONS. WHEN PROPERLY INSTALLED, STANDARD GENESET ISOLATORS WILL DEFLECT APPROXIMATELY 13 mm FROM THEIR UNCOMPRESSED HEIGHT. RESTRAINED ISOLATORS WILL INCREASE IN HEIGHT BY APPROXIMATELY 5 mm. CUSTOMER EXHAUST AND SITE CONNECTIONS SHALL BE CAPABLE OF ACCOMMODATING THIS RANGE.

8. SEE NOTES ON SHEET 8 AND 10





STANDARD GENSET WITH S9HID-H42 ALTERNATOR AND HEAVY DUTY AIR INDUCTION CONFIGURATION D036-2 SHOWN

LAST DATUM LETTER USED: ,	LAST REFERENCE LETTER USED:
MODEL/PLATFORM: C325D6	THIS PART IS SIMILAR TO: A049P698
Cummins Inc.	
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: INCHES	SIZE: A1 SCALE:0.04
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009	THIRD ANGLE PROJECTION
	CAD SYSTEM PTC® Creo® Parametric

FIGURE 524. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 1 OF 10)

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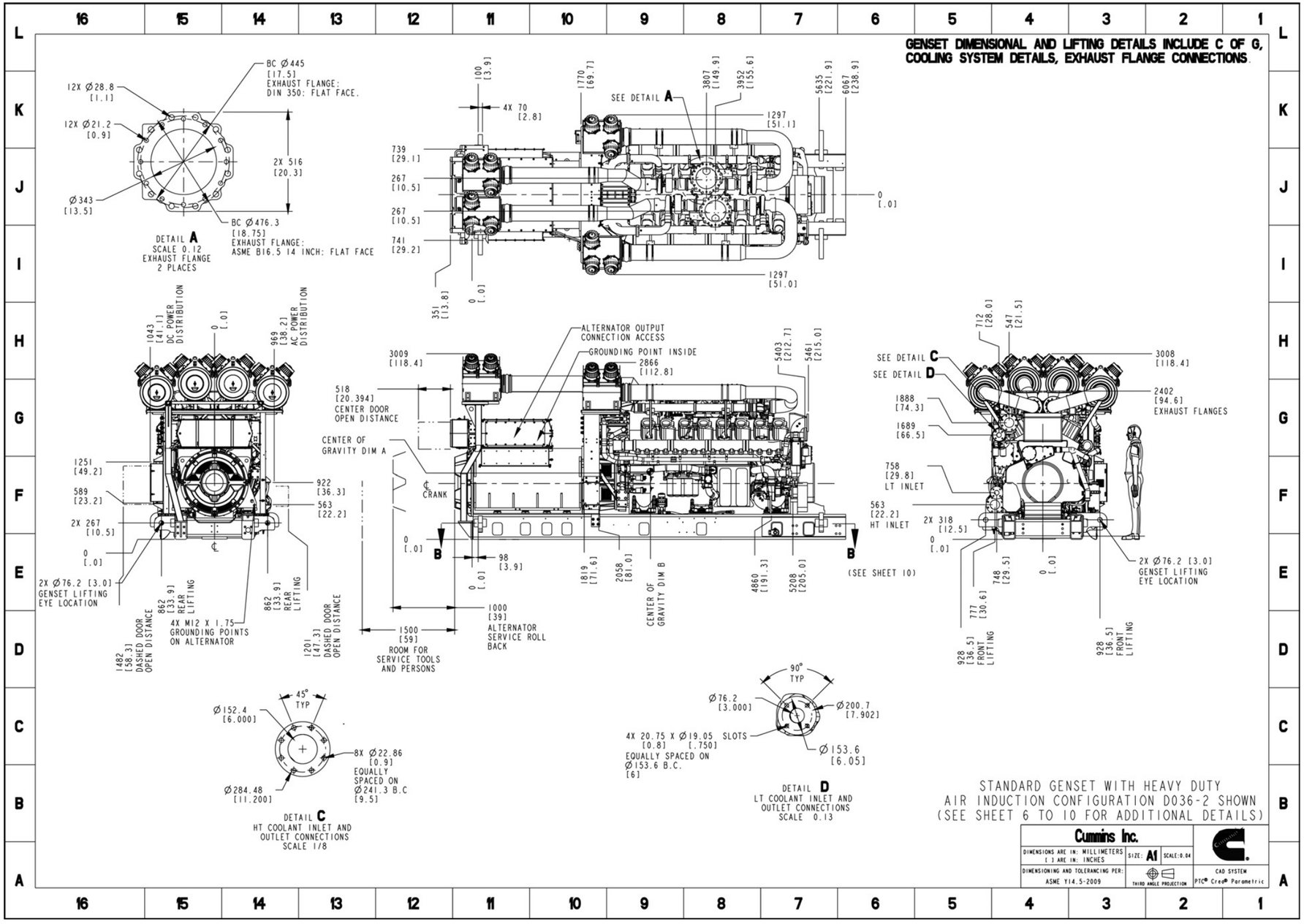


FIGURE 525. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 2 OF 10)

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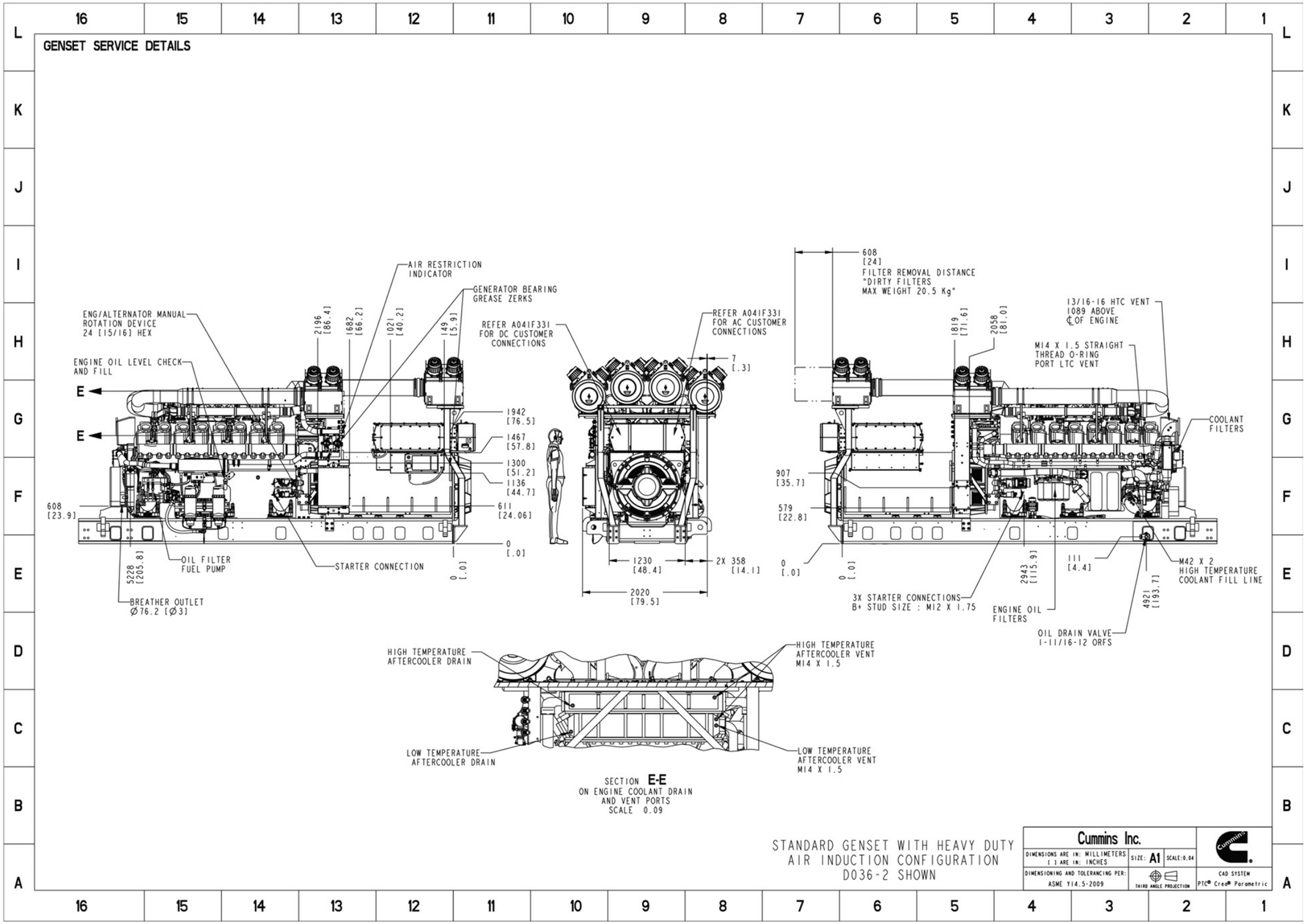


FIGURE 526. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 3 OF 10)

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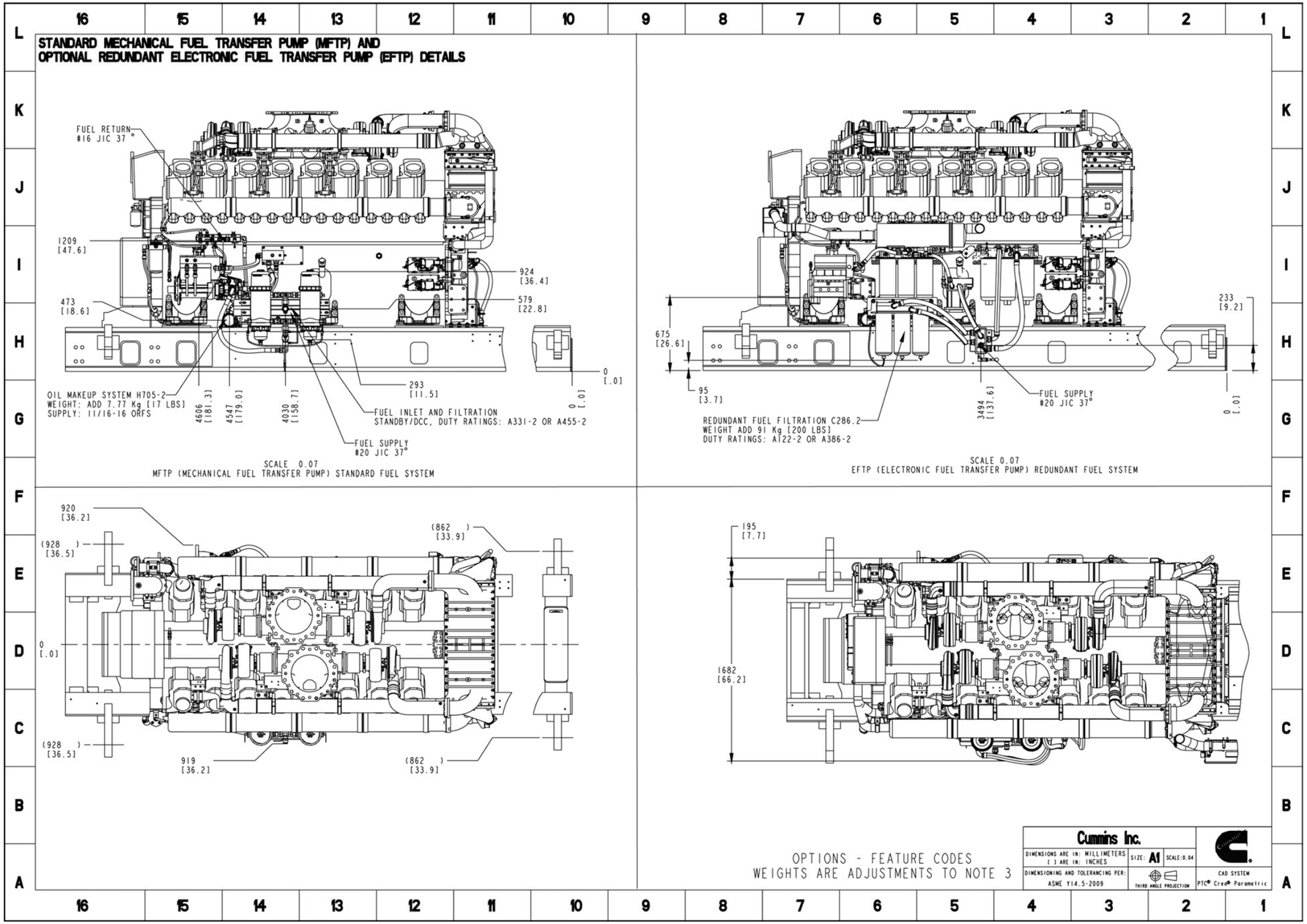


FIGURE 527. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 4 OF 10)

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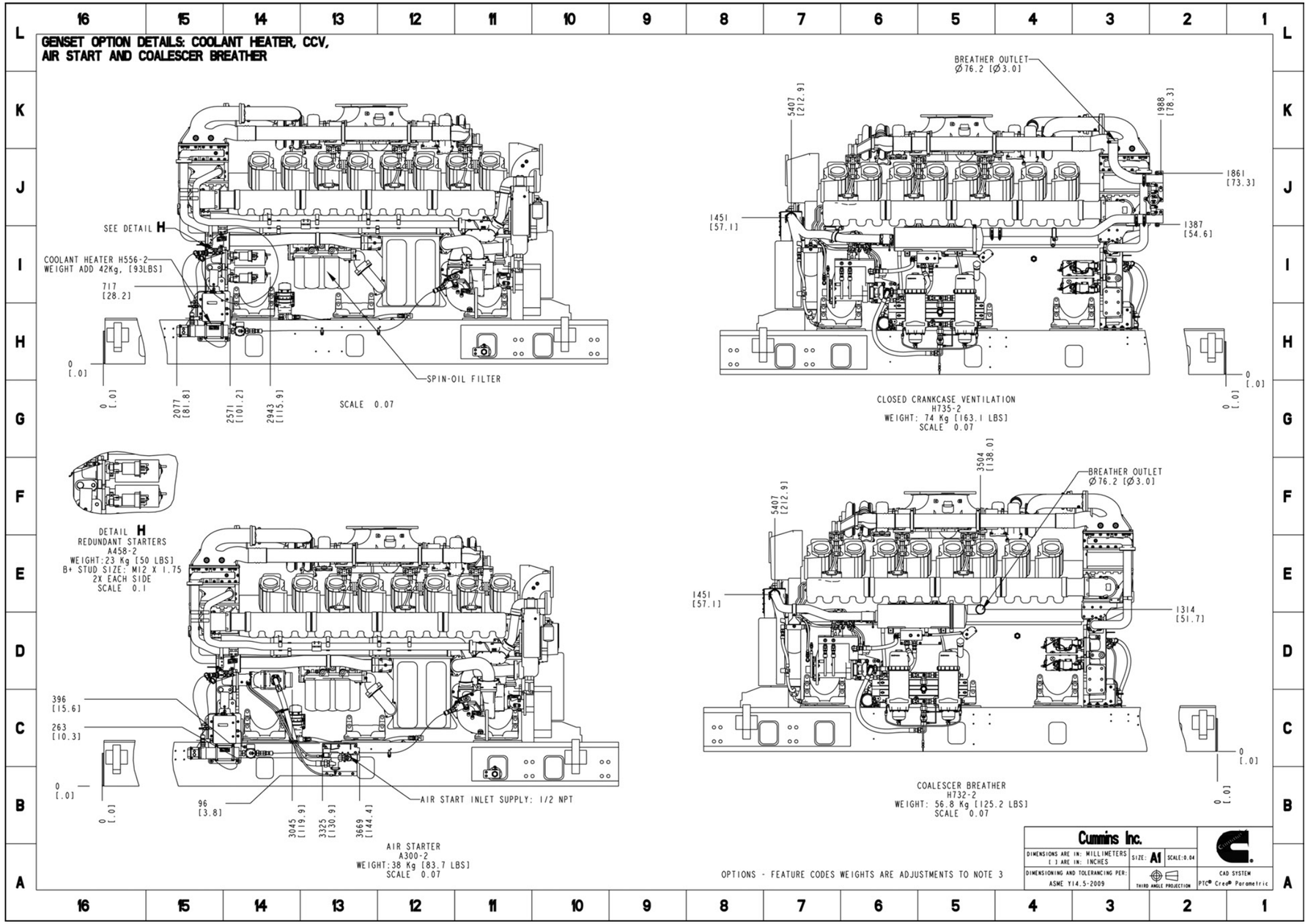


FIGURE 528. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 5 OF 10)

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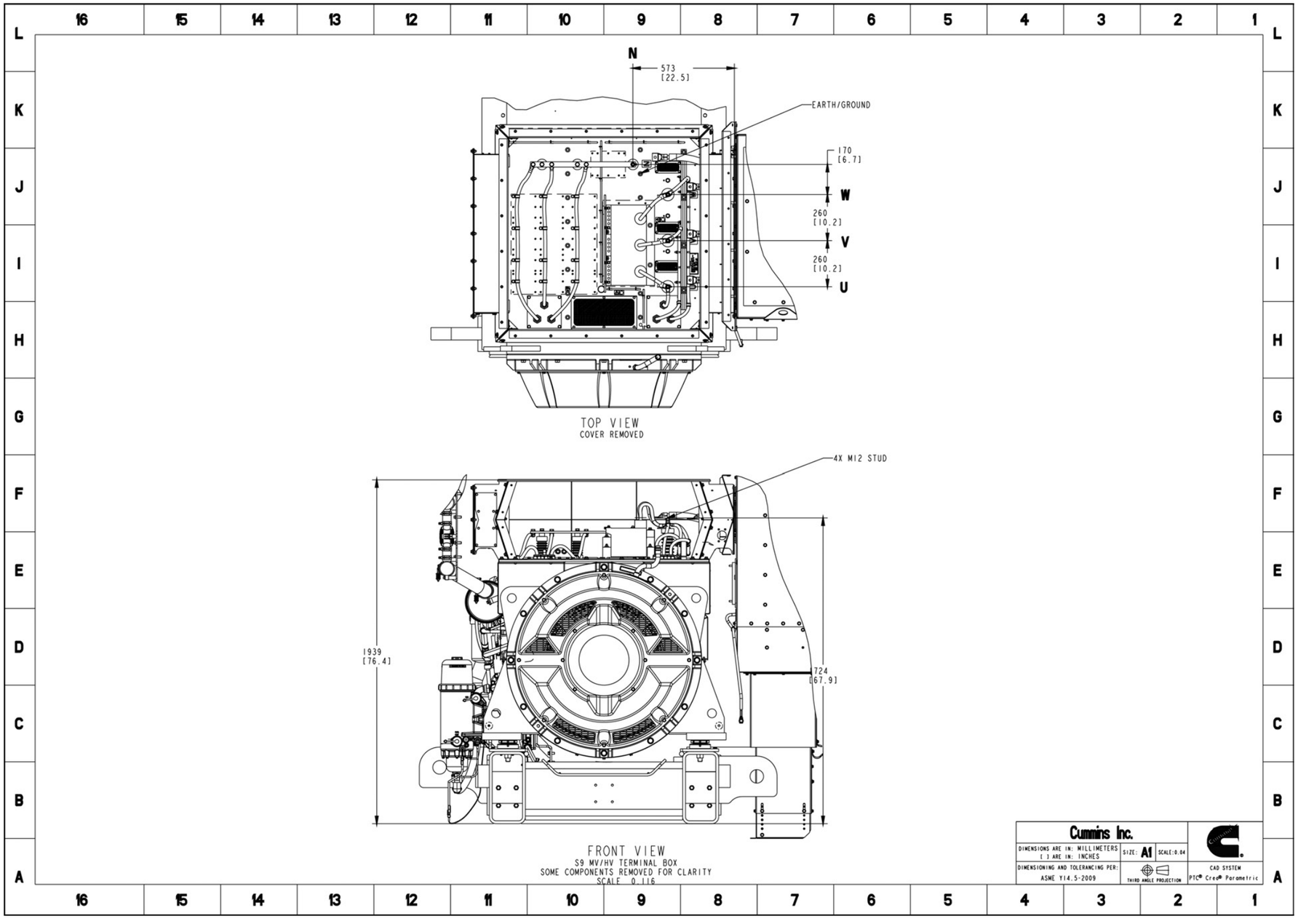


FIGURE 529. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 6 OF 10)

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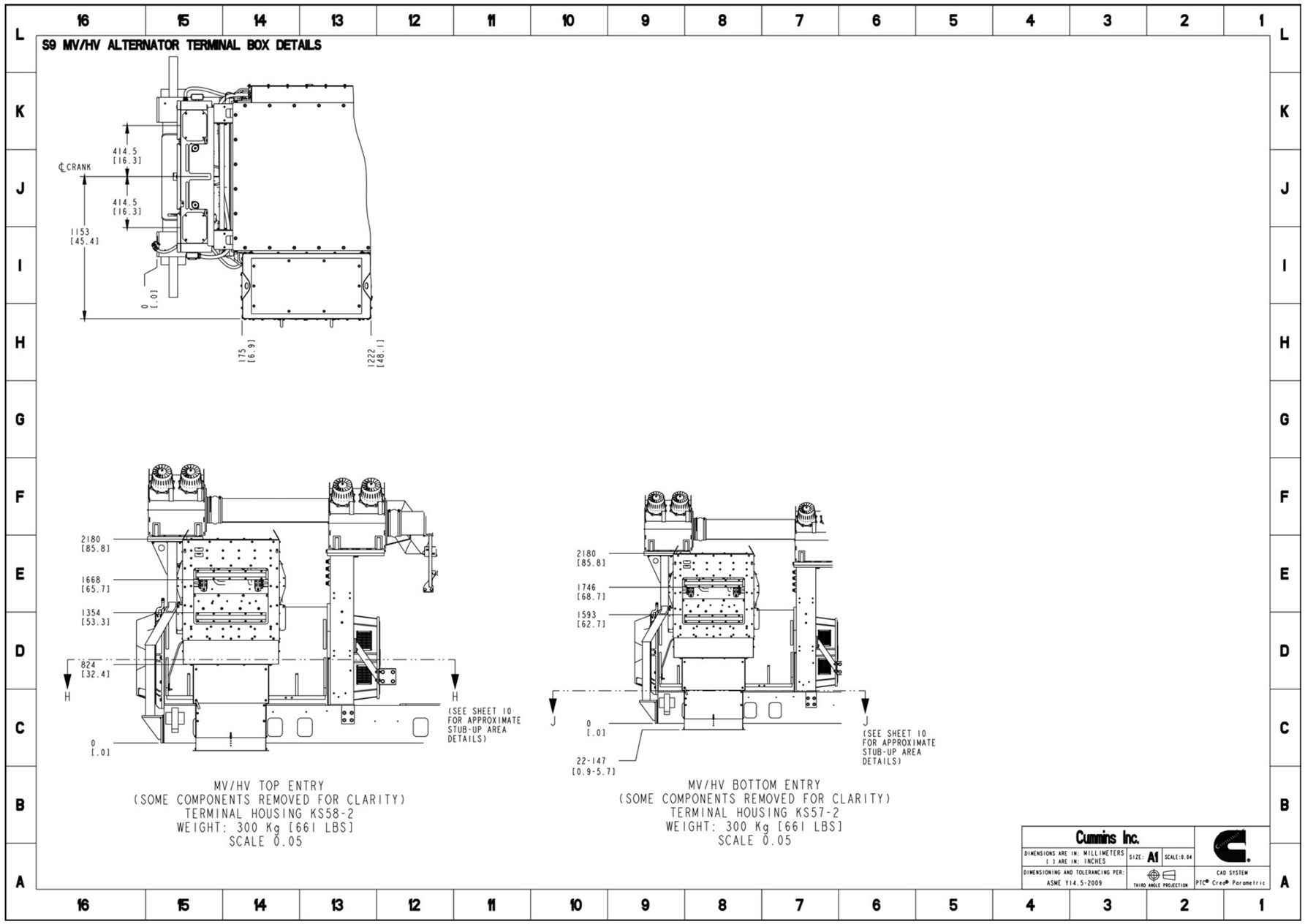


FIGURE 530. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 7 OF 10)

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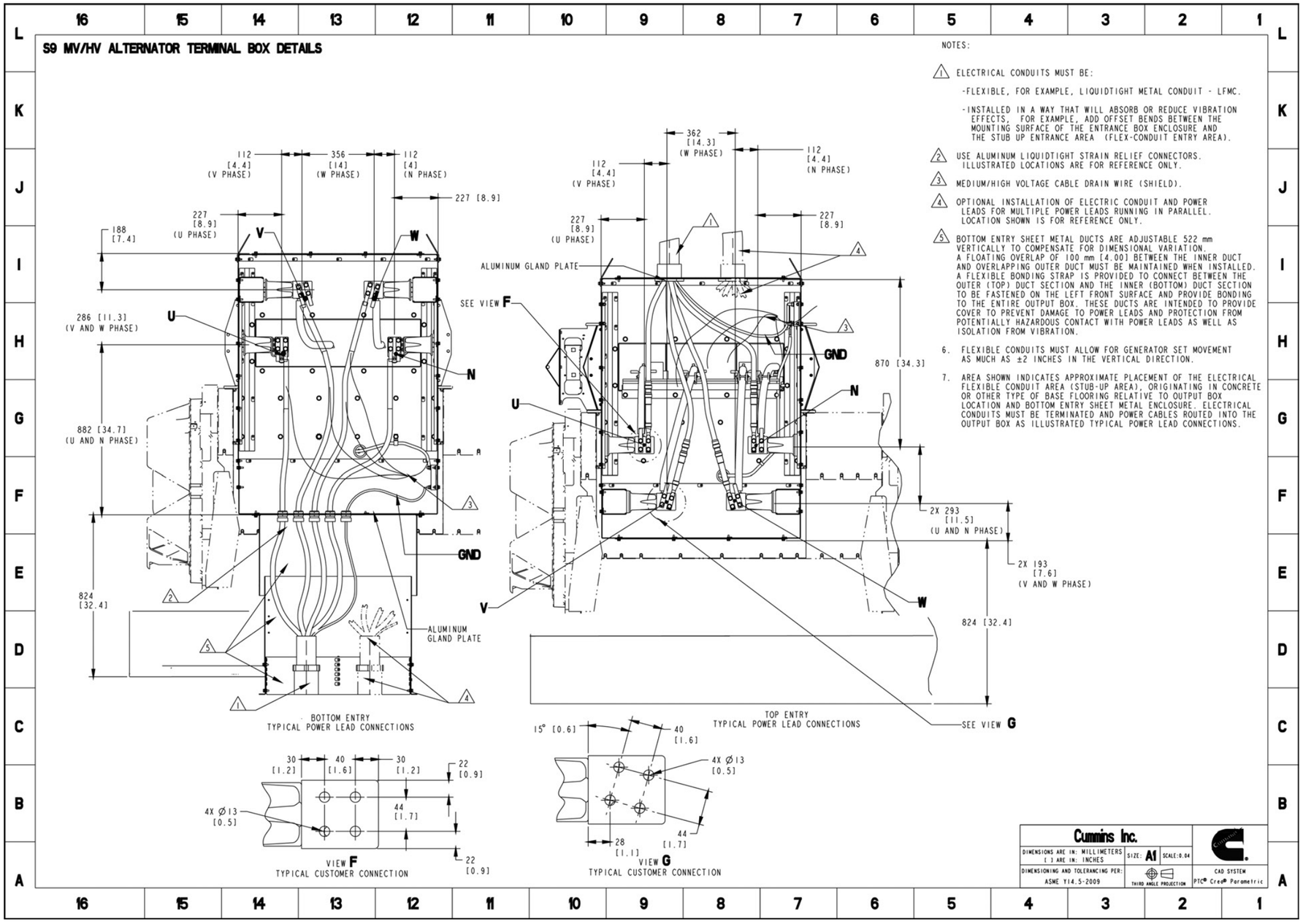


FIGURE 531. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 8 OF 10)

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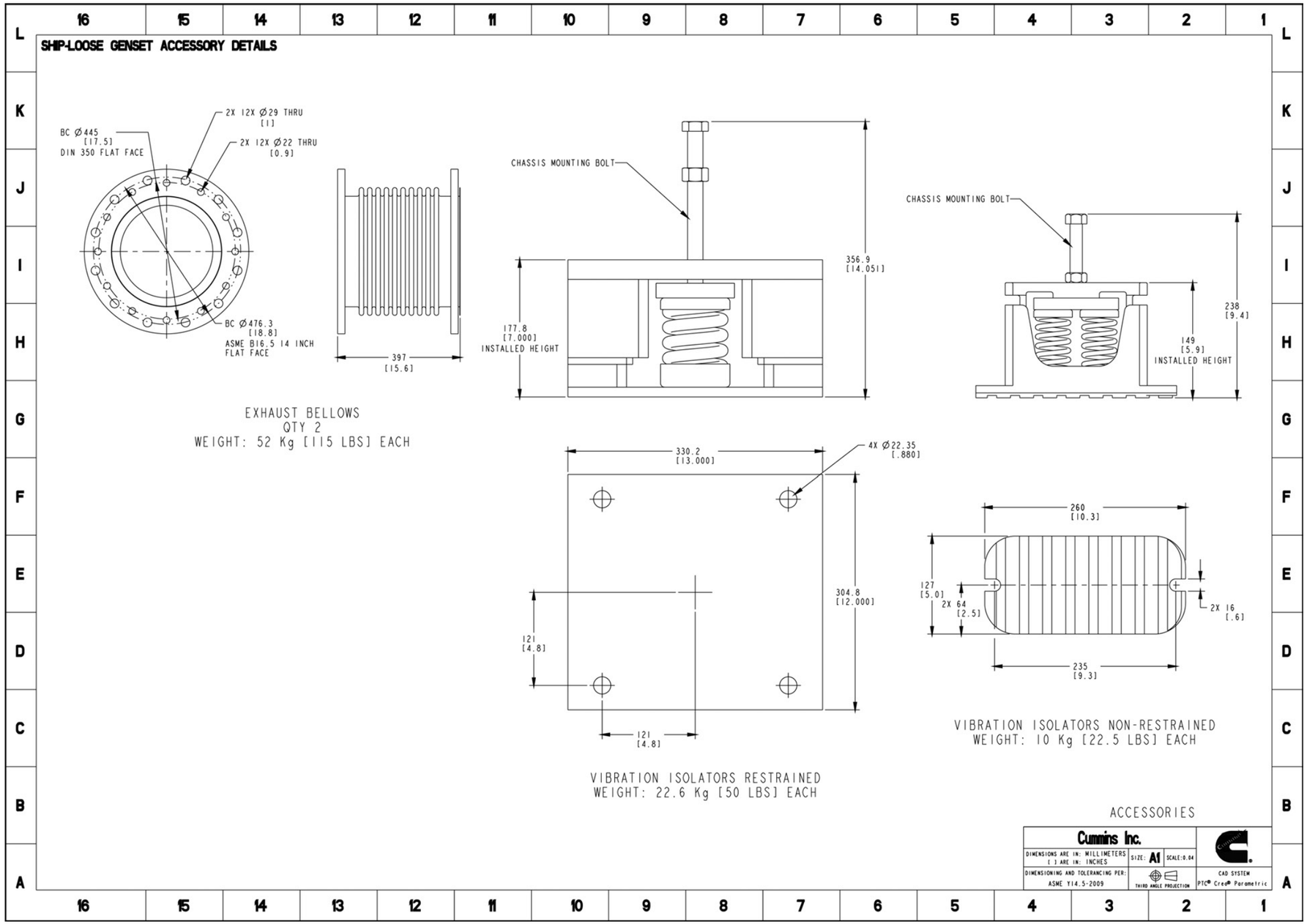


FIGURE 532. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 9 OF 10)

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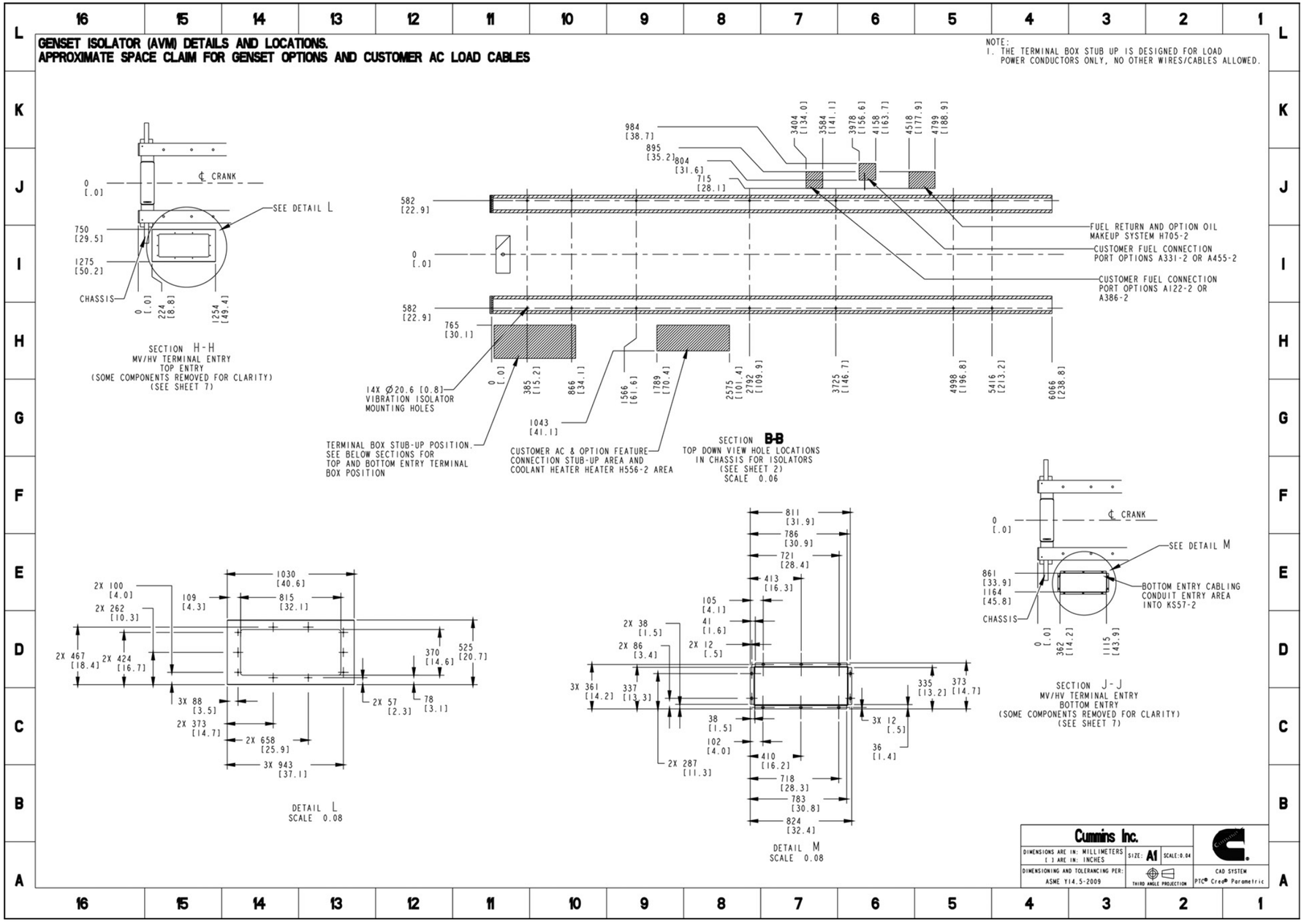


FIGURE 533. OUTLINE DRAWING – HEAVY DUTY AIR CLEANER WITHOUT RADIATOR (SHEET 10 OF 10)

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A.9 Outline Drawing A078A144

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS WITH IMPERIAL INCH CONVERSIONS IN "[ ]".

   1.1 IN EVENT OF A DISCREPANCY BETWEEN METRIC AND IMPERIAL DIMENSIONS, THE METRIC DIMENSIONS CONTROL.

2. ALL DIMENSIONS ARE REFERENCE, UNLESS SPECIFICALLY TOLERANCED..

3. WEIGHT: REFER TO TABLE FOR STANDARD GENSET.

   *3.1 INCLUDES WEIGHT OF 606 LITERS [160 GALLONS] SUPPLIED ENGINE OIL.(530 KG/1168 LBS)

   **3.2 DOES NOT INCLUDE NON-SUPPLIED 378.5 LITERS [100 GALLONS] OF ENGINE COOLANT CAPACITY.

4. LARGEST REMOTE COOLED GENSET DIMENSIONS:
   4.1 LENGTH: 6415 [252.6]
   4.2 WIDTH: 2594 [102.1]
   4.3 HEIGHT: 3009 [118.5]
   4.4 DOES NOT INCLUDE THE HEIGHT OF VIBRATION ISOLATOR

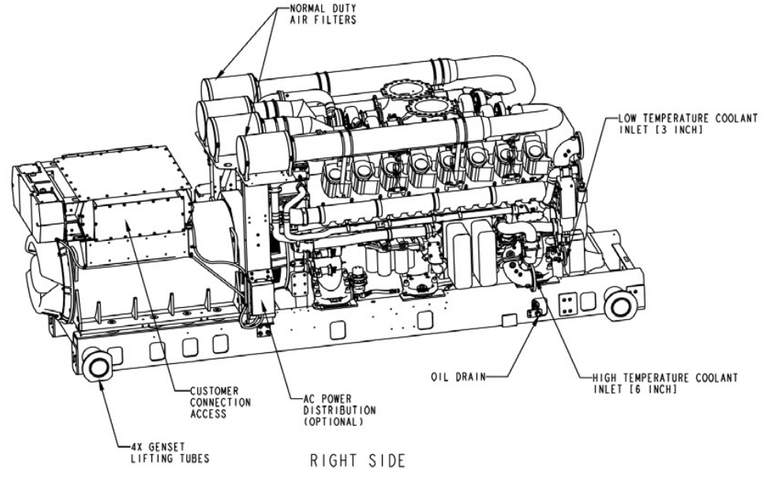
5. LIFTING INSTRUCTIONS: REFER TO GENSET INSTALLATION MANUAL AND LIFTING LABEL.

   NOTE: GENSET SHALL NOT BE LIFTED USING THE LIFTING TUBES WHEN ATTACHED TO THE RADIATOR. RADIATOR AND GENSET SHALL ALWAYS BE LIFTED SEPARATELY PER INSTALLATION MANUAL AND LIFTING DIAGRAMS.

6. ALLOW 1 METER OF SPACE AROUND THE GENSET FOR SERVICE.

7. ISOLATORS ARE MODELED IN THEIR UNCOMPRESSED STATE AND THEIR HEIGHT CHANGE UNDER LOAD MUST BE CONSIDERED FOR SITE CONNECTIONS. WHEN PROPERLY INSTALLED, STANDARD GENSET ISOLATORS WILL DEFLECT APPROXIMATELY 13 mm FROM THEIR UNCOMPRESSED HEIGHT. RESTRAINED ISOLATORS WILL INCREASE IN HEIGHT BY APPROXIMATELY 5 mm. CUSTOMER EXHAUST AND SITE CONNECTIONS SHALL BE CAPABLE OF ACCOMMODATING THIS RANGE.

8. SEE NOTES ON SHEET 7, 8, 11, 13, 14, 17 AND 20.



STANDARD GENSET WITH S9HID-H42 ALTERNATOR AND NORMAL DUTY AIR INDUCTION CONFIGURATION SHOWN

Cummins Inc.
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: INCHES
SIZE: A1 SCALE:1/32
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009
THIRD ANGLE PROJECTION
CAD SYSTEM PTC® Creo® Parametric

FIGURE 534. SHEET 1 OF 22

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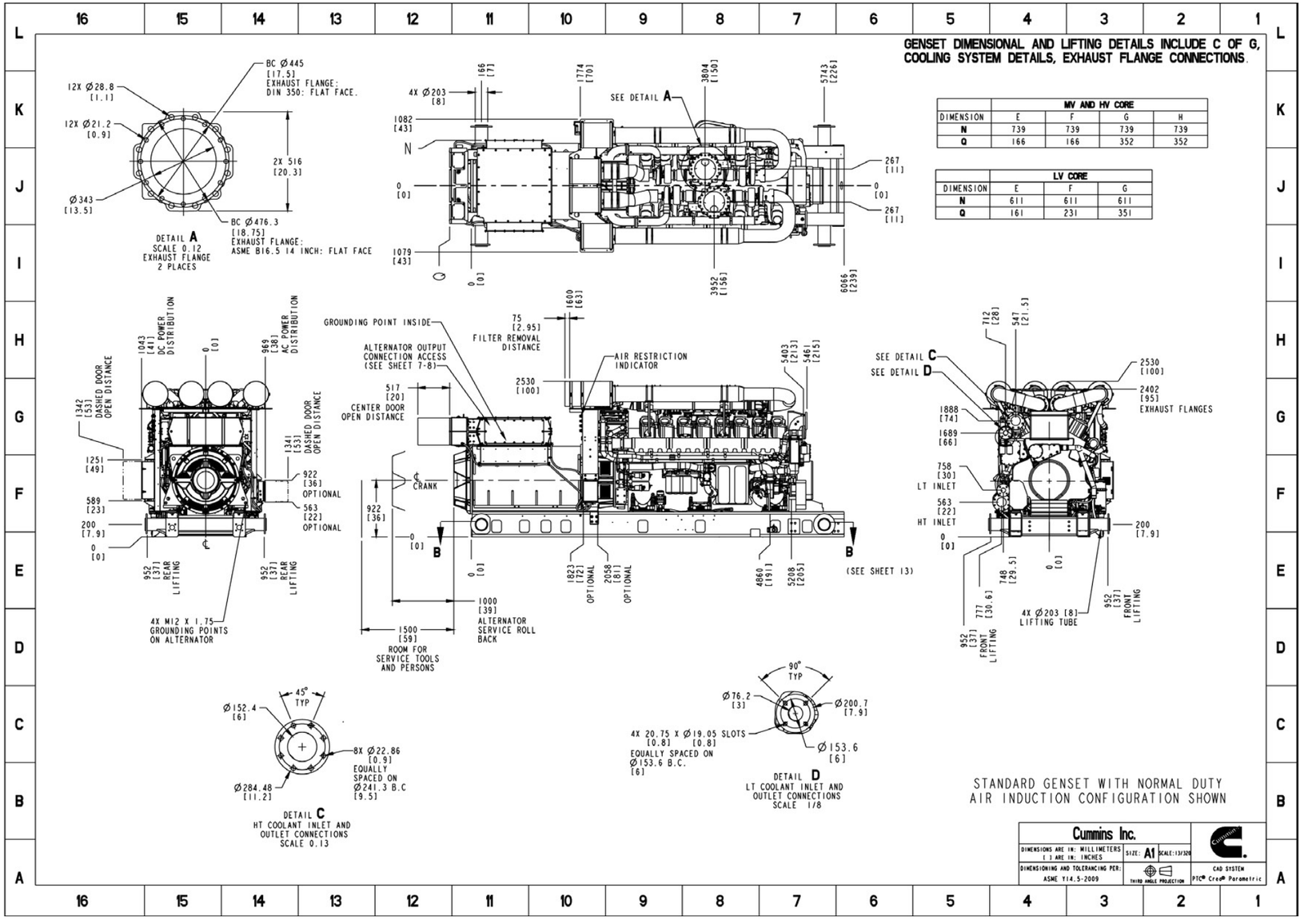


FIGURE 535. SHEET 2 OF 22

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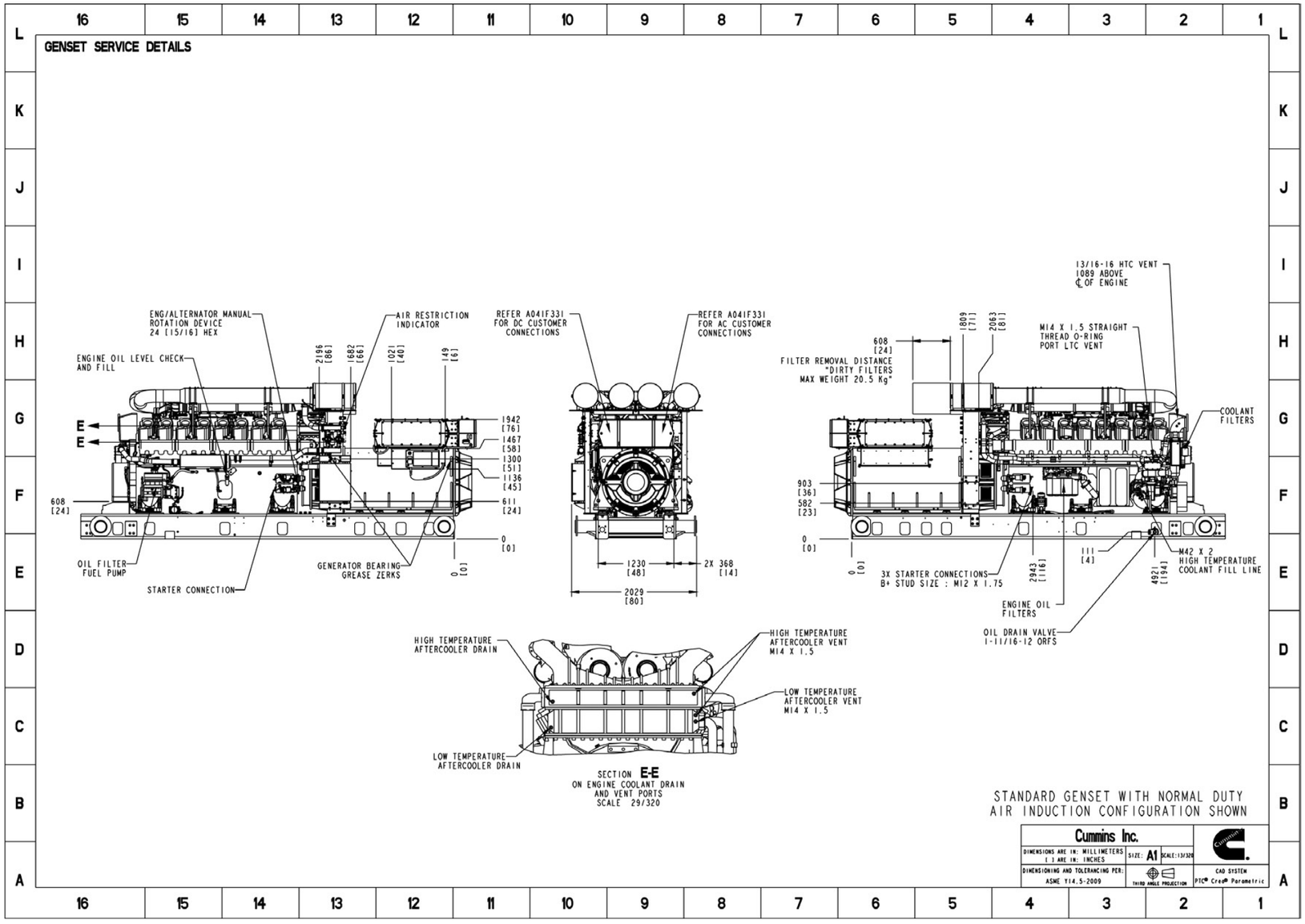


FIGURE 536. SHEET 3 OF 22

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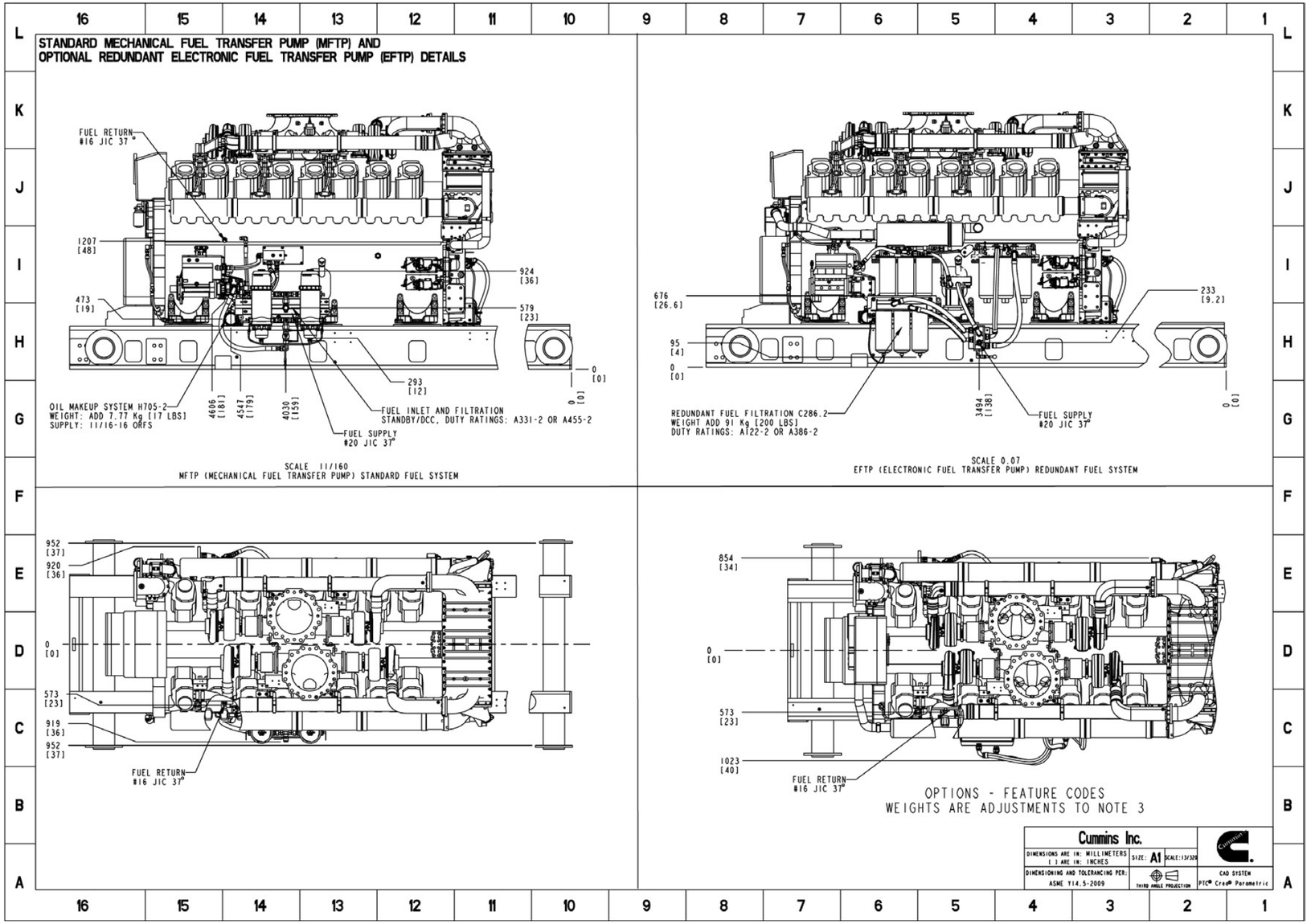


FIGURE 537. SHEET 4 OF 22

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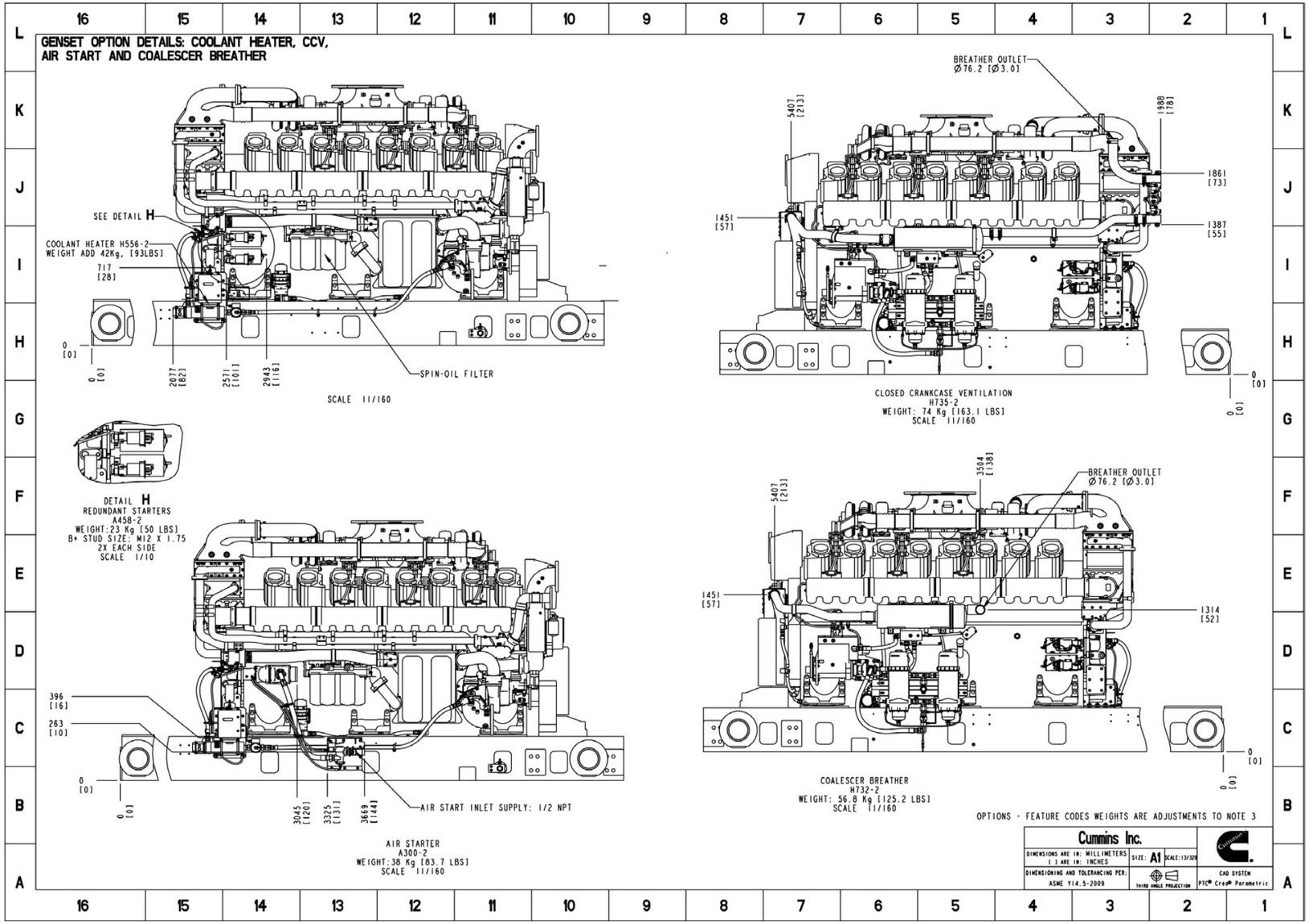


FIGURE 538. SHEET 5 OF 22

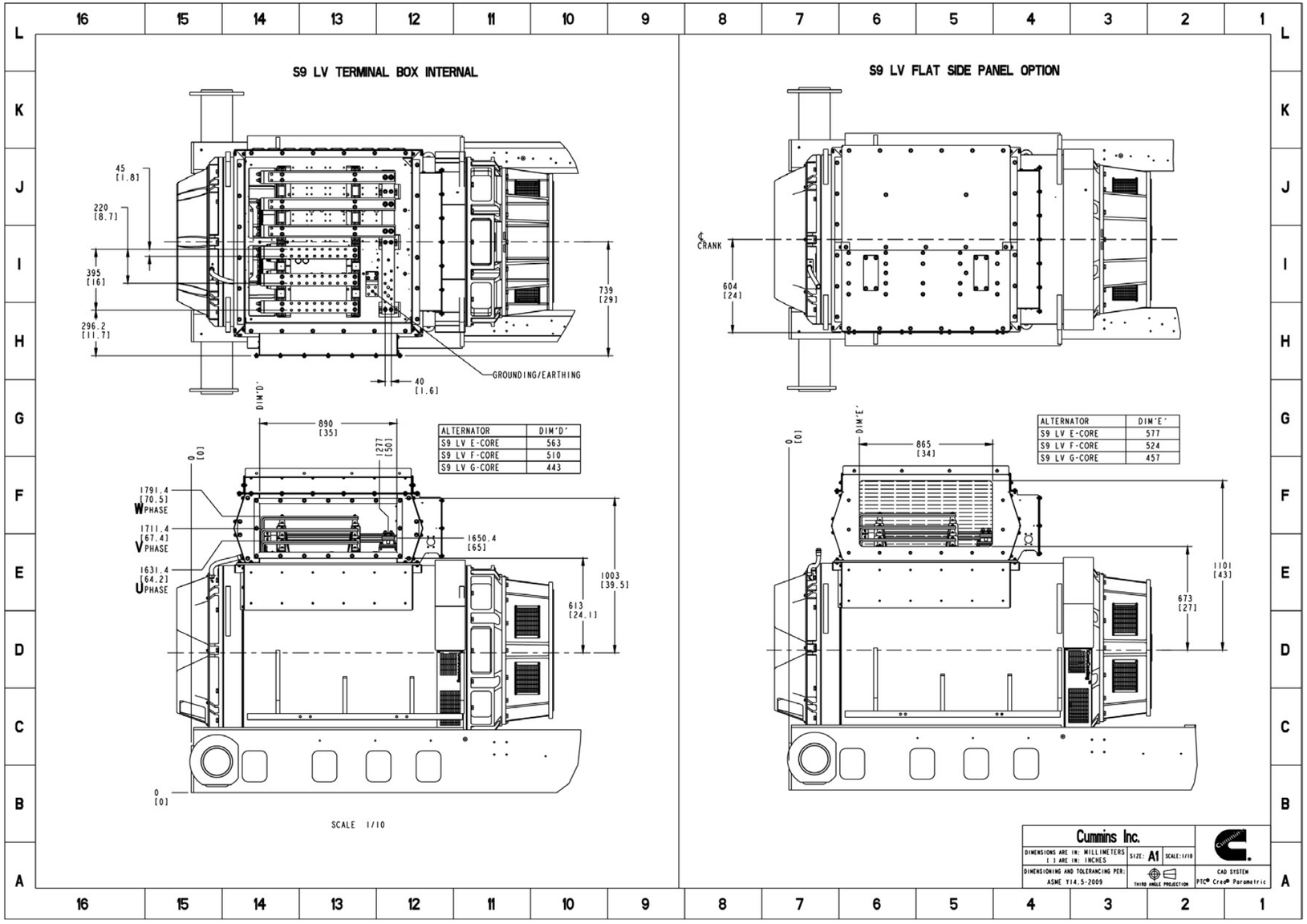


FIGURE 539. SHEET 6 OF 22

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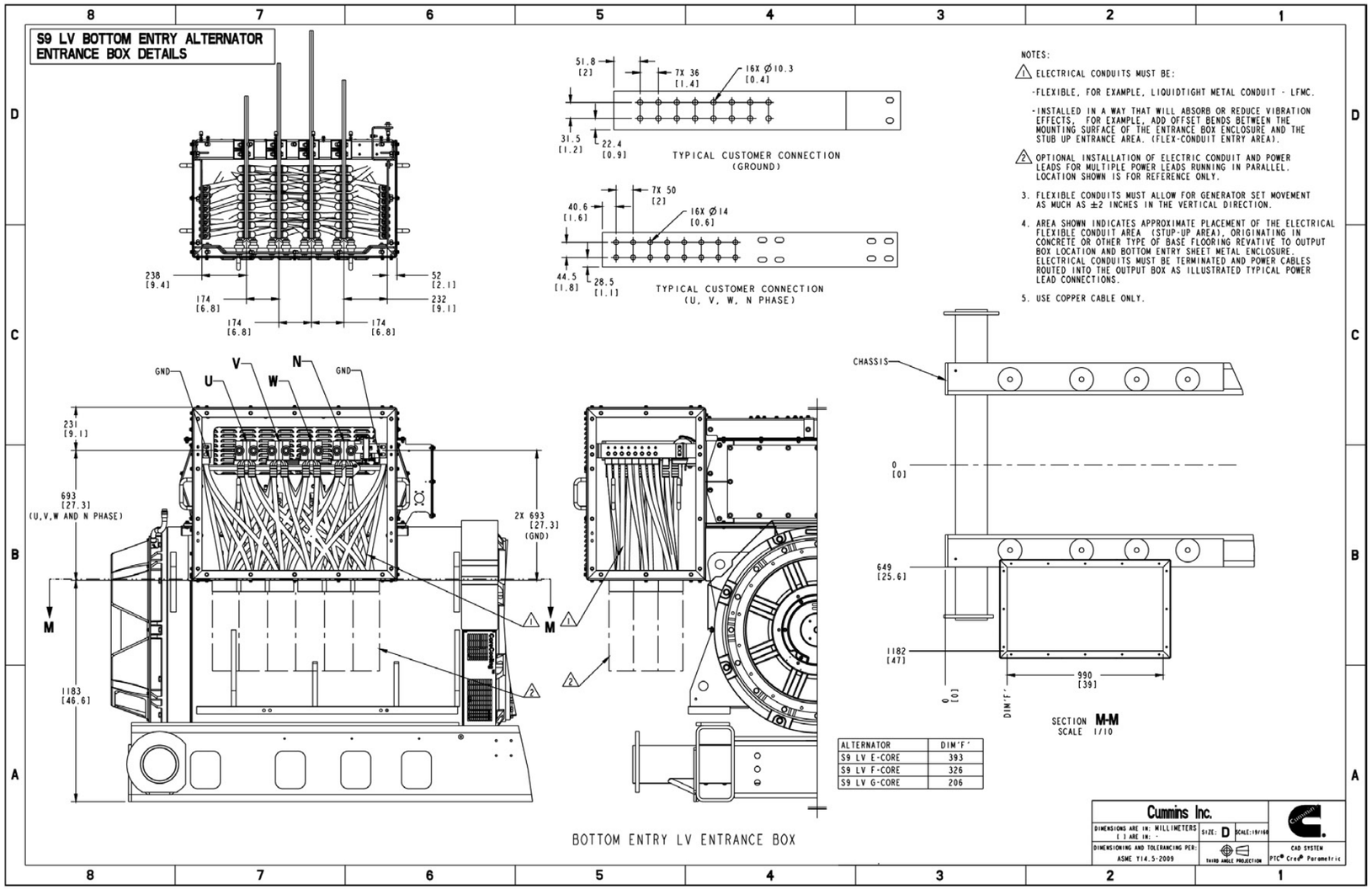


