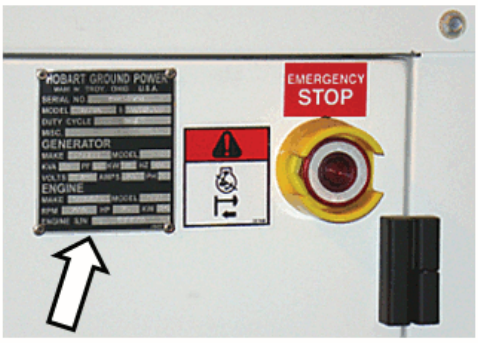
Preventive Maintenance

This is a brief list of replacement filters for 90CU20 (500392E) ground power unit. This is provided, as a quick reference chart for the maintenance technician or diesel mechanic in charge of routine preventative maintenance to the ground power unit.

Generator Model Number

Identify your generator model number by looking on the data plate, which is located on the control box door near the emergency stop.



Filter Part Numbers

The table below lists the filter part numbers for your generator set. You can also order a set of fuel and oil filters as a kit (see page 2).

Filter	Hobart Part Number	Models Where Used
Air Filter	287548	All 500392E specifications
Oil Filter	286897-029	All 500392E specifications
Fuel Filter Element	286897-030	All 500392E specifications
Lubricity/Fuel Water Separator Element	286897-031	All 500392E specifications

Filter Kits

Preventative Maintenance kits are for generator sets with 500 hours of operation from last performed maintenance.

Kit	Hobart Part Number	Models Where Used
Preventative Maintenance Kit *This kit includes:* • *Engine Oil Filter (286897-029)* • *Fuel Filter Element Elements (286897-030)* • *Lubricity / Fuel Water Separator Element (286897-031)*	290300-006	All 500392E specifications

Hobart Ground Power - Supply Contact Information

Hobart Ground Power has a supply staff that is able to help with the quote and sale of parts. Our helpful supply staff is also able to provide delivery information for the customer.

Carla Montoya

Toll Free: 800-422-4166
Direct Line: 937-332-5175
e-mail: cmontoya@itwgsegroup.com

Jim Carine

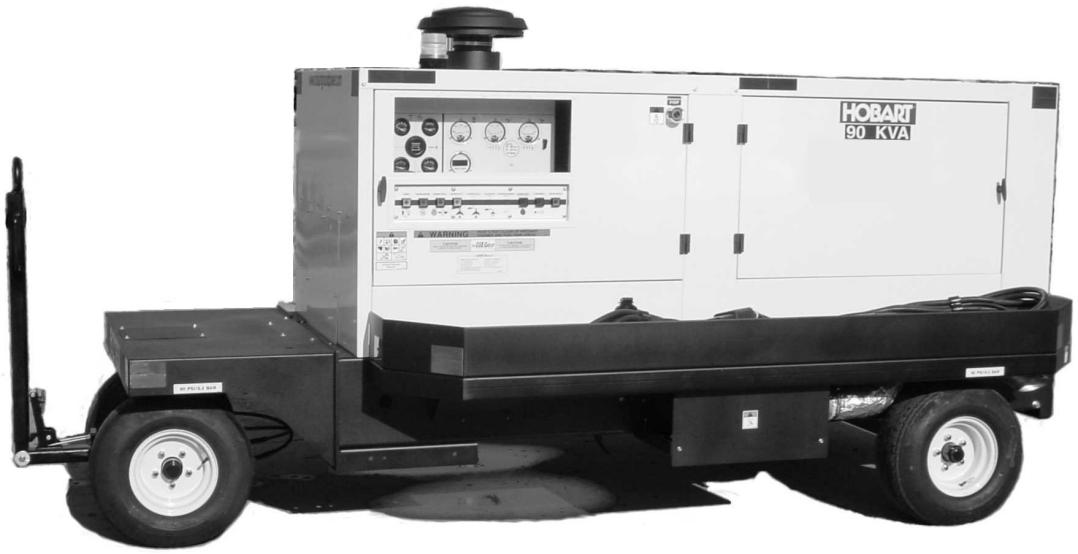
Toll Free: 800-422-4166
Direct Line: 937-332-5173
e-mail: jcarine@itwgsegroup.com

OM-2130C
7/29/11 – Original

HOBART® GROUND POWER

Operation and Maintenance Manual
with
Illustrated Parts List
for
90CU20

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



Series 500392E

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

2) Shock Prevention

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

The electrical resistance of the body is decreased when wet, permitting dangerous currents to flow through it. When inspecting or servicing 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 by electric motors *(rather than by diesel or gasoline engines)* must be installed and maintained in accordance with the National Electrical Code, ANSI/NFPA 70, or other applicable codes. A power disconnect switch or circuit breaker must be located at the equipment. Check the nameplate for voltage, frequency, and phase requirements. If only 3-phase power is available, connect any single-phase rated equipment to only two wires of the 3-phase line. **DO NOT CONNECT** the equipment grounding conductor (lead) to the third live wire of the 3-phase line, as this makes the equipment frame electrically **HOT**, which can cause a fatal shock.

Always connect the grounding lead, if supplied in a power line cable, to the grounded switch box or building ground. If not provided, use a separate grounding lead. Ensure that the current (amperage) capacity of the grounding lead will be adequate for the worst fault current situation. Refer to the National Electrical Code ANSI/NFPA 70 for details. Do not remove plug ground prongs. 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 90CU20, 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.).”

The Appendix is the last section. Its 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.

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

Contents of the manual is 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:	Service Department Hobart Ground Power 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@hobartgroundpower.com
Web Page:	www.hobartgroundpower.com

Table of Contents

Chapter 4 Illustrated Parts List Chapter-Section/Page#

Chapter 1 Description/Operation

Section 1 Description

1) General

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

The number 500392E identifies the "model or series" of the GPU. The part number is followed by a different dash number that separates the basic units available. Table 1 uses the part number to identify the variations covered in this manual.

Part & Dash Number	Mounting	AC Outputs	28.5 VDC Output	Fuel Tank
500392E-001	Trailer	1	--	Stainless
500392E-002	Trailer	2	--	Stainless
500392E-003	Fixed/Truck	1	--	Stainless
500392E-004	Fixed/Truck	2	--	Stainless
500392E-005	Trailer	1	Yes	Stainless
500392E-006	Trailer	2	Yes	Stainless
500392E-007	Fixed/Truck	1	Yes	Stainless
500392E-008	Fixed/Truck	2	Yes	Stainless
500392E-101	Trailer	1	--	Composite
500392E-102	Trailer	2	--	Composite
500392E-103	Fixed/Truck	1	--	Composite
500392E-104	Fixed/Truck	2	--	Composite
500392E-105	Trailer	1	Yes	Composite
500392E-106	Trailer	2	Yes	Composite
500392E-107	Fixed/Truck	1	Yes	Composite
500392E-108	Fixed/Truck	2	Yes	Composite

Table 1: Series 500392E Generator Set Part Number Descriptions

2) Optional Equipment - Appendix A

Chapters 1 through 5 of this Operation and Maintenance Manual identifies only the "stripped down" version of the 90CU20 generator set. A list of optional equipment which make 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, trailers, 28-volt DC power transformer-rectifiers, etc.

3) Orientation

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

4) Special Features

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

a) Protective Monitoring

The protective monitoring system receives signals from the fault sensing 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

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

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) Specifications

a) Physical Specifications

Physical	Basic Unit (Fixed Mount)	With Trailer
Length	105 in. (2667 mm)	150 in. (3810 mm)
Width	45 in. (1143 mm)	77 in. (1956 mm)
Height	52 in. (1321 mm)	62 in. (1575 mm)
Weight (Full of Fuel)	5600 lb. (2540 kg.)	6000 lb. (2722 kg.)
Weight with 28.5 VDC T-R	5900 lb. (2676 kg.)	6300 lb. (2858 kg.)

b) AC Generator Specifications

Output power rating	90 kVA (72 kW)
Output voltage	115 / 200 VAC
Rated load capacity	261 Amps
Frequency	400 Hz.
Power factor	0.8
Duty Cycle	100%
Operating speed	2000 RPM
Overload capacity, both outputs 125% rated load	326 Amps
Output cable size	2/0

c) Generator Protective System Specifications

Condition	Trip Point	Time Delay
Over voltage	126 volts	1-second
	140 volts	160 milliseconds
	180 volts	50 milliseconds
Under voltage	any voltage below 100 volts	7 seconds
Over frequency	420 Hz to 480 Hz	5 seconds
	above 480 Hz	immediate
Under frequency	380 Hz. or less	7-seconds
Output overload	125% load of 90 kVA on either output or	approximately 5 minutes
	125% load of 120 kVA on both outputs combined	approximately 5 minutes
	150% load	30 seconds
	200% load	10 seconds

d) DC Output Specifications (with optional TR unit)

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

e) Engine Specifications

Manufacturer	Cummins Engine Company
Model No.	QSB6.7
Type	6 cylinder, 4 cycle diesel, electronic controlled
Bore and Stroke	4.21 in. x 4.88 in. (107 mm x 124 mm)
Displacement	409 in^3 (6.7 L)
Horsepower	170 hp (127 kW)
Idle speed	1000 ± 50 rpm
High speed limiting	2350 ± 75 rpm
Normal governed speed	2000 rpm
Firing Order	1-5-3-6-2-4
Electrical system	12 VDC
Ground	Negative
Lubricating oil capacity (w/ filter)	16 quarts (15.1 liters)
Coolant capacity system	40 quarts (37.8 liters)

f) Normal Operating Characteristics

Engine oil pressure (warm and at rated speed 2000 RPM)	45 PSI (310 kPa) minimum 50 to 65 PSI (345 to 448 kPA) typical
Engine coolant temperature (normal operation)	180 to 200º F (82 to 93º C)

7) 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 2 and 3 are illustrations showing the location of all major components and sub-assemblies.

a) Basic Engine.

The basic diesel engine is a fuel injection, 6-cylinder, electronically controlled engine rated at 165 horsepower.

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 includes an alternator, voltage regulator, and starter with solenoid switch.

(2) Lubricity Additive Fuel Filter

The fuel filter is a spin-on disposable type, located on the interior bulkhead located in the middle of the unit, on the left-hand side. The fuel filter primary function, other than remove contaminants from the fuel, is to automatically add a lubricity additive to the fuel. Although, the engine manufacturer does not recommend low lubricity fuels, this additive can extends the life of the fuel pump.

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

(3) Oil Filter

The engine oil filter is a spin-on, full-flow type, located on the left 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.

c) Engine-cooling fan

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

d) Factory Installed Equipment

This generator set is modified at the factory by the addition of the following equipment:

(1) Shut Down/Reset device

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

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. It is located on the left side of the generator set near the control box (see Figure 1).

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 230º F (110º 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 12 PSI (82.7 kPA).

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

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

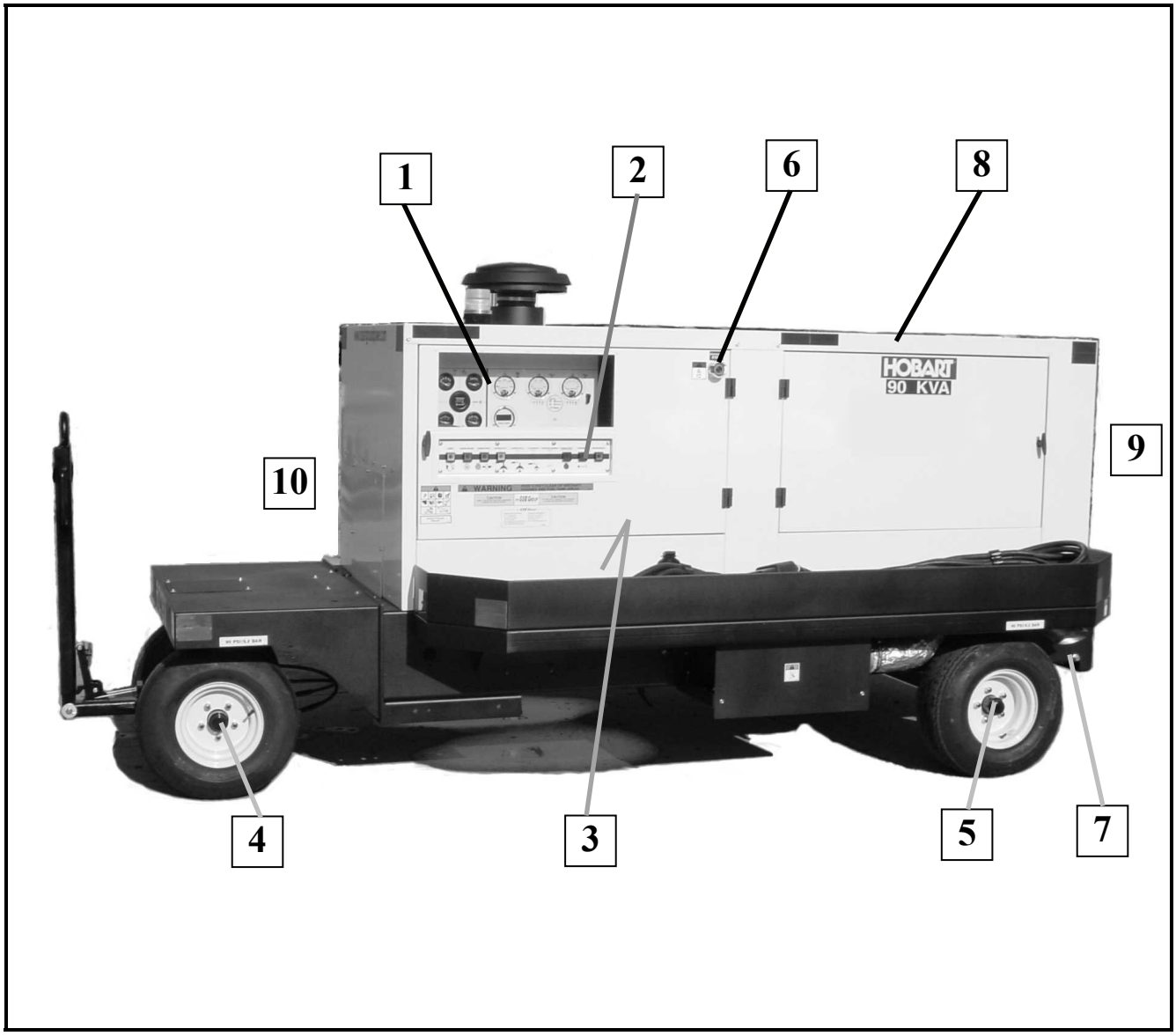
(3) Air Cleaner

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 display to warn the operator that the air cleaner must be changed. The electrical indicator automatically resets when the restriction level drops sufficiently.

e) Engine faults

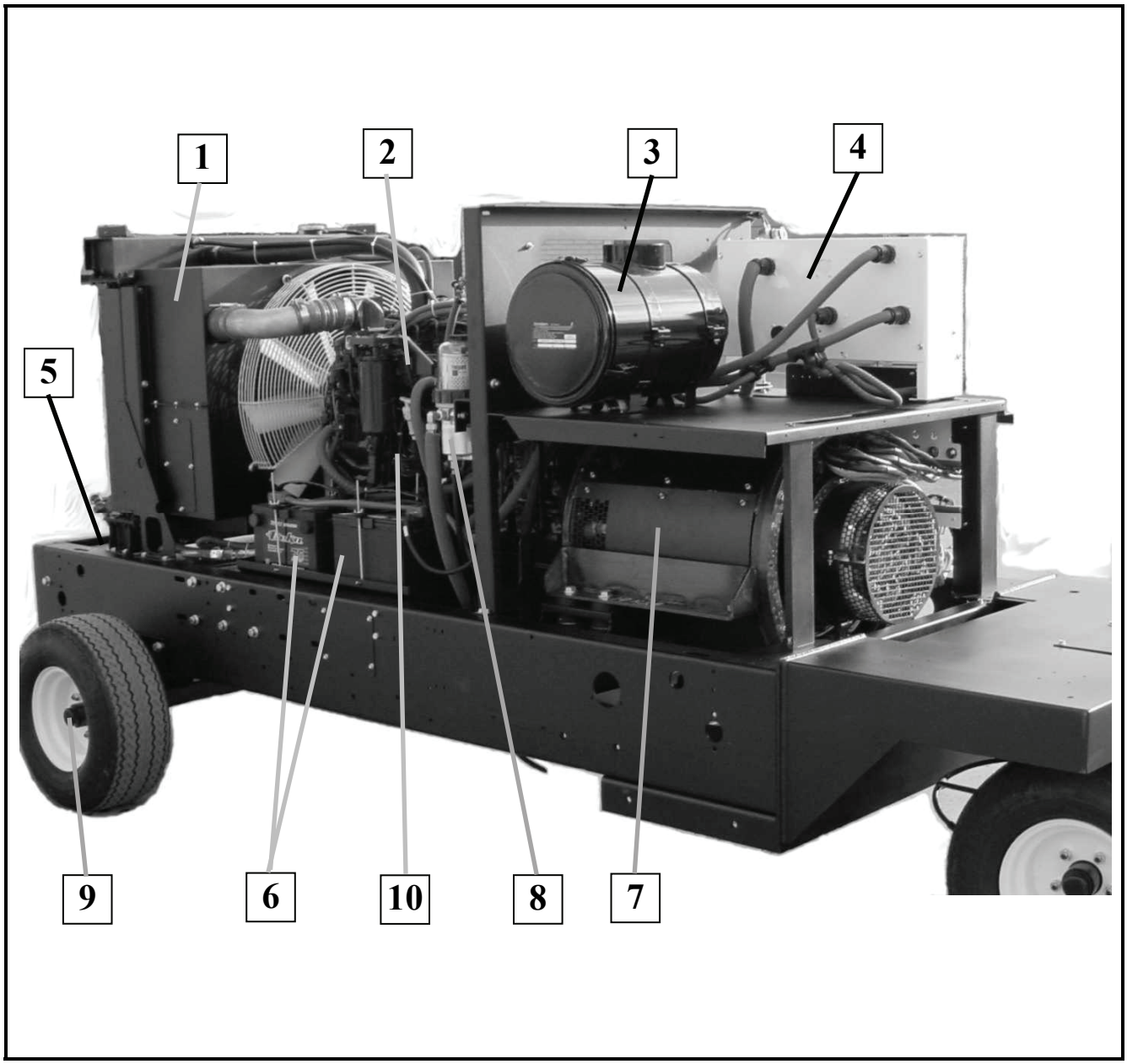
The following is a table listing faults, which may occasionally occur. Column two of the table explains what happens in the engine's circuitry when the fault occurs, and column three tells how to return the generator set to service once the problem is solved. Refer to Chapter 2 for more details on all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

ENGINE FAULTS		
Engine Fault Condition	**What Occurs**	**How To Reset**
Over temperature or low oil pressure	Shuts down the engine, and will be indicated will 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 fuel warning and shutdown	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)** The low fuel fault indicating function must be reset by pressing the engine stop button Fuel must be added prior to attempting another engine start. **b)** Or use E-STOP button for immediate reset.
Clogged air cleaner or other restriction in the combustion air inlet.	Turns on the air cleaner restriction indicating fault code.	**a)** Press the engine stop button. The restriction must be removed prior to attempting another engine start. **b)** Or use E-STOP button for immediate reset.



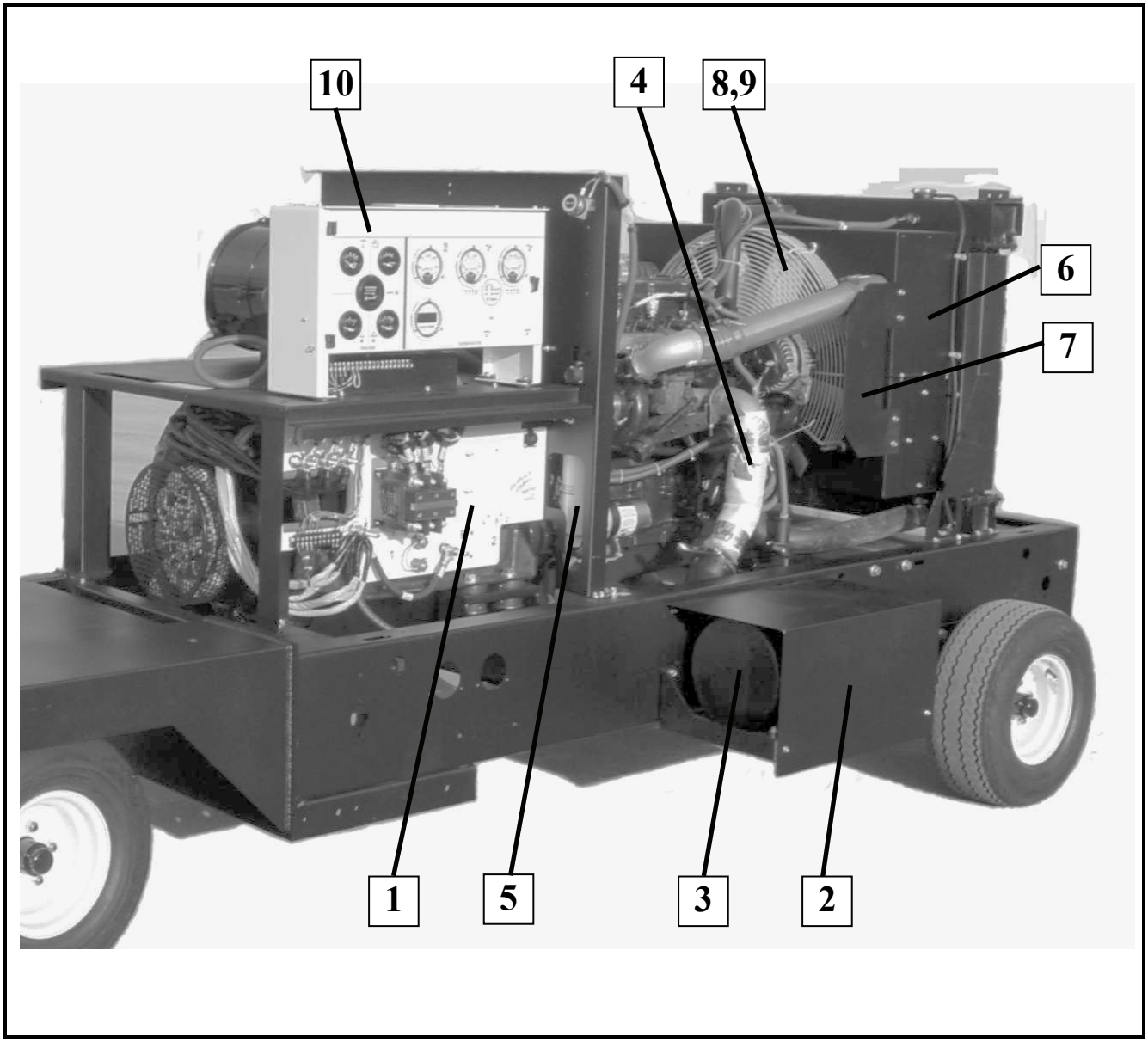
1. Control Panel
2. Operator's Pushbutton Panel
3. Output Cable Location
4. Front Axle Assembly
5. Rear Axle Assembly
6. Emergency Stop Switch (S28)
7. Exhaust Outlet
8. Canopy
9. Charge Air Cooler/Radiator End (Rear)
10. Generator End (Front)

Figure 1: General Assembly of Generator Set



1. Radiator/Charge-Air-Cooler
2. Cummins QSB6.7 Engine
3. Air Cleaner
4. Control Box
5. Fuel Tank
6. 12 VDC Batteries (BT1, BT2)
7. Generator
8. Pre-Fuel Filter
9. Rear Axle
10. Air Intake Heater (BH1)

Figure 2: Main Components of Generator Set (Right Side)



1. Single Output Power Module
2. Exhaust Muffler Shield
3. Exhaust Muffler
4. Exhaust Piping
5. Lubricity Additive Fuel Filter (Not Shown)
6. Top and Bottom Fan Shroud
7. Alternator Fan/Belt Guard
8. Engine Cooling Fan
9. Fan Guard
10. Control Box

Figure 3: Main Components of Generator Set (Left Side)

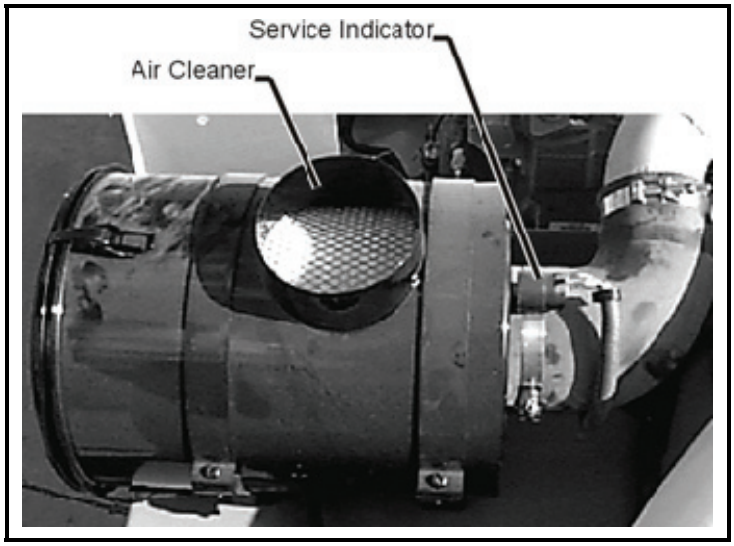


Figure 4: Air Cleaner and Service Indicator

f) Generator

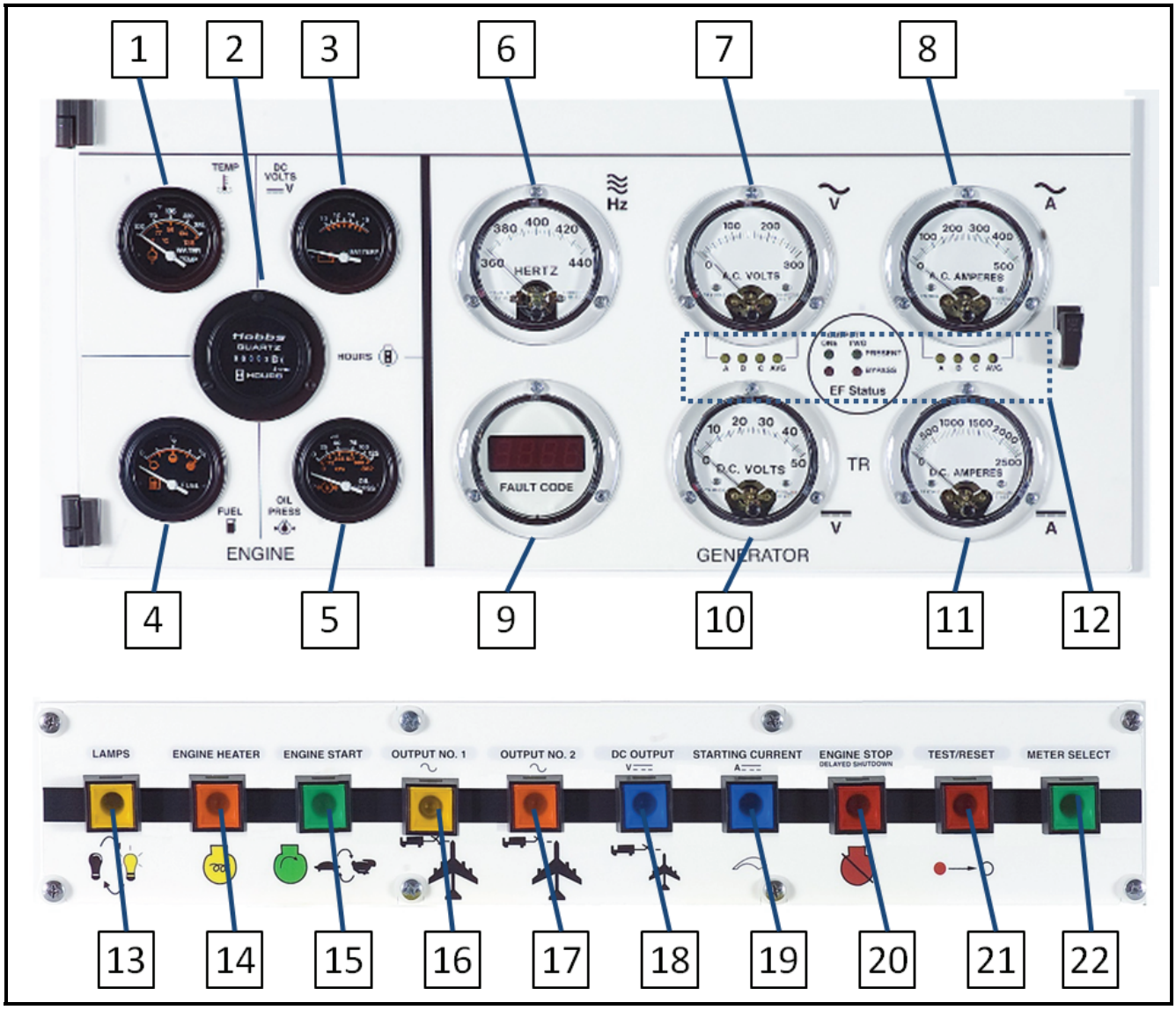
The 400 Hz generator is a brushless, revolving field, three-phase, alternating current type. The generator set covered by this manual is a dual-bearing type. The front end of the rotor shaft extends forward beyond the front bearing and is attached to the engine flywheel by a flexible coupling assembly. 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 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.

8) Control Box Assembly

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

a) Operator Controls

The control system is divided into three sections. On the left side of the control panel, as one faces it, are engine meters. On the right side of the control panel are generator meters. Below the control panel are push-button switches for operating the engine and generator.



1. Engine Coolant Temperature Gauge (M24)
2. Running Time Meter (M4)
3. Battery Voltmeter (M5)
4. Fuel Gauge (M13)
5. Oil Pressure Gauge (M25)
6. Frequency Meter (M3)
7. AC Generator Voltmeter (M2)
8. AC Generator Ammeter (M1)
9. Fault Code Meter (M6)
10. DC Voltmeter *[Optional with TR]*
11. DC Ammeter *[Optional with TR]*
12. Front LED Display (A5)

13. Panel Light Switch (S74)
14. Air Intake Heater Switch (S79)
15. Engine Start Switch (S24)
16. AC Output No. 1 Switch (S75)
17. AC Output No. 2 Switch (S275 if applicable)
18. DC Output Switch (S430) *[Optional with TR]*
19. DC Starting Current Switch (S431) *[Optional with TR]*
20. Engine Stop Switch (S76)
21. Test/Reset Switch (S77)
22. Meter Selector Switch (S3)

Figure 5: Operator Controls

(1) 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.

(2) Engine hour meter (M4)

The hour meter is electrically driven from the 12-volt DC 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 oil pressure gauge (M24)

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

(4) Engine ON indicating light (DS58)

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

(5) Engine coolant temperature gauge

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

(6) "**ENGINE START"** push-button switch (S24)

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

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

(7) **"ENGINE HEATER"** push-button switch (S79)

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

(8) **"ENGINE STOP"** push-button switch (S76)

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

(9) Engine voltmeter (M5)

The voltmeter indicates the voltage across the 12 VDC batteries. It is graduated 10 V to 16 V.

(10) Engine fuel gauge (M13)

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

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

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

(12) Engine systems fault codes

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

(13) AC Generator output monitors (meters)

Three instruments, a frequency meter, a voltmeter, and an ammeter monitor the generator output. 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). The voltmeter indicates the generator output voltage in each phase-to-neutral (A-N, B-N and C-N) or phase-to-phase (A-B, B-C and C-A) as selected by the "**METER SELECT"** switch. The voltmeter has a scale of 0 to 300 V. The ammeter has a scale of 0 to 500 A. The amperage value in each of the three phases may be read on the ammeter by selecting the desired phase with "**METER SELECT"** switch. The ammeter current transformers, located in the output power module circuit, lower the output load current to a lesser value, of definite ratio, which is sent to the Voltage Regulator PC Board (REG). The ammeter dial scale is numbered so that the pointer will indicate the true load current value.

(14) Load contactor indicating lights [Yellow # 1 and Orange # 2] (S75, S275)

Indicating lights within the respective contactor control push-button switches (**"OUTPUT NO. 1"** and or **"OUTPUT NO. 2"**) glow when the circuit is energized, indicating that power is available at the plug. When the load contactor opens for any reason, the light is turned OFF.

(15) Front LED Display (A5)

The front LED display indicates which voltage (A-N, A-B, etc…) and amperage are shown on the meters and whether **"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 any exposed cable may be live.

(16) DC Generator output monitors (meters) *[Optional with TR, Reference Appendix A]*

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.

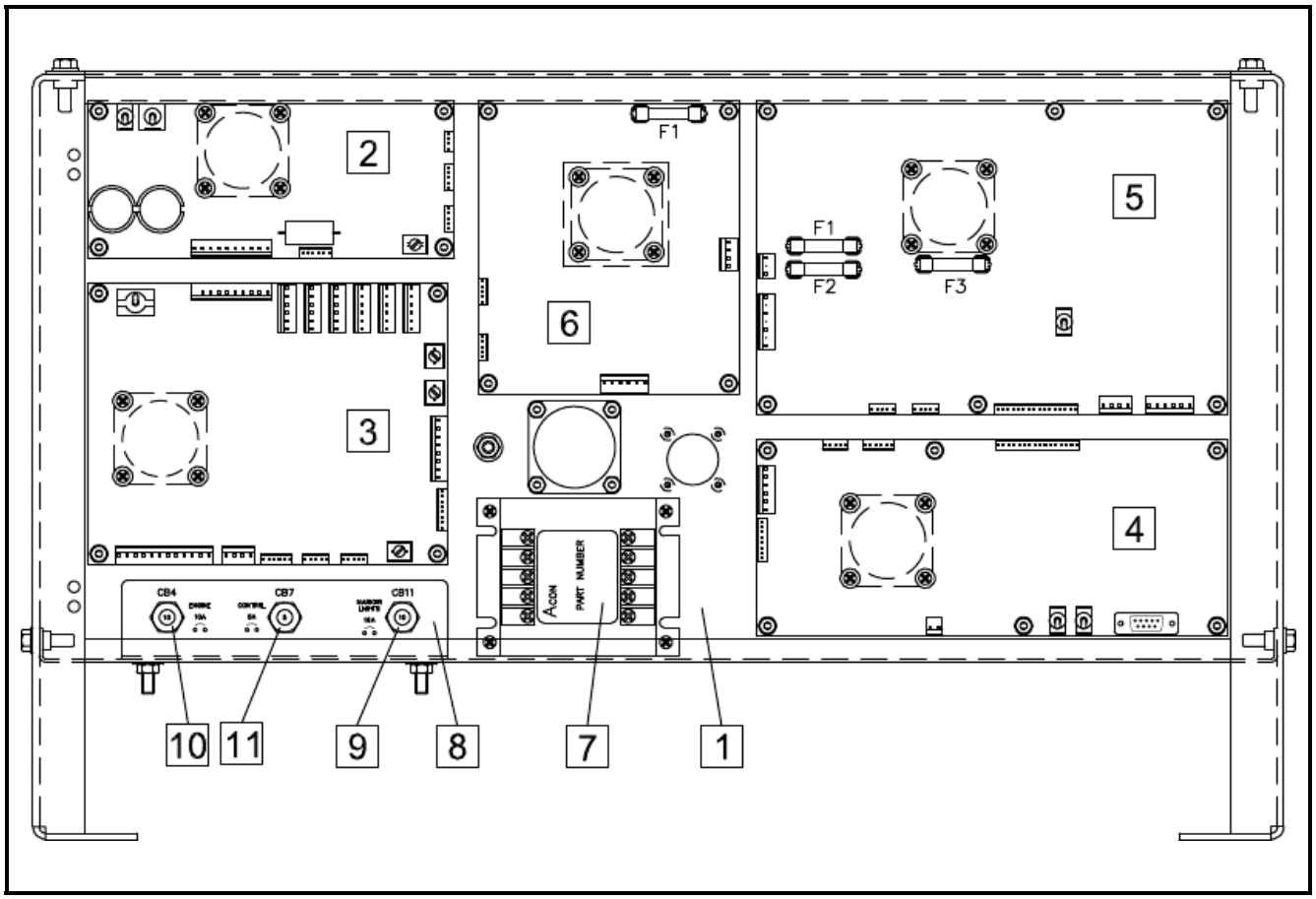
(17) **"STARTING CURRENT"** Switch (S431) *[Optional with TR, Reference Appendix A]*

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

(18) **"DC OUTPUT"** Contactor Switch (S430) *[Optional with TR, Reference Appendix A]*

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

b) Control Box Interior Components



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

Figure 6: Control Box Interior Components

(1) EF Bypass switches (located on CTL)

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

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

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

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

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

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

The digital control PC board is the center for all communications throughout the entire control system. All push-button panel commands run through the digital control PC board, which communicates 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.

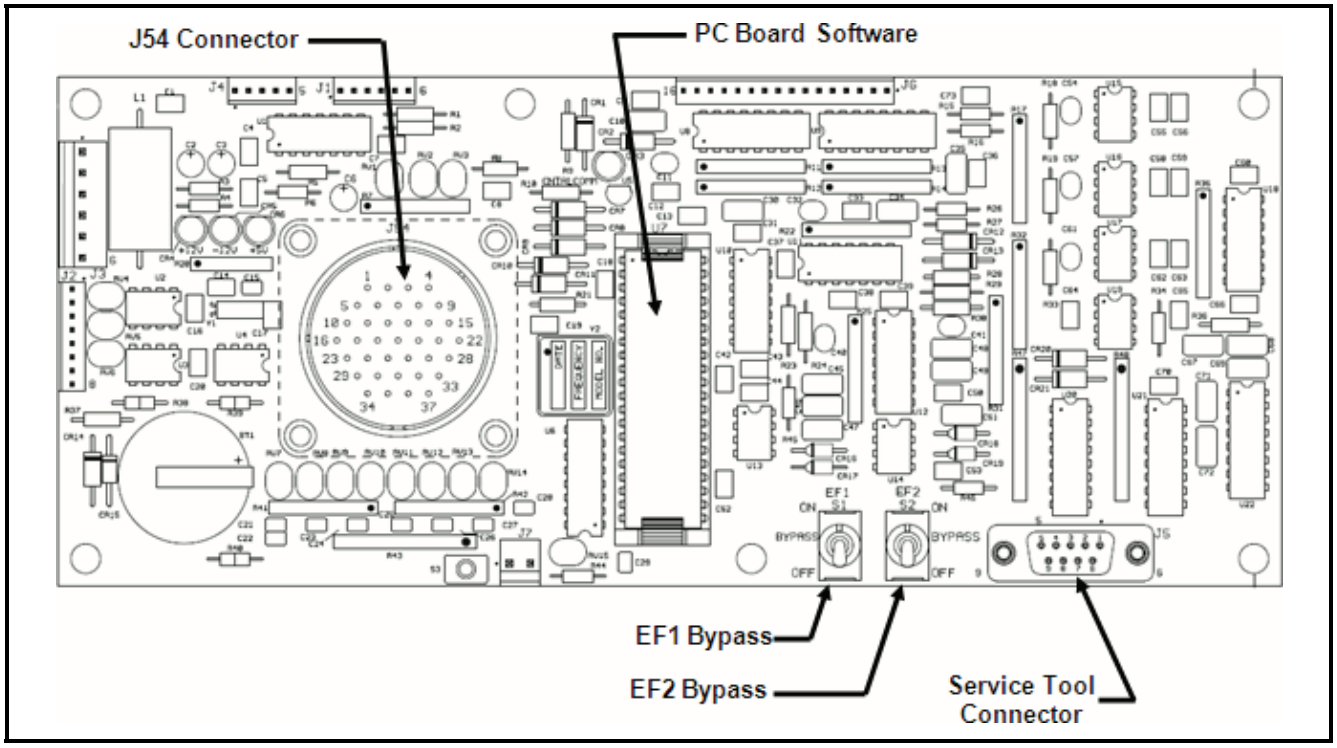


Figure 7: Digital Control PC Board

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

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

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

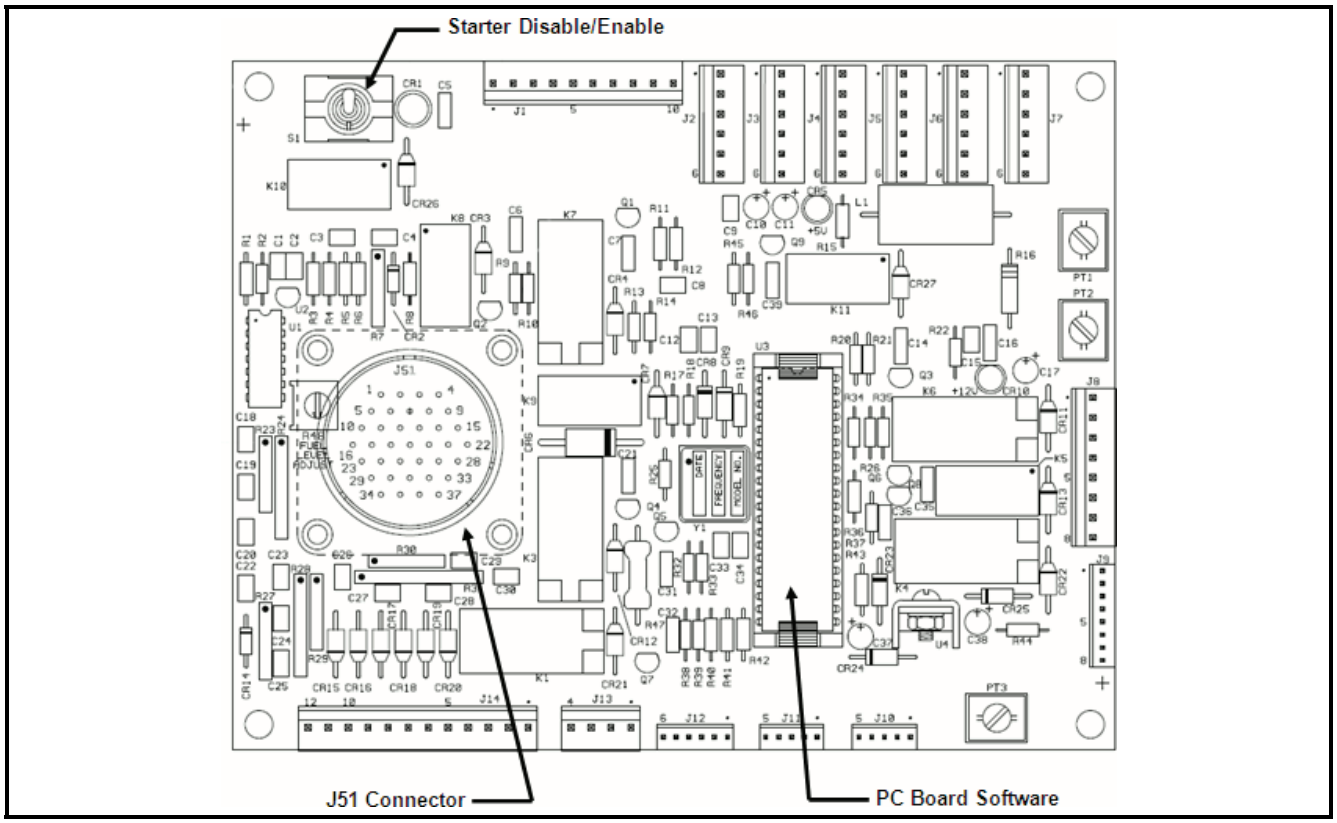


Figure 8: Engine Interface PC Board

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

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

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

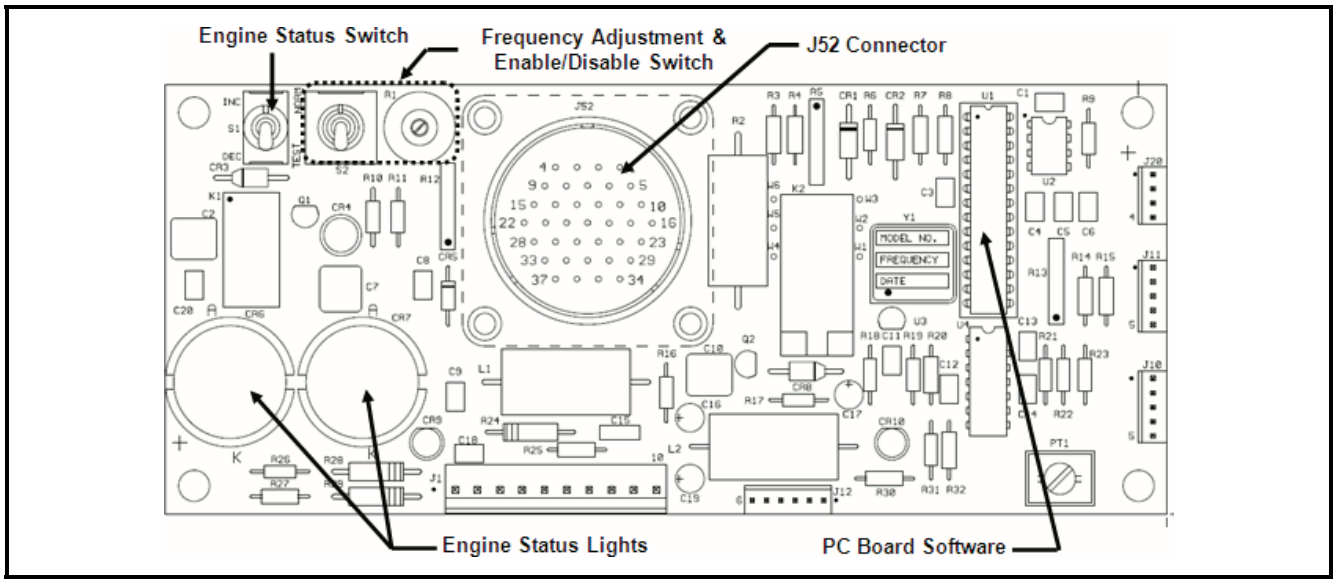


Figure 9: Engine Specific PC Board

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

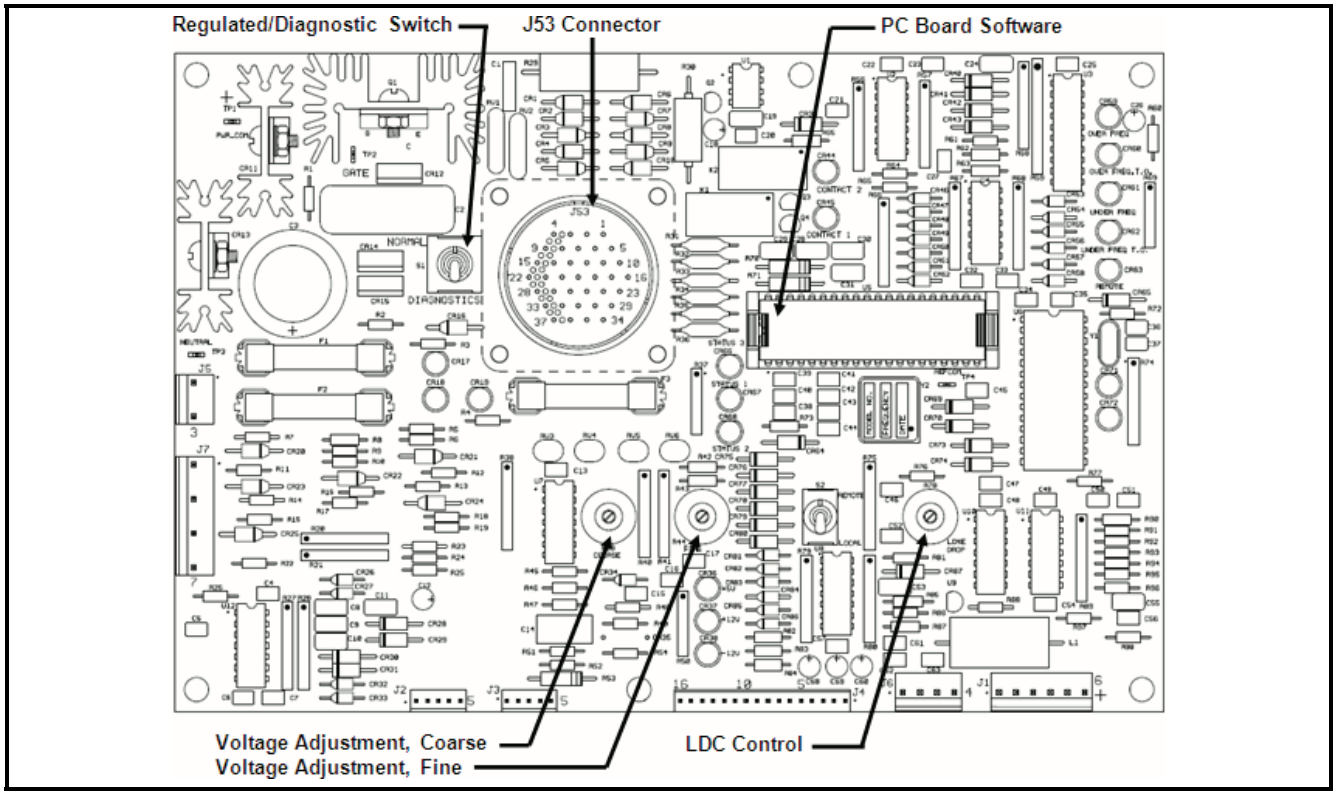


Figure 10: Voltage Regulator PC Board

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

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, 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, lowering the rectified three-phase voltage of the voltage sensing circuit. The sensing voltage is low in respect to its reference voltage, causing the voltage regulator PC circuitry to increase the power to the field of the rotary exciter. The alternator voltage increases until the voltage returns to its regulated value.

c When a load is removed from the alternator, the alternator voltage rises. The rectified three-phase voltage-sensing signal increases, causing this signal to be higher than the reference signal. The associated voltage regulator circuitry causes the field power of the rotary exciter to decrease, lowering the alternator voltage until the voltage returns to regulated value. The line drop voltage compensation circuit consists of a current transformer on each phase of the load circuit, and fixed resistance in parallel with each current transformer. The current transformers 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) Transformer-Rectifier PC Board [TRB] (A404) *{Optional with TR, Reference Appendix A}*

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

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

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

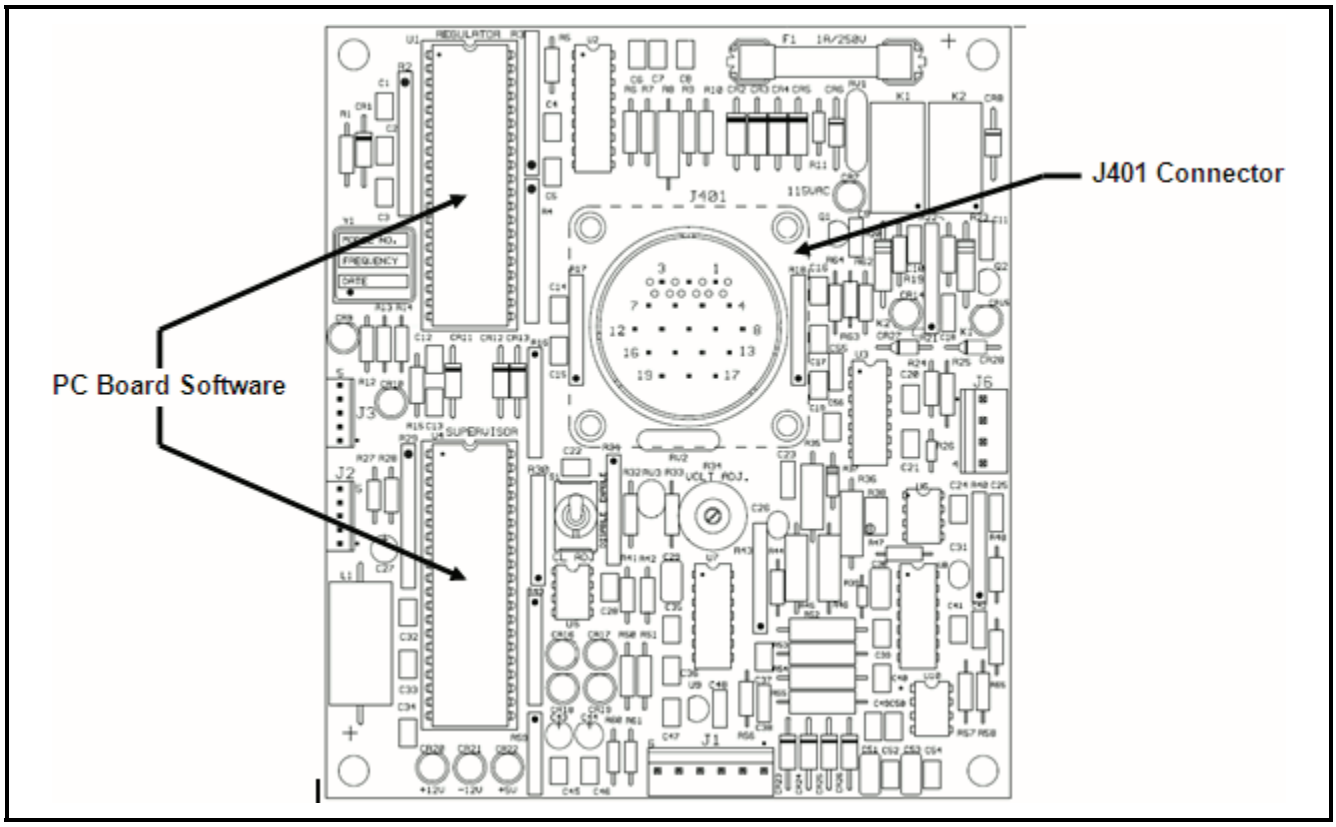


Figure 11: Transformer-Rectifier PC Board

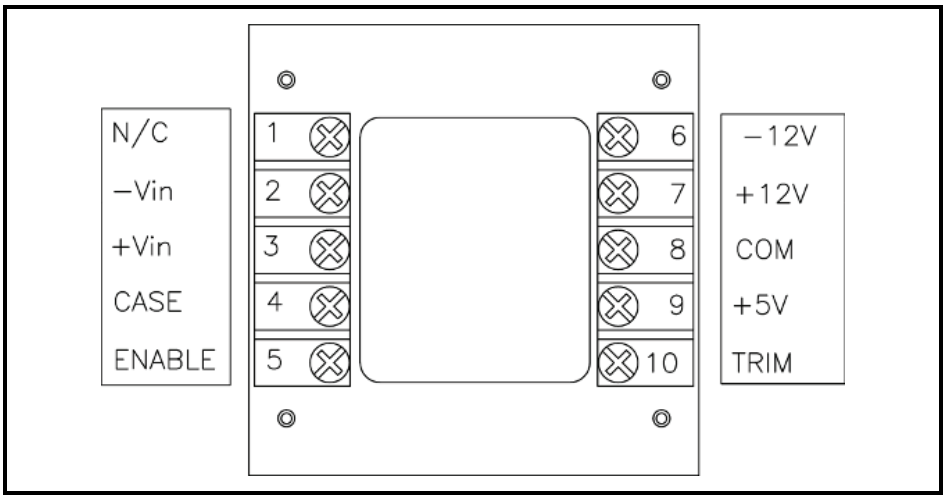


Figure 12: Control System Power Source

9) Power Module Panel Assembly

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

a) Load contactor(s)

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

b) Current transformers (CT1-CT3 or CT1-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 transformers detects the magnitude and power factor of current flowing from generator to load. They feed a signal to the voltage regulator that interprets the signal and alters the exciter field current as required to maintain a constant predetermined voltage at the load.

