



# Service Manual

## Onan Generator Set for RV

HDKAH (Spec A-T)

HDKAJ (Spec A-L)

HDKAK (Spec A-T)

HDKAT (Spec A-T)

HDKAU (Spec A-T)

HDKAV (Spec A-T)



# Table of Contents

---

1. SAFETY PRECAUTIONS .....	1
1.1 Overview .....	1
1.2 Precaution Symbols .....	1
1.3 General Safety Precautions .....	1
1.4 Automatic Generator Start Control Hazards .....	3
1.5 Electrical Shocks and Arc Flashes Can Cause Severe Personal Injury or Death.....	3
1.6 Generator Voltage Is Deadly .....	4
1.7 Engine Exhaust is Deadly .....	5
1.8 Fuel is Flammable and Explosive .....	5
1.9 Diesel Fuel Is Combustible .....	6
1.10 Battery Gas Is Explosive.....	6
1.11 Moving Parts Can Cause Severe Personal Injury or Death .....	6
1.12 CARB .....	7
1.13 Generator Set Warning Labels .....	7
2. INTRODUCTION.....	9
2.1 About this Manual .....	9
2.2 Related Literature .....	9
2.3 Model Identification .....	11
2.3.1 Nameplate Location .....	11
2.4 Manufacturing Facilities .....	11
3. OVERVIEW .....	13
3.1 Electromagnetic Compatibility Compliance.....	13
3.2 Specifications.....	13
3.2.1 Diesel Model Specifications .....	13
3.2.2 Torque Specifications.....	15
3.3 List of Acronyms .....	17
4. PREPARING FOR SERVICE.....	19
4.1 Troubleshooting .....	19
4.2 Safety .....	19
4.3 Special Tools .....	20
4.4 Removing the Generator Set.....	20
4.4.1 Disconnecting the Generator Set.....	22
4.4.2 Generator Set Removal .....	23
4.4.3 Reinstalling the Generator Set.....	24
4.4.4 Remove Housing Panels .....	24
4.4.5 Installing the Housing Panels.....	27
5. GENERATOR SET CONTROL.....	29
5.1 Control-Inverter .....	29
5.1.1 Major Functions.....	31

---

5.1.2 Control-Inverter Removal .....	34
5.1.3 Control-Inverter Replacement .....	34
6. PERMANENT MAGNET ALTERNATOR (PMA) .....	35
6.1 Stator .....	35
6.1.1 Stator Tests .....	36
6.1.2 Stator Removal .....	38
6.1.3 Stator Installation .....	39
6.2 Rotor .....	39
6.2.1 Rotor Removal .....	39
6.2.2 Rotor Installation .....	40
7. BATTERY CHARGER .....	41
7.1 Battery Charger Removal .....	41
7.2 Battery Charger Installation .....	41
7.3 Battery Transformer Removal .....	42
7.4 Battery Transformer Installation .....	42
8. PRIMARY ENGINE SYSTEMS .....	43
8.1 Introduction .....	43
8.2 Engine .....	44
8.2.1 Engine Removal .....	44
8.2.2 Engine Installation .....	44
8.3 Cooling System .....	44
8.3.1 Inspection .....	46
8.3.2 Water Pump Belt Removal .....	46
8.3.3 Water Pump Belt Installation .....	47
8.3.4 Cooling System Removal .....	47
8.3.5 Cooling System Installation .....	47
8.3.6 Radiator Removal .....	48
8.3.7 Radiator Installation .....	48
8.4 Governor .....	48
8.4.1 Governor Removal .....	51
8.4.2 Governor Installation .....	51
8.4.3 Governor Actuator Speed Control Lever Stop (Spec B and later) .....	52
8.4.4 High-Idle Speed Adjustment .....	53
8.4.5 High-Idle Stop Screw Adjustment .....	55
8.5 Fuel System .....	57
8.5.1 Diesel Fuel System .....	57
8.5.2 Fuel Pump .....	59
8.5.3 Fuel Filter .....	59
8.5.4 Fuel Injection System .....	60
8.6 Starter .....	60
8.6.1 Starter Solenoid Test .....	61
8.6.2 Starter Motor Removal .....	62
8.6.3 Starter Motor Installation .....	62
8.6.4 Starter Solenoid Removal .....	62

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8.6.5 Starter Solenoid Installation .....	62
8.7 Engine Air Intake.....	63
8.8 Exhaust System .....	63
8.8.1 Exhaust Manifold Removal .....	64
8.8.2 Exhaust Manifold Installation .....	64
9. TROUBLESHOOTING .....	65
9.1 Troubleshooting by Symptom .....	65
9.1.1 Engine Will Not Shut Off, Status Indicator On .....	65
9.1.2 Engine Will Not Shut Off, Status Indicator Off .....	65
9.1.3 Status Indicator Stays On .....	66
9.1.4 Engine Cranks When Battery Connected .....	66
9.1.5 Engine Won't Crank - Fuel Pump Won't Stop.....	66
9.1.6 Status Indicator Light Dead.....	67
9.1.7 Starting Batteries Run Down.....	68
9.1.8 Engine Cranks But Does Not Start .....	69
9.1.9 Starter Engages and Disengages .....	69
9.1.10 No Power-Generator Set Running, Run Light On.....	70
9.1.11 Engine Hunts Under Full Load.....	71
9.1.12 Local Hour Meter Not Functioning .....	71
9.1.13 Control Board Not Powering Up .....	71
9.2 Fault Codes.....	72
9.2.1 Code No. 1 - High Engine Temperature .....	72
9.2.2 Code No. 2 - Low Oil Pressure .....	72
9.2.3 Code No. 3 - Service Check .....	73
9.2.4 Code No. 4 - Overcrank.....	73
9.2.5 Code No. 8 - Overload.....	73
9.2.6 Code No. 11 - Overcurrent .....	73
9.2.7 Code No. 12 - Inverter Overvoltage.....	74
9.2.8 Code No. 13 - Inverter Undervoltage.....	74
9.2.9 Code No. 14 - Inverter Overfrequency.....	75
9.2.10 Code No. 15 - Underfrequency Fault.....	75
9.2.11 Code No. 17 - Fuel Pump Fault * .....	76
9.2.12 Code No. 18 - Glow Plug Circuit Protection Fault* .....	76
9.2.13 Code No. 19 - Actuator Shorted or Open .....	76
9.2.14 Code No. 21 - Starter Solenoid Circuit Protection Fault* .....	77
9.2.15 Code No. 22 - Governor Overload.....	77
9.2.16 Code No. 23 - Faulty Oil Pressure Sender* .....	78
9.2.17 Code No. 24 - Faulty Temperature Sender* .....	78
9.2.18 Code No. 25 - Engine Above Speed Target Fault.....	79
9.2.19 Code No. 26 - Engine Below Speed Target Fault .....	79
9.2.20 Code No. 27 - PMA Sense Lost Fault .....	80
9.2.21 Code No. 28 - DC Sense Lost Fault.....	81
9.2.22 Code No. 29 - High Battery Voltage .....	81
9.2.23 Code No. 31 - Overspeed Fault.....	82
9.2.24 Code No. 32 - Low Cranking Speed Fault.....	82

9.2.25 Code No. 33 - High Engine Coolant Temperature Fault.....	84
9.2.26 Code No. 34 - High Inverter Temperature Fault .....	85
9.2.27 Code No. 35 - Control Card Fault.....	85
9.2.28 Code No. 36 - Unknown Shutdown Fault .....	85
9.2.29 Code No. 37 - Invalid Generator Set Configuration .....	86
9.2.30 Code No. 38 - Overcurrent Fault .....	86
9.2.31 Code No. 39 - Low Battery Voltage Fault*.....	87
9.2.32 Code No. 42 - Processor Fault* .....	87
9.2.33 Code No. 43 - Processor Fault* .....	88
9.2.34 Code No. 46 - Inverter Power Supply Fault* .....	88
10. SERVICE CHECKLIST .....	89
10.1 Housing .....	89
10.2 Mounting .....	89
10.3 Lubrication .....	89
10.4 Cooling System.....	89
10.5 Wiring.....	89
10.6 Output Check .....	89
10.7 Exhaust System .....	89
10.8 Fuel System .....	90
10.9 Control .....	90
10.10 Mechanical.....	90
APPENDIX A. WIRING DIAGRAMS .....	91
A.0 Wiring Diagrams (0611-1236) .....	93
A.1 FC32 TS Wiring Diagram .....	94
APPENDIX B. WIRING HARNESSSES .....	95
B.0 Engine Wiring Harness (338-3822).....	97
B.1 Battery Wiring Harness (338-3841).....	98
B.2 AC Wiring Harness (338-3823) .....	99
APPENDIX C. OUTLINE DRAWINGS .....	101
C.0 Outline Drawing (0500-3159) .....	103

# 1 Safety Precautions

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## 1.1 Overview

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

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

## 1.2 Precaution Symbols

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

### **DANGER**

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

### **WARNING**

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

### **CAUTION**

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

### **NOTICE**

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

## 1.3 General Safety Precautions

### **WARNING**

*Operation of equipment is unsafe when mentally or physically fatigued. Do not operate equipment in this condition, or after consuming any alcohol or drug.*

### **WARNING**

*Maintaining or installing a generator set can cause severe personal injury. Wear personal protective equipment such as safety glasses, protective gloves, hard hats, steel-toed boots, and protective clothing when working on equipment.*

**⚠ WARNING**

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

**⚠ WARNING**

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

**⚠ WARNING**

*Hot metal parts can cause severe burns, Avoid contact with the radiator, turbo charger, and exhaust system.*

**⚠ WARNING**

*Starting fluids, such as ether, can cause explosion and generator set engine damage. Do not use.*

**⚠ WARNING**

*Ethylene glycol, used as engine coolant, is toxic to humans and animals. Clean up coolant spills and dispose of used antifreeze in accordance with local environmental regulations.*

**⚠ WARNING**

*Used engine oils have been identified by some state and federal agencies to cause cancer or reproductive toxicity. Do not ingest, breathe the fumes, or contact used oil when checking or changing engine oil.*

**⚠ CAUTION**

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

**⚠ CAUTION**

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

**⚠ CAUTION**

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

**⚠ CAUTION**

*Accumulated grease and oil can cause overheating and engine damage presenting a potential fire hazard. Keep the generator set clean and repair any oil leaks promptly.*

**NOTICE**

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

## 1.4 Automatic Generator Start Control Hazards

**⚠ WARNING**

***Accidental starting can cause severe personal injury or death. Turn off the AGS whenever performing maintenance or service, when the vehicle is stored between uses, is awaiting service, or is parked in a garage or other confined area.***

Unexpected starting may occur if the generator set is equipped with an inverter-charger or other Automatic Generator Start (AGS) control. This may cause exposure to:

- Unexpected generator starting
- Moving parts hazards
- Electric shock
- Exhaust carbon monoxide (CO)

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

**⚠ WARNING**

***Energized circuits.***

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

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

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

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

## 1.6 Generator Voltage Is Deadly

**⚠ WARNING**

*Improperly connected generator electrical output connections can cause equipment damage, severe personal injury, or death. Electrical connections must be made by a trained and experienced electrician in accordance with applicable codes.*

**⚠ WARNING**

*Improper installations can cause equipment damage, severe personal injury, or death. All installations must be conducted by trained and experienced personnel in accordance with the installation instructions and all applicable codes.*

**⚠ WARNING**

*Back feed to shore power can cause electrocution and damage to equipment. The generator set must not be connected to shore power or to any other source of electrical power. An approved switching device must be used to prevent interconnections.*

**⚠ WARNING**

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

## 1.7 Engine Exhaust is Deadly

### WARNING

*When equipped with an integral or add-on Automatic Generator Starting System (AGS) control, carbon monoxide exhaust inhalation (CO), electric shock, and moving parts hazards are possible due to unexpected starting. Turn off AGS whenever performing maintenance or service, when the vehicle is stored between uses, is awaiting service, or is parked in a garage or other confined area to avoid these hazards.*

### WARNING

*Carbon monoxide is a poisonous gas. Inhalation of this gas can cause severe personal injury or death. Adhere to the following bullet points to make sure carbon monoxide is not being inhaled by occupants of the vehicle as well as others working on or around the generator set.*

- *Inspect for exhaust leaks at every startup and after every eight hours of running.*
- *Never occupy the vehicle while the generator set is running unless the vehicle is equipped with a working carbon monoxide detector.*
- *Never operate the generator set when the vehicle is in a confined space, such as a garage, basement, or building of any kind.*
- *Make sure the exhaust system is installed in accordance with the generator set installation manual.*
- *Never use engine cooling air for heating a working or living space compartment.*

Carbon monoxide poisoning symptoms include:

- headache
- dizziness
- weakness
- nausea
- vomiting
- chest pain
- confusion
- loss of consciousness

## 1.8 Fuel is Flammable and Explosive

### WARNING

*Fuel and fuel vapor is highly explosive. Adhere to the following bullets to avoid igniting fuel and fuel vapors.*

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

Leaks can lead to explosive accumulations of gas.

- **LPG** sinks when released and can accumulate inside housings and basements and other below-grade spaces.

**NOTICE**

**Propane (LPG) is identifiable by the rotten egg smell it emits.**

## 1.9 Diesel Fuel Is Combustible

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

## 1.10 Battery Gas Is Explosive

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

## 1.11 Moving Parts Can Cause Severe Personal Injury or Death

**⚠ WARNING**

*Moving parts can cause severe personal injury or death, and hot exhaust parts can cause severe burns. Make sure all protective guards are properly in place before starting the generator set.*

**⚠ WARNING**

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

**⚠ WARNING**

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

**⚠ WARNING**

*Moving parts can catch on loose items such as clothing or jewelry. Do not wear loose clothing or jewelry near moving parts such as PTO (power take-off) shafts, fans, belts, and pulleys.*



<b>⚠ WARNING</b>
<i>Moving parts can entangle appendages such as fingers. Keep the protective guards in place over fans, belts, pulleys, and other moving parts and keep hands away from all moving parts.</i>





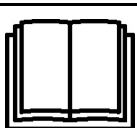

## 1.12 CARB






<b>⚠ CAUTION</b>
<i>Unauthorized modifications or replacement of fuel, exhaust, air intake, or speed control system components that affect engine emissions are prohibited by law in the state of California.</i>

The California Air Resources Board (CARB) has requirements regarding modification & repair of fuel system & exhaust components including, but not limited to, adherence to evaporative emissions requirements in mobile installations. Evaporative generator sets must be used in trailers, fifth wheel trailers, and other non-motorized vehicles where on-board gasoline fuel storage is self-contained in the trailer equipment. Completing the installation of the generator set fuel evaporative system provides compliance with the California code of regulations for small off-road equipment effective January 1, 2008 and Federal Small SI regulation effective January 1, 2011. Any questions regarding the installation or evaporative emission certification should be directed to Cummins Inc. for clarification.

## 1.13 Generator Set Warning Labels

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

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

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

## 2 Introduction

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### WARNING

#### **Hazardous Voltage**

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

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

### WARNING

#### **Electrical Generating Equipment**

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

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

## 2.1 About this Manual

This manual provides information necessary for servicing the generator set or sets listed on the front cover. Read and carefully observe all of the instructions and precautions in this manual.

See the Operator Manual for instructions concerning operation, maintenance, and storage; and for recommendations concerning engine lubricating oil and fuel.

See the Installation Manual for important recommendations concerning the installation and for a list of installation codes and standards for safety that may be applicable.

See the Parts Manual for part identification numbers and required quantities, and exploded views of the generator set subassemblies. Genuine Cummins replacement parts are recommended for best results.

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

## 2.2 Related Literature

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

### CAUTION

**A generator set must be operated and maintained properly if you are to expect safe and reliable operation. The Operator manual includes a maintenance schedule and a troubleshooting guide. The Health and Safety manual must be read in conjunction with this manual for the safe operation of the generator set:**

- Health and Safety Manual (0908-0110)

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

- Operator Manual for RV Generator Set (A046L053)
- Installation Manual for RV Generator Set (A046L051)
- Operator Manual for Commercial Mobile Generator Set (0981-0161)
- Installation Manual for Commercial Mobile Generator Set (0981-0623)
- Installation of Remote Air Cleaner Kit 541-0531 on Commercial HDKAJ, HDKAK Generator Set 1 (G299)
- Installation of Auxiliary Fuel Pump Kit 541-0530 on Commercial HDKAJ, HDKAK Generator Set 1 (G300)
- Service Manual for HDKAH–K (Spec A–N) and HDKAT–V (Spec A–P) (0981-0522)
- Recommended Spares List (RSL) for RV Generator Set (HDKAH) (A043T620)
- Recommended Spares List (RSL) for RV Generator Set (HDKAJ) (A043T622)
- Recommended Spares List (RSL) for RV Generator Set (HDKAJ, Spec A) (RSL-498)
- Recommended Spares List (RSL) for RV Generator Set (HDKAJ, Spec B) (RSL-499)
- Recommended Spares List (RSL) for RV Generator Set (HDKAJ, Spec C) (RSL-500)
- Recommended Spares List (RSL) for RV Generator Set (HDKAJ, Spec D) (RSL-501)
- Recommended Spares List (RSL) for RV Generator Set (HDKAJ, Spec E) (RSL-502)
- Recommended Spares List (RSL) for RV Generator Set (HDKAJ, Spec F) (RSL-503)
- Recommended Spares List (RSL) for RV Generator Set (HDKAJ, Spec G) (RSL-504)
- Recommended Spares List (RSL) for RV Generator Set (HDKAK) (A043T622)
- Recommended Spares List (RSL) for RV Generator Set (HDKAK, Spec A) (RSL-505)
- Recommended Spares List (RSL) for RV Generator Set (HDKAK, Spec B) (RSL-506)
- Recommended Spares List (RSL) for RV Generator Set (HDKAK, Spec C) (RSL-507)
- Recommended Spares List (RSL) for RV Generator Set (HDKAK, Spec D) (RSL-508)
- Recommended Spares List (RSL) for RV Generator Set (HDKAT) (A043T624)
- Recommended Spares List (RSL) for RV Generator Set (HDKAT, Spec E) (RSL-514)
- Recommended Spares List (RSL) for RV Generator Set (HDKAU) (A043T632)
- Recommended Spares List (RSL) for RV Generator Set (HDKAV) (A043T634)
- Parts Manual for RV Generator Set (HDKAH–V, Spec A–K) (0981-0200)
- Parts Manual for RV Generator Set (HDKAH–K, Spec L–N) (A029S789)
- Parts Manual for Commercial Mobile Generator Set (HDKAT–V, Spec L–P) (A029S841)
- Standard Repair Times – AK Family (0900-0615)
- Service Tool Manual (A043D529)
- Failure Code Manual (F1115C)
- Engine Operation & Maintenance Manual for Kubota, 68 mm Stroke Series (0981-0514)
- Warranty Administration Manual (4021290)
- Global Commercial Warranty Statement (A028U870)

## 2.3 Model Identification

Each generator set is provided with a nameplate that contains the model and serial numbers. This information is needed when contacting Cummins for parts, service, and product information.

Every character of the model number is significant. The last character of the model number is the specification letter which is important for obtaining the correct parts.

Record the generator set model and serial numbers in the figure below to have them available if needed.

### 2.3.1 Nameplate Location

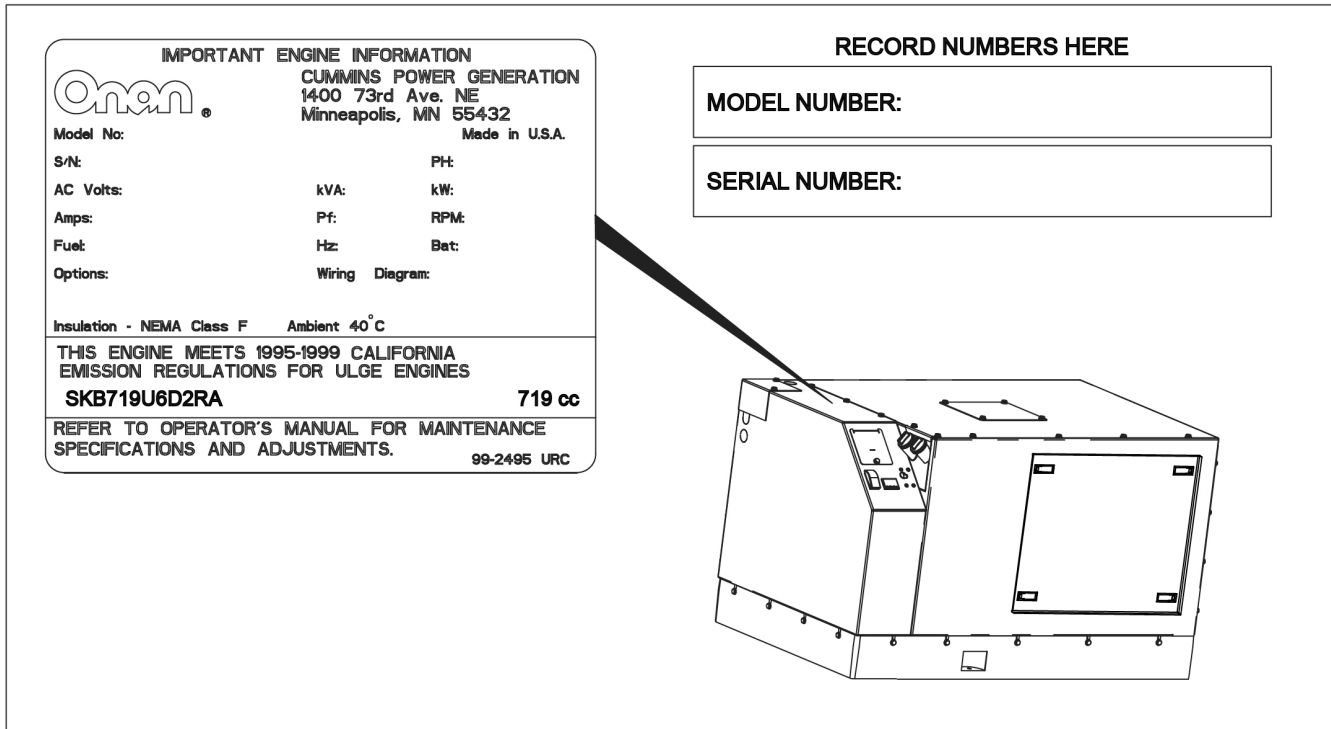


FIGURE 1. NAMEPLATE LOCATION

## 2.4 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

<b>CHINA</b>	<b>INDIA</b>	<b>ASIA PACIFIC</b>
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
<b>LATIN AMERICA</b>	<b>MEXICO</b>	
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	

# 3 Overview

## 3.1 Electromagnetic Compatibility Compliance

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

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

## 3.2 Specifications

### 3.2.1 Diesel Model Specifications

TABLE 1. DIESEL MODEL SPECIFICATIONS RV

	HDKAH	HDKAJ	HDKAK
<b>GENERATOR SET CONTROL:</b> Integrated Microprocessor Based Engine and Generator Control			
<b>ALTERNATOR:</b> Brushless, Exciterless, Bearingless, Permanent Magnet Alternator			
<b>AC OUTPUT RATINGS:</b>			
Power (@1.0 power factor)	6000 W	7500 W	8000 W
Frequency	60 Hz	60 Hz	60 Hz
Voltage	120 Volts	120 Volts	120 Volts
Number of Phases	1	1	1
Current	50.0 Amps	62.5 Amps	66.7 Amps
Line Circuit Breaker(s)	2-pole, 30 Amp	2-pole, 30 or 35 Amp	2-pole, 30 or 35 Amp
<b>FUEL CONSUMPTION:</b>			
No Load	.49 l/h (.13 gpm)	.49 l/h (.13 gpm)	.49 l/h (.13 gpm)
Half Load (4000 W)	1.85 l/h (.49 gph)	1.85 l/h (.49 gph)	1.85 l/h (.49 gph)
Full Load	3.03 l/h (.80 gph)	3.63 l/h (.96 gph)	3.86 l/h (1.02 gph)
<b>ENGINE:</b> 3-Cylinder In-Line, Water-Cooled, Indirect-Injection, 4-Stroke Cycle Diesel			
Bore	67 mm (2.64 in)		
Stroke	68 mm (2.68 in)		
Displacement	719 cc (44 <sup>3</sup> in)		
Stroke	68 mm (2.68 in)		
Compression Ratio	23:1		
Intake and Exhaust Valve Lash (Cold)	0.165 mm (0.0065 in)		
Oil Capacity (with filter)*	2.6 l (3 qt)		

	HDKAH	HDKAJ	HDKAK
Cooling System Capacity**	4 l (4.2 qt)		
<b>OPERATING SPEED RANGE:</b>	1600 to 2900 RPM	1600 to 3200 RPM	1600 to 3300 RPM
<b>DC SYSTEM:</b>			
Nominal Battery Voltage	12 Volts		
Minimum Battery Capacity CCA	450 CCA*** down to -17° C (0° F) 650 CCA*** down to -29° C (-20° F)		
Maximum Regulated Charging Current	10 Amp		
Fuse F1 (control circuit)	15 Amp mini-bayonet		
Fuse F2 (starter solenoid circuit)	15 Amp mini-bayonet		
Fuse F3 (glow plug circuit)	25 Amp		
<b>INSTALLATION:</b>			
Weight (wet)	191 kg (420 lbs)		
Size (L x W x H)	922 x 599 x 566 mm (36.3 x 23.6 x 22.3 in)		
* See oil filling instructions.			
** Includes coolant recovery tank.			
*** Cold Cranking Amps @ -17° C (0° F)			

TABLE 2. DIESEL MODEL SPECIFICATIONS COMMERCIAL

	HDKAT	HDKAU	HDKAV
<b>GENERATOR SET CONTROL:</b> Integrated Microprocessor Based Engine and Generator Control			
<b>ALTERNATOR:</b> Brushless, Exciterless, Bearingless, Permanent Magnet Alternator			
<b>AC OUTPUT RATINGS:</b>			
Power (@1.0 power factor)	7500 W	8000 W	6000 W
Frequency	60 Hz	60 Hz	60 Hz
Voltage	120 Volts	120 Volts	120 Volts
Number of Phases	1	1	1
Current	62.5 Amps	66.7 Amps	50.0 Amps
Line Circuit Breaker(s)	2-pole, 30 or 35 Amp	2-pole, 30 or 35 Amp	2-pole, 30 Amp
<b>FUEL CONSUMPTION:</b>			
No Load	.49 l/h (.13 gph)	.49 l/h (.13 gph)	.49 l/h (.13 gph)
Half Load (4000 W)	1.85 l/h (.40 gph)	1.85 l/h (.49 gph)	1.85 l/h (.49 gph)
Full Load	3.63 l/h.96 gph (.96 gph)	3.86 l/h (1.02 gph)	3.03 l/h (.80 gph)
<b>ENGINE:</b> 3-Cylinder In-Line, Water-Cooled, Indirect-Injection, 4-Stroke Cycle Diesel			
Bore	67 mm (2.64 in)		



	HDKAT	HDKAU	HDKAV
Stroke	68 mm (2.68 in)		
Displacement	719 cc (44 in <sup>3</sup> )		
Stroke	68 mm (2.68 in)		
Compression Ratio	23:1		
Intake and Exhaust Valve Lash (Cold)	0.165 mm (0.0065 in)		
Oil Capacity (with filter)*	2.6 l (3 qt)		
Cooling System Capacity**	4 l (4.2 qt)		
<b>OPERATING SPEED RANGE:</b>	1600 to 3200 RPM	1600 to 3300 RPM	1600 to 2900 RPM
<b>DC SYSTEM:</b>			
Nominal Battery Voltage	12 Volts		
Minimum Battery Capacity CCA	450 CCA*** down to -17° C (0° F ) 650 CCA*** down to -29° C (-20° F)		
Maximum Regulated Charging Current	10 Amp		
Fuse F1 (control circuit)	15 Amp mini-bayonet		
Fuse F2 (starter solenoid circuit)	15 Amp mini-bayonet		
Fuse F3 (glow plug circuit)	25 Amp		
<b>INSTALLATION:</b>			
Weight (wet)	191 kg (420 lbs)		
Size (L x W x H)	922 x 599 x 566 mm (36.3 x 23.6 x 22.3 in )		
* See oil filling instructions.			
** Includes coolant recovery tank.			
*** Cold Cranking Amps @ -17° C (0° F)			

### 3.2.2 Torque Specifications

Mounting screws and nuts must be tightened to the specified torque settings. All threads must be clean and lubricated with new engine oil. The cylinder head mounting bolts must be tightened in the proper sequence (refer to Engine Operation and Maintenance Manual).