FIGURE 540. SHEET 7 OF 22

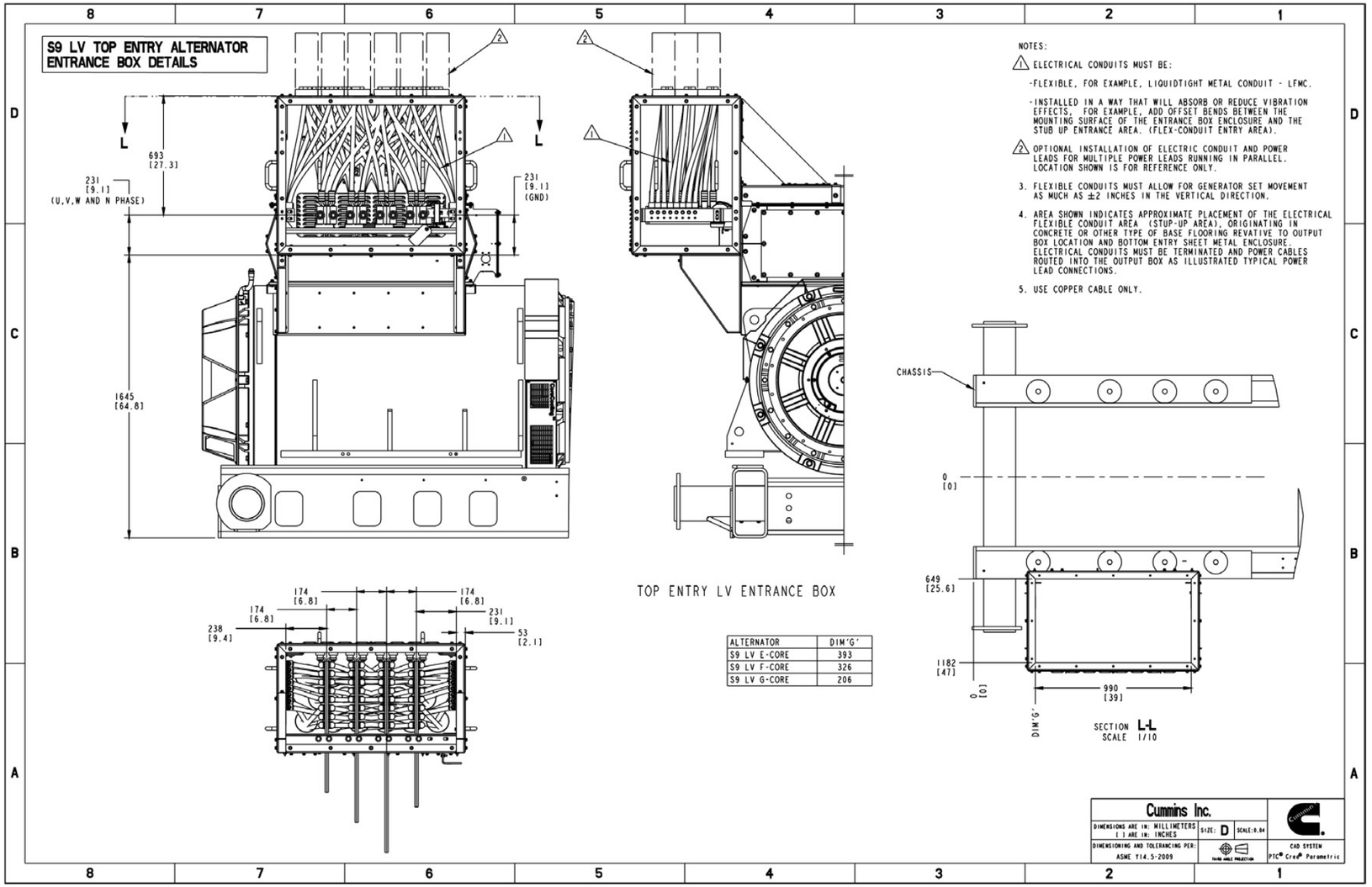


FIGURE 541. SHEET 8 OF 22

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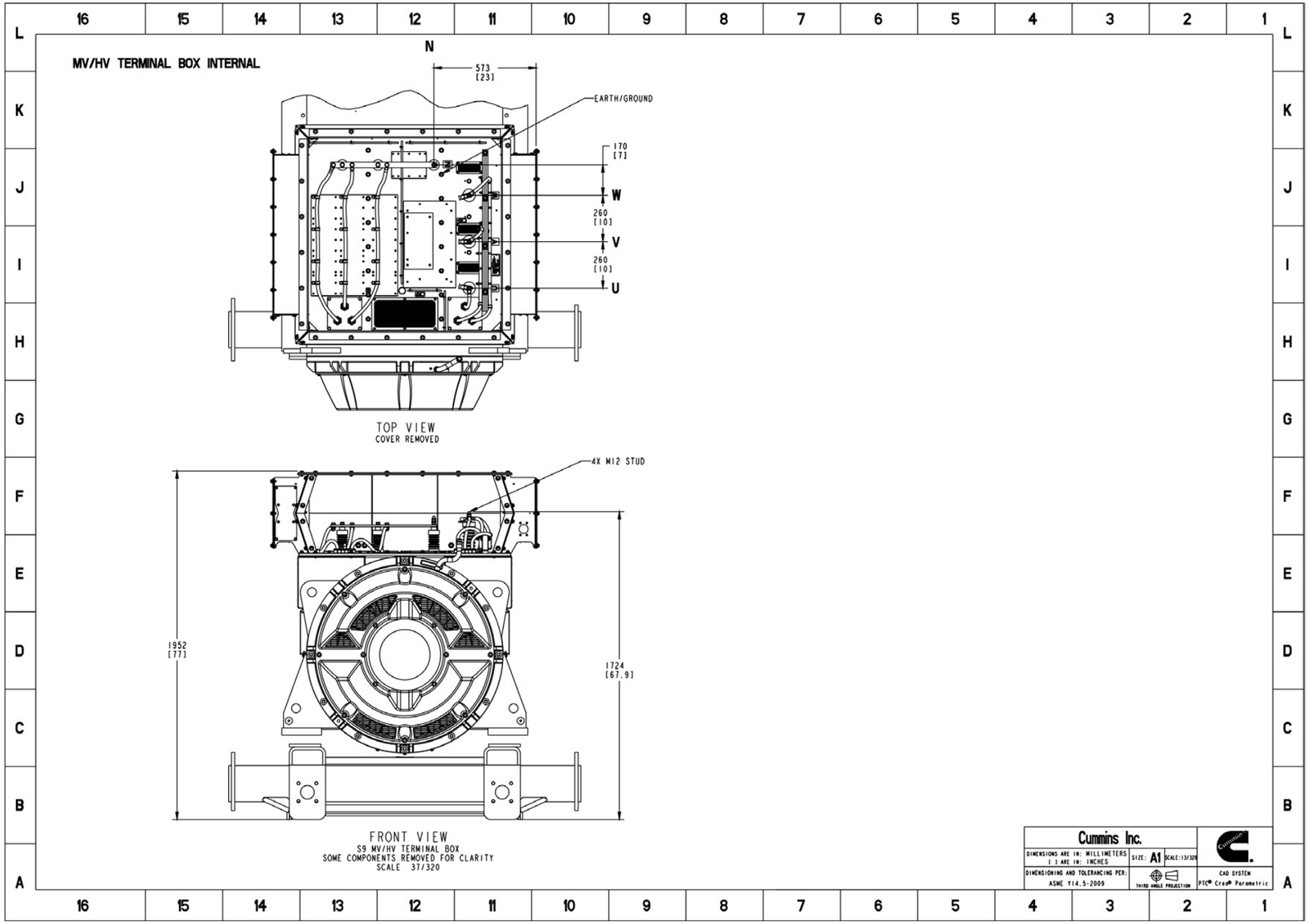
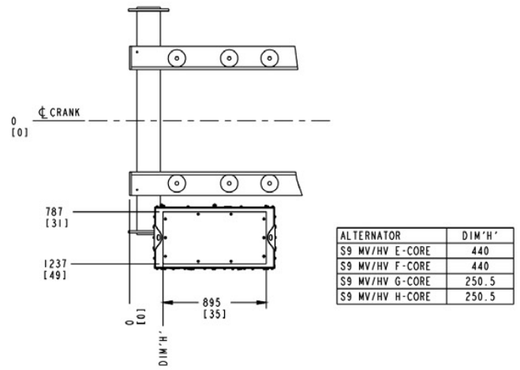


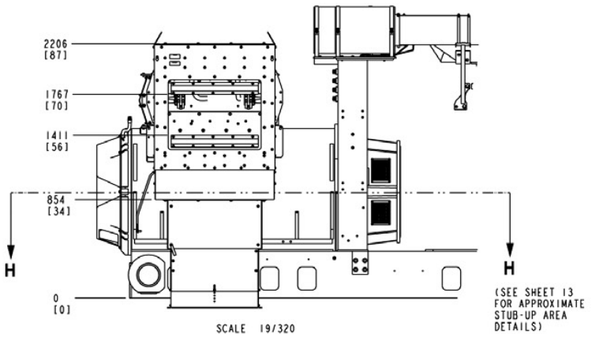
FIGURE 542. SHEET 9 OF 22

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S9 MV/HV ALTERNATOR TERMINAL BOX DETAILS

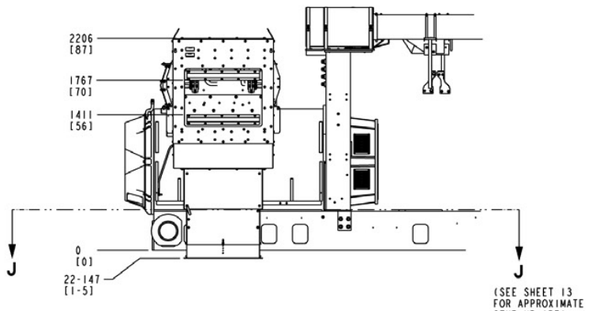


ALTERNATOR	DIM 'H'
S9 MV/HV E-CORE	440
S9 MV/HV F-CORE	440
S9 MV/HV G-CORE	250.5
S9 MV/HV H-CORE	250.5



SCALE 19/320

MV/HV TOP ENTRY
(SOME COMPONENTS REMOVED FOR CLARITY)
TERMINAL HOUSING KS58-2
WEIGHT: 300 Kg [661 LBS]
SCALE 0.05



MV/HV BOTTOM ENTRY
(SOME COMPONENTS REMOVED FOR CLARITY)
TERMINAL HOUSING KS57-2
WEIGHT: 300 Kg [661 LBS]
SCALE 0.05

Cummins Inc.		
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: INCHES	SIZE: A1	SCALE: 19/320
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009	THIRD ANGLE PROJECTION	CAD SYSTEM PTC® Creo® Parametric

FIGURE 543. SHEET 10 OF 22

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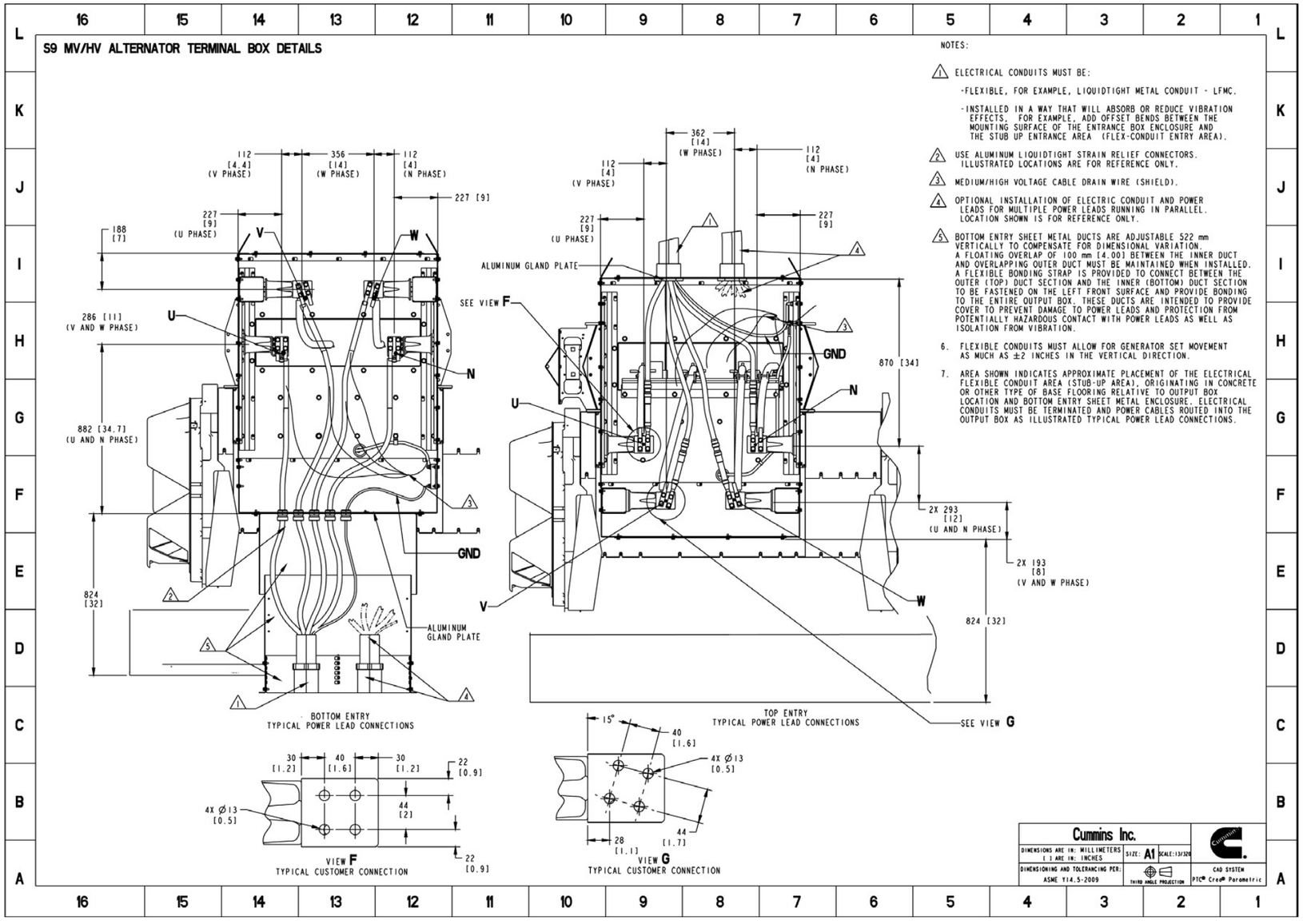


FIGURE 544. SHEET 11 OF 22

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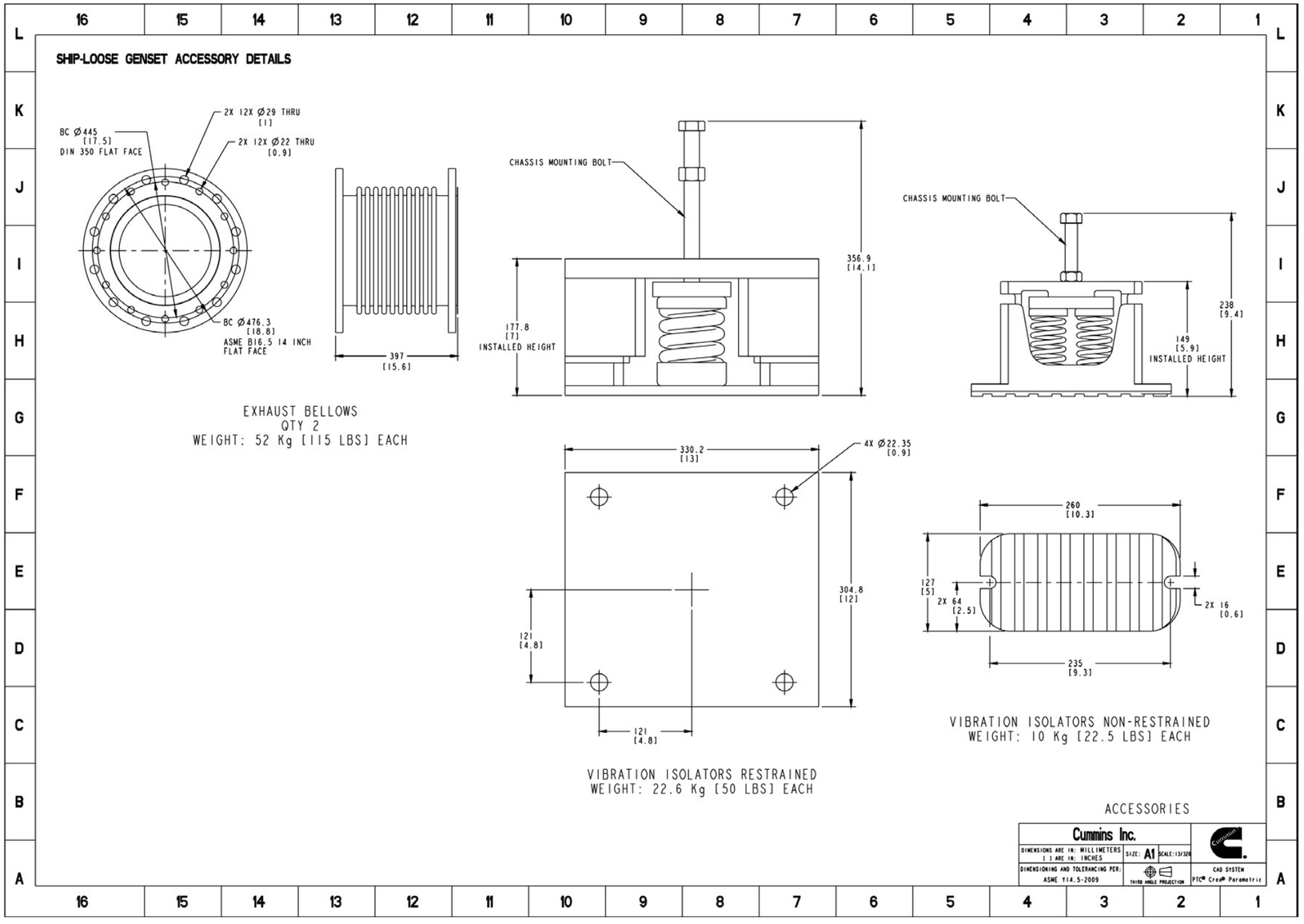
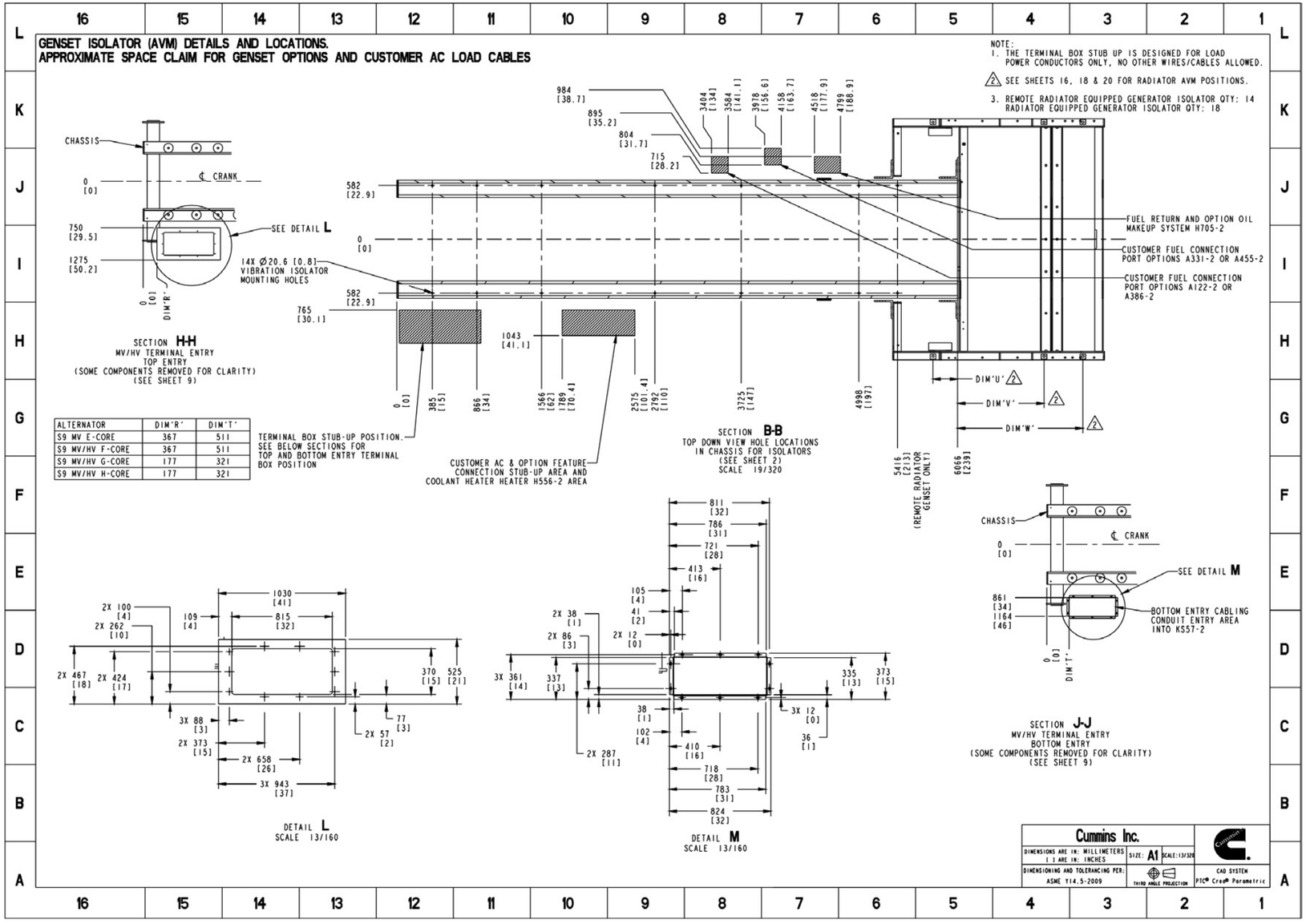


FIGURE 545. SHEET 12 OF 22

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ALTERNATOR	DIM'R'	DIM'T'
S9 MV E-CORE	367	511
S9 MV/HV F-CORE	367	511
S9 MV/HV G-CORE	177	321
S9 MV/HV H-CORE	177	321

FIGURE 546. SHEET 13 OF 22

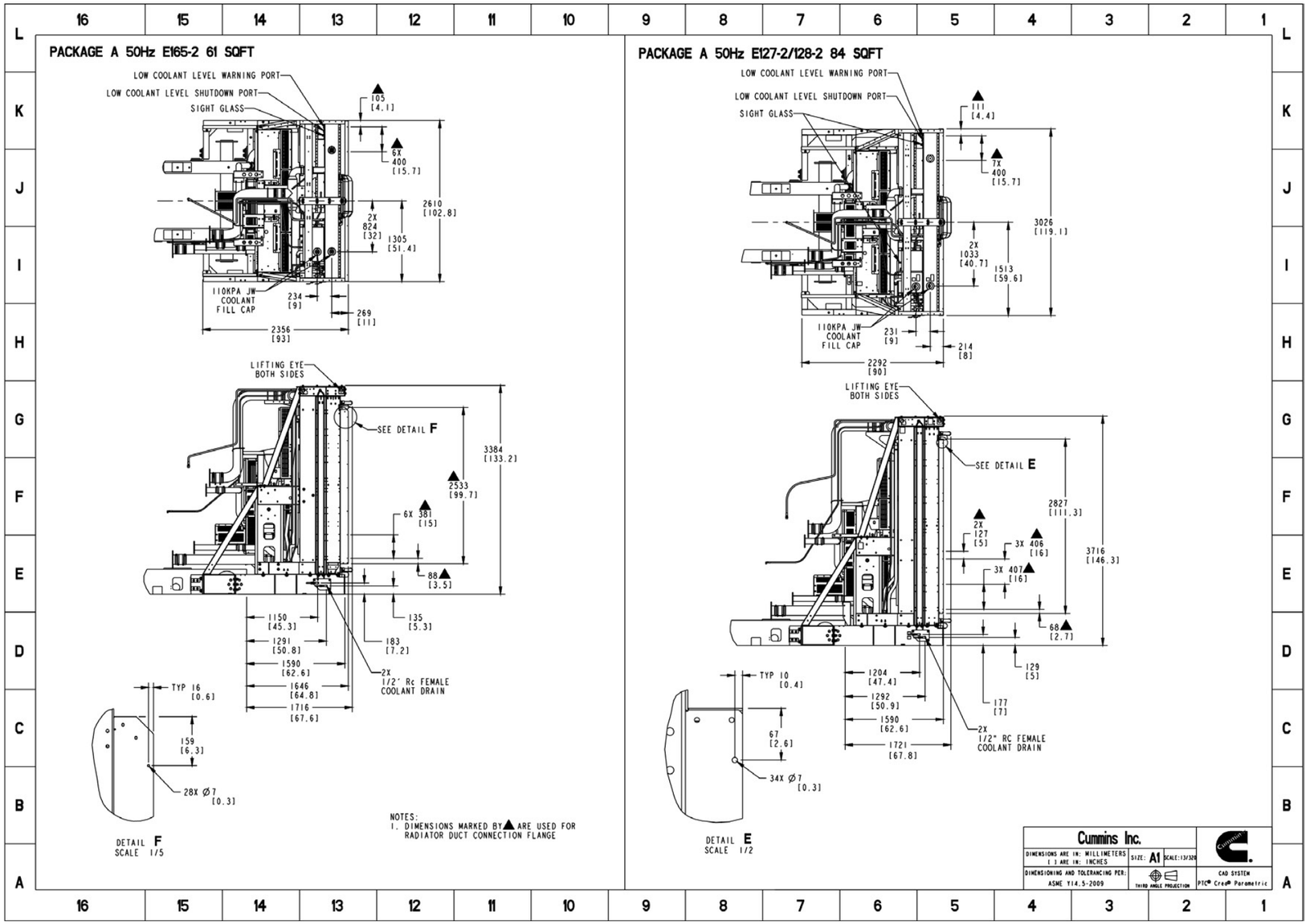


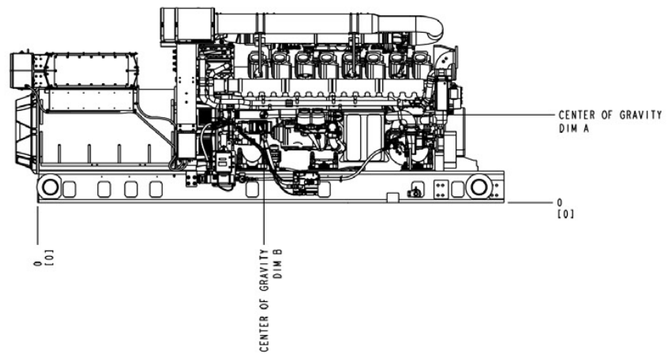
FIGURE 547. SHEET 14 OF 22

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ALTERNATOR		PACKAGE A 50Hz E165-2 61 SQFT		
ALTERNATOR	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH RADIATOR* Kg [lbs]	C OF G WITH RADIATOR DIM A (SHOWN)* mm [inch]	C OF G WITH RADIATOR DIM B (SHOWN)* mm [inch]
S9LID-E42	7500 [16600]	29100 [64200]	1082 [43]	3637 [143]
S9LID-F42	7900 [17500]	29500 [65100]	1079 [42]	3591 [141]
S9LID-G42	8800 [19500]	30400 [67100]	1075 [42]	3501 [138]
S9MID-E42	6600 [14600]	28200 [62200]	1083 [43]	3710 [146]
S9MID-F42	7000 [15500]	28700 [63300]	1081 [43]	3662 [144]
S9MID-G42	7800 [17200]	29400 [64900]	1076 [42]	3576 [141]
S9MID-H42	8200 [18100]	29900 [66000]	1073 [42]	3529 [139]
S9HID-E42	6600 [14600]	28200 [62200]	1083 [43]	3710 [146]
S9HID-F42	7000 [15500]	28700 [63300]	1081 [43]	3662 [144]
S9HID-G42	7800 [17200]	29400 [64900]	1076 [42]	3576 [141]
S9HID-H42	8200 [18100]	29900 [66000]	1073 [42]	3529 [139]

ALTERNATOR		PACKAGE A 50Hz E127-2/128-2 84 SQFT		
ALTERNATOR	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH RADIATOR* Kg [lbs]	C OF G WITH RADIATOR DIM A (SHOWN)* mm [inch]	C OF G WITH RADIATOR DIM B (SHOWN)* mm [inch]
S9LID-E42	7500 [16600]	29600 [65300]	1104 [43]	3690 [145]
S9LID-F42	7900 [17500]	30000 [66200]	1101 [43]	3645 [143]
S9LID-G42	8800 [19500]	30900 [68200]	1096 [43]	3555 [140]
S9MID-E42	6600 [14600]	28700 [63300]	1106 [44]	3764 [148]
S9MID-F42	7000 [15500]	29100 [64200]	1103 [43]	3716 [146]
S9MID-G42	7800 [17200]	29900 [66000]	1098 [43]	3630 [143]
S9MID-H42	8200 [18100]	30300 [66800]	1095 [43]	3584 [141]
S9HID-E42	6600 [14600]	28700 [63300]	1106 [44]	3764 [148]
S9HID-F42	7000 [15500]	29100 [64200]	1103 [43]	3716 [146]
S9HID-G42	7800 [17200]	29900 [66000]	1098 [43]	3630 [143]
S9HID-H42	8200 [18100]	30300 [66800]	1095 [43]	3584 [141]

ALTERNATOR		REMOTE COOLED		
ALTERNATOR	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH NO RADIATOR* Kg [lbs]	C OF G WITHOUT RADIATOR DIM A (SHOWN)* mm [inch]	C OF G WITHOUT RADIATOR DIM B (SHOWN)* mm [inch]
S9LID-E42	7400 [16400]	23900 [52700]	1027 [40]	2916 [115]
S9LID-F42	7900 [17300]	24300 [53600]	1025 [40]	2874 [113]
S9LID-G42	8700 [19200]	25200 [55500]	1022 [40]	2790 [110]
S9MID-E42	6600 [14400]	23000 [50700]	1027 [40]	2978 [117]
S9MID-F42	7000 [15400]	23500 [51700]	1025 [40]	2934 [115]
S9MID-G42	7800 [17100]	24200 [53400]	1021 [40]	2852 [112]
S9MID-H42	8200 [18100]	24700 [54300]	1019 [40]	2809 [111]
S9HID-E42	6600 [14400]	23000 [50700]	1027 [40]	2978 [117]
S9HID-F42	7000 [15400]	23500 [51700]	1025 [40]	2934 [115]
S9HID-G42	7800 [17100]	24200 [53400]	1021 [40]	2852 [112]
S9HID-H42	8200 [18100]	24700 [54300]	1019 [40]	2809 [111]



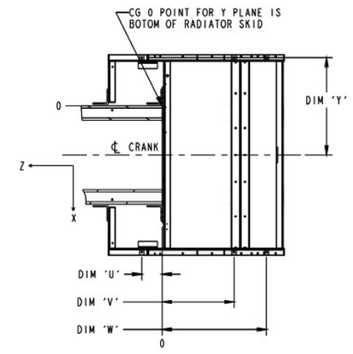
Cummins Inc.
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: INCHES
SIZE: A1 SCALE:1/3(2/3)
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009
THIRD ANGLE PROJECTION
CAD SYSTEM PTC® Creo® Parametric

FIGURE 548. SHEET 15 OF 22

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RADIATOR VARIATON	CORE SIZE	FREQUENCY	COOLANT VOLUME L [GAL]		DRY WEIGHT KG [LBS]	WET WEIGHT KG [LBS]	RAD X-AXIS CG [INCHES]	RAD Y-AXIS CG [INCHES]	RAD Z-AXIS CG [INCHES]	ALTERNATOR	GENSET O/A LENGTH [INCHES]	GENSET O/A WIDTH [INCHES]	GENSET O/A HEIGHT [INCHES]
			JACKET WATER	LOW-TEMP AFTERCOOLER									
PACKAGE A 50Hz E165-2 61 SQFT	61 SQFT	50	400 [88.0]	165 [36.3]	4620 [10185]	5185 [11431]	698 [28]	1272 [50]	-823 [-32]	S9 MV/HV E & F CORE	7948 [313]	2650 [104]	3384 [133]
										S9 MV/HV G & H CORE	8134 [320]	2650 [104]	3384 [133]
										S9 LV E CORE	7943 [313]	2650 [104]	3384 [133]
										S9 LV F CORE	8013 [315]	2650 [104]	3384 [133]
										S9 LV G CORE	8133 [320]	2650 [104]	3384 [133]
PACKAGE A 50Hz E127-2/128-2 84 SQFT	84 SQFT	50	465 [102.3]	205 [45.1]	5000 [11023]	5670 [12500]	680 [27]	1472 [58]	-823 [-32]	S9 MV/HV E & F CORE	7953 [313]	3057 [120]	3716 [146]
										S9 MV/HV G & H CORE	8139 [320]	3057 [120]	3716 [146]
										S9 LV E CORE	7948 [313]	3057 [120]	3716 [146]
										S9 LV F CORE	8018 [316]	3057 [120]	3716 [146]
										S9 LV G CORE	8138 [320]	3057 [120]	3716 [146]

RADIATOR AVM POSITION				
RADIATOR VARIATION	DIM 'U'	DIM 'V'	DIM 'W'	DIM 'Y'
PACKAGE A 50Hz E165-2 61 SQFT	266	935	1355	1265
PACKAGE A 50Hz E127-2/128-2 84 SQFT	266	935	1355	1464



Cummins Inc.
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: INCHES
SIZE: A1 SCALE: 1/3 1/2
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009
THIRD ANGLE PROJECTION
CAD SYSTEM PTC® Creo® Parametric

FIGURE 549. SHEET 16 OF 22

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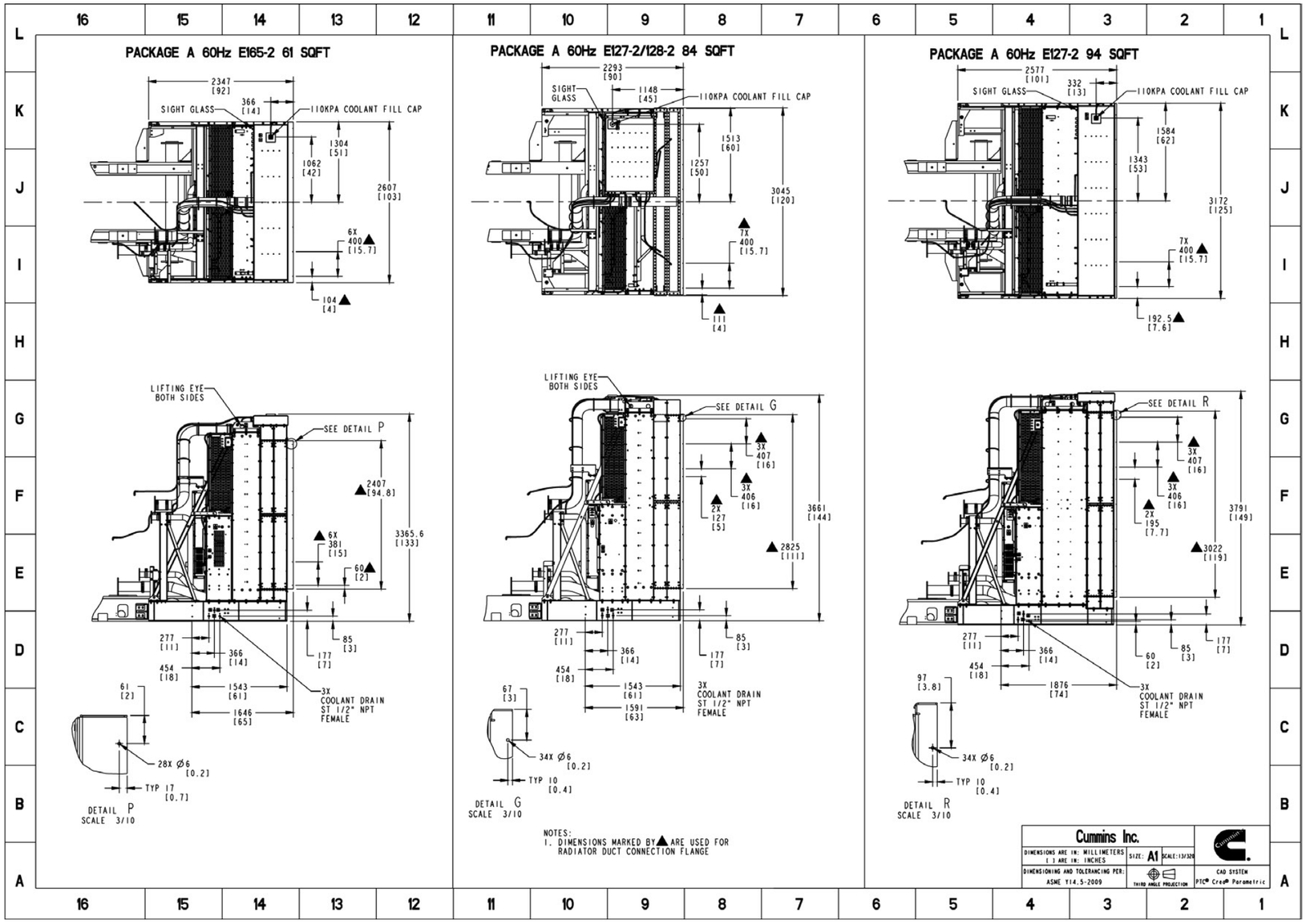


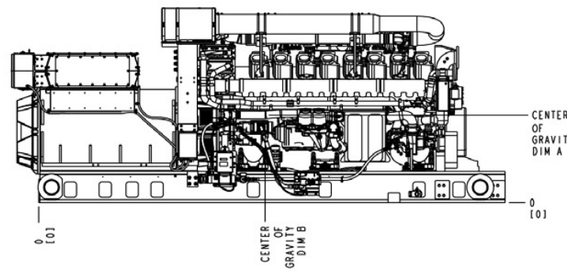
FIGURE 550. SHEET 17 OF 22

ALTERNATOR		PACKAGE A 60Hz E165-2 61 SQFT		
ALTERNATOR	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH RADIATOR* Kg [lbs]	C OF G WITH RADIATOR DIM A (SHOWN)* mm [inch]	C OF G WITH RADIATOR DIM B (SHOWN)* mm [inch]
S9L1D-E42	7500 [16600]	28200 [62200]	1099 [43]	3516 [138]
S9L1D-F42	7900 [17500]	28600 [63100]	1096 [43]	3471 [137]
S9L1D-G42	8800 [19500]	29500 [65100]	1091 [43]	3382 [133]
S9M1D-E42	6600 [14600]	27300 [60200]	1101 [43]	3587 [141]
S9M1D-F42	7000 [15500]	27800 [61300]	1098 [43]	3540 [139]
S9M1D-G42	7800 [17200]	28500 [62900]	1092 [43]	3455 [136]
S9M1D-H42	8200 [18100]	29000 [64000]	1089 [43]	3409 [134]
S9H1D-E42	6600 [14600]	27300 [60200]	1101 [43]	3587 [141]
S9H1D-F42	7000 [15500]	27800 [61300]	1098 [43]	3540 [139]
S9H1D-G42	7800 [17200]	28500 [62900]	1092 [43]	3455 [136]
S9H1D-H42	8200 [18100]	29000 [64000]	1089 [43]	3409 [134]

ALTERNATOR		PACKAGE A 60Hz E127-2/128-2 84 SQFT		
ALTERNATOR	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH RADIATOR* Kg [lbs]	C OF G WITH RADIATOR DIM A (SHOWN)* mm [inch]	C OF G WITH RADIATOR DIM B (SHOWN)* mm [inch]
S9L1D-E42	7500 [16600]	28800 [63500]	1131 [45]	3584 [141]
S9L1D-F42	7900 [17500]	29300 [64600]	1128 [44]	3539 [140]
S9L1D-G42	8800 [19500]	30100 [66400]	1122 [44]	3450 [136]
S9M1D-E42	6600 [14600]	28000 [61800]	1135 [45]	3656 [144]
S9M1D-F42	7000 [15500]	28400 [62700]	1131 [45]	3609 [142]
S9M1D-G42	7800 [17200]	29200 [64400]	1125 [44]	3523 [139]
S9M1D-H42	8200 [18100]	29600 [65300]	1121 [44]	3477 [137]
S9H1D-E42	6600 [14600]	28000 [61800]	1135 [45]	3656 [144]
S9H1D-F42	7000 [15500]	28400 [62700]	1131 [45]	3609 [142]
S9H1D-G42	7800 [17200]	29200 [64400]	1125 [44]	3523 [139]
S9H1D-H42	8200 [18100]	29600 [65300]	1121 [44]	3477 [137]

ALTERNATOR		PACKAGE A 60Hz E127-2 94 SQFT		
ALTERNATOR	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH RADIATOR* Kg [lbs]	C OF G WITH RADIATOR DIM A (SHOWN)* mm [inch]	C OF G WITH RADIATOR DIM B (SHOWN)* mm [inch]
S9L1D-E42	7500 [16600]	29500 [65100]	1151 [45]	3699 [146]
S9L1D-F42	7900 [17500]	30000 [66200]	1148 [45]	3654 [144]
S9L1D-G42	8800 [19500]	30800 [68000]	1141 [45]	3563 [140]
S9M1D-E42	6600 [14600]	28600 [63100]	1155 [45]	3773 [149]
S9M1D-F42	7000 [15500]	29100 [64200]	1151 [45]	3725 [147]
S9M1D-G42	7800 [17200]	29800 [65700]	1144 [45]	3639 [143]
S9M1D-H42	8200 [18100]	30300 [66800]	1141 [45]	3592 [141]
S9H1D-E42	6600 [14600]	28600 [63100]	1155 [45]	3773 [149]
S9H1D-F42	7000 [15500]	29100 [64200]	1151 [45]	3725 [147]
S9H1D-G42	7800 [17200]	29800 [65700]	1144 [45]	3639 [143]
S9H1D-H42	8200 [18100]	30300 [66800]	1141 [45]	3592 [141]

ALTERNATOR		REMOTE COOLED		
ALTERNATOR	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH NO RADIATOR* Kg [lbs]	C OF G WITHOUT RADIATOR DIM A (SHOWN)* mm [inch]	C OF G WITHOUT RADIATOR DIM B (SHOWN)* mm [inch]
S9L1D-E42	7400 [16400]	23900 [52700]	1027 [40]	2916 [115]
S9L1D-F42	7900 [17300]	24300 [53600]	1025 [40]	2874 [113]
S9L1D-G42	8700 [19200]	25200 [55500]	1022 [40]	2790 [110]
S9M1D-E42	6600 [14400]	23000 [50700]	1027 [40]	2978 [117]
S9M1D-F42	7000 [15400]	23500 [51700]	1025 [40]	2934 [115]
S9M1D-G42	7800 [17100]	24200 [53400]	1021 [40]	2852 [112]
S9M1D-H42	8200 [18100]	24700 [54300]	1019 [40]	2809 [111]
S9H1D-E42	6600 [14400]	23000 [50700]	1027 [40]	2978 [117]
S9H1D-F42	7000 [15400]	23500 [51700]	1025 [40]	2934 [115]
S9H1D-G42	7800 [17100]	24200 [53400]	1021 [40]	2852 [112]
S9H1D-H42	8200 [18100]	24700 [54300]	1019 [40]	2809 [111]



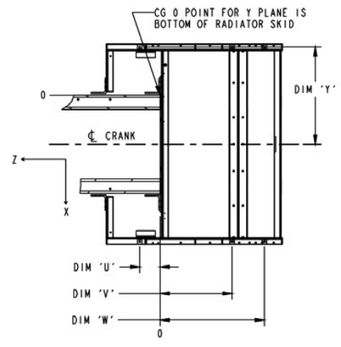
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FIGURE 551. SHEET 18 OF 22

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RADIATOR VARIATON	CORE SIZE	FREQUENCY	COOLANT VOLUME L [GAL]	DRY WEIGHT KG [LBS]	WET WEIGHT KG [LBS]	RAD X-AXIS CG [INCHES]	RAD Y-AXIS CG [INCHES]	RAD Z-AXIS CG [INCHES]	ALTERNATOR	GENSET O/A LENGTH [INCHES]	GENSET O/A WIDTH [INCHES]	GENSET O/A HEIGHT [INCHES]
PACKAGE A 60Hz E165-2	61 SQFT	60	585 [155]	3715 [8190]	4300 [9480]	703 [28]	1414 [56]	-737 [-29]	S9 MV/HV E & F CORE	7879 [310]	2610 [103]	3366 [133]
									S9 MV/HV G & H CORE	8065 [318]	2610 [103]	3366 [133]
									S9 LV E CORE	7874 [310]	2610 [103]	3366 [133]
									S9 LV F CORE	7944 [313]	2610 [103]	3366 [133]
									S9 LV G CORE	8064 [318]	2610 [103]	3366 [133]
PACKAGE A 60Hz E127-2/128-2	84 SQFT	60	674 [179]	4298 [9475]	4929 [10867]	671 [26]	1555 [61]	-725 [-29]	S9 MV/HV E & F CORE	7824 [308]	3045 [120]	3661 [144]
									S9 MV/HV G & H CORE	8010 [315]	3045 [120]	3661 [144]
									S9 LV E CORE	7819 [308]	3045 [120]	3661 [144]
									S9 LV F CORE	7889 [311]	3045 [120]	3661 [144]
									S9 LV G CORE	8009 [315]	3045 [120]	3661 [144]
PACKAGE A 60Hz E127-2	94 SQFT	60	761 [202]	4849 [10690]	5608 [12364]	694 [27]	1595 [63]	-910 [-36]	S9 MV/HV E & F CORE	8109 [319]	3171 [125]	3791 [149]
									S9 MV/HV G & H CORE	8295 [327]	3171 [125]	3791 [149]
									S9 LV E CORE	8104 [319]	3171 [125]	3791 [149]
									S9 LV F CORE	8174 [322]	3171 [125]	3791 [149]
									S9 LV G CORE	8294 [327]	3171 [125]	3791 [149]

RADIATOR AVM POSITION				
RADIATOR VARIATION	DIM 'U'	DIM 'V'	DIM 'W'	DIM 'Y'
PACKAGE A 60Hz E165-2	266	935	1355	1265
PACKAGE A 60Hz E127-2/128-2	266	935	1355	1464
PACKAGE A 60Hz E127-2	266	1221	1641	1535



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FIGURE 552. SHEET 19 OF 22

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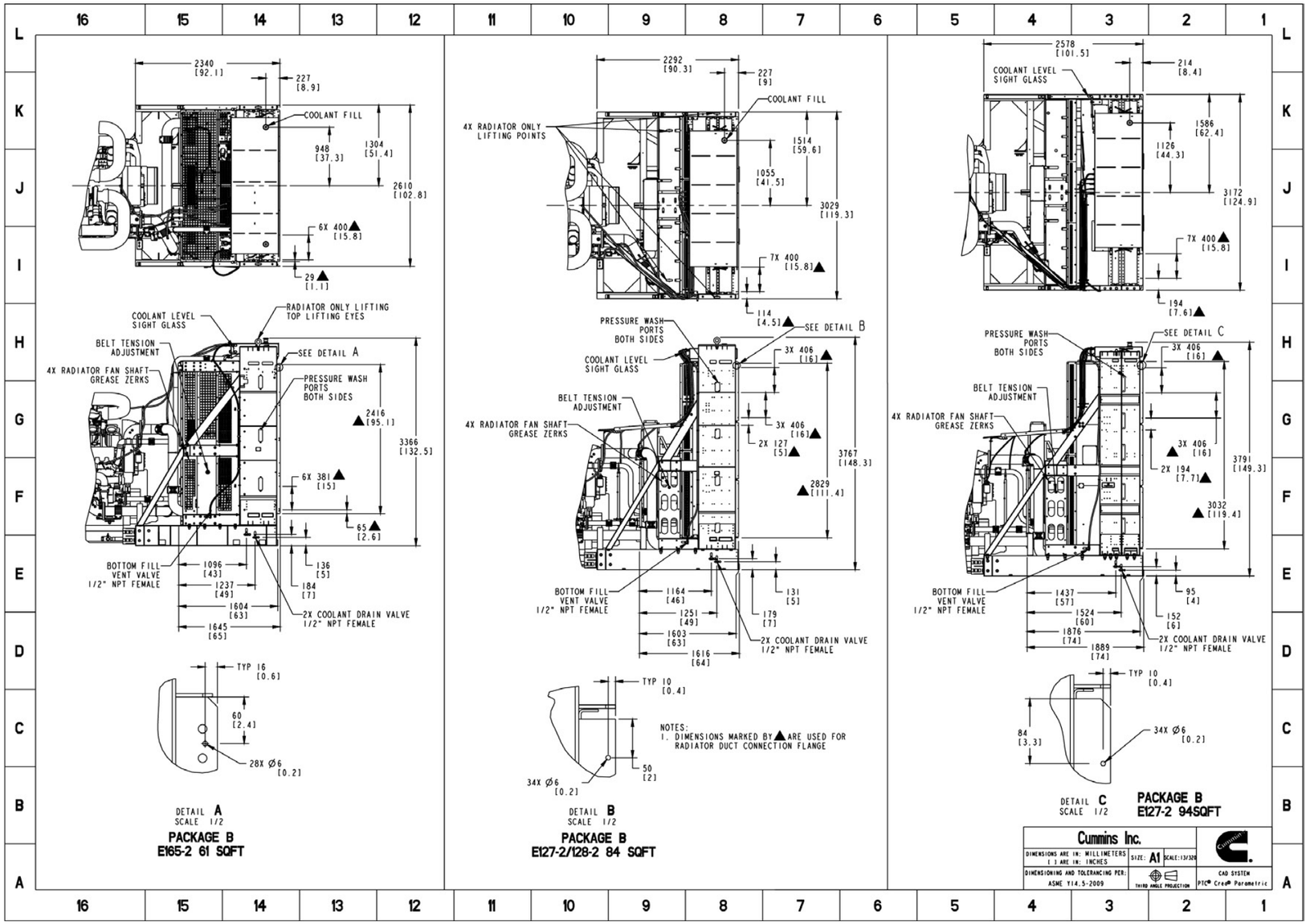


FIGURE 553. SHEET 20 OF 22

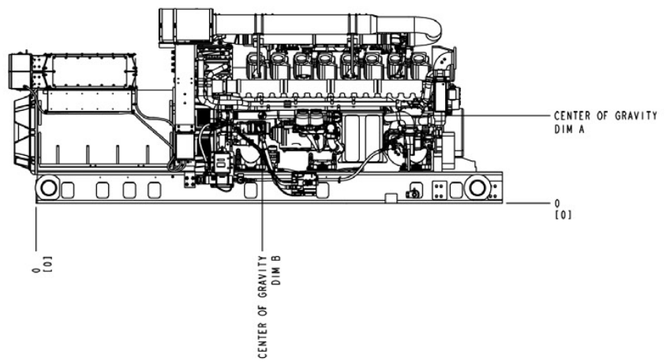
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ALTERNATOR		PACKAGE B E165-2 61 SQFT		
ALTERNATOR	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH RADIATOR* Kg [lbs]	C OF G WITH RADIATOR DIM A (SHOWN)* mm [inch]	C OF G WITH RADIATOR DIM B (SHOWN)* mm [inch]
S9L1D-E42	7500 [16600]	29500 [65100]	1160 [46]	3712 [146]
S9L1D-F42	7900 [17500]	30000 [66200]	1157 [46]	3666 [144]
S9L1D-G42	8800 [19500]	30800 [68000]	1150 [45]	3575 [141]
S9M1D-E42	6600 [14600]	28600 [63100]	1164 [46]	3786 [149]
S9M1D-F42	7000 [15500]	29100 [64200]	1161 [46]	3738 [147]
S9M1D-G42	7800 [17200]	29800 [65700]	1154 [45]	3651 [144]
S9M1D-H42	8200 [18100]	30300 [66800]	1150 [45]	3604 [142]
S9H1D-E42	6600 [14600]	28600 [63100]	1164 [46]	3786 [149]
S9H1D-F42	7000 [15500]	29100 [64200]	1161 [46]	3738 [147]
S9H1D-G42	7800 [17200]	29800 [65700]	1154 [45]	3651 [144]
S9H1D-H42	8200 [18100]	30300 [66800]	1150 [45]	3604 [142]

ALTERNATOR		PACKAGE B E127-2/128-2 84 SQFT		
ALTERNATOR	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH RADIATOR* Kg [lbs]	C OF G WITH RADIATOR DIM A (SHOWN)* mm [inch]	C OF G WITH RADIATOR DIM B (SHOWN)* mm [inch]
S9L1D-E42	7500 [16600]	29500 [65100]	1143 [45]	3687 [145]
S9L1D-F42	7900 [17500]	29900 [66000]	1140 [45]	3642 [143]
S9L1D-G42	8800 [19500]	30800 [68000]	1133 [45]	3552 [140]
S9M1D-E42	6600 [14600]	28600 [63100]	1146 [45]	3761 [148]
S9M1D-F42	7000 [15500]	29000 [64000]	1143 [45]	3713 [146]
S9M1D-G42	7800 [17200]	29800 [65700]	1136 [45]	3627 [143]
S9M1D-H42	8200 [18100]	30200 [66600]	1133 [45]	3580 [141]
S9H1D-E42	6600 [14600]	28600 [63100]	1146 [45]	3761 [148]
S9H1D-F42	7000 [15500]	29000 [64000]	1143 [45]	3713 [146]
S9H1D-G42	7800 [17200]	29800 [65700]	1136 [45]	3627 [143]
S9H1D-H42	8200 [18100]	30200 [66600]	1133 [45]	3580 [141]

ALTERNATOR		PACKAGE B E127-2 94 SQFT		
ALTERNATOR	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH RADIATOR* Kg [lbs]	C OF G WITH RADIATOR DIM A (SHOWN)* mm [inch]	C OF G WITH RADIATOR DIM B (SHOWN)* mm [inch]
S9L1D-E42	7500 [16600]	30200 [66600]	1181 [46]	3885 [153]
S9L1D-F42	7900 [17500]	30700 [67700]	1177 [46]	3837 [151]
S9L1D-G42	8800 [19500]	31500 [69500]	1170 [46]	3744 [147]
S9M1D-E42	6600 [14600]	29300 [64600]	1185 [47]	3962 [156]
S9M1D-F42	7000 [15500]	29800 [65700]	1181 [46]	3913 [154]
S9M1D-G42	7800 [17200]	30500 [67300]	1174 [46]	3824 [151]
S9M1D-H42	8200 [18100]	31000 [68400]	1170 [45]	3775 [149]
S9H1D-E42	6600 [14600]	29300 [64600]	1185 [47]	3962 [156]
S9H1D-F42	7000 [15500]	29800 [65700]	1181 [46]	3913 [154]
S9H1D-G42	7800 [17200]	30500 [67300]	1174 [46]	3824 [151]
S9H1D-H42	8200 [18100]	31000 [68400]	1170 [46]	3775 [149]

ALTERNATOR		REMOTE COOLED		
ALTERNATOR	ALTERNATOR WEIGHT Kg [LBS]	GENSET WEIGHT WITH NO RADIATOR* Kg [lbs]	C OF G WITHOUT RADIATOR DIM A (SHOWN)* mm [inch]	C OF G WITHOUT RADIATOR DIM B (SHOWN)* mm [inch]
S9L1D-E42	7400 [16400]	23900 [52700]	1027 [40]	2916 [115]
S9L1D-F42	7900 [17300]	24300 [53600]	1025 [40]	2874 [113]
S9L1D-G42	8700 [19200]	25200 [55500]	1022 [40]	2790 [110]
S9M1D-E42	6600 [14400]	23000 [50700]	1027 [40]	2978 [117]
S9M1D-F42	7000 [15400]	23500 [51700]	1025 [40]	2934 [115]
S9M1D-G42	7800 [17100]	24200 [53400]	1021 [40]	2852 [112]
S9M1D-H42	8200 [18100]	24700 [54300]	1019 [40]	2809 [111]
S9H1D-E42	6600 [14400]	23000 [50700]	1027 [40]	2978 [117]
S9H1D-F42	7000 [15400]	23500 [51700]	1025 [40]	2934 [115]
S9H1D-G42	7800 [17100]	24200 [53400]	1021 [40]	2852 [112]
S9H1D-H42	8200 [18100]	24700 [54300]	1019 [40]	2809 [111]



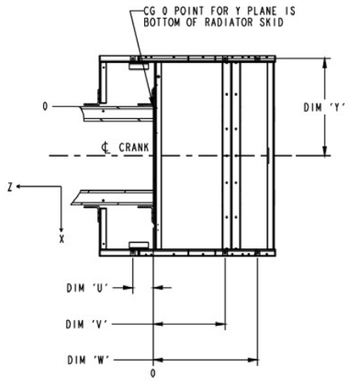
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FIGURE 554. SHEET 21 OF 22

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RADIATOR VARIATON	CORE SIZE	FREQUENCY	COOLANT VOLUME L [GAL]			RAD DRY WEIGHT [LBS]	RAD WET WEIGHT [LBS]	RAD X-AXIS CG [INCHES]	RAD Y-AXIS CG [INCHES]	RAD Z-AXIS CG [INCHES]	ALTERNATOR	GENSET O/A LENGTH [INCHES]	GENSET O/A WIDTH [INCHES]	GENSET O/A HEIGHT [INCHES]
			HT (CT1)	LT (CT1)	SURGE TANK									
PACKAGE B E165-2	61 SQFT	50/60	388 [103]	321 [84.8]	183 [40.2]	4647 [10245]	5610 [12368]	665 [26]	1542 [61]	-1053 [-41]	S9 MV/HV E & F CORE	7878 [310]	2610 [103]	3366 [133]
											S9 MV/HV G & H CORE	8064 [317]	2610 [103]	3366 [133]
											S9 LV E CORE	7873 [310]	2610 [103]	3366 [133]
											S9 LV F CORE	7943 [313]	2610 [103]	3366 [133]
											S9 LV G CORE	8063 [317]	2610 [103]	3366 [133]
PACKAGE B E127-2 /128-2	84 SQFT	50/60	546 [120.1]	204 [44.8]	179 [39.4]	4772 [10520]	5561 [12260]	672 [26]	1677 [66]	-969 [-38]	S9 MV/HV E & F CORE	7823 [308]	3029 [119]	3767 [148]
											S9 MV/HV G & H CORE	8009 [315]	3029 [119]	3767 [148]
											S9 LV E CORE	7818 [308]	3029 [119]	3767 [148]
											S9 LV F CORE	7888 [311]	3029 [119]	3767 [148]
											S9 LV G CORE	8008 [315]	3029 [119]	3767 [148]
PACKAGE B E127-2	94 SQFT	60	584 [128.4]	217 [47.7]	179 [39.4]	5321 [11730]	6309 [13908]	680 [27]	1536 [61]	-1203 [-47]	S9 MV/HV E & F CORE	8108 [319]	3172 [125]	3791 [149]
											S9 MV/HV G & H CORE	8294 [327]	3172 [125]	3791 [149]
											S9 LV E CORE	8103 [319]	3172 [125]	3791 [149]
											S9 LV F CORE	8173 [322]	3172 [125]	3791 [149]
											S9 LV G CORE	8293 [327]	3172 [125]	3791 [149]

RADIATOR AVM POSITIONS				
RADIATOR VARIATION	DIM 'U'	DIM 'V'	DIM 'W'	DIM 'Y'
PACKAGE B E165-2	266	935	1355	1265
PACKAGE B E127-2/128-2	266	935	1355	1464
PACKAGE B E127-2	266	1221	1641	1535



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FIGURE 555. SHEET 22 OF 22

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Appendix B. Wiring Diagrams

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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.