(2) Ammeter

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

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

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

On each individual output the current transformers converts a current signal to a voltage signal. The voltage signal is sent to the ammeter and to the overload monitoring circuit for that output. The overload monitoring circuit will open the contactors 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.

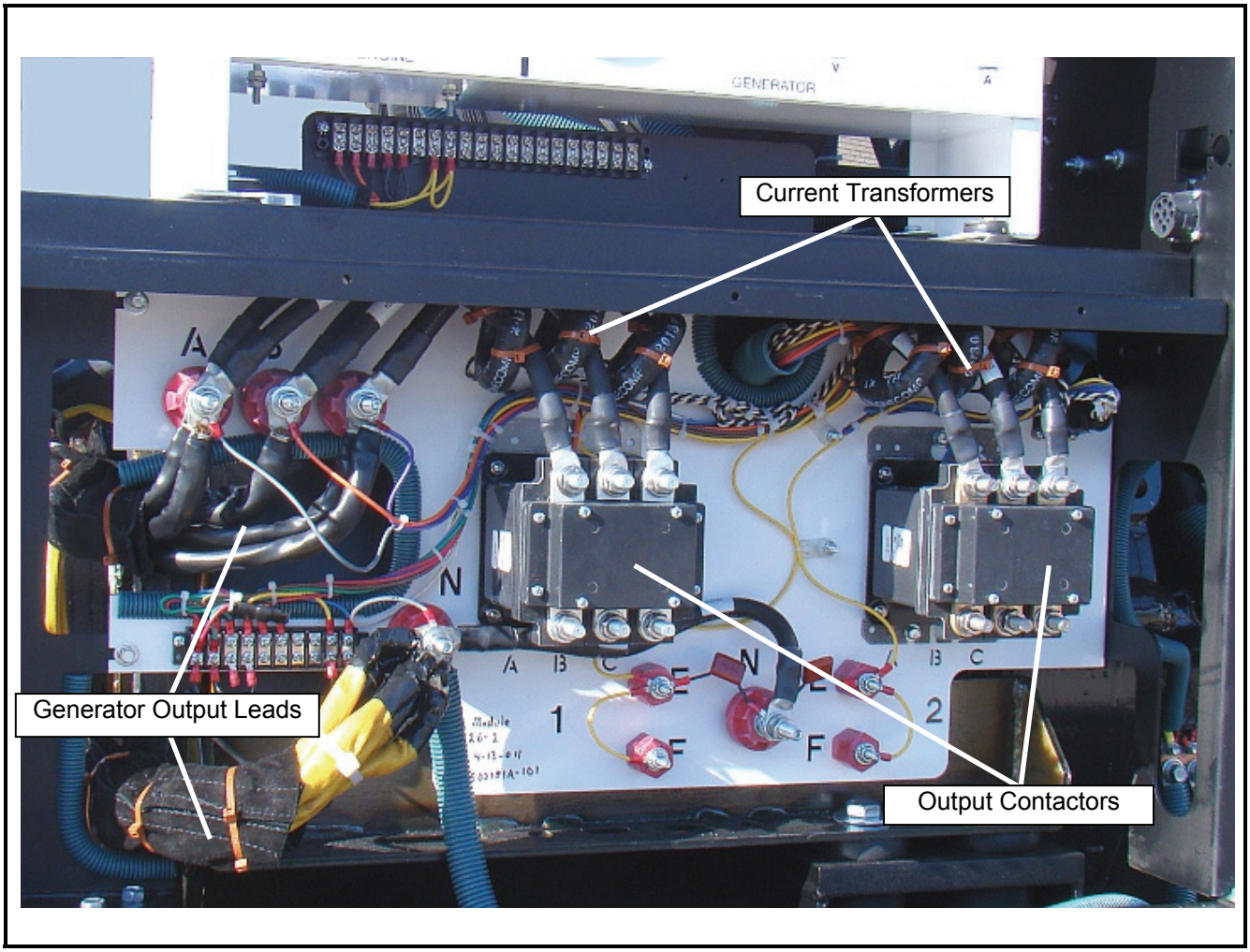


Figure 13: Output Power Module Components

10) Cold Weather Starting System (BH1)

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

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

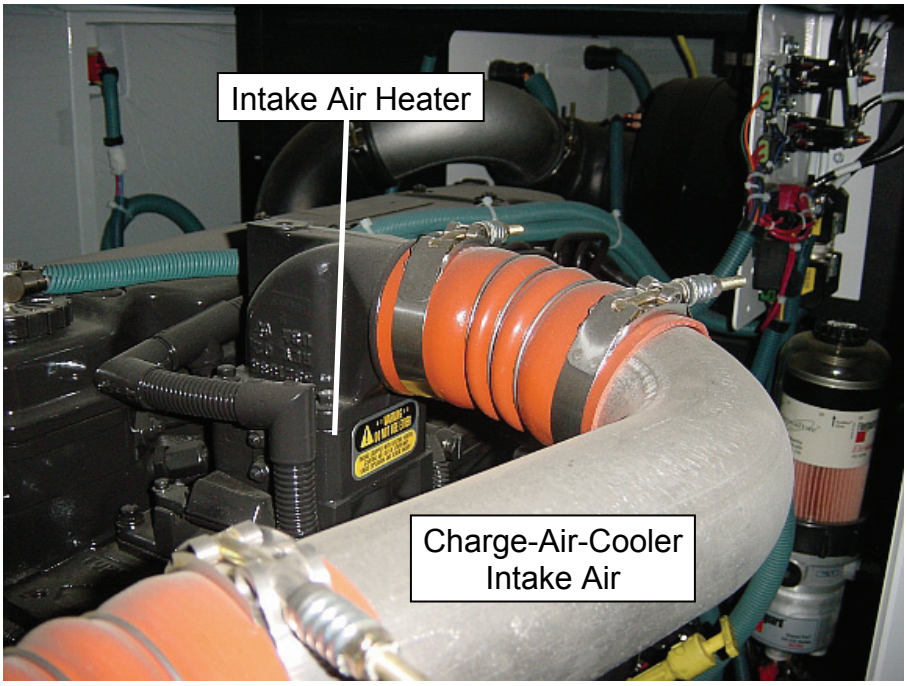


Figure 14: Intake Air Heater

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. Correct any leaks by tightening hose clamps, tube fitting, etc., as required.

(5) Check security of generator set retaining components.

(6) Check the following for sufficient quantity:

a Fuel

Press the **"LAMPS"** push-button button to energize the fuel gauge when the engine is stopped. Fuel is supplied from a customer-furnished source.

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

b Engine coolant

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

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

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

ENGINE OIL AND COOLANT CAPACITIES	
Lubricating oil capacity (w/ filter)	16 quarts (15.1 liters)
Coolant capacity system	40 quarts (37.8 liters)

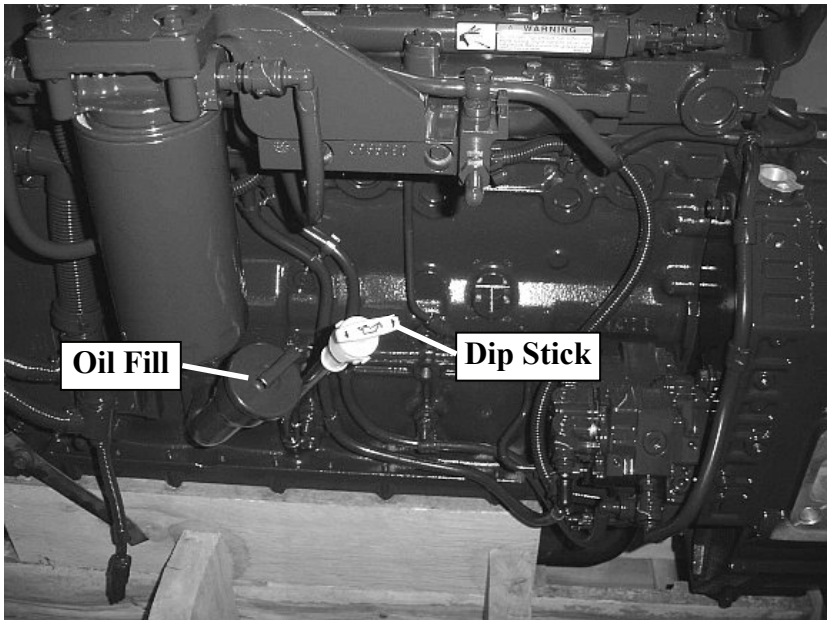
Figure 1

c Engine lubricating oil level

The oil gauge rod has “H” high mark and “L” low-level marks to indicate the operating lubrication oil supply. Oil level should be kept as near the high mark as possible, without going over it. See Figure 1 for capacity.

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

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



Oil Fill and Oil Level Check Locations
Figure 2

d Check Batteries

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

b) Installing Three-Phase AC Output Cables

The generator set may be shipped without aircraft cables. The output cables connect to the load contactors, which are located on the power module assembly (left side of the unit beneath the engine control panel).

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

To install AC output cables proceed as follows:

(1) Open control box door of the generator set and remove the lower panel.

(2) Remove Plexiglas cover in front of the power module assembly.

(3) Remove the cover panel on the cable tray covering the cable clamps.

(4) Loosen screws on cable clamps.

(5) Route cables through cable clamps, and up to the load side of the load contactor(s).

(6) Connect the phase cable terminal lugs to the appropriate terminal studs on the contactor(s): cable lug “A” to terminal stud “A”, “B” to “B”, and “C” to “C”.

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

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

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

(10) Replace Plexiglas cover panel, lower panel, and close canopy door.

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.

(3) Moisture-absorbing chemicals (Hobart 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 (Hobart Part No. 76A-1354-001) in the unit before packaging. The unit may be stored for long periods with no special preparation if it is possible to operate the engine once each week. When starting once a week proceed as follows:

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

WARNING	**ENSURE** adequate ventilation before starting the engine.

(2) Start the engine and operate under full load until coolant temperature has reached at least 176ºF (80ºC).

(3) While the engine is running, ensure that normal operating controls are in good working condition before shutdown and storage. If weekly operation is not possible, contact the nearest engine manufacturer distributor for instructions.

3) Preparation for Shipment

a) Disconnect battery negative terminal before shipping.

b) During long shipments, vibration, jolting, etc may loosen the generator set retaining hardware.

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

NOTE: It is suggested that strong banding be used to secure the generator set, or a strong steel bar be either welded or bolted across the front of the generator set frame.

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.

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.

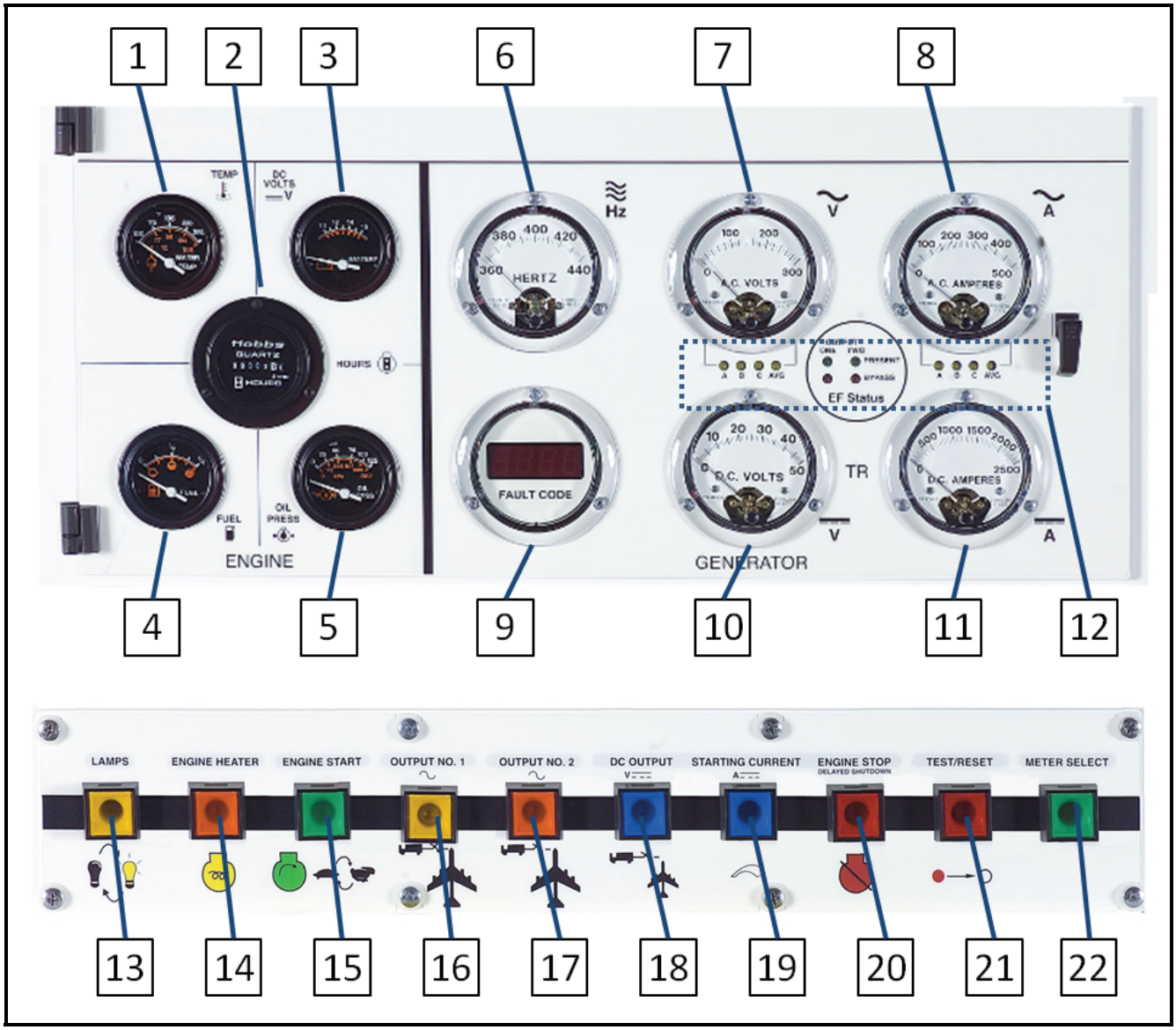
(2) Ensure 12 VDC power is available to the engine starting system.

(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.

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



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3. Battery Voltmeter (M5)
4. Fuel Gauge (M13)
5. Oil Pressure Gauge (M25)
6. Frequency Meter (M3)
7. AC Generator Voltmeter (M2)
8. AC Generator Ammeter (M1)
9. Fault Code Meter (M6)
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11. DC Ammeter *[Optional with TR]*
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17. AC Output No. 2 Switch (S275 if applicable)
18. DC Output Switch (S430) *[Optional with TR]*
19. DC Starting Current Switch (S431) *[Optional with TR]*
20. Engine Stop Switch (S76)
21. Test/Reset Switch (S77)
22. Meter Selector Switch (S3)

Figure 1: Operator Controls

b) Normal Engine Starting Procedures

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

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

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

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

(2) On days when the ambient temperatures are below 60° F, press the **"ENGINE HEATER"** push-button to engage the air intake heater prior to starting the engine. The light in the button will illuminate when the intake heater is engaged (if the light does not illuminate, the engine is ready to start) and will go off when the intake heater is disengaged, thus signifying the engine is ready to start.

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

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

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

CAUTION	If the engine fails to start, the control system will automatically disable the starting motor and indicate a low oil pressure fault. The emergency stop switch must be pressed to reset the control system and allow another starting attempt. If the engine fails to start after four attempts, an inspection should be made to determine the cause. If the engine fires sufficiently to disengage the starter gear, but does not start, allow the starting motor to come to a complete stop before attempting to engage the starter again, then press the start pushbutton switch.

(4) Check oil pressure to make certain that it is normal and observe all other engine instruments for normal operation.

(5) Allow engine to idle and warm for **3 - 5 minutes** before bringing it up to rated speed.

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

c) Failed Starting Procedure

CAUTION	To prevent damage to the starting motor, do not engage the starting motor for more than 30 seconds. Wait two (2) minutes between each attempt to start.

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

(1) Push the red "**EMERGENCY STOP/RESET BUTTON"** on the control box door to the right of the control panel.

(2) Pull the red "**EMERGENCY STOP/RESET BUTTON"** back out before the next attempt to start the generator set.

d) Power Delivery

(1) Press **"ENGINE START"** pushbutton switch a second time to bring engine from idle speed to rated speed. The ECM will immediately increase engine speed to 2000 RPM and maintain it. The voltage build-up will occur automatically. In addition, 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"** pushbutton 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"** pushbutton switch set to any line-to-line position, (A-B, B-C, or C-A), the voltmeter should read 200 volts.

(3) The final step in delivering power is closing one or both of the load contactors. When the instruments indicate satisfactory frequency and voltage values, close either load contactor (or both load contactors) by momentarily pressing the load contactor(s) (**"OUTPUT NO. 1"** or **"OUTPUT NO. 2"**) pushbutton switch. The yellow or orange indicating light of the pushbutton 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"** pushbutton switch to select the either the line-to-line or line-to-neutral voltage. If the load is changing, observe the instruments until load conditions stabilize.

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

(5) A condition of over-voltage, under-voltage, under-frequency, over-frequency, or overload in the output circuit will automatically open the load contactor and display a fault code to signal the operator which of the above 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 pushbutton 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 technicians should work on this generator set.

e) Failed Power Delivery

If the contactor indicating light goes out approximately two seconds after the output pushbutton switch is released, and the fault code meter shows an **EF1** or **EF2** fault code, this indicates that the aircraft is not supplying the 28.5 VDC interlock signal to the plug interlock circuit. Correct the condition and again press the output pushbutton switch.

The "**REGULATED/DIAGNOSTIC"** switch (located on the voltage regulator PC board) must be set to "**NORMAL**" for power delivery.

If the aircraft (or load bank) does not have the 28.5 VDC signal, set the **EF Bypass ON/OFF** switch (located on the digital control PC board) to the "**ON**" position.

See "Load Contactor Operating Circuits" in Section 2-4 for other for additional troubleshooting procedures.

f) Discontinue Power Delivery with Unit Shutdown

(1) Normal conditions

a Push the "**OUTPUT"** (No. 1 or No. 2) pushbutton switch to open the output load contactor. The indicating light (yellow or orange depending on the contactor used) on that 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"** pushbutton switch once to bring the engine down to idle speed. This will begin the automatic shutdown sequence to shut off the engine, gauges, lights, etc., after approximately 3 - 5 minutes.

c Disconnect output cable from aircraft after engine is at idle speed only.

(2) Emergency conditions

a Depress the "**EMERGENCY STOP BUTTON**" located on the control box door to the right of the control panel. When pushed this button instantly shuts the generator set off. Pull the button back out to reset it before restarting the generator set.

CAUTION

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

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

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

Chapter 2 Service and Troubleshooting

Section 1 Maintenance Inspection/Check

1) General

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

WARNING

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

2) Maintenance Schedule

a) General

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

b) Maintenance Schedule Check Sheet

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

c) Time Intervals

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

d) Identification of Interval Periods

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

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

Maintenance Schedule
Figure 1 (Sheet 1 of 2)

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

Maintenance Schedule
Figure 1 (Sheet 2 of 2)

3) Inspection/Check

a) General

See Section 2-2 for detailed maintenance procedures.

See Section 2-3 for adjustment and test procedures.

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

(1) Engine

a Change Air Cleaner

Replace the air filter when the fault code meter shows the "air" code. These filters should not be washed because washing breaks down the material inside the filters.

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

(2) Electrical System (12 VDC) – 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 posts and connectors with a light film of petroleum lubricant before reconnecting cables.

(3) Electrical (400 Hz System) -- Check Output Voltage

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

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

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

(1) Engine

a Check for leaks and correct. This involves an overall inspection of the engine and may require some maintenance if leaks are found. Refer to the engine manufacturer's operations manual for assistance.

b Change all fuel filter elements. Metal shavings from the new fuel tank can clog the filter.

c Change crankcase oil. New engines often release metal shavings more frequently. Therefore, the crankcase oil must be changed as a precautionary measure.

d Change oil filter element. The oil filter should be changed with the oil.

e Check engine and generator mounts to ensure they are properly installed and they have not worked loose. (Torque is set at 122 N-m, 90 ft-lb.).

f Check coolant additive concentration. Refer to the engine manufacturer's operations manual for assistance.

g Steam clean the engine to free it of oil and dirt to prevent uneven engine cooling "hot spots". The oil and dirt can also fall into the engine and fuel system when covers are removed during repair work.

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

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

(1) Engine

a Check Crankcase Oil Level

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

(i) Check oil level daily with oil 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.

b Drain Fuel Lubricity Filter/Pre-Filter Element

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

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

(i) Provide a container for catching drained fuel.

(ii) Open the drain valve on the fuel/water filter by turning it counterclockwise.

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

(iv) Tighten the drain valve.

(v) Safely dispose of drained fuel.

(vi) Purge air from fuel system if necessary.

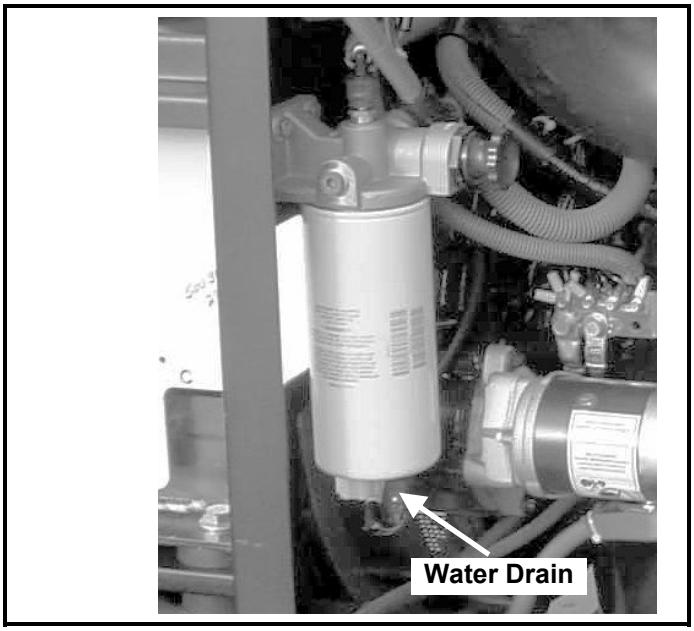
c Check Coolant Level

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

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

d Check for Leaks and Correct

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



Fuel Pre-Filter and Drain
Figure 2

e Check Fault Code Meter

At each daily start-up, observe the fault code meter on the control panel. If the display shows "air", change the air filter. See Section 2-4 for other fault codes.

f Check Exhaust System

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

WARNING

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

(2) Electrical System (12 VDC)

a Check All Lights

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

b Check Engine Battery Voltage

Observe the 12-VDC engine voltmeter each time the engine is started to be sure the alternator is functioning correctly and charging the batteries. If the batteries need to be replaced, be sure the replacements meet the specifications for Cold Cranking Amps (CCA) and Reserve Capacity.

c Check the operation of all the engine meters.

(3) Electrical (400 Hz System)

b Check Output Cables and Connector

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

b Monitoring Instruments

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

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

(1) Engine

a Charge-Air-Cooler and Piping

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

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

b Check and record oil pressure

After each oil change, check and record oil pressure at idle speed after oil has warmed to approximately 140º F. Record oil pressure under identical conditions at each oil change interval. A comparison of pressure at idle speed with previous readings will give an indication of progressive wear of oil pump, bearings, shafts, etc. Investigate any abnormal change in pressure readings.

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.

d Check Fuel Pump

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

(2) Electrical (12 VDC system)

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

Check battery terminals and clean if necessary.

(3) Electrical (400 Hz System)

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

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

(1) Engine

a Check Engine and Generator Mounts

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

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

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

b Change oil and oil filters

c Change all fuel filters.

d Check Coolant Additive Concentration

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

(2) Electrical (12 VDC system)

a Wiring

Inspect all cables and leads for worn or damaged insulation.

b Connections

Inspect connectors for damaged or corroded condition.

(3) Electrical (400 Hz System)

a Protective Monitoring Circuits

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

b Inspect Wiring and Connections

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

c Clean and inspect generally

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

(1) Engine

a Check Fan Hub and Drive Pulley

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

b Check Hose Clamps on Air Intake Side

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

c Check Belt Condition and Tensioner

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

d Check and/or Adjust Valve Clearance

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

e Check Water Pump

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

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

(1) Engine

a Steam Clean Engine

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

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

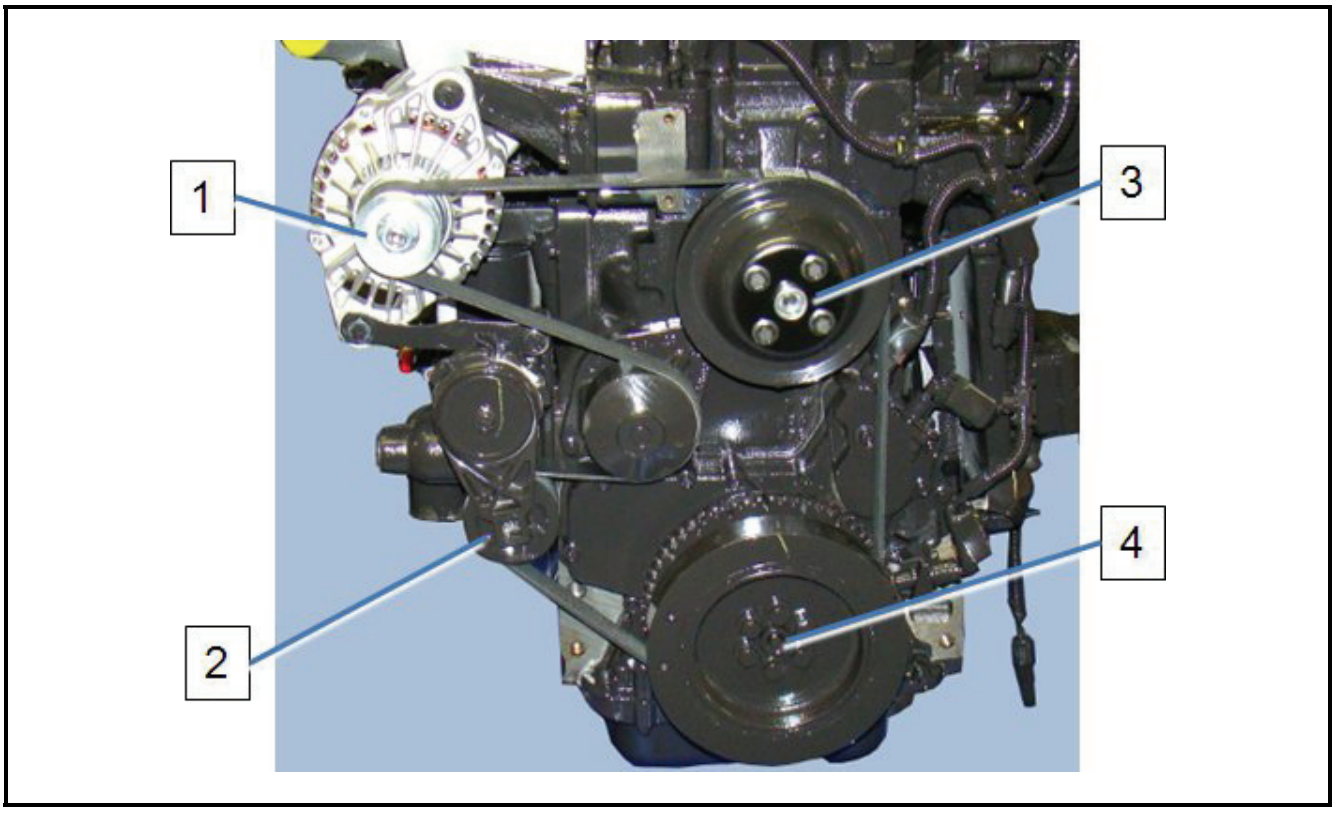
CAUTION	
	1. If a cleaning compound is used, select one that is free from acid and will not remove paint. 2. Protect (or remove) all electrical accessories, such as voltage regulator, alternator, and electrical wiring. 3. Seal all openings. DO NOT use a flammable solvent. 4. **DO NOT** use mineral spirits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

b Clean Fuel System

See engine manufacturer's operation manual for instructions.

c Check Alternator and Cranking Motor.

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



1. Alternator
2. Belt Tensioner
3. Fan Pulley
4. Vibration Damper

Engine Accessories
Figure 3

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

(1) Engine

a Check Vibration Damper.

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

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

b Check Charge-Air-Cooler and Radiator Systems

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

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

c Flush cooling system and change coolant.

j) Seasonal Maintenance Checks Spring/Fall (Engine)

(1) Check Fan Mounting

a Check fan to be sure it is securely mounted.

b Check for fan wobble and/or broken/cracked blades.

c Check fan hub and crankshaft pulley for secure mounting.

(2) Check cooling system each spring and fall. Clean if necessary.

(3) Check All Hoses.

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

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

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

k) Lamps Circuit breakers, and Fuses

(1) Check all lamps daily

(2) Check circuit breakers and fuses as required.

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

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

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

Item Protected	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 (optional)	Inside Control Box	1	10 A

Circuit Breaker Identification Chart
Figure 6

Section 2 Maintenance Procedures

1) General

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

WARNING

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

2) Lubrication

a) General

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

b) AC Generator

The 400 Hz generator requires NO lubrication.

c) Generator Controls

Generator controls and instruments require no periodic lubrication.

d) Engine

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

(1) Lubrication schedule

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

(2) Oil specification

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

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

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

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

(3) Oil viscosity

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

(4) Changing engine oil

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

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

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

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

CAUTION	Do not use solvents as flushing oils in running engines.

Change oil as follows:

a Provide an open container for catching the old oil below the oil drain plug. Container capacity must be greater than 30 quarts (28.4 liters).

b The oil drain tube can be attained though a hole in the access panel underneath the generator set.

c Open drain plug located in oil pan.

Item	Maintenance Required
Lube Oil	Check oil level daily or after every 10 hours of use. Change oil and the oil filter after the first 50 to 150 hours of use, then at 500 hour or 6 month intervals thereafter. Use oil specification API CF-4, HT/HS Viscosity 3.7cP minimum.
Oil Capacity	16 quarts (15.1 liters)
Oil Filter Replacement Part Number	Hobart: 286897-029 Cummins: LF9370
Lube Oil Viscosity Required as per Ambient Temperatures	**VISCOSITY AMBIENT** — **TEMPERATURE CONDITIONS** SAE 15W40 (Preferred) — 0ºF (-18ºC) and above for most climates SAE 10W30 — -10ºF to +50ºF (-23ºC to +10ºC) Winter conditions SAE 5W30 — -20ºF to +50ºF (-29ºC to +10ºC) Arctic Conditions SAE 0W30 — -20ºF and below to +50ºF (-29ºC and Below to +10ºC)
Synthetic Oils	See the engine manufacturer's operations manual for usable synthetic oils and instructions.
Fuel Water Separator/ Lubricity Additive Filter	Drain filters daily. Change filter element every 500 hours or after 3 months of use, whichever comes first.
Coolant	Check coolant level daily. Engine coolant capacity (system): 40 quarts (37.8 liters)
Coolant hoses and connections	Check coolant hoses and connections daily for leaks.
Fan Belt	Check fan belt condition and tension every 500 hours or 6 months of use.
AC Generator	AC generator bearings are sealed and require no periodic lubrication.
Alternator	Alternator bearings are sealed and require no periodic lubrication.
Starter	Starter motor bearings are sealed and require no periodic lubrication.
Water Pump	The water pump is packed at assembly and requires no periodic lubrication.
Fan Hub	The fan hub is lubricated at assembly and requires no periodic lubrication.

Lubrication and Maintenance Chart
Figure 1

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

Lubricants Chart

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

(i) Provide a container for catching spilled oil from the filter.

(ii) Remove the oil filter by twisting counter-clockwise and inspect it.

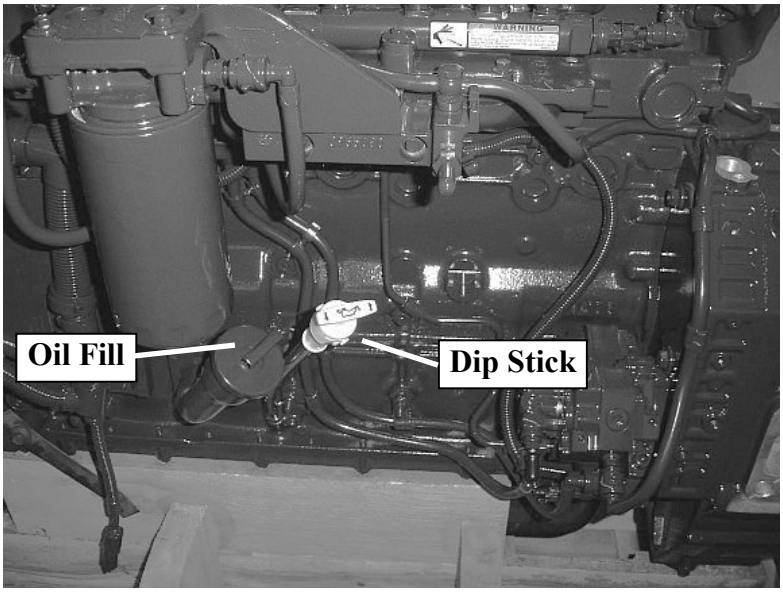
NOTE: The gasket can stick to the filter head. Make sure it is removed before installing a new filter.

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

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

(iii) Fill the new filter with clean lubricating oil before installation.

(iv) Apply a light coating of lubricating oil to the gasket-sealing surface and install the filter. **DO NOT** over tighten the filter.



Lubrication System
Figure 2

e Clean the drain plug and install when engine oil has completely drained. Torque the drain plug to 50 foot-pound (68 Nm).

f Use the oil refill tube to refill the crankcase with new, clean oil that meets engine manufacturer's recommendations.

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

Lubricating oil capacity (w/ filter)	16 quarts (15.1 liters)
Coolant capacity system	40 quarts (37.8 liters)

CAUTION

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

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

h After the engine has been stopped for about 5 minutes, recheck the oil level. Add oil, if required, to bring the level up to the high bar on the oil dipstick.

e) Engine Accessories Lubrication

(1) Alternator

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

(2) Starter

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

(3) Water Pump

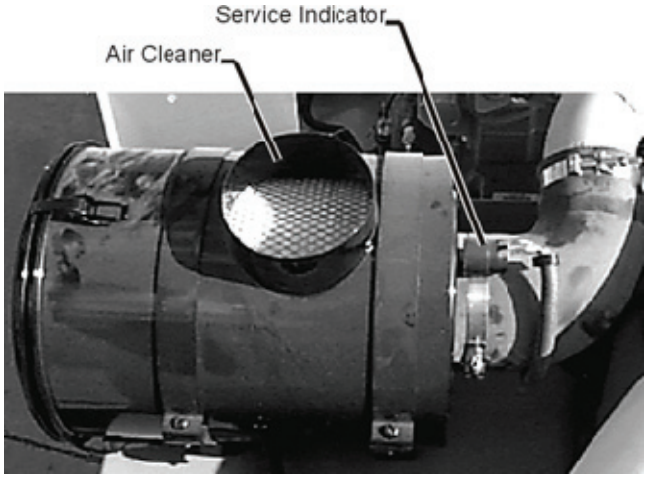
The water pump is packed at assembly and requires no periodic lubrication. Replace pump if signs of lubricant leakage are found.

(4) Fan Pulley

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

3) Servicing the Air Cleaner

This air filter element is a disposable type which, when dirty, may be discarded. A definite time schedule for cleaning or changing the air cleaner cannot be determined because of varying operating conditions. This air cleaner filter can be removed from the air cleaner housing and replaced by unfastening the three metal clamps on the end of the air cleaner housing. Replace the air filter element when the fault code gauge on the operator panel shows the “Air” code.



Air Cleaner Assembly
Figure 3

a) Inspecting the Air Cleaner

(1) Make periodic checks of air cleaner inlet screen for obstructions. If any obstructions are present, remove them.

(2) Check outlet connection for proper seal.

b) Changing the Air Filter

(1) Unfasten the three metal clamps on the end of the air cleaner housing.

(2) Remove end cover of housing

(3) Pull out air filter element and replace.

(4) Replace end cover on housing, making certain that the filter is centered in the housing.

(5) Refasten the three metal clamps on the end of housing.

c) Air Filter Element Replacement Part Number:

- Hobart: 287548
- Donaldson: P18-1028

d) Disposal

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

3) Engine Fuel

a) How to select Fuel—Quality

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

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

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

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

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

b) Cold Weather Operation

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

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

5) Engine Fuel System

The fuel system consists of five primary components: Fuel tank, Fuel Water Separator (Pre-Filter), Fuel Lift Pump, Lubricity Additive 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 in the fuel tank. The fuel tank must be removed and flushed out if objects are found in the Fuel Water Separator

b) Fuel Water Separator

The equipment manufacturer has mounted a fuel water separator on the inner wall of the canopy. Its function is to remove foreign material and extract water from the fuel before it enters the fuel lift pump. Daily draining of the filter water separator bowl is required.

(1) Draining the fuel water separator bowl.

a Open drain valve

b Drain accumulated water and contaminants.

c Close drain valve.

(2) Priming fuel water separator (when applicable).

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 as necessary with the engine off.

(3) Changing the fuel filter.

a The filter element replacement part numbers:

- Hobart : 286897-030
- Cummins: FF5421

b Apply a coating of clean fuel or motor oil to the new O-ring and element seal. Spin the filter onto the fuel filter element.

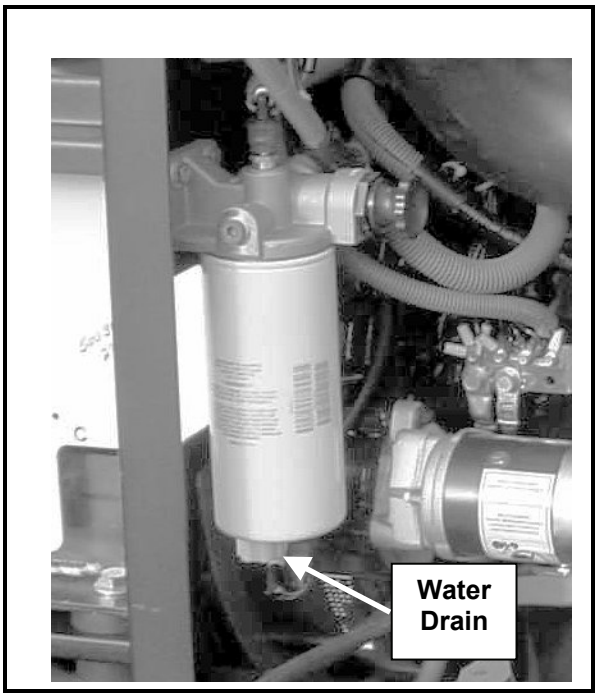
c The fuel filter must be change after every 500 hours of operation.

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 is necessary. Loss in fuel pressure in the fuel line may indicate a faulty fuel pump.

d) Engine Lubricity Additive Fuel Filter

The forth item in the fuel line system is the factory installed lubricity additive fuel filter. The filter's function is to remove foreign material from the fuel and add a lubricity additive into the fuel before it enters the engine's fuel pump. The filament element is a throwaway type in which the case and element are made as one disposable part.



Fuel/Water Separator/Lubricity Fuel Filter
Figure 4

(1) Changing the lubricity fuel filter

a Replacement lubricity filter part number:

- Hobart: 286897-031
- Cummins: FS20022

b The lubricity filter must be change after every 500 hours of operation in order for the fuel filter to continue adding the proper amounts of the lubricity additive into the fuel system.

c Shut off fuel valve.

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

e Undo fuel filter with commercial tool and spin off.

f Catch any fuel.

g Clean any dirt from the filter carrier rim

h Apply a light film of oil or diesel on the rubber seal on the new filter.

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

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.

k Open fuel valve.

e) Fuel Return

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

f) Priming Fuel System (when applicable)

If this generator set has been run out of fuel, the fuel system must be manually primed with diesel fuel up to the fuel water separator before the generator set can be started again. See Paragraph 5 for instructions for priming the fuel water separator system. Once the fuel has reached the fuel water separator, close all open valves (i.e. filter vent plug) and cranked the engine until the fuel reaches the injectors and the engine starts.

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

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

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 (103.4 Kpa).

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

(2) Removal

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

CAUTION	Allow engine to cool before adding coolant.

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

(3) Installation

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

c) Coolant

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

CAUTION	Never use soluble oil in the cooling system.

(1) General

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

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

(2) Selecting antifreeze

a Select a permanent type antifreeze known to be satisfactory for use with chromate corrosion resistor.

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

(3) Checking antifreeze solution

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

d) Draining the Cooling System

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

To drain the cooling system, proceed as follows:

(1) Remove radiator cap.

(2) Place a drain pan with at least a 40 quarts (28.4 liters) capacity under radiator to catch coolant.

(3) Place the radiator drain hose that comes off the two radiator drain valves, into the drain pans.

(4) Open the radiator drain valves.

(5) Allow the system to drain completely.

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

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

e) Flushing the Cooling System

Flushing the cooling system should be a yearly maintenance procedure. Flushing the system forces clean water through the engine block to remove expired coolant and other contaminants.

f) Cleaning the Radiator Core

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

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

g) Filling the Cooling System

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

(1) Install coolant

a Remove radiator cap. Be sure that both radiator drain valves are closed.

b Pour coolant into radiator very slowly until it reaches the bottom of fill neck. Allow time for trapped air to escape from the system then continue filling until the coolant level remains at the bottom of the fill neck.

c Start the engine, bring it up to rated speed, and allow the thermostat to open. Add coolant as trapped air escapes from the system and the coolant level falls.

d Continue to check coolant level until all trapped air escapes. Add coolant if needed to fill to the bottom of fill neck. Install radiator cap.

(2) Inspection/Check

a Check system for evidence of leaks.

b Inspect all hoses. Install new hoses as necessary. Tighten hose clamps as required.

c Check the condition of fan and water pump belts. Replace belts if necessary.

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

h) Thermostat

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

7) Generator Maintenance

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

a) Cleaning

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

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

b) Adjustment

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

8) Drive Belt

a) General

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

b) Preparation for Belt Check and Adjustment

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

c) Checking Belt Tension

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

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

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

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

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

Section 3 Adjustment/Test

1) General

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

IMPORTANT	In order to perform most of the following tests, a load bank with an EF interlock circuit is required. 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 cables from the generator output terminals to a load bank. Use cables of the same size and length as those used in service. Be sure the generator output N cable is grounded.

(2) Check engine oil level. Oil should be at high bar on the dipstick.

(3) Check radiator coolant level (See Section 2-2).

(4) Check tension of drive belt (See Section 2-2).

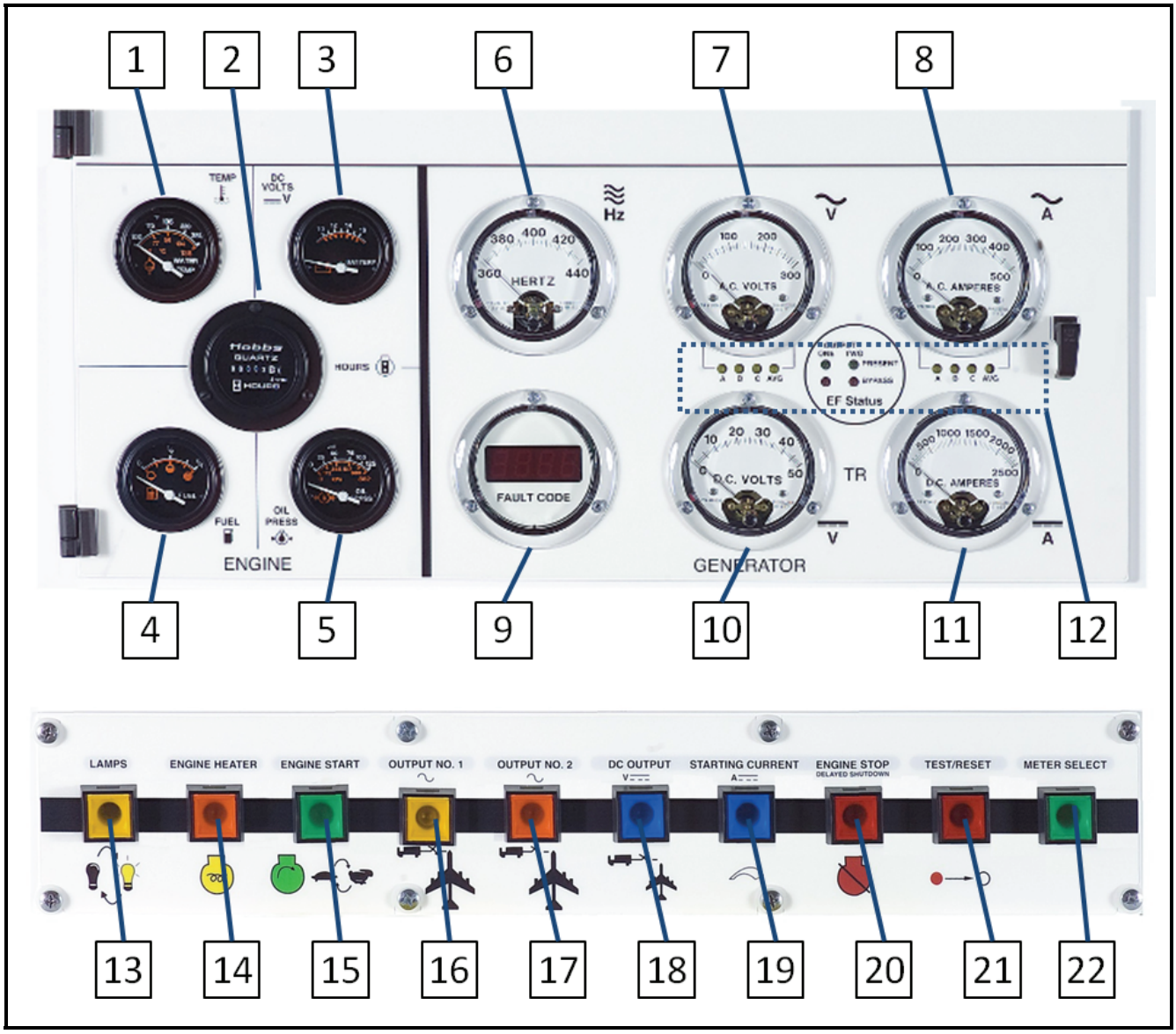
(5) Inspect for oil, fuel and coolant leaks.