**TABLE 3. TORQUE SPECIFICATIONS**

DESCRIPTION	Nm*	ft-lb*
Air Cleaner Cover Bolt - 3 to 4 clicks past seating	-	-
Air Cleaner Housing Mounting Screws	10-12	7-9
Intake Air Hose Clamp Screws	10-12	7-9
Air Intake Resonator Mounting Screws	10-12	7-9
Fuel Pump Mounting Screws	8.5-9	75-80 lbf-inch
Fuel Fitting at Fuel Pump	10-12	7-9

DESCRIPTION	Nm*	ft-lb*
Fuel Fitting at Fuel Filter -1 flat past finger tight	-	-
Exhaust Assembly Flange Bolts	22-28	16-20
Exhaust Isolator Clamp Screws	10-12	7-9
Housing Panel Screws	15-18	11-13
Component Mounting Screws (threads into skid-base)	10-12	7-9
Vibration Isolator Center Bolt	58-72	43-53
Vibration Isolator Mounting Screws	10-12	7-9
Battery Cable Terminal Block Nuts	9-11	6.7-8.3
Battery Cable Terminal Block Mounting Screws	10-12	7-9
Starter Solenoid Terminal Nuts	5.9-11.8	4.4-8.7
AC Output Terminal Block Screws	1.4-1.6	12-14 lbf-inch
AC Output Terminal Block Mounting Screws	2.2-2.5	20-22 lbf-inch
Circuit Breaker Terminal Screws	1.4-1.6	12-14 lbf-inch
Circuit Breaker Mounting Screws	1.4-1.6	12-14 lbf-inch
Flywheel Housing Mounting Bolts	24-30	18-22
Rotor/Flywheel Mounting Bolts	53.9-58.8	40-43
Stator Mounting Bolts	10-12	7-9
Blower Mounting Bolts	10-12	7-9
Starter Mounting Bolts	24-30	18-22
Oil Pan Mounting Bolts	7.9-9.3	5.8-6.9
Coolant Temperature Sender (use thread sealant)	35-43	26-32
Low Oil Pressure Switch (use thread sealant)	14.7-19.6	10.8-14.5
Governor Actuator Bearing Carrier Mounting Screws	2.4-3.0	21-27 lbf-inch
Oil Fill Hose Support Clip Screw	10-12	7-9
M6 Engine Bolts (except when otherwise specified)	7.9-9.3	5.8-6.9
M8 Engine Bolts (except when otherwise specified)	17.7-20.6	13.0-15.2
M10 Engine Bolts (except when otherwise specified)	39.2-45.1	28.9-33.3
M12 Engine Bolts (except when otherwise specified)	62.8-72.6	46.3-53.5
* Use Engine oil as a lubricant for all threads except when otherwise specified		

### 3.2.2.1 Metric Bolt Torque Specifications

When engine torques are not specified in Torque Specifications, tighten the screws and nuts according to the following tables. The grade numbers are indicated on top of the screw or bolt head.

**TABLE 4. METRIC BOLT TORQUE SPECIFICATIONS - NO GRADE OR 8.8 GRADE**

Size	Nm	ft-lb
M6	8-9	6-7
M8	18-21	13-15
M10	39-45	29-33
M12	63-73	46-54

**TABLE 5. METRIC BOLT TORQUE SPECIFICATIONS - 10.9 GRADE**

Size	Nm	ft-lb
M6	10-11	7-8
M8	24-27	17-20
M10	48-56	35-41
M12	77-90	57-67

### 3.3 List of Acronyms

**TABLE 6. ACRONYM DEFINITIONS**

Acronym	Definition
AC	Alternating Circuit
AGS	Automatic Generator Start
CCA	Cold Cranking Amp
CO	Carbon Monoxide
DC	Direct Current
GFCI	Grounded Fault Circuit Interrupters
LED	Light-emitting Diode
NFPA	National Fire Protection Agency
RV	Recreational Vehicle
RVIA	RV Industry Association
SAE	Society of Automotive Engineers

**TABLE 7. ACRONYMS FOR UNITS OF MEASUREMENT**

Acronym	Definition
Amp	Ampere
C	Celsius

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Acronym	Definition
F	Fahrenheit
Hz	Hertz
kW	kilowatt
lb	Pound
M	Meters
mm	millimeters
RPM	Revolutions per Minute
V	Volts
VDC	Volts Direct Current
W	Watts

# 4 Preparing for Service

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## 4.1 Troubleshooting

Refer to Troubleshooting before servicing the generator set. Note that some problems have several possible causes.

## 4.2 Safety

There are hazards in servicing generator sets. Study [Chapter 1](#) and become familiar with the hazards listed in the table below. Note the following safeguards and ways of avoiding hazards:

- Use personal protection: Wear protective safety equipment, such as safety shoes and safety glasses.
- Do not wear rings or jewelry and do not wear loose or damp clothing that might get caught in equipment or conduct electricity.
- Reduce the hazard: A safe, orderly workshop area and well-maintained equipment reduce the hazard potential. Keep guards and shields in place on machinery and maintain equipment in good working condition. Store flammable liquids in approved containers; away from fire, flame, spark, pilot light, switches, arc-producing equipment and other ignition sources. Keep the workshop clean and well lit, and provide adequate ventilation.
- Develop safe work habits: Unsafe actions cause accidents with tools and machines. Be familiar with the equipment and know how to use it safely. Use the correct tool for the job and check its condition before starting. Comply with the warnings in this manual and take special precautions when working around electrical equipment. Do not work alone, if possible, and do not take risks.
- Be prepared for an accident: Keep fire extinguishers and safety equipment nearby. Agencies such as the Red Cross and public safety departments offer courses in first aid, CPR, and fire control. Take advantage of this information to be ready to respond to an accident. Learn to be safety conscious and make safety procedures part of the work routine.

**TABLE 8. SAFETY HAZARDS**

Hazard	Source
Fire and Explosion	<ul style="list-style-type: none"><li>• Leaking or spilled fuel</li><li>• Hydrogen gas from battery</li><li>• Oily rags improperly stored</li><li>• Flammable liquids improperly stored</li></ul>
Burns	<ul style="list-style-type: none"><li>• Hot exhaust pipes</li><li>• Hot engine and generator surfaces</li><li>• Electrical shorts</li></ul>
Poisonous Gas	<ul style="list-style-type: none"><li>• Operating generator set where exhaust gases can accumulate</li></ul>
Electrical Shock (AC)	<ul style="list-style-type: none"><li>• Improper generator connections</li><li>• Faulty wiring</li><li>• Working in damp conditions</li><li>• Jewelry touching electrical components</li></ul>
Rotating Machinery	<ul style="list-style-type: none"><li>• Fan guards not in place</li></ul>

Hazard	Source
Slippery Surfaces	• Leaking or spilled oil
Heavy Objects	• Removing generator set from boat • Removing heavy components

## 4.3 Special Tools

Special tools are required to service the generator set. See Onan Tool Catalog.

**TABLE 9. SPECIAL TOOLS**

Engine Tools	Generator Tools
Cylinder Compression Tester	Frequency Meter
Cylinder Hone	Lead or dead-blow hammer
Cylinder Ridge Reamer	Load Test Panel and Leads
Feeler Gauge	Steel Rod (0.4 in OD x 7-7/8 in long)
Flywheel Puller	VOM Multitester
Hole Gauge	Harness Kit for InPower Diagnostic Service Tool (0541-1287)
Leak Down Tester	Harness Kit for InPower Diagnostic Service Tool (0541-1374)
Outside Micrometer Set (1-4 in)	Harness Kit for InPower Diagnostic Service Tool (0541-1389)
Piston Groove Cleaner	
Piston Ring Compressor	
Piston Ring Spreader	
Plastigage Bearing Clearance Guide	
Snap Ring Pliers	
Telescoping Gauge Set (0.500-4.000 in)	
Torque Wrench (0-100 Nm (0-75 ft-lbs))	
Valve Seat Cutter	
Valve Spring Compressor	

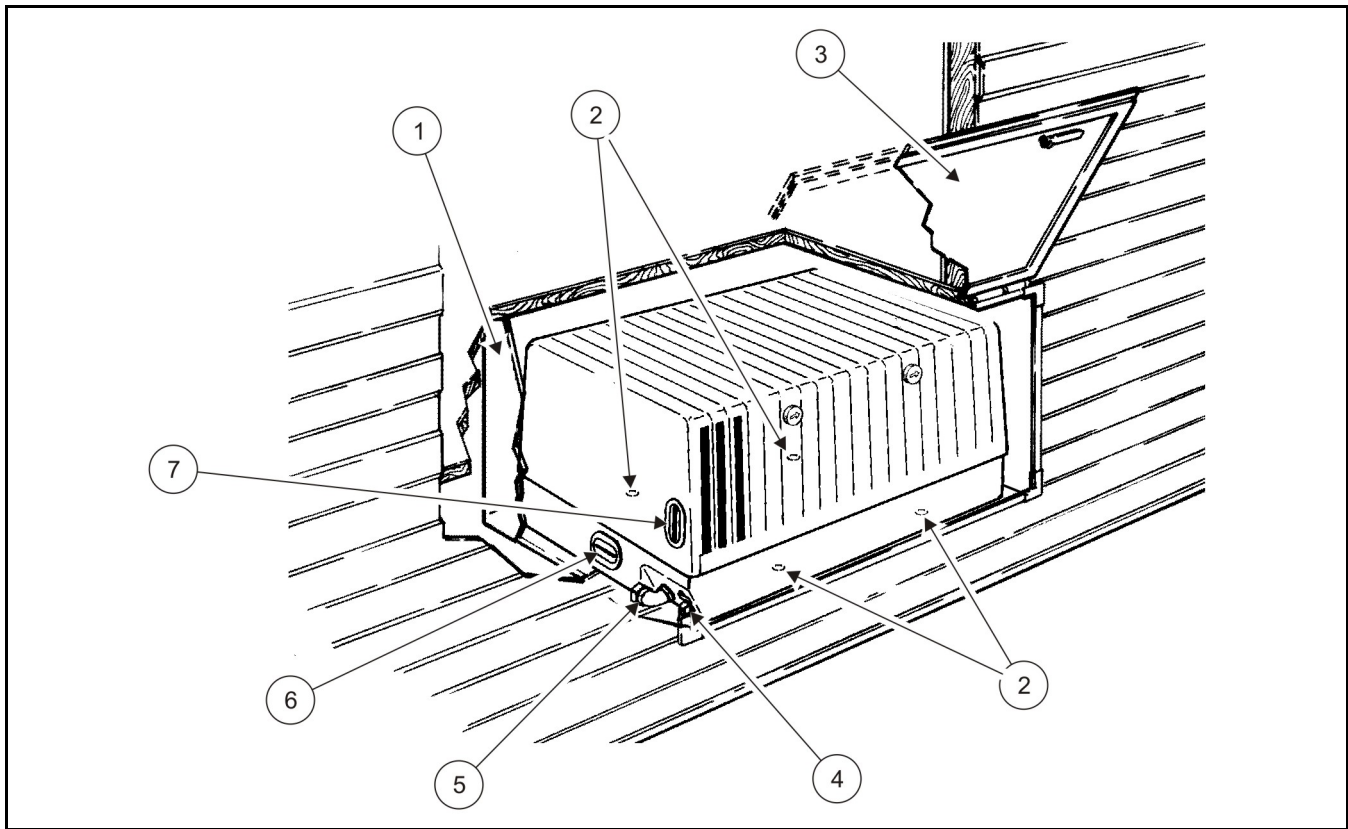
## 4.4 Removing the Generator Set

Some service procedures require removing the generator set from the vehicle. While there are many variations, generator set installations are generally classified as either conventional compartment mount or under floor mount.

In a compartment mount installation, a special compartment is built into the vehicle to house the generator set. The compartment is constructed with a vapor-tight barrier that seals off the generator set from the vehicle interior. The generator set is usually mounted to the floor of the compartment. Access to the compartment is through a door located in the exterior of the vehicle.

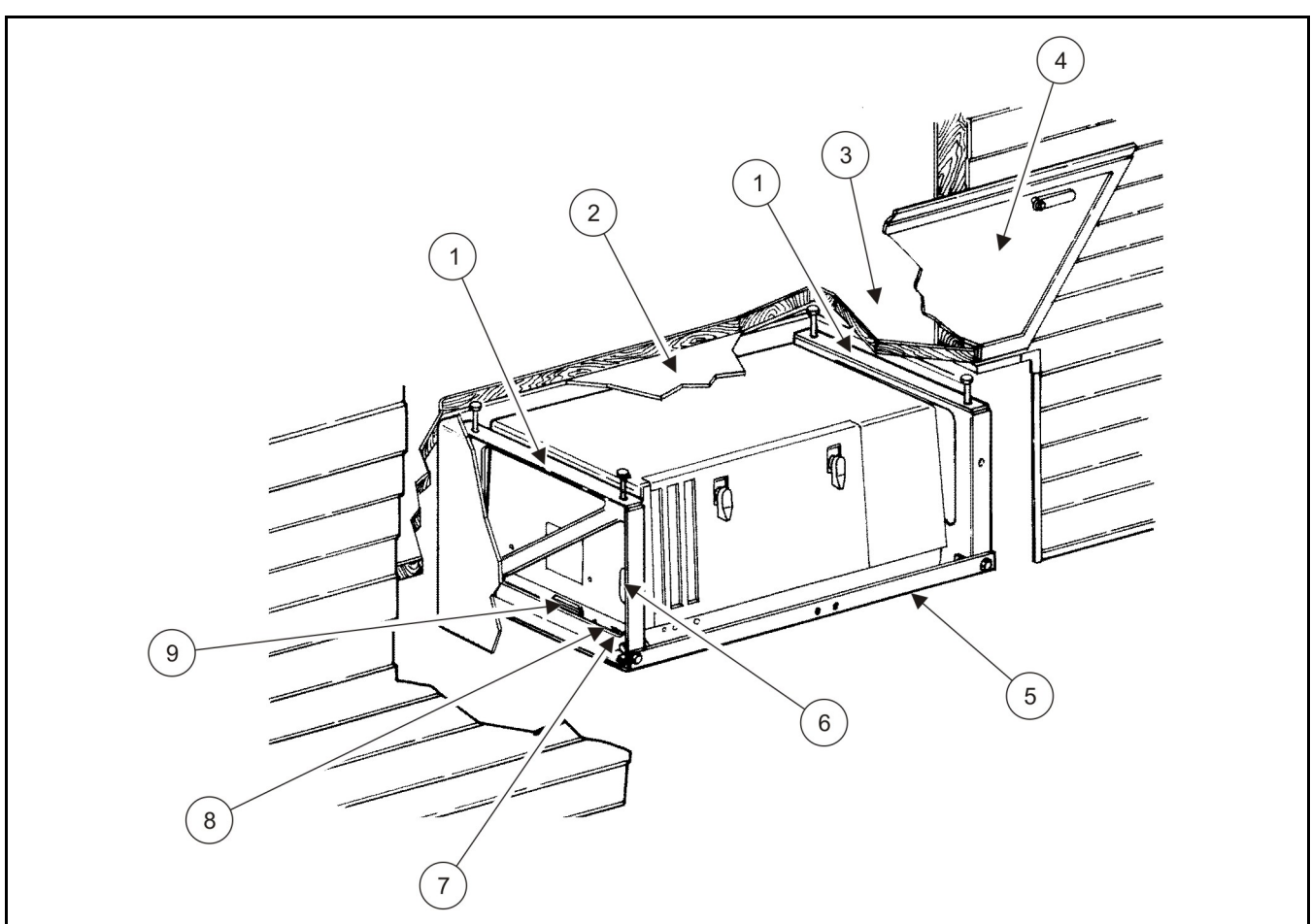
The under-floor-mount installation uses special brackets to suspend the generator set under the floor of the vehicle. The mounting brackets bolt to support members that are built into the vehicle framework. The generator set is mounted near the exterior of the vehicle. Access is provided through a door located in the exterior of the vehicle.

Due to the wide variety of vehicle designs it is not possible to specify the exact removal procedures for each type of installation. If, after examining the following sections, a satisfactory method for removing the set cannot be determined, contact the vehicle manufacturer or set installer to obtain their recommendations before attempting set removal.



No.	Description	No.	Description
1	Metal Barrier	5	AC Conduit Connection
2	Mounting Holes	6	Fuel Line Connection (EVAP Line if applicable)
3	Door	7	Battery Positive (+) Connection and Remote Control Harness Opening
4	Battery Negative (-) Connection		

**FIGURE 2. TYPICAL COMPARTMENT MOUNT INSTALLATION**



No.	Description	No.	Description
1	Side Panels	6	Battery Positive (+) Connection and Remote Control Harness Opening
2	Metal Barrier (required if installed below a wooden floor)	7	Battery Negative (-) Connection
3	Coach Floor	8	AC Conduit Connection
4	Door	9	Fuel Line Connection (EVAP line if applicable)
5	Bottom Rail		

FIGURE 3. TYPICAL UNDER FLOOR MOUNT INSTALLATION

### 4.4.1 Disconnecting the Generator Set

Some installations may require partial removal of the generator set to gain access to the battery cable, fuel line, and other connections. Read this section before starting the removal.

1. Disconnect the vehicle negative (-) battery cable at the battery terminal.



**⚠ WARNING**

***Arcing at battery terminals or in a light switch or other equipment, flames and sparks can ignite battery gas causing severe personal injury. Ventilate the battery compartment before connecting or disconnecting battery cables. Disconnect the negative (-) cable first and reconnect it last. Wear safety glasses. Do not smoke. Switch lights on and off away from the battery.***

2. Remove the generator set negative (-) battery cable at the battery terminal.
3. Disconnect the generator set positive (+) battery cable from the B+ connection on the generator set.
4. Disconnect the remote control wire connector.
5. Disconnect the generator load wires inside the generator set.
  - a. Move the control/start relay assembly aside.
  - b. Disconnect the ground and neutral (L2) lead from the ground terminal.
  - c. Disconnect the inline load (L1) lead connection.
  - d. Tag the wires to identify them for reconnection.
6. Loosen the conduit connector elbow and pull the load wires and flexible conduit free of the generator set.
7. Disconnect the exhaust tail pipe from the generator set, removing any exhaust support brackets or hangers that restrict removal.
8. Disconnect the supply and return fuel line from the generator set securely plugging the fuel lines to prevent leakage.

## 4.4.2 Generator Set Removal

After the generator set is disconnected from electrical, exhaust, and fuel systems; examine the mounting and support system. Locate all mounting bolts and support members. In most installations, the generator housing will be mounted to the coach framework. Depending on the installation, the generator set may be removable from the side, back, or bottom.

Verify that the generator set is adequately supported before loosening any of the mounting bolts or support members. Use a forklift to lift or move the generator set.

Park the vehicle on a level surface which can support the forklift. Move the transmission to PARK, lock the brakes, and remove the ignition key. Do not move the vehicle during this procedure.

### 4.4.2.1 Compartment Mount Removal

**⚠ WARNING**

***Generator sets are heavy and can cause severe personal injury if dropped. Use adequate lifting devices and keep hands and feet clear while lifting.***

1. Remove all mounting bolts.
2. Slide the generator set out of the compartment onto the forklift.
3. Slowly lower the generator set before moving it to the service area.

## 4.4.2.2 Under Floor Mount Removal

**⚠ WARNING**

***Generator sets are heavy and can cause severe personal injury if dropped. Use adequate lifting devices and keep hands and feet clear while lifting.***

1. Use a forklift to support the generator set. Raise the lift so it contacts the bottom of the generator set housing, making slight upward pressure on the generator set. Make certain the generator set is fully supported by the lift before continuing.
2. Loosen the bolts between the generator set base pan and side mounting panels (loosen bolts about six turns).
3. Loosen the bolts securing the side panels to the rear panel (note slotted holes) or braces and pull side panels away from the generator set.
4. Retighten side panels to back panel bolts.
5. Remove the mounting bolts securing the side and rear panels to the generator set.
6. Slowly lower the generator set until it clears all obstructions and can be safely moved out from under the vehicle.

## 4.4.3 Reinstalling the Generator Set

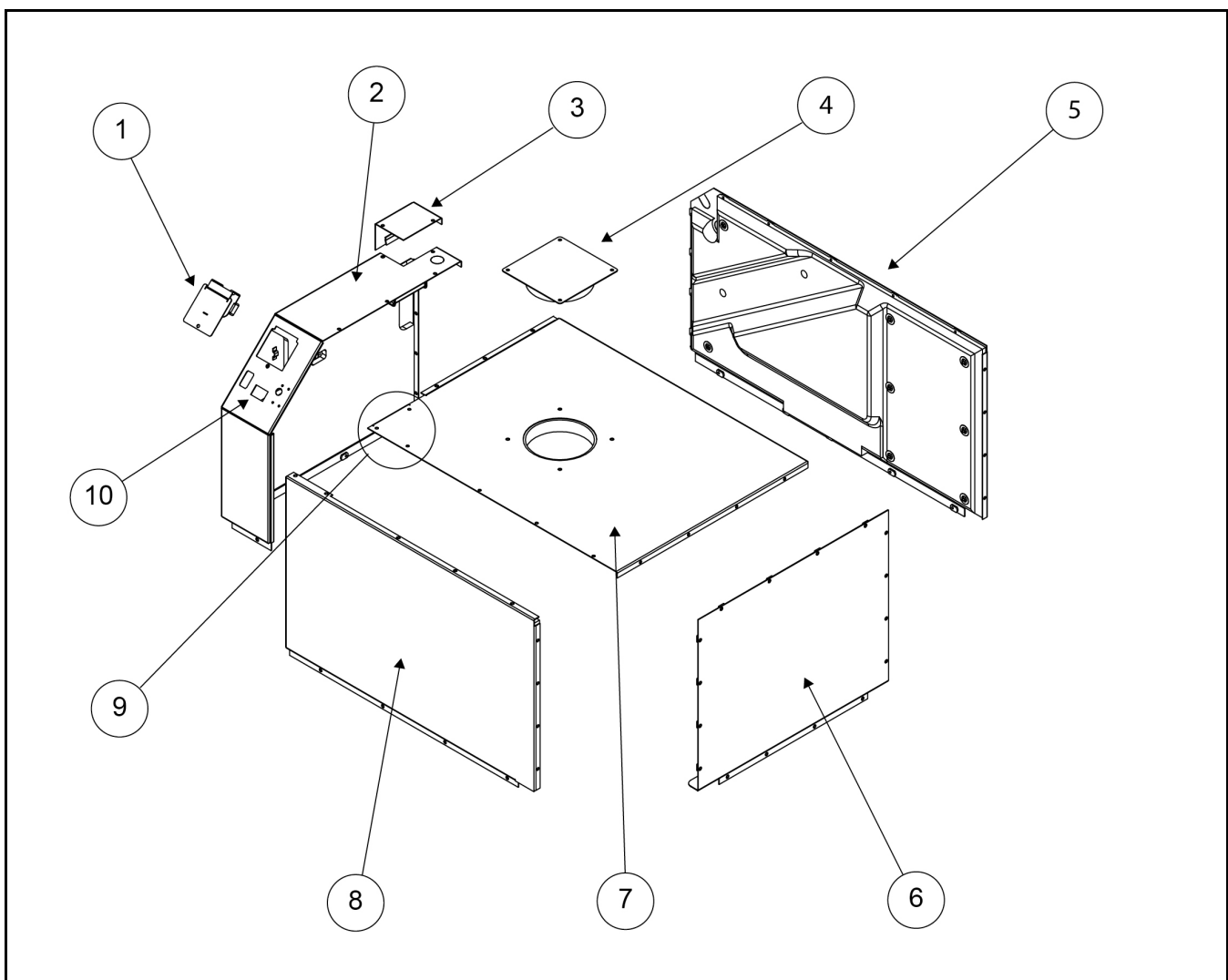
Generally, reinstallation of the generator set is performed in reverse order of the removal. Make sure all bolts and brackets, and electrical, exhaust, and fuel line system components are connected exactly as they were before removal. Perform the Service Checklist before placing the generator set back into service.

## 4.4.4 Remove Housing Panels

**⚠ WARNING**

***Do not operate the generator set without the housing panels secured in place. The panels guard against rotating parts and bare live electrical parts that can cause severe personal injury or death. The housing is also required for proper generator set cooling.***

The housing consists of 5 removable panels. The front (service) panel may also include a removable service door secured by latches. Note that the screws which secure the panels to the skid base are slightly longer than the screws between panels. Keep the screws separate to make reassembly easier.



No.	Description	No.	Description
1	Access Cover Fuses and Coolant Pressure Cap	6	Right End Panel
2	Left End Panel	7	Top Panel
3	Access Cover AD Terminals	8	Front (Service) Panel (may include a Service Door)
4	Access Cover Lifting Eye	9	Screw Holes for screws which also secure the coolant recovery tank
5	Back Panel	10	Control Panel

FIGURE 4. GENERATOR SET HOUSING

### 4.4.4.1 Removing the Front and Top Panels

**⚠ CAUTION**

*Screws that are too long will damage the coolant recovery tank and may cause it to break away. Make sure that the shorter panel screws are used for the recovery tank.*

It may be necessary to remove only the front (service) or front and top panels for access to the parts which need service.

1. Remove the tall screws around the perimeter of each panel.
2. Pull the panel away.

Note that the 3 screws in the top panel (circled in the figure above) also support the coolant recovery tank.

#### 4.4.4.2 Removing the Back Panel

1. Remove the top panel.
2. Remove the screws around the perimeter of the back panel.
3. Remove the 2 screws securing the back panel to the radiator frame.
4. Loosen the screws along the bottom edge of the left end panel, tilt the left end panel out so the back panel can be removed.

#### 4.4.4.3 Removing the Right End Panels

1. Remove the top panel.
2. Remove the screws around the perimeter of the right end panel.
3. Remove the right end panel.

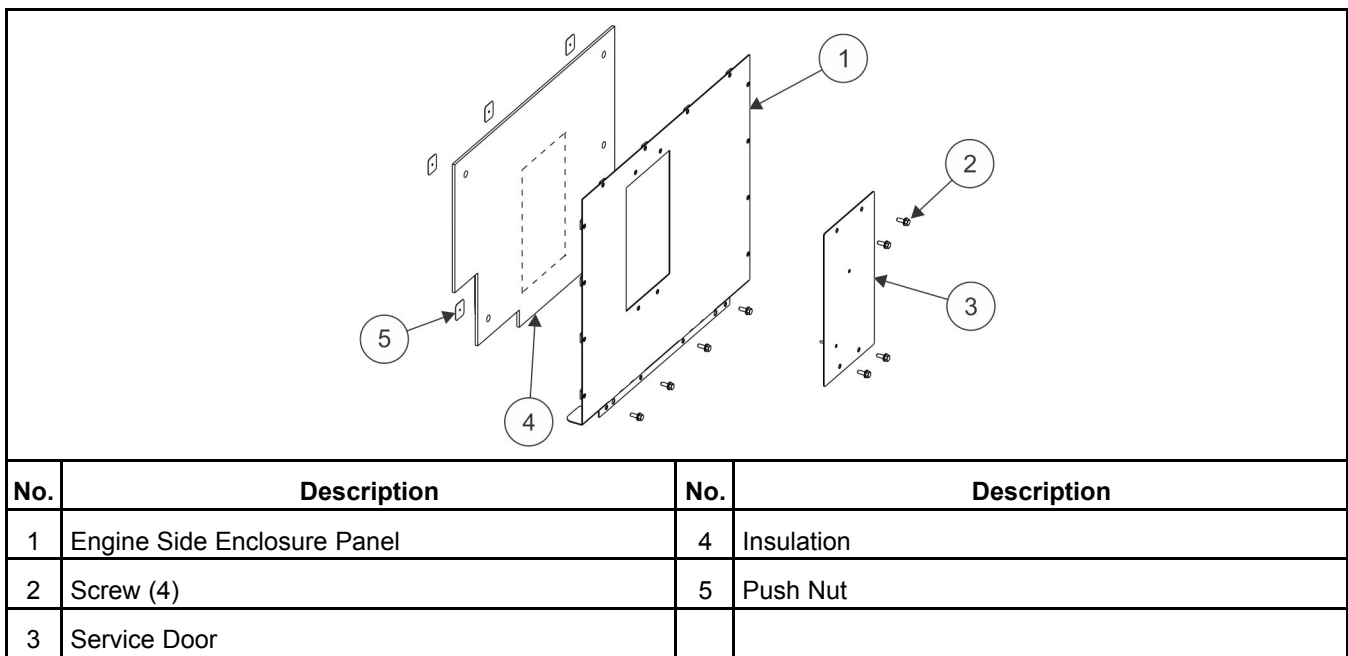
#### 4.4.4.4 Removing the Left End Panel

1. Remove the front, top and back panels.
2. Remove the AC terminal block mounting screws.
3. Remove the line circuit breaker mounting screws from the control panel.
4. Disconnect the engine harness from the control panel switch and hour meter (if provided).
5. Remove the screws along the bottom edge of the left panel and tilt panel out.
6. Disconnect the leads to the control switch and the hour meter (if provided), cutting wire ties securing the wiring harness to the panel.
7. Remove the left end panel.

#### 4.4.4.5 Service Door

**⚠ WARNING**

***Do not operate the generator set without the enclosure panel and service door secured in place. The enclosure panel and service door guard against rotating parts and bare live electrical parts that can cause severe personal injury or death.***



**FIGURE 5. SERVICE DOOR**

1. Remove the 4 screws holding the service door on the engine side enclosure panel. Make sure that one hand is supporting the service door while the other hand is removing the screws.
2. Pull the service door straight out until the 2 studs are free from the insulation.
3. Set the service door aside and use a box cutter to cut the insulation along the edge of the rectangular opening as cleanly as possible.
4. Pull the insulation out and use push nuts to secure the cutout piece of insulation onto the service door.
5. Reinstall the service door with the attached piece of insulation onto the engine side enclosure panel.

### 4.4.5 Installing the Housing Panels

Install the housing panels as follows:

1. Installation is the reverse of the removal.
2. Use wire ties to secure the engine and AC harness to the left end panel.
3. Tighten the panel screws according to torque specifications.

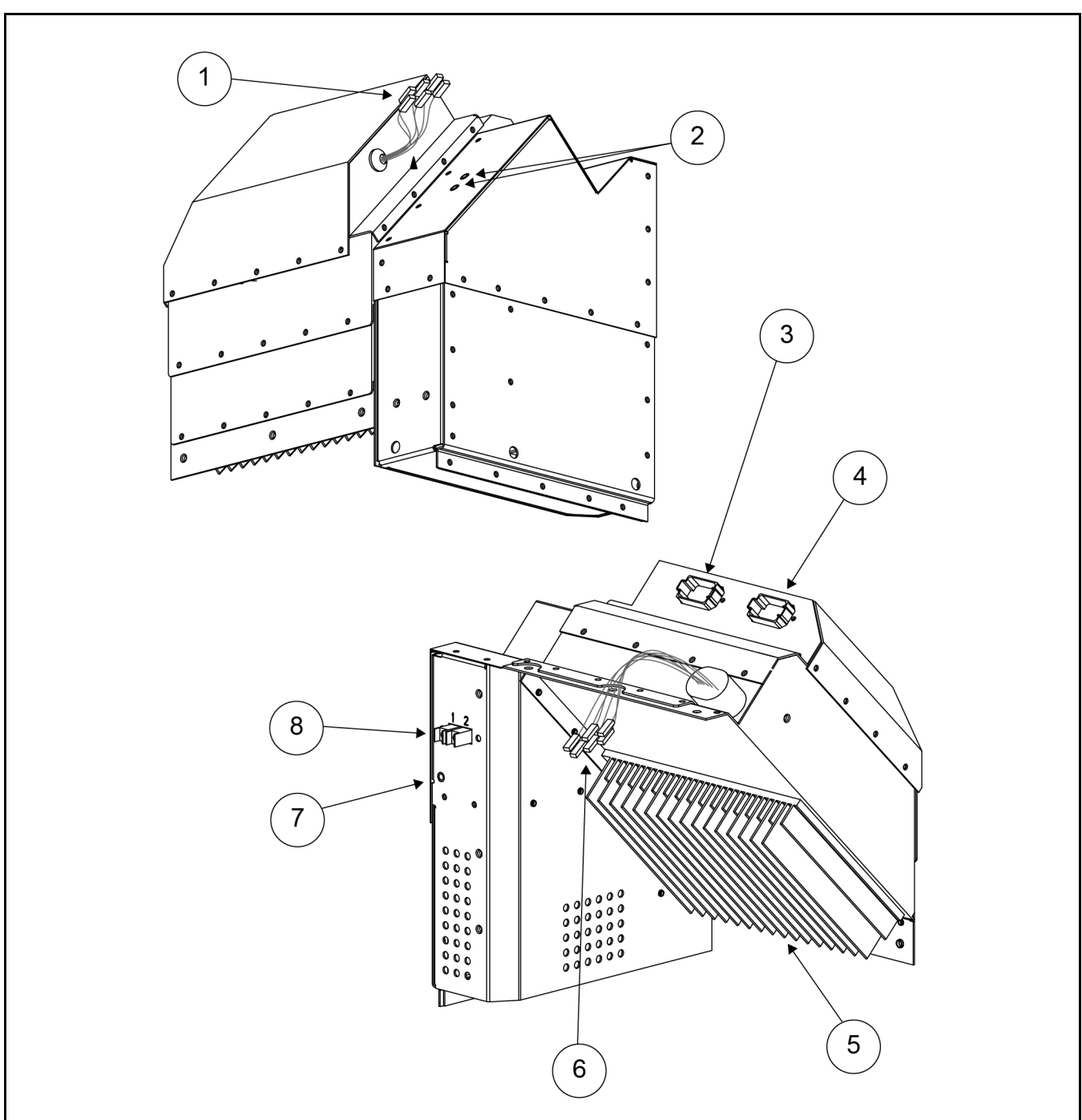
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# 5 Generator Set Control

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## 5.1 Control-Inverter

The control-inverter is an integrated microprocessor-based engine and generator set control. It provides all the control, monitoring, and diagnostic functions required to operate the generator set control.



No.	Description	No.	Description
1	Six quick disconnects leads (2 to current transformer, 4 Glow Plugs and starter solenoid)	5	Heat sink
2	Secure engine and AC harness support clips here	6	Six leads to PMA
3	J1 engine harness	7	Ground straps connect here
4	J2 engine harness	8	TB3 for AC harness

**FIGURE 6. CONTROL-INVERTER HOUSING**



## 5.1.1 Major Functions

- Initialization: Control checks memory (RAM, ROM, EPROM) and generator set configuration.
- Startup: When the control switch is pressed and held in the start position until start disconnect, the control starts the generator set.

The control:

1. Energizes fuel pump.
  2. Flashes the status indicator to indicate preheat and crank.
  3. Energizes the glow plugs for temperature-dependent durations.
    - Preheat Timing: For coolant temperatures greater than 49°C (120°F), preheat timing is 0 seconds. For coolant temperatures less than 10°C (50°F), the preheat time is 15 seconds. The glow plug timing duration varies from 0-15 seconds for coolant temperatures between 10°C (50°F) and 49°C (120°F).
    - Postheat Timing: For coolant temperatures greater than 21°C (70°F), postheat timing is 0 seconds. For coolant temperatures less than 21°C (70°F), the postheat timing is 5 seconds.
  4. Energizes the governor actuator (moves toward full rack).
  5. Energizes the starter when preheat is complete.
  6. De-energizes the starter at 800 RPM.
  7. Turns on the status indicator to indicate start disconnect.
  8. Turns on switched B+ (remote connector pin J8-F).
  9. Enables the inverter (output voltage).
- Stop: When the control switch stop position is pressed momentarily, the control:
    1. Disables output voltage.
    2. De-energizes the fuel pump and the governor actuator.
    3. Turns off the status indicator.
    4. Writes session data (number of cranks, minutes of operation, last fault, etc.) to non-volatile memory (NVM).
    5. Removes processor power when idle 5 minutes (battery saver function).

### NOTICE

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

- Fuel prime: When the control switch is pressed and held in the Stop position for more than 2 seconds, the control:
  1. Energizes the fuel pump.
  2. Turns on the status indicator for as long as Stop is held.
- Speed Control: The control maintains the speed range for which the generator set is configured. An example for RV configurations:
  1. 2300 RPM is commanded during the first minute of operation.
  2. 1950 RPM is commanded during minute 2.
  3. 1600 RPM (idle speed) is command for every minute thereafter.

**NOTICE**

**Speed increases as loading requires.**

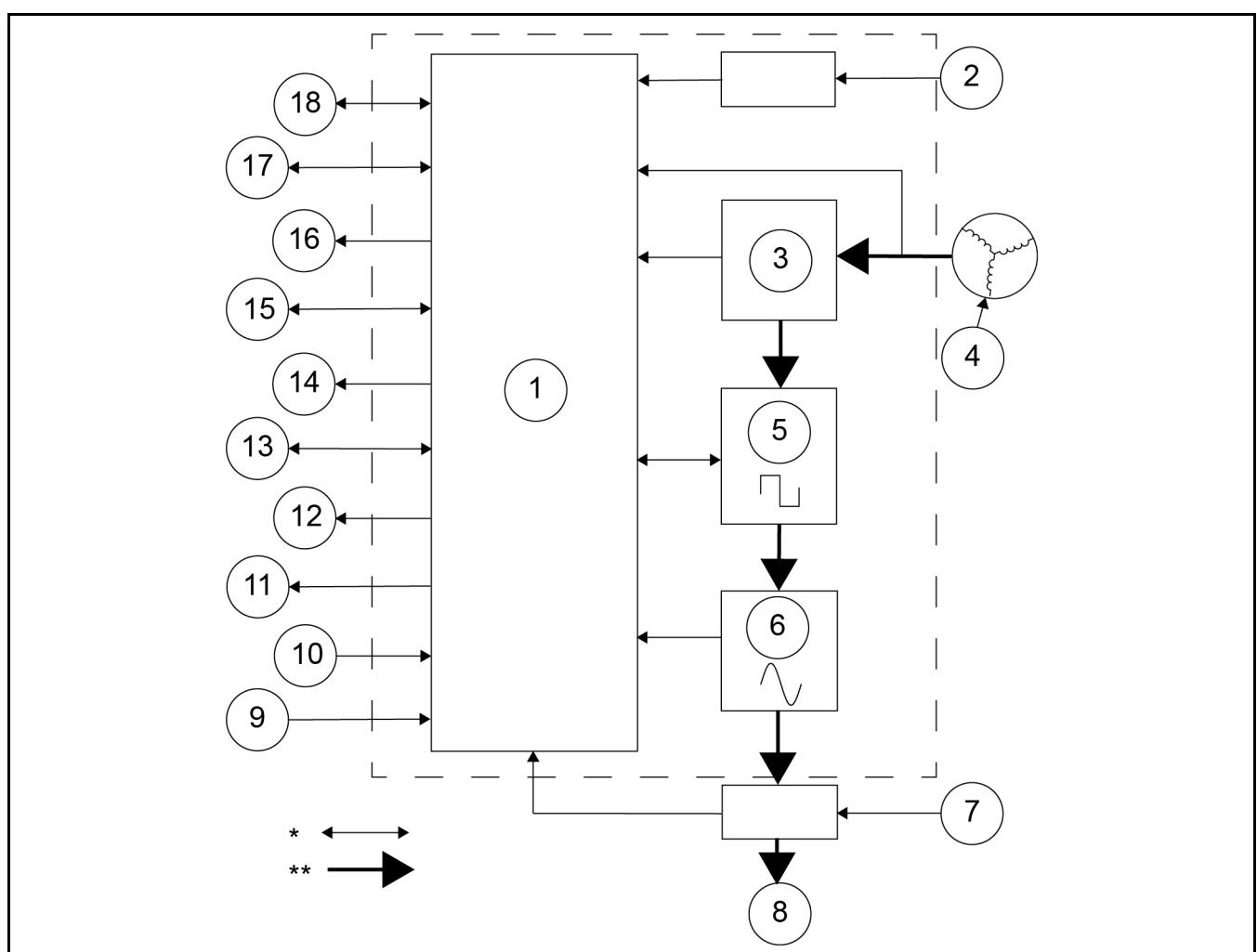
- Voltage Control: The inverter converts the 3-phase AC output of the engine-driven PMA (permanent magnet alternator) into single phase AC output at the configured voltage and frequency:
  1. Maintains normal output voltage during steady state.
  2. Adjusts the voltage setpoints for transient loads to allow engine recovery.
- Voltage Adjustment:

**⚠ WARNING**

***Touching uninsulated live parts inside the generator set or connected equipment can result in severe personal injury or death. Stand on a dry wooden platform or rubber insulating mat. Make sure clothing and shoes are dry and remove jewelry. Use tools with insulated handles.***

Before adjusting voltage, make sure that the proper fuel, exhaust, raw water, and battery connections have been made and the engine has proper oil and coolant levels. Make sure that loads have been disconnected and accurate meters are connected to measure AC voltage and frequency.

- To increase voltage:
    1. Start the generator set and allow the voltage and frequency to stabilize for 3 to 5 seconds.
    2. Rapidly press the Start switch 6 times during the first minute after startup to put the control into voltage adjust mode:
      - The amber status light begins to blink about once a second to indicate the change to voltage adjustment.
      - The green status light remains on.
    3. Press and quickly release the Start switch to increase voltage approximately 0.6 volts. Repeat until voltage is adjusted to the desired value.
    4. Wait about 20 seconds for the amber status light to stop blinking and press the Stop switch to save the adjustment.
  - To decrease voltage:
    1. Start the generator set and allow the voltage and frequency to stabilize for 3 to 5 seconds.
    2. Rapidly press the Start switch 6 times during the first minute after startup to put the control into voltage adjust mode:
      - The amber status light begins to blink about once a second to indicate the change to voltage adjustment.
      - The green status light remains on.
    3. Press and holding the Start switch for about 1 second to decrease voltage approximately 0.6 volts. Repeat until voltage is adjusted to the desired value.
    4. Wait about 20 seconds for the amber status light to stop blinking and press the Stop switch to save the adjustment.
- Fault Shutdown and Diagnostics: See Troubleshooting in [Chapter 9 on page 65](#)



No.	Description	No.	Description
1	Control	10	Engine Sensor
2	Inverter Overtemp	11	Governor Actuator
3	DC Bus	12	Starter
4	PMA (Permanent Magnet Alternator)	13	Glow Plugs
5	Power Devices	14	Fuel Pump
6	AC Filters	15	PC Serial Connection (For Factory Only)
7	Current Sensor	16	Switched B+
8	AC Output	17	Remote Control
9	Battery	18	Local Control

\* Control and Feedback  
 \*\* Output Power

FIGURE 7. CONTROL-INVERTER BLOCK DIAGRAM

## 5.1.2 Control-Inverter Removal

1. Disconnect the negative (-) battery cable from the battery to prevent the generator set from starting.
2. Remove the generator set housing panels (front, top and left).
3. Disconnect all external wiring connections and ground straps from the housing.
4. Remove the screw securing the housing to the radiator frame.
5. Remove the 6 screws securing the housing to the inlet baffle assembly.
6. Remove the 5 screws along the lower back of the housing.
7. Lift the control-inverter housing out of the generator set.

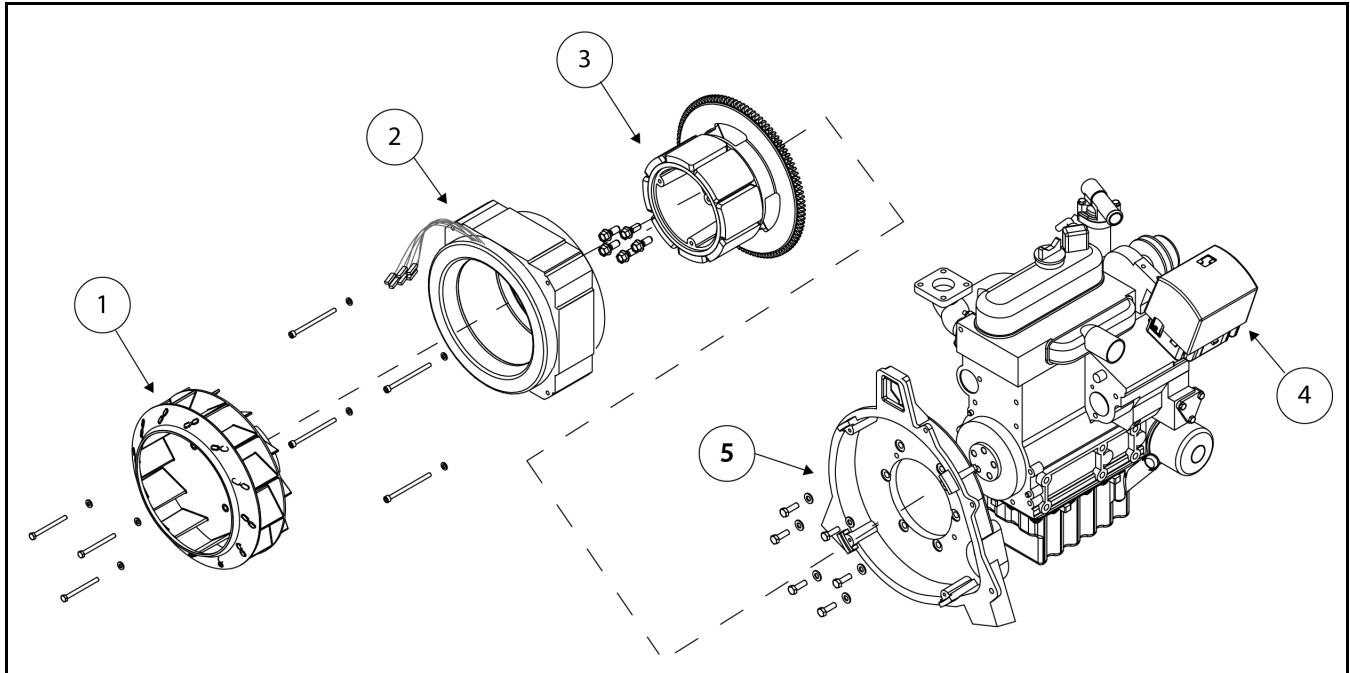
## 5.1.3 Control-Inverter Replacement

Replacement is the reverse of removal.

Make sure that the ground straps from the AC harness and skid base are reconnected and screws are tightened to Torque Specifications.

# 6 Permanent Magnet Alternator (PMA)

The generator set has an 8-pole permanent magnet alternator (PMA) with a 3-phase stator. The magnets are bonded to the rotor with adhesive. The rotor is a 1 piece casting with the flywheel. A bearing is not used to support the end of the rotor and there are no slip rings, brushes or exciters.



No.	Description	No.	Description
1	Engine Cooling Blower	4	Engine
2	PMA Stator Winding Leads	5	Flywheel Housing
3	PMA Rotor Flywheel and Stator Ring Gear		

FIGURE 8. PMA GENERATOR

## 6.1 Stator

**NOTICE**

**There is a consumer alternator service strategy change starting with Spec N to P, and R to S alternators/serialized alternators. See below for more information.**

Beginning with HDKAK Spec P, HDKAH Spec P, HDKAT Spec S, HDKAU Spec S, and HDKAV Spec S, the rotor (A) and stator (B) will no longer be orderable as individual service parts. The rotor and stator must be replaced together. Going forward there will be one part number for the complete alternator assembly (C). See Support Plan SP\_0000038.

The new (Spec P, S) may have slightly different characteristics, but the overall form, fit, function, and performance will be the same as that of existing alternators. New spec alternators will be backwards compatible with old spec generator set models. However, the new spec and old spec alternator parts are not interchangeable. If a rotor or stator fails in the existing alternator, the entire alternator must be replaced with the new (Spec P, S) alternator assembly.

Wiring connections and labels will remain the same as the old spec alternators.

Each new spec alternator is serialized. The serial number sticker will be located on the stator and rotor.

New spec alternators may have different cold resistive (R) values depending on model (see the following table).

Bearings and slip rings will not be individually replaceable on the new spec alternators.

## 6.1.1 Stator Tests

- Winding Insulation Resistance Test:

### NOTICE

**A 500 VDC megger is recommended for testing the winding insulation resistance. A digital Ohmmeter can be used when set to the highest scale as a preliminary check. It should read infinite resistance.**

1. Remove battery negative (–) lead to prevent generator from starting.
2. Remove generator set top panel.
3. Disconnect the 6 PMA winding leads from the control-inverter.
4. Apply test voltage between each winding group (T1-1 and T1-2) and ground.
5. Voltage is applied for 10 minutes and recorded resistance values are taken at the 1 minute ( $R_1$ ) and 10 minute ( $R_{10}$ ) marks.
6. Resistance values should be greater than 5 megohms with a polarization index (PI) of at least 2 for a new stator. A generator set that has been in service should read at least 1 megohm with a PI of 2.

### NOTICE

**Low readings can be caused by high humidity. The test should be repeated after the windings have been dried. If the generator set is operational, drying the windings can be accomplished by running the generator set under full load for at least 1 hour.**

$$PI = \frac{R_{10}}{R_1}$$

- Testing Stator Dynamic Voltage:

A generator running at a high speed when under a moderate load indicates an open stator, control is attempting to get more from the stator by increasing the engine speed.

1. Start the generator set.
2. Check engine speed using the following formula:

$$\frac{HZ \times 120}{16} = \text{Engine Speed}$$

3. Check stator voltage at high idle (2100 RPM) (199 VAC), medium idle (1900 RPM) (173 VAC) and low idle (1600 RPM) (148 VAC).
  4. Compare engine speed and load. With a 30 amp load the generator set speed should be 2400 rpm. A speed of 3400 rpm would indicate an open stator winding.
- Winding Resistance tests:
    1. Test using a Digital Ohmmeter (preliminary indication only):
      - a. Set ohmmeter for lowest scale.
      - b. Ohmmeter should read approximately 1 ohm when measuring across T1-1 and T2-1 (see Stator Winding Groups Figure below).
      - c. Measure remaining stator windings, all should read about 1 ohm.
    2. Test using a Wheatstone Bridge:

**NOTICE**

**Use a Wheatstone Bridge having at least a 0.001 ohm precision.**

- a. Test stator windings across T1-1 and T2-1.
- b. Resistance should be 1 ohms ± .15 at 25 °C (77 °F)
- c. Measure remaining stator winding.

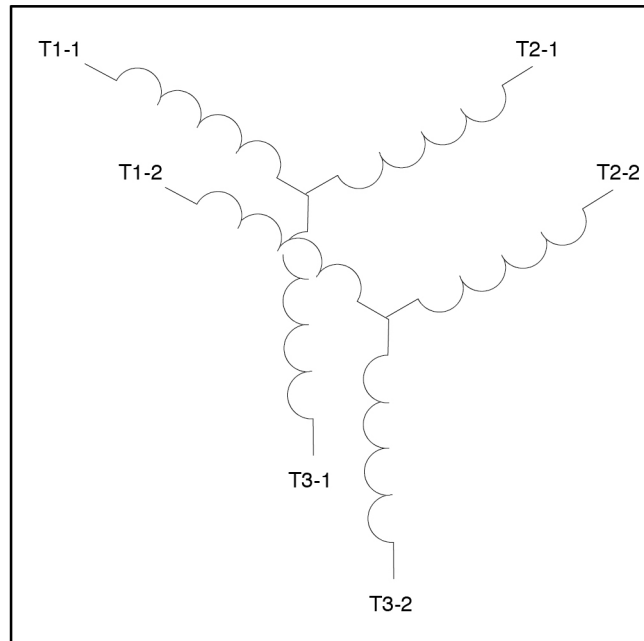
**NOTICE**

**Starting with generator spec P and spec S, alternators are serialized. These alternators will also be backwards compatible with previous spec generator sets. Verify whether the alternator is serialized or not before taking resistance measurements. A serial number tag can be found on both the stator and rotor.**

**TABLE 10. STATOR WINDING RESISTANCES**

<b>RESISTANCE MEASUREMENTS (Ω) ± 15% @ 25 °C (77°F)</b>	
<b>Terminal Connections</b>	<b>A053K355 6-8 kW</b>
Main Winding T1-1 - T2-1	1 ± 0.15
Main Winding T1-1 - T3-1	1 ± 0.15
Main Winding T2-1 - T3-1	1 ± 0.15
Main Winding T1-2 - T2-2	1 ± 0.15
Main Winding T1-2 - T3-2	1 ± 0.15
Main Winding T2-2 - T3-2	1 ± 0.15

Note: Even though winding resistance may be within the tolerances of this Table, replace the Alternator if winding-to-winding or winding-to-ground resistance (winding insulation resistance) is less than 1 megaohm. (An ohmmeter must indicate an open circuit or infinite resistance between windings or between any winding and ground)



**FIGURE 9. STATOR WINDING GROUPS**

## 6.1.2 Stator Removal

1. Disconnect the negative (–) battery cable from the battery to prevent the generator set from starting.
2. Disconnect stator winding leads.
3. Remove the generator set housing panels (front, top and left).
4. Disconnect all external wiring connections and ground straps from the housing.
5. Remove the screw securing the housing to the radiator frame.
6. Remove the 6 screws securing the housing to the inlet baffle assembly.
7. Remove the 5 screws along the lower back of the housing.
8. Lift the control-inverter out of the generator set.
9. Remove the engine cooling blower.
10. Remove the air filter cover and element.
11. Remove the 3 screws securing the inlet baffle assembly to the base.
12. Remove the 2 screws that secure the inlet baffle assembly to the inner bulkhead and tilt it out.

### **⚠ CAUTION**

***The rotor magnets can be chipped by rough handling. Guide the stator on and off carefully to avoid chipping the edges of the magnets.***

13. Remove the 4 stator mounting bolts and pull the stator straight back (the rotor magnets will resist the motion).

### **NOTICE**

**To prevent loss of magnetism due to shock, protect the rotor from being dropped or struck while the stator is removed. Keep metal chips away from the rotor.**



### 6.1.3 Stator Installation

Installation is the reverse of removal.

- The stator leads must be oriented to the top of the stator when replacing.
- The stator should sit square within the four guide ears in the flywheel.
- Make sure that the ground straps from the AC harness and skid base are reconnected.
- Tighten all screws according to Torque Specifications.

## 6.2 Rotor

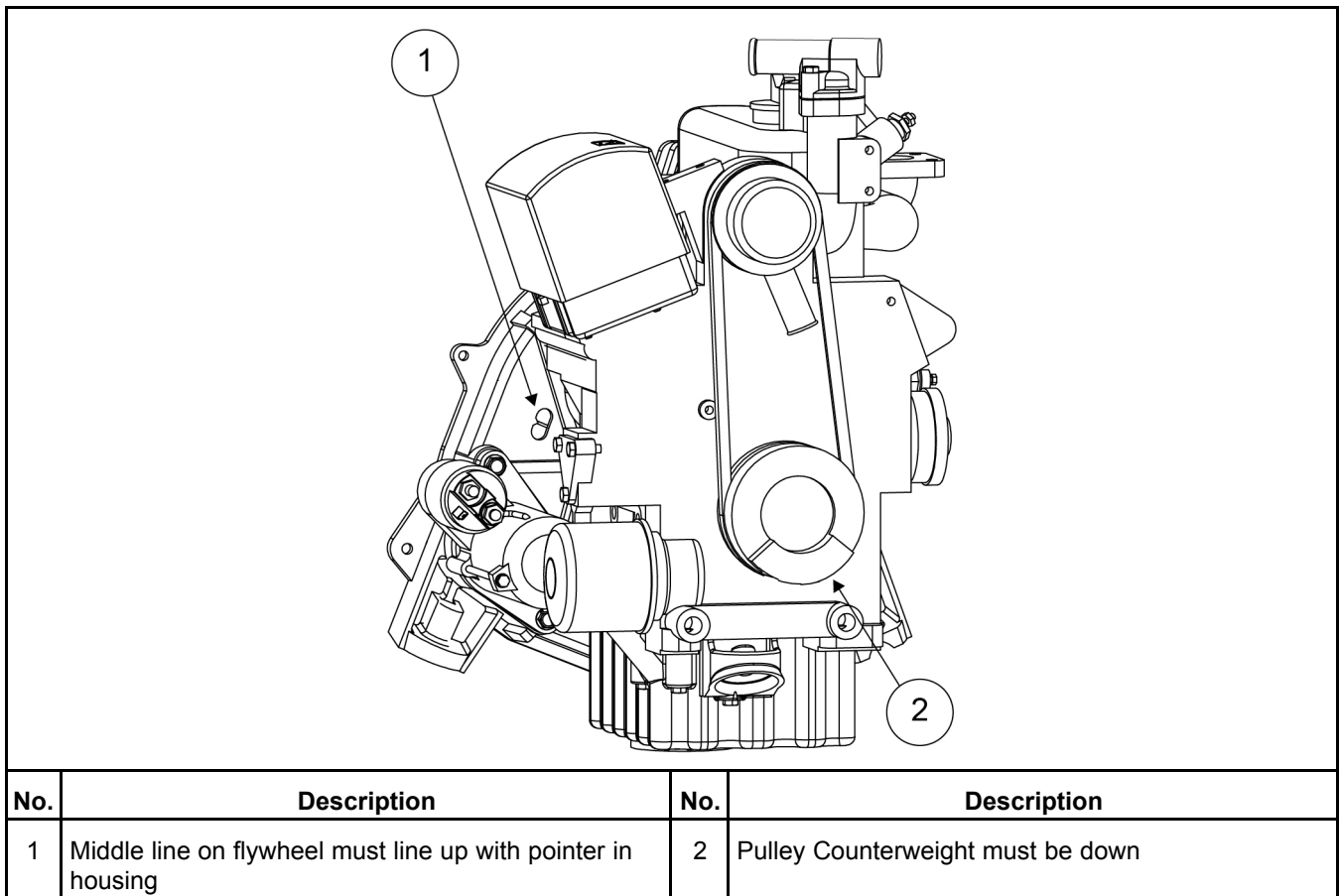


FIGURE 10. ROTOR-CRANKSHAFT ALIGNMENT

### 6.2.1 Rotor Removal

1. Perform Stator removal procedure.
2. Remove the 5 screws securing the rotor to the flywheel housing.

**NOTICE**

To prevent loss of magnetism due to shock, protect the rotor from being dropped or struck while the stator and rotor are removed. Keep metal chips away from the rotor.

- 
3. Remove the rotor.

## 6.2.2 Rotor Installation

### **NOTICE**

**To prevent loss of magnetism due to shock, protect the rotor from being dropped or struck while the stator and rotor are removed. Keep metal chips away from the rotor.**

1. Bar the engine until the counterweight on the front engine pulley is straight down. (As shown in figure below.)
2. Mate the rotor to the crankshaft such that the middle line on the back of the flywheel lines up with the pointer in the flywheel housing.
3. Secure the rotor to the flywheel housing with 5 screws.
4. Perform stator installation.

# 7 Battery Charger

The battery charger and its transformer are mounted on the skid base.

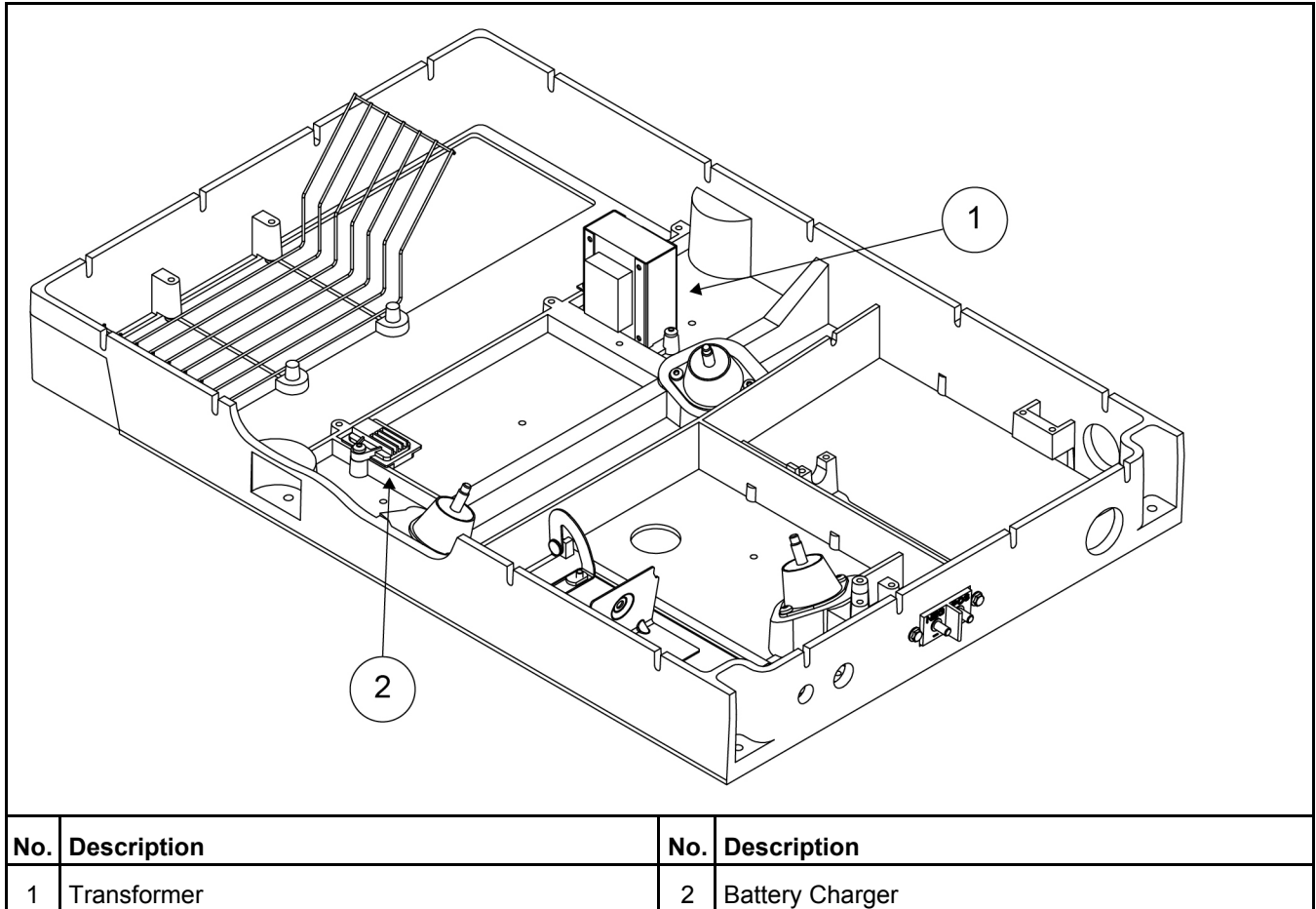


FIGURE 11. BATTERY CHARGER AND TRANSFORMER

## 7.1 Battery Charger Removal

The battery charger is mounted on the skid base as shown above.

1. Disconnect the negative (-) battery cable from the battery to prevent the generator set from starting.
2. Remove the front housing panel.
3. Disconnect the quick connectors going to the transformer and the lead at the starter housing.
4. Remove the mounting screw and remove the battery charger.

## 7.2 Battery Charger Installation

Installation of the battery charger is the reverse of removal.

Tighten all screws according to Torque Specifications.

---

## 7.3 Battery Transformer Removal

Transformer Removal:

1. Disconnect the negative (-) battery cable from the battery to prevent the generator set from starting.
2. Remove the front, top and left housing panels.
3. Disconnect the quick connectors on the battery charger going to the transformer and the lead at the starter housing.
4. Remove the mounting screw and remove the battery charger.
5. Disconnect all external wiring connections and ground straps from the housing.
6. Remove the screw securing the housing to the radiator frame.
7. Remove the 6 screws securing the housing to the inlet baffle assembly.
8. Remove the 5 screws along the lower back of the housing.
9. Lift the control-inverter housing out of the generator set.
10. Remove the engine cooling blower.
11. Remove the air intake hoses from the back of the air filter housing.
12. Disconnect the remaining quick connectors from the transformer.
13. Remove the 2 mounting screws.
14. Remove the transformer.

## 7.4 Battery Transformer Installation

Installation of the transformer is the reverse of removal.

Tighten all screws according to Torque Specifications.

# 8 Primary Engine Systems

## 8.1 Introduction

See *Engine Workshop Manual* (981-0514) for servicing the engine proper, adjusting valve clearance (lash), replacing glow plugs, cleaning the crankcase breather assembly, replacing the coolant thermostat and pump and service of the fuel injector system.

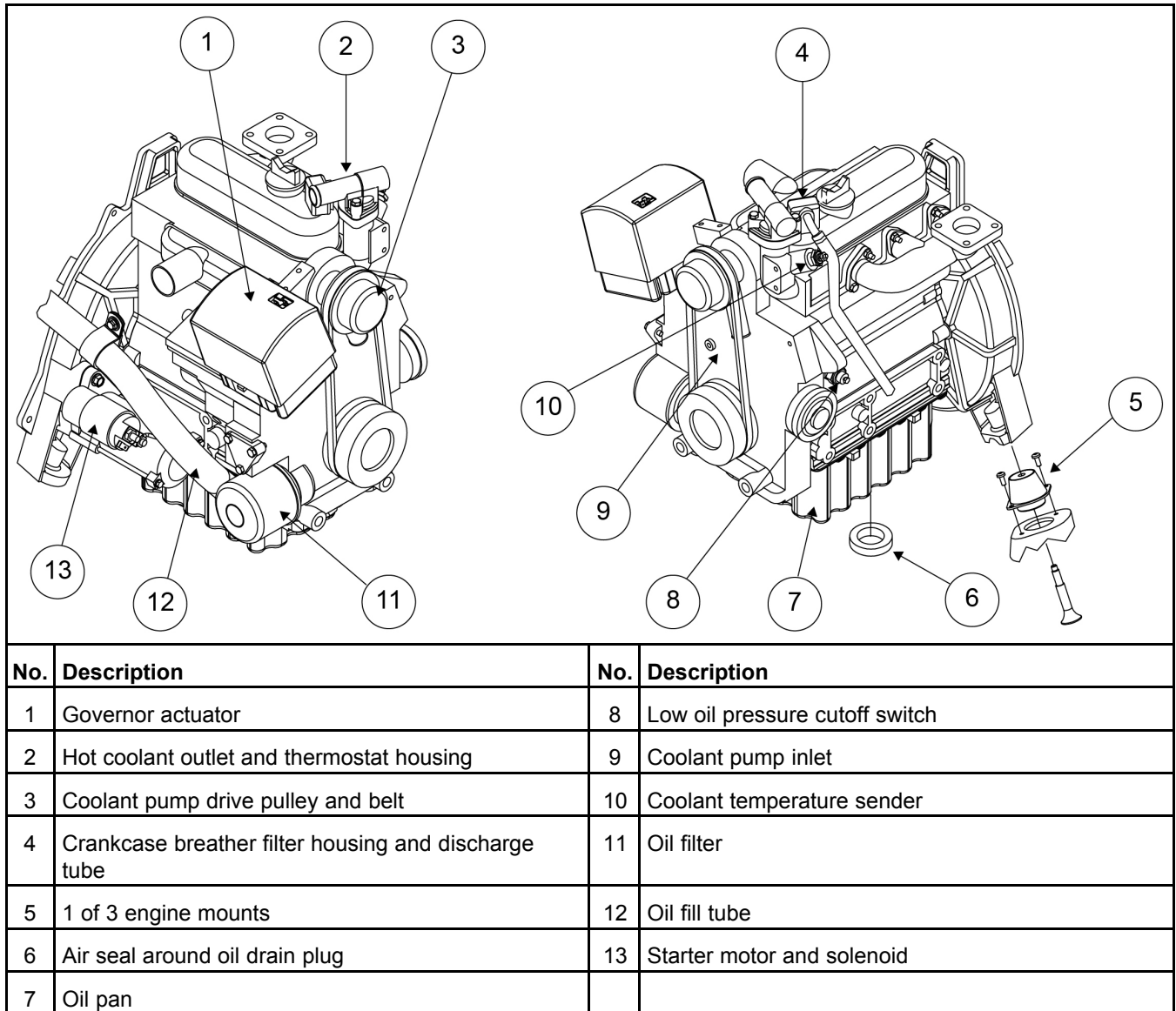


FIGURE 12. ENGINE AND ACCESSORIES

## 8.2 Engine

### 8.2.1 Engine Removal

The engine is mounted on 3 vibration isolator mounts and secured to the skid base.

1. Disconnect the negative (–) battery cable to prevent the generator set from starting.
2. Remove the front, top, back and right end housing panels.
3. Remove the muffler.
4. Remove the oil dipstick and disconnect the oil fill tube from the recovery tank. If the oil fill tube is to be removed from the oil pan, drain the oil first to avoid spillage.
5. Drain the coolant system, disconnect the hoses at the engine, and remove the radiator and inner bulkhead.
6. Disconnect the air inlet hose at the resonator.
7. Disconnect the PMA stator leads.
8. Disconnect the engine harness from the control-inverter assembly and fuel pump.
9. Disconnect the skid-base ground strap from the flywheel housing.
10. Disconnect the battery harness from the engine.

**⚠ CAUTION**

***Using only one lifting eye will cause the unit to rotate and drop, causing severe equipment damage and possible personal injury.***

11. Attach the hoist at both the flywheel housing lift and the front engine lifting eye.
12. Remove the 3 isolator-mount center bolts and lift the engine/PMA assembly away.
13. Remove the cooling blower, PMA stator, rotor, and flywheel housing from the engine.

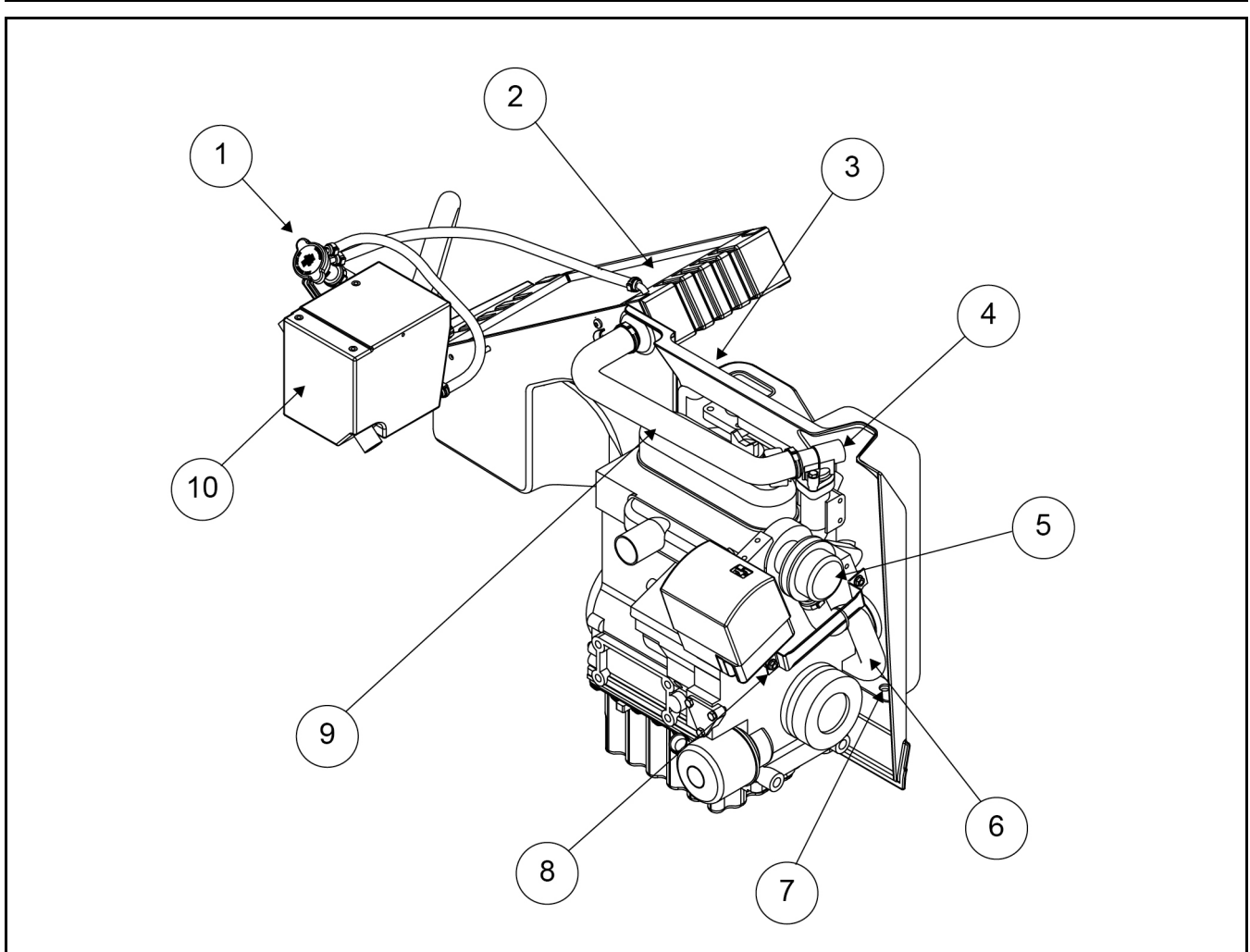
### 8.2.2 Engine Installation

Installation is the reverse of removal.

- Make sure that the seal ring is in place around the oil drain hole in the skid base to seal against leakage of cooling air and noise.
- Make sure that the engine crankcase breather hose is pushed back through the hole in the inner bulkhead.
- Tighten all screws and bolts according to Torque Specifications.

## 8.3 Cooling System

The generator set has a liquid cooled engine. A centrifugal blower is mounted on the end of the PMA rotor to move air for the cooling of the generator set. The blower pulls the air in from an opening in the bottom of the generator set to pressurize the engine compartment. Air flows through the radiator from the top side of the muffler compartment and then out the bottom.



No.	Description	No.	Description
1	Pressure Cap	6	Lower Engine Hose
2	Radiator	7	Crankcase Breather Hose Exit
3	Inner Bulkhead	8	Hose Bracket
4	Thermostat Housing	9	Upper Radiator Hose
5	Coolant Pump	10	Coolant Recovery Tank

**FIGURE 13. ENGINE COOLING SYSTEM (1 OF 2)**

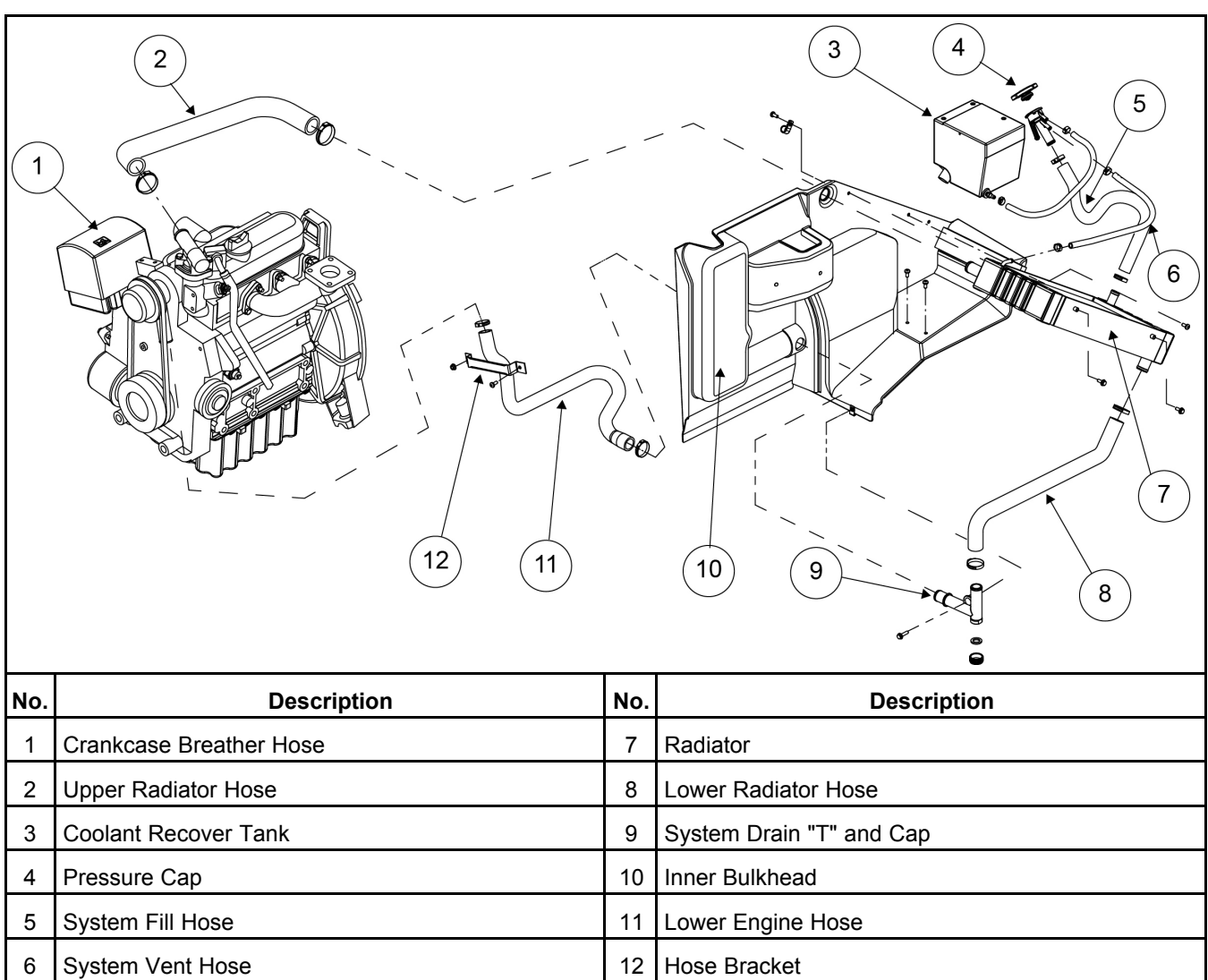


FIGURE 14. ENGINE COOLING SYSTEM (2 OF 2)

### 8.3.1 Inspection

1. Remove the access panel and inspect the engine and control area.

If the areas are clean, there is no need to disassemble for engine cleaning.

### 8.3.2 Water Pump Belt Removal

1. Remove the negative (-) battery cable from the battery to prevent accidental starting of the generator set during removal.
2. Remove the 4 bolts which secure the pump pulley to its hub.
3. Pull the pulley and belt off.



### 8.3.3 Water Pump Belt Installation

#### ⚠ CAUTION

*Using the wrong water pump drive belt can lead to engine overheating.*

#### NOTICE

**Since there is no way to adjust the belt tension, it is critical that the correct replacement belt be used.**

1. Place the belt over both pulleys.
2. Pull the pump pulley up to its hub and push the pulley onto the hub.
3. Secure the pulley with the 4 bolts and tighten to 17.6-23 Nm (13-17 ft-lb).

#### NOTICE

**Belt tension increases slightly as the engine runs and is sufficient for the relatively light pump load.**

### 8.3.4 Cooling System Removal

1. Remove the top and back housing panels from the generator set.

#### ⚠ WARNING

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

2. Drain fluids from the cooling system.
3. Remove the muffler.
4. Disconnect the upper and lower hoses from the engine and loosen the hose bracket at the front of the engine (see figure below).
5. Remove the screw securing the system drain "T".
6. Remove the 2 screws in the horizontal portion of the bulkhead that projects under the radiator.
7. Pull the radiator, coolant recovery tank, and inner bulkhead away as an assembly with all hoses still connected.

### 8.3.5 Cooling System Installation

Install the cooling system in reverse order of removal.

- If the inner bulkhead was removed, make sure that the crankcase breather hose is pushed back through the exit hole in the bulkhead.
- Make sure to reinstall the hose bracket at the front of the engine to keep the belt from rubbing on the hose.
- Tighten all screws according to Torque Specifications.

---

## 8.3.6 Radiator Removal

1. Remove the top and back housing panels from the generator set.

 **WARNING**

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

2. Drain fluids from the cooling system.
3. Disconnect the 4 hoses.
4. Remove the 2 screws that secure the radiator to the inner bulkhead and pull it away.

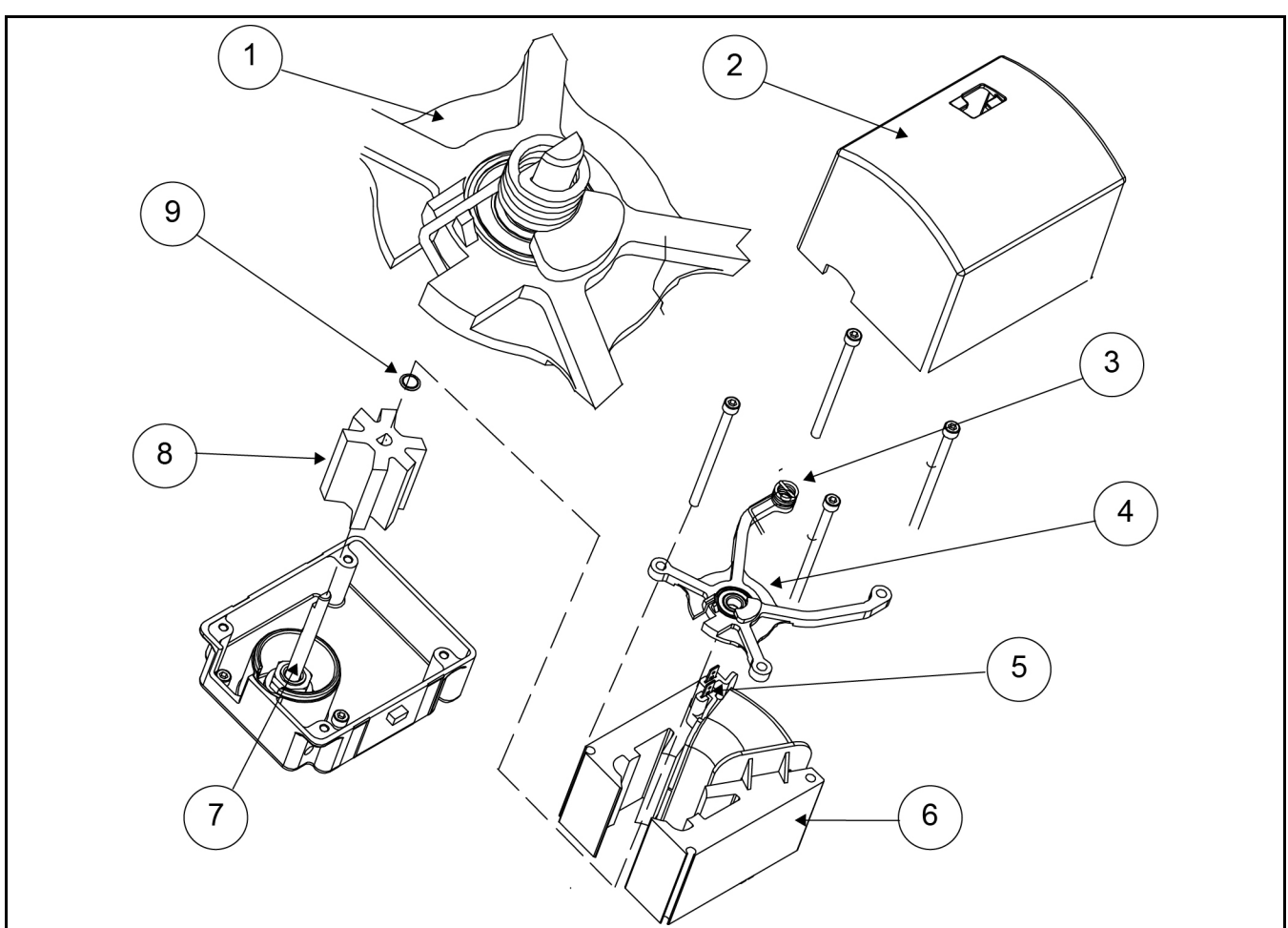
## 8.3.7 Radiator Installation

Install the radiator in reverse order of removal.

- If the inner bulkhead was removed make sure that the crankcase breather hose is pushed back through the exit hole in the bulkhead.
- Make sure to reinstall the hose bracket at the front of the engine to keep the belt from rubbing on the hose.
- Tighten all screws according to Torque Specifications.

