

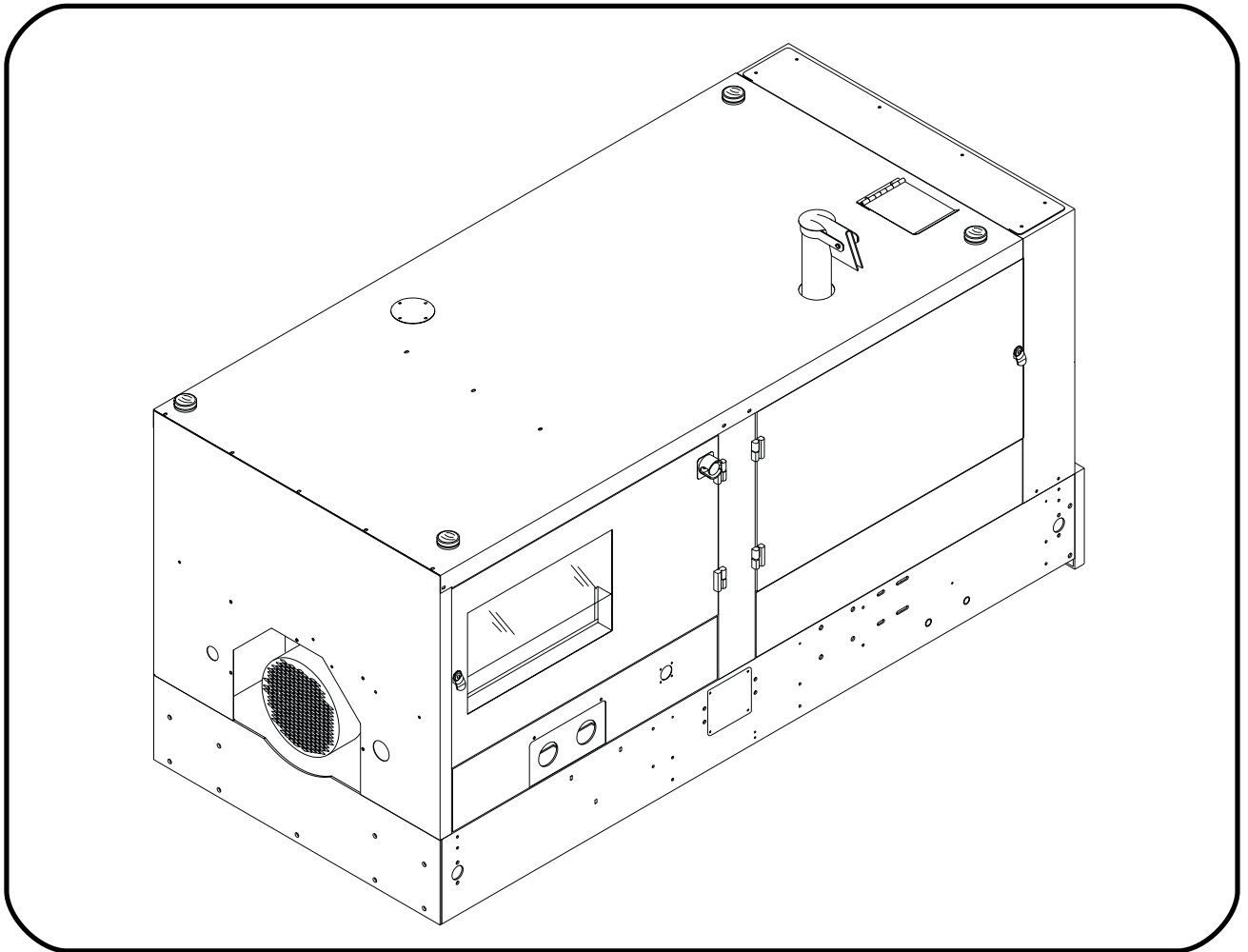
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HOBART[®]
GROUND POWER

Operation and Maintenance Manual



Model 120CU24 Generator Sets Series 500391A

Hobart Brothers Company
Ground Power Division
Troy, OH 45373
U.S.A.

WARRANTY

HOBART BROTHERS COMPANY TROY, OHIO 45373
GROUND POWER DIVISION

1. Hobart Brothers Company (hereinafter called **HOBART**) warrants that each new and unused Hobart Ground Power Equipment, (hereinafter called the **PRODUCT**) is of good workmanship and is free from mechanical defects, provided that (1) the **PRODUCT** is installed and operated in accordance with the printed instructions of **HOBART**, (2) the **PRODUCT** is used under the normal operating conditions for which it is designed, (3) the **PRODUCT** is not subjected to misuse, negligence or accident, and (4) the **PRODUCT** receives proper care, lubrication, protection, and maintenance under the supervision of trained personnel.
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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.
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WARNING

AT ALL TIMES, SAFETY MUST BE CONSIDERED AN IMPORTANT FACTOR IN THE INSTALLATION, SERVICING AND OPERATION OF THE PRODUCT, AND SKILLED, TECHNICALLY QUALIFIED PERSONNEL SHOULD ALWAYS BE EMPLOYED FOR SUCH TASKS.

Safety Warnings and Cautions

WARNING

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.

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.

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, or 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, 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 and mechanical 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 electrically-powered equipment, take the following precautions:

- a. **Shut OFF all power at the disconnecting switch or line breaker 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 piping, 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 removing 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 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 inspect all labels that cannot be easily read.

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Introduction

This manual contains operation and maintenance information for a Hobart generator set manufactured by Hobart Brothers Company, Ground Power Division, 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. Each chapter is divided into as many sections as required. Each new section starts with page 1. Each page is identified by chapter, section and page number, which are located in the lower, outside corner. When information located in another portion of the manual is referred to, its location is identified by a chapter, section, and paragraph or figure number.

For example: “(see Section 2-3, Paragraph 1.a.)” refers to information located in Chapter 2, Section 3, Paragraph 1.a. If a chapter and section are not indicated in a reference, the referenced material is located in the same section as the reference, For example: “(see Paragraph 1.a.)”.

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

Appendix A contains a list of options and corresponding TO documents. If the machine purchased contains one of these options, the corresponding TO will be inserted in this section.

Content 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 / Features

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Table of Contents

Chapter-Section Page

Chapter 1. Description / Operation

Section 1. Description	1-1	1
General	1-1	1
Orientation	1-1	1
Optional Equipment.	1-1	1
Special Features	1-1	1
Protective Monitor	1-1	1
Voltage Regulator.	1-1	1
Electric Governor	1-1	1
Canopy	1-1	1
Engine, Generator, and Control Box	1-1	4
Basic Engine	1-1	4
Engine Manufacturer's Equipment	1-1	4
Engine Cooling Fan	1-1	6
Occasional Engine Faults	1-1	6
Hobart Installed Engine Equipment	1-1	7
Generator	1-1	8
Control Box Assembly	1-1	9
Power Module Panel Assembly.	1-1	18
Section 2. Preparation for Use, Storage or Shipping . .	1-2	1
Preparation for Use	1-2	1
Inspection/Check	1-2	1
Installing Three-phase AC Output Cables	1-2	2
Preparation for Storage.	1-2	3
General	1-2	3
Temporary Storage.	1-2	3
Long Time Storage (Over 30 Days).	1-2	3
Preparation for Shipment	1-2	4

Section 3.Operation	1-3	1
General	1-3	1
Operating the Unit	1-3	1
Pre-start inspection	1-3	1
Normal Engine Starting Procedures	1-3	1
Failed Starting Procedures	1-3	4
Power Delivery	1-3	4
Discontinue Power Delivery with Unit Shutdown	1-3	5

Chapter 2. Servicing

Section 1.Maintenance Inspection/Check	2-1	1
General	2-1	1
Maintenance Schedule	2-1	1
General	2-1	1
Maintenance Schedule Check Sheet	2-1	1
Time Intervals	2-1	1
Identification of Interval Periods	2-1	1
Inspection/Check	2-1	4
General	2-1	4
“AR” Checks and Operations (As Required)	2-1	4
“BR” Checks and Operations (Break-In Period)	2-1	4
“A” Checks and Operations (10 Hours or Daily)	2-1	5
“B” Check and Operations (250 Hours or 3 Months)	2-1	7
“C” Checks and Operations (500 Hours or 6 Months)	2-1	7
“D” Checks and Operations (1000 Hours or 1 Year)	2-1	8
“E” Checks and Operations (1500 Hours or 1 ½ Years)	2-1	8
“F” Checks and Operations (2000 Hours or 2 Years)	2-1	10
Seasonal Maintenance Checks (Engine)	2-1	11
Lamps and Circuit Breakers	2-1	12
Section 2.Maintenance Procedures	2-2	1
General	2-2	1
Lubrication	2-2	1
General	2-2	1
AC Generator	2-2	1
Generator Controls	2-2	1
Engine	2-2	1
Engine Accessories Lubrication	2-2	5
Servicing the Air Cleaner	2-2	6
Inspecting the Air Cleaner	2-2	6
Changing the Air Filter	2-2	6
Disposal	2-2	6

Engine Fuel	2-2	7
How to Select Fuel—Quality	2-2	7
Cold Weather Operation	2-2	7
Engine Fuel System	2-2	7
Fuel Tank	2-2	8
Fuel Pre-Filter/Separator	2-2	8
Fuel Pump	2-2	9
Fuel Filter and Pre-filter Straining Screen	2-2	9
Fuel Return	2-2	11
Priming Fuel System	2-2	11
Engine Cooling System	2-2	14
General	2-2	14
Radiator Cap	2-2	14
Coolant	2-2	14
Draining the Cooling System	2-2	15
Flushing the Cooling System	2-2	15
Cleaning the Radiator Core	2-2	15
Filling the Cooling System	2-2	16
Thermostat	2-2	16
Coolant Filter Removal	2-2	16
Drive Belts	2-2	17
General	2-2	17
Preparation for Belt Check and Adjustment	2-2	17
Check Fan Belt Tension	2-2	17
Generator Maintenance	2-2	18
Cleaning	2-2	18
Adjustment	2-2	18
Section 3. Adjustment/Test	2-3	1
General	2-3	1
Testing the Generator Set	2-3	1
Pre-operational Test Procedures	2-3	1
Operational Test Procedures	2-3	4
Testing the No. 1 output circuit	2-3	5
Testing the No. 2 output circuit	2-3	6
Testing and checking meters, switches, relays, and indicating lights	2-3	7
Re-checking the entire unit after testing	2-3	9
Generator Set Adjustment	2-3	10
Generator Adjustment	2-3	10
Adjust 400 Hz voltage regulator	2-3	10
Basic Engine Adjustments	2-3	11
Engine Accessories Adjustment	2-3	11
Electric Governor System Adjustment	2-3	12
Generator and Exciter Test	2-3	18
Diode Test	2-3	18

Section 4. Troubleshooting Procedures	2-4	1
General	2-4	1
Equipment for Troubleshooting	2-4	1
Parts Replacement	2-4	1
Test Values	2-4	2
Check Connections and Leads	2-4	2
Electric Governor Troubleshooting	2-4	2
Engine Troubleshooting	2-4	3
Illustrations	2-4	3
Connection and Schematic Diagrams	2-4	3
Engine Controls	2-4	7
Generator Excitation Circuits	2-4	13
No. 1 Load Contactor Operating Circuit	2-4	15
No. 2 Load Contactor Operating Circuit	2-4	18
Protective Circuit	2-4	20
Generator	2-4	23

Chapter 3. Overhaul/Major Repair

Section 1. Exciter Armature	3-1	1
General	3-1	1
Exciter Armature	3-1	2
Exciter Armature Replacement	3-1	2
General	3-1	2
Tools Needed for Exciter Armature Removal and Installation	3-1	3
Conditions for Exciter Removal	3-1	3
Preparation for Exciter Armature Removal	3-1	4
Exciter Armature Removal	3-1	4
Installing the Exciter Armature	3-1	6
Preparation for Exciter Armature Installation	3-1	6
Exciter Armature Installation	3-1	6

Section 2. Dual Bearing Flexible Coupling

General	3-2	1
Coupling Bolts	3-2	1
Disassembly	3-2	1
Separate Engine and Generator	3-2	1
Remove Coupling Assembly	3-2	2
Coupling Service	3-2	3
Coupling Kit	3-2	4
Bushing Kits	3-2	4
Bushing Replacement	3-2	4
Coupling Installation	3-2	5
Cleaning	3-2	5
Assembly	3-2	5
Reassemble Engine and Generator	3-2	10
Run-in and Periodic Check	3-2	10

Section 3. Generator Assembly

General	3-3	1
Procedure for Generator Assembly Removal	3-3	1
Procedure for Gaining Access to the Generator	3-3	1
Removing the generator Assembly	3-3	3
Installing a Generator Assembly	3-3	4
Remounting the Generator Assembly	3-3	4
Remounting the Previously Removed Assemblies	3-3	4

Chapter 4. Illustrated Parts List	4-1	1
<hr/>		
Section 1. Introduction	4-1	1
General	4-1	1
Purpose	4-1	1
Arrangement	4-1	1
Explanation of Parts List	4-1	1
Contents	4-1	1
Parts List Form	4-1	1
Section 2. Manufacturer's Codes	4-2	1
Explanation of Manufacturer's (Vendor) Code List	4-2	1
Section 3. Illustrated Parts List	4-3	1
Explanation of Parts List Arrangement	4-3	1
Symbols and Abbreviations	4-3	1
Section 4. Numerical Index	4-4	1
Explanation of Numerical Index	4-4	1
Numerical Index	4-4	1
Chapter 5. Manufacturer's Literature	5-1	1
<hr/>		
Appendix A. Options/Features	Appendix A	1
<hr/>		
Unusual Service Conditions		
<hr/>		
Wet Stacking		
<hr/>		

Chapter 1. Description / Operation

Section 1. Description

1. General

The basic generator set covered in this manual, manufactured by Hobart Brothers Company, Ground Power Division. It is rated at 120 KVA. It is designed to produce and deliver 115/200-volt, 400 Hz, 3-phase AC power to a parked aircraft or Hobart approved test banks only. Series 500391A consists of the following part numbers:

Part Number 500391A-001 identifies a unit structured for trailer mounting.

Part Number 500391A-002 identifies a unit structured for stationary/truck mounting.

2. 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 side at the FRONT of the unit.

3. Optional Equipment

Chapters 1 through 5 of this Operation and Maintenance Manual identifies only the “strip down” version of the 120CU24 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.

4. Special Features

The generator set has special features in which are described more fully under assemblies in which they appear. Three features, protective monitor, voltage regulator, and electric governor are mentioned here and described briefly.

a. Protective Monitor

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

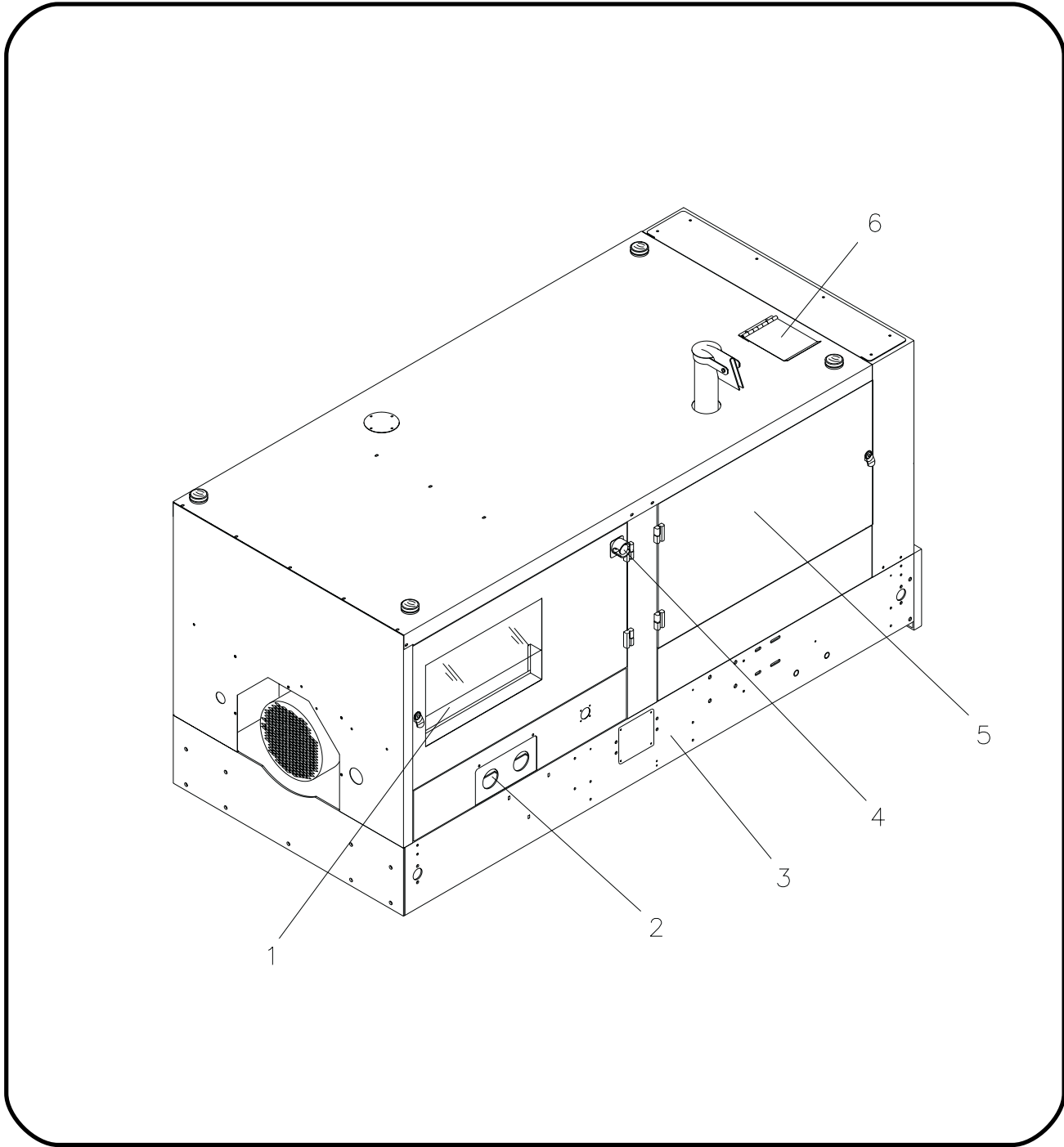
A microprocessor-type, adjustable voltage regulator provides automatic voltage regulation at the aircraft. The regulator is also adjustable for a variety of output cable sizes and lengths.

c. Electric Governor

The engine is equipped with an electric governor kit and other special equipment more fully described under the engine description.

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.



- | | |
|------------------------|--------------------------|
| 1. Control Panel | 4. Emergency Stop Switch |
| 2. Output Cable Clamps | 5. Canopy |
| 3. Frame | 6. Radiator Access Door |

**Generator Set
Figure 1**

Physical	Basic Unit	With Trailer
Length	100 in. (2540 mm)	148 in. (3759 mm)
Width	45 in. (1143 mm)	77 in. (1956 mm)
Height	47.5 in. (1203 mm)	61 in. (1549mm)
Weight with T-R	5200 lb. (2359 kg)	5600 lb. (2540 kg)
Weight of optional T-R	Not applicable	5900 lb. (2676 kg)
Generator		
Output power rating (kVA)	120 kVA	
Output Voltage	115/200 Volts	
Rated load capacity (Amps)	348 Amps	
Frequency (Hz)	400 Hz	
Output kilowatts	96	
Power factor	0.8	
Duty cycle	100%	
Operating speed (RPM)	2400 RPM	
Overload capacity, both outputs: 125% rated load (Amps)	435	
Output cable size	2/0	
Generator Protective System		
Over voltage	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	Trips at any voltage below 100 volts after 7 seconds.	
Over frequency	Trips at any value between 420-Hz and 480-Hz after a 5-second time delay. Trips immediately at any frequency exceeding 480-Hz.	
Under frequency	Trips at 380-Hz or less after a 7-second time delay.	
Overload time delay	Trips in approximately 5 minutes at 125% load of 90KVA on either output or 120KVA on both outputs combined.	

Specifications and Capabilities
Figure 2 (Sheet 1 of 2)

Engine	
Manufacturer	Cummins Engine Company
Model No.	B5.9C200
Type	In-line 6 cylinder 4 Cycle Diesel
Bore and Stroke	4.02 x 4.72 inches (102 x 120 mm)
Displacement	359 c.i. (5.9 liters)
Compression Ratio	17.3 : 1
Horsepower (kW)	200 hp (149 kw)
Idle speed	850 +/-50 RPM
High speed limiting	2750 +/- 75 RPM
Normal governed speed	2400 RPM
Electrical system	12-V DC
Ground	Negative
Firing order (RH rotation)	1-5-3-6-2-4
Lubricating oil capacity (w/filter)	16 quarts (15.1 Liters)
Coolant capacity system	28 quarts (26.5 Liters)

Specifications and Capabilities
Figure 2 (Sheet 2 of 2)

6. Engine and Generator

The engine and generator comprise the principal components of the generator set. They are mounted on the welded steel frame of the chassis. The engine coolant radiator is also mounted on the frame just forward of the engine-generator combination. Figure 3 is an illustration showing the location of all major components and sub-assemblies.

a. Basic Engine.

The basic engine is an in-line 6-cylinder diesel rated at 200 horsepower. See Fig. 2 for general specifications.

b. Engine Manufacturer's Equipment

As received from the engine manufacturer, the engine includes the following equipment which is more fully described in the Cummins "Operation Manual".

(1) Electrical System

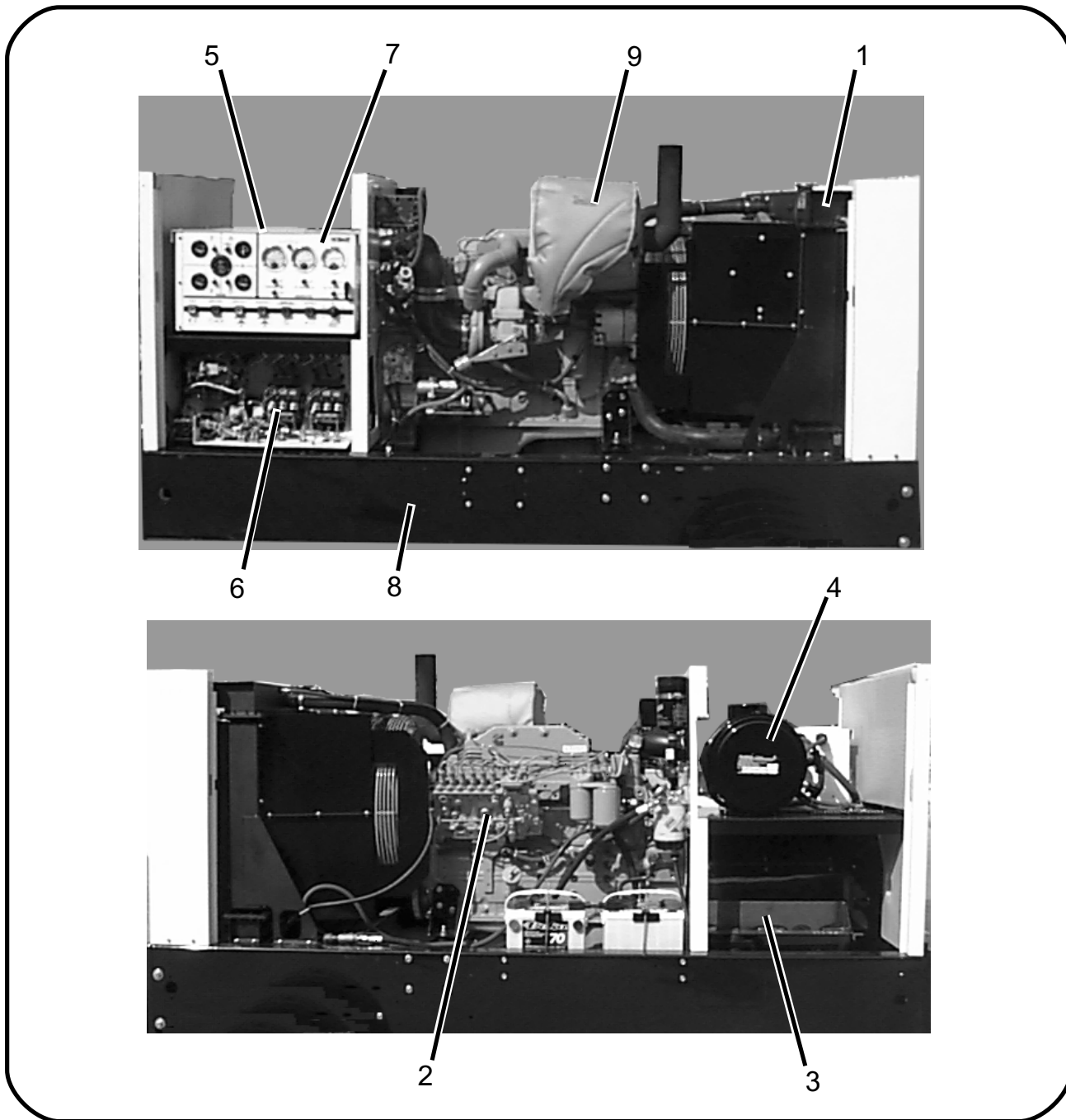
The 12-V DC electrical generating and starting system includes an alternator, voltage regulator, and starter with solenoid switch.

(2) Fuel Filter

The fuel filter is a vacuum type connected between the fuel supply and the pump. It has two throwaway type elements located side by side on a single head.

(3) Oil Filter

The engine oil filter is a spin-on, full-flow type. It is mounted on the right side of the engine.



- | | |
|----------------|-----------------------------------|
| 1. Radiator | 6. Output Module Panel |
| 2. Engine | 7. Engine-Generator Control Panel |
| 3. Generator | 8. Mounting Frame |
| 4. Air Cleaner | 9. Muffler |
| 5. Control Box | |

Generator Set Components
Figure 3

(4) Engine over-speed protection

The engine is protected against over-speed by a speed-limiting mechanism in the mechanical governor.

c. Engine-cooling fan

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

Refer to the engine Operation and Maintenance Manual in Chapter 5 for more engine details.

d. 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.

ENGINE FAULTS

Engine Fault Condition	What This Fault Condition Does	To Put the Generator Set Back into Service:
Over temperature or low oil pressure	Automatically removes power from the electric governor controller, shuts down the engine, and turns on the applicable indicating light.	a) Press the engine stop button (20, Fig. 5) to turn off the indicating light and reset the protective system. b) Or use E-STOP (4, fig.4) button for immediate reset.
Low fuel	Turns on the low fuel indicating light (27, Fig. 5). Depending on the position of JP2 and JP3 on the control PC board, a low fuel fault may cause the engine to idle, shut down, or continue to run at rated speed.	a) The low fuel fault indicating function must be reset by pressing the engine stop button (20, Fig. 5). Fuel must be added prior to attempting another engine start. b) Or use E-STOP (4, fig.4) button for immediate reset.
Clogged air cleaner or other restriction in the combustion air inlet.	Turns on the air cleaner restriction indicating light (6, Fig. 5)	a) Press the engine stop button (20, Fig. 5). The restriction must be removed prior to attempting another engine start. b) Or use E-STOP (4, fig.4) button for immediate reset.

e. Hobart Installed Equipment

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

(1) Shut Down/Reset device

In addition to the other devices provided by the engine manufacturer, an engine shutdown/reset feature is added by Hobart Brothers.

a. **EMERGENCY SHUTDOWN/RESET SWITCH** (mushroom button).

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 **shut off** of the generator set by disconnecting power to the governor circuit through the control box. It is located on the left side of the generator set on the door near the control box.

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

Push button in until engine stops or until button travel stops

Pull the button back out to reset

b. Coolant high temperature shutdown system

This is a highly sensitive temperature switch mounted at the front of the engine in the coolant crossover system. It is electrically connected in series with the fuel shutoff valve solenoid and is normally closed. The switch will open to stop engine when the internal coolant system temperature reaches 205° F (96° C).

c. Oil pressure shutdown system

The Oil pressure shutdown system consists of a Hobart supplied oil pressure switch. This switch controls a relay in the control box that works in series with the governor system, that stops the engine if the oil pressure is under 12 PSI (82.7 kPA).

(2) Electric governor system

An electric governor kit is installed on the engine to replace a conventional mechanical type. The electric governor was selected for control of engine speed (and generator output frequency) because it provides faster engine response to changes in load conditions. This fast response results in very close frequency control. A brief description is given below:

The governor system consists of the following main components:

a. Magnetic pickup

The magnetic pickup is a device for detecting the speed of the engine. It is mounted in the flywheel housing directly over the ring gear. It produces an AC signal to the control unit when the ferrous flywheel teeth pass through the magnetic field at the end of the pickup.

b. Control unit

The control unit is a box containing a compact assembly of solid state components. It receives an AC signal from the magnetic pickup and senses speed changes in the engine. It provides a voltage signal to the actuator which causes the actuator to move the fuel control lever as required to maintain a predetermined engine speed. Its power is received from the 12-V DC battery system.

c. Actuator

The actuator supplies the force needed to move and position the fuel lever as required to maintain a constant engine speed. The actuator is operated by a DC signal from the control unit.

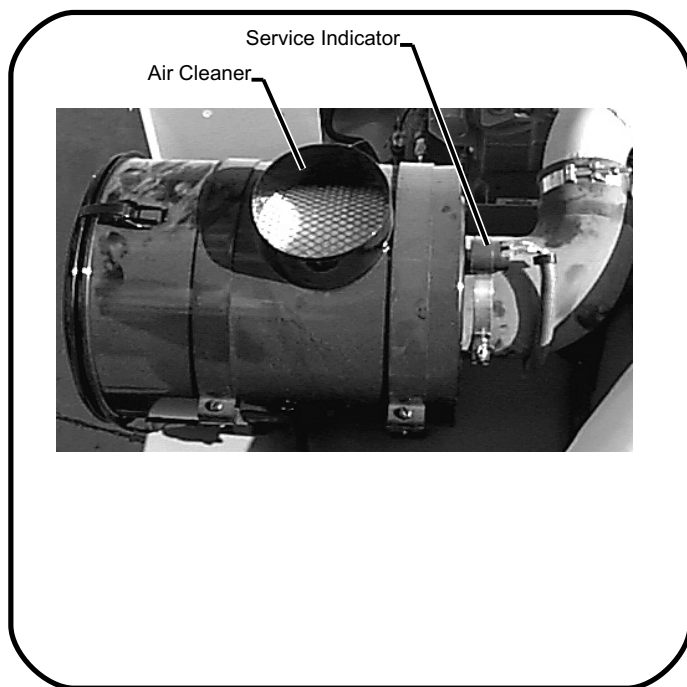
(3) Radiator

The radiator is a one-piece type designed for long periods of operation without servicing. Refer to Section 2-2; 6 for servicing procedure.

(4) Air cleaner

The diesel-engine air cleaner (fig. 4) is so constructed that air enters through its cylindrical body, and then is filtered in the process before being passed onto the engine turbo-charge assembly.

An air cleaner service indicator device is mounted on the air cleaner assembly to monitor air flow in the air cleaner. As the air cleaner becomes filled with dust, dirt, and carbon, the intake system air flow 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 light (6, Fig. 5) on the engine-generator control panel is illuminated to warn the operator that the air cleaner must be changed. The electrical indicator automatically resets after a new air cleaner is installed.



**Air Cleaner and
Service Indicator
Figure 4**

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 three diodes is mounted on the exciter rotor and converts exciter AC output to DC for excitation of the generator revolving fields. The exciter DC output to the generator fields, and consequently the generator output, is controlled by the amount of DC voltage supplied to exciter fields by the voltage regulator. 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 is bolted to the engine flywheel housing.

7. Control Box Assembly

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

a. Control Panel (Fig. 5)

On the door of this control box is the control panel. The control panel is divided into three sections. On the left side of the control panel, as one faces it, are engine meters and indicating lights. On the right side of the control panel are generator meters and indicating lights. At the bottom of the control panel are push-button switches for operating the engine and generator.

(1) Panel lights and panel light push-button switch

Meters are lighted from inside the control panel. They are controlled by a push-button switch (28) at the bottom left on the control panel.

(2) Engine hour meter

The hour meter (5) is electrically driven from the 12-V DC battery system. The hour meter measures and records engine running time and will record up to 9999.9 hours on five revolving drums. It is only functional when the engine is running and the oil pressure safety shutdown switch, mounted on the engine block, is closed.

(3) Engine oil pressure gage

The oil pressure gage (7) is an electrical type which 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

When the engine control push-button switch (26) is pressed to start the engine, a green indicating light within the push-button switch glows.

(5) Engine coolant temperature gage

The temperature gage (3) is an electrical type which is connected by a wire to a water temperature sensor installed in the engine cooling system. The gage indicates engine coolant temperature in the range of 100 to 240 ° F (38 to 116° C).

(6) Engine start push-button switch

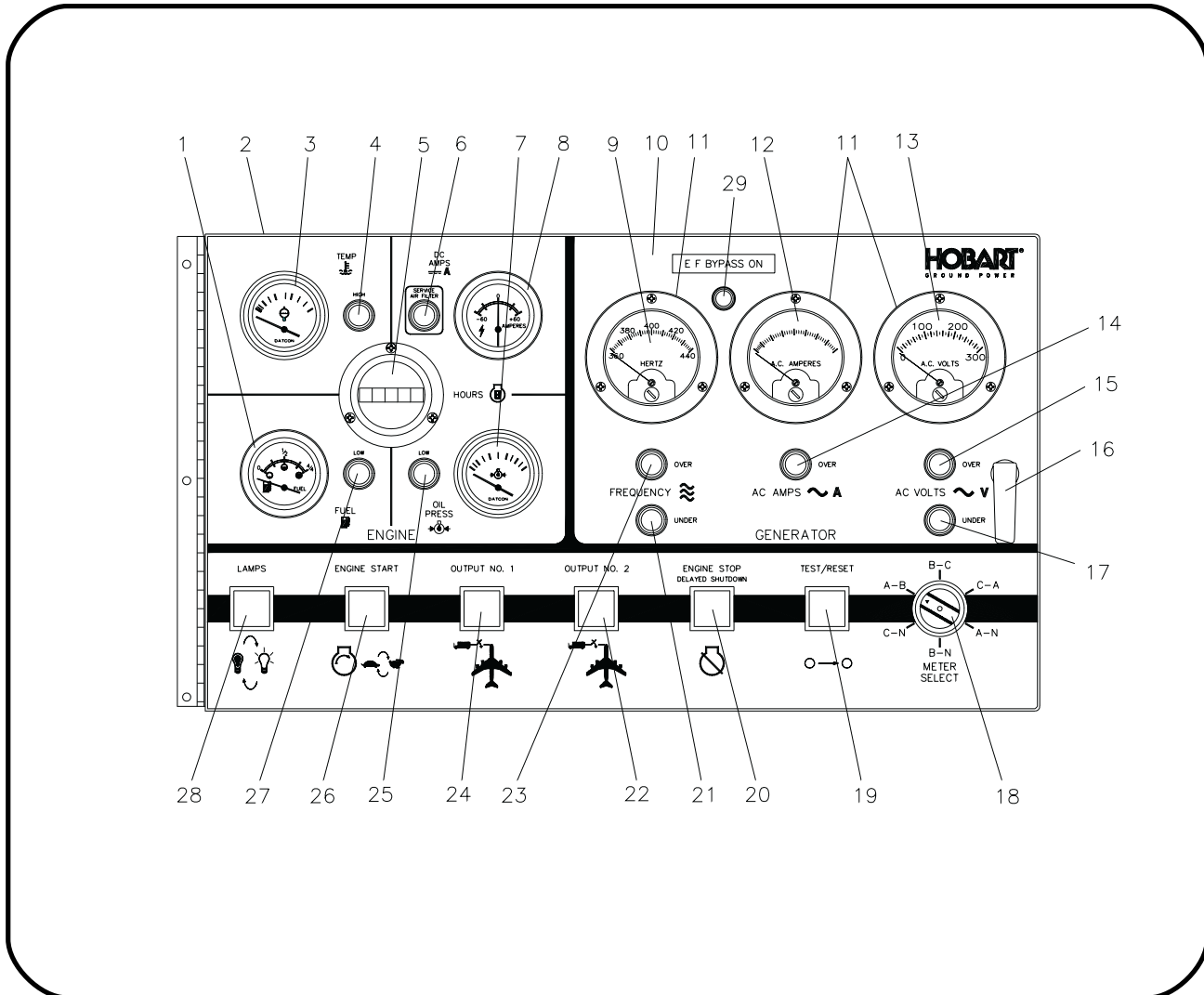
This push-button switch (26), when pressed, connects 12-V DC power to the starter solenoid coil which actuates the solenoid switch to connect power to the engine starting motor. 12-V DC power is supplied directly to the governor controller and the oil pressure safety shutdown switch is bypassed. This bypass is necessary for engine starting because the low oil pressure switch is CLOSED until the engine is running normally.

When pressed a second time (after a 5 second delay), this push-button switch provides a 12-V DC signal to the speed adjust PC board on the governor controller, which causes the governor actuator to adjust the engine speed to 2400 RPM. 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.

(7) Engine stop push-button switch

When the engine stop push-button switch (20) is pressed once, the indicator within the switch will glow (red). 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 governor controller. This governor actuator will then close and shut off fuel to the engine so the engine can shut down.



- | | |
|--|---|
| 1. Fuel Gage | 16. Adjustable Grip Latch |
| 2. Front Panel | 17. Under Voltage Indicator Light (Red) |
| 3. Engine Coolant Temperature Meter | 18. Meter Selector Switch |
| 4. Over Temperature Indicator Light (Red) | 19. Test-Reset Push-Button Switch (Red) |
| 5. Engine Hour Meter | 20. Engine Stop Push-Button Switch |
| 6. Indicating Light, Air Cleaner Restriction (Red) | 21. Under Frequency Indicator Light (Red) |
| 7. Oil Pressure Gage | 22. No. 2 Contactor Push-Button Switch (Orange) |
| 8. Engine Ammeter | 23. Over Frequency Indicator Light (Red) |
| 9. Frequency Meter | 24. No. 1 Contactor Push-Button Switch (Yellow) |
| 10. Control Box Label | 25. Low Oil Pressure Indicator Light (Red) |
| 11. Strip Lights (3) | 26. Engine Start Push-Button Switch (Green) |
| 12. Generator Ammeter | 27. Low Fuel Indicator Light (Red) |
| 13. Voltmeter | 28. Panel Light Push-Button Switch (Yellow) |
| 14. Overload Indicator Light (Red) | 29. E-F By-Pass Indicator (Red) |
| 15. Over Voltage Indicator Light (Red) | |

**Engine Generator Control Panel
 Figure 5**

(8) Engine ammeter

The ammeter (8) indicates the direction and value of current flow from or to the 12-V DC battery. Its graduated range is from -60 A through 0 A to + 60 A.

(9) Engine fuel gage

An electric fuel gauge (1) receives its controlling signal from a sending unit in the fuel tank. Twelve volt DC operating power is supplied to the fuel gauge when the green engine start push-button switch (26) is pressed. The fuel level can be checked when the unit isn't running by pressing the yellow lamps push-button switch (28).

(10) Protective system Indicating lights, test and reset push-button switches

The function of this set of five lights (14, 15, 17, 21 and 23), is to indicate, to the operator, the abnormal condition of over voltage, under frequency, etc., which caused the protective monitor system to function. Each of the five lights is connected to an actuating circuit within the memory and time delay module. When one of the circuits is activated, it turns on the applicable indicating light. The light will remain on until the test/reset push-button switch (19) is pushed. All lamps in indicating lights may be tested by pressing the test/reset push-button switch. A lamps test should be performed only when disconnected from a load, as the contactor(s) will open during the test cycle.

(11) Engine systems warning lights (red)

Four red indicator lights are illuminated to warn the operator of abnormal engine operations which must be corrected. These indicators are: The over temperature indicator light (4), air cleaner restriction indicator (6), low oil pressure indicator light (25), and low fuel indicator light (27). The function of the air cleaner indicator circuit is explained in detail in Para. 6, E, (4).

(12) Generator output monitors (*meters*)

The generator output is monitored by three instruments; a frequency meter (9), a voltmeter (13), and an ammeter (12). 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 selector switch (18). The voltmeter has a 3-1/2-inch face and the scale is graduated 0 to 300 V. The ammeter is also 3-1/2-inch size and is graduated 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 selector switch (18). Three ammeter current transformers, located on the output module (*Fig. 9*), lower the output load current to a lesser value, of definite ratio, which will operate the ammeter movement without damage. The ammeter dial scale is graduated and numbered so that the pointer will indicate the true load current value rather than the meter movement current.

(13) Voltmeter-ammeter selector switch

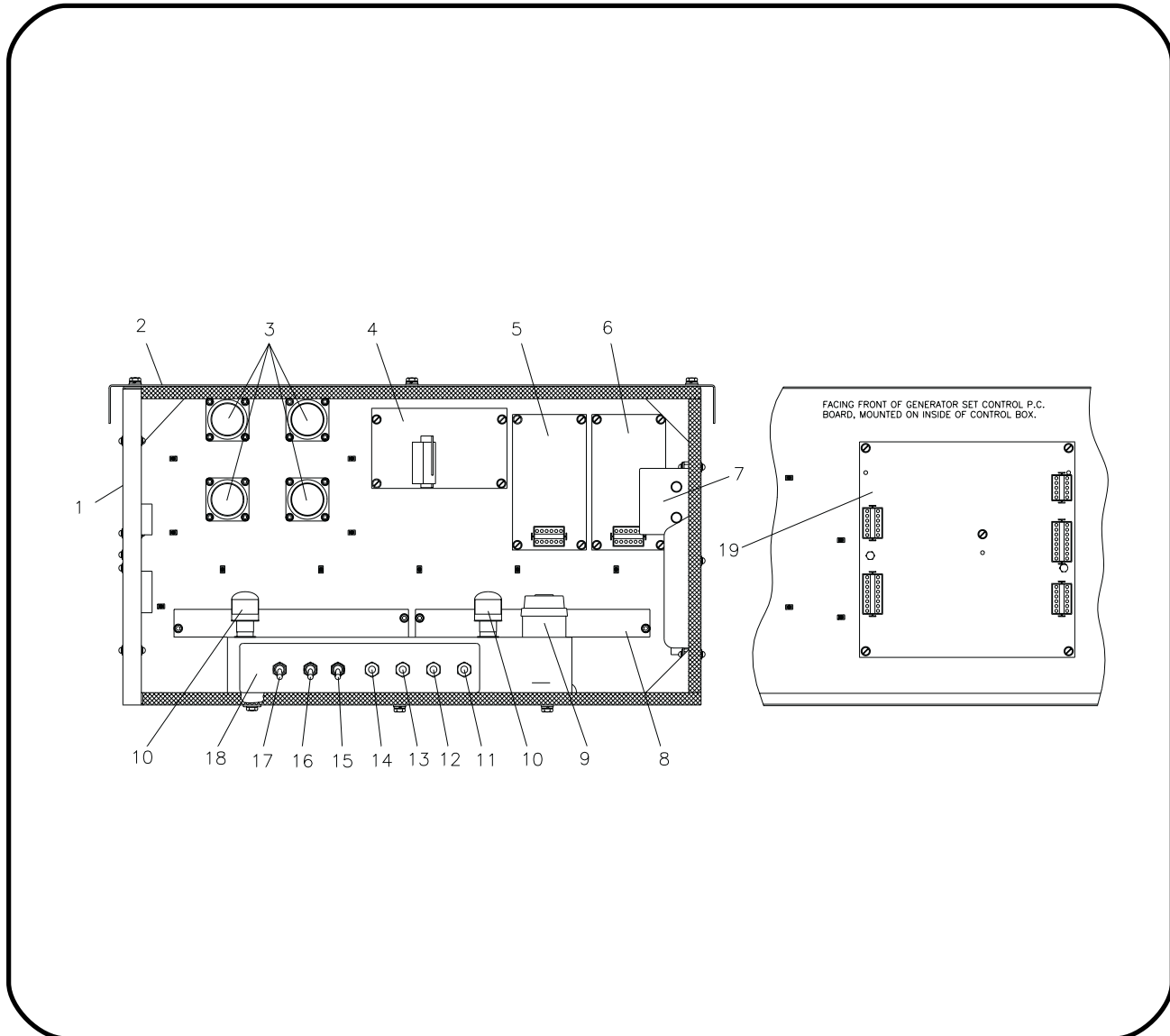
This switch provides a means of selecting and determining which phase of voltage and current is indicated on the voltmeter and ammeter and whether the voltage is line-to-neutral or line-to-line. The meter switch (18) is a six-position, rotary type. A nameplate, located under the switch knob, is marked and lettered to indicate the six functional positions of the meter switch.

(14) Load contactor indicating lights

Indicating lights within the respective contactor control push-button switches (22 orange and 24 yellow) 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) E F By-pass

The EF by-pass indicator light (29) will illuminate when either test bank/aircraft switch No. 1 or No. 2 is in the TEST position. This light serves to warn the operator that the plug interlock system has been by-passed and that any exposed cable may be live.



- | | |
|-----------------------------------|---|
| 1. Control Box Wrapper | 11. Engine Circuit Breaker (10A) |
| 2. Control Box Top | 12. Controls Circuit Breaker (5A) |
| 3. Receptacles (4) | 13. Marker Light Circuit Breaker (10A) |
| 4. Memory and Time Delay PC Board | 14. Contactors Circuit Breaker (5A) |
| 5. Over-Under Frequency PC Board | 15. Test Bank / Aircraft Switch, No. 2 Output |
| 6. Over-Under Voltage PC Board | 16. Test Bank / Aircraft Switch, No. 1 Output |
| 7. Voltage Regulator PC Board | 17. Regulated / Diagnostic Switch |
| 8. Terminal Blocks (2) | 18. Label, Switch Mounting Bracket |
| 9. Delay Shutdown Relay | 19. Generator Set Control PC Board |
| 10. Panel Lights (2) | |

**Control Box
 Interior Components
 Figure 6**

b. Control Box Interior Components (Fig. 6)

(1) Test bank aircraft switches

For each load contactor circuit, a single-pole, single-throw toggle switch (16 or 17) provides a means of bypassing the interlock circuit for that contactor when supplying power to a load bank or to an aircraft not equipped with a plug interlock system.

WARNING

Use of the test bank/aircraft switch(s) in the TEST position will result in "live" output cable(s). Exercise extreme caution or fatal shock may result.

(2) Regulated-diagnostic switch

When the regulated-diagnostic switch (17) is in the REGULATED (*down*) position, generator output voltage is regulated by the solid state voltage regulator (7, Fig. 6, and Fig. 8) for 115/200 V-AC output to an aircraft. When this switch is placed in the DIAGNOSTIC (*up*) position, battery voltage (12-V DC) is applied to the generator exciter with the engine running at rated RPM, in order to check the operation of the generator. By applying this 12 V-DC battery voltage to the exciter and observing generator output voltage, it can be determined 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. However, a low-level, unregulated voltage of approximately 30-V AC will be produced at the generator output terminals due to the residual magnetism of the exciter.

(3) Circuit breakers

A 10-ampere circuit breaker (11), protects the 12-V DC engine governor and fault circuits, and another 10-ampere circuit breaker (13), protects the 12-V DC lighting system. A 5-ampere circuit breaker (12) protects the 12-V DC control system, and another 5-ampere circuit breaker (14) protects the circuits of the load contactors.

(4) Memory-time delay module

The memory and time delay module (4) is sometimes called the protective monitor module. It is a solid-state device with a hermetically-sealed, reed-type circuit. The printed circuit board includes five memory circuits and a time delay circuit. Each circuit is connected to a corresponding sensing circuit in the sensing modules. All memory circuits are connected to the module circuit relay coil, and any one of the circuits can energize the coil to open the circuit relay contacts. Thus, when a sensing device energizes any one of the module circuits, the module circuit is also energized to break the load contactor holding circuit and allow the load contactor to open. A time delay system is designed into the under voltage circuit to prevent nuisance opening of the contactor under conditions of momentary under voltage in the generator output. An under voltage condition which continues uninterrupted for a period of 4 to 12 seconds (adjustable) will cause the time delay circuit to open the load contactor. Each of the five circuits is connected to a corresponding indicating light (Fig. 5; 14, 15, 17, 21 or 23), which is turned on when a fault occurs. The module circuit will remain energized (*OPEN*) and the light will remain ON until the reset push-button switch (19, Fig. 5) is pushed to break the module 12-V circuit, and allow the circuit to return to normal, *CLOSED* position.

(5) Sensing modules

The voltage sensing module (6) and frequency sensing module (5) are connected to generator output leads between the generator and load contactor. These solid-state modules sense any abnormal condition of voltage or frequency and signal the solid-state circuitry of the memory and time delay module (4) to open the load contactor and disconnect output to the aircraft. Trip values are adjustable; however, adjustments should be made *ONLY* under laboratory conditions.

On the 400-Hz output module, one solid-state overload signaling device (1, Fig. 9), is also connected to the protective monitor module. Its function is similar to the voltage and frequency sensing modules.

Trip values for protective circuits are as follows:

Over voltage relay	Trips at 126 volts after 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 420-Hz and 480-Hz after a 5-second time delay. Trips immediately at any frequency exceeding 480-Hz.
Under frequency	Trips at 380-Hz or less after a 7-second time delay.
Overload time delay	Trips in approximately 5 minutes at 125% load of 90KVA on either output or 120KVA on both outputs combined.

(6) Generator Set Control PC Board

The generator set control PC board (19, Fig. 6 and Figure 7) is a central location for the various plug-in relays used for generator operation. Troubleshooting is thus easier for technicians working on the generator set. This PC board contains the following relays and associated circuitry.

Master relay, K69, routes 12-V DC power to all circuits, except panel and clearance lights. This relay is operated upon pressing the START push-button switch (26, Fig. 5), and remains in the OPERATE condition until it is RESET by the STOP push-button switch (20, Fig. 5).

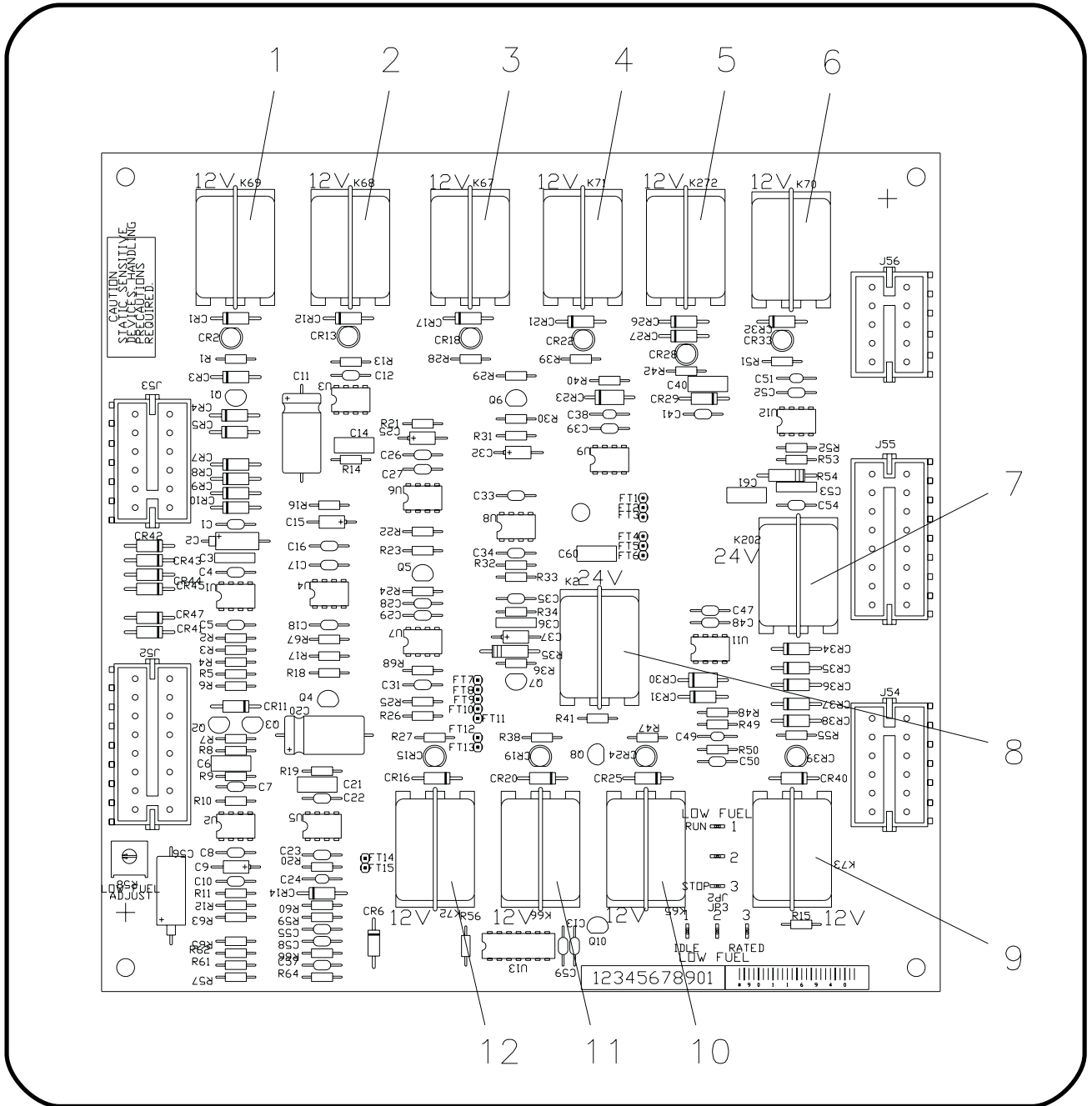
Bypass relay, K73, is also activated by pressing the START push-button switch. Relay K73 enables the start signal to the starter solenoid for 5 seconds after it is initially activated. K73 also disables the low oil pressure fault circuit during this 5 second period.

Idle-excitation relay, K68, controls engine speed and generator excitation. K68 activates to idle the engine and remove excitation from the generator. In the RESET state, K68 provides a 12-V DC signal to the governor controller, causing the engine to attain rated speed (2400 RPM). At the same time, K68 provides a ground signal to voltage regulator, which enables excitation current to the generator. When the engine is running, K68 changes from OPERATE to RESET, or vice-versa, with each closure of the START push-button switch. Auxiliary circuit also controls the idle-excitation relay. This auxiliary circuit causes the relay to operate when: (1) Engine is at rest and the start push-button switch (26, Fig. 5) is pressed, (2) Any engine fault, except the air filter restriction, occurs.

The circuit which controls K68 also drives a flasher circuit that controls the lamp within the START push-button switch (26, Fig. 5).

Relay K72 controls the No. 1 contactor. When the engine is at rated speed, and voltage has built up, K72 changes from OPERATE to RESET, or vice-versa, with each closure of the No. 1 contactor push-button switch. An auxiliary circuit will reset K72 when the No. 1 plug is removed from the aircraft. The No. 2 contactor control relay, K272 operates in the same manner.

Relay K70 controls panel and clearance lights. This relay changes from OPERATE to RESET, or vice-versa, with each closure of the LAMPS push-button switch (28, Fig. 5). The fuel gage is also powered by K70 when the engine is at rest. K70 is reset, turning off all lights, when the engine STOP push-button switch is pressed.



