OM-2098E
101708 – Original
040910 – Revision 5

Operation and Maintenance Manual
with
Illustrated Parts List
for
60CU24

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

Series 500060E

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.
2. This warranty expires 15 months after shipment by HOBART to the first user, or 12 months after installation, whichever first occurs.
3. This warranty does not apply to: primary and secondary switch contacts, cable connectors, carbon brushes, fuses, bulbs, and filters unless found to be defective prior to use.
4. Hobart DOES NOT WARRANT THE FOLLOWING COMPONENTS: Engines, engine components; such as: starters, alternators, regulators, governors, etc., and cable retrieving devices. Many of the foregoing components are warranted directly by the manufacturer to the first user and serviced by a worldwide network of distributors and others authorized to handle claims for component manufacturers. A first user's claim should be presented directly to such an authorized component service outlet. In the event any component manufacturer has warranted its component to HOBART and will not deal directly with a first user then HOBART will cooperate with the first user in the presentation of a claim to such manufacturer. Under NO circumstances does HOBART assume any liability for any warranty claim against or warranty work done by or in behalf of any manufacturer of the foregoing components.
5. This warranty is extended by HOBART only to the purchaser of new PRODUCTS from HOBART or one of its authorized distributors. The PRODUCTS purchased under this warranty are intended for use exclusively by the buyer and his employees and by no other persons and, therefore, there shall be no third party beneficiary to this warranty.
6. A claim of defects in any PRODUCT covered by this warranty is subject to HOBART factory inspection and judgment. HOBART'S liability is limited to repair of any defects found by HOBART to exist, or at HOBART'S option the replacement of the defective product, F.O.B. factory, after the defective product has been returned by the purchaser at its expense to HOBART'S shipping place. Replacement and exchange parts will be warranted for the remainder of the original Warranty, or for a period of ninety (90) days, whichever is greater.
7. UNDER NO CIRCUMSTANCES whatsoever shall HOBART and its authorized distributors be liable for any special or consequential damages, whether based on lost goodwill, lost resale profits, work stoppage impairment of other goods or otherwise, and whether arising out of breach of any express or implied warranty, breach of contract, negligence or otherwise, except only in the case of personal injury as may be required by applicable law.
8. Continued use of the PRODUCT(S) after discovery of a defect VOIDS ALL WARRANTIES.
9. Except as authorized in writing, this warranty does not cover any equipment that has been altered by any party other than HOBART.
10. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HERE OF. HOBART MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.
11. HOBART neither assumes nor authorizes any person to assume for HOBART any liability in connection with the PRODUCTS sold, and there are no oral agreements or warranties collateral to or affecting this written Warranty. This warranty and all undertakings of HOBART thereunder shall be governed by the laws of the State of Ohio, United States of America.

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, death, or damage to other equipment and/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 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

Equipment driven or operated by facility electrical input or electric motors *(rather than by diesel or gasoline engines)* must be installed and maintained in accordance with the National Electrical Code, ANSI/NFPA 70E (most current version), 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. 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 70E (most current version) 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 trouble-shooting 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 60CU24, 400 Hz Generator Set manufactured by ITW GSE Group, Hobart Ground Power Troy, Ohio 45373.

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 who have never operated this equipment. It is the intent of this manual to guide and assist operators and maintenance people in the proper use and care of the equipment.

Use of the manual should not be put off until a trouble or 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, its location is identified by a chapter, section, and paragraph or figure number.

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.).”

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.

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

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

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

Write:	ITW GSE Group Hobart Ground Power Service Department 1177 Trade Road 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@itwgsegroup.com
Web Page:	www.itwgsegroup.com

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Chapter 1 Description/Operation

Section 1 Description

1) General

Hobart Ground Power, part of the ITW GSE Group, in Troy, Ohio, manufactures the basic generator set covered in this manual. The is rated at 60 kVA and designed to produce and deliver 115/200-volt, 400 Hz, 3-phase AC power, or 28.5V DC power to a parked aircraft or to Hobart approved test banks only.

The number 500060E 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 identifies the variations covered in this manual.

Specification Series Part Number 500060E	
Dash No.	**Model Description**
-101	Single Output, Trailer Mounted
-102	Dual Output, Trailer Mounted
-103	Single Output, Fixed/Truck Mounted
-104	Dual Output, Fixed/Truck Mounted
-105	Single Output, Trailer Mounted, 28.5V DC TR
-106	Single Output, Fixed/Truck Mounted, 28.5V DC TR
-108	Single Output, Trailer Mounted, Digital AC Meters
-109	Single Output, Fixed/Truck Mounted, Digital AC Meters
-110	Single Output, Trailer Mounted, 28.5V DC TR, Digital AC/DC Meters
-111	Single Output, Fixed/Truck Mounted, 28.5V DC TR, Digital AC/DC Meters

Generator Set Part Number Descriptions
Figure 1

2) Orientation

For purpose of orientation, the radiator is considered to be at the FRONT of the unit. The generator and controls are at the REAR. LEFT and RIGHT are determined by standing at the REAR end facing the control box.

3) Optional Equipment - Appendix A

Chapters 1 through 5, of this Operation and Maintenance Manual, identify only the "strip down" version of the 60CU24 generator set. A list of optional equipment which makes this manual unique to the generator set that you have purchased, appears in Appendix A. A few items included in Appendix A are cable trays rollers, 28 VDC power transformer-rectifiers, etc.

Physical	Basic Unit (Fixed Mount)	Trailer Mounted Unit
Length	74 in. (1880 mm)	99 in. (2515 mm)
Width	37 in. (940 mm)	67 in. (1702 mm)
Height	50 in. (1270 mm)	64 in. (1626 mm)
Weight (AC output only)	3250 lb. (1474 kg.)	3450 lb. (1565 kg.)
Weight (AC & DC outputs)	3550 lb. (1610 kg.)	3750 lb. (1701 kg.)
AC GENERATOR		
Output power rating	60 kVA 48 kW	
Output voltage	115 / 200 VAC	
Rated load capacity	174 Amps	
Frequency	400 Hz.	
Power factor	0.8	
Duty Cycle	100%	
Operating speed	2400 RPM	
Overload capacity, both outputs 125% rated load	217.5 Amps	
Output cable size	2/0	
GENERATOR PROTECTIVE SYSTEM		
Over voltage (per SAE ARP 5015)	Trips above 124 volts after a 1 second time delay. Trips at 140 volts in 160 milliseconds. Trips at 180 volts in 50 milliseconds.	
Under voltage (per SAE ARP 5015)	Trips at any voltage below 104 volts after 7 seconds.	
Over frequency	Trips at any value between 420 Hz and 480 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 approximately 5 minutes at 125% of 60 kVA on either output or on both outputs combined.	
DC OUTPUT (OPTIONAL, SEE APPENDIX A)		
Output Voltage	28.5 VDC	
Amps (Continuous)	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	

Specifications and Capabilities
Figure 2 (Sheet 1 of 2)

4) Special Features

The generator set has special features that are described more fully under the assemblies in which they appear. Some of these features include, engine electronic control, protective monitoring and voltage regulator described briefly below.

a) Protective Monitoring

The protective monitoring system receives signals from the fault sensing units 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 regulator is also adjustable for a variety of output cable sizes and lengths.

c) Engine Electronic Control Module (ECM)

The engine is equipped with an electronic control module (ECM) that monitors, records, and controls engine performance. The ECM is calibrated special in the factory to ensure the ground power unit performance meets industry standards.

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 the welded steel frame of the chassis. The engine coolant radiator is also mounted on the frame just forward of the engine-generator combination. Figures 4 and 5 are illustrations showing the location of all major components and sub-assemblies.

a) Basic Engine (See Figure 3)

The basic diesel engine is a in-line 4-cylinder, electronically controlled engine rated at 110 horsepower. See Figure 2 for specifications and capabilities.

b) Engine Manufacturer's Equipment

As received from the engine manufacturer, the engine includes the following equipment, which is more fully described in the engine manufacturer's operation manual.

(1) Electrical System

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

(2) Lubricity Additive Fuel Filter

The fuel filter is a spin-on disposable, vacuum type connected between the fuel lift pump and injector pump. The filter automatically adds a lubricity additive into the fuel mixture for use with Jet-A fuels.

ENGINE	
Manufacturer	Cummins Engine Company
Model No.	QSB4.5
Type	In-Line 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	110 hp (82 kW)
Idle speed	1000 ± 50 rpm
Maximum overspeed capability	3700 ± 50 rpm
Normal governed speed	2400 rpm
Firing Order	1-3-4-2
Electrical system	12 VDC
Ground	Negative
Lubricating oil capacity (w/ filter)	11.6 quarts (11 liters)
Coolant capacity system	20 quarts (18.9 liters)

Engine Specifications and Capabilities
Figure 2 (Sheet 2 of 2)

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.

(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.

(5) Engine low coolant sensor

The engine is equipped with a low coolant sensor that is located in the top tank of the radiator. The sensor will send a signal to the engine's ECM to shut the engine down in case of low coolant.

c) Hobart Installed Equipment

This generator set is modified at Hobart Ground Power by the addition of the following equipment:

(1) Radiator and Charge-Air-Cooler

The radiator and charge-air-cooler are combined into one complete module assembly in a side to side fashion.

(2) Engine-cooling fan

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

(3) Shut Down/Reset devices

In addition to the other devices provided by the engine manufacturer, the factory also added an engine shutdown/reset features and protections.

a **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. The switch is located below 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

b 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 219º F (104º C).

c 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 20 PSI (138 kPA).

(4) Air cleaner

The diesel engine air cleaner is so constructed that air enters through its cylindrical body, and then is filtered in the process before being passed onto 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 code display to warn the operator that the air cleaner must be changed soon. The electrical indicator automatically resets when the restriction level drops sufficiently.

(5) Exhaust System with Muffler

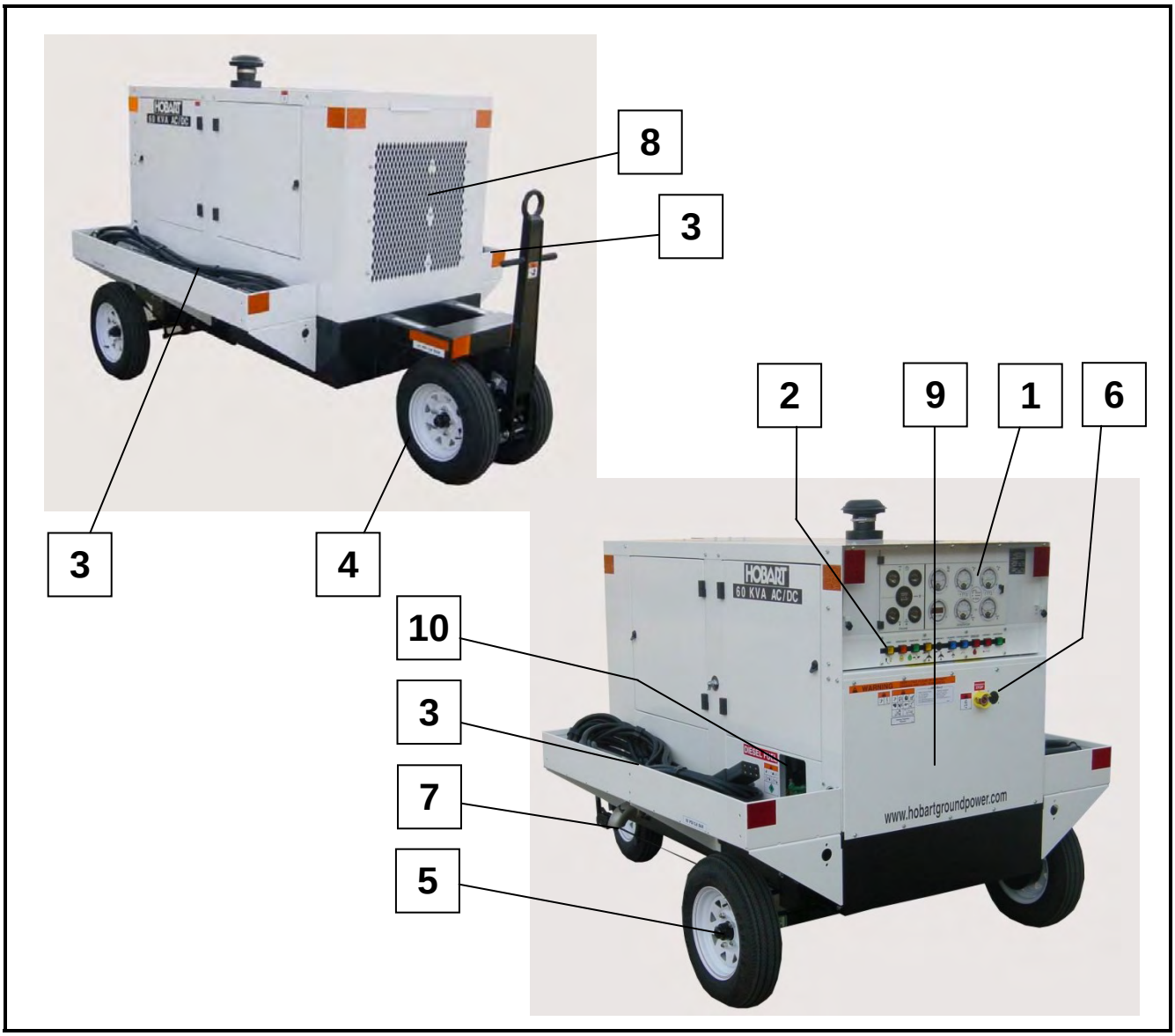
The exhaust system is designed to safely route the engine exhaust out of the GPU and reduce the engine exhaust noise level. The exhaust exit is located on the left front side of the GPU under the cable tray.

d) Commonly Known Engine faults

The following table lists some commonly known engine faults which may occur. Column two of the table explains what happens in the engine's circuitry when the fault occurs, and column three tells how to return the generator set to service once the problem is solved. Refer to Chapter 2 for more details on all other faults and for possible corrective actions.

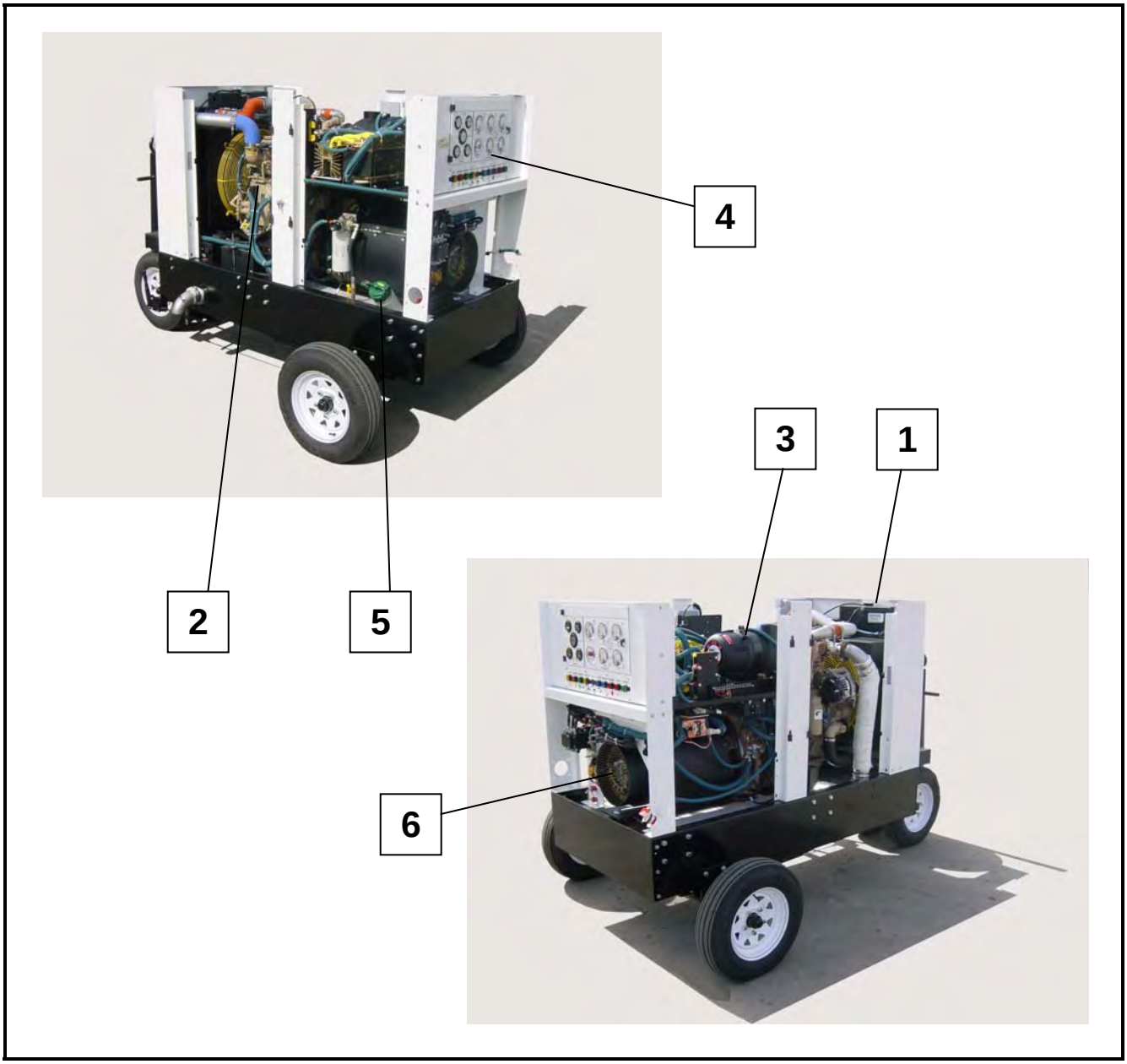
ENGINE FAULTS		
Engine Fault Condition	**What Occurs / Corrective Action**	**How to Reset**
Over temperature (monitored by external switch)	Shuts down the engine, and will be indicated with the appropriate fault code.	**a)** Press the engine stop button to reset the fault code and reset the protective system. **b)** Or use E-STOP button for immediate reset.
Low oil pressure (monitored by external switch)	Shuts down the engine, and will be indicated with the appropriate fault code.	**a)** Press the engine stop button to reset the fault code and reset the protective system. **b)** Or use E-STOP button for immediate reset.
Low Coolant Shutdown (monitored by engine's ECM)	Shuts down the engine and will be indicated by the ESB PCB enigne fault lights.	**a)** Press the engine stop button to reset the engine's ECM. **b)** Or use E-STOP button for immediate reset.
Low fuel warning and shutdown (monitored by EIB PCB)	Turns on the low fuel indication on the fault code meter. The GPU is programmed at the factory to warn at $^1/_4$ tank and to shutdown at $^1/_8$ tank.	**a)** Press the engine stop button to reset the fault code and reset the protective system. **b)** Or use E-STOP button for immediate reset.
Clogged air cleaner or other restriction in the combustion air inlet. (monitored by EIB PCB)	Turns on the air cleaner restriction indicating fault code.	**a)** Press the engine stop button to reset the fault code and reset the protective system. **b)** Or use E-STOP button for immediate reset.

Engine Faults
Figure 3



1. Control Panel
2. Operator's Push-Button Panel
3. Output Cable Location
4. Front Axle Assembly
5. Rear Axle Assembly
6. Emergency Stop Switch (S28)
7. Exhaust Outlet
8. Radiator End
9. Generator End
10. Fuel Fill Location

General Assembly of Generator Set
Figure 4



1. Radiator
2. Cummins QSB Engine
3. Air Cleaner
4. Control Box
5. Fuel Tank
6. Generator

Main Components of Generator Set
Figure 5

e) Generator

The 400 Hz generator is a brush-less, revolving field, three-phase, alternating current type. The generator set covered by this manual is a dual-bearing type. The front end of the rotor shaft extends forward beyond the front bearing and is attached 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 with six diodes is 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, which is part of the flexible coupling assembly, 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 flywheel housing.

7) Control Box Assembly (Operator Station)

The control box is a sheet metal enclosure that houses and provides mounting facilities for engine and generator controls and monitoring instrumentation.

a) Control Panel (Operator Interface)

The control system is divided into three sections. On the left side of the control panel are engine meters. On the right side of the control panel are AC/DC generator meters. Below the control panel are push-button switches for operating the ground power unit.

(1) Engine coolant temperature gauge (M24)

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

(2) 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.

(3) Engine voltmeter (M5)

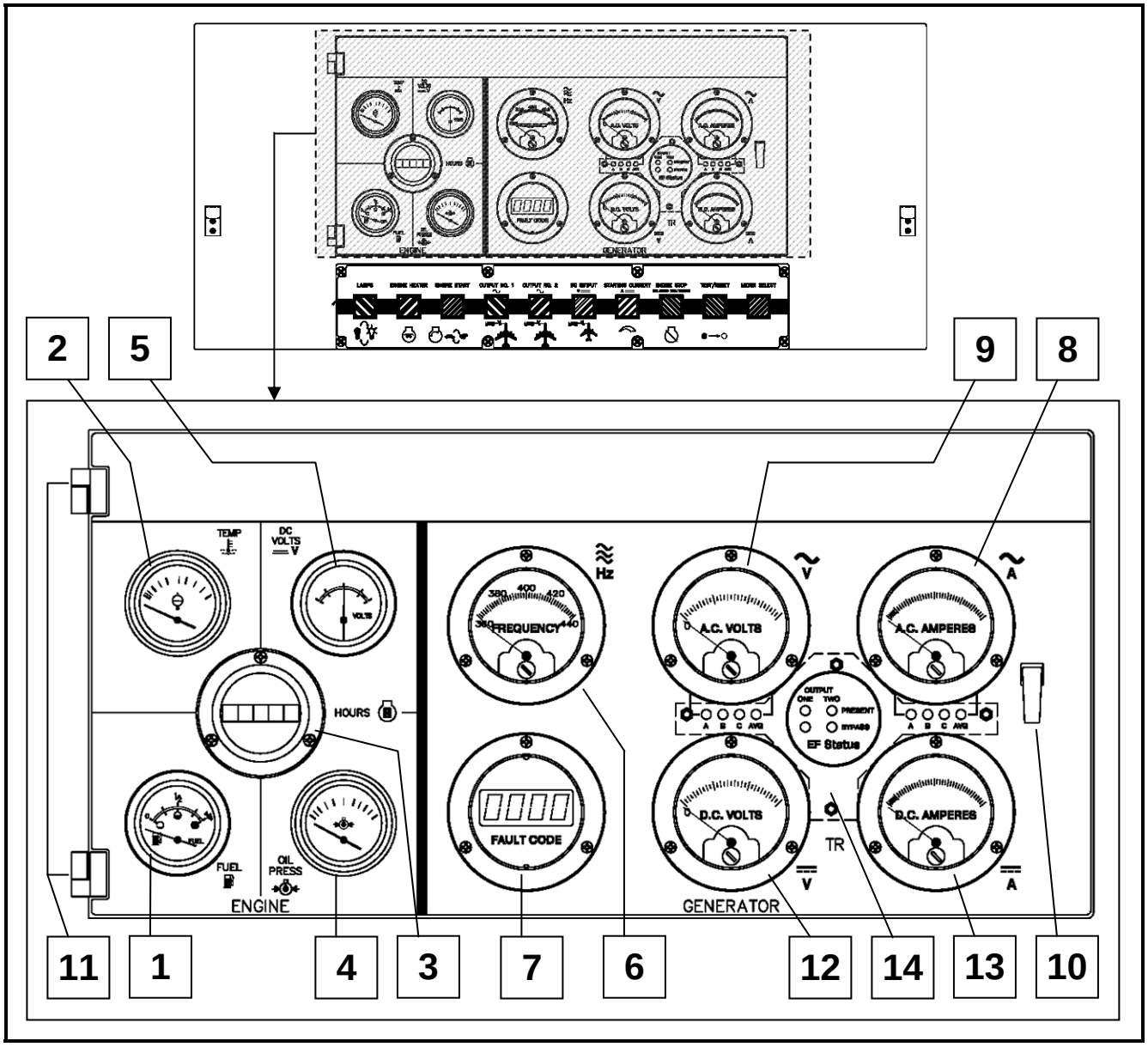
The voltmeter indicates the direction and value of current flow from or to the 12 VDC battery. The gauge is graduated from 10 V to 16 V.

(4) Engine fuel gauge (M13)

The 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.

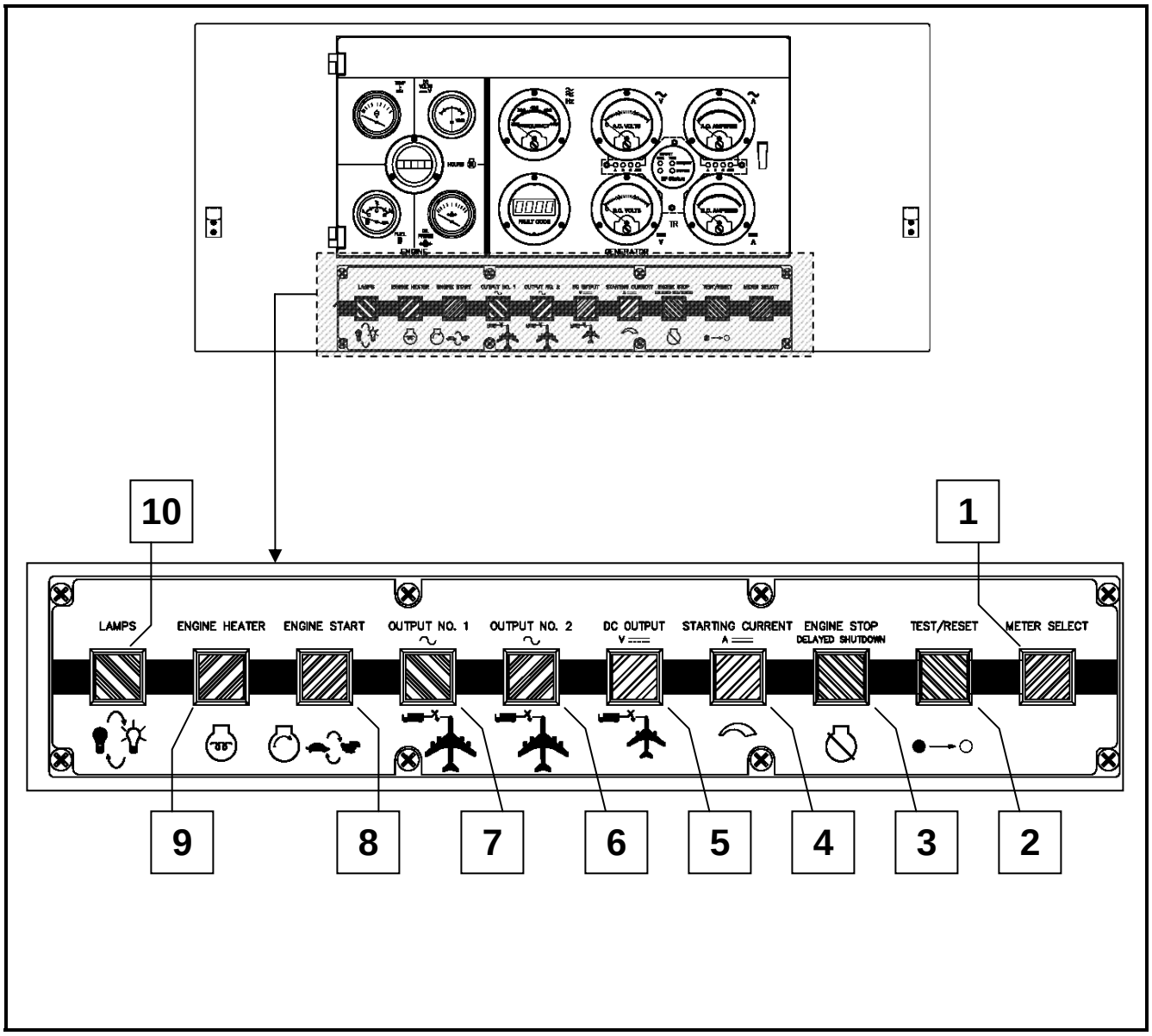
(5) Engine oil pressure gauge (M25)

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



1. Fuel Gage (M13)
2. Engine Coolant Temperature Gauge (M24)
3. Running Time Meter (M4)
4. Oil Pressure Gage (M25)
5. Battery Voltmeter (M5)
6. AC Frequency Meter (M3)
7. Fault Code Meter (M6)
8. AC Ammeter (M1)
9. AC Voltmeter (M2)
10. Adjustable Grip Latch
11. (2) Control Panel Door Hinge
12. DC Voltmeter (M402) *[Optional with TR]*
13. DC Ammeter (M401) *[Optional with TR]*
14. Front LED PC Board (A5) [Shown Opposite Side]

Control Panel Door
Figure 6



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

Control Push-Button Switch Panel
Figure 7

(6) Panel lights and panel light push-button switch (S74)

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

(7) "**ENGINE START**" push-button switch (S24) and indicating light (DS58)

The "**ENGINE START**" push-button switch, when pressed, connects 12 VDC power to the starter solenoid coil and activates the solenoid switch to connect power to the engine starter motor. The 12 VDC power is also 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). A green indicator light in the push-button will blink (1 second on, 1 second off) once the engine is in idle mode.

When pressed a second time, this push-button switch provides a signal to the ECM to adjust the engine speed to 2400 RPM (operating speed). A green indicator light in the push-button will glow continuously. At the same time, a ground signal is provided to the regulator, enabling the generator to build up voltage for the 400-Hz generator output. Pressing the push-button switch once more removes these signals and the engine reverts to its idle speed and a blinking green indicator light.

(8) "**ENGINE HEATER**" push-button switch (S79) and indicating light (DS64)

The "**ENGINE HEATER**" push-button switch activates the standard cold starting aid (a manifold air intake heater) which is 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 and is indicated by a orange light in 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.

(9) "**ENGINE STOP**" push-button switch (S76) and indicating light (DS63)

When the "**ENGINE STOP**" push-button switch is pressed, a red indicator light inside the push-button will glow. A 3 to 5 minute delay will start allowing the turbo and other engine components to cool evenly before shutdown. After the shutdown delay power is disconnected from the engine ECM causing the engine to shut down.

(10) Fault Code meter and "**TEST/RESET**" push-button switch (M6) and indicating light (DS77)

The function of the fault code meter is to indicate to the operator, that a generator or an engine abnormal condition has occurred (over-voltage, over-frequency, high coolant temperature, oil pressure, etc…) which caused the protective monitoring system to function. The fault code meter will also indicate warnings of low fuel and air restriction. When one of the circuits is activated, it shows the code on the fault code meter and the indicating light in the "**TEST RESET**" push-button will glow. 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.

(11) AC generator 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).

(12) AC generator voltmeter (M2)

The voltmeter is an analog type and indicates the generator output phase to neutral voltage in a range of 0 to 300 V.

(13) AC generator ammeter (M1)

The ammeter is an analog type and indicates the generator output current in a range of 0 to 500 A. The ammeter current reading is generated by current transformers located in the output power module circuit. The current transformers lower the output load current to a lesser value, of definite ratio, which is sent to the Voltage Regulator PC Board (REG) for processing. The ammeter dial scale is numbered so that the pointer will indicate the true load current value.

(14) AC "**METER SELECT**" push-button switch (S3)

The "**METER SELECT**" push-button switch allows the operator to look at the output (voltage and current) of each phase (A-B-C). Each time the push-button is pressed the display changes from a (L-N) or a (L-L) 3-phase average reading to individual a (L-N) and a (L-L) phase reading. The indication for which reading the operator is seeing is noted by the LED's under each meter.

(15) AC "**OUTPUT NO. 1**" push-button switch and indicating light (S75, DS59)
AC "**OUTPUT NO. 2**" push-button switch and indicating light (S275, DS259)

The "**OUTPUT NO. 1**" push-button switch energizes and closes the output contactor. The successful closing of the output contactor is indicated by an orange light inside the push-button. When the load contactor opens for any reason, the light is turned off.

The "**OUTPUT NO. 2**" (if applicable) operates in the same manner, but the indicating light is yellow.

(16) 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 by-passed the exposed cable may be live.

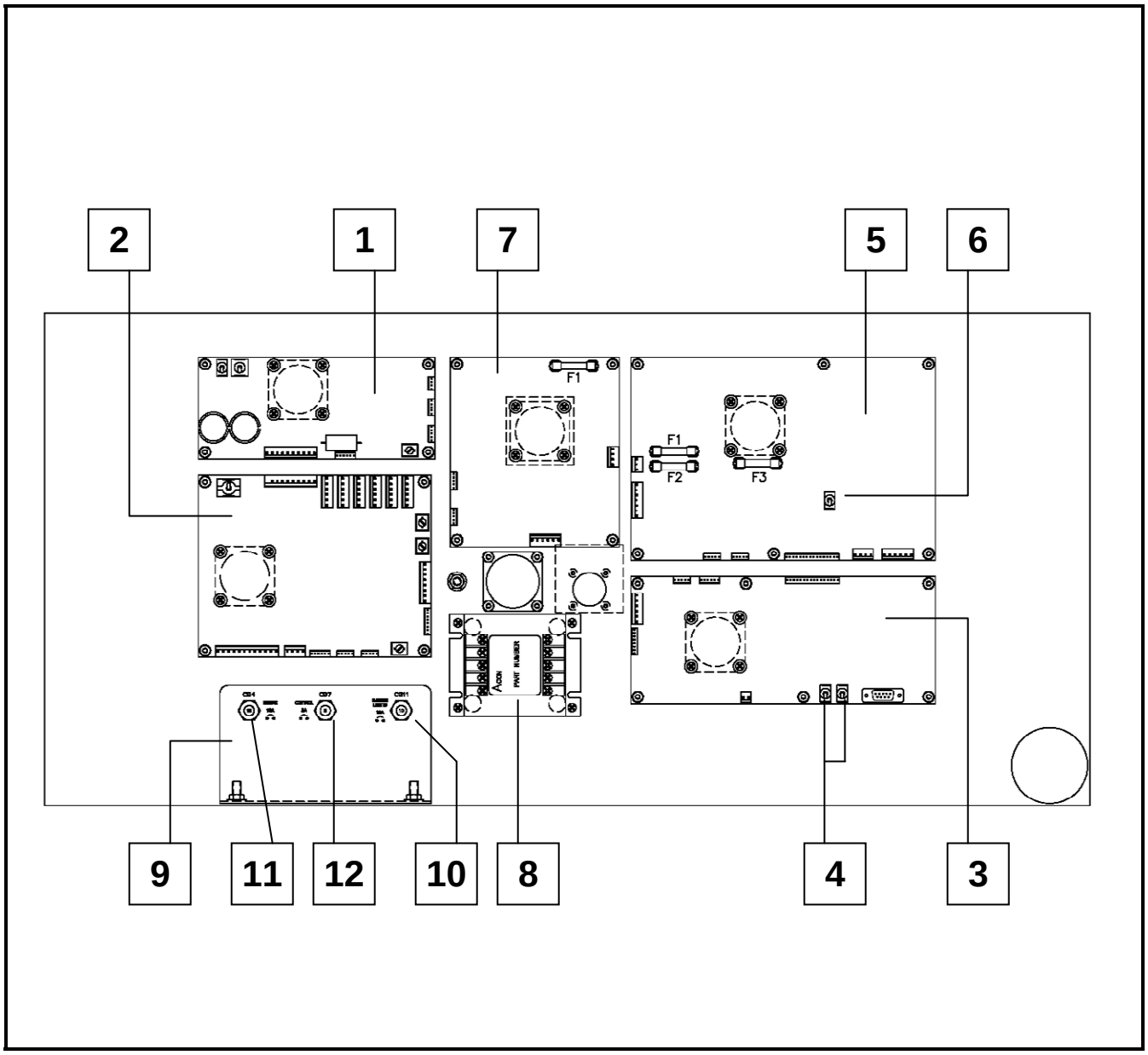
[Optional DC meters and push-buttons, see manual in Appendix A, if supplied]

(17)DC Generator output meters (M401 and M402)

Two instruments, a voltmeter and an ammeter, monitor and display the transformer-rectifier's output. The voltmeter and ammeter meters are both analog type and indicate the output voltage from 0 to 50 VDC and the amperage from 0 to 2500 A.

(18) "**STARTING CURRENT**" Switch (S431)

Each time the "**STARTING CURRENT**" push-button switch is pressed, the blue indicator light inside the push-button switch will glow and the present current limiting amperage setting will be displayed on the fault code meter. After a short period of time the starting current level will start incrementing, at 100 A increments, up to 2500 A. Once 2500 A has been reached, the incrementing will start over from the beginning.



1. Engine Specific PC Board [ESB] (A1)
2. Engine Interface PC Board [EIB] (A2)
3. Digital Control PC Board [CTL] (A3)
4. EF By-Pass Switch
5. Voltage Regulator PC Board [REG] (A4)
6. Regulated-Diagnostic Switch
7. Transformer-Rectifier PC Board [TRB] (A404) *{Optional}*
8. +5, -12 VDC Power Supply (PS1)
9. Circuit Breaker Support Bracket
10. Marker Lights Circuit Breaker, 10 A (CB11)
11. Engine Circuit Breaker, 10 A (CB4)
12. Controls Circuit Breaker, 5 A (CB7)

Control Box Interior Components
Figure 8

(19) "**DC OUTPUT**" Contactor Switch (S430)

Each time the "**DC OUTPUT**" push-button switch is pressed, the blue indicator light inside the push-button switch will glow indicating successful closing of the contactor and 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 NO. 1**" (or "**EF2 BYPASS**" for "**OUTPUT NO. 2**", if applicable) provides a means of by passing the 28 VDC interlock circuit for the output 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, a low-level, unregulated voltage of approximately 30 VAC may be produced at the generator output terminals due to the residual magnetism of the exciter.

(3) Circuit breakers (CB11, CB4, CB7)

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

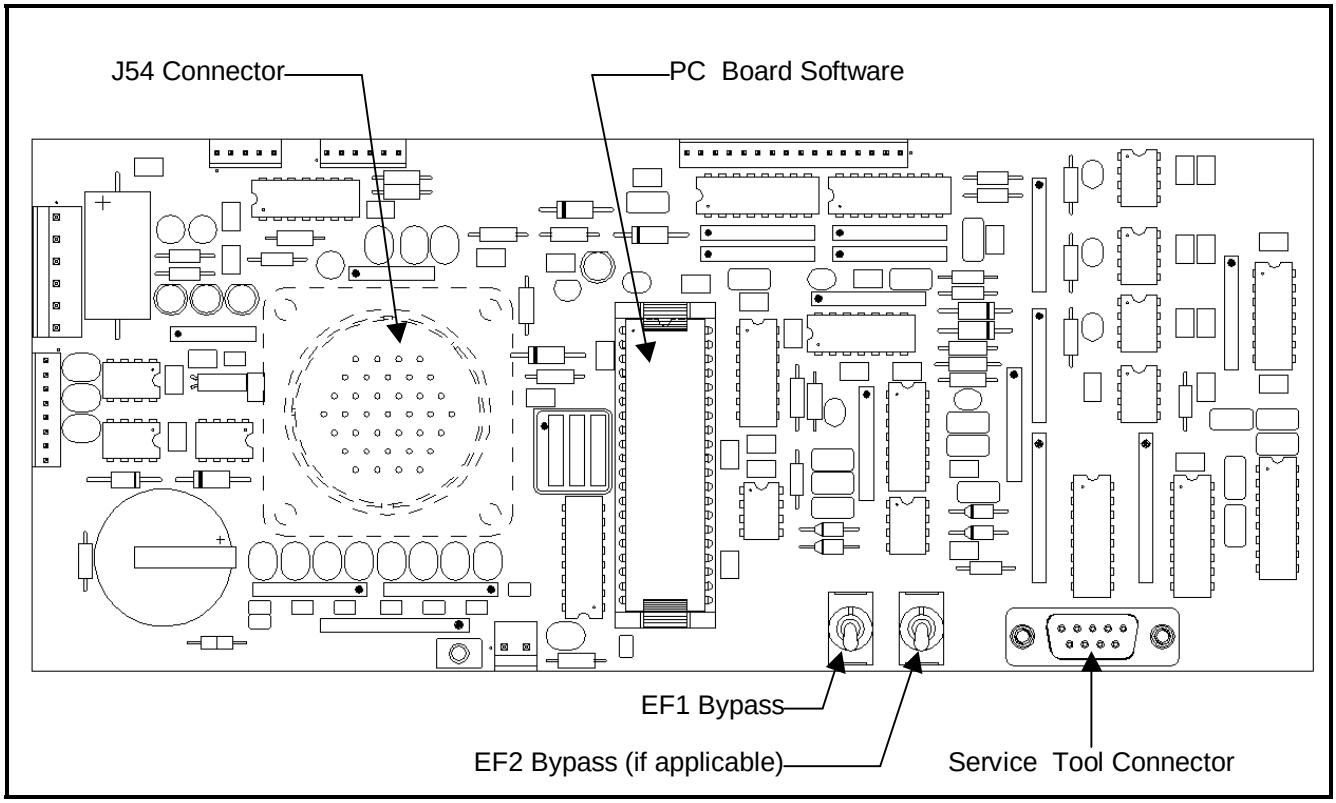
(4) Digital Control PC Board [CTL] (A3)

The digital control PC board (see Figure 9) is the center for all communications throughout the entire control system. All push-button panel commands run through the digital control PC board and 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.

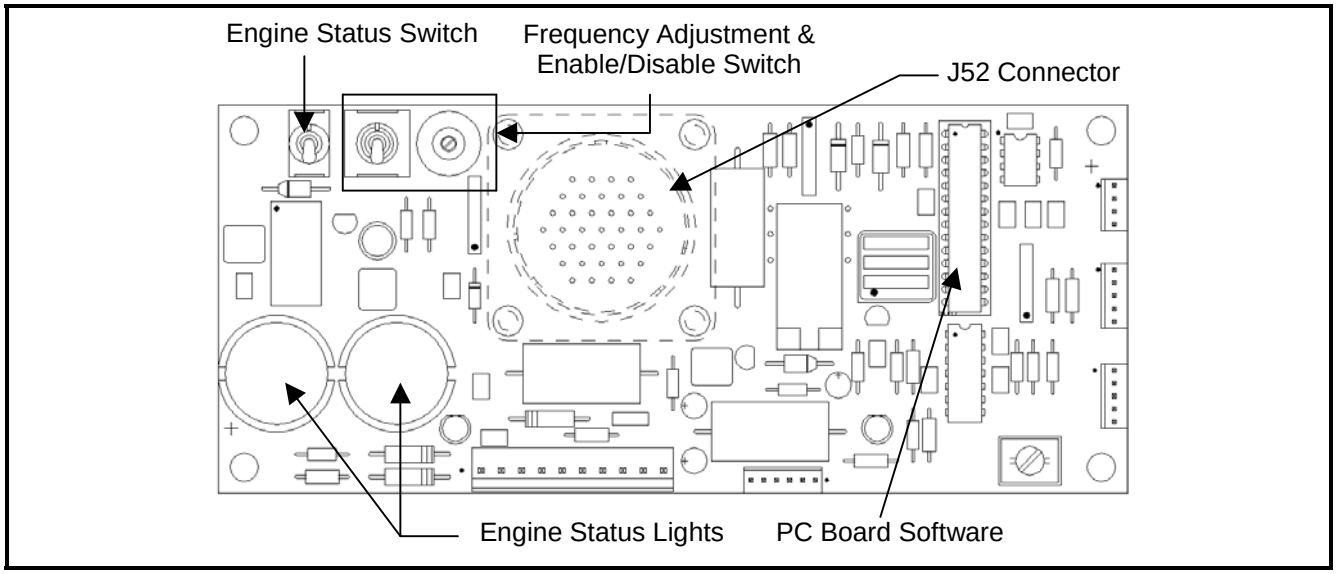
(5) Engine Specific PC Board [ESB] (A1)

The ESB (see figure 10) 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 (ECM). When the CTL senses the engine start button has been pressed it signals to the ESB, which then communicates to the ECM what mode of operation is required (idle or rated speed).

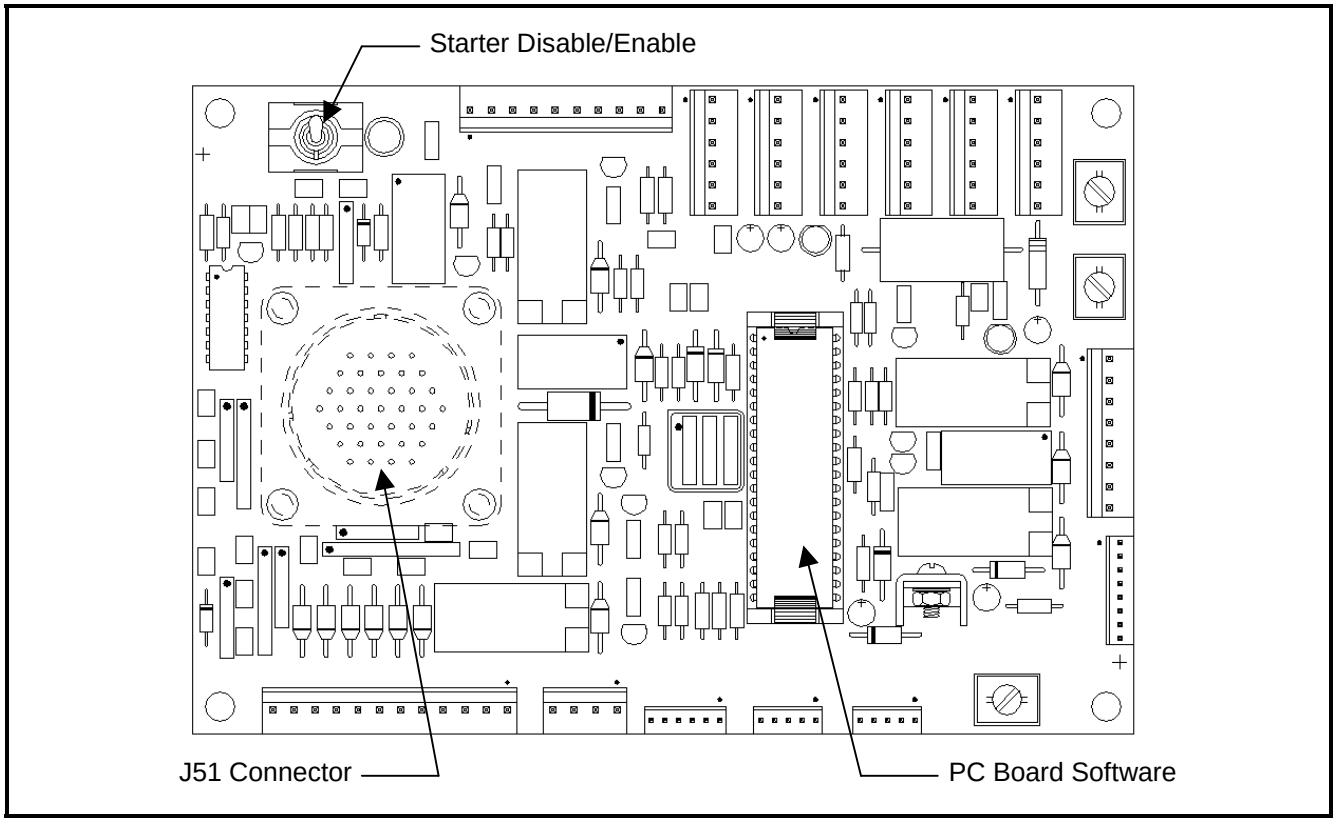
The ESB controls the "**FREQUENCY ADJUST**" switch that is used to enable the "**FREQUENCY ADJUST ENABLE/DISABLE**" potentiometer to test the over/under frequency fault limits of the generator set system. The ESB also controls the "**DATA REQUEST**" button and diagnostic indicator light to read the engine's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



Digital Control PC Board
Figure 9



Engine Specific PC Board
Figure 10



Engine Interface PC Board
Figure 11

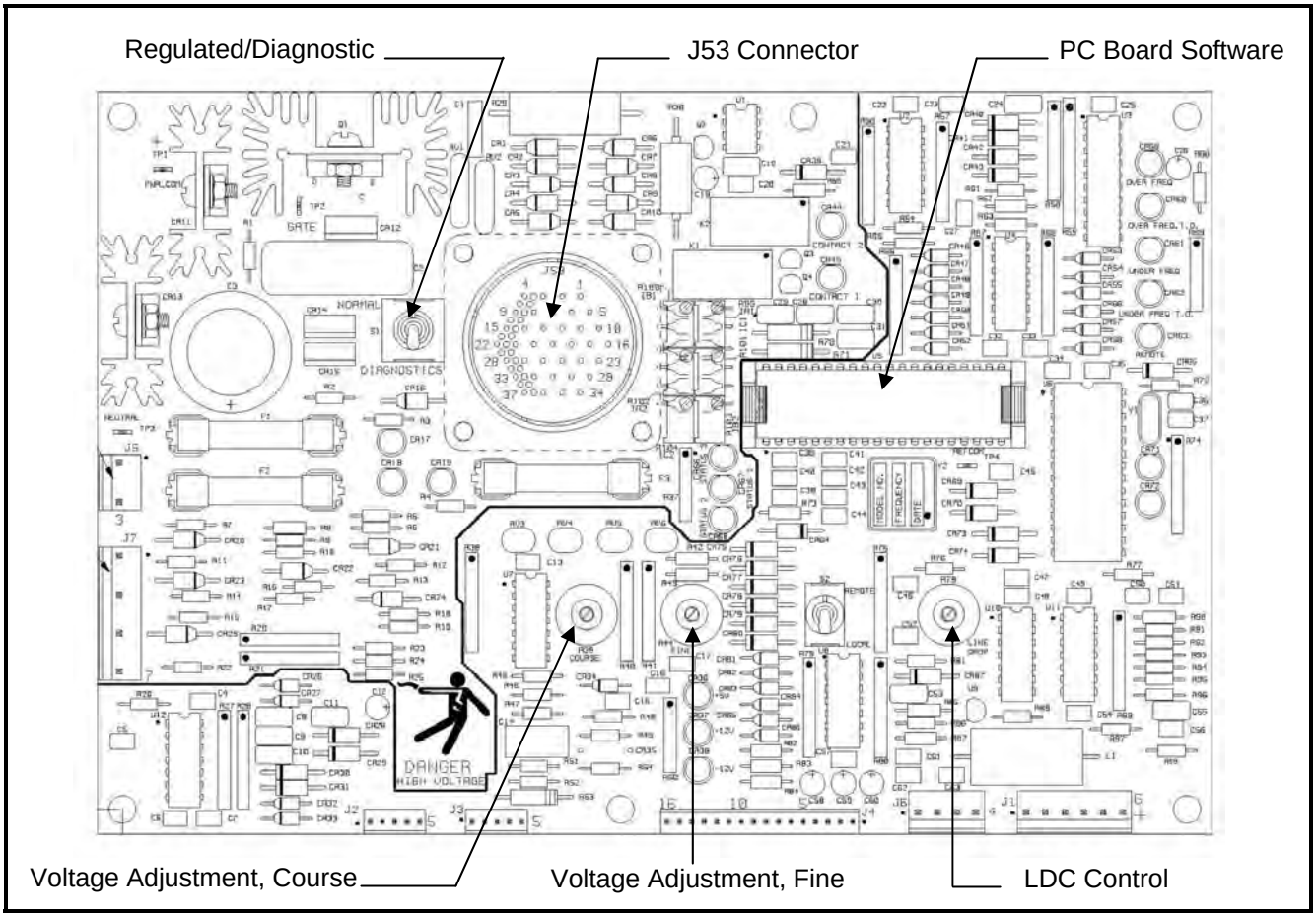
(6) Engine Interface PC Board [EIB] (A2)

The EIB (see figure 11) 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, and high air restriction. The warning switches signal the EIB when a fault occurs and 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.

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

This voltage regulator PC board (see Figure 12) is designed to provide voltage regulation for a three-phase, four-wire, 115/200-volt, 400-Hz brush-less 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 thus varying the field power supplied to the rotary exciter.



Voltage Regulator PC Board
Figure 12

a 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 the 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.

b When the alternator is loaded its terminal voltage decreases thus lowering the rectified three-phase voltage of the voltage sensing circuit. The sensing voltage is low in respect to its reference voltage thus 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.

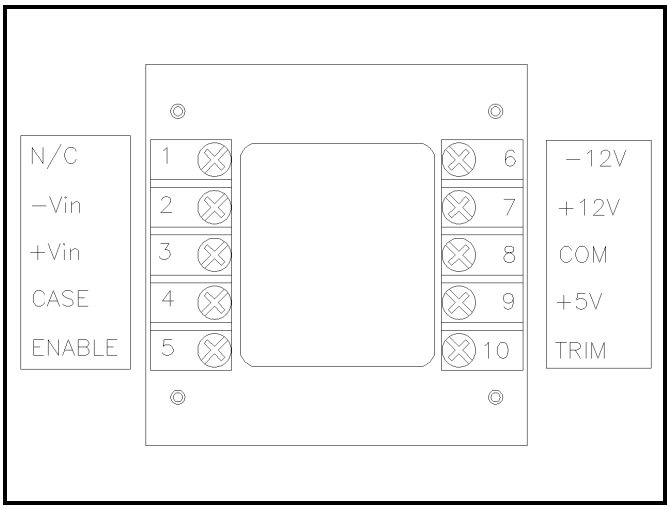
c When a load is removed from the alternator the alternator voltage rises. The rectified three-phase voltage-sensing signal increases thus causing this signal to be higher than the reference signal. The associated voltage regulator circuitry causes the field power of the rotary exciter to decrease thus lowering the alternator voltage until the voltage returns to regulated value.

d 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 transformer detects the magnitude of current flowing through the power cables from the alternator to its load and feeds 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) +5, -12 VDC Power Source (PS1)

Supplies the internal power distribution of +5 VDC and –12 VDC into the control system.

