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Manual

ITW GSE 4400

60-90 kVA, 3 Phase, 115 Volt, 400 Hz Generator Set

Series no.	**500100**
Type	4400

ITW GSE HOBART • 11001 Us Highway 41 North • Palmetto, FL 34221 • U.S.A
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Introduction

This manual contains operation and maintenance information for a diesel engine-generator manufactured by ITW GSE, Palmetto, Florida 34221

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

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

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

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

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

Contents of the manual are arranged as follows:

Chapter 1 Description/Operation

Chapter 2 Servicing/Troubleshooting

Chapter 3 Overhaul/Major Repair

Chapter 4 Illustrated Parts List

Chapter 5 Manufacturer’s Literature

Appendix A ARU

Appendix B Options

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

Write:	ITW GSE Service Department 11001 US Highway 41, North Palmetto, FL 34221 U.S.A.
Call Inside U.S.A.:	(866) 845-0441 (Parts) (877) 874-5322 (Service)
Call From Foreign Countries:	(941) 721-1092 (Technical Support) (941) 721-1000 (Spare Parts)
FAX inside U.S.A.	(800) 367-4945
FAX From Foreign Countries:	(941) 721-1091
E-Mail:	technicalsupport@itwgse.us parts@itwgse.us
Web Page:	www.itwgse.com

Safety Warnings and Cautions.

WARNING

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

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

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

IMPORTANT

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

WARNING

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

1) General

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

2) Shock Prevention

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

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

a) Output Cables and Terminals

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

3) Service and Maintenance

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

a) Shut off all power at the battery disconnect before inspecting or servicing the equipment.

b) Lockout the equipment at the battery disconnect switch if it is out of service.

c) If troubleshooting must be done with the unit energized, have another person present who is trained in turning off the equipment and providing or calling for first aid.

4) Fire and Explosion Prevention.

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

a) Electrical Short Circuits and Overloads.

Overloaded or shorted equipment can become hot enough to cause fires by self-destruction or by causing nearby combustibles to ignite.

b) Batteries.

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

c) Engine Fuel.

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

5) Toxic Fume Prevention.

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

6) Bodily Injury Prevention.

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

7) Medical and First Aid Treatment.

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

EMERGENCY FIRST AID	. **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.

8) Equipment Precautionary Labels

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

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Chapter 1 Description/Operation Chapter-Section/Page#

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Chapter 1 Description/Operation

Section 1 Description

1) General

The basic generator sets covered in this manual, manufactured by ITW GSE Group, are rated at 60-kVA and 90-kVA and are designed to produce and deliver 115/200-volt, 400 Hz, 3-phase AC power to a parked aircraft or other load. Some generator models with the Active Rectified Unit (ARU) also provide 28.5 volts DC for aircraft having those requirements. A comprehensive review of the 28VDC output Active Rectifier Unit (ARU) is located in Appendix A.

Table 1-1-1 uses the model number to identify the variations covered in this manual.

Model Number	kVA	Mounting	Engine Certification	Outputs	28.5 DC Output
ACE4460STT3-US	60	Trailer	Tier 3 US Labeled	Single 400Hz	No
ACE4460STT3-EU	60	Trailer	Stage 3a EU Labeled	Single 400Hz	No
ACE4460S28TT3-US	60	Trailer	Tier 3 US Labeled	Single 400Hz	Yes
ACE4460S28TT3-EU	60	Trailer	Stage 3a EU Labeled	Single 400Hz	Yes
ACE4460DTT3-US	60	Trailer	Tier 3 US Labeled	Dual 400Hz	No
ACE4460DTT3-EU	60	Trailer	Stage 3a EU Labeled	Dual 400Hz	No
ACE4460D28TT3-US	60	Trailer	Tier 3 US Labeled	Dual 400Hz	Yes
ACE4460D28TT3-EU	60	Trailer	Stage 3a EU Labeled	Dual 400Hz	Yes
ACE4490STT3-US	90	Trailer	Tier 3 US Labeled	Single 400Hz	No
ACE4490STT3-EU	90	Trailer	Stage 3a EU Labeled	Single 400Hz	No
ACE4490S28TT3-US	90	Trailer	Tier 3 US Labeled	Single 400Hz	Yes
ACE4490S28TT3-EU	90	Trailer	Stage 3a EU Labeled	Single 400Hz	Yes
ACE4490DTT3-US	90	Trailer	Tier 3 US Labeled	Dual 400Hz	No
ACE4490DTT3-EU	90	Trailer	Stage 3a EU Labeled	Dual 400Hz	No
ACE4490D28TT3-US	90	Trailer	Tier 3 US Labeled	Dual 400Hz	Yes
ACE4490D28TT3-EU	90	Trailer	Stage 3a EU Labeled	Dual 400Hz	Yes

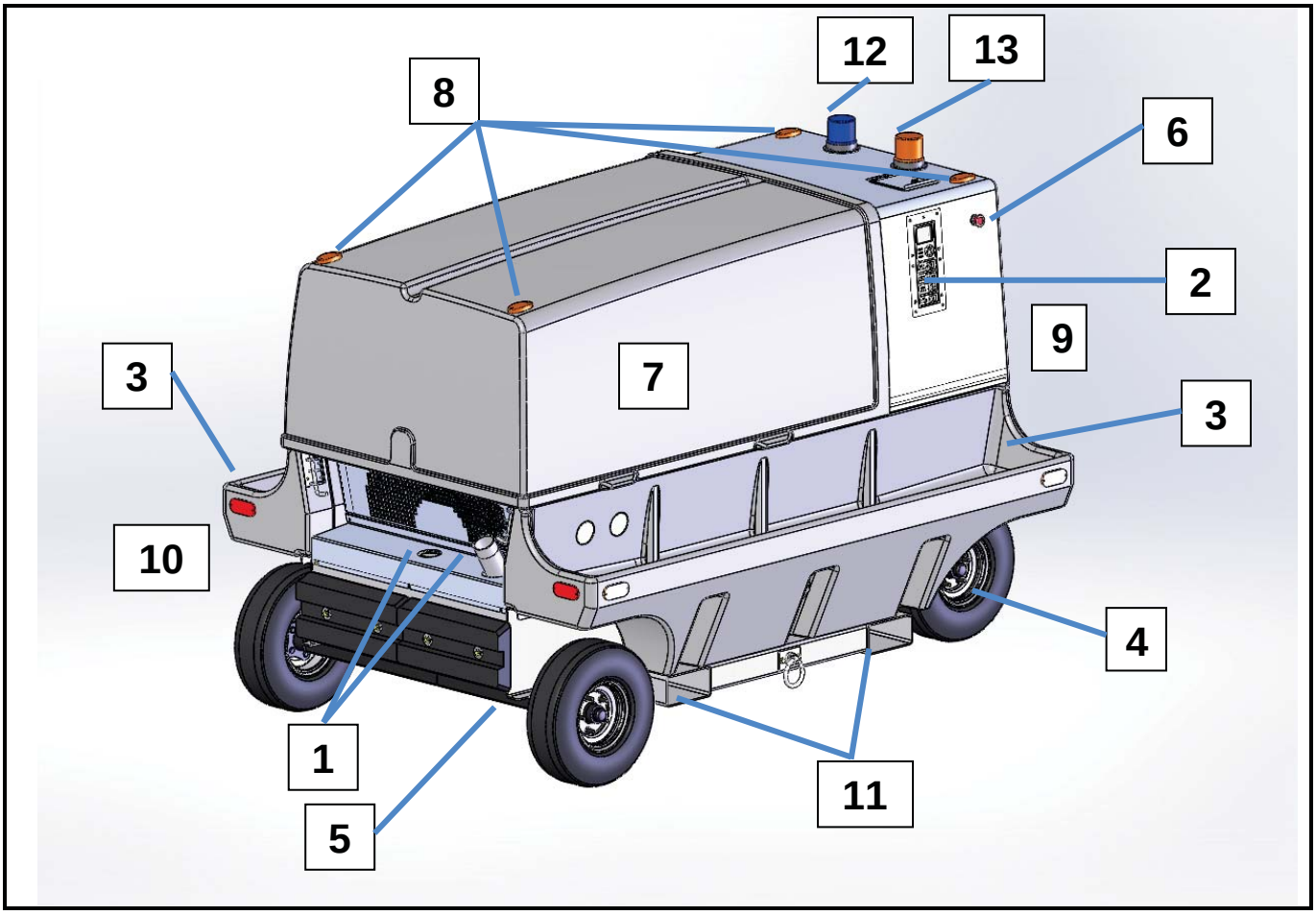
Table 1-1-1: ITW GSE 4400 Series Generator Set Part Number Descriptions

2) Optional Equipment - Appendix B

Chapters 1 through 5 of this Operation and Maintenance Manual identify only the basic version of the ITW GSE 4400 generator set. A list of optional equipment appears in Appendix B.

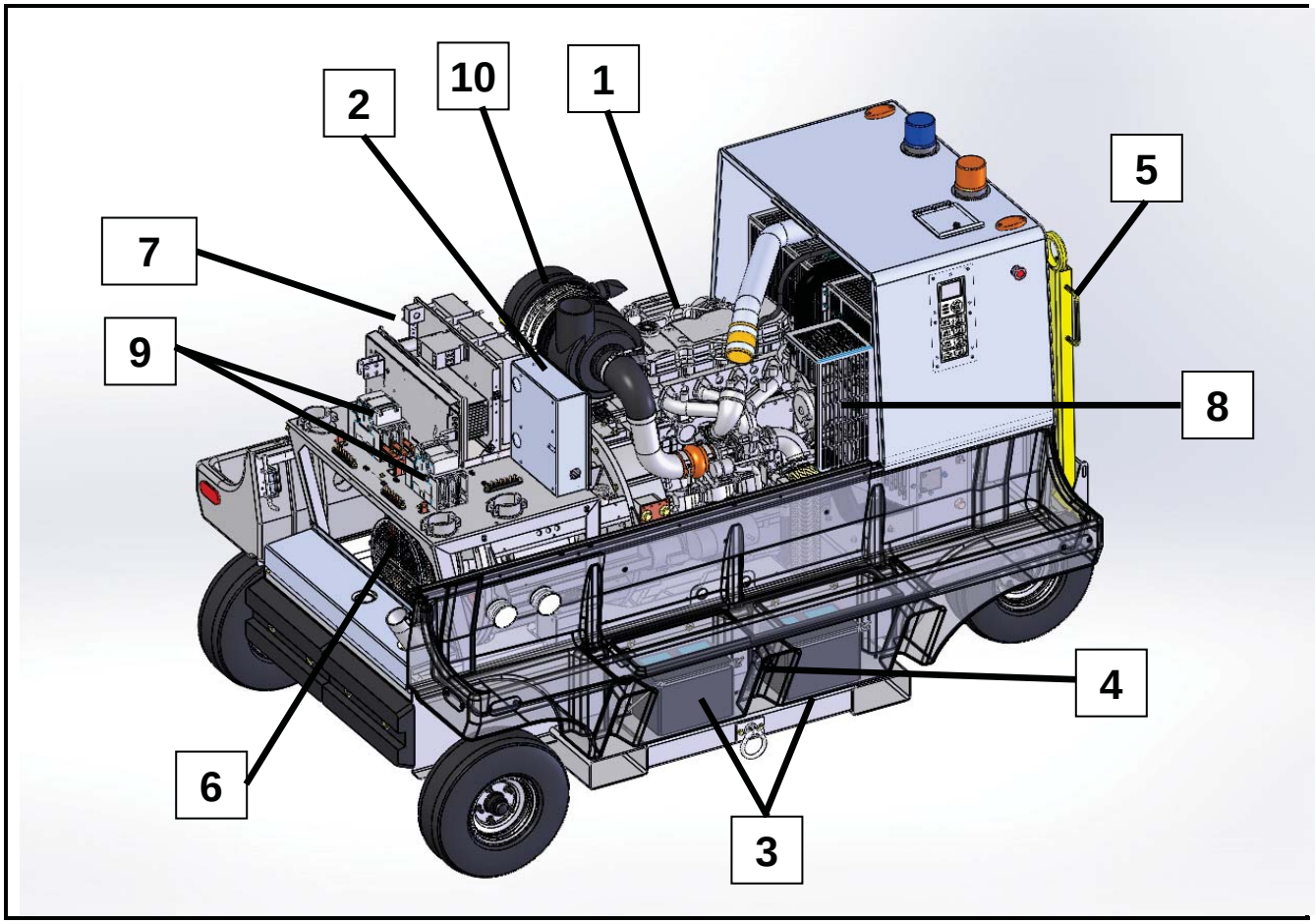
3) Component Locations

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



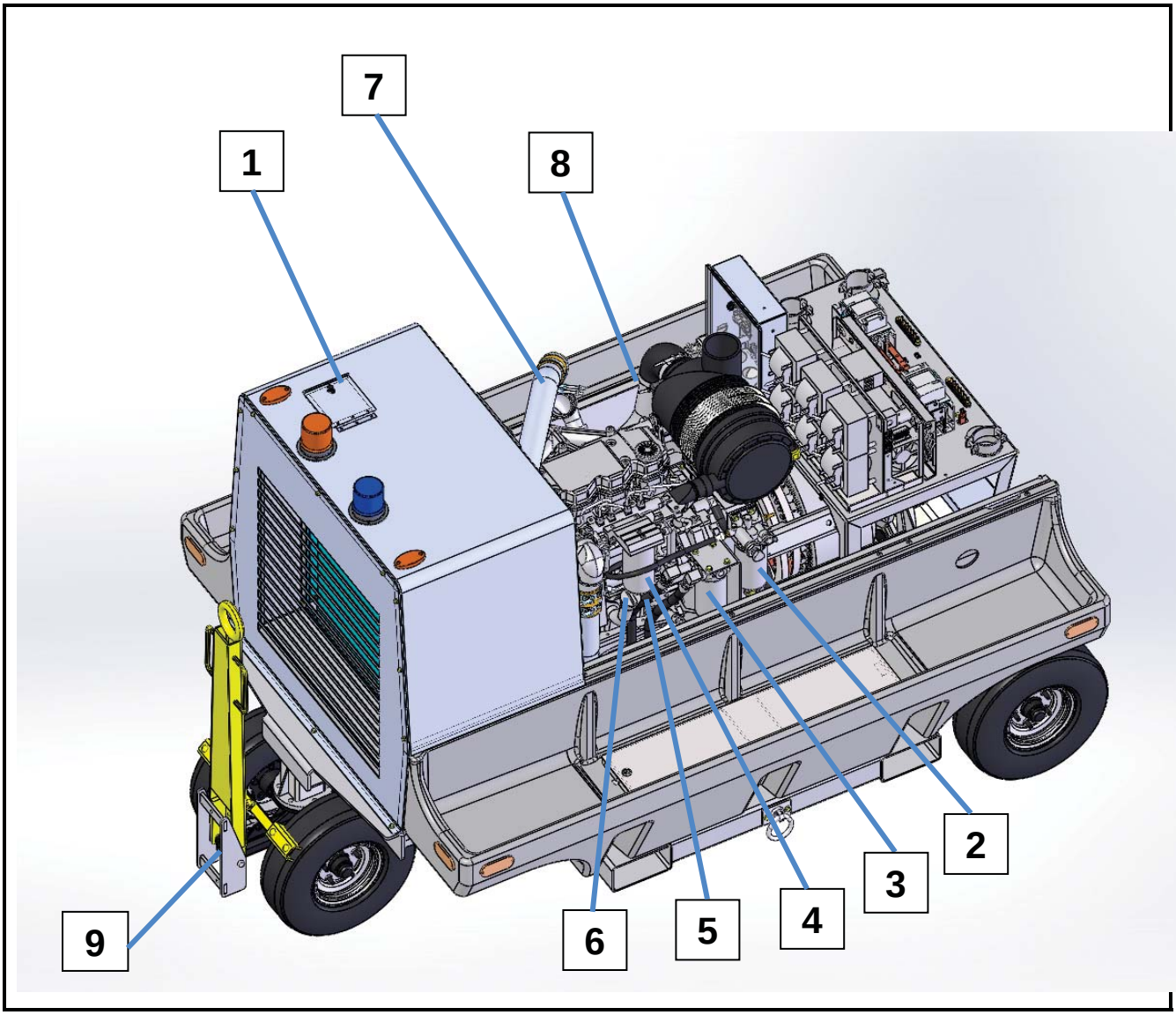
1. **Fuel Filler Neck / Manual Gauge**
2. **Operator Control Panel**
3. **Composite Output Cable Trays**
4. **Fifth Wheel Assembly**
5. **Rear Axle Assembly**
6. **Emergency Stop Switch**
7. **Sliding/Removable Canopy**
8. **Clearance Lights (Option)**
9. **Radiator End**
10. **Generator End**
11. **Forklift Pockets**
12. **Low Fuel Beacon (Option)**
13. **Operating Beacon (Option)**