(6) If the setting of the output voltage coarse adjustment potentiometer (Figure 7) on the voltage regulator has been disturbed, set it at center position (halfway between full clockwise position and full counterclockwise position).

(7) Check control panel lights circuit breaker (Figure 2) by pressing panel "**LAMPS**" push button switch (Figure 1). If panel lights operate, the circuit breaker, switch, and lamps are good.

(8) Check fault indication lights by pressing "**TEST/RESET**" push button switch. If fault code display lights up, the control circuit breaker is good.

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



1. Engine Coolant Temperature Gauge (M24)
2. Running Time Meter (M4)
3. Battery Voltmeter (M5)
4. Fuel Gauge (M13)
5. Oil Pressure Gauge (M25)
6. Frequency Meter (M3)
7. AC Generator Voltmeter (M2)
8. AC Generator Ammeter (M1)
9. Fault Code Meter (M6)
10. DC Voltmeter *[Optional with TR]*
11. DC Ammeter *[Optional with TR]*
12. Front LED Display (A5)

13. Panel Light Switch (S74)
14. Air Intake Heater Switch (S79)
15. Engine Start Switch (S24)
16. AC Output No. 1 Switch (S75)
17. AC Output No. 2 Switch (S275)
18. DC Output Switch (S430) *[Optional with TR]*
19. DC Starting Current Switch (S431) *[Optional with TR]*
20. Engine Stop Switch (S76)
21. Test/Reset Switch (S77)
22. Meter Selector Switch (S3)

Figure 1: Operator Controls

b) Operational Test Procedures

(1) Start the engine according to the instructions in Section 1-3.

(2) Check operation of engine instruments; voltmeter, coolant temperature indicator, oil pressure gauge and hour meter (all shown in Figure 1).

(3) Check engine idle speed. Should be 1000 +/- 25 RPM.

NOTE: A stroboscope may be required for this check.

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

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

a Place regulated-diagnostic switch (Figure 7) in "**REGULATED**" position.

b Place EF Bypass switches (Figure 3) in "**BYPASS / OFF**" position.

c If the output voltage coarse adjustment potentiometer on the voltage regulator has been disturbed, place the knob at mid-range position.

(6) Bring the engine up to rated speed, which also energize the generator, by pressing the "**ENGINE START**" push button switch a second time. If the engine comes up to rated speed and a 115 V voltage value appears on the voltmeter, the engine ECM and excitation circuits are functioning.

(7) After generator overhaul or repair, the Regulated/Diagnostic switch must be placed in the "**DIAGNOSTIC**" position for 3 to 5 seconds to re-magnetize the exciter. Then return the switch to the "**REGULATED** "position after voltage has built-up.

(8) Observe frequency meter. If engine speed is properly set, frequency should read 400 Hz.

(9) Observe voltmeter. Use output fine voltage coarse adjustment potentiometer (Figure 7) to adjust voltage to 115 V AC.

(10)Check adjustable voltage range.

a Observe voltmeter and turn output voltage coarse adjustment potentiometer to full clockwise position. Maximum voltage should be 134 volts or higher.

NOTE: If voltage should decrease when regulator potentiometer is turned clockwise, it indicates that internal wiring in the voltage regulator is incorrect. Replace complete voltage regulator assembly.

b Observe voltmeter and turn regulator potentiometer knob to full counterclockwise position. The minimum voltage should be 95 volts or lower.

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

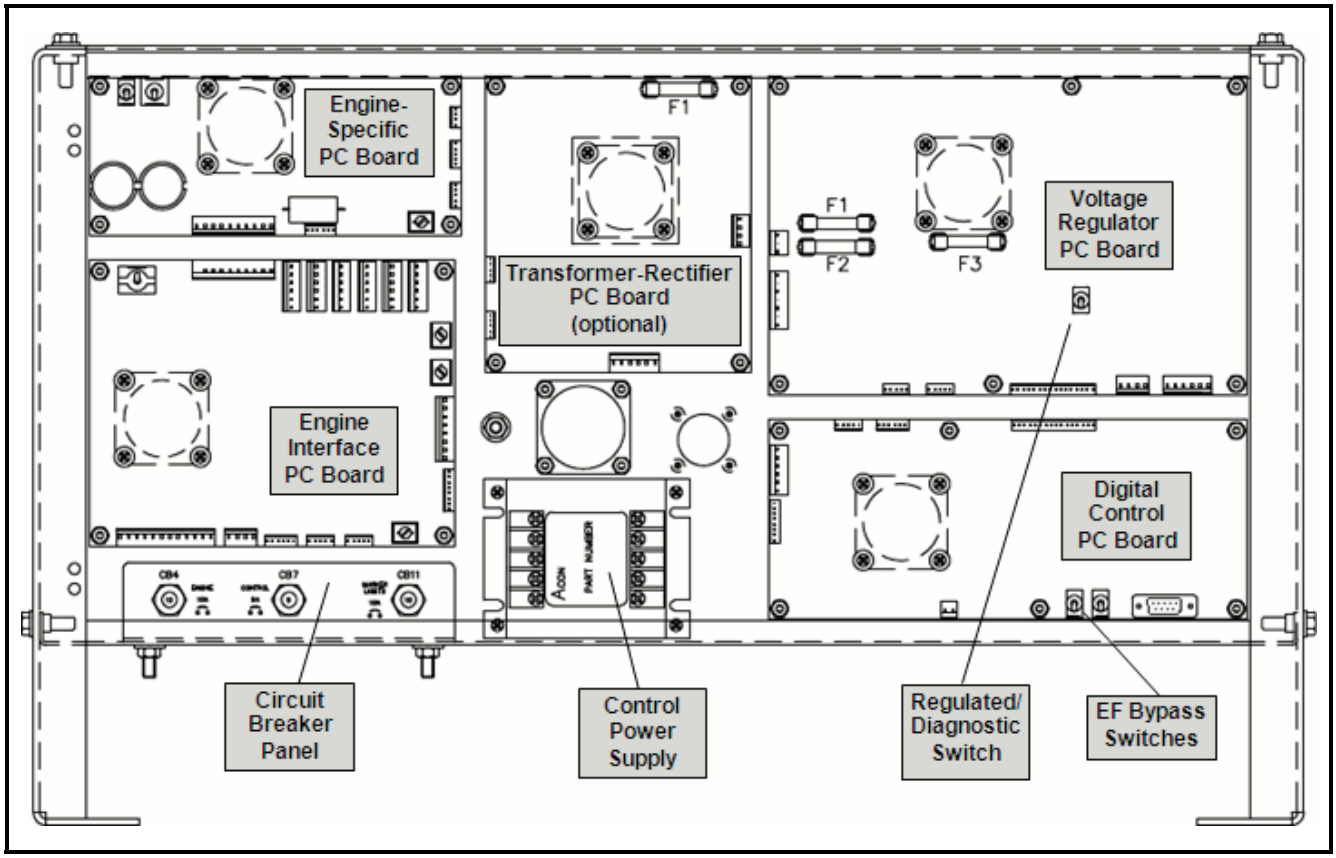


Figure 2: Control Box Interior Components

c) Testing the No. 1 Output Circuit

(1) Place the EF Bypass switch in "**BYPASS / OFF**" position and turn the EF signal "**ON**" on the load bank. Then press the yellow No. 1 load contactor push button switch to close contactor, which is indicated when its internal indicating light glows.

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

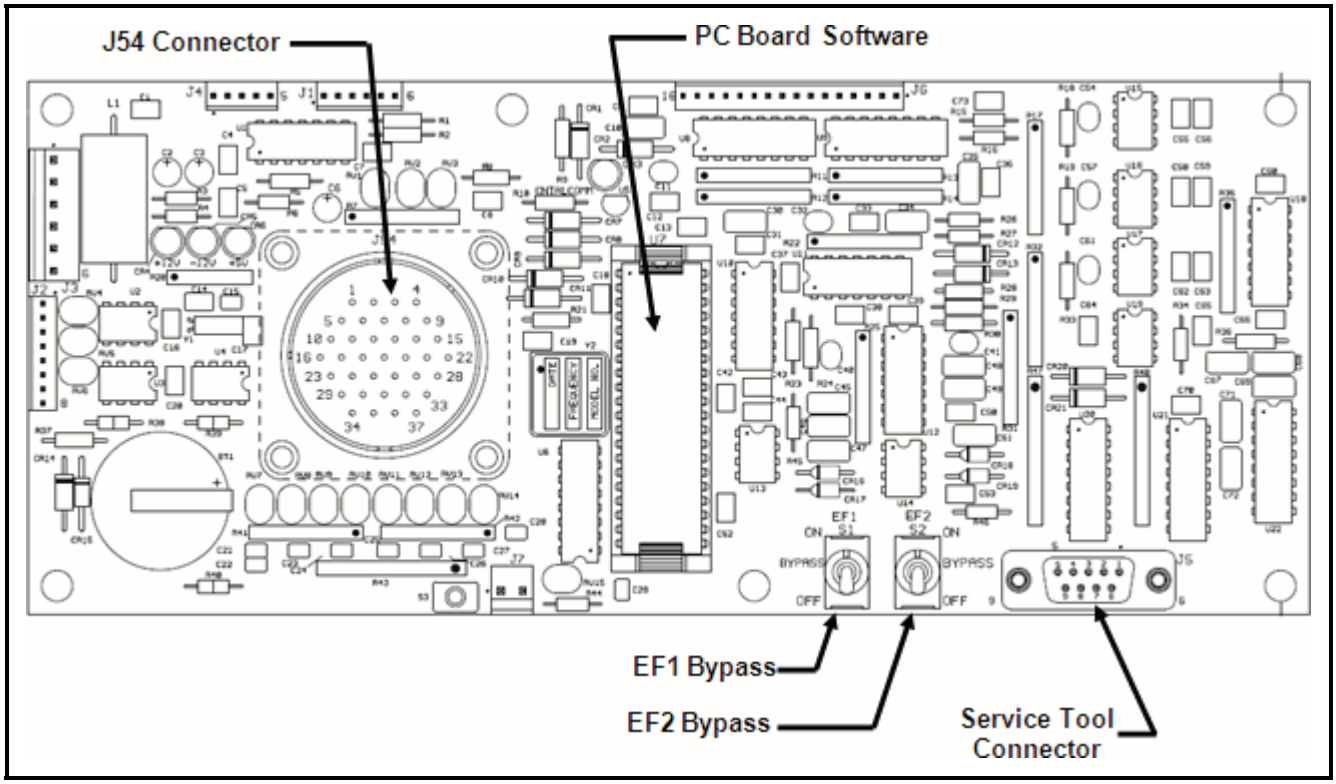


Figure 3: Digital Control PC Board

(3) Verify that when the EF Bypass switch is in the "**BYPASS / ON**" position or the "**BYPASS / OFF**" position, that the appropriate LED indication on the control panel display (Figure 4) is correct.

(4) Place EF bypass switch (Figure 4) in "**BYPASS / ON**" position. Press the No. 1 load contactor push button switch. The No. 1 contactor power indicating light within the push button switch should glow and remain on when the push button switch is released. This indicates that EF bypass switch is functioning correctly. The corresponding LED should also indicate the bypass mode.

(5) Place the No. 1 EF bypass switch to "**BYPASS / OFF**" position. The No. 1 load contactor should open at once and the yellow indicating light within the No. 1 load contactor push button switch should go off and the fault code display should also read "**EF 1**", indicating a EF warning. The corresponding LED should also indicate the EF present mode. Reset the fault by pressing the "**TEST/RESET**" push button.

(6) Proceed to step 12.

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

(7) Connect a source of 24 VDC power (two twelve-volt batteries connected in series) to terminals N, F (or E) at the output terminal panel. Connection polarity is important. Connect plus (+) to terminals E or F, and minus (-) to terminal N.

(8) Verify that when the EF Bypass switch is in the "**BYPASS / ON**" position or the "**BYPASS / OFF**" position, that the appropriate LED indication on the control panel display (Figure 5) is correct during the following steps 9 and 10.

(9) Place the No. 1 EF bypass switch to "**BYPASS / OFF**" position. Press the No. 1 Output pushbutton switch. The No. 1 Output indicating light, within the push button switch, should glow and remain on when the push button switch is released. This indicates that the load contactor is closed and the plug interlock circuit is functioning properly.

(10) Disconnect the 24-VDC power source and the No. 1 load contactor should open immediately, and the indicating light within the push button switch should go OFF. The fault code display should also read "**EF 1**", indicating an EF warning. This is because the interlock circuit of the control PC board is not receiving 28.5 VDC signal from an outside source. It indicates that the No. 1 interlock circuit is OPEN, as it should be when the interlock circuit is not receiving a 28 VDC signal. Reset the fault by pressing the "**TEST/RESET**" push button.

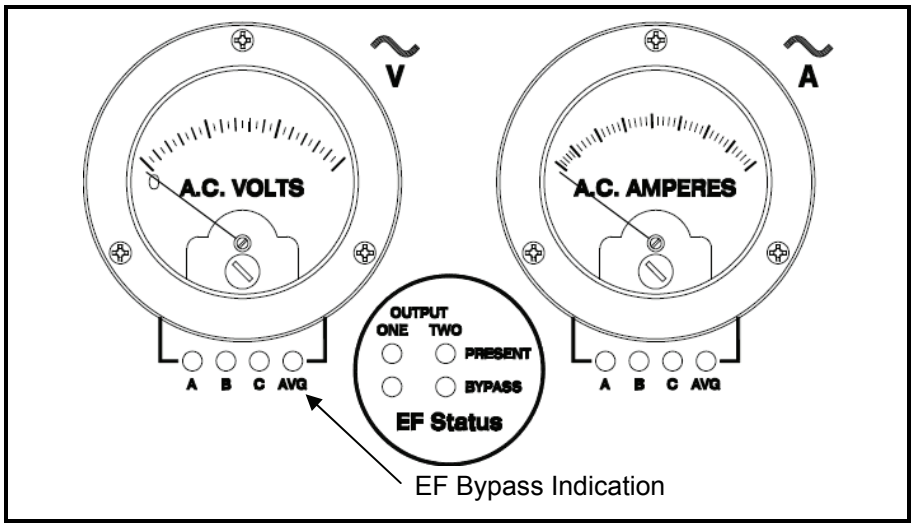


Figure 4: EF Bypass Indication

(11) In EF bypass mode, apply 1/3 to 1/2 load at the load bank and allow the unit to run for 15 to 30 minutes. Observe operation of all monitoring instruments.

(12) Increase load at the load bank to full load.

(13) Check operation of the engine ECM by observing the frequency meter when generator is switched from no load to full load, and vice versa. Use the No. 1 contactor control push button switch to apply and remove load several times. Steady-state frequency droop should be no more than 1 Hz.

(14) Follow instructions in Paragraph 3 to set voltage regulator line-drop compensation for the length and size of cable being used.

(15) Check voltage regulator, at intervals, from no load to full load. Observe and note voltage at various loads. Steady-state voltages should vary no more than +/- 1% from normal output voltage.

(16) Operate the No. 1 output circuit of the unit no less than 10 minutes under full load. The overload protection MUST NOT trip.

(17) Operate the No. 1 output circuit of the unit at 125% load (325 amperes) for 5 minutes immediately following the full load run. The overload device MUST trip within 5 minutes, and the fault code display should read "**70.18**" indicating an overload condition in "**OUTPUT NO 1**" (Reference fault chart in Section 2-4).

(18) Reset the fault by pressing "**TEST/RESET**" push button.

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

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

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

(1) Check accuracy of AC voltmeter

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

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

(2) Check accuracy of AC ammeter

a Connect a master ammeter of known accuracy to the AC ammeter.

b Compare the unit's ammeter reading with master meter under various loads. Error must not exceed 4% of full scale.

(3) Check operation of the "**METER SELECT**" switch.

a In any LINE-TO-NEUTRAL position, the voltmeter reading should be 115 volts when the LED under the voltmeter indicates one of the three phases being check (Figure 4).

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

(4) Check accuracy of frequency meter

a Connect a master frequency meter of known accuracy to the terminals of the frequency meter.

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

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

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

a With the unit running at a normal load, adjust the coarse adjustment potentiometer (Figure 7) on the voltage regulator clockwise to increase voltage until the over-voltage sensing circuit actuates the protective monitor. After the protective monitor is activated, the load contactor will open and the fault code display will display fault "**70.16**". At 125 volts, the circuit will trip after a 1-second time delay. At higher values of voltage, time delays for over voltage trips are as follow:

- At 140 volts, the circuit will trip within 160 milliseconds.
- At 180 volts, the circuit will trip within 50 milliseconds.

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

c Return unit to normal operating conditions by adjusting coarse adjustment potentiometer (turning it counterclockwise) and pressing "**TEST/RESET**" button switch to clear the fault code.

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

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

a With the unit running at normal load, use the output voltage coarse adjustment potentiometer on the voltage regulator to reduce the voltage to 104 volts. The load contactor should NOT open.

b Reduce voltage in increments of 1 volt, with a time delay of 7 seconds between steps. At a setting of 100 volts, the load contactor will open and the under voltage light will glow after a 7-second time delay.

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

d If the under voltage circuit performs satisfactorily, return unit to normal operation by adjusting output voltage coarse adjustment potentiometer for normal output voltage, pressing the "**TEST/REST**" push button switch to clear the fault code.

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

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

a While the unit is operating normally under load, set the frequency adjust switch (Figure 5) to "**TEST**". Use the frequency adjust potentiometer (Figure 6) to adjust frequency to 400 HZ.

b Reduce frequency in steps of 1 Hz, with a time delay of 7 seconds between steps.

c If the protective circuit opens the load contactor and displays fault "**70.23**" on the fault code display after 7 seconds, at 380 Hz or less, all components of the system are functioning properly.

d If the load contactor is not opened at 380 Hz or less after 7 seconds, refer to Troubleshooting Chart in Chapter 2, Section 4.

e Return unit to normal operating condition by setting the frequency adjust switch to "**NORMAL**" and pressing "**TEST/RESET**" button switch to clear fault code.

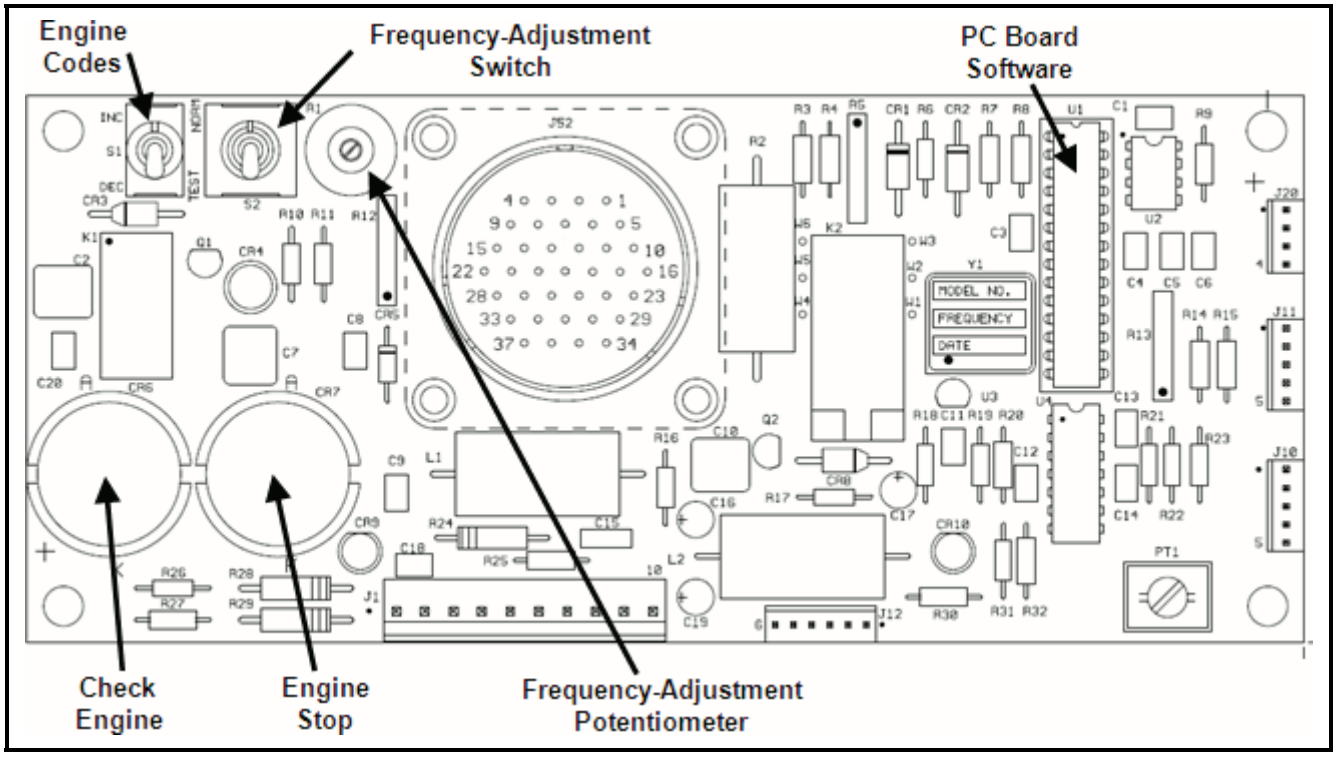


Figure 5: Engine Specific PC Board

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

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

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

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

a While the unit is operating normally under load, set the frequency adjust switch to "**TEST**". Use the frequency-adjust potentiometer to adjust frequency to 400 HZ.

b Increase frequency in steps of 1 Hz, with a time delay of 5-7 seconds between steps.

c If the protective circuit opens the load contactor and displays fault "**70.22**" on the fault code after 5 seconds at 426 Hz, all components of the system are functioning properly.

d If the load contactor is not opened at 426 Hz after 5 seconds, refer to Troubleshooting Chart in Chapter 2, Section 4.

e Return unit to normal operating condition by setting the frequency adjust switch to "**NORMAL**" and pressing "**TEST/RESET**" button switch to clear fault code.

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

f) Testing for engine ECM faults

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

(2) Press the green "**ENGINE START**" push button switch. Although the engine is not running, the green light in the "**ENGINE START**" switch will flash to indicate that power is available to the engine ECM.

(3) If no active codes are recorded, both the "Engine Stop" and "Check Engine" (Figure 5) lamps will come on and stay on.

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

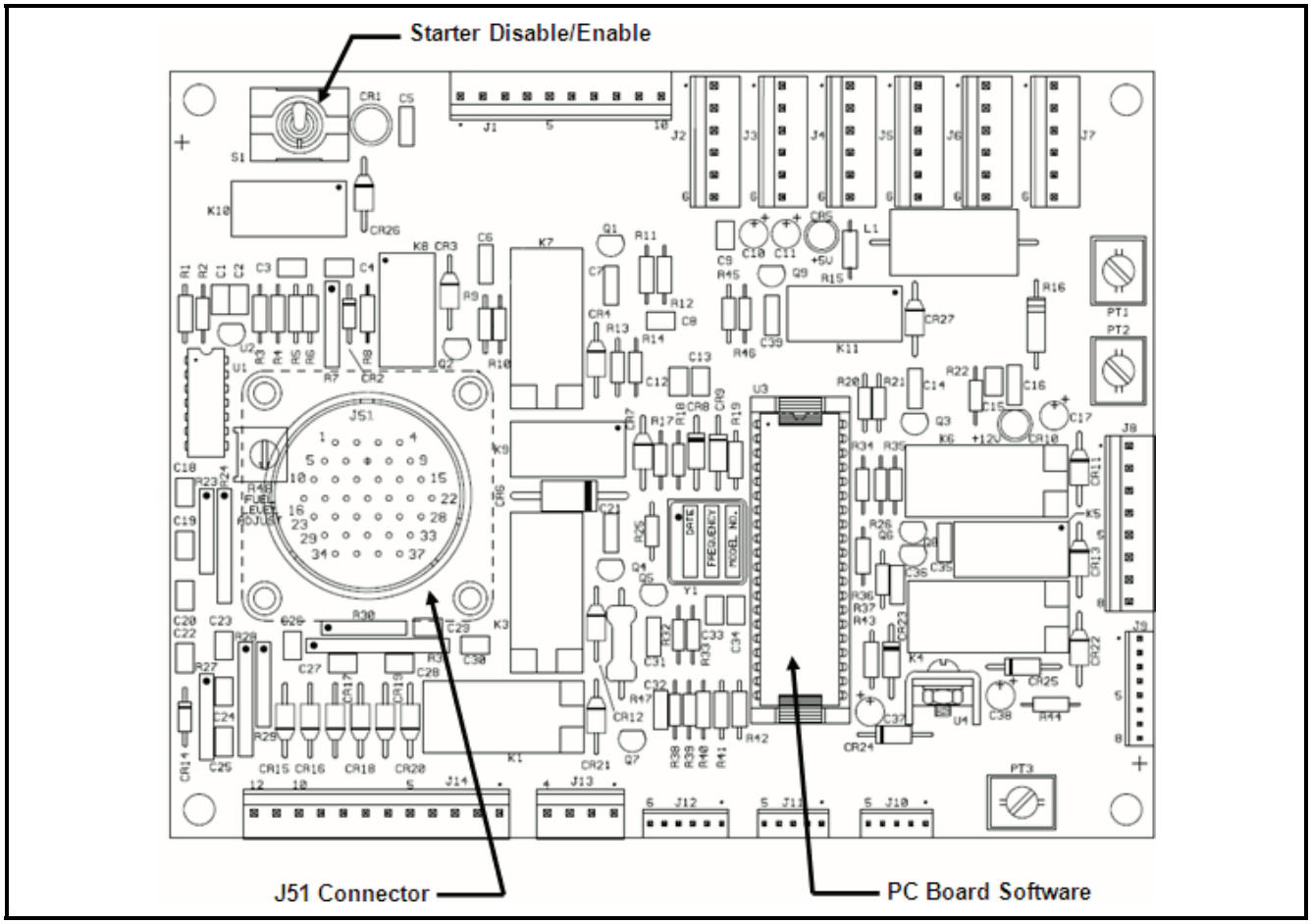


Figure 6: Engine Interface PC Board

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

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

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

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

g) Re-checking the entire unit after testing

(1) With the engine running at normal rated speed, check the entire unit for vibration and for any parts that may have become loosened during the above checks. Tighten any loose hardware as required.

(2) Check engine oil pressure at rated speed (2000 RPM). The oil pressure gauge should indicate at least 44.9 psi (3.1 bar) when engine is hot. Also at rated speed, check the engine coolant temperature. The temperature gauge should indicate 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 Set Adjustment

a) Generator Adjustment

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

b) Voltage Regulator Adjustment

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

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

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

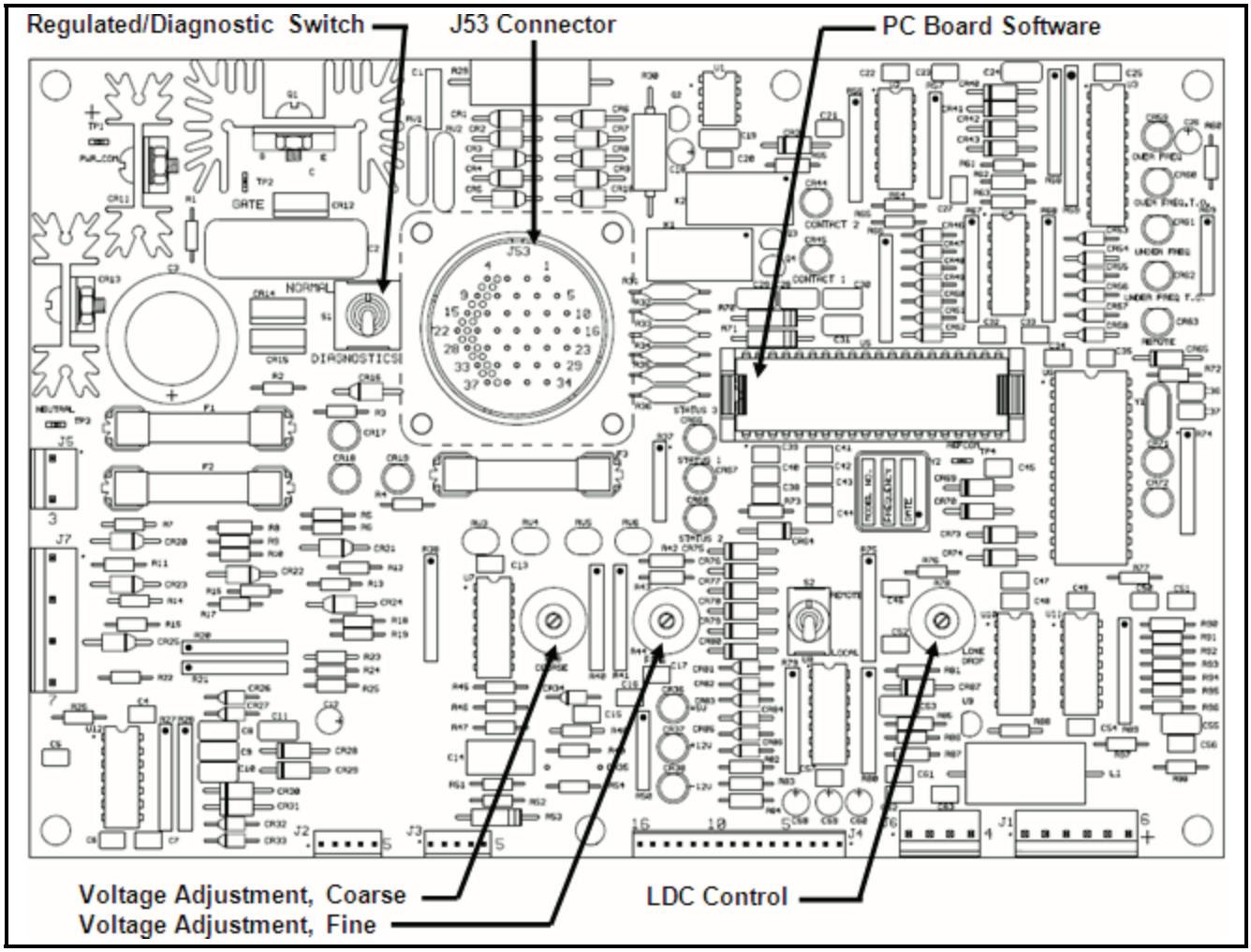


Figure 7: Voltage Regulator PC Board

(1) Output Voltage Adjustment

a Adjust Voltage Control

The output voltage, at which the generator is regulated, is adjustable by the fine voltage-adjustment potentiometer (Figure 7). Turn the potentiometer adjustment clockwise to increase generator output voltage and counterclockwise to decrease voltage.

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

b Adjust Line-Drop Compensation

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

(i) Connect the generator set output cables to a load. Load the generator set with the largest available three-phase load of rated power factor not exceeding the maximum rating of the generator set.

(ii) Measure output voltage at the load end of the cables. If the load voltage rises or drops more than 1% at the load end of the cables, decrease or increase the line drop compensation for proper voltage at the load end of the line (115-V AC line-to-neutral and 200-V AC line-to-line).

(iii) If the line-drop compensation adjustments have affected the no-load voltage output, adjust the fine output voltage control potentiometer to the desired value.

(2) Test the Voltage Regulator

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

a Connect a voltmeter at the load end of the generator output cables.

b Operate the generator set at no-load and observe voltage reading.

c Operate the generator set under load and observe voltage reading.

d Voltage under load and no load should vary no more than 1% at the load end of the cables.

c) Basic Engine Adjustments

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

- Exhaust valve adjustment
- Fuel injector timing adjustment
- Engine idle speed adjustment

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

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.

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

d) Engine Accessories Adjustment

(1) Alternator and fan belt adjustment: refer to Section 2-1 and engine manufacturer's manual.

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. Zero (0) resistance indicates a short circuit condition. An infinite resistance reading indicates an open circuit condition. See Figure 8 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 the chart below.

Test Connection	Resistance (Ohms)
Generator Stator Phase A to N (G1)*	0.0026
Generator Stator Phase B to N (G1)*	0.0026
Generator Stator Phase C to N (G1)*	0.0026
Exciter Stator Field (L2)	29
A - B, B - C, C - A Exciter Armature (G2)	0.041
Generator Revolving Field (L1)	2.1
***NOTE:** The two leads of a phase must be connected when test is made. Take readings when unit is cold and in an ambient temperature of 70 ºF (21ºC.).	

Figure 8: Generator and Exciter Test Readings

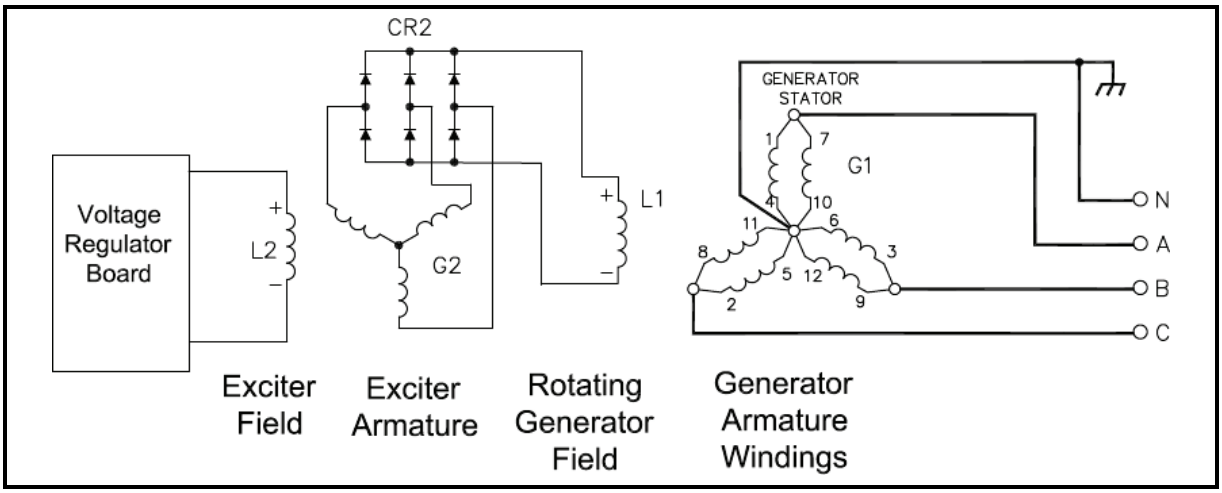


Figure 9: Generator connections

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 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. If an infinite or very high resistance was indicated with the leads connected one way and a low, readable resistance was indicated with the leads connected the opposite way, the diode may be considered good.

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

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

Section 4 Troubleshooting Procedures

1) General

The Troubleshooting Chart and Fault Code Chart located in this section cover 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 at the source of power in the affected circuit. Refer to the schematic and connection diagrams in Chapter 5. Test the circuit systematically until the source of the malfunction is isolated. See Appendix A for the 28.5 VDC Transformer-Rectifier troubleshooting information.

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

The Troubleshooting Chart is arranged under three 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 provides 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, Sections 1-3, of this manual.

2) Equipment for Troubleshooting

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

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

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

3) Parts Replacement

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

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

4) 400 Hz. Test Values

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

Generator output voltage at maximum voltage regulator potentiometer setting:	120 volts or higher
Generator output voltage at minimum voltage regulator potentiometer setting:	110 volts or lower
Over voltage relay	Trips at 126 volts after a 1-second time delay
	Trips at 140 volts in 160 milliseconds
	Trips at 180 volts in 50 milliseconds
Under voltage relay	Trips at 100 volts after 7 seconds.
Over frequency relay	Trips at any value between 426-Hz and 480-Hz after a 5-second time delay. Trips immediately at any frequency exceeding 480-Hz.
Under frequency relay	Trips at 375 Hz or less after a 5-second time delay
Overload time delay	Trips in approximately 5 minutes at 125% load of GPU rating or at 90 kVA on either output.

Frequency at rated speed of 2000 RPM is 400 +/- 2 Hz at no load and rated load

Engine oil pressure (warm and at rated speed 2000 RPM) 50 to 65 PSI (345 to 448 kPa)

Engine coolant temperature (normal operation) 180 to 200º F (82 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.

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

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

7) Illustrations

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

8) Connection and Schematic Diagrams

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

9) GPU Control Monitoring

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

a) Commands

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

Commands

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

Operating Commands
Table 1

(1) Self-Test Mode

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

(2) Engine Start Mode

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

(3) Engine Idle Mode

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

(4) Engine Run Mode

After the engine has been warmed up properly in the Engine Idle Mode, pressing the **"ENGINE START"** push-button again brings the GPU up to rated speed. The **"ENGINE START"** push-button light no longer flashes, but instead becomes 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 starts the 3-5 minutes delayed shutdown period. The **"ENGINE STOP"** push-button flashes and the engine returns to idle speed. The shutdown period is required to sufficiently cool the engine's turbocharger.

(6) Engine Stop Mode

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

(7) System Off Mode

The power is 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
have no effect on the operation of the GPU. An example is an intake air restriction fault due to a dirty filter. Although the GPU continues to operate, the fault appears on the fault code display. Pressing the "**TEST/RESET**" pushbutton or shutting down the GPU resets the fault.

(2) Run Mode

Run mode faults remove power form the aircraft but do not change the operating speed of the engine. An example is an over voltage fault. Although the contactors open and remove power from the aircraft, the engine remains at rated speed, and the fault appears on the fault code display along with the command. Pressing the "**TEST/RESET**" pushbutton or shutting down the GPU resets the fault.

(3) Idle Mode

Idle mode faults remove power from the aircraft and drop the operating speed of the engine to the idle setting. A possible example (depending on customer configuration) is a high temperature fault. The contactors open and remove power from the aircraft, the engine drops to its idle speed, and the fault appears on the fault code display along with the command. Pressing the "**TEST/RESET**" pushbutton or shutting down the GPU resets the fault.

(4) Stop Mode

Stop mode faults remove power form the aircraft and shut the engine down. An example is a low oil pressure fault. The contactors open and remove power from the aircraft, the engine shuts down, and the fault appears on the fault code display along with the command. Pressing the "**TEST/RESET**" pushbutton or shutting down the GPU resets the fault.

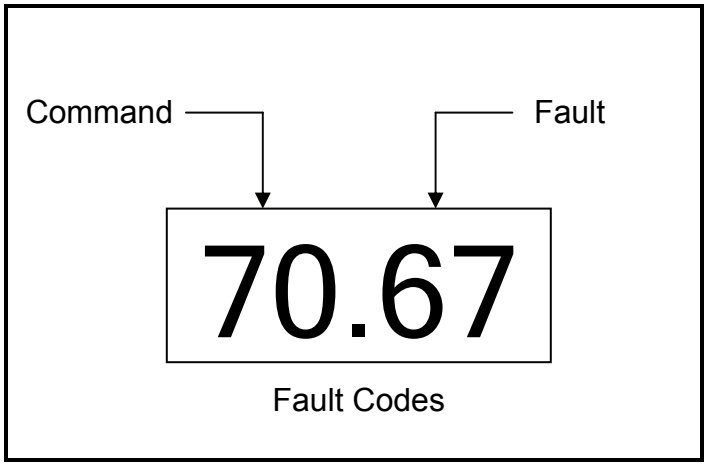
(5) Special Configuration

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. The first two digits represent one-half of the fault code and the last two digits represent the other half.

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



Fault Meter Display
Figure 1

d) Operation Monitoring

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

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

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

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

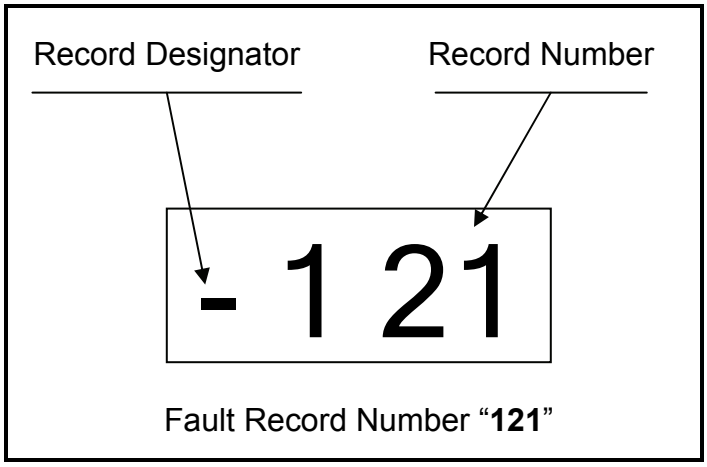
e) Extracting Fault Code Information

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

(1) Pull the "**EMERGENCY STOP**" button out.

(2) Press the "**LAMPS**" pushbutton to turn on the control box lights.

(3) Press the "**TEST/RESET**" pushbutton and hold for 2 to 3 seconds until the data record number appears on the display (See Figure 2).

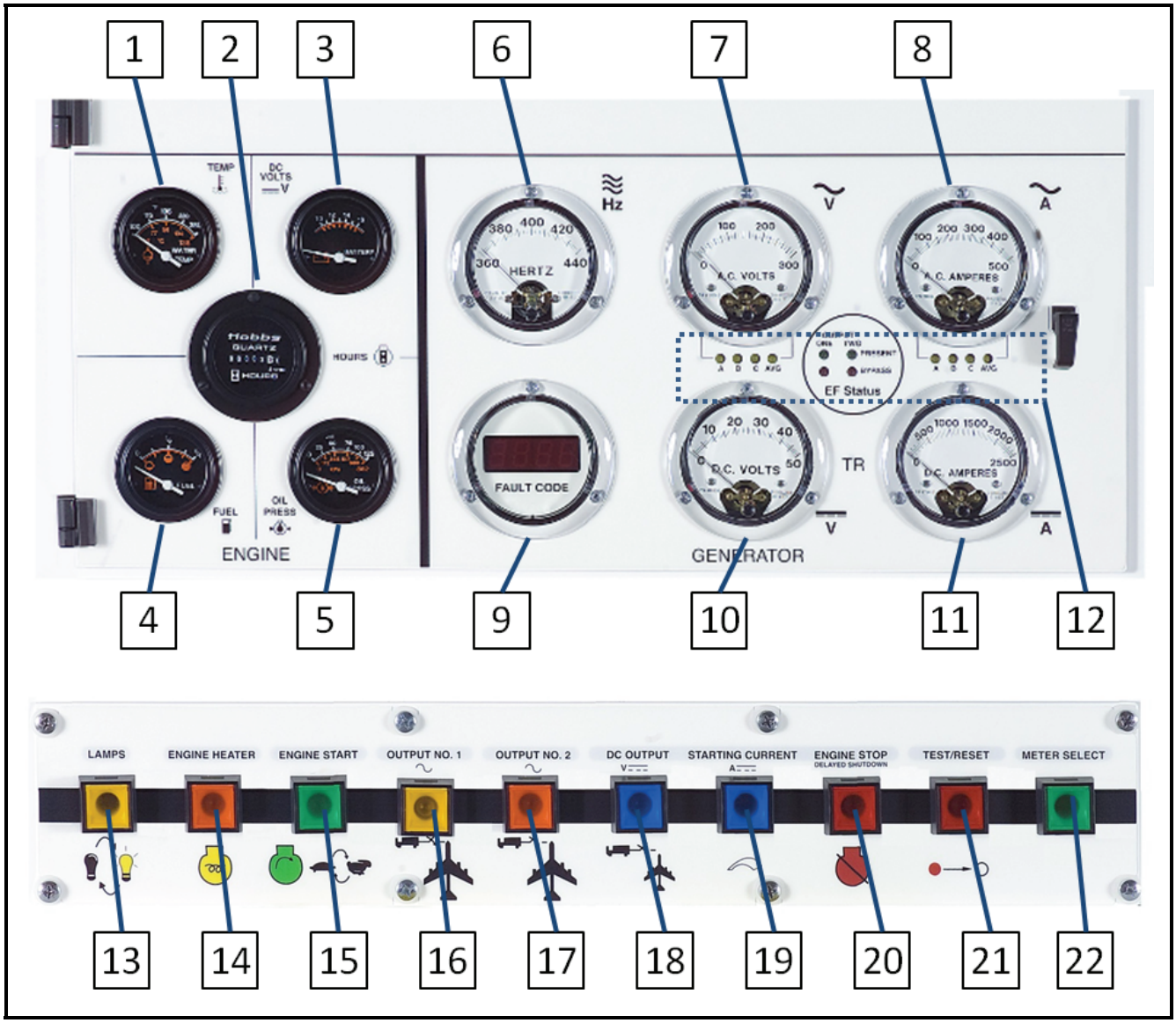


Fault Meter Display (Fault Record Number)
Figure 2

(4) Release the "**TEST/RESET**" pushbutton. The display alternates between the fault record number (See Figure 2) and the fault code (See Figure 1).

(5) To continue scrolling backward through the previous fault codes, press and release the "**TEST/RESET**" pushbutton again. The previous fault record number and fault code are displayed as described in Step 4.

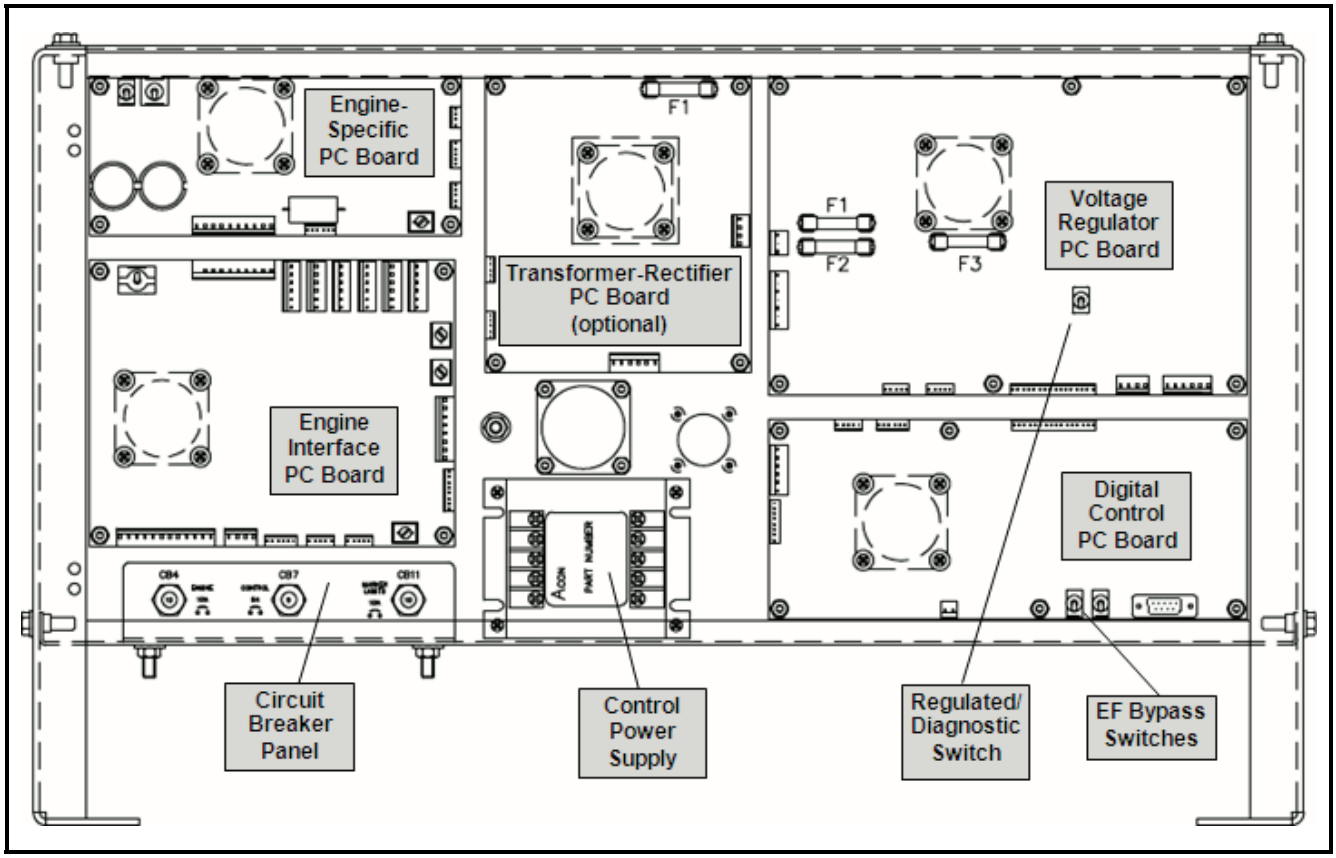
(6) Repeat Step 5 to continue scrolling backward. Once the first fault record is reached, the scrolling stops. To begin again, press the "**LAMPS**" pushbutton to turn off the control box lights and repeat Steps 2 through 5.