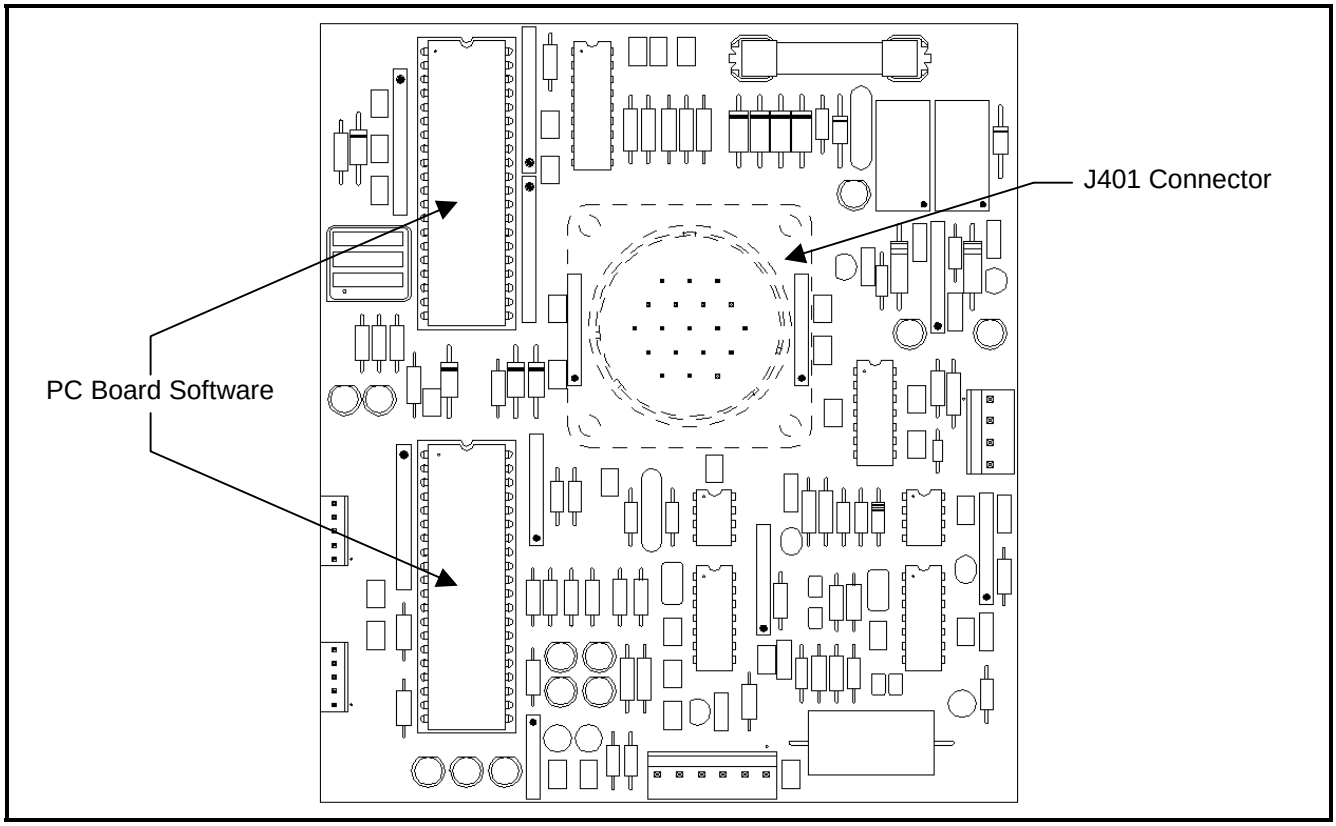


Control System Power Source
Figure 13

[Optional DC circuit, see manual in Appendix A, if supplied]

(9) Transformer-Rectifier PC Board [TRB] (A404)

The TRB PC Board (see Figure 14) 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 14

8) Power Module Panel Assembly

The power module panel assembly, sometimes referred to as the contactor panel, is the rear of the machine under the control box. The panel assembly provides a means of connecting and disconnecting the generator output to and from the load (i.e. aircraft or load bank).

a) Load contactor

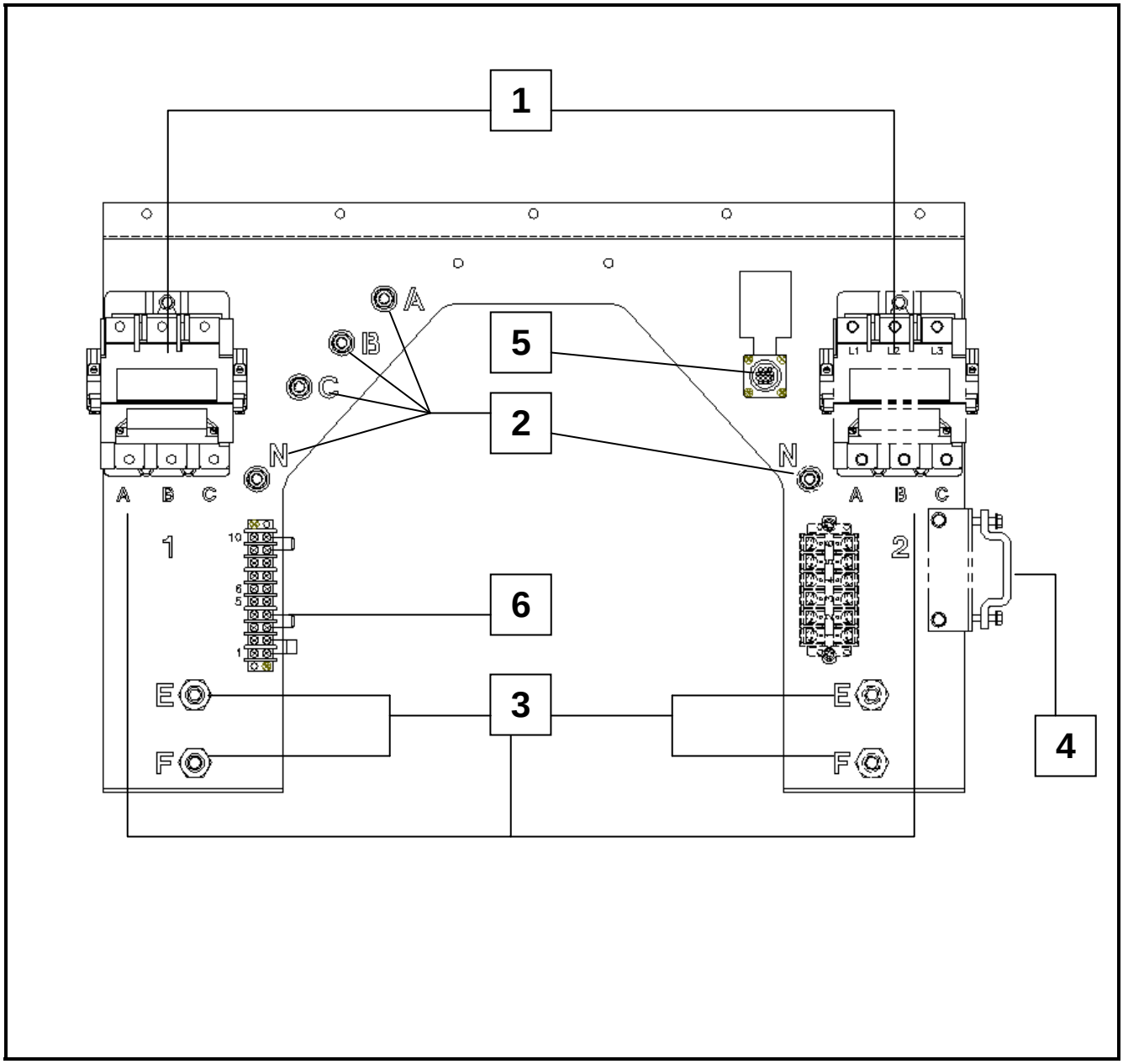
The load contactor contains a magnetic operating coil and four sets of contacts. The three larger contacts conduct three-phase AC generator output. A small contact set is connected to the Digital Control PC Board (CTL) for activating the protective monitor circuit.

b) Current transformer (CT1-CT3 or CT4-CT6 if second output installed)

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 transformer detects the magnitude and power factor of current flowing from generator to load. They feed a signal to the Voltage Regulator PC Board (REG) that interprets the signal and alters the exciter field current as required to maintain a constant 115/200 VAC at the load.



1. Load Contactors
2. Generator Leads Connection Points
3. Output Cable Connection Points
4. DC Cable Clamp (if applicable)
5. Wire Harness to Voltage Regulator
6. 60 kVA ID Resistor

Output Power Module Components
Figure 15

(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 217 amperes per output or 125% of rated load), the main overload sensing circuit sends signals to the contactor circuit to open the load contactor.

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

On each individual output the current transformers convert 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 moniters each individual output, as well as, the overall current for a dual output machines.

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.

NOTE: The overload protective system will function when any phase carries 123% to 127% of rated load. All times are plus or minus 25% and are non-adjustable.

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…

(5) Check to be sure the battery is connected correctly.

(6) Check the following for sufficient quantity:

a Fuel

The fuel tank is shipped empty. Press **"LAMPS"** push-button button to energize fuel gage when engine is stopped. Fill the fuel tank as required.

For recommended fuel specifications that meet the EPA/CARB/EURO emissions, refer to the Engine Manufacturers Operation and Maintenance Manual provided with this manual.

b Engine coolant

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

For nominal ambient operating conditions use a solution of 50% permanent antifreeze (Ethylene glycol) and 50% clean water.

As an alternative, under high ambient operating conditions, using 100% water with a coolant additive conditioner, to prevent corrosion and pitting inside the engine and radiator, will improve the cooling system performance. 100% water will not protect the engine from freezing temperatures.

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

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

c Engine lubricating oil level

The oil gage rod has “H” high mark and “L” low level mark 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.

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

Oil Fill and Oil Level Check Locations
Figure 1

b) Installing Three-Phase AC Output Cables

The generator set may be shipped with or without aircraft cables per the user’s request.

The conductor size recommended for AC output cables is 2/0 AWG with two (2) No. 12 control wires for the EF connection. The 2/0 cable (for A, B, C, and N) should be equipped with a terminal having

at least a 3/8-inch diameter mounting hole. Mounting holes in the 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 and disconnect the emergency stop button.

(2) Loosen screws on cable clamps.

(3) Route cables through cable clamps and up to the load side of the output contactor.

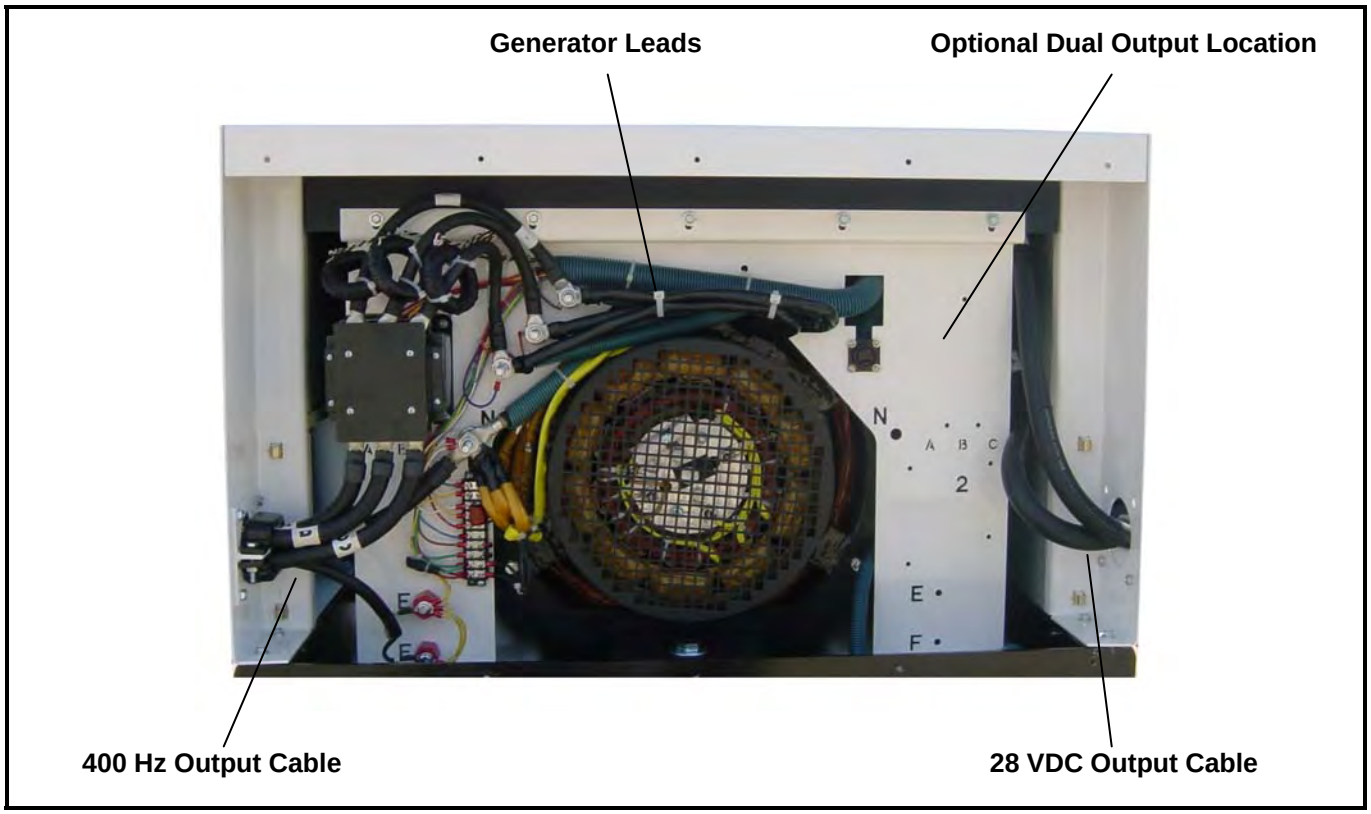
(4) Connect the phase cable terminal lugs to the appropriate terminal stud on the contactor. Cable lug “A” belongs on terminal stud “A”, “B” to “B”, and “C” to “C”.

(5) Connect the cable’s neutral terminal lug securely to the neutral (ground) stud on the power module assembly.

(6) Connect the “E” and “F” cables to the “E” and “F” studs on the power module assembly.

(7) Tighten cable clamp screws securely, but avoid damage to cable insulation.

(8) Reconnect the emergency stop button and replace lower panel.



Output Cable Installation
Figure 2

c) Field Commissioning

If required, a standard field commissioning instructions can obtain by contacting Hobart Ground Power.

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/or disconnect battery negative terminal.

(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. If a heated environment is not possible, make certain the cooling system antifreeze solution is adequate to protect below the lowest temperatures expected during the storage period.

(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. 76A1354-001) in the unit before packaging.

(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: Also refer to the Engine Manufacturer's Operation Maintenance Manual for engine storage recommendations.

(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.

If possible, the unit may be stored for long periods with no special preparations if the engine can be operated once each week as follows:

WARNING

ENSURE adequate ventilation before starting the engine.

(6) Start the engine and operate under full load until coolant temperature has reached at least 190º F (88º C).

(7) While the engine is running, ensure that normal operating controls are in good working condition before shutting down and storing.

If weekly operation is no longer possible prepare the unit as specified above.

3) Preparation for Shipment

a) Disconnect battery negative terminal before shipping.

b) During long shipments, vibration and jolting may loosen the generator set retaining hardware. All hardware should be checked at final destination.

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.

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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 400-Hz power or 28.5V DC power.

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. The control panel lights circuit breaker can be checked by pressing the panel "**LAMPS**" push-button switch. If panel lights operate, the circuit breaker, switch, and lamps are good.

(6) Make certain the "**STARTER ENABLE/DISABLE"** switch is enabled (located on EIB), and the **"FREQUENCY ADJUST"** switch is disabled (located on ESB).

b) Normal Engine Starting Procedures

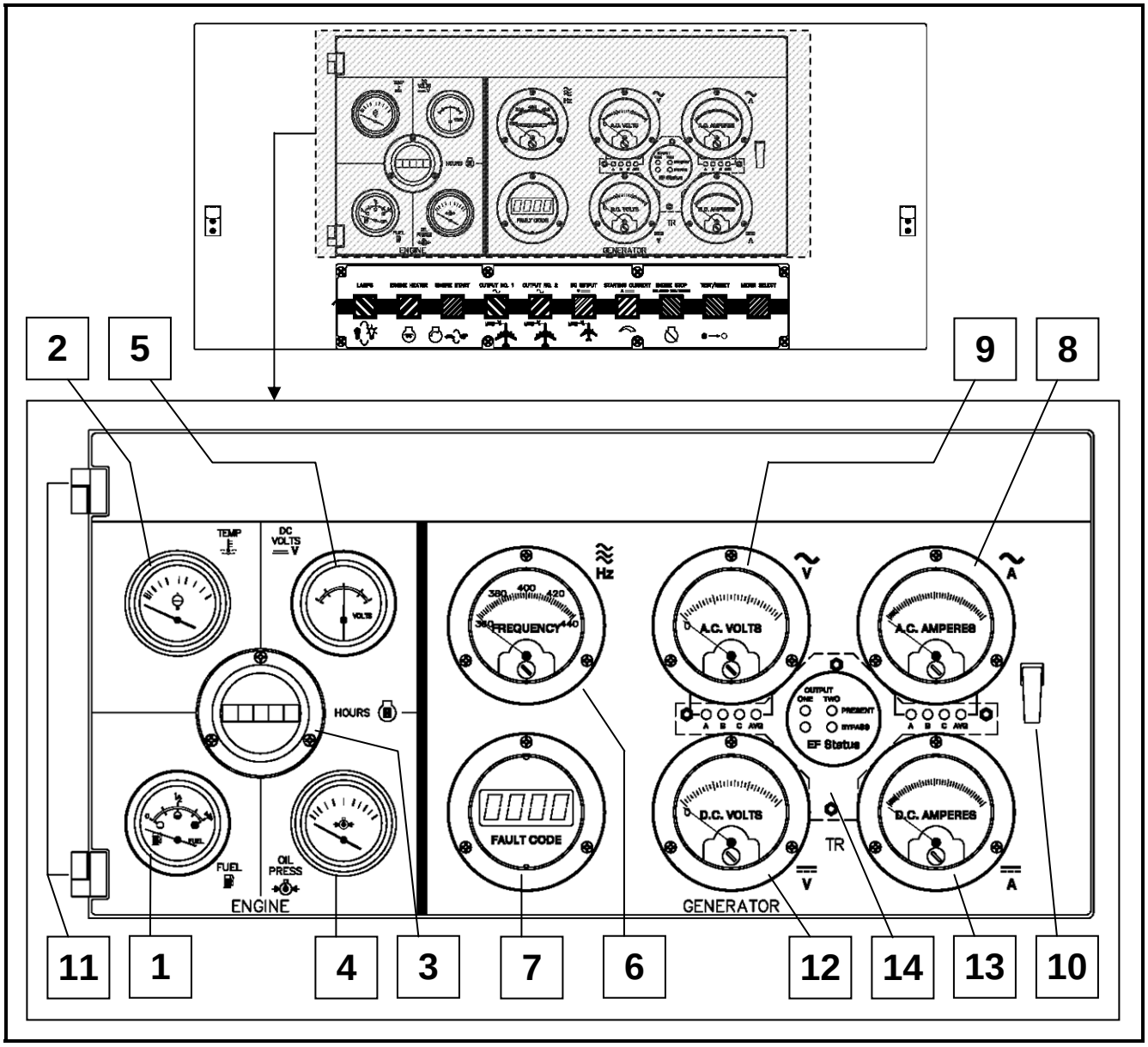
Engine starting procedures are outlined below. The engine's operating controls and monitoring instruments are illustrated in Figure 1 and 2.

CAUTION

Also refer to any special operating instructions in the engine manufacturer's operational manual when starting engine for the first time.

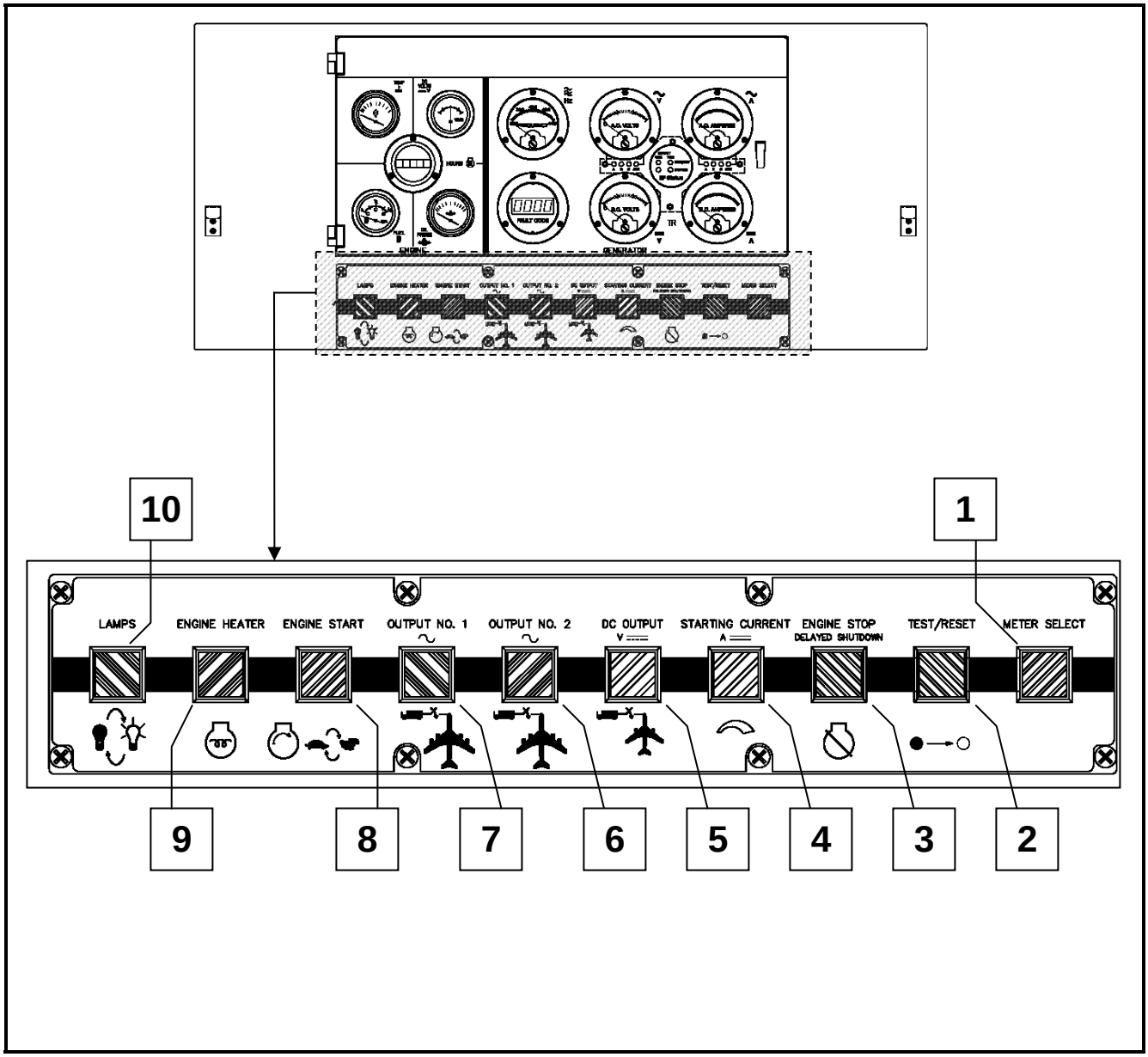
(1) If illumination is required, press "**LAMPS"** push-button switch one time. Pressing this button switch also activates the fuel gauge.

(2) On days when the ambient temperatures are below 50° F (10° C), press the **"ENGINE HEATER"** push-button switch to engage the air intake heater prior to starting the engine. The light in the button will illuminate when the intake heater is energized (if the light does not stay illuminated, the engine is ready to start) and will go off when the intake heater is de-energized, thus signifying the engine is ready to start.



1. Fuel Gage (M13)
2. Engine Coolant Temperature Gauge (M24)
3. Running Time Meter (M4)
4. Oil Pressure Gage (M25)
5. Battery Voltmeter (M5)
6. AC Frequency Meter (M3)
7. Fault Code Meter (M6)
8. AC Ammeter (M1)
9. AC Voltmeter (M2)
10. Adjustable Grip Latch
11. (2) Control Panel Door Hinge
12. DC Voltmeter (M402) *[Optional with TR]*
13. DC Ammeter (M401) *[Optional with TR]*
14. Front LED PC Board (A5) [Shown Opposite Side]

Control Panel Door
Figure 1



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

Control Push-Button Switch Panel
Figure 2

CAUTION	Never use an ether start system on engine with an intake air heater.

(3) Press the green **"ENGINE START"** push-button switch and hold until the engine starts. The engine will start in the idle speed mode 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.

If the push-button switch is released and 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 and released 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 to 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.

CAUTION	The ground power unit should not be towed with the engine running to prevent possible damage that may result (i.e. engine cooling fan contact fan shroud).

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 press and release the red "**EMERGENCY STOP/RESET BUTTON"** below the control box panel.

CAUTION	Do not crank the engine for more then 15 seconds continuously. Allow the starter to cool for 15 seconds between attempts.

d) AC 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 2400 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 the load contactor (or both load contactors) by momentarily pressing the load contactor push-button switch (**"OUTPUT NO. 1"** or **"OUTPUT NO. 2"**, if applicable). The yellow or orange indicating light of the push button switch that is pressed 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 the 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) If a fault condition occurs (i.e. over-voltage, under-voltage, under-frequency, over-frequency, or overload) the output circuit will automatically open the load contactor and display a fault code to signal the operator which 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 licensed and trained technicians should work on this generator set.

e) Failed AC Power Delivery

If the contactor indicating light should go 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"**, if applicable).

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"**, if applicable) **"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 Push the load contactor (**"OUTPUT NO. 1"** or **"OUTPUT NO. 2"**, if applicable) push-button switch to open the contactor. The indicating light (yellow or orange depending on the contactor used) in that push-button switch 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, and lights after approximately 3 to 5 minutes.

c Disconnect output cable from aircraft after the engine has reached idle speed only.

(2) Emergency conditions

a Depress the "**EMERGENCY STOP BUTTON**" located under the control box panel. When pushed this button instantly removes battery power and shuts the generator set off. The button must be pulled back out to reset itself 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 switch 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 ground power unit 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 ground power unit 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	10	250	500	1000	1500	2000
Calendar Interval		**Daily**	**3 Mo.**	**6 Mo.**	**1 Yr.**	**1.5 Yr.**	**2 Yr.**
Symbol	**AR**	**A**	**B**	**C**	**D**	**E**	**F**
Change Air Cleaner Cartridge	X						
Check Coolant Hose and Clamps	X						
Check Air Cleaner		X	X				
Check Crankcase Oil Level		X					
Check Crankcase Breather Tube		X					
Drain Fuel/Water Separator Element		X					
Check Coolant Level		X	X				
Check for Leaks and Correct		X					
Check Exhaust System		X					
Air Intake Piping and Hoses			X				
Check Charge-Air-Cooler and Hoses			X				
Check Radiator Core and Hoses			X				
Check Belts Conditions			X				
Check and Record Oil Pressure			X				
Check Engine Coolant				X	X		
Change Lubricity Fuel Filter Element				X			
Change Primary Fuel Filter Element				X			
Change Oil and Filter Element				X			
Check Oil Pressure and Record				X			
Engine Cylinder Carbon Build-Up				X			
Check Cooling Fan Belt Tensioner					X		
Check Fan Hub and Drive Pulley					X		
Drain and Flush Cooling System					X		
Check Vibration Damper					X		
Check Engine and Generator Mounts					X		
Steam Clean Engine						X	
Check and/or Adjust Valve Clearance							X
Check Alternator							X
Check Starter Motor							X
Clean Cooling System Cores			Spring & Fall				

Maintenance Schedule
Figure 1 (Sheet 1 of 2)

Hourly Interval	AR	10	250	500	1000	1500	2000
Calendar Interval		**Daily**	**3 Mo.**	**6 Mo.**	**1 Yr.**	**1.5 Yr.**	**2 Yr.**
Symbol	**AR**	**A**	**B**	**C**	**D**	**E**	**F**
Engine (continued)							
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			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 all Components				X			

Maintenance Schedule
Figure 1 (Sheet 2 of 2)

3) Inspection/Check

a) General

Inspections, checks, and maintenance are described in general with more specific and detailed information that can be found in Chapter 2, Section 2 and 3.

Always refer to the engine manufacturer's operations and maintenance manual for assistance and the most update to date information on inspection, repair and replacement procedures.

b) "AR" Checks and Operations (As Required)

(1) Engine

a Change Air Cleaner Cartridge

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

b Check Coolant Hose and Clamps

Check and tighten all coolant hose clamps, air intake hose clamps and exhaust clamps as required. 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 and/or Adjust Output Voltage

Check the output voltage and be sure it is set for 115/200 VAC ± 1 V. Adjustments can be made using the fine and course adjustment potentiometer located on the Voltage Regulator PC Board (REG).

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

(1) Engine

a Check Air Cleaner

Check for excessive dirt build-up and/or air blockages. Change or clean the filter as necessary to allow the proper amount of air flow to the engine.

At each daily start-up, observe the air cleaner indicator light. If this light comes on, it indicates that the air cleaner should be changed or it is obstructed.

b 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 gauge 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.

c Check Crankcase Breather Tube

Inspect the breather tube for sludge, debris or ice in the tube. Inspect the tube more frequently in icy conditions.

d Drain Fuel/Water Separator Element

The life of the fuel pump and injectors can be extended if the operator drains water from the fuel/water separator on a daily basis.

(i) Provide a container for catching drained fuel and water.

(ii) Open the drain valve on the fuel/water separator.

(iii) Drain the filter until clear fuel is visible.

Fuel/Water Separator Drain
Figure 2

(iv) Tighten the drain valve.

(v) Safely dispose of drained fuel.

(vi) Purge air from fuel system if necessary.

e Check Coolant Level

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

WARNING

Cooling system is pressurized. To avoid personal injury, DO NOT remove radiator cap when engine is hot. Wait until the engine is below 120° F [50° C] before removing the radiator cap.

f 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.

g Check Exhaust System

Visually inspect muffler and exhaust pipes for rust, leaks and signs of approaching failure.

WARNING

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

(1) 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 battery is charging.

c Check All Engine Meters

Check the operation of all the engine meters.

(3) Electrical (400 Hz System)

a 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. If the cable head sockets are exposed, even just a little, the cable head or cable should be changed immediately.

b Check Volt, Amp & Frequency Meters

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

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

(1) Engine

a Check Air Intake Piping and Hoses

Visually inspect piping and hoses for wear points and damage. Inspect clamps for proper tightening to prevent air from leaking. Check for corrosion under the clamps and hoses to prevent corrosive products and dirt from entering the air intake system.

b Check Charge-Air-Cooler and Hoses

Inspect the charge-air-cooler for dirt and debris blocking the fins. Clean as necessary. 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 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.

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

d Check Belts Conditions

Inspect the belt for cracks and proper tension. Refer to the engine operation and maintenance manual for details on belt repair and tightening.

e Check Air Cleaner

Check for excessive dirt build-up and/or air blockages. Change or clean the filter as necessary to allow the proper amount of air flow to the engine.

At each daily start-up, observe the air cleaner indicator light. If this light comes on, it indicates that the air cleaner should be changed or it is obstructed.

h Check Coolant Level

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

WARNING

Cooling system is pressurized. To avoid personal injury, DO NOT remove radiator cap when engine is hot. Wait until the engine is below 120° F [50° C] before removing the radiator cap.

f Check and record oil pressure

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

(2) Electrical (12 VDC system)

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

a Battery Electrolyte Level (if applicable)

Battery electrolyte level must be maintained above top of plates. Add distilled water as required.

b Check Battery

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

CAUTION

DO NOT over fill battery.

b 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 E-F By-Pass Operation

Check the operation of the E-F bypass system. This check should be done with a load bank that has EF capability.

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

(1) Engine

a Check Engine Coolant

Check the coolant level and fill as necessary.

Check the anti-freeze concentration. Use a 50/50 mixture of water and ethylene glycol as the preferred mixture.

b Change Lubricity Fuel Filter and Primary Fuel Filter Element

Change all fuel filter elements. The lubricity fuel filter can only be changed with a lubricity fuel filter replacement.

c Change Oil Filter Element.

The oil filter must be changed with the every oil change.

g Check and record oil pressure

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

h Engine Cylinder Carbon Build-Up

To prevent the build-up of oil and sludge in the cylinders and prevent "wet stacking" of the engine a full operating load should be placed on the unit for 30 minutes during each preventative maintenance cycle.

(2) Electrical (12 VDC system)

a Check Wiring and Connections

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

(3) Electrical (400 Hz System)

a Check and/or Adjust Output Voltage

Check the output voltage and be sure it is set for 115/200 VAC ± 1 V. Adjustments can be made using the fine and course adjustment potentiometer located on the Voltage Regulator PC Board (REG).

b Inspect Wiring and Connections

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

c Clean and Inspect all Components

A periodic clean of all control PCB's, terminal blocks, terminal studs, relays, fuse holders, etc. will help eliminate hot spots and possible premature failure.

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

(1) Engine

a Check Cooling Fan Belt Tensioner

Check the tensioner arm, pulley and stops for cracks. Tensioner must be replaced if cracks or found.

Check for belt location on pulley. The belt should be centered or in the middle of the pulley. Incorrect belt location can cause premature belt wear, belt roll-off, or tensioner bushing wear.

b 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.

c Drain and Flush Cooling System

Periodic flushing of the coolant system is essential to efficient engine heat transfer and preventing engine cooling jacket damage. Refer to the engine manufacturer's operations and maintenance manual for assistance and the most update to date information.

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.

d Check Engine and Generator Mounts

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

(i) Engine mount bolts must be torqued to 136 N-m (100 ft-lb).

(ii) Generator mount bolts must be torqued to 122 N-m (90 ft-lb).

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. A clean engine will run cooler and develop fewer hot-spots. Steam cleaning is one of the most satisfactory methods of cleaning an 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.

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

(1) Engine

a 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.

b Check Alternator

Check the drive belt and alternator pulley to be sure the alternator is rotating properly.

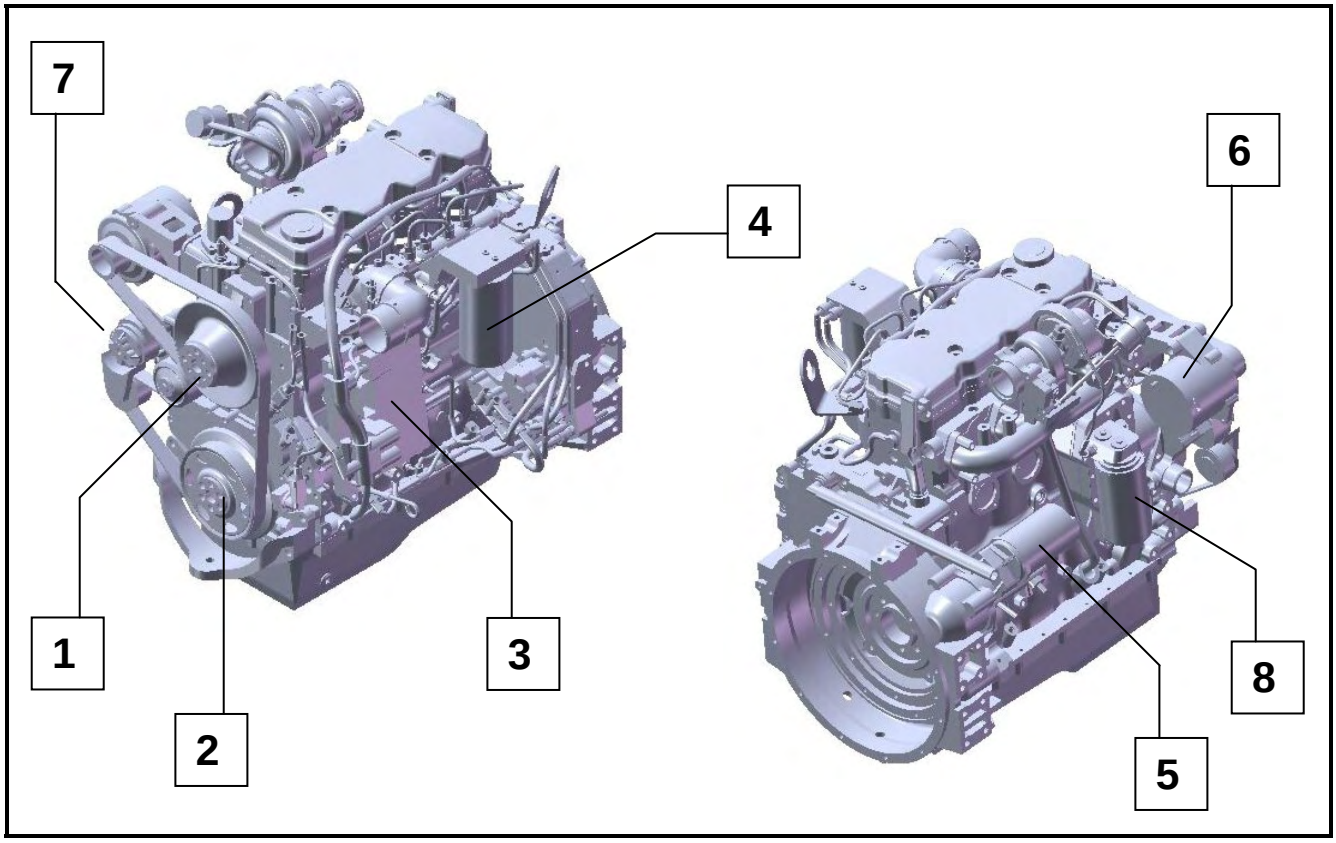
Check all wiring connections for cleanliness, tightness and defects.

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

c Check Starter Motor

Check all wiring connections for cleanliness, tightness and defects.

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



1. Fan Pulley
2. Vibration Damper
3. ECM (Electronic Control Module)
4. Primary Fuel Filter (Remote Mounted)
5. 12 VDC Starter
6. 12 VDC Alternator
7. Belt Tensioner
8. Oil Filter

Engine Accessories
Figure 3

j) Seasonal Maintenance Checks Spring/Fall (Engine)

(1) Clean Cooling System Cores

Cleaning the radiator core and the charge-air-cooler core will keep the cooling system running efficiently and keep the engine operating temperatures within limits to meet the emissions standards (EPA/CARB/EURO).

(2) Check All Electrical Connections

Check all wiring connection. Check for damages wires and connections.

Clean and remove all dirt and debris.

(3) Check Thermostats and Seals

Check thermostat operation and all engine seals.
Refer to the engine manufacturer's operations and maintenance manual for assistance and the most update to date information.

4) Lamps Circuit breakers, and Fuses

a) Check all lamps daily

The lamp chart lists all lamps with their location and identifying trade number in table below.

b) Check circuit breakers and fuses as required.

The circuit breaker chart lists all circuit breakers with their location, size, and type.

c) Check all fuses

The fuse chart lists all fuses with their location, size, and type.

Item Protected	Location	Quantity	Size
Engine Air Intake Heater	Top of Inside Bulkhead	1	100 A
Load Contactor Circuit	Voltage Regulator PCB	1	1 A
Voltage Regulator PCB	Voltage Regulator PCB	1	1 A
Field Voltage Circuit	Voltage Regulator PCB	1	5 A
Transformer-Rectifier *[Optional]*	Transformer-Rectifier PCB	1	1 A

Fuse Identification Chart
Figure 4

Light Identification	Location	Lamp (Bulb) as per Lamp Industry Trade Number or Description
Instrument Panel Lights	Switch Panel	67
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	53

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	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 was provided in Section 1 of this chapter. Each step of the schedule was also covered. 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	286897-030
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 290300-011.

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: hgpparts@itwgsegroup.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 following figures and tables.

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's "Operation and Maintenance Manual" and incorporated here to make them more readily available to operators and maintenance personnel.

(1) Lubrication schedule

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.

(3) Oil viscosity

A temperature and oil viscosity index chart is shown below. For operation at temperatures consistently below 5º F (-15º 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.

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 20 quarts (19 liters).

b Remove drain plug in the oil pan.

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.

Lubrication System
Figure 1

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 hours or 3 month intervals thereafter. Use oil SAE 15W40 heavy duty oil which meets API CH-4/SJ or CI-4/SK.
Capacity	11.6 quarts (11 liters)
Oil Filter Replacement	Oil Filter Replacement-Equipment Manufacturer No. 286897-029 Oil Filter Replacement-Engine Manufacturer No. LF9370
Lube Oil Viscosity Required as per Ambient Temperatures	**VISCOSITY AMBIENT** — **TEMPERATURE CONDITIONS** SAE 15W40 (Preferred) — 5ºF (-15ºC) and above for most climates CI-4 and SAE 10W30 — -10ºF to +70ºF (-23ºC to +21ºC) Winter conditions SAE 5W30 — -15ºF to +70ºF (-26ºC to +21ºC) Artic Conditions SAE 0W30 — -30ºF and below to 32ºF (-34ºC and below to 0ºC)
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 filters elements every 500 hours or after 3 months of use, whichever comes first.
Coolant	Check coolant level daily. Engine coolant capacity (system): 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 2

Symbol	Name	Specification	Notes
1	Grease, General Purpose	MIL-G-3545	Excludes those of sodium or soda soap thickness.
2	Oil, Engine, Heavy Duty	API Class CC	Must contain as but not more than 1.85%
3	Dry Graphite Lubricant (for trailer brake cables)	MIL-T-5544, or equivalent	Use on brake cables. DO NOT use general purpose grease.

Lubricants Chart
Figure 2

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

(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.

f Clean the drain plug and install when engine oil has completely drained.

g Refill the crankcase with new clean oil that meets engine manufacturer's recommendations.

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.

h Start engine and check oil pressure at once. Allow engine to idle for 5 minutes, check for leaks, than stop the engine.

i 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 may be discarded when dirty. 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 and replaced by removing the rear 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 hood for obstructions. If any obstructions are present, remove them.

(2) Check all connections for proper seal.

b) Changing the Air Filter

(1) Remove the rear air cleaner housing.

(2) Remove end and replace the filters element.

(3) Replace the air cleaner housing.

c) Disposal

Normal trash pick-up 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.

For recommended fuel specifications that meet the EPA/CARB/EURO emissions, refer to the Engine Manufacturers Operation and Maintenance Manual provided with this manual. In general, fuels meeting the properties of ASTM designation 2D will result in optimum engine performance.

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 providing good cloud point temperatures, but result in a lighter fuel with 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 a fuel tank, fuel supply line, fuel/water separator (lubricity filter), fuel lift pump, engine fuel filter, 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 into the fuel tank. The fuel tank must be removed and flushed out if objects are found in the fuel filters.

b) Fuel Supply Line

The fuel supply line takes fuel from the tank and delivers it to the fuel/water separator. No maintenance is required.

c) Fuel/Water Separator (Lubricity Filter)

The fuel/water separator in mounted on the inner wall. Its function is to remove foreign material, extract water from the fuel before it enters the fuel lift pump and automatically add lubricity additives to the fuel. Daily draining of the filter/water separator is required.

(1) Draining the fuel/water separator.

a Open drain valve

b Drain accumulated water and contaminants.

c Close drain valve.

(2) Priming fuel/water separator.

a Loosen the vent plug.

b Pump until fuel purges at the vent plug.

c Close the vent plug, start the engine and check for leaks,

d Correct leaks as necessary with the engine off.

(3) Changing the fuel water/separator element.

a The filter element replacement part number:

- Equipment Manufacturer Part No. 286897-031
- Engine Manufacturer Part No. FS20022

b Drain off some fuel by loosening the vent plug and opening the drain valve.

c Shut off fuel valve.

d Remove the element and clean the O-ring gland in the filter head.

e Apply a coating of clean fuel or motor oil to the new O-ring and element seal.

f Screw in the new fuel filter “snug”. Check that the cartridge is seated correctly against the gasket and tighten with a final half turn. DO NOT USE OVER TIGHTEN!

g Open fuel valve

h With the vent plug still loosened pump knob until fuel purges at the vent plug. Close the vent plug, start the engine and check for leaks, correct leaks as necessary with the engine off.

Lubricity Filter

Primary Filter (Remote Mount)

Engine Fuel Filters
Figure 4

c) Fuel Pump

The fuel pump supplies pressure to the fuel system so the diesel fuel can circulate freely. A consistent check of the fuel pressure maybe necessary at times, because a loss in fuel pressure in the fuel line may indicate a faulty fuel pump.

d) Engine Fuel Filter (Primary Filter)

The engine filter removes the smaller particles not removed in the pre-filter before the fuel enters the engine's fuel pump.

(1) Changing the engine fuel filter

a Replacement fuel filter part number:

- Equipment Manufacturer Part No. 286897-036
- Engine Manufacturer Part No. FF5612

b The fuel filter must be change after every 500 hours.

c Shut off fuel valve.

d Place a pan underneath the fuel filter to catch spilled fuel.

e Remove the fuel filter.

f Catch any fuel.

g Clean any dirt from the filter head.

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.

i Fill new filter with diesel fuel

j Screw in the new fuel filter "snug". Check that the cartridge is seated correctly against the gasket and tighten with a final half turn. DO NOT USE OVER TIGHTEN!

k Open fuel valve.

l With the vent plug still loosened pump knob until fuel purges at the vent plug. Close the vent plug, start the engine and check for leaks, correct leaks as necessary with the engine off.

e) Fuel Lift Pump

Observe for leaks. Refer to a local engine manufacturer's agent for maintenance or repair.

f) Fuel Return Line

The fuel return line 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 by 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 (1.03 bars).

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 or consult the local engine manufacturer's representative.

(1) Filling Radiator

A fully formulated type antifreeze meeting ASTM4985 or ASTMD6210 are acceptable for use in the cooling system.

CAUTION	**DO NOT** mix brands or type of antifreeze. A solution containing two or more types of antifreeze is impossible to test accurately.

(2) 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 and the radiator assembly.

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 over 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.

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 outward.

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 the radiator drain valve is 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.

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

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 one belt thickness per foot of deflection.

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

The following 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.

2) Testing the 400 Hz. Generator Set

a) Pre-operational Test Procedures

(1) Connect the output cable to a load bank. If using a dual output unit, use cables of the same size and length as those to be used in service.

(2) Make certain there is sufficient lubricating oil and coolant in the engine.

(3) Inspect for oil, fuel and coolant leaks.

(4) Be sure the fuel shutoff valve on the unit is open.

(5) Ensure 12 VDC power is available to the engine starting system.

(6) Make certain the "STARTER **ENABLE/DISABLE"** switch is enabled (located on EIB), and the **"FREQUENCY ADJUST"** switch is disabled (located on ESB).

(7) Check that all circuit breakers are reset. The control panel lights circuit breaker can be checked by pressing the panel "**LAMPS**" push-button switch. If panel lights operate, the circuit breaker, switch, and lamps are good.

(8) Make a general inspection of all wiring, and terminals. Inspect the equipment to be certain there are no obstructions and no damage will result from starting the engine.

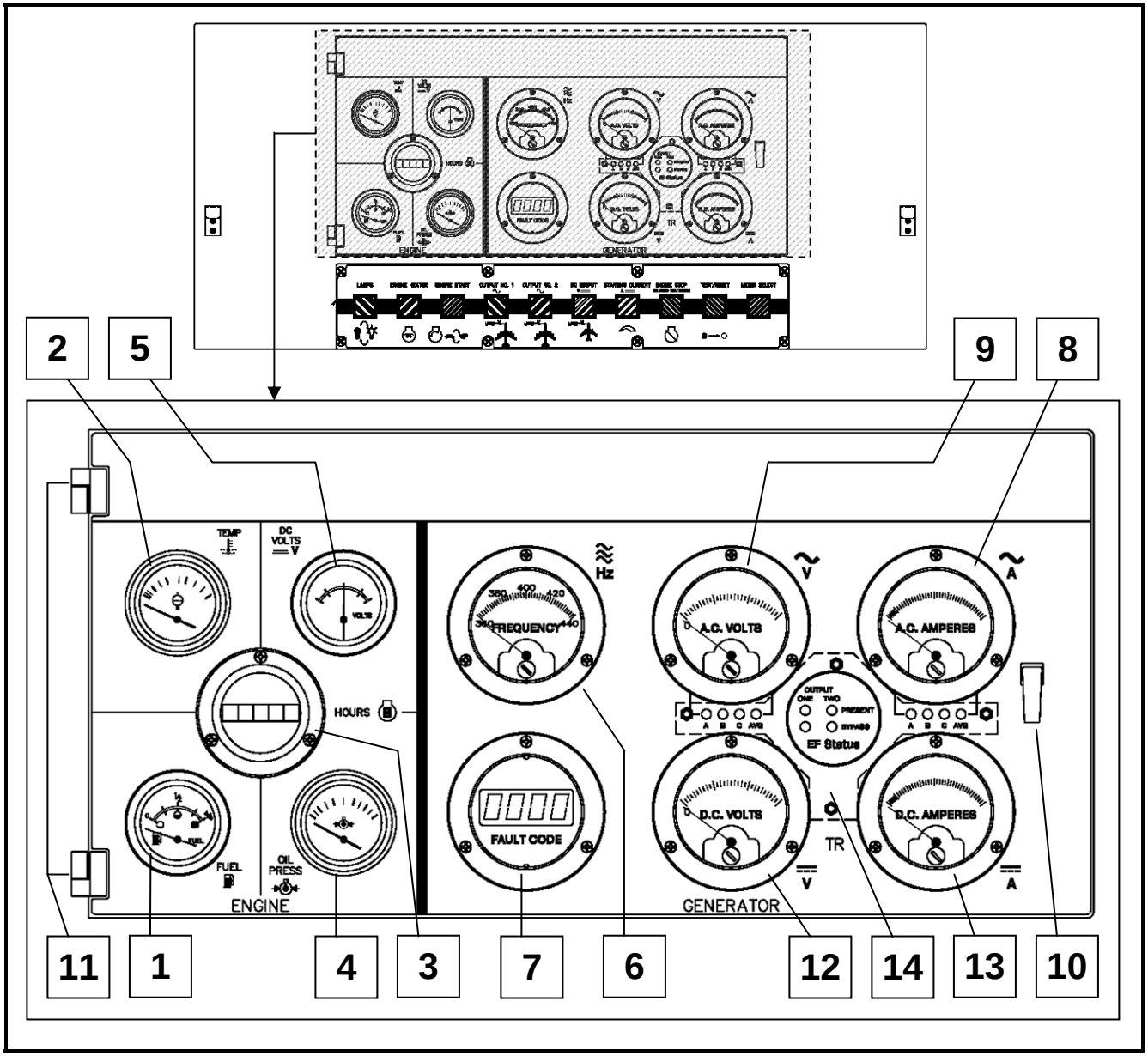
b) Operational Test Procedures

(1) Start the engine in accordance with instructions in Chapter 1, Section 3.

(2) Check operation of engine instruments: fuel level gauge, voltmeter, coolant temperature gauge, oil pressure gauge and hour meter.

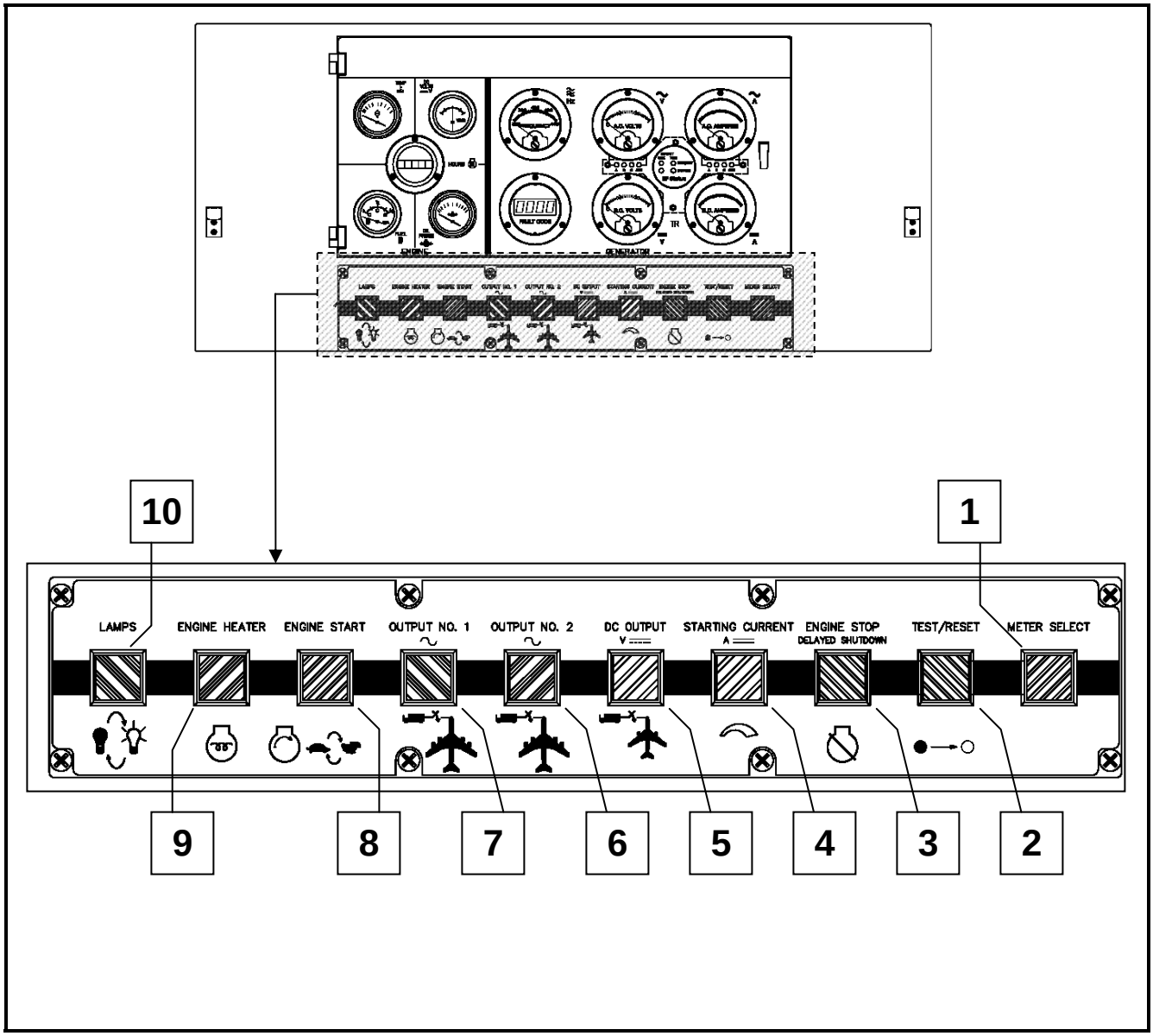
(3) Check engine idle speed. Should be 1000 +/- 25 RPM (a stroboscope can be used to perform this check).

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



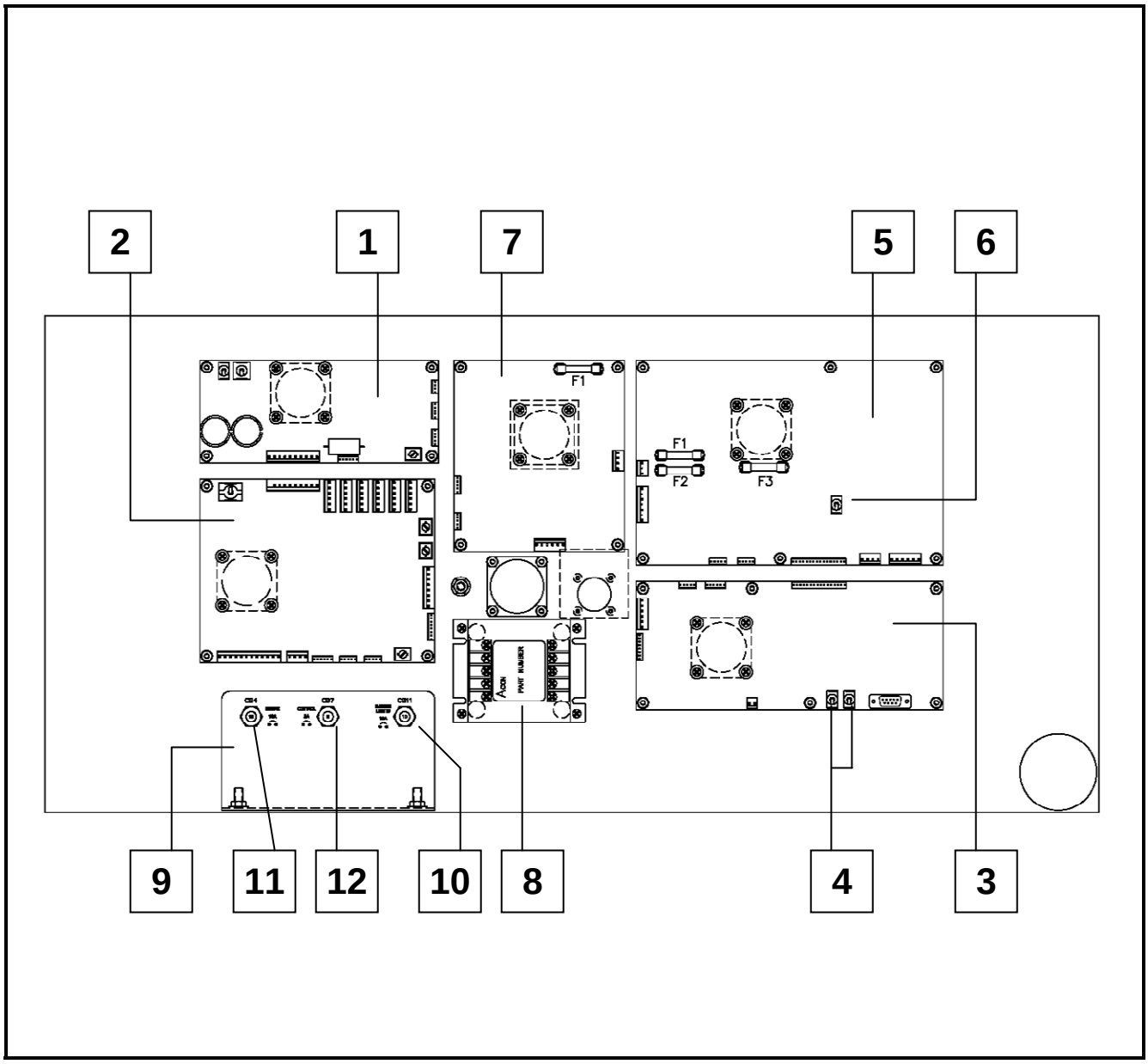
1. Fuel Gage (M13)
2. Engine Coolant Temperature Gauge (M24)
3. Running Time Meter (M4)
4. Oil Pressure Gage (M25)
5. Battery Voltmeter (M5)
6. AC Frequency Meter (M3)
7. Fault Code Meter (M6)
8. AC Ammeter (M1)
9. AC Voltmeter (M2)
10. Adjustable Grip Latch
11. (2) Control Panel Door Hinge
12. DC Voltmeter (M402) *[Optional with TR]*
13. DC Ammeter (M401) *[Optional with TR]*
14. Front LED PC Board (A5) [Shown Opposite Side]

Control Panel Door
Figure 1



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

Control Push-Button Switch Panel
Figure 2



1. Engine Specific PC Board [ESB] (A1)
2. Engine Interface PC Board [EIB] (A2)
3. Digital Control PC Board [CTL] (A3)
4. EF By-Pass Switch
5. Voltage Regulator PC Board [REG] (A4)
6. Regulated-Diagnostic Switch
7. Transformer-Rectifier PC Board [TRB] (A404) *{Optional}*
8. +5, -12 VDC Power Supply (PS1)
9. Circuit Breaker Support Bracket
10. Marker Lights Circuit Breaker, 10 A (CB11)
11. Engine Circuit Breaker, 10 A (CB4)
12. Controls Circuit Breaker, 5 A (CB7)

Control Box Interior Components
Figure 3

(5) Position switches and controls for automatic voltage regulation and power delivery as follows:

a Place regulated-diagnostic switch in "**REGULATED**" position (Figure 8).

b Place EF Bypass switches in "**BYPASS / OFF**" position (Figure 4).

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 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 generator 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 generator frequency meter. If engine speed is properly set, generator frequency should read 400 Hz.

(9) Observe generator voltmeter. Use output fine voltage or coarse adjustment potentiometer to adjust voltage to 115 V AC.

(10) Check adjustable voltage range.

a Observe generator voltmeter and turn output voltage coarse adjustment potentiometer to full clockwise position. Maximum voltage should be around 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 generator voltmeter and turn regulator potentiometer knob to full counterclockwise position. The minimum voltage should be around 95 volts or lower.

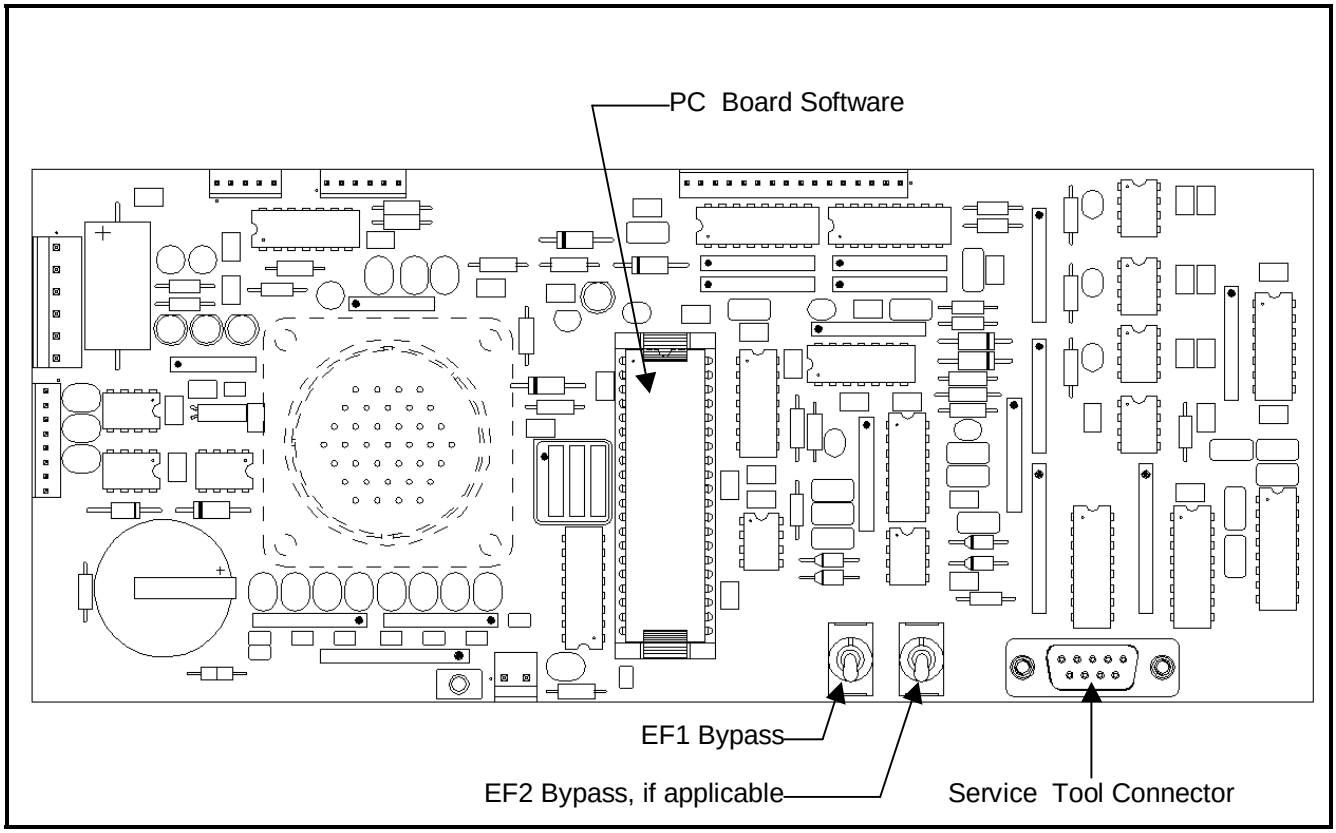
(11) Position load bank switches to apply a light load to the generator.

c) Testing the No. 1 Output Circuit

(Steps 1 - 6 are only required if EF interlock system is available on a load bank.)

(1) Place the EF bypass switch in "**BYPASS / OFF**" position and turn the EF switch on the load bank to the on position. Then press the yellow "**OUTPUT NO. 1**" push-button switch to close the contactor. The light in the push-button switch will glow continuously when the contactor is closed.

(2) Place the EF bypass switch on the load bank in the off position. The output 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, monitored by the control PC board (CTL), is not receiving the 28.5 VDC signal from an outside source. Reset the fault by pressing the "**TEST/RESET**" push-button switch.



Digital Control PC Board
Figure 4

(3) Place the EF bypass switch in "**BYPASS / ON**" position. Press the "**OUTPUT NO. 1**" push-button switch to the close the contactor. The 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 (Figure 5) should also indicate the bypass mode.

(4) Place the EF bypass switch in "**BYPASS / OFF**" position. The "**OUTPUT NO. 1**" push-button switch should open at once and the yellow indicating light within the push-button switch should go off. The fault code display should also read "**EF 1**" indicating an EF warning. The corresponding LED should also indicate the EF not present mode. Reset the fault by pressing the "**TEST/RESET**" push-button switch.

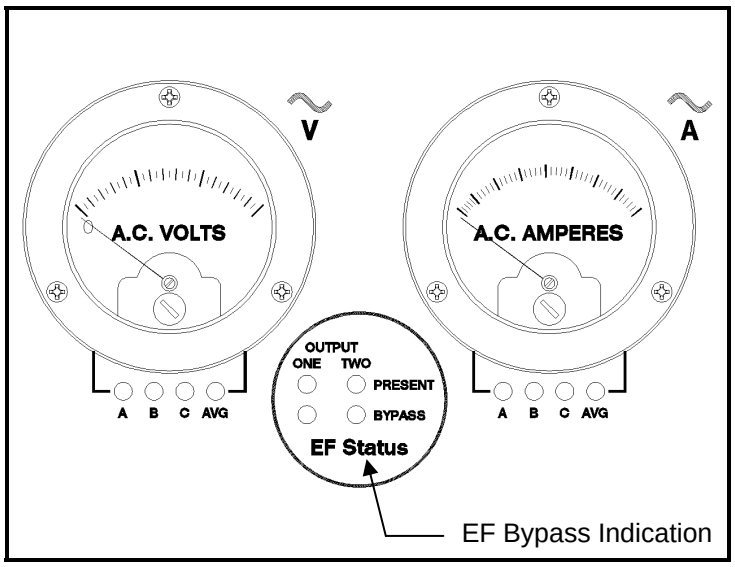
(5) Proceed to step 11.

(Steps 7 - 11 are only required if EF interlock system is not available on a load bank.)

(6) Connect a source of 27 VDC power (three nine-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.

(7) Place the EF bypass switch in "**BYPASS / OFF**" position and connect the 27 VDC power supply. Then press the yellow "**OUTPUT NO. 1**" push-button switch to close the contactor. The light in the push-button switch will glow continuously when the contactor is closed.

(8) Remove the 27 VDC power supply and the output 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, monitored by the control PC board (CTL), is not receiving the 28.5 VDC signal from an outside source. Reset the fault by pressing the "**TEST/RESET**" push-button switch.



EF Bypass Indication
Figure 5

(9) Place the EF bypass switch in "**BYPASS / ON**" position. Press the "**OUTPUT NO. 1**" push-button switch to the close the contactor. The 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.

(10) Place the EF bypass switch in "**BYPASS / OFF**" position. The "**OUTPUT NO. 1**" push-button switch should open at once and the yellow indicating light within the push-button switch should go off. The fault code display should also read "**EF 1**" indicating an EF warning. The corresponding LED should also indicate the EF not present mode. Reset the fault by pressing the "**TEST/RESET**" push-button switch.

(11) Verify that when the EF Bypass switch is in the "**BYPASS / ON**" position, or the "**BYPASS / OFF**" position, the appropriate LED indication on the control panel display is correct.

(12) Increase load at the load bank to full load and allow the unit to run for 15 to 30 minutes. Observe the operation of all monitoring instruments.

(13) Check operation of the engine ECM by observing the generator frequency. Use the "**OUTPUT NO. 1**" push-button switch to apply and remove a 100% load several times. Transient frequency events should not vary more than ±5 Hz and the steady state frequency should vary no more than ±2 Hz.

(14) Set line drop compensation on the voltage regulator for the length of cable being used.

(15) Apply a 100% load and observe the voltage. Steady-state voltages should vary no more than ± 1% from normal output voltage.

d) Testing the No. 2 output circuit (if applicable)

(1) Repeat steps (1) through (15) in the previous section "**Testing the No. 1 Output Circuit**".

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

(1) Check accuracy of AC generator voltmeter

a Open door of control box and connect a master voltmeter of known accuracy to terminals of the AC generator voltmeter.

b Compare the unit's voltmeter reading with master voltmeter. Error must not exceed 2% of full scale.

(2) Check accuracy of AC generator ammeter

a Connect a master ammeter of known accuracy to the AC generator 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 generator voltmeter reading should be 115 volts when the LED under the voltmeter indicates one of the 3 phases being checked.

b In any LINE-TO-LINE position, the generator voltmeter reading should be 200 volts when the LED under the voltmeter indicates two of the phases being checked.

(4) Check accuracy of generator frequency meter

a Connect a master voltmeter, with frequency capability, of known accuracy to the terminals of the generator frequency meter or voltmeter.

b Compare meter readings. Error must not exceed 1% of full scale.

(Make all protective system tests with the output contactor closed 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 a voltage great than 124 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 the unit to normal operating conditions by adjusting the coarse adjustment potentiometer and returning the voltage back to 115 VAC (turning it counterclockwise). Press the "**TEST/RESET**" push-button switch to clear the fault code.

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

a 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**". At a voltage less than 104 V the circuit will trip after a 7-second time delay.

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 the unit to normal operating conditions by adjusting the coarse adjustment potentiometer and returning the voltage back to 115 VAC (turning it clockwise). Press the "**TEST/RESET**" push-button switch to clear the fault code.

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

a Set the frequency adjust switch on the ESB (Figure 6) to "**TEST**" and use the frequency adjust potentiometer to adjust frequency to 400 HZ.

b With the unit running at a normal load adjust the frequency adjustment potentiometer counterclockwise to decrease frequency until the under-frequency 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 "**70.23**". At a frequency less than 380 Hz the circuit will trip after a 7-second time delay.

c If the load contactor does not open under the conditions described in step (a), refer to the Troubleshooting Chart in Section 2-4.

d Return the unit to normal operating conditions by adjusting the frequency adjustment potentiometer and returning the frequency back to 400 Hz (turning it clockwise). Press the "**TEST/RESET**" push-button switch to clear the fault code and return the frequency adjust switch back to "**NORMAL**".

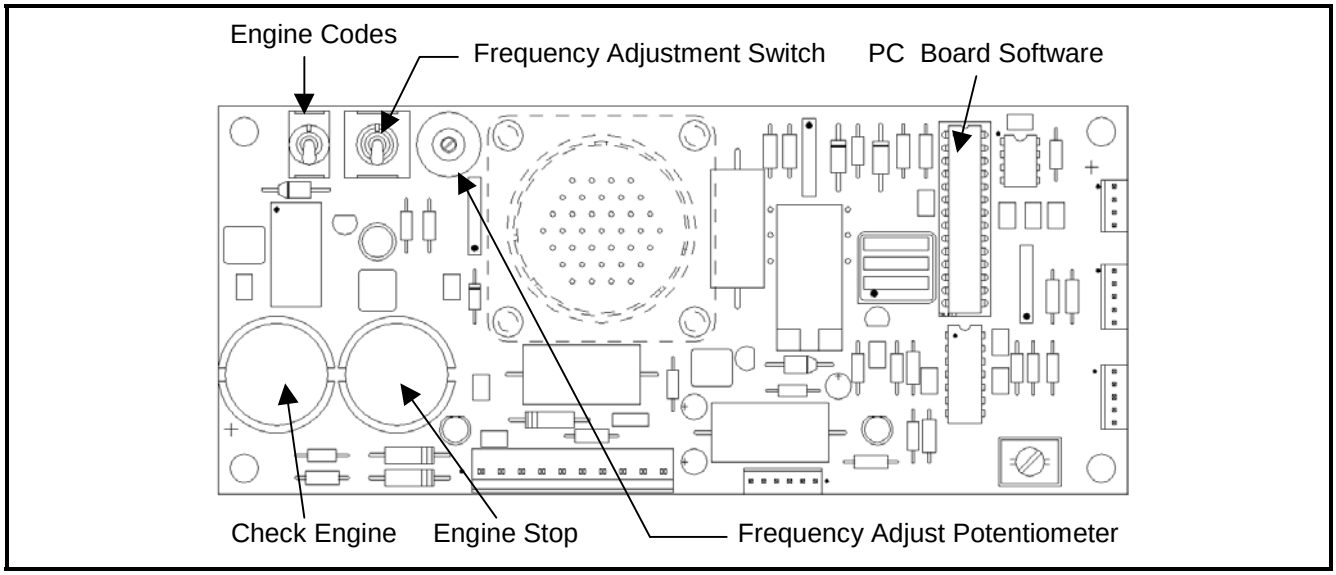
(8) Check over-frequency circuit and fault code display.

a Set the frequency adjust switch on the ESB (Figure 6) to "**TEST**" and use the frequency adjust potentiometer to adjust frequency to 400 HZ.

b With the unit running at a normal load adjust the frequency adjustment potentiometer clockwise to increase frequency until the over-frequency 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 "**70.22**". At a frequency less than 420 Hz the circuit will trip after a 5 to 7-second time delay.

c If the load contactor does not open under the conditions described in step (a), refer to the Troubleshooting Chart in Section 2-4.

d Return the unit to normal operating conditions by adjusting the frequency adjustment potentiometer and returning the frequency back to 400 Hz (turning it clockwise). Press the "**TEST/RESET**" push-button switch to clear the fault code and return the frequency adjust switch back to "**NORMAL**".



Engine Specific PC Board
Figure 6

(9) Check over-overload circuit and fault code display.

a Apply a 125% load (>217 amperes) for 5 minutes. 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**".

b Reset the fault by pressing "**TEST/RESET**" push button.

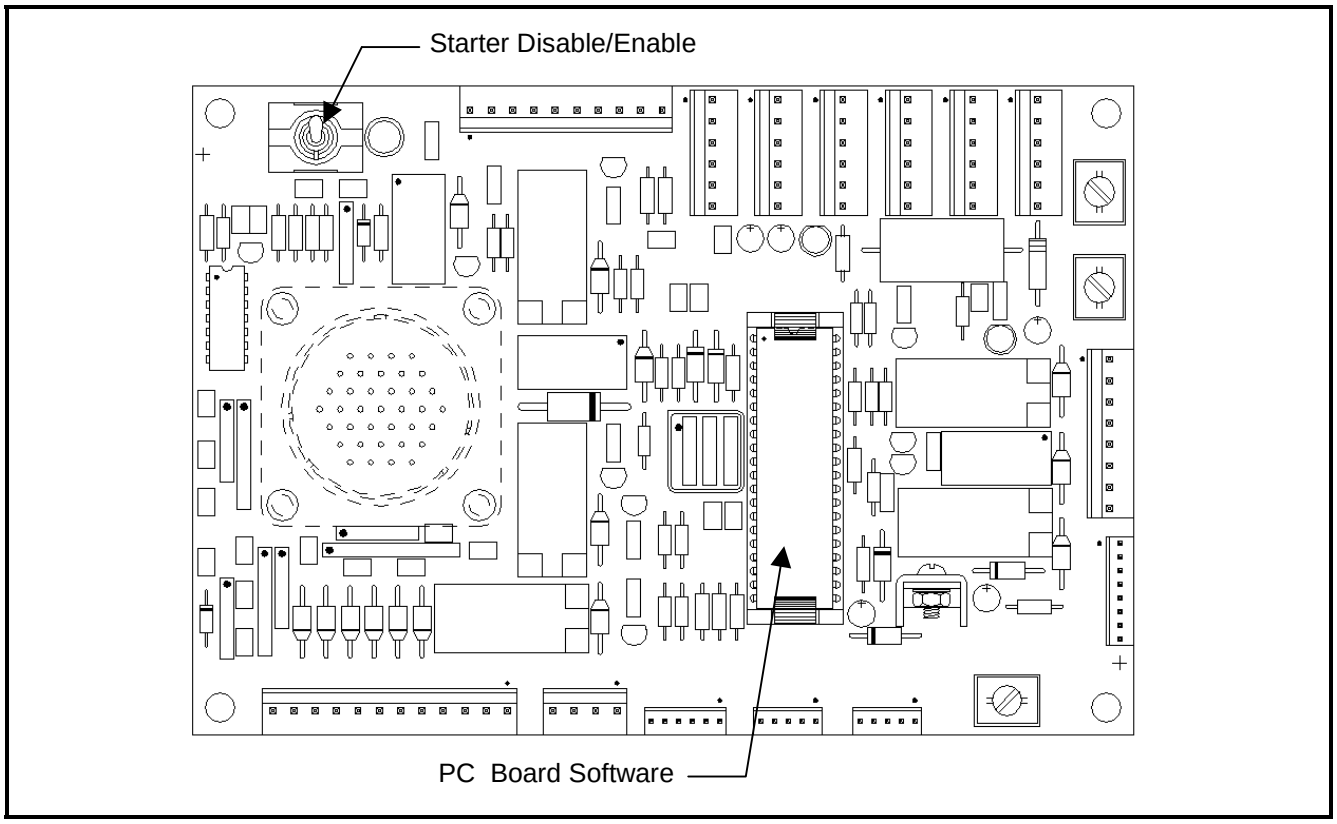
f) Testing for engine stored ECM faults

(1) Set the starter enable/disable switch on the EIB board (Figure 7) to "**DISABLE**". "**DISABLE**" will prevent the engine from starting, but will still supplying 12 VDC to the control system, while checking the stored 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.

(3) If no active codes are recorded, both the "Engine Stop" and "Check Engine" lamps on the ESB board will come on and stay on.

If active codes are recorded, both lamps will come on momentarily and then begin to flash fault codes on at a time.



Engine Interface PC Board
Figure 7

(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, on the ESB board, 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 ECM will continuously display the same fault code when the Engine Codes Switch is moved either the UP or DOWN.

(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 loose during the above checks. Tighten any loose hardware as required.

(2) Check engine oil pressure at rated speed. The oil pressure gauge should indicate at least 45 psi (3.1 bar) when engine is hot. Also at rated speed check the engine coolant temperature. The temperature gauge should be in the range of 180° to 190° F (82º to 88º 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 on 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 Adjustments

a) Generator Adjustment

The 400 Hz generator is a brush-less type requiring no adjustments of any kind.

b) Adjust 400 Hz voltage regulator (Figure 8)

When a voltage regulator is first put into service, or when output 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

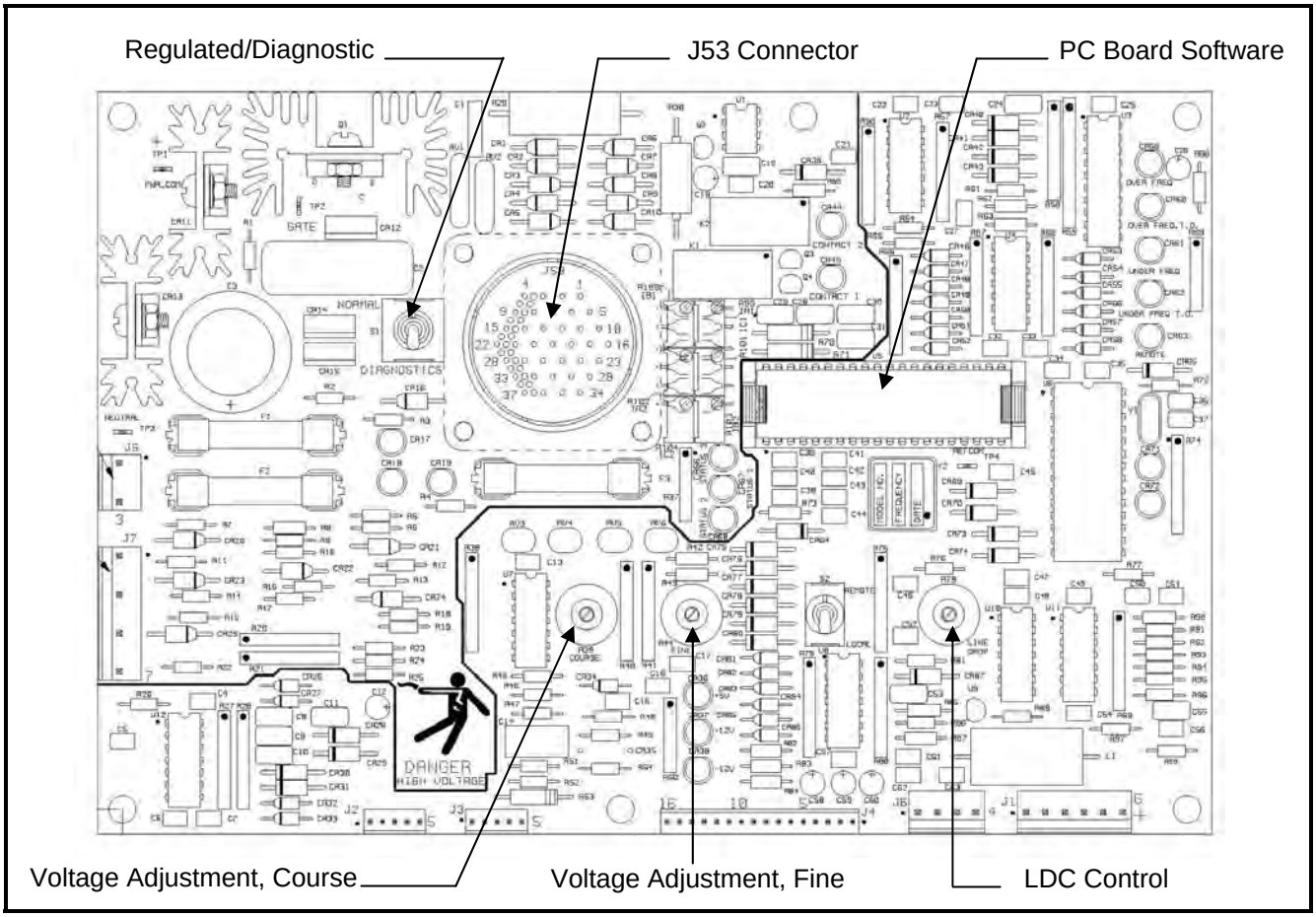
For the following adjustment the generator set must be running at rated speed under no-load conditions. Adjust the regulator as follows:

(1) Output Voltage Adjustment

a Adjust Voltage Control

The output voltage, at which the generator is regulated, is adjustable by the fine or course 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. Set output voltage at 115 VAC line-to-neutral (200 VAC line-to-line).



Voltage Regulator PC Board
Figure 8

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 output cable 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 cable. If the load voltage rises or drops to an unacceptable level at the load end of the cable decrease or increase the line drop compensation until an acceptable voltage level is reached.

- 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) Re-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.

4) Engine Adjustments

a) Basic Engine Adjustments

Adjustment procedures applicable to the diesel engine are included in the engine manufacturer's operation manual. Specific information for these engines is listed in Figure 9. Refer to the engine operation manual for detailed information on all required 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.

(1) Engine speed limiting adjustment

The speed limiting adjustment is also set and sealed at the factory. Speed should be limited to approximately 2750 RPM. If adjustment is required, contact your local engine distributor.

ENGINE	
Manufacturer	Cummins Engine Company
Model No.	QSB4.5
Type	In-Line 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	110 hp (82 kW)
Idle speed	1000 ± 50 rpm
Maximum overspeed capability	3700 ± 50 rpm
Normal governed speed	2400 rpm
Firing Order	1-3-4-2
Electrical system	12 VDC
Ground	Negative
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 resistances 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. See Figure 10 for resistance values.

a) Disconnect generator stator leads at the output module panel.

b) Disconnect the two black exciter field leads from terminal block mounted on output module panel.

c) Check resistance and compare to values given in Figure 5.

Test Connection	Resistance (Ohms)
Generator Stator Phase A to N (G1)*	0.00235
Generator Stator Phase B to N (G1)*	0.00235
Generator Stator Phase C to N (G1)*	0.00235
Exciter Stator Field (L2)	26.5
A - B, B - C, C - A Exciter Armature (G2)	0.1
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 ºF (21ºC.).

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:

a) Disconnect (may required de-soldering) exciter windings from diode lead(s).

b) 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.

c) 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 in good condition.

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.

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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 of malfunction is not listed in the chart start looking for the cause 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 is 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. 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)
- Enigne Interface PC Board (EIB)
- 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:	134 volts or higher.
Generator output voltage at minimum voltage regulator potentiometer setting:	108 volts or lower.
Over voltage relay	Trips above 124 volts after a 1-second time delay.
	Trips above 140 volts in 160 milliseconds.
	Trips above 180 volts in 50 milliseconds.
Under voltage relay	Trips below 104 volts after 7 seconds.
Over frequency relay	Trips at any value above 420 Hz after a 5 to 7-second time delay. Trips immediately at any frequency exceeding 480 Hz.
Under frequency relay	Trips at 380 Hz or less after a 7-second time delay.
Overload time delay	Trips in approximately 5 minutes at a 125% total load or 125% on a single output.

Frequency at rated speed of 2400 RPM is 400 +/- 2 Hz at no load and rated load.

Engine oil pressure (warm and at rated speed 2400 RPM) 45 to 90 PSI (445 to 621 kPa).

Engine coolant temperature (normal operation) 160 to 200º F (71 to 93º 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.

a) An adequate supply of 12 VDC power reaching a good starter and starter button
b) An adequate supply of air, compressed to a sufficiently high pressure.
c) 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

Illustration 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 (CTL) 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 switch is pressed 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 switch 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 switch again will bring the GPU up to run mode. The **"ENGINE START"** push-button switch 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 switch will start the 3 to 5 minutes delayed shutdown period. The **"ENGINE STOP"** push-button switch will flash 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 to 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 until the condition is corrected. 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 form 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 form the aircraft and drop the operating speed of the engine to the idle setting. A possible example would be a low fuel 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 form 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.

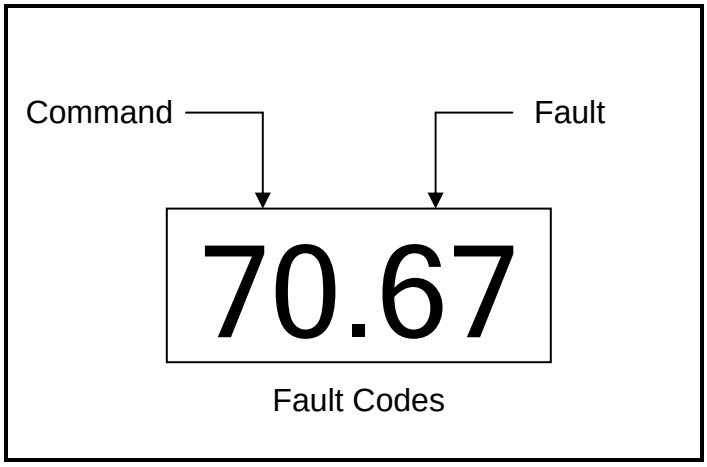
(5) Special Configuration

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 **c**ondition.



Fault Code 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 and power delivery the GPU continually performs Command "70" (Engine Run Mode). When a fault is detected during operation this command and the detected fault are indicated on the "**FAULT CODE**" display.

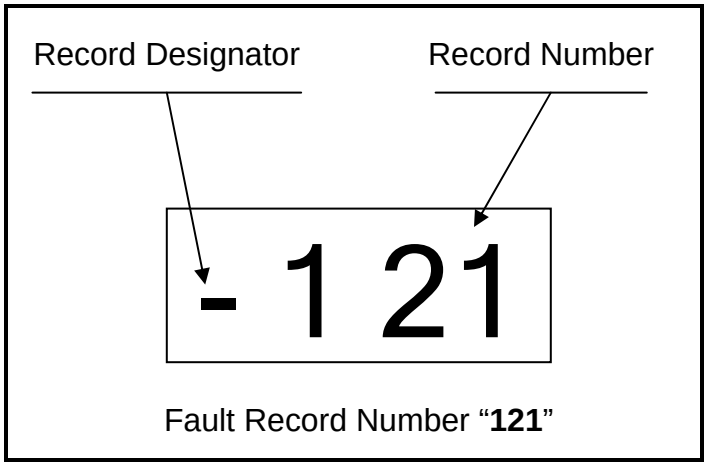
By referencing the command and fault code charts the GPU state and exact fault can be determined. When the fault is reset, and the GPU restarted, the GPU may often detect the fault again revealing additional information. This method yields a high degree of troubleshooting accuracy.

"**FAULT CODE**" 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 are stored in the control system's memory (i.e. data records) and can be extracted and viewed on the "**FAULT CODE**" 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:

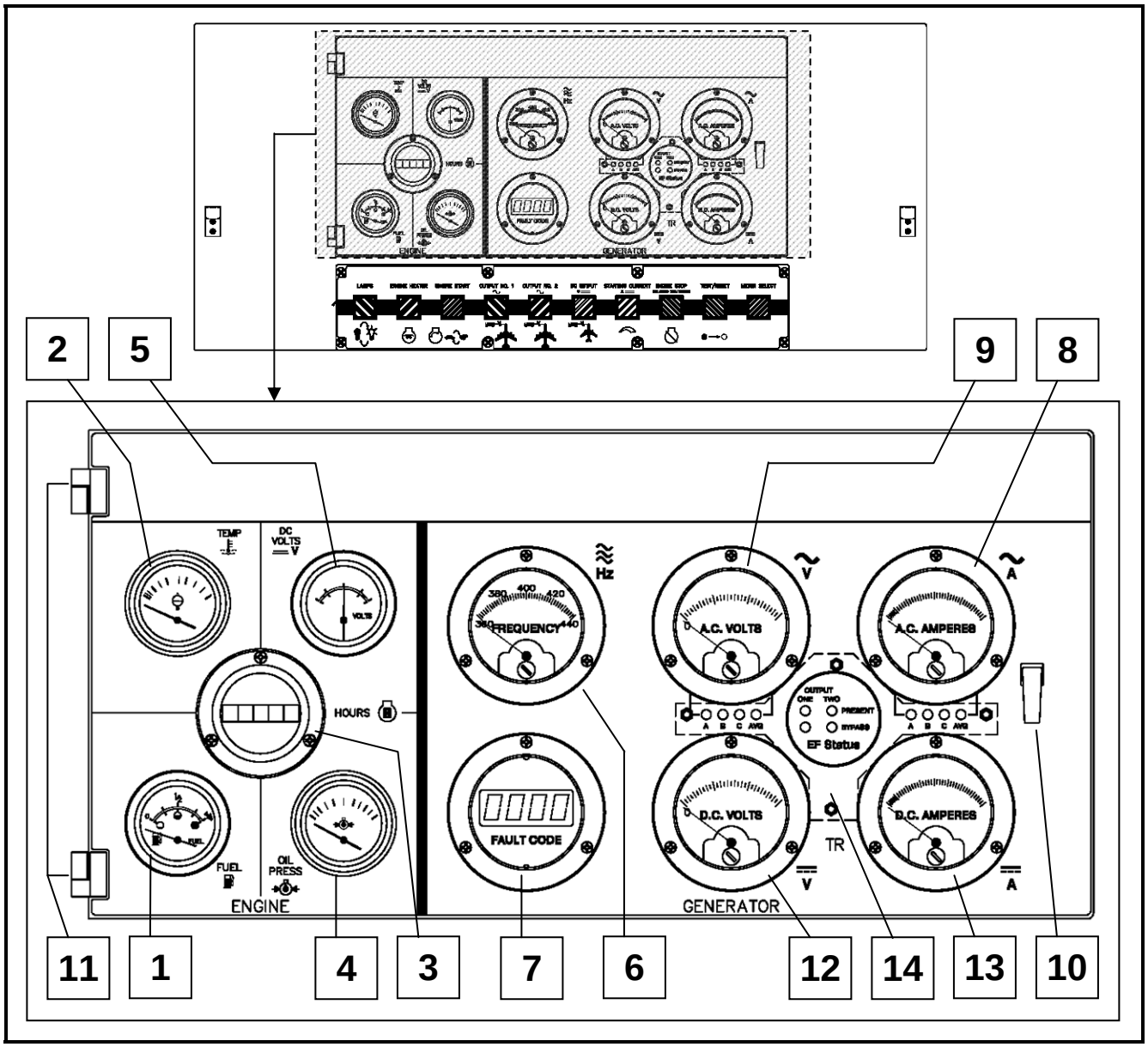
(1) Pull the "**EMERGENCY STOP**" button out.
(2) Press the "**LAMPS**" push-button switch to turn on the control box lights.
(3) Press the "**TEST/RESET**" push button and hold for 2 to 3 seconds until the last data record number appears on the display (See Figure 1A).



Fault Code Display (Fault Record Number)
Figure 1A

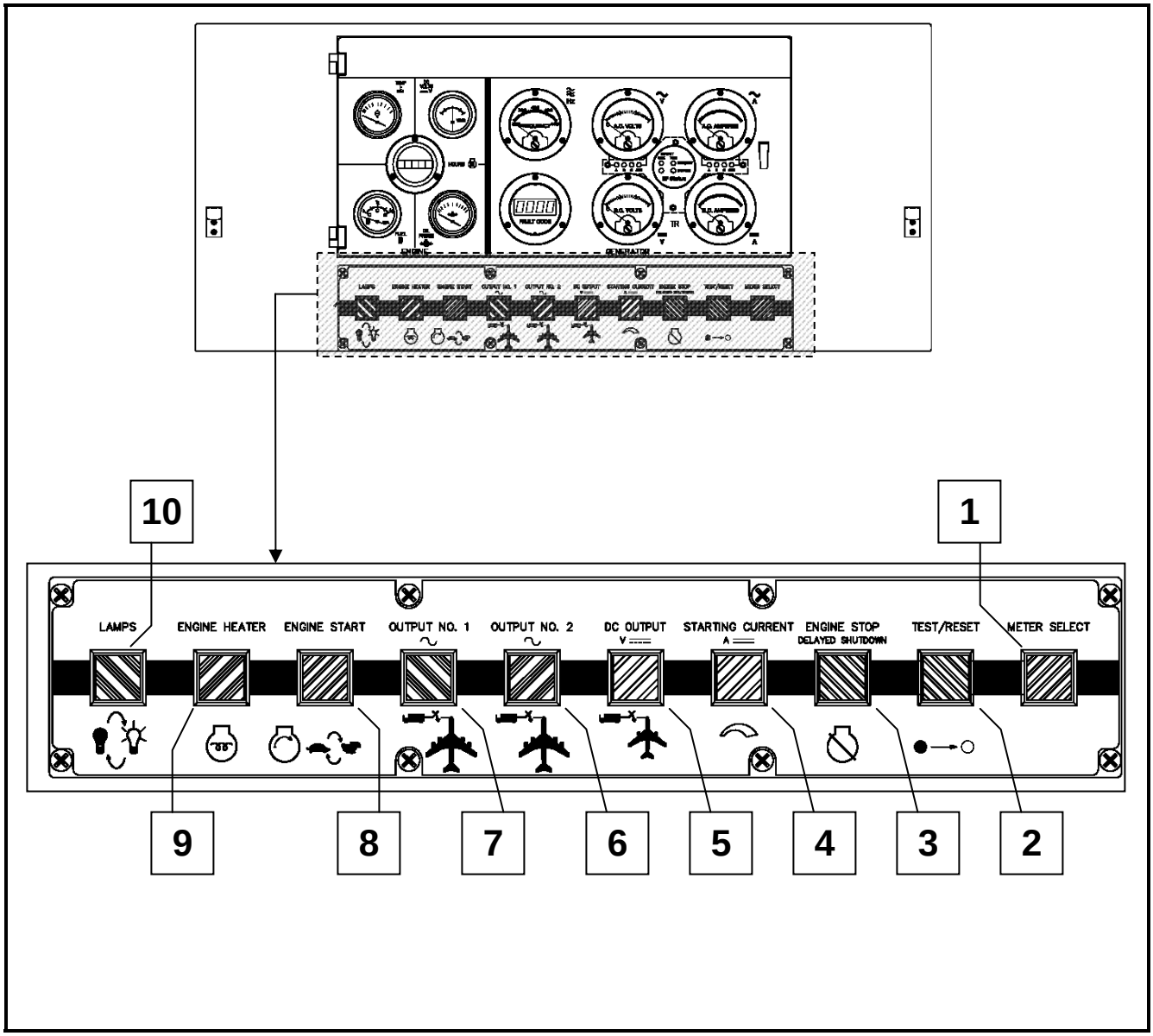
(4) Release the "**TEST/RESET**" push-button switch and the display will alternate between the fault record number and the fault code (See Figure 1).
(5) To continue scrolling backward through the previous fault codes press and release the "**TEST/RESET**" push-button switch and the previous fault record 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 reach, 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.

NOTE: This method of data record review will only show records with faults attached. All other data records can only be retrieved and viewed with service tool software available from the factory.



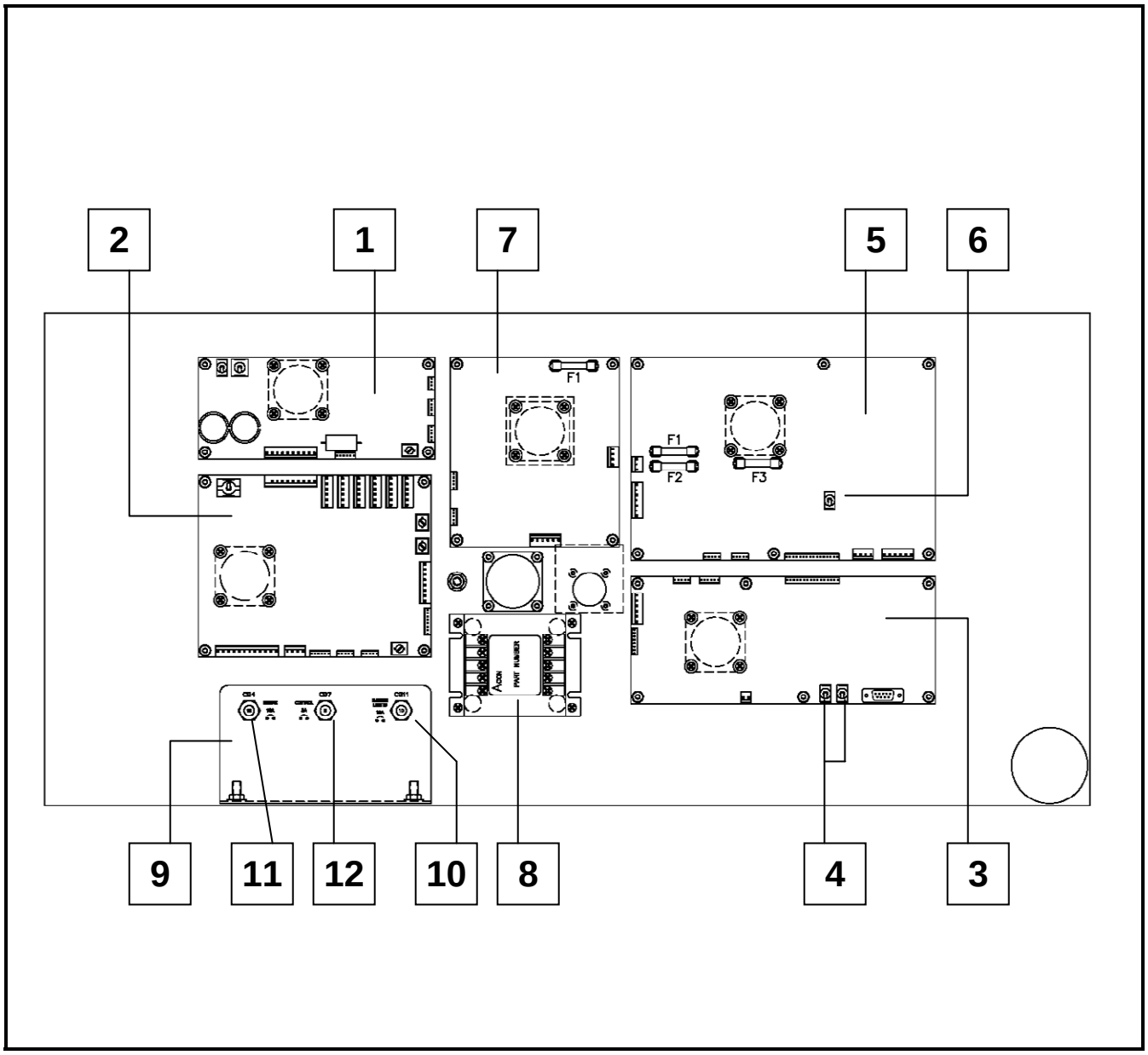
1. Fuel Gage (M13)
2. Engine Coolant Temperature Gauge (M24)
3. Running Time Meter (M4)
4. Oil Pressure Gage (M25)
5. Battery Voltmeter (M5)
6. AC Frequency Meter (M3)
7. Fault Code Meter (M6)
8. AC Ammeter (M1)
9. AC Voltmeter (M2)
10. Adjustable Grip Latch
11. (2) Control Panel Door Hinge
12. DC Voltmeter (M402) *[Optional with TR]*
13. DC Ammeter (M401) *[Optional with TR]*
14. Front LED PC Board (A5) [Shown Opposite Side]

Control Panel Door
Figure 2



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

Control Push-Button Switch Panel
Figure 3



1. Engine Specific PC Board [ESB] (A1)
2. Engine Interface PC Board [EIB] (A2)
3. Digital Control PC Board [CTL] (A3)
4. EF By-Pass Switch
5. Voltage Regulator PC Board [REG] (A4)
6. Regulated-Diagnostic Switch
7. Transformer-Rectifier PC Board [TRB] (A404) *{Optional}*
8. +5, -12 VDC Power Supply (PS1)
9. Circuit Breaker Support Bracket
10. Marker Lights Circuit Breaker, 10 A (CB11)
11. Engine Circuit Breaker, 10 A (CB4)
12. Controls Circuit Breaker, 5 A (CB7)

Control Box Interior Components
Figure 4

Engine Controls

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
1. Engine will not start. Starter will NOT crank engine.	**a.** Battery discharged, loose battery or ground connection.	Check voltage across batteries. Voltage should be approximately 12.8 volts DC. Check all battery terminals. Be sure 12.8 volts DC is reaching solenoid input terminal.
	b. Electrical defect in starter.	Momentarily connect a large capacity jumper cable (No. 1/0 minimum) between hot side of starter solenoid and starter input terminal. If starter does not crank engine, proceed to step **c.** If starter does crank engine, proceed to step **e.**
	c. Mechanical defect in starter.	Remove starter motor from engine and apply 12 VDC to test it. If it doesn't operate it is defective. Replace starter. If starter motor does operate proceed to step **d**.
	d. Internal seizure.	If battery and starter are good and starter is unable to crank the engine internal seizure is indicated. Attempt to hand crank engine with a ¾-inch square drive on a long flex handle on crankshaft pulley. If engine cannot be turned one complete revolution, internal seizure is indicated. Remove engine and contact the engine manufacturer and/or nearest dealer.
	e. Defective starter solenoid.	Momentarily connect a large capacity jumper cable (No. 1/0 minimum) between the auxiliary solenoid terminals (one on each side). If engine does not crank replace starter solenoid. If engine cranks proceed to step **f** below.
	f. Defective auxiliary starter solenoid.	Momentarily connect a small lug jumper on front of auxiliary solenoid to the battery terminal of the auxiliary starter. If engine does not crank replace auxiliary starter solenoid. If engine cranks, proceed to step **g** below.

Engine Controls (continued)

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
1. Engine will not start. Starter will NOT crank engine (continued).	**g.** Defective EIB Board.	Replace EIB board.
	h. Defective engine start button.	Depress button and check continuity between button contacts. If no continuity exists replace button. If there is continuity replace EIB board.
2. Engine will not start. Cranking speed low.	**a.** Low battery output check battery.	Recharge or replace.
	b. Loose starting circuit connections or faulty cables.	Check all connections and cables. Tighten or replace as required.
	c. Improper lubricating oil viscosity	Check oil and remove and replace as necessary.
3. Engine cranks, but will not start.	**a.** No fuel or insufficient fuel level in tank. Low FUEL indication appears 3 seconds after cranking is initiated.	Fill fuel tank if it is empty or if amount of fuel in it is low. If necessary fill each filter with fuel. If engine will not start after priming filters fuel pump trouble is indicated. If engine starts and stops after a short time trouble between fuel source and suction side of pump is indicated. Check and/or remedy as follows.
	b. Fuel shutoff valve closed.	Open shutoff valve on fuel tank.
	c. Loose connections, damaged hoses or fuel lines between tank and fuel pump	Tighten all fittings and connections. Replace any damaged hoses or fuel links.
	d. Plugged or defective filter.	Do not overlook the possibility of restricted flow through the fuel filters. Also check gaskets for leaking or damaged condition.
	e. Defective EIB board.	Replace EIB board.
4. Engine cranks, but will not start. Over-temperature indication appears immediately.	**a.** Defective or incorrectly wired high temperature switch, located on the top of the engine block.	Check wiring to high temperature switch according to connection diagram in Chapter 5 and see that wiring is correct. 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. Replace switch if defective.
	b. Defective EIB board	Replace EIB board.

Engine Controls (continued)

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
5. Engine is hard to start. Cranking speed normal, fuel supply adequate.	**a.** Low compression which may be caused by any one of following: Sticking or burned exhaust valves, worn or broken compression rings, leaking cylinder head gasket, or improper valve clearance adjustment.	Check compression in accordance with instructions in engine manufacturer's operation manual. Overhaul engine to make repairs as necessary.
6. Engine starts. Stops after a few seconds by automatic shutdown.	**a.** Shutdown circuit may have functioned normally to stop engine because of low lubricating oil pressure or due to a defective oil pressure switch.	Restart engine, and observe oil pressure gage. If oil pressure is 12 psi or more disconnect wire from oil pressure switch terminal N.C. Restart engine. If engine continues to run oil pressure switch is defective. Replace oil pressure switch. If engine stops check for following malfunctions:
	b. Defective EIB board	Replace EIB board.
7. All panel and clearance lights are either always ON or always OFF.	**a.** Marker light circuit breaker, (CB1) won't close.	Replace marker lights circuit breaker (CB1) if defective.
	b. Defective CTL board	Replace CTL board.
8. Engine either goes from rated speed to idle speed or shuts down.	**a.** Low fuel was detected, the EIB board could be defective or a fault has occurred.	Add No. 2 diesel fuel. Replace EIB board. Review fault code solutions.
9. Engine has slow response time.	**a.** Engine needs tune-up	Tune-up as required. Refer to engine manufacturer's operation manual.
10. Engine "misses". Runs unevenly.	**a.** Insufficient fuel	Check low fuel level and fuel filters. Repair or replace parts as required.
	b. Faulty injector	Check injectors in accordance with engine manufacturer's operation manual.
	c. Low compression pressure	Check compression in accordance with engine manufacturer's operation manual.
	d. Air in fuel system	Check all fittings to be sure they are tight and the thread sealant is still present. Tight the fittings and add new thread sealant as required.

Engine Controls (continued)

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
11. Engine lacks power	**a.** Improper engine adjustments and gear train timing	"Tune-up" engine in accordance with engine manufacturer's operation manual.
	b. Insufficient fuel	Check low fuel level and fuel filters. Repair or replace parts as required.
	c. Insufficient inlet air due to damaged or dirty air cleaner.	Check air cleaner for "plugging" and/or damage. Replace as required.
	d. Restricted exhaust system	Check exhaust pipes for restrictions. Check muffler for clogged condition. Replace as required.

Generator Excitation Circuits

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
1. No (or low) generator output voltage in all phases. Generator operating at 400 Hz.	**a.** Defective generator or excitation circuit.	Place Regulated/ Diagnostic switch in Diagnostic position on the voltage regulator PCB. This applies 12 VDC from 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 is in voltage regulator circuit. Proceed to Step **b**.
	b. Defective voltage regulator (REG)	Connect a known working voltage regulator PCB to regulator wiring assembly (avoid short circuiting bottom of PCB). Then start generator set and perform tests and adjustments according to instructions in Section 2-3. If generator set works properly with a known working voltage regulator PCB temporarily connected shut off generator set and replace defective PCB.
	c. Open fuse on REG.	Check fuses thoroughly. Replace fuses if defective.
	d. Defective connector at voltage regulator or defective wiring from regulator to exciter field	Disconnect exciter wires at terminal strip. Using jumper leads with clip terminals and connect 12 VDC to the wires. If generator will produce at least 80 VAC replace or repair connection and wiring between voltage regulator and exciter field as required.

No. 1 Load Contactor Operating Circuit

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
1. Load contactor (K1) will not close when output "**OUTPUT NO. 1**" push-button switch is held in close position. Generator running at normal voltage. Rectifier circuit breaker CB2 closed. No fault indicated	**a.** Defective circuit breaker (CB2).	Remove terminal leads from circuit breaker, press circuit breaker button to close circuit breaker and check with an ohmmeter. Replace circuit breaker if defective.
	b. In addition to defective wiring and connections in AC and DC load contactor actuating circuits, load contactor may be prevented from closing for any one of following reasons:	Check all wiring and connections in load contactor circuits.
	c. 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.
	d. Defective voltage regulator (REG).	After making certain that "**OUTPUT NO. 1**" push-button switch is working measure DC output voltage at contactor coil. If voltage measured isn't approximately 90 VDC replace REG.
	e. Defective coil in load contactor (K1).	Disconnect leads at load contactor terminals V and W. Check coil resistance between these terminals. Resistance should be approximately 50 ohms. If coil is defective replace complete load contactor.
2. Load contactor (K1) will close when "**OUTPUT NO. 1**" push-button switch is held in close position. Opens immediately when switch is released.	**a.** No. 1 plug interlock EF1 circuit on CTL board could be defective	Place No. 1 output EF Bypass switch in ON position. If load contactor remains closed, proceed to step **b.**
	b. 28.5-V DC is not reaching the No. 1 plug interlock EF1 circuit from aircraft for following reasons **c & d**:	Proceed as follows to find the cause of this malfunction.
	c. Generator to aircraft cable connector defective or not plugged into aircraft receptacle connector correctly.	Inspect cable connector plug thoroughly for damaged E and F terminals. Be sure plug is fully mated with aircraft receptacle connector and making good contact.

No. 1 Load Contactor Operating Circuit (continued)

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
2. Load contactor (K1) will close when "**OUTPUT NO. 1**" push-button switch is held in close position. Opens immediately when switch is released (continued).	**d.** Aircraft rejecting power.	Check aircraft on-board electrical equipment and controls.
3. Load contactor opens during power delivery. No fault indicated.	**a.** A fault has developed in load contactor holding circuit.	If load contactor cannot be closed by operation of "**OUTPUT NO. 1**" push-button switch (S75), check circuit in accordance with instructions in Trouble, Symptom, Condition 1 above. If load contactor can be closed but opens as soon as power accepted switch (S75) is released, check for trouble under Condition 2 above.
	c. Cable accidentally disconnected from aircraft.	Reconnect cable. Check for wear in cable head sockets and on aircraft receptacle.

No. 2 Load Contactor Operating Circuit (if applicable)

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
1. Load contactor (K201) will not close when output "**OUTPUT NO. 2**" push-button switch is held in close position. Generator running at normal voltage. Rectifier circuit breaker CB2 closed. No fault indicated	**a.** Defective circuit breaker (CB2).	Remove terminal leads from circuit breaker, press circuit breaker button to close circuit breaker and check with an ohmmeter. Replace circuit breaker if defective.
	b. In addition to defective wiring and connections in AC and DC load contactor actuating circuits, load contactor may be prevented from closing for any one of following reasons:	Check all wiring and connections in load contactor circuits.
	c. 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.
	d. Defective voltage regulator (REG).	After making certain that "**OUTPUT NO. 2**" push-button switch is working measure DC output voltage at contactor coil. If voltage measured isn't approximately 90 VDC replace REG.
	e. Defective coil in load contactor (K201).	Disconnect leads at load contactor terminals V and W. Check coil resistance between these terminals. Resistance should be approximately 50 ohms. If coil is defective replace complete load contactor.

No. 2 Load Contactor Operating Circuit (Continued)

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
2. Load contactor (K201) will close when "**OUTPUT NO. 2**" push- button switch is held in close position. Opens immediately when switch is released.	**a.** No. 2 plug interlock EF1 circuit on CTL board could be defective	Place No. 2 output EF Bypass switch in ON position. If load contactor remains closed, proceed to step **b.**
	b. 28.5-V DC is not reaching the No. 1 plug interlock EF1 circuit from aircraft for following reasons **d** & **e**:	Proceed as follows to find the cause of this malfunction.
	d. Generator to aircraft cable connector defective or not plugged into aircraft receptacle connector correctly.	Inspect cable connector plug thoroughly for damaged E and F terminals. Be sure plug is fully mated with aircraft receptacle connector and making good contact.
	e. Aircraft rejecting power.	Check aircraft on-board electrical equipment and controls.
3. Load contactor opens during power delivery. No fault indicated.	**a.** A fault has developed in load contactor holding circuit.	If load contactor cannot be closed by operation of "**OUTPUT NO. 2**" push-button switch (S275), check circuit in accordance with instructions in Trouble, Symptom, Condition 1 above. If load contactor can be closed but opens as soon as power accepted switch (S275) is released, check for trouble under Condition 2 above.
	c. Cable accidentally disconnected from aircraft.	Reconnect cable. Check for wear in cable head sockets and on aircraft receptacle.

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.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
1. Load contactor opens during power delivery. Over-voltage fault indicated.	**a.** Over-voltage condition may have been result of a sudden drop in load, possible tampering with voltage regulator and may have been a normal action.	Press "**TEST/RESET**" push-button switch and resume power delivery. Observe voltmeter to be certain voltage is normal 115 VAC. Adjust to normal if necessary. If load contactor is opened again and the fault code meter indicates an over-voltage condition, proceed to step **b**.
	b. Defective control board (CTL).	Adjust the voltage regulator potentiometer to reduce voltage to 110 V AC. Observe voltmeter and gradually increase voltage with potentiometer. If sensing circuit opens the load contactor at any value less than 124 VAC, it is defective. Replace CTL board.
2. Load contactor opens during power delivery. Under-voltage fault indicated.	**a.** Under-voltage condition may have been result of a sudden shock load, possible tampering with voltage regulator and may have been a normal action.	Press "**TEST/RESET**" push-button switch and resume power delivery. Observe voltmeter to be certain voltage is normal 115 VAC. Adjust to normal if necessary. If load contactor is opened again and the fault code meter indicates an under-voltage condition, proceed to step **b**.
	b. Defective CTL board.	Adjust the voltage regulator potentiometer to reduce voltage below 104 V AC. Observe voltmeter and gradually decrease voltage with potentiometer. If sensing circuit opens the load contactor at any value great than 104 VAC, it is defective. Replace CTL board.
3. Load contactor opens during power delivery. Over-frequency fault indicated.	**a.** Frequency adjust switch is enabled.	Set frequency adjust switch to DISABLE on the EIB board.
	b. Defective REG board.	If over-frequency faults continue after engine's ECM is proven to be good and an over-frequency condition does not exist, replace voltage regulator board.

Protective Circuit (continued)

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.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
4. Load contactor opens during power delivery. Under-frequency fault indicated.	**a.** Frequency adjust switch is enabled.	Set frequency adjust switch to DISABLE on the EIB board.
	b. Defective REG board.	If over-frequency faults continue after engine's ECM is proven to be good and an over-frequency condition does not exist, replace voltage regulator board.
5. Load contactor opens during power delivery. Overload fault indicated.	**a.** There may have been an overload condition.	Observe ammeter. Check for abnormal overload condition and correct. If overload device functions to open load contactor when an overload does not exist, proceed to step B.
	b. Defective CTL board.	Replace CTL board.

Generator

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
1. No (or low) voltage output	**a.** Shorted diode in exciter rectifier (CR2).	Check diodes in accordance with Chapter 2, Section 3. If diodes are good proceed to step **b**.
	b. Open or shorted exciter rotor winding (G2)	Use ohmmeter to check for open or shorted condition diodes in accordance with Chapter 2, Section 3. If exciter rotor windings are good proceed to step **c**.
	c. Open or shorted exciter field windings (L2)	Check field resistance. See Chapter 2, Section 3 for normal values.
	d. Open or shorted generator rotor windings (L1)	Check resistance with ohmmeter to determine if open or short circuited diodes in accordance Chapter 2, Section 3
2. Generator operates single phase.	**a.** Open or short circuited winding in generator stator (G1)	Check stator-winding resistances. Chapter 2, Section 3 for normal values.
3. Generator overheats	**a.** Loose connection causing high resistance.	Check all output connections. Look for discoloration caused by heat. Tighten or replace as required.
	b. Improper or blocked ventilation.	Check for foreign material (rags, etc.) blocking air-flow. Provide adequate ventilation.
	c. Generator stator windings short circuited.	Check stator windings. See Chapter 2, Section 3.
4. Unbalanced output	**a.** Loose connection in output circuit.	Check all output connections. Discolored connectors indicate a loose connection. Tighten or replace as required.
	b. Open or short circuited phase	Check stator windings in accordance with Chapter 2, Section 3. Repair or replace as required.
	c. Defective connection in output circuit.	Check plug and receptacle connectors at aircraft. Tighten, repair, or replace as required.
	b. Break or cut in output cable assembly.	Inspect. Repair or replace as required.
	c. Unbalanced load	Check aircraft 400-Hz 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 $^{1}/_{8}$ 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 loosing coolant.	Refill radaitor. 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.

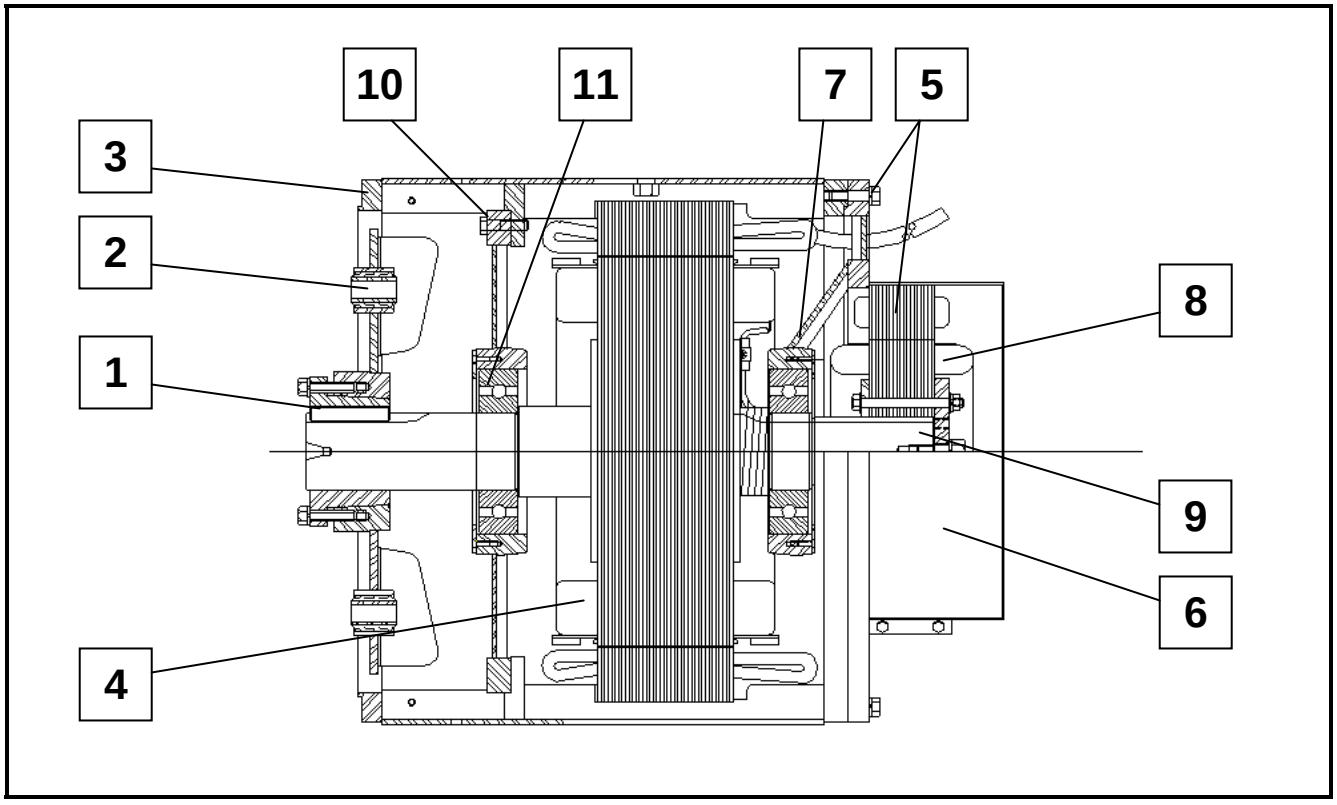
Troubleshooting Table Faults			
Fault code	**Name**	**Possible Cause(s)**	**Corrective Action**
_ _.69			
_ _.70			
_ _.71			
_ _.72			
_ _.73			
_ _.74			
_ _.75			
_ _.76			
_ _.77			
_ _.78			
_ _.79			
_ _.80			
_ _.81			
_ _.82			
_ _.83			
_ _.84			
_ _.85			
_ _.86			
_ _.87			
_ _.88			
_ _.89			
_ _.90			
_ _.91			
_ _.92			
_ _.93			
_ _.94			
_ _.95			
_ _.96			
_ _.97			
_ _.98			
_ _.99			

Chapter 3 Overhaul/Major Repair

Section 1 Exciter Armature

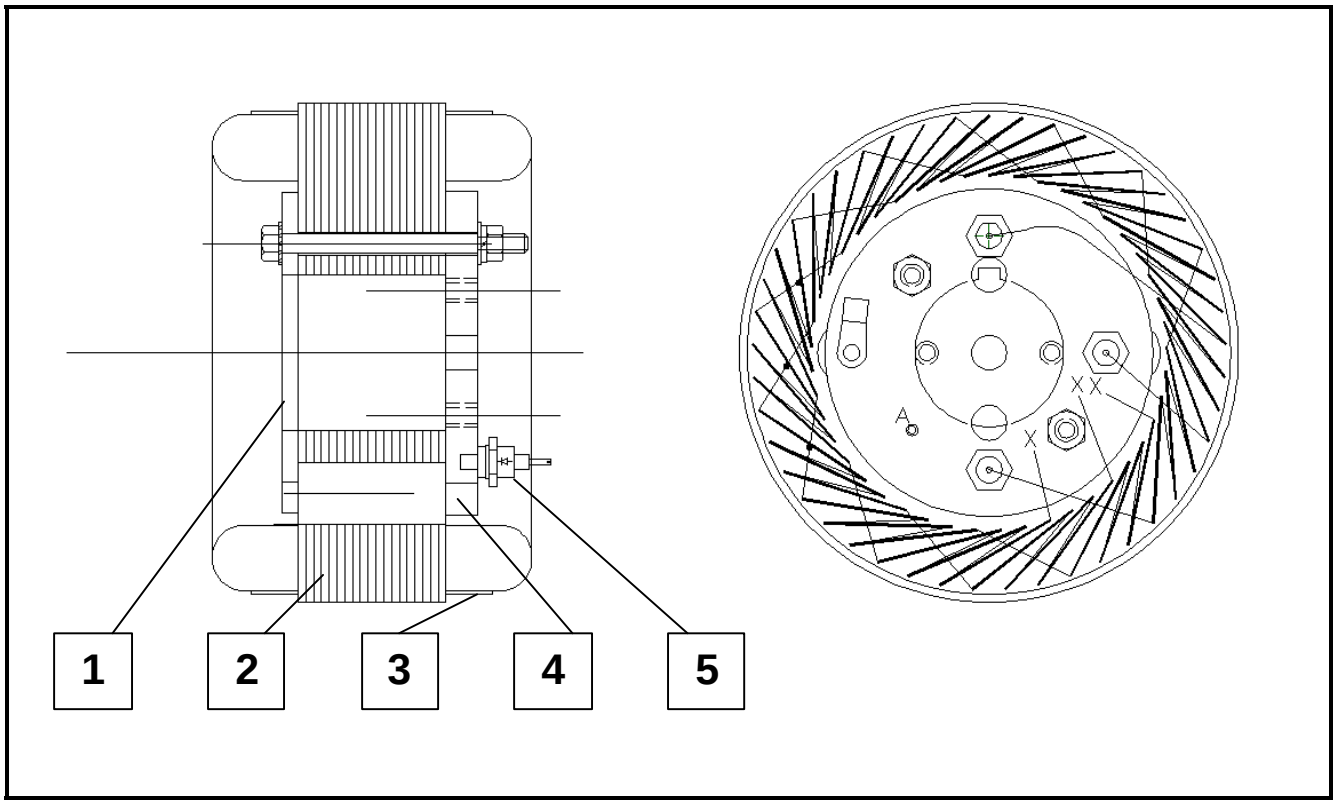
1) General

This section provides information and instructions for removal and installation of the exciter armature used on this generator set. Through design improvements, 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
2. Fan / Flex Coupling Assembly
3. Generator Housing & Stator Assembly
4. Armature Assembly
5. Exciter Housing & Coils Assembly
6. Exciter Cover
7. Rear Bearing Retainer
8. Exciter Armature Assembly (Figure 2)
9. Exciter Key
10. Front Bearing Retainer
11. Front Bearing

Generator (Section Cut View)
Figure 1



1. Exciter Core Flange
2. Exciter Core Lamination
3. Banding Glass Tape
4. Diode Mounting Plate
5. Silicon Diode

Exciter Armature
Figure 2

The exciter armature covered by the manual 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 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 section has been prepared to assist mechanics in the operation. 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 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 and held in place by a 3/8-inch square machine key and a ½ - 13 hex head cap screw in the center of the diode mounting plate.

3) Exciter Armature Replacement

a) General

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, you will also need the following items for removing the exciter armature:

- A small, lightweight, sling-hammer puller (see Figure 3)
- Two (2) 3/8-16 x 5-inch fully threaded hex head bolts

The sling-hammer puller is necessary for removing the threaded machine key, which keeps the exciter armature from spinning on the main generator armature shaft. If you do not have such a puller in your equipment inventory, Figure 3 illustrates components and dimensions for fabricating such a tool. Sling-hammer pullers may also be commercially available. Instructions for using the tool are provided in this manual.

Once the threaded machine key is removed no other special tools are required for removing the exciter from the generator shaft. This can be done using the two 3/8-16 X 5-inch fully threaded hex head bolts. Instructions for doing this are provided in this manual.

c) Conditions for Exciter Removal

The mechanics performing this 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 majority of cases the exciter removal will be for replacing the rear bearing. This operation 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

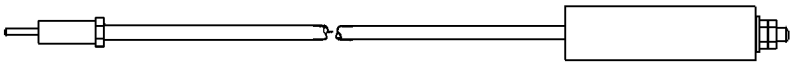
(1) Remove exciter canopy cover from the end of the canopy and the exciter armature cover from the end of the generator.

(2) Place a blocking bar (or a pry bar) into the generator fan assembly to keep the generator armature from rotating.

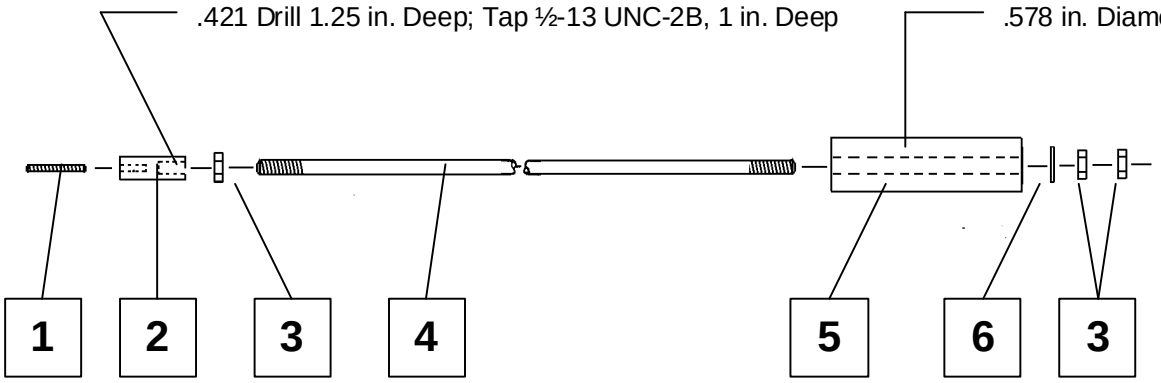
WARNING

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

(3) Remove the ½ - 13 cap screw, which holds the exciter armature and key retainer on the generator shaft.



Sling Hammer Assembly



Sling Hammer Components

1. Stud, ¼ - 28 UNF 2A, Grade 5 or 8 ONLY
2. Adapter, 3/4" Round CR Steel
3. Nut, ½ - 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

(4) Referring figure 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 connection as to preserve lead length for reconnection later during exciter armature installation.

(5) Take **EXERCISE CARE** to prevent damage to leads. Remove kinks in the two generator leads as much as possible before starting removal operation (The exciter armature will be sliding over these leads.).

e) Exciter Armature Removal

(1) Removing the threaded key with sling hammer puller

Refer to Figure 2 for location of threaded machined key. Attachment of the assembled puller to the key in one operation is not recommended because the weight and bulk of the assembly 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 stud (1, Figure 3) into adapter (2) until it bottoms, then thread this assembly (1) and (2) into key until stud bottoms in key threads. Tighten securely.

b If hammer (5) and rod (4) are not already assembled, thread one nut (3) onto adapter end of rod (4). Thread rod into adapter until it bottoms, then tighten nut securely against adapter. Slide hammer (5) onto rod and install washer (6) and two nuts (3). 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 and then remove key and slide-hammer puller together.

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 rotated too far in either direction.

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

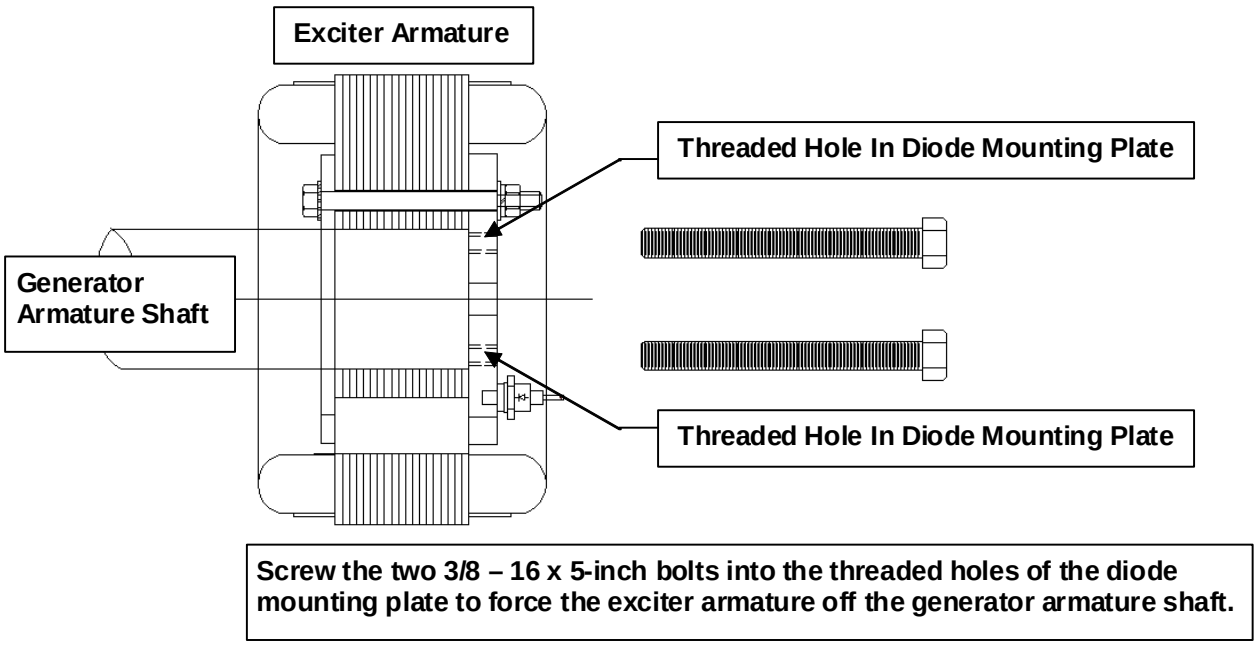
WARNING

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 3/8-16 x 5-inch 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.**

CAUTION

Pay close attention to field leads while pulling exciter armature from shaft. Make **CERTAIN** that the leads stay in the 1/2" 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. Straighten leads and remove kinks as required to avoid damage to insulation.



Exciter Armature Removal
Figure 4

4) Installation Exciter Armature

a) Preparation for Exciter Armature Installation

(1) Clean the generator shaft and exciter armature bore. Remove all rust, corrosion, oil and grease.

(2) Make **CERTAIN** that the leads are tucked into the ½-inch keyway, which is opposite from the $^{3}/_{8}$-inch keyway in the main generator armature shaft.

(3) Route the revolving field leads through exciter armature hole, which is opposite the keyway.

(4) Align armature keyway with the key in shaft and start sliding the armature on the 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 ½ - 13 X 5-inch hex-head bolt and ½ - 13 nut as shown in Figure 5 to pull the exciter armature onto the generator shaft. Put the exciter armature on slowly and at the same time pull field leads through the hole (Figure 2) in the diode mounting plate. Screw the 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, and screw it into the end of the armature shaft. Screw the nut up against the diode mounting plate. Continue turning the nut until the diode mounting plate contacts the end of the generator shaft, just as is shown in the lower portion of Figure 5. After installation, remove the bolt and nut.

(2) Connect the two generator field leads to the exciter armature as follows:

a Connect the 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 a parallel splice connector, crimp and solder for a good connection.

c Insulate with sleeving material or wrap with electrical tape.

(3) Install the machined key

a Clean the machined key thoroughly. All mounting surfaces must be free of rust, corrosion, oil and grease.

b Apply **LOCTITE LOCQUIC** primer, No. 7649, to all sides of machined key. Do not over prime. A thin film is best. Allow to dry for three to four minutes.

c Apply a thin coating of **LOCTITE**, No. 242, adhesive to all side of keyways in shaft and armature.

d Apply **LOCTITE**, No. 242, to all sides of new type threaded machine key. A thin film is adequate and desirable.

e Ensure keyways in the generator armature shaft and exciter armature are aligned.

f Insert unthreaded end of key into the keyway and then tap lightly until threaded end is flush with end of shaft.

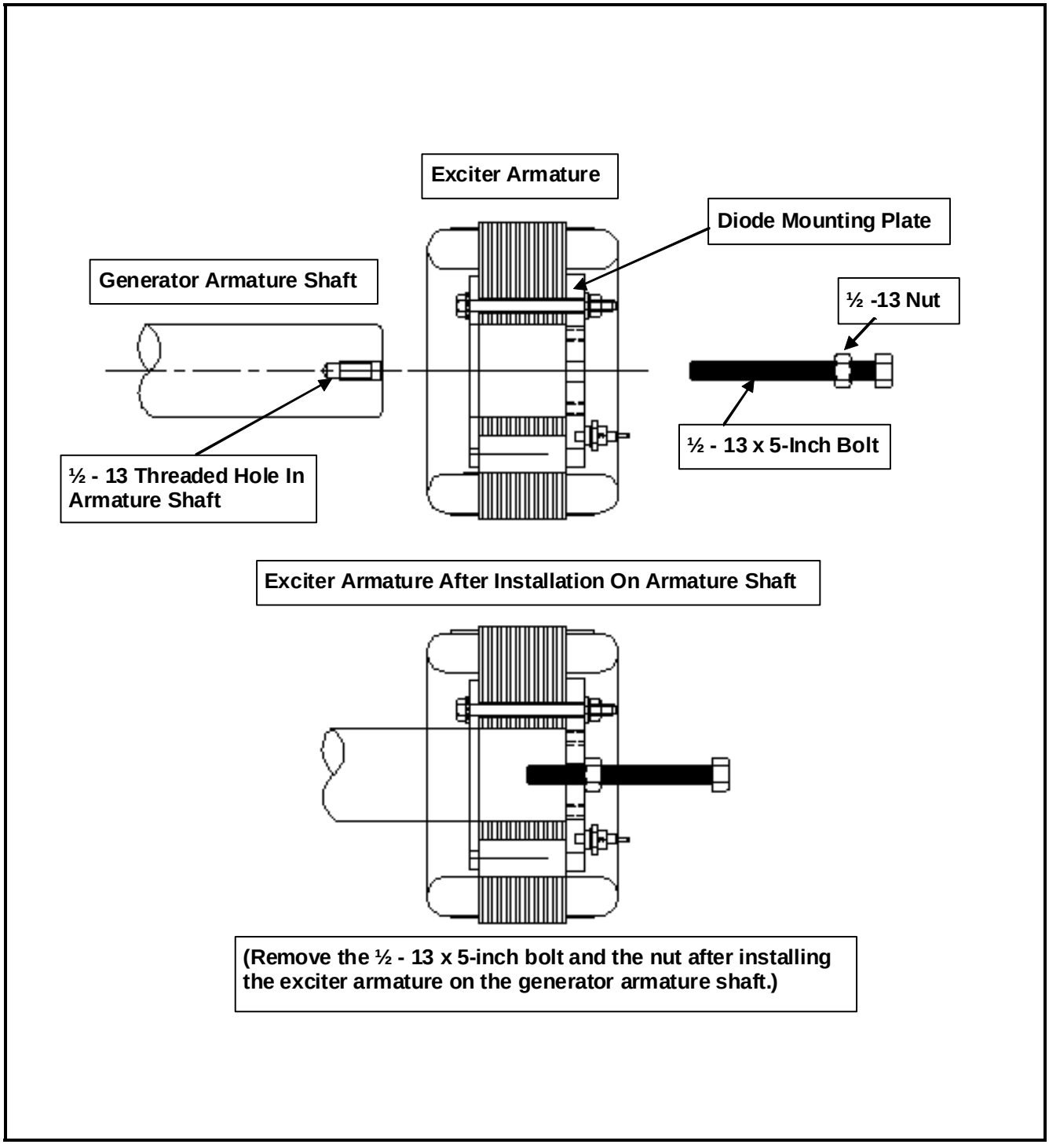
NOTE: Application of **LOCTITE** is to compensate for any looseness in machine key and keyway (up to 0.005 inch).

When kits are involved, the correct grade of **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 anti-rust products.

(4) Secure the exciter armature and key retainer on generator shaft with the ½-13 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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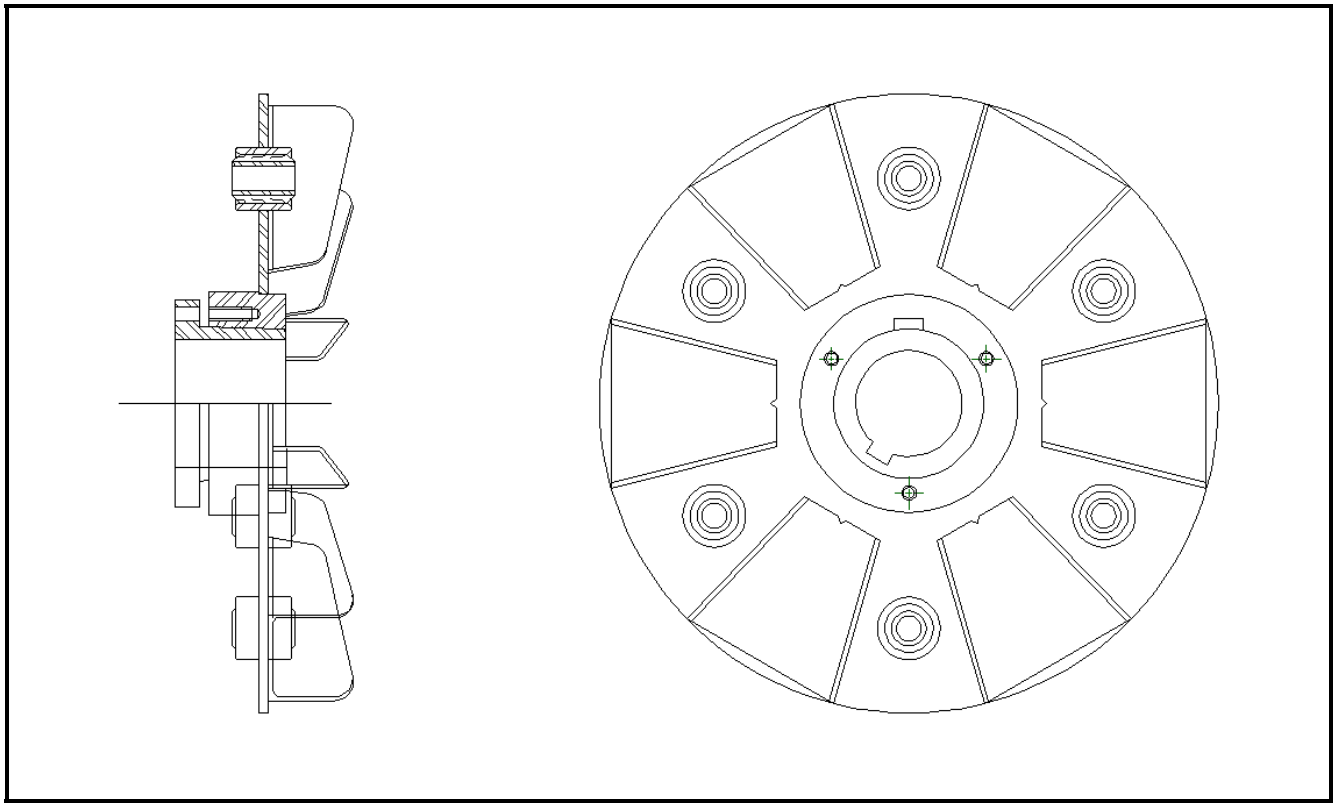
Section 2 Dual Bearing Flexible Coupling

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 283555. This assembly is illustrated in Figure 1. The primary function of this assembly is to couple a Hobart 2400 RPM generator to a diesel engine. The flexible coupling assembly compensates for a slight misalignment between the engine and the generator due to manufacturing tolerances and dampens the torsional vibrations that may develop with a rotating mass. A tapered lock bushing and hub secures the coupling to the generator shaft.



Coupling Assembly
Figure 1

2) Coupling Service

When ordering coupling kits, or any other parts 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 serial number)

If you have any questions concerning your equipment, immediately contact our Service Department by mail, telephone, e-mail, or fax.

Write:	ITW GSE Group Hobart Ground Power Service Department 1177 Trade Road 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@itwgsegroup.com
Web Page :	www.itwgsegroup.com

a) Replacement Coupling Kit

The kit provides a replacement coupling assembly with attaching hardware and installation instructions.

b) Bushing Kit

A bushing kit is available for replacing the rubber bushings in the coupling assembly. However, if not replacing the entire coupling assembly, it should be noted that the finished coupling assembly must be balanced to 1/2 inch-ounce ***(360 mg-m)*** minimum before re-installing. The bushing replacement kit part number is 480290. Each kit contains the required number of bushings, a container of lubrication, and installation instructions.

3) Disassembly

Removal of the flexible coupling is required for servicing the generator armature, generator bearings, or the flexible coupling itself. To remove the coupling, for any reason, it is necessary to separate the engine and generator. 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.

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) Carefully Inspect the coupling assembly components as follows:

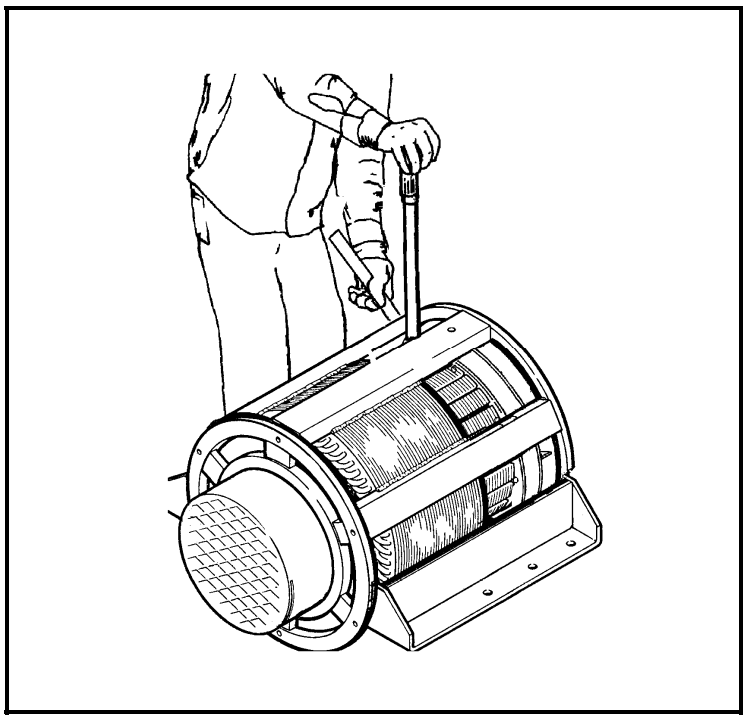
a Check for deformed fan blades and damage to the disk.

b Check the rubber exposed at both ends of the bushings for signs of deterioration.

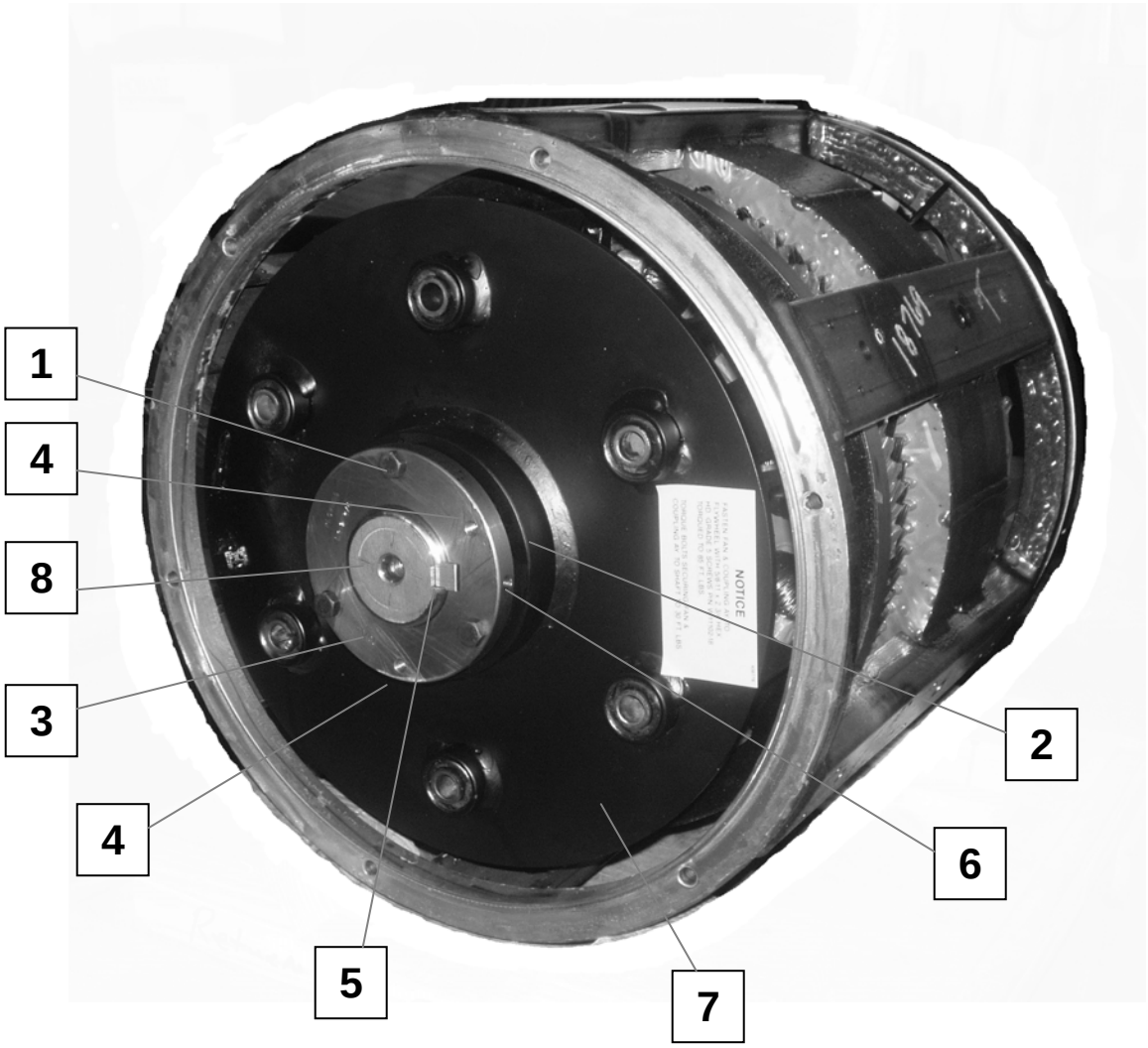
c Check hub and bushing for cracks, evidence of galling, and rust pits. Light rust is permissible on the bushing and the tapered bore of the hub.

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.



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



1. (3) Bolt, 3/8-16 UNC
2. Taper Lock Bushing
3. Taper Lock Hub
4. (2) Tapped holes (for removal)
5. Machined Key
6. Locking Set Screw
7. Fan/Coupling Disk
8. Main Armature Shaft

Hub and Bushing
Figure 3

4) Bushing Replacement

To replace bushings only, proceed as follows:

(1) Press out all old bushings.

(2) 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 poor 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.

5) 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 the outside of the split bushing, and the tapered inside of the hub be thoroughly cleaned and 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 the new socket head bolts.

Torque all bolts to 30 ft-lbs (40 N-m).

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

(2) Assemble the taper lock 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.

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

(4) 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.

(5) Install the key in the shaft keyway.

(6) 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.

(7) Using a 3/16-inch Allen wrench, tighten the set screw in the bushing to apply pressure on the key.

(8) 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 1/16-inch (1.6 mm) less than the dimension recorded in Figure 6. 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.

(9) Tighten the 3/8-16 bolts alternately and evenly as follows:

a Set a torque wrench to 30 foot-pounds (40 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.

6) 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 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.

d) Insert all remaining bolts attaching the generator flange and flywheel housing and tighten them all securely (25 ft-lb of 33 N-m).

e) Torque all coupling bolts to 85 ft-lbs (115 N-m).

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

7) 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.

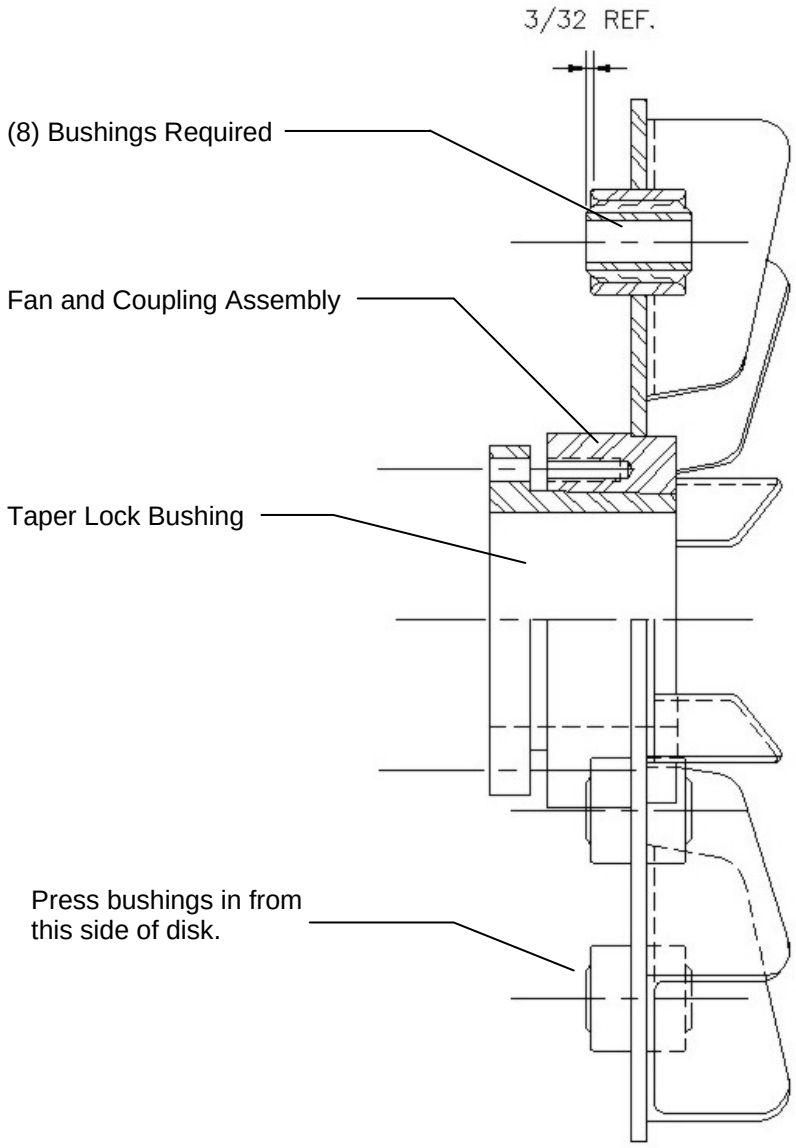
b) Shut down the engine after 2 hours and re-torque all coupling bolts to 85 foot-pounds (115 N-m) to compensate for normal torque relaxation.

c) Return the unit to normal service.

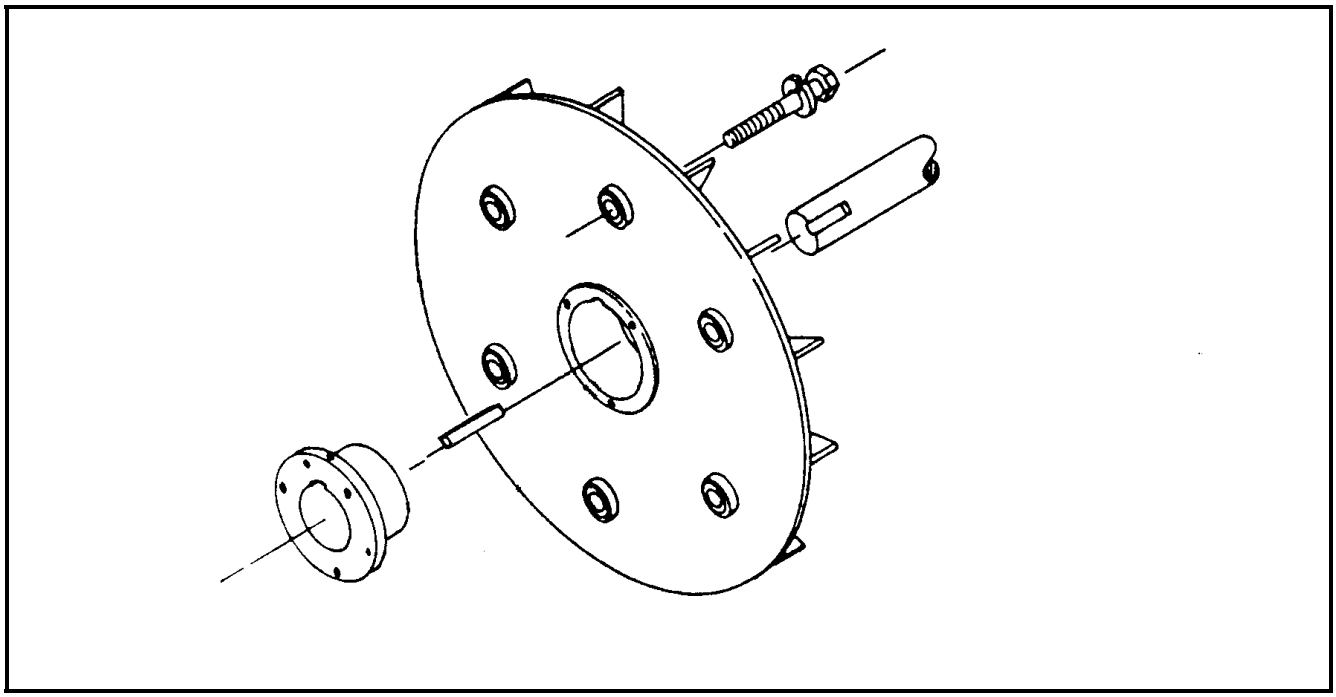
d) After 200 hours of operation, check all coupling bolts with a torque wrench set to 85 foot-pounds (115 N-m).

e) Return the unit to normal service.

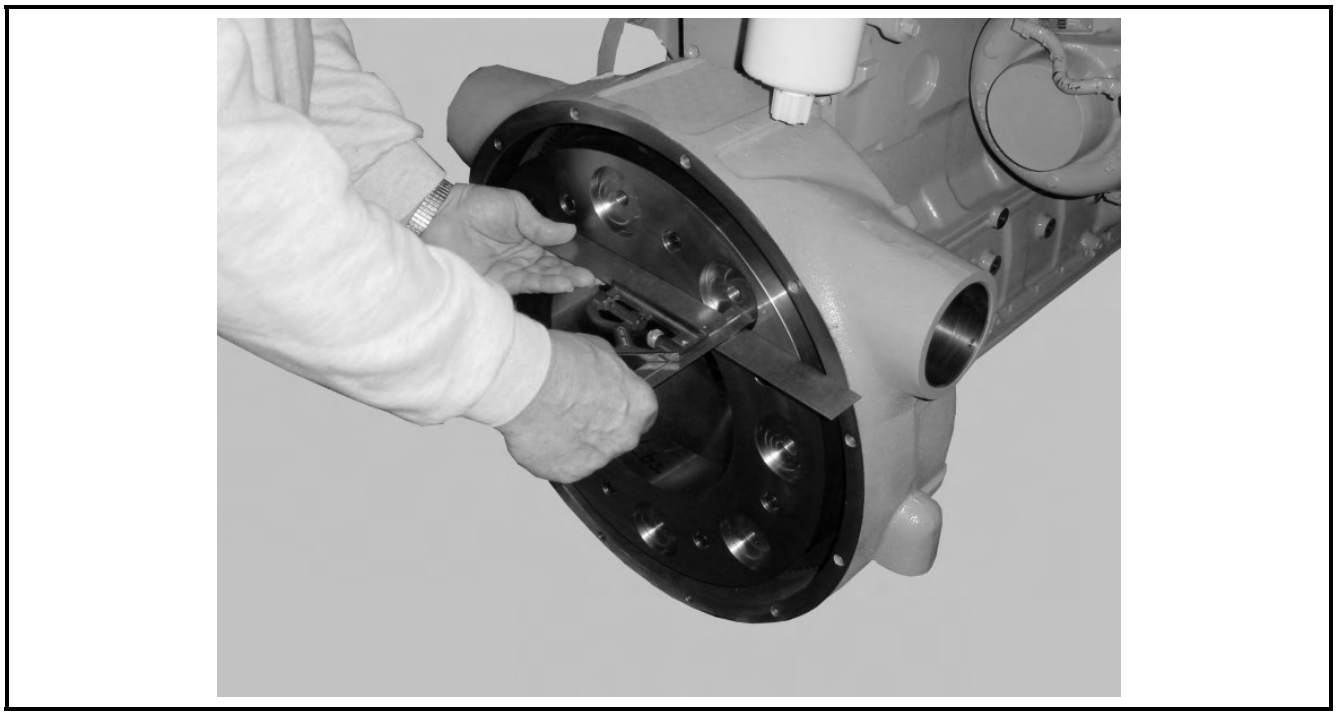
f) After each additional 2,000 hours of operation (or every year) recheck all coupling bolts to maintain the same torque value.



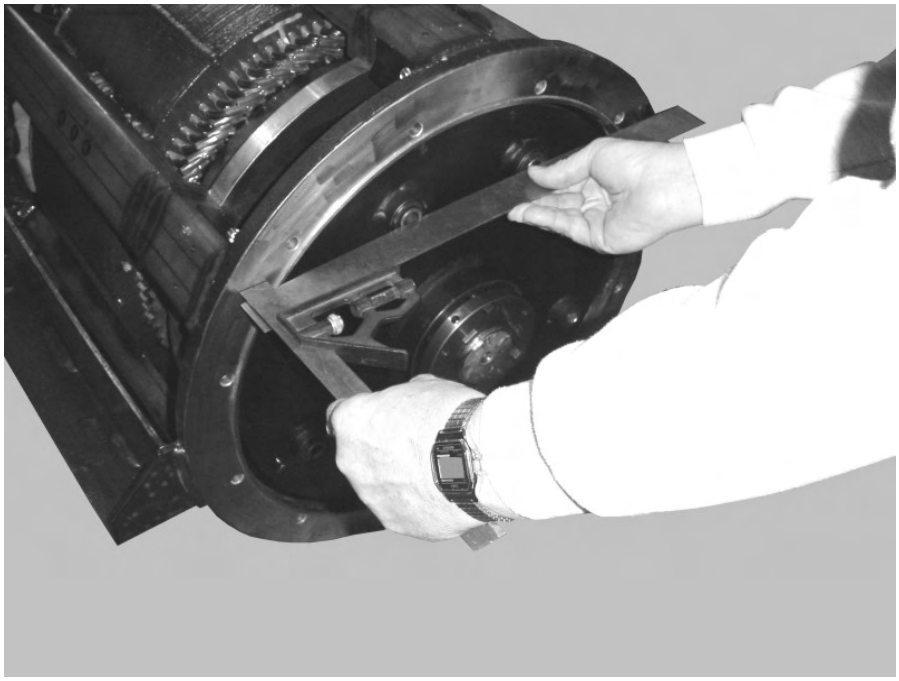
Bushing Installation
Figure 4



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 assembly.

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 940 pounds (426 kg), which is the weight of the generator assembly.

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

(1) Disconnect battery leads from the generator set.

(2) If a transformer-rectifier (T-R) assembly is mounted on the generator set, remove T-R assembly.

(3) Disconnect clearance light wires from the top canopy (if installed).

(4) Remove top canopy panel.

(5) Remove all four doors, and panels below door.

(6) Remove the control box.

(7) Remove the air cleaner, pipes and hoses connecting the filter to the engine.

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

(8) Disconnect generator leads from contactor and CT wires from power module.

(9) Remove the power module.

(10) Remove the support tray and any DC components (if applicable) as necessary.

(11) Remove generator housing cover.

b) Removing the generator Assembly

(1) Support the engine at the flywheel housing with wooden blocks, or second hoist if available.

(2) Remove the generator wrapper on the generator assembly.

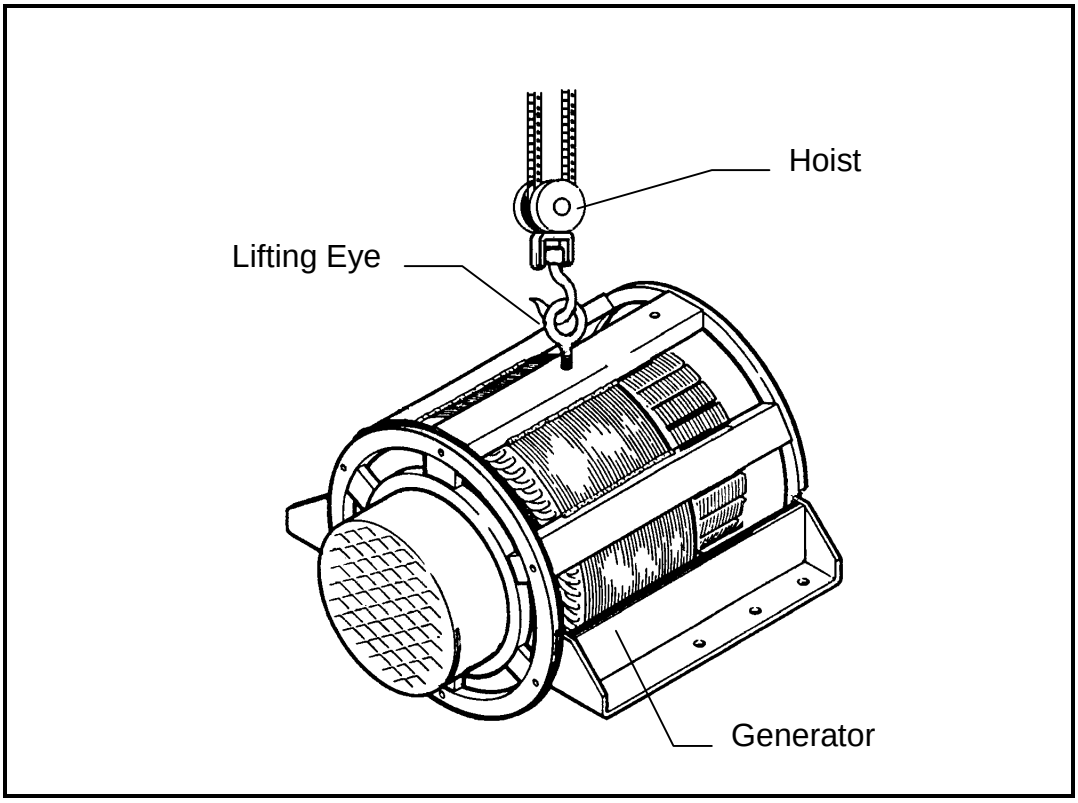
(3) Remove the $^{5}/_{8}$ - 11 x 4 lg. bolt that mounts the rear of the generator assembly to the frame of the generator set.

(4) Using the hoist, support the generator assembly. For lifting convenience a ½ - 13 threaded nut is installed in the top of the generator housing. Insert a ½ - 13 lifting eye in the hole and attach the hoist chain to the eyebolt as shown in Figure 1.

(5) Remove the $^{5}/_{8}$ - 11 x 4 lg. bolts that connect the generator to the engine flywheel.

(6) Detach the generator housing from the engine by removing the 3/8-16 x $1^{1}/_{2}$ lg. bolts that attached the generator to the adapter ring..

(7) 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 adapter plate, using the six $^{3}/_{8}$-16-$1^{1}/_{2}$ lg. bolts. Torque bolts to 30 ft-lb (40 N-m).

(4) Attach the generator to the flywheel coupling using the $^{5}/_{8}$ - 11 x 4 lg. bolts. Torque bolts to 85 ft-lb (115 N-m).

(5) Mount the generator housing to the frame of the generator set, using the $^{5}/_{8}$ - 11 x 4 lg. bolt.

Note: Inspect the shock mount before installing for damage and deterioration. Replace as necessary.

(6) Install the generator wrapper on the generator assembly.

b) Remounting the previously removed assemblies

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

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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 Code	Part Number	Parts Code	Part Number
A	500060E-101	F	500060E-106
B	500060E-102	G	500060E-108
C	500060E-103	H	500060E-109
D	500060E-104	J	500060E-110
E	500060E-105	K	500060E-111

(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
00779	Amp Inc. 2800 Fulling Mill Rd. P.O. Box 3608 Harrisburg, PA 17105-3608	05HB5	Magnecomp Inc 161 Eagles Nest Dr Pickens Sc 29671-7808
01XD4	Contact Industries Inc 25 Lex-Industrial Dr P.O. Box 3086 Mansfield OH 44904-3086	05YB3	Acon Inc. 22 Bristol Dr. South Easton, MA 02375
01428	Tuthill Corp. Superior Linkage Div. 2110 Summit St. New Haven, IN 46774-9524	0E8J0	Emka Inc. 1961 Fulling Mill Rd. Middletown, PA 17057-3125
016T7	Amaton Inc. 446 Blake St. New Haven, CT 06515	0HZP9	Diesel Radiator Co. 1985 Janice Ave. Melrose Park, IL 60160
01989	Dana Corp Weatherhead Div U.S. 24 E. Antwerp, OH 45813	0H8R0	Magnetics 200 10TH St. P.O. Box 391 Butler, PA 16003-0391
02660	Amphenol Corp. 720 Sherman Ave Hamden, CT 06514-1146	0MR72	Power Devices Inc. 26941 Cablot Rd, Suite 124 Laguna Hills, CA 92653-7006
02768	Illinois Tool Works Inc. Fastex Division 19 S. Algonguin Rd. Des Plaines, IL 60016	0ZW45	KHD Deutz Of America Corp 3883 Steve Reynolds Blvd Norcross Ga 30093
05277	Westinghouse Electric Company Semiconductor Division Hill Street Youngwood, PA 15697	1AA44	Collmer Semiconductor Inc. C/O NA-NA Co. 14368 Protopn Rd. Dallas, TX 75244-3511
054W1	Talema Electronic Inc. 3 Industrial Park Dr. P.O. Box 306 Saint James, MO 65559	1DG36	E. M. Products Inc. 220 W. 90th St. Minneapolis, MN 55420

Code	Vendor's Name and Address
1E045	Austin Hardware and Supply Co. 10220 E. 65TH St. P.O. Box 9550 Kansas City, MO 64133-5205
1E222	Furnas Electric Co. Richmond, VA 23200
1FQ83	Newark Electronics Div 3033 Kettering Blvd Dayton OH 45439
1PAM0	DAVCO Manfacturing 1600 Woodland Dr. Saline MI 48176
1SPJ9	Hobart Ground Power 1177 Trade Road East Troy, OH 45373
1W134	Eaton Corp. 4201 N. 27TH Ave. Milwaukee, WI 53216-1807
1Y498	F B Wright 100 E Wilson Bridge Rd Columbus Oh 43085-2334
12662	Peterson Mfg Co. 4200 E 135th St Grandview MO 64030-2821
12687	Trilectron Industries 11001 U.S. Hwy. 41 North Palmetto, Florida 34221
13445	Cole-Herse 20 Old Colony Ave. Boston, MA 02127
13902	Smith Valve Corp. 1 Apple HL Suite 316 Natick, MA 01760-2072
14552	Microsemi Corp 2830 S. Fairview St. Santa Ana, CA 92704-5948
14799	Square D Co. Chicago Assembly Plant 9522 W. Winona Schiller Park, IL 60176-1025
14604	Elmwood Sensors, Inc. Subsidary Fasco Ind. 1655 Elmwood Avenue Cranston, RI 02907
14892	Bendix Corp. The Brake And Steering Div. 401 N Bendix Dr South Bend IN 46634
16238	Lord Mfg. Co. Inc. Sterling Road South Lancaster, Mass 01561
16476	Maxima Technologies 1811 Rohrerstown Rd. Lancaster PA 17601-2321
17284	Mercury Metal Company 1201 S. Mercury Dr. Schaumburg, IL 60193
18265	Donaldson Co. Inc. 1400 W. 94th St. P.O. Box 1299 Minneaplis, MN 55440-1299
2B664	All-Phase Electric Supply Co 1620 W Main St P.O. Box 149 Springfield OH 45501-0149
2N562	Power Transmission Sales Inc. 351 Washington P.O. Box 229 Chagrin Falls, OH 44022-4446
23826	Furnas Electric Company 1004 McKee Street Batavia, IL 60510

Code	Vendor's Name and Address	Code	Vendor's Name and Address
24161	Gates Rubber Co 900 S Broadway Denver CO 80217-5887	38151	Marathon Electric Mfg. Co. 100 E. Randolph St. P.O. Box 8003 Wausau, WI 54401-2568
24446	General Electric Co. 3135 Easton Tpke. Fairfield, CT 06431	40121	Peterson Mfg. Co. Inc. 700 W. 143rd St. P.O. Box 8 Plainfield, IL 60544-9733
25710	Deka Plastics Inc. 914 Westfield Ave. Elizabeth, NJ 07208-1222	44655	Heico Ohmite LLC 3601 W. Howard St. Skokie, IL 60076-4014
26794	Connectron Inc. 12 Industrial Dr. South Amboy, NJ 08879	46922	Crawford Electric Co 445 E 32 Mile Rd Romeo MI 48065-0120
27410	Harris Corp. 1025 Nasa Blvd. Melbourne, FL 32919	49234	Protectoseal Company 1920 S. Western Chicago, Illinois 60608
28520	Heyco Molded Products Inc. 1800 Industrial Way N. P.O. Box 517 Toms River, NJ 08755	5E599	NVF Company Primary Products Div Yorklyn Rd Yorklyn, DE 19736
3A054	McMaster Carr Supply Co. 9630 Norwalk Blvd. Santa Fe Springs, CA 90670-2932	5P059	Tech Products Corp. 2348 Sandridge Dr. Dayton, OH 45439
3Y208	Taylor And Summerville Battery Co 3485 Successful Way Dayton Oh 45414-4319	5U553	Wes-Garde Components Group Inc 300 Enterprise Dr Westerville OH 43081-8840
30104	Automotive Controls Corp. 1300 W. Oak St. P.O. Box 788 Independence, KS 67301-2347	50508	Magnetic Components Inc. 9520 Ainslie St. Schiller Park, IL 60176-1116
30327	Imperial Eastman Corporation 6300 W. Howard Street Chicago, IL 60648	52793	Saginaw Products Corp. 68 Williamson St. Saginaw, MI 48601-3246
30430	Marathon Electric Mfg. Corp. 398 Beach Rd. Burlingame, CA 94010-2004	55752	Parker Hannifin Corp. Racor Div. 3400 Finch Rd. Modesto, CA 95353-3208

Code	Vendor's Name and Address	Code	Vendor's Name and Address
56289	Sprague Electric Company 87 Marshall St. North Adams, MA, 01247	66180	Automatic Timing and Controls 3312 Bloomingdale Melrose Park, IL 60160-1030
57347	Wall Industries Inc. 5 Watson Brook Rd. Exeter, NH 03833	66844	Powerex Inc. E. Hillis St. Youngwood, PA 15697-1176
57448	Stephens & Adamson Mfg. Company 275 Ridgeway Avenue Aurora, Illinois 60507	62292	EBM Industries Inc. 110 Hyde Rd. P.O. Box 4009 Farmington, CT 06034-4009
57733	Stewart-Warner Corporation 1826 Diversey Parkway Chicago, Illinois 60614	67529	All-Phase Electric Supply Co. 875 Riverview Dr. P.O. Box 67 Benton Harbor, MI 49022-0067
59993	International Rectifier Corp 233 Kansas St. El Segundo, CA 90245	7E222	Littlefuse Inc. 800 E. Northwest Highway Des Plaines, IL 60016
6H359	Hobbs Division of Stewart Warner Corp. Highway 6 Spring Valley, IL 61362	7M613	Wright F.B. Co. of Cincinnati 4689 Ashley Dr. Hamilton, Oh 45011-9706
6S553	Wes-Garde Components Group Inc 300 Enterprise Dr Westerville, OH 43081-8840	71382	Seal Master Bearings 1901 Bilter Rd. Aurora, IL 60504-9620
6Y440	Micron Technologies Inc. 8000 S. Federal Way Boise, ID 83707	71400	Bussman Manufacturing Division of McGraw-Edison Company 114 Old State Road St. Louis, MO 63178
6Y481	Hamilton Avnet Electronics Corp 777 Brooksedge Blvd Westerville, OH 43081-2821	71774	General Electric Corp. Lamp Division 4433 N. Ravenswood Ave. Chicago, IL 60640
60038	Timken Corp 1835 Dueber Ave Sw Canton, OH 44706-2798	72582	Detroit Diesel Corp 13400 W. Outer Dr. Redford, MI 48239-4001
61706	EAO Switch Corp. 198 Pepes Farm Rd. P.O. Box 552 M O Milford, CT 06460-3670	72619	Amperex Electronic Corp. Dialight Division 203 Harrison Place Brooklyn, NY 11237

Code	Vendor's Name and Address
74829	Ilsco Corp. 4730 Madison Rd. Cincinnati, OH 45227-1426
77166	Pass and Seymour P.O. Box 4822 Syracuse, NY 13221
74542	Hoyt Electrical Instruments P.O. Box 8798 Penacook, NH 03303
74545	Hubbell Harvey Inc. 584 Derby Milford Rd. Orange, CT 06477
75418	Kysor Industrial Corporation 1100 W. Wright Street Cadillac, Michigan 49601
74559	Electrical Enclosures Div Of Hoover Systems 12118 Corporate Dr Dallas TX 75228
77342	Potter and Brumfield Inc 200 S. Richland Creek Dr. Princeton, IN 47671-0001
78377	Superior Carbon Products Inc Cleveland OH 44100
78388	Synchro-Start Products Inc Sub of Knowles Electronics Inc 6250 W Howard St Niles, Il 60714
79497	Western Rubber Co. 620 E. Douglas Goshen, IN 46526-4035
8A334	Cummins Interstate Power Inc 4000 Lyman Dr Hilliard OH 43026
8T246	Whitesell RO & Associates, Inc. 4133 S. Dixie Ave. Dayton, OH 45439
81074	Holub Industries, Inc. 413 DeKalb Avenue Sycamore, Illinois 60178
81703	Mulberry Metal Products Inc. 2199 Stanley Terrace Union , NJ 07083
82866	Research Products Corp. 1015 E. Washington Ave. Madison, WI 53701
83330	Dialight Corp. 1913 Atlantic Ave. Manasquan, NJ 08736-1005
86797	Rogan Corp 3455 Woodhead Dr. Northbrook, IL 60062-1812
90201	Emhart Ind., Inc. Mallory Capacitor Co. 4760 Kentucky Ave. Indianapolis, IN 46206
91637	Dale Electronics Inc. 1122 23RD St. Columbas, NE 68601-3647
91929	Honeywell Inc. Microswitch Div. 11 W. Spring St. Freeport, IL 61032
94222	Southco Inc. 210 N. Brinton Lake Rd. Concordville, PA 19331
97520	Basler Electric Company Route 143 P.O. Box 269 Highland, IL 62249

Code	Vendor's Name and Address	Code	Vendor's Name and Address
99186	Borg-Warner Automotive 700 S 25th Ave. Bellwood, IL 60104		
D0024	Semikron International Sigmundstrasse 200 P.O. Box 820251 Nuerengerg, Germany 90253		
E0615	Kraus and Naimer 42 Miramar Avenue P.O. Box 15-009 Wellington, New Zealand		
S7023	Bossard LTD Fasteners Steinhauserstrasse 70 Zug Switzerland, CH-6300		

Section 3 Illustrated Parts List

1) Explanation of Parts List Arrangement

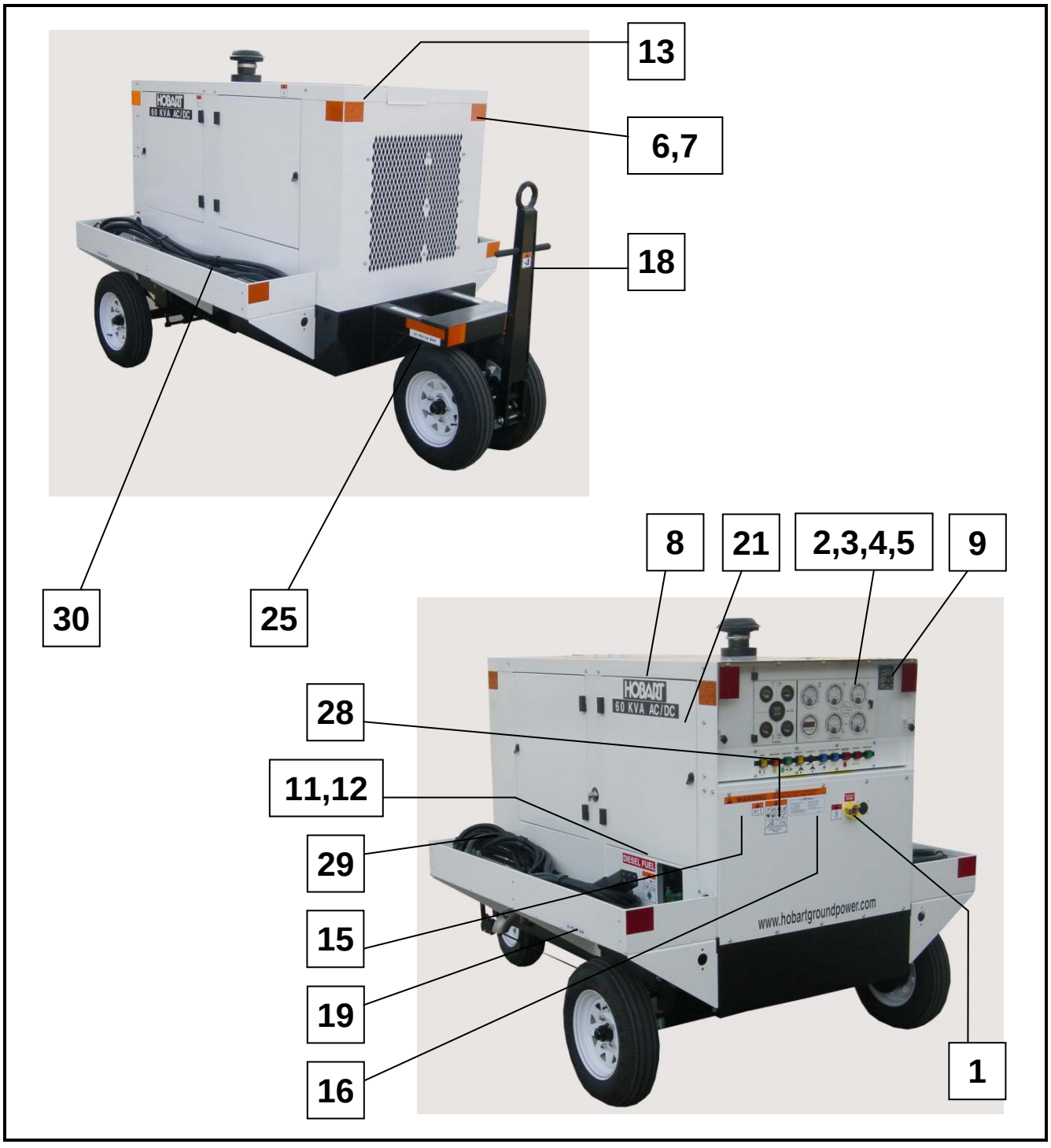
The parts list is arranged so that the illustration will appear on a left-hand page and the applicable parts list will appear on the opposite right-hand page. Unless the list is unusually long, the user will be able to look at the illustration and read the parts list without turning a page.

2) Symbols and Abbreviations

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

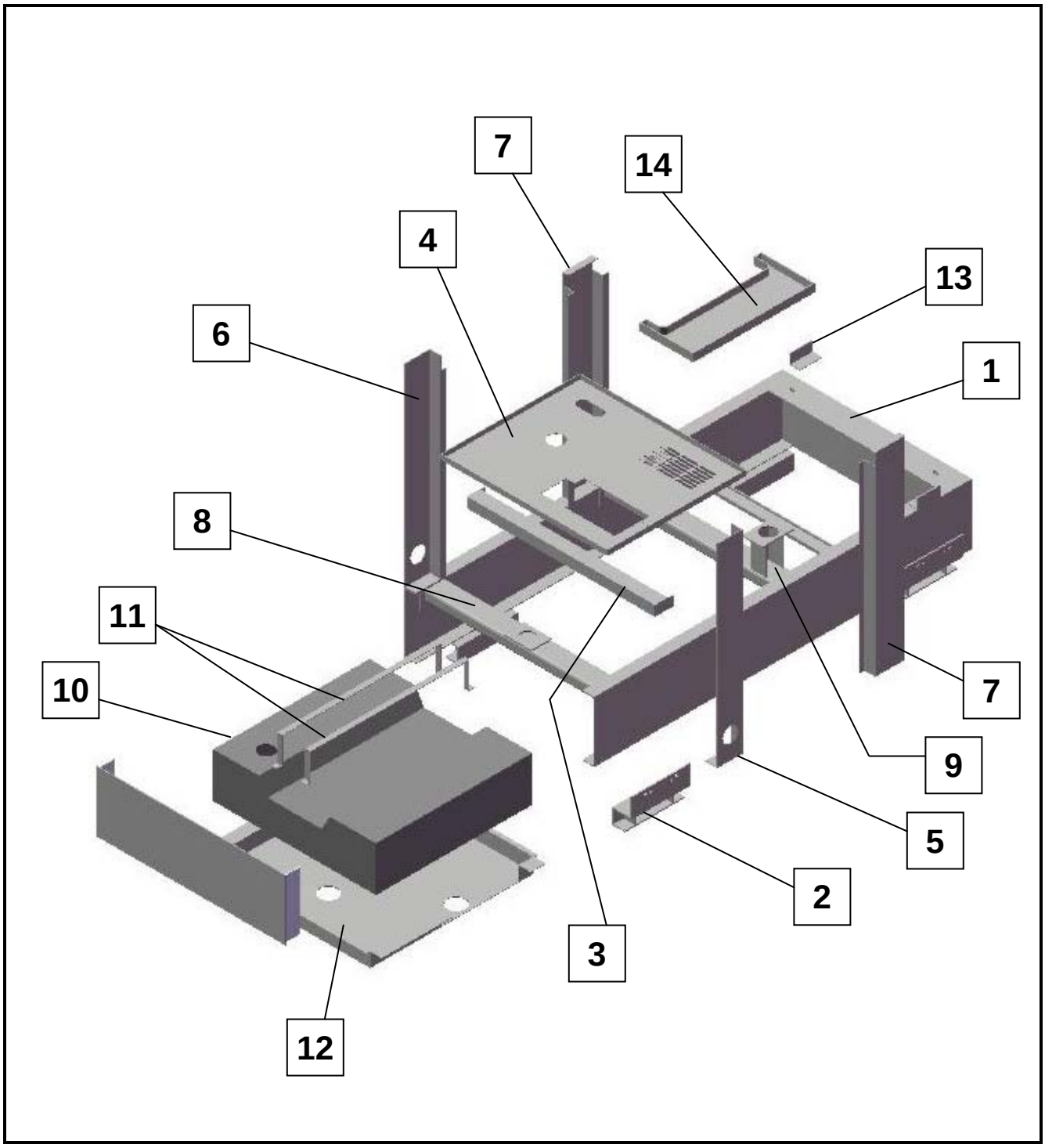
*	-	Item not illustrated
A, or AMP	-	Ampere
AC	-	Alternating current
AR	-	As required
DC	-	Direct current
Fig.	-	Figure
hd.	-	Head
hex	-	Hexagon
Hz	-	Hertz (cycles-per-second)
I.D.	-	Inside diameter
IN or “	-	Inch
KVA	-	Kilovolt-ampere
uF	-	Microfarad
No.	-	Number
NHA	-	Next higher assembly
PRV	-	Peak 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.



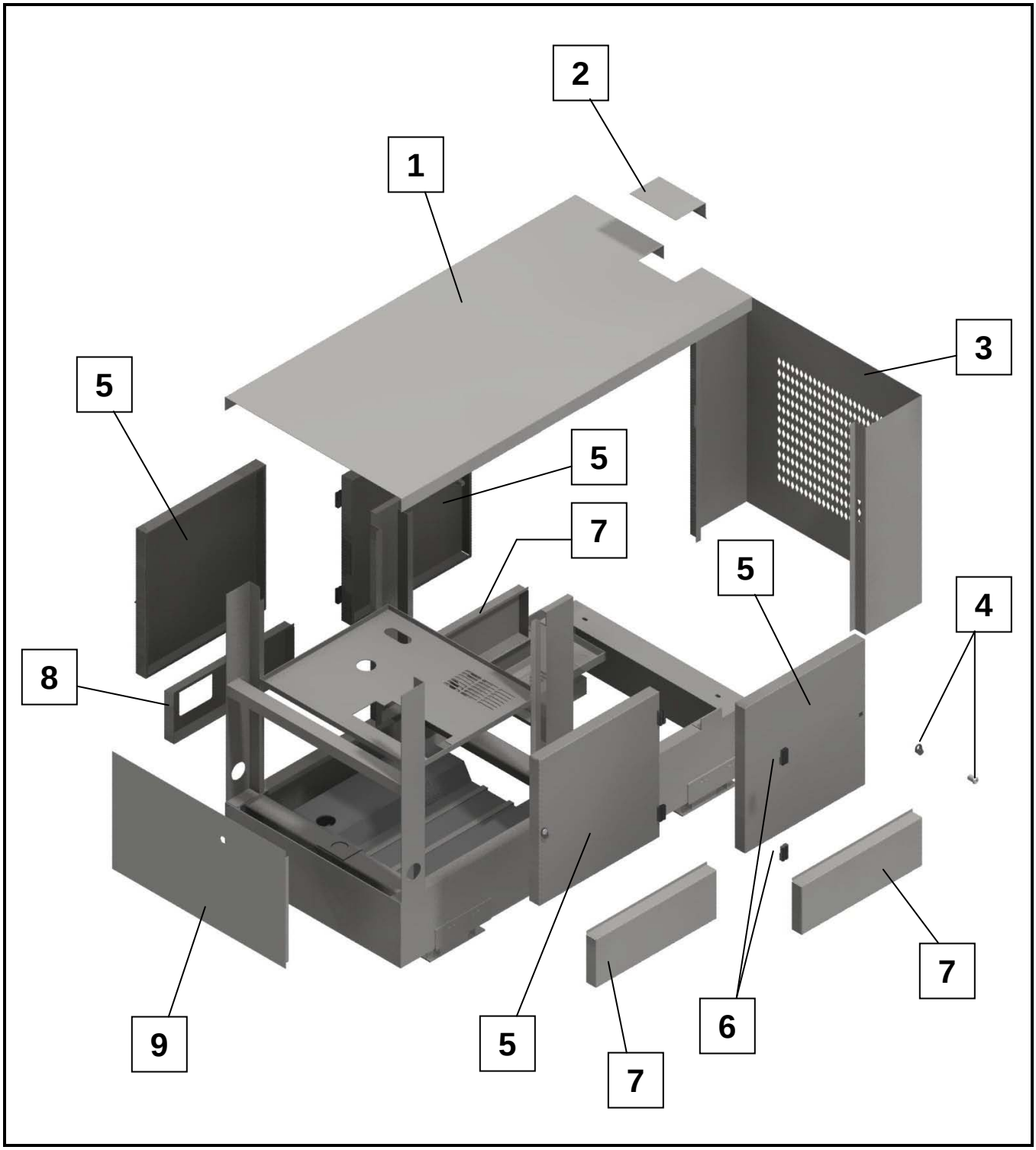
General Assembly
Figure 1

FIGURE ITEM NO.		FACTORY PART NO.	NOMENCLATURE	EFF	QTY PER ASSY.
1-	1		***Emergency Stop Button***		
		285125	…Guard, Mushroom Button *(V14799 #K56YM)*		1
		288300	…Emergency Stop Label		1
		77A1157	…Switch, Push-Pull *(V14799 #KR-9R-H6)*		1
		287466	…Label, Emergency Stop		1
			Operator Control Panel		
	2	290709	…Control Cover		1
	3	288023	…Wing Knob Latch		2
	4	288020	…Bracket Latch		2
	5	290687	…Hinge, Control Cover		1
			Labels, Nameplates and Reflectors		
	6	408665-001	Red Reflector	A,B,E,G,J	8
		408665-001	Red Reflector	C,D,F,H,K	4
	7	408665-002	Amber Reflector	A,B,E,G,J	24
		408665-002	Amber Reflector	C,D,F,H,K	12
	8	402987	Hobart Label		2
	9	78A-1000	I.D. Label		1
*	10	79A-1110	Option Label		1
	11	287461	Fuel Label		1
	12	76B-1148	Diesel Fuel Label		1
*	13	287462	Radiator Label		1
*	14	287463	Hot Muffler Label		1
	15	282658	Label, Warning, Clearance		1
	16	288866	Support Center Label		1
*	17	288862	Engine Speed “Caution” Label		1
	18	287465	Warning Drawbar Label	A,B,E,G,J	1
	19	287565	Tire Pressure Label	A,B,E,G,J	4
*	20	287696	Hearing Protection Label		1
	21	283714-004	KVA Rating Label	A,B,C,D,G,H	2
*	22	288164-002	Label, TR Unit	E,F,J,K	2
*	23	407366	Label, Caution		1
*	24	287467	Label, Glow Plug		2
	25	288388	Label, Not a Step	A,B,E,G,J	2
*	26	400435	Nameplate, 28 VDC	E,F,J,K	1
*	27	81B1084	Nameplate, Output Cable, 28 VDC	E,F,J,K	1
	28	287459	Label, General Information		1
			Output Cables and Accessories		
	29	402034-002	Cable, Output, AC, 30 ft. (if supplied)		1
			Cable, Output, AC, 30 ft. (if supplied)	B,D	2
	30	402025-003	Cable, Output, DC, 30 ft. (if supplied)	E,F,J,K	1
	31	288120	Output Cable Bracket, AC		1
		288120	Output Cable Bracket, AC	B,D	2
	32	488640	Output Cable Bracket, DC	E,F,J,K	1
*	33	7J422-0	Cable Clamp		2
		7J422-0	Cable Clamp	B,D	4
		7J422-0	Cable Clamp	E,F,J,K	3
*	34	287698-001	Output Cable Covers	A,C,G,H	1
*	35	403091-008	Hole Plug		1



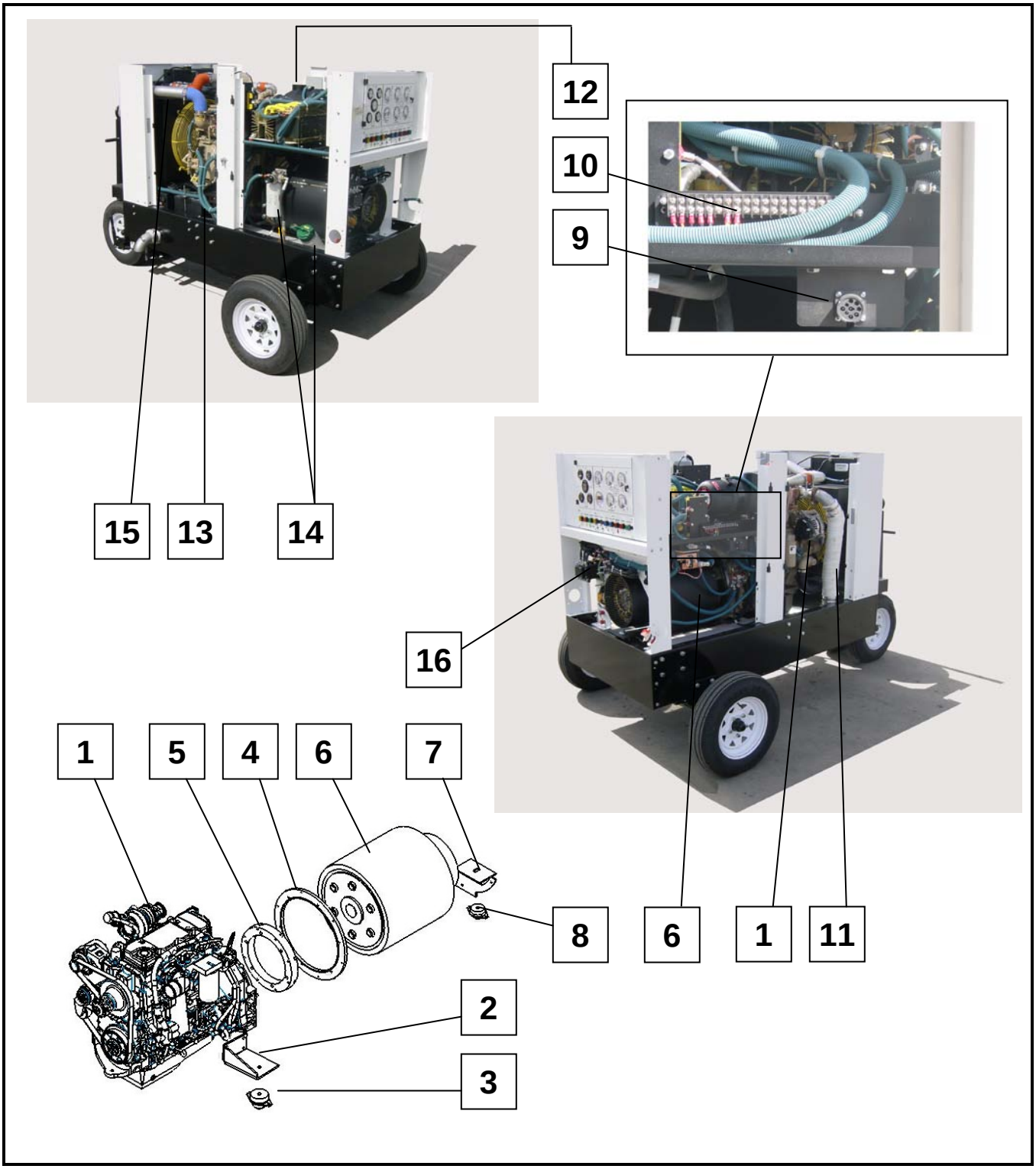
Frame Assembly
(Stationary Frame Shown)
Figure 2

FIGURE ITEM NO.	FACTORY PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
2 - 1		See Figure 18 for Trailer Assembly	A,B,E,G,J	1
	290707	Mounting Frame, Stationary	C,D,F,H,K	1
2	290933	Stationary Mounting Bracket	C,D,F,H,K	4
3	287986	Control Panel Support		1
4	290487	TR Support Panel		1
5	290485-002	Control Panel Support, Right		1
6	290485-001	Control Panel Support, Left		1
7	290486	Door Support Panel		2
	290690-003	…Panel Noise Insulation, Bottom		1
	290690-004	…Panel Noise Insulation, Top		1
8	287957	Generator Support		1
9	288373	Engine Support		1
10	290701	Fuel Tank, Composite		1
*	486719-005	…Fuel Tank Sender		1
*	282562	…Fuel Fill Cap		1
11	290702	Composite Fuel Tank Strap		2
*	290267	…Composite Fuel Tank Strap Gasket		2
12	289895	Composite Fuel Tank Belly Pan		1
13	287998	Front Panel Bracket		2
14	287795	Battery Tray		1



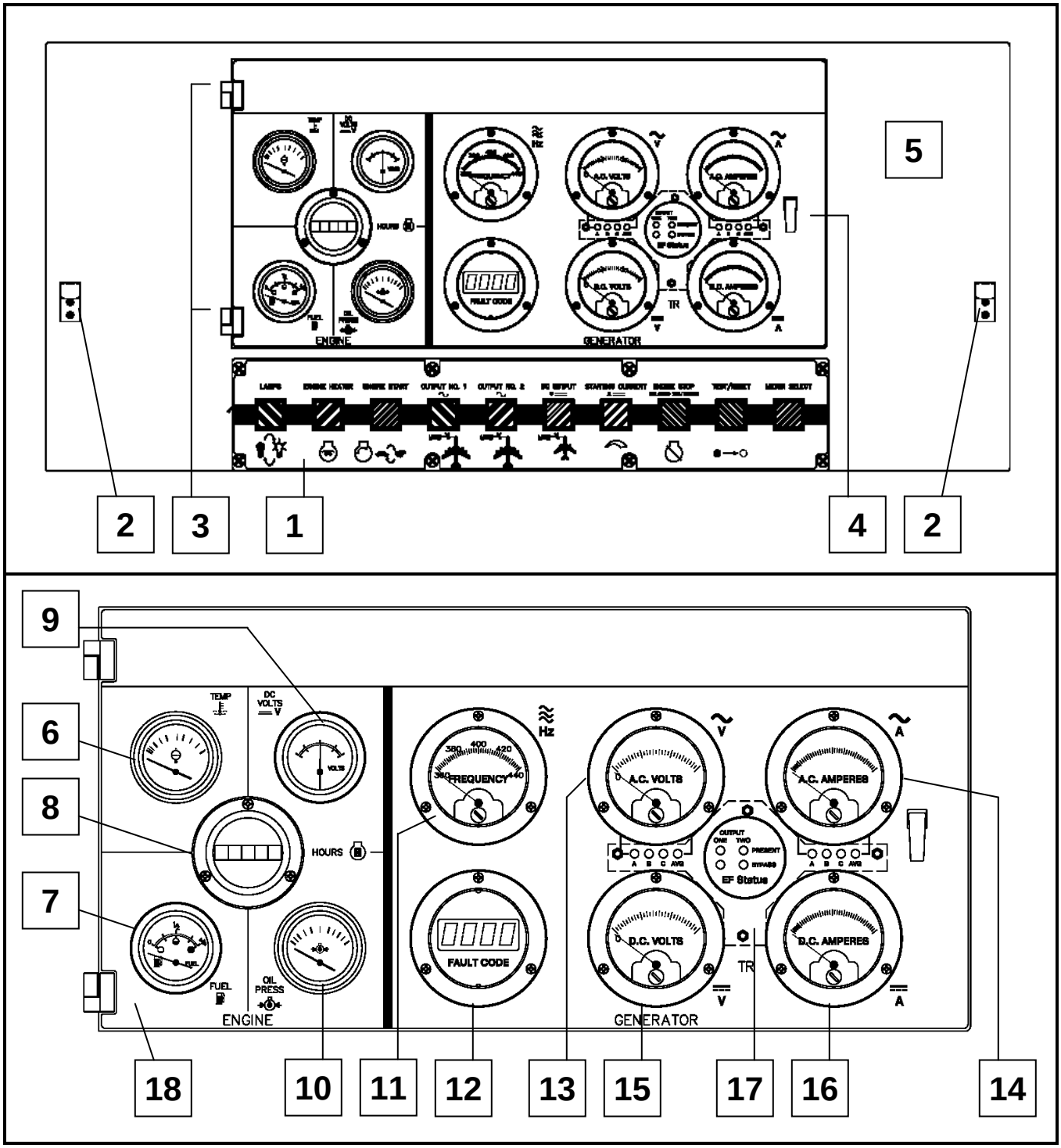
Canopy Assembly
(Stationary Frame Shown)
Figure 3

FIGURE ITEM NO.		FACTORYP ART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
3 -	1	290935	Top Canopy		1
*		288064-005	Top Canopy Insulation, Center		1
*		288064-003	Top Canopy Insulation, Radiator End		1
*		290690-009	Top Canopy Insulation, c. Box End		1
	2	287999	Radiator Cap Access Door		1
	3	290559	Front Panel		1
*		290690-005	…Front Panel Insulation, LH		1
*		290690-006	…Front Panel Insulation, RH		1
	4	287542-001	Door Latch, Hex *(V94222 #E3-16-15)*		4
		287526-002	…Door Latch Pull Tab *(V94222 #E3-27-1)*		4
	5	290589	Access Door		4
*		290690-001	Door Noise Insulation		3
*		290690-002	Door Noise Insulation, 1”		1
	6	283597	Door Hinge *(V94222 #96-10-520-50)*		4
		283824	Door Hinge *(V94222 #96-10-510-50)*		4
	7	287977	Side Panel		3
		287785	…Access Panel Fastener		12
*		288064-002	…Side Panel Insulation		3
		288064-006	…Side Panel Insulation		1
	8	289094	Side Panel with Fuel Opening		1
*		287785	…Access Panel Fastener		4
	9	290590	Lower Rear Panel		1



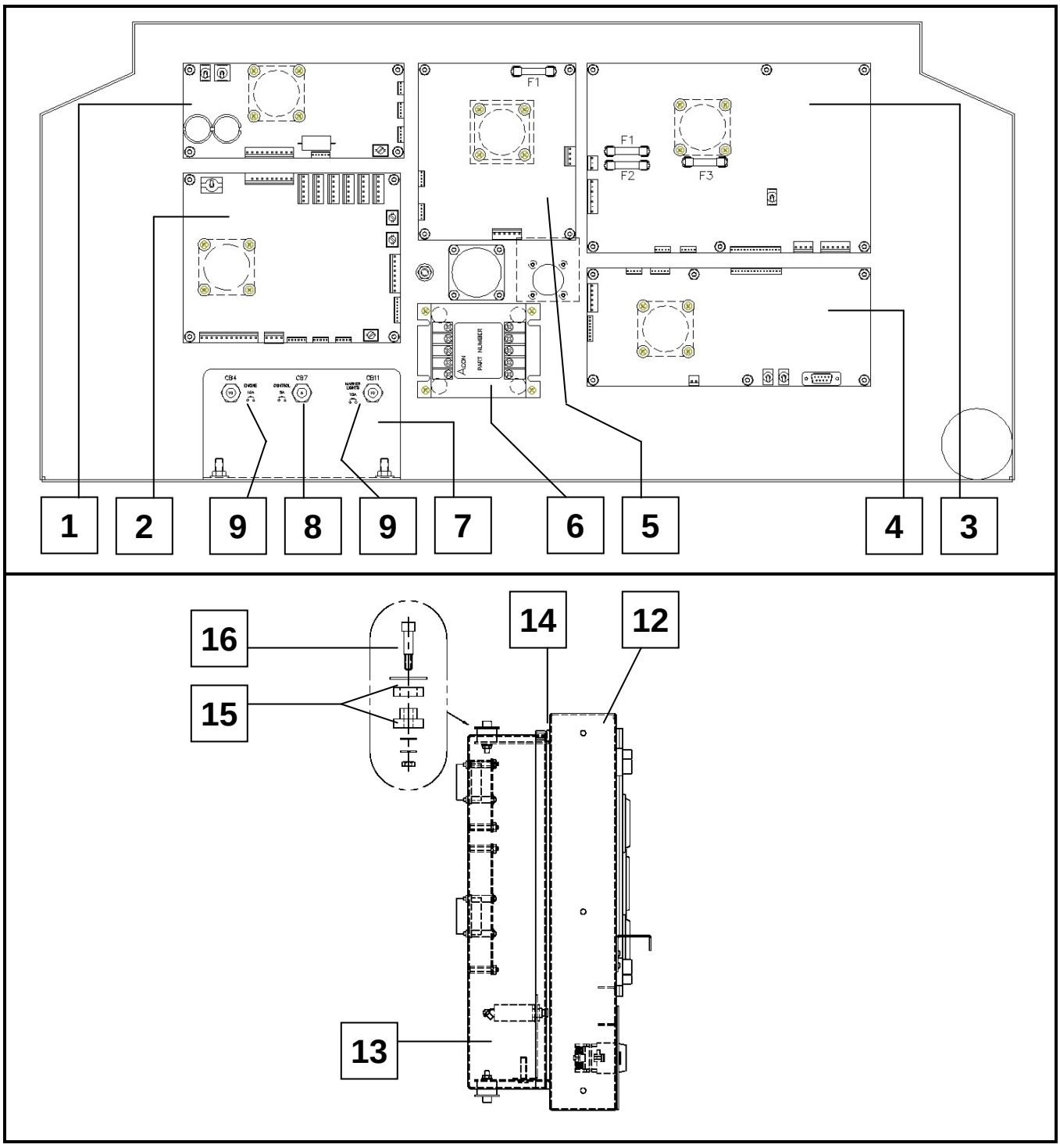
Internal Components
Figure 4

FIGURE ITEM NO.		FACTORY PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
4-	1	290065	QSB4.5 Cummins Engine		1
	2	290313	Engine Support Bracket		2
	3	288109-001	Engine Shock Mount *(V5P059 #51512-1)*		2
	4	287967	Engine Flywheel Housing Adapter		1
	5	287968	Flexible Coupling Adapter Ring		1
	6	287060-003	60 kVA Hobart Generator		1
		287866	…Generator Cover		1
	7	287958	Generator Support Bracket		1
	8	284372-001	Generator Shock Mount *(V5P059 #51510-1)*		1
	9	290684	Engine Dongle Panel		1
		290679	…Electronic Engine Wire Harness		1
	10	288895	Options Terminal Block Panel		1
		290678	…Engine Wire Harness		1
	11		Engine Exhaust System (See Figure 14)		
	12		Engine Intake Air Assembly (See Figure 12)		
	13		12 VDC Battery System (See Figure 11)		
	14		Engine Fuel System (See Figure 10)		
	15		Engine Cooling System (See Figure 9)		
	16		Power Module Assembly (See Figure 8)		



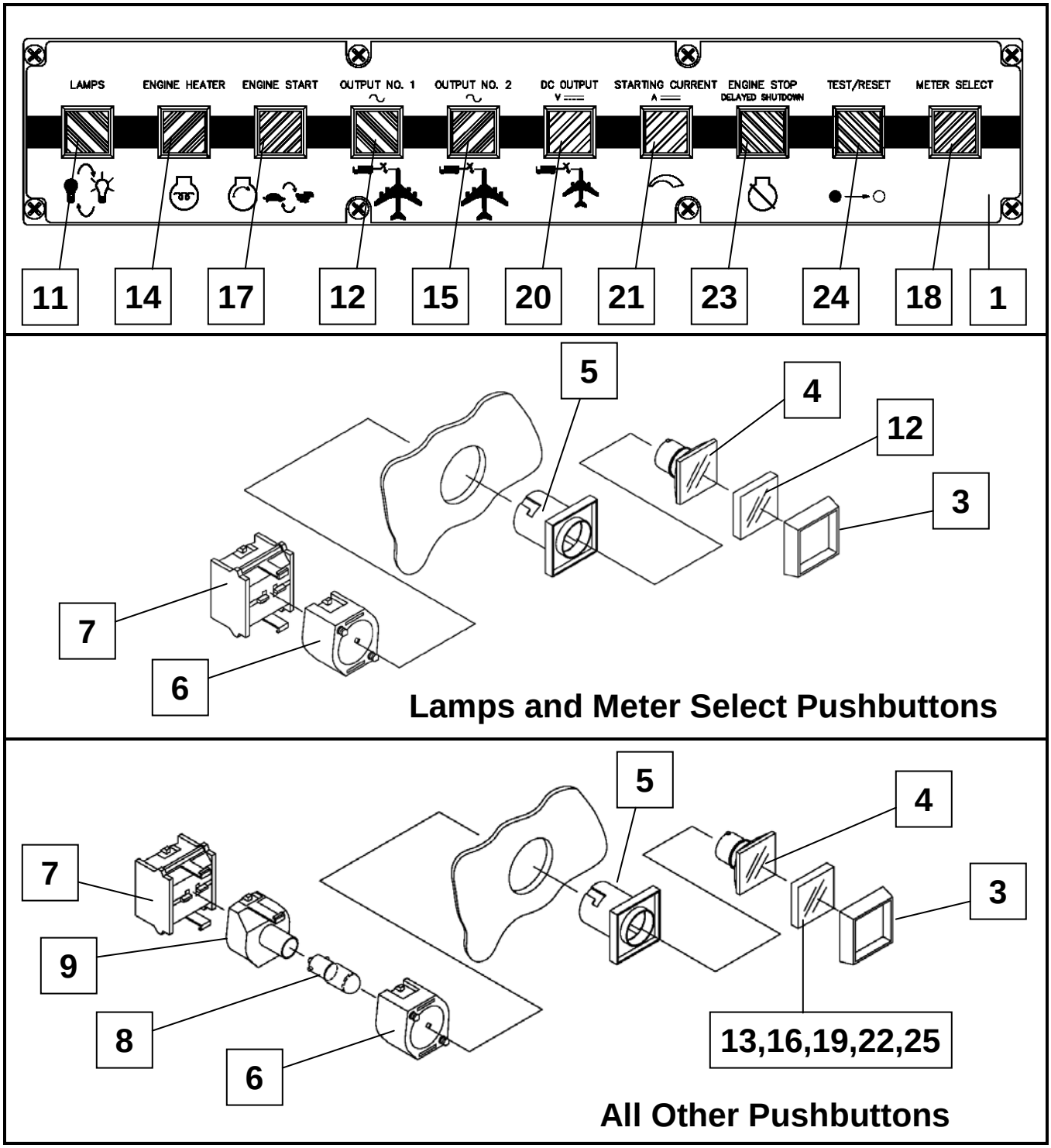
Control Box Assembly
Figure 5

FIGURE ITEM NO.	FACTORY PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
5 - 1		Switch Panel (See Figure 7)		
*		Control Box Interior Components (See Figure 6)		
2	288020	Cover, Support Bracket		1
3	288836-001	Top Door Hinge *(V94222 #96-141 Type A)*		1
	288836-002	Bottom Door Hinge *(V94222 #96-142 Type B)*		1
	289078	…Spacer, Hinge		2
4	288999-001	Control Box Door Latch		1
5	289077	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	Hour Meter *(V6H359 #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
	288858-002	Digital Frequency Meter	G,H	1
12	288858-004	Fault Code Mater		1
13	W8105A-009	Analog AC Voltmeter		1
	288858-003	Digital AC Voltmeter	G,H	1
14	288814-003	Analog AC Ammeter		1
	288858-001	Digital AC Ammeter	G,H	1
15	400642-008	Analog DC Voltmeter	E,F	1
	288858-006	Digital DC Voltmeter	J,K	1
16	400641-015	Analog DC Ammeter	E,F	1
	288858-005	Digital AC Ammeter	J,K	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