Figure 1-1-1: General Assembly of Generator Set



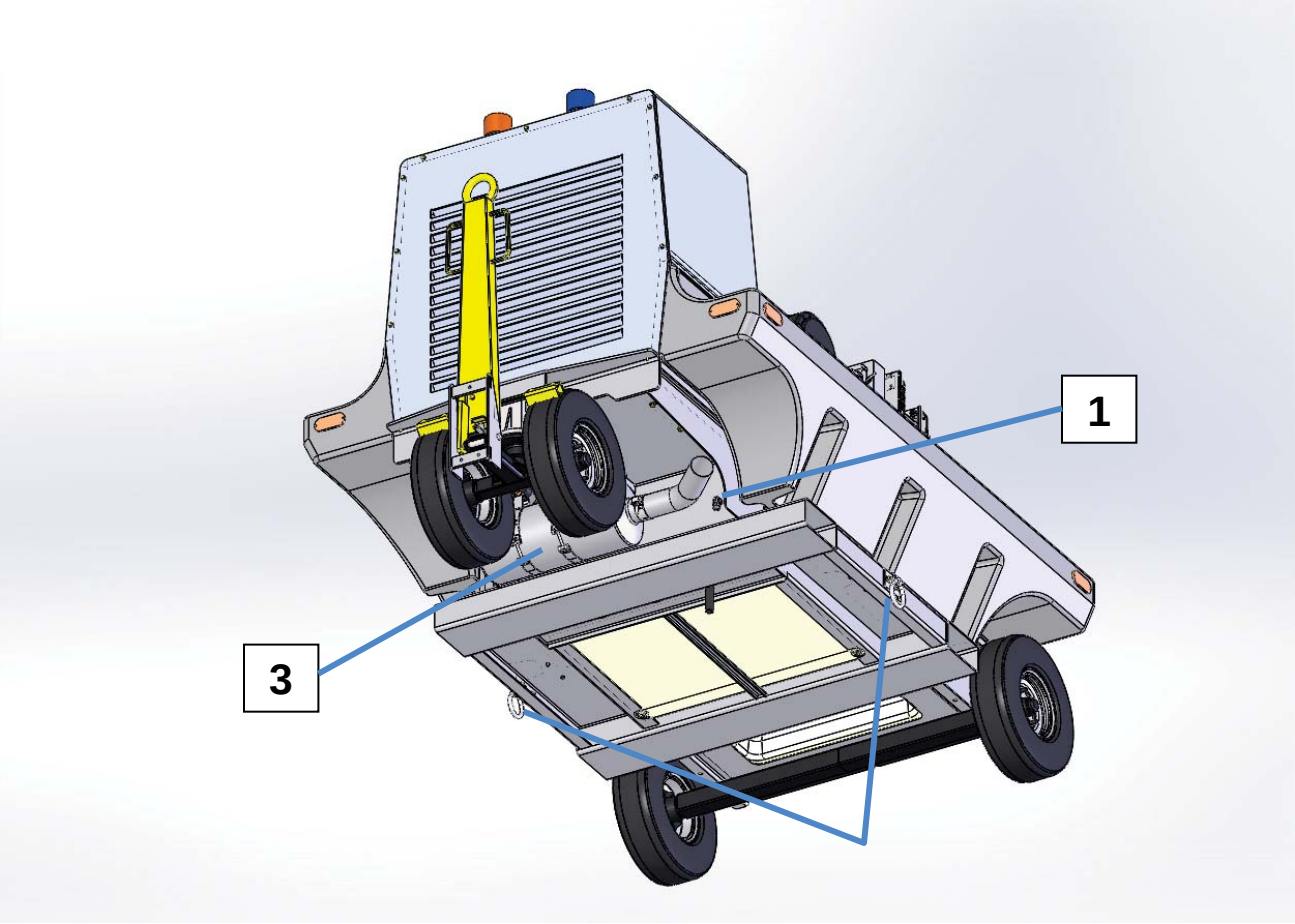
1. **Cummins QSB4.5 Engine**
2. **Control Module Assembly**
3. **Batteries (inside tray pockets)**
4. **Battery Disconnect**
5. **Tow bar Assembly**
6. **Generator**
7. **28.5 VDC ARU (Option)**
8. **Engine Alternator**
9. **Output Contactors**
10. **Air Filter Assembly**

Figure 1-1-2: Main Components of Generator Set (Right Side)



1. **Coolant fill access cover**
2. **Lubricity Additive Fuel Pre-Filter**
3. **Engine Oil Filter**
4. **Fuel Filter**
5. **Engine Control Module (ECM)**
6. **Engine Oil Fill Tube**
7. **Charge-Air-Cooler Piping**
8. **Engine Air Intake Piping**
9. **Tow Bar/Brake Release Lever**

Figure 1-1-3: Main Components of Generator Set (Left Side)



1. **Oil Drain Tube**
2. **Tie Down Rings**
3. **Muffler Assembly**

Figure 1-1-4: Main Components of Generator Set (Bottom)

4) Specifications

a) Physical Specifications

Length	103 in. (2615 mm) w/ towbar up
Width	66.7 in. (1694.3 mm)
Height	65.9 in. (1674 mm)
Weight (dry)	4000 lb. (1814 kg.)
Weight with 28.5 VDC T-R	4300 lb. (1950 kg.)

b) AC Generator Specifications

Output power rating	90 kVA (72 kW)
Output voltage	115 / 200 VAC
Rated load capacity	260 Amps
Frequency	400 Hz.
Power factor	0.8
Duty Cycle	100%
Operating speed	2000 RPM
Overload capacity 125% rated load	325 Amps
Output cable size	2/0

c) AC Generator Protective System Specifications

Condition	**Trip Point**	**Time Delay**
Over voltage	130 volts	250 milliseconds
	140 volts	15 milliseconds
Under voltage	any voltage below 104 volts	500 milliseconds
Over frequency	380 Hz to 420 Hz	1 second
	above 480 Hz	immediate
Under frequency	380 Hz. or less	5 seconds
Output overload	80% load at PF > 0.8 to 1.0	Continuous
	100% load at PF > 0.7 to 0.8	Continuous
	100% load at PF > 0.8 to 1.0	5 minutes
	100% to 120% load (PF 0.7 to 0.8)	10 seconds
	120% to 150% load (PF 0.7 to 0.8)	2 seconds

d) DC Output Specifications (with optional TR unit)

Output Power Rating	17.1 kW
Output Voltage	28.5 VDC
Load Capacity (Continuous)	600 A
Current Limiting Capability	400 to 2000 A in 300 A steps
Peak/Starting Load Capacity	2000 A for 5 seconds
Output cable size	4/0 for continuous loads up to 400A 2x 4/0 for continuous loads up to 600A

e) DC Protective System Specifications

Condition	**Trip Point**	**Time Delay**
Over Voltage	32 - 40 VDC Over 40 VDC	4 seconds 150 ms
Output Overload	2000 A	5 seconds
	1800 A	10 seconds
	1200 A	30 seconds
	800 A	30 seconds

f) Engine Specifications

Manufacturer and Model	Cummins Engine Company / QSB4.5
Type	4 cylinder, 4 cycle diesel, electronic controlled
Bore and Stroke	4.21 in. x 4.88 in. (107 mm x 124 mm)
Displacement	275 in^3 (4.5 L)
Horsepower	171 hp (132 kW)
Idle speed (factory set option) (Not authorized for EU units)	1000 ± 50 rpm
Normal governed speed	2000 rpm
Firing Order	1-3-4-2
Electrical system	24 VDC
Lubricating oil capacity (w/ filter)	11.6 quarts (11 liters)
Coolant capacity system	20 quarts (18.9 liters)

g) Normal Operating Characteristics

Engine oil pressure (warm and at rated speed 2000 RPM)	45 to 90 PSI (445 to 621 kPa).
Engine coolant temperature (normal operation)	160 to 200º F (71 to 93º C).

5) Special Features

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

a) Protective Monitoring

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

b) Voltage Regulator

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

c) Engine Electronic Control Module

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

d) Battery System Disconnect Switch

The generator set is equipped with a battery disconnect switch outside the unit on the RIGHT side. The disconnect switch should be placed in the OFF position during long periods of shutdown.

6) Canopy

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

7) Engine and Generator

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

a) Diesel Engine

The diesel engine is a fuel injection, 4-cylinder, electronically controlled engine rated at 171 horsepower.

b) Engine Manufacturer's Components

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

(1) Electrical System

The 24 VDC electrical generating and starting system includes an alternator and starter with solenoid switch.

.

(2) Lubricity Additive Fuel Filter

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

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

(3) Oil Filter

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

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

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

c) Factory Installed Components and Protective Systems

This generator set is assembled with the following components and protective systems:

(1) Shutdown/Reset Systems

- Emergency Shutdown

The emergency shutdown switch is to provide instant manual shut off of the generator set by disconnecting power to the ECM through the control box. It is located on the FRONT RIGHT of the generator set next to the control box.

To operate the **EMERGENCY SHUTDOWN**

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

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

- Low fuel warning system

The low fuel warning system monitors the fuel level in the fuel tank. When the fuel tank level reaches approximately 10%, a warning is generated signifying that it is time to put fuel in the tank. Once the engine is not running, a low fuel fault is generated and the engine is not allowed to start.

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

The radiator and charge-air-cooler is a two-piece type designed for long periods of operation without servicing.

(3) Engine-cooling fan

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

(4) Master [Battery] Disconnect Switch

The master disconnect switch is designed to isolate the batteries from the entire electrical system to eliminate the possibility of battery current draw by the engine ECM or any other components during long periods of no operation. The switch can also be used to lock-out the starting circuit of the equipment for maintenance safety purposes.

(5) Air cleaner

The diesel engine air cleaner is so constructed that air enters through its cylindrical body, and then is filtered before being passed into the engine turbo-charger assembly. An air cleaner service indicator device is mounted on the air cleaner assembly to monitor the airflow into the air cleaner. As the air cleaner becomes filled with dust, dirt, and carbon, the intake system airflow becomes increasingly restricted. This restriction causes a diaphragm inside the indicator to move toward an electrical contact. When the maximum allowable restriction level is reached, the circuit closes and the air cleaner indicator fault appears on the control panel fault display to warn the operator that the air cleaner must be changed. The electrical indicator automatically resets when the restriction level drops sufficiently. Note: This function should not be used as a replacement indicator. Follow recommended replacement schedule as specified in this manual.

d) Warnings/Faults

The control system reacts appropriately to different detected issues. These types can be generalized between warnings and faults. Warnings are given when the system is able to function but requires servicing/user interaction. Faults are generated when the unit cannot or should not supply regulated power to the aircraft.

All faults prevent the engine from starting. However, they react differently to an operating unit. Faults can be categorized into three subcategories as defined by the fault number.

- Fault numbers less than 6000
  - Minor faults: Disconnect power to the aircraft but do not affect engine and generator functions.
- Fault numbers between 6000 and 8000
  - Mid-level faults: Disconnect power to the aircraft, turn off the generator and shut down the engine after the required 5 minute cool down.
- Fault numbers greater than 8000
  - Major faults: Result in immediate shutdown of all system components including the engine. Service is required on the unit before it is returned to operation.

Engine generated warnings and faults are also monitored and their respective Cummins fault numbers are shown on the display.

e) Generator

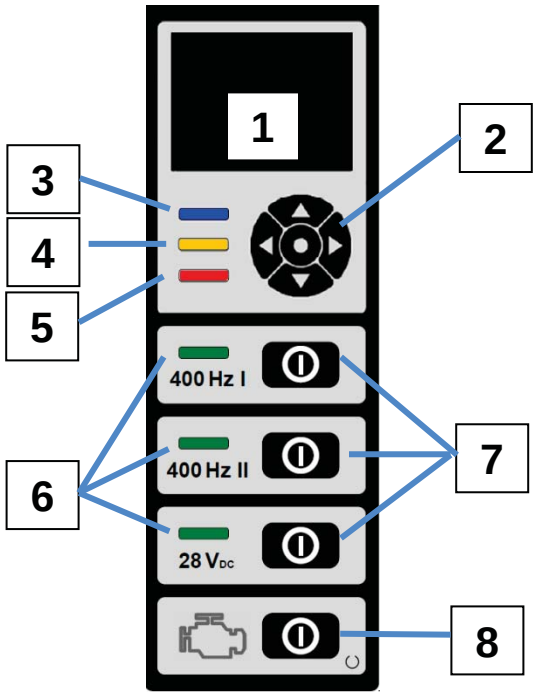
The 400 Hz generator is a brushless, dual bearing, revolving field, three-phase, alternating current type unit. The front end of the rotor shaft extends forward beyond the front bearing and is coupled to the engine flywheel by a flexible coupling assembly. The rear end of the rotor shaft extends rearward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

The rectifier has six diodes mounted on the exciter rotor and converts exciter AC output to DC for excitation of the generator revolving fields. The exciter outputs DC to the generator fields, and consequently the generator output, is controlled by the voltage regulator PC board (REG). A centrifugal, radial-blade fan draws cooling air over all internal windings. Air enters at the exciter end and is discharged at the drive end. The complete generator assembly is bolted to the engine's flywheel and housing.

8) Operator Controls

The control box is a protected enclosure on the right front panel of the GPU that has a modern graphical display and easy to understand controls. The display allows the user to easily have access to all critical operational information as well as providing textual descriptions of all warnings and failures.

a) Operator Controls



1. LED Graphical Display
2. Navigation Keypad
3. Power ON "Blue" LED
4. Warning "Amber" LED
5. Alert/Failure "Red" LED
6. Output ON "Green" LEDs
7. Output ON/OFF (Reset)
8. Power ON & Engine Start/Stop (Reset)

Figure 1-1-5 Control Panel

1: The color LED Graphical Display and easy to use menu system places all required operational information at the fingertips of the operator/maintenance personnel. Its color presentation accents critical data and simplifies the troubleshooting process by giving textual descriptions of any potential issues.

2: The navigation keypad is used to navigate through the simple menu systems.

3: The blue LED indicates that power is on. (It is off in sleep mode)

4: The Amber LED indicates a warning. The details of that warning are available on the display. Up to five warnings can be displayed at one time.

5: The Red LED indicates a fault. The details of this fault are also visible on the graphics display. Only one fault can be displayed at one time.

6: The green LED's indicate that the respective output is on.

7: The ON/OFF buttons are used to turn on and off their respective outputs. If a specific output has a fault, the corresponding ON/OFF button will also reset that fault.

8: The power ON & Engine Start/Stop button will wake the unit from low-power sleep mode. Pressing it again will begin the start-up sequence for the diesel engine. Pressing it again will shut down the engine. If the engine is already running, it will begin the manufacturer required 5 minute cool down. If the unit has a fault, this button will reset the fault.