- | | |
|---|---|
| 1. Master Relay (K69) | 7. No. 2 Plug-Interlock Relay (K202) |
| 2. Idle-Excitation Relay (K68) | 8. No. 1 Plug-Interlock Relay (K2) |
| 3. Over Temperature Fault Relay (K67) | 9. Bypass Relay (K73) |
| 4. Low Oil Pressure Fault Relay (K71) | 10. Low Fuel Fault Relay (K65) |
| 5. No. 2 Contactor Control Relay (K272) | 11. Air Filter Fault Relay (K66) |
| 6. Panel and Clearance Lights Relay (K70) | 12. No. 1 Contactor Control Relay (K72) |

**Generator Set Control PC Board
 Figure 7**

Relays K65, K66, K67 and K71 are fault relays. Each receives a signal from engine sensors, and illuminate panel lights to indicate the presence of a fault. Activation of the over temperature relay, K67, or low oil pressure relay, K71, result in interruption of 12-V DC power to the governor controller, causing the engine to shut down. Activation of low fuel relay K65 may result in the engine reverting to idle speed or shut-down, depending on the condition set by jumpers JP2 and JP3. The only result of an air filter fault, is that relay K66 causes illumination of the panel light. All engine fault relays remain activated until power is removed by pressing the STOP push-button switch (20, Fig. 5) or the emergency stop switch.

The plug-interlock relays (K2 and K202) on the control PC board cause the respective output load contactors to open in the event the cable plug connector becomes accidentally disconnected from the aircraft during power delivery, or if an attempt is made to deliver power when the output cable is not connected to the aircraft. Twenty-eight volt direct current for operation of the circuit is supplied from the aircraft either through an on-board transformer-rectifier, or from a twenty-eight volt electrical system. Connection from aircraft to the interlock circuit is made through terminals E and F on the output cable plug

(7) Voltage regulator PC board

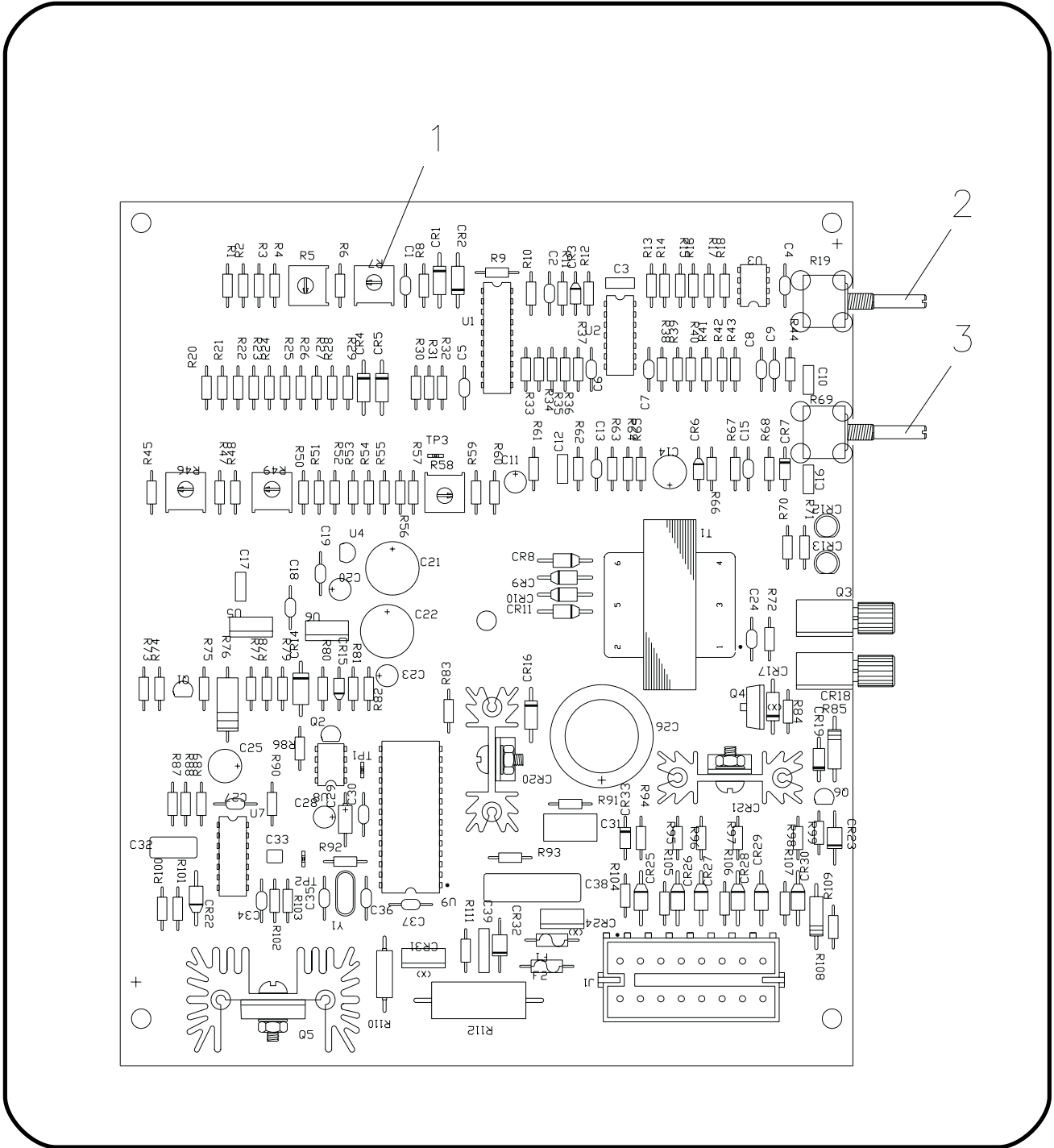
This voltage regulator (7, Fig. 6 and Fig. 8) is designed to provide 1% voltage regulation for all loads up to 100% of rated load on a three-phase, four-wire, 115/200-volt, 400-Hz brushless alternator. This regulator provides field excitation power as required to meet varying alternator load conditions to hold the alternator voltage constant. In addition, the voltage regulator PC board circuitry provides line drop compensation. Any deviation of the alternator voltage from its set, regulated level is sensed at the voltage regulator PC board. The sensing signal is compared to a reference signal, and, with associated circuitry, varies the field power supplied to the rotary exciter.

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

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

When a load is removed from the alternator, the alternator voltage rises. The rectified three-phase voltage sensing signal increases, causing this signal to be higher than the reference signal. The associated voltage regulator circuitry causes the field power of the rotary exciter to decrease, lowering the alternator voltage until the voltage returns to regulated value. The line drop voltage compensation circuit consists of: (1) A current transformer on each phase of the load circuit, and (2) A fixed resistance in parallel with each current transformer. The current transformers detect the magnitude of current flowing through the power cables from the alternator to its load and feed a signal into the voltage regulator PC board. The PC board processes this signal to change the output voltage proportional to the current draw. The regulator output increases slightly so that the alternator output voltage is equal to the regulated voltage plus the voltage drop in the lines. The line drop compensation potentiometer may be adjusted to match exactly the voltage drop of the power cables carrying the load current.

A receptacle connector at the bottom of the voltage regulator PC board provides a quick connect-disconnect facility for interconnecting wire leads.



- 1. Output Voltage Adjustment (Course)
- 2. Output Voltage Adjustment (Fine)

- 3. Line Drop Compensation Adjustment

Voltage Regulator PC Board
 Figure 8

8. Power Module Panel Assembly (See figure 9)

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. It is accessible by opening the left front door. The panel assembly provides sensing and overload protection for the output circuit and provides a means of connecting and disconnecting generator output to and from the load (aircraft).

(1) Load contactors

The load contactors (15 and 16) on this dual output machine 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 in the protective monitor circuit and supplies 12-V DC power used by sensing relays to signal the protective monitor when a fault occurs. Three-phase, 400-Hz generator output power is conducted to the load contactors by 2/0 cables which pass through three sets of current transformers (1,2,6 and 9).

(2) Current transformers

a. Line-drop current transformers

The three line-drop current transformers (1), in conjunction with burden resistors (4), detect the magnitude and power factor of current flowing from generator to load. They feed a signal to the voltage regulator which interprets the signal and alters the exciter field current as required to maintain a constant predetermined voltage at the load.

b. Main generator ammeter and overload current transformers

A set of three main current transformers, (2), in conjunction with a set of burden resistors (3), convert a current signal to a voltage signal which is sent to the ammeter and to the main overload sensing board. The ammeter is really a voltmeter graduated and numbered in amperes to show current proportional to the voltage signal received. This ammeter is so graduated and numbered that, when cables running through the current transformers carry a current of 347 amperes (rated load), 6.67 volts is sent to the ammeter, which shows it as 347 amperes.

When there is load on both outputs and an overload condition develops, wherein load exceeds 434 amperes (125% of rated load) the main overload sensing board sends a signal to the memory and time delay PC board (14, Fig. 6), which interrupts the load contactor circuit to open both load contactors.

c. Main generator overload module

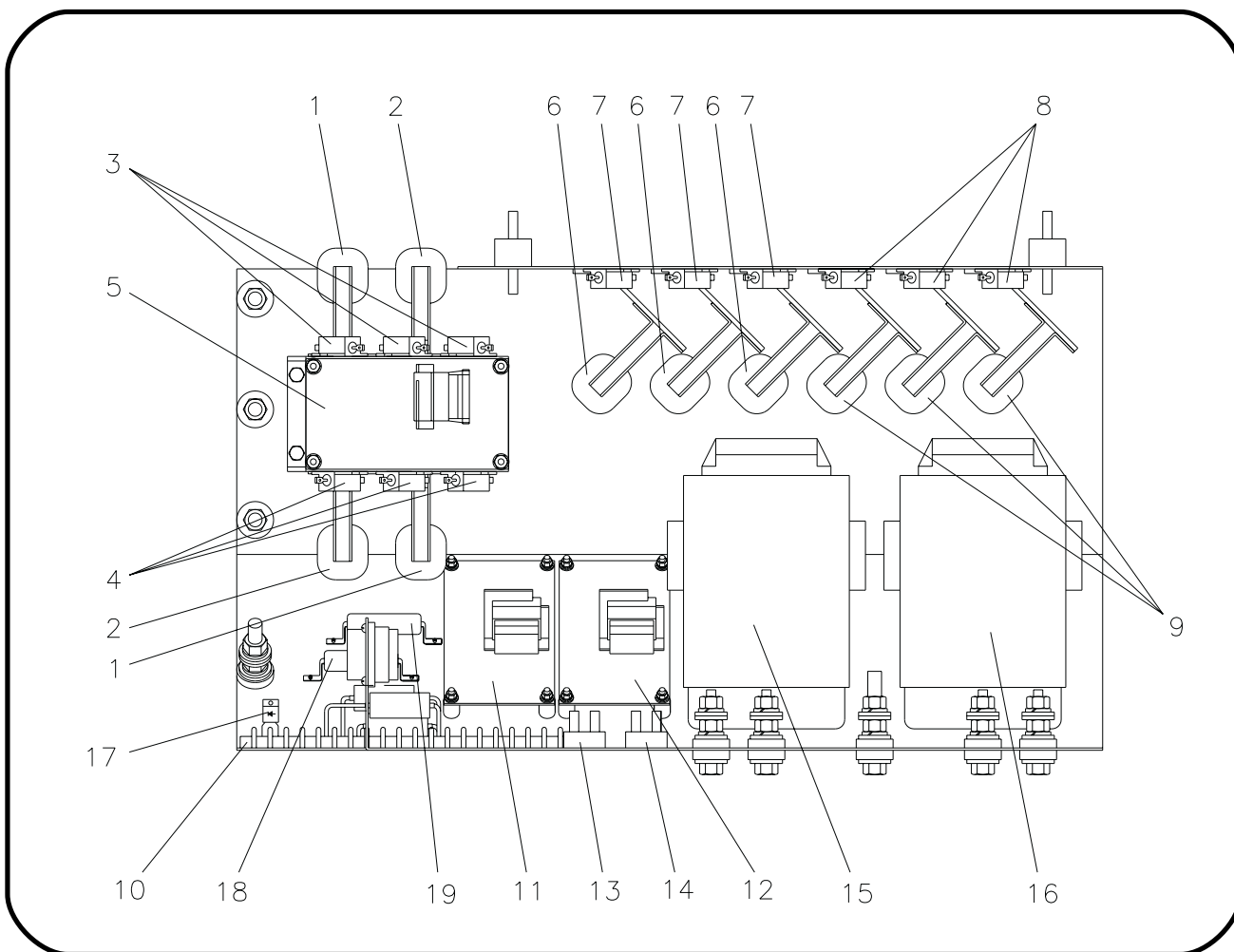
When there is load on both outputs of the generator set, and an overload condition exists which exceeds 125% of the generator's rated load (150-KVA, or 434 amperes), this solid-state over-load module (5) interprets a signal from the main generator overload current transformers (2) and sends a signal to the memory and time delay PC board (14, Fig. 6).

To do this, the overload module is equipped with a hermetically-sealed, reed-type relay. Relay contacts are normally open. The solid-state circuitry is designed to close relay contacts when output current reaches 125% of normal rated output capacity. The closed relay sends a signal to the protective monitor. This signal gates the overload SCR (silicone-controlled rectifier) in the protective monitor and opens both contactors (15 and 16).

d. Ammeter and overload current transformers, No 1 and No. 2 output

On each individual output, a set of three current transformers, (6 or 9), in conjunction with a set of burden resistors (7 or 8), convert a current signal to a voltage signal which is sent to the ammeter and to the overload sensing board (11 or 12) for that output. When cables running through the current transformers for either output carry a current of 260 amperes (rated load for either output), 5 volts is sent to the ammeter, which shows it as 260 amperes.

When an overload condition develops on either output, wherein load exceeds 325 amperes (125% of rated load) the overload sensing board for that circuit sends a signal to the memory and time delay board, which interrupts the load contactor circuit to open the load contactor.



- | | |
|--|---|
| 1. Line drop current transformers | 9. Overload current transformers No. 2 output |
| 2. Main generator overload current transformers | 10. Terminal block |
| 3. Main generator overload resistors,
12.5-ohm, 20-watt | 11. Overload PC board, No. 1 output |
| 4. Line drop resistors, 50-ohm, 20 watt | 12. Overload PC board, No. 2 output |
| 5. Main generator overload PC board | 13. Rectifier, No. 1 output |
| 6. Overload current transformers, No. 1 output | 14. Rectifier, No. 2 output |
| 7. Overload resistors, 16.6 ohm, 20-watt No. 1
output | 15. Load contactor, No. 1 output |
| 8. Overload resistors, 16.6 ohm, 20-watt No. 2
output | 16. Load contactor, No. 2 output |
| | 17. Flyback diode |
| | 18. No. 1 Output hold circuit resistor (R46) |
| | 19. No. 2 output hold circuit resistor (R246) |

**Dual Output Power Module
 Figure 9**

e. Overload modules, No 1 and No. 2 output

When there is load on either of the two outputs of the generator set, and an overload condition exists which exceeds 125% of the rated load capacity of that output circuit, (112-KVA, or 325 amperes), the solid-state overload module for that output circuit (11 or 12) interprets a signal from the main generator overload current transformers (2) and sends a signal to the Memory and Time Delay PC Board (4, Fig. 6) . The protective monitor module then functions to open the holding circuit of the contactor in the overloaded output circuit.

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 16 seconds.

AT 200% load the module will function in 4 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.

(3) Rectifier

For each output, a diode-bridge rectifier (13 or 14) receives 400-Hz AC from phase C of the generator output and converts it to a pulsating, direct current for energization of the load contactor holding coil only. This DC coil-holding circuit is controlled indirectly by controlling the 400-Hz AC to the rectifier. The ground circuit for the rectifier's AC supply must pass through the relay contacts in the protective monitor module to ground cable N. Therefore, any time a protective device functions to open the protective monitor relay, the rectifier's AC circuit is opened. No DC is then available for the load contactor holding coil, hence, the load contactor opens.

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, and oil hoses and connections for visible leaks. Visually inspect the compartment floor and ground surface under the unit for signs of leakage. If leaks are found, correct by tightening hose clamps, tube fitting, etc., as required.
- (5) Check security of generator set retaining components.
- (6) Check the following for sufficient quantity:

a. Fuel

Press lamps button to energize fuel gage when engine is stopped. Fuel is supplied from a customer-furnished source.

NOTE: For recommended fuel specifications refer to the Cummins Operation and Maintenance Manual provided with this Hobart manual (OM-2083A).

b. Engine coolant

Remove radiator cap to check coolant level. Coolant level should be at the bottom of the filler neck. See figure 2 for coolant capacities.

CAUTION

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

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

c. Engine lubricating oil level

The oil gage rod (See Fig 1) 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 2 for oil capacity specifications.

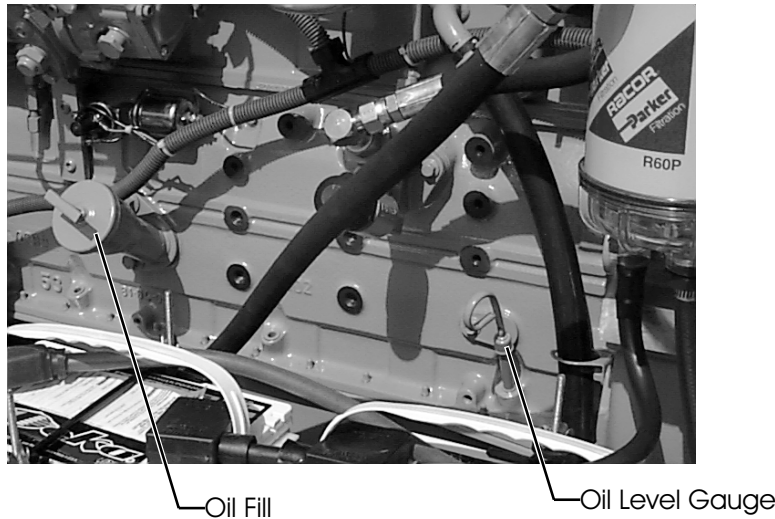
CAUTION

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

See the Cummins Operation Maintenance Manual for oil recommendations.

d. Check Batteries

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



Oil Fill and Check Locations
Figure 1

Lubricating oil capacity with filter	16 Quarts (15.1 liters)
Coolant capacity including radiator	28 Quarts (26.4 liters)

Capacities
Figure 2

b. Installing Three-phase AC Output Cables

The generator set may be shipped without aircraft cables. The load contactors, to which cables must be connected, are located on the 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, 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 the left front canopy door of the generator set.
- (2) Remove plexiglass.
- (3) Remove upper panel below door.
- (4) Loosen screws on cable clamps located on the side panel beneath the left rear canopy door.
- (5) Route cables through cable clamp, and up to the load sides (bottoms) of the load contactors.
- (6) Connect the phase cable terminal lugs to the appropriate terminal studs on the contactors: 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.

- (8) Connect the "E" and "F" cables to the "E" and "F" studs on the power module.
- (9) Tighten clamp screws securely on the side panel, but avoid damage to cable insulation.
- (10) Replace upper panel and plexiglass.

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 Brothers Part No. 76A-1354-001) 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. See 2-2; Para 6. 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 which 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 Brothers 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 140°F (60°C).
- (3) While the engine is running, ensure that normal operating controls are in good working condition before shutdown and storage.

If weekly operation is not possible, contact the nearest Cummins Engine Company distributor for instructions.

d. Preparation for Shipment

- (1) Disconnect battery negative terminal before shipping.
- (2) During long shipments, the generator set retaining hardware may become loosened by vibration, jolting, etc.

CAUTION

When shipping the unit, provide sufficient retaining materials to ensure the generator set cannot roll out of 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 may be 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. Operating the Unit

a. Pre-start inspection

- (1) Be sure the fuel shutoff valve on the unit is open.
- (2) Ensure 12-V DC 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.

b. Normal Engine Starting Procedures

Engine starting procedures are outlined below. Engine operating controls and monitoring instruments are illustrated in Fig. 1.

CAUTION

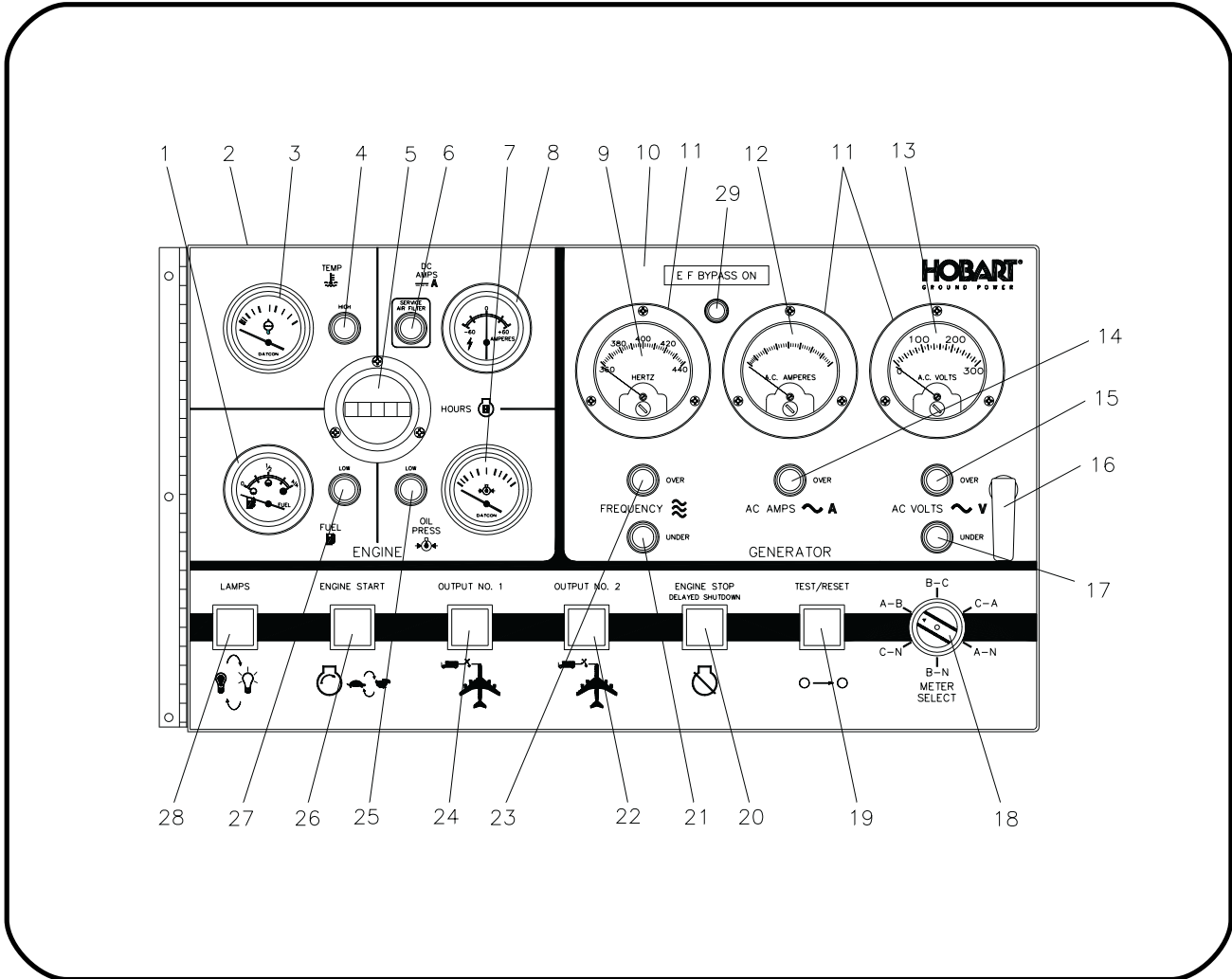
Refer to Operating Instructions in the Cummins Operation Manual, when starting engine for the first time.

NOTE: The Cummins Operation Manual is provided with this Hobart manual (OM-2083A).

- (1) If illumination is required, press lamps push-button switch (28) one time. Pressing this button switch also activates the fuel gage. (1, Fig. 1).
- (2) Press the green engine start push-button switch (26) 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 protective circuit and electric governor.

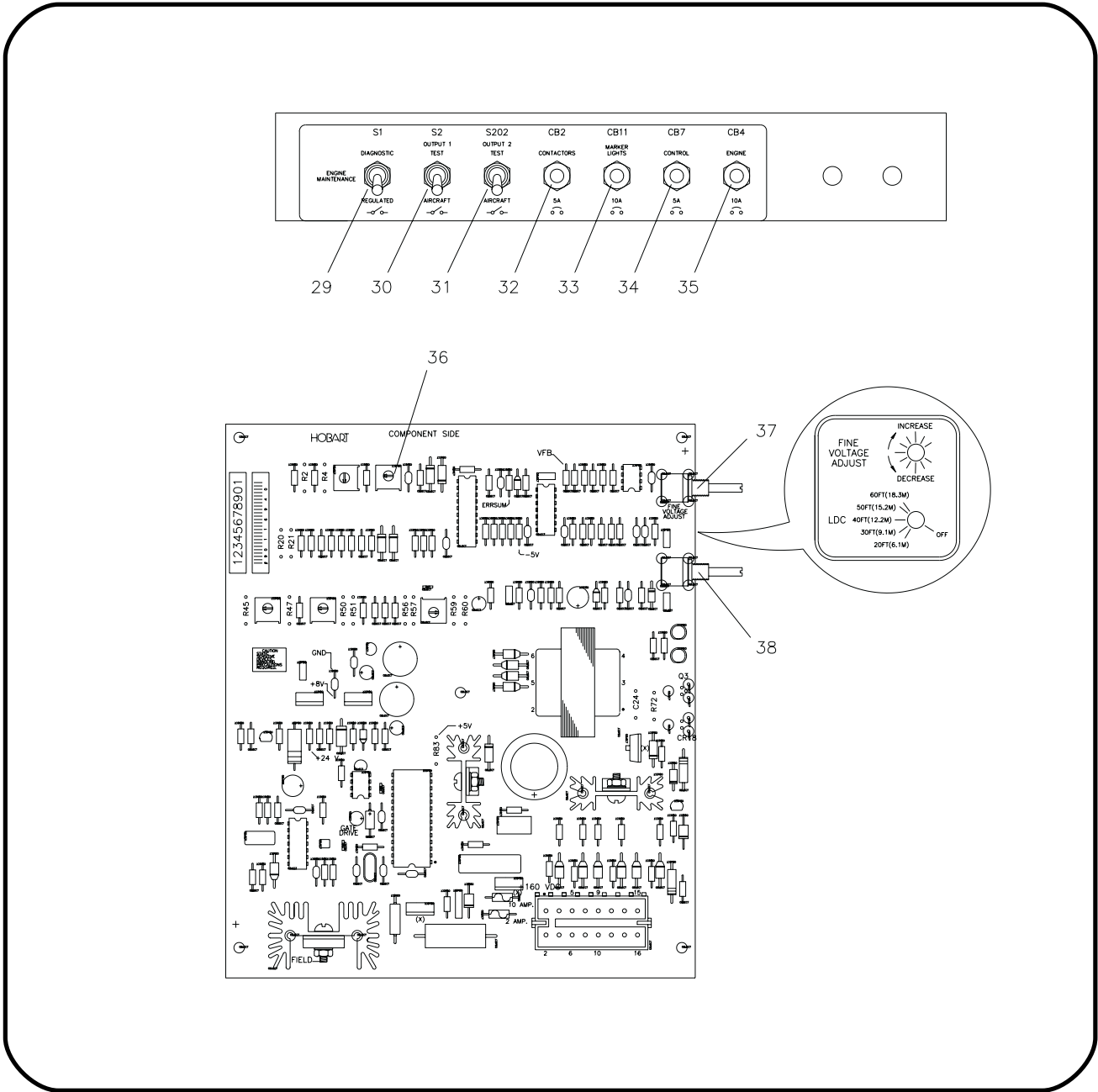
CAUTION

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



- | | |
|--|---|
| 1. Fuel gage | 16. Adjustable grip latch |
| 2. Front panel | 17. Undervoltage indicator light (red) |
| 3. Engine coolant temperature meter | 18. Meter Selector switch |
| 4. Over temperature indicator light (red) | 19. Test-reset push button switch (red) |
| 5. Engine hour meter | 20. Engine stop push button switch (red) |
| 6. Indicating light, air cleaner restriction | 21. Underfrequency indicator light (red) |
| 7. Oil pressure gage | 22. No. 2 contactor push button switch (orange) |
| 8. Engine ammeter | 23. Overfrequency indicator light (red) |
| 9. Frequency meter | 24. No. 1 contactor push button switch (yellow) |
| 10. Control Box label | 25. Low Oil Pressure indicator light (red) |
| 11. Strip lights (3) | 26. Engine start push button switch (green) |
| 12. Generator ammeter | 27. Low Fuel indicator light (red) |
| 13. Voltmeter | 28. Panel light push button switch (yellow) |
| 14. Overload indicator light (red) | 29. EF By-pass Indicator |
| 15. Overvoltage indicator light (red) | |

Operating Controls and Instruments
 Figure 1 (Sheet 1 of 2)



- | | |
|---|--|
| 29. Regulated-diagnostic switch | 34. Circuit Breaker, control (5-amp) |
| 30. Test bank-aircraft switch No. 1 output | 35. Engine circuit breaker (10-amp) |
| 31. Test bank-aircraft switch, No. 2 output | 36. Output voltage adjustment (coarse) |
| 32. Circuit Breaker, contactors (5-amp) | 37. Output voltage adjustment (fine) |
| 33. Circuit Breaker, marker lights (10-amp) | 38. Line drop compensation adjustment |

Operating Controls and Instruments
Figure 1 (Sheet 2 of 2)

CAUTION

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

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

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

CAUTION

DO NOT allow the engine to idle for long periods of time.

c. Failed Starting Procedure

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

- (1) Push the red **EMERGENCY STOP/RESET BUTTON** on the left side door of the generator set.
- (2) Pull the red **EMERGENCY STOP/RESET BUTTON** back out before the next attempt of starting the generator set.

d. Power Delivery

- (1) Press engine start push button switch (26, Fig. 1) a second time to bring engine from idle speed to rated speed. The electric governor will immediately increase engine speed to 2400 RPM and maintain it. The voltage build-up will occur automatically. Also the green indicating light in the engine start push-button (26) switch will glow continuously.
- (2) Observe generator instruments. The frequency meter (9, Fig. 1) should indicate exactly 400 Hz. With voltmeter-ammeter selector switch (18) in any line-to-neutral position, (A-N, B-N, or C-N), the voltmeter (13) should read 115 volts. With voltmeter-ammeter selector switch in any line-to-line position, (A-B, B-C, or C-A), the voltmeter should read 200 volts.

The final step in delivering power is closing one or both of the load contactors. When satisfactory frequency and voltage values are indicated by the instruments, close either load contactor (or both load contactors) by momentarily pressing the load contactor control push button switch (22 and/or 24,). The yellow or orange indicating light of the push button switch that is pressed will glow at once, to indicate that the load contactor is closed and power is available at the aircraft. As soon as the light glows, release the push button switch.

- (3) 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 switch (18, Fig. 1) to select the phase and line-to-line or line-to-neutral voltage. If the load is changing, it is good operating practice to observe the instruments until load conditions stabilize.

CAUTION

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

- (4) A condition of overvoltage, undervoltage, underfrequency, overfrequency, or overload in the output circuit will automatically open the load contactor and turn on the applicable indicating light 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 (19, Fig. 1) to turn off the indicating light and reset the protective relay system. Proceed with power delivery by operating the load contactor push button switch.

CAUTION

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

e. Failed Power Delivery (See Fig. 1)

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.

If the indicating light should go out as soon as the push button switch is released, and the no fault lights are ON, it indicates that 28.5-V DC holding current is not being supplied from the aircraft to the plug-interlock relay. Correct the condition and again operate load contactor control push button switch (22 or 24).

The regulated/diagnostic switch (29) must be set to REGULATED for power delivery. This switch is located inside the control box behind the control panel.

The No. 1 and/or No. 2 output switch (30 or 31) must be set to AIRCRAFT position. These switches are located inside the control box behind the control panel.

See section 2-4 for other No. 1 and/or No. 2 Load Contactor Operating Circuit troubleshooting procedures.

f. Discontinue Power Delivery with Unit Shutdown (See Fig. 1)

(1) Normal conditions

- a. Push the load contactor push button switch (22 or 24) to open the 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 push-button switch (20) 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** (sect. 1-1; 4, fig.1) located on the left front side of the generator set canopy. When pushed, this button instantly shuts the generator set off and **must be pulled back to reset itself for restarting the generator set.**

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Chapter 2. Servicing/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 Fig. 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 Cummins 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 (See Fig. 1 and 2)

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 (See Fig. 1 and 2)

Each interval period is identified by a letter A, B, C, etc., (See Fig. 2). For example, services under B schedule should be performed at the end of each 250 hours of operation, or every three months period, BR service is performed during the BREAK IN period (first 50-150 hours). AR service is performed AS REQUIRED.

HOURLY INTERVAL CALENDAR INTERVAL	As Req.	Once after 50 to 150	10 or Daily	250 or 3Mo.	500 or 6Mo.	1000 or 1 Year	1500 or 1-1/2 Years	2000 or 2 Years
SYMBOL	AR	BR	A	B	C	D	E	F
ENGINE								
Change Air Cleaner Cartridge	X							
Tighten Manifold Hardware	X							
Check Crankcase Oil Level			X					
Drain Fuel Pre-Filter Elements			X					
Check Coolant Level			X					
Check for Leaks and Correct		X	X					
Check Air Cleaner Indicator			X					
Check Exhaust System			X					
Check and Record Oil Pressure				X				
Change Fuel Filter Elements		X		X				
Clean Radiator Core (external)				X				
Check Governor Linkage				X				
Change Crankcase Oil		X			X			
Change Oil Filter Element		X			X			
Check/Adjust Drive Belt(s) Tension					X			
Check Engine and Generator Mounts		X			X			
Check Coolant, Additive-Concentration					X			
Check Fan Hub and Drive Pulley						X		
Check Fuel Pre-filter Cartridge		X				X		
Check Hose Clamps on Air Intake Side						X		
Service Fuel Cooler (If Applicable)						X		
Steam Clean Engine		X					X	
Clean fuel system							X	
Check Vibration Damper							X	
Check Injectors and Valve Clearance (adjust if necessary)		X					X	
Check Fuel Manifold Pressure							X	
Check Water Pump							X	
Check Alternator							X	
Check Cranking Motor							X	

Maintenance Schedule
 Figure 1 (Sheet 1 of 2)

SYMBOL	AR	BR	A	B	C	D	E	F
Clean/Calibrate/Replace Injectors								X
Check Fuel Pump Calibration								X
Change Coolant								X
Inspect Cylinder Heads								X
Inspect Pistons and Piston Rings								X
Inspect Bearings and Journals								X
Clean fuel cooler (If Applicable)				Spring & Fall				
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-V DC System)								
Check All Lights			X					
Check Charging Rate			X					
Check Battery and Fluid Level				X				
Clean Battery Terminals	X			X				
Check Wiring and Connections					X			
ELECTRICAL (400-Hz System)								
Check Output Cable and Connectors			X					
Check Volt, Amp & Frequency Meters			X					
Check Protective Relays					X			
Inspect Wiring and Connectors					X			
Clean and Inspect Generally					X			

Maintenance Schedule
 Figure 1 (Sheet 2 of 2)

Symbols	Time Intervals	
	Hours	Calendar
BR	50-150	None
AR	As Required	None
A	10 Hours	Daily
B	250 Hours	3 Months
C	500 Hours	6 Months
D	1000 Hours	1 Year
E	1500 Hours	1-½ Years
F	2000 Hours	2 Years
S	Seasonally	Spring and/or Fall

Symbols and Time Intervals
Figure 2

3. Inspection/Check

a. General

Inspections, checks, and maintenance are described in general here. More specific and detailed information contained in 2-2 and 2-3, will be referenced when applicable.

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

(1) Engine

a. Change air cleaner.

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

b. Tighten manifold, muffler, and exhaust pipe attaching hardware as required.

(2) Electrical System (12-V DC)

a. Check battery terminals

Anytime the battery 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-and-connector cleaning tool. Coat posts and connectors with a light film of petroleum lubricant before reconnecting cables.

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) 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 Cummins Operations Manual for assistance.
- (2) Change fuel filter elements. Metal shavings from the new fuel tank can clog the filter. See 2 -2, Para. 5, d, (1) for details.
- (3) Change crankcase oil. New engines often release metal shavings more frequently. Therefore the crankcase oil must be changed as a precautionary measure. See 2-2, Para. 2, d, (4) for instructions.

- (4) Change oil filter element. The oil filter should be changed with the oil. See 2-2, Para 2, d, (4) for details.
- (5) Check engine mounts to ensure they are properly installed and that they have not worked loose. (Torque is set at 285 Nm, 210 ft-lb.)
- (6) Check fuel prefilter cartridges for foreign substances which could have come in from the new fuel tank or possibly the fuel.
- (7) 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.
- (8) Check Injectors and Valve clearances and adjust if necessary. Refer to Cummins Operations manual for details.

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

- (1) 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.

- a. Check oil level daily with oil gage dipstick (see 1-2, Fig. 1.)
 - b. Oil level should not be checked until 3 to 5 minutes after engine shutdown. Keep oil level as near the upper bar as possible.
- (2) Drain fuel prefilter (see fig. 3)

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



Fuel PreFilter
Figure 3

CAUTION

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

- a. Provide a container for catching drained fuel.
 - b. Open the drain valve on the fuel/water filter by turning it counterclockwise.
 - c. Drain the filter until clear fuel is visible.
 - d. Tighten the drain valve.
 - e. Safely dispose of drained fuel.
 - f. Purge air from fuel system if necessary.
- (3) Check coolant level
- Check coolant level daily or at each fuel fill interval. Investigate for cause of any coolant loss.
- (4) 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.
- (5) Check air cleaner indicator
- At each daily start-up, observe the air cleaner indicator light (1-3; 6, Fig. 1). If this light comes **ON**, it indicates that the air cleaner should be changed.
- (6) 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.

- (7) Electrical (Engine)
- a. Check all lights
- Check all indicating lights to be sure they will operate when they should. If any light fails to operate, check both the lamp and its protective circuit breaker. Figure 5 lists all lamps with their location and part number. Figure 6 lists all circuit breakers.
- b. Check alternator charging rate
- Observe the 12-V DC ammeter each time the engine is started. A zero amperage reading or extremely high reading for any length of time indicates trouble in the alternator, regulator, battery, or interconnecting wiring.
- (8) Electrical (Generator)
- a. Output cable plug connector
- Check the output cable plug connection for damaged insulation and contacts each time the connector is attached to an 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. Check and record oil pressure

After each oil change, check and record oil pressure at idle speed after oil has warmed to approximately 140° F (60° C). 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.

- b. Change fuel filters. Refer to 2-2; Para. 5.
c. Clean radiator core. See 2-2; Para. 6, for instructions.
d. Check governor linkage

Check all attaching hardware. Check ball joints for wear and looseness. Check linkage for free movement throughout its complete travel range.

(2) Electrical (12-V DC system)

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

- a. Battery electrolyte level (if applicable)

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

CAUTION

DO NOT overfill.

- b. Check battery

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

- c. Battery terminals

Check battery terminals and clean if necessary in accordance with Para. 3, B, (2) (a) above.

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

(1) Engine

- a. Change crankcase oil. See 2-2, Para. 2, D, (4) for details.
b. Change oil filter element each time crankcase oil is changed. See 2-2, Para. 2, D, (4) for details.

(2) Check and adjust drive belts

- a. See 2-2; Para. 8 for tension check and adjustment instructions.

(3) Check engine mounts

CAUTION

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

- a. Engine mount bolts must be torqued to 285 Nm (210 ft-lb.).

(4) Check coolant additive concentration

The cooling system protective liquid (nitrite-, amine- and phosphate free) provides effective protection against corrosion, cavitation, and freezing. See Cummins Owners and Operations Manual for ordering and mixture details.

(5) Electrical (12-V DC system)

a. Wiring

Inspect all cables and leads for worn or damaged insulation.

b. Connections

Inspect connectors for security and damaged or corroded condition.

(6) Electrical Generator

a. Protective relays

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

b. 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

b. Check fuel pre-filter cartridge (See 2-2; 5, B).

Pre-filter may accumulate foreign substances that may cause damage to fuel system if not removed. Inspected pre-filter thoroughly.

c. Check hose/clamps on air intake side.

Be sure that all clamps are properly secured to prevent leaks.

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 which is free from acid and which 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 Owner and Operations Manual for instructions.

c. Check vibration damper. (see Fig. 4)

Check vibration damper for looseness or wobble, verifying the hub bolts are tightened to the Cummins specifications.

d. Check adjustment of injectors and valves

Injectors and valves must be in correct adjustment at all times for best engine performance. Refer to Cummins Operation Manual for injector and valve adjusting instructions.

e. Check fuel manifold pressure

This check is necessary only if there is an apparent or suspected loss of power. Refer to Cummins Operation Manual for tools required and test instructions.

f. Check water pump (see Fig. 4)

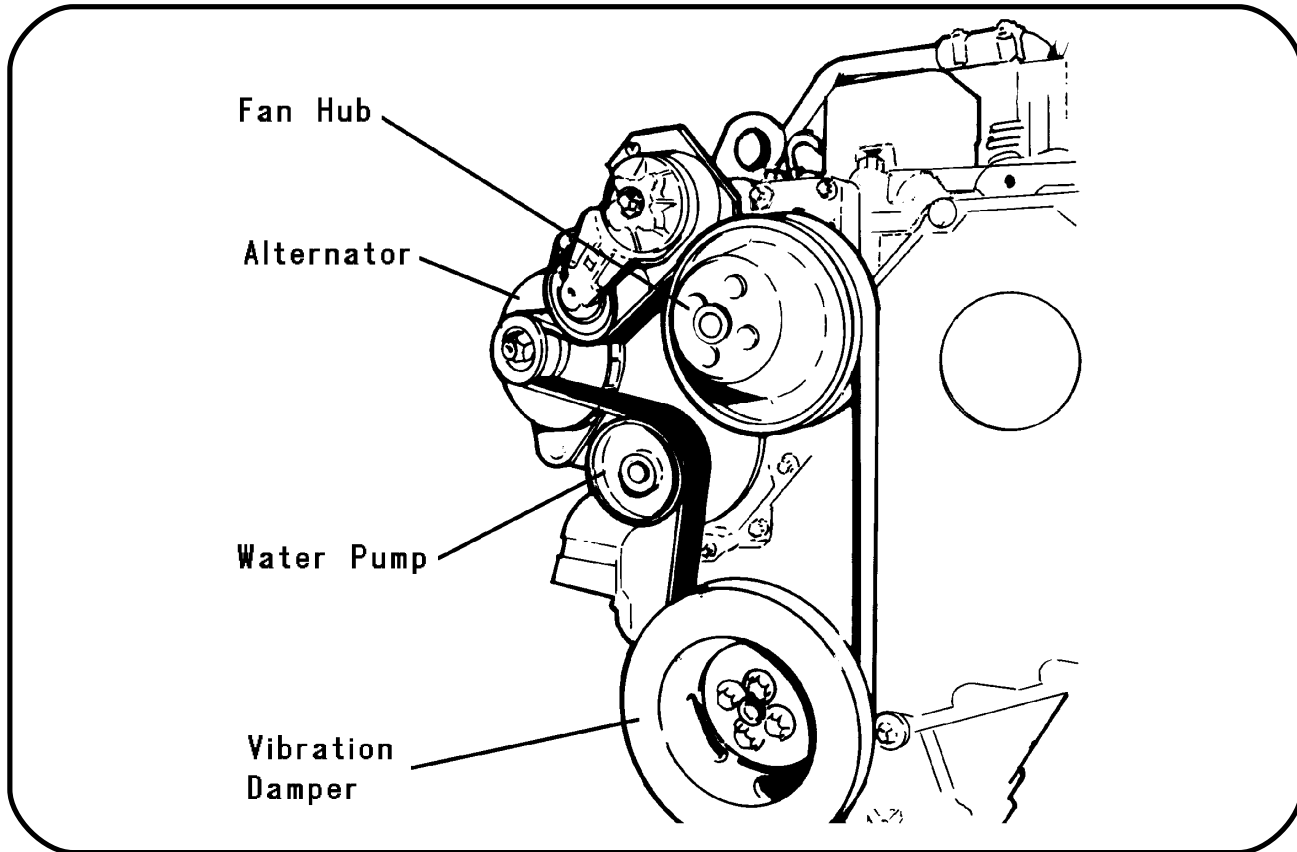
Check water pump for signs of leaking and lubricant loss. Replace with new pre-lubricated pump if lubricant is being lost.

g. Check fan hub (see Fig. 4)

Check fan hub for signs of lubricant loss. Replace with new prepacked hub if lubricant is leaking.

h. Check alternator and cranking motor (See Fig. 4).

The alternator and cranking motor on this particular engine require no periodic lubrication. See 2-2, Para. 2, E, (1) and (2) for details. Check your alternator for lubrication points.



Engine Accessories
Figure 4

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

(1) Engine

These checks should determine whether the engine requires a complete overhaul or whether it may be operated for another service period. High oil consumption, low oil pressure at idle speed, oil dilution and other signs of wear must be considered.

Disassemble the engine sufficiently to perform the following inspections and services. Complete overhaul facilities should be available. If the user performs this operation in his own shop, a shop manual should be procured from Cummins Engine Company.

a. Clean/Calibrate/Replace injectors

Injectors must be cleaned and calibrated regularly to insure proper fuel delivery to combustion chambers. Special tools are required. It is suggested that the Cummins Distributor be consulted for this operation.

b. Check fuel pump calibration

This operation may be performed on an as required basis. Pump calibration also requires special tools and testing equipment. Consult a Cummins Distributor for information.

- c. Change coolant
- d. Inspect cylinder heads for the possibility of overhaul
- e. Inspect pistons and piston rings
- f. Inspect bearings and Journals

j. Seasonal Maintenance Checks Spring/Fall (Engine)

- (1) Inspect engine cooling fan each spring and fall.
 - 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. See 2-2, Para. 6, for cooling system maintenance.
- (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.

 - a. Inspect for cracks and cuts
 - b. Inspect for cutting and deformation caused by hose clamps.
 - c. Replace hoses as required.
- (4) Check and adjust V belts each time the cooling system is cleaned, or on an as required basis. See 2-2, Para. 8.
- (5) Check thermostat and seals each fall when cooling system is serviced.

k. Lamps and Circuit breakers

- (1) Check all lamps daily and check circuit breakers as required.
- (2) A lamp chart (Fig. 5) lists all lamps with their location and identifying trade number in table below.
- (3) The circuit breaker chart (Fig. 6) lists all circuit breakers with their location, size, and type.

Light Identification	Location	Lamp (Bulb): as per Lamp Industry Trade Number
Instrument Panel Lights	Control box Interior (1-1; Figure 6, Item 11)	67
Engine Start Indicator	Engine-Generator Control Panel (1-1; Figure 5, Item 26)	1815
No. 2 Load Contactor Switch	Engine-Generator Control Panel (1-1; Figure 5, Item 22)	1815
No. 1 Load Contactor Switch	Engine-Generator Control Panel (1-1; Figure 5, Item 24)	1815
FAULT Indicators (9)	Engine-Generator Control Panel	1815
Clearance (Marker) Lights (4)	Canopy	57
Engine Gauge Lights	Oil pressure, Engine Temp., ammeter, and fuel gauge on control box	53

**Lamp Identification Chart
 Figure 5**

Item Protected	Location	Illustration	Size and Type
Engine Circuit and Instrument Panel	Control box Interior	1-1; Figure 6, Item 12	10A Circuit Breaker
Controls	Control box Interior	1-1; Figure 6, Item 13	5A Circuit Breaker
Marker Lights	Control box Interior	1-1; Figure 6, Item 14	10A Circuit Breaker
Load Contactor Circuit	Control box Interior	1-1; Figure 6, Item 15	5A Circuit Breaker

**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 operation immediately 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 Figure 1 and 2.

b. AC Generator

The 400 Hz generator requires NO lubrication.

c. Generator Controls

Generator controls and instruments require no periodic lubrication. A few drops of oil may be required on door hinges occasionally to insure free and quiet operation.

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, Fig. 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 CE/SGT.

Lubricating oil is discussed in detail in the Cummins Operation Manual.

(3) Oil viscosity

A temperature and oil viscosity index chart is shown below. For operation at temperatures consistently below -13°F (-25°C), refer to the Cummins Operation Manual.

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 there after. Use oil that conforms to API specification CE/SG.								
Capacity	Engine lube oil capacity with filter: 16 quarts (15.1 liters)								
Oil Filter Replacement	Oil Filter Replacement Hobart Brothers Part No. 286987-006 Oil Filter Replacement Cummins Part No. 3908615								
Lube Oil Viscosity Required as per Ambient Temperatures	<table border="0"> <tr> <td><u>VISCOSITY</u></td> <td><u>AMBIENT TEMPERATURE CONDITIONS</u></td> </tr> <tr> <td>SAE 15W40</td> <td>13°F (-11°C) and above for all seasons</td> </tr> <tr> <td>SAE 10W30</td> <td>-10°F to +68°F (-23°C to +20°C) Winter conditions</td> </tr> <tr> <td>SAE 5W30</td> <td>-20°F to +50°F (-29°C to +10°C) Arctic Conditions</td> </tr> </table>	<u>VISCOSITY</u>	<u>AMBIENT TEMPERATURE CONDITIONS</u>	SAE 15W40	13°F (-11°C) and above for all seasons	SAE 10W30	-10°F to +68°F (-23°C to +20°C) Winter conditions	SAE 5W30	-20°F to +50°F (-29°C to +10°C) Arctic Conditions
<u>VISCOSITY</u>	<u>AMBIENT TEMPERATURE CONDITIONS</u>								
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SAE 10W30	-10°F to +68°F (-23°C to +20°C) Winter conditions								
SAE 5W30	-20°F to +50°F (-29°C to +10°C) Arctic Conditions								
Synthetic Oils	See the Cummins Operator's Manual for usable synthetic oils and instructions.								
Fuel Pre-filter	Drain Filter Daily. Change filter element every 250 hours or 3 months of use.								
Coolant	Check coolant level daily. Service and maintain coolant system according to sect. 2-2, para. 6. Engine coolant capacity (system): 28 quarts (26.4 liters)								
Coolant hoses and connections	Check coolant hoses and connections daily for leaks.								
Air Cleaner	Change air cleaner filter as required when air cleaner indicator (on engine control panel) shows that it should be changed.								
Fan Belt	Check fan belt condition and tension every 500 hours or 6 months of use.								
AC Generator	AC generator bearings are sealed and require no periodic lubrication.								
Alternator	Alternator bearings are sealed and require no periodic lubrication.								
Starter Motor	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 thickeners

Lubricants
Figure 2

(4) Changing engine oil (See Fig. 4)

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 plug can be attained through a hole in the access panel underneath the generator set.
- c. Unloosen and remove the drain plug located in oil pan.
- d. While oil is draining, change the oil filter element (Fig. 4). See instructions below.

Provide a container for catching spilled oil from the filter.

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 results.

CAUTION

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

Fill the new filter with clean lubricating oil before installation.

NOTE: Oil Filter Replacement Hobart Brothers Part No. 286987-006
Oil Filter Replacement Cummins Part No. 3908615

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

- e. Clean the drain plug and install when engine oil has completely drained. Torque the drain plug to 60 ft-lb (80 Nm).

- f. The oil fill tube on this Cummins engine (Sect. 1-2, Fig. 1) also holds the oil level gage rod. It is located on the right side of the engine next to the fuel filter. Turn the t-handle on the gage rod counter-clockwise and lift the cap straight up to remove.

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

- g. Use the oil refill tube to refill the crankcase with new, clean oil which meets engine manufacturer's recommendations. See Figures 1, 2, and 3, or Cummins Operation Manual for oil specifications.

CAUTION

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

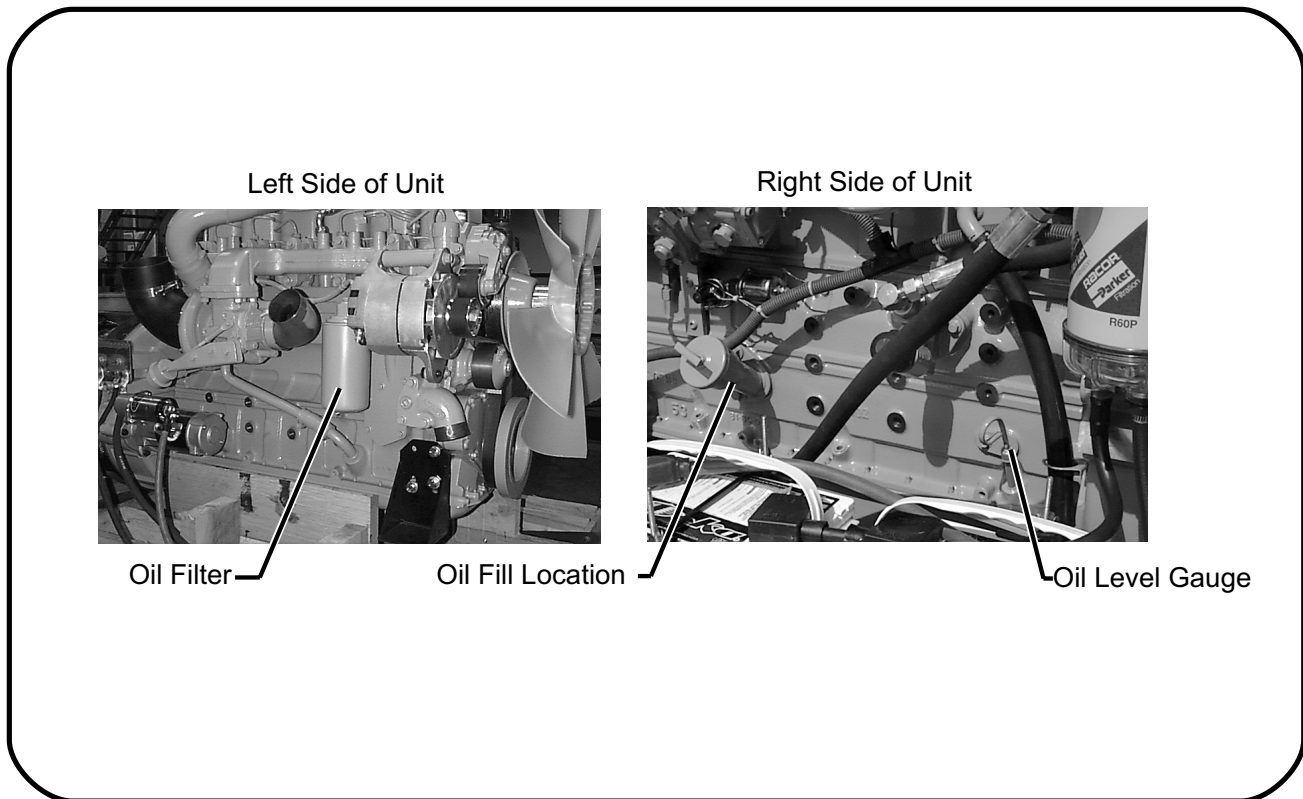
- h. Install filler cap and check oil level on gage rod (Sect. 1-2, Fig. 1).

