

OM-2167

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Operation and Maintenance Manual with Illustrated Parts List for 90CU420

90 kVA, 3 Phase, 115/200 Volt,
400 Hz. Generator Set



Series 500090

ITW GSE Group
Hobart Ground Power
Troy, Ohio 45373
U.S.A.



Warranty

Data Sheet 165
Index: 990223
Replaces: 980601

HOBART GROUND POWER
TROY, OHIO 45373

1. Hobart Brothers Company (hereinafter called HOBART) warrants that each new and unused Hobart Ground Power Equipment, (hereinafter called the PRODUCT) is of good workmanship and is free from mechanical defects, provided that (1) the PRODUCT is installed and operated in accordance with the printed instructions of HOBART, (2) the PRODUCT is used under the normal operating conditions for which it is designed, (3) the PRODUCT is not subjected to misuse, negligence or accident, and (4) the PRODUCT receives proper care, lubrication, protection, and maintenance under the supervision of trained personnel.
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WARNING: AT ALL TIMES, SAFETY MUST BE CONSIDERED AN IMPORTANT FACTOR IN THE INSTALLATION, SERVICING AND OPERATION OF THE PRODUCT, AND SKILLED, TECHNICALLY QUALIFIED PERSONNEL SHOULD ALWAYS BE EMPLOYED FOR SUCH TASKS.

Safety Warnings and Cautions

WARNING

ELECTRIC SHOCK can **KILL**. Do not touch live electrical parts.

ELECTRIC ARC FLASH can injure eyes, burn skin, cause equipment damage, and ignite combustible material. **DO NOT** use power cables to break load and prevent tools from causing short circuits.

IMPROPER PHASE CONNECTION, PARALLELING, OR USE can damage this and attached equipment.

IMPORTANT

Protect all operating personnel. Read, understand, and follow all instructions in the Operating/Instruction Manual before installing, operating, or servicing the equipment. Keep the manual available for future use by all operators.

WARNING

CALIFORNIA PROPOSITION 65 - DIESEL ENGINES. Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects and other reproductive harm.

1) General

Equipment that supplies electrical power can cause serious injury or death, damage to other equipment or property. The operator must strictly observe all safety rules and take precautionary actions. Safe practices have been developed from past experience in the use of power source equipment. While certain practices below apply only to electrically powered equipment, other practices apply to engine-driven equipment, and some practices to both.

2) Shock Prevention

Bare conductors, terminals in the output circuit, or ungrounded, electrically live equipment can fatally shock a person. Have a certified electrician verify that the equipment is adequately grounded and learn what terminals and parts are electrically **HOT**. Avoid hot spots on machine. Use proper safety clothing, procedures, and test equipment.

The electrical resistance of the body is decreased when wet, permitting dangerous currents to flow through it. When inspecting or servicing the equipment, do not work in damp areas. Stand on a dry rubber mat or dry wood, and use insulating gloves when dampness or sweat cannot be avoided. Keep clothing dry, and never work alone.

a) Installation and Grounding of Electrically Powered Equipment

This equipment must be installed and maintained in accordance with the National Electrical Code, ANSI/NFPA 70, or other applicable codes. A power disconnect switch or circuit breaker must be located at the equipment. Check the nameplate for voltage, frequency, and phase requirements. If only 3-phase power is available, connect any single-phase rated equipment to only two wires of the 3-phase line. **DO NOT CONNECT** the equipment grounding conductor (lead) to the third live wire of the 3-phase line, as this makes the equipment frame electrically **HOT**, which can cause a fatal shock.

Always connect the grounding lead, if supplied in a power line cable, to the grounded switch box or building ground. If not provided, use a separate grounding lead. Ensure that the current (amperage) capacity of the grounding lead will be adequate for the worst fault current situation. Refer to the National Electrical Code ANSI/NFPA 70 for details. Do not remove plug ground prongs and use correctly mating receptacles.

b) Output Cables and Terminals

Inspect cables frequently for damage to the insulation and the connectors. Replace or repair cracked or worn cables immediately. Do not overload cables. Do not touch output terminal while equipment is energized.

3) Service and Maintenance

This equipment must be maintained in good electrical condition to avoid hazards stemming from disrepair. Report any equipment defect or safety hazard to the supervisor and discontinue use of the equipment until its safety has been assured. Repairs should be made by qualified personnel only. Before inspecting or servicing this equipment, take the following precautions:

- a)** Shut off all power at the disconnecting switch, or line breaker, or by disconnecting battery, before inspecting or servicing the equipment.
- b)** Lock switch OPEN (or remove line fuses) so that power cannot be turned on accidentally.
- c)** Disconnect power to equipment if it is out of service.
- d)** If troubleshooting must be done with the unit energized, have another person present who is trained in turning off the equipment and providing or calling for first aid.

4) Fire And Explosion Prevention

Fire and explosion are caused by electrical short circuits, combustible material near engine exhaust pipes, misuse of batteries and fuel, or unsafe operating or fueling conditions.

a) Electrical Short Circuits and Overloads

Overloaded or shorted equipment can become hot enough to cause fires by self-destruction or by causing nearby combustibles to ignite. For electrically powered equipment, provide primary input protection to remove short circuited or heavily overloaded equipment from the line.

b) Batteries

Batteries may explode and/or give off flammable hydrogen gas. Acid and arcing from a ruptured battery can cause fires and additional failures. When servicing, do not smoke, cause sparking, or use open flame near the battery.

c) Engine Fuel

Use only approved fuel container or fueling system. Fires and explosions can occur if the fuel tank is not grounded prior to or during fuel transfer. Shut unit **DOWN** before opening fuel tank cap. **DO NOT** completely fill tank, because heat from the equipment may cause fuel expansion overflow. Remove all spilled fuel **IMMEDIATELY**, including any that penetrates the unit. After clean-up, open equipment doors and blow fumes away with compressed air.

5) Toxic Fume Prevention

Carbon monoxide - Engine exhaust fumes can kill and cause health problems. Pipe or vent the exhaust fumes to a suitable exhaust duct or outdoors. Never locate engine exhausts near intake ducts of air conditioners.

6) Bodily Injury Prevention

Serious injury can result from contact with fans or hot spots inside some equipment. Shut **DOWN** such equipment for inspection and routine maintenance. When equipment is in operation, use extreme care in doing necessary troubleshooting and adjustment. Do not remove guards while equipment is operating.

7) Medical and First Aid Treatment

First aid facilities and a qualified first aid person should be available for each shift for immediate treatment of all injury victims. Electric shock victims should be checked by a physician and taken to a hospital immediately if any abnormal signs are observed.

EMERGENCY FIRST AID

Call physician immediately. Seek additional assistance. Use First Aid techniques recommended by American Red Cross until medical help arrives.

IF BREATHING IS DIFFICULT, give oxygen, if available, and have victim lie down.
FOR ELECTRICAL SHOCK, turn off power. Remove victim; if not breathing, begin artificial respiration, preferably mouth-to-mouth. If no detectable pulse, begin external heart massage. **CALL EMERGENCY RESCUE SQUAD IMMEDIATELY.**

8) Equipment Precautionary Labels

Inspect all precautionary labels on the equipment monthly. Order and replace all labels that cannot be easily read.

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Introduction

This manual contains operation and maintenance information for a diesel engine-generator manufactured by Hobart Ground Power, Troy, Ohio 45373.

This manual, including all information contained thereon, is exclusive and confidential property of Hobart Ground Power. This manual is not to be copied, reproduced, or delivered or disclosed to others, in whole or in part, except with express written permission of Hobart Ground Power.

This manual is not intended to be a textbook on electricity or electronics. Its primary purpose is to provide information and instructions to experienced operators, electricians, and mechanics that have never operated this equipment. It is the intent of this manual to guide and assist operators and maintenance personnel in the proper use and care of the equipment.

Use of the manual should not be put off until trouble or a need for help develops. Read the instructions before starting the unit. Learn to use the manual and to locate information contained in it. Its style and arrangement are very similar to commercial aircraft manuals.

The manual is divided into five chapters plus an appendix. Each chapter is divided into as many sections as required. Each new section starts with page 1. Each page is identified by chapter, section and page number, which are located in the lower, outside corner.

When information located in another portion of the manual is referred to, a chapter, section, and paragraph or figure number identify its location. For example: "(see Section 2-3, Paragraph 1.a.)" refers to information located in Chapter 2, Section 3, Paragraph 1.a. If a chapter and section are not indicated in a reference, the referenced material is located in the same section as the reference, for example: "(see Paragraph 1.a.)."

The appendix is the last section. It contains a list of available options that may be purchased or have been purchased with that unit. Items on the list with check marks next to them have been added to the standard unit per the customer's order. Literature for each option follows. The appendix will help control the information in the manual making it unique to the unit purchased.

In addition to operation and maintenance instructions, the manual contains an illustrated parts list in Chapter 4 and a collection of manufacturer's literature and supplemental information in Chapter 5.

Contents of the manual are arranged as follows:

Chapter 1 Description/Operation

Chapter 2 Servicing/Troubleshooting

Chapter 3 Overhaul/Major Repair

Chapter 4 Illustrated Parts List

Chapter 5 Manufacturer's Literature

Appendix A Options

OM-2167 / Operation and Maintenance Manual
90CU420 / Series 500090 / 400 Hz. Generator Set

If you have any questions concerning your Hobart Ground Power equipment, immediately contact our Service Department by mail, telephone, FAX, or E-Mail.

Write:	Hobart Ground Power Service Department 1177 Trade Square East Troy, Ohio 45373 U.S.A.
Call Inside U.S.A.:	(800) 422-4166 (Parts) (800) 422-4177 (Service)
Call From Foreign Countries:	(937) 332-5050 (Parts) (937) 332-5060 (Service)
FAX Inside U.S.A.	(800) 367-4945
FAX From Foreign Countries:	(937) 332-5121
E-Mail :	service@hobartgroundpower.com
Web Page :	www.hobartgroundpower.com

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Chapter 1 Description/Operation

Section 1 Description

1) General

The basic generator set covered in this manual, manufactured by ITW GSE Group, Hobart Ground Power is rated at 90-kVA and designed to produce and deliver 115/200-volt, 400 Hz, 3-phase AC power to a parked aircraft or other load.

The number 500090 identifies the “model or series” of the GPU. The part number is followed by a different dash number that separates the basic units available. Figure 1 uses the part number to identify the variations covered in this manual.

Part & Dash Number	Model Description
500090-101	Single Output, Trailer Mounted, Vertical Exhaust
500090-102	Dual Output, Trailer Mounted, Vertical Exhaust
500090-103	Single Output, Fixed Mounted, Vertical Exhaust
500090-104	Dual Output, Fixed Mounted, Vertical Exhaust
500090-105	Single Output, Trailer Mounted with 28.5 VDC TR, Vertical Exhaust
500090-106	Single Output, Fixed Mounted with 28.5 VDC TR, Vertical Exhaust
500090-201	Single Output, Trailer Mounted, Horizontal Exhaust
500090-202	Dual Output, Trailer Mounted, Horizontal Exhaust
500090-203	Single Output, Fixed Mounted, Horizontal Exhaust
500090-204	Dual Output, Fixed Mounted, Horizontal Exhaust
500090-205	Single Output, Trailer Mounted with 28.5 VDC TR, Horizontal Exhaust
500090-206	Single Output, Fixed Mounted with 28.5 VDC TR, Horizontal Exhaust

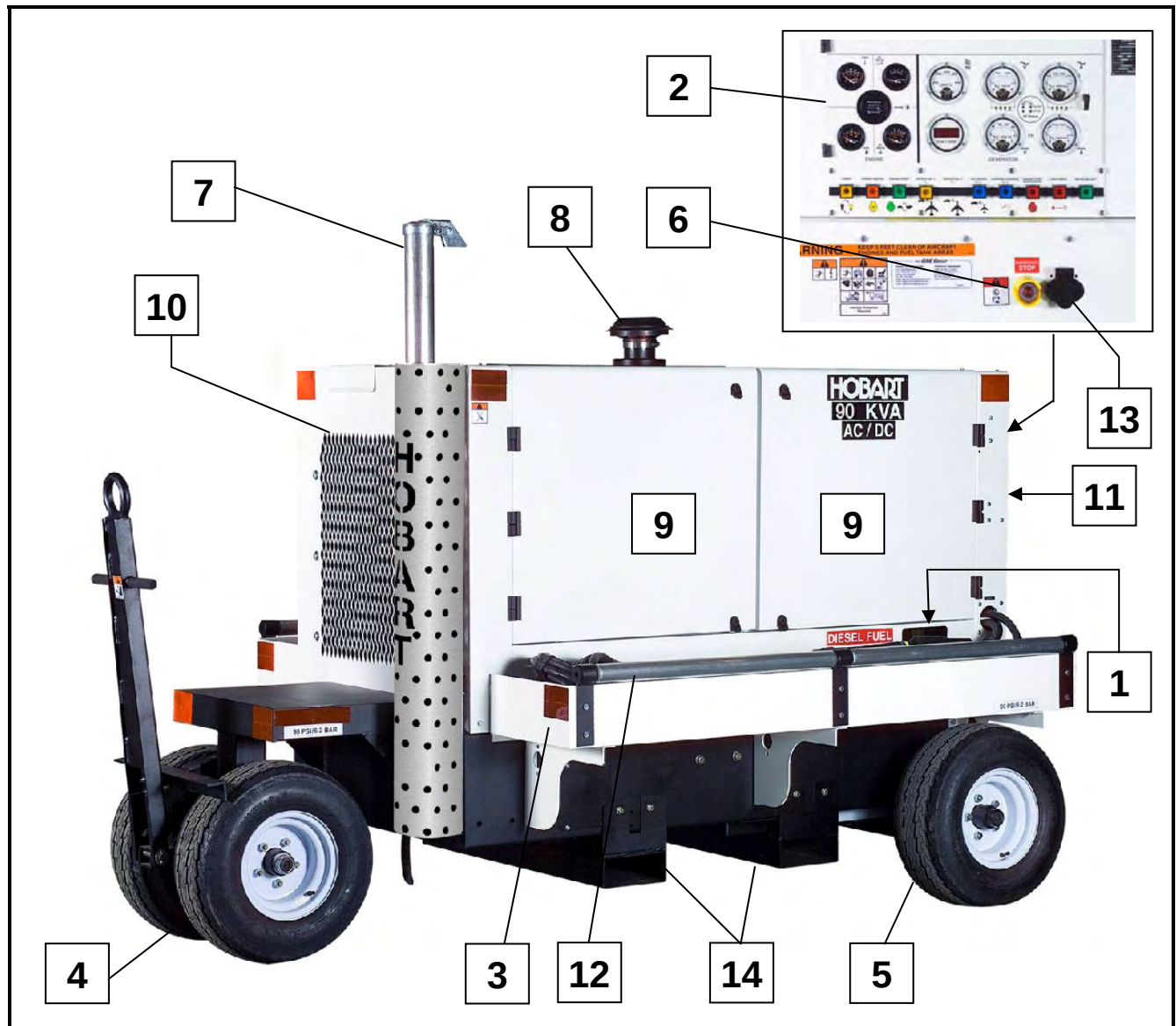
Series 500090 Generator Set Part Number Descriptions
Figure 1

2) Optional Equipment - Appendix A

Chapters 1 through 5 of this Operation and Maintenance Manual identify only the “strip down” version of the 90CU420 generator set. A list of optional equipment which makes this manual unique to the generator set that was purchased appears in Appendix A. A few items included in Appendix A are beacon lights, forklift pockets, 28 VDC transformer-rectifiers, etc.

3) Orientation

For purpose of orientation when designating RIGHT and LEFT throughout this manual, the radiator is considered to be at the FRONT of the unit and the generator and controls are at the REAR. RIGHT and LEFT are determined by standing at the REAR facing the machine. As an example, the fuel filler neck is mounted on the LEFT REAR side of the unit.



- | | |
|-----------------------------------|--|
| 1. Fuel Filler Neck | 8. Engine Air Intake |
| 2. Operator's Control Panel | 9. Lift Off Access Doors |
| 3. Output Cable Trays | 10. CAC/Radiator End |
| 4. 5 th Wheel Assembly | 11. Generator End |
| 5. Rear Drop Axle Assembly | 12. Cable Rollers (optional) |
| 6. Emergency Stop Switch (S28) | 13. Block Heater Receptacle (optional) |
| 7. Exhaust Stack Outlet | 14. Forklift Pockets (optional) |

General Assembly of Generator Set
Figure 2

Physical	Basic Unit (Fixed Mount)	With Trailer
Length	74 in. (1880 mm)	101 in. (2570 mm) w/ tow bar up
Width	67 in. (1702 mm)	67 in. (1702 mm)
Height	59 in. (1499 mm)	67 in. (1702 mm)
Weight	4000 lb. (1814 kg.)	4300 lb. (1950 kg.)
Weight with 28.5 VDC T-R	3700 lb. (1678 kg.)	4000 lb. (1814 kg.)
AC GENERATOR		
Output power rating	90 kVA (72 kW)	
Output voltage	115 / 200 VAC	
Rated load capacity	261 Amps	
Frequency	400 Hz.	
Power factor	0.8	
Duty Cycle	100%	
Operating speed	2000 RPM	
Overload capacity 125% rated load	326 Amps	
Output cable size	2/0	
GENERATOR PROTECTIVE SYSTEM		
Over voltage	Trips at 124-126 volts after a 1 second time delay. Trips at 140 volts in 160 milliseconds. Trips at 180 volts in 50 milliseconds.	
Under voltage	Trips at any voltage below 104 volts after 7 seconds.	
Over frequency	Trips at any value above 420 Hz after a 5 second time delay. Trips immediately at any frequency exceeding 480 Hz.	
Under frequency	Trips at 380 Hz. or less after a 7 second time delay.	
Overload time delay	Trips in 5 minutes at 125% load of 90-kVA on one or two outputs.	
DC OUTPUT (OPTIONAL, SEE APPENDIX A)		
Continuous Output Voltage and Amps	28.5 VDC and 600 A	
Amps (Peak/Starting/Overload)	2700 A for 2 seconds 2000 A for 10 seconds 1500 A for 30 seconds 1200 A 90 seconds 750 A 600 seconds	
DIESEL ENGINE		
Manufacturer and Model	Cummins Engine Company / QSB4.5	
Type	4 cylinder, 4 cycle diesel, electronic controlled	
Bore and Stroke	4.21 in. x 4.88 in. (107 mm x 124 mm)	
Displacement	275 in ³ (4.5 L)	
Horsepower	155 hp (116 kW)	
Idle speed	1000 ± 50 rpm	
Normal governed speed	2000 rpm	
Firing Order	1-3-4-2	
Electrical system	12 VDC	
Lubricating oil capacity (w/ filter)	11.6 quarts (11 liters)	
Coolant capacity system	20 quarts (18.9 liters)	

Specifications and Capabilities
Figure 3

4) Special Features

The generator set has special features that are described more fully under the assemblies in which they appear.

a) Protective Monitoring

The protective monitoring system receives signals from the fault sensing components in the generator output circuit and functions to cause the load to be disconnected from the generator if an abnormal condition of voltage, frequency, or load develops.

b) Voltage Regulator

A microprocessor-type, adjustable voltage regulator provides automatic voltage regulation at the aircraft. The regulated out is also adjustable for a variety of output cable sizes and lengths.

c) Engine Electronic Control Module

The engine is equipped with an electronic control module that monitors, records, and controls engine performance.

d) Battery System Disconnect Switch

The generator set is equipped with a battery disconnect switch inside the unit on the LEFT side. The disconnect switch can be placed in the off position during long periods of shutdown.

5) Canopy

A sheet metal enclosure, identified as a canopy, provides protection for the engine, generator and electrical controls. The canopy is designed to reduce the operational noise level in the immediate area of the machine.

6) Engine and Generator

The engine and generator comprise the principal components of the generator set. They are mounted on a welded steel frame chassis. Some of the following figures are showing the locations of all major components and sub-assemblies.

a) Diesel Engine

The diesel engine is a fuel injection, 4-cylinder, electronically controlled engine rated at 155 horsepower. See Figure 3 for specifications and capabilities.

b) Generator



The 400 Hz generator is a brushless, dual bearing, revolving field, three-phase, alternating current type. The front end of the rotor shaft extends forward beyond the front bearing and is coupled to the engine flywheel by a flexible coupling assembly. The rear end of the rotor shaft extends rearward beyond the rear bearing and into the exciter stator housing. The exciter rotor is mounted on this shaft extension with a key and is secured by a washer and 1/2-13 thread cap screw. A rectifier has six diodes mounted on the exciter rotor and converts exciter AC output to DC for excitation of the generator revolving fields. The exciter

DC output to the generator fields, and consequently the generator output, is controlled by the voltage regulator PC board (REG). A centrifugal, radial-blade fan draws cooling air over all internal windings. Air enters at the exciter end and is discharged at the drive end. The complete generator assembly is bolted to the engine's flywheel and housing.

c) Engine Manufacturer's Components

As received from the engine manufacturer, the engine includes some of the following components, which are more fully described in the engine manufacturer's manual.

(1) Electrical System

The 12 VDC electrical generating and starting system includes an alternator and starter with solenoid switch.

(2) Lubricity Additive Fuel Filter

The fuel filter is a spin-on disposable type located on the inside near the engine's fuel pump. The fuel filter's primary function, other than remove contaminants from the fuel, is to automatically add a lubricity additive to the fuel. Although, the engine manufacturer does not recommend low lubricity fuels, this additive can extend the life of the fuel pump.

CAUTION

The use of low lubricity fuels can shorten life and/or damage the engine's fuel pump. Only diesel fuel is recommended by the engine manufacturer. Refer to engine manufacturer's manual for approved fuels.

(3) Oil Filter

The engine oil filter is a spin-on, full-flow type, located on the right side of the engine near the front.

(4) Pre-programmed Electronic Control Module (ECM)

The ECM is a pre-programmed engine control module, mounted directly to the engine block.

d) Factory Installed Components and Protective Systems

This generator set is assembled at the factory with some of the following components and protective systems:

(1) Emergency Shutdown / Reset Switch (S28)

The emergency shutdown switch has two purposes. One is to reset the starting circuit following a failed starting sequence. The other is to provide instant manual shut off of the generator set by disconnecting power to the ECM through the control box. It is located on the rear of the generator set under the control box.

To operate the **EMERGENCY SHUTDOWN/RESET SWITCH**:

- Push button in until engine stops or until button travel stops
- Pull the button back out to reset

(2) Coolant high temperature shutdown system

The coolant temperature shutdown system consists of a factory supplied temperature switch. This switch is monitored by the microprocessor on the EIB ("Engine Interface Board") PC Board, which will stop the engine if the temperature reaches 210° F (99° C).

(3) Low coolant shutdown system

The low coolant shutdown system consists of an engine manufactured supplied switch. This switch is mounted in the radiator top tank and monitored by the engine's ECM, which will stop the engine when a low coolant level is reached.

(4) Oil pressure shutdown system

The oil pressure shutdown system consists of a factory supplied oil pressures switch. This switch is monitored by the microprocessor on the EIB ("Engine Interface Board") PC Board, which will stop the engine if the oil pressure is under 12 PSI (82.7 kPa).

(5) Low fuel shutdown system

The low fuel shutdown system monitors the fuel level in the fuel tank. When the fuel tank level reaches approximately $\frac{1}{4}$ tank the word "fuel" is displayed on the fault code gauge signifying that it is time to put fuel in the tank. Once the fuel level reach approximately $\frac{1}{8}$ tank the engine will shutdown.

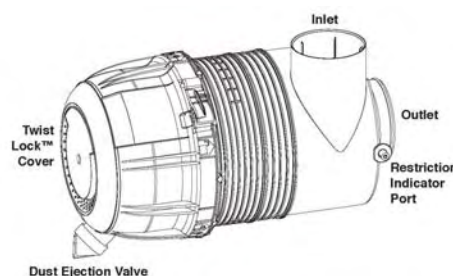
(6) Radiator and Charge-Air-Cooler (CAC)

The radiator and charge-air-cooler is a two-piece type designed for long periods of operation without servicing. Refer to Section 2-1 for servicing procedure.

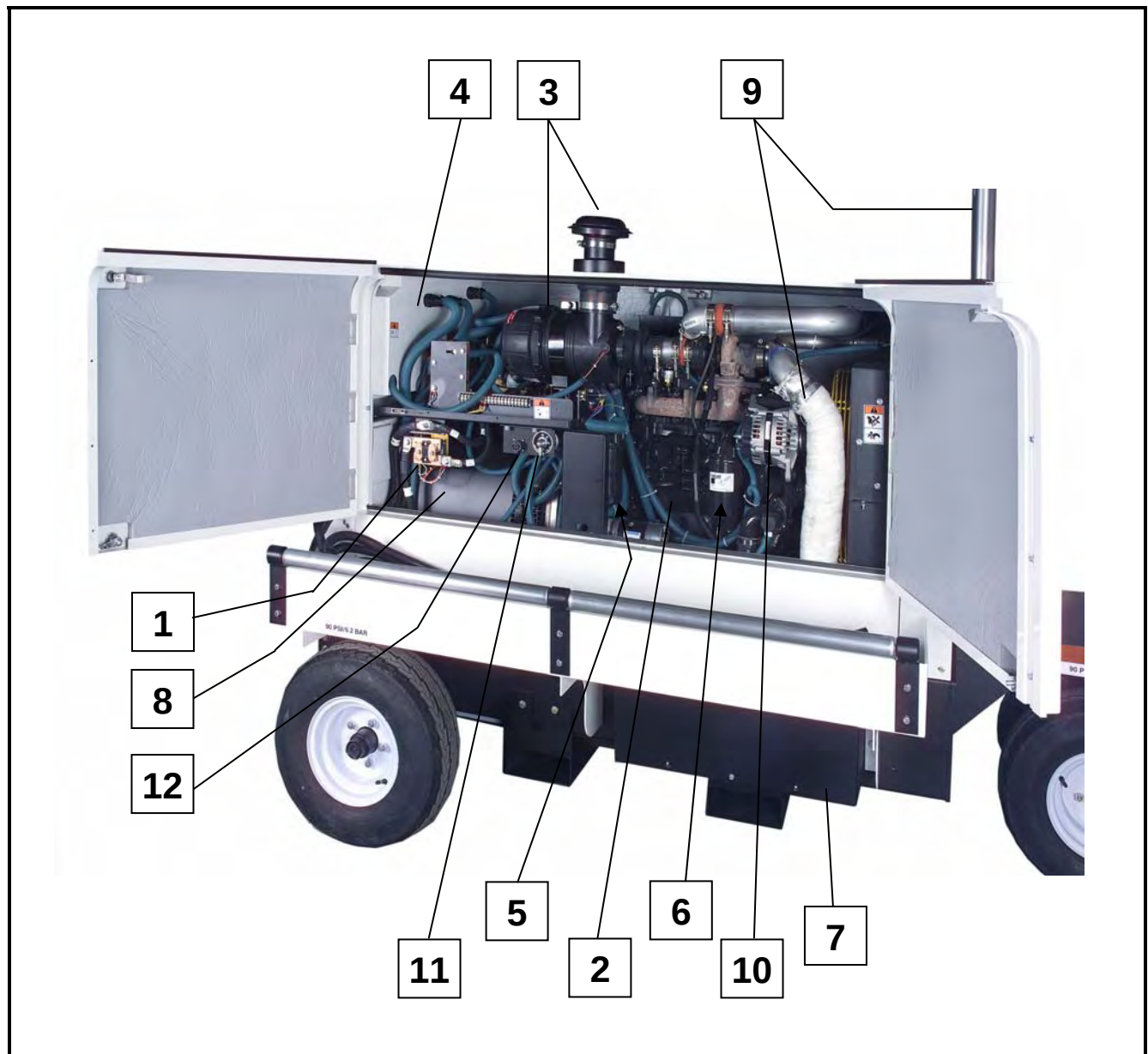
(7) Engine-cooling fan

The engine fan is designed to blow air outward through the radiator, rather than pulling the air inward as a conventional fan does.

(8) Air cleaner

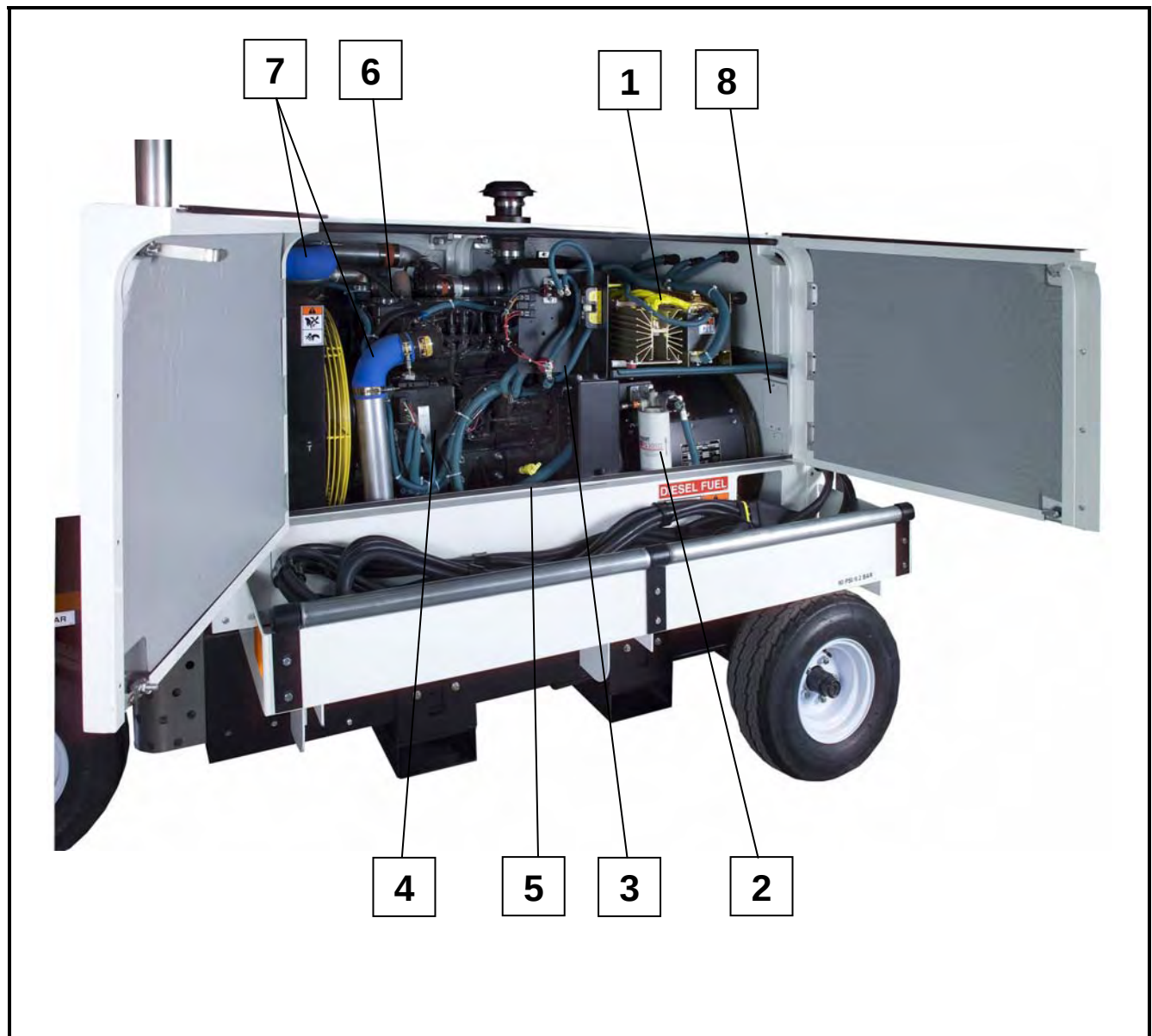


The diesel engine air cleaner is so constructed that air enters through its cylindrical body, and then is filtered before being passed into the engine turbo-charger assembly. An air cleaner service indicator device is mounted on the air cleaner assembly to monitor the airflow into the air cleaner. As the air cleaner becomes filled with dust, dirt, and carbon, the intake system airflow becomes increasingly restricted. This restriction causes a diaphragm inside the indicator to move toward an electrical contact. When the maximum allowable restriction level is reached, the circuit closes and the air cleaner indicator fault appears on the control panel fault display to warn the operator that the air cleaner must be changed. The electrical indicator automatically resets when the restriction level drops sufficiently.



- | | |
|--|---|
| 1. 28.5 VDC Contactor (optional) | 7. 12 VDC Batteries (incase in housing) |
| 2. Cummins QSB4.5 Engine | 8. Generator |
| 3. Air Filter Assembly | 9. Turbo Exhaust Pipe / Exhaust Outlet |
| 4. Operator's Control Panel (back side) | 10. Engine Alternator |
| 5. Engine Fuel Filter (behind support leg) | 11. Battery Disconnect Switch |
| 6. Engine Oil Filter | 12. Engine ECM Connector |

Main Components of Generator Set (Right Side)
Figure 4



- | | |
|--|---|
| 1. 28.5 VDC Transformer-Rectifier (optional) | 5. Engine Oil Level Check |
| 2. Lubricity Additive Fuel Pre-Filter | 6. Engine Air Intake Heater |
| 3. Engine Electronic Fuse and Relay Panel | 7. Charge-Air-Cooler Piping |
| 4. Engine Control Module (ECM) | 8. Power Module / Contactor Panel (back side) |

Main Components of Generator Set (Left Side)
Figure 5

7) Control Box Assembly

The control box is a sheet metal enclosure that houses and provides mounting facilities for engine and generator controls, as well as, monitoring device and circuits.

a) Control Panel

The control system is divided into two sections. On the left side of the control panel are engine monitoring meters. On the right side of the control panel are generator monitoring meters. Below the control panel are push-button switches for operating the generator set.

(1) Engine Monitoring Section

- Engine hour meter (M4)

The hour meter is electrically driven from the 12 VDC battery system. The hour meter measures and records the engine's running time and will record up to 9999.9 hours on five revolving drums. It is only functional when the engine is running.

- Engine oil pressure gage (M25)

The oil pressure gage is an electrical type that is connected by a wire to an oil pressure sensor installed in the engine lubricating system. The range is 0 to 125 PSI (0 to 862 kPA).

- Engine coolant temperature gage (M24)

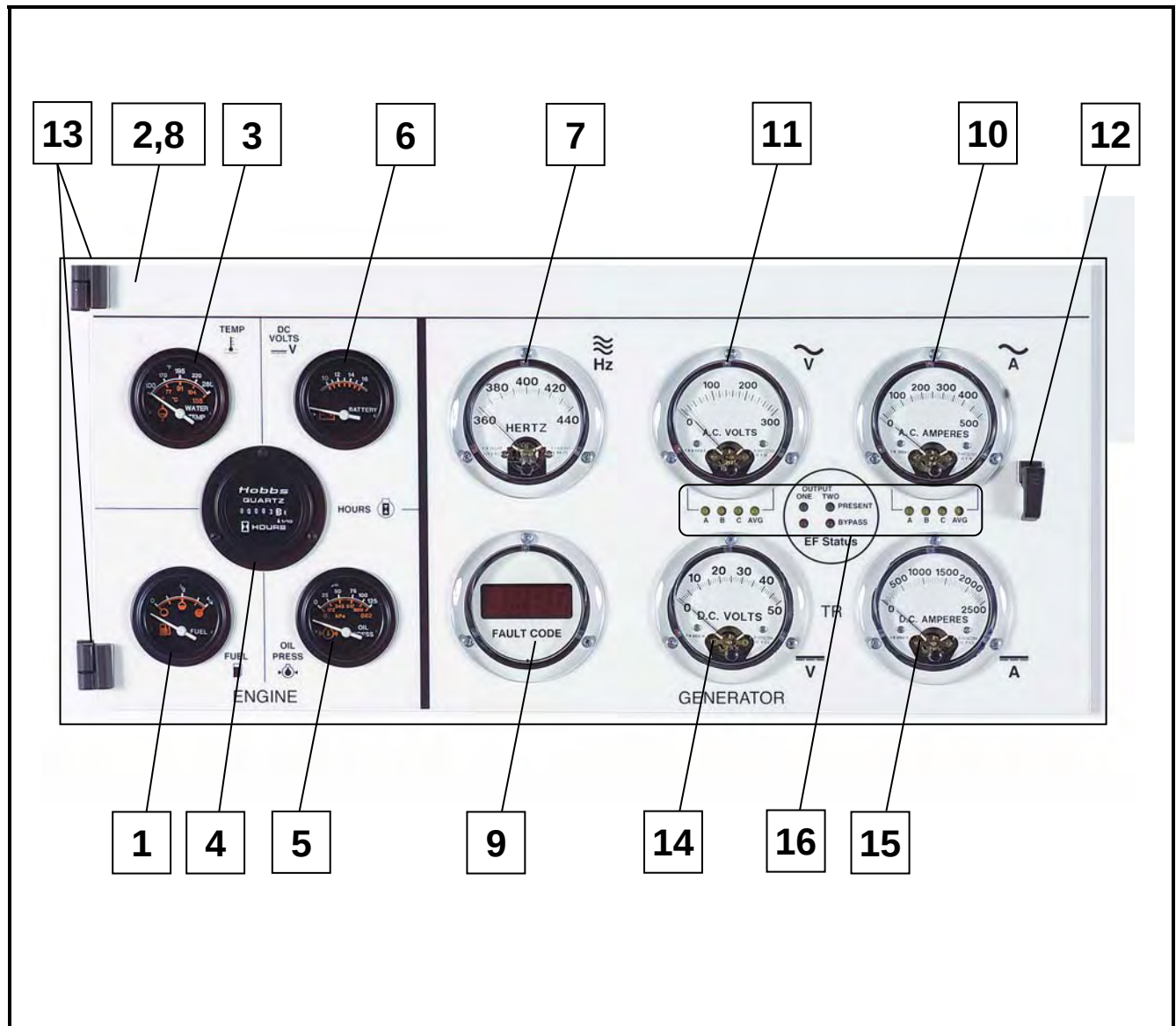
The temperature gage is an electrical type that is connected by a wire to a water temperature sensor installed in the engine cooling system. The gage indicates engine coolant temperature in the range of 100-280 ° F (38-138° C).

- Engine voltmeter (M5)

The ammeter indicates the direction and value of current flow from or to the 12 VDC battery. Its graduated 10 V to 16 V.

- Engine fuel gage (M13)

An electric fuel gauge receives its controlling signal from a sending unit in the fuel tank. 12 VDC operating power is supplied to the fuel gauge when the "**ENGINE START**" push-button switch is pressed. The fuel level can also be checked when the unit isn't running by pressing the panel light "**LAMPS**" push-button switch.



- | | |
|---|--|
| 1. Fuel Gage (M13) | 9. Fault Code Meter (M6) |
| 2. Door Assembly Panel | 10. AC Generator Ammeter (M1) |
| 3. Engine Coolant Temperature Gauge (M24) | 11. AC Voltmeter (M2) |
| 4. Running Time Meter (M4) | 12. Adjustable Grip Door Latch |
| 5. Oil Pressure Gage (M25) | 13. Control Panel Door Hinges |
| 6. Battery Voltmeter (M5) | 14. DC Voltmeter [Optional, included with TR] |
| 7. Frequency Meter (M3) | 15. DC Ammeter [Optional, included with TR] |
| 8. Control Panel Laminate | 16. LED PC Board (A5) [Not Shown, Opposite Side] |

Control Panel Door
Figure 6

(2) Generator Monitoring Section

- Frequency Meter (M3)

The frequency meter is an analog type and indicates the frequency of the generator output alternating current in the range of 360 to 440 Hz (cycles per second).

- Voltmeter Meter (M2)

The voltmeter indicates the generator output voltage in each phase-to-neutral (A-N, B-N and C-N) or phase-to-phase (A-B, B-C and C-A) as selected by the "METER SELECT" switch. The voltmeter has a scale of 0 to 300 V.

- Ammeter Meter (M1)

The ammeter indicates the generator output current in each phase (A, B and C) as selected by the "METER SELECT" switch. The ammeter has a scale of 0 to 520 A.

- Front LED Display (A5)

The front LED display signifies to the operator which voltage (A-N, A-B, etc...) and amperage are shown on the meters, as well as, when "EF BY-PASS" is present or bypassed. This "EF BY-PASS" indicator serves to warn the operator that if the plug interlock system was bypassed any exposed cable may be live.

- Fault Code meter (M6)

The function of the fault code meter is to indicate to the operator, that an abnormal condition of over voltage, under frequency, etc. occurred, which caused the protective monitoring system to function. When one of the circuits is activated, it shows the code on the fault code meter.

Engine fault codes will be shown to warn the operator of abnormal engine operations that must be corrected. These indicators are over temperature, air cleaner restriction, low oil pressure, and low fuel indication.

- DC Voltmeter [Optional with TR, Reference Appendix A]

The voltmeter monitors and displays the transformer-rectifier's output voltage. The voltmeter is an analog type and indicates the output voltage from 0 to 50 VDC.

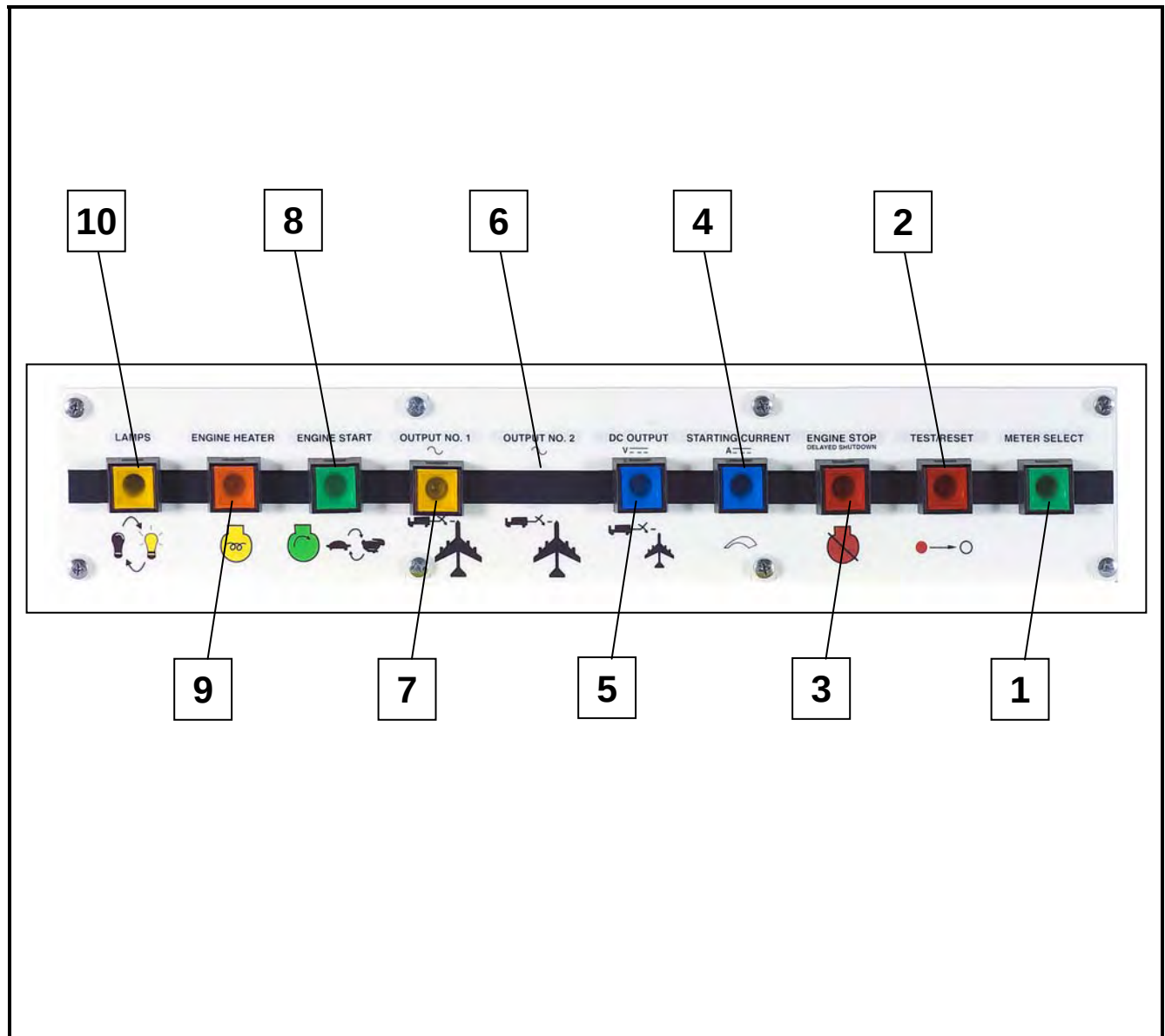
- DC Ammeter [Optional with TR, Reference Appendix A]

The ammeter monitors and displays the transformer-rectifier's output current. The ammeter is an analog type and indicates the output voltage from 0 to 2500 A.

(3) Operator's Pushbutton Section

- "LAMPS" push-button switch (S74)

The "**LAMPS**" push-button switch controls the lights. Meters are lighted from inside the control panel.



- | | |
|---|--|
| 1. Meter Selector Switch (S3) | 6. AC Output No. 2 Contactor Switch (S275) |
| 2. Test/Reset Switch (S77) | 7. AC Output No. 1 Contactor Switch (S75) |
| 3. Engine Stop Switch (S76) | 8. Engine Start Switch (S24) |
| 4. DC Starting Current Switch (S431) [Optional with TR] | 9. Air Intake Heater Switch (S79) |
| 5. DC Output Contactor Switch (S430) [Optional with TR] | 10. Panel Light Switch (S74) |

Control Push-Button Switch Panel
Figure 7

- “ENGINE HEATER” push-button switch (S79)

The “**ENGINE HEATER**” push-button switch activates the standard cold starting aid (manifold air intake heater), which is totally controlled by the engine’s ECM. Once the heater is activated, the engine’s ECM will control the operation. The heater typically stays on for a period of approximately 30 seconds, which is indicated by the light on the push-button. When the light goes out, the engine is ready to start. Starting a cold engine without first warming the engine will lead to excessive white smoke exhaust and the engine may be hard to start.

- “ENGINE START” push-button switch (S24)

The “**ENGINE START**” push-button switch, when pressed, connects 12 VDC power to the starter solenoid coil, which actuates the solenoid switch to connect power to the engine starting motor. The 12 VDC power is supplied directly to the engine ECM and the oil pressure shutdown switch is bypassed (This bypass is necessary for engine starting because the low oil pressure switch is CLOSED until the engine is running normally). The green indicator light will blink.

When pressed a second time, this push-button switch provides a signal to the ECM to adjust the engine speed to 2000 RPM. The green indicator light will glow continuously. At the same time, a ground signal is provided to the regulator, enabling the generator to build up voltage for 400-Hz generator output. Pressing the push-button switch once more removes these signals and the engine reverts to idle speed and a blinking green indicator light.

- Engine ON indicating light (DS58)

When the engine is running at idle speed, a green indicating light, within the “**ENGINE START**” push button switch, flashes at a rate of 1 second on, 1 second off. When the engine is running at rated speed, the light will stay on continuously.

- “ENGINE STOP” push-button switch (S76)

When the “**ENGINE STOP**” push-button switch is pressed, the red indicator will blink. Then a 3 to 5 minute delay will occur to permit the turbo and other engine components to cool evenly. After the delay, power is disconnected from the engine ECM causing the engine to shut down.

- Output push-button switch(s) [Yellow # 1 and/or Orange # 2] (S75, S275)

The load contactor push button switch, when pressed, closes the output contactor and turns on the respective indicating light within contactor control push-button switches (“**OUTPUT NO. 1**” and or “**OUTPUT NO. 2**”), indicating that power is available at the plug. When the load contactor opens for any reason, the light is turned OFF.

- Fault Code meter and “**TEST/RESET**” push-button switch (M6, S77)

The function of the fault code meter is to indicate to the operator, that an abnormal condition of over voltage, under frequency, etc. occurred, which caused the protective monitoring system to function. When one of the circuits is activated, it shows the code on the fault code meter. The fault will remain on for a short period of time or until the “**TEST/RESET**” push-button switch is pressed. Pressing the “**TEST/RESET**” push-button switch can also test the fault code meter operation. A meter test should be performed only when disconnected from a load, as the contactor(s) will open during the test cycle.

- **“STARTING CURRENT” Switch (S431)** [Optional with TR, Reference Appendix A]

Each time the **“STARTING CURRENT”** push-button switch is pressed, the BLUE indicator will glow. The present current limiting amperage setting will be displayed on the fault code meter for a short time delay, before incrementing, at 100 A increments, up to 2500 A. Once 2500 A has been reached, the incrementing will start over from the beginning.

- **“DC OUTPUT” Contactor Switch (S430)** [Optional with TR, Reference Appendix A]

Each time the **“DC OUTPUT”** push-button switch is pressed, the BLUE indicator will glow when the circuit is energized, indicating that power is available at the plug. When the load contactor opens for any reason, the light is turned OFF.

b) Control Box Interior Components

- (1) EF Bypass switches (located on CTL)

For each load contactor circuit, a single-pole, single-throw **“EF1 BYPASS”** for **“OUTPUT 1”** or **“EF2 BYPASS”** for **“OUTPUT 2”** provides a means of bypassing the 28 VDC interlock circuit for that contactor when supplying power to a load bank or to an aircraft not equipped with a plug interlock system.

- (2) Regulated-diagnostic switch (located on the REG)

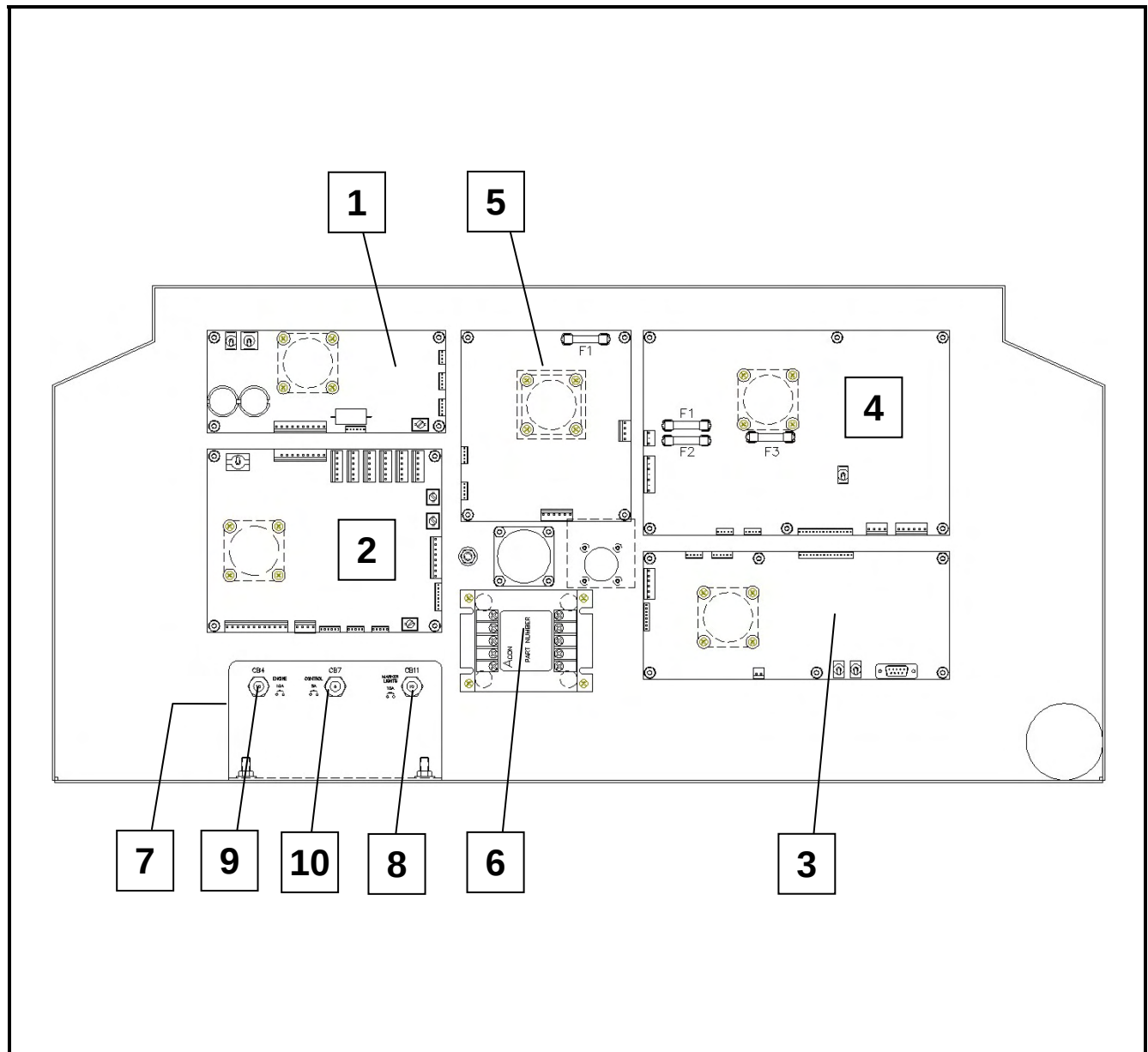
When the **“REGULATED/DIAGNOSTIC”** switch is in the **“REGULATED”** (down) position, the generator output voltage is regulated by the PC board for 115/200 VAC output to an aircraft. When this switch is placed in the **“DIAGNOSTIC”** (up) position, 12 VDC is applied to the generator exciter with the engine running at rated RPM, in order to check the operation of the generator. This is done to determine if a particular power output malfunction is caused by a defective generator or by a defective voltage regulator. When this switch is in the MAINTENANCE position, no current is supplied to the generator exciter. In this condition, a low-level, unregulated voltage of approximately 30 VAC will be produced at the generator output terminals due to the residual magnetism of the exciter.

- (3) Circuit breakers (CB1, CB4, CB7)

A 10-ampere **“ENGINE”** circuit breaker, protects the 12 VDC engine electrical and fault circuits, and another 10-ampere **“MARKER LIGHTS”** circuit breaker protects the 12 VDC lighting system. A 5-ampere **“CONTROL”** circuit breaker protects the 12 VDC control system.

- (4) Digital Control PC Board [CTL] (A3)

The digital control PC board is the center for all communications throughout the entire control system. All push-button panel commands run through the digital control PC board and will communicate the commands to the appropriate area (i.e. other PC boards) in the control system. The digital control PC board also controls the real time clock, monitors the over/under voltage and overload protection, push-button panel indicator lights, generator output meters, EF bypass switches, and communicates with the optional service tool.



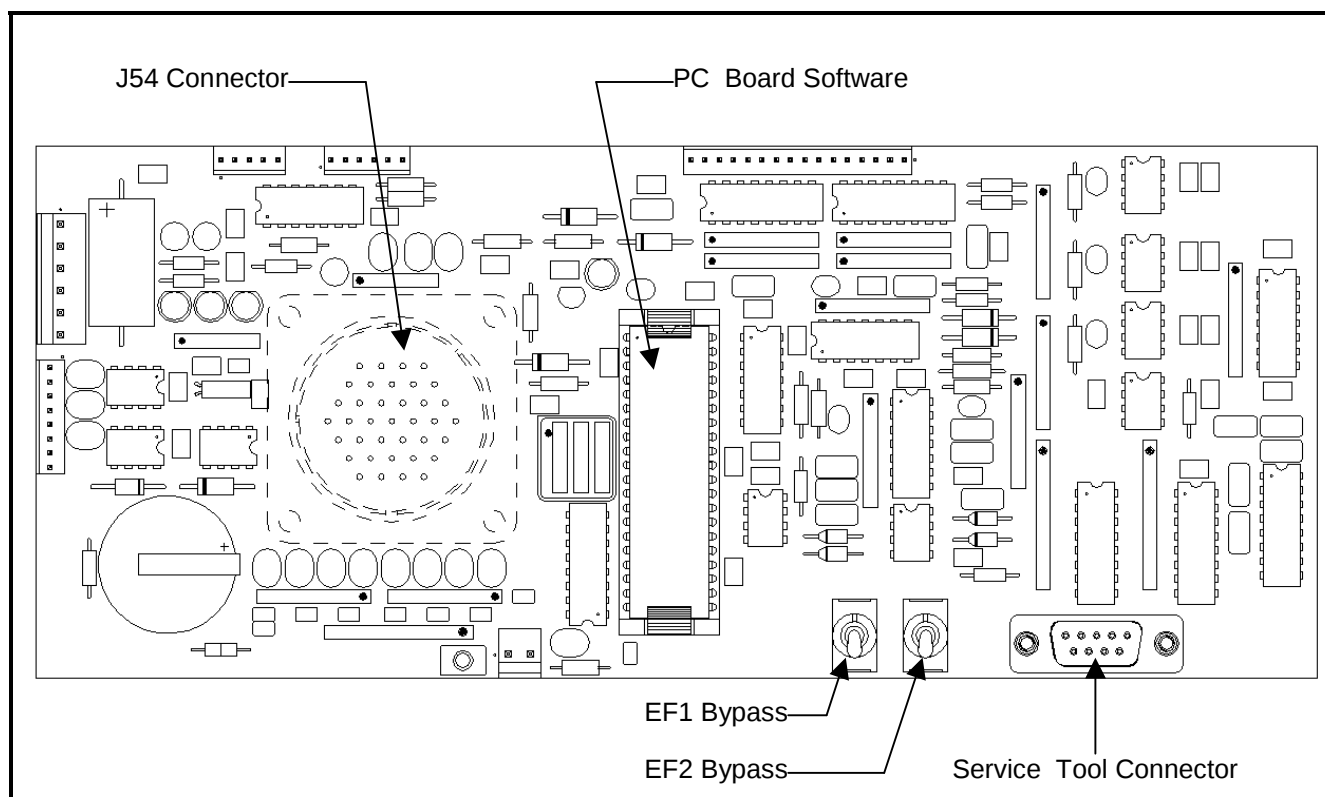
- | | |
|---|--|
| 1. Engine Specific PC Board [ESB] (A1) | 6. +5, -12 VDC Power Supply (PS1) |
| 2. Engine Interface PC Board [EIB] (A2) | 7. Circuit Breaker Support Bracket |
| 3. Digital Control PC Board [CTL] (A3) | 8. Marker Lights Circuit Breaker, 10 A (CB1) |
| 4. Voltage Regulator PC Board [REG] (A4) | 9. Engine Circuit Breaker, 10 A (CB4) |
| 5. Transformer-Rectifier PC Board [TRB] (A404) {Optional} | 10. Controls Circuit Breaker, 5 A (CB7) |

Control Box Interior Components
Figure 8

(5) Engine Interface PC Board [EIB] (A2)

The EIB is common between all engine models and monitors coolant temperature, oil pressure, battery voltage, and fuel tank level monitoring. The EIB is also responsible for the monitoring the warning switches for high coolant temperature, low oil pressure, high air restriction, and low coolant level (optional). The warning switches signal the EIB when a fault occurs, which then the EIB relays this information to the CTL. The CTL will issue the command to the system that fits the fault event.

The EIB also controls the power distribution in the control system, hour meter, lights, and the engine starter operation.