1. Engine Coolant Temperature Gauge (M24)
2. Running Time Meter (M4)
3. Battery Voltmeter (M5)
4. Fuel Gauge (M13)
5. Oil Pressure Gauge (M25)
6. Frequency Meter (M3)
7. AC Generator Voltmeter (M2)
8. AC Generator Ammeter (M1)
9. Fault Code Meter (M6)
10. DC Voltmeter *[Optional with TR]*
11. DC Ammeter *[Optional with TR]*
12. Front LED Display (A5)

13. Panel Light Switch (S74)
14. Air Intake Heater Switch (S79)
15. Engine Start Switch (S24)
16. AC Output No. 1 Switch (S75)
17. AC Output No. 2 Switch (S275)
18. DC Output Switch (S430) *[Optional with TR]*
19. DC Starting Current Switch (S431) *[Optional with TR]*
20. Engine Stop Switch (S76)
21. Test/Reset Switch (S77)
22. Meter Selector Switch (S3)

Figure 3: Operator Controls



Control Box Interior Components
Figure 4

Engine Controls

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
1. The engine will not start. The starter will not crank the engine.	**a.** Battery discharged or loose battery or ground connection	Check the voltage across batteries. Voltage should be approximately 12.8 volts DC. Check all battery terminals. Be sure 12.8 volts DC is reaching the solenoid input terminal.
	b. Electrical defect in starter	Momentarily connect a large-capacity jumper cable (No. 1/0 minimum) between the hot side of starter solenoid and the 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 the starter motor from engine and apply 12 VDC to test it. If it doesn't operate, it is defective. Replace it. If starter motor does operate, proceed to step **d**.
	d. Internal seizure	If battery and starter are good and the starter is unable to crank the engine, an 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 the 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 the auxiliary solenoid to the battery terminal of the auxiliary starter. If the engine does not crank, replace auxiliary starter solenoid. If the engine cranks, proceed to step **g** below.
	g. Defective EIB Board	Replace EIB board.
	h. Defective engine start button	Depress the button and check the continuity between button contacts. If no continuity exists, replace the button. If there is continuity, replace the EIB board.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Engine Controls (continued)		
2. Engine will not start. Cranking speed low.	**a.** Low battery output	Check the battery and 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 the oil. Refer to Section 2-2. Remove and replace the oil 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 the pump is indicated. Check and/or remedy as follows.
	b. Fuel shutoff valve closed.	Open the 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 the 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 the wiring to the 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.
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 the compression in accordance with instructions in the engine manufacturer's operation manual. Overhaul the engine to make repairs as necessary.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Engine Controls (continued)		
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 the engine and observe oil pressure gauge. 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 or the EIB board could be defective.	Add No. 2 diesel fuel. Replace EIB board.
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" or runs unevenly.	**a.** Insufficient fuel	Check low fuel level in accordance with engine manufacturer's operation manual. Repair or replace parts as required.
	b. Faulty injector	Check injectors in accordance with engine manufacturer's operation manual. See causes of low compression listed under ENGINE CONTROLS.
	c. Low compression pressure	Check compression in accordance with engine manufacturer's operation manual. See causes of low compression listed under ENGINE CONTROLS.
	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.
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 in accordance with engine manufacturer's operation manual. 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.
	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.	On REG place Regulated/ Diagnostic switch in Diagnostic position. 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 properly working REG board to regulator wiring assembly, avoid short circuiting bottom of properly working REG board. Then start generator set and perform tests and adjustments according to instructions in Section 2-3. If generator set works properly with a properly working REG board temporarily connected, shut off generator set and replace defective REG board with one that is properly working (preferably, same REG board used for this troubleshooting check).
	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, connect 12 VDC to wires. If generator will produce at least 80 VAC, replace or repair connector and wiring between voltage regulator and exciter field as required.

Load Contactor Operating Circuit

Output 1: Contactor K1, Pushbutton switch S75

Output 2: Contactor K201, Pushbutton switch S275

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
1. Load contactor will not close when the corresponding Output pushbutton switch is held in closed position. Generator is running at normal voltage.	**a.** Blow contactor fuse (F3) on regulator board.	Check the fuse and replace if blown. If it blows again, check the contactor.
	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 REG board.	After making certain that the output pushbutton switch is working, measure the DC output voltage at contactor coil. If the voltage measured isn't approximately 90 VDC, replace REG.
		Replace REG board with a board known to be operating properly. If contactor still doesn't close, proceed to step **d**.
	d. Defective Output pushbutton switch.	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.
	e. Defective coil in load contactor.	Disconnect leads at load contactor terminals V and W. Check coil resistance between these terminals. Resistance should be approximately 600 ohms. If coil is defective, replace complete load contactor.

Load Contactor Operating Circuit (Continued)

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
2. Load contactor closes when output pushbutton switch is held in CLOSED position. Opens immediately when switch is released.	**a.** The plug interlock EF circuit on CTL board could be defective	Place EF Bypass switch in the ON position. If load contactor remains closed, proceed to step **b.**
	b. 28.5 VDC is not reaching the plug interlock EF circuit from aircraft for following reasons:	Proceed as follows to find the cause of this malfunction.
	c. Generator-to-aircraft cable connector defective or not plugged into aircraft receptacle connector.	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.
	d. Aircraft rejecting power.	Check aircraft on-board electrical equipment and controls.
	e. Defective contacts in N.O. auxiliary pushbutton switch mounted on right side of contactor.	Connect a jumper lead between terminals of N.O. auxiliary switch. If load contactor will now remain closed, replace N.O. auxiliary switch or complete load contactor.
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 pushbutton switch, check circuit in accordance with instructions in Trouble, Symptom, Condition 1. If the load contactor can be closed, but opens as soon as power accepted switch is released, check for trouble under Trouble 2, above.
	b. Cable accidentally disconnected from aircraft.	Reconnect cable.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Protective Circuit		
NOTE: Protective monitoring is not completely functional until the load contactor is CLOSED. Since it is not advisable to vary voltages for test purposes while delivering power to an aircraft, the GPU should be connected to a load bank for trouble shooting protective circuits. To avoid repetition, it will be assumed that "**TEST/RESET**" push-button switch has been pressed and the load contactor has been closed before commencing each test.		
1. Load contactor opens during power delivery. Over voltage fault indicated.	**a.** Over-voltage condition may have been result of a sudden drop in load, or possible tampering with REG potentiometer, 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 CTL board	Use REG potentiometer to reduce voltage to 110 VAC. Observe voltmeter and gradually increase voltage with potentiometer. If sensing circuit CTL board functions to open load contactor at any value less than 125 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, or possible tampering with REG potentiometer, 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	Use REG potentiometer to reduce voltage to 100 VAC. Observe voltmeter and gradually decrease voltage with potentiometer. If sensing circuit CTL board functions to open load contactor at any value great than 100VAC, it is defective. Replace CTL board.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
Protective Circuit (continued)		
3. Load contactor opens during power delivery. Over frequency fault indicated.	**a.** Frequency adjust switch is enabled.	Set frequency adjust switch to DISABLE
	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 REG board.
4. Load contactor opens during power delivery. Under frequency fault indicated.	**a.** Frequency adjust switch is enabled	Set frequency adjust switch to DISABLE
	b. Defective REG board.	If under-frequency faults continue after engine's ECM is proven to be good, and an under-frequency condition does not exist, replace REG 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 Section 2-3. 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 Section 2-3. If exciter rotor windings are good, proceed to step C.
	c. Open or shorted exciter field windings (L2)	Check field resistance. See Section 2-3 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 with Section 2-3
2. Generator operates single phase.	**a.** Open or short circuited winding in generator stator (G1)	Check stator-winding resistances. See Section 2-3 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 Section 2-3.
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 Section 2-3. 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.
40. _ _	ENGINE START MODE	Engine starter and engine's ECM is activated.
50. _ _	ENGINE IDLE MODE	Engine idles at approximately 1000 RPM
55. _ _	ENGINE RAMP UP	Period when engine goes from idle to rate speed.
63. _ _	REG TEST OUTPUT FREQUENCY	Check for 400 Hz. output frequency.
68. _ _	CTL TEST OUTPUT	Checks the CTL communications.
70. _ _	ENGINE RUN MODE	The engine is at rated speed and ready for aircraft load.
75. _ _	ENGINE RAMP DOWN	Period when engine goes from rated to idle speed.
80. _ _	ENGINE DELAYED SHUTDOWN MODE	Allows the turbocharger to cooling properly.
90. _ _	ENGINE STOP MODE	Engine is brought to a complete stop.
99. _ _	System Off Mode	All electrical circuits have been turned off.

Troubleshooting Table

Faults			
Fault code	**Name**	**Possible Cause(s)**	**Corrective Action**
Air	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.
FUEL	EIB LOW FUEL WARNING	Fuel tank level is below ¼ tank.	Fill fuel tank.
_ _.00	Invalid Fault		
_ _.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	TRB EF3 LOSS FAULT	EF3 voltage signal not present TRB board defective K403 relay defective Defective Output Cable	Check cable/aircraft connection. Place a 28 VDC signal of DC+ at output cable and at GPU. Replace defective components.
_ _.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 not balanced	Repair sensing wire. Check load imbalance and correct as required.
_ _.22	REG OUTPUT OVER FREQ FAULT	Defective engine ECM Defective REG board	Replace engine ECM. Replace REG board.

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.
_ _.40	CTL ID FAULT	Defective CTL board	Replace CTL board.
_ _.41	TRB ID FAULT	Defective TRB board Defective or missing ID resistor	Replace TRB board. Replace or install ID resistor.
_ _.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	Obstructed cooling air path	Clear air obstruction.

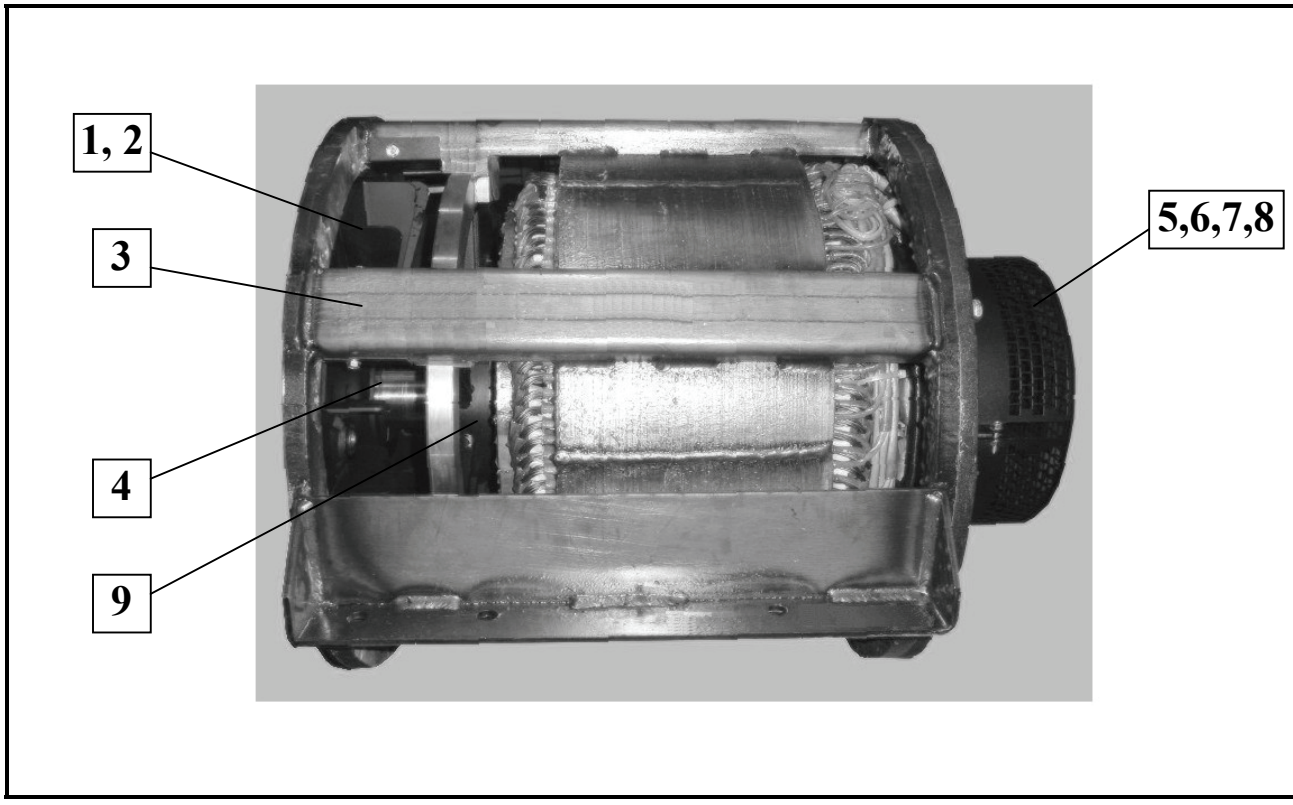
Faults			
Fault code	**Name**	**Possible Cause(s)**	**Corrective Action**
	OVERTEMP FAULT	Defective thermal switch	Replace switch.
_ _.46	TRB INPUT CONTACTOR FAULT	Defective input contactor. Defective TRB board.	Replace input contactor. Replace TRB board.
_ _.47			
_ _.48	GEN ID FAULT	The REG board cannot 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.
_ _.55	EIB LOW FUEL FAULT	Fuel tank level is below $^{1}/_{8}$ tank.	Fill fuel tank.
_ _.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.
_ _.66	EIB LOW ENGINE COOLANT FAULT	Engine coolant level is too low. Engine is loosing coolant.	Refill radiator. Check for leaks and replace defect components.
_ _.67	EIB ENGINE OVERTEMP FAULT	Engine is over-heated. Coolant level is too low. Radiator is dirty or obstructed. Defective EIB board Defective temperature switch	Let engine cool then restart. Check coolant level and add. Clean radiator. Replace EIB board. Replace switch.
_ _.68	EIB LOW OIL PRESSURE FAULT	Engine oil level is too low. Defective EIB board. Defective oil pressure switch.	Check oil level and add. Replace EIB board. Replace switch.

Chapter 3 Overhaul/Major Repair

Section 1 Exciter Armature

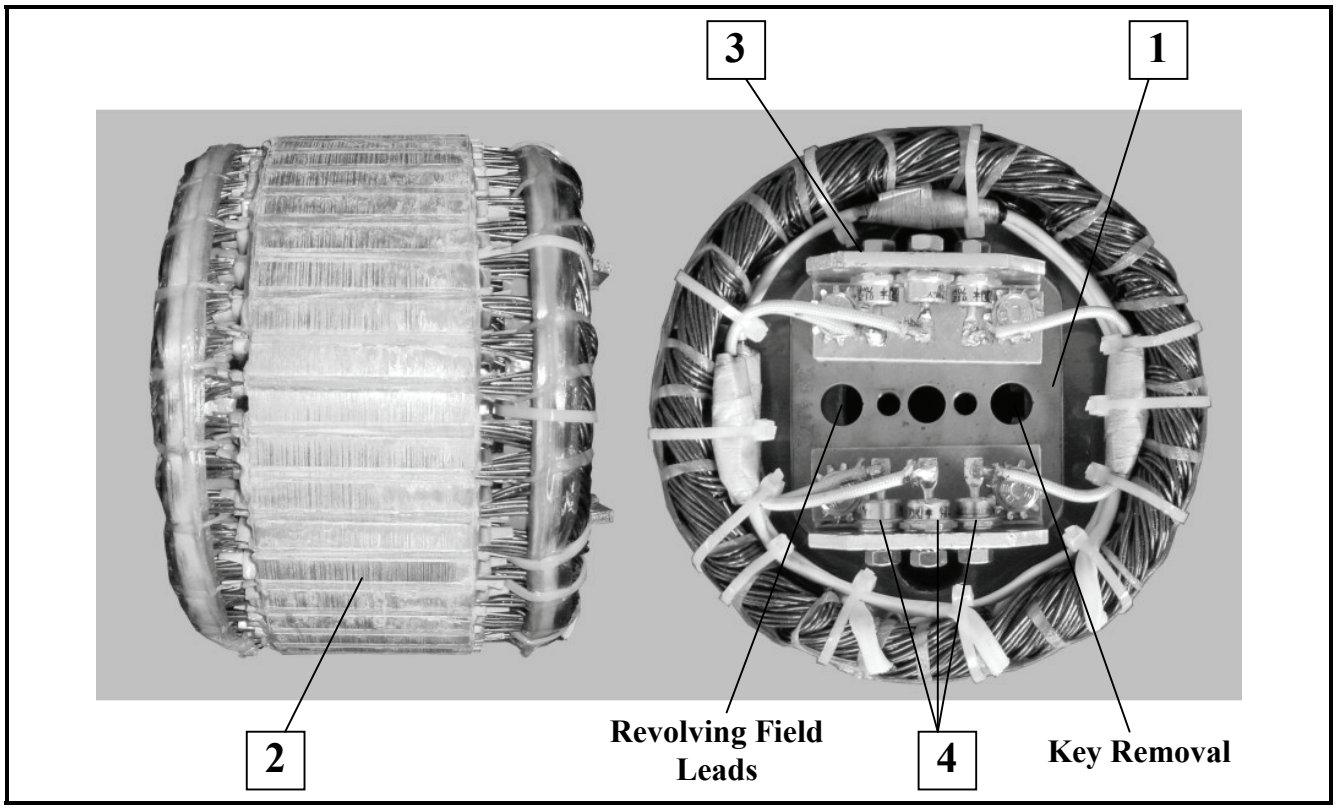
1) General

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

General Assembly
Figure 1



1. Exciter Core Flange
2. Exciter Core Lamination
3. Diode Mounting Plate
4. Silicon Diode

Exciter Armature
Figure 2

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

Since the removal and installation of exciter armatures can be rather complicated, this manual has been prepared to assist mechanics in the 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 set consists of a revolving winding assembly on a laminated core, a rectifier assembly (diode mounting plate with diodes), and a mounting flange. The flange, core, and diode mounting plate are bolted together to make the complete exciter armature.

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

3) Exciter Armature Replacement

a) General

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

b) Tools needed for Exciter Armature Removal and Installation

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

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

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

Once the 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 M10-1.5 fully-threaded hex-head bolts. Instructions for doing this are provided in this manual.

c) Conditions for Exciter Removal

The mechanics performing the work must decide upon the best and most convenient method of removing the exciter armature. If the exciter armature is being replaced, then the work may be performed without removing the generator from the machine. In a great majority of cases, exciter removal will be for the replacement of the rear bearing. This 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 cover from end canopy and the exciter armature cover from the end of the generator.

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

WARNING

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

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

(4) Disconnect the two rectifier-to-generator field leads, which are attached to the rectifier mounting plate with ring terminals.

(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 machine 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, then remove key and slide-hammer puller.

f After key is removed, apply penetrating oil in the armature and shaft keyways.

(2) Removing the Exciter Armature

CAUTION

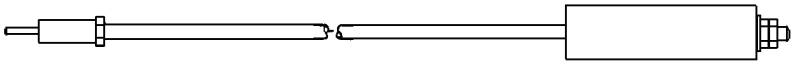
Leads may be damaged if armature is turned too far in either direction.

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

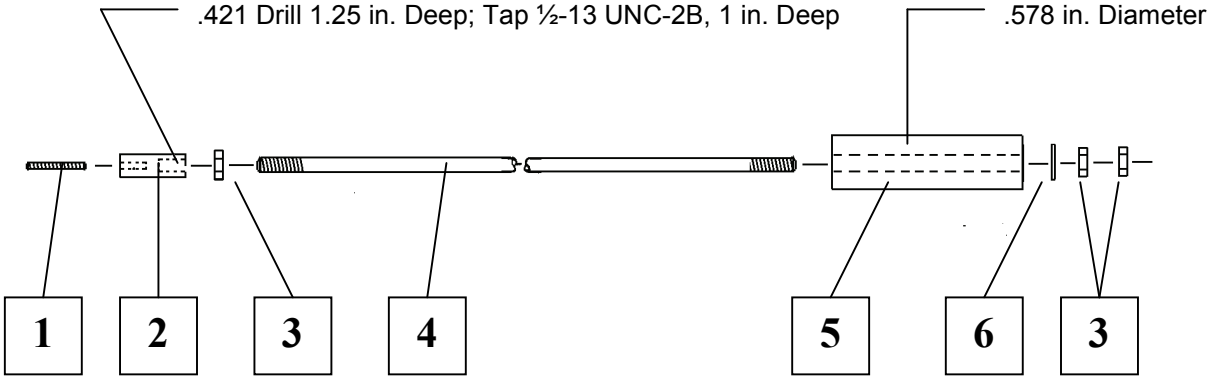
WARNING

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

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



Sling Hammer Assembly



Sling Hammer Components

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

Sling Hammer Puller
Figure 3

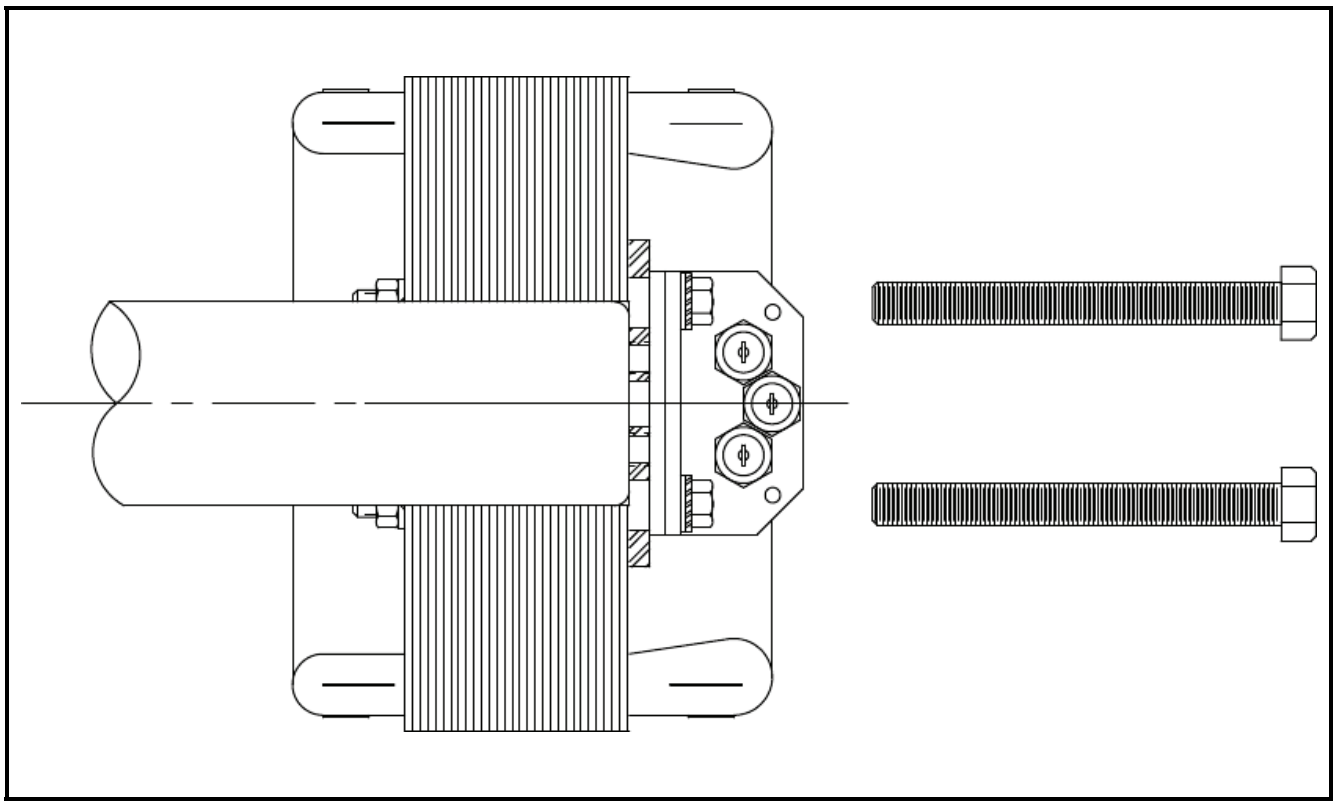
CAUTION	Pay close attention to field leads while pulling exciter armature from shaft. Make **CERTAIN** that the leads stay in the 1/2" keyway. One mechanic should watch them constantly while another operates the puller. Make certain that leads do not catch and be sure that they slide smoothly through the hole (Figure 2). Straighten leads and remove kinks as required to avoid damage to insulation.

4) Exciter Armature Installation

a) Preparation for Exciter Armature Installation

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

(2) Make **CERTAIN** that the leads are tucked into the 1/2" keyway, which is opposite from the 3/8" keyway in the generator armature shaft.



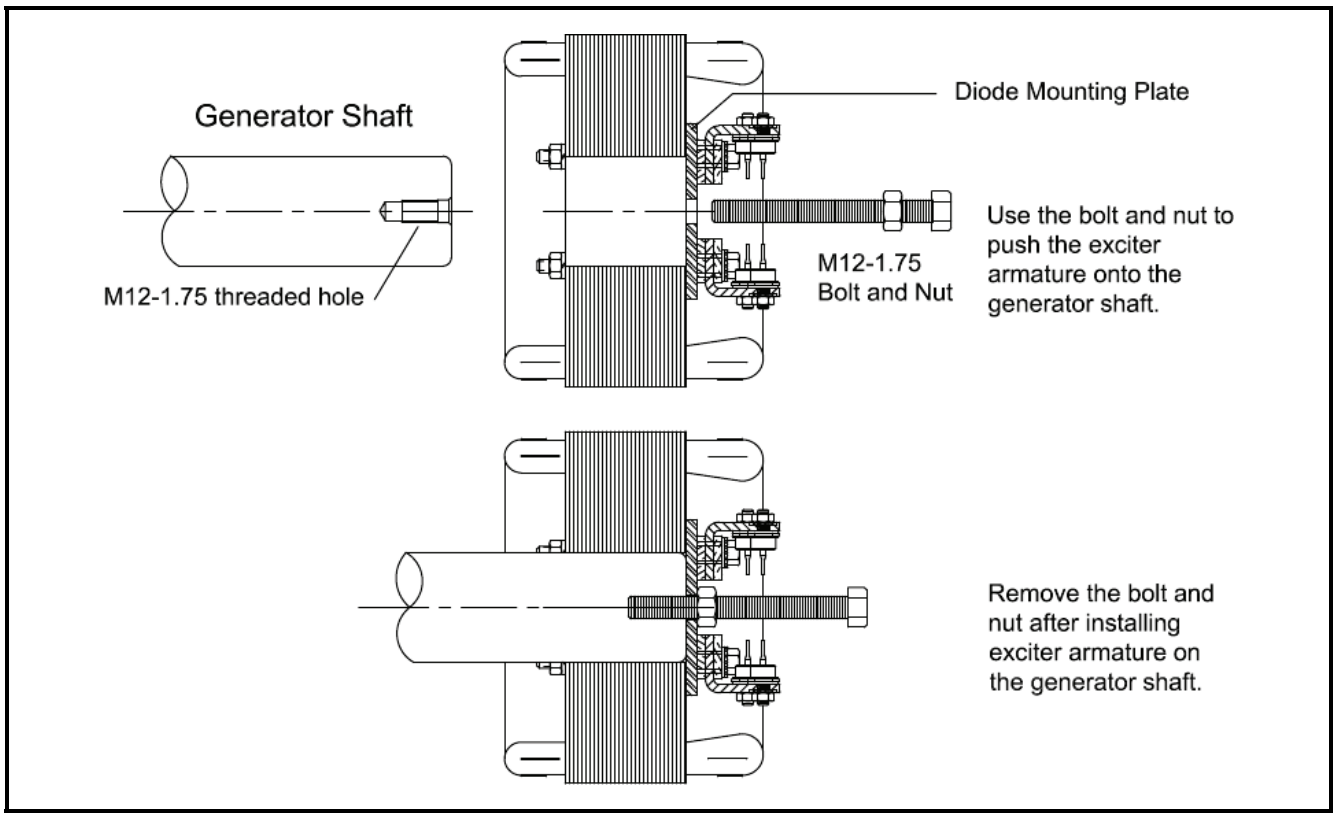
Exciter Armature Removal
Figure 4

(3) Route the revolving field leads (step 2 above) through exciter armature hole (Figure 2), which is opposite the keyway.

(4) Align armature keyway with key in shaft and start armature on shaft.

b) Exciter Armature Installation

(1) If the exciter armature-to-generator shaft fit is such that the exciter armature may be pushed on by hand, push it on very slowly while another mechanic carefully watches and pulls field leads through hole in the exciter armature diode mounting plate. Continue installation until the diode mounting plate contacts the end of the generator shaft. If the exciter armature cannot be pushed on by hand, use a M12-1.75 hex-head bolt and M12-1.75 nut as shown in Figure 5 to pull the exciter armature onto the generator shaft. 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.



Exciter Armature Installation
Figure 5

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

a Connect lead with ring type terminal to the screw provided to the mounting plate (Figure 2).

b Connect the other field lead to the three leads coming off of the exciter armature windings. Use parallel splice connector, crimp and solder for a good connection.

c Insulate with sleeving material or wrap with electrical tape.

(3) Install the Machine Key

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

b Apply **LOCQUIC** primer, No. 47-56 grade T to **SIDES** of machine key. Do not over prime. A thin film is best. Allow to dry three to four minutes.

c Apply a thin coating of **LOCTITE**, No. 242 adhesive to **SIDES** of keyways in shaft and armature. Be certain to remove any excess from mounting surfaces on shaft and bore of armature.

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

When exciter armature removal is for the replacement of bearings and no kit is involved, be sure that **LOCTITE** is used (No. 242 is recommended), which is a milder adhesive than that recommended in the manual.

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 antirust products.

Recommended Products Manufacturers:

- "LOCQUIC" No. 47-56, Primer Grade T
- "LOCTITE" No. 40-31, Retaining Compound, Manufactured by Loctite Corporation, Newington, Connecticut 06111
- "NEVER-SEEZ" No. NSBT-8 (8 oz. can), Manufactured by Never-Seez Compound Corporation, Broadview, Illinois 60153
- "NOCO10" Varnish No. T-211 (clear, air dry), Manufactured by Sterling Division of Reichhold Chemical Incorporated, Marysville, Pennsylvania 17053

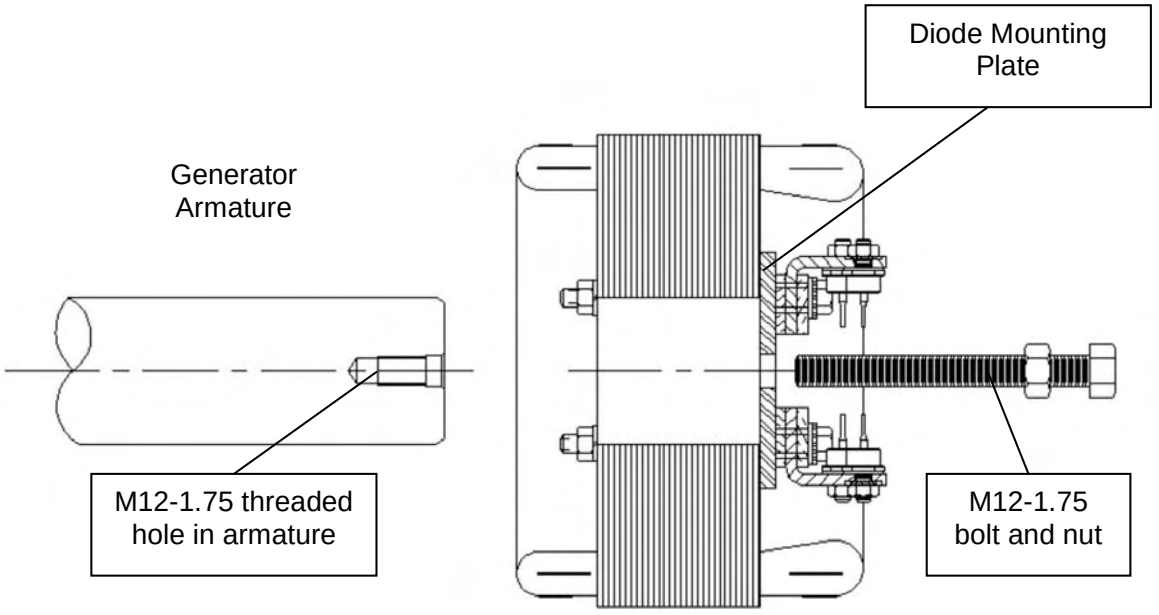
d Apply **LOCTITE**, No. 242 to **SIDES** of new type threaded machine key. A thin film 0.005 to 0.010 inch thick is adequate and desirable.

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

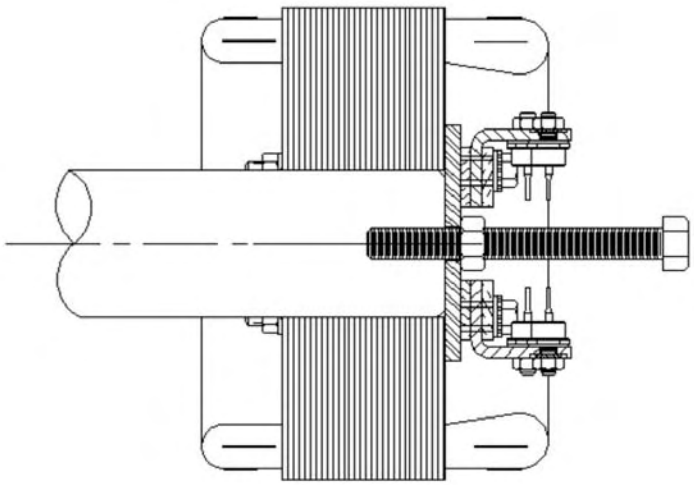
f Insert **UNTHREADED** end of key in keyways, and then tap lightly until threaded end is flush with end of shaft.

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

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



Exciter armature after installation on shaft



Remove the M12-1.75 bolt and the nut after installing the exciter armature on the generator armature shaft.

Exciter Armature Installation
Figure 5

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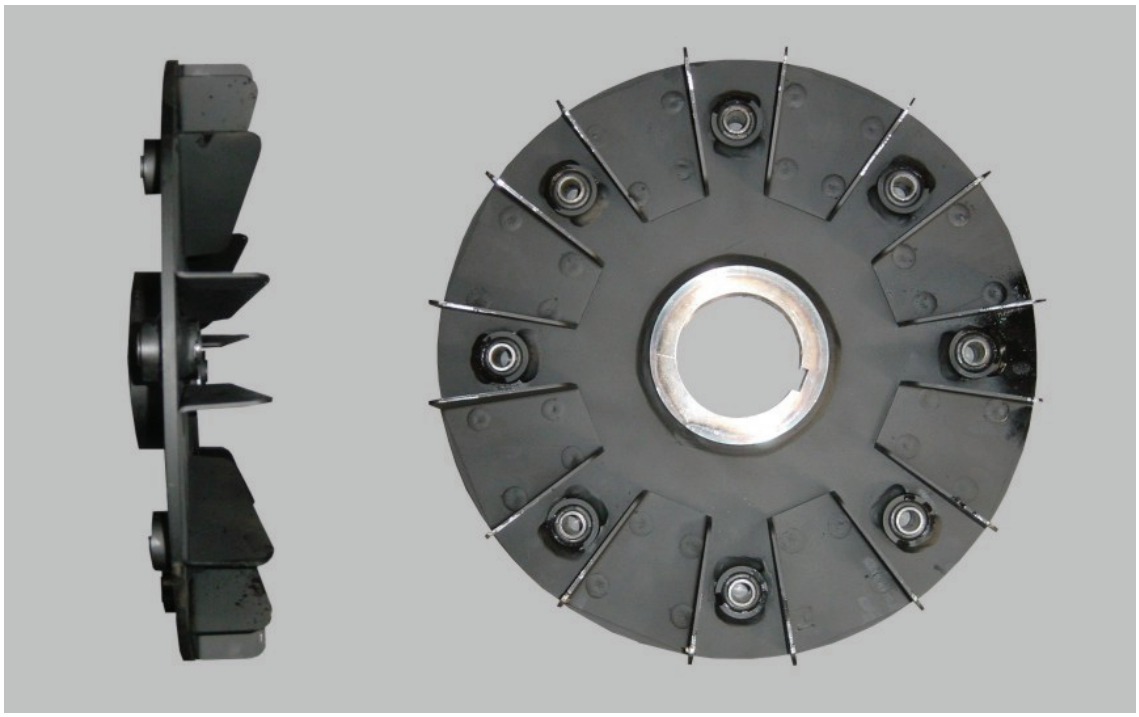
Section 2 Dual Bearing Flexible Coupling

1) General

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



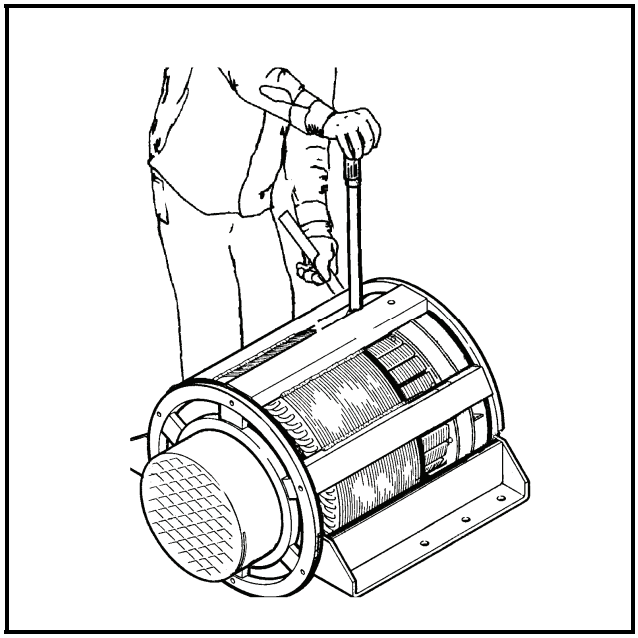
Coupling Assembly
Figure 1

2) Disassembly

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

a) Separate Engine and Generator

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



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

b) Remove Coupling Assembly

WARNING

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

(1) Refer to Figure 3. Using a socket wrench, remove all three of the 3/8-16 bolts that secure the bushing to the hub.

(2) Using a 3/16-inch Allen wrench, loosen the setscrew in the bushing to release pressure on the key.

(3) To separate the bushing from the hub, lubricate two of the 3/8-16 bolts and insert them into the two threaded holes in the bushing flange. With socket wrench, screw these bolts into the bushing such that the bushing pops loose from the hub, alternating from bolt to bolt.

(4) When the bushing is loose in the hub, use a mallet to **GENTLY** tap the bushing out of the hub.

(5) Slide the coupling assembly off the shaft and remove the key.

(6) Inspect the coupling assembly components carefully as follows:

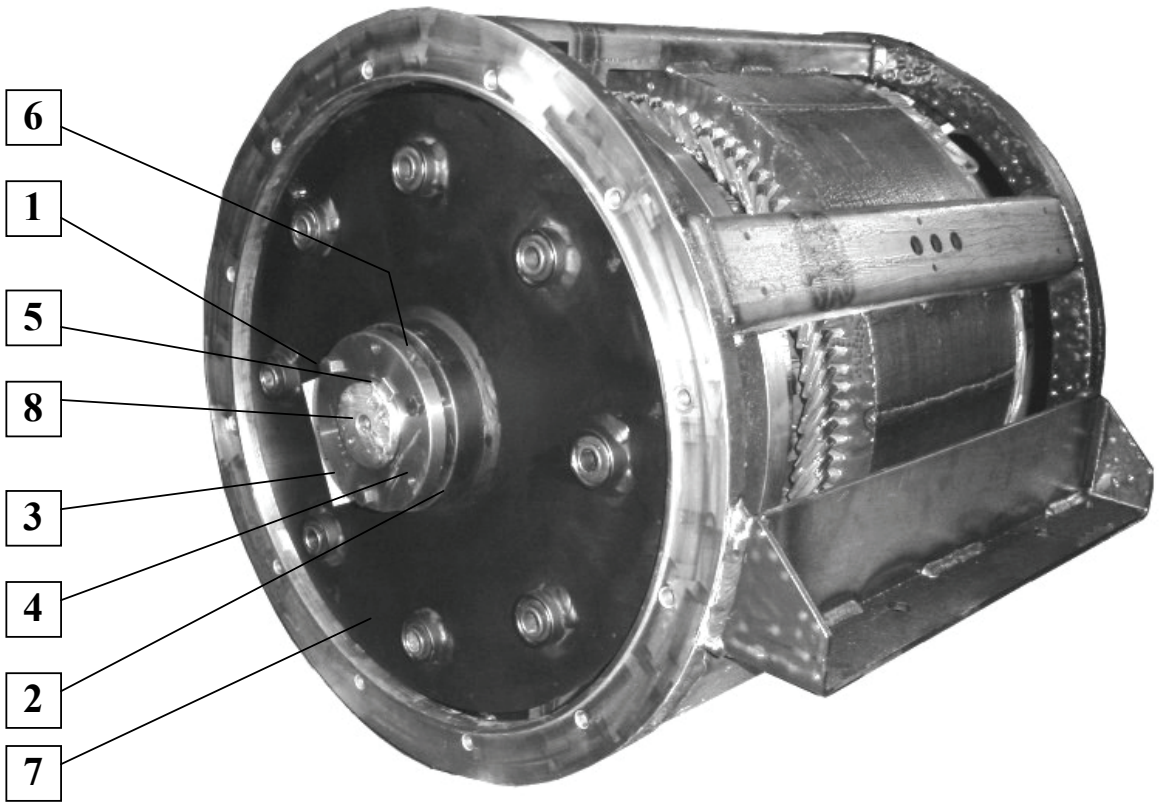
a Check for deformed fan blades and damage to the disk.

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

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

d Check the shaft for any damage or deformation where the coupling was mounted on it.

e Check rubber bushing alignment to make sure that the dimension illustrated in Figure 4 is maintained.



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

Hub and Bushing
Figure 3

3) Coupling Service

When ordering coupling kits or other parts from your ITW GSE Group Distributor, be sure to include all pertinent information from the unit's identification plate: Specification No., Model No., and unit rating.

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

Write:	Service Department Hobart Ground Power 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@hobartgroundpower.com
Web Page :	www.hobartgroundpower.com

a) Replacement Coupling Kit

A replacement coupling kit is available from your ITW GSE Group Distributor. This kit provides a replacement coupling assembly with attaching hardware and installation instructions.

b) Bushing Kit

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

c) Bushing Replacement

To replace bushings only, proceed as follows:

(1) Press out **ALL** old bushings.

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

(3) Shake the container of lubricant (supplied with kit) vigorously and 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.

4) Coupling Installation

WARNING

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

CAUTION

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

a) Cleaning

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

CAUTION

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

b) Assembly

(1) If an adapter ring must be replaced, remove the bolts that secure it to the flywheel. Discard the old adapter ring and bolts. Install the new adapter ring (see Chapter 4) using the new socket head bolts.

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

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

(2) Refer to Figure 3. Assemble the bushing into the hub.

CAUTION

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

(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 setscrew 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 above. 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 (41 N-m) and tighten all three 3/8-16 bolts to that value. Block the coupling against clockwise rotation with a bar, as illustrated in Figure 2. Observe the **CAUTION** above when it is necessary to rotate the shaft.

b Repeat step (a) above until 3/8-16 bolts can no longer be tightened.

c Recheck the dimension in Figure 7 to be sure it is the same as the dimension in Figure 6.

5) Reassemble Engine and Generator

CAUTION

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

a) Insert the new coupling bolts (see Chapter 4) with lock washers through the bushings from the FAN side of the coupling.

b) Using a hoist, align the generator fan housing flange with the flange on the engine flywheel housing and insert two of the attaching bolts, one on each side of the flange. Start the bolts into the tapped holes in the flywheel housing just enough to ensure thread engagement. DO NOT TIGHTEN.

c) Block rotation of generator and turn all of the coupling bolts into the tapped holes in the flywheel until finger tight. DO NOT tighten with a wrench.

d) Insert all remaining attaching bolts *(two installed in Step B, above)* through the generator flange, engaging the tapped holes in the flywheel housing, and tighten them all securely.

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

CAUTION

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

6) Run-in and Periodic Check

a) Mount the engine-generator assembly in a suitable test area and operate it for a 2-hour run-in.

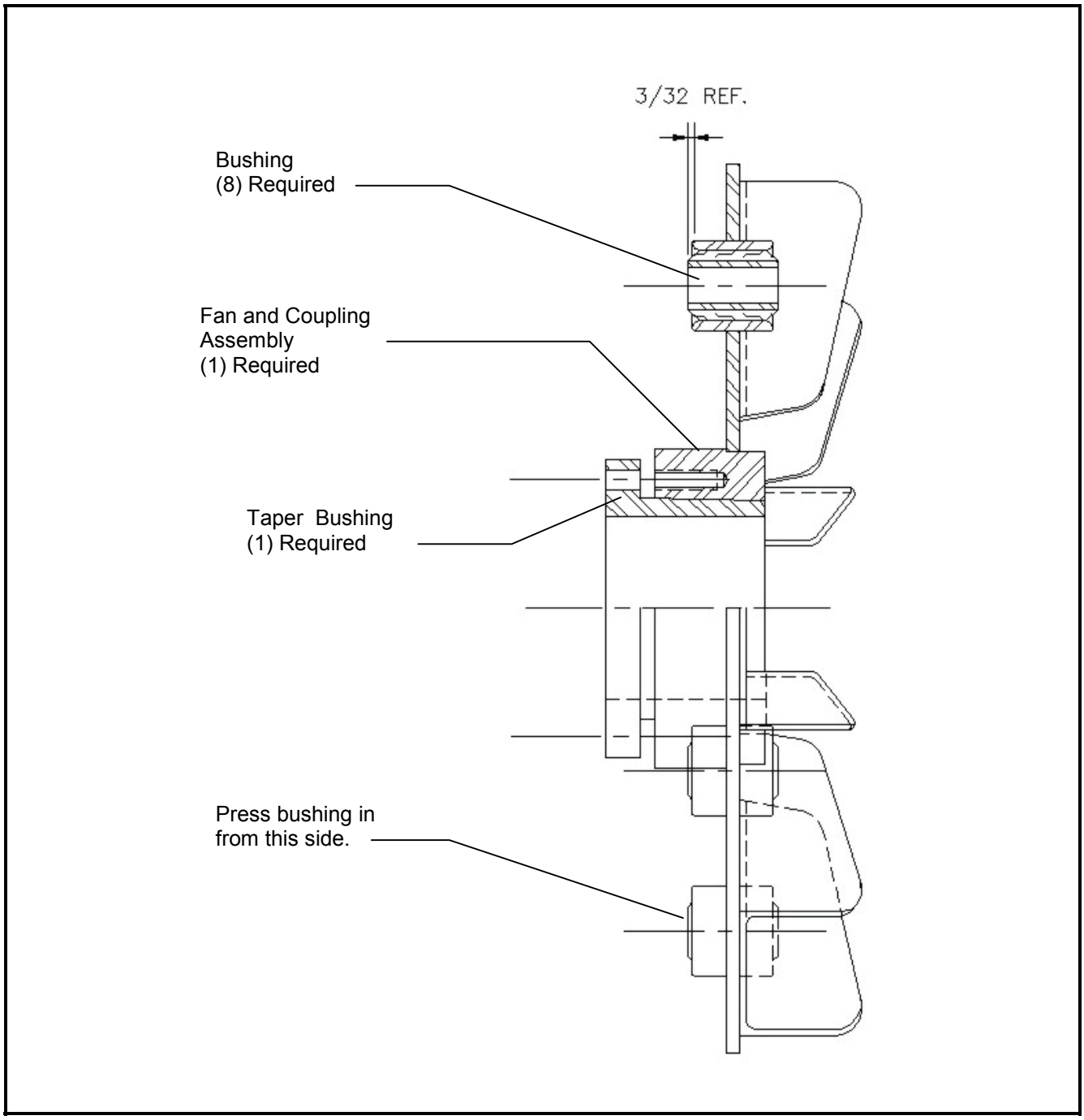
b) Shut down the engine after 2 hours and re-torque all coupling bolts to 85 foot-pounds *(115 N-m)* to compensate for normal torque relaxation.

c) Return the unit to normal service.

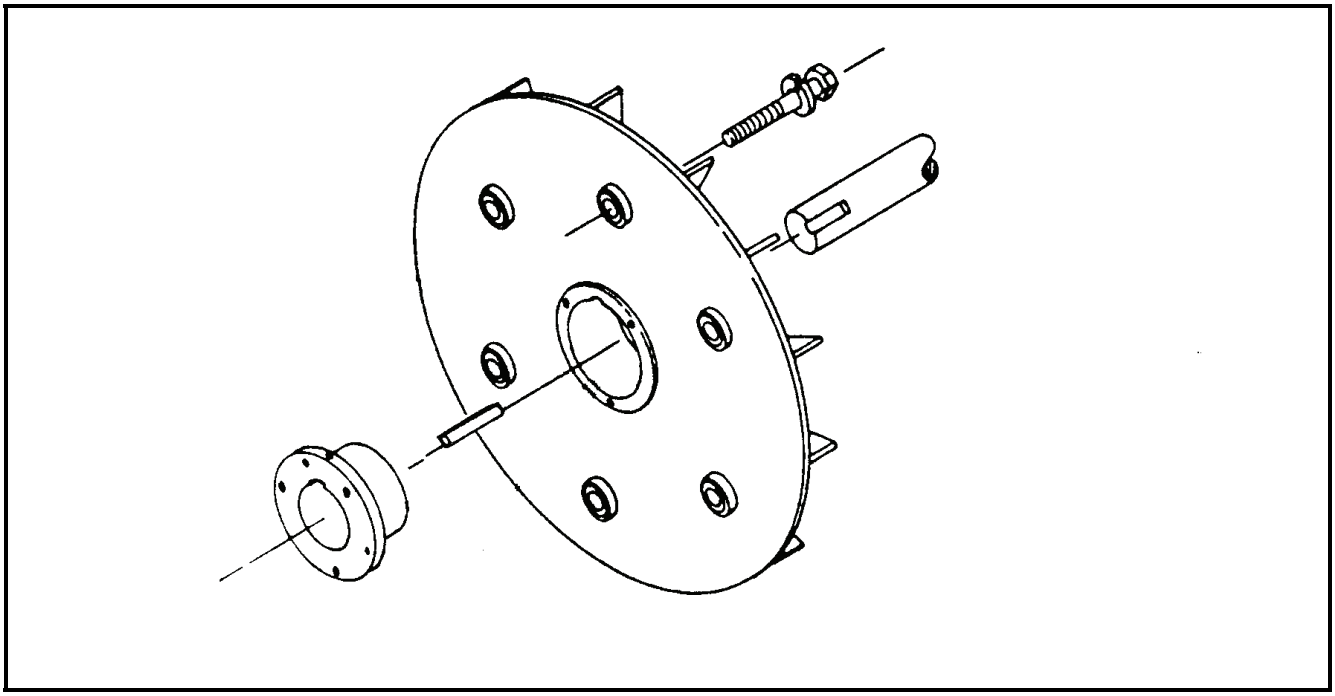
d) After 200 hours of operation, check all coupling bolts with a torque wrench set at 85 foot-pounds *(115 N-m).*

e) Return the unit to normal service.

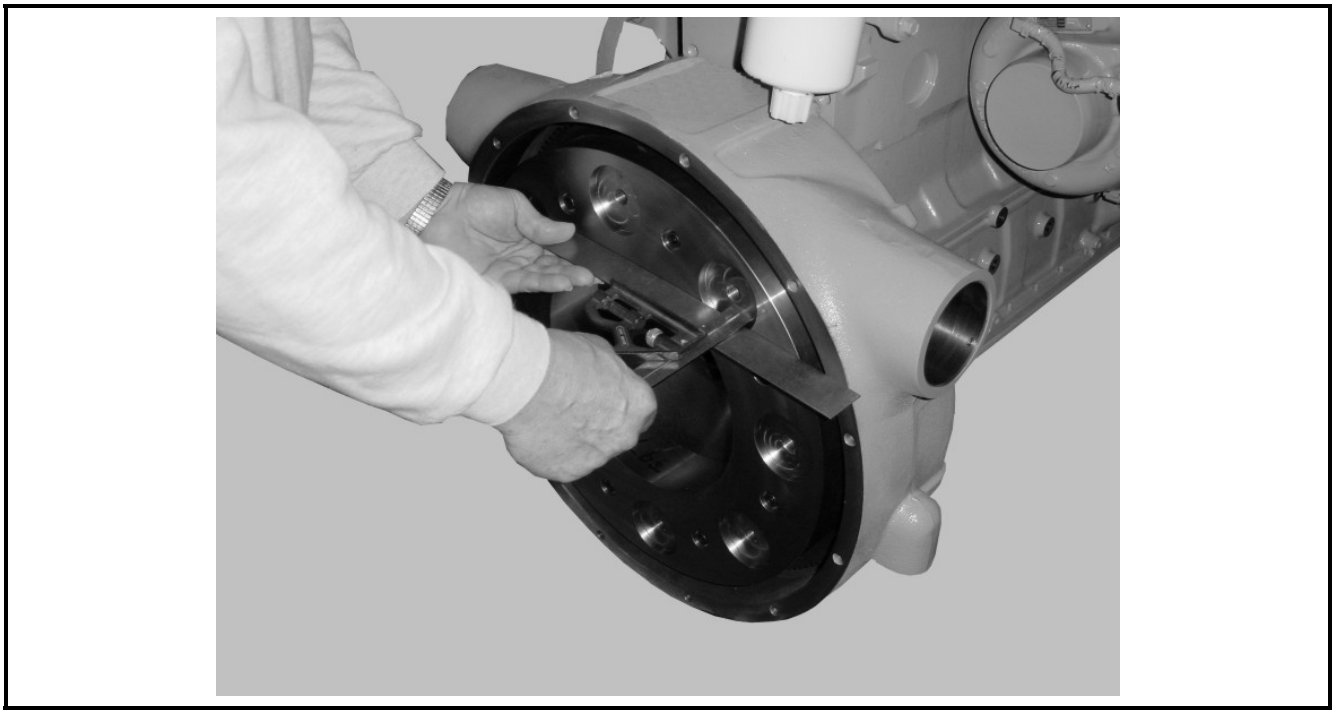
f) After each additional 2,000 hours of operation *(or every year),* recheck all coupling bolts to maintain the same torque value.



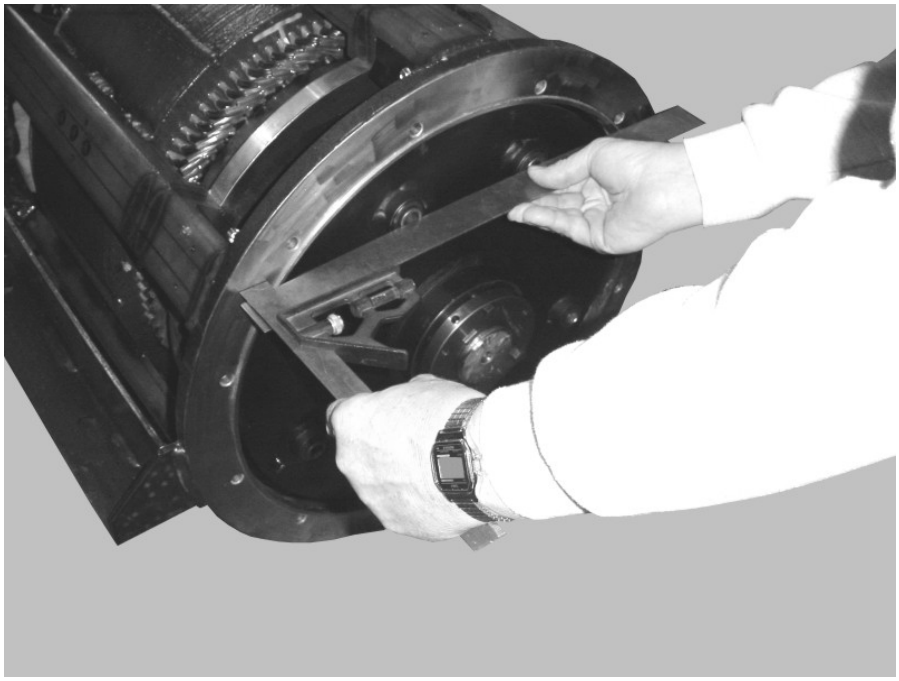
Bushing Installation
Figure 4



Assembly Procedure
Figure 5



Measure from mounting face to adapter ring
Figure 6



Measuring From Mounting Face To Bushing
Figure 7

Section 3 Generator Assembly

1) General

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

2) Generator Assembly Removal

a) Procedure for Gaining Access to the Generator

WARNING

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

When removing generator assembly, refer to Figure 2 and Connection Diagram in Chapter 5 and proceed as follows:

(1) Disconnect battery leads from the generator set.

(2) Remove top charge air cooler hood (1).

(3) Remove bottom charge air cooler hood (2) and bottom charge air cooler gasket (3).

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

(5) Disconnect clearance light wires from the top canopy (4), if installed.

(6) Remove top canopy panel (4).

(7) Remove the left front (5) and right front (6) doors.

(8) Remove the following: right front lower panel (8) and left front lower panel (7). Disconnect the clear power module cover (9) from the angle bracket on the frame and loosen cable clamps to so that the aircraft cables can be disconnected from the load contactors on the power module (10).

(9) Disconnect plug connectors from the back of the control box (11).

(10) Remove the control box (11).

(11) Remove the air cleaner (12) and the pipe/hoses connecting it to the engine.

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

(12) Remove the generator stator leads from the power module (10).

(13) Route wire harness through the bulkhead panel (13) towards the engine compartment, so that the front canopy panel (14), the control box support panel (15), power module assembly (10), and the bulkhead panel (13) can be lifted off the unit in a one piece assembly.

(14) Remove the generator housing cover (16).

b) Removing the generator Assembly

(1) Remove the four 5/8 - 11 x 4-1/2 bolts that mount the generator assembly to the frame of the generator set.

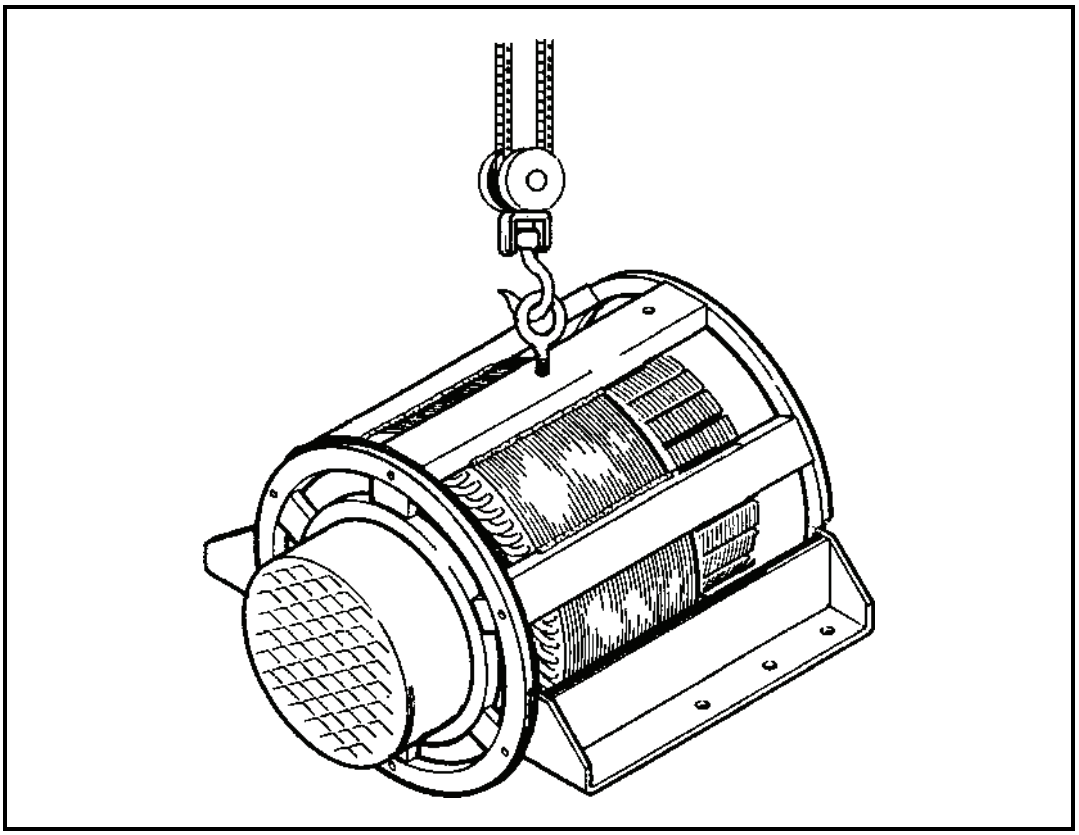
(2) Support the engine at the flywheel housing with wooden blocks, or second hoist if available.

(3) Using the hoist, support the generator assembly. For lifting convenience, a M12-1.75 threaded hole is drilled in the top of the generator housing. Insert a M12-1.75 eyebolt in the hole and attach the hoist chain to the eyebolt as shown in Figure 1.

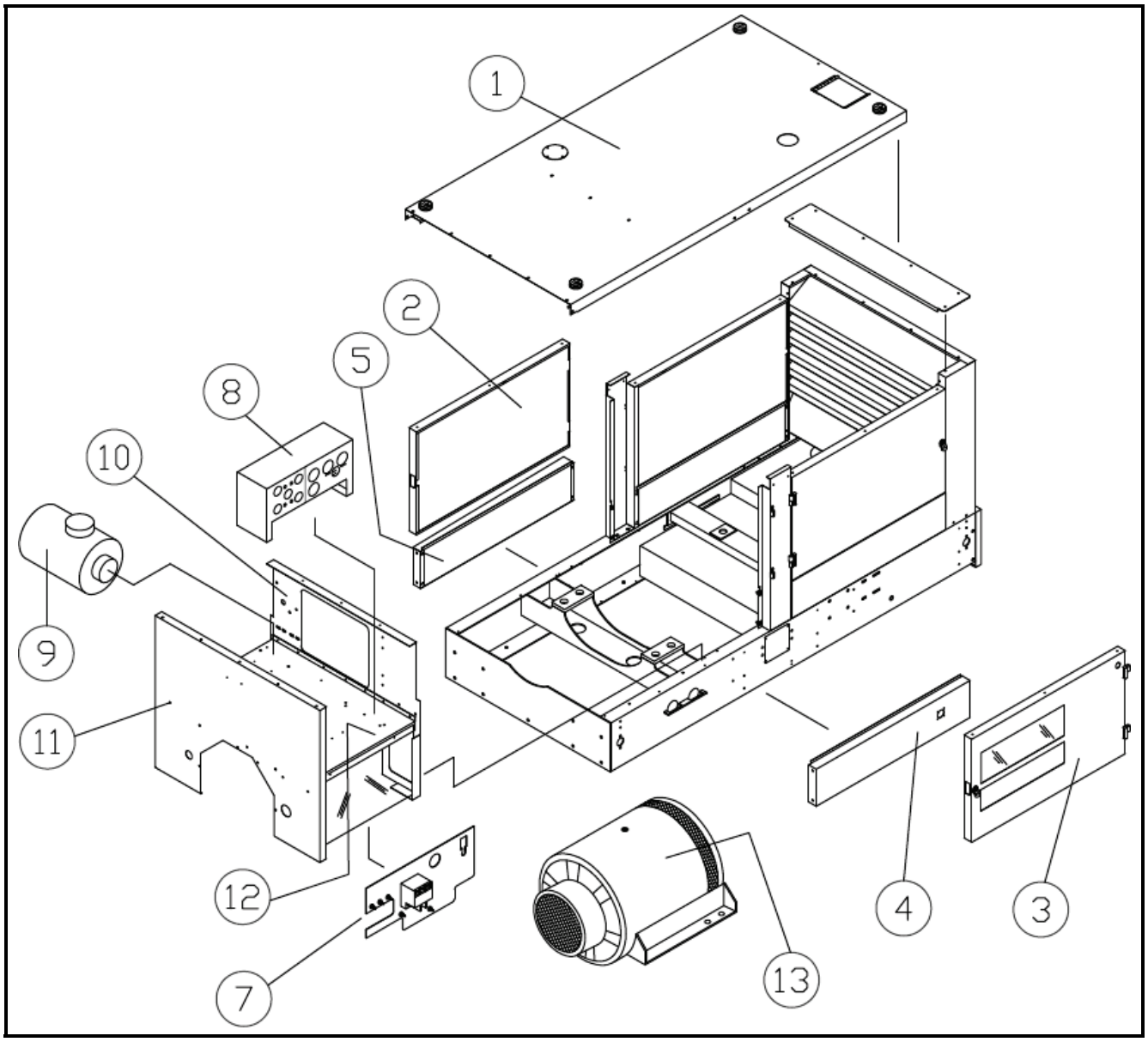
(4) Remove the M12-1.75 bolts generator-to-flywheel coupling bolts.

(5) Detach the generator housing from the engine. Do this by removing the six M10 - 1.5 x 35 metric bolts.

(6) Carefully lift and separate the generator from the engine.



Generator Lifting Arrangement
Figure 1



1. Canopy Top Assembly
2. Right Front Door
3. Control Box Door (Left Front Door)
4. Left Front Lower Panel
5. Right Front Lower Panel
6. Power Module Cover
7. Power Module Assembly
8. Control Box Assembly
9. Air Filter Assembly
10. Bulkhead Panel
11. Front Canopy Panel
12. Control Box Support
13. Generator Cover

Component Removal Required for Access to Generator
Figure 2

3) Generator Assembly Installation

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

a) Remounting the Generator Assembly

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

(2) Using the hoist, support the generator assembly and lower it carefully and slowly into position for attachment to the engine.

(3) While still supporting the generator assembly with the hoist, attach the generator housing to the engine, using the six M10 - 1.5 x 35 metric bolts. Torque bolts to 30 ft-lb (41 N-m).

(4) Attach the generator to the flywheel coupling, using the eight M12-1.75 bolts. Torque bolts to 85 ft-lb (115 N-m).

(5) Mount the generator housing to the frame of the generator set, using the four 5/8 - 11 x 4-1/2 bolts.

(6) Install the generator wrapper on the generator assembly, using 1/4 - 20 x 1/2 tap-tite screws.

b) Remounting the previously removed assemblies

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

Chapter 4 Illustrated Parts List

Section 1 Introduction

1) General

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

2) Purpose

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

3) Arrangement

Chapter 4 is arranged as follows:

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

4) Explanation of Parts List

a) Contents

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

- Standard hardware items (attaching parts) such as nuts, screws, washers, etc., which are available commercially
- Bulk items such as wire, cable, sleeving, tubing, etc., which are also commercially available
- 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 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:

Model Code	Part & Dash Number	Mounting	AC Outputs	28.5 VDC Output	Fuel Tank
A	500392E-001	Trailer	1	--	Stainless
B	500392E-002	Trailer	2	--	Stainless
C	500392E-003	Fixed/Truck	1	--	Stainless
D	500392E-004	Fixed/Truck	2	--	Stainless
E	500392E-005	Trailer	1	Yes	Stainless
F	500392E-006	Trailer	2	Yes	Stainless
G	500392E-007	Fixed/Truck	1	Yes	Stainless
H	500392E-008	Fixed/Truck	2	Yes	Stainless
J	500392E-101	Trailer	1	--	Composite
K	500392E-102	Trailer	2	--	Composite
L	500392E-103	Fixed/Truck	1	--	Composite
M	500392E-104	Fixed/Truck	2	--	Composite
N	500392E-105	Trailer	1	Yes	Composite
P	500392E-106	Trailer	2	Yes	Composite
R	500392E-107	Fixed/Truck	1	Yes	Composite
S	500392E-108	Fixed/Truck	2	Yes	Composite

Parts with no model code in the EFF column are used on all models.

(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. If a manufacturer does not have a code, the manufacturer's full name is listed in the nomenclature column.

Code	Vendor's Name and Address
D0024	SEMIKRON ELEKTRONIK GMBH Sigmundstrasse 200 P.O. Box 82 02 51 Nuernberg, Germany 90431
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
0CYC7	Western Rubber & Supply 7888 Marathon Dr Ste Livermore, CA 94550 - 9314
0E8J0	Emka Inc. 1961 Fulling Mill Rd. Middletown, PA 17057-3125
0HZP9	Diesel Radiator Co. 1985 Janice Ave. Melrose Park, IL 60160-1008
0MR72	Henkel Corp 26941 Cablot Rd, Suite 124 Laguna Hills, CA 92653-7007
0TSE6	Infineon Technologies Industrial Power Inc. 1050 US HWY 22 Lebanon, NJ 08833-4208
00779	Tyco Electronics (Amp) 2800 Fulling Mill Rd Bldg-38 Middletown, PA 17057 - 3142

Code	Vendor's Name and Address
01XD4	Contact Industries Inc 25 Lex-Industrial Dr Mansfield OH 44903 - 8699
01428	Tuthill Corporation DBA Tuthill Controls Group 2110 Summit St. New Haven, IN 46774-9524
02660	Amphenol Corp. Spectra-Strip/ltd 40-60 Delaware Ave SIDNEY, NY 13838 - 1395
02768	Illinois Tool Works Inc. Fastex Division 195 S. Algonguin Rd. Des Plaines, IL 60016-6197
02929	Newark Electronics Div 4801 N Ravenswood Ave Chicago, IL 60640 - 4457
05HB5	Magnecomp Inc. 161 Eagles Nest Dr Pickens, SC 29671-7808
05YB3	Acon Inc. 22 Bristol Dr. South Easton, MA 02375-1108
1AA44	Collmer Semiconductor Inc. 2542 Highlander Way Carrollton, TX 75006
1DG36	Phillips And Temro Industries Inc E. M. Products Inc. 5380 Cottonwood Ln Prior Lake, MN 55372

Code	Vendor's Name and Address
1DL99	Fleetguard Inc. Div. of Cummins Engine Company 311 N. Park Street Lake Mills, IA 50450 - 1299
1E045	Austin Hardware and Supply Co. 950 Northwest Technology Dr Lees Summit, MO 64086 - 5692
1SPJ9	Hobart Ground Power 1177 Trade Road East Troy, OH 45373
1W134	Eaton Corp. 4201 N. 27TH St Milwaukee, WI 53216-1897
12662	Peterson Mfg Co. 4200 E 135th St Grandview MO 64030-2896
13445	Cole-Herse 20 Old Colony Ave. Boston, MA 02127-2405
14552	Microsemi Corporation 2381 Morse Ave Irvine, CA 92614-6233
14799	Square D Company, Inc Dba Schneider Electric USA, Inc. 9522 Winona Ave Schiller Park, IL 60176-1084
16476	Maxima Technologies & Systems Llc 1811 Rohrerstown Rd Lancaster, PA 17601-2321
18265	Donaldson Company Inc. DBA Torit Products 1400 W. 94th St. Minneapolis, MN 55431-2370
2B428	MJO Industries Inc. DBA Hughes-Peters 8000 Technology Blvd. Huber Heights, OH 45424 - 1573
2B664	All-Phase Electric Supply Co 1620 W Main St P.O. Box 149 Springfield OH 45501-0149

Code	Vendor's Name and Address
2N562	Power Transmission Sales Inc. 531 Washington P.O. Box 229 Chagrin Falls, OH 44022-0229
23803	N T N Bearing Corp of America 191 Sheree Blvd Ste 101 Exton PA 19341-1265
24161	Gates Corporation 900 S Broadway Denver CO 80217-5887
24446	General Electric Co. 3135 Easton Tpke. Fairfield, CT 06431
25710	Deka Plastics Inc. 914 Westfield Ave. Elizabeth, NJ 07208-1222
27410	Harris Corp. 1025 W NASA Blvd. Melbourne, FL 32901
28520	Heyco Inc. 1800 Industrial Way N. Toms River, NJ 08755-4809
3A054	McMaster Carr Supply Co. 9630 Norwalk Blvd. Santa Fe Springs, CA 90670-2932
3Y208	Taylor And Summerville Battery Co 3485 Successful Way Dayton Oh 45414-4319
30104	Automotive Controls Corp. 1300 W. Oak St. P.O. Box 788 Independence, KS 67301-0788
30430	Marathon Electric Mfg. Corp. 398 Beach Rd. Burlingame, CA 94010-2004
311K7	Kissling Electrotec Incorporated 320 Business Pkwy, Ste A Greer, SC 29651
38151	Marathon Electric Mfg. Co. 100 E. Randolph St. Wausau, WI 54401-2568

Code	Vendor's Name and Address
39TH9	Motion Industries Inc. 8580 Industry Park Dr. Piqua, OH 45356-8535
40121	Peterson Mfg. Co. Inc. 700 W. 143rd St. Plainfield, IL 60544-9733
44655	Heico Ohmite LLC 1600 GOLF RD 850 ROLLING MEADOWS, IL 60008-4204
46922	Crawford Electric Co 445 E 32 Mile Rd Romeo MI 48065-5270
49234	Protectoseal Company 225 W Foster Ave Bensenville, IL 60106-1631
5N8K3	Alpha Devices 11963 Abbey Rd. Cleveland, OH 44133
5P059	Tech Products Corp. 2215 Lyons Rd Miamisburg, OH 45342-4465
50508	Magnetic Components Inc. 9520 Ainslie St. Schiller Park, IL 60176-1191
52793	Saginaw Products Corp. DBA CIGNYS 68 Williamson St. Saginaw, MI 48601-3246
54646	Clampco Products Inc. 1743 Wall Road Wadsworth, OH 44281-9558
55752	Parker Hannifin Corp. DBA Racor Div. 3400 Finch Rd. Modesto, CA 95354-4125
56289	Sprague Electric Company 678 Main St Sanford, MA, 04073-7003
57330	Remke Industries Inc. 310 Chadick Drive Wheeling, IL 60090-6039

Code	Vendor's Name and Address
57347	Wall Industries Inc. 5 Watson Brook Rd. Exeter, NH 03833-4589
57733	Stewart-Warner Corporation 333 Ludlow St Stamford, CT 06902-6987
59656	Dean Technology Inc. DBA CKE 1000 Lucerne Road Lucernemines, PA 15754-0211
6S553	Wes-Garde Components Group Inc 300 Enterprise Dr Westerville, OH 43081-8840
6Y440	Micron Technologies Inc. 8000 S. Federal Way Boise, ID 83716-7128
60038	Timken Corporation 1835 Dueber Ave Sw Canton, OH 44706-2728
61706	EAO Switch Corporation 98 Washington St. Milford, CT 06460-3133
62292	EBM Industries Inc. 110 Hyde Rd. P.O. Box 4009 Farmington, CT 06034-4009
62445	Deutz Corporation 3883 Steve Reynolds Blvd Norcross Ga 30093
66180	Automatic Timing and Controls 3312 Bloomingdale Melrose Park, IL 60160-1030
66844	Powerex Inc. 173 PAVILION LN Youngwood, PA 15697-1800
7M613	Wright F.B. Co. of Cincinnati 4689 Ashley Dr. Hamilton, OH 45011-9706
71382	Seal Master Bearings Sub Of Emerson Electric Co. 1901 Bilter Rd. Aurora, IL 60502-9704

Code	Vendor's Name and Address
71400	Cooper Bussmann Inc. 114 Old State Road Ellisville, MO 63021-5942
72619	Dialight Corporation 1501 State Rte 34 S Farmingdale, NJ 07727-3932
74400	Hobbs Corporation 1034 East Ash Street PO Box 19424 Springfield, IL 62794-9424
74542	Hoyt Electrical Instruments 23 Meter ST. Concord, NH 03303-1894
74545	Hubbell Inc Wiring Device Div 185 Plains Road Milford, CT 06460
74829	Ilsco Corp. 4730 Madison Rd. Cincinnati, OH 45227-1426
75418	Kysor Industrial Corporation 1 Madison Ave Cadillac, Michigan 49601-9784
75915	Littelfuse, Inc. 8755 W Higgins Road Ste 500 Chicago, IL 60631 - 2701
77342	TYCO Electronics Corporation 8010 Piedmont Triad Pkwy Greensboro, NC 27409
78388	Woodward Controls Inc. 6250 W Howard St Niles, Il 60714-3433
8A334	Cummins Bridgeway LLC 2297 SW Blvd Ste K Grove City, OH 43123-1822
8T246	Whitesell RO & Associates, Inc. 7009 CORPORATE WAY Dayton, OH 45459-4238
81483	International Rectifier Corp 233 Kansas St. El Segundo, CA 90245
81703	Mulberry Metal Products Inc. 2199 Stanley Terrace Union , NJ 07083-4399
82866	Research Products Corp. P.O. Box 1467 1015 E. Washington Ave. Madison, WI 53701
86797	Rogan Corp 3455 Woodhead Dr. Northbrook, IL 60062-1812
9Y826	Marsh Electronics Inc. 1563 S. 101st St. Milwaukee, WI 53214-4032
91637	Vishay Dale Electronics Inc. 1122 23RD St. Columbus, NE 68601-3647
91929	Honeywell International Inc. DBA Honeywell 11 W. Spring St. Freeport, IL 61032-4316
94222	Southco Inc. 210 N. Brinton Lake Rd. Concordville, PA 19331
97520	Basler Electric Company Route 143 Highland, IL 62249-1074

Section 3 Illustrated Parts List

1) Explanation of Parts List Arrangement

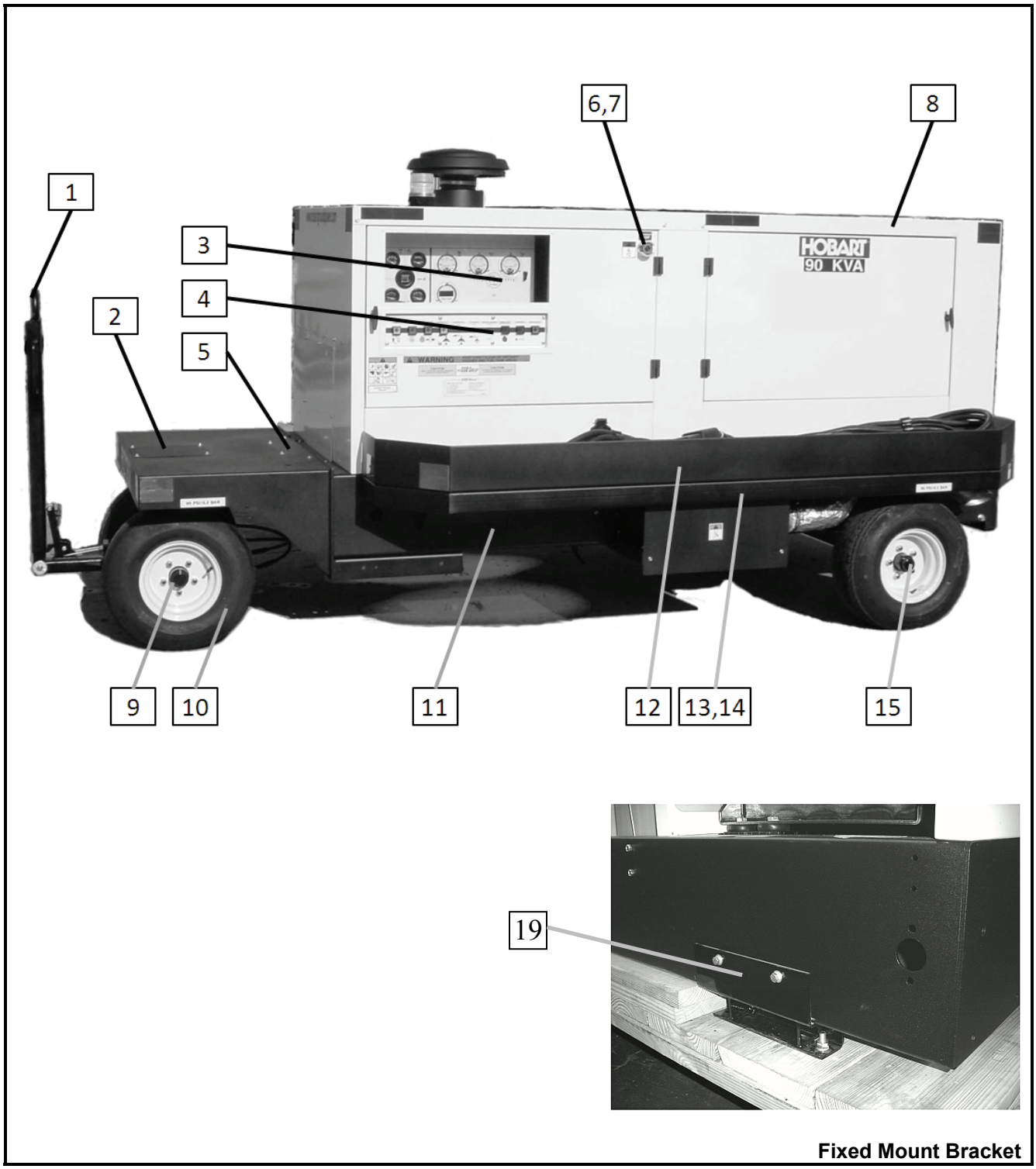
The parts list is arranged so that the illustration will appear on a left-hand page and the applicable parts list will appear on the opposite right-hand page. Unless the list is unusually long, the user will be able to look at the illustration and read the parts list without turning a page.

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	-	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

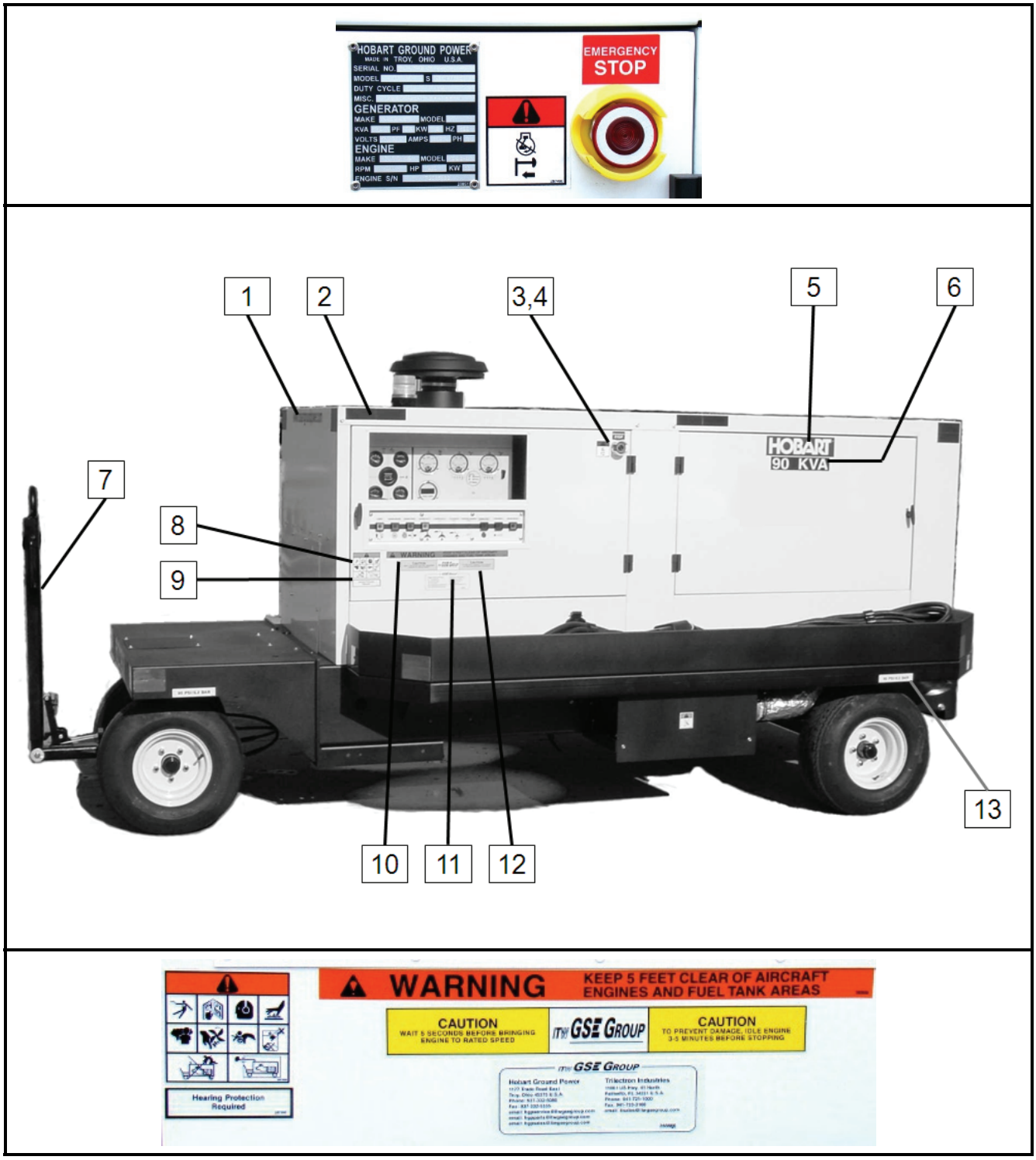
NOTE: An item which does not reflect an index number is an assembly which is not illustrated in its assembled state, or it is similar (right-hand, left-hand, top, etc.) to an item which is illustrated.



Fixed Mount Bracket

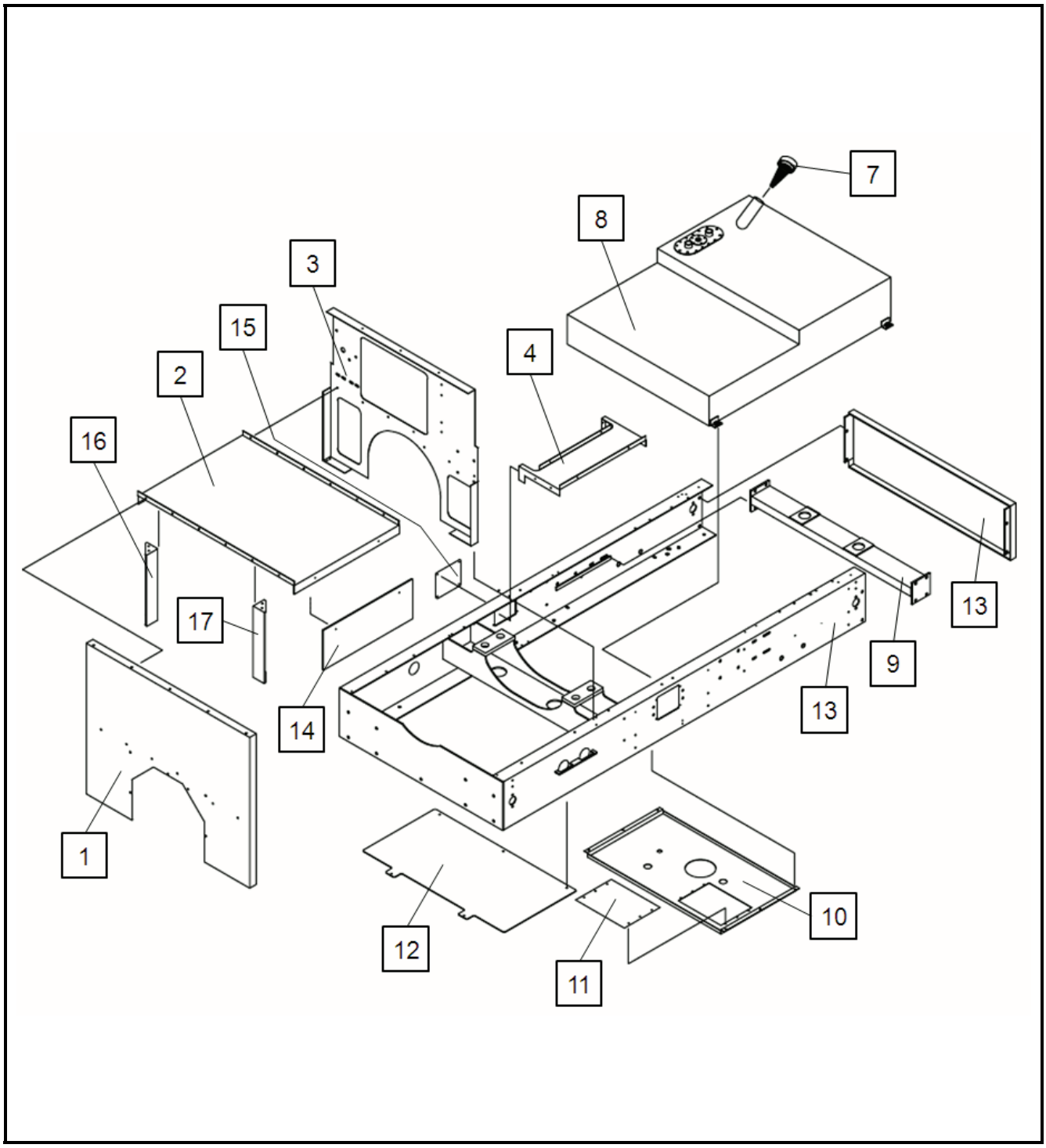
General Assembly
Figure 1

FIGURE ITEM NO.		HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
1-	1	286956	Draw Bar (all trailer mount units)	A,B,E,F,J,K,N,P	1
	2	282667	Bracket, Pivot Arm Assembly	A,B,E,F,J,K,N,P	1
		282727	…Cover, Plate, Pivot Arm	A,B,E,F,J,K,N,P	1
*		280763	…Plate, Bearing	A,B,E,F,J,K,N,P	1
*		408781-001	…Pin, Spring	A,B,E,F,J,K,N,P	2
	3		Control Box Door (See Figure 7)		Ref.
	4		Pushbutton Switches (See Figure 9)		Ref.
	5	288700	Cover, 5th Wheel Opening	A,B,E,F,J,K,N,P	
	6	285125	Guard, Mushroom Button *(V14799 # K564M)*		1
	7	77A1157	Switch, Maintained, Push-Pull *(V14799 #KR-9R-H6)*		1
	8		Canopy Assembly (See Figure 3)		Ref.
	9	287120	Front, Axle	A,B,E,F,J,K,N,P	1
		W11439-001	…Fitting, Grease, Screw Type	A,B,E,F,J,K,N,P	1
	10	285418	Tire, 20.5 x 8.00 – 10	A,B,E,F,J,K,N,P	4
	11		Frame Assembly (See Figure 2)		Ref.
	12	288696	Tray, Cable, Left	A,B,E,F,J,K,N,P	1
*		288695	…Cover, AC Cable	A,B,E,F,J,K,N,P	1
	13	287376	Bumper, Side	A,B,E,F,J,K,N,P	2
	14	287377	Support, Fender	A,B,E,F,J,K,N,P	4
	15	288703	Rear, Axle	A,B,E,F,J,K,N,P	1
*	16	288697	Tray, Cable, Right	A,B,E,F,J,K,N,P	1
*		288698	…Cover, DC Cable	A,B,E,F,J,K,N,P	1
*		288694	…Panel, Cable Guide	A,B,E,F,J,K,N,P	1
*	17	7J422-000	Clamp, Cable (1 output, no DC)	A,C,J,L	2
*			Clamp, Cable (2 output, no DC)	B,D,K,M	4
*			Clamp, Cable (1 output with DC)	E,G,N,R	3
*			Clamp, Cable (2 output with DC)	F,H,P,S	5
*	18	287491	Shield, Heat, Tray, Cable	A,B,E,F,J,K,N,P	1
	19	287892	Mount, Stationary (fixed-mount units)	C,D,G,H,LM,R,S	4
*	20	100GH121	Bracket, Mounting, Cable Clamp	A,C,J,L	1
			Bracket, Mounting, Cable Clamp	B,D,E,G,K,M,N,R	2
			Bracket, Mounting, Cable Clamp	F,H,P,S	3



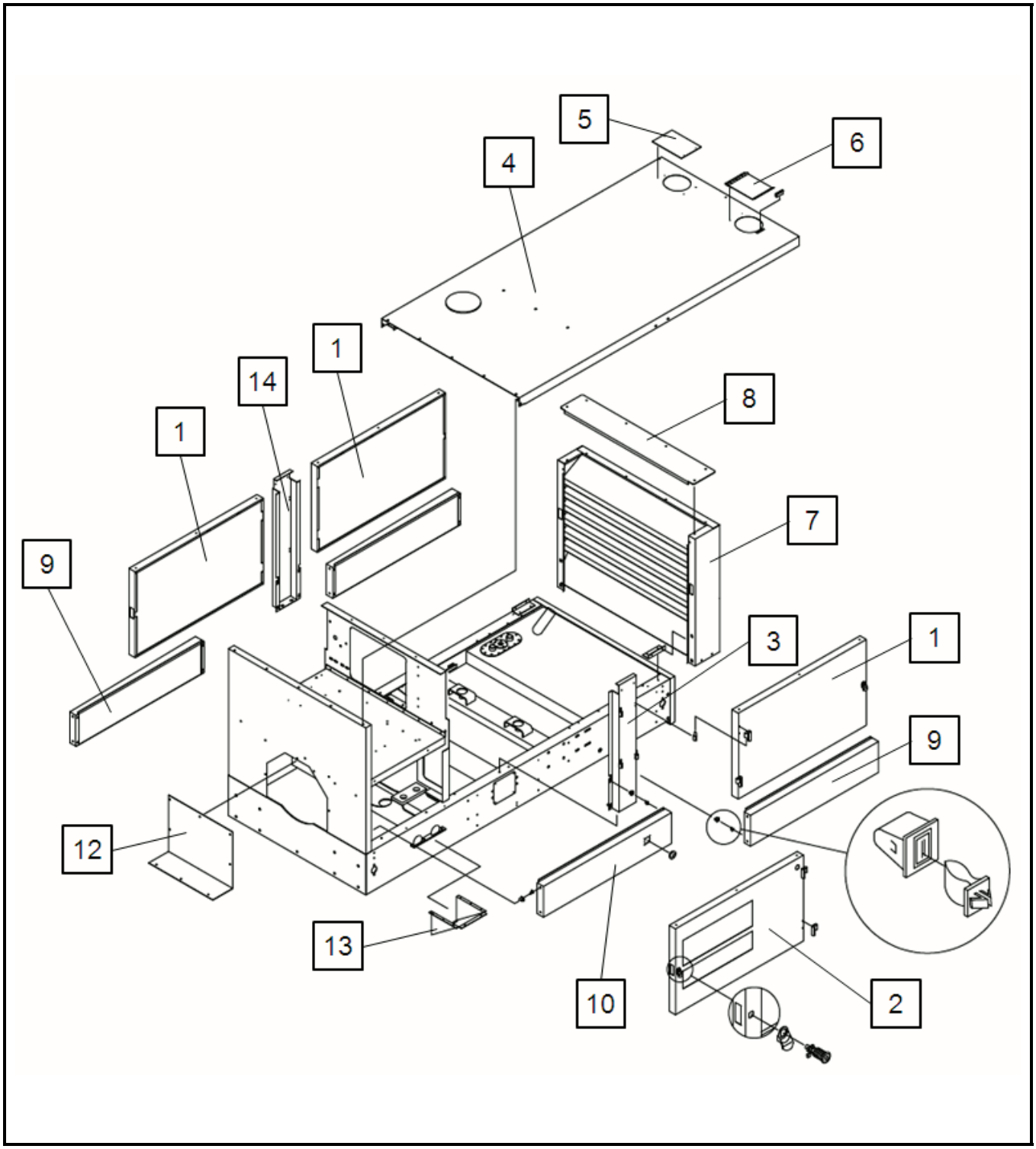
Labels and Reflectors
Figure 2

FIGURE ITEM NO.		HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
2-	1	289842-001	Label, www.hobartgroundpower.com		1
	2	408665-002	Reflector, Amber *(V12662 #B491A)*		32
	3	287466	Label, Emergency Stop		1
	4	288300	Plate, Legend, Emergency Stop		1
	5	402987	Label, Hobart		3
	6	283714-002	Label, kVA Rating (90)		2
	7	287465	Label, Warning Drawbar (trailers)	A,B,E,F,J,K,N,P	2
	8	287459	Label, General Warnings		1
	9	287696	Label, Hearing Protection		1
	10	282658	Label, Warning Clearance		1
	11	288862	Label, Caution, Engine Speed		1
	12	288866	Label, Support Center		1
	13	287571	Label, Tire Pressure (trailer units)	A,B,E,F,J,K,N,P	4
*	14	288917-002	Label, I.D.		1
*	15	288918-002	Label, Options (Inside Control Box)		1
*	16	76B1148	Label, Diesel Fuel		1
*	17	287460	Label, High Voltage (no DC)	A,B,C,D,J,K,L,M	3
*			Label, High Voltage (with DC)	E,F,G,H,N,P,R,S	4
*	18	287461	Label, Fuel		1
*	19	287462	Label, Radiator		1
*	20	287463	Label, Hot Muffler		2
*	21	287464	Label, Moving Parts		2
*	22	288872	Label, Command & Fault		1
*	23	408665-001	Reflector, Red (V12662 #B491) (on back)		20
*	24	289127	Label, Option, Terminal Block		1
*	25	287467	Label, Glow Plug		2
*	26	290216	Label, Low Emissions		1
*	27	291609	Label, Emission Control		1
*	28	288164-001	Label, AC/DC	E,F,G,H,N,P,R,S	2



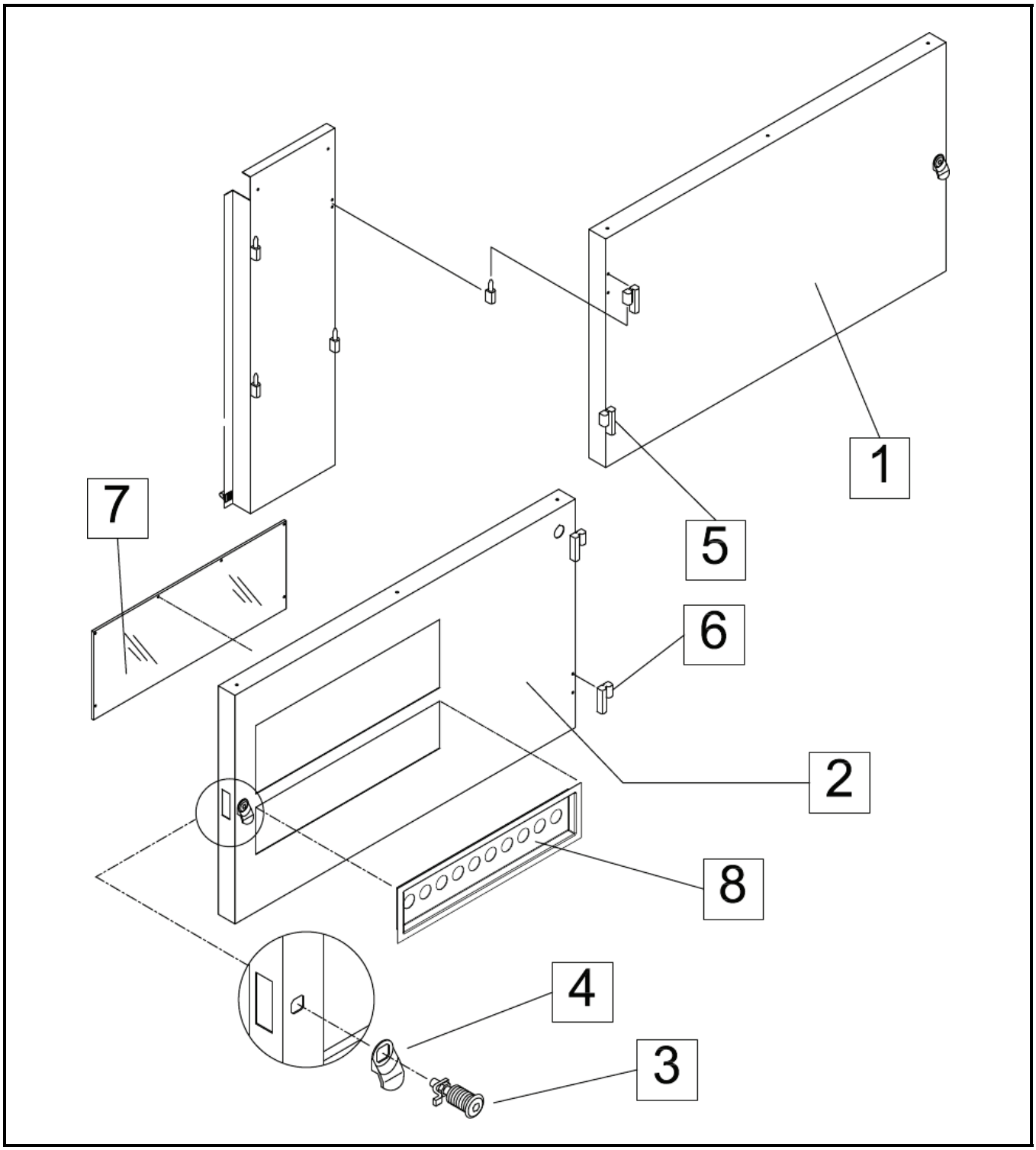
Frame Assembly
Figure 3

FIGURE ITEM NO.		HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
3 -	1	288879	Panel, Front Canopy		1
*		287738-025	…Insulation, Top		1
*		287738-029	…Insulation, Left Center		1
*		287738-030	…Insulation, Left		1
*		287738-031	…Insulation, Right Center		1
*		287738-032	…Insulation, Right		1
	2	288691A	Support, Control Box		1
	3	288835A	Panel, Bulkhead, Center		1
	4	289224	Tray, Battery		1
	5	289223-001	Battery Tray, Bracket, Right Hand		1
	6	289223-002	Battery Tray, Bracket, Left Hand		1
*		289239	…Pad, Battery Tray		1
	7	282562	Cap, Fuel *(V49234 #1275/0003)*		1
	8		Tank, Fuel (see Figure 13)		Ref.
	9	289557	Support, Engine, Front (see also Figure 17)		1
	10	287739	Panel, Bottom, Bellypan		1
*		287738-003	…Insulation, Bottom, Panel		1
	11	287437	Cover, Panel, Bottom		1
	12	288701	Panel, Bottom, Generator		1
*		288702-007	…Insulation, Noise, Bottom, Generator		1
	13	288704	Frame Assembly		1
	14	288882	Cover, Power Module		1
	15	287506	Cover, Frame, Exhaust		1
	16	288692	Leg, Control Box Support, Left		1
	17	288693	Leg, Control Box Support, Right		1
*	18	288699	Cover, Frame		1



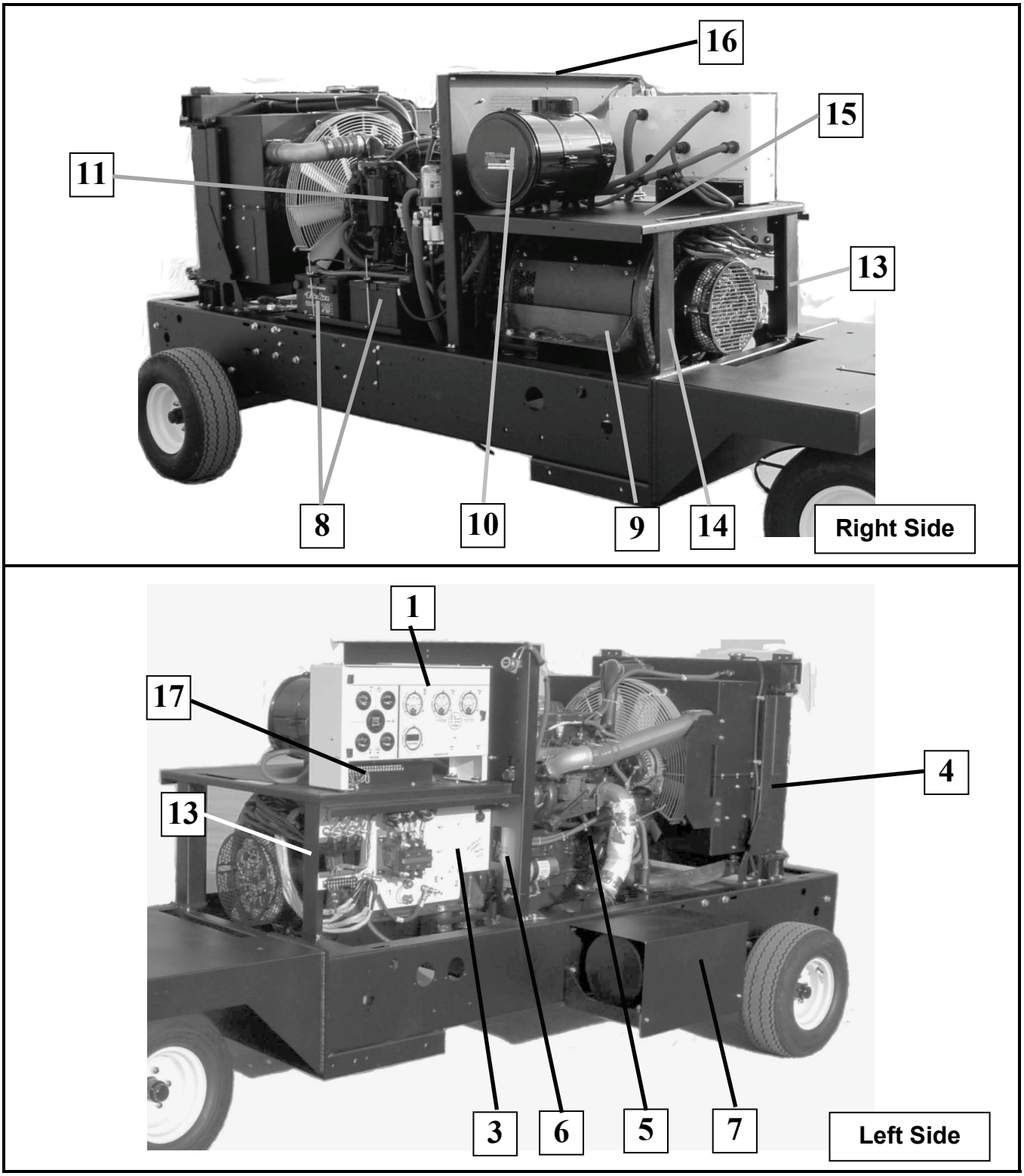
Canopy Assembly
Figure 4

FIGURE ITEM NO.		HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
4-	1	287701	Door Assembly (see Figure 5)		3
	2	288880	Door, Control Box (see Figure 5)		1
	3	288544	Panel, Support Door		1
*		287738-020	…Insulation, Panel, Door Support		2
	4	289979	Top, Canopy Assembly		1
		288912	…Kit, Clearance Lights (Optional)		Ref.
*		287738-021	…Insulation, Noise, Canopy Top, Rear		1
*		287738-022	…Insulation, Noise, Canopy Top, Front		1
	5	288919	Cover, Radiator Hole		1
	6	283647	Door, Radiator Access		1
*		403127	…Catch, Magnetic *(V94222 #02-10-201-10)*		1
	7	287819	Panel, Rear Assembly		1
*		287805	…Deflector, Radiator, Left		1
*		287806	…Deflector, Radiator, Right		1
*		287793	…Bracket, Mounting Plenum		2
	8	287889	Cover, Louver Panel		1
	9	287703	Panel, Side, RR, RF, and LF		3
*		287738-004	…Insulation, Noise, Lower Panel		3
		287785	…Fastener, Panel, Access		12
			(VA5733 #7800-00 & #263-000006-00-0017)		
	10	288878	Panel, Side, Left Front		1
*		287738-027	…Insulation, Noise, Lower Panel		1
		287785	…Fastener, Panel, Access		4
			(VA5733 #7800-00 & #263-000006-00-0017)		
*	11	403091-008	Plug, Hole, Heater, 1.75 *(V28520 #DP-1750)*		1
	12	287808	Cover, Opening, Front Canopy		1
	13	288694	Panel, Cable Guide		1
	14	291704	Panel, Support, Door, MD (see Figure 15)		1



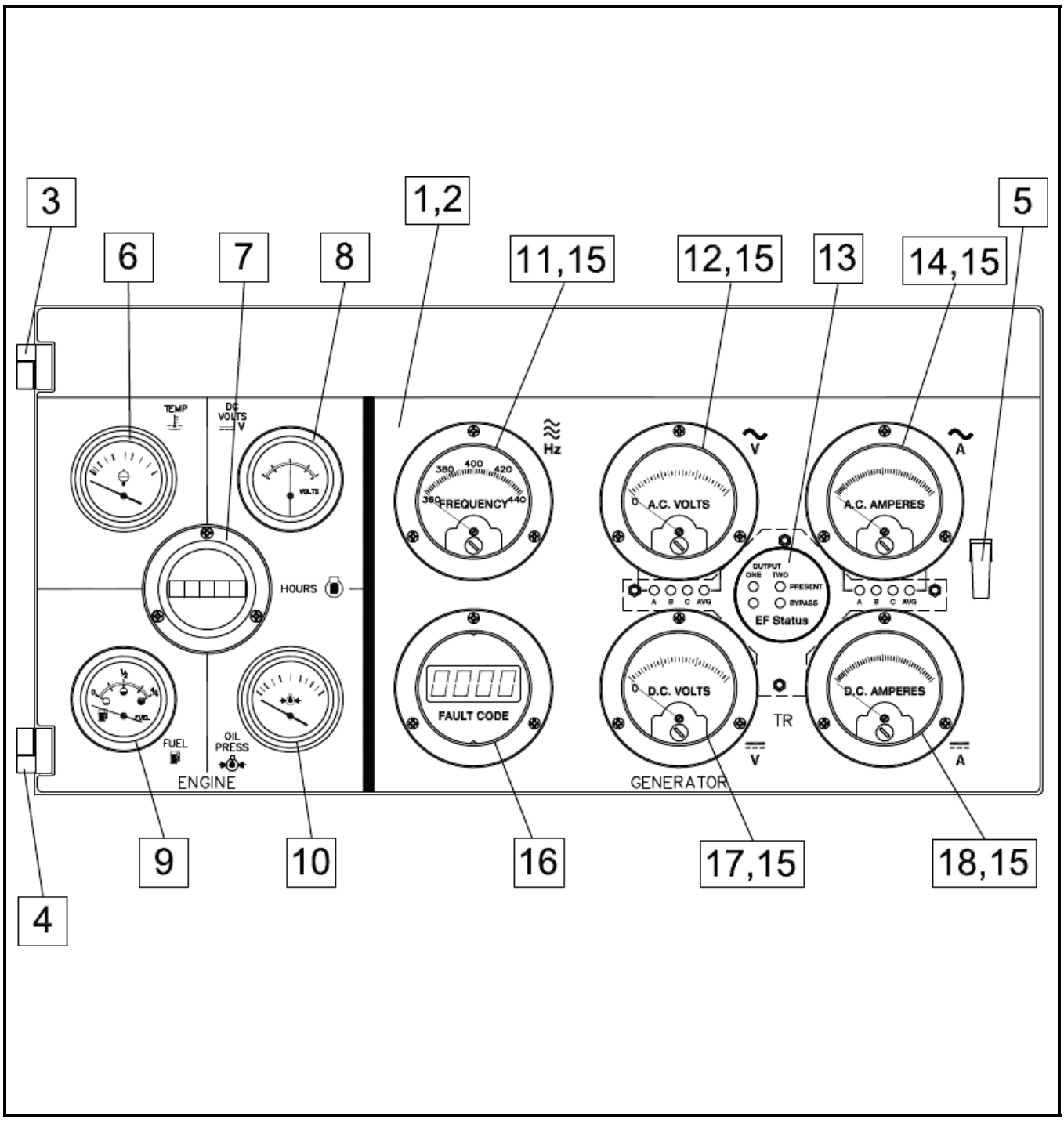
Canopy Doors
Figure 5

FIGURE ITEM NO.		HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
5 -	1	287701	Door, Assembly		3
*		287738-001	…Insulation, Noise, Door		3
	2	288880	Door, Control Box		1
*		287738-028	…Insulation, Noise, Door		1
	3	287542-001	Latch, Door, Hex *(V94222 #E3-16-15)*		4
	4	287526-002	Tab, Pull, Door Latch *(V94222 #E3-27-1)*		4
	5	283824	Hinge, RH Access Door *(V94222 #96-10-520-50)*		4
	6	283597	Hinge, LH Access Door *(V94222 #96-10-510-50)*		4
	7	288881	Window, Control Side Door		1
	8	291679	Guard, Button		1
*		291681	…Channel, Bottom, Button Guard		1
*		291682	…Channel, Left, Button Guard		1
*		291683	…Channel, Right, Button Guard		1
*		291684	…Shim, Button Guard		1



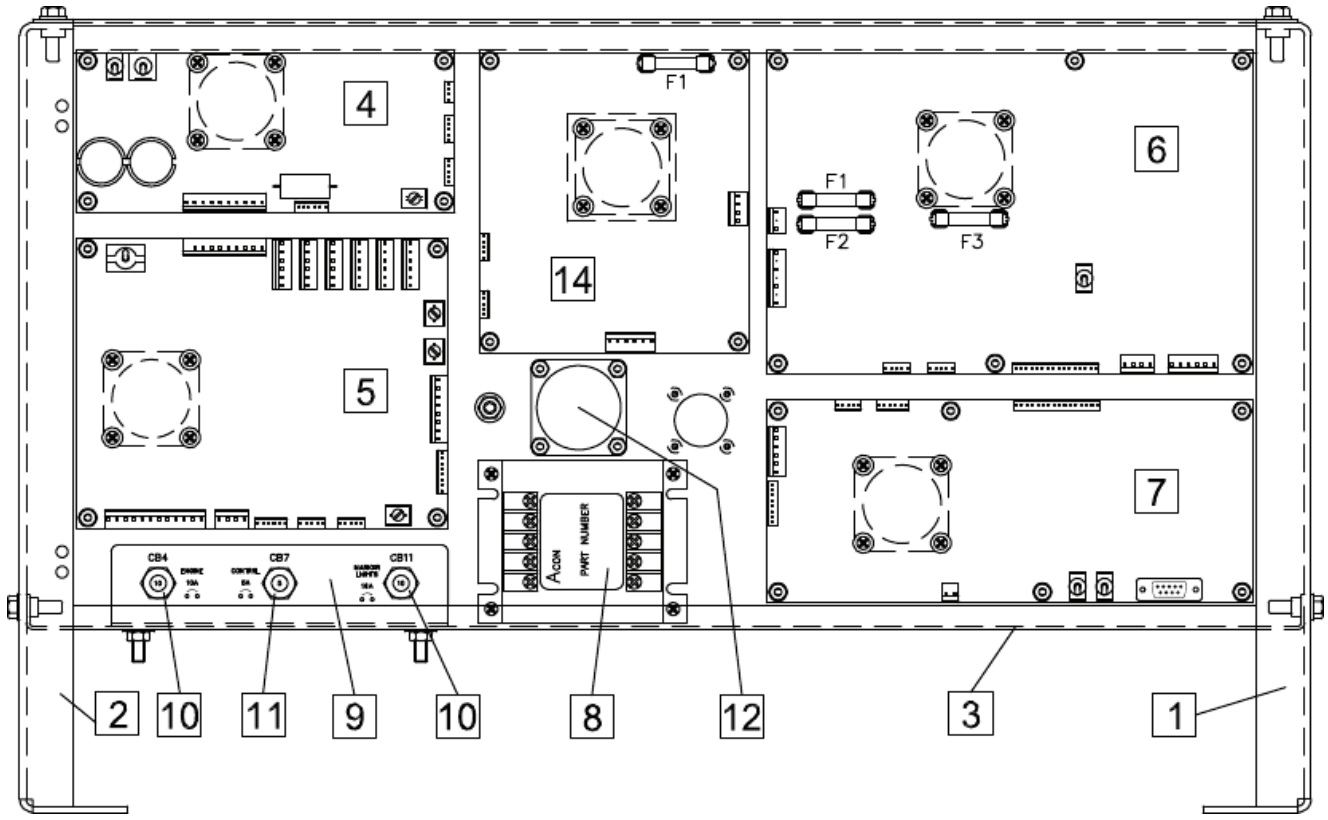
Internal Components
Figure 6

FIGURE ITEM NO.		HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
6 -			**Left Side**		
	1		Control Box Assembly (see Figures 7 and 8)		Ref.
*		289593-001	…Mount, Rubber *(V5P059 #51225)*		4
	2		Control Switch Panel Assembly (see Figure 9)		Ref.
	3		400 Hz. Power Module (see Figure 10)		Ref.
*		288882	…Cover, Power Module		1
	4		Cooling System Components (See Figure 11)		Ref.
	5		Engine Ground Plate and Cables (See Figure 12)		Ref.
	6		Fuel System Components (See Figure 13)		Ref.
	7		Engine Exhaust Components (See Figure 14)		Ref.
			Right Side		
	8		12 VDC Battery Components (See Figure 15)		Ref.
	9	288460-001	Generator Assembly (See Figure 19)		Ref.
	10		Air Cleaner Components (See Figure 16)		Ref.
	11	291690	Engine, Cummins, QSB6.7, (see Figure 17)		1
*	12		Engine Electronic Panel Components (See Figure 18)		Ref.
			Miscellaneous		
	13	288692	Leg, Control Box Support, Left		1
	14	288693	Leg, Control Box Support, Right		1
	15	288691A	Support, Control, Box		1
	16	288835A	Panel, Bulkhead, Center		1
	17	288895	Support, Option Terminal Block		1



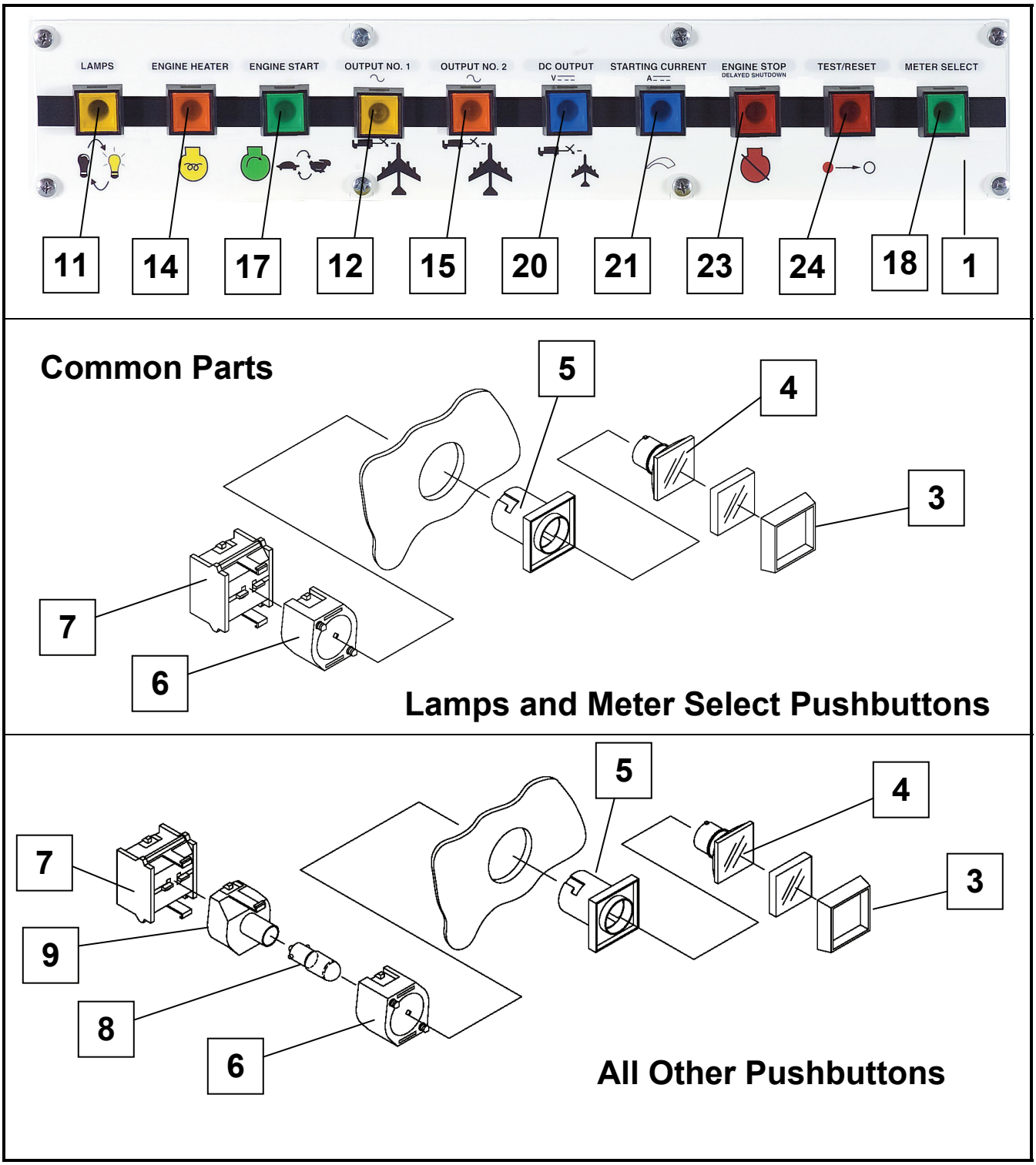
Control Box Door Panel Assembly
Figure 7

FIGURE ITEM NO.		HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
7 -		**289018-002**	**Door, Control Panel, Assembly** – no DC	A,B,C,D,J,K,L,M	**1**
		289018-004	**Door, Control Panel, Assembly** – with DC	E,F,G,H,N,P,R,S	**1**
	1	288995	Panel, Door, Control Box		1
	2	289017	Label, Control Box		1
	3	288836-002	Hinge, Offset, Bottom *(V94222 # 96-142 Type B)*		1
	4	288836-001	Hinge, Offset Top *(V94222 # 96-141Type A)*		1
	5	288999-001	Latch, Control Box *(V94222 #62-20-25)*		1
	6	287908	Gauge, Water Temperature *(V16476 #06347-01)*		1
	7	181358	Meter, Running Time *(6H359 #85101)*		1
	8	286699-001	Voltmeter, Battery *(V16476 #06351-01)*		1
	9	494134-001	Gauge, Fuel Level *(V16476 #06339-01)*		1
	10	78A1117-002	Gauge, Oil Pressure *(V16476 # 06395-01)*		1
	11	283167	Meter, Frequency *(V74542 #D-1255119311)*		1
	12	W8105A-009	Voltmeter, AC *(V74542 #D-1497222103)*	A-J,M-Y,BB-DD	1
	13	288806	Board, P.C., Front Panel, Led		1
		288820	…Gasket, LED PC Board		1
	14	288814-001	Ammeter, AC *(V74542#D-1497322103)*	A-J,M-Y,BB-DD	1
*	15	285172	Light Strip – no DC	A,B,C,D,J,K,L,M	3
*			Light Strip – with DC	E,F,G,H,N,P,R,S	5
	16	288858-004	Meter, Fault, Digital		1
	17	400642-008	Voltmeter, DC [if applicable]	E,F,G,H,N,P,R,S	1
	18	400641-015	Ammeter, DC [if applicable]	E,F,G,H,N,P,R,S	1



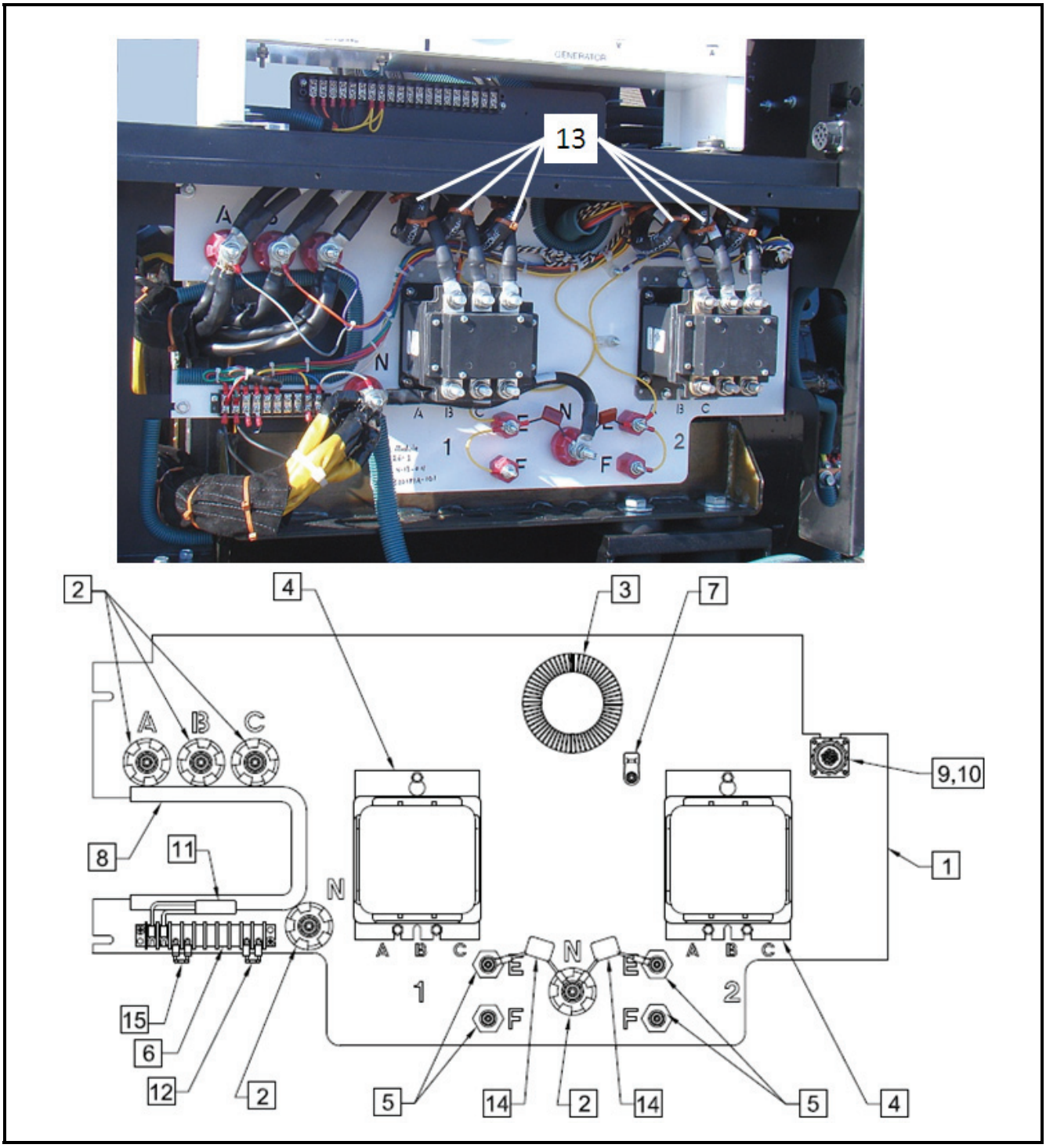
Control Box Interior Components
Figure 8

FIGURE ITEM NO.	HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
8 -	289019-001	**Control Box – no DC**	A,B,C,D,J,K,L,M	1
	289019-002	**Control Box – with DC**	E,F,G,H,N,P,R,S	1
1	288994	Side, Left, Control Box		1
2	288993	Side, Right, Control Box		1
3	288992	Wrapper, Control Box		1
4	288745	Board, PC, ESB		1
*	288813	…Label, ESB [Engine Control]		1
5	288937	Board, PC, EIB		1
*	288791	…Label, EIB [Starter Control]		1
6	288940B	Board, PC, Regulator		1
*	288876	…Label, Regulator [Generator Control]		1
	288896	…Label, Regulator [LDC & Voltage Control]		1
	W11166-009	…Fuse, 1 A, 250 V *(V2B664)*		2
	W11166-002	…Fuse, 5 A, 250 V *(V2B664)*		1
7	289026	Board, PC, Digital Controls		1
*	288875	…Label, Control [EF Bypass Control]		1
8	286367-001	Power Supply *(V05YB3 # M30D1205-12TS)*		1
	288605	…Support, Power Supply		1
9	289059	Support, Circuit Breakers		1
	289060	…Label, Circuit Breakers		1
10	283978-002	Circuit Breaker, 10A *(V77342 #W23-X1A16-10)*		2
11	283978-001	Circuit Breaker, 5A *(V77342 #W23-X1A16-5)*		1
* 12	289073	Harness, Wire, Control Box Assembly		1
		DC Components for TR Option		
* 13	289072	Harness, Wire, DC [See TR Manual]	E,F,G,H,N,P,R,S	1
14	288914	Board, PC, T-R [See TR Manual]	E,F,G,H,N,P,R,S	1
	W11166-009	…Fuse, 1 A, 250 V *(V2B664)*	E,F,G,H,N,P,R,S	1



Pushbutton Switches
Figure 9

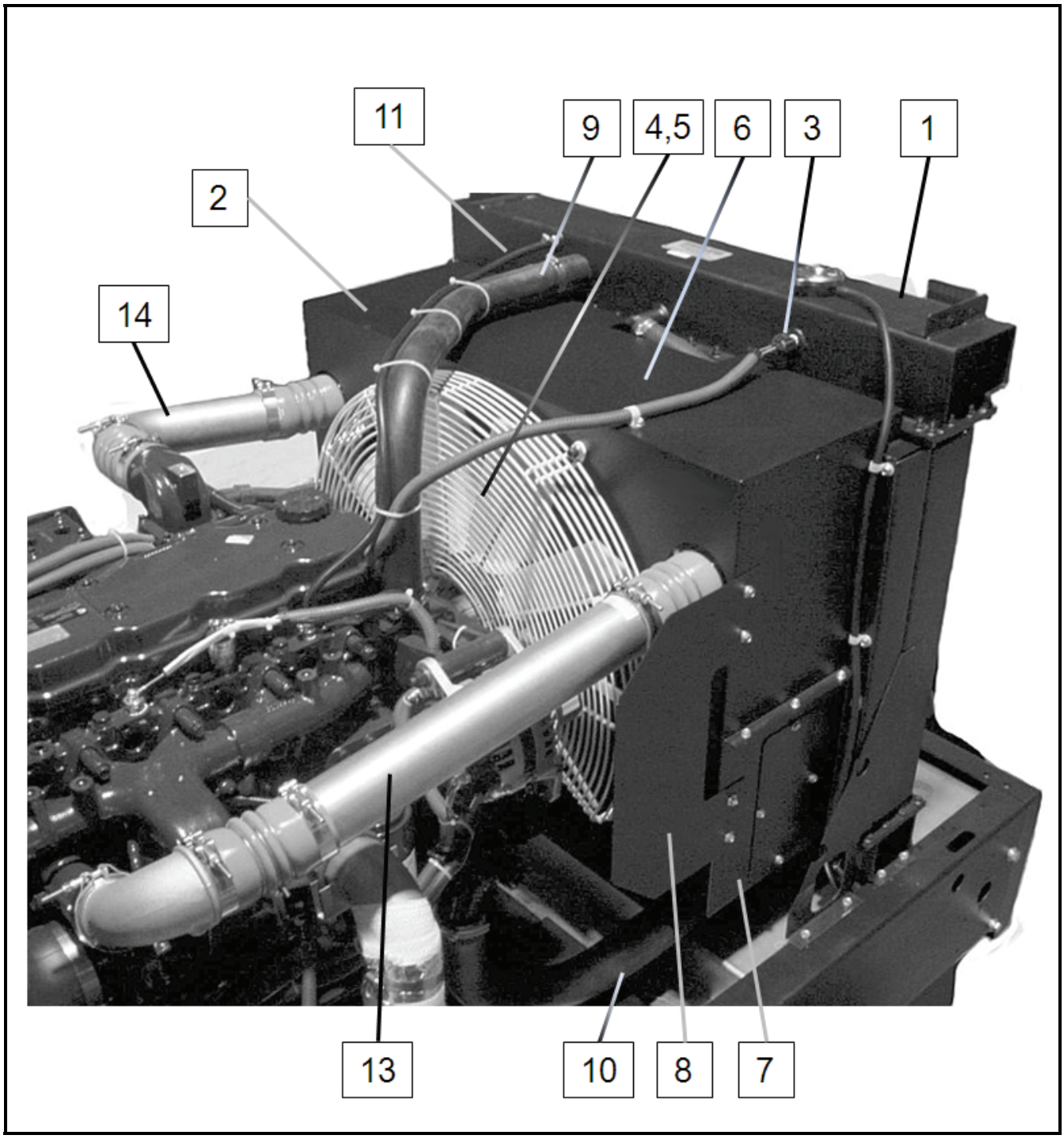
FIGURE ITEM NO.		PART NO.	DESCRIPTION	EFF	UNITS PER ASSY
9 -		**289012-001**	**Switch Panel Assembly – 1 output**	**A,C,J,L**	**1**
		289012-002	**Switch Panel Assembly – 2 outputs**	**B,D,K,M**	**1**
		289012-003	**Switch Panel Assembly – 1 output with DC**	**E,G,N,R**	**1**
		289012-004	**Switch Panel Assembly – 2 outputs with DC**	**F,H,P,S**	**1**
	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	Switch, Contact Block *(V61706 #704-900.3)*		1
	8	400613-004	Type 1815 Bulb *(V02929)*		1
	9	285034-001	Lamp Holder *(V61706 #704-950.0)*		1
*	10	290080	Contact Block Cover		1
	11	289601-001	***Lamps Pushbutton***		1
	12	289601-004	***Output # 1 Pushbutton***		1
	13	285030-002	Yellow Lens *(V61706 #704-702.4)*		1
	14	289601-005	***Pre-heater Pushbutton***		1
	15	289601-005	***Output # 2 Pushbutton***	B,D,F,H,K,M,P,S	1
	16	285030-004	Orange Lens *(V61706 #704-702.3)*	B,D,F,H,K,M,P,S	1
	17	289601-006	***Engine Start Pushbutton***		1
	18	289601-006	***Meter Select Pushbutton***		1
	19	285030-003	Green Lens *(V61706 #704-702.5)*		1
	20	289601-007	***DC Output Pushbutton***	E,F,G,H,N,P,R,S	1
	21	289601-007	***Current Pushbutton***	E,F,G,H,N,P,R,S	1
	22	285030-005	Blue Lens *(V61706 #704-702.6)*	E,F,G,H,N,P,R,S	1
	23	289601-003	***Engine Stop Pushbutton***		1
	24	289601-003	***Test/Reset Pushbutton***		1
	25	285030-001	Red Lens *(V61706 #704-702.2)*		1
			Other Parts		
	26	287038-001	Plug, Hole (when switch is not installed)		1
	27	288773	Panel, Switch Box		1
*	28	288772	Wrapper, Switch Box		1
*	29	288771	Top, Switch Box		2



400 Hz. Power Module Assembly
Figure 10

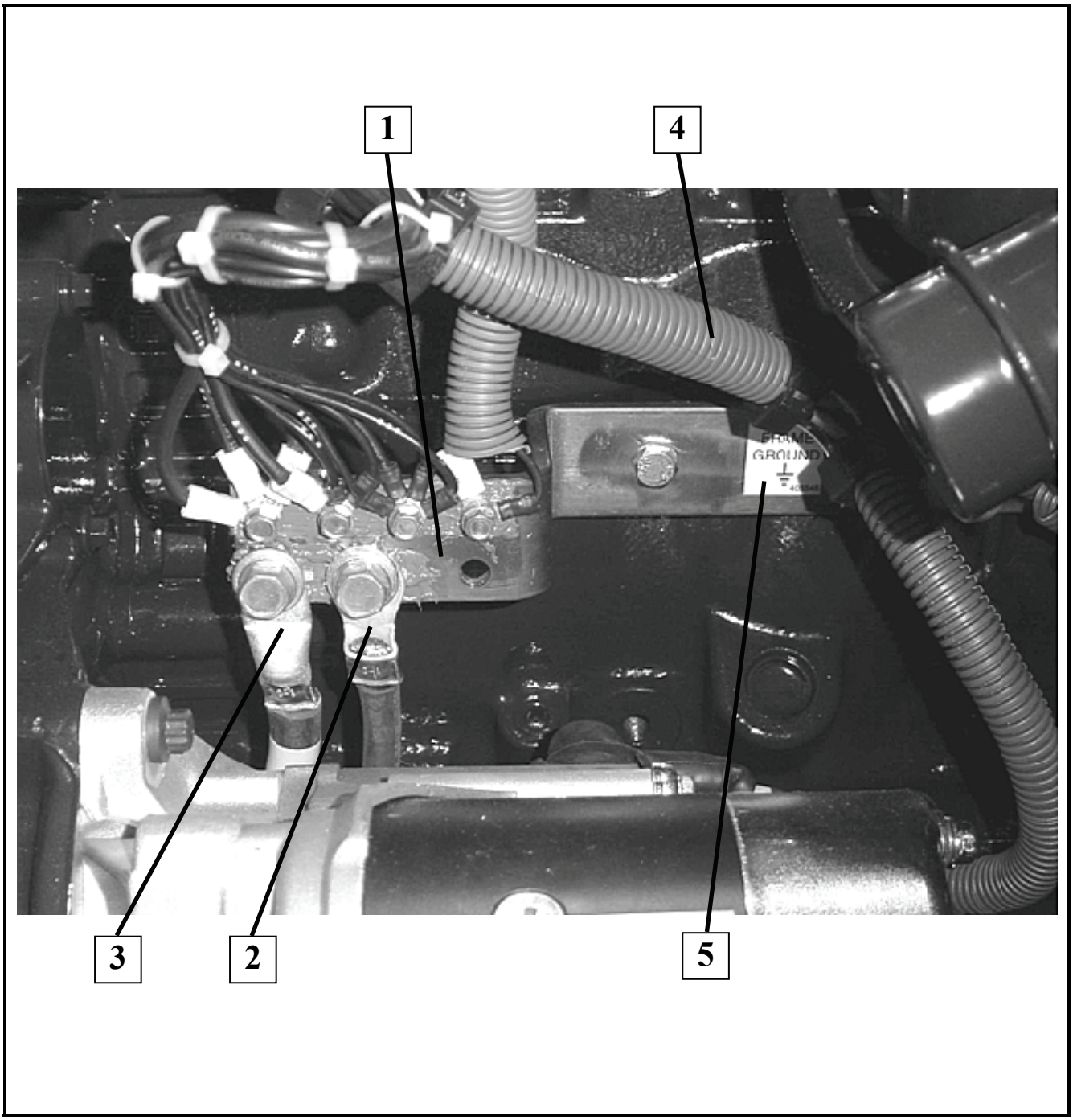
FIGURE ITEM NO.	HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
10 -	**291626-001**	**Power Panel Module Assembly**	A,C,E,G,J,L,N,R	Ref.
	291626-002	**Power Panel Module Assembly**	B,D,F,H,K,M,P,S	Ref.
1	291625	Panel, Power Module		1
2	283154-001	Standoff, 3/8-16		5
3	76A1131	Tubing, Z-flex, 1/2		0.79 ft.
4	282130-001	Contactor, Line, 3-Pole	A,C,E,G,J,L,N,R	1
		Contactor, Line, 3-Pole	B,D,F,H,K,M,P,S	2
5	286266	Standoff, Short, 1/4-20, (E, F)	A,C,E,G,J,L,N,R	2
		Standoff, Short, 1/4-20, (E, F)	B,D,F,H,K,M,P,S	4
6	401911-010	Block, Terminal		1
7	288078-001	Tie, Screw Mount		1
8	050988	Trim, .12, Black, Alum, Vinyl (PVC)		18 in.
9	288829	Harness, Wire, Power Module		1
		…(No. 101) “A” Stator Terminal to “K1”, # 1 Output		1
		…(No. 102) “B” Stator Terminal to “K1”, # 1 Output		1
		…(No. 103) “C” Stator Terminal to “K1”, # 1 Output		1
		…(No. 110) “N” Stator Terminal to “N”, Neutral		1
10	288832	Harness, Wire, 2nd Output	B,D,F,H,K,M,P,S	1
		…(No. 104) “A” Stator Terminal to “K201”, # 2 Output		1
		…(No. 105) “B” Stator Terminal to “K201”, # 2 Output		1
		…(No. 106) “C” Stator Terminal to “K201”, # 2 Output		1
11	282089-011	Diode, Flyback, Assembly		1
12	288892-009	Resistor Assembly, ID, Power Module	A,C,E,G,J,L,N,R	1
	288892-001	Resistor Assembly, ID, Power Module	B,D,F,H,K,M,P,S	1
13	285102-001	Current, Transformer *(V05HB5 # 20130)*		3
		Current, Transformer *(V05HB5 # 20130)*		6
14	290227	Capacitor, Noise Suppression	A,C,E,G,J,L,N,R	1
		Capacitor, Noise Suppression	B,D,F,H,K,M,P,S	2
15	288892-001	Resistor, ID, 90 KVA		1

Models A,C,E,G,J,L,N,R have 1 output
Models B,D,F,H,K,M,P,S have 2 outputs



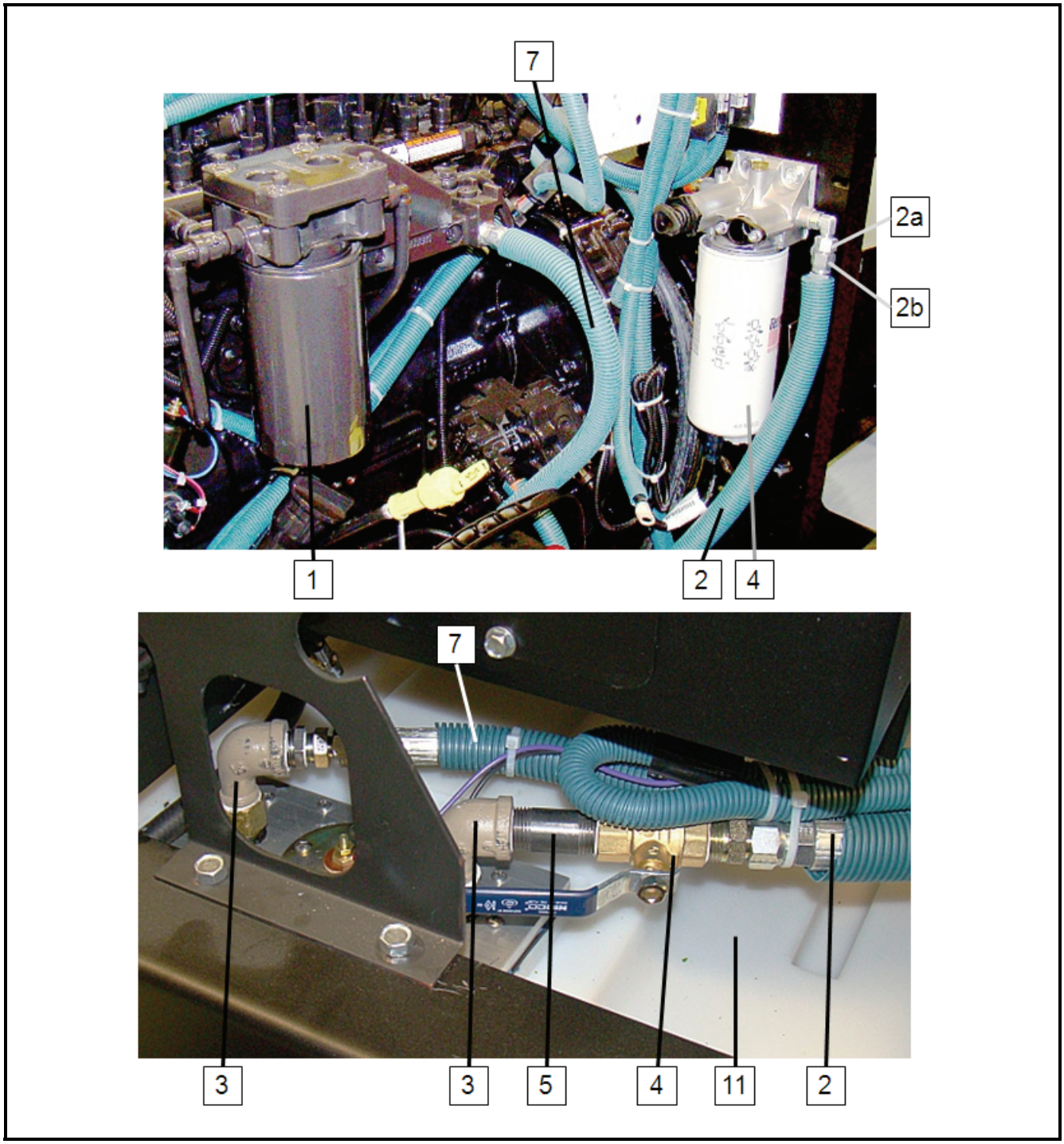
Cooling System Components
Figure 11

FIGURE ITEM NO.		PART NO.	NOMENCLATURE	EFF	UNIT PER ASSY.
11 -	1	288240	Radiator Assembly *(V0HZP9)*		1
	2	289814	Charge-Air-Cooler Assembly		1
	3	290145	Sensor, Coolant Level		1
	4	287249	Fan, Cooling, 26”		1
	5	289559	Guard, Spiral, Fan		1
	6	289977	Shroud, Fan, Top		1
*		289977-001	…Access Panel (included with 289977)		Ref.
	7	290097	Shroud, Fan, Bottom		1
	8	288328	Guard, Fan Belt		1
	9	287659	Hose, Radiator, Upper *(V24161)*		1
		W10869-003	…Clamp, Hose (1 $^{9}/_{16}$” – 2 ½”)		2
*	10	288309	Hose, Radiator, Lower *(V24161)*		1
*		W10869-005	…Clamp, Hose (2 $^{5}/_{16}$” – 3 ¼”)		2
	11		Line, De-Aeration		Ref.
		W7814-000	…Bushing, Pipe, Steel, ¼” – $^{1}/_{8}$”		2
		288123-001	…Connector, Male		2
		056534	…Hose, ¼”, ID		40”
		W10869-014	…Clamp, Hose ($^{7}/_{32}$” – $^{5}/_{8}$”)		
*	12	283873	Valve, Drain, Radiator		2
		056535	…Hose, 3/8” ID, Low Pressure		60”
		W10869-014	…Clamp, Hose (7/32” – 5/8”)		2
	13	289978	Pipe, CAC, Inlet, Straight		1
		288355	…Hose, CAC, Inlet *(V8A334)*		2
		280597-001	…Clamp, T-Bolt, Floating Bridge		4
	14	288330	Pipe, CAC, Outlet, 90°		1
		288355	…Hose, CAC, Inlet		2
		280597-001	…Clamp, T-Bolt, Floating Bridge		4



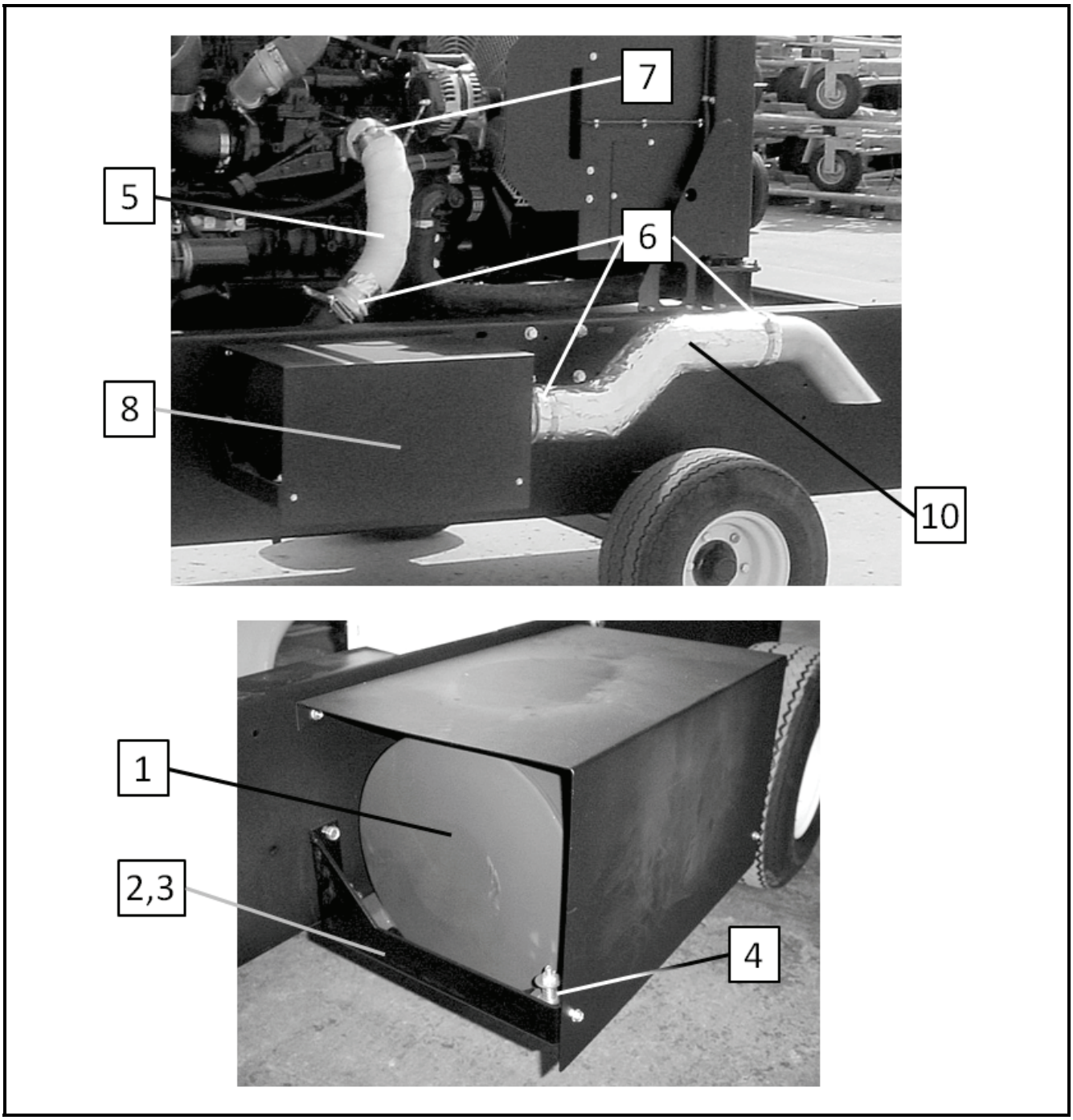
Engine Ground Plate and Cables
Figure 12

FIGURE ITEM NO.		HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
12 -	1	288723	Plate, Ground		1
	2	W9407-446	Cable, Engine to Ground		1
	3	W9360-289	Cable, #111, Power Mod. To Ground		1
	4	291686	Wire Harness, Engine		1
	5	405548	Label, Frame Ground		1



Fuel System Components
Figure 13

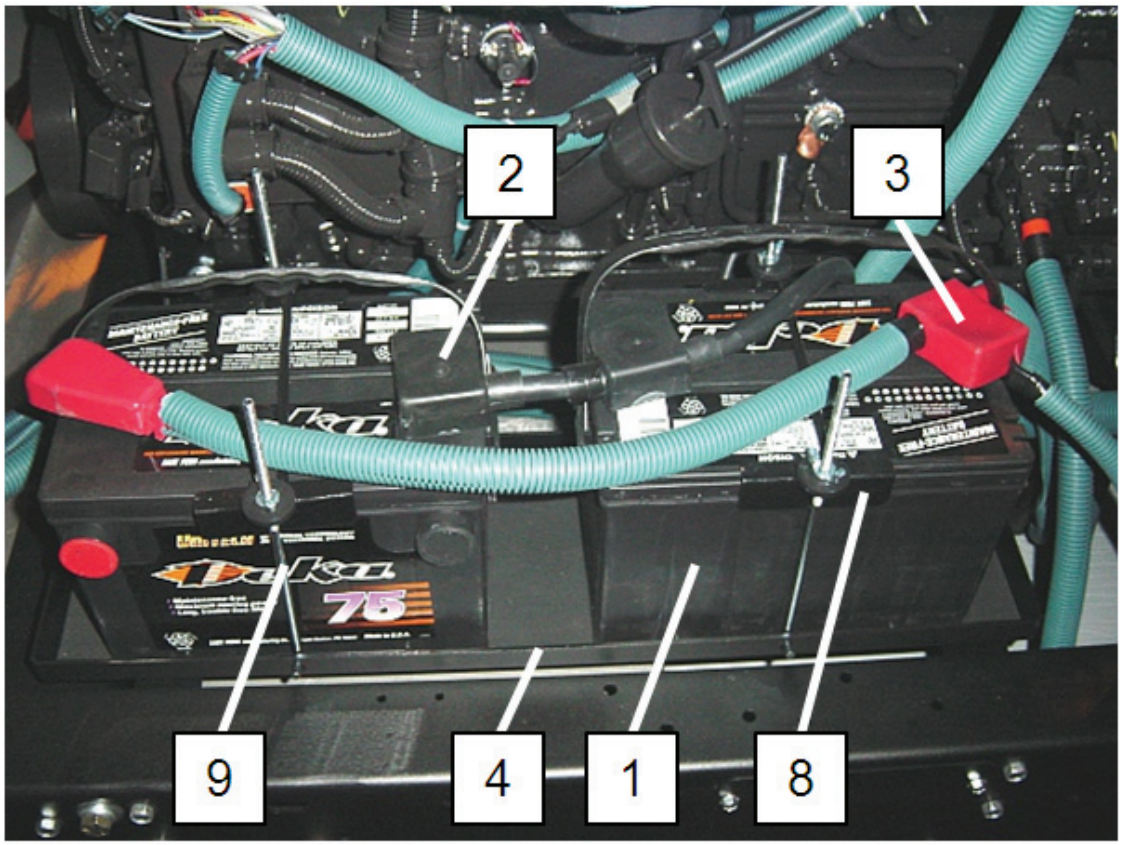
FIGURE ITEM NO.		HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
13 -	1	286897-030	Filter, Fuel [Supplied by Cummins]		1
	2	287804	Line, Fuel, Tank to Filter		1
	2a	290388	…Adapter, 12mm x 3/8 MJIC		1
	2b	290389	…Tube, Reducer JIC		1
	3	12CW2077-003	Elbow, ½" NPT, ST., 90°		2
	4	400819-003	Valve, Ball, ½" NPT		1
	5	W10760-003	Nipple, Pipe, ½"		1
*	6		Line, Fuel, Filter to Pump [Supplied by Cummins]		1
	7	291258	Line, Fuel, Return		Ref.
	8	286897-031	Filter, Lubricity Fuel		1
	9		Lubricity Filter Fuel Lines [Supplied by Cummins]		1
*	10	282562	Cap, Fuel Neck *(V49234 #1275G/12T)*		1
	11	287781	Tank, Fuel, 65 Gallon (Stainless Steel)	A –H	1
		486719-012	…Sender, Fuel Gauge	A – H	Ref.
*	11	290677	Kit, Composite, Fuel Tank	J-S	Ref.
*		290650	…Bellypan, Fuel, Tank, 65 Gallon	J-S	1
*		287684	…Tank, Fuel, Composite, 65 Gallon	J-S	1
*		486719-012	…Sender, Gauge, Fuel, 12V	J-S	1
*		290651	…Strap, Support, Fuel Tank, 65 Gal.	J-S	1
*		290642	…Strap, Mounting, Fuel Tank, 65 Gal.	J-S	1
*		290267	…Rubber, Strap, Fuel Tank	J-S	1
*		290639	…Shield, Heat	J-S	1
*		290640	…Bracket, Shield, Heat	J-S	1

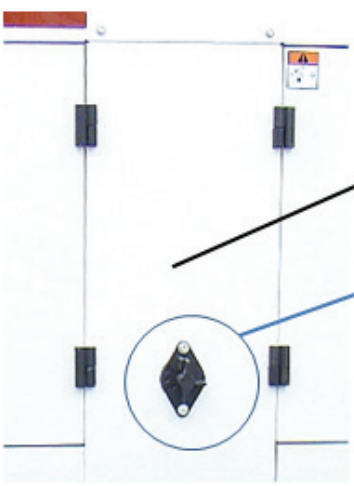


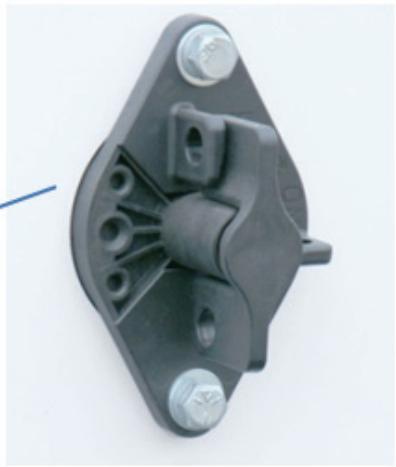
Engine Exhaust Components
Figure 14

FIGURE ITEM NO.		HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
14 -	1	287405	Muffler and Exhaust Assembly		1
	2	287431	Bracket, Muffler Mounting, Front (trailer)	A,B,E,F,J,K,N,P	1
			Bracket, Muffler Mounting, Front (fixed)	C,D,G,H,L,M,R,S	2
	3	287432	Bracket, Muffler Mounting, Front		1
	4	287691	Spring, Muffler, Mounting		8
	5	288311	Pipe, Turbo, Assembly		1
	6	404154-016	Clamp, Full Circle, 4” Pipe		4
	7	404154-013	Clamp, Full Circle, 3”		1
	8	287406	Shield, Heat, Muffler	A,B,E,F,J,K,N,P	1
*		287644	Shield, Heat, Muffler	C,D,G,H,L,M,R,S	1
*		287647	Shield, Heat, Muffler [End]	C,D,G,H,L,M,R,S	1
*	9	287645	Support, Exhaust Pipe	C,D,G,H,L,M,R,S	1
	10	291260	Pipe, Exhaust, Muffler Outlet, Assembly	A,B,E,F,J,K,N,P	1
*		287643	Pipe, Exhaust, Muffler Outlet, Assembly	C,D,G,H,L,M,R,S	1

Models A,B,E,F,J,K,N,P are trailer-mount.
Models C,D,G,H,L,M,R,S are fixed/truck-mount.