Default Screen:

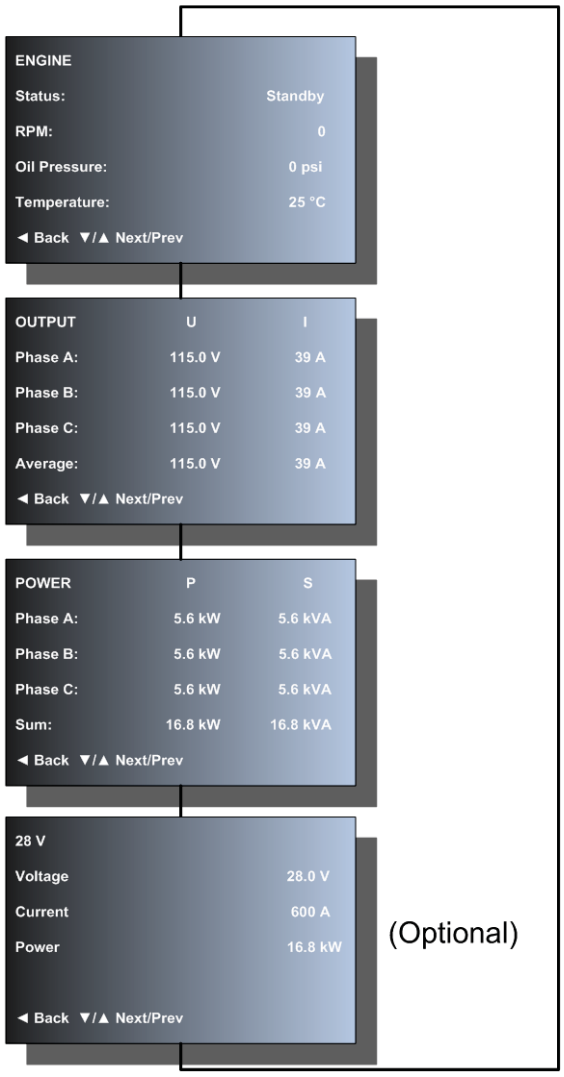
There are two default displays depending on whether the engine is running or not. When the engine is not running, the following screen is visible:

During the startup process, the screen will be modified to show the current status until the engine is running and the unit is ready to output power.

Note: If the engine is configured to go to idle until an output is activated, it will still say it is ready for use. However, the engine will have to ramp up to 2000 RPM and the voltage stabilized before the output contactor will close.

When output power is ready, the screen will appear as follows showing all available outputs:

Both default screens enable the user to quickly have access to other pertinent information by pressing ▼ or▲ to cycle through the display screens below:



The 28V data page will only be displayed if that option is available.

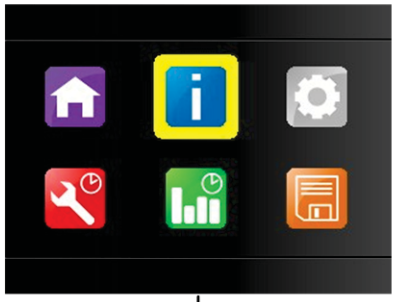
Pressing ◄ will return to the default menu screen.

Unit information is displayed using the information icon. To access the information icon, press the To enter the Icon Menu, press the ● from the default menu and hold it down for approximately 5 seconds.

To Select a submenu, simply use the navigation keys ◄▼▲► to highlight the icon and then press the ● to enter the sub-menu.

To leave the Icon Menu highlight the ”Home” icon and press ●

Parameters – Menu structure



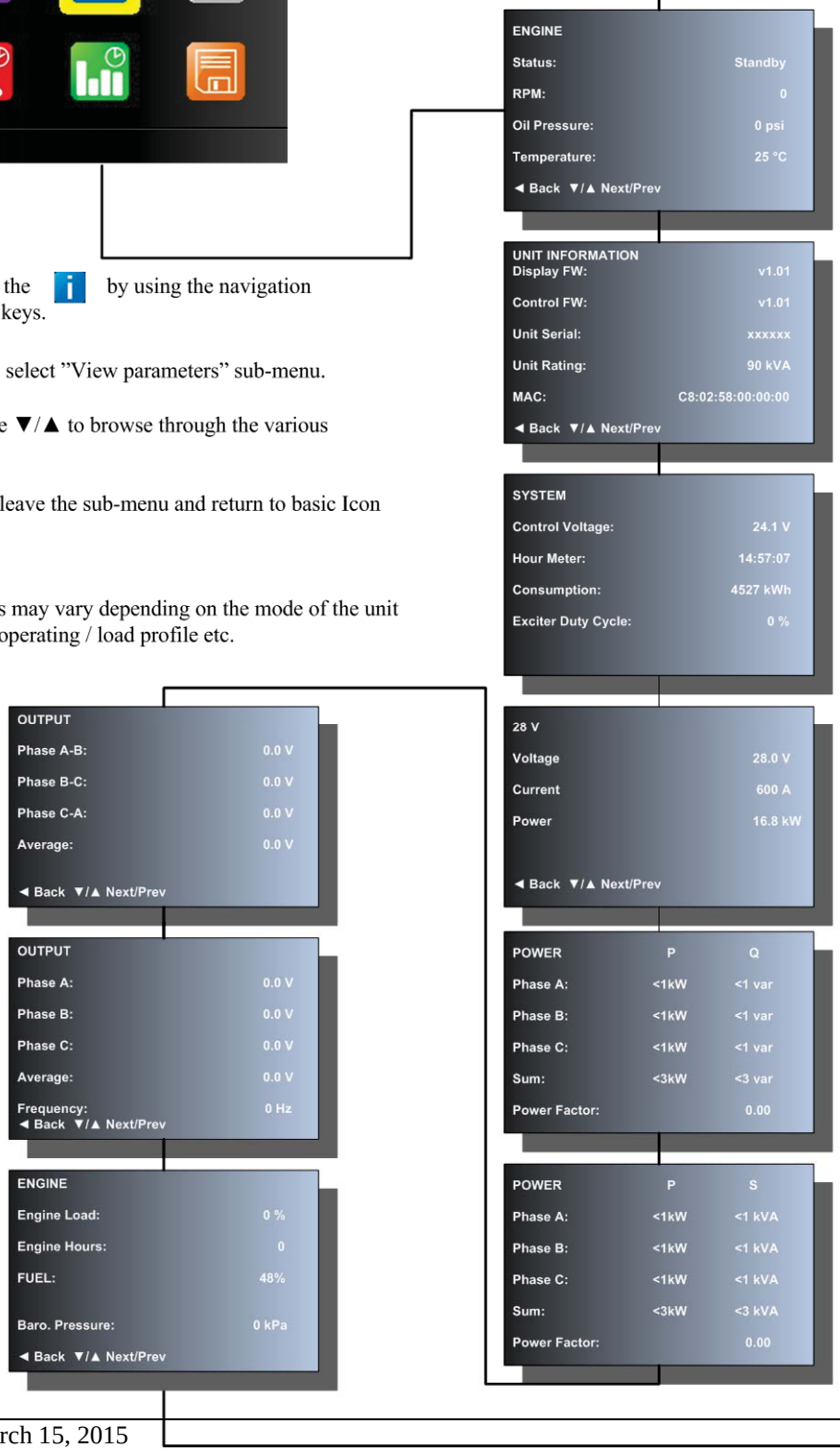
Highlight the by using the navigation ◄▼▲► keys.

Press ● to select ”View parameters” sub-menu.

Use the the ▼/▲ to browse through the various screens.

Use ◄ to leave the sub-menu and return to basic Icon Menu.

Notice!
Parameters may vary depending on the mode of the unit Standby / operating / load profile etc.



9.0 Power Module Assembly

The power module assembly, mounted to the back of the ARU bracket, is located at the rear of the machine over the generator. The panel assembly provides a means of connecting and disconnecting the generator output to and from the aircraft.

a) Load contactor (K1 and K2)

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

b) Current transformers (CT1-CT3)

A set of current transformers are used to monitor and control the line-drop compensation, ammeter, and overload circuit.

(1) Line-Drop Compensation

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

(2) Ammeter

The current transformers convert a current signal to a voltage signal, which is sent to the interface board and read by the processor boards. This signal is digitized and sent to the display board where it is able to be read by the user on the color display in phase to phase or phase to N format.

(3) Overload

The digitized signal is also processed to determine if the generator output is within the defined specifications. If the current is within the following values, then the output contactor(s) are opened at the prescribed time.

- Continuous 100% rated load at PF 0.7 - 0.8
- Continuous 80% rated load at PF 0.8 - 1.0
- 5 minutes 100% rated load at PF 0.8 - 1.0
- 10 seconds 120% rated load at PF 0.7 - 0.8
- 2 seconds 150% rated load at PF 0.7 - 0.8

10) Cold Weather Starting System (BH1)

The intake air heater, located on the intake manifold, is used for starting the engine at very cold temperatures and reduces the white smoke associated with a cold start. The intake air heater (or grid heater) is energized or de-energized from a power relay controlled by the ECM. The amount of time the air intake heaters stay on, in the preheat phase, is a function of the intake manifold temperature at start up. (The pre-heat time increases with colder intake manifold temperatures). The maximum duration of the pre-heat phase is around 30 seconds.

CAUTION

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

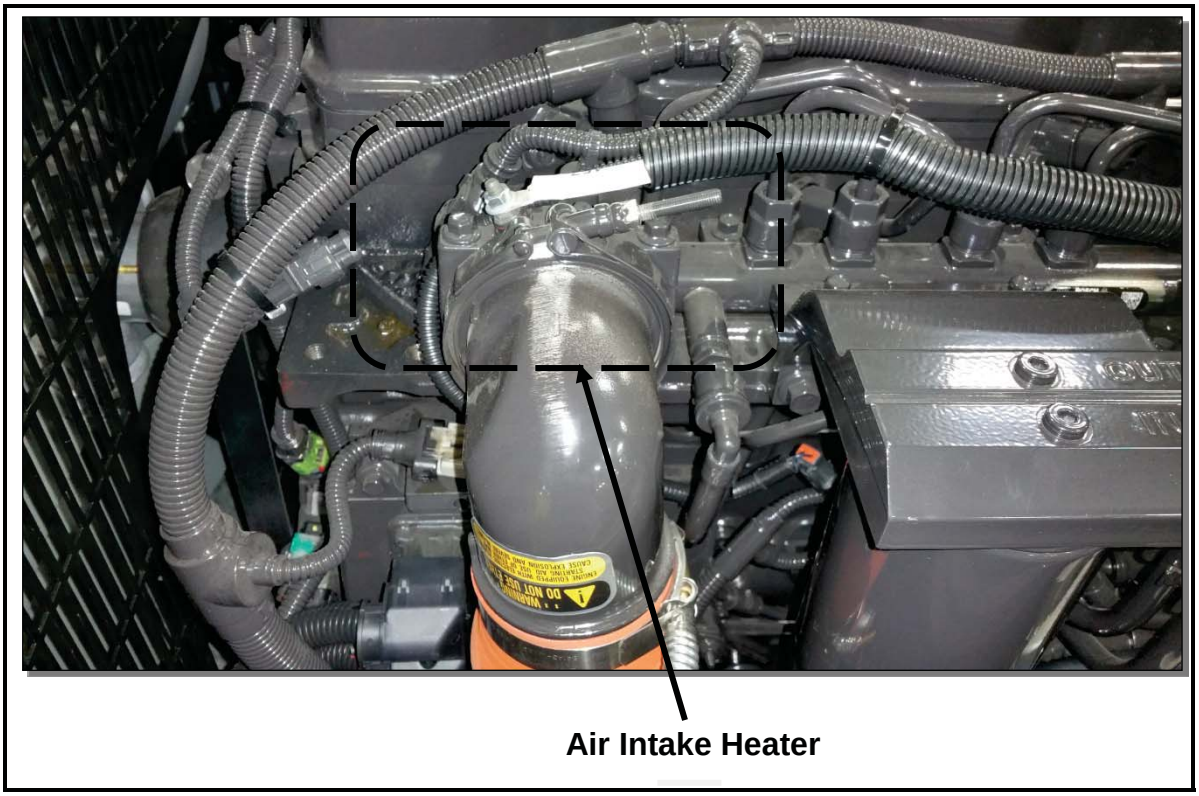


Figure 1-1-6: Air Intake Heater

11) Active Rectifier Unit (ARU)

The ARU provides a regulated output voltage of 28.5 VDC. Input power is provided to the DC components from the 115/200 volt, 400 Hz generator set, through an input contactor. The output contactor provides DC power to the load. Both 400 Hz & 28 VDC outputs can be used simultaneously. The 28 VDC power is provided by an Active Rectifier Unit which is supplied from the 400 Hz output. The 28 VDC output voltage is controlled regardless of any variations in the 400 Hz input voltage. The total continuous amount of power from the unit is calculated as the sum of the 400 Hz and 28 VDC outputs and cannot exceed units 400 Hz power rating.

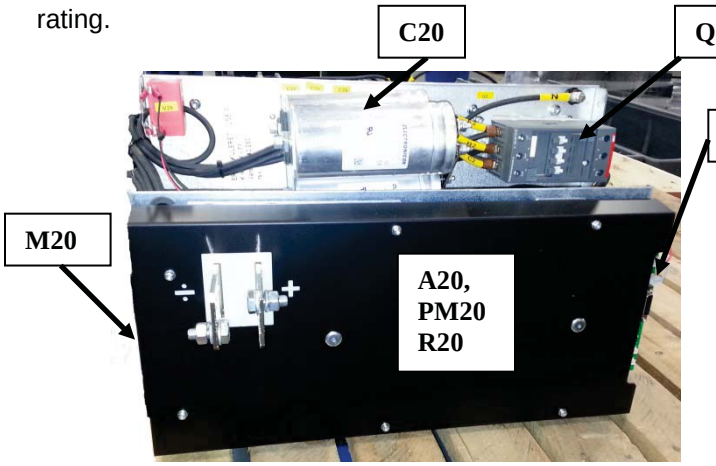


Figure 1-1-7 ARU Front view

Figure 1-1-8 ARU Rear View

Input Contactor (Q3):
The 400 Hz input power to the ARU is supplied and controlled via Q3.

Supply Module (G20):

The generation of the 24 VDC / 10 A (Adjusted from factory = 25 Volt) regulated control voltage is done by the Supply Module G20. This module has a wide input range (340-575 VAC). It is supplied via the capacitor module and pre-fused from the 3-phase circuit breaker Q4 (shared with G1) and located in 400 Hz part.
Refer to section 3.0 for picture.

ARU Transformers (T20):

The ARU transformers receive the 3 phased 400 Hz voltage 3 x 200 Vac and steps down the voltage to an appropriate level to obtain 28 VDC at the output.

ARU Rectifier (PM20):
By controlling six thyristors the output voltage is kept at 28 VDC, regardless of the input voltage level and the load.

ARU Board (A20):
The ARU Board interfaces with the processor board and the rest of the 28 VDC unit. It has the following functions:

- Supplied from G20 (X2)
- Connection to ARU control input on A2 (X1)
- Control of thyristors.
- Measures the output voltage.
- Interface for heat sink thermostat (X5)
- Input for current transformer T20 (X6)

Resistor (R20):
The discharge resistor R20 is part of the output filter stage and discharges the capacitor C20, when the unit is turned off.

Filter Capacitor (C20)
The output filter capacitor is part of the output filter stage and ensures that the AC ripple is kept to a minimum, less than 2% at the output.

Fan (M20)

The fan M20 is part of the total forced cooling of the unit, the primary task for the fan is to cool down the rectifier module. The air is blown out via the filter grill on the left hand side of the base module. The ARU transformers are cooled from the fans located in the 400 Hz part.