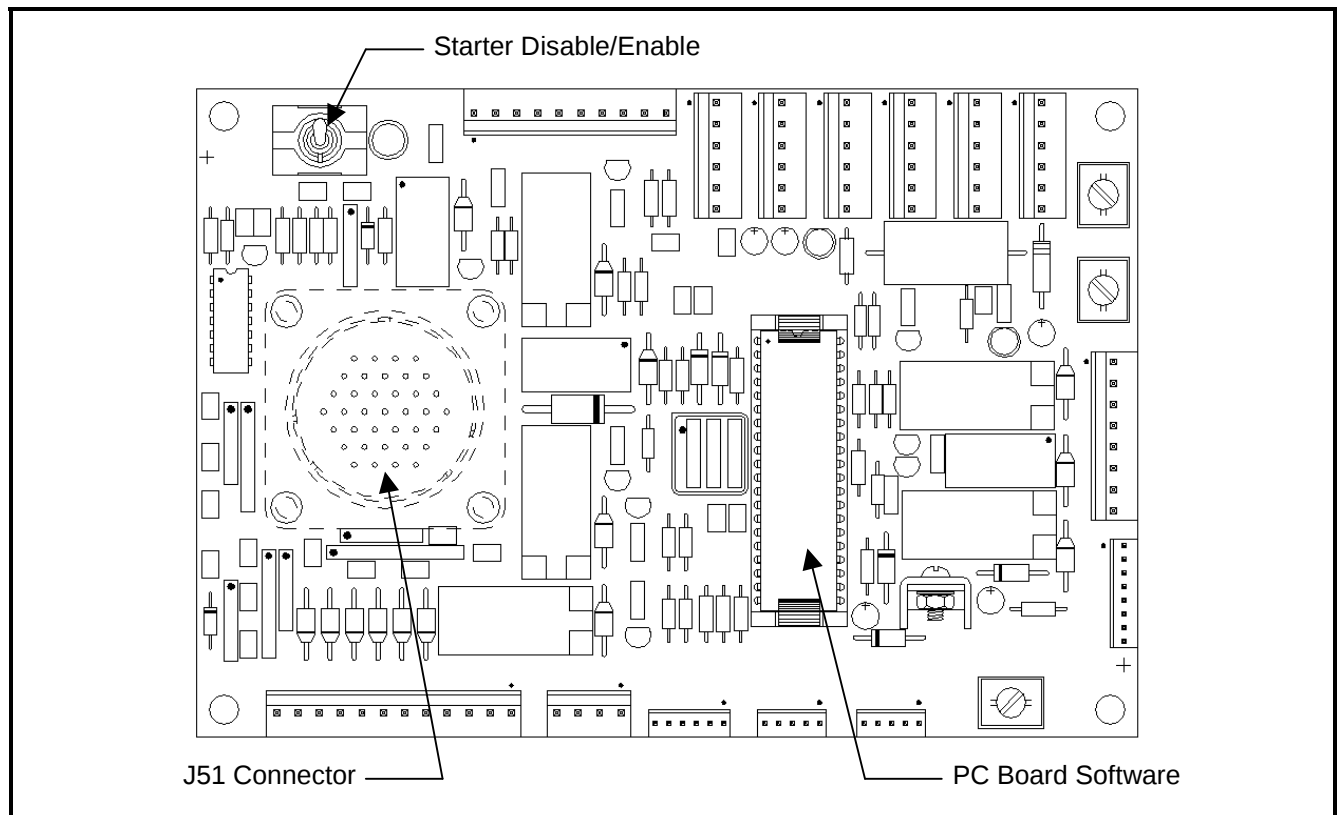


Digital Control PC Board
Figure 9

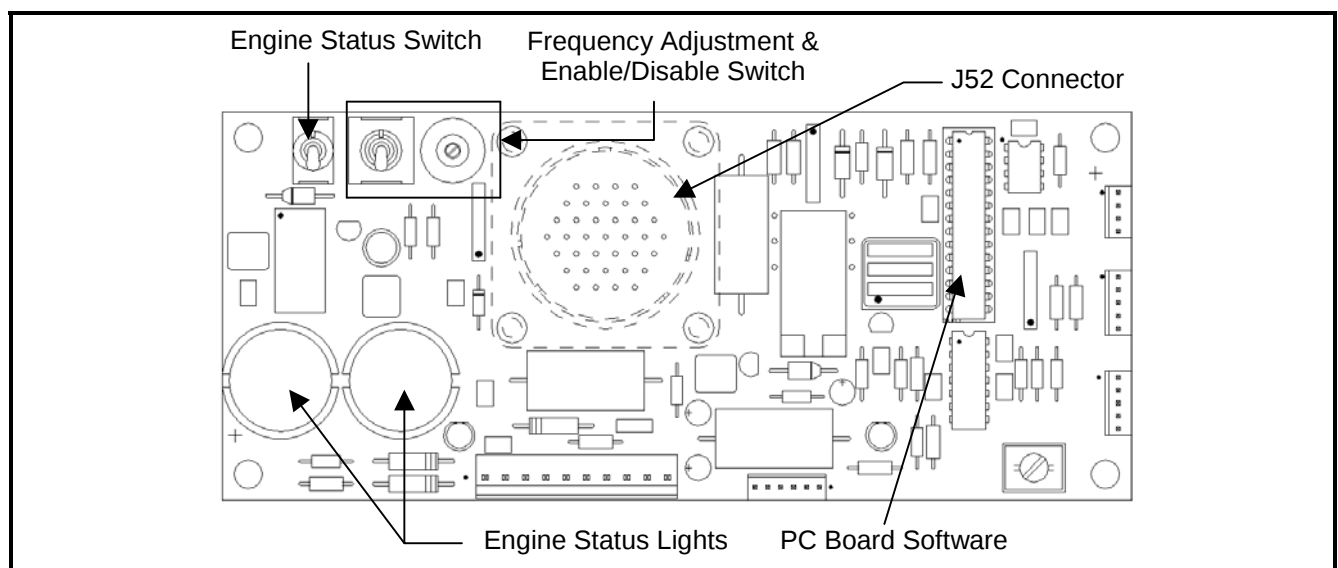
(6) Engine Specific PC Board [ESB] (A1)

The ESB is unique only to the engine model used in the GPU purchased. The ESB is the primary interface between the control system and the engine's electronic control module. When the CTL senses the engine start button has been pressed it signals to the ESB, which then communicates to the engine control module what mode of operation is required (idle or rated speed).

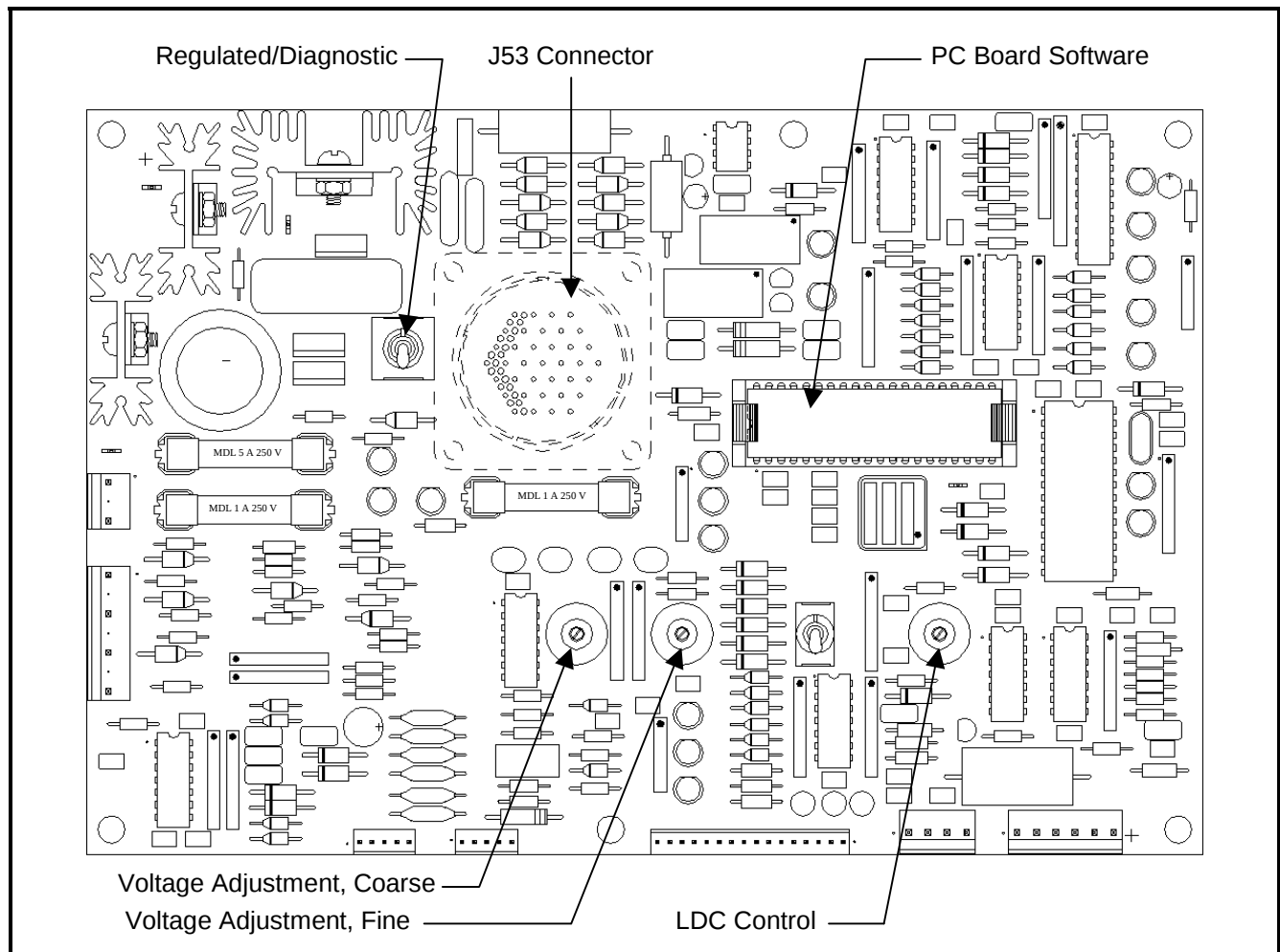
The ESB controls the "**FREQUENCY ADJUST**" switch that is used to enable the "**FREQUENCY ADJUST ENABLE/DISABLE**" potentiometer to test the over/under frequency fault limits of the generator set system. The ESB also controls the "**DATA REQUEST**" button and diagnostic indicator light to read the engine's ECM diagnostic error codes.



Engine Interface PC Board
Figure 10



Engine Specific PC Board
Figure 11



Voltage Regulator PC Board
Figure 12

(7) Voltage regulator PC board [REG] (A4)

This voltage regulator PC board is designed to provide voltage regulation for a three-phase, four-wire, 115/200-volt, 400-Hz brushless alternator. This regulator provides field excitation power as required to meet varying alternator load conditions to hold the alternator voltage constant. In addition, the voltage regulator PC board circuitry provides line drop compensation. Any deviation of the alternator voltage from its set, regulated level is sensed at the voltage regulator PC board. The sensing signal is compared to a reference signal, and, with associated circuitry, varies the field power supplied to the rotary exciter.

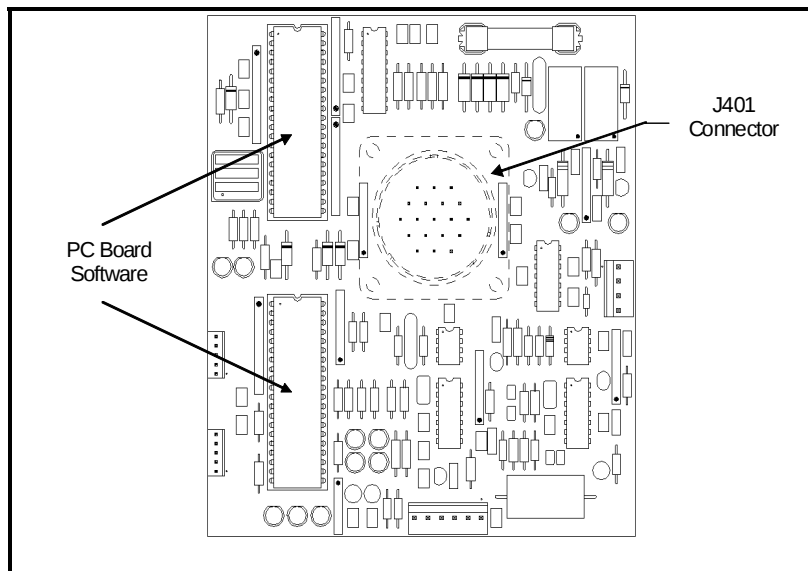
- When the machine is started, and the engine is at rated speed, the rotary exciter is excited from alternator residual magnetism through the half-wave rectifier-bridge, located on the voltage regulator PC board assembly. As the rotary exciter voltage increases, alternator excitation increases and the alternator voltage builds up. The sensing circuit of the voltage regulator PC board then compares the input voltage to a reference voltage and adjusts the field power of the rotary exciter to bring the voltage into regulation limits.

- When the alternator is loaded, its terminal voltage decreases, lowering the rectified three-phase voltage of the voltage sensing circuit. The sensing voltage is low in respect to its reference voltage, causing the voltage regulator PC circuitry to increase the power to the field of the rotary exciter. The alternator voltage increases until the voltage returns to its regulated value.
- When a load is removed from the alternator, the alternator voltage rises. The rectified three-phase voltage-sensing signal increases, causing this signal to be higher than the reference signal. The associated voltage regulator circuitry causes the field power of the rotary exciter to decrease, lowering the alternator voltage until the voltage returns to regulated value. The line drop voltage compensation circuit consists of a current transformer on each phase of the load circuit, and fixed resistance in parallel with each current transformer. The current transformers detect the magnitude of current flowing through the power cables from the alternator to its load and feed a signal into the voltage regulator PC board. The PC board processes this signal to change the output voltage proportional to the current draw. The regulator output increases slightly so that the alternator output voltage is equal to the regulated voltage plus the voltage drop in the lines. The line drop compensation potentiometer may be adjusted to match exactly the voltage drop of the power cables carrying the load current.

The under/over frequency protection, EF signal, and lost neutral detection are also monitored by the REG and will signal the CTL when a fault has occurred. The CTL issues the appropriate command that corresponds to the fault.

(8) Transformer-Rectifier PC Board [TRB] (A404) [Optional with TR, Reference Appendix A]

The TRB PC Board is only used when the optional 28.5 VDC transformer-rectifier assembly is installed. The TR monitors the output voltage, output current, controls the input and output contactors, and monitors all fault events associated with the DC output. When a fault event does occur the TRB relays this information to the CTL. The CTL will issue the command to the system that fits the fault event.



**Transformer-Rectifier PC Board
Figure 13**

(9) +5, -12 VDC Power Source (PS1)

The internal power supply distributes the +5 VDC and -12 VDC into the control system.

8) Power Module Panel Assembly

The power module panel assembly sometimes referred to as the contactor panel, is located at the rear of the machine under the control box. The panel assembly provides a means of connecting and disconnecting generator output to and from the aircraft.

a) Load contactor (K1 and K201)

Each load contactor contains a magnetic operating coil and four sets of contacts. The three larger contacts conduct three-phase AC generator output. A small contact set is connected to the Digital Control PC Board (CTL) to activate the protective monitor circuit. Three-phase, 400-Hz generator output power is distributed to the load contactor by 2/0 cables that pass through current transformers.

b) Current transformers (CT1-CT3 and CT4-CT6)

On each individual output a set of current transformers are used to monitor and control the line-drop compensation, ammeter, and overload circuit.

(1) Line-Drop Compensation

The current transformers detect the magnitude and power factor of current flowing from generator to load. They feed a signal to the voltage regulator that interprets the signal and alters the exciter field current as required to maintain a constant predetermined voltage at the load.

(2) Ammeter

The current transformers convert a current signal to a voltage signal, which is sent to the Voltage Regulator PC Board (REG). The ammeter is really a voltmeter graduated and numbered in amperes to show current proportional to the voltage signal received.

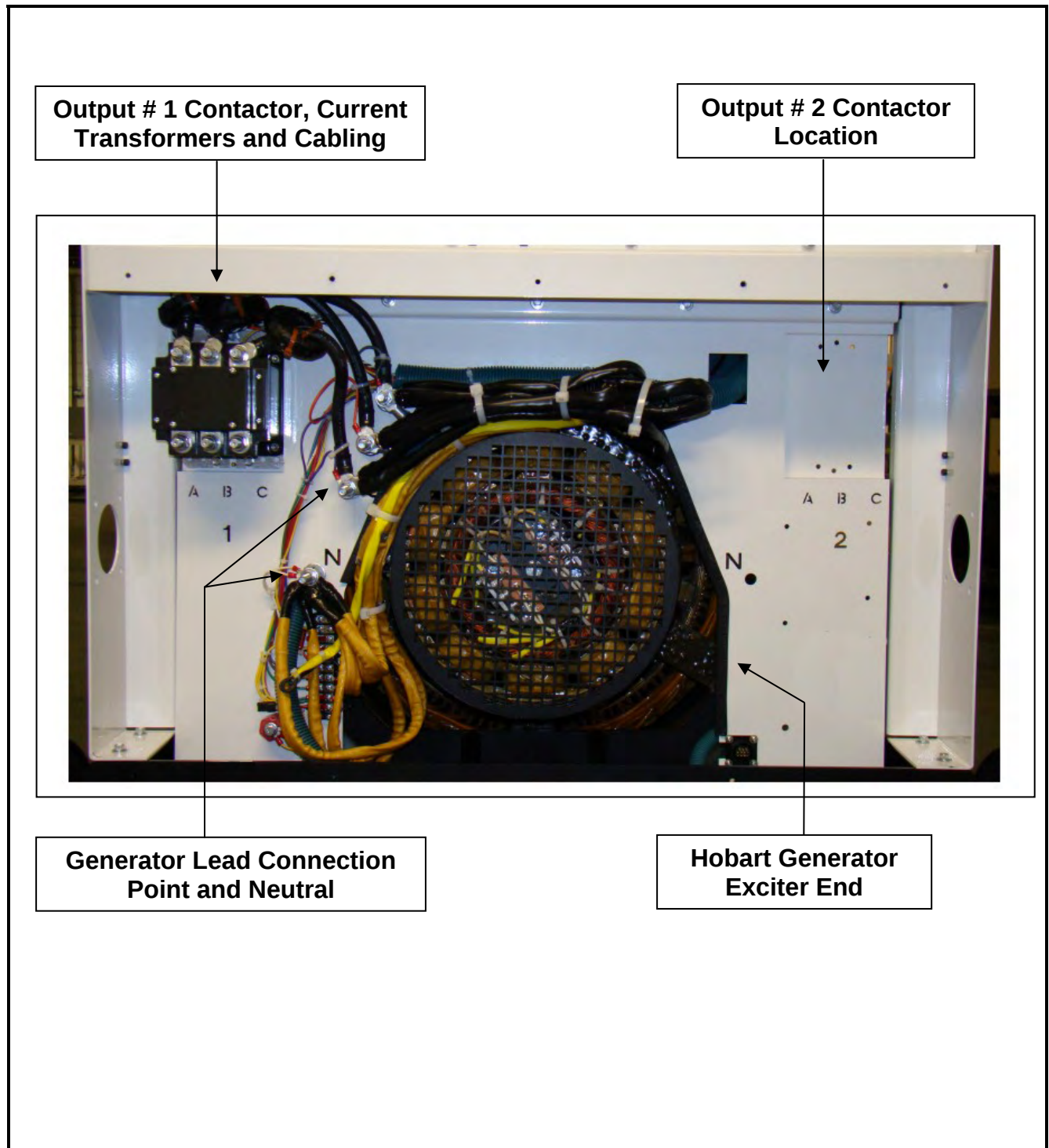
When there is overload on the output for more than 5 minutes (load exceeding 326 amperes per output or 125% of rated load), the main overload sensing circuit sends signals the load the contactor circuit to open the load contactor.

(3) Overload, No 1 and/or No. 2 output

On each individual output the current transformers converts a current signal to a voltage signal. The voltage signal is sent to the ammeter and to the overload monitoring circuit for that output. The overload monitoring circuit will open the contactor when the output current reaches 125% of the normal rated output current. The monitoring circuit monitors each individual output, as well as, the overall current for a dual output machine.

The following is a list of overload module characteristics:

- At 125% load the module will function in 5 minutes.
- At 150% load the module will function in 30 seconds.
- AT 200% load the module will function in 10 seconds.



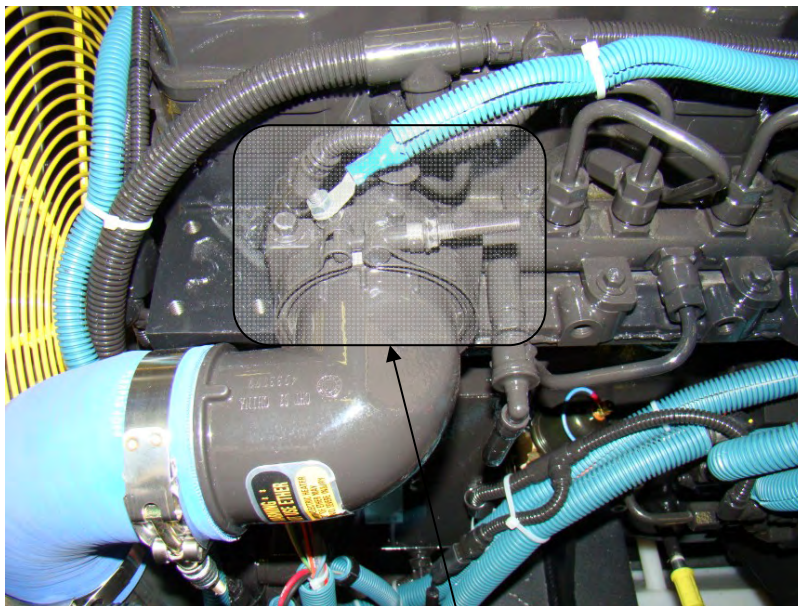
Output Power Module Components
Figure 14

9) Cold Weather Starting System (BH1)

The intake air heater, located on the intake manifold, is used for starting the engine at very cold temperatures and reduces the white smoke associated with a cold start. This cold weather starting system is a fully automatic once engaged by the operator (Chapter 1, Section 3). The intake air heater (or grid heater) is energized or de-energized from a power relay controlled by the ECM. The amount of time the air intake heaters stay on, in the preheat phase, is a function of the intake manifold temperature at start up. (The pre-heat time increases with colder intake manifold temperatures). The maximum duration of the pre-heat phase is around 30 seconds. During cranking, the intake air heater is turned off to allow maximum current to be used by the starter.

CAUTION

Never use an ether start system in conjunction with the air intake heater.



Air Intake Heater

**Air Intake Heater
Figure 15**

Section 2 Preparation for Use, Storage, or Shipping

1) Preparation for Use

a) Inspection/Check

Inspect the unit thoroughly prior to operation.

- (1) Remove blocking, banding, ties, and other securing material.
- (2) Inspect exterior for shipping damage such as broken lights, damaged sheet metal, etc.
- (3) Open all canopy doors and inspect interior for foreign material such as rags, tools, shipping papers, etc.
- (4) Check fuel, coolant, oil hoses and connections for visible leaks. Visually inspect the compartment floor and ground surface under the unit for signs of leakage. If leaks are found, correct by tightening hose clamps, tube fitting, etc., as required.
- (5) Check security of generator set retaining components.
- (6) Check the following for sufficient quantity:

- Fuel

Press “**LAMPS**” push-button button to energize fuel gage when engine is stopped. Fuel is supplied from a customer-furnished source.

NOTE: For recommended fuel specifications refer to the Engine Manufacturers Operation and Maintenance Manual provided with this manual.

- Engine coolant

Remove radiator cap to check coolant level. Coolant level should be at the bottom of the filler neck.

CAUTION

BE SURE the cooling system antifreeze solution is adequate to protect below the lowest temperature expected.

NOTE: For antifreeze protection, use a solution of 50% permanent antifreeze (Ethylene glycol) and 50% clean water.

ENGINE OIL AND COOLANT CAPACITIES	
Lubricating oil capacity (w/ filter)	11.6 quarts (11 liters)
Coolant capacity system	20 quarts (18.9 liters)

Figure 1

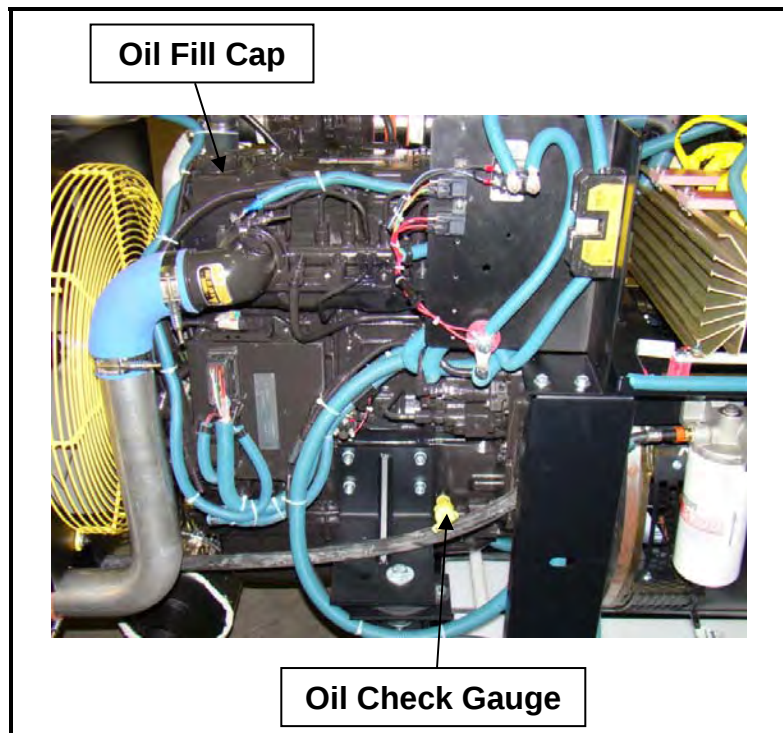
- Engine lubricating oil level

The oil gage rod has “H” high mark and “L” low level marks to indicate the operating lubrication oil supply. Oil level should be kept as near the high mark as possible, without going over it.

CAUTION

NEVER operate the engine with oil level below the “L” level mark or above the “H” level mark.

NOTE: See the Engine Manufacturer’s Operation Maintenance Manual for oil recommendations.



**Oil Fill and Oil Level Check Locations
Figure 2**

- Check Batteries

Inspect the batteries for proper connection of the terminals and also check the electrolyte level (if possible). Service or replace if necessary.

b) Installing Three-Phase AC Output Cables

The generator set may be shipped without aircraft cables. The load contactor is located on the power module assembly.

The conductor size recommended for an 400 Hz output cables is 2/0 AWG. Use No. 12 size for control (E and F) terminals. Large cables (A, B, C, and N) should be equipped with terminals having at least a 3/8-inch diameter mounting hole. Mounting hole in small leads (E and F) should be at least 1/4-inch diameter.

To install AC output cables proceed as follows:

- (1) Remove the lower rear panel below the control box. Take care when removing the panel and disconnecting the emergency stop button connector.
- (2) Route cables through cable clamps on the side where the cable is located.
- (3) Connect the phase cable terminal lugs to the appropriate terminal studs on the contactor: cable lug "A" to terminal stud "A", "B" to "B", and "C" to "C".
- (4) Connect the cable's neutral terminal lug securely to the neutral (ground) stud on the power module assembly.
- (5) Connect the "E" and "F" cables to the "E" and "F" standoffs on the power module assembly.
- (6) Tighten clamp screws securely, but avoid damage to cable insulation.
- (7) Reconnect the emergency stop button and replace the lower rear panel.

2) Preparation for Storage

When a generator set is to be stored or removed from operation, special precautions should be taken to protect the internal and external parts from rust, corrosion, and gumming in the engine fuel system.

a) General

Pull all circuit breakers and place the battery disconnect switch in the off position.

- (1) The unit should be prepared for storage as soon as possible after being removed from service.
- (2) The unit should be stored in a building which is dry and which may be heated during winter months.
- (3) Moisture absorbing chemicals (Factory Part No. 76A1354-001) are available for use where excessive dampness is a problem; however, the unit must be completely packaged and sealed if moisture absorbing chemicals are to be effective.

b) Temporary Storage

When storing the unit for 30 days or less, prepare as follows:

- (1) Lubricate the unit completely in accordance with instructions in Section 2-2. This will include changing engine oil, and all filter elements.
- (2) Start the engine and operate for about two minutes so that all internal engine components will be coated with new oil.

NOTE: Do not drain the fuel system or crankcase after this run.

- (3) Make certain the cooling system antifreeze solution is adequate to protect below the lowest temperatures expected during the storage period. Be sure the solution is thoroughly mixed.
- (4) Clean the exterior of the engine. Dry with clean rags and compressed air.

- (5) Seal all engine openings. Use a waterproof, vapor proof material that is strong enough to resist puncture damage from air pressures.

c) Long Time Storage (Over 30 Days)

To protect the generator and other electrical components, the complete unit should be packaged using moisture proof packaging material and sealing material. Place containers of moisture absorbing chemicals (Factory Part No. 76A-1354-001) in the unit before packaging. The unit may be stored for long periods with no special preparation if it is possible to operate the engine once each week. When starting once a week, proceed as follows:

- (1) Make certain the cooling system is adequately protected.

WARNING

ENSURE adequate ventilation before starting the engine.

- (2) Start the engine and operate under full load until coolant temperature has reached at least 176°F (80°C).
- (3) While the engine is running, ensure that normal operating controls are in good working condition before shutdown and storage. If weekly operation is not possible, contact the nearest engine manufacturer distributor for instructions.

3) Preparation for Shipment

- a) Place the battery disconnect switch in the off position before shipping.
- b) During long shipments, vibration, jolting, etc may loosen the generator set retaining hardware.

CAUTION

When shipping the unit, provide sufficient retaining materials to ensure the generator set cannot roll out or off the vehicle in which it is being transported.

Section 3 Operation

1) General

This section contains information and instructions for the safe and efficient operation of the equipment. Operating instructions are presented in step-by-step sequence of procedures to be followed in supplying power to the aircraft.

NOTE: Read ALL of the operating instructions before attempting to operate the equipment.

WARNING

Ear protection equipment may be necessary when working close to this equipment.

2) 400 Hz. Operating Procedure

a) Pre-start inspection

- (1) Be sure the fuel shutoff valve on the unit is open.
- (2) Ensure 12 VDC power is available to the engine starting system.
- (3) Check the engine and generator compartments to make certain they are free of rags or other foreign materials.
- (4) Make certain there is sufficient lubricating oil and coolant in the engine.
- (5) Check that all circuit breakers are reset and the battery disconnect switch is in the on position.
- (6) Make certain the “**STARTER ENABLE/DISABLE**” switch is enabled, and the “**FREQUENCY ADJUST**” switch is disabled.

b) Normal Engine Starting Procedures

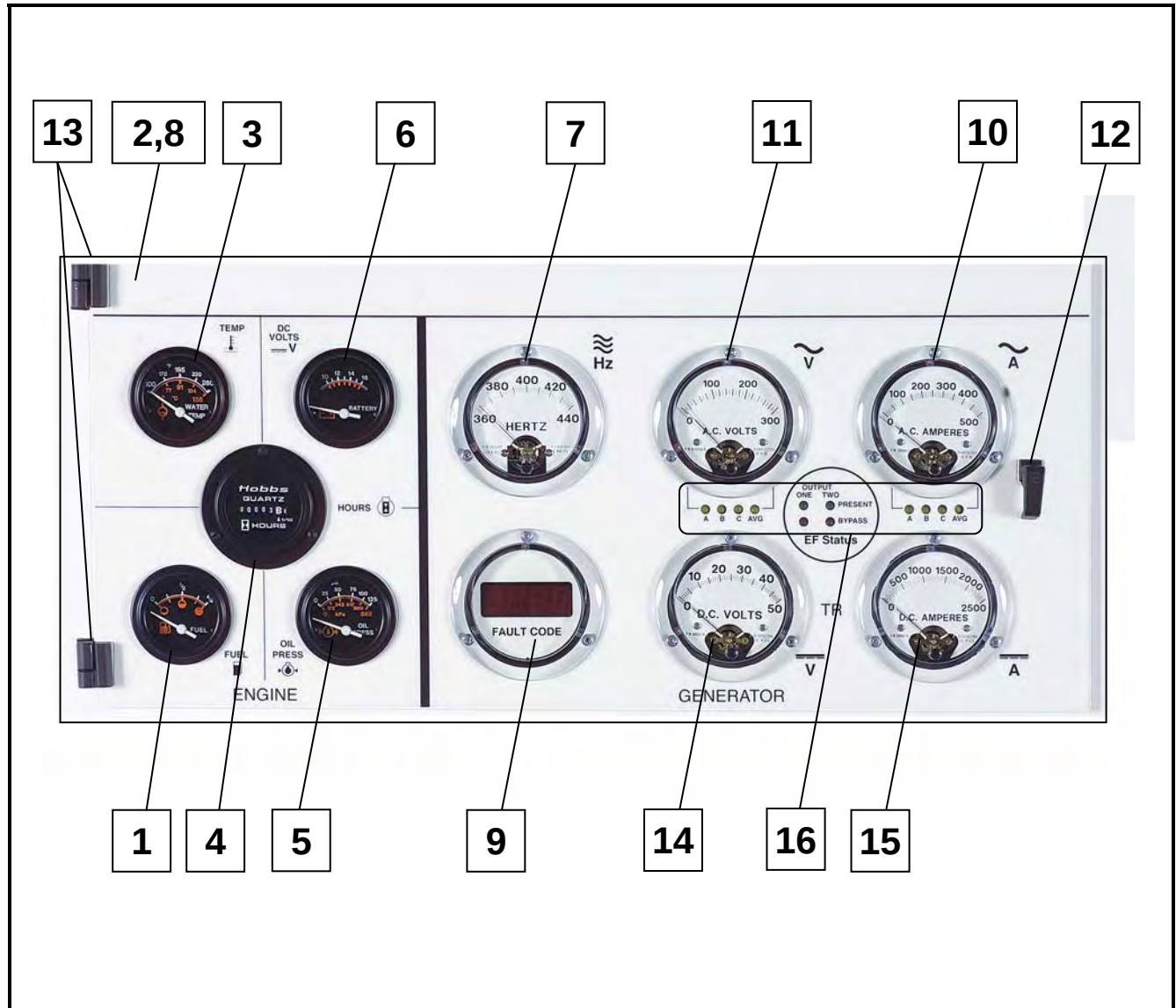
Engine starting procedures are outlined below. The engine's operating controls and monitoring instruments are illustrated in Figure 1 and 2.

CAUTION

Refer to operating instructions in the engine manufacturer's operation manual, when starting engine for the first time.

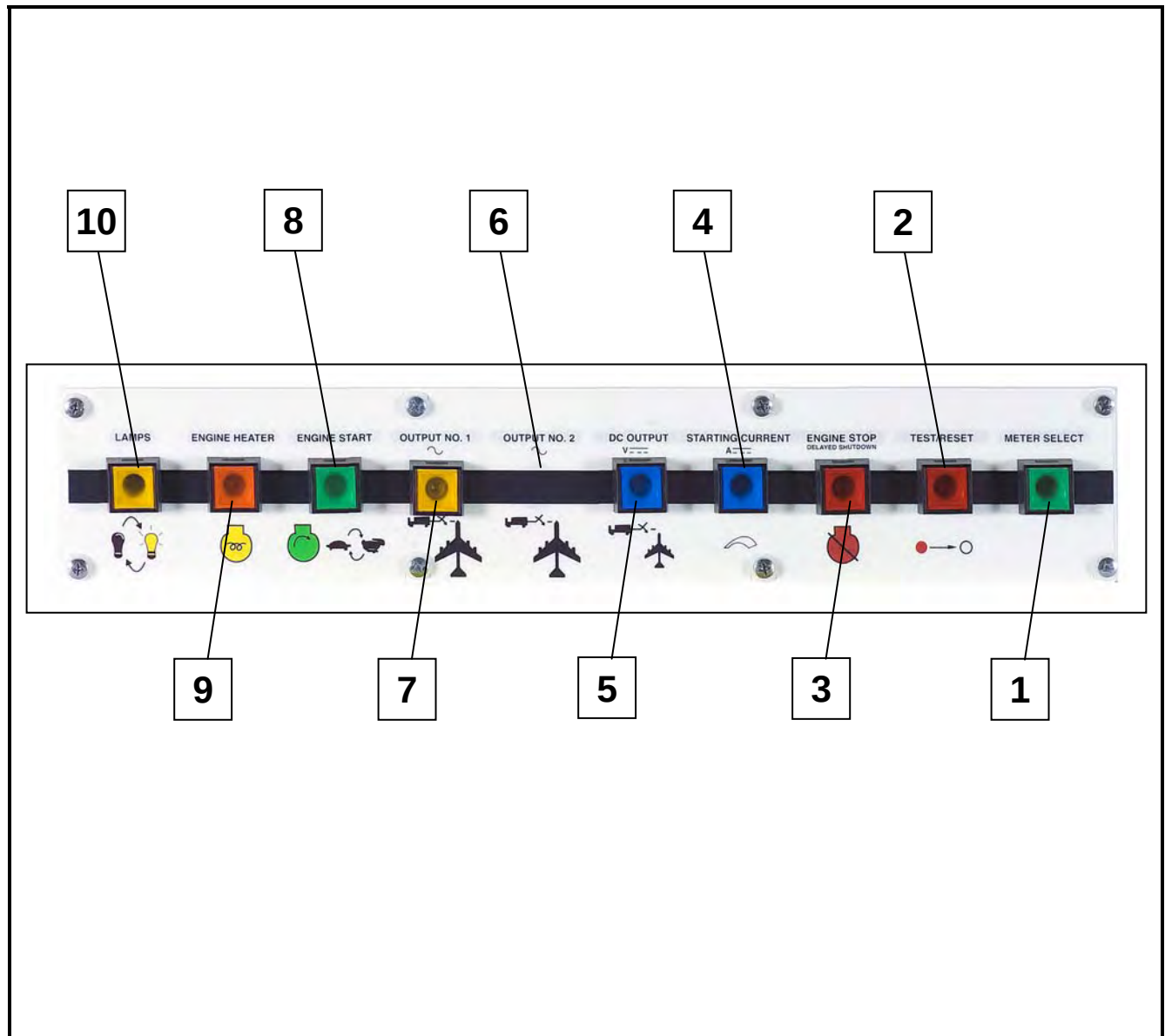
NOTE: The engine manufacturer's operation manual is provided with this manual.

- (1) If illumination is required, press “**LAMPS**” push-button switch one time. Pressing this button switch also activates the fuel gage.
- (2) On days when the ambient temperatures are below 60° F, press the “**ENGINE HEATER**” push-button to engage the air intake heater prior to starting the engine. The light in the button will illuminate when the intake heater is engaged (if the light does not illuminate, the engine is ready to start) and will go off when the intake heater is disengaged, thus signifying the engine is ready to start.



- | | |
|---|--|
| 1. Fuel Gage (M13) | 9. Fault Code Meter (M6) |
| 2. Door Assembly Panel | 10. AC Generator Ammeter (M1) |
| 3. Engine Coolant Temperature Gauge (M24) | 11. AC Voltmeter (M2) |
| 4. Running Time Meter (M4) | 12. Adjustable Grip Door Latch |
| 5. Oil Pressure Gage (M25) | 13. Control Panel Door Hinges |
| 6. Battery Voltmeter (M5) | 14. DC Voltmeter [Optional, included with TR] |
| 7. Frequency Meter (M3) | 15. DC Ammeter [Optional, included with TR] |
| 8. Control Panel Laminate | 16. LED PC Board (A5) [Not Shown, Opposite Side] |

Control Panel Door
Figure 1



- | | |
|---|--|
| 1. Meter Selector Switch (S3) | 6. AC Output No. 2 Contactor Switch (S275) |
| 2. Test/Reset Switch (S77) | 7. AC Output No. 1 Contactor Switch (S75) |
| 3. Engine Stop Switch (S76) | 8. Engine Start Switch (S24) |
| 4. DC Starting Current Switch (S431) [Optional with TR] | 9. Air Intake Heater Switch (S79) |
| 5. DC Output Contactor Switch (S430) [Optional with TR] | 10. Panel Light Switch (S74) |

Control Push-Button Switch Panel
Figure 2

CAUTION

Never use an ether start system in conjunction with the air intake heater.

- (3) Press the green **“ENGINE START”** push-button switch and hold until engine starts. The engine will start at idle speed, and the green light in the **“ENGINE START”** push-button switch will flash to indicate that power is available to the engine's ECM circuit.

CAUTION

Do not attempt to bring to rated speed for at least 5 seconds after engine starts. Damage to the starter and flywheel will result.

CAUTION

If the engine fails to start within 5 seconds, the control system will automatically disable the starting motor and indicate a low oil pressure fault. The emergency stop switch must be pressed to reset the control system and allow another starting attempt. If the engine fails to start after four attempts, an inspection should be made to determine the cause.

If the engine fires sufficiently to disengage the starter gear, but does not start, allow the starting motor to come to a complete stop before attempting to engage the starter again, then press the start push button switch.

- (4) Check oil pressure to make certain that it is normal, and observe all other engine instruments for normal operation.
- (5) Allow engine to idle and warm for **3 - 5 minutes** before bringing it up to rated speed.

CAUTION

To eliminate the possibility of wet stacking (See Appendix A), DO NOT allow the engine to idle for long periods of time.

c) Failed Starting Procedure

In the event that the engine fails to start, the circuitry must be reset before the next attempt. To do this:

- (1) Push the red **“EMERGENCY STOP/RESET BUTTON”** below the control box.
- (2) Pull the red **“EMERGENCY STOP/RESET BUTTON”** back out before the next attempt to start the generator set.

d) Power Delivery

- (1) Press **“ENGINE START”** push button switch a second time to bring engine from idle speed to rated speed. The ECM will immediately increase engine speed to 2000 RPM and maintain it. The voltage build-up will occur automatically. Also the green indicating light in the **“ENGINE START”** push-button switch will glow continuously.

- (2) Observe generator instruments. The frequency meter should indicate exactly 400 Hz. With the **"METER SELECT"** push button switch set to read any line-to-neutral position, (A-N, B-N, or C-N), the voltmeter should read 115 volts. With the **"METER SELECT"** push button switch set to any line-to-line position, (A-B, B-C, or C-A), the voltmeter should read 200 volts.
- (3) The final step in delivering power is closing one or both of the load contactors. When the instruments indicate satisfactory frequency and voltage values, close either load contactor (or both load contactors) by momentarily pressing the load contactor(s) (**"OUTPUT NO. 1"** or **"OUTPUT NO. 2"**) push button switch. The yellow or orange indicating light in the push button switch will glow continuously, indicating that the load contactor is closed and power is available at the aircraft.
- (4) Early in the power delivery run it is recommended that the operator check output voltage and current in each of the three phases. Use the **"METER SELECT"** push button switch to select either the line-to-line or line-to-neutral voltage. If the load is changing, it is good operating practice to observe the instruments until load conditions stabilize.

CAUTION

NEVER press the test/reset push button switch while power is being delivered. The contactors will open and power to the aircraft will be suddenly interrupted.

- (5) A condition of over-voltage, under-voltage, under-frequency, over-frequency, or overload in the output circuit will automatically open the load contactor and display a fault code to signal the operator which of the faults caused the protective monitor system to operate. After the fault has been corrected, press the **"TEST/RESET"** push-button switch to reset the protective relay system. Proceed with power delivery by operating the load contactor push button switch.

WARNING

NEVER disconnect the output cable while power is being delivered. Output contactors must be open prior to removal of the cable from the aircraft.

CAUTION

The generator set must be shut down so that the failed power delivery problems can be diagnosed. Only trained technicians should work on this generator set.

e) Failed Power Delivery

If the contactor indicating light goes out approximately 2 seconds after the push-button switch is released, and an **"EF1"** or **"EF2"** fault code is displayed, this indicates that 28.5 VDC interlock signal is not being supplied from the aircraft to the plug interlock relay. Correct the condition and again press the load contactor push-button switch (**"OUTPUT NO. 1"** or **"OUTPUT NO. 2"**).

The **"REGULATED/DIAGNOSTIC"** switch (located on REG) must be set to **"NORMAL"** for power delivery.

If the aircraft (or load bank) does not have the 28.5 VDC signal, the **"OUTPUT NO. 1"** (or **"OUTPUT NO. 2"**) **"EF BY-PASS ON/OFF"** switch (located on the CTL) must be set to the **"ON"** position. The **"EF BY-PASS ON/OFF"** switch should be turned back to **"OFF"** positions in normal operating conditions for personnel safety.

See Chapter 2, Section 4 for additional troubleshooting procedures.

f) Discontinue Power Delivery with Unit Shutdown

(1) Normal conditions

- a Press the load contactor push button (“**OUTPUT NO. 1**” or “**OUTPUT NO. 2**”) to open the contactor. The indicating light (yellow or orange depending on the contactor used) will go OFF immediately to indicate that the load contactor has opened and power is no longer being delivered to the aircraft. The engine will remain at rated speed.
- b Push the red “**ENGINE STOP**” push-button switch once to bring the engine down to idle speed. This will begin the automatic shutdown sequence to shut off the engine, gauges, lights, etc., after approximately 3 - 5 minutes.
- c Disconnect output cable from aircraft after engine is at idle speed only.

(2) Emergency conditions

- a Press the “**EMERGENCY STOP BUTTON**” located below the control box. When pushed this button instantly shuts the generator set off and must be pulled back out to reset for restarting the generator set.

CAUTION

Do not use the “**EMERGENCY STOP BUTTON**” button as a normal shutdown device. Damage to the engine turbo charger may result without proper cooling time. Use the “**ENGINE STOP**” push-button for all normal engine shutdowns.

3) DC Operating Procedure (Optional, See Appendix A)

The 28.5 VDC transformer-rectifier is an optional add-on to the GPU. See Appendix A for more details on the operation of the transformer-rectifier.

Chapter 2 Service and Troubleshooting

Section 1 Maintenance Inspection/Check

1) General

To make certain the generator set is always ready for operation, it must be inspected and maintained regularly and systematically so that defects may be discovered and corrected before they result in serious damage to components, or failure of the equipment.

WARNING

STOP operations at once if a serious or possibly dangerous fault is discovered.

2) Maintenance Schedule

a) General

A periodic maintenance schedule should be established and maintained. A suggested schedule is provided in Figure 1 on the following pages. It may be modified, as required to meet varying operating and environmental conditions. It is suggested that generator set and vehicle inspections be coordinated as much as possible.

b) Maintenance Schedule Check Sheet

It is strongly recommended that the customer use a maintenance schedule check sheet such as the one in engine manufacture's operation manual. The check sheet will provide a record and serve as a guide for establishment of a schedule to meet the customer's maintenance requirements for his specific operation.

c) Time Intervals

The schedule is based on both hours of operation and calendar intervals. These two intervals are not necessarily the same. For example, in normal operation the oil change period, based on hours of operation, will be reached long before the three months calendar period. The calendar period is included to make certain services are performed regularly when the equipment is stored, or being operated infrequently. Lubricating oil standing in engines that are stored, or used very little, may tend to oxidize and may require changing although it is not dirty. Perform all services on whichever-comes-first basis.

d) Identification of Interval Periods

Each interval period is identified by a letter A, B, C, etc. For example, services under B schedule should be performed at the end of each 250 hours of operation, or every three months, BR service is performed during the BREAK IN period (first 50-150 hours) and AR service is performed AS REQUIRED.

Hourly Interval	AR	50-150	10	250	500	1000	1500	2000
Calendar Interval		Once	Daily	3 Mo.	6 Mo.	1 Yr.	1.5 Yr.	2 Yr.
Symbol	AR	BR	A	B	C	D	E	F
Engine								
Change Air Cleaner Cartridge	X							
Check Coolant Hose and Clamps	X							
Check Crankcase Oil Level			X					
Drain Fuel Pre-Filter Elements			X					
Check Coolant Level			X					
Check for Leaks and Correct		X	X					
Check Air Cleaner Indicator			X					
Check Exhaust System	X		X					
Loading/Cleaning Exhaust System				X				
Charge-Air-Cooler (CAC) and Piping				X				
Change Lubricity Fuel Filter Element		X			X			
Change Fuel Pre-Filter Element		X			X			
Check Fuel Pump				X				
Check Radiator Core and Hoses				X				
Check Oil Pressure and Record				X				
Change Crankcase Oil		X			X			
Change Oil Filter Element		X			X			
Check Engine and Generator Mounts		X			X			
Check Coolant, Additive-Concentration		X			X			
Check Fan Hub and Drive Pulley						X		
Check Hose Clamps on Air Intake Side	X					X		
Check Belts Conditions and Tensioner						X		
Check and/or Adjust Valve Clearance						X		
Check Water Pump		X				X		
Steam Clean Engine		X					X	
Clean Fuel System							X	
Check Alternator							X	
Check Cranking Motor							X	
Check Vibration Damper								X

Maintenance Schedule
Figure 1 (Sheet 1 of 2)

Hourly Interval	AR	50-150	10	250	500	1000	1500	2000
Calendar Interval		Once	Daily	3 Mo.	6 Mo.	1 Yr.	1.5 Yr.	2 Yr.
Symbol	AR	BR	A	B	C	D	E	F
Engine (continued)								
Check Cooling and CAC systems								X
Flush and Change Coolant								X
Check Fan Mounting				Spring & Fall				
Clean Cooling System				Spring & Fall				
Check Hoses				Spring & Fall				
Clean Electrical Connections				Spring & Fall				
Check Thermostats and Seals				Fall				
Electrical (12 VDC System)								
Check All Lights			X					
Check Alternator Charging Rate			X					
Check Battery and Fluid Level				X				
Clean Battery Terminals	X			X				
Check Wiring and Connections					X			
Check All Engine Meters			X					
Electrical (400-Hz System)								
Check E-F By-Pass Operation				X				
Check Output Cable and Connectors			X					
Check Volt, Amp & Frequency Meters			X					
Check and/or Adjust Output Voltage	X				X			
Inspect Wiring and Connectors					X			
Clean and Inspect Generally					X			

Maintenance Schedule
Figure 1 (Sheet 2 of 2)

3) Inspection/Check

a) General

Inspections, checks, and maintenance are described in general and more specific and detailed information can be found in Section 2-2 and 2-3, when applicable.

b) “AR” Checks and Operations (As Required)

(1) Engine

a Change Air Cleaner

A definite time schedule for changing the air cleaner cannot be established. This filter should not be washed more than six times or retained for more than one year of service, whichever comes first.

b Check and tighten, as required, all coolant hose clamps, air intake hose clamps and exhaust clamps. Check all coolant hoses, air intake hoses and exhaust pipes for leaks.

(2) Electrical System (12 VDC)

a Check Battery Terminals

Anytime the compartment doors are opened for any reason, visually check battery cable connectors and battery posts. If corrosion is observed, disconnect cables and clean battery posts and connectors with a wire brush or special battery post-cleaning tool. Coat the posts and connectors with a light film of petroleum lubricant before reconnecting cables.

(3) Electrical (400 Hz System)

a Check the output voltage and be sure it is set for 115 VAC $\pm$ 1 V. Adjustment can be made using the fine adjustment located on the Voltage Regulator PC Board (REG).

c) “BR” Checks and Operations (Break-In Period, Once After 50-150 hrs.)

The following procedures are precautionary measures taken on most new engines. If a problem occurs with any of the following issues be sure to recheck it after the next 50-150 hours.

(1) Engine

- a Check for leaks and correct. This involves an overall inspection of the engine and may require some maintenance if leaks are found. Refer to the engine manufacturer's operations manual for assistance.
- b Change all fuel filter elements. Metal shavings from the new fuel tank can clog the filter.
- c Change crankcase oil. New engines often release metal shavings more frequently. Therefore the crankcase oil must be changed as a precautionary measure.
- d Change oil filter element. The oil filter should be changed with the oil.
- e Check engine and generator mounts to ensure they are properly installed and they have not worked loose.
 - (i) Engine mount bolts must be torqued to 135 N-m (100 ft-lb.).
 - (ii) Generator mount bolts must be torqued to 122 N-m (90 ft-lb.).

- f Check coolant additive concentration. Refer to the engine manufacturer's operations manual for assistance.
- g Steam clean the engine to free it of oil and dirt to prevent uneven engine cooling "hot spots". The oil and dirt can also fall into the engine and fuel system when covers are removed during repair work.
- h Inspect the water pump weep hole for indication of a steady leak. If a steady flow of coolant or oil is observed, replace the water pump with a new or rebuilt unit. Refer to the engine manufacturer's operations manual for assistance.

d) "A" Checks and Operations (10 Hours or Daily)

(1) Engine

a Check Crankcase Oil Level

CAUTION

DO NOT overfill. **DO NOT** operate the engine with oil level below the lower bar or above the upper bar on the dipstick.

- (i) Check oil level daily with oil gage dipstick.
- (ii) Oil level should not be checked until 3 to 5 minutes after engine shutdown. Keep oil level as near the upper bar as possible.

b Drain Fuel Pre-Filter Element

The life of the fuel pump and injectors can be extended if the operator drains about a cup of fuel from the fuel pre-filter element to remove water and sediment before starting the engine each day.

CAUTION

BE SURE to prime and bleed the fuel system after draining the filters, replacing filter element, or if the fuel tank has run empty. Failure to do so can cause engine starting problems.

- (i) Provide a container for catching drained fuel.
- (ii) Open the drain valve on the fuel/water filter by turning it counterclockwise.
- (iii) Drain the filter until clear fuel is visible.
- (iv) Tighten the drain valve.
- (v) Safely dispose of drained fuel.
- (vi) Purge air from fuel system if necessary.

c Check Coolant Level

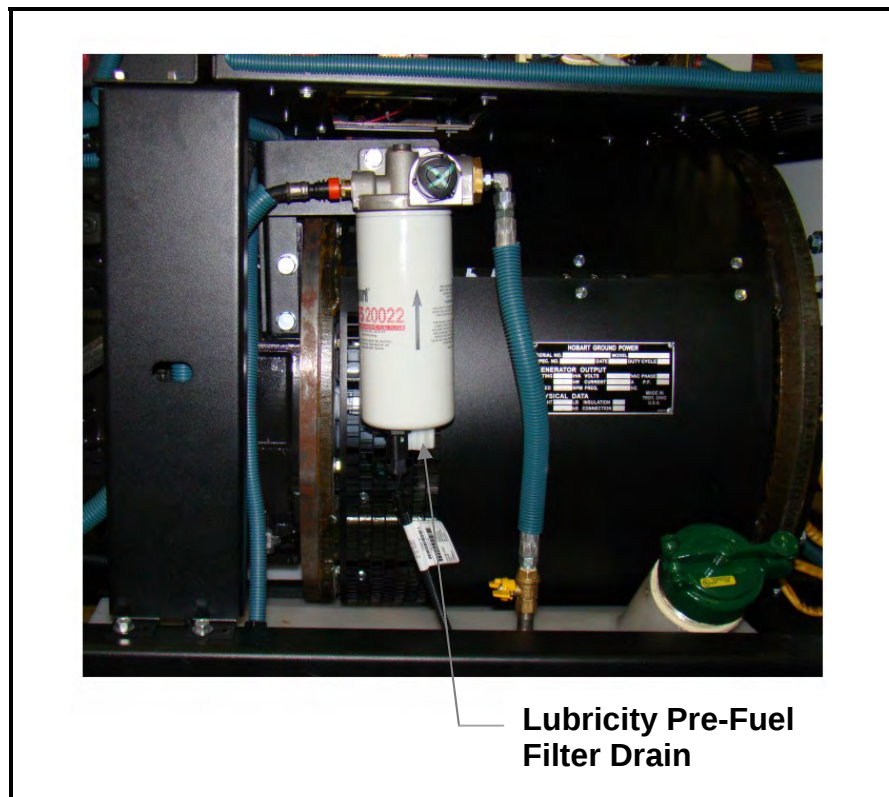
Check coolant level daily or at each fuel fill interval. Investigate for cause of any coolant loss.

WARNING

Cooling system is pressurized. To avoid personal injury, DO NOT remove radiator cap when engine is hot.

d Check for Leaks and Correct

At each daily start-up, check for coolant, fuel, and oil leaks. Coolant leaks may be more noticeable when components are cold. Observe pumps, hoses, fittings, gasket connections, etc., for signs of leakage. Correct as required.



**Fuel Pre-Filter and Drain
Figure 2**

e Check Air Cleaner Indicator

At each daily start-up, observe the air cleaner indicator light. If this fault meter reads “**air**”, it indicates that the air cleaner should be changed.

f Check Exhaust System

Visually inspect muffler and exhaust pipes for rust and signs of approaching failure. Listen for any gasket or joint leaks.

WARNING

A leaking and defective exhaust system could be a fire hazard.

(2) Electrical System (12 VDC)

a Check All Lights

Check all indicating lights to be sure they will operate when they should. If any light fails to operate, check both the lamp and its protective circuit breaker. Figure 5 lists all lamps with their location and part number. Figure 6 lists all circuit breakers.

b Check Alternator Charging Rate

Observe the 12-VDC voltmeter each time the engine is started to be sure the alternator is functioning correctly and charging the batteries.

c Check the operation of all the engine meters.

(3) Electrical (400 Hz System)

b Check Output Cables and Connector

Check the output cable plug connection for damaged insulation and contacts each time the connector is detached from the aircraft.

b Monitoring Instruments

Check operation of voltmeter, ammeter and frequency meter each time the unit is started.

e) "B" Check and Operations (250 Hours or 3 Months)

(1) Engine

a Prevent Diesel Engines Wet Stacking

All diesel engines operated for extended periods under light load may develop a condition commonly referred to as wet-stacking. This condition results from the accumulation of unburned fuel in the exhaust system. It is recognizable by fuel oil wetness around the exhaust manifold, pipes, and muffler along with an excessive amount of soot.

Wet-stacking is common, and can be expected in diesel engines operated under light loads. Light loads do not allow the engine to reach the most efficient operating temperature for complete combustion of fuel and will also increase the fuel consumption rate. The unburned fuel collects in the exhaust system to create the wet condition known as wet-stacking.

To alleviate wet-stacking in lightly loaded engines, it is recommended that the machine be connected to a load bank after each 250 hours of use and operated under full rated load for one hour. This will burn away and evaporate the accumulation of fuel and soot in the exhaust system. This clean-out procedure should be considered as a regular maintenance operation for machines operated under light loads.

b Charge-Air-Cooler and Piping

Inspect the charge-air-cooler for dirt and debris blocking the fins. Check for cracks, holes, or other damage.

Inspect the pipes and hoses for leaks, holes, cracks, or loose connections. Tighten the hose clamps if necessary.

c Check and record oil pressure

After each oil change, check and record oil pressure at idle speed after oil has warmed up. Record oil pressure under identical conditions at each oil change interval. A comparison of pressure at idle speed with previous readings will give an indication of progressive wear of oil pump, bearings, shafts, etc. Investigate any abnormal change in pressure readings.

d Check Radiator Core and Hoses

Inspect the radiator core for dirt and debris blocking the fins. Clean as necessary. Check for cracks, holes, or other damage.

e Check Fuel Pump

Inspect the fuel injection pump mounting nuts for loose or damaged hardware.

(2) Electrical (12 VDC system)

NOTE: The battery furnished with this generator set is MAINTENANCE FREE.

a Battery Electrolyte Level (if applicable)

If non-maintenance free batteries are being used rather than the batteries supplied by the factory, the electrolyte level must be maintained above top of plates. Add distilled water as required.

CAUTION

DO NOT overfill.

b Check Battery

If battery requires water frequently, or is low in charge, the reason for the condition must be found and corrected.

c Check battery terminals and clean, if necessary.

(3) Electrical (400 Hz System)

a Check the operation of the E-F bypass system.

f) "C" Checks and Operations (500 Hours or 6 Months)

(1) Engine

a Check Engine and Generator Mounts

CAUTION

An unstable or loosely mounted engine can create hazardous environment and may also damage equipment.

- (iii) Engine mount bolts must be torqued to 135 N-m (100 ft-lb.).
- (iv) Generator mount bolts must be torqued to 122 N-m (90 ft-lb.).

- b Change oil and oil filters
- c Change all fuel filters
- d Check Coolant Additive Concentration

The cooling system protective liquid (nitrite-, amine- and phosphate free) provides effective protection against corrosion, cavitation, and freezing. See engine manufacturer's operation manual for ordering and mixture details.

(2) Electrical (12 VDC system)

- a Wiring

Inspect all cables and leads for worn or damaged insulation.

- b Connections

Inspect connectors for damaged or corroded condition.

(3) Electrical (400 Hz System)

- a Protective Monitoring Circuits

Check operation of all protective monitoring circuits to make certain they will function if a fault should occur in the output circuit. Procedures for testing these circuits are contained in the Adjustment/Test section of this manual.

- b Inspect Wiring and Connections

Check all cables, leads, and wiring for broken, worn and damaged insulation. Check all connections for tightness.

- c Clean and inspect generally

g) "D" Checks and Operations (1000 Hours or 1 Year)

(1) Engine

- a Check Fan Hub and Drive Pulley

Inspect for loose bolts or worn features. Tighten bolts and replace parts if necessary. Refer to the engine manufacturer's operations and maintenance manual for assistance and the most update to date information.

- b Check Hose Clamps on Air Intake Side

Be sure that all clamps are properly secured to prevent leaks and all hose are in good condition.

c Check Belt Condition and Tensioner

Refer to the engine manufacturer's operations and maintenance manual for assistance and the most update to date information.

d Check and/or Adjust Valve Clearance

Refer to the engine manufacturer's operations and maintenance manual for assistance and the most update to date information.

e Check Water Pump

Inspect the water pump weep hole for indication of a steady leak. If a steady flow of coolant or oil is observed, replace the water pump with a new or rebuilt unit. Refer to the engine manufacturer's operations manual for assistance.

h) "E" Checks and Operations (1500 Hours or 1.5 Year)

(1) Engine

a Steam Clean Engine

There are several reasons why the engine exterior should be kept clean. Dirt on the outside will enter fuel and oil filter cases and rocker housings when covers are removed, unless dirt is removed first. A clean engine will run cooler and develop fewer hot-spots. Steam cleaning is one of the most satisfactory methods of cleaning and engine; however, there are some **CAUTIONS** to be observed:

WARNING

Exercise care to avoid injury and damage to eyes and skin.