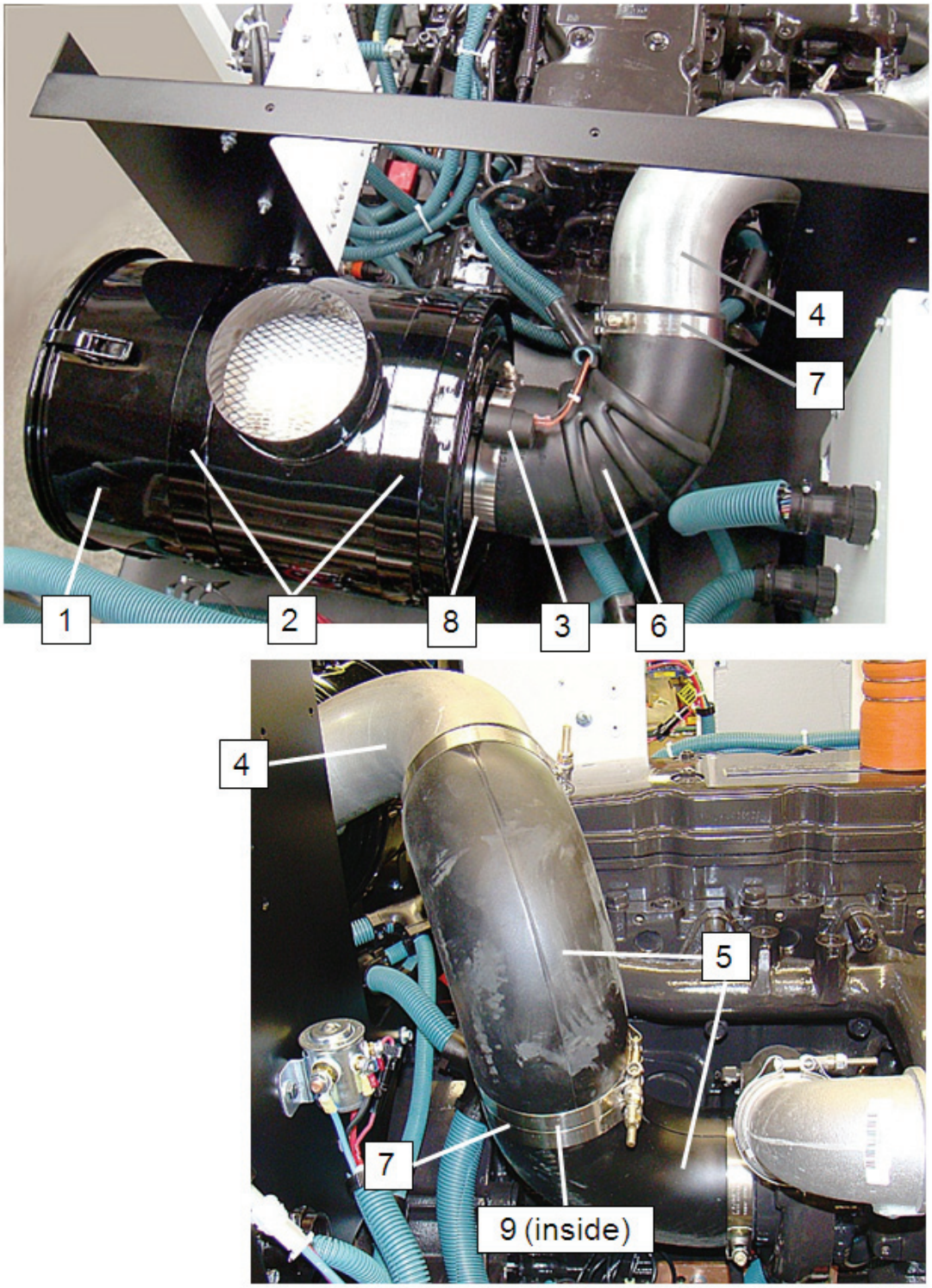






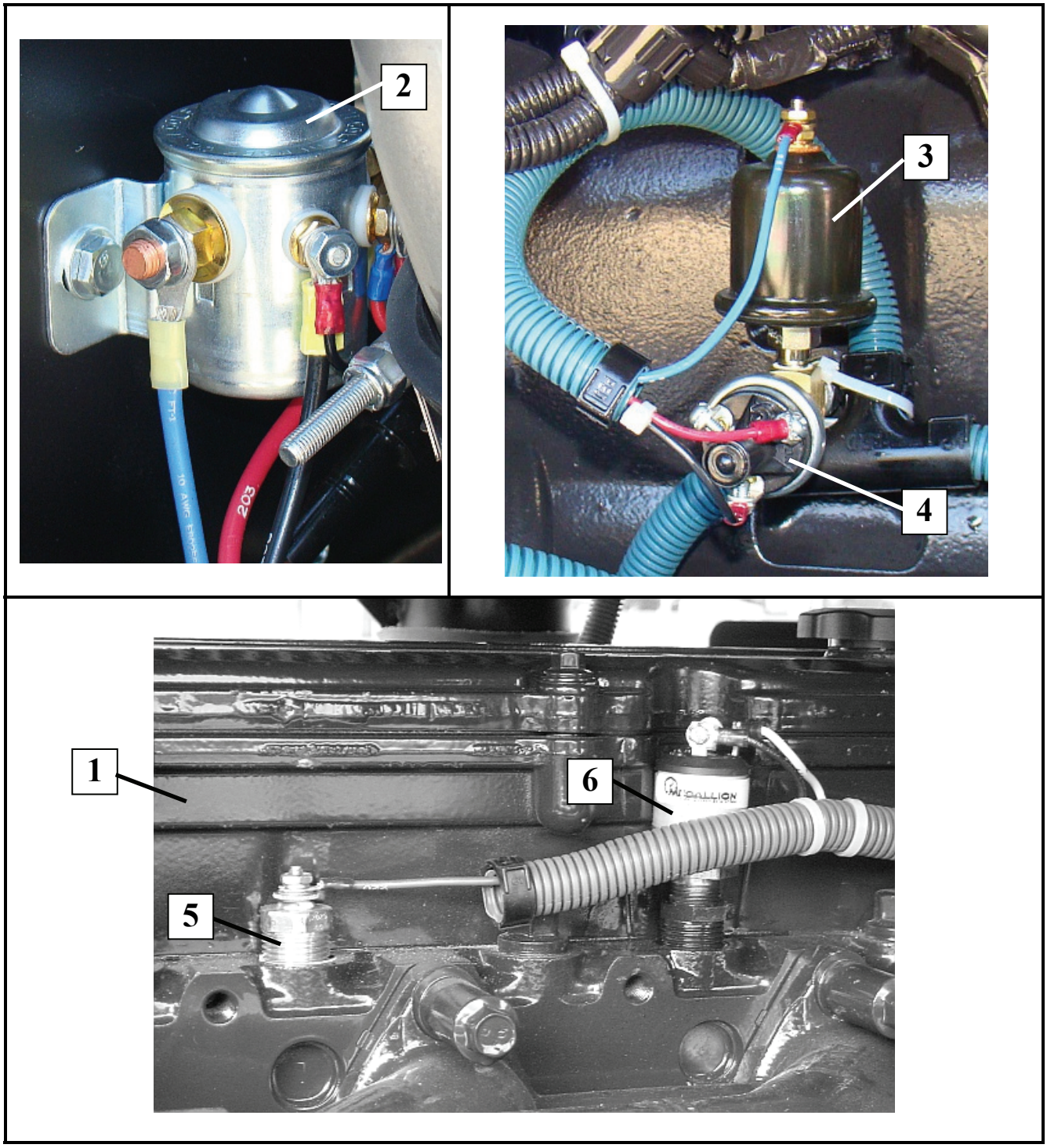
12 VDC Battery System
Figure 15

FIGURE ITEM NO.		HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
15 -	1	281881-001	Battery, 12 V *(V25710 #1231-PMF)*		2
	2	287797	Cable, Battery, Negative *(V3Y208)*		1
	3	291728	Cable, Battery, Positive *(V3Y208)*		1
	4	289224	Tray, Battery		1
*	5	289223-001	Bracket, Battery Tray, RH		1
*	6	289223-002	Bracket, Battery Tray, LH		1
*	7	289239	Pad, Battery Tray		1
	8	287796	Hold Down, Battery *(V3Y208)*		2
	9	494295	Bolt, Hold Down, Battery *(V3Y208)*		2
	10	291704	Panel, Support, Door, MD (see Figure 4)		1
		287738-020	…Insulation, Noise, Support, Door		1
		291611	…Disconnect Switch, Master, Battery 2000A		1
		291718	…Cable, Disconnect Switch, Starter		1



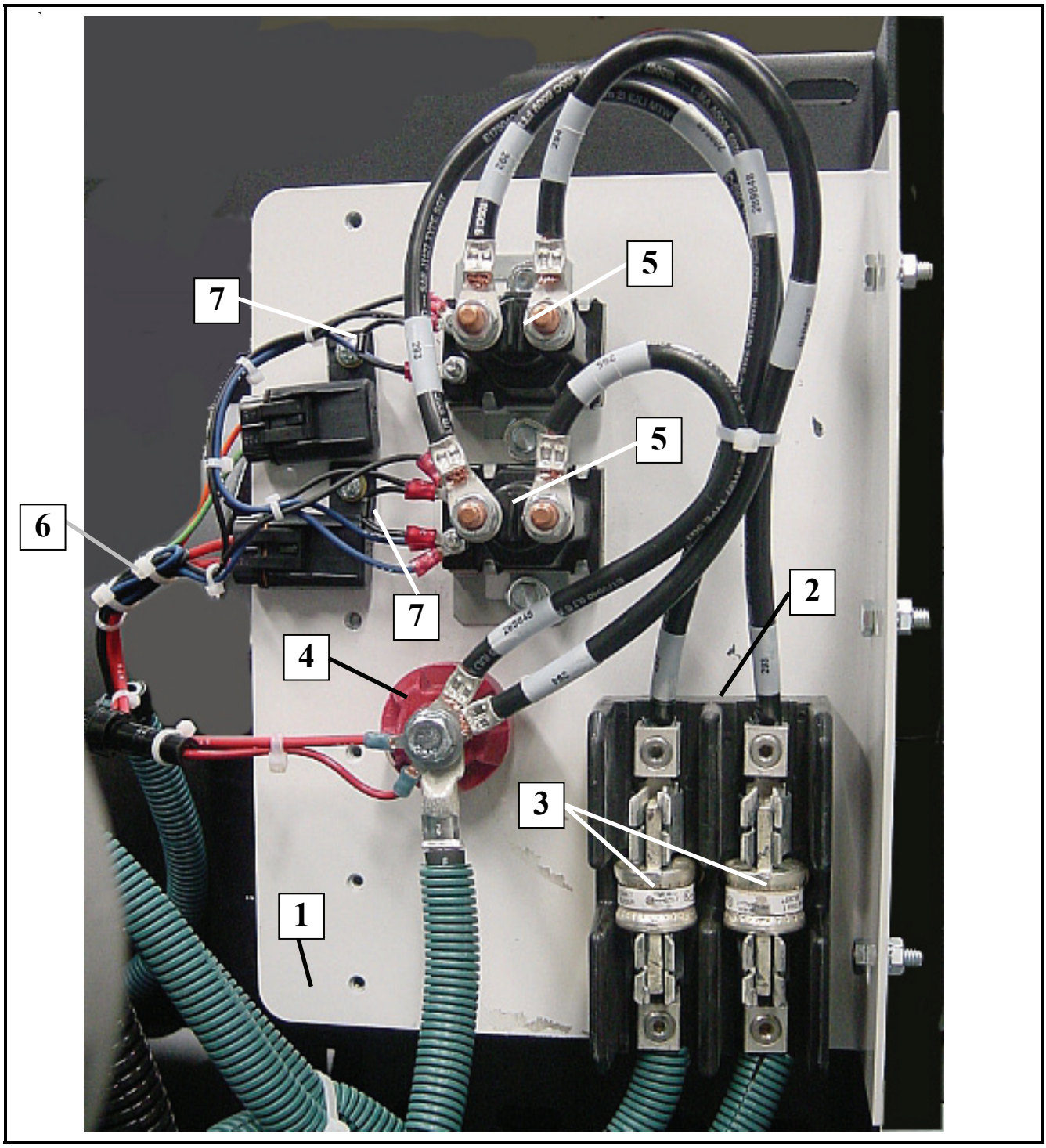
Air Cleaner Components
Figure 16

FIGURE ITEM NO.		HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
16 -	1	286061	Air Cleaner *(V18265 #EBB12-0271)*		1
		287548	… Air Cleaner Element only		Ref.
	2	284923	Mount, Band, Air Cleaner *(V18265 #AAH00-0349)*		2
	3	282918	Indicator, Restriction, Electric *(V18265 #REX77-0062)*		1
	4	288054-003	Pipe, Air Inlet, Assembly		1
	5	287371	Elbow, Rubber, 90° *(V55752 # 4014-03002)*		2
	6	284925	Reducer, Rubber, 90° Elbow *(V18265 # P12-1482)*		1
	7	280732-006	Clamp, T-Bolt *(V18265 # P148343)*		5
	8	280732-007	Clamp, T-Bolt *(V18265 # P148345)*		1
*	9	284461	Connector, Pipe, Short, Air Inlet		1
*	10	289688	Intake, Air Extension		1
*	11	289661	Adaptor, Hump Hose		1
*	12	289694	Clamp, Hump Hose		2
*	13	289662	Hood, Intake, Pipe		1
*	14		…Clamp, Hood, Intake, Pipe (included)		Ref.



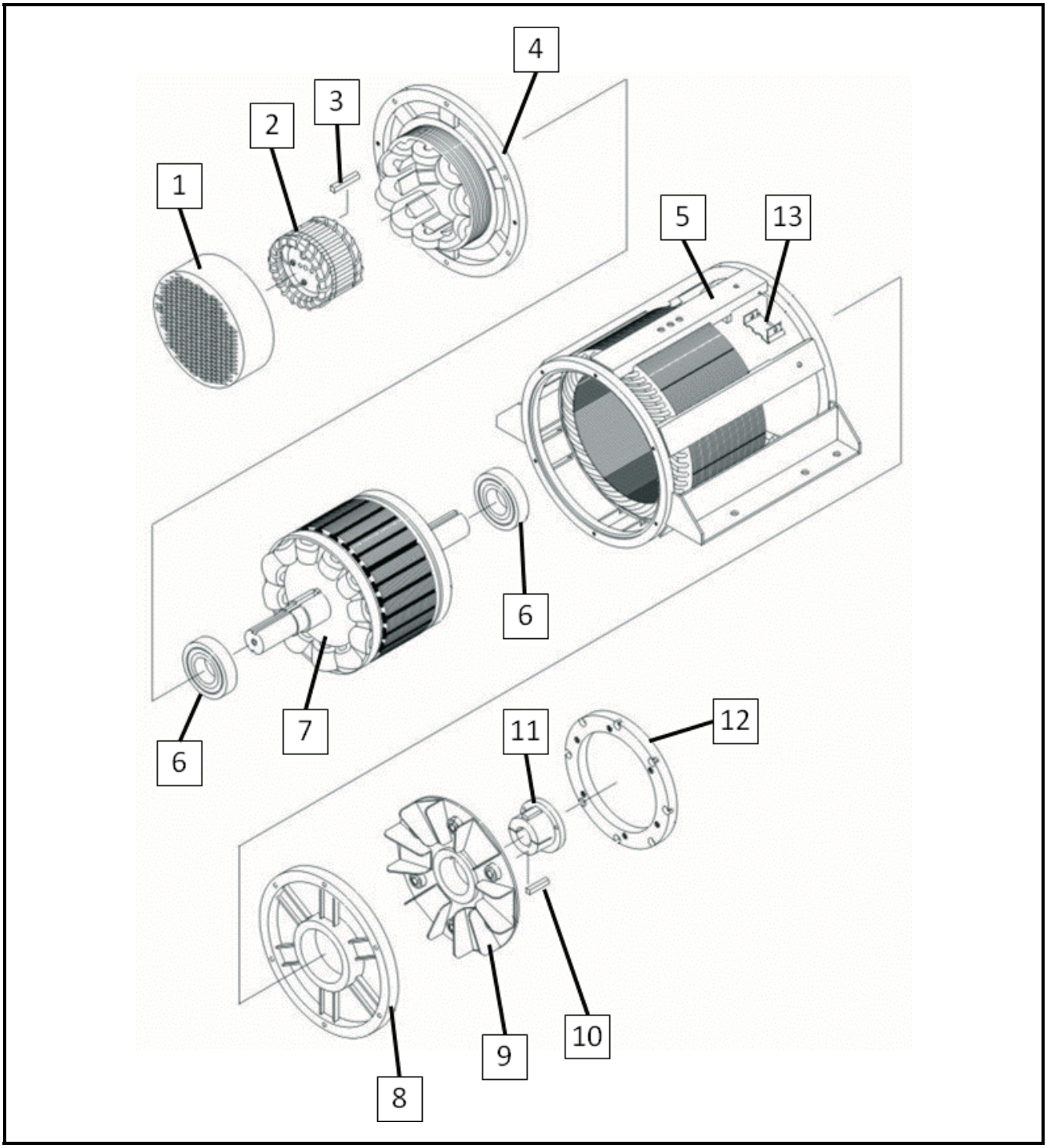
Engine Components
Figure 17

FIGURE ITEM NO.		HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
17 -	1	291690	**Engine, Cummins, QSB6.7, 170 HP**		1
*		286897-029	…Engine Oil Filter, Replacement		Ref.
*		289815	…Valve, Oil, Drain		1
*		289843	… Hose, 5/8", ID		12"
*		W10869-009	…Clamp, Hose		1
			Engine Electrical Components		
	2	286850	Starter Solenoid *(V13445 # 24059)*		1
*		288973-001	…Diode Assembly, Starter Solenoid		1
	3	403809-001	Switch, Oil Pressure *(V75419 #1042-08210-10)*		1
	4	78B1118-002	Sender, Oil Pressure, 0 – 125 PSI *(V16476 #16476)*		1
		287419	…Adapter, M10-1.0 x 1/8 NPTF		1
		W10910-000	…Fitting, Tee		1
		W10750-001	…Nipple, Pipe, $^{1}/_{8}$"		1
	5	403782-002	Switch, Shutdown, 210° F *(V75418 #1002-04880-36)*		1
		W7814-004	…Adapter, $^{3}/_{8}$" x ½" NPT		1
	6	287909	Sender, Water Temperature *(V16476 #02019)*		1
			Engine Mounting Components		
*	7	480603-001	Mount, Shock, Engine		2
*	8	282852	Mount, Engine, Front, Assembly		1
*	9	289816	Mount, Engine, Front, Assembly		1
*	10	289557	Support, Engine, Front (see Figure 3)		1
*	11		Drain, Blow-by		Ref.
		056535	…Hose, 3/4" ID (Rear Hose)		36"
			…Clamp, Hose (Cummins Engine)		Ref.



Engine Electronic Panel Components
Figure 18

FIGURE ITEM NO.		HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
18 -	1	288333	Panel, “E” Engine, Parts		1
	2	287145-002	Holder, Fuse *(V17400 # T30100-1CR)*		1
	3	287144-002	Fuse, Fast Acting *(V17400 # JJN-125)*		2
	4	283154-001	Insulator, Standoff		1
	5	288331	Relay, Grid Heater, Power *(V1FQ83 50F3662)*		2
	6	291717	Harness, Wire, Engine, Electronic		1
	7	489658-007	…Diode Assembly		2
*	8	291686	Wire Harness, Engine		1



Generator Assembly
Figure 19

FIGURE ITEM NO.		HOBART PART NO.	NOMENCLATURE	EFF	UNITS PER ASSY.
19 -	1	288486	Exciter Cover		1
	2	288494	Exciter Armature		1
	3	180696-003	Exciter Key		1
	4	288440	Exciter Housing and Coils Assembly		1
	5	288471	Generator Housing and Coils Assembly		1
	6	W10072-068	Bearing		2
	7	288447-001	Generator Rotor		1
	8	288461	Front Bearing Support		1
	9	288481	Flexible Coupling Kit		1
		480290	…Coupling Bushing		8
	10	85B1039	Coupling Key		1
	11	85C1004-001	Split Taper Bushing		1
	12	289305	Ring, Spacer, Flex Coupling		1
	13	288458	Generator Air Deflector		6
*	14	288478	Generator Cover		1
*	15	288491	Tab, Fastener, Exciter Key		1
*	16	480603-001	Mount, Shock, Generator		4

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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. 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.
9-	040201
10-8	050988
11-	056534
11-	056535
17-	056535
1-20	100GH121
13-3	12CW2077-003
19-3	180696-003
7-7	181358
11-	280597-001
16-7	280732-006
16-8	280732-007
1-	280763
15-1	281881-001
10-11	282089-011
10-4	282130-001
3-7	282562
13-10	282562
2-10	282658
1-2	282667
1-	282727
17-8	282852
16-3	282918
10-2	283154-001
18-4	283154-001
7-11	283167
5-6	283597
4-6	283647
2-6	283714-002
5-5	283824
11-12	283873
8-11	283978-001
8-10	283978-002
16-9	284461
9-7	284475-001
16-2	284923
16-6	284925
9-3	285029-001
9-25	285030-001
9-13	285030-002
9-19	285030-003
9-16	285030-004
9-22	285030-005
9-4	285031-001
9-5	285032-001
9-6	285033
9-9	285034-001
10-13	285102-001
1-6	285125
7-15	285172
1-10	285418
16-1	286061
10-5	286266
8-8	286367-001
7-8	286699-001
17-2	286850
17-	286897-029
13-1	286897-030
13-8	286897-031
1-1	286956
9-26	287038-001
1-9	287120
18-3	287144-002
18-2	287145-002
11-4	287249
16-5	287371
1-13	287376
1-14	287377
14-1	287405
14-8	287406
17-	287419
14-2	287431
14-3	287432
3-11	287437
2-8	287459
2-17	287460
2-18	287461
2-19	287462
2-20	287463
2-21	287464
2-7	287465
2-3	287466

FIGURE ITEM NO.	HOBART PART NO.
2-25	287467
1-18	287491
3-15	287506
5-4	287526-002
5-3	287542-001
16-	287548
2-13	287571
14-	287643
14-	287644
14-9	287645
14-	287647
11-9	287659
13-	287684
14-4	287691
2-9	287696
4-1	287701
5-1	287701
4-9	287703
5-	287738-001
3-	287738-003
4-	287738-004
4-	287738-020
15-	287738-020
4-	287738-021
4-	287738-022
3-	287738-025
4-	287738-027
5-	287738-028
3-	287738-029
3-	287738-030
3-	287738-031
3-	287738-032
3-10	287739
13-11	287781
4-	287785
4-	287793
15-8	287796
15-2	287797
13-2	287804
4-	287805
4-	287806
4-12	287808
4-7	287819
4-8	287889
1-19	287892
7-6	287908
17-6	287909
16-4	288054-003
10-7	288078-001
11-	288123-001
2-28	288164-001

FIGURE ITEM NO.	HOBART PART NO.
11-1	288240
2-4	288300
11-10	288309
14-5	288311
11-8	288328
11-14	288330
18-5	288331
18-1	288333
11-	288355
19-4	288440
19-7	288447-001
19-13	288458
6-9	288460-001
19-8	288461
19-5	288471
19-14	288478
19-9	288481
19-1	288486
19-15	288491
19-2	288494
4-3	288544
8-	288605
3-2	288691A
6-15	288691A
3-16	288692
6-13	288692
3-17	288693
6-14	288693
1-	288694
4-13	288694
1-	288695
1-12	288696
1-16	288697
1-	288698
3-18	288699
1-5	288700
3-12	288701
3-	288702-007
1-15	288703
3-13	288704
12-1	288723
8-4	288745
9-29	288771
9-28	288772
9-27	288773
8-	288791
7-13	288806
8-	288813
7-14	288814-001
7-	288820
10-9	288829

FIGURE ITEM NO.	HOBART PART NO.
10-10	288832
3-3	288835A
6-16	288835A
7-4	288836-001
7-3	288836-002
7-16	288858-004
2-11	288862
2-12	288866
2-22	288872
8-	288875
8-	288876
4-10	288878
3-1	288879
4-2	288880
5-2	288880
5-7	288881
3-14	288882
6-	288882
10-15	288892-0001
10-	288892-001
10-12	288892-009
6-17	288895
8-	288896
4-	288912
8-14	288914
2-14	288917-002
2-15	288918-002
4-5	288919
8-5	288937
8-6	288940B
17-	288973-001
8-3	288992
8-2	288993
8-1	288994
7-1	288995
7-5	288999-001
9-1	289004
9-	289012-001
9-	289012-002
9-	289012-003
9-	289012-004
9-	289014
9-2	289015
7-2	289017
7-	289018-002
7-	289018-004
8-	289019-001
8-	289019-002
8-7	289026
8-9	289059
8-	289060

FIGURE ITEM NO.	HOBART PART NO.
8-13	289072
8-12	289073
2-24	289127
3-5	289223-001
15-5	289223-001
3-6	289223-002
15-6	289223-002
3-4	289224
15-4	289224
3-	289239
15-7	289239
19-12	289305
3-9	289557
17-10	289557
11-5	289559
6-	289593-001
9-11	289601-001
9-23	289601-003
9-24	289601-003
9-12	289601-004
9-14	289601-005
9-15	289601-005
9-17	289601-006
9-18	289601-006
9-20	289601-007
9-21	289601-007
16-11	289661
16-13	289662
16-10	289688
16-12	289694
11-2	289814
17-	289815
17-9	289816
2-1	289842-001
17-	289843
11-6	289977
11-	289977-001
11-13	289978
4-4	289979
9-10	290080
11-7	290097
11-3	290145
2-26	290216
10-14	290227
13-	290267
13-2a	290388
13-2b	290389
13-	290639
13-	290640
13-	290642
13-	290650

FIGURE ITEM NO.	HOBART PART NO.
13-	290651
13-11	290677
13-7	291258
14-10	291260
2-27	291609
15-	291611
10-1	291625
10-	291626-001
10-	291626-002
5-8	291679
5-	291681
5-	291682
5-	291683
5-	291684
12-4	291686
18-8	291686
6-11	291690
17-1	291690
4-14	291704
15-10	291704
18-6	291717
15-	291718
15-3	291728
9-8	400613-004
7-18	400641-015
7-17	400642-008
13-4	400819-003
10-6	401911-010
2-5	402987
4-11	403091-008
4-	403127
17-5	403782-002
17-3	403809-001
14-7	404154-013
14-6	404154-016
12-5	405548
2-23	408665-001
2-2	408665-002
1-	408781-001
19-	480290
17-7	480603-001
19-16	480603-001
13-	486719-012
18-7	489658-007
7-9	494134-001
15-9	494295
10-3	76A1131
2-16	76B1148
1-7	77A1157
7-10	78A1117-002
17-4	78B1118-002

FIGURE ITEM NO.	HOBART PART NO.
1-17	7J422-000
19-10	85B1039
19-11	85C1004-001
19-6	W10072-068
17-	W10750-001
13-5	W10760-003
11-	W10869-003
11-	W10869-005
17-	W10869-009
11-	W10869-014
17-	W10910-000
8-	W11166-002
8-	W11166-009
1-	W11439-001
11-	W7814-000
17-	W7814-004
7-12	W8105A-009
12-3	W9360-289
12-2	W9407-446

Chapter 5 Manufacturer's Literature

Vendor Literature

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

Diagram Number	Diagram Description
291687, rev. 0	Diagram, Schematic & Connections
289022, rev. 2	Diagram, Connection, Control Box
289002, rev. 6	Diagram, Connection, Power Module
289013, rev. 3	Diagram, Connection, Switch Box
See Appendix A	Diagram, Connection, Transformer-Rectifier

Contact Hobart Ground Power if copies of these drawings or manuals are not with this manual (unless otherwise noted above). Refer to Appendix A for specific information on 90CU20, 400 Hz. Generator Set, optional equipment.

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CR2
L2
L1
G2
GENERATOR EXCITER
GENERATOR STATOR
G1
TRANSFORMER–RECTIFIER CONNECTION
#1 OUTPUT TERMINALS
CT1
CT2
CT3
K1
#2 OUTPUT TERMINALS
CT4
CT5
CT6
K201
J53 P53
J54 P54
J44 P44
A3 (CTRL)
A4 (REG)
A5 (LED)
S74
DS64
S79
DS58
S24
DS59
S75
DS259
S275
DS63
S76
DS77
S77
DS70
S3
M1
M2
M6
M3
COM.
N.O.
TB1–2
TB1–1
CR10
R2
R3
TB1–4
TB1–9
TB1–3
TB1–5
TB1–6
TB1–10
J5 P5

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

ACE	8/11
TEST	8/11
OUTSIDE DISTR.	

DISTRIBUTION TABLE

CHANGE RECORD

E.C. No.	DATE

FILE NAME 291687s1 | PLOT DATE 08/02/11

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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.
–

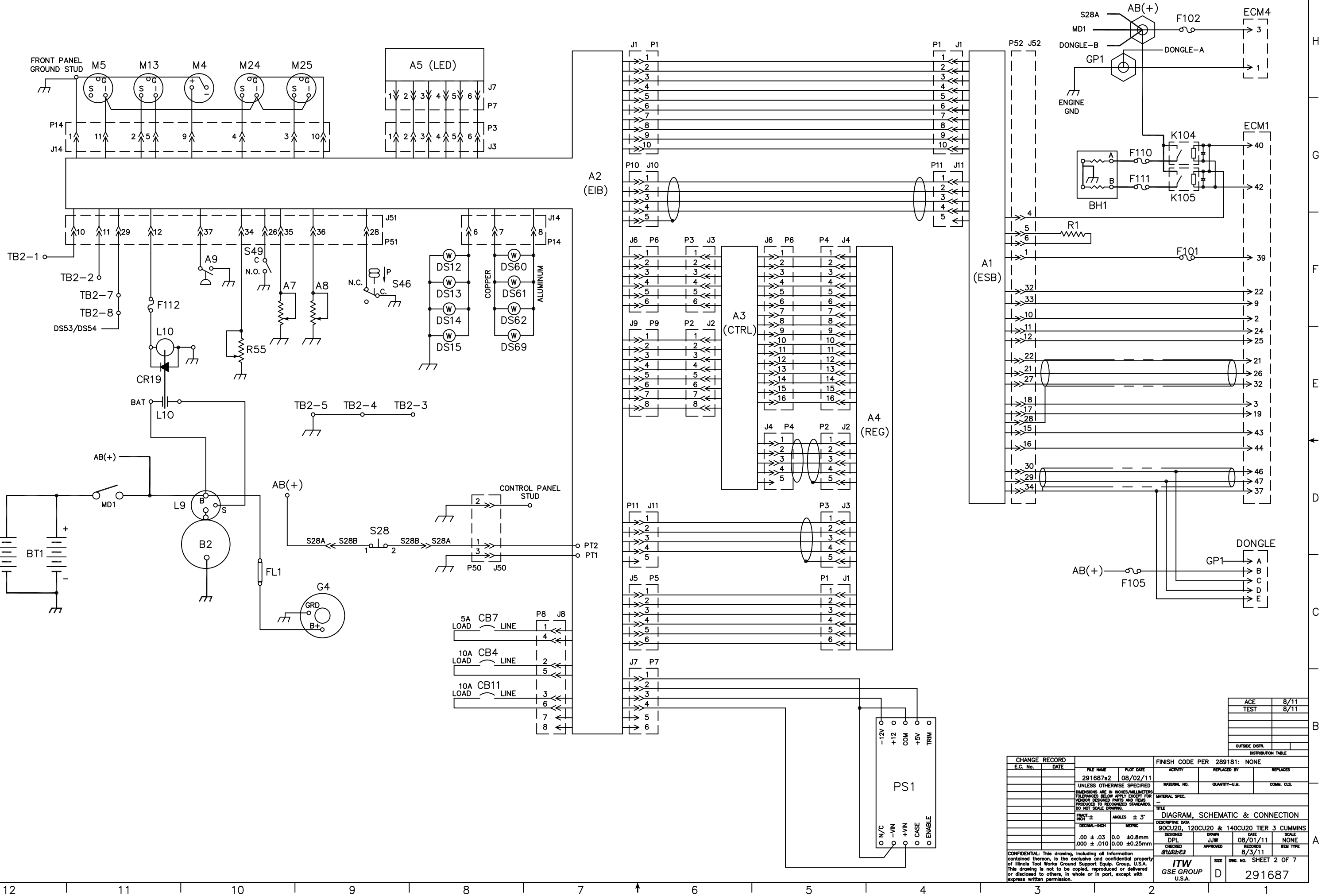
TITLE
DIAGRAM, SCHEMATIC & CONNECTION

DESCRIPTIVE DATA
90CU20, 120CU20 & 140CU20 TIER 3 CUMMINS

DESIGNED	DRAWN	DATE	SCALE
DPL	JJW	08/01/11	NONE
CHECKED	APPROVED	RECORDS	ITEM TYPE
dwabes		8/3/11	

ITW GSE GROUP U.S.A.

SIZE D | DWG. NO. 291687 | SHEET 1 OF 7



ACE	8/11
TEST	8/11
OUTSIDE DISTR.	

DISTRIBUTION TABLE

CHANGE RECORD	
E.C. No.	DATE

FILE NAME	PLOT DATE
291687s2	08/02/11

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. ±	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
90CU20, 120CU20 & 140CU20 TIER 3 CUMMINS

DESIGNED	DRAWN	DATE	SCALE
DPL	JJW	08/01/11	NONE
CHECKED	APPROVED	RECORDS	ITEM TYPE
dubbes		8/3/11	

ITW GSE GROUP U.S.A.

SIZE D | DWG. NO. 291687 | SHEET 2 OF 7

LEGEND

A1	BOARD, P.C., ENGINE SPECIFIC BOARD (ESB)
A2	BOARD, P.C., ENGINE INTERFACE BOARD (EIB)
A3	BOARD, P.C., CONTROL BOARD (CTRL)
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. POSITIVE BATTERY TERMINAL
B2	STARTER, ENGINE, 12 V.
BH1	GRID HEATER
BT1, BT2	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 (AMBER)
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 (ORANGE) (WHEN FURNISHED)
ECM	CONNECTOR, ELECTRONIC CONTROL MODULE 1
ECM2	CONNECTOR, ELECTRONIC CONTROL MODULE 2 (DONGAL)
ECM4	CONNECTOR, ELECTRONIC CONTROL MODULE 4
F101	FUSE, "E" ENGINE, 5A.
F102	FUSE, "E" ENGINE, 30A.
F105	FUSE, DONGAL, 1A, FAST BLOW
F110	FUSE, GRID HEATER, 125A., FAST ACTING
F111	FUSE, GRID HEATER, 125A., FAST ACTING
FL1	FUSIBLE LINK (8 GAUGE)
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 #1
K105	RELAY, AIR INTAKE, HEATER #2
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	MASTER DISCONNECT SWITCH
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, 1/4 W, 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
S275	SWITCH. PUSHBUTTON, OUTPUT NO. 2 (WHEN FURNISHED)
TB1	TERMINAL BLOCK, POWER MODULE
TB2	TERMINAL BLOCK, OPTIONS

DISTRIBUTION TABLE	
ACE	8/11
TEST	8/11
OUTSIDE DISTR.	

CHANGE RECORD					
E.C. No.	DATE				
		FILE NAME	PLOT DATE		
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		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, CONNECTION, CONTROL BOX

DESCRIPTIVE DATA: 90CU20, 120CU20 & 140CU20 TIER 3 CUMMINS

DESIGNED	DRAWN	DATE	SCALE
DPL	JJW	08/01/11	NONE
CHECKED	APPROVED	RECORDS	ITEM TYPE
		8/3/11	

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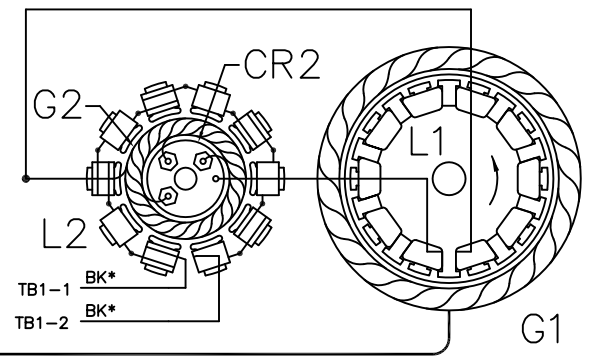
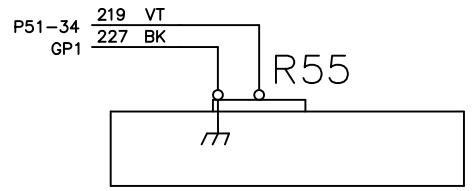
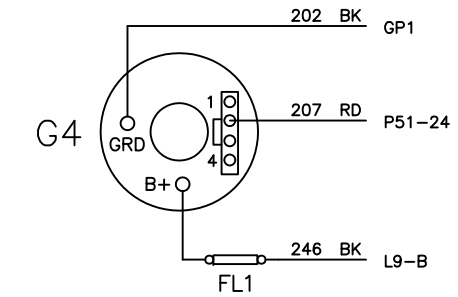
SIZE D | DWG. NO. 291687 | SHEET 3 OF 7

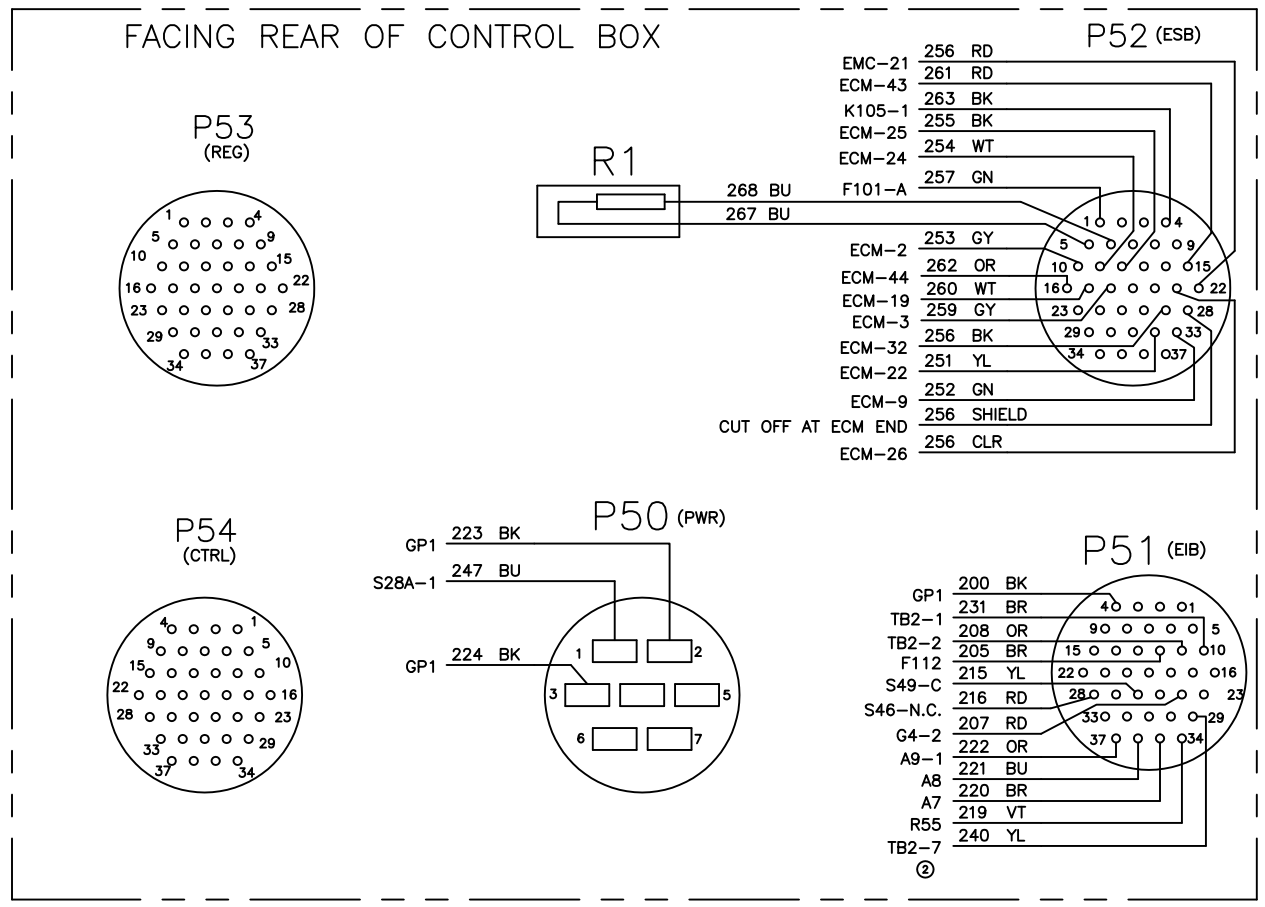
NOTES:

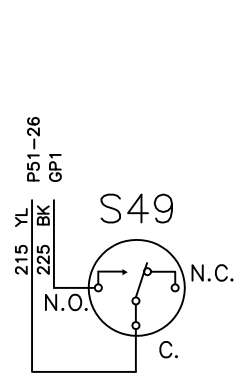
1. * WIRES FURNISHED.
2. WRAP TERMINAL ON WIRE 218 AND TUCK INTO HARNESS.

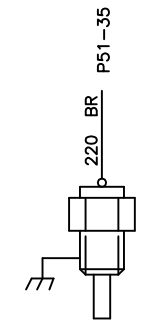


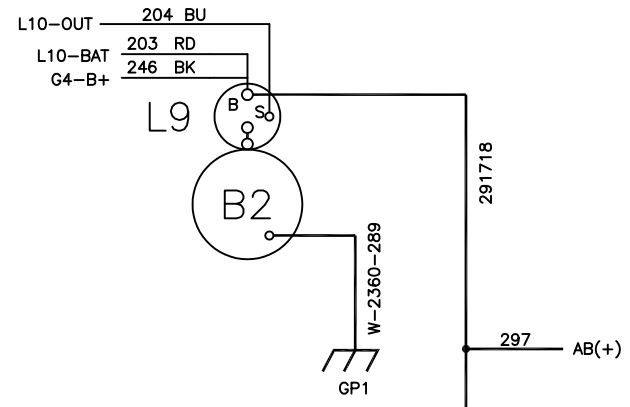


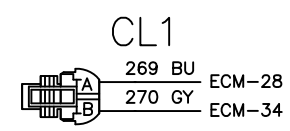


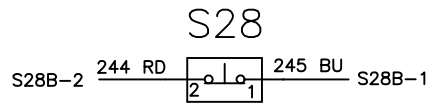


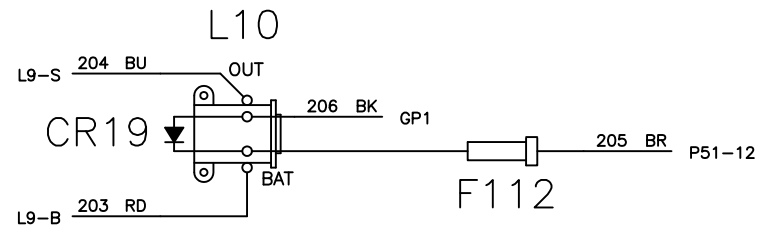


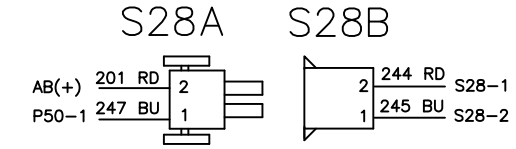


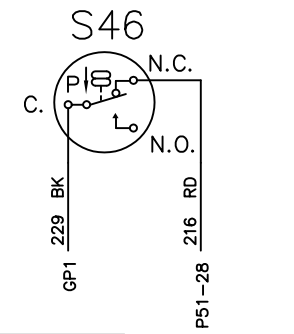


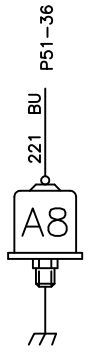


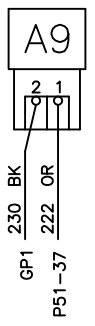


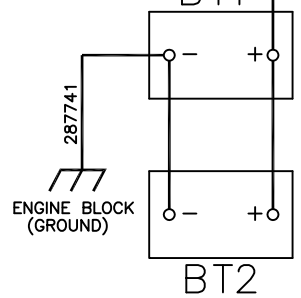


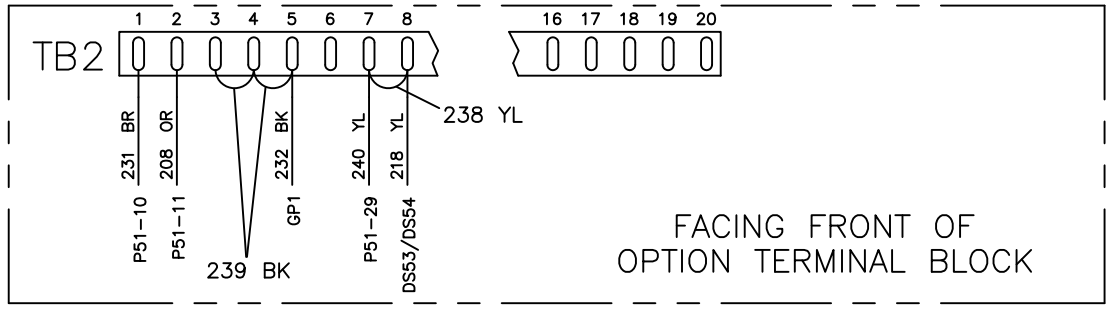


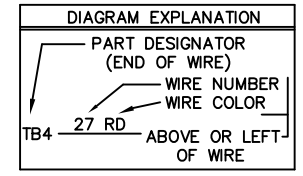




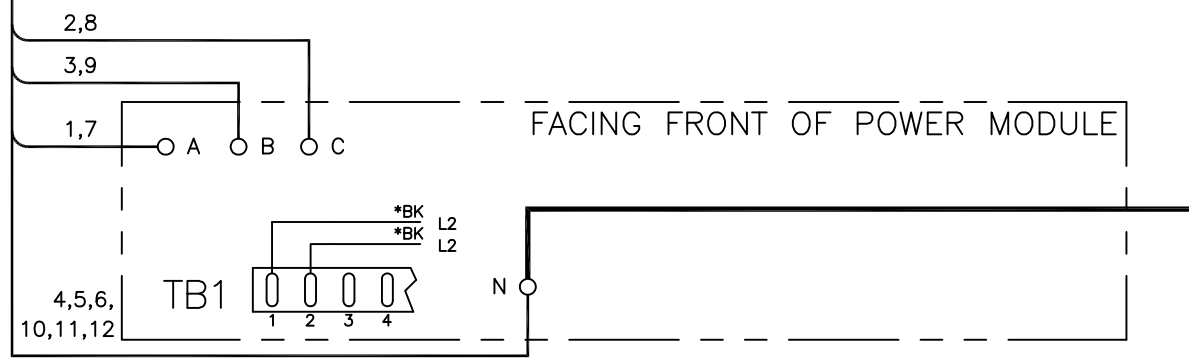


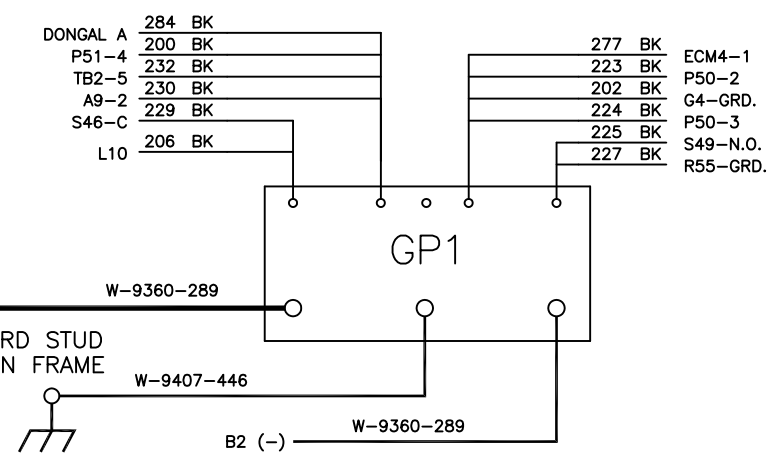






COLOR CODE			
BK	BLACK	RD	RED
BU	BLUE	TN	TAN
BR	BROWN	VT	VIOLET(PURPLE)
GN	GREEN	WT	WHITE
GY	GRAY(SLATE)	YL	YELLOW
OR	ORANGE	D	DARK (PREFIX)
PK	PINK	L	LIGHT(PREFIX)





ACE	8/11
TEST	8/11
OUTSIDE DISTR.	
DISTRIBUTION TABLE	

CHANGE RECORD	
E.C. No.	DATE

FILE NAME: 291687s4 | PLOT DATE: 08/02/11

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. ± | 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.
–

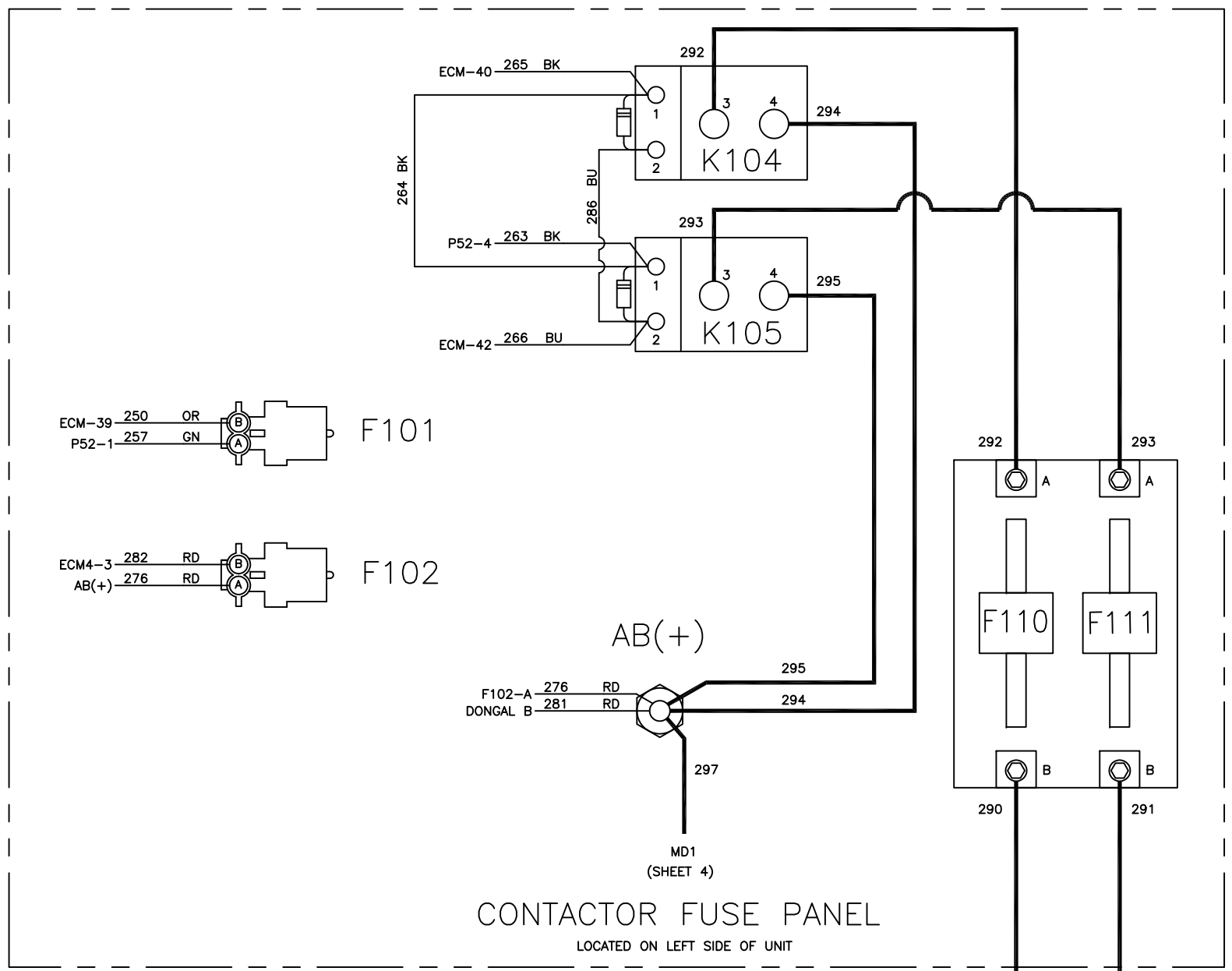
TITLE
DIAGRAM, SCHEMATIC & CONNECTION

DESCRIPTIVE DATA
90CU20, 120CU20 & 140CU20 TIER 3 CUMMINS

DESIGNED	DRAWN	DATE	SCALE
DPL	JJW	08/01/11	NONE
CHECKED	APPROVED	RECORDS	ITEM TYPE
dwaves		8/3/11	

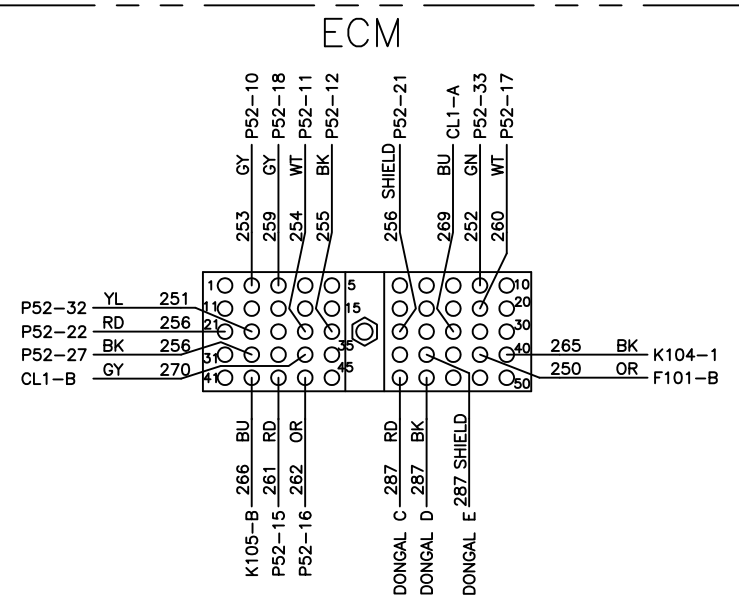
ITW GSE GROUP U.S.A.

SIZE D | DWG. NO. 291687 | SHEET 4 OF 7



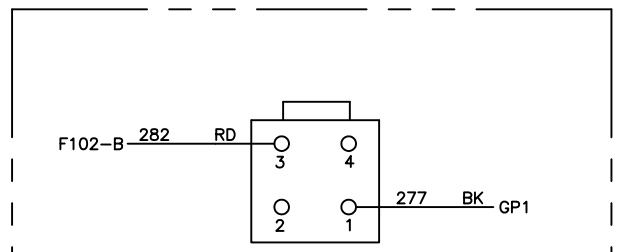
CONTACTOR FUSE PANEL

LOCATED ON LEFT SIDE OF UNIT



ELECTRONIC CONTROL MODULE 1

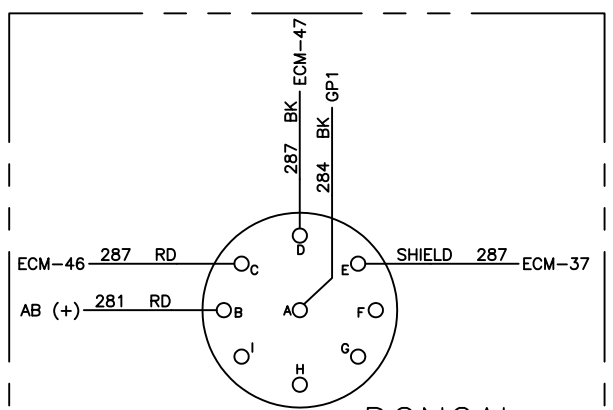
LOCATED ON LEFT SIDE OF ENGINE



ECM4

ELECTRONIC CONTROL MODULE 4

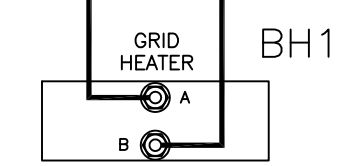
LOCATED ON LEFT SIDE OF ENGINE



DONGAL

ELECTRONIC CONTROL MODULE 2 (DONGAL)

LOCATED ON THE BULKHEAD



BH1

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)

TB4 27 RD — WIRE NUMBER / WIRE COLOR

ABOVE OR LEFT OF WIRE

ACE	8/11
TEST	8/11
OUTSIDE DISTR.	

DISTRIBUTION TABLE

CHANGE RECORD

E.C. No. | DATE

FILE NAME: 291687s5 | PLOT DATE: 08/02/11

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.

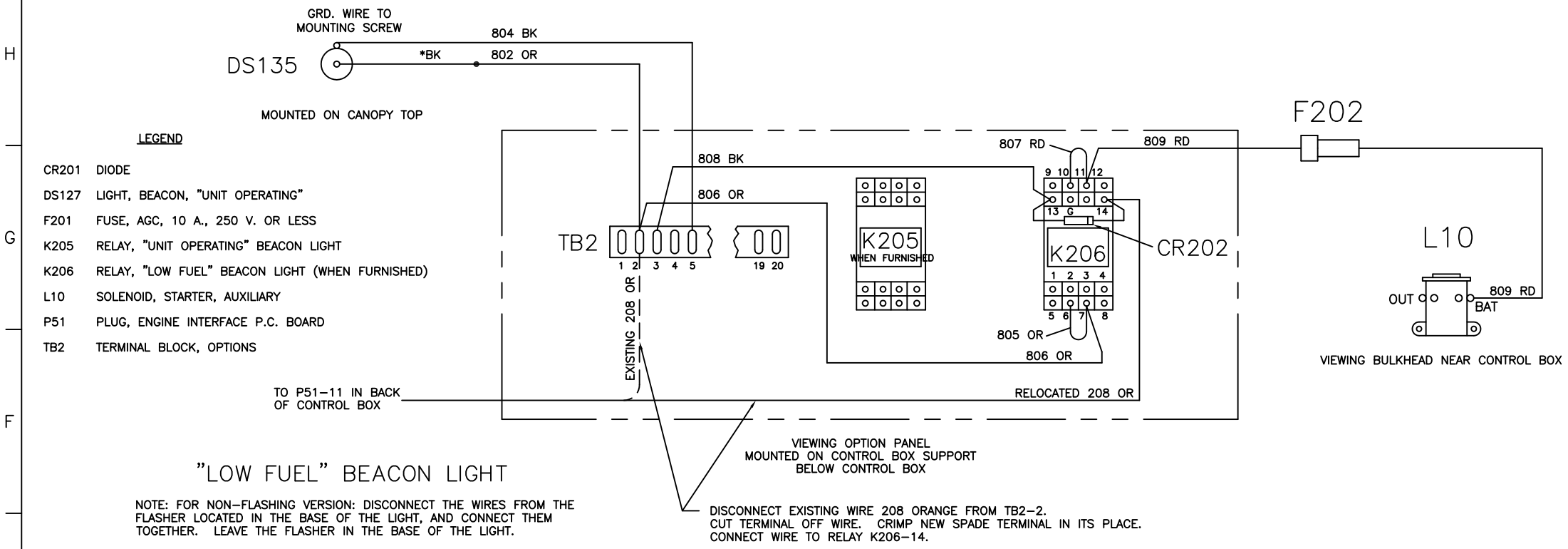
MATERIAL SPEC.: —

TITLE: DIAGRAM, SCHEMATIC & CONNECTION

DESCRIPTIVE DATA: 90CU20, 120CU20 & 140CU20 TIER 3 CUMMINS

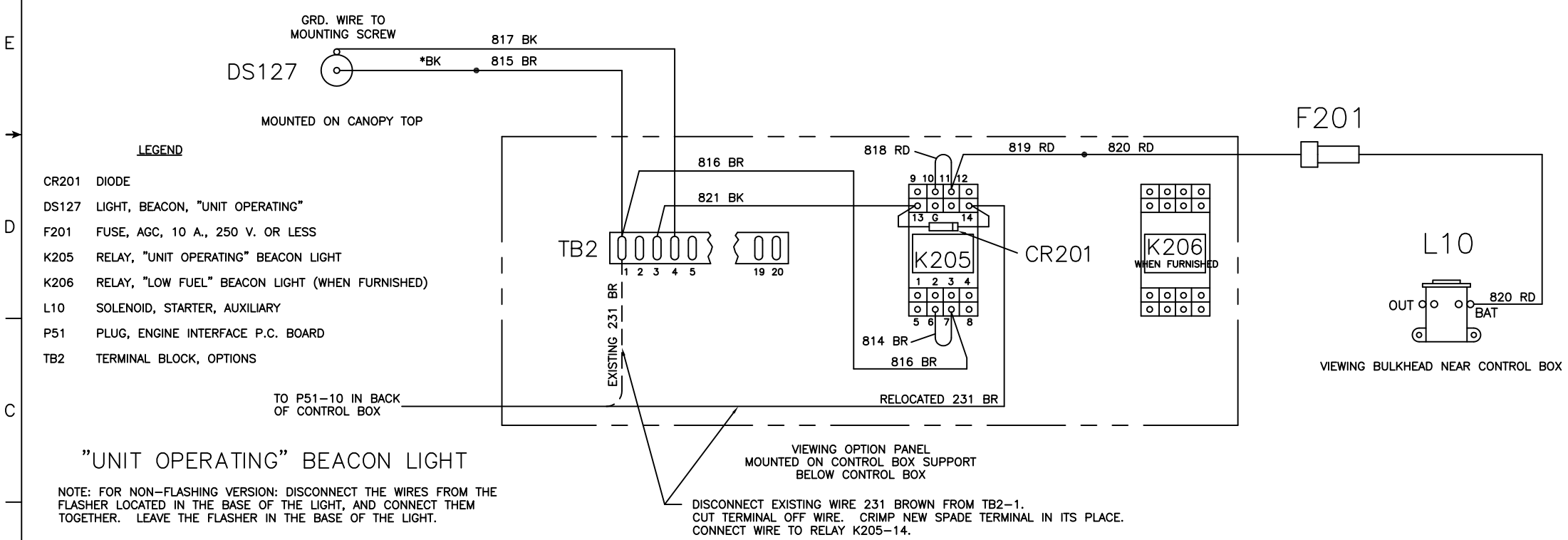
DESIGNED	DRAWN	DATE	SCALE
DPL	JJW	08/01/11	NONE
CHECKED: DUBBS	APPROVED	RECORDS 8/3/11	ITEM TYPE

ITW GSE GROUP U.S.A. | SIZE D | DWG. NO. 291687 | SHEET 5 OF 7



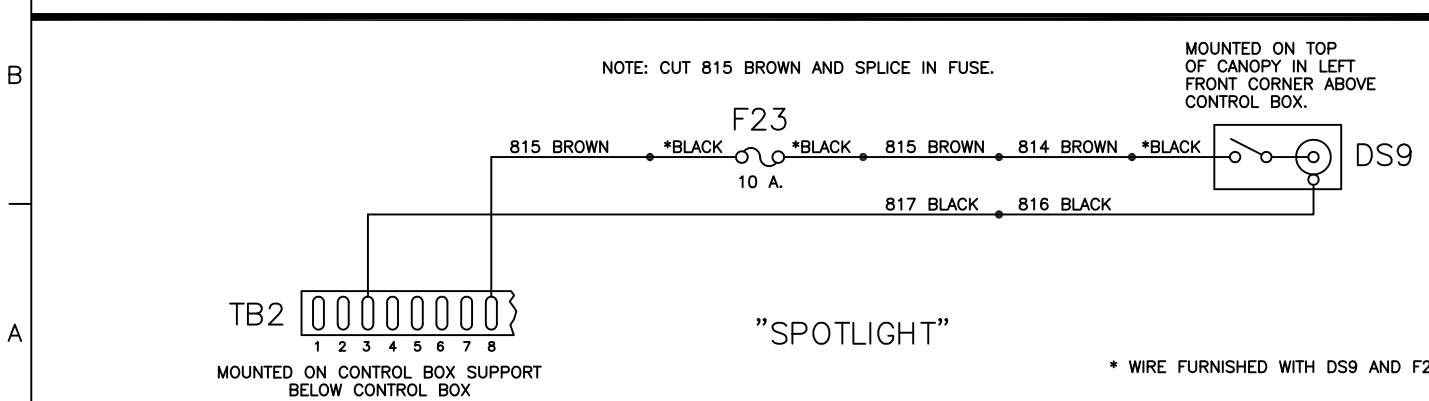
"LOW FUEL" BEACON LIGHT

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.



"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.



"SPOTLIGHT"

* WIRE FURNISHED WITH DS9 AND F23

ACE	8/11
TEST	8/11
OUTSIDE DISTR.	

DISTRIBUTION TABLE

CHANGE RECORD	
E.C. No.	DATE

FILE NAME	PLOT DATE	
291687s6	08/02/11	
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
90CU20, 120CU20 & 140CU20 TIER 3 CUMMINS

DESIGNED	DRAWN	DATE	SCALE
DPL	JJW	08/01/11	NONE
CHECKED	APPROVED	RECORDS	ITEM TYPE
cubbes		8/3/11	

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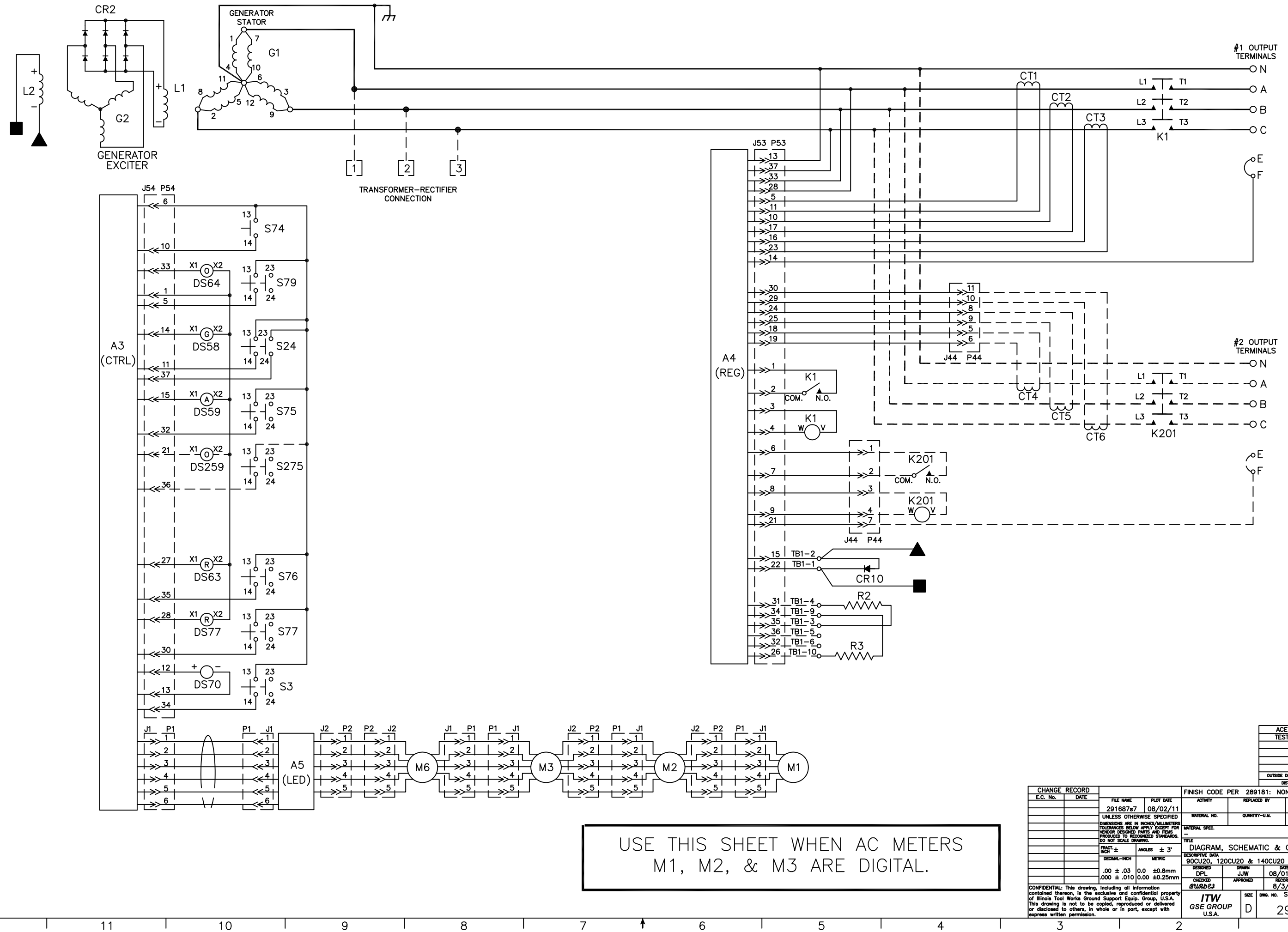
ITW GSE GROUP U.S.A.

SIZE D | DWG. NO. 291687 | SHEET 6 OF 7



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

ACE	8/11
TEST	8/11
OUTSIDE DISTR.	

DISTRIBUTION TABLE

CHANGE RECORD		
E.C. No.	DATE	

FILE NAME	PLOT DATE
291687s7	08/02/11

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

90CU20, 120CU20 & 140CU20 TIER 3 CUMMINS

DESIGNED	DRAWN	DATE	SCALE
DPL	JJW	08/01/11	NONE
CHECKED	APPROVED	RECORDS	ITEM TYPE
dwabes		8/3/11	

ITW GSE GROUP U.S.A.

SIZE D

DWG. NO. 291687

SHEET 7 OF 7

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

A1
ENGINE SPECIFIC BRD.
(ESB)

A2
(EIB)
ENGINE INTERFACE BRD.

A404
T-R BRD.
(TR)

A4
(REG)
REGULATOR BRD.

A3
(CTRL)
CONTROL BRD.

J50

J450

FACING INSIDE OF CONTROL BOX

NOTE: LABEL MUST BE FACING THIS DIRECTION.

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) 3226M	4/8/04		
2) 3257M	05/10/04		

FINISH CODE PER 910178: NONE

FILE NAME	PLOT DATE
2880225T	05/10/04

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES/MILLIMETERS
TOLERANCES BELOW ARE T DECIMAL PER
VENDOR DESIGNED PARTS AND FIGURE
PROJECTED TO REFERENCE STANDARDS.
DO NOT SCALE DRAWING.

DECIMAL-INCH	METRIC
.00 ± .03	0.0 ±0.8mm
.000 ± .010	0.00 ±0.025mm

ANGLES ± 1°

DESCRIPTIVE DATA

DIAGRAM, CONNECTION, CONTROL BOX

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

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TROY, OHIO 45373
U.S.A.

SIZE D | DWG NO. 289022 | SHEET 1 OF 4

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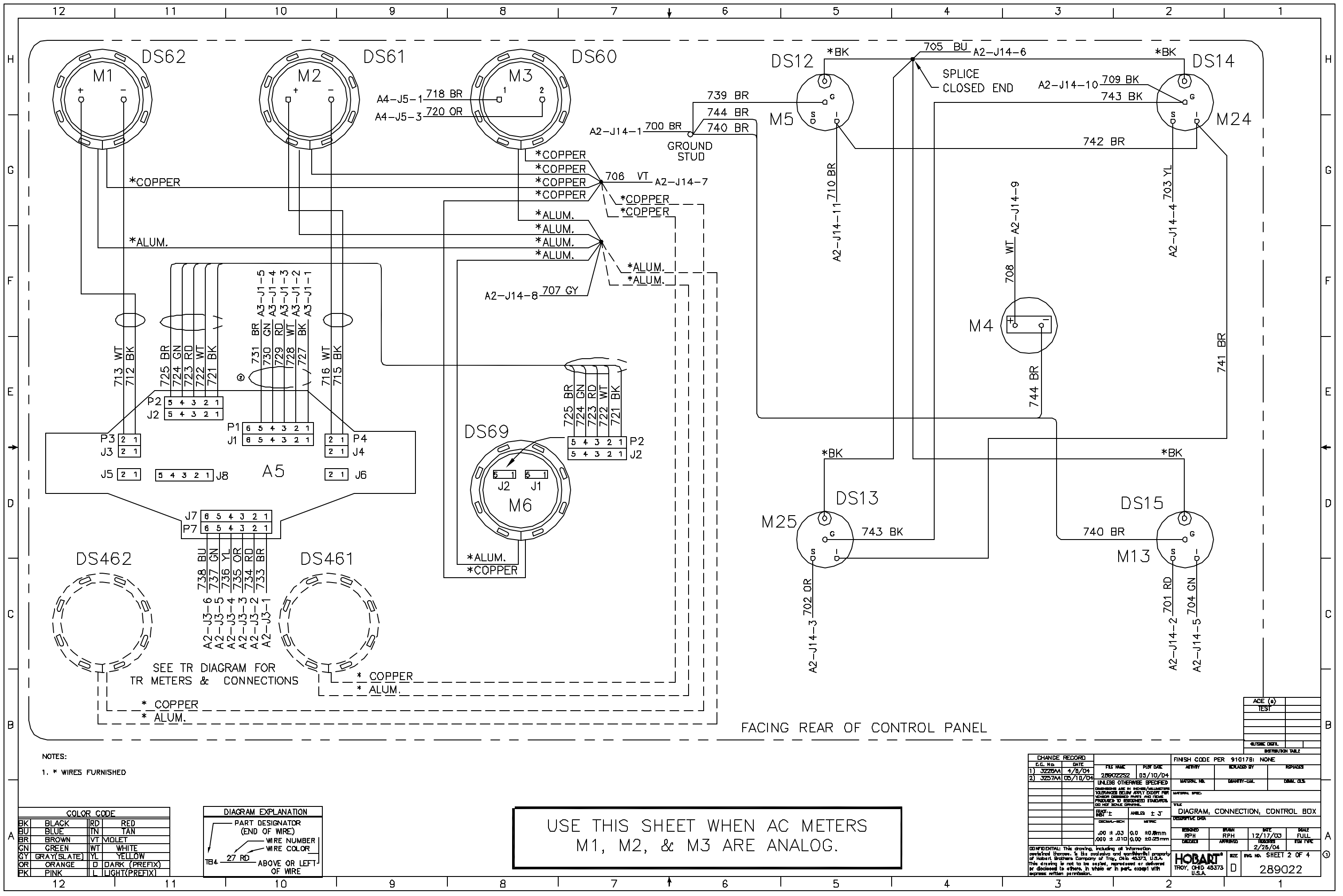
DISTRIBUTION TABLE



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

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

CHANGE RECORD			
E.C. No.	DATE		
1) J2264A	4/8/04		
2) J2574A	05/10/04		

FILE NAME 289022S2 PLOT DATE 05/10/04

UNLESS OTHERWISE SPECIFIED

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

FRACT ± ANGLES ± J

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

DESIGNATIVE DATA

DESIGNED	DRAWN	DATE	SCALE
RPH	RPH	12/17/03	FULL
CHECKED	APPROVED	REVISED 2/25/04	ITEM TYPE

FINISH CODE PER 910178: NONE

ACTIVITY	REPLACED BY	REPLACES
MATERIAL NO.	QUANTITY-UNIT	ORIGINAL DES.

MATERIAL SPEC.

TITLE
DIAGRAM, CONNECTION, CONTROL BOX

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HOBART® TROY, OHIO 45373 U.S.A.

SIZE D DWG. NO. 289022 SHEET 2 OF 4 REV 1

ACE (e) TEST

ELECTRONIC DIGITAL 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 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

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FINISH CODE PER 910176: NONE

ACTIVITY	REPLACED BY	REPLACES
MATERIAL NO.	QUANTITY-U.M.	CONN. 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

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U.S.A.

SIZE C

DWG. NO. 289022 SHEET 3 OF 4 ①

DS62 DS61 DS60 M1 M2 M3 J2 J1 P1 P2 761 BR 760 GN 759 RD 758 WT 757 BK 755 BR 754 GN 753 RD 752 WT 751 BK 749 BR 748 GN 747 RD 746 WT 745 BK

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

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

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

A5 J3 J4 J5 J6 J7 J8 P7 725 BR 724 GN 723 RD 722 WT 721 BK 731 730 729 728 727 A3-J1-5 A3-J1-4 A3-J1-3 A3-J1-2 A3-J1-1 738 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

DS69 M6 DS462 DS461

SEE TR DIAGRAM FOR TR METERS & CONNECTIONS

* COPPER * ALUM.

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; TB14 27 RD ABOVE OR LEFT OF WIRE

NOTES:
1. * WIRES FURNISHED

CHANGE RECORD		
E.C. No.	DATE	
1) JZ26AA	4/8/04	
2 JZ57AA	05/18/04	

FILE NAME 258UZZS4 PLOT DATE 03/10/04

UNLESS OTHERWISE SPECIFIED

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

FRACTIONAL ± 1/64 ANGLES ± 1°

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

FINISH CODE PER 910178: NONE

ACTIVITY REVISED BY REVISED MATERIAL NO. QUANTITY-UNIT. ORIGINAL DES. MATERIAL SPEC.

TITLE: DIAGRAM, CONNECTION, CONTROL BOX

DESCRIPTIVE DATA

DESIGNED RPH DRAWN RPH CHECKED APPROVED DATE 4/8/04 REVISED SCALE FULL NEW TYPE

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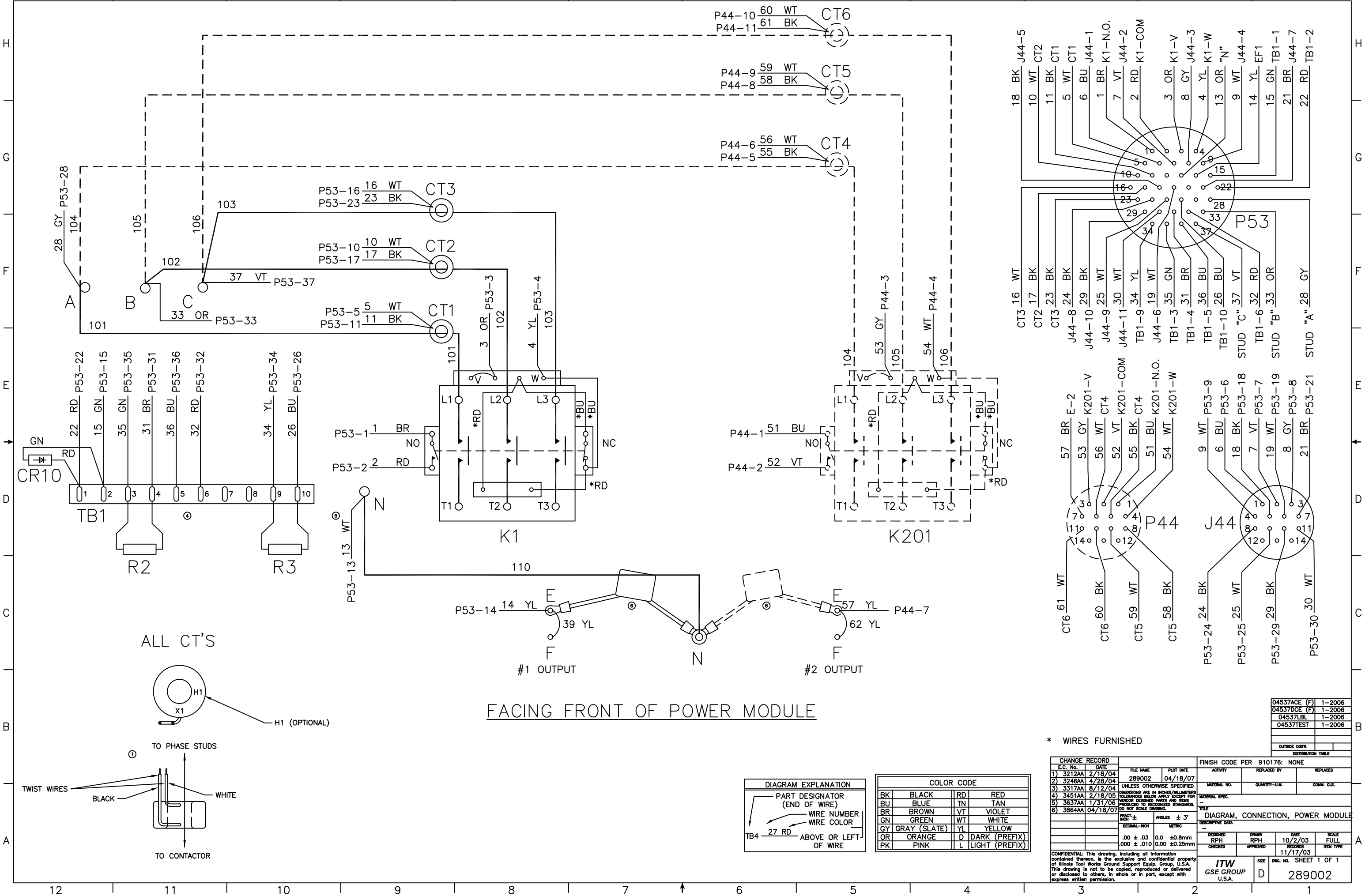
SIZE D DWG. NO. 289022 SHEET 4 OF 4

ACE (s) Tool

ELTRONIC DIGITAL DISTRIBUTION TABLE



* WIRES FURNISHED

04537ACE (F)	1–2006
04537DCE (F)	1–2006
04537LBL	1–2006
04537TEST	1–2006
OUTSIDE DISTR.	

DISTRIBUTION TABLE

CHANGE RECORD			
E.C. No.	DATE	FILE NAME	PLOT DATE
1) 3212AA	2/18/04	289002	04/18/07
2) 3246AA	4/28/04		
3) 3317AA	8/12/04		
4) 3451AA	2/18/05		
5) 3637AA	1/31/06		
6) 3864AA	04/18/07		

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, POWER MODULE

DESCRIPTIVE DATA
–

DESIGNED	DRAWN	DATE	SCALE
RPH	RPH	10/2/03	FULL
CHECKED	APPROVED	RECORDS 11/17/03	ITEM TYPE

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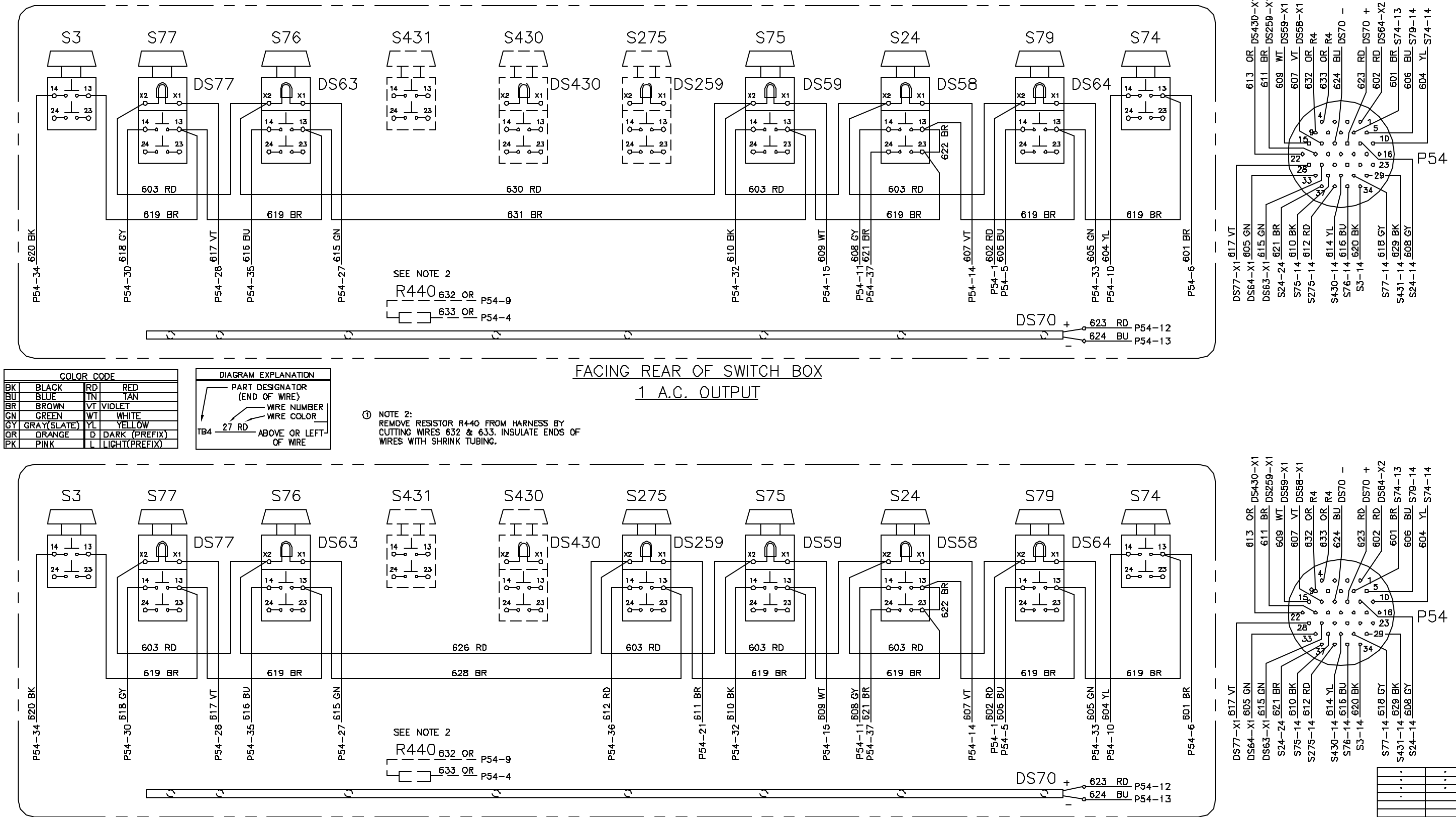
ITW GSE GROUP U.S.A.

SIZE D | DWG. NO. 289002 | SHEET 1 OF 1



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

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

NOTES:

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

FACING REAR OF SWITCH BOX
2 A.C. OUTPUTS

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)
①②③R440	RESISTOR, 1K, T-R I.D.	S431	SWITCH, PUSHBUTTON, DC, STARTING CURRENT, (WHEN FURNISHED)

CHANGE RECORD							
E.C. No.	DATE		FILE NAME	PLOT DATE	FINISH CODE PER 910178: NONE		
1) RPH	2/12/04		288013S1	03/11/04	ACTIVITY	REMARKS BY	REMARKS
2) 32264A	4/5/04		UNLESS OTHERWISE SPECIFIED		MATERIAL NO.	QUANTITY-LNG.	DIMNL CLS.
3) 32613A	05/11/04		DIMENSIONS ARE IN INCHES/MILLIMETERS TOLERANCES BELOW ARE'T DOUBT PER VENDOR DIMENSIONED PARTS AND ISSUE PROCURED TO ECONOMICS STANDARDS. DO NOT SCALE DRAWING.		MATERIAL SPEC.		
			DECIMAL ±	ANGLES ±	TITLE	DIAGRAM, CONNECTION, SWITCH BOX	
			DECIMAL-INCH	METRIC	DESCRIPTIVE DATA		
			.00 ± .03	0.0 ±0.8mm	DESIGNED	DRAWN	DATE	SCALE
			.000 ± .010	0.00 ±0.025mm	RPH	RPH	12/12/03	FULL
					DRAWING STATUS	APPROVED	02/11/04	TEST TAPE

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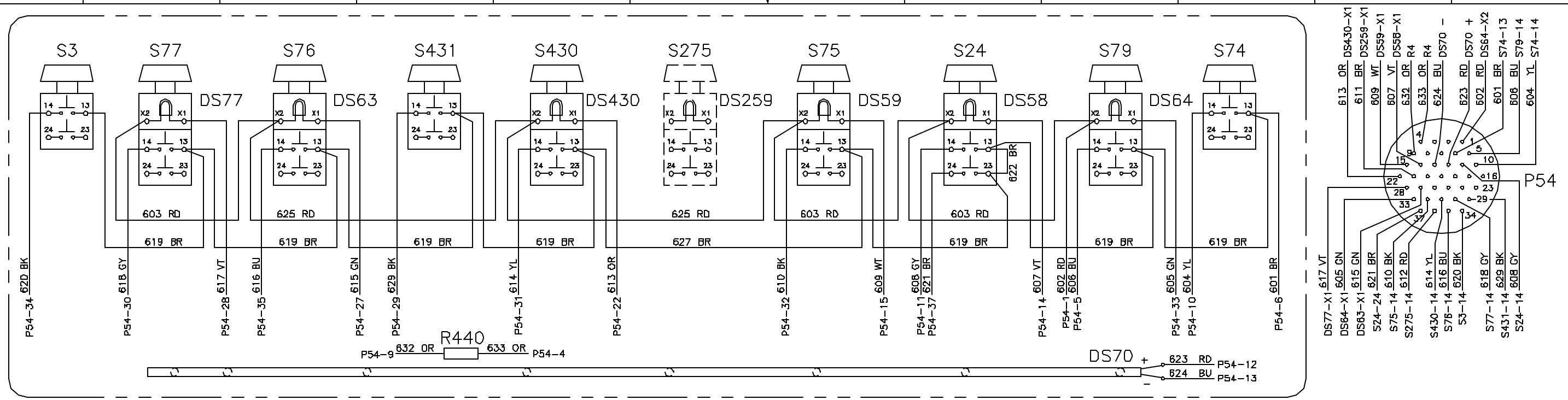
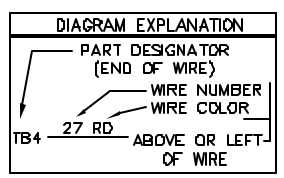
SIZE D | DWG NO. 289013 | SHEET 1 OF 2

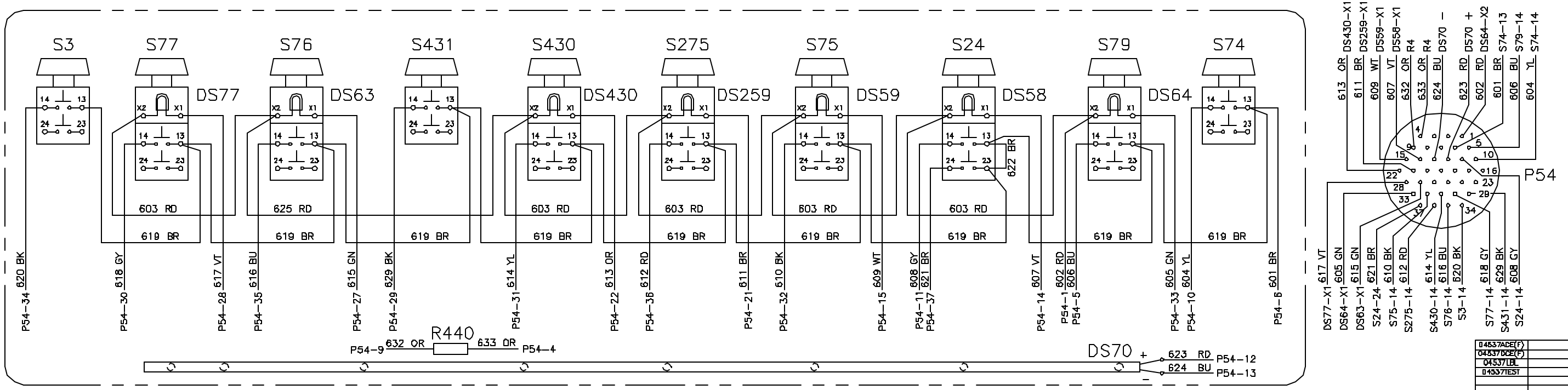


FACING REAR OF SWITCH BOX
1 A.C. & 1 D.C. OUTPUT

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





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)	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)	S79	SWITCH, PUSHBUTTON, PREHEATER
		S275	SWITCH, PUSHBUTTON, #2 OUTPUT, (WHEN FURNISHED)
◎R440	RESISTOR, 1K, T-R I.D.	S430	SWITCH, PUSHBUTTON, DC OUTPUT, (WHEN FURNISHED)
		S431	SWITCH, PUSHBUTTON, DC, STARTING CURRENT, (WHEN FURNISHED)

CHANGE RECORD					
	E.C. No.	DATE			
1)	RPH	2/12/04	FILE NAME	PLOT DATE	
2)	322GAA	4/8/04	289013S2	05/11/04	
3)	326TAA	05/11/04	UNLESS OTHERWISE SPECIFIED		
			DIMENSIONS ARE IN INCHES/MILLIMETERS TOLERANCES BELOW ARE/T 200PT PER VENDOR DRESSED PARTS AND HOUSE PRODUCED TO ECONOMIZED STANDARDS DO NOT SCALE DRAWING.		
			FRACT ±	ANGLES ± 3°	
			DECIMAL-INCH	METRIC	
			.00 ± .03	0.0 ±0.8mm	
			.000 ± .010	0.00 ±0.025mm	

FINISH CODE PER 910178: NONE

ACTIVITY	REMADE BY	REMADES
MATERIAL NO.	QUANTITY-LOT	ORIGINAL DES.
MATERIAL SPEC.		

TITLE: DIAGRAM, CONNECTION, SWITCH BOX

DESCRIPTIVE DATA

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

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HOBART® TROY, OHIO 45373 U.S.A.

SIZE D | DWG NO. 289013 | SHEET 2

04537ADE(F)	
04537DCE(F)	
04537LBL	
04537TEST	
#UTSMC DISTR.	
DISTRIBUTION TABLE	

Appendix A Options / Features

The following is a list of options/features available for the 90CU20, 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.

Option/Features Available			
Description	**Part Number**	**Document Number**	**In This Section**
Drawbar, 1-1/2" Eye	286944	n/a	
Kit, Battery Blanket, 120V	287917	n/a	
Kit, Beacon, Low Fuel (Flash/No-Flash/Strobe)*	289208-XXX	n/a	
Kit, Beacon , Unit Operating(Flash/No-Flash)*	289210-XXX	n/a	
Kit, Block Heater, 120V	289261-001	n/a	
Kit, Block Heater, 240V	289261-001	n/a	
Kit, CE Certification – Trailer Mount Units	287589-001	n/a	
Kit, CE Certification – Fixed/Truck Mount Units	287589-002	n/a	
Kit, Clearance Lights	288912	TO-297	
Kit, Fire Extinguisher, 5 lb. Carbon Dioxide	283012	TO-252	
Kit, Fixed Mounting	287892	n/a	
Kit, Pin Hitch	381441	381441	
Kit, Pintle Hitch	76A1361	76A1361	
Kit, Spotlight	289064	n/a	
Kit, Tie-Down	284706	n/a	
Kit, Transformer-Rectifier, 28 VDC	Call Factory	OM-2136	
Support, Fork Lift Assembly	287694	TO-281	
T-Handle Latch (as required)	287542-002	n/a	
Trailer, with Tongue Actuated Brakes/Cable Trays	Standard	TO-257	
Trailer, with Lever Actuated Brakes/Cable Trays	No Number	TO-241	
Wheel Chocks	287609	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.

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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