Oil Capacity (including filter)	15 quarts (14.2 liters)
Coolant Capacity	28 quarts (26.4 liters)

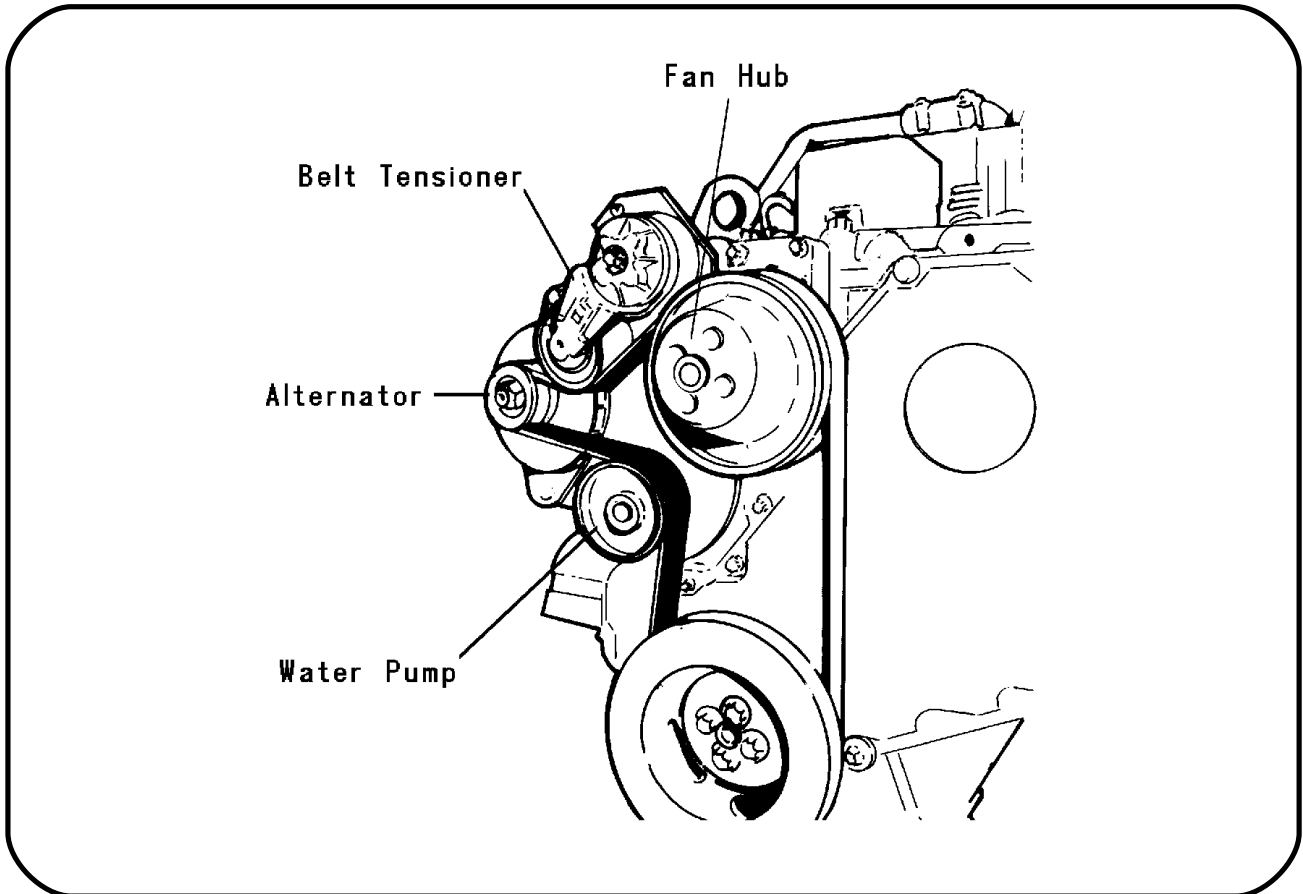
Oil and Coolant Capacities

Figure 3

- i. Start engine and check oil pressure at once. Allow engine to idle for 5 minutes, check for leaks, then stop the engine.
- j. 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.



Changing Oil Filter
Figure 4



e. Engine Accessories Lubrication (See Fig. 5)

(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 coolant leakage is found.

(4) Fan Hub

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

3. Servicing the Air Cleaner (See Fig. 6)

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

a. Inspecting the Air Cleaner

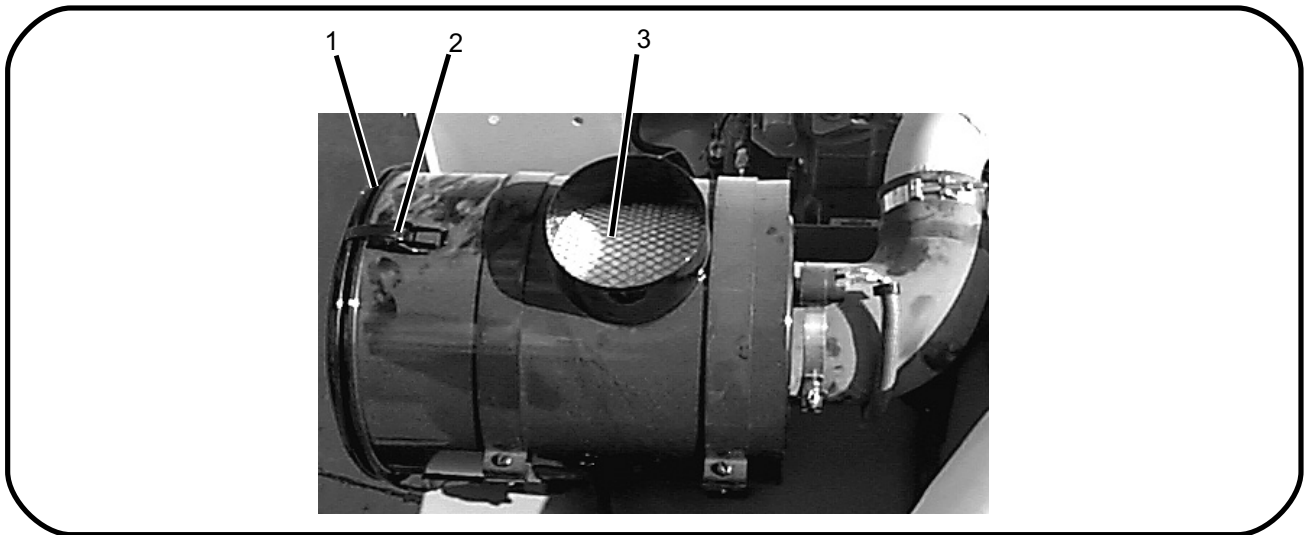
- (1) Make periodic checks of air cleaner inlet screen for obstructions. If any obstructions are present, remove them.
- (2) Check outlet connection for proper seal.

b. Changing the Air Filter

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

c. Disposal

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



1. End Cover
2. Clamps (3)
3. Filter Element

**Air Filter Assembly
Figure 6**

4. Engine Fuel

a. How to select Fuel—Quality

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

CAUTION

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

CAUTION

Use diesel fuel ONLY

Use ASTM No. 2 D fuel with a minimum Cetane number of 40. No. 2 diesel fuel gives the best economy and performance under most operating conditions. Fuels with Cetane numbers higher than 40 may be needed in high altitudes or extremely low ambient temperatures to prevent misfires and excessive smoke.

For more information regarding the selection of fuel to use, refer to a Cummins Operation Manual for further fueling instructions.

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 mileage.

In most cases, adequate resistance to cold can be obtained by adding a flow improver (additive). For further assistance contact the nearest Cummins service representative.

5. Engine Fuel System (See Fig, 7)

The fuel system consists of five primary components: Fuel tank, Fuel Pre-filter/separator, Fuel Pump, Fuel Filter, and the Fuel Return Line. The maintenance procedures for each of these items follow.

a. Fuel Tank

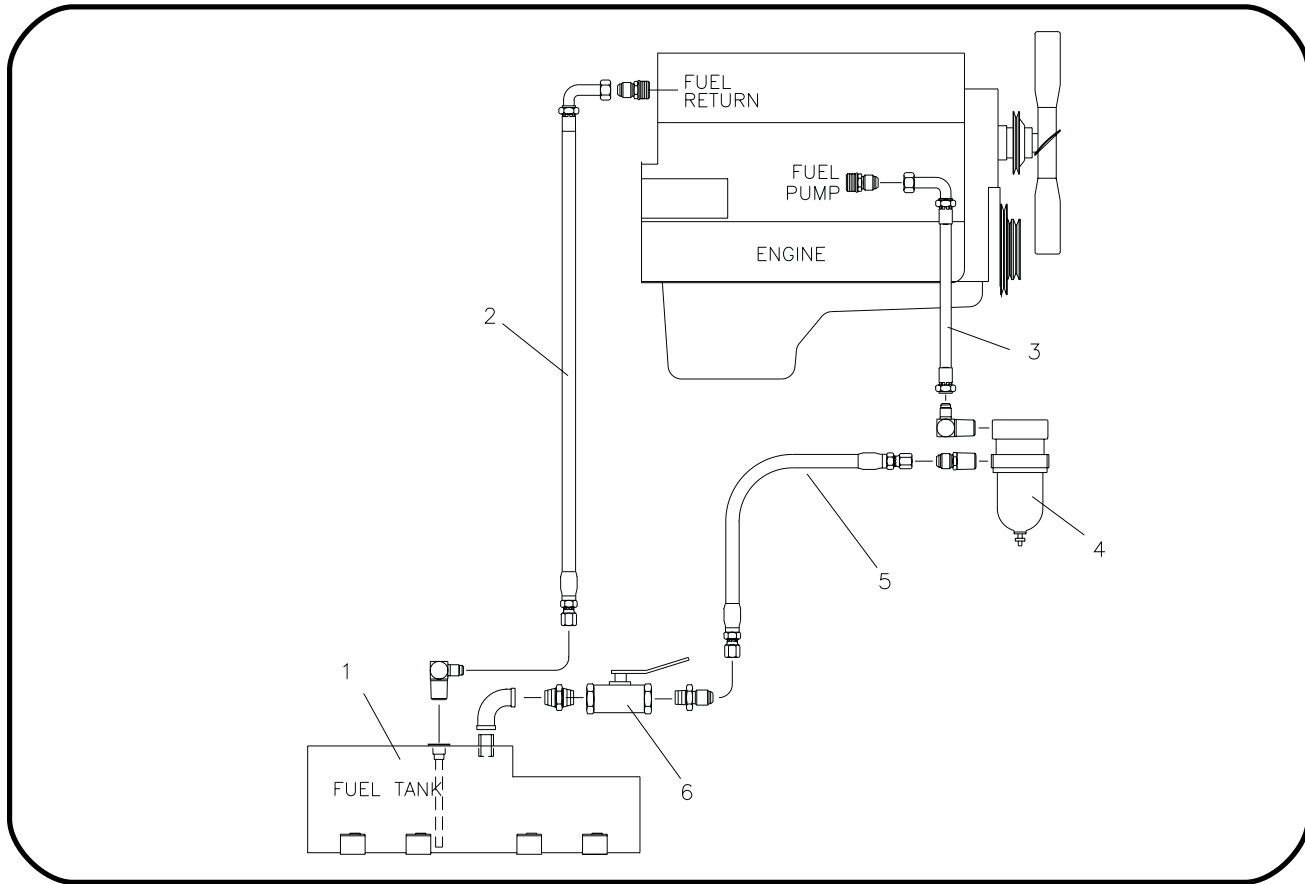
Be sure that no foreign objects are permitted in the fuel tank. The fuel tank must be removed and flushed out if objects are found in the Fuel Pre/Filter.

b. Fuel PreFilter/Separator

A fuel prefilter/water separator has been mounted on the side of the engine block by Hobart Brothers. Its function is to remove foreign material and extract water from the fuel before it enters the fuel pump. Daily draining of the filter/separator bowl is required.

(1) Draining the pre-filter/separator bowl (See Fig. 8).

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



- | | |
|--|--|
| 1. Fuel Tank | 4. Fuel Pre-filter/Separator |
| 2. Fuel Return Line | 5. Fuel Supply Line (Shut-off valve to Pre-filter) |
| 3. Fuel Supply Line (Pre-filter to Pump) | 6. Shut-off Valve |

**Fuel Line System
Figure 7**

(2) Priming (See Fig. 8)

- a. Loosen the vent plug.
- b. Twist the primer pump knob from the filter header, and 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 Pre-filter/Separator Element. (See Fig. 8)

CAUTION

If a vacuum gage has been installed on the outlet side of the filter, change the element at 6 to 10 inches of mercury restriction.

NOTE: The new element replacement number is Racor Part No. R26S.

- a. Drain off some fuel by loosening the vent plug and opening the drain valve.
- b. Spin the element and bowl off together. Remove the bowl and clean the O-ring gland.
- c. Apply a coating of clean fuel or motor oil to the new O-ring and element seal. Spin the bowl onto the new element and the spin them both onto the filter head snugly by hand only. **DO NOT USE TOOLS TO TIGHTEN!**
- d. With the vent plug still loosened, twist the primer pump knob until fuel purges at the vent plug. Close the vent plug, start the engine and check for leaks, correct as necessary with the engine off.

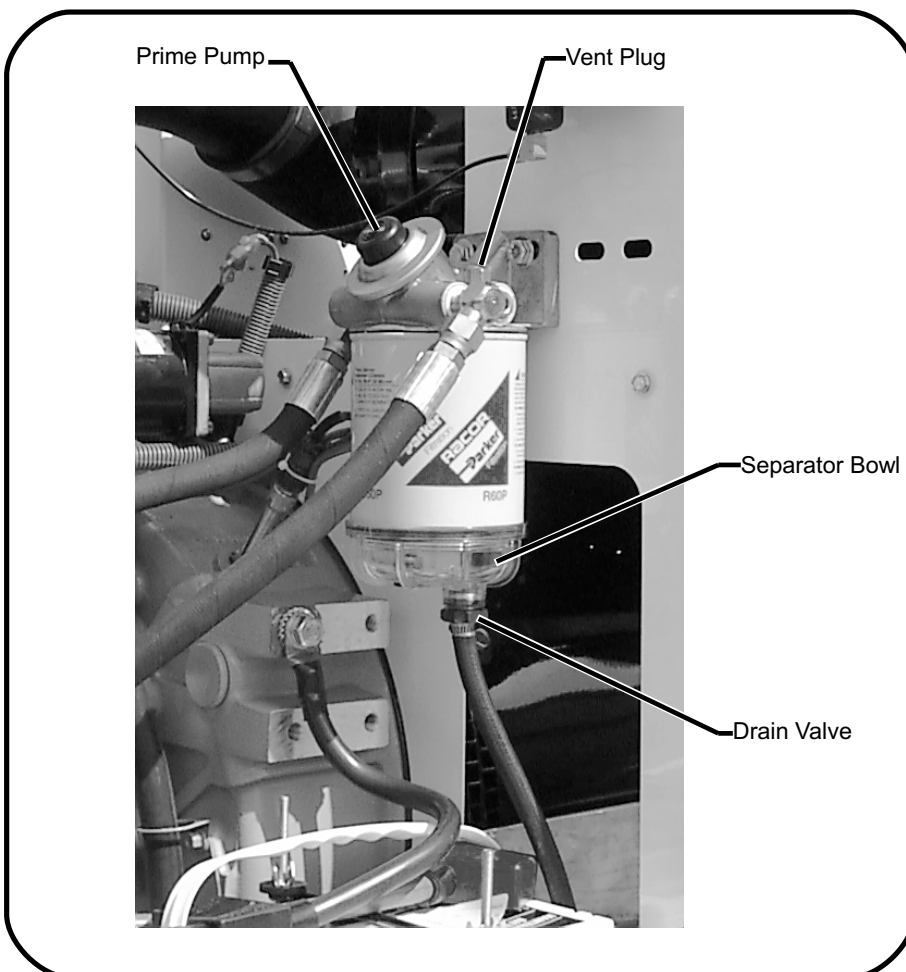
NOTE: The priming pump is intended for priming fuel into the Racor filter only and not the entire fuel system.

c. Fuel Pump

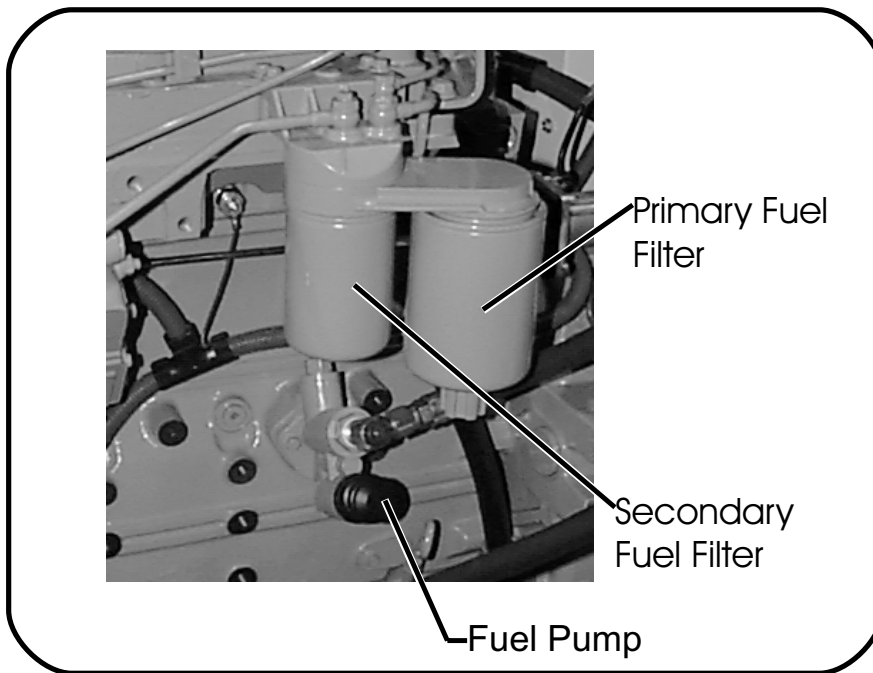
The fuel pump supplies pressure to the fuel system so the diesel fuel can circulate freely. A consistent check of the fuel pressure is necessary. Loss in fuel pressure in the fuel line may indicate a faulty fuel pump.

d. Fuel Filter(Fig. 9)

The forth item in the fuel line system is the factory installed **Fuel Filter**. The filters function is to remove foreign material from the fuel under pressure before it enters the engine. The filament elements are throwaway type in which the case and element are made as one disposable part.



**Fuel Pre-filter
Figure 8**



Fuel Filter and Pump
Figure 9

(1) Changing fuel filter

a. Replacement primary fuel filter

Cummins Part No. 3903640

Hobart Brothers Part No. 286897-004

b. Replacement secondary fuel filter

Cummins Part No. 3903410

Hobart Brothers Part No. 286897-005

- c. Change fuel filter after each 200 hours of operation unless a restriction test indicates the time period should be extended.
- d. Shut off fuel valve.
- e. Place a pan underneath the fuel filter to catch spilled fuel.
- f. Undo fuel filter with commercial tool and spin off.
- g. Catch any fuel.
- h. Clean any dirt from the filter carrier rim.
- i. Apply a light film of oil or diesel fuel on the rubber seal on the new filter.

CAUTION

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

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

e. Operating Pressure

- a. Operate the engine at governed speed and under full load. When running properly, the fuel maximum fuel pressure drop across filters is 5 psi (34 kPA).

f. Fuel Return

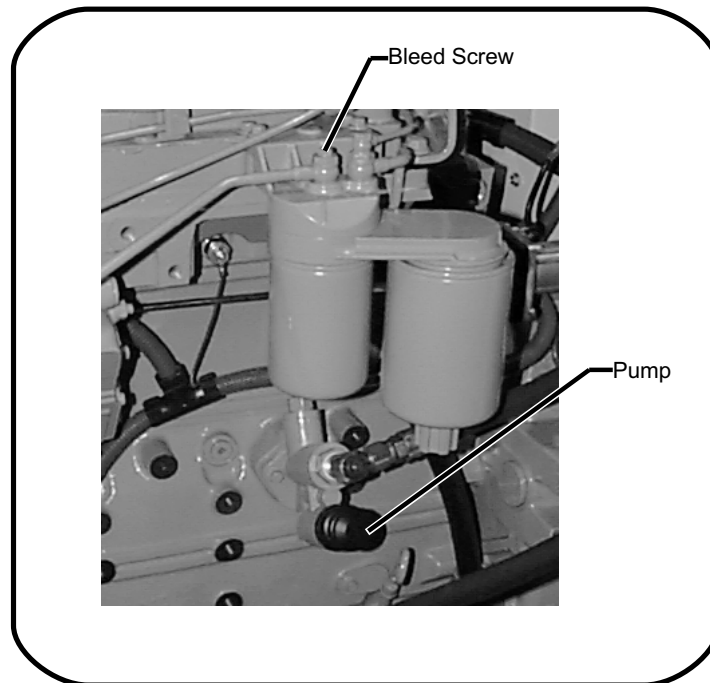
The fuel return is a fuel line (tube) that takes unused fuel from the engine, and delivers it to the fuel tank. No maintenance is required.

6. Priming Fuel System

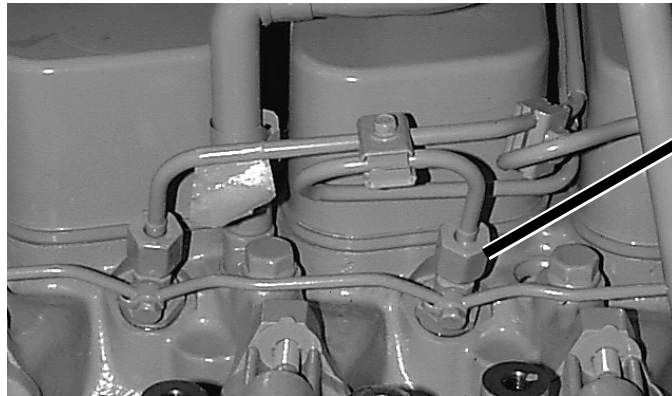
Controlled venting is provided at the injection pump through the fuel drain manifold. Small amounts of air introduced by changing the filters or injection pump supply line will be vented automatically. If the fuel filter is changed in accordance with the instructions, no manual bleeding of fuel lines is required.

a. Manual priming is required if:

- The fuel filter is not filled prior to its installation
- Injection pump is replaced
- High pressure fuel line connections are loosened or lines replace
- Initial engine start up or start up after an extended period of no engine operation
- The fuel tank has run empty



Fuel Primer/Bleeder Pump
Figure 10



Injector Fuel
Lines (6)

Right Side of Engine

Injection Pump
Figure 11

b. Priming procedures

If this generator set has been run out of fuel, the entire fuel system must be manually primed with diesel fuel before the generator set can be started again. Two hand operated pumps (Fig. 8 and 10) are used to bleed the fuel through the fuel lines from the fuel tank, until it reaches the injectors. Instructions for priming the fuel systems are as follows:

(1) From tank to fuel pre-filter

Place rags and/or absorbent sheets around and under the engine and fuel lines to catch excess fuel.

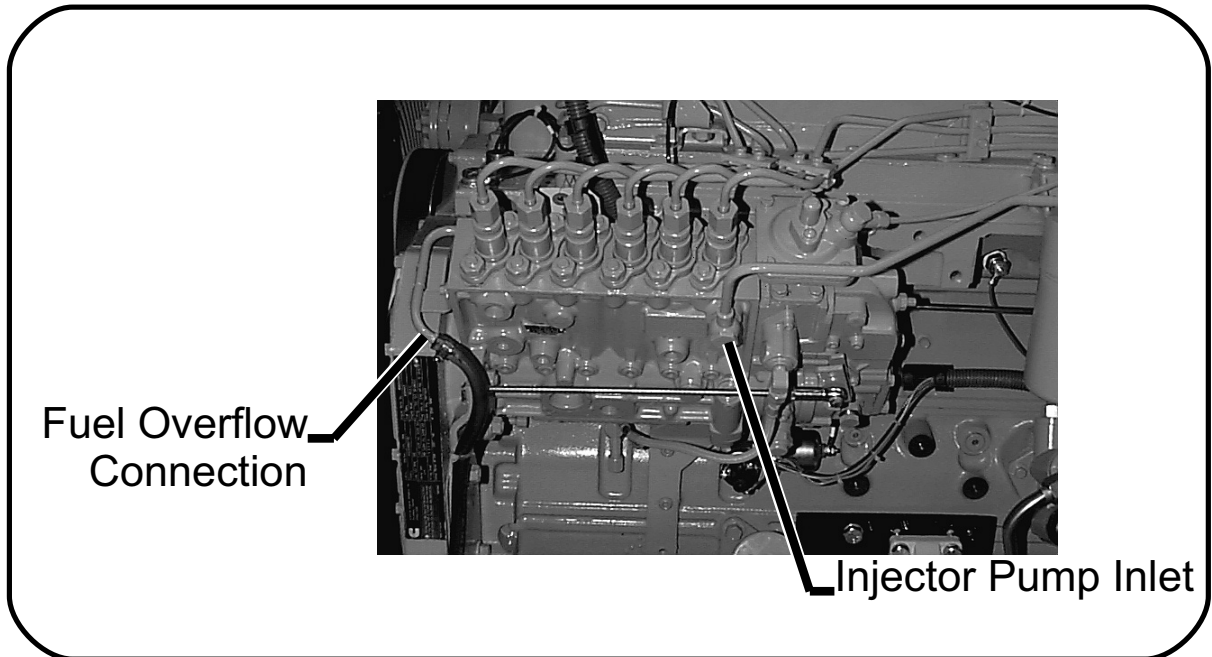
- a. Open the fuel shutoff valve (6, fig. 7.); it should be point up..
- b. Loosen final fuel filter inlet connection on pump knob (fig. 8).
- c. Operate the Racor primer pump (fig. 8) until air-free fuel fills the separator bowl.

NOTE: This Racor priming pump is intended for priming fuel into the Racor filter only and not the entire fuel system.

- d. Tighten Racor primer pump knob.

(2) From pre-filter to final fuel filters

- a. Loosen bleed screw on final fuel filter header casting (fig. 10).
- b. Operate primer pump (fig. 10) on fuel lift pump until air-free (no bubbles) fuel comes out of bleed screw.
- c. Tighten bleed screw.



**Injector Pump
Figure 12**

- (3) From fuel filter to injector pump
 - a. Remove fuel return hose at the fuel tank only (fig. 11) and feed into a bucket.
 - b. Operate primer pump until air-free fuel drains into the bucket.
 - c. Tighten fuel return hose back onto fuel tank.
- (4) Injector pump to injectors
 - a. Loosen the six high pressure injector fuel lines (fig. 11) at the injectors.

CAUTION

Make sure the rags or absorbent sheets are secure from contact with moving engine parts, and also cannot be drawn into the radiator fan or belts.

- b. Have a second person operate the ENGINE START push-button switch (Sect. 1-1; 26, Fig. 5) and crank engine over. Crank engine until air-free fuel (no bubbles) squirts out of each injector line.

CAUTION

Do not crank engine for more than 15 seconds continuously; allow starter to cool for 15 seconds between attempts.

WARNING

Keep face and hands away from this squirting fuel, it is under very high pressure and will penetrate the skin.

- c. Tighten each injector line after it flows air-free fuel. The engine might start after only 2 or 3 injector lines have been tightened. Have the second person stop the engine with the EMERGENCY STOP BUTTON (Sect. 1-1; 4, fig. 1) to allow enough time to tighten the remaining injector lines.
- d. After the engine has shown it is able to run, tighten the remaining injector lines.
- e. Pull the emergency stop button out and start the unit. Listen closely for any rough running. The engine should smooth out fairly soon. If it does, you are done. If not, see next step.
- f. Start the engine. With the engine running at idle, crack (loosen) each injector line at the injector, one at a time, for just long enough to make sure that a good squirt of fuel is coming out of the pump.

WARNING

Keep face and hands away from this squirting fuel, it is under very high pressure and will penetrate the skin.

- g. Properly tighten the injector lines.
- h. Remove rags and absorbent sheets and dry any spilled fuel.
- i. resume normal operation.

7. Engine Cooling System

a. General

Cooling system service requires more than maintaining the proper coolant level in the radiator and protecting the system against freezing. Water should be clean and free of any corrosive chemicals such as chloride, sulfate, and acids. It should be kept slightly alkaline with a pH value in the range of 8.0 to 9.5. Any water which is suitable for drinking can be used in the engine when properly treated as described in Cummins Operation Manual. The Cummins Distributor 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 7 psi (48.3 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.

NOTE: Do not attempt to repair the valve in a radiator cap. 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 manual, "Operation and Maintenance Manual", that we will not attempt to condense or explain it here. For information regarding coolant specifications, testing equipment, antifreeze, etc., refer to Cummins Operation Manual that accompanies the Hobart manual or consult the local Cummins Distributor.

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 an antifreeze.

2. **Do** no 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 Cummins Distributor for a list of compatible antifreezes.

(3) Checking antifreeze solution

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

NOTE: When testing, be sure coolant is at operating temperature. Follow manufacturer's instructions on tester.

d. Draining the Cooling System

NOTE: To completely empty the cooling system requires draining the engine block 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:

WARNING

Engine temperature must be no higher than 120° F (50° C) before removing radiator cap.

- (1) Remove radiator cap.
- (2) Place a drain pan with at least a 30 quart (28.4 liters) capacity under radiator and water inlet to catch coolant.
- (3) Place the radiator drain hose that comes off the drain valve, into the drain pan.
- (4) Open the radiator drain valve.
- (5) Remove plug in the bottom of water inlet.
- (6) Allow the system to drain completely.

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

- (7) When the system is completely drained, close the drain valve.
- (8) When the system is completely drained, close the drain plug.

e. Flushing the Cooling System

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

f. Cleaning the Radiator Core

Blow out accumulated dirt from the radiator core air passages, using water. Engine overheating is often caused by bent or clogged radiator fins. When straightening bent fins, be careful not to injure the tubes or to break the bond between fins and tubes.

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

g. Filling the Cooling System

The preparation and monitoring of coolant in liquid-cooled engines is especially important because corrosion, cavitation, and freezing can lead to engine damage. For coolant system protecting details see the Cummins Operations Manual.

- (1) Install coolant

WARNING

Engine temperature must be no higher than 120° F (50° C) before removing radiator cap.

- a. Remove radiator cap. Be sure the drain valve is closed.
 - b. Pour coolant into radiator very slowly until it reaches the bottom of fill neck.
 - c. Start the engine and allow it to idle. 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 Cummins Operation for recommended instructions.

8. Generator Maintenance

The 400 Hz generator requires no maintenance or service other than periodic cleaning. The unit is brushless, with 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 2-3.

9. Drive Belt (See Fig. 13)

a. General

The engine cooling fan, alternator, coolant pump, and fuel pump 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

Check, tension and changing the serpentine belt only with the engine off.

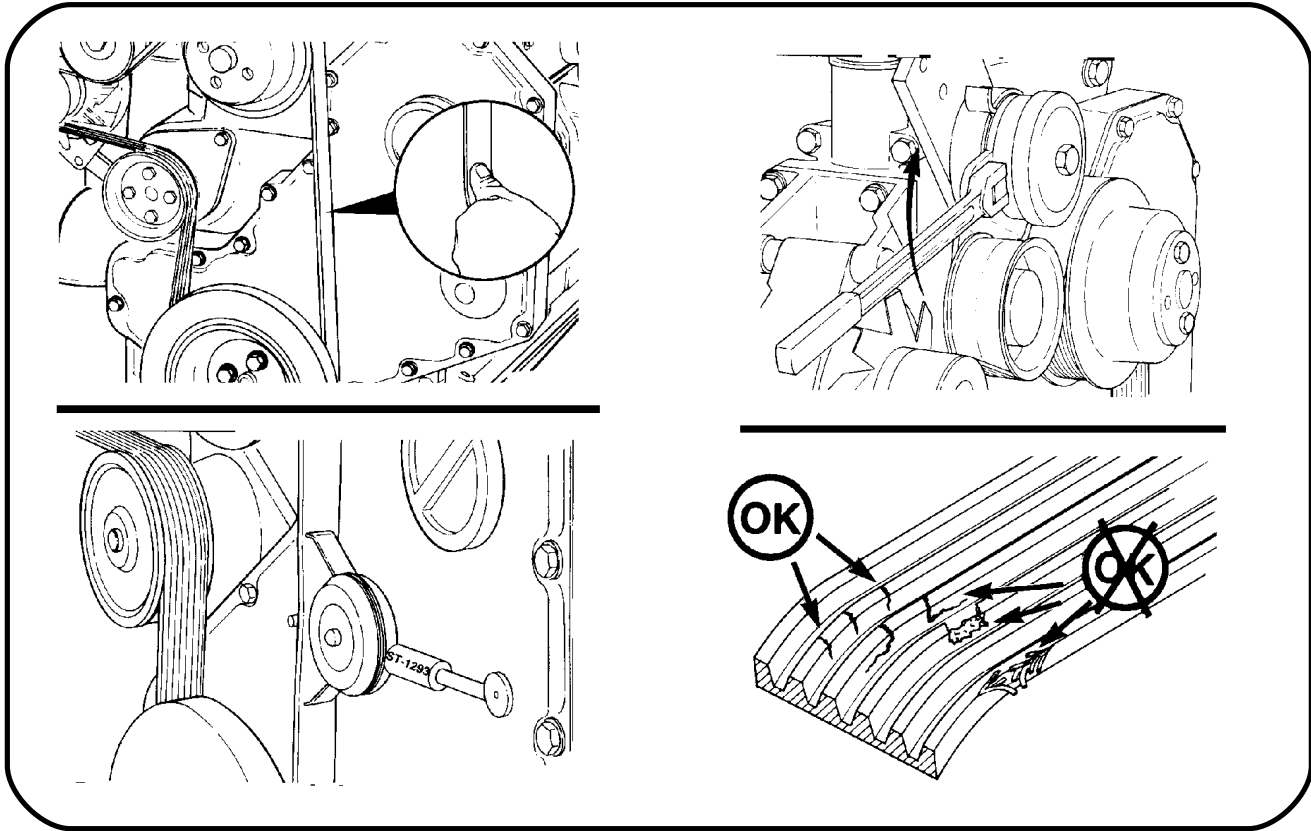
Check belt tension every 500 hours, or once a half-year, whichever comes first. A belt which is too tight is destructive to bearings of the driven part. A loose belt will slip and cause inefficient operation of the part being driven as well as wear to the belt.

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 Cummins Operation Manual for checking belt tension and changing worn belts.



Drive Belts
Figure 13

Section 3. Adjustment/Test

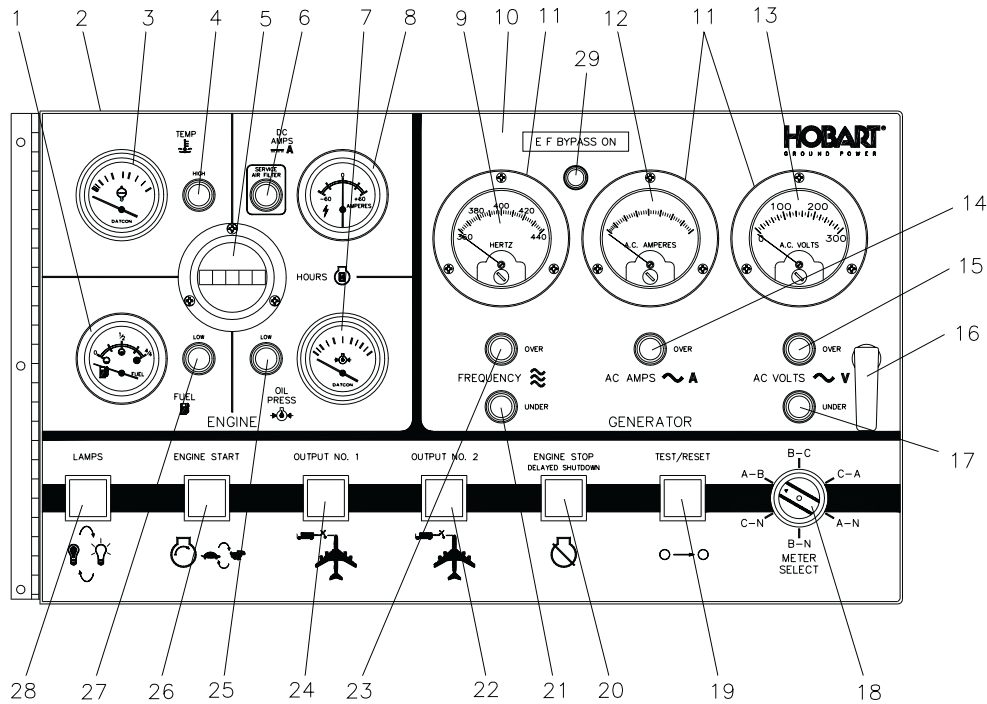
1. General

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

2. Testing the Generator Set

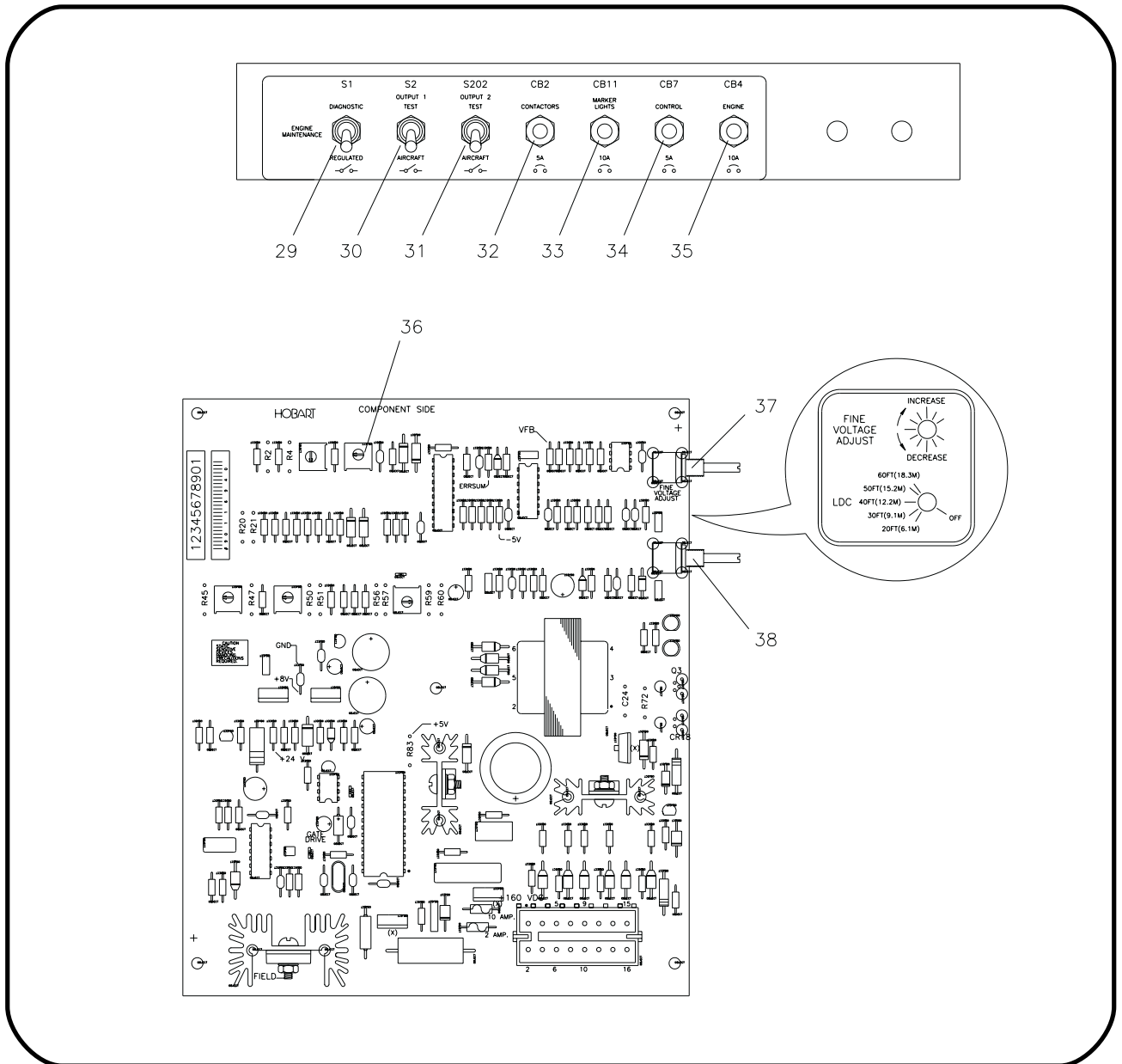
a. Pre-operational Test Procedures

- (1) Connect cables from the generator output terminals to a load bank. Use cables of the same size and length as those to be used in service. Be sure the generator output N cable is grounded.
- (2) Check engine oil level. Oil should be at high bar on the dipstick.
- (3) Check radiator coolant level (See 2-2, Para. 6; g, (1), b).
- (4) Check tension of drive belt (See 2-2, Para. 8).
- (5) If governor throttle linkage was disturbed, check all linkage to make certain engine speed may be controlled when the engine is started. Refer to Paragraph 3, e, (1) and see Figure 3.
- (6) Inspect for oil, fuel and coolant leaks.
- (7) If the setting of the output voltage coarse adjustment potentiometer (36, Fig.1) on the voltage regulator has been disturbed, set it at CENTER position (halfway between full clockwise position and full counterclockwise position).
- (8) Check marker lights circuit breaker (33, Fig. 1) by pressing panel light push button switch (28). If panel lights (11) operate, the circuit breaker, switch, and lamps are good.
- (9) Check fault indicating lights by pressing test/reset push button switch (19, fig.1). If lights glow, the control circuit breaker (34) and indicating lamps are good.
- (10) Make a general inspection of all wiring, and terminals. Inspect the equipment to be certain no damage will result from starting the engine.



- | | |
|--|---|
| 1. Fuel gage | 15. Over voltage indicator light (red) |
| 2. Front panel | 16. Adjustable grip latch |
| 3. Engine coolant temperature meter | 17. Under voltage indicator light (red) |
| 4. Over temperature indicator light (red) | 18. Meter Selector switch |
| 5. Engine hour meter | 19. Test-reset push button switch |
| 6. Indicating light, air cleaner restriction | 20. Engine stop push button switch |
| 7. Oil pressure gage | 21. Under frequency indicator light (red) |
| 8. Engine ammeter | 22. No. 2 contactor push button switch |
| 9. Frequency meter | 23. Over frequency indicator light (red) |
| 10. Control Box label | 24. No. 1 contactor push button switch |
| 11. Strip lights (3) | 25. Low Oil Pressure indicator light (red) |
| 12. Generator ammeter | 26. Engine start push button switch (green) |
| 13. Voltmeter | 27. Low Fuel indicator light (red) |
| 14. Overload indicator light (red) | 28. Panel light push button switch |
| | 29. EF By-Pass Indicator |

Operating Controls and Instruments
Figure 1 (Sheet 1 of 2)



- | | |
|---|--|
| 29. Regulated-diagnostic switch | 34. Circuit breaker, control (5-amp) |
| 30. Test bank-aircraft switch, No. 1 output | 35. Engine circuit breaker (10-amp) |
| 31. Test bank-aircraft switch, No. 2 output | 36. Output voltage adjustment (course) |
| 32. Circuit breaker, contactors (5-amp) | 37. Output voltage adjustment (fine) |
| 33. Circuit breaker, marker lights (10-amp) | 38. Line drop compensation adjustment |

Operating Controls and Instruments
Figure 1 (Sheet 2 of 2)

b. Operational Test Procedures (See Fig. 1)

- (1) Start the engine in accordance with instructions in 1-3, Para. 2, A thru C.
- (2) Check operation of engine instruments; DC ammeter (8), coolant temperature indicator (3), oil pressure gage (7) and hourmeter (5).
- (3) Check engine idle speed. Should be 850 +/- 50 RPM. If adjustment is necessary, adjust the idle speed potentiometer on the governor control box.

NOTE: A stroboscope is 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 (29) in REGULATED position.
 - b. Place test-bank switches (30 and 31) in AIRCRAFT position.
 - c. If the of the output voltage coarse adjustment potentiometer (38) on the voltage regulator regulator has been disturbed, place the knob at mid-range position.
- (6) Bring the engine up to governed speed and also energize the generator by pressing the engine start push button switch (26) a second time. If the engine comes up to governed speed and a voltage value appears on the voltmeter (13), the electric governor and excitation circuits are functioning.
- (7) After generator overhaul or repair, the Regulated/Diagnostic switch (29, Fig. 1) must be placed in the **DIAGNOSTIC** position for 3 to 5 seconds to remagnetize the exciter. Then return the switch to the **REGULATED** position after voltage has built-up.
- (8) Observe frequency meter (9). If engine speed is properly adjusted, frequency will be exactly 400 Hz. If not, adjust engine governed speed in accordance with Para. 3, E, (3). See Fig. 6.
- (9) Observe voltmeter (13). Use output voltage coarse adjustment potentiometer (38) to adjust voltage to 115 V AC.
- (10) Measure governor actuator input signal. See Para. 3, e.
- (11) Measure governor magnetic pickup signal. See Para. 3, e.
- (12) Check high-speed limiting governor.
Engine limiting speed governor should limit engine speed to approximately 2750 RPM.
- (13) Check adjustable voltage range.
 - a. Observe voltmeter (13) and turn output voltage coarse adjustment potentiometer (38) 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.
- (14) Position load bank switches, etc., to apply a light load to the generator.

c. Testing the No. 1 Output Circuit (See Fig. 1)

- (1) Make certain that the orange No. 2 contactor on-off push button switch (22) is in the OFF position, which is indicated when its internal indicating light doesn't glow. Then press the yellow No. 1 load contactor push button switch (24). The No. 1 contactor power ON indicating light within the push button switch should glow, and an amperage value should appear on the AC ammeter (12). Hold in this position momentarily.
- (2) Release the No. 1 load contactor push button switch. The No. 1 load contactor should open immediately, and the No. 1 ON indicating light within the push button switch should go OFF. This is because the interlock circuit of the control PC board is not receiving power from an outside source of 28 V DC. It indicates that the No. 1 interlock circuit is OPEN as it should be when the interlock circuit is not receiving 28 V DC power.
- (3) Open the control panel door and place the No. 1 test bank switch (30) in TEST BANK position.
- (4) Press the No. 1 load contactor push button switch (24). The No. 1 contactor power ON indicating light within the push button switch should glow and remain ON when the push button switch is released. This indicates that the No. 1 test bank switch (30) is functioning to bypass the plug interlock circuit.
- (5) Return the No. 1 test bank switch (30) to AIRCRAFT position. The No. 1 load contactor should open at once and the yellow indicating light within the No. 1 load contactor push button switch (24) should go OFF.
- (6) Connect a source of 24 V-DC power (two twelve-volt batteries connected in series) to terminals N and F (or E) at the output terminal panel. Connection polarity is important. Connect plus (+) to terminals E or F, and minus (-) to terminal N.
- (7) With test-bank switch in AIRCRAFT position, press the No. 1 contactor operating push button switch (24). The No. 1 contactor power ON indicating light, within the push button switch, should glow and remain on when the push button switch is released. This indicates that the load contactor is closed and the plug interlock circuit is functioning properly.
- (8) Apply 1/3 to 1/2 load (30 to 45-KVA) at the load bank and allow the unit to run for 15 to 30 minutes. Observe operation of all monitoring instruments.
- (9) Increase load at the load bank to 90-KVA.
- (10) Check operation of the governor by observing the frequency meter (9) when generator is switched from no load to full load. and vice versa. Use the No. 1 contactor control push button switch (24) to apply and remove load several times. Steady-state frequency droop should be no more than 1 Hz. Adjust governor if necessary [see Para. 3, E, (3)].
- (11) Follow instructions in Para. 3, B, (2) (b) to set voltage regulator line drop compensation for the length and size of cable being used.
- (12) Check voltage regulator, at intervals, from no load to full load and on up to 125% load. Observe and note voltage at various loads. Steady-state voltages should vary no more than +/- 1% from normal output voltage.
- (13) Operate the No. 1 output circuit of the unit not less than 10 minutes under full 140-KVA load. The overload device (Ref. 1-1; 8, Fig. 10) **MUST NOT** trip.
- (14) 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 overload indicating light on the engine generator control panel must come ON to indicate an overload condition.
- (15) Reduce load to normal. Turn off overload indicating light by pressing reset push button switch (19).

d. Testing the No. 2 output circuit (See Fig. 1)

- (1) Make certain that the No. 1 contactor on-off push button switch (24) is in the OFF position, which is indicated when its internal indicating light doesn't glow. Then press the orange No. 2 load contactor push button switch (22). The No. 2 contactor power ON indicating light within the push button switch should glow, and an amperage value should appear on the AC ammeter (12). Hold in this position momentarily.
- (2) Release the No. 2 load contactor push button switch. The No. 2 load contactor should open immediately, and the No. 2 ON indicating light within the push button switch should go OFF. This is because the interlock circuit of the control PC Board is not receiving power from an outside source of 28 V DC. It indicates that the No. 2 interlock circuit is OPEN as it should be when the interlock circuit is not receiving 28 V DC power.
- (3) Open the control panel door and place the No. 2 test bank switch (31) in TEST BANK position.
- (4) Press the No. 2 load contactor push button switch (22). The No. 2 contactor power ON indicating light within the push button switch should glow and remain ON when the push button switch is released. This indicates that the No. 2 test bank push button switch (31) is functioning to bypass the plug interlock circuit.
- (5) Return the No. 2 test bank switch (31) to AIRCRAFT position. The No. 2 load contactor should open at once and the orange indicating light within the No. 2 load contactor push button switch (22) should go OFF.
- (6) Connect a source of 24 V-DC power (two twelve-volt batteries connected in series) to terminals N and F (or E) at the output terminal panel. Connection polarity is important. Connect plus (+) to terminals E or F, and minus (-) to terminal N.
- (7) With test-bank switch in AIRCRAFT position, press the No. 2 contactor operating push button switch (22). The No. 2 contactor power ON indicating light, within the push button switch, should glow and remain on when the switch is released. This indicates that the load contactor is closed and the plug interlock circuit is functioning properly.
- (8) Operate the No. 2 output circuit of the unit not less than 10 minutes under full 120-KVA load. The overload device (Ref. 1-1; 8, Fig. 9) MUST NOT trip.
- (9) Operate the No. 2 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 overload indicating light on the engine generator control panel must come ON to indicate an overload condition.
- (10) Reduce load to normal. Turn off overload indicating light by pressing reset push button switch (19).

e. Testing and checking meters, switches, circuits, and indicating lights (See Fig. 1)

- (1) Check accuracy of voltmeter
 - a. Open door of control box and connect a master voltmeter of known accuracy to terminals of the voltmeter (13).
 - 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 (12).
 - 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 meter selector switch (18). A voltage value should be shown in each switch position.
 - a. In any LINE-TO-NEUTRAL position, voltmeter reading should be 115 volts.
 - b. In any LINE-TO-LINE position, voltmeter reading should be 200 volts.
- (4) Check accuracy of frequency meter
 - a. Connect a master frequency meter of known accuracy to the terminals of the frequency meter (9).
 - b. Compare meter readings. Error must not exceed 1% of full scale.

NOTE: Make all protective system tests with the unit operating under load.

- (5) Check operation of over voltage circuit and indicating light.
 - a. With the unit running at normal load, adjust the coarse adjustment potentiometer (38,) of the voltage regulator **CLOCKWISE** to increase voltage until the over voltage sensing circuit actuates the protective monitor to open the load contactor and turn on the over voltage indicating light. At 126 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 reset push button switch (19).

- (6) This step checks operation of the under voltage sensing circuit, indicating light, and time delay circuit.

When the voltage is reduced to a predetermined value, the under voltage sensing circuit activates the under voltage time delay circuit. If the under voltage condition continues for approximately 7 seconds, the time delay circuitry will activate the protective monitor's under voltage circuit, which in turn opens the load contactor to stop power delivery and turns on the under voltage indicating light (17).

A stopwatch is required for this check.

- a. With the unit running at normal load, use the output voltage coarse adjustment potentiometer (38) on the voltage regulator to reduce the voltage to 104 volts. The load contactor should NOT open.
 - b. Reduce voltage in steps 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 in step (b), 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 reset push button switch, and closing the load contactor.
- (7) Check under frequency sensing circuit, protective monitor, and indicating light. At some frequency value from 380 Hz or less, after 7 seconds, the under frequency condition should signal the under frequency circuit in the protective monitor module to OPEN the load contactor holding circuit, thus OPENING the load contactor. To check the under frequency protective components, proceed as follows:
- a. While the unit is operating normally under load, reduce generator output frequency by reducing engine speed. Use the governed speed setting potentiometer (Ref. Fig. 5). Turn adjusting screw gradually COUNTERCLOCKWISE to reduce engine speed until frequency meter indicates 385 Hz. Under frequency protective circuit should not open the load contactor at this frequency.
 - 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 turns on the under frequency light after 7 seconds at 380 Hz, all components of the system are functioning properly.
 - d. If the load contactor is not opened at 380 Hz after 7 seconds, refer to Troubleshooting Chart to determine which component is defective.
 - e. Return unit to normal operating condition.

- (8) Check over frequency sensing circuit, protective monitor, and indicating light.

At some frequency value from 420 Hz to 480 Hz, after 7 seconds, the over frequency sensing circuit should signal the over frequency circuit in the protective monitor module to OPEN the load contactor holding circuit, thus OPENING the load contactor.

At any frequency value exceeding 480-Hz, the over frequency sensing circuit should immediately signal the over frequency circuit in the protective monitor module to OPEN the load contactor holding circuit, thus OPENING the load contactor.

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

- a. While the unit is operating normally under load, increase generator output frequency by increasing engine speed. Use the governed speed setting potentiometer (Ref. Fig. 5). Turn adjusting screw CLOCKWISE gradually to increase engine speed until frequency meter indicates 415 Hz. Over frequency protective circuit should not open the load contactor at this frequency.
 - b. Increase frequency in steps of 1 Hz, with a time delay of 5 seconds between steps.
 - c. If the protective system opens the load contactor and turns on the over frequency light 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 to determine which component is defective.
 - e. Return unit to normal operating condition.
- (9) If the generator is operating under load at this point, place the contactor control switch(s) (22 and 24, Fig. 1) in OFF position to open load contactors and disconnect load. There will be no further need for the load bank in the following check.

f. Re-checking the entire unit after testing

- (1) With the engine running at normal governed speed, check the entire unit for vibration and for any parts which may have become loosened during the above checks. Tighten any loose attaching hardware as required.
- (2) Check engine oil pressure at rated speed (2400 RPM). The oil pressure gage should indicate at least 3.1 bar (45 psi) when engine is hot. Also at rated speed, check engine coolant temperature. The needle in the temperature gage should indicate in the range of 180° to 190° F (82.2° to 87.8° C), depending upon ambient temperature.

WARNING

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

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

3. Generator Set Adjustment

a. Generator Adjustment

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

b. Adjust 400 Hz voltage regulator.

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

- (1) a coarse output voltage potentiometer,
- (2) a fine output voltage potentiometer, and
- (3) a line-drop compensation potentiometer. See Figure 1, Sheet 2 for identification of components used for regulator adjustment. For this adjustment, the generator set must be running at rated RPM, under no-load conditions. Adjust the regulator as follows:

(1) Adjustment

a. Adjust Voltage Control

The output voltage at which the generator is regulated is adjustable by the PC board fine output voltage adjustment potentiometer (36, Fig. 1). Turn the potentiometer adjustment clockwise (CW) to increase generator output voltage, and counterclockwise (CCW) to decrease voltage.

Observe the output voltage as indicated by the voltmeter which is 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 (34, Fig. 1). Turning the potentiometer knob clockwise increases the magnitude of the compensation, and turning the potentiometer knob counterclockwise decreases the magnitude. To adjust the line drop compensation, proceed as follows:

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

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

If the line drop compensation adjustments have affected the no-load voltage output, adjust the fine output voltage control potentiometer (36, Fig. 1) 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 should vary no more than 1% at the load end of the cables from voltage under no-load.

c. Basic Engine Adjustments

Adjustment procedures applicable to the diesel engine are included in the Cummins Operation Manual, which is located in Chapter 5. Specific information for these engines is listed in Figure 2. Refer to the Cummins Operation and Manual for detailed information on the following engine adjustments.