CAUTION

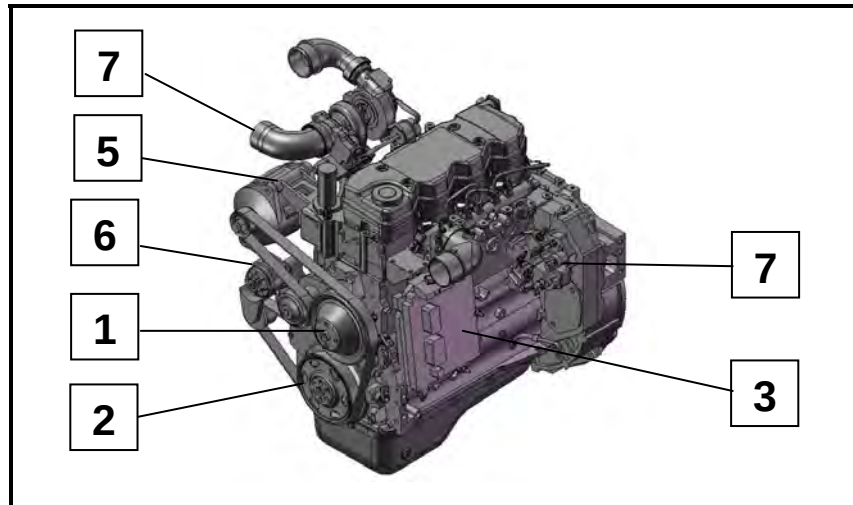
1. If a cleaning compound is used, select one that is free from acid and will not remove paint.
2. Protect (or remove) all electrical accessories, such as voltage regulator, alternator, and electrical wiring.
3. Seal all openings. **DO NOT** use a flammable solvent.
4. **DO NOT** use mineral spirits or solvents on a hot engine.
5. Remove or protect bottom panel of unit (belly pan) to protect insulation.

b Clean Fuel System

See engine manufacturer's operation manual for instructions.

c Check Alternator and Cranking Motor.

The alternator and cranking motor on this particular engine require no periodic lubrication.



- | | |
|--------------------------------|-------------------|
| 1. Fan Pulley | 5. Alternator |
| 2. Vibration Damper | 6. Belt Tensioner |
| 3. Engine Control Module (ECM) | 7. Fuel Pump |
| 4. Exhaust Outlet | |

Engine Accessories
Figure 3

i) "F" Checks and Operations (2000 Hours or 2 Years)

(1) Engine

a Check Vibration Damper.

Check vibration damper for looseness, wobble, chunking and streaking. Also verify the hub bolts are tightened to the engine manufacturer's specifications.

Refer to the engine manufacturer's operations and maintenance manual for assistance and the most update to date information.

b Check Charge-Air-Cooler and Radiator Systems

(i) Check for damaged hoses and loose or damaged hose clamps.

(ii) Check the radiator for leaks, damage, and build up of dirt in the fins. Clean or replace as necessary.

c Flush cooling system and change coolant.

j) Seasonal Maintenance Checks Spring/Fall (Engine)

- (1) Check Fan Mounting
 - a Check fan to be sure it is securely mounted.
 - b Check for fan wobble and/or broken/cracked blades.
 - c Check fan hub and crankshaft pulley for secure mounting.
- (2) Check cooling system each spring and fall. Clean if necessary.
- (3) Check All Hoses.

In addition to daily checks of hoses for leaks, inspect hoses thoroughly each time the cooling system is cleaned and serviced.

Inspect for signs of deterioration and collapse. Inspect for cracks and cuts. Inspect for cutting and deformation caused by hose clamps. Replace hoses as required.

- (4) Check thermostat and seals each fall when cooling system is serviced.

k) Lamps Circuit breakers, and Fuses

- (1) Check all lamps daily
- (2) Check circuit breakers and fuses as required.
- (3) The lamp chart lists all lamps with their location and identifying trade number in table below.
- (4) The circuit breaker chart lists all circuit breakers with their location, size, and type.
- (5) The fuse chart lists all fuses with their location, size, and type.

Item Protected	Schematic Identifier	Quantity	Size
Engine Air Intake Heater	F110	1	125 A
REG Load Contactor Circuit (F2)	MDL 250 V	1	1 A
REG Diagnostics (F3)	MDL 250 V	1	1 A
REG Field Voltage Circuit (F2)	MDL 250 V	1	5 A
TRB Load Contactor Circuit (F1)	MDL 250 V	1	1 A
ECM Protection	F101	1	5 A
ECM Protection	F102	1	30 A
Starter Solenoid (250 V)	F112 (Fast Blow)	1	2 A

Fuse Identification Chart
Figure 4

Light Identification	Location	Lamp (Bulb) as per Lamp Industry Trade Number or Description
Engine Start Indicator	Switch Panel	1815
Engine Stop Indicator	Switch Panel	1815
No. 1 Load Contactor Indicator	Switch Panel	1815
No. 2 Load Contactor Indicator	Switch Panel	1815
Test/Reset Indicator	Switch Panel	1815
Pre-heater Indicator	Switch Panel	1815
Clearance Lights (optional)	Canopy Top	57
Engine Gauge Lights	Inside Each Gauge	Chapter 4, Section3, Fig. 5
Generator Gauge Light Strip	Around Meter	Chapter 4, Section3, Fig. 5

Lamp Identification Chart
Figure 5

Item Protected	Location	Quantity	Size
Engine Circuit and Instrument Panel	Inside Control Box	1	10 A
Controls	Inside Control Box	1	5 A
Marker Lights (optional)	Inside Control Box	1	10 A

Circuit Breaker Identification Chart
Figure 6

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Section 2 Maintenance Procedures

1) General

A suggested maintenance schedule is provided in Section 1 of this Servicing Chapter. Each step of the schedule is also covered in general in Section 1. This Section covers maintenance in more detail, where necessary.

WARNING

STOP operations at once if a serious or possibly dangerous fault is discovered.

2) Preventative Maintenance

The following is a brief list of replacement filters for maintenance technicians or diesel mechanics performing routine preventative maintenance.

Filter	Hobart Part Number
Oil Filter Element	286897-029
Engine Fuel Filter Element	286897-036
Lubricity Fuel Water Separator Element	286897-031
Air Filter Replacement Element	290941



A preventative maintenance kit is also available with all the above engine filter elements (not including the air filter). The kit part number is 290300-013.

Contact the Hobart Ground Power supply department staff for all the preventative maintenance parts.

Hobart Ground Power - Supply Contact Information:

Toll Free: 800-422-4166

e-mail: hqpparts@itwgsegroupp.com

3) Lubrication

a) General

Proper lubrication is one of the most important steps in good maintenance procedure. Proper lubrication means the use of correct lubricants and adherence to a proper time schedule. Lubrication points, frequency of lubrication, and recommended lubricants are indicated in Figures 1 and 2.

b) AC Generator

The 400 Hz generator requires NO lubrication.

c) Generator Controls

Generator controls and instruments require no periodic lubrication.

d) Engine

Although the engine and its accessories require no more attention than any other similar installation, they still inherently require a major portion of the generator set lubrication and maintenance. Recommendations regarding engine lubrication have been taken from the engine manufacturer "Operation and Maintenance Manual" and incorporated here to make them more readily available to operators and maintenance personnel.

(1) Lubrication schedule

Time schedules indicated on the Lubrication Chart, Figure 1, are approximate. They are based on average operating conditions. It may be necessary to lubricate more frequently under severe operating conditions such as: low engine temperatures, high oil temperatures, or intermittent operation. However, time intervals should not exceed those indicated in the chart without careful evaluation.

(2) Oil specification

Engine lubricating oil, recommended by the engine manufacturer, is identified by an API (American Petroleum Institute) classification designation. The manufacturer does not recommend any specific brand of lubricating oil.

The use of quality lubricating oil, combined with appropriate lubricating oil drain and filter change intervals, are important factors in extending engine life.

Oil recommended for the diesel engines in this application is API Class CCMC.

Lubricating oil is discussed in detail in the engine manufacturer's operation manual.

(3) Oil viscosity

A temperature and oil viscosity index chart is shown below. For operation at temperatures consistently below -13°F (-25°C), refer to the engine manufacturer's operation manual.

(4) Changing engine oil

Oil should be changed once after the first 50 - 150 hours of use, then every 500 hours of engine operation thereafter. The generator set is equipped with an hour meter to record actual engine operating time. The ideal time to change engine oil is soon after a power delivery run, when the engine is at operating temperature.

Change the oil filter element each time the oil is changed.

NOTE: If lubricating oil is drained immediately after the unit has been run for some time, most of the sediment will be in suspension and will drain readily.

CAUTION

High ash oils may produce harmful deposits on valves that can cause valve burning.

CAUTION

Do not use solvents as flushing oils in running engines.

Change oil as follows:

- a Provide an open container for catching the old oil below the oil drain plug. Container capacity must be greater than 30 quarts (28.4 liters).
- b The oil drain tube can be attained through a hole in the access panel underneath the generator set.
- c Open drain plug located in oil pan.

Item	Maintenance Required										
Lube Oil	Check oil level daily or after every 10 hours of use. Change oil and the oil filter after the first 50 to 150 hours of use, then at 500 hour or 6 month intervals thereafter. Use oil specification API CF-4, HT/HS Viscosity 3.7cP minimum.										
Capacity	Approximately 11.5 quarts (10.9 liters)										
Oil Filter Replacement	Oil Filter Replacement – Hobart Ground Power Part No. 286897-029 Oil Filter Replacement – Engine Manufacturer Part No. LF9370										
Lube Oil Viscosity Required as per Ambient Temperatures	<table> <tr> <th><u>VISCOSITY AMBIENT</u></th><th><u>TEMPERATURE CONDITIONS</u></th></tr> <tr> <td>SAE 15W40 (Preferred)</td><td>0°F (-18°C) and above for most climates</td></tr> <tr> <td>SAE 10W30</td><td>-10°F to +50°F (-23°C to +10°C) Winter conditions</td></tr> <tr> <td>SAE 5W30</td><td>-20°F to +50°F (-29°C to +10°C) Artic Conditions</td></tr> <tr> <td>SAE 0W30</td><td>-20°F and below to +50°F (-29°C and Below to +10°C)</td></tr> </table>	<u>VISCOSITY AMBIENT</u>	<u>TEMPERATURE CONDITIONS</u>	SAE 15W40 (Preferred)	0°F (-18°C) and above for most climates	SAE 10W30	-10°F to +50°F (-23°C to +10°C) Winter conditions	SAE 5W30	-20°F to +50°F (-29°C to +10°C) Artic Conditions	SAE 0W30	-20°F and below to +50°F (-29°C and Below to +10°C)
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SAE 0W30	-20°F and below to +50°F (-29°C and Below to +10°C)										
Synthetic Oils	See the engine manufacturer's operations manual for usable synthetic oils and instructions.										
Fuel Water Separator and Lubricity Additive Filter	Drain filters daily. Change the filter elements every 500 hours or after 6 months of use, whichever comes first.										
Coolant	Check coolant level daily. Service and maintain coolant system according to Section 2-2, paragraph 6. Engine coolant capacity is approximately 20 quarts (18.9 liters)										
Coolant hoses and connections	Check coolant hoses and connections daily for leaks.										
Air Cleaner	Change air cleaner filter as required when air cleaner indicator (on engine control panel) shows that it should be changed.										
Fan Belt	Check fan belt condition and tension every 500 hours or 6 months of use.										
AC Generator	AC generator bearings are sealed and require no periodic lubrication.										
Alternator	Alternator bearings are sealed and require no periodic lubrication.										
Starter	Starter motor bearings are sealed and require no periodic lubrication.										
Water Pump	The water pump is packed at assembly and requires no periodic lubrication.										
Fan Hub	The fan hub is lubricated at assembly and requires no periodic lubrication.										

Lubrication and Maintenance Chart
Figure 1

Symbol	Name	Specification	Notes
1	Grease, General Purpose	MIL-G-3545	Excludes those of sodium or soda soap thickness.

Lubricants Chart

d While oil is draining, change the oil filter element. See instructions below.

- (i) Provide a container for catching spilled oil from the filter.
- (ii) Remove the oil filter by twisting counter-clockwise and inspect it.

NOTE: The gasket can stick to the filter head. Make sure it is removed before installing a new filter.

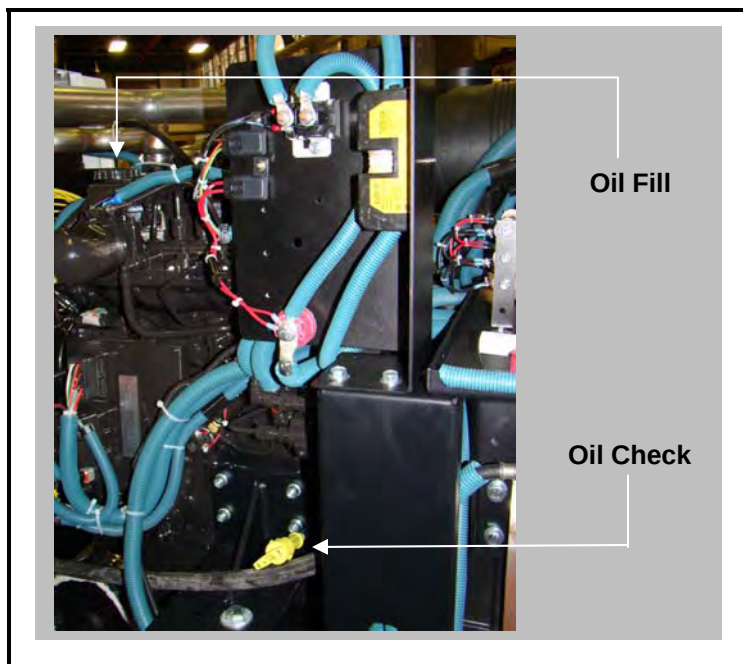
CAUTION

If bearing metal particles are found on the element or in the shell, the source should be determined before a failure.

CAUTION

Determine source of moisture, internal leaks, defective seals, gaskets, etc.

- (iii) Fill the new filter with clean lubricating oil before installation.
- (i) Apply a light coating of lubricating oil to the gasket sealing surface and install the filter. **DO NOT** over tighten the filter.



**Lubrication System
Figure 2**

- e Clean the drain plug and install when engine oil has completely drained. Torque the drain plug to 50 foot-pound (68 Nm).
- f Use the oil refill tube to refill the crankcase with new, clean oil that meets engine manufacturer's recommendations.

NOTE: Using a funnel to fill the oil crankcase will help prevent spills.

Lubricating oil capacity (w/ filter)	11.5 quarts (10.9 liters)
Coolant capacity system	20 quarts (18.9 liters)

CAUTION

1. Always use clean containers, funnels, etc.
2. Don't forget to close the drain plug valve, and install the new oil, before starting the engine.

- g Start engine and check oil pressure at once. Allow engine to idle for 5 minutes, check for leaks, than stop the engine.
- h After the engine has been stopped for about 5 minutes, recheck the oil level. Add oil, if required, to bring the level up to the high bar on the oil dipstick.

e) Engine Accessories Lubrication

(1) Alternator

Most alternators contain sealed bearings and require no periodic lubrication, however, check to make certain there are no lubrication points on your particular alternator.

(2) Starter

Most starting motors are lubricated at assembly and should be re-lubricated only when the starter is removed and disassembled, however, inspect the starter to make certain it has no lubrication points.

(3) Water Pump

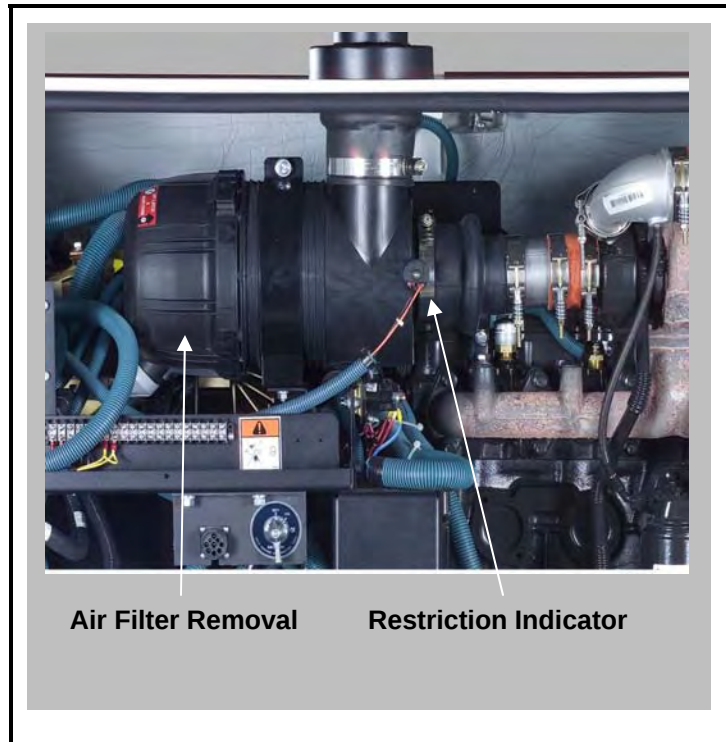
The water pump is packed at assembly and requires no periodic lubrication. Replace pump if signs of lubricant leakage are found.

(4) Fan Pulley

The fan hub is also lubricated at assembly and requires no periodic lubrication. Replace hub if lubricant is leaking.

3) Servicing the Air Cleaner

This air cleaner is a disposable type which, when dirty may be discarded. A definite time schedule for cleaning or changing the air cleaner cannot be determined because of varying operating conditions. This air cleaner filter can be removed from the air cleaner housing and replaced by unfastening the three metal clamps on the end of the air cleaner housing. It may be inspected either at prescribed service intervals or at any time deemed necessary.



**Air Cleaner Assembly
Figure 3**

a) Inspecting the Air Cleaner

- (1) Make periodic checks of air cleaner inlet screen for obstructions. If any obstructions are present, remove them.
- (2) Check outlet connection for proper seal.

b) Changing the Air Filter

- (1) Unfasten the three metal clamps on the end of the air cleaner housing.
- (2) Remove end cover of housing
- (3) Pull out air filter element and replace.
- (4) Replace end cover on housing, making certain that the filter is centered in the housing.
- (5) Refasten the three metal clamps on the end of housing.

c) Disposal

Normal trash pick-up is should be acceptable. **NEVER** burn the air filter for disposal.

4) Engine Fuel

a) How to select Fuel—Quality

The quality of fuel oil used in the diesel engine is a major factor in engine performance and life. Fuel oil must be clean, completely distilled, stable and non-corrosive.

CAUTION

Due to the precise tolerances of diesel injection systems, it is extremely important that the fuel be kept clean and free of dirt or water. Dirt or water in the system can cause severe damage to both the injection pump and the injection nozzles.

CAUTION

The use of low lubricity fuels can shorten life and/or damage the engine's fuel pump. The engine manufacturer recommends only diesel fuel.

Use commercially available diesel fuel with less than 0.5% sulfur content. If the sulfur content is higher than 0.5%, oil change intervals should be reduced (See engine manufacturer's operation manual).

In general, fuels meeting the properties of ASTM designation D 975 (grades 1-D and 2-D) have provided satisfactory performance. For more information regarding the selection of fuel to use, refer to publication "Engine Requirements—Lubricating Oil, Fuel, and Filters" available from authorized engine manufacturer's service outlets.

b) Cold Weather Operation

In cold weather, diesel fuel will form wax crystals, which can restrict flow and clog filters. Fuel oil suppliers approach this problem several ways. Some provide a specially refined product, while others may use flow-improving additives or winter blends. Winter blended fuel will likely contain kerosene or 1-D fuel, which provide good cloud point temperatures, but result in a lighter fuel with a lower heat content. These fuels may be used, but they may result in reduced engine power and/or fuel consumption.

In most cases, adequate resistance to cold can be obtained by adding an additive. For further assistance contact the nearest engine manufacturer's service representative.

5) Engine Fuel System

The fuel system consists of five primary components: Fuel tank, Fuel Water Separator (Pre-Filter) or Lubricity Additive Filter, Fuel Filter, Fuel Lift Pump, and the Fuel Return Line. The following are maintenance procedures for each of these items.

a) Fuel Tank

Be sure that no foreign objects are permitted in the fuel tank. The fuel tank must be removed and flushed out if objects are found in the Fuel Water Separator or Lubricity Additive Filter.

b) Fuel Water Separator or Lubricity Additive Filter

A lubricity fuel filter, which is also a fuel/water separator, is mounted in the generator compartment above the fuel tank outlet. The filter's function is to add a lubricant to the fuel to help prolong the engine seals and fuel pump life when fuels, other than diesel, are used (i.e. jet fuel). The filter also removes foreign material and removes both free and emulsified water from the fuel before it enters the fuel lift pump. Daily draining of the filter is required.

(1) Draining the fuel filter of water

- a Open drain valve
- b Drain accumulated water and contaminants.
- c Close drain valve.

(2) Changing the lubricity fuel filter (also fuel water separator)

- a Replacement fuel filter part number:
 - Hobart Ground Power Part No. 286897-031
 - Engine Manufacturer Part No. FS20022
- b The fuel filter must be changed after every 500 hours of operation in order for the fuel filter to continue adding the proper amounts of the lubricity additive into the fuel system.
- c Shut off fuel valve.
- d Place a pan underneath the fuel filter to catch spilled fuel.
- e Undo fuel filter with commercial tool and spin off.
- f Catch any fuel.
- g Clean any dirt from the filter carrier rim
- h Apply a light film of oil or diesel on the rubber seal on the new filter.

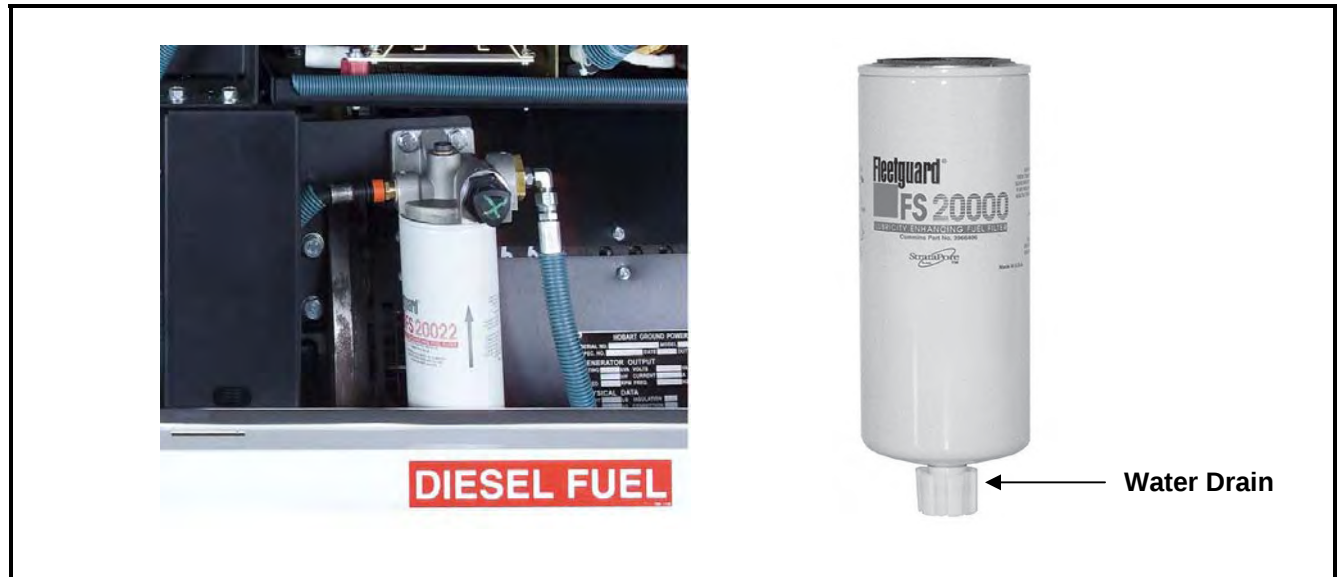
CAUTION

When installing new element, do not over tighten it; mechanical tools may distort or crack filter head.

CAUTION

Make sure that all rags, or absorbent sheets, are clear of moving engine parts and cannot be drawn in to the radiator fan.

- i Fill new filter with diesel fuel. Screw in the new fuel filter "snug". Check that the cartridge is seated correctly against the gasket and tighten with a final half turn.
- j Open fuel valve.



Lubricity Fuel Filter Water Separator
Figure 4

d) Primary Fuel Filter

A primary fuel filter is mounted above the engine starter in the engine compartment. The filter's function is to remove foreign material from the fuel before it enters the fuel lift pump.

(1) Changing the fuel filter

- a Replacement fuel filter part number:
 - Hobart Ground Power Part No. 286897-036
 - Engine Manufacturer Part No. FF5612
- i The fuel filter must be change after every 500 hours of operation.
- j Shut off fuel valve.
- k Place a pan underneath the fuel filter to catch spilled fuel.
- l Undo fuel filter with commercial tool and spin off.
- m Catch any fuel.
- n Clean any dirt from the filter carrier rim
- o Apply a light film of oil or diesel on the rubber seal on the new filter.

CAUTION

When installing new element, do not over tighten it; mechanical tools may distort or crack filter head.

CAUTION

Make sure that all rags, or absorbent sheets, are clear of moving engine parts and cannot be drawn in to the radiator fan.

- k Fill new filter with diesel fuel. Screw in the new fuel filter “snug”. Check that the cartridge is seated correctly against the gasket and tighten with a final half turn.
- l Open fuel valve.



**Primary Fuel Filter
Figure 5**

e) Fuel Pump

The fuel pump supplies high pressure to the fuel system so the diesel fuel can circulate freely. This engine is equipped with a common rail fuel system that is under very high pressure. **DO NOT** attempt to crack fuel lines.

WARNING

DO NOT attempt to crack fuel lines. This engine is equipped with a common rail fuel system that is under very high pressure. Failure to follow this guideline could result in injury or death.

e) Fuel Return

The fuel return is a fuel line (tube) that takes unused fuel from the engine, and delivers it to the fuel tank. No maintenance is required.

6) Engine Cooling System

a) General

Cooling system service requires more than maintaining the proper coolant level in the radiator and protecting the system against freezing. Water should be clean and free of any corrosive chemicals such as chloride, sulfate, and acids. It should be kept slightly alkaline with a pH value in the range of 8.0 to 9.5. Any water, which is suitable for drinking, can be used in the engine when properly treated as described in engine manufacturer's operation manual. The engine manufacturer's representative should be consulted regarding the selection of satisfactory brand, permanent-type antifreeze for use in the cooling system.

b) Radiator Cap

(1) General

A pressure relief valve is built into the radiator cap. It is designed to open at a pressure of approximately 15 psi (103.4 Kpa).

WARNING

When removing cap from a very hot radiator, do not turn cap past safety stop until the pressure or steam has escaped.

(2) Removal

To remove, turn the cap to the left (counterclockwise) to the safety stop. When all pressure is released, press down on the cap and continue to turn until the cap is free to be removed.

CAUTION

Allow engine to cool before adding coolant.

CAUTION

Do not attempt to repair the valve in a radiator cap in case of failure. Replace with a new cap.

(3) Installation

When installing the cap, be sure it is turned clockwise as far as it will go so that the pressure retaining valve will be functional.

c) Coolant

The preparation and maintenance of the coolant solution is important to engine life and is completely covered in the engine manufacturer's operation manual. For information regarding coolant specifications, testing equipment, antifreeze, etc., refer to engine manufacturer's operation manual that accompanies the equipment manufacturer's manual or consult the local engine manufacturer's representative.

CAUTION

Never use soluble oil in the cooling system.

(1) General

A permanent type antifreeze is recommended for use in the cooling system.

CAUTION

1. **DO NOT** use methanol or alcohol as antifreeze.
2. **DO NOT** mix brands or type of antifreeze. A solution containing two or more types of antifreeze is impossible to test accurately.

(2) Selecting antifreeze

- a Select a permanent type antifreeze known to be satisfactory for use with chromate corrosion resistor.
- b When it is not known if the antifreeze is satisfactory for use with chromate resistor, check with local engine manufacturer's representative for a list of compatible antifreezes.

(3) Checking antifreeze solution

Check the solution with a reliable tester when in doubt about antifreeze protection.

d) Draining the Cooling System

To completely empty the cooling system requires draining the engine block (if furnished) and the radiator assembly. Both of the drain valves (radiator and block drain), can be opened/closed at the same time but they do not need to be.

To drain the cooling system, proceed as follows:

- (1) Remove radiator cap.
- (2) Place a drain pan with at least a 40 quarts (28.4 liters) capacity under radiator to catch coolant.
- (3) Place the radiator drain hose that comes off the two radiator drain valves, into the drain pans.
- (4) Open the radiator drain valves.
- (5) Allow the system to drain completely.

NOTE: Be sure the drain valves do not clog during draining.

- (6) When the system is completely drained, close the drain valves and replace engine drain plug.

e) Flushing the Cooling System

Flushing the cooling system should be a yearly maintenance procedure. By flushing the system, clean water is forced through the engine block to remove expired coolant and other contaminants.

f) Cleaning the Radiator Core

Blow out accumulated dirt from the radiator core air passages, using water. Bent or clogged radiator fins often cause engine overheating. When straightening bent fins, be careful not to damage the tubes or to break the bond between fins and tubes.

NOTE: Direct the water in a reverse direction to normal air flow. Normal flow on this installation is from the engine compartment out ward.

g) Filling the Cooling System

The preparation and monitoring of coolant in liquid-cooled engines is especially important because corrosion, cavitation, and freezing can lead to engine damage. For coolant system protection details see the engine manufacturer's operations manual.

(1) Install coolant

- a Remove radiator cap. Be sure that both radiator drain valves are closed.
- b Pour coolant into radiator very slowly until it reaches the bottom of fill neck. Allow time for trapped air to escape from the system then continue filling until the coolant level remains at the bottom of the fill neck.
- c Start the engine and bring up to rated speed and allow the thermostat to open. Add coolant as trapped air escapes from the system and the coolant level falls.
- d Continue to check coolant level until all trapped air escapes. Add coolant if needed to fill to the bottom of fill neck. Install radiator cap.

(2) Inspection/Check

- a Check system for evidence of leaks.
- b Inspect all hoses. Install new hoses as necessary. Tighten hose clamps as required.
- c Check the condition of fan and water pump belts. Replace belts if necessary.

NOTE: It is good practice to attach a card, indicating the cooling system contents and date serviced, to the radiator filler neck.

h) Thermostat

The thermostat should be checked each fall, or as required. Refer to engine manufacturer's operations manual for recommended instructions.

7) Generator Maintenance

The 400 Hz generator requires no maintenance or service other than periodic cleaning. The unit is brushless and has bearings that are permanently lubricated and sealed.

a) Cleaning

The generator may be cleaned by careful use of compressed air and/or a good, SAFE commercial cleaner. Steam cleaning of the generator is not recommended because the use of steam and harsh chemical compounds may result in damage to insulation and other generator components.

CAUTION

Do not use a flammable solvent. Be sure the unit is completely dry before operating.

b) Adjustment

The generator itself requires no adjustment. Adjustment procedures for generator controls are covered in Section 2-3.

8) Drive Belt

a) General

The engine cooling fan, alternator, and water pumps are driven by one serpentine belt, which must be replaced if worn or damaged.

b) Preparation for Belt Check and Adjustment

All driven assemblies must be securely mounted in operating position before checking belt tension.

c) Checking Belt Tension

CAUTION

Checking the tension and changing the serpentine belt should only be performed with the engine off.

Check belt tension every 1000 hours, or once year, whichever comes first. A belt that is too tight is destructive to bearings of the driven part. A loose belt will slip and cause inefficient operation of the part being driven as well as wear to the belt.

CAUTION

Inspect and replace the belt if it has unacceptable cracks, is frayed, or has pieces of material missing.

Belt tension may be checked by hand. To do so, manually depress the belt with an index finger to determine the amount of belt deflection obtained. When a force is applied at a point halfway between pulleys on the longest span of a belt, there should be no more than 1/2 inch of deflection attained.

Refer to the engine manufacturer's operation manual for checking belt tension and changing worn belts.

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Section 3 Adjustment/Test

1) General

These adjustments and test procedures are applicable to testing and adjusting the generator set after major repair, major parts replacements, or overhaul.

IMPORTANT	In order to perform most of the following test, a load bank with an EF interlock circuit is required. But if no EF interlock is available on a load bank, see special procedure in the EF Bypass section for testing the EF circuit.
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2) Testing the 400 Hz. Generator Set

a) Pre-operational Test Procedures

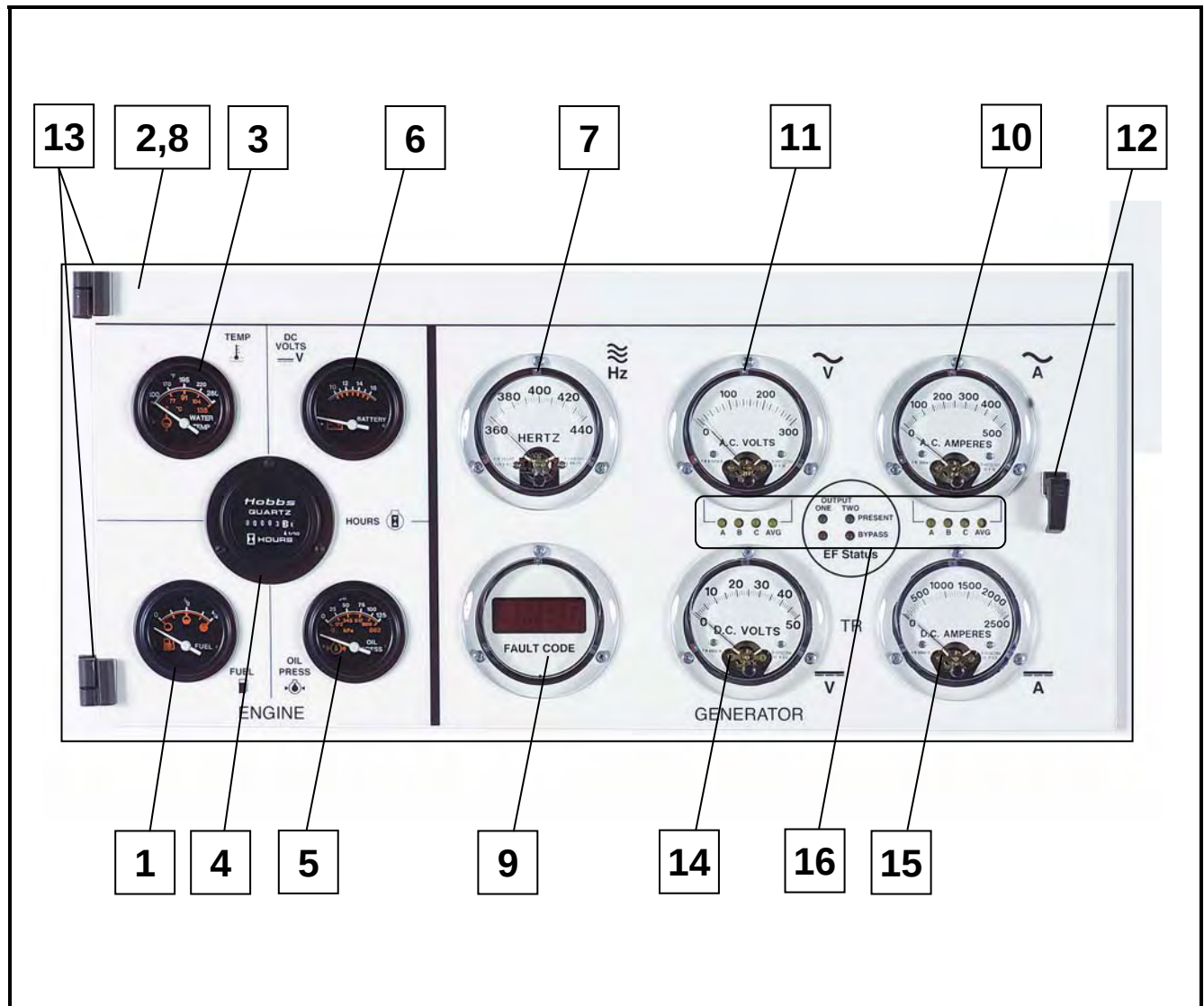
- (1) Connect cables from the generator output terminals to a load bank. Use cables of the same size and length as those to be used in service. Be sure the generator output N cable is grounded.
- (2) Check engine oil level. Oil should be at high bar on the dipstick.
- (3) Check radiator coolant level.
- (4) Check tension of drive belt.
- (5) Inspect for oil, fuel and coolant leaks.
- (6) If the setting of the output voltage coarse adjustment potentiometer on the voltage regulator has been disturbed, set it at center position (halfway between full clockwise position and full counterclockwise position).
- (7) Check control panel lights circuit breakers by pressing panel "**LAMPS**" push button switch. If panel lights operate, the circuit breaker, switch, and lamps are good.
- (8) Check fault indication lights by pressing "**TEST/RESET**" push button switch. If fault code display lights up, the control circuit breaker is good.
- (9) Make a general inspection of all wiring, and terminals. Inspect the equipment to be certain no damage will result from starting the engine.

b) Operational Test Procedures

- (1) Start the engine in accordance with instructions in Section 1-3.
- (2) Check operation of engine instruments; ammeter, coolant temperature indicator, oil pressure gage and hour meter.
- (3) Check engine idle speed. Should be 1000 +/- 25 RPM.

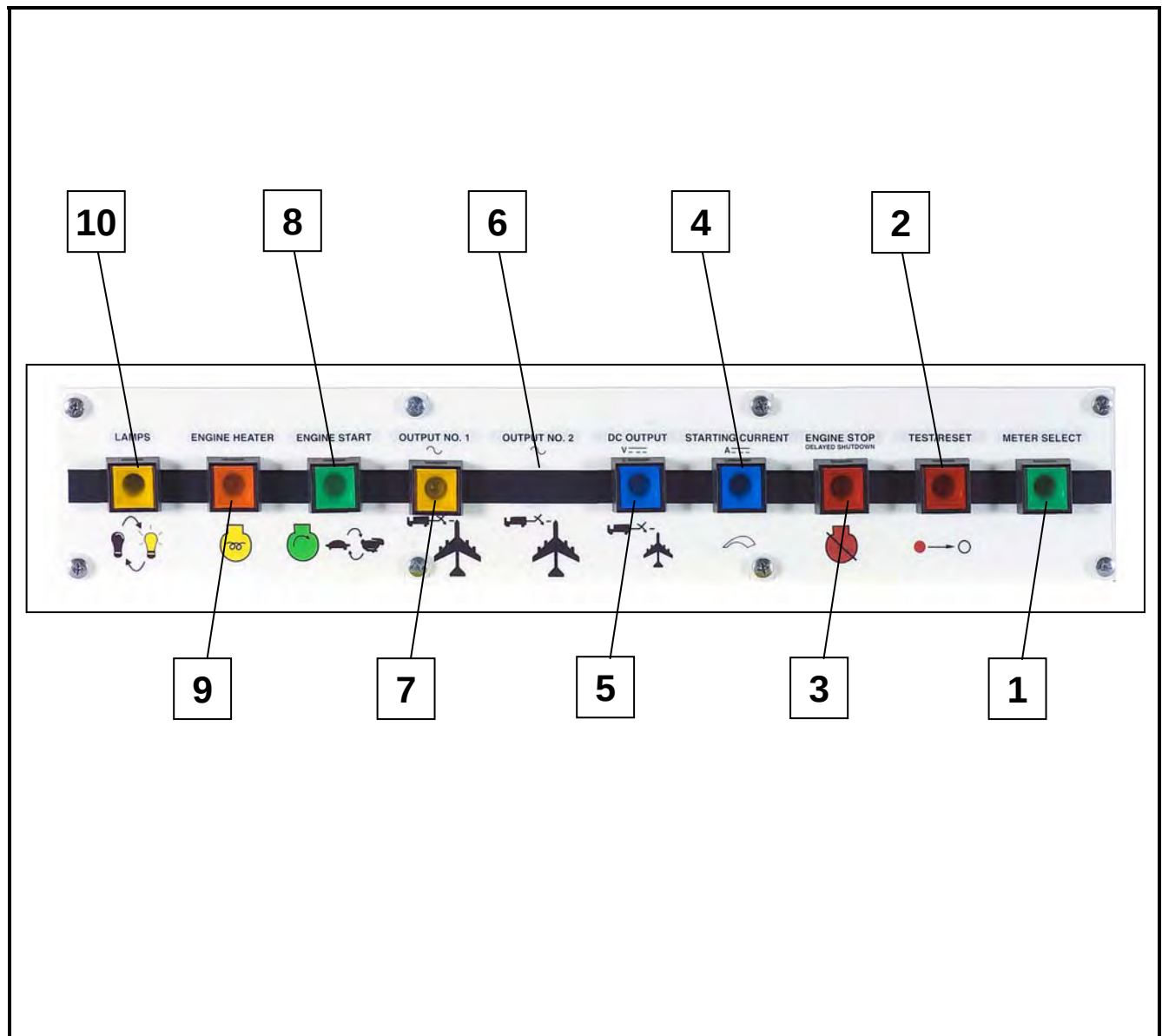
NOTE: A stroboscope may be required for this check.

- (4) Again check for oil, fuel, and coolant leaks and correct any leaking condition.



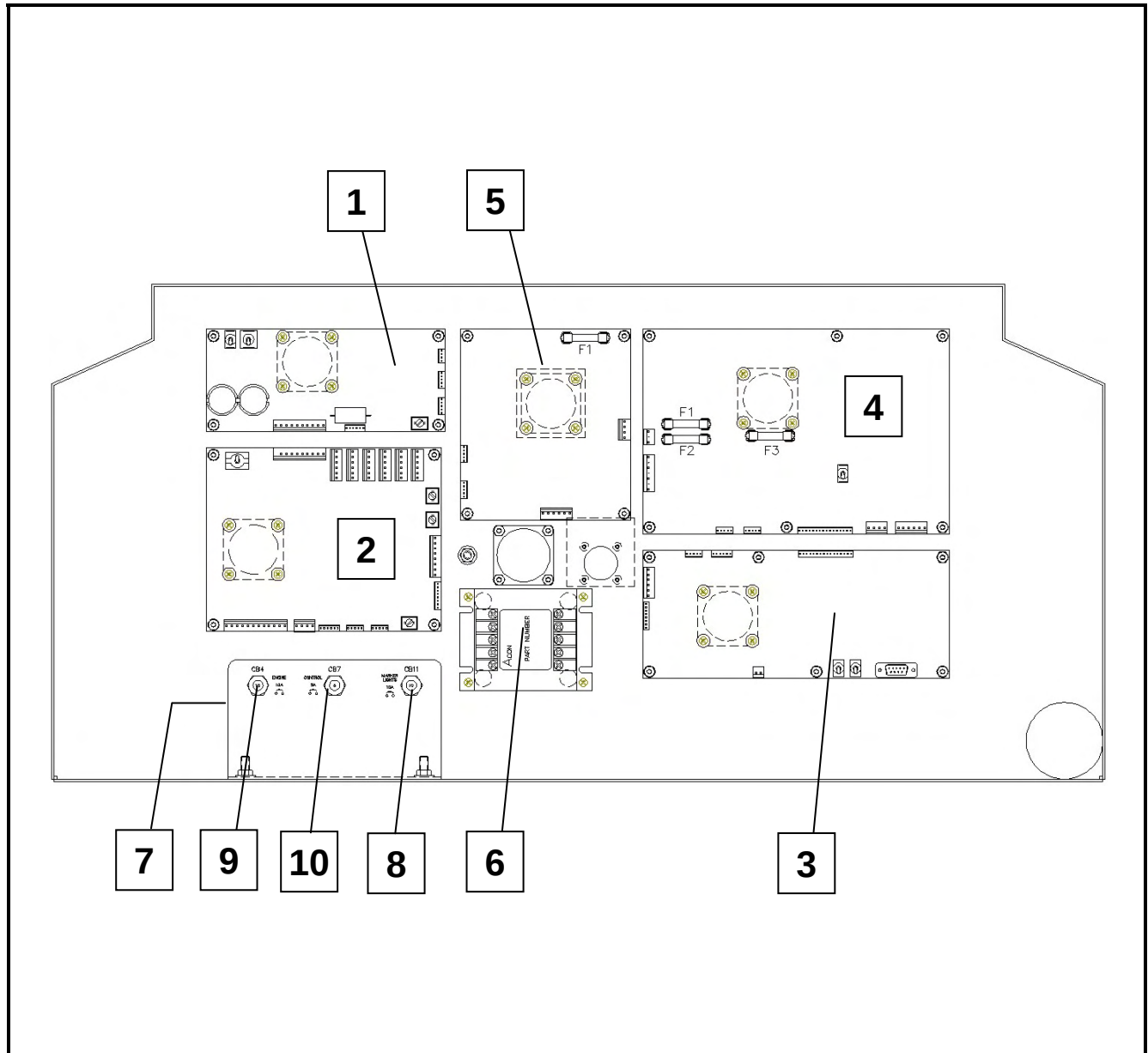
- | | |
|---|--|
| 1. Fuel Gage (M13) | 9. Fault Code Meter (M6) |
| 2. Door Assembly Panel | 10. AC Generator Ammeter (M1) |
| 3. Engine Coolant Temperature Gauge (M24) | 11. AC Voltmeter (M2) |
| 4. Running Time Meter (M4) | 12. Adjustable Grip Door Latch |
| 5. Oil Pressure Gage (M25) | 13. Control Panel Door Hinges |
| 6. Battery Voltmeter (M5) | 14. DC Voltmeter [Optional, included with TR] |
| 7. Frequency Meter (M3) | 15. DC Ammeter [Optional, included with TR] |
| 8. Control Panel Laminate | 16. LED PC Board (A5) [Not Shown, Opposite Side] |

Control Panel Door
Figure 1



- | | |
|---|--|
| 1. Meter Selector Switch (S3) | 6. AC Output No. 2 Contactor Switch (S275) |
| 2. Test/Reset Switch (S77) | 7. AC Output No. 1 Contactor Switch (S75) |
| 3. Engine Stop Switch (S76) | 8. Engine Start Switch (S24) |
| 4. DC Starting Current Switch (S431) [Optional with TR] | 9. Air Intake Heater Switch (S79) |
| 5. DC Output Contactor Switch (S430) [Optional with TR] | 10. Panel Light Switch (S74) |

Control Push-Button Switch Panel
Figure 2



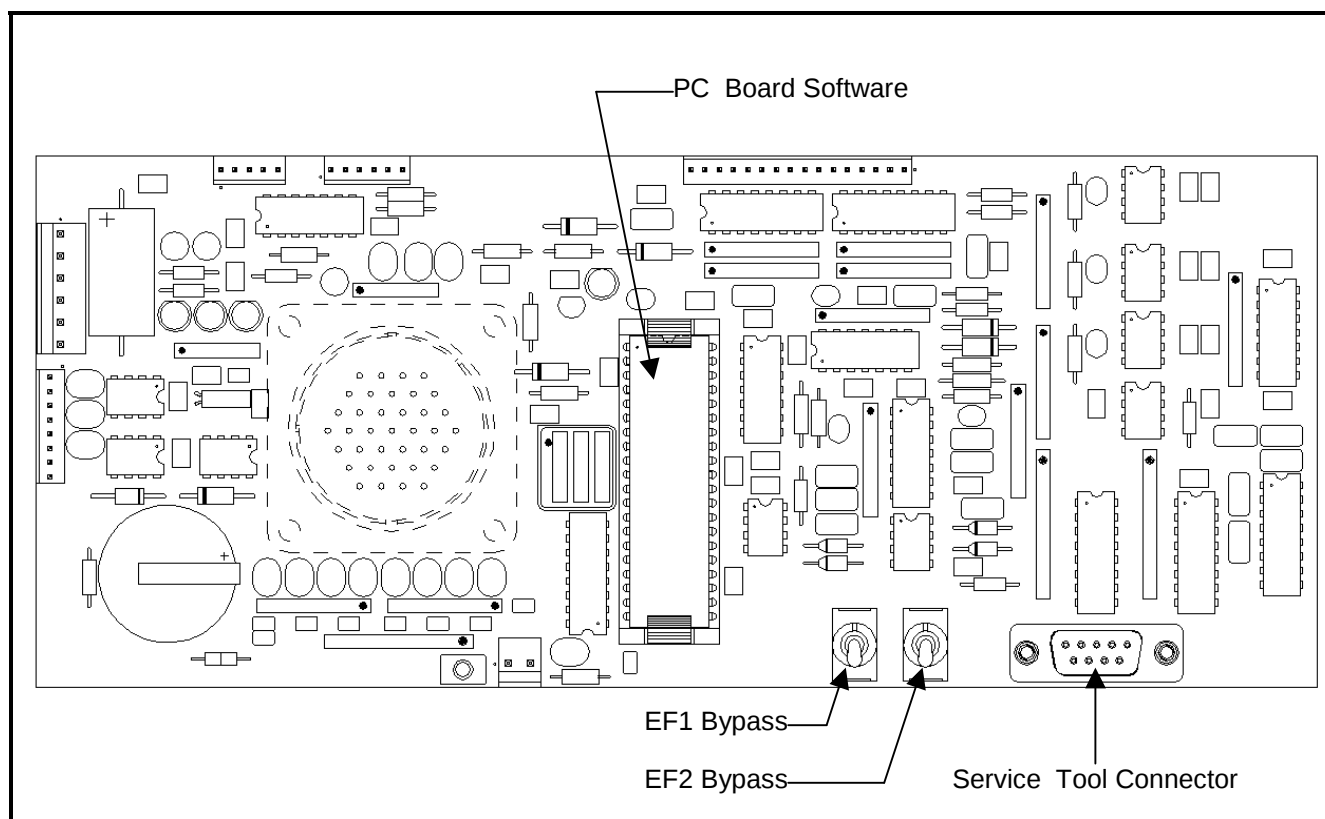
- | | |
|---|--|
| 1. Engine Specific PC Board [ESB] (A1) | 6. +5, -12 VDC Power Supply (PS1) |
| 2. Engine Interface PC Board [EIB] (A2) | 7. Circuit Breaker Support Bracket |
| 3. Digital Control PC Board [CTL] (A3) | 8. Marker Lights Circuit Breaker, 10 A (CB1) |
| 4. Voltage Regulator PC Board [REG] (A4) | 9. Engine Circuit Breaker, 10 A (CB4) |
| 5. Transformer-Rectifier PC Board [TRB] (A404) {Optional} | 10. Controls Circuit Breaker, 5 A (CB7) |

Control Box Interior Components (Rear Panel)
Figure 3

- (5) Position switches and controls for automatic voltage regulation and power delivery as follows:
 - a Place regulated-diagnostic switch in "**REGULATED**" position.
 - b Place EF Bypass switches in "**BYPASS / OFF**" position.
 - c If the output voltage coarse adjustment potentiometer on the voltage regulator has been disturbed, place the knob at mid-range position.
 - (6) Bring the engine up to rated speed, which also energize the generator, by pressing the "**ENGINE START**" push button switch a second time. If the engine comes up to rated speed and a 115 V voltage value appears on the voltmeter, the engine ECM and excitation circuits are functioning.
 - (7) After generator overhaul or repair, the Regulated/Diagnostic switch must be placed in the "**DIAGNOSTIC**" position for 3 to 5 seconds to re-magnetize the exciter. Then return the switch to the "**REGULATED**" position after voltage has built-up.
 - (8) Observe frequency meter. If engine speed is properly set, frequency should read 400 Hz.
 - (9) Observe voltmeter. Use output fine voltage coarse adjustment potentiometer to adjust voltage to 115 V AC.
 - (10) Check adjustable voltage range.
 - a Observe voltmeter and turn output voltage coarse adjustment potentiometer to full clockwise position. Maximum voltage should be 134 volts or higher.
- NOTE:** If voltage should decrease when regulator potentiometer is turned clockwise, it indicates that internal wiring in the voltage regulator is incorrect. Replace complete voltage regulator assembly.
- b Observe voltmeter and turn regulator potentiometer knob to full counterclockwise position. The minimum voltage should be 95 volts or lower.
 - (11) Position load bank switches, etc., to apply a light load to the generator.

c) Testing the No. 1 Output Circuit

- (1) Place EF Bypass switch in "**BYPASS / OFF**" position turn the EF signal "**ON**" on the load bank. Then press the yellow No. 1 load contactor push button switch to close contactor, which is indicated when its internal indicating light glows.
- (2) Place EF switch on the load bank in the off position. The No. 1 load contactor should open immediately, and the indicating light within the push button switch should go off. The fault code display should also read "**EF 1**", indicating an EF warning. This is because the interlock circuit of the control PC board is not receiving 28.5 VDC signal from an outside source. It indicates that the No. 1 interlock circuit is OPEN, as it should be when the interlock circuit is not receiving a 28 VDC signal. Reset the fault by pressing the "**TEST/RESET**" push button.

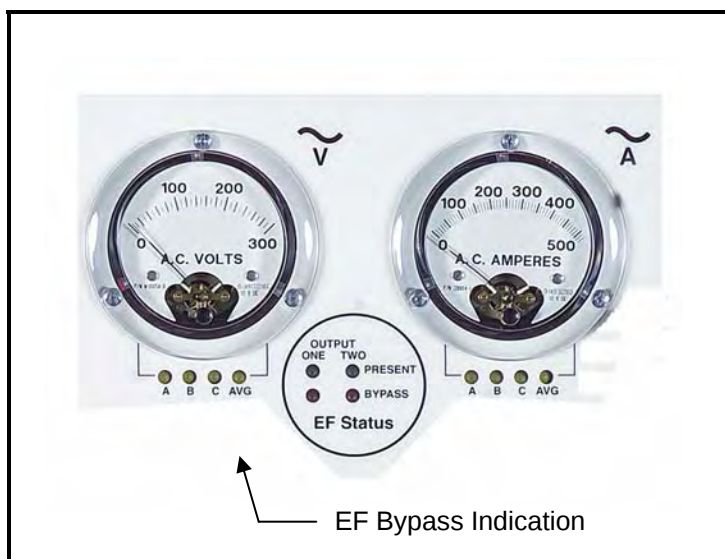


Digital Control PC Board
Figure 4

- (3) Verify that when the EF Bypass switch is in the **"BYPASS / ON"** position or the **"BYPASS / OFF"** position, that the appropriate LED indication on the control panel display is correct.
- (4) Place EF bypass switch in **"BYPASS / ON"** position. Press the No. 1 load contactor push button switch. The No. 1 contactor power indicating light within the push button switch should glow and remain on when the push button switch is released. This indicates that EF bypass switch is functioning correctly. The corresponding LED should also indicate the bypass mode.
- (5) Place the No. 1 EF bypass switch to **"BYPASS / OFF"** position. The No. 1 load contactor should open at once and the yellow indicating light within the No. 1 load contactor push button switch should go off and the fault code display should also read **"EF 1"**, indicating a EF warning. The corresponding LED should also indicate the EF present mode. Reset the fault by pressing the **"TEST/RESET"** push button.
- (6) Proceed to step 12.

(Steps 8 - 11 are only required if EF interlock system is not available on a load bank.)

- (7) Connect a source of 24 V-DC power (two twelve-volt batteries connected in series) to terminals N, F (or E) at the output terminal panel. Connection polarity is important. Connect plus (+) to terminals E or F, and minus (-) to terminal N.
- (8) Verify that when the EF Bypass switch is in the **"BYPASS / ON"** position or the **"BYPASS / OFF"** position, that the appropriate LED indication on the control panel display is correct during the following steps 9 and 10.
- (9) Place the No. 1 EF bypass switch to **"BYPASS / OFF"** position. Press the No. 1 contactor operating push button switch. The No. 1 contactor power on indicating light, within the push button switch, should glow and remain on when the push button switch is released. This indicates that the load contactor is closed and the plug interlock circuit is functioning properly.
- (10) Disconnect the 24 V-DC power source and the No. 1 load contactor should open immediately, and the indicating light within the push button switch should go OFF. The fault code display should also read **"EF 1"**, indicating an EF warning. This is because the interlock circuit of the control PC board is not receiving 28.5 VDC signal from an outside source. It indicates that the No. 1 interlock circuit is OPEN, as it should be when the interlock circuit is not receiving a 28 VDC signal. Reset the fault by pressing the **"TEST/RESET"** push button.



**EF Bypass Indication
Figure 5**

- (11) In EF bypass mode, apply 1/3 to 1/2 load at the load bank and allow the unit to run for 15 to 30 minutes. Observe operation of all monitoring instruments.
- (12) Increase load at the load bank to full load.
- (13) Check operation of the engine ECM by observing the frequency meter when generator is switched from no load to full load, and vice versa. Use the No. 1 contactor control push button switch to apply and remove load several times. Steady-state frequency droop should be no more than 1 Hz.
- (14) Follow instructions in Paragraph 3 to set voltage regulator line drop compensation for the length and size of cable being used.

- (15) Check voltage regulator, at intervals, from no load to full load. Observe and note voltage at various loads. Steady-state voltages should vary no more than +/- 1% from normal output voltage.
- (16) Operate the No. 1 output circuit of the unit no less than 10 minutes under full load. The overload protection **MUST NOT** trip.
- (17) Operate the No. 1 output circuit of the unit at 125% load (325 amperes) for 5 minutes immediately following the full load run. The overload device **MUST** trip within 5 minutes, and the fault code display should read **"70.18"** indicating an overload condition in **"OUTPUT NO 1"** (Reference fault chart in Section 2-4).
- (18) Reset the fault by pressing **"TEST/RESET"** push button.

d) Testing the No. 2 output circuit

- (1) Repeat steps (1) through (18) in the previous section **"Testing the No. 1 Output Circuit"** for testing the No. 2 output circuit.

e) Testing and checking meters, switches, protective monitoring circuits, and fault code display

- (1) Check accuracy of AC voltmeter
 - a Open door of control box and connect a master voltmeter of known accuracy to terminals of the AC voltmeter.
 - b Compare the unit's voltmeter reading with master meter. Error must not exceed 2% of full scale.
- (2) Check accuracy of AC ammeter
 - a Connect a master ammeter of known accuracy to the AC ammeter.
 - b Compare the unit's ammeter reading with master meter under various loads. Error must not exceed 4% of full scale.
- (3) Check operation of the **"METER SELECT"** switch.
 - a In any LINE-TO-NEUTRAL position, the voltmeter reading should be 115 volts when the LED under the voltmeter indicates one of the 3-phase being checked.
 - b In any LINE-TO-LINE position, voltmeter reading should be 200 volts when the LED under the voltmeter indicates two of the phases being checked.
- (4) Check accuracy of frequency meter
 - a Connect a master frequency meter of known accuracy to the terminals of the frequency meter.
 - b Compare meter readings. Error must not exceed 1% of full scale.

NOTE: Make all protective system tests with the unit operating under a load for the following steps. (Reference Chapter 2, Section 4, for all fault codes)

(5) Check operation of over-voltage circuit and fault code display.

- a With the unit running at a normal load, adjust the coarse adjustment potentiometer on the voltage regulator clockwise to increase voltage until the over-voltage sensing circuit actuates the protective monitor. After the protective monitor is activated, the load contactor will open and the fault code display will display fault “**70.16**”. At 125 volts, the circuit will trip after a 1-second time delay. At higher values of voltage, time delays for over voltage trips are as follow:
 - At 140 volts, the circuit will trip within 160 milliseconds.
 - At 180 volts, the circuit will trip within 50 milliseconds.
- b If the load contactor does not open under the conditions described in step (a), refer to the Troubleshooting Chart in Section 2-4.
- c Return unit to normal operating conditions by adjusting coarse adjustment potentiometer (turning it counterclockwise) and pressing “**TEST/RESET**” button switch to clear the fault code.

(6) Check operation of under-voltage circuit and fault code display.

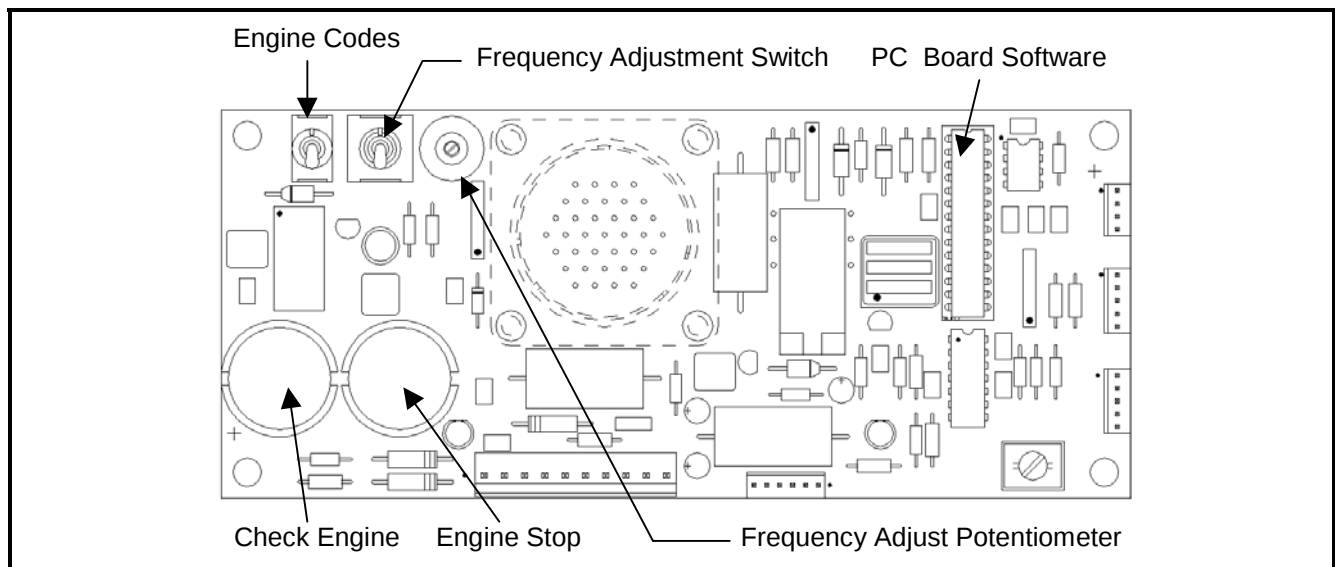
With the unit running at a normal load, adjust the coarse adjustment potentiometer on the voltage regulator counterclockwise to decrease voltage until the under-voltage sensing circuit actuates the protective monitor. After the protective monitor is activated, the load contactor will open and the fault code display will display fault “**70.17**”. Follow the following steps below to activate the under-voltage protective monitor. A stopwatch is required for this check.

- a With the unit running at normal load, use the output voltage coarse adjustment potentiometer on the voltage regulator to reduce the voltage to 104 volts. The load contactor should NOT open.
- b Reduce voltage in increments of 1 volt, with a time delay of 7 seconds between steps. At a setting of 100 volts, the load contactor will open and the under voltage light will glow after a 7-second time delay.
- c If the load contactor does not open under the conditions described, refer to the Troubleshooting Chart in Section 2-4.
- d If the under voltage circuit performs satisfactorily, return unit to normal operation by adjusting output voltage coarse adjustment potentiometer for normal output voltage, pressing the “**TEST/REST**” push button switch to clear the fault code.

(7) Check under-frequency circuit and fault code display.

At some frequency value 380 Hz or less, after 7 seconds, the frequency condition should signal the under-frequency circuit protective monitor to OPEN the load contactor and display “**70.23**” on fault code display. To check the under-frequency protective components, proceed as follows:

- a While the unit is operating normally under load, set the frequency adjust switch to **"TEST"**. Rotate the frequency adjust potentiometer to adjust frequency to 400 HZ.
- b Reduce frequency in steps of 1 Hz, with a time delay of 7 seconds between steps.
- c If the protective circuit opens the load contactor and displays fault **"70.23"** on the fault code display after 7 seconds, at 380 Hz or less, all components of the system are functioning properly.
- d If the load contactor is not opened at 380 Hz or less after 7 seconds, refer to Troubleshooting Chart in Chapter 2, Section 4.
- e Return unit to normal operating condition by setting the frequency adjust switch to **"NORMAL"** and pressing **"TEST/RESET"** button switch to clear fault code.



Engine Specific PC Board
Figure 6

(8) Check over-frequency circuit and fault code display.

At some frequency value 420 Hz to 440 Hz, after 5 seconds, the over frequency sensing circuit should signal the over-frequency circuit protective monitor to OPEN the load contactor and display **"70.22"** on fault code display.

At any frequency value exceeding 440 Hz, the over-frequency circuit should immediately signal the protective monitor to OPEN the load contactor and display **"70.22"** on fault code display..

To check the under frequency protective components, proceed as follows:

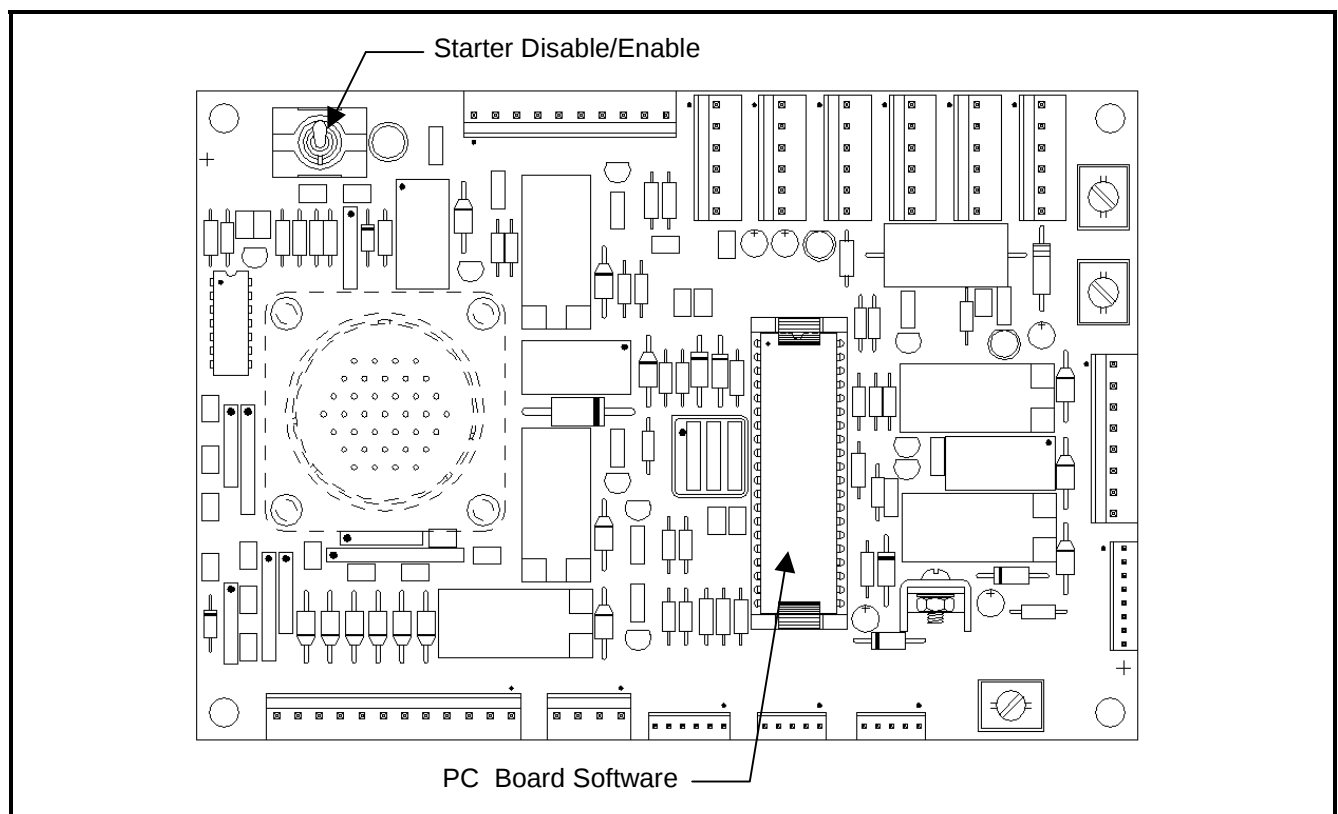
- a While the unit is operating normally under load, set the frequency adjust switch to **"TEST"**. Rotate the frequency adjust potentiometer to adjust frequency to 400 HZ.
- b Increase frequency in steps of 1 Hz, with a time delay of 5-7 seconds between steps.

- c If the protective circuit opens the load contactor and displays fault **"70.22"** on the fault code after 5 seconds at 426 Hz, all components of the system are functioning properly.
- d If the load contactor is not opened at 426 Hz after 5 seconds, refer to Troubleshooting Chart in Chapter 2, Section 4.
- e Return unit to normal operating condition by setting the frequency adjust switch to **"NORMAL"** and pressing **"TEST/RESET"** button switch to clear fault code.

NOTE: If the generator is operating under load at this point, open the contactors. There will be no further need for the load bank in the following checks.

f) Testing for engine ECM faults

- (1) Set the starter enable/disable switch to **"DISABLE"**. **"DISABLE"** will prevent the engine from starting, but will still supplying 12 VDC to the control system, while checking the ECM faults.
- (2) Press the green **"ENGINE START"** push button switch. Although the engine is not running, the green light in the **"ENGINE START"** switch will flash to indicate that power is available to the engine ECM.



Engine Interface PC Board
Figure 7

- (3) If no active codes are recorded, both the “Engine Stop” and “Check Engine” lamps will come on and stay on.

If active codes are recorded, both lamps will come on momentarily and then begin to flash one code of the recorded faults.

- (4) The fault code will flash in the following sequence:

First, a “Check Engine” (yellow) lamp will flash. There will be a short 1- or 2-second pause after which the number of the recorded fault code will flash in the “Engine Stop” (red) lamp. There will be a 1- or 2-second pause between each number. When the number has finished flashing in the red lamp, the yellow lamp will appear again. The fault code will repeat in the same sequence.

The lamps flash each fault code 3 times before advancing to the next code. To skip to the next fault code, move the Engine Codes Switch momentarily to the UP position. You can go back to the previous fault code by momentarily moving the Engine Codes Switch to the DOWN position. If only one fault is recorded, the QSB control system will continuously display the same fault code when the Engine Codes Switch is moved to either the UP or DOWN position.

- (5) See engine manufacture’s manual for code meanings.

g) Re-checking the entire unit after testing

- (1) With the engine running at normal rated speed, check the entire unit for vibration and for any parts that may have become loosened during the above checks. Tighten any loose hardware as required.
- (2) Check engine oil pressure at rated speed (2000 RPM). The oil pressure gage should indicate at least 44.9 psi (3.1 bar) when engine is hot. Also at rated speed, check the engine coolant temperature. The temperature gage should indicate in the range of 180° to 190° F (82° to 88° C), depending upon operating conditions.

WARNING

If a metal sounding rod is used to detect bearing noises, exercise extreme care to avoid injury from moving components.

- (3) Check 400 Hz generator bearings. Use a stethoscope or metal sounding rod to listen for unusual noises. If using a metal rod, place one end on the generator housing and hold the other end near the ear. Hold the rod with three fingers and use the index finger and thumb to form a sounding chamber between the rod and the ear. Do NOT allow the rod to touch the ear. Listen for grinding or pounding sounds, which would indicate a defective bearing. An engine noise may be telegraphed to the generator and misinterpreted as a generator noise. Contact the equipment manufacturer if in doubt of bearing serviceability.

3) Generator Set Adjustment

a) Generator Adjustment

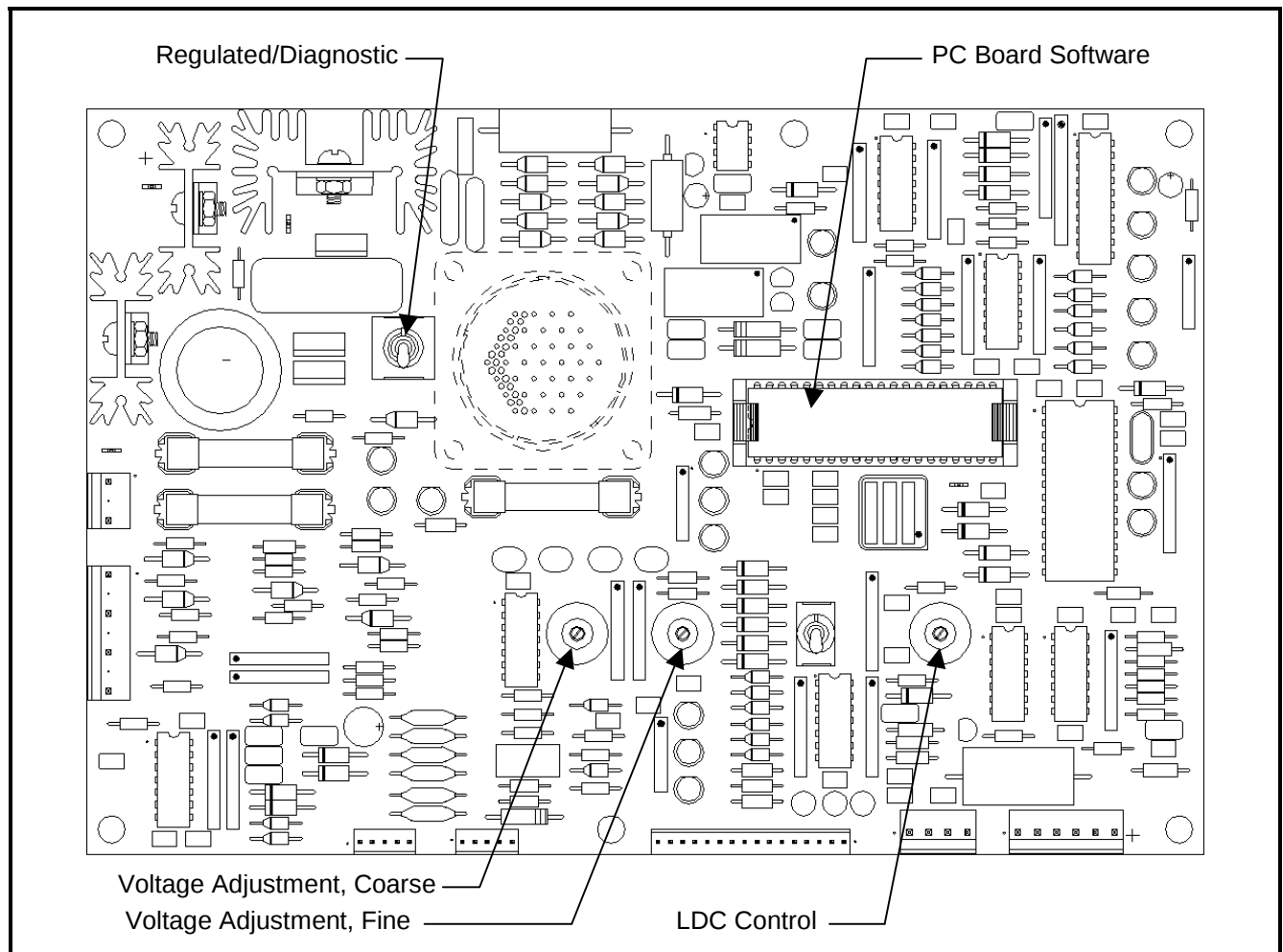
The 400 Hz generator is a brushless type requiring no adjustments of any kind.

b) Adjust 400 Hz voltage regulator.

When a voltage regulator is first put into service, or when output (generator-to-aircraft) cables are changed, the regulator may require adjustments of output voltage value and line-drop compensation. For making these adjustments, the voltage regulator has three potentiometers:

- A coarse output voltage potentiometer
- A fine output voltage potentiometer
- A line-drop compensation potentiometer

For the following adjustment, the generator set must be running at rated speed (2000 RPM), under no-load conditions. Adjust the regulator as follows:



Voltage Regulator PC Board
Figure 8

(1) Output Voltage Adjustment

a Adjust Voltage Control

The output voltage, at which the generator is regulated, is adjustable by the fine voltage adjustment potentiometer. Turn the potentiometer adjustment clockwise to increase generator output voltage, and counterclockwise to decrease voltage.

Observe the output voltage as indicated by the voltmeter, located on the control panel of the generator set. Set output voltage at 115-V AC line-to-neutral (200-V AC line-to-line).

b Adjust Line Drop Compensation

Adjustment of line drop compensation is made with the line drop compensation potentiometer. Turning the potentiometer knob clockwise increases the magnitude of the compensation, and turning the potentiometer knob counterclockwise decreases the magnitude (A graduated nameplate for specified cable lengths is included for quick reference.). To adjust the line drop compensation, proceed as follows:

- Connect the generator set output cables to a load. Load the generator set with the largest available three-phase load of rated power factor not exceeding the maximum rating of the generator set.
- Measure output voltage at the load end of the cables. If the load voltage rises or drops more than 1% at the load end of the cables, decrease or increase the line drop compensation until the regulation is flat (115-V AC line-to-neutral and 200-V AC line-to-line).
- If the line drop compensation adjustments have affected the no-load voltage output, adjust the fine output voltage control potentiometer to the desired value.

(2) Test the Voltage Regulator

After necessary adjustments have been completed, re-test the voltage regulator as follows:

- a Connect a voltmeter at the load end of the generator output cables.
- b Operate the generator set at no-load and observe voltage reading.
- c Operate the generator set under load and observe voltage reading.
- d Voltage under load and no load should vary no more than 1% at the load end of the cables.

c) Basic Engine Adjustments

Adjustment procedures applicable to the diesel engine are included in the engine manufacturer's operation manual, which is referenced in Chapter 5. Refer to the engine operation manual for detailed information on the following engine adjustments.

Engine idle speed is programmed at the factory. If adjustment is required, contact the local engine distributor. The recommended idle speed is 1000 RPM, +/- 25 RPM.

NOTE: A stroboscope is required for engine idle speed checks.

(1) Engine speed limiting adjustment

The speed limiting adjustment is also set and sealed at the factory. Speed should be limited to approximately 2350 RPM. If adjustment is required, contact your local engine distributor.

d) Engine Accessories Adjustment

(1) Alternator and fan belt adjustment

Refer to Section 2-1 and engine manufacturer manual.

DIESEL ENGINE	
Manufacturer and Model	Cummins Engine Company / QSB4.5
Type	4 cylinder, 4 cycle diesel, electronic controlled
Bore and Stroke	4.21 in. x 4.88 in. (107 mm x 124 mm)
Displacement	275 in ³ (4.5 L)
Horsepower	155 hp (116 kW)
Idle speed	1000 ± 50 rpm
Normal governed speed	2000 rpm
Firing Order	1-3-4-2
Electrical system	12 VDC
Lubricating oil capacity (w/ filter)	11.6 quarts (11 liters)
Coolant capacity system	20 quarts (18.9 liters)

Specifications and Capabilities
Figure 9

4) Generator and Exciter Test

The generator fields and exciter stator may be tested with a Kelvin bridge. This is a double-bridge type instrument required for the very low resistance's encountered in this test. It is understood that zero (0) resistance indicates a **SHORT CIRCUITED** condition. An infinite resistance reading indicates an **OPEN CIRCUITED** condition.

- Disconnect generator stator leads at the output module panel.
- Disconnect the two black exciter field leads from terminal block mounted on output module panel.
- Check resistance and compare to values.

Test Connection	Resistance (Ohms)
Generator Stator Phase A to N (G1)*	0.0026
Generator Stator Phase B to N (G1)*	0.0026
Generator Stator Phase C to N (G1)*	0.0026
Exciter Stator Field (L2)	29
A - B, B - C, C - A Exciter Armature (G2)	0.041
Generator Revolving Field (L1)	2.1

***NOTE:** The two leads of a phase must be connected when test is made. Take readings when unit is cold and in an ambient temperature of 70 °F (21°C.).

Generator and Exciter Test Readings
Figure 10

5) Diode Test

Test values for diodes are not given here because they could be misleading. Test values may vary even between diodes of the same part number, rating, and manufacturer. General instructions for testing diodes are as follows:

- Disconnect exciter windings from diode lead(s).
- Use a good quality ohmmeter. An instrument, which indicates 50 ohms at the center of the scale, is preferable.

NOTE: Make certain the battery is in good condition and the pointer is adjusted to zero when the test lead points are shorted together.

- Hold one ohmmeter lead point on the threaded end of the diode. Hold the other lead point on the wire terminal end. Observe and note the indicated resistance. Now reverse the lead connection on the diode. Again observe and note the ohmmeter indicated resistance. Generally speaking, if an infinite or very high resistance was indicated with the leads connected one way and a low, readable resistance was indicated with the leads connected the opposite way, the diode may be considered good.

6) Testing the Transformer-Rectifier (Optional, See Appendix A)

The 28.5 VDC transformer-rectifier is an optional add-on to the GPU. See Appendix A for more details on the adjustment and test of the transformer-rectifier.

Section 4 Troubleshooting Procedures

1) General

The Troubleshooting Chart (See Appendix A for the 28.5 VDC Transformer-Rectifier troubleshooting information) and Fault Code Chart, located in this section, covers the common faults and malfunctions that you may find during operation or maintenance of this equipment. The charts may not list all faults and malfunctions that may occur. If a fault or malfunction is not listed in the chart, start looking for the cause at the source of power in the affected circuit. Refer to the schematic and connection diagrams in Chapter 5. Test the circuit, step by step, until the source of the malfunction is isolated.

The Fault Code Chart is arranged under 2 headings: Commands and Faults. Commands display the operation mode at the time a fault code is triggered.

The Troubleshooting Chart is arranged under 3 headings: Trouble Symptom and Condition, Probable Cause, and Test Check and/or Remedy. Trouble(s), Symptom(s), and Condition(s) are described and numbered. Probable Cause(s) are indented to the right and listed in numbered steps below Probable Cause. Test Check and/or Remedy provide instructions for correcting the malfunction, and are listed below each Test or Inspection procedure. Tests and inspections called for in the Troubleshooting Chart are to be performed as described in Chapter 2, Section 1-3, of this manual.

2) Equipment for Troubleshooting

WARNING

Exercise extreme care to avoid contact with high voltage leads and components. High voltage can kill!

CAUTION

Maintenance personnel must be very careful when performing terminal-to-terminal checks to be certain the proper terminals are being used, especially when using jumper leads. Damage to electrical components may result from the application of improper voltage and current.

A good quality multi-scale voltmeter is the only instrument required for troubleshooting. At least two jumper leads with alligator, or similar clips, will be required. The engine electrical system may be used as a 12 VDC power source.

3) Parts Replacement

To lessen end item down time, and to get a faulty machine back on line as quickly as possible, the black box concept of parts replacement is reflected in the Troubleshooting and Fault Code Chart. For example, if a component on a control box PC board is defective, the quickest way to remedy the situation is to replace the complete PC board and send the old to stock. Some of the assemblies that tend to lend themselves to this concept are:

- Voltage regulator PC Board (REG)
- Control PC board (CTL)
- Engine Specific PC Board (ESB)
- Engine Interface PC Board (EIB)
- LED PC Board (LED)
- 28.5 VDC Transformer-Rectifier PC Board (TRB) *[Optional, See Appendix A]*

4) 400 Hz. Test Values

Although test values are provided throughout the troubleshooting chart, additional information and values are given here.

Generator output voltage at maximum voltage regulator potentiometer setting:	120 volts or higher.
Generator output voltage at minimum voltage regulator potentiometer setting:	110 volts or lower.
Over voltage relay	Trips at 124-126 volts after a 1-second time delay. Trips at 140 volts in 160 milliseconds. Trips at 180 volts in 50 milliseconds.
Under voltage relay	Trips at 104 volts after 7 seconds.
Over frequency relay	Trips when greater than 420 Hz after a 5-second time delay. Trips immediately at any frequency exceeding 480 Hz.
Under frequency relay	Trips at 380 Hz or less after a 5-second time delay.
Overload time delay	Trips in approximately 5 minutes at 125% load of GPU rating or at 90 kVA on either output.
Frequency at rated speed of 2000 RPM is 400 +/- 2 Hz at no load and rated load.	
Engine oil pressure (warm and at rated speed 2000 RPM) 45 to 90 PSI (445 to 621 kPa).	
Engine coolant temperature (normal operation) 160 to 200° F (71 to 93° C).	

5) Check Connections and Leads

ALWAYS make a check of connections and leads to a component suspected of being faulty. With the exception of a few instances, we will assume that connections and wiring have always been checked first and that power has not been lost as a result of defective wiring or connections.

6) Engine Troubleshooting

The ability of the engine to start and run properly depends upon a number of things.

- An adequate supply of 12 VDC power reaching a good starter and starter button
- An adequate supply of air, compressed to a sufficiently high pressure.
- The injection of the correct amount of clean fuel at the proper time

NOTE: When trouble shooting the engine, keep these requirements in mind.

7) Illustrations

Illustrations, Figures 1, 2, 3 and 4, are referred to throughout the Troubleshooting Chart

8) Connection and Schematic Diagrams

All connection and schematic diagrams for generator, engine, lights, and all controls are located in Chapter 5.

9) GPU Control Monitoring

The GPU control system performs complete diagnostic testing and continuous monitoring of all critical circuits and operating electrical values. If the control system senses a problem with one of the circuits or if any of the electrical values exceeds its safe operating limit, the control system will shut the GPU down, or may allow the GPU to continue operation depending on the severity of the condition.

a) Commands

The ongoing operations conducted by the GPU are driven by the list of commands in Table 1. The control PC board communicates these commands to all of the PC boards in the GPU. The first half of the fault code identifies the command that was present when the fault occurred.

Commands	
01. \ 39.	Self-Test Mode
40.	Engine Start Mode
50.	Engine Idle Mode
70.	Engine Run Mode
80.	Engine Shutdown Mode
90.	Engine Stop Mode
99.	System Off Mode

Operating Commands
Table 1

(1) Self-Test Mode

When power is first applied to the control circuit, the GPU performs complete self diagnostics of the internal circuitry. During this self test, the GPU will perform the commands listed in the enclosed charts. When a fault is detected during the self test, the current **“COMMAND”** and detected **“FAULT”** are displayed on the fault code display.

(2) Engine Start Mode

When the **“ENGINE START”** push-button is activated, the engine's starter and the engine's ECM will be energized.

(3) Engine Idle Mode

When the engine has been started, the engine will begin in the idle mode. The “**ENGINE START**” push-button will flash indicating the engine is in the idle mode.

(4) Engine Run Mode

After the engine has been warmed up properly in the Engine Idle Mode, pressing the “**ENGINE START**” push-button again will bring the GPU up to rated speed. The “**ENGINE START**” push-button light will no longer flash, but instead become continuously illuminated. The GPU is now ready for aircraft loading.

(5) Engine Shutdown Mode

When shutting the GPU down, pressing the “**ENGINE STOP**” push-button will start the 3-5 minutes delayed shutdown period. The “**ENGINE STOP**” push-button will flashed and the engine will return to idle speed. The shutdown period is required to sufficiently cool the engine's turbocharger.

(6) Engine Stop Mode

After the 3-5 minutes delayed shutdown period, the engine will stop running.

(7) System Off Mode

The power will be removed from the GPU's entire control system.

b) Faults

Faults result when any of the fault limits are exceeded, when an internal problem occurs, or under certain conditions that would cause injury to personnel or damage to an aircraft or the GPU. Faults are also stored in memory as event records. The fault limits and conditions are preset at the factory.

Faults	
.01 \ .09	Warning (no operation changes)
.10 \ .39	Run Mode (minor fault)
.40 \ .59	Idle Mode (moderate fault)
.60 \ .79	Stop Mode (major fault)
.80 \ .99	Special Configuration (reserved)

Fault Codes
Table 2

(1) Warning

Warning faults are faults that occur and have no effect on the operation of the GPU. An example would be an intake air restriction fault due to a dirty filter. Although the GPU will continue to operate, the fault will appear on the fault code display. Pressing the "**TEST/RESET**" push button or shutting down the GPU will reset the fault.

(2) Run Mode

Run mode faults that occur will remove power from the aircraft but will not change the operating speed of the engine. An example would be an over voltage fault. Although the contactors will open and remove power from the aircraft, the engine will remain at rated speed, and the fault will appear on the fault code display, along with the appropriate command. Pressing the "**TEST/RESET**" push button or shutting down the GPU will reset the fault.

(3) Idle Mode

Idle mode faults that occur will remove power from the aircraft and drop the operating speed of the engine to the idle setting. A possible example (depending on customer configuration) would be a high temperature fault. The contactors will open and remove power from the aircraft, the engine will drop to its idle speed, and the fault will appear on the fault code display, along with the appropriate command. Pressing the "**TEST/RESET**" push button or shutting down the GPU will reset the fault.

(4) Stop Mode

Stop mode faults that occur will remove power from the aircraft and shut the engine down. An example would be a low oil pressure fault. The contactors will open and remove power from the aircraft, the engine will shut down, and the fault will appear on the fault code display, along with the appropriate command. Pressing the "**TEST/RESET**" push button or shutting down the GPU will reset the fault.

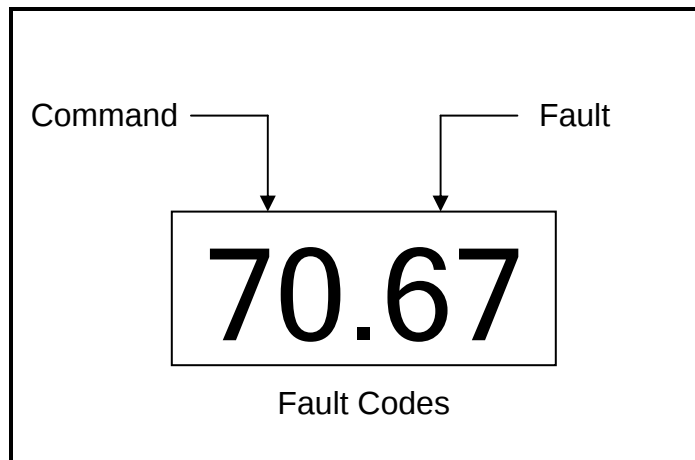
(5) Special Configuration

These fault codes are reserved for special customer configurations. Contact the factory for information.

c) Fault Code Display

The numbers that appear in the "**FAULT CODE**" display are used for troubleshooting the GPU. To read the four-digit fault code properly, it must be understood that the first two digits represent one half of the fault code and the last two digits represent the other half.

- The first two digits on the left side of the Fault Code represent the **Command**.
- The two digits on the right side of the Fault Code represent the **Fault Condition**.



Fault Meter Display
Figure 1

d) Operation Monitoring

While applying power to an aircraft, the GPU continually monitors all critical circuits and operating electrical values.

During 400 Hz AC and 28.5 VDC (if supplied) operation, the GPU continually performs Command "70" (Engine Run Mode). When a fault is detected during operation, this **Command** and the detected **Fault** are indicated in the "**FAULT CODE**" display.

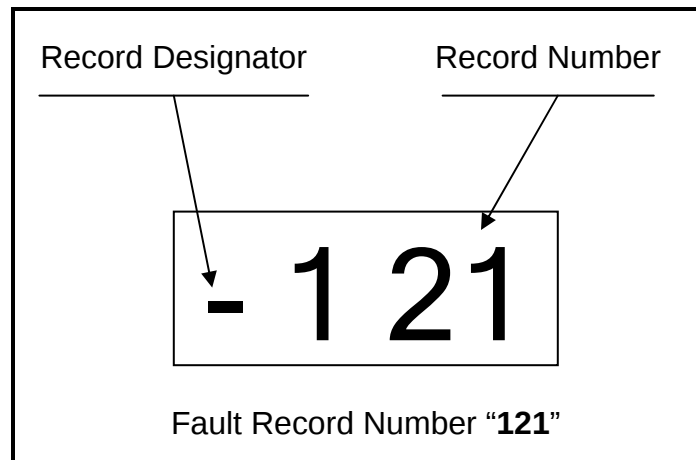
By referencing the Command and Fault Code chart, the GPU state and exact fault can be determined. When the fault is reset, and the GPU restarted, the GPU may often detect the fault again revealing additional information. This method yields a high degree of troubleshooting accuracy.

Fault meter display example shown above: If the engine shuts down with the above fault code, "70.67", the engine ceases operation due to high coolant temperatures in the engine. The "70" represents the command the GPU was executing at the time of the fault and shutdown (Command "70" indicates an Engine Run Mode command.). The "67" represents the fault code that indicates the action taken by the control system upon faulting (Fault "67" indicates a Stop Mode fault which shuts the GPU down.).

e) Extracting Fault Code Information

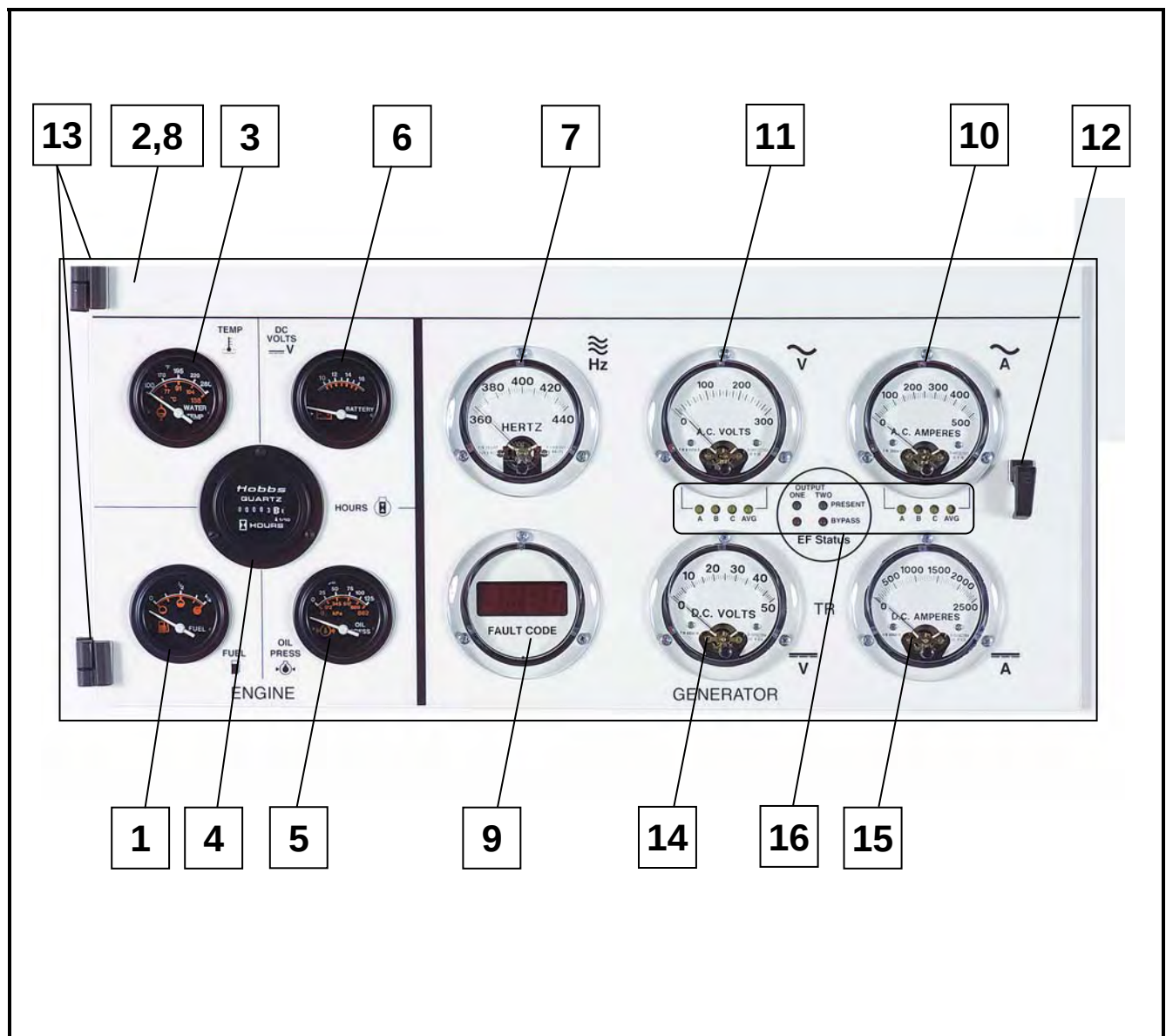
In the event the GPU fault code history information is required for troubleshooting, all fault codes stored in the control system's memory (i.e. data records) can be extracted and viewed on the Fault Meter Display (starting with the last fault code and scrolling backward through all previous fault codes). The following are the procedures for extracting the fault code information:

- (1) Pull the "**EMERGENCY STOP**" button out.
- (2) Press the "**LAMPS**" push button to turn on the control box lights.
- (3) Press the "**TEST/RESET**" push button and hold for 2 to 3 seconds until the data record number appears on the display (See Figure 1A).



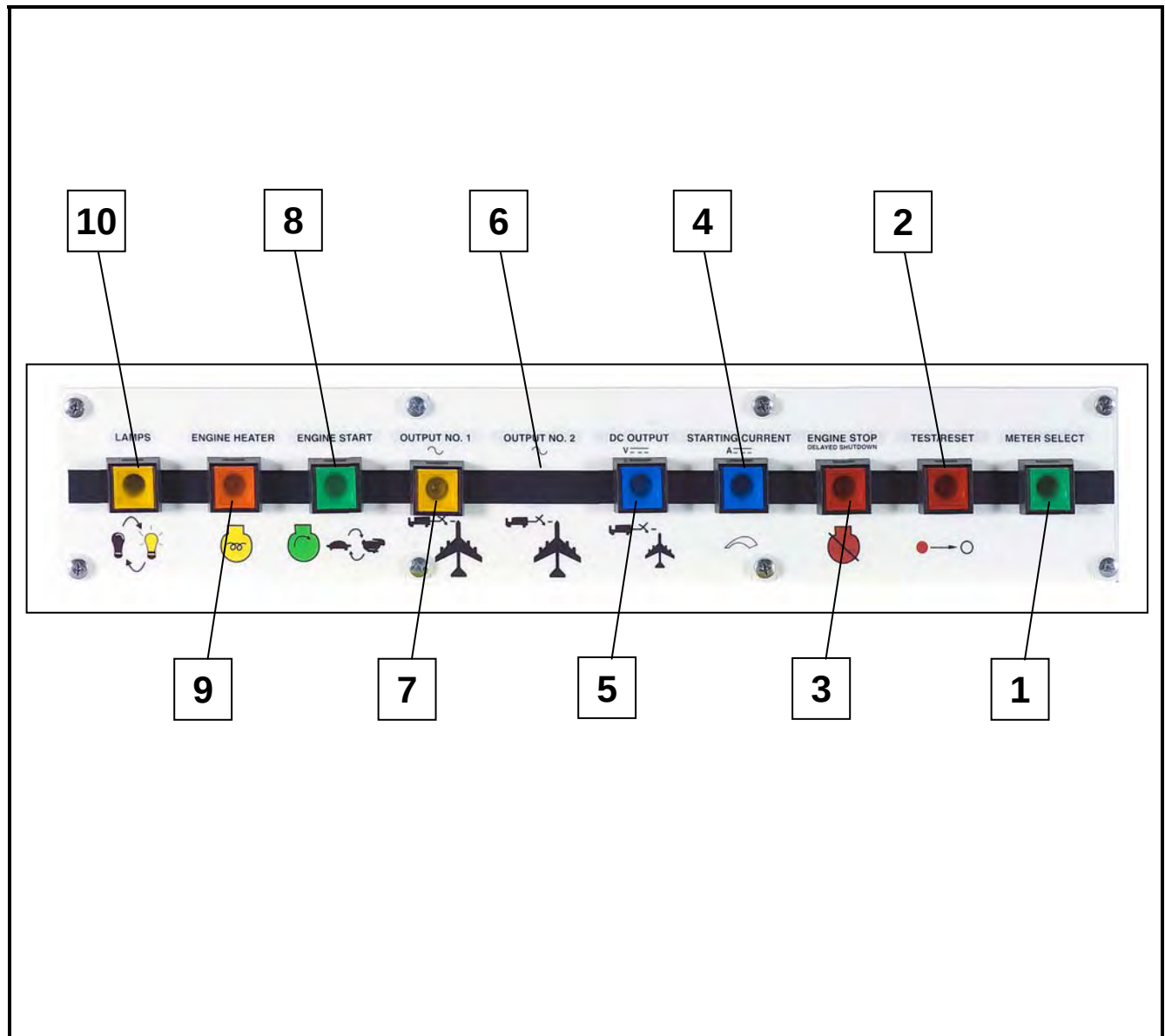
Fault Meter Display (Fault Record Number)
Figure 1A

- (4) Release the **"TEST/RESET"** push button and the display will alternate between the fault record number (See Figure 1A) and the fault code (See Figure 1).
- (5) To continue scrolling backward through the previous fault codes, press and release the **"TEST/RESET"** push button again and the previous fault record number and fault code will be displayed as described in Step 4.
- (6) Repeat Step 5 to continue scrolling backward. Once the first fault record is reached, the scrolling will stop. To begin again, press the **"LAMPS"** push button to turn off the control box lights and repeat Steps 2 through 5.



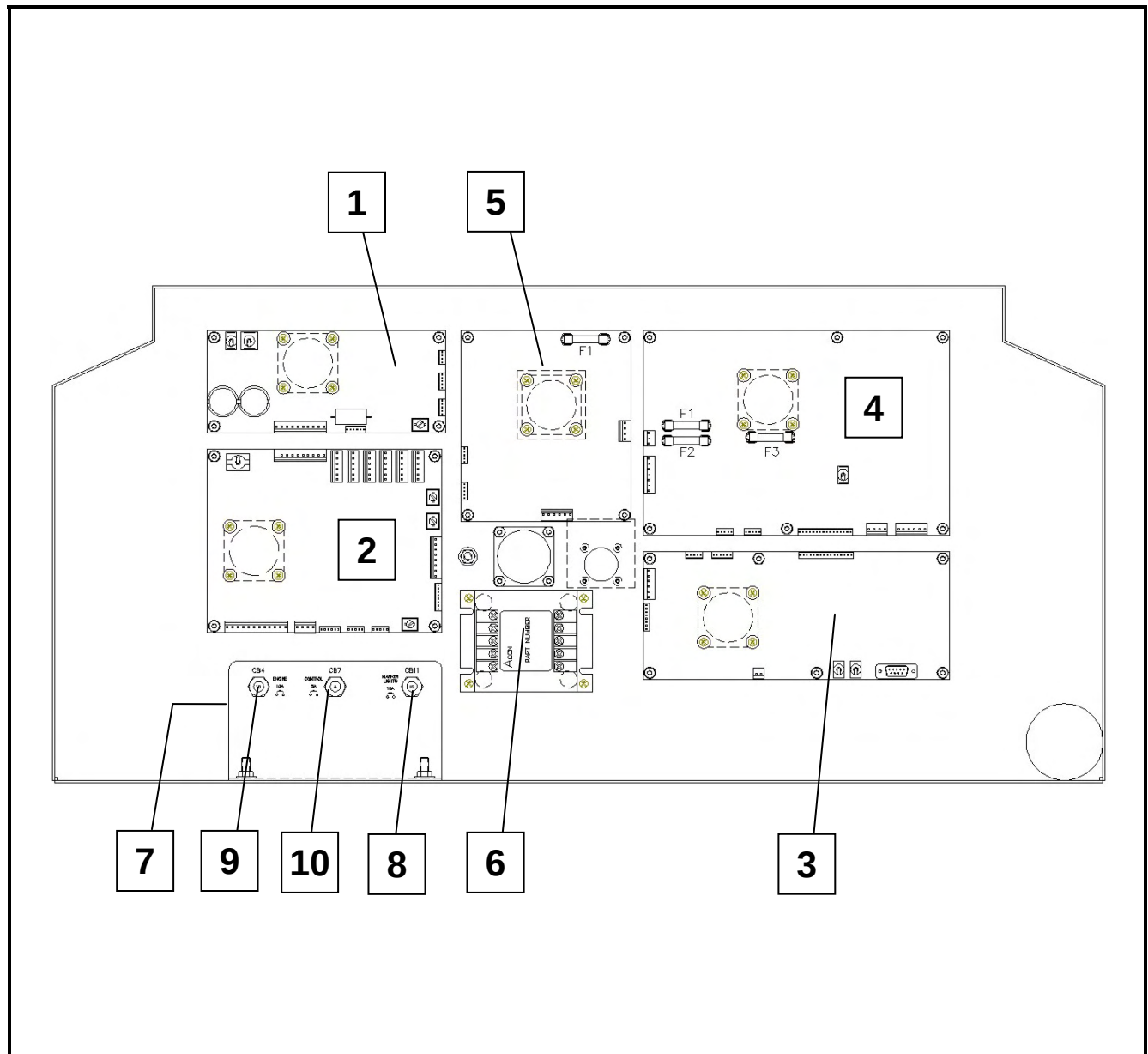
- | | |
|---|--|
| 1. Fuel Gage (M13) | 9. Fault Code Meter (M6) |
| 2. Door Assembly Panel | 10. AC Generator Ammeter (M1) |
| 3. Engine Coolant Temperature Gauge (M24) | 11. AC Voltmeter (M2) |
| 4. Running Time Meter (M4) | 12. Adjustable Grip Door Latch |
| 5. Oil Pressure Gage (M25) | 13. Control Panel Door Hinges |
| 6. Battery Voltmeter (M5) | 14. DC Voltmeter [Optional, included with TR] |
| 7. Frequency Meter (M3) | 15. DC Ammeter [Optional, included with TR] |
| 8. Control Panel Laminate | 16. LED PC Board (A5) [Not Shown, Opposite Side] |

Control Panel Door
Figure 2



- | | |
|---|--|
| 1. Meter Selector Switch (S3) | 6. AC Output No. 2 Contactor Switch (S275) |
| 2. Test/Reset Switch (S77) | 7. AC Output No. 1 Contactor Switch (S75) |
| 3. Engine Stop Switch (S76) | 8. Engine Start Switch (S24) |
| 4. DC Starting Current Switch (S431) [Optional with TR] | 9. Air Intake Heater Switch (S79) |
| 5. DC Output Contactor Switch (S430) [Optional with TR] | 10. Panel Light Switch (S74) |

Control Push-Button Switch Panel
Figure 3



- | | |
|---|--|
| 1. Engine Specific PC Board [ESB] [A1] | 6. +5, -12 VDC Power Supply (PS1) |
| 2. Engine Interface PC Board [EIB] [A2] | 7. Circuit Breaker Support Bracket |
| 3. Digital Control PC Board [CTL] [A3] | 8. Marker Lights Circuit Breaker, 10 A (CB1) |
| 4. Voltage Regulator PC Board [REG] [A4] | 9. Engine Circuit Breaker, 10 A (CB4) |
| 5. Transformer-Rectifier PC Board [TRB] [A404] {Optional} | 10. Controls Circuit Breaker, 5 A (CB7) |

Control Box Interior Components
Figure 4

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Engine Controls		
1. Engine will not start. Starter will NOT crank engine.	a. Emergency Stop switch has been pressed or is defective	Check to be sure the Emergency Stop is pulled out or replace if defective.
	b. Battery disconnect switch is in the "OFF" position	Open the canopy doors on and be sure the battery disconnect switch is in the "ON" position.
	c. Battery discharged or loose battery or ground cable connection	Check voltage across batteries terminals. Voltage should be approximately 12.8 volts DC. Check all battery terminals connections.
	d. Loss of battery voltage to the EIB PC board (A2)	Check for battery voltage at PT1 (ground) and PT2 (+12 VDC) on the EIB. If voltage is low then charge or replace batteries.
	e. Loss of battery voltage at EIB J51 connector terminal 12	While pressing the start button monitor battery voltage from P51 connector terminal 12 to ground. If no battery voltage exists replace EIB.
	f. "ENGINE START" pushbutton switch failure	Press the engine start button and check continuity between contacts. If there is no change the switch is defective.
	g. Defective starter	Remove starter from the engine and apply 12vdc to test it.
	h. Starter auxiliary solenoid (L10) does not energize	While pressing the start button check for battery voltage across the coil of (L10). If no voltage exist then check fuse (F112). If voltage is good to the solenoid coil but still does not energize then replace solenoid.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Engine Controls (continued)		
2. Engine will not start. Starter tries and then clicks on and off.	a. Low battery voltage	Charge batteries or replace.
3. The Engine will not start and cranking speed low.	a. Low battery voltage	Recharge or replace batteries.
	b. Loose or faulty starting circuit connections	Check all connections and cables. Tighten or replace as required.
	c. Improper engine lubricating oil viscosity for unit operating conditions	Reference Chapter 2, Section 2 for details on lubricating oil and the engine manufacturer's owners manual.
4. Engine cranks, but will not start. The cranking speed is normal.	a. No fuel or insufficient fuel level in tank. Low FUEL indication appears three (3) seconds after cranking is initiated	Fill fuel tank if empty or if fuel level is low. If necessary, fill each filter with fuel and pump the fuel system with filter primer pump. If engine will not start after priming filters, fuel pump may be defective. If engine starts and stops after a short time, trouble between fuel source and suction side of pump is indicated.
	b. Fuel shutoff valve closed	Open shutoff valve on fuel tank inlet.
	c. Loose connections, damaged hoses or fuel lines between tank and fuel pump	Tighten all hose fittings and connections points. Replace any damaged hoses, fittings or fuel links.
	d. Plugged fuel lines or defective filter	Be sure there are no fuel restrictions in the fuel line (i.e. debris from fuel tank) fittings and filters. Also check gaskets for leaking or damaged condition.
	e. Defective EIB PC board (A2)	Replace EIB board.
	f. Defective engine ECM or ESB PC board (A1)	Check for battery voltage at fuse F102. If the fuse is good, contact the local engine manufacturer service center. If no voltage replace ESB.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Engine Controls (continued)		
5. Engine cranks, but will not start. An engine coolant over-temperature fault code appears immediately.	a. Defective or incorrectly wired coolant temperature switch, located on the engine block	Check wiring according to the connection diagram in Chapter 5. If wiring is correct, remove wires and check resistance between terminals C and N.O. A resistance of less than 10 ohms indicates a defective switch.
	b. Defective EIB PC board (A2)	Replace EIB board.
6. Engine is hard to start. The cranking speed is normal and the fuel supply is adequate.	a. Low cylinder compression, which may be caused by any one of following: > sticking or burned exhaust valves > worn or broken compression rings > leaking cylinder head gasket > improper valve clearance adjustment.	Check compression in accordance with instructions in the engine manufacturer's owner's manual. Overhaul engine to make repairs as necessary.
7. Engine starts and stops after a few seconds by automatic shutdown and/or an engine low oil pressure fault code appears immediately	a. Shutdown circuit may have functioned normally to stop engine because of low lubricating oil pressure or due to a defective oil pressure switch	Check oil engine level. If the oil level is good, attempt to restart the engine and observe oil pressure gage. If oil pressure is 12 psi or more, disconnect wire from oil pressure switch terminal N.C. and restart the engine. If engine continues to run the oil pressure switch is defective.
	c. Defective EIB PC board (A2)	Replace EIB board.
8. All panel and clearance lights are either always ON or always OFF.	a. Marker light circuit breaker will not close	Marker lights circuit breaker (CB1) is defective.
	b. Defective CTL PC board (A3)	Replace CTL board.
9. Engine either goes from rated speed to idle speed or shuts down.	a. Low fuel level was detected or the EIB PC board (A2) could be defective	Add fuel and restart engine. If no change then replace EIB board.
10. Engine has slow response time when a load is applied.	a. Plugged fuel lines or defective filter	Be sure there are no fuel restrictions in the fuel line (i.e. debris from fuel tank) fittings and filters. Also check gaskets for leaking or damaged condition.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Engine Controls (continued)		
Engine has slow response time when a load is applied (continued).	b. Engine may need a tune-up	Perform a tune-up as required in the engine manufacturer's owner's manual.
11. Engine sounds like it "misses" or runs unevenly.	a. Insufficient fuel	Check fuel tank level and fill as necessary.
	b. Faulty engine injectors	Check injectors as instructed in the engine manufacturer owner's manual. Contact local engine manufacturer's service shop for engine related issues
	c. Low compression pressure in a cylinder	Check injectors as instructed in the engine manufacturer owner's manual. Contact local engine manufacturer's service shop for engine related issues
	d. Air in the fuel system	Check all fittings to be sure they are tight and sealed. Tighten the fittings and add new thread sealant as required.
12. Engine lacks power	a. Insufficient fuel	Check fuel tank level and fill as necessary.
	b. Insufficient inlet air due to a damaged or dirty air cleaner	Check air cleaner for "plugging" and/or damage.
	c. Restrict in the exhaust system	Check exhaust pipes for restrictions and leaks. Check muffler for a "clogged" condition. Replace as required.
	d. Improper engine adjustments and gear train timing	"Tune-up" engine in accordance with engine manufacturer owner's manual. Contact local engine manufacturer's service shop for engine related issues

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Generator Excitation Circuits		
1. No (or low) generator output voltage is seen in all phases. Generator operating at 400 Hz.	a. Generator or excitation circuit may be defective	On REG PC board (A4) place the "Regulated/ Diagnostic" switch in "Diagnostic" position. This will apply 12 VDC from the battery to exciter field, which should produce an indicated output voltage of 100 +/- 20 VAC line to neutral. If voltage produced is within this range, the generator is good, and trouble may be in the voltage regulator circuit.
	b. Open fuse on voltage regulator (REG) PC board	Check fuses thoroughly. Replace fuses if defective.
	c. Defective connector at voltage regulator, or defective wiring from regulator to exciter field	Disconnect exciter wires at the terminal strip. Using jumper leads with clip terminals, connect 12 VDC to wires. If generator will produce at least 80 VAC, replace or repair connector and wiring between voltage regulator and exciter field as required.
	d. Defective connector at voltage regulator, or defective wiring from regulator to exciter field	Disconnect exciter field wires at terminal strip. Using jumper leads with clip terminals, connect 12 VDC to wires. If generator will produce at least 80 VAC, replace or repair connector and wiring as required.
	e. The voltage regulator (REG) PC board may be defective	Verify by swapping with a known good voltage regulator (REG) PC board and replace if required.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
No. 1 Load Contactor Operating Circuit		
1. Output load contactor (K1) will not close when "OUTPUT NO 1" push button switch is pressed. The generator is running at normal voltage, the rectifier circuit breaker CB2 is closed, and no fault code is indicated.	a. Defective "OUTPUT NO 1" push button switch (S75)	At rated speed, measure the voltage across the switch. The voltage should read approximately 5 VDC. Press the switch again and the voltage should go to 0 V. If voltage does not go to 0 V, the switch is defective and needs to be replaced.
	b. The voltage regulator (REG) PC board may be defective	Replace REG PC board with a known good board and verify operation. If contactor still doesn't close replace original REG PC board. Check resistance between the terminals C and NO connection on the output contactor. The resistance should be approximately 10k ohms. After making certain that the "OUTPUT NO 1" push button switch is working, measure the DC output voltage at contactor coil W and V. If the voltage measured isn't approximately 90 VDC, check for the same voltage at the REG P53 terminals 3 and 4. If the above are correct, proceed to step c. If not, replace REG PC board.
	c. Defective fuse on the REG PC board	Check all fuses.
	d. Defective load contactor (K1).	Disconnect the leads at load contactor terminals W and V. Check coil resistance between these terminals. The resistance should be around 600 ohms $\pm$ 10%. If coil is defective, replace the load contactor.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
No. 1 Load Contactor Operating Circuit (Continued)		
2. Load contactor (K1) will close when "OUTPUT NO 1" push button switch is held in CLOSE position, but will not remain closed.	a. Output No. 1 plug interlock EF1 circuit on CTL PC board could be defective	Place EF Bypass switch for output 1 contactor in the ON position. If load contactor remains closed, proceed to step b.
	b. 28.5 VDC from the aircraft is not reaching the output 1 plug EF interlock circuit	Proceed as follows to find the cause of this malfunction.
	c. The output cable is defective or not plugged securely in the aircraft receptacle	Inspect cable plug thoroughly for damaged to the EF terminals. Be sure plug is fully mated with aircraft receptacle.
	d. Aircraft rejecting power.	Check aircraft on-board electrical equipment and controls.
	e. Defective load contactor (K1) auxiliary switch	Replace load contactor.
3. The output contactor opens automatically during power delivery and no fault code is indicated.	a. A fault has developed in output contactor holding circuit	If output contactor cannot be closed by pressing the "OUTPUT No. 1" push button switch, check circuit in accordance condition 1 above. If load contactor can be closed, but opens as soon as the switch is released, check for trouble under condition 2, above.
4. An EF1 fault code is indicated.	a. The output cable may be from disconnected from the aircraft	Reconnect cable.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
No. 2 Load Contactor Operating Circuit		
1. Output load contactor (K201) will not close when "OUTPUT NO 2" push button switch is pressed. The generator is running at normal voltage, the rectifier circuit breaker CB2 is closed, and no fault code is indicated.	a. Defective "OUTPUT NO 2" push button switch (S275)	At rated speed, measure the voltage across the switch. The voltage should read approximately 5 VDC. Press the switch again and the voltage should go to 0 V. If voltage does not go to 0 V, the switch is defective and needs to be replaced.
	b. The voltage regulator (REG) PC board may be defective	Replace REG PC board with a known good board and verify operation. If contactor still doesn't close replace original REG PC board. Check resistance between the terminals C and NO connection on the output contactor. The resistance should be approximately 10k ohms. After making certain that the "OUTPUT NO 2" push button switch is working, measure the DC output voltage at contactor coil W and V. If the voltage measured isn't approximately 90 VDC, check for the same voltage at the REG P53 terminals 3 and 4. If the above are correct, proceed to step c. If not, replace REG PC board.
	c. Defective fuse on the REG PC board	Check all fuses.
	d. Defective load contactor (K201).	Disconnect the leads at load contactor terminals W and V. Check coil resistance between these terminals. The resistance should be around 600 ohms $\pm$ 10%. If coil is defective, replace the load contactor.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
No. 2 Load Contactor Operating Circuit (Continued)		
2. Load contactor (K201) will close when "OUTPUT NO 2" push button switch is held in CLOSE position, but will not remain closed.	a. Output No. 2 plug interlock EF1 circuit on CTL PC board could be defective	Place EF Bypass switch for output 2 contactor in the ON position. If load contactor remains closed, proceed to step b.
	b. 28.5 VDC from the aircraft is not reaching the output 1 plug EF interlock circuit	Proceed as follows to find the cause of this malfunction.
	c. The output cable is defective or not plugged securely in the aircraft receptacle	Inspect cable plug thoroughly for damaged to the EF terminals. Be sure plug is fully mated with aircraft receptacle.
	d. Aircraft rejecting power.	Check aircraft on-board electrical equipment and controls.
	e. Defective load contactor (K201) auxiliary switch	Replace load contactor.
3. The output contactor opens automatically during power delivery and no fault code is indicated.	a. A fault has developed in output contactor holding circuit	If output contactor cannot be closed by pressing the "OUTPUT No. 2" push button switch, check circuit in accordance condition 1 above. If load contactor can be closed, but opens as soon as the switch is released, check for trouble under condition 2, above.
4. An EF2 fault code is indicated.	a. The output cable may be from disconnected from the aircraft	Reconnect cable.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Protective Circuit		
NOTE: Protective monitoring is not completely functional until load contactor is CLOSED. Since it is not advisable to vary voltages for test purposes while delivering power to an aircraft, the GPU should be connected to a load bank for trouble shooting protective circuits. To avoid repetition, it will be assumed that "TEST/RESET" push-button switch has been pressed and the load contactor has been closed before commencing each test.		
1. Load contactor opens during power delivery and an over voltage fault is indicated.	a. The over voltage condition may be a result of a sudden drop in load; possible tampering with the REG PC board adjustment or it may have been a normal action	Press the "TEST/RESET" push button and resume power delivery. Observe voltmeter to be certain voltage is normal range of 115 VAC. Adjust to normal if necessary. If load contactor opens again and the fault code meter indicates an over voltage condition, proceed to step b.
	b. Defective CTL PC board	Using the REG PC board adjustment, reduce the output voltage to 110 VAC. Observe voltmeter and gradually increase voltage. If sensing circuit opens the load contactor at any value less than 124-125 VAC, the CTL PC board is defective.
2. Load contactor opens during power delivery and an under voltage fault is indicated.	a. The under voltage condition may be a result of a large sudden shock load; possible tampering with the REG PC board adjustment or it may have been a normal action	Press the "TEST/RESET" push button and resume power delivery. Observe voltmeter to be certain voltage is normal range of 115 VAC. Adjust to normal if necessary. If load contactor opens again and the fault code meter indicates an under voltage condition, proceed to step b.
	b. Defective CTL board	Using the REG PC board adjustment, reduce the output voltage to 110 VAC. Observe voltmeter and gradually decrease voltage. If sensing circuit opens the load contactor at any value greater than 104 VAC, the CTL PC board is defective.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Protective Circuit		
NOTE: Protective monitoring is not completely functional until load contactor is CLOSED. Since it is not advisable to vary voltages for test purposes while delivering power to an aircraft, the GPU should be connected to a load bank for trouble shooting protective circuits. To avoid repetition, it will be assumed that "TEST/RESET" push-button switch has been pressed and the load contactor has been closed before commencing each test.		
3. Load contactor opens during power delivery and an over frequency fault is indicated.	a. The frequency adjustment switch is enabled on the ESB PC board	Set frequency adjust switch to disable.
	b. Defective REG board	Bring the unit to rated speed (2000 RPM). If the over frequency fault continues, the engine's ECM is good and the REG PC board is defective.
4. Load contactor opens during power delivery and an under frequency fault is indicated.	a. The frequency adjustment switch is enabled on the ESB PC board	Set frequency adjust switch to disable.
	b. Engine speed slowing down	Check fuel supply lines for leaks or air in the fuel system. Contact local engine manufacturer's service center for engine related issues.
	c. Defective REG board	Bring the unit to rated speed (2000 RPM). If the over frequency fault continues, the engine's ECM is good and the REG PC board is defective.
5. Load contactor opens during power delivery and an over load fault is indicated.	a. There may have been an over load condition	Press the "TEST/RESET" push button and resume power delivery. Observe ammeter and check for abnormal over load condition and correct. If over load device functions to open load contactor when an over load condition does not exist, proceed to step b.
	b. Defective CTL board	Replace CTL board.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Generator		
1. No (or low) voltage output	a. Possible shorted diode in exciter rectifier circuit (CR2)	Check diodes in accordance with Chapter 2, Section 3. If diodes are good, proceed to step b .
	b. Possible opened or shorted exciter rotor winding (G2)	Using an ohmmeter, check the exciter rotor winding resistances. Reference Chapter 2, Section 3 for normal values. If exciter rotor windings are good, proceed to step c .
	c. Possible opened or shorted exciter field windings (L2)	Using an ohmmeter, check the field resistance and verify with Chapter 2, Section 3 for normal values.
	d. Possible opened or shorted generator rotor windings (L1)	Using an ohmmeter, check the main rotor winding resistances. Reference Chapter 2, Section 3 for normal values.
2. The generator operates as a single phase unit.	a. Possible opened or short windings in the generator stator (G1)	Using an ohmmeter, check the main stator-winding resistances. Reference Chapter 2, Section 3 for normal values.
3. Generator overheats	a. Loose connection causing high resistance	Check all the output connections. Look for discoloration caused by excessive heating and tighten or replace as required.
	b. Improper or blocked ventilation paths	Check to be sure all air paths are free from foreign debris and be sure there is adequate ventilation.
	c. Generator stator windings may be short circuited	Using an ohmmeter, check the main stator winding resistances. Reference Chapter 2, Section 3 for normal values.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Generator (continued)		
4. Unbalanced generator output	a. Loose connection in output circuit	Check all output connections. Discolored or output connections could indicate a loose connection. Tighten or replace as required.
	b. Open or short circuited phase	Using an ohmmeter, check the stator winding resistances. Reference Chapter 2, Section 3 for normal values.
	c. Defective connection in output circuit	Check output plug and receptacle connectors at aircraft. Tighten, repair, or replace as required.
	d. Defective or damaged output cable assembly	Inspect cable and repair or replace as necessary.
	e. Unbalanced load application	Check the aircraft 400-Hz circuit and components.

Troubleshooting Table		
GPU Commands		
Cmd code	Name	Description
00. __	Invalid Command	
01. __	ENGINE SELF TEST CMD	All boards test the communication between each other.
02. __		
03. __		
04. __		
05. __		
06. __		
07. __		
08. __		
09. __		
10. __		
11. __		
12. __		
13. __		
14. __		
15. __		
16. __		
17. __		
18. __		
19. __		
20. __		
21. __		
22. __		
23. __		
24. __		
25. __		
26. __		
27. __		
28. __		
29. __		
30. __		

Troubleshooting Table		
GPU Commands		
Cmd code	Name	Description
31. __		
32. __		
33. __		
34. __		
35. __		
36. __		
37. __		
38. __		
39. __		
40. __	ENGINE START MODE	Engine starter and engine's ECM is activated.
41. __		
42. __		
43. __		
44. __		
45. __		
46. __		
47. __		
48. __		
49. __		
50. __	ENGINE IDLE MODE	Engine idles at approximately 1000 RPM
51. __		
52. __		
53. __		
54. __		
55. __	ENGINE RAMP UP	Period when engine goes from idle to rate speed.
56. __		
57. __		
58. __		
59. __		
60. __		
61. __		

Troubleshooting Table		
GPU Commands		
Cmd code	Name	Description
62. __		
63. __	REG TEST OUTPUT FREQUENCY	Check for 400 Hz. output frequency.
64. __		
65. __		
66. __		
67. __		
68. __	CTL TEST OUTPUT	Checks the CTL communications.
69. __		
70. __	ENGINE RUN MODE	The engine is at rated speed and ready for aircraft load.
71. __		
72. __		
73. __		
74. __		
75. __	ENGINE RAMP DOWN	Period when engine goes from rated to idle speed.
76. __		
77. __		
78. __		
79. __		
80. __	ENGINE DELAYED SHUTDOWN MODE	Allows the turbocharger to cooling properly.
81. __		
82. __		
83. __		
84. __		
85. __		
86. __		
87. __		
88. __		
89. __		
90. __	ENGINE STOP MODE	Engine is brought to a complete stop.
91. __		
92. __		

Troubleshooting Table		
GPU Commands		
Cmd code	Name	Description
93. __		
94. __		
95. __		
96. __		
97. __		
98. __		
99. __	System Off Mode	All electrical circuits have been turned off.

Troubleshooting Table			
Faults			
Fault code	Name	Possible Cause(s)	Corrective Action
___.00	Invalid Fault		
___.01			
___.02			
___.03	CTL MEMORY FAULT	CTL board defective	Replace the CTL board.
___.04	REG EF1 LOSS FAULT	EF1 voltage signal not present. CTL board defective.	Switch the EF1 switch to "ON" Check cable contacts. Replace the CTL board.
___.05	REG EF2 LOSS FAULT	EF2 voltage signal not present. CTL board defective.	Switch the EF2 switch to "ON" Check cable contacts. Replace the CTL board.
___.06			
___.07			
___.08	EIB AIR RESTRICTION FAULT	Air filter is obstructed or dirty. Bad air restriction indicator	Check for obstructions. Change air filter cartridge or air restriction indicator.
___.09	EIB LOW FUEL WARNING	Fuel tank level is below ¼ tank.	Fill fuel tank.
___.10			
___.11			
___.12			
___.13			
___.14			
___.15			
___.16	CTL OUTPUT OVER VOLTAGE FAULT	Voltage set too high. LDC set too high. CTL board defective.	Adjust voltage or the LDC on the REG board. Replace CTL board.
___.17	CTL OUTPUT UNDER VOLTAGE FAULT	Voltage set too low. CTL board defective.	Adjust voltage on the REG board. Replace CTL board.
___.18	CTL OUTPUT 1 OVERLOAD FAULT	Overload on Output 1	Reset and restart GPU.
___.19	CTL OUTPUT 2 OVERLOAD FAULT	Overload on Output 2	Reset and restart GPU.
___.20	CTL MACHINE OVERLOAD FAULT	Total overload on Output 1 & 2.	Reset and restart GPU.
___.21	CTL OUTPUT VOLTAGE IMBALANCE FAULT	Open or broken sense line. Load is imbalance.	Repair sensing wire. Check load inbalance and correct as required..
___.22	REG OUTPUT OVER FREQ FAULT	Defective engine ECM. Defective REG board.	Replace engine ECM. Replace REG board.

Troubleshooting Table			
Faults			
Fault code	Name	Possible Cause(s)	Corrective Action
--.23	REG OUTPUT UNDER FREQ FAULT	Defective engine ECM. Defective REG board.	Replace engine ECM. Replace REG board.
--.24	REG CONTACTOR1 FAULT	Defective output contactor. Defective REG board.	Replace output contactor. Replace REG board.
--.25	REG CONTACTOR 2 FAULT	Defective output contactor. Defective REG board.	Replace output contactor. Replace REG board.
--.26	CTL DC OVER VOLTAGE FAULT	Defective CTL board.	Replace CTL board.
--.27	CTL DC UNDER VOLTAGE FAULT	Defective CTL board.	Replace CTL board.
--.28	TRB OUTPUT OVER VOLTAGE FAULT	Voltage set too high. TRB board defective.	Reset and restart GPU. Replace TRB board.
--.29	TRB OUTPUT UNDER VOLTAGE FAULT	Voltage set too low. TRB board defective.	Reset and restart GPU. Replace TRB board.
--.30	TRB OUTPUT OVERLOAD FAULT	DC load over rating of GPU.	Reset and restart GPU.
--.31	TRB DC CONTACTOR FAULT	Defective output contactor. Defective TRB board.	Replace output contactor. Replace TRB board.
--.32	REG EF1 VOLTAGE TOO HIGH FAULT	EF voltage being sent from aircraft on output 1 to the GPU is too high. Output cable is defective.	Reset and restart GPU. Check output cable.
--.33	REG EF2 VOLTAGE TOO HIGH FAULT	EF voltage being sent from aircraft on output 2 to the GPU is too high. Output cable is defective.	Reset and restart GPU. Check output cable.
--.34	TRB AC CONTACTOR FAULT	Defective input contactor. Defective TRB board.	Replace input contactor. Replace TRB board.
--.35			
--.36			
--.37			
--.38			
--.39			
--.40	CTL ID FAULT	Defective CTL board.	Replace CTL board.
--.41	TRB ID FAULT	Defective TRB board.	Replace TRB board.
--.42	ESB ID FAULT	Defective ESB board.	Replace ESB board.
--.43	REG ID FAULT	Defective REG board.	Replace REG board.
--.44	TRB HEATSINK OVERTEMP FAULT	Obstructed cooling air path. Defective thermal switch	Clear air obstruction. Replace switch.
--.45	TRB TRANSFORMER OVERTEMP FAULT	Obstructed cooling air path. Defective thermal switch	Clear air obstruction. Replace switch.

Troubleshooting Table			
Faults			
Fault code	Name	Possible Cause(s)	Corrective Action
--.46	TRB INPUT CONTACTOR FAULT	Defective input contactor. Defective TRB board.	Replace input contactor. Replace TRB board.
--.47			
--.48	GEN ID FAULT	The REG board cannot find the generator. Defective REG board.	Check for ID R2 on TB1. Check for broken wire on ID R2 on TB1. Replace REG board.
--.49	CTL POWER MODULE ID FAULT	Call Factory	Call Factory
--.50	TRB SELF TEST FAULT	TRB board defective.	Replace TRB board.
--.51			
--.52			
--.53			
--.54			
--.55	EIB LOW FUEL FAULT	Fuel tank level is below $\frac{1}{8}$ tank.	Fill fuel tank.
--.56			
--.57			
--.58			
--.59			
--.60	CTL COMM FAULT	Defective CTL board.	Replace CTL board.
--.61	EIB COMM FAULT	Defective EIB board.	Replace EIB board.
--.62	ESB COMM FAULT	Defective ESB board.	Replace ESB board.
--.63	REG COMM FAULT	Defective REG board.	Replace REG board.
--.64	TRB COMM FAULT	Defective TRB board.	Replace TRB board.
--.65			
--.66	EIB LOW ENGINE COOLANT FAULT	Engine coolant level is too low. Engine is losing coolant.	Refill radiator. Check for leaks and replace defect components.
--.67	EIB ENGINE OVERTEMP FAULT	Engine is over-heated. Coolant level is too low. Radiator is dirty or obstructed. Defective EIB board. Defective temperature switch.	Let engine cool then restart. Check coolant level and add. Clean radiator. Replace EIB board. Replace switch.
--.68	EIB LOW OIL PRESSURE FAULT	Engine oil level is too low. Defective EIB board. Defective oil pressure switch.	Check oil level and add. Replace EIB board. Replace switch.

Troubleshooting Table			
Faults			
Fault code	Name	Possible Cause(s)	Corrective Action
___.69			
___.70			
___.71			
___.72			
___.73			
___.74			
___.75			
___.76			
___.77			
___.78			
___.79			
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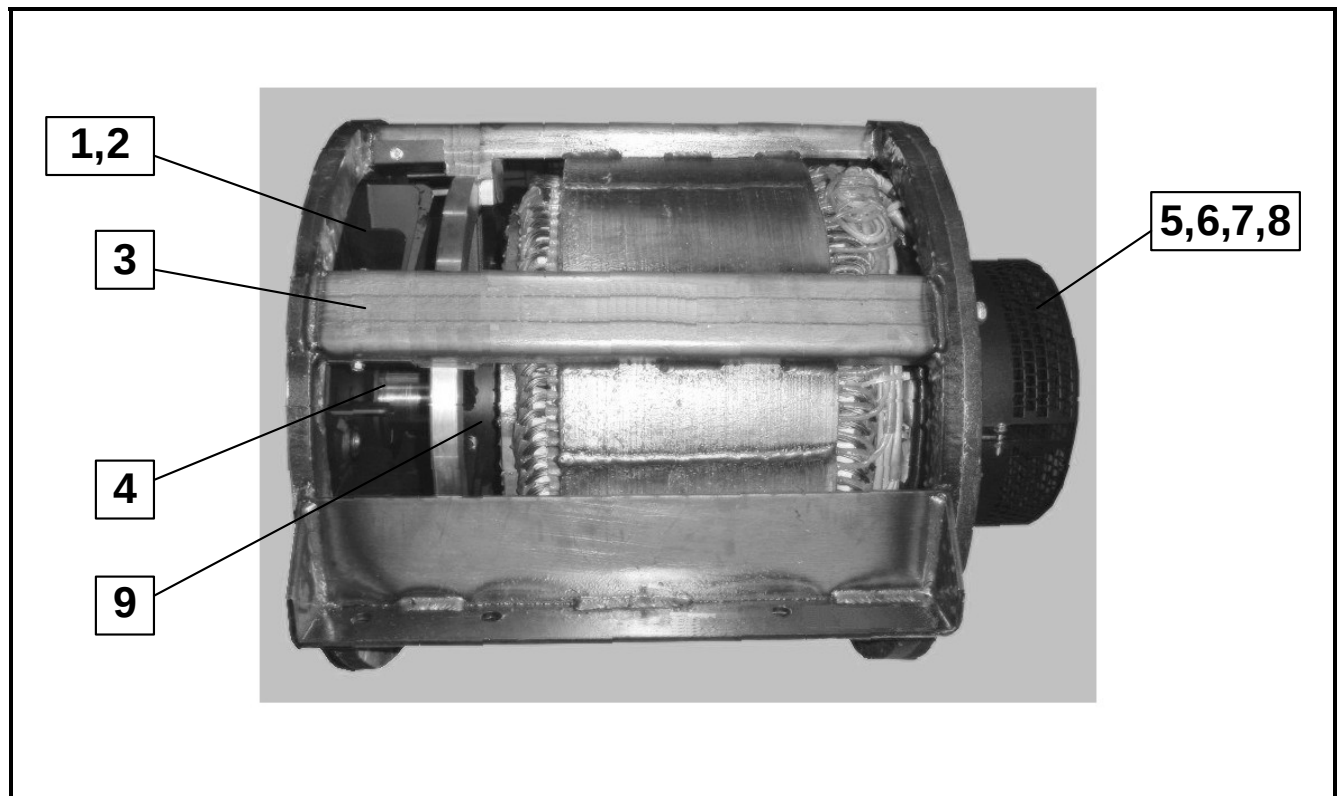
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Chapter 3 Overhaul/Major Repair

Section 1 Exciter Armature

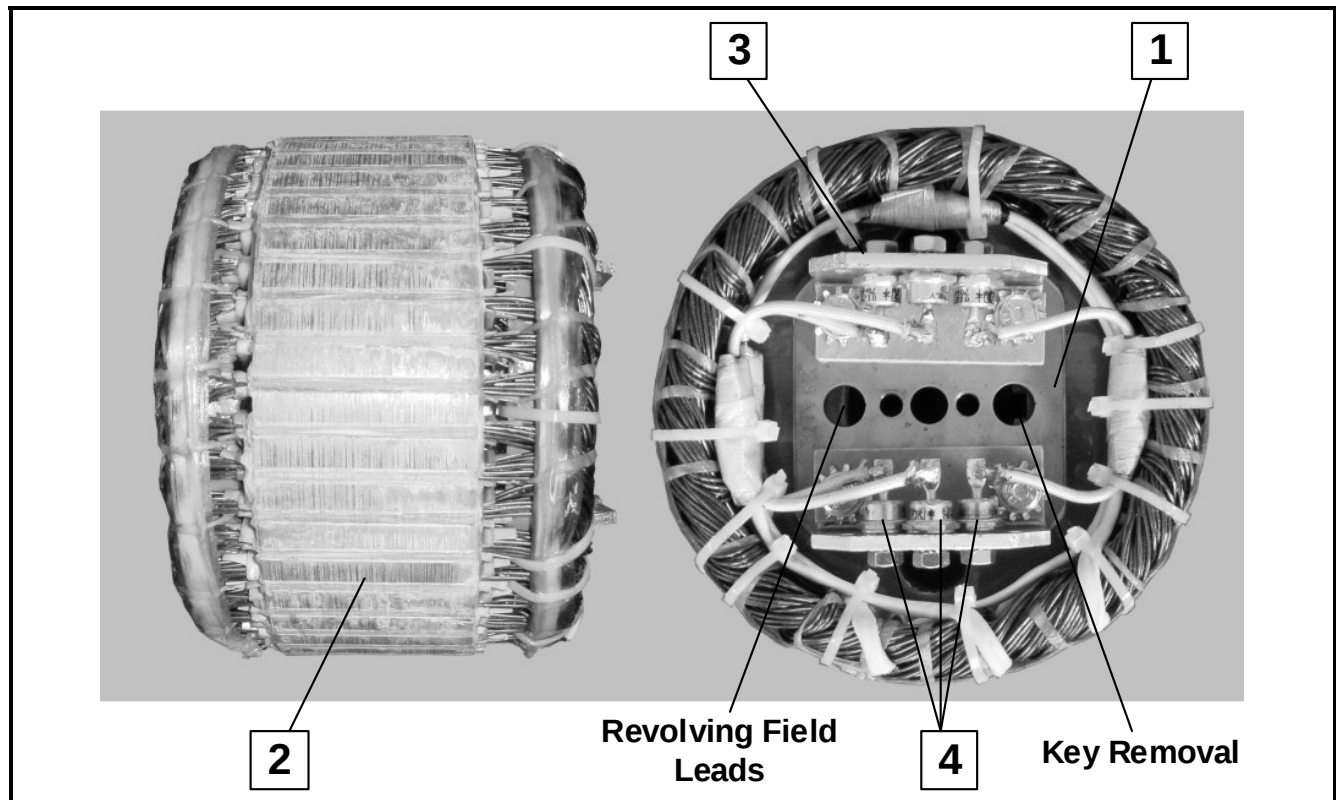
1) General

This section provides information and instructions for removal and installation of the exciter armature used on this generator set. The exciter and rear main bearing can be removed without removing the generator from the generator set. The name exciter armature refers to the shaft-mounted, revolving three-phase windings of the exciter.



- | | |
|--|---|
| 1. Coupling Key (Not Shown) | 6. Exciter Cover |
| 2. Flex Coupling Assembly | 7. Exciter Armature Assembly |
| 3. Generator Housing & Stator Assembly | 8. Exciter Key (Not Shown) |
| 4. Armature Assembly | 9. Front Bearing (Located Inside Housing Shown) |
| 5. Exciter Housing & Coils Assembly | 10. Rear Bearing (Located In Exciter Housing) |

General Assembly
Figure 1



Exciter Armature
Figure 2

The exciter armature is mounted on the rear portion of the main generator armature shaft, which extends rearward beyond the rear generator bearing into the exciter housing (See Figure 1). Because of its location on the shaft, the exciter armature must be removed for rear main bearing replacement. The exciter armature has two M10-1.5 tapped holes in the diode mounting plate to accommodate pulling it off the shaft.

Since the removal and installation of exciter armatures can be rather complicated, this manual has been prepared to assist mechanics in the process. It may be necessary to remove the exciter armature several times for bearing replacement during the life of a generator set.

2) Exciter Armature

The exciter armature used in this generator set consists of a revolving winding assembly on a laminated core, a rectifier assembly (diode mounting plate with diodes), and a mounting flange. The flange, core, and diode mounting plate are bolted together to make the complete exciter armature.

The exciter armature is mounted on the main generator armature shaft with a 3/8-inch square machine key that held in place by a key retainer, and an M12-1.75 hex head cap screw in the center of the diode mounting plate.

3) Exciter Armature Replacement

a) General

As stated earlier, exciter armature removal is often required for rear bearing replacement rather than for replacement of the exciter armature itself. Other reasons for exciter armature removal are generator armature replacement, general overhaul, etc.

b) Tools needed for Exciter Armature Removal and Installation

In addition to the standard mechanic's hand tools such as wrenches, etc., you will need only the following items for removing the exciter armature:

- A small, lightweight, sling-hammer puller
- Two M10-1.5 x 127 mm long fully-threaded hex-head bolts

A small, lightweight, sling-hammer puller is shown in Figure 3. This tool is necessary for removing the threaded machine key, which keeps the exciter armature from spinning on the generator armature shaft. If no such puller exists in the user's equipment inventory, Figure 3 illustrates components and dimensions for fabricating such a tool. Sling-hammer pullers are also commercially available. Instructions for using tool are provided in this manual.

Once the exciter armature key is removed, no other special tools are required for removing the exciter from the generator shaft. This can be done using the two M10-1.5 fully-threaded hex-head bolts. Instructions for doing this are provided in this manual.

c) Conditions for Exciter Removal

The mechanics performing the work must decide upon the best and most convenient method of removing the exciter armature. If the exciter armature is being replaced, then the work may be performed without removing the generator from the machine. In a great majority of cases, exciter removal will be for the replacement of the rear bearing. This procedure can also be accomplished without removing the generator. Replacement of the front bearing requires removal of the generator from the unit.

d) Preparation for Exciter Armature Removal

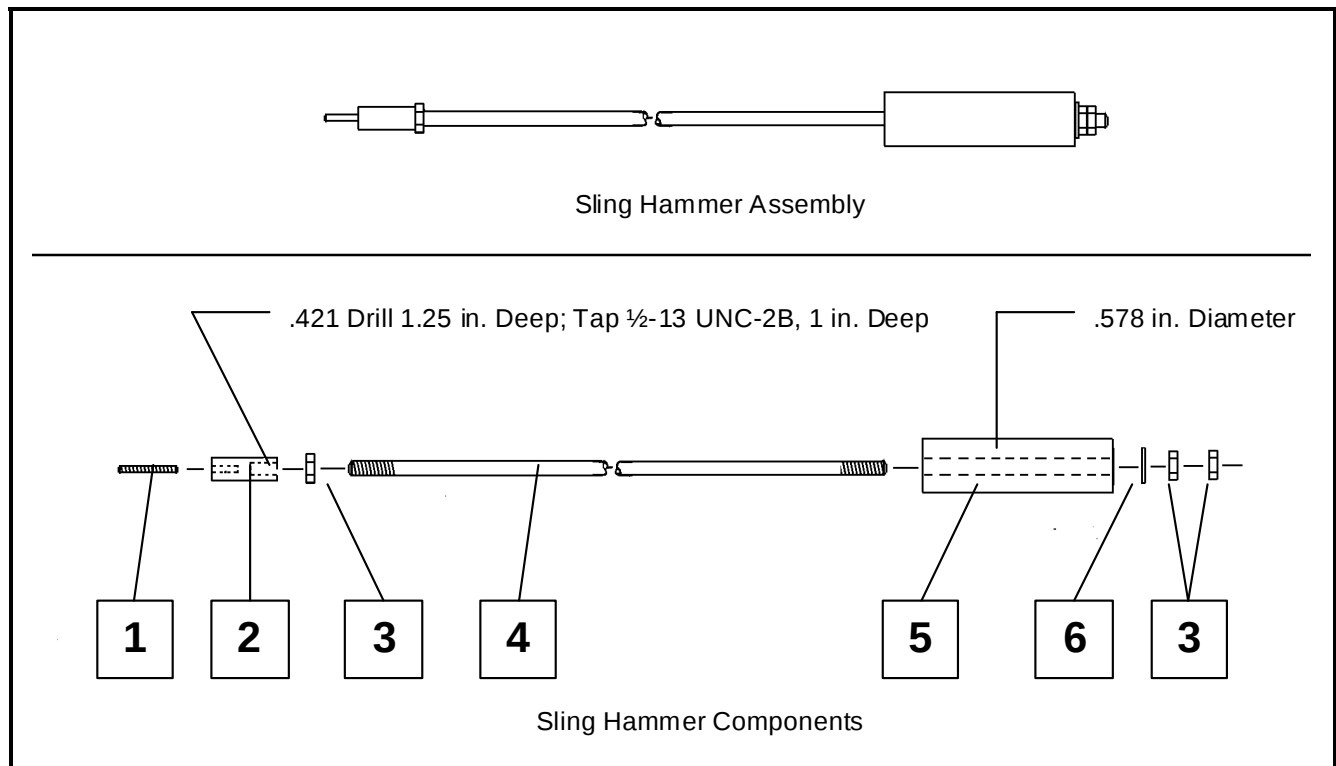
- (1) Remove exciter cover from the end of the GPU canopy and the exciter armature cover from the end of the generator.
- (2) Place a block bar (pry bar) into the generator fan assembly to keep the generator armature from rotating.

WARNING

To prevent personal injury, keep fingers and hands clear of generator assembly until the armature is block into place to prevent rotation.

- (3) Remove exciter housing cover as required. Remove the M12-1.75 cap screw, which holds the exciter armature and key retainer on the generator shaft.

- (4) Referring to Figures 1 and 2 disconnect the two rectifier-to-generator field leads. One lead, with a ring type terminal, is attached to the rectifier mounting plate with a screw and the other lead goes into a splice type connector with three other leads coming from the exciter armature windings. Cut the leads at the connector for removal of the one field lead. Cut as close as possible to the connector as to preserve lead length for reconnection later during exciter armature installation.
- (5) **EXERCISE CARE** to prevent damage to leads. Remove kinks in the two generator leads as much as possible before starting the removal process (The exciter armature will be sliding over these leads.).



1. Stud, 1/4-28 UNF 2A, Grade 5 or 8 ONLY
2. Adapter, 3/4" Round CR Steel
3. Nut, 1/2-13 Hex, Steel (3 required)

4. Rod, 1/2" Round, CR Steel
5. Hammer, 2" Round, CR Steel
6. Washer, Flat, 1/2" Steel

Sling Hammer Puller
Figure 3

e) Exciter Armature Removal

(1) Removing the Threaded Key with Sling-Hammer Puller

Refer to Figure 2 for location of threaded machine key. Attachment of a completely assembled puller to the key is not recommended because the weight and bulk of the assembly will make threading the 1/4 inch stud into the key rather clumsy. This could result in cross-threading and damage to key and stud. It is safer and easier to attach as follows:

- a Thread ¼-20 stud into adapter until it bottoms, then thread this assembly into the key until stud bottoms in the threads. Tighten securely.
- b If hammer and rod are not already assembled, thread one ½-13 nut onto adapter end of rod and thread rod into adapter until it bottoms (tighten nut securely against adapter). Slide hammer onto rod and install a washer and attach to ½-13 nuts. Thread nuts onto rod until both nuts are full threaded and locked together.

WARNING

Be very careful during removal process (slide-hammering) to avoid injury to hands.

CAUTION

Exercise care to prevent breaking or damaging stud.

- c Position hammer at adapter end of rod.
- d Quickly move hammer to outer end of rod with a rapid, slinging motion. **HOLD** the hammer through the entire motion. If hammer is allowed to slide free on the rod, the stud could be **DAMAGED** or **BROKEN**.
- e Repeat step (c) and (d) as required to loosen key, then remove key and slide-hammer puller.
- f After key is removed, apply penetrating oil in the armature and shaft keyways.

(2) Removing the Exciter Armature

CAUTION

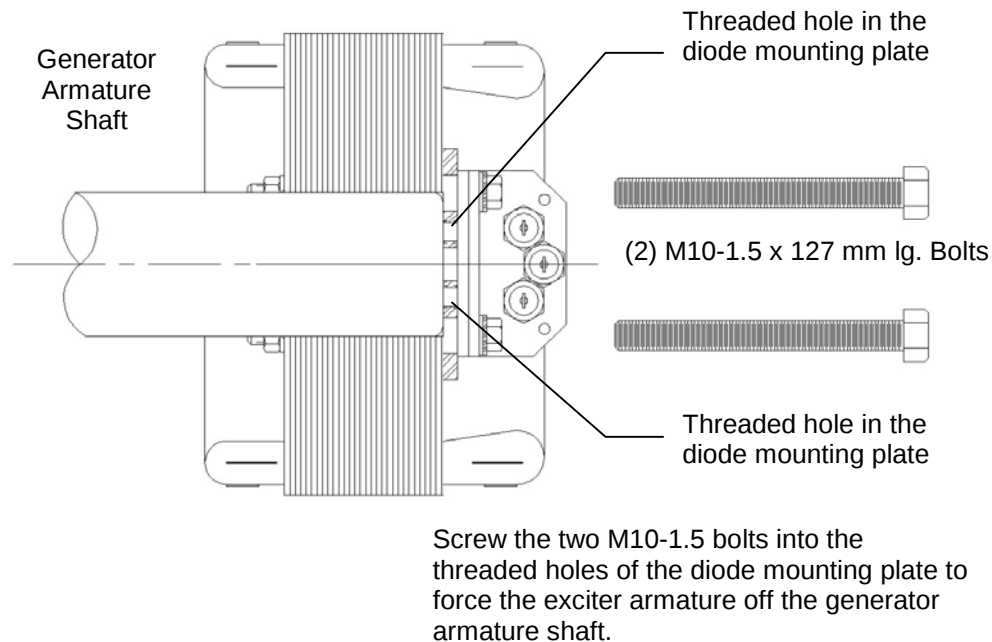
Leads may be damaged if armature is turned too far in either direction.

- a Place a block bar (pry bar) into the generator fan assembly to keep the generator armature from rotating.

WARNING

To prevent personal injury, keep fingers and hands clear of generator assembly until the armature is block into place to prevent rotation.

- b Attempt to loosen exciter armature on shaft by rotating it slightly back and forth. If armature cannot be loosened by hand, use two M10-1.5 hex-head bolts as shown in Figure 4 to force the exciter armature off the shaft. Turn each of the two screws a few turns at a time into the threaded holes of the diode mounting plate until the exciter armature is sufficiently loosened from the shaft and can be removed by hand. Remove it slowly from the shaft and at the same time observe the following **CAUTION**.



Exciter Armature Removal
Figure 4

CAUTION

Pay close attention to field leads while pulling exciter armature from shaft. Make **CERTAIN** that the leads stay in the keyway. One mechanic should watch them constantly while another operates the puller. Make certain that leads do not catch and be sure that they slide smoothly through the hole in the diode mounting plate. Straighten leads and remove kinks as required to avoid damage to insulation.

4) Installation Exciter Armature

a) Preparation for Exciter Armature Installation

- (1) Clean generator shaft and exciter armature bore. Remove all rust, corrosion, etc.
- (2) Make **CERTAIN** that the leads are tucked into the generator shaft keyway.
- (3) Route the revolving field leads (step 2 above) through the hole in the diode mounting plate.
- (4) Align armature keyway with key in shaft and start armature on shaft.

b) Exciter Armature Installation

- (1) If the exciter armature-to-generator shaft fit is such that the exciter armature may be pushed on by hand, push it on very slowly while another mechanic carefully watches and pulls field leads through hole in the exciter armature diode mounting plate. Continue installation until the diode mounting plate contacts the end of the generator shaft. If the exciter armature cannot be pushed on by hand, use a M12-1.75 hex-head bolt and M12-1.75 nut as shown in Figure 5 to pull the exciter armature onto the generator shaft. Screw the hex nut onto the bolt until it is near the head of the bolt. Insert the bolt through the hole in the center of the diode mounting plate as far as it will go until it screws it into the end of the armature shaft. Move the hex nut up against the diode mounting plate. Continue turning the nut until the diode mounting plate contacts the end of the generator shaft as is shown in Figure 5. Pull the exciter armature on slowly and at the same time pulling field leads through the diode mounting plate. After installation, remove the bolt and nut.
- (2) Connect the two generator field leads to the exciter armature as follows:
 - a Connect lead with ring type terminal to the screw provided to the diode mounting plate.
 - b Connect the other field lead to the three leads coming off of the exciter armature windings. Use parallel splice connector, crimp and solder for a good connection.
 - c Insulate with sleeving material or wrap with electrical tape.
- (3) Install the Machine Key
 - a Clean the machine key thoroughly. All mounting surfaces must be free of rust, corrosion, oil, grease, etc.
 - b Apply **LOCQUIC** primer, No. 47-56 grade T to sides of machine key. Do not over prime. A thin film is best. Allow to dry three to four minutes.
 - c Apply a thin coating of **LOCTITE**, No. 242 adhesive to sides of keyways in shaft and armature. Be certain to remove any excess from mounting surfaces on shaft and bore of armature.

NOTE: Application of "**LOCTITE**" is to compensate for any looseness in machine key and keyway (up to 0.005 inch). Manufacturers of **LOCTITE** and other recommended products are listed below.

When exciter armature removal is for the replacement of bearings and no kit is involved, be sure that **LOCTITE** is used.

When kits are involved, the **LOCTITE** is included in the Kit.

The application of **NEVER-SEEZ** to the shaft and armature bore is **NOT** recommended because there is a danger that it may mix with and contaminate the **LOCTITE**. Application of **NEVER-SEEZ** will be at the customer's risk. **LOCTITE** can lose its adhesive and tightening properties if contaminated by rust preventatives, oil, or other lubricants and antirust products.

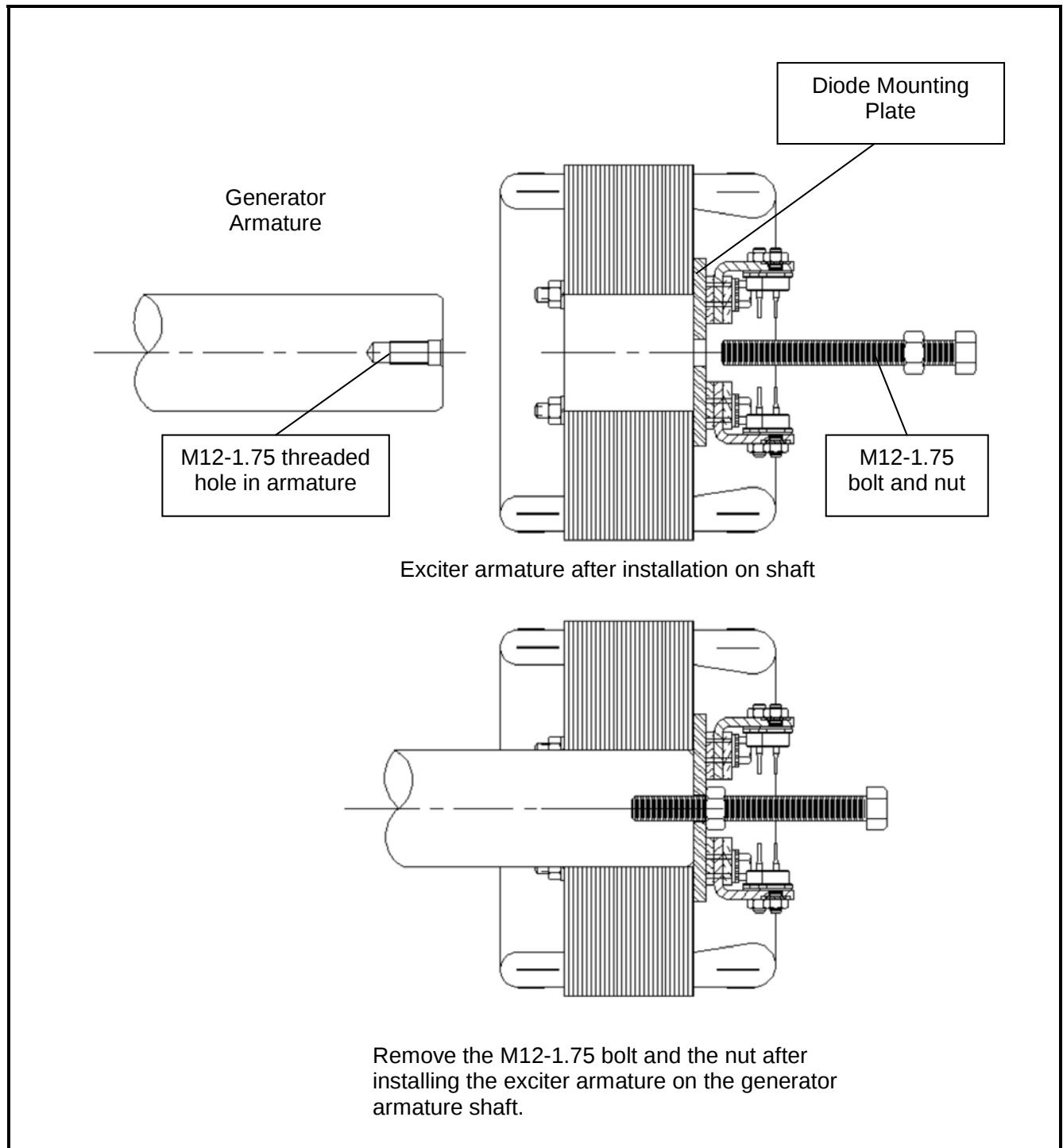
- d Apply **LOCTITE**, No. 242 to **SIDES** of new type threaded machine key. A thin film 0.005 to 0.010 inch thick is adequate and desirable.
- e Ensure keyways in the generator armature shaft and exciter armature are aligned.

- f Insert **UNTHREADED** end of key in keyways, and then tap lightly until threaded end is flush with end of shaft.

(4) Secure the exciter armature and key retainer on generator shaft with the M12-1.75 hex head cap screw.

CAUTION

Allow at least 6 hours for complete cure and set up of Loctite before operating machine.



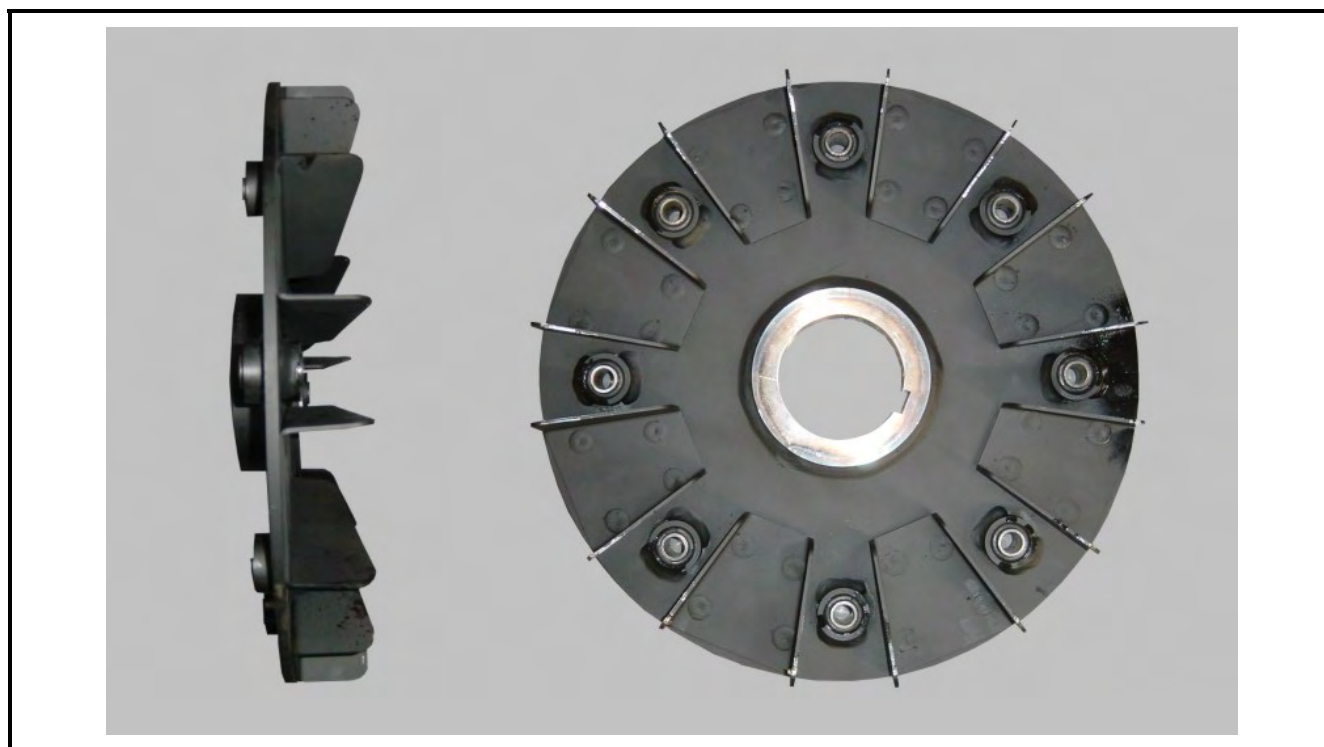
Exciter Armature Installation
Figure 5

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Section 2 Dual Bearing Flexible Coupling

1) General

This manual provides basic instructions for removal, service and installation of a flexible coupling assembly, with generator fan, manufactured by **Hobart Ground Power** as **Part Number 288481**. This assembly is illustrated in Figure 1. The primary function of this assembly is to couple a Hobart 2000 RPM Generator to a Diesel engine. The flexible coupling assembly compensates for slight misalignment between the engine and the generator, due to manufacturing tolerances. A tapered bushing and hub secures the coupling to the generator shaft.



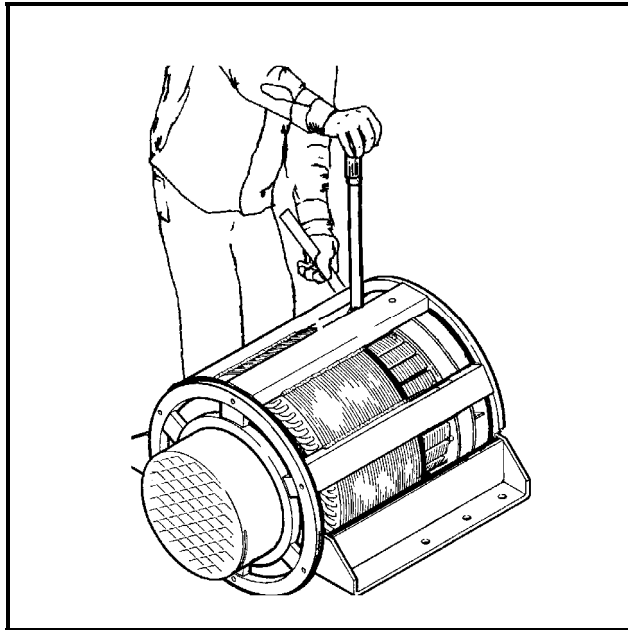
Coupling Assembly
Figure 1

2) Disassembly

Removal of the flexible coupling is required for servicing the generator armature, generator bearings, or the coupling itself. To remove the coupling, for any reason, it is necessary to separate the engine and generator. However, separating the engine and generator while they are installed in the Ground Power Unit is **VERY DIFFICULT** because of the limited working space. During removal **DO NOT** cut any cables or wires. Disconnect and tag them for re-assembly.

a) Separate Engine and Generator

- (1) Refer to Chapter 3, Section 3 for generator assembly removal.



**Access to Coupling Bolts
(for removal or installation)
Figure 2**

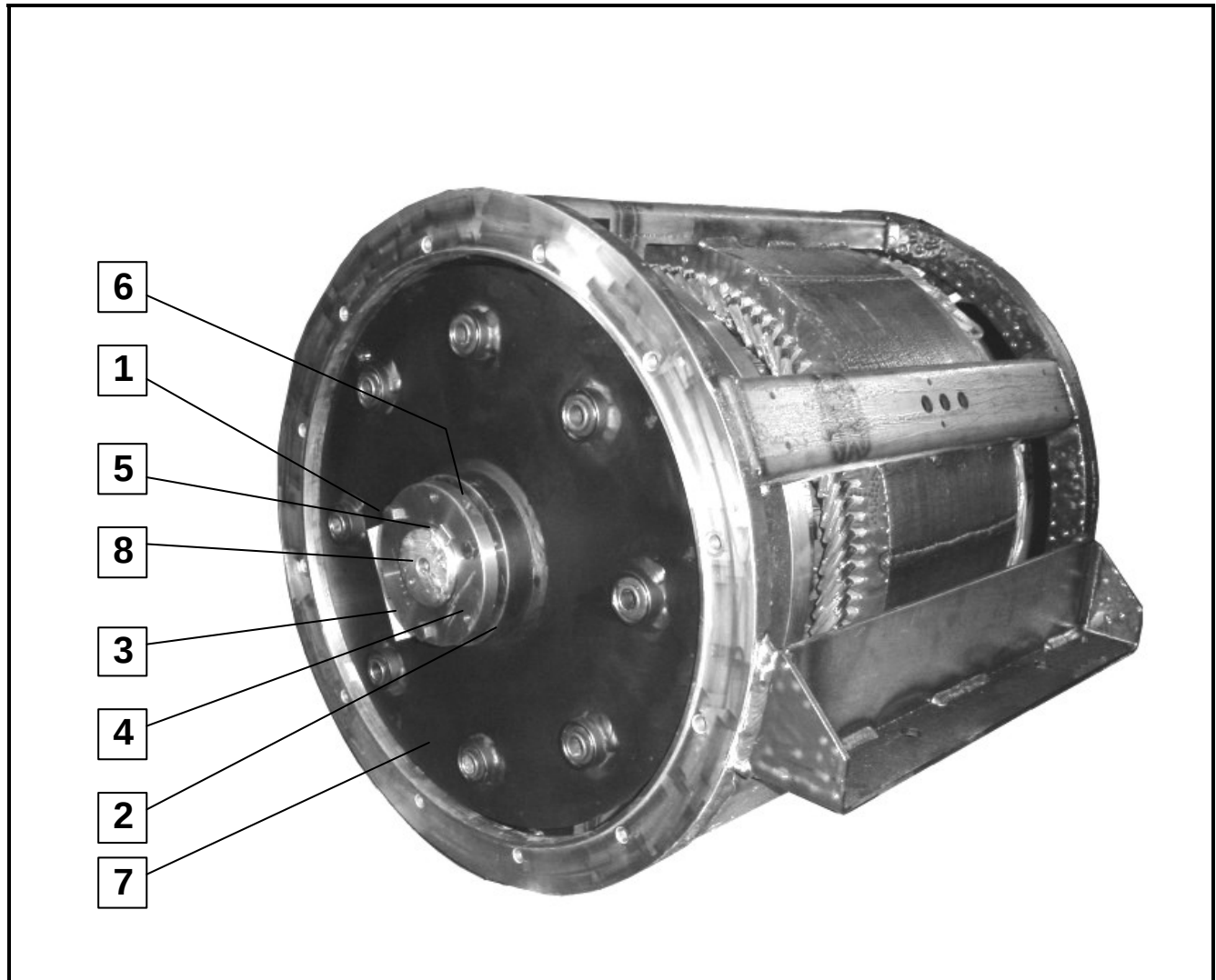
b) Remove Coupling Assembly

WARNING

To prevent personal injury, keep fingers and hands clear of generator assembly until the armature is block into place to prevent rotation.

- (1) Refer to Figure 3. Using a socket wrench, remove all three of the 3/8-16 bolts that secure the bushing to the hub.
- (2) Using a 3/16-inch Allen wrench, loosen the set-screw in the bushing to release pressure on the key.
- (3) To separate the bushing from the hub, lubricate two of the 3/8-16 bolts and insert them into the two threaded holes in the bushing flange. With socket wrench, screw these bolts into the bushing such that the bushing pops loose from the hub, alternating from bolt to bolt.
- (4) When the bushing is loose in the hub, use a mallet to **GENTLY** tap the bushing out of the hub.
- (5) Slide the coupling assembly off the shaft and remove the key.
- (6) Inspect the coupling assembly components carefully as follows:
 - a Check for deformed fan blades and damage to the disk.
 - b Check the rubber exposed at both ends of the bushings for signs of deterioration.
 - c Check hub and bushing for cracks, evidence of galling, fretting and rust pits. Light rust is permissible on the bushing and the tapered bore of the hub.

- d Check the shaft for any damage or deformation where the coupling was mounted on it.
- e Check rubber bushing alignment to make sure that the dimension illustrated in Figure 4 is maintained.



- 1. Bolt, 3/8-16 UNC (3)
- 2. Taper Lock Bushing
- 3. Taper Lock Hub
- 4. Tapped holes (2)

- 5. Key
- 6. Set Screw
- 7. Fan/Coupling Disk
- 8. Armature Shaft

Hub and Bushing
Figure 3

3) Coupling Service

When ordering coupling kits from Hobart Ground Power or an authorized distributor, be sure to include all pertinent information from the unit's identification plate (i.e. Specification No., Model No., and unit rating).

If you have any questions concerning your ITW GSE Group equipment, immediately contact our Service Department **by mail, telephone, e-mail, or FAX.**

Write:	Hobart Ground Power Service Department 1177 Trade Square East Troy, Ohio 45373 U.S.A.
Call Inside U.S.A.:	(800) 422-4166 (Parts) (800) 422-4177 (Service)
Call From Foreign Countries:	(937) 332-5050 (Parts) (937) 332-5060 (Service)
FAX Inside U.S.A.	(800) 367-4945
FAX From Foreign Countries:	(937) 332-5121
E-Mail :	service@hobartgroundpower.com
Web Page :	www.hobartgroundpower.com

a) Replacement Coupling Kit

A replacement coupling kit is available from your Hobart Ground Power. The kit provides a replacement coupling assembly with attaching hardware and installation instructions.

b) Bushing Kit

A bushing kit is available from the Hobart Ground Power for replacing the rubber bushing only in the coupling assembly. However, it should be noted that the finished coupling assembly must be balanced to 1/2 inch-ounce (360 mg-m) minimum. If bushing replacement only is required, the kit part number is 480290. Each kit contains the required number of bushings, a container of lubrication, and installation instructions.

c) Bushing Replacement

To replace bushings only, proceed as follows:

- (1) Press out all old bushings.
- (2) Refer to Figure 4. Clean each bushing socket thoroughly, removing all traces of old rubber. DO NOT scratch or deform the bore of the bushing socket.

- (3) Shake the container of lubricant (supplied with kit) vigorously and pour it into a small shallow dish.
- (4) Roll a bushing in the lubricant to coat it thoroughly. Press it into a socket (from the chamfered end) to the dimension shown in Figure 4.
- (5) Repeat step 4 until all new bushings are installed.
- (6) Balance the complete coupling assembly to 1/2 inch-ounce (360 mg-m) minimum.

4) Coupling Installation

WARNING

To prevent personal injury, keep fingers and hands clear of generator assembly until the armature is block into place to prevent rotation.

CAUTION

Improper installation of the coupling assembly can result in serious damage to the equipment. Follow these installation instructions exactly.

a) Cleaning

Refer to Figure 5. It is **VERY IMPORTANT** that the shaft, the bore and the outside of the split bushing, and the tapered inside of the hub be thoroughly **CLEANED FREE OF DIRT AND GRIT**.

CAUTION

Do not lubricate any of the surfaces listed above. Lubrication of these surfaces can cause the coupling to fail and damage the generator set. Slight traces of rust are permissible on the surfaces.

b) Assembly

- (1) If an adapter ring must be replaced, remove the bolts that secure it to the flywheel. Discard the old adapter ring and bolts. Install the new adapter ring using new socket head bolts.

Torque all bolts to 100 ft-lbs (135 N-m).

The new adapter ring and bolts are included in the kit, when required.

- (2) Refer to Figure 6. Place a straight edge across the engine flywheel housing face and take a measurement from the face to the adapter plate. Record this dimension for locating the coupling assembly on the generator shaft in the next steps.
- (3) Refer to Figure 3. Assemble the bushing into the hub.

CAUTION

Make certain that only the bolts are lubricated, and that no lubricant is permitted to get inside the bushing where the armature shaft will enter the bushing.

- (4) Lubricate the three 3/8-16 bolts **SPARINGLY** and start them into the three (unthreaded) holes finger-tight.

- (5) Slide the generator armature as far as it will go toward the fan housing. Block the armature to maintain this forward position throughout the installation procedure. Block the armature with a wooden block or wedge, being careful not to damage any components of the armature or exciter.

CAUTION

Do not rotate the armature while this block is installed.

- (6) Install the key in the shaft keyway.
- (7) Place the bushing in the hub over the installed key, and install the coupling assembly on the shaft, with the bushing approximately flush with the end of the shaft.
- (8) Using a 3/16-inch Allen wrench, tighten the set screw in the bushing to apply pressure on the key.
- (9) Refer to Figure 7. Place a straightedge across the two adjacent bushings and measure the distance from the bushings to the mounting face of the generator fan housing. Slide the coupling assembly on the shaft until this dimension is met and then move the coupling 1/16-inch (1.6 mm) less than the dimension recorded from the adapter ring measurement. The tapered hub will be pulled onto the split bushing 1/16-inch (1.6 mm) when the 3/8-16 bolts are completely tightened.
- (10) Tighten the 3/8-16 bolts alternately and evenly as follows:
- a Set a torque wrench to 30 foot-pounds (41 N-m) and tighten all three 3/8-16 bolts to that value. Block the coupling against clockwise rotation with a bar, as illustrated in Figure 2. Observe the **CAUTION** above when it is necessary to rotate the shaft.
 - b Repeat step (a) above until 3/8-16 bolts can no longer be tightened.
 - c Recheck the dimension in Figure 7 to be sure it is the same as the dimension in Figure 6.

5) Reassemble Engine and Generator

CAUTION

Use of the proper coupling bolts is very important. Failure to use the proper bolts, as outlined below, can result in coupling failure and damage to the generator set.

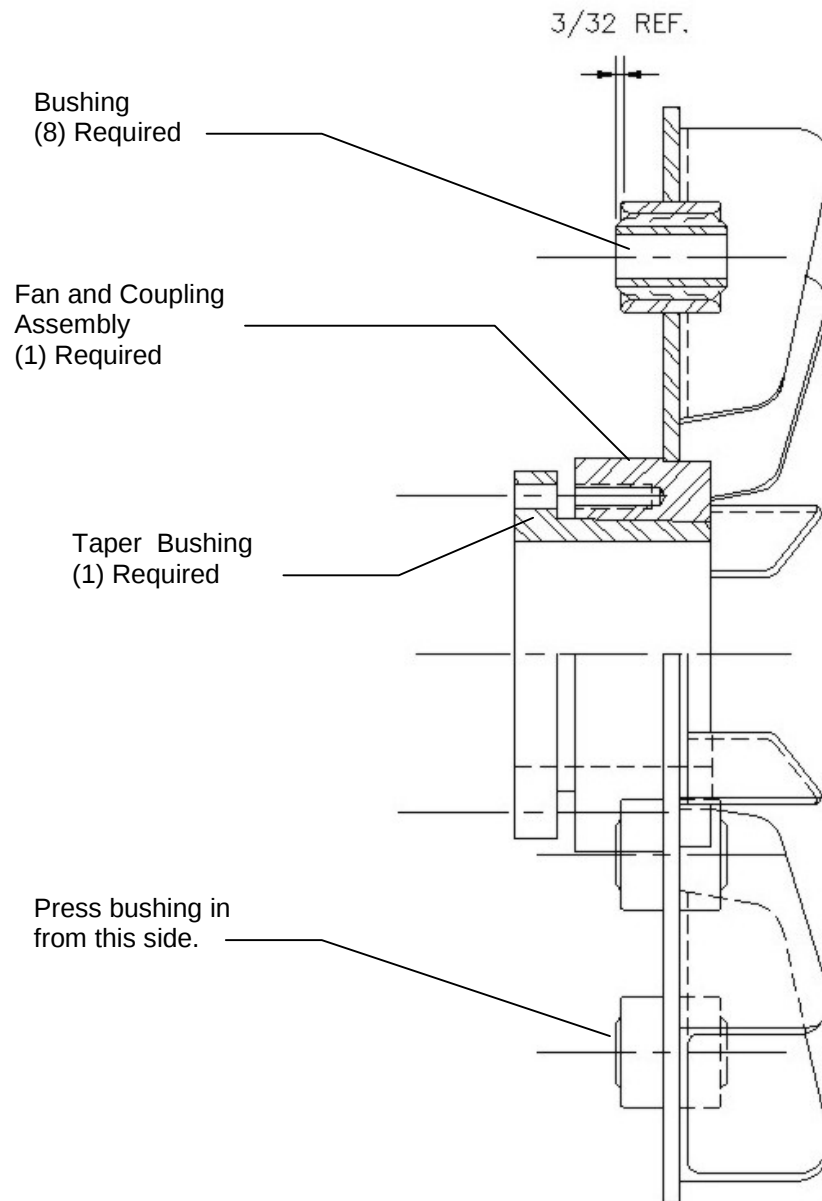
- a) Insert the new coupling bolts with lock washers through the bushings from the fan side of the coupling.
- b) Using a hoist, align the generator fan housing flange with the flange on the engine flywheel housing and insert two of the attaching bolts, one on each side of the flange. Start the bolts into the tapped holes in the flywheel housing just enough to ensure thread engagement. **DO NOT TIGHTEN.**
- c) Block rotation of generator and turn all of the coupling bolts into the tapped holes in the flywheel until finger tight. **DO NOT** tighten with a wrench.
- d) Insert all remaining attaching bolts through the generator flange, engaging the tapped holes in the flywheel housing, and tighten them all securely.
- e) Torque all coupling bolts to 85 ft-lbs (115 N-m).

CAUTION

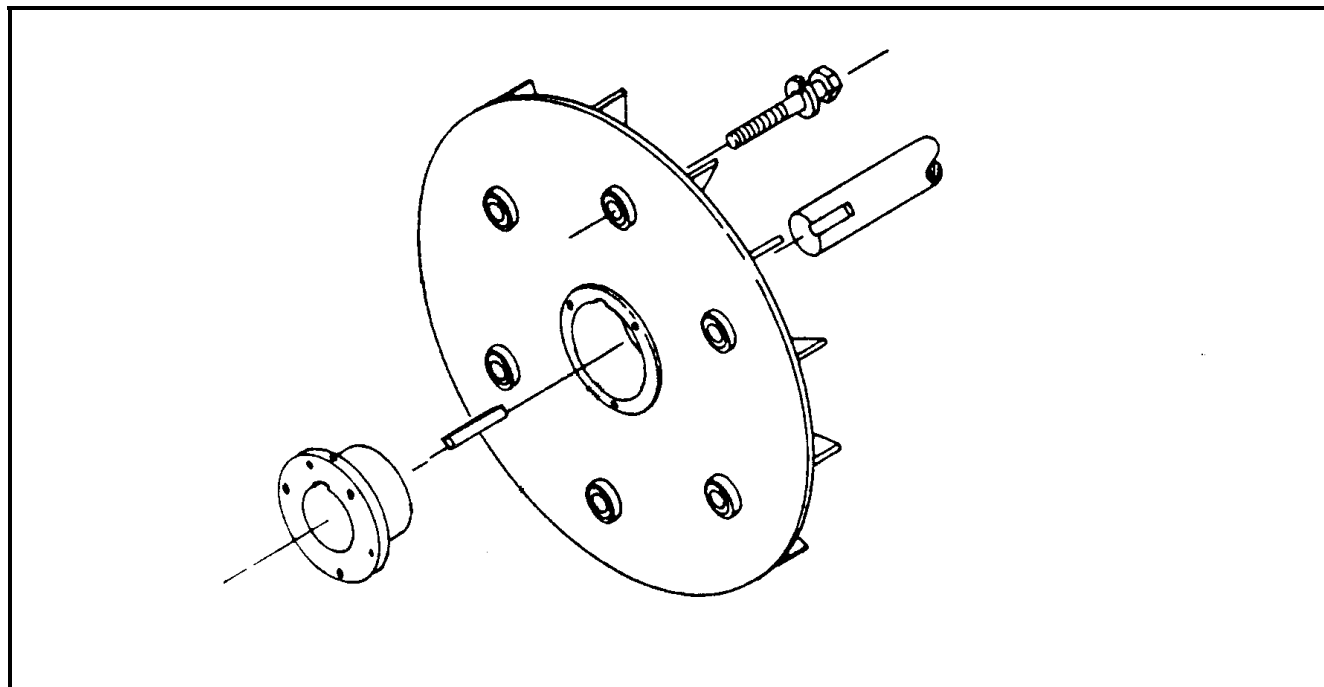
Remove all armature blocks, otherwise, damage to the armature could result.

6) Run-in and Periodic Check

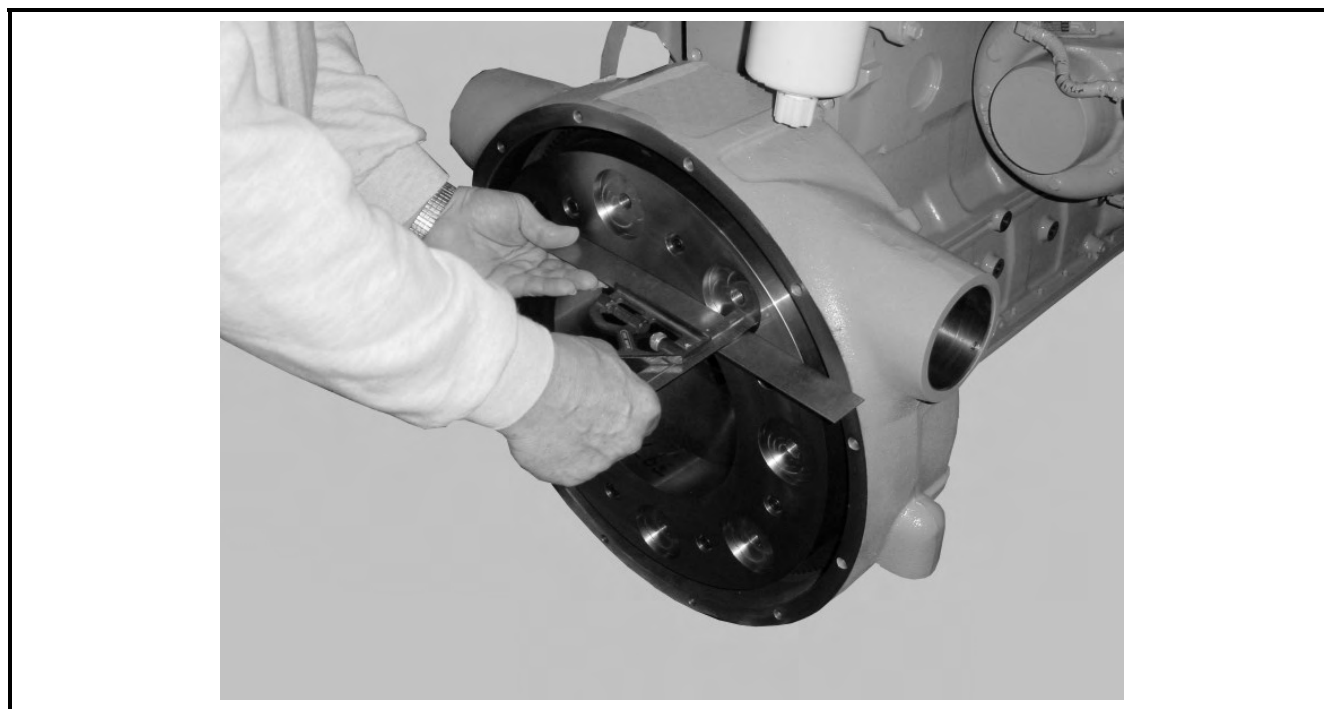
- a)** Mount the engine-generator assembly in a suitable test area and operate it for a 2-hour run-in.
- b)** Shut down the engine after 2 hours and re-torque all coupling bolts to 85 foot-pounds (115 N-m) to compensate for normal torque relaxation.
- c)** Return the unit to normal service.
- d)** After 200 hours of operation, check all coupling bolts with a torque wrench set at 85 foot-pounds (115 N-m).
- e)** Return the unit to normal service.
- f)** After each additional 2,000 hours of operation (or every year) recheck all coupling bolts to maintain the same torque value.



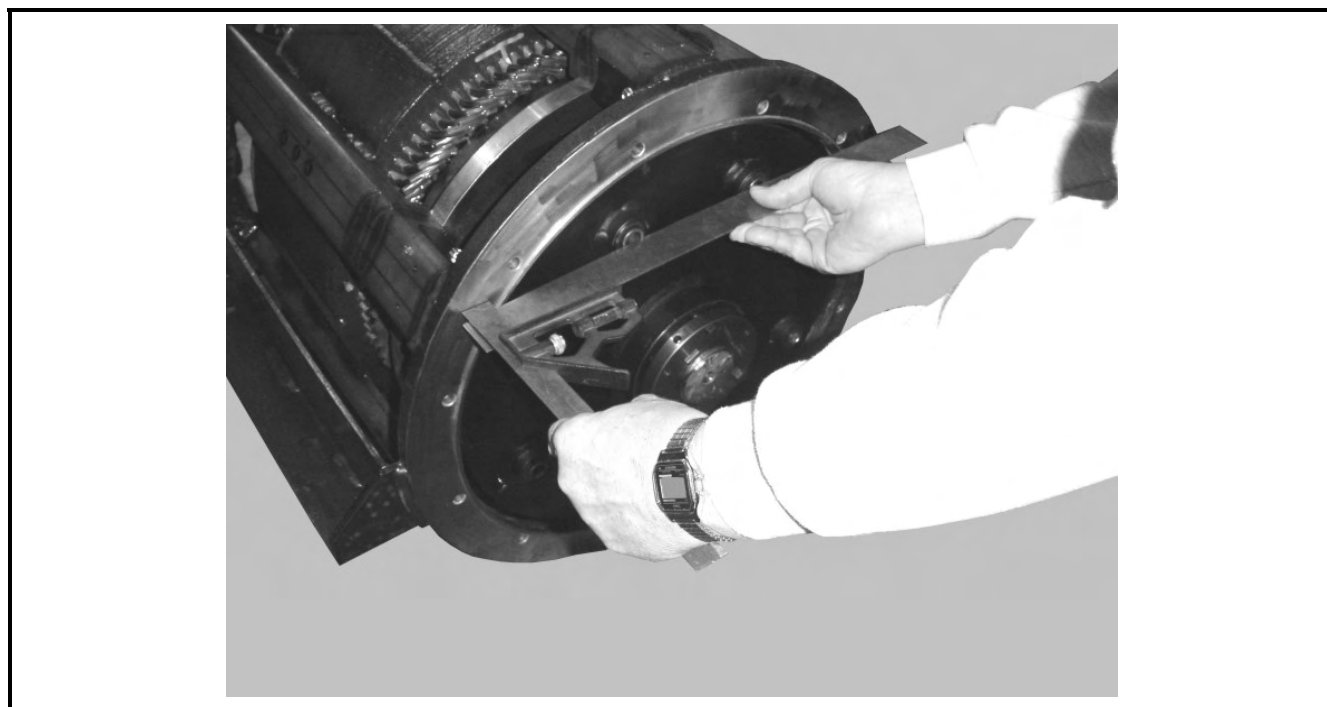
Bushing Installation
Figure 4



**Assembly Procedure
Figure 5**



**Measure from mounting face to adapter ring.
Figure 6**



Measuring From Mounting Face To Bushing
Figure 7

Section 3 Generator Assembly

1) General

This section provides information and instructions for removal and installation of the generator set.

2) Generator Assembly Removal

a) Procedure for Gaining Access to the Generator

WARNING

Before starting removal of the generator assembly, position the front section of the generator set under a hoist, which is capable of lifting at least 1500 pounds (560 kg).

When removing generator assembly, refer to Connection Diagram in Chapter 5 and proceed as follows:

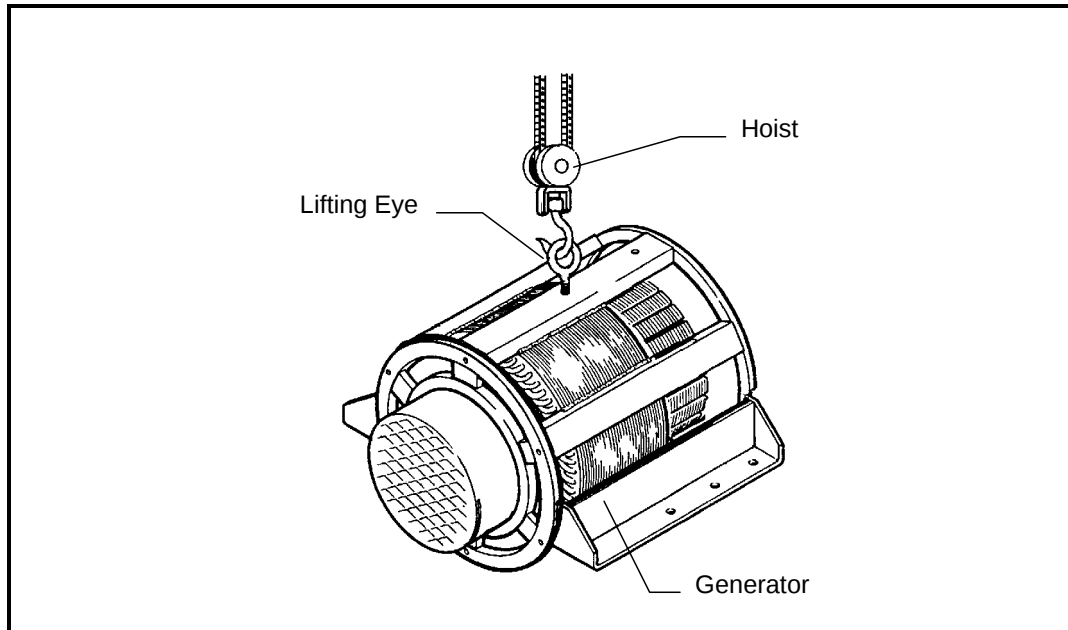
- (1) Disconnect battery leads from the generator set.
- (2) Remove required canopy assembly components.
- (3) Disconnect output cables from the power module load contactors.
- (4) Disconnect plug connectors from the back of the control box and remove the control box
- (5) Remove the air cleaner and the pipe/hoses connecting it to the engine.

Note: cover the turbo inlet while the air cleaner is removed.

- (6) Remove the generator stator leads from the power module and remove the power module.
- (7) Remove required support table components above the generator.
- (8) Remove generator housing cover.

b) Removing the generator Assembly

- (1) Remove the bolt that mounts the generator assembly to the frame of the generator set.
- (2) Support the engine at the flywheel housing with wooden blocks, or second hoist if available.
- (3) Using the hoist, support the generator assembly. For lifting convenience, a M12-1.75 threaded hole is drilled in the top of the generator housing. Insert a M12-1.75 eyebolt in the hole and attach the hoist chain to the eyebolt as shown in Figure 1.
- (4) Remove the generator-to-flywheel coupling bolts.
- (5) Remove the bolts and detach the generator housing from the engine.
- (6) Carefully lift and separate the generator from the engine.



Generator Lifting Arrangement
Figure 1

3) Generator Assembly Installation

Installation of a generator assembly is essentially a reversal of the procedure for removal of the generator assembly: the re-mounting of the generator assembly to the frame of the generator set, and the remounting of the assemblies that were removed to gain access to the generator assembly. To install the generator assembly, refer to Connection Diagram, and proceed as follows:

a) Remounting the Generator Assembly

- (1) Support engine at flywheel housing with wooden blocks, or second hoist if available.
- (2) Using the hoist, support the generator assembly and lower it carefully and slowly into position for attachment to the engine.
- (3) While still supporting the generator assembly with the hoist, attach the generator housing to the engine using the bolts remove earlier. Torque bolts to 30 ft-lb (41 N-m).
- (4) Attach the flywheel coupling to the engine using the bolts remove earlier. Torque bolts to 85 ft-lb (115 N-m).
- (5) Mount the generator housing to the frame of the generator set, using the bolts remove earlier. Torque bolts to 90 ft-lb (122 N-m).
- (6) Install the generator wrapper on the generator assembly, using 1/4 - 20 x 1/2 tap-tite screws.

b) Remounting the previously removed assemblies

- (1) Remount the remaining pieces of the unit in reverse order of disassembly procedure.

Chapter 4 Illustrated Parts List

Section 1 Introduction

1) General

The Illustrated Parts List identifies, describes, and illustrates main assemblies, subassemblies, and detail parts of an Engine-Generator Set manufactured by ITW GSE Group, Hobart Ground Power.

2) Purpose

The purpose of this list is to provide parts identification and descriptive information to maintenance and provisioning personnel for use in provisioning, requisitioning, purchasing, storing, and issuing of spare parts.

3) Arrangement

Chapter 4 is arranged as follows:

Section 1 - Introduction
Section 2 - Manufacturer's Codes
Section 3 - Parts List
Section 4 - Numerical index

4) Explanation of Parts List

a) Contents

The parts list contains a breakdown of the equipment into assemblies, subassemblies, and detail parts. All parts of the equipment are listed except:

- (1) Standard hardware items (attaching parts) such as nuts, screws, washers, etc., which are available commercially.
- (2) Bulk items such as wire, cable, sleeving, tubing, etc., which are also commercially available.
- (3) Permanently attached parts, which lose their identity by being welded, soldered, riveted, etc., to other parts, weldments, or assemblies.

b) Parts List Form

This form is divided into six columns. Beginning at the left side of the form and proceeding to the right, columns are identified as follows:

- (1) FIGURE-ITEM NO. Column

This column lists the figure number of the illustration applicable to a particular parts list and also identifies each part in the list by an item number. These item numbers also appear on the illustration. Each item number on an illustration is connected to the part to which it pertains by a leader line. Thus the figure and item numbering system ties the parts lists to the illustrations and

vice-versa. The figure and index numbers are also used in the numerical index to assist the user in finding the illustration of a part when the part number is known.

(2) FACTORY PART NUMBER Column

All part numbers appearing in this column are Hobart numbers. In all instances where the part is a purchased item, the vendor's identifying five-digit code and his part number will appear in the "NOMENCLATURE" column. Vendor parts, which are modified by Hobart, will be identified as such in the "NOMENCLATURE" column. In case Hobart does not have an identifying part number for a purchased part, the "FACTORY PART NUMBER" column will reflect "No Number" and the vendor's number will be shown in the "NOMENCLATURE" column. Parts manufactured by Hobart will reflect no vendor or part number in the "NOMENCLATURE" column.

(3) NOMENCLATURE Column

The item-identifying name appears in this column. The indenture method is used to indicate item relationship. Thus, components of an assembly are listed directly below the assembly and indented one space. Vendor codes and part numbers for purchased parts are also listed in this column when applicable. Hobart modification to vendor items is also noted in this column.

(4) EFF (Effective) Column

This column is used to indicate the applicability of parts to different models of equipment. When more than one model of equipment is covered by a parts list, there are some parts that are used on only one model. This column is used for insertion of a code letter A, B, etc., to indicate these parts and to identify the particular model they are used on. Since this manual covers more than one generator set specification, this column is used as follows:

Parts coded "A" is usable on Part Number 500090-101 only.
Parts coded "B" is usable on Part Number 500090-102 only.
Parts coded "C" is usable on Part Number 500090-103 only.
Parts coded "D" is usable on Part Number 500090-104 only.
Parts coded "E" is usable on Part Number 500090-105 only.
Parts coded "F" is usable on Part Number 500090-106 only.
Parts coded "G" is usable on Part Number 500090-201 only.
Parts coded "H" is usable on Part Number 500090-202 only.
Parts coded "J" is usable on Part Number 500090-203 only.
Parts coded "K" is usable on Part Number 500090-204 only.
Parts coded "L" is usable on Part Number 500090-205 only.
Parts coded "M" is usable on Part Number 500090-206 only.

(5) UNITS PER ASSEMBLY Column

This column indicates the quantity of parts required for an assembly or subassembly in which the part appears. This column does not necessarily reflect the total used in the complete end item.

Section 2 Manufacturer's Codes

1) Explanation of Manufacturer's (Vendor) Code List

The following list is a compilation of vendor codes with names and addresses for suppliers of purchased parts listed in this publication. The codes are in accordance with the Federal Supply Codes for Manufacturer's Cataloging Handbook H4-1, (CAGE CODES) and are arranged in numerical order. Vendor codes are inserted in the nomenclature column of the parts list directly following the item name and description. In case a manufacturer does not have a code, the full name of the manufacturer will be listed in the nomenclature column.

Code	Vendor's Name and Address	Code	Vendor's Name and Address
D0024	Semikron International Sigmundstrasse 200 P.O. Box 820251 Nuerengerg, Germany 90253	05HB5	Magnecomp Inc. 161 Eagles Nest Dr Pickens, SC 29671-7808
E0615	Kraus and Naimer 42 Miramar Avenue P.O. Box 15-009 Wellington, New Zealand	00779	Tyco Electronics (Amp) 2800 Fulling Mill Rd Bldg-38 Middletown, PA 17057 - 3142
S7023	Bossard LTD Fasteners Steinhauserstrasse 70 Zug, Switzerland, CH-6300	01428	Tuthill Corporation DBA Tuthill Controls Group 2110 Summit St. New Haven, IN 46774-9524
0E8J0	Emka Inc. 1961 Fulling Mill Rd. Middletown, PA 17057-3125	02660	Amphenol Corp. Spectra-Strip/ltd 40-60 Delaware Ave SIDNEY, NY 13838 - 1395
0MR72	Henkel Corp 26941 Cablot Rd, Suite 124 Laguna Hills, CA 92653-7007	02768	Illinois Tool Works Inc. Fastex Division 195 S. Algonguin Rd. Des Plaines, IL 60016-6197
0CYC7	Western Rubber & Supply 7888 Marathon Dr Ste Livermore, CA 94550 - 9314	02929	Newark Electronics Div 4801 N Ravenswood Ave Chicago, IL 60640 - 4457
0HZIP9	Diesel Radiator Co. 1985 Janice Ave. Melrose Park, IL 60160-1008	1SPJ9	Hobart Ground Power 1177 Trade Road East Troy, OH 45373
01XD4	Contact Industries Inc 25 Lex-Industrial Dr Mansfield OH 44903 - 8699	1W134	Eaton Corp. 4201 N. 27 TH St Milwaukee, WI 53216-1897
05YB3	Acon Inc. 22 Bristol Dr. South Easton, MA 02375-1108	1AA44	Collmer Semiconductor Inc.. 2542 Highlander Wa Carrollton, TX 75006

Code	Vendor's Name and Address	Code	Vendor's Name and Address
1DG36	Phillips And Temro Industries Inc E. M. Products Inc. 5380 Cottonwood Ln Prior Lake, MN 55372	23803	N T N Bearing Corp of America 191 Sheree Blvd Ste 101 Exton PA 19341-1265
1DL99	Fleetguard Inc. Div. of Cummins Engine Company 311 N. Park Street Lake Mills, IA 50450 - 1299	24161	Gates Corporation 900 S Broadway Denver CO 80217-5887
1E045	Austin Hardware and Supply Co. 950 Northwest Technology Dr Lees Summit, MO 64086 - 5692	24446	General Electric Co. 3135 Easton Tpke. Fairfield, CT 06431
12662	Peterson Mfg Co. 4200 E 135th St Grandview MO 64030-2896	25710	Deka Plastics Inc. 914 Westfield Ave. Elizabeth, NJ 07208-1222
13445	Cole-Herse 20 Old Colony Ave. Boston, MA 02127-2405	27410	Harris Corp. 1025 W NASA Blvd. Melbourne, FL 32901
14552	Microsemi Corporation 2381 MORSE AVE Irvine, CA 92614-6233	28520	Heyco Inc. 1800 Industrial Way N. Toms River, NJ 08755-4809
14799	Square D Company, Inc Dba Schneider Electric 9522 W. Winona Schiller Park, IL 60176-1084	3A054	McMaster Carr Supply Co. 9630 Norwalk Blvd. Santa Fe Springs, CA 90670-2932
16476	Maxima Technologies & Systems Llc 1811 Rohrerstown Rd Lancaster, PA 17601-2321	3Y208	Taylor And Summerville Battery Co 3485 Successful Way Dayton Oh 45414-4319
18265	Donaldson Company Inc. DBA Torit Products 1400 W. 94th St. Minneapolis, MN 55431-2370	30104	Automotive Controls Corp. 1300 W. Oak St. P.O. Box 788 Independence, KS 67301-0788
2B664	All-Phase Electric Supply Co 1620 W Main St P.O. Box 149 Springfield OH 45501-0149	30430	Marathon Electric Mfg. Corp. 398 Beach Rd. Burlingame, CA 94010-2004
2N562	Power Transmission Sales Inc. 531 Washington P.O. Box 229 Chagrin Falls, OH 44022-0229	38151	Marathon Electric Mfg. Co. 100 E. Randolph St. Wausau, WI 54401-2568

Code	Vendor's Name and Address	Code	Vendor's Name and Address
40121	Peterson Mfg. Co. Inc. 700 W. 143rd St. Plainfield, IL 60544-9733	57733	Stewart-Warner Corporation 333 Ludlow St Stamford, CT 06902-6987
44655	Heico Ohmite LLC 1600 GOLF RD 850 ROLLING MEADOWS, IL 60008 - 4204	6S553	Wes-Garde Components Group Inc 300 Enterprise Dr Westerville, OH 43081-8840
46922	Crawford Electric Co 445 E 32 Mile Rd Romeo MI 48065-5270	6Y440	Micron Technologies Inc. 8000 S. Federal Way Boise, ID 83716-7128
49234	Protectoseal Company 225 W Foster Ave Bensenville, IL 60106-1631	60038	Timken Corporation 1835 Dueber Ave Sw Canton, OH 44706-2728
5P059	Tech Products Corp. 2215 Lyons Rd Miamisburg, OH 45342 - 4465	61706	EAO Switch Corporation 98 Washington St. Milford, CT 06460-3133
50508	Magnetic Components Inc. 9520 Ainslie St. Schiller Park, IL 60176-1191	62292	EBM Industries Inc. 110 Hyde Rd. P.O. Box 4009 Farmington, CT 06034-4009
52793	Saginaw Products Corp. DBA CIGNYS 68 Williamson St. Saginaw, MI 48601-3246	66180	Automatic Timing and Controls 3312 Bloomingdale Melrose Park, IL 60160-1030
54646	Clampco Products Inc. 1743 Wall Road Wadsworth, OH 44281-9558	66844	Powerex Inc. 173 PAVILION LN Youngwood, PA 15697-1800
55752	Parker Hannifin Corp. DBA Racor Div. 3400 Finch Rd. Modesto, CA 95354-4125	7M613	Wright F.B. Co. of Cincinnati 4689 Ashley Dr. Hamilton, OH 45011-9706
56289	Sprague Electric Company 678 Main St Sanford, MA, 04073-7003	71382	Seal Master Bearings Sub Of Emerson Electric Co. 1901 Bilter Rd. Aurora, IL 60502-9704
57347	Wall Industries Inc. 5 Watson Brook Rd. Exeter, NH 03833-4589	71400	Cooper Bussmann Inc. 114 Old State Road Ellisville, MO 63021-5942

Code	Vendor's Name and Address	Code	Vendor's Name and Address
72619	Dialight Corporation 1501 State Rte 34 S Farmingdale, NJ 07727-3932	81483	International Rectifier Corp 233 Kansas St. El Segundo, CA 90245
74400	Hobbs Corporation 1034 E ASH ST Spring Valley, IL 62703-3551	81703	Mulberry Metal Products Inc. 2199 Stanley Terrace Union , NJ 07083-4399
74542	Hoyt Electrical Instruments 23 Meter ST. Concord, NH 03303-1894	82866	Research Products Corp. P.O. Box 1467 1015 E. Washington Ave. Madison, WI 53701
74545	Hubbell Inc Wiring Device Div 185 Plains Road Milford, CT 06460	86797	Rogan Corp 3455 Woodhead Dr. Northbrook, IL 60062-1812
74829	IlSCO Corp. 4730 Madison Rd. Cincinnati, OH 45227-1426	91637	Vishay Dale Electronics Inc. 1122 23RD St. Columbus, NE 68601-3647
75418	Kysor Industrial Corporation 1 Madison Ave Cadillac, Michigan 49601-9784	91929	Honeywell International Inc. DBA Honeywell 11 W. Spring St. Freeport, IL 61032-4316
75915	Littelfuse, Inc. 8755 W Higgins Road Ste 500 Chicago, IL 60631 - 2701	94222	Southco Inc. 210 N. Brinton Lake Rd. Concordville, PA 19331
77342	TYCO Electronics Corporation 8010 Piedmont Triad Pkwy Greensboro, NC 27409	97520	Basler Electric Company Route 143 Highland, IL 62249-1074
78388	Woodward Controls Inc. 6250 W Howard St Niles, IL 60714-3433		
8A334	Cummins Bridgeway LLC 2297 SW Blvd Ste K Grove City, OH 43123-1822		
8T246	Whitesell RO & Associates, Inc. 7009 CORPORATE WAY Dayton, OH 45459-4238		

Section 3 Illustrated Parts List

1) Explanation of Parts List Arrangement

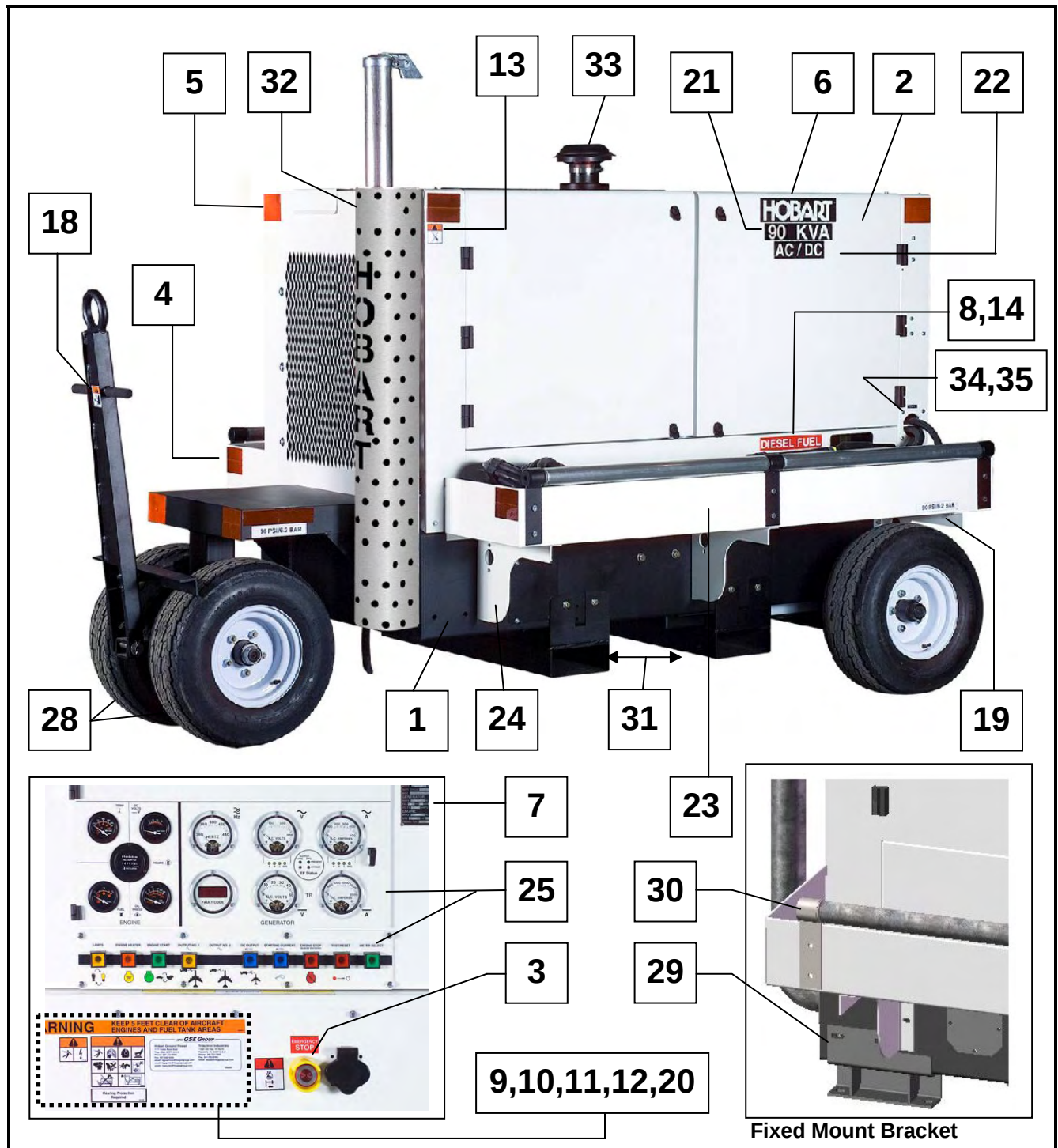
The parts list is arranged so that the illustration will appear on a left-hand page and the applicable parts list will appear on the opposite right-hand page. Unless the list is unusually long, the user will be able to look at the illustration and read the parts list without turning a page.

2) Symbols and Abbreviations

The following is a list of symbols and abbreviations used in the parts list:

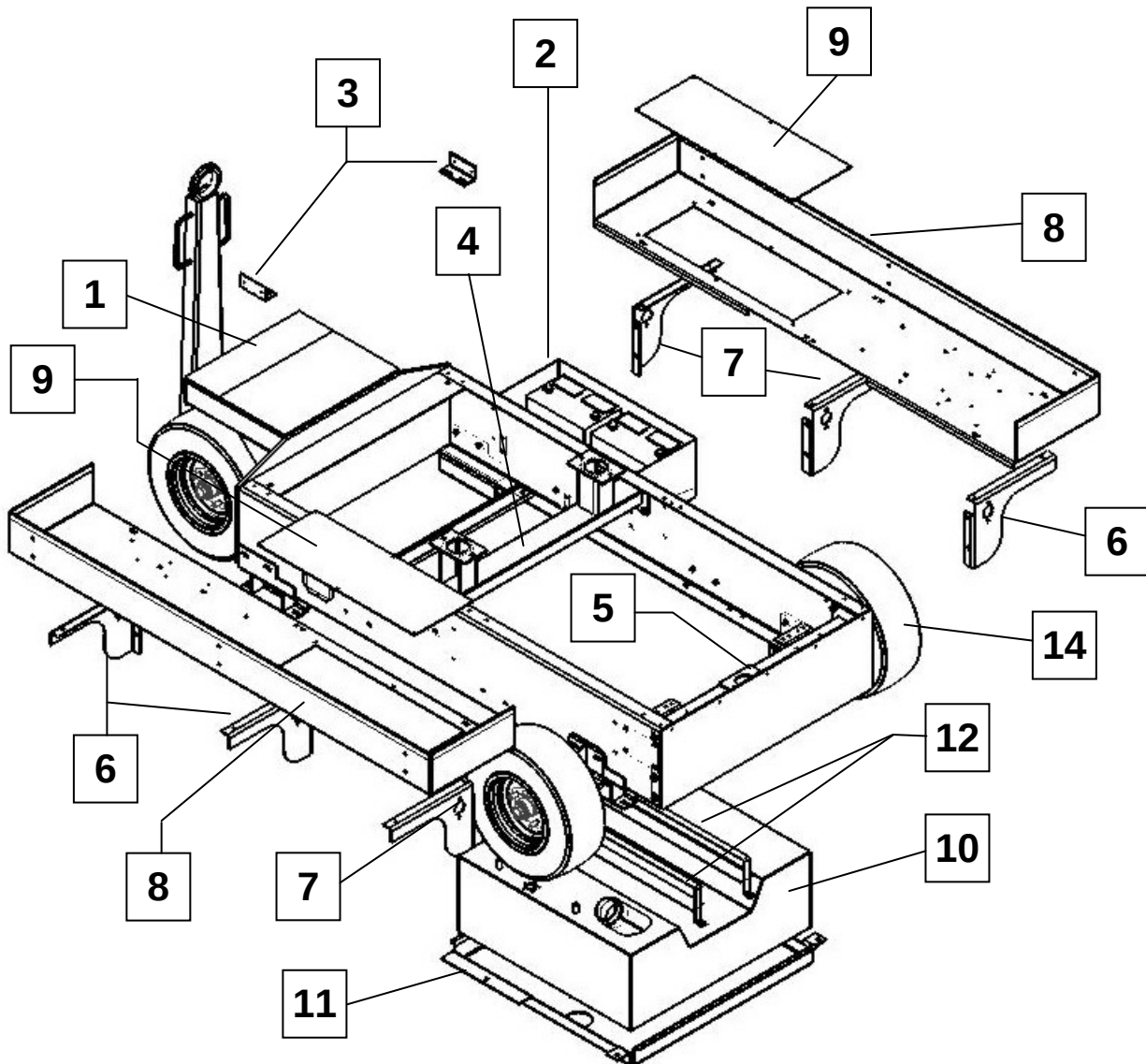
*	-	Item not illustrated
A, or AMP	-	Ampere
AC	-	Alternating current
AR	-	As required
DC	-	Direct current
Fig.	-	Figure
hd.	-	Head
hex	-	Hexagon
Hz	-	Hertz (cycles-per-second)
I.D.	-	Inside diameter
IN or "	-	Inch
KVA	-	Kilovolt-ampere
uF	-	Microfarad
No.	-	Number
NHA	-	Next higher assembly
PRV	-	Peak reverse voltage
PSI	-	Pounds per square inch
Ref	-	Reference (the item has been listed previously)
RH	-	Right Hand
LH	-	Left Hand
TM	-	Technical Manual
T-R	-	Transformer-rectifier
V	-	Volt or used as a prefix indicating vendor code

NOTE: An item which does not reflect an index number is an assembly which is not illustrated in it's assembled state, or it is similar (right-hand, left-hand, top, etc.) to an item which is illustrated.



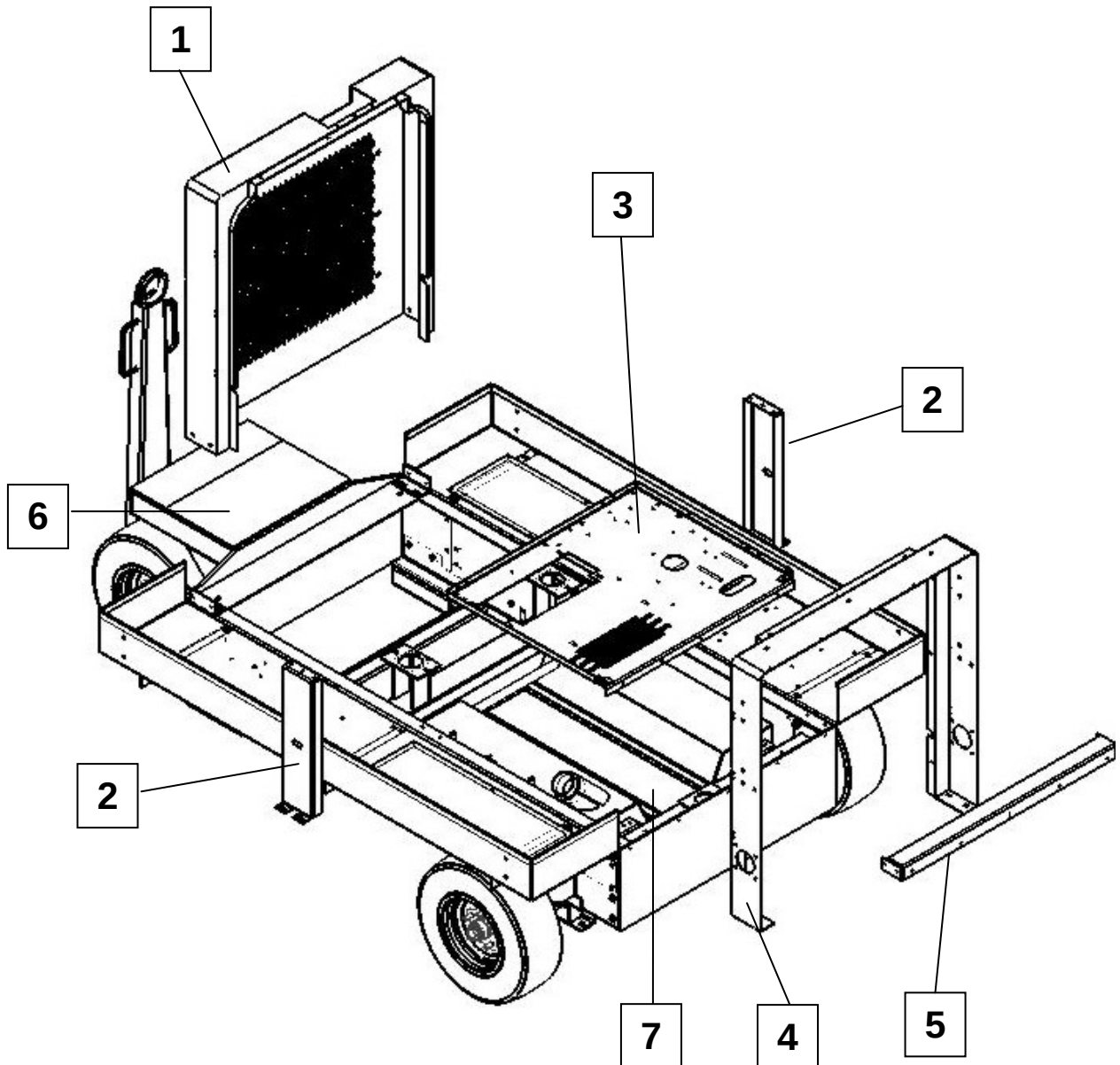
General Assembly
Figure 1

FIGURE ITEM NO.	FACTORY PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
1-	1	Frame Assembly (See Figure 2)		Ref.
	2	Canopy Assembly (See Figure 3 and 4)		Ref.
	3	Emergency Stop Button Assembly		
	285125	...Guard, Mushroom Button (V14799 # K564M)		1
	288300	...Label, Emergency Stop		1
	77A1157	...Switch, Maintained, Push-Pull (V14799 #KR-9R-H6)		1
	291393	...Emergency Stop Harness Extension		1
4	408665-001	Reflector, Red (V12662 #B491)	A,B,E	8
	408665-001	Reflector, Red (V12662 #B491)	C,D,F	4
5	408665-002	Reflector, Amber (V12662 #B491A)	A,B,E	24
	408665-002	Reflector, Amber (V12662 #B491A)	C,D,F	12
6	402987	Label, Hobart		2
7	288917-002	Label, I.D. (Inside Control Box)		1
8	76B1148	Label, Diesel Fuel		1
9	287459	Label, General		1
10	287460	Label, High Voltage		5
11	282658	Label, Warning Clearance		1
12	288866	Label, Support Center		1
13	287463	Label, Hot Muffler		2
*	14	287461 Label, Fuel (located under Diesel Fuel label)		1
*	15	287462 Label, Radiator (located on radiator access door)		1
*	16	287464 Label, Moving Parts (located inside on the fan shrouds)		2
*	17	288862 Label, Caution, Engine Speed (located near control panel)		1
	18	287465 Label, Warning Drawbar	A,B,E	2
	19	287571 Label, Tire Pressure	A,B,E	4
	20	287696 Label, Hearing Protection		1
	21	283714-002 Label, kVA Rating		2
	22	288164-001 Label, TR Unit	E,F	2
	23	Tray, Cable (See Figure 2)	A,B,E	Ref.
	24	Bracket, Cable Tray Fender (See Figure 2)	A,B,E	Ref.
	25	Bracket, Cable Tray Fender (See Figure 2)	A,B,E	Ref.
	26	Control Box Assembly (See Figure 5,6, and 7)		Ref.
*	26	402034-002 Cable, AC Output 30 ft.	A,C,E,F	1
		Cable, AC Output 30 ft.	B,D	2
*	27	402025-003 Cable, DC Output 30 ft.	E,F	1
	28	Call Factory Tire, Trailer Assembly (See Figure 2)	A,B,E	Ref.
	29	291253-001 Bracket, Fixed Mount, LH (optional)	C,D,F	2
		291253-002 Bracket, Fixed Mount, RH (optional)	C,D,F	2
30	288987-002	Kit, Cable Tray Rollers (optional)	A,B,E	2
	288961-002	...Roller, Cable Tray	A,B,E	4
	288988	...Support, Cable Roller	A,B,E	6
	288989-001	...Spacer, Roller Support	A,B,E	6
31	291351	Pocket, Forklift (optional)		2
32		Engine Exhaust System (See Figure 13)		Ref.
33		Engine Air Intake System (See Figure 15)		Ref.
*	34	288120 Output Cable Bracket	A,B,C,D	1
		288120 Output Cable Bracket	E,F	2
	35	7J422-000 Output Cable Clamp	A,B,C,D	1
*		7J422-000 Output Cable Clamp	E,F	2
*	36	290216 Low Emissions Label (in location of diesel fuel label)		1



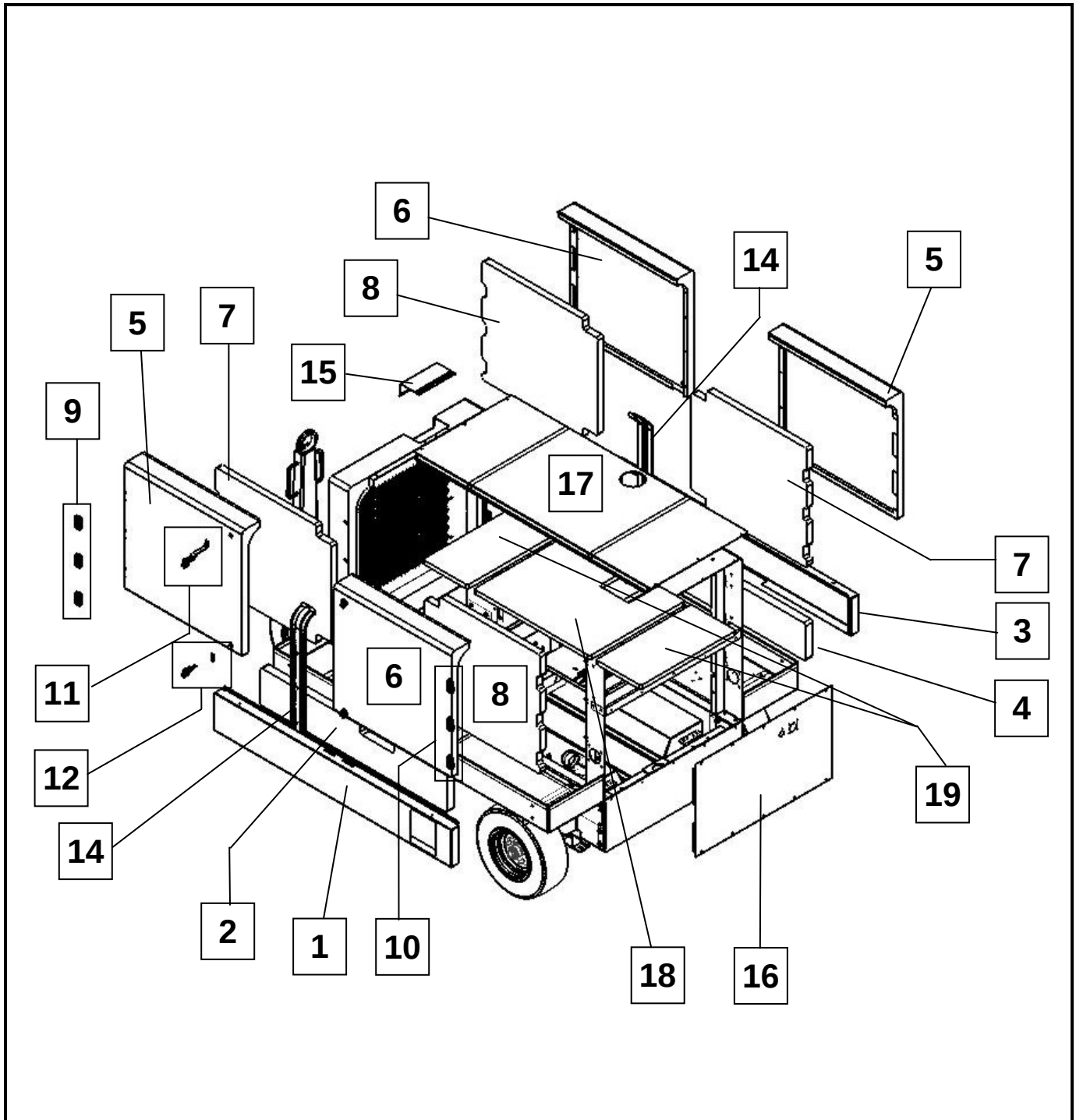
Trailer / Frame Assembly
Figure 2

FIGURE ITEM NO.	FACTORY PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
2 -	1	291053	A,B,E	1
	2	12 VDC Battery Tray Assembly (See Figure 14)		1
	3	287998		2
	4	291047		1
	5	287957		1
	6	291088	A,B,E	3
	7	291089	A,B,E	3
	8	291092	A,B,E	2
	9	291093	A,B,E	2
	10	290701		1
		486719-005		1
	11	289895		1
	12	290702		2
		290267		2
*	13	282562		1
	14	Call Factory	A,B,E	4



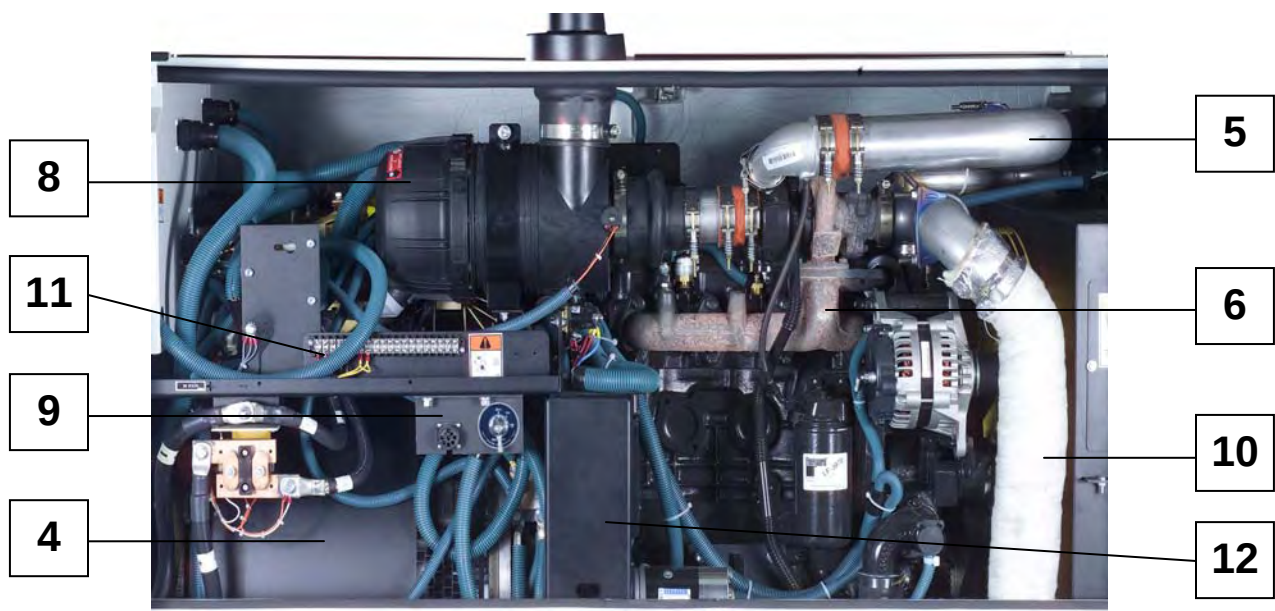
Canopy Frame Assembly
Figure 3

FIGURE ITEM NO.	FACTORY PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
3 - *	1 291069	Front Panel		1
	287998	...Front Panel Bracket (See Figure 2)		1
	2 291152	TR Panel Support Leg		2
	3 291066	TR Support Panel		1
	4 291056	Control Panel Support		1
	5 287986	Control Panel Support Bar		1
	6	Trailer/Frame Assembly (See Figure 2)		Ref.
	7	Fuel Tank Assembly (See Figure 2)		Ref.

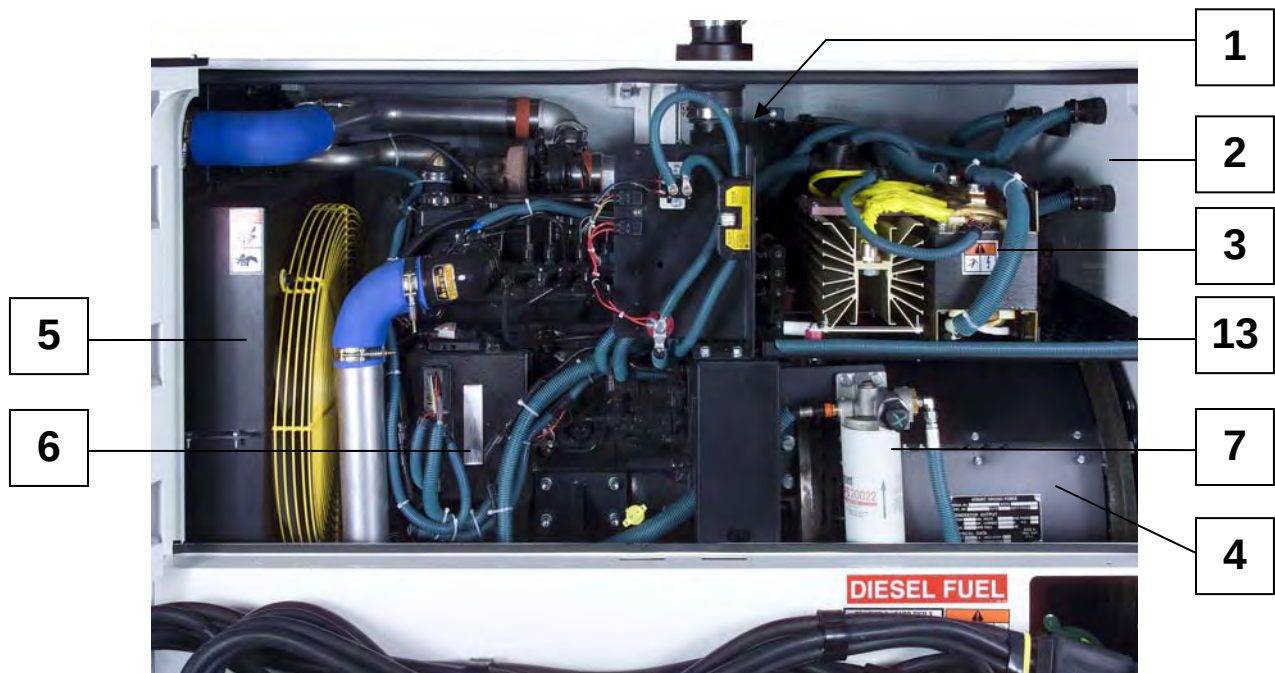


Canopy Assembly
Figure 4

FIGURE ITEM NO.	FACTORY PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
4 -	1	291080 Fuel Side Lower Door Panel		1
	2	291237-002 Fuel Side Lower Door Panel Insulation		1
	3	291081 Lower Door Panel		1
		287785 Access Panel Fastener		2
4	291237-001	Lower Door Panel Insulation		1
	287785	Access Panel Fastener		2
5	291084	Access Door		2
6	291297	Access Door		2
7	291237-004	...Access Door Insulation		2
8	291237-003	...Access Door Insulation		2
9	283824	...Access Door Hinge Assembly (<i>To Door PN 291084</i>)		6
10	283597	...Access Door Hinge Assembly (<i>To Door PN 291297</i>)		6
11		...Access Door Top Latch Assembly		4
	291335	Access Door Latch Pawl		4
	287542-001	Access Door Latch		4
	287526-002	Access Door Latch Pull Tab		4
12		...Access Door Bottom Latch Assembly		4
	291386	Access Door Latch Pawl		4
	287542-001	Access Door Latch		4
	287526-002	Access Door Latch Pull Tab		4
*	13	286485-001 ...Access Door Gasket (cut into 31-inch strips)		124 in.
*		050984 ...Access Door Gasket (cut into 62-inch strips)		124 in.
14	291057	Access Door Stop		2
15	291302	Radiator Cap Access Door		1
16	291087	Lower Rear Panel		1
17	291085	Top Canopy Assembly		1
18	291237-006	...Top Canopy Insulation		1
19	291237-005	...Top Canopy Insulation		2



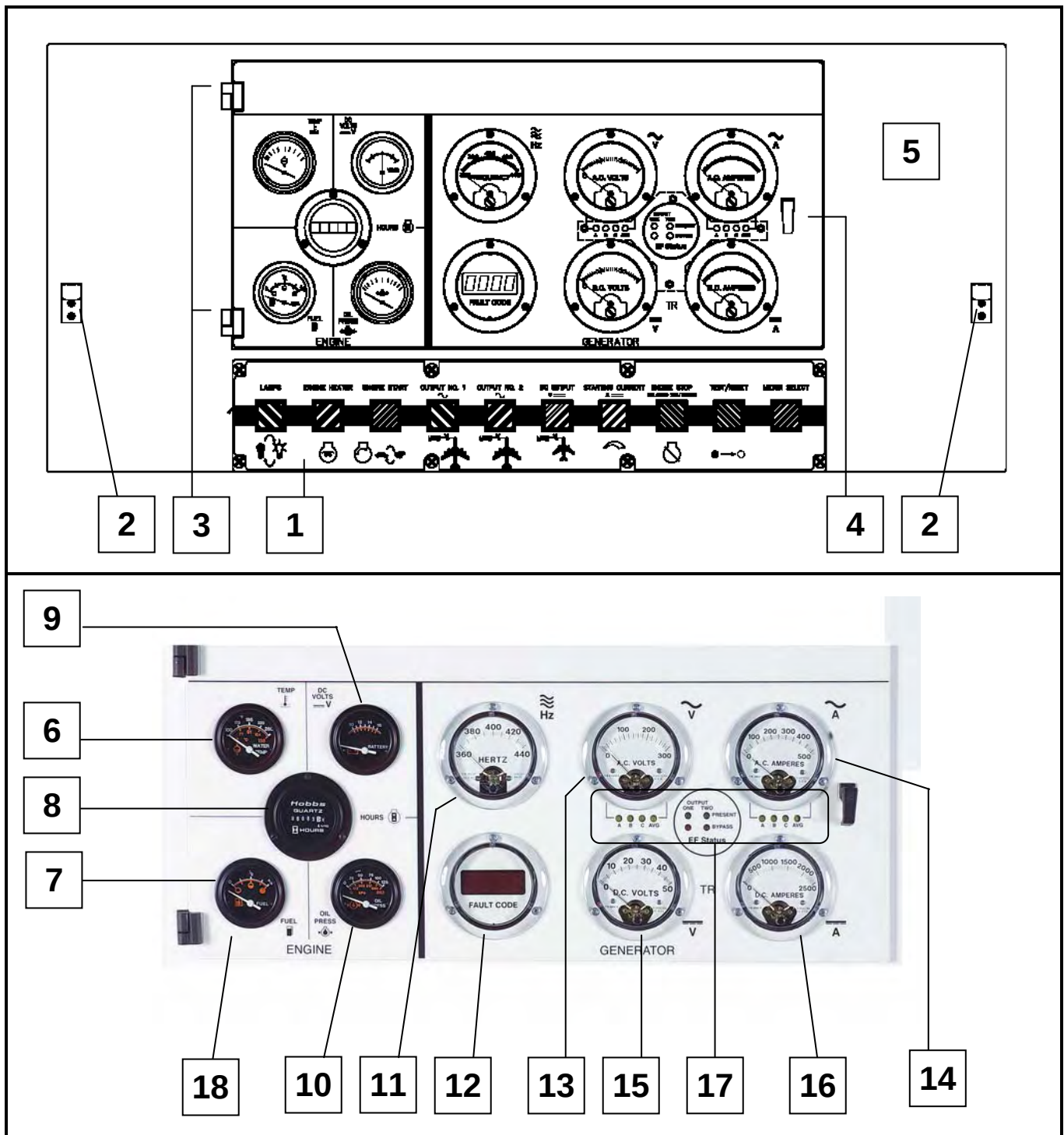
Right Side



Left Side

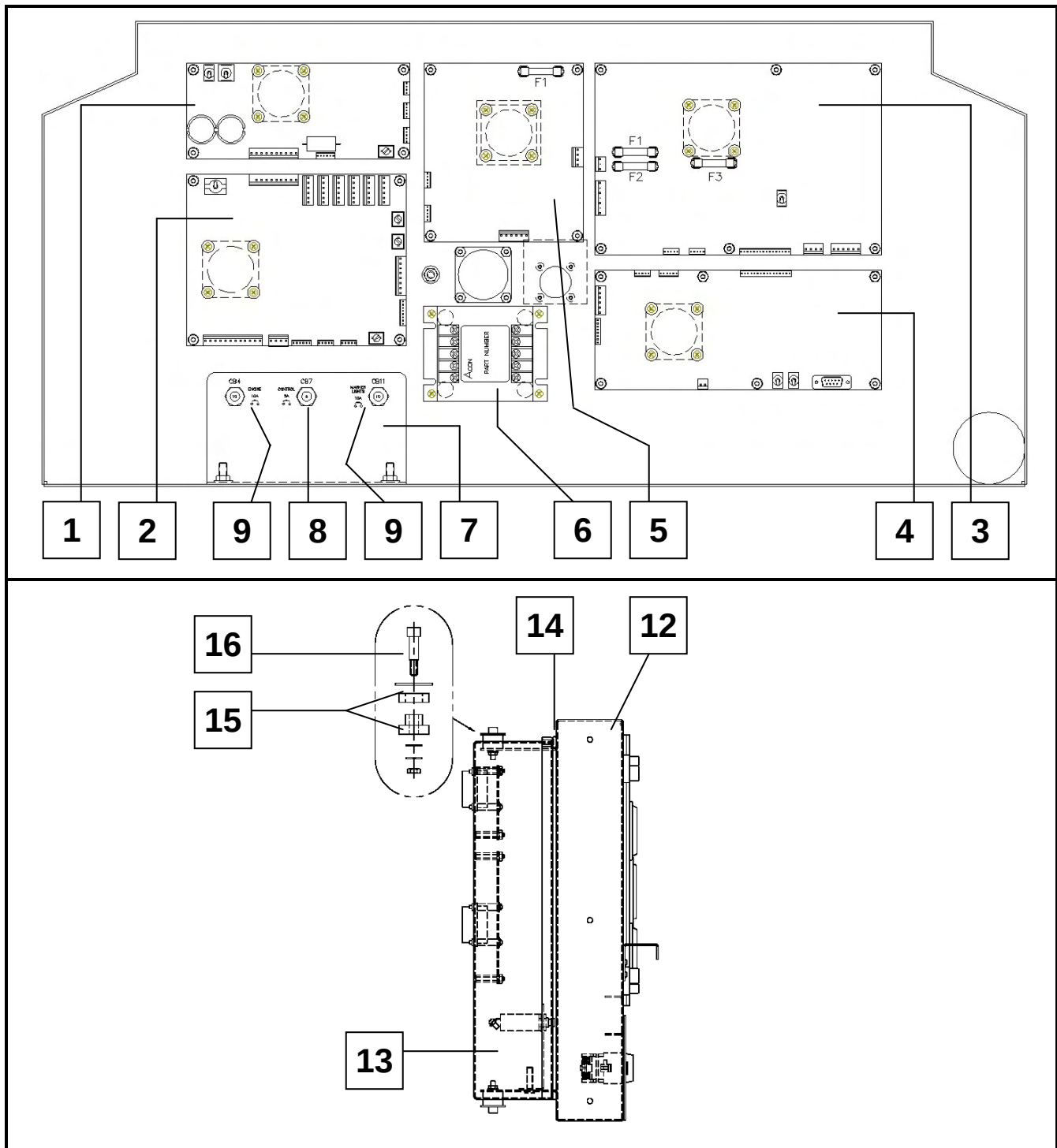
**Internal Components
Figure 5**

FIGURE ITEM NO.	FACTORY PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
5 -		Left Side		
1		Engine Electronic Panel (See Figure 17)		1
	290944	...Wire Harness, Engine Electronics		1
2		Control Box Assembly (See Figures 6, 7, and 8)		1
3		28.5 VDC Transformer-Rectifier Assembly (optional)	E,F	1
4	288460-003	Hobart Generator Assembly (See Figure 18)		1
*	290870	...Flywheel Spacer Ring (mounted to engine flywheel)		1
*	290869	...Flywheel Housing Adapter		1
*	291055	...Bracket, Generator Support (mounted on generator)		1
*	284372-001	...Mount, Shock		1
5		Engine Cooling System Assembly (See Figure 10)		1
6	291111	Cummins QSB4.5 Electronic Engine (V8A334)		1
*	291054	...Bracket, Engine Support (mounted on generator)		2
*	288109-001	...Mount, Shock		2
	290678	...Wire Harness, Engine		1
7		Engine Fuel System (See Figure 12)		Ref.
		Right Side		
8		Engine Air Intake System (See Figure 15)		Ref.
9		Engine Dongle and Battery Disconnect Panel		Ref.
	291334	...Panel, Engine Dongle/Battery Disconnect		1
	290831	...Switch, Battery Disconnect		1
	290847	Plate, Disconnect Switch		1
	290832	...Cable, Disconnect Switch to Starter		1
	290903	...Cable, Disconnect Switch to Electronics Panel		1
10		Engine Exhaust System (See Figure 13)		Ref.
11	288895	Support, Option Terminal Block		1
*	289127	...Label, Terminal Block		1
		Miscellaneous		
12	291152	TR Panel Support Leg		2
13	291066	TR Support Panel		1



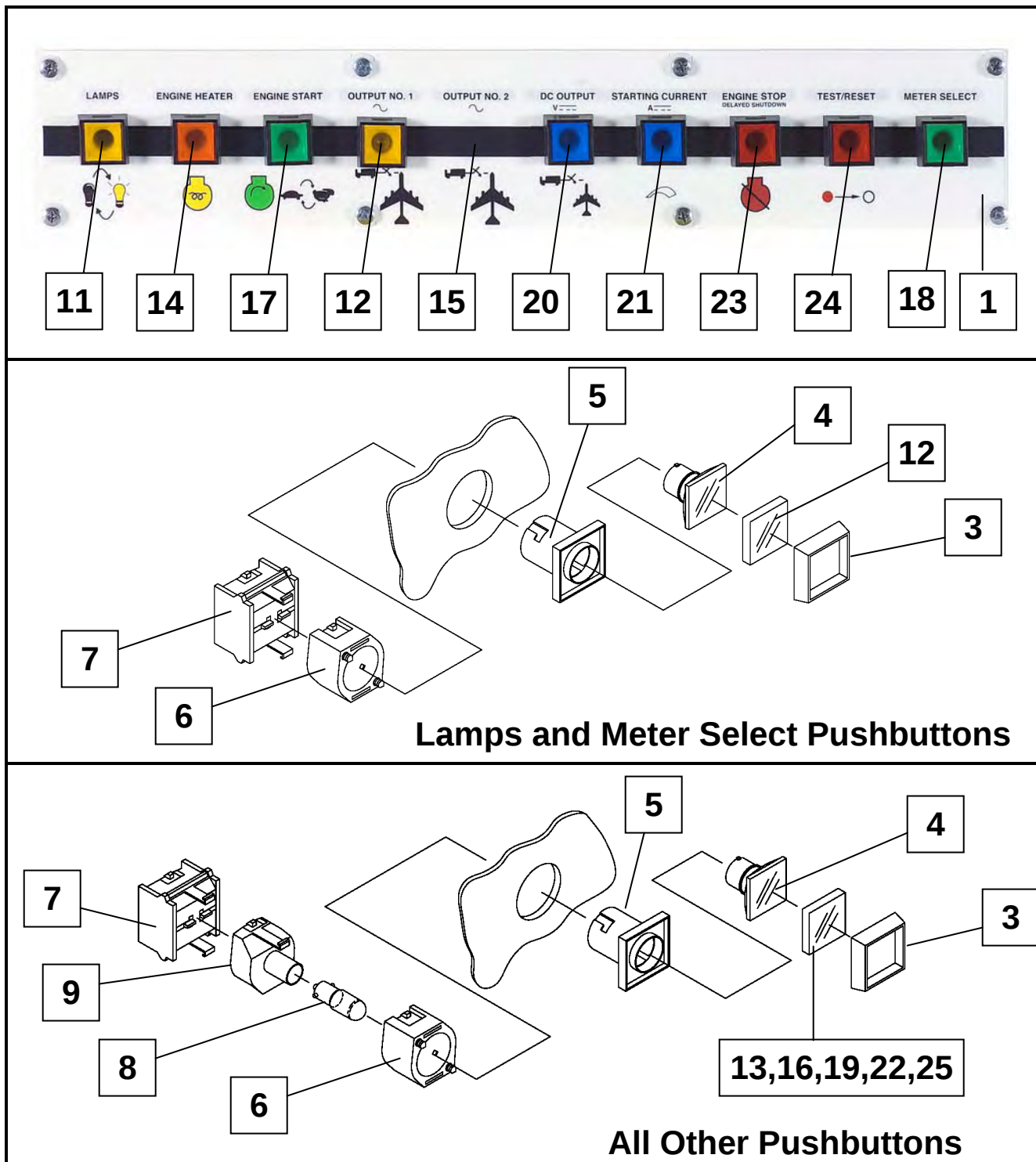
Control Box and Door Assembly
Figure 6

FIGURE ITEM NO.	FACTORY PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
6 - *	1	Switch Panel (See Figure 7)		
		Control Box Interior Components (See Figure 6)		
	2 288020	Bracket, Control Cover		1
	3 288836-001	Top Door Hinge (V94222 #96-141 Type A)		1
	288836-002	Bottom Door Hinge (V94222 #96-142 Type B)		1
	4 288999-001	Control Box Door Latch		1
	5 291307	Control Box Enclosure (front only)		1
	6 287908	Water Temperature Gauge (V16476 #06347-01)		1
	7 494134-001	Fuel Level Gauge (V16476 #06339-01)		1
	8 181358	Hobbs Hour Meter (V74400 #85101)		1
	9 286699-001	Battery Voltmeter (V16476 #06351-01)		1
	10 78A1117-002	Oil Pressure Gauge (V16476 #06395-01)		1
	11 283167	Analog Frequency Meter		1
	12 288858-004	Fault Code Mater		1
	13 W8105A-009	Analog AC Voltmeter		1
	14 288814-001	Analog AC Ammeter		1
	15 400642-008	Analog DC Voltmeter	E,F	1
	16 400641-015	Analog DC Ammeter	E,F	1
	17 288806	LED PC Board (shown opposite side)		1
	288820	...LED PC Board Gasket		1
	18 288995	Control Panel Door		1
	289017	...Control Panel Door Label		1
*	040213	...Gasket, Door, Neoprene		50 in.



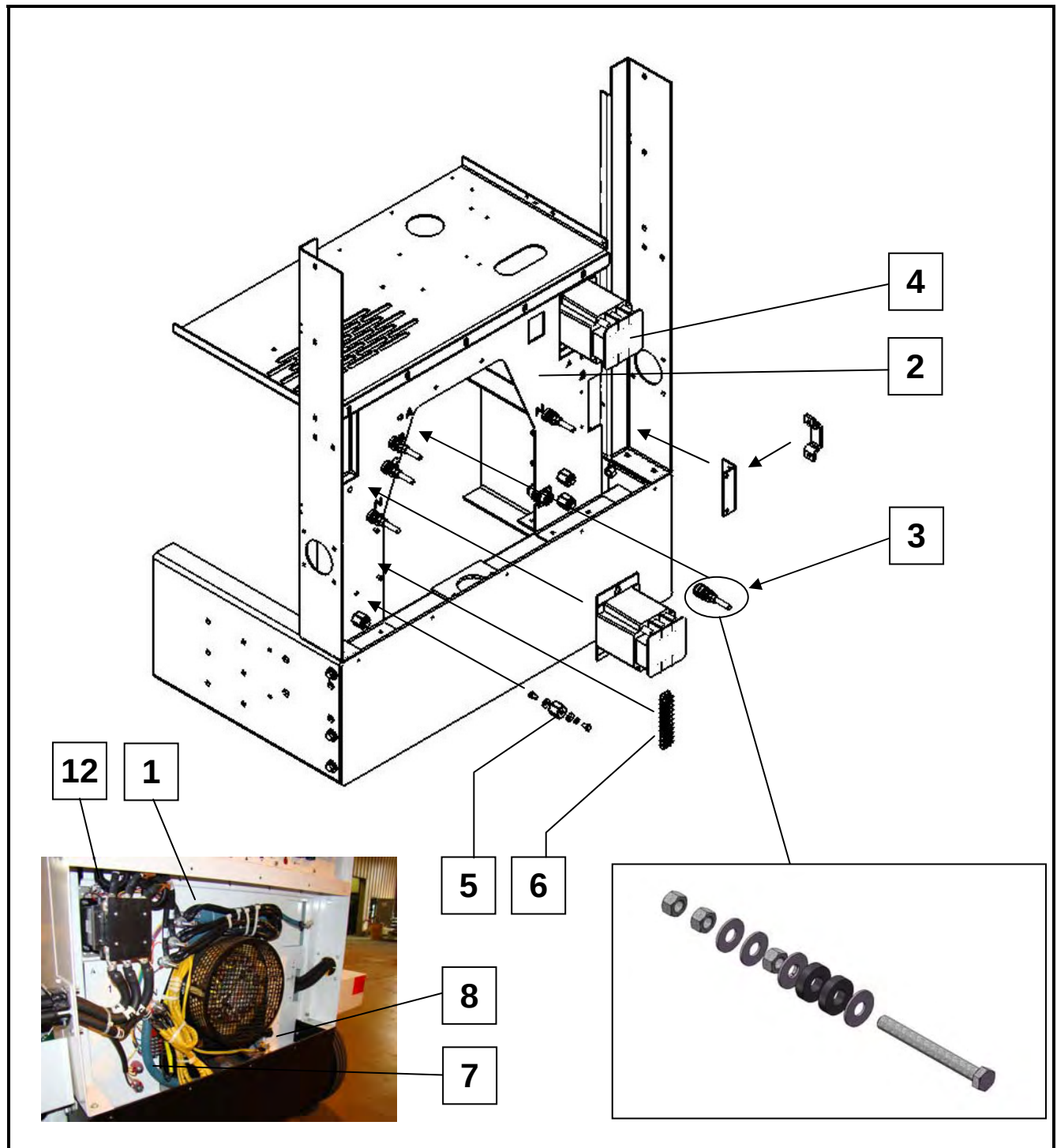
Control Box Interior Components
Figure 7

FIGURE ITEM NO.	FACTORY PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
7 -	1	288745		1
*		284316-004		4
	2	288937		1
*		284316-004		4
	3	288940B		1
*		284316-004		6
	4	289026		1
*		284316-004		6
	5	288914A	E,F	1
*		284316-004		4
	6	288818-001		1
*		288605		1
	7	289122		1
		289060		1
	8	283978-001		1
	9	283978-002		2
*	10	289073		1
*	11	289072	E,F	1
	12	291307		1
	13	291298		1
	14	286485-001		72 in.
	15	286388-001		4
	16	289104-001		4
		286477-002		4



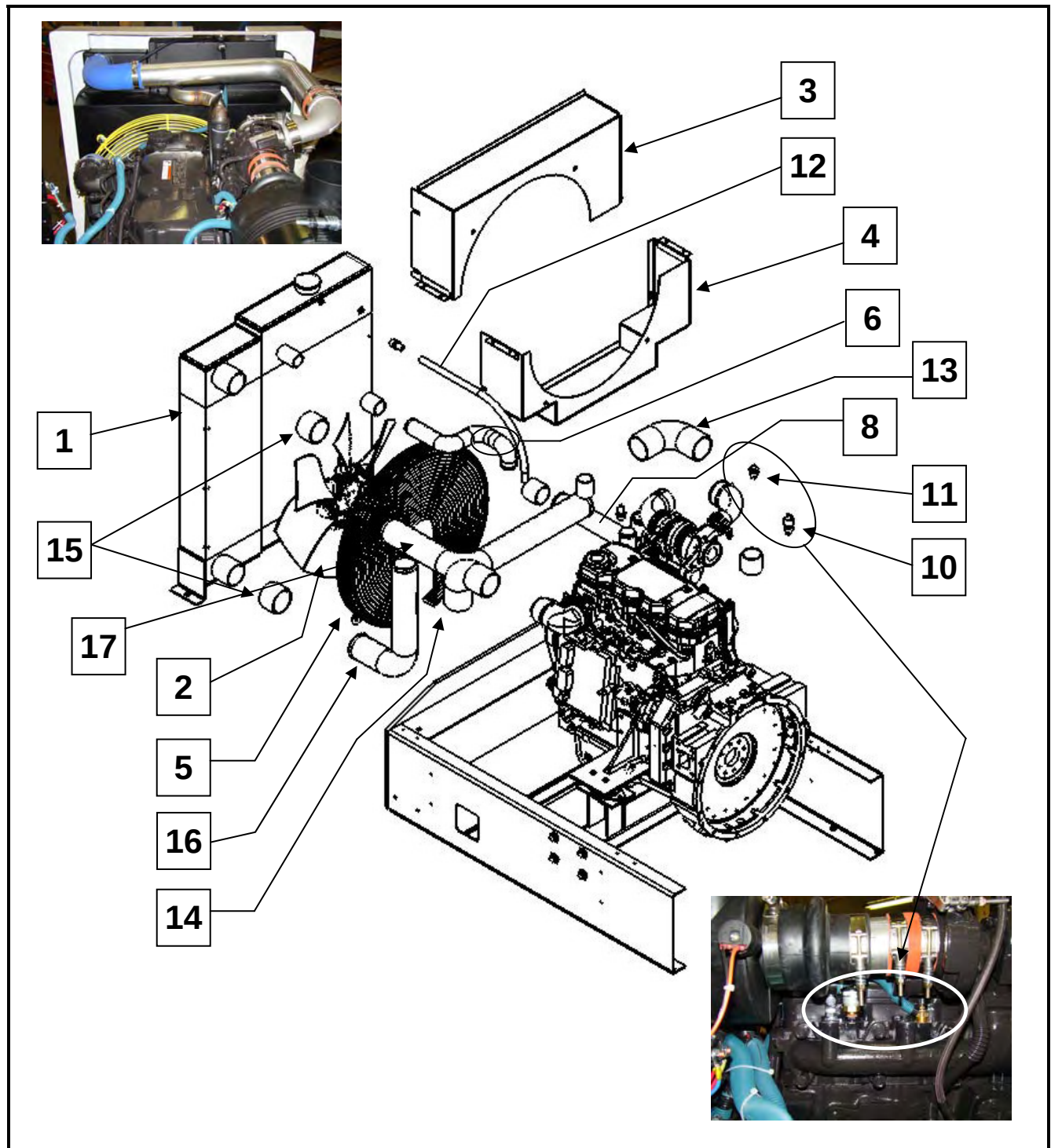
Control Switch Panel Components
Figure 8

FIGURE ITEM NO.	PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
8 -	1	289004 Switch Panel		1
		289014 ...Switch Panel Label		1
*		040201 ...Strip, Gasket, Neoprene		66 in.
*	2	289015 Switch Panel Wire Harness		1
		Common Pushbutton Parts		
	3	285029-001 Bezel Frame(V61706 #704-701.0)		1
	4	285031-001 Lens Holder(V61706 #704-709.7)		1
	5	285032-001 Sleeve Actuator (V61706 #704-731.0)		1
	6	285033 Mounting Flange(V61706 #704-950.5)		1
	7	284475-001 N.O. Contact Block (V61706 #704-900.3)		1
	8	400613-004 Type 1815 Bulb (V02929)		1
	9	285034-001 Lamp Holder (V61706 #704-950.0)		1
*	10	290080 Contact Block Cover		1
	11	Lamps Pushbutton		1
	12	Output # 1 Pushbutton		1
	13	285030-002 Yellow Lens (V61706 #704-702.4)		1
	14	Pre-heater Pushbutton		1
	15	Output # 2 Pushbutton	B,D	1
	16	285030-004 Orange Lens (V61706 #704-702.3)	B,D	1
	17	Engine Start Pushbutton		1
	18	Meter Select Pushbutton		1
	19	285030-003 Green Lens (V61706 #704-702.5)		1
	20	DC Output Pushbutton	E,F	1
	21	Current Pushbutton	E,F	1
	22	285030-005 Blue Lens (V61706 #704-702.6)	E,F	1
	23	Engine Stop Pushbutton		1
	24	Test/Reset Pushbutton		1
	25	285030-001 Red Lens (V61706 #704-702.2)		1



400 Hz. Power Module Assembly
Figure 9

FIGURE ITEM NO.	PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
9 -	1	291115		1
	2	291058		1
	3	Generator Lead Connection Assembly		
*		AW626		4
		AW626	B,D	5
		A25		8
		A25	B,D	10
		W11097-028		4
		W11097-028	B,D	5
		W11242-018		8
		W11242-018	B,D	10
		W11242-010		8
		W11242-010	B,D	10
		W11254-006		8
		W11254-006	B,D	10
4		W11278-005		12
		W11278-005	B,D	15
		282130-001		1
		282130-001	B,D	2
		286266		2
6		402119-002		4
		286266	B,D	4
		402119-002	B,D	8
		401911-010		1
		290683		1
8		289318	B,D	1
		282089-011		1
		288892-001		1
		288974		1
		285102-001		3
*		285102-001	B,D	6
13		Cable, Power, Ay.		Ref.
		...(No. 101) "A" Stator Terminal to "K1", # 1 Output		1
		...(No. 102) "B" Stator Terminal to "K1", # 1 Output		1
		...(No. 103) "C" Stator Terminal to "K1", # 1 Output		1
14		Cable, Power, Ay.		
		...(No. 104) "A" Stator Terminal to "K2", # 2 Output	B,D	1
		...(No. 105) "B" Stator Terminal to "K2", # 2 Output	B,D	1
		...(No. 106) "C" Stator Terminal to "K2", # 2 Output	B,D	1
		...(No. 110) "N" Stator Terminal to "N", Neutral	B,D	1



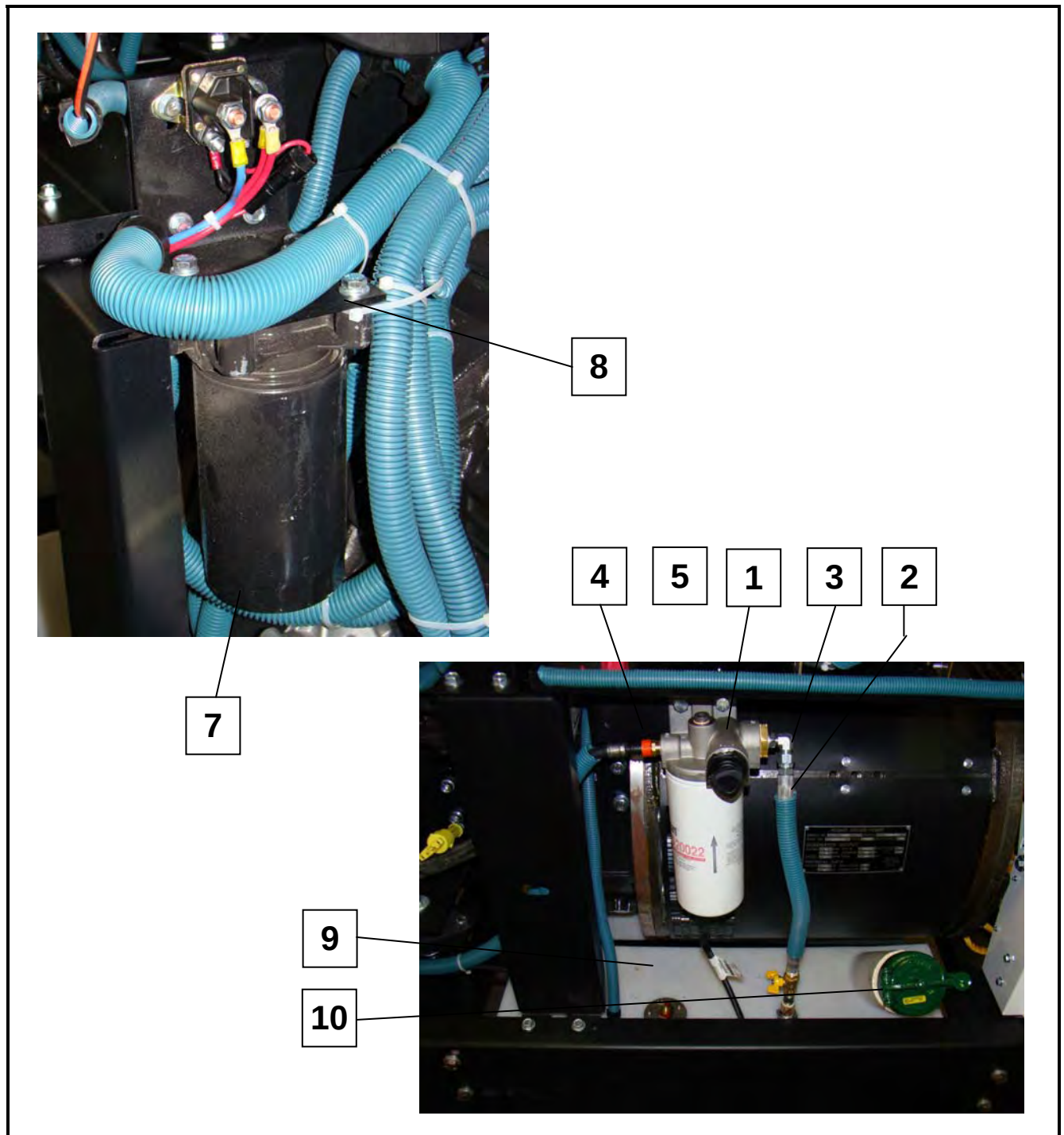
Engine Cooling System Assembly
Figure 10

FIGURE ITEM NO.	PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
10 -	1	291223	Radiator/CAC Assembly	1
*		290145	...Coolant Level Sensor	1
*		283873	...Radiator Drain Valve	1
	2	291224	Radiator Fan, 22" Diameter	1
	3	291070	Top Fan Shroud	1
		291097	...Access Panel	1
	4	291071	Bottom Fan Shroud	1
	5	291225	Fan Guard	1
	6	291072	Top Radiator Hose	1
	7	289200-001	...1.75" ID Hose (each piece is 3" long)	2
	8	291073	Bottom Radiator Hose	1
	9	289200-002	...2.25" ID Hose (each piece is 3" long)	2
	10	403782-002	Shutdown Switch, 210° F (V75418 #1002-04880-36)	1
	11	287909	Water Temperature Sender (V16476 #02019)	1
*		W7814-004	...Bushing, Reducer	1
	12		Deaeration Line	1
		288123-001	...Male Connector	1
	13	289828	90° Elbow, 3.00" ID	1
	14	289827	90° Elbow, 3.00" ID	1
	15	290936	3.00" ID Connection Hose	2
	16	291075	CAC Intake Manifold Hose	1
	17	291074	CAC Turbo Outlet Hose	1
*	18	290597-001	CAC Cooler Hose Clamps	8



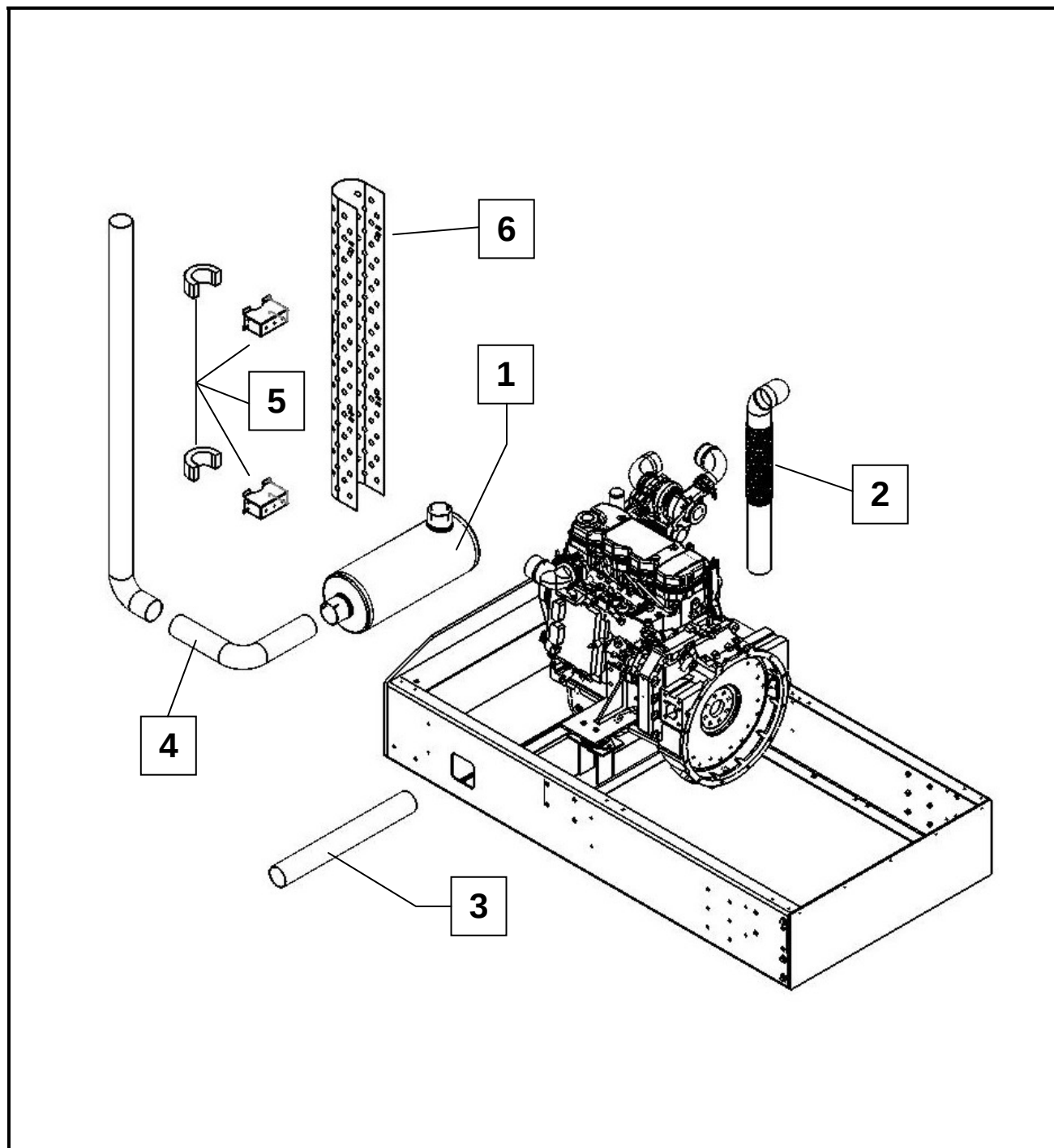
Engine Ground Plate and Battery Disconnect Switch
Figure 11

FIGURE ITEM NO.	PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
11 -	1	291079		1
		405548		2
	2	W9407-446		2
	3	W9360-381		1
	4	Engine Dongle and Battery Disconnect Panel		Ref.
		291334		1
		290831		1
		290847		1
		290832		1
		W9360-289		1
*	5	290678		1
		Wire Harness, Engine		



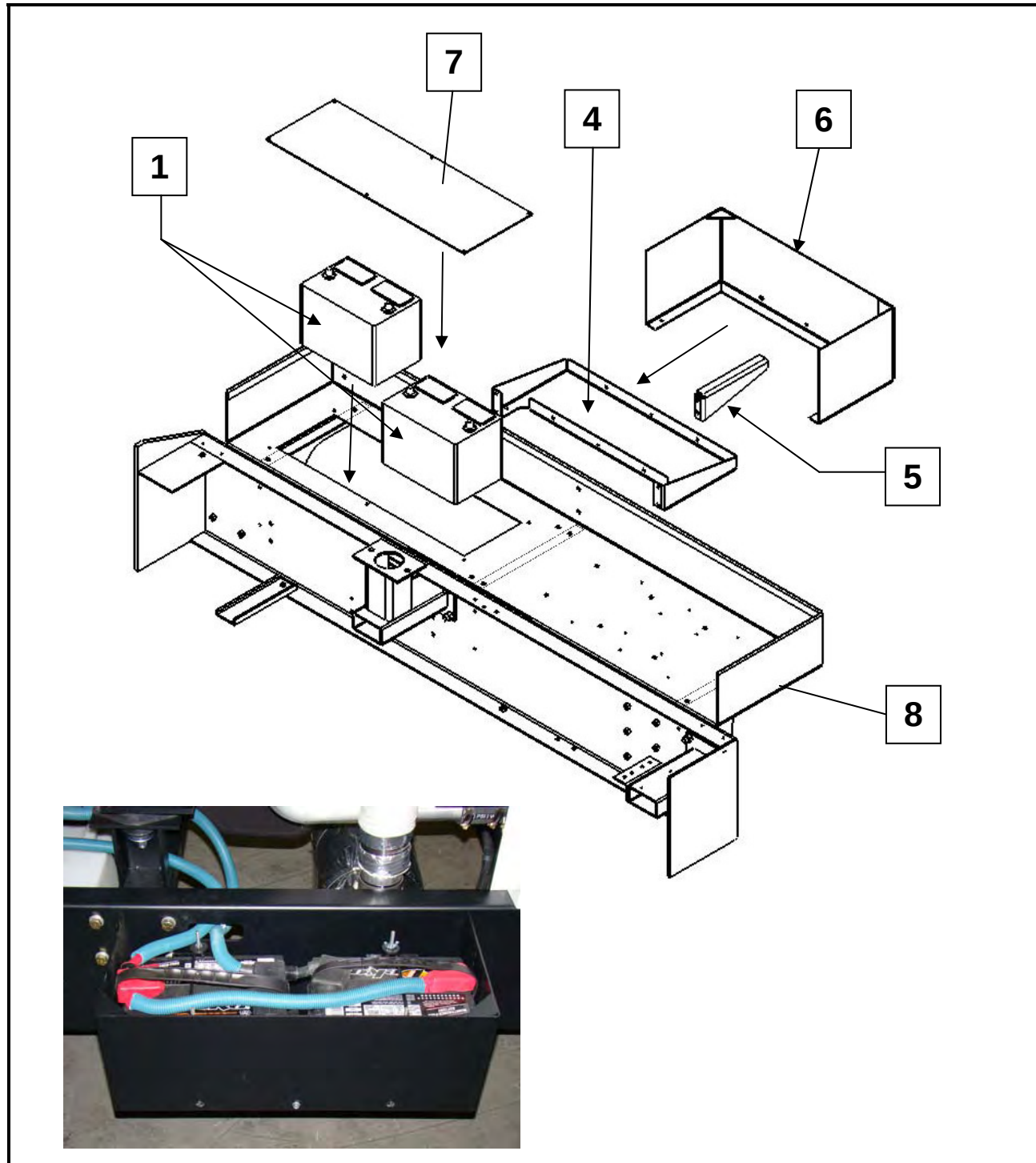
Engine Fuel Filters and Fuel Lines
Figure 12

FIGURE ITEM NO.	PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
12 -	1	286897-031		1
	2	291114		1
	3	290388		1
	4	Call Factory		1
	5	289037		1
*	6	290686		1
	7	286897-036		1
	8	291076		1
	9	291420		1
		486719-005		1
		291407		1
		291408		2
		291409		2
	10	282562		1
		Cap, Fuel Neck (V49234 #1275G/12T)		



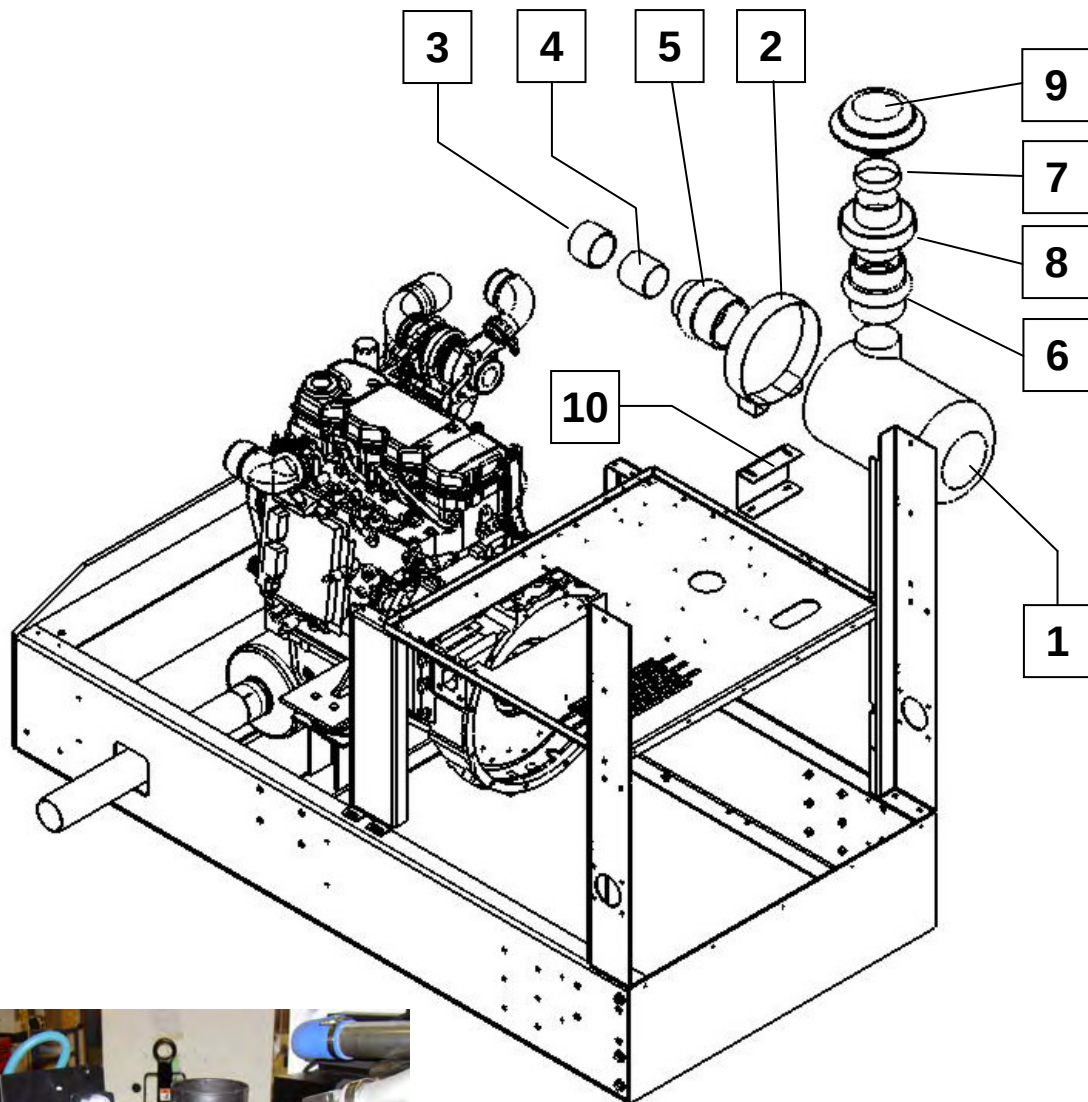
Engine Exhaust Components
Figure 13

FIGURE ITEM NO.	PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
13 -	1	291168 Muffler and Exhaust Ay.		1
		042471 ...Muffler Wrap Insulation		3.5 ft ²
		288052-002 ...Accuseal Clamp (3.0")		
	2	291077 Exhaust Flex Pipe Assembly		1
		042471 ...Muffler Wrap Insulation		1.7 ft ²
		404154-013 ...Full Circle Clamp, 3.0"		1
		W10869-006 ...Stainless Steel Hose Clamp		7
	3	291169 Exhaust Outlet Pipe	G,H,J,K,L,M	1
		042471 ...Muffler Wrap Insulation	G,H,J,K,L,M	1.5 ft ²
	4	291379 Exhaust Outlet Elbow		1
		288052-002 ...Accuseal Clamp (3.0")		1
		042471 ...Muffler Wrap Insulation		3.0 ft ²
		W10869-006 ...Stainless Steel Hose Clamp		2
	5	291383 Stainless Steel Exhaust Clamp		2
	6	291382 Stainless Steel Exhaust Clamp		1
*	7	291394 Exhaust Hole Cover		1



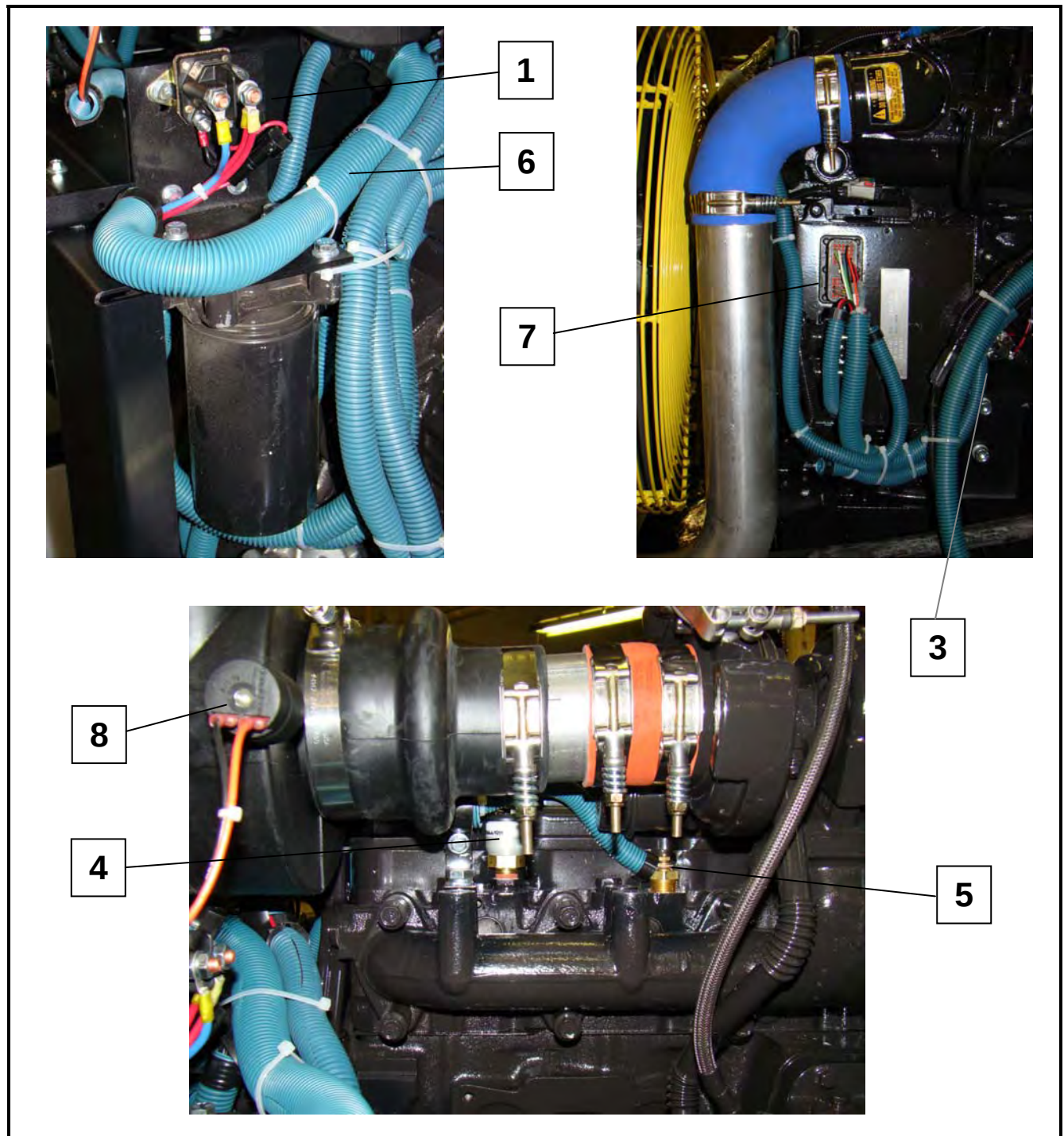
12 VDC Battery System
Figure 14

FIGURE ITEM NO.	PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
14 -	1	281881-001 Battery, 12 V (V25710 #1231-PMF)		2
		287796 ...Hold Down, Battery (V3Y208)		4
		494295 ...Bolt, Hold Down, Battery (V3Y208)		2
*	2	290902 Cable, Battery, Negative (V3Y208)		1
*	3	287740 Cable, Battery, Positive (V3Y208)		1
	4	287795 Battery Tray		1
	5	291160 Battery Tray Support Bracket		1
	6	291067 Battery Tray Housing		1
	7	291093 Battery Cover		1
	8	291092 Cable Tray	A,B,E	1



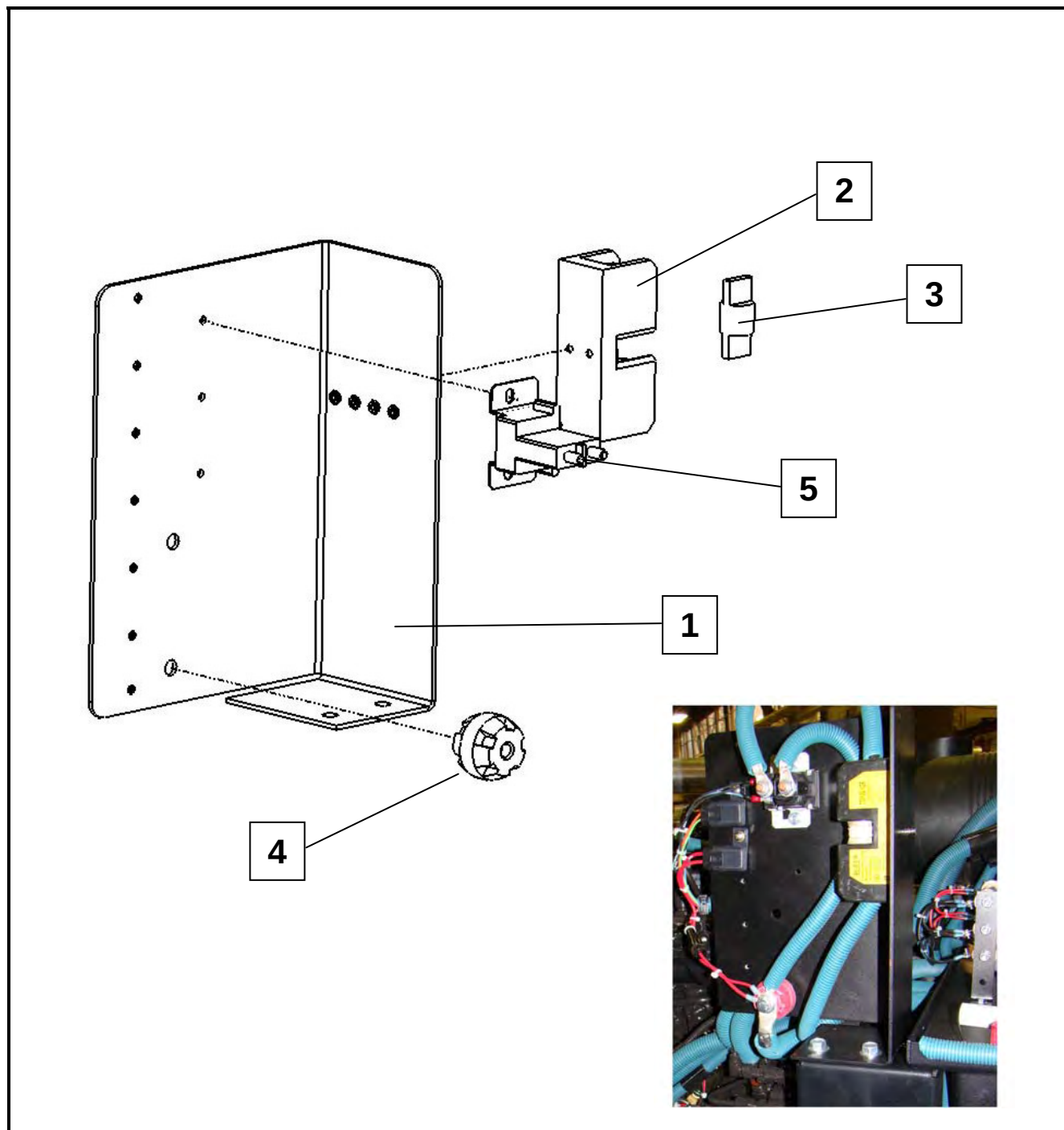
Engine Air Intake Assembly
Figure 15

FIGURE ITEM NO.	PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
15 -	1	290938 Air Cleaner (V1DL99 # AH19261)		1
		282918 ...Air Restriction Indicator (V18265 #REX77-0062)		1
		282919 ...Indicator Adapter Fitting		1
	2	290940 Mount, Band, Air Cleaner (V1DL99 # 3918197S)		2
	3	290936 3 in. I.D. Straight Hose		1
	4	290950 Air Cleaner Tube		1
	5	288197-001 3 in to 4 in. Hump Hose Fitting (V1DL99 # 3316617S)		1
	6	290953 4 in. Hump Hose Fitting		1
	7	290952 Hump Hose Sleeve		1
	8	290951 Intake Air Extension		1
	9	290939 Weather Hood (V1DL99 # 3946458S)		1
	10	291078 Air Filter Mounting Bracket		1
*	11	290597-001 3 in Floating Bridge Clamp (V54646 # 94143-0325)		2
*	12	290597-006 4.5 in Floating Bridge Clamp (V54646 # 94143-0450)		1
*	13	290597-007 3.5 in Floating Bridge Clamp (V54646 # 94143-0350)		1



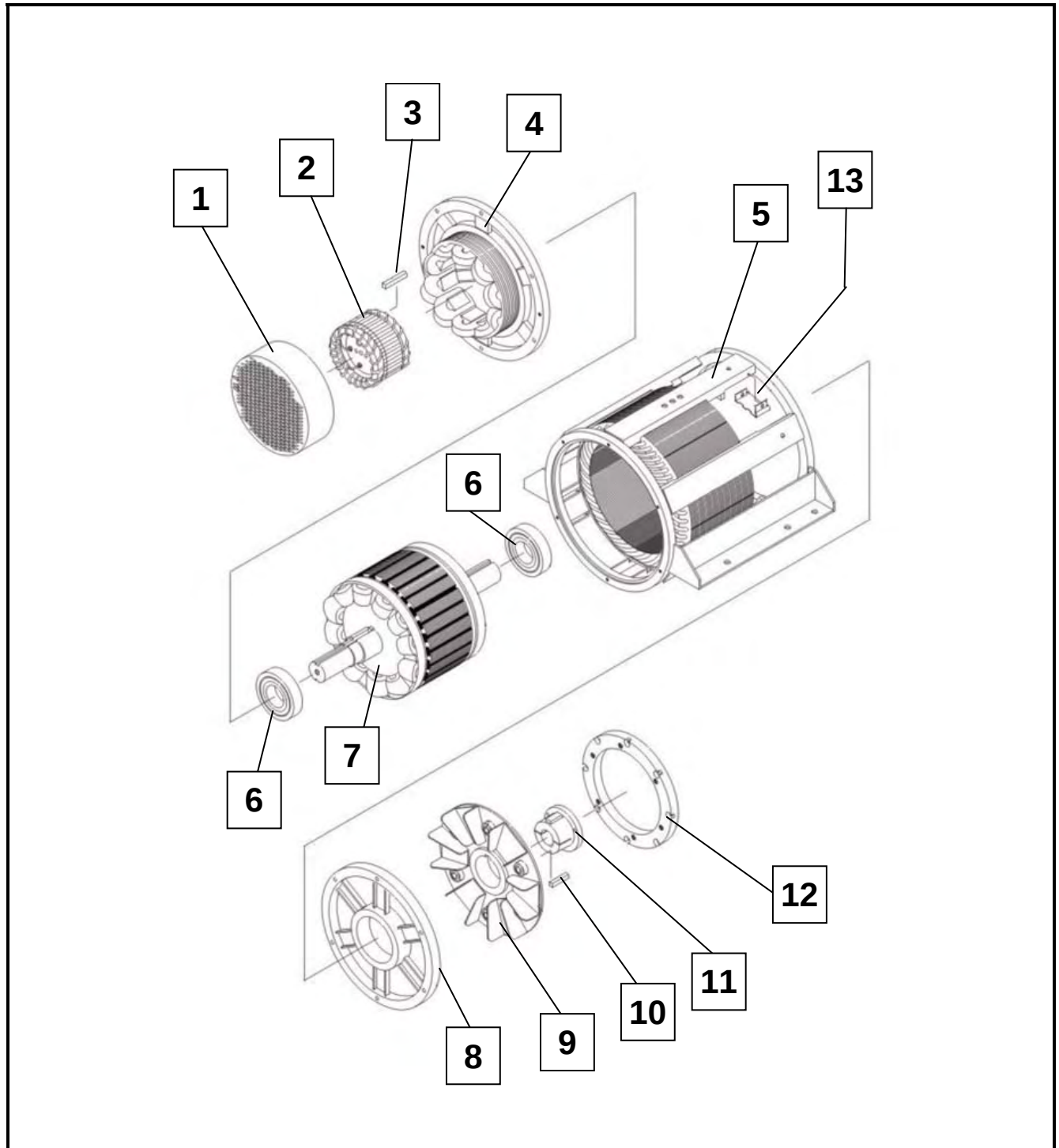
Engine Components
Figure 16

FIGURE ITEM NO.	PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
16 -	1	286850 Starter Solenoid (V13445 # 24059)		1
		288973-001 ...Diode, Flyback		1
*	2	403809-002 Switch, Oil Pressure (V75419 #1042-08210-20)		1
	3	78B1118-002 Sender, Oil Pressure (V16476 #16476)		1
*		W7814-000 ...Bushing, Pipe, Steel, 1/4 X 1/8		1
*		286903 ...Adapter, M14-1.5 x 1/4 NPT		1
*		W10910-000 ...Fitting, Tee		1
*		W10750-001 ...Nipple, Pipe, 1/8"		1
	4	403782-002 Switch, Shutdown, 210° F (V75418 #1002-04880-36)		1
	5	287909 Sender, Water Temperature (V16476 #02019)		1
	6	290678 Engine Wire Harness		1
	7	290944 Electronic Engine Wire Harness		1
	8	282918 Air Restriction Indicator (V18265 #REX77-0062)		1



Engine Electronic Panel Components
Figure 17

FIGURE ITEM NO.	PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
17 -	1	291248		1
	2	287145-001		1
	3	287144-002		1
	4	283154-001		1
	5	288331		1
	6	290944		1
		Panel, "E" Engine, Parts		
		Holder, Fuse		
		Fuse, Fast Acting		
		Insulator, Standoff		
		Relay, Grid Heater, Power (V02929 50F3662)		
		Harness, Wire, Engine, Electronic		



Generator Assembly
Figure 18

FIGURE ITEM NO.	PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
18 -	1	288486		1
	2	288494		1
	3	180696-003		1
	4	288440		1
	5	291082		1
	6	W10072-068		2
	7	288447-003		1
	8	288461		1
	9	288481		1
		480290		8
	10	85B1039		1
	11	85C1004-001		1
	12	290870		1
	13	288458		6
*	14	291103		1

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Section 4 Numerical Index

1) Explanation of Numerical Index

The purpose of this index is to assist the user in finding the illustration and description of a part when the part number is known. Part numbers are arranged in alphanumerical sequence. Thus, any part number beginning with the letter "A" would be located at or near the top of the index list. Likewise, a part number "9" would be listed near the end of the list and far below a part number "1000". The figure number and item number location of the part is directly opposite the part. If the part is used in more than one place, each location is listed commencing with the first location the part is listed.

FIGURE ITEM NO.	HOBART PART NO.	FIGURE ITEM NO.	HOBART PART NO.
9-	A25	7-9	283978-002
9-	AW626	7-	284316-004
18-6	W10072-068	5-	284372-001
16-	W10750-001	8-7	284475-001
13-	W10869-006	8-3	285029-001
16-	W10910-000	8-25	285030-001
9-	W11097-028	8-13	285030-002
9-	W11242-010	8-19	285030-003
9-	W11242-018	8-16	285030-004
9-	W11254-006	8-22	285030-005
9-	W11278-005	8-4	285031-001
16-	W7814-000	8-5	285032-001
10-	W7814-004	8-6	285033
6-13	W8105A-009	8-9	285034-001
11-	W9360-289	9-12	285102-001
11-3	W9360-381	1-	285125
11-2	W9407-446	9-5	286266
8-	040201	7-15	286388-001
6-	040213	7-	286477-002
13-	042471	4-13	286485-001
4-	050984	7-14	286485-001
18-3	180696-003	6-9	286699-001
6-8	181358	16-1	286850
14-1	281881-001	12-1	286897-031
9-9	282089-011	12-7	286897-036
9-4	282130-001	16-	286903
2-13	282562	17-3	287144-002
12-10	282562	17-2	287145-001
1-11	282658	1-9	287459
15-	282918	1-10	287460
16-8	282918	1-14	287461
15-	282919	1-15	287462
17-4	283154-001	1-13	287463
6-11	283167	1-16	287464
4-10	283597	1-18	287465
1-21	283714-002	4-	287526-002
4-9	283824	4-	287542-001
10-	283873	1-19	287571
7-8	283978-001	1-20	287696

FIGURE ITEM NO.	HOBART PART NO.	FIGURE ITEM NO.	HOBART PART NO.
14-3	287740	6-18	288995
4-	287785	6-4	288999-001
14-4	287795	8-1	289004
14-	287796	8-	289014
6-6	287908	8-2	289015
10-11	287909	6-	289017
16-5	287909	7-4	289026
2-5	287957	12-5	289037
3-5	287986	7-	289060
2-3	287998	7-11	289072
3-	287998	7-10	289073
6-2	288020	7-16	289104-001
13-	288052-002	7-7	289122
5-	288109-001	5-	289127
1-34	288120	10-7	289200-001
10-	288123-001	10-9	289200-002
1-22	288164-001	9-8	289318
15-5	288197-001	10-14	289827
1-	288300	10-13	289828
17-5	288331	2-11	289895
18-4	288440	8-10	290080
18-7	288447-003	10-	290145
18-13	288458	1-36	290216
5-4	288460-003	2-	290267
18-8	288461	12-3	290388
18-9	288481	10-18	290597-001
18-1	288486	15-11	290597-001
18-2	288494	15-12	290597-006
7-	288605	15-13	290597-007
7-1	288745	5-	290678
6-17	288806	11-5	290678
6-14	288814-001	16-6	290678
7-6	288818-001	9-7	290683
6-	288820	12-6	290686
6-3	288836-001	2-10	290701
6-	288836-002	2-12	290702
6-12	288858-004	5-	290831
1-17	288862	11-	290831
1-12	288866	5-	290832
9-10	288892-001	11-	290832
5-11	288895	5-	290847
7-5	288914A	11-	290847
1-7	288917-002	5-	290869
7-2	288937	5-	290870
7-3	288940B	18-12	290870
1-	288961-002	14-2	290902
16-	288973-001	5-	290903
9-11	288974	10-15	290936
1-30	288987-002	15-3	290936
1-	288988	15-1	290938
1-	288989-001	15-9	290939

FIGURE ITEM NO.	HOBART PART NO.	FIGURE ITEM NO.	HOBART PART NO.
15-2	290940	10-1	291223
5-	290944	10-2	291224
16-7	290944	10-5	291225
17-6	290944	4-4	291237-001
15-4	290950	4-2	291237-002
15-8	290951	4-8	291237-003
15-7	290952	4-7	291237-004
15-6	290953	4-19	291237-005
2-4	291047	4-18	291237-006
2-1	291053	17-1	291248
5-	291054	1-29	291253-001
5-	291055	1-	291253-002
3-4	291056	4-6	291297
4-14	291057	7-13	291298
9-2	291058	4-15	291302
3-3	291066	6-5	291307
5-13	291066	7-12	291307
14-6	291067	5-	291334
3-1	291069	11-	291334
10-3	291070	4-	291335
10-4	291071	1-31	291351
10-6	291072	13-4	291379
10-8	291073	13-6	291382
10-17	291074	13-5	291383
10-16	291075	4-	291386
12-8	291076	1-	291393
13-2	291077	13-7	291394
15-10	291078	12-	291407
11-1	291079	12-	291408
4-1	291080	12-	291409
4-3	291081	12-9	291420
18-5	291082	8-8	400613-004
4-5	291084	6-16	400641-015
4-17	291085	6-15	400642-008
4-16	291087	9-6	401911-010
2-6	291088	1-27	402025-003
2-7	291089	1-26	402034-002
2-8	291092	9-	402119-002
14-8	291092	1-6	402987
2-9	291093	10-10	403782-002
14-7	291093	16-4	403782-002
10-	291097	16-2	403809-002
18-14	291103	13-	404154-013
5-6	291111	11-	405548
12-2	291114	1-4	408665-001
9-1	291115	1-5	408665-002
3-2	291152	18-	480290
5-12	291152	2-	486719-005
14-5	291160	12-	486719-005
13-1	291168	6-7	494134-001
13-3	291169	14-	494295

FIGURE ITEM NO.	HOBART PART NO.	FIGURE ITEM NO.	HOBART PART NO.
1-8	76B1148		
1-	77A1157		
6-10	78A1117-002		
16-3	78B1118-002		
1-35	7J422-000		
18-10	85B1039		
18-11	85C1004-001		

Chapter 5 Manufacturer's Literature

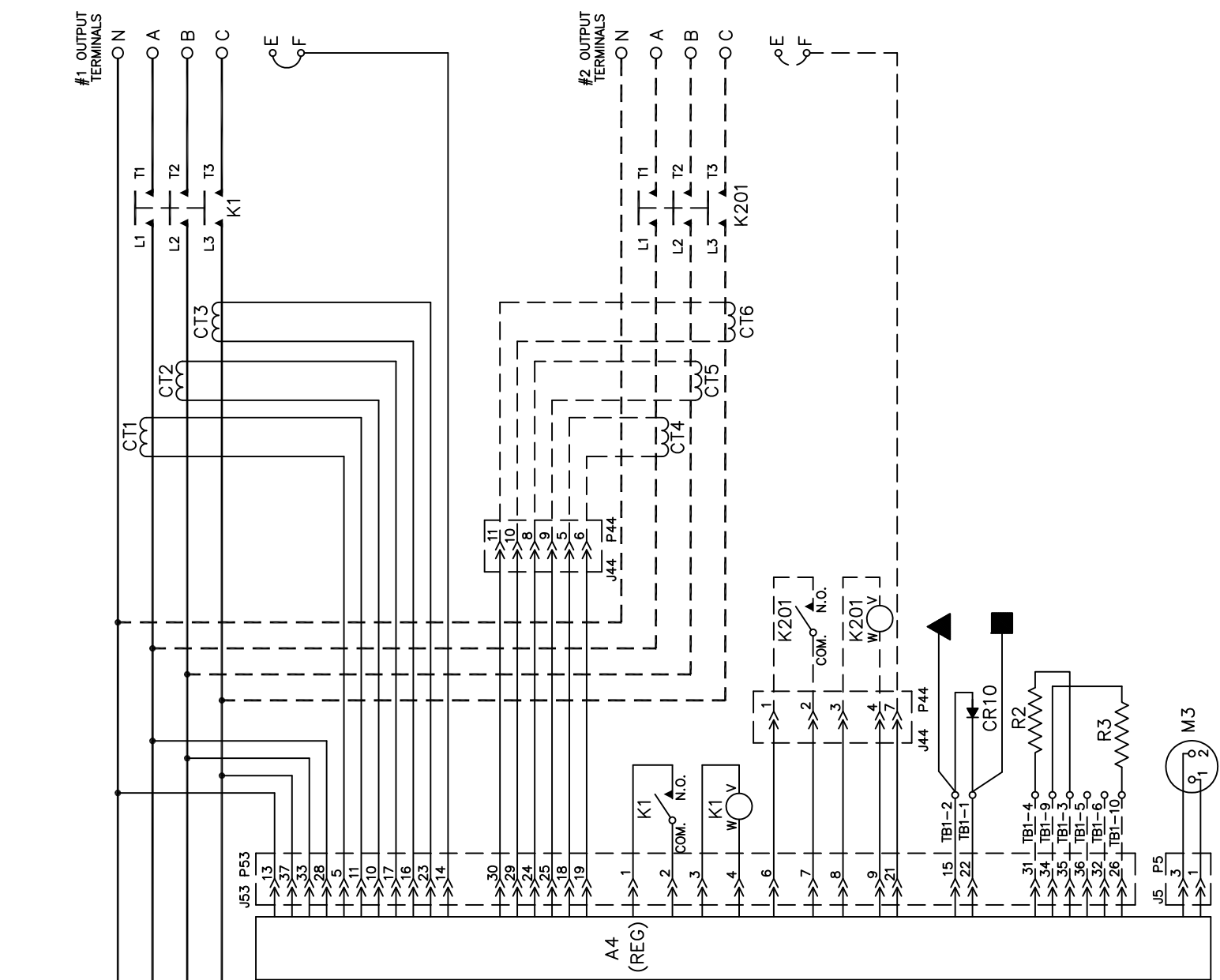
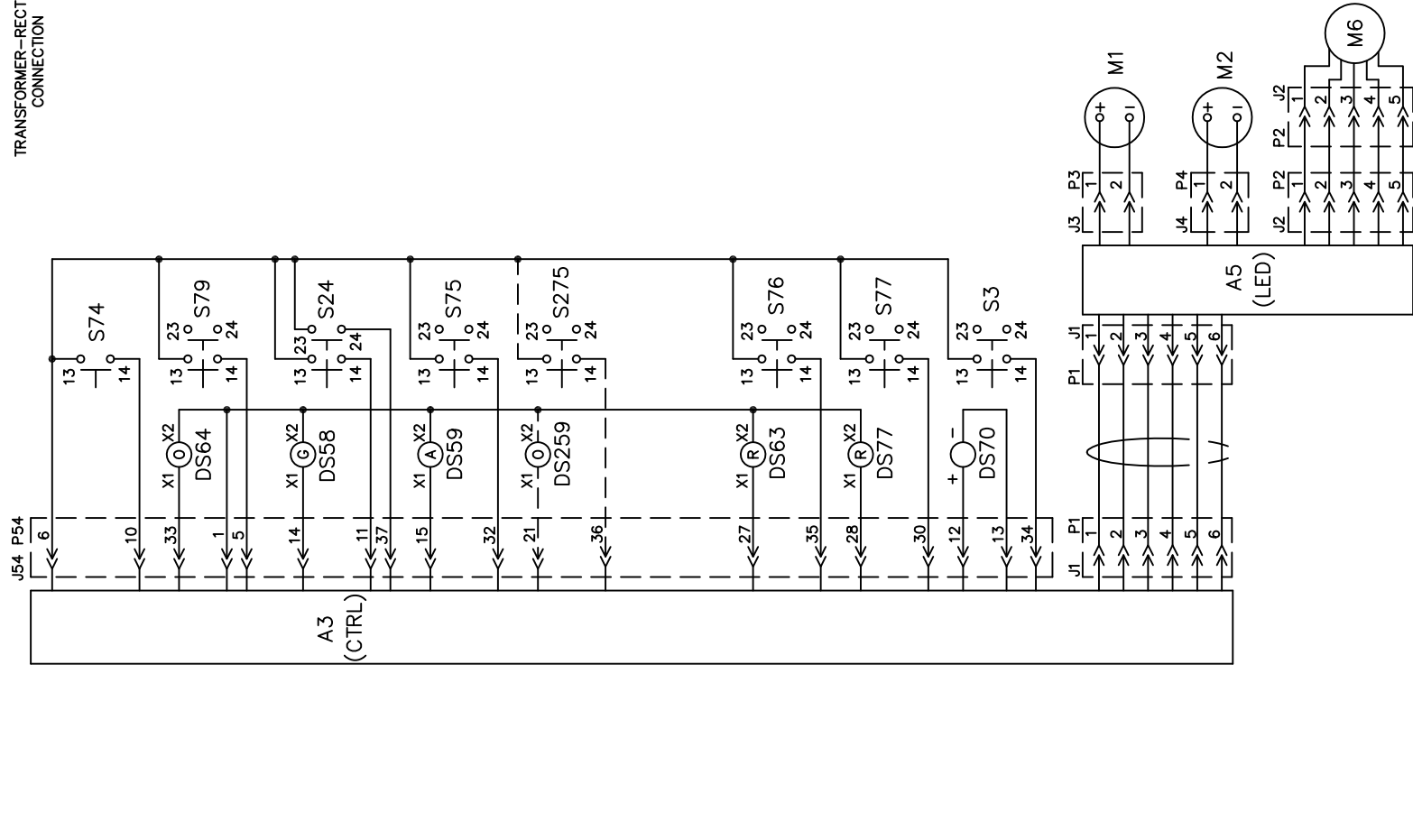
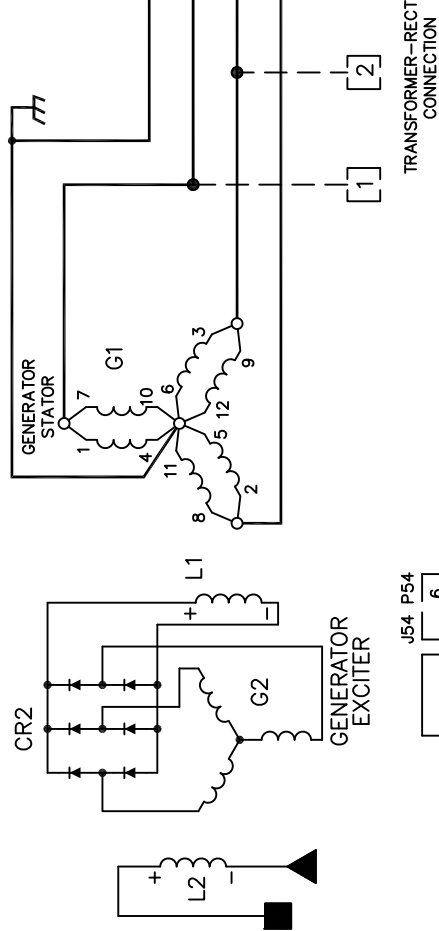
Vendor Literature

Type	Diagram Description
Engine	Operation and Maintenance Manual (Cummins Bulletin # 4021531) Parts Catalog (Not Included. Purchased separately from Cummins.) Cummins Bulletin # 4056538

Diagram Number	Diagram Description
291331, Rev. 0	Diagram, Schematic & Connection (Analog Generator Gauges)
289022, Rev. 2	Diagram, Connection, Control Box
289102, Rev. 3	Diagram, Connection, Power Module
289013, Rev. 3	Diagram, Connection, Switch Box
See Appendix A	Diagram, Connection, Transformer-Rectifier

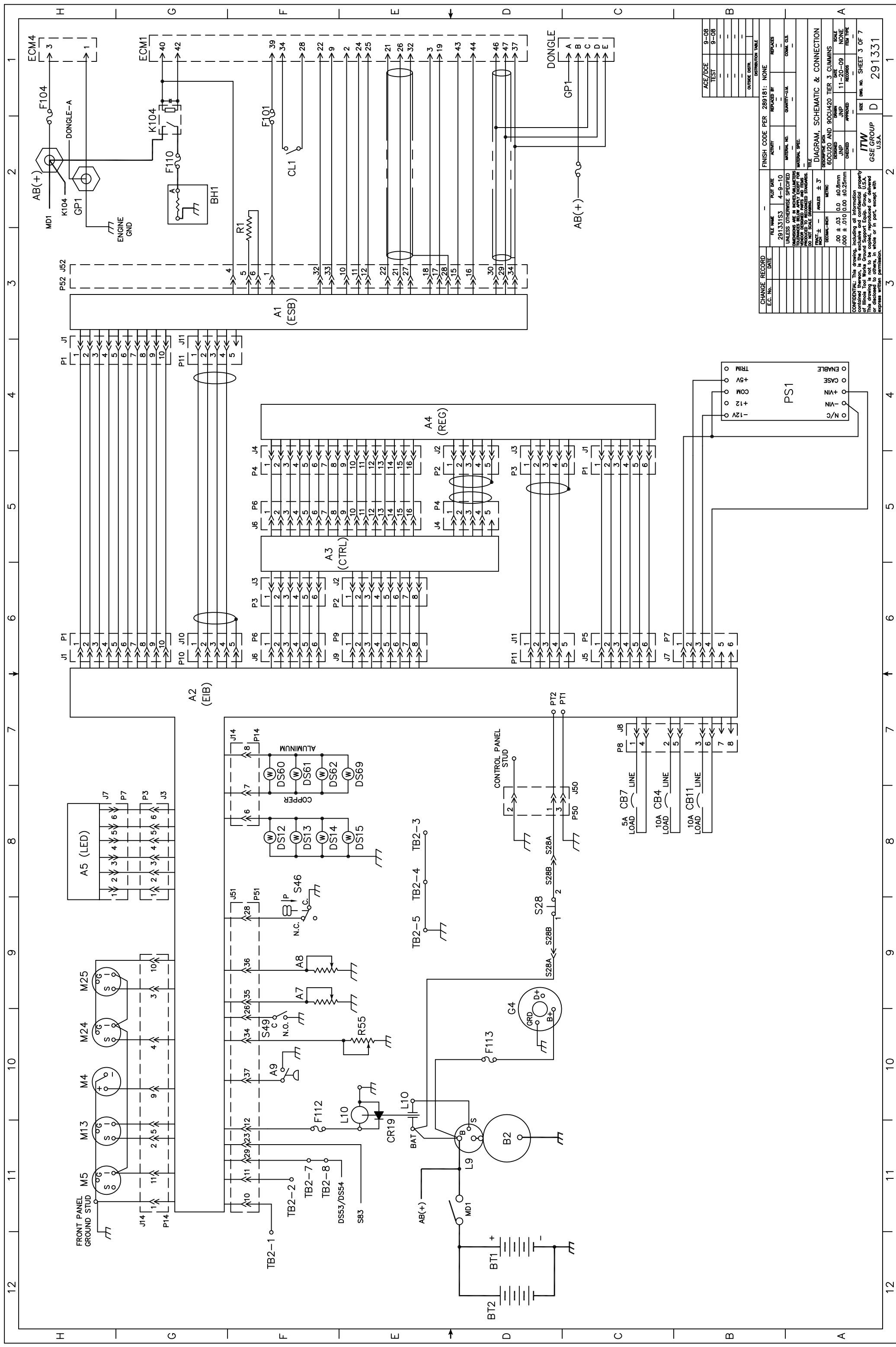
Contact Hobart Ground Power if either copy of these drawings or manuals are not with this manual (unless otherwise noted above). Refer to Appendix A for specific information on 90CU420, 400 Hz. Generator Set, optional equipment.

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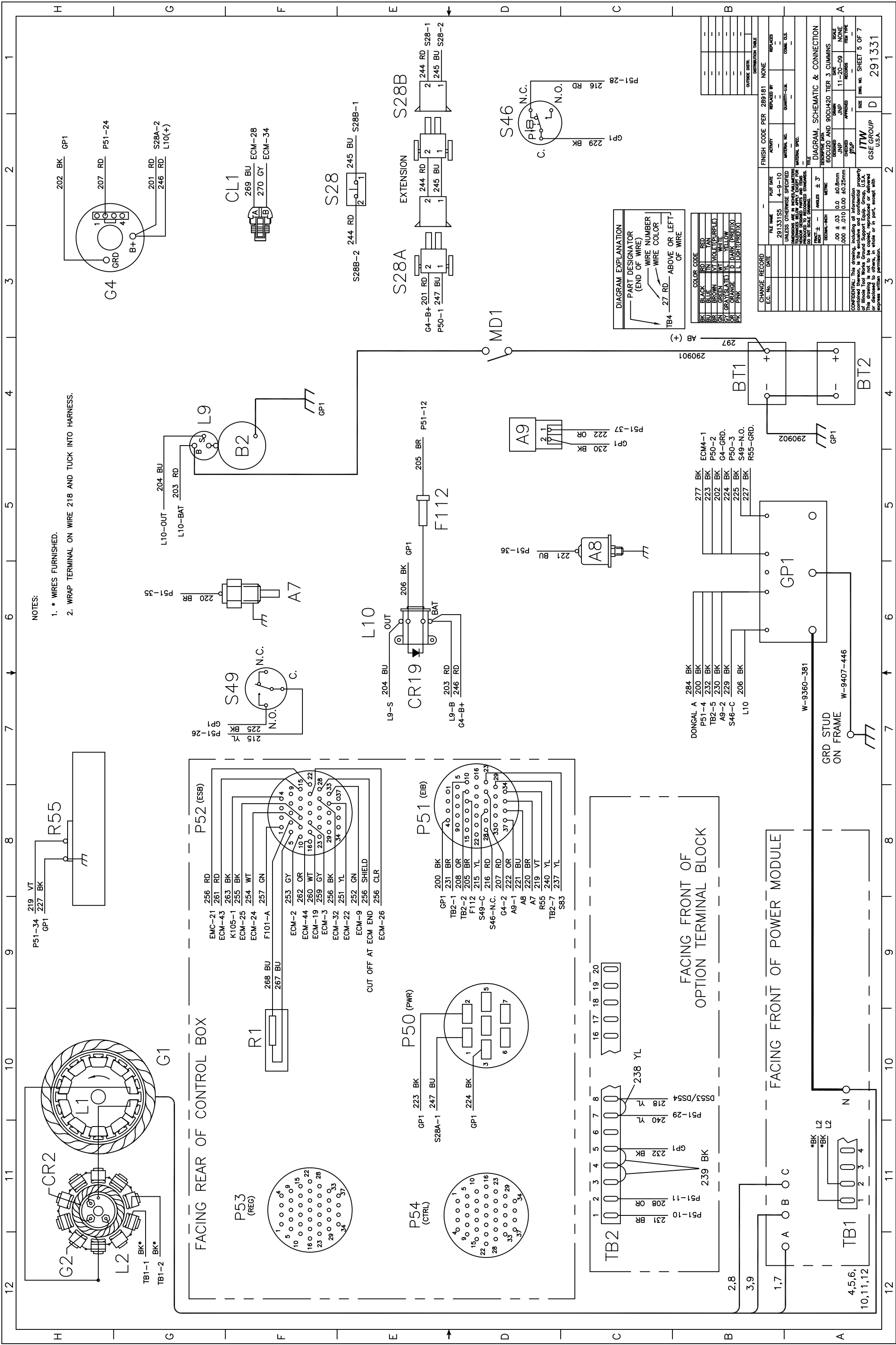
USE THIS SHEET WHEN AC METERS
M1, M2, & M3 ARE ANALOG.

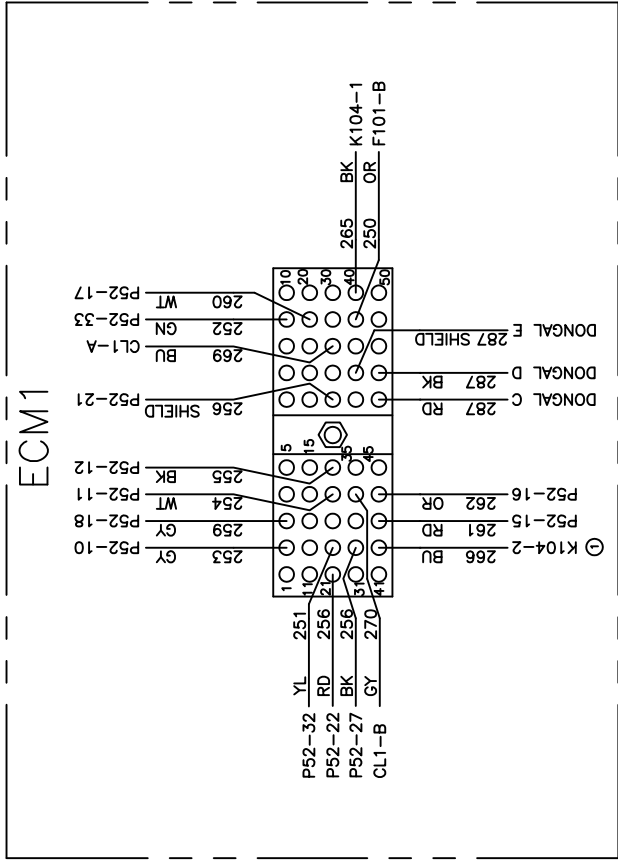
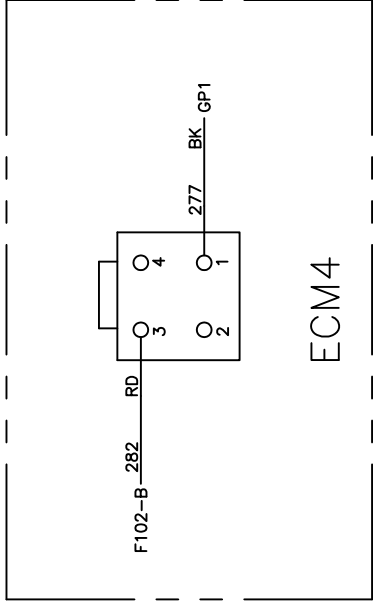
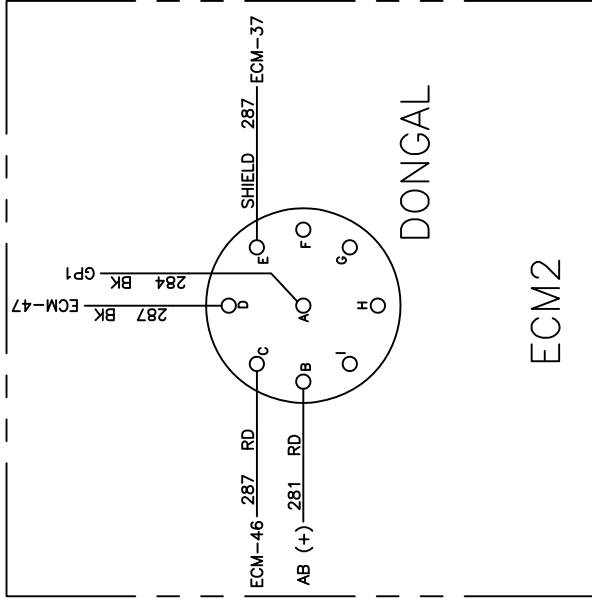
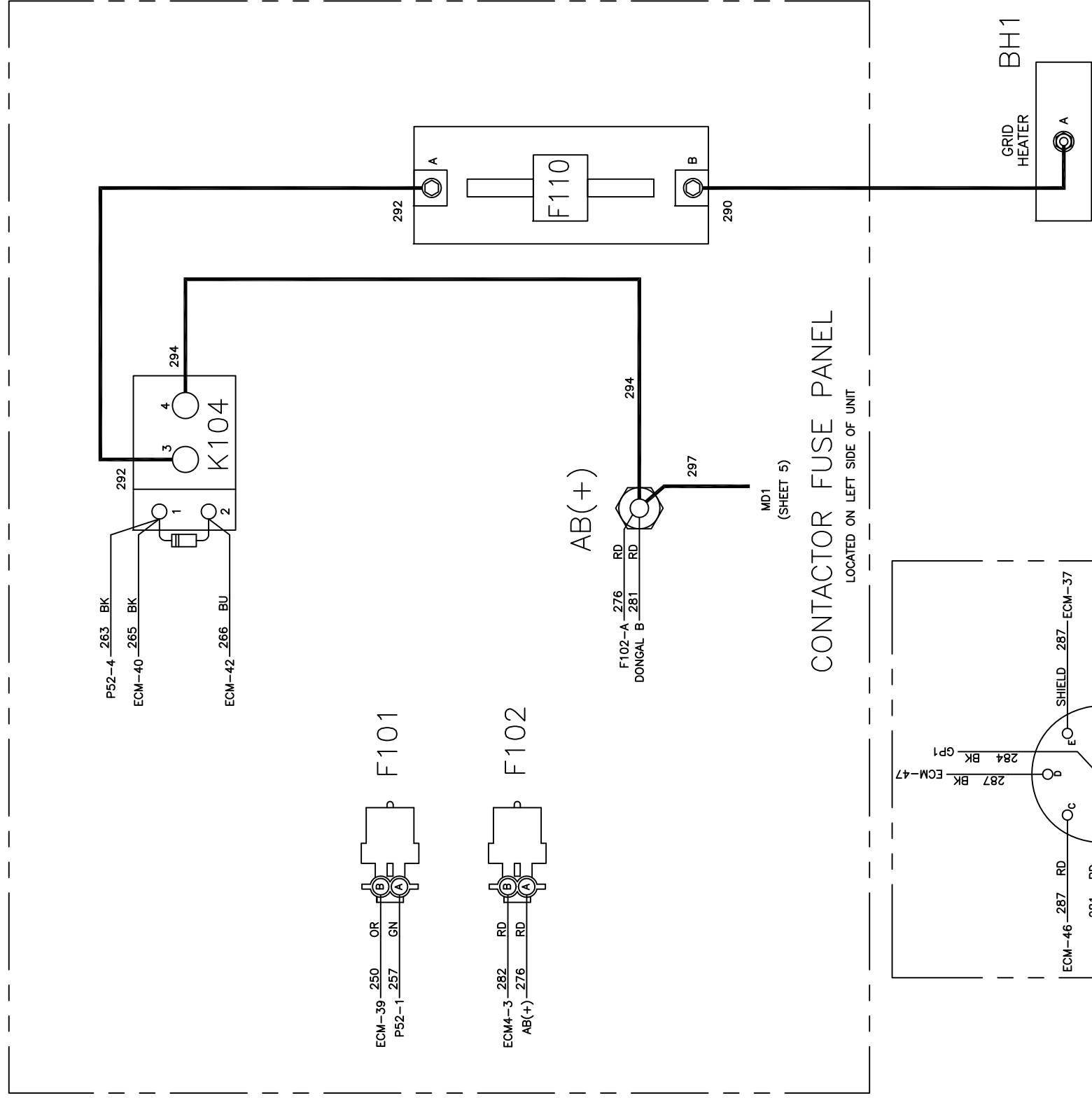
[illegible]



LEGEND

[illegible]





ELECTRONIC CONTROL MODULE (MAIN)

LOCATED ON LEFT SIDE OF ENGINE

ELECTRONIC CONTROL MODULE (POWER)

LOCATED ON LEFT SIDE OF ENGINE

COLOR CODE			
BK	BLACK	RD	RED
BU	BLUE	TN	TAN
BR	BROWN	VT	VIOLET
GN	GREEN	WT	WHITE
GY	GRAY(SLATE)	YL	YELLOW
OR	ORANGE	D	DARK (PREFIX)
PK	PINK	L	LIGHT(PREFIX)

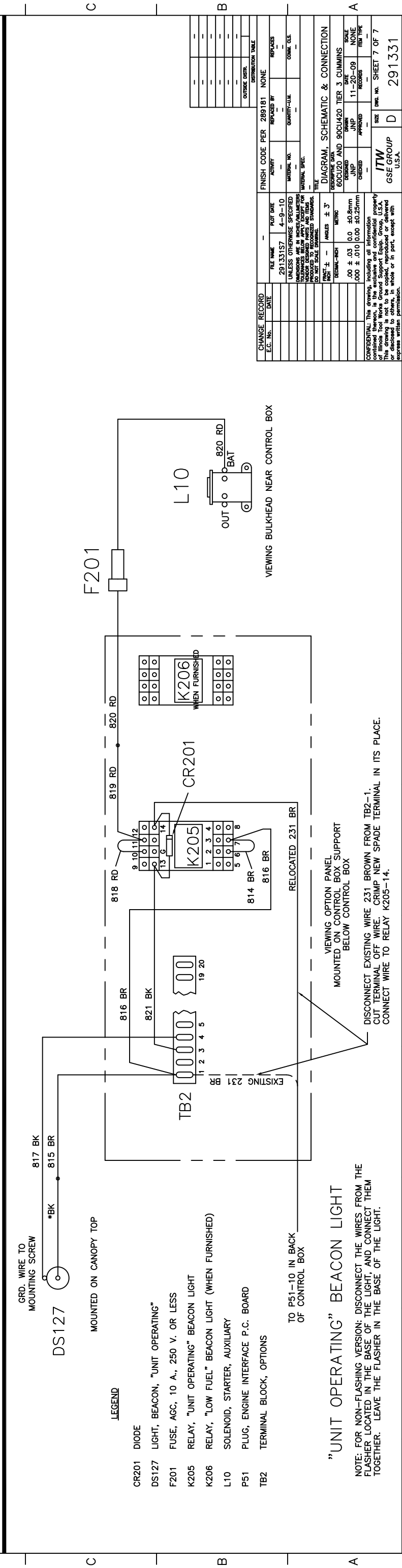
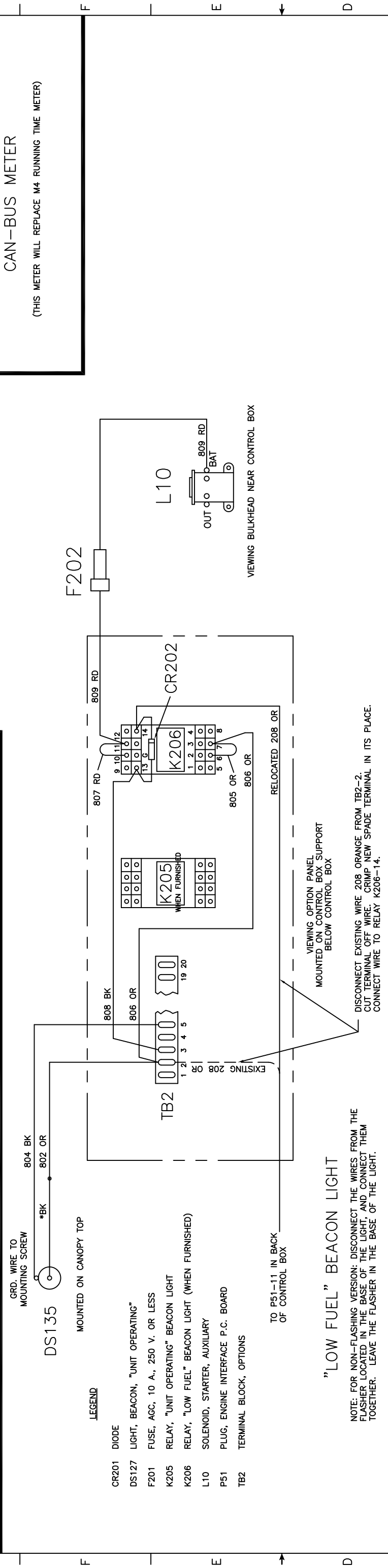
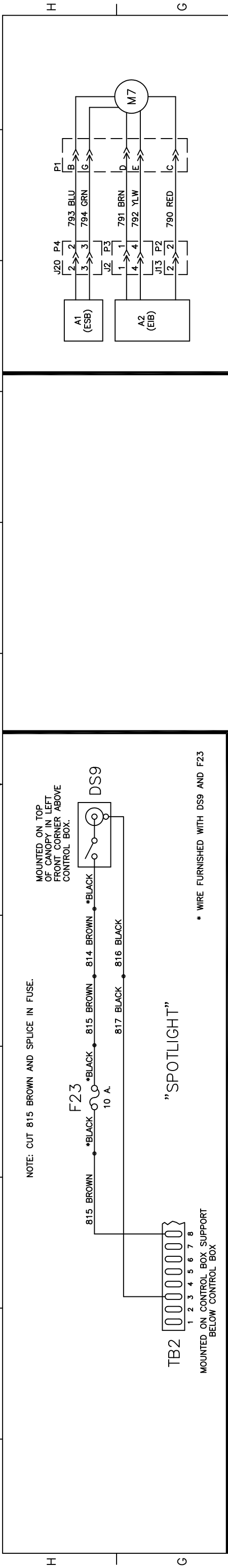
DIAGRAM	EXPLANATION
	— PART DESIGNATOR (END OF WIRE) — WIRE NUMBER — WIRE COLOR — 27 RD — ABOVE OR LEFT OF WIRE

CHANGE RECORD		FILE NAME		PLAT DATE		FINISH CODE PER 29181 NONE				DISTRIBUTION TABLE	
E.C. No.	DATE	291331S6		4-9-10		ACTIVITY		REPLACED BY		REPLACES	
		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES/MILLIMETERS DIMENSIONS BETWEEN PARENT PARTS FOR MEMBERS DESIGNED PRINTS AND ITEMS DO NOT HAVE DIMENSIONED STANDARDS. DO NOT SCALE DIMENSIONS				MATERIAL NO.		QUANTITY-CUM.		COMM. CLS.	
		FRAC ± — ANGLES ± 3"		TOLERANCES		DIAGRAM, SCHEMATIC & CONNECTION TITLE					
		DECIMAL—H3		METRIC		DEScriptive DATA					
		.00 ± .03		0.0 40.8mm		DRAWN		DATE		SCALE	
		.000 ± .010		0.0 40.25mm		JNP		11-20-09		NONE	
						APPROVED		RECORDS		ITEM TYPE	
						JNP					
						SIZE		DWG. NO.		SHEET 6 OF 7	
						ITW		D		291331	
						GSE GROUP				U.S.A.	

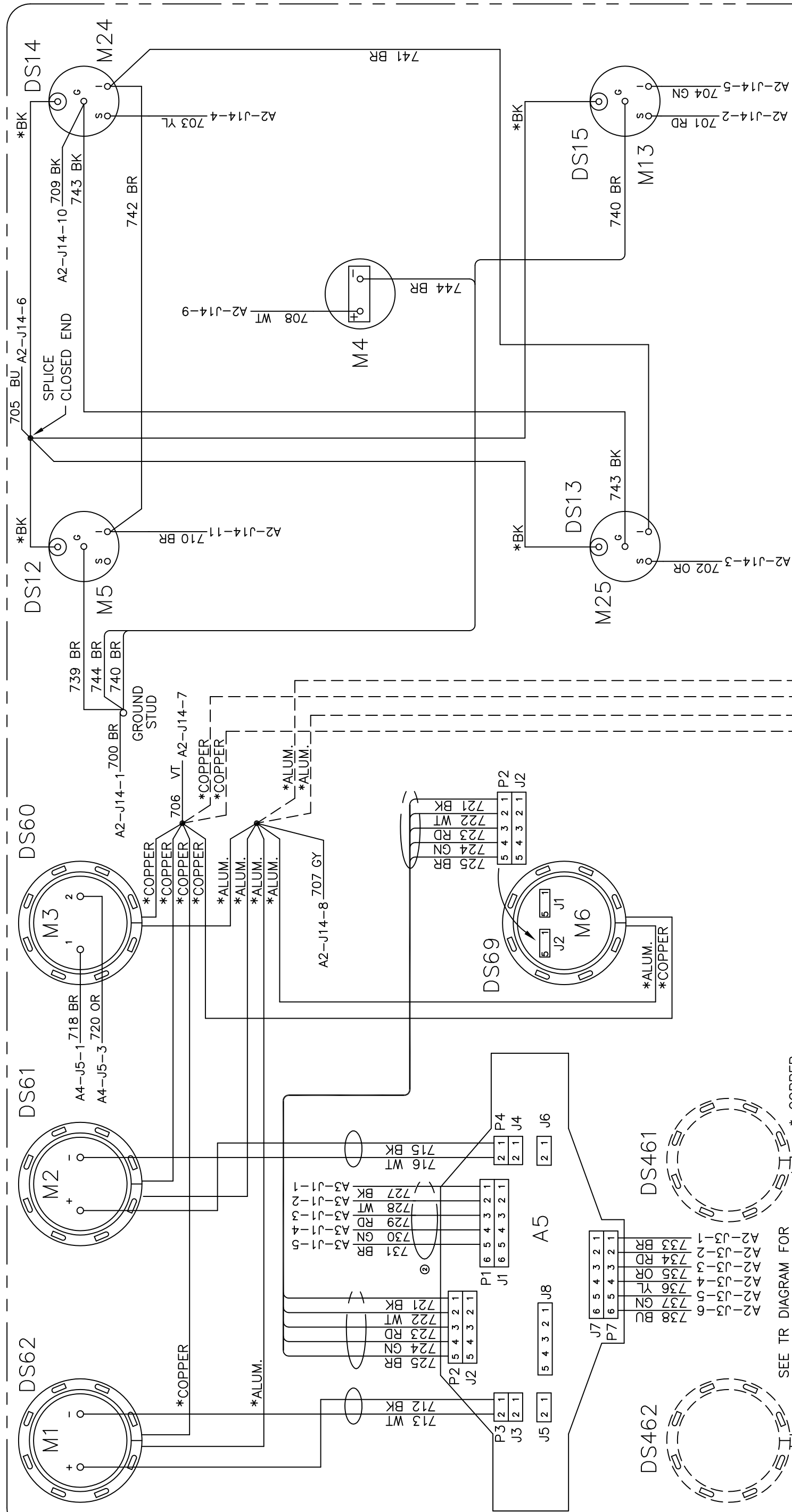
ELECTRONIC CONTROL MODULE (DONGAL)

LOCATED ON THE BULKHEAD

ELECTRONIC ENGINE



CHANGE RECORD		FINISH CODE PER 289181 NONE	
E.C. NO.	DATE	FILE NAME	PLT DATE
		29133157	4-9-10
UNLESS OTHERWISE SPECIFIED			
TOLERANCES ARE IN INCHES EXCEPT FOR			
VENOR DESIGNED PARTS AND ITEMS			
WHICH ARE SPECIFICALLY IDENTIFIED			
DO NOT SCALE DIMENSIONS			
INCH ±		ANGLES ±	
TOLERANCE		TOLERANCE	
	.00 ± .03	0.0 ± 0.0	
	.000 ± .010	0.0 ± 0.0	
FINISH		FINISH	
REFUSED BY		REFUSED BY	
QUANTITY-VAL.		QUANTITY-VAL.	
MATERIAL NO.		MATERIAL NO.	
INTERNAL SPEC.		INTERNAL SPEC.	
TITLE			
DIAGRAM, SCHEMATIC & CONNECTION			
RESPECTIVE DATA			
TOLERANCE		TOLERANCE	
FINISH		FINISH	
REFUSED BY		REFUSED BY	
QUANTITY-VAL.		QUANTITY-VAL.	
MATERIAL NO.		MATERIAL NO.	
INTERNAL SPEC.		INTERNAL SPEC.	
TITLE			
DIAGRAM, SCHEMATIC & CONNECTION			
RESPECTIVE DATA			
TOLERANCE		TOLERANCE	
FINISH		FINISH	
REFUSED BY		REFUSED BY	
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MATERIAL NO.		MATERIAL NO.	
INTERNAL SPEC.		INTERNAL SPEC.	
TITLE			
DIAGRAM, SCHEMATIC & CONNECTION			
RESPECTIVE DATA			
TOLERANCE		TOLERANCE	
FINISH		FINISH	
REFUSED BY		REFUSED BY	
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MATERIAL NO.		MATERIAL NO.	
INTERNAL SPEC.		INTERNAL SPEC.	
TITLE			
DIAGRAM, SCHEMATIC & CONNECTION			
RESPECTIVE DATA			
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REFUSED BY		REFUSED BY	
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MATERIAL NO.		MATERIAL NO.	
INTERNAL SPEC.		INTERNAL SPEC.	
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DIAGRAM, SCHEMATIC & CONNECTION			
RESPECTIVE DATA			
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TOLERANCE		TOLERANCE	
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FACING REAR OF CONTROL PANEL

NOTES:

1. * WIRES FURNISHED

COLOR CODE			
BK	BLACK	RD	RED
BU	BLUE	TN	TAN
BR	BROWN	VT	VIOLET
GN	GREEN	WT	WHITE
GY	GRAY(SLATE)	YL	YELLOW
OR	ORANGE	D	DARK (PREFIX)
PK	PINK	L	LIGHT(PREFIX)

DIAGRAM	EXPLANATION
	— PART DESIGNATOR (END OF WIRE) — WIRE NUMBER — WIRE COLOR — 27 RD — ABOVE OR LEFT OF WIRE TB4

USE THIS SHEET WHEN AC METERS
M1, M2, & M3 ARE ANALOG.

[illegible]

LEGEND

- | | | | |
|------|--------|-------|---|
| A1 | BOARD, | P.C., | ENGINE SPECIFIC (ESB) |
| A2 | BOARD, | P.C., | ENGINE INTERFACE (EIB) |
| A3 | BOARD, | P.C., | CONTROL (CTRL) |
| A4 | BOARD, | P.C., | REGULATOR (REG) |
| A5 | BOARD, | P.C., | LED (LED) |
| A404 | BOARD, | P.C., | TRANSFORMER-RECTIFIER (TR) (WHEN FURNISHED) |

- CB4 CIRCUIT BREAKER, ENGINE ELECTRICAL, 10 A.
CB7 CIRCUIT BREAKER, CONTROL CIRCUIT, 5 A.
CB11 CIRCUIT BREAKER, MARKER LIGHTS, 10 A.

- | | |
|-------|---|
| DS12 | LIGHT, VOLTMETER, BATTERY (WHITE) |
| DS13 | LIGHT, OIL PRESSURE GAUGE (WHITE) |
| DS14 | LIGHT, TEMPERATURE GAUGE (WHITE) |
| DS15 | LIGHT, FUEL GAUGE (WHITE) |
| DS60 | LIGHT, STRIP, FREQUENCY METER |
| DS61 | LIGHT, STRIP, AC AMMETER |
| DS62 | LIGHT, STRIP, AC VOLTMETER |
| DS69 | LIGHT, STRIP, FAULT METER |
| DS461 | LIGHT, STRIP, DC AMMETER (WHEN FURNISHED) |
| DS462 | LIGHT, STRIP, DC VOLTMETER (WHEN FURNISHED) |

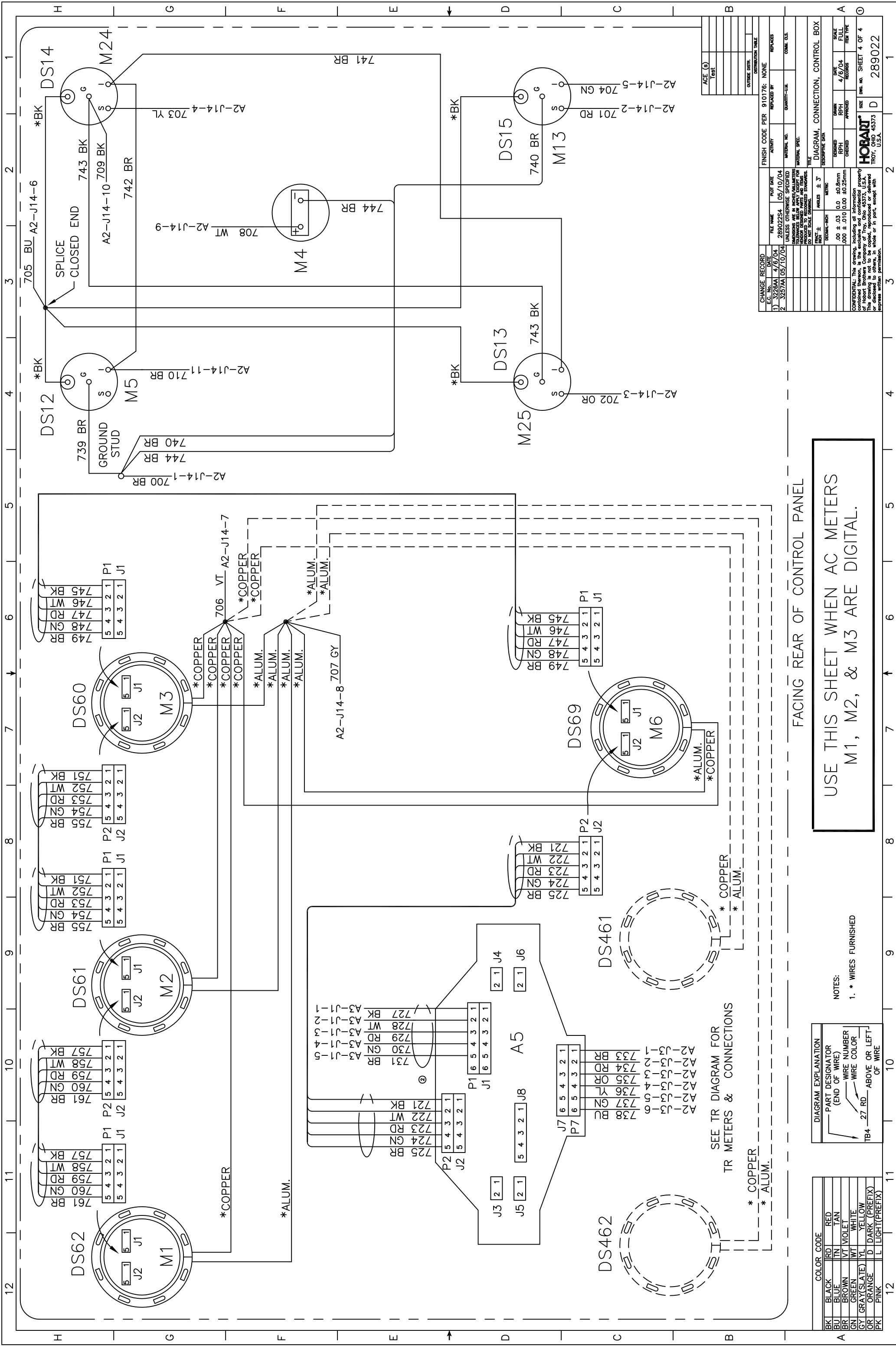
- | | | | |
|----|----|------|------------------------------------|
| F1 | ON | A4 | FUSE, 5 A, 250 V. |
| F2 | ON | A4 | FUSE, 1 A, 250 V. |
| F3 | ON | A4 | FUSE, 1 A, 250 V. |
| F1 | ON | A404 | FUSE, 1 A, 250 V. (WHEN FURNISHED) |

- | | |
|------|---|
| J50 | RECEPTACLE, POWER |
| J51 | RECEPTACLE, ENGINE INTERFACE (EIB) |
| J52 | RECEPTACLE, ENGINE SPECIFIC (ESB) |
| J53 | RECEPTACLE, REGULATOR (REG) |
| J54 | RECEPTACLE, CONTROL (CTRL) |
| J401 | RECEPTACLE, TRANSFORMER-RECTIFIER (WHEN FURNISHED) |
| J450 | RECEPTACLE, REMOTE VOLTAGE SENSING (WHEN FURNISHED) |

- | | |
|-----|--------------------------------------|
| M1 | AMMETER, A.C. GENERATOR |
| M2 | VOLTMETER, A.C. GENERATOR |
| M3 | FREQUENCY METER |
| M4 | RUNNING TIME METER, ENGINE-GENERATOR |
| M5 | VOLTMETER, BATTERY |
| M6 | GAUGE, FAULT CODE |
| M13 | GAUGE, FUEL ELECTRIC |
| M24 | GAUGE, WATER TEMPERATURE |
| M25 | GAUGE, OIL PRESSURE |

- PS1 POWER SUPPLY

[illegible]



USE THIS SHEET WHEN AC METERS
M1, M2, & M3 ARE DIGITAL.

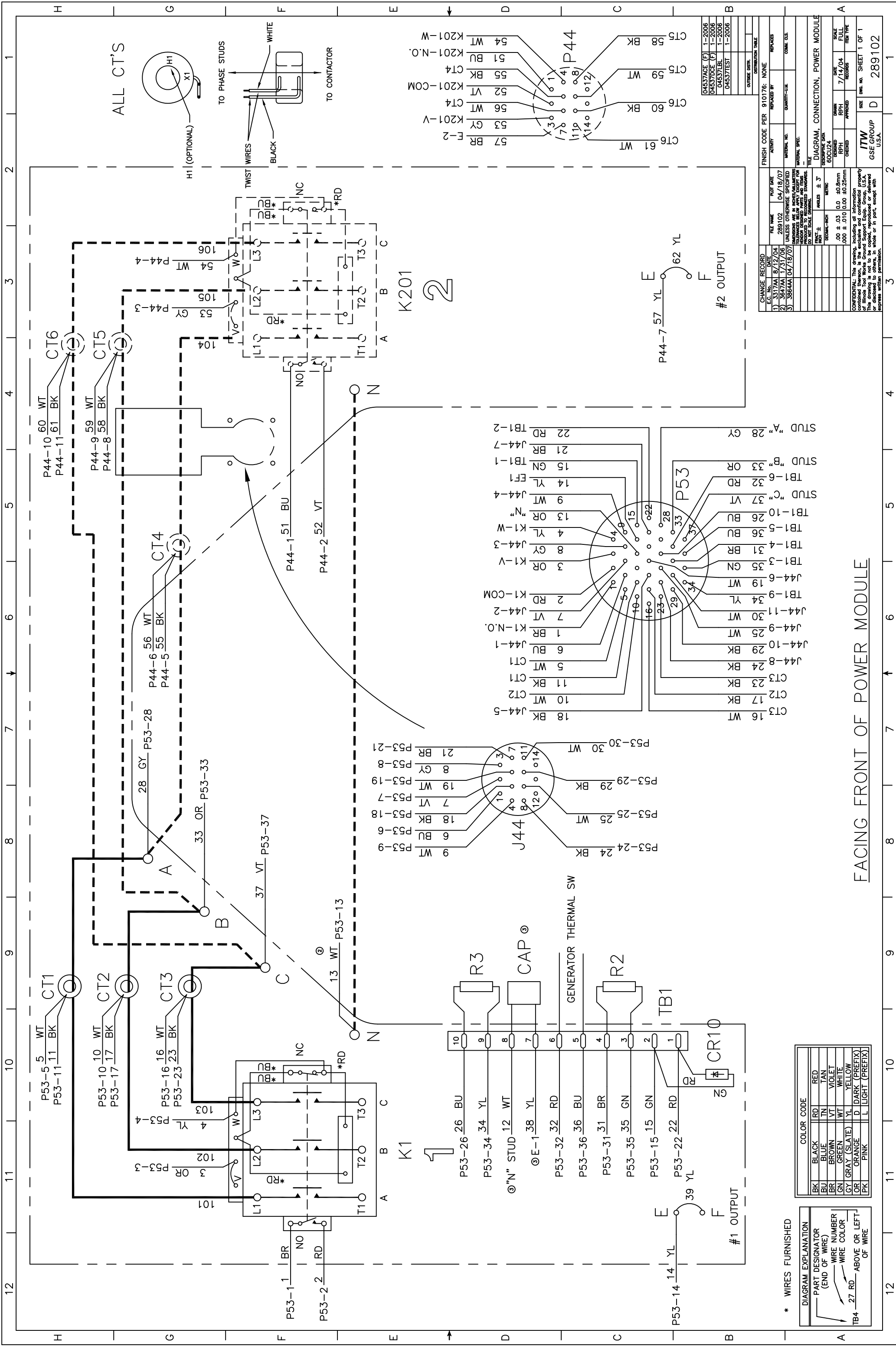
NOTES:

1. * WIRES FURNISHED

COLOR CODE				_____ PART DESIGNATOR (END OF WIRE) _____ WIRE NUMBER _____ WIRE COLOR _____ 27 RD _____ ABOVE OR LEFT TB4 _____ OF WIRE
BK	BLACK	RD	RED	
BU	BLUE	TN	TAN	
BR	BROWN	VT	VIOLET	
GN	GREEN	WT	WHITE	
GY	GRAY(SLATE)	YL	YELLOW	
OR	ORANGE	D	DARK (PREFIX)	
PK	PINK	L	LIGHT(PREFIX)	

DIAGRAM	EXPLANATION
	— PART DESIGNATOR (END OF WIRE) — WIRE NUMBER — WIRE COLOR — 27 RD — ABOVE OR LEFT OF WIRE

CHANGE RECORD		FINISH CODE PER 910176: NONE	
E.C. No.	DATE	ACTIVITY	REPLACES
1 3276AA	4/6/04		
2 3276AA	05/10/04	QUANTITY-LUL	CGAL CLS
FILE NAME		QUANTITY-LUL	
28900225A		05/10/04	
UNLESS OTHERWISE SPECIFIED			
DIMENSIONS ARE IN INCHES EXCEPT FOR			
TOLERANCES ARE IN INCHES EXCEPT FOR			
VENOR DESIGNED PARTS AND ITEMS			
WHICH ARE IDENTIFIED BY A STAR IN THE DRAWING			
DO NOT SCALE DIMENSIONS			
TITLE			
DIAGRAM, CONNECTION, CONTROL BOX			
SYMBOLS			
DESIGNED			
RPH			
CHECKED			
APPROVED			
DATE			
4/6/04			
REVISION			
DATE			
4/6/04			
FILE NAME			
28900225A			
UNLESS OTHERWISE SPECIFIED			
DIMENSIONS ARE IN INCHES EXCEPT FOR			
TOLERANCES ARE IN INCHES EXCEPT FOR			
VENOR DESIGNED PARTS AND ITEMS			
WHICH ARE IDENTIFIED BY A STAR IN THE DRAWING			
DO NOT SCALE DIMENSIONS			
TITLE			
DIAGRAM, CONNECTION, CONTROL BOX			
SYMBOLS			
DESIGNED			
RPH			
CHECKED			
APPROVED			
DATE			
4/6/04			
REVISION			
DATE			
4/6/04			
FILE NAME			
28900225A			
UNLESS OTHERWISE SPECIFIED			
DIMENSIONS ARE IN INCHES EXCEPT FOR			
TOLERANCES ARE IN INCHES EXCEPT FOR			
VENOR DESIGNED PARTS AND ITEMS			
WHICH ARE IDENTIFIED BY A STAR IN THE DRAWING			
DO NOT SCALE DIMENSIONS			
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DIAGRAM, CONNECTION, CONTROL BOX			
SYMBOLS			
DESIGNED			
RPH			
CHECKED			
APPROVED			
DATE			
4/6/04			
REVISION			
DATE			
4/6/04			
FILE NAME			
28900225A			
UNLESS OTHERWISE SPECIFIED			
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TOLERANCES ARE IN INCHES EXCEPT FOR			
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DIAGRAM, CONNECTION, CONTROL BOX			
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28900225A			
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DIAGRAM, CONNECTION, CONTROL BOX			
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VENOR DESIGNED PARTS AND ITEMS			
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DIAGRAM, CONNECTION, CONTROL BOX			
SYMBOLS			
DESIGNED			
RPH			
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APPROVED			
DATE			
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REVISION			
DATE			
4/6/04			
FILE NAME			
28900225A			
UNLESS OTHERWISE SPECIFIED			
DIMENSIONS ARE IN INCHES EXCEPT FOR			
TOLERANCES ARE IN INCHES EXCEPT FOR			

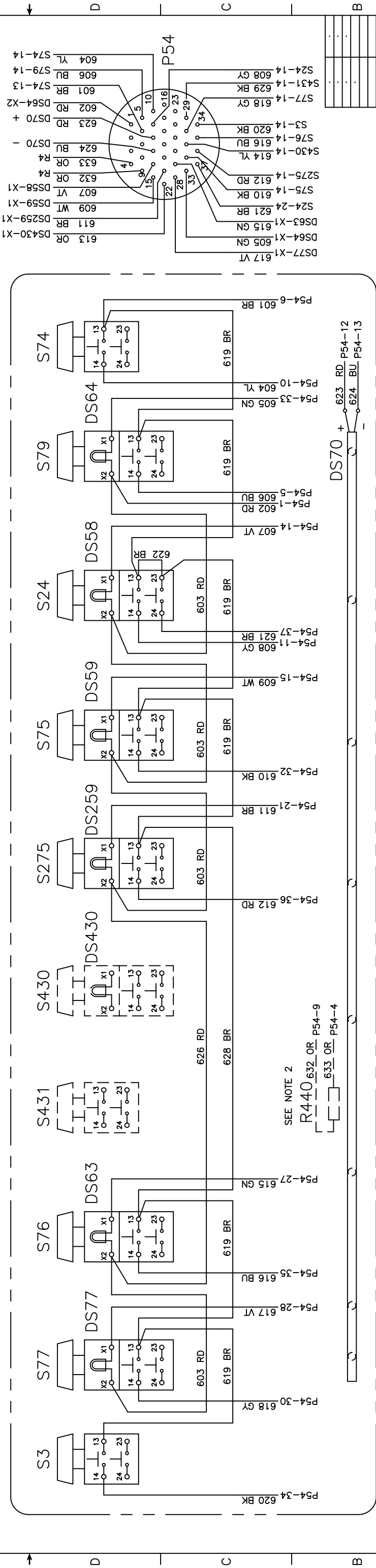
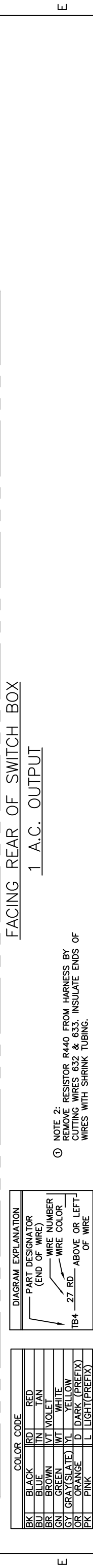
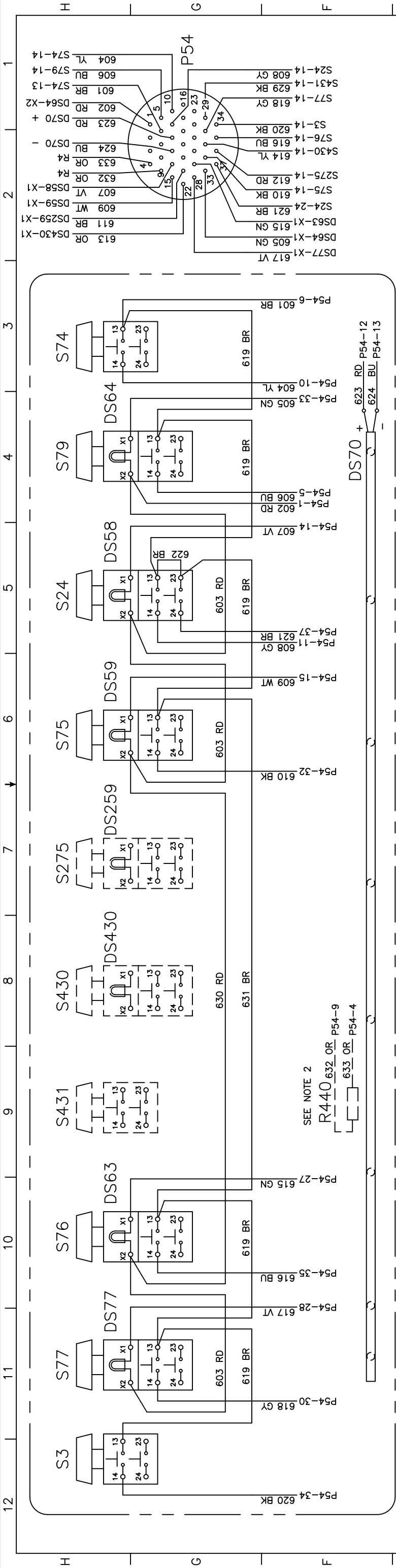


FACING FRONT OF POWER MODULE

[illegible]

* WIRES FURNISHED

DIAGRAM EXPLANATION	
—	PART DESIGNATOR (END OF WIRE)
↖	WIRE NUMBER
↘	WIRE COLOR
27 RD	ABOVE OR LEFT- OF WIRE
TS4	



NOTES:

② 1. TIE ANY UNUSED WIRES INTO HARNESS AFTER REMOVING TERMINAL AND INSULATING END OF WIRE WITH SHRINK TUBING.

LEGEND

COMPONENT	FUNCTION
DS58	INDICATOR, PUSHBUTTON, ENGINE START (GREEN)
DS59	INDICATOR, PUSHBUTTON, #1 OUTPUT (YELLOW)
DS63	INDICATOR, PUSHBUTTON, DELAYED ENGINE SHUTDOWN (RED)
DS64	INDICATOR, PUSHBUTTON, PRE-HEATER, (ORANGE)
DS77	INDICATOR, PUSHBUTTON, TEST/RESET, (RED)
DS259	INDICATOR, PUSHBUTTON, #2 OUTPUT (ORANGE) (WHEN FURNISHED)
DS430	INDICATOR, PUSHBUTTON, DC OUTPUT, (BLUE), (WHEN FURNISHED)
③R440	RESISTOR, 1K, T-R I.D.

③ SWITCH, METER SELECTOR

S3 SWITCH, ENGINE START

S24 SWITCH, PUSHBUTTON, LAMPS & FUEL CHECK

S74 SWITCH, PUSHBUTTON, #1 OUTPUT

S75 SWITCH, PUSHBUTTON, ENGINE STOP, DELAYED SHUTDOWN

S76 SWITCH, PUSHBUTTON, TEST/RESET

S77 SWITCH, PUSHBUTTON, #2 OUTPUT, (WHEN FURNISHED)

S275 SWITCH, PUSHBUTTON, #2 OUTPUT, (WHEN FURNISHED)

S430 SWITCH, PUSHBUTTON, DC OUTPUT, (WHEN FURNISHED)

S431 SWITCH, PUSHBUTTON, DC, STARTING CURRENT, (WHEN FURNISHED)

CHANGE RECORD

REV.	DATE	BY	DESCRIPTION
1	2/12/04	289013S1	05/11/04
2	3/28/04	4/6/04	UNLESS OTHERWISE SPECIFIED
3	3/28/04	05/11/04	UNLESS OTHERWISE SPECIFIED

FINISH CODE PER 910176: NONE

ACTIVITY

REPLACED BY

REPLACES

QUANTITY-UM

CONV. QTY

DIAGRAM, CONNECTION, SWITCH BOX

DESCRIPTION DATA

DESIGNED RPH

CHECKED RPH

DATE 12/12/03

SCALE FULL

ITEM TYPE

SIZE

DWG. NO. SHEET 1 OF 2

HOBBART TROY, OHIO 45373 U.S.A.

289013

Appendix A Options / Features

Option/Features Available			
Description	Part Number	Document Number	In This Section
Kit, Noise Reduction	291375	n/a	
Kit, Spotlight	289064	n/a	
Kit, Block Heater, 120V	289261-001	n/a	
Kit, Block Heater, 240V	289261-002	n/a	
Kit, Fire Extinguisher, 5 lb. Carbon Dioxide	283012	TO-252	
Kit, Forklift Pockets	291402	n/a	
Kit, Tie-Down	284706	n/a	
*Kit, Unit Operating, Non-Flashing Beacon	289210-XXX	n/a	
*Kit, Low Fuel, Flashing/Non-Flashing Beacon	289208-XXX	n/a	
*Kit, Low Fuel Strobe Beacon	289208-XXX	n/a	
Kit, Battery Blanket, 120V	287917	n/a	
Kit, T-Handle Latch	287546-2	n/a	
Kit, Wheel Chocks	287609	n/a	
Kit, Clearance Lights	288912	TO-297	
Kit, Transformer-Rectifier, 28 VDC	Call Factory	OM-2136	
Kit, Cable Tray Rollers	288987-002	n/a	

* – A large number of variations exist under this part number. Call the factory for details.

n/a – Not Available, call the factory for details.

The following is a list of options/features available for the 90CU420, 400 Hz. Generator Set. This chart contains the description, part number, and document number (if applicable) of the option/feature. There is also a column to identify which option/feature document is contained in this Appendix.

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Wet-Stacking in Generator Set

1) Diesel Engines

All diesel engines operated for extended periods under light load may develop a condition commonly referred to as wet-stacking. This condition results from the accumulation of unburned fuel in the exhaust system. It is recognizable by fuel oil wetness around the exhaust manifold, pipes, and muffler, as well as, excessive soot around the exit point area. Liquid fuel, in the form of droplets, may be also be spewed from the exhaust outlet.

Wet-stacking is common, and may be expected in diesel engines operated under light load. Light loads do not allow the engine to reach the most efficient operating temperature for complete combustion of fuel. The unburned fuel collects in the exhaust system to create the wet condition known as wet-stacking.

To alleviate wet-stacking in lightly loaded engines, it is recommended that the machine be connected to a load bank after each 200 hours of use and operated under full rated load for one hour. This will burn away and evaporate the accumulation of fuel in the exhaust system. This clean-out procedure should be considered as a regular maintenance operation for machines operated under light loads. The time schedule of 200 hours may be changed as required to suit each user's particular needs and operating conditions.

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Unusual Service Conditions

This information is a general guideline and cannot cover all possible conditions of equipment use. The specific local environments may be dependent upon conditions beyond the manufacturer's control. The manufacturer should be consulted if any unusual conditions of use exist which may affect the physical condition or operation of the equipment or safety to surrounding personnel.

Among such conditions are:

1) Exposure to:

- a) Combustible, explosive, abrasive or conducting dusts.
- b) Environments where the accumulation of lint or excessive dirt will interfere with normal ventilation.
- c) Chemical fumes, flammable, or explosive gases.
- d) Nuclear radiation.
- e) Steam, salt-laden air, or oil vapor.
- f) Damp or very dry locations, radiant heat, vermin infestation, or atmospheres conducive to fungus growth.
- g) Abnormal shock, vibration or mechanical loading from external sources during equipment operation.
- h) Abnormal axial or side thrust imposed on rotating equipment shafts.
- i) Low and/or high ambient temperatures.
- j) High electromagnetic fields

2) Operation at:

- a) Voltages above or below rated voltage.
- b) Speeds other than rated speed.
- c) Frequency other than rated frequency.
- d) Standstill with rotating equipment windings energized.
- e) Unbalanced voltages.
- f) Operation at loads greater than rated.

3) Operation where low acoustical noise levels are required.

4) Operation with:

- a) Improper fuel, lubricants or coolant.
- b) Parts or elements unauthorized by the manufacturer.
- c) Unauthorized modifications.

5) Operation in poorly ventilated areas.