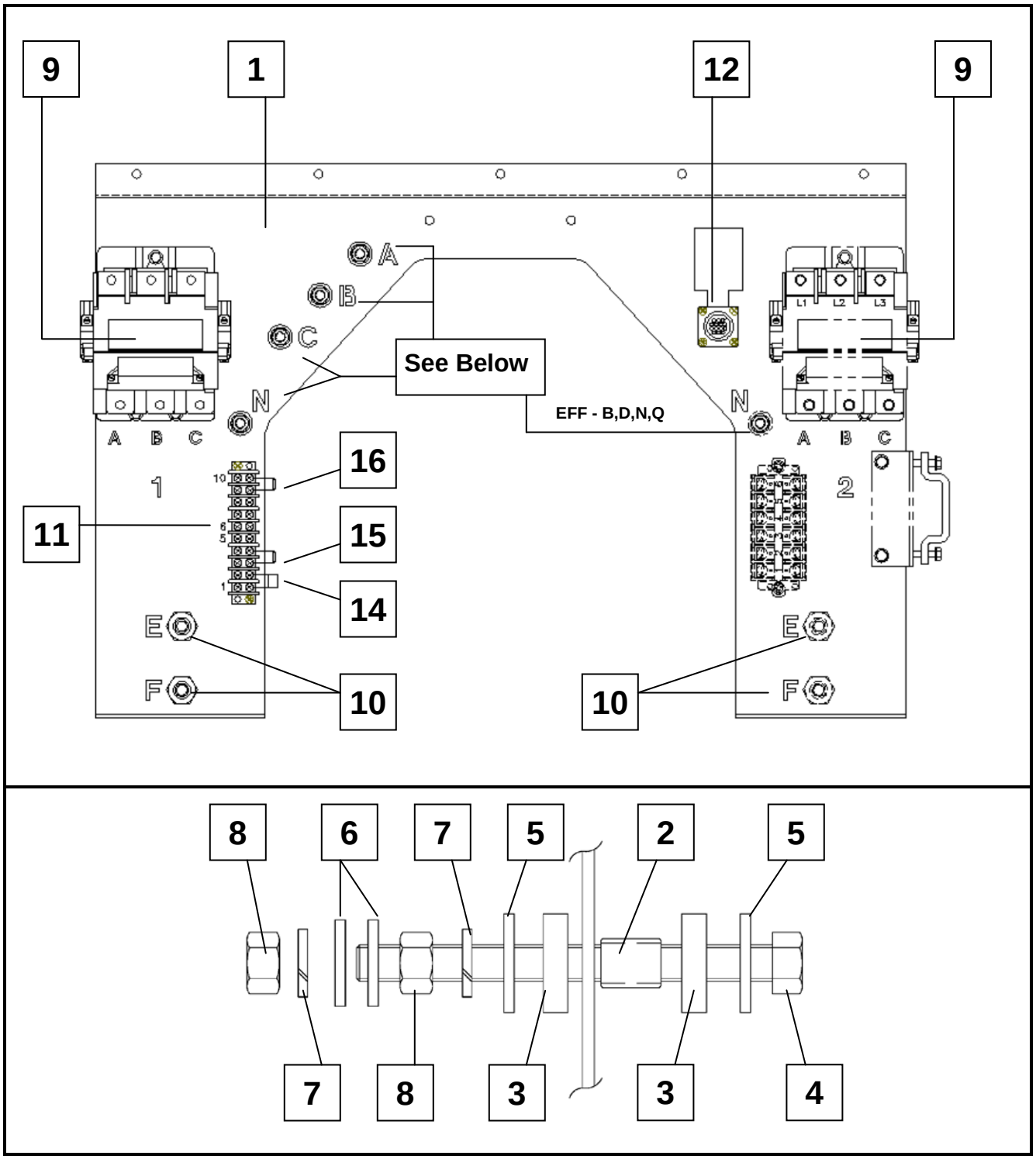
Control Box Interior Components
Figure 6

FIGURE ITEM NO.		FACTORYPART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
6 -	1	288745	Engine Specific PC Board		1
*		284316-004	…PC Board Spacer		4
	2	288937	Engine Interface PC Board		1
*		284316-004	…PC Board Spacer		4
	3	288940A	Voltage Regulator PC Board		1
*		284316-004	…PC Board Spacer		6
	4	289026	Control PC Board		1
*		284316-004	…PC Board Spacer		6
	5	288914	T-R PC Board		1
*		284316-004	…PC Board Spacer		4
	6	288818-001	Power Supply		1
*		288605	…Power Supply Support		1
	7	289122	Circuit Breaker Support		1
		289060	…Circuit Breaker Support Label		1
	8	283978-001	5 A Circuit Breaker *(V77342 #W23-X1A1G-5)*		1
	9	283978-002	10 A Circuit Breaker *(V77342 #W23-X1A1G-10)*		2
*	10	289073	Main Wire Harness		1
*	11	289072	DC Wire Harness		1
	12	291307	Control Box Enclosure		1
	13	291298	Control Box Rear Panel		1
	14	286485-001	…Gasket		6 ft.
	15	286388-001	Ring and Bushing Mount		4
	16	289104-001	Shoulder Bolt, #10-24		4
		286477-002	Snubber Washer		4



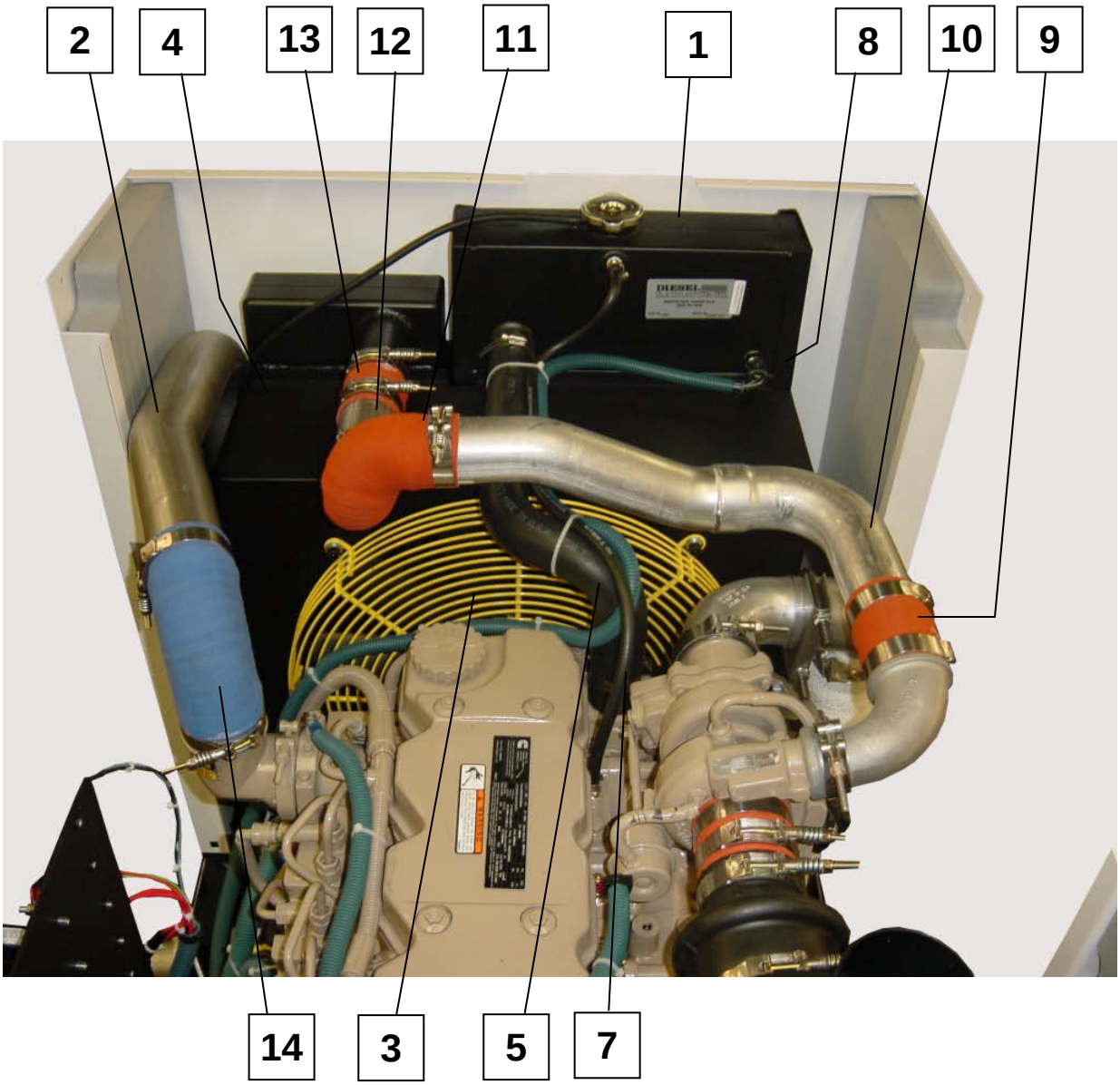
Control Switch Panel Components
Figure 7

FIGURE ITEM NO.		PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
7 -	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 *(V1FQ83)*		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)*		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,J,K	1
	21		***Current Pushbutton***	E,F,J,K	1
	22	285030-005	Blue Lens *(V61706 #704-702.6)*		1
	23		***Engine Stop Pushbutton***		1
	24		***Test/Reset Pushbutton***		1
	25	285030-001	Red Lens *(V61706 #704-702.2)*		1



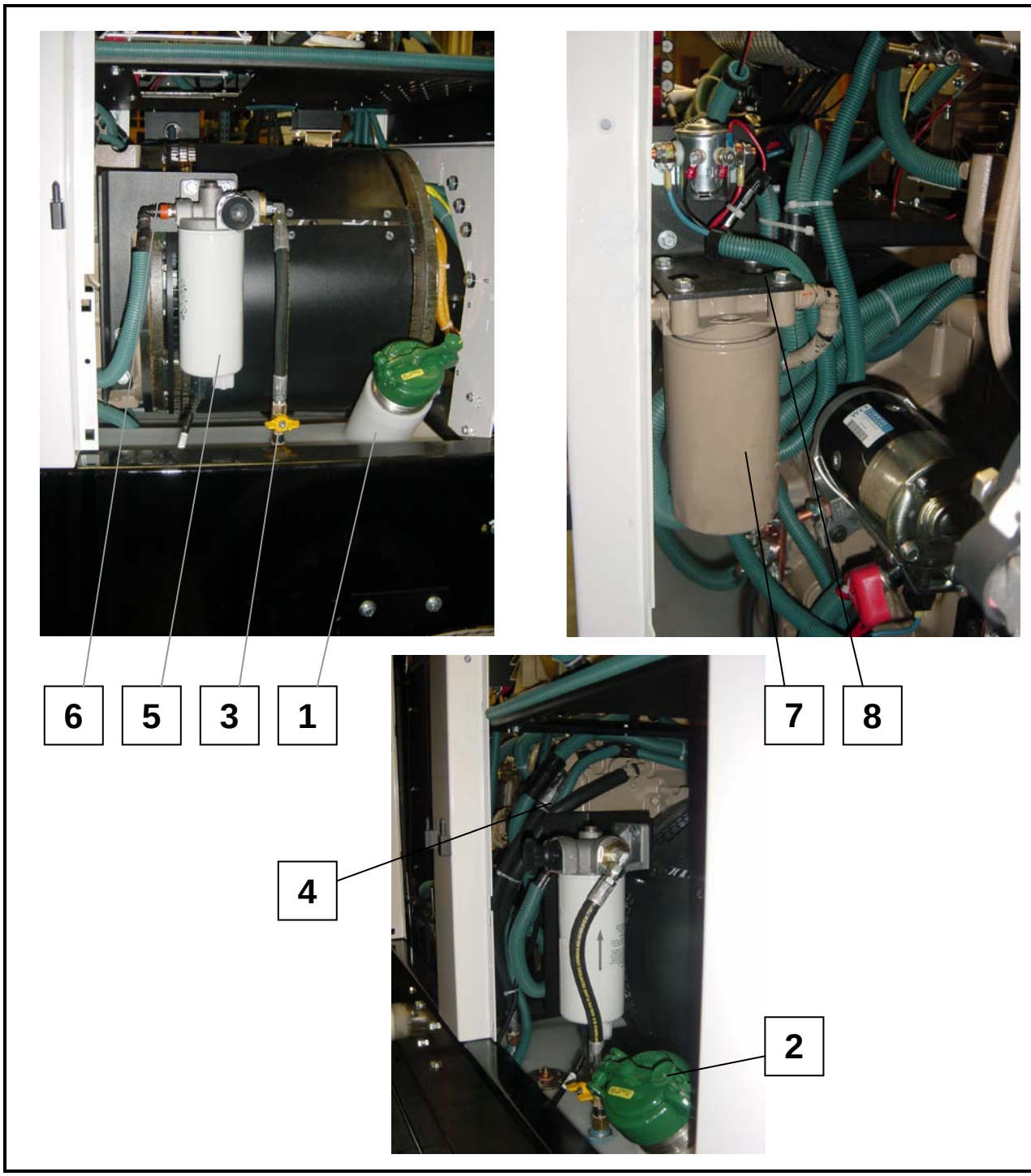
400 Hz. Power Module Assembly
Figure 8

FIGURE ITEM NO.		PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
8 -	1	289093	Power Module Panel		1
			[A,B,C,N] Generator Lead Connections		
	2	AW626	Insulating Bushing *(V1Y498)*		1
	3	A25	Insulating Washer		2
	4	W11097-028	$^{3}/_{8}$-16 x 3.5 in. Lg. Steel Hex Head Bolt		1
	5	W11242-018	$^{3}/_{8}$ Flat Washer		2
	6	W11242-010	$^{3}/_{8}$ Flat Washer		2
	7	W11254-006	$^{3}/_{8}$ Lock Washer		2
	8	W11278-005	$^{3}/_{8}$-16 Hex Nut		2
	9	282130-001	3-Pole AC Contactor		1
		282130-001	3-Pole AC Contactor	B,D	1
	10	286266	[E-F] Short Insulating Standoff		2
		286266	[E-F] Short Insulating Standoff	B,D	4
	11	401911-010	10-Position Terminal Block		1
	12	290683	Power Module Wire Harness		1
			…Cable, Power, Ay.		Ref.
*			…(No. 101) “A” Stator Terminal to “K1”		1
*			…(No. 102) “B” Stator Terminal to “K1”		1
*			…(No. 103) “C” Stator Terminal to “K1”		1
*			…(No. 110) “N” Stator Terminal to “N”l		1
			…Current, Transformer *(V05HB5 # 20130)*		3
*	13	289318	2nd Output Wire Harness	B,D	1
			…Cable, Power, Ay.		
*			…(No. 104) “A” Stator Terminal to “K201”		1
*			…(No. 105) “B” Stator Terminal to “K201”		1
*			…(No. 106) “C” Stator Terminal to “K201”		1
*			…Current, Transformer *(V05HB5 # 20130)*		3
	14	282089-011	Flyback Diode Assembly		1
	15	288892-009	60 kVA I.D. Resistor		1
	16	288892-001	Power Module I.D. Resistor		1
	17	488640	DC Output Cable Clamp Bracket	E,F,J,K	1
	18	7J422-000	DC Output Cable Clamp	E,F,J,K	1
*	19	288974	Noise Suppression Capacitor	All (except B,D)	1



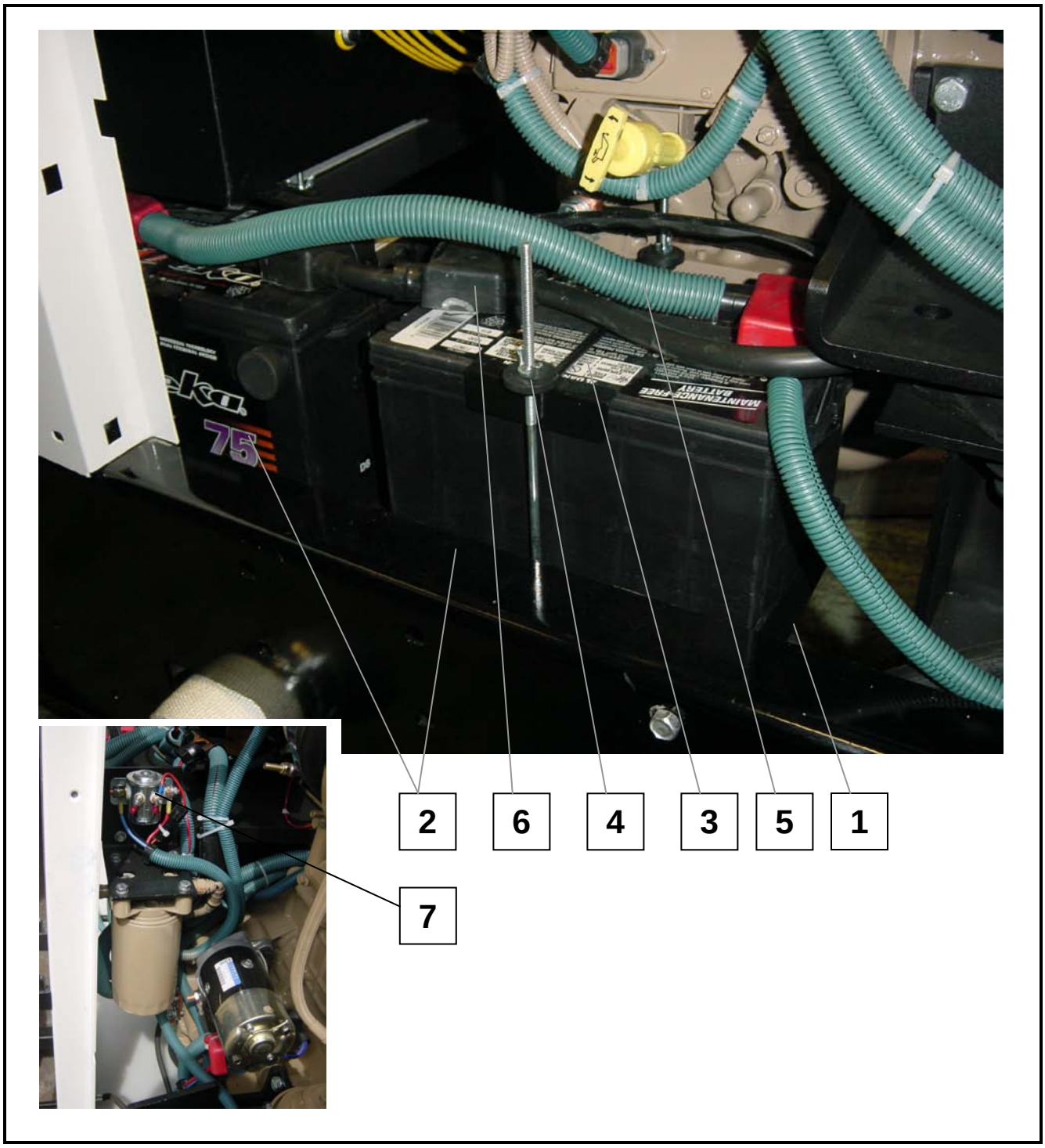
Cooling System Components
Figure 9

FIGURE ITEM NO.		PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
9 -	1	288343	Radiator		1
		283873	…Drain Valve		1
		056535	…3/8 inch Drain Hose		12 inches
		W10869-014	…Hose Clamp		1
		287333-002	…Radiator Cap, 15 PSI		1
	2	Call Factory	Pipe, CAC Inlet		1
*		290936	…Hose, CAC, Straight, 3” ID		1
		290597-001	…Clamp, T-Bolt, Floating Bridge, 3.25” *(V4K938 #94143-0325)*		2
	3		**Cooling Fan Assembly**		
*		288001	…Fan, 20 inch Cooling		1
		288002	…Guard, Fan		1
	4	290575	Shroud, Fan		1
	5	290356	Hose, Top Radiator		1
		W10869-003	…Hose Clamp		2
*	6	290357	Hose, Bottom Radiator		1
		W10869-005	…Hose Clamp		2
	7	056534	Deaeration Hose		28 in.
		288123-001	…Male Connector		2
		W10869-014	…Hose Clamp		2
	8	290145	Switch, Low Coolant Shutdown *(V8A334 #4903016)*		1
	9	290624	Hose, CAC, Straight, 2.5” ID		1
		290597-004	…Clamp, T-Bolt, Floating Bridge, 2.65” *(V4K938 #94143-0265)*		2
	10	290339	Pipe, CAC Outlet		1
	11	290623	Hose, CAC, Elbow, 90°, 2.5” ID		1
		290597-004	…Clamp, T-Bolt, Floating Bridge, 2.65” *(V4K938 #94143-0265)*		2
	12	290943	Pipe, CAC, Straight, 2.5” ID		1
	13	290624	Hose, CAC, Straight, 2.5” ID		1
		290597-004	…Clamp, T-Bolt, Floating Bridge, 2.65” *(V4K938 #94143-0265)*		2
	14	290619	Hose, CAC, 90° Elbow, 3” ID		1
		290597-001	…Clamp, T-Bolt, Floating Bridge, 3.25” *(V4K938 #94143-0325)*		2



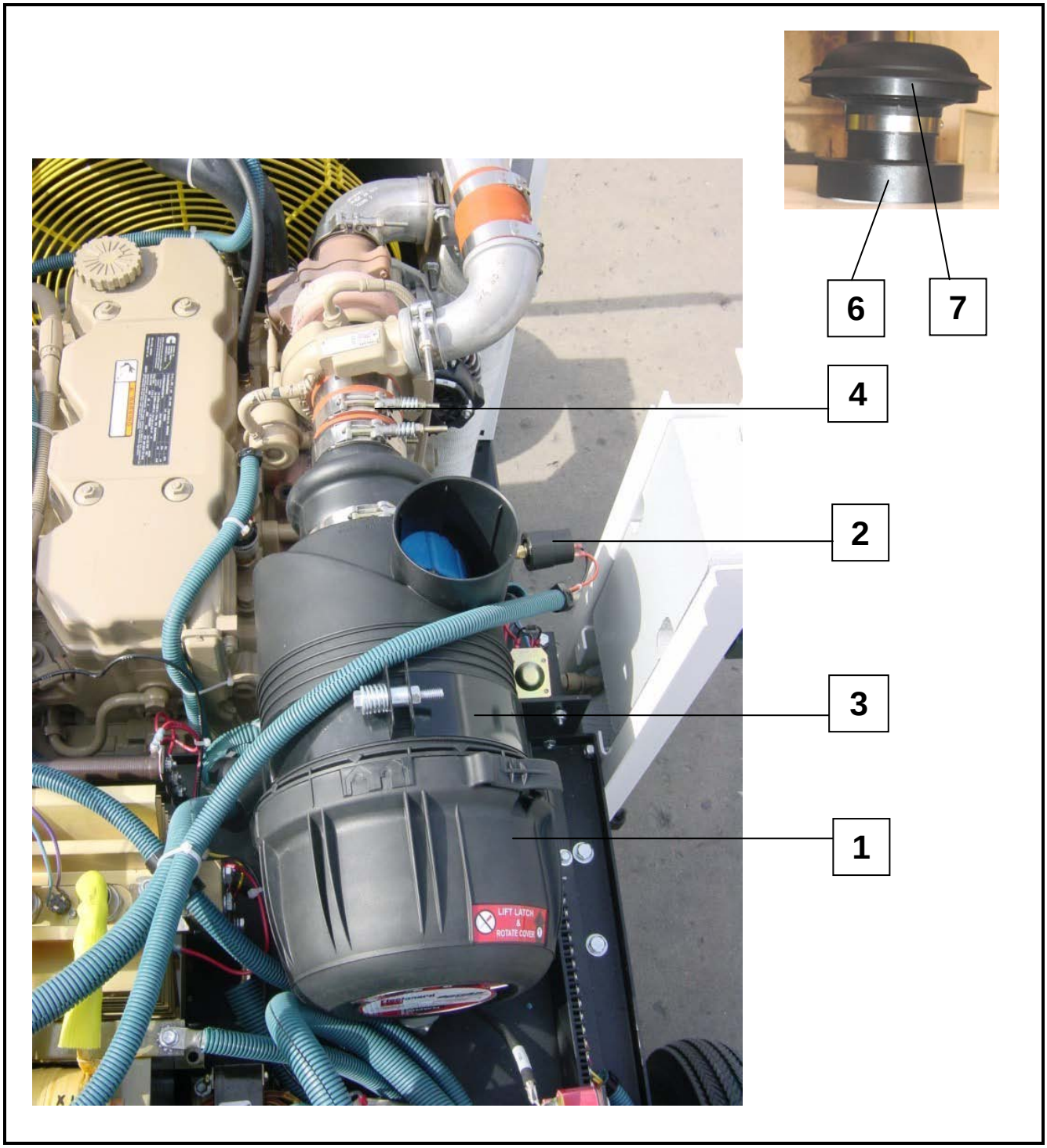
Fuel System Components
Figure 10

FIGURE ITEM NO.		PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
10 -	1	290701	Fuel Tank, Composite		1
		486719-005	…Fuel Tank Sender		1
	2	282562	Fuel Fill Cap *(V49234 #1257G/12T)*		1
	3	290685	Tank to Filter Fuel Line		1
		290388	…Adapter, 12 mm x 3/8 MJIC		1
	4	290686	Fuel Return Line		1
	5	286897-031	Lubricity Fuel Filter *(V8A334 #FS20022)*		1
	6	289037	Lubricity Fuel Filter Bracket		1
	7	286897-030	Primary Fuel Filter *(V8A334 #FF5421)*		1
	8	290681	Primary Fuel Filter Bracket		1



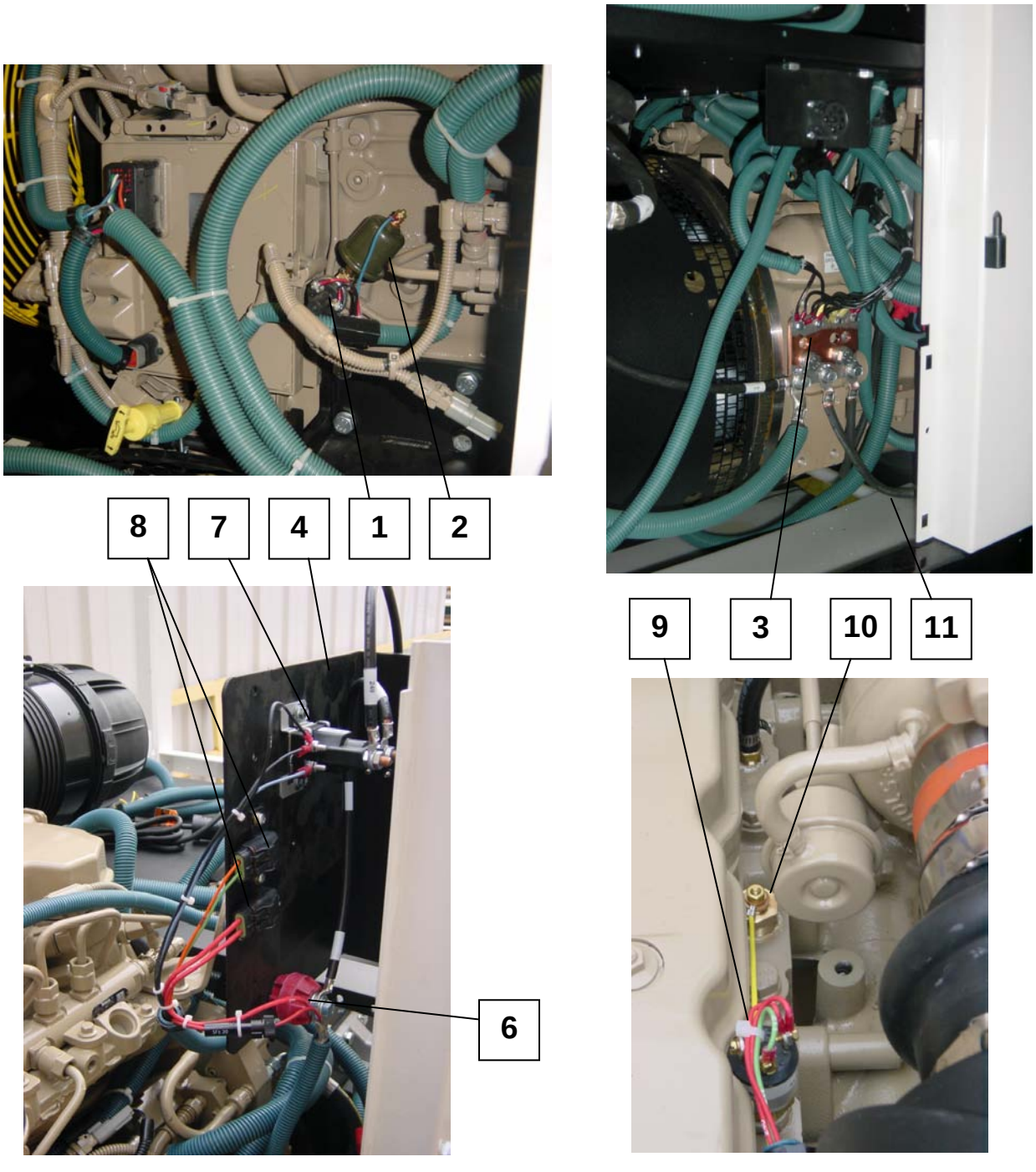
12 VDC Battery System
Figure 11

FIGURE ITEM NO.		PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
11 -	1	287795	Battery Tray		1
	2	281881-001	12 Volt Battery *(V25710 #1231-PMF)*		2
	3	287796	Battery Hold Down *(V3Y208)*		2
	4	494295	Battery Hold Down Bolt *(V3Y208 #06156)*		4
	5	287740	Positive Battery Cable		1
	6	287797	Negative Battery Cable		1
	7	286850	Starter Cut-Out Soleniod		1
		288973-001	…Flyback Diode		1
		290678	…Engine Wire Harness		1



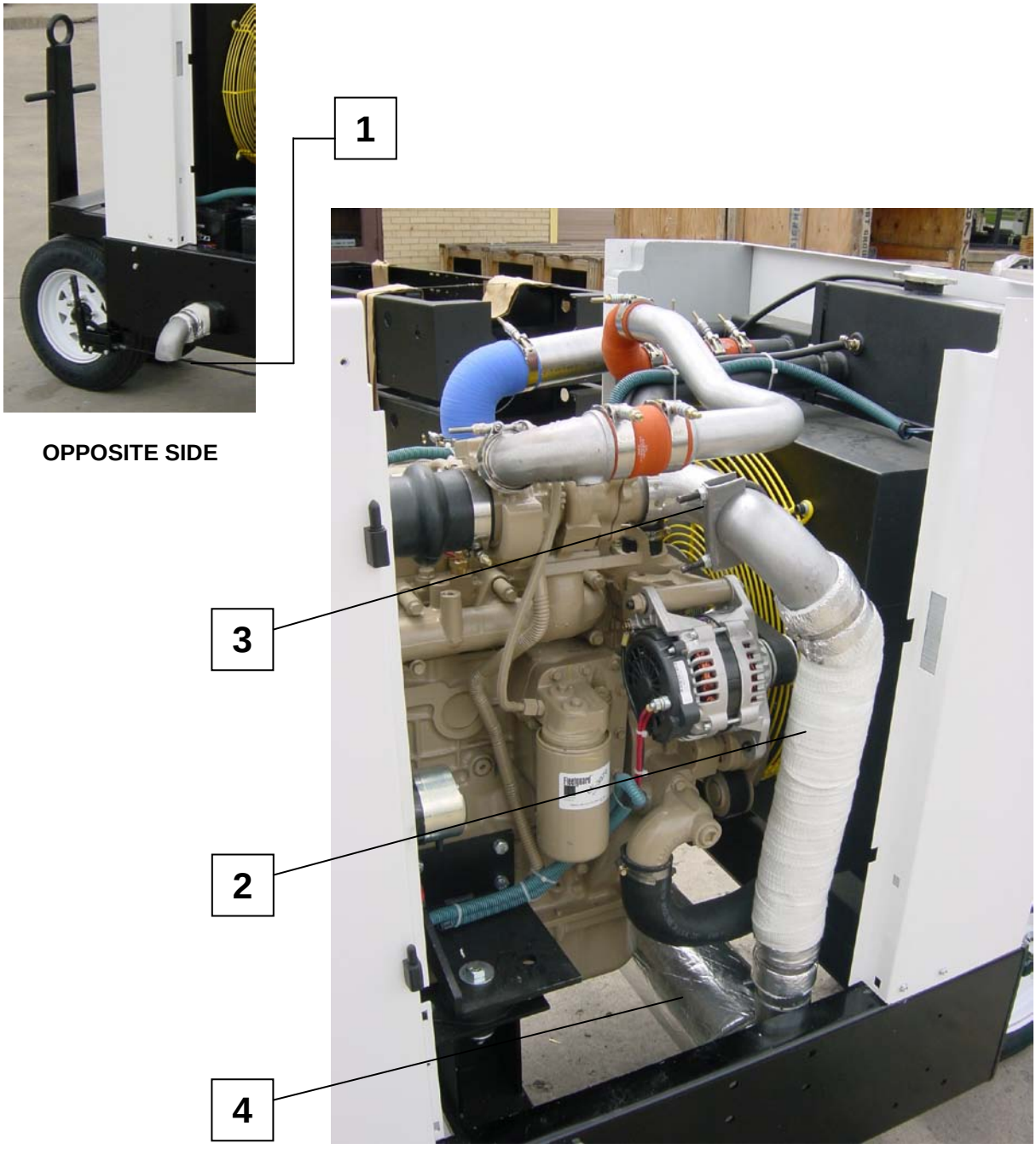
Engine Intake Air Assembly
Figure 12

FIGURE ITEM NO.		PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
12 -	1	290938	Air Cleaner *(V84334 # AH19260)*		1
		290941	…Primary Replacement Filter *(V84334 # AF25960)*		1
	2		**Air Restriction Indicator Assembly**		
		290956	…Coupling, 1/8”-27, Black Steel		1
		282918	…Air Restriction Indicator *(V18265 # REX77-0062)*		1
		282919	…Indicator Adapter		1
	3		**Air Cleaner Bracket Assembly**		1
		290940	…Bracket, Air Cleaner *(V84334 # 3918197S)*		1
*		290937	…Bracket, Air Filter Mounting		1
	4		**Engine Inlet Connection Assembly**		
		290936	…Hose, CAC, Straight, 3” I.D.		1
		290597-001	…Clamp, T-Bolt, Floating Bridge, 3.25” *(V4K938 #94143-0325)*		2
		290950	…Tube, Air Cleaner		1
		288197-001	…Hose, Hump [3” ID to 4” ID] *(V84334 # 3316617S)*		1
		290597-006	…Clamp, T-Bolt, Floating Bridge, 4.50” *(V4K938 #94143-0450)*		1
		290597-007	…Clamp, T-Bolt, Floating Bridge, 3.50” *(V4K938 #94143-0350)*		1
*	5		**Inlet Connection Assembly**		
		290953	...Hose, Hump, 4” ID		1
		290952	…Hose, Hump (3.75” ID to 4” ID)		2
		290597-006	…Clamp, T-Bolt, Floating Bridge, 4.50” *(V4K938 #94143-0450)*		1
		403483	…Clamp, Fitting		1
	6	290951	Intake, Air Extension		1
	7	290939	Hood, Weather *(V84334 # 3946458S)*		1
		403483	…Clamp, Fitting		1



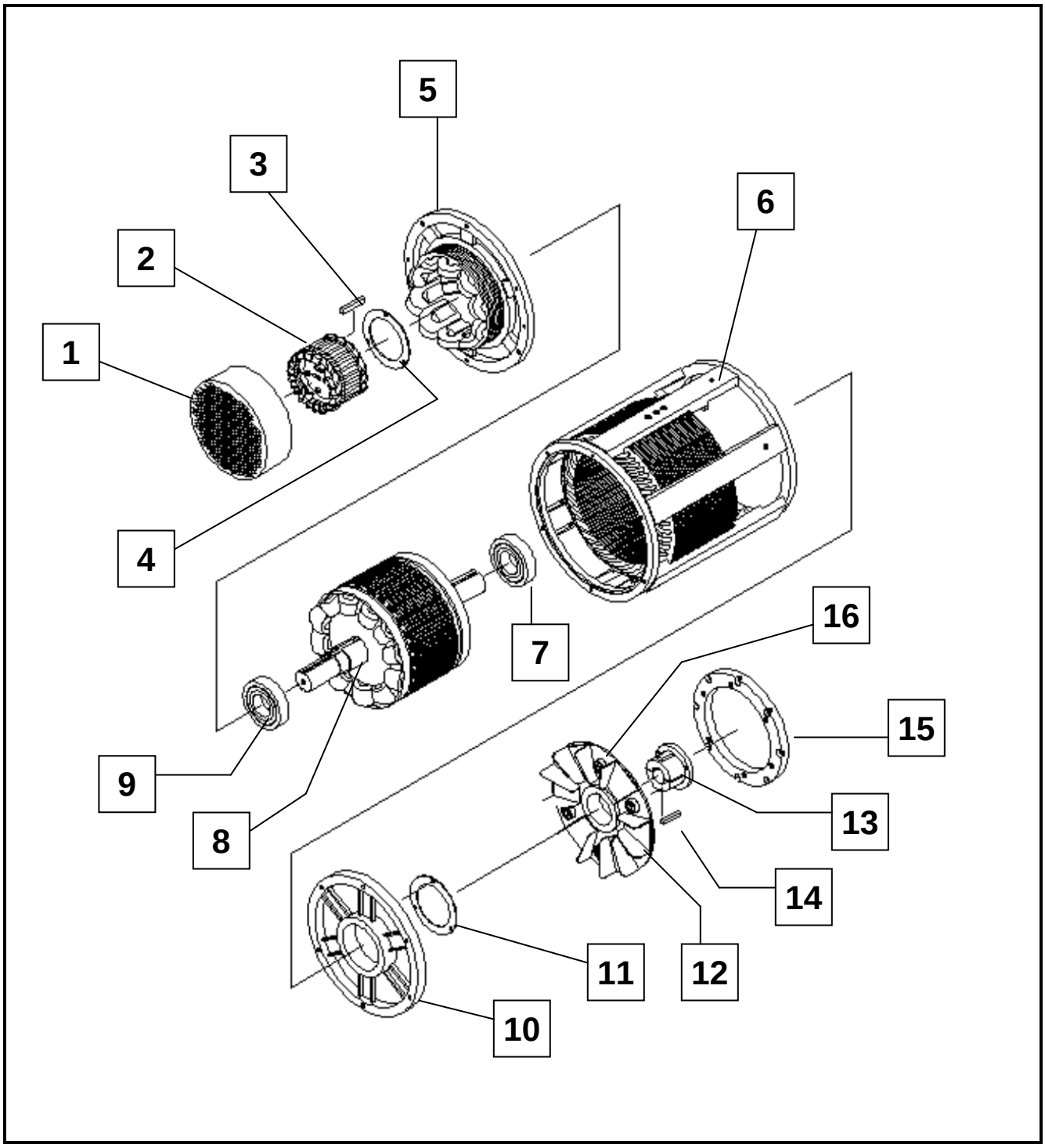
Engine Components
Figure 13

FIGURE ITEM NO.		PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
13 -	1	403809-002	Oil Pressure Switch *(V99186 #1042-08210-20)*		1
	2	78B1118-002	Oil Pressure Sender *(V16476 #16476)*		1
		287419	…M10-1.0 x $^{1}/_{8}$" NPTF Adapter		1
		W10910-000	…Tee Fitting		1
		W10750-001	…$^{1}/_{8}$" Pipe Nipple		1
	3	287735	Ground Plate		1
		290678	…Engine Wire Harness		1
		290944	…Electronic Engine Wire Harness		1
	4	289136	Electronic Engine Parts Panel		1
*	5	287145-001	Pre-Heater Fuse Holder		1
*		287144-002	…100 A, 300 V Fast Acting Fuse *(V71400 #JJN-125)*		1
	6	283154-001	Insulated Standoff		1
	7	288331	Pre-Heater Power Relay *(V1FQ83 #50F3662)*		1
	8		...5 A Fuse *(V7E222 # 257-5)*		1
			…30 A Fuse *(V7E222 # 257-30)*		1
	9	403782-002	Water Temperature Switch *(V99186 #1002-04880-34)*		1
		W7814-004	…$^{3}/_{8}$ to$^{1}/_{2}$ Pipe Bushing		1
	10	287909	Water Temperature Sender *(V16476 #02025-00)*		1
	11	W9407-446	Engine to Frame Ground Cable		1



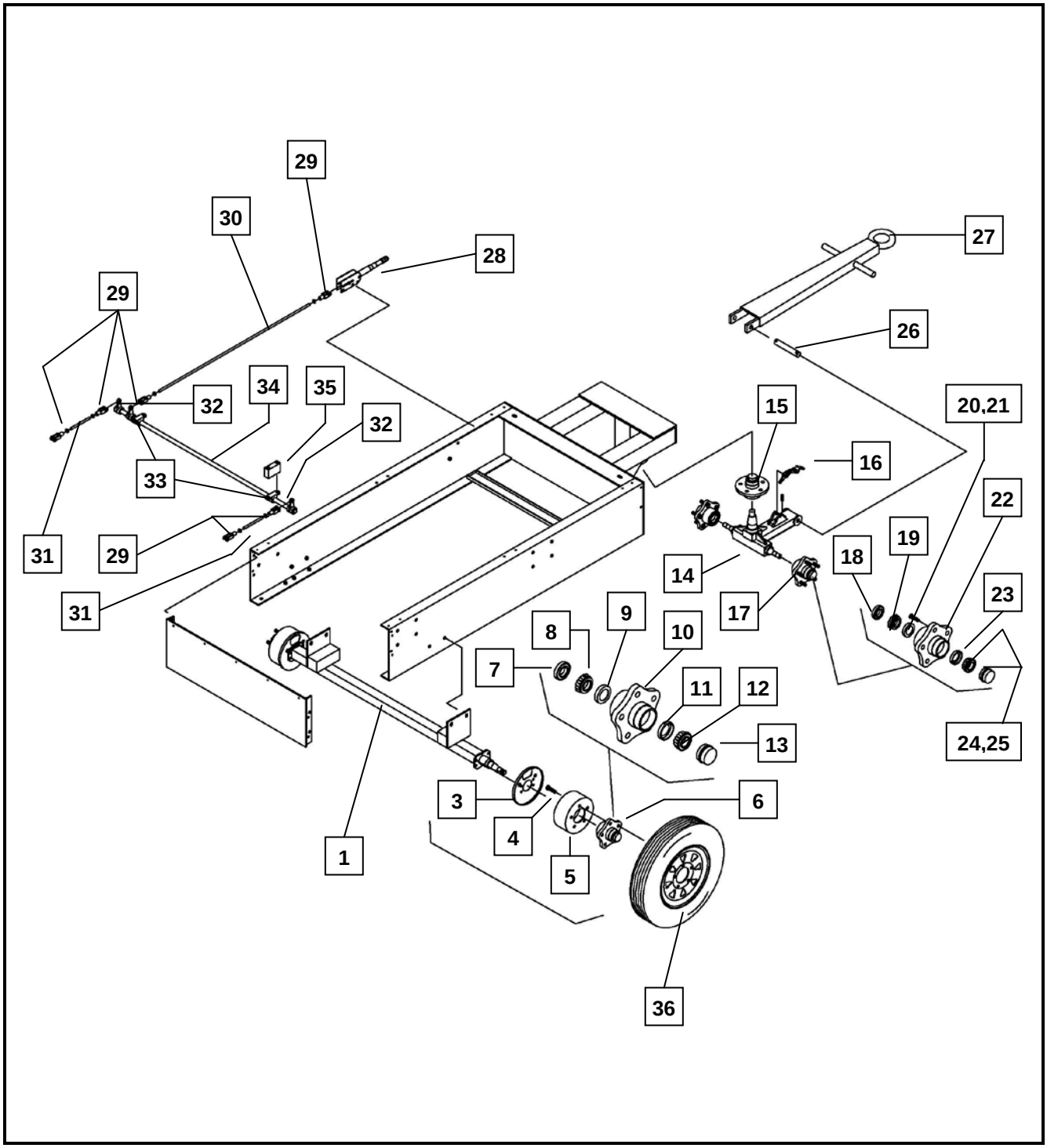
Engine Exhaust Assembly
Figure 14

FIGURE ITEM NO.	PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
14 - 1	290638	90° Exhaust Elbow		1
	042471	…Muffler Wrap Insulation		1.2 ft^2
	W10869-006	…Hose Clamp (to hold insulation)		2
	288052-2	…3” Accuseal Clamp		1
2	290632	Flexible Exhaust Pipe Connector		1
	042471	…Muffler Wrap Insulation		1.7 ft^2
3	404154-013	…3” Full Circle Clamp		1
	W10869-006	…Hose Clamp (to hold insulation)		2
	288052-2	…3” Accuseal Clamp		1
4	288376	Exhaust Muffler		1
	042471	…Muffler Wrap Insulation		3.5 ft^2
	288059-1	…Hose Clamp (to hold insulation)		2



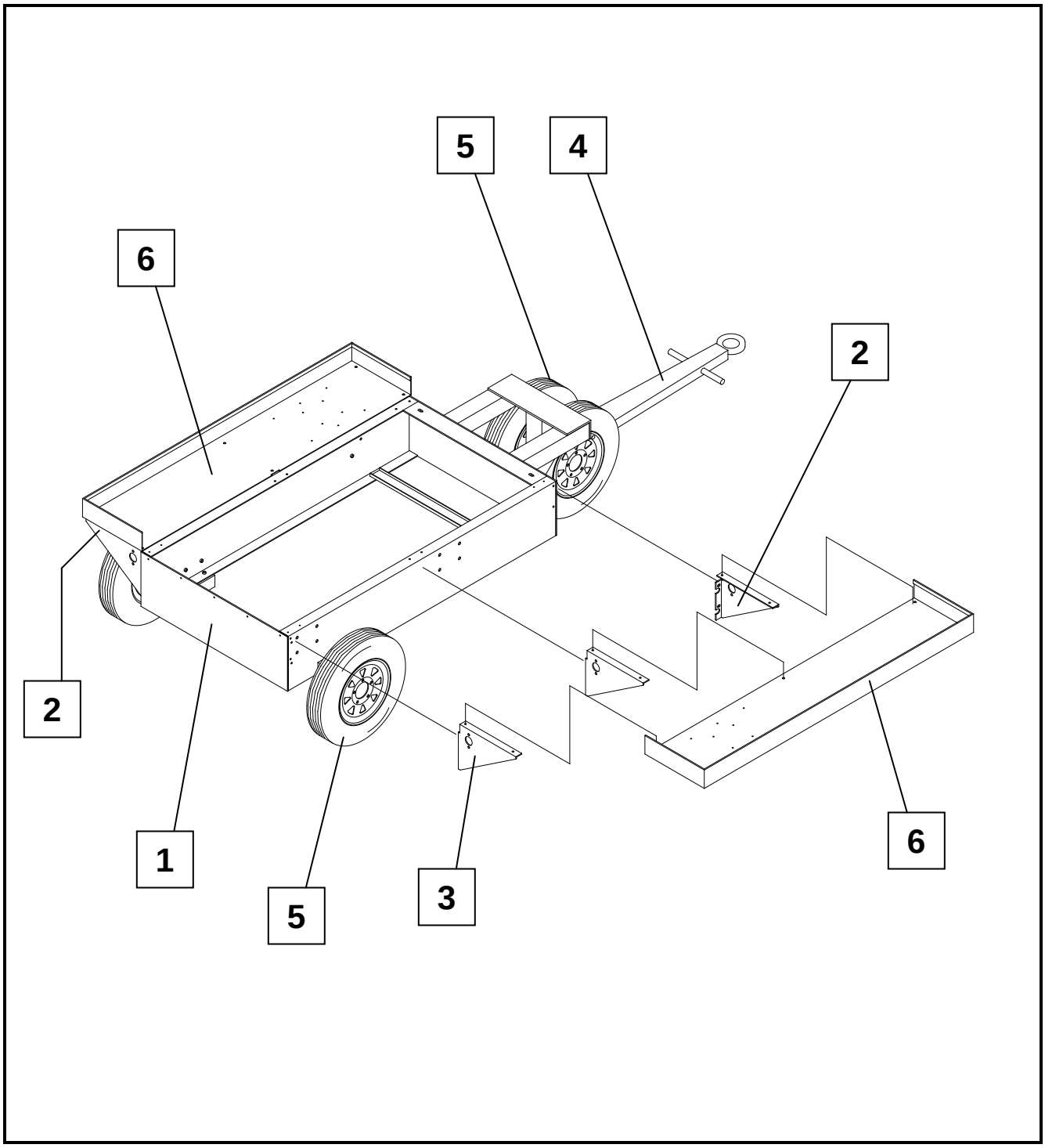
Generator Assembly
Figure 15

FIGURE ITEM NO.		PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
15 -	1	281698	Exciter Cover		1
	2	282132	Exciter Armature Assembly		1
	3	180696-002	Exciter Key		1
	4	282128	Bearing Retainer		1
	5	285121	Exciter Housing		1
	6	287821-002	Housing and Stator Generator Assembly		1
	7	W10072-068	Generator Bearing		1
	8	287820-001	Armature Assembly		1
	9	W10072-068	Generator Bearing		1
	10	287729	Front Bearing Support		1
	11	282128	Bearing Retainer		1
	12	281701	Flexible Coupling Kit		1
	13	85C-1004-1	…Split Taper Bushing (Part of Item 12)		1
	14	85B-1039	Coupling Key		1
	15	287968	Flex Coupling Ring Spacer		1
	16	483756	Bushing Replacement Kit (6 Bushings)		Ref.
*	17	287886	Generator Cover		1
*	18	284372-001	Generator Shock Mount (Yellow)		1
*	19	287958	Generator Support Bracket		1



Trailer Components (Front and Rear Axles and Hand Brake)
Figure 16

FIGURE ITEM NO.		PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
16 -					
		290588	**Frame/Trailer Assembly**	A,B,E,G,J	**1**
	1	288389	Rear Axle Weldment (V52793 #53285)	A,B,E,G,J	1
		287587	**…Brake Assembly (V52793 #46894)**	A,B,E,G,J	2
*	2	286201	……Brake Assembly	A,B,E,G,J	2
	3	285911	……Dust Shield (V52793 #317968)	A,B,E,G,J	1
	4	286205	……Hub Bolt (V52793 #06440)	A,B,E,G,J	5
	5	287627	……Brake Drum (V52793 #05-006712-21)	A,B,E,G,J	1
		285917	……Lug Nut (V52793 #05-007805)	A,B,E,G,J	5
	6	287626	**…Hub Assembly (V52793 #05-046879-1AL)**	A,B,E,G,J	1
	7	287626-001	……Grease Seal (V52793 #16743 CR)	A,B,E,G,J	1
	8	287626-002	……Inner Bearing Cone (V60038 #67048)	A,B,E,G,J	1
	9	287626-003	……Inner Bearing Cup (V60038 #67010)	A,B,E,G,J	1
	10	287628	……Hub (V52793 #03-044880-AL)	A,B,E,G,J	1
	11	287626-004	……Outer Bearing Cup (V60038 #11910)	A,B,E,G,J	1
	12	287626-005	……Outer Bearing Cone (V60038 #11949)	A,B,E,G,J	1
	13	287626-006	……Wheel Hub Cap (V52793 #1517)	A,B,E,G,J	1
	14	288390	Front Axle Weldment (V52793 #53308)	A,B,E,G,J	1
	15	288392	…Hub Assembly (V52793 #2-1206-01-01)	A,B,E,G,J	1
	16	285851	**…Latch Pedal (V52793 #05-051009)**	A,B,E,G,J	1
		285850	……Compression Spring (V52793 #LC-063F-7)	A,B,E,G,J	1
	17	286735	**…Hub Assembly (V52793 #03-044876-1AL)**	A,B,E,G,J	2
		285917	……Lug Nut (V52793 #05-007805)	A,B,E,G,J	5
	18	286735-001	……Grease Seal (V52793 #16743 CR)	A,B,E,G,J	1
	19	286735-002	……Inner Bearing Cone (V60038 #67048)	A,B,E,G,J	1
	20	286735-003	……Inner Bearing Cup (V60038 #67010)	A,B,E,G,J	1
	21	286205	……Hub Bolt (V52793 #03-006440)	A,B,E,G,J	5
	22	286734	……Wheel Hub (52793 #03-044875-AL)	A,B,E,G,J	1
	23	287626-004	……Outer Bearing Cup (V60038 #11910)	A,B,E,G,J	1
	24	287626-005	……Outer Bearing Cone (V60038 #11949)	A,B,E,G,J	1
	25	287626-006	……Wheel Hub Cap (V52793 #1517)	A,B,E,G,J	1
	26	285844	Drawbar Pin Assembly (V52793 #05-046787-A)	A,B,E,G,J	1
	27	288393	Drawbar Weldment (V52793 #53590)	A,B,E,G,J	1
			Hand Brake Assembly (V52793 #58342)	A,B,E,G,J	1
	28	286978	…Brake Leveler Assembly (V52793 #31110)	A,B,E,G,J	1
	29	286982	…Clevis (V52793 #2708-4A)	A,B,E,G,J	6
	30	288394	…Brake Handle Rod (V52793 #58343)	A,B,E,G,J	1
	31	288395	…Brake Level Rod (V52793 #53304)	A,B,E,G,J	2
	32	288398	…Shaft Lever	A,B,E,G,J	3
		286985	……Collar, Set Screw (V52793 #SC-075)	A,B,E,G,J	2
		286984	……Roll Pin (V52793 #LL 5/16 X 1-1/4RP)	A,B,E,G,J	3
	33	286981	…Shaft Bearing (V52793 #46646)	A,B,E,G,J	2
	34	288396	…Brake Cross Bar (V52793 #53306)	A,B,E,G,J	1
	35	288397	…Spacer Block (V52793 #53414)	A,B,E,G,J	1
	36	282720	Wheel and Tire Assembly (V52793 #53318)	A,B,E,G,J	4



Trailer Components (Cable Trays)
Figure 17

FIGURE ITEM NO.	PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
17 - 1	290588	Frame/Trailer Assembly	A,B,E,G,J	1
	290707	…Frame/Fixed Assembly	C,D,F,H,K	1
2	287993	Fender Mounting Bracket	A,B,E,G,J	3
3	287994	Fender Mounting Bracket	A,B,E,G,J	3
4	288393	Drawbar Weldment (V52793 #53590)	A,B,E,G,J	1
5	282720	Wheel and Tire Assembly (V52793 #53318)	A,B,E,G,J	4
6	290919	Fender / Cable Tray	A,B,E,G,J	2

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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.
8-2	AW626	16-36	282720
8-3	A25	17-5	282720
13-11	W9407-446	12-	282918
15-7	W10072-068	12-	282919
15-9	W10072-068	13-6	283154-001
8-4	W11097-028	5-11	283167
8-5	W11242-018	3-6	283597
9-	W10869-014	1-21	283714-004
9-	W10869-014	3-	283824
8-6	W11242-010	9-	283873
5-13	W8105A-009	6-9	283978-002
8-7	W11254-006	6-8	283978-001
14-	W10869-006	6-	284316-004
14-	W10869-006	6-	284316-004
8-8	W11278-005	6-	284316-004
9-	W10869-005	6-	284316-004
13-	W7814-004	6-	284316-004
9-	W10869-003	4-8	284372-001
13-	W10750-001	15-18	284372-001
13-	W10910-000	7-7	284475-001
14-	042471	7-22	285030-005
14-	042471	7-16	285030-004
14-	042471	7-19	285030-003
9-7	056534	7-3	285029-001
9-	056535	7-25	285030-001
15-3	180696-002	7-4	285031-001
5-8	181358	7-5	285032-001
15-1	281698	7-6	285033
15-12	281701	7-9	285034-001
11-2	281881-001	15-5	285121
8-14	282089-011	1-	285125
15-4	282128	16-26	285844
15-11	282128	16-	285850
8-9	282130-001	16-16	285851
8-	282130-001	16-3	285911
15-2	282132	16-	285917
2-	282562	16-	285917
10-2	282562	16-2	286201
1-15	282658	16-4	286205

FIGURE ITEM NO.	HOBART PART NO.	FIGURE ITEM NO.	HOBART PART NO.
16-21	286205	13-3	287735
8-10	286266	11-5	287740
8-	286266	3-	287785
6-15	286388-001	3-	287785
6-	286477-002	2-14	287795
6-14	286485-001	11-1	287795
5-9	286699-001	11-3	287796
16-20	286735-003	11-6	287797
16-19	286735-002	15-6	287821-002
16-18	286735-001	15-8	287820-001
16-22	286734	4-	287866
16-17	286735	15-17	287886
11-7	286850	5-6	287908
10-5	286897-031	13-10	287909
10-7	286897-030	2-8	287957
16-28	286978	4-7	287958
16-33	286981	15-19	287958
16-29	286982	4-4	287967
16-	286984	4-5	287968
16-	286985	15-15	287968
4-6	287060-003	3-7	287977
13-	287144-002	2-3	287986
13-5	287145-001	17-2	287993
9-	287333-002	17-3	287994
13-	287419	2-13	287998
1-28	287459	3-2	287999
1-11	287461	9-	288001
1-13	287462	9-	288002
1-14	287463	1-4	288020
1-18	287465	5-2	288020
1-	287466	1-3	288023
1-24	287467	14-	288052-2
3-	287526-002	14-	288052-2
3-4	287542-001	3-	288064-006
1-19	287565	14-	288059-1
16-	287587	3-	288064-005
16-13	287626-006	3-	288064-003
16-25	287626-006	3-	288064-002
16-12	287626-005	4-3	288109-001
16-24	287626-005	1-	288120
16-11	287626-004	1-31	288120
16-23	287626-004	9-	288123-001
16-9	287626-003	1-22	288164-002
16-8	287626-002	12-	288197-001
16-7	287626-001	1-	288300
16-6	287626	13-7	288331
16-5	287627	9-1	288343
16-10	287628	2-9	288373
1-20	287696	14-4	288376
1-34	287698-001	1-25	288388
15-10	287729	16-1	288389

FIGURE ITEM NO.	HOBART PART NO.	FIGURE ITEM NO.	HOBART PART NO.
16-14	288390	13-4	289136
16-15	288392	8-13	289318
16-27	288393	2-12	289895
17-4	288393	4-1	290065
16-30	288394	7-10	290080
16-31	288395	9-8	290145
16-34	288396	2-	290267
16-35	288397	4-2	290313
16-32	288398	9-10	290339
6-	288605	9-5	290356
6-1	288745	9-6	290357
5-17	288806	10-	290388
5-14	288814-003	2-5	290485-002
6-6	288818-001	2-6	290485-001
5-	288820	2-7	290486
5-	288836-002	2-4	290487
5-3	288836-001	9-4	290575
5-	288858-006	16-	290588
5-	288858-005	17-1	290588
5-12	288858-004	3-5	290589
5-	288858-003	3-9	290590
5-	288858-002	12-	290597-007
5-	288858-001	12-	290597-006
1-17	288862	12-	290597-006
1-16	288866	9-	290597-004
8-15	288892-009	9-	290597-004
8-16	288892-001	9-	290597-004
4-10	288895	9-	290597-001
6-5	288914	9-	290597-001
6-2	288937	12-	290597-001
6-3	288940A	3-3	290559
11-	288973-001	9-14	290619
8-19	288974	9-11	290623
5-18	288995	9-9	290624
5-4	288999-001	9-13	290624
7-1	289004	14-2	290632
7-	289014	14-1	290638
7-2	289015	4-	290678
5-	289017	11-	290678
6-4	289026	13-	290678
10-6	289037	4-	290679
6-	289060	3-	290690-009
6-11	289072	10-8	290681
6-10	289073	8-12	290683
5-5	289077	3-	290690-006
6-12	289077	4-9	290684
6-13	289090	3-	290690-005
8-1	289093	10-3	290685
3-8	289094	2-	290690-004
6-16	289104-001	10-4	290686
6-7	289122	1-5	290687

FIGURE ITEM NO.	HOBART PART NO.	FIGURE ITEM NO.	HOBART PART NO.
2-	290690-003	8-17	488640
3-	290690-002	5-7	494134-001
3-	290690-001	11-4	494295
2-10	290701	1-33	7J422-0
10-1	290701	1-	7J422-0
2-11	290702	1-	7J422-0
2-	290707	8-18	7J422-000
17-	290707	1-12	76B-1148
1-2	290709	1-	77A1157
17-6	290919	1-9	78A-1000
2-2	290933	5-10	78A1117-002
3-1	290935	13-2	78B1118-002
9-	290936	1-10	79A-1110
12-	290936	1-27	81B1084
12-	290937	15-14	85B-1039
12-1	290938	15-13	85C-1004-1
12-7	290939		
12-	290940		
12-	290941		
12-	290942		
9-12	290943		
13-	290944		
12-	290950		
12-6	290951		
12-	290952		
12-	290953		
12-	290956		
1-26	400435		
7-8	400613-004		
5-16	400641-015		
5-15	400642-008		
8-11	401911-010		
1-30	402025-003		
1-29	402034-002		
1-8	402987		
1-35	403091-008		
12-	403483		
12-	403483		
13-9	403782-002		
13-1	403809-002		
14-3	404154-013		
1-23	407366		
1-7	408665-002		
1-	408665-002		
1-6	408665-001		
1-	408665-001		
15-16	483756		
2-	486719-005		
10-	486719-005		
1-32	488640		

Chapter 5 Manufacturer's Literature

Vendor Literature

Type	Diagram Description
Engine	Operation and Maintenance Manual (Cummins Bulletin # 4021531)
	Manuals not included, but purchased separately from Cummins.
	Parts Catalog (Cummins Bulletin # 4915973)
	Maintenance and Overhaul Manual (Cummins Bulletin # 4021416)

Diagram Number	Diagram Description
290945, Rev. 0	Diagram, Schematic & Connection
289022, Rev. 2	Diagram, Connection, Control Box
289102, Rev. 3	Diagram, Connection, Power Module
289013, Rev. 3	Diagram, Connection, Switch Box
289155 (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 60CU24, 400 Hz. Generator Set, optional equipment.

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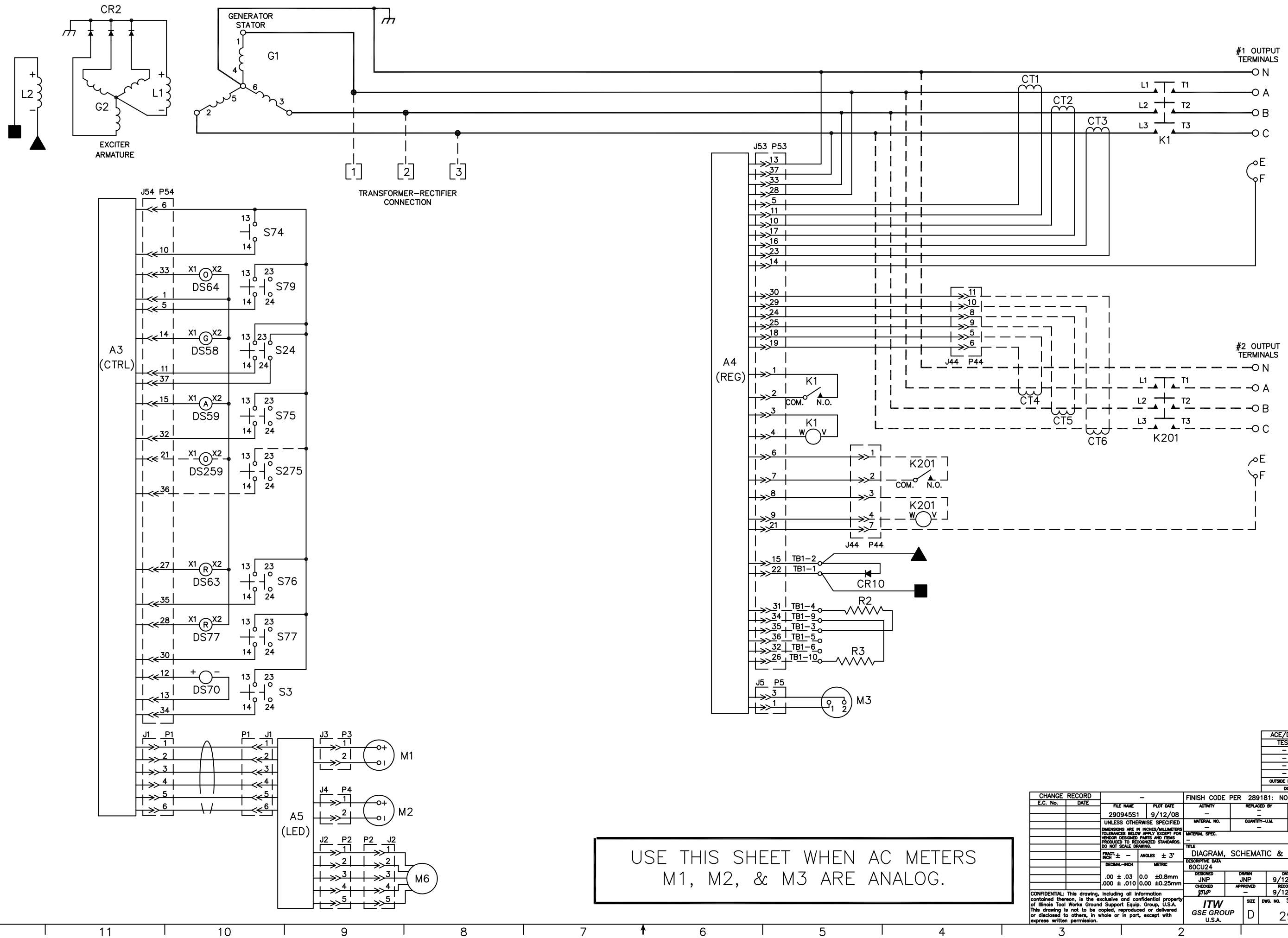

USE THIS SHEET WHEN AC METERS M1, M2, & M3 ARE ANALOG.

ACE/DCE	9–08
TEST	9–08
–	–
–	–
–	–
–	–
OUTSIDE DISTR.	

DISTRIBUTION TABLE

CHANGE RECORD	
E.C. No.	DATE

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FILE NAME	PLOT DATE
290945S1	9/12/08

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES/MILLIMETERS TOLERANCES BELOW APPLY EXCEPT FOR VENDOR DESIGNED PARTS AND ITEMS PRODUCED TO RECOGNIZED STANDARDS. DO NOT SCALE DRAWING.

FRACT. INCH ± – ANGLES ± 3°

DECIMAL–INCH	METRIC
.00 ± .03	0.0 ±0.8mm
.000 ± .010	0.00 ±0.25mm

FINISH CODE PER 289181: NONE

ACTIVITY	REPLACED BY	REPLACES
–	–	–
MATERIAL NO.	QUANTITY–U.M.	COMM. CLS.
–	–	–

MATERIAL SPEC.
–

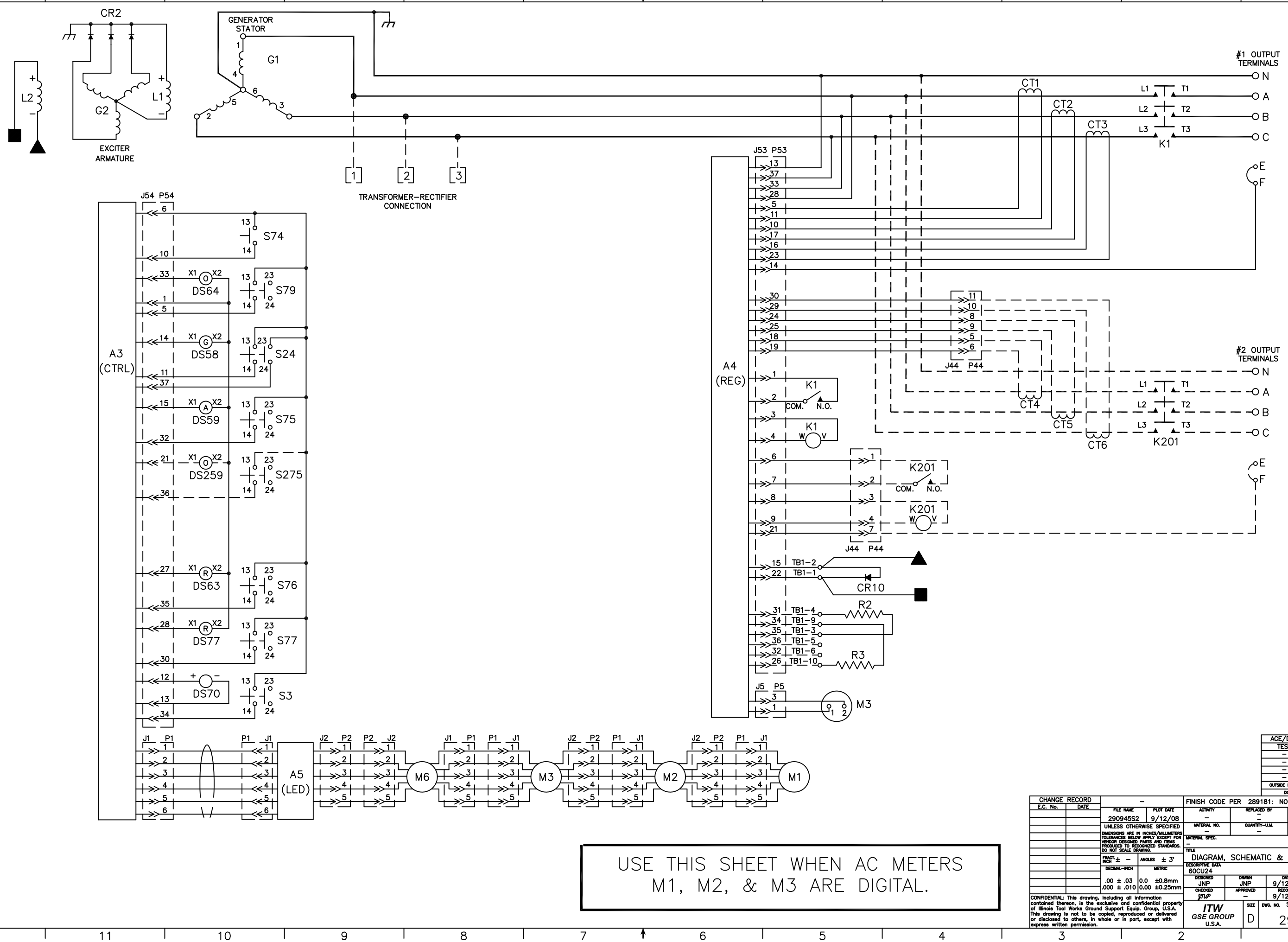
TITLE
DIAGRAM, SCHEMATIC & CONNECTION

DESCRIPTIVE DATA
60CU24

DESIGNED	DRAWN	DATE	SCALE
JNP	JNP	9/12/08	NONE
CHECKED	APPROVED	RECORDS	ITEM TYPE
[illegible]	–	9/12/08	–

ITW GSE GROUP U.S.A.

SIZE D DWG. NO. 290945 SHEET 1 OF 7



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

ACE/DCE	9–08
TEST	9–08
–	–
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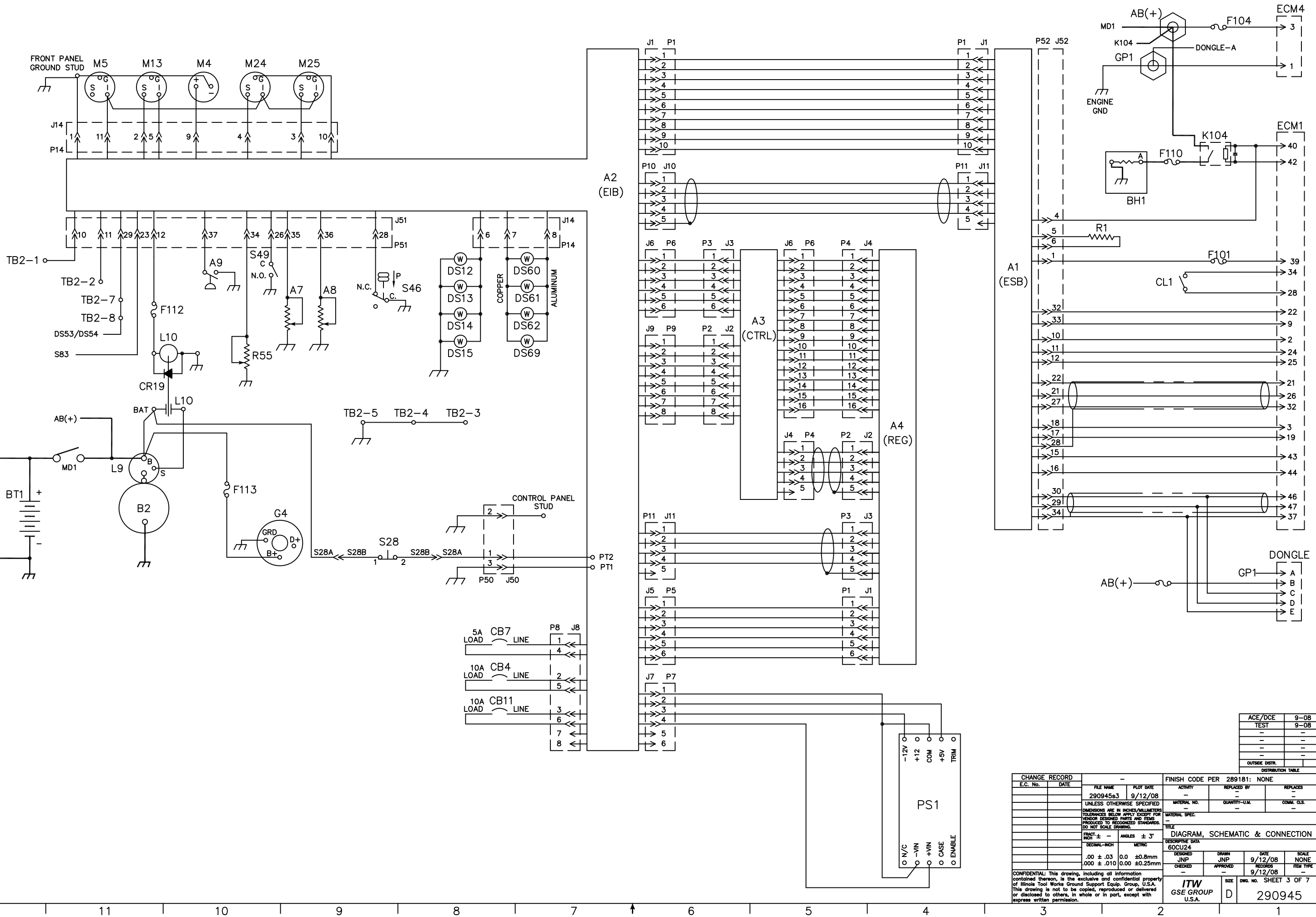
–	–
–	–
OUTSIDE DISTR.	

DISTRIBUTION TABLE

CHANGE RECORD		–	FINISH CODE PER 289181: NONE		
E.C. No.	DATE	FILE NAME / PLOT DATE: 290945S2 / 9/12/08	ACTIVITY: –	REPLACED BY: –	REPLACES: –
		UNLESS OTHERWISE SPECIFIED	MATERIAL NO.: –	QUANTITY–U.M.: –	COMM. CLS.: –
		DIMENSIONS ARE IN INCHES/MILLIMETERS TOLERANCES BELOW APPLY EXCEPT FOR VENDOR DESIGNED PARTS AND ITEMS PRODUCED TO RECOGNIZED STANDARDS. DO NOT SCALE DRAWING.	MATERIAL SPEC.: –		
		FRACT. INCH ± – ANGLES ± 3°	TITLE: DIAGRAM, SCHEMATIC & CONNECTION		
		DECIMAL–INCH: .00 ± .03, .000 ± .010 / METRIC: 0.0 ±0.8mm, 0.00 ±0.25mm	DESCRIPTIVE DATA: 60CU24		
			DESIGNED: JNP / DRAWN: JNP / DATE: 9/12/08 / SCALE: NONE		
			CHECKED: JNP / APPROVED: – / RECORDS: 9/12/08 / ITEM TYPE: –		

ITW GSE GROUP U.S.A.

SIZE D | DWG. NO. 290945 | SHEET 2 OF 7



ACE/DCE	9–08
TEST	9–08
–	–
–	–
–	–
–	–
OUTSIDE DISTR.	

DISTRIBUTION TABLE

CHANGE RECORD	
E.C. No.	DATE

–	
FILE NAME	PLOT DATE
290945s3	9/12/08

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES/MILLIMETERS TOLERANCES BELOW APPLY EXCEPT FOR VENDOR DESIGNED PARTS AND ITEMS PRODUCED TO RECOGNIZED STANDARDS. DO NOT SCALE DRAWING.

FRACT. INCH ± – ANGLES ± 3°

DECIMAL–INCH	METRIC
.00 ± .03	0.0 ±0.8mm
.000 ± .010	0.00 ±0.25mm

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FINISH CODE PER 289181: NONE

ACTIVITY	REPLACED BY	REPLACES
–	–	–
MATERIAL NO.	QUANTITY–U.M.	COMM. CLS.
–	–	–

MATERIAL SPEC.
–

TITLE
DIAGRAM, SCHEMATIC & CONNECTION

DESCRIPTIVE DATA
60CU24

DESIGNED	DRAWN	DATE	SCALE
JNP	JNP	9/12/08	NONE
CHECKED	APPROVED	RECORDS	ITEM TYPE
–	–	9/12/08	–

ITW GSE GROUP U.S.A.

SIZE D DWG. NO. SHEET 3 OF 7

290945

LEGEND

A1	BOARD, P.C., ENGINE SPECIFIC BOARD (ESB)
A2	BOARD, P.C., ENGINE INTERFACE BOARD (EIB)
A3	BOARD, P.C., CONTROL BOARD (CTL)
A4	BOARD, P.C., REGULATOR BOARD (REG)
A5	BOARD, P.C., LED BOARD (LED)
A7	SENSOR, WATER TEMPERATURE
A8	SENSOR, OIL PRESSURE
A9	SENSOR, AIR CLEANER SERVICE
AB(−)	AUX. NEGATIVE BATTERY TERMINAL
AB(+)	AUX. POSITIVE BATTERY TERMINAL
B2	STARTER, ENGINE, 12 V.
BH1	GRID HEATER
BT1	BATTERY, 12 V.
CL1	SENSOR, COOLANT LEVEL
CB4	CIRCUIT BREAKER, ENGINE ELECTRICAL, 10 A.
CB7	CIRCUIT BREAKER, CONTROL CIRCUIT, 5 A.
CB11	CIRCUIT BREAKER, MARKER LIGHTS, 10 A.
CR2	RECTIFIER, GENERATOR REVOLVING FIELD
CR10	DIODE, FLYBACK, EXCITER
CR19	DIODE, FLYBACK, AUXILIARY STARTER SOLENOID
CT1−CT3	TRANSFORMER, CURRENT, #1 OUTPUT
CT4−CT6	TRANSFORMER, CURRENT, #2 OUTPUT (WHEN FURNISHED)
DS12	LIGHT, VOLTMETER, BATTERY (WHITE)
DS13	LIGHT, OIL PRESSURE GAUGE (WHITE)
DS14	LIGHT, TEMPERATURE GAUGE (WHITE)
DS15	LIGHT, FUEL GAUGE (WHITE)
DS58	INDICATOR, PUSHBUTTON, ENGINE START (GREEN)
DS59	INDICATOR, PUSHBUTTON, OUTPUT NO. 1 (ORANGE)
DS60	LIGHT, STRIP, FREQUENCY METER
DS61	LIGHT, STRIP, AMMETER
DS62	LIGHT, STRIP, VOLTMETER
DS63	INDICATOR, PUSHBUTTON, DELAYED ENGINE SHUTDOWN (RED)
DS64	INDICATOR, PUSHBUTTON, PRE−HEATER (ORANGE)
DS69	LIGHT, STRIP, FAULT METER
DS70	LIGHT, STRIP, SWITCH BOX
DS77	INDICATOR, PUSHBUTTON, TEST/RESET (RED)
DS259	IND., PUSHBUTTON, OUTPUT NO. 2 (YELLOW) (WHEN FURNISHED)
ECM1	CONNECTOR, ELECTRONIC CONTROL MODULE (MAIN)
ECM2	CONNECTOR, ELECTRONIC CONTROL MODULE (DONGAL)
ECM4	CONNECTOR, ELECTRONIC CONTROL MODULE (POWER)
F102	FUSE, "E" ENGINE, 5A.
F103−F105	FUSE, "E" ENGINE, 7.5A.
F106, F107	FUSE, "E" ENGINE, 10A.
F110	FUSE, PRE−HEATER
F112	FUSE, STARTER SOLENIOD, 3 A., 250 V.
F113	FUSE, LINK, ALTERNATOR
G1	GENERATOR, STATOR
G2	EXCITER, ARMATURE GENERATOR
G4	ALTERNATOR, ENGINE, 12 V.
GP1	GROUND PLATE
J44	RECEPTACLE, POWER MODULE, 2ND OUTPUT
J50	RECEPTACLE, POWER
J51	RECEPTACLE, ENGINE INTERFACE (EIB)
J52	RECEPTACLE, ENGINE SPECIFIC PCB (ESB)
J53	RECEPTACLE, REGULATOR PCB (REG)
J54	RECEPTACLE, CONTROL PCB (CTRL)
K1	CONTACTOR, #1 A.C. OUTPUT
K104	RELAY, AIR INTAKE, HEATER
K201	CONTACTOR, #2 A.C. OUTPUT (WHEN FURNISHED)
L1	FIELD, REVOLVING, GENERATOR
L2	FIELD, EXCITER, GENERATOR
L9	SOLENOID, STARTER
L10	SOLENOID, STARTER, AUXILIARY
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
MD1	SWITCH, MASTER DISCONNECT
P44	PLUG, 2ND OUTPUT (WHEN FURNISHED)
P50	PLUG, POWER
P51	PLUG, ENGINE INTERFACE BOARD
P52	PLUG, ENGINE SPECIFIC BOARD
P53	PLUG, REGULATOR PCB TO POWER MODULE
P54	PLUG, CONTROL BOARD
PS1	POWER SUPPLY
R1	RESISTOR, ENGINE I.D., 1K, 1/4W, 1%
R2	RESISTOR, GENERATOR/KVA, I.D.
R3	RESISTOR, POWER MODULE I.D.
R55	SENDER, ELECTRIC FUEL GAUGE
S3	SWITCH, METER SELECTOR
S24	SWITCH, ENGINE START
S28	SWITCH, PUSHBUTTON, EMERGENCY STOP
S28A	SWITCH. EMERGENCY STOP, MALE CONNECTOR
S28B	SWITCH, EMERGENCY STOP, FEMALE CONNECTOR
S46	SWITCH, LUBE OIL PRESSURE ENGINE
S49	SWITCH. HIGH TEMPERATURE, ENGINE
S74	SWITCH, PUSHBUTTON, LAMPS AND FUEL CHECK
S75	SWITCH. PUSHBUTTON, OUTPUT NO. 1
S76	SWITCH, PUSHBUTTON, ENGINE STOP & ENGINE FAULT RESET
S77	SWITCH, PUSHBUTTON, TEST/RESET
S79	SWITCH, PUSHBUTTON, PRE−HEATER
S83	SWITCH. LOW COOLANT, (WHEN FURNISHED)
S275	SWITCH. PUSHBUTTON, OUTPUT NO. 2 (WHEN FURNISHED)
TB1	TERMINAL BLOCK, POWER MODULE
TB2	TERMINAL BLOCK, OPTIONS

DISTRIBUTION TABLE	
ACE/DCE	9−08
TEST	9−08
−	−
−	−
−	−
−	−
OUTSIDE DISTR.	

CHANGE RECORD — E.C. No. | DATE

FILE NAME: 290945s4 — PLOT DATE: 9/12/08

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES/MILLIMETERS TOLERANCES BELOW APPLY EXCEPT FOR VENDOR DESIGNED PARTS AND ITEMS PRODUCED TO RECOGNIZED STANDARDS. DO NOT SCALE DRAWING.

FRACT. INCH ± − | ANGLES ± 3°

DECIMAL−INCH: .00 ± .03, .000 ± .010 | METRIC: 0.0 ±0.8mm, 0.00 ±0.25mm

FINISH CODE PER 289181: NONE

ACTIVITY: − | REPLACED BY: − | REPLACES: −

MATERIAL NO.: − | QUANTITY−U.M.: − | COMM. CLS.: −

MATERIAL SPEC.: −

TITLE: DIAGRAM, SCHEMATIC & CONNECTION

DESCRIPTIVE DATA: 60CU24

DESIGNED: JNP | DRAWN: JNP | DATE: 9/12/08 | SCALE: NONE

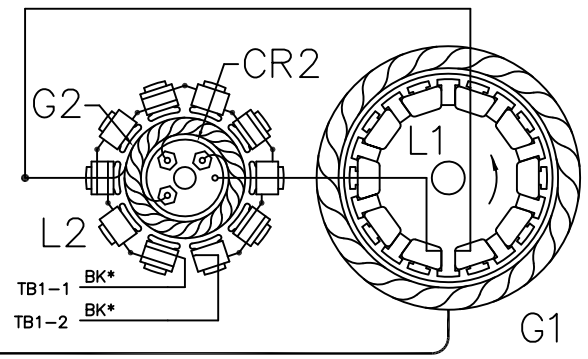
CHECKED: − | APPROVED: − | RECORDS: 9/12/08 | ITEM TYPE: −

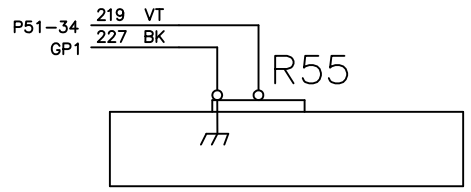
ITW GSE GROUP U.S.A.

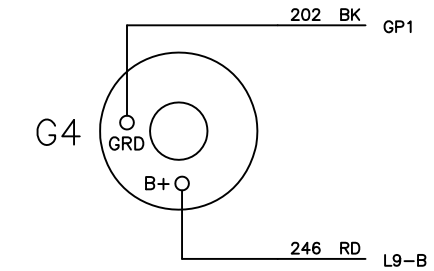
SIZE: D | DWG. NO. 290945 | SHEET 4 OF 7

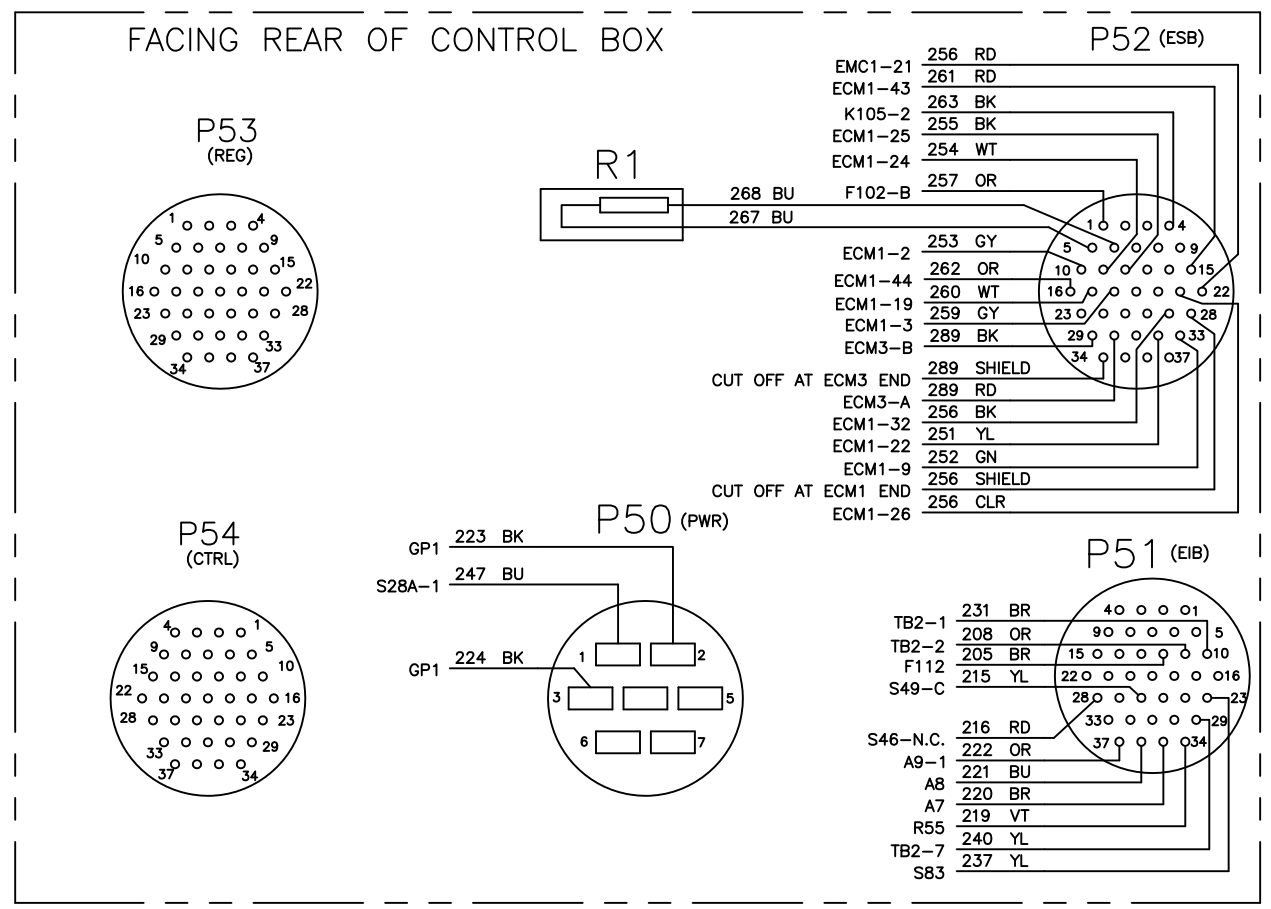
NOTES:

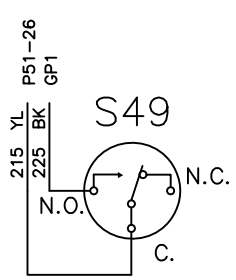
1. * WIRES FURNISHED.
2. WRAP TERMINAL ON WIRE 218 AND TUCK INTO HARNESS.

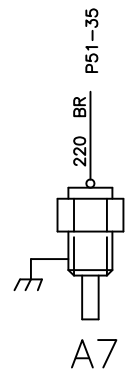


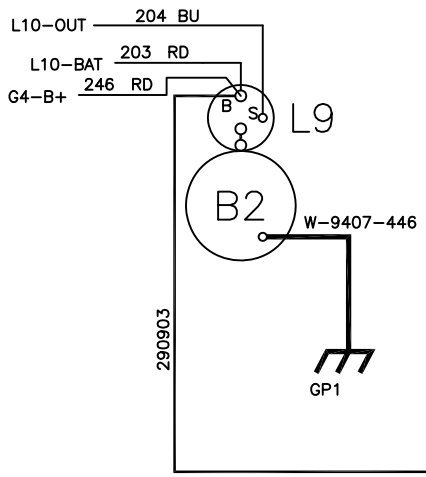


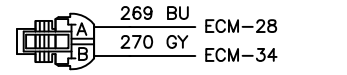


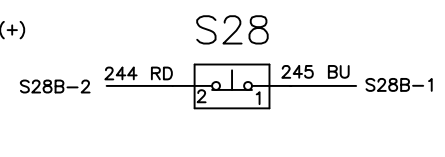


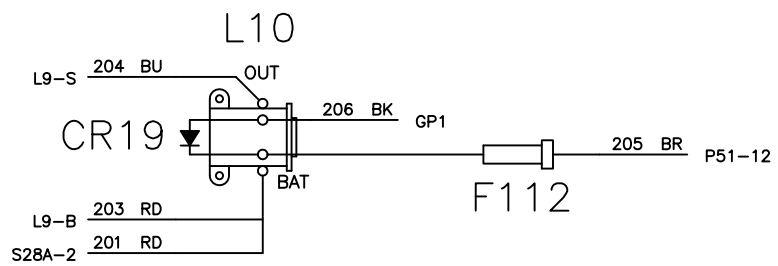


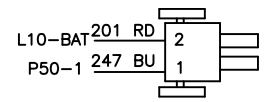


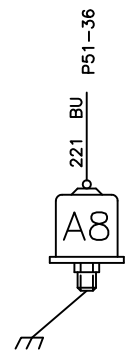


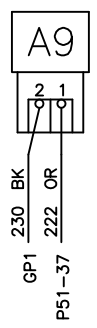


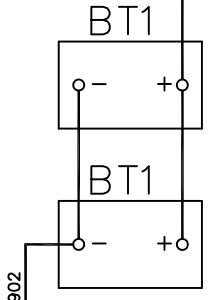


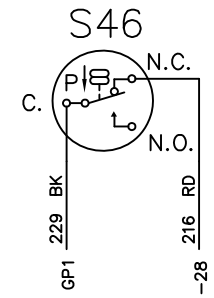


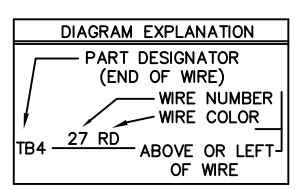




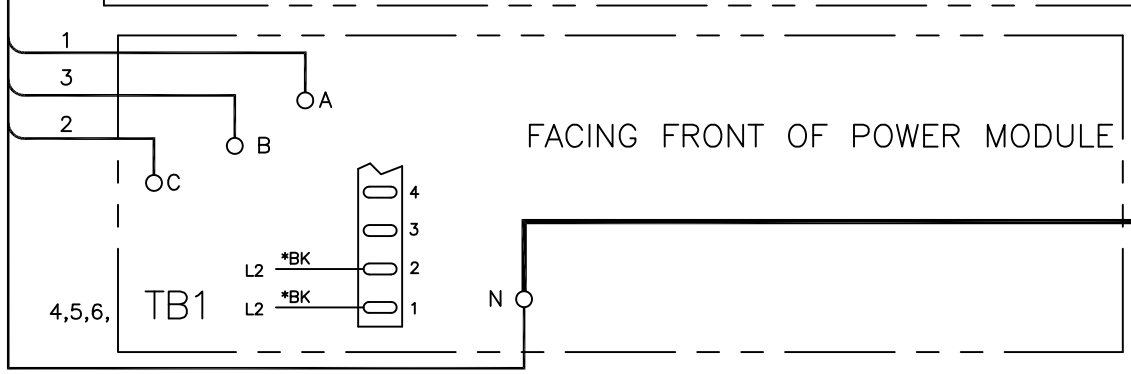


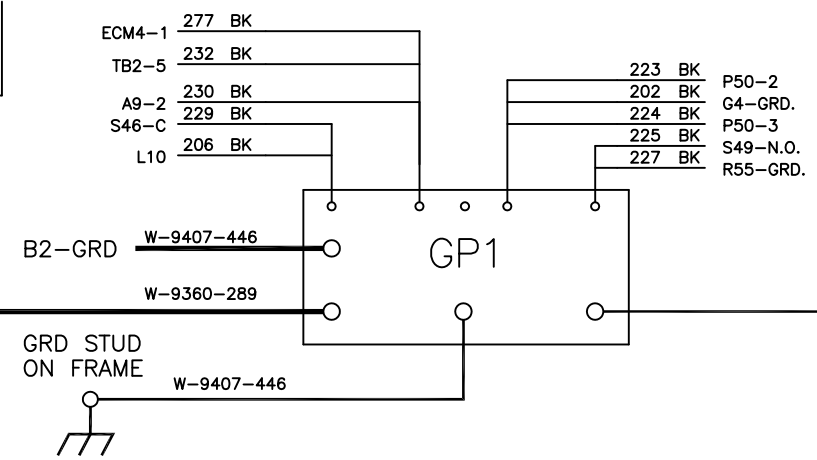






COLOR CODE			
BK	BLACK	RD	RED
BU	BLUE	TN	TAN
BR	BROWN	VT	VIOLET(PURPLE)
GN	GREEN	WT	WHITE
GY	GRAY(SLATE)	YL	YELLOW
OR	ORANGE	D	DARK (PREFIX)
PK	PINK	L	LIGHT(PREFIX)





ACE/DCE	9-08
TEST	9-08
–	–
–	–
–	–
–	–
OUTSIDE DISTR.	

DISTRIBUTION TABLE

CHANGE RECORD	
E.C. No.	DATE

FILE NAME	PLOT DATE
290945s5	9/12/08

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES/MILLIMETERS
TOLERANCES BELOW APPLY EXCEPT FOR VENDOR DESIGNED PARTS AND ITEMS PRODUCED TO RECOGNIZED STANDARDS.
DO NOT SCALE DRAWING.

FRACT. INCH	ANGLES
± –	± 3°

DECIMAL-INCH	METRIC
.00 ± .03	0.0 ±0.8mm
.000 ± .010	0.00 ±0.25mm

FINISH CODE PER 289181: NONE

ACTIVITY	REPLACED BY	REPLACES
–	–	–
MATERIAL NO.	QUANTITY-U.M.	COMM. CLS.
–	–	–

MATERIAL SPEC.
–

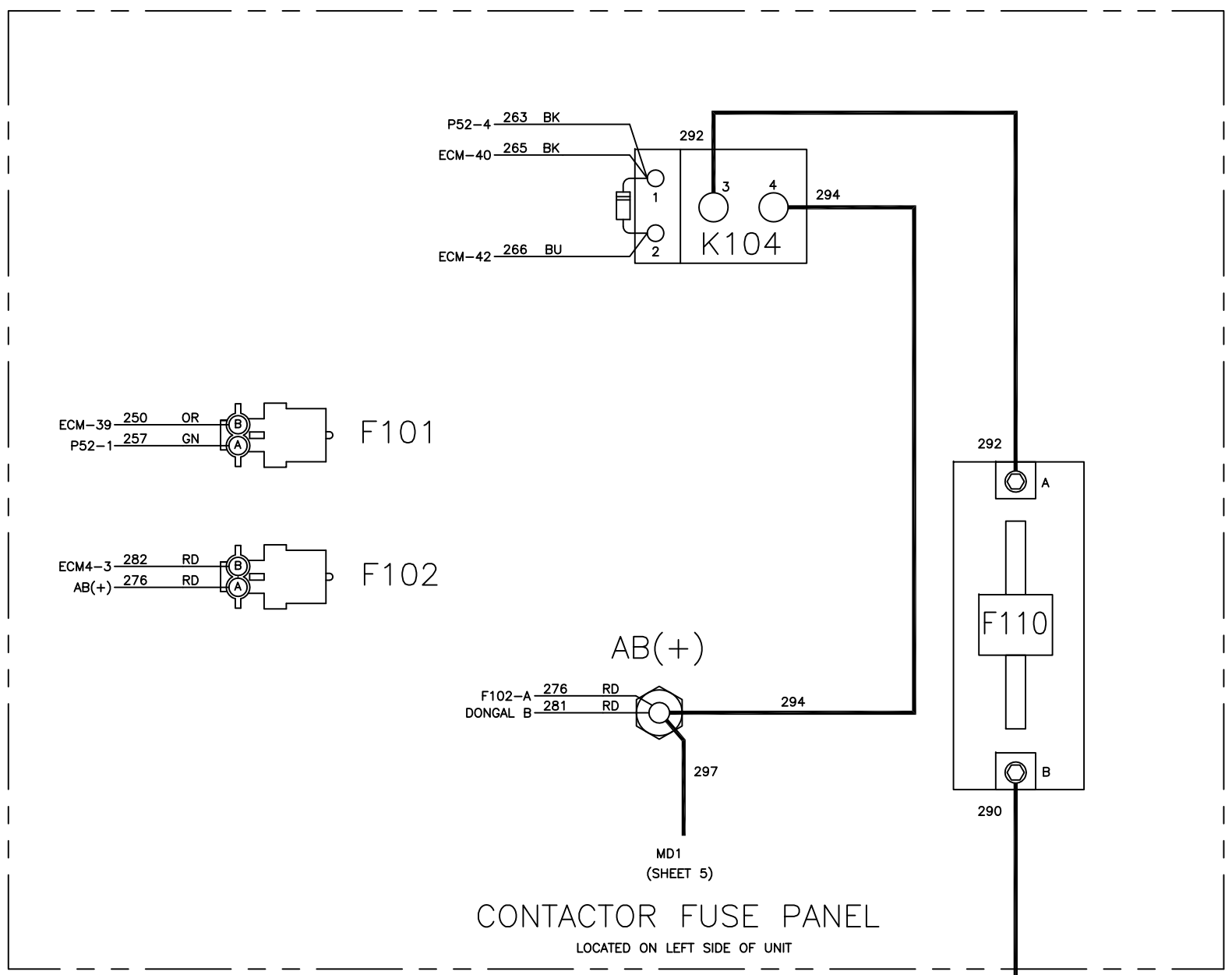
TITLE
DIAGRAM, SCHEMATIC & CONNECTION

DESCRIPTIVE DATA
60CU24

DESIGNED	DRAWN	DATE	SCALE
JNP	JNP	9/12/08	NONE
CHECKED	APPROVED	RECORDS	ITEM TYPE
–	–	9/12/08	–

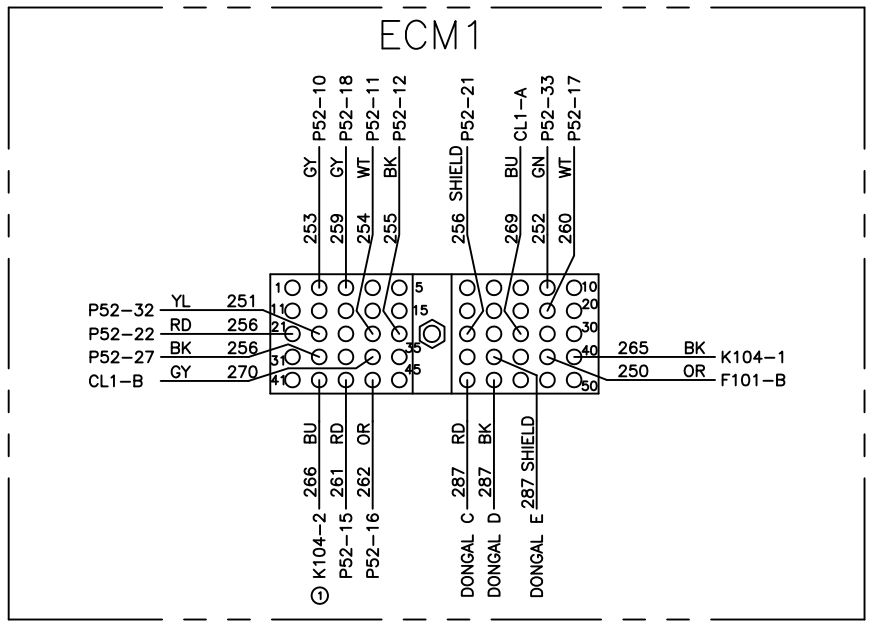
ITW GSE GROUP U.S.A.

SIZE D | DWG. NO. 290945 | SHEET 5 OF 7



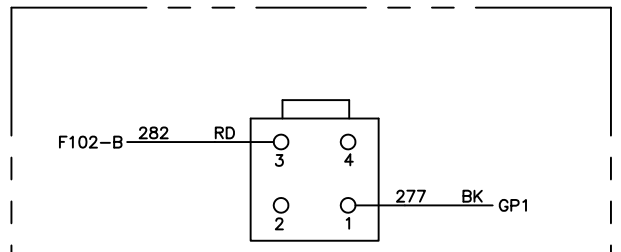
CONTACTOR FUSE PANEL

LOCATED ON LEFT SIDE OF UNIT



ELECTRONIC CONTROL MODULE (MAIN)

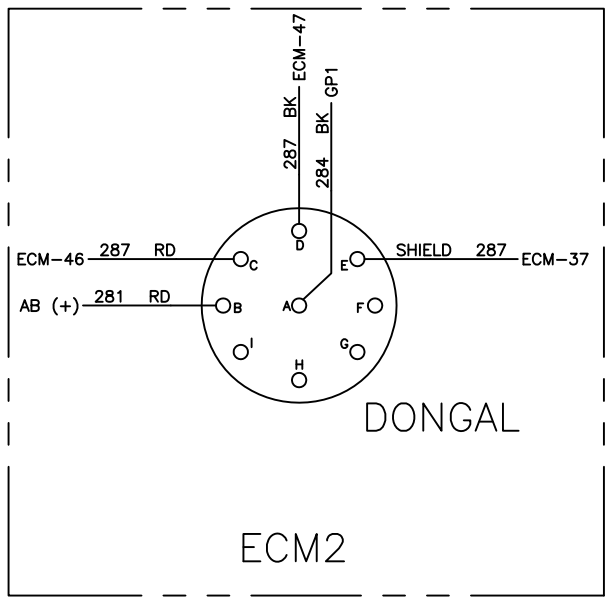
LOCATED ON LEFT SIDE OF ENGINE



ECM4

ELECTRONIC CONTROL MODULE (POWER)

LOCATED ON LEFT SIDE OF ENGINE

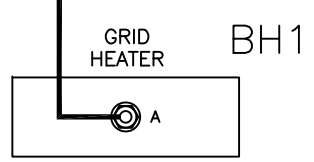


DONGAL

ECM2

ELECTRONIC CONTROL MODULE (DONGAL)

LOCATED ON THE BULKHEAD



ELECTRONIC 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

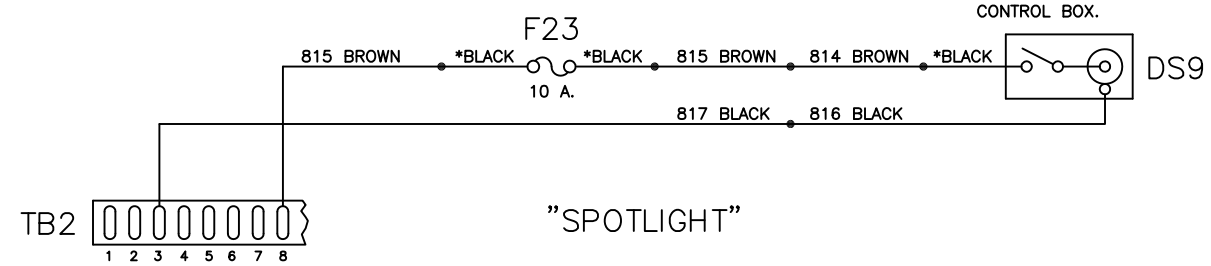
TB4 27 RD ABOVE OR LEFT OF WIRE

ACE/DCE	9-08
TEST	9-08
–	–
–	–
–	–
–	–
OUTSIDE DISTR.	
DISTRIBUTION TABLE	

CHANGE RECORD		–	FINISH CODE PER 289181 NONE		
E.C. No.	DATE	FILE NAME / PLOT DATE	ACTIVITY	REPLACED BY	REPLACES
		290945s6 9/12/08	–	–	–
		UNLESS OTHERWISE SPECIFIED	MATERIAL NO.	QUANTITY-U.M.	COMM. CLS.
		DIMENSIONS ARE IN INCHES/MILLIMETERS TOLERANCES BELOW APPLY EXCEPT FOR VENDOR DESIGNED PARTS AND ITEMS PRODUCED TO RECOGNIZED STANDARDS. DO NOT SCALE DRAWING.	–	–	–
		FRACT. ± – ANGLES ± 3°	MATERIAL SPEC. –		
		DECIMAL–INCH METRIC	TITLE DIAGRAM, SCHEMATIC & CONNECTION		
		.00 ± .03 0.0 ±0.8mm	DESCRIPTIVE DATA 60CU24		
		.000 ± .010 0.00 ±0.25mm	DESIGNED JNP	DRAWN JNP	DATE 9/12/08
		CONFIDENTIAL: This drawing, including all information contained thereon, is the exclusive and confidential property of Illinois Tool Works Ground Support Equip. Group, U.S.A. This drawing is not to be copied, reproduced or delivered or disclosed to others, in whole or in part, except with express written permission.	CHECKED JNP	APPROVED –	RECORDS 9/12/08
		ITW GSE GROUP U.S.A.	SIZE D	DWG. NO. 290945	SHEET 6 OF 7
			SCALE NONE	ITEM TYPE –	

NOTE: CUT 815 BROWN AND SPLICE IN FUSE.

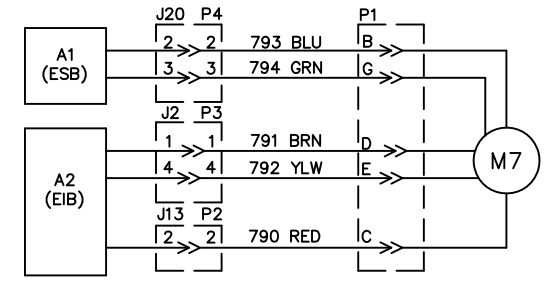
MOUNTED ON TOP OF CANOPY IN LEFT FRONT CORNER ABOVE CONTROL BOX.



MOUNTED ON CONTROL BOX SUPPORT BELOW CONTROL BOX

"SPOTLIGHT"

* WIRE FURNISHED WITH DS9 AND F23



CAN–BUS METER

(THIS METER WILL REPLACE M4 RUNNING TIME METER)

GRD. WIRE TO MOUNTING SCREW

DS135

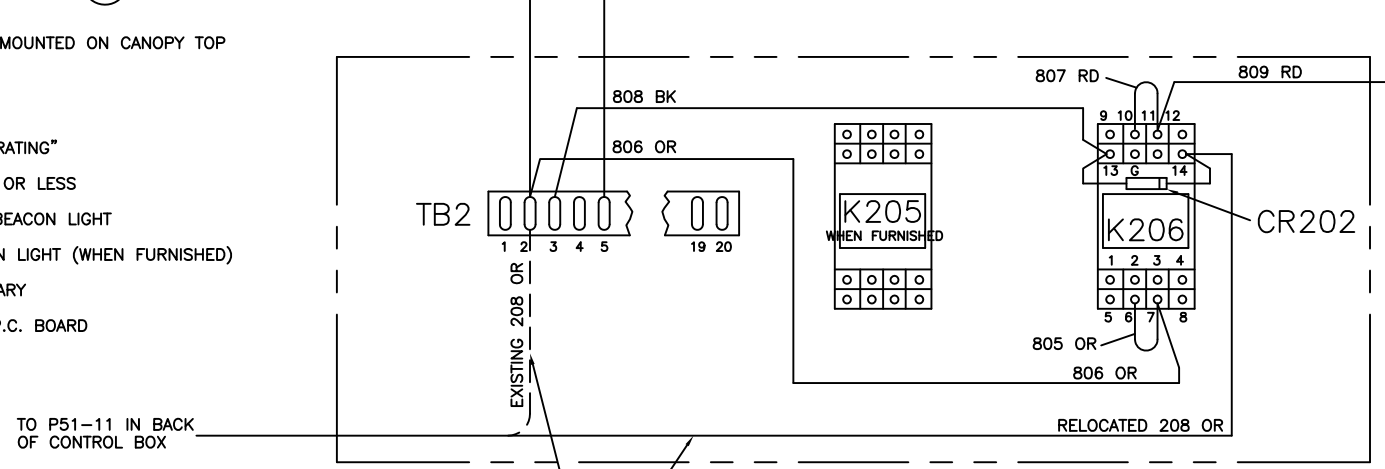
804 BK

*BK 802 OR

MOUNTED ON CANOPY TOP

LEGEND

CR201	DIODE
DS127	LIGHT, BEACON, "UNIT OPERATING"
F201	FUSE, AGC, 10 A., 250 V. OR LESS
K205	RELAY, "UNIT OPERATING" BEACON LIGHT
K206	RELAY, "LOW FUEL" BEACON LIGHT (WHEN FURNISHED)
L10	SOLENOID, STARTER, AUXILIARY
P51	PLUG, ENGINE INTERFACE P.C. BOARD
TB2	TERMINAL BLOCK, OPTIONS



L10

OUT BAT 809 RD

VIEWING BULKHEAD NEAR CONTROL BOX

VIEWING OPTION PANEL MOUNTED ON CONTROL BOX SUPPORT BELOW CONTROL BOX

"LOW FUEL" BEACON LIGHT

NOTE: FOR NON–FLASHING VERSION: DISCONNECT THE WIRES FROM THE FLASHER LOCATED IN THE BASE OF THE LIGHT, AND CONNECT THEM TOGETHER. LEAVE THE FLASHER IN THE BASE OF THE LIGHT.

DISCONNECT EXISTING WIRE 208 ORANGE FROM TB2–2. CUT TERMINAL OFF WIRE. CRIMP NEW SPADE TERMINAL IN ITS PLACE. CONNECT WIRE TO RELAY K206–14.

GRD. WIRE TO MOUNTING SCREW

DS127

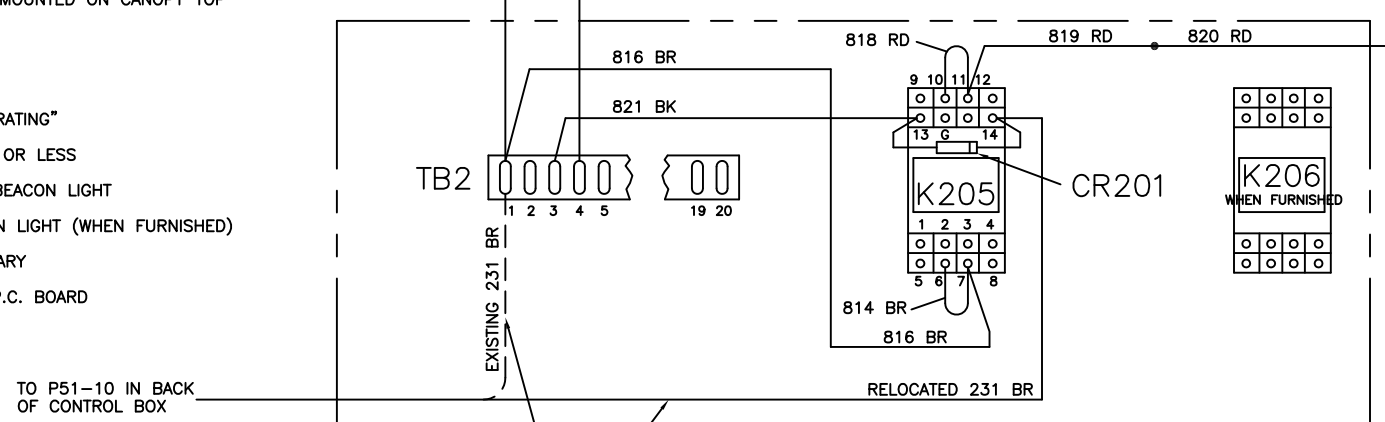
817 BK

*BK 815 BR

MOUNTED ON CANOPY TOP

LEGEND

CR201	DIODE
DS127	LIGHT, BEACON, "UNIT OPERATING"
F201	FUSE, AGC, 10 A., 250 V. OR LESS
K205	RELAY, "UNIT OPERATING" BEACON LIGHT
K206	RELAY, "LOW FUEL" BEACON LIGHT (WHEN FURNISHED)
L10	SOLENOID, STARTER, AUXILIARY
P51	PLUG, ENGINE INTERFACE P.C. BOARD
TB2	TERMINAL BLOCK, OPTIONS



L10

OUT BAT 820 RD

VIEWING BULKHEAD NEAR CONTROL BOX

VIEWING OPTION PANEL MOUNTED ON CONTROL BOX SUPPORT BELOW CONTROL BOX

"UNIT OPERATING" BEACON LIGHT

NOTE: FOR NON–FLASHING VERSION: DISCONNECT THE WIRES FROM THE FLASHER LOCATED IN THE BASE OF THE LIGHT, AND CONNECT THEM TOGETHER. LEAVE THE FLASHER IN THE BASE OF THE LIGHT.

DISCONNECT EXISTING WIRE 231 BROWN FROM TB2–1. CUT TERMINAL OFF WIRE. CRIMP NEW SPADE TERMINAL IN ITS PLACE. CONNECT WIRE TO RELAY K205–14.

ACE/DCE	9–08
TEST	9–08
–	–
–	–
–	–
–	–
OUTSIDE DISTR.	

DISTRIBUTION TABLE

CHANGE RECORD	
E.C. No.	DATE

–

FILE NAME	PLOT DATE
290945s7	9/12/08

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES/MILLIMETERS TOLERANCES BELOW APPLY EXCEPT FOR VENDOR DESIGNED PARTS AND ITEMS PRODUCED TO RECOGNIZED STANDARDS. DO NOT SCALE DRAWING.

FRACT– INCH	ANGLES
± –	± 3°

DECIMAL–INCH	METRIC
.00 ± .03	0.0 ±0.8mm
.000 ± .010	0.00 ±0.25mm

FINISH CODE PER 289181 NONE

ACTIVITY	REPLACED BY	REPLACES
–	–	–

MATERIAL NO.	QUANTITY–U.M.	COMM. CLS.
–	–	–

MATERIAL SPEC.

–

TITLE

DIAGRAM, SCHEMATIC & CONNECTION

DESCRIPTIVE DATA

60CU24

DESIGNED	DRAWN	DATE	SCALE
JNP	JNP	9/12/08	NONE
CHECKED	APPROVED	RECORDS	ITEM TYPE
–	–	9/12/08	–

ITW GSE GROUP U.S.A.

SIZE D

DWG. NO. 290945

SHEET 7 OF 7

USE ONLY WHEN M1, M2, & M3 METERS ARE ANALOG

A1
ENGINE SPECIFIC BRD.
(ESB)

A2
(EIB)
ENGINE INTERFACE BRD.

A3
(CTRL)
CONTROL BRD.

A4
(REG)
REGULATOR BRD.

A404
T-R BRD.
(TR)

J401

J50

J450

J51

J52

J53

J54

P1 J1 — 524 BR, 525 RD, 526 OR, 527 YL, 528 GN, 529 BU, 530 VT, 531 GY, 532 WT, 533 BK

J2 — 656 BU, 655 GN, 654 YL, 653 OR, 652 RD, 651 BR

J3 — 733 BR, 734 RD, 735 OR, 736 YL, 737 GN, 738 BU

J4 — 651 BR, 652 RD, 653 OR, 654 YL, 655 GN, 656 BU

J5 — 545 BR, 546 RD, 547 OR, 548 YL, 549 GN, 550 BU

J6 — 539 BR, 540 RD, 541 OR, 542 YL, 543 GN, 544 BU

J7 — 551 BR, 552 RD, 553 OR, 554 YL

J1 — 657 BR, 658 RD, 659 OR, 660 YL

J11 P11 — 567 RD, 568 BK, 569 GN, 570 WT

J10 P10 — 665 SHIELD, 664 WT, 663 GN, 662 BK, 661 RD

J20 — A2-J10-1, A2-J10-2, A2-J10-3, A2-J10-4

P3 J3 — A4-J6-1, A4-J6-2, A4-J6-3, A4-J6-4

P2 J2 — A2-J11-1, A2-J11-2, A2-J11-3, A2-J11-4

P1 J1 — A4-J4-6, A4-J4-5, A4-J4-4, A4-J4-3, A4-J4-2, A4-J4-1

P6 J6 — 657 BR, 658 RD, 659 OR, 660 YL

P5 J5 — M3 - LT. 718 BR; M3 - RT. 720 OR

P7 J7 — J450-1 690 BR; J450-3 691 OR; J450-7 692 GN; J450-9 693 VT

P4 J4 — 557 RD, 558 BK, 559 GN, 560 WT, 561 SHIELD

P1 J1 — A2-J11-1, A2-J11-2, A2-J11-3, A2-J11-4

P3 J3 — 562 RD, 563 BK, 564 GN, 565 WT, 566 SHIELD

P4 J4 — 523 BU, 522 GN, 521 YL, 520 OR, 519 RD, 518 BR, 517 BK, 516 WT, 515 GY, 514 VT, 513 BU, 512 GN, 511 YL, 510 OR, 509 RD, 508 BR

P6 J6 — A404-J6-1, A404-J6-2, A404-J6-3, A404-J6-4

P1 J1 — A2-J5-1, A2-J5-2, A2-J5-3, A2-J5-4, A2-J5-5, A2-J5-6

P3 J3 — A5-J1-1, A5-J1-2, A5-J1-3, A5-J1-4, A5-J1-5

P4 J4 — 727 BK, 728 WT, 729 RED, 730 GN, 731 BR, 732 SHIELD

P1 J1 — 523 BU, 522 GN, 521 YL, 520 OR, 519 RD, 518 BR, 517 BK, 516 WT, 515 GY, 514 VT, 513 BU, 512 GN, 511 YL, 510 OR, 509 RD, 508 BR

P6 J6 — A404-J6-1, A404-J6-2, A404-J6-3, A404-J6-4

P1 J1 — A2-J5-1, A2-J5-2, A2-J5-3, A2-J5-4, A2-J5-5, A2-J5-6

P3 J3 — A2-J6-1 539 BR; A2-J6-2 540 RD; A2-J6-3 541 OR; A2-J6-4 542 YL; A2-J6-5 543 GN; A2-J6-6 544 BU

P2 J2 — A2-J9-1 579 BR; A2-J9-2 580 RD; A2-J9-3 581 OR; A2-J9-4 582 GN; A2-J9-5 583 YL; A2-J9-6 584 BU; A2-J9-7 585 VT; A2-J9-8 586 GY

J7 — 1, 2

J5

PT1 — 574 BK

PT2 — 572 BU

PT3

CHASSIS STUD — 573 BK

J8 P8 — 500 BR CB7-LINE; 501 RD CB4-LINE; 502 OR CB11-LINE; 503 YL CB7-LOAD; 504 GN CB4-LOAD; 505 BU CB11-LOAD

J9 P9 — 579 BR A3-J2-1; 580 RD A3-J2-2; 581 OR A3-J2-3; 582 YL A3-J2-4; 583 GN A3-J2-5; 584 BU A3-J2-6; 585 VT A3-J2-7; 586 GY A3-J2-8

692 GN — A4-J7-5; 690 BR — A4-J7-1; 691 OR — A4-J7-3; 693 VY — A4-J7-7

J14 P14 — M5-I 710 BR; M24-G 709 BK; M4+ 708 WT; M4- 707 GY; G MTR LITE 2 706 VT; G MTR LITE 1 705 BU; E MTR LITE 704 GN; M25-I 703 YL; M5-S 702 OR; M23-S 701 RD; M13-S 700 BR; GROUND

J13 — 4, 3, 2, 1

J12 — 5, 4, 3, 2, 1

J11 P11 — 565 WT, 564 GN, 563 BK, 562 RD

J10 P10 — 571 SHIELD, 570 WT, 569 GN, 568 BK, 567 RD

A4-J3-4, A4-J3-3, A4-J3-2, A4-J3-1

A1-J11-4, A1-J11-3, A1-J11-2, A1-J11-1

NOTE: LABEL MUST BE FACING THIS DIRECTION.

PS1 — TRIM, +5V, COM, +12, −12V; ENABLE, CASE, +VIN, −VIN, N/C

A2-J7-2 552 RD; A2-J7-3 553 OR; 554 YL — A2-J7-4; 551 BR — A2-J7-1; 599 BR

FACING INSIDE OF CONTROL BOX

CB4 CB7 CB11 — LINE / LOAD

A2-J8-2 501 RD; A2-J8-5 504 GN; A2-J8-1 500 BR; A2-J8-4 503 YL; A2-J8-3 502 OR; A2-J8-6 505 BU

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
TB4 — 27 RD — ABOVE OR LEFT OF WIRE

CHANGE RECORD		
E.C. No.	DATE	
1) 3226AA	4/6/04	
2) 3257AA	05/10/04	

FILE NAME 289022S1 — PLOT DATE 05/10/04

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES/MILLIMETERS
TOLERANCES BELOW APPLY EXCEPT FOR VENDOR DESIGNED PARTS AND ITEMS PRODUCED TO RECOGNIZED STANDARDS.
DO NOT SCALE DRAWING.

FRACT. INCH ± — ANGLES ± 3°
DECIMAL-INCH — METRIC
.00 ± .03 — 0.0 ±0.8mm
.000 ± .010 — 0.00 ±0.25mm

OUTSIDE DISTR.
DISTRIBUTION TABLE

FINISH CODE PER 910176: NONE

ACTIVITY	REPLACED BY	REPLACES
MATERIAL NO.	QUANTITY-U.M.	COMM. CLS.

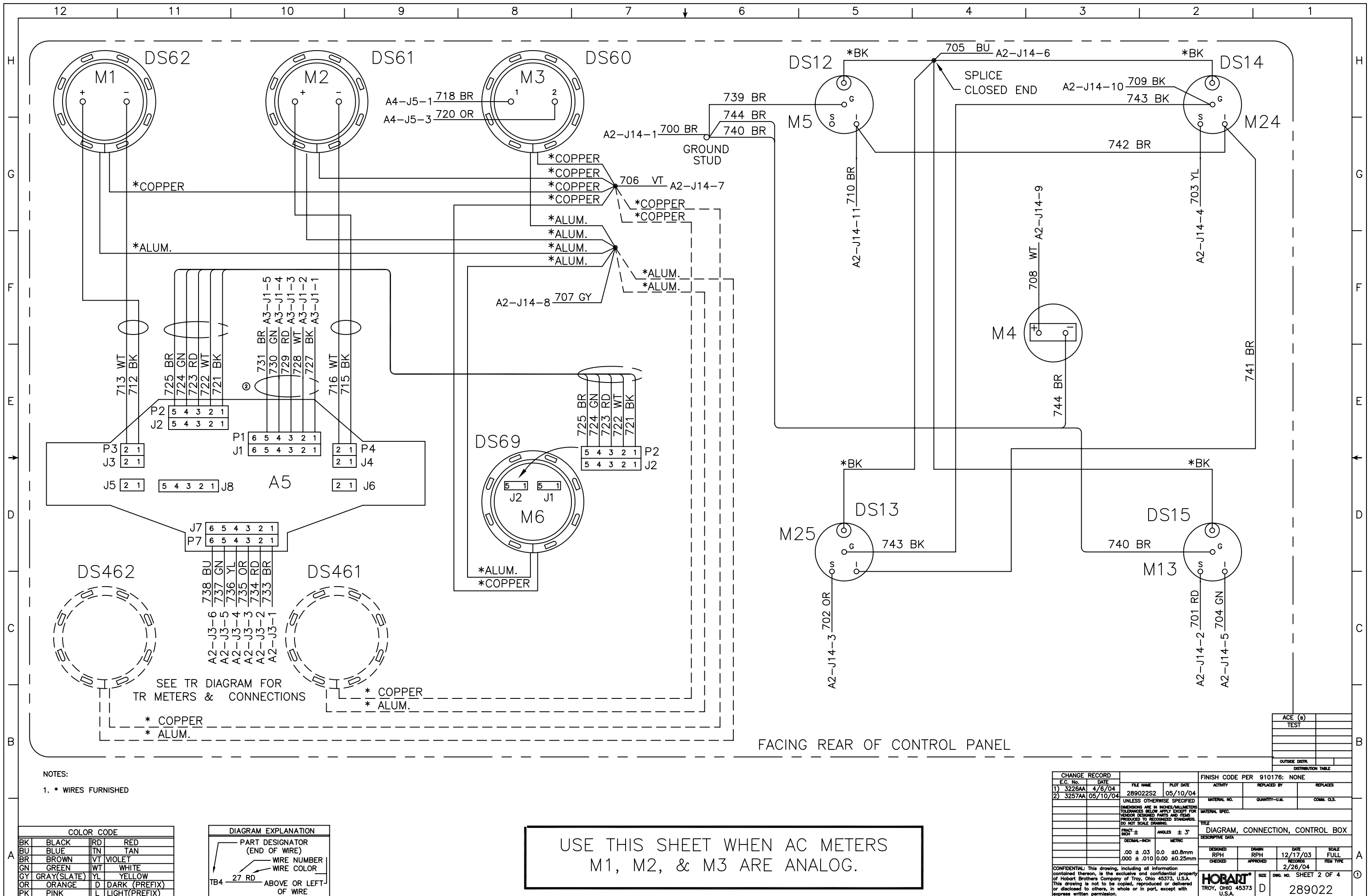
MATERIAL SPEC.

TITLE: DIAGRAM, CONNECTION, CONTROL BOX

DESCRIPTIVE DATA

DESIGNED	DRAWN	DATE	SCALE
RPH	RPH	12/17/03	FULL
CHECKED	APPROVED	RECORDS 2/26/04	ITEM TYPE

HOBART® TROY, OHIO 45373 U.S.A. — SIZE D — DWG. NO. 289022 — SHEET 1 OF 4



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
TB4 — 27 RD — ABOVE OR LEFT OF WIRE

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

CHANGE RECORD	
E.C. No.	DATE
1) 3226AA	4/6/04
2) 3257AA	05/10/04

FILE NAME	PLOT DATE
289022S2	05/10/04

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES/MILLIMETERS
TOLERANCES BELOW APPLY EXCEPT FOR VENDOR DESIGNED PARTS AND ITEMS PRODUCED TO RECOGNIZED STANDARDS.
DO NOT SCALE DRAWING.

FRACT. ± INCH	ANGLES ± 3°
DECIMAL-INCH	METRIC
.00 ± .03	0.0 ±0.8mm
.000 ± .010	0.00 ±0.25mm

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FINISH CODE PER 910176: NONE

ACTIVITY	REPLACED BY	REPLACES
MATERIAL NO.	QUANTITY-U.M.	COMM. CLS.

MATERIAL SPEC.

TITLE
DIAGRAM, CONNECTION, CONTROL BOX

DESCRIPTIVE DATA

DESIGNED	DRAWN	DATE	SCALE
RPH	RPH	12/17/03	FULL
CHECKED	APPROVED	RECORDS 2/26/04	ITEM TYPE

HOBART® TROY, OHIO 45373 U.S.A.

SIZE D | DWG. NO. 289022 | SHEET 2 OF 4

ACE (s)	
TEST	
OUTSIDE DISTR.	
DISTRIBUTION TABLE	

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
①	
①	
PS1	POWER SUPPLY

ACE (s)	
TEST	
OUTSIDE DISTR.	
DISTRIBUTION TABLE	

CHANGE RECORD	
E.C. No.	DATE
1) 3226AA	4/6/04
2) 3257AA	05/10/04

FILE NAME	PLOT DATE
289022S3	05/10/04

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES/MILLIMETERS TOLERANCES BELOW APPLY EXCEPT FOR VENDOR DESIGNED PARTS AND ITEMS PRODUCED TO RECOGNIZED STANDARDS. DO NOT SCALE DRAWING.

FRACT INCH	ANGLES
±	± 3°

DECIMAL–INCH	METRIC
.00 ± .03	0.0 ±0.8mm
.000 ± .010	0.00 ±0.25mm

FINISH CODE PER 910176: NONE

ACTIVITY	REPLACED BY	REPLACES
MATERIAL NO.	QUANTITY–U.M.	COMM. CLS.

MATERIAL SPEC.
–

TITLE
DIAGRAM, CONNECTION, CONTROL BOX

DESCRIPTIVE DATA
90/120 DIGITAL CONTROLS

DESIGNED	DRAWN	DATE	SCALE
RPH	RPH	2/23/04	FULL
CHECKED	APPROVED	RECORDS 2/26/04	ITEM TYPE

HOBART®
TROY, OHIO 45373
U.S.A.

SIZE C

DWG. NO. SHEET 3 OF 4
289022

①

DS62 M1 J2 J1 P1 J1 P2 J2 761 BR 760 GN 759 RD 758 WT 757 BK

DS61 M2 761 BR 760 GN 759 RD 758 WT 757 BK

DS60 M3 755 BR 754 GN 753 RD 752 WT 751 BK

755 BR 754 GN 753 RD 752 WT 751 BK

749 BR 748 GN 747 RD 746 WT 745 BK

*COPPER
*COPPER
*COPPER
*COPPER
706 VT A2-J14-7
*COPPER
*COPPER
*ALUM.
*ALUM.
*ALUM.
*ALUM.
A2-J14-8 707 GY
*ALUM.
*ALUM.
*ALUM.

*COPPER

DS12 *BK 705 BU A2-J14-6 *BK DS14
SPLICE CLOSED END
739 BR
GROUND STUD
743 BK
A2-J14-10 709 BK
M5 M24
742 BR
A2-J14-1 700 BR
744 BR
740 BR
A2-J14-11 710 BR
A2-J14-4 703 YL
A2-J14-9
708 WT
M4
744 BR
741 BR

*BK *BK
DS13 DS15
M25 743 BK 740 BR M13
A2-J14-3 702 OR
A2-J14-2 701 RD
A2-J14-5 704 GN

725 BR 724 GN 723 RD 722 WT 721 BK
731 BR 730 GN 729 RD 728 WT 727 BK
A3-J1-5 A3-J1-4 A3-J1-3 A3-J1-2 A3-J1-1
② P2 J2 P1 J1 J3 J4 J5 J8 J6 J7 P7 A5
738 BU 737 GN 736 YL 735 OR 734 RD 733 BR
A2-J3-6 A2-J3-5 A2-J3-4 A2-J3-3 A2-J3-2 A2-J3-1

DS462 DS461 DS69 M6
725 BR 724 GN 723 RD 722 WT 721 BK
749 BR 748 GN 747 RD 746 WT 745 BK
*ALUM. *COPPER
* COPPER * ALUM.
* COPPER * ALUM.

SEE TR DIAGRAM FOR TR METERS & CONNECTIONS

FACING REAR OF CONTROL PANEL

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

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
TB4 27 RD ABOVE OR LEFT OF WIRE

NOTES:
1. * WIRES FURNISHED

ACE (s)
Test
OUTSIDE DISTR.
DISTRIBUTION TABLE

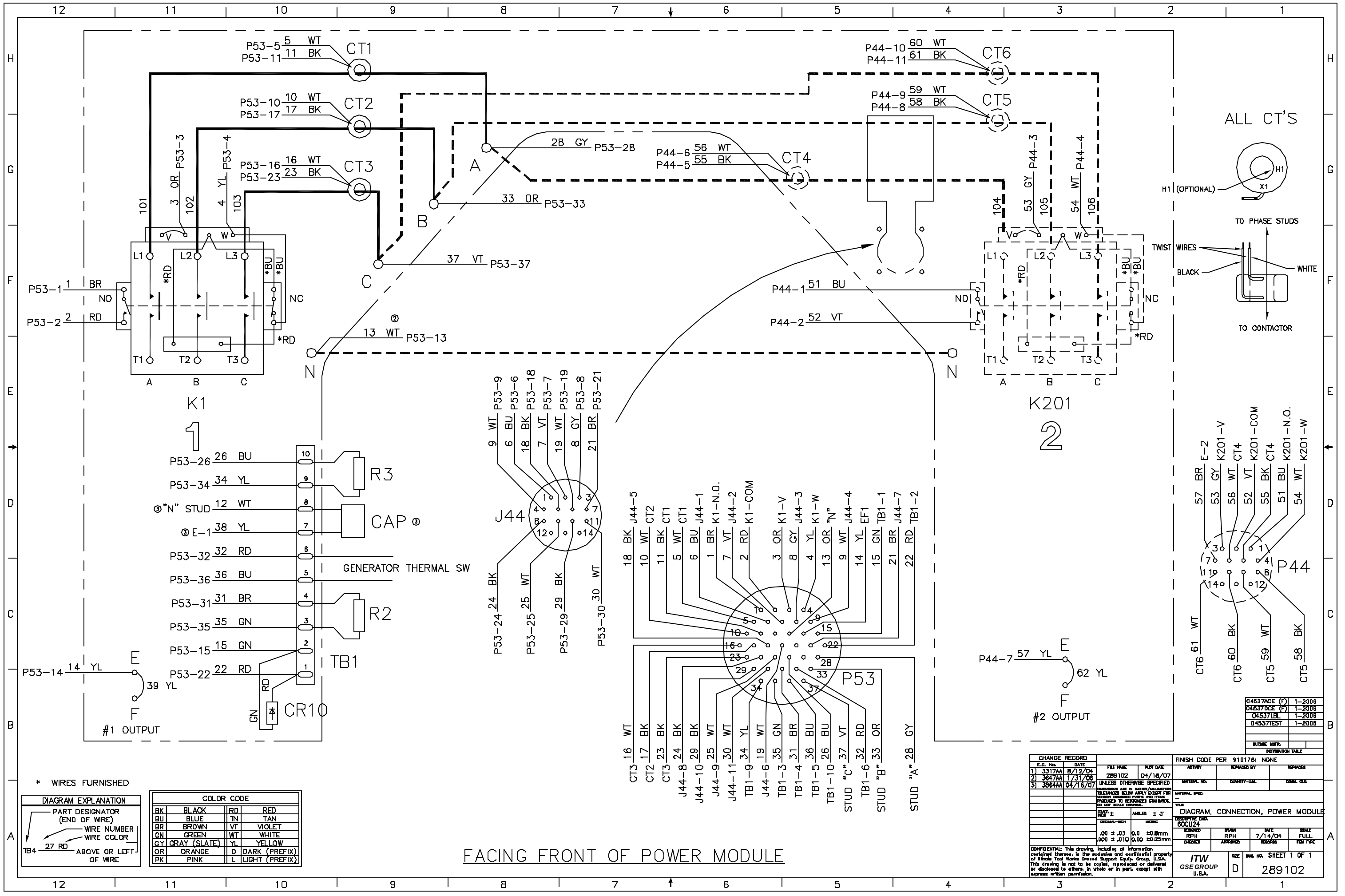
CHANGE RECORD			
E.C. No.	DATE	FILE NAME	PLOT DATE
1) 3226AA	4/6/04	289022S4	05/10/04
2 3257AA	05/10/04		

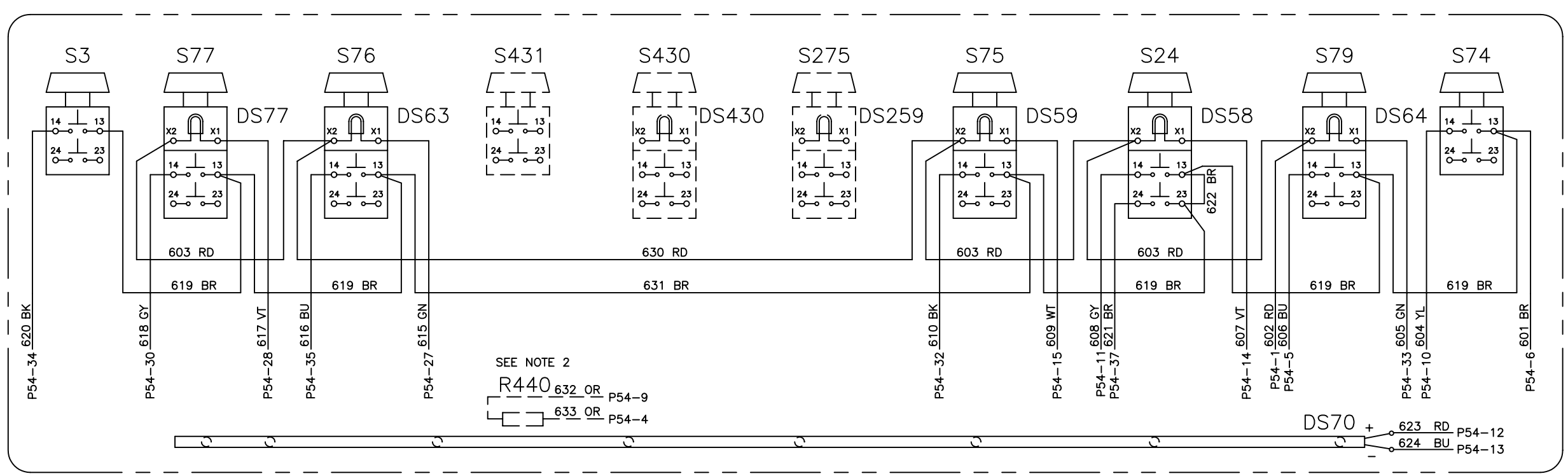
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES/MILLIMETERS
TOLERANCES BELOW APPLY EXCEPT FOR VENDOR DESIGNED PARTS AND ITEMS PRODUCED TO RECOGNIZED STANDARDS.
DO NOT SCALE DRAWING.
FRACT. INCH ± ANGLES ± 3°
DECIMAL-INCH .00 ± .03 .000 ± .010 METRIC 0.0 ±0.8mm 0.00 ±0.25mm

FINISH CODE PER 910176: NONE
ACTIVITY | REPLACED BY | REPLACES
MATERIAL NO. | QUANTITY-U.M. | COMM. CLS.
MATERIAL SPEC.
TITLE
DIAGRAM, CONNECTION, CONTROL BOX
DESCRIPTIVE DATA

DESIGNED	DRAWN	DATE	SCALE
RPH	RPH	4/6/04	FULL
CHECKED	APPROVED	RECORDS	ITEM TYPE

HOBART® TROY, OHIO 45373 U.S.A.
SIZE D DWG. NO. 289022 SHEET 4 OF 4


CT1
CT2
CT3
CT4
CT5
CT6
P53-5 5 WT
P53-11 11 BK
P53-10 10 WT
P53-17 17 BK
P53-16 16 WT
P53-23 23 BK
P44-10 60 WT
P44-11 61 BK
P44-9 59 WT
P44-8 58 BK
P44-6 56 WT
P44-5 55 BK
28 GY P53-28
33 OR P53-33
37 VT P53-37
13 WT P53-13
3 OR P53-3
4 YL P53-4
101
102
103
104
105
106
P53-1 1 BR
P53-2 2 RD
NO
NC
*RD
*BU
L1
L2
L3
T1
T2
T3
A
B
C
K1
K201
P44-1 51 BU
P44-2 52 VT
P44-3 53 GY
P44-4 54 WT
ALL CT'S
H1 (OPTIONAL)
X1
TO PHASE STUDS
TWIST WIRES
WHITE
BLACK
TO CONTACTOR
1
2
R3
R2
CAP ③
TB1
CR10
GENERATOR THERMAL SW
③"N" STUD 12 WT
③E-1 38 YL
P53-32 32 RD
P53-36 36 BU
P53-31 31 BR
P53-35 35 GN
P53-15 15 GN
P53-22 22 RD
P53-14 14 YL
39 YL
#1 OUTPUT
P44-7 57 YL
62 YL
#2 OUTPUT
J44
P53
P53-24 24 BK
P53-25 25 WT
P53-29 29 BK
P53-30 30 WT
9 WT P53-9
6 BU P53-6
18 BK P53-18
7 VT P53-7
19 WT P53-19
8 GY P53-8
21 BR P53-21
18 BK J44-5
10 WT CT2
11 BK CT1
5 WT CT1
6 BU J44-1
1 BR K1-N.O.
7 VT J44-2
2 RD K1-COM
3 OR K1-V
8 GY J44-3
4 YL K1-W
13 OR "N"
9 WT J44-4
14 YL EF1
15 GN TB1-1
21 BR J44-7
22 RD TB1-2
16 WT CT3
17 BK CT2
23 BK CT3
24 BK J44-8
29 BK J44-10
25 WT J44-9
30 WT J44-11
34 YL TB1-9
19 WT J44-6
35 GN TB1-3
31 BR TB1-4
36 BU TB1-5
26 BU TB1-10
37 VT "C"
32 RD TB1-6
33 OR "B"
28 GY "A"
57 BR E-2
53 GY K201-V
56 WT CT4
52 VT K201-COM
55 BK CT4
51 BU K201-N.O.
54 WT K201-W
61 WT CT6
60 BK CT6
59 WT CT5
58 BK CT5
E
F
* WIRES FURNISHED
DIAGRAM EXPLANATION
PART DESIGNATOR (END OF WIRE)
WIRE NUMBER
WIRE COLOR
TB4 27 RD ABOVE OR LEFT OF WIRE
COLOR CODE
BK BLACK
BU BLUE
BR BROWN
GN GREEN
GY GRAY (SLATE)
OR ORANGE
PK PINK
RD RED
TN TAN
VT VIOLET
WT WHITE
YL YELLOW
D DARK (PREFIX)
L LIGHT (PREFIX)
FACING FRONT OF POWER MODULE
CHANGE RECORD
E.O. No. DATE
1) 3317AM 8/12/04
2) 3647AM 1/31/06
3) 3864AM 04/16/07
FINISH CODE PER 910176: NONE
FILE NAME 289102
PLOT DATE 04/16/07
UNLESS OTHERWISE SPECIFIED
DIAGRAM, CONNECTION, POWER MODULE
60CU24
ITW GSE GROUP U.S.A.
SIZE D
DWG NO. 289102
SHEET 1 OF 1
04537ACE (F) 1-2008
04537DCE (F) 1-2008
04537LBL 1-2008
04537TEST 1-2008

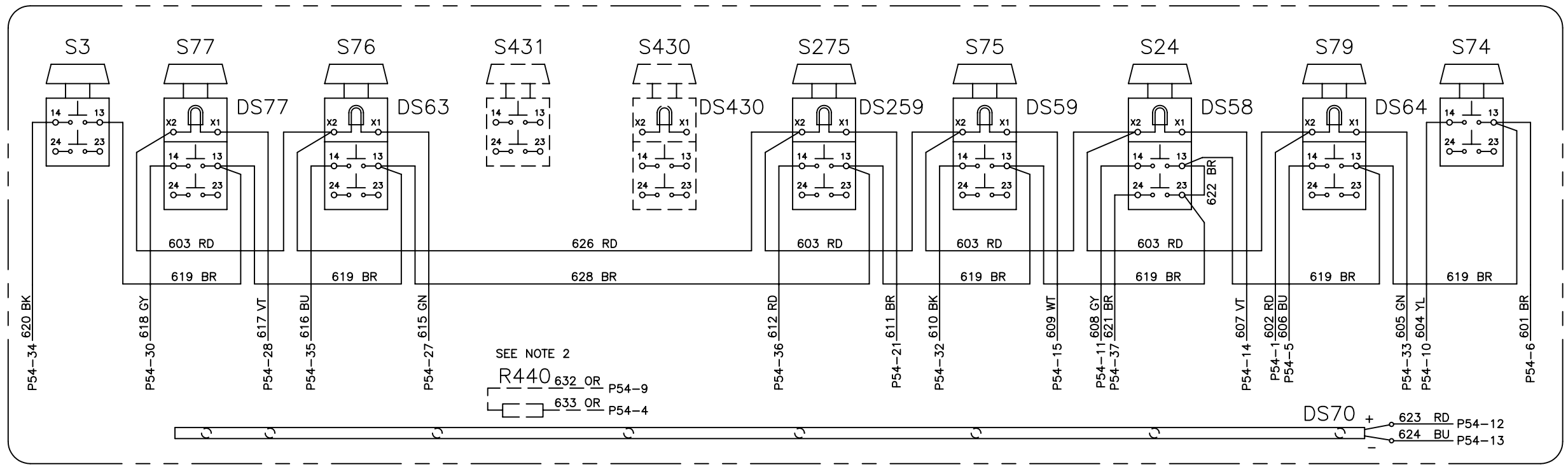


FACING REAR OF SWITCH BOX
1 A.C. OUTPUT

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
TB4 — 27 RD — ABOVE OR LEFT OF WIRE

① NOTE 2:
REMOVE RESISTOR R440 FROM HARNESS BY CUTTING WIRES 632 & 633. INSULATE ENDS OF WIRES WITH SHRINK TUBING.



FACING REAR OF SWITCH BOX
2 A.C. OUTPUTS

NOTES:

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

LEGEND

DS58	INDICATOR, PUSHBUTTON, ENGINE START (GREEN)	S3	SWITCH, METER SELECTOR
DS59	INDICATOR, PUSHBUTTON, #1 OUTPUT (YELLOW)	S24	SWITCH, ENGINE START
DS63	INDICATOR, PUSHBUTTON, DELAYED ENGINE SHUTDOWN (RED)	S74	SWITCH, PUSHBUTTON, LAMPS & FUEL CHECK
DS64	INDICATOR, PUSHBUTTON, PRE-HEATER, (ORANGE)	S75	SWITCH, PUSHBUTTON, #1 OUTPUT
DS77	INDICATOR, PUSHBUTTON, TEST/RESET, (RED)	S76	SWITCH, PUSHBUTTON, ENGINE STOP, DELAYED SHUTDOWN
DS259	INDICATOR, PUSHBUTTON, #2 OUTPUT (ORANGE) (WHEN FURNISHED)	S77	SWITCH, PUSHBUTTON, TEST/RESET
DS430	INDICATOR, PUSHBUTTON, DC OUTPUT, (BLUE), (WHEN FURNISHED)	S275	SWITCH, PUSHBUTTON, #2 OUTPUT, (WHEN FURNISHED)
		S430	SWITCH, PUSHBUTTON, DC OUTPUT, (WHEN FURNISHED)
①③R440	RESISTOR, 1K, T-R I.D.	S431	SWITCH, PUSHBUTTON, DC, STARTING CURRENT, (WHEN FURNISHED)

DISTRIBUTION TABLE	
OUTSIDE DISTR.	

CHANGE RECORD	
E.C. No.	DATE
1) RPH	2/12/04
2) 3226AA	4/6/04
3 3261AA	05/11/04

FINISH CODE PER 910176: NONE

FILE NAME	PLOT DATE
289013S1	05/11/04

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES/MILLIMETERS TOLERANCES BELOW APPLY EXCEPT FOR VENDOR DESIGNED PARTS AND ITEMS PRODUCED TO RECOGNIZED STANDARDS. DO NOT SCALE DRAWING.

FRACT. ± INCH	ANGLES ± 3°
DECIMAL-INCH	METRIC
.00 ± .03	0.0 ±0.8mm
.000 ± .010	0.00 ±0.25mm

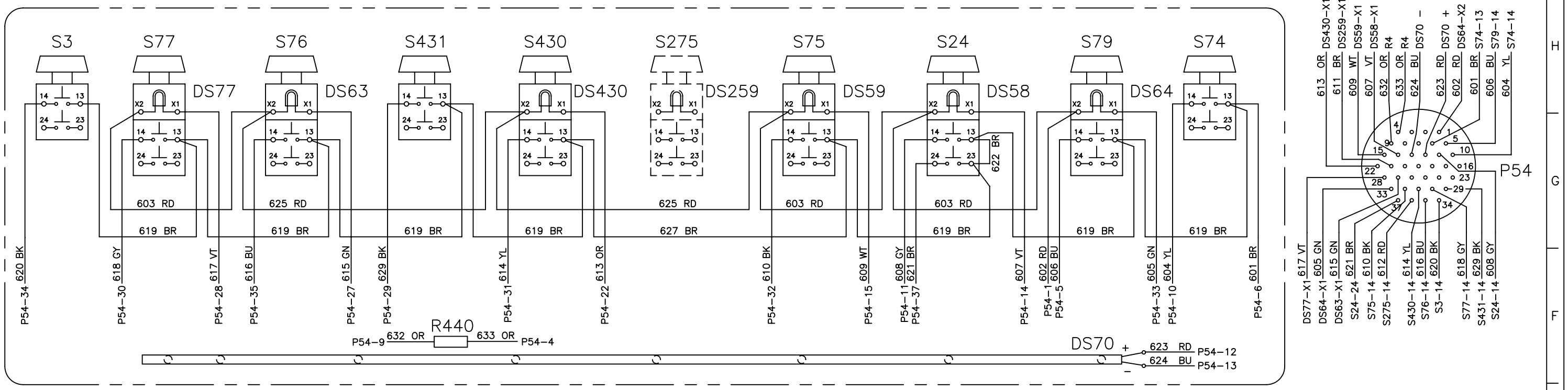
ACTIVITY	REPLACED BY	REPLACES
MATERIAL NO.	QUANTITY-U.M.	COMM. CLS.
MATERIAL SPEC.		

TITLE
DIAGRAM, CONNECTION, SWITCH BOX
DESCRIPTIVE DATA

DESIGNED	DRAWN	DATE	SCALE
RPH	RPH	12/12/03	FULL
CHECKED	APPROVED	RECORDS 02/11/04	ITEM TYPE

HOBART® TROY, OHIO 45373 U.S.A.

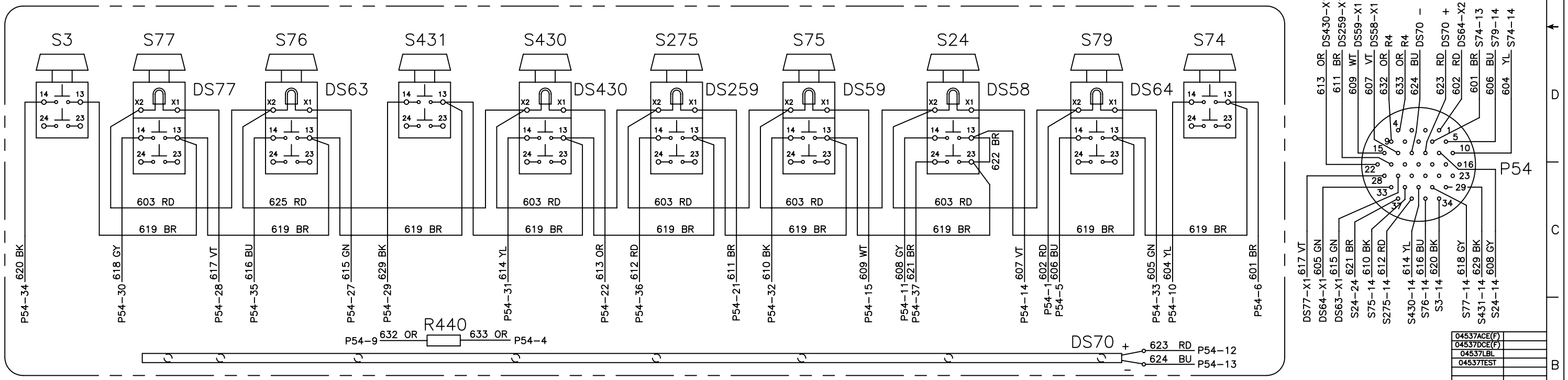
SIZE D | DWG. NO. 289013 | SHEET 1 OF 2



FACING REAR OF SWITCH BOX
1 A.C. & 1 D.C. OUTPUT

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
TB4 — 27 RD — ABOVE OR LEFT OF WIRE



FACING REAR OF SWITCH BOX
2 A.C. & 1 D.C. OUPUT

NOTES:

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

LEGEND

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.
S3	SWITCH, METER SELECTOR
S24	SWITCH, ENGINE START
S74	SWITCH, PUSHBUTTON, LAMPS & FUEL CHECK
S75	SWITCH, PUSHBUTTON, #1 OUTPUT
S76	SWITCH, PUSHBUTTON, ENGINE STOP, DELAYED SHUTDOWN
S77	SWITCH, PUSHBUTTON, TEST/RESET
S79	SWITCH, PUSHBUTTON, PREHEATER
S275	SWITCH, PUSHBUTTON, #2 OUTPUT, (WHEN FURNISHED)
S430	SWITCH, PUSHBUTTON, DC OUTPUT, (WHEN FURNISHED)
S431	SWITCH, PUSHBUTTON, DC, STARTING CURRENT, (WHEN FURNISHED)

DISTRIBUTION TABLE	
04537ACE(F)	
04537DCE(F)	
04537LBL	
04537TEST	
OUTSIDE DISTR.	

CHANGE RECORD	
E.C. No.	DATE
1) RPH	2/12/04
2) 3226AA	4/6/04
3) 3261AA	05/11/04

FINISH CODE PER 910176: NONE

FILE NAME	PLOT DATE
289013S2	05/11/04

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES/MILLIMETERS
TOLERANCES BELOW APPLY EXCEPT FOR VENDOR DESIGNED PARTS AND ITEMS PRODUCED TO RECOGNIZED STANDARDS.
DO NOT SCALE DRAWING.

FRACT. INCH ±	ANGLES ± 3°
DECIMAL–INCH	METRIC
.00 ± .03	0.0 ±0.8mm
.000 ± .010	0.00 ±0.25mm

ACTIVITY	REPLACED BY	REPLACES
MATERIAL NO.	QUANTITY–U.M.	COMM. CLS.
MATERIAL SPEC.		

TITLE
DIAGRAM, CONNECTION, SWITCH BOX
DESCRIPTIVE DATA

DESIGNED	DRAWN	DATE	SCALE
RPH	RPH	12/12/03	FULL
CHECKED	APPROVED	RECORDS 02/11/04	ITEM TYPE

HOBART® TROY, OHIO 45373 U.S.A.

SIZE D | DWG. NO. 289013 | SHEET 2

Appendix A Options / Features

Option/Features Available			
Description	**Part Number**	**Document Number**	**In This Section**
Kit, Ring, Tie-Down	284706	n/a	
*Kit, Low Fuel, Flashing/Non-Flashing Beacon	289208-XXX	n/a	
*Kit, Low Fuel Strobe Beacon	289208-XXX	n/a	
Kit, T-Handle Latch	287546-2	n/a	
Wheel Chocks	287609	n/a	
Kit, Water Heater	287632	n/a	
Kit, CE Certification, Trailer Mount	287589-3	n/a	
Kit, CE Certification, Fixed Mount	287589-4	n/a	
Cable, Aircraft, AC, 4/0, 30 Ft.	402034-2	n/a	
Cable, Aircraft, AC, 4/0, 40 Ft.	402034-3	n.a	
Cable, Aircraft, DC, 4/0, 30 Ft.	402025-3	n/a	
Cable, Aircraft, DC, 4/0, 40 Ft.	402025-4	n/a	
Kit, Fork Lift Pockets	290710-001	n/a	
Kit, Water Heater	288139-3	n/a	
Kit, Cable Tray Roller, 60 CU	288987-2	TO-302	
Kit, Transformer-Rectifier, 28 VDC	Call Factory	OM-2144	
Kit, Meter, Can-Bus	290090	TO-329	
Kit, Plenum	289213	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 60CU24, 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. Liquid fuel, in the form of droplets, may 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.

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.