- (1) Exhaust valve adjustment
- (2) Fuel injector timing adjustment
- (3) Engine idle speed adjustment

Engine idle speed is set at the factory. The adjustment is then sealed to discourage tampering. Idle speed should not be changed by the user. If adjustment is required, contact the local Cummins Distributor. The recommended idle speed is 850 +/-50 RPM.

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

- (4) Engine speed limiting adjustment

The speed limiting adjustment is also set and sealed at the factory. Speed should be limited to approximately 2640 RPM. If adjustment is required, contact your local Cummins Distributor.

d. Engine Accessories Adjustment

- (1) Alternator and fan belt adjustment

Refer to 2-2, Par. 8, for belt adjustment instruction.

Manufacturer	Cummins Engine Company
Type engine	In-line 6 cylinder, 4 cycle diesel
Model	B5.9C200
Engine governed speed	2400 RPM
Idle speed	850 +/-50 RPM
Speed limiting governor	approximately 2640 RPM
Firing order	1-5-3-6-2-4
Fuel pump speed limiting governor	automotive type
Lubricating oil pressure at 2400 RPM	45 to 50 psi (310 to 621 kVA)
Engine coolant temperature	160° F to 200° F (71° C to 93° C)

**Engine Specifications
 Figure 2**

e. Electric Governor System Adjustment

The governor system consists of three main components: governor control box, magnetic pickup, and the governor actuator with linkage. The adjustment of these components is critical for proper engine performance and power generation.

NOTE: When servicing the actuator linkage, **DO NOT** lubricate the ball joints as they are self lubricating. Lubricating the ball joints will can cause damage to them.

When the complete system is to be checked, and/or adjusted, a definite sequence of procedures should be followed:

- First - Check or adjust actuator linkage
- Second - Check or adjust magnetic pickup
- Third - Check or adjust electronic control box.

NOTE: When making governor system adjustments, an important factor in such adjustments is the type of fuel used in the generator set. For the engine of this generator set, carefully follow the engine fuel guidelines referenced in 2-2, 4, (a and b).

(1) Actuator linkage adjustment (See Fig. 3)

The proper adjustment of the mechanical linkage between the electric actuator and engine stop lever is important to the satisfactory operation of the complete system. The Cummins is engine comes equipped with an engine run lever (7) and the engine stop lever (5). The engine run lever (7) is preset at the factory for wide open throttle. To do this, a stop rod (6) and a ball joint (4), are used to keep the engine run lever stationary. **To ensure that the engine run lever remains wide open, this assembly should not be tampered with.**

The engine stop lever (5) along with the Hobart installed governor actuator is used to control the engine speed. The actuator, its linkage (2, 3, and 4), and the engine stop lever are the items used to adjust the mechanical part of the governor. The stop lever is keyed to its own shaft and therefore needs no adjustment.

Two definite rules must be followed in making the adjustment:

Adjust linkage to use the full travel of the actuator (1) and the stop lever (5).

Actuator (1) must move engine stop lever (5) from no fuel to maximum speed (2850 rpm) position, or very close to maximum speed position to allow engine to pull 125% load.

Refer to figure 3 while making linkage adjustments. With engine stopped, check and adjust linkage as follows:

- a. With linkage assembled as shown in figure 3, make sure that approximately ½ inch of the threaded rod (3) is threaded into the rod end bearings and ball joint (2).
- b. Make sure the actuator clevis is threaded onto the actuator shaft for five full turns and tightened with a jam nut.
- c. Make sure the linkage parts are loose except actuator clevis jam nut.
- d. In order to properly set the governor linkage, the exact No Fuel position of the stop lever must be known. This is accomplished by starting the engine and manually operating the stop lever.

WARNING

Work safely by keeping hands, hair, and loose clothing away from moving parts. Be aware that while finding the no fuel position, the only way to shut the unit down will be to manually pull the stop lever to the no fuel position.

Make sure that the stop lever (5) has not slipped on its self.

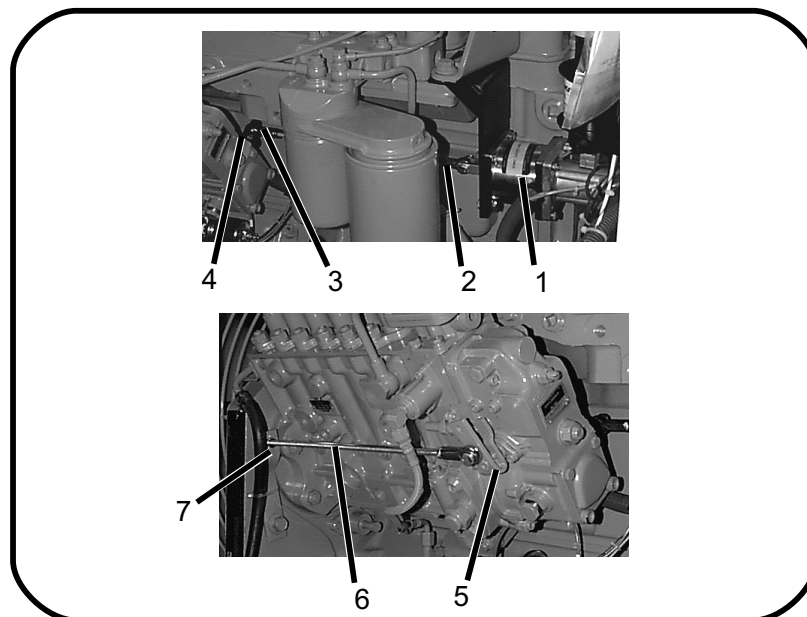
Disconnect ball joint (2) from the stop lever.

Disconnect electrical leads to actuator (1).

Holding the stop lever at about mid-travel, start the unit and run the engine slowly.

By moving the stop lever toward the actuator (no fuel position) find the exact position where the engine stops. Hold the lever at this exact spot or maybe a slight bit past no fuel.

- e. With the engine stopped and power to the actuator off, adjust the linkage to place the rod end stud in the stop lever hole (4). Install the nut and washers on the stud to hold it to the stop lever, and snug them up.
- f. With the electrical leads to the actuator still disconnected, hold the lever off the no fuel position and start the unit.
- g. Using a stroboscope, manually run the engine speed up to the maximum travel position. Verify the speed to be to 2750 maximum rpm.
- h. Slowly let the mechanical spring in the actuator pull the linkage to the minimum position. The unit should shut down completely.
- i. If the conditions in steps (f) and (g) were not seen, then make slight adjustments to the linkage to get the maximum rpm and the shut down, moving the stud in toward the pivot point of the stop lever, increases the actuator's effective travel.
- j. If it is not possible to get maximum rpm and shut down, a compromise is needed. Maximum rpm can be less than stated (no less than 2560 rpm). **BUT THE UNIT MUST BE ABLE TO SHUT DOWN!** This is the fail-safe. If the governor electric power is lost, the mechanical spring in the actuator must shut the unit down.
- k. Tighten all the linkage hardware. Make sure the linkage does not bind up. It must move freely.



- | | |
|----------------------|------------------------------|
| 1. Actuator | 5. Engine Run Lever |
| 2. Threaded Rod | 6. Throttle Holdback Rod |
| 3. Ball Joint | 7. Throttle Holdback Bracket |
| 4. Engine Stop Lever | |

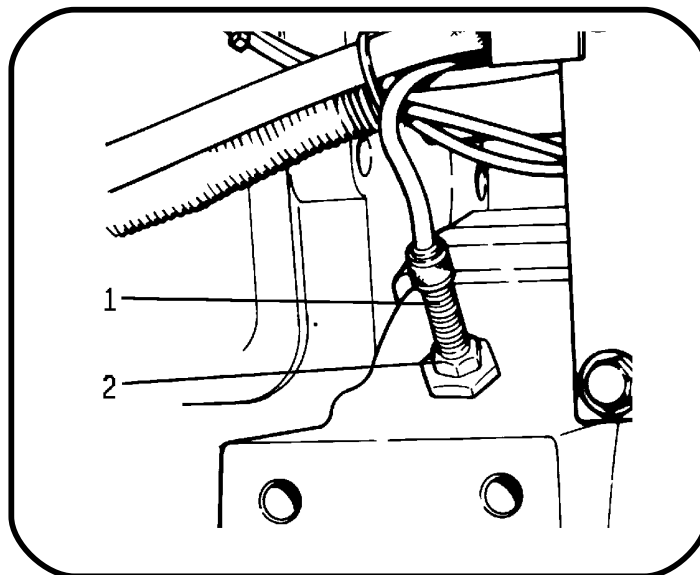
Governor Actuator Linkage
Figure 3

(2) Magnetic pickup adjustment (see fig. 4)

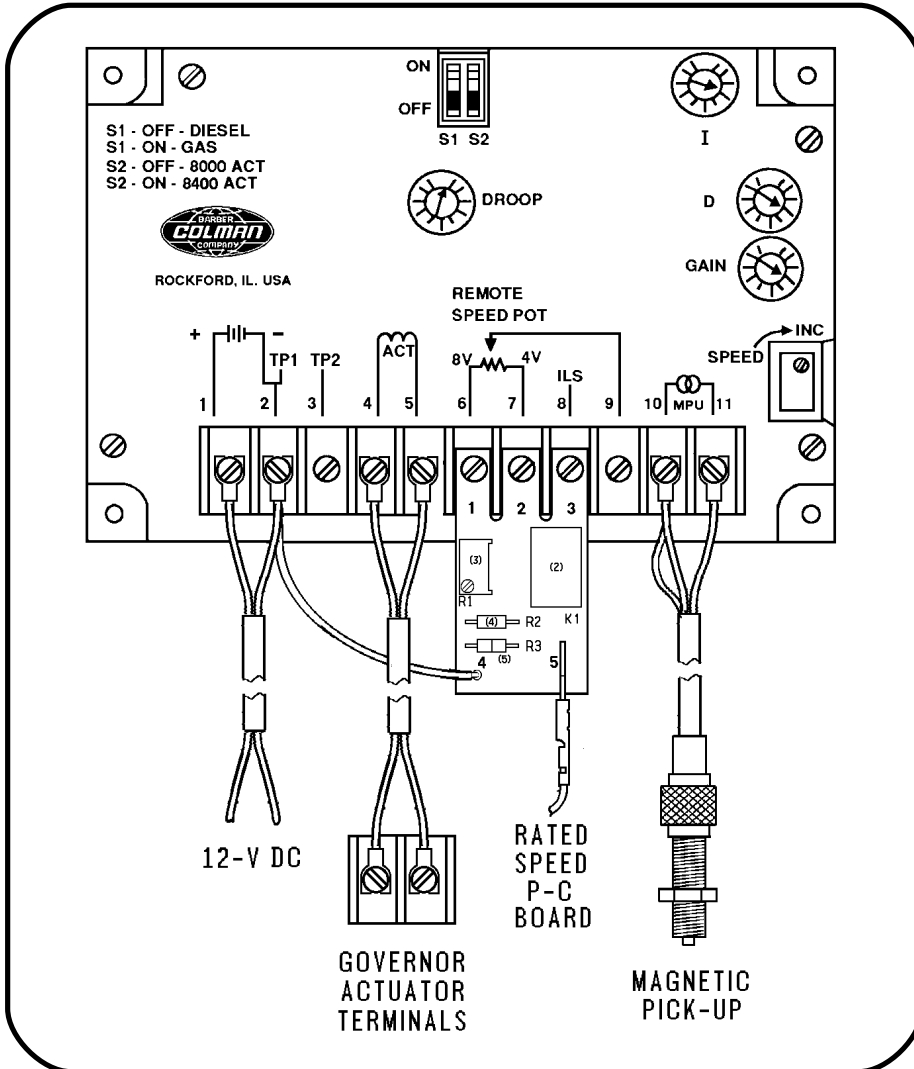
The strength of the magnetic pickup signal to the governor control box can be weakened if the tip of the pickup is too far from the flywheel ring gear or if it becomes damaged. If the pickup is removed for any reason, or if the signal is weak, as indicated by test in Par. 3, e, (3), adjust the pickup as follows:

- a. Disconnect the cable connector from the magnetic pickup.
- b. Loosen the jam nut (2) and remove the magnetic pickup (1).
- c. Inspect to make sure that the pickup is not damaged from contact with the ring gear teeth. Replace the pickup if damaged. If it is not damaged, make sure that it is clean.
The pickup must be directly over a ring gear tooth and not between teeth when adjustment is made.
- d. Look straight into the magnetic pickup hole, rotate the engine until a tooth is centered in the hole.
- e. **USING MINIMAL FORCE**, install the magnetic pickup and thread it in **CLOCKWISE** until it bottoms out.
- f. Back the pickup out **COUNTER CLOCKWISE** $\frac{1}{2}$ to $\frac{3}{4}$ of a turn. This will create a gap within the range of .030 and .035 inches, which is optimal.
- g. Reconnect the cable connector to the magnetic pickup.
- h. Start the engine and run at idle speed.
- i. Check the voltage at the governor control box terminals 10 and 11. It should be about 10 volts AC.
- j. If the signal is weaker than 4 volts AC, check the connections. If necessary, check the magnetic pickup continuity with an ohmmeter.
- k. Tighten the jam nut when the magnetic pickup is properly adjusted.

NOTE: A minimum of 1.5 VAC is required during engine cranking. This minimum voltage is necessary to energize the electronics in the governor control box. At rated speed, the magnetic pickup voltage could go as high as 25 to 30 volts AC without damage to the control box.



Magnetic Pick-up Adjustment
Figure 4



Governor Actuator Linkage
 Figure 3

(3) Governor control box adjustment (See fig. 5)

The control box has three control potentiometers (pot) for setting the response characteristics of the governor system. They are: "I", "D", and "GAIN." There is a fourth potentiometer named "DROOP", which is not used in this installation. It is set to zero or minimum. There are two potentiometers for controlling speed. The "SPEED" potentiometer in the control box is for setting IDLE speed. The potentiometer on the external printed circuit board is for setting the RATED speed. These are both multi-turn controls. They are also interactive with each other.

Make the controller settings as follows:

a. Preliminary controller settings

Turn the engine OFF

Set the "I" potentiometer (pot) (2) to the FORTH increment mark from zero.

Set the "D" potentiometer (3) to the THIRD increment mark from 0 (zero).

Set the "GAIN" potentiometer (4) to the THIRD increment mark from 0 (zero).

Set the "DROOP" potentiometer (1) COUNTER CLOCKWISE to minimum 0 (zero).

Turn the rated speed potentiometer (5) all the way COUNTER CLOCKWISE. Then count twelve full turns CLOCKWISE.

Start the engine, leave at IDLE speed and adjust the IDLE speed potentiometer in the control box until the engine is operating at 850 RPM. Turning the potentiometer CLOCKWISE increases engine RPM.

b. Checking No-Load Operation of Controller (See fig. 5)

Press engine start switch (26, Fig. 1) a second time to increase engine RPMs to approximately the rated speed (2400 RPM).

Turn the "GAIN" potentiometer (4) full CLOCKWISE. The frequency meter gage and governor should become unstable and oscillate. If it does not, manually bump the linkage to cause it to oscillate.

Slowly turn the "GAIN" potentiometer (3) COUNTER CLOCKWISE until the oscillations stop. Turn the "GAIN" potentiometer $\frac{1}{2}$ an increment past a point where the oscillations stop.

Turn the "D" potentiometer full CLOCKWISE. The frequency meter gage and governor should become unstable and oscillate. If it does not, manually bump the linkage to cause it to oscillate.

Slowly turn the "D" potentiometer COUNTER CLOCKWISE until the oscillations stop. Turn the "D" potentiometer $\frac{1}{2}$ an increment past a point where the oscillations stop.

Turn the "I" potentiometer (2) full CLOCKWISE. The frequency meter gage and governor should become unstable and oscillate. If it does not, manually bump the linkage to cause it to oscillate.

Slowly turn the "I" potentiometer COUNTER CLOCKWISE until the oscillations stop.

NOTE: If the frequency meter gage and/or governor should still oscillate after the adjustment of these potentiometers, the type of oscillation might give an indication of which of the other potentiometer ("GAIN" or "I") might need further adjustment. If the oscillation is fast and jagged, the "I" needs to be reduced by $\frac{1}{2}$ to 1 increment. If the oscillation is slower and not as sharp, the "GAIN" needs to be reduced by $\frac{1}{2}$ to 1 increment.

Use the start switch to toggle between the rated and idle speed. Run the engine from rated speed to idle speed. The governor should regain control after a short delay, there should only be between 2 to 4 oscillations (bounces) in the frequency meter. If this does not happen, the "GAIN" or "I" might need to be further adjusted. Again, the type of oscillation in the meter will tell which potentiometer to adjust (see above note). Repeat this procedure several times to assure consistency.

Using the engine start switch, run the engine up to rated speed. After a short delay, there should be only 2 to 4 oscillations in the frequency meter. If there is more oscillations than that, then further adjustment is needed. If the oscillations are 2 to 4 or less, then the controls are set.

NOTE: The "GAIN" and "I" controls interact with each other. That is to say that when one of them is adjusted, it affects the other. So it might be necessary to adjust back and forth between the two potentiometers several times to optimize performance.

c. Adjust for RATED speed operation (fig. 5)

The function of the speed adjust p.c. board is to set the rated engine speed. To check for proper adjustment, proceed with the following steps:

With the engine running and properly adjusted for IDLE speed, press engine start switch (26) to increase RPMs to RATED SPEED. The engine should be running at 2400 RPM and have an output frequency of 400 Hertz.

If the frequency reading is high or low (from 400 Hertz), operate the generator set at RATED speed, turn the adjustment pot on the speed adjust P.C. board in the CLOCKWISE direction to increase RPM's or COUNTERCLOCKWISE direction to decrease RPM's.

After making any adjustments, switch to IDLE speed, allow the engine to stabilize, then switch back to RATED speed.

a. Checking the Actuator

The actuator does not require any adjustments. An actuator malfunction, when it occurs, will result in the actuator being totally inoperative, either due to the actuator coil being open or shorted to the actuator case. Resistance measurements will reveal either of these conditions.

b. Checking Operation of Controller Under Load

Apply a load to the generator set, then remove the load and observe the length of time required for engine speed to stabilize. Engine speed should stabilize within 3 to 5 diminishing oscillations on the frequency meter. If this does not happen, proceed as follows:

With the generator set operating at no load, turn the GAIN setting slightly in the COUNTERCLOCKWISE direction.

Apply a load again to the generator set. Then remove the load again and observe the length of time required for engine speed to stabilize. It should now stabilize in 3 to 5 diminishing oscillations on the frequency meter.

NOTE: If engine speed STILL doesn't stabilize, recheck governor linkage. If the linkage is set properly, the governor controller is probably defective.

c. Checking Magnetic Pick-up Signal

Connect a high impedance voltmeter to magnetic pick-up input terminals (terminals 10 and 11, Fig. 5) on controller terminal board. The voltage value at no load, governed speed should be 4-V AC MINIMUM.

NOTE: A signal as low as 2.5-V is sufficient to operate the control unit satisfactorily. If a no-voltage condition is indicated, the magnetic pick-up is too far away from flywheel teeth, or it is defective.

4. Generator and Exciter Test

The generator fields and exciter stators may be tested with a Kelvin bridge. This is a double-bridge type instrument required for the very low resistance's encountered in this test. It is understood that 0 (zero) resistance indicates a SHORT CIRCUITED condition. An infinite resistance reading indicates an OPEN CIRCUITED condition. See Fig. 6 for resistance values.

- a. Disconnect generator stator leads at the output module panel.
- b. Disconnect the two black exciter field leads from terminal block mounted on output module panel.
- c. Check resistance and compare to values given in Figure 6.

Test Connection	Resistance (Ohms)
Generator Stator Phase A to N (G1)*	0.00235
Generator Stator Phase B to N (G1)*	0.00235
Generator Stator Phase C to N (G1)*	0.00235
Exciter Stator Field (L2)	26.5
A - B, B - C, C - A Exciter Armature (G2)	0.1
Generator Revolving Field (L1)	2.1

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

**Generator and Exciter Stator Tests
 Figure 6**

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 follow:

- 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. Set the scale selector to RX1.

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

Section 4. Troubleshooting Procedures

1. General

The Troubleshooting Chart, beginning on Page 6, covers the common malfunctions which you may find during operation or maintenance of this equipment. It cannot list all malfunctions that may occur. If a 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 and test the circuit, step by step, until the source of the malfunction is isolated.

The Troubleshooting Chart is arranged under 3 headings: Trouble Symptom and Condition, Probable Cause, and Test Check and/or Remedy. Trouble(s), Symptom(s), and Condition(s) are described and numbered. Probable Cause(s) are indented to the right and listed in numbered steps below Probable Cause. Test Check and/or Remedy 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 section 2-3 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 volt ohmmeter 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-V DC 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 Chart. For example, if a component in the governor control box is defective, the quickest way to remedy the situation is to replace the complete control box and send the old box to stock. Assemblies which lend themselves to this concept are:

Electric governor control box	Over-Under frequency PC board
Electric governor actuator	Overload PC boards
Voltage regulator	Generator Set Control PC Board
Over-Under voltage PC board	
Protective monitor PC board	

4. Test Values

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

Generator output voltage at maximum voltage regulator potentiometer setting: 134 volts or higher.

Generator output voltage at minimum voltage regulator potentiometer setting: 108 volts or lower.

Over voltage relay	Trips 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 90KVA on either output or 120KVA on both outputs combined.

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

Engine oil pressure (warm and at rated speed 2400 RPM) 50 to 90 PSI (344 to 621 kPa).

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

5. Check Connections and Leads

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

6. Electric Governor Troubleshooting

The following facts concerning the operation of the electric governor may be helpful in understanding the system and in determining which unit in the system is faulty in case of troubles.

- (1) The system requires two sources of power to operate normally.
 - a. 12 V DC input power (from engine electrical system)
 - b. 4 V AC input voltage normal, the actuator will go to, or remain in **STOP** position under the following conditions:
 - No 12 V DC power
 - No voltage from control box to actuator
 - Inadequate magnetic pickup voltage

- (2) The actuator will surge under the following conditions:
- a. Stability or gain adjustment set too high
 - b. Actuator linkage loose
 - c. Actuator linkage binding

7. Engine Troubleshooting

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

An adequate supply of 12 V DC power reaching a good starter (fig. 1) and starter button .

Sufficient 12 V DC power reaching the fuel.

An adequate supply of air, compressed to a sufficiently high pressure.

The injection of the correct amount of clean fuel at the proper time

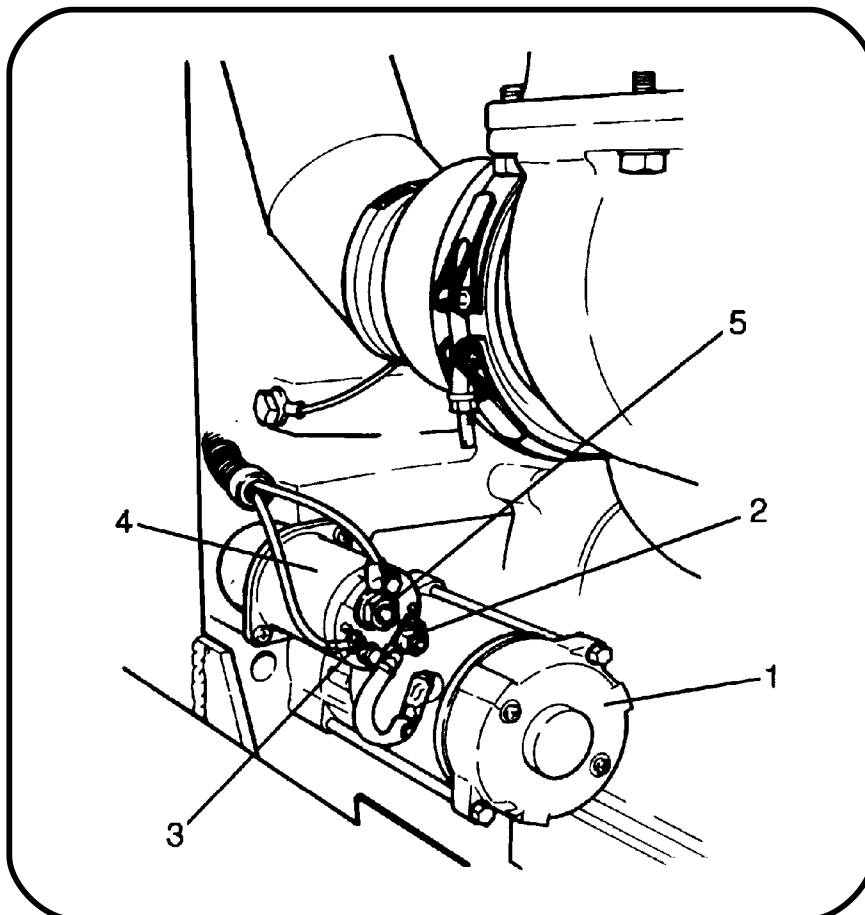
NOTE: When troubleshooting the engine, keep the above requirements in mind.

8. Illustrations

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

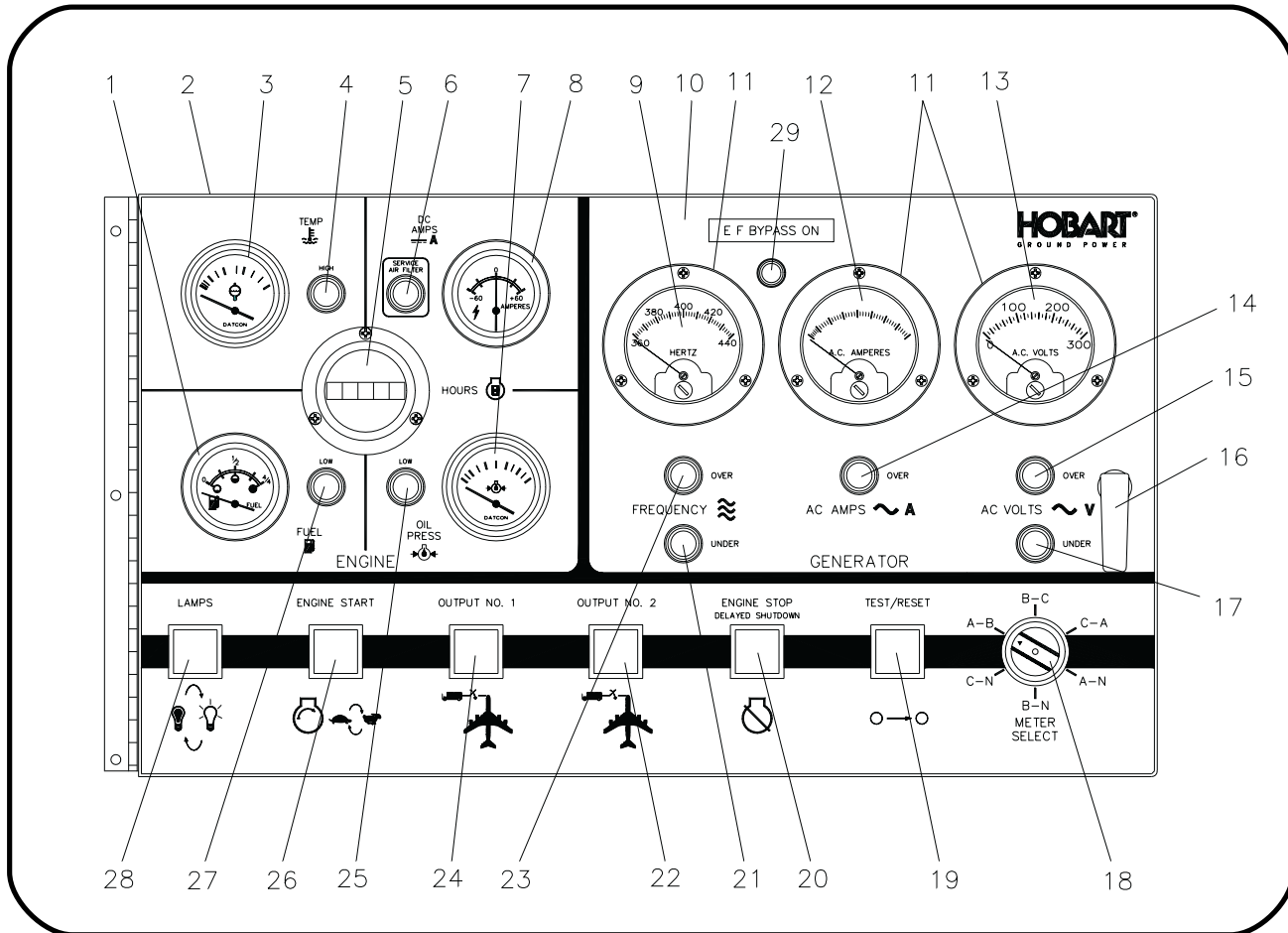
9. Connection and Schematic Diagrams

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



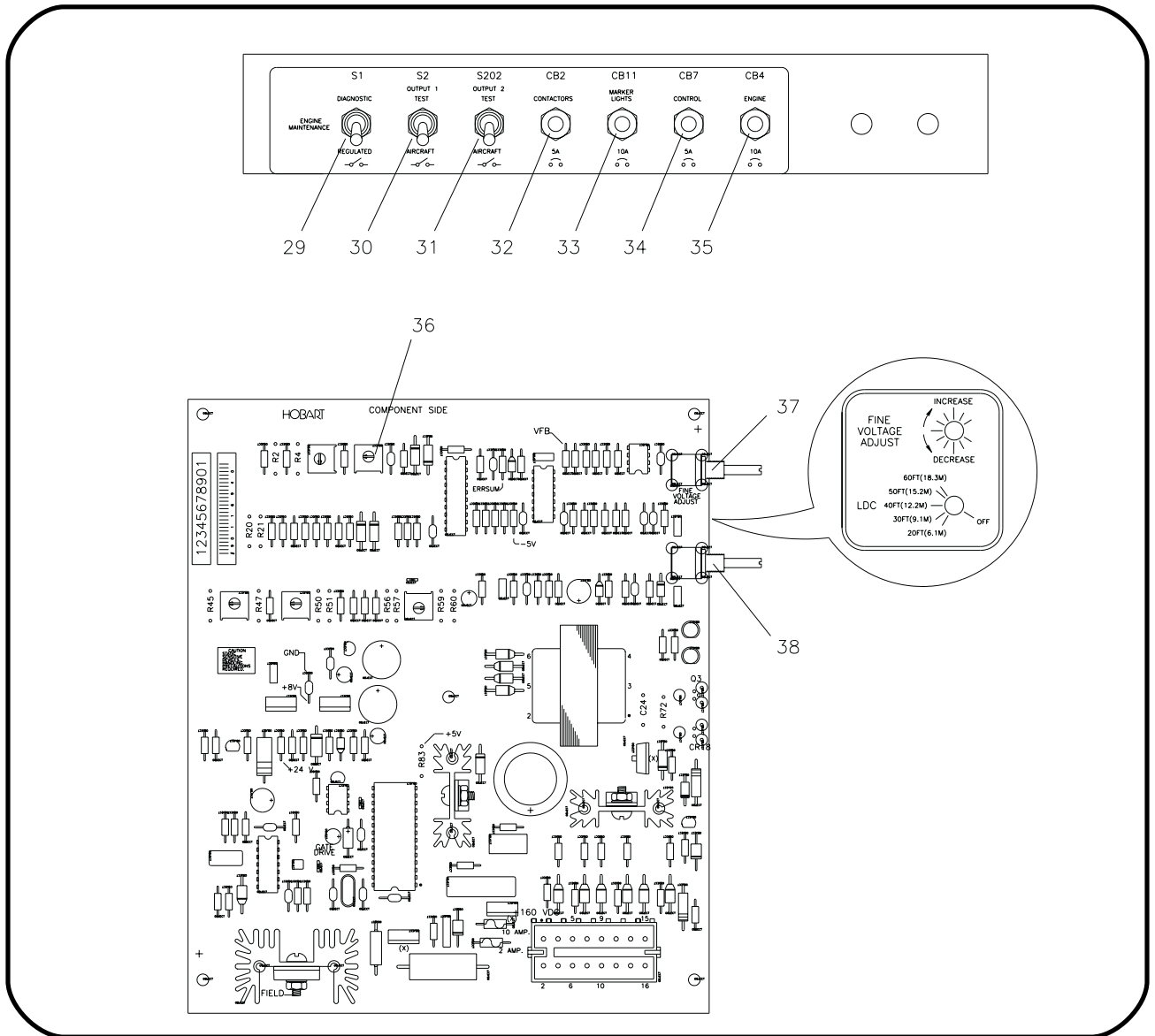
- 1. Starter
- 2. Starter Terminal
- 3. Switch to starter terminal
- 4. Starter solenoid
- 5. Solenoid switch input terminal

Starter and Solenoid Switch
Figure 1



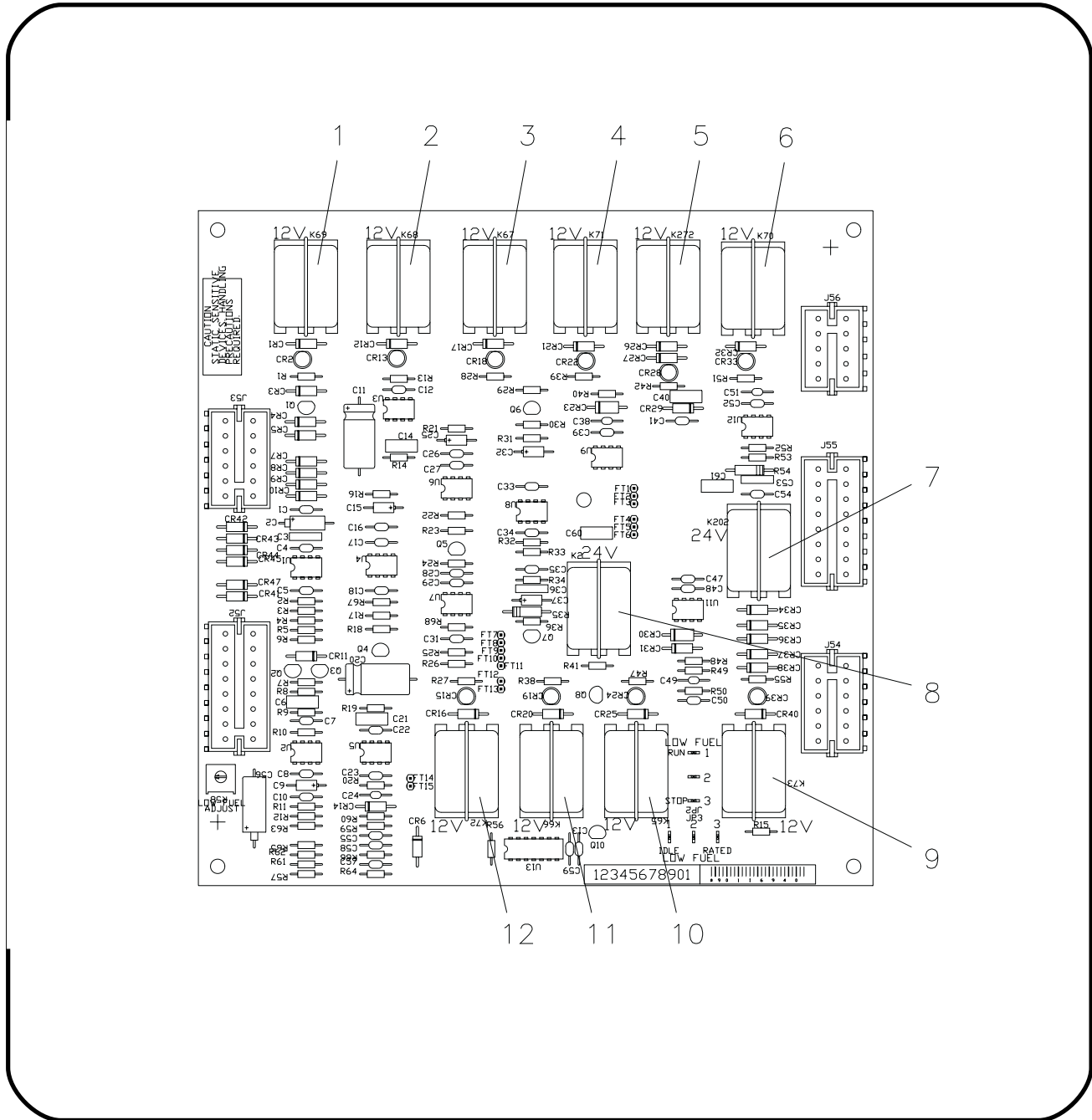
- | | |
|--|---|
| 1. Fuel gage | 15. Over voltage indicator light (red) |
| 2. Front panel | 16. Adjustable grip latch |
| 3. Engine coolant temperature meter | 17. Under voltage indicator light (red) |
| 4. Over temperature indicator light (red) | 18. Meter Selector switch |
| 5. Engine hour meter | 19. Test-reset push button switch |
| 6. Indicating light, air cleaner restriction | 20. Engine stop push button switch |
| 7. Oil pressure gage | 21. Under frequency indicator light (red) |
| 8. Engine ammeter | 22. No. 2 contactor push button switch |
| 9. Frequency meter | 23. Over frequency indicator light (red) |
| 10. Control Box label | 24. No. 1 contactor push button switch |
| 11. Strip lights (3) | 25. Low Oil Pressure indicator light (red) |
| 12. Generator ammeter | 26. Engine start push button switch (green) |
| 13. Voltmeter | 27. Low Fuel indicator light (red) |
| 14. Overload indicator light (red) | 28. Panel light push button switch |
| | 29. EF By-Pass Indicator |

Operating Controls and Instruments
Figure 2 (Sheet 1 of 2)



- | | |
|--|--|
| 29. Regulated-diagnostic switch | 34. Circuit Breaker, control (5-amp) |
| 30. Test bank-aircraft switch,
No. 1 output | 35. Engine circuit breaker (10-amp) |
| 31. Test bank-aircraft switch, No. 2 | 36. Output voltage adjustment (coarse) |
| 32. Circuit Breaker, contactors (5-amp) | 37. Output voltage adjustment (fine) |
| 33. Circuit Breaker, marker lights (10-amp) | 38. Line drop compensation adjustment |

Operating Controls and Instruments
Figure 2 (Sheet 2 of 2)



- | | |
|---|---|
| 1. Master Relay (K69) | 7. No. 2 Plug-Interlock Relay (K202) |
| 2. Idle-Excitation Relay (K68) | 8. No. 1 Plug-Interlock Relay (K2) |
| 3. Over Temperature Fault Relay (K67) | 9. Bypass Relay (K73) |
| 4. Low Oil Pressure Fault Relay (K71) | 10. Low Fuel Fault Relay (K65) |
| 5. No. 2 Contactor Control Relay (K272) | 11. Air Filter Fault Relay (K66) |
| 6. Panel and Clearance Lights Relay (K70) | 12. No. 1 Contactor Control Relay (K72) |

**Generator Set Control PC Board
 Figure 3**

Engine Controls

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
NOTE: Diesel engine trouble shooting is covered in Cummins Operation Manual under Fault Diagnosis.		
1. Engine will not start. Starter will NOT crank engine. (See fig. 1)	a. Battery discharged, or loose battery or ground connection.	Check voltage across batteries. Voltage should be approximately 12.8 volts DC. Check all battery terminals. Be sure 12.8 volts DC is reaching solenoid input terminal.
	b. Electrical defect in starter. See fig. 1.	Momentarily connect a large capacity jumper cable (No. 1/0 minimum) between hot side of starter solenoid and starter input terminal. If starter does not crank engine, proceed to step c. If starter does crank engine, proceed to step e.
	c. Mechanical defect in starter. See fig. 1.	Remove starter motor from engine and apply 12-V DC 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 starter is unable to crank engine, internal seizure is indicated. Attempt to hand crank engine with a 3/4 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 disassemble to locate problem.
	e. Defective starter solenoid. See fig. 1.	Momentarily connect a large capacity jumper cable (No. 1/0 minimum) between the auxiliary solenoid terminals (one on each side). If engine does not crank, replace starter solenoid. If engine cranks, proceed to step f below.
	f. Defective auxiliary starter solenoid. See fig. 1.	Momentarily jumper small lug on front of auxiliary solenoid to ground. If engine does not crank, replace auxiliary starter solenoid. If engine cranks, proceed to step g below.

Engine Controls

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
Engine will not start. Starter will NOT crank engine. (continued)	g. Either of two defective relays on the generator control PC board (Fig. 3) could cause this trouble: either master relay K69 (1, Fig. 3) or bypass relay K73 (9, Fig. 3) . Or the PC board itself could have developed a malfunction.	Press lamps button. If clearance lights do not come on, replace relay K69. with a relay known to be good, and attempt to crank the engine. If engine still won't crank, replace bypass relay K73 and try once more to crank the engine. If engine still won't crank, proceed to step h below.
	h. Defective engine start button, S24 (26, Fig. 1) .	Depress button and check continuity between button contacts. If no continuity exists, replace button. If there is continuity, replace generator control PC board.
2. Engine will not start. Cranking speed low.	a. Low battery output	Check battery. Recharge or replace.
	b. Loose starting circuit connections or faulty cables.	Check all connections and cables. Tighten or replace as required.
	c. Improper lubricating oil viscosity	Check oil. See Chapter 1-2; 1, (a). Remove and replace oil if/as necessary.
3. Engine WILL NOT start. Cranking speed normal. LOW OIL indicating lamp on after 5 seconds.	a. No fuel or insufficient fuel in tank. LOW FUEL indicating lamp comes ON 10 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 oil and prime fuel pump according to instructions in Chapter 2-1. If engine will not start after priming, mechanical pump trouble is indicated. If engine starts and stops after a short time, trouble between fuel source and suction side of pump is indicated. Check and/or remedy as follows.

Engine Controls

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
Engine WILL NOT start. Cranking speed normal. LOW OIL indicating lamp on after 5 seconds. (continued)	b. Defective or misadjusted magnetic pickup (Chapter 2-3, Fig. 4).	The control unit may not be receiving a signal from the magnetic pickup and the "fail-safe" feature of unit may be functioning to prevent any signal from reaching the actuator. To check the magnetic pickup for Series 500391, refer to diagram 287451. Use this diagram to disconnect pickup input leads at terminals 10 and 11 on controller. Connect a high impedance AC voltmeter to pickup output leads. Crank engine but don't start. Voltage reading should be a minimum of one (1) volt. If no or low voltage is indicated, check pickup adjustment [see 2-3, Para. 3, e,(2)]. If pickup is properly adjusted and voltage is still zero, replace pickup.
	c. Defective actuator	Apply 12-V DC to two actuator input leads (terminals 4 and 5 on terminal strip). Actuator lever should move immediately to full speed position. If lever does not move, replace actuator.
	d. Faulty controller	Connect a DC voltmeter to terminals 4 and 5 on the controller terminal strip. Crank engine. Voltmeter should indicate within two (2) volts of system voltage. If not, replace controller.
	e. Loose connections, damaged hoses or fuel lines between tank and fuel pump	Tighten all fittings and connections. Replace any damaged hoses or fuel links.
	f. Plugged or defective filter	Do not overlook the possibility of restricted flow through the fuel filters. Also check gaskets for leaking or damaged condition.

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
Engine WILL NOT start. Cranking speed normal. LOW OIL indicating lamp on after 5 seconds. (continued)	g. Faulty fuel pump.	Replace fuel pump if defective.
4. Engine cranks, but will not start. LOW OIL indicating lamp comes on immediately.	a. Either of two relays, the bypass relay, K73 (9, Fig. 3), or the low oil pressure fault relay, K71 (4, Fig. 3), or the engine control PC board could be defective.	Attempt to correct this malfunction by replacing, in sequence, each of these relays and the PC board. Replace the component found to be defective.
5. Engine cranks, but will not start. LOW FUEL indicating lamp comes on immediately.	a. Either the low fuel fault relay, K65 (10, Fig. 3), or the engine control PC board is defective.	Attempt to correct this malfunction by replacing low fuel fault relay, K65. If this does not correct the malfunction, replace the engine control PC board.
6. Engine cranks, but will not start. HIGH TEMPERATURE indicating lamp comes ON immediately.	a. Defective or incorrectly wired high temperature switch (S49, located on engine block on right side).	Check wiring to high temperature switch according to connection diagram in Chapter 6, 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 over temperature fault relay, K67 (3, Fig. 3) or engine control PC board.	Attempt to correct this malfunction by replacing over temperature fault relay (K67). If this does not correct the malfunction, replace the engine control PC board.
7. Engine is HARD to start. Cranking speed normal, fuel supply adequate.	a. Low compression, which may be caused by any one of following: Sticking or burned exhaust valves, worn or broken compression rings, leaking cylinder head gasket, or improper valve clearance adjustment.	Check compression in accordance with instructions in Cummins Operation Manual. Overhaul engine to make repairs as necessary.

Engine Controls

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
<p>8. Engine starts. Stops after a few seconds by automatic shutdown.</p>	<p>a. Shut-down circuit may have functioned normally to stop engine because of low lubricating oil pressure or due to a defective oil pressure switch (S46, located on engine block on right side).</p>	<p>Restart engine, and observe oil pressure gage. If oil pressure is 12 psi or more, disconnect wire from oil pressure switch terminal N.C. Restart engine. If engine continues to run, oil pressure switch is defective. Replace oil pressure switch. If engine stops, check for following malfunctions:</p>
	<p>b. Failure of fault relays on the generator control PC board can cause this malfunction: The low oil pressure relay, K71, (4, Fig. 3), or the PC board itself could have developed a malfunction.</p>		In search of this malfunction, replace, in sequence, the low oil pressure fault relay, and the generator control PC board itself.
<p>9. All panel and clearance lights are either always ON or always OFF.</p>	<p>a. Marker lights circuit breaker ,CB11 (33, Fig. 2) won't close</p>	<p>Replace marker lights circuit breaker (CB11) if defective.</p>
	<p>b. Clearance/panel lights relay, K70 (6, Fig 3) could be defective, or the PC board itself could have developed a malfunction.</p>	<p>Replace relay K70 in attempt to make the lights function correctly. If replacement of this relay doesn't correct the malfunction, replace the generator control PC board.</p>
<p>10. Engine either goes from rated speed to idle speed, or shuts down.</p>	<p>a. Low fuel relay, K65 (10, Fig. 3), or the generator control PC board itself, could be defective.</p>	<p>Replace relay K65 and restart unit. If fault remains, replace the PC board.</p>
<p>11. Engine has slow response time.</p>	<p>a. Governor controller improperly adjusted</p>	<p>Adjust. See 2-3; Para. 3.</p>
	<p>b. Actuator linkage binding</p>	<p>Inspect and repair as required.</p>
	<p>c. Engine needs tune-up</p>	<p>Tune-up as required. Refer to Cummins Operation Manual.</p>

Engine Controls

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
12. Engine "misses". Runs unevenly.	a. Insufficient fuel	Check fuel flow in accordance with Cummins Operation Manual. Repair or replace parts as required. Also see Engine, Trouble 3.
	b. Faulty injector	Check injectors in accordance with Cummins Operation and Maintenance Manual. See causes of low compression listed under ENGINE CONTROLS.
	c. Low compression pressure	Check compression in accordance with Cummins Operation Manual. See causes of low compression listed under ENGINE CONTROLS.
13. Engine lacks power	a. Improper engine adjustments and gear train timing	"Tune-up" engine in accordance with Cummins Operation Manual.
	b. Insufficient fuel	See ENGINE CONTROLS
	c. Insufficient inlet air due to damaged 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 and Condition	Probable Cause	Test, Check, And/or Remedy
1. No (or low) generator output voltage in all phases. Generator operating at 400 Hz.	a. Idle-excitation relay (K68) (2, Fig 3), or the generator control PC board itself, could be defective. A defect in this circuitry can prevent power from reaching voltage regulator	Replace relay K68, bring unit up to rated speed. Proper voltage should now be generated. If not, replace generator control PC board, and recheck voltage. If this doesn't correct the problem, proceed to Step b
	b. Defective generator or excitation circuit.	Place REGULATED/DIAGNOSTIC switch (29, Fig. 2) in DIAGNOSTIC position. This applies 12-V DC from battery to exciter field, which should produce an indicated output voltage of 100 +/- 20- V AC line-to-neutral. If voltage produced is within this range, generator is good, and trouble is in voltage regulator circuit. Proceed to step B.
	c. Defective voltage regulator	Disconnect rectangular plug connector of regulator wiring assembly from suspect PC board, and connect a properly working PC board to regulator wiring assembly, while avoiding short circuiting bottom of properly working PC board to installed PC board. Then start generator set and perform tests and adjustments according to instructions in Section 2-3. If generator set works properly with properly working PC board temporarily connected, shut off generator set and replace defective PC board with one that is properly working (preferably, same PC board used for this troubleshooting check).
	d. Defective REGULATED/DIAGNOSTIC switch (29, Fig. 2)	Check switch thoroughly. A defective switch may prevent current reaching and/or leaving voltage regulator. Replace switch if defective.

Generator Excitation Circuits

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
No (or low) generator output voltage in all phases. Generator operating at 400 Hz (continued).	e. Defective connector at voltage regulator, or defective wiring from regulator to exciter field	Disconnect plug from voltage regulator PC board. Using jumper leads with clip and prod terminals, connect 12-V DC to terminals 1 and 4 in loose plug. Connect NEGATIVE to terminal 4 Connect POSITIVE lead to terminal 1 (see Schematic and Connection Diagrams in Chapter 5). If generator will NOT produce at least 80 V-AC, replace or repair connector and wiring between voltage regulator and exciter field as required.

No. 1 Load Contactor Operating Circuit

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
<p>1. Load contactor (K1) will not close when output No. 1 push button switch (24, Fig. 2) is held in CLOSE position. Generator running at normal voltage. Rectifier circuit breaker CB2 (32, Fig. 2) closed. No fault lights on.</p>	<p>a. Defective circuit breaker CB2 (32, Fig. 2)</p>	<p>Remove terminal leads from circuit breaker, press circuit breaker button to close circuit breaker, and use an ohmmeter to check for continuity. Replace circuit breaker if defective.</p>
	<p>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:</p>	<p>Check all wiring and connections in load contactor circuits. Then check components as follows:</p>
	<p>c. Defective (open) relay in memory and time delay PC board (1-1; 4, Fig. 6)</p>	<p>Replace memory and time delay PC board with a board known to be operating properly. If contactor still doesn't close, proceed to step (d).</p>
	<p>d. Defective output No. 1 push button switch (S75) (24 Fig. 2)</p>	<p>Check AC voltage input to contactor rectifier CR6 (1-1: 6, Fig. 10). If voltage isn't approximately 115-V AC, output No. 1 push button switch is defective and must be replaced.</p>

No. 1 Load Contactor Operating Circuit

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
Load contactor (K1) will not close when output No. 1 push button switch (24, Fig. 2) is held in CLOSE position. Generator running at normal voltage. Rectifier circuit breaker (CB2) (32, Fig. 2) closed. No fault lights on (continued).	e. Defective rectifier (CR6) (1-1: 13, Fig. 10)	After making certain that output No. 1 push button switch (S75) is providing 115-V AC to rectifier (CR6), measure DC out put voltage between positive (+) and negative (-) terminals of rectifier. If voltage measured isn't approximately 90-V DC, replace rectifier.
	f. Defective coil in load contactor (K1)(1-1;15, Fig. 9)	Disconnect leads at load contactor terminals V and W. Check coil resistance between these terminals. Resistance should be approximately 50 ohms. If coil is defective, replace complete load contactor.
2. Load contactor (K1) will close when output No. 1 push button switch (24, Fig. 2) is held in CLOSE position. Opens immediately when switch is released.	a. No. 1 plug interlock relay (K2) (8, Fig. 3) on generator control PC board could be defective	Place test bank/aircraft switch, No. 1 output (S2) (30, Fig. 2) in TEST BANK position. If load contactor will now remain closed, replace plug interlock relay, K2. If not, proceed to step b.
	b. No. 1 load contactor relay (K72) (12, Fig. 3) on generator control PC board, or the board itself, could be defective	Replace relay K72 and again close contactor. If contactor still opens, replace generator control PC board. If this doesn't correct the problem, proceed to step c.
	c. 28.5-V DC is not reaching No. 1 plug interlock relay (K2) from aircraft for following reasons:	Proceed as follows to find the cause of this malfunction.
	d. 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.
	e. Aircraft rejecting power.	Check aircraft on-board electrical equipment and controls.

No. 1 Load Contactor Operating Circuit

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
Load contactor (K1) will close when No. 1 power accepted push button switch (24, Fig. 2) is held in CLOSE position. Opens immediately when switch is released to center ON position (continued).	f. Defective contacts in N.O. auxiliary push button 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.
	g. Defective No. 1 output hold circuit resistor (R46) (1-1; 19, Fig. 10) .	Connect a 100-ohm resistor across R46. If contactor will now remain closed, replace No. 1 output hold circuit resistor (R46). If not, replace contactor.
3. Load contactor opens during power delivery. NO fault indicating lights on.	a. No. 1 load contactor relay (K72) (12, Fig. 3) on generator control PC board, or the PC board itself, could be defective	Replace relay K72 and again close contactor. If contactor still opens, try replacing the PC board to correct this malfunction. Proceed with troubleshooting as follows if malfunction is not corrected.
	b. A fault has developed in load contactor holding circuit.	If load contactor cannot be closed by operation of output No. 1 push button switch (S75) (24, Fig. 2), check circuit in accordance with instructions in Trouble 1, above under LOAD CONTACTOR OPERATING CIRCUIT. If load contactor can be closed, but opens as soon as power accepted switch (S75) is released, check for trouble under Trouble 2, above.
	c. Cable accidentally disconnected from aircraft.	Reconnect cable.

No. 2 Load Contactor Operating Circuit

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
<p>1. Contactor (K201) will not close when No. 2 power accepted push button switch (22, Fig. 2) is held in CLOSE position. Generator running at normal voltage. Contactor circuit breaker (CB2) (32, Fig. 2) closed. No fault lights on.</p>	<p>a. Defective contactor circuit breaker (CB2) (32, Fig. 2)</p>	<p>Remove terminal leads from circuit breaker, press circuit breaker button to close circuit breaker, and use an ohmmeter to check for continuity. Replace circuit breaker if defective.</p>
	<p>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:</p>	<p>Check all wiring and connections in load contactor circuits. then check components as follows:</p>
	<p>c. Defective (open) relay in memory and time delay PC board (1-1; 4 Fig. 6)</p>	<p>Replace memory and time delay PC board with a board known to be operating properly. If contactor still doesn't close, proceed to step (d).</p>
	<p>d. Defective output No. 2 push button switch (S275) (22, Fig. 2)</p>	<p>Check AC voltage input to contactor rectifier CR206 (1-1:13, Fig. 9). If voltage isn't approximately 115-V AC, contactor output No. 2 push button switch is defective and must be replaced.</p>
	<p>e. Defective rectifier (CR206) (1-1; 13, Fig. 9)</p>	<p>After making certain that output No. 2 push button switch (S275) is providing 115-V AC to rectifier (CR206), measure DC out put voltage between positive (+) and negative (-) terminals of rectifier. If voltage measured isn't approximately 90-V DC, replace rectifier.</p>
	<p>f. Defective coil in load contactor (K201) (1-1; 16 Fig. 9)</p>	<p>Disconnect leads at load contactor terminals V and W. Check coil resistance between these terminals. Resistance should be approximately 50 ohms. If coil is defective, replace complete load contactor.</p>

No. 2 Load Contactor Operating Circuit

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
<p>2. Contactor (K201) will close when No. 2 output push button switch (22, Fig. 2) is held in CLOSE position. Opens immediately when push button switch is released.</p>	<p>a. No. 2 plug interlock relay K202 (7, Fig. 3) on generator control PC board or the board itself, could be defective</p>	<p>Place test bank/aircraft push button switch, No. 2 output (S202) (31, Fig. 2) in TEST BANK position. If load contactor will now remain closed, replace plug interlock relay K202. If not proceed to step b.</p>
	<p>b. No. 2 load contactor relay K272 (5, Fig. 3) on generator control PC board defective.</p>	<p>Replace relay K272 and again close contactor. If contactor still opens, replace generator control PC board. If this doesn't correct the problem, proceed to step c.</p>
	<p>c. 28.5-V DC is not reaching No. 2 plug interlock relay (K202) from aircraft for following reasons:</p>	<p>Proceed as follows to find cause of this malfunction.</p>
	<p>d. Generator to aircraft cable connector defective or not plugged into aircraft receptacle connector.</p>	<p>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.</p>
	<p>e. Aircraft rejecting power.</p>	<p>Check aircraft on-board electrical equipment and controls.</p>
	<p>f. Defective contacts in N.O. auxiliary switch mounted on right side of contactor.</p>	<p>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.</p>
	<p>g. Defective No. 2 output hold circuit resistor (R246) (1-1; 19, Fig. 9) .</p>	<p>Connect a 100-ohm resistor across R46. If contactor will now remain closed, replace No. 2 output hold circuit resistor (R46). If not, replace contactor.</p>

No. 2 Load Contactor Operating Circuit

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
3. Contactor opens during power delivery. NO fault indicating lights on.	a. No. 2 load contactor relay (K272) (5, Fig. 3) on generator control PC board, or the PC board itself, could be defective	Replace relay K272 and again close contactor. If contactor still opens, try replacing the PC board to correct this malfunction. Proceed with troubleshooting as follows if malfunction is not corrected.
	b. A fault has developed in load contactor holding circuit.	If load contactor cannot be closed by operation of output No. 2 push button switch (S275) (22, Fig. 2), check circuit in accordance with instructions in Trouble 1, above under LOAD CONTACTOR OPERATING CIRCUIT. If load contactor can be closed, but opens as soon as power accepted push button switch (S275) is released, check for trouble under Trouble 2, above.
	c. Cable accidentally disconnected from aircraft.	Reconnect cable.

Protective Circuit

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
<p>NOTE: Protective relays and protective monitor are not completely functional until load contactor is CLOSED. Since it is not advisable to vary voltages for test purposes while delivering power to an aircraft, generator should be connected to a load bank for trouble shooting protective circuits.</p> <p>To avoid repetition, it will be assumed that reset push button switch (19, Fig. 2) has been pushed and load contactor has been closed before commencing each test.</p>		
1. Load contactor opens during power delivery. Over voltage indicating light ON.	a. Over voltage condition may have been result of a sudden drop in load, or possible tampering with the fine or course voltage regulator potentiometer (36 or 37, Fig. 2), and may have been a normal action.	Press reset push button switch (19, Fig. 2) and resume power delivery. Observe voltmeter (13, Fig. 2) to be certain voltage is normal 115 V-AC. Adjust to normal if necessary. If load contactor is opened again and an over- voltage condition is indicated by OV indicating light, proceed to step b.

Protective Circuit

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
Load contactor opens during power delivery. Over voltage indicating light ON.	b. Defective over-under-voltage PC board (K26) (1-1; 6, Fig. 6)	Use course voltage adjusting potentiometer (36, Fig. 2) to reduce voltage to 110 V AC. Observe voltmeter and gradually increase voltage with potentiometer. If sensing circuit in over-under voltage PC board (K26) functions to open load contactor at any value less than 125-VAC, it is defective. Replace over- under voltage PC board.
2. Load contactor opens during power delivery. Under voltage indicating light ON.	a. An under voltage condition has caused sensing circuit in over-under- voltage PC board (K26) to function normally.	Observe generator voltage on voltmeter and adjust to normal 115 V AC with voltage regulator potentiometer (36, Fig. 2). Resume normal operation. If load contactor opens again and an under voltage condition is indicated by UV indicating light, proceed to step B.
	b. Defective over-under-voltage PC board (K26).	Use potentiometer (36, Fig. 2) to reduce voltage to 95-V. Under voltage indicating light should NOT come on during a time delay of 4 to 12 seconds. If light comes on before a delay of 4 to 12 seconds, under voltage relay is defective. Replace over-under voltage PC board (K26).
	c. Defective memory and time delay (protective monitor) PC board (K14)(1-1; 4, Fig. 6).	With unit running normally, use potentiometer (36, Fig. 2) to reduce voltage quickly to 90 V. If under voltage indicating light (DS38) on control panel is turned ON immediately, memory and time delay PC board is defective. Replace PC board (K14).
3. Load contactor opens during power delivery. Over frequency indicating light (DS40) ON.	a. Electric governor improperly adjusted, or malfunctioning	Proceed as follows:
	b. Governor improperly adjusted	Adjust in accordance with Sect. 2-3, Para. 3, E, (3).

Protective Circuit

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
4. Load contactor opens during power delivery. Over frequency indicating light (DS40) ON.	a. Electric governor system malfunctioning	Check and adjust or repair in accordance with governor system information listed in this chapter under ENGINE AND CONTROLS.
	b. Defective over-under-frequency PC board (K27)(1-1; 5, Fig. 6).	If over-under frequency tripping continues after governor system is proven to be good, and an over frequency condition does not exist, replace over-under frequency PC board(K27)
5. Load contactor opens during power delivery. Under-frequency light ON.	a. Electric governor improperly adjusted, or malfunctioning	Proceed as follows:
	b. Governor improperly adjusted	Adjust in accordance with Sect. 2-3, Para. 3, E, (3).
	c. Electric governor system malfunctioning	Check and adjust or repair in accordance with governor system information listed in this chapter under ENGINE AND CONTROLS.
	d. Defective over-under-frequency PC board (K27)	If under frequency tripping continues after governor system is proven to be good, and an under frequency condition does not exist, replace over-under frequency PC board.
6. Load contactor opens during power delivery. Overload indicating light ON.	a. There may have been an overload condition which caused overload device (K4).	Observe ammeter (12, Fig. 2). 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. One of resistors across an overload transformer may be open circuited. Check resistors (R26, R27, and R28).	An open resistor will cause a higher than normal voltage. Refer to 1-1; items 7 and 8, Fig. 10 for exact location of these resistors. Check resistors. Replace any resistors found to be defective.
	c. Overload device printed circuit board defective (K4)	Replace overload PC board (Sect. 1-1; 11 or 12, Fig. 9) with an overload module known to be operating properly.

Protective Circuit

Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
Load contactor opens during power delivery. Overload indicating light ON. (continued)	d. Faulty overload resistors in main overload circuit. Check resistors.	Replace faulty resistors - R33, R34, R35 - if any. If none of these resistors are defective, replace main overload PC board, K3 (1-1; 11 or 12, Fig. 9).

Generator

Trouble, Symptom and 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 Sect. 2-3, para. 5. 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. If exciter rotor windings are good, proceed to step C.
	c. Open or shorted exciter field windings (L2)	Check field resistance. See Sect. 2-3, Fig. 6 for normal values.
	d. Open or shorted generator rotor windings (L1)	Check resistance with ohmmeter to determine if open or short circuited.
2. Generator operates single phase	a. Open or short circuited winding in generator stator (G1)	Check stator winding resistances. See Sect. 2-3, Fig. 6 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 Sect. 2-3, Fig. 6.
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 2-3, Para. 5. Repair or replace as required.

Generator

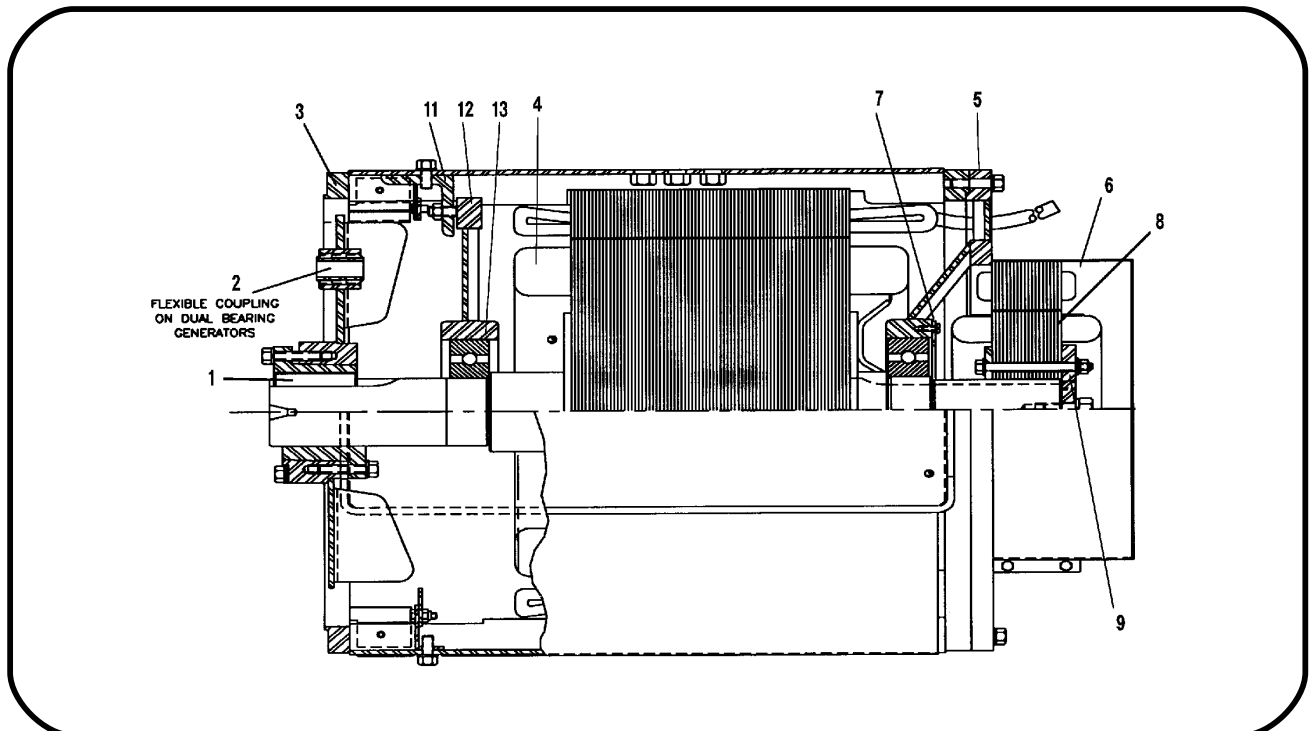
Trouble, Symptom and Condition	Probable Cause	Test, Check, And/or Remedy
Unbalanced output	<ul style="list-style-type: none">a. Defective connection in output circuit.b. Break or cut in output cable assembly.c. Unbalanced load	<p>Check plug and receptacle connectors at aircraft. Tighten, repair, or replace as required.</p> <p>Inspect. Repair or replace as required.</p> <p>Check aircraft 400-Hz components.</p>

Chapter 3. Overhaul/Major Repair

Section 1. Exciter Armature

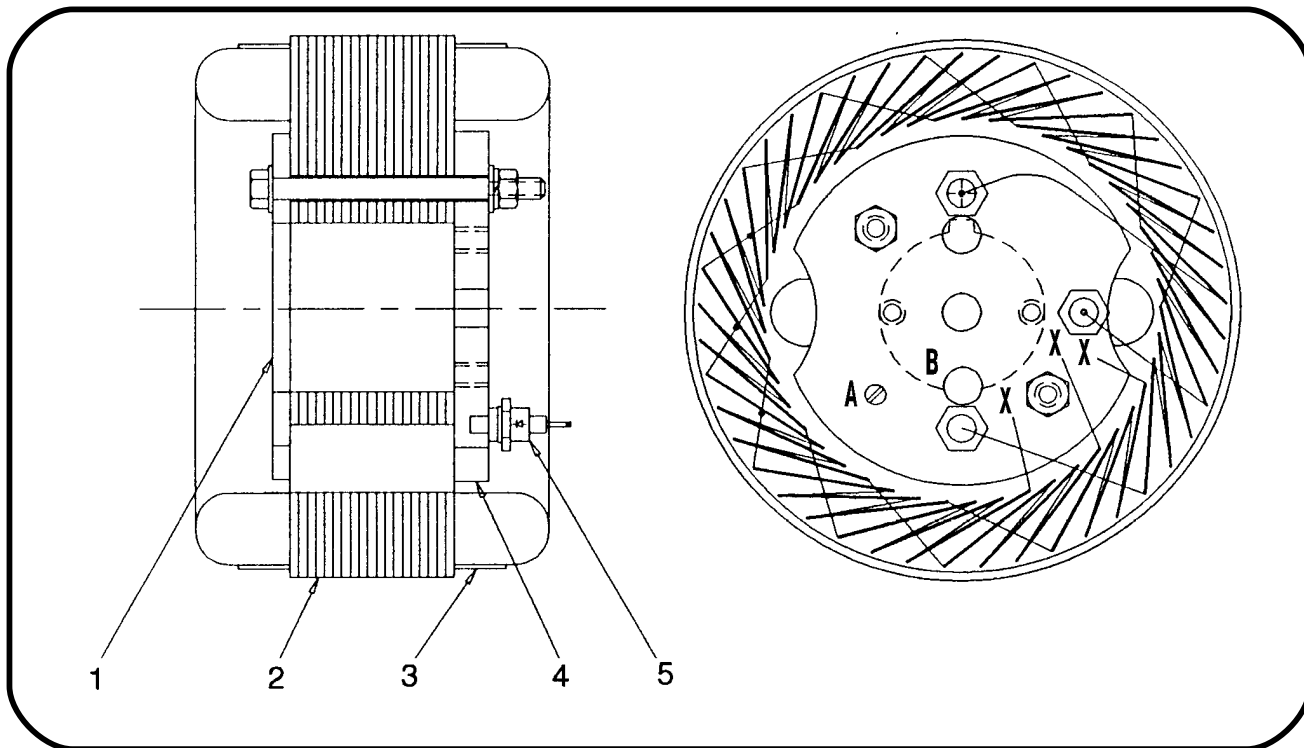
1. General

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 now 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 | 8. Exciter Armature Assembly |
| 2. Flex Coupling Assembly | 9. Exciter Key |
| 3. Generator Housing & Stator Assembly | 10. Not Used |
| 4. Armature Assembly | 11. Mounting Bracket |
| 5. Exciter Housing & Coils Assembly | 12. Front Bearing Retainer |
| 6. Exciter Cover | 13. Front Bearing |
| 7. Rear Bearing Retainer | |

Generator (Top Half Section)
Figure 1



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

Exciter Armature
Figure 2

The exciter armature covered by the manual is mounted on the rear portion of the main generator armature shaft which extends rearward, beyond the rear generator bearing, into the exciter housing (See Fig. 1). Because of its location on the shaft, the exciter armature must be removed for rear main bearing replacement. The exciter armature has two 3/8-16 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 and is held in place by a 1/2-13 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.

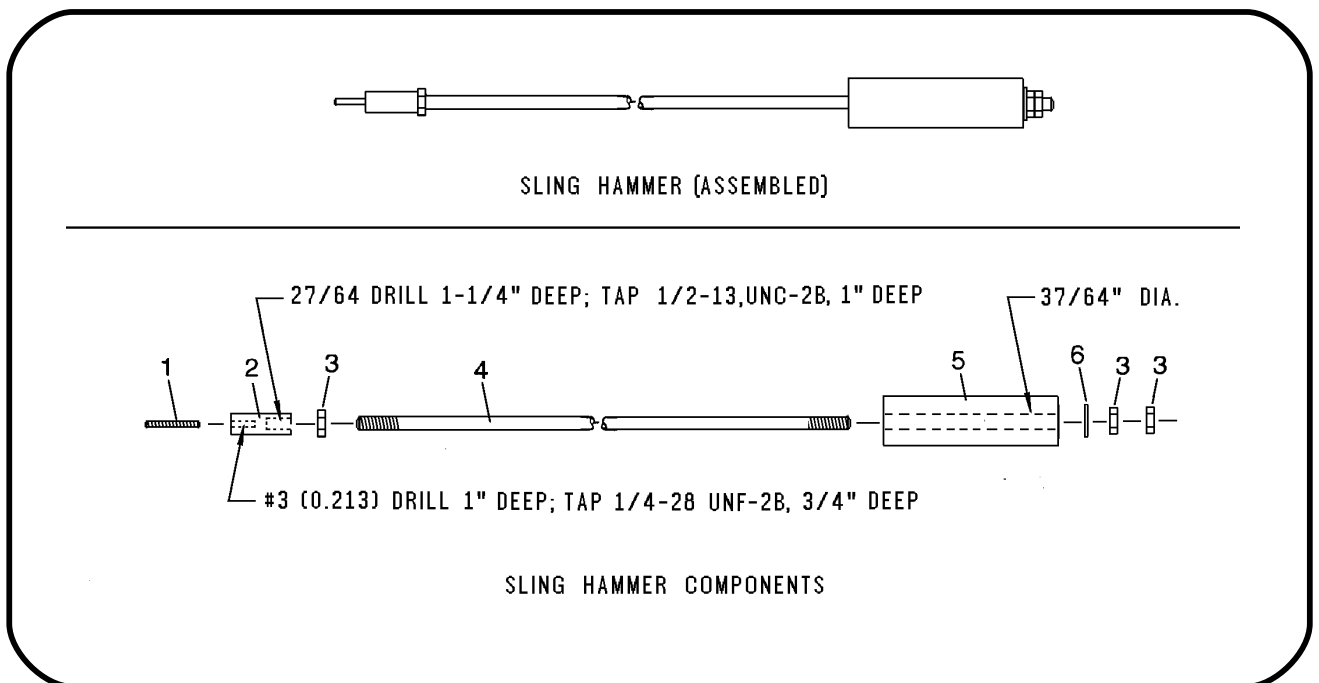
b. Tools needed for Exciter Armature Removal and Installation

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 3/8 - 16 X 5-inch 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 tightens the exciter armature on the generator armature shaft. You may have such a puller in your equipment. 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 Paragraph e, (1)

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 two 3/8 - 16 X 5-inch fully-threaded hex-head bolts. Instructions for doing this are provided in Paragraph e, (2).



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

Sling-Hammer Puller
Figure 3

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 louvered exciter cover from end canopy.
- (2) Remove exciter housing cover as required. Remove the 1/2-13 cap screw which holds the exciter armature on the generator shaft.
- (3) Refer to Figures 1 and 2. Disconnect the two rectifier-to-generator field leads. One lead with a ring type terminal is attached to the rectifier mounting plate with a screw ("A", Fig. 2) and the other lead goes into a splice type connector with three other leads ("X", Fig. 2) coming from the exciter armature windings. Cut the leads at the connector for removal of the one field lead. Cut as close as possible to the connection as to preserve lead length for reconnection later during exciter armature installation.
- (4) **EXERCISE CARE** to prevent damage to leads. Remove kinks in the two generator leads as much as possible before starting removal operation.

e. Exciter Armature Removal

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

Refer to Figure 4 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, Fig. 4) 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, then lock together.

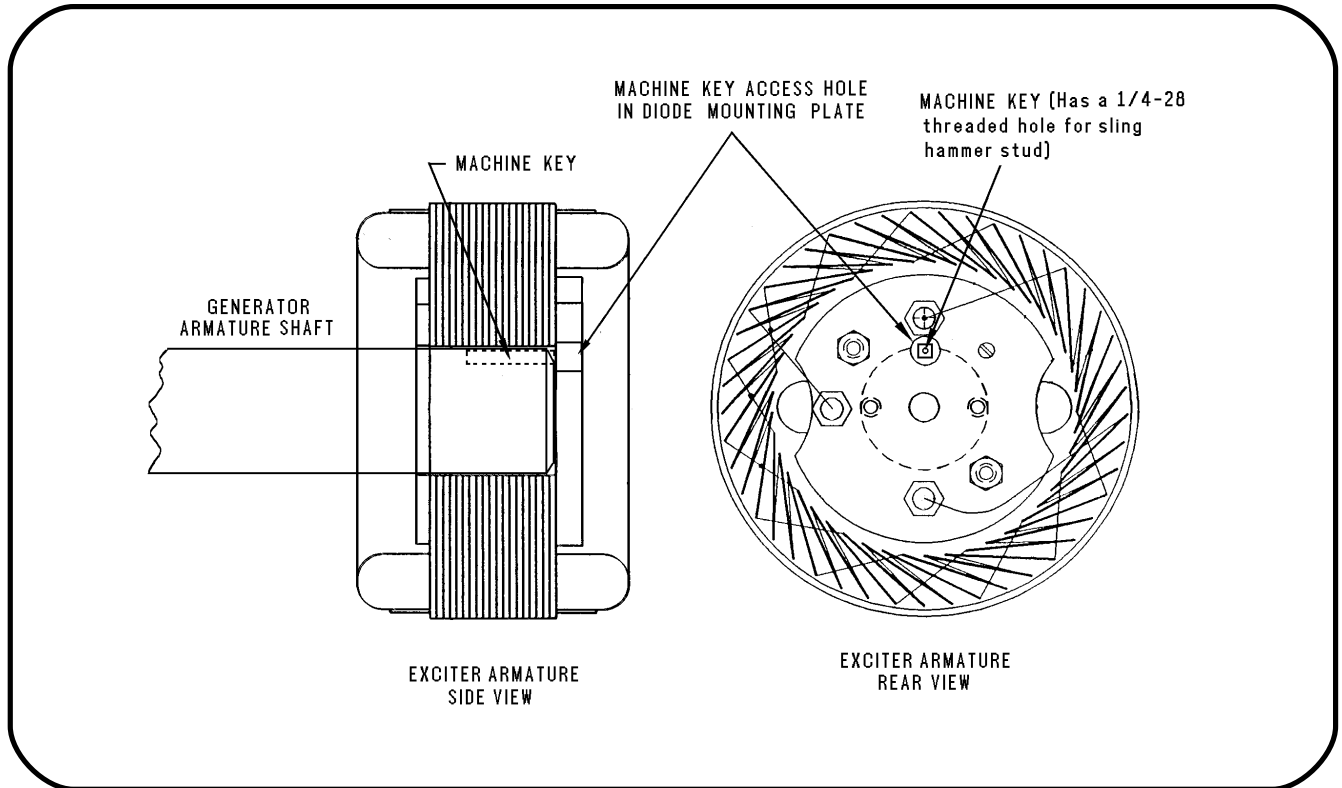
WARNING

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 steps (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.



Location of Exciter Armature Machine Key
Figure 4

(2) Removing the Exciter Armature

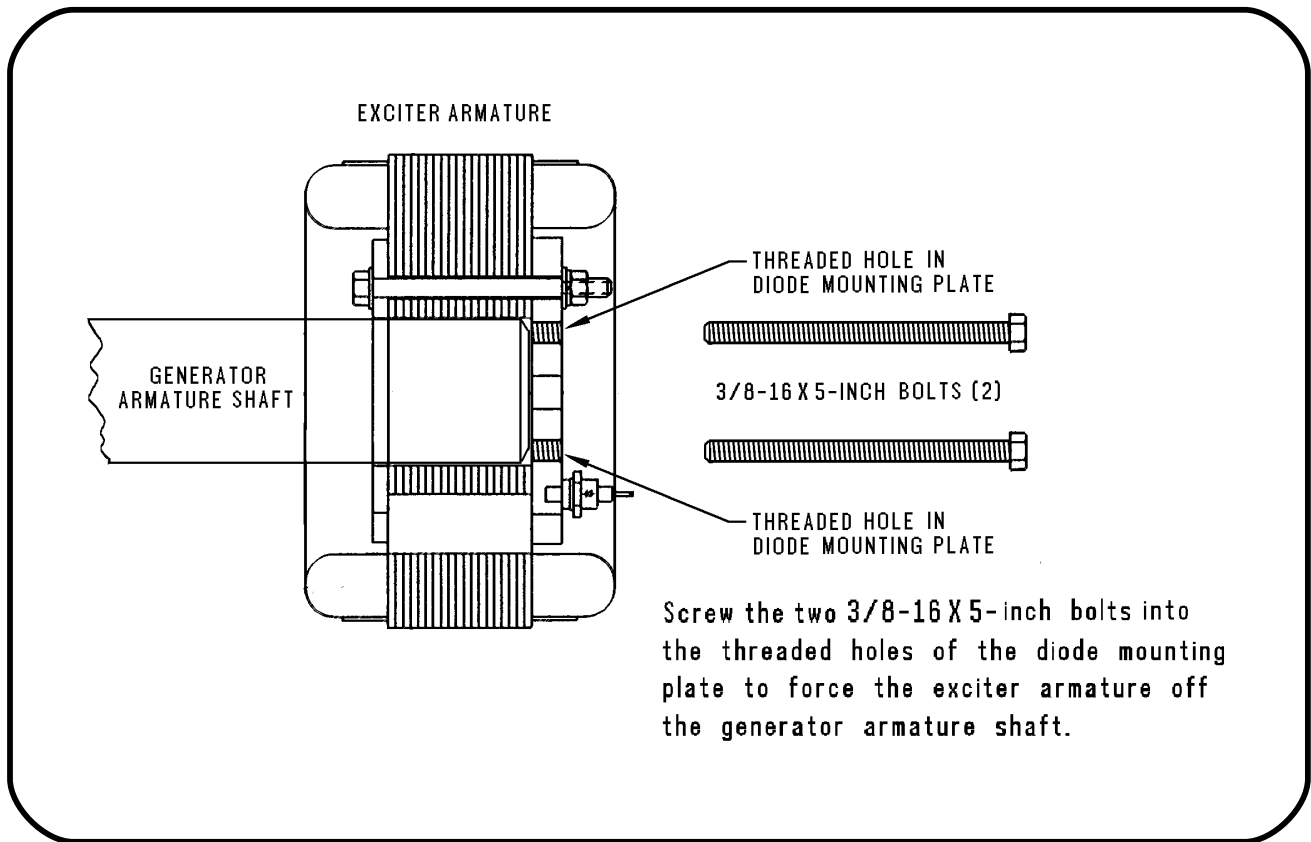
CAUTION

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

Attempt to loosen exciter armature on shaft by rotating it slightly back and forth. If armature cannot be loosened by hand, use two 3/8 - 16 X 5-inch hex-head bolts as shown in Figure 5 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**.

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 hole ("B", Fig. 2) Straighten leads and remove kinks as required to avoid damage to insulation.



Removing Exciter Armature from Generator Armature Shaft
Figure 5

4. Installing the Exciter Armature

a. Preparation for Exciter Armature Installation

- (1) Clean generator shaft and exciter armature bore. Remove all rust, corrosion, etc.
- (2) Make **CERTAIN** that the leads are tucked into the 1/2" keyway, which is opposite from the 3/8" keyway in the generator armature shaft.
- (3) Route the revolving field leads (step 2 above) through exciter armature hole ("B", Fig. 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 1/2 - 13 X 5-inch hex-head bolt and 1/2 - 13 nut as shown in Figure 6 to pull the exciter armature onto the generator shaft. Put the exciter armature on slowly and at the same time pull field leads through hole ("B", Fig. 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 1/2 - 13 threaded hole in the end of the armature shaft. Screw the 1/2 - 13 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 6. After installation, remove the 1/2 - 13 bolt and nut.

- (2) Connect the two generator field leads to the exciter armature as follows:
- Connect lead with ring type terminal with screw provided to the rear mounting plate ("A", Fig. 2).
 - Connect the other field lead to the three leads coming off of the exciter armature windings ("X", Fig. 2). Use parallel splice connector, crimp and solder for a good connection.
 - Insulate with sleeving material or wrap with electrical tape.
- (3) Install the Machine Key
- Clean the machine key thoroughly. All mounting surfaces must be free of rust, corrosion, oil, grease, etc.
 - Apply **LOCQUIC** primer, No. 47-56 grade T to **SIDES** of machine key. Do not overprime. A thin film is best. Allow to dry three to four minutes.
 - 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** 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.

- 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.
- Ensure keyways in the generator armature shaft and exciter armature are aligned.
- Insert **UNTHREADED** end of key in keyways, then tap lightly until threaded end is flush with end of shaft.

- (4) Secure the exciter armature on generator shaft with the 1/2-13 cap screw.

CAUTION

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

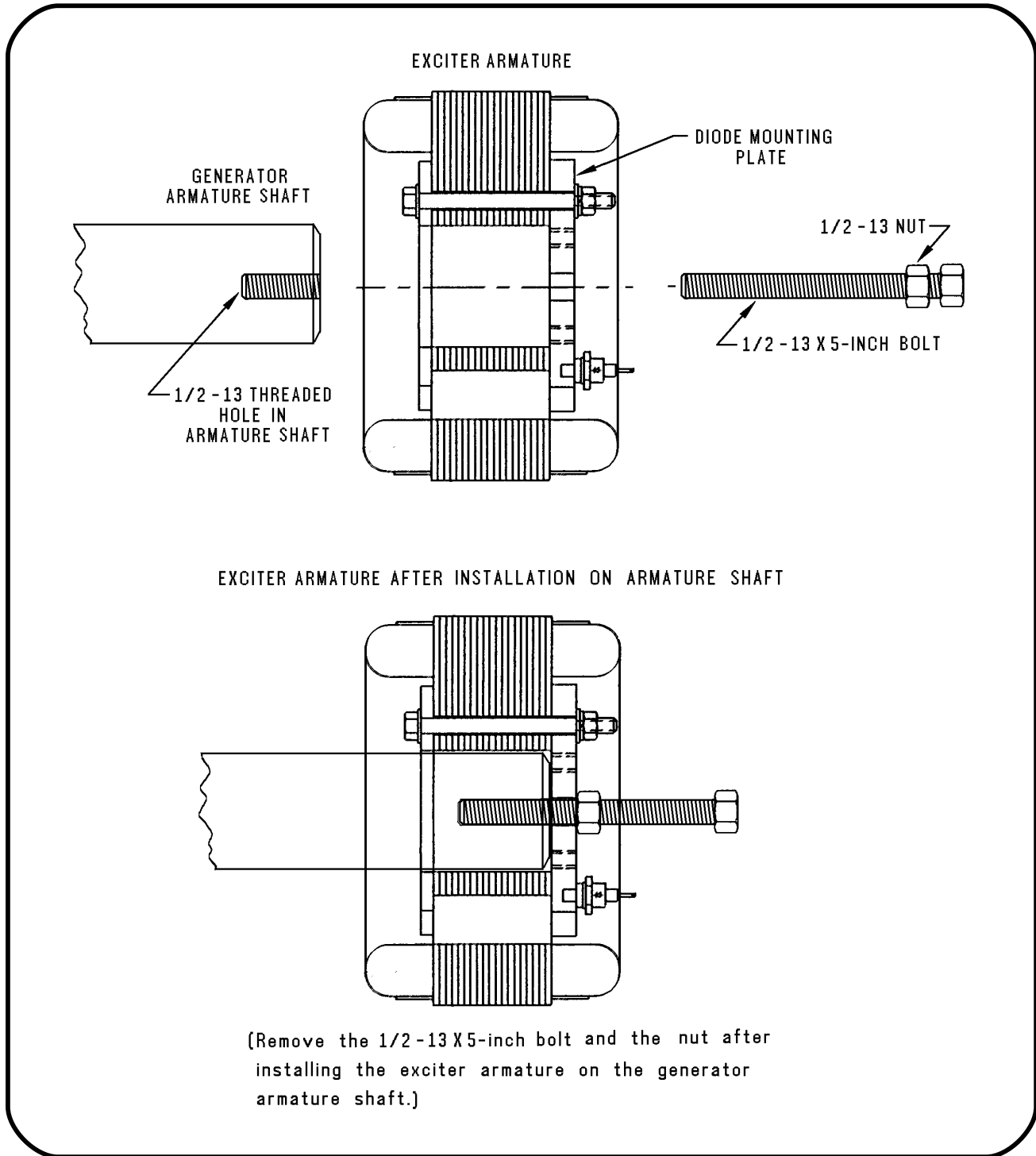
Recommended Products Manufacturers

"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



Installing the Exciter Armature
Figure 6

Section 2. Dual Bearing Flexible Coupling

1. General

This manual provides basic instructions for removal, service and installation of a flexible coupling assembly, with fan attached, manufactured by **Hobart Brothers Company** as **Part Number 281701**. This assembly is illustrated in Figure 1. The primary function of this assembly is to couple a Hobart Generator Set 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.

a. Coupling Bolts

CAUTION

Failure to verify proper coupling bolt installation may result in coupling failure and damage equipment.

NOTE: It is not necessary to separate the engine and generator if all that is being done is checking and replacing the coupling bolts. Removal of the perforated cover over the fan housing provides access to the coupling bolts for removal and installation.

- (1) Refer to Figure 2. Use a long-handled, reversible ratchet drive with a 15/16-inch hex socket wrench to remove one coupling bolt. Measure its length. If it is 3-1/2 inches (89 mm) long, reinstall it and torque **ALL** three of the coupling bolts to 85 foot-pounds (115 N-m).
- (2) Use of the proper coupling bolts for replacement is **VERY IMPORTANT**. Replacement bolts **MUST** be 5/8-11, SAE Grade 5, hex-head bolts, 2-3/4 inches (70 mm) long, reinstall it and torque **ALL** of the coupling bolts to 85 foot-pounds (115 N-m). **Only three bolts must be used and they must be equally spaced**. There is **NO ACCEPTABLE SUBSTITUTE** for these bolts. Hobart Brothers stocks these bolts as Part Number W-11102-18.

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. On self-propelled units, many mechanics prefer to remove the engine and generator as an assembly, and then separate them. Others may prefer to remove the engine or the generator separately to reach the coupling. 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 reassembly.

a. Separate Engine and Generator

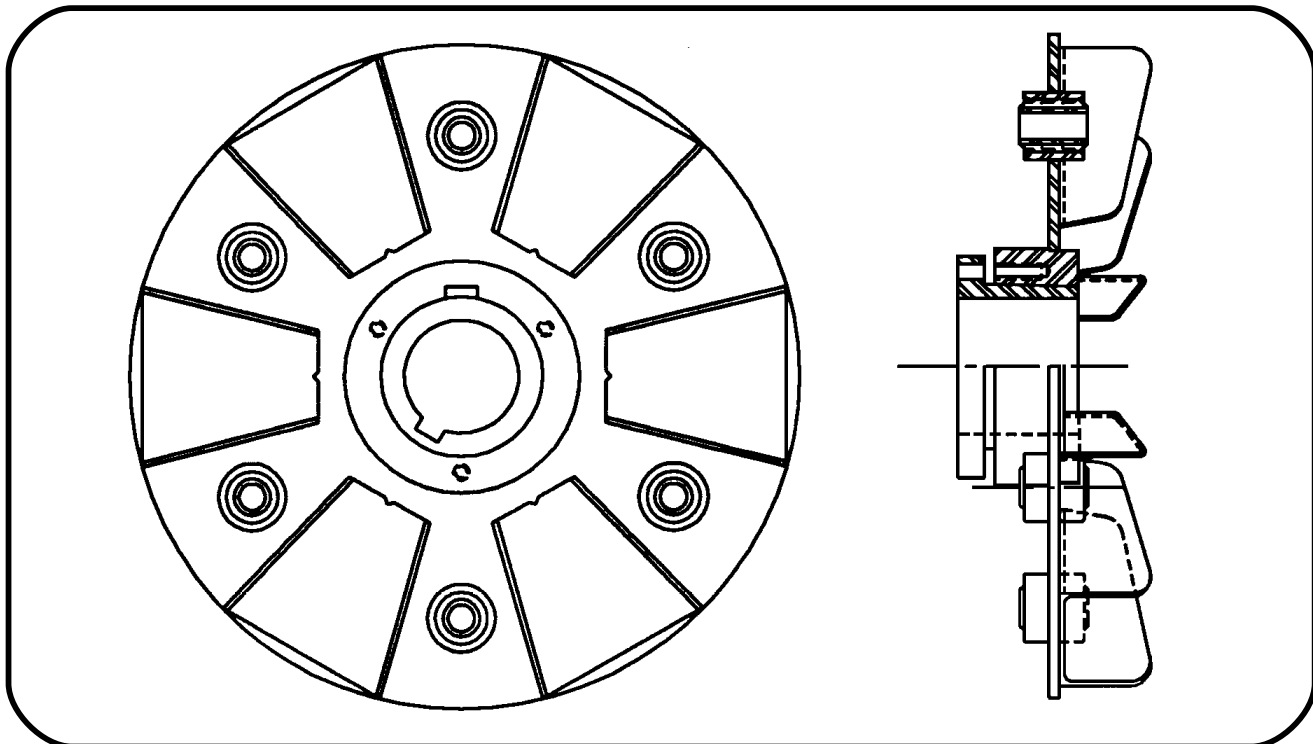
- (1) Install a lifting eye with 1/2-13 threads in the tapped hole on top of the generator frame, and attach a hoist to it. Lifting eyes are available from Hobart as Part Number CTW-116A.
- (2) Remove the fan housing cover from the generator fan housing.
- (3) Refer to Figure 2. Use a 15/16-inch socket on a long-handled ratchet and remove the three hex-head bolts which attach the coupling to the spacer ring.

NOTE: These bolts were torqued to 85-foot pounds (115 N-m) at installation. Therefore it may be necessary to block the armature against counterclockwise rotation to remove them.

- (4) Remove bolts attaching the generator fan housing to the engine flywheel housing.
- (5) Separate the generator from the engine with a hoist and move it to a clear working area.

b. Remove Coupling Assembly

- (1) Refer to Figure 3. Using a socket wrench, remove all three of the 3/8-16 bolts (1) that secure the bushing (2) to the hub (3).
- (2) To separate the housing from the hub, lubricate two of the 3/8-16 bolts and insert them into the threaded holes (4) in the bushing. With socket wrench, screw these bolts into the bushing such that the bushing pops loose from the hub.
- (3) Using a 3/16-inch Allen wrench, loosen the set screw (7) in the bushing to release pressure on the key (5).
- (4) When the bushing (2) is loose in the hub (3), use a mallet to **GENTLY** tap the bushing out of the hub.
- (5) Slide the coupling assembly off the shaft and remove the key (5).
- (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 split bushing for cracks, evidence of galling, and rust pits. Light rust is permissible on the split 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 bushing alignment to make sure that the dimension illustrated in Figure 9 is maintained.



Coupling Assembly
Figure 1

3. Coupling Service

When ordering coupling kits or other parts from your Hobart Brothers Company 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 **Hobart Ground Power** equipment, immediately contact our Service Department **by mail, telephone or FAX.**

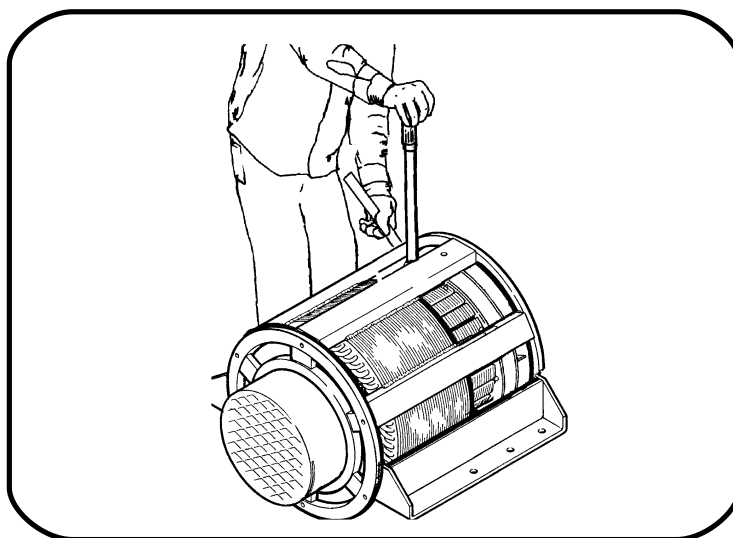
Write: Hobart Brother Company
Ground Power Division
Service Department
1177 Trade Square East
Troy, Ohio 45373
U.S.A.

In U.S.A. Call: (800) 422-4166 (Parts)
(800) 422-4177 (Service)

From Foreign Countries Call: (937) 332-5050 (Parts)
(937) 332-5060 (Service)

FAX: (937) 332-5121
(800) 367-4945 Toll Free in U.S.A.

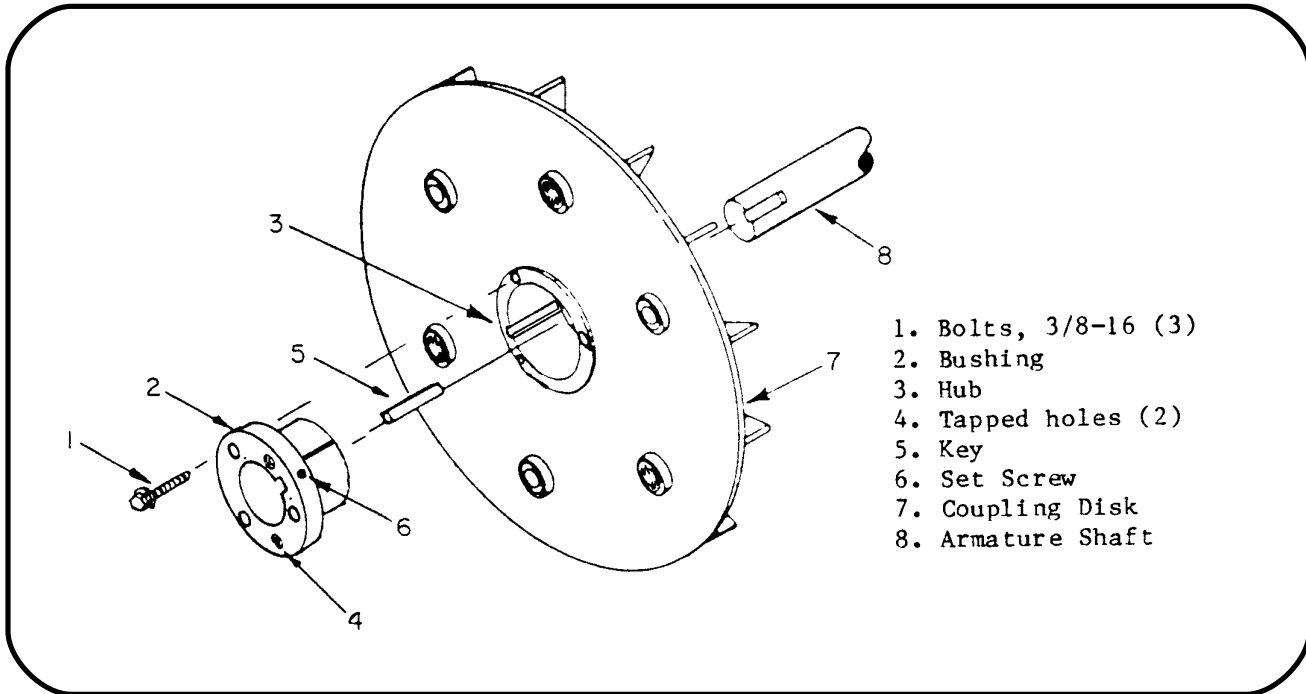
WWW WWW.hobartgroundpower.com



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

a. Replacement Coupling Kit

A replacement coupling kit is available from your Hobart Brothers Company Distributor. This kit provides a replacement coupling assembly with attaching hardware and installation instructions. The Part Number for this kit is 283555. This kit is illustrated in Figure 4



Hub and Bushing
Figure 3

b. Bushing Kit

A bushing kit is available from Hobart Brothers Company 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 5. 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 vigorously and pour it into a small shallow dish.
- (4) Roll a bushing in the lubricant to coat it thoroughly, and press it into a socket (*from the chamfered end*) to the dimension shown in Figure 5: $3/32 \pm 1/64$ -inch (2.381 ± 0.397 mm) from the face of the bushing socket to the face of the bushing, on the side opposite the fan blades.
- (5) Repeat step 4 until all three new bushings are installed. The three bushings must be equally spaced.
- (6) Balance the complete coupling assembly to 1/2 inch-ounce (**360 mg-m**) minimum.

4. Coupling Installation

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 6. 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 marked "x", but nothing else.

b. Assembly

- (1) If an adapter ring must be replaced, remove the 8 bolts which secure it to the flywheel. Discard the old adapter ring and bolts. Install the new adapter ring Part No. **386612** using the new bolts Part No. **402789-3** (3/8-16 X 2-1/2 Socket Head Cap Screws).

Torque all 8 bolts to 45 foot-pounds (61 N-m).

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

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

CAUTION

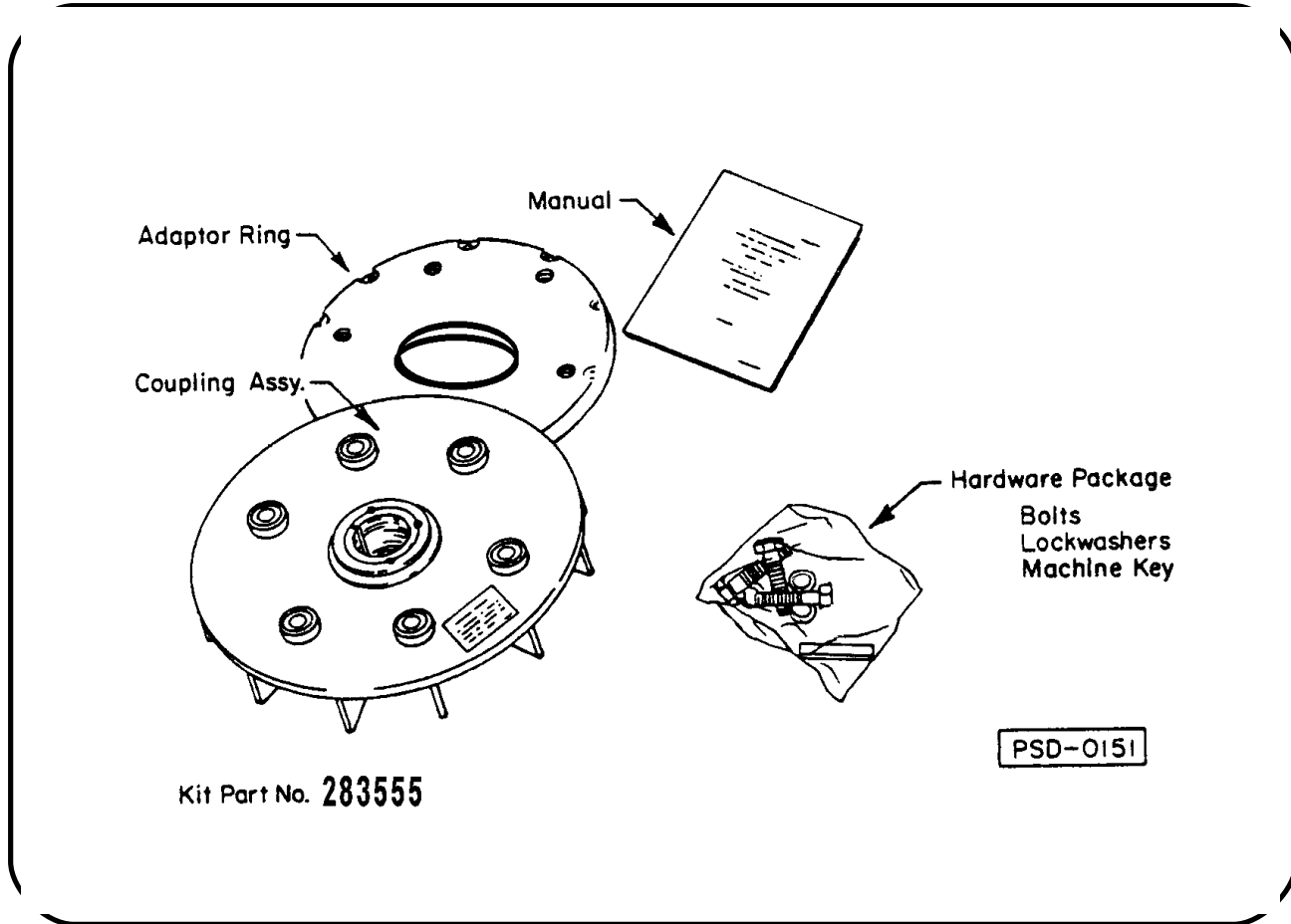
Make certain that only the bolts are lubricated, and that no lubricant is permitted to get inside the bushing where the armature shaft will enter the bushing.

- (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 (5), and install the coupling assembly on the shaft, with the split bushing approximately flush with the end of the shaft.
- (7) Using a 3/16-inch Allen wrench, tighten the set screw (6) in the bushing (2) to apply pressure on the key (5).

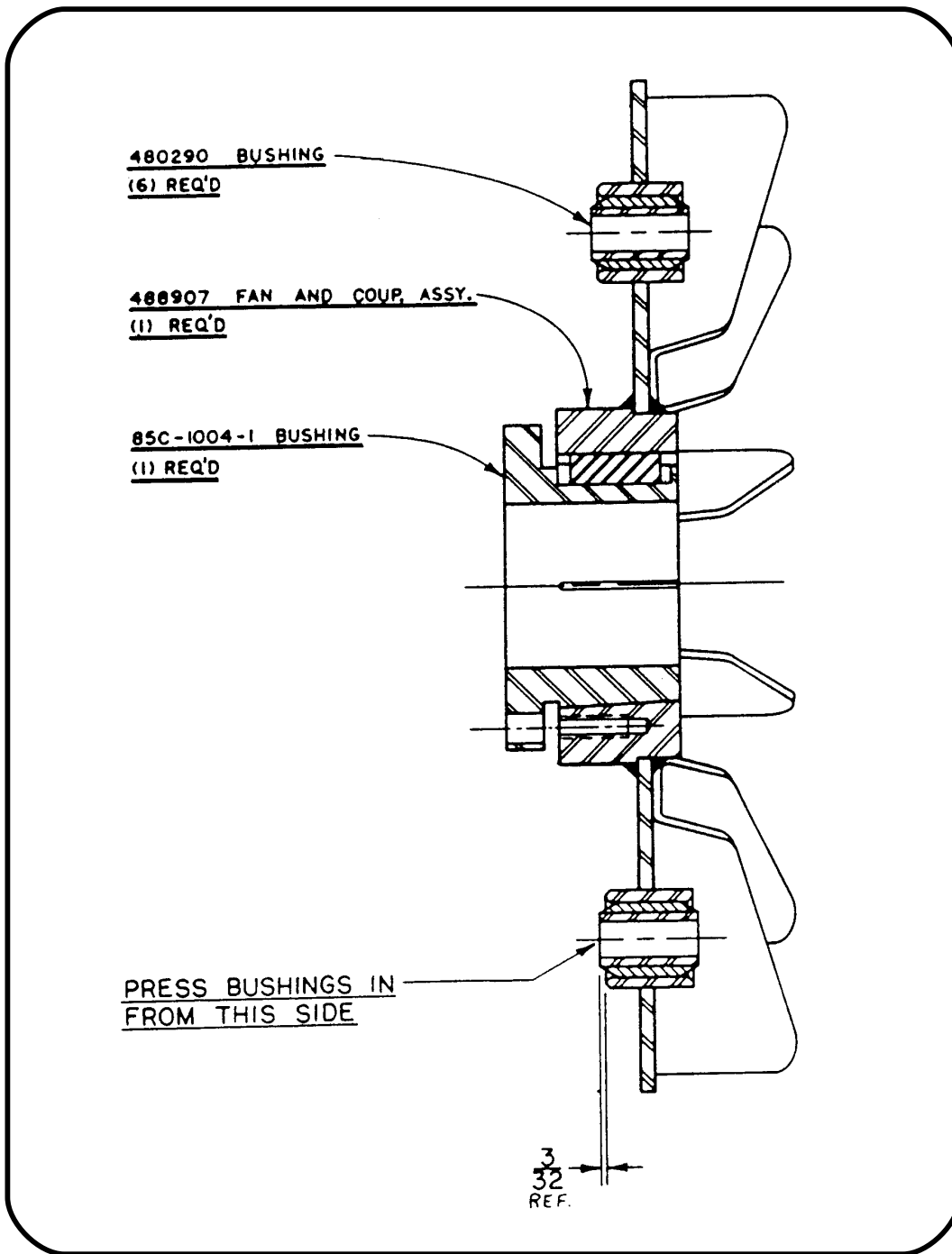


Coupling Kit
Figure 4

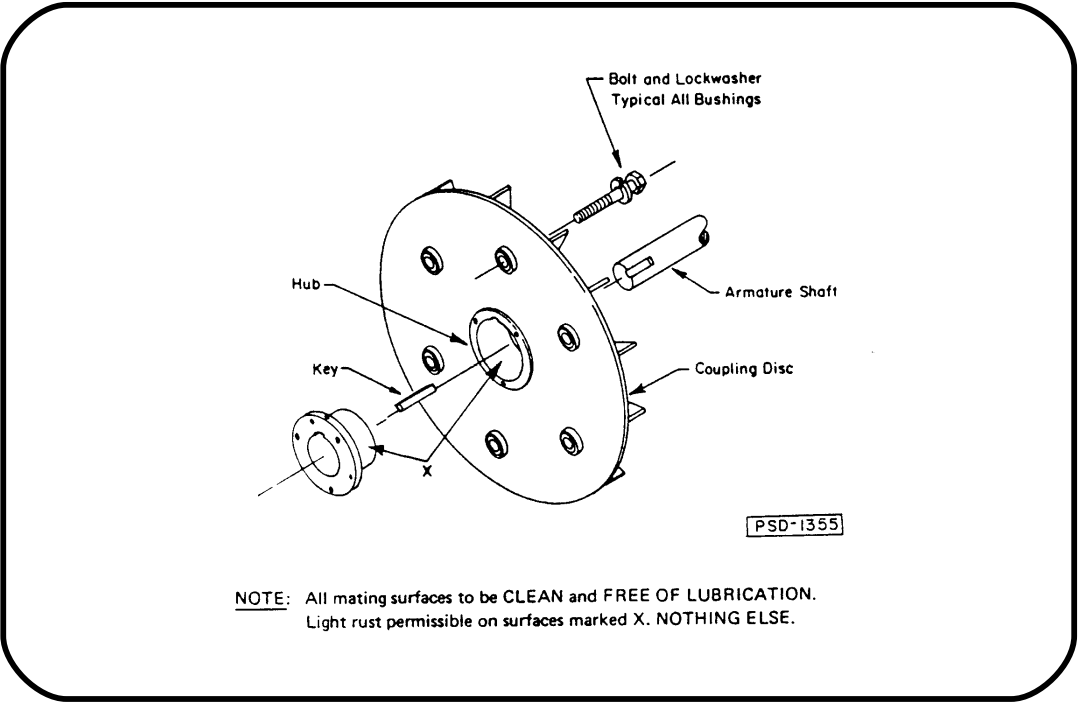
- (8) Refer to Figure 9. Place a straightedge across the two adjacent bushings and measure the distance from the bushings to the mounting face of the generator fan housing. Slide the coupling assembly on the shaft until this dimension is 1/16-inch (1.6 mm) **LESS** than the dimension recorded in step 7 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 (1, Figure 3) alternately and evenly as follows:
- 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 10. Observe the **CAUTION** above when it is necessary to rotate the shaft.
 - Repeat step (a) above until 3/8-16 bolts can no longer be tightened.
 - Recheck the dimension in Figure 9 to be sure it is the same as the dimension in (7) above.

CAUTION

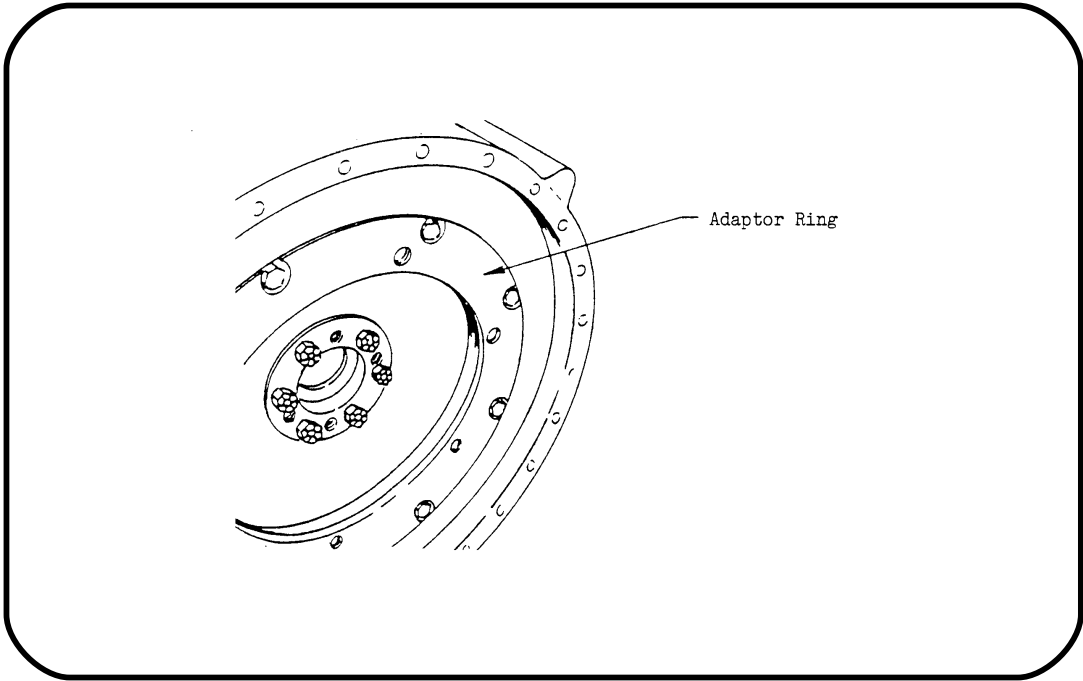
Remove armature block installed in para. 4.b.(3). otherwise, damage to the armature could result.



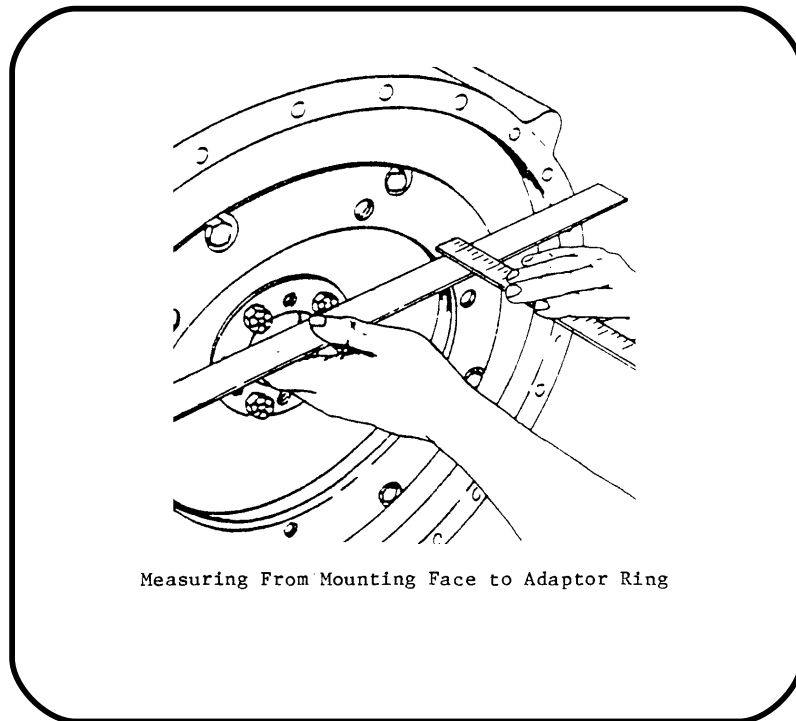
Bushing Installation
Figure 5



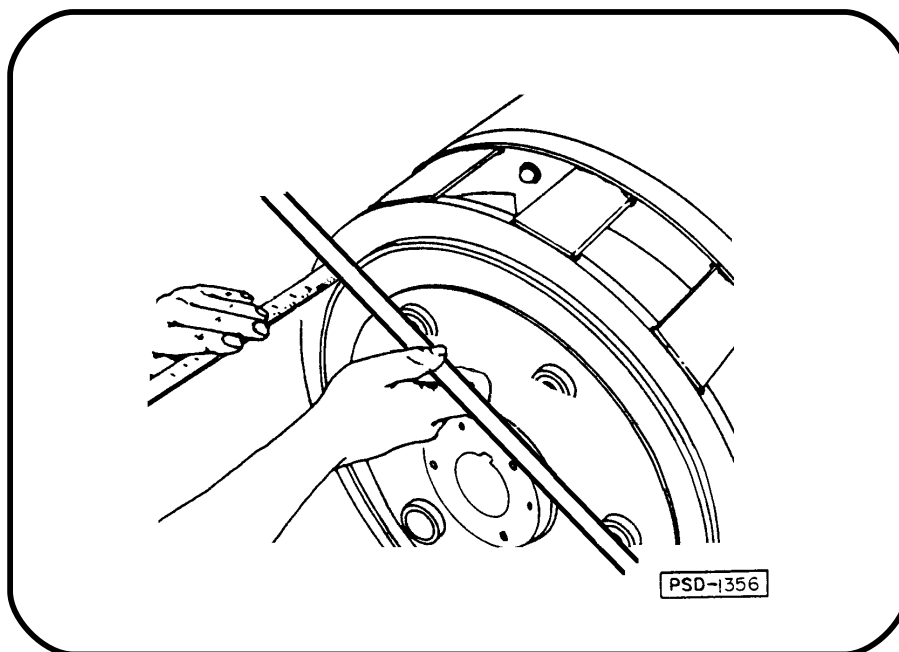
Assembly Procedure
Figure 6



Flywheel Adapter
Figure 7



Engine Measurement
Figure 8



Measuring from Mounting Face to Bushing
Figure 9

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.

Use **5/8-11 SAE GRADE 5** hex-head bolts, 2-3/4 inches (70 mm) long. These bolts are included in the coupling kit, and are available from **Hobart Brothers** as Part No. **W-11102-18**.

- a. Insert the proper coupling bolts with lock washers through the bushings from the FAN side of the coupling.
- b. Using a hoist, align the generator fan housing flange with the flange on the engine flywheel housing and insert two of the attaching bolts, one on each side of the flange. Start the bolts into the tapped holes in the flywheel housing just enough to ensure thread engagement. **DO NOT TIGHTEN**.
- c. Turn all of the coupling bolts into the tapped holes in the flywheel, 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. Refer to Figure 2. Insert a long piece of wood through the fan housing to block the armature against clockwise rotation. Torque all of the coupling bolts to 85 foot-pounds (115 N-m).

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.

Section 3. Generator Assembly

1. General

This section provides information and instructions for removal and installation of the generator assembly used on Part Number 500051 generator sets.

2. Procedure for Generator Assembly Removal

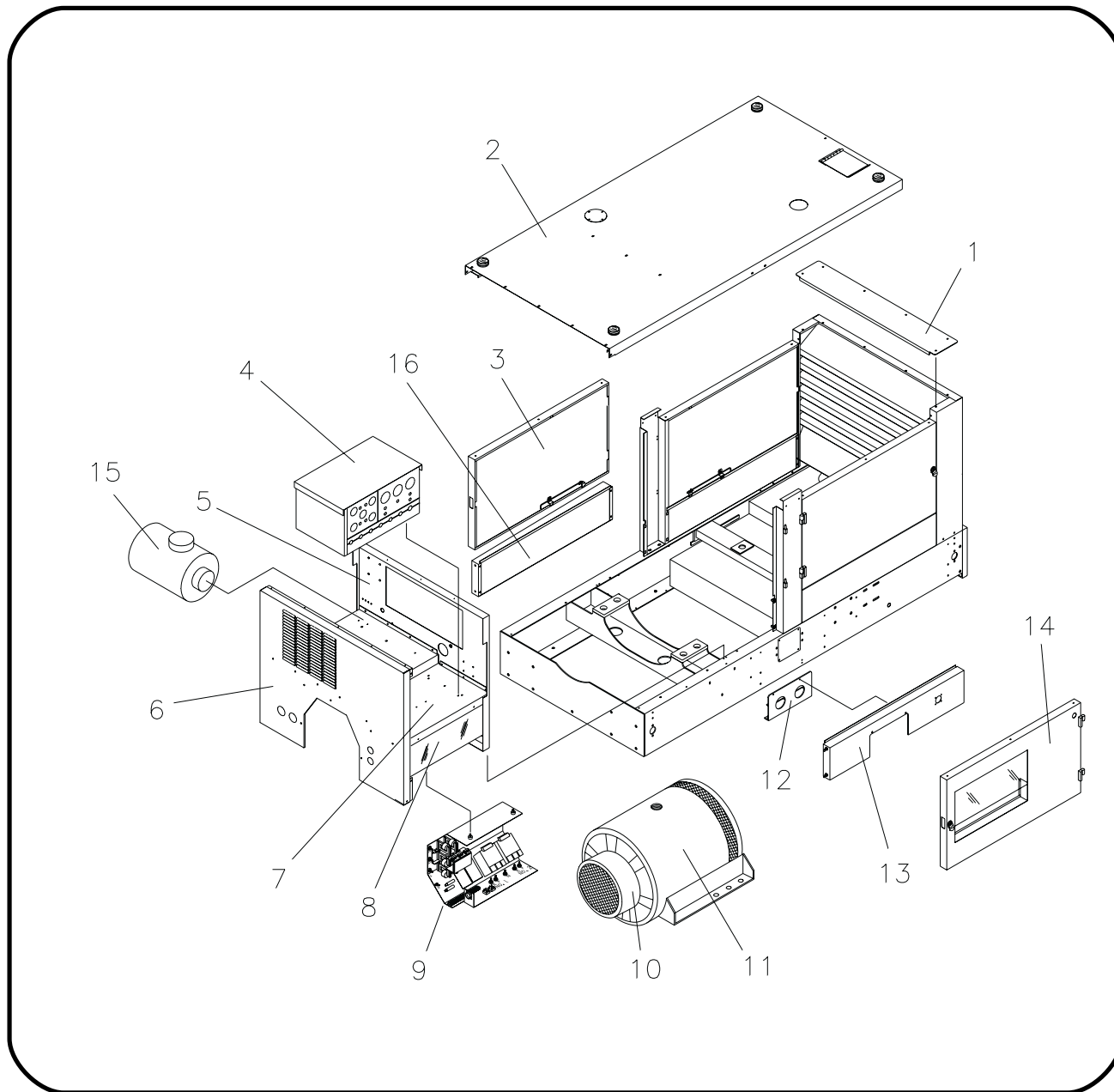
a. Procedure for Gaining Access to the Generator

WARNING

Before starting removal of the generator assembly, position the front section of the generator set under a hoist which is capable of lifting at least 940 pounds (426 kg), which is the weight of the generator assembly.

To gain access to the generator assembly, refer to Figure 1 and Connection Diagram 283122 in Chapter 5 and proceed as follows:

- (1) Disconnect battery leads from the generator set.
- (2) If a transformer-rectifier (T-R) assembly is mounted on the generator set, remove T-R assembly. Remove both T-R assemblies if two are mounted on the generator set.
- (3) Disconnect clearance light wires from the top canopy (2).
- (4) Remove rear panel cover (1)
- (5) Remove top canopy panel (2).
- (6) Remove the left front (14) and right front (3) doors.
- (7) Remove the following: right front panel (16) and the left front panel (13). Remove the clear power module cover (8) and loosen cable clamps panel (12) so that the aircraft cables can be disconnected from the load contactors on the power module (9).
- (8) Disconnect plug connectors from the back of the control box (4), and remove wires going to TB-5. Disconnect plug from power module (9).
- (9) Remove the control box (4).
- (10) Remove the air cleaner (15) and the pipe/hoses connecting it to the engine. Note: cover the turbo inlet while the air cleaner is removed.
- (11) Route wire harness through the bulkhead panel (5) towards the engine compartment, so that the front canopy panel (6), the control box support panel (7), and the bulkhead panel (5) can be lifted off the unit.
- (12) Remove the two keps nuts mounting the top of the power module (9) to the control box mounting panel (7).
- (13) Remove the front canopy panel (6), the control box support panel (7), and the bulkhead panel (5). These panels can be removed as one assembly as shown in Fig. 1.
- (14) Remove the generator stator leads from the power module (9), and remove the power module.
- (15) Remove generator wrapper (11).

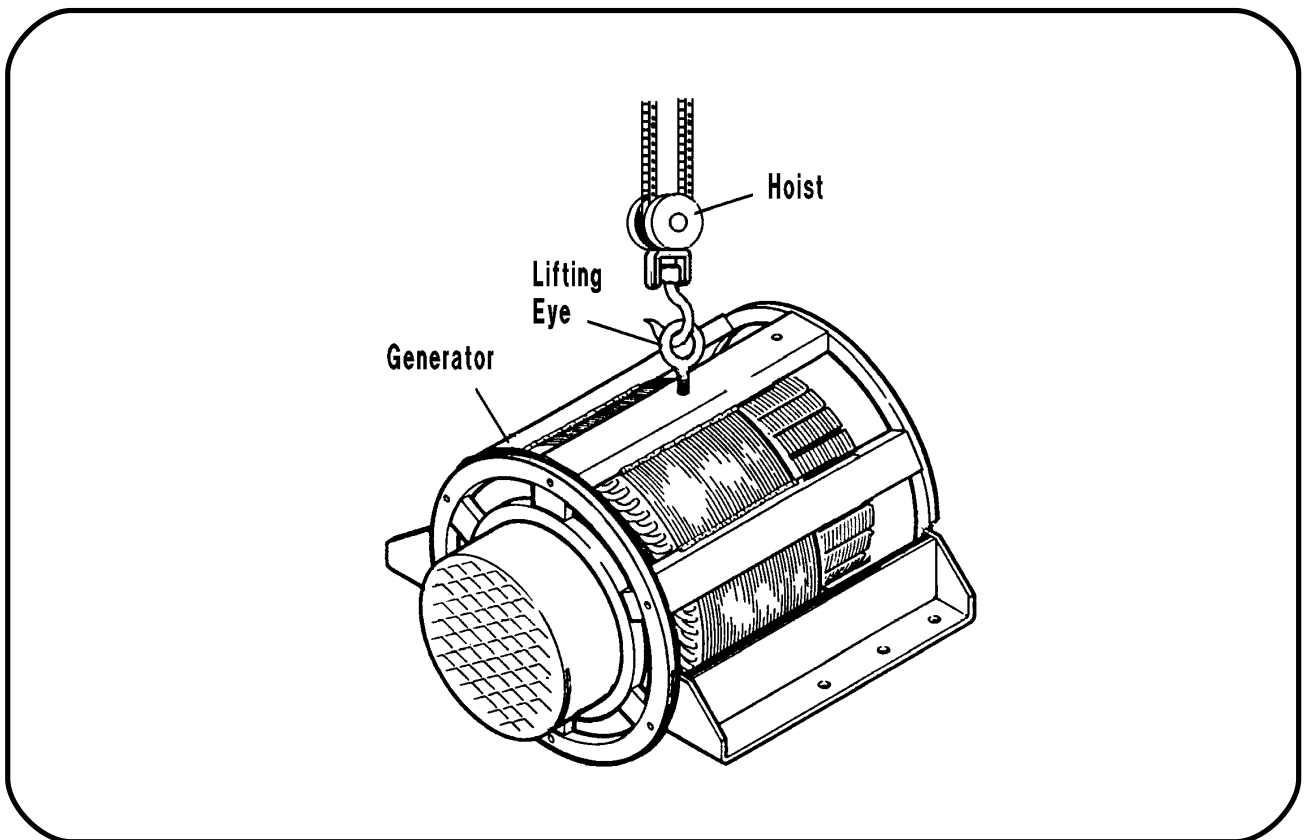


- | | |
|-----------------------------|--------------------------------|
| 1. Rear Panel Cover | 10. Generator Assembly |
| 2. Canopy Top Assembly | 11. Generator Wrapper |
| 3. Right Front Door | 12. Cable Clamp Mounting Panel |
| 4. Control Box Assembly | 13. Left Front Lower Panel |
| 5. Bulkhead Panel | 14. Control Box Door |
| 6. Front Canopy Panel | 15. Air Cleaner |
| 7. Control Box Mounting Pnl | 16. Right Front Lower Panel |
| 8. Clear Power Module Cover | |
| 9. Power Module | |

**Assembly Removal Required for Access to Generator
Figure 1**

b. Removing the generator Assembly

- (1) Remove the four 5/8 - 11 x 4-1/2 bolts which mount the generator assembly to the frame of the generator set.
- (2) Support the engine at the flywheel housing with wooden blocks.
- (3) Using the hoist, support the generator assembly as shown in Figure 2. For lifting convenience, a 1/2 - 13 threaded hole is drilled in the top of the generator housing. Insert a 1/2 - 13 eye-bolt in the hole and attach the hoist chain to the eye-bolt as shown in Figure 2.
- (4) Remove the 5/8 - 11 x 4-1/2 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 2**

3. Installing a Generator Assembly

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 re-mounting of the assemblies that were removed to gain access to the generator assembly. To install the generator assembly, refer to Connection Diagram 287439, and proceed as follows:

a. Remounting the Generator Assembly

- (1) Support engine at flywheel housing with wooden blocks.
- (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.
- (4) Attach the generator to the flywheel coupling, using the six 5/8 - 11 x 4-1/2 bolts.
- (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 (11, Fig. 1) on the generator assembly (12, Fig. 1), 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 listed in para. 2. a.

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 a Diesel Engine-Generator Set manufactured by Hobart Brothers Company, Ground Power Division, Troy, Ohio.

2. Purpose

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

3. Arrangement

Chapter 4 is arranged as follows:

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

4. Explanation of Parts List

a. Contents

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

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

b. Parts List Form

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

- (1) FIGURE-ITEM NO. Column

This column lists the figure number of the illustration applicable to a particular parts list and also identifies each part in the list by an item number. These item numbers also appear on the illustration. Each item number on an illustration is connected to the part to which it pertains by a leader line. Thus the figure and item numbering system ties the parts lists to the illustrations and vice versa. The figure and index numbers are also used in the numerical index to assist the user in finding the illustration of a part when the part number is known.

(2) HOBART 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 "HOBART 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) AIRLINE PART NUMBER Column

This column will appear blank. Eleven character spaces have been reserved for filling in part numbers that may have been assigned by individual airlines.

(4) 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.

(5) 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 which 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 only one generator set specification, this column is not used in this manual.

(6) UNITS PER ASSEMBLY Column

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

Section 2. Manufacturer's Codes

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

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

Code	Vendor's Name & Address	Code	Vendor's Name & Address
00779	AMP Inc. P.O. Box 3608 Harrisburg, PA 17105	14552	Microsemi Corp 2830 S. Fairview St. Santa Ana, CA 92704-5948
01428	Tuthill Corp. Superior Linkage Div. 2110 Summit St. P.O. Box 227 New Haven, IN 46774-9524	14799	Square D Co. Chicago Assembly Plant 9522 W. Winona Schiller Park, IL 60176-1025
016T7	Amaton Inc. 446 Blake St. New Haven, CT 06515	15434	Cummins Engine Company 1000 Fifth Street Columbus, IN 47201
01989	Dana Corp Weatherhead Div U.S. 24 E. Antwerp, OH 45813	16238	Lord Mfg. Co. Inc. Sterling Road South Lancaster, Mass 01561
02660	Amphenol Corp. 720 Sherman Ave Hamden, CT 06514-1146	16476	Datcon Instrument Co. P.O. Box 128 East Petersburg, PA 17520
0HZP9	Diesel Radiator Co. 1985 Janice Ave. Melrose Park, IL 60160	18265	Donaldson Co. Inc. 1400 W. 94th St. P.O. Box 1299 Minneapolis, MN 55440-1299
11641	Furnas Electric Co. 1004 McKee St. Batavia, IL 60510	1DG36	E. M. Products Inc. 220 W. 90th St. Minneapolis, MN 55420
13445	Cole-Herse 20 Old Colony Ave. Boston, MA 02127	25710	Deka Plastics Inc. 914 Westfield Ave. Elizabeth, NJ 07208-1222
13902	Smith Valve Corp. 1 Apple HL Suite 316 Natick, MA 01760-2072	28520	Heyco Molded Products. 750 Boulevard P.O. Box 160 Kenilworth, New Jersey 07033-1721
		2B928	Barber Colman Co. Pasadena, TX 77501

Code	Vendor's Name & Address	Code	Vendor's Name & Address
2N562	Power Transmission Sales Inc. 351 Washington P.O. Box 229 Chagrin Falls, OH 44022-4446	61706	EAO Switch Corp. 198 Pepes Farm Rd. P.O. Box 552 M O Milford, CT 06460-3670
30104	Automotive Controls Corp. 1300 W. Oak St. P.O. Box 788 Independence, KS 67301-2347	66180	Automatic Timing and Controls 3312 Bloomingdale Melrose Park, IL 60160-1030
30327	Imperial Eastman Corporation 6300 W. Howard Street Chicago, IL 60648	7M613	Wright F.B. Co. of Cincinnati 4689 Ashley Dr. Hamilton, Oh 45011-9706
30430	Marathon Electric Mfg. Corp. 398 Beach Rd. Burlingame, CA 94010-2004	74542	Hoyt Electrical Instruments P.O. Box 8798 Penacook, NH 03303
40121	Peterson Mfg. Co. Inc. 700 W. 143rd St. P.O. Box 8 Plainfield, IL 60544-9733	75418	Kysor Industrial Corporation 1100 W. Wright Street Cadillac, Michigan 49601
41197	Madine Manufacturing Company 1500 Dekoven Avenue Racine, Wisconsin 53401	77342	Potter and Brumfield Inc 200 S. Richland Creek Dr. Princeton, IN 47671-0001
49234	Protectoseal Company 1920 S. Western Chicago, Illinois 60608	81074	Holub Industries, Inc. 413 DeKalb Avenue Sycamore, Illinois 60178
5PO59	Tech Products Corp. 2348 Sandridge Dr., Dayton, Ohio 45439	86797	Rogan Corp 3455 Woodhead Dr. Northbrook, IL 60062-1812
50508	Magnetic Components Inc. 9520 Ainslie St. Schiller Park, IL 60176-1116	91637	Dale Electronics, Inc. P.O. Box 609 Columbus, Nebraska 68601
55752	Parker Hannifin Corp. Racor Div. 3400 Finch Rd. P.O. Box 3208 Modesto, CA 95353-3208	94222	Southco Inc. 210 N. Brinton Lk. Rd. Concordville, PA 19331
57448	Stephens & Adamson Mfg. Company 275 Ridgeway Avenue Aurora, Illinois 60507	E0615	Kraus and Naimer 42 Miramar Avenue P.O. Box 15-009 Wellington, New Zealand
57733	Stewart-Warner Corporation 1826 Diversey Parkway Chicago, Illinois 60614		

Section 3. Illustrated Parts List

1. Explanation of Parts List Arrangement

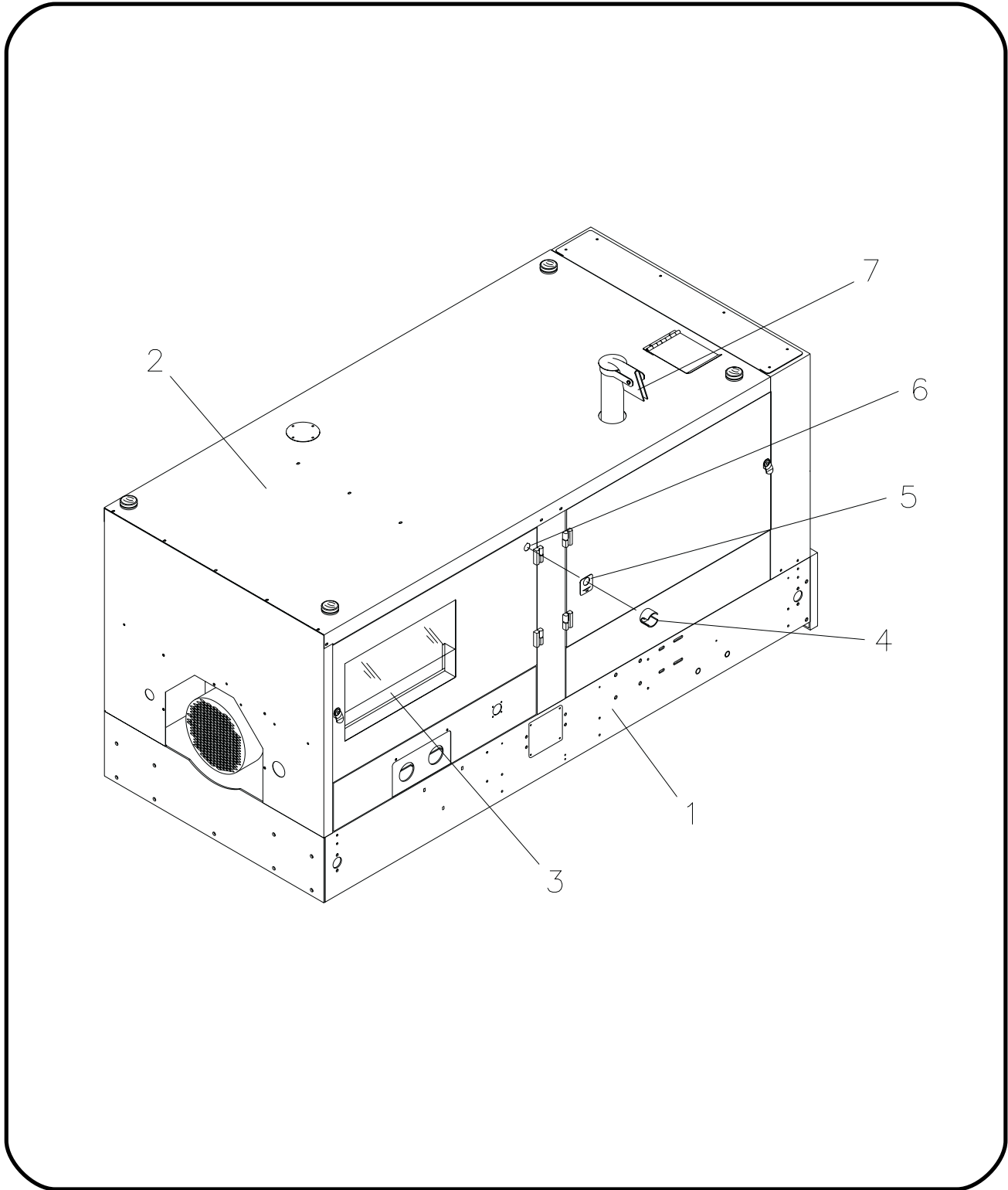
The parts list is arranged so that the illustration will appear on a left-hand page and the applicable parts list will appear on the opposite right-hand page. Unless the list is unusually long, the user will be able to look at the illustration and read the parts list without turning a page.

2. Symbols and Abbreviations

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

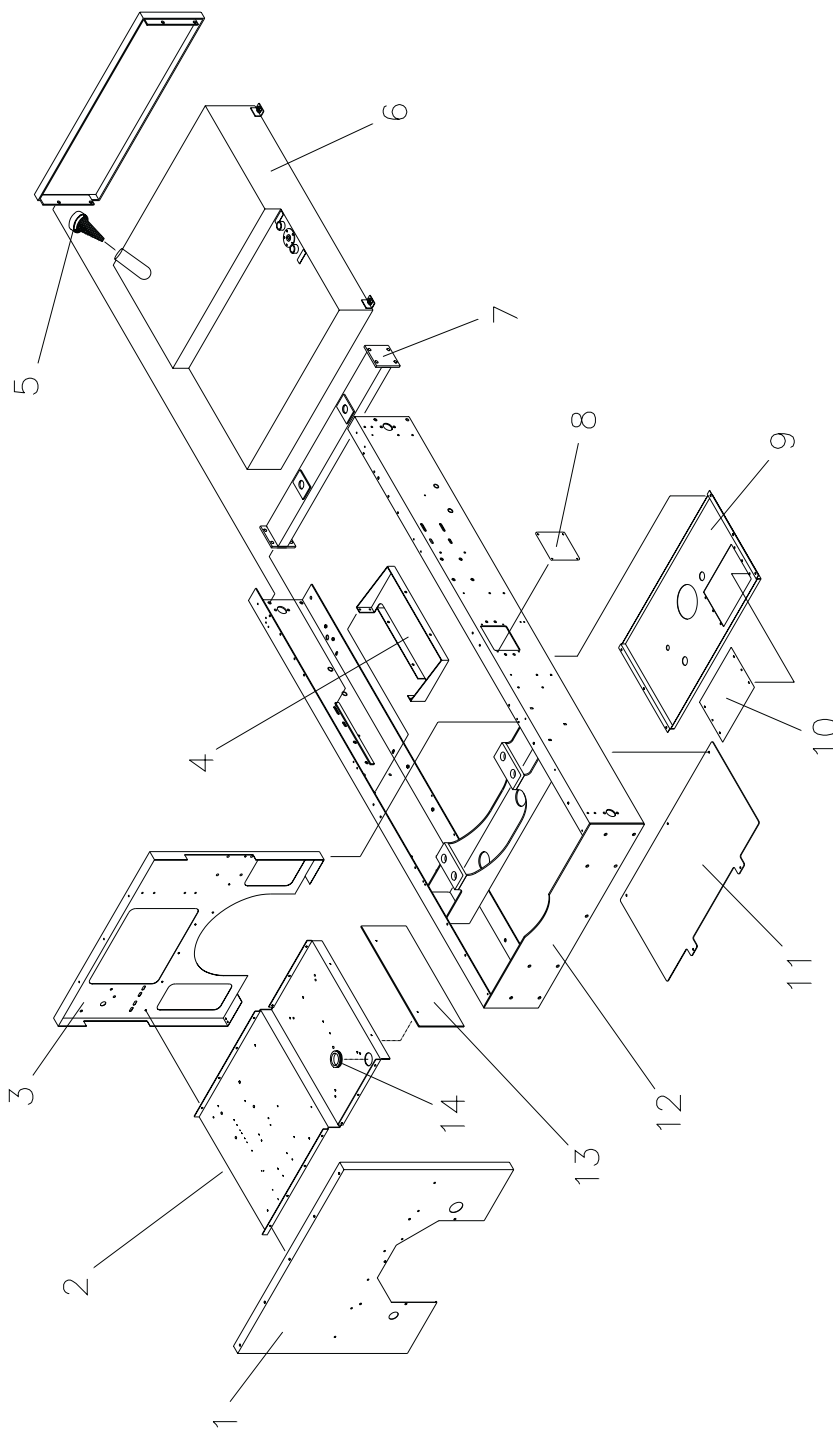
- * - Item not illustrated
- A, or AMP - Ampere
- AC - Alternating current
- AR - As required
- DC - Direct current
- Fig. - Figure
- hd. - Head
- hex - Hexagon
- Hz - Hertz (cycles-per-second)
- I.D. - Inside diameter
- IN - Inch
- KVA - Kilovolt-ampere
- uF - Microfarad
- No. - Number
- NHA - Next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

NOTE: An item which does not reflect an index number is a 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.



**Generator Set
Figure 1**

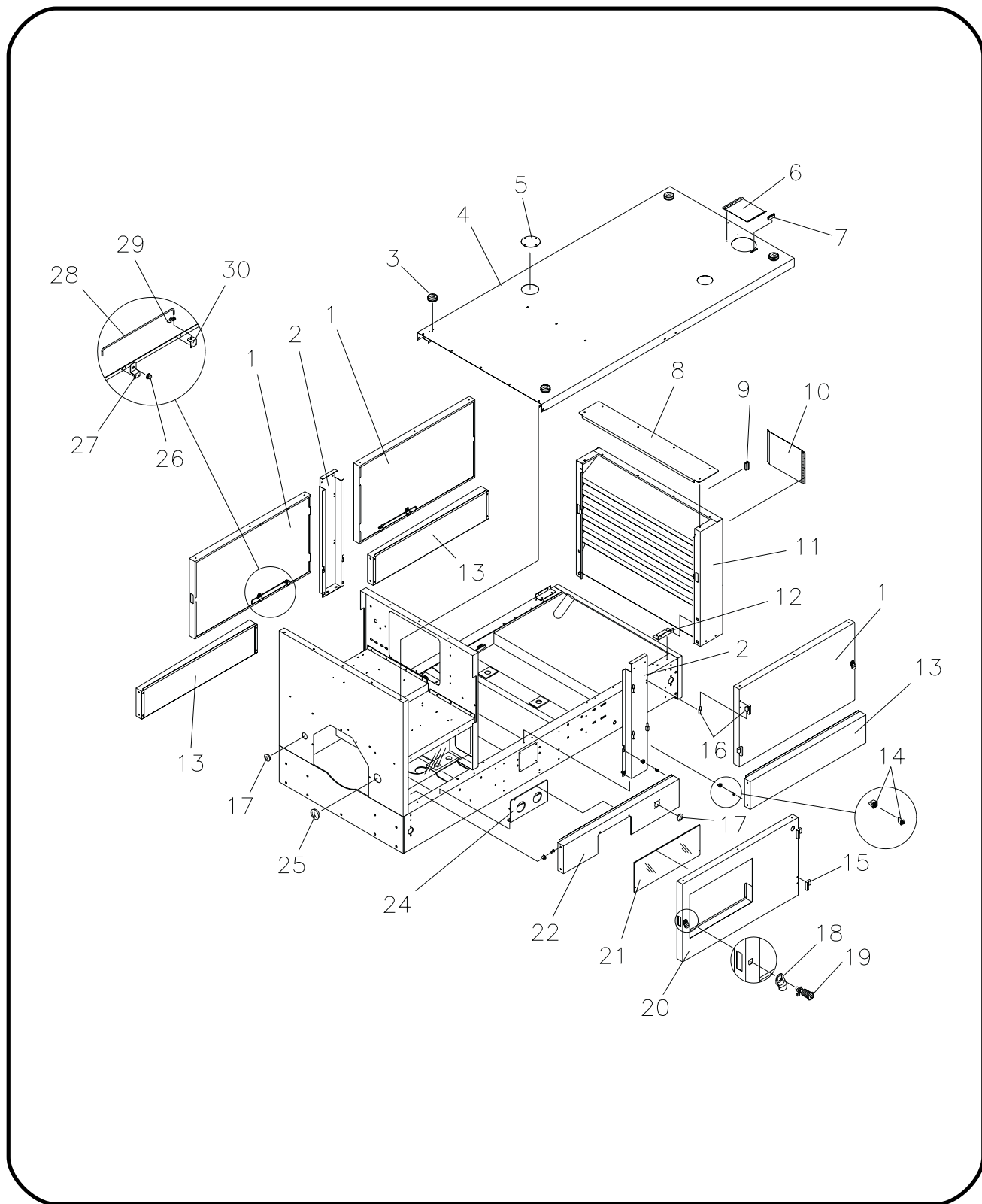
FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY	
			1	2	3	4	5	6		
1 -	500391A-001		GENERATOR SET FOR TRAILER MOUNTING						REF	
1 -	500391A-002		GENERATOR SET FOR FIXED OR TRUCK MOUNTING						REF	
1 - 1	No Number		. FRAME ASSEMBLY (See Fig. 2)						REF	
1 - 2	No Number		. CANOPY ASSEMBLY (See Fig. 3)						REF	
1 - 3	No Number		. GENERATOR SET INTERIOR COMPONENTS (See Fig. 4)						REF	
1 - 4	285125		. GUARD, MUSHROOM BUTTON (V14799 #K564M)						1	
1 - 5	285681		. PLATE, LEGEND, EMERGENCY STOP						1	
1 - 6	77A-1157		. SWITCH, MAINTAINED, PUSH-PULL (V14799 #KR-9R-H6)						1	
1 - 7	DDW495-001		. CAP, RAIN, EXHAUST (V17284 #FB0032)						1	
* 1 - 8	287048		. LABEL, TERMINAL BLOCK						1	
* 1 - 9	402987		. LABEL, HOBART						3	
* 1 - 10	78A-1000		. LABEL, I.D.						1	
* 1 - 11	287459		. LABEL, GENERAL WARNING						1	
* 1 - 12	79A-1110		. LABEL, OPTIONS						1	
* 1 - 13	76B-1148		. LABEL, DIESEL FUEL						1	
* 1 - 14	430077-002		. LABEL, HANDLING						1	
* 1 - 15	287460		. LABEL, HIGH VOLTAGE						1	
* 1 - 16	287461		. LABEL, FUEL						1	
* 1 - 17	287462		. LABEL, RADIATOR						1	
* 1 - 18	287463		. LABEL, HOT MUFFLER						1	
* 1 - 19	287464		. LABEL, MOVING PARTS						2	
* 1 - 20	287466		. LABEL, EMERGENCY STOP						1	
* 1 - 21	282658		. LABEL, WARNING, CLEARANCE						1	
* 1 - 22	282659		. LABEL, GOVERNOR DIESEL FUEL						1	
* 1 - 23	283533		. LABEL, SUPPORT CENTER						1	
* 1 - 24	287454		. LABEL, CAUTION, ENGINE SPEED						1	
* 1 - 25	287696		. LABEL, HEARING PROTECTION						1	
* 1 - 26	408665-001		. REFLECTOR, RED						8	
* 1 - 27	408665-002		. REFLECTOR, AMBER						24	
* NOT ILLUSTRATED										



Frame Assembly
Figure 2

FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY	
			1	2	3	4	5	6		
2 -	No Number		FRAME ASSEMBLY						REF	
2 - 1	287706		. PANEL, FRONT CANOPY						1	
*	287738-008		. INSULATION, TOP						1	
*	287738-009		. INSULATION, LEFT						1	
*	287738-010		. INSULATION, RIGHT						1	
2 - 2	287802		. SUPPORT, CONTROL BOX						1	
2 - 3	287707		. PANEL, BULKHEAD, CENTER						1	
2 - 4	287795		. BRACKET, BATTERY MTG.						1	
2 - 5	282562		. CAP, FUEL (V49234 #1275/0003)						1	
2 - 6	287781		. TANK, FUEL, 65 GAL						1	
2 - 7	287424		. SUPPORT, ENGINE, FRONT						1	
2 - 8	287506		. COVER, EXHAUST, FRAME						1	
2 - 9	287739		. PANEL, BOTTOM						1	
*	287738-003		. INSULATION, BOTTOM PANEL						1	
2 - 10	287437		. COVER, FUEL COOLER						1	
2 - 11	287798		. PANEL, BOTTOM, GENERATOR						1	
*	287738-015		. INSULATION, GENERATOR PANEL						1	
2 - 12	287713		. FRAME ASSEMBLY						1	
2 - 13	287803		. COVER, POWER MODULE						1	
2 - 14	402037-028		. GROMMET, RUBBER (V7M613 #HW-2036)						1	

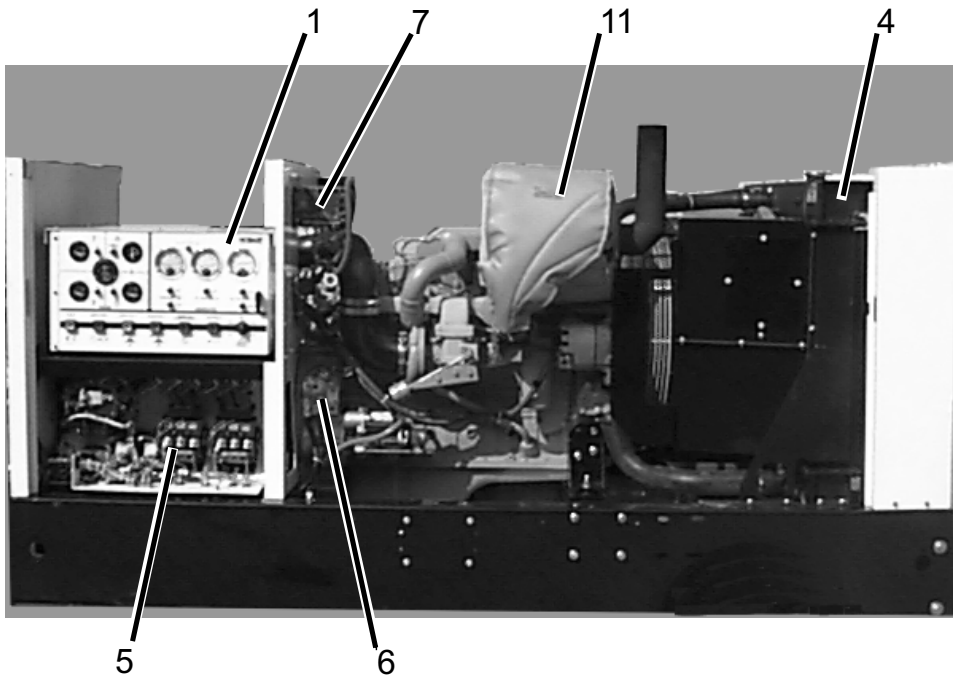
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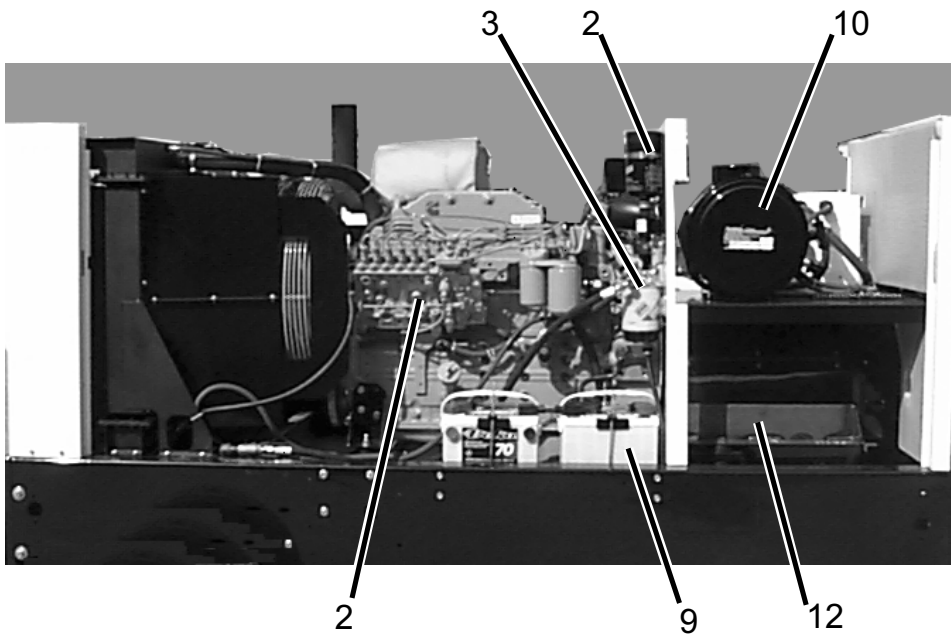
Canopy Assembly
Figure 3

FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY	
			1	2	3	4	5	6	REF	
3 -	No Number		CANOPY ASSEMBLY						REF	
3 - 1	287701		.							3
*	287738-001		.							3
3 - 2	287699		.							2
*	287738-011		.							2
3 - 3	282732-001		.							4
3 - 4	287705		.							1
*	287738-006		.							1
*	287738-007		.							1
3 - 5	287422		.							2
3 - 6	283647		.							1
3 - 7	403127		.							1
3 - 8	287889		.							1
3 - 9	403127		.							1
3 - 10	287794		.							1
3 - 11	287819		.							1
3 - 12	287793		.							2
3 - 13	287703		.							3
*	287738-004		.							3
3 - 14	287785		.							16
										(VA5733 #7800-00 & #263-000006-00-0017)
3 - 15	283824		.							4
3 - 16	283597		.							4
3 - 17	403091-008		.							2
3 - 18	287526-002		.							4
3 - 19	287542-001		.							4
3 - 20	287710		.							1
*	287738-002		.							1
3 - 21	286834		.							1
3 - 22	287704		.							1
*	287738-005		.							1
3 - 23										NOT USED
3 - 24	287786		.							1
*	7J422-000		.							4
3 - 25	403091-017		.							2
3 - 26	287788		.							4
3 - 27	287789		.							4
3 - 28	287791		.							4
3 - 29	287792		.							4
3 - 30	287790		.							4

*** NOT ILLUSTRATED**



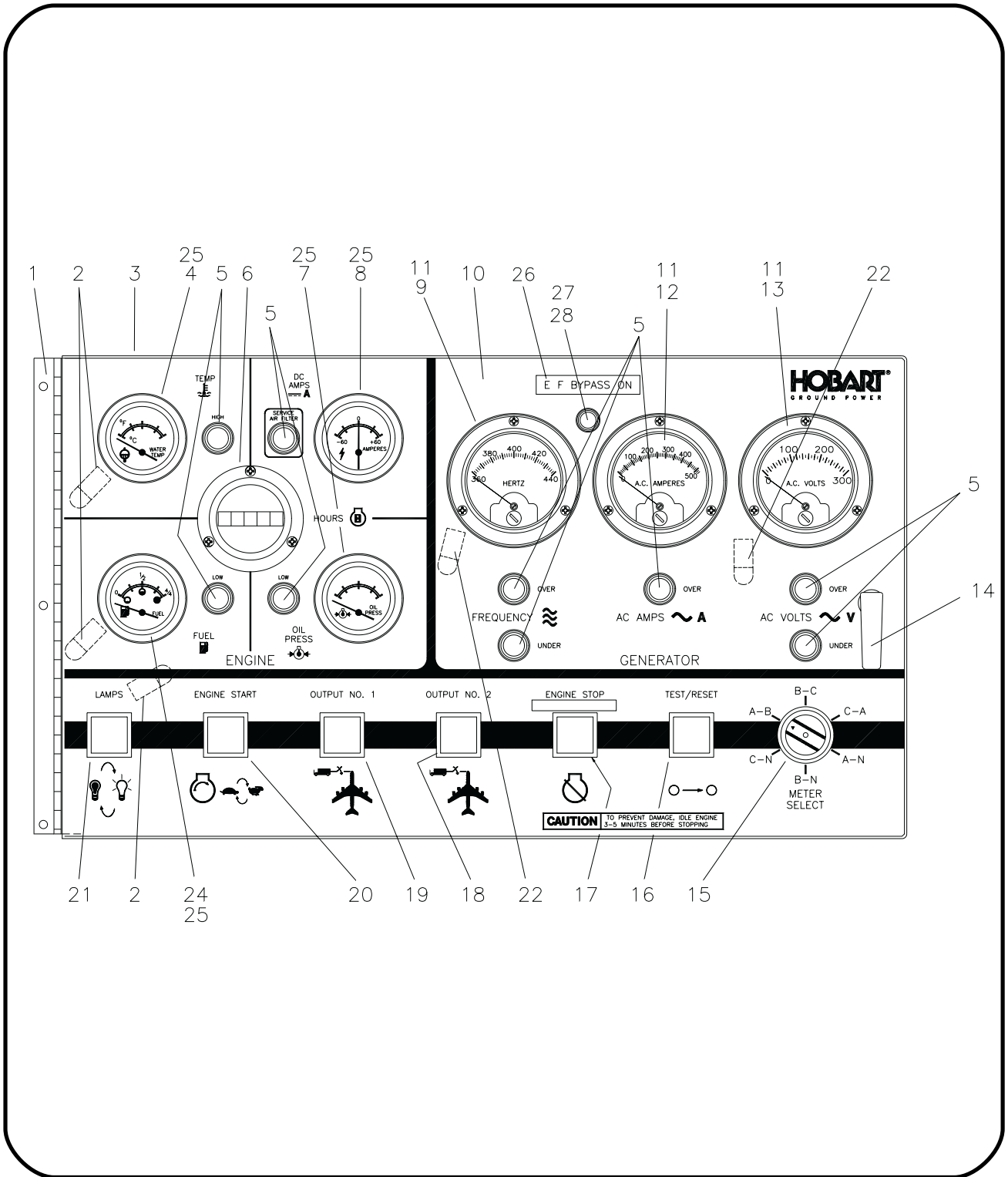
Interior Components (Left Side)



Interior Components (Right Side)

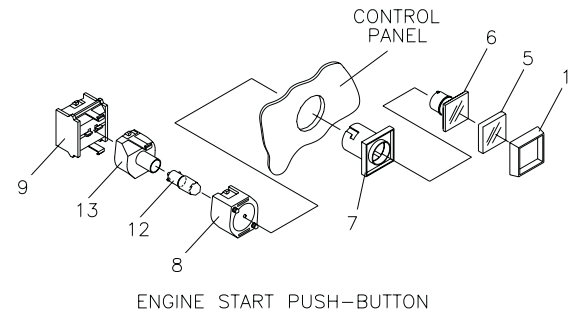
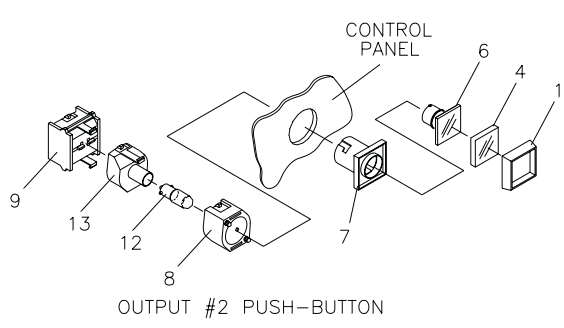
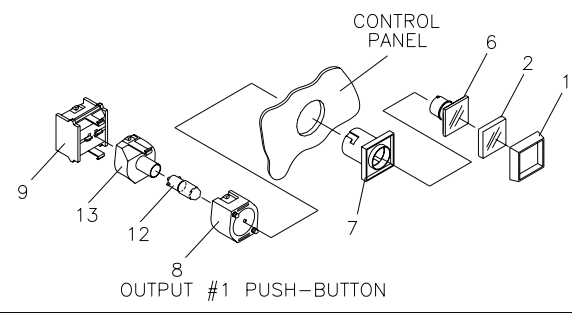
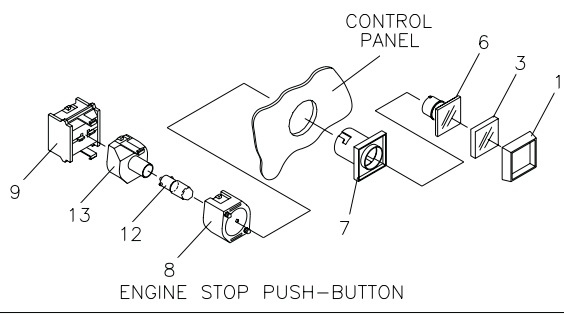
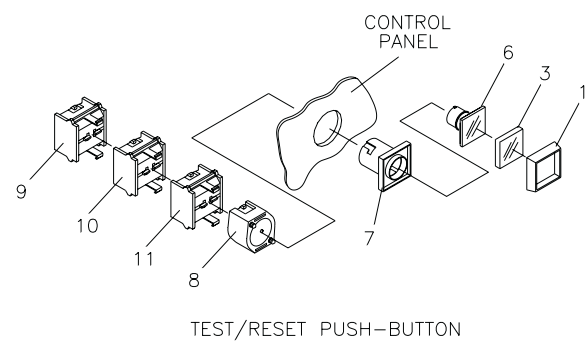
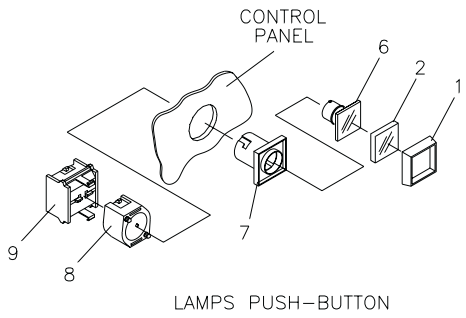
Interior Components
Figure 4

FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY	
			1	2	3	4	5	6		
4 -	No Number		INTERIOR COMPONENTS						REF	
4 - 1	287749-004		.	CONTROL BOX ASSEMBLY (See Fig. 5)					REF	
*	HF-2752		.	MOUNT, RUBBER (V5P059 #51153)					4	
4 - 2	No Number		.	KIT, COLD WEATER START (See Fig 18)					REF	
4 - 3	No Number		.	FUEL SYSTEM (See Fig. 9)					REF	
4 - 4	No Number		.	COOLING SYSTEM COMPONENTS (See Fig. 10)					REF	
4 - 5	287760		.	POWER MODULE ASSEMBLY (See Fig. 11)					REF	
*	HF-2752		.	MOUNT, RUBBER (V5P059 #51153)					2	
4 - 6	No Number		.	GROUNDING PLATE (See Fig. 12)					REF	
4 - 7	287532-001		.	KIT, GOVERNOR (See Fig. 7 and 8)					REF	
4 - 8	No Number		.	ENGINE COMPONENTS (See Fig. 13)					REF	
4 - 9	No Number		.	BATTERY COMPONENTS (See Fig 14)					REF	
4 - 10	No Number		.	AIR CLEANER COMPONENTS (See Fig. 15)					REF	
4 - 11	No Number		.	MUFFLER AND EXHAUST COMPONENTS (See Fig. 16)					REF	
4 - 12	285120A-006		.	GENERATOR ASSEMBLY (See Fig. 17)					REF	
* 4 - 13	287708		.	WIRE HARNESS, ENGINE					1	
* 4 - 14	287747		.	WIRE HARNESS, CONT. BOX TO PWR. MOD.					1	
* 4 - 15	287748		.	WIRE HARNESS, OPTIONS					1	
* 4 - 16	401911-020		.	TERMINAL BLOCK (V30430 #0220081)					1	
* 4 - 17	408173		.	SOLENOID					1	
* 4 - 18	285200		.	DIODE ASSEMBLY						
* NOT ILLUSTRATED										



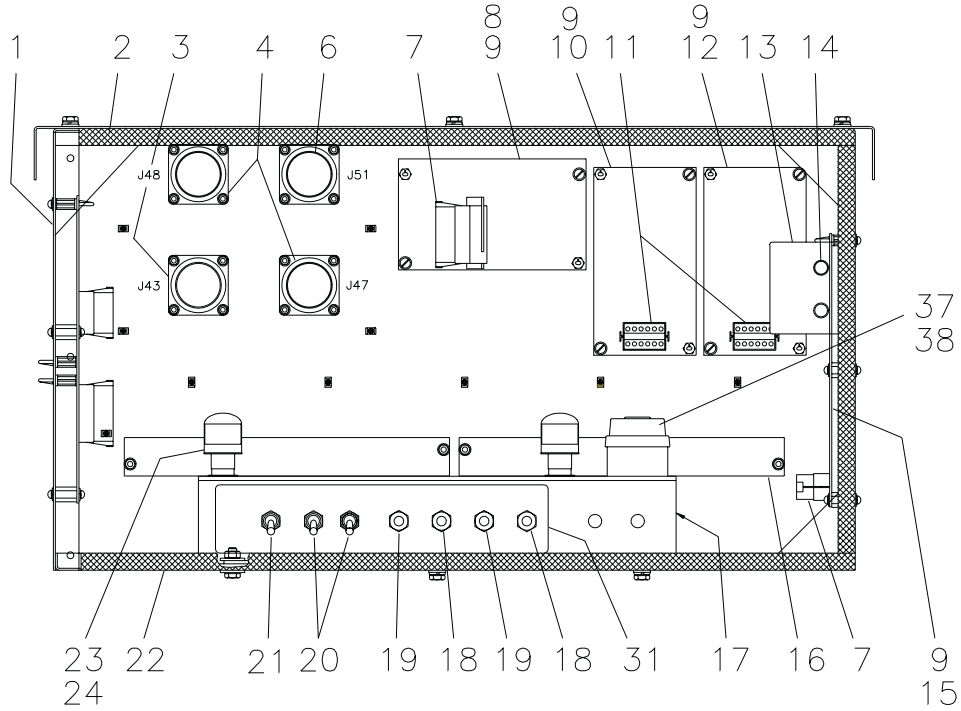
**Control Box Door Assembly
 Figure 5**

FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY	
			1	2	3	4	5	6		
5 -	287749-004		CONTROL BOX ASSEMBLY						1	
5- 1	287752-004		.	.	CONTROL BOX DOOR ASSEMBLY				1	
5- 2	W10051-013		.	.	CLAMP, WIRE, 7/8" (V81074 #MPC-14)				3	
5- 3	287753		.	.	PANEL, DOOR, CONTROL BOX, ASSY.				1	
5- 4	287908		.	.	GAUGE, WATER TEMP. (V16476 #06343-01)				1	
5- 5	HF2518-002		.	.	LIGHT, PILOT, RED, ASSY.				9	
5- 6	W9917-018		.	.	METER, RUNNING TIME				1	
5- 7	78A1117-002		.	.	GAUGE, OIL PRESSURE (V16476 #06395-01)				1	
5- 8	78A1115-001		.	.	AMMETER, ENGINE (V16476 #06354-01)				1	
5- 9	283167		.	.	METER, FREQUENCY				1	
5-10	285080		.	.	LABEL, CONTROL BOX				1	
5-11	285172		.	.	LIGHT, STRIP				3	
5-12	283165		.	.	AMMETER, GENERATOR, AC (V74542 #2735/R)				1	
5-13	W8105A-004		.	.	VOLTMETER, AC				1	
5-14	285501		.	.	LATCH, SWELL (V94222 #19-14-10)				1	
5-15	79C1158		.	.	SWITCH, SELECTOR, METER(VE0615 #USA-900)				1	
5-16	See Figure 5A		.	.	SWITCH,TEST/RESET				REF	
5-17	See Figure 5A		.	.	SWITCH, ENGINE STOP				REF	
5-18	See Figure 5A		.	.	SWITCH, OUTPUT NO. 2				REF	
5-19	See Figure 5A		.	.	SWITCH, OUTPUT NO. 1				REF	
5-20	See Figure 5A		.	.	SWITCH, ENGINE START				REF	
5-21	See Figure 5A		.	.	SWITCH, LAMPS				REF	
5-22	W10051-010		.	.	CLAMP, WIRE, 5/8"				2	
5-23	NOT USED									
2-24	494134-001		.	.	GAUGE, FUEL LEVEL				1	
2-25	284486-001		.	.	LIGHT, GAUGE				4	
2-26	287754		.	.	LABEL, EF BY-PASS				1	
2-27	287687-001		.	.	INDICATOR LIGHT, RED				1	
2-28	400613-016		.	.	LAMP, 12VDC, TYPE 382				1	

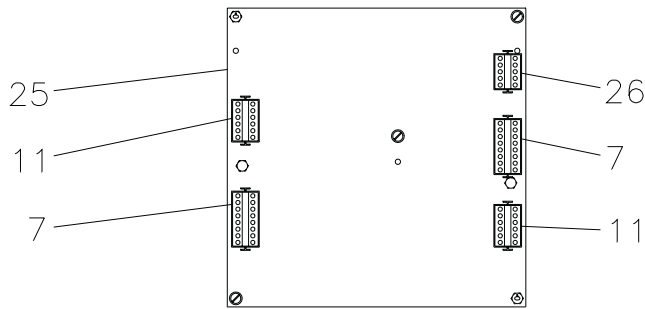


Push Buttons Details
Figure 5A

FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY
			1	2	3	4	5	6	
5A -	No Number		. LAMPS PUSH-BUTTON DETAILS						REF
5A- 1	285029-001		. .						1
5A- 2	285030-002		. .						1
5A- 3	285030-001		. .						1
5A- 4	285030-004		. .						1
5A- 5	285030-003		. .						1
5A- 6	285031-001		. .						1
5A- 7	285032-001		. .						1
5A- 8	285033		. .						1
5A- 9	284475-001		. .						1
5A-10	284475-003		. .						1
5A-11	284475-002		. .						1
5A-12	400613-004		. .						1
5A-13	285034-001		. .						1

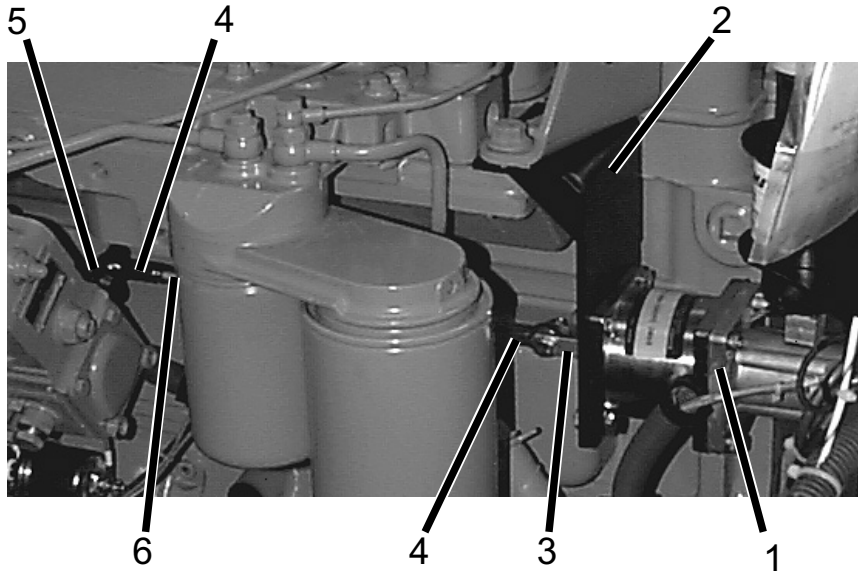


FACING FRONT OF GENERATOR SET CONTROL P.C. BOARD, MOUNTED ON INSIDE OF CONTROL BOX.

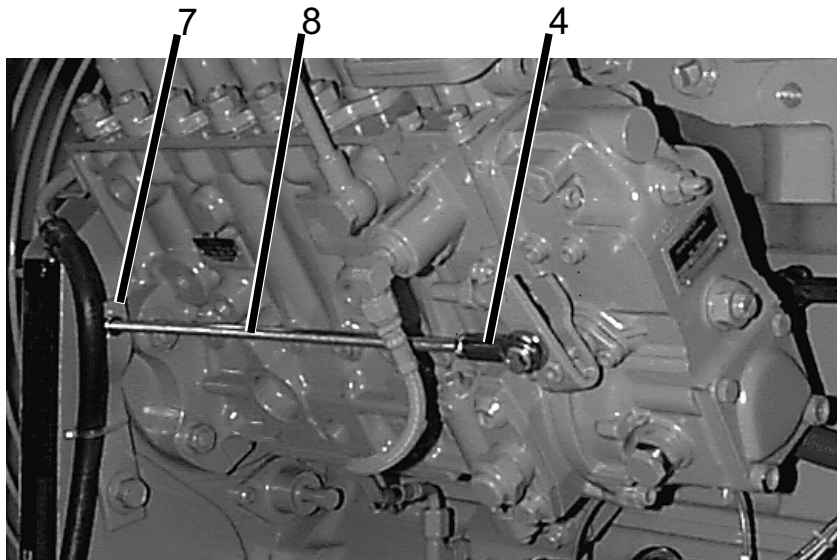


Control Box Interior Components
Figure 6

FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY
			1	2	3	4	5	6	
6 -	287749-004		CONTROL BOX ASSEMBLY INTERIOR COMPONENTS						REF
6- 1	284970		.	WRAPPER, CONTROL BOX, ASSY					1
6- 2	284935		.	TOP, CONTROL BOX					1
6- 3	79B-1159-1		.	RECEPTACLE, 37-PIN					1
6- 4	79B-1159-2		.	RECEPTACLE, 37-SOCKET					2
* 6- 5	79A-1164		.	PLUG, KEYING					2
6- 6	79B-1159-6		.	RECEPTACLE, 7-PIN					1
6- 7	401564-005		.	HOUSING, CONNECTOR, 16-CIRCUIT					4
6- 8	387736C		.	BOARD, PC, MEMORY & TIME DELAY					1
6- 9	375426-003		.	SPACER, PC BOARD (V016T7 #8575-N-0632-0)					24
6-10	482039C		.	BOARD, PC, OVER-UNDER FREQUENCY					1
6-11	401564-004		.	HOUSING, CONNECTOR, 12-CIRCUIT					4
6-12	482038A		.	BOARD, PC, OVER-UNDER VOLTAGE					1
6-13	285627		.	LABEL, REGULATOR					1
6-14	406807-002		.	KNOB, RED (V86797 #200085A)					2
6-15	282800A-001		.	BOARD, PC, VOLTAGE REGULATOR, .					1
6-16	401911-020		.	BLOCK, TERMINAL, 20-STATION (V30430 #0220081)					2
6-17	284937		.	BRACKET, MOUNTING, SWITCHES					1
6-18	283978-002		.	CIRCUIT BREAKER, 10A (V77342 #W23-X1A16-10)					2
6-19	283978-001		.	CIRCUIT BREAKER, 5A (V77342 #W23-X1A16-5)					2
6-20	402662		.	SWITCH, TOGGLE,					2
6-21	400292-006		.	SWITCH, TOGGLE, 4PDT					1
6-22	40201		.	INSULATION, STRIP, NEOPRENE, 1/8 X 1/2					58"
6-23	30GH-1262		.	SOCKET, LIGHT PANEL (V13445 #DL-21)					2
6-24	50GHP-206		.	LAMP, PILOT LIGHT					2
6-25	284908A		.	BOARD, PC, GENERATOR SET CONTROL					1
6-26	401564-003		.	HOUSING, CONNECTOR, 10-CIRCUIT					1
6-27				NOT USED					
6-28				NOT USED					
*6-29	489658-002		.	DIODE, ASSY.					3
*6-30	401923-003		.	CONNECTOR, WIRE, CLOSED-IN					1
6-31	285186		.	LABEL, SWITCH BRACKET					1
*6-32	181158		.	TUBING, Z-FLEX, 1"					4"
*6-33	400826-001		.	TIE, ANCHOR, CABLE, PLASTIC					23
*6-34	285160-002		.	SCREW, M3 X 6, TAPTITE, PAN-HD					23
*6-35	400828-001		.	TIE, CABLE, PLASTIC					50
*6-36	287766		.	HARNESS, CONTROL BOX ASSEMBLY					1
6-37	287075-001		.	RELAY, TIME DELAY, ENGINE SHUTDOWN (V66180 #405A100E1X)					1
6-38	405699		.	BASE, RELAY (V02660 #146-103)					1



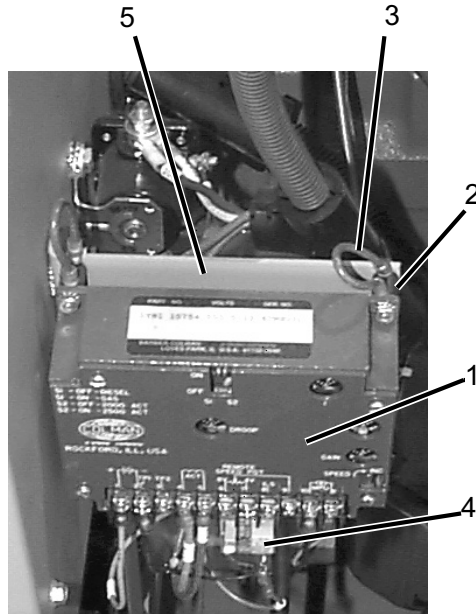
GOVERNOR ACTUATOR



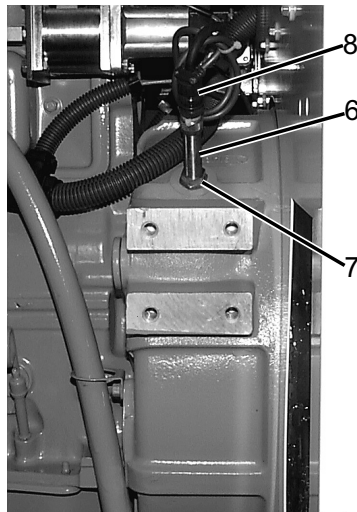
THROTTLE HOLDBACK

Governor Kit
Figure 7

FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY	
			1	2	3	4	5	6		
7-	287532-001		KIT, GOVERNOR (Also See Fig. 8)						1	
7 - 1	281772		. ELECTRIC GOVERNOR ACTUATOR (V2B928 #DYNC 10502-000-0-12)						1	
7 - 2	284223		. BRACKET, GOVERNOR ACT. MTG.						1	
7 - 3	281775		. CLEVIS, ACTUATOR ROD (V2B928 #DYNK 218-1)						1	
7 - 4	281776		. JOINT, BALL, GOVERNOR LINKAGE (V2B928 #DYNZ 7-1)						3	
7 - 5	287649		. LEVER, FUEL PUMP STOP						1	
7 - 6	287717-003		. THROTTLE LINKAGE ARM						1	
7 - 7	285436		. BRACKET, STOP ROD						1	
7 - 8	287717-005		. ROD, STOP						1	



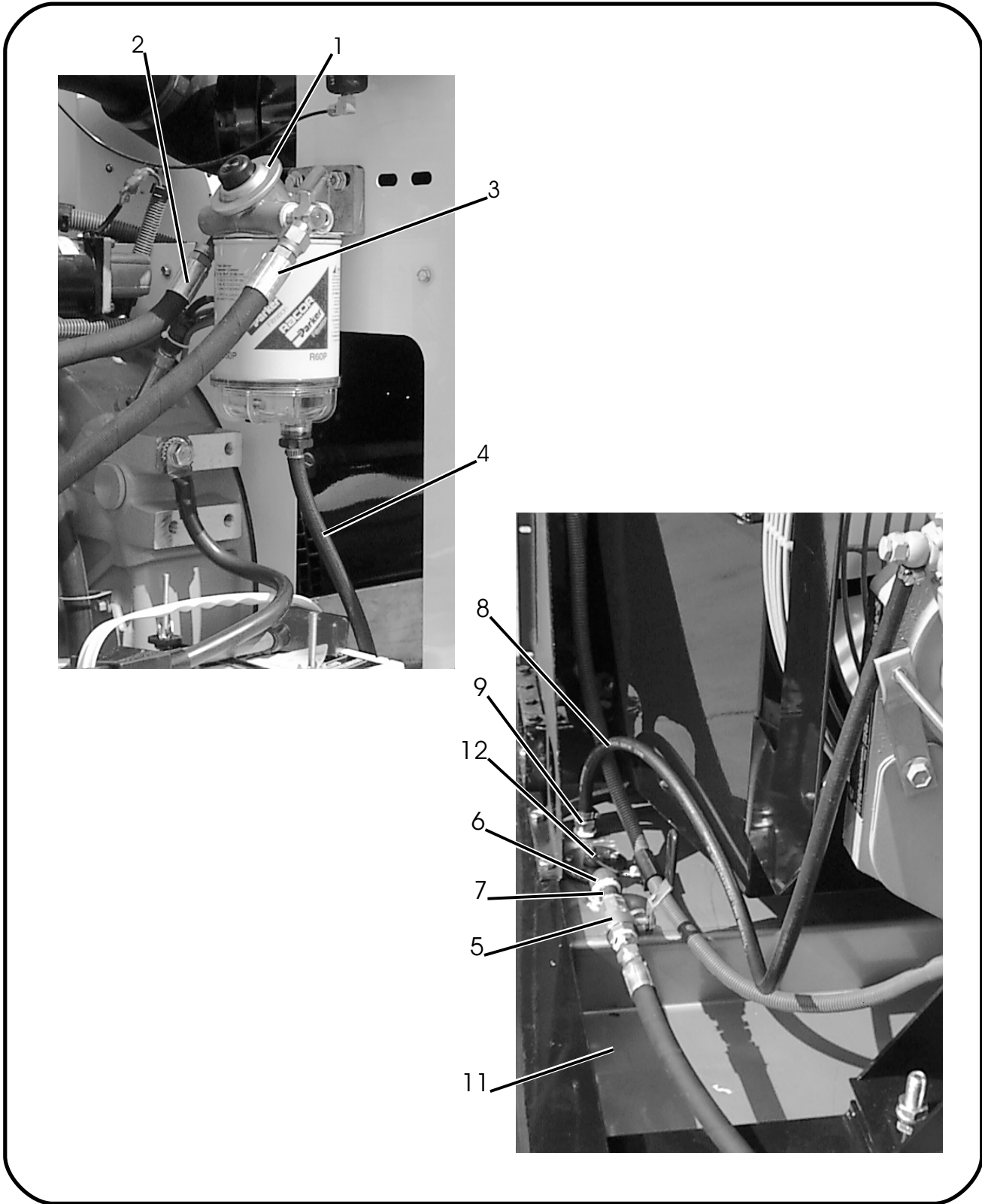
Governor Controller
(Left Side of Unit)



Magnetic Pickup
(Right side of Engine)

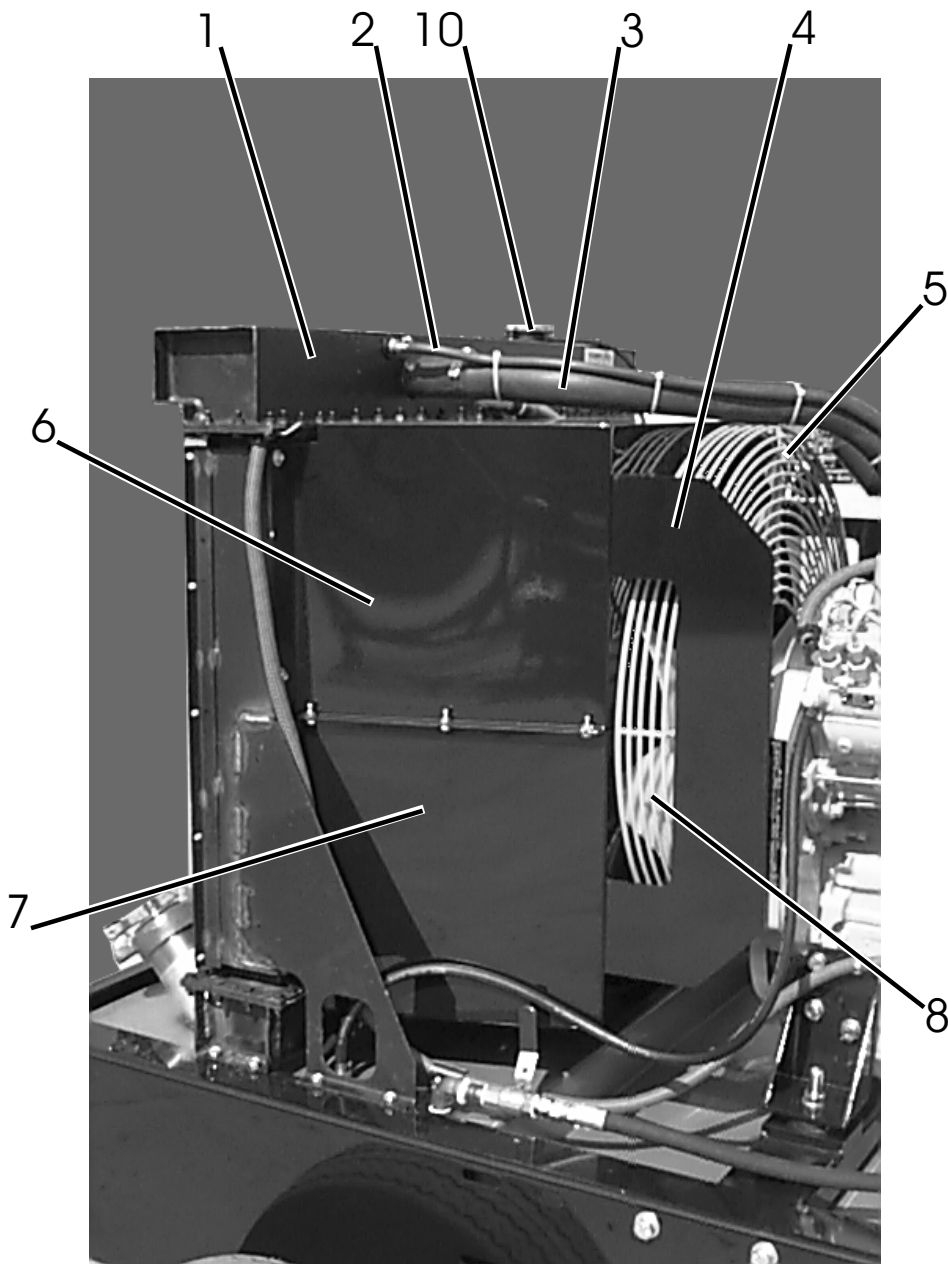
Governor Kit (Continued)
Figure 8

FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY	
			1	2	3	4	5	6	REF	
8-	287532-001		KIT, GOVERNOR (CONTINUED)						REF	
8 - 1	283990-001		.	CONTROLLER, GOV. ELECTRIC (V2B928 #DYN1-10756-000-0-12)						1
8 - 2	84A-1075		.	MOUNT, RUBBER						4
8 - 3	482989		.	STRAP, CONTROLLER						2
8 - 4	181891-003		.	BOARD, PC SPEED ADJUST						1
8 - 5	285141		.	BRACKET, CONTROLLER MTG.						1
8 - 6	285062-001		.	SENSOR, MAGNETIC PICKUP (V2B928 #3040AN25)						1
8 - 7	281751-003		.	ADAPTER, MAGNETIC PICKUP						1
8 - 8	285063A-002		.	CABLE ASSEMBLY						1



Fuel System Components
Figure 9

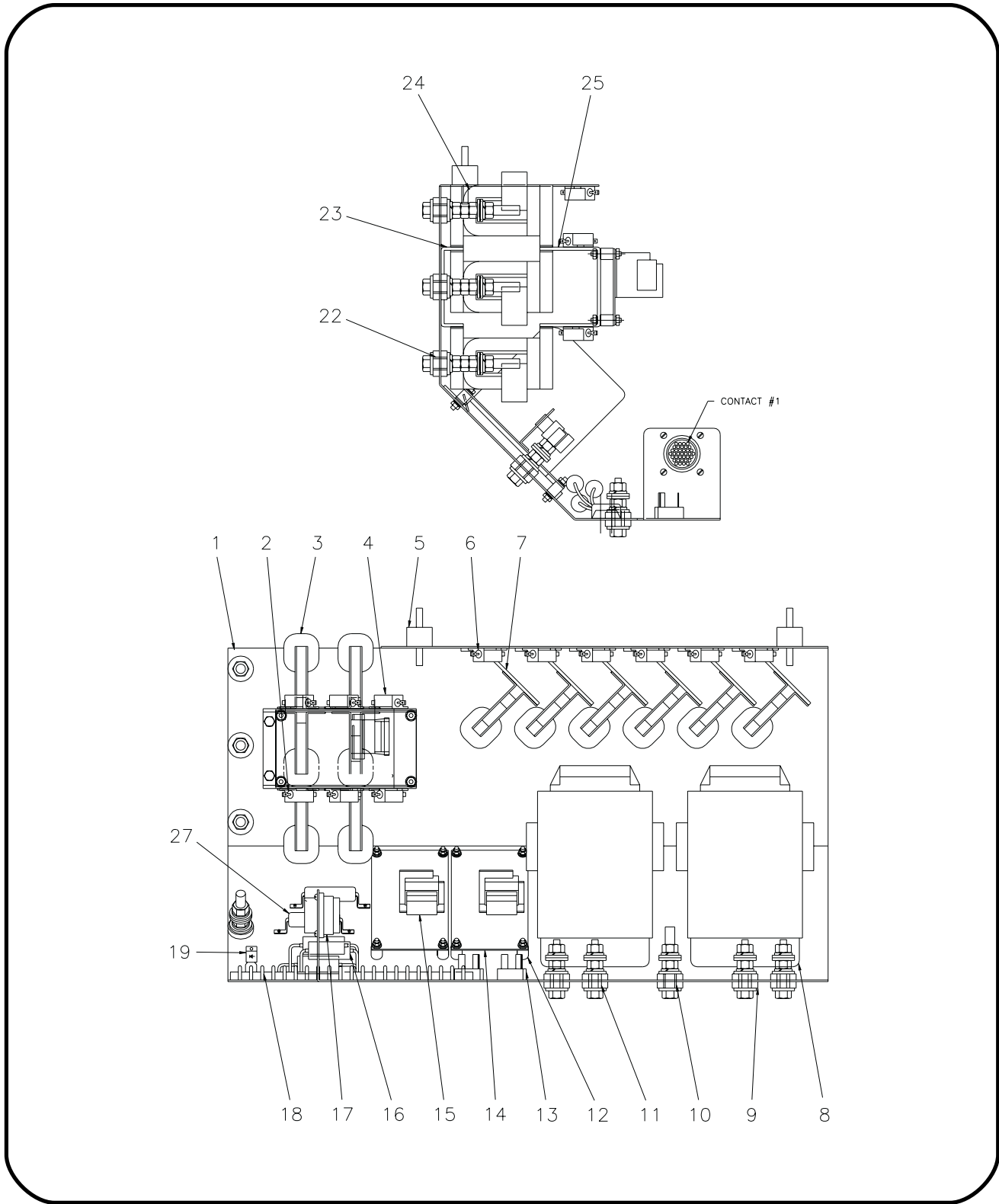
FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY	
			1	2	3	4	5	6		
9-	No Number		FUEL SYSTEM COMPONENTS						REF	
Note: All fuel lines (items 2, and 3) are supplied with fittings on each end as one complete assembly.										
9 - 1	287639		. FILTER, FUEL/WATER SEPARATOR (V55752 # 460R30)						1	
9 - 2	287641		. LINE, FILTER TO PUMP						1	
9 - 3	287804		. FUEL LINE, TANK TO FILTER						1	
9 - 4	056544		. HOSE, LOW PRESSURE						21"	
*	W10869-014		. HOSE CLAMP						1	
9 - 5	400819-003		. VALVE, BALL, 1/2" (V13902 #F-125R)						1	
9 - 6	12CW2077-003		. ELBOW, 1/2 N PT, ST, 90DEG.						1	
9 - 7	W10760-003		. NIPPLE, PIPE, 1" X 1/2						1	
9 - 8	056544		. LINE, FUEL RETURN						36"	
*	W10869-014		. HOSE CLAMP						2	
9 - 9	286851		. FITTING, HOSE, BARBED, BRASS						1	
9 - 10	NOT USED									
9 - 11	287781		. FUEL TANK, 65 GAL., STAINLESS STEEL						1	
9 - 12	486719-005		. FUEL SENDER						1	
* 9 - 13	286897-004		. PRIMARY FUEL FILTER						REF	
* 9 - 14	286897-005		. SECONDARY FUEL FILTER						REF	



Cooling System Components
Figure 10

FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY
			1	2	3	4	5	6	
10-	No Number		COOLING SYSTEM COMPONENTS						REF
10 -1	287780		.	.	.	.	.	.	1
10 -2	No Number		.	.	.	.	.	.	REF
	W-7814-000		.	.	.	.	.	.	1
	W-7814-011		.	.	.	.	.	.	1
	402927-003		.	.	.	.	.	.	2
	56534		.	.	.	.	.	.	30"
	W-10869-014		.	.	.	.	.	.	2
10 -3	287659		.	.	.	.	.	.	1
*	W10869-003		.	.	.	.	.	.	2
*	287660		.	.	.	.	.	.	1
*	W10869-005		.	.	.	.	.	.	2
10 -4	287453		.	.	.	.	.	.	1
*	287656		.	.	.	.	.	.	1
10 -5	287612		.	.	.	.	.	.	1
10 -6	287619		.	.	.	.	.	.	1
10 -7	287620		.	.	.	.	.	.	1
10 -8	286654		.	.	.	.	.	.	1
* 10 -9	283873		.	.	.	.	.	.	2
*	56535		.	.	.	.	.	.	40"
*	W-10869-014		.	.	.	.	.	.	1
*	80A1117		.	.	.	.	.	.	1
*	386751		.	.	.	.	.	.	2
* 10-10	287333		.	.	.	.	.	.	1
* 10 -11	287805		.	.	.	.	.	.	1
* 10 -12	287806		.	.	.	.	.	.	1

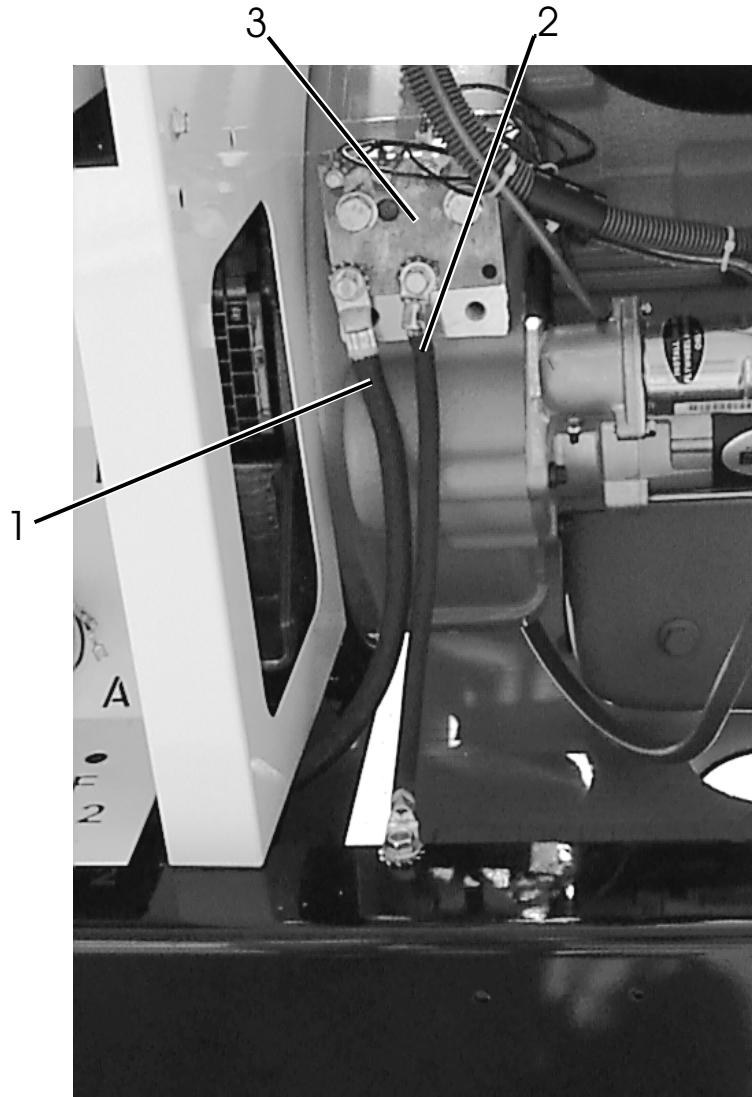
*** NOT ILLUSTRATED**



**Power Module Assembly
Figure 11**

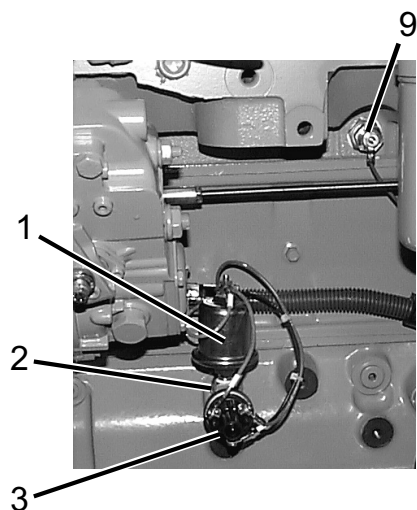
FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY
			1	2	3	4	5	6	
11 -	287760		OUTPUT MODULE PANEL ASSEMBLY						1
11 -1	283127		. PANEL, OUTPUT MODULE						1
11 -2	404402-008		. RESISTOR, 50 OHM, 20 WATT						3
11 -3	1CZ-148		. TRANSFORMER, CURRENT LINE DROP & OVERLOAD (V14831 #E-6170)						12
11 -4	404402-009		. RESISTOR, 12.5 OHM, 20 WATT						3
11 -5	HF-2752		. MOUNT, SHOCK, RUBBER						2
11 -6	404402-001		. RESISTOR, 16.6 OHM, 20 WATT						6
11 -7	283195		. BRACKET, MTG., CURRENT TRANSFORMER						12
11 -8	282130-001		. CONTACTOR, LINE, 3-POLE						2
11 -9	A-25		. WASHER, INSULATING						18
11 -10	AW-626		. BUSHING, INSULATING, NEUTRAL						2
11 -11	DW-1704		. BUSHING, INSULATING, E-F						4
11 -12	84A-1075		. MOUNT, SHOCK, RUBBER						12
11 -13	404065-002		. RECTIFIER, SILICON						2
11 -14	387738A		. BOARD, PC, OVERLOAD, ASSEMBLY						3
11 -15	401564-004		. HOUSING, SOCKET						3
11 -16	180593-002		. CAPACITOR, 0.1 MFD, 500 VAC, ASSEMBLY						3
11 -17	287762		. HARNESS, RECEPTACLE, ASSEMBLY						1
11 -18	401911-020		. BLOCK, TERMINAL (V30430 #0220081)						1
11 -19	282089-010		. DIODE, FLYBACK						1
* 11 -20	403069		. TERMINAL, QUICK CONNECT						2
* 11 -21	400828-002		. TIE, WIRE, PLASTIC						2
11 -22	AW-626		. BUSHING, INSULATING, A-B-C						3
11 -23	283193		. BRACKET, MTG., BOTTOM, C.T.						1
11 -24	76A-1131		. TUBING, Z-FLEX, 1/2 DIA (<i>Six 4.5" pieces</i>)						2.25'
11 -25	283192		. BRACKET, MTG., TOP, C.T						1
* 11 -26	NO NUMBER		. CABLE, ASSEMBLY, POWER						
*	W-9350-302		. . (No. 101) "A" Stator Terminal to "T1" No. 1 Contactor						1
*	W-9350-301		. . (No. 102) "B" Stator Terminal to "T2" No. 1 Contactor						1
*	W-9350-201		. . (No. 103) "C" Stator Terminal to "T3" No. 1 Contactor						1
*	W-9350-224		. . (No. 104) "A" Stator Terminal to "T1" No. 2 Contactor						1
*	W-9350-205		. . (No. 105) "B" Stator Terminal to "T2" No. 2 Contactor						1
*	W-9350-305		. . (No. 106) "C" Stator Terminal to "T3" No. 2 Contactor						1
*	W-9350-301		. . (No. 110) "N" Stator Terminal to "N" Terminal to ground						1
11 -27	W-9746-3		. . RESISTOR, 100-OHM, 20-WATT						2
* 11 -28	287774		. INSULATOR, CURRENT TRANSFORMER						6

* NOT ILLUSTRATED

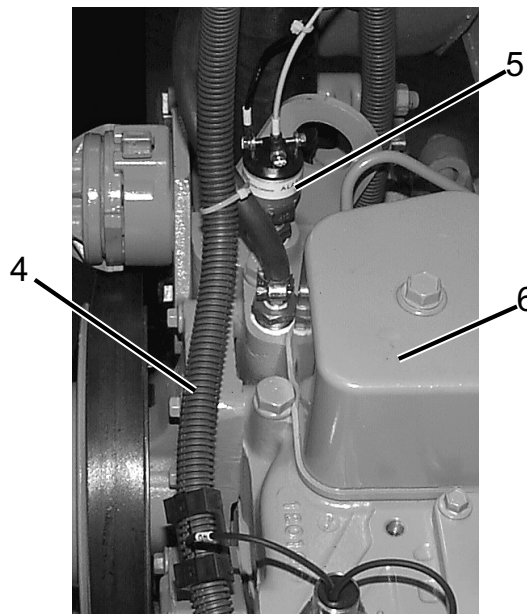


Grounding Plate
and Cables
Figure 12

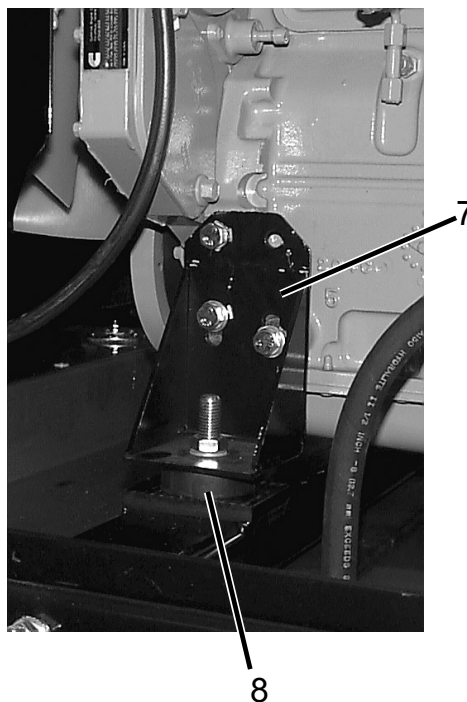
FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY	
			1	2	3	4	5	6	REF	
12 -	No	Number	GROUND PLATE COMPONENTS						REF	
12 - 1	W-9360-289		.	CABLE, #111, POWER MOD. TO GROUND						1
12 - 2	W-9407-446		.	CABLE, ENGINE TO GROUND						1
12 - 3	287735		.	PLATE, GROUND						1
* NOT ILLUSTRATED										



Right Side of Engine



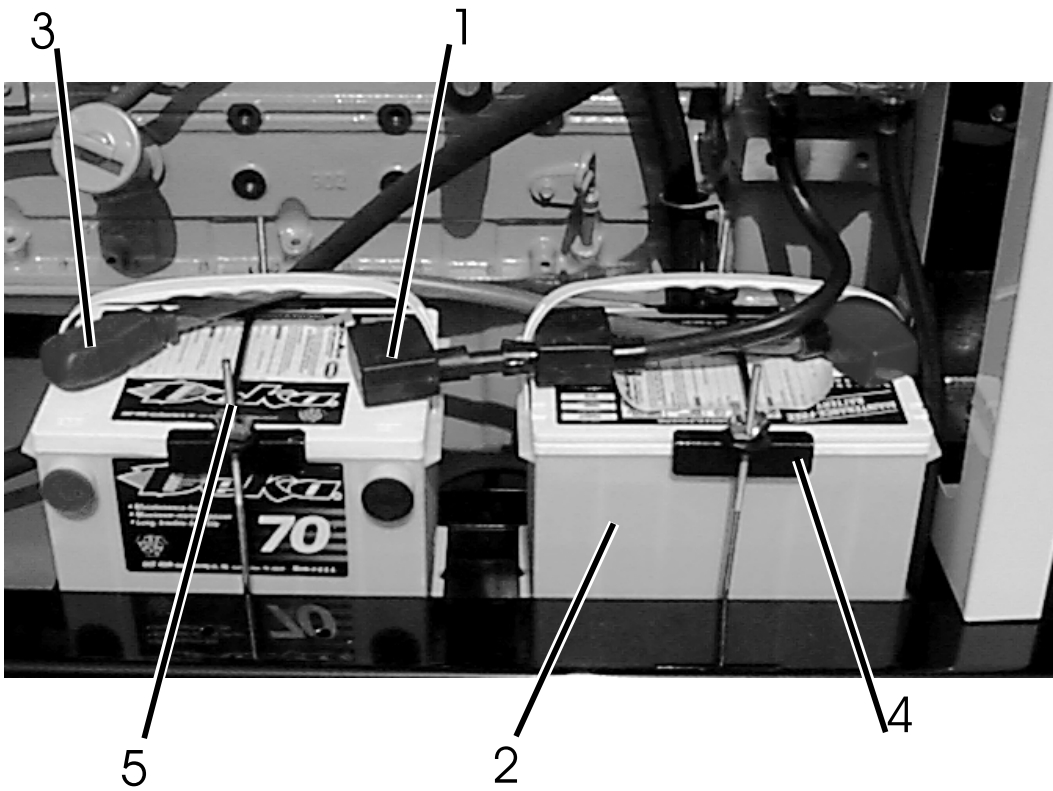
Top Front of Engine



Engine Components
Figure 13

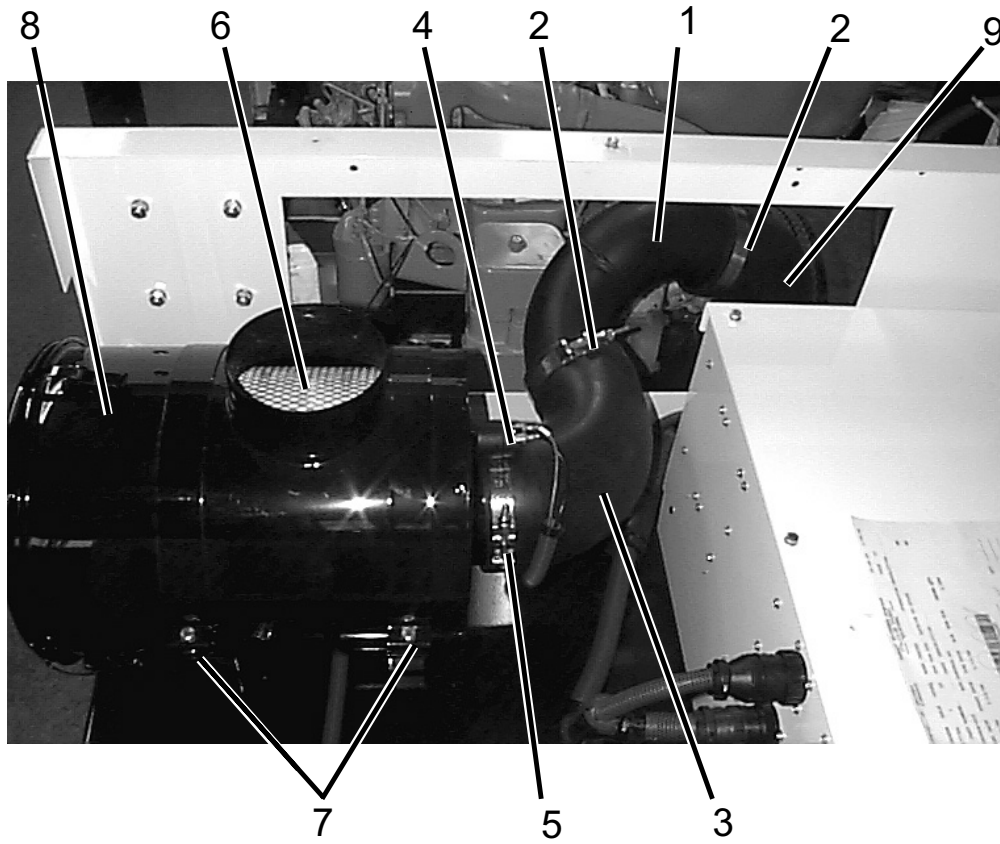
FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY	
			1	2	3	4	5	6	REF	
13 -	No Number		ENGINE COMPONENTS						REF	
13 - 1	78B-1118-2		.	OIL PRESSURE SENDER (V16476 #16476)					1	
13 - 2	W-10910-0		.	TEE FITTING					1	
*	287419		.	ADAPTER, M10 X 1/8"					1	
*	W-10750-001		.	ADAPTER, 3/8" X 1/2"					1	
13 - 3	403809-001		.	SWITCH, OIL PRESSURE (V75419 #1042-08210-10)					1	
13 - 4	287708		.	ENGINE HARNESS					1	
13 - 5	403782-002		.	SWITCH, SHUT DOWN					1	
*	W-7814-004		.	ADAPTER, 3/8" X 1/2"					1	
13 - 6	287568		.	ENGINE, CUMMINS					1	
*	287438		.	VALVE, OIL DRAIN					1	
13 - 7	282852		.	MOUNT, ENGINE					2	
13 - 8	480603-002		.	SHOCK MOUNT (GREEN)					2	
*	480628		.	WASHER, SHOCK MOUNT					2	
13 - 9	78B-1119-1		.	SENDER, WATER TEMP. (V16476 #02019)					1	
*	W-7814-004		.	ADAPTER, 3/8" X 1/2"					1	
*	13 - 10	286897-006	.	OIL FILTER					1	
*		286897-004	.	PRIMARY FUEL FILTER					1	
*		286897-005	.	SECONDARY FUEL FILTER					1	

* NOT ILLUSTRATED



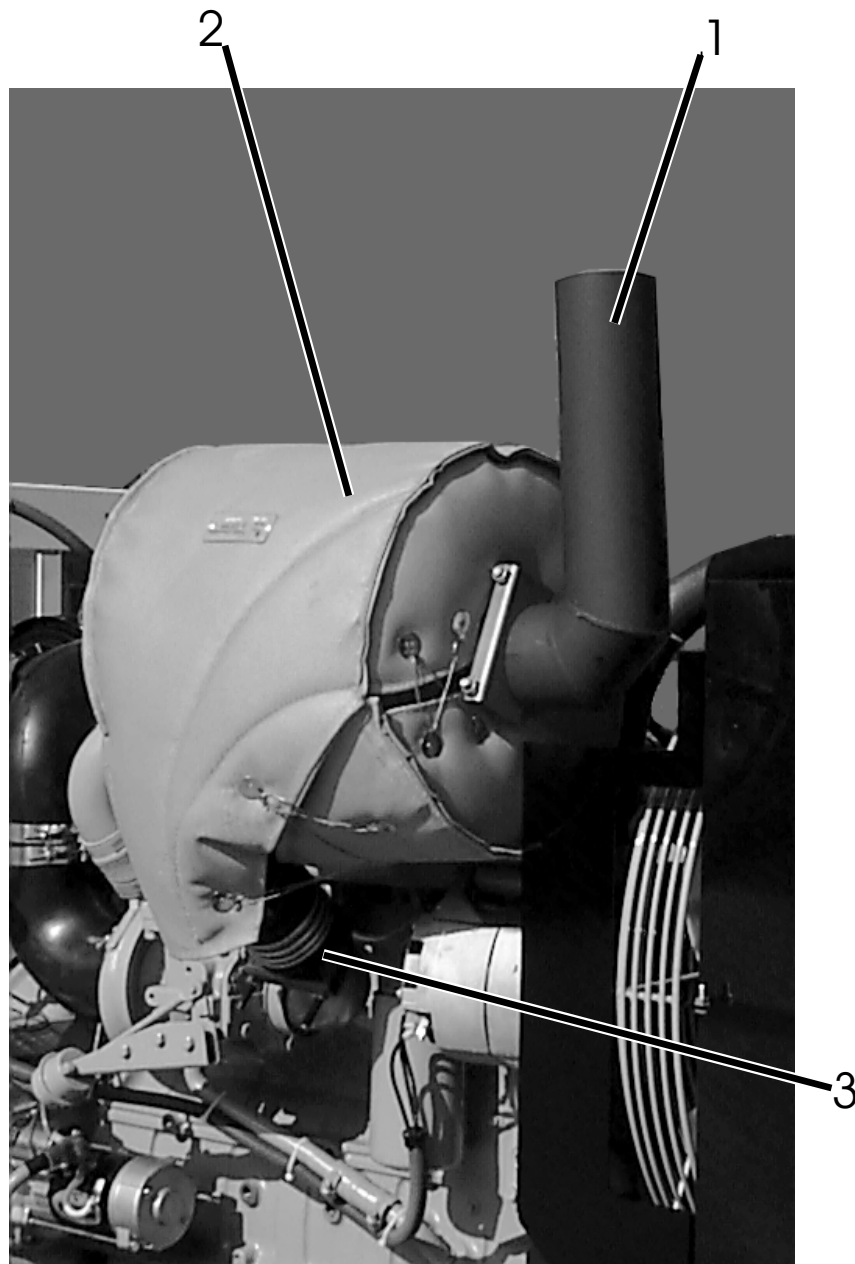
Battery Components
Figure 14

FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY	
			1	2	3	4	5	6		
14 -	No	Number	BATTERY COMPONENTS						REF	
14 - 1	287797		.							1
14 - 2	281881-001		.							2
14 - 3	287740		.							1
14 - 4	287796		.							1
14 - 5	494295		.							2



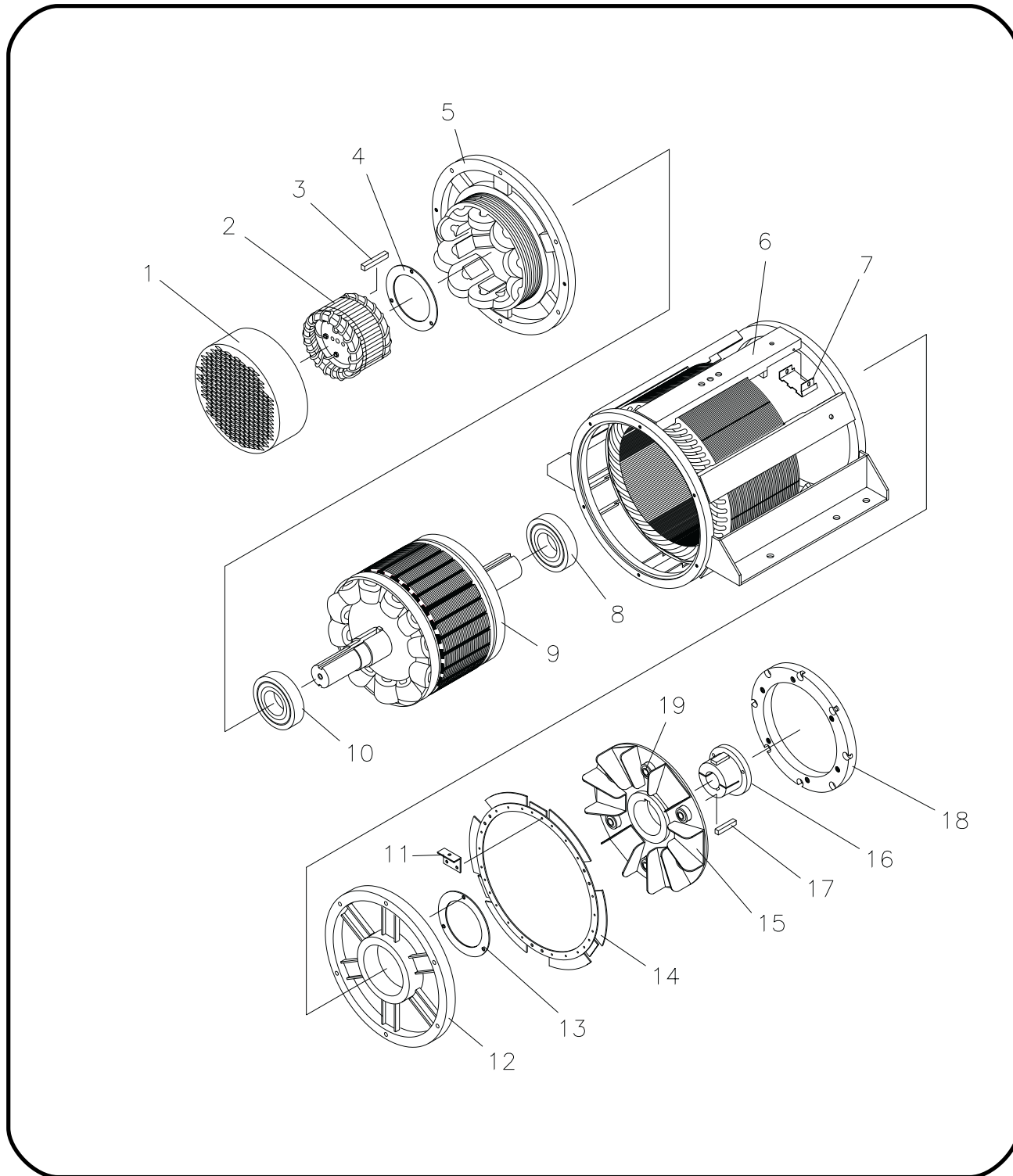
Air Cleaner Components
Figure 15

FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY	
			1	2	3	4	5	6		
15 -	No Number		AIR CLEANER COMPONENTS						REF	
15 - 1	287531		.	PIPE, AIR INTAKE ASSEMBLY						1
15 - 2	280732-006		.	CLAMP, T-BOLT						5
15 - 3	284925		.	REDUCER, RUBBER, 90° ELBOW						1
15 - 4	282918		.	ELECTRIC RESTRICTION INDICATOR (V18265 #REX77-0062)						1
15 - 5	280732-007		.	CLAMP, T-BOLT						1
15 - 6	287548		.	AIR CLEANER REPLACEMENT						REF
15 - 7	284923		.	MOUNT, AIR CLEANER BAND (V18265 #AAH00-0349)						2
15 - 8	286061		.	CLEANER, AIR (V18265 #EBB12-0271)						1
15 - 9	287371		.	ELBOW, 4" 'I.D.						2
* 15 - 10	284461		.	CONNECTOR, SHORT PIPE						1
* NOT ILLUSTRATED										



Muffler and Exhaust Components
Figure 16

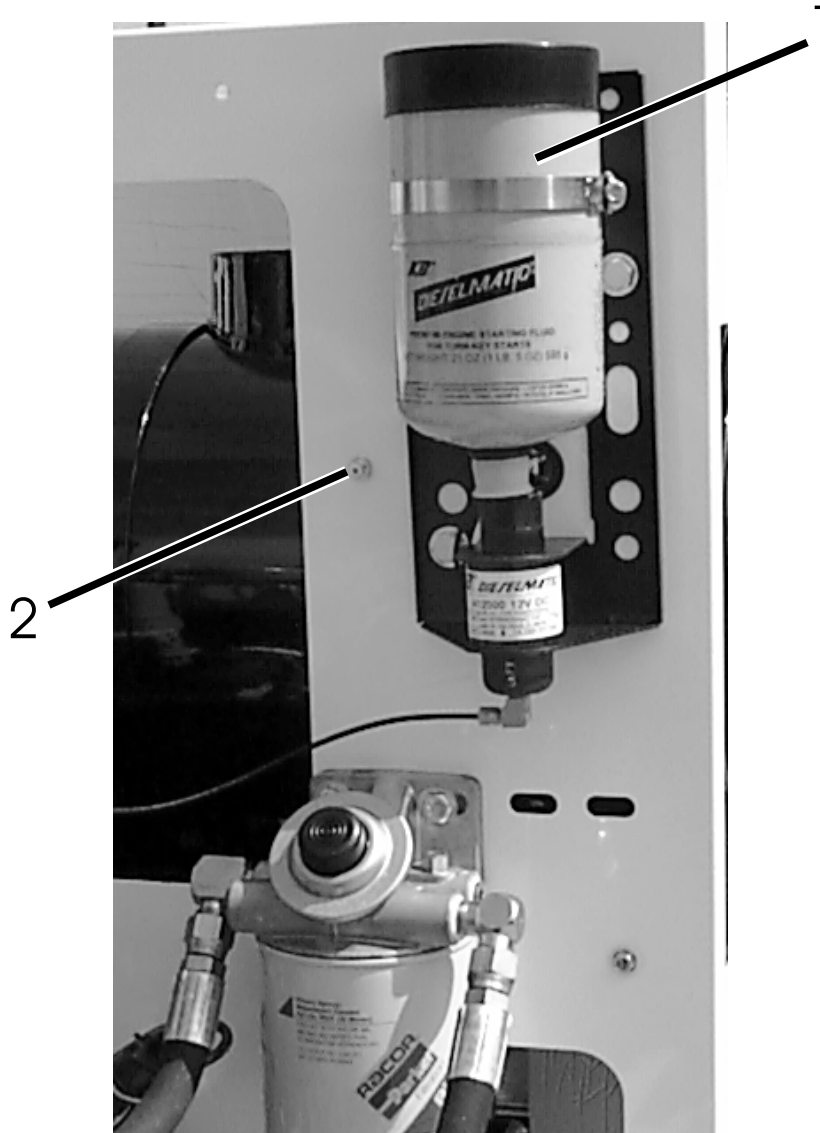
FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY	
			1	2	3	4	5	6	REF	
16 -	No	Number	MUFFLER & EXHAUST COMPONENTS						REF	
16 - 1	287596		.	MUFFLER,	EXHAUST					1
16 - 2	287597		.	MUFFLER	WRAPPER					1
16 - 3	287624		.	PIPE,	EXHAUST,	TURBO	TO	SILENCER		1
	404154-013		.	CLAMP,	PIPE					1



Generator Assembly
Figure 17

FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY	
			1	2	3	4	5	6		
17 -	285120A-006		GENERATOR, 2400 RPM, 120kVA, DUAL BEARING						1	
	286092		GENERATOR, 120KVA, (REPLACEMENT ONLY)						REF	
17- 1	281698		.						COVER, EXCITER	1
17- 2	282132		.						EXCITER ARMATURE ASSEMBLY	1
17- 3	180696-002		.						KEY, EXCITER	1
17- 4	282128		.						RETAINER, BEARING	1
17- 5	285121		.						EXCITER HOUSING	1
17- 6	287724		.						HOUSING AND STATOR ASSEMBLY	1
17- 7	283620		.						AIR DEFLECTOR	6
17- 8	W10072-068		.						BEARING, GENERATOR	1
17- 9	281690A-006		.						ARMATURE ASSEMBLY	1
17- 10	W10072-068		.						BEARING, GENERATOR	1
17- 11	283560		.						BRACKET, SHROUD MTG.	3
17- 12	287729		.						FRONT BEARING SUPPORT	1
17- 13	282128		.						RETAINER, BEARING	1
17- 14	283546		.						SHROUD, FAN, ASSEMBLY	1
17- 15	281701		.						KIT, FLEX COUPLING	1
17- 16	85C1004-001		.	.					BUSHING, SPLIT TAPER (PART OF ITEM 15)	1
17- 17	85B1039		.						KEY, BUSHING	1
17- 18	386612		.						FLEX COUPLING RING SPACER	1
17- 19	483756		.						KIT, BUSHING REPLACEMENT (6 BUSHINGS)	REF
*17- 20	281699		.						COVER, GENERATOR	1
*17- 21	480603-001		.						GENERATOR SHOCK MOUNT	4
*17- 22	480628		.						WASHER, SHOCK MOUNT	4

*** NOT ILLUSTRATED**



Cold Weather Start Components
Figure 18

FIGURE & ITEM NO.	HOBART PART NO.	AIRLINE PART NO.	NOMENCLATURE						UNITS PER EFF ASSY										
			1	2	3	4	5	6	REF										
19 -	No Number		COLD WEATER START COMPONENTS						REF										
19 - 1	408506		.	C	O	L	D	W	E	A	T	E	R	S	T	K	I	T	1
18 - 2	409527-003		.	C	I	R	C	B	R	E	A	K	E	R	, 15A				1

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Section 4. Numerical Index

1. Explanation of Numerical Index

The purpose of this index is to assist the user in finding the illustration and description of a part when the part number is known. Part numbers are arranged in numeric-alpha sequence. Thus, any number beginning with the letter "A" would be located toward the end of the index list. On the other hand, a part number starting with a "1" would be listed near the beginning of the list. The figure number and item number location of the part is directly opposite the part. If the part is used more than one place, each location beginning with the first is listed.