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B.1 Schematic Diagram A041F331 with PowerCommand 3.3 Control

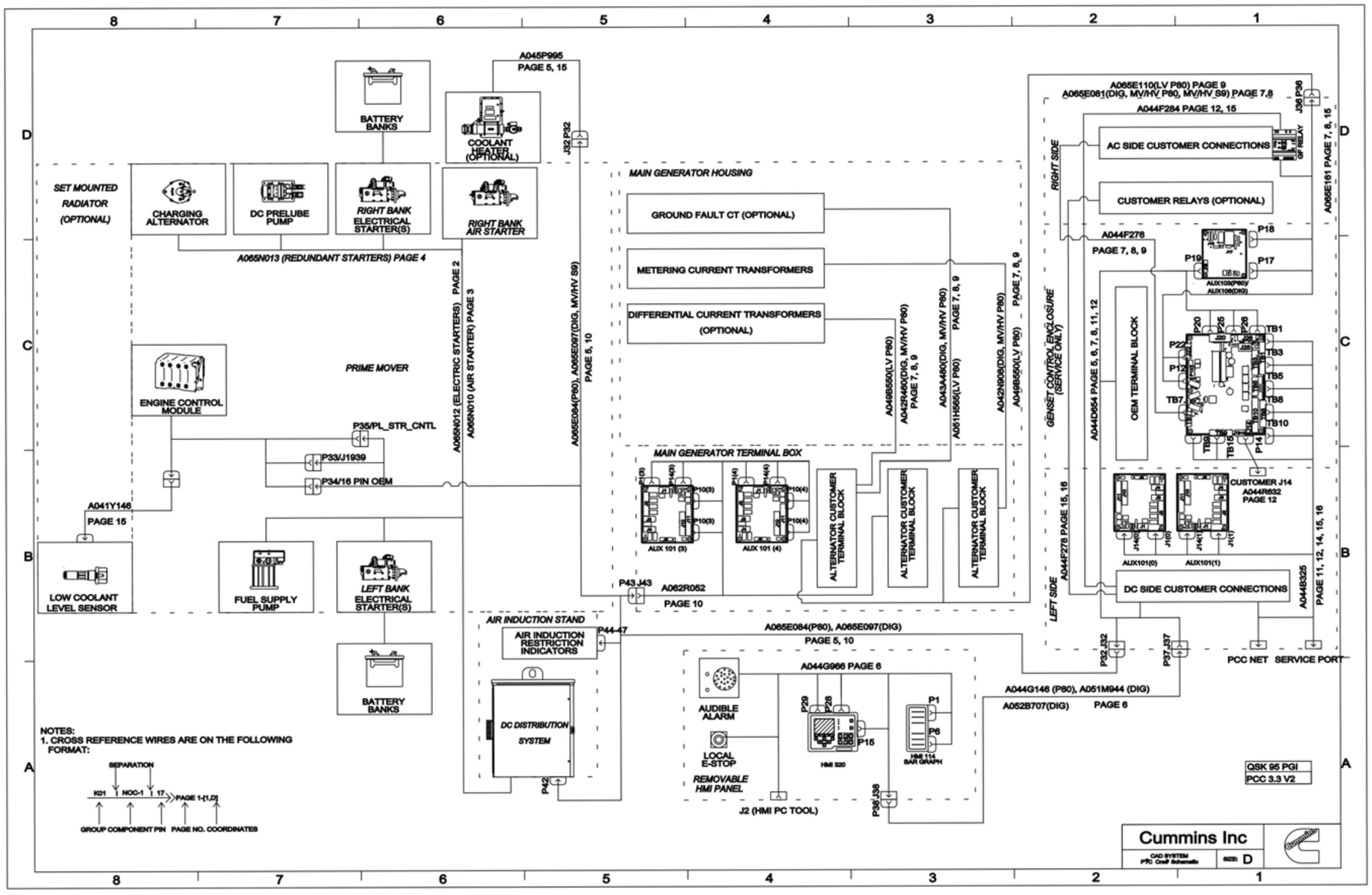


FIGURE 556. SCHEMATIC DIAGRAM (SHEET 1 OF 21)

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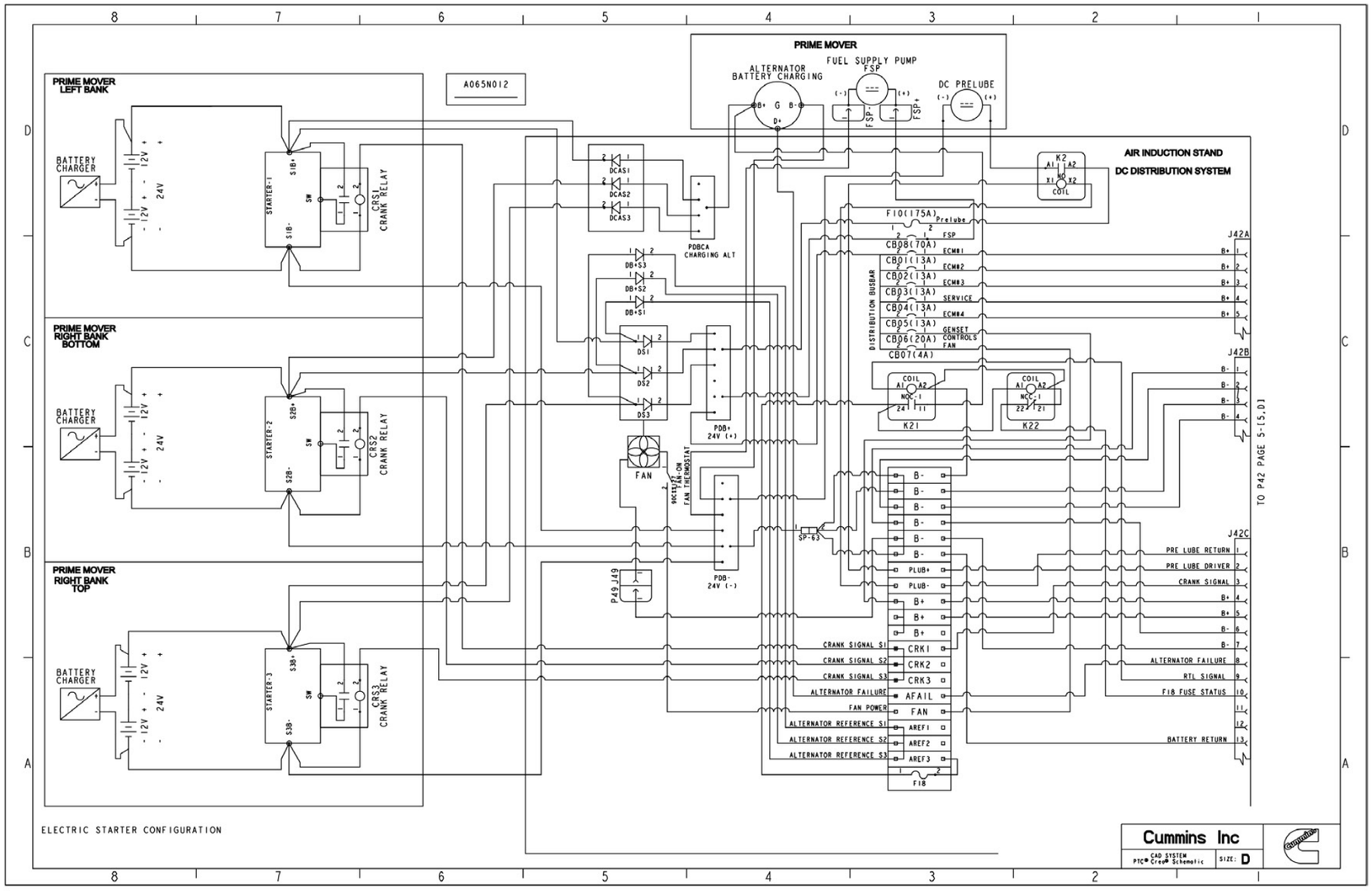


FIGURE 557. SCHEMATIC DIAGRAM (SHEET 2 OF 21)

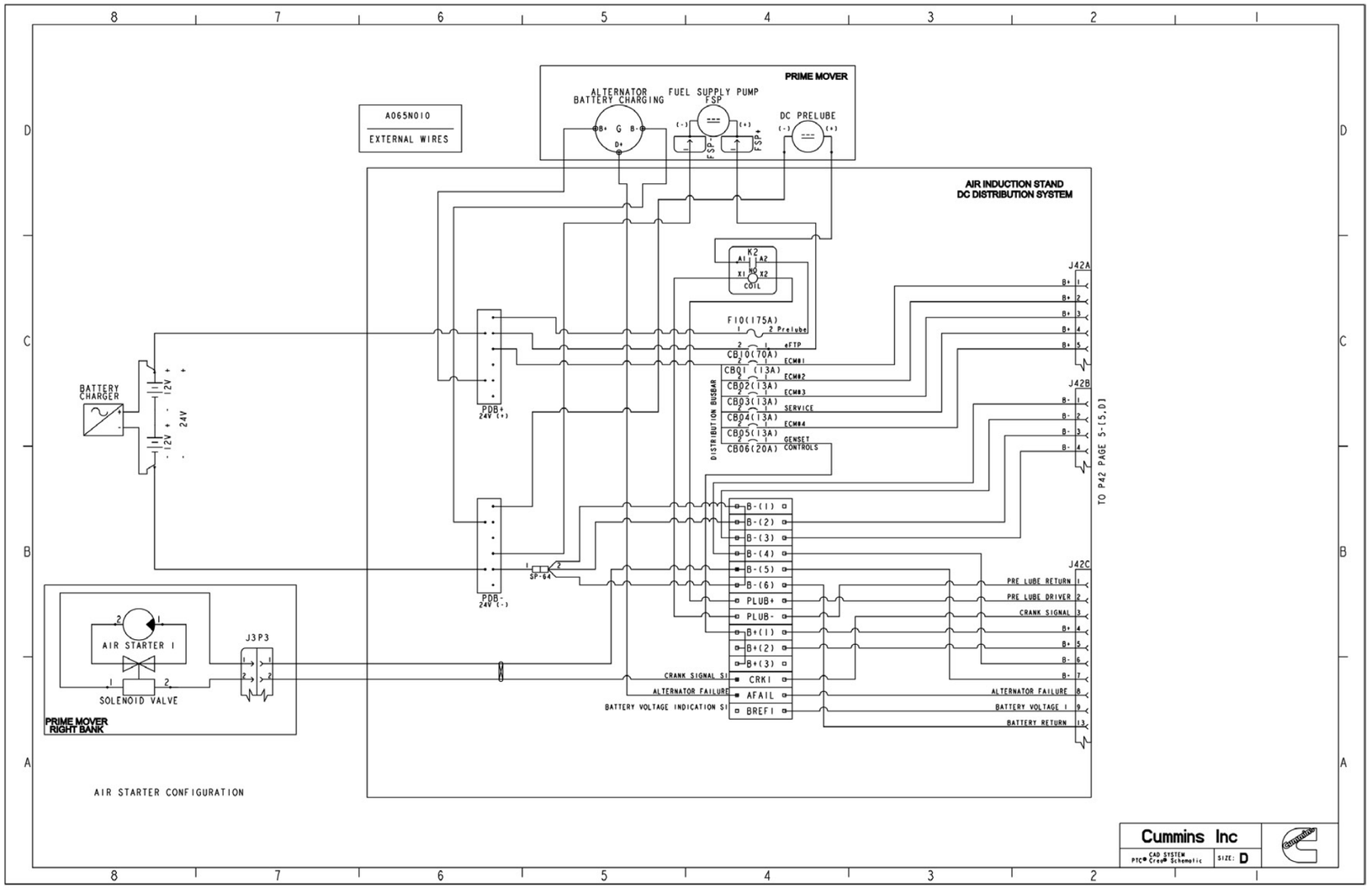


FIGURE 558. SCHEMATIC DIAGRAM (SHEET 3 OF 21)

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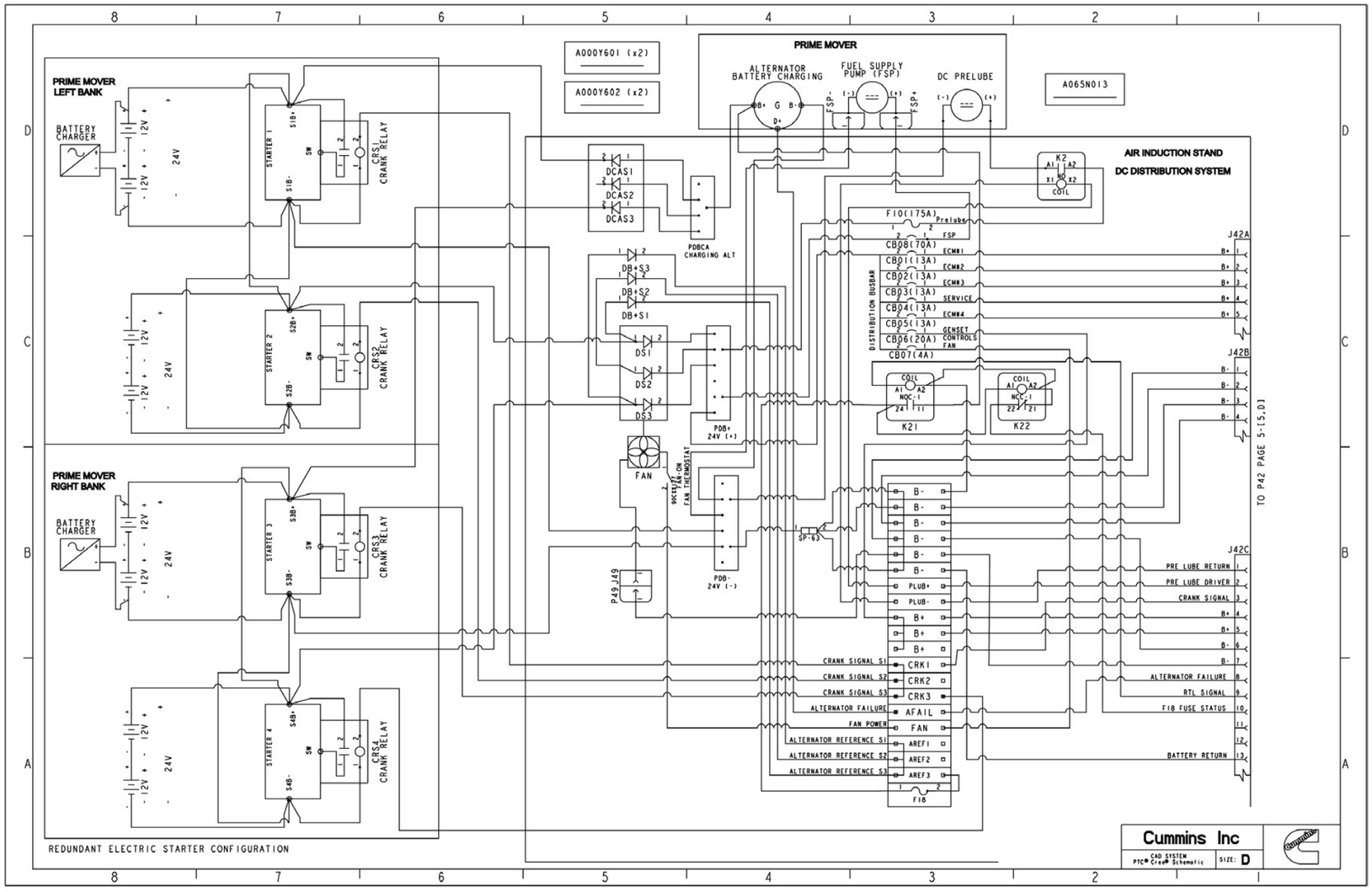


FIGURE 559. SCHEMATIC DIAGRAM (SHEET 4 OF 21)

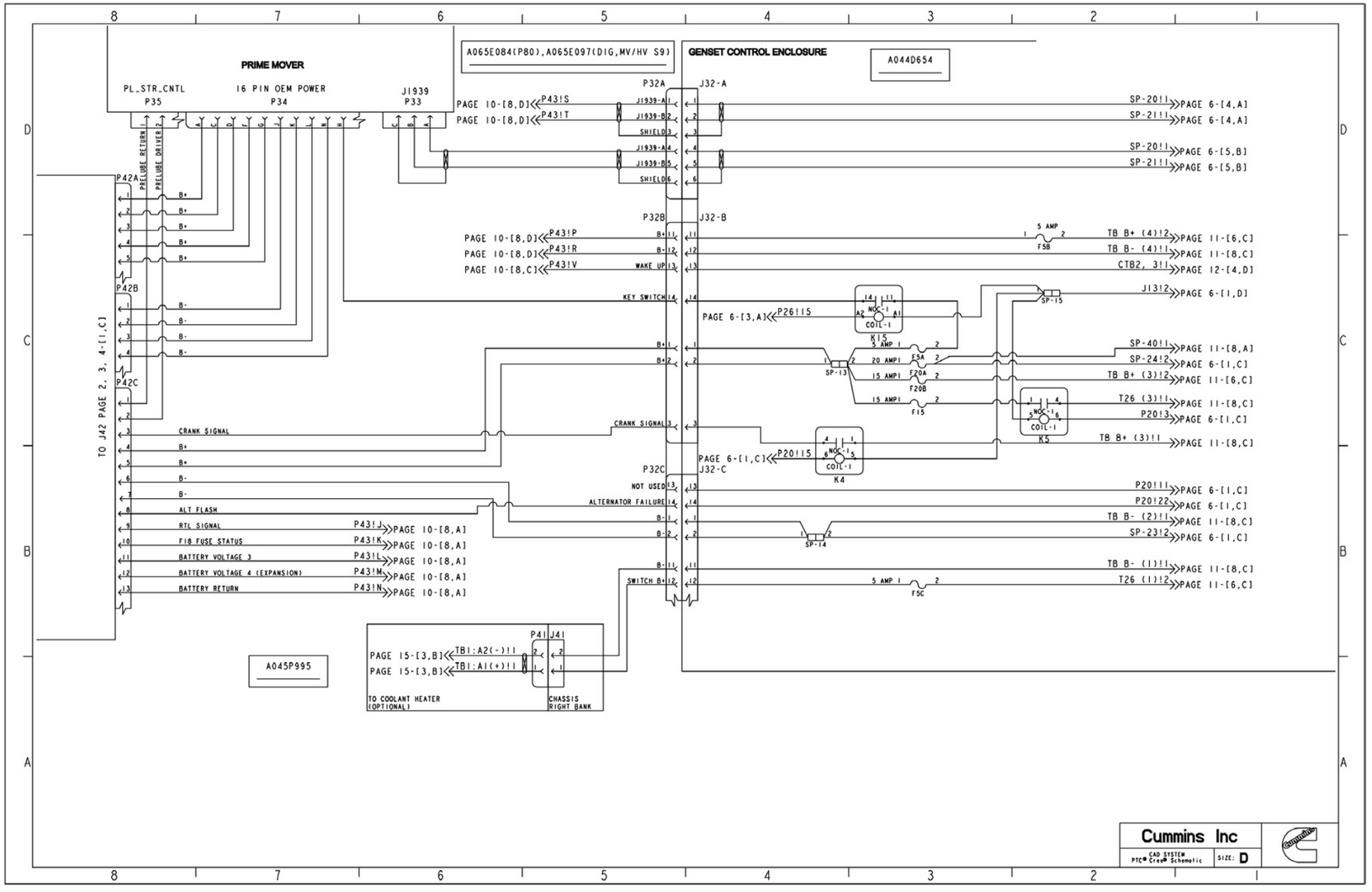


FIGURE 560. SCHEMATIC DIAGRAM (SHEET 5 OF 21)

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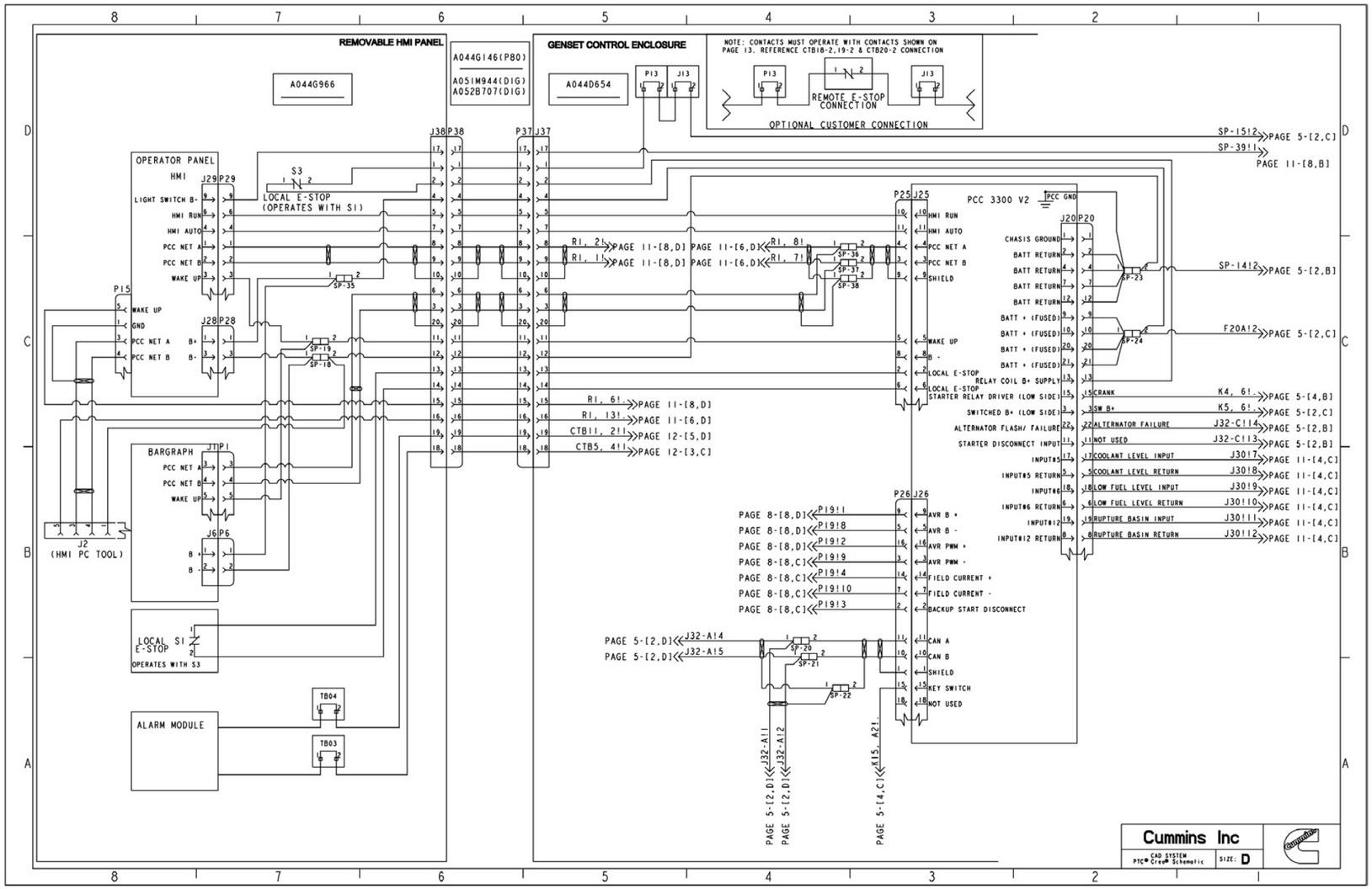


FIGURE 561. SCHEMATIC DIAGRAM (SHEET 6 OF 21)

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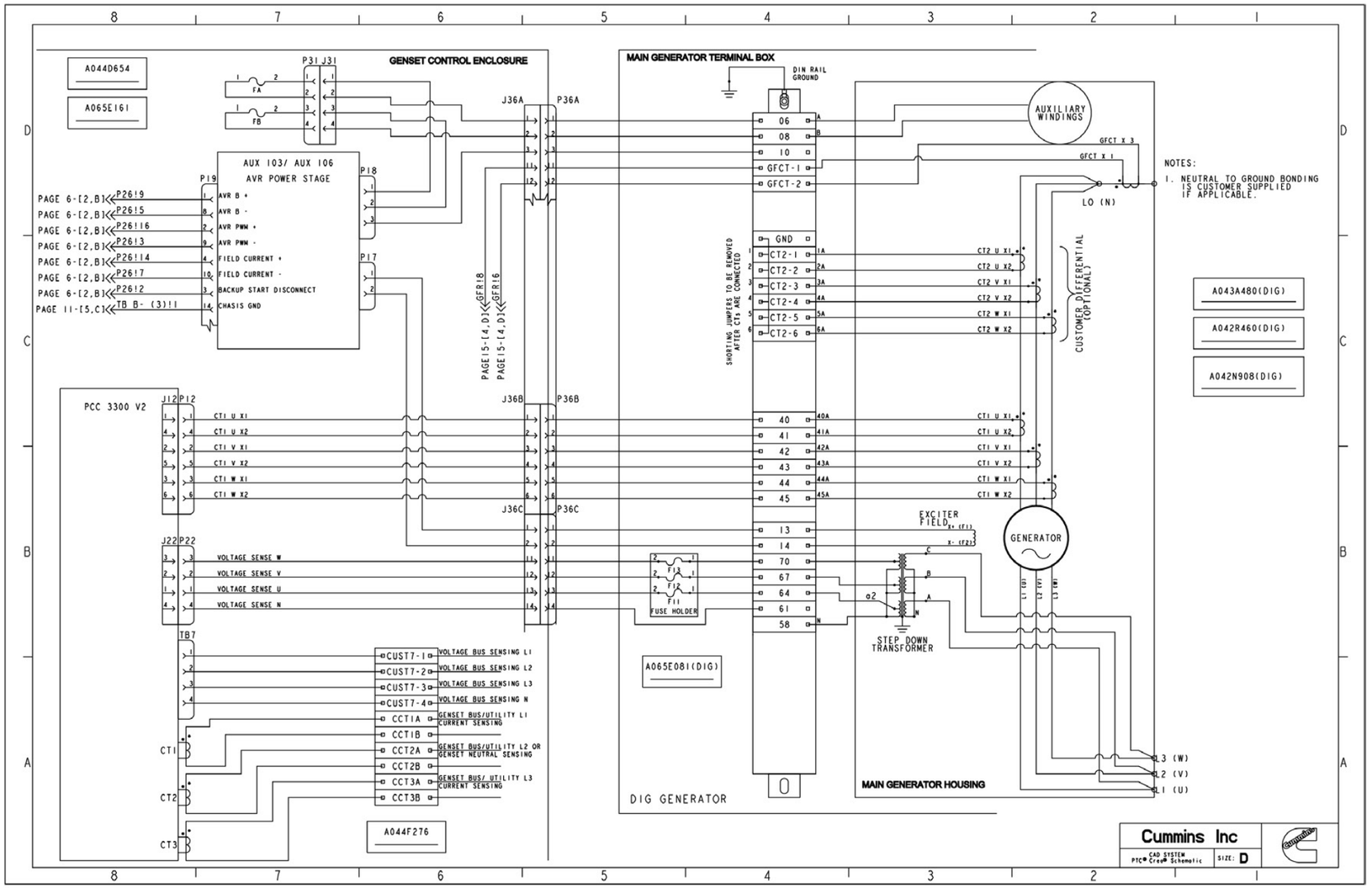


FIGURE 562. SCHEMATIC DIAGRAM (SHEET 7 OF 21)

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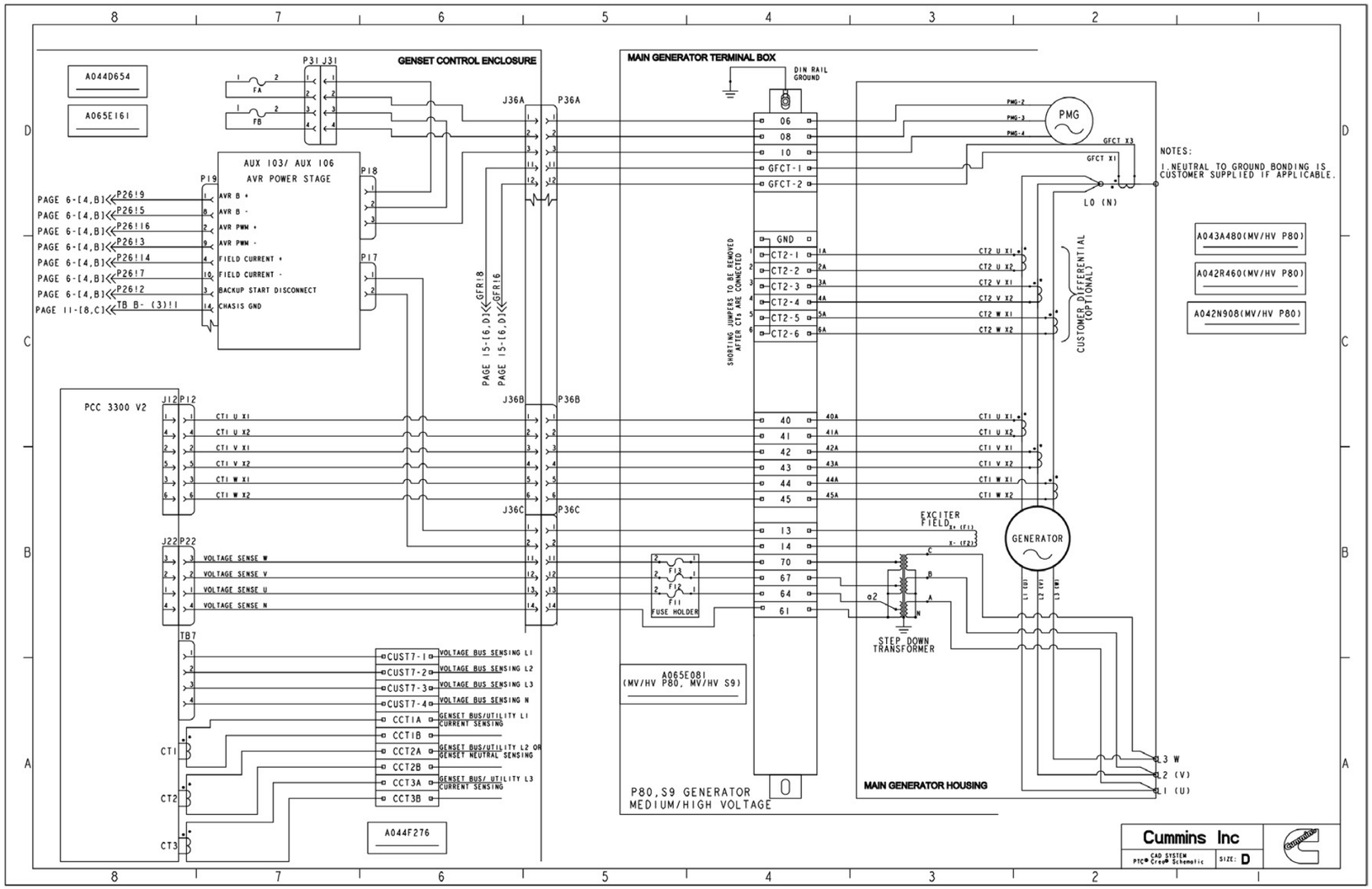


FIGURE 563. SCHEMATIC DIAGRAM (SHEET 8 OF 21)

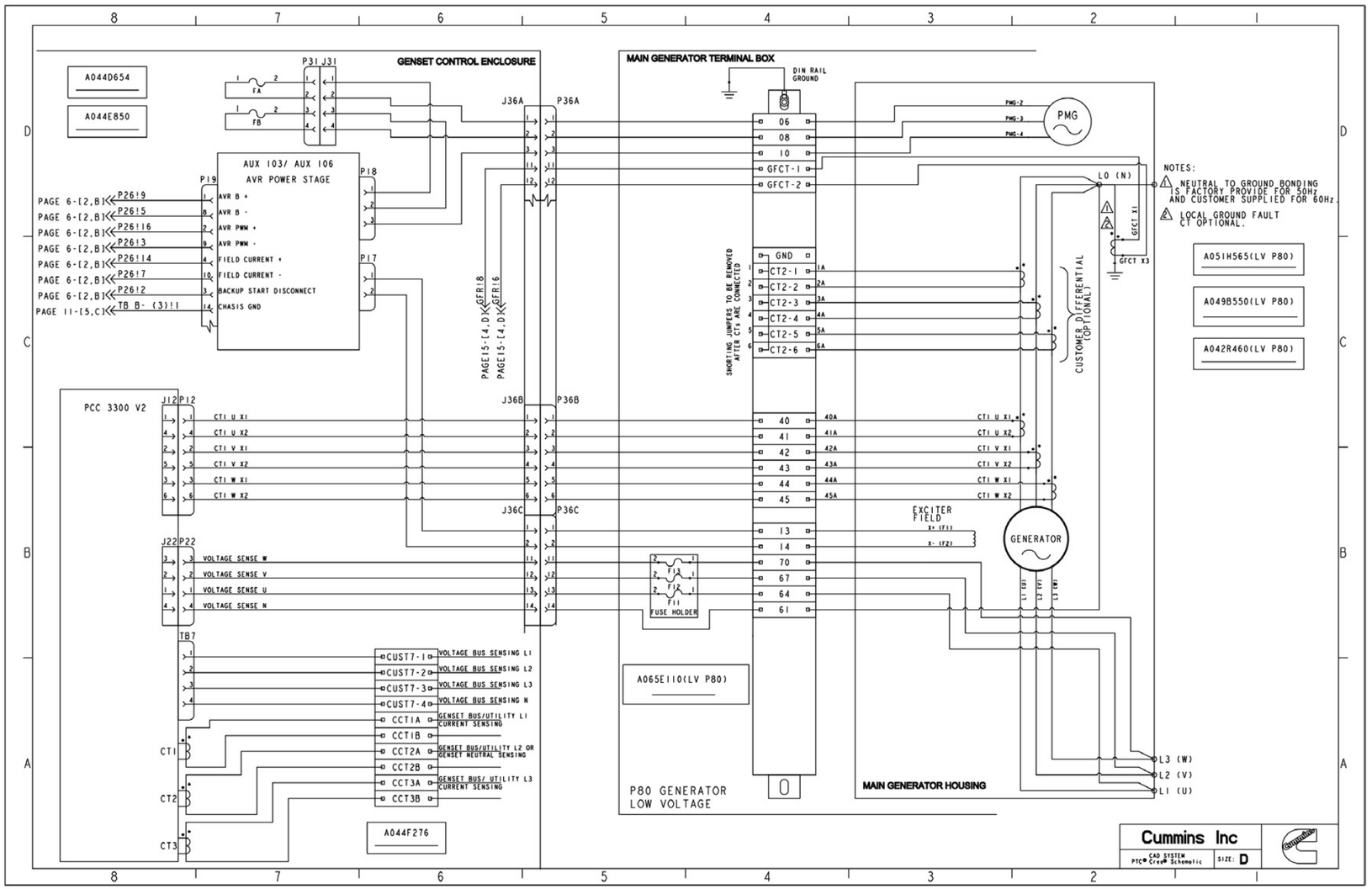


FIGURE 564. SCHEMATIC DIAGRAM (SHEET 9 OF 21)

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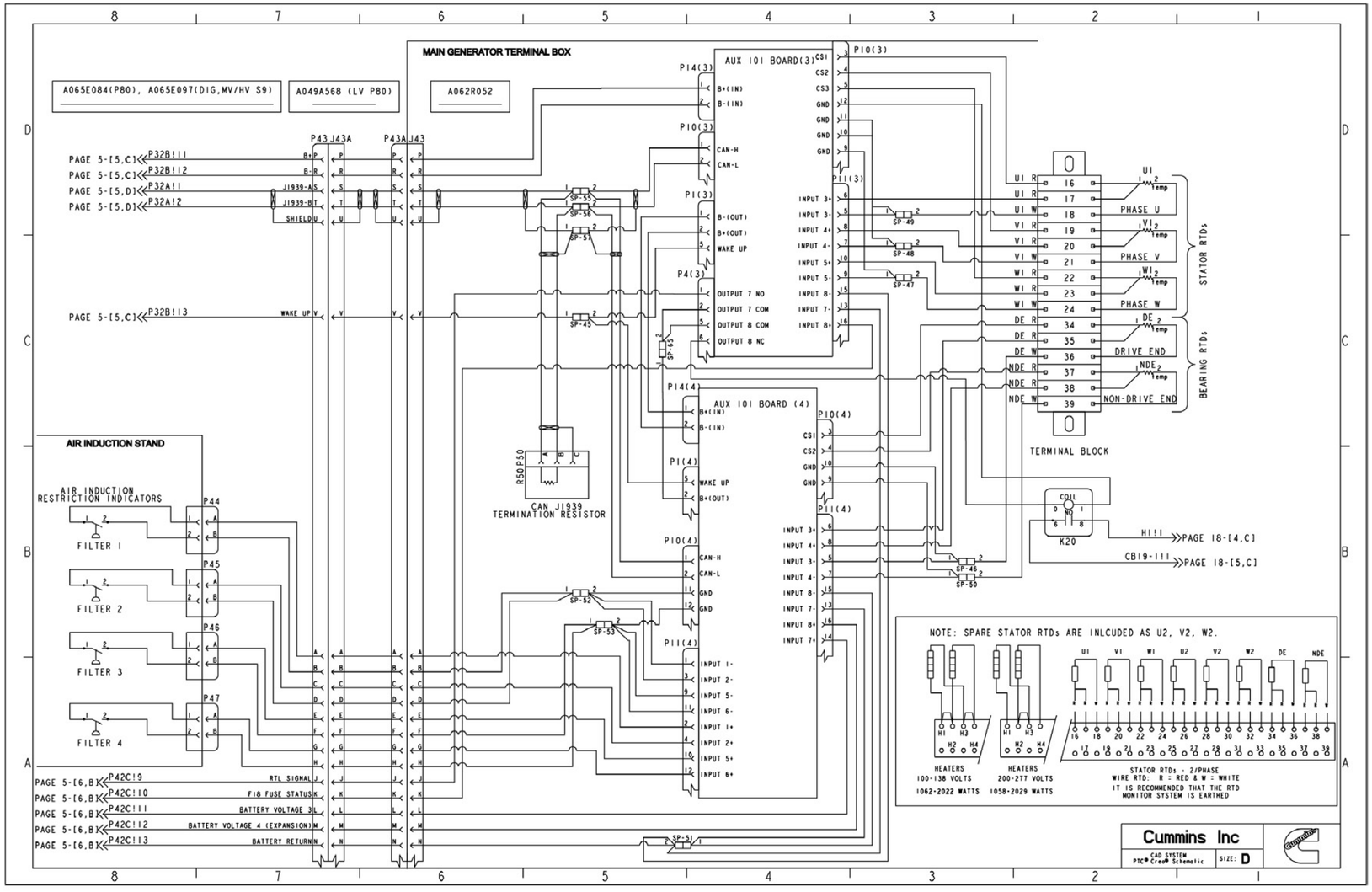


FIGURE 565. SCHEMATIC DIAGRAM (SHEET 10 OF 21)

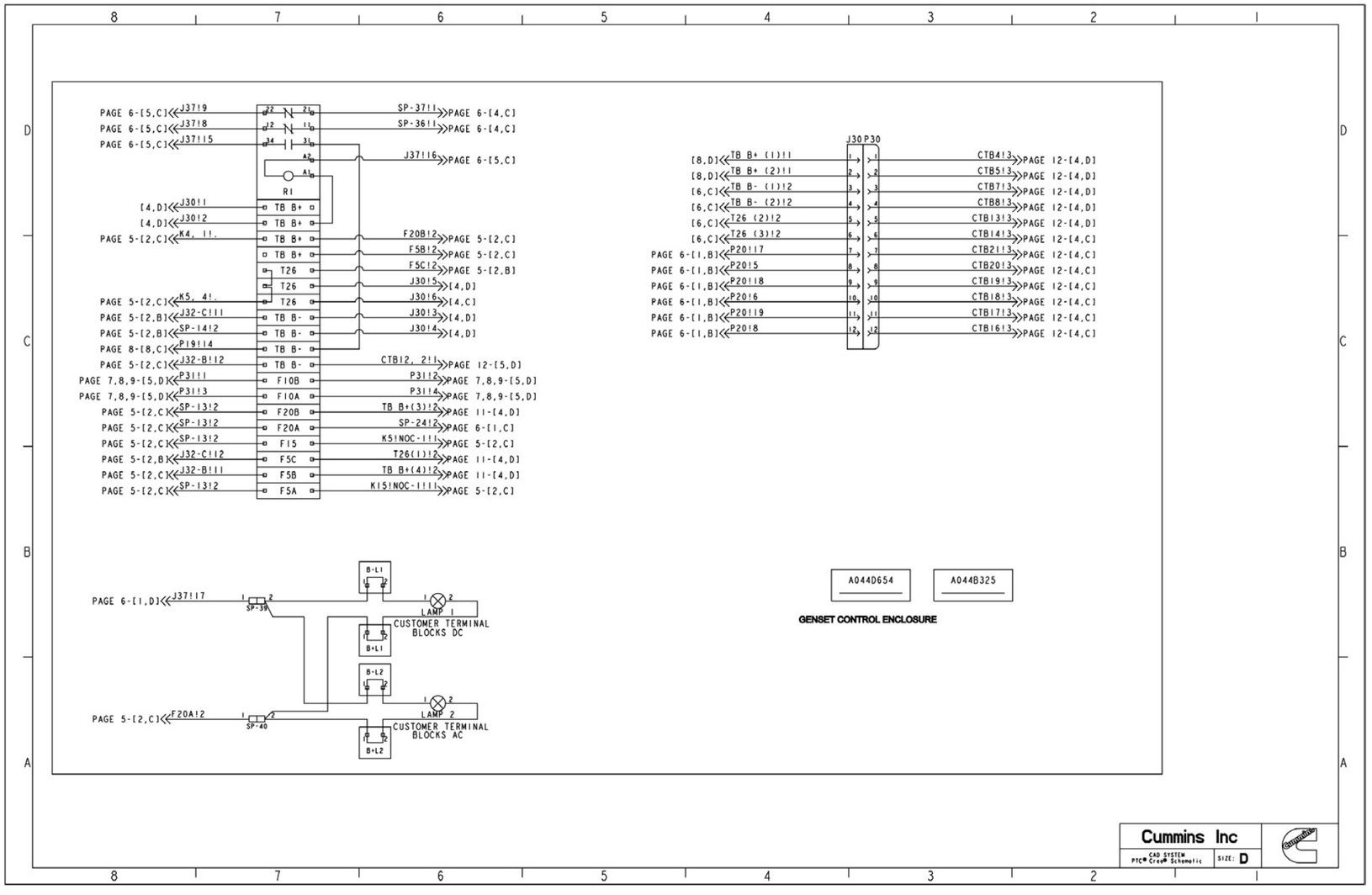


FIGURE 566. SCHEMATIC DIAGRAM (SHEET 11 OF 21)

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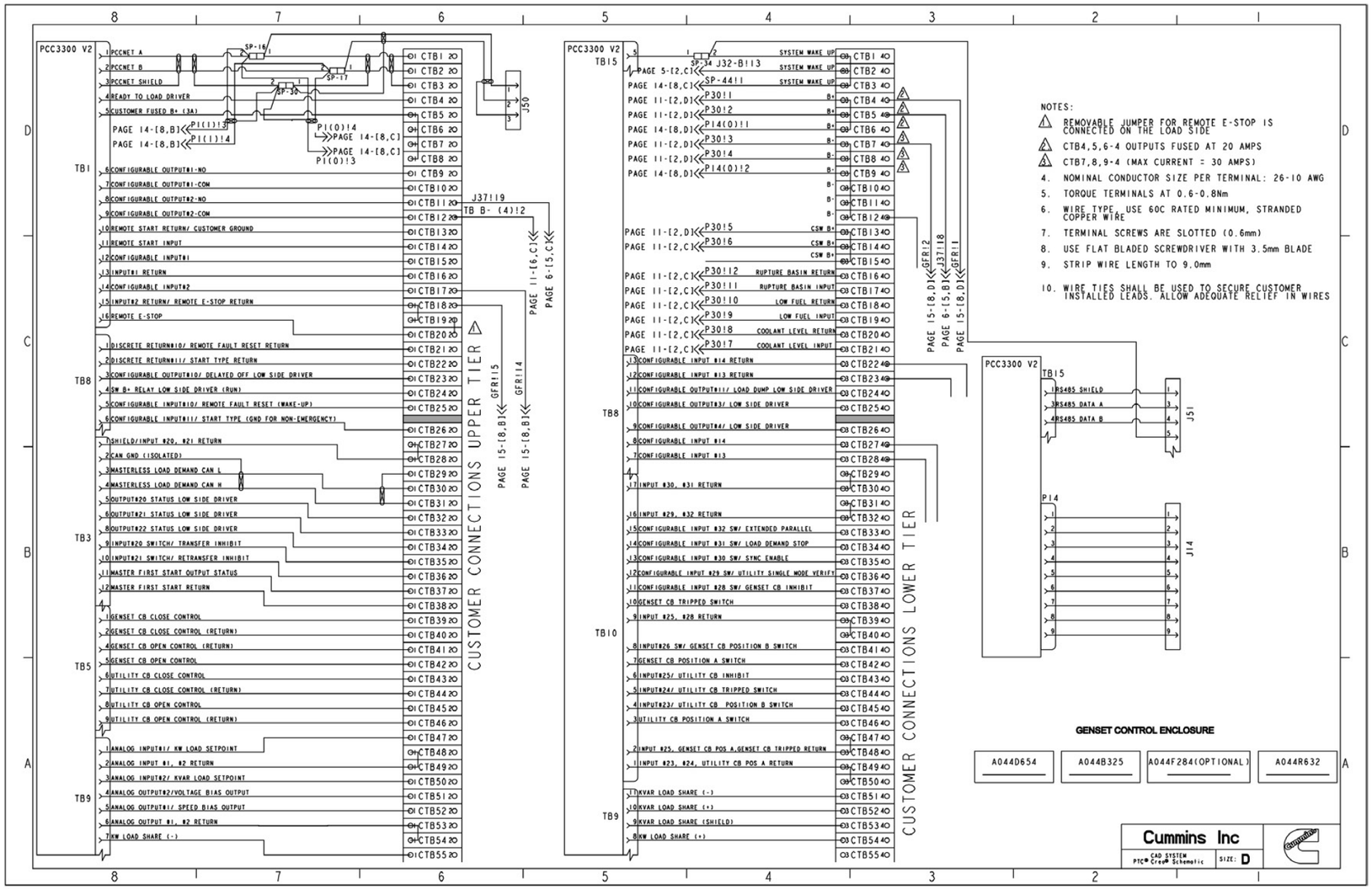


FIGURE 567. SCHEMATIC DIAGRAM (SHEET 12 OF 21)

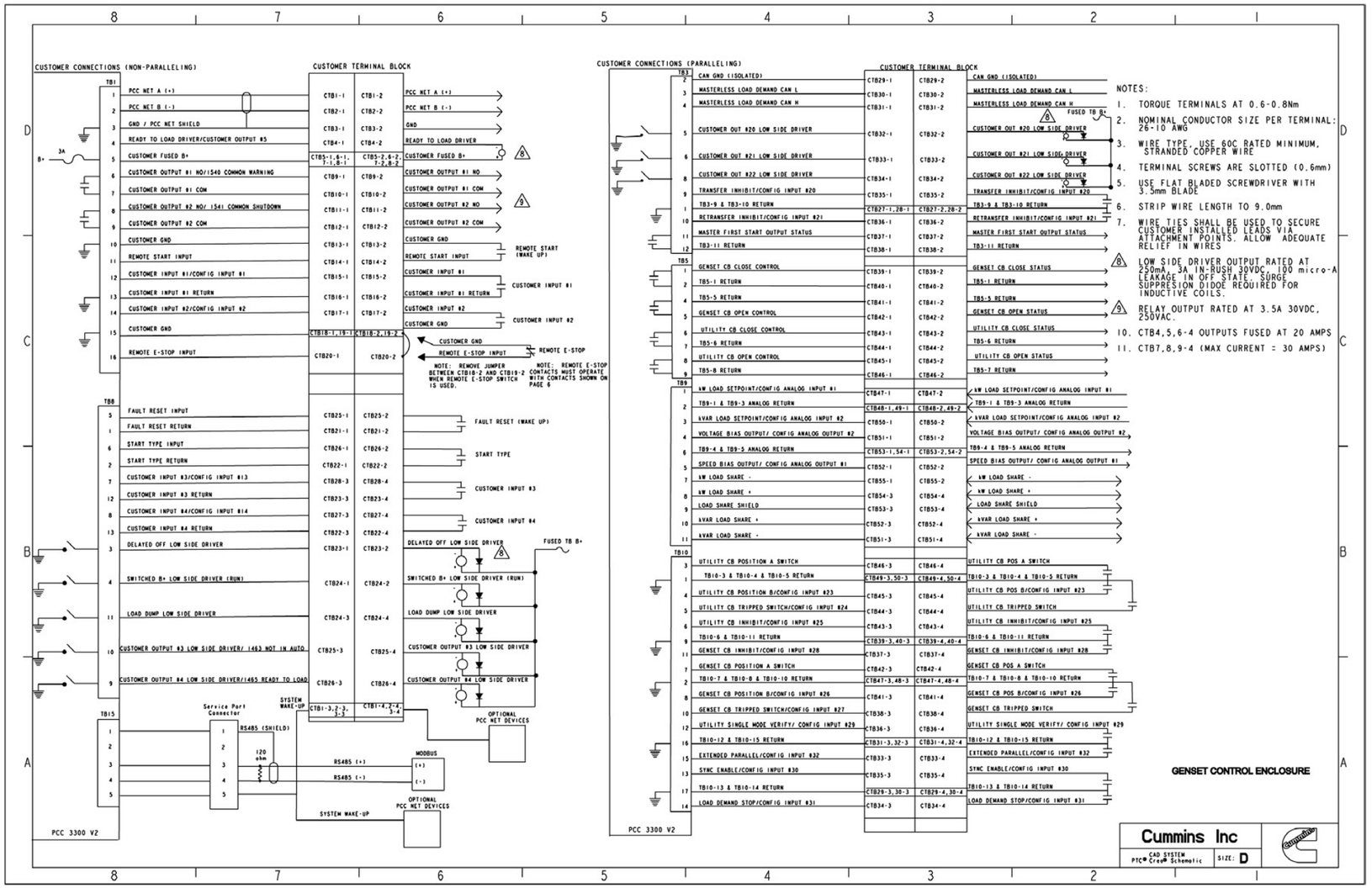


FIGURE 568. SCHEMATIC DIAGRAM (SHEET 13 OF 21)

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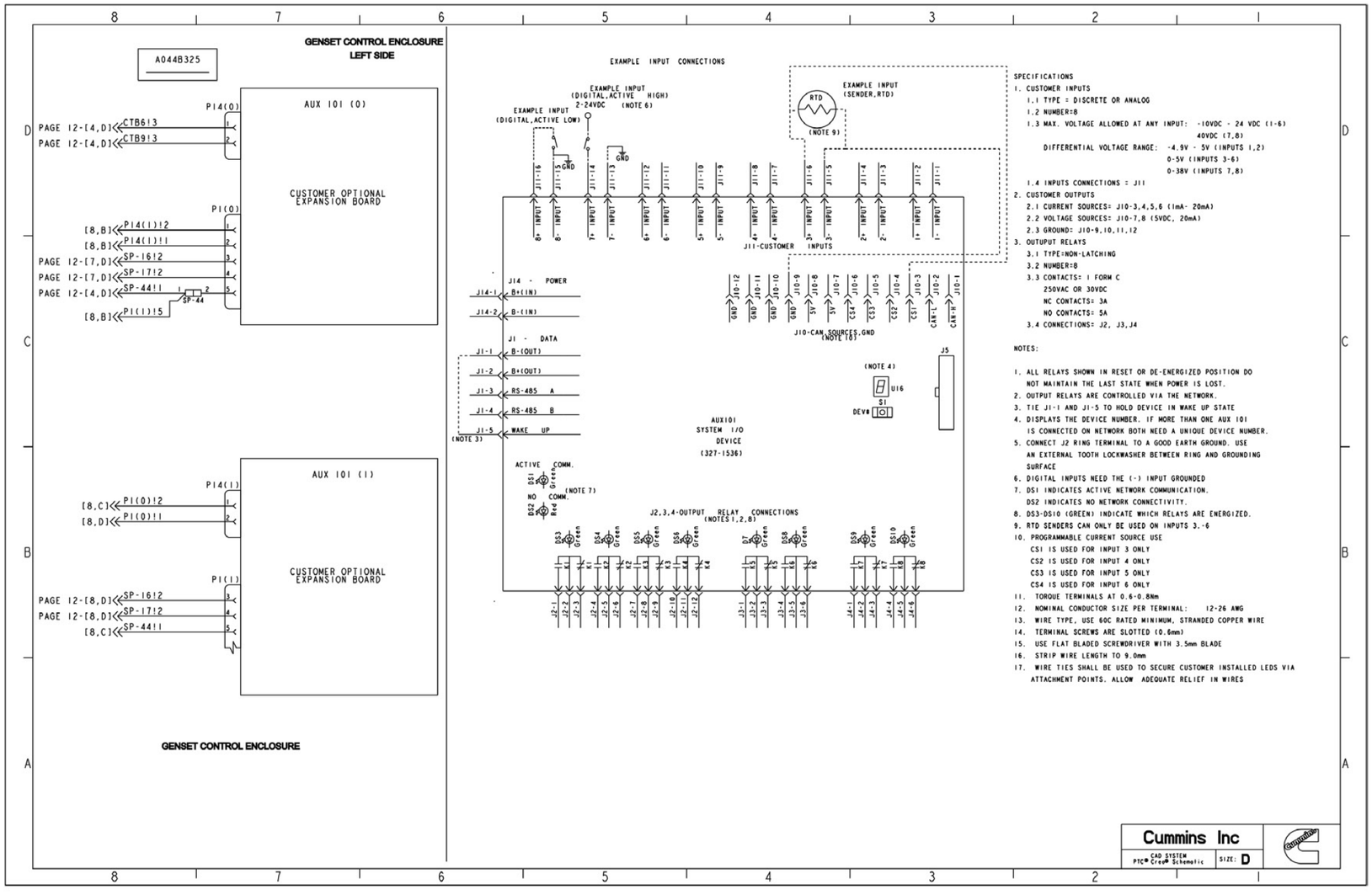


FIGURE 569. SCHEMATIC DIAGRAM (SHEET 14 OF 21)

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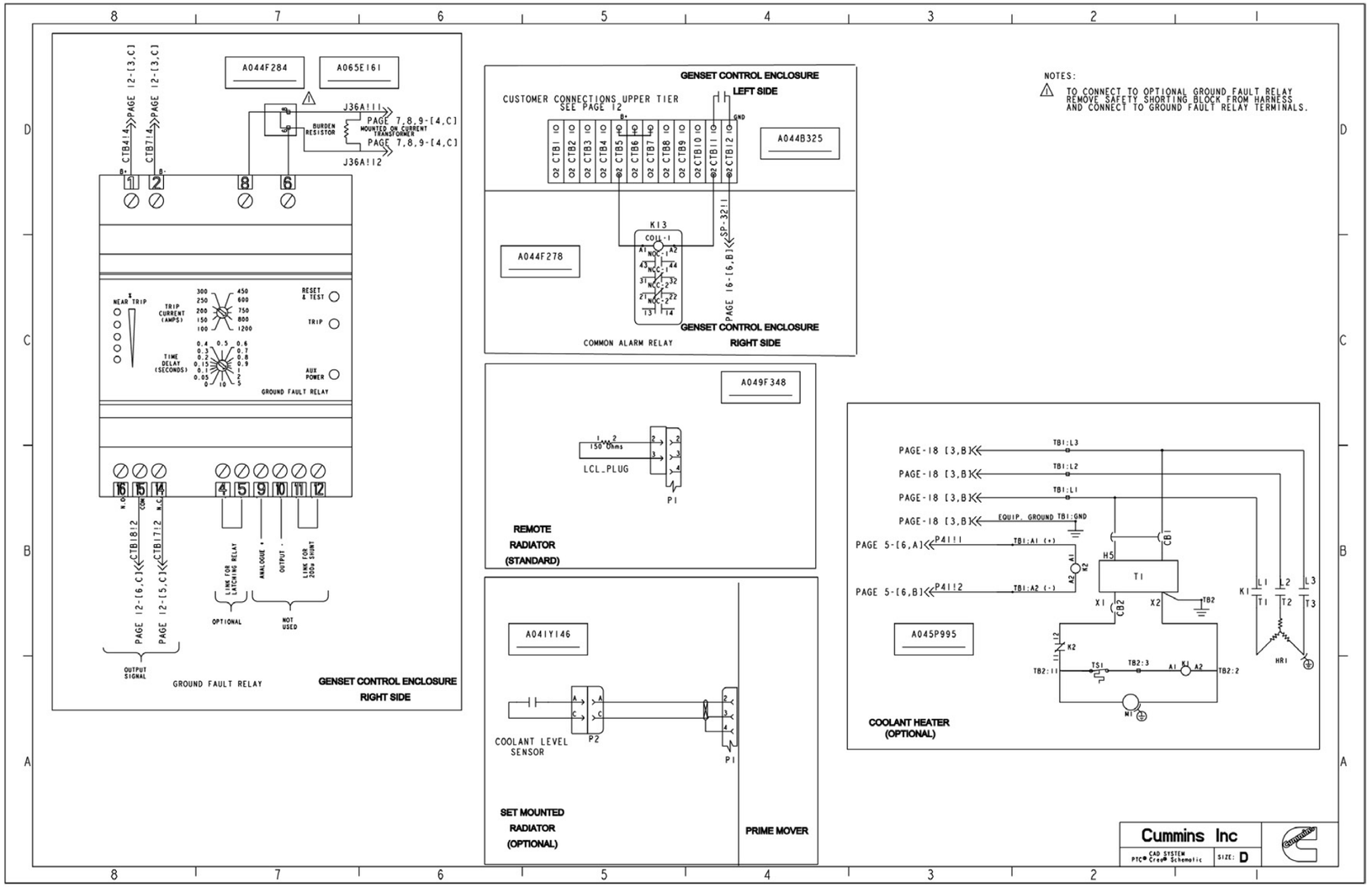


FIGURE 570. SCHEMATIC DIAGRAM (SHEET 15 OF 21)

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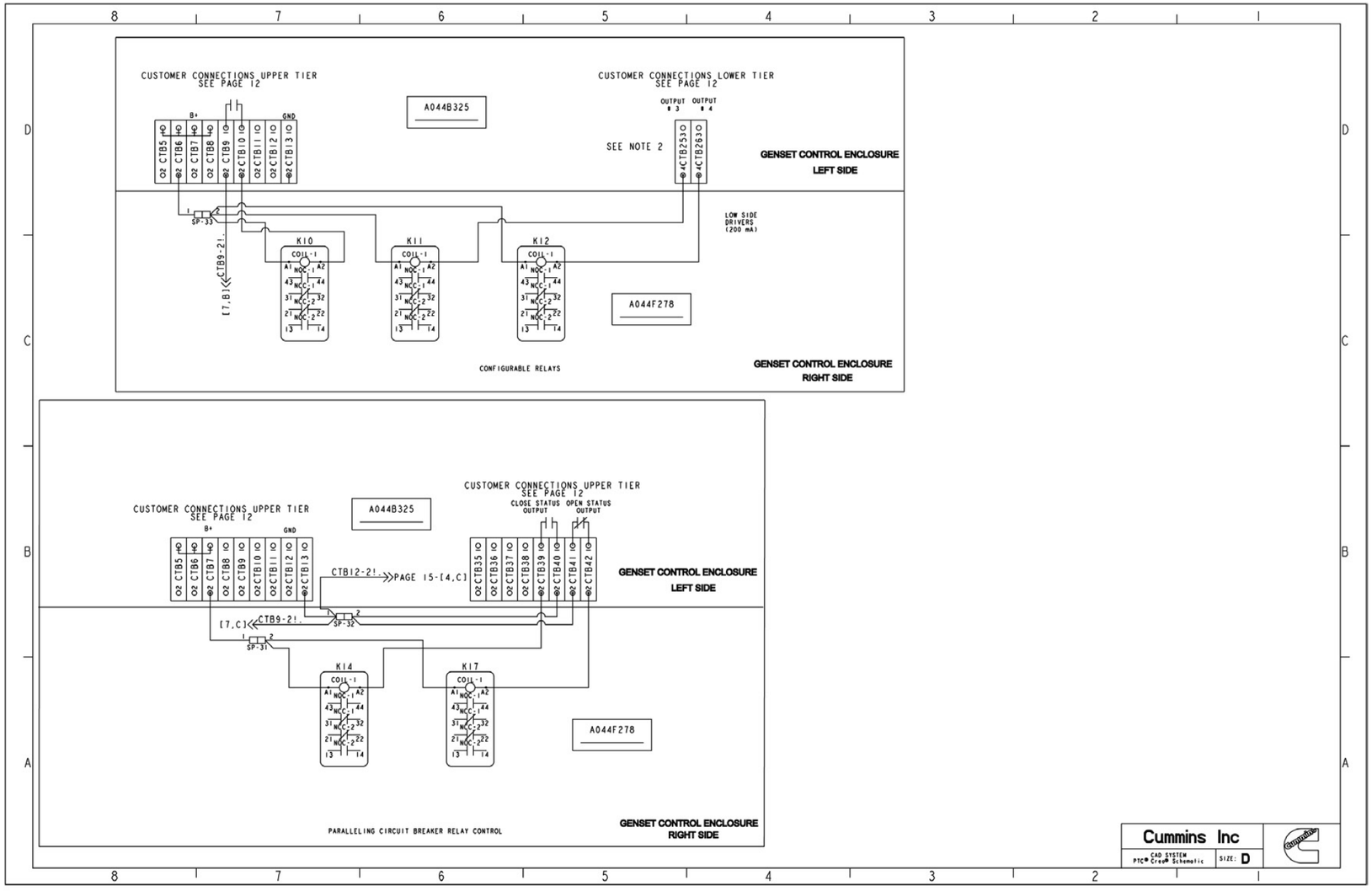


FIGURE 571. SCHEMATIC DIAGRAM (SHEET 16 OF 21)

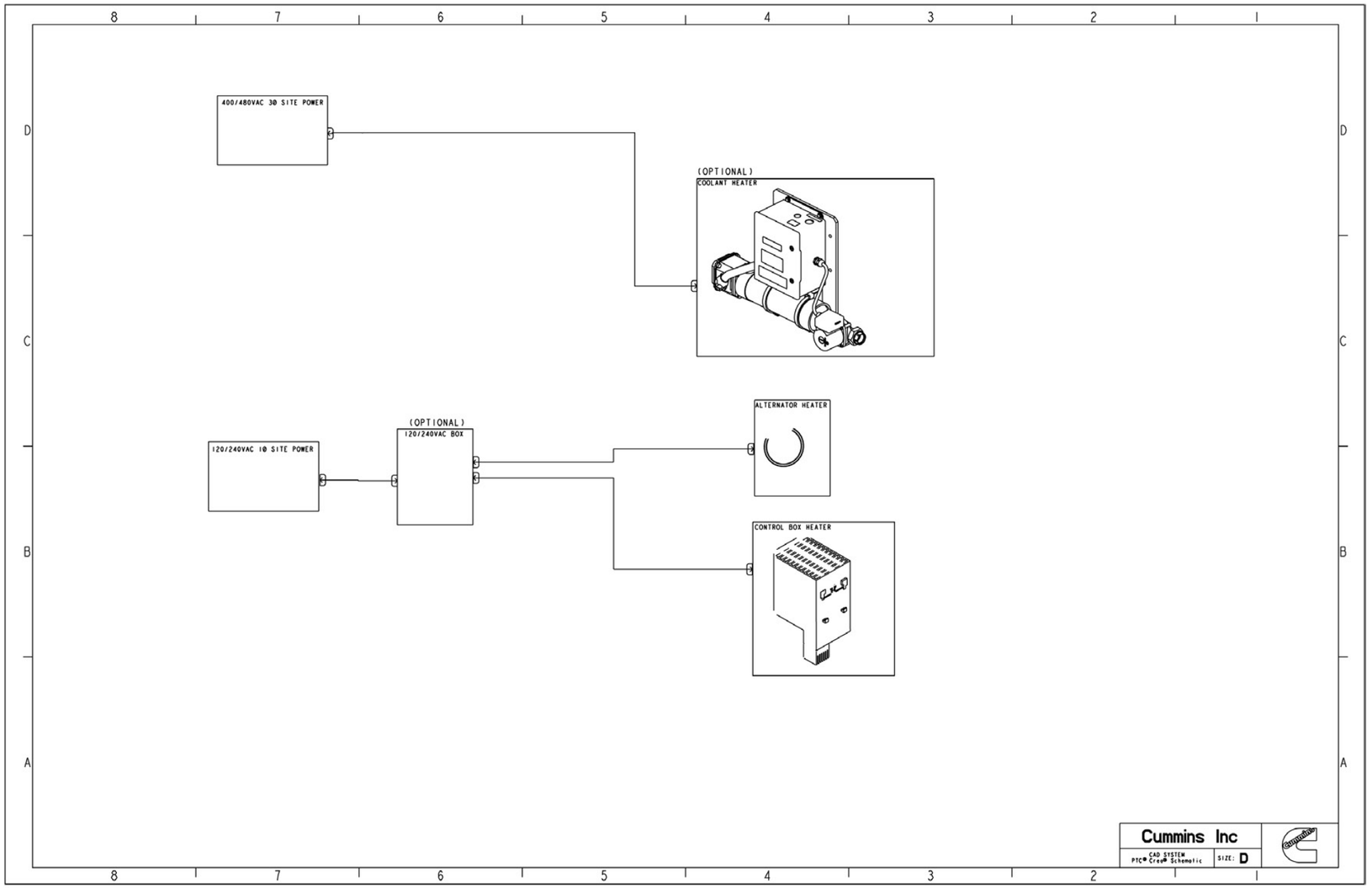


FIGURE 572. SCHEMATIC DIAGRAM (SHEET 17 OF 21)