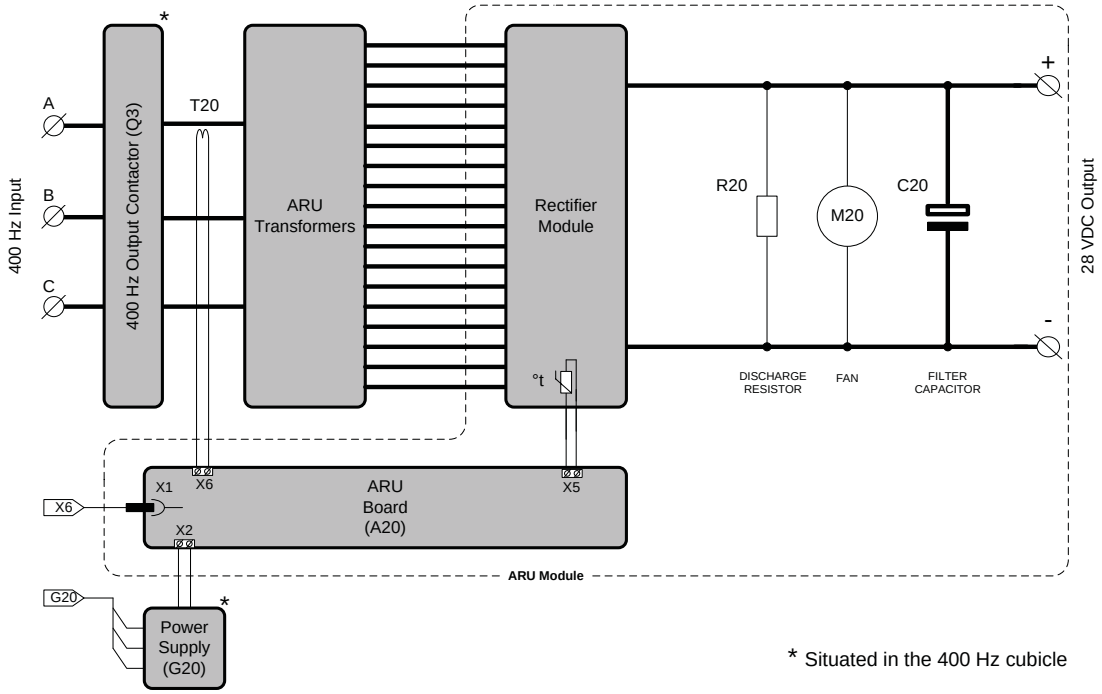


Figure 1-1-9 ARU functional Diagram

Section 2 Preparation for Use, Storage, or Shipping

1) Preparation for use after receipt of unit

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 canopy door and inspect interior for foreign material such as rags, tools, shipping papers, etc.

(4) Check fuel, coolant, oil hoses and connections for visible leaks. Visually inspect the compartment floor and ground surface under the unit for signs of leakage. Correct any leaks by tightening hose clamps, tube fitting, etc., as required.

(5) Check tightness of the generator set retaining components.

(6) Check the fuel level. (A manual quick reference fuel gauge is located at the back of the unit.)

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

(7) Check the engine coolant. Remove the radiator cap (under the hatch on the top of the operator section) to check coolant level. Coolant level should be at the bottom of the filler neck.

CAUTION	Be sure the cooling system antifreeze solution is adequate to protect below the lowest temperature expected.

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

Lubricating oil capacity (w/ filter)	2.9 gallons (11 liters)
Coolant capacity system	5 gallons (18.9 liters)

Figure 1-2-1: Engine Oil and Coolant Capacities

(8) Check the engine lubricating oil level. The oil gauge rod has H high mark and L low-level marks to indicate the operating lubrication oil supply. Oil level should be kept as near the high mark as possible, without going over it. See Figure 1-2-1 for capacity.

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

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

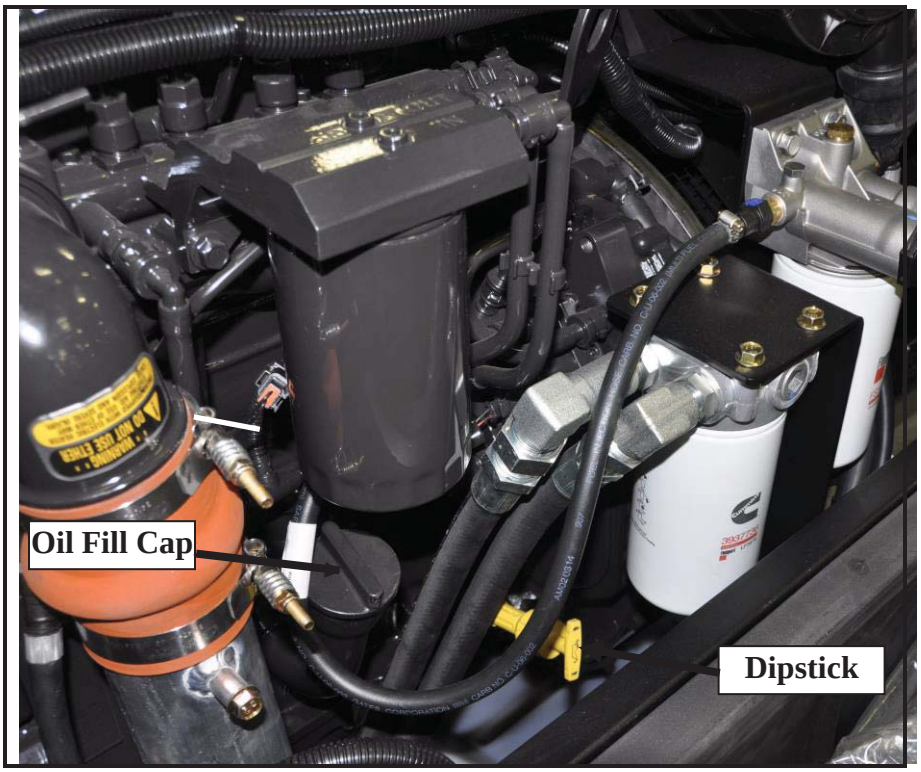


Figure 1-2-2: Oil Fill and Oil Level Check Locations

(9) Check the batteries which are located in the right side cable tray. Inspect the batteries for proper connection of the terminals. Service or replace if necessary.

b) Installing Three-Phase AC Output Cables

Figure 1-2-3

Figure 1-2-4

Figure 1-2-5

The generator set may be shipped without aircraft cables. The output cables connect to the load contactors, which are located at the rear of the unit. (See Figure 1-2-3)

The conductor size recommended for AC output cables is 2/0 AWG. Use No. 12 AWG for the E and F terminals. The lugs must have at least a 3/8-inch diameter hole to fit into the output contactor. (See Figure 1-2-4) The E and F wires should be fitted with 16 gauge forks or into a double ferrule and then inserted into the normally open auxiliary contact block attached to the side of the output contactor. (See Figure 1-2-5)

To install AC output cables proceed as follows:

(1) Remove the canopy. (While this may not be necessary, it greatly simplifies the process.)

(2) Loosen the screws on the cable clamps.

(3) Route the cables through the hole in the cable tray and then through the cable clamps, and up to the load side of the load contactor(s).

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

(5) Connect the cable's neutral terminal lug securely to the neutral (ground) stud on the power module assembly. (See Figure 1-2-4)

(6) Connect the E and F cables into the auxiliary contact block on the side of the output contactor..

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

(8) Replace the canopy.

c) Installing the DC Output Cable (optional)

(1) Remove canopy. (While this may not be necessary, it greatly simplifies the process.)

(2) The DC output cable is not normally supplied unless specifically ordered. For normal aircraft service, use cable assembly JB2840-30 (which meets Mil-C-7974D Assembly specification) with 30 feet of AWG 4/0 cables having a positive and negative connection.

(3) The output cable is extended through the frame via the supplied hole in the cable tray. (See Figure 1-2-3)

(4) The cables will be connected to the output bus bar located on the ARU assembly on the left rear of the unit. (See Figure 1-2-6)

(5) Replace the canopy.

Figure 1-2-6

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

Open battery disconnect switch and then disconnect the battery negative terminal at the battery.

(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 should be used 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 a minimum of two minutes so that all internal engine components will be coated with new oil. (Note: if the unit is operated outside of the diagnostic mode, it will run for 5 minutes in the cool down mode after the stop button is pressed.)

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

(3) Make certain the cooling system antifreeze solution is adequate to protect below the lowest temperatures expected during the storage period. Be sure the solution is thoroughly mixed.

(4) Clean the exterior of the engine. Dry with clean rags and compressed air.

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

c) Long-Term 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 in the unit before packaging.

The unit may be stored for long periods without the above 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 (using a resistive load bank or aircraft) until the coolant temperature has reached at least 176ºF (80ºC).

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

3) Preparation for Shipment

a) Disconnect the battery negative terminal before shipping.

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

CAUTION

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

NOTE: It is suggested that strong banding be used to secure the generator set.

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 systematic sequence of procedures to be followed in supplying 400-Hz or 28.5 VDC power.

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

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

2) 400 Hz. Operating Procedure

a) Pre-start Inspection

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

ii) Check the engine and generator compartments to make certain they are free of rags or other foreign materials.

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

iv) Be sure that the battery isolation switch is closed, ensuring that 24 VDC power is available to the engine starting and control systems.

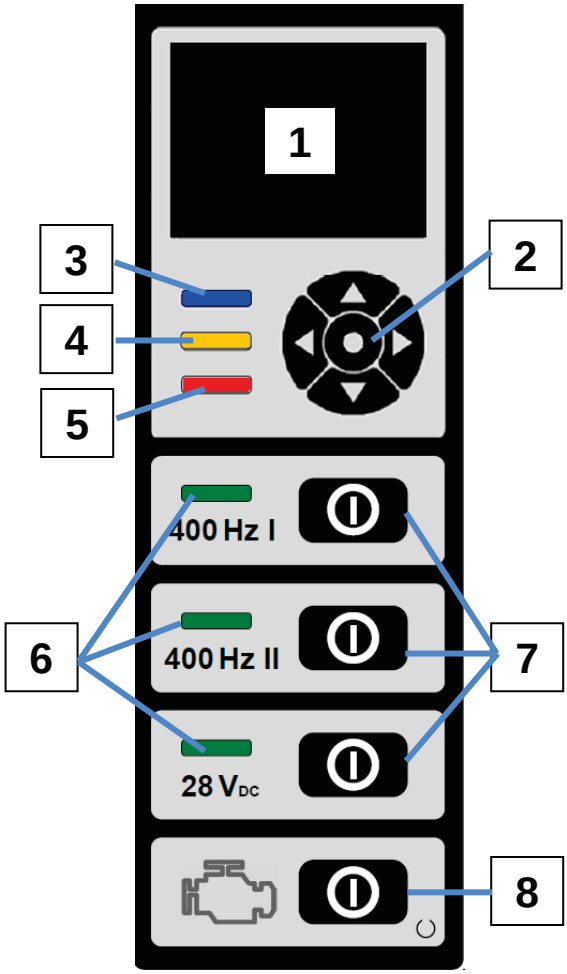
v) Make certain the control panel is on. If not, press the Power ON/Engine Start-Stop button to wake the unit.

b) Normal Engine Starting Procedures

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

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

i) Press and release the Engine start button. The remaining portion of the startup procedure is automated. Startup status will be shown on the display.
The procedure will begin by turning on power to the engine and other vital components. It will then begin to interrogate the engine to insure proper operation. Once verified, the key switch is turned on and engine data is begun to be processed. The engine will begin its initialization and warmup procedures. When finished, the starter will begin to crank.



1. LED Graphical Display
2. Navigation Keypad
3. Power ON "Blue" LED
4. Warning "Amber" LED
5. Alert/Failure "Red" LED
6. Output ON "Green" LEDs
7. Output ON/OFF (Reset) *
8. Power ON & Engine Start/Stop (Reset) *

* All output and engine buttons are multitasking buttons dependent upon the current status of the unit. The displayed screen is NOT important. These buttons are always active.

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

ii) Check oil pressure to make certain that it is normal and observe all other engine values for normal operation.

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

c) **Failed Starting Procedure**

In the event that there is an error during initialization or if the engine fails to start after 3 attempts, the display will show a fault. Diagnose and treat the reason for the fault, clear the fault, and press the engine start button again.

d) Power Delivery

i) After the engine has started and the display has changed to the output status default screen, any of the output ON/OFF buttons can be pressed. If the unit is already at rated speed, the contactor will immediately close. If at idle, the engine will ramp up to rated speed, the generator will set the output voltage, then the contactor will close. The green LED will turn ON next to the active output. In addition, current power status information will appear on the output status default screen.

WARNING	**All output ON/OFF buttons are active regardless of the displayed screen.**

ii) Early in the power delivery run it is recommended that the operator check output voltage and current in each of the three phases. Use ▼ ▲ push-buttons to view either the line-to-line or line-to-neutral voltage. If the load is changing, observe the display until load conditions stabilize.

iii) A condition of over-voltage, under-voltage, under-frequency, over-frequency, or overload in the output circuit will automatically open the load contactor and display a fault code to signal the operator which of the above faults caused the protective monitor system to operate. After the fault has been corrected, press the respective output push-button to reset the system. Proceed with power delivery by pressing the same switch.

WARNING	**NEVER** disconnect the output cable while power is being delivered. Output contactor's must be open prior to removal of the cable from the aircraft.

CAUTION	The generator set must be shut down so that the failed power delivery problems can be diagnosed. Only trained or qualified personnel with this type of equipment should work on this GPU.

e) Failed Power Delivery

If the contactor indicating light goes out and EF fault is shown on the display, this indicates that the aircraft is not supplying the 28.5 VDC interlock signal to the plug interlock circuit. Correct the condition and press the output push-button to reset the fault. Press the button again to close the output contactor and provide 400Hz to the aircraft/load bank.

If the aircraft (or load bank) does not have the 28.5 VDC signal, set the **EF Bypass ON** through the Setup icon menu.

1. Press and hold ● for approximately 5 seconds.
2. Use navigation keys (◄▼▲►) to highlight the setup icon.  Press ● to select.
3. Use navigation keys (▼▲) to highlight the EF Interlock line. Press ● to select.
4. Set EF interlock to bypass.
5. Press ● to accept the change.
6. Use navigation keys (◄ or ►) to go back to the default screen. Display will automatically return to the default screen after a period of inactivity.

f) Discontinue Power Delivery with Unit Shutdown

i) Normal conditions

a Push the Output ON/OFF push-button next to the lit green LED indicator to open that output load contactor. The indicating light next to that button will go OFF, indicating that the load contactor has opened and power is no longer being delivered to the aircraft. Once all of the contactors are opened, the engine will remain at rated speed and the generator will remain active. If idle is enabled, the generator will deactivate and the engine will return to idle after a short delay.

b Push the engine Start/Stop push-button switch once to begin the automatic shutdown sequence to shut off the engine after approximately 5 minutes.

ii) Emergency conditions

(1) Depress the "**EMERGENCY STOP BUTTON**" located on the front of the unit to the right of the control panel. When pushed, this button shuts the generator set off. Pull the button back out to reset it before restarting the generator set.

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

g) Display –

i) The display will automatically dim if the engine has been off for at least 10 minutes. Pushing any button will return the display to full brightness. Once the display dims, if no button is pushed in the next couple of minutes, the display will turn off.

ii) If the display is off, and the battery disconnect switch is closed, press the Engine pushbutton to return the display to full brightness.

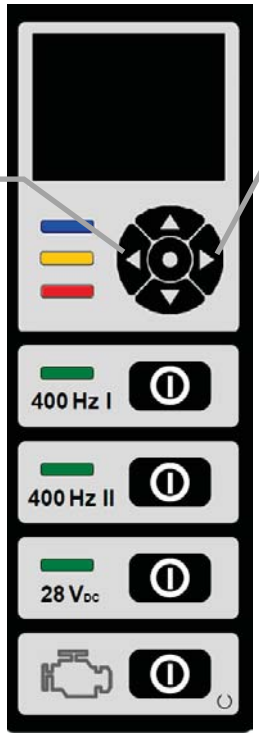
3) Active Rectifier Unit (ARU) – 28.5 VDC Power Supply

CAUTION	The ARU can deliver up to 2,000 amps of current during the starting of an aircraft engine. This much current will shear the propeller shaft of some aircraft. Therefore, make sure that the current limit is correctly set for the aircraft that is being powered.

1) Setting the Current Limit
   a) The Setup menu is used to change the default current limit value. This value will be used whenever the 28VDC output is turned on.
      i) Refer to section 4.0.2 for instruction in how to get into the Setup Menu. Use the up or down arrow buttons to scroll to the 28V Current Limit menu item and press ● twice.
      ii) Use the up or down arrow buttons to change the default value to the desired current limit for the aircraft being powered.
      iii) Press ● to accept the changed value as the new default value.
   b) If the current limit only needs to be changed for a one time use, use the following procedure:
      i) With the unit's engine running and the 28 VDC power is off, the right or left arrows can be used to change the default current limit value. (400, 600, 900, 1200, 1500, 1800, & 2000)
      ii) Once the correct value is selected, use the below procedure to start the unit.