Figure & Item Number	Part Number	Figure & Item Number	Part Number
10-1	056535	11-7	283195
9-4	056544	1 - 23	283533
9-6	12CW2077-003	17-14	283546
11-16	180593-002	17-11	283560
17-3	180696-002	3-16	283597
6-32	181158	17-7	283620
8-4	181891-003	3-6	283647
11 -3	1CZ-148	3-15	283824
15-2	280732-006	10-1	283873
15-5	280732-007	6-19	283978-001
17-9	281690A-007	6-18	283978-002
17-1	281698	8-1	283990-002
17-20	281699	15 - 10	284461
17-15	281701	5-25	284486-001
8-7	281751-003	6-25	284908A
7-1	281772	15-7	284923
7-3	281775	15-3	284925
7-4	281776	6- 2	284935
14-2	281881-001	6-17	284937
11-19	282089-010	6- 1	284970
17-13	282128	8-6	285062-001
17-4	282128	8-8	285063A-003
11-8	282130-001	5-10	285080
2-5	282562	4-12	285120-007
1 - 21	282658	17-	285120A-007
1 - 22	282659	17-5	285121
3-3	282732-001	1 - 4	285125
6-15	282800A-001	8-5	285141
15-4	282918	6-34	285160-002
11-1	283127	5-11	285172
5- 9	283167	6-31	285186
11-25	283192	4 - 18	285200
11-23	283193	5-14	285501

Figure & Item Number	Part Number	Figure & Item Number	Part Number
7-2	285585	16 - 6	287643
6-13	285627	16 - 5	287644
1 - 5	285681	16 - 5	287645
7-7	285734	16 - 5	287647
10-4	285749	7-5	287649
15-8	286061	5-27	287687-001
3-21	286834	16-2	287691
1 - 8	287048	1 - 25	287696
6-37	287075-001	3-2	287699
10-7	287337	3-1	287701
10 - 8	287338	3-13	287703
4 - 17	287368	3-22	287704
16-1	287369	3-4	287705
16 - 6	287370	2-1	287706
15-9	287371	2-3	287707
10-5	287390	3-20	287710
10-5	287391	2-12	287713
4 - 17	287397	7-6	287717-004
4 - 17	287398	7-8	287717-006
16-2	287405	17-6	287724
16 - 5	287406	17-12	287729
15-1	287420	12-3	287735
3-5	287422	3-1	287738-001
16-3	287431	3-20	287738-002
16-3	287431	2-9	287738-003
16-4	287432	3-13	287738-004
2-10	287437	3-22	287738-005
10 - 9	287453	3-4	287738-006
1 - 24	287454	3-4	287738-007
1 - 11	287459	2-1	287738-008
1 - 15	287460	2-1	287738-009
1 - 16	287461	2-1	287738-010
1 - 17	287462	3-2	287738-011
1 - 18	287463	2-11	287738-015
1 - 19	287464	2-9	287739
1 - 20	287466	12-4	287741
10-2	287471	14-1	287741
3-18	287526-002	14-3	287742
3-19	287542-001	4 - 14	287747
15-6	287548	4 - 15	287748
10-6	287612	4-1	287749-005
9-1	287639	5 -	287749-005
9-2	287640	6 -	287749-005

Figure & Item Number	Part Number	Figure & Item Number	Part Number
5- 1	287752-005	6-33	400826-001
5- 3	287753	6-35	400828-001
5-26	287754	11-21	400828-002
11-17	287762	6-26	401564-003
6-36	287766	11-15	401564-004
11 -28	287774	6-11	401564-004
2-6	287781	6- 7	401564-005
9 - 9	287781	11-18	401911-020
3-14	287785	4 - 16	401911-020
3 - 24	287786	6-16	401911-020
3 - 26	287788	6-30	401923-003
3 - 27	287789	6-22	40201
3 - 30	287790	2-14	402037-028
3 - 28	287791	6-20	402662
3 - 29	287792	1 - 9	402987
3-12	287793	11-20	403069
3-10	287794	3-17	403091-008
2-4	287795	3 - 25	403091-017
14-4	287796	3-7	403127
2-11	287798	3-9	403127
2-2	287802	13-4	403782-004
2-13	287803	13-2	403809-001
9-3	287804	11-13	404065-002
17-2	287814	16 - 6	404154-016
11-	287815	16-1	404154-016
4-5	287815	11-6	404402-001
10-1	287816	11-2	404402-008
3-11	287819	11-4	404402-011
3-8	287889	6-38	405699
4 - 13	287900	6-14	406807-002
5-4	287908	4 - 18	408173
13-3	287909	19 - 1	408506
5-12	287912	1 - 26	408665-001
9-8	287922	1 - 27	408665-002
2-7	287923	18 - 2	409527-003
6-23	30GH-1262	1 - 14	430077-002
6- 9	375426-003	17-21	480603-001
17-18	386612	17-22	480628
6- 8	387736C	6-12	482038A
11-14	387738A	6-10	482039C
6-21	400292-006	8-3	482989
5-28	400613-016	17-19	483756
9-5	400819-003	9 - 10	486719-005

Figure & Item Number	Part Number	Figure & Item Number	Part Number
6-29	489658-002	5- 5	HF2518-002
5-24	494134-001	4-1	HF2752
14-5	494295	4-5	HF2752
1-	500140-001	11-5	HF-2752
1-	500140-002	5-22	W10051-010
6-24	50GHP-206	5- 2	W10051-013
10-3	56535	17-10	W10072-068
4 - 17	56553	17-8	W10072-068
11-24	76A-1131	9-7	W10760-001
1 - 13	76B1148	9-4	W10869-014
1 - 6	77A1157	10-3	W-10886-003
1 - 10	78A1000	10-3	W-10891-003
5- 8	78A1115-001	10-3	W-10893-000
5- 7	78A1117-002	13-6	W10909-001
13-5	78B1118-002	13-1	W7814-004
1 - 12	79A1110	10-3	W-7814-004
6- 5	79A-1164	10-3	W-7814-005
6- 3	79B-1159-1	5-13	W8105A-004
6- 4	79B-1159-2	11-26	W-9350-201
6- 6	79B-1159-6	11-26	W-9350-205
5-15	79C1158	11-26	W-9350-224
3 - 24	7J422-000	11-26	W-9350-301
8-2	84A1075	11-26	W-9350-301
11-12	84A-1075	11-26	W-9350-302
17-17	85B1039	11-26	W-9350-305
17-16	85C1004-001	12-1	W9360-289
11-9	A-25	12-2	W9407-446
11-10	AW-626	11 -27	W-9746-3
11-22	AW-626	5- 6	W9917-018
11-11	DW-1704		

Chapter 5. Manufacturers' Literature

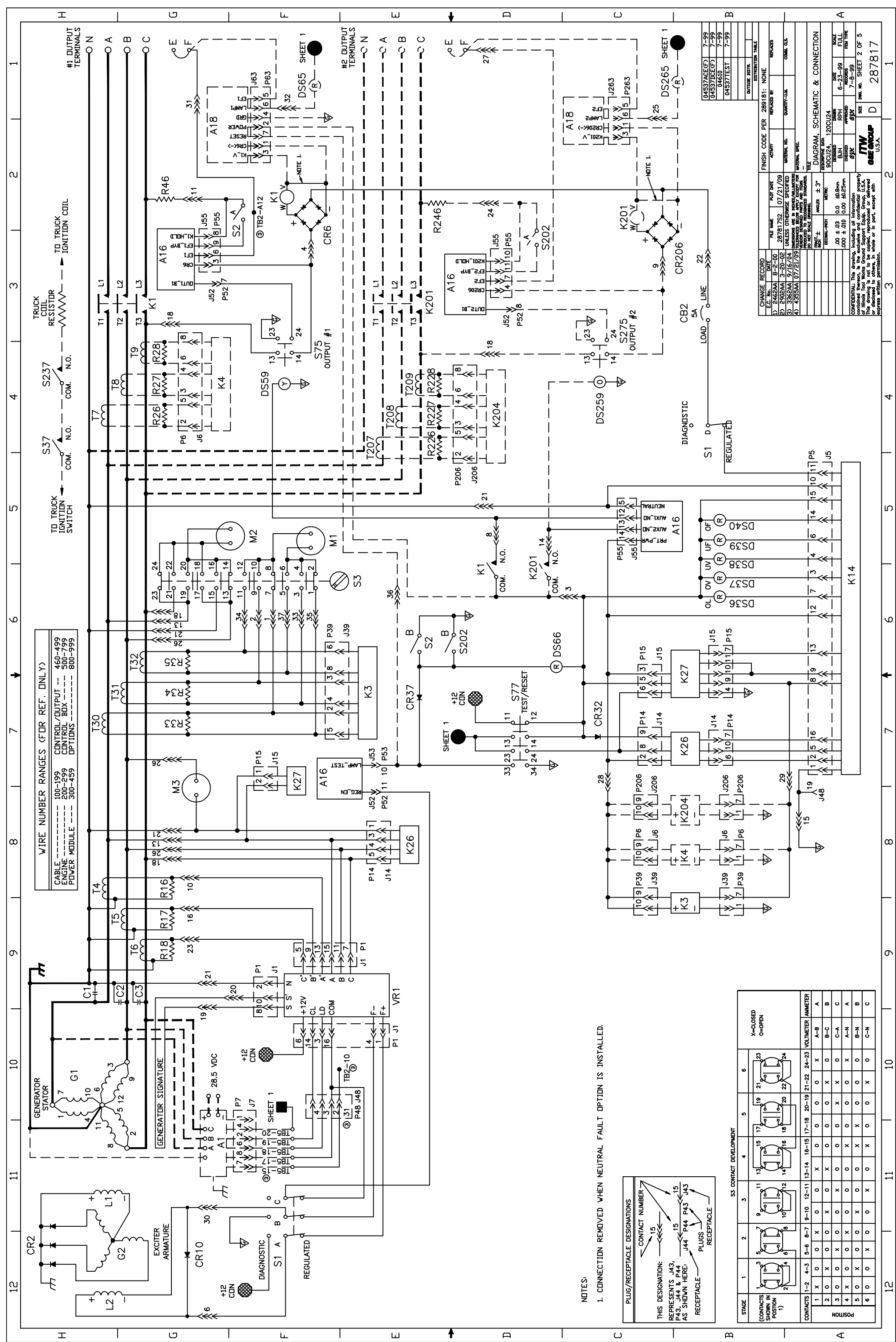
VENDOR LITERATURE

Engine	Cummins Diesel Engine Operation Manual Cummins Diesel Spare Parts Catalogue
--------	--

HOBART DIAGRAMS:

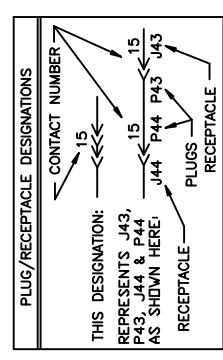
DIAGRAM #	DIAGRAM
287817	Schematic and Connection, Engine, Generator, and Options
287750	Connection, Control Box
287761	Connection, Power Module

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WIRE NUMBER RANGES (FOR REF. ONLY)	
CABLE	100-199
ENGINE	200-299
POWER MODULE	300-459
CONTROL/OUTPUT	460-499
CONTROL BOX	500-799
OPTIONS	800-999

NOTES:
1. CONNECTION REMOVED WHEN NEUTRAL FAULT OPTION IS INSTALLED.



STAGE	S3 CONTACT DEVELOPMENT											
	1	2	3	4	5	6	7	8	9	10	11	12
(CONTACTS SHOWN IN POSITION 1)	[Contact Development Diagrams]											
CONTACTS 1-2	X	0	0	0	0	0	0	0	0	0	0	0
CONTACTS 3-4	0	X	0	0	0	0	0	0	0	0	0	0
CONTACTS 5-6	0	0	X	0	0	0	0	0	0	0	0	0
CONTACTS 7-8	0	0	0	X	0	0	0	0	0	0	0	0
CONTACTS 9-10	0	0	0	0	X	0	0	0	0	0	0	0
CONTACTS 11-12	0	0	0	0	0	X	0	0	0	0	0	0
CONTACTS 13-14	0	0	0	0	0	0	X	0	0	0	0	0
CONTACTS 15-16	0	0	0	0	0	0	0	X	0	0	0	0
CONTACTS 17-18	0	0	0	0	0	0	0	0	X	0	0	0
CONTACTS 19-20	0	0	0	0	0	0	0	0	0	X	0	0
CONTACTS 21-22	0	0	0	0	0	0	0	0	0	0	X	0
CONTACTS 23-24	0	0	0	0	0	0	0	0	0	0	0	X
POSITION	A	A-B	B	B-C	C	C-A	A-N	A	B-N	B	C-N	C

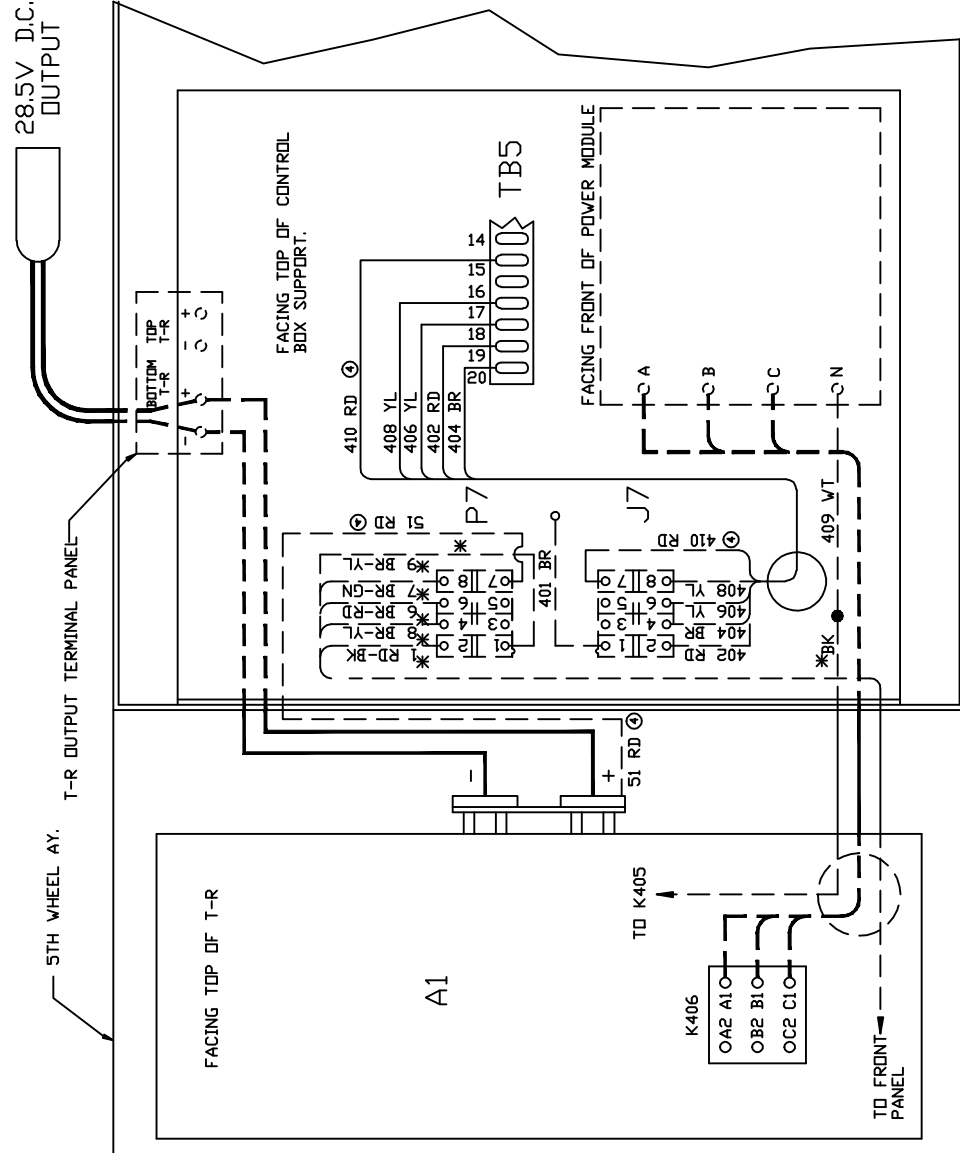
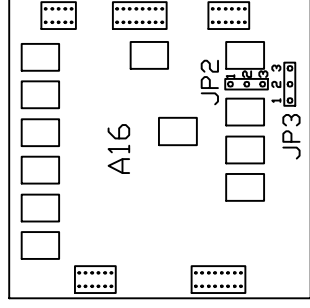
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100	07/21/09	UNLESS OTHERWISE SPECIFIED	

INSTALL JUMPERS JP2 & JP3 ON GENERATOR CONTROL P.C. BOARD (A16) PER TABLE 1 (BELOW) TO OBTAIN DESIRED ACTION.

DESIRED ACTION FOR "LOW FUEL" CONDITION	TERMINAL CONNECTIONS FOR JUMPER		
	JP2	JP3	
ENGINE SHUT-DOWN	2-3 (STOP)	1-2 (IDLE)	
ENGINE IDLE	1-2 (RUN)	1-2 (IDLE)	
INDICATION ONLY	1-2 (RUN)	2-3 (CRATED)	

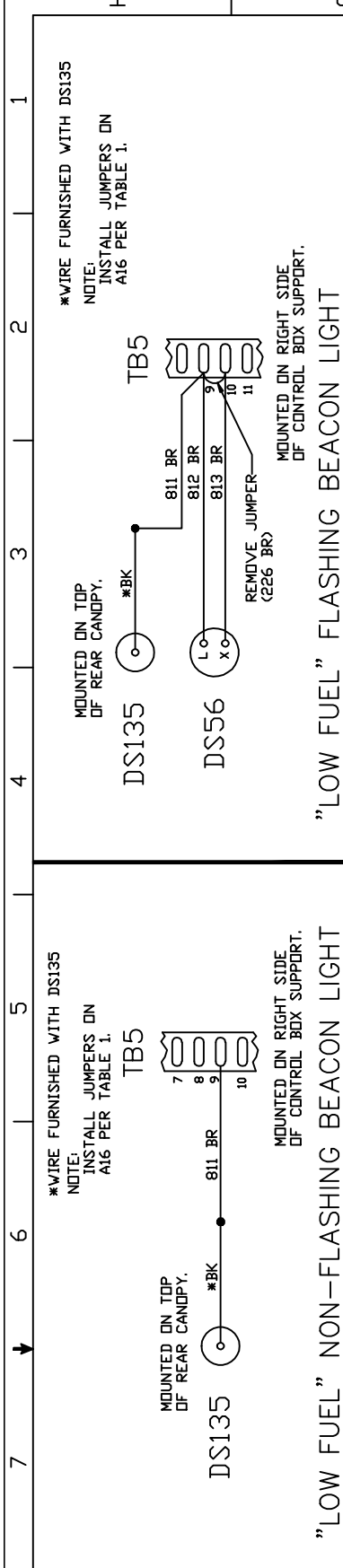
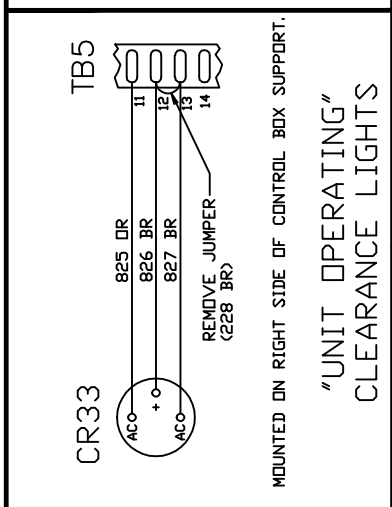
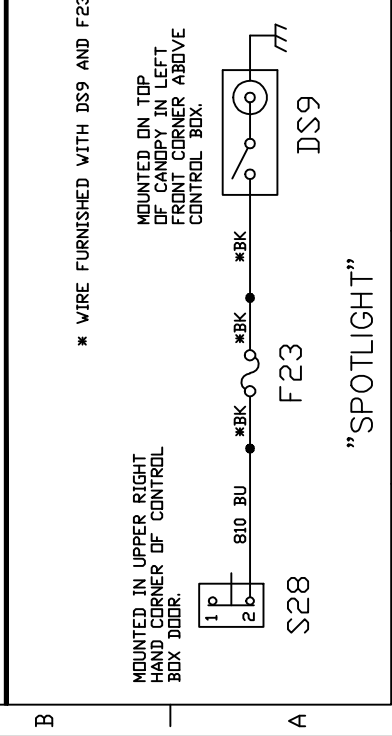
NOTE:
BEACON LIGHT MAY BE
INSTALLED FOR ANY MODE.

"LOW FUEL" SHUT-DOWN / IDLE / INDICATION



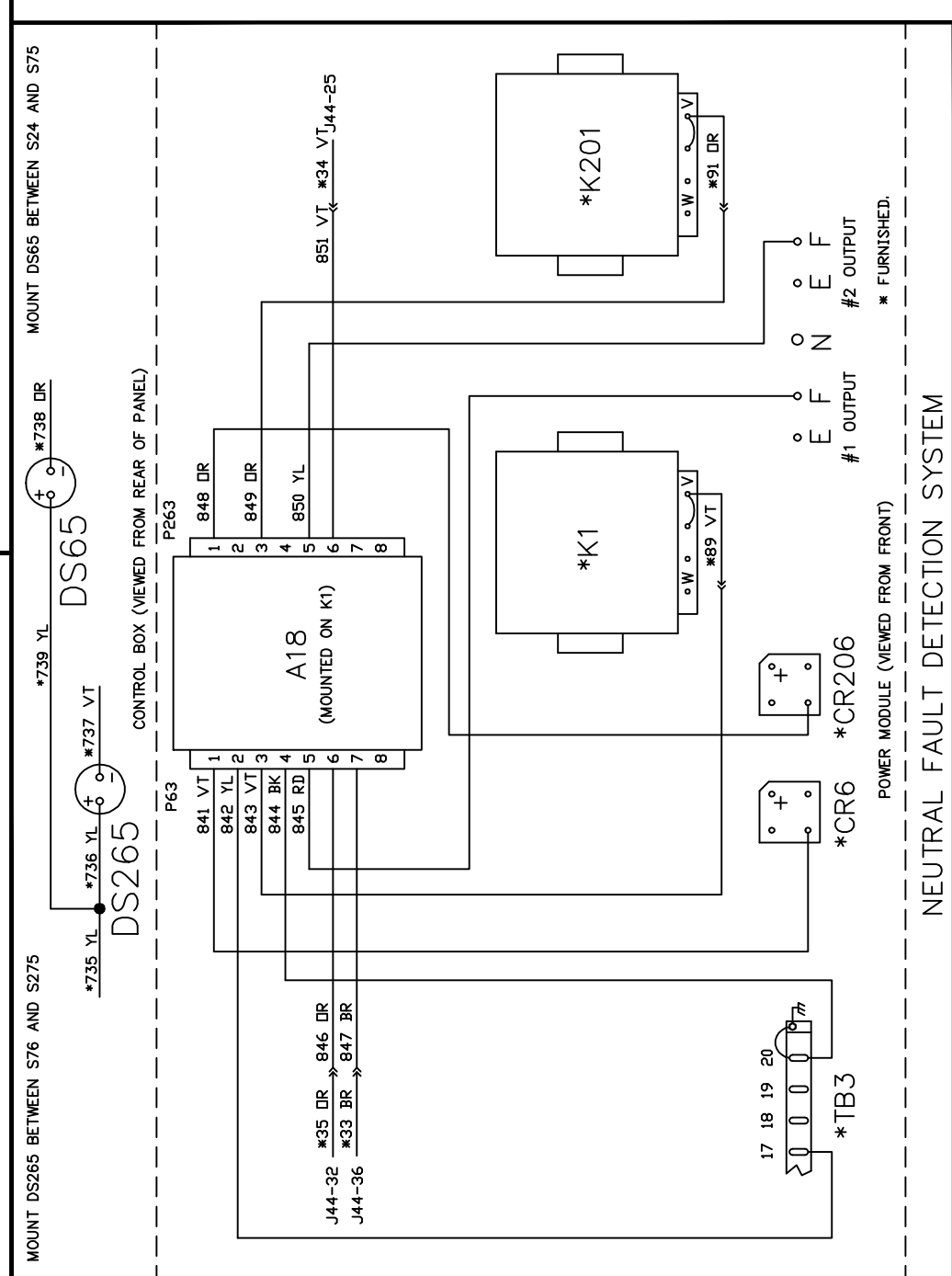
28.5V. TRANSFORMER-RECTIFIER

* WIRES AND PLUG ARE
PART OF THE T-R AY.

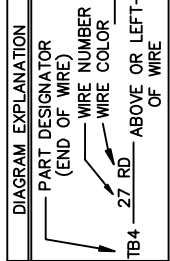
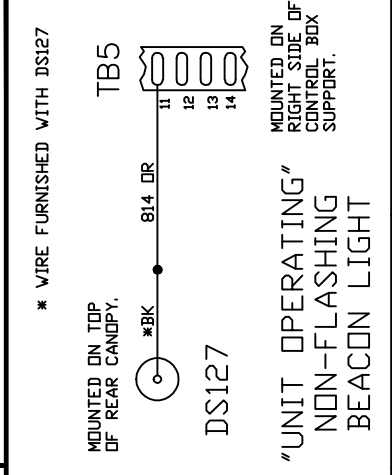
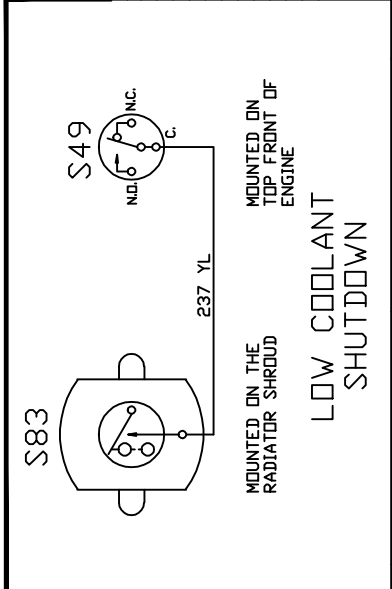


"LOW FUEL" NON-FLASHING BEACON LIGHT

"LOW FUEL" FLASHING BEACON LIGHT



NEUTRAL FAULT DETECTION SYSTEM



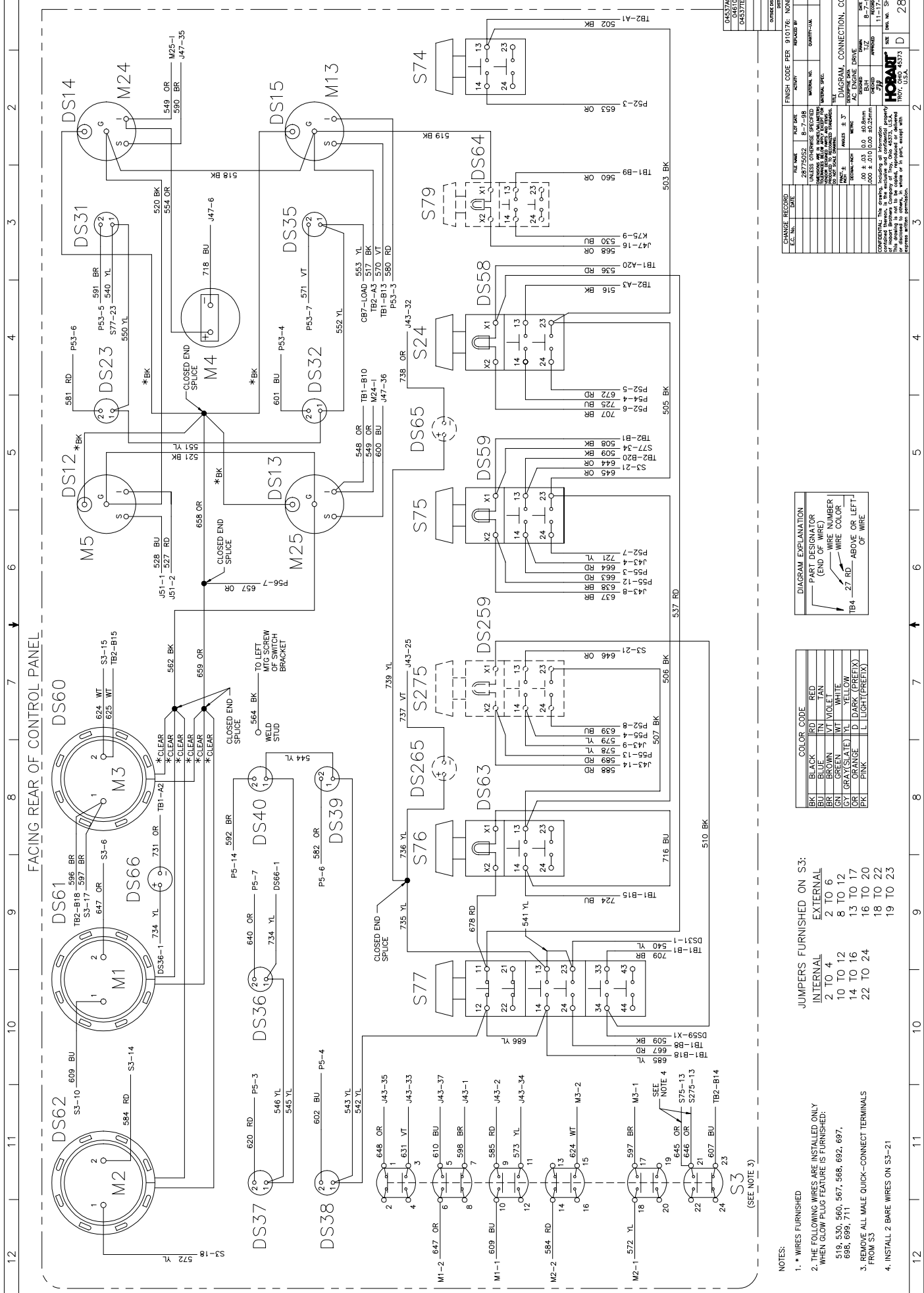
BK	BLACK	RD	RED
BU	BLUE	TN	TAN
BR	BROWN	VT	VIOLET(PURPLE)
GN	GREEN	WT	WHITE
GY	GRAY(SLATE)	YL	YELLOW
OR	ORANGE	D	DARK (PREFIX)
PK	PINK	L	LIGHT(PREFIX)

CHANGE RECORD	FILE NAME	DATE	ACTIVITY	FINISH CODE PER 289181	REPLACED BY	REPLACES
1-1	28781755	07/21/09				
2-1						
3-1						
4-1						

NO.	DATE	BY	APPROVED	REVISIONS	REASON
1	90C024	12C0024		1	ISSUE
2				2	REVISION
3				3	REVISION
4				4	REVISION

DATE	DESCRIPTION	BY	APPROVED
04537ACE(F)	7-99		
04537BCE(F)	7-99		
04537DCE(F)	7-99		
04537EEST	7-99		
OUTSIDE INSTR.			

DIAGRAM, SCHEMATIC & CONNECTION
90C024, 12C0024
BY: 81B
CHECKED: 81B
APPROVED: 81B
DATE: 6-21-99
REVISIONS: 4
REASON: 5 OF 5
PART NO. 287817
U.S.A.



FACING REAR OF CONTROL PANEL

DATE	BY	REVISION
04/15/98	04537/EST	2-99
06/16/98		
11-98		
04/15/98		

CHANGE RECORD	DATE	BY	REVISION
1	04/15/98	04537/EST	2-99

FINISH CODE PER 910176	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
28776052														

THE NAME	NOV DATE	NOV DATE	NOV DATE
28776052	8-7-98		

DATE	BY	REVISION
11-17-98		
8-7-98		
11-17-98		

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DIAGRAM EXPLANATION

END OF WIRE	WIRE COLOR
WIRE COLOR	ABOVE OR LEFT
27 RD	OR WHITE

COLOR CODE

BLACK	RED
BK	RD
BROWN	VT
BR	WT
GREEN	YL
GR	OR
GRAY/SLAL	OR
OR	PK
PINK	L
PK	L

- JUMPERS FURNISHED ON S3:
- INTERNAL
 - 2 TO 4
 - 10 TO 12
 - 14 TO 16
 - 22 TO 24
 - EXTERNAL
 - 2 TO 6
 - 8 TO 12
 - 13 TO 17
 - 16 TO 20
 - 18 TO 22
 - 19 TO 23

- NOTES:
1. WIRES FURNISHED
 2. THE FOLLOWING WIRES ARE INSTALLED ONLY WHEN GLOW PLUG FEATURE IS FURNISHED:
 - 519, 530, 560, 567, 568, 692, 697, 698, 699, 711
 3. REMOVE ALL MALE QUICK-CONNECT TERMINALS FROM S3
 4. INSTALL 2 BARE WIRES ON S3-21

(SEE NOTE 3)

287750
D
SHEET 2 OF 3

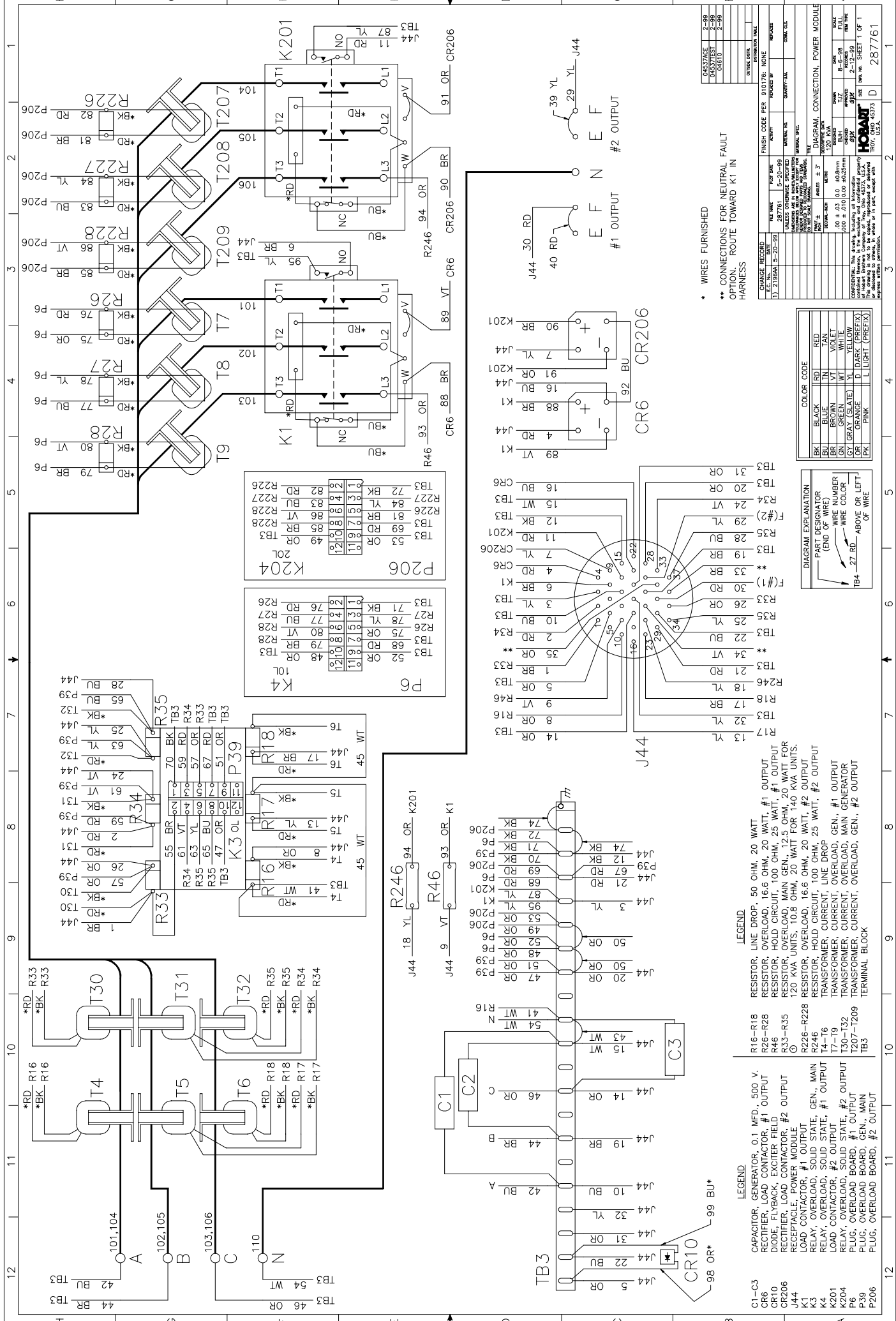
LEGEND

- A16 GENERATOR SET CONTROL P.C. BOARD
- CB2 CIRCUIT BREAKER, CONTACTORS, 5 A.
- CB4 CIRCUIT BREAKER, ENGINE ELECTRICAL, 10 A.
- CB7 CIRCUIT BREAKER, CONTROL CIRCUIT, 5 A.
- CB11 CIRCUIT BREAKER, MARKER LIGHTS, 10 A.
- CR32 DIODE, BLOCKING
- CR35 DIODE, FLY-BACK
- CR36 DIODE, FLY-BACK, GLOW PLUG (WHEN FURNISHED)
- CR37 DIODE, BLOCKING, E-F BYPASS
- DS1-DS2 LIGHT, PANEL (WHITE)
- DS12 LIGHT, CHARGING AMP METER (WHITE)
- DS13 LIGHT, OIL PRESSURE GAUGE (WHITE)
- DS14 LIGHT, TEMPERATURE GAUGE (WHITE)
- DS15 LIGHT, FUEL GAUGE (WHITE)
- DS23 INDICATOR, AIR CLEANER SERVICE (RED)
- DS31 INDICATOR, HIGH TEMPERATURE (RED)
- DS32 INDICATOR, LOW OIL (RED)
- DS35 INDICATOR, LOW FUEL LEVEL (RED)
- DS36 INDICATOR, OVERLOAD FAULT (RED)
- DS37 INDICATOR, OVERVOLTAGE FAULT (RED)
- DS38 INDICATOR, UNDERVOLTAGE FAULT (RED)
- DS39 INDICATOR, UNDERFREQUENCY FAULT (RED)
- DS40 INDICATOR, OVERFREQUENCY FAULT (RED)
- DS58 INDICATOR, PUSHBUTTON, ENGINE START (GREEN)
- DS59 INDICATOR, PUSHBUTTON, OUTPUT NO. 1 (GREEN)
- DS60 LIGHT, STRIP, FREQUENCY METER
- DS61 LIGHT, STRIP, AMMETER
- DS62 LIGHT, STRIP, VOLTMETER
- DS63 INDICATOR, PUSHBUTTON, DELAYED ENGINE SHUTDOWN
- DS64 INDICATOR, PUSHBUTTON, GLOW PLUG (WHEN FURNISHED)
- DS65 INDICATOR, NEUTRAL FAULT, OUTPUT NO. 1 (RED)(WHEN FURNISHED)
- IND., PUSHBUTTON, OUTPUT NO. 2 (GREEN)(WHEN FURN.)
- DS259 INDICATOR, NEUTRAL FAULT, OUTPUT NO. 2 (RED)(WHEN FURNISHED)
- DS265
- J43 RECEPTACLE, POWER MODULE
- J47 RECEPTACLE, ENGINE
- J48 RECEPTACLE, OPTIONS
- J51 RECEPTACLE, POWER

- K14 RELAY, MEMORY AND TIME DELAY, SOLID STATE
- K26 RELAY, OVER-UNDERVOLTAGE, SOLID STATE
- K27 RELAY, OVER-UNDERFREQUENCY, SOLID STATE
- K74 RELAY, TIME DELAY, ENGINE SHUTDOWN
- K75 RELAY, GLOW PLUG (WHEN FURNISHED)
- M1 AMMETER, GENERATOR
- M2 VOLTMETER, GENERATOR
- M3 FREQUENCY METER
- M4 RUNNING TIME METER, ENGINE-GENERATOR
- M5 AMMETER, BATTERY
- M13 GAUGE, FUEL, ELECTRIC
- M24 GAUGE, WATER TEMPERATURE
- M25 GAUGE, OIL PRESSURE
- P1 PLUG, VOLTAGE REGULATOR
- P5 PLUG, MEMORY AND TIME DELAY BOARD
- P14 PLUG, OVER-UNDERVOLTAGE BOARD
- P15 PLUG OVER-UNDERFREQUENCY BOARD
- P52-P56 PLUG, GENERATOR SET CONTROL BOARD
- S1 SWITCH, REGULATED-DIAGNOSTIC
- S2 SWITCH, TEST BANK, NO. 1 OUTPUT
- S3 SWITCH, METER SELECTOR
- S24 SWITCH, ENGINE START
- 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, GLOW PLUG (WHEN FURNISHED)
- S202 SWITCH, TEST BANK, NO. 2 OUTPUT (WHEN FURNISHED)
- S275 SWITCH, PUSHBUTTON, OUTPUT NO. 2 (WHEN FURNISHED)
- TB1-TB2 TERMINAL BLOCK

DATE	11-98
BY	6/66/05
04537TEST	2-99

CHANGE RECORD	DATE	THE NAME	NO. OF SHEETS	FINISH CODE PER 910176	NOTES
E.C. No.		28775053	8-7-98		
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HOBART CORPORATION, COLUMBUS, OHIO 43270					
SHEET 3 OF 3					
287750					

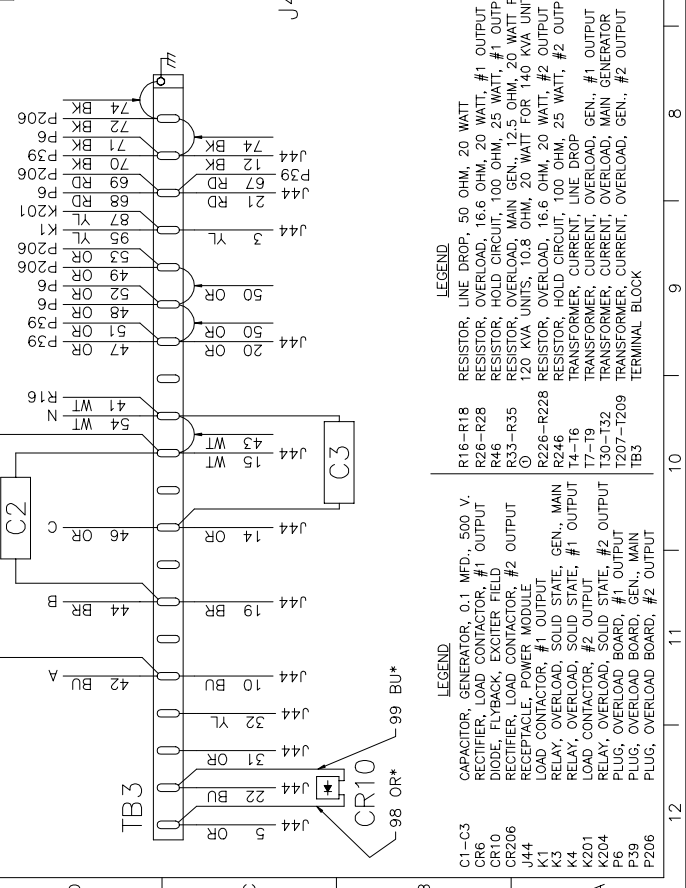
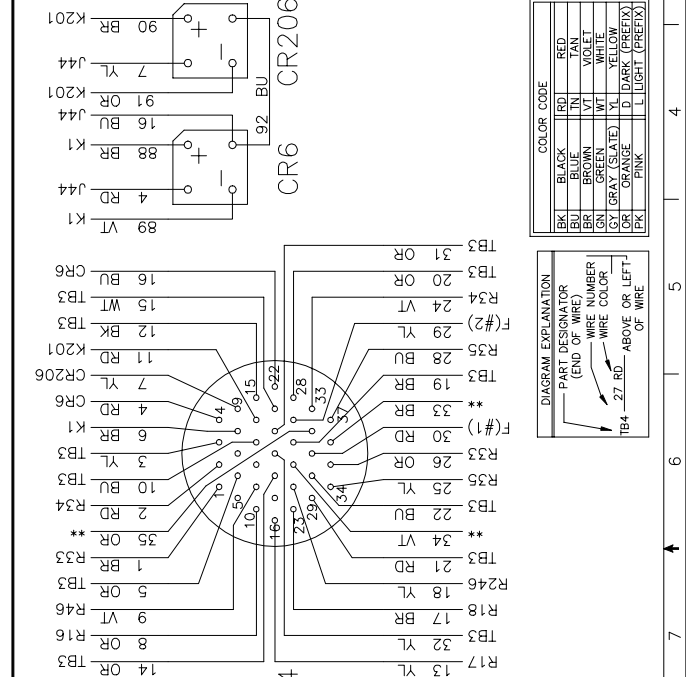
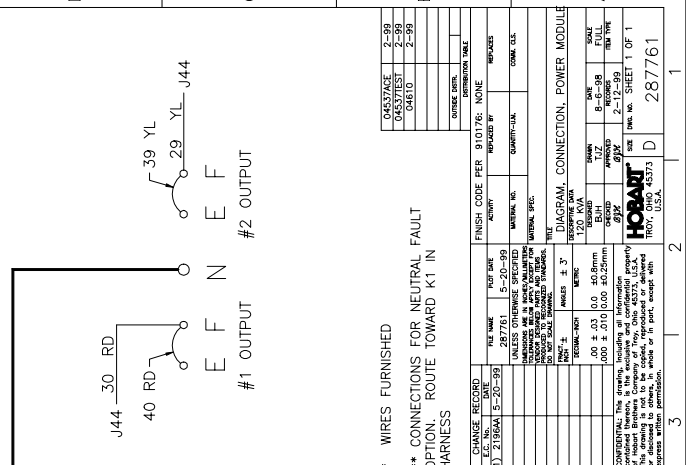


Terminal Block P206

1	95	BR	VT	R228
2	96	VT	VT	R228
3	95	BR	VT	R227
4	84	YL	BR	R227
5	82	BK	RD	R226
6	84	YL	BR	R227
7	82	BK	RD	R226
8	83	BU	P206	R228
9	84	YL	P206	R227
10	81	BR	P206	R226
11	82	BK	RD	R226
12	82	BK	RD	R226

Terminal Block P206

1	20	OR	TB3	R226
2	21	OR	TB3	R226
3	22	OR	TB3	R226
4	23	OR	TB3	R226
5	24	OR	TB3	R226
6	25	OR	TB3	R226
7	26	OR	TB3	R226
8	27	OR	TB3	R226
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11	30	OR	TB3	R226
12	31	OR	TB3	R226

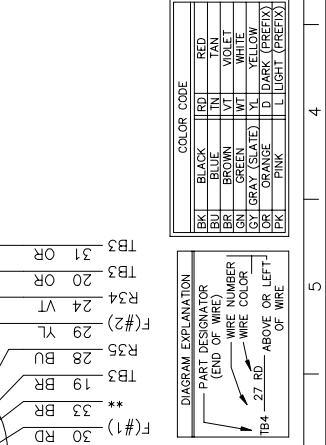


CHANGE RECORD

DATE	DESCRIPTION	BY
2-2-99	DESIGN	...
2-9-99	REVISE	...
2-9-99	REVISE	...
2-9-99	REVISE	...

WIRE COLOR CODE

BK	BLACK	BK	BLACK
BR	BROWN	VT	VIOLET
BU	BLUE	WT	WHITE
GN	GREEN	YL	YELLOW
GR	GRAY (SLATE)	OR	ORANGE
OR	ORANGE	RD	RED
PK	PINK	BL	BLUE (PREGN)
RD	RED	LT	LIGHT (PREGN)



LEGEND

C1-C3	CAPACITOR, GENERATOR, 0.1 MFD., 500 V.
CR6	RECTIFIER, 10A, CONTACTOR, #1 OUTPUT
CR10	RECTIFIER, 10A, CONTACTOR, #2 OUTPUT
CR206	DIODE, FEEDBACK, EXCITER, FIELD
J44	RECEPTACLE, POWER MODULE
K1	LOAD CONTACTOR, #1 OUTPUT
K3	RELAY, OVERLOAD, SOLID STATE, GEN., MAIN
K4	RELAY, OVERLOAD, SOLID STATE, #1 OUTPUT
K201	LOAD CONTACTOR, #2 OUTPUT
K204	RELAY, OVERLOAD, SOLID STATE, #2 OUTPUT
P6	PLUG, OVERLOAD BOARD, #1 OUTPUT
P39	PLUG, OVERLOAD BOARD, GEN., MAIN
P206	PLUG, OVERLOAD BOARD, #2 OUTPUT
R16-R18	RESISTOR, LINE DROP, 50 OHM, 20 WATT
R26-R28	RESISTOR, OVERLOAD, 16.6 OHM, 20 WATT, #1 OUTPUT
R26	RESISTOR, HOLD CIRCUIT, 1.0 OHM, 25 WATT, #1 OUTPUT
R33-R35	RESISTOR, OVERLOAD, MAIN GEN, 25 OHM, 2 WATT FOR 120 KVA UNITS, 20 WATT FOR 140 KVA UNITS
R226-R228	RESISTOR, OVERLOAD, 16.6 OHM, 20 WATT, #2 OUTPUT
R246	RESISTOR, HOLD CIRCUIT, 1.0 OHM, 25 WATT, #2 OUTPUT
T4-T6	TRANSFORMER, CURRENT, OVERLOAD, GEN.
T7-T9	TRANSFORMER, CURRENT, OVERLOAD, MAIN GENERATOR
T30-T32	TRANSFORMER, CURRENT, OVERLOAD, GEN., #1 OUTPUT
T207-T209	TRANSFORMER, CURRENT, OVERLOAD, GEN., #2 OUTPUT
TB3	TERMINAL BLOCK

Appendix A. Options/Features

The following is a list of options available for series 500391A generator sets. This chart contains the description, part number, and document number of the option. There is also a column to identify which option is contained in this Appendix.

OPTIONS / FEATURES EQUIPPED ON UNIT

DESCRIPTION	PART NUMBER	DOCUMENT NUMBER	IN THIS SECTION
Trailer, with Tongue Actuated Brakes/Cable Trays	No Number	TO-257	
Trailer, with Lever Actuated Brakes/Cable Trays	No Number	TO-241	
Kit, Noise Reduction	287911	TO-279	
Transformer Rectifier Assembly, 28.5V	487750-1	OM-433	
Kit, Spotlight	287061	TO-280	
Kit, Block Heater, 120V	287528-1	TO-256	
Kit, Block Heater, 240V	287528-2	TO-256	
Kit, Fire Extinguisher	283012	TO-252	
Kit, Pin Hitch (500391A-001 Only)	381441		
Kit, Pintle Hitch (500391A-001 Only)	76A-1361		
Kit, Fixed Mounting (500391A-002 Only)	287807	TO-263	
Kit, Drawbar, Variable Height (500391A-001 Only)	283946	TO-250	
Kit, T-R Mounting, Single (500391A-001 Only)	286103-1		
Support, Fork Lift Assembly	287694	TO-281	
Kit, Tie-Down (500391A-001 Only)	284706		
Kit, Unit Operating, Non-Flashing Beacon	287063-X	TO-282	
Kit, Low Fuel, Flashing/Non-Flashing Beacon	287062-X	TO-255	
Kit, Low Fuel, Strobe Beacon	287490-X	TO-247	
Kit, CE Certification	287589-1		
Kit, CE Certification	287589-2		
Kit, Low Coolant Shutdown	288074	TO-283	
Kit, T-R Mounting on Stationary unit (500391A-002 Only)	286103-5		

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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:

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

2. Operation at:

- Voltages above or below rated voltage.
- Speeds other than rated speed.
- Frequency other than rated frequency.
- Standstill with rotating equipment windings energized.
- Unbalanced voltages.
- Operation at loads greater than rated.

3. Operation where low acoustical noise levels are required.

4. Operation with:

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

5. Operation in poorly ventilated areas.

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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 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 load. 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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