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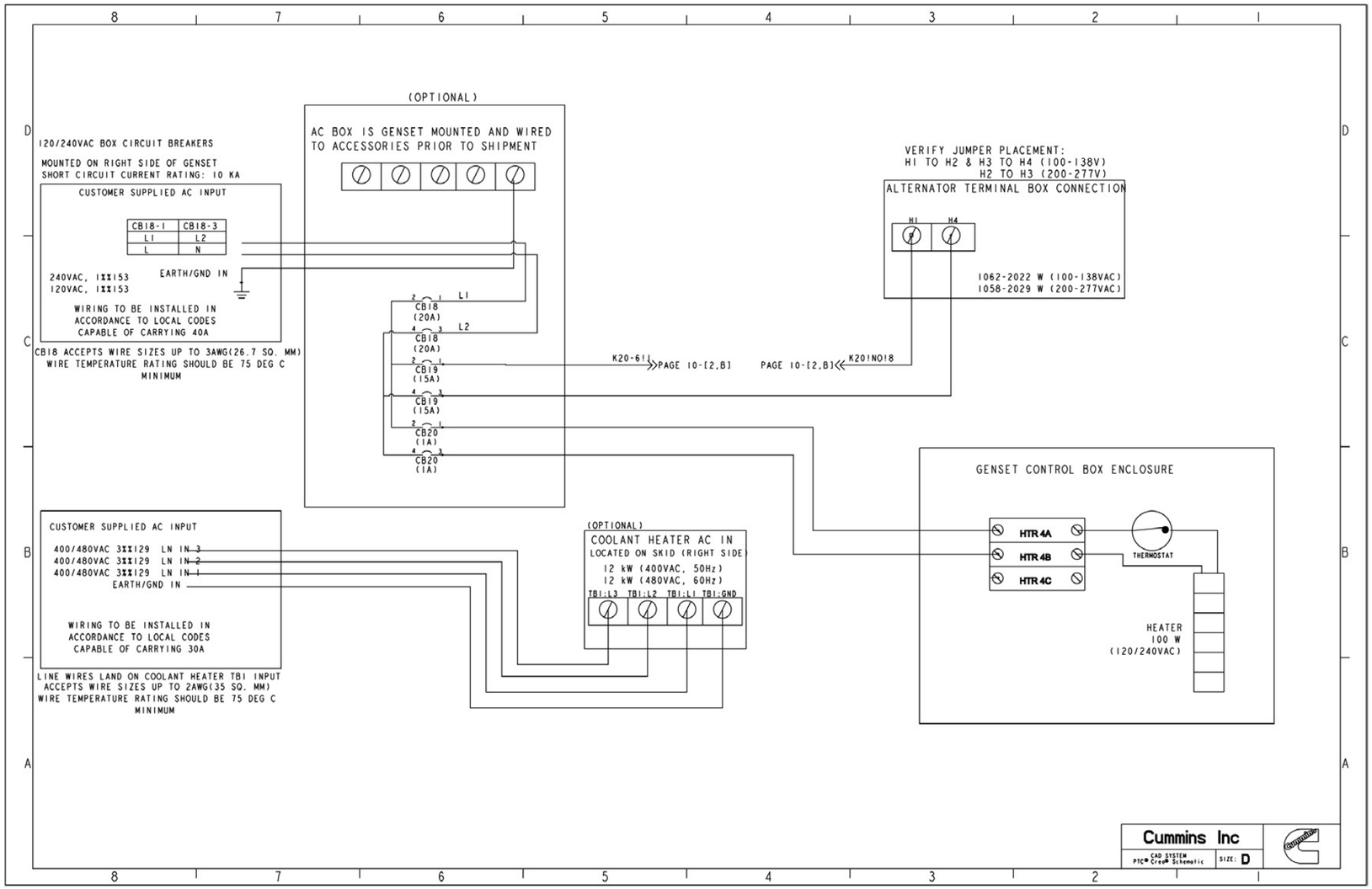


FIGURE 573. SCHEMATIC DIAGRAM (SHEET 18 OF 21)

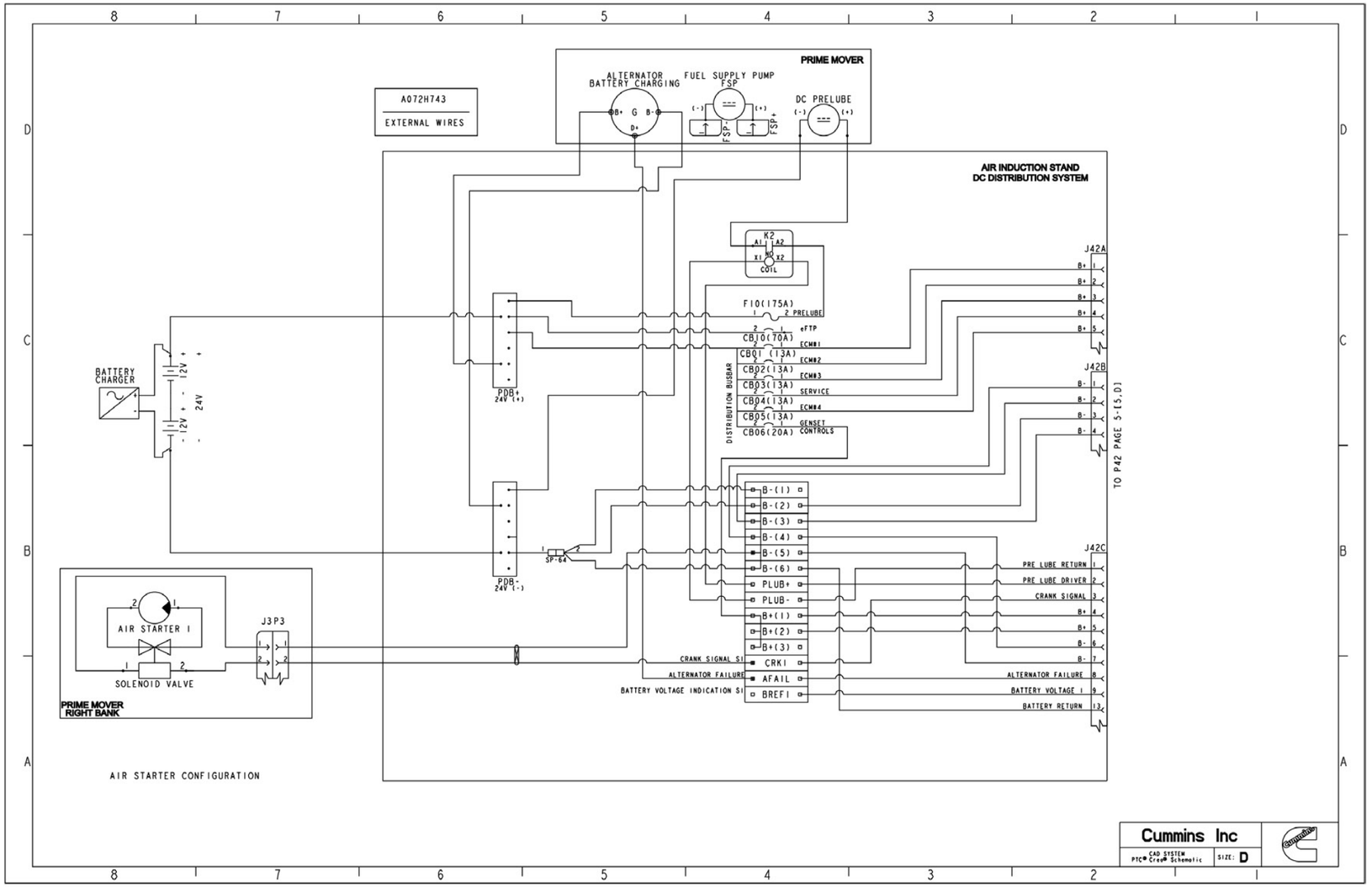


FIGURE 574. SCHEMATIC DIAGRAM (SHEET 19 OF 21)

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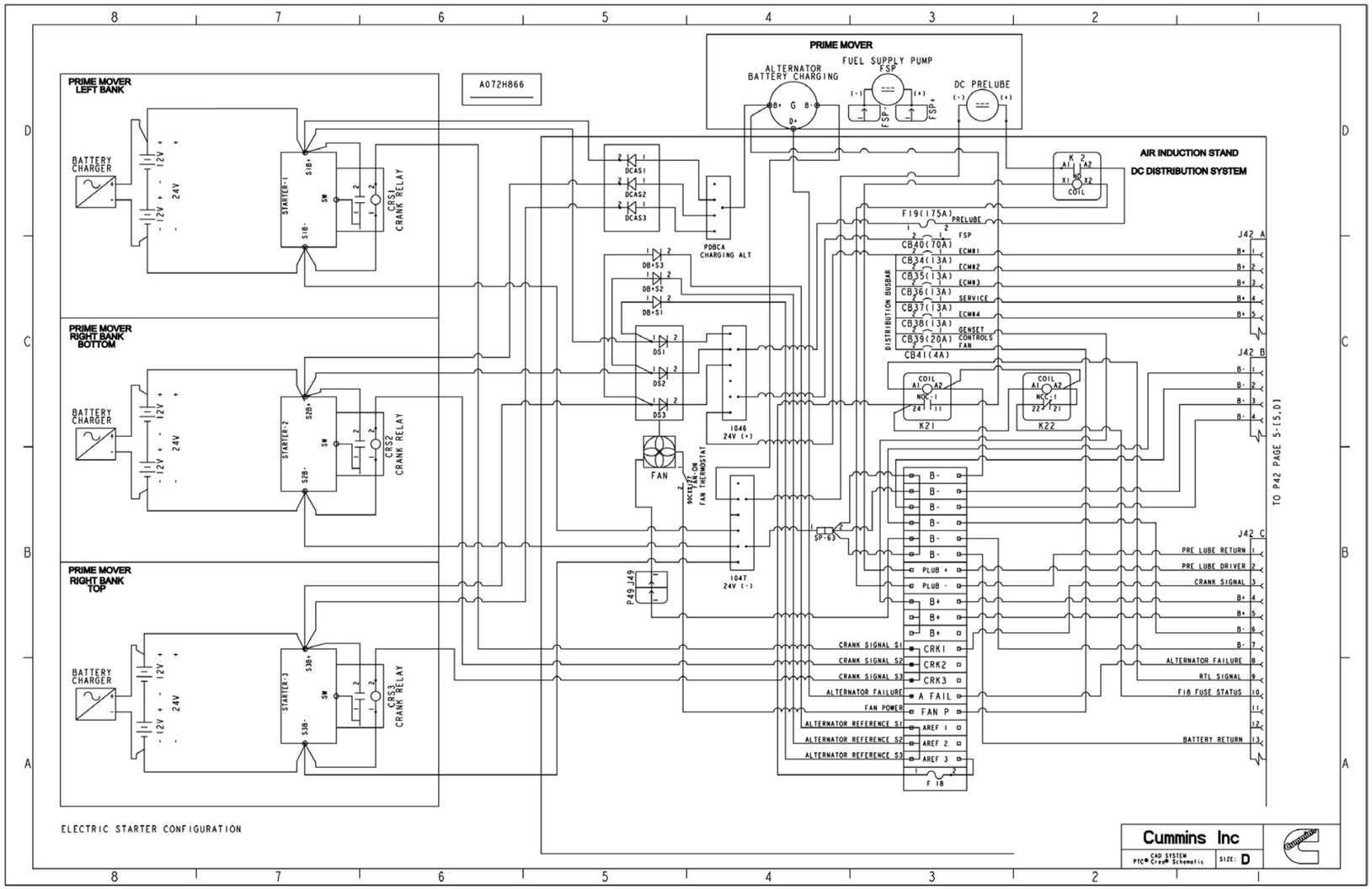


FIGURE 575. SCHEMATIC DIAGRAM (SHEET 20 OF 21)

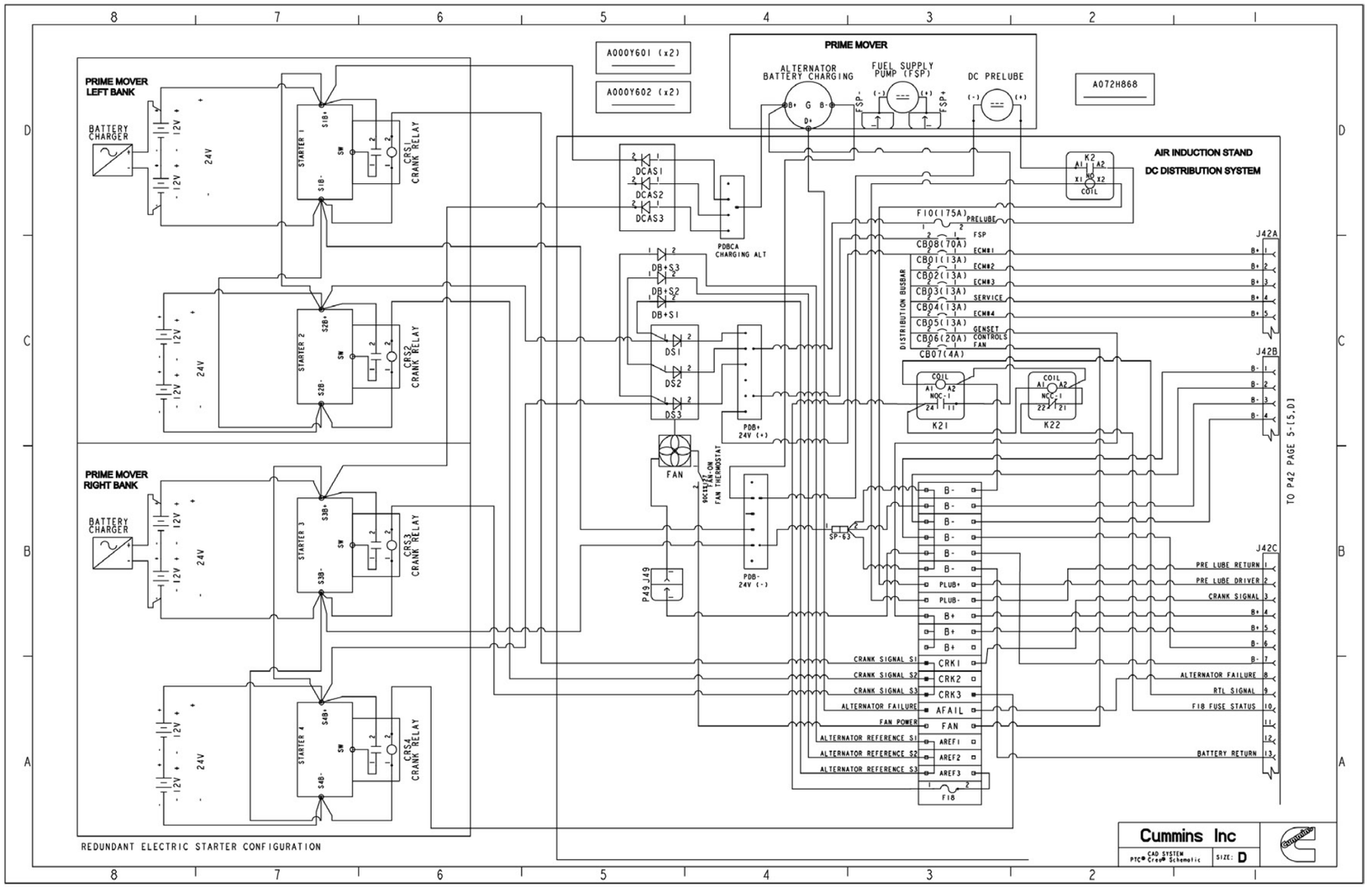


FIGURE 576. SCHEMATIC DIAGRAM (SHEET 21 OF 21)

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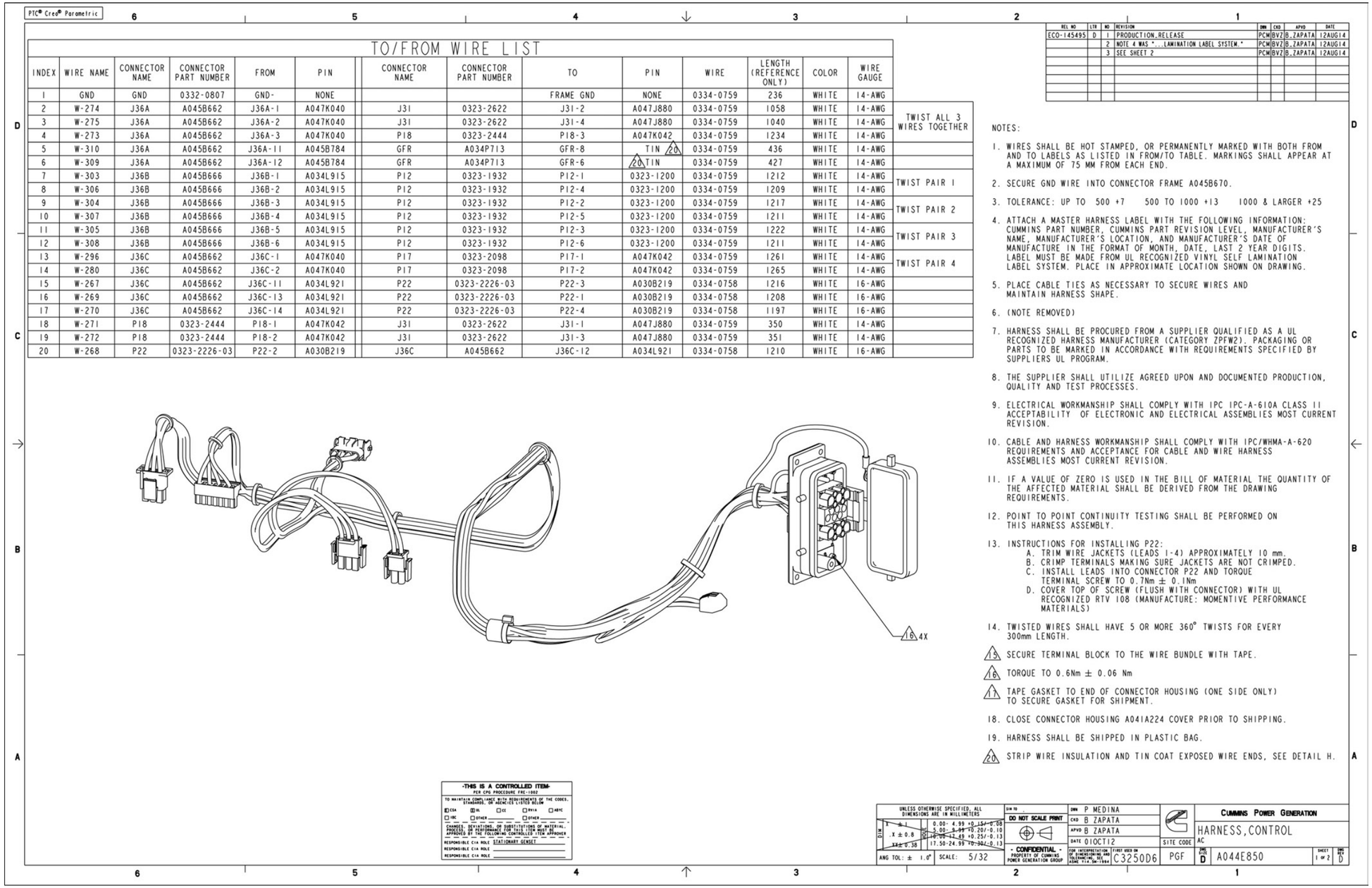
The drawings included in this section are representative. For current complete information, refer to the drawing package that was shipped with the unit.

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C.1 A044E850 AC Control Harness



TO/FROM WIRE LIST

INDEX	WIRE NAME	CONNECTOR NAME	CONNECTOR PART NUMBER	FROM	PIN	CONNECTOR NAME	CONNECTOR PART NUMBER	TO	PIN	WIRE	LENGTH (REFERENCE ONLY)	COLOR	WIRE GAUGE	
1	GND	GND	0332-0807	GND-	NONE			FRAME GND	NONE	0334-0759	236	WHITE	14-AWG	
2	W-274	J36A	A045B662	J36A-1	A047K040	J31	0323-2622	J31-2	A047J880	0334-0759	1058	WHITE	14-AWG	TWIST ALL 3 WIRES TOGETHER
3	W-275	J36A	A045B662	J36A-2	A047K040	J31	0323-2622	J31-4	A047J880	0334-0759	1040	WHITE	14-AWG	
4	W-273	J36A	A045B662	J36A-3	A047K040	P18	0323-2444	P18-3	A047K042	0334-0759	1234	WHITE	14-AWG	
5	W-310	J36A	A045B662	J36A-11	A045B784	GFR	A034P713	GFR-8	TIN 20	0334-0759	436	WHITE	14-AWG	
6	W-309	J36A	A045B662	J36A-12	A045B784	GFR	A034P713	GFR-6	20 TIN	0334-0759	427	WHITE	14-AWG	
7	W-303	J36B	A045B666	J36B-1	A034L915	P12	0323-1932	P12-1	0323-1200	0334-0759	1212	WHITE	14-AWG	TWIST PAIR 1
8	W-306	J36B	A045B666	J36B-2	A034L915	P12	0323-1932	P12-4	0323-1200	0334-0759	1209	WHITE	14-AWG	
9	W-304	J36B	A045B666	J36B-3	A034L915	P12	0323-1932	P12-2	0323-1200	0334-0759	1217	WHITE	14-AWG	TWIST PAIR 2
10	W-307	J36B	A045B666	J36B-4	A034L915	P12	0323-1932	P12-5	0323-1200	0334-0759	1211	WHITE	14-AWG	
11	W-305	J36B	A045B666	J36B-5	A034L915	P12	0323-1932	P12-3	0323-1200	0334-0759	1222	WHITE	14-AWG	TWIST PAIR 3
12	W-308	J36B	A045B666	J36B-6	A034L915	P12	0323-1932	P12-6	0323-1200	0334-0759	1211	WHITE	14-AWG	
13	W-296	J36C	A045B662	J36C-1	A047K040	P17	0323-2098	P17-1	A047K042	0334-0759	1261	WHITE	14-AWG	TWIST PAIR 4
14	W-280	J36C	A045B662	J36C-2	A047K040	P17	0323-2098	P17-2	A047K042	0334-0759	1265	WHITE	14-AWG	
15	W-267	J36C	A045B662	J36C-11	A034L921	P22	0323-2226-03	P22-3	A030B219	0334-0758	1216	WHITE	16-AWG	
16	W-269	J36C	A045B662	J36C-13	A034L921	P22	0323-2226-03	P22-1	A030B219	0334-0758	1208	WHITE	16-AWG	
17	W-270	J36C	A045B662	J36C-14	A034L921	P22	0323-2226-03	P22-4	A030B219	0334-0758	1197	WHITE	16-AWG	
18	W-271	P18	0323-2444	P18-1	A047K042	J31	0323-2622	J31-1	A047J880	0334-0759	350	WHITE	14-AWG	
19	W-272	P18	0323-2444	P18-2	A047K042	J31	0323-2622	J31-3	A047J880	0334-0759	351	WHITE	14-AWG	
20	W-268	P22	0323-2226-03	P22-2	A030B219	J36C	A045B662	J36C-12	A034L921	0334-0758	1210	WHITE	16-AWG	

REL NO	LTR	NO	REVISION	DRN	CKD	APVD	DATE
ECO-145495	D	1	PRODUCTION RELEASE	PCM	BVZ	B.ZAPATA	12AUG14
		2	NOTE 4 WAS "...LAMINATION LABEL SYSTEM."	PCM	BVZ	B.ZAPATA	12AUG14
		3	SEE SHEET 2	PCM	BVZ	B.ZAPATA	12AUG14

NOTES:

1. WIRES SHALL BE HOT STAMPED, OR PERMANENTLY MARKED WITH BOTH FROM AND TO LABELS AS LISTED IN FROM/TO TABLE. MARKINGS SHALL APPEAR AT A MAXIMUM OF 75 MM FROM EACH END.
2. SECURE GND WIRE INTO CONNECTOR FRAME A045B670.
3. TOLERANCE: UP TO 500 +7 500 TO 1000 +13 1000 & LARGER +25
4. ATTACH A MASTER HARNESS LABEL WITH THE FOLLOWING INFORMATION: CUMMINS PART NUMBER, CUMMINS PART REVISION LEVEL, MANUFACTURER'S NAME, MANUFACTURER'S LOCATION, AND MANUFACTURER'S DATE OF MANUFACTURE IN THE FORMAT OF MONTH, DATE, LAST 2 YEAR DIGITS. LABEL MUST BE MADE FROM UL RECOGNIZED VINYL SELF LAMINATION LABEL SYSTEM. PLACE IN APPROXIMATE LOCATION SHOWN ON DRAWING.
5. PLACE CABLE TIES AS NECESSARY TO SECURE WIRES AND MAINTAIN HARNESS SHAPE.
6. (NOTE REMOVED)
7. HARNESS SHALL BE PROCURED FROM A SUPPLIER QUALIFIED AS A UL RECOGNIZED HARNESS MANUFACTURER (CATEGORY ZPFW2). PACKAGING OR PARTS TO BE MARKED IN ACCORDANCE WITH REQUIREMENTS SPECIFIED BY SUPPLIERS UL PROGRAM.
8. THE SUPPLIER SHALL UTILIZE AGREED UPON AND DOCUMENTED PRODUCTION, QUALITY AND TEST PROCESSES.
9. ELECTRICAL WORKMANSHIP SHALL COMPLY WITH IPC IPC-A-610A CLASS II ACCEPTABILITY OF ELECTRONIC AND ELECTRICAL ASSEMBLIES MOST CURRENT REVISION.
10. CABLE AND HARNESS WORKMANSHIP SHALL COMPLY WITH IPC/WHMA-A-620 REQUIREMENTS AND ACCEPTANCE FOR CABLE AND WIRE HARNESS ASSEMBLIES MOST CURRENT REVISION.
11. IF A VALUE OF ZERO IS USED IN THE BILL OF MATERIAL THE QUANTITY OF THE AFFECTED MATERIAL SHALL BE DERIVED FROM THE DRAWING REQUIREMENTS.
12. POINT TO POINT CONTINUITY TESTING SHALL BE PERFORMED ON THIS HARNESS ASSEMBLY.
13. INSTRUCTIONS FOR INSTALLING P22:
    A. TRIM WIRE JACKETS (LEADS 1-4) APPROXIMATELY 10 mm.
    B. CRIMP TERMINALS MAKING SURE JACKETS ARE NOT CRIMPED.
    C. INSTALL LEADS INTO CONNECTOR P22 AND TORQUE TERMINAL SCREW TO 0.7Nm ± 0.1Nm
    D. COVER TOP OF SCREW (FLUSH WITH CONNECTOR) WITH UL RECOGNIZED RTV 108 (MANUFACTURE: MOMENTIVE PERFORMANCE MATERIALS)
14. TWISTED WIRES SHALL HAVE 5 OR MORE 360° TWISTS FOR EVERY 300mm LENGTH.

15 SECURE TERMINAL BLOCK TO THE WIRE BUNDLE WITH TAPE.

16 TORQUE TO 0.6Nm ± 0.06 Nm

17 TAPE GASKET TO END OF CONNECTOR HOUSING (ONE SIDE ONLY) TO SECURE GASKET FOR SHIPMENT.

18. CLOSE CONNECTOR HOUSING A041A224 COVER PRIOR TO SHIPPING.
19. HARNESS SHALL BE SHIPPED IN PLASTIC BAG.

20 STRIP WIRE INSULATION AND TIN COAT EXPOSED WIRE ENDS, SEE DETAIL H.

-THIS IS A CONTROLLED ITEM-
PER CPG PROCEDURE FKE-1002
TO MAINTAIN COMPLIANCE WITH REQUIREMENTS OF THE CODES, STANDARDS, OR AGENCIES LISTED BELOW
☑ CSA ☑ UL ☐ CE ☐ RINA ☐ ABYC ☐ IBC ☐ OTHER ☐ OTHER
CHANGES, DEVIATIONS, OR SUBSTITUTIONS OF MATERIAL, PROCESS, OR PERFORMANCE FOR THIS ITEM MUST BE APPROVED BY THE FOLLOWING CONTROLLED ITEM APPROVER
RESPONSIBLE C1A ROLE STATIONARY GENSET
RESPONSIBLE C1A ROLE
RESPONSIBLE C1A ROLE

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS
DIM: .X ± 0.8; .XX ± 0.38; ANG TOL: ± 1.0°
0.00- 4.99 +0.15/-0.08
5.00- 9.99 +0.20/-0.10
10.00-17.49 +0.25/-0.13
17.50-24.99 +0.30/-0.13
SCALE: 5/32
DO NOT SCALE PRINT
- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP
DRN P MEDINA
CKD B ZAPATA
APVD B ZAPATA
DATE 01OCT12
FIRST USED ON C3250D6
SITE CODE PGF
CUMMINS POWER GENERATION
HARNESS,CONTROL
AC
DWG SIZE D | A044E850 | SHEET 1 of 2 | DWG REV D

FIGURE 577. A044E850 AC CONTROL HARNESS (SHEET 1)

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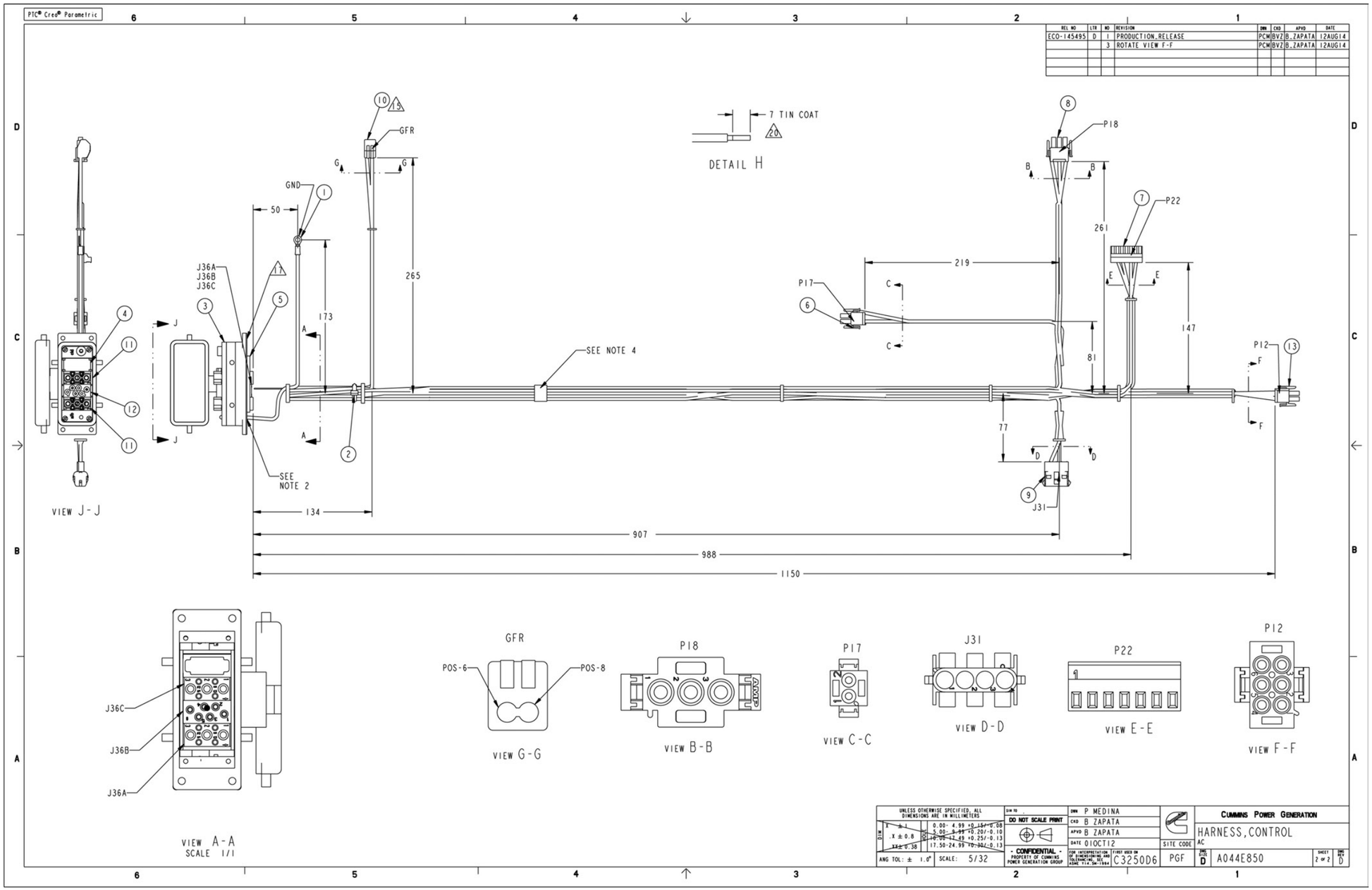


FIGURE 578. A044E850 AC CONTROL HARNESS (SHEET 2)

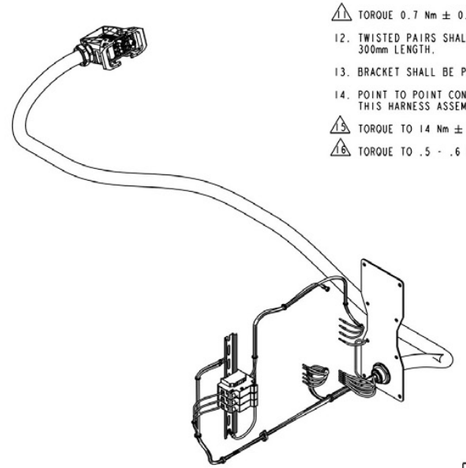
C.2 A065E081 Alternator Interface Alternating Current Harness

TO/FROM WIRE LIST

INDEX	WIRE NAME	CONNECTOR NAME	CONNECTOR PART NUMBER	FROM	PIN	CONNECTOR NAME	CONNECTOR PART NUMBER	TO	PIN	WIRE	LENGTH (REFERENCE ONLY)	COLOR	WIRE GAUGE	PAIRED WIRES
1	W-042	F11-1	A050H823	F11-1-.	NONE	SENSE U (64)	A050H823	SENSE U (64)	NONE	0334-0757	668	WHITE	18-AWG	
2	W-041	F12-1	A050H823	F12-1-.	NONE	SENSE V (67)	A050H823	SENSE V (67)	NONE	0334-0757	642	WHITE	18-AWG	
3	W-039	F13-1	A050H823	F13-1-.	NONE	SENSE W (70)	A050H823	SENSE W (70)	NONE	0334-0757	627	WHITE	18-AWG	
4	W-790	P36A	A045B610	P36A-1	A046E213	PMG-2 (06)	A045C955	PMG-2 (06)	NONE	0334-0759	2252	WHITE	14-AWG	
5	W-791	P36A	A045B610	P36A-2	A046E213	PMG-3 (08)	A045C955	PMG-3 (08)	NONE	0334-0759	2247	WHITE	14-AWG	
6	W-792	P36A	A045B610	P36A-3	A046E213	PMG-4 (10)	A045C955	PMG-4 (10)	NONE	0334-0759	2235	WHITE	14-AWG	
7	W-036	P36A	A045B610	P36A-11	A045B782	GF CT-X1	A045C955	GF CT-X1	NONE	0334-0759	2658	WHITE	14-AWG	
8	W-037	P36A	A045B610	P36A-12	A045B782	GF CT-X2	A045C955	GF CT-X2	NONE	0334-0759	2651	WHITE	14-AWG	
9	W-068	P36B	A045B622	P36B-1	A034S536	CTI U-X1 (40)	A045C955	CTI U-X1 (40)	NONE	0334-0759	2031	WHITE	14-AWG	TWISTED PAIR 1
10	W-069	P36B	A045B622	P36B-2	A034S536	CTI U-X2 (41)	A045C955	CTI U-X2 (41)	NONE	0334-0759	2030	WHITE	14-AWG	
11	W-070	P36B	A045B622	P36B-3	A034S536	CTI V-X1 (42)	A045C955	CTI V-X1 (42)	NONE	0334-0759	2034	WHITE	14-AWG	TWISTED PAIR 2
12	W-023	P36B	A045B622	P36B-4	A034S536	CTI V-X2 (43)	A045C955	CTI V-X2 (43)	NONE	0334-0759	2030	WHITE	14-AWG	
13	W-071	P36B	A045B622	P36B-5	A034S536	CTI W-X1 (44)	A045C955	CTI W-X1 (44)	NONE	0334-0759	2032	WHITE	14-AWG	TWISTED PAIR 3
14	W-024	P36B	A045B622	P36B-6	A034S536	CTI W-X2 (45)	A045C955	CTI W-X2 (45)	NONE	0334-0759	2036	WHITE	14-AWG	
15	W-794	P36C	A045B610	P36C-1	A046E213	FIELD 1 (13)	A045C955	FIELD 1 (13)	NONE	0334-0759	2226	WHITE	14-AWG	TWISTED PAIR 4
16	W-793	P36C	A045B610	P36C-2	A046E213	FIELD 2 (14)	A045C955	FIELD 2 (14)	NONE	0334-0759	2216	WHITE	14-AWG	
17	W-038	P36C	A045B610	P36C-11	A034R823	F13-2	A050H823	F13-2	NONE	0334-0757	2588	WHITE	18-AWG	
18	W-040	P36C	A045B610	P36C-12	A034R823	F12-2	A050H823	F12-2	NONE	0334-0757	2568	WHITE	18-AWG	
19	W-043	P36C	A045B610	P36C-13	A034R823	F11-2	A050H823	F11-2	NONE	0334-0757	2564	WHITE	18-AWG	
20	W-795	P36C	A045B610	P36C-14	A034R821	SENSE N (61)	A045C818	SENSE N (61)	NONE	0334-0758	2114	WHITE	16-AWG	
21	W-1107	RAIL GND 1	0332-0350	RAIL GND 1-.	NONE	RAIL GND 2	0332-0350	RAIL GND 2	NONE	0334_1222	561	GREEN	12-AWG	

SERVICE PARTS LIST - FOR REFERENCE ONLY

QTY	MANUFACTURER	MANUFACTURER PART NO.	DESCRIPTION
0	VARIOUS		WIRE, UL3173, STRANDED, 125C, 600V, 12 AWG, GREEN
0	VARIOUS		WIRE, UL3173, STRANDED, 125C, 600V, 14 AWG, WHITE
5	PHOENIX CONTACT	3201107	TERMINAL-PIN 10 AWG
1	PHOENIX CONTACT	1663433	TERMINAL - SOCKET
3	PHOENIX CONTACT	1663420	TERMINAL - SOCKET
0	VARIOUS		WIRE, UL3173, STRANDED, 125C, 600V, 18 AWG, WHITE
0	VARIOUS		WIRE-CCXL, CL125I,STRANDED, 125C, 600V, 16 AWG, WHITE
0	PANDUIT	PLT1.5M-XMR30	TIE-CABLE
10	PHOENIX	3201482	TERMINAL,PIN 16 AWG
2	KOPEX OR EQUIVALENT	XQM0606	CONNECTOR,STRAIGHT M32 - CONDUIT SIZE 1.00 INCH
1	KOPEX OR EQUIVALENT	WHMS06	HEX, LOCKNUT, M32, ZINC PLATE
0	KOPEX	FUB06	CONDUIT 1.00 INCH, LT FLEX, UL/CSA
1	HAWKE	M32	SERRATED WASHER, M32
1	COOPER BUSSMAN	CHCC3DU	HOLDER, FUSE
3	LITTELFUSE OR MERSEN	KLKR01.5T OR KLKR01.5TS OR (ATMR-1-1/2)	FUSE, FAST ACTING
2	PHOENIX CONTACT	1585786	HOUSING,SOCKET CONNECTOR (P36A, P36C)
1	PHOENIX CONTACT	1636460	HOUSING,SOCKET CONNECTOR (P36B)
1	PHOENIX CONTACT	1679265	CONNECTOR, HOUSING (FRAME)
1	PHOENIX CONTACT	1676828	CONNECTOR, HOUSING (DUMMY MODULE)
1	PHOENIX CONTACT	1412703	CONNECTOR, HOUSING (BACKSHELL)
5	PHOENIX CONTACT	1663307	TERMINAL, SOCKET
6	PHOENIX CONTACT	1663682	TERMINAL, SOCKET
2	PHOENIX CONTACT	1663446	TERMINAL, SOCKET
252mm	WEIDMULLER	0514500000	DIN RAIL (2000 mm)
2	PHOENIX CONTACT	1201442 E/NS 35 N	END BRACKET
8	PHOENIX CONTACT	3200962	TERMINAL,PIN (14 AWG FERRULE)
2	TYCO	2-36161-2	TERMINAL,RING (12AWG M5)



NOTES:

1. WIRES SHALL BE HOT STAMPED, OR PERMANENTLY MARKED WITH BOTH FROM AND TO LABELS AS LISTED IN TABULATION. MARKINGS SHALL BE LOCATED SO THEY WILL BE VISIBLE AFTER WIRE IS INSTALLED INTO CONNECTORS, MAXIMUM OF 75mm FROM CONNECTOR END.
   1.1 TRAILING DASHES AND PERIODS SHALL BE OMITTED.
   1.2 ADD SHRINKWRAP LABEL WITH FROM/TO MARKINGS TO "CTI.." AND "FIELD..." TWISTED WIRES SHOWN ON SHEET 2.
2. DIMENSIONS ARE IN MILLIMETERS.
3. TOLERANCE: UP TO 500 MM ±1.5 MM
   500 MM TO 1000 MM ±4.0 MM
   1000 MM & LARGER ±6.0 MM
4. ATTACH A MASTER HARNESS LABEL WITH THE FOLLOWING INFORMATION: CUMMINS PART NUMBER, CUMMINS PART REVISION LEVEL, MANUFACTURER'S NAME, MANUFACTURER'S LOCATION, AND MANUFACTURER'S DATE OF MANUFACTURE IN THE FORMAT OF MONTH, DATE, LAST 2 YEAR DIGITS. LABEL MUST BE MADE FROM UL RECOGNIZED SELF LAMINATION LABEL SYSTEM. PLACE IN APPROXIMATE LOCATION SHOWN ON DRAWING.
5. PLACE CABLE TIES (0332-3388) AS NECESSARY TO SECURE WIRES AND MAINTAIN HARNESS SHAPE.
6. HARNESS SHALL BE PROCURED FROM A SUPPLIER QUALIFIED AS A UL RECOGNIZED HARNESS MANUFACTURER (CATEGORY ZPFW2). PACKAGING OR PARTS TO BE MARKED IN ACCORDANCE WITH REQUIREMENTS SPECIFIED BY SUPPLIERS UL PROGRAM.
7. THE SUPPLIER SHALL UTILIZE AGREED UPON AND DOCUMENTED PRODUCTION, QUALITY AND TEST PROCESSES.
8. HARNESS SHALL BE SHIPPED IN PLASTIC BAG.
9. ELECTRICAL WORKMANSHIP SHALL COMPLY WITH IPC IPC-A-610A CLASS II ACCEPTABILITY OF ELECTRONIC AND ELECTRICAL ASSEMBLIES MOST CURRENT REVISION.
10. CABLE AND HARNESS WORKMANSHIP SHALL COMPLY WITH IPC/WHMA-A-620 REQUIREMENTS AND ACCEPTANCE FOR CABLE AND WIRE HARNESS ASSEMBLIES MOST CURRENT REVISION.
11. ⚠1 TORQUE 0.7 Nm ± 0.07 Nm
12. TWISTED PAIRS SHALL HAVE 5 OR MORE 360° TWISTS FOR EVERY 300mm LENGTH.
13. BRACKET SHALL BE PROTECTED FROM SCRATCHING DURING SHIPPING.
14. POINT TO POINT CONTINUITY TESTING SHALL BE PERFORMED ON THIS HARNESS ASSEMBLY.
15. ⚠5 TORQUE TO 14 Nm ± 1.2 Nm.
16. ⚠6 TORQUE TO .5 - .6 Nm.

Cummins Inc.
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: - | SIZE: A1 | SCALE:1/2
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009 | THIRD ANGLE PROJECTION
CAD SYSTEM PTC® Creo® Parametric

Part Number: **A065E081** Part Revision: **C**
Part Name: **HARNESS,ALTERNATING CURRENT**

FIGURE 579. A065E081 ALTERNATOR INTERFACE ALTERNATING CURRENT HARNESS (SHEET 1)

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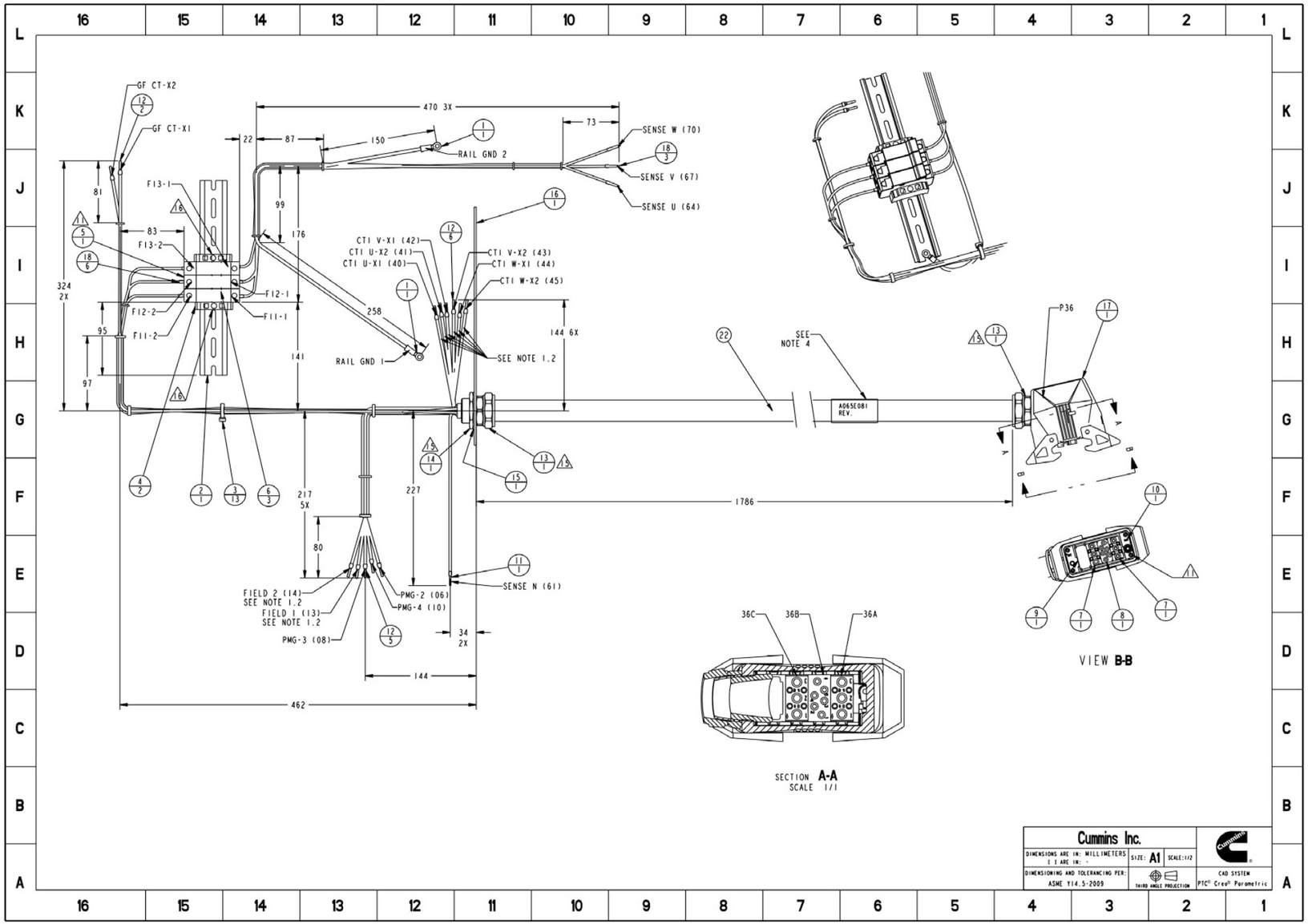


FIGURE 580. A065E081 ALTERNATOR INTERFACE ALTERNATING CURRENT HARNESS (SHEET 2)

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C.3 A045S873 Alternator OEM Harness Installation

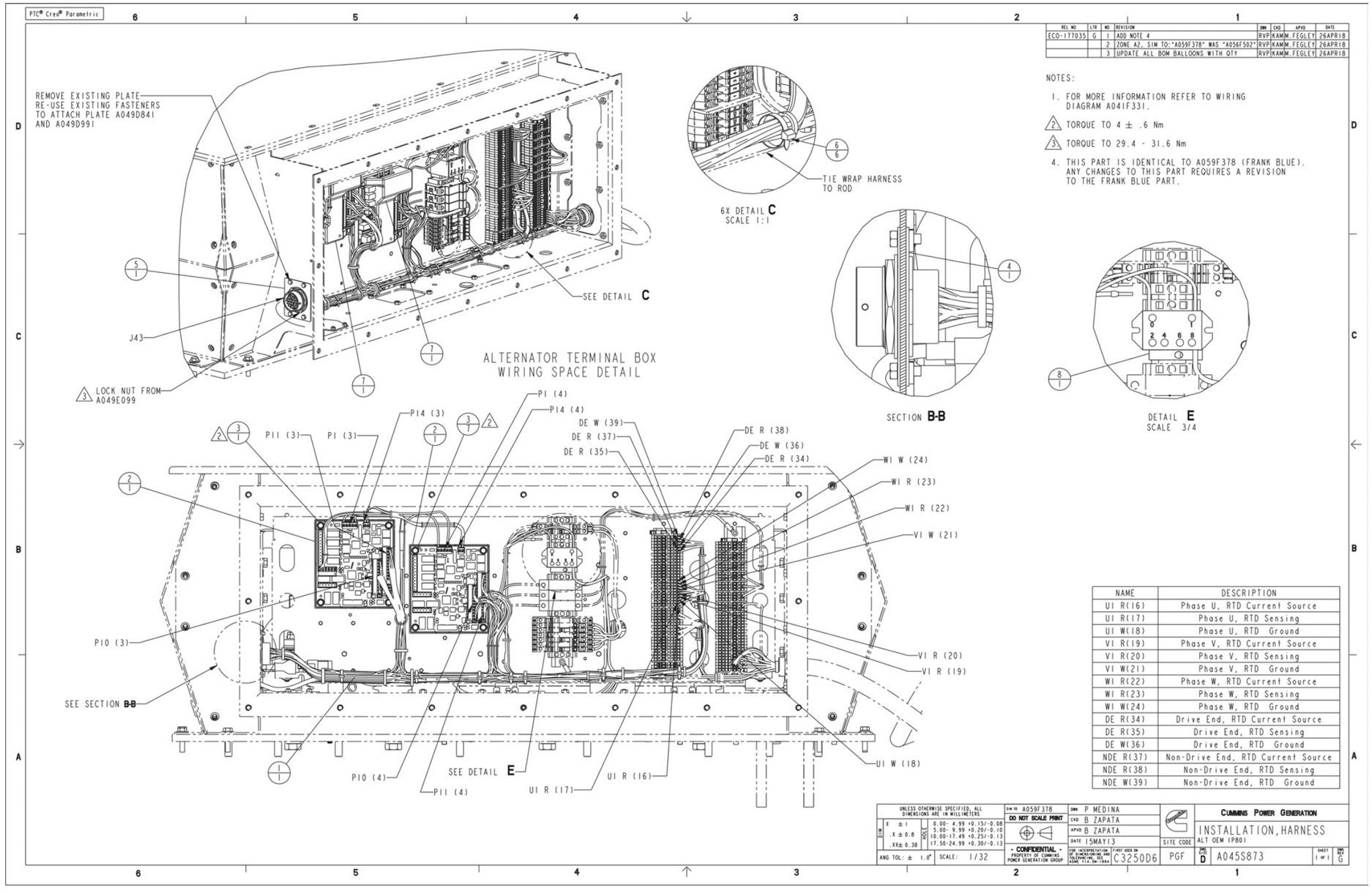


FIGURE 581. A045S873 ALTERNATOR OEM HARNESS INSTALLATION (SHEET 1)

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C.4 A045P995 Coolant Heater Extension Harness

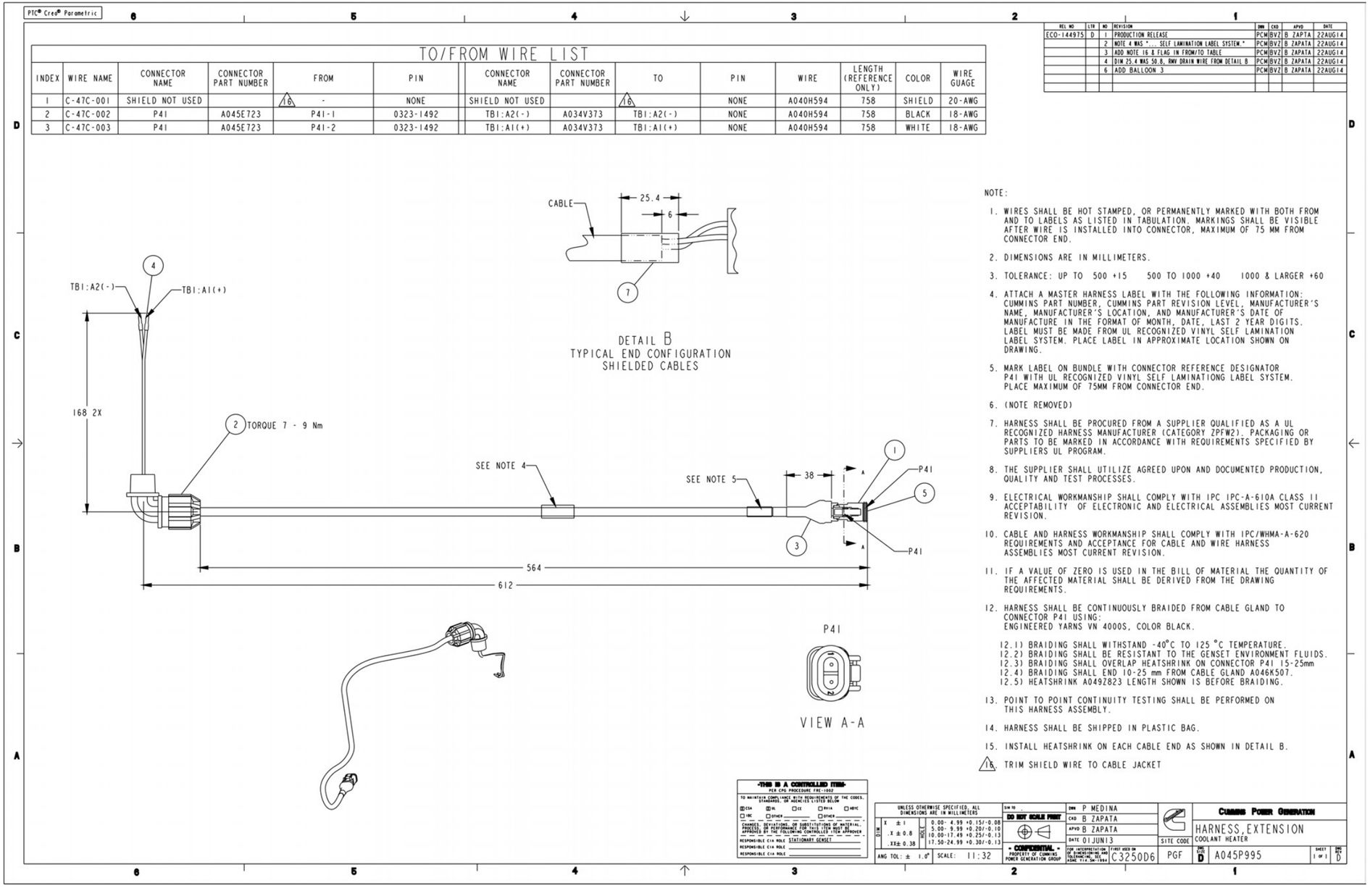


FIGURE 582. A045P995 COOLANT HEATER EXTENSION HARNESS (SHEET 1)

C.5 A044F276 Customer AC Control Harness

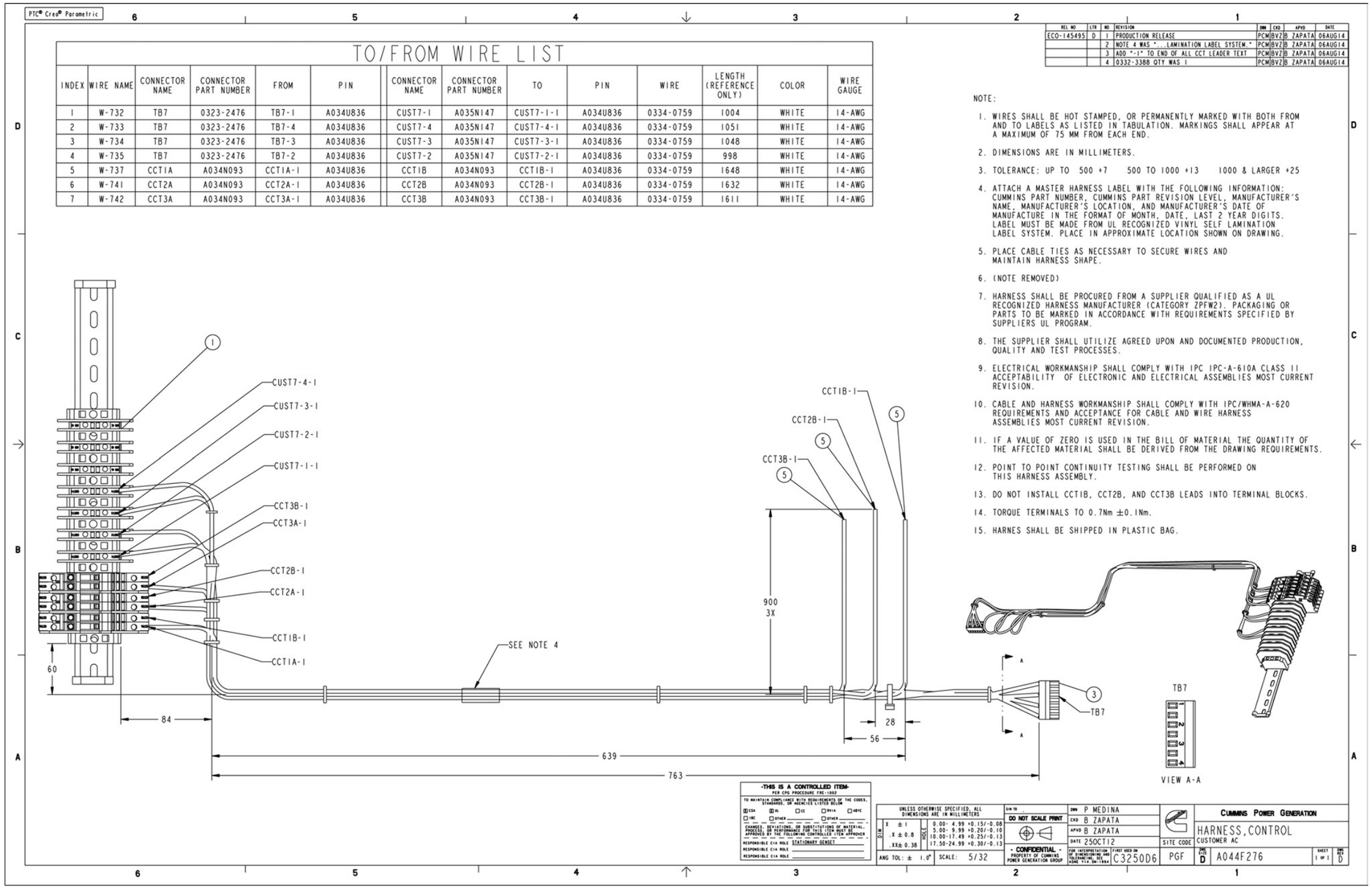


FIGURE 583. A044F276 CUSTOMER AC CONTROL HARNESS (SHEET 1)

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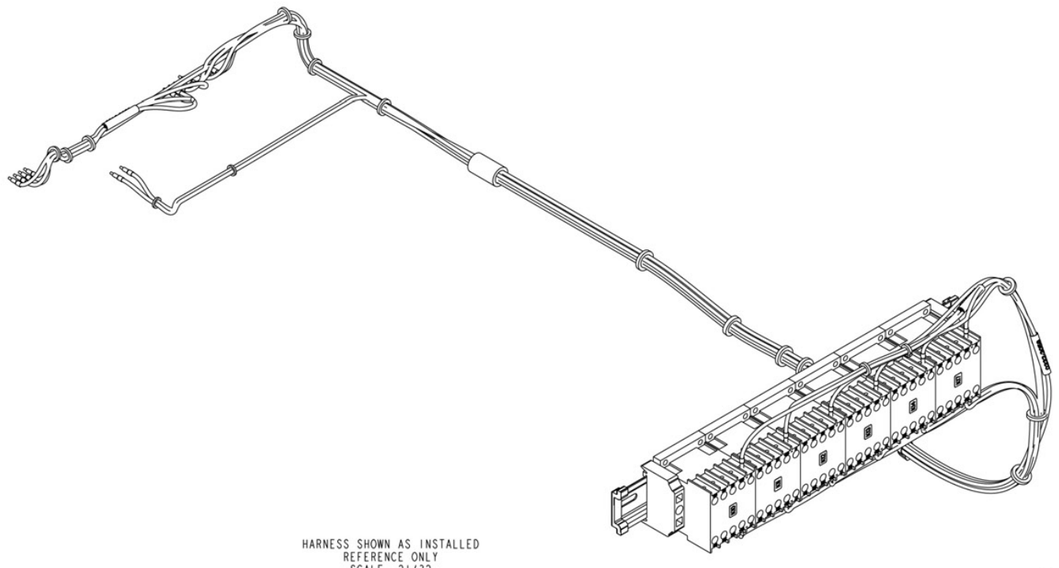
C.6 A044F278 Customer Relay Harness

PTC® Creo® Parametric

TO/FROM WIRE LIST

INDEX	WIRE NAME	CONNECTOR NAME	CONNECTOR PART NUMBER	FROM	PIN	CONNECTOR NAME	CONNECTOR PART NUMBER	TO	PIN	WIRE	LENGTH (REFERENCE ONLY)	COLOR	WIRE GAUGE
1	W-681	CTB9-2	A040H579	CTB9-2	NONE	SP-32	0332-0430	SP-32	NONE	0334-0756	92	WHITE	20-AWG
2	W-682	SP-33	0332-0430	SP-33	NONE	K10, A1	A040H579	K10, A1	NONE	0334-0756	242	WHITE	20-AWG
3	W-683	K10, A2	A040H579	K10, A2	NONE	CTB10-2	A040H579	CTB10-2	NONE	0334-0756	1316	WHITE	20-AWG
4	W-684	K11, A11	A040H579	K11, A11	NONE	SP-33	0332-0430	SP-33	NONE	0334-0756	200	WHITE	20-AWG
5	W-685	SP-33	0332-0430	SP-33	NONE	K12, A1	A040H579	K12, A1	NONE	0334-0756	152	WHITE	20-AWG
6	W-686	K12, A2	A040H579	K12, A2	NONE	CTB26-4	A040H579	CTB26-4	NONE	0334-0756	1260	WHITE	20-AWG
7	W-687	K11, A2	A040H579	K11, A2	NONE	CTB25-4	A040H579	CTB25-4	NONE	0334-0756	1302	WHITE	20-AWG
8	W-688	K14, A2	A040H579	K14, A2	NONE	CTB39-2	A040H579	CTB39-2	NONE	0334-0756	1287	WHITE	20-AWG
9	W-689	K17, A1	A040H579	K17, A1	NONE	SP-31	0332-3058	SP-31	NONE	0334-0756	161	WHITE	20-AWG
10	W-690	K14, A1	A040H579	K14, A1	NONE	SP-31	0332-3058	SP-31	NONE	0334-0756	197	WHITE	20-AWG
11	W-691	SP-31	0332-3058	SP-31	NONE	CTB7-2	A040H579	CTB7-2	NONE	0334-0756	990	WHITE	20-AWG
12	W-692	K17, A2	A040H579	K17, A2	NONE	CTB42-2	A040H579	CTB42-2	NONE	0334-0756	1269	WHITE	20-AWG
13	W-693	SP-32	0332-0430	SP-32	NONE	CTB40-2	A040H579	CTB40-2	NONE	0334-0756	104	WHITE	20-AWG
14	W-694	CTB41-2	A040H579	CTB41-2	NONE	SP-32	0332-0430	SP-32	NONE	0334-0756	104	WHITE	20-AWG
15	W-695	SP-32	0332-0430	SP-32	NONE	CTB13- 2	A040H579	CTB13- 2	NONE	0334-0756	78	WHITE	20-AWG
16	W-696	K13, A1	A040H579	K13, A1	NONE	CTB5-2	A040H579	CTB5-2	NONE	0334-0756	1250	WHITE	20-AWG
17	W-697	K13,A2	A040H579	K13,A2	NONE	CTB11- 2	A040H579	CTB11- 2	NONE	0334-0756	1184	WHITE	20-AWG
18	W-698	CTB12-2	A040H579	CTB12-2	NONE	SP-32	0332-0430	SP-32	NONE	0334-0756	77	WHITE	20-AWG
19	W-859	SP-33	0332-0430	SP-33	NONE	CTB6-2	A040H579	CTB6-2	NONE	0334-0756	1107	WHITE	20-AWG

REL NO	LTR	NO	REVISION	DWN	CKD	APVD	DATE
ECO-167269	G	1	RMV TOLERANCES IN TOLERANCE BLOCK	LDE	AJB	K. FARMER	20JAN17
		2	REVISE NOTE 15; WAS "...0.7 ±0.1 Nm"	LDE	AJB	K. FARMER	20JAN17
		3	REVISE WIRE LENGTHS (REFERENCE ONLY) IN TO/FROM WIRE LIST	LDE	AJB	K. FARMER	20JAN17
		4	REVISE BOM: 0334-0756 (WIRE) QTY 40.599 WAS 40.499; ADD 0332-3388 (TIE-WRAP) QTY 0	LDE	AJB	K. FARMER	20JAN17
		5	ZONE A5; ADD "HARNESS SHOWN AS INSTALLED REFERENCE ONLY SCALE 21/32"	LDE	AJB	K. FARMER	20JAN17
		6	ADD NOTE 18	LDE	AJB	K. FARMER	20JAN17
		7	SEE SHEET 2	LDE	AJB	K. FARMER	20JAN17
		8	SEE SHEET 2	LDE	AJB	K. FARMER	20JAN17
		9	SEE SHEET 2	LDE	AJB	K. FARMER	20JAN17
		10	SEE SHEET 2	LDE	AJB	K. FARMER	20JAN17
		11	SEE SHEET 2	LDE	AJB	K. FARMER	20JAN17
		12	SEE SHEET 2	LDE	AJB	K. FARMER	20JAN17



HARNESS SHOWN AS INSTALLED
REFERENCE ONLY
SCALE 21/32

NOTE:

1. WIRES SHALL BE HOT STAMPED, OR PERMANENTLY MARKED WITH BOTH FROM AND TO LABELS AS LISTED IN TABULATION. MARKINGS SHALL APPEAR AT A MAXIMUM OF 75 MM FROM EACH END. TRAILING DASHES AND PERIODS MAY BE OMITTED.
2. DIMENSIONS ARE IN MILLIMETERS.
3. TOLERANCE: UP TO 500 +7 500 TO 1000 +13 1000 & LARGER +25
4. ATTACH A MASTER HARNESS LABEL WITH THE FOLLOWING INFORMATION: CUMMINS PART NUMBER, CUMMINS PART REVISION LEVEL, MANUFACTURER'S NAME, MANUFACTURER'S LOCATION, AND MANUFACTURER'S DATE OF MANUFACTURE IN THE FORMAT OF MONTH, DATE, LAST 2 YEAR DIGITS. LABEL MUST BE MADE FROM UL RECOGNIZED VINYL SELF LAMINATION LABEL SYSTEM. PLACE IN APPROXIMATE LOCATION SHOWN ON DRAWING.
5. PLACE CABLE TIES AS NECESSARY TO SECURE WIRES AND MAINTAIN HARNESS SHAPE.
6. (NOTE REMOVED)
7. HARNESS SHALL BE PROCURED FROM A SUPPLIER QUALIFIED AS A UL RECOGNIZED HARNESS MANUFACTURER (CATEGORY ZPFW2). PACKAGING OR PARTS TO BE MARKED IN ACCORDANCE WITH REQUIREMENTS SPECIFIED BY SUPPLIERS UL PROGRAM.
8. THE SUPPLIER SHALL UTILIZE AGREED UPON AND DOCUMENTED PRODUCTION, QUALITY AND TEST PROCESSES.
9. ELECTRICAL WORKMANSHIP SHALL COMPLY WITH IPC IPC-A-610A CLASS II ACCEPTABILITY OF ELECTRONIC AND ELECTRICAL ASSEMBLIES MOST CURRENT REVISION.
10. CABLE AND HARNESS WORKMANSHIP SHALL COMPLY WITH IPC/WHMA-A-620 REQUIREMENTS AND ACCEPTANCE FOR CABLE AND WIRE HARNESS ASSEMBLIES MOST CURRENT REVISION.
11. POINT TO POINT CONTINUITY TESTING SHALL BE PERFORMED ON THIS HARNESS ASSEMBLY.
12. COVER ALL SPLICES WITH HEAT SHRINK 0898-1337-03.
13. HARNESS SHALL BE SHIPPED IN PLASTIC BAG.
14. TORQUE ALL TERMINALS TO 0.6 - 0.9 Nm
15. TORQUE TERMINAL BLOCK TO 0.4-0.5 Nm. (SEE SHEET 2)
16. IF A VALUE OF ZERO IS USED IN THE BILL OF MATERIAL THE QUANTITY OF THE AFFECTED MATERIAL SHALL BE DERIVED FROM THE DRAWING REQUIREMENTS.
17. ORIENT LABEL,IDENTIFICATION (A055Z217) AS SHOWN. (SHEET 2)
18. NOMINAL WEIGHT BASED ON PHYSICAL MEASUREMENT (1.6 KILOGRAMS) NOT FOR INSPECTION.

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS
DIM: X ±- .X ±- .XX± -
MCE: 5.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13
ANG TOL: ± 1.0° SCALE: 5/32
DO NOT SCALE PRINT
- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP
DWN P MEDINA CKD B ZAPATA APVD B ZAPATA DATE 11OCT12
FIRST USED ON C3250D6
SITE CODE PGF
CUMMINS POWER GENERATION
HARNESS, RELAY CUSTOMER RELAYS
SIZE D A044F278 SHEET 1 OF 2 DWG REV G

FIGURE 584. A044F278 CUSTOMER RELAY HARNESS (SHEET 1)

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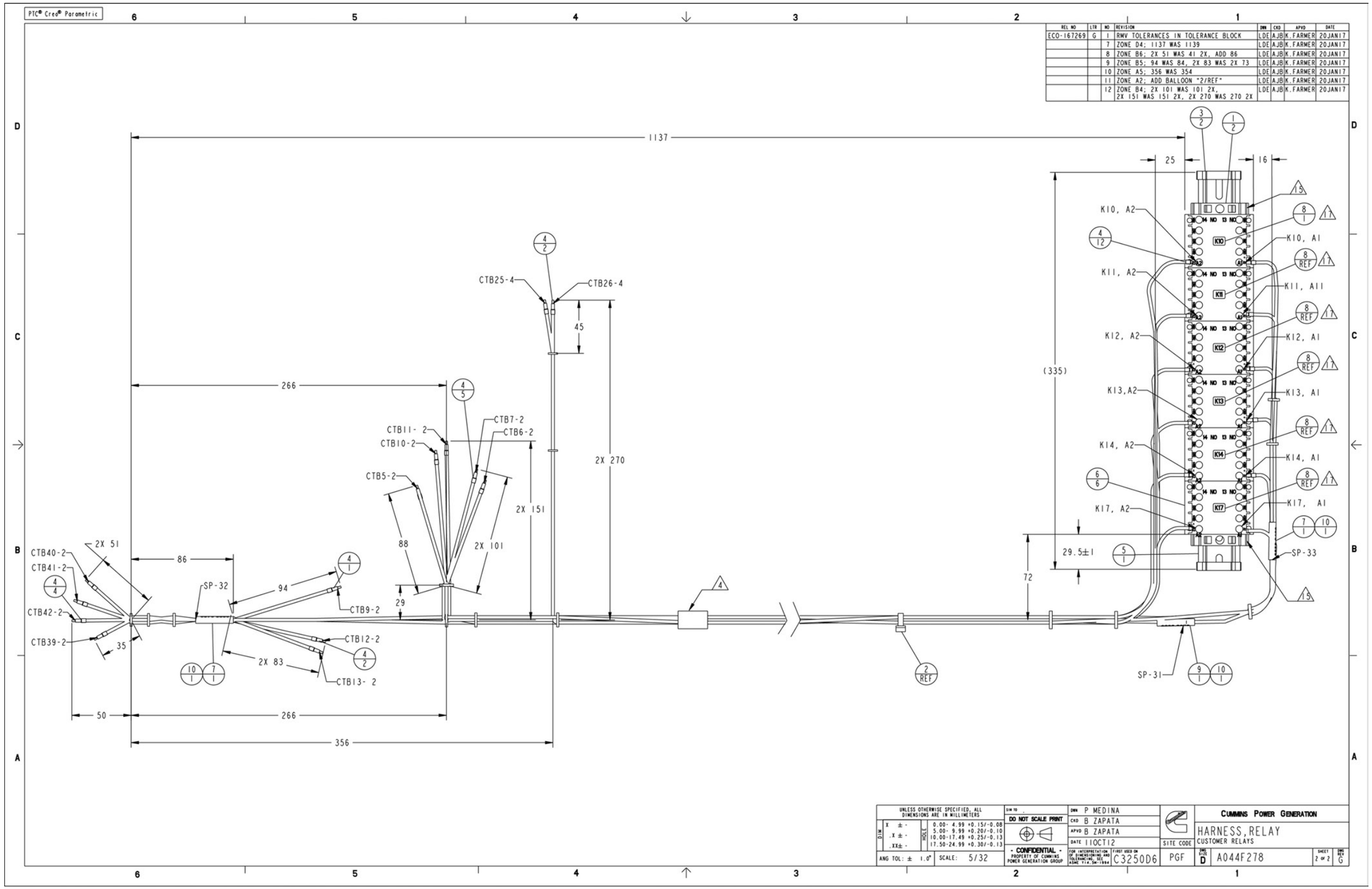


FIGURE 585. A044F278 CUSTOMER RELAY HARNESS (SHEET 2)

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C.7 A044D654 Generator Set Input Control Harness

PTC® Creo® Parametric

TO/FROM WIRE LIST

INDEX	WIRE NAME	CONNECTOR NAME	CONNECTOR PART NUMBER	FROM	PIN	CONNECTOR NAME	CONNECTOR PART NUMBER	TO	PIN	WIRE	LENGTH (REFERENCE ONLY)	COLOR	WIRE GAUGE
1	W-1177	CTB12, 2	A034V373	CTB12, 2-.	NONE	TB B- (4)	0332-4324	TB B- (4)-2	A034V373	0334-0757	624	WHITE	18-AWG
2	W-756	F15	0321-0445	F15-2	A030B219	K5,1	0332-1993	K5,1-.	NONE	0334-0758	316	WHITE	16-AWG
3	W-787	F20A	0321-0445	F20A-2	A045F409	SP-40	0332-3058	SP-40-1	NONE	0334-0757	88	WHITE	18-AWG
4	W-757	F5A	0321-0445	F5A-2	A034V373	K15, 11	0332-3491-01	K15, 11-.	NONE	0334-0757	336	WHITE	18-AWG
5	W-416	F5B	0321-0445	F5B-1	A034V373	J32-B	A045B662	J32-B-11	A034L923	0334-0757	791	WHITE	18-AWG
6	W-1108	F5B	0321-0445	F5B-2	A034V373	TB B+ (4)	0332-4321	TB B+ (4)-2	A034V373	0334-0757	199	WHITE	18-AWG
7	W-417	F5C	0321-0445	F5C-1	A034V373	J32-C	A045B662	J32-C-12	A034L923	0334-0757	817	WHITE	18-AWG
8	W-277	FA	A047W341	FA-1	A045C955	P31	0323-2624	P31-2	0323-2332	0334-0759	335	WHITE	14-AWG
9	W-278	FA	A047W341	FA-2	A045C955	P31	0323-2624	P31-1	0323-2332	0334-0759	611	WHITE	14-AWG
10	W-276	FB	A047W341	FB-1	A045C955	P31	0323-2624	P31-4	0323-2332	0334-0759	336	WHITE	14-AWG
11	W-418	J30	A040M607	J30-1	0323-1681	TB B+ (1)	0332-4321	TB B+ (1)-1	A034U838	0334-0760	367	WHITE	12-AWG
12	W-419	J30	A040M607	J30-4	A029C992	TB B- (2)	0332-4324	TB B- (2)-2	A034U838	0334-0760	744	WHITE	12-AWG
13	W-420	J30	A040M607	J30-5	0323-1681	T26 (2)	0332-4323	T26 (2)-2	A034U836	0334-0759	689	WHITE	14-AWG
14	W-421	J30	A040M607	J30-3	A029C992	TB B- (1)	0332-4324	TB B- (1)-1'	A034U838	0334-0760	755	WHITE	12-AWG
15	W-759	J30	A040M607	J30-2	0323-1681	TB B+ (2)	0332-4321	TB B+ (2)-1	A034U838	0334-0760	374	WHITE	12-AWG
16	W-760	J30	A040M607	J30-6	0323-1681	T26 (3)	0332-4323	T26 (3)-2	A034U836	0334-0759	691	WHITE	14-AWG
17	W-800	J30	A040M607	J30-7	0323-1681	P20	0323-2446	P20-17	0323-2466	0334-0756	733	WHITE	20-AWG
18	W-802	J30	A040M607	J30-9	0323-1681	P20	0323-2446	P20-18	0323-2466	0334-0756	726	WHITE	20-AWG
19	W-804	J30	A040M607	J30-11	0323-1681	P20	0323-2446	P20-19	0323-2466	0334-0756	714	WHITE	20-AWG
20	C-8 C-001	J32-A	A045B666	J32-A-6 △12	A050B351	SP-22	0332-3058	SP-22-1 △12	NONE	A040H594	225	SHIELD	20-AWG
21	C-8 C-002	J32-A	A045B666	J32-A-5	A045L356	SP-21	0332-4173	SP-21-1	NONE	A040H594	225	BLACK	18-AWG
22	C-8 C-003	J32-A	A045B666	J32-A-4	A045L356	SP-20	0332-4173	SP-20-1	NONE	A040H594	225	WHITE	18-AWG
23	W-408	J32-B	A045B662	J32-B-1	A045L454	SP-13	0332-0385-03	SP-13-1	NONE	0334-0760	553	WHITE	12-AWG
24	W-409	J32-B	A045B662	J32-B-2	A045L454	SP-13	0332-0385-03	SP-13-1	NONE	0334-0760	564	WHITE	12-AWG
25	W-532	J32-B	A045B662	J32-B-14	A034L923	K15, 14	0332-3491-01	K15, 14-.	NONE	0334-0757	808	WHITE	18-AWG
26	W-758	J32-B	A045B662	J32-B-3	A045L450	K4, 4	0332-1992	K4, 4-.	NONE	0334-0758	1053	WHITE	16-AWG
27	W-1021	J32-B	A045B662	J32-B-12	A034L923	TB B- (4)	0332-4324	TB B- (4)-1	A034V373	0334-0757	899	WHITE	18-AWG
28	W-1140	J32-B	A045B662	J32-B-13	A034L923	CTB2, 3	A034V373	CTB2, 3-.	NONE	0334-0757	457	WHITE	18-AWG
29	W-376	J32-C	A045B662	J32-C-14	A034L923	P20	0323-2446	P20-22	0323-2466	0334-0757	1254	WHITE	18-AWG
30	W-414	J32-C	A045B662	J32-C-2	A045L454	SP-14	0332-1105	SP-14-1	NONE	0334-0760	536	WHITE	12-AWG
31	W-789	J32-C	A045B662	J32-C-1	A045L454	SP-14	0332-1105	SP-14-1	NONE	0334-0760	529	WHITE	12-AWG
32	W-798	J32-C	A045B662	J32-C-13	A034L923	P20	0323-2446	P20-11	0323-2466	0334-0757	1250	WHITE	18-AWG
33	W-1020	J32-C	A045B662	J32-C-11	A034L923	TB B- (1)	0332-4324	TB B- (1)-1	A034V373	0334-0757	923	WHITE	18-AWG
34	C-20 C-001	J37	A043G719	J37-10 △14	A045R442	C-20		C-20--	NONE	A040H594	1099	SHIELD	20-AWG
35	C-20 C-002	J37	A043G719	J37-9	A044C667	R1, 22	A046V216	R1, 22-.	NONE	A040H594	1099	BLACK	18-AWG
36	C-20 C-003	J37	A043G719	J37-8	A044C667	R1, 12	A046V216	R1, 12-.	NONE	A040H594	1099	WHITE	18-AWG
37	C-43 C-001	J37	A043G719	J37-20 △14	A045R442	SP-38	0332-3058	SP-38-1 △14	NONE	A040H594	1258	SHIELD	20-AWG
38	C-43 C-002	J37	A043G719	J37-3	A034E918	SP-37	0332-4173	SP-37-1	NONE	A040H594	1258	BLACK	18-AWG
39	C-43 C-003	J37	A043G719	J37-6	A034E918	SP-36	0332-4173	SP-36-1	NONE	A040H594	1258	WHITE	18-AWG
40	W-355	J37	A043G719	J37-2	A043Z403	P20	0323-2446	P20-13	0323-2466	0334-0757	1334	WHITE	18-AWG
41	W-391	J37	A043G719	J37-14	A043Z403	P25	0323-2445	P25-6	0323-2466	0334-0757	1435	WHITE	18-AWG
42	W-392	J37	A043G719	J37-13	A043Z403	P25	0323-2445	P25-2	0323-2466	0334-0757	1442	WHITE	18-AWG
43	W-393	J37	A043G719	J37-12	A043Z403	SP-23	0332-0418-01	SP-23-2	NONE	0334-0757	1241	WHITE	18-AWG
44	W-394	J37	A043G719	J37-5	A043Z403	P25	0323-2445	P25-10	0323-2466	0334-0757	1465	WHITE	18-AWG
45	W-395	J37	A043G719	J37-7	A043Z403	P25	0323-2445	P25-11	0323-2466	0334-0757	1457	WHITE	18-AWG
46	W-396	J37	A043G719	J37-4	A043Z403	SP-24	0332-1105	SP-24-2	NONE	0334-0757	1240	WHITE	18-AWG
47	W-400	J37	A043G719	J37-11	A043Z403	P25	0323-2445	P25-5	0323-2466	0334-0757	1472	WHITE	18-AWG
48	W-788	J37	A043G719	J37-17	A043Z403	SP-39	0332-3058	SP-39-1	NONE	0334-0757	737	WHITE	18-AWG
49	W-851	J37	A043G719	J37-19	A043Z403	CTB11, 2	A034V373	CTB11, 2-.	NONE	0334-0757	773	WHITE	18-AWG
50	W-852	J37	A043G719	J37-18	A043Z403	CTB5, 4	A034V373	CTB5, 4-.	NONE	0334-0757	807	WHITE	18-AWG
51	W-1114	J37	A043G719	J37-15	A043Z403	R1, 34	A046V216	R1, 34-.	NONE	0334-0757	1062	WHITE	18-AWG
52	W-1142	J37	A043G719	J37-1	A043Z403	P13	A034P713	P13-1	A034V373	0334-0757	674	WHITE	18-AWG
53	W-755	K15, A1	0332-3491-01	K15, A1-.	NONE	SP-15	0332-4222	SP-15-1	NONE	0334-0757	140	WHITE	18-AWG

REL NO	LTR	NO	REVISION	DWN	CKD	APVD	DATE
ECO-183152	F	1	BOM WIRE LENGTH 0334.0757, 111.55B WAS 110.423, 0334.0758 7.741 WAS 7.723, 0334.0759 18.202 WAS 18.203, A040H594 14.394 WAS 14.381	MRJ	DW	M_FEGLEY	24JAN19
		2	SEE SHEET 4	MRJ	DW	M_FEGLEY	24JAN19
		3	SEE SHEET 4	MRJ	DW	M_FEGLEY	24JAN19
		4	SEE SHEET 4	MRJ	DW	M_FEGLEY	24JAN19
		5	SEE SHEET 4	MRJ	DW	M_FEGLEY	24JAN19
		6	SEE SHEET 4	MRJ	DW	M_FEGLEY	24JAN19
		7	SEE SHEET 4	MRJ	DW	M_FEGLEY	24JAN19
		8	SEE SHEET 4	MRJ	DW	M_FEGLEY	24JAN19

NOTE:

1. WIRES SHALL BE HOT STAMPED, OR PERMANENTLY MARKED WITH BOTH FROM AND TO LABELS AS LISTED IN TABULATION. MARKINGS SHALL APPEAR AT A MAXIMUM OF 75 MM FROM EACH END. MARKING SHALL BE VISIBLE AFTER WIRE IS INSTALLED INTO CONNECTORS.
2. DIMENSIONS ARE IN MILLIMETERS.
3. TOLERANCE: UP TO 500 +7 500 TO 1000 +40 1000 & LARGER +60
4. ATTACH A MASTER HARNESS LABEL WITH THE FOLLOWING INFORMATION: CUMMINS PART NUMBER, CUMMINS PART REVISION LEVEL, MANUFACTURER'S NAME, MANUFACTURER'S LOCATION, AND MANUFACTURER'S DATE OF MANUFACTURE IN THE FORMAT OF MONTH, DATE, LAST 2 YEAR DIGITS. LABEL MUST BE MADE FROM UL RECOGNIZED VINYL SELF LAMINATION LABEL SYSTEM. PLACE IN APPROXIMATE LOCATION SHOWN ON DRAWING.
5. PLACE CABLE TIES AS NECESSARY TO SECURE WIRES AND MAINTAIN HARNESS SHAPE.
6. (NOTE REMOVED)
7. HARNESS SHALL BE PROCURED FROM A SUPPLIER QUALIFIED AS A UL RECOGNIZED HARNESS MANUFACTURER (CATEGORY ZPFW2). PACKAGING OR PARTS TO BE MARKED IN ACCORDANCE WITH REQUIREMENTS SPECIFIED BY SUPPLIERS UL PROGRAM.
8. THE SUPPLIER SHALL UTILIZE AGREED UPON AND DOCUMENTED PRODUCTION, QUALITY AND TEST PROCESSES.
9. ELECTRICAL WORKMANSHIP SHALL COMPLY WITH IPC IPC-A-610A CLASS II ACCEPTABILITY OF ELECTRONIC AND ELECTRICAL ASSEMBLIES MOST CURRENT REVISION.
10. CABLE AND HARNESS WORKMANSHIP SHALL COMPLY WITH IPC/WHMA-A-620 REQUIREMENTS AND ACCEPTANCE FOR CABLE AND WIRE HARNESS ASSEMBLIES MOST CURRENT REVISION.
11. IF A VALUE OF ZERO IS USED IN THE BILL OF MATERIAL THE QUANTITY OF THE AFFECTED MATERIAL SHALL BE DERIVED FROM THE DRAWING REQUIREMENTS.
12. POINT TO POINT CONTINUITY TESTING SHALL BE PERFORMED ON THIS HARNESS ASSEMBLY.
13. SPLICE LOCATIONS ARE REFERENCE ONLY. SPLICES SHALL BE OFFSET TO PREVENT EXCESSIVE BULGES.
12. INSERT ALL SHIELD WIRES INTO UL RECOGNIZED TRANSPARENT (CLEAR) PLASTIC TUBE. TUBE INSULATION TO BE RATED AT 600V, 105°C. HEAT SHRINK CABLE, CONDUCTORS AND TRANSPARENT TUBE USING ITEM 0898-1337-05. SEE DETAIL V, SHEET 3.
15. TORQUE ALL TERMINALS AT 0.6-0.8 Nm.
16. ALL SPLICES SHALL BE COVERED WITH HEAT SHRINK.
17. HARNESS SHALL BE SHIPPED IN PLASTIC BAG.
18. MARK RELAYS 0307-2968-04 "K4" AND "K5" WITH UL RECOGNIZED VINYL SELF LAMINATING LABEL. PLACE IN APPROXIMATE LOCATION SHOWN ON SHEET 3.
19. (NOTE REMOVED)

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS
DIM: X ± 1 | .X ± 0.8 | .XX ± 0.38
0.00- 4.99 +0.15/-0.08
5.00- 9.99 +0.20/-0.10
10.00-17.49 +0.25/-0.13
17.50-24.99 +0.30/-0.13
ANG TOL: ± 1.0° SCALE: 5/32

SIM TO
DO NOT SCALE PRINT
- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP

DWN P MEDINA
CKD B ZAPATA
APVD B ZAPATA
DATE 01OCT12
FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994
FIRST USED ON C3250D6

SITE CODE PGF

CUMMINS POWER GENERATION
HARNESS,CONTROL
GENSET INPUT

SIZE D | A044D654 | SHEET 1 OF 6 | DWG REV F

FIGURE 586. A044D654 GENERATOR SET INPUT CONTROL HARNESS (SHEET 1)

INDEX	WIRE NAME	CONNECTOR NAME	CONNECTOR PART NUMBER	FROM	PIN	CONNECTOR NAME	CONNECTOR PART NUMBER	TO	PIN	WIRE	LENGTH (REFERENCE ONLY)	COLOR	WIRE GAUGE
54	W-1118	K4, 1	0332-1992	K4, 1-.	NONE	TB B+ (3)	0332-4321	TB B+ (3)-1	A030B219	0334-0758	667	WHITE	16-AWG
55	W-1109	K5, 4	0332-1993	K5, 4-.	NONE	T26 (3)	0332-4323	T26 (3)-1	A034U836	0334-0759	739	WHITE	14-AWG
56	W-1176	P13	A034P713	P13-2	A034V373	J13	A034P713	J13-1	A034V373	0334-0757	85	WHITE	18-AWG
57	W-311	P19	0323-2453	P19-1	0323-2466	P26	0323-2454	P26-9	0323-2466	0334-0757	265	WHITE	18-AWG
58	W-314	P19	0323-2453	P19-9	0323-2466	P26	0323-2454	P26-3	0323-2466	0334-0757	259	WHITE	18-AWG
59	W-316	P19	0323-2453	P19-10	0323-2466	P26	0323-2454	P26-7	0323-2466	0334-0757	265	WHITE	18-AWG
60	W-319	P20	0323-2446	P20-2	0323-2466	SP-23	0332-0418-01	SP-23-1	NONE	0334-0757	162	WHITE	18-AWG
61	W-320	P20	0323-2446	P20-4	0323-2466	SP-23	0332-0418-01	SP-23-1	NONE	0334-0757	166	WHITE	18-AWG
62	W-321	P20	0323-2446	P20-7	0323-2466	SP-23	0332-0418-01	SP-23-1	NONE	0334-0757	151	WHITE	18-AWG
63	W-322	P20	0323-2446	P20-12	0323-2466	SP-23	0332-0418-01	SP-23-1	NONE	0334-0757	167	WHITE	18-AWG
64	W-323	P20	0323-2446	P20-9	0323-2466	SP-24	0332-1105	SP-24-1	NONE	0334-0757	138	WHITE	18-AWG
65	W-335	P20	0323-2446	P20-10	0323-2466	SP-24	0332-1105	SP-24-1	NONE	0334-0757	144	WHITE	18-AWG
66	W-338	P20	0323-2446	P20-20	0323-2466	SP-24	0332-1105	SP-24-1	NONE	0334-0757	137	WHITE	18-AWG
67	W-354	P20	0323-2446	P20-21	0323-2466	SP-24	0332-1105	SP-24-1	NONE	0334-0757	150	WHITE	18-AWG
68	W-374	P20	0323-2446	P20-15	0323-2466	K4, 6	0332-1992	K4, 6-.	NONE	0334-0756	568	WHITE	20-AWG
69	W-375	P20	0323-2446	P20-3	0323-2466	K5, 6	0332-1992	K5, 6-.	NONE	0334-0756	602	WHITE	20-AWG
70	W-801	P20	0323-2446	P20-5	0323-2466	J30	A040M607	J30-8	0323-1681	0334-0756	709	WHITE	20-AWG
71	W-803	P20	0323-2446	P20-6	0323-2466	J30	A040M607	J30-10	0323-1681	0334-0756	705	WHITE	20-AWG
72	W-805	P20	0323-2446	P20-8	0323-2466	J30	A040M607	J30-12	0323-1681	0334-0756	716	WHITE	20-AWG
73	C-44 C-001	P25	0323-2445	P25-9 (14)	0323-2466	SP-38	0332-3058	SP-38-2 (14)	NONE	A040H594	180	SHIELD	20-AWG
74	C-44 C-002	P25	0323-2445	P25-3	0323-2466	SP-37	0332-4173	SP-37-2	NONE	A040H594	180	BLACK	18-AWG
75	C-44 C-003	P25	0323-2445	P25-4	0323-2466	SP-36	0332-4173	SP-36-2	NONE	A040H594	180	WHITE	18-AWG
76	C-5 C-001	P26	0323-2454	P26-1 (14)	0323-2466	SP-22	0332-3058	SP-22-2 (14)	NONE	A040H594	1108	SHIELD	20-AWG
77	C-5 C-002	P26	0323-2454	P26-10	0323-2466	SP-21	0332-4173	SP-21-2	NONE	A040H594	1108	BLACK	18-AWG
78	C-5 C-003	P26	0323-2454	P26-11	0323-2466	SP-20	0332-4173	SP-20-2	NONE	A040H594	1108	WHITE	18-AWG
79	W-312	P26	0323-2454	P26-5	0323-2466	P19	0323-2453	P19-8	0323-2466	0334-0757	262	WHITE	18-AWG
80	W-313	P26	0323-2454	P26-16	0323-2466	P19	0323-2453	P19-2	0323-2466	0334-0757	259	WHITE	18-AWG
81	W-315	P26	0323-2454	P26-14	0323-2466	P19	0323-2453	P19-4	0323-2466	0334-0757	261	WHITE	18-AWG
82	W-317	P26	0323-2454	P26-2	0323-2466	P19	0323-2453	P19-3	0323-2466	0334-0757	268	WHITE	18-AWG
83	W-730	P26	0323-2454	P26-15	0323-2466	K15, A2	0332-3491-01	K15, A2-.	NONE	0334-0757	524	WHITE	18-AWG
84	W-279	P31	0323-2624	P31-3	0323-2332	FB	A047W341	FB-2	A045C955	0334-0759	613	WHITE	14-AWG
85	W-762	R1, 31	A046V216	R1, 31-.	NONE	TB B- (3)	0332-4324	TB B- (3)-2	A034V373	0334-0757	454	WHITE	18-AWG
86	W-761	R1, A1	A046V216	R1, A1-.	NONE	TB B+ (2)	0332-4321	TB B+ (2)-2	A034V373	0334-0757	176	WHITE	18-AWG
87	W-1106	R1, A2	A046V216	R1, A2-.	NONE	J37	A043G719	J37-16	A043Z403	0334-0757	1142	WHITE	18-AWG
88	W-411	SP-13	0332-0385-03	SP-13-2	NONE	F20A	0321-0445	F20A-1	A034U836	0334-0759	319	WHITE	14-AWG
89	W-412	SP-13	0332-0385-03	SP-13-2	NONE	F20B	0321-0445	F20B-1	A034U836	0334-0759	337	WHITE	14-AWG
90	W-533	SP-13	0332-0385-03	SP-13-2	NONE	F5A	0321-0445	F5A-1	A034V373	0334-0757	280	WHITE	18-AWG
91	W-534	SP-13	0332-0385-03	SP-13-2	NONE	F15	0321-0445	F15-1	A030B219	0334-0758	323	WHITE	16-AWG
92	W-406	SP-15	0332-4222	SP-15-1	NONE	K5, 5	0332-1992	K5, 5-.	NONE	0334-0757	314	WHITE	18-AWG
93	W-407	SP-15	0332-4222	SP-15-1	NONE	K4, 5	0332-1992	K4, 5-.	NONE	0334-0757	270	WHITE	18-AWG
94	W-782	SP-15	0332-4222	SP-15-2	NONE	J13	A034P713	J13-2	A034V373	0334-0757	250	WHITE	18-AWG
95	C-35 C-003	SP-20	0332-4173	SP-20-1	NONE	J32-A	A045B666	J32-A-1	A045L356	A040H594	229	WHITE	18-AWG
96	C-35 C-002	SP-21	0332-4173	SP-21-1	NONE	J32-A	A045B666	J32-A-2	A045L356	A040H594	229	BLACK	18-AWG
97	C-35 C-001	SP-22	0332-3058	SP-22-1 (14)	NONE	J32-A	A045B666	J32-A-3 (14)	A050B351	A040H594	229	SHIELD	20-AWG
98	W-643	SP-23	0332-0418-01	SP-23-1	NONE	PCC GND	0332-0804	PCC GND-.	NONE	0334-0757	292	WHITE	18-AWG
99	W-884	SP-23	0332-0418-01	SP-23-2	NONE	SP-14	0332-1105	SP-14-	NONE	0334-0760	599	WHITE	12-AWG
100	W-779	SP-24	0332-1105	SP-24-2	NONE	F20A	0321-0445	F20A-2	A045F409	0334-0759	743	WHITE	14-AWG
101	C-45 C-003	SP-36	0332-4173	SP-36-1	NONE	R1, 11	A046V216	R1, 11-.	NONE	A040H594	289	WHITE	18-AWG
102	C-45 C-002	SP-37	0332-4173	SP-37-1	NONE	R1, 21	A046V216	R1, 21-.	NONE	A040H594	289	BLACK	18-AWG
103	C-45 C-001	SP-38	0332-3058	SP-38-1 (14)	NONE	C-45		C-45--	NONE	A040H594	289	SHIELD	20-AWG
104	W-776	SP-39	0332-3058	SP-39-2	NONE	B-L2	A034P713	B-L2-1	A034V373	0334-0757	739	WHITE	18-AWG
105	W-781	SP-39	0332-3058	SP-39-2	NONE	B-L1	A034P713	B-L1-1	A034V373	0334-0757	531	WHITE	18-AWG

REL NO	LTR	NO	REVISION	DWN	CKD	APVD	DATE
ECO-183152	F	--	---	MRJ	DW	M_FEGLEY	24JAN19

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS
DIM X ± 1 | .X ± 0.8 | .XX ± 0.38
0.00- 4.99 +0.15/-0.08
5.00- 9.99 +0.20/-0.10
10.00-17.49 +0.25/-0.13
17.50-24.99 +0.30/-0.13
ANG TOL: ± 1.0° SCALE: 5/32
DO NOT SCALE PRINT
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DWN P MEDINA
CKD B ZAPATA
APVD B ZAPATA
DATE 01OCT12
FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994
FIRST USED ON C3250D6
SITE CODE PGF
CUMMINS POWER GENERATION
HARNESS, CONTROL
GENSET INPUT
DWG SIZE D A044D654 SHEET 2 of 6 DWG REV F

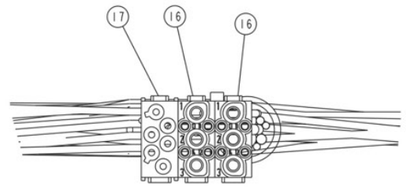
FIGURE 587. A044D654 GENERATOR SET INPUT CONTROL HARNESS (SHEET 2)

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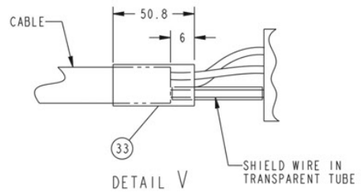
PTC® Creo® Parametric

INDEX	WIRE NAME	CONNECTOR NAME	CONNECTOR PART NUMBER	FROM	PIN	CONNECTOR NAME	CONNECTOR PART NUMBER	TO	PIN	WIRE	LENGTH (REFERENCE ONLY)	COLOR	WIRE GAUGE
106	W-777	SP-40	0332-3058	SP-40-2	NONE	B+L1	A034P713	B+L1-1	A034V373	0334-0757	403	WHITE	18-AWG
107	W-785	SP-40	0332-3058	SP-40-2	NONE	B+L2	A034P713	B+L2-1	A034V373	0334-0757	896	WHITE	18-AWG
108	W-1105	T26 (1)	0332-4323	T26 (1)-1'	A034V373	F5C	0321-0445	F5C-2	A034V373	0334-0757	152	WHITE	18-AWG
109	W-883	TB B- (2)	0332-4324	TB B- (2)-1	A034U838	SP-14	0332-1105	SP-14-2	NONE	0334-0760	356	WHITE	12-AWG
110	W-318	TB B- (3)	0332-4324	TB B- (3)-1	A034V373	P19	0323-2453	P19-14	0323-2466	0334-0757	715	WHITE	18-AWG
111	W-1104	TB B+ (3)	0332-4321	TB B+ (3)-2	A034U836	F20B	0321-0445	F20B-2	A034U836	0334-0759	135	WHITE	14-AWG

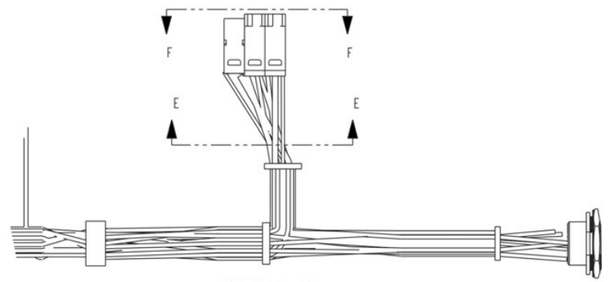
REL NO	LTR	NO	REVISION	DWN	CKD	APVD	DATE
ECO-183152	F	--	---	MRJ	DW	M_FEGLEY	24JAN19



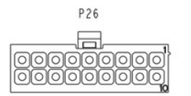
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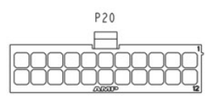
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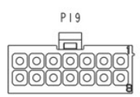
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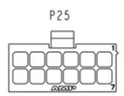
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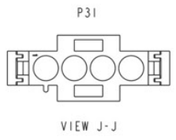
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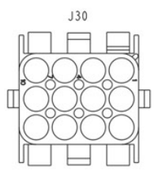
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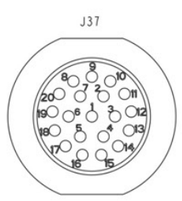
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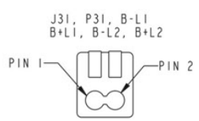
VIEW J-J



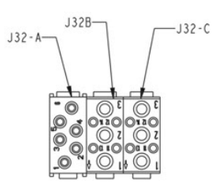
VIEW K-K



VIEW L-L



VIEW D-D



VIEW E-E
SCALE 9/8

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS		DWN P MEDINA	CUMMINS POWER GENERATION	
DIM X ±1 / .X ±0.8 / .XX ±0.38	0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13	DO NOT SCALE PRINT	CKD B ZAPATA	
			APVD B ZAPATA	HARNESS, CONTROL GENSET INPUT
			DATE 01OCT12	
ANG TOL: ± 1.0°	SCALE: 5/32	- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP	FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING SEE ASME Y14.5M-1994 C3250D6	SITE CODE PGF
				ENG SIZE D A044D654 SHEET 3 of 6 ENG REV F

FIGURE 588. A044D654 GENERATOR SET INPUT CONTROL HARNESS (SHEET 3)

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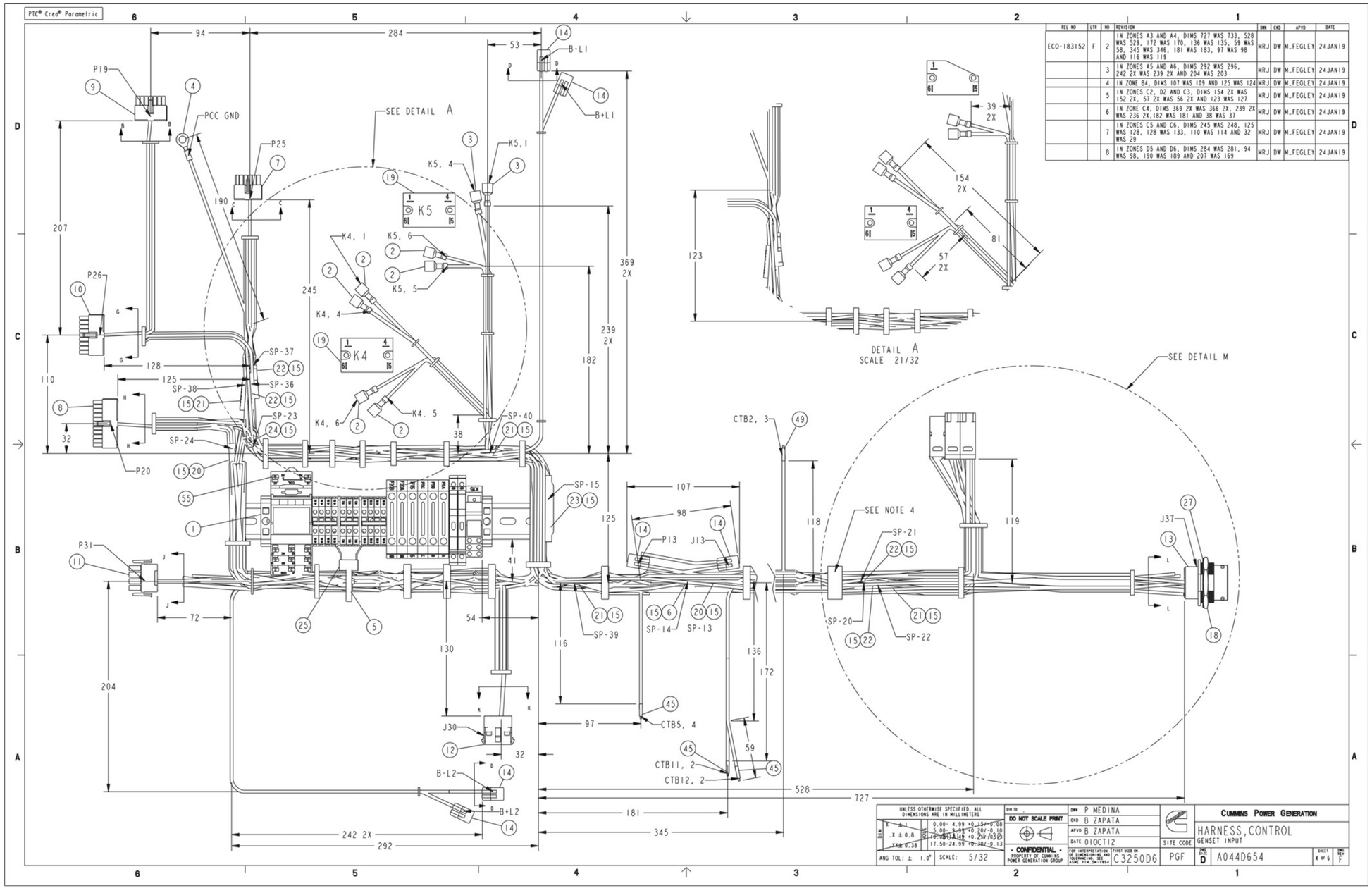


FIGURE 589. A044D654 GENERATOR SET INPUT CONTROL HARNESS (SHEET 4)

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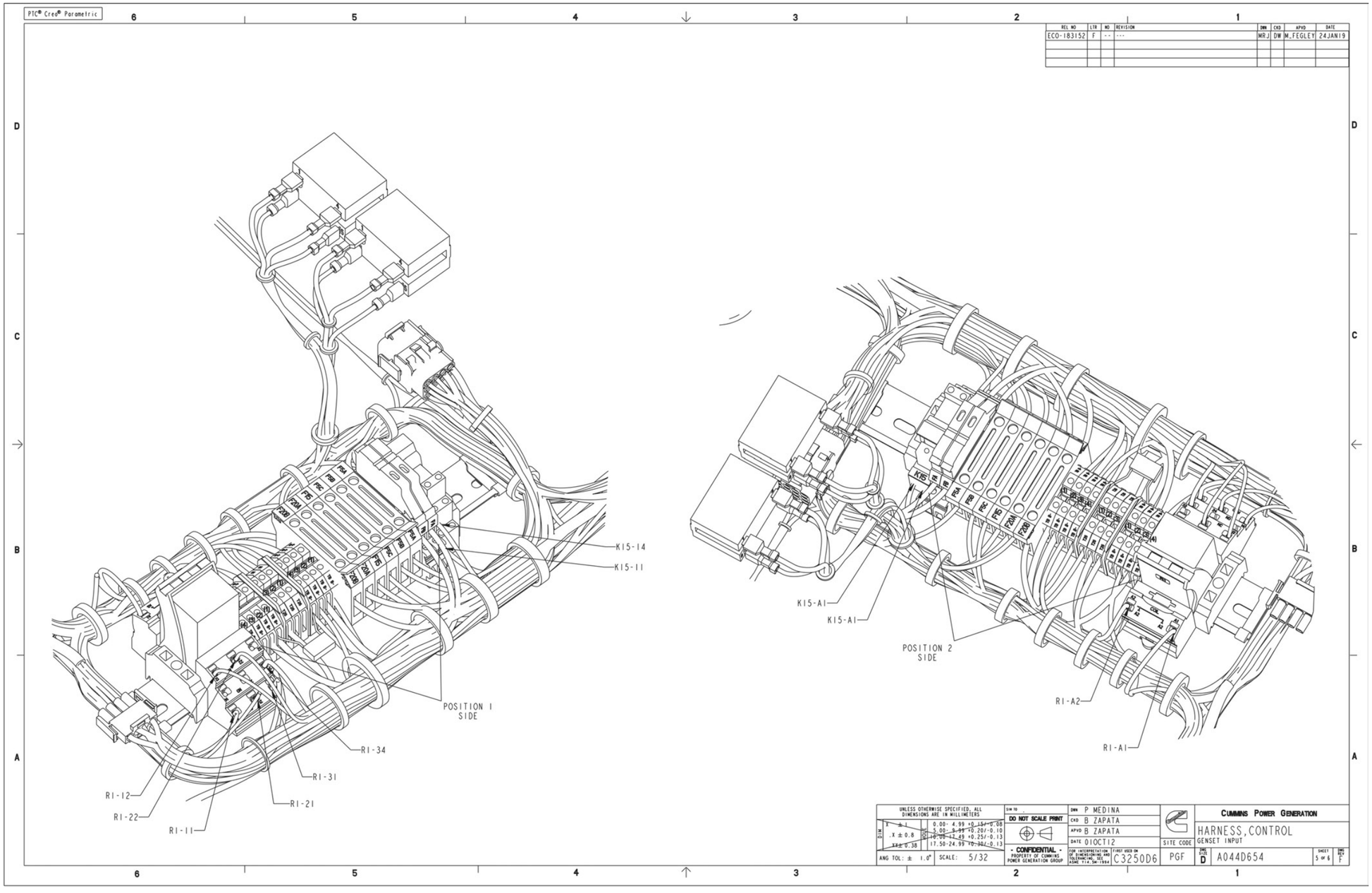


FIGURE 590. A044D654 GENERATOR SET INPUT CONTROL HARNESS (SHEET 5)

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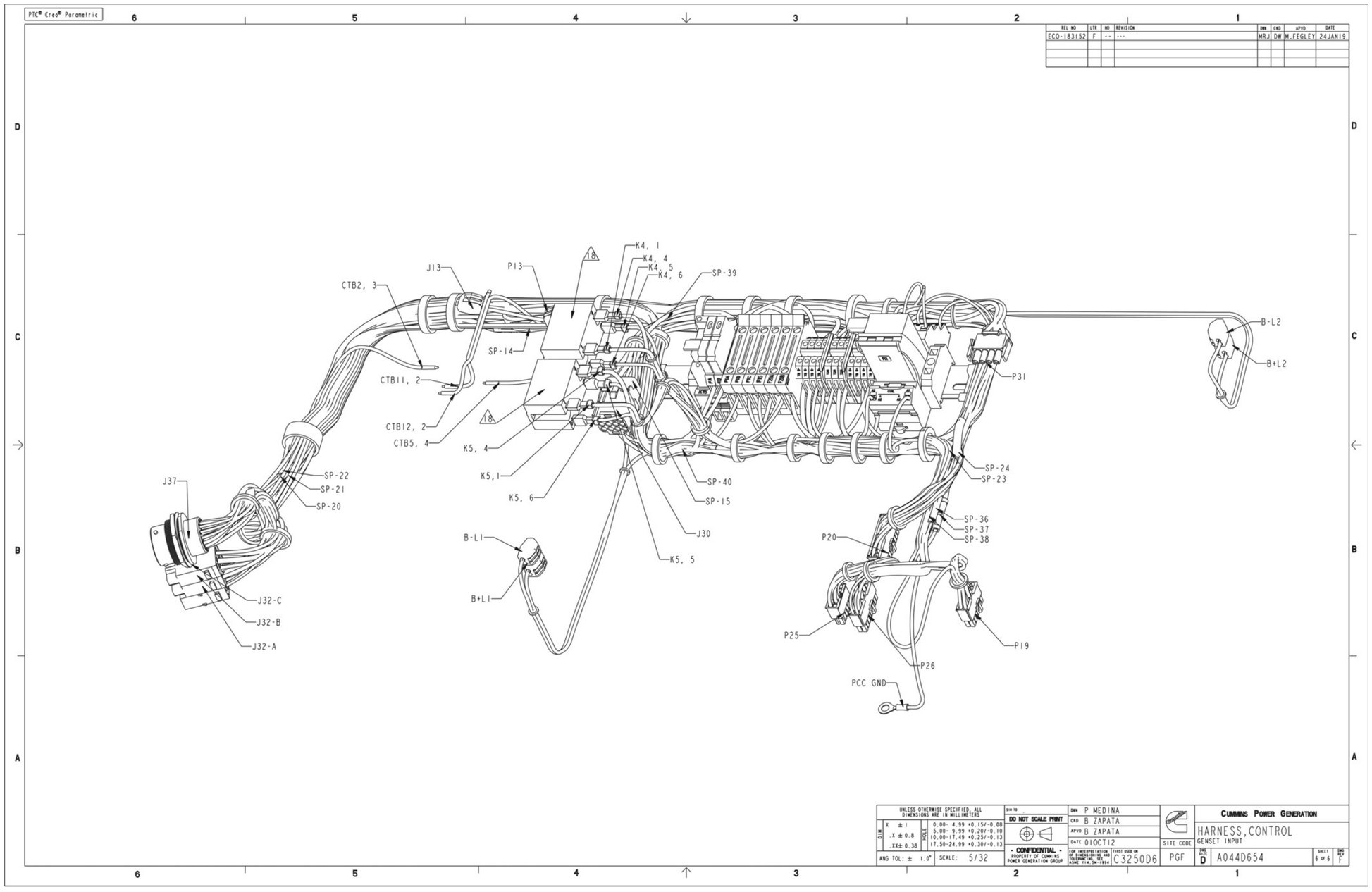


FIGURE 591. A044D654 GENERATOR SET INPUT CONTROL HARNESS (SHEET 6)

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C.8 A044F284 Ground Fault Relay Control Harness

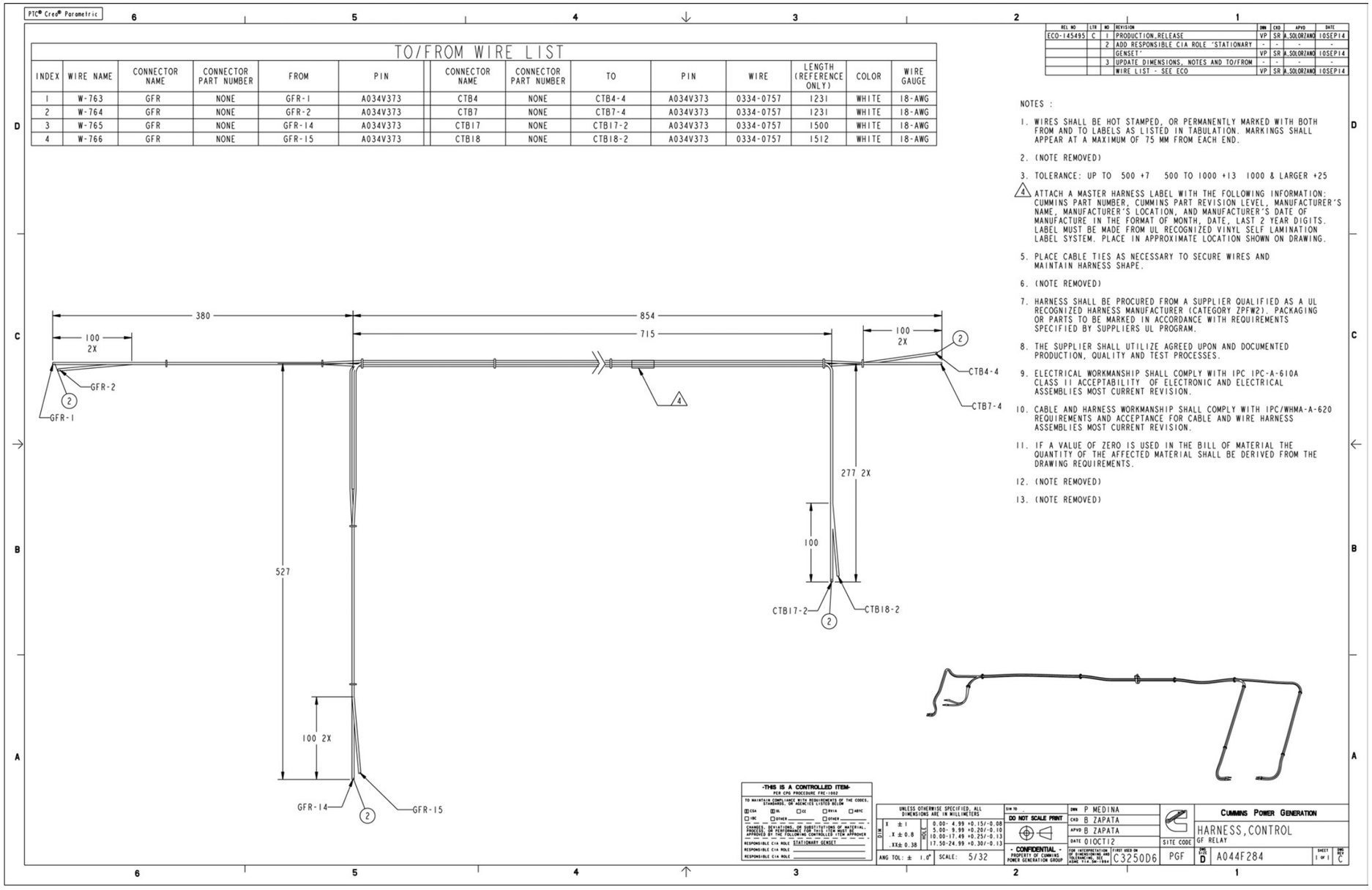


FIGURE 592. A044F284 GROUND FAULT RELAY CONTROL HARNESS (SHEET 1)

C.9 A041Y146 Low Coolant Level Harness

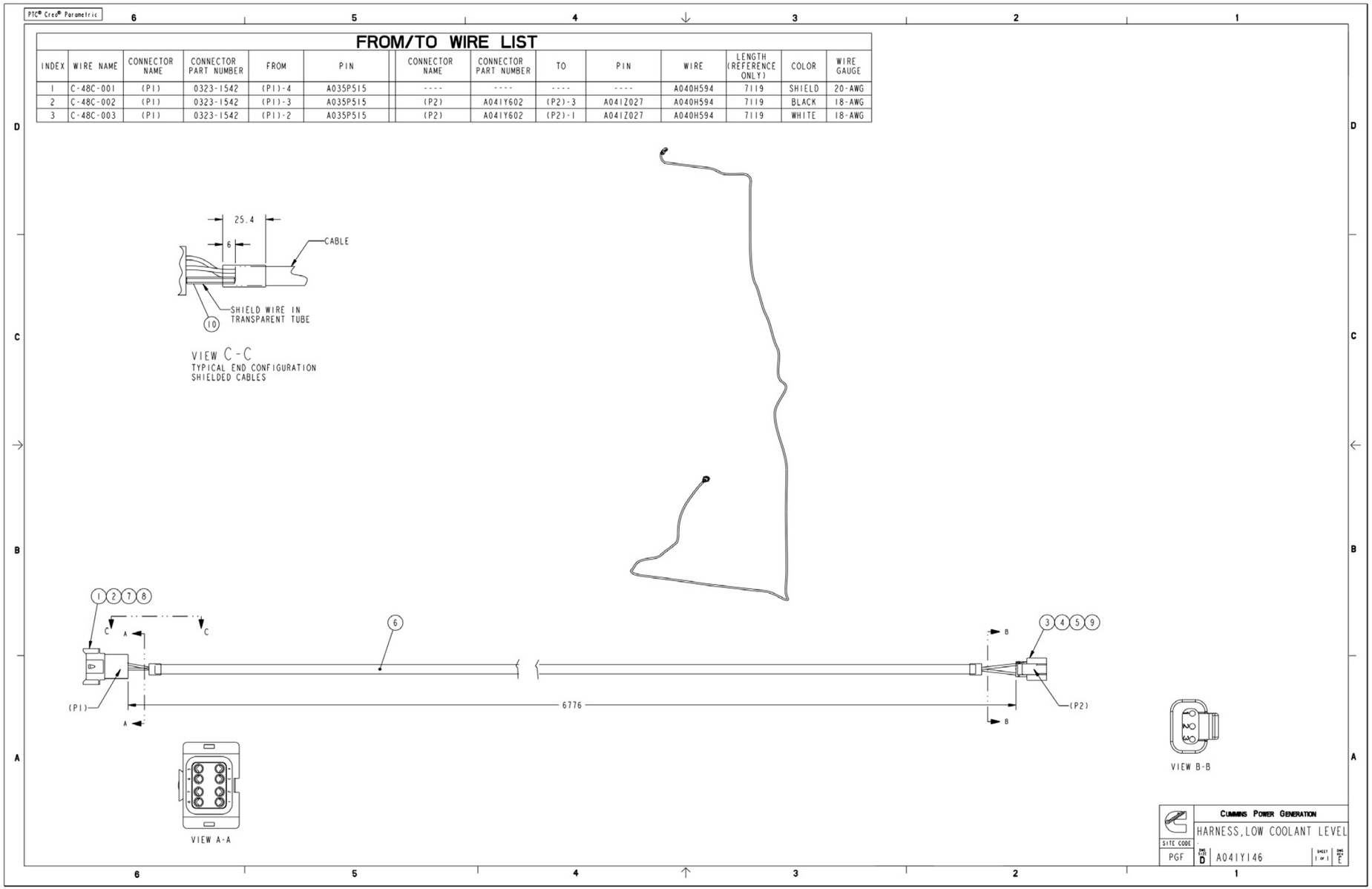


FIGURE 593. A041Y146 LOW COOLANT LEVEL HARNESS (SHEET 1)

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C.10 A064N798 Low Coolant Level Harness

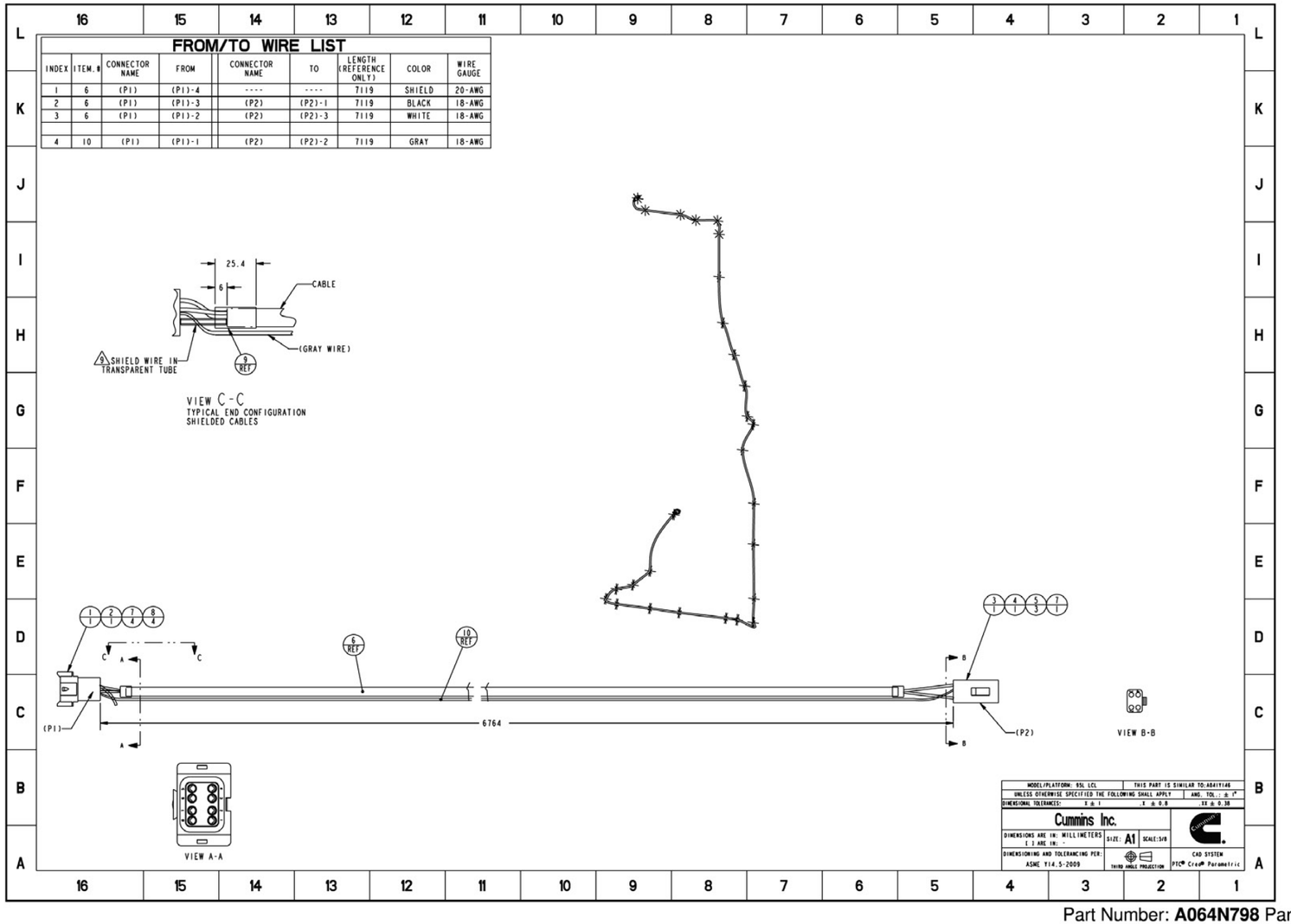


FIGURE 594. A064N798 LOW COOLANT LEVEL HARNESS (SHEET 1)

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C.11 A049B550 LV Metering Transformer Harness

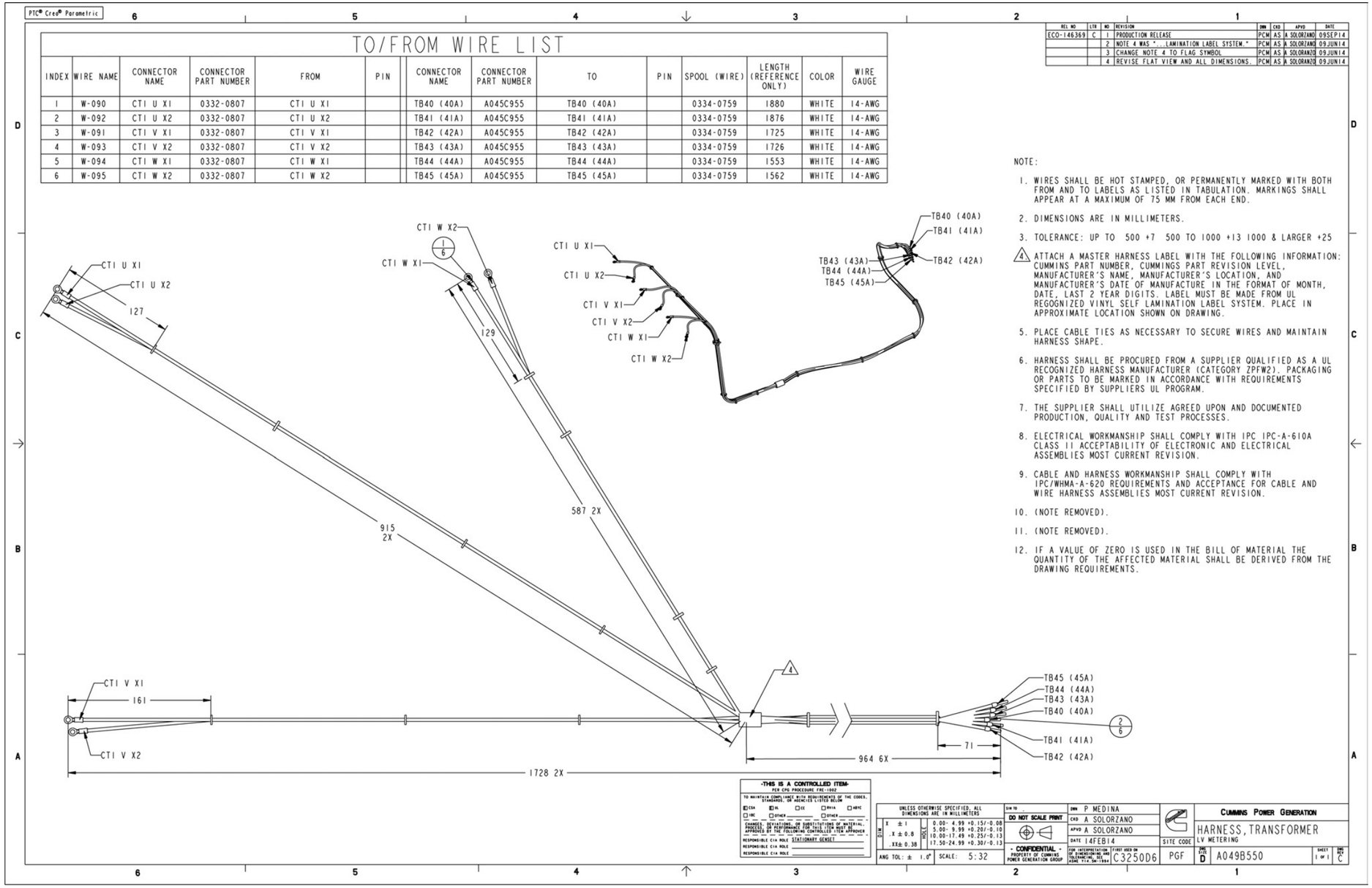
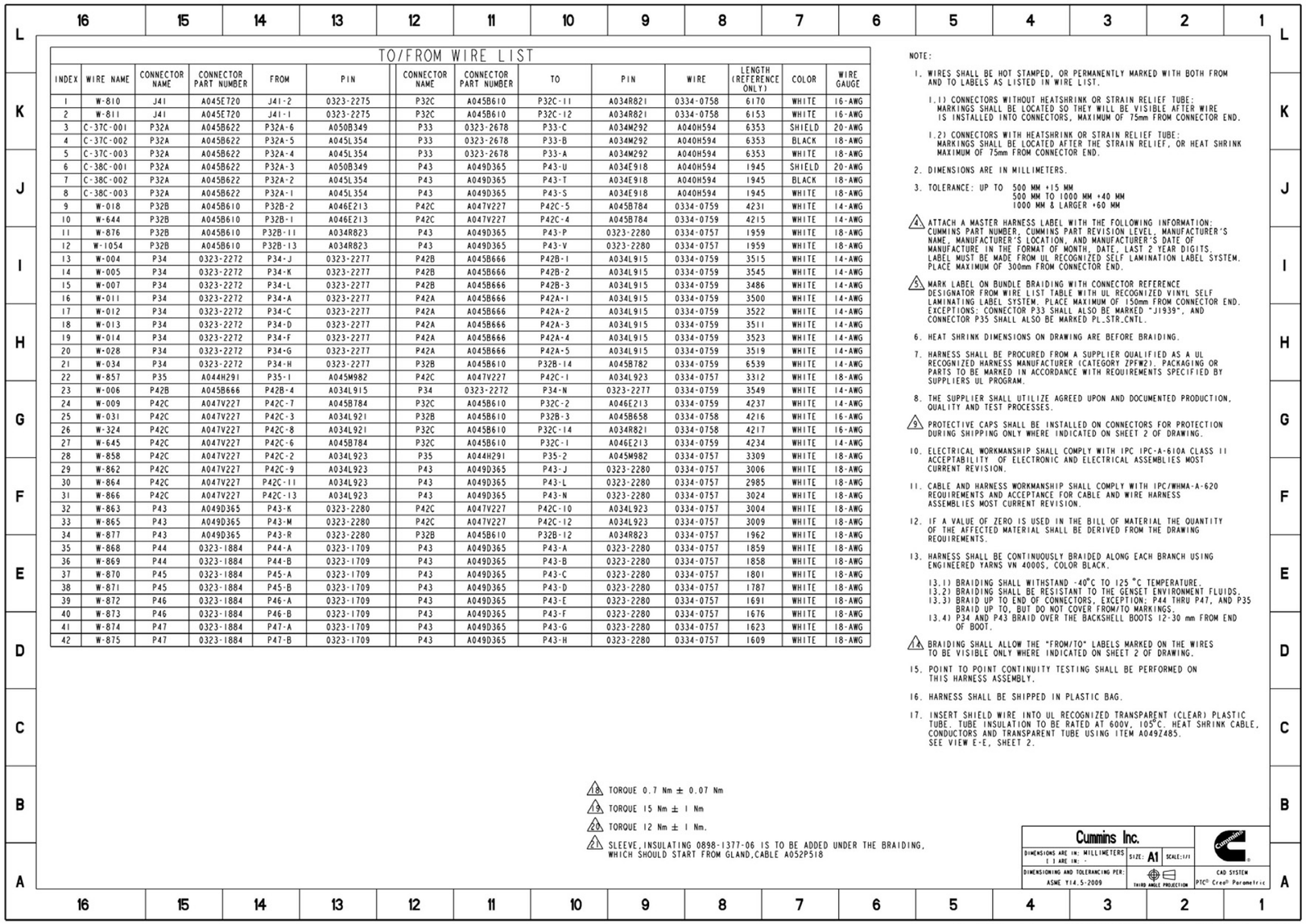


FIGURE 595. A049B550 LV METERING TRANSFORMER HARNESS (SHEET 1)

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C.12 A065E097 Main Generator Set Harness



TO/FROM WIRE LIST

INDEX	WIRE NAME	CONNECTOR NAME	CONNECTOR PART NUMBER	FROM	PIN	CONNECTOR NAME	CONNECTOR PART NUMBER	TO	PIN	WIRE	LENGTH (REFERENCE ONLY)	COLOR	WIRE GAUGE
1	W-810	J41	A045E720	J41-2	0323-2275	P32C	A045B610	P32C-11	A034R821	0334-0758	6170	WHITE	16-AWG
2	W-811	J41	A045E720	J41-1	0323-2275	P32C	A045B610	P32C-12	A034R821	0334-0758	6153	WHITE	16-AWG
3	C-37C-001	P32A	A045B622	P32A-6	A050B349	P33	0323-2678	P33-C	A034M292	A040H594	6353	SHIELD	20-AWG
4	C-37C-002	P32A	A045B622	P32A-5	A045L354	P33	0323-2678	P33-B	A034M292	A040H594	6353	BLACK	18-AWG
5	C-37C-003	P32A	A045B622	P32A-4	A045L354	P33	0323-2678	P33-A	A034M292	A040H594	6353	WHITE	18-AWG
6	C-38C-001	P32A	A045B622	P32A-3	A050B349	P43	A049D365	P43-U	A034E918	A040H594	1945	SHIELD	20-AWG
7	C-38C-002	P32A	A045B622	P32A-2	A045L354	P43	A049D365	P43-T	A034E918	A040H594	1945	BLACK	18-AWG
8	C-38C-003	P32A	A045B622	P32A-1	A045L354	P43	A049D365	P43-S	A034E918	A040H594	1945	WHITE	18-AWG
9	W-018	P32B	A045B610	P32B-2	A046E213	P42C	A047V227	P42C-5	A045B784	0334-0759	4231	WHITE	14-AWG
10	W-644	P32B	A045B610	P32B-1	A046E213	P42C	A047V227	P42C-4	A045B784	0334-0759	4215	WHITE	14-AWG
11	W-876	P32B	A045B610	P32B-11	A034R823	P43	A049D365	P43-P	0323-2280	0334-0757	1959	WHITE	18-AWG
12	W-1054	P32B	A045B610	P32B-13	A034R823	P43	A049D365	P43-V	0323-2280	0334-0757	1959	WHITE	18-AWG
13	W-004	P34	0323-2272	P34-J	0323-2277	P42B	A045B666	P42B-1	A034L915	0334-0759	3515	WHITE	14-AWG
14	W-005	P34	0323-2272	P34-K	0323-2277	P42B	A045B666	P42B-2	A034L915	0334-0759	3545	WHITE	14-AWG
15	W-007	P34	0323-2272	P34-L	0323-2277	P42B	A045B666	P42B-3	A034L915	0334-0759	3486	WHITE	14-AWG
16	W-011	P34	0323-2272	P34-A	0323-2277	P42A	A045B666	P42A-1	A034L915	0334-0759	3500	WHITE	14-AWG
17	W-012	P34	0323-2272	P34-C	0323-2277	P42A	A045B666	P42A-2	A034L915	0334-0759	3522	WHITE	14-AWG
18	W-013	P34	0323-2272	P34-D	0323-2277	P42A	A045B666	P42A-3	A034L915	0334-0759	3511	WHITE	14-AWG
19	W-014	P34	0323-2272	P34-F	0323-2277	P42A	A045B666	P42A-4	A034L915	0334-0759	3523	WHITE	14-AWG
20	W-028	P34	0323-2272	P34-G	0323-2277	P42A	A045B666	P42A-5	A034L915	0334-0759	3519	WHITE	14-AWG
21	W-034	P34	0323-2272	P34-H	0323-2277	P32B	A045B610	P32B-14	A045B782	0334-0759	6539	WHITE	14-AWG
22	W-857	P35	A044H291	P35-1	A045M982	P42C	A047V227	P42C-1	A034L923	0334-0757	3312	WHITE	18-AWG
23	W-006	P42B	A045B666	P42B-4	A034L915	P34	0323-2272	P34-N	0323-2277	0334-0759	3549	WHITE	14-AWG
24	W-009	P42C	A047V227	P42C-7	A045B784	P32C	A045B610	P32C-2	A046E213	0334-0759	4237	WHITE	14-AWG
25	W-031	P42C	A047V227	P42C-3	A034L921	P32B	A045B610	P32B-3	A045B658	0334-0758	4216	WHITE	16-AWG
26	W-324	P42C	A047V227	P42C-8	A034L921	P32C	A045B610	P32C-14	A034R821	0334-0758	4217	WHITE	16-AWG
27	W-645	P42C	A047V227	P42C-6	A045B784	P32C	A045B610	P32C-1	A046E213	0334-0759	4234	WHITE	14-AWG
28	W-858	P42C	A047V227	P42C-2	A034L923	P35	A044H291	P35-2	A045M982	0334-0757	3309	WHITE	18-AWG
29	W-862	P42C	A047V227	P42C-9	A034L923	P43	A049D365	P43-J	0323-2280	0334-0757	3006	WHITE	18-AWG
30	W-864	P42C	A047V227	P42C-11	A034L923	P43	A049D365	P43-L	0323-2280	0334-0757	2985	WHITE	18-AWG
31	W-866	P42C	A047V227	P42C-13	A034L923	P43	A049D365	P43-N	0323-2280	0334-0757	3024	WHITE	18-AWG
32	W-863	P43	A049D365	P43-K	0323-2280	P42C	A047V227	P42C-10	A034L923	0334-0757	3004	WHITE	18-AWG
33	W-865	P43	A049D365	P43-M	0323-2280	P42C	A047V227	P42C-12	A034L923	0334-0757	3009	WHITE	18-AWG
34	W-877	P43	A049D365	P43-R	0323-2280	P32B	A045B610	P32B-12	A034R823	0334-0757	1962	WHITE	18-AWG
35	W-868	P44	0323-1884	P44-A	0323-1709	P43	A049D365	P43-A	0323-2280	0334-0757	1859	WHITE	18-AWG
36	W-869	P44	0323-1884	P44-B	0323-1709	P43	A049D365	P43-B	0323-2280	0334-0757	1858	WHITE	18-AWG
37	W-870	P45	0323-1884	P45-A	0323-1709	P43	A049D365	P43-C	0323-2280	0334-0757	1801	WHITE	18-AWG
38	W-871	P45	0323-1884	P45-B	0323-1709	P43	A049D365	P43-D	0323-2280	0334-0757	1787	WHITE	18-AWG
39	W-872	P46	0323-1884	P46-A	0323-1709	P43	A049D365	P43-E	0323-2280	0334-0757	1691	WHITE	18-AWG
40	W-873	P46	0323-1884	P46-B	0323-1709	P43	A049D365	P43-F	0323-2280	0334-0757	1676	WHITE	18-AWG
41	W-874	P47	0323-1884	P47-A	0323-1709	P43	A049D365	P43-G	0323-2280	0334-0757	1623	WHITE	18-AWG
42	W-875	P47	0323-1884	P47-B	0323-1709	P43	A049D365	P43-H	0323-2280	0334-0757	1609	WHITE	18-AWG

NOTE:

1. WIRES SHALL BE HOT STAMPED, OR PERMANENTLY MARKED WITH BOTH FROM AND TO LABELS AS LISTED IN WIRE LIST.

   1.1) CONNECTORS WITHOUT HEATSHRINK OR STRAIN RELIEF TUBE: MARKINGS SHALL BE LOCATED SO THEY WILL BE VISIBLE AFTER WIRE IS INSTALLED INTO CONNECTORS, MAXIMUM OF 75mm FROM CONNECTOR END.

   1.2) CONNECTORS WITH HEATSHRINK OR STRAIN RELIEF TUBE: MARKINGS SHALL BE LOCATED AFTER THE STRAIN RELIEF, OR HEAT SHRINK MAXIMUM OF 75mm FROM CONNECTOR END.

2. DIMENSIONS ARE IN MILLIMETERS.

3. TOLERANCE: UP TO 500 MM ±1.5 MM
   500 MM TO 1000 MM ±4.0 MM
   1000 MM & LARGER ±6.0 MM

4. ATTACH A MASTER HARNESS LABEL WITH THE FOLLOWING INFORMATION: CUMMINS PART NUMBER, CUMMINS PART REVISION LEVEL, MANUFACTURER'S NAME, MANUFACTURER'S LOCATION, AND MANUFACTURER'S DATE OF MANUFACTURE IN THE FORMAT OF MONTH, DATE, LAST 2 YEAR DIGITS. LABEL MUST BE MADE FROM UL RECOGNIZED SELF LAMINATION LABEL SYSTEM. PLACE MAXIMUM OF 300mm FROM CONNECTOR END.

5. MARK LABEL ON BUNDLE BRAIDING WITH CONNECTOR REFERENCE DESIGNATOR FROM WIRE LIST TABLE WITH UL RECOGNIZED VINYL SELF LAMINATING LABEL SYSTEM. PLACE MAXIMUM OF 150mm FROM CONNECTOR END. EXCEPTIONS: CONNECTOR P33 SHALL ALSO BE MARKED "J1939", AND CONNECTOR P35 SHALL ALSO BE MARKED PL_STR_CNTL.

6. HEAT SHRINK DIMENSIONS ON DRAWING ARE BEFORE BRAIDING.

7. HARNESS SHALL BE PROCURED FROM A SUPPLIER QUALIFIED AS A UL RECOGNIZED HARNESS MANUFACTURER (CATEGORY ZPFW2). PACKAGING OR PARTS TO BE MARKED IN ACCORDANCE WITH REQUIREMENTS SPECIFIED BY SUPPLIERS UL PROGRAM.

8. THE SUPPLIER SHALL UTILIZE AGREED UPON AND DOCUMENTED PRODUCTION, QUALITY AND TEST PROCESSES.

9. PROTECTIVE CAPS SHALL BE INSTALLED ON CONNECTORS FOR PROTECTION DURING SHIPPING ONLY WHERE INDICATED ON SHEET 2 OF DRAWING.

10. ELECTRICAL WORKMANSHIP SHALL COMPLY WITH IPC IPC-A-610A CLASS II ACCEPTABILITY OF ELECTRONIC AND ELECTRICAL ASSEMBLIES MOST CURRENT REVISION.

11. CABLE AND HARNESS WORKMANSHIP SHALL COMPLY WITH IPC/WHMA-A-620 REQUIREMENTS AND ACCEPTANCE FOR CABLE AND WIRE HARNESS ASSEMBLIES MOST CURRENT REVISION.

12. IF A VALUE OF ZERO IS USED IN THE BILL OF MATERIAL THE QUANTITY OF THE AFFECTED MATERIAL SHALL BE DERIVED FROM THE DRAWING REQUIREMENTS.

13. HARNESS SHALL BE CONTINUOUSLY BRAIDED ALONG EACH BRANCH USING ENGINEERED YARNS VN 4000S, COLOR BLACK.

    13.1) BRAIDING SHALL WITHSTAND -40°C TO 125 °C TEMPERATURE.
    13.2) BRAIDING SHALL BE RESISTANT TO THE GENSET ENVIRONMENT FLUIDS.
    13.3) BRAID UP TO END OF CONNECTORS, EXCEPTION: P44 THRU P47, AND P35 BRAID UP TO, BUT DO NOT COVER FROM/TO MARKINGS.
    13.4) P34 AND P43 BRAID OVER THE BACKSHELL BOOTS 12-30 mm FROM END OF BOOT.

14. BRAIDING SHALL ALLOW THE "FROM/TO" LABELS MARKED ON THE WIRES TO BE VISIBLE ONLY WHERE INDICATED ON SHEET 2 OF DRAWING.

15. POINT TO POINT CONTINUITY TESTING SHALL BE PERFORMED ON THIS HARNESS ASSEMBLY.

16. HARNESS SHALL BE SHIPPED IN PLASTIC BAG.

17. INSERT SHIELD WIRE INTO UL RECOGNIZED TRANSPARENT (CLEAR) PLASTIC TUBE. TUBE INSULATION TO BE RATED AT 600V, 105°C. HEAT SHRINK CABLE, CONDUCTORS AND TRANSPARENT TUBE USING ITEM A049Z485. SEE VIEW E-E, SHEET 2.

18. TORQUE 0.7 Nm ± 0.07 Nm

19. TORQUE 15 Nm ± 1 Nm

20. TORQUE 12 Nm ± 1 Nm.

21. SLEEVE, INSULATING 0898-1377-06 IS TO BE ADDED UNDER THE BRAIDING, WHICH SHOULD START FROM GLAND, CABLE A052P518

Cummins Inc.
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: - | SIZE: A1 | SCALE: 1:1
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009 | THIRD ANGLE PROJECTION
CAD SYSTEM PTC® Creo® Parametric

Part Number: **A065E097** Part Revision: **B**
Part Name: **HARNESS,GENSET**

FIGURE 596. A065E097 MAIN GENERATOR SET HARNESS (SHEET 1)

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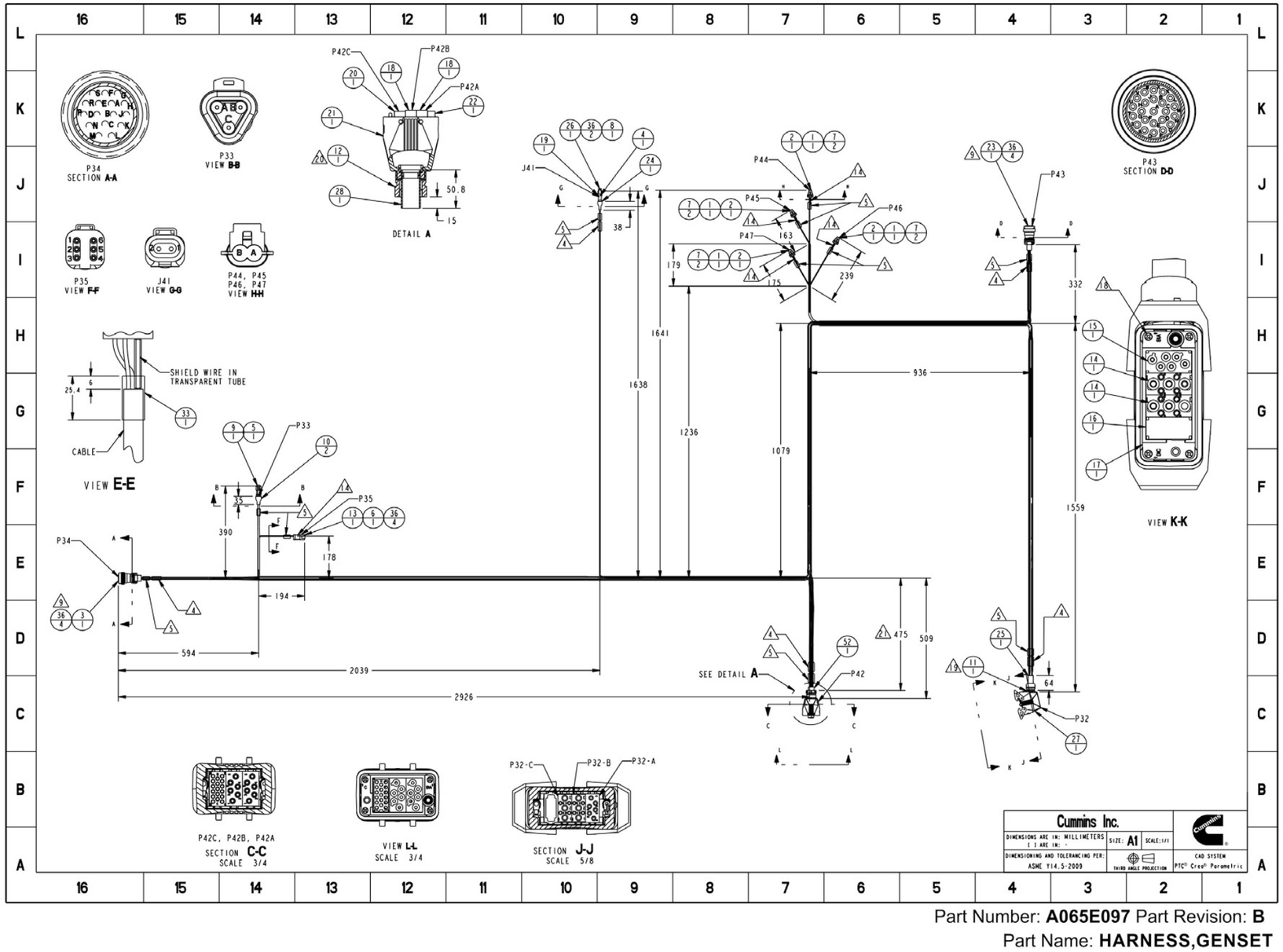


FIGURE 597. A065E097 MAIN GENERATOR SET HARNESS (SHEET 2)

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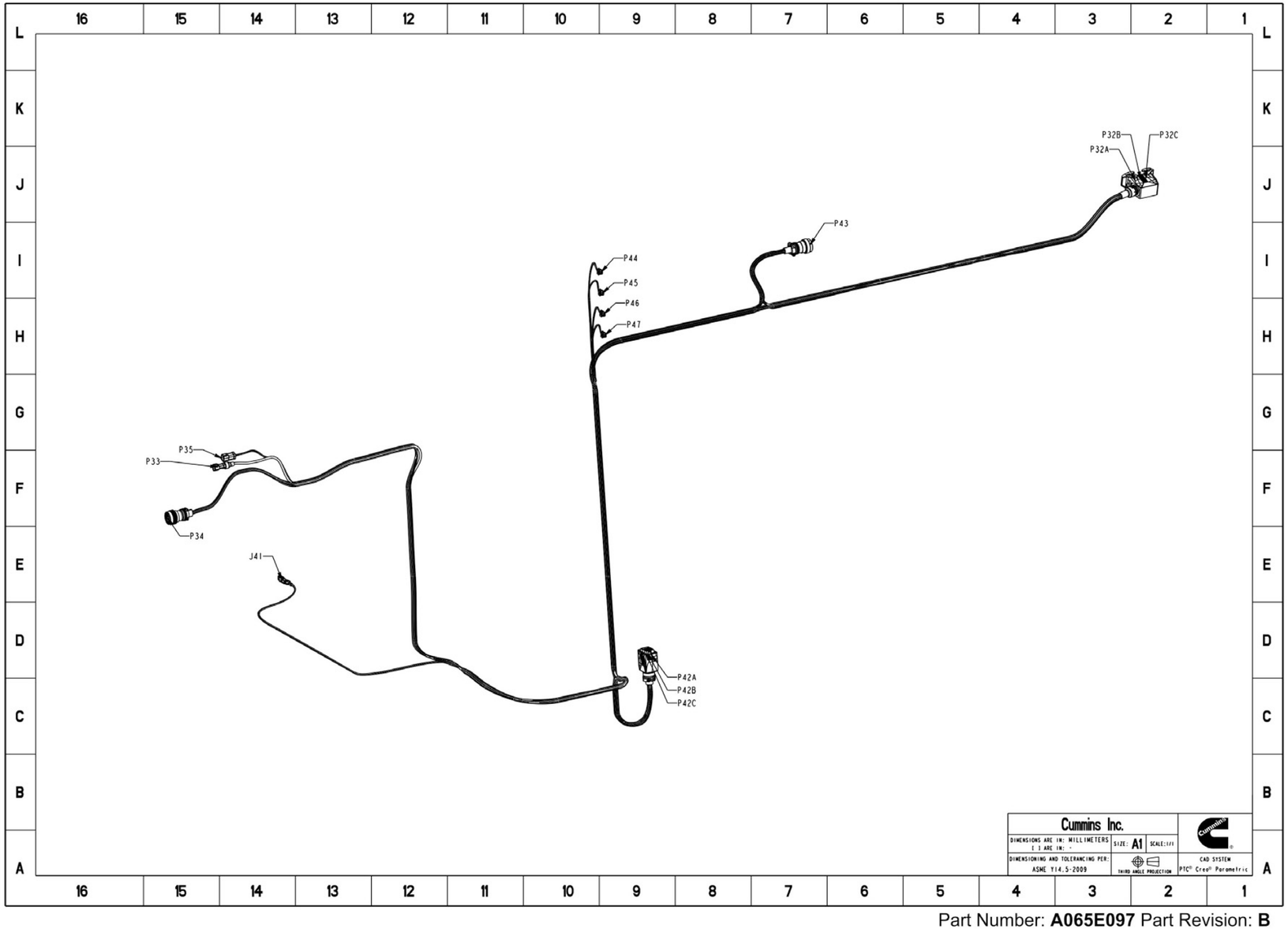


FIGURE 598. A065E097 MAIN GENERATOR SET HARNESS (SHEET 3)

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C.13 A044R632 Modbus Control Harness

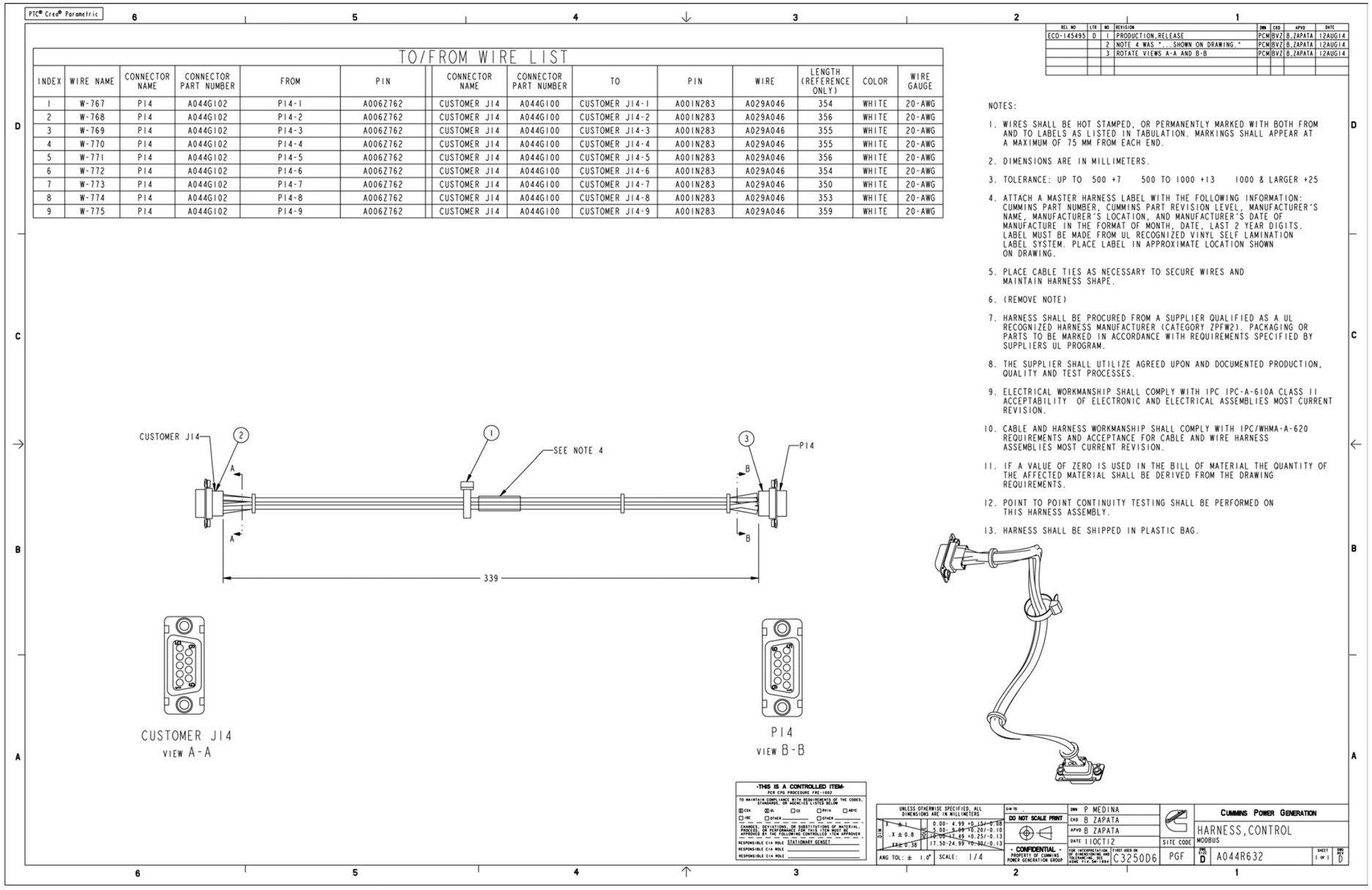


FIGURE 599. A044R632 MODBUS CONTROL HARNESS (SHEET 1)

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C.14 A049E099 OEM Alternator Harness

PTC® Creo® Parametric

TO/FROM WIRE LIST

INDEX	WIRE NAME	CONNECTOR NAME	CONNECTOR PART NUMBER	FROM	PIN	CONNECTOR NAME	CONNECTOR PART NUMBER	TO	PIN	WIRE	LENGTH (REFERENCE ONLY)	COLOR	WIRE GUAGE
1	C-28C-001	J43	A040P562	J43-U	A034M292	SP-57	0332-1506	SP-57-1	NONE	A040H594	178	SHIELD	20-AWG
2	C-28C-002	J43	A040P562	J43-T	A034M292	SP-56	0332-1506	SP-56-1	NONE	A040H594	178	BLACK	18-AWG
3	C-28C-003	J43	A040P562	J43-S	A034M292	SP-55	0332-1506	SP-55-1	NONE	A040H594	178	WHITE	18-AWG
4	W-820	J43	A040P562	J43-P	A001N285	PI4(3)	A047X291	PI4(3)-1	A034V373	0334-0757	657	WHITE	18-AWG
5	W-821	J43	A040P562	J43-R	A001N285	PI4(3)	A047X291	PI4(3)-2	A034V373	0334-0757	645	WHITE	18-AWG
6	W-822	J43	A040P562	J43-J	A001N285	PII(3)	0323-1678-16	PII(3)-14	A034V373	0334-0757	528	WHITE	18-AWG
7	W-823	J43	A040P562	J43-K	A001N285	PII(3)	0323-1678-16	PII(3)-16	A034V373	0334-0757	526	WHITE	18-AWG
8	W-824	J43	A040P562	J43-A	A001N285	PII(4)	0323-1678-16	PII(4)-2	A034V373	0334-0757	633	WHITE	18-AWG
9	W-825	J43	A040P562	J43-B	A001N285	SP-52	0332-2981	SP-52-1	NONE	0334-0757	320	WHITE	18-AWG
10	W-826	J43	A040P562	J43-D	A001N285	SP-52	0332-2981	SP-52-1	NONE	0334-0757	326	WHITE	18-AWG
11	W-827	J43	A040P562	J43-C	A001N285	PII(4)	0323-1678-16	PII(4)-4	A034V373	0334-0757	626	WHITE	18-AWG
12	W-828	J43	A040P562	J43-F	A001N285	SP-53	0332-2981	SP-53-1	NONE	0334-0757	330	WHITE	18-AWG
13	W-829	J43	A040P562	J43-H	A001N285	SP-53	0332-2981	SP-53-1	NONE	0334-0757	337	WHITE	18-AWG
14	W-830	J43	A040P562	J43-E	A001N285	PII(4)	0323-1678-16	PII(4)-10	A034V373	0334-0757	620	WHITE	18-AWG
15	W-831	J43	A040P562	J43-G	A001N285	PII(4)	0323-1678-16	PII(4)-12	A034V373	0334-0757	612	WHITE	18-AWG
16	W-838	J43	A040P562	J43-V	A001N285	SP-45	0332-3058	SP-45-1	NONE	0334-0757	439	WHITE	18-AWG
17	W-848	J43	A040P562	J43-L	A001N285	PII(4)	0323-1678-16	PII(4)-14	A034V373	0334-0757	634	WHITE	18-AWG
18	W-849	J43	A040P562	J43-M	A001N285	PII(4)	0323-1678-16	PII(4)-16	A034V373	0334-0757	639	WHITE	18-AWG
19	W-850	J43	A040P562	J43-N	A001N285	SP-51	0332-2981	SP-51-2	NONE	0334-0757	310	WHITE	18-AWG
20	W-1557	K20-8	A034U838	K20-8-1	NONE	H1	NONE	H1-1	TIN /20	0334-0760	411	WHITE	12-AWG
21	W-806	PI(3)	A047X281	PI(3)-1	A034V373	PI4(4)	A047X291	PI4(4)-2	A034V373	0334-0757	283	WHITE	18-AWG
22	W-807	PI(3)	A047X281	PI(3)-2	A034V373	PI4(4)	A047X291	PI4(4)-1	A034V373	0334-0757	285	WHITE	18-AWG
23	W-044	PI0(3)	0323-1678-11	PI0(3)-9	A034V373	SP-47	0332-3058	SP-47-1	NONE	0334-0757	515	WHITE	18-AWG
24	W-045	PI0(3)	0323-1678-11	PI0(3)-10	A034V373	SP-48	0332-3058	SP-48-1	NONE	0334-0757	539	WHITE	18-AWG
25	W-046	PI0(3)	0323-1678-11	PI0(3)-11	A034V373	SP-49	0332-3058	SP-49-1	NONE	0334-0757	493	WHITE	18-AWG
26	W-048	PI0(3)	0323-1678-11	PI0(3)-3	A034V373	UI R (16)	A034V373	UI R (16)-1	NONE	0334-0757	999	WHITE	18-AWG
27	W-049	PI0(3)	0323-1678-11	PI0(3)-4	A034V373	VI R (19)	A034V373	VI R (19)-1	NONE	0334-0757	1006	WHITE	18-AWG
28	W-050	PI0(3)	0323-1678-11	PI0(3)-5	A034V373	WI R (22)	A034V373	WI R (22)-1	NONE	0334-0757	999	WHITE	18-AWG
29	W-1556	PI0(3)	0323-1678-11	PI0(3)-12	A034V373	K20-1	A045E935	K20-1-1	NONE	0334-0757	862	WHITE	18-AWG
30	W-047	PI0(4)	0323-1678-11	PI0(4)-9	A034V373	SP-50	0332-3058	SP-50-1	NONE	0334-0757	439	WHITE	18-AWG
31	W-051	PI0(4)	0323-1678-11	PI0(4)-3	A034V373	DE R (34)	A034V373	DE R (34)-1	NONE	0334-0757	877	WHITE	18-AWG
32	W-066	PI0(4)	0323-1678-11	PI0(4)-4	A034V373	NDE R (37)	A034V373	NDE R (37)-1	NONE	0334-0757	868	WHITE	18-AWG
33	W-058	PII(3)	0323-1678-16	PII(3)-6	A034V373	UI R (17)	A034V373	UI R (17)-1	NONE	0334-0757	1021	WHITE	18-AWG
34	W-059	PII(3)	0323-1678-16	PII(3)-8	A034V373	VI R (20)	A034V373	VI R (20)-1	NONE	0334-0757	1002	WHITE	18-AWG
35	W-060	PII(3)	0323-1678-16	PII(3)-10	A034V373	WI R (23)	A034V373	WI R (23)-1	NONE	0334-0757	1001	WHITE	18-AWG
36	W-844	PII(3)	0323-1678-16	PII(3)-15	A034V373	SP-51	0332-2981	SP-51-2	NONE	0334-0757	348	WHITE	18-AWG
37	W-845	PII(3)	0323-1678-16	PII(3)-13	A034V373	SP-51	0332-2981	SP-51-2	NONE	0334-0757	329	WHITE	18-AWG
38	W-061	PII(4)	0323-1678-16	PII(4)-6	A034V373	DE R (35)	A034V373	DE R (35)-1	NONE	0334-0757	859	WHITE	18-AWG
39	W-067	PII(4)	0323-1678-16	PII(4)-8	A034V373	NDE R (38)	A034V373	NDE R (38)-1	NONE	0334-0757	881	WHITE	18-AWG
40	W-832	PII(4)	0323-1678-16	PII(4)-11	A034V373	SP-53	0332-2981	SP-53-2	NONE	0334-0757	251	WHITE	18-AWG
41	W-834	PII(4)	0323-1678-16	PII(4)-3	A034V373	SP-52	0332-2981	SP-52-2	NONE	0334-0757	287	WHITE	18-AWG
42	W-846	PII(4)	0323-1678-16	PII(4)-13	A034V373	SP-51	0332-2981	SP-51-1	NONE	0334-0757	295	WHITE	18-AWG
43	W-847	PII(4)	0323-1678-16	PII(4)-15	A034V373	SP-51	0332-2981	SP-51-1	NONE	0334-0757	301	WHITE	18-AWG
44	W-1554	P4(3)	0323-1678-05	P4(3)-5	A034V373	PI(4)	A047X281	PI(4)-2	A034V373	0334-0757	390	WHITE	18-AWG
45	W-1558	P4(3)	0323-1678-05	P4(3)-6	A034V373	K20-0	A045E935	K20-0-1	NONE	0334-0757	1050	WHITE	18-AWG
46	W-808	SP-45	0332-3058	SP-45-2	NONE	PI(4)	A047X281	PI(4)-5	A034V373	0334-0757	168	WHITE	18-AWG
47	W-809	SP-45	0332-3058	SP-45-2	NONE	PI(3)	A047X281	PI(3)-5	A034V373	0334-0757	217	WHITE	18-AWG
48	W-057	SP-46	0332-3058	SP-46-2	NONE	DE W (36)	A034V373	DE W (36)-1	NONE	0334-0757	448	WHITE	18-AWG
49	W-062	SP-46	0332-3058	SP-46-1	NONE	PI0(4)	0323-1678-11	PI0(4)-10	A034V373	0334-0757	401	WHITE	18-AWG
50	W-842	SP-46	0332-3058	SP-46-1	NONE	PII(4)	0323-1678-16	PII(4)-5	A034V373	0334-0757	403	WHITE	18-AWG
51	W-056	SP-47	0332-3058	SP-47-2	NONE	WI W (24)	A034V373	WI W (24)-1	NONE	0334-0757	464	WHITE	18-AWG
52	W-841	SP-47	0332-3058	SP-47-1	NONE	PII(3)	0323-1678-16	PII(3)-9	A034V373	0334-0757	512	WHITE	18-AWG
53	W-055	SP-48	0332-3058	SP-48-2	NONE	VI W (21)	A034V373	VI W (21)-1	NONE	0334-0757	446	WHITE	18-AWG
54	W-840	SP-48	0332-3058	SP-48-1	NONE	PII(3)	0323-1678-16	PII(3)-7	A034V373	0334-0757	537	WHITE	18-AWG
55	W-054	SP-49	0332-3058	SP-49-2	NONE	UI W (18)	A034V373	UI W (18)-1	NONE	0334-0757	512	WHITE	18-AWG
56	W-839	SP-49	0332-3058	SP-49-1	NONE	PII(3)	0323-1678-16	PII(3)-5	A034V373	0334-0757	496	WHITE	18-AWG

REL NO	LTR	NO	REVISION	DWN	CKD	APVD	DATE
ECO-149830	E	1	UPDATE BOM - SEE ECO	SA	SR	A.SOLORZANO	06NOV15
		2	UPDATE TO/FROM WIRE LIST TABLE - SEE ECO	SA	SR	A.SOLORZANO	06NOV15
		3	ADD NOTE 20,21	SA	SR	A.SOLORZANO	06NOV15
		4	SEE SHEET 2	SA	SR	A.SOLORZANO	06NOV15
		5	SEE SHEET 3	SA	SR	A.SOLORZANO	06NOV15
		6	SEE SHEET 3	SA	SR	A.SOLORZANO	06NOV15
		7	ADD SHEET 4	SA	SR	A.SOLORZANO	06NOV15

NOTES:

1. WIRES SHALL BE HOT STAMPED, OR PERMANENTLY MARKED WITH BOTH FROM AND TO LABELS AS LISTED IN TABULATION. MARKINGS SHALL BE LOCATED SO THEY WILL BE VISIBLE AFTER WIRE IS INSTALLED INTO CONNECTORS, MAXIMUM OF 75mm FROM CONNECTOR END.
2. DIMENSIONS ARE IN MILLIMETERS.
3. TOLERANCE: UP TO 500 +15 500 TO 1000 +40 1000 & LARGER +60
4. ATTACH A MASTER HARNESS LABEL WITH THE FOLLOWING INFORMATION: CUMMINS PART NUMBER, CUMMINS PART REVISION LEVEL, MANUFACTURER'S NAME, MANUFACTURER'S LOCATION, AND MANUFACTURER'S DATE OF MANUFACTURE IN THE FORMAT OF MONTH, DATE, LAST 2 YEAR DIGITS. LABEL MUST BE MADE FROM UL RECOGNIZED VINYL SELF LAMINATION LABEL SYSTEM. PLACE LABEL IN APPROXIMATE LOCATION SHOWN ON DRAWING.
5. PLACE CABLE TIES (0332-3388) AS NECESSARY TO SECURE WIRES AND MAINTAIN HARNESS SHAPE.
6. WIRE INSULATION DIAMETER SHALL BE COMPATIBLE WITH TERMINALS, SEALS, AND RELATED CONNECTOR COMPONENTS.

/1 SHIELD WIRE IS NOT TERMINATED ON CABLE END INDICATED IN FROM/TO TABLE ON SHEET 2. TRIM SHEILD WIRE TO CABLE JACKET.

8. HARNESS SHALL BE PROCURED FROM A SUPPLIER QUALIFIED AS A UL RECOGNIZED HARNESS MANUFACTURER (CATEGORY ZPFW2). PACKAGING OR PARTS TO BE MARKED IN ACCORDANCE WITH REQUIREMENTS SPECIFIED BY SUPPLIERS UL PROGRAM.
9. THE SUPPLIER SHALL UTILIZE AGREED UPON AND DOCUMENTED PRODUCTION, QUALITY AND TEST PROCESSES.
10. TORQUE CONNECTOR TERMINALS TO .8 -.9 Nm.
11. ELECTRICAL WORKMANSHIP SHALL COMPLY WITH IPC IPC-A-610A CLASS II ACCEPTABILITY OF ELECTRONIC AND ELECTRICAL ASSEMBLIES MOST CURRENT REVISION.
12. CABLE AND HARNESS WORKMANSHIP SHALL COMPLY WITH IPC/WHMA-A-620 REQUIREMENTS AND ACCEPTANCE FOR CABLE AND WIRE HARNESS ASSEMBLIES MOST CURRENT REVISION.
13. IF A VALUE OF ZERO IS USED IN THE BILL OF MATERIAL THE QUANTITY OF THE AFFECTED MATERIAL SHALL BE DERIVED FROM THE DRAWING REQUIREMENTS.
14. POINT TO POINT CONTINUITY TESTING SHALL BE PERFORMED ON THIS HARNESS ASSEMBLY.
15. SPLICE LOCATIONS ARE REFERENCE ONLY. SPLICES SHALL BE OFFSET TO PREVENT EXCESSIVE BULGES. ALL SPLICES SHALL BE COVERED WITH HEAT SHRINK.
16. HARNESS SHALL BE SHIPPED IN PLASTIC BAG.
17. PROTECTIVE CAP SHALL BE INSTALLED ON CONNECTOR A040P562 FOR PROTECTION DURING SHIPPING.
18. SECURE CONNECTOR P50 AND CAP R50 TO MAIN HARNESS BUNDLE USING CABLE TIES.
19. INSERT SHIELD WIRE INTO UL RECOGNIZED TRANSPARENT (CLEAR) PLASTIC TUBE. TUBE INSULATION TO BE RATED AT 600V, 105°C. HEAT SHRINK CABLE, CONDUCTORS AND TRANSPARENT TUBE USING ITEM A049Z485. SEE VIEW K-K, SHEET 3.

/20 LEAD W-1557 REMOVE 10mm INSULATION FROM WIRE END AND TIN THE WIRE.

/21 K20 WIRES ARE TO BE CONNECTED PRIOR TO SHIPPING.

-THIS IS A CONTROLLED ITEM-
PER CPG PROCEDURE FPE-1002
TO MAINTAIN COMPLIANCE WITH REQUIREMENTS OF THE CODES, STANDARDS, OR AGENCIES LISTED BELOW.
☒ CSA ☒ UL ☐ CE ☐ RMRA ☐ ABYC ☐ IBC ☐ OTHER ☐ OTHER
CHANGES, DEVIATIONS OR SUBSTITUTIONS OF MATERIAL, PROCESS OR METHOD SHALL NOT BE MADE WITHOUT APPROVED BY THE FOLLOWING CONTROLLED ITEM APPROVER
RESPONSIBLE C/A ROLE STATIONARY GENSET
RESPONSIBLE C/A ROLE
RESPONSIBLE C/A ROLE

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS
DIM: X ±1; .X ±0.8; .XX± 0.38
TOL: 0.00- 4.99 +0.15/-0.08; 5.00- 9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13
ANG TOL: ± 1.0° SCALE: 1/2

SH'N A041W030 DO NOT SCALE PRINT
- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP
DWN P MEDINA CKD B VAZQUEZ ZAPATA APVD B VAZQUEZ ZAPATA DATE 26FEB14
FOR INTERPRETATION OF DIMENSIONS AND TOLERANCING, SEE ASME Y14.5M-1994 FIRST USED ON C3250D6
SITE CODE PGF

CUMMINS POWER GENERATION
HARNESS, ALTERNATOR
ALTERNATOR OEM
SIZE D A049E099 SHEET 1 of 4 REV E

FIGURE 600. A049E099 OEM ALTERNATOR HARNESS (SHEET 1)

INDEX	WIRE NAME	CONNECTOR NAME	CONNECTOR PART NUMBER	FROM	PIN	CONNECTOR NAME	CONNECTOR PART NUMBER	TO	PIN	WIRE	LENGTH (REFERENCE ONLY)	COLOR	WIRE GUAGE
57	W-063	SP-50	0332-3058	SP-50-2	NONE	NDE W (39)	A034V373	NDE W (39)-1	NONE	0334-0757	402	WHITE	18-AWG
58	W-843	SP-50	0332-3058	SP-50-1	NONE	P11(4)	0323-1678-16	P11(4)-7	A034V373	0334-0757	450	WHITE	18-AWG
59	W-835	SP-52	0332-2981	SP-52-2	NONE	P11(4)	0323-1678-16	P11(4)-1	A034V373	0334-0757	274	WHITE	18-AWG
60	W-837	SP-52	0332-2981	SP-52-2	NONE	P10(4)	0323-1678-11	P10(4)-11	A034V373	0334-0757	276	WHITE	18-AWG
61	W-833	SP-53	0332-2981	SP-53-2	NONE	P11(4)	0323-1678-16	P11(4)-9	A034V373	0334-0757	265	WHITE	18-AWG
62	W-836	SP-53	0332-2981	SP-53-2	NONE	P10(4)	0323-1678-11	P10(4)-12	A034V373	0334-0757	255	WHITE	18-AWG
63	C-29C-003	SP-55	0332-1506	SP-55-1	NONE	P50	0323-2514	P50-A	0323-2513	A040H594	305	WHITE	18-AWG
64	C-30C-003	SP-55	0332-1506	SP-55-2	NONE	P10(3)	0323-1678-11	P10(3)-1	A034V373	A040H594	358	WHITE	18-AWG
65	C-34C-003	SP-55	0332-1506	SP-55-2	NONE	P10(4)	0323-1678-11	P10(4)-1	A034V373	A040H594	458	WHITE	18-AWG
66	C-29C-002	SP-56	0332-1506	SP-56-1	NONE	P50	0323-2514	P50-B	0323-2513	A040H594	305	BLACK	18-AWG
67	C-30C-002	SP-56	0332-1506	SP-56-2	NONE	P10(3)	0323-1678-11	P10(3)-2	A034V373	A040H594	358	BLACK	18-AWG
68	C-34C-002	SP-56	0332-1506	SP-56-2	NONE	P10(4)	0323-1678-11	P10(4)-2	A034V373	A040H594	458	BLACK	18-AWG
69	C-29C-001	SP-57	0332-1506	SP-57-1	NONE	P50	0323-2514	P50-C	0323-2513	A040H594	305	SHIELD	20-AWG
70	C-30C-001	SP-57	0332-1506	SP-57-2	NONE	[redacted] 7	SEE NOTE 7	[redacted]	NONE	A040H594	358	SHIELD	20-AWG
71	C-34C-001	SP-57	0332-1506	SP-57-2	NONE	7	SEE NOTE 7	-	NONE	A040H594	458	SHIELD	20-AWG

REL NO	LTR	NO	REVISION	DRN	CKD	APVD	DATE
ECO-149830	E	4	UPDATE VIEW TO SHOW NEW WIRES	SA	SR	A.SOLORZANO	06NOV15

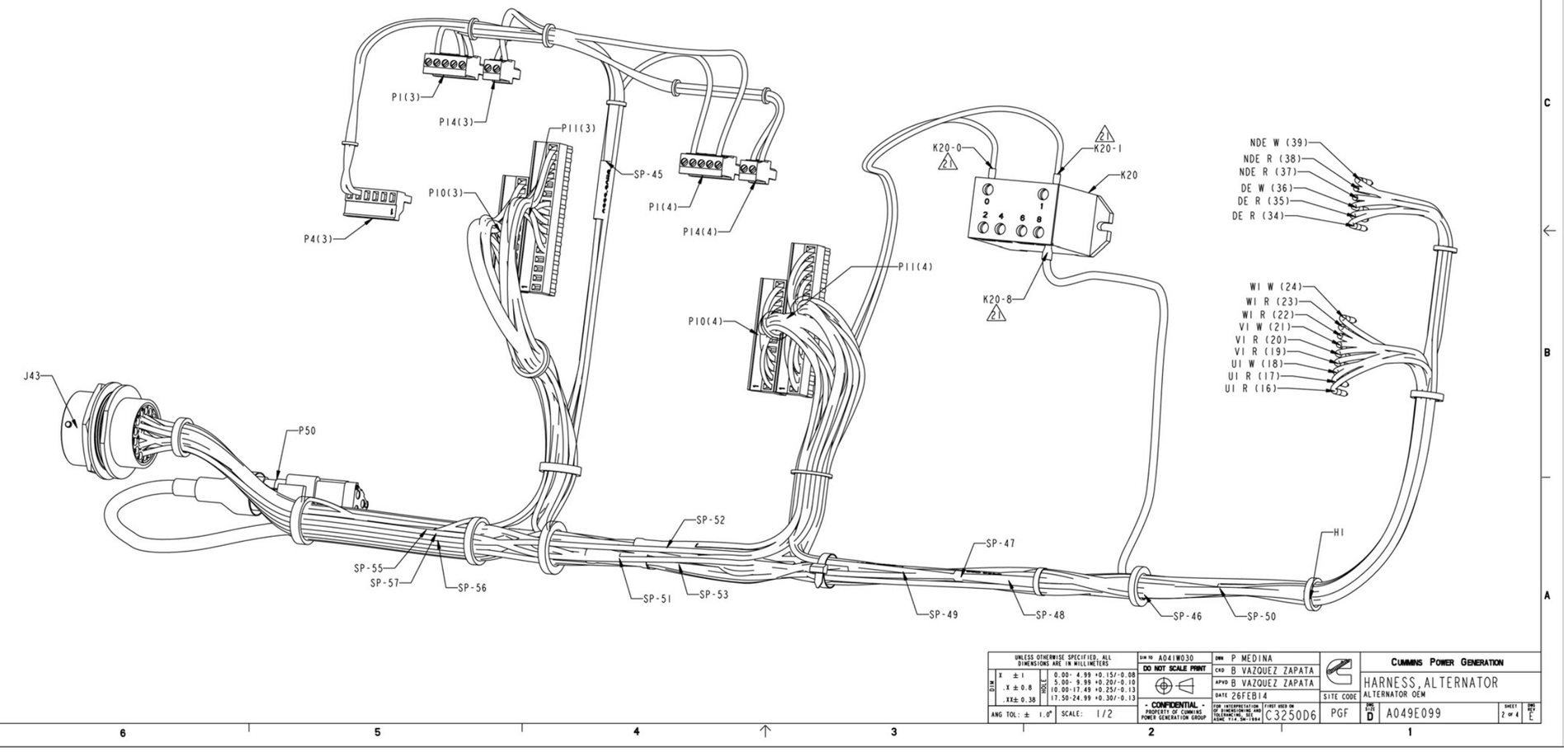


FIGURE 601. A049E099 OEM ALTERNATOR HARNESS (SHEET 2)

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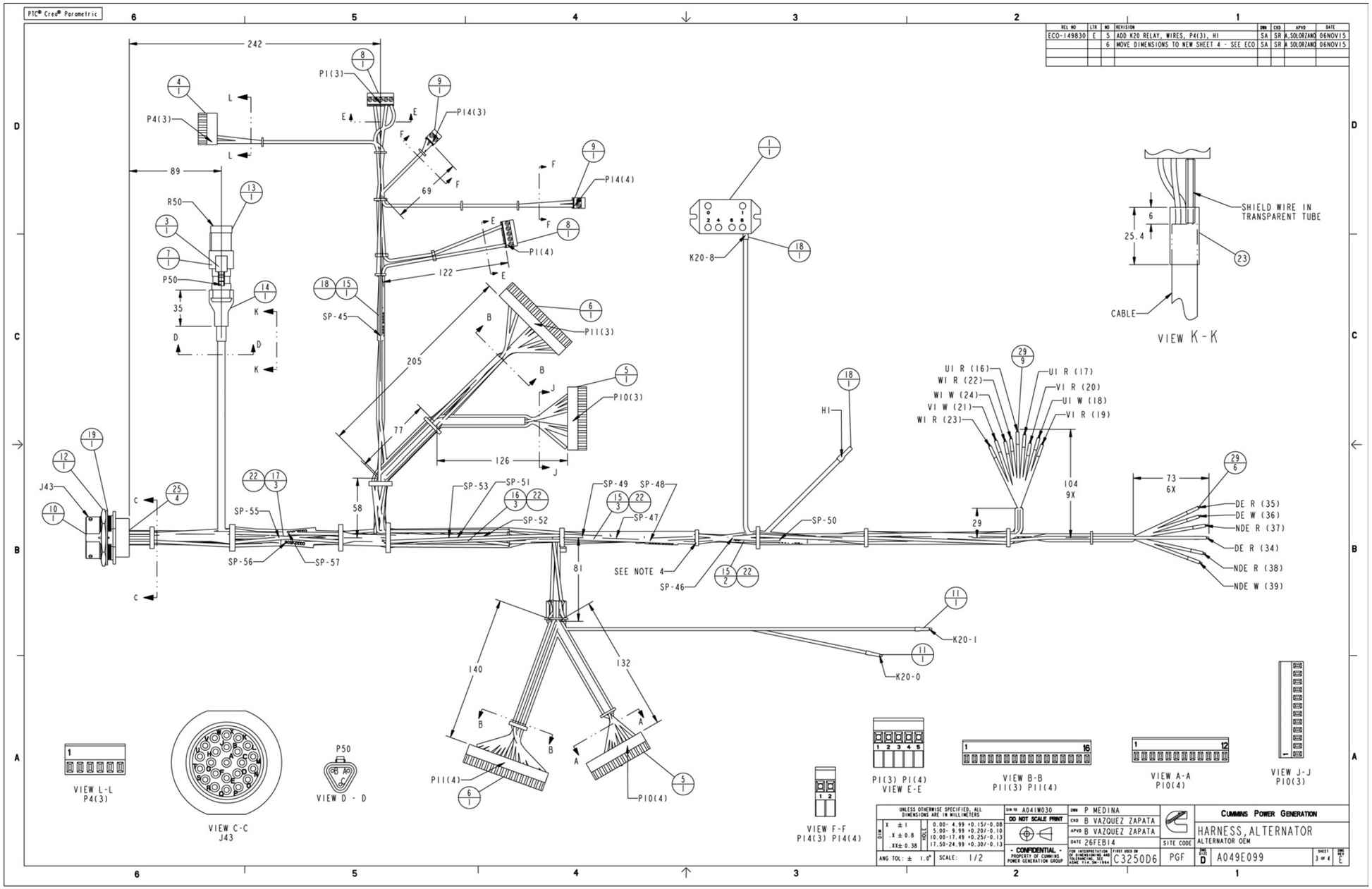


FIGURE 602. A049E099 OEM ALTERNATOR HARNESS (SHEET 3)

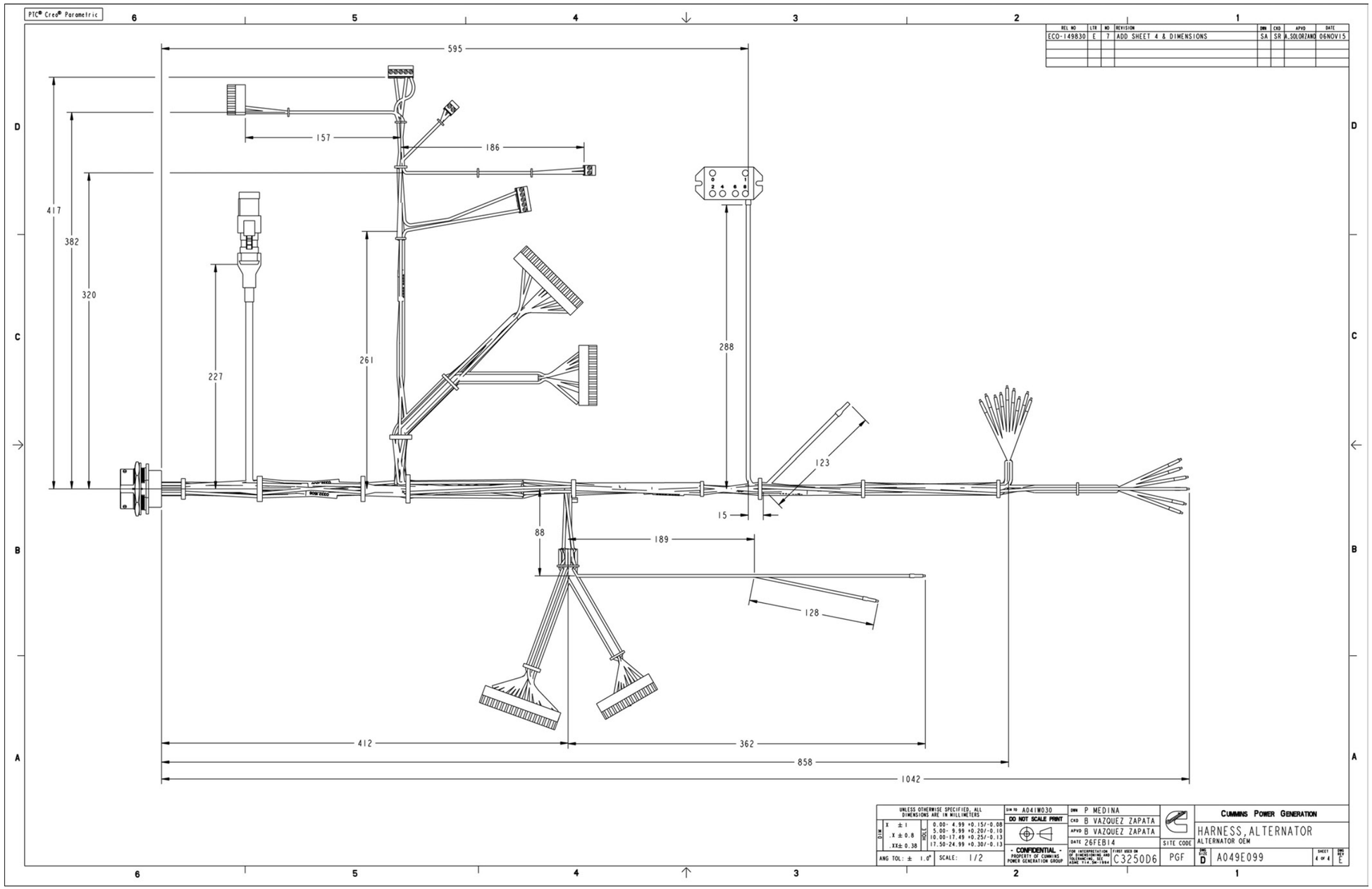


FIGURE 603. A049E099 OEM ALTERNATOR HARNESS (SHEET 4)

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C.15 A042R460 MV/HV Customer Differential Transformer Harness

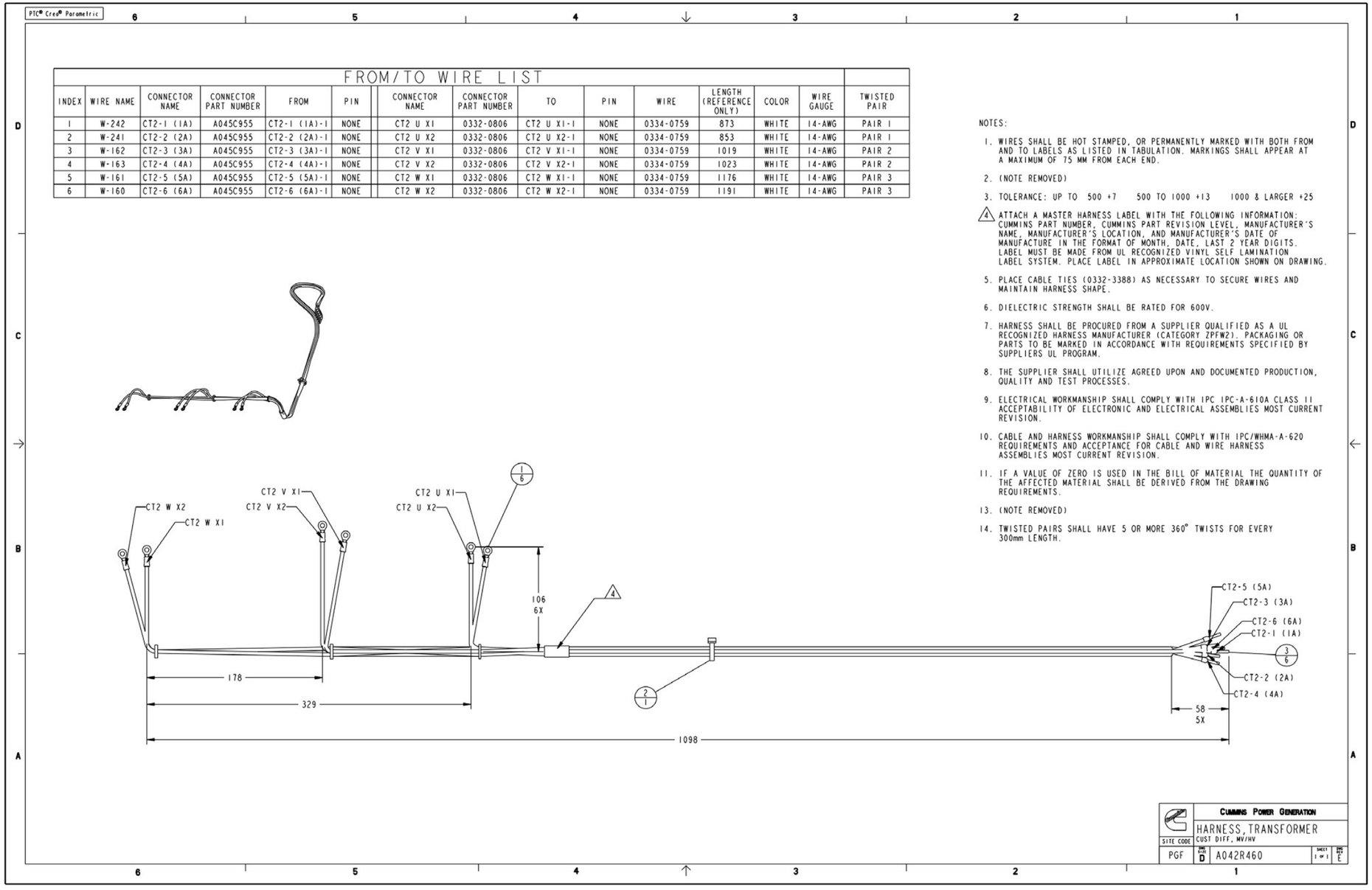
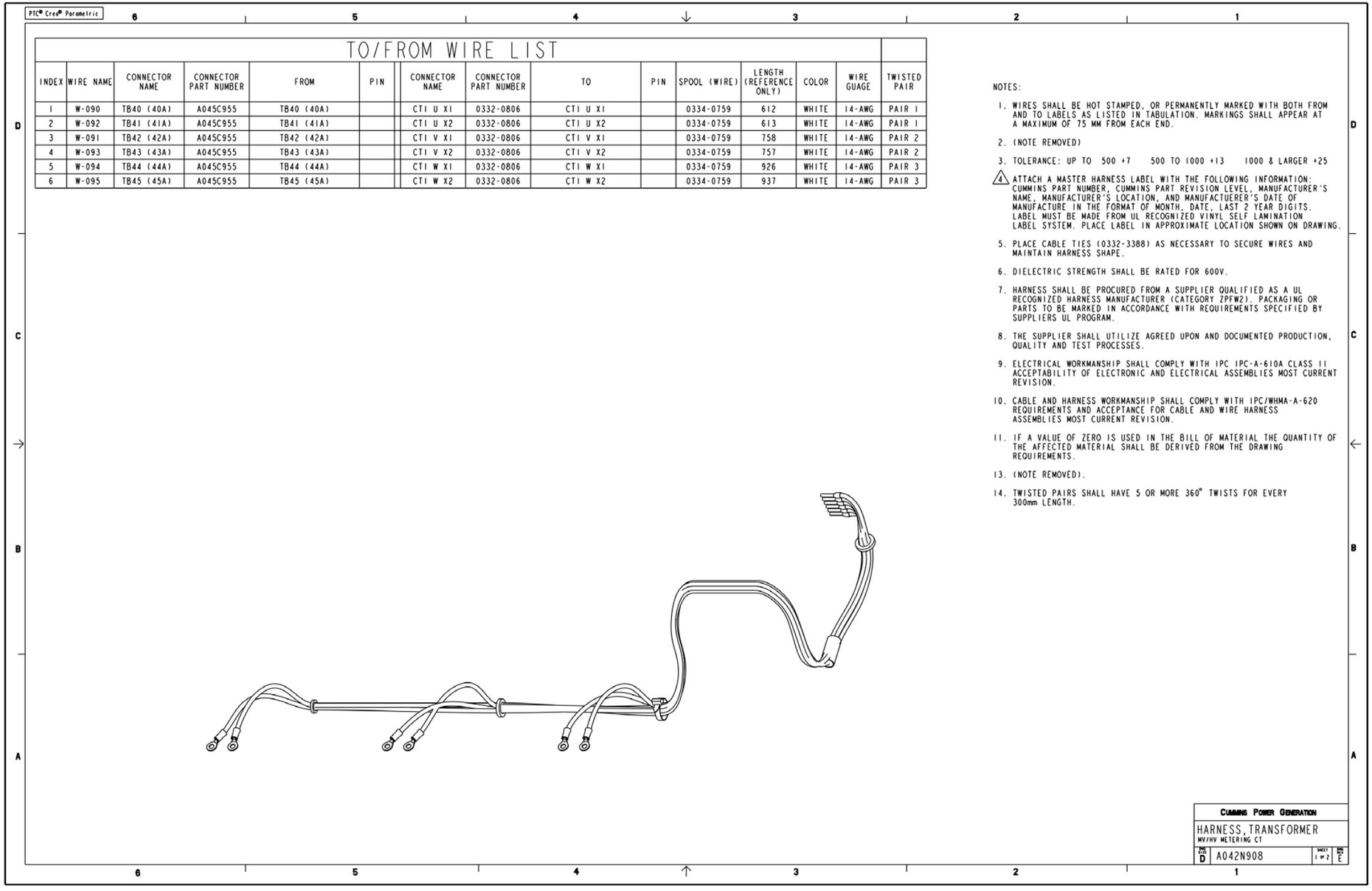


FIGURE 604. A042R460 MV/HV CUSTOMER DIFFERENTIAL TRANSFORMER HARNESS (SHEET 1)

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C.16 A042N908 MV/HV Metering CT Transformer Harness



TO/FROM WIRE LIST

INDEX	WIRE NAME	CONNECTOR NAME	CONNECTOR PART NUMBER	FROM	PIN	CONNECTOR NAME	CONNECTOR PART NUMBER	TO	PIN	SPOOL (WIRE)	LENGTH (REFERENCE ONLY)	COLOR	WIRE GUAGE	TWISTED PAIR
1	W-090	TB40 (40A)	A045C955	TB40 (40A)		CTI U X1	0332-0806	CTI U X1		0334-0759	612	WHITE	14-AWG	PAIR 1
2	W-092	TB41 (41A)	A045C955	TB41 (41A)		CTI U X2	0332-0806	CTI U X2		0334-0759	613	WHITE	14-AWG	PAIR 1
3	W-091	TB42 (42A)	A045C955	TB42 (42A)		CTI V X1	0332-0806	CTI V X1		0334-0759	758	WHITE	14-AWG	PAIR 2
4	W-093	TB43 (43A)	A045C955	TB43 (43A)		CTI V X2	0332-0806	CTI V X2		0334-0759	757	WHITE	14-AWG	PAIR 2
5	W-094	TB44 (44A)	A045C955	TB44 (44A)		CTI W X1	0332-0806	CTI W X1		0334-0759	926	WHITE	14-AWG	PAIR 3
6	W-095	TB45 (45A)	A045C955	TB45 (45A)		CTI W X2	0332-0806	CTI W X2		0334-0759	937	WHITE	14-AWG	PAIR 3

NOTES:

1. WIRES SHALL BE HOT STAMPED, OR PERMANENTLY MARKED WITH BOTH FROM AND TO LABELS AS LISTED IN TABULATION. MARKINGS SHALL APPEAR AT A MAXIMUM OF 75 MM FROM EACH END.
2. (NOTE REMOVED)
3. TOLERANCE: UP TO 500 +7 500 TO 1000 +13 1000 & LARGER +25
4. ATTACH A MASTER HARNESS LABEL WITH THE FOLLOWING INFORMATION: CUMMINS PART NUMBER, CUMMINS PART REVISION LEVEL, MANUFACTURER'S NAME, MANUFACTURER'S LOCATION, AND MANUFACTUERER'S DATE OF MANUFACTURE IN THE FORMAT OF MONTH, DATE, LAST 2 YEAR DIGITS. LABEL MUST BE MADE FROM UL RECOGNIZED VINYL SELF LAMINATION LABEL SYSTEM. PLACE LABEL IN APPROXIMATE LOCATION SHOWN ON DRAWING.
5. PLACE CABLE TIES (0332-3388) AS NECESSARY TO SECURE WIRES AND MAINTAIN HARNESS SHAPE.
6. DIELECTRIC STRENGTH SHALL BE RATED FOR 600V.
7. HARNESS SHALL BE PROCURED FROM A SUPPLIER QUALIFIED AS A UL RECOGNIZED HARNESS MANUFACTURER (CATEGORY ZPFW2). PACKAGING OR PARTS TO BE MARKED IN ACCORDANCE WITH REQUIREMENTS SPECIFIED BY SUPPLIERS UL PROGRAM.
8. THE SUPPLIER SHALL UTILIZE AGREED UPON AND DOCUMENTED PRODUCTION, QUALITY AND TEST PROCESSES.
9. ELECTRICAL WORKMANSHIP SHALL COMPLY WITH IPC IPC-A-610A CLASS II ACCEPTABILITY OF ELECTRONIC AND ELECTRICAL ASSEMBLIES MOST CURRENT REVISION.
10. CABLE AND HARNESS WORKMANSHIP SHALL COMPLY WITH IPC/WHMA-A-620 REQUIREMENTS AND ACCEPTANCE FOR CABLE AND WIRE HARNESS ASSEMBLIES MOST CURRENT REVISION.
11. IF A VALUE OF ZERO IS USED IN THE BILL OF MATERIAL THE QUANTITY OF THE AFFECTED MATERIAL SHALL BE DERIVED FROM THE DRAWING REQUIREMENTS.
13. (NOTE REMOVED).
14. TWISTED PAIRS SHALL HAVE 5 OR MORE 360° TWISTS FOR EVERY 300mm LENGTH.

CUMMINS POWER GENERATION

HARNESS, TRANSFORMER
MV/HV METERING CT

SIZE D | A042N908 | SHEET 1 OF 2 | REV C

FIGURE 605. A042N908 MV/HV METERING CT TRANSFORMER HARNESS (SHEET 1)

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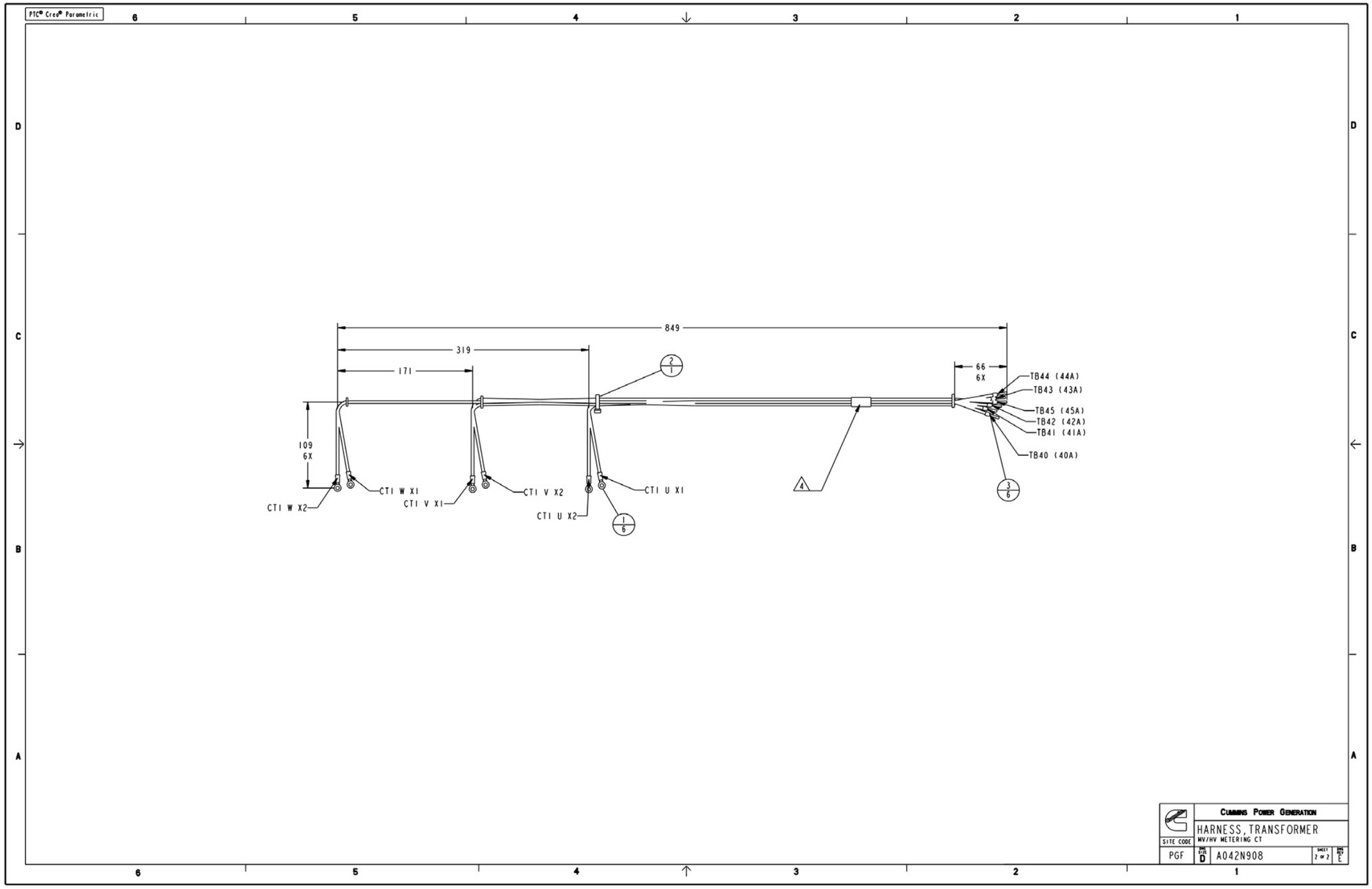


FIGURE 606. A042N908 MV/HV METERING CT TRANSFORMER HARNESS (SHEET 2)

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C.17 A043A480 GFI CT Transformer Harness

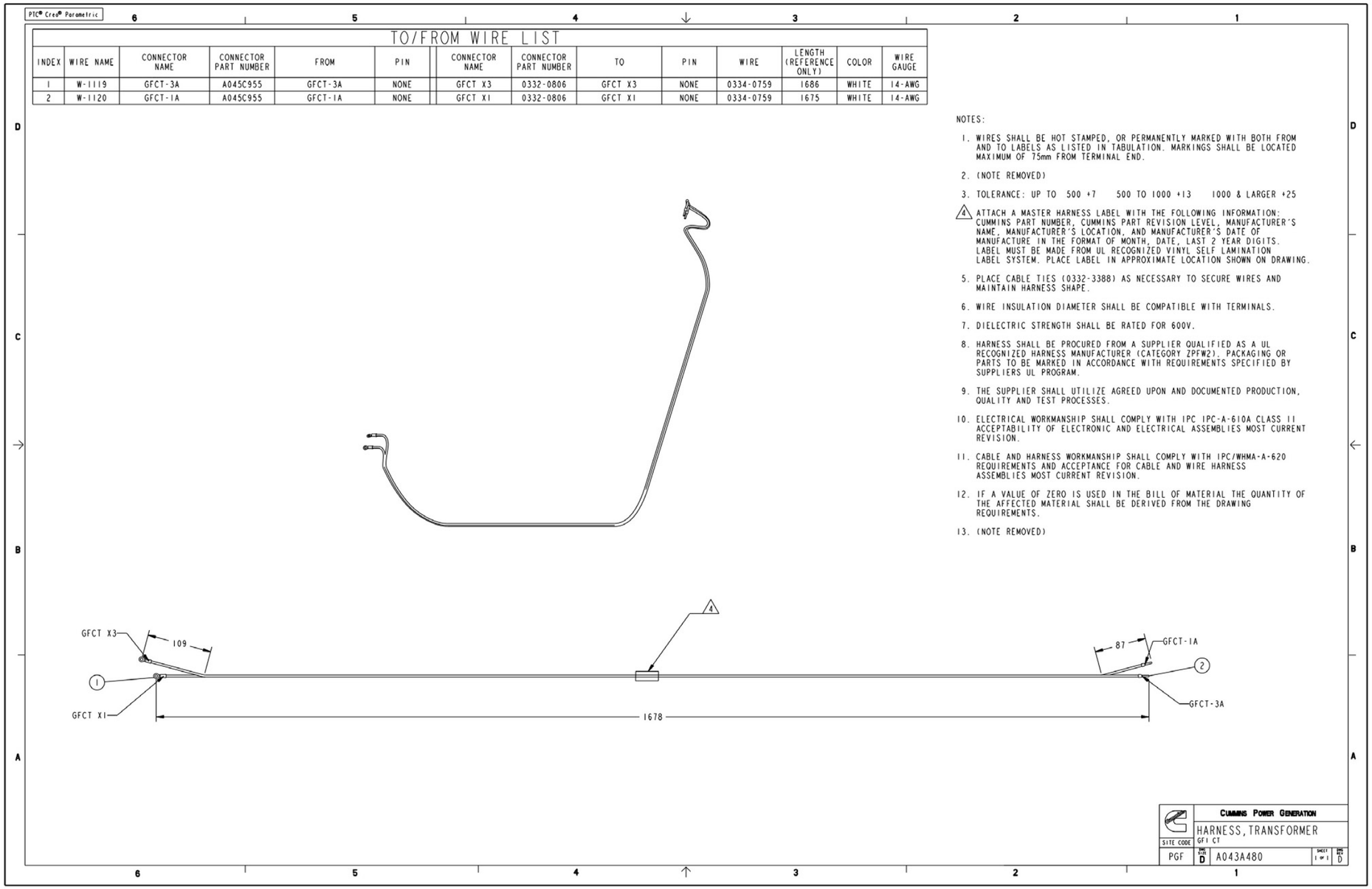


FIGURE 607. A043A480 GFI CT TRANSFORMER HARNESS (SHEET 1)

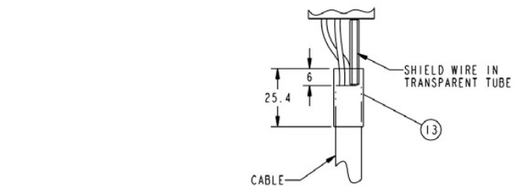
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C.18 A044G146 P80 Interface Control Harness

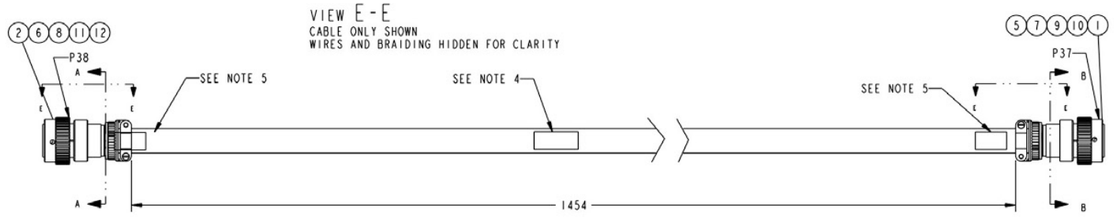
PTC® Creo® Parametric

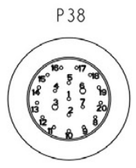
TO/FROM WIRE LIST

INDEX	WIRE NAME	CONNECTOR NAME	CONNECTOR PART NUMBER	FROM	PIN	CONNECTOR NAME	CONNECTOR PART NUMBER	TO	PIN	WIRE AND CABLE	LENGTH (REFERENCE ONLY)	COLOR	WIRE GAUGE
1	W-718	P38	A043Y878	P38-1	A043Z403	P37	A043Y875	P37-1	A044C656	0334-0757	1602	WHITE	18-AWG
2	W-719	P38	A043Y878	P38-2	A043Z403	P37	A043Y875	P37-2	A044C656	0334-0757	1602	WHITE	18-AWG
3	C-42 C-002	P38	A043Y878	P38-3	A034E918	P37	A043Y875	P37-3	A034M292	A040H594	1604	BLACK	18-AWG
4	W-720	P38	A043Y878	P38-4	A043Z403	P37	A043Y875	P37-4	A044C656	0334-0757	1602	WHITE	18-AWG
5	W-721	P38	A043Y878	P38-5	A043Z403	P37	A043Y875	P37-5	A044C656	0334-0757	1602	WHITE	18-AWG
6	C-42 C-003	P38	A043Y878	P38-6	A034E918	P37	A043Y875	P37-6	A034M292	A040H594	1604	WHITE	18-AWG
7	W-722	P38	A043Y878	P38-7	A043Z403	P37	A043Y875	P37-7	A044C656	0334-0757	1602	WHITE	18-AWG
8	C-23 C-003	P38	A043Y878	P38-8	A044C667	P37	A043Y875	P37-8	A044C663	A040H594	1605	WHITE	18-AWG
9	C-23 C-002	P38	A043Y878	P38-9	A044C667	P37	A043Y875	P37-9	A044C663	A040H594	1605	BLACK	18-AWG
10	C-23 C-001	P38	A043Y878	P38-10	A045R442	P37	A043Y875	P37-10	A034E916	A040H594	1605	SHIELD	20-AWG
11	W-726	P38	A043Y878	P38-11	A043Z403	P37	A043Y875	P37-11	A044C656	0334-0757	1604	WHITE	18-AWG
12	W-727	P38	A043Y878	P38-12	A043Z403	P37	A043Y875	P37-12	A044C656	0334-0757	1603	WHITE	18-AWG
13	W-728	P38	A043Y878	P38-13	A043Z403	P37	A043Y875	P37-13	A044C656	0334-0757	1603	WHITE	18-AWG
14	W-729	P38	A043Y878	P38-14	A043Z403	P37	A043Y875	P37-14	A044C656	0334-0757	1604	WHITE	18-AWG
15	W-754	P38	A043Y878	P38-15	A043Z403	P37	A043Y875	P37-15	A044C656	0334-0757	1604	WHITE	18-AWG
16	W-753	P38	A043Y878	P38-16	A043Z403	P37	A043Y875	P37-16	A044C656	0334-0757	1603	WHITE	18-AWG
17	W-1141	P38	A043Y878	P38-17	A043Z403	P37	A043Y875	P37-17	A044C656	0334-0757	1603	WHITE	18-AWG
18	W-854	P38	A043Y878	P38-18	A043Z403	P37	A043Y875	P37-18	A044C656	0334-0757	1604	WHITE	18-AWG
19	W-853	P38	A043Y878	P38-19	A043Z403	P37	A043Y875	P37-19	A044C656	0334-0757	1605	WHITE	18-AWG
20	C-42 C-001	P38	A043Y878	P38-20	A045R442	P37	A043Y875	P37-20	A034E916	A040H594	1604	SHIELD	20-AWG

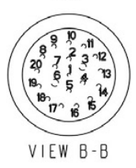


VIEW E-E
CABLE ONLY SHOWN
WIRES AND BRAIDING HIDDEN FOR CLARITY





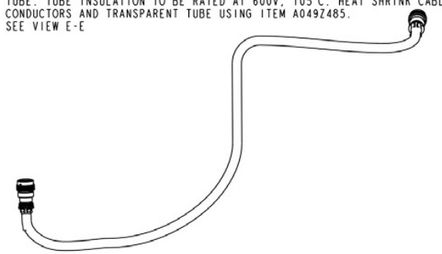
VIEW A-A



VIEW B-B

NOTE:

1. WIRES SHALL BE HOT STAMPED, OR PERMANENTLY MARKED WITH BOTH FROM AND TO LABELS AS LISTED IN TABULATION. MARKINGS SHALL BE VISIBLE AFTER WIRE IS INSTALLED INTO CONNECTOR, MAXIMUM OF 75 MM FROM CONNECTOR END.
2. DIMENSIONS ARE IN MILLIMETERS.
3. TOLERANCE: UP TO 500 ±15 500 TO 1000 ±40 1000 & LARGER ±60
4. ATTACH A MASTER HARNESS LABEL WITH THE FOLLOWING INFORMATION: CUMMINS PART NUMBER, CUMMINS PART REVISION LEVEL, MANUFACTURER'S NAME, MANUFACTURER'S LOCATION, AND MANUFACTURER'S DATE OF MANUFACTURE IN THE FORMAT OF MONTH, DATE, LAST 2 YEAR DIGITS. LABEL MUST BE MADE FROM UL RECOGNIZED VINYL SELF LAMINATION LABEL SYSTEM. PLACE LABEL APPROXIMATELY IN LOCATION SHOWN.
5. MARK LABEL ON BUNDLE WITH CONNECTOR REFERENCE DESIGNATOR FROM WIRE LIST TABLE WITH UL RECOGNIZED VINYL SELF LAMINATIONG LABEL SYSTEM. PLACE MAXIMUM OF 75MM FROM CONNECTOR END.
6. (NOTE REMOVED)
7. HARNESS SHALL BE PROCURED FROM A SUPPLIER QUALIFIED AS A UL RECOGNIZED HARNESS MANUFACTURER (CATEGORY ZPFW2). PACKAGING OR PARTS TO BE MARKED IN ACCORDANCE WITH REQUIREMENTS SPECIFIED BY SUPPLIERS UL PROGRAM.
8. THE SUPPLIER SHALL UTILIZE AGREED UPON AND DOCUMENTED PRODUCTION, QUALITY AND TEST PROCESSES.
9. ELECTRICAL WORKMANSHIP SHALL COMPLY WITH IPC IPC-A-610A CLASS II ACCEPTABILITY OF ELECTRONIC AND ELECTRICAL ASSEMBLIES MOST CURRENT REVISION.
10. CABLE AND HARNESS WORKMANSHIP SHALL COMPLY WITH IPC/WHMA-A-620 REQUIREMENTS AND ACCEPTANCE FOR CABLE AND WIRE HARNESS ASSEMBLIES MOST CURRENT REVISION.
11. IF A VALUE OF ZERO IS USED IN THE BILL OF MATERIAL THE QUANTITY OF THE AFFECTED MATERIAL SHALL BE DERIVED FROM THE DRAWING REQUIREMENTS.
12. HARNESS SHALL BE CONTINUOUSLY BRAIDED TO CONNECTOR BACKSHELLS USING ENGINEERED YARNS VN 4000S, COLOR BLACK.
    - 12.1) BRAIDING SHALL WITHSTAND -40°C TO 125 °C TEMPERATURE.
    - 12.2) BRAIDING SHALL BE RESISTANT TO THE GENSET ENVIRONMENT FLUIDS.
    - 12.3) BRAIDING OVER BOOT ON EACH CONNECTOR BACKSHELL.
13. POINT TO POINT CONTINUITY TESTING SHALL BE PERFORMED ON THIS HARNESS ASSEMBLY.
14. HARNESS SHALL BE SHIPPED IN PLASTIC BAG.
15. INSERT SHIELD WIRE INTO UL RECOGNIZED TRANSPARENT (CLEAR) PLASTIC TUBE. TUBE INSULATION TO BE RATED AT 600V, 105°C. HEAT SHRINK CABLE, CONDUCTORS AND TRANSPARENT TUBE USING ITEM A049Z485. SEE VIEW E-E



SITE CODE	CUMMINS POWER GENERATION	
PGF	HARNESS, CONTROL INTERFACE	
	DWG D	A044G146
	SHEET 1 OF 1	REV E

FIGURE 608. A044G146 P80 INTERFACE CONTROL HARNESS (SHEET 1)

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C.19 A044B325 PCC to Customer Control Harness

PTC® Creo® Parametric

TO/FROM WIRE LIST

INDEX	WIRE NAME	CONNECTOR NAME	CONNECTOR PART NUMBER	FROM	PIN	CONNECTOR NAME	CONNECTOR PART NUMBER	TO	PIN	WIRE	LENGTH (REFERENCE ONLY)	COLOR	WIRE GAUGE
1	C-11C-001	J50	A040D567	J50-3	NONE	SP-30	0332-2981	SP-30-1	NONE	A040H594	444	SHIELD	20-AWG
2	C-11C-002	J50	A040D567	J50-1	NONE	SP-16	0332-2981	SP-16-1	NONE	A040H594	444	BLACK	18-AWG
3	C-11C-003	J50	A040D567	J50-2	NONE	SP-17	0332-2981	SP-17-1	NONE	A040H594	444	WHITE	18-AWG
4	C-18C-001	SP-30	0332-2981	SP-30-2	NONE	TB1	0323-1678-15	TB1-3	A040H579	A040H594	446	SHIELD	20-AWG
5	C-18C-002	SP-16	0332-2981	SP-16-2	NONE	TB1	0323-1678-15	TB1-1	A034V373	A040H594	446	BLACK	18-AWG
6	C-18C-003	SP-17	0332-2981	SP-17-2	NONE	TB1	0323-1678-15	TB1-2	A034V373	A040H594	446	WHITE	18-AWG
7	C-19C-001	SP-30	0332-2981	SP-30-1	NONE	CTB3	A040H039	CTB3-1	A040H579	A040H594	487	SHIELD	20-AWG
8	C-19C-002	SP-16	0332-2981	SP-16-1	NONE	CTB1	A040H039	CTB1-1	A034V373	A040H594	487	BLACK	18-AWG
9	C-19C-003	SP-17	0332-2981	SP-17-1	NONE	CTB2	A040H039	CTB2-1	A034V373	A040H594	487	WHITE	18-AWG
10	C-39C-001	C-39		C-39--	NONE	SP-30	0332-2981	SP-30-2	NONE	A040H594	348	SHIELD	20-AWG
11	C-39C-002	PI(0)	A047X281	PI(0)-3	A034V373	SP-16	0332-2981	SP-16-2	NONE	A040H594	348	BLACK	18-AWG
12	C-39C-003	PI(0)	A047X281	PI(0)-4	A034V373	SP-17	0332-2981	SP-17-2	NONE	A040H594	348	WHITE	18-AWG
13	C-40C-001	SP-30	0332-2981	SP-30-2	NONE	C-40		C-40--	NONE	A040H594	185	SHIELD	20-AWG
14	C-40C-002	SP-16	0332-2981	SP-16-2	NONE	PI(1)	A047X281	PI(1)-3	A034V373	A040H594	185	BLACK	18-AWG
15	C-40C-003	SP-17	0332-2981	SP-17-2	NONE	PI(1)	A047X281	PI(1)-4	A034V373	A040H594	185	WHITE	18-AWG
16	C-51C-001	CTB29	A040H039	CTB29-1	A040H579	TB3	0323-2498	TB3-2	A040H579	A040H594	849	SHIELD	20-AWG
17	C-51C-002	CTB30	A040H039	CTB30-1	A034V373	TB3	0323-2498	TB3-3	A034V373	A040H594	849	BLACK	18-AWG
18	C-51C-003	CTB31	A040H039	CTB31-1	A034V373	TB3	0323-2498	TB3-4	A034V373	A040H594	849	WHITE	18-AWG
19	W-452	TB1	0323-1678-15	TB1-4	A034V373	CTB4	A040H039	CTB4-1	A034V373	0334-0757	929	WHITE	18-AWG
20	W-453	TB1	0323-1678-15	TB1-5	A034V373	CTB5	A040H039	CTB5-1	A034V373	0334-0757	944	WHITE	18-AWG
21	W-454	TB1	0323-1678-15	TB1-6	A034V373	CTB9	A040H039	CTB9-1	A034V373	0334-0757	925	WHITE	18-AWG
22	W-455	TB1	0323-1678-15	TB1-7	A034V373	CTB10	A040H039	CTB10-1	A034V373	0334-0757	918	WHITE	18-AWG
23	W-456	TB1	0323-1678-15	TB1-8	A034V373	CTB11	A040H039	CTB11-1	A034V373	0334-0757	931	WHITE	18-AWG
24	W-457	TB1	0323-1678-15	TB1-9	A034V373	CTB12	A040H039	CTB12-1	A034V373	0334-0757	946	WHITE	18-AWG
25	W-458	TB1	0323-1678-15	TB1-10	A034V373	CTB13	A040H039	CTB13-1	A034V373	0334-0757	920	WHITE	18-AWG
26	W-459	TB1	0323-1678-15	TB1-11	A034V373	CTB14	A040H039	CTB14-1	A034V373	0334-0757	910	WHITE	18-AWG
27	W-460	TB1	0323-1678-15	TB1-12	A034V373	CTB15	A040H039	CTB15-1	A034V373	0334-0757	925	WHITE	18-AWG
28	W-461	TB1	0323-1678-15	TB1-13	A034V373	CTB16	A040H039	CTB16-1	A034V373	0334-0757	946	WHITE	18-AWG
29	W-462	TB1	0323-1678-15	TB1-14	A034V373	CTB17	A040H039	CTB17-1	A034V373	0334-0757	933	WHITE	18-AWG
30	W-463	TB1	0323-1678-15	TB1-15	A034V373	CTB18	A040H039	CTB18-1	A034V373	0334-0757	925	WHITE	18-AWG
31	W-464	TB1	0323-1678-15	TB1-16	A034V373	CTB20	A040H039	CTB20-1	A034V373	0334-0757	906	WHITE	18-AWG
32	W-465	TB8	0323-2500	TB8-1	A034V373	CTB21	A040H039	CTB21-1	A034V373	0334-0757	792	WHITE	18-AWG
33	W-466	TB8	0323-2500	TB8-2	A034V373	CTB22	A040H039	CTB22-1	A034V373	0334-0757	759	WHITE	18-AWG
34	W-467	TB8	0323-2500	TB8-3	A034V373	CTB23	A040H039	CTB23-1	A034V373	0334-0757	748	WHITE	18-AWG
35	W-468	TB8	0323-2500	TB8-4	A034V373	CTB24	A040H039	CTB24-1	A034V373	0334-0757	723	WHITE	18-AWG
36	W-469	TB8	0323-2500	TB8-5	A034V373	CTB25	A040H039	CTB25-1	A034V373	0334-0757	718	WHITE	18-AWG
37	W-470	TB8	0323-2500	TB8-6	A034V373	CTB26	A040H039	CTB26-1	A034V373	0334-0757	712	WHITE	18-AWG
38	W-471	TB3	0323-2498	TB3-1	A034V373	CTB28	A040H039	CTB28-1	A034V373	0334-0757	856	WHITE	18-AWG
39	W-472	TB3	0323-2498	TB3-5	A034V373	CTB32	A040H039	CTB32-1	A034V373	0334-0757	795	WHITE	18-AWG
40	W-473	TB3	0323-2498	TB3-6	A034V373	CTB33	A040H039	CTB33-1	A034V373	0334-0757	806	WHITE	18-AWG
41	W-474	TB3	0323-2498	TB3-8	A034V373	CTB34	A040H039	CTB34-1	A034V373	0334-0757	788	WHITE	18-AWG
42	W-475	TB3	0323-2498	TB3-9	A034V373	CTB35	A040H039	CTB35-1	A034V373	0334-0757	783	WHITE	18-AWG
43	W-476	TB3	0323-2498	TB3-10	A034V373	CTB36	A040H039	CTB36-1	A034V373	0334-0757	814	WHITE	18-AWG
44	W-477	TB3	0323-2498	TB3-11	A034V373	CTB37	A040H039	CTB37-1	A034V373	0334-0757	826	WHITE	18-AWG
45	W-478	TB3	0323-2498	TB3-12	A034V373	CTB38	A040H039	CTB38-1	A034V373	0334-0757	812	WHITE	18-AWG
46	W-479	TB5	0323-2499	TB5-1	A034V373	CTB39	A040H039	CTB39-1	A034V373	0334-0757	746	WHITE	18-AWG
47	W-480	TB5	0323-2499	TB5-2	A034V373	CTB40	A040H039	CTB40-1	A034V373	0334-0757	747	WHITE	18-AWG
48	W-481	TB5	0323-2499	TB5-4	A034V373	CTB41	A040H039	CTB41-1	A034V373	0334-0757	758	WHITE	18-AWG
49	W-482	TB5	0323-2499	TB5-5	A034V373	CTB42	A040H039	CTB42-1	A034V373	0334-0757	698	WHITE	18-AWG
50	W-483	TB5	0323-2499	TB5-6	A034V373	CTB43	A040H039	CTB43-1	A034V373	0334-0757	702	WHITE	18-AWG
51	W-518	TB9	0323-2501	TB9-11	A034V373	CTB51	A040H039	CTB51-3	A034V373	0334-0757	654	WHITE	18-AWG
52	W-519	TB9	0323-2501	TB9-10	A034V373	CTB52	A040H039	CTB52-3	A034V373	0334-0757	661	WHITE	18-AWG
53	W-520	TB9	0323-2501	TB9-9	A034V373	CTB53	A040H039	CTB53-3	A034V373	0334-0757	660	WHITE	18-AWG
54	W-521	TB9	0323-2501	TB9-8	A034V373	CTB54	A040H039	CTB54-3	A034V373	0334-0757	663	WHITE	18-AWG

REL NO	LTR	NO	REVISION	DRN	CKD	APVD	DATE
ECO-175201	G	1	ZONE A1, RMV C11 LABEL	RVP	JBP	M.FEGLEY	06FEB18
		2	ADD NOTE 16	RVP	JBP	M.FEGLEY	06FEB18
		3	UPDATE NOTE 11	RVP	JBP	M.FEGLEY	06FEB18
		4	ADD FLAG TO NOTE 11	RVP	JBP	M.FEGLEY	06FEB18
		5	ZONE A2, SIM TO: ADD "A059E467"	RVP	JBP	M.FEGLEY	06FEB18
		6	SEE SHEET 3	RVP	JBP	M.FEGLEY	06FEB18

NOTES:

1. WIRES SHALL BE HOT STAMPED, OR PERMANENTLY MARKED WITH BOTH FROM AND TO LABELS AS LISTED IN TABULATION. MARKINGS SHALL APPEAR AT A MAXIMUM OF 75 MM FROM EACH END.
2. TORQUE TERMINALS AT 0.6-0.8 Nm.
3. TOLERANCE: UP TO 500 +7 500 TO 1000 +13 1000 & LARGER +25
4. ATTACH A MASTER HARNESS LABEL WITH THE FOLLOWING INFORMATION: CUMMINS PART NUMBER, CUMMINS PART REVISION LEVEL, MANUFACTURER'S NAME, MANUFACTURER'S LOCATION, AND MANUFACTURER'S DATE OF MANUFACTURE IN THE FORMAT OF MONTH, DATE, LAST 2 YEAR DIGITS. LABEL MUST BE MADE FROM UL RECOGNIZED VINYL SELF LAMINATION LABEL SYSTEM. PLACE IN APPROXIMATE LOCATION SHOWN ON DRAWING.
5. PLACE CABLE TIES AS NECESSARY TO SECURE WIRES AND MAINTAIN HARNESS SHAPE.
6. (NOTE REMOVED)
7. HARNESS SHALL BE PROCURED FROM A SUPPLIER QUALIFIED AS A UL RECOGNIZED HARNESS MANUFACTURER (CATEGORY ZPFW2). PACKAGING OR PARTS TO BE MARKED IN ACCORDANCE WITH REQUIREMENTS SPECIFIED BY SUPPLIERS UL PROGRAM.
8. THE SUPPLIER SHALL UTILIZE AGREED UPON AND DOCUMENTED PRODUCTION, QUALITY AND TEST PROCESSES.
9. ELECTRICAL WORKMANSHIP SHALL COMPLY WITH IPC IPC-A-610A CLASS II ACCEPTABILITY OF ELECTRONIC AND ELECTRICAL ASSEMBLIES MOST CURRENT REVISION.
10. CABLE AND HARNESS WORKMANSHIP SHALL COMPLY WITH IPC/WHMA-A-620 REQUIREMENTS AND ACCEPTANCE FOR CABLE AND WIRE HARNESS ASSEMBLIES MOST CURRENT REVISION.
11. IF A VALUE OF 0 (ZERO) IS USED IN THE BILL OF MATERIAL, THE QUANTITY OF THE AFFECTED ITEMS SHALL BE DERIVED FROM THE DRAWING REQUIREMENTS.
12. POINT TO POINT CONTINUITY TESTING SHALL BE PERFORMED ON THIS HARNESS ASSEMBLY.
13. SPLICE LOCATIONS ARE REFERENCE ONLY. SPLICES SHALL BE OFFSET TO PREVENT EXCESSIVE BULGES. HEATSHRINK ITEM 18 SHALL BE USED TO COVER ALL SPLICES.
14. INSERT ALL SHIELD WIRES INTO UL RECOGNIZED TRANSPARENT (CLEAR) PLASTIC TUBE. THIS TUBE SHALL BE RATED AT 600V, 105°C. HEATSHRINK CABLE CONDUCTORS AND TRANSPARENT TUBE USING HEATSHRINK ITEM 15 SEE DETAIL K, SHEET 3.
15. HARNESS SHALL BE SHIPPED IN PLASTIC BAG.
16. THIS PART IS IDENTICAL TO A059E467 (FRANK BLUE). ANY CHANGES TO THIS PART REQUIRES A REVISION TO THE FRANK BLUE PART.

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS
DIM TOL: X ± 0.8 (.xx ± 0.38); 0.00-4.99 ±0.15/-0.08; 5.00-9.99 ±0.20/-0.10; 10.00-17.49 ±0.25/-0.13; 17.50-24.99 ±0.30/-0.13
ANG TOL: ± 1.0° SCALE: 5/32
SIM TO A059E467 DO NOT SCALE PRINT
* CONFIDENTIAL * PROPERTY OF CUMMINS POWER GENERATION GROUP
FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING, SEE ASME Y14.5M-1994 FIRST USED ON C3250D6
DRN P MEDINA CKD B ZAPATA APVD B ZAPATA DATE 26OCT12
SITE CODE PGF
CUMMINS POWER GENERATION
HARNESS,CONTROL
PCC TO CUST
SIZE D A044B325 SHEET 1 OF 4 REV G

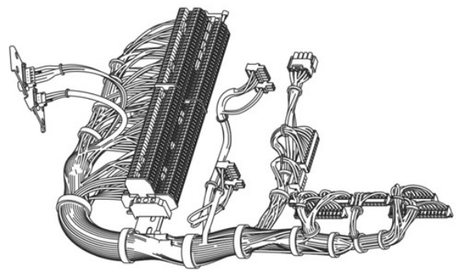
FIGURE 609. A044B325 PCC TO CUSTOMER CONTROL HARNESS (SHEET 1)

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INDEX	WIRE NAME	CONNECTOR NAME	CONNECTOR PART NUMBER	FROM	PIN	CONNECTOR NAME	CONNECTOR PART NUMBER	TO	PIN	WIRE	LENGTH (REFERENCE ONLY)	COLOR	WIRE GAUGE
55	W-522	TB15	0323-2192-04	TB15-5	A034V373	SP-34	0332-1506	SP-34-1	NONE	0334-0757	230	WHITE	18-AWG
56	W-646	TB8	0323-2500	TB8-13	A034V373	CTB22	A040H039	CTB22-3	A034V373	0334-0757	762	WHITE	18-AWG
57	W-647	TB8	0323-2500	TB8-12	A034V373	CTB23	A040H039	CTB23-3	A034V373	0334-0757	770	WHITE	18-AWG
58	W-648	TB8	0323-2500	TB8-11	A034V373	CTB24	A040H039	CTB24-3	A034V373	0334-0757	749	WHITE	18-AWG
59	W-649	TB8	0323-2500	TB8-10	A034V373	CTB25	A040H039	CTB25-3	A034V373	0334-0757	767	WHITE	18-AWG
60	W-650	TB8	0323-2500	TB8-9	A034V373	CTB26	A040H039	CTB26-3	A034V373	0334-0757	761	WHITE	18-AWG
61	W-651	TB8	0323-2500	TB8-8	A034V373	CTB27	A040H039	CTB27-3	A034V373	0334-0757	752	WHITE	18-AWG
62	W-652	TB8	0323-2500	TB8-7	A034V373	CTB28	A040H039	CTB28-3	A034V373	0334-0757	741	WHITE	18-AWG
63	W-653	P30	A040M662	P30-12	A040M659	CTB16	A040H039	CTB16-3	A034V373	0334-0757	892	WHITE	18-AWG
64	W-654	CTB17	A040H039	CTB17-3	A034V373	P30	A040M662	P30-11	A040M659	0334-0757	869	WHITE	18-AWG
65	W-655	P30	A040M662	P30-10	A040M659	CTB18	A040H039	CTB18-3	A034V373	0334-0757	882	WHITE	18-AWG
66	W-656	CTB19	A040H039	CTB19-3	A034V373	P30	A040M662	P30-9	A040M659	0334-0757	875	WHITE	18-AWG
67	W-657	P30	A040M662	P30-8	A040M659	CTB20	A040H039	CTB20-3	A034V373	0334-0757	857	WHITE	18-AWG
68	W-658	CTB21	A040H039	CTB21-3	A034V373	P30	A040M662	P30-7	A040M659	0334-0757	842	WHITE	18-AWG
69	W-662	TB9	0323-2501	TB9-4	A034V373	CTB51	A040H039	CTB51-1	A034V373	0334-0757	660	WHITE	18-AWG
70	W-663	TB9	0323-2501	TB9-5	A034V373	CTB52	A040H039	CTB52-1	A034V373	0334-0757	660	WHITE	18-AWG
71	W-664	TB9	0323-2501	TB9-6	A034V373	CTB53	A040H039	CTB53-1	A034V373	0334-0757	634	WHITE	18-AWG
72	W-665	TB9	0323-2501	TB9-7	A034V373	CTB55	A040H039	CTB55-1	A034V373	0334-0757	611	WHITE	18-AWG
73	W-666	TB10	0323-2502	TB10-15	A034V373	CTB33	A040H039	CTB33-3	A034V373	0334-0757	682	WHITE	18-AWG
74	W-667	TB10	0323-2502	TB10-14	A034V373	CTB34	A040H039	CTB34-3	A034V373	0334-0757	669	WHITE	18-AWG
75	W-668	TB10	0323-2502	TB10-13	A034V373	CTB35	A040H039	CTB35-3	A034V373	0334-0757	654	WHITE	18-AWG
76	W-669	TB10	0323-2502	TB10-12	A034V373	CTB36	A040H039	CTB36-3	A034V373	0334-0757	650	WHITE	18-AWG
77	W-670	TB10	0323-2502	TB10-11	A034V373	CTB37	A040H039	CTB37-3	A034V373	0334-0757	646	WHITE	18-AWG
78	W-671	TB10	0323-2502	TB10-10	A034V373	CTB38	A040H039	CTB38-3	A034V373	0334-0757	644	WHITE	18-AWG
79	W-672	TB10	0323-2502	TB10-9	A034V373	CTB39	A040H039	CTB39-3	A034V373	0334-0757	662	WHITE	18-AWG
80	W-673	TB10	0323-2502	TB10-8	A034V373	CTB41	A040H039	CTB41-3	A034V373	0334-0757	596	WHITE	18-AWG
81	W-674	TB10	0323-2502	TB10-7	A034V373	CTB42	A040H039	CTB42-3	A034V373	0334-0757	600	WHITE	18-AWG
82	W-675	TB10	0323-2502	TB10-6	A034V373	CTB43	A040H039	CTB43-3	A034V373	0334-0757	594	WHITE	18-AWG
83	W-676	TB10	0323-2502	TB10-5	A034V373	CTB44	A040H039	CTB44-3	A034V373	0334-0757	595	WHITE	18-AWG
84	W-677	TB10	0323-2502	TB10-4	A034V373	CTB45	A040H039	CTB45-3	A034V373	0334-0757	599	WHITE	18-AWG
85	W-678	TB10	0323-2502	TB10-3	A034V373	CTB46	A040H039	CTB46-3	A034V373	0334-0757	599	WHITE	18-AWG
86	W-679	TB10	0323-2502	TB10-2	A034V373	CTB48	A040H039	CTB48-3	A034V373	0334-0757	595	WHITE	18-AWG
87	W-680	TB10	0323-2502	TB10-1	A034V373	CTB49	A040H039	CTB49-3	A034V373	0334-0757	606	WHITE	18-AWG
88	W-699	TB10	0323-2502	TB10-17	A034V373	CTB30	A040H039	CTB30-3	A034V373	0334-0757	735	WHITE	18-AWG
89	W-700	TB10	0323-2502	TB10-16	A034V373	CTB32	A040H039	CTB32-3	A034V373	0334-0757	742	WHITE	18-AWG
90	W-701	P30	A040M662	P30-1	A040M659	CTB4	A040H039	CTB4-3	A034U838	0334-0760	899	WHITE	12-AWG
91	W-702	CTB5	A040H039	CTB5-3	A034U838	P30	A040M662	P30-2	A040M659	0334-0760	909	WHITE	12-AWG
92	W-703	P30	A040M662	P30-5	A040M659	CTB13	A040H039	CTB13-3	A034V373	0334-0759	851	WHITE	14-AWG
93	W-704	CTB14	A040H039	CTB14-3	A034V373	P30	A040M662	P30-6	A040M659	0334-0759	832	WHITE	14-AWG
94	W-705	P30	A040M662	P30-3	A040M658	CTB7	A040H039	CTB7-3	A034U838	0334-0760	889	WHITE	12-AWG
95	W-706	CTB8	A040H039	CTB8-3	A034U838	P30	A040M662	P30-4	A040M658	0334-0760	885	WHITE	12-AWG
96	W-745	P14(1)	A047X291	P14(1)-1	A034V373	P1(0)	A047X281	P1(0)-2	A034V373	0334-0757	396	WHITE	18-AWG
97	W-746	P14(1)	A047X291	P14(1)-2	A034V373	P1(0)	A047X281	P1(0)-1	A034V373	0334-0757	409	WHITE	18-AWG
98	W-747	J51	A035P671	J51-1	NONE	TB15	0323-2192-04	TB15-1	A034V373	0334-0757	813	WHITE	18-AWG
99	W-748	J51	A035P671	J51-3	NONE	TB15	0323-2192-04	TB15-3	A034V373	0334-0757	822	WHITE	18-AWG
100	W-749	J51	A035P671	J51-4	NONE	TB15	0323-2192-04	TB15-4	A034V373	0334-0757	823	WHITE	18-AWG
101	W-750	J51	A035P671	J51-5	NONE	SP-34	0332-1506	SP-34-2	NONE	0334-0757	572	WHITE	18-AWG
102	W-751	CTB1	A040H039	CTB1-3	A034V373	SP-34	0332-1506	SP-34-2	NONE	0334-0757	617	WHITE	18-AWG
103	W-882	CTB9	A040H039	CTB9-3	A034V373	P14(0)	A047X291	P14(0)-2	A034V373	0334-0757	851	WHITE	18-AWG
104	W-885	P1(1)	A047X281	P1(1)-5	A034V373	SP-44	0332-1506	SP-44-1	NONE	0334-0757	241	WHITE	18-AWG
105	W-1023	CTB3	A040H039	CTB3-3	A034V373	SP-44	0332-1506	SP-44-1	NONE	0334-0757	707	WHITE	18-AWG
106	W-1024	P1(0)	A047X281	P1(0)-5	A034V373	SP-44	0332-1506	SP-44-2	NONE	0334-0757	166	WHITE	18-AWG
107	W-1110	P14(0)	A047X291	P14(0)-1	A034V373	CTB6	A040H039	CTB6-3	A034V373	0334-0757	900	WHITE	18-AWG
108	W-1131	TB9	0323-2501	TB9-3	A034V373	CTB50	A040H039	CTB50-1	A034V373	0334-0757	716	WHITE	18-AWG
109	W-1132	TB9	0323-2501	TB9-2	A034V373	CTB49	A040H039	CTB49-1	A034V373	0334-0757	707	WHITE	18-AWG

REL NO	LTR	NO	REVISION	DRN	CKD	APVD	DATE
ECO-175201	G	--	----	RVP	JBP	M.FEGLEY	06FEB18



UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN MILLIMETERS

DIM: X ± 0.8; .X ± 0.38; 0.00-4.99 +0.10/-0.08; 5.00-9.99 +0.20/-0.10; 10.00-17.49 +0.25/-0.13; 17.50-24.99 +0.30/-0.13

ANG TOL: ± 1.0° SCALE: 5/32

SYM TO A059E467 DO NOT SCALE PRINT

- CONFIDENTIAL - PROPERTY OF CUMMINS POWER GENERATION GROUP

DWN P MEDINA CKD B ZAPATA APVD B ZAPATA DATE 26OCT12

FOR INTERPRETATION OF DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994 FIRST USED ON C3250D6

SITE CODE PGF

CUMMINS POWER GENERATION

HARNESS, CONTROL PCC TO CUST

SIZE D A044B325 SHEET 2 of 4 REV C

FIGURE 610. A044B325 PCC TO CUSTOMER CONTROL HARNESS (SHEET 2)

INDEX	WIRE NAME	CONNECTOR NAME	CONNECTOR PART NUMBER	FROM	PIN	CONNECTOR NAME	CONNECTOR PART NUMBER	TO	PIN	WIRE	LENGTH (REFERENCE ONLY)	COLOR	WIRE GAUGE
110	W-1133	TB9	0323-2501	TB9-1	A034V373	CTB47	A040H039	CTB47-1	A034V373	0334-0757	707	WHITE	18-AWG
111	W-1134	TB5	0323-2499	TB5-9	A034V373	CTB46	A040H039	CTB46-1	A034V373	0334-0757	733	WHITE	18-AWG
112	W-1135	TB5	0323-2499	TB5-8	A034V373	CTB45	A040H039	CTB45-1	A034V373	0334-0757	734	WHITE	18-AWG
113	W-1136	TB5	0323-2499	TB5-7	A034V373	CTB44	A040H039	CTB44-1	A034V373	0334-0757	732	WHITE	18-AWG

REL NO	LTR	NO	REVISION	DWN	CKD	APVD	DATE
ECO-175201	G	6	ADD FLAG NOTE 11 TO BALLOONS 15 & 18	RVP	JBP	M.FEGLEY	06FEB18

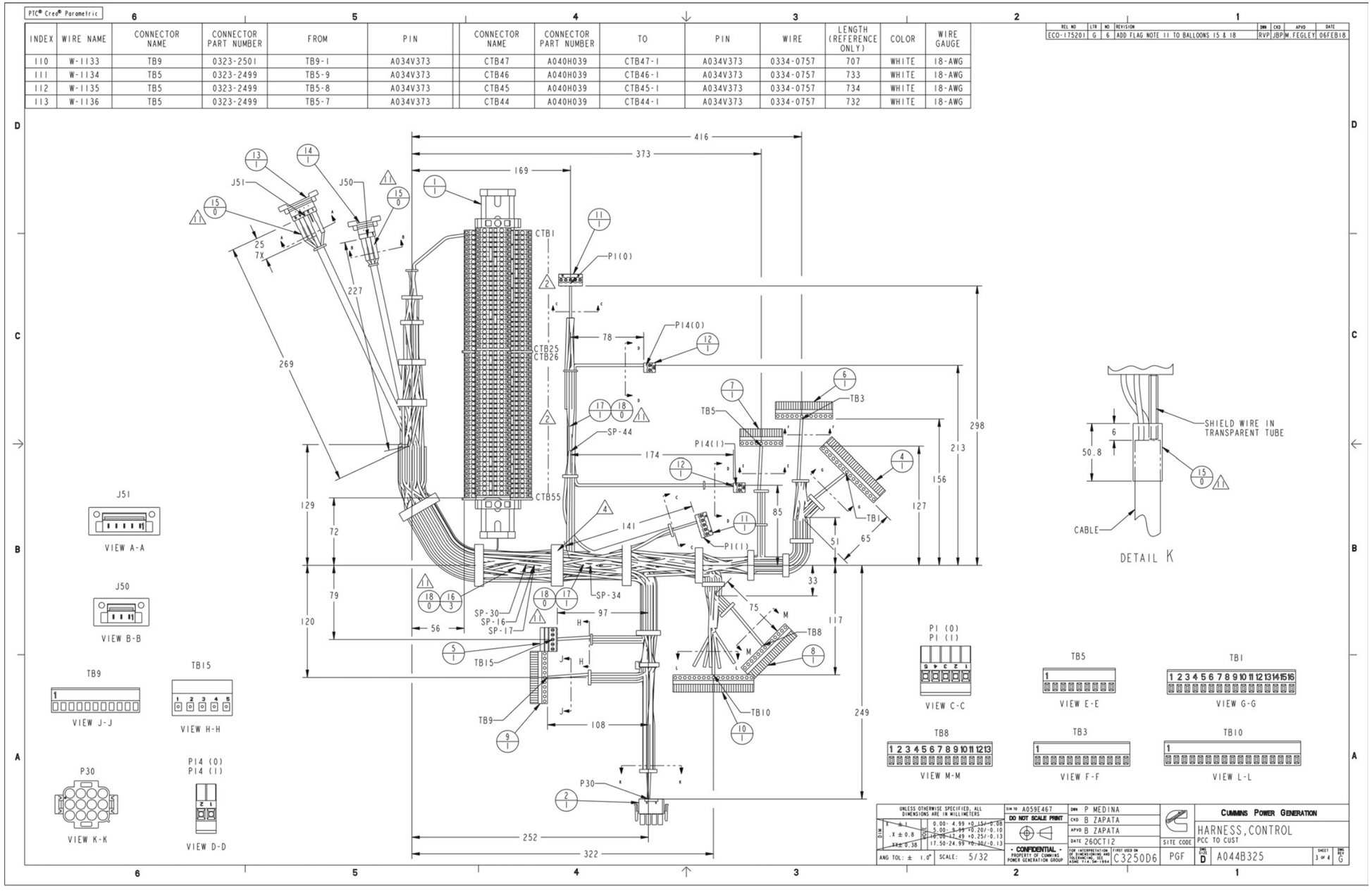


FIGURE 611. A044B325 PCC TO CUSTOMER CONTROL HARNESS (SHEET 3)

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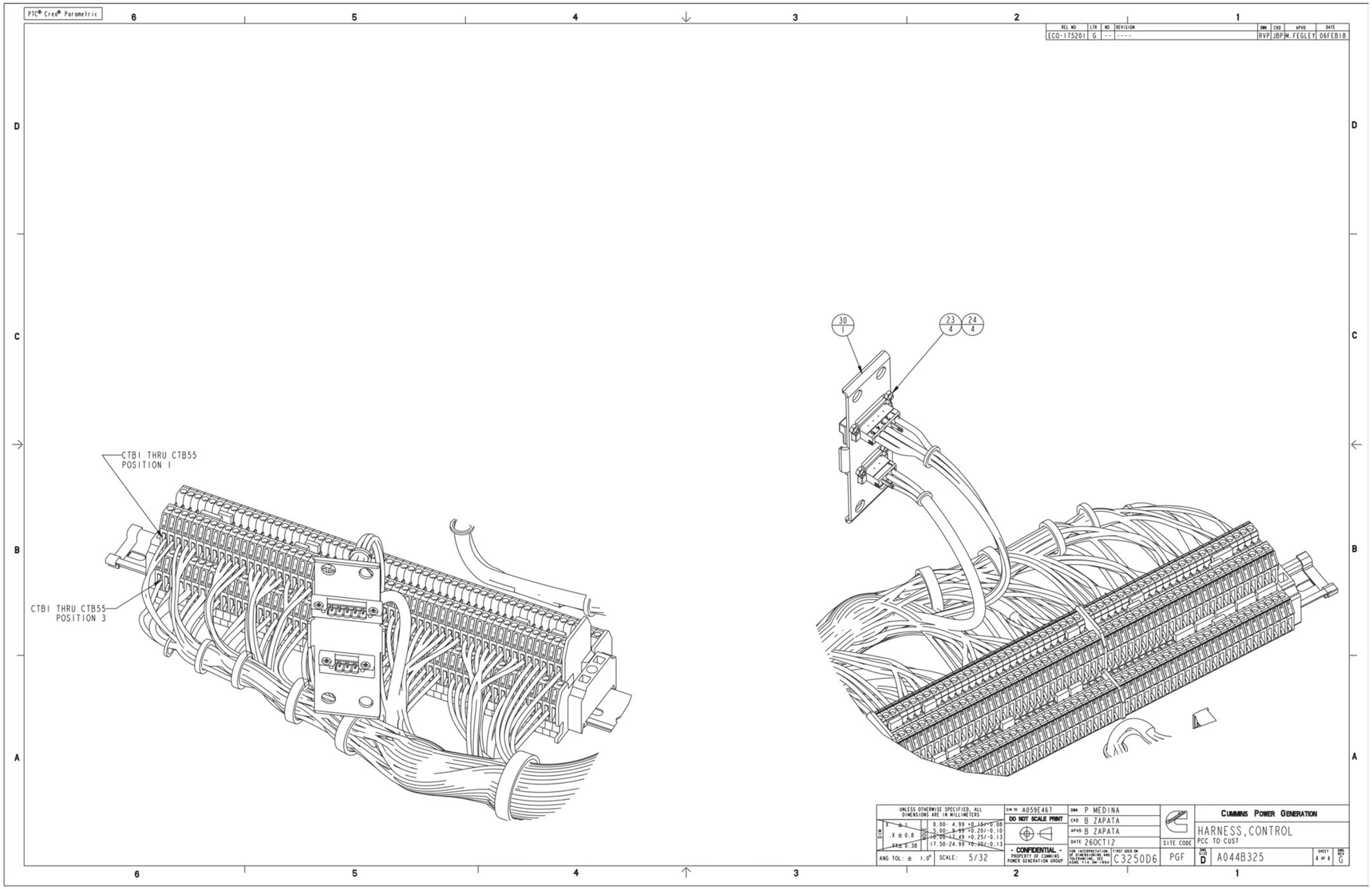


FIGURE 612. A044B325 PCC TO CUSTOMER CONTROL HARNESS (SHEET 4)

C.20 A044G966 Removable Panel Control Harness

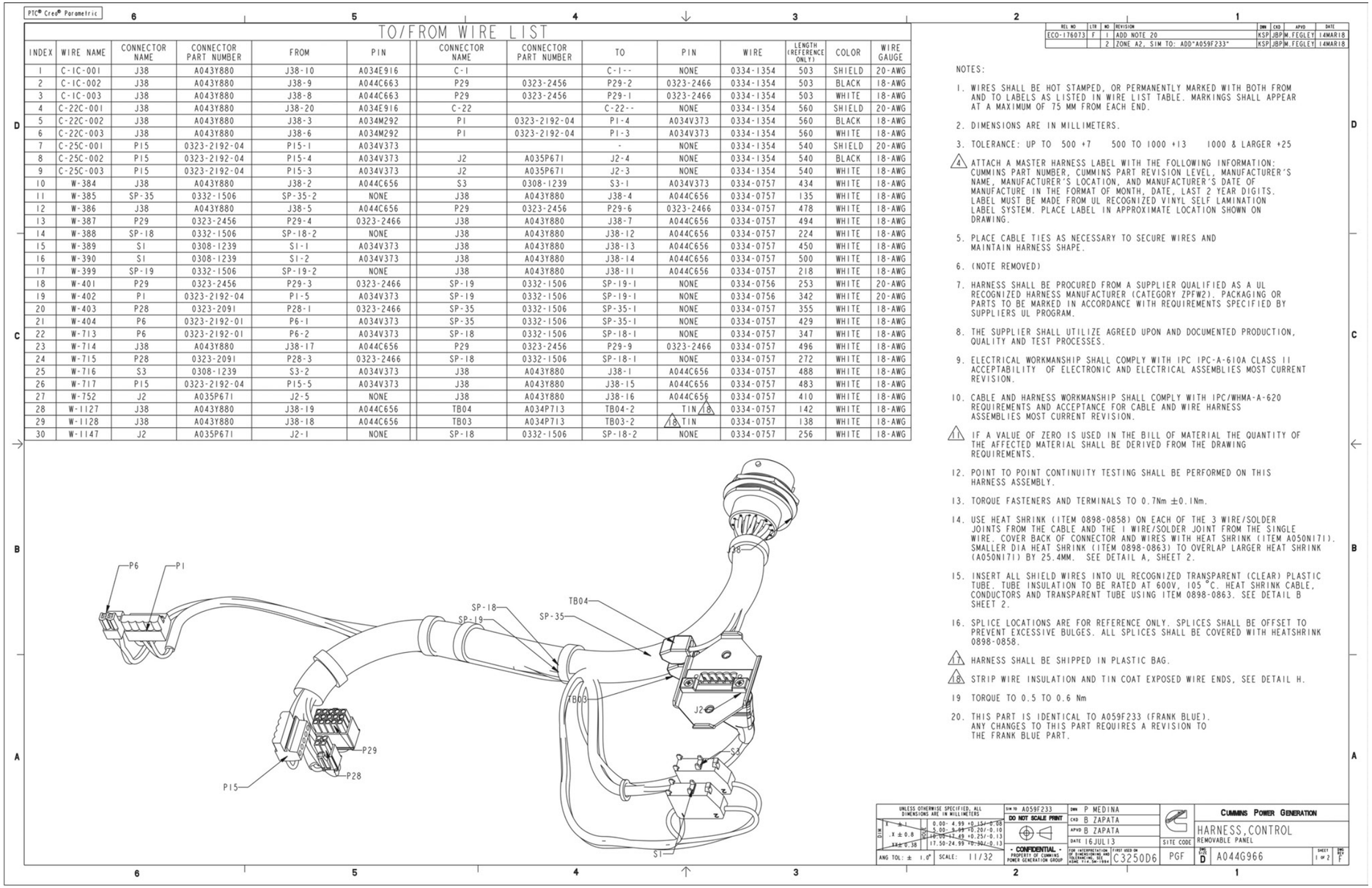


FIGURE 613. A044G966 REMOVABLE PANEL CONTROL HARNESS (SHEET 1)

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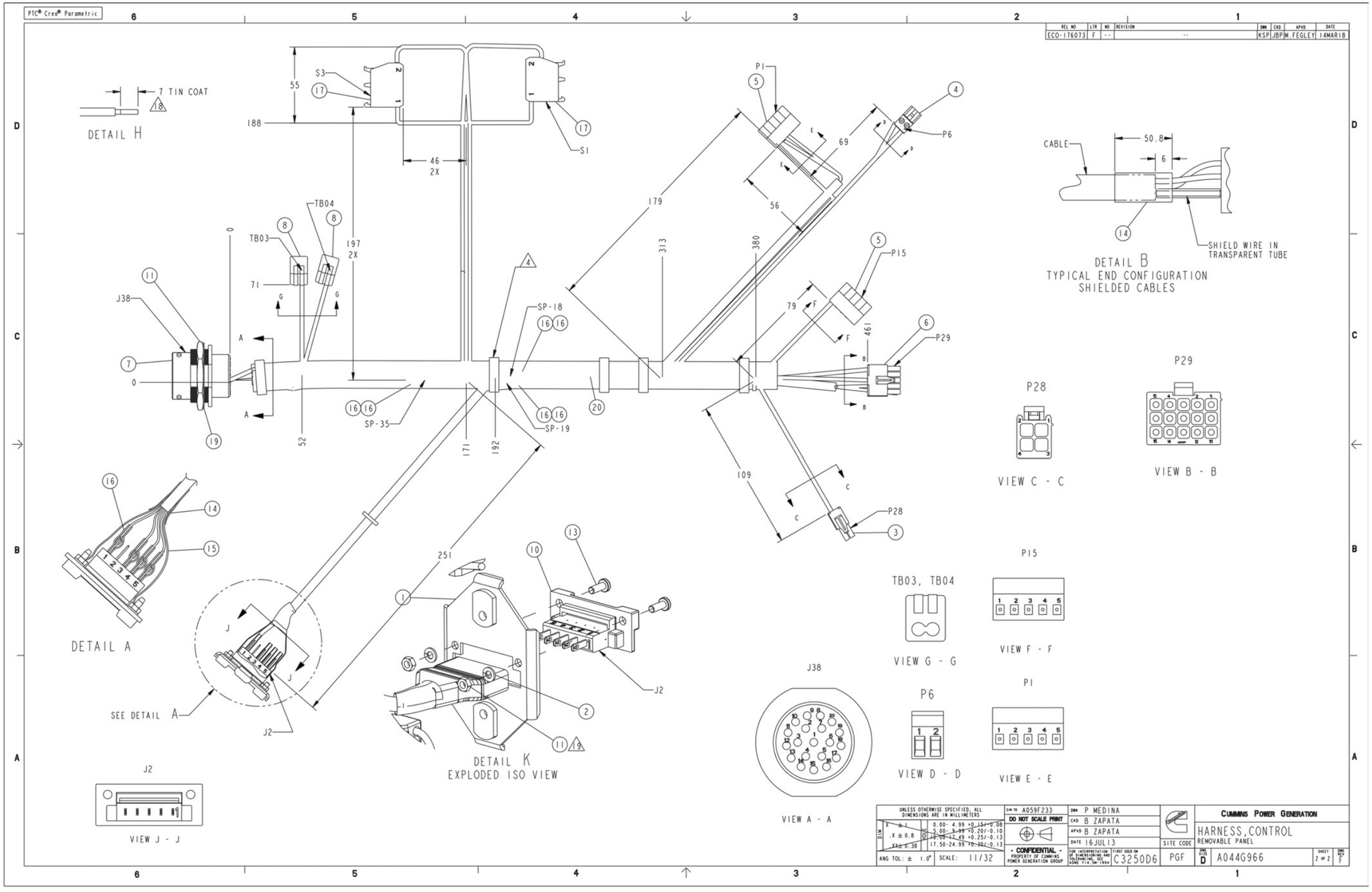


FIGURE 614. A044G966 REMOVABLE PANEL CONTROL HARNESS (SHEET 2)

C.21 A062R014 Starter/Charger/EFTP/PL Pump Power Harness (Spec A)

TO/FROM WIRE LIST

INDEX	WIRE NAME	CONNECTOR NAME	CONNECTOR PART NUMBER	FROM	PIN	CONNECTOR NAME	CONNECTOR PART NUMBER	TO	PIN	WIRE	LENGTH (REFERENCE ONLY)	COLOR	WIRE GAUGE	
1	W-83	S1 B+	A042T424	S1 B+	NONE	DS1-1	A042T544	DS1-1	NONE	2 0334-0933	2245	BLACK	2-AWG	BRAID BUNDLE 2
2	W-108	DCAS3-2	0332-1379	DCAS3-2	NONE	S3B+	0332-1108	S3B+	NONE	2 A048W176	3375	BLACK	6-AWG	BRAID BUNDLE 1
3	W-109	DCAS2-2	0332-1379	DCAS2-2	NONE	S2B+	0332-1108	S2B+	NONE	2 A048W176	3230	BLACK	6-AWG	BRAID BUNDLE 1
4	W-110	DCAS1-2	0332-1379	DCAS1-2	NONE	S1B+	0332-1108	S1B+	NONE	2 A048W176	2130	BLACK	6-AWG	BRAID BUNDLE 2
5	W-112	S2 B+	A042T424	S2 B+	NONE	DS2-1	A042T544	DS2-1	NONE	2 0334-0933	3295	BLACK	2-AWG	BRAID BUNDLE 1
6	W-137	CRS1-1	0332-0350	CRS1-1	NONE	S1 B-	0332-1046	S1 B-	NONE	0334-0760	423	WHITE	12-AWG	----
7	W-139	CRK3-1	A034U838	CRK3-1	NONE	CRS3-2	0332-0350	CRS3-2	NONE	0334-0760	4369	WHITE	12-AWG	BRAID BUNDLE 1
8	W-140	CRK2-1	A034U838	CRK2-1	NONE	CRS2-2	0332-0350	CRS2-2	NONE	0334-0760	4177	WHITE	12-AWG	BRAID BUNDLE 1
9	W-143	CRS2-1	0332-0350	CRS2-1	NONE	S2 B-	0332-1046	S2 B-	NONE	0334-0760	402	WHITE	12-AWG	----
10	W-146	CRS3-1	0332-0350	CRS3-1	NONE	S3 B-	0332-1046	S3 B-	NONE	0334-0760	450	WHITE	12-AWG	----
11	W-179	CAB-	0332-0457	CAB-	NONE	PDB-, 7 18	A056C836	PDB-, 7	NONE	2 0334-0934	5491	BLACK	1/0-AWG	BRAID BUNDLE 3
12	W-190	S2B-	0332-2000	S2B-	NONE	PDB-, 4 18	A056C839	PDB-, 4	NONE	2 0334-0934	2802	BLACK	1/0-AWG	BRAID BUNDLE 1
13	W-191	CAB+	0332-0457	CAB+	NONE	PDBCA, 1 18	A056C836	PDBCA, 1	NONE	2 0334-0934	5432	BLACK	1/0-AWG	BRAID BUNDLE 3
14	W-193	S1B-	0332-2000	S1B-	NONE	PDB-, 5 18	A056C839	PDB-, 5	NONE	2 0334-0934	2062	BLACK	1/0-AWG	BRAID BUNDLE 2
15	W-226	CB08- 1 18	A056D039	CB08- 1	NONE	FSP+	A048Z025	FSP+	A048Z027	2 0334-0931	3071	BLACK	4-AWG	BRAID BUNDLE 2
16	W-530	K2,NO-A1	0332-0101	K2,NO-A1	NONE	PL+	0332-0211	PL+	NONE	2 0334-0933	3618	BLACK	2-AWG	BRAID BUNDLE 1
17	W-898	S3B-	0332-2000	S3B-	NONE	PDB-, 3 18	A056C839	PDB-, 3	NONE	2 0334-0934	2958	BLACK	1/0-AWG	BRAID BUNDLE 1
18	W-899	PL-	0332-0211	PL-	NONE	PDB-, 1 18	A056C831	PDB-, 1	NONE	2 0334-0933	3960	BLACK	2-AWG	BRAID BUNDLE 1
19	W-917	CRS1-2	0332-0350	CRS1-2	NONE	CRK1-1	A034U838	CRK1-1	NONE	0334-0760	3052	WHITE	12-AWG	BRAID BUNDLE 2
20	W-919	FSP-	A048Z034	FSP-	A048Z027	PDB-, 6 18	A056C828	PDB-, 6	NONE	2 0334-0931	2771	BLACK	4-AWG	BRAID BUNDLE 2
21	W-1022	CA B+	0332-1194	CA B+	NONE	K2I NOC-1 11	A045C818	K2I NOC-1 11	NONE	0334-0758	6472	WHITE	16-AWG	BRAID BUNDLE 3
22	W-1115	CAD+	0332-0807	CAD+	NONE	AFAIL-1	A030B219	AFAIL-1	NONE	0334-0758	6370	WHITE	16-AWG	BRAID BUNDLE 3
23	W-1612	S3 B+	A042T424	S3 B+	NONE	DS3-1	A042T544	DS3-1	NONE	2 0334-0933	3395	BLACK	2-AWG	BRAID BUNDLE 1

NOTES:

1. WIRES SHALL BE HOT STAMPED, OR PERMANENTLY MARKED WITH BOTH FROM AND TO LABELS AS LISTED IN THE WIRE LIST TABLE. MARKINGS SHALL BE VISIBLE AFTER WIRE IS INSTALLED INTO CONNECTOR, MAXIMUM OF 75 MM FROM CONNECTOR END.

2 FOR 6-AWG AND LARGER, ATTACH WRAP AROUND LABEL OR SHRINK TUBE LABEL WITH BOTH FROM AND TO LABELS AS LISTED IN THE WIRE TABLE LIST. WIRE MARKINGS TO BE PRINTED MULTIPLE TIMES PER LABEL AND ARE PARALLEL TO THE DIRECTION OF THE WIRE SUCH THAT THEY CAN BE READ AT ANY ANGLE.

3 WIRE LENGTH TOLERANCES:
UP TO 500 -0/+15 500 TO 1000 -0/+40 1000 & LARGER -0/+60

4 ATTACH A MASTER HARNESS LABEL WITH THE FOLLOWING INFORMATION:CUMMINS PART NUMBER, CUMMINS PART REVISION LEVEL, MANUFACTURER'S NAME, MANUFACTURER'S LOCATION, AND MANUFACTURER'S DATE OF MANUFACTURE IN THE FORMAT OF MONTH, DATE, LAST 2 YEAR DIGITS. LABEL MUST BE MADE FROM UL RECOGNIZED VINYL SELF LAMINATION LABEL SYSTEM. PLACE IN APPROXIMATE LOCATIONS SHOWN ON DRAWING.

5. HARNESS SHALL BE PROCURED FROM A SUPPLIER QUALIFIED AS A UL RECOGNIZED HARNESS MANUFACTURER (CATEGORY ZPFW2). PACKAGING OR PARTS TO BE MARKED IN ACCORDANCE WITH REQUIREMENTS SPECIFIED BY SUPPLIERS UL PROGRAM.

6. ALL UNINSULATED RING TERMINALS SHALL BE COVERED WITH HEATSHRINK.

7. ELECTRICAL WORKMANSHIP SHALL COMPLY WITH IPC IPC-A-610A CLASS II ACCEPTABILITY OF ELECTRONIC AND ELECTRICAL ASSEMBLIES MOST CURRENT REVISION.

8. CABLE AND HARNESS WORKMANSHIP SHALL COMPLY WITH IPC/WHMA-A-620 CLASS II REQUIREMENTS AND ACCEPTANCE FOR CABLE AND WIRE HARNESS ASSEMBLIES MOST CURRENT REVISION.

9 HARNESS SHALL BE CONTINUOUSLY BRAIDED USING ENGINEERED YARNS VN 4000S, OR EQUIVALENT COLOR BLACK. HARNESS SHALL BE BRAIDED INTO 3 SEPARATE BUNDLES AS INDICATED IN WIRE LIST TABLE. TIE WRAP THE 3 BUNDLES TOGETHER AS SHOWN ON SHEET 3.

9.1) BRAIDING SHALL WITHSTAND -40°C TO 125 °C TEMPERATURE.
9.2) BRAID UP TO, BUT DO NOT COVER THE "FROM/TO" MARKINGS ON EACH WIRE, OR AS SHOWN ON DRAWING.
9.3) NO BRAIDING ON ALL WIRES THAT GO THROUGH SEALING BLOCKS IN THE AREA SHOWN ON SHEET 3.

10. POINT TO POINT CONTINUITY TESTING SHALL BE PERFORMED ON THIS HARNESS ASSEMBLY.

11 ITEMS 22 SHALL BE ORIENTATED AS SHOWN. USE FASTENERS FOR ATTACHING SIDE PANEL AS A REFERENCE GUIDE AS SHOWN ON SHEET 2.

12. ITEMS 22-28 AND 30-32 SHALL BE INSTALLED PER MANUFACTURERS SPECIFICATIONS.

13. HARNESS SHALL BE SHIPPED IN PLASTIC BAG.

14. IF A VALUE OF ZERO IS USED IN THE BILL OF MATERIAL THE QUANTITY OF THE AFFECTED MATERIAL SHALL BE DERIVED FROM THE DRAWING REQUIREMENTS.

15 TAPE EACH GASKET FOR ITEMS 21 TO TOP OF EACH FRAME TO SECURE FOR SHIPPING, SEE DETAIL E ON SHEET 2.

16 SECURE SEAL PLUG ITEMS 28, 29, 30, & 31 TO FRAMES ITEM 22 WITH TAPE. SEE VIEW G-G ON SHEET 2

17. HEATSHRINK DIMENSIONS ARE REFERENCE ONLY.

18 DIAMETER OF CRIMPED FERRULE IS NOT TO EXCEED THE DIAMETER OF THE UNCRIMPED FERRULE.

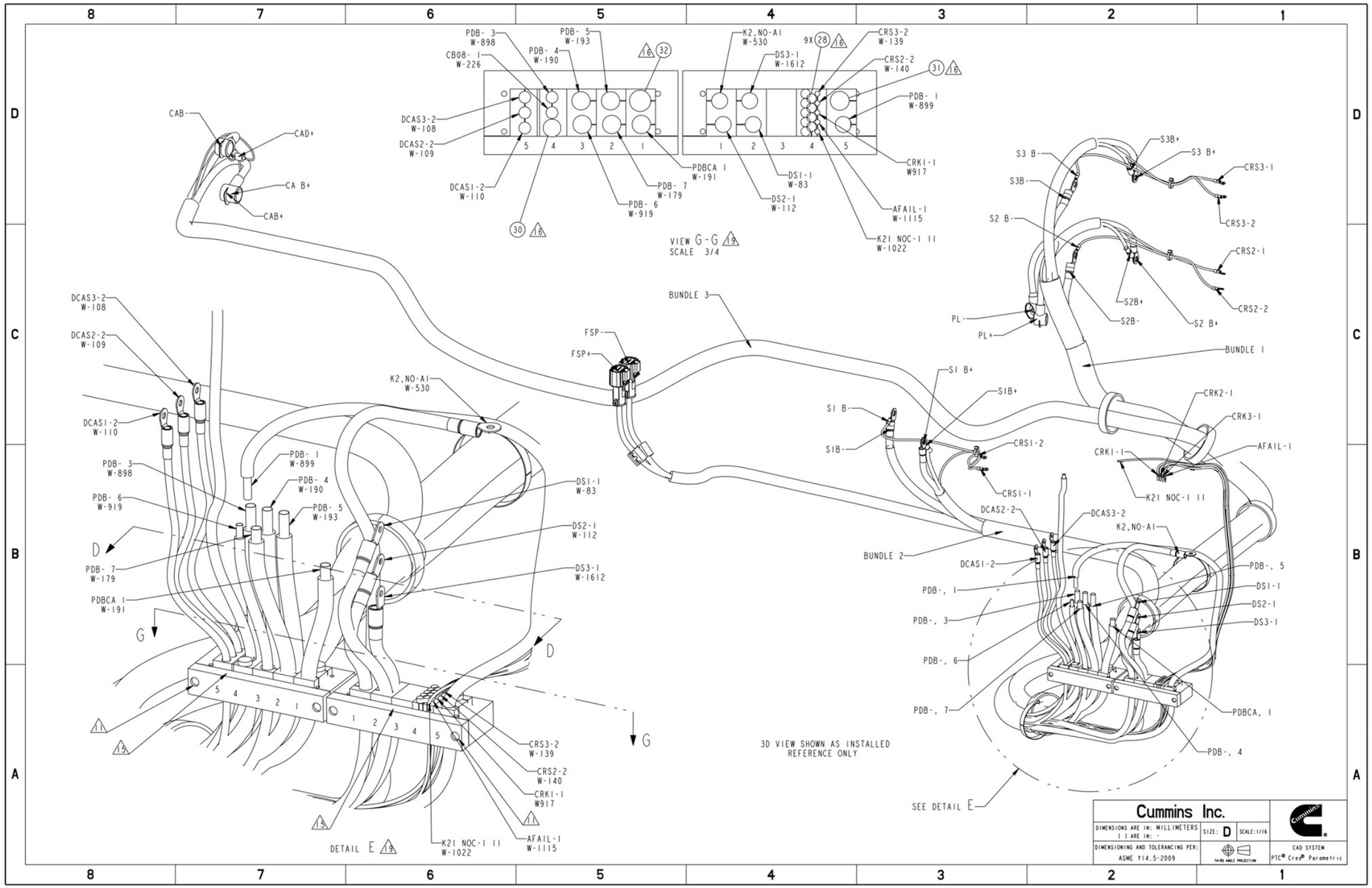
19 ENSURE CABLE GLAND BLOCKS, CABLES, AND SEAL PLUGS ARE ORIENTATED AND POSITIONED TO FRAME BLOCKS PER VIEW G-G AND DETAIL E ON SHEET 2.

MODEL/PLATFORM: C325D6	THIS PART IS SIMILAR TO: A049B313
Cummins Inc.	
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: -	SIZE: D SCALE: 1/16
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009	THIRD ANGLE PROJECTION
	CAD SYSTEM PTC® Creo® Parametric

Part Number: **A062R014** Part Revision: **A**
Part Name: **HARNESS,POWER**

FIGURE 615. A062R014 STARTER/CHARGER/EFTP/PL PUMP POWER HARNESS SPEC A (SHEET 1)

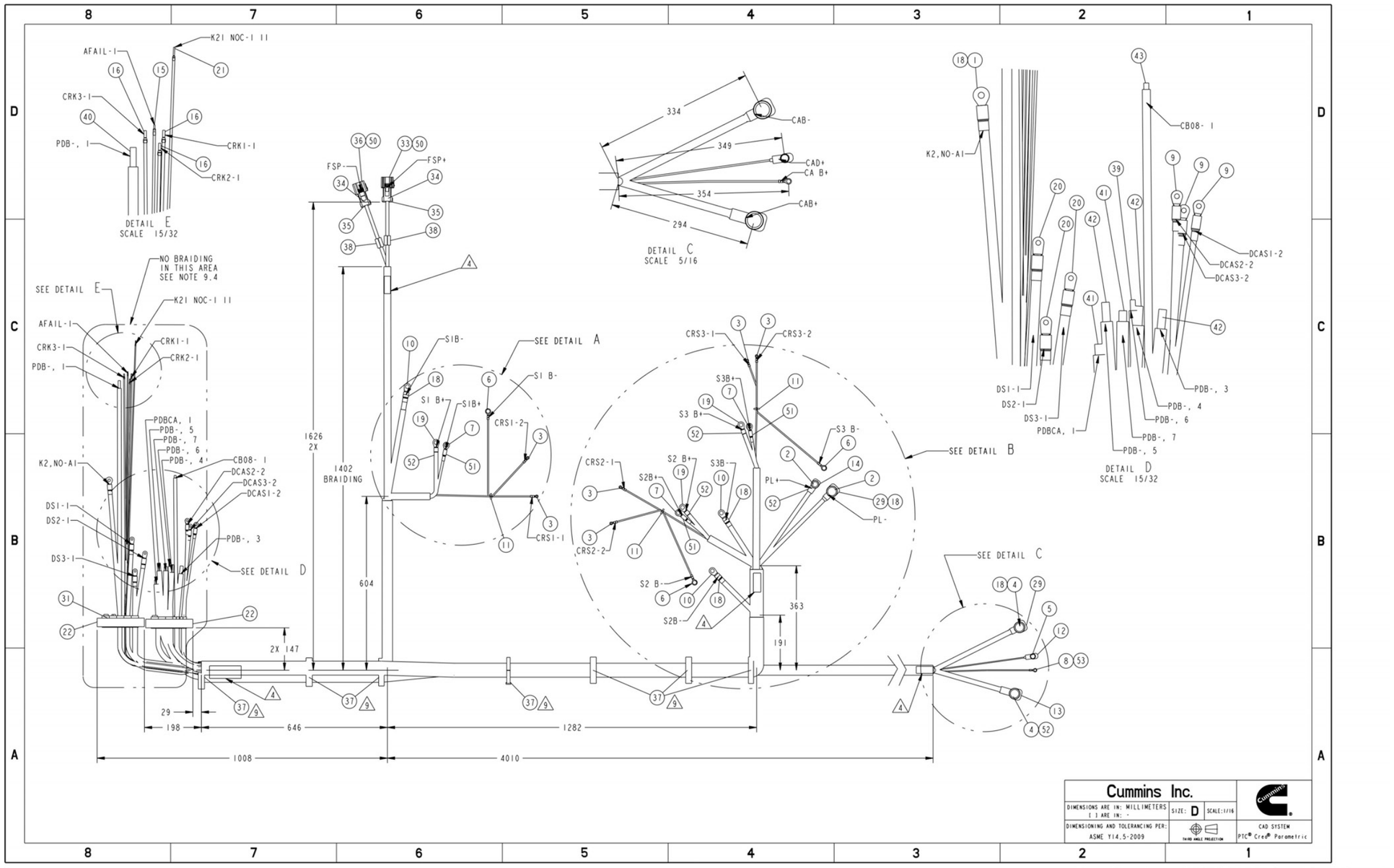
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Part Number: **A062R014** Part Revision: **A**
Part Name: **HARNESS,POWER**

FIGURE 616. A062R014 STARTER/CHARGER/EFTP/PL PUMP POWER HARNESS SPEC A (SHEET 2)

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Part Number: **A062R014** Part Revision: **A**
Part Name: **HARNESS,POWER**

FIGURE 617. A062R014 STARTER/CHARGER/EFTP/PL PUMP POWER HARNESS SPEC A (SHEET 3)

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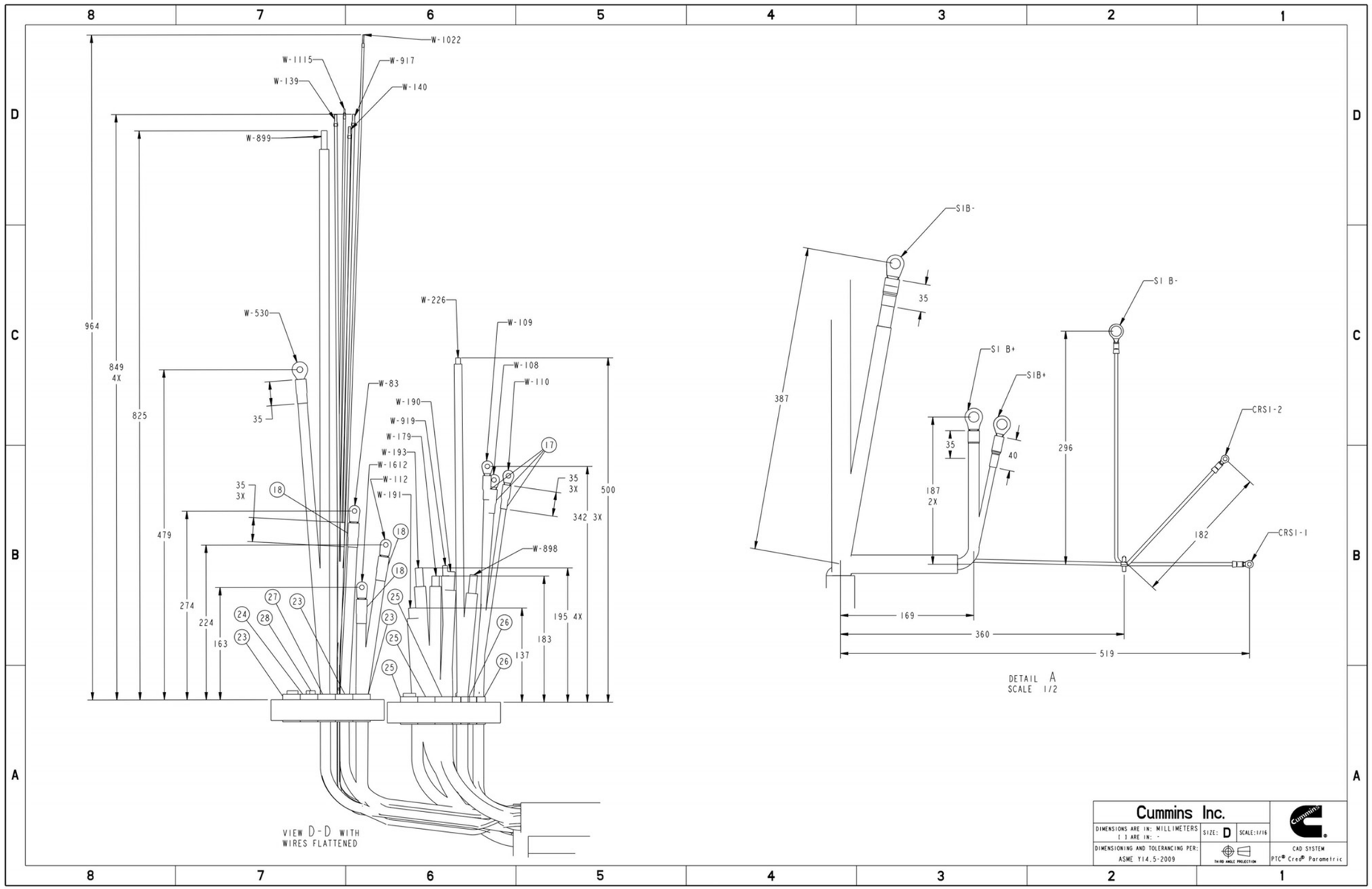


FIGURE 618. A062R014 STARTER/CHARGER/EFTP/PL PUMP POWER HARNESS SPEC A (SHEET 4)

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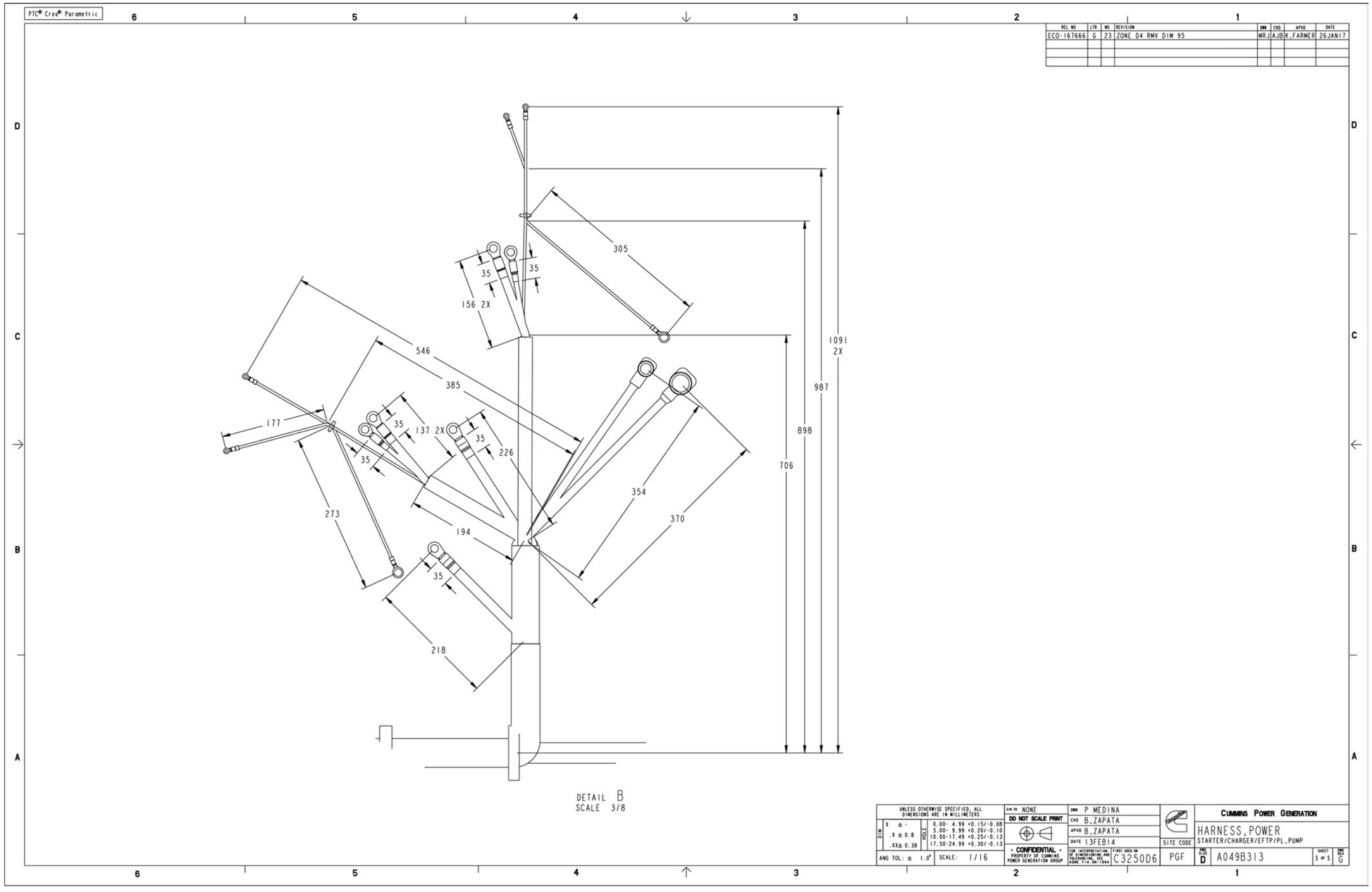


FIGURE 619. A062R014 STARTER/CHARGER/EFTP/PL PUMP POWER HARNESS SPEC A (SHEET 5)

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C.22 A065N012 Starter/Charger/EFTP/PL Pump Power Harness (Spec B)

TO/FROM WIRE LIST

INDEX	WIRE NAME	CONNECTOR NAME	CONNECTOR PART NUMBER	FROM	PIN	CONNECTOR NAME	CONNECTOR PART NUMBER	TO	PIN	WIRE	LENGTH (REFERENCE ONLY)	COLOR	WIRE GAUGE	
1	W-83	S1 B+	A042T424	S1 B+	NONE	DS1-1	A042T544	DS1-1	NONE	2 0334-0933	2248	BLACK	2-AWG	BRAID BUNDLE 2
2	W-108	DCAS3-2	0332-1379	DCAS3-2	NONE	S3B+	0332-1108	S3B+	NONE	2 A048W176	3379	BLACK	6-AWG	BRAID BUNDLE 1
3	W-109	DCAS2-2	0332-1379	DCAS2-2	NONE	S2B+	0332-1108	S2B+	NONE	2 A048W176	3233	BLACK	6-AWG	BRAID BUNDLE 1
4	W-110	DCAS1-2	0332-1379	DCAS1-2	NONE	S1B+	0332-1108	S1B+	NONE	2 A048W176	2133	BLACK	6-AWG	BRAID BUNDLE 2
5	W-112	S2 B+	A042T424	S2 B+	NONE	DS2-1	A042T544	DS2-1	NONE	2 0334-0933	3295	BLACK	2-AWG	BRAID BUNDLE 1
6	W-137	CRS1-1	0332-0350	CRS1-1	NONE	S1 B-	0332-1046	S1 B-	NONE	0334-0760	423	WHITE	12-AWG	----
7	W-139	CRK3-1	A034U838	CRK3-1	NONE	CRS3-2	0332-0350	CRS3-2	NONE	0334-0760	4370	WHITE	12-AWG	BRAID BUNDLE 1
8	W-140	CRK2-1	A034U838	CRK2-1	NONE	CRS2-2	0332-0350	CRS2-2	NONE	0334-0760	4178	WHITE	12-AWG	BRAID BUNDLE 1
9	W-143	CRS2-1	0332-0350	CRS2-1	NONE	S2 B-	0332-1046	S2 B-	NONE	0334-0760	402	WHITE	12-AWG	----
10	W-146	CRS3-1	0332-0350	CRS3-1	NONE	S3 B-	0332-1046	S3 B-	NONE	0334-0760	451	WHITE	12-AWG	----
11	W-179	CAB-	0332-0457	CAB-	NONE	PDB-, 7 18	A056C836	PDB-, 7	NONE	2 0334-0934	5491	BLACK	0-AWG	BRAID BUNDLE 3
12	W-190	S2B-	0332-2000	S2B-	NONE	PDB-, 4 18	A056C839	PDB-, 4	NONE	2 0334-0934	2799	BLACK	0-AWG	BRAID BUNDLE 1
13	W-191	CAB+	0332-0457	CAB+	NONE	PDBCA, 1 18	A056C836	PDBCA, 1	NONE	2 0334-0934	5431	BLACK	0-AWG	BRAID BUNDLE 3
14	W-193	S1B-	0332-2000	S1B-	NONE	PDB-, 5 18	A056C839	PDB-, 5	NONE	2 0334-0934	2060	BLACK	0-AWG	BRAID BUNDLE 2
15	W-226	CB08- 1 18	A056D039	CB08- 1	NONE	FSP+	0332-0162	FSP+	NONE	2 A074M171	3036	BLACK	4-AWG	BRAID BUNDLE 2
16	W-530	K2,NO-A1	0332-0101	K2,NO-A1	NONE	PL+	0332-4153	PL+	NONE	2 0334-0933	3614	BLACK	2-AWG	BRAID BUNDLE 1
17	W-898	S3B-	0332-2000	S3B-	NONE	PDB-, 3 18	A056C839	PDB-, 3	NONE	2 0334-0934	2955	BLACK	0-AWG	BRAID BUNDLE 1
18	W-899	PL-	0332-4153	PL-	NONE	PDB-, 1 18	A056C831	PDB-, 1	NONE	2 0334-0933	3957	BLACK	2-AWG	BRAID BUNDLE 1
19	W-917	CRS1-2	0332-0350	CRS1-2	NONE	CRK1-1	A034U838	CRK1-1	NONE	0334-0760	3055	WHITE	12-AWG	BRAID BUNDLE 2
20	W-919	FSP-	0332-0162	FSP-	NONE	PDB-, 6 18	A074Y856	PDB-, 6	NONE	2 A074M171	2732	BLACK	4-AWG	BRAID BUNDLE 2
21	W-1022	CA B+	0332-1194	CA B+	NONE	K21 NOC-1 11	A045C818	K21 NOC-1 11	NONE	0334-0758	6491	WHITE	16-AWG	BRAID BUNDLE 3
22	W-1115	CAD+	0332-0807	CAD+	NONE	AFAIL-1	A030B219	AFAIL-1	NONE	0334-0758	6401	WHITE	16-AWG	BRAID BUNDLE 3
23	W-1612	S3 B+	A042T424	S3 B+	NONE	DS3-1	A042T544	DS3-1	NONE	2 0334-0933	3397	BLACK	2-AWG	BRAID BUNDLE 1

20 LOOSE WIRES SHALL BE ZIP TIED TO THE MAIN HARNESS AS FOLLOWS:

20.1. ZIP TIE WIRE (S1 B-, CRS1-2) TO CRS1-1 REFER TO SHEET 3 DETAIL A & SHEET 4 DETAIL A
20.2. ZIP TIE WIRE (S2 B-, CRS2-2) TO CRS2-1 REFER TO SHEET 3 DETAIL B & SHEET 5 DETAIL B
20.3. ZIP TIE WIRE (S3 B-, CRS3-1) TO CRS3-2 REFER TO SHEET 3 DETAIL B & SHEET 5 DETAIL B

NOTES:

1. WIRES SHALL BE HOT STAMPED, OR PERMANENTLY MARKED WITH BOTH FROM AND TO LABELS AS LISTED IN THE WIRE LIST TABLE. MARKINGS SHALL BE VISIBLE AFTER WIRE IS INSTALLED INTO CONNECTOR, MAXIMUM OF 75 mm FROM CONNECTOR END.

1.1 TRAILING DASHES AND PERIODS (IF SHOWN) SHALL BE OMITTED.

2 FOR 6-AWG AND LARGER, ATTACH WRAP AROUND LABEL OR SHRINK TUBE LABEL WITH BOTH FROM AND TO LABELS AS LISTED IN THE WIRE TABLE LIST. WIRE MARKINGS TO BE PRINTED MULTIPLE TIMES PER LABEL AND ARE PARALLEL TO THE DIRECTION OF THE WIRE SUCH THAT THEY CAN BE READ AT ANY ANGLE.

3. WIRE LENGTH TOLERANCES:
   UP TO 500 -0/+15
   500 TO 1000 -0/+40
   1000 & LARGER -0/+60

4 ATTACH A MASTER HARNESS LABEL WITH THE FOLLOWING INFORMATION: CUMMINS PART NUMBER, CUMMINS PART REVISION LEVEL, MANUFACTURER'S NAME, MANUFACTURER'S LOCATION, AND MANUFACTURER'S DATE OF MANUFACTURE IN THE FORMAT OF MONTH, DATE, LAST 2 YEAR DIGITS. LABEL MUST BE MADE FROM UL RECOGNIZED SELF LAMINATION LABEL SYSTEM. PLACE IN APPROXIMATE LOCATIONS SHOWN ON DRAWING.

5. HARNESS SHALL BE PROCURED FROM A SUPPLIER QUALIFIED AS A UL RECOGNIZED HARNESS MANUFACTURER (CATEGORY ZPFW2). PACKAGING OR PARTS TO BE MARKED IN ACCORDANCE WITH REQUIREMENTS SPECIFIED BY SUPPLIERS UL PROGRAM.

6. ALL UNINSULATED RING TERMINALS SHALL BE COVERED WITH HEATSHRINK.

7. ELECTRICAL WORKMANSHIP SHALL COMPLY WITH IPC IPC-A-610A CLASS II ACCEPTABILITY OF ELECTRONIC AND ELECTRICAL ASSEMBLIES MOST CURRENT REVISION.

8. CABLE AND HARNESS WORKMANSHIP SHALL COMPLY WITH IPC/WHMA-A-620 CLASS II REQUIREMENTS AND ACCEPTANCE FOR CABLE AND WIRE HARNESS ASSEMBLIES MOST CURRENT REVISION.

9 HARNESS SHALL BE CONTINUOUSLY BRAIDED USING ENGINEERED YARNS VN 4000S, OR EQUIVALENT COLOR BLACK. HARNESS SHALL BE BRAIDED INTO 3 SEPARATE BUNDLES AS INDICATED IN WIRE LIST TABLE. TIE WRAP THE 3 BUNDLES TOGETHER AS SHOWN ON SHEET 3.

9.1 BRAIDING SHALL WITHSTAND -40 °C TO 125 °C TEMPERATURE.
9.2 BRAID UP TO, BUT DO NOT COVER THE "FROM/TO" MARKINGS ON EACH WIRE, OR AS SHOWN ON DRAWING.
9.3 NO BRAIDING ON ALL WIRES THAT GO THROUGH SEALING BLOCKS IN THE AREA SHOWN ON SHEET 3.
9.4 BRAIDING SHALL PROVIDE COVERAGE OF 12±2 PICKS PER 25 mm.

10. POINT TO POINT CONTINUITY TESTING SHALL BE PERFORMED ON THIS HARNESS ASSEMBLY.

11 F/N 22 SHALL BE ORIENTATED AS SHOWN. USE FASTENERS FOR ATTACHING SIDE PANEL AS A REFERENCE GUIDE AS SHOWN ON SHEET 2.

12. F/N 22-28 AND 30-32 SHALL BE INSTALLED PER MANUFACTURERS SPECIFICATIONS.

13. HARNESS SHALL BE SHIPPED IN PLASTIC BAG.

14. (NOTE REMOVED)

15 SECURE EACH GASKET FOR F/N 22 TO TOP OF EACH FRAME WITH [.500] WIDE BLACK DUCT POLYKEN #223 TAPE FOR SHIPPING, SEE DETAIL F ON SHEET 2.

16 SECURE SEAL PLUG F/N 28, 30, 31, & 32 TO FRAMES F/N 22 WITH [.500] WIDE BLACK DUCT POLYKEN #223 TAPE FOR SHIPPING. SEE VIEW G-G ON SHEET 2.

17. HEATSHRINK DIMENSIONS ARE REFERENCE ONLY.

18 DIAMETER OF CRIMPED FERRULE IS NOT TO EXCEED THE DIAMETER OF THE UNCRIMPED FERRULE.

19 ENSURE CABLE GLAND BLOCKS, CABLES, AND SEAL PLUGS ARE ORIENTATED AND POSITIONED TO FRAME BLOCKS PER VIEW G-G AND DETAIL F ON SHEET 2.

Cummins Inc.
DIMENSIONS ARE IN: MILLIMETERS [ ] ARE IN: INCHES
SIZE: A1 SCALE: 0.063
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009
THIRD ANGLE PROJECTION
CAD SYSTEM PTC® Creo® Parametric

FIGURE 620. A065N012 STARTER/CHARGER/EFTP/PL PUMP POWER HARNESS SPEC B (SHEET 1)

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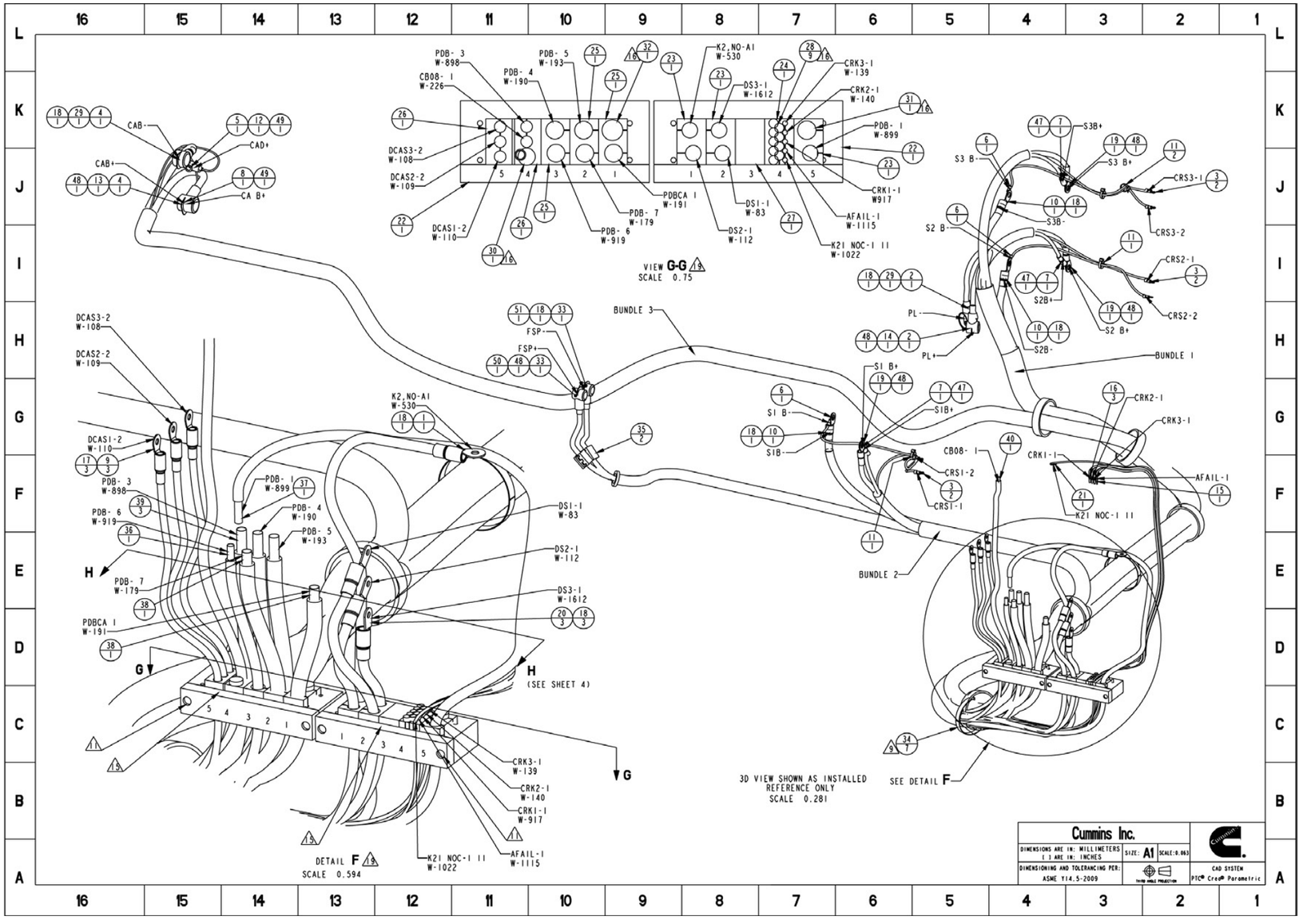


FIGURE 621. A065N012 STARTER/CHARGER/EFTP/PL PUMP POWER HARNESS SPEC B (SHEET 2)

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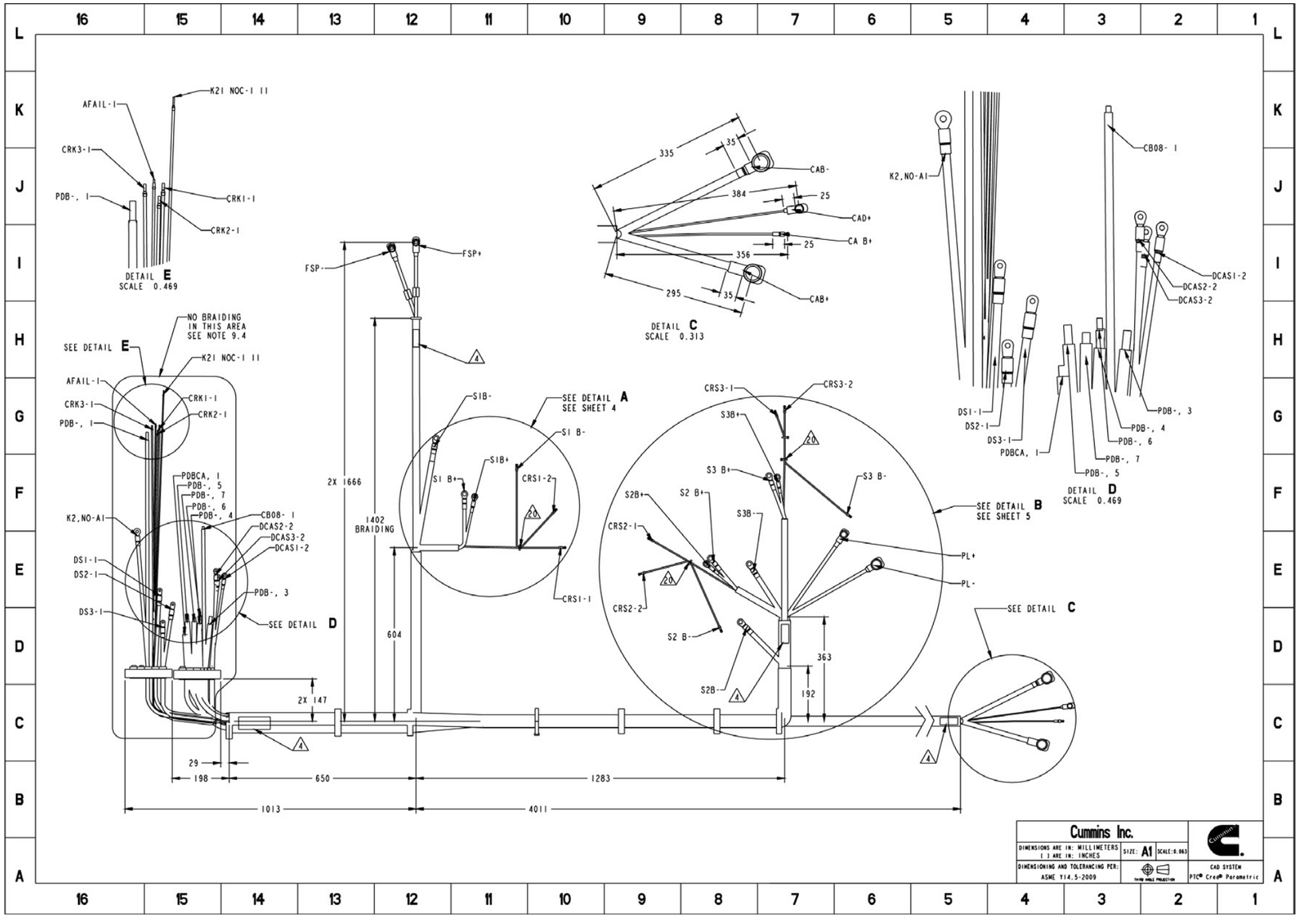


FIGURE 622. A065N012 STARTER/CHARGER/EFTP/PL PUMP POWER HARNESS SPEC B (SHEET 3)

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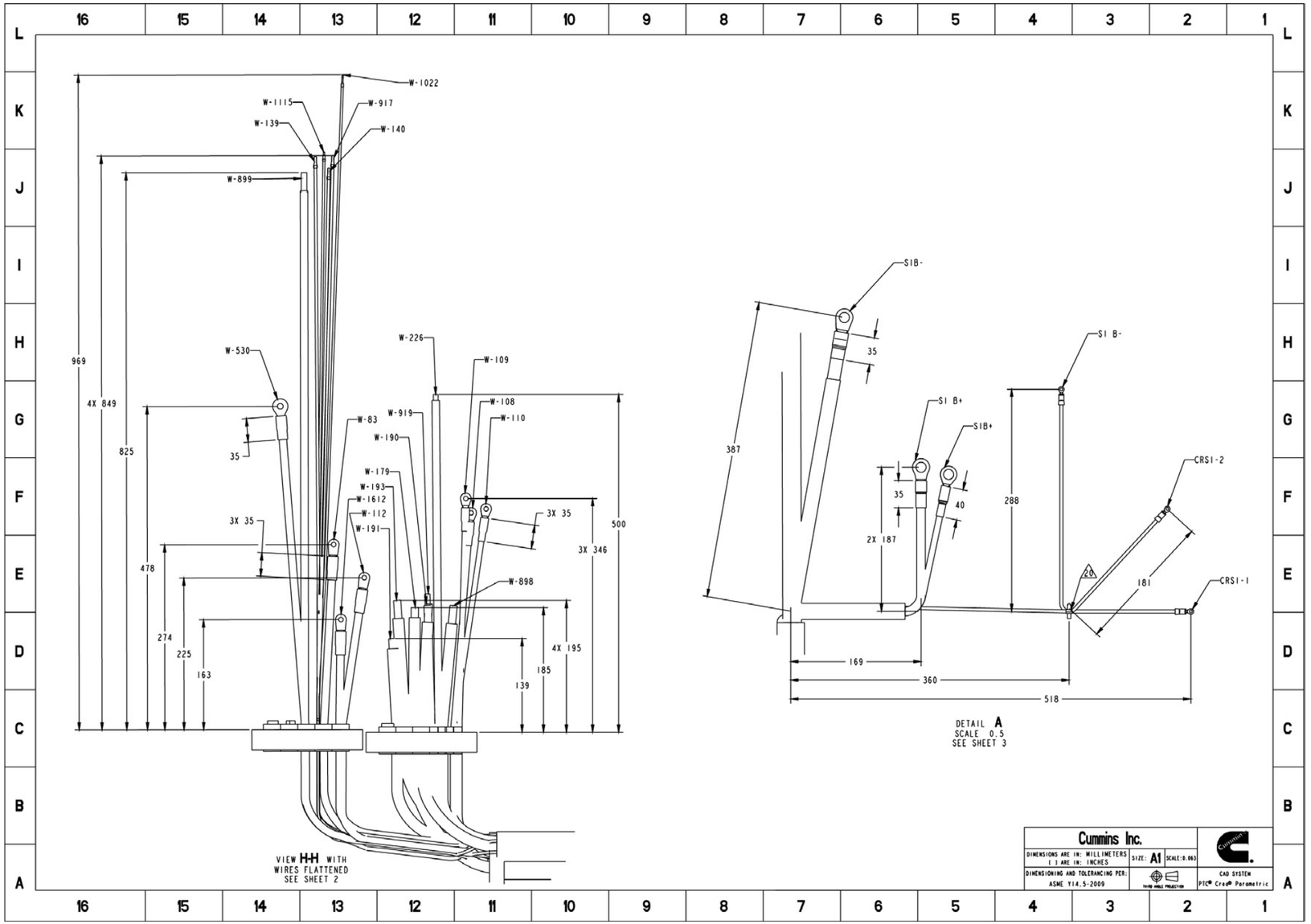


FIGURE 623. A065N012 STARTER/CHARGER/EFTP/PL PUMP POWER HARNESS SPEC B (SHEET 4)

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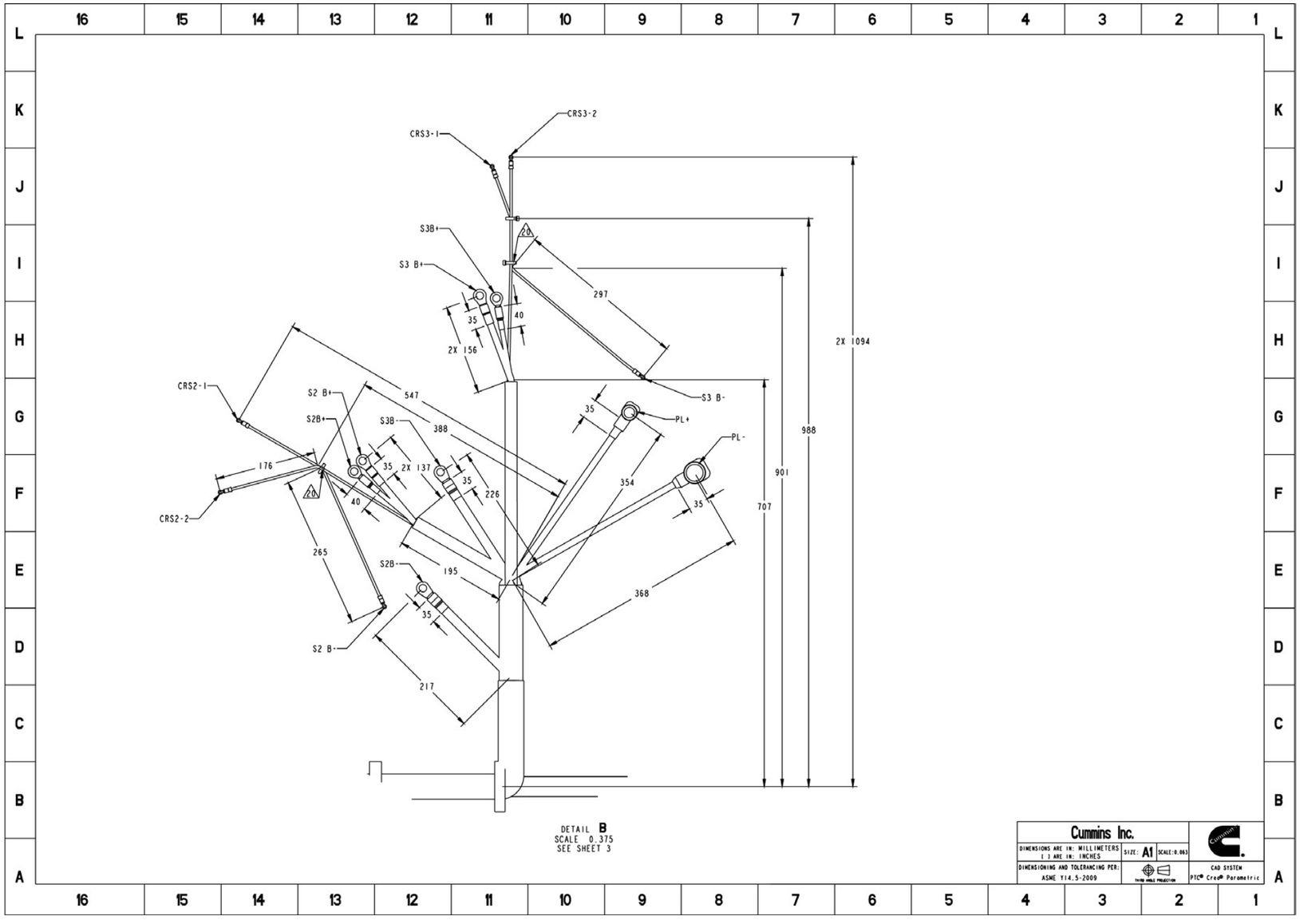


FIGURE 624. A065N012 STARTER/CHARGER/EFTP/PL PUMP POWER HARNESS SPEC B (SHEET 5)

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