Note: To ensure hassle-free starting of the aircraft engine, the current limit function is delayed 0.7 seconds.

With the engine running and DC power OFF, press the *"Left arrow"* to temporarily decrease the DC current limit.



With the engine running and DC power OFF, press the *"Right arrow"* to temporarily increase the DC current limit.

2) Starting the 28 VDC ARU.

a) Insert the aircraft cable into the aircraft. Make sure the cable is inserted until you feel a natural resistance. The plug may be equipped with a 90% insertion switch (split “C” pin). In this case, the unit will not function if the plug not is fully inserted.

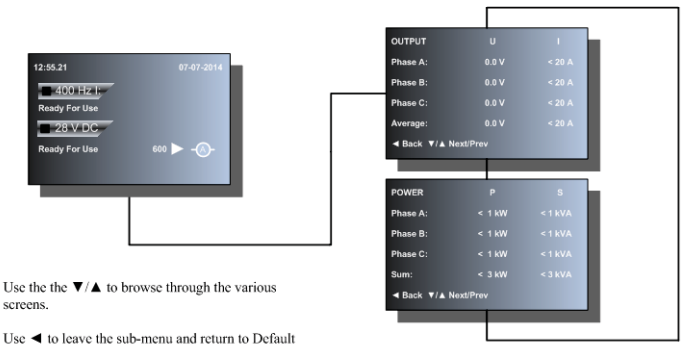
b) Press the 28 VDC Start/Stop button.

c) The unit is now in operation and supplying power to the aircraft. This is also indicated via the green LED located close to the 28VDC Start/Stop button.

d) If the unit shuts off and is no longer supplying power to the aircraft, this is reported in clear text in the display. Also, a corrective action is displayed.

e) During operation, various parameters can be viewed via the display. Use the navigation keys ▼▲ to browse through the available screens:

Default Display Screen Standby

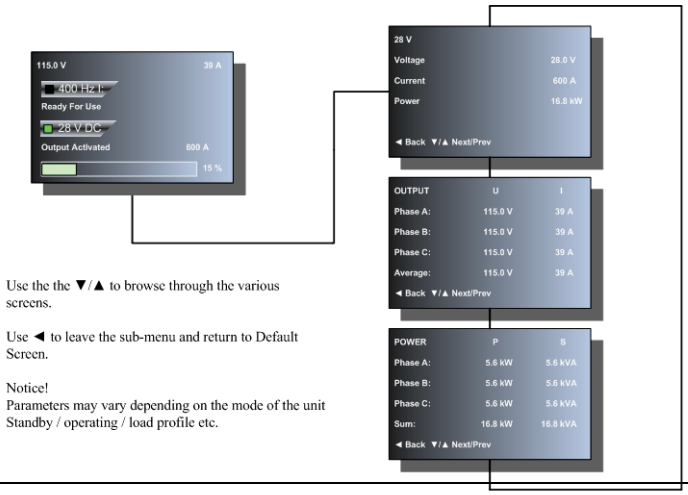


Use the the ▼/▲ to browse through the various screens.

Use ◄ to leave the sub-menu and return to Default Screen.

Notice!
Parameters may vary depending on the mode of the unit Standby / operating / load profile etc.

Default Display Screen Operating



Use the the ▼/▲ to browse through the various screens.

Use ◄ to leave the sub-menu and return to Default Screen.

Notice!
Parameters may vary depending on the mode of the unit Standby / operating / load profile etc.

f) After operation, the unit has to be turned off before removing the aircraft plug. Press the 28 VDC Start/stop button

g) The aircraft cable can now be removed from the aircraft and placed at the cable rest position.

Note!
Please note that the 28 VDC Start/Stop button also functions as a Reset push button.

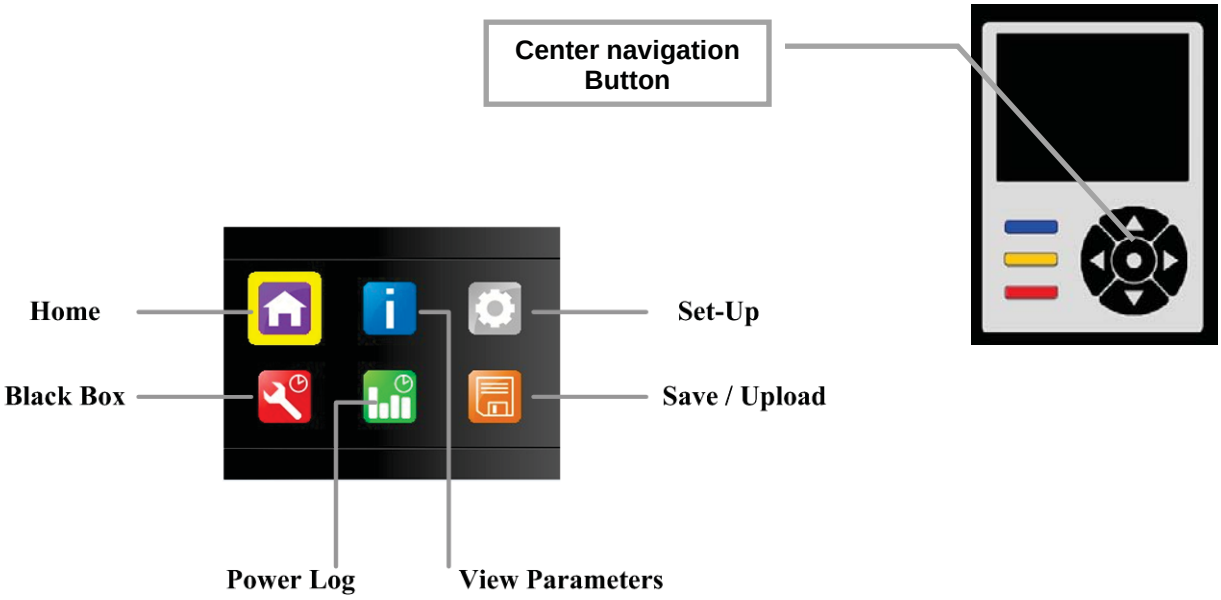
If, for some reason, the unit stops due to an error / failure, record the fault number and message and forward this information to your maintenance personnel. If the fault is no longer active, press the Start/Stop/Reset to reset the alarm and the unit.

3) ARU Default Factory Settings:

28 V Voltage (V):	28.0
28 V Compensation (V/600A):	0.0 (Set if GPU supplied with cable)
28 V Current Limit (A):	1500.0
Output Mode:	Simultaneous
Fan Control:	Normal
Plug Temperature:	Normally Open

4.0 Icon Menu

The Icon Menu is accessed from the Default screen. Press the center navigation button ● while in the default menu and hold it down for approximately 5 seconds.



The basic Icon Menu is shown above with the available sub-menus.

To enter the Icon Menu, press the ● from the default menu and hold it down for approximately 5 seconds.

To Select a sub-menu, simply use the navigation keys ◄▼▲► to highlight the icon and then press the ● to enter the sub-menu.

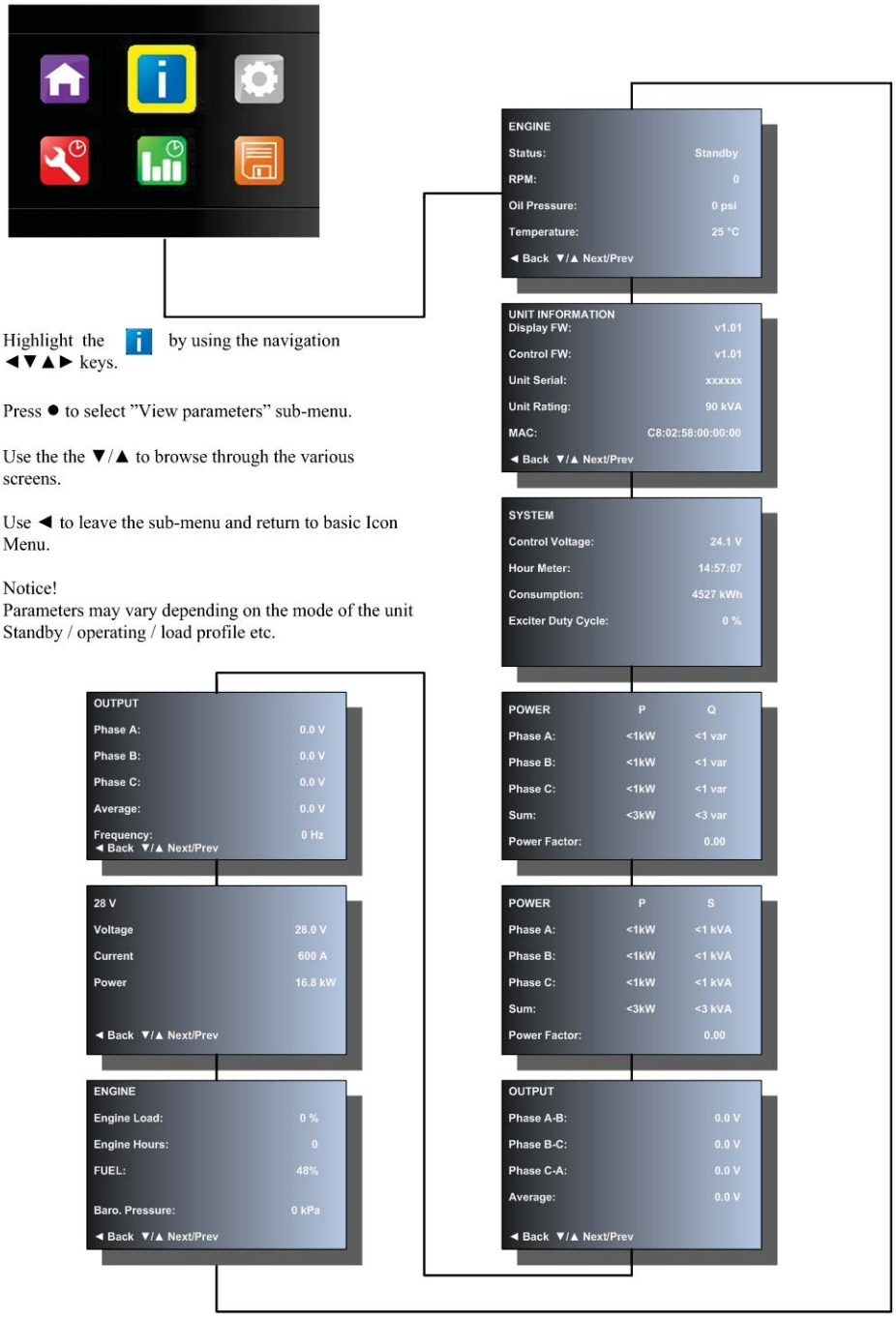
To leave the Icon Menu highlight the ”Home” icon and press ●

Icon explanation:

- Back to Default screen
- Viewing actual converter parameters
- Set-up menu for changing converter parameters
- Black Box with last 100 failures / errors
- Power Log with last 100 operations
- Save ”Black Box” / ”Power Log” records or update control card software

4.0.1 View Parameters Menu

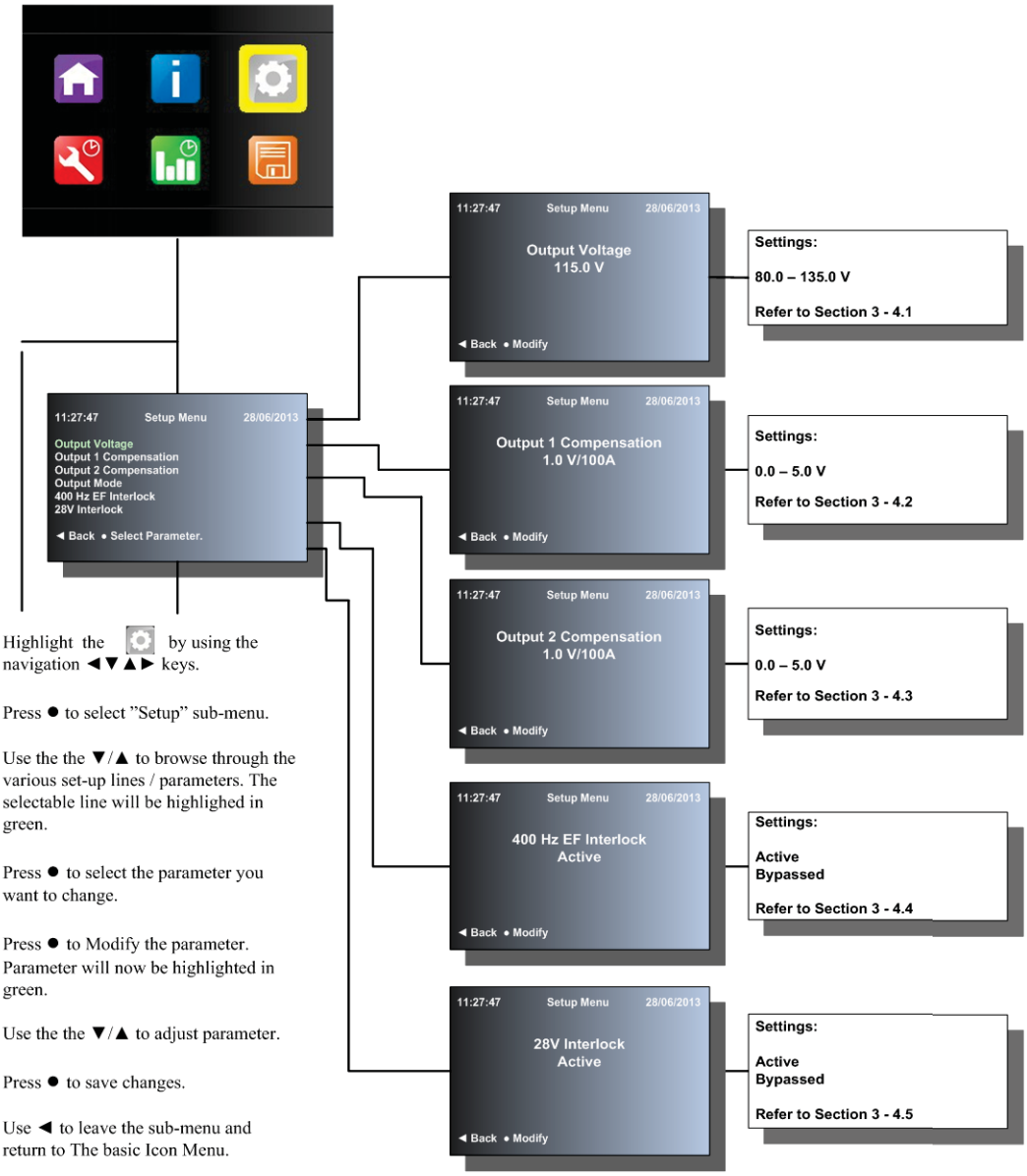
The View Parameters Menu is accessed from the Icon screen. Press the center navigation button ● while in the default menu and hold it down for approximately 5 seconds. The Icon menu is displayed, press the right navigation button to highlight the icon.



4.0.2 Setup Menu

The Setup Menu is accessed from the Icon screen. Press the center navigation button ● while in the default menu and hold it down for approximately 5 seconds. The Icon menu is displayed, press the right navigation button to highlight the Setup icon.

Setup – Menu structure



Highlight the by using the navigation ◄▼▲► keys.

Press ● to select "Setup" sub-menu.

Use the the ▼/▲ to browse through the various set-up lines / parameters. The selectable line will be highlighed in green.

Press ● to select the parameter you want to change.