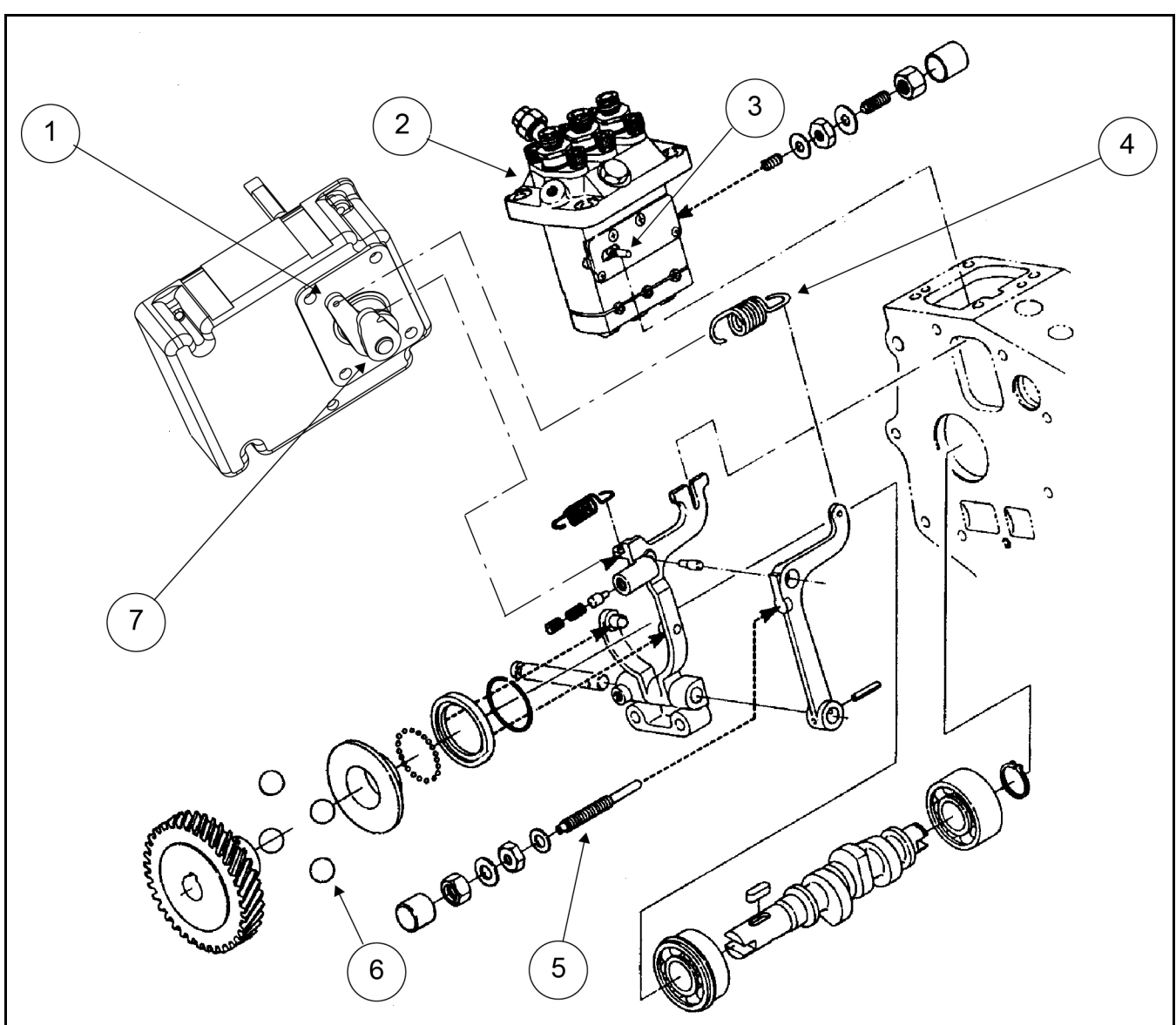
## 8.4 Governor

The Governor is powered by the generator set control to position the fuel rack according to the load demand.



No.	Description	No.	Description
1	Spring, Shaft, Bearing Assembly	6	Governor Arm
2	Snap-On Cover	7	Governor Linkage
3	Fuel Rack Return Spring	8	Speed Adjustment Screw
4	Bearing Carrier	9	Rotor Retaining Screw
5	Terminals		

FIGURE 15. GOVERNOR



No.	Description	No.	Description
1	Governor High-Idle Speed Control Lever	5	High-idle Stop Screw
2	Fuel injection Pump Assembly	6	4-Ball Governor
3	Fuel rack Control Rod	7	Governor Speed Control Lever
4	Governor Spring		

**FIGURE 16. GOVERNOR AND INTERNAL PARTS**

The governor controls engine speed (frequency) within specified limits of "droop" between no load and full load. Too large a droop results in objectionable voltage and frequency drops. Too small a droop results in hunting.

**⚠ CAUTION**

*Voltage or frequency sensitive equipment, such as VCRs, televisions, computers, etc., may be damaged by power line frequency variations. Some solid-state devices are powered when connected to an AC outlet even if the device is not in actual operation. For this reason, disconnect all devices which are voltage or frequency sensitive before attempting any governor adjustments. If disconnecting the devices is not possible, open the circuit breaker(s) at the distribution panel or at the generator set.*

## 8.4.1 Governor Removal

Before removing the governor, check other conditions that could also be causing hunting or droop, such as binding in the governor linkage, or dirty fuel filter.

**NOTICE**

The governor used in these generator sets has 4 steel balls instead of the 8 shown in the Engine Workshop manual.

Remove the governor as follows:

1. Disconnect the negative (–) battery cable from the battery to prevent the generator set from starting.
2. Remove the front housing panel.
3. Disconnect the 2 leads from the engine harness and remove the snap on cover.

**⚠ CAUTION**

*Uncontrolled release of spring tension can cause eye damage. Wear safety glass with side shields when removing spring.*

4. Use a screwdriver to pry the leg of the fuel rack return spring out of its slot in the bearing carrier. Take measures to restrain the spring from flying off the bearing carrier.
5. Remove the 4 stator screws and lift off the bearing carrier and stator.
6. Pry the rotor off the shaft.
7. Remove the 4 screws that secure the base to the top of the engine gear cover. Note that there are copper washers under the 2 inboard screw heads. These washers seal against oil seepage since these screw holes run through the gear case.
8. Unhook the governor spring from the actuator high idle speed control lever (top lever) while lifting the governor assembly away.

## 8.4.2 Governor Installation

**NOTICE**

The governor base assembly used for generator sets beginning Spec B is also the replacement part for Spec A generator set.

Installation is the reverse of removal.

During installation of the governor, note the following:

- Use a long nosed plier to hook the governor spring to the actuator high-idle speed control lever.

- Apply a liquid type (Three Bond 1215 or equivalent) to both sides of the new gasket between the engine gear cover and governor base.
- Tighten the 4 base mounting screws according to Torque Specifications.
- Adjust the actuator speed control lever stop (beginning Spec B) before installing the rotor.
- Install the rotor using a new retainer ring. Note that the ring is concave (dished). Push the dished side down against the rotor to keep it in place on the shaft.
- Install the stator and bearing carrier. Tighten the 4 screws according to Torque Specifications.

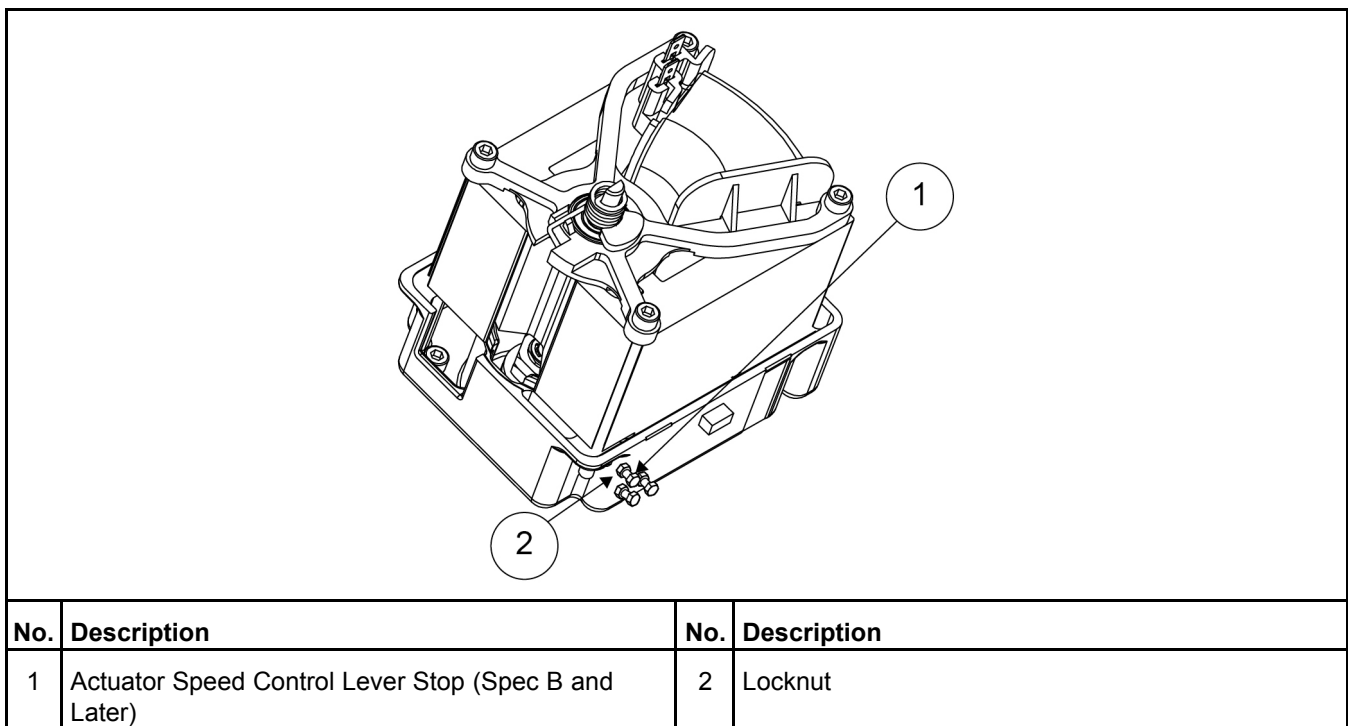
**⚠ CAUTION**

***The generator set may not stop on command if the fuel rack return spring is not assembled properly.***

- Check the fuel rack return spring for wear and replace if worn. This spring returns the fuel rack to the no-fuel position.
  1. Push the ring on over the flat on the shaft.
  2. Pry the leg into its slot on the bearing carrier (the extension below the knee must catch under the bearing carrier).
  3. Push the spring down as far as it will go on the shaft.
- Readjust idle speed.
- Snap the cover onto the governor, secure the cover with a wire tie to ensure that it remains in place.
- Reconnect the 2 leads from the engine harness.

### 8.4.3 Governor Actuator Speed Control Lever Stop (Spec B and later)

The actuator speed control lever stop must be adjusted whenever a different actuator base assembly is installed. The stop screw, rather than the fuel rack control lever, must stop the speed control linkage when the fuel rack is driven to the no fuel position (to the right).



**FIGURE 17. SPEED CONTROL LEVER STOP**

There are two procedures that can be used to adjust the stop, one is when the governor is not in place in the generator set and the other is with the governor installed. The procedures are as follows:

- Actuator rotor not in place:
  1. Assemble the actuator stator and bearing carrier to the base so that the shaft will be supported in its bearing.
  2. Loosen the stop screw locknut and back the screw out a few turns (top in the group of 3 screws in figure below).
  3. Turn the stop screw in until it just makes contact. Turn the screw 1 full turn further in and set the locknut.
  4. Remove the bearing carrier and the stator and complete reassembly with the rotor in place.
- Actuator in place:
  1. Loosen the set screw locknut and back the screw out a few turns (top in the group of 3 screws in figure below).
  2. Turn the stop screw in until it just makes contact and then set the locknut.

## 8.4.4 High-Idle Speed Adjustment

High-Idle speed must be adjusted each time the governor actuator base or the fuel injector pump is replaced.

### **⚠ WARNING**

*This adjustment involves operating the generator set without a housing panel in place. The panels guard against rotating parts and bare electrical parts that can cause severe personal injury or death. Keep your hands, clothing, and jewelry away from the engine pulleys, blower blades and electrical block TB3 on the control-inverter housing.*

**NOTICE**

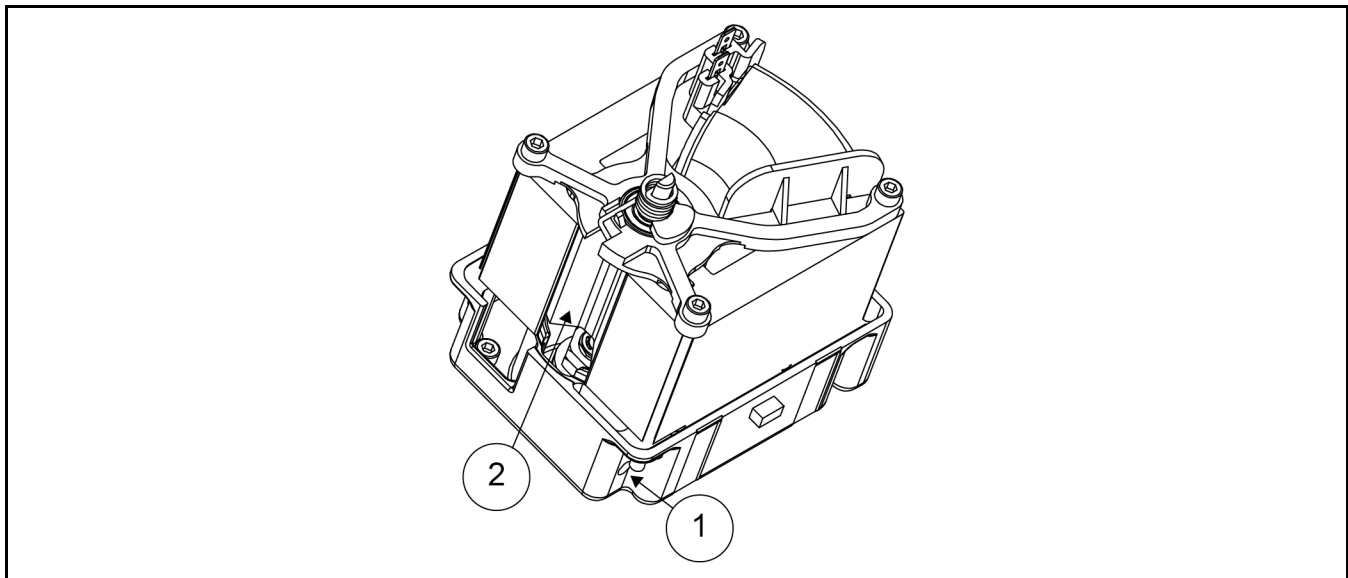
**The generator set will only run for a few minutes before shutting down because the control has shut down the fuel pump.**

1. Remove the front housing panel.
2. Set up a tachometer to indicate engine speed. (If the tachometer needs to be held or adjusted while taking the reading, it will take 2 people to make this adjustment.)
3. Remove the actuator cover and reattach the leads.
4. Start the generator set and push the actuator rotor clockwise by hand as far as it will go, about 12 mm (½ in) and hold it there. (It may be easier to use a wrench on the flat at the top of the shaft to hold the rotor position.) Make sure the fuel rack return spring is in place on the rotor shaft to shut down the generator set if you lose hold.

**⚠ CAUTION**

***Do not let engine speed exceed 3600 RPM. PMA voltages caused by higher speeds can damage the control-inverter.***

5. Adjust high-idle speed to 3500–3600 RPM:
  - Spec A:
    - a. If the generator set hunts under full load, see High Idle Stop Screw Adjustment.
    - b. Adjust high-idle speed by turning the adjustment screw.



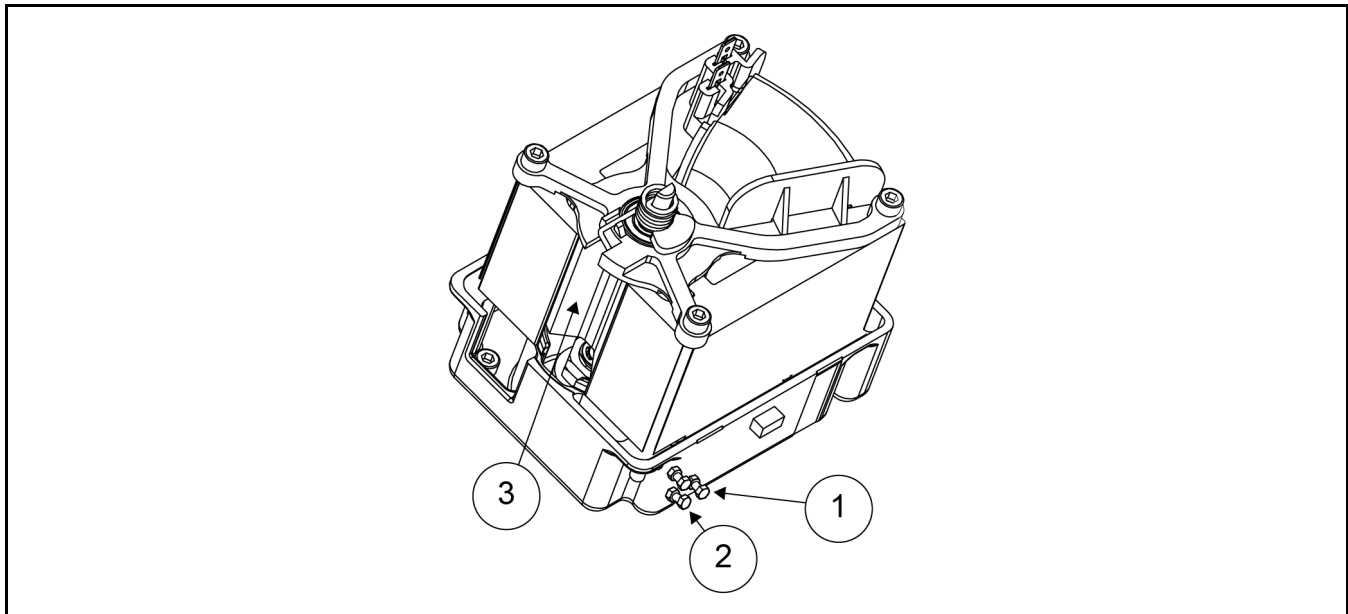
No.	Description	No.	Description
1	High Idle Speed Adjustment Access	2	Push Here to Rotate Rotor

**FIGURE 18. HIGH SPEED IDLE ADJUSTMENT (SPEC A)**

- Beginning Spec B:
  - a. Loosen the locknuts on the 2 screws in the bottom row and remove the clamping screw.
  - b. Adjust high-idle speed by turning the adjustment screw and set its locknut.



- c. Run the clamping screw back in by hand until snug, back it out 1½ turns and set its locking nut.



No.	Description	No.	Description
1	Clamping Adjustment Screw	3	Push Here to Rotate Rotor
2	Speed Adjustment Screw		

**FIGURE 19. HIGH SPEED IDLE ADJUSTMENT (BEGINNING SPEC B)**

- 6. Let the rotor go. The generator set should stop and display a fault code. Restart the generator set and recheck the high idle speed. If required, readjust the high idle speed.

### 8.4.5 High-Idle Stop Screw Adjustment

For Spec A engines prior to 1997, adjust the high-idle stop screw if the generator set hunts under full load.

**⚠ WARNING**

*This adjustment involves operating the generator set without a housing panel in place. The panels guard against rotating parts and bare electrical parts that can cause severe personal injury or death. Keep your hands, clothing, and jewelry away from the engine pulleys, blower blades and electrical block TB3 on the control-inverter housing.*

**NOTICE**

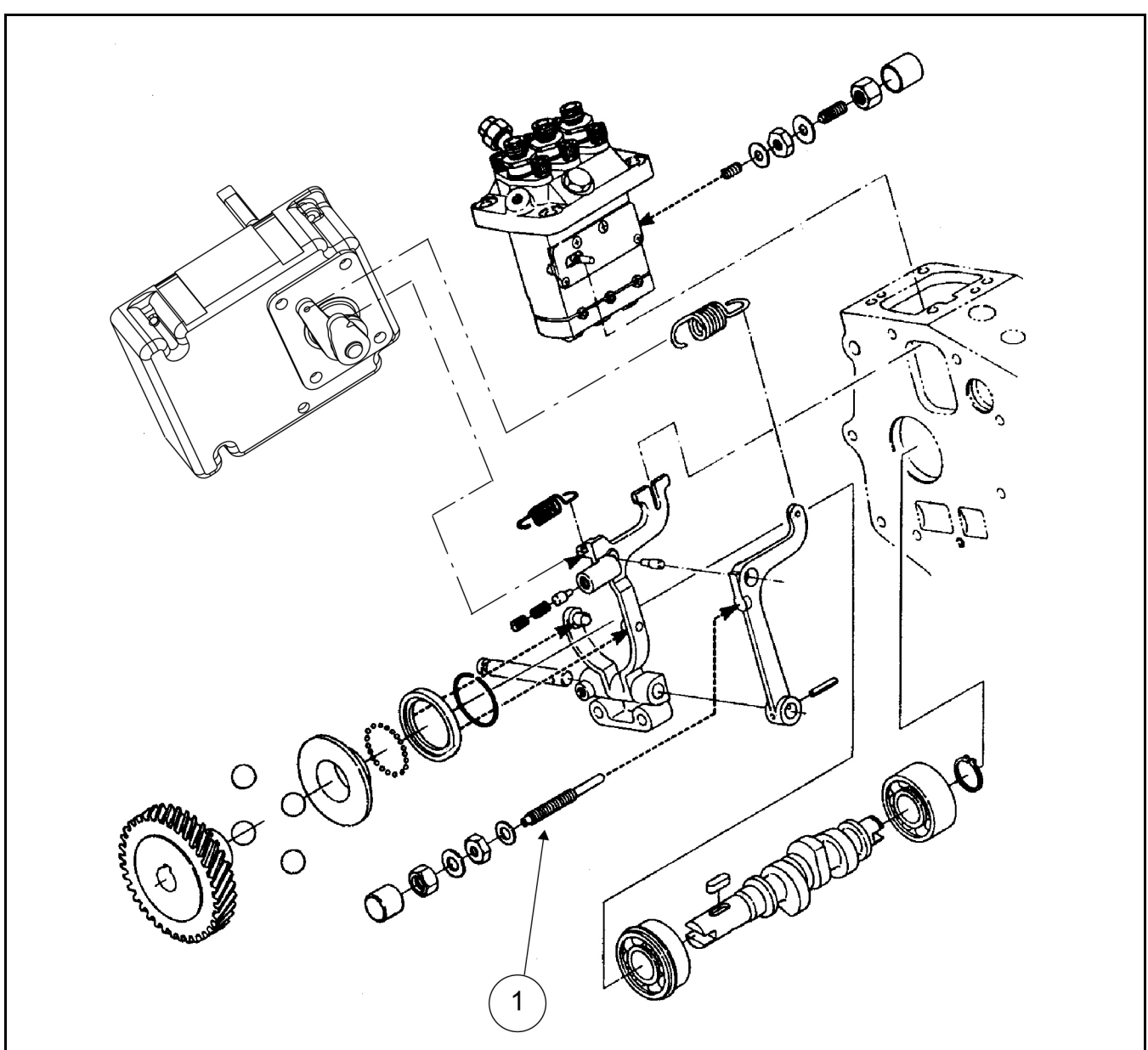
**The generator set will only run for a few minutes before shutting down because the control has shut down the fuel pump.**

- 1. Start the generator set and push the actuator rotor clockwise by hand as far as it will go, about 12 mm (½ in) and hold it there. Make sure the fuel rack return spring is in place on the rotor shaft to shut down the generator set if you lose hold.

**⚠ CAUTION**

***Do not let engine speed exceed 3600 RPM. PMA voltages caused by higher speeds can damage the control-inverter.***

2. Adjust high-idle speed to less than 3300 RPM.
3. Adjust the high-idle stop screw to obtain a speed of 3550–3590 rpm, while holding the actuator fully clockwise, and set the jamnut.
4. Let the rotor go. The generator set should stop and display a fault code. Restart the generator set and check idle speed. Idle speed should be 3500–3600 rpm, readjust idle speed as needed.



No.	Description
1	Clamping Adjustment Screw

FIGURE 20. HIGH SPEED STOP SCREW

## 8.5 Fuel System

The fuel system delivers fuel to and from the fuel injection system.

### 8.5.1 Diesel Fuel System

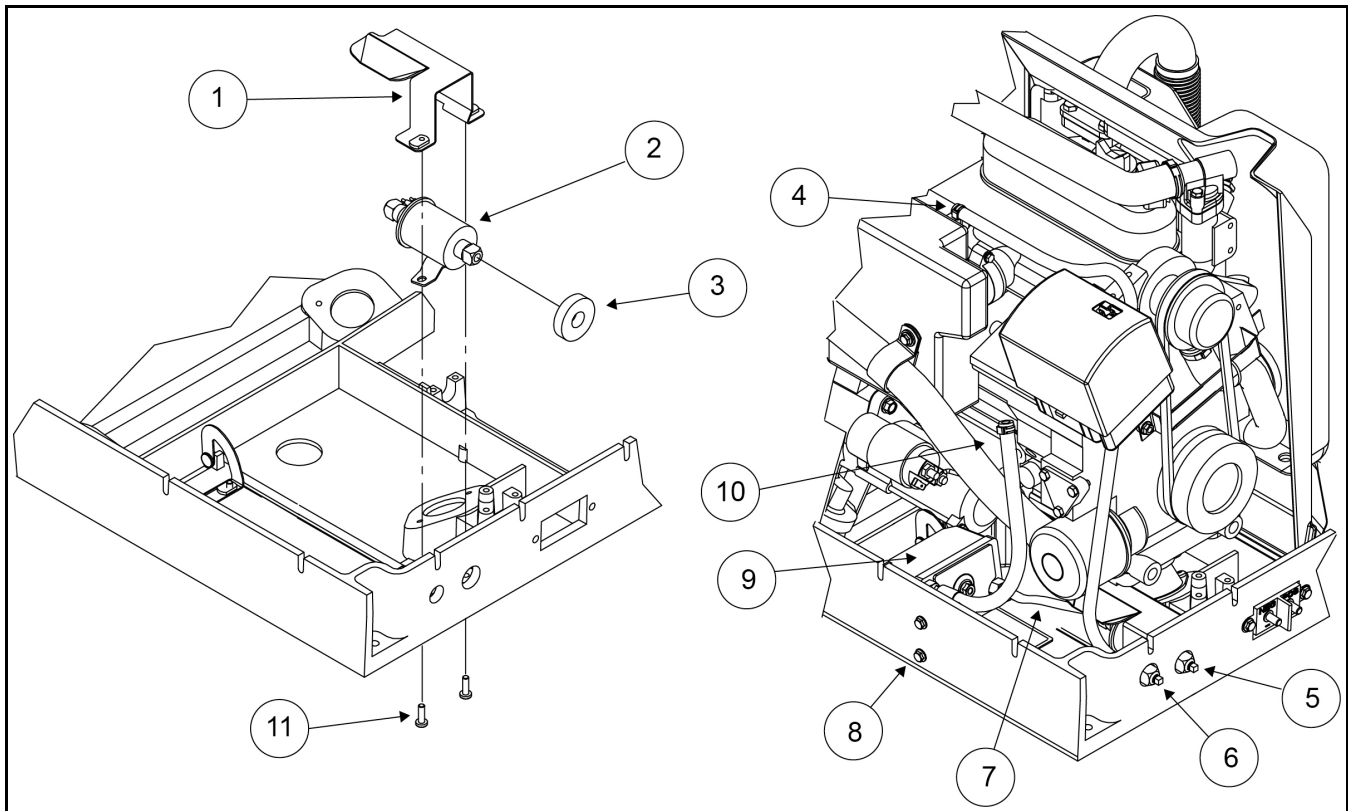
The fuel system consists of the fuel filter, pump, and hoses that deliver fuel to and from the fuel injectors.

**⚠ WARNING**

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

**⚠ CAUTION**

*Always wipe dirt off fuel line fittings before disconnecting them to prevent dirt from getting into the fuel system.*



No.	Description	No.	Description
1	Fuel Pump Shield	7	Pump to Filter Line
2	Fuel Pump	8	Fuel Filter Bracket Mounting Screws
3	Air Seal	9	Fuel Filter
4	Injector Return Line	10	Injector Pump Supply
5	Fuel Supply Fitting	11	Pump Mounting Screws
6	Fuel Return Fitting		

**FIGURE 21. FUEL DELIVERY SYSTEM**

## 8.5.2 Fuel Pump

The fuel pump supplies the fuel to and from the fuel injection system.

### 8.5.2.1 Fuel Pump Test

1. Disconnect the fuel return hose from the line to the supply tank and point the end into a container of known volume, such as a 1 or 2 liter (quart) bottle.
2. Prime the generator set by pushing the Start/Stop switch to STOP (Prime) and hold it there for the duration of the test. Flow should not be less than 200 ml (0.4 pints) per minute.
3. If flow is less than specified above:
  - a. Replace the fuel filter.
  - b. Check for other restrictions in the fuel lines.
  - c. Check for air bubbles in the fuel. Tighten fittings and replace fuel lines as needed.
  - d. Replace a cracked fuel filter body.
  - e. Replace the fuel pump.

### 8.5.2.2 Fuel Pump Removal

The fuel pump screws are removed from the bottom of the skid base and the pump is removable from the maintenance access door. The generator set must be tilted or removed from the vehicle.

1. Disconnect and cap the fuel lines.
2. Remove the 2 cap screws and withdraw the pump. Cover the opening in the block to keep out debris.
3. Inspect the fuel lines and connections for wear, replace as needed.

### 8.5.2.3 Fuel Pump Installation

1. Install the fuel pump and secure with 2 screws.
2. Make sure that the air seal is placed around the inlet fitting to seal against leakage of cooling air and noise.
3. Replace the fuel line to the fuel pump from the fuel filter (this is a flared fitting, no sealant should be applied).

**⚠ CAUTION**

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

4. Replace the fuel lines that extend through the side of the base. Use liquid type thread seal on the male threads of the fitting.
5. Prime the fuel system by holding down the control switch in the stop position for at least 1 min.

## 8.5.3 Fuel Filter

The fuel filter is mounted on a bracket just above the maintenance access door in the skid base.

### 8.5.3.1 Fuel Filter Removal

1. Open maintenance access door.

2. Disconnect and cap the fuel lines.
3. Remove the 2 screws securing the filter to the bracket.
4. Inspect the fuel lines and connections for wear, replace as needed.

### **8.5.3.2 Fuel Filter Installation**

1. Replace the fuel filter and secure with 2 screws.
2. Replace the fuel lines to the fuel filter (these are flared fittings, no sealant should be applied).
3. Close the maintenance access door.
4. Prime the fuel system by holding the control switch down in the stop position for at least 1 min.

## **8.5.4 Fuel Injection System**

See the *Engine Workshop Manual* (981-0514) for fuel injection system service.

## **8.6 Starter**

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

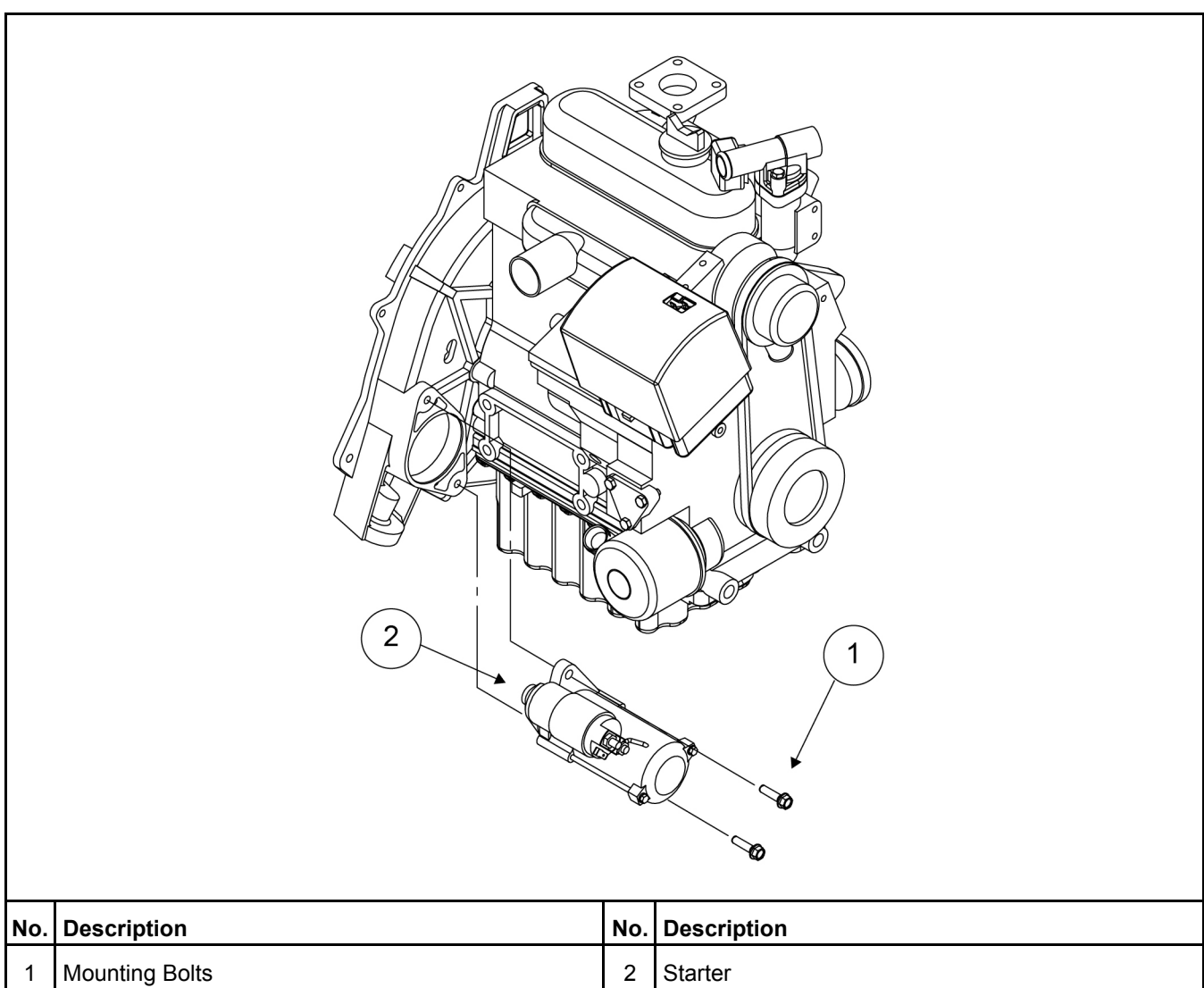


FIGURE 22. STARTER MOTOR AND SOLENOID

## 8.6.1 Starter Solenoid Test

### **⚠ WARNING**

*This test involves high electrical currents, strong arcing, and moving parts that can cause severe personal injury. Do not conduct this test near fuel tanks or when flammable vapors are present. Wear safety glass. Keep fingers away from the pinion gear.*

1. After removing the starter motor from the generator set, secure the starter motor assembly in a vise.
2. Using a heavy jumper cable, connect the motor terminal on the solenoid (closest to the motor) to the positive (+) terminal of a 12 volt battery.
3. Using a heavy jumper cable, connect one end to the negative (–) terminal of the battery.
4. With the other end of the negative cable, briefly touch the mounting flange of the motor.
  - If the starter motor does not spin up quickly and smoothly, replace the starter motor.
  - If the starter motor does spin up quickly and smoothly, replace the solenoid.

## 8.6.2 Starter Motor Removal

1. Disconnect the negative (–) battery cable to prevent the generator set from starting.
2. If the generator set is installed in the vehicle and does not have an access door in the front panel, open the maintenance access door in the skid-base and remove the fuel filter and bracket.

 **WARNING**

*Diesel fuel is combustible and can cause severe personal injury or death. Keep flames, sparks, pilot lights, electrical arcs, or arc producing equipment, and all other sources of ignition well away. Keep a type ABC fire extinguisher handy.*

3. If the generator set has been removed from the vehicle, remove the front housing panel. (If the generator set is mounted and has front panel access, remove the access door if installed.)
4. Disconnect all wires and cables from the starter motor terminals.
5. Remove the 2 starter motor mounting bolts and remove the starter motor.

## 8.6.3 Starter Motor Installation

Installation is the reverse of removal.

Tighten bolts and terminals according to Torque Specifications.

## 8.6.4 Starter Solenoid Removal

1. Disconnect the motor lead from the solenoid terminals.
2. Remove the 2 solenoid mounting nuts.
3. Separate the motor and solenoid.

## 8.6.5 Starter Solenoid Installation

1. Install the solenoid into the starter, make sure that the solenoid plunger engages the shift fork.
2. Replace the solenoid mounting nuts.
3. Reconnect the motor lead to the solenoid terminal.



## 8.7 Engine Air Intake

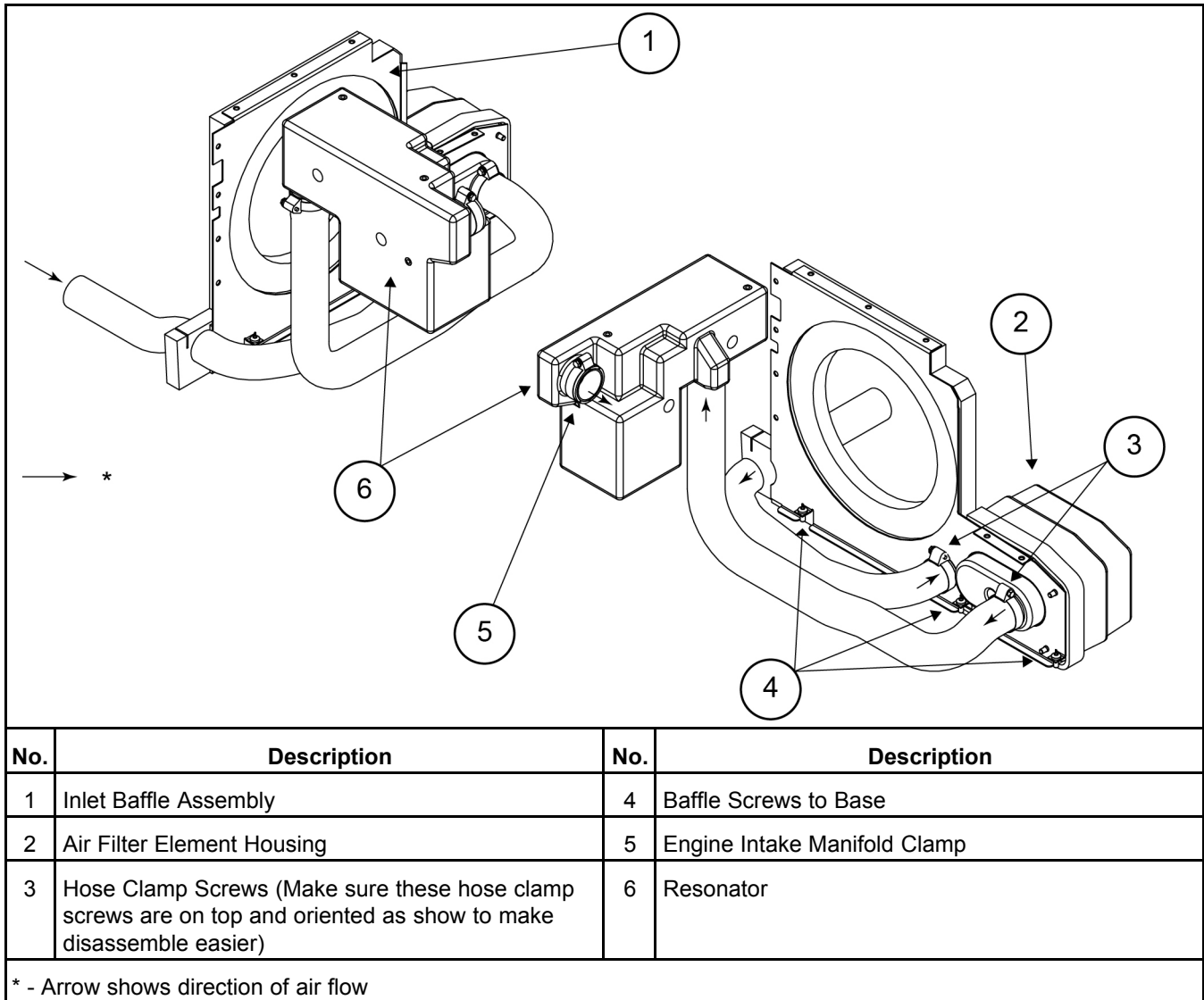


FIGURE 23. ENGINE AIR INTAKE ASSEMBLY

## 8.8 Exhaust System

**⚠ WARNING**

**Exhaust gas is deadly. Modifying the exhaust system may let poisonous exhaust gases enter the vehicle interior. Use only Onan replacement parts to service the exhaust system. Unauthorized modifications will void the Onan warranty. Liability for injury or damages due to unauthorized modifications becomes the responsibility of the person making the modification.**

The generator set exhaust system must be gas-tight and prevent entry of exhaust gases into the vehicle interior.

Failure to provide and maintain an approved spark arresting exhaust system can be a violation of the law. Liability for damage, injury, and warranty expense due to the modification of the exhaust system, or use of unapproved parts is the responsibility of the person performing the modification. Contact an Onan dealer for approved exhaust system parts.

### 8.8.1 Exhaust Manifold Removal

1. Disconnect the negative (-) battery cable from the battery to prevent the generator set from starting.
2. Remove the top and back generator set housing panels.
3. Disconnect the tailpipe.

**⚠ CAUTION**

***Bending or twisting the flexible connector can cause damage to the flexible connector.***

4. Remove the flange bolts on both ends of the flexible connector and remove it carefully.
5. Remove the outboard bearing clamp and slide the assembly to the right (when facing the rear of the generator) until the pins in the 2 inboard bearings are free.
6. Remove the exhaust assembly.

### 8.8.2 Exhaust Manifold Installation

**⚠ CAUTION**

***Bending or twisting the flexible connector can cause damage to the flexible connector. Make sure muffler is securely in place and properly aligned before connecting the flexible connector.***

Installation is the reverse of removal.

Always install new flange gaskets when reinstalling the muffler and torque the flange nuts according to Torque Specifications.

Important safety instructions regarding the routing and termination of the tailpipe (not supplied by Onan) are included in the Installation Manual. Always use a new flange gasket when connecting the tailpipe.

# 9 Troubleshooting

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## 9.1 Troubleshooting by Symptom

### 9.1.1 Engine Will Not Shut Off, Status Indicator On

Logic:

Faulty Stop Switch or grounded wiring.

Corrective Action:

**⚠ WARNING**

***Removing generator set panels or disconnecting fuel lines to stop a generator set that won't stop can lead to severe personal injury or death from electrocution, contact with moving parts or fire.***

**⚠ WARNING**

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

1. Try the generator set Stop Switch if the remote Stop Switch does not work, and vice versa. If only the generator set Stop Switch works, go to Step 2. If neither switch works, or only the remote Stop Switch, go to Step 3.
2. Disconnect the remote control panel connector (J8/P8). While pressing the Remote Stop Switch, check for electrical continuity between remote control connector pins J8-A and J8-E. Replace a switch that does not close when pressed to Stop and repair or reconnect wiring as necessary.
3. Remove the front and top housing panels and disconnect engine harness connector P2 from the control. Reconnect the remote control panel (J8/P8) and while pressing the respective Stop Switch, check for electrical continuity between:
  - a. Pin P2-3 (remote stop) and pin P2-2 (remote ground).
  - b. Pin P2-10 (local stop) and pin P2-11 (local ground).
  - c. Replace a switch that does not close when pressed to Stop, check for missing, bent or corroded terminals and connector pins and repair or reconnect wiring as necessary.
4. Replace the control assembly.

### 9.1.2 Engine Will Not Shut Off, Status Indicator Off

Logic:

Binding governor mechanism, misadjusted speed stop.

Corrective Action:

**⚠ WARNING**

***Removing generator set panels or disconnecting fuel lines to stop a generator set that won't stop can lead to severe personal injury or death from electrocution, contact with moving parts or fire.***

**⚠ WARNING**

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

1. Remove the front and top housing panels and check the fuel rack return spring and replace it if worn or broken. Make sure it is reassembled correctly.
2. Check for binding in the governor mechanism by pushing the actuator rotor clockwise by hand against the action of the fuel rack return spring. It should rotate smoothly about 12 mm (1/2 inch) and return smoothly. If it binds or catches, remove the governor actuator base assembly and replace it or service the internal engine governor mechanism as necessary.

### 9.1.3 Status Indicator Stays On

Logic:

Reversed battery connections.

Corrective Action:

Reconnect the battery correctly.

### 9.1.4 Engine Cranks When Battery Connected

Logic:

Faulty Start Switch or grounded wiring.

Corrective Action:

1. Disconnect the remote control panel connector (J8/P8). Check for electrical continuity between remote control connector pins J8-A and J8-C. Replace a switch that does not open when released and repair or reconnect wiring as necessary.
2. Remove the front and top housing panels and disconnect engine harness connector P2 from the control. Reconnect the remote control panel (J8/P8) and check for electrical continuity between:
  - a. Pin P2-1 (remote start) and pin P2-2 (remote ground).
  - b. Pin P2-12 (local start) and pin P2-11 (local ground).
  - c. Replace a switch that does not open when released and repair or reconnect wiring as necessary.
3. Replace the control assembly.

### 9.1.5 Engine Won't Crank - Fuel Pump Won't Stop

Logic:

Faulty Stop Switch or grounded wiring.

Corrective Action:

1. Disconnect the remote control panel connector. Check for electrical continuity between remote control connector pins J8-A and J8-E. Replace a switch that does not open when released and repair or reconnect wiring as necessary.
2. Remove the front and top housing panels and disconnect engine harness connector P2 from the control. Reconnect the remote control panel (J8/P8) and check for electrical continuity between:
  - a. Pin P2-3 (remote stop) and pin P2-2 (remote ground).

- b. Pin P2-10 (local stop) and pin P2-11 (local ground).
  - c. Replace a switch that does not open when released and repair or reconnect wiring as necessary.
3. Replace the control assembly.

## 9.1.6 Status Indicator Light Dead

Logic:

Faulty connections, no battery voltage.

Corrective Action:

1. If the remote Start Switch does not work, try the generator set Start Switch. If the generator set Start Switch does not work, try the remote Start Switch. Disconnect the remote control panel (J8/P8) and try the generator set Start Switch again.
  - If nothing works, perform Step 2.
  - If only the generator set start switch works, perform Step 9.
  - If only the remote start switch works, perform Step 12.
2. Replace Fuse F1 (B+) if blown.
3. Clean and tighten the positive (+) and negative (–) battery cable connections at the battery, vehicle frame and generator set.
4. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.
5. Remove the front and top housing panel. Check that all engine and battery harness wires are properly connected to the grounding bolt on the flywheel housing, to the B+ terminal on the starter solenoid and to the battery terminal block. Clean and tighten connections and replace wiring as necessary.
6. Disconnect engine harness connector P1 from the control. Check for B+ (12 VDC) at pin P1-8 and for continuity to ground at pin P1-7. Check for missing, bent or corroded connector pins and faulty wiring and repair as necessary.
7. Disconnect engine harness connector P2 from the control and reconnect the remote control panel (J8/P8). Press the switch and check for electrical continuity between:
  - a. Pin P2-1 (remote start) and pin P2-2 (remote ground).
  - b. Pin P2-3 (remote stop) and pin P2-2 (remote ground).
  - c. Pin P2-12 (local start) and pin P2-11 (local ground).
  - d. Pin P2-10 (local stop) and pin P2-11 (local ground).
  - e. Replace switches that do not close when pressed, check for missing, bent or corroded terminals and connector pins and faulty wiring and repair as necessary.
8. Replace the control assembly.
9. Disconnect the remote control panel (J8/P8). Check for electrical continuity between remote control connector pins J8-A and J8-C. Replace a switch that does not close when pressed and repair or reconnect wiring as necessary.
10. Remove the front and top housing panels and disconnect engine harness connector P2 from the control and reconnect the remote control panel (J8/P8). Press the switch, check and for electrical continuity between:
  - a. Pin P2-1 (remote start) and pin P2-2 (remote ground).
  - b. Pin P2-3 (remote stop) and pin P2-2 (remote ground).

- c. Replace a switch that does not close when pressed, check for missing, bent or corroded terminals and connector pins and faulty wiring and repair as necessary.
11. Replace the control assembly.
12. Remove the front and top housing panels and disconnect engine harness connector P2 from the control. Press the switch and check for electrical continuity between:
  - a. Pin P2-12 (local start) and pin P2-11 (local ground).
  - b. Pin P2-10 (local stop) and pin P2-11 (local ground).
  - c. Replace a switch that does not close when pressed, check for missing, bent or corroded terminals and connector pins and faulty wiring and repair as necessary.
13. Replace the control assembly.

### 9.1.7 Starting Batteries Run Down

Logic:

Marginal battery, battery connections or charging system or parasitic loads.

Corrective Action:

#### WARNING

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

1. Clean and tighten the positive (+) and negative (–) battery cable connections at the battery, vehicle frame and generator set.
2. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.
3. Install or service a battery charging system in the vehicle if the generator set is not so equipped.
4. If the generator set is equipped with a battery charging system, check performance by measuring voltage across the battery terminals while running the generator set. Watch the meter while turning the generator set circuit breaker (operator's console) on and off several times. The battery charger is probably okay if voltage jumps to more than 12 VDC each time the breaker is turned on. Check for parasitic loads external to the generator set and/or replace the battery.

#### WARNING

***This test involves operating the generator set with housing panels removed. The panels guards against rotating parts and bare live electrical parts that can cause severe personal injury or death. Keep your hands away from the engine pulleys, blower blades and electrical terminal block TB3 on the control housing.***

5. If the battery charger does not seem to be working, remove the front housing panel. If loose, reconnect battery charger transformer input connectors J12 and J13 to the AC harness, output connectors J14 and J15 to the battery charger and the battery charger output lead to the B+ terminal on the starter solenoid.
6. Disconnect transformer connectors J12 through J15 and check winding continuity across J12-J13 and across J14-J15. Replace the transformer if a winding is open.
7. Reconnect J12 and J13 and run the generator set. Replace the battery charger if transformer output across J14-J15 is approximately 16.3 VAC. If not, go to Step 8.

8. Disconnect J12 and J13 and measure voltage. Replace the transformer if there is approximately 120 VAC across J12--J13. If not, go to Step 9.
9. Replace or repair wiring in the AC harness if there is no voltage.

## 9.1.8 Engine Cranks But Does Not Start

Logic:

Fuel delivery, glow plugs or engine are marginal.

Corrective Action:

1. Check fuel level. (The generator set fuel pickup could be higher than the vehicle engine pickup.)
2. Prime the engine fuel system.
3. Check the engine air filter and remove any blockage.
4. Replace Fuse F3 (glow plugs) if blown. If it blows again, go to Step 8.
5. Check for fuel and air leaks at each fitting in the fuel supply line. (Note: White smoke indicates air in the fuel.)
6. Conduct a fuel flow test and service as necessary.
7. Remove the top housing panel and observe the governor actuator rotor while cranking. (Remember to reattach the leads after removing the cover.) The rotor should rotate smoothly through about 12 mm (1/2 inch). If it does not, check for binding in the governor mechanism by pushing the actuator rotor clockwise by hand against the action of the fuel rack return spring. If it binds or catches, remove the governor actuator base assembly and replace it, or service the internal engine governor mechanism as necessary.
8. Remove the front and top housing panels and check out the glow plug system as follows:
  - a. If the glow plugs are not working, it can be the result of a failed temperature sensor which results in a no start.
  - b. If loose, reconnect spade connector HR-1 to the glow plug bus bar at the front of the engine, engine harness connectors A1-J7 and A1-J8 to the leads from the control assembly, and the engine harness ground connections to the flywheel housing.
  - c. Disconnect HR-1 from the glow plug bus bar and A1-J8 from the control assembly. Check for continuity (ground short) between either connector and ground. Replace wiring as necessary.
  - d. Remove the glow plug bus bar alongside the engine valve cover and check for electrical continuity between each glow plug terminal and ground. Replace any open glow plug.

### NOTICE

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

- e. Check for B+ on the glow plug bus bar while pressing Start. Replace the control assembly if B+ is not available for preheat.
- f. Service the engine.

## 9.1.9 Starter Engages and Disengages

Logic:

Cranking voltage dips below 6 volts, low battery charge, poor connections, long cables.

Corrective Action:

**⚠ WARNING**

***Some Generator Set service procedures present hazards that can result in severe personal injury or death. Only trained and experienced service personnel with knowledge of fuels, electricity, and machinery hazards should perform generator set service. See Safety Precautions.***

1. Have the vehicle engine running while trying to start the generator set, the battery charging alternator may be able to maintain starting voltage high enough to get the generator set started.
2. Clean and tighten the positive (+) and negative (-) battery cable connections at the battery, vehicle frame and generator set.
3. Recharge or replace the battery. Refer to the battery manufacturer's recommendations.
4. Increase battery cable size or run parallel cables.
5. Remove the front and top housing panels. Check that all engine and battery harness wires are properly connected to the grounding bolt on the flywheel housing, to the B+ terminal on the starter solenoid and to the battery terminal block. Clean and tighten connections and replace wiring as necessary.
6. Disconnect engine harness connector P1 from the control. Check for B+ (12 VDC) at pin P1-8 and for continuity to ground at pin P1-7. Check for missing, bent or corroded connector pins and faulty wiring and repair as necessary.

## 9.1.10 No Power-Generator Set Running, Run Light On

Logic:

Line circuit breaker OFF or tripped or faulty wiring.

Corrective Action:

1. Reset or turn "On" the line circuit breaker on the generator set operator's console.
2. Reset or turn "On" the line circuit breakers on the main distribution panel in the vehicle.
3. Check the voltage at generator set AC output terminal block TB2. If there is approximately 120 VAC across TB2-1 and TB2-3 and across TB2-2 and TB2-4, repair or reconnect the wiring between the generator set and the vehicle. If there is no voltage, go to Step 4.

**⚠ WARNING**

***This test involves operating the generator set with housing panels removed. The panel guard against rotating parts and bare live electrical parts that can cause severe personal injury or death. Keep your hands, clothing, jewelry, and hair away from the engine pulleys, blower blades and electrical terminal block TB3 on the control housing.***

4. Remove the front and top housing panels and check for proper AC harness connections at TB3, TB2 and the line circuit breakers. Reconnect wiring as necessary and tighten all terminal screws and nuts.
5. Check for electrical continuity across the terminals of each breaker. Replace a circuit breaker which lacks electrical continuity when "On".
6. Run the generator set and measure voltages. If there is approximately 120 VAC across TB3-1 and TB3-2, replace the AC wiring harness. If there is no voltage, replace the control assembly.



## 9.1.11 Engine Hunts Under Full Load

Logic:

Fuel delivery marginal, governor misadjusted.

Corrective Action:

1. Prime the engine fuel system by holding the control switch down in its Stop position for at least 1 minute.
2. Check for fuel and air leaks at each fitting in the fuel supply line.
3. Conduct a fuel flow test and service as necessary.
4. Connect a source of known fuel quality, prime the fuel system, and run the generator set. If performance improves, replace the bad fuel in the supply tank.
5. Readjust high-idle speed.

## 9.1.12 Local Hour Meter Not Functioning

Logic:

Faulty connections, no battery voltage.

Corrective Action:

1. Disconnect the remote control panel connector J8/P8 and check for damage or broken pins.
2. Repair or replace as necessary and reconnect the remote control panel.
3. Verify the local hour meter is receiving 12VDC from the control assembly.
4. Check for electrical continuity between P1-3 and the local meter.
5. Verify path to ground from the local hour meter.

## 9.1.13 Control Board Not Powering Up

Logic:

Crystal X2 on the control board has failed.

Corrective Action:

1. Push START button and the Status indicator light should blink, control should provide supply voltage (should be 11V +/- 0.3V or above) to start-solenoid leading to cranking of engine.
2. Hold the STOP button for more than 2 seconds, this should enable Prime mode and turn the Status indicator light ON solid with providing supply voltage (should be 11V +/- 0.3V or above) to fuel pump.
3. If the above conditions hold true, then the control board is able to power up without any problem. If the above conditions do not hold true then the control board is not able to power up, proceed with next step.
4. Check the Start and Stop circuit for loose connections and repair, if any.
5. Check battery voltage at the generator set terminal, typical voltage should be 11V +/- 0.3V or above. If not, inspect battery connections and check once again. Replace/recharge battery.
6. Replace the control board.

## 9.2 Fault Codes

The generator set control contains extensive diagnostics to detect shutdown faults. Following a fault shutdown, the control indicates the fault code by flashing the numeric code on the status indicator in the control switch.

Determine the fault code as follows:

- 1 flash indicates a high engine coolant temperature.
- 2 flashes indicates a low oil pressure fault (Code 2 fault).
- 3 flashes indicates a service fault (Code 3 fault).
  1. Press **STOP/PRIME** on the control switch once to have the 2-digit service fault code flash.
 

The 2-digit code consists of two sets of flashes. The first set is of flashes represents the 10s digit of the code. After a brief pause, the second digit of the code flashes representing the unit digit of the code. This is followed by a long pause before repeating the flashing of the fault code.

For example, Fault Code 36 appears as: blink-blink-blink—pause—blink-blink-blink-blink-blink-blink—long pause—repeat
  2. Press **STOP/PRIME** to stop flashing the fault code.
- 4 flashes indicates that cranking exceeded 30 seconds without the engine starting (Code 4 fault).

### NOTICE

**Fault codes 33 and 34 are not assigned as fault codes. Be careful of interpreting Fault Codes 3 and 4 as second-level faults.**

The fault code stops flashing after 5 minutes. Pressing **STOP/PRIME** 3 times within 5 seconds causes the fault code to resume flashing.

### NOTICE

**The last fault logged continues to flash even though the condition that caused the shutdown has been corrected.**

### 9.2.1 Code No. 1 - High Engine Temperature

Logic:

Engine coolant or inverter heat sink temperature exceeded design limit.

Corrective Action:

1. Check the second-level fault code by touching Stop. The second-level fault will be either No. 33 or No. 34.

### 9.2.2 Code No. 2 - Low Oil Pressure

Logic:

Low oil pressure cutoff switch did not open

Corrective Action:

**⚠ WARNING**

***This test involves operating the generator set with housing panels removed. The panels guard against rotating parts and bare live electrical parts that can cause severe personal injury or death. Keep your hands, clothing, jewelry, and hair away from the engine pulleys, blower blades and electrical terminal block TB3 on the control housing.***

1. Check the engine oil level and add or drain oil as necessary. Repair any oil leaks.
2. Remove the top housing panel. Reconnect engine harness spade connector S2 to the low oil pressure cutout switch if it is loose (short to ground will cause shutdown).
3. Disconnect engine harness connector P2 from the control assembly and the pressure switch. Check both ends for electrical continuity to ground. Replace wiring as necessary if the lead is shorted to ground.
4. Install an oil pressure gauge in place of the pressure switch and observe oil pressure after the engine has run a few minutes (let RV models step down to low idle speed). Replace the low oil pressure cutoff switch if engine oil pressure is 14 psi (98 kPa) or greater. Service the engine if engine oil pressure is less than 14 psi (98 kPa). (Simulate normal switch operation to keep the generator set running during the test by starting with connector S2 grounded and removing it from ground when the engine starts.)
5. After all other troubleshooting has been exhausted, replace the control assembly.

### 9.2.3 Code No. 3 - Service Check

Logic:

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

Corrective Action:

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

### 9.2.4 Code No. 4 - Overcrank

Logic:

Set has been commanded to crank, and cranks for a total of 35 seconds continuous, without the set starting (speed exceeding - 1200 RPM) (Begin Spec K)

Corrective Action:

1. Typical troubleshooting should be related to an out of fuel condition (see FC36), check fuel flow and return, actuator operation, wiring, etc.

### 9.2.5 Code No. 8 - Overload

Logic:

Models HDKAH & HDKAV only: Load exceeded 110 percent of generator set rating for 2 minutes.

Corrective Action:

1. Reduce load and restart.

### 9.2.6 Code No. 11 - Overcurrent

Logic:

If inverter is enabled and inverter short circuit is indicated for > 3 counts.

## Corrective Action:

1. Turn off the generator set line circuit-breaker. If the generator set no longer shuts down, the generator set is probably okay. Check for and repair, a short-circuit in the vehicle, wiring or shorted battery-charger transformer.
  - Short Circuit Test:
    - a. Check resistance across inverter output terminals (with and without breaker).
    - b. Meter should read 'Open' if there are no shorts.
    - c. If meter reads a low resistance value, it indicates a short either in wiring and/or loads.
2. Remove battery charger loads and transfer switches connected directly to the inverter output. Also remove any motor starting loads such as air conditioners, vacuum cleaners etc.

**NOTICE**

**If this step resolves the issue, check to see if there are any issues with specific loads.**

3. Check whether the vehicle engine and generator set share the same starting battery, if so and this fault occurs when cranking the vehicle engine, low battery voltage maybe causing this shutdown. Increase battery capacity or connect to house battery or install a separate battery and battery charging system for the generator set. If the generator set still shuts down and has spec # "11296" in the Model Number, go to step 4, if not, go to step 5.
4. Remove the front and top housing panels and disconnect the AC harness from TB3 on the control assembly. Reconnect the short grounding lead in the harness to TB3-2 so that the generator set will run. If the generator set no longer shuts down, find and repair the short in the AC harness, reconnecting the line circuit breaker, output terminal block (TB2) and battery-charger as necessary.
5. Perform PMA stator test. If all values are within spec, go to step 6.
6. Replace the control assembly.

**NOTICE**

**Document all details of the troubleshooting steps including load type and conditions.**

## 9.2.7 Code No. 12 - Inverter Overvoltage

## Logic:

Control not able to regulate to rated voltage.

## Corrective Action:

1. Check whether the vehicle engine and generator set share the same starting battery. If so, and this fault occurs when cranking the vehicle engine, low battery voltage may be causing this shutdown. Increase battery capacity or install a separate battery and battery charging system for the generator set.
2. Replace the control assembly.

## 9.2.8 Code No. 13 - Inverter Undervoltage

## Logic:

Control not able to regulate to rated voltage.

## Corrective Action:

**⚠ WARNING**

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

1. Check whether the vehicle engine and generator set share the same starting battery. If so, and this fault occurs when cranking the vehicle engine, low battery voltage may be causing this shutdown. Increase battery capacity or install a separate battery and battery charging system for the generator set.
2. Remove the front and top housing panels:
  - If loose, reconnect the leads of current transformer to control leads J9 and J10. If that does not work, check resistance. If electrical resistance is not 15 to 25 ohms, replace the current transformer.
  - Check for proper connections between the generator (PMA) and the control assembly and reconnect as necessary.
  - Check for a shorted generator stator winding. If a winding is shorted, replace the stator.
3. Replace the control assembly.

## 9.2.9 Code No. 14 - Inverter Overfrequency

Logic:

Control not able to regulate to rated frequency. With inverter enabled, set is running at rpm > 800 and inverter frequency > 102.5% rated for 5 samples (125ms).

Corrective Action:

1. Reduce the number of connected appliances, especially when air conditioners and on board battery-charger are running.
2. Replace the control assembly.

**NOTICE**

**Document all details of the troubleshooting steps.**

## 9.2.10 Code No. 15 - Underfrequency Fault

Logic:

Control not able to regulate to rated frequency.

Corrective Action:

1. Reduce the number of connected appliances, especially when air conditioners and battery charger are running.
2. Verify that air conditioners are working properly.
3. Remove the top housing panel and check for correct connections at terminal TB3-1 and TB3-2.
4. Check PMA connections for continuity. Reconnect PMA leads and retest.
5. Check high idle adjustments.
6. If problem is not resolved, replace the control assembly.
7. Document all details of the troubleshooting steps.

## 9.2.11 Code No. 17 - Fuel Pump Fault \*

Logic:

Control sensed open circuit.

Corrective Action:

### WARNING

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

1. Try priming the fuel system by holding the control switch at Stop. If the fuel pump functions, the fault was improperly declared and will probably not recur.
2. If loose, reconnect the two fuel pump leads. They are accessible through the access door in the skid-base, and also through an access door in the front panel on some models.
3. Disconnect the fuel pump leads from the engine wiring harness and connect the white fuel pump lead to the positive (+) terminal of a 12 volt battery and the black lead to the negative (-) terminal. Replace the pump if there is no audible sound or vibration.
4. Remove the front and top housing panels and disconnect engine harness connector P1 from the control assembly. Check for electrical continuity between pin P1-2 and connector E2-1 and between E2-2 and ground and repair as necessary. Also check for missing, bent or corroded terminals and connector pins and repair or reconnect as necessary.
5. Reconnect the wiring harness and check the voltage being sent to the fuel pump while cranking. Troubleshoot the control assembly if 12VDC is not measured.

\* - This Fault is discontinued beginning Spec F.

## 9.2.12 Code No. 18 - Glow Plug Circuit Protection Fault\*

Logic:

Control sensed short circuit.

Corrective Action:

1. Remove the top housing panel and, if loose, reconnect engine harness spade connector HR-1 to the glow plug bus bar at the front of the engine (a short to ground will cause shutdown).
2. Disconnect engine harness connector HR-1 at the glow plug bus bar and A1-J8 at the control assembly. Check for continuity between either connector and ground (ground short). Replace the engine harness if it is shorted to ground.
3. Replace the control assembly.

\*- This is a bypassable fault discontinued after Spec F.

## 9.2.13 Code No. 19 - Actuator Shorted or Open

Logic:

Control sensed open or short circuit.

Corrective Action:

1. Remove the front housing panel and reconnect the engine wiring harness connectors E1-1 and E1-2 to the governor actuator if they are loose. Polarity does not matter.

2. Measure actuator coil resistance with a digital ohmmeter. Replace the actuator stator assembly if coil resistance is not 1.7 to 2.8 ohms.
3. Disconnect engine harness connector P1 from the control assembly. Check for electrical continuity between pin P1-1 and quick connector E1-1 and between E1-2 and ground. Replace the engine harness if either leg lacks electrical continuity. Also check for missing, bent or corroded terminals and connector pins and repair or reconnect as necessary.

## 9.2.14 Code No. 21 - Starter Solenoid Circuit Protection Fault\*

Logic:

Control sensed short circuit.

Corrective Action:

### **WARNING**

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

1. Open the maintenance access door and reconnect engine harness quick connector K-1 to the starter motor solenoid if it is loose.
2. Disconnect engine harness connector K-1 from the starter solenoid and connect battery positive (+) by means of a switch and jumper to energize the solenoid. If the starter does not crank the engine when the solenoid is energized, remove the starter motor assembly. Replace the starter motor assembly or solenoid, as necessary.
3. Remove the top housing panel and reconnect engine harness connector A1-J6 to the lead from the control assembly if it is loose.
4. Disconnect engine harness connector A1-J6 at the control assembly and connector K1 at the starter solenoid and check for continuity to ground from either connector (ground short). Replace the engine harness if it is shorted to ground.
5. Replace the control assembly.

\* - Discontinued beginning Spec F.

## 9.2.15 Code No. 22 - Governor Overload

Logic:

Duration of operation at or near full-duty cycle beyond design limit.

Diagnosis and Repair:

1. Reduce the number of connected appliances, especially when air conditioners and battery chargers are running.
2. Check the leads from the current transformer (CT-1 and CT-2) for proper connection. Ensure there are no breaks in leads and ensure continuity.
3. Check for fuel and air leaks at each fitting in the fuel supply line.
4. Conduct a fuel flow test and service as necessary.
5. Replace the engine air filter and clean the spark-arrest muffler.

6. Remove the front and top housing panels. Check for binding in the governor mechanism by pushing the actuator rotor clockwise by hand against the action of the fuel rack return spring. It should rotate smoothly about 12 mm (1/2 inch) and return smoothly. If it binds or catches, remove the governor actuator base assembly and replace it or service the internal engine governor mechanism as necessary.
7. Check for an open or shorted PMG stator winding. (The control will drive the actuator harder to compensate for loss of output.)
8. Readjust high-idle speed.
9. Service the fuel injectors and injection pump as necessary.
10. Check fuel injection timing.
11. Service a worn engine.

## 9.2.16 Code No. 23 - Faulty Oil Pressure Sender\*

Logic:

Control sensed switch still open during start—not a running fault\*\*

Corrective Action:

### **WARNING**

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

1. Remove the top housing panel. If loose, reconnect engine harness spade connector S2 to the low oil pressure cutoff switch.
2. Disconnect engine harness connector P2 from the control assembly. Check for electrical continuity between pin P2-9 and connector S2 and for missing, bent or corroded connector pins and repair as necessary.
3. Check for loose or corroded ground connections between the engine and the base and the base and control assembly and repair as necessary.
4. Replace the low oil pressure cutoff switch.

\* - This is a bypassable fault prior to Spec F.

\*\* - Beginning Spec F, this fault is enabled 20 seconds after the generator set stops and is declared during start.

## 9.2.17 Code No. 24 - Faulty Temperature Sender\*

Logic:

Detects if sender is failed open, shorted, or stuck. Takes 5 minutes to detect if stuck. Otherwise detected at startup.

Corrective Action:

1. Check for a stuck or leaking coolant thermostat. Replace as necessary.
2. Remove the top housing panel. If loose, reconnect engine harness spade connector E3-1 to the coolant temperature sender.



3. Disconnect engine harness connector P1 from the control assembly. Check for electrical continuity between pin P1-12 and connector E3-1 and for missing, bent or corroded connector pins and repair as necessary.
4. Replace the coolant temperature sender.

\* - This is a bypassable fault prior to Spec F. Note also that an open circuit is sensed as cold temperature, resulting in maximum pre-heat and post-heat times.

## 9.2.18 Code No. 25 - Engine Above Speed Target Fault

Logic:

Governor unable to regulate to target speed.

Corrective Action:

1. Check the leads from the current transformer (CT-1 and CT-2) for proper connection. Ensure there are no breaks in leads and ensure continuity.
2. Remove the front and top housing panels. Check the fuel rack return spring and replace it if it is worn or broken. Make sure it is reassembled correctly.
3. Check for binding in the governor mechanism by pushing the actuator rotor clockwise by hand against the action of the fuel rack return spring. It should rotate smoothly about 12 mm (1/2 in) and return smoothly. If it binds or catches, remove the governor actuator base assembly and replace it or service the internal engine governor mechanism as necessary.
4. Readjust high-idle speed.

## 9.2.19 Code No. 26 - Engine Below Speed Target Fault

Logic:

Governor unable to regulate to target speed.

Corrective Action:

### **WARNING**

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

1. Reduce the number of connected appliances, especially when air conditioners and battery chargers are running.
2. Prime the engine fuel system.
3. Check for fuel and air leaks at each fitting in the fuel supply line.
4. Conduct a fuel flow test and service as necessary.
5. Replace the engine air filter and clean the spark-arrest muffler.
6. Connect a source of known fuel quality, prime the fuel system and run the generator set. If performance improves, replace the bad fuel in the supply tank.
7. Remove the front and top housing panels. Check for binding in the governor mechanism by pushing the actuator rotor clockwise by hand against the action of the fuel rack return spring. It should rotate smoothly about 12 mm (1/2 inch) and return smoothly. If it binds or catches, remove the governor actuator base assembly and replace it or service the internal engine governor mechanism as necessary.

8. Readjust high-idle speed.
9. Service the fuel injectors and injection pump, as necessary.
10. Check fuel injection timing.
11. Service a worn engine.

## 9.2.20 Code No. 27 - PMA Sense Lost Fault

Logic:

Control unable to sense PMA frequency. If between cranking and run-down, rpm = 0 and dc bus voltage present for greater than 2 seconds.

Corrective Action:

### WARNING

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

1. Disconnect vehicle loads, connect load bank and operate the generator set at varying loads. Does Fault Code 27 occur?
  - If Fault Code 27 returns continue to step 4.
  - If Fault Code 27 does not return, continue to step 2.
2. Reconnect vehicle loads and verify that Fault Code 27 occurs.
  - Isolate and operate each load individually to identify which is causing the fault.
3. Remove or repair loads causing the Fault Code.
4. Check for proper connections between the generator (PMA) stator and the control assembly and reconnect as necessary.
5. Disconnect the PMA leads from the control. Using InPower, turn on the control starter relay in control assembly. Do not crank for more than 30 seconds. (Refer to Step 7.)
6. Connect Digital Multimeter (DMM) to the PMA leads. While the engine is cranking, measure the voltage between PMA leads T1-T2, T2-T3 and T3-T1 using DMM. Set DMM to AC and range. Do not crank the engine for more than 30 seconds:
  - If all of the leads measure greater than 20 Vrms, replace control-assembly.
  - If any of the leads measure less than 20 Vrms, troubleshoot PMA (Refer Step 6).
    - If values of all leads (T1-T2, T2-T3 and T3-T1) is less than 20 Vrms, problem is with the rotor.
    - If value of one/more leads is less than 20 Vrms, problem lies with the stator.
7. After measuring the PMA leads, turn off control starter relay in control assembly (Refer Step 7E) using InPower.
8. Run the set again and check if fault is cleared.
9. PMA Troubleshooting Steps:
  - a. Check for PMA to Ground shorts using a digital multimeter to measure resistance between each PMA lead to Ground.
    - Meter will read 'Open' if there are no shorts.

- If meter reads a finite resistance, it indicates a short.
- b. Check for an open generator stator winding. If winding is open, replace the stator.
- c. Remove top housing panel, check PMA rotor and integrity of the magnets. Attempt to bar the engine by hand to check for jammed magnets. Replace the rotor if damaged.

### NOTICE

**If the rotor is damaged, do not replace the control-assembly. Replace the rotor first a check to verify if that solves the problem.**

10. Steps for turning on the control starter relay in control assembly using Inpower:
  - a. Enable the parameter “Starter Override Request”.
  - b. Turn on the parameter “Starter Override Command”.
  - c. To verify, check to see if “Starter Override Status” = on.
  - d. To switch off starter relay, turn off the parameter “Starter Override Command”.
  - e. To verify, check to see if “Starter Override Status” = off.

## 9.2.21 Code No. 28 - DC Sense Lost Fault

Logic:

Control unable to sense DC bus voltage.

Corrective Action:

### ⚠ WARNING

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

1. Open the circuit breaker. If the fault does not persist, check for and disconnect excessive loads from the generator set before starting.
2. Check for proper connections between the generator (PMA) stator and the control assembly and reconnect as necessary.
3. Replace the control assembly.

## 9.2.22 Code No. 29 - High Battery Voltage

Logic:

Voltage across battery system greater than 19 volts.

Corrective Action:

1. Check battery bank connections and reconnect if necessary so that the 12 volt batteries serving the generator set are connected in parallel (12 volt) rather than in series (24 volt).
2. Measure DC voltage at battery, generator set, and connector P1: reconnect battery or repair wiring as necessary.
3. Measure DC voltage with battery charger on: reduce boost charge rate or diagnose faulty charger as necessary.

4. Disconnect generator set control P1 connector, verify P1 pins are fully inserted and inspect pin condition: insert, repair, or replace pins as necessary.
5. Verify ground at P1 – 7.
6. Reconnect P1 connector and test run generator set for fault occurrence.
7. If installed, check wiring connections at the battery charger.
8. Measure AC voltage between J12 and J13 at the battery charger. If 120VAC is measured, diagnose faulty battery charger as necessary. If 120VAC is not measured, verify AC output from the generator.

### 9.2.23 Code No. 31 - Overspeed Fault

Logic:

Engine speed greater than 3600 rpm.

Corrective Action:

1. Remove the front and top housing panels. Check for binding in the governor mechanism by pushing the actuator rotor clockwise by hand against the action of the fuel rack return spring. It should rotate smoothly about 12 mm (1/2 in) and return smoothly. If it binds or catches, remove the governor actuator base assembly and replace it or service the internal engine governor mechanism as necessary.
2. Readjust high-idle speed.
3. Replace the control assembly.

### 9.2.24 Code No. 32 - Low Cranking Speed Fault

Logic:

Cranking speed less than 180 rpm for more than 2 seconds. If crank and generator frequency less than 3Hz for greater than 2 seconds.

Corrective Action:

**⚠ WARNING**

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

Troubleshooting for Fault Code 32 is divided into 2 failure modes:

1. The engine does not crank.
2. The engine cranks.

If the engine does not crank:

1. Inspect fuse F2. If blown, inspect wiring connections for shorts to chassis or other shorts. Replace fuse and repeat test.
2. Check battery voltage at the generator set terminal it should be  $11 \pm 0.2V$  or above. Replace/recharge battery as necessary.
3. Inspect battery connections at the terminals. Check DC system and cables.
4. Follow the steps below to troubleshoot and verify control starter relay (in control assembly) and starter motor assembly. In the steps below the numbers in parenthesis refer to the wiring diagrams.
  - a. Using InPower, turn ON the control starter relay (in control assembly) (Refer Step 5).

- b. Measure voltage at A1-J6-K1 (1) at starter assembly. If measured voltage is greater than 10V, replace starter assembly.
  - c. If measured voltage is less than 10V, unplug A1-J6-K1 at the Starter Assembly (2).
  - d. Measure voltage at A1-J6-K1 (2) at the harness. It should measure approximately battery voltage.
    - If it measures approximately battery voltage, replace starter motor.
    - If it does not measure approximately battery voltage or measures less than 10V, unplug J6 from A1-J6 (3) at control assembly and measure voltage at J6 (4) on control assembly:
      - If measured voltage at (4) less than 10V, then disconnect A1-J5 (5) from J5 (6) and measure voltage at A1-J5 (5). If value is greater than 10V at A1-J5 (5), then replace control assembly.
      - If measured voltage at (5) less than 10V, verify wiring.
5. Steps for turning on the control starter relay in control assembly using Inpower:
- a. Enable the parameter "Starter Override Request".
  - b. Turn on the parameter "Starter Override Command".
  - c. To verify, check to see if "Starter Override Status" = on.
  - d. To switch off starter relay, turn off the parameter "Starter Override Command".
  - e. To verify, check to see if "Starter Override Status" = off.

If the engine cranks:

1. While the start button is pressed, monitor the parameters "Waveform period", "Inverter dc voltage" using Inpower and refer to table below.

**NOTICE**

**Waveform period < 80000 indicates normal cranking speed. Waveform period of greater than 80000 indicates unit is cranking to slow.**

Condition Number	Waveform Period	Symptom	Troubleshooting
1	8000-14000	Engine cranking slow	See step 1
2	30000000 for > 4s	Engine cranks normal but control does not sense PMA output	See step 2

Step 1. Engine cranking slow:

1. Verify engine setup for ambient conditions.
2. Low or weak batteries cause starting issues. Monitor battery voltage during crank. It must be greater than 8V. Ideally it should be greater than 9V.
  - If the battery voltage is less than or equal to 8V, inspect battery connections at the terminals.

Step 2. Engine cranks normal but control does not sense PMA output:

1. Check for proper connections between the generator (PMA) stator and the control assembly and reconnect as necessary.

2. Disconnect the PMA leads from the control. Using InPower, turn on the control starter relay in control assembly (Refer Step 7). Do not crank for more than 30 seconds.
3. While the engine is cranking (do not crank for more than 30 seconds), use a digital multimeter (DMM) set to AC and range to measure the voltage between PMA leads T1-T2, T2-T3 and T3-T1:
  - a. If any of the leads measure greater than 20 Vrms, replace control assembly.
  - b. If any of the leads measure less than 20 Vrms, troubleshoot PMA. (Refer Step 6.)
    - If values of all leads (T1-T2, T2-T3 and T3-T1) is greater than 20 Vrms, problem is with the magnetic field.
    - If value of one or more leads is less than 20 Vrms, problem lies with the stator.
4. Turn off control starter relay in the inverter (Refer Step 7D) using InPower after measuring the leads.
5. Run the set again and check if fault is cleared.
6. PMA Troubleshooting Steps:
  - a. Check for PMA to Ground shorts using a digital multimeter to measure resistance between each PMA lead to Ground:
    - Meter will read 'Open' if there are no shorts.
    - If meter reads a finite resistance, it indicates a short.
  - b. Check for an open generator stator winding. If winding is open, replace the stator.

**⚠ CAUTION**

***Ensure actuator is at zero and/or fuel is off.***

- c. Remove top housing panel, check PMA rotor and integrity of the magnets. Attempt to bar the engine by hand to check for jammed magnets. Replace the rotor if damaged.

**NOTICE**

**If the rotor is damaged, Do not replace the control assembly. Replace the rotor first and check to verify if that solves the problem.**

7. Steps for turning on the control starter relay in control assembly using Inpower:
  - a. Enable the parameter "Starter Override Request".
  - b. Turn on the parameter "Starter Override Command".
  - c. To verify, check to see if "Starter Override Status" = on.
  - d. To switch off starter relay, turn off the parameter "Starter Override Command".
  - e. To verify, check to see if "Starter Override Status" = off.

## 9.2.25 Code No. 33 - High Engine Coolant Temperature Fault

Logic:

Engine coolant temperature exceeded design limit.

Corrective Action:

1. Check the engine coolant level and add coolant and repair leaks as necessary.
2. Check for and remove any objects blocking the air inlet or outlet openings in the bottom of the generator set.

3. Reduce the number of appliances connected at the same time. (Note that high altitude and high ambient temperature decrease engine cooling capacity.)
4. Look for a broken or worn coolant pump drive belt and replace as necessary. (Visible through the maintenance access door in the skid-base.)
5. Remove the air intake grille in the skid-base and check to see that the cooling blower is secure and that the blades are not fouled.
6. Check for air leaks in the housing, missing or loose housing panels and access covers, including the access covers for the fuses and AC terminals.
7. Clean and flush the cooling system to remove coolant passage fouling.
8. Remove the top housing panel. If loose, reconnect engine harness spade terminal connector E3-1 to the coolant temperature sender. (If the lead is loose and touching ground, the control will sense a high engine temperature.)
9. While the top housing panel is off, check for fouling of the radiator air passages and clear out dust and debris with compressed air directed from below (reverse of normal air flow).
10. Replace the coolant thermostat.
11. If the generator set overheats only underway, see the coach manufacture regarding air baffles or other means to direct cooling air into the generator set.

## 9.2.26 Code No. 34 - High Inverter Temperature Fault

Logic:

Inverter heat sink temperature exceeded design limit.\*

Corrective Action:

1. Check for and remove any objects blocking the air inlet or outlet openings in the bottom of the generator set.
2. Remove the air intake grille in the skid-base and clean the heat sink fins if they are fouled. Also check to see that the cooling blower is secure and that the blades are not fouled.
3. Reduce the number of appliances connected at the same time. (Note that high altitude and high ambient temperature decrease cooling capacity.)
4. Replace the control assembly if the generator set cannot carry rated load.

\* - Prior to Spec F, use compressed air to cool off the fins of the heat sink if it is necessary to get the generator set started right away. Beginning Spec F, the generator set will run for 2 minutes after being restarted, which is enough time to cool down the heat sink if the connected load is less than 2 kW.

## 9.2.27 Code No. 35 - Control Card Fault

Logic:

Microprocessor EPROM error during self-test.

Corrective Action:

Report this failure to the Factory and replace the control assembly. This fault occurs when using obsolete software.

## 9.2.28 Code No. 36 - Unknown Shutdown Fault

Logic:

Engine stopped without command by control.

**Corrective Action:**

1. Check fuel level. (Note: The generator set fuel pickup is probably higher than the vehicle engine pickup.)
2. Prime the engine fuel system if the generator set ran out of fuel.
3. Check for fuel and air leaks at each fitting in the fuel supply line. (Note: White smoke indicates air in the fuel.)
4. Check the engine air filter and remove any blockage.
5. Check for mechanical damage.
6. Check auxiliary fuel pump (if equipped).
7. Conduct a fuel flow test and service as necessary.
8. Remove the front and top housing panels and disconnect engine harness connectors P1 and P2 from the control. Check for missing, bent or corroded connector pins and faulty wiring and repair as necessary.
9. Conduct the hot air recirculation test (Refer to Installation Manual).
10. Service the engine.

## 9.2.29 Code No. 37 - Invalid Generator Set Configuration

**Logic:**

The generator set control is not configured properly for the generator set. Generator set configuration is preprogrammed at the factory.

**Corrective Action:**

Replace the control assembly. The control assembly must be configured at the factory.

## 9.2.30 Code No. 38 - Overcurrent Fault

**Logic:**

Too many loads connected.

**Corrective Action:**

** WARNING**

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

1. Reduce the number of appliances running at the same time, especially those with high starting loads such as air conditioners. Start up with no load and let the generator set run for five minutes to cool down the inverter.
2. If the appliance and air conditioner loading patterns have remained the same but generator set performance has deteriorated:
  - a. Check for fuel and air leaks at each fitting in the fuel supply line. (Note: White smoke indicates air in the fuel.)
  - b. Conduct a fuel flow test and service as necessary.



- c. Remove the front and top housing panels. Check for binding in the governor mechanism by pushing the actuator rotor clockwise by hand—against the action of the fuel rack return spring. It should rotate smoothly about 12 mm (1/2 in) and return smoothly. If it binds or catches, remove the governor actuator base assembly and replace it or service the internal engine governor mechanism as necessary.
- d. Readjust high-idle speed.
- e. Service the fuel injectors and injection pump as necessary.
- f. Service a worn engine.

### 9.2.31 Code No. 39 - Low Battery Voltage Fault\*

**Logic:**

Battery voltage dropped below 9 volts while generator set running.

**Corrective Action:**

1. Inspect connections at battery and generator set.
2. If the appliance and air conditioner loading patterns have remained the same but generator set performance has deteriorated:
  - a. Check for fuel and air leaks at each fitting in the fuel supply line. (Note: White smoke indicates air in the fuel.)
  - b. Avoid running the generator set while cranking the propulsion engine, especially in installations where generator set batteries are used to supplement vehicle engine batteries.
  - c. Check battery voltage at the generator set terminal, typical should be  $11V \pm 0.3V$  or above. If not, replace/recharge battery.

**NOTICE**

**Due to the long battery cables, battery voltage at the generator set terminal may be lower than at battery terminals.**

- d. Check Battery Voltage at the generator set terminal” while cranking engine”. If battery Voltage drops less than  $9V \pm 0.2V$ , replace/recharge the battery.

**NOTICE**

**Battery voltage dipping below 9V during crank indicates a potentially weak battery. Battery needs to be replaced.**

\* - Fault Code Active for Specs A-E and beginning M, Fault Inactive for Specs F-L.

### 9.2.32 Code No. 42 - Processor Fault\*

**Logic:**

Microprocessor ROM error during self-test.

**Corrective Action:**

Replace the control assembly.

\* - Beginning Spec F and replacement control assemblies.

### 9.2.33 Code No. 43 - Processor Fault\*

**Logic:**

Microprocessor RAM error during self-test.

**Corrective Action:**

Replace the control assembly.

\* - Beginning Spec F and replacement control assemblies.

### 9.2.34 Code No. 46 - Inverter Power Supply Fault\*

**Logic:**

Low battery voltage or power supply device failure.

If input indicates power supply shutdown for 3 samples at 32ms rate.

**Corrective Action:**

1. Avoid running the generator set while cranking the propulsion engine, especially in installations where generator set batteries are used to supplement vehicle engine batteries.
2. Inspect battery cable connections at the battery, vehicle frame, and generator set.
3. Check battery voltage at the generator set terminal, typical voltage should be 11V  $\pm$ 0.3V or above. If not, replace/recharge battery.

**NOTICE**

**Due to the long battery cables, battery voltage at the generator set terminal may be lower than at battery terminals.**

4. Check battery voltage at the generator set terminal, "while cranking engine". If battery Voltage drops to less than 9V  $\pm$  0.2V, replace/recharge the battery.
5. Remove battery charger or unplug the battery charger from its AC source, before cranking.
6. Replace the control assembly.

\* - Beginning Spec F and replacement control assemblies.

# 10 Service Checklist

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After servicing, inspect and test the installation to confirm that the generator set operates as intended. Check each of the areas described below before putting the generator set into service.

## 10.1 Housing

Make sure that all housing panels and access covers are properly in place and secured.

## 10.2 Mounting

Examine all mounting bolts and supporting members to verify that the generator set is properly mounted. All fasteners should be tightened securely to prevent them from working loose when subjected to vibration.

## 10.3 Lubrication

Make sure that oil has been properly filled.

## 10.4 Cooling System

If the engine coolant was drained, refill as instructed in *Periodic Maintenance*.

## 10.5 Wiring

Verify that all wiring connections are tight and installed properly:

- Load wires
- Control wires
- Ground straps
- Battery cables

## 10.6 Output Check

Apply a full load to make sure the generator set can produce its full rated output. Use a load test panel to apply a progressively greater load until full load is reached.

## 10.7 Exhaust System

 **WARNING**

***Exhaust gas is deadly. The exhaust system must not leak and must discharge all exhaust away from the vehicle. Do not run the generator set until exhaust leaks have been repaired.***

While the generator set is running, inspect the entire exhaust system. Look and listen for leaks at all connections, welds, gaskets, and joints. Also make sure the exhaust pipe is not overheating adjacent materials or equipment. If discrepancies are detected, secure the generator set, do not run until all exhaust leaks and hot spots have been repaired

**NOTICE**

**The exhaust tailpipe must be supported by a hanger near the vehicle perimeter and terminated at least 1 inch outside that perimeter. The tailpipe must be terminated no closer than 1 foot away from doors and windows.**

## 10.8 Fuel System

**⚠ WARNING**

***Diesel fuel is combustible. Leaking fuel could lead to fire and to severe personal injury or death. Repair fuel leaks immediately.***

While the generator set is running, inspect the fuel supply and return lines, filter, and fittings for leaks. Check flexible sections for cuts, cracks and abrasions and make sure they are not rubbing against anything that could cause leakage. Repair all fuel leaks immediately.

## 10.9 Control

Stop and start the generator set several times at the control panel, on the generator set, and at the remote control board, (if provided) to verify that they work properly.

## 10.10 Mechanical

Stop the generator set and inspect it for leaking gaskets, loose fasteners, damaged components, and interference with other equipment. Repair as necessary.

Inspect the generator set compartment and verify that there are no breaks or openings in the vapor-proof wall that separates the compartment from the vehicle interior. Seal openings as necessary. Make sure that all soundproofing material is in place.

# Appendix A. Wiring Diagrams

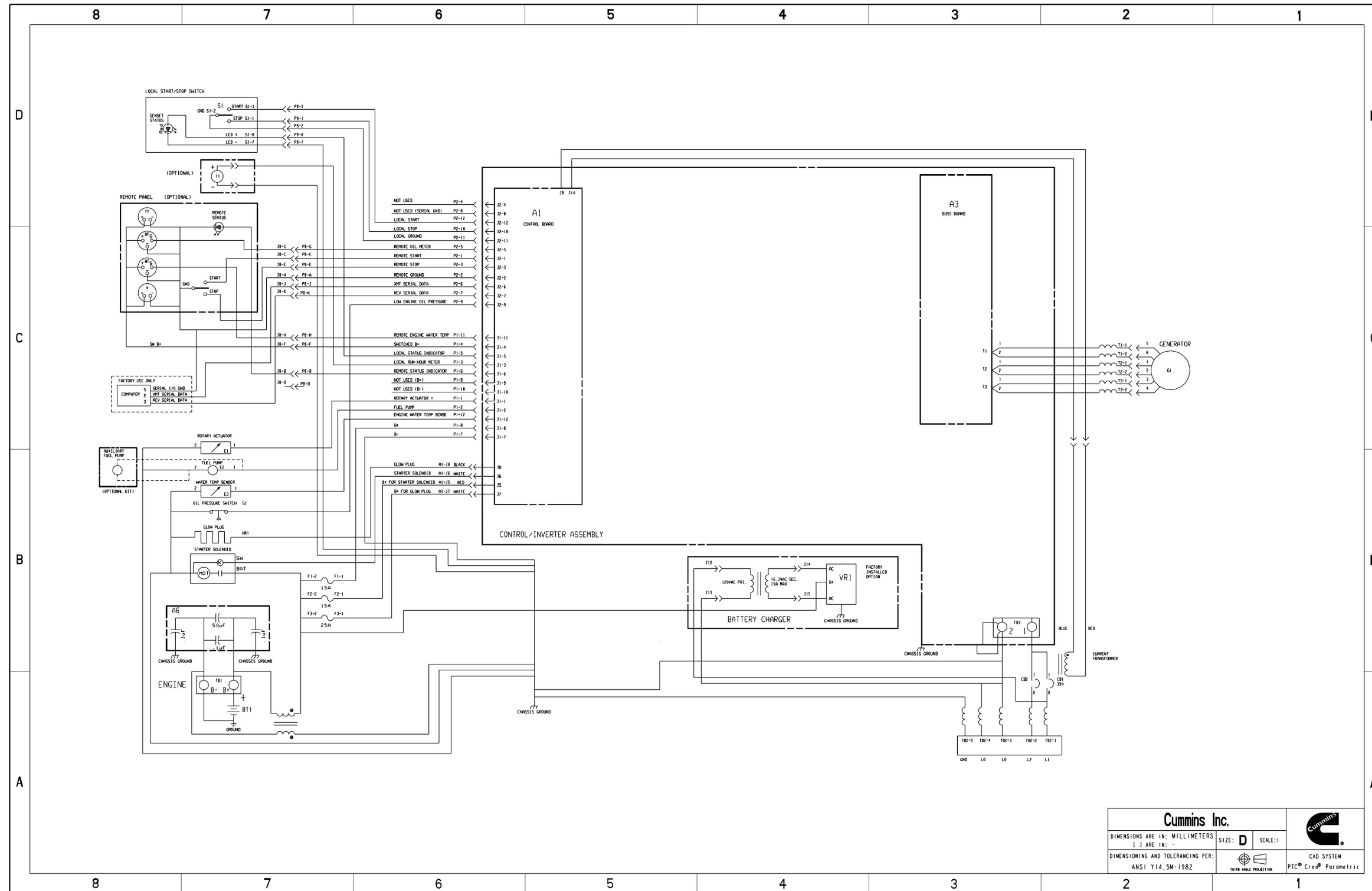
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## Table of Contents

Figure 24. WIRING DIAGRAM 0611-1236 .....	93
Figure 25. FC32 TROUBLESHOOTING WIRING DIAGRAM .....	94

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# A.0 Wiring Diagrams (0611-1236)



Part Number: **0611-1236** Part Revision: **A**  
 Part Name: **CONTROL,GENSET**

FIGURE 24. WIRING DIAGRAM 0611-1236

# A.1 FC32 TS Wiring Diagram

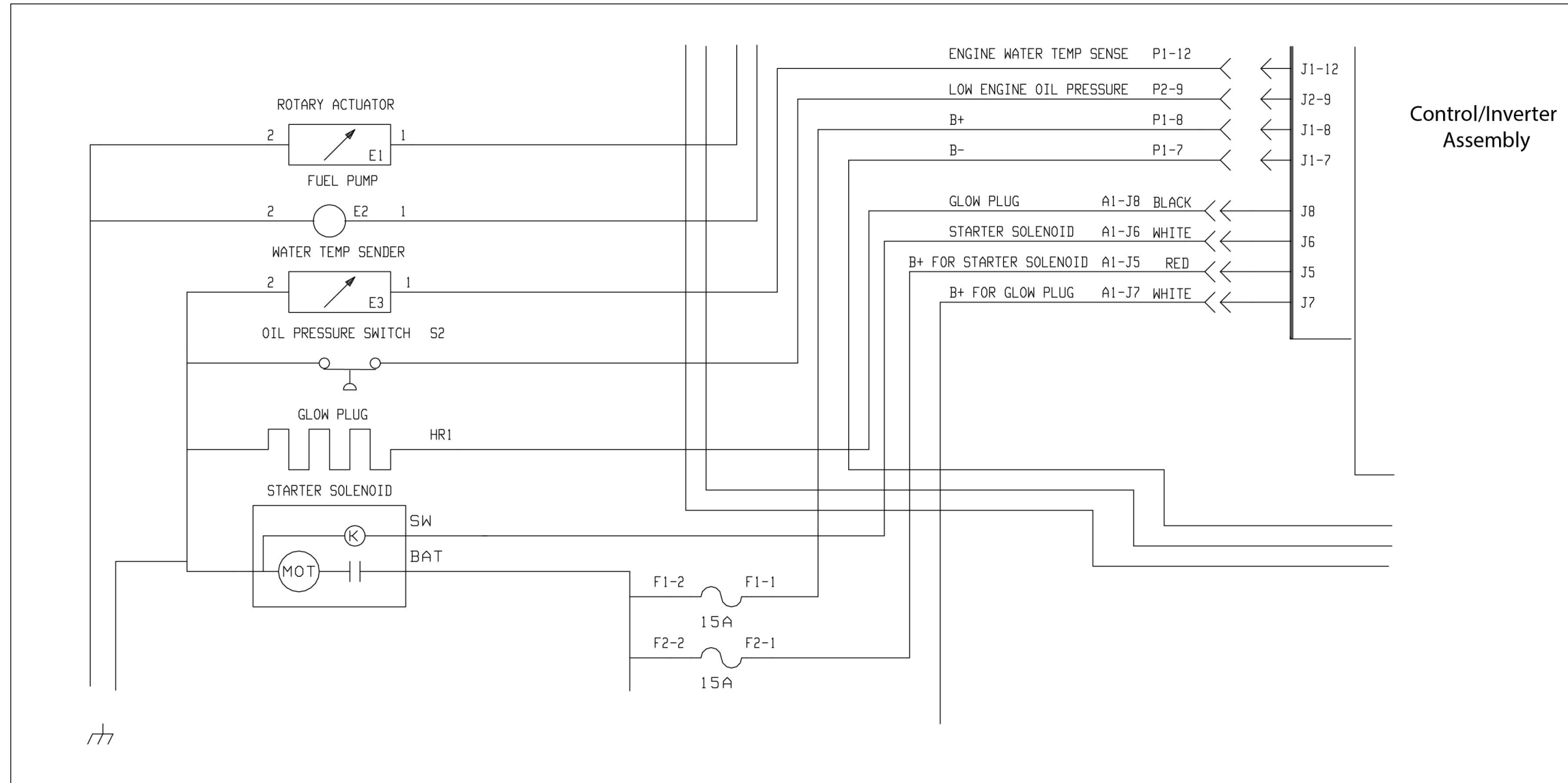


FIGURE 25. FC32 TROUBLESHOOTING WIRING DIAGRAM



# Appendix B. Wiring Harnesses

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## Table of Contents

Figure 26. ENGINE WIRING HARNESS .....	97
Figure 27. BATTERY WIRING HARNESS .....	98
Figure 28. AC WIRING HARNESS .....	99

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### B.0 Engine Wiring Harness (338-3822)

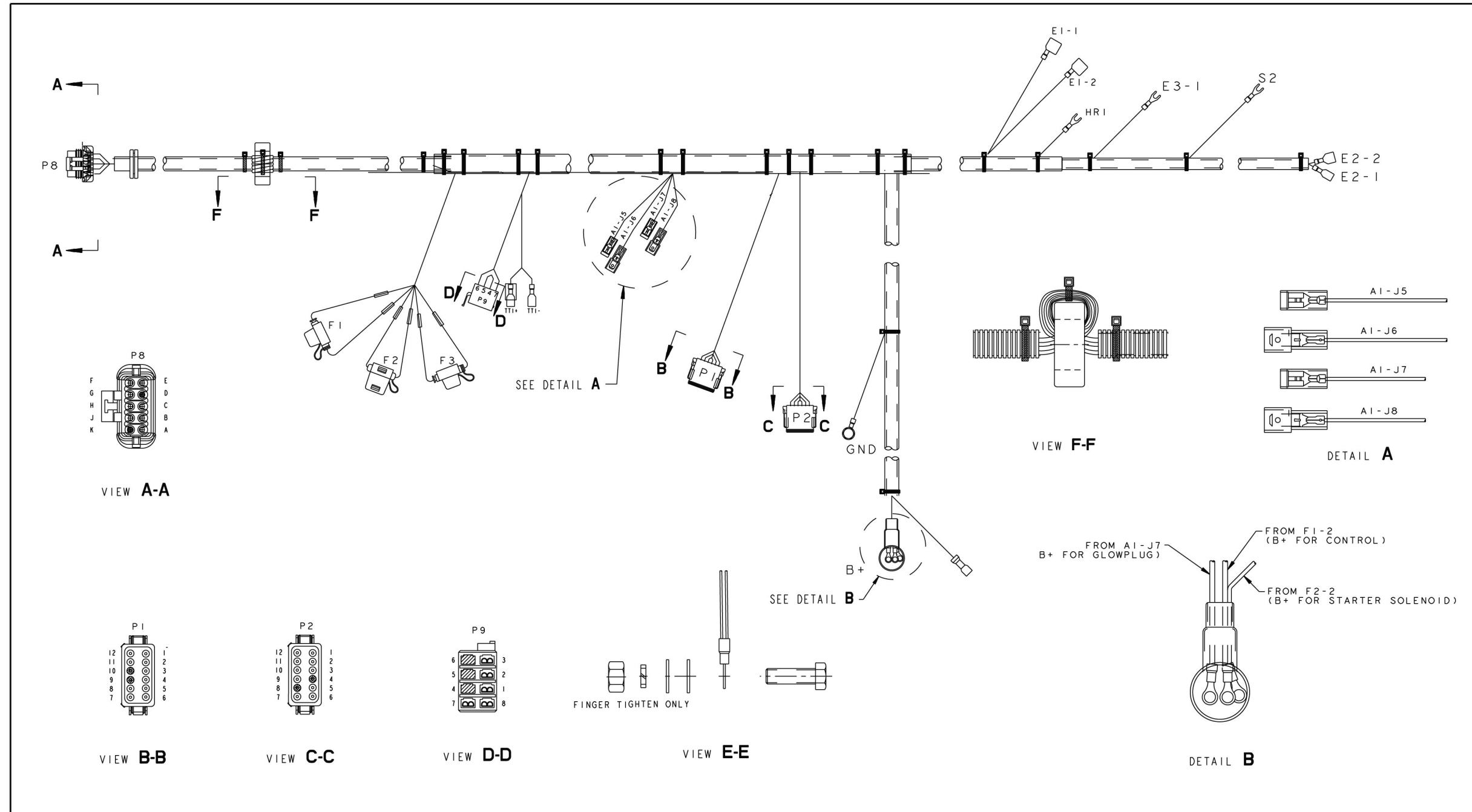


FIGURE 26. ENGINE WIRING HARNESS

## B.1 Battery Wiring Harness (338-3841)

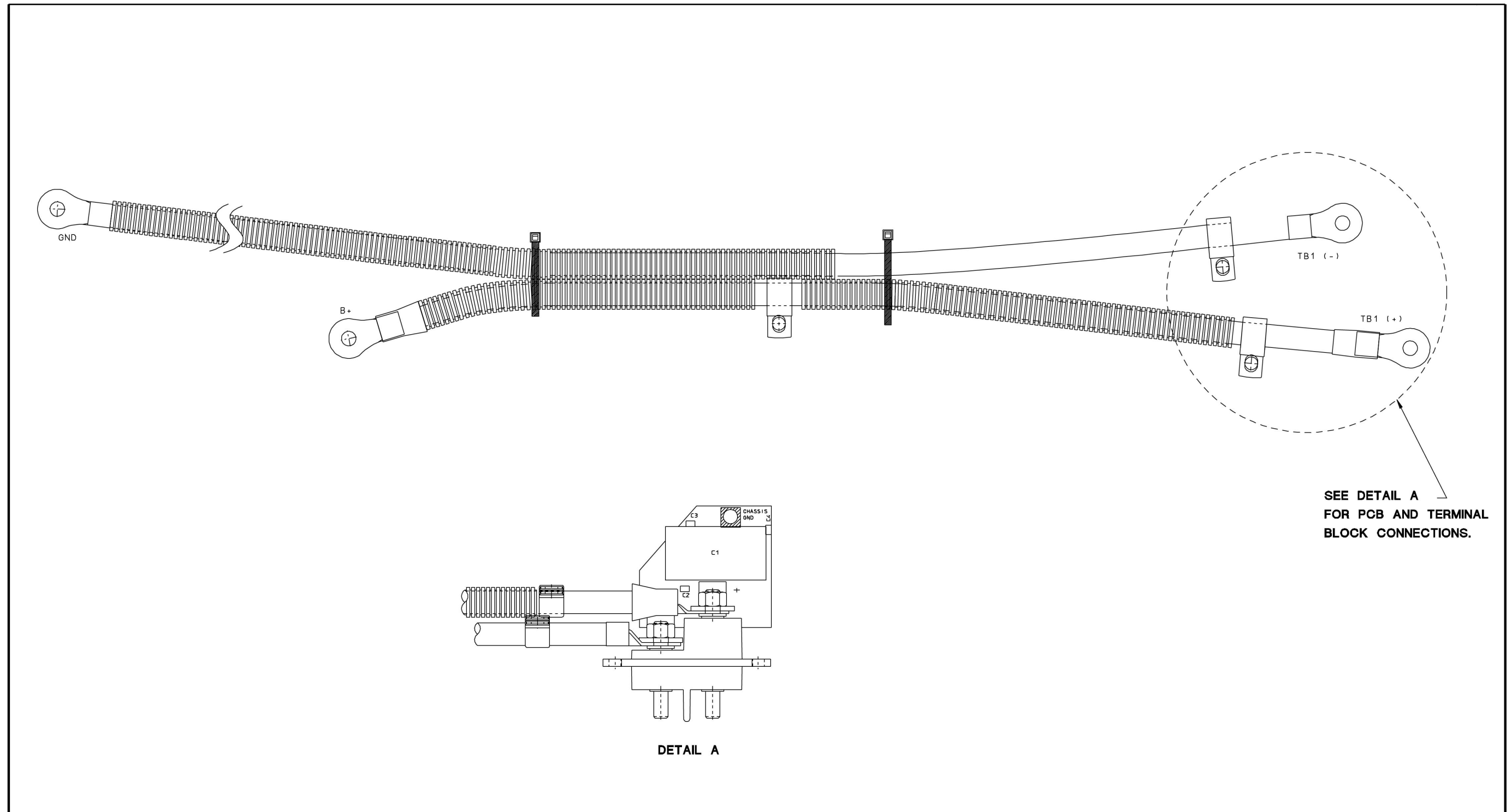


FIGURE 27. BATTERY WIRING HARNESS

## B.2 AC Wiring Harness (338-3823)

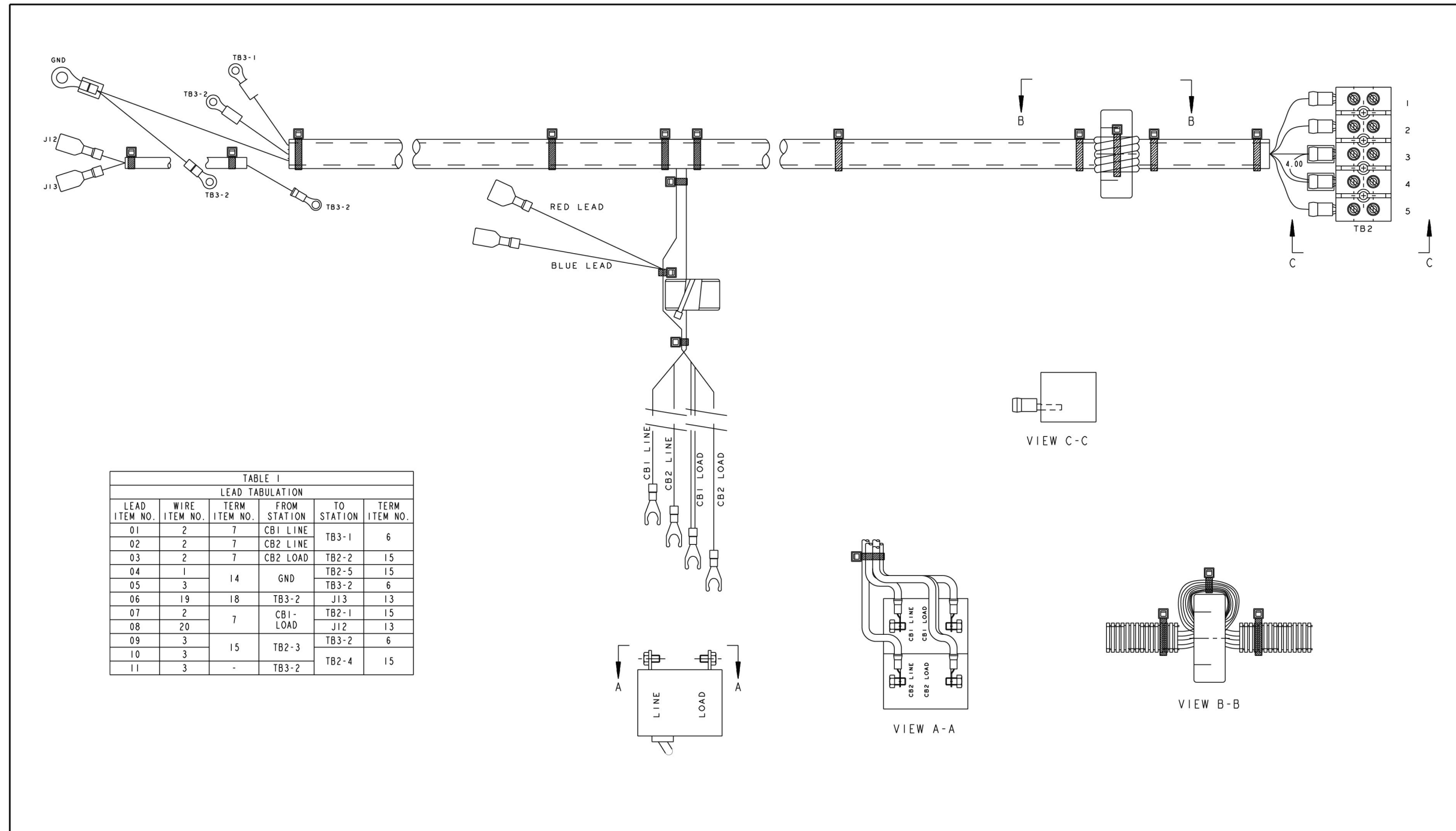


FIGURE 28. AC WIRING HARNESS

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# Appendix C. Outline Drawings

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## Table of Contents

Figure 29. Outline Drawing 0500-3159 ..... 103

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### C.0 Outline Drawing (0500-3159)

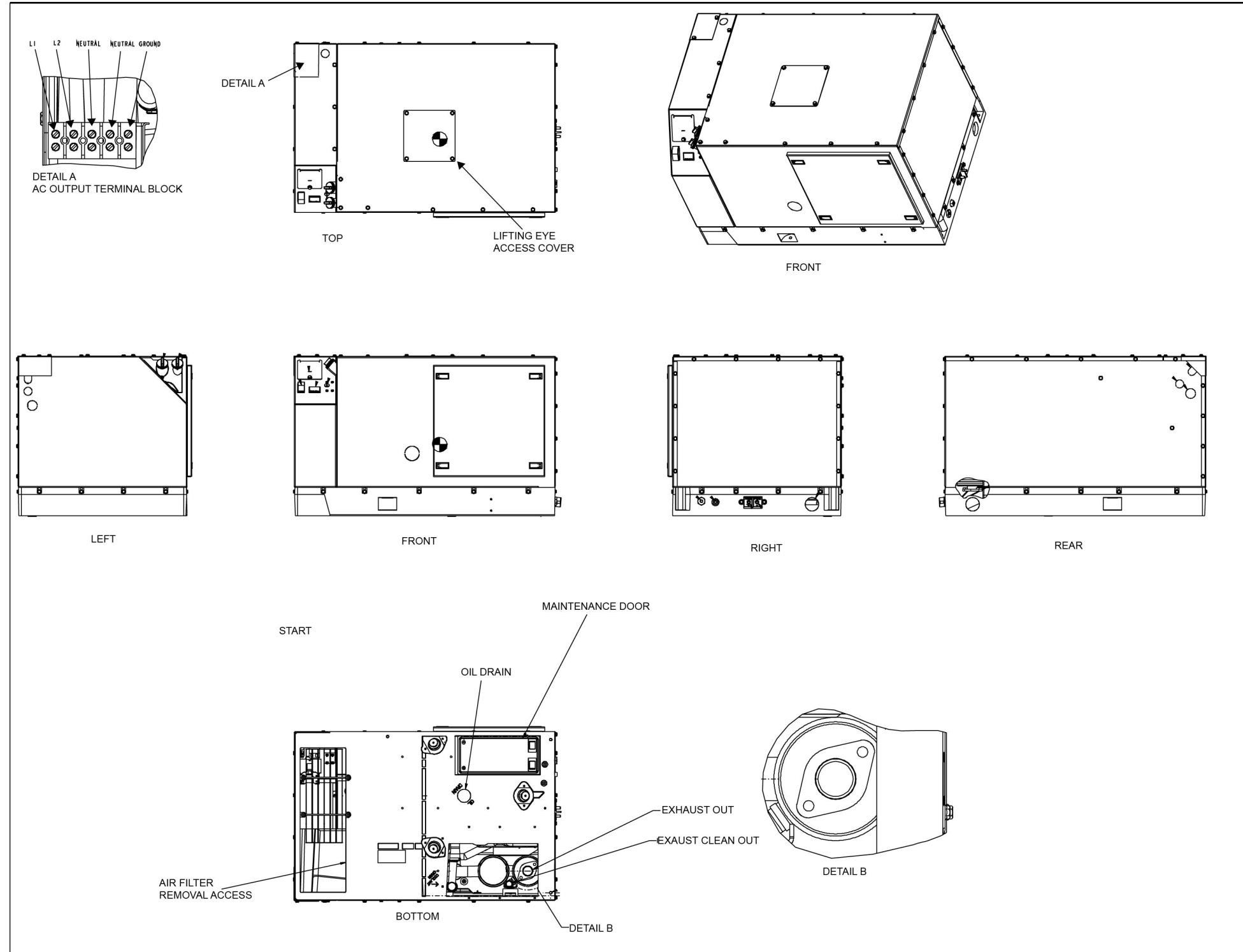


FIGURE 29. OUTLINE DRAWING 0500-3159

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