



Installation Manual

CENTUM™ Series Generator Sets

**QSK78 Engine with PowerCommand® 3.3 Control and
S9 Alternator**

C2750D6E (Spec A)

C3000D6EB (Spec A)

Table of Contents

1. IMPORTANT SAFETY INSTRUCTIONS	1
1.1 Warning, Caution, and Note Styles Used in This Manual	1
1.2 General Information	1
1.2.1 General Safety Precautions	2
1.3 Generator Set Safety Code	5
1.3.1 Moving Parts Can Cause Severe Personal Injury or Death	5
1.4 Electrical Shocks and Arc Flashes Can Cause Severe Personal Injury or Death.....	5
1.4.1 Locking the Generator Set Out of Service	6
1.4.2 AC Supply and Isolation.....	7
1.4.3 AmpSentry	8
1.4.4 AC Disconnect Sources	8
1.4.5 Medium Voltage Equipment (601 V to 15 kV - U.S. and Canada)	8
1.5 Fuel and Fumes Are Flammable	8
1.5.1 Spillage	8
1.5.2 Fluid Containment.....	9
1.5.3 Do Not Operate in Flammable and Explosive Environments	9
1.6 Exhaust Gases Are Deadly.....	9
1.6.1 Exhaust Precautions	9
1.7 Earth Ground Connection	10
1.8 Decommissioning and Disassembly	10
2. INTRODUCTION.....	11
2.1 About This Manual	11
2.1.1 Additional Installation Manual Information	11
2.2 Schedule of Abbreviations	12
2.3 Related Literature	13
2.4 After Sales Services.....	14
2.4.1 Maintenance.....	14
2.4.2 Warranty.....	14
3. SYSTEM OVERVIEW	17
3.1 Generator Set Identification	17
3.1.1 Nameplate.....	17
3.2 Generator Set Components.....	17
3.3 Generator Set Rating.....	18
3.4 Engine.....	18
3.5 Sensors.....	19
3.6 System Options.....	19
3.6.1 Annunciators	19
3.6.2 Battery Charger.....	20
3.6.3 Heaters.....	20
3.6.4 Relays	20

3.6.5 Seismic Installation Requirements.....	21
3.6.6 Oil Sampling Valve	21
3.6.7 Oil Maintainer System.....	21
3.6.8 Coolant Heater	22
4. INSTALLATION OVERVIEW	23
4.1 Application and Installation	23
4.2 Safety Considerations.....	23
4.3 Seismic Installations	24
4.3.1 Seismic Installation Notes.....	24
4.4 Standby Heating Devices.....	25
4.5 Product Modifications.....	25
5. SPECIFICATIONS	27
5.1 Generator Set Specifications	27
5.2 Generator Set Fuel Consumption	28
6. INSTALLING THE GENERATOR SET	29
6.1 Transportation.....	29
6.2 Location	30
6.3 Moving the Generator Set.....	31
6.4 Rigging Instructions	32
6.5 Mounting	32
6.6 Access to Generator Set.....	33
6.7 Vibration Isolator Installation and Adjustment Procedure.....	33
6.8 Generator Set Long Term Storage	34
7. MECHANICAL CONNECTIONS	35
7.1 Fuel System.....	35
7.1.1 Fuel Return Restrictions (or Pressure) Limit.....	36
7.1.2 Fuel Line Connections	36
7.1.3 Engine Fuel Connections.....	37
7.1.4 Supply Tank.....	37
7.1.5 Fuel Inlet Pressure/Restriction Limit	38
7.2 Exhaust System	38
7.3 Ventilation and Cooling.....	42
7.4 Vents and Ducts.....	43
7.5 Dampers	44
7.6 Air Inlet and Outlet Openings.....	44
7.7 Breakerless Conductor Connections	45
7.7.1 Overload and Short Circuit Protection of Generator.....	45
7.7.2 Coordination of Protective Devices.....	48
7.7.3 Additional AmpSentry Protective Relay Information	48
8. RADIATOR ASSEMBLY INSTRUCTIONS	51
8.1 Introduction	51
8.1.1 Radiator Assembly.....	51
8.2 Preparing for the Installation of the Radiator	52

8.2.1	Required Items.....	52
8.2.2	Safety Precautions.....	53
8.3	Removing the Radiator From the Skid	54
8.4	Radiator Installation	55
8.4.1	Installing the Engine Stub Shaft and Pulley.....	55
8.4.2	Install Vibration Isolators.....	57
8.4.3	Connecting the Radiator Skid to the Generator Skid.....	58
8.4.4	Aligning the Cooling System Fan Drive	60
8.4.5	Radiator Coolant Connections	62
8.4.6	Installing the Vent Lines and Low Coolant Level Sensor/Cable	65
8.4.7	Engine Damper Guard Installation.....	67
8.4.8	Fan Belt Installation	68
8.4.9	Greasing the Fan Bearings.....	69
8.4.10	Fan Drive Guard Installation	69
8.4.11	Coolant Level Sensor Installation	70
8.4.12	Charge Air Cooler	71
8.5	Radiator Drain Valve Installation	75
8.6	Coolant Circuit Pressure Test Requirement.....	75
8.7	Filling the Cooling System – Top Fill	76
8.8	Filling the Cooling System – Bottom Fill	77
8.9	Test Running the Generator Set.....	78
9.	DC CONTROL WIRING	79
9.1	Guidelines for Customer Connections to the Control System	79
9.1.1	Digital Connections	80
9.1.2	Relay Connections.....	80
9.2	PowerCommand 3.3 Customer Connections	80
9.2.1	Configurable Outputs	80
9.2.2	Remote Start.....	80
9.2.3	Configurable Inputs.....	81
9.2.4	Remote Emergency Stop.....	81
9.3	Customer Relays	82
9.3.1	Location of Customer Relays.....	82
9.4	Paralleling Circuit Breaker Control Relays.....	83
9.4.1	Paralleling Circuit Breaker Control Relays Installation	83
9.5	Ground Fault Relays.....	84
9.5.1	Ground Fault Relay.....	84
9.5.2	Ground Fault Relay Installation.....	85
10.	AC ELECTRICAL CONNECTIONS.....	89
10.1	Transfer Switch.....	90
10.2	Alternator Voltage Connections	91
10.3	Load Connections	92
10.3.1	Generator Set Load Cable Installation.....	92
10.3.2	Cabling through Non-Ferrous Gland Plates.....	92
10.3.3	Cabling through Ferrous Gland Plates	92
10.3.4	Distribution Cables.....	93

10.4 Load Balancing	94
10.5 Current Transformers.....	94
10.5.1 CT Installation Requirements.....	94
10.6 Coolant Heater.....	94
10.6.1 Coolant Heater Connection.....	94
10.6.2 Coolant Heater Specifications.....	95
10.7 Alternator Heaters.....	95
10.7.1 Alternator Heater Connection	95
10.7.2 Installed Alternator Heaters	96
10.8 Control Box Heater	96
10.8.1 Control Cabinet Heater Installation.....	96
10.9 Annunciators	98
10.9.1 PowerCommand Universal Annunciator	98
10.10 Battery Charger.....	99
10.10.1 Battery Charger - 20 Amp/24 Volt.....	99
10.11 Grounding	100
11. PRE-START PREPARATION.....	103
11.1 Electrical System	103
11.2 Battery Connections.....	103
11.3 Site-Specific Configuration.....	104
11.4 Starting.....	104
12. INSTALLATION CHECKLIST	105
12.1 Checklist	105
13. MANUFACTURING FACILITIES	107
13.1 How to Obtain Service	107
13.1.1 Locating a Distributor	107
APPENDIX A. WIRING DIAGRAMS	109
A.1 QSK78 Wiring Diagram with PowerCommand 3.3 Control	111
A.2 Control Wiring Diagrams (0630-3440).....	127
APPENDIX B. OUTLINE DRAWINGS	139
B.1 Outline Drawing A073W614	141
B.2 Outline Drawing A072A401 - Radiator Part List.....	149
APPENDIX C. SEISMIC REQUIREMENTS.....	151
C.1 Seismic Installation Instructions	153

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

 WARNING
<i>Indicates a hazardous situation that, if not avoided, could result in death or serious injury.</i>

 CAUTION
<i>Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.</i>

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.

1.2.1 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.

⚠ 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.

⚠ 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.)

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.

1.4 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.

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 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.

NOTICE

Refer also to the engine specific Operator Manual. This manual contains specific equipment instructions that may differ from the standard generator set.


1.4.1.1 Immobilizing for Safe Working

To immobilize the generator set:

1. Press the **Off** mode switch on the operator panel to shut down the generator set.

- Press the **Emergency Stop** button. This prevents the generator set starting, regardless of the Start signal source and provides an additional safety step for immobilizing the generator set.

NOTICE

When the **Emergency Stop** button is pressed, the operator panel indicates a **Shutdown** condition. The red **Shutdown** status LED  illuminates and a message is displayed.

NOTICE

Do not cover Emergency stop button in any situation for easy accessibility

NOTICE

This condition is stored in the Fault History.

- Isolate and lock off the starting battery/batteries.
- As an additional precaution, thoroughly ventilate the plant room before disconnecting any leads.
- Isolate and lock off the supply to the heater, where fitted.
- Isolate and lock off the supply to the battery charger, where fitted.
- Isolate the fuel supply to the engine.
- Using an insulated wrench, disconnect the negative (–) cable first on the starting batteries and control system batteries (if separate).
- Fit warning notices at each of the above points to indicate Maintenance in Progress — Plant Immobilized for Safe Working.

1.4.2 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.

1.4.3 AmpSentry

Generator sets with PC 3.3 control utilize AmpSentry™ protective relay which includes integral AC protective functions for the alternator and conductors, if conductors are rated for operation at a minimum of 100% of the generator nameplate rating.

1.4.4 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.

1.4.5 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.
- 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.

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.

1.7 Earth Ground Connection

The neutral of the generator set may be required to be bonded to earth ground at the generator set location, or at a remote location, depending on system design requirements. Consult the engineering drawings for the facility or a qualified electrical design engineer for proper installation.

NOTICE

The end user is responsible to make sure that the ground connection point surface area is clean and free of rust before making a connection.

NOTICE

The end user is responsible for making sure that an earthing arrangement that is compliant with local conditions is established and tested before the equipment is used.

1.8 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.

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

The purpose of this manual is to provide the users with sound, general information. It is for guidance and assistance with recommendations for correct and safe procedures, which may from time to time be updated. It is the user's responsibility to ensure they are aware of any updates to this guidance before commencing operational activities. Cummins shall not be liable for any operational consequences arising as a result of not following the guidance outlined in this manual, nor for any discretionary actions taken by the user in response to recommendations outlined in this manual.

The information contained within the manual is based on information available at the time of going to print. In line with Cummins 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>).

Users are respectfully advised that, in the interests of good practice and safety, it is their responsibility to employ competent persons to carry out any installation work. Consult your authorized distributor for further installation information. It is essential that the utmost care is taken with the application, installation, and operation of any engine due to their potentially hazardous nature. Careful reference should also be made to other Cummins literature. A generator set must be operated and maintained properly for safe and reliable operation.

For further assistance, contact your authorized distributor.

2.1.1 Additional Installation Manual Information

The purpose of this manual is to provide the Installation Engineer with sound, general information for the installation of the generator set. Refer to the Generator Set Operator Manual for additional information which must also be read before operating the set.

This manual provides installation instructions for the generator set models listed on the front cover. This includes the following information:

- Mounting Recommendations - for fastening the generator set to a base and space requirements for normal operation and service.
- Mechanical and Electrical Connections - covers most aspects of the generator set installation.
- Prestart - checklist of items or procedures needed to prepare the generator set for operation.

- Installation Checklist - reference checks upon completion of the installation.

This manual does not provide application information for selecting a generator set or designing the complete installation. If it is necessary to design the various integrated systems (fuel, exhaust, cooling, etc.), additional information is required. Review standard installation practices. For engineering data specific to the generator set, refer to the Specification and Data Sheets. For application information, refer to Application Manual T-030, "Liquid Cooled Generator Sets." To find this manual online:

1. Go to powersuite.cummins.com
2. Click on **Login** on the Home page.
3. Click on **T-030**, Liquid Cooled Generator Set Application Manual under Application Manuals.

2.2 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

ABBR.	DESCRIPTION	ABBR.	DESCRIPTION
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
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

2.3 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 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.

- Installation Manual for C2750D6E and C3000D6EB with QSK78 Engine and PowerCommand® 3.3 or 3.3 MLD and S9 Alternator (A075L574)

- Operator Manual for C2750D6E and C3000D6EB with QSK78 Engine and PowerCommand® 3.3 or 3.3 MLD and S9 Alternator (A075L575)
- Service Manual for C2750D6E and C3000D6EB with QSK78 Engine and PowerCommand® 3.3 or 3.3 MLD and S9 Alternator (A075L576)
- Control Service Manual for PowerCommand® 3.3 (900-0670)
- Engine Operation and Maintenance Manual for QSK78 (5677186)
- Alternator Service Manual for S9 (A062L877)
- S-6763 *Specification and Data Sheet* (for engineering data specific to the generator set)
- T-030, *Liquid Cooled Generator Set Application Manual* (for application information)
- Parts Manual for C2750D6E and C3000D6EB (A076F900)
- Standard Repair Times - BK Family (0900-0904)
- Recommended Spares List (RSL) for C2750D6E (A075N340)
- Recommended Spares List (RSL) for C3000D6EB (A075N341)
- Warranty Administration Manual (4021290)
- Global Commercial Warranty Statement (A072R157)

2.4 After Sales Services

Cummins offers a full range of maintenance and warranty services.

2.4.1 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.

2.4.2 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.

2.4.2.1 Warranty Limitations

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

This page is intentionally blank.

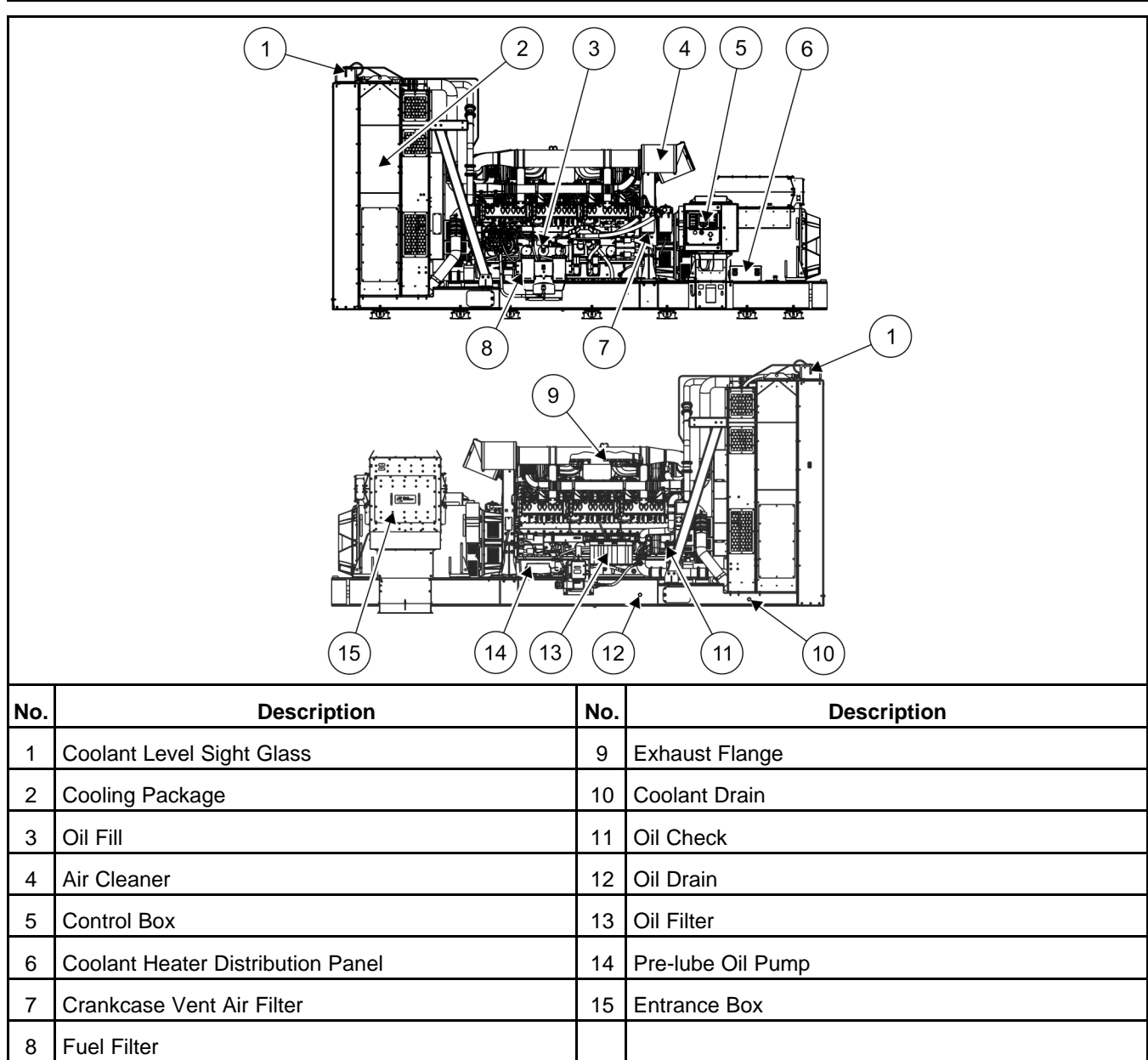


FIGURE 2. GENERATOR SET WITH CIRCUIT BREAKER BOX OR ENTRANCE BOX

3.3 Generator Set Rating

For details of the generator set rating, refer to the generator set nameplate. For operation at temperatures or altitudes above those stated on the nameplate, a derate may be necessary.

3.4 Engine

For additional engine specific information, refer to the relevant engine manual for the generator set.

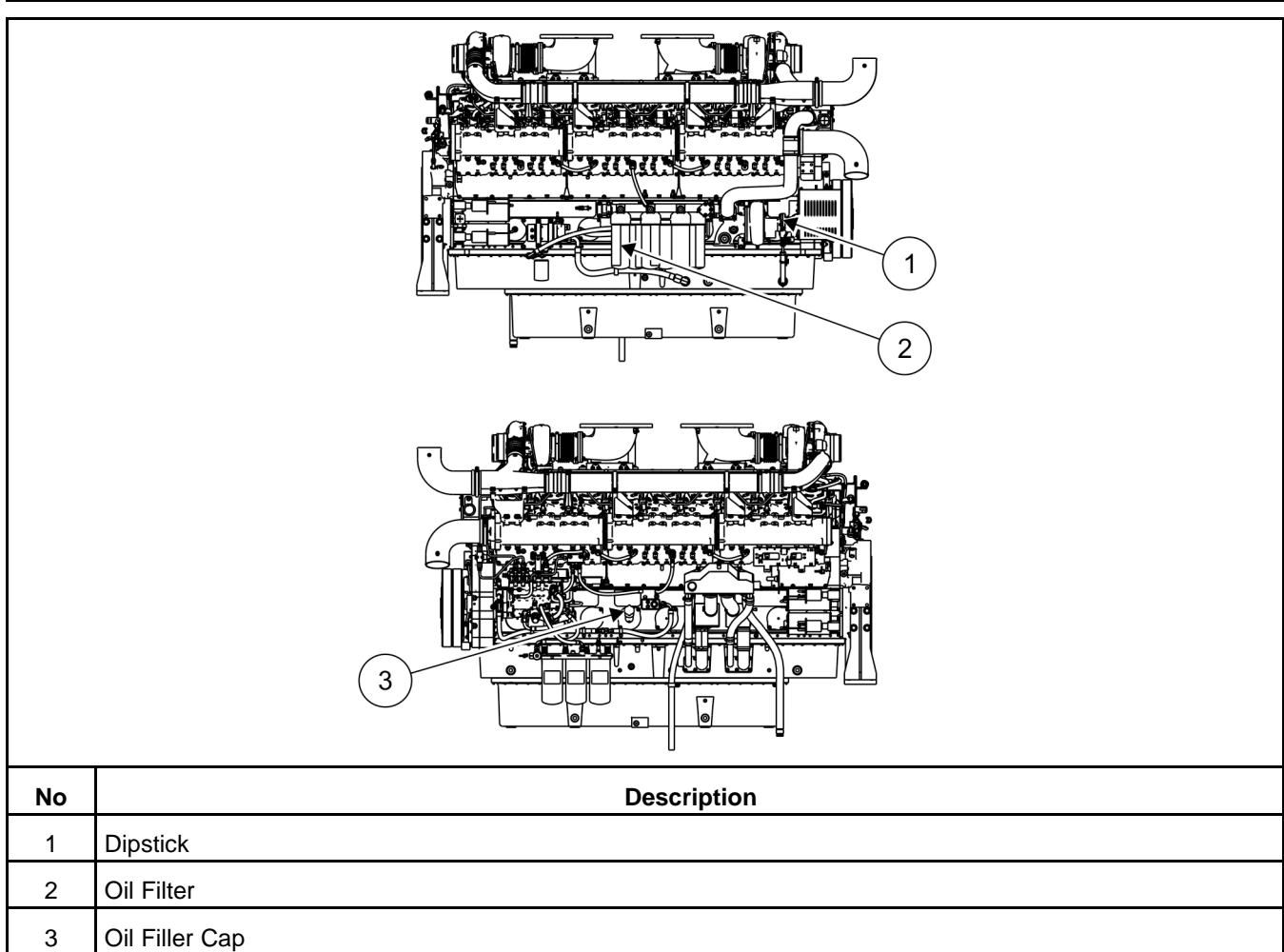


FIGURE 3. TYPICAL ENGINE COMPONENTS (QSK78)

3.5 Sensors

Various generator set parameters are measured by sensors, and the resulting signals are processed by the control board.

Engine-mounted sensors monitor a number of different systems, such as:

- Lube Oil Pressure
- Cooling System Temperature

3.6 System Options

3.6.1 Annunciators

The annunciator's lamps and alarm indicate the operating status and fault conditions of an emergency power system.

3.6.2 Battery Charger

Battery chargers can be wall, bench, or skid mounted. For more information, see [Section 10.10 on page 99](#).

3.6.3 Heaters

3.6.3.1 Heater Supply and Isolation

An external power supply is required for the operation of the generator set heaters.

NOTICE

If not already provided, it is the sole responsibility of the customer to provide the power supply and the means to isolate the AC input to the terminal box. Cummins accepts no responsibility for providing the means of isolation.

3.6.3.2 Alternator Heaters

Alternator heaters are used to help keep the alternator free of condensation when the generator set is not running. For more information on alternator heater components and specifications, refer to [Section 10.7.1 on page 95](#)

3.6.3.3 Coolant Heater

A coolant heater keeps the engine coolant warm when the engine is shut down. For more information on coolant heater components, specifications, and wiring, see [Section 10.6 on page 94](#).

3.6.3.4 Control Box Heater

A control box heater provides a means of humidity and temperature control of the control box interior. It protects the components when the generator set is subjected to varying ambient air conditions during extended periods of non-use. For more information on heater components and wiring, see [Section 10.8 on page 96](#).

3.6.4 Relays

3.6.4.1 Customer Relays

These relays are used for customer-specific applications. For more information, see [Section 9.3 on page 82](#).

3.6.4.2 Ground Fault Relays

A Ground Fault Relay (GFR) continuously monitors the neutral-to-ground connection and activates a fault alarm when the connection is broken. During generator set operation, the relay continuously monitors the line-to-neutral and activates a fault alarm when a ground fault is sensed.

A control reset will clear the fault at the control panel and will also reset the ground fault relay.

Ground fault relays can be used in the following applications:

- Local CT for 4-pole transfer switch
- Remote CT for 3-pole transfer switch

3.6.4.3 Paralleling Circuit Breaker Control Relays

Paralleling circuit breaker control relays can be installed on generator sets used in paralleling applications. For more information on relay components and wiring, see [Section 9.3 on page 82](#).

3.6.5 Seismic Installation Requirements

Seismically certified generator set installations have special requirements, as defined by IAA-VMC (Independent Approval Agency, the VMC Group).

For special installation requirements, refer to the tabulated and written seismic requirements listed in the Seismic Requirements appendix [Appendix C on page 151](#). The installation of the seismically certified generator set should be overseen by the installation project structural engineer of record.

The "Seismic Certificate of Compliance" should be kept with the Warranty and other generator set documents.

The seismic requirements installation drawing and the Seismic Certificate of Compliance for generator sets are included in the literature package of each seismically certified generator set.

3.6.6 Oil Sampling Valve

The oil sampling valve is a means of taking live oil samples from the engine to provide a sample for analysis. The valve is located on the inlet side of the oil filters to capture a sample before being filtered.

The sample to be used for analysis must be representative of the oil in the engine.

It is also important to conduct oil analysis on new (unused) oil to establish a baseline. New (unused) oil analysis samples should be taken twice a year or each time the oil type is changed at a minimum. Samples should be taken from the bulk supply tanks to determine the makeup of the oil and also to confirm that no contaminants are being introduced by the storage system.

3.6.7 Oil Maintainer System

The oil maintainer system includes a 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.

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.

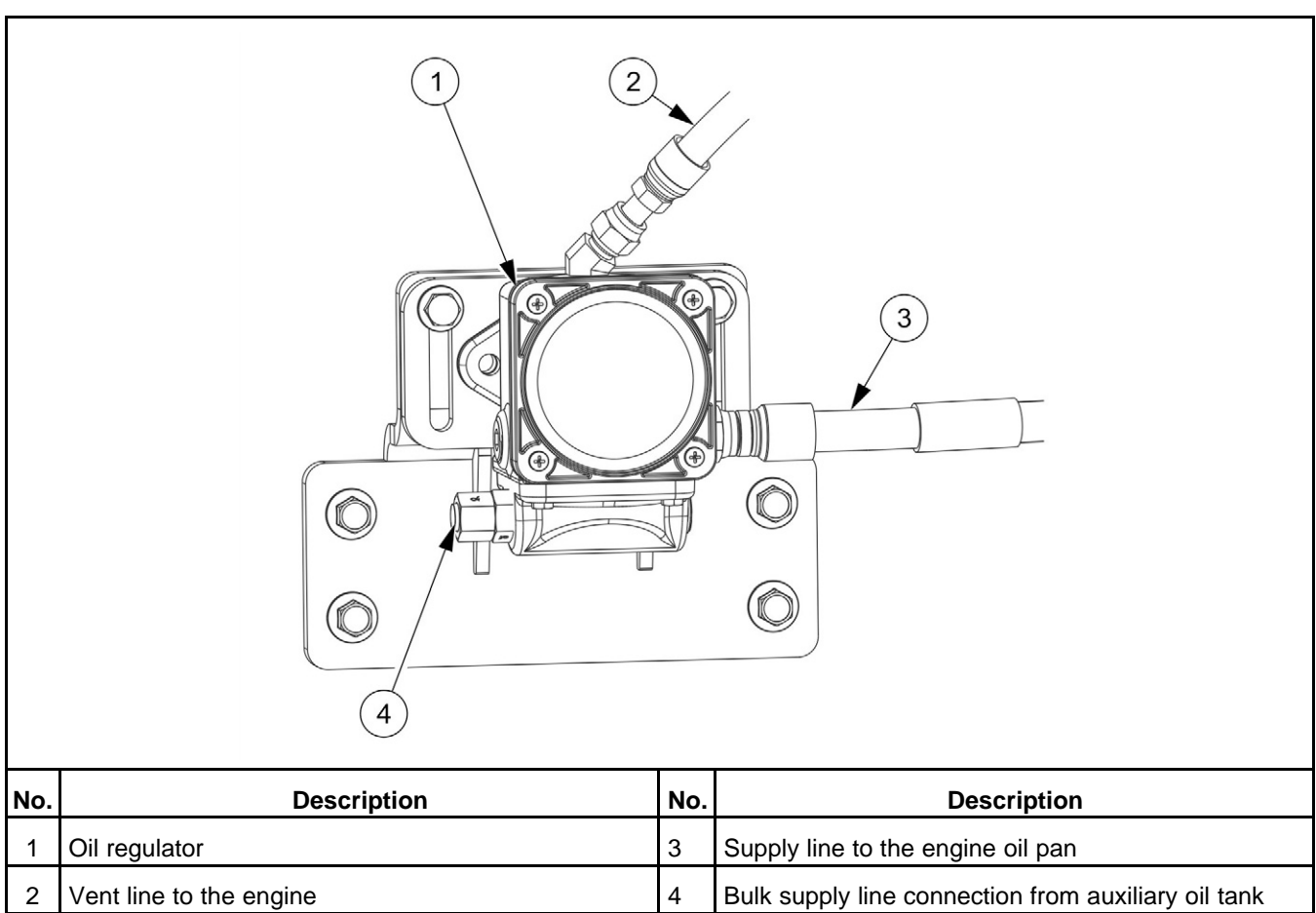


FIGURE 4. OIL MAINTAINER

3.6.8 Coolant Heater

NOTICE	
<p>Operating the heater or heaters when the coolant system has been drained, or there is a suspicion that the coolant is frozen, can result in equipment damage.</p> <p>Always make sure the coolant is not frozen and the radiator is filled to the recommended level before energizing the heater or heaters.</p>	

A coolant heater keeps the engine coolant warm when the engine is shut down. It heats and circulates the coolant within the engine. This reduces start-up time and lessens engine wear caused by cold starts. It is electrically operated and thermostatically controlled.

4 Installation Overview

These installation recommendations apply to typical installations with standard model generator sets. Whenever possible, these recommendations also cover factory designed options or modifications. However, because of the many variables in any installation, it is not possible to provide specific recommendations for every situation. If there are any questions not answered by this manual, contact your nearest authorized distributor for assistance.

4.1 Application and Installation

A power system must be carefully planned and correctly installed for proper operation. This involves two essential elements.

- **Application** (as it applies to generator set installations) refers to the design of the complete power system that usually includes power distribution equipment, transfer switches, ventilation equipment, mounting pads, cooling, exhaust, and fuel systems. Each component must be correctly designed so the complete system will function as intended. Application and design is an engineering function generally done by specifying engineers or other trained specialists. Specifying engineers or other trained specialists are responsible for the design of the complete power system and for selecting the materials and products required.
 - Generator sets are designed and manufactured for specific environments.
 - Open generator sets are designed for use inside a building or plant where they will not be subjected to extreme environments.
 - Enclosed generator sets are designed for use outside, with features designed to enable operation in a wide range of climates.
- **Installation** refers to the actual set-up and assembly of the power system. The installers set up and connect the various components of the system as specified in the system design plan. The complexity of the system normally requires the special skills of qualified electricians, plumbers, sheet-metal workers, etc. to complete the various segments of the installation. This is necessary so that all components are assembled using standard methods and practices.

4.2 Safety Considerations

The generator set has been carefully designed to provide safe and efficient service when properly installed, maintained, and operated. However, the overall safety and reliability of the complete system is dependent on many factors outside the control of the generator set manufacturer. To avoid possible safety hazards, make all mechanical and electrical connections to the generator set exactly as specified in this manual. All systems external to the generator (fuel, exhaust, electrical, etc.) must comply with all applicable codes. Make certain all required inspections and tests have been completed and all code requirements have been satisfied before certifying the installation is complete and ready for service.

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.

4.3 Seismic Installations

Seismically certified generator set installations have special requirements, as defined by IAA-VMC (Independent Approval Agency, the VMC Group).

For special installation requirements, refer to the tabulated and written seismic requirements listed in [Appendix C on page 151](#).

The installation of the seismically certified generator set should be overseen by the installation project structural engineer of record.

The "Seismic Certificate of Compliance" should be kept with the Warranty and other generator set documents.

The seismic requirements installation drawing and the Seismic Certificate of Compliance for generator sets are included in the literature package of each seismically certified generator set.

4.3.1 Seismic Installation Notes

1. The design of post-installed anchors in concrete used for the component anchorage is pre-qualified for seismic applications in accordance with "ACI 355.2" and documented in a report by a reputable testing agency. (ex. the evaluation service report issued by the International Code Council)
2. Anchors must be installed to an embedment depth as recommended in the pre-qualification test report as defined in Note 1. For "IBC 2000" and "IBC 2003" applications, the minimum embedment must be 8X for the anchor diameter.
3. Anchors must be installed in minimum 4000 PSI compressive strength normal weight concrete. Concrete aggregate must comply with "ASTM C33". Installation in structural lightweight concrete is not permitted unless otherwise approved by the structural engineer of record.
4. Anchors must be installed to the torque specification as recommended by the anchor manufacturer to obtain maximum loading.
5. Anchors must be installed in locations specified in this section.
6. Wide washers must be installed at each anchor location between the anchor head and equipment for tension load distribution. Wide washers must be Series "W" of American National Standard Type "A" plain washers (ANSI B18.22.1-1965, R1975) with the nominal washer size selected to match the specified nominal anchor diameter.
7. Concrete floor slab and concrete housekeeping pads must be designed and rebar reinforced for seismic applications in accordance with "ACI 318". The design loads shall be taken as those specified in this section.
8. All housekeeping pad thicknesses must be designed in accordance with the pre-qualification test report as defined in Note 1 or a minimum of 1.5X the anchor embedment depth, whichever is largest.
9. All housekeeping pads must be dowelled or cast into the building structural floor slab and designed for seismic application per "ACI 318" and as approved by the structural engineer of record.
10. Wall mounted equipment must be installed to a rebar reinforced structural concrete wall that is seismically designed and approved by the engineer of record to resist the added seismic loads from components being anchored to the wall.
11. Floor mounted equipment (with or without a housekeeping pad) must be installed to a rebar reinforced structural concrete floor that is seismically designed and approved by the engineer of record to resist the added seismic loads from components being anchored to the floor.
12. When installing to a floor or wall, rebar interference must be considered.
13. Attaching seismic certified equipment to any floor or wall other than those constructed of structural concrete and designed to accept the seismic loads from said equipment is not permitted by this specification and beyond the scope of this certification.

14. Attaching seismic certified equipment to any floor constructed of light weight concrete over steel decking is not permitted by this specification and beyond the scope of this certification.
15. Attaching the seismic certified equipment to any concrete block walls or cinder block walls is not permitted by this specification and beyond the scope of this certification.
16. Installation upon a rooftop steel dunnage shall be coordinated with the structural engineer of record.
17. Installation upon any rooftop curb shall be coordinated with the curb manufacturer and the structural engineer of record. Any curb or concrete pad that supports the generator set unit is beyond the scope of this certification.
18. Connections to the equipment, including but not limited to conduit, wiring from cable trays, other electrical services, ducting, piping such as exhaust, steam, water, coolant, refrigerant, fuel, or other connections, are the responsibility of the installing contractor and beyond the scope of this document. Typical requirements for these connections are stated in the equipment installation manual. Special considerations for seismic applications are as follows; connections to non-isolated components or equipment may be installed as typical for that particular application. Connections to isolated components (ex. breaker box bolted directly to an isolated generator set) or isolated equipment (ex. an enclosed generator set mounted on external isolators) must be flexibly attached. The flexible attachment must provide for enough relative displacement to remain connected to the equipment and functional during and after a seismic event.

4.4 Standby Heating Devices

Cummins requires installing standby generator sets (life safety systems) with engine jacket water coolant heaters in order to ensure a 10 second start. Jacket water coolant heaters are also recommended in prime and continuous applications where time and load acceptance is to be minimized.

The jacket water coolant heater provided by Cummins rated to provide the above requirements in ambient temperatures as low as 4 °C (40 °F). Although most Cummins generator sets will start in temperatures down to -32 °C (-25 °F) when equipped with engine jacket water coolant heaters, it might take more than 10 seconds to warm the engine before a load can be applied when ambient temperatures are below 4 °C (40 °F).

On generator sets equipped with a graphic display, the **Low Coolant Temperature** message, in conjunction with illumination of the Warning LED, is provided to meet the current requirements. The engine cold sensing logic initiates a warning when the engine jacket water coolant temperature falls below 21 °C (70 °F). In applications where the ambient temperature falls below 4 °C (40 °F), or there exists a high amount of cold airflow, the jacket water coolant heater may not provide the necessary heating. Under these conditions, although the generator set may start, it may not be able to accept load within 10 seconds. When this condition occurs, check the coolant heaters for proper operation. If the coolant heaters are operating properly, other precautions may be necessary to warm the engine before applying a load.

4.5 Product Modifications

Agency certified products purchased from Cummins comply only with those specific requirements and as noted on company product specification sheets. Subsequent modifications must meet commonly accepted engineering practices and/or local and national codes and standards. Product modifications must be submitted to the local authority having jurisdiction for approval.

This page is intentionally blank.

5 Specifications

5.1 Generator Set Specifications

TABLE 1. SPECIFICATIONS

MODELS	C2750D6E	C3000D6EB	C3000D6EB
Engine Cummins Diesel Series	QSK78-G36	QSK78-G36	QSK78-G37
Generator kW Rating	See generator set nameplate for rating information.		
Engine Fuel Connection Inlet/Outlet Thread Size	Refer to generator set outline drawing supplied. • A073W614		
Maximum Weight (with Enhanced High Ambient Radiator)	Dry - 25059 kg (55246 lb) Wet - 25361 kg (55911 lb)		
Fuel Max. Fuel Inlet Restriction Fuel Pump Flow Rate Fuel Pump Return Flow Rate at 1800 RPM Dead Head Pressure	47 kpa (13.8 in-hg) with clean fuel filter at maximum flow; 44 kpa (12.9 in-hg) with dirty fuel filter at maximum flow Maximum Flow: 18 L/min (4.75 gal/min) Maximum Flow: 7 L/min (1.8 gal/min) 34 kpa (10 in-hg)		
Exhaust Outlet Size Max. Allowable Back Pressure Exhaust Flow at Rated Load Exhaust Temperature	1800 RPM 12 inch (ASME B16.1 Class 125 NPS 12) 51 mm (2 inch) Hg 642 m ³ /min (22676 cfm) at Standby Standby: 460 °C (860 °F), Continuous 439 °C (822 °F)	1800 RPM 12 inch (ASME B16.1 Class 125 NPS 12) 51 mm (2 inch) Hg 704 m ³ /min (24878 cfm) at Standby Standby: 490 °C (914 °F), Continuous 460 °C (860 °F)	1800 RPM 12 inch (ASME B16.1 Class 125 NPS 12) 51 mm (2 inch) Hg 615 m ³ /min (21721 cfm) at Standby Standby: 462 °C (863 °F), Continuous 444 °C (831 °F)
Electrical System Starting Voltage: Battery Group Number: Battery CCA: Generator Set minimum CCA: Cold Soak @ 0 °F (-18 °C) Required Battery Quantity:	24 Volts DC 8D 1400 A 2200 A at -18 °C to 0 °C (0 °F to 32 °F) 6 (Two 12 Volt batteries per starter)		
Cooling System Capacity with Standard Radiator	For 50 °C (122 °F) radiator, 455 liters (120.2 US gallons) For 40 °C (109 °F) radiator, 455 liters (120.2 US gallons)		
Lubricating System Oil Capacity with Filters	466 Liters (123 gallons)		

5.2 Generator Set Fuel Consumption

TABLE 2. FUEL CONSUMPTION L/HR (GAL/HR) AT 1800 RPM (60 HZ)

Model	Engine	Fuel Consumption Data at 60 Hz ¹
C2750D6E	QSK78-G36	738.7 L/hr (195.1 gal/hr)
C3000D6EB	Low NOx QSK78-G36	823.4 L/hr (217.5 US gal/hr)
C3000D6EB	QSK78-G37	773.2 L/hr (204.3 US gal/hr)

1. Standby/Full Load
Refer to data sheets for other applications. In line with the Cummins Inc. policy of continuous improvement, these figures are subject to change.

6 Installing the Generator Set

Generator set installations must be engineered so that the generator set will function properly under the expected load conditions. Use these instructions as a general guide only. Follow the instructions of the consulting engineer when locating or installing any components. The complete installation must comply with all local and state building codes, fire regulations, and other applicable regulations.

Requirements to be considered prior to installation are:

- Level mounting surface
- Adequate cooling air
- Adequate fresh induction air
- Discharge of generator set air
- Non-combustible mounting surface
- Discharge of exhaust gases
- Electrical connections
- Accessibility for operation and servicing
- Noise levels
- Vibration isolation
- Environmental conditions:
 - High and low temperatures, humidity
 - Rain and snowfall
 - Flood risk
 - Period of exposure to detrimental weather conditions
 - Wind

NOTICE

Depending on the location and intended use, ensure that international, national or local laws and regulations regarding Air Quality Emissions have been observed and complied with. Be sure to consult local pollution control or air quality authorities before completing construction plans.

6.1 Transportation

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.

⚠ 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.

NOTICE

On an enclosed generator set, the canopy doors must be locked before re-positioning and must remain locked during transportation and siting.

- Ensure the generator set is prepared for transport. If necessary drain fluids and ensure that acid or fumes do not leak from the battery (where applicable).
- If the generator set is transported over long distances, protect it against environmental influences by sealing it in a plastic cover or similar.
- Ensure the generator set is secured to the vehicle with suitable securing straps. Wooden chocks and pallets alongside the securing straps can prevent movement during transportation.
- If required, attached impact indicators to the generator set. Upon delivery, check these impact indicators and contact the transport company immediately if an impact has been detected. Impacts can cause serious damage to the generator set and its components.
- Ensure that the generator set cannot turn over during transportation.
- Do not overload the transport vehicle. Under no circumstances should the generator set be started while inside a truck.
- Lifting eyes, where fitted, are to be checked at regular intervals to ensure they are damage free and tight.

6.2 Location

⚠ 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**Incorrect installation**

Incorrect installation of the generator set, service or parts replacement, can result in severe personal injury, death, and/or equipment damage.

Service personnel must be trained and experienced to perform electrical and mechanical component installation.

NOTICE

Depending on your location and intended use, additional laws and regulations may require for you to obtain an air quality emissions permit before beginning installation of your generator set. Be sure to consult local pollution control or air quality authorities before completing your construction plans.

Generator set location is decided mainly by related systems such as ventilation, wiring, fuel, and exhaust. The set should be located as near as possible to the main power service entrance. Exhaust gases must not be able to enter or accumulate around inhabited areas.

Provide a location away from extreme ambient temperatures and protect the generator set from adverse weather conditions.

Use the following information to locate the generator set for optimal operating conditions:

Surface: Concrete or compacted gravel with the generator set resting on solid, poured concrete blocks, or timber blocks spaced at reasonable intervals around the perimeter of the generator set.

Leveling: Level the generator set from side-to-side within 3.5°, and end-to-end within 2.5°.

Placement:

- Generator sets should be a minimum of 5 m (16.4 ft) apart to allow for adequate access.
- Make sure that the air inlets are not obstructed by surrounding trees, buildings, or other obstructions.
- Make sure noise distribution (to prevent echoing) is kept to a minimum.
- Consider exhaust for immediate neighbors.
- The prevailing wind direction should be considered so that the engine combustion air inlet is upwind and the exhaust discharge is downwind.
- The immediate area around the proposed location of the mounting surface should be evaluated for proper drainage so that moisture run-off is sufficient to prevent ponding around the unit(s).

6.3 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.

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

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.

It is not permitted to move the Generator Set with the Radiator attached. If the generator set is to be moved after the radiator has been assembled, then the radiator must be removed and moved separately.

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 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.

6.4 Rigging Instructions

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

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.

Consult the generator set outline drawing for weight and center-of-gravity information and rigging specifications.

6.5 Mounting

Generator sets are mounted on a steel skid that provides proper support, which is sited on mechanical spring isolators to provide adequate vibration isolation per application.

NOTICE

The use of unapproved isolators may result in harmful resonances and may void the generator set warranty.

Mount the generator set on a substantial and level base such as a concrete pad. A non-combustible material must be used for the pad.

The fixing centers for the mounting bolts can be found on the generator set Outline Drawing.

6.6 Access to Generator Set

Generally, at least 1 meter (3.3 ft) of clearance should be provided on all sides of the generator set for maintenance and service access. (Increase clearance by width of door if optional housing is used.) A raised foundation or slab of 152 mm (6 inches) or more above floor level will make servicing easier. Lighting should be adequate for operation, maintenance and service operations and should be connected on the load side of the transfer switch so that it is available at all times.

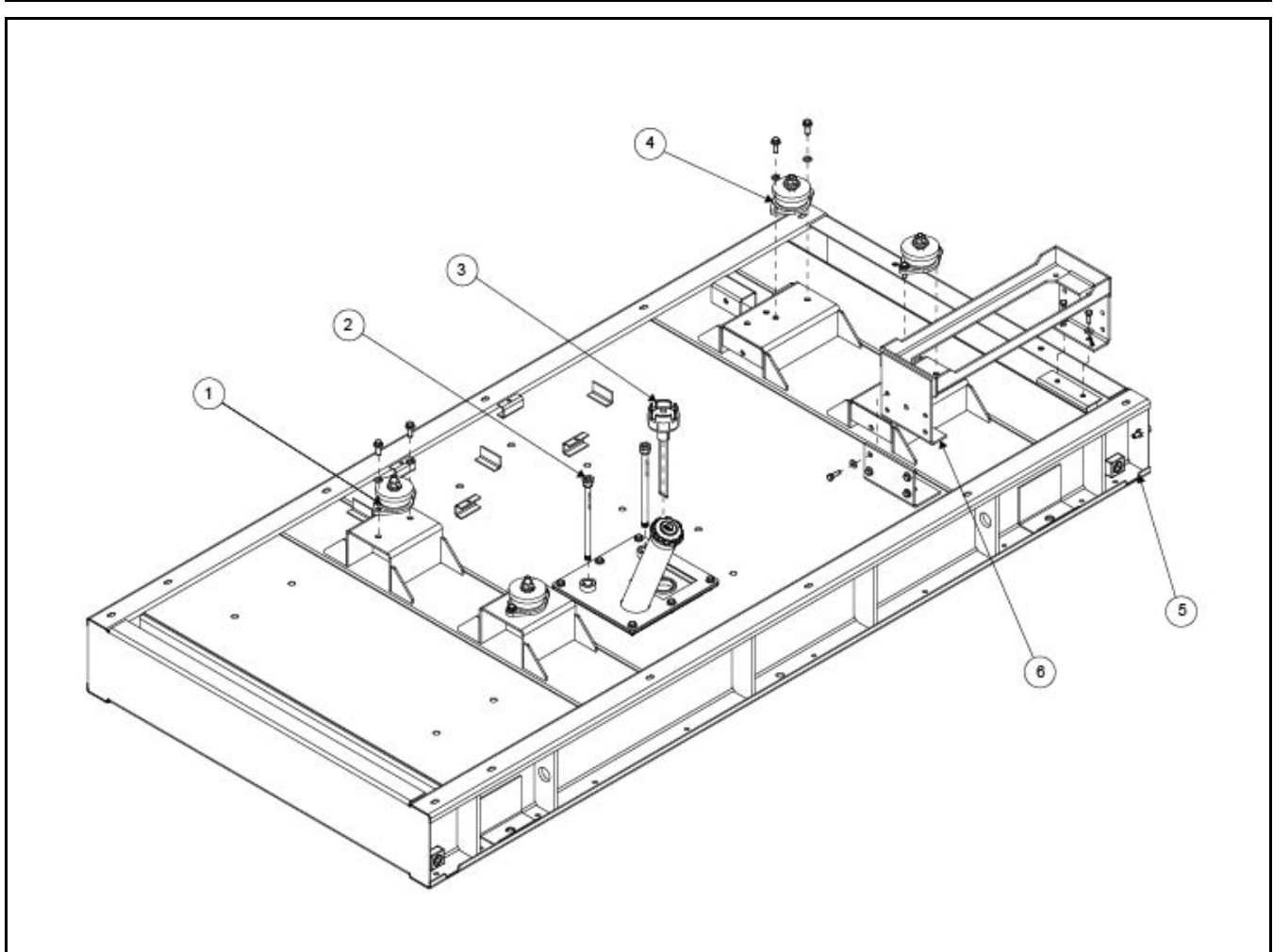
6.7 Vibration Isolator Installation and Adjustment Procedure

This procedure covers installing the following non-seismic rated isolators (Does not carry IBC/OSHPD certification). Part numbers: A041V109 (90 kVA), 0402-0972 (110 & 150 kVA) - Alternator side, 0402-0958 (90, 110 & 150 kVA)-Engine side.

1. Place the vibration isolators (see [Figure 5](#)) on the generator set support structure. The isolators should be shimmed or grouted to make sure that all of the isolator bases are within 6 mm (0.25 inches) elevation of each other. The surface that the isolator bases rest on must also be flat and level.
2. Loosen the side snubber lock nuts so that the top plate of the isolator is free to move vertically and horizontally. Be sure that the top plate is correctly aligned with the base and springs.
3. Place the generator set onto the isolators while aligning the skid's mounting with the threaded isolator hole. The top plates will move down and approach the base of the isolator as load is applied.
4. Once the generator set is in position, the isolators may require adjusting so that the set is level. The isolators are adjusted by inserting the leveling bolt through the skid and into the isolator (the leveling bolt's locking nut should be threaded up towards the bolt head).

The leveling bolt will adjust the clearance between the top plate and the isolator base. A nominal clearance of 6 mm (0.25 inches) or greater is desired. This will provide sufficient clearance for the rocking that occurs during startup and shutdown. If the 6 mm (0.25 inches) clearance is not present, turn the leveling bolt until the desired clearance is achieved.

5. If the radiator and engine are mounted on separate skids, make sure the radiator skid and engine/alternator skid are level with each other after adjusting the isolators. If not level, proper fan belt alignment cannot be achieved.
6. If the generator set is not yet level, adjust the leveling bolts until the set is level and sufficient clearance still remains. (Clearance on all isolators should be roughly equal).
7. Once all isolators have been set, lock the leveling bolt in place with the lock nut.
8. The snubber nuts must remain loose to provide better isolation between the generator set and the support structure.



No.	Description	No.	Description
1	ISOLATOR,VIBRATION	4	ISOLATOR,VIBRATION
2	PICKUP,FUEL	5	CHASSIS,GENSET
3	SWITCH,LEVEL	6	BRACKET,SUPPORT

FIGURE 5. VIBRATION ISOLATOR INSTALLATION

6.8 Generator Set Long Term Storage

If long term storage of the generator set is required refer to the Long Term Storage section in the generator set service manual.

Fan belt drive shelf life is 5 Years.

7 Mechanical Connections

The generator set mechanical system installation includes connecting the fuel, exhaust, ventilation, and cooling systems. Before starting any type of fuel installation, all pertinent state and local codes must be complied with and the installation must be inspected before the unit is put in service.

7.1 Fuel System

Cummins engines normally use a diesel fuel specified to ASTM D975 grade 2 or BS EN 590:2000 is for automotive diesel, BS 2869:2010+A1:2011 Fuel oils for agricultural, domestic and industrial engines and boilers.

In all fuel system installations, cleanliness is of the utmost importance. Make every effort to prevent entrance of moisture, dirt, or contaminants of any kind into the fuel system. Clean all fuel system components before installing.

NOTICE

A fuel filter/strainer/water separator of 100-120 mesh or equivalent (approximately 150 microns nominal) must be fitted between either the main tank and day tank, or between the main tank and the engine.

Use only compatible metal fuel lines to avoid electrolysis when fuel lines must be buried. Buried fuel lines must be protected from corrosion.

NOTICE

Never use galvanized or copper fuel lines, fittings, or fuel tanks. Condensation in the tank and lines combines with the sulfur in diesel fuel to produce sulfuric acid. The molecular structure of the copper or galvanized lines or tanks reacts with the acid and contaminates the fuel.

An electric solenoid valve in the supply line is recommended for all installations and required for indoor automatic or remote starting installations. Connect the solenoid wires to the generator set "Switched B+" circuit to open the valve during generator set operation.

Separate fuel return lines to the day tank or supply tank must be provided for each generator set in a multiple-set installation to prevent the return lines of idle sets from being pressurized. Fuel return lines must not contain a shutoff device. Engine damage will occur if the engine is run with the return fuel lines blocked or restricted.

NOTICE

Never install a shutoff device in fuel return line(s). If fuel return line(s) is blocked or exceeds fuel restriction limit, engine damage will occur.

NOTICE

A base mounted fuel tank may be part of the generator set build. An additional external fuel system may be required if the on board fuel capacity is not sufficient for the application.

7.1.1 Fuel Return Restrictions (or Pressure) Limit

Fuel return drain restriction (consisting of friction head and static head) between the engine injector return line connection and the fuel tank must not exceed the limit stated in the model-specific generator set *Specification Sheet*.

7.1.2 Fuel Line Connections

WARNING

Combustible Liquid

Fuel leaks are a fire and explosion hazard which can cause severe personal injury or death.

Always use flexible tubing between the engine and fuel supply to avoid line failure and leaks due to vibration. The fuel system must meet all application codes.

WARNING

Combustible Liquid

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

Do not route fuel lines near electrical wiring.

WARNING

Hot Surface

Hot surfaces can ignite fuel. Ignited fuel is a fire and explosion hazard which can cause severe burns or death.

Do not route fuel lines near hot exhaust parts.

NOTICE

Fuel lines must be routed and secured to maintain a 12.7 mm (½ inch) minimum clearance from electrical wiring and a 51 mm (2 inches) minimum clearance from hot exhaust parts.

Flexible lines for connecting between the engine and the skid mounted fuel tank (if fitted) are supplied as standard equipment.

Flexible lines for connecting between the engine and an external fuel supply must be used between the engine fuel system, and the fuel supply and return lines to protect the fuel system from damage caused by vibration, expansion, and contraction.

For additional information refer to T-030 Application Manual.

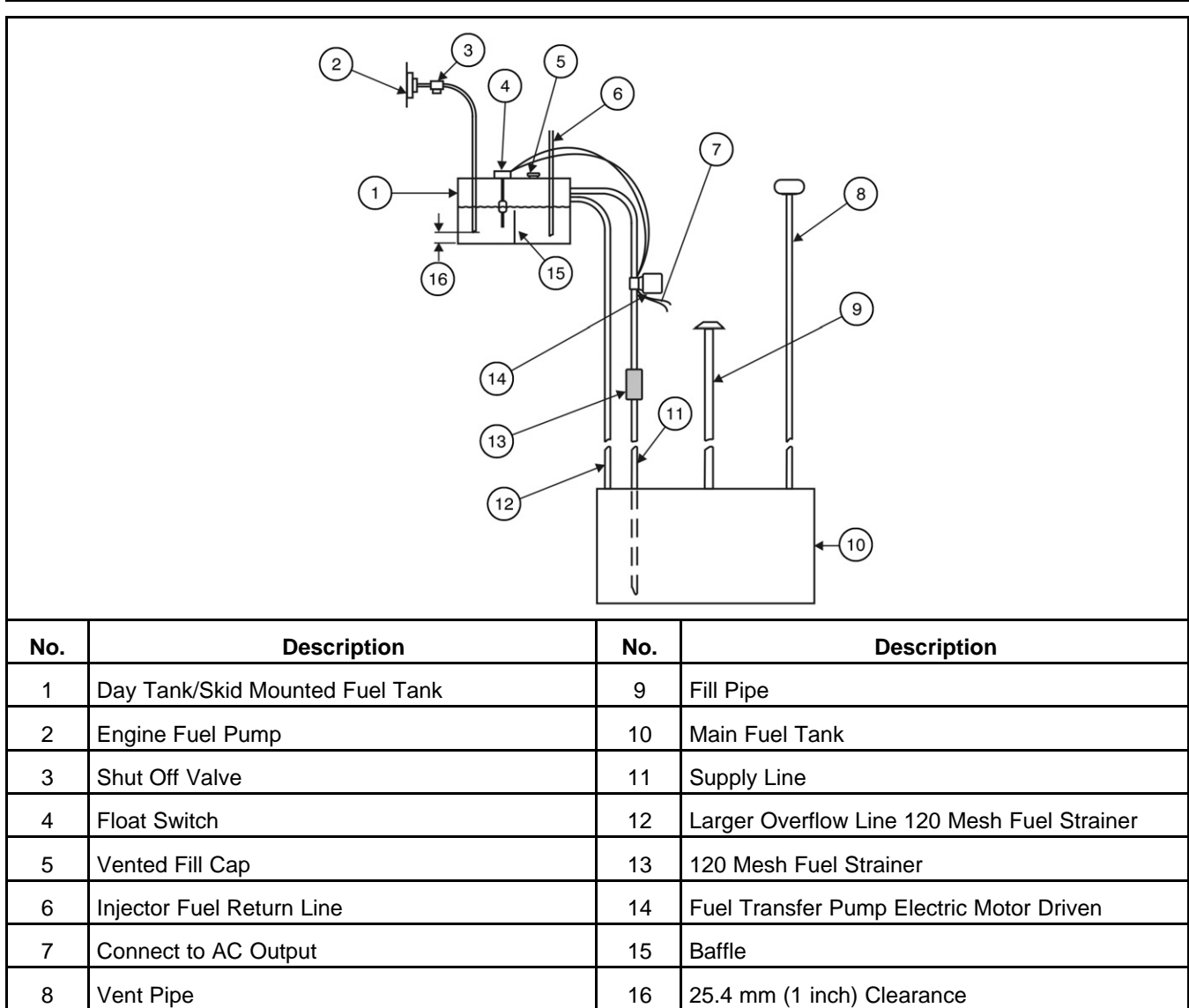


FIGURE 6. TYPICAL FUEL SUPPLY INSTALLATION

7.1.3 Engine Fuel Connections

Identification tags are attached to the fuel supply line and fuel return line connections. All models require a fuel return line from the injectors to the tank.

7.1.4 Supply Tank

The fuel supply tank, day tank, or other reservoir must be arranged so that the highest fuel level does not exceed the maximum height above the fuel injectors specified for the engine. The lowest level must not fall below the specified lift height of the engine fuel lift pump. In critical start applications, the lowest level should not be less than 150 mm (6 inches) above the engine fuel pump inlet to make sure there is no air in the fuel line during startup. Provisions must be made for draining or pumping out water.

For critical start applications, where generator sets are paralleled or must satisfy emergency start-time requirements, it is recommended that a fuel tank or reservoir be located such that the lowest possible fuel level is not less than 150 mm (6 in) above the fuel pump inlet. This will prevent air from accumulating in the fuel line while the generator set is in standby, eliminating the period during startup when it has to be purged.

Locate the fuel tank as close as possible to the generator set and within the restriction limitations of the fuel pump.

Install a fuel tank that has sufficient capacity to supply the generator set depending on its application:

- Continuous power
- Prime power
- Standby power

Refer to the Engine Fuel Consumption section for fuel consumption data.

If the fuel inlet restriction exceeds the defined limit due to the distance/customer-supplied plumbing between the generator set and the main fuel tank, a transfer tank (sometimes referred to as a day tank) and auxiliary pump will also be required. If an overhead main fuel tank is installed, a transfer tank and float valve will be required to prevent fuel head pressures from being placed on the fuel system components.

For additional information on the size and installation of a supply tank for the application, consult your local authorized Cummins distributor or dealer.

7.1.5 Fuel Inlet Pressure/Restriction Limit

Engine performance and fuel system durability is compromised if the fuel inlet pressure or restriction limits are not adhered to. Fuel inlet pressure or restriction must not exceed the limits stated in the model-specific generator set *Specification Sheet*.

7.2 Exhaust System

WARNING

Toxic Gases

Inhalation of exhaust gases can cause asphyxiation and death.

Use extreme care during installation to provide a tight exhaust system. Terminate exhaust pipes away from enclosed or sheltered areas, windows, doors, and vents. Do not use exhaust heat to warm a room, compartment, or storage area.

WARNING

Hot Surface

Hot surfaces can start a fire which can cause severe burns or death.

Use an approved thimble where exhaust pipes pass through wall or partitions.

NOTICE

Weight applied to the engine manifold can result in turbocharger damage. Support the silencer and exhaust piping so no weight or stress is applied to the engine exhaust elbow.

NOTICE

Liability for injury, death, damage, and warranty expense due to use of unapproved silencers or modifications to the exhaust system becomes the responsibility of the person installing the unapproved silencer or performing the modification. Contact your authorized distributor for approved exhaust system parts.

Pipe exhaust gases to the outside of any enclosure/room. Locate the exhaust outlets away from any air inlets to avoid gases re-entering the enclosure/room. Exhaust installations are subject to various detrimental conditions such as extreme heat, infrequent operation, and light loads. Regularly inspect the exhaust system both visually and audibly to see that the entire system remains fume tight and safe for operation.

NOTICE

Enclosed generator sets are not generally designed to be used in a building. If the generator set is to be used in a building, additional requirements must be applied.

Where an enclosed generator set is used in a building, the exhaust system should be extended to vent the exhaust gases. Use sealed joint type fittings where possible to provide a tight exhaust system. Use of slip type fittings (secured with a clamp) may allow leakage of exhaust gases into the building if not fitted correctly. Check to make sure there are no exhaust leaks.

NOTICE

Flexible pipes must be installed vertically and must be aligned fully with engine and exhaust tubes. The pipes must not have any bends or curves.

When a unit is provided with a partially installed or incomplete exhaust system, exhaust piping and chimneys shall be designed, constructed, and installed in accordance with the Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, NFPA 37, or applicable local standards. Build according to the code requirements in effect at the installation site.

For indoor installation, the exhaust system should use sealed joint type fittings where possible to provide a tight exhaust system. Use of slip type fittings (secured with a clamp) may allow leakage of exhaust gases into the building if not fitted correctly. Check to make sure there are no exhaust leaks.

Use an approved thimble (see [Figure 11 on page 42](#)) where exhaust pipes pass through a wall or partition. Insulated wall/roof thimbles are used where exhaust pipes pass through a combustible roof or wall. This includes structures, such as wood framing or insulated steel decking, etc. Uninsulated wall/roof thimbles are used where exhaust pipes pass through a non-combustible wall or roof, such as concrete. When a unit is provided with a partially installed or incomplete exhaust system, exhaust piping and chimneys shall be designed, constructed, and installed in accordance with the Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, NFPA 37, or applicable local standards. Build according to the code requirements in effect at the installation site.

Rain caps are available for the discharge end of vertical exhaust pipes. The rain cap clamps onto the end of the pipe and opens due to exhaust discharge force from the generator set. When the generator set is stopped, the rain cap automatically closes, protecting the exhaust system from rain, snow, etc.

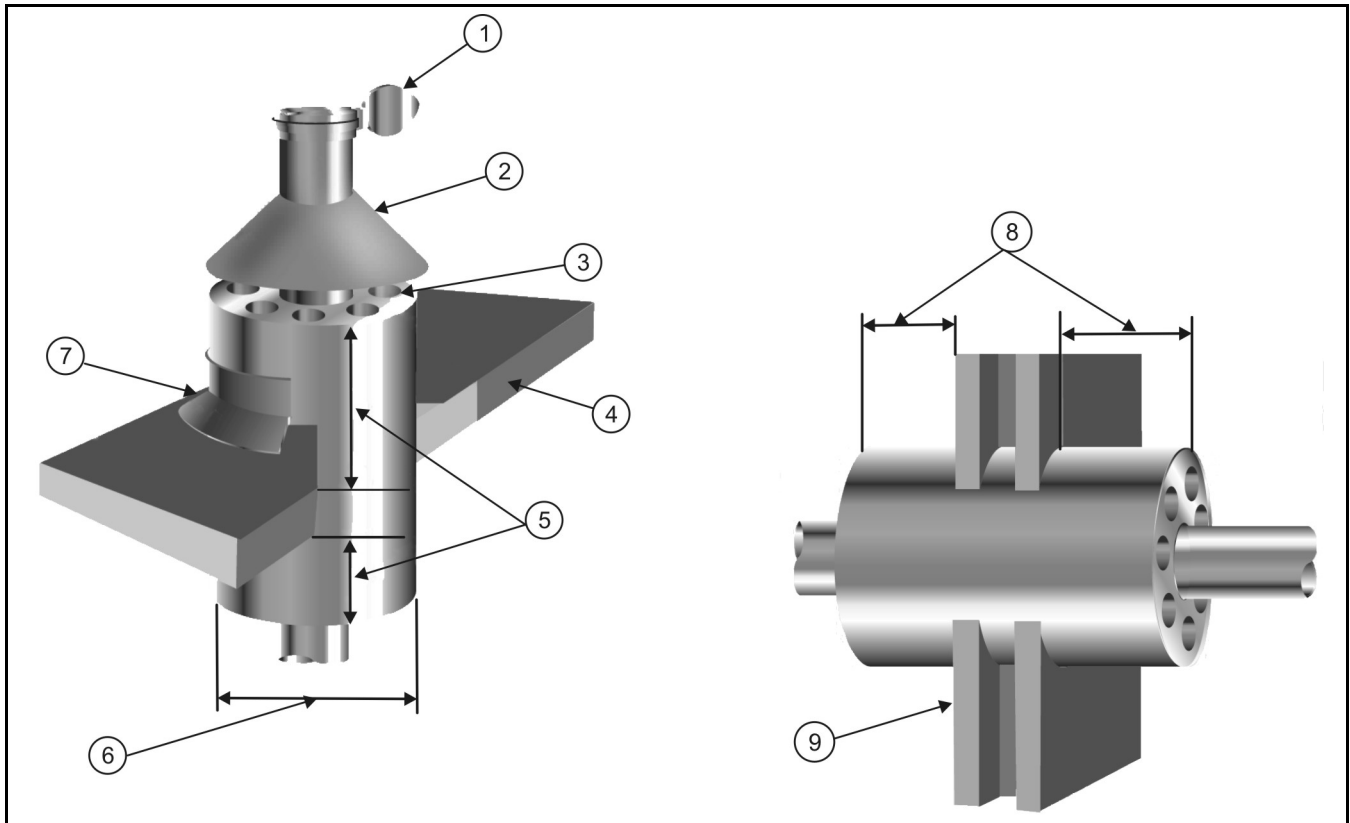
Use a section of flexible exhaust pipe between the engine and remainder of exhaust system. Support the exhaust system to prevent weight from being applied to engine exhaust outlet elbow/turbocharger connection.

The exhaust system design should meet local code requirements.

Avoid sharp bends by using sweeping, long radius elbows and provide adequate support for the silencer and tailpipe. Pitch a horizontal run of exhaust pipe downward (away from engine) to allow any moisture condensation to drain away from the engine. If an exhaust pipe must be turned upward, install a condensation trap at the point where the rise begins (see [Figure 8 on page 40](#)).

Shield or insulate exhaust lines if there is danger of personal contact. Allow at least 305 mm (12 inches) of clearance if the pipes pass close to a combustible wall or partition. Before installing insulation on exhaust system components, check the exhaust system for leaks while operating the generator set under full load and correct all leaks.

Refer to T-030, *Liquid Cooled Generator Set Application Manual* for more detailed information about sizes of exhaust system pipes and fittings.



No.	Description	No.	Description
1	Rain Cap	6	Exhaust Pipe Diameter Plus 304 mm (12 Inches)
2	Drip Cap	7	Flashing
3	Holes in End of Inner Sleeve	8	230 mm (9 Inches) Minimum
4	Roof	9	Outside or Dividing Wall
5	230 mm (9 inches) Minimum		

FIGURE 7. EXHAUST THIMBLE

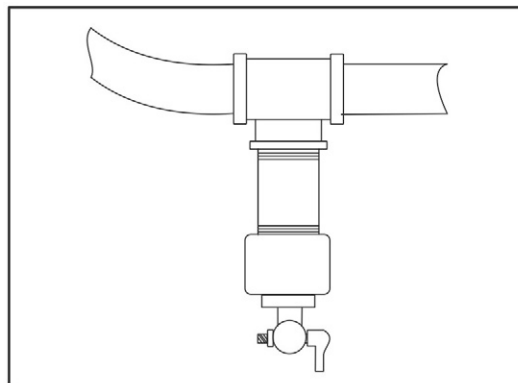


FIGURE 8. CONDENSATION TRAP

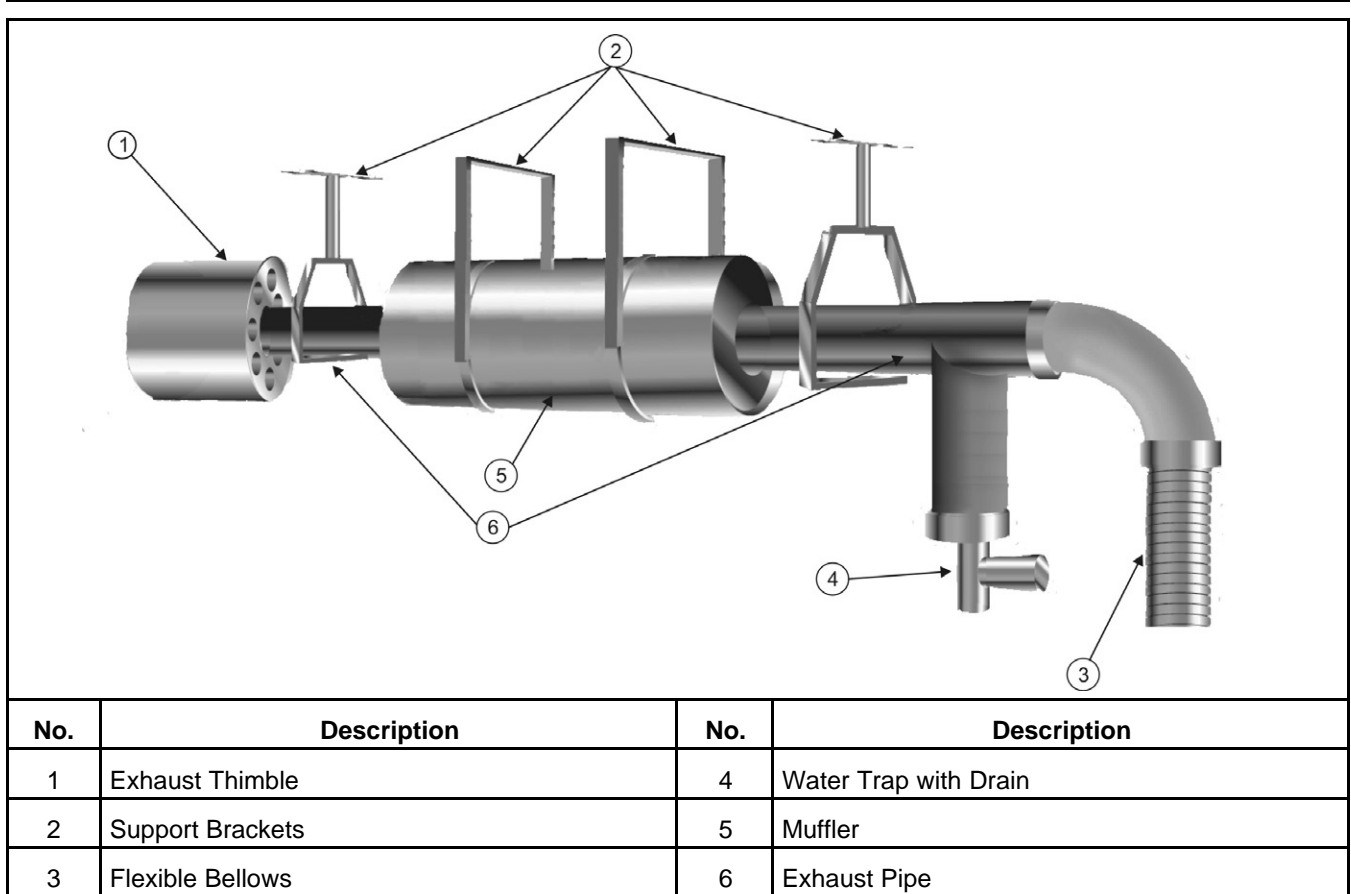


FIGURE 9. TYPICAL SUSPENDED EXHAUST SYSTEM

The bottom of the muffler is being supported by two mounting brackets with 4 M20 screws under the mounting brackets used to fix them. Two clamps on the top of the silencer fits with mounting brackets and 4 M20 screws, nuts, and gaskets. Installation torque for the screw following Q/STB 12.521.5-2000 is required.

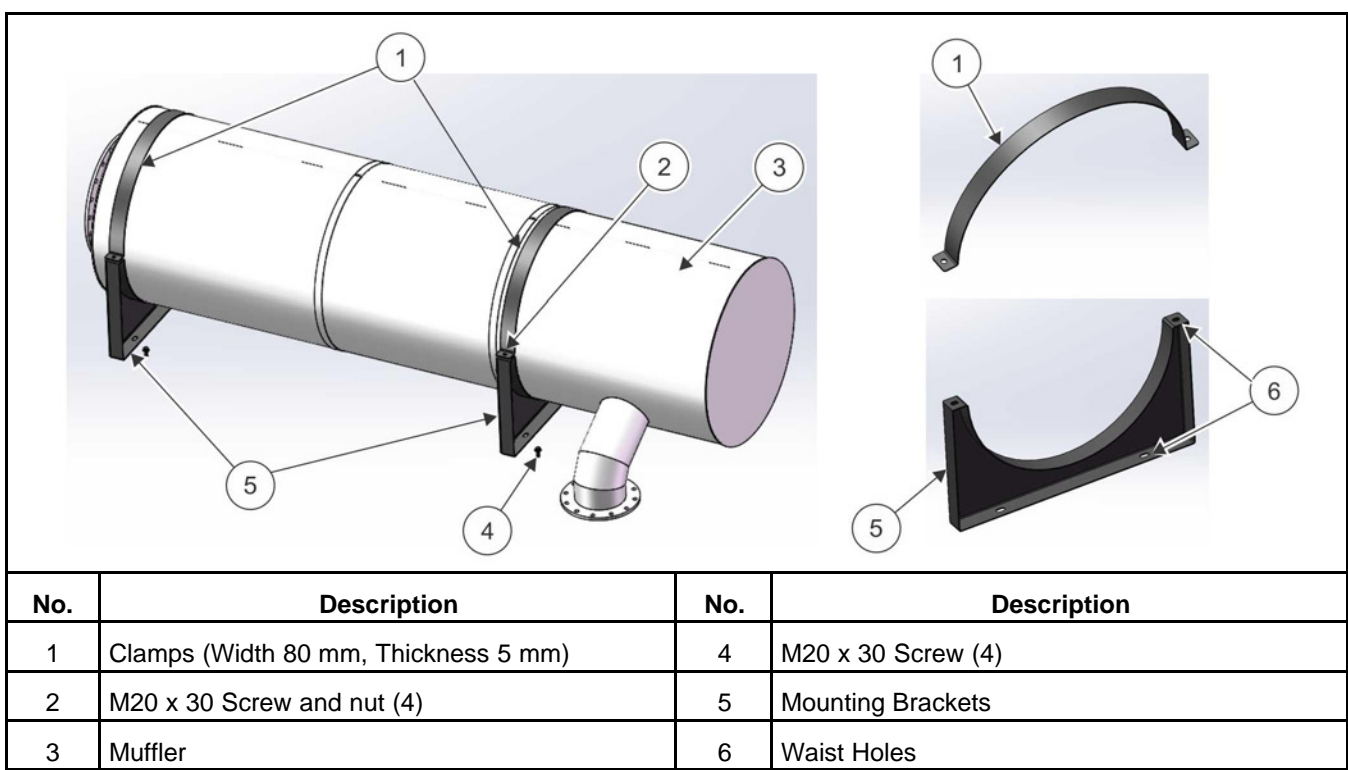


FIGURE 10. MUFFLER ASSEMBLY INSTALLATION (4 IN 1)

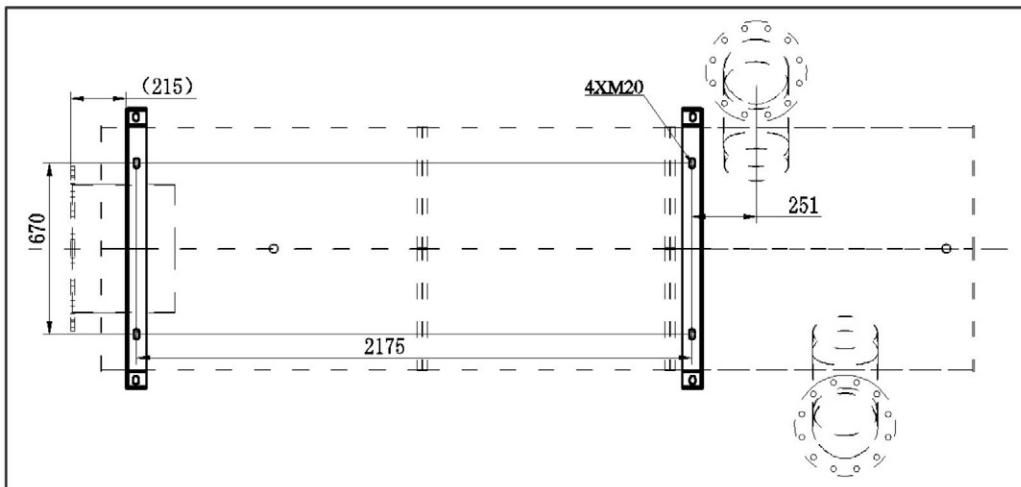


FIGURE 11. MUFFLER INSTALLATION HOLES (WITH DISTANCE FOR BRACKET INSTALLATION)

7.3 Ventilation and Cooling

⚠ WARNING

Toxic Gases

Engine and radiator cooling air may carry carbon monoxide gas, which 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.

Generator sets create considerable heat that must be removed by proper ventilation.

Generator sets in factory-mounted housings for outdoor installation are designed for proper cooling and ventilation.

Indoor installations require careful design with respect to cooling and ventilation. In an indoor installation, all radiator cooling air must be discharged to the out-of-doors. Duct adapter kits are available.

Outdoor installations normally rely on natural air circulation but indoor installations need properly sized and positioned vents for required airflow.

Transfer the stray voltage from the cooling system to the ground through the skid.

7.4 Vents and Ducts

1. For indoor installations, locate vents so incoming air passes through the immediate area of the installation before exhausting. Install the air outlet higher than the air inlet to allow for convection air movement.
2. Size the vents and ducts so they are large enough to allow the required flow rate of air.
3. Wind will restrict free airflow if it blows directly into the air outlet vent. Locate the outlet vent so the effects of wind are eliminated, or if the outlet vent cannot be located as mentioned, install a wind barrier. See [Figure 12](#).

NOTICE

The "free area" of ducts must be as large as the exposed area of the radiator. Refer to the generator set Specification Sheet for the airflow requirements and allowed airflow restriction.

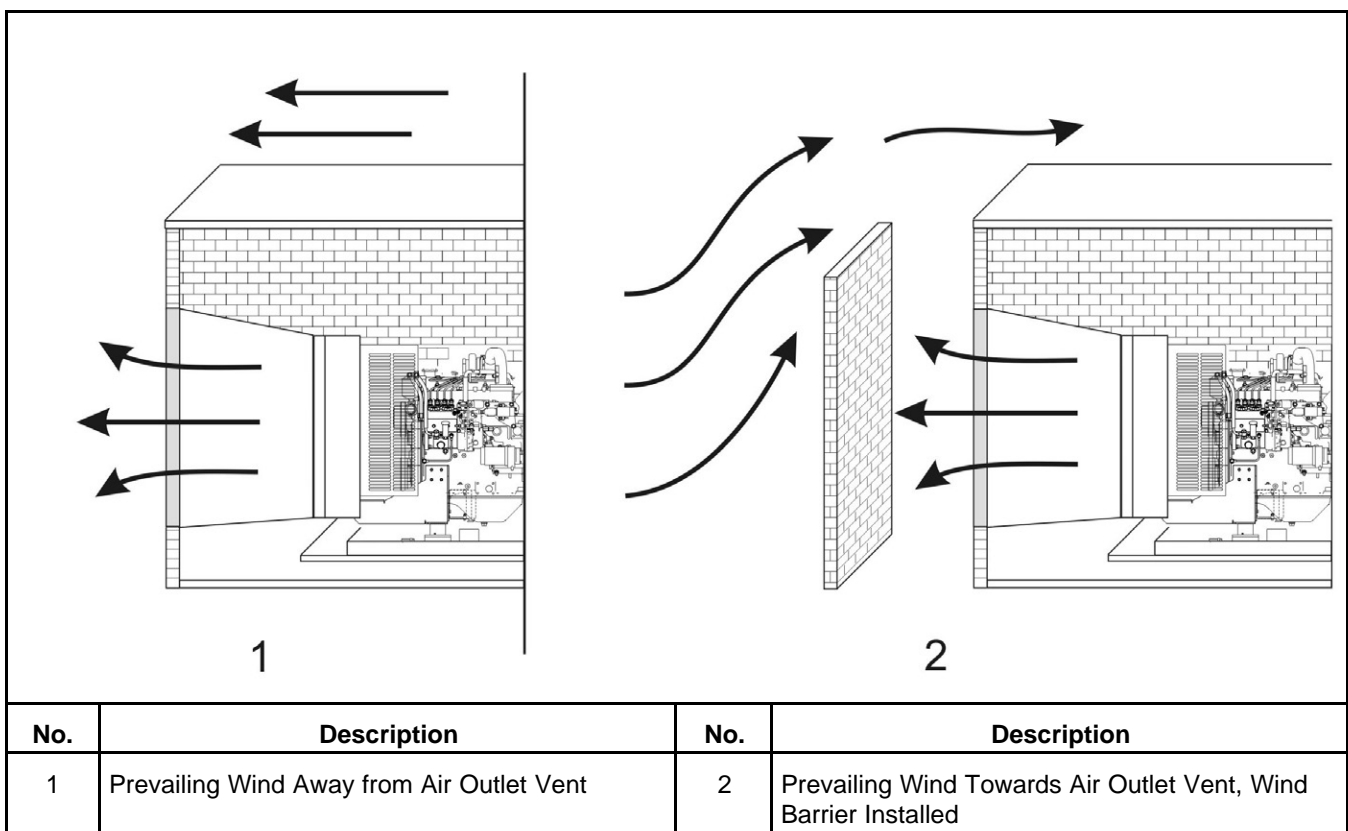


FIGURE 12. WIND BARRIER

7.5 Dampers

Dampers or louvers protect the generator set and equipment room from the outside environment. Their operation of opening and closing should be controlled by operation of the generator set.

In cold climates, the radiator exhaust air can be recirculated to modulate the ambient air temperature in the generator set room. This will help the generator set warm up faster, and help to keep fuel temperatures higher than the cloud point of the fuel. If recirculation dampers are used, they should be designed to 'fail closed', with the main exhaust dampers open, so that the generator set can continue to operate when required. Designers should be aware that the generator set room operating temperature will be very close to the outdoor temperature, and either not route water piping through the generator set room, or protect it from freezing.

7.6 Air Inlet and Outlet Openings

Louvers and screens over air inlet and outlet openings restrict air flow and vary widely in performance.

A louver assembly with narrow vanes, for example, tends to be more restrictive than one with wide vanes. The effective open area specified by the louver or screen manufacturer should be used.

Radiator set cooling air is drawn past the control end of the set by a pusher fan that blows air through the radiator. Locate the air inlet to the rear of the set. Make the inlet vent opening 1.5 times larger than the radiator area.

Locate the cooling air outlet directly in front of the radiator and as close as possible. The outlet opening must be at least as large as the radiator area. Length and shape of the air outlet duct should offer minimum restriction to airflow.

A flexible duct connector must be provided at the radiator to prevent exhaust air recirculation around the radiator, to take up generator set movement and vibration, and to prevent transmission of noise. Attach the flexible duct using screws and nuts so that the duct can be removed for maintenance purposes. Before installing the duct, remove the radiator core guard.

Enclosed generator sets are primarily designed to work in an open environment. When considering installing an enclosed generator set in an enclosed environment specific application factors must be considered (air flow, exhaust gas extraction, fuel supply and storage, etc.). For advice, contact the Application Engineering Group at Cummins.

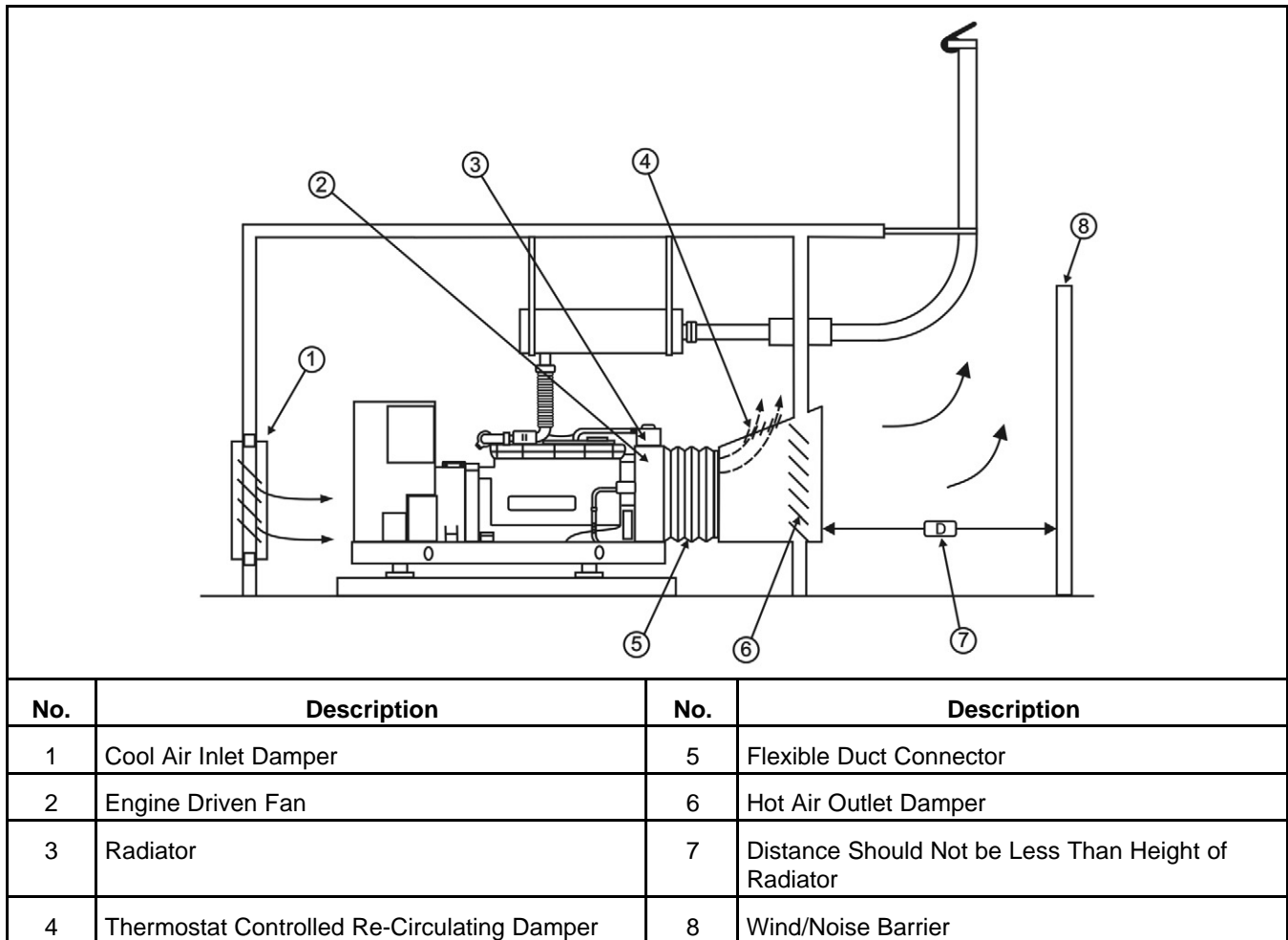


FIGURE 13. TYPICAL OPEN GENERATOR SET INSTALLATION

7.7 Breakerless Conductor Connections

7.7.1 Overload and Short Circuit Protection of Generator

NFPA 70: National Electrical Code compliant generator sets are required to be protected from an overload. Cummins generator sets with UL Listed AmpSentry Protective Relay as a standard feature do not require a circuit breaker or other protective device for NEC compliance or UL 2200 Listing.

CEC: Each conductor between the generator terminal and the point where load receives supply of generator current must be protected by an overcurrent device in accordance with the requirement of CEC 14-100: Overcurrent Protection of Conductor.

UL label indicates to the Authority Having Jurisdiction (AHJ) that the generator set incorporates a UL Listed Protective Relay that provides overload and short circuit protection for the generator and its conductors. The generator set does not require use of a circuit breaker or other protective device for NFPA 70: National Electrical Code compliance or UL 2200 Listing.

If Amp Sentry is not being used as the primary overload device, the size of the circuit breaker **must** be rated equal to or greater than the generator set voltage with a current rating at least 100 percent (inclusive) of the rated output current of the unit and no more than 125 percent. The circuit breaker **must** be installed no more than 25 feet (7.6 m) from the generator set output terminals.

7.7.1.1 AmpSentry Labels

These are typical labels for UL compliant generator sets produced after January 2012.



FIGURE 14. POWER COMMAND 3.3 LABEL

**PowerCommand Generator Set Protective Relay with AmpSentry™
Current Monitoring and Control**

PowerCommand Protective Relay with AmpSentry current monitoring and control provides overload and overcurrent protection of generator and feeder conductors at generator terminals in accordance with the requirements of 2011 NFPA 70: National Electrical Code®, Articles 240.15(A), 240.21(G), 445.12(A), 445.13 and Canadian Electrical Code, Part I, C22.1-09, Section 28-902 without the use of an additional protective device.

A disconnect for the generator set is required per 2011 NFPA 70: National Electrical Code®, Articles 225.31, 225.32, and 445.18 and Canadian Electrical Code, Part I, C22.1-09, Section 28-900 unless the driving means for the generator set can be readily shutdown and the generator is not arranged to operate in parallel with another generator or source of voltage. This engine-generator includes an emergency stop switch with lockout/tagout capability that meets this requirement.

PowerCommand Protective Relay with AmpSentry current monitoring and control allows selective coordination of generator with a downstream instantaneous trip overcurrent protective device in accordance with the requirements of 2011 NFPA 70: National Electrical Code® Articles 700.27, 701.27, 708.54 and Canadian Electrical Code, Part I, C22.1-09, Section 46-206. Verification of generator set electrical system coordination must be achieved by a coordination study.

**Relais de protection de groupe électrogène PowerCommand avec
fonction de mesurage et contrôle AmpSentry™**

Le relais de protection PowerCommand avec fonction de mesurage et contrôle Ampsentry fournit une protection contre les surintensités à l'alternateur du groupe électrogène ainsi qu'aux conducteurs y étant raccordés conformément aux conditions énumérées dans le Code Canadien de l'Électricité Partie I, CSA C22.2-09 Section 28-902 et ce, sans l'usage d'appareils de protection supplémentaires.

Un sectionneur permettant de déconnecter l'alternateur du groupe électrogène est exigé par le Code Canadien de l'Électricité Partie I, CSA C22.2-09 Section 28-900 à moins que les moyens d'entraînement du groupe électrogène puisse être facilement mis à l'arrêt et que le groupe électrogène ne puisse pas fonctionner en parallèle avec un autre groupe électrogène ou une autre alimentation électrique (réseau du distributeur d'électricité). Ce groupe électrogène inclut un arrêt d'urgence avec provision de cadenassage d'étiquetage (lockout/tagout) qui rencontre cette condition.

Le relais de protection PowerCommand avec fonction de mesurage et contrôle Ampsentry permet la coordination sélective de l'alternateur de ce groupe électrogène et les appareils de protection contre les surintensités de courant instantanées et temporisées situés en aval en conformité avec le Code Canadien de l'Électricité Partie I, CSA C22.2-09 Section 46-206. La vérification de la coordination sélective doit être vérifiée par une étude de coordination.

A041T769

FIGURE 15. TYPICAL INFORMATION LABEL

PowerCommand 22, 23, 33	
DC Supply Rating:	<input type="checkbox"/> 12V <input type="checkbox"/> 24V 22A Maximum
Voltage Sensing:	347/600VAC Maximum, 50/60 Hz
Current Sensing:	<input type="checkbox"/> 1A <input type="checkbox"/> 5A
Heater Voltage (opt):	<input type="checkbox"/> 120V <input type="checkbox"/> 240V
AC Input:	<input type="checkbox"/> 210V (PMG) <input type="checkbox"/> 240V (Shunt), 50/60Hz, 4 Amps
Field Output:	240V Peak, 4 Amps
Remote Input and Sensor Circuits -	24VDC Max
Output Relay Contacts:	30VAC, 3A, Resistive
Operating Ambient:	60°C Maximum Surrounding Air (Open Type)
Digital Outputs	24V, 1A
Sensor Inputs:	5VDC
Environmental:	Type I
Optional Relays (3.3 only):	250VAC/30VDC, C300 Pilot Relay

Trip Current Setting	110% of the Generator Nameplate Rating
Percent Current Setting	Trip Time
100%	Will Not Trip
135%	90 Seconds
200%	25 Seconds
300%	9 Seconds
600%	0.6 to 0.9 Seconds to Current Limiting Mode Then 9 seconds To Shut Down

A041V083

FIGURE 16. POWER COMMAND 2.2, 2.3, AND 3.3 SPECIFIC CHECK LABEL

7.7.2 Coordination of Protective Devices

Conduct a selective coordination (discrimination) study on the distribution system that incorporates the generator set when choosing a generator set. Visit power.cummins.com for a copy of document R-1053, or it can be found using SKM Power Tools for Windows library or from your distributor.

7.7.3 Additional AmpSentry Protective Relay Information

TABLE 3. ADDITIONAL AMPSENTRY PROTECTIVE RELAY INFORMATION FOR POWERCOMMAND 2100 CONTROL

	Voltage	No. of Phases	Frequency (Hz)	Current (Max)	Connection
Battery Supply	8-30 V		DC	22 A	TB1 (17-22)
Voltage Sense Input	347/600 V	3	50/60	10 mA	J8 (4, 7, 12, 20)
Current Sense Input		3	50/60	5 A	J7 (11, 12, 15, 16, 19, 20)

	Voltage	No. of Phases	Frequency (Hz)	Current (Max)	Connection
AVR Shunt Supply	240 V	1	50/60	100 mA	J8 (21-23)
AVR PMG Supply	210 V	1	50/60	100 mA	
AVR Output (Continuous)	300 V (Peak)	1	PWM	4 A	J8 (5,13)
AVR Output (Max/10 seconds)	300 V (Peak)	1	PWM	6 A	
Run Relay Output	30 V		DC	8 A; 1.44 A Pilot Duty	TB1 (17-22)
Customer Relay Output	30 V		DC	5 A	TB1 (8-15)
	250 V	1	AC	5 A; C300 Pilot Duty	
Indicator Supply	5 V		DC	50 mA	J2
Engine Sensors	5 V		DC	3 mA	J7 (13, 17, 21, 22, 25, 26, 29-35)
Governor Drive	5-30 V		DC	100 mA	J7 (14, 24, 28, 36)
Power Out	8-30 V		DC	100 mA	J7 (1-8, 18)
Solenoid Driver Signal	5-30 V		DC	100 mA	J7 (9, 10, 23, 27)
Switch Input	8-30 V		DC	1 mA	J1
Membrane Switch Input	5 V		DC	1 mA	J3
Customer Inputs	8-30 V		DC	1 mA	TB1 (1-6)
Power Transfer Status	5-30 V		DC	1 mA	TB2 (5)
Power Transfer Signal Supply	5-30 V		DC	100 mA	TB2 (3, 4, 6)
Interface	5 V		DC	1 mA	J50, J51, J4, J6
Communication	RS485				TB2 (1, 2)
	RS232				J9 (1-5, 9)
	CAN (Optional)				J10 (1-5)
Trip Current	110% generator nameplate Full Load Amperage				
Percentage of Trip Current	100		300		600
Trip Times	500 seconds		10 seconds		1 second
Temperature	70 °C Maximum Surrounding Air Ambient				

This page is intentionally blank.

8 Radiator Assembly Instructions

8.1 Introduction

The following procedure describes how to install the radiator assembly when the radiator and generator set are shipped as separate items.

This procedure includes:

1. Preparing for the installation
2. Removing the cooling system from the transportation skid and mounting to the generator set skid
3. Connecting the radiator to the engine (see the outline drawing in [Appendix B on page 139](#))
4. Filling the coolant system
5. Test running the generator set

8.1.1 Radiator Assembly

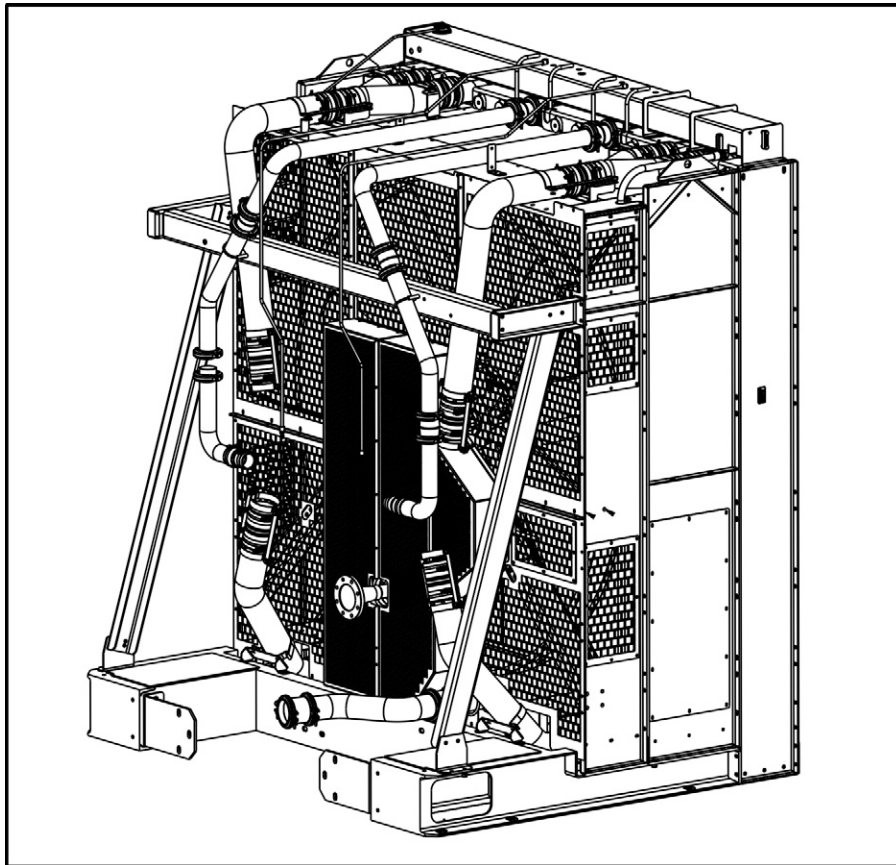


FIGURE 17. RADIATOR ASSEMBLY

The cooling fan is pre-assembled with the radiator. Once the radiator assembly is mounted, the installer must connect the radiator to the engine, install the pulleys and belts, and complete the electrical connections.

8.2 Preparing for the Installation of the Radiator

Before mounting the generator set on isolators and leveling the set (see [Chapter 6 on page 29](#)), make sure there is enough space to install the radiator. Basic radiator dimensions are shown in the outline drawing in [Appendix B on page 139](#).

After the generator set is installed,

- Make sure you have the required tools to complete the installation.
- Become familiar with all safety precaution issues that apply to the installation procedure. Read these instructions completely and become familiar with the 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 assembly, with an appropriate lifting strength margin.

8.2.1 Required Items

The following equipment is required to complete this installation.

- Crane hoist (a fork lift can be used to remove the radiator with skid from the truck flat bed)
- Lifting straps and spreader bar with shackles capable of lifting 7.25 metric tons (eight US tons)
- Straightedge at least 1219 mm (48 inches) long
- Large pry bar - used to align the radiator to the skid
- Spanner wrenches
- Impact sockets
- Air ratchet wrench
- Browning 1302546 belt tension checker
- Torque wrench capable of 950 nm (700 ft-lb)
- AVM vibration mounts
- 440 cleaner degreaser or similar
- Two M14 x 1.5 x 105 mm long guide studs - used to install the engine stub shaft onto the damper (supplied with the radiator parts)
- M22 hex capscrews, washers and hex nuts - quantity 12 (supplied with the radiator parts)
- M24 hex capscrews, washers and hex nuts - quantity 8 (supplied with the radiator parts)
- M16 hex capscrews, washers and hex nuts - quantity 6 (supplied with the radiator parts)
- Cable Ties
- Loctite 277 (or equivalent high strength thread locking compound)
- Loctite 592 (or equivalent thread sealant)
- Assembly grease compatible with Viton

Also required is enough coolant mixture to fill the radiator. Refer to the *Cummins QSK78 Series Engine Operation and Maintenance Manual (5677186)* for cooling system coolant requirements.

8.2.2 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.

⚠ 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.

8.3 Removing the Radiator From the Skid

The radiator with skid can be lifted off the truck flat bed using a crane hoist or fork lift.

⚠ WARNING

Improper lifting techniques can result in personal injury and equipment damage. If using a crane hoist to move the radiator, the skid must stay attached to the radiator and lifting straps must be attached to the two lifting brackets.

⚠ DANGER

Dropping the radiator assembly can cause severe personal injury or death. The radiator and skid assembly is heavy (weighs 9000 pounds). Use a hoist of sufficient capacity. Do not stand under a raised radiator and keep hands and feet clear of the perimeter of the radiator while it is being maneuvered.

1. Use a crane hoist and lifting straps and spreader bar with shackles capable of lifting 7257 kg (8 US ton) or a fork lift to remove the radiator with skid from the truck flat bed and place it on the ground.

NOTICE

Use of a spreader bar is required to maintain a vertical lift on the lifting eyes.

2. Unpack the radiator assembly. Remove all the bolts that attach the radiator to the shipping skid. Remove the components box.
3. After the radiator assembly is removed from the skid, dispose of the shipping skid.

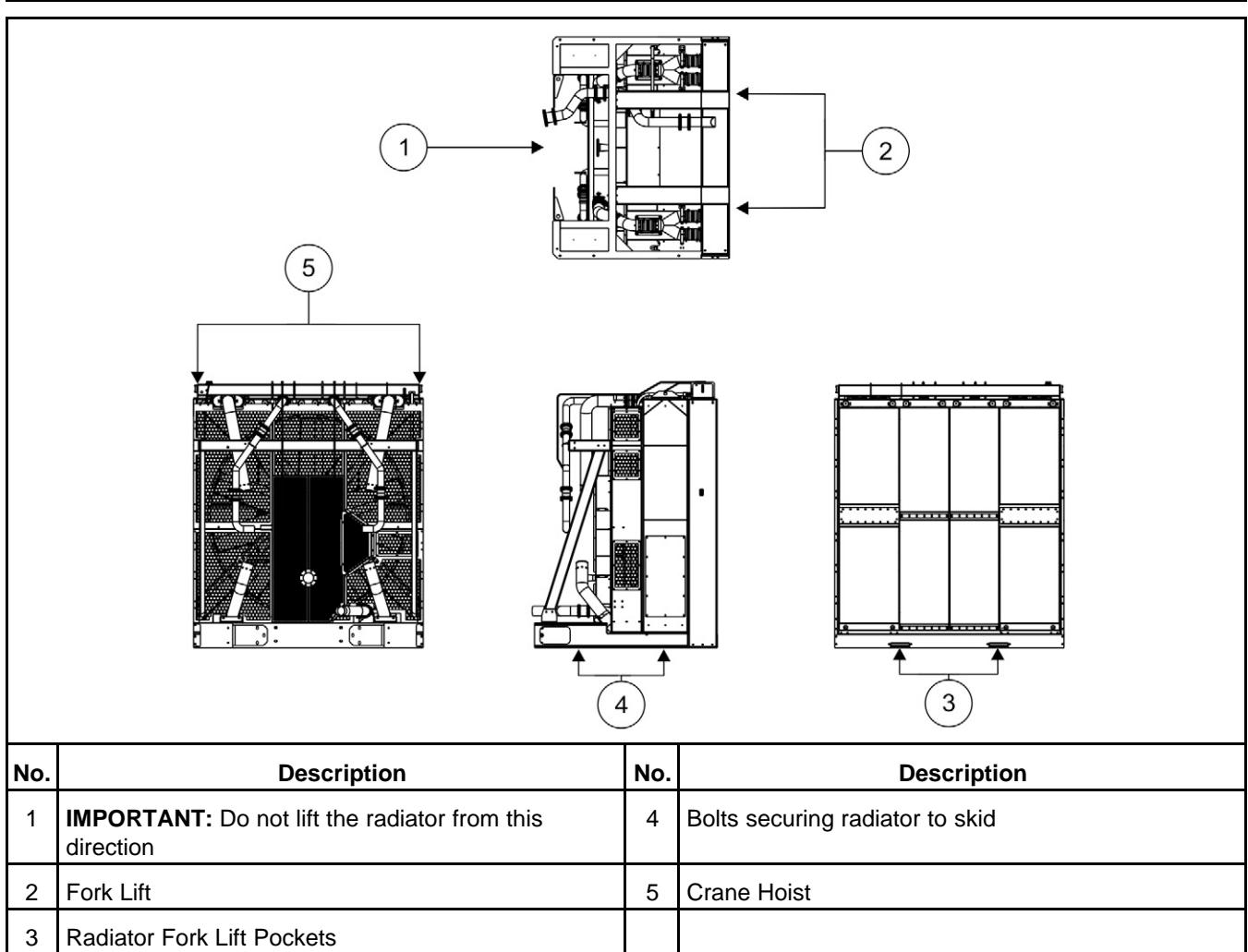


FIGURE 18. LIFTING/HOISTING LOCATIONS

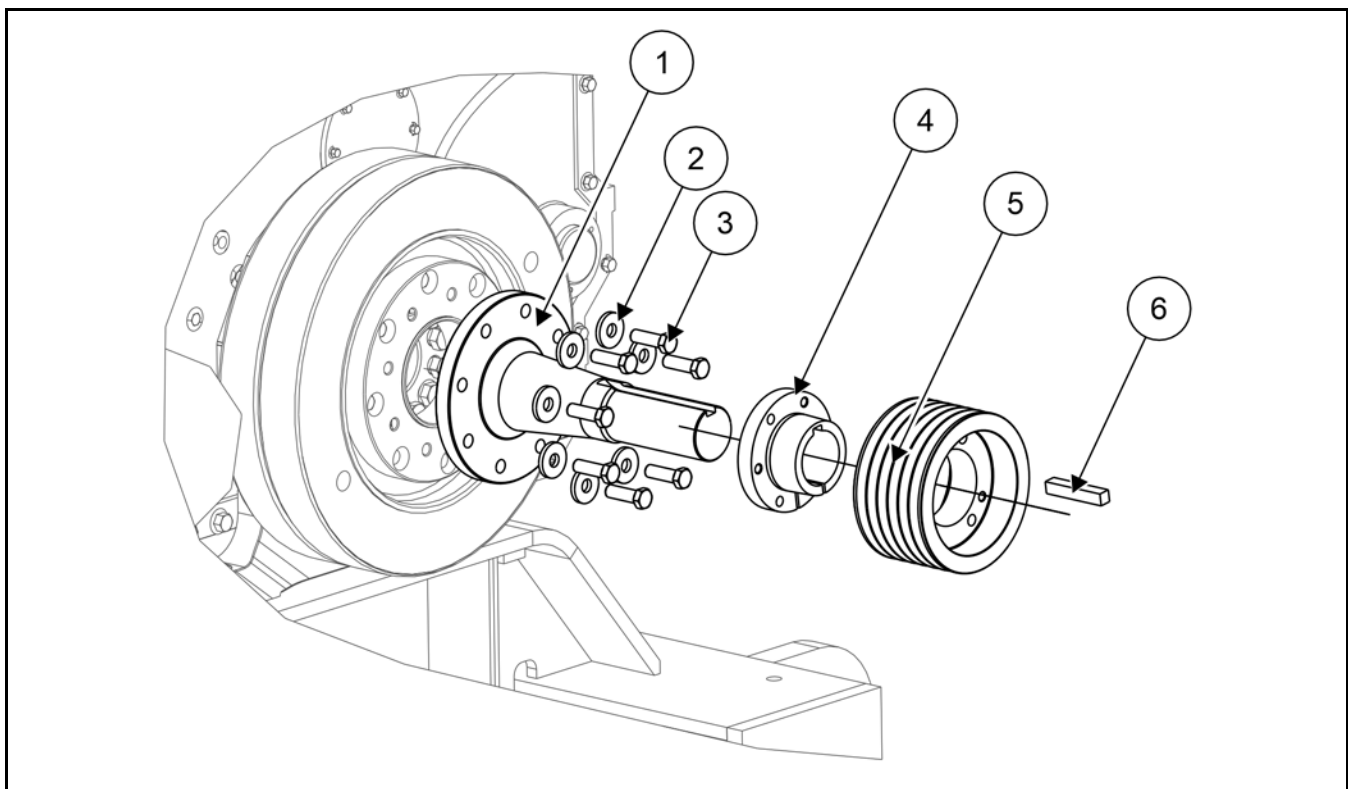
8.4 Radiator Installation

Refer to radiator outline drawing [Section B.2](#) for the parts required to install the radiator. Some parts are shipped loose.

8.4.1 Installing the Engine Stub Shaft and Pulley

The engine stub shaft is installed onto the engine damper, along with the engine pulley for the fan drive belts.

1. Clean the mounting surface of the engine vibration damper with degreaser.
2. Clean the fan drive input shaft with degreaser.



No.	Description	No.	Description
1	Stub Shaft	4	Driver Bushing
2	Flat Washer	5	Drive Pulley
3	M16 Hex Head Cap Screw	6	Square Key

FIGURE 19. FAN DRIVE INPUT SHAFT

3. Install the fan drive input shaft onto the engine vibration damper using eight M16 hex cap screws and washers. Apply Loctie 277 thread locking compound or equivalent.
4. Tighten the capscrews in the sequence as shown. Torque to: first step 183 Nm (135 ft-lb), second step 245 Nm (180.7 ft-lb).

Step 1. 183 Nm (135 ft-lb)
 Step 2. 245 Nm (180.7 ft-lb)

FIGURE 20. CAPSCREW TIGHTENING SEQUENCE

5. Clean keyway with degreaser.

6. Clean the driver bushing and key with degreaser.
7. Place the driver bushing key in to the fan drive input shaft keyway.
- 8.

NOTICE

Install fan drive input shaft with the keyway facing up.

9. Place the driver bushing over the fan drive input shaft align the keyways and slide the bushing over the key.
10. Install the driver pulley onto the driver bushing.
 - The non-threaded holes of the bushing must align with the threaded holes of the pulley.
 - Insert the capscrews with washers through the non-threaded holes in the bushing flange by hand.
11. Do not torque the pulley capscrews at this time. The pulley is aligned later in this installation.

8.4.2 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 21](#)) 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.

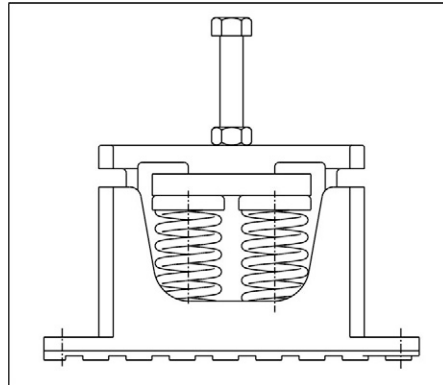


FIGURE 21. VIBRATION ISOLATOR

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.

8.4.3 Connecting the Radiator Skid to the Generator Skid

The Generator Set is not permitted to be moved once the Radiator skid has been attached to the main Engine/Generator skid. Securing the Radiator skid should be done only after the Engine/Generator skid and Radiator skid are in the final mounting location. Assembly should take place on a floor surface that is flat and level. If the generator set is to be moved after assembly then the radiator must be removed and moved separately.

⚠ WARNING

Improper lifting methods and dropping heavy equipment can cause severe personal injury or death. The engine/generator platform and radiator cooling system are heavy; the approximate dry weight of the radiator cooling system is 4,077 kg (9,000 pounds) and the engine/generator/radiator assembly can weigh up to 25,400 kg (56,000 pounds), without coolant. Use a hoist or fork lift of sufficient capacity. Do not stand under a raised radiator or engine/generator and keep hands and feet clear of the perimeter of the radiator or engine/generator while maneuvering them.

1. Move the radiator into position in alignment with the generator and align with the height of the generator set. If placing the generator set on AVM mounts note that it would result in the generator set being at a different height than the radiator due to a weight difference.
2. Use a straight edge along the bottom of the radiator and the bottom of the generator set for setting the alignment of the radiator to chassis.
 - Vertical alignment spec is ± 3 mm between radiator skid and generator set skid bolt holes.
3. Insert the M24 bolts and washers (quantity 8 each) from the radiator side and fit a washer and hex nut on each bolt from the generator set side.

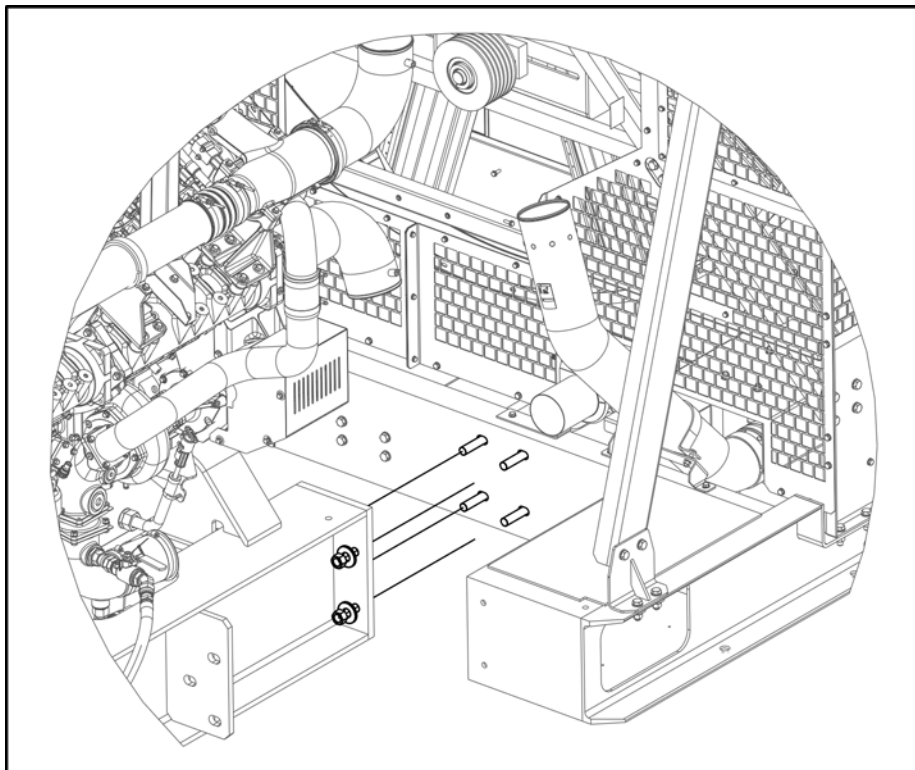


FIGURE 22. GENERATOR SET SKID TO RADIATOR SKID PRIMARY INTERFACE

4. Loosely install two L-brackets to the radiator skid with M22 (quantity 6) bolts and hardware. Fit a washer between the chassis and bolt head and hex nut face.
 - Insert the bolt and washer from the inboard side and fit the washer and hex nut from the outboard side.

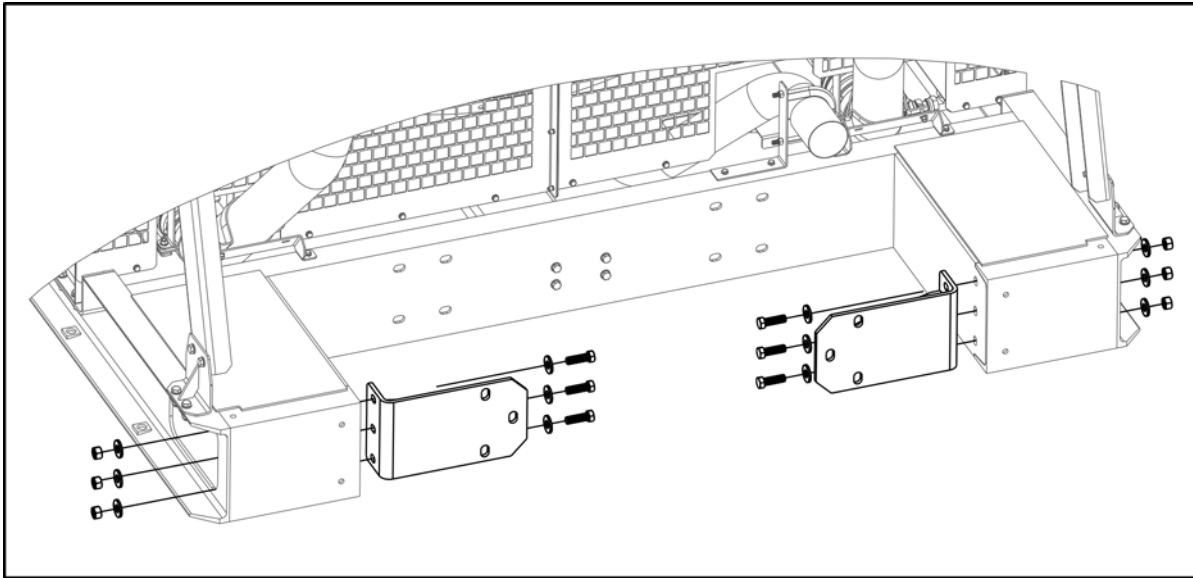


FIGURE 23. RADIATOR SKID L-BRACKETS

5. Loosely install two L-brackets to the generator set skid with M24 (quantity 6) bolts and hardware. Fit a washer between the chassis and bolt head and hex nut face.
 - Insert the bolt and washer from the radiator side and fit the washer and hex nut from the generator set side.

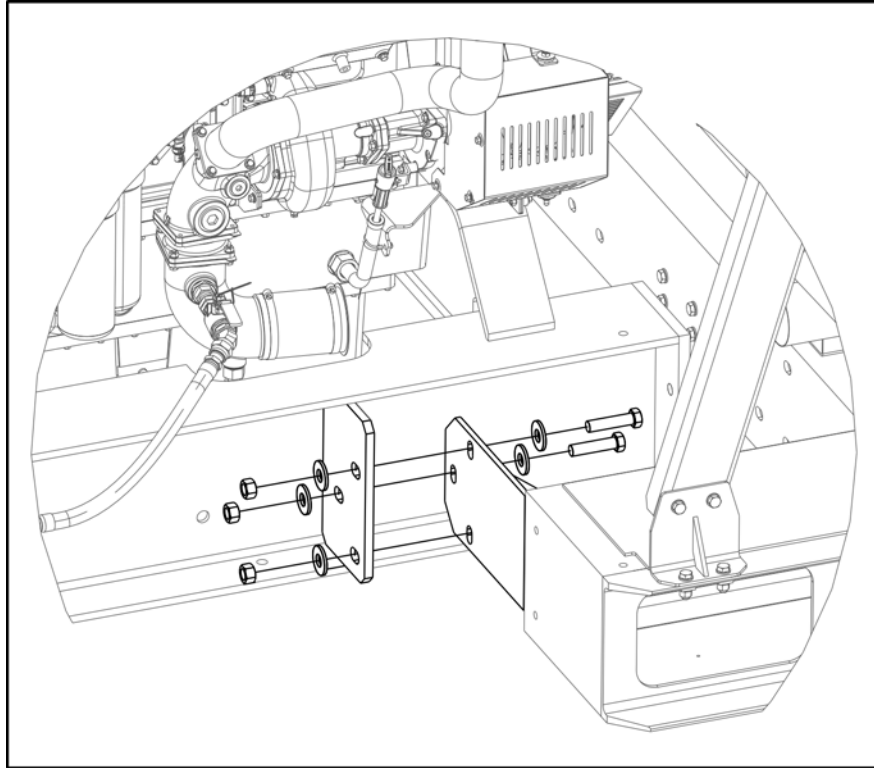


FIGURE 24. GENERATOR SET SKID TO RADIATOR SKID L-BRACKET INTERFACE

6. Use a long level to check alignment between engine pulley and fan pulley surface. Verify that both pulleys are parallel to each other.
7. Level the generator set or radiator as necessary to bring the pulleys parallel.
8. Tighten the 6 M22 bolts and hex nuts between the radiator set skid and L-brackets. Torque to 750 Nm (533 ft-lb).
9. Tighten the 8 M24 bolts and hex nuts between the generator set skid and radiator skid. Torque to 950 Nm (700 ft-lb).
10. Tighten the 6 M24 bolts and hex nuts between the generator set skid and L-brackets. Torque to 950 Nm (700 ft-lb).
11. Verify engine pulley and fan pulley remained parallel during torquing process. Adjust as needed.

8.4.4 Aligning the Cooling System Fan Drive

Align the fan drive after the generator set is assembled, mounted, filled with coolant and leveled. The fan drive pulleys must be aligned for proper fan drive operation.

The fan and idler pulleys are installed and aligned when shipped from the factory. The engine pulley, after installation, needs to be aligned to the fan pulley.

1. Use a long straightedge (not supplied) to align the engine pulley to the fan drive pulley. The straightedge should be flat against the vertical surface of the fan and engine pulleys near the center. See the following figure.
2. The pulleys (all) should be aligned correctly to ± 3 mm (± 0.12 inch), or premature belt failure may occur.

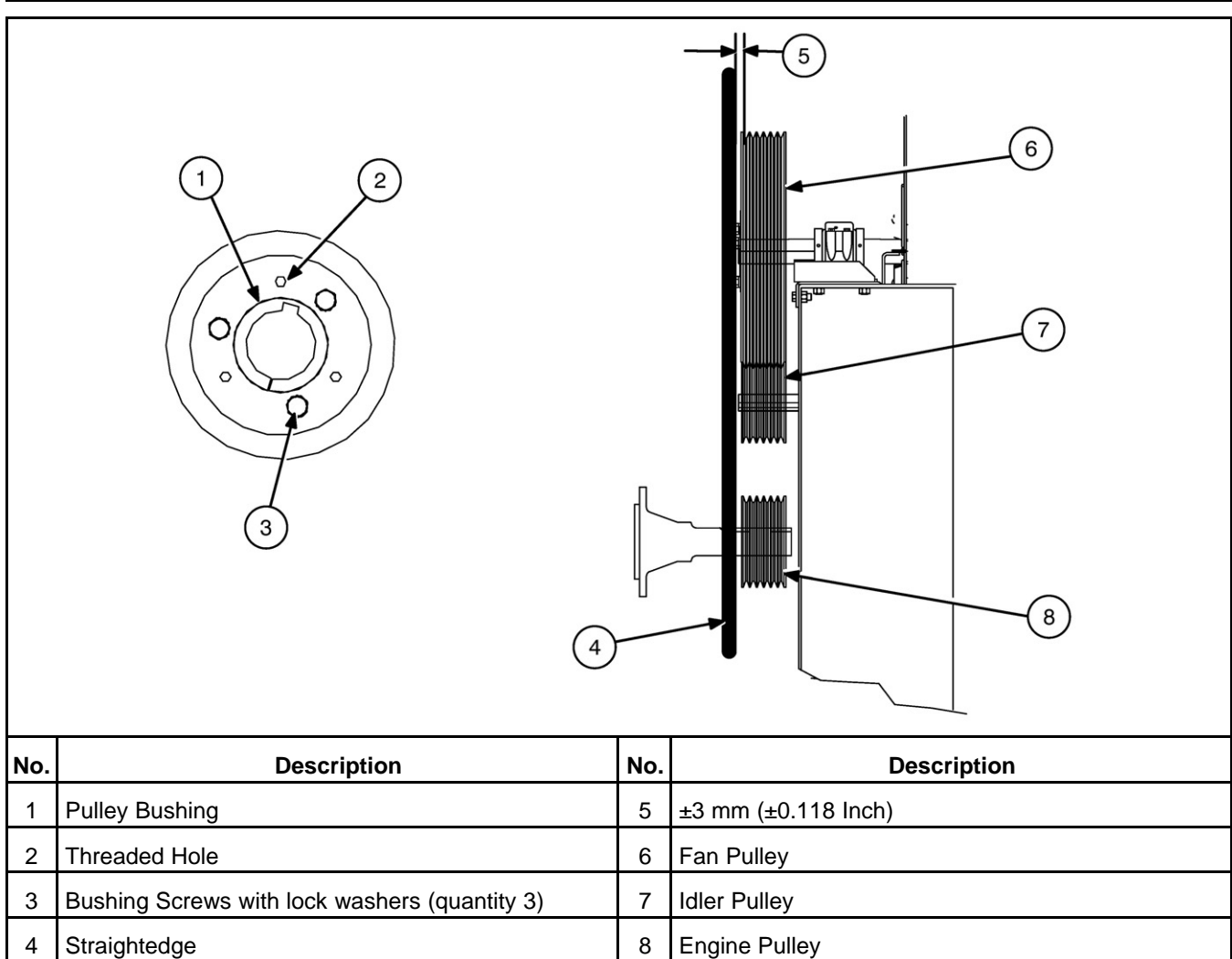


FIGURE 25. ALIGNING THE ENGINE PULLEY TO THE FAN DRIVE PULLEY

3. Align the engine pulley and bushing to the fan pulley on the stub shaft within the specified alignment tolerance. Mark the position of the bushing on the shaft with an indelible marker.
4. Remove only the engine pulley and align the bushing with the mark. Torque bushing set screw to 20 Nm (15 ft-lb).
5. Install the engine pulley to the bushing. Torque the engine pulley screws to 68 Nm (50 ft-lb).
6. Verify the engine pulley and bushing alignment with a straight edge. Adjust as necessary and proceed to belt installation.
 - If the bushing requires adjustment, remove the three screws from the fan pulley bushing. Install one of these screws into the threaded hole located between two of the screws that were removed. Tighten the screw to separate bushing from pulley and remove the screw.
7. Install the belts onto the pulleys. Refer to [Section 8.4.8](#) procedure in this section to loosen idler pulley for belt installation and setting belt tension.

NOTICE

The fan pulley (not shown) capscrews are torqued at the assembly plant and do not require adjustment.

8.4.5 Radiator Coolant Connections

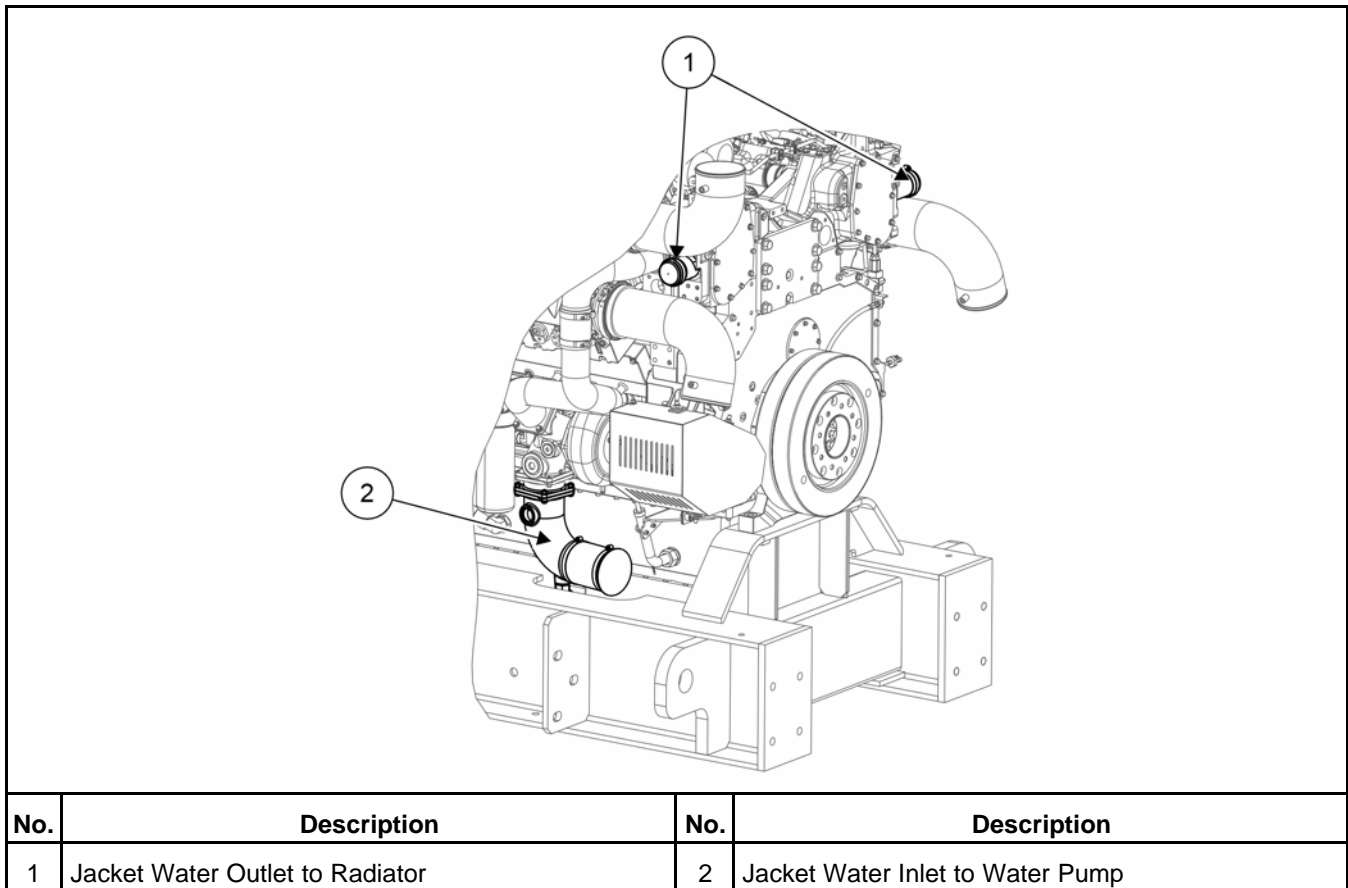


FIGURE 26. WATER CONNECTIONS

8.4.5.1 Installing J/W Inlet Tubing and Couplings

1. Locate the following parts from the kit of parts shipped loose with the radiator:
 - One 5 inch diameter HT pipe
 - One 5 inch diameter Flexmaster coupling

NOTICE

Verify the shipping cover is removed from the engine elbow and the coupling is intact and in place. There may be coolant behind the caps, use care to collect and dispose of in accordance with local regulations.

2. Identify the end of the HT tube that has the beaded edge and align with the engine elbow coupling.
 - a. Make sure the pipe ends are clean. Surfaces should be free of deep scratches, gouges, dents, dirt, etc.

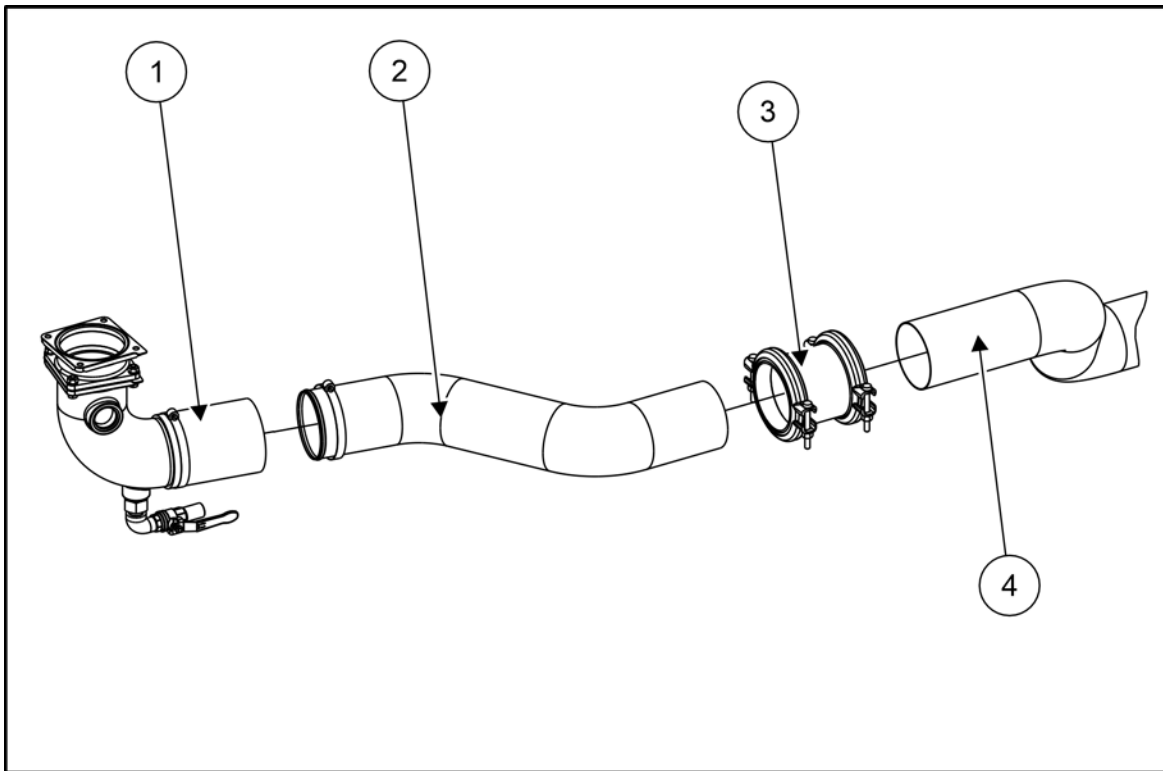


FIGURE 27. COOLANT ELBOW CONNECTION

3. Install the beaded edge of the HT pipe (2) into the engine elbow coupling (1).
4. Make sure the joint is well seated with an overlap of 45 – 53 mm (1.75 – 2 in). Torque clamp fasteners to 8.5 nm (75.2 in-lb).
5. Use Flexmaster coupling (3) to connect the non-beaded end of the HT pipe (2) to the radiator hose (4).

NOTICE

The assembly of gaskets can be made easier by dipping the gasket in a soap/water solution or the fluid to be sealed. The use of other lubricants can be detrimental to the life of the gaskets. Never lubricate the metal parts.

6. Make sure the joint is well seated with an overlap of 45 – 53 mm (1.75 – 2 in). Torque Flexmaster coupling fasteners to 27 nm (239 in-lb).

8.4.5.2 Installing J/W Outlet Tubing and Couplings

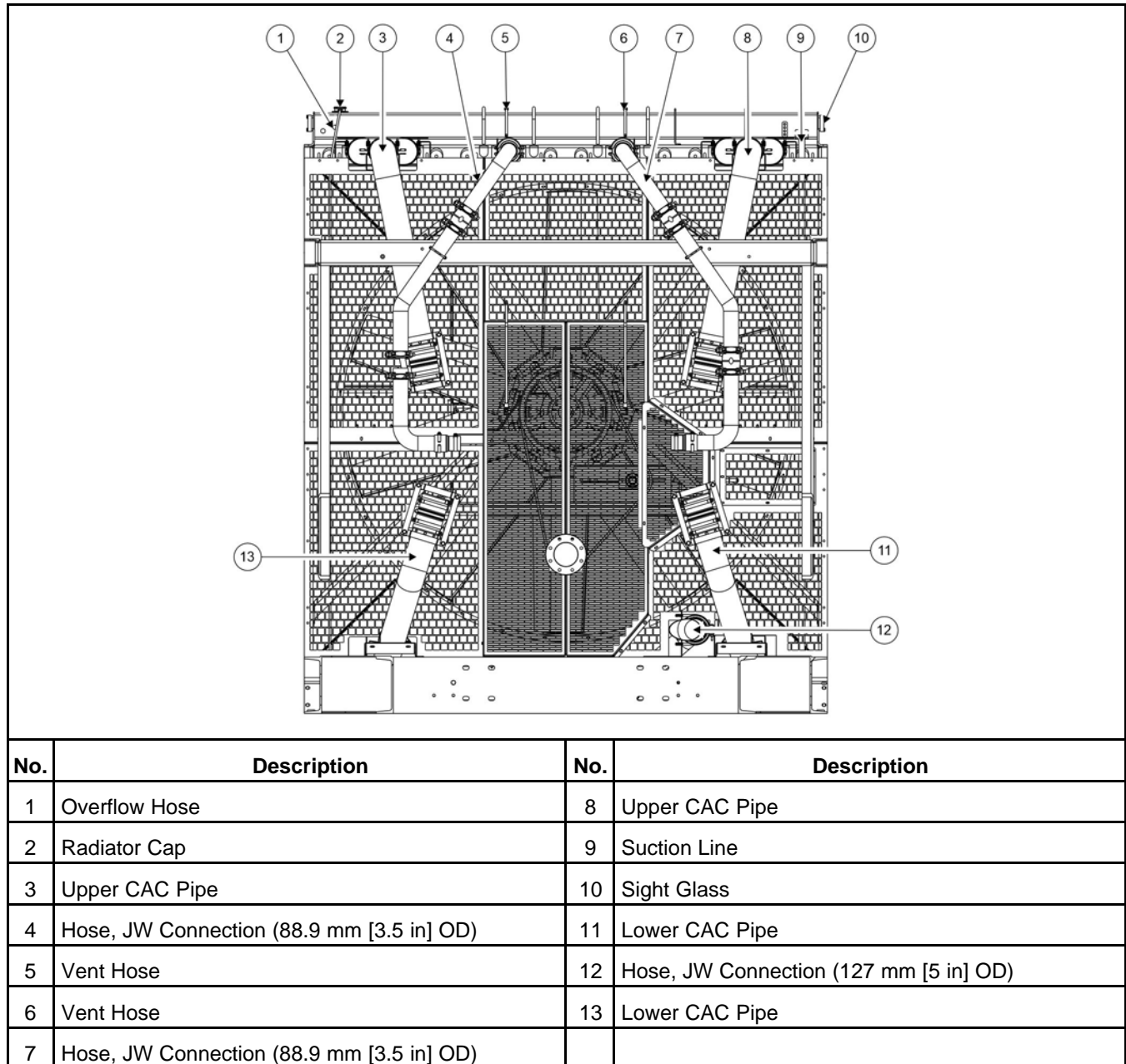


FIGURE 28. PLUMBING DIAGRAM

1. Locate the following parts from the kit of parts shipped loose with the radiator:

- Two 3.5 inch diameter HT pipes
- Two 3 inch to 3.5 inch diameter HT couplings
- Two 3.5 Flexmaster couplings
- Four 3.5 inch heavy duty pipe clamps
- Four 3 inch spring loaded T-bolt clamps

NOTICE

Verify the shipping cover is removed from the engine elbow and the coupling is intact and in place.

2. Make sure the pipe ends are clean. Surfaces should be free of deep scratches, gouges, dents, dirt, etc.
3. On each engine outlet, assemble the HT pipework in the following sequence:
 - a. Slide two spring loaded T-bolt clamps on to the engine side HT pipe.
 - b. Install the 3 inch end of the 3 inch to 3.5 inch diameter HT coupler on to the engine side HT pipe. Make sure the joint is well seated with an overlap of 30 – 47 mm (1.17 – 1.83 in). Secure with the spring loaded T-bolt clamps, torque to 8.5 nm (75.2 in-lb)
 - c. Insert the 3.5 inch HT pipe in to the other end of the 3 inch to 3.5 inch diameter coupler and secure with the heavy duty pipe clamps. Make sure the joint is well seated with an overlap of 44 – 62 mm (1.72 – 2.42 in). Torque to 8.5 nm (75.2 in-lb).
4. Use Flexmaster couplings to connect the pipes to the radiator. Make sure the joint is well seated with an overlap of 44 – 62 mm (1.72 – 2.42 in). Torque to 23 nm (203.5 in-lb).

NOTICE

The assembly of gaskets can be made easier by dipping the gasket in a soap/water solution or the fluid to be sealed. The use of other lubricants can be detrimental to the life of the gaskets. Never lubricate the metal parts.

8.4.6 Installing the Vent Lines and Low Coolant Level Sensor/Cable

1. Remove the plugs from the engine thermostat housing vent line ports using a 6 mm Allen wrench.
2. Install two M14 STOR adapter fittings into the engine thermostat housing vent line ports. Torque to 34 nm (25 ft-lb)
3. Install one vent line on each adapter. Torque to 27 nm (238 in-lb).
4. Secure the vent lines and harness to the upper radiator tubes with cable ties.

NOTICE

Make sure the vent lines do not have any "dips or sags" that trap air.

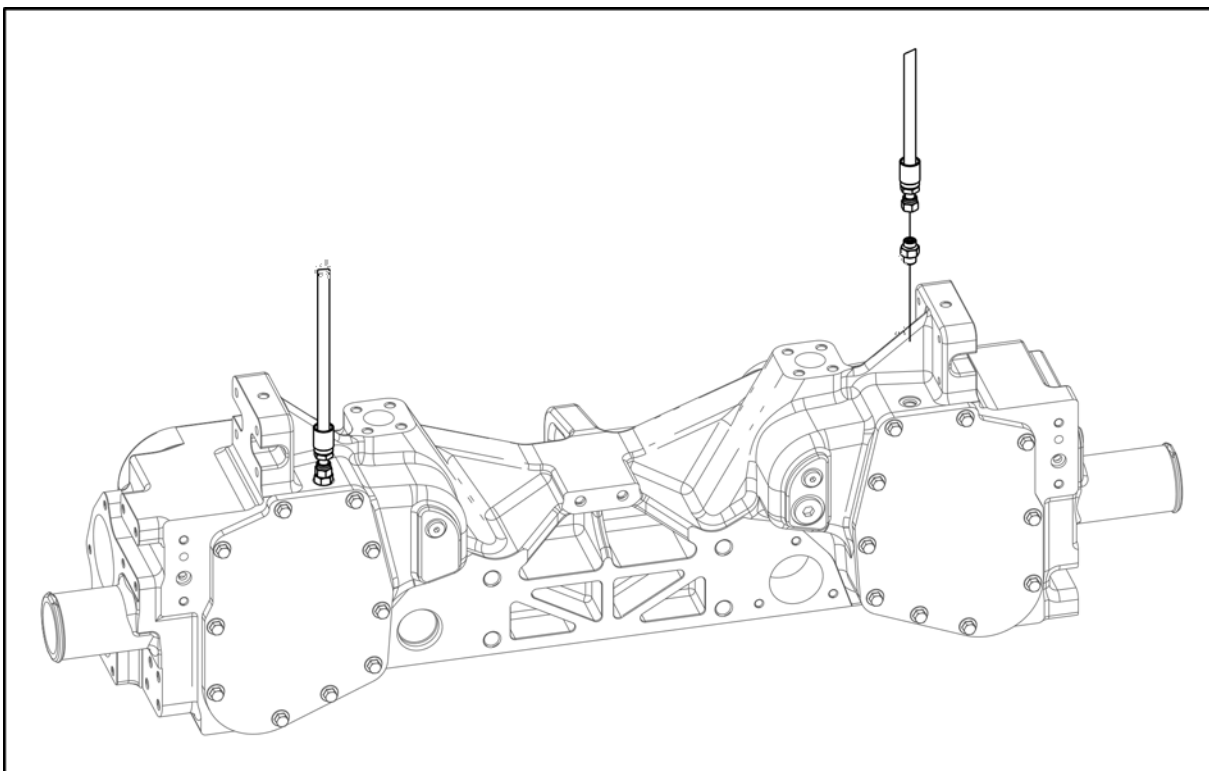


FIGURE 29. RADIATOR VENT LINES

8.4.7 Engine Damper Guard Installation

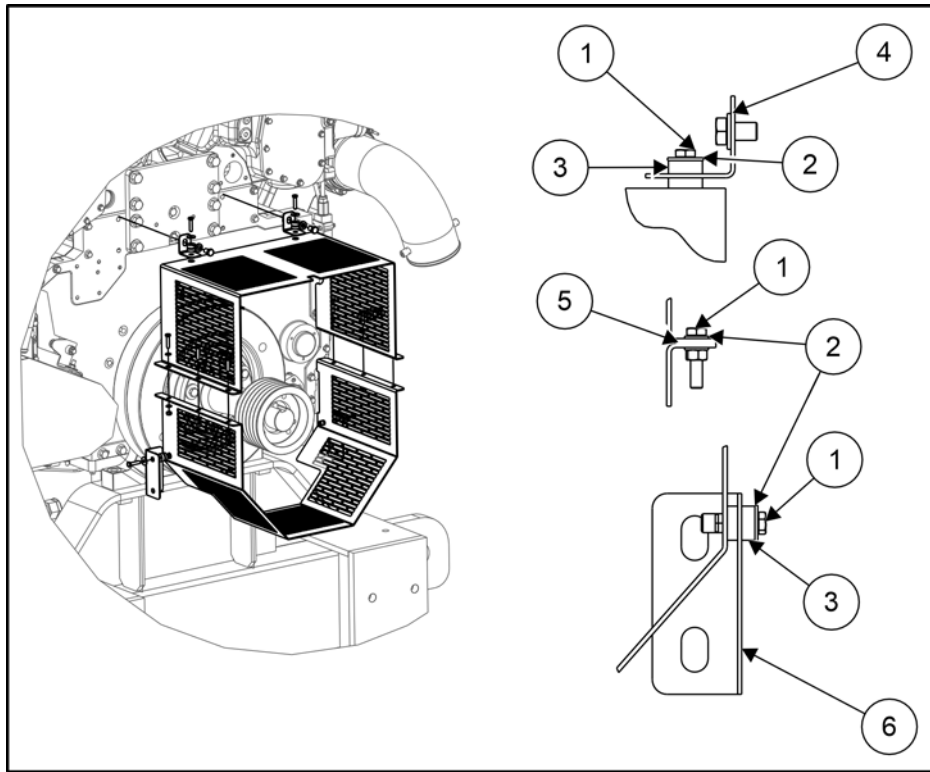


FIGURE 30. ENGINE DAMPER GUARD COMPONENTS

1. Attach the lower brackets (6) to the lower guard panel using the M8 bolts (1), washers (2), and vibration damper (3). Torque to 25.5 nm (226 in-lb).
2. Attach the upper brackets (4) to the upper guard panel using the M8 bolts (1), washers (2), and vibration damper (3). Torque to 25.5 nm (226 in-lb).
3. Remove the M16 gear housing capscrew aligned with the damper guard.
4. Loosely install the M16 gear housing capscrew through the lower damper guard brackets (4, 6).

NOTICE

No washer is required at this joint.

5. Loosely install M12 upper damper guard capscrews to the engine.
6. Loosely install M8 capscrews and washers between upper and lower damper guards (5).
7. Torque M16 gear housing capscrews to 195 nm (144 ft-lb).
8. Torque M12 upper damper guard to engine capscrews to 80 nm (56 ft-lb).
9. Torque M8 upper damper guard to lower damper guard capscrews to 25 nm (226 in-lb).

8.4.8 Fan Belt Installation

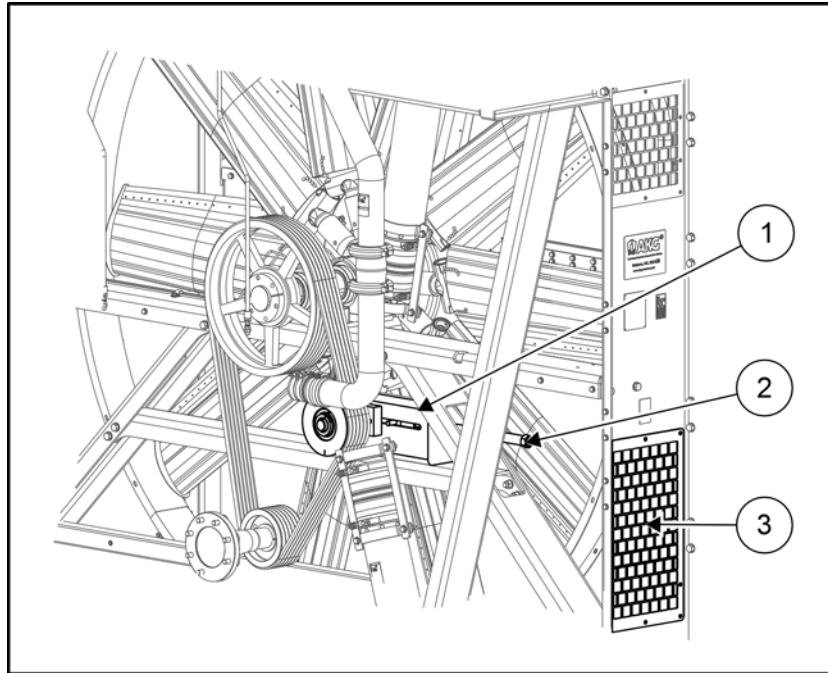


FIGURE 31. FAN BELT TENSIONER

1. Remove the belt tensioner access panel (3) to gain access to the belt tensioner assembly.
2. Loosen two M16 capscrews on the tensioner block (1).
3. Loosen the tensioner rod to move the tensioner pulley inboard (2).
4. Install the six belts over the three pulleys.
5. Tighten the tensioner rod to move the pulley outboard and apply tension to the belts.
6. Verify all belts are seated in the grooves of the pulleys.

NOTICE

The following deflection measurement should be measured from the tip of the Browning belt tension tool to the large o-ring on the tool. This measurement may not align with the scale on the tool

- New belts – 8 mm deflection with 16.9 pound-force (7.6 kg-force) on the middle of the longest section of belt.
 - Used belts – 12 mm deflection with 16.9 pound-force (7.6 kg-force) on the middle of the longest section of belt.
7. Tighten the M16 capscrews (1) on the tensioner block. Torque to 245 nm (181 ft-lb).
 8. Check that the belt tension remained in spec during tightening process.
 9. Loosen tensioner and adjust belt tension if necessary (2).
 10. Install belt tensioner access panel (3).

8.4.9 Greasing the Fan Bearings

NOTICE

The fan bearings are pre-lubed and do not require additional grease to be added during radiator installation.

8.4.10 Fan Drive Guard Installation

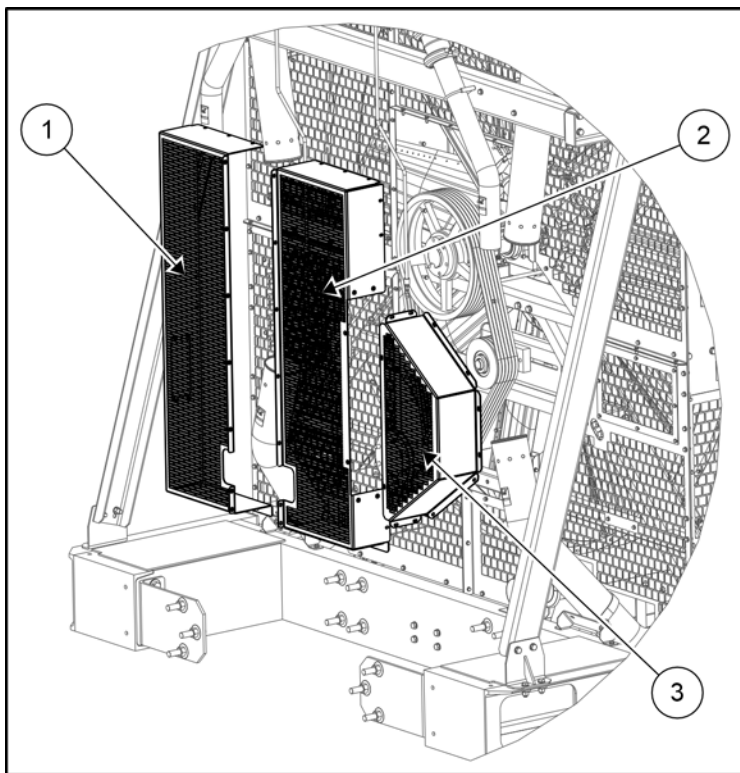


FIGURE 32. FAN DRIVE BELT GUARDS

1. Install the following guard panels using the M8 capscrews provided with the radiator.
 - Left belt guard panel (1)
 - Right guard panel (2)
 - Idler pulley guard panel (3)
2. Torque all M8 capscrews to 30 nm (22.1 ft-lb).

8.4.11 Coolant Level Sensor Installation

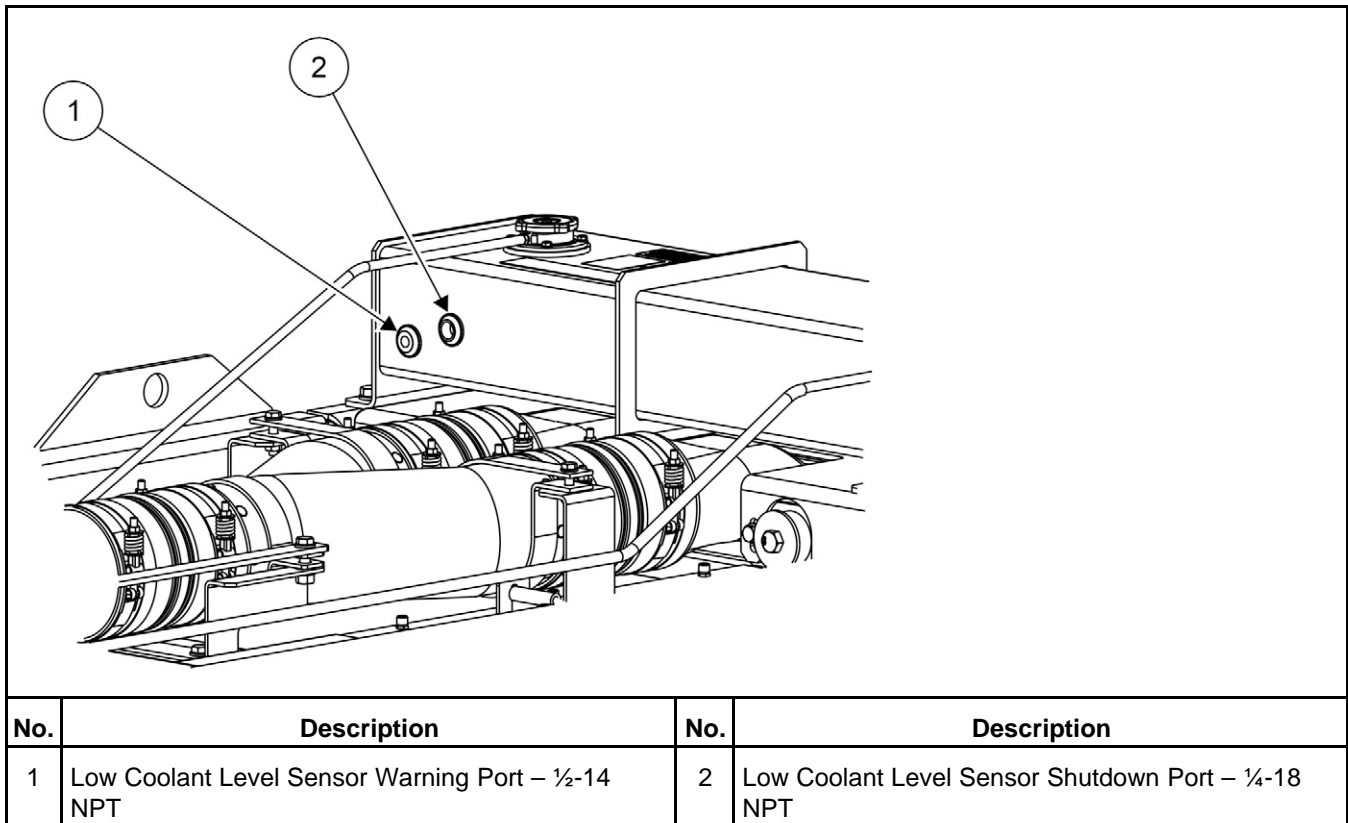


FIGURE 33. COOLANT LEVEL SENSOR LOCATION

1. Remove and dispose of the hex plugs in the two coolant level sensor ports in the radiator expansion tank.

NOTICE

When installing the coolant level sensors, apply thread sealant to the threads only. Do not allow sealant to contact the sensor sender. Do not use Teflon tape.

2. Install the ½ in low coolant level warning sensor into the upper ½ in port and hand tighten.
3. Install the ¼ in low coolant level shutdown sensor into the lower ¼ in port and hand tighten.
4. Torque both sensors to 8 nm (71 in-lb).
5. Connect the harness to the low coolant level warning sensor.
6. Connect the harness to the low coolant level shutdown sensor.
7. Connect ground lead from sensor wiring harness. Torque to 11 nm (97 in-lb).

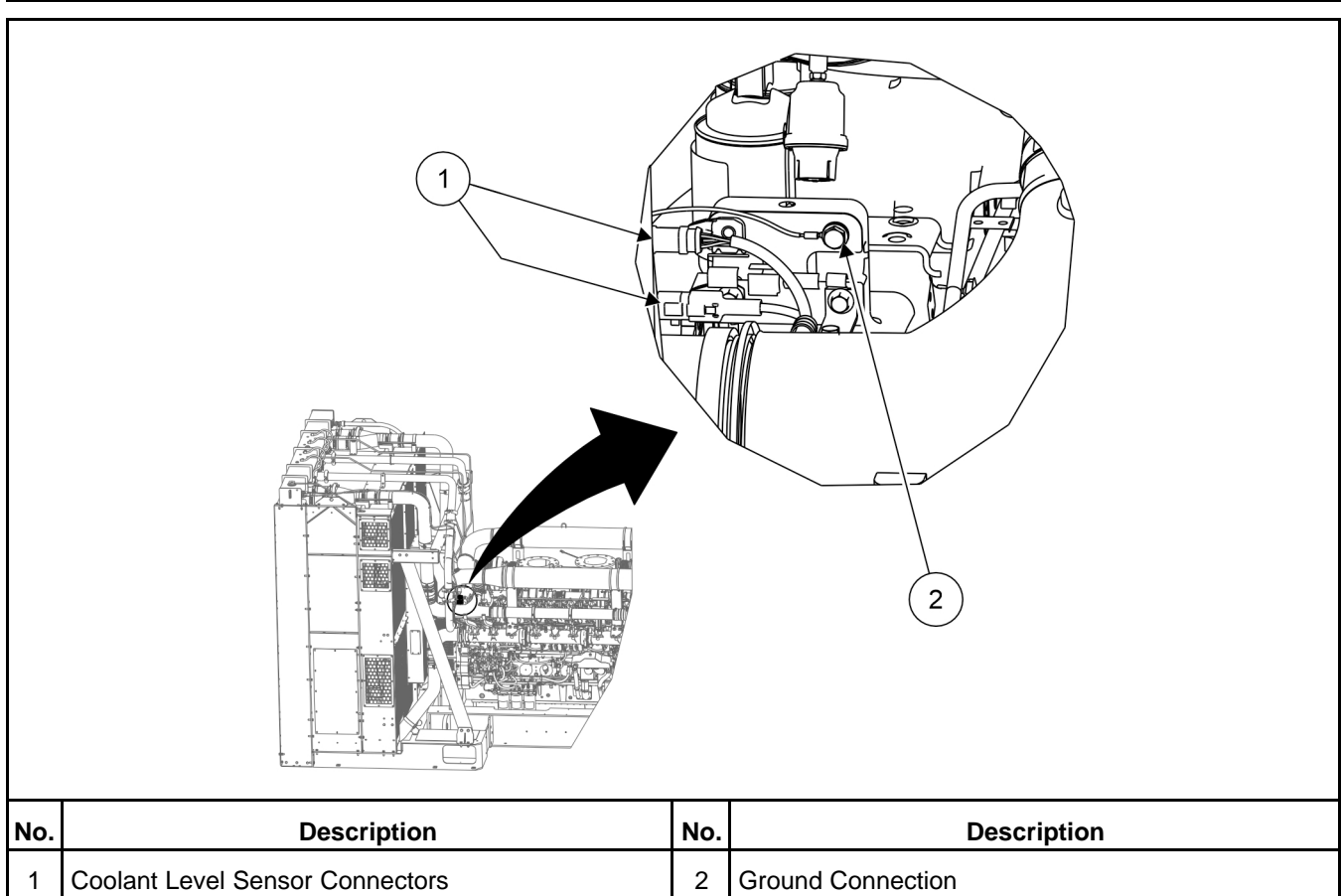


FIGURE 34. RADIATOR DRAIN VALVE

8. Route the wiring harness down the radiator tube and secure with cable ties.

8.4.12 Charge Air Cooler

8.4.12.1 Installing the Charge Air Cooler Elbows to the Engine

Mount the Charge Air Cooler (CAC) engine elbow on to the compressor outlet using the v-band clamp secured to the marmon joint. Later adjustment will be required when the CAC pipe is connected.

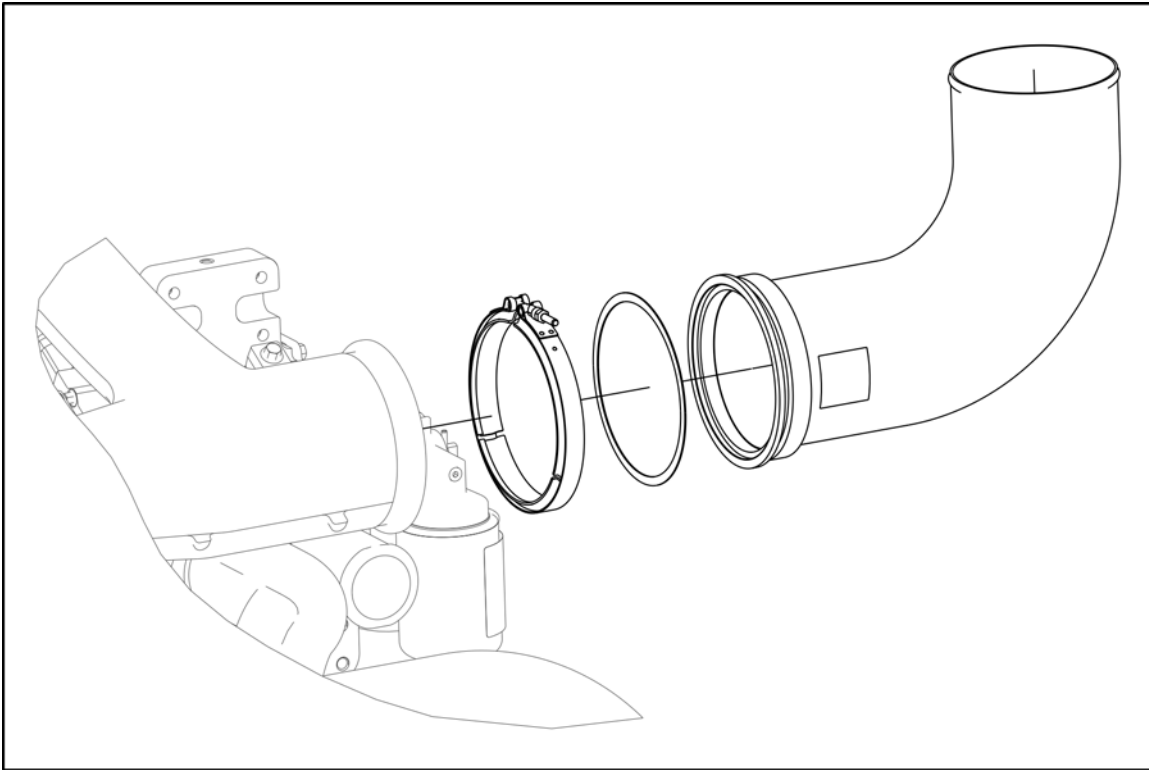


FIGURE 35. CHARGE AIR COOLER ELBOW

8.4.12.2 Charge Air Cooler Connections Overview

Each Charge Air Cooler (CAC) connection is comprised of the following:

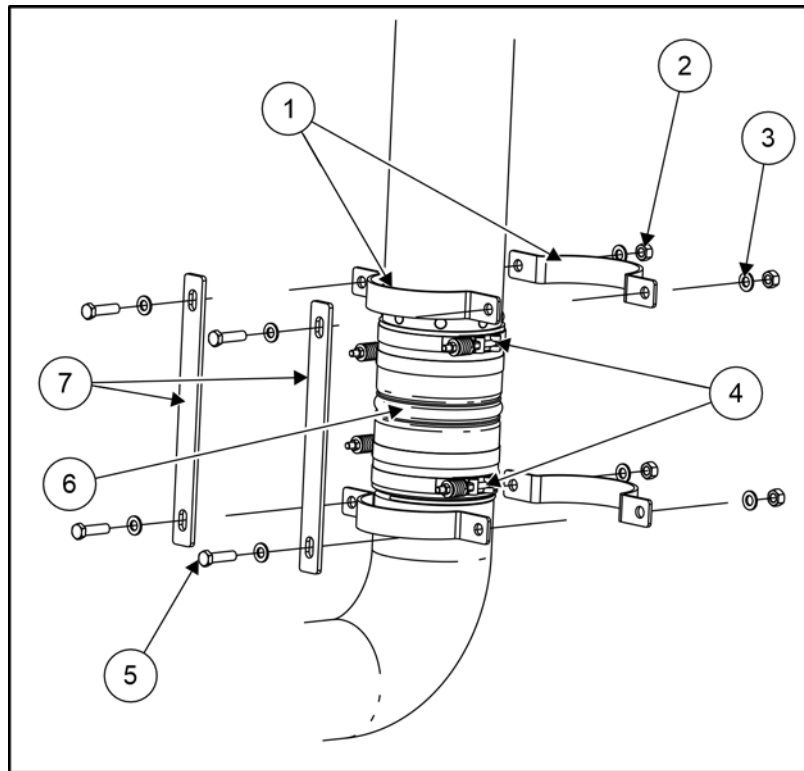


FIGURE 36. CHARGE AIR COOLER PIPE CLAMP DETAIL

- Two 6 in saddle clamps (each clamp is made of two halves)
- Two retaining straps
- Four M12 hex bolts
- Four M12 hex flange nuts
- Eight M12 flat washers
- One 6 in. silicone coupling
- Four 6 in. spring loaded t-bolt (SLTB) clamps

Assemble the coupling.

1. Loosely slide two SLTB clamps (4) on to each coupling.
2. Position the silicone coupling (6) on the end of the CAC tube and the engine-mounted elbow, joining the two.
3. Fully seat the silicone coupling at each end with enough room to install the SLTB clamps between the tube bead and the end of the silicone coupling.
4. Align the SLTB clamps on the ends of the silicone couplings .
5. Torque the SLTB clamp bolts to 6.8 nm (60.1 in-lb).

NOTICE

Verify the SLTB clamps have not pinched the silicone coupling

Assemble the saddle over the CAC coupling.

1. Align two saddle clamps (1) to each silicone coupling, one at each end.

2. Secure a retaining strap (7) between the two halves of the saddle clamps.

NOTICE

The retaining straps will be parallel to the CAC pipe.

3. Insert a M12 hex head bolt (5) with a flat washer (3) through the clamp and fasten with a flat washer followed by a hex nut (2).
4. Torque to 100 nm (75 ft-lb).

8.4.12.2.1 Charge Air Cooler Upper Connection

Align the two upper Charge Air Cooler (CAC) pipes with the engine compressor outlet elbows.

- Engine elbows can be rotated within the v-band clamp for alignment.

NOTICE

Gasket damage can occur during engine elbow rotation. Use care to make gentle movements.

- Adjustment of the CAC pipe position can be made by loosening the upper saddle clamps.

Tighten the upper CAC pipe saddle clamps as needed after final CAC pipe position has been determined.

Torque the engine elbow v-band clamp to 10 Nm (88.5 in-lb)..

8.4.12.2.2 Charge Air Cooler Lower Connection

Align the two lower Charge Air Cooler (CAC) pipes with the engine intake elbows.

- Engine elbows can be rotated within the v-band clamp for alignment.

NOTICE

O-ring damage can occur during engine elbow rotation. Use care to make gentle movements. If removing the CAC tube for lifting, verify o-rings are properly seated when installed. Apply Haynes Lubri-film to hold the o-ring in place during installation.

- Adjustment of the CAC pipe position can be made by loosening the lower saddle clamps.

Tighten the lower CAC pipe saddle clamps as needed after final CAC pipe position has been determined.

Torque the engine elbow v-band clamp to 10 Nm (88.5 in-lb)..

8.5 Radiator Drain Valve Installation

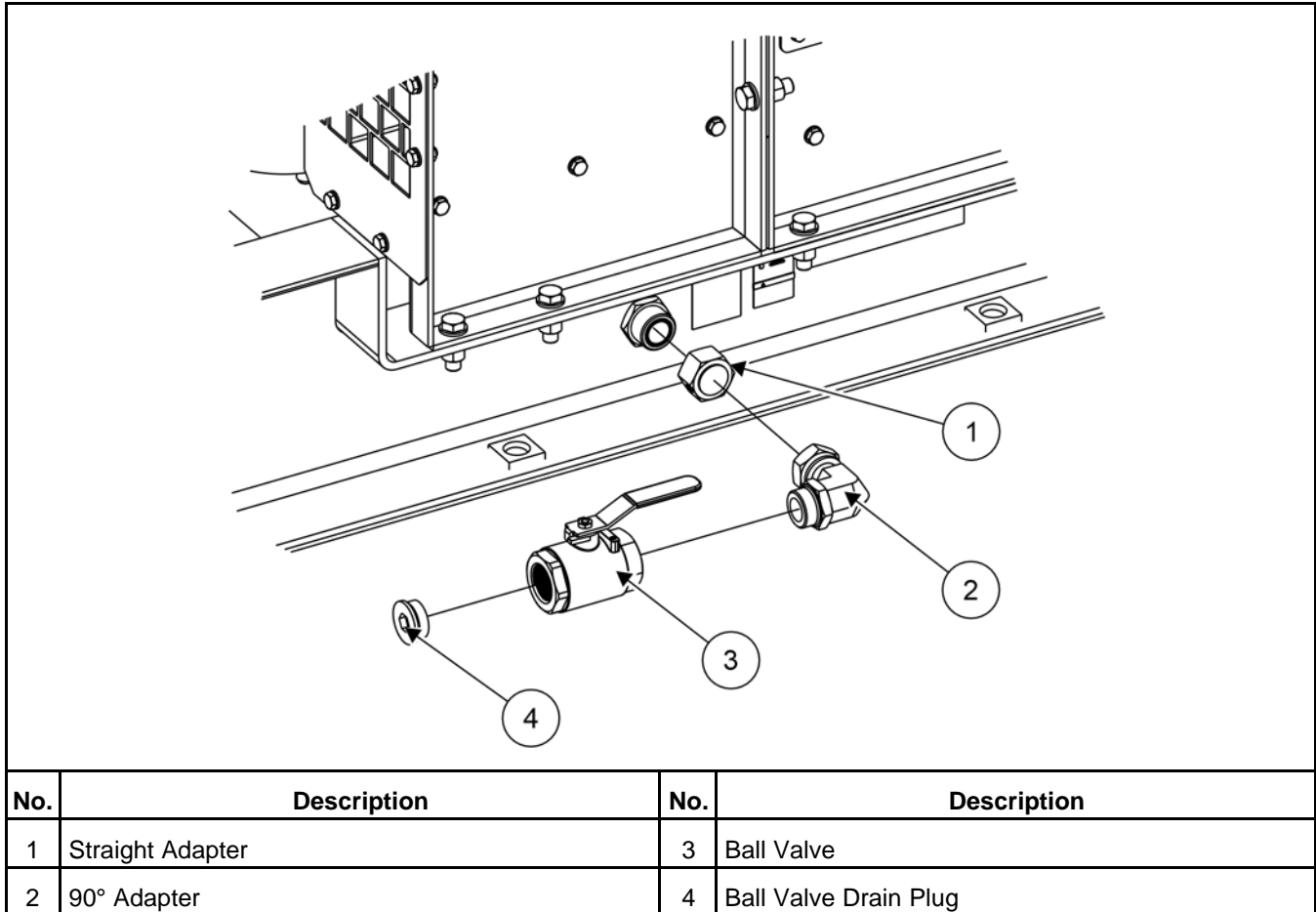


FIGURE 37. RADIATOR DRAIN VALVE

1. Remove the cap from the radiator drain valve port on the bottom right side of the radiator skid.
2. Install 90° adapter (3) to the drain port. Orient the adapter so the open end points toward the rear of the generator set.
3. Install the ball valve (1) to the 90° adapter. Orient the ball valve so the ball valve handle (2) faces up.
 - Verify the ball valve is in the closed position.

8.6 Coolant Circuit Pressure Test Requirement

Upon completion of a radiator installation a pressure test should be completed on the coolant circuit.

1. Connect a regulated compressed air source to the radiator drain valve.

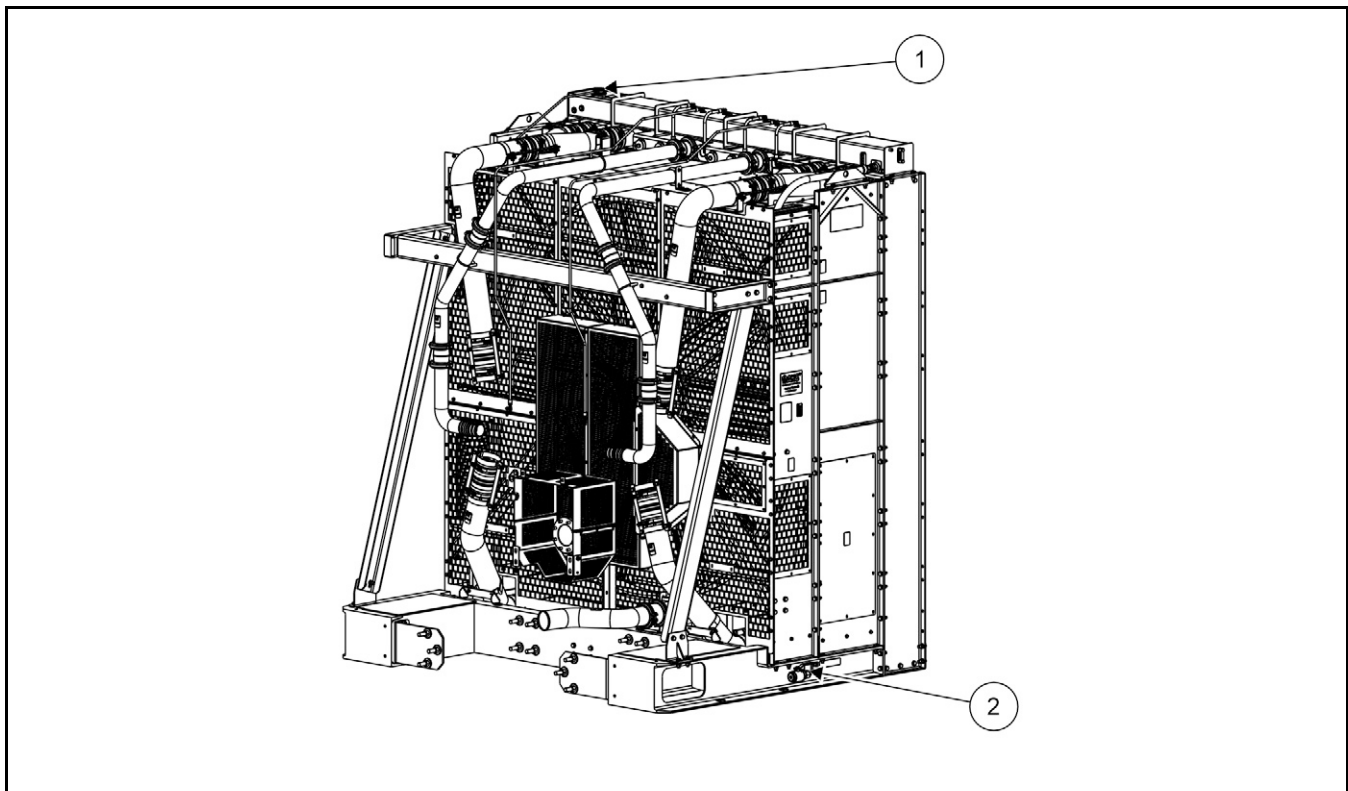
NOTICE

Use of a pressure regulator is required to avoid over-pressurization. Do not exceed 13 psi or damage to the radiator cap can occur.

2. Zero the regulator pressure gauge.

3. Pressurize the cooling system to a pressure of 48 – 69 kpa (7 – 10 psi).
4. Once pressurized wait 3 minutes, then note the observed pressure.
5. Observe pressure for 5 minutes for a pressure drop greater than .69 kpa (0.1 psi).
6. If a pressure drop greater than specified is observed, inspect the cooling system connections for leaks using a mixture of 5:1 water to mild soap.
 - a. Correct any leaks and re-test.
 - b. If leaks persist after re-testing contact Cummins for further direction.
7. If no leaks are found, gradually release the pressure and proceed to fill the radiator.

8.7 Filling the Cooling System – Top Fill



No.	Description	No.	Description
1	Fill Neck	2	Drain Valve

FIGURE 38. RADIATOR FILL LOCATION

1. Remove the pressure cap from the radiator fill neck.
2. Fill with 455 L (120 US Gal) of 50/50 mixed water/ethylene glycol coolant at a fill rate of 11.4 lpm (3 gpm).
3. Check the coolant level via the sight glass mounted on either side of the radiator top tank.
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.

8.8 Filling the Cooling System – Bottom Fill

NOTICE

Bottom fill option must be installed prior to performing this procedure.

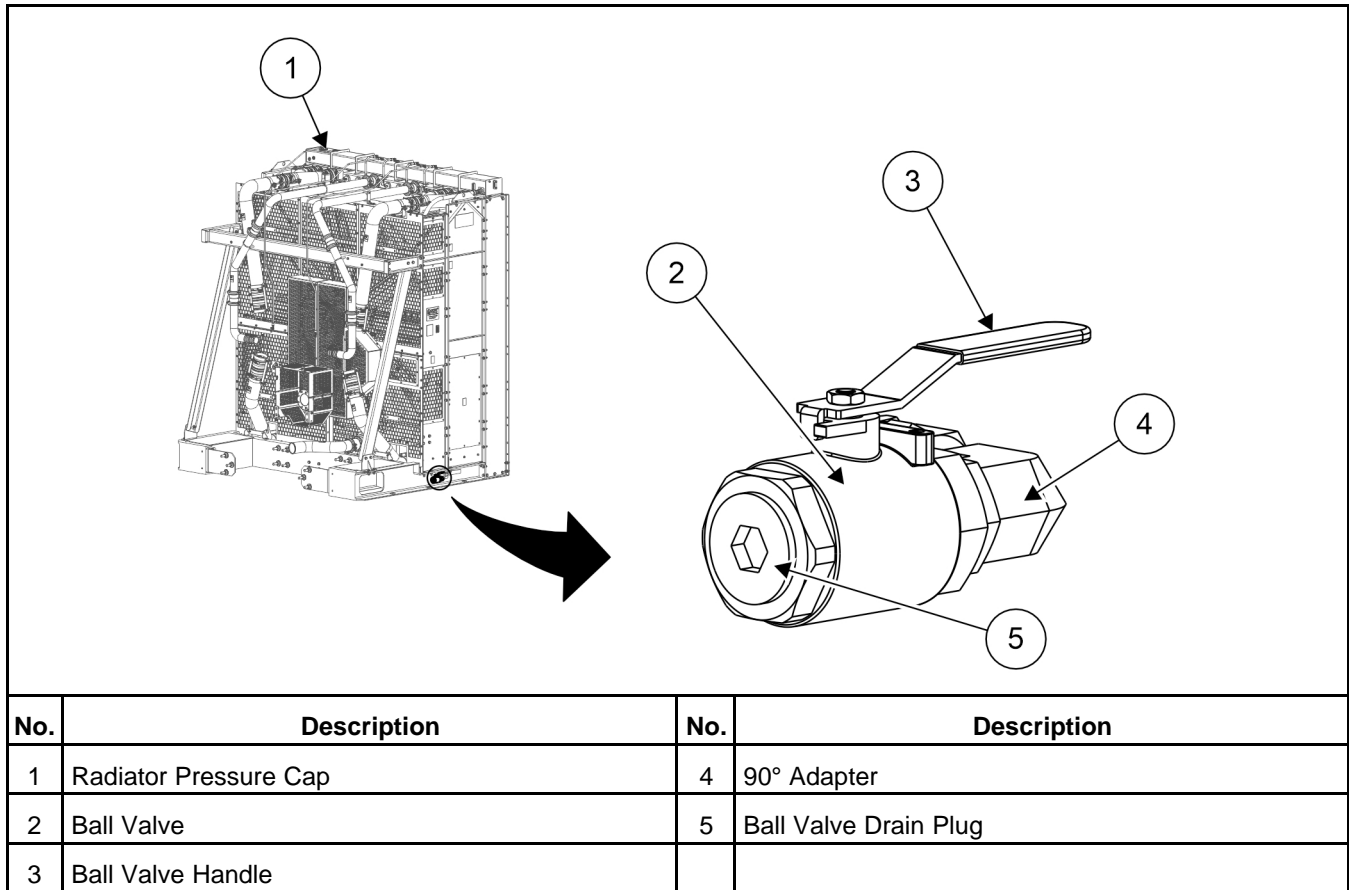


FIGURE 39. RADIATOR DRAIN VALVE

1. Remove the pressure cap (1) from the fill neck.
2. Remove the plug (5) from the ball valve.
 - Do not dispose of the plug, it will be replaced after filling.
3. Connect the coolant supply to the radiator shutoff valve (2).
4. Open the shutoff valve.
5. Fill with 455 L (120 US Gal) of 50/50 water/ethylene glycol coolant mixture at a maximum fill rate of 11.4 Lpm (3 US gpm).
6. Close the shutoff valve (2).
7. Check the coolant level via the sight glass and adjust as necessary.

8. Check for coolant leaks during and after the radiator fill process.
9. Install the pressure cap (1).
10. Test run the generator for 10 minutes with the coolant temperature above 82°C (180°F).
11. Check for coolant leaks.
12. When cooled to allow safe checking of the coolant level, top off as needed.

8.9 Test Running the Generator Set

The final check is to observe the drive belts when the generator set is running.

 **WARNING**

A misaligned fan drive or improperly installed drive belt can cause the belt to break, causing severe injury to nearby personnel. A properly aligned belt can grab loose clothing or body parts, causing severe personal injury. Wear safety glasses and stand far back from the running fan drive without guards installed.

When starting the engine for the first time after completing the installation of the generator set at the site, confirm that the drive belts are properly seated in all grooves of the pulleys. This only requires a visual inspection.

9 DC Control Wiring

WARNING

Electric Shock Hazard

Voltages and currents present an electrical shock hazard that can cause severe burns or death. Avoid contact with the voltage sense and bus sense leads; voltages of up to 600 VAC may still be present. These voltages could be live even when the generator set is switched off.

WARNING

Electric Shock Hazard

Voltages and currents present an electrical shock hazard that can cause severe burns or death. Make sure all power is off before performing control wire installation.

WARNING

Electric Shock Hazard

Voltages and currents present an electrical shock hazard that can cause severe burns or death. To prevent accidental electrocution, stand on a clean dry wooden platform or clean rubber insulating mat, make sure your clothing and shoes are dry, remove all jewelry, and use tools with insulated handles.

The generator set control box contains connection points for remote control and monitor options.

NOTICE

Always run control circuit wiring in a separate metal conduit from the AC power cables to avoid inducing currents that could cause problems within the control.

Use cable ties to keep control wiring away from sharp edges and AC power cables within the control housing.

NOTICE

Stranded copper wire must be used for all customer connections to the control panel. Solid copper wire may break due to the generator set vibration.

Use flexible conduit for all wiring connections to the generator set.

9.1 Guidelines for Customer Connections to the Control System

- Torque terminals to 0.5 Nm (4.4 in-lb)
- Wire type: Use 60 C rated minimum copper wire
- Terminal screws (if fitted) are slotted 0.6 mm
- Use flat bladed screwdriver with 2.5 mm blade

- Strip wire length to 6.0 mm (0.236 in) for screw type terminals and 10 mm (0.75 in) for push type terminals

9.1.1 Digital Connections

Connection points, other than relayed outputs and network are considered digital connections. The type/gauge wire to use for these connections are:

- Less than 305 m (1000 ft), use 0.5 mm² (20 gauge) stranded copper wire.
- 305 m to 610 m (1000 ft to 2000 ft), use 0.75 mm² (18 gauge) stranded copper wire.

9.1.2 Relay Connections

Due to the wide variety of devices that can be attached to the relay outputs, the electrical contractor must determine the gauge of the stranded copper wire that is used.

9.2 PowerCommand 3.3 Customer Connections

Refer Wiring Diagrams drawing.

9.2.1 Configurable Outputs

Each output has normally-open contacts. The contacts can be used to control small devices, indicator lamps, or relays.

The contacts are programmed to energize by entering a code number for the desired event.

NOTICE

Using the InPower service tool or accessing the Setup submenus is required to modify the customer outputs. Contact an authorized distributor for assistance.

9.2.1.1 Contact Ratings for Configurable Outputs

TABLE 4. CONTACT RATINGS FOR CONFIGURABLE OUTPUTS

Description	Value
Maximum Voltage	30 VDC
Maximum Current	3.5 Amps

9.2.2 Remote Start

⚠ 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.

NOTICE

Remote start terminals should only be used for a remote application. Remote start terminals are not to be shorted if the remote start function is not intended to be used.

When the control is in Auto/Remote mode, grounding this input initiates the engine cranking and start sequence. This circuit must be opened to permit resetting a shutdown condition with the Reset input. (The remote stop is actually the removal of the remote start signal to the control.)

9.2.3 Configurable Inputs

Grounding any one of these inputs activates the corresponding warning or shutdown sequence.

External sensing equipment must be connected to the designated digital input.

The nature of the fault is an optional customer selection. Example inputs: Low Coolant Level, Low Fuel Level, Ground Fault, etc.

NOTICE

The InPower service tool or access to the Setup submenus is required to modify the customer fault inputs. Contact your authorized distributor for assistance.

9.2.4 Remote Emergency Stop

Opening this input causes an immediate shutdown. Emergency stop must be reset at the remote panel, then at the front panel.

9.3 Customer Relays

9.3.1 Location of Customer Relays

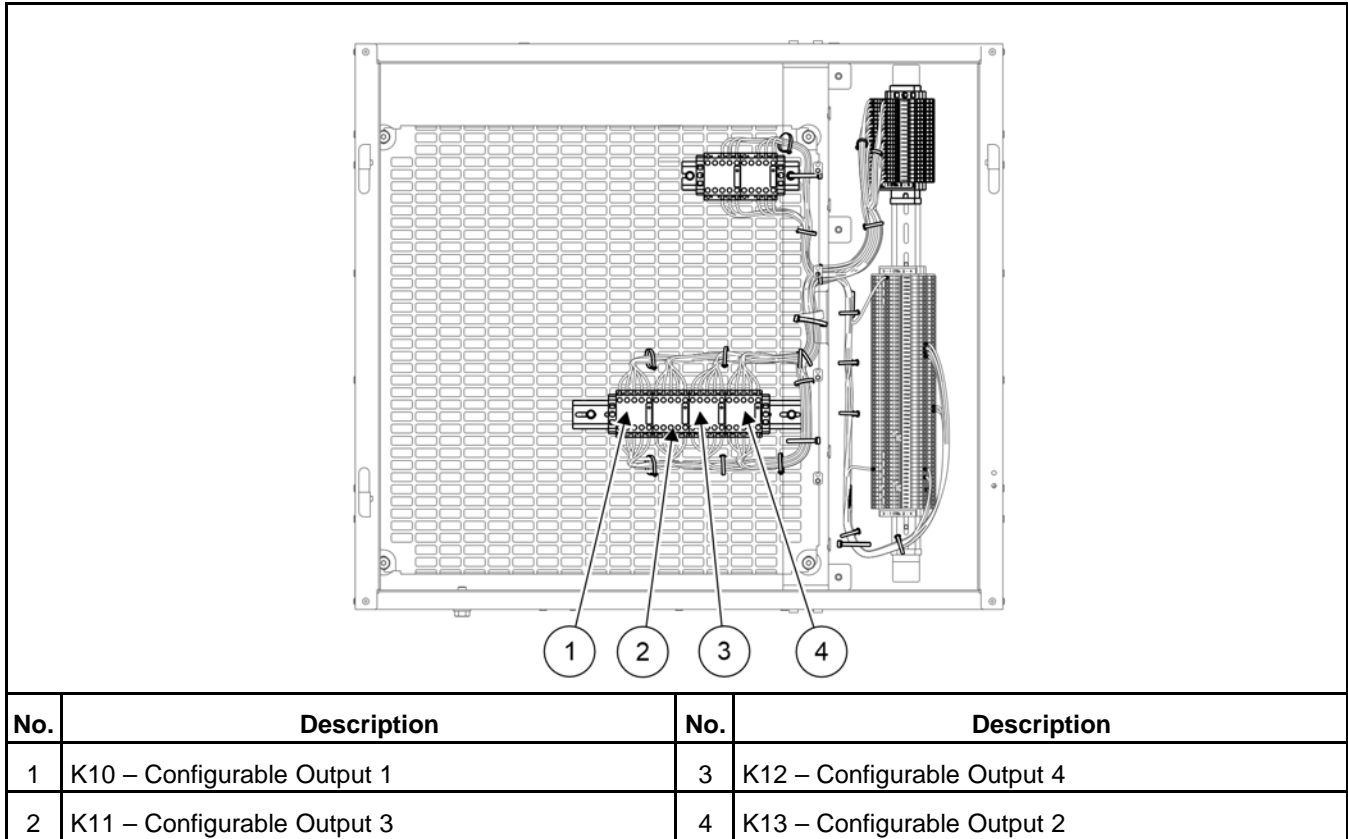


FIGURE 40. LOCATION OF CUSTOMER RELAYS

9.3.1.1 Configurable Outputs

This relay is connected to the corresponding configurable output on the control. If the configurable output is active, the relay is active. If the configurable output is inactive, the relay is inactive.

This relay allows the configurable output to control larger devices, and it isolates the control from these devices.

9.3.1.2 Contact Specifications

The contacts are rated at 10 A at 600 VAC.

9.3.1.3 Schematic

Refer to [Section A.1](#).

9.4 Paralleling Circuit Breaker Control Relays

9.4.1 Paralleling Circuit Breaker Control Relays Installation

The circuit breaker control and monitor function manages opening and closing the generator set breaker. It also manages sensing/determining both generator set and utility breaker positions. The generator set breaker is controlled with two separate relays -one for closing and one for opening.

The control logic instructs the generator set breaker to always (except for a short delay) close or always open the breaker. Opening the breaker always takes priority over any close.

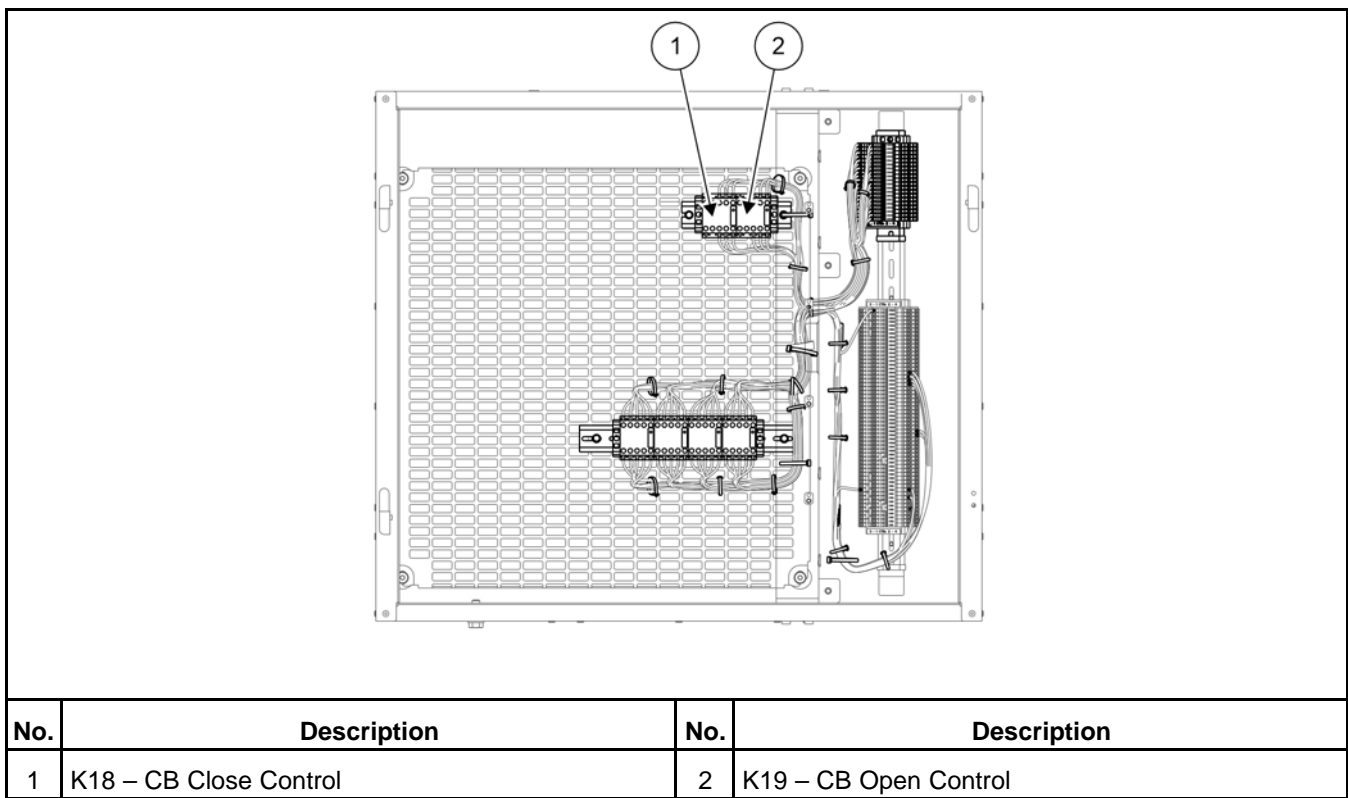
Only two functions can close the breaker - either a dead bus close or the permissive close (sync check).

In single generator set applications, the relay contact used for breaker closing is capable of being set up to trip the breaker on fault shutdowns only and the breaker position is not sensed.

TABLE 5. BREAKER CONTROL FUNCTIONS

Connector Pins	Signal Name	Signal Type	Description of Default Function
TB5-1, TB5-2	Genset CB Close Status	Relay Output	Contact for closing generator set breaker, ratings 5A 30 VDC inductive L/R = 7 msec
TB5-3, TB5-4, TB5-5	Genset CB Open Status	Relay Output	Contact for opening generator set breaker, ratings 5A 30 VDC inductive L/R = 7 msec
TB5-6, TB5-7	Utility CB Close Status	Relay Output	Contact for closing utility breaker, ratings 5A 30 VDC inductive L/R = 7 msec
TB5-8, TB5-9	Utility CB Open Status	Relay Output	Contact for opening utility breaker, ratings 5A 30 VDC inductive L/R = 7 msec

Paralleling circuit breaker control relays are located in the control pedestal.



For a wiring diagram of the paralleling circuit, see [Section A.1](#)

FIGURE 41. PARALLELING CIRCUIT BREAKER CONTROL RELAYS

9.5 Ground Fault Relays

A Ground Fault Relay (GFR) continuously monitors the neutral-to-ground connection and activates a fault alarm when the connection is broken. During generator set operation, the relay continuously monitors the line-to-neutral and activates a fault alarm when a ground fault is sensed.

A control reset will clear the fault at the control panel and will also reset the ground fault relay. The Ground Fault Relay is in customer scope.

9.5.1 Ground Fault Relay

TABLE 6. SPECIFICATIONS

Description	Specification
Maximum AC Terminal Voltage	600 VAC
Supply Voltage	12 – 48 VDC
Continuous Current	5 Amps
Operating Ambient Temperature	-10 to +60 Degrees C
Weight	Less than 250 Grams
Time Delay Setpoint	Adjustable 0 to 10 Seconds

Description	Specification
Tip Current Setpoint	100 / 150 / 200 / 250 / 300 / 450 / 600 / 750 / 800 / 1200 Amps
Burden	Less than 1.5 Watts
Response Time	Less than 200 MS
Rated Contact Voltage	8 Amps at 250 VAC
Rated Contact Voltage	8 Amps at 30 VDC

9.5.2 Ground Fault Relay Installation

The connection points on the ground fault relay that are used are listed in the following table.

TABLE 7. GROUND FAULT RELAY CONNECTIONS

Relay Connection	Terminal Block Connection	Harness
GFR-1	CTB7-4	Relay
GFR-2	CTB53-4	
GFR-14	CTB14-2	
GFR-15	CTB15-2	
GFR-6	J36-R	AC
GFR-8	J36-P	

The two leads connected from GFR-14 and GFR-15 to CI-14 and 15 are configurable inputs. Refer to the following figure when making wiring connections.

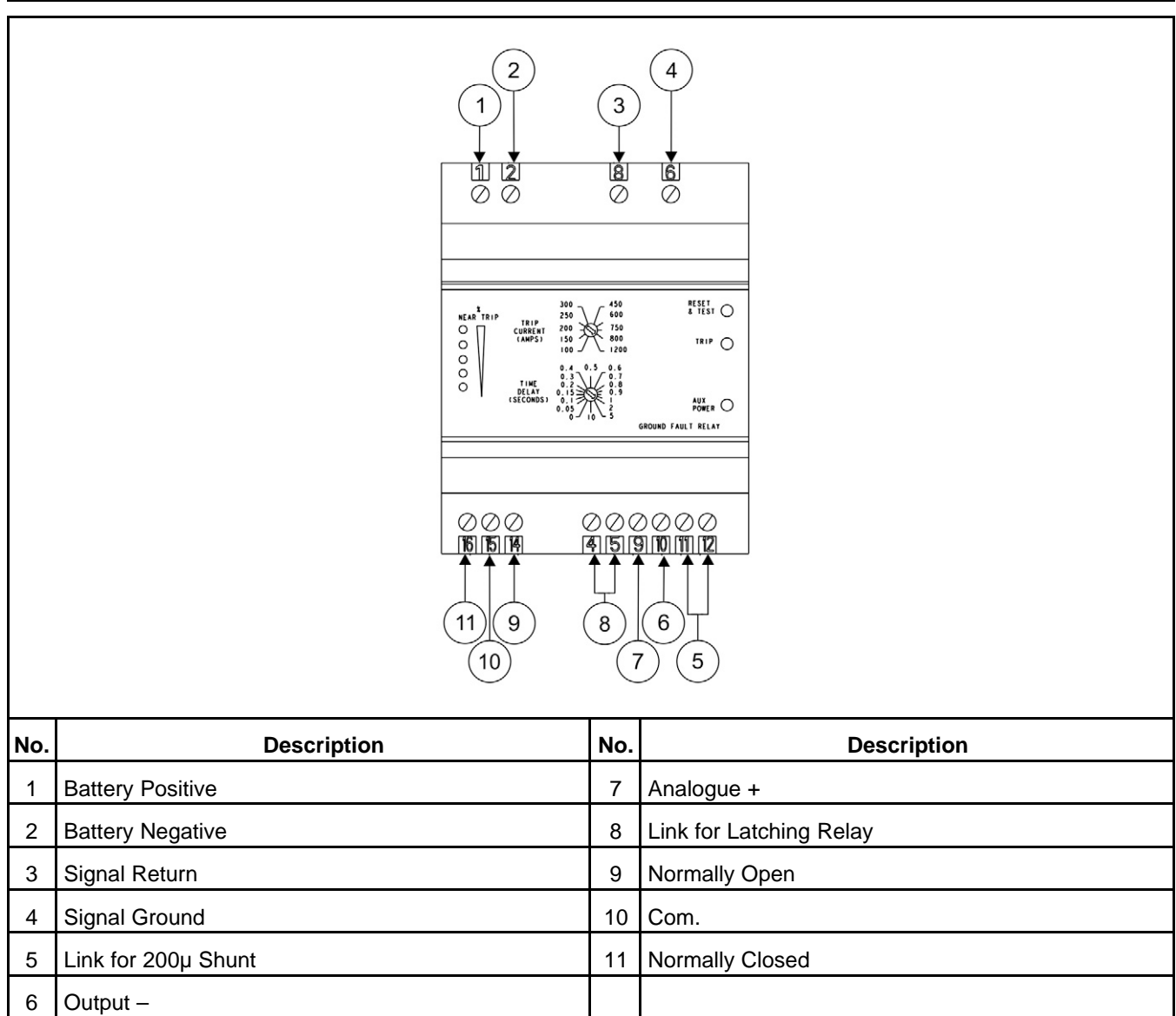


FIGURE 42. GROUND FAULT RELAY WIRING CONNECTIONS

1. Install the ground fault relay and the two terminal end brackets on the terminal DIN rail, as shown in the following figure.
2. Install the two AC wires to the ground fault relay.
3. Secure the AC wires using cable ties.
4. Install the ground fault relay harness.
5. Torque all screws securing wires on the ground fault relay to 0.6 - 0.8 Nm (5.3 - 7.1 in-lb).

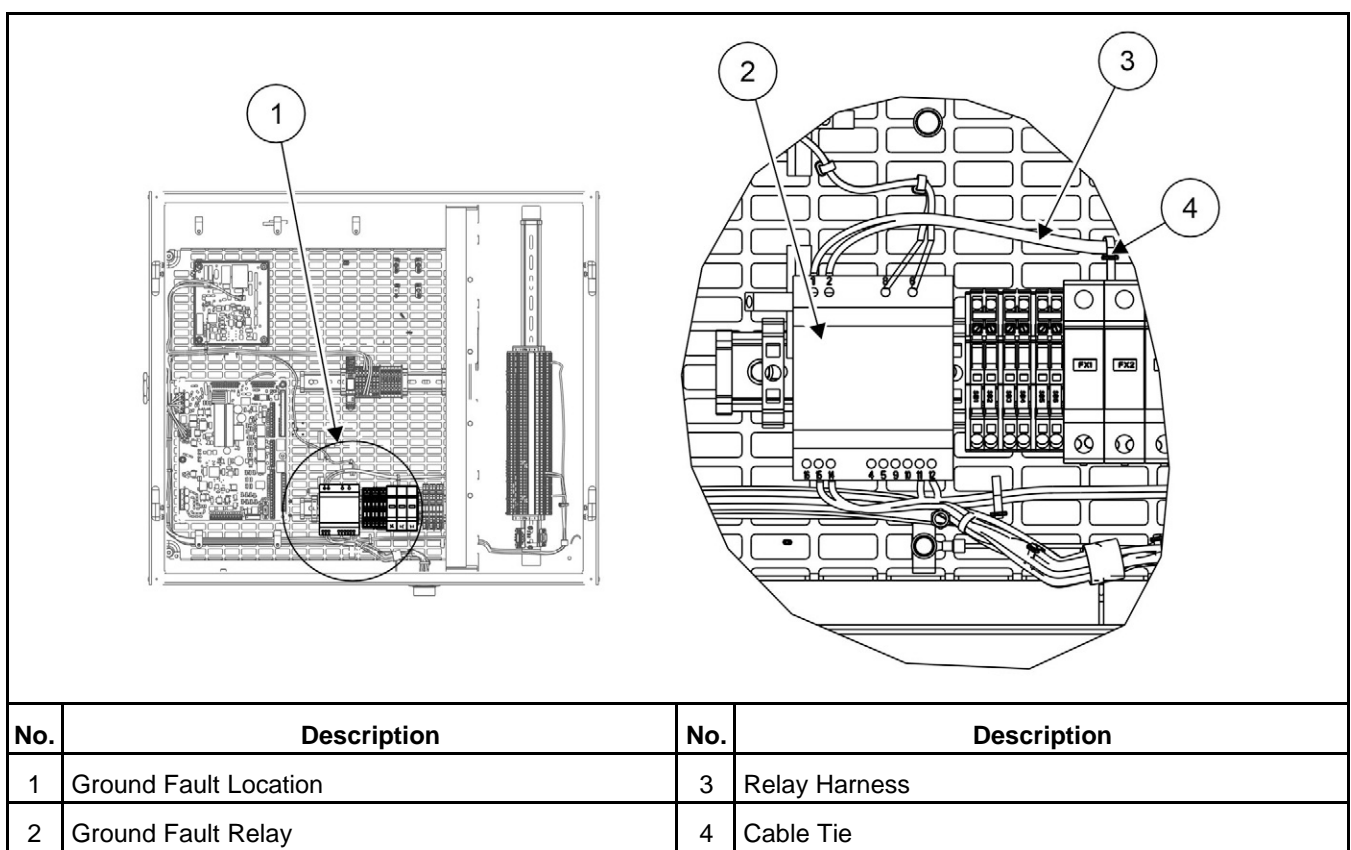
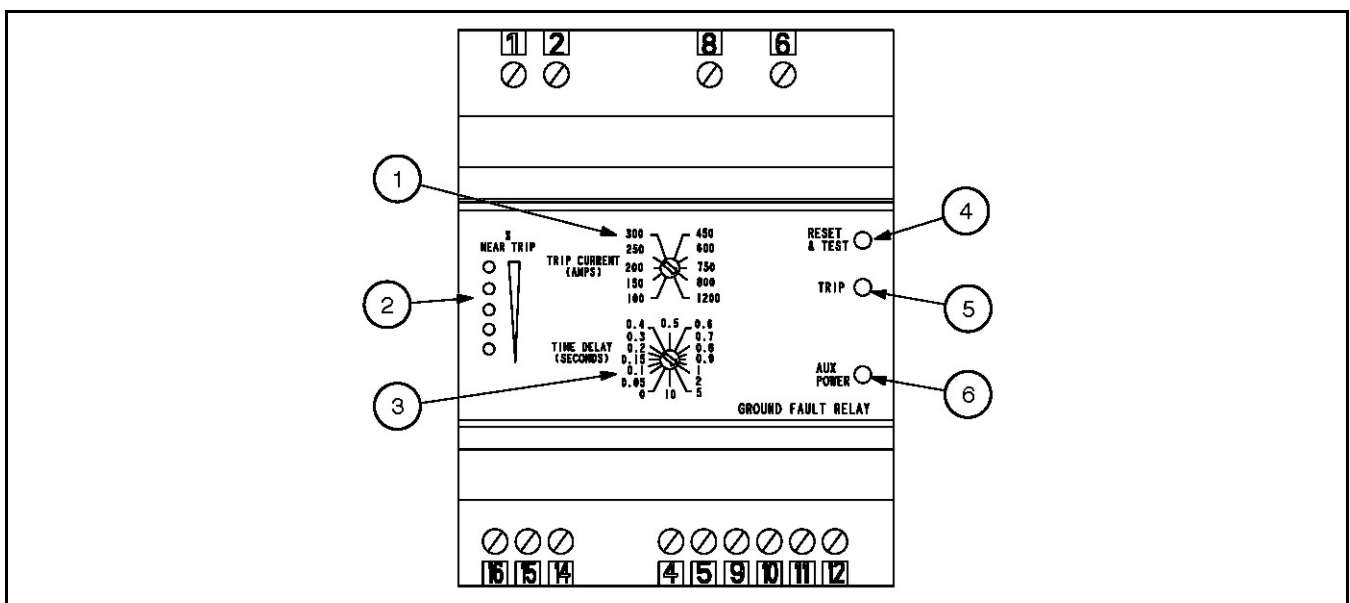


FIGURE 43. GROUND FAULT RELAY INSTALLATION

The relay has a time delay setting of 0–10 seconds and a current setting of 100–1200 amperes. Adjust the Current and Time Delay controls on the ground fault relay to the customer's specifications.



No.	Description	No.	Description
1	Trip Current Control	4	Reset and Test Button
2	Percent Near Trip Indicators	5	Test Button
3	Time Delay Control	6	Auxiliary Power Indicator

FIGURE 44. GROUND FAULT RELAY

10 AC Electrical Connections

WARNING

Arc Flash and 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. The AC sensing harness and other cabling will become energized when the generator set is in operation.

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

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

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. Avoid contact with the voltage sense and bus sense leads; voltages of up to 600 VAC may still be present. These voltages could be live even when the generator set is switched off.

This section provides the procedure that is used to connect the AC electrical system of the generator set.

Before making any AC electrical connections, make certain the generator set cannot be accidentally started. Make sure the Operator Panel is in OFF mode. Turn off or remove AC power from the battery charger and then remove the negative (-) battery cable from the set starting battery using an insulated wrench.

If the generator set is being installed in an application where it may parallel with other generators or utility sources, the generator set control system may be energized from an external source. Lock out tag out any external source that can provide AC power to the generator set.

NOTICE

Ventilate the battery area before working on or near battery. Wear goggles. Stop the generator set and disconnect the battery charger before disconnecting battery cables. Disconnect negative (-) cable first and reconnect last using an insulated wrench.

Connecting the generator set AC electrical system involves:

- Installation of transfer switch
- Generator output voltage selection
- Load cable connection
- Standard and optional AC equipment connections (e.g., control box heater, coolant heater, etc.).

For all output connections, including when field connection is made at the alternator terminations, installation should be completed with conductors of appropriate size, type, and rating specified in local codes (or UL). For UL compliant installations, use conductor size, X AWG, 75 °C or 90 °C copper wire, 600V. Where X AWG is the conductor size specified by the local electrical code for 75 °C at the rated output current for the generator set. Use copper conductors only. For non-UL compliant installations, use cable sizes, composition, and rating per local codes. Strain relief, bending space, raceway, and other installation features should be completed in compliance with local code.

Local regulations often require that wiring connections be made by a licensed electrician, and that the installation be inspected and approved before operation. All connections, wire sizes, materials used, etc. must conform to the requirements of electrical codes in effect at the installation site.

Before starting the generator set, check to make sure that all electrical connections are secure, and that all wiring is complete. Replace and secure any access panels that have been removed during installation. Check that the load cables from the generator set are properly connected.

NOTICE

Backfeed to a utility system can cause electrocution or property damage. Do not connect to any building electrical system except through an approved device and after the building main switch is opened.

10.1 Transfer Switch

A transfer switch must be used for switching the load from the normal power source to the generator set (see [Figure 45](#)). Follow the installation instructions provided with the transfer switch when connecting the load and control wiring.

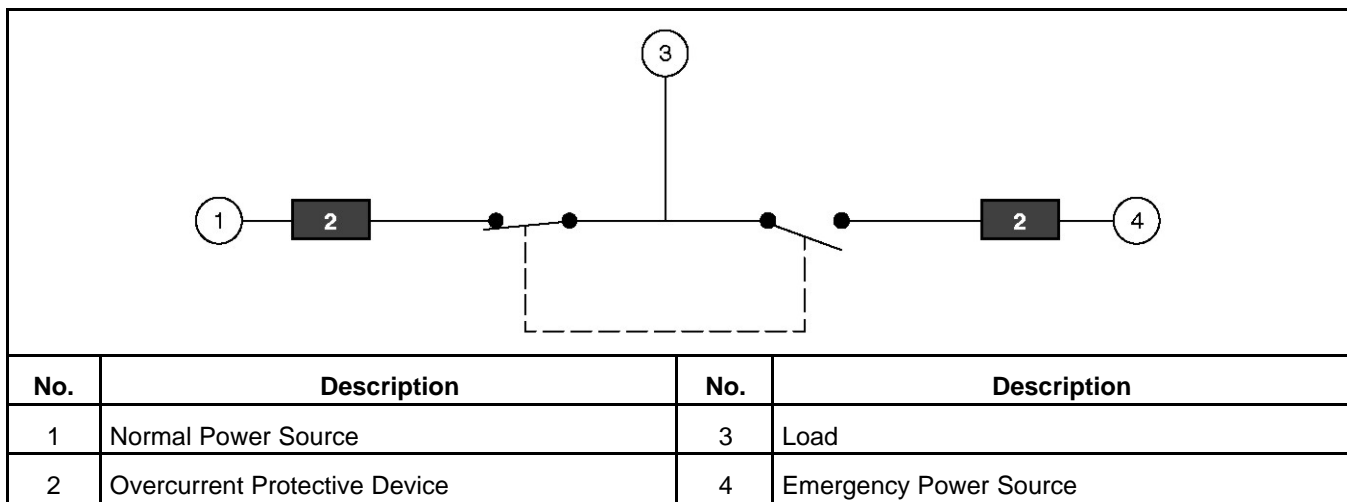


FIGURE 45. TYPICAL LOAD TRANSFER FUNCTION

10.2 Alternator Voltage Connections

These alternators can be configured to the nameplate voltages as shown on the Reconnection Diagram decal, attached to the backside of the control box cover. Many of the voltages listed will require reconfiguration of the alternator output leads on the connection terminal block. This reconfiguration must only be done by service personnel that are trained and experienced to perform electrical installation. The generator set was adjusted to produce a specified voltage during production verification testing prior to shipment. The installer must always check the stator lead terminal block connections and perform any necessary reconnect to obtain the voltage required.

Some generator sets are capable of producing a wide range of voltages and connection configurations; others have specific limited capabilities. Refer to wiring diagram and generator voltages (from the nameplate) when reviewing the voltage connection information and use the wiring diagram supplied with your generator set when actually performing load connections.

NOTICE

Reconfiguring generator sets to higher voltages can exceed the voltage capability of the specific generator windings and damage the generator and also decrease line current, rendering line circuit breakers too large. Consult with your authorized distributor before performing reconnection for a different voltage.

NOTICE

Reconfiguring generator sets to lower voltages can reduce generator set ratings, and also increase line current, rendering line circuit breakers too small. Consult with your authorized distributor before performing reconnection for a different voltage.

10.3 Load Connections

NOTICE

Flexible conduit and stranded conductors must be used for connections to take up movement of the generator set.

All loads are connected to the alternator by bolting stranded load wires to the appropriate terminals on the alternator reconnection terminal block or circuit breaker lugs. The terminals are marked U, V, W, and N to indicate the line and neutral connections. (Reference: U, V, and W correspond with L1, L2 and L3; and N with L0 respectively). See [Appendix B on page 139](#) for details about the following:

- Load connections
- Conduit
- Cable Size

10.3.1 Generator Set Load Cable Installation

To ensure optimum performance of the generator set, load cables passing through cable gland plates must be adequately protected and secured.

10.3.2 Cabling through Non-Ferrous Gland Plates

Single core load cables must be secured using non-ferrous cable glands.

10.3.3 Cabling through Ferrous Gland Plates

Single core load cables must pass through the same hole, or slotted cable grommet holes as illustrated (see [Figure 46](#)). Cable glands must be made from non-ferrous material.

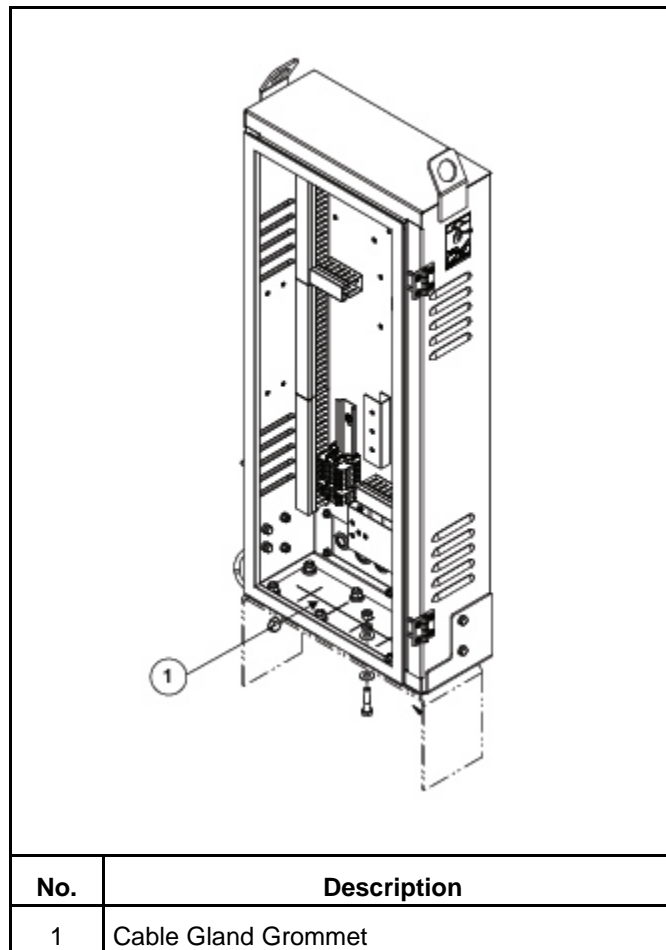


FIGURE 46. FERROUS GLAND PLATES

10.3.4 Distribution Cables

Single core power distribution cables should be grouped in a trefoil formation as illustrated (See [Figure 47](#)). (Trefoil grouping provides optimum cable loading and reduces electrical emissions). To minimize cable temperature rise and reduce cable de-rate factors, cable groups where possible, should be spaced to provide ventilation. Cable groups must be secured with non-ferrous material.

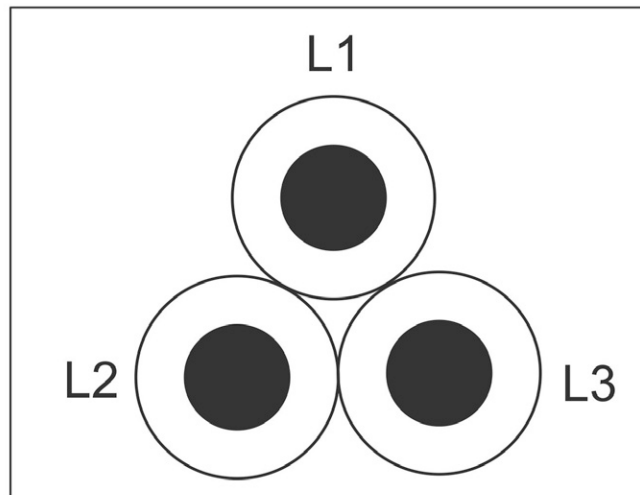


FIGURE 47. TREFOIL FORMATION

10.4 Load Balancing

When connecting loads to the generator set, balance the loads so that the current flow from each line terminal (L1, L2, and L3) is about the same. This is especially important if both single phase and three phase loads are connected. Any combination of single phase and three phase loading can be used as long as each line current is about the same, within 10 percent of median value and no line current exceeds the name plate rating of the generator. Check the current flow from each line after connections by observing the Operator Panel ammeter.

10.5 Current Transformers

Current transformers (CTs) reduce high voltage currents (AC) to enable safe monitoring.

10.5.1 CT Installation Requirements

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). A dot is also used to indicate pin 1 of the CT.

Route the load lead through the appropriate CT.

The CTs have dual secondary's (3 pins). The CT secondary wire marked 1 is connected to pin 1 of the CT. CT secondary wire marked 2/3 is connected to pin 3 for low voltage generator sets.

10.6 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.

10.6.1 Coolant Heater Connection

NOTICE

The coolant heater must not be operated while the cooling system is empty or damage to the heater will occur.

A coolant heater keeps the engine coolant warm when the engine is shut down. It heats and circulates the coolant within the engine. This reduces start-up time and lessens engine wear caused by cold starts. It is electrically operated and thermostatically controlled.

Refer to [Appendix A](#) for electrical connections.

10.6.2 Coolant Heater Specifications

The coolant heaters are designed to allow the generator set to start and pick up load within 10 seconds in a 4.4 °C (40 °F) environment. In colder ambient temperature environments, the starting time may be longer. The installation may include two coolant heaters.

TABLE 8. COOLANT HEATER SPECIFICATIONS

Power	12 kW
Voltage	480 VAC 3 Phase or 208 VAC 3 Phase
Thermostat Setting	38 – 54 °C (100 – 129 °F)

10.7 Alternator Heaters

10.7.1 Alternator Heater Connection

WARNING

Electric Shock Hazard

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

Water or moisture inside an alternator increases the possibility of flashing and electrical shock.

Do not use an alternator which is not dry inside and out.

An alternator heater(s) is used to help keep the alternator free of condensation when the generator set is not running. During cool and humid conditions, condensation can form within an alternator, creating flashing and shock hazards.

Connect the heater(s) terminals to a source of power that will be on during the time the engine is not running. Be sure the supply voltage and circuit amperage is correct for the heater element rating.

10.7.2 Installed Alternator Heaters

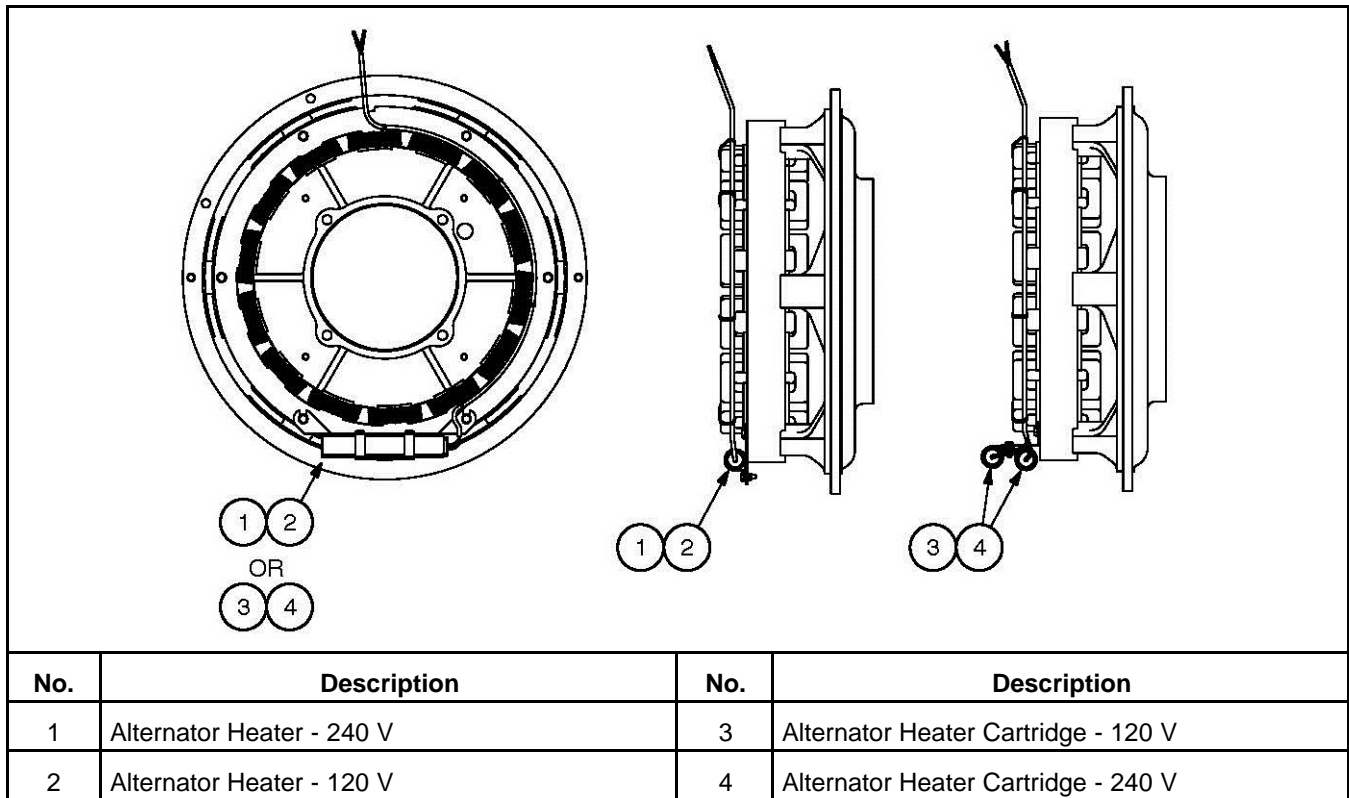


FIGURE 48. INSTALLED ALTERNATOR HEATERS

10.8 Control Box Heater

10.8.1 Control Cabinet Heater Installation

A thermostat controlled heater is installed inside the control cabinet.

[Figure 49](#) shows an installed heater. The hex nuts used to install the thermostat are to be torqued to 5.8 - 7.2 Nm (51 - 64 in-lb). The screws used to secure the terminal blocks to the terminal rail are to be torqued to 0.58 - 0.78 Nm (5.1-6.9 in-lb).

[Figure 50](#) shows heater wiring. Connect the heater wires to the top side of the gray terminal blocks.

The heater power cord must be connected to a grounded outlet.

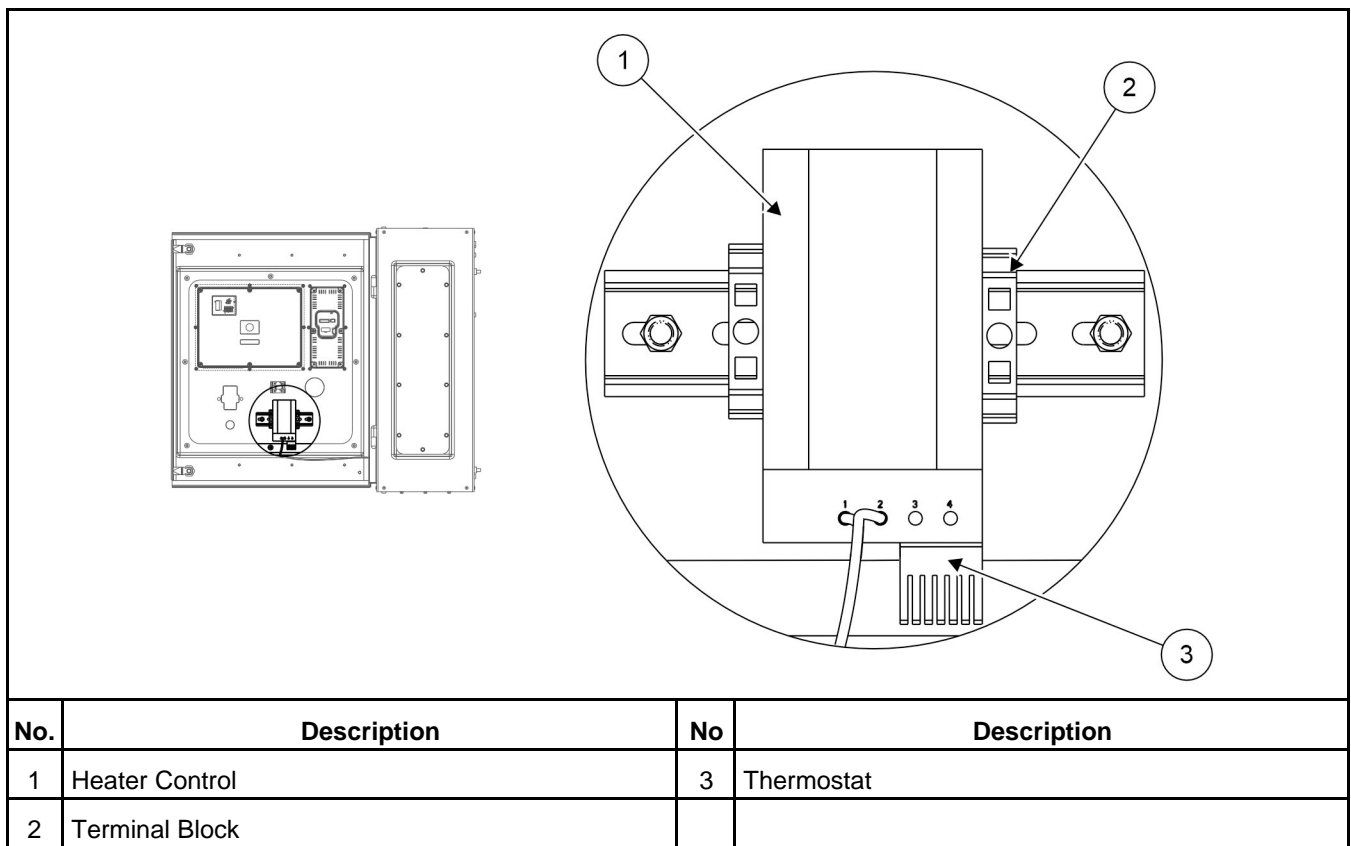


FIGURE 49. TYPICAL CONTROL CABINET HEATER

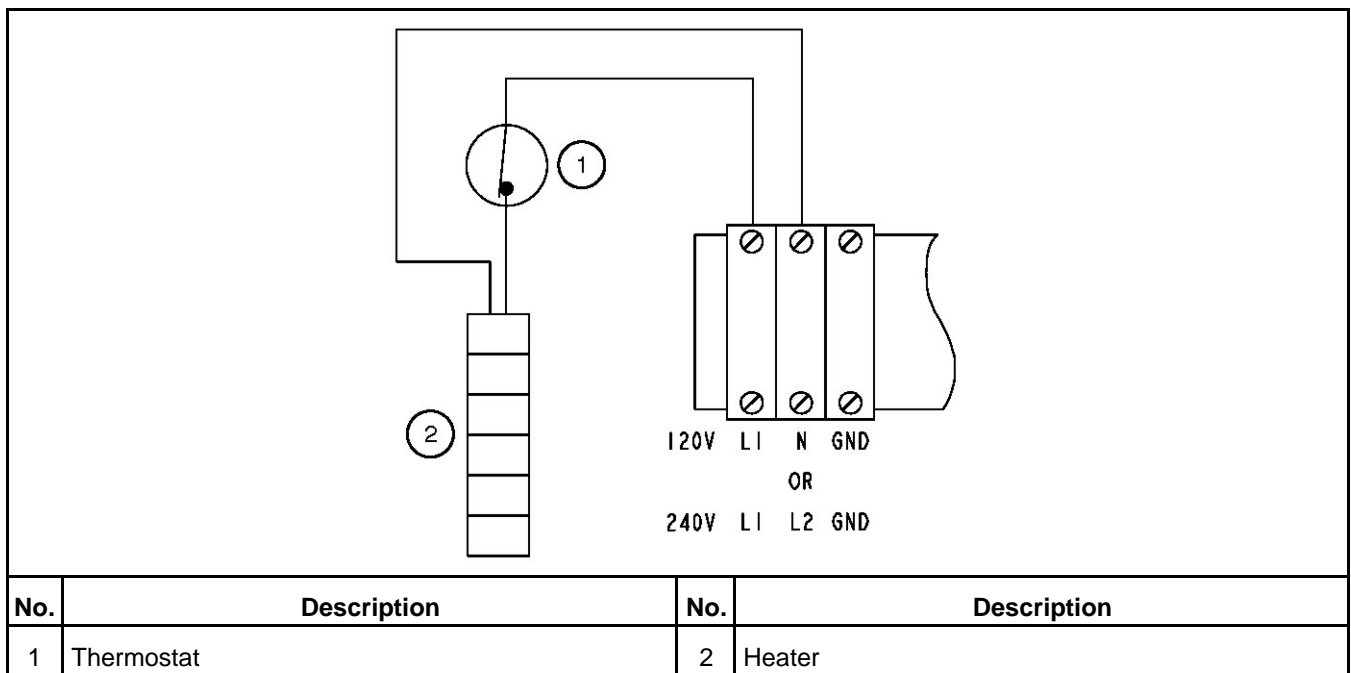


FIGURE 50. CONTROL CABINET HEATER WIRING

10.9 Annunciators

10.9.1 PowerCommand Universal Annunciator

A universal annunciator provides lamps and a horn to annunciate the operating status and fault conditions of an emergency power system. It is designed for connection to either a 12 VDC or a 24 VDC control system. It can be configured to be either a positive or negative signal device.

Two versions of the PowerCommand universal annunciator are available.

- Panel Mounted
- Panel with Enclosure

The universal annunciator can communicate using either a PCCNet or a Modbus network.

Refer to the PowerCommand Universal Owners Manual for more information.

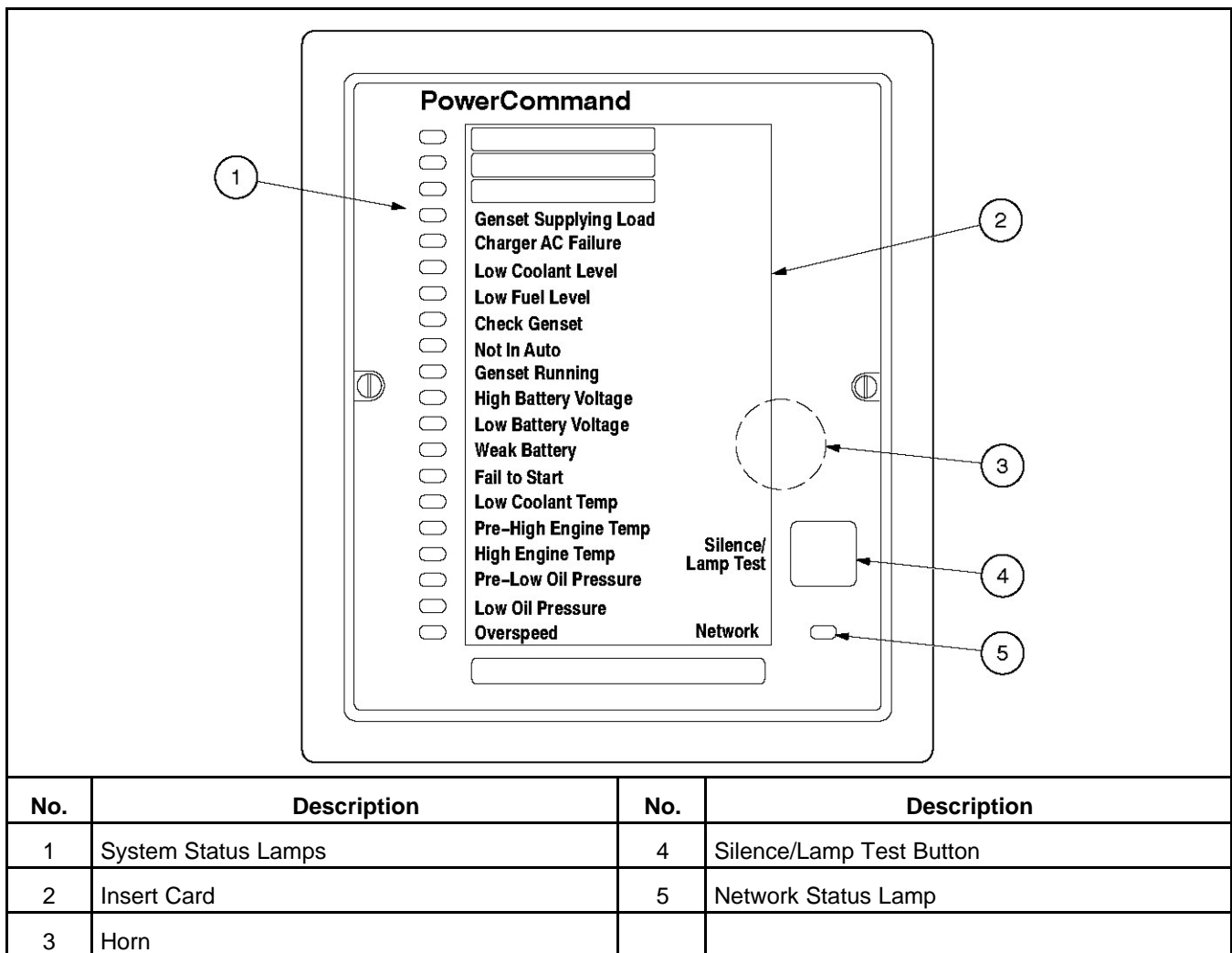


FIGURE 51. ANNUNCIATOR COMPONENTS

10.10 Battery Charger

10.10.1 Battery Charger - 20 Amp/24 Volt

The 20 amp battery charger is fully automatic, constant voltage/constant current, and incorporates a 4-stage charging algorithm for optimum battery life. It is configurable for 24 VDC battery systems at 60 Hz.

The four-stage charge cycles are:

- Constant current: The charger operates at maximum possible output in the fast charge mode.
- High-rate taper: The charger stays at fast charge voltage level until battery current acceptance falls to a portion of the chargers rated output.
- Finishing: The charger operates at the float voltage and completes the battery charge.
- Maintenance charge cycle: The charger supplies only a few milliamps required by the battery to stay at peak capability.

10.10.1.1 Features

Some of the battery charger features include:

- Surge Protection to IEEE and EN standards
- Convenient Input and Output Connections
- Battery Charger Status Display
- Adjustable Float Voltage
- Corrosion Resistant Aluminum Construction
- Fault Annunciation
- Vibration Resistant Design
- Five Year Warranty

10.10.1.2 Battery Charger Display

The battery charger user display indicates output voltage/current, fault information/status, and precision ammeter/voltmeter readings. LED indicators show the charger condition.

LEDs on the right indicate operational functions for:

- Temperature Compensation (TCOMP ACTIVE) (green)
- AC Voltage (AC ON) (green)
- Float Status (FLOAT MODE) (Green)
- Boost Status (BOOST MODE) (Amber)
- Battery Fault (BATT FAULT) (Red)

LEDs on the left are red when:

- There is a charger failure (CHG FAIL)
- There is high or low VDC (DC HIGH, DC LOW)
- The AC fails to occur (AC FAIL)

10.10.1.3 Battery Charger Display Location

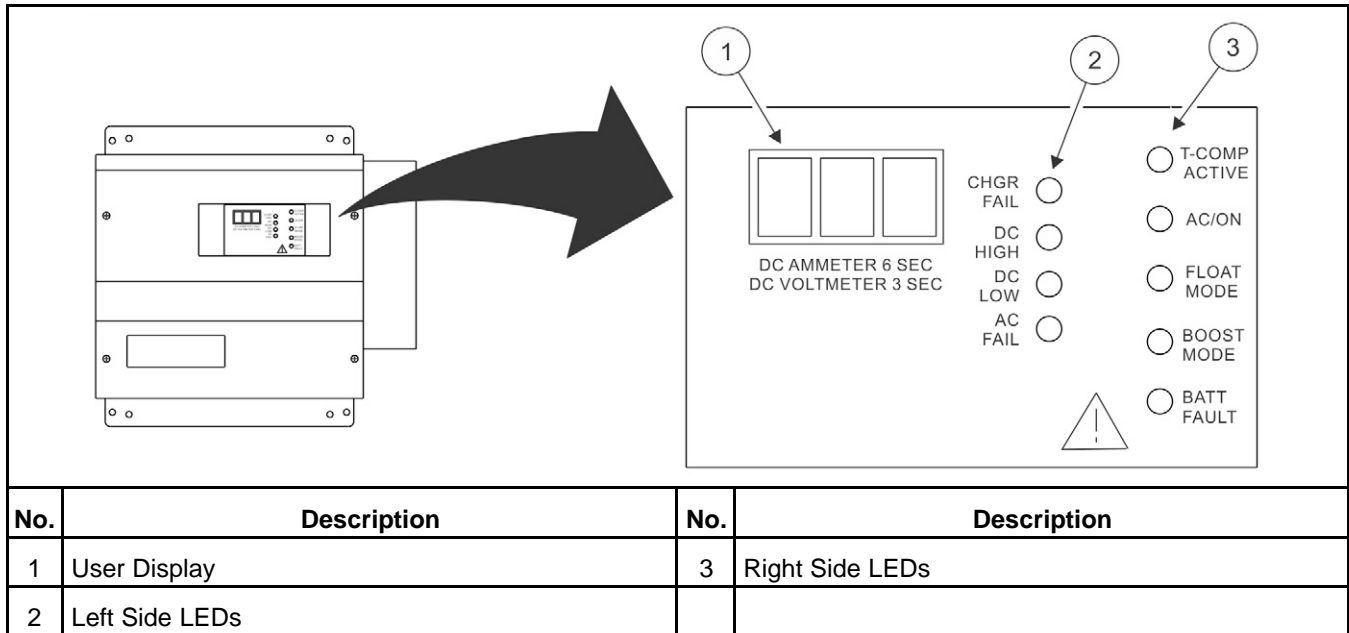


FIGURE 52. BATTERY CHARGER DISPLAY LOCATION

10.11 Grounding

⚠ 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. Bonding and grounding must be done properly. All metallic parts that could become energized under abnormal conditions must be properly grounded.

The following is a brief description of system and equipment grounding of permanently installed AC generators within a facility wiring system.

NOTICE

It is important to follow the requirements of the local electrical code.

NOTICE

A UL-listed grounding electrode terminal within its ratings and suitable for the application must be installed and labeled "Grounding Electrode Terminal" for UL compliance.

[Figure 53](#), [Figure 54](#) and [Figure 55](#) illustrate typical system grounding for a 2-pole, 3-pole, and 4-pole Automatic Transfer Switch (ATS). In the 2-pole and 3-pole ATS, note that the generator neutral is connected to the ATS and is NOT bonded to ground at the generator. In the 4-pole ATS system, a grounding electrode conductor and a bonding jumper are used to connect the generator neutral to ground.

Make sure the generator set is grounded to earth in one location only. On generator sets without a circuit breaker, ground to the point indicated on the top of the generator. On generator sets with circuit breakers, use the ground lug provided in the circuit breaker box.

The grounding electrode terminal is not provided. Make sure UL listed terminals are used, are sized for the generator set ratings, and are suitable for the application.

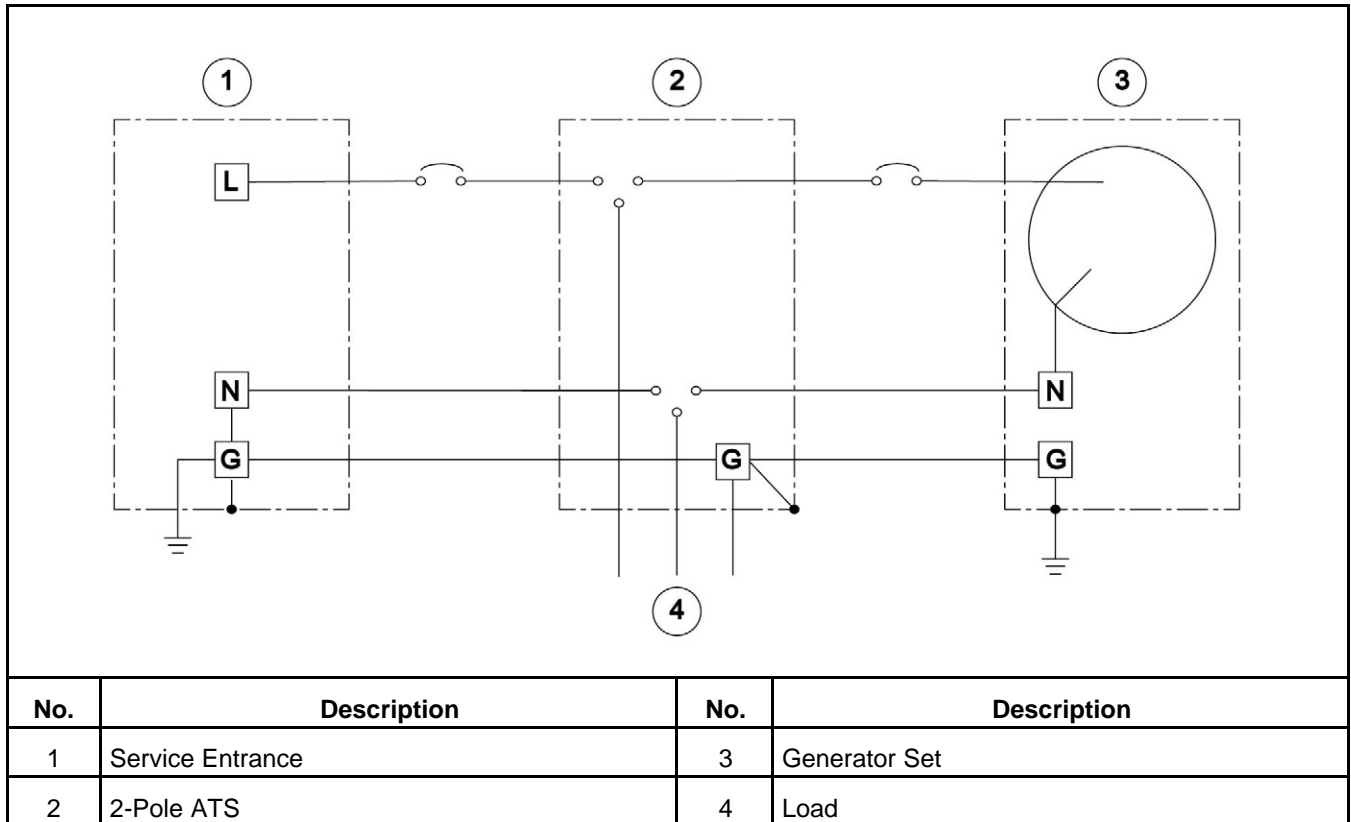


FIGURE 53. TYPICAL SYSTEM - ONE-PHASE, THREE WIRE UTILITY, TWO-POLE ATS

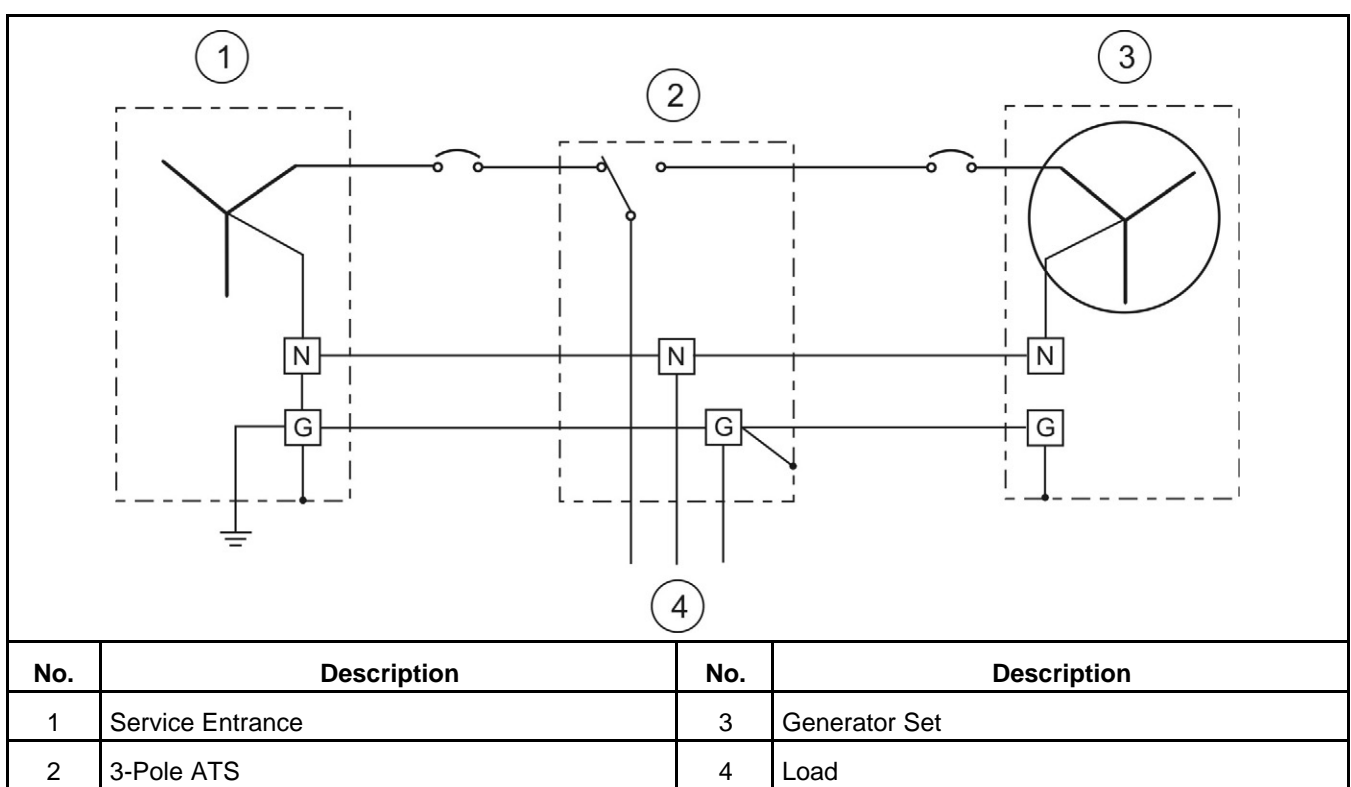


FIGURE 54. TYPICAL SYSTEM - THREE-PHASE, FOUR WIRE UTILITY, THREE-POLE ATS

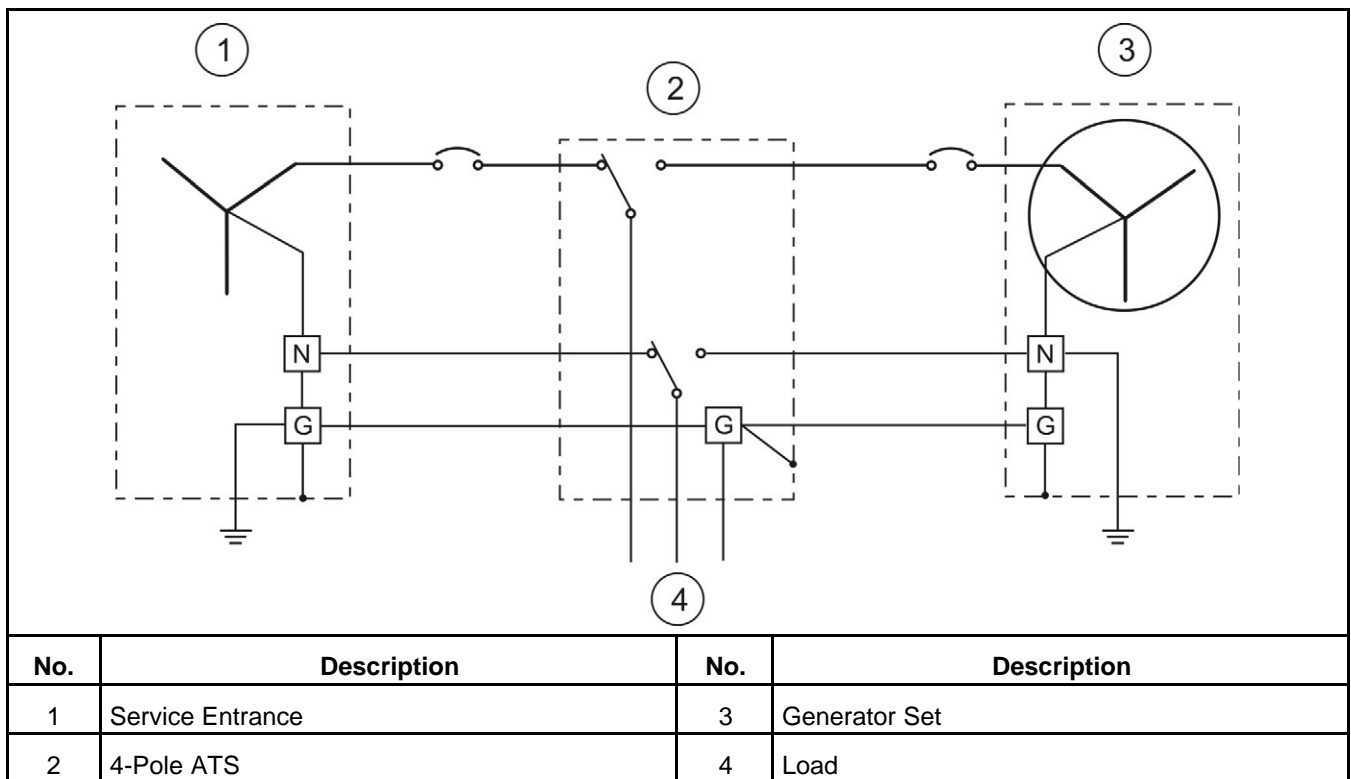


FIGURE 55. TYPICAL SYSTEM - THREE-PHASE, FOUR WIRE UTILITY, FOUR-POLE ATS

11 Pre-Start Preparation

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.

Before an initial start of the generator set, complete the Installation Checklist, see [Chapter 12 on page 105](#).

11.1 Electrical System

Verify all electrical connections are secure and all wiring is complete and inspected. Replace and secure any access panels that may have been removed during installation.

11.2 Battery Connections

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

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.

Starting the unit requires one or more batteries. For more information on batteries, refer to the Model Specifications section. To prevent arcing, use an insulated wrench to connect the positive battery cable, then connect the negative battery cable.

If an automatic transfer switch is installed without a built-in charge circuit, connect a separate battery charger. Proper selection and maintenance of batteries and battery chargers is essential for system reliability.

11.3 Site-Specific Configuration

NOTICE

Site-specific configuration is to be undertaken by suitably trained and qualified service personnel only.

The generator set is configured at the factory. Before starting the generator set, any site-specific configuration should be completed by qualified service personnel.

11.4 Starting

Refer to the generator set Operator manual for important safety precautions and recommended procedures for starting the generator set and verifying proper operation. Start the generator set and verify all engine and generator set menus are displaying the correct values.

12 Installation Checklist

12.1 Checklist

Tick	General Items
	Generator set wattage capacity is sufficient to handle maximum anticipated load.
	At least 3 feet (914.4 mm) of clearance (or greater for housing door) is provided around the entire generator set for service and ventilation.
	The generator set is located in an area not subject to flooding.
	All operating personnel have read and are familiar with the generator set Operator manual, all health and safety procedures, warnings, cautions, precautions, and the other documentation supplied with the generator set.
	All operators have been thoroughly briefed on preventative maintenance procedures.
	All operators have read and understand all important safety instructions.
	Generator Set Support
	The floor, roof, or earth on which the generator set rests is strong enough and will not allow shifting or movement. Observe local codes on soil bearing capacity due to freezing and thawing.
	The generator set is properly supported and retained to an approved base
	The supporting base is large enough and is of non-combustible material, extending 6 inches (152.4 mm) all around the generator set.
	Cooling Air Flow
	Generator set air inlet is faced into direction of strongest, prevailing winds.
	Air inlet openings are unrestricted and are at least 1 to 1½ times larger than air outlet area.
	Cooling air outlet is on downwind side of building (if not, wind barrier is constructed).
	Proper ducting material (sheet metal, canvas) is used between radiator and air outlet.
	Diesel Fuel System (if applicable)
	Fuel tanks meet or exceed all Local, State, or National codes (if applicable).
	Fuel lines are properly installed, supported, and protected against damage.
	The fuel filters have been installed.
	Approved flexible fuel line is installed between the main fuel supply and the generator set's fuel system near the generator set, to protect it against damage caused by vibration, expansion, and contraction.
	Fuel supply shutoff valves are installed to prevent fuel flow in case of leaks.
	No shutoff valves are installed on engine fuel return line (if applicable).
	External fuel pumps are connected and operational at all times - generator set started or shut down (if applicable).
	Fuel tanks are filled with the correct grade / type of fuel (if applicable).
	Fuel system is properly primed.

	No fuel leaks are found in supply line or engine fuel system.
	Exhaust System
	The breather tube routing is set up to blow the fumes away from the generator set (if applicable)
	Operators are thoroughly briefed on the dangers of carbon monoxide gas.
	If the installation includes a heavy duty air cleaner, it has been installed.
	Areas around generator set are well ventilated. No possibility of exhaust fumes entering building doors, windows, or intake fans.
	Exhaust gases are piped safely outside and away from building.
	The correct length of approved rigid pipe is connected to the generator set flexible pipe using approved securing methods with no weight resting on engine exhaust components. There are no bends in flex section.
	Condensation drain is provided in lowest section of exhaust piping.
	Exhaust piping is insulated to guard against burns to personnel.
	Exhaust piping passing through walls or ceilings have approved fire-proof materials and are in compliance with all codes.
	Exhaust piping is large enough in diameter to prevent excessive back pressure on engine.
	Verify that the pyrometer meters are functioning.
	AC and DC Wiring
	For bottom entry circuit breaker installations, the cable chute has been installed (if applicable).
	Wire sizes, insulation, conduits and connection methods all meet applicable codes.
	AC and DC wires are separated in their own conduit to prevent electrical induction.
	All load, line and generator connections are well made and correct.
	Flexible conduit is used between the generator and the building or surrounding structure.
	Check phase rotation.
	Generator Set Pre-Start
	Generator set engine is properly serviced with oil and coolant.
	Battery charger is installed using the appropriate cable size and is operational.
	Battery charger is configured for the proper DC battery voltage, battery type, and float voltage.
	Batteries are properly installed, serviced and charged.
	Battery temperature sensor is connected and operational (if applicable).
	Engine coolant heater is connected and operational.
	All generator set covers and safety shields are installed correctly.
	All fuel and coolant shutoff valves are operational.
	Radiator fan and other external moving parts including drive belts are unrestricted.

13 Manufacturing Facilities

U.S. and CANADA	EMEA, CIS	BRAZIL
Cummins Inc. 1400 73rd Ave. NE Minneapolis, MN 55432 USA	Cummins Inc. Royal Oak Way South Daventry Northamptonshire NN11 8NU United Kingdom	Rua Jati, 310, Cumbica Guarulhos, SP 07180-900 CNPJ: 43.2201.151/0001-10 Brazil
Toll Free 1-800-CUMMINS™ (1-800-286-6467) Fax +1 763-574-5298	Phone +44 1327 88-6453 Fax +44 1327 88-6125	Phone 0800 286 6467
CHINA	INDIA	ASIA PACIFIC
Cummins Inc. No.118 South Quanli Road , Wuhan Economic& Technological Development Zone , Hubei, P.R.China 430058	Cummins Inc. Plot No B-2, SEZ Industrial Area, Village-Nandal & Surwadi, Taluka- Phaltan Dist- Satara, Maharashtra 415523 India	Cummins Sales and Service Singapore Pte Ltd 85 Tuas South Avenue 1 Singapore 637419
Phone + 86 (27) 8421 4008 Fax + 86 (27) 8421 4804	Phone +91 021 66305514	Fax +65 6265 6909
LATIN AMERICA	MEXICO	
3350 Southwest 148th Ave. Suite 205 Miramar, FL 33027 USA	Eje 122 No. 200 Zona Industrial San Luis Potosi, S.L.P. 78395 Mexico Eje 120 No. 201 Zona Industrial San Luis Potosi, S.L.P. 78395 Mexico	
Phone +1 954 431 551 Fax +1 954 433 5797	Phone +52 444 870 6700 Fax +52 444 824 0082	

13.1 How to Obtain Service

When a product requires servicing, contact the nearest Cummins service provider. To locate the distributor, go to www.cummins.com/support and select Find a Sales or Service Location. When contacting the service provider, always supply the complete model, specification, and serial number as shown on the nameplate.

13.1.1 Locating a Distributor

In the U.S. and Canada

To easily locate the nearest certified distributor/dealer for Cummins generator sets in your area, or for more information, contact us at 1-800-CUMMINS™ (1-800-286-6467) or visit www.cummins.com/support.

If unable to contact a distributor using the automated service, consult the Internet.

If unable to arrange a service or resolve an issue, contact the Service Manager at the nearest Cummins distributor for assistance.

When contacting the distributor, always supply the complete Model, Specification, and Serial Number as shown on the product nameplate.

Appendix A. Wiring Diagrams

Table of Contents

- Figure 56. Wiring Schematic (Sheet 1) 111
- Figure 57. Wiring Schematic (Sheet 2) 112
- Figure 58. Wiring Schematic (Sheet 3) 113
- Figure 59. Wiring Schematic (Sheet 4) 114
- Figure 60. Wiring Schematic (Sheet 5) 115
- Figure 61. Wiring Schematic (Sheet 6) 116
- Figure 62. Wiring Schematic (Sheet 7) 117
- Figure 63. Wiring Schematic (Sheet 8) 118
- Figure 64. Wiring Schematic (Sheet 9) 119
- Figure 65. Wiring Schematic (Sheet 10) 120
- Figure 66. Wiring Schematic (Sheet 11) 121
- Figure 67. Wiring Schematic (Sheet 12) 122
- Figure 68. Wiring Schematic (Sheet 13) 123
- Figure 69. Wiring Schematic (Sheet 14) 124
- Figure 70. Wiring Schematic (Sheet 15) 125
- Figure 71. Wiring Schematic (Sheet 16) 126
- Figure 72. Control Customer Connections - PCC Net Devices 127
- Figure 73. Customer Connections 128
- Figure 74. PowerCommand 3.3 Connections - ECM-Based Engines 129
- Figure 75. PowerCommand 3.3 Connections - Hydromechanical Engine 130
- Figure 76. PowerCommand 3.3 Paralleling Connections - Standalone Generator Set 131
- Figure 77. PowerCommand 3.3 Paralleling Connections - Synchronize Only 132
- Figure 78. PowerCommand 3.3 Paralleling Connections - Isolated Bus Only 133
- Figure 79. PowerCommand 3.3 Paralleling Connections - Utility Single 134
- Figure 80. PowerCommand 3.3 Paralleling Connections - Utility Multiple 135
- Figure 81. PowerCommand 3.3 Paralleling Connections - Power Transfer Control 136
- Figure 82. PowerCommand 3.3 Paralleling Connections - Configurable Paralleling I/O 137

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

A.1 QSK78 Wiring Diagram with PowerCommand 3.3 Control

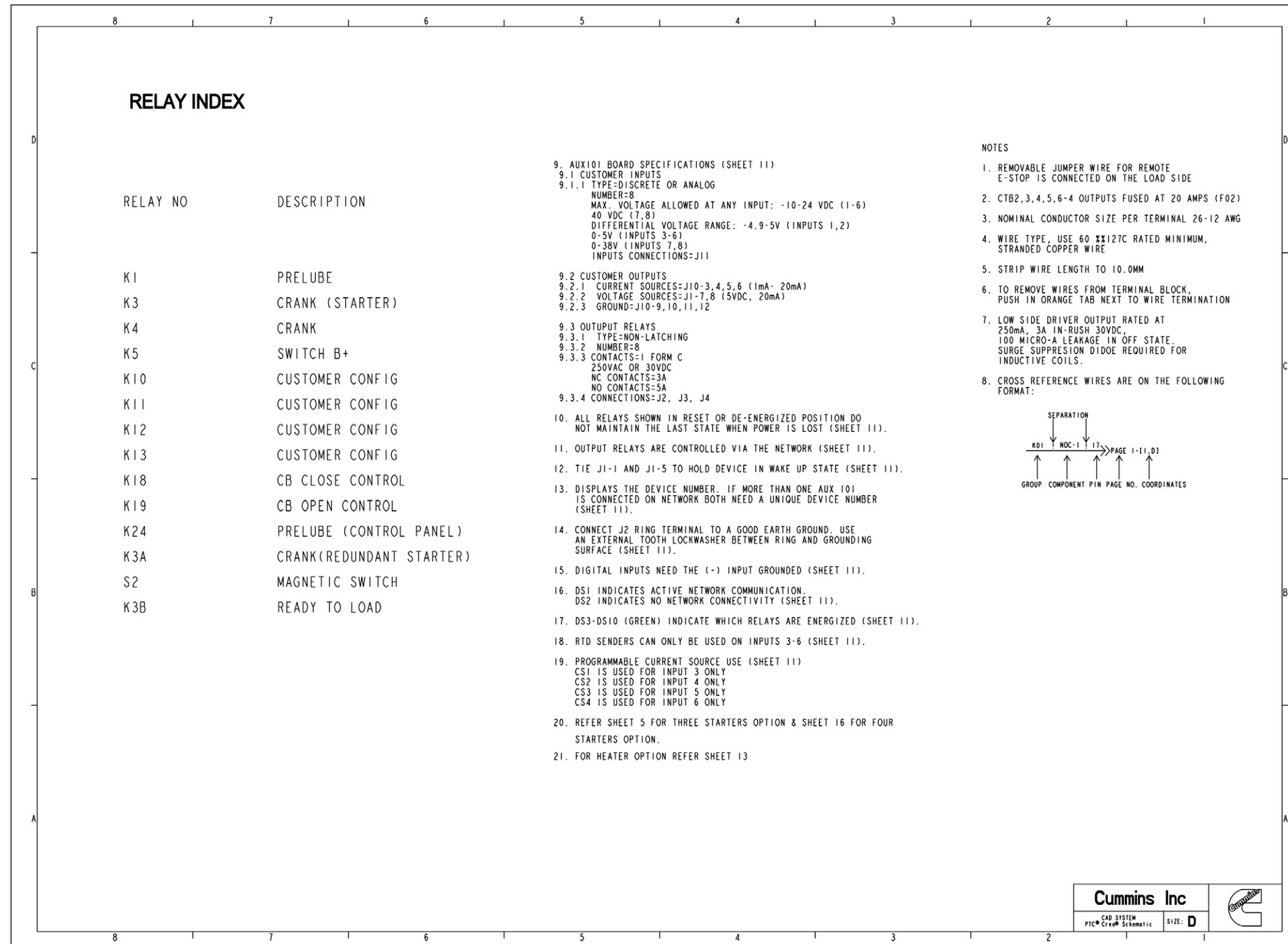


FIGURE 56. WIRING SCHEMATIC (SHEET 1)

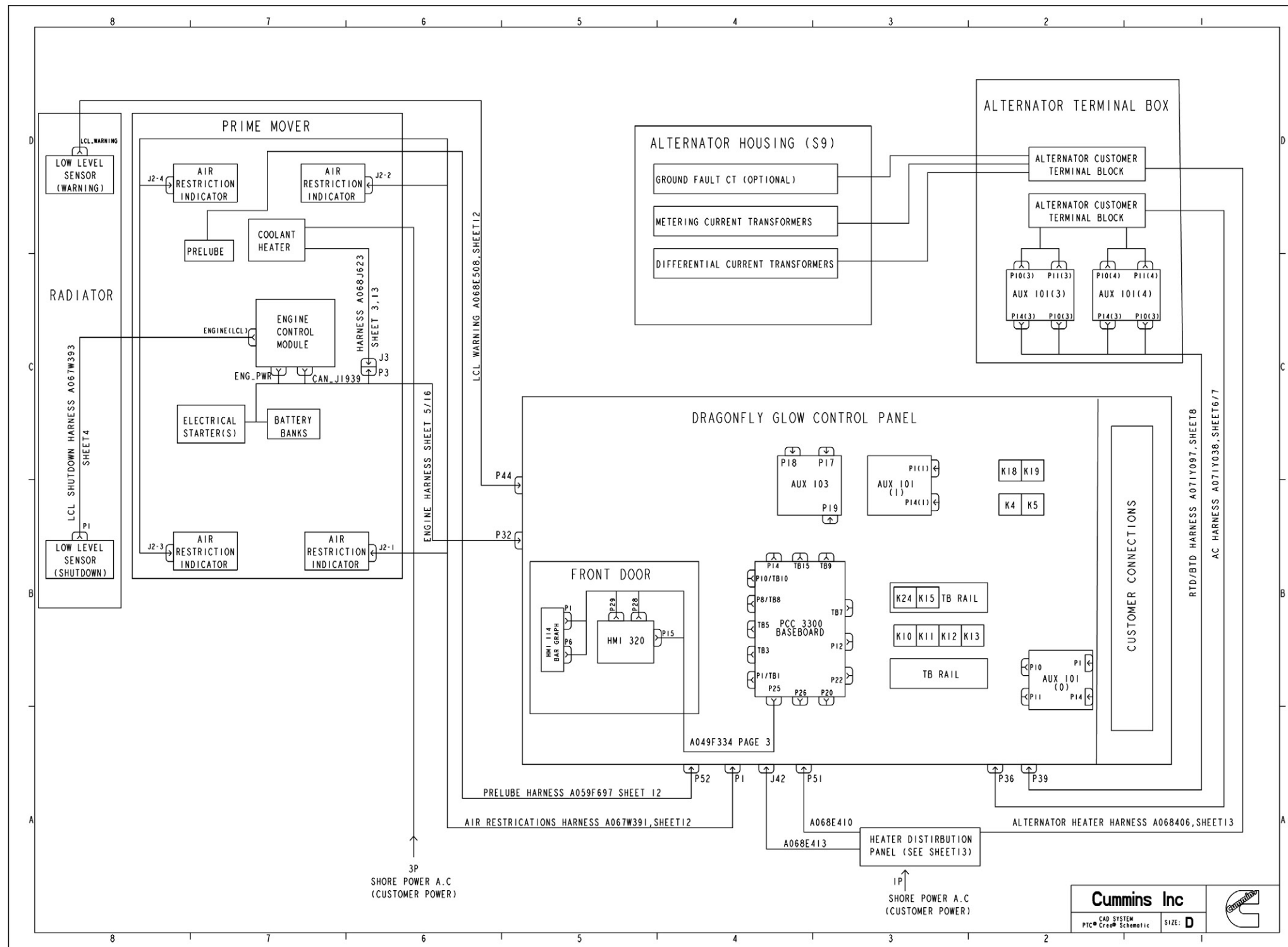


FIGURE 57. WIRING SCHEMATIC (SHEET 2)

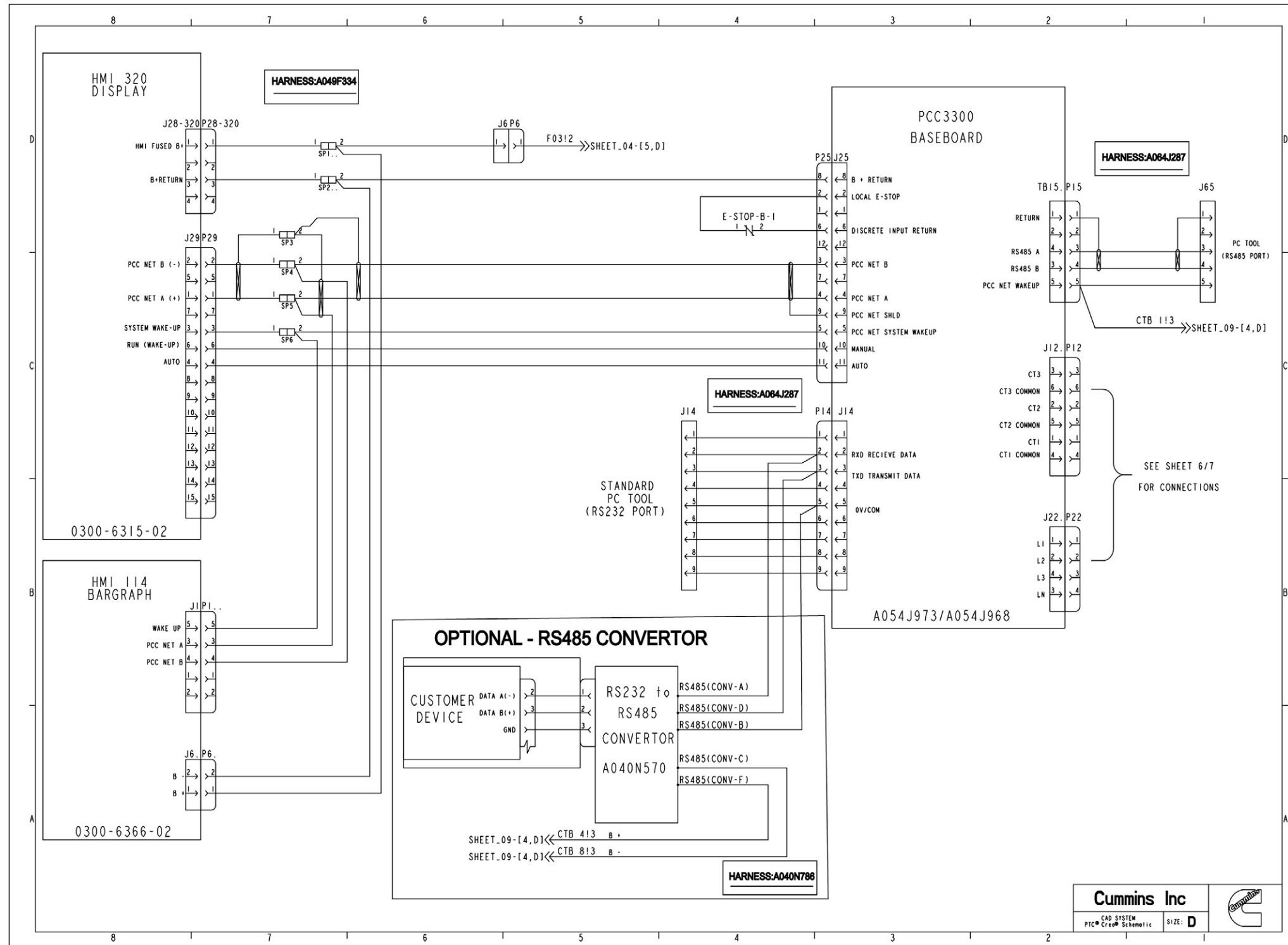


FIGURE 58. WIRING SCHEMATIC (SHEET 3)

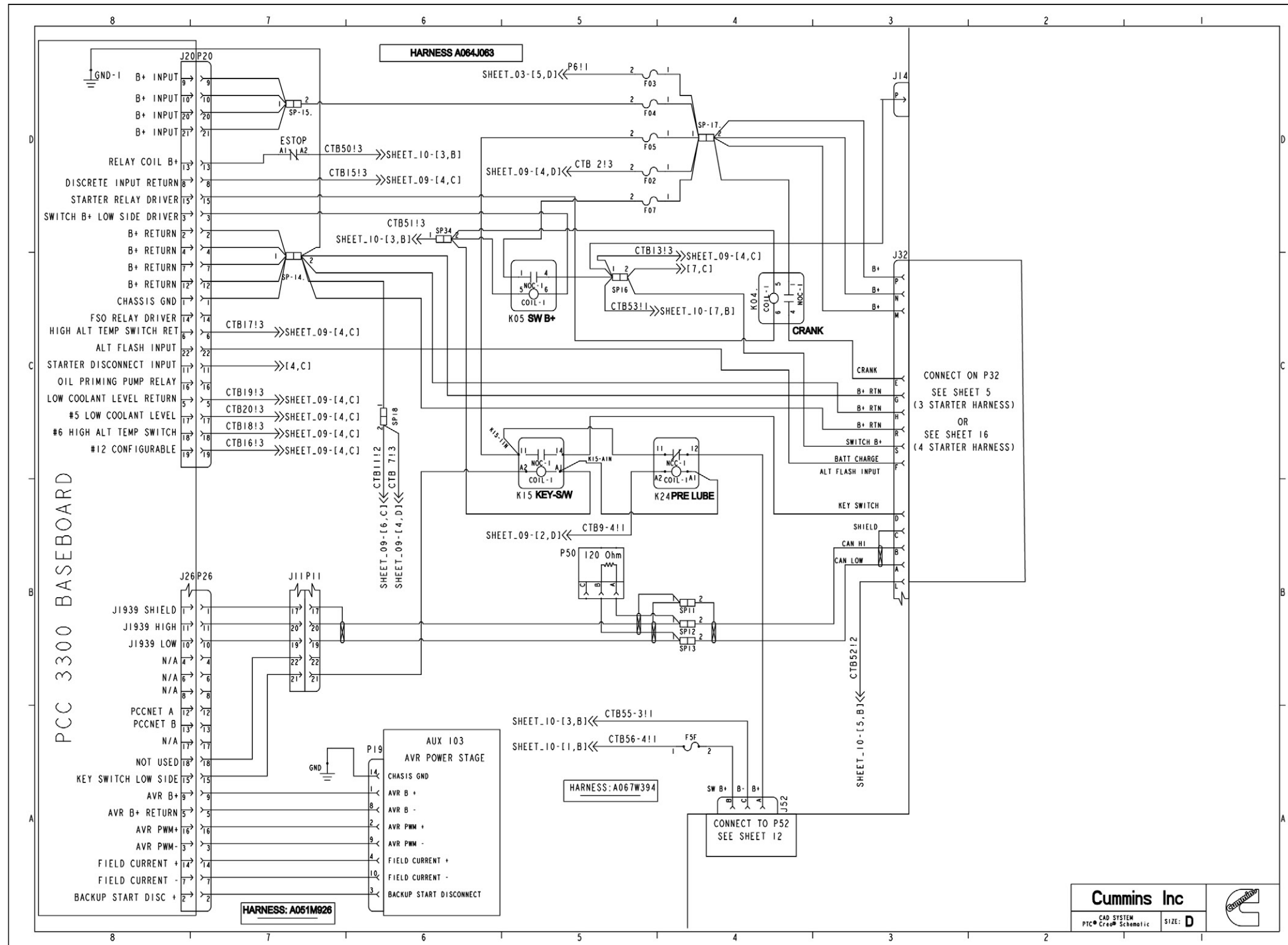


FIGURE 59. WIRING SCHEMATIC (SHEET 4)

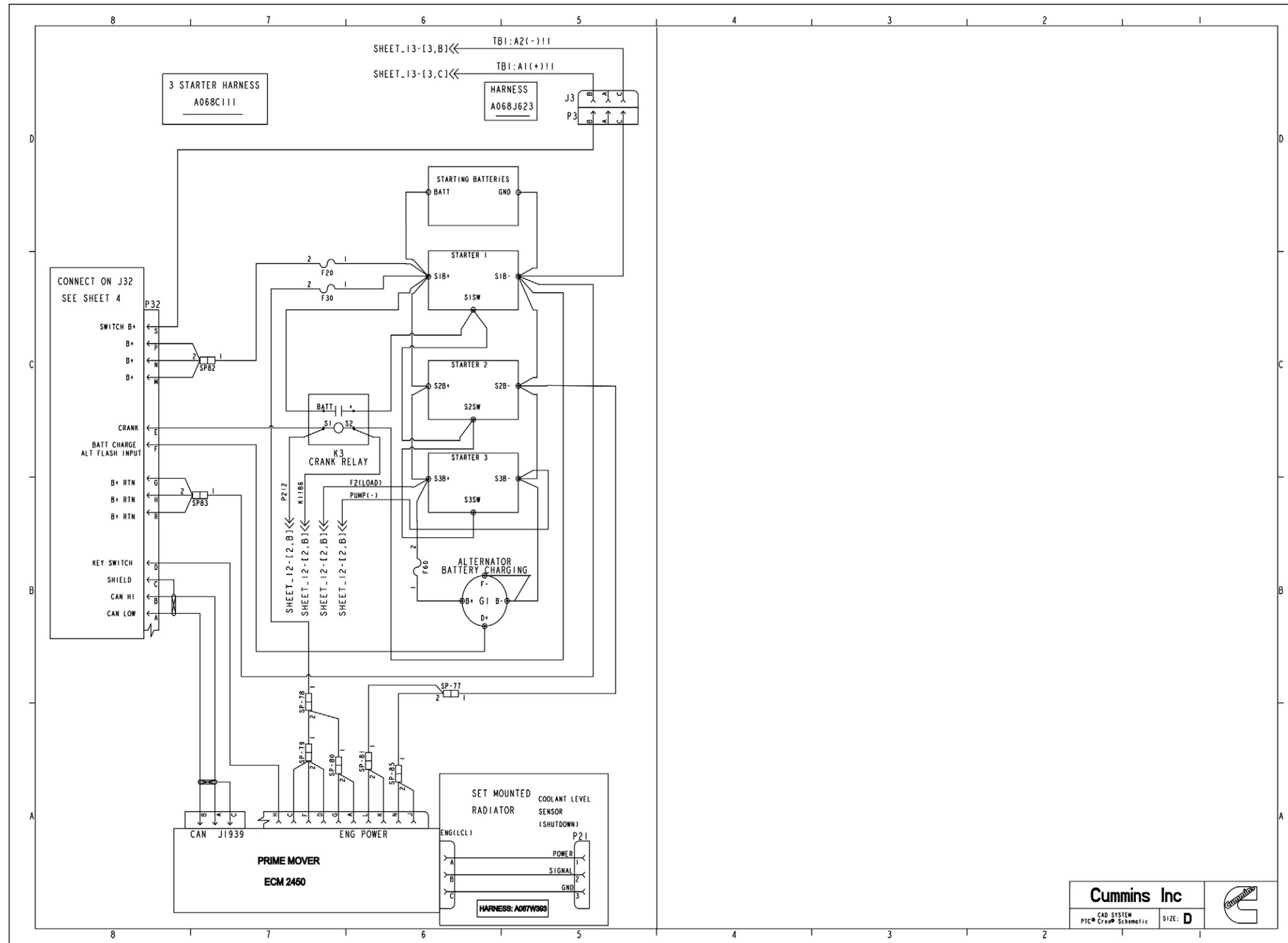


FIGURE 60. WIRING SCHEMATIC (SHEET 5)

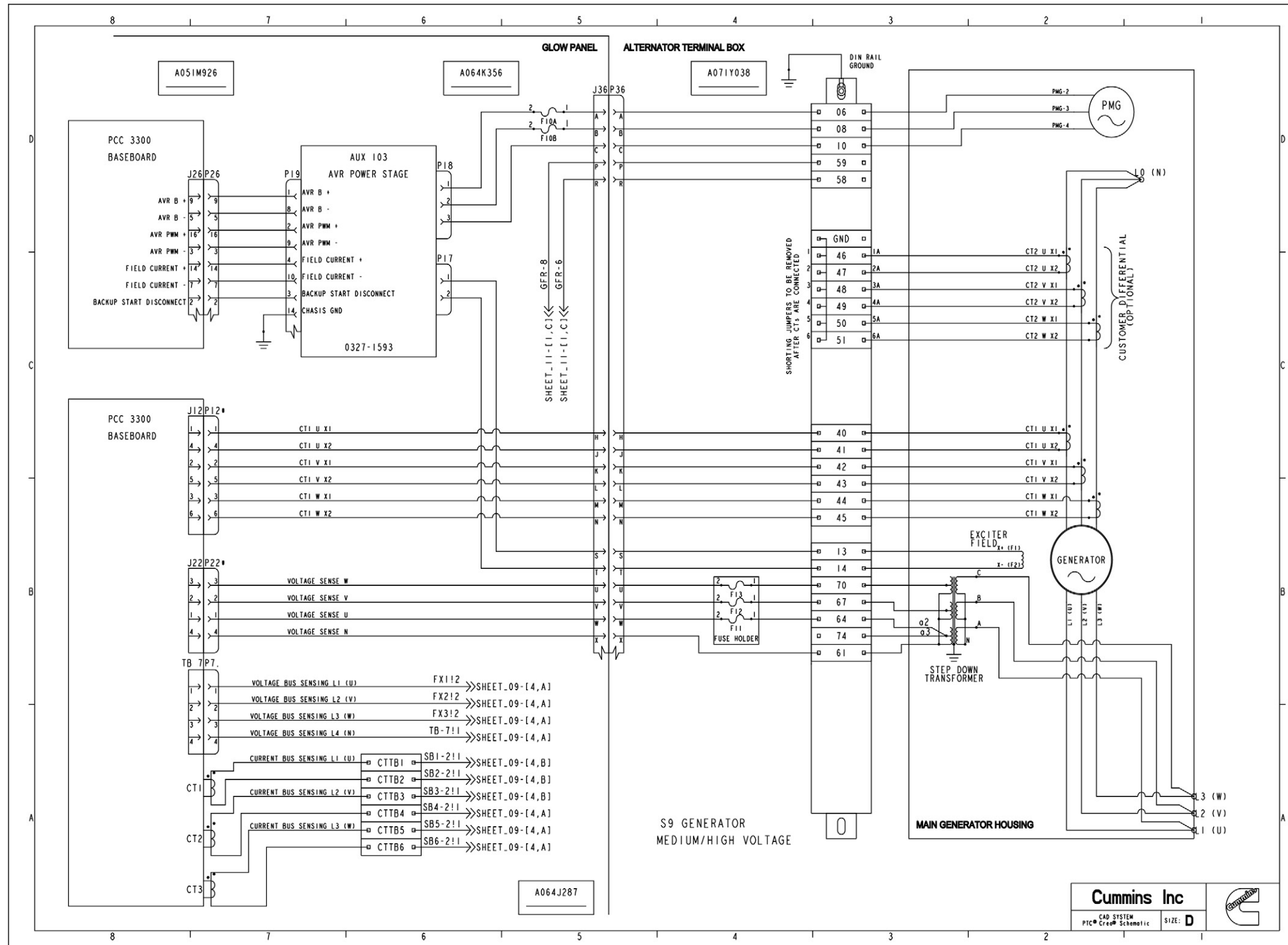


FIGURE 61. WIRING SCHEMATIC (SHEET 6)

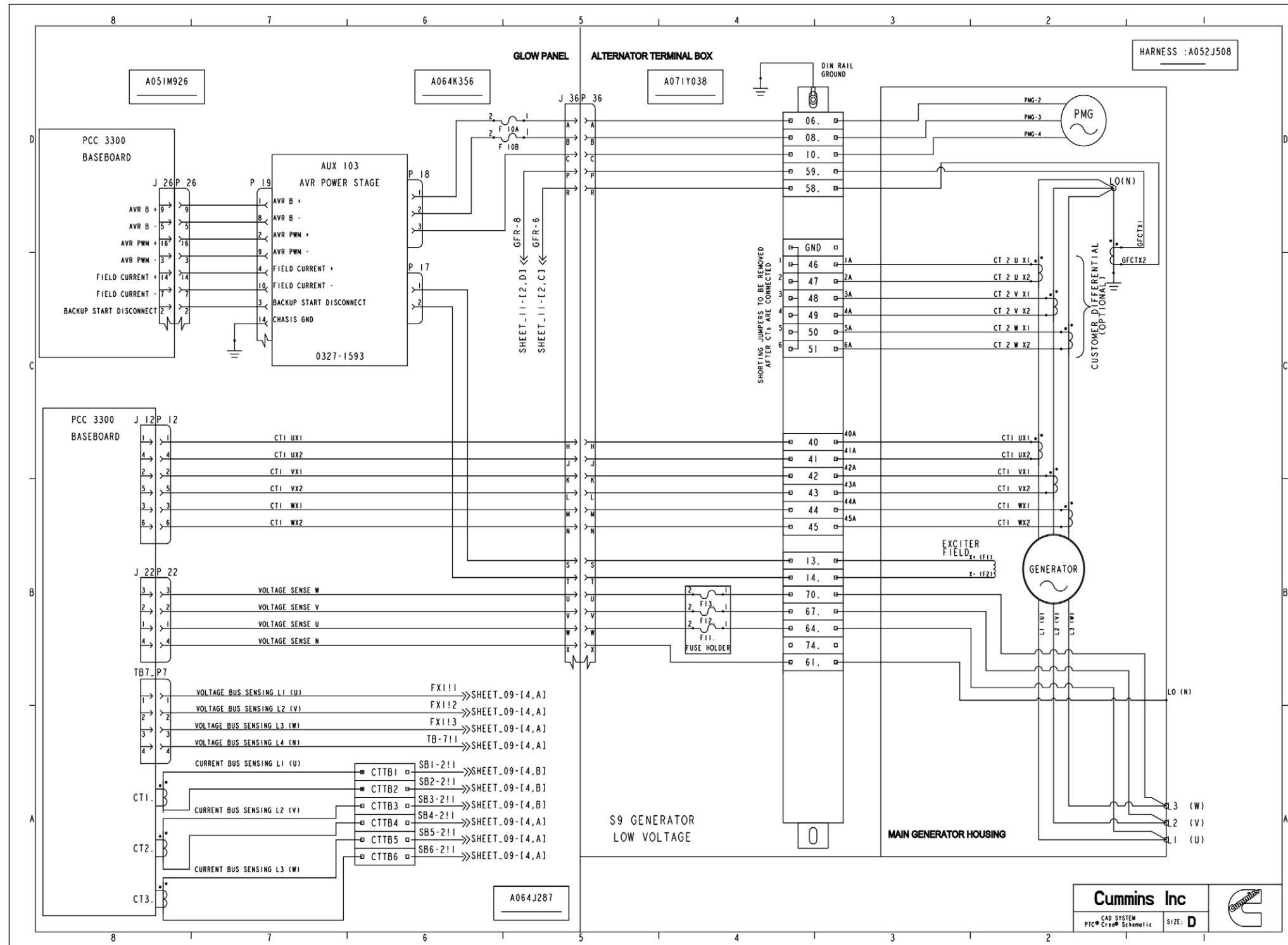


FIGURE 62. WIRING SCHEMATIC (SHEET 7)

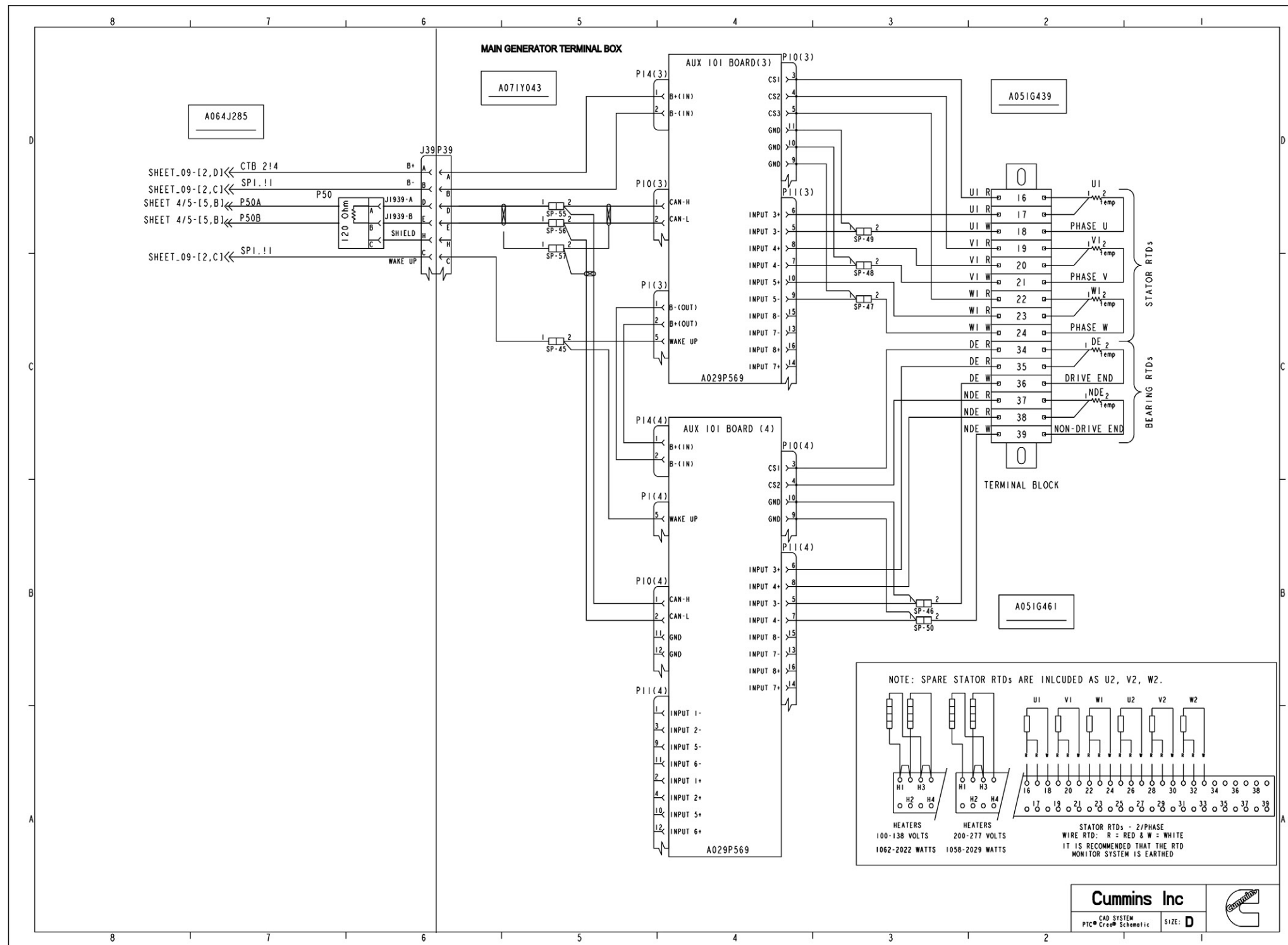


FIGURE 63. WIRING SCHEMATIC (SHEET 8)

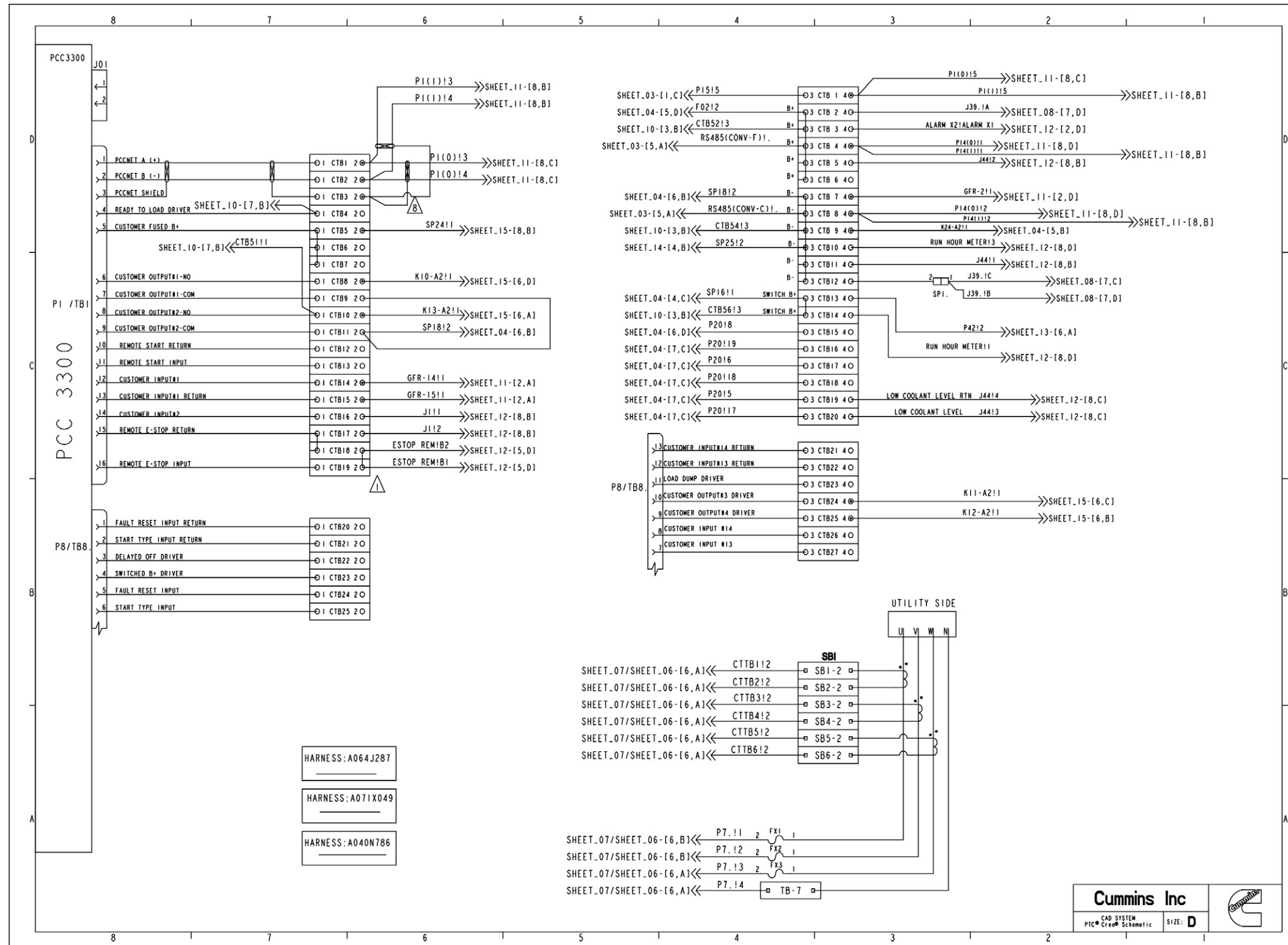


FIGURE 64. WIRING SCHEMATIC (SHEET 9)

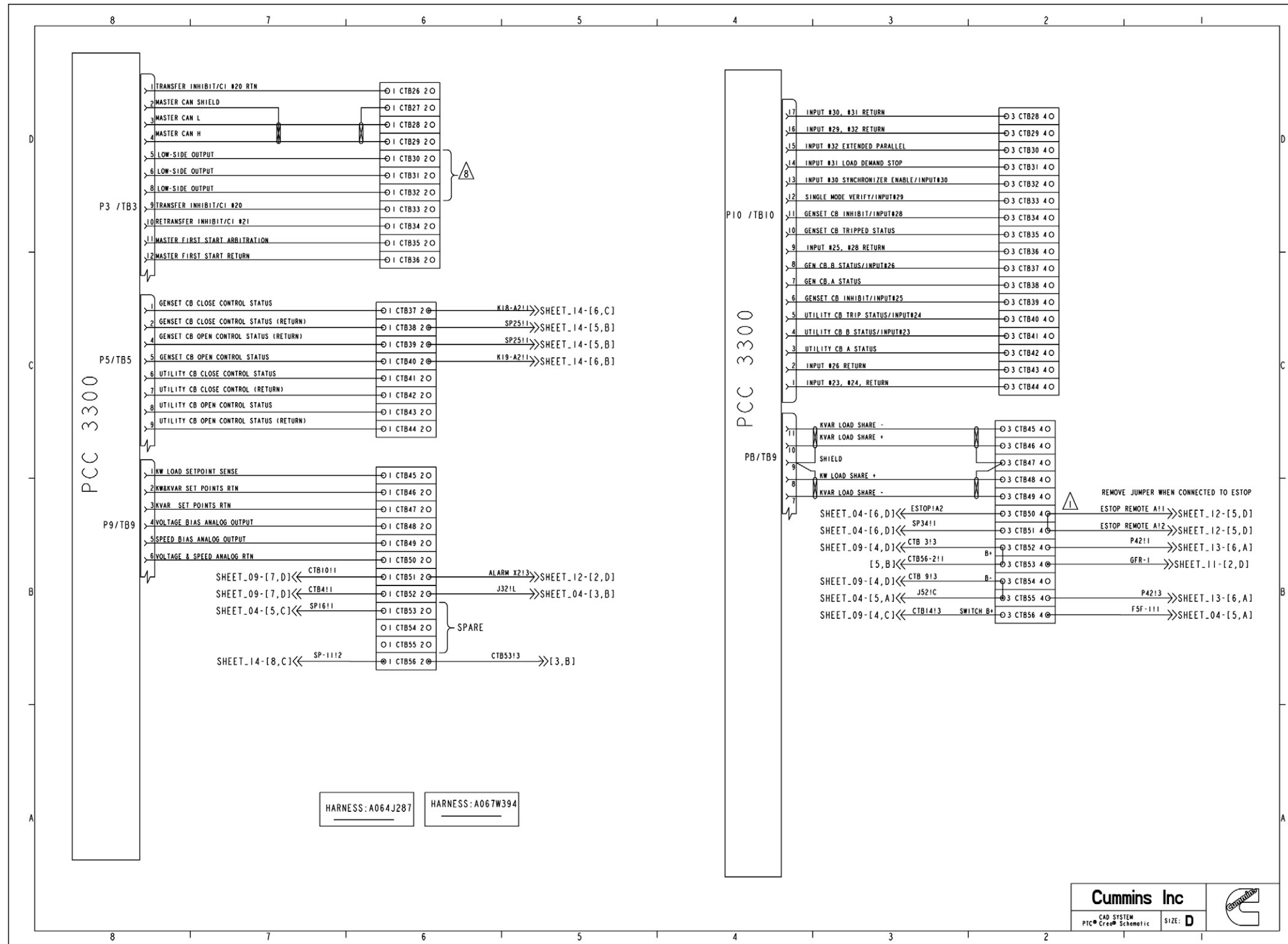


FIGURE 65. WIRING SCHEMATIC (SHEET 10)

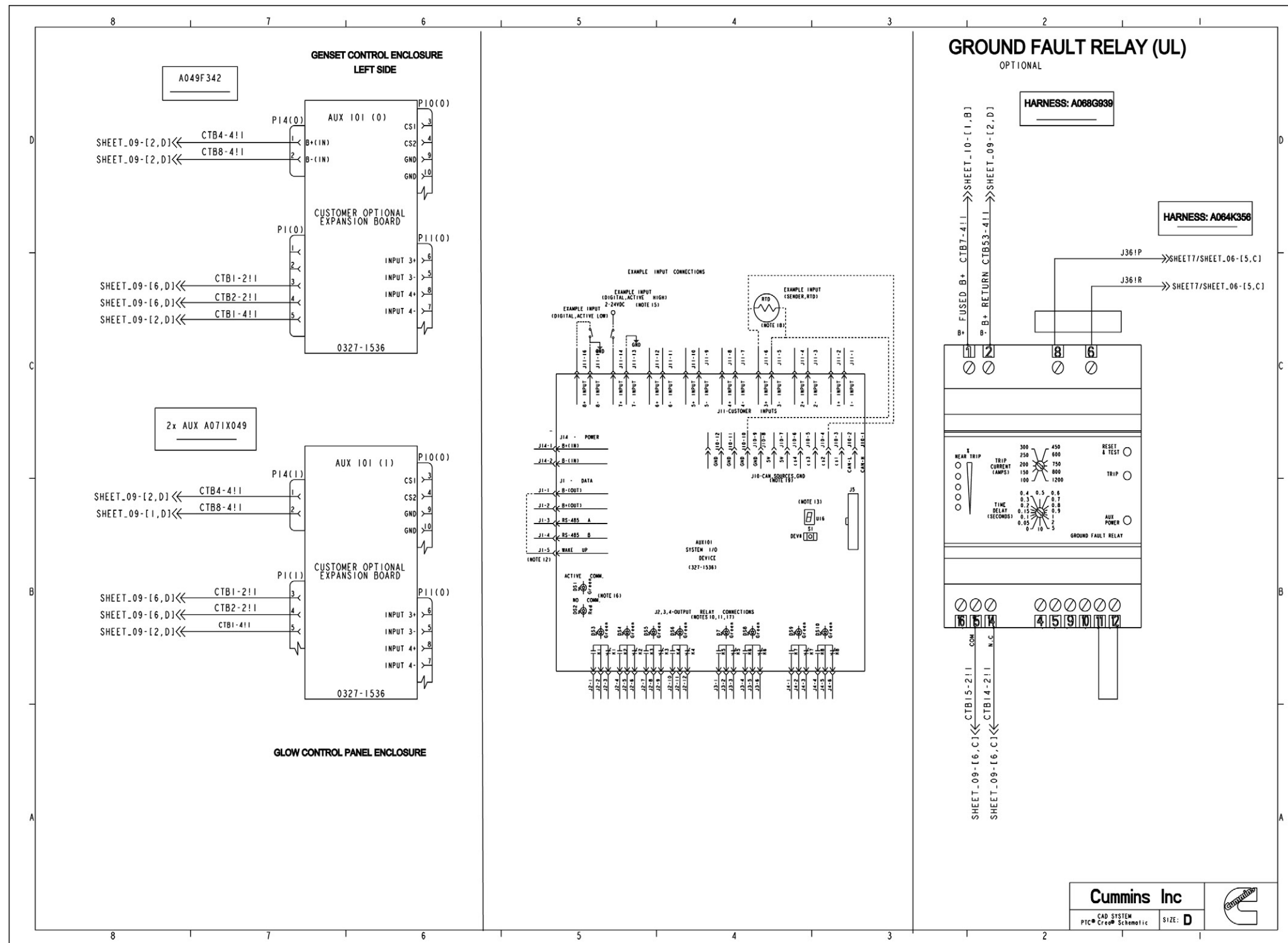


FIGURE 66. WIRING SCHEMATIC (SHEET 11)

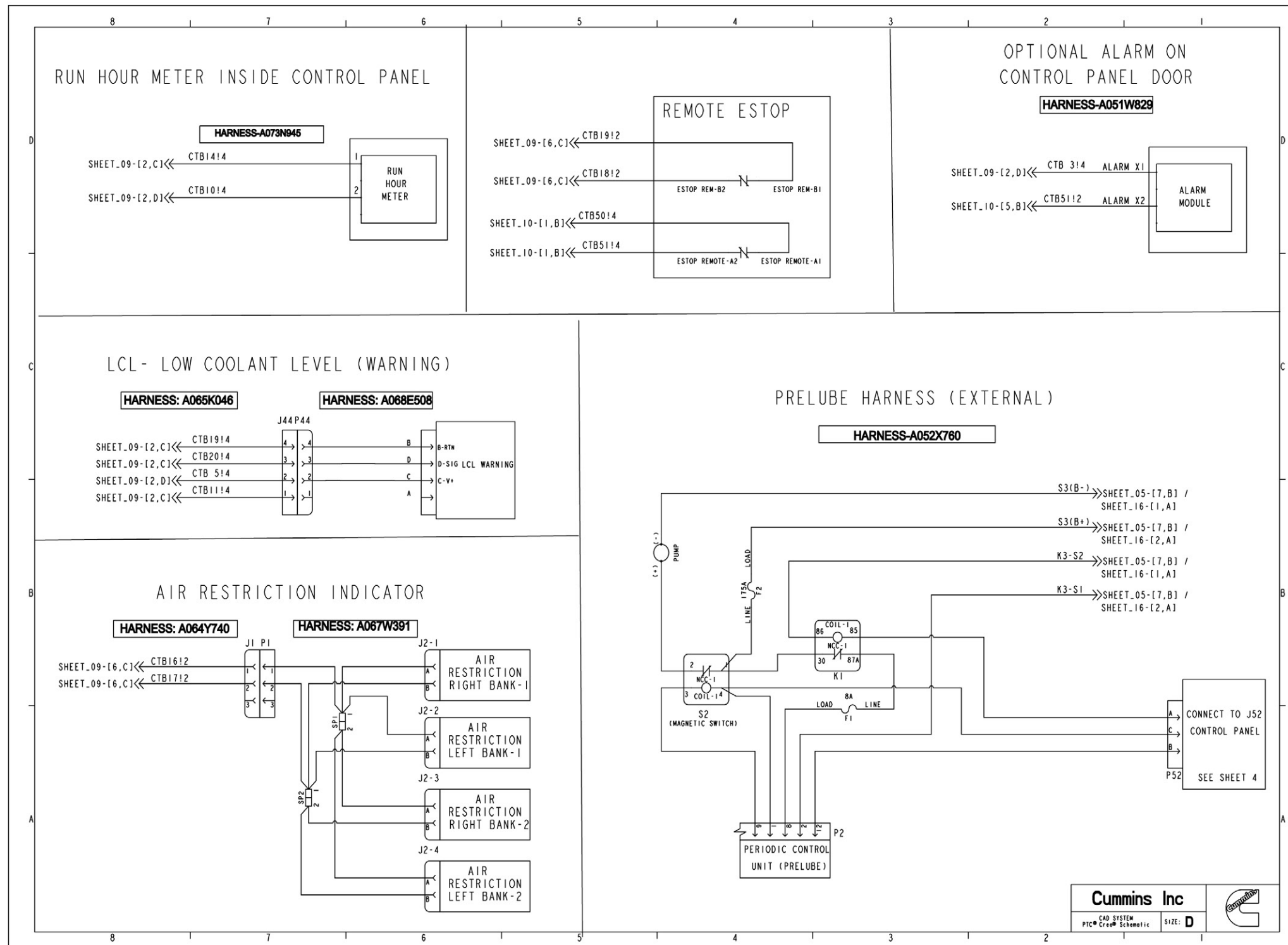


FIGURE 67. WIRING SCHEMATIC (SHEET 12)

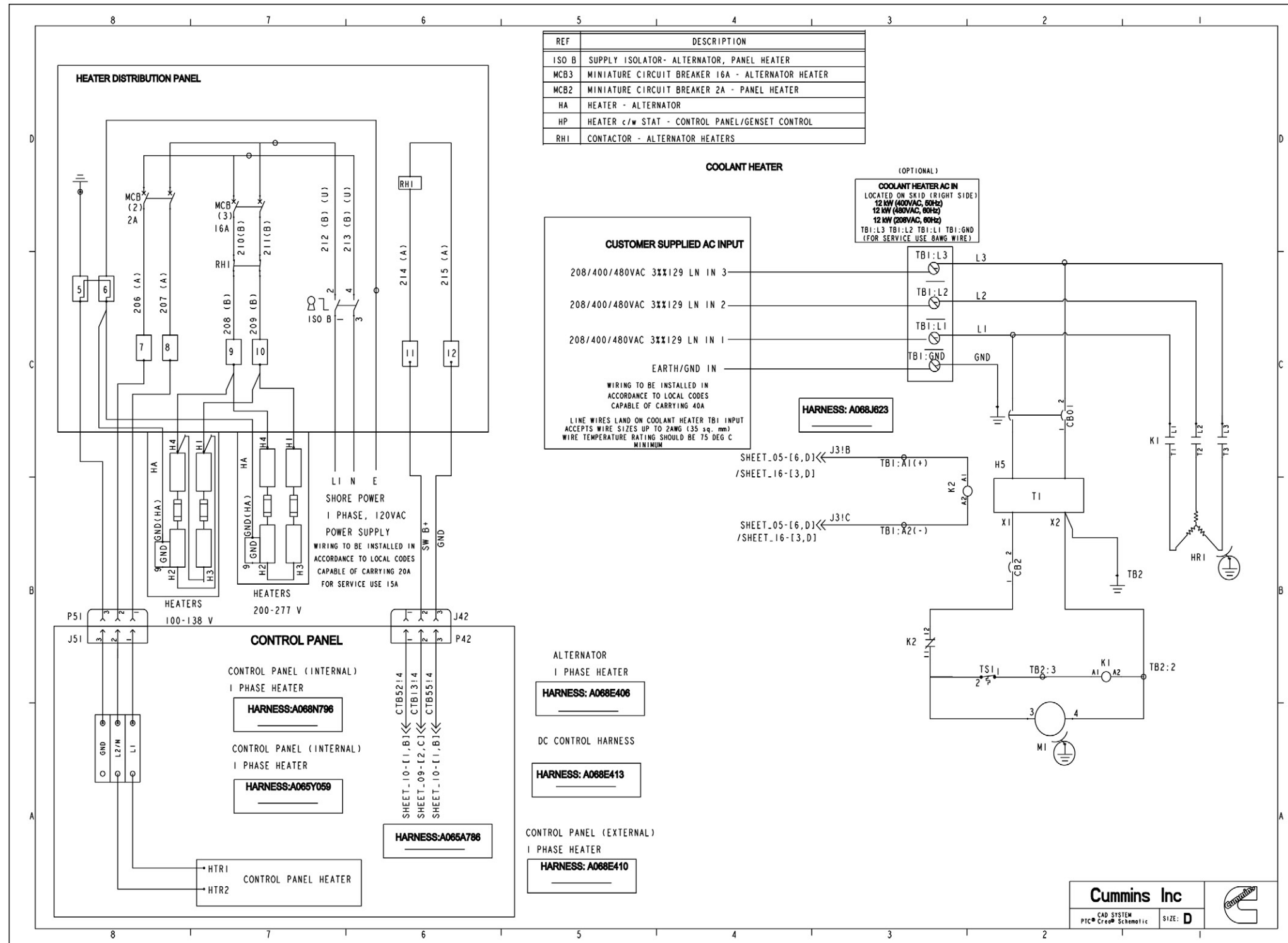


FIGURE 68. WIRING SCHEMATIC (SHEET 13)

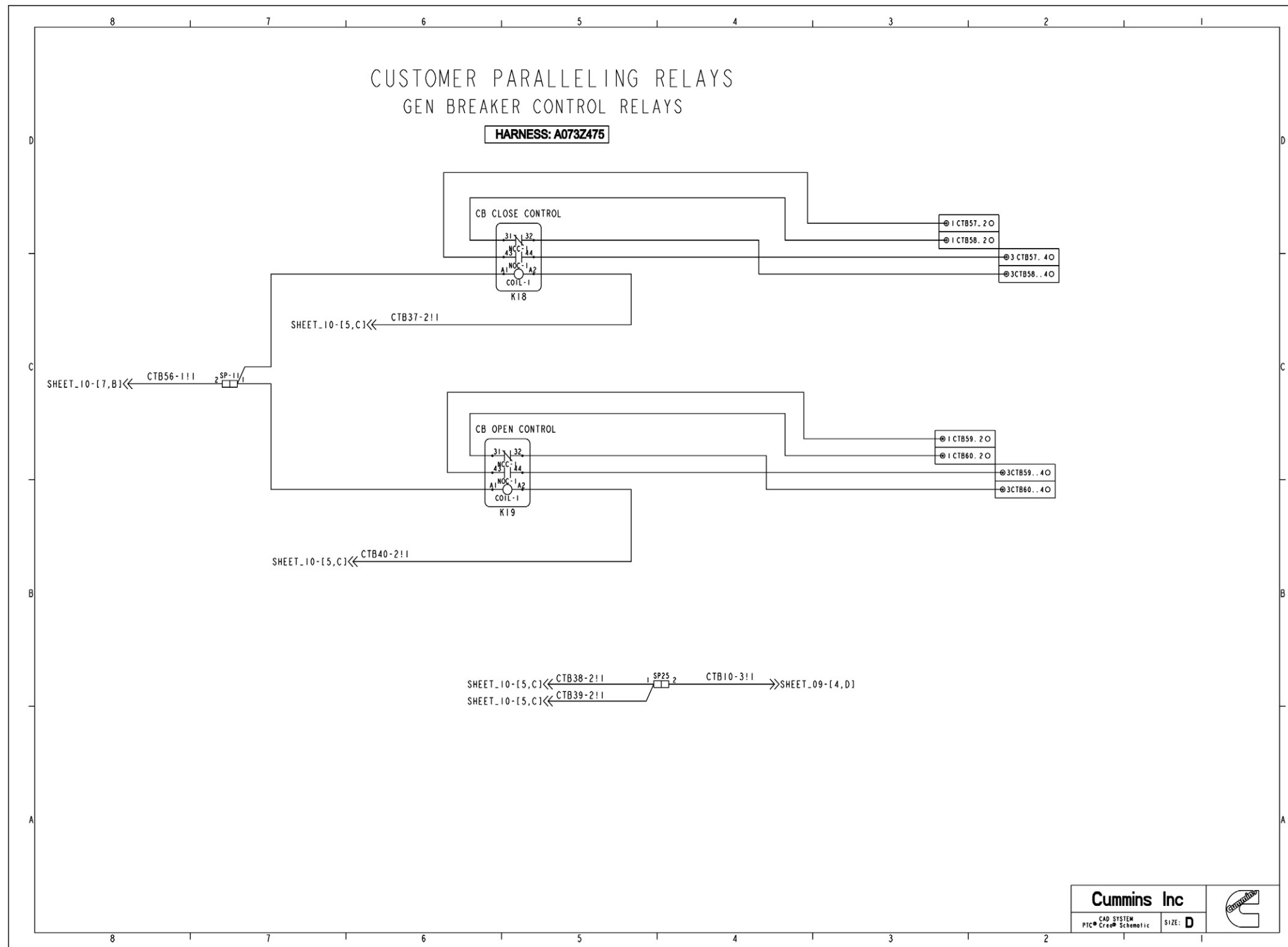


FIGURE 69. WIRING SCHEMATIC (SHEET 14)

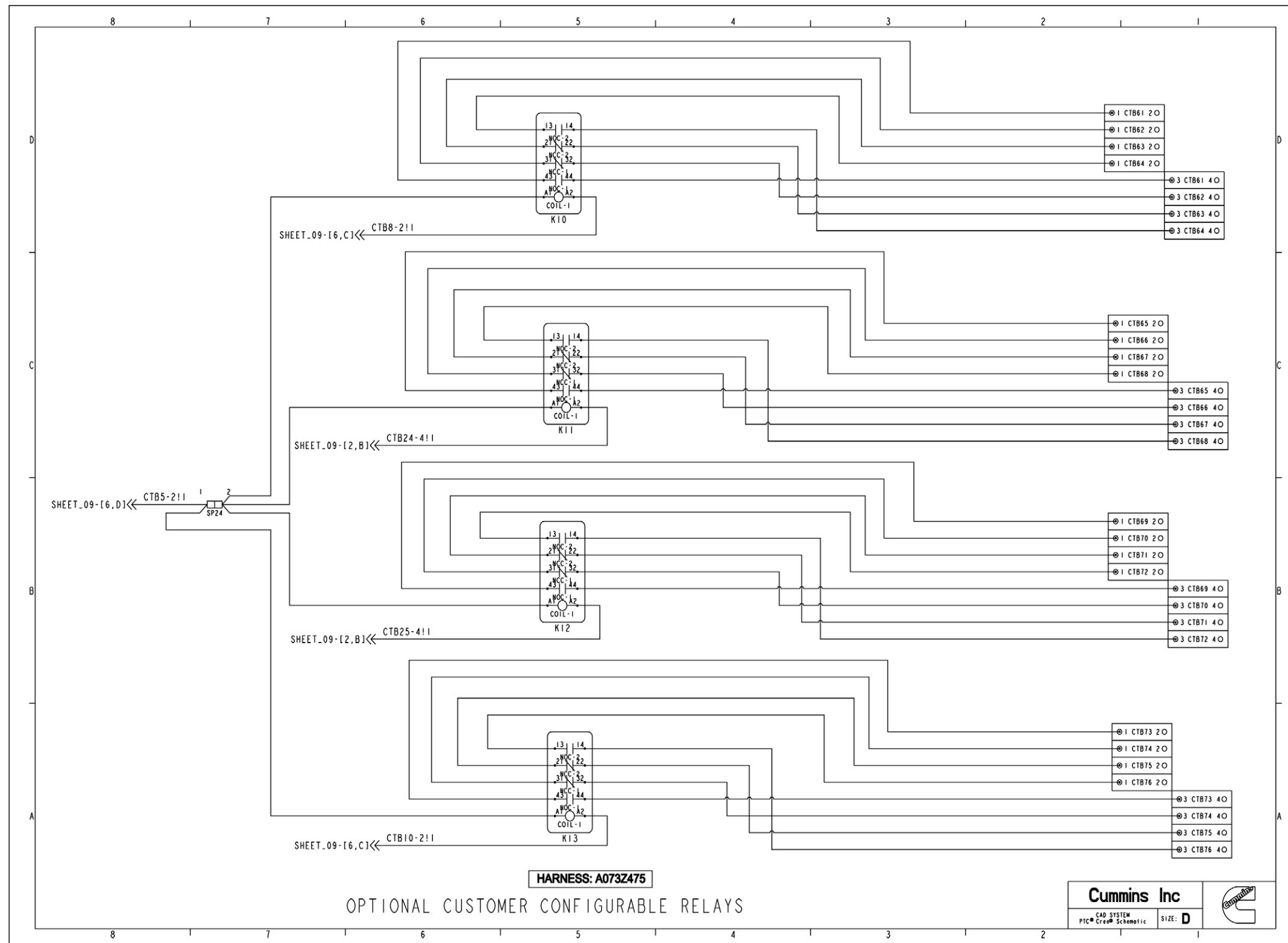


FIGURE 70. WIRING SCHEMATIC (SHEET 15)

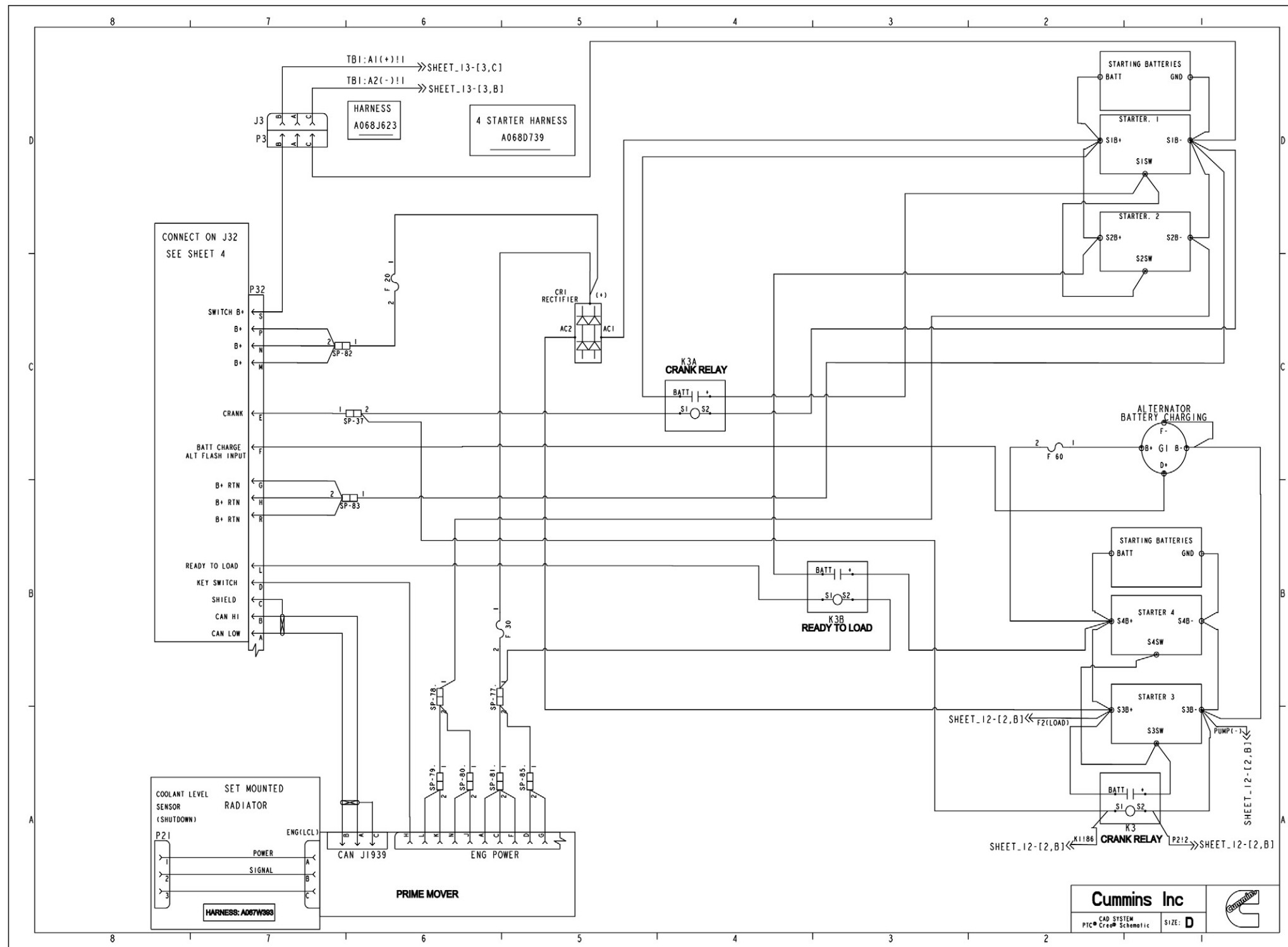


FIGURE 71. WIRING SCHEMATIC (SHEET 16)

A.2 Control Wiring Diagrams (0630-3440)

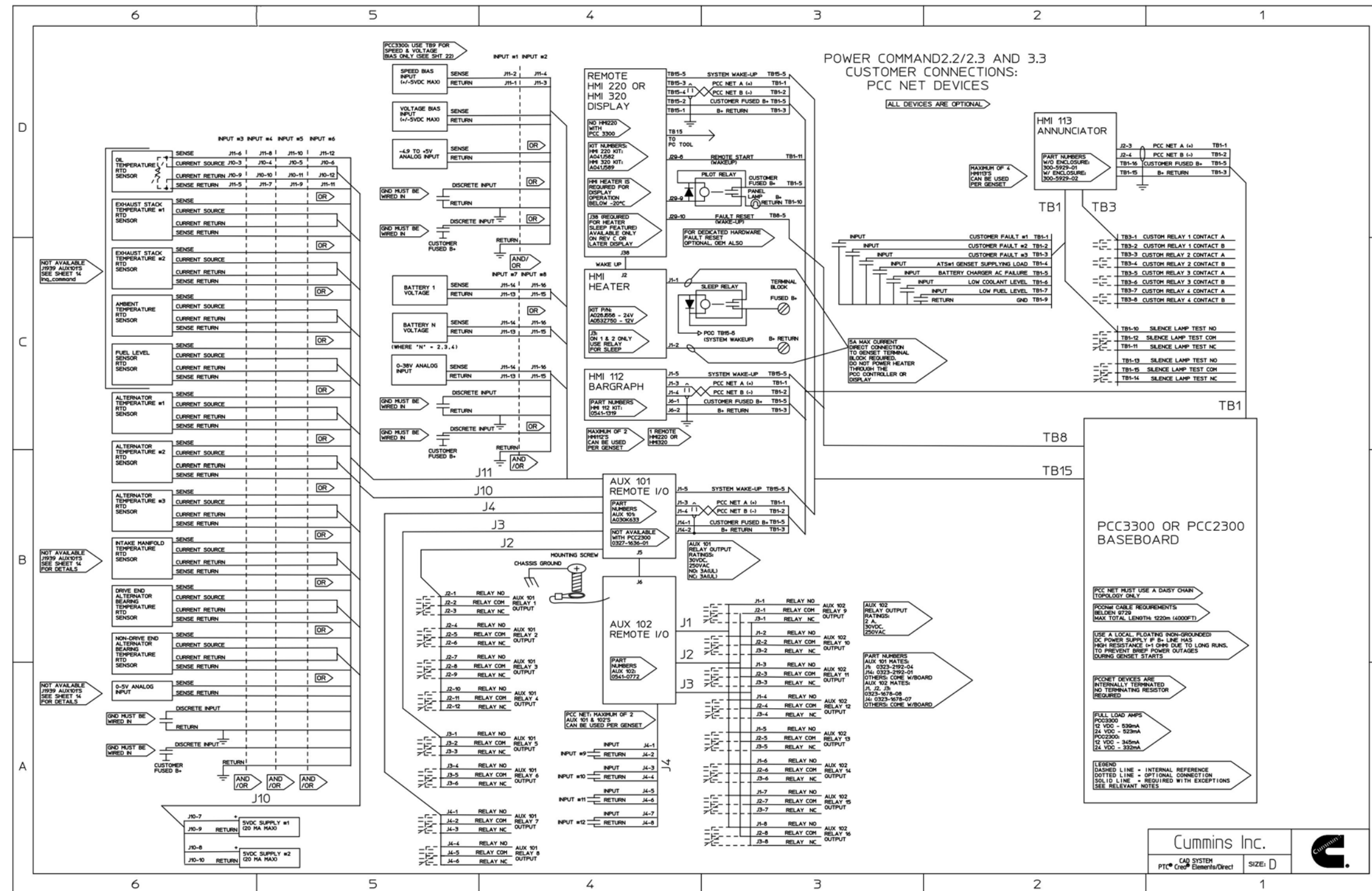


FIGURE 72. CONTROL CUSTOMER CONNECTIONS - PCC NET DEVICES

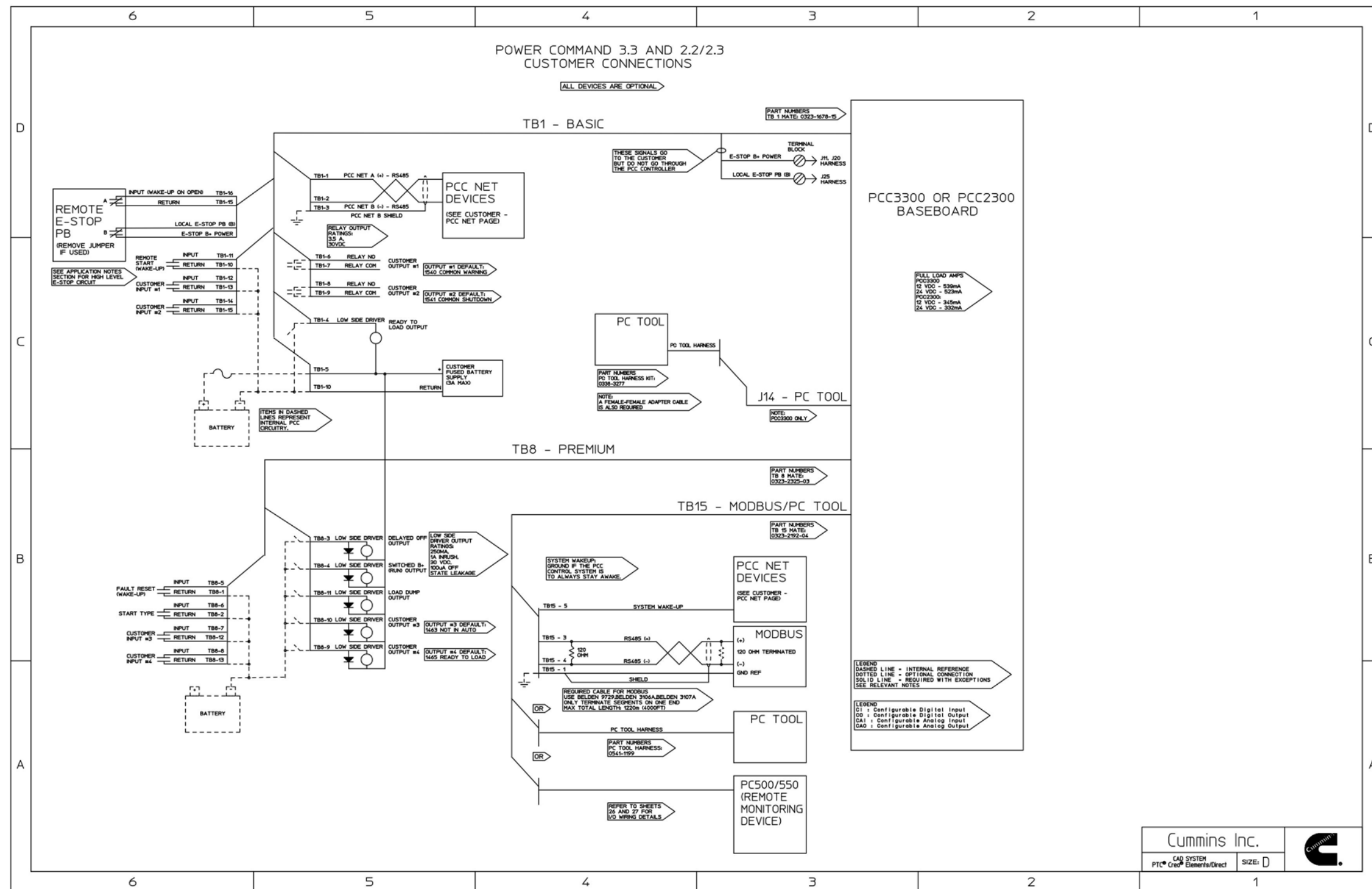


FIGURE 73. CUSTOMER CONNECTIONS

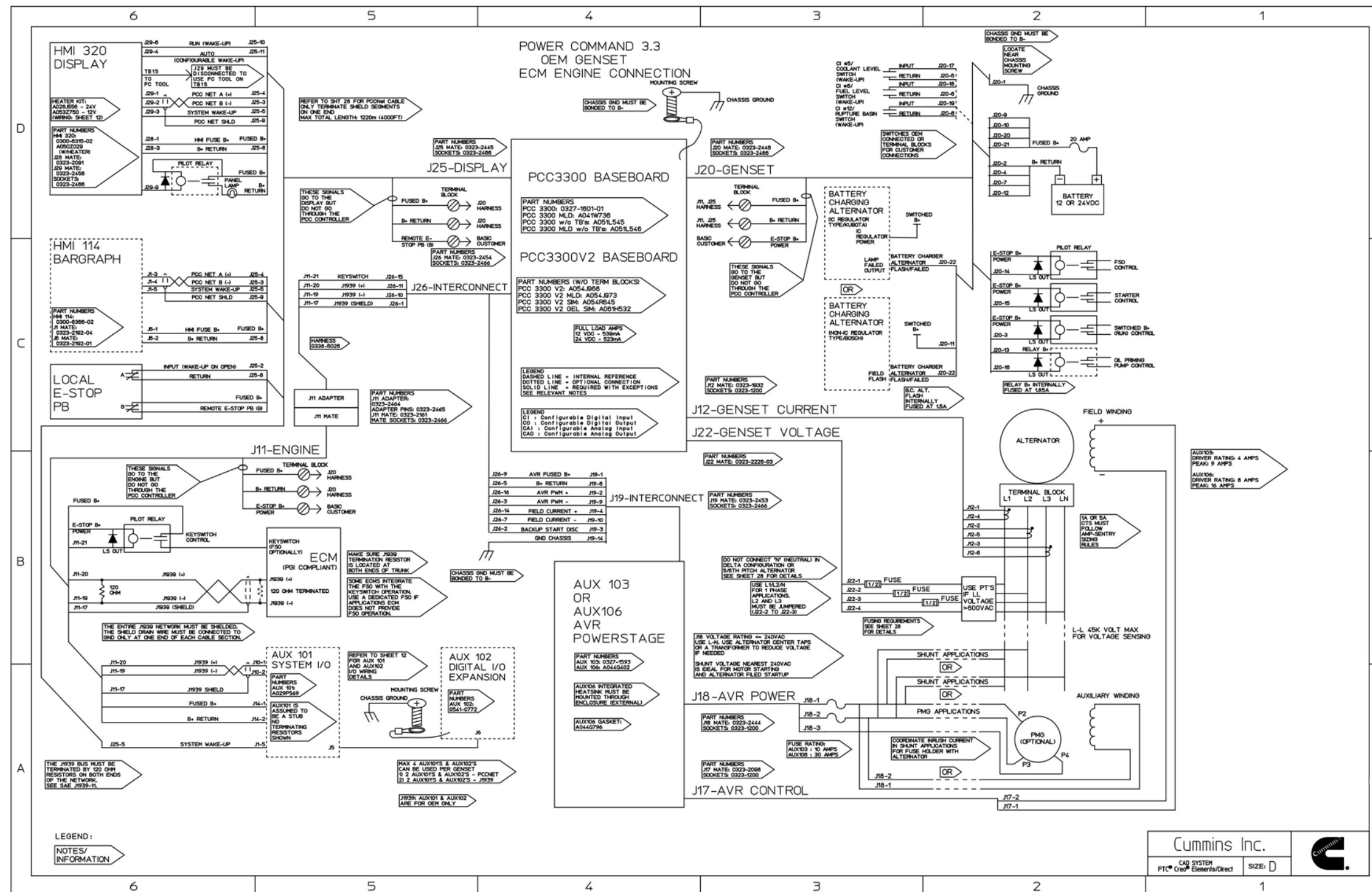


FIGURE 74. POWERCOMMAND 3.3 CONNECTIONS - ECM-BASED ENGINES

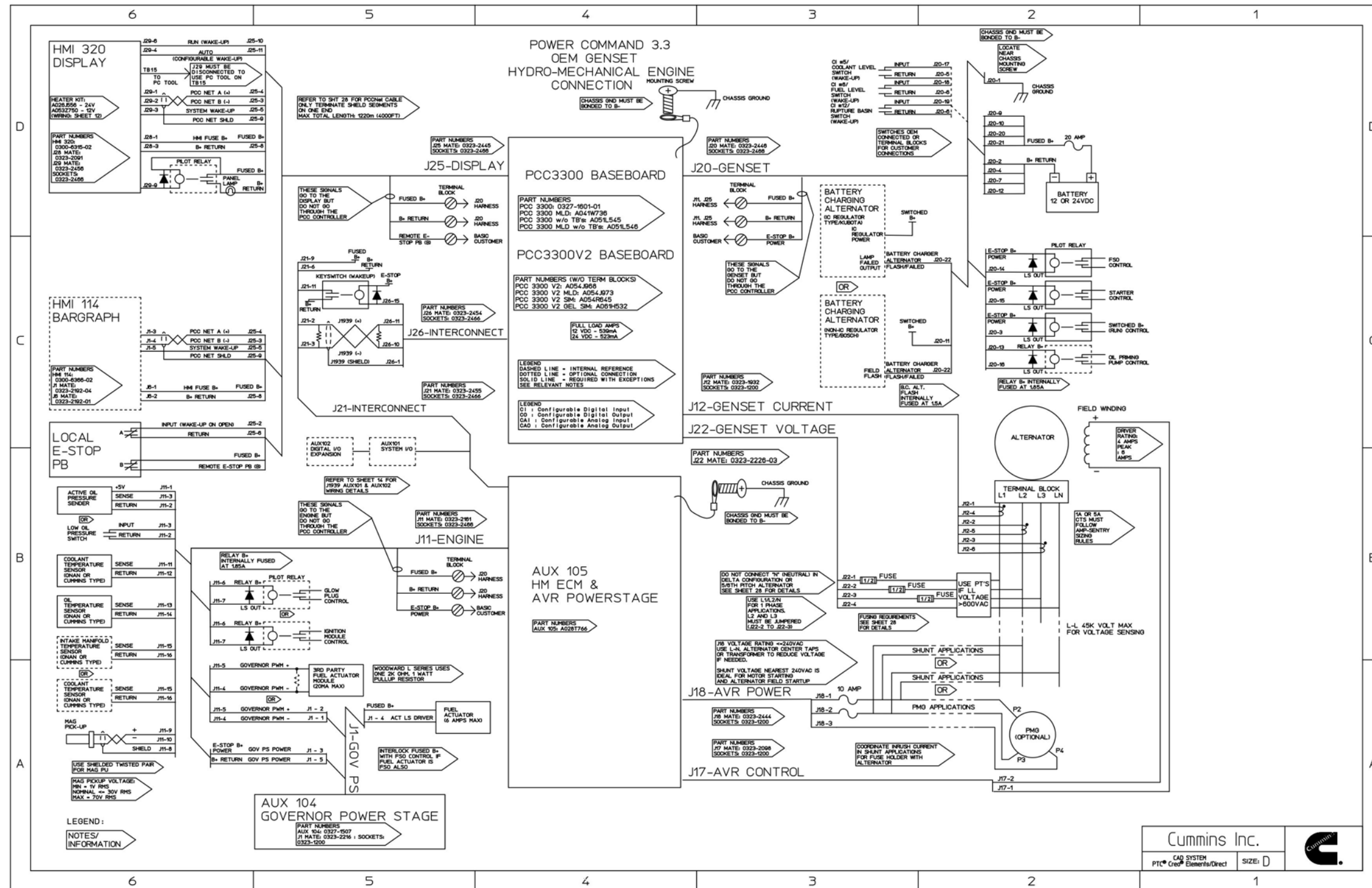


FIGURE 75. POWERCOMMAND 3.3 CONNECTIONS - HYDROMECHANICAL ENGINE

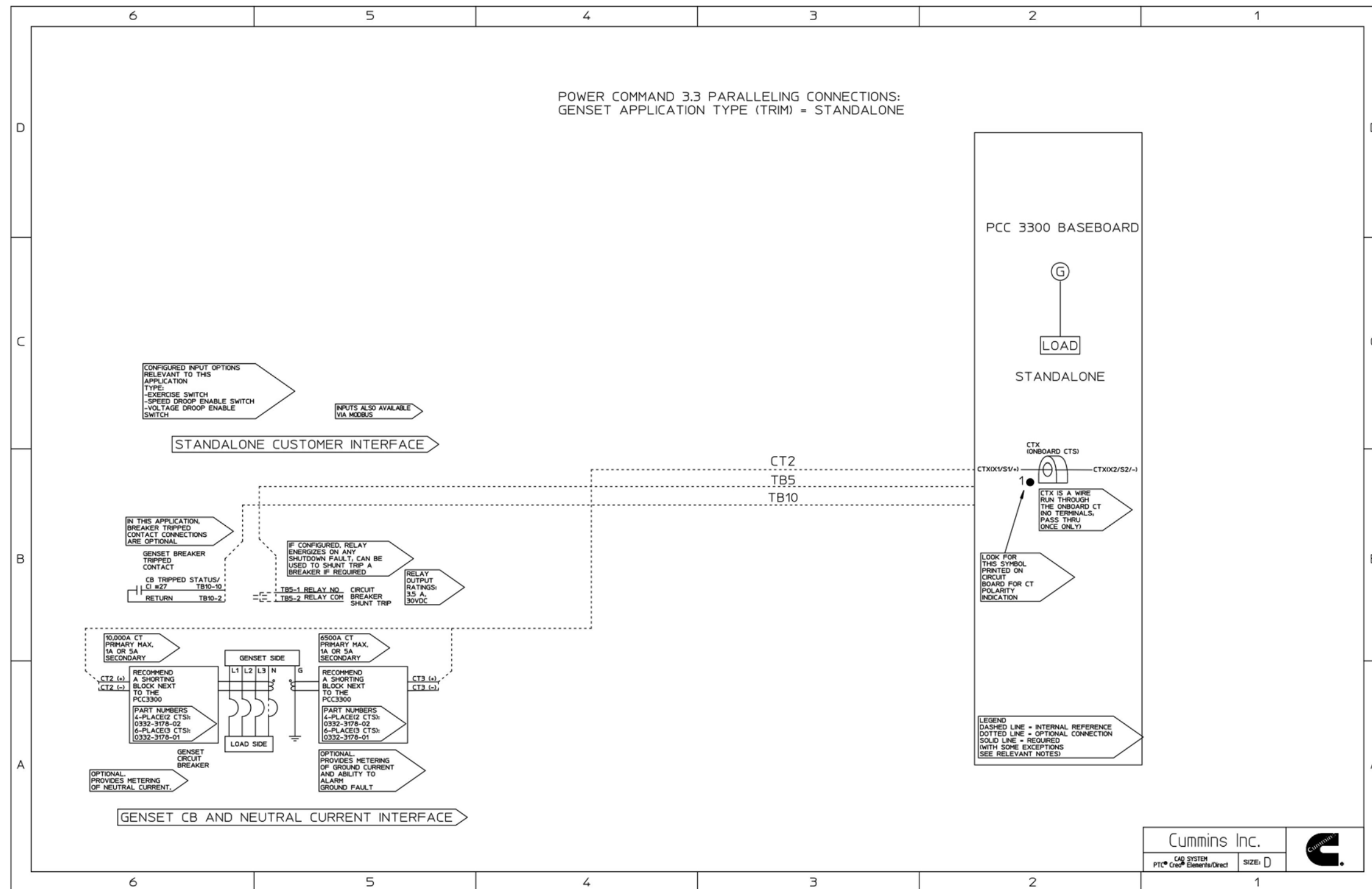


FIGURE 76. POWERCOMMAND 3.3 PARALLELING CONNECTIONS - STANDALONE GENERATOR SET

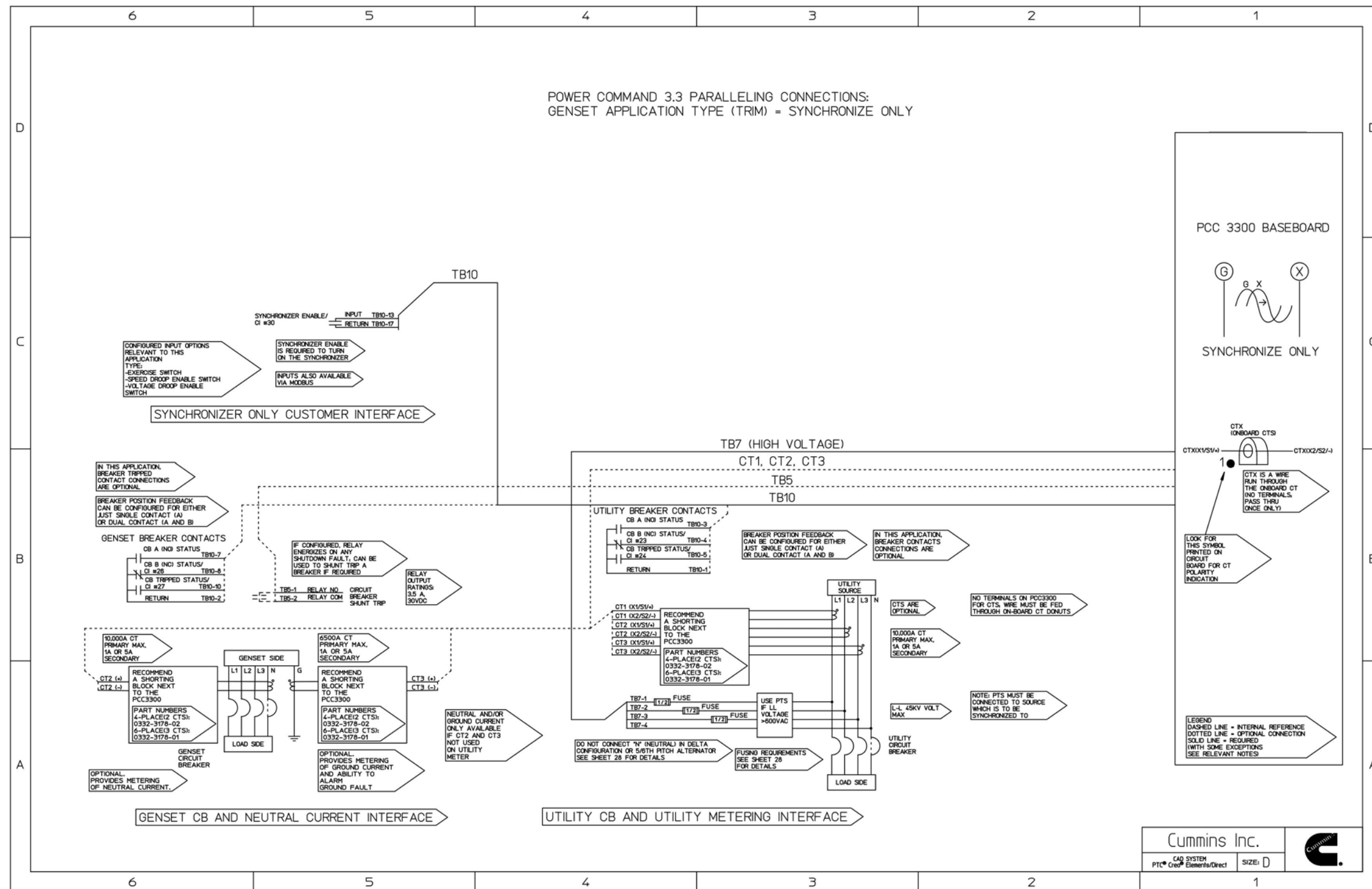
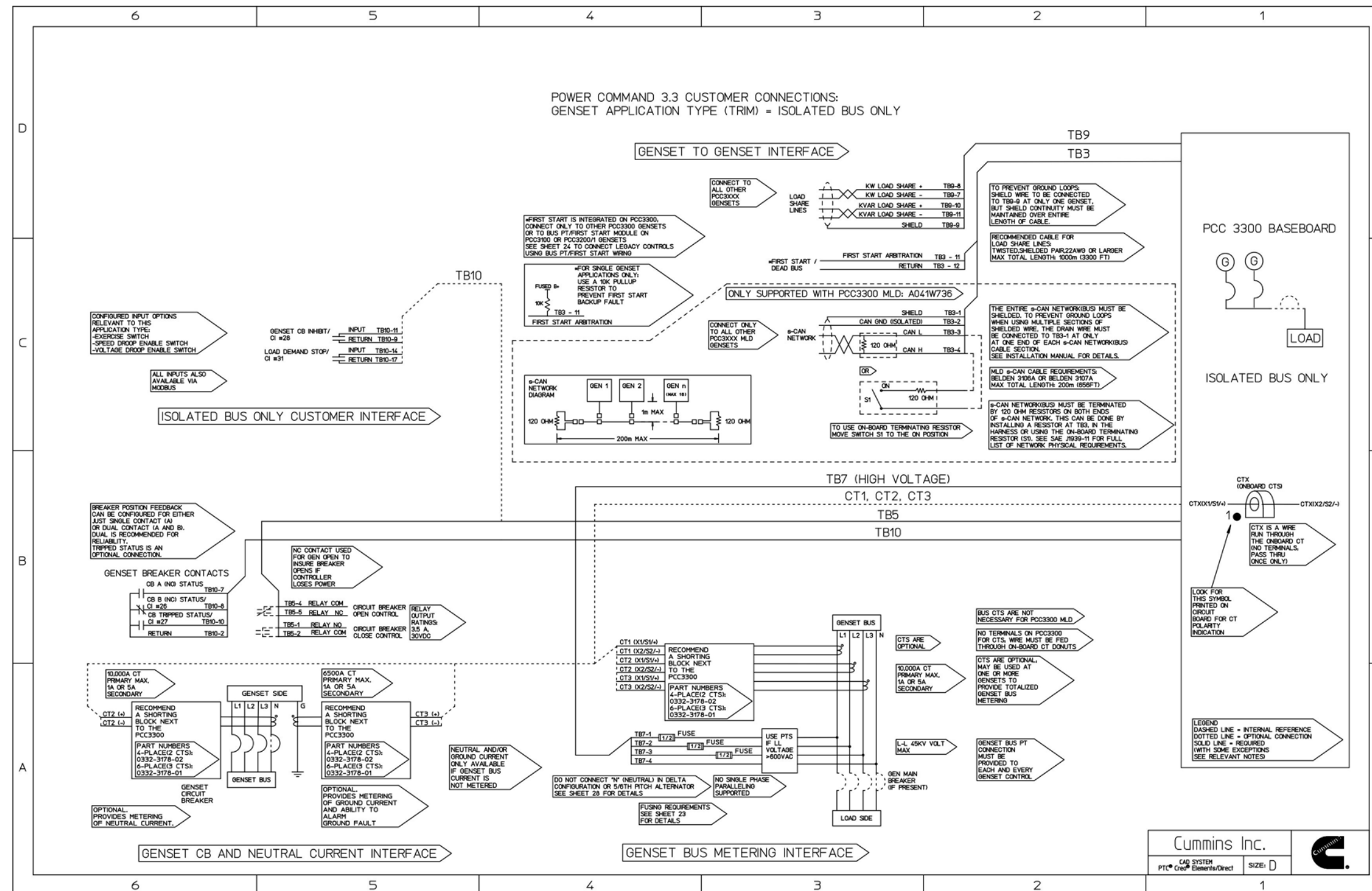


FIGURE 77. POWERCOMMAND 3.3 PARALLELING CONNECTIONS - SYNCHRONIZE ONLY



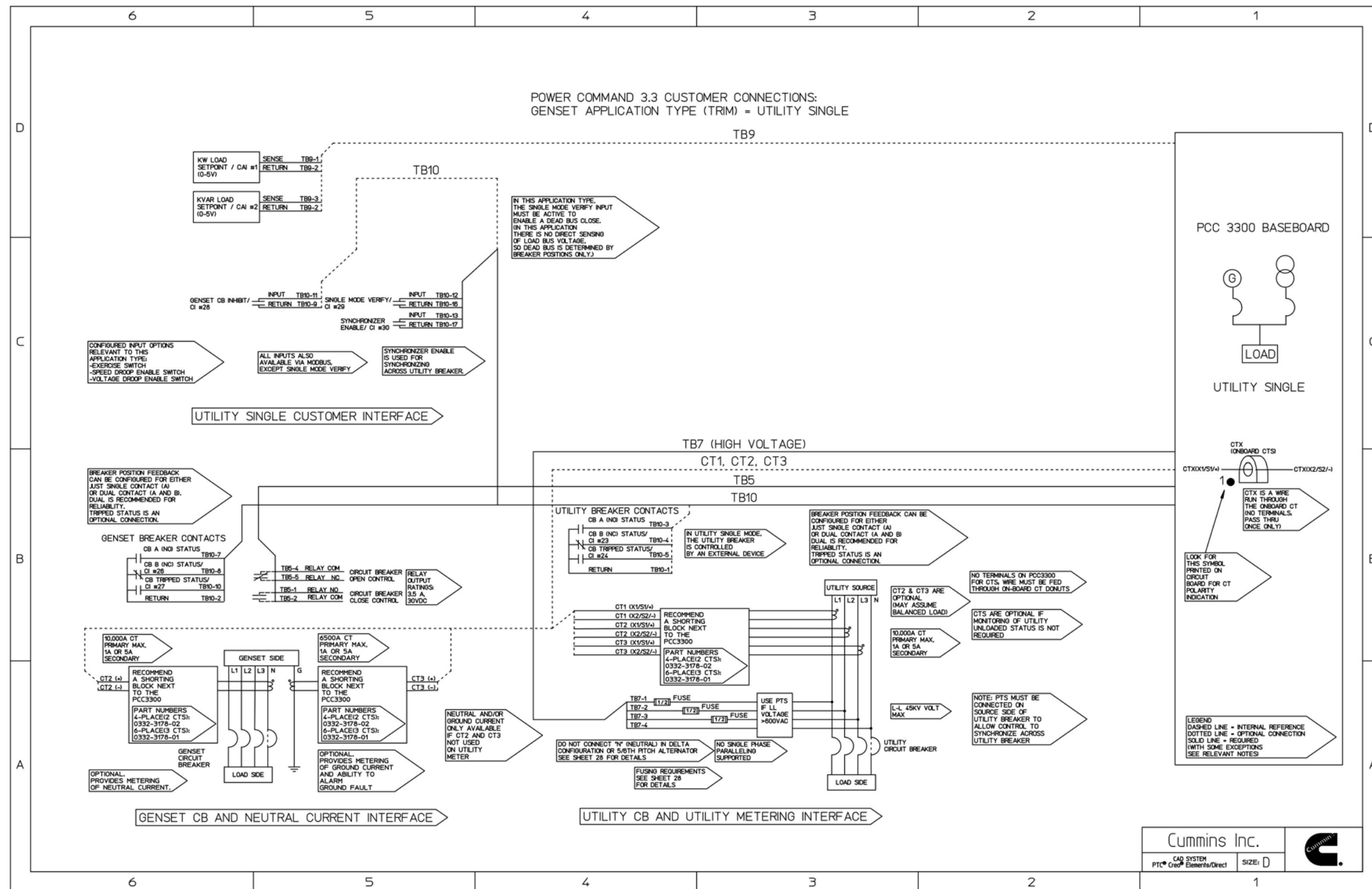


FIGURE 79. POWERCOMMAND 3.3 PARALLELING CONNECTIONS - UTILITY SINGLE

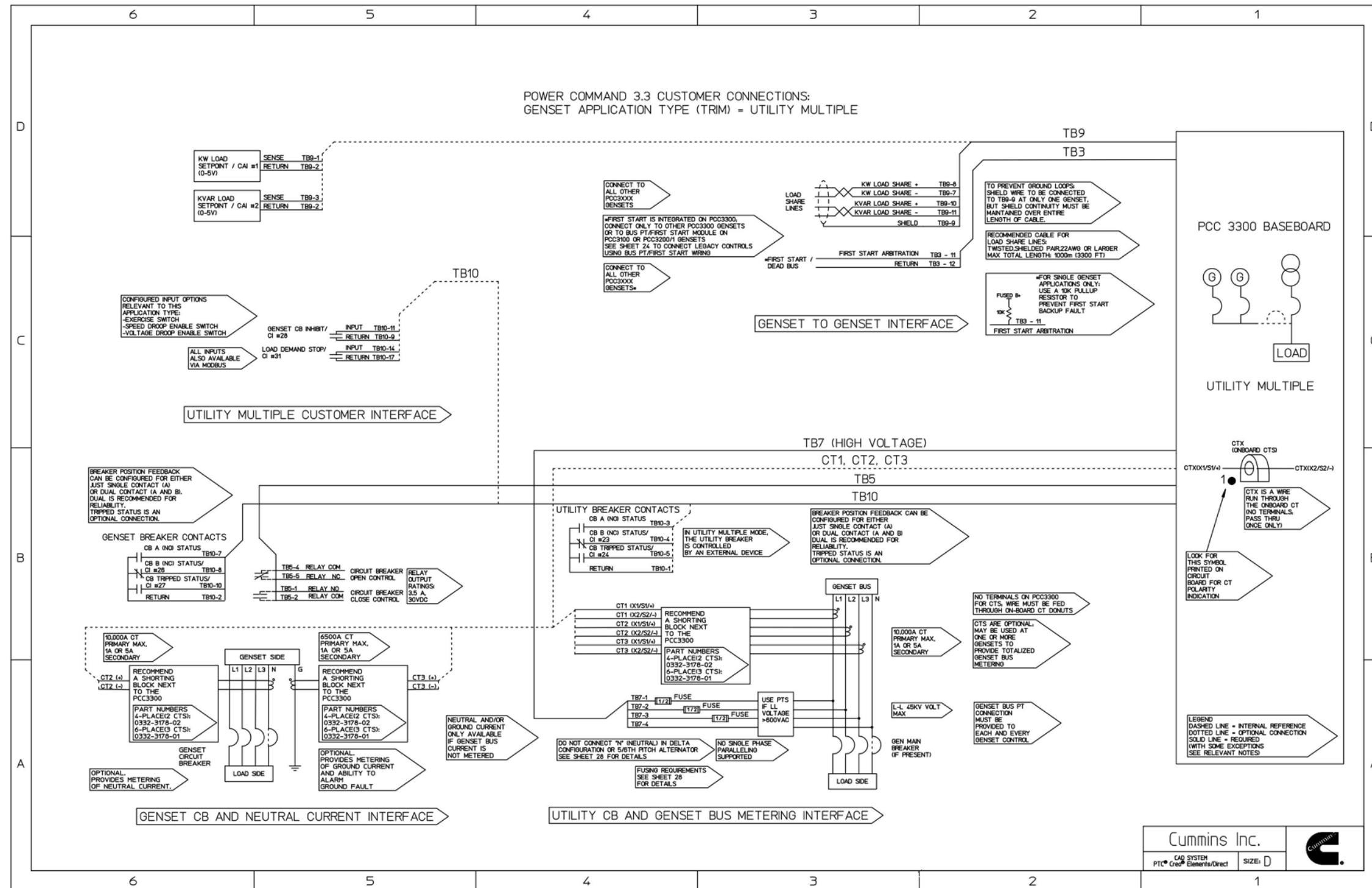


FIGURE 80. POWERCOMMAND 3.3 PARALLELING CONNECTIONS - UTILITY MULTIPLE

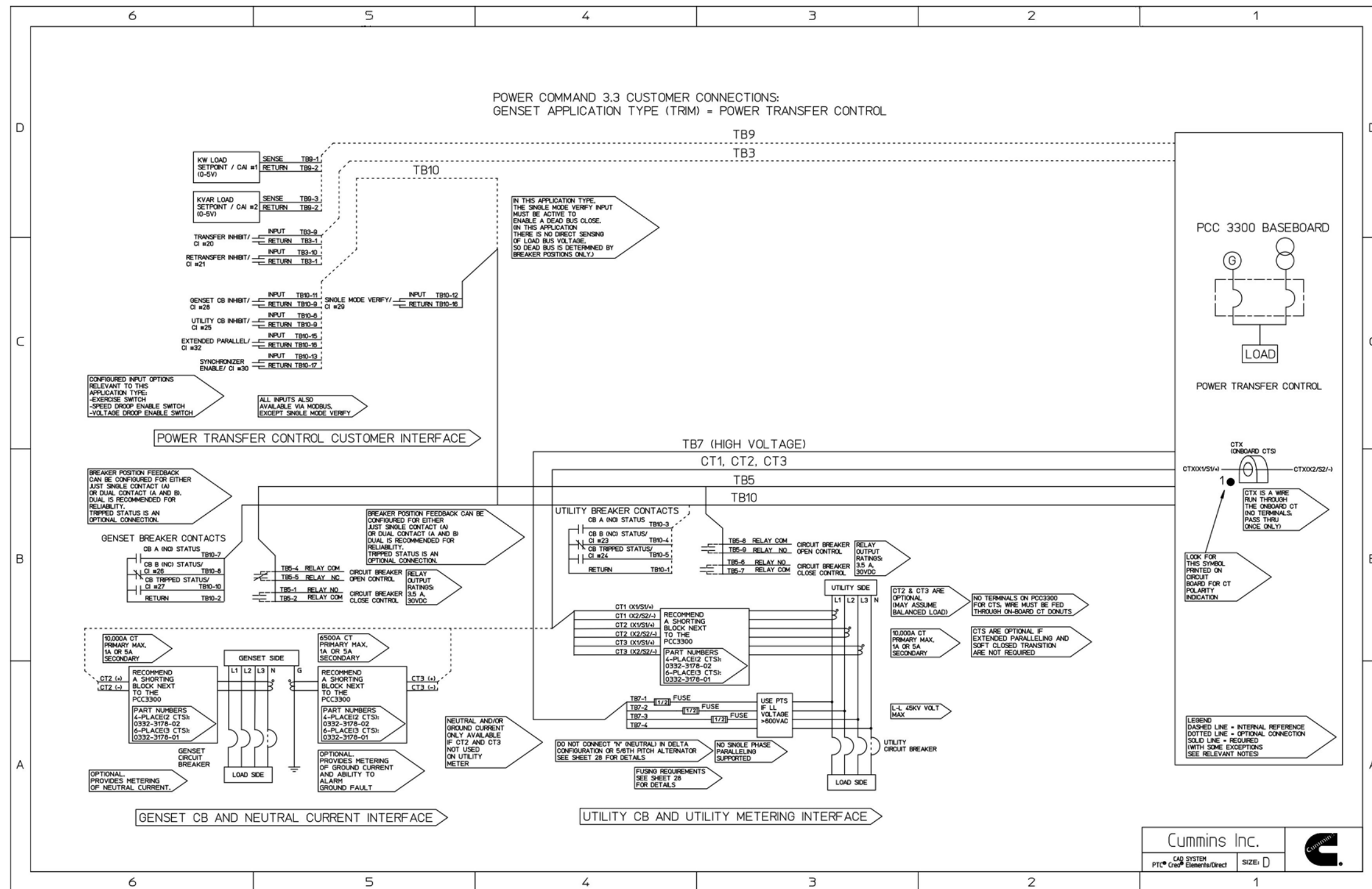


FIGURE 81. POWERCOMMAND 3.3 PARALLELING CONNECTIONS - POWER TRANSFER CONTROL

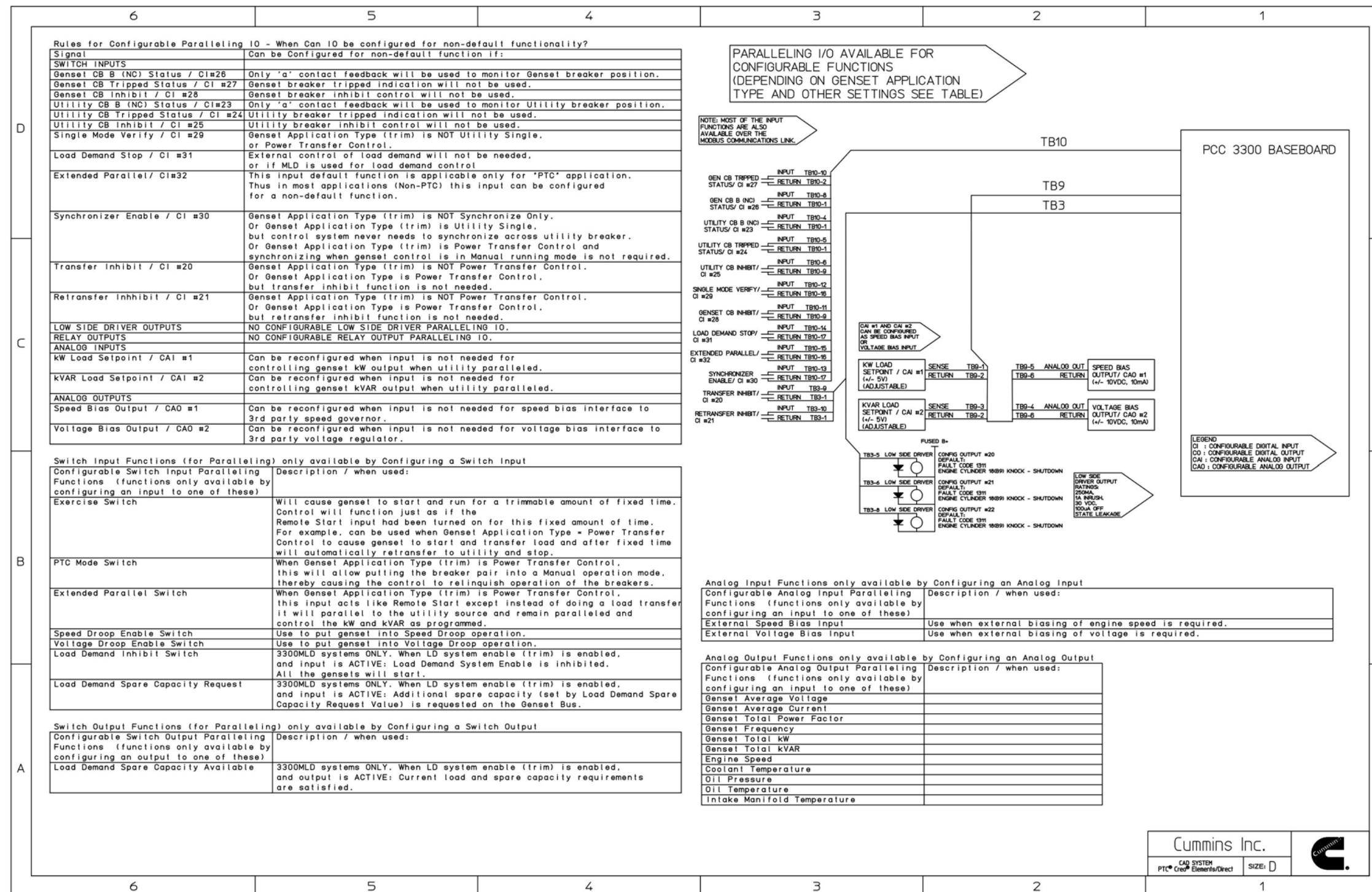


FIGURE 82. POWERCOMMAND 3.3 PARALLELING CONNECTIONS - CONFIGURABLE PARALLELING I/O

This page is intentionally blank.

Appendix B. Outline Drawings

Table of Contents

Figure 83. Outline Drawing (Sheet 1 of 8) 141

Figure 84. Outline Drawing (Sheet 2 of 8) 142

Figure 85. Outline Drawing (Sheet 3 of 8) 143

Figure 86. Outline Drawing (Sheet 4 of 8) 144

Figure 87. Outline Drawing (Sheet 5 of 8) 145

Figure 88. Outline Drawing (Sheet 6 of 8) 146

Figure 89. Outline Drawing (Sheet 7 of 8) 147

Figure 90. Outline Drawing (Sheet 8 of 8) 148

Figure 91. Outline Drawing (Sheet 1 of 1) 149

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

B.1 Outline Drawing A073W614

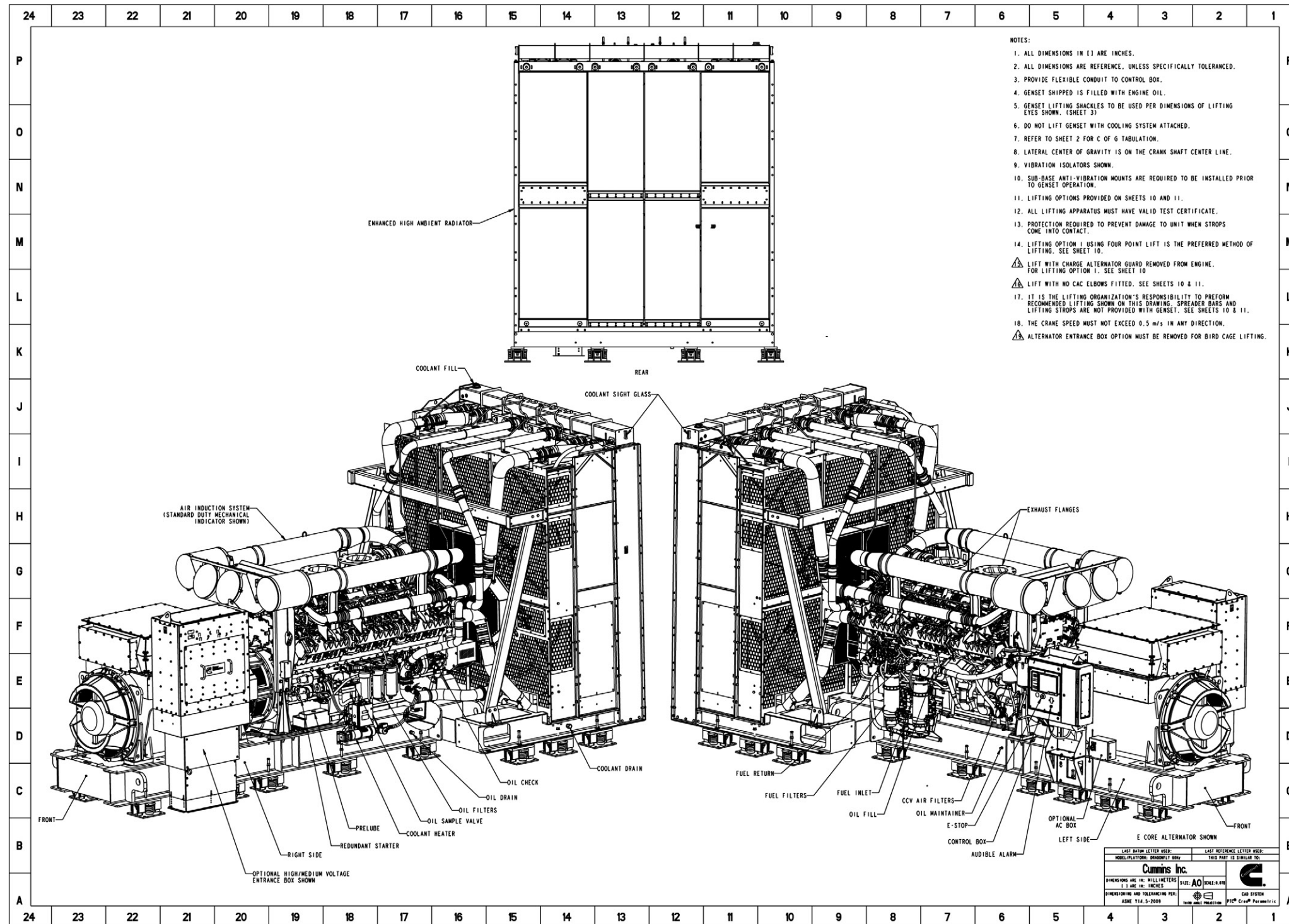


FIGURE 83. OUTLINE DRAWING (SHEET 1 OF 8)

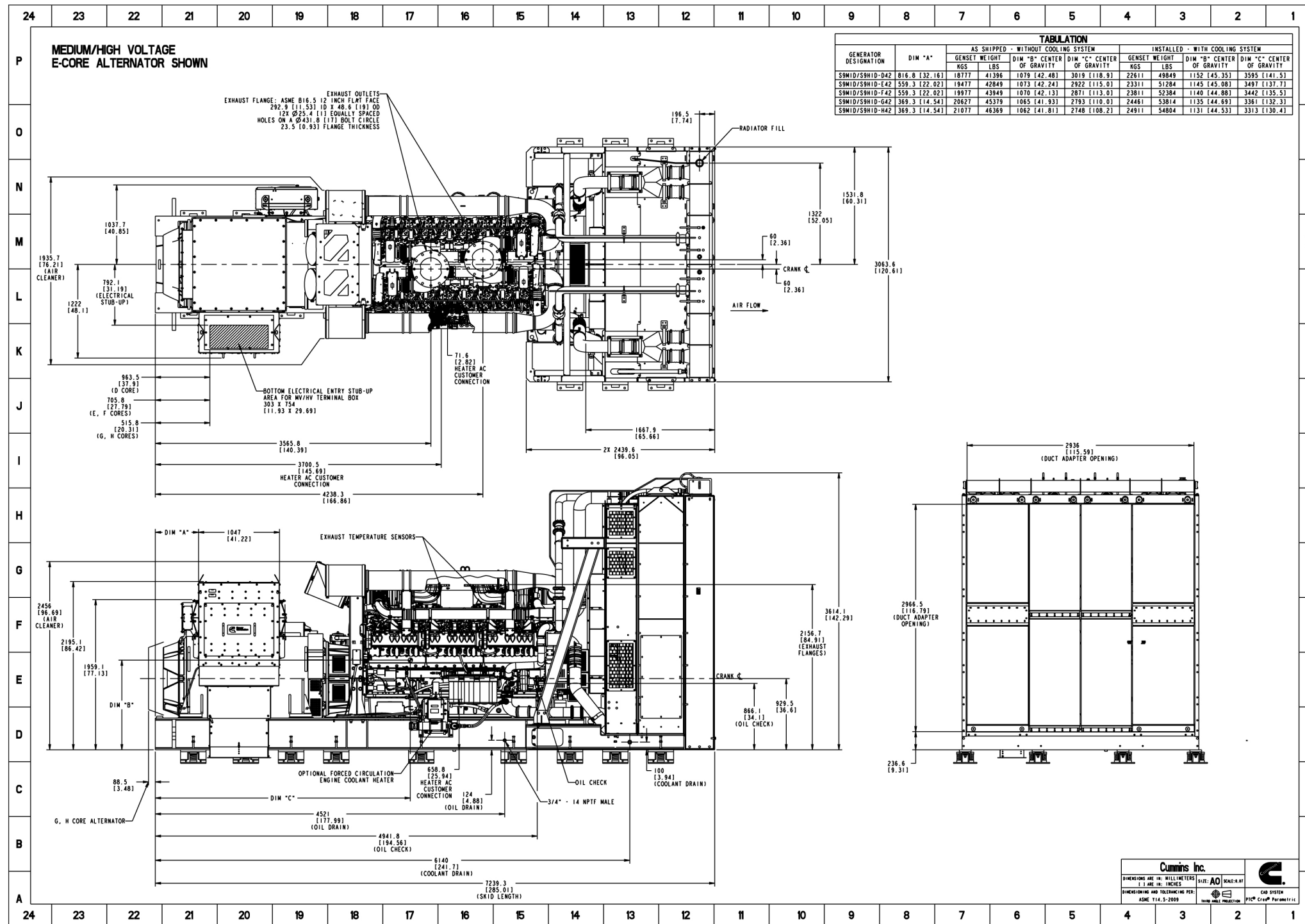


FIGURE 84. OUTLINE DRAWING (SHEET 2 OF 8)

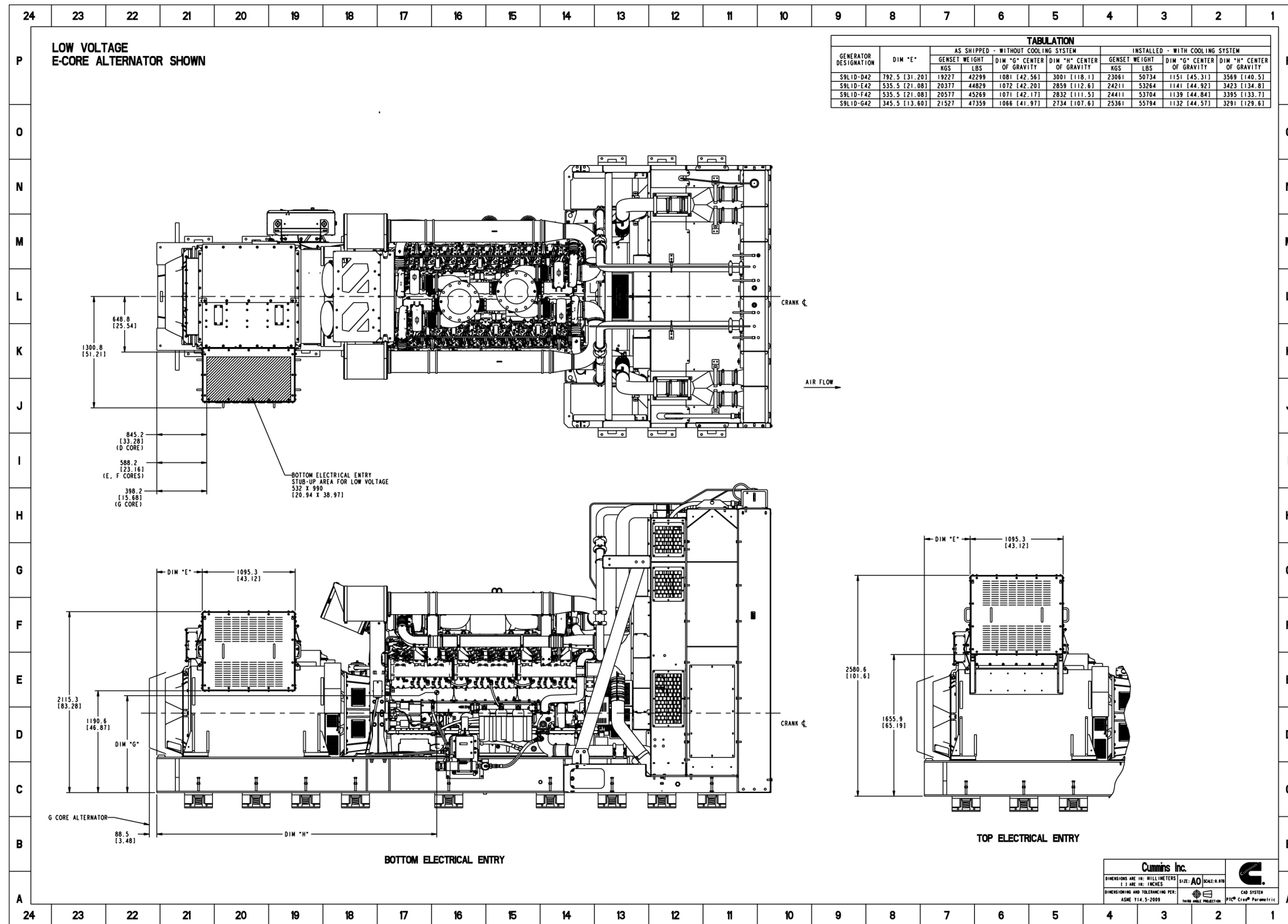


FIGURE 85. OUTLINE DRAWING (SHEET 3 OF 8)

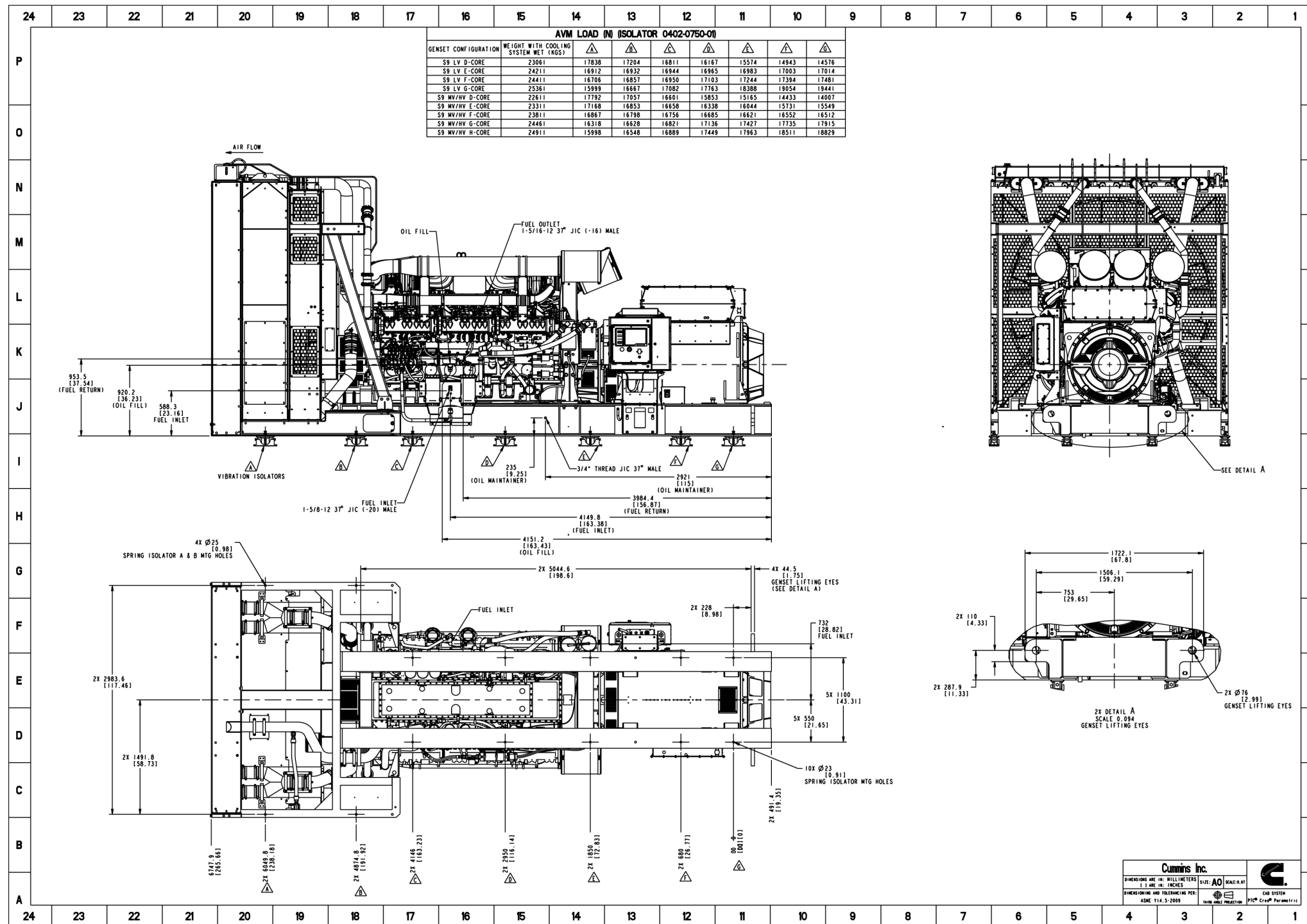


FIGURE 86. OUTLINE DRAWING (SHEET 4 OF 8)

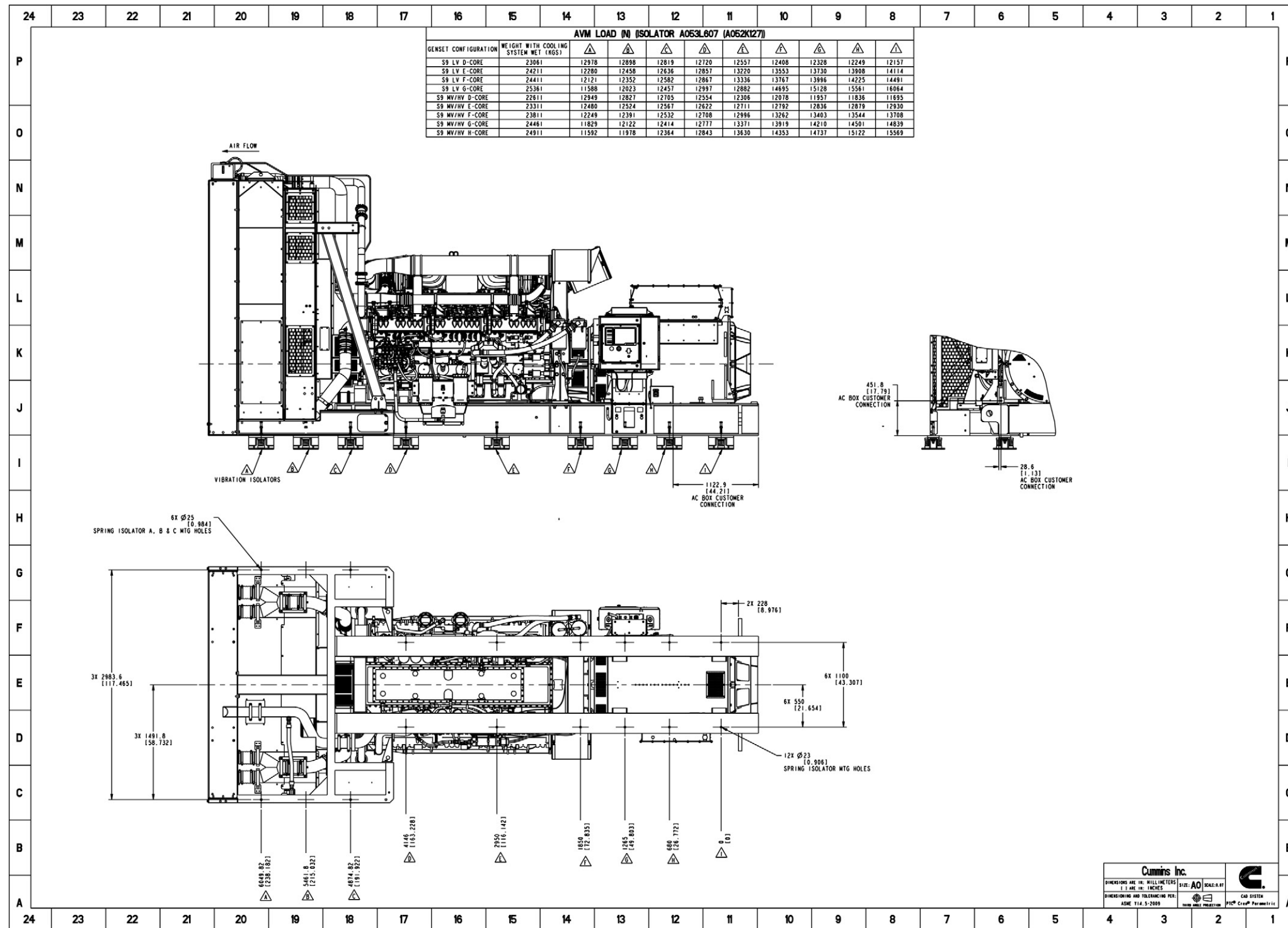


FIGURE 87. OUTLINE DRAWING (SHEET 5 OF 8)

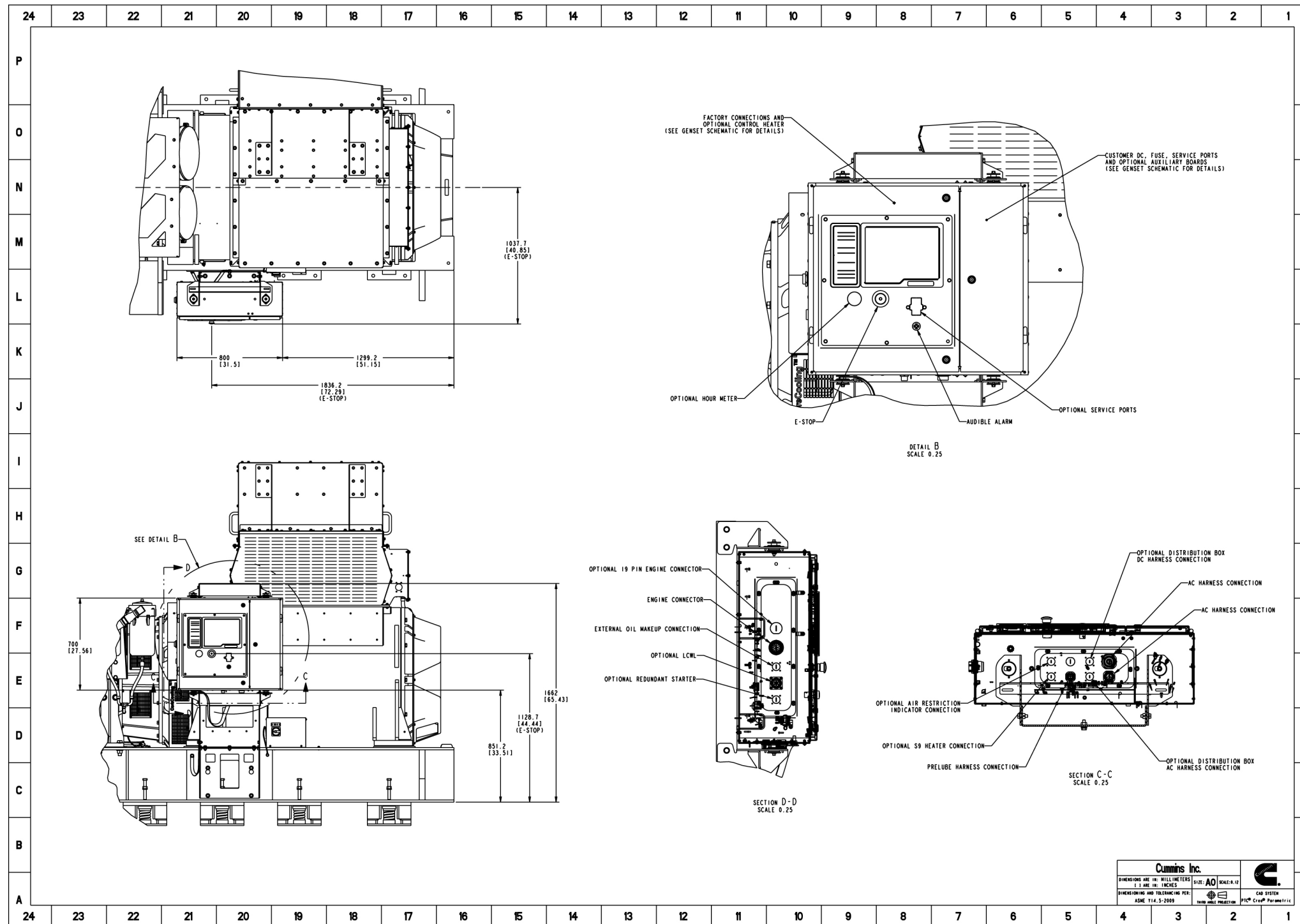


FIGURE 88. OUTLINE DRAWING (SHEET 6 OF 8)

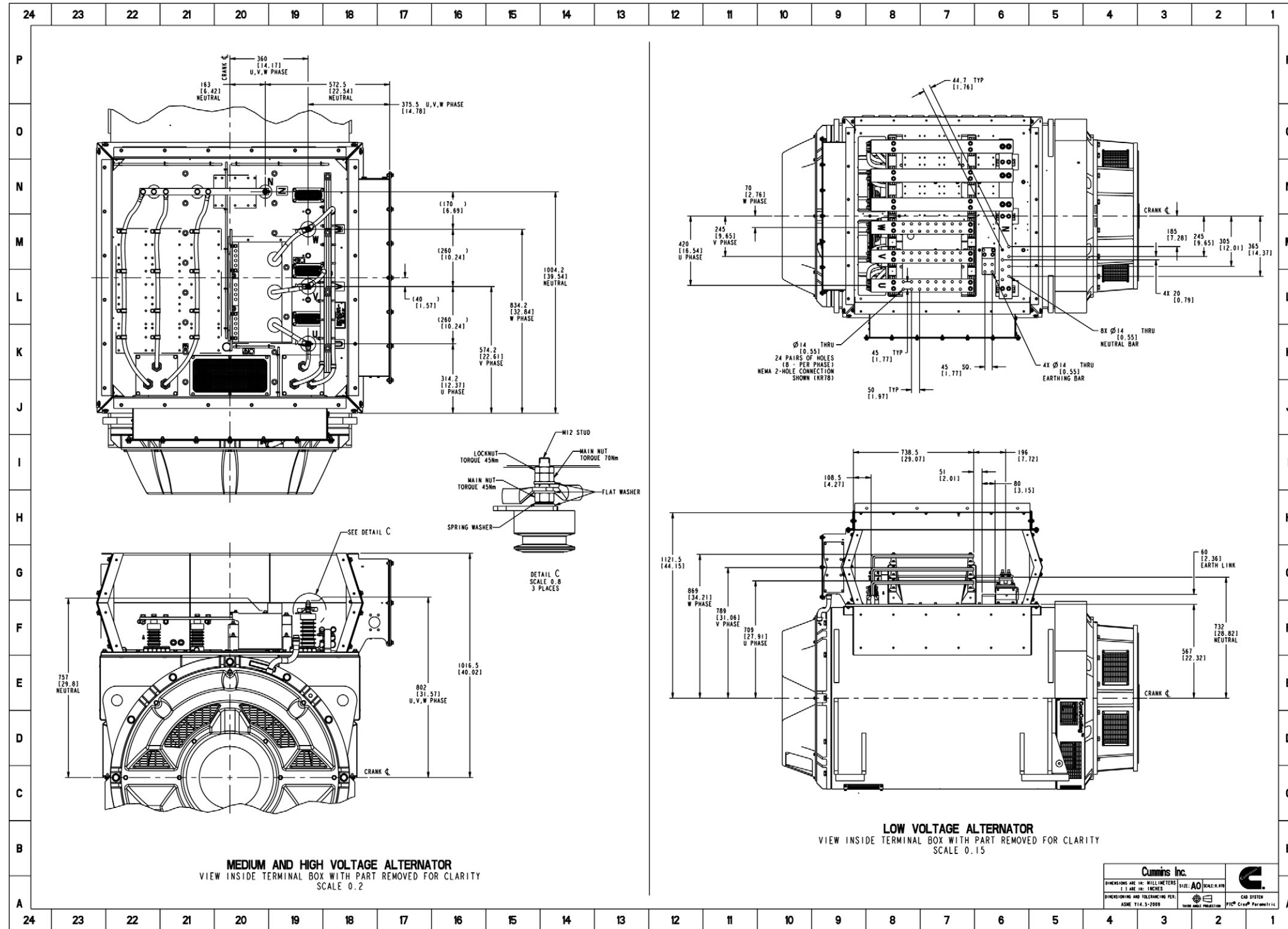


FIGURE 89. OUTLINE DRAWING (SHEET 7 OF 8)

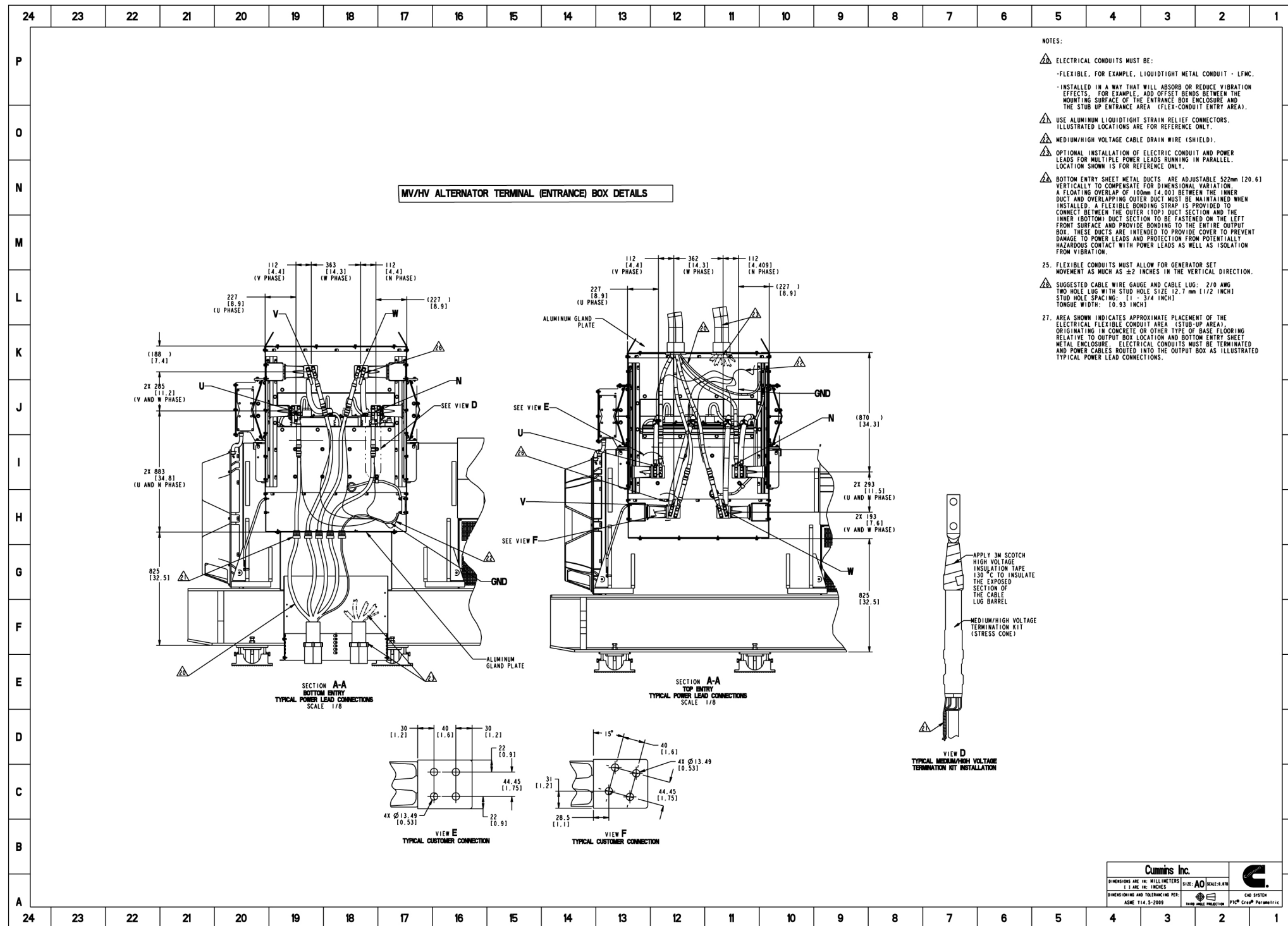


FIGURE 90. OUTLINE DRAWING (SHEET 8 OF 8)

B.2 Outline Drawing A072A401 - Radiator Part List

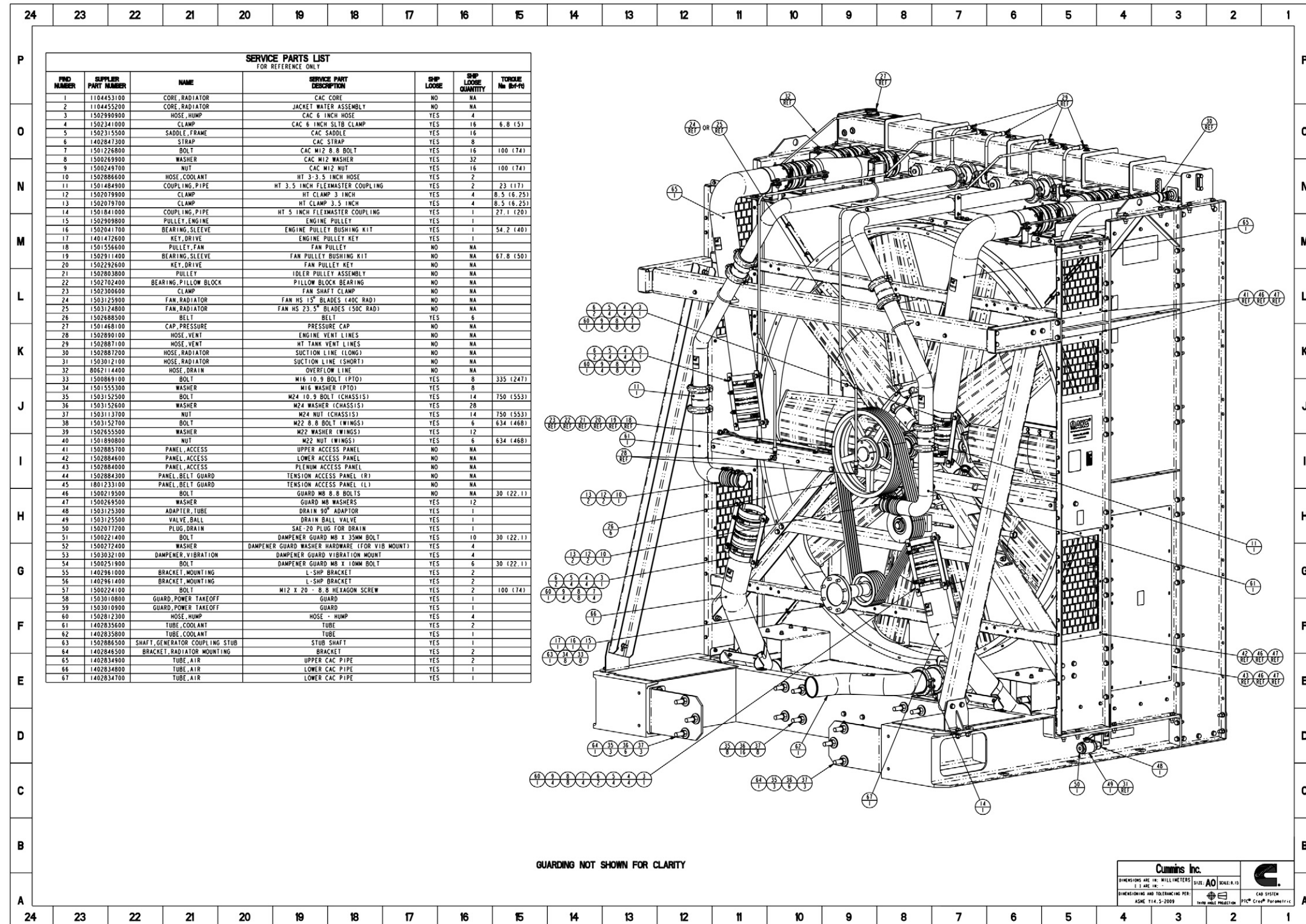


FIGURE 91. OUTLINE DRAWING (SHEET 1 OF 1)

This page is intentionally blank.

Appendix C. Seismic Requirements

Table of Contents

Figure 92. Seismic Installation Instructions (Sheet 1 of 2) 153
Figure 93. Seismic Installation Instructions (Sheet 2 of 2) 154

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

C.1 Seismic Installation Instructions

SPRING-ISOLATED GENERATOR SETS: GROUND LEVEL INSTALLATIONS											
CUMMINS GENSET MODEL	CONFIGURATION	SEISMIC ISOLATOR		ATTACHMENT TO STEEL		ATTACHMENT TO CONCRETE					
		MODEL	QTY	SEISMIC LEVEL	ISOLATOR ATTACHMENT TO STEEL	SEISMIC LEVEL	ISOLATOR ATTACHMENT TO CONCRETE	MINIMUM ANCHOR EMBEDMENT	MINIMUM EDGE DISTANCE (FROM ANCHOR LOCATION)	CONCRETE COMPRESSIVE STRENGTH	MINIMUM SLAB THICKNESS
C2750D6E C3000D6EB	SET-MOUNTED COOLING	A053L607	18	SDS<=2.2 Z/H=0.0	4 PER ISOLATOR (72 TOTAL) Ø3/4" HEX HEAD STEEL BOLT (ASTM A325, GRADE 5)	SDS<=2.2 Z/H=0.0	4 PER ISOLATOR (72 TOTAL) HILTI HIT-RE 500 V3 +HAS-E-55, Ø3/4"	12.8"	18"	5000 PSI	18"
SPRING-ISOLATED GENERATOR SETS: ROOF LEVEL INSTALLATIONS											
CUMMINS GENSET MODEL	CONFIGURATION	SEISMIC ISOLATOR		ATTACHMENT TO STEEL		ATTACHMENT TO CONCRETE					
		MODEL	QTY	SEISMIC LEVEL	ISOLATOR ATTACHMENT TO STEEL	SEISMIC LEVEL	ISOLATOR ATTACHMENT TO CONCRETE	MINIMUM ANCHOR EMBEDMENT	MINIMUM EDGE DISTANCE (FROM ANCHOR LOCATION)	CONCRETE COMPRESSIVE STRENGTH	MINIMUM SLAB THICKNESS
C2750D6E C3000D6EB	SET-MOUNTED COOLING	A053L607	18	SDS<=1.9 Z/H=1.0	4 PER ISOLATOR (72 TOTAL) Ø3/4" HEX HEAD STEEL BOLT (ASTM A325, GRADE 5)	SDS<=1.5 Z/H=1.0	4 PER ISOLATOR (72 TOTAL) HEAVY HEX HEAD, ASTM F1554 Gr105, Ø3/4"	12"	24"	10000 PSI	18"

FIGURE 92. SEISMIC INSTALLATION INSTRUCTIONS (SHEET 1 OF 2)

	8	7	6	5	4	3	2	1	
D	<p>SEISMIC INSTALLATIONS NOTES:</p> <ol style="list-style-type: none"> 1. THE INSTALLATION GUIDELINES IN THIS DRAWING ARE RECOMMENDATIONS FROM THE ISOLATOR SUPPLIER AND SHOULD BE CONTACTED IF IN DOUBT. 2. THE DESIGN OF POST-INSTALLED ANCHORS IN CONCRETE USED FOR THE COMPONENT ANCHORAGE IS PRE-QUALIFIED FOR SEISMIC APPLICATIONS IN ACCORDANCE WITH "ACI 355.2" AND DOCUMENTED IN A REPORT BY A REPUTABLE TESTING AGENCY. (EX. THE EVALUATION SERVICE REPORT ISSUED BY THE INTERNATIONAL CODE COUNCIL) 3. EQUIPMENT ANCHORAGE MUST BE INSTALLED PER THE MANUFACTURER'S INSTRUCTIONS. 4. ANCHORS MUST BE INSTALLED IN MINIMUM 4000 PSI COMPRESSIVE STRENGTH NORMAL WEIGHT CONCRETE EXCEPT WHERE OTHERWISE INDICATED. CONCRETE AGGREGATE MUST COMPLY WITH "ASTM C33". INSTALLATION IN STRUCTURAL LIGHTWEIGHT CONCRETE IS NOT PERMITTED UNLESS OTHERWISE APPROVED BY THE STRUCTURAL ENGINEER OF RECORD. 5. ANCHORS MUST BE INSTALLED TO THE TORQUE SPECIFICATION AS RECOMMENDED BY THE ANCHOR MANUFACTURER TO OBTAIN MAXIMUM LOADING. 6. ANCHORS MUST BE INSTALLED IN LOCATIONS SPECIFIED ON THIS INSTALLATION DRAWING. 7. WIDE WASHERS MUST BE INSTALLED AT EACH ANCHOR LOCATION BETWEEN THE ANCHOR HEAD AND EQUIPMENT FOR TENSION LOAD DISTRIBUTION. WIDE WASHERS MUST BE SERIES "W" OF AMERICAN NATIONAL STANDARD TYPE "A" PLAIN WASHERS (ANSI B18.22.1-1965, R1975) WITH THE NOMINAL WASHER SIZE SELECTED TO MATCH THE SPECIFIED NOMINAL ANCHOR DIAMETER. 8. CONCRETE FLOOR SLAB AND CONCRETE HOUSEKEEPING PADS MUST BE DESIGNED AND REBAR REINFORCED FOR SEISMIC APPLICATIONS IN ACCORDANCE WITH "ACI 318". 9. ALL HOUSEKEEPING PAD THICKNESSES MUST BE DESIGNED IN ACCORDANCE WITH THE PRE-QUALIFICATION TEST REPORT AS DEFINED IN NOTE 1 OR A MINIMUM OF 1.5X THE ANCHOR EMBEDMENT DEPTH, WHICHEVER IS LARGEST. 10. ALL HOUSEKEEPING PADS MUST BE DOWELLED OR CAST INTO THE BUILDING STRUCTURAL FLOOR SLAB AND DESIGNED FOR SEISMIC APPLICATION PER "ACI 318" AND AS APPROVED BY THE STRUCTURAL ENGINEER OF RECORD. 11. FLOOR MOUNTED EQUIPMENT (WITH OR WITHOUT A HOUSEKEEPING PAD) MUST BE INSTALLED TO A REBAR REINFORCED STRUCTURAL CONCRETE FLOOR THAT IS SEISMICALLY DESIGNED AND APPROVED BY THE ENGINEER OF RECORD TO RESIST THE ADDED SEISMIC LOADS FROM COMPONENTS BEING ANCHORED TO THE FLOOR. 12. WHEN INSTALLING TO A FLOOR, REBAR INTERFERENCE MUST BE CONSIDERED. 13. ATTACHING SEISMIC CERTIFIED EQUIPMENT TO ANY FLOOR OR WALL OTHER THAN THOSE CONSTRUCTED OF STRUCTURAL CONCRETE AND DESIGNED TO ACCEPT THE SEISMIC LOADS FROM SAID EQUIPMENT IS NOT PERMITTED BY THIS SPECIFICATION AND BEYOND THE SCOPE OF THIS CERTIFICATION. 14. ATTACHING SEISMIC CERTIFIED EQUIPMENT TO ANY FLOOR CONSTRUCTED OF LIGHT WEIGHT CONCRETE OVER STEEL DECKING IS NOT PERMITTED BY THIS SPECIFICATION AND BEYOND THE SCOPE OF THIS CERTIFICATION. 15. ATTACHING SEISMIC CERTIFIED EQUIPMENT TO ANY CONCRETE BLOCK WALLS OR CINDER BLOCK WALLS IS NOT PERMITTED BY THIS SPECIFICATION AND BEYOND THE SCOPE OF THIS CERTIFICATION. 16. INSTALLATION UPON ANY STEEL DUNNAGE SHALL BE COORDINATED WITH THE STRUCTURAL ENGINEER OF RECORD. STEEL DUNNAGE MUST BE CERTIFIED BY OTHERS AS IS BEYOND THE SCOPE OF THIS REPORT. 17. INSTALLATION UPON ANY ROOFTOP CURB SHALL BE COORDINATED WITH THE CURB MANUFACTURER AND THE STRUCTURAL ENGINEER OF RECORD. ANY CURB OR CONCRETE PAD THAT SUPPORTS THE GENSET UNIT IS BEYOND THE SCOPE OF THIS CERTIFICATION. 18. ALL ACCESSORY ATTACHMENTS (PIPE, CONDUIT, ETC.) TO THE EQUIPMENT SHALL BE ATTACHED IN A MANNER THAT ALLOWS RELATIVE MOTION (FLEX, SWING, JOIN/ELBOW, ETC.) TO PREVENT FAILURE DUE TO DIFFERENTIAL MOVEMENT BETWEEN THE EQUIPMENT AND ATTACHED ACCESSORY CAUSED BY SEISMIC LOADING ON THE SYSTEM. 19. REFER TO THE MANUFACTURER'S INSTALLATION INSTRUCTIONS FOR ANCHOR REQUIREMENTS AND MOUNTING CONSIDERATIONS FOR SEISMIC APPLICATIONS. MOUNTING REQUIREMENT DETAILS SUCH AS BRAND, TYPE, EMBEDMENT DEPTH, EDGE SPACING, ANCHOR SPACING, CONCRETE STRENGTH, WALL BRACING, AND SPECIAL INSPECTION MUST BE OUTLINED AND APPROVED BY THE PROJECT STRUCTURAL ENGINEER OF RECORD. THE INSTALLING CONTRACTOR IS RESPONSIBLE FOR THE PROPER INSTALLATION OF ALL ANCHORS AND MOUNTING HARDWARE, OBSERVING THE MOUNTING REQUIREMENT DETAILS OUTLINED BY THE ENGINEER OF RECORD. CONTACT THE MANUFACTURER'S REPRESENTATIVE IF A DETAILED SEISMIC INSTALLATION CALCULATION PACKAGE IS REQUIRED. 								D
C									C
B									B
A									A
	8	7	6	5	4	3	2	1	

Cummins Inc.		
DIMENSIONS ARE IN: MILLIMETERS I J ARE IN: -	SIZE: D SCALE: 1:1	
DIMENSIONING AND TOLERANCING PER: ASME Y14.5-2009		CAD SYSTEM PTC® Creo® Parametric

FIGURE 93. SEISMIC INSTALLATION INSTRUCTIONS (SHEET 2 OF 2)

power.cummins.com

Copyright © 2025 Cummins Inc. All rights reserved.

Cummins, the "C" logo, PowerCommand, AmpSentry, and InPower are trademarks of Cummins Inc.

Other company, product, or service names may be trademarks or service marks of others.

Specifications are subject to change without notice.