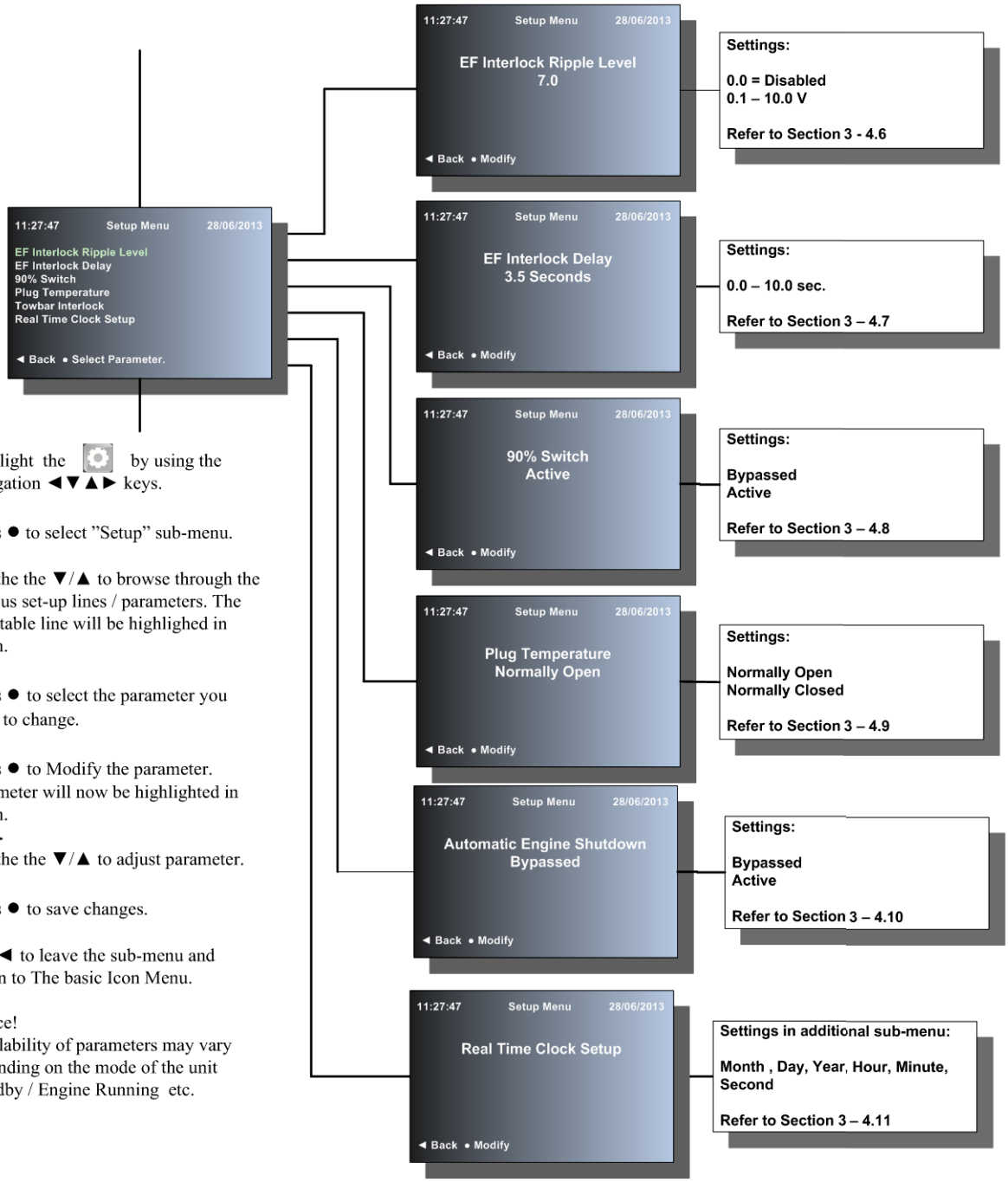
Press ● to Modify the parameter. Parameter will now be highlighted in green.

Use the the ▼/▲ to adjust parameter.

Press ● to save changes.

Use ◄ to leave the sub-menu and return to The basic Icon Menu.

Notice!
Availability of parameters may vary depending on the mode of the unit Standby / Engine Running etc.



Highlight the ⚙ by using the navigation ◄▼▲► keys.

Press ● to select ”Setup” sub-menu.

Use the the ▼/▲ to browse through the various set-up lines / parameters. The selectable line will be highlighed in green.

Press ● to select the parameter you want to change.

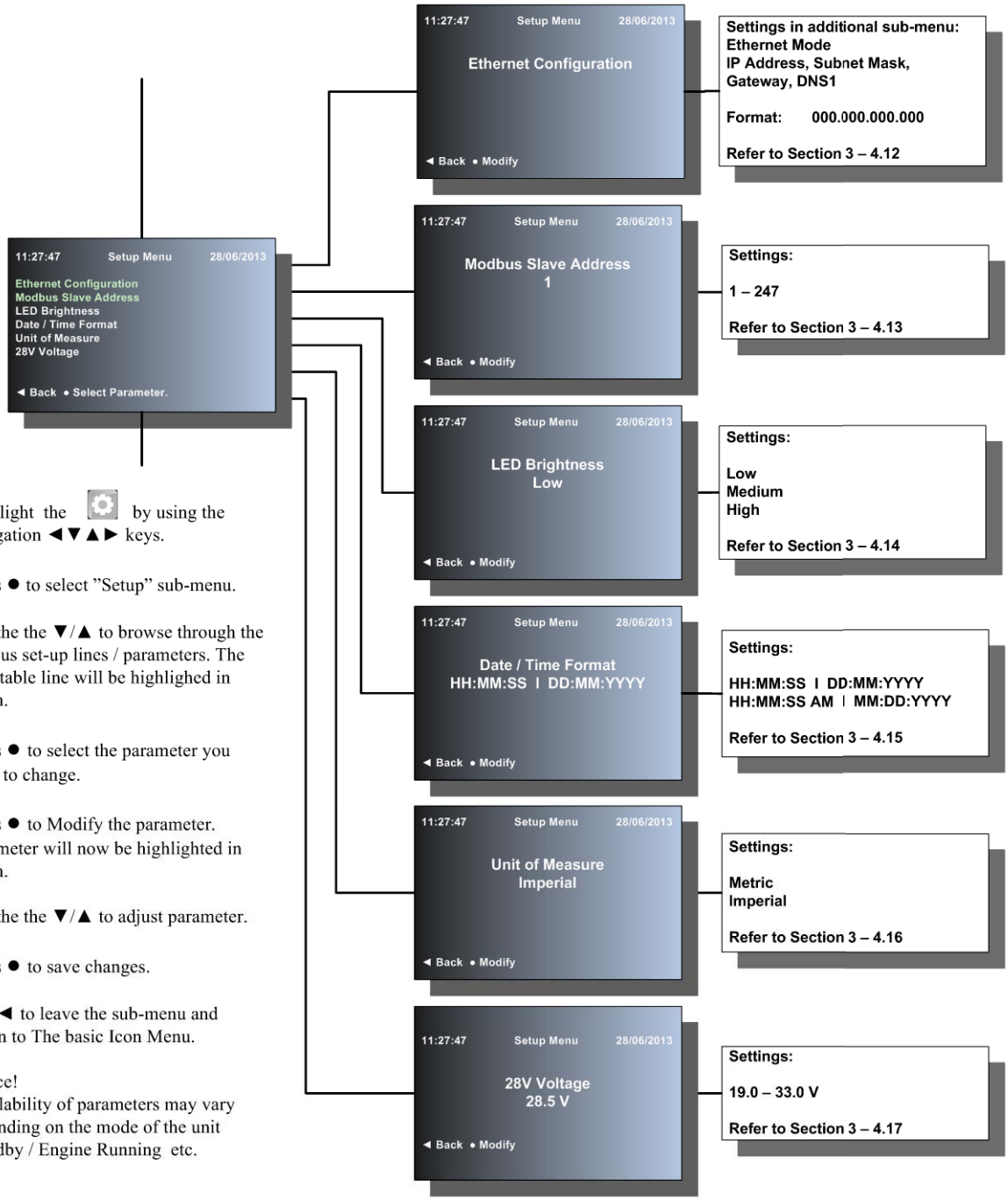
Press ● to Modify the parameter. Parameter will now be highlighted in green.

Use the the ▼/▲ to adjust parameter.

Press ● to save changes.

Use ◄ to leave the sub-menu and return to The basic Icon Menu.

Notice!
Availability of parameters may vary depending on the mode of the unit Standby / Engine Running etc.



Highlight the by using the navigation ◄▼▲► keys.

Press ● to select ”Setup” sub-menu.

Use the the ▼/▲ to browse through the various set-up lines / parameters. The selectable line will be highlighed in green.

Press ● to select the parameter you want to change.

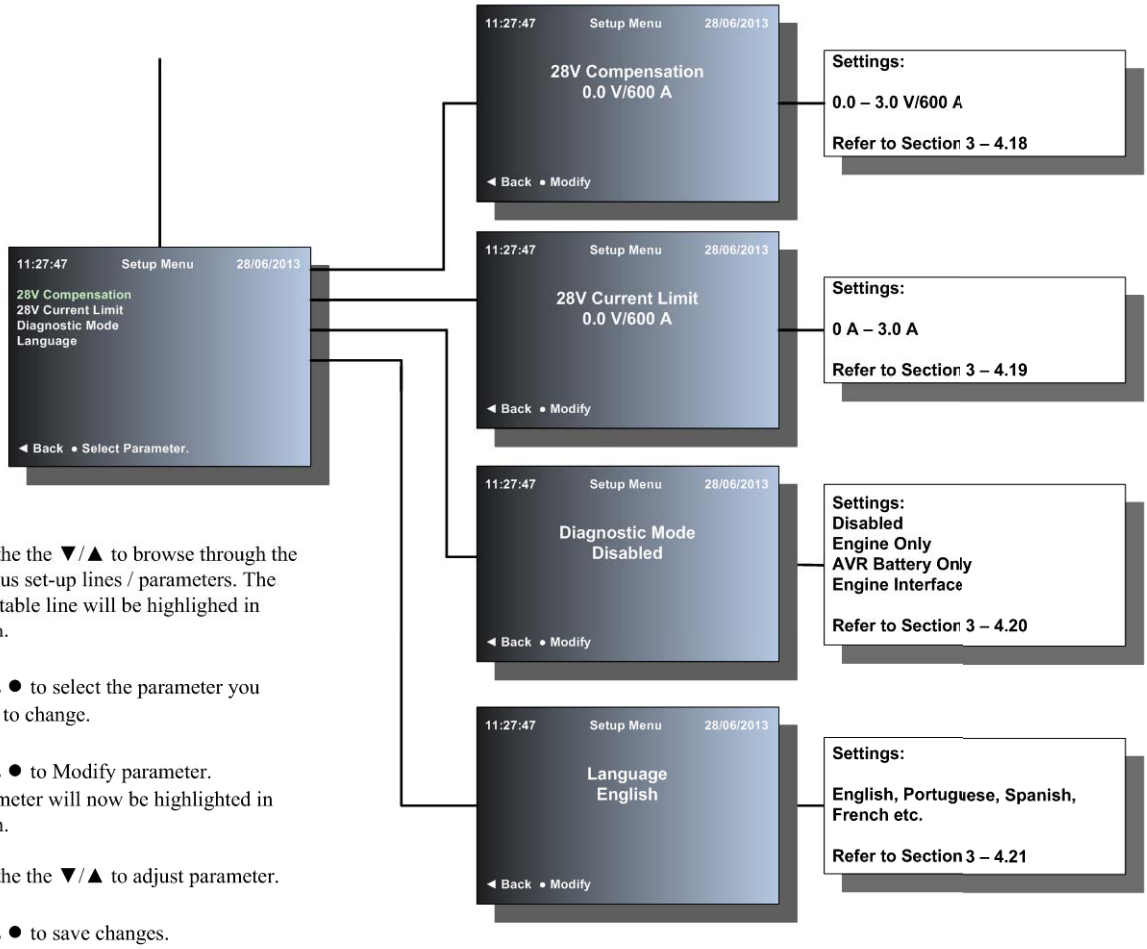
Press ● to Modify the parameter. Parameter will now be highlighted in green.

Use the the ▼/▲ to adjust parameter.

Press ● to save changes.

Use ◄ to leave the sub-menu and return to The basic Icon Menu.

Notice!
Availability of parameters may vary depending on the mode of the unit Standby / Engine Running etc.



Use the the ▼/▲ to browse through the various set-up lines / parameters. The selectable line will be highlighed in green.

Press ● to select the parameter you want to change.

Press ● to Modify parameter. Parameter will now be highlighted in green.

Use the the ▼/▲ to adjust parameter.

Press ● to save changes.

Use ◄ to leave the sub-menu and return to basic Icon Menu.

Notice!
Availability of parameters may vary depending on the mode of the unit Standby / Engine Running etc.

4.1 Output Voltage:

This Setup submenu allows the output voltage to be adjusted between 80.0 VAC and 135 VAC using the UP and DOWN navigation buttons. (Please note that the acceptable voltage range for all commercial aircraft is 115V ±3V. This range is even tighter for some aircraft.)

Enter the Setup Menu and then scroll up or down to the Output Voltage submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.2 Output 1 Compensation:

The output voltage is increased in proportion to the load current (Volt / 100 A).

1. Apply full load to output 1.

2. Enter the “OUTPUT 1 COMPENSATION” submenu. Press the center button to allow the value to be adjusted.

3. Adjust the compensation using the vertical arrow buttons until the voltage at the aircraft connector equals the no load value. Press center ● button to accept and record this value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.3 Output 2 Compensation:

The output voltage is increased in proportion to the load current (Volt / 100 A).

1. Apply full load to output 2.

2. Enter the “OUTPUT 2 COMPENSATION” submenu. Press the center button to allow the value to be adjusted.

3. Adjust the compensation using the vertical arrow buttons until the voltage at the aircraft connector equals the no load value. Press center ● button to accept and record this value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.4 400 Hz EF Interlock

The EF interlock is a personnel and equipment safety feature that is found in all commercial aircraft. This 28VDC signal will not be present until the GPU closes its output contactor and provides 400 Hz power to the aircraft. The aircraft will evaluate the 400 Hz power and if it is within the aircrafts tolerance limits it will then close a relay in the aircraft to provide a 28VDC signal to the “F” pin/wire in the power connector plug/cable.

Some load banks do not provide this EF Interlock so the EF interlock function in the unit has to be bypassed. Do not set this value to Bypassed for normal operation with aircraft. This setting is only to be used by qualified personnel for testing the GPU unit or when the unit will be providing power to equipment outside of an aircraft.

Note! The value will be automatically reset to Active if the unit detects 28 volts on the "F" pin input of the I/O board.

Go into the Setup Menu and then scroll up or down to the EF Interlock submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.5 28V Interlock

The 28V interlock is a personnel and equipment safety feature that is found on some commercial turboprop aircraft. This 28VDC signal will not be present until the GPU closes its output contactor and provides power to the aircraft connector. The connector typically has a split “F” socket with +28VDC on one side and a jumper to the return wire on the other side of the socket. The GPU will not keep the output contactor closed if this voltage is not detected on the return wire in the cable. (This option requires a special cable such as the JB2840-30CS, JB2840-40CS or JB2840-50CS.)

Note! The value will be automatically reset to Active if the unit detects 28 volts on the "F" pin input of the I/O board.

Go into the Setup Menu and then scroll up or down to the 28V Interlock submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.6 EF Interlock Ripple Level

The EF Interlock Ripple Level is part of the Neutral Voltage Displacement circuit. If an aircraft has a large unbalanced load and the aircraft power cable has a broken neutral, then it is possible for the aircraft frame to be energized to a dangerous level. This condition will result in an AC voltage induced onto the EF DC signal.

This sub-menu sets the trip level for the AC ripple on the DC EF interlock signal. The default value is 7.0 volts and a setting of 0.0 volts disables the function.

Go into the Setup Menu and then scroll up or down to the EF Interlock Ripple Level submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.7 EF Interlock Delay

Some of the newer aircraft take a longer time between when 400 Hz power is supplied to the aircraft and when the aircraft returns the 28 VDC EF Interlock signal. This setting allows the adjustment of the amount of time the unit will wait until determining that the EF signal is not present and that the output power should be shut off. The default value is 3.5 seconds.

Go into the Setup Menu and then scroll up or down to the EF Interlock Delay submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.8 90% Switch

Some aircraft power cables are equipped with a micro-switch or split "F" socket in the connector. This device sends a 28 VDC signal to the unit when the connector is inserted at least 90% of the way into the aircraft power receptacle. Set this sub-menu value to Enable when such a cable is connected to the unit. The default value is set to Disable.

Go into the Setup Menu and then scroll up or down to the 90% Insertion Switch submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.9 Plug Temperature

Some aircraft cables have temperature sensors installed in the connector. This sub-menu allows the unit to accept Normally Opened or Normally Closed temperature sensor switches to be used.

Go into the Setup Menu and then scroll up or down to the Plug Temperature submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.10 Automatic Engine Shutdown:

If all outputs are off for five (5) minutes, the engine will automatically go into its 5 minute shutdown mode when this function is active. The Setup submenu allows this option to be activated or bypassed.

Enter the Setup Menu and then scroll up or down to the Automatic Engine Shutdown submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.11 Real Time Clock Setup

This set of sub-menu s allows the user to adjust the internal clock to the correct local time.

Go into the Setup Menu and then scroll up or down to the Real Time Clock Setup submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.12 Ethernet Configuration

This set of sub-menu s allows the user to enter the Ethernet IP address, Subnet Mask, Gateway address and DNS1 values for TCP/IP communications with a BMS or RMS central monitoring system.

Go into the Setup Menu and then scroll up or down to the Ethernet Configuration submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.13 Modbus Slave Address

If the unit will be part of an RS-485 Modbus RTU BMS/RMS monitoring system, it must be assigned a Modbus Slave Address. This sub-menu allows the user to enter the slave address.

Go into the Setup Menu and then scroll up or down to the Modbus Slave Address submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.14 LED Brightness

The unit status LED's have three brightness levels. The default is set to medium.

Go into the Setup Menu and then scroll up or down to the LED Brightness submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.15 Date/Time Format

The date and time format that is displayed on all of the screens and reports can be adjusted using this submenu. The selection is a 24 hour clock and DD:MM:YYYY date format or a 12 hour clock with the MM:DD:YYYY date format.

Go into the Setup Menu and then scroll up or down to the Date/Time Format submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.16 Unit of Measure

This submenu is used to set the unit of measurements to Metric or Imperial.

Go into the Setup Menu and then scroll up or down to the Unit of Measure submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.17 28V Voltage

This Setup submenu allows the 28 volt output to be adjusted between 19.0 VDC and 33.0 VDC using the UP and DOWN navigation buttons. (Please note that the acceptable voltage range for all commercial DC powered aircraft is 26V to 29V.

Enter the Setup Menu and then scroll up or down to the ARU Voltage submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.18 28V Compensation

DC voltage drops quickly as the current increases over a given length of cable. This Setup submenu allows the 28 volt output to be automatically adjusted as the load increases. The allowed setting is between 0.0 and 3.0 VDC at the rated continuous load of the unit. Note that the maximum output voltage of the unit is 33 VDC.

Enter the Setup Menu and then scroll up or down to the 28V Compensation submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.19 28V Current Limit

If too much current is supplied to an engine, it is possible for the engine to shear the engines propeller shaft. This Setup submenu is used to set the default limit for the amount of current that the 28 VDC module will supply to start the aircrafts engine. Typically this value is set to the maximum current of the smallest aircraft the unit will service. If more current is required for larger aircraft, then the operator can adjust the current limit using the RIGHT and LEFT navigation buttons when the diesel is running, the 28VDC ARU is NOT on and the “default” operator screen is displayed. The current limit settings are from 200 amps to 1600 amps for the 400 amp version of the unit and from 400 amps to 2400 amps for the 600 amp version.

To change the default current limit setting, enter the Setup Menu and then scroll up or down to the 28V Current Limit submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.20 Diagnostic Mode

This setup submenu is used to assist in the troubleshooting procedure. The default setting is “Disabled”; use the “Engine Only” to verify engine performance; use the “AVR Battery Only” to verify the operation of the generator (with engine operation). The “Engine Interface” allows read only access to the engine ECM module. In the “Engine Interface” mode, the engine ECM will perform a self-test and then enter its Run mode. (The display will indicate running in the engine screen). In this mode each of the output contactors can be toggled on and off to verify that they are functioning correctly.

The engine must be stopped before any of these modes can be changed.

Enter the Setup Menu and then scroll up or down to the 28V Current Limit submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.21 Language

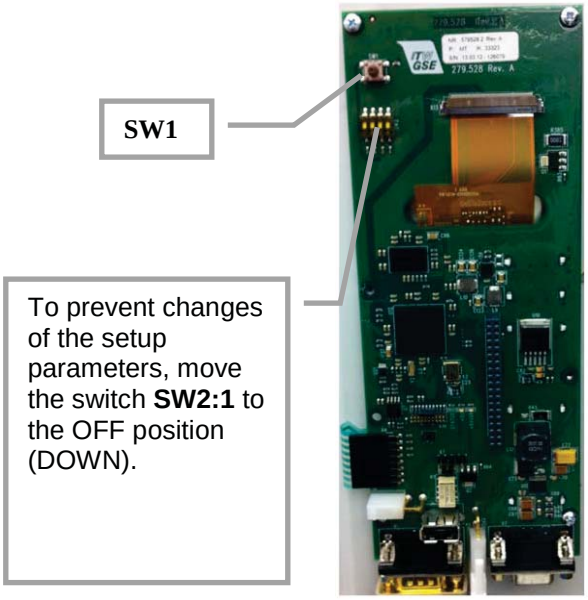
This submenu is used to change the language that all of the display screens, messages, alarms and reports are displayed in. The unit comes with Danish, English, German, French and Spanish already installed. The default is set to English.

Go into the Setup Menu and then scroll up or down to the Language submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

4.22 Preventing changes of set-up parameters

To avoid unintentional modification of the Set-up parameters, it is possible to block the access to the Set-up Mode, by means of a DIP switch situated at the Display Board A3.

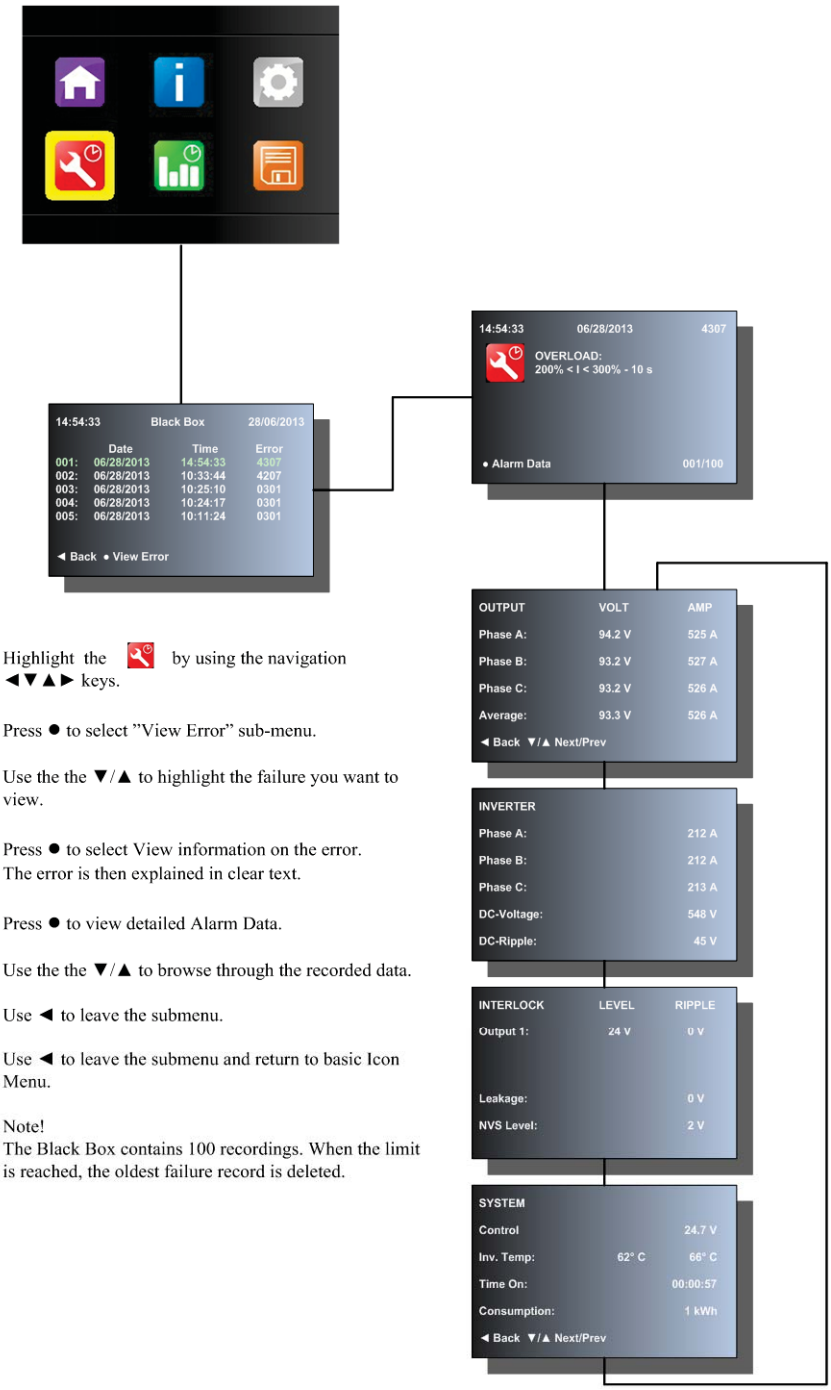
Note!
If the DIP switch is set to blocked, pressing the SW1 enables the user to enter the set-up menu within 10 seconds. After the time elapses the menu will be blocked again.



4.0.3 Black Box

The Black Box Menu is accessed from the Icon screen. Press the center navigation button ● while in the default menu and hold it down for approximately 5 seconds. The Icon menu is displayed, press the right navigation button to highlight the Setup icon.

Black Box – Menu structure



Highlight the by using the navigation ◄▼▲► keys.

Press ● to select "View Error" sub-menu.

Use the the ▼/▲ to highlight the failure you want to view.

Press ● to select View information on the error. The error is then explained in clear text.

Press ● to view detailed Alarm Data.

Use the the ▼/▲ to browse through the recorded data.

Use ◄ to leave the submenu.

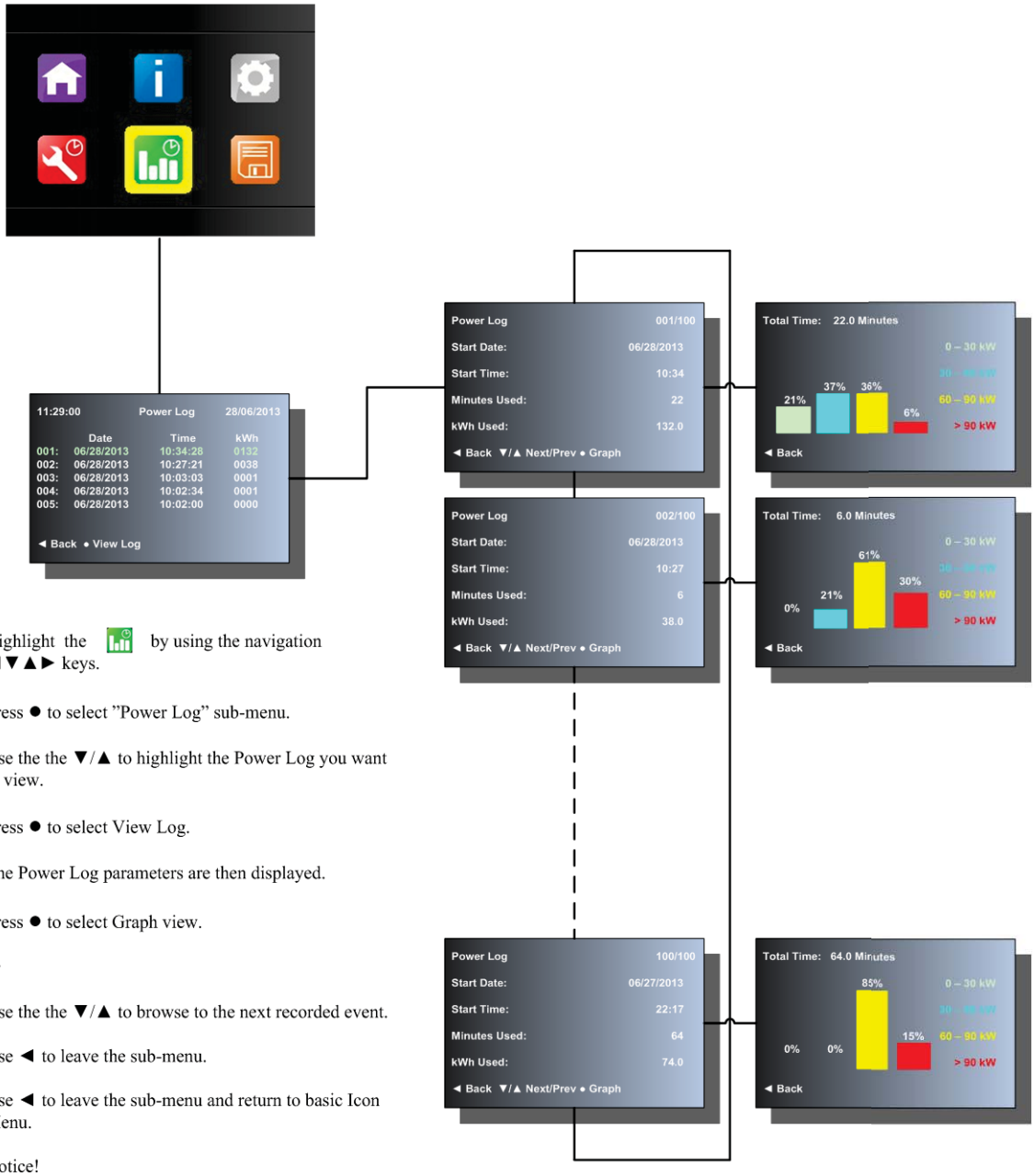
Use ◄ to leave the submenu and return to basic Icon Menu.

Note!
The Black Box contains 100 recordings. When the limit is reached, the oldest failure record is deleted.

4.0.4 Power Log

The Power Log Menu is accessed from the Icon screen. Press the center navigation button ● while in the default menu and hold it down for approximately 5 seconds. The Icon menu is displayed, press the right navigation button to highlight the Setup icon.

Power Log – Menu structure



Highlight the by using the navigation ◄▼▲► keys.

Press ● to select "Power Log" sub-menu.

Use the the ▼/▲ to highlight the Power Log you want to view.

Press ● to select View Log.

The Power Log parameters are then displayed.

Press ● to select Graph view.

or

Use the the ▼/▲ to browse to the next recorded event.

Use ◄ to leave the sub-menu.

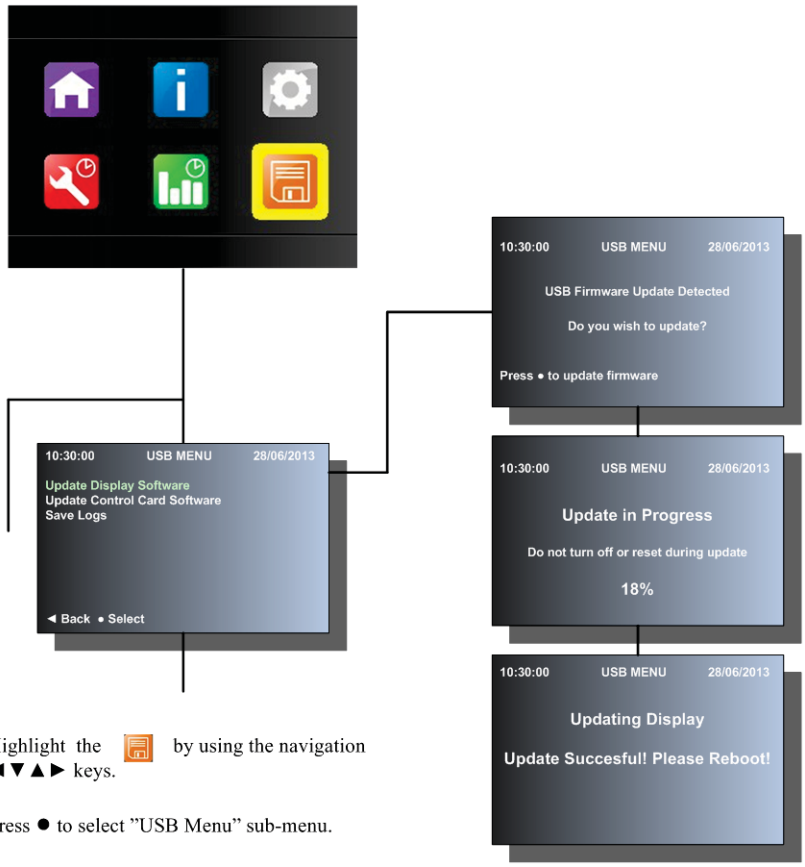
Use ◄ to leave the sub-menu and return to basic Icon Menu.

Notice!
The Power Log contains 100 recordings. When the limit is reached, the oldest Log record is deleted.

4.0.5 Upload/Download Menu

The Upload/Download Menu is accessed from the Icon screen. Press the center navigation button ● while in the default menu and hold it down for approximately 5 seconds. The Icon menu is displayed, press the right navigation button to highlight the Setup icon.

Save/Upload – Menu structure



Highlight the by using the navigation ◄▼▲► keys.

Press ● to select "USB Menu" sub-menu.

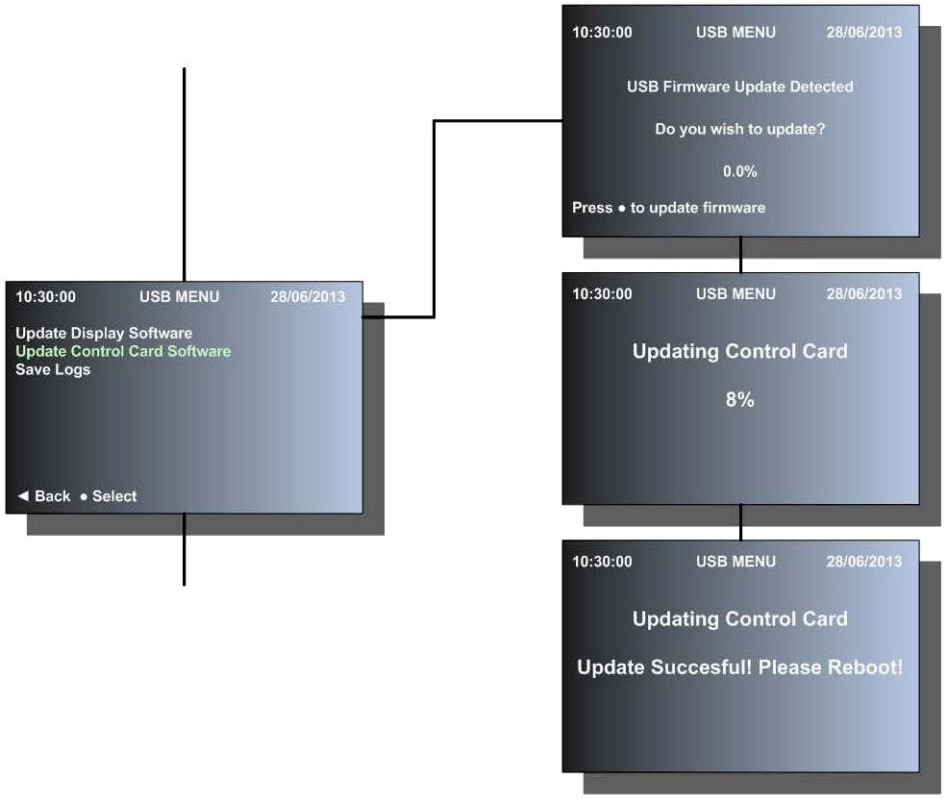
The default function "Update Display Software" is green highlighted. If another function is wanted, use the the ▼/▲ to highlight the function.

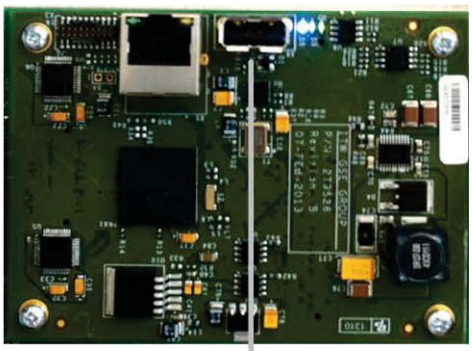
Before pressing ● to select "Update Display Software", please remember to insert a USB stick into the USB port on the Display (located on the side of the Display enclosure inside the unit).

Press ● to select the function.

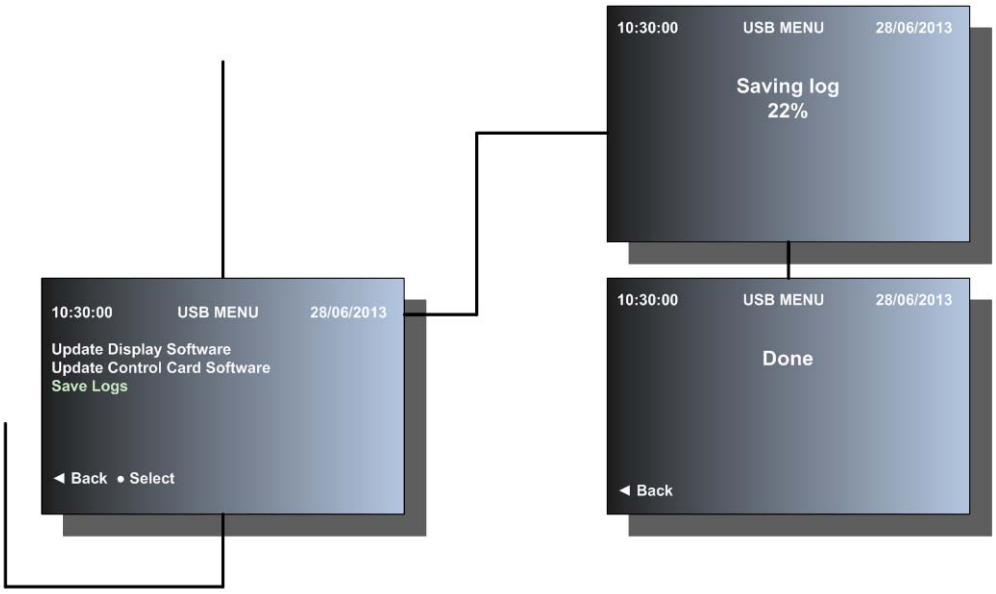
Press ● to confirm update firmware.

The firmware is now being uploaded to the display card. Upload % is counting from 0% to 100%. The system automatically reboots if the update is successful. Otherwise, an Update has failed! Message is displayed.





USB connection
Control card



Highlight the by using the navigation ◄▼▲► keys.

Press ● to select ”USB MENU” sub-menu.

Use the the ▼/▲ to highlight the function ”Save Logs”.

Before pressing ● to select Save logs, please remember to insert an USB stick into the USB port on the display (loacted on backside of the front door).

Press ● to select function.

The logs are now saved to the USB stick. Saving log % is counting from 0% to 100% and ”Done” is displayed, when the saving has been completed.

The logs are saved as one CSV File and can be viewed with the **ITW GSE LOG Programme**.

Note!
The USB stick can be inserted while the unit is connected to the power.

Chapter 2 Service and Troubleshooting

Section 1 Maintenance Inspection/Check

1) General

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

WARNING

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

2) Maintenance Schedule

a) General

A periodic maintenance schedule should be established and maintained. A suggested schedule is provided in Figure 2-1-1 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 the engine manufacture's operation manual. The check sheet will provide a record and serve as a guide for establishment of a schedule to meet the customer's maintenance requirements for his specific operation.

c) Time Intervals.

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

d) Identification of Interval Periods.

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

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

Figure 2-1-1 Maintenance Schedule
(Sheet 1 of 2)

Hourly Interval	AR	50-150	10	250	500	1000	1500	2000
Calendar Interval		**Once**	**Daily**	**3 Mo.**	**6 Mo.**	**1 Yr.**	**1.5 Yr.**	**2 Yr.**
Symbol	**AR**	**BR**	**A**	**B**	**C**	**D**	**E**	**F**
Engine (continued)								
Flush and Change Coolant								X
Check Fan Mounting				Spring & Fall				
Clean Cooling System				Spring & Fall				
Check Hoses				Spring & Fall				
Clean Electrical Connections				Spring & Fall				
Check Thermostats and Seals				Fall				
Electrical (24 VDC System)								
Check All Lights			X					
Check Alternator Charging Rate			X					
Check Battery				X				
Clean Battery Terminals	X			X				
Check Wiring and Connections					X			
Check All Engine Meters			X					
Electrical (400-Hz System)								
Check E-F By-Pass Operation				X				
Check Output Cable and Connectors			X					
Check Volt, Amp & Frequency Displays			X					
Check and/or Adjust Output Voltage	X				X			
Inspect Wiring and Connectors					X			
Clean and Inspect Generally					X			

Figure 2-1-1 Maintenance Schedule
(Sheet 2 of 2)

3) Inspection/Checks

a) General

See Chapter 2-2 for detailed maintenance procedures.

See Chapter 2-3 for adjustment and test procedures.

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

(1) Engine

a Change Air Cleaner

Replace the air filter when the "Air Filter Clogged" warning is displayed. These filters should not be washed because washing breaks down the material inside the filters.

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

(2) Electrical System (24 VDC) – Check Battery Terminals

Periodically, open the battery compartment panel in the right cable tray and visually check the battery cable connectors and battery posts. If corrosion is observed, disconnect the cables and clean battery posts and connectors with a wire brush or special battery post-cleaning tool. Coat the posts and connectors with a light film of petroleum lubricant before reconnecting the cables.

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

Check the output voltage and be sure it is set for 115 VAC ± 1 V. Adjustment can be made using the Setup menu. (See Chapter 1-3, paragraph 4.1.)

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

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

(1) Engine

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

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

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

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

e Check engine and generator mounts to ensure they are properly installed and they have not worked loose. (Torque is set at 100 N-m, 73.7 ft-lb.).

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

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

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

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

(1) Engine.

a Check Crankcase Oil Level.

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

(i) Check oil level daily with oil gauge dipstick.

(ii) Oil level should not be checked until 3 to 5 minutes after engine shutdown. Keep oil level as near the upper bar as possible.

b Drain Fuel Lubricity Filter/Pre-Filter Element

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

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

(i) Provide a container for catching drained fuel.

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

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

(iv) Tighten the drain valve.

(v) Safely dispose of drained fuel.

(vi) Purge air from fuel system if necessary.

c Check Coolant Level

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

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

d Check for Leaks and Correct

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

Figure 2-1-2 Fuel Lubricity Drain

e Check Fault Code Meter.

At each daily start-up, observe the fault screen on the display of the control panel. If the display shows “AIR FILTER CLOGGED”, change the air filter. See Chapter 2-4 for other fault codes.

f Check Exhaust System.

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

WARNING

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

(2) Electrical System (24 VDC)

a Check All Lights.

Check all indicating lights to be sure they operate when they should. If any light fails to operate, check the indicator and insure proper power is being given. If power is present and the light does not activate, replace the light fixture.

b Check Engine Battery Voltage.

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

c Check the operation of all the engine indicators.

(3) Electrical (400 Hz System).

a Check Output Cables and Connector.

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

b Monitoring sensors.

Verify that the voltage, amps and frequency readings are displaying correctly (use up and down arrows) each time the unit is started.

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

(1) Engine.

a Prevent Diesel Engines Wet Stacking.

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

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

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

b Charge-Air-Cooler and Piping.

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

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

c Check and record oil pressure.

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

d Check Radiator Core and Hoses.

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

e Check Fuel Pump.

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

(2) Electrical (24 VDC system).

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

Check battery terminals and clean if necessary.

(3) Electrical (400 Hz System).

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

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

(1) Engine.

a Check Engine and Generator Mounts

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

(i) Engine mount bolts must be torqued to 100 N-m (73.7 ft-lb.).

(ii) Generator mount bolts must be torqued to 100 N-m (73.7 ft-lb.).

b Change oil and oil filters.

c Change all fuel filters.

d Check Coolant Additive Concentration.

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

(2) Electrical (24 VDC system).

a Wiring.

Inspect all cables and leads for worn or damaged insulation.

b Connections.

Inspect connectors for damaged or corroded condition.

(3) Electrical (400 Hz System).

a Protective Monitoring Circuits.

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

b Inspect Wiring and Connections.

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

c Clean and inspect generally.

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

(1) Engine.

a Check Fan Hub and Drive Pulley.

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

b Check Hose Clamps on Air Intake Side.

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

c Check Belt Condition and Tensioner.

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

d Check and/or Adjust Valve Clearance.

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

e Check Water Pump.

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

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

(1) Engine.

a Steam Clean Engine.

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

WARNING

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

CAUTION

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

b Clean Fuel System.

See engine manufacturer's operation manual for instructions.

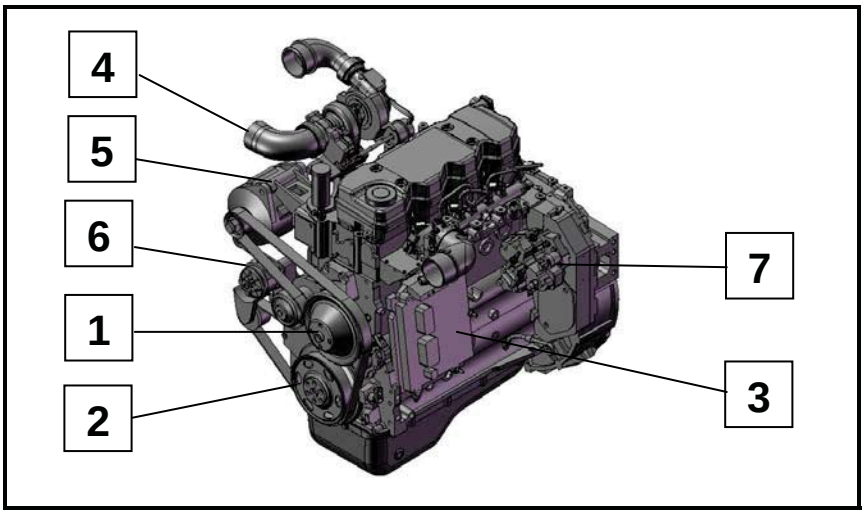
c Check Alternator and Cranking Motor.

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

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

(1) Engine.

a Check Vibration Damper.



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

Figure 2-1-3 Engine Accessories

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

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

b Check Charge-Air-Cooler and Radiator Systems.

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

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

c Flush cooling system and change coolant.

j) Seasonal Maintenance Checks Spring/Fall (Engine).

(1) Check Fan Mounting.

a Check fan to be sure it is securely mounted.

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

c Check fan hub and crankshaft pulley for secure mounting.

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

(3) Check All Hoses.

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

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

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

k) Lamps and Fuses:

(1) Check all lamps daily.

(2) Check fuses as required.

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

Item Protected	**Location**	**Schematic Identifier**	**Type**
Display Board	Interface Board	F1	2A
Control Board	Interface Board	F2	5A
Exciter Circuit (24V)	Interface Board	F3	5A
Contactors	Interface Board	F4	5A
Relays	Interface Board	F5	2A
Key Switch	Interface Board	F6	5A
ECM Dongle	Interface Board	F7	5A
Exciter Circuit (180 V)	Interface Board	F8	500V, 6.3A
ECM	Interface Board	F9	20A
Engine Air Intake Heater	Engine Electrical Panel	F10	AMG-150

Figure 2-1-4 Fuse Identification Chart

Section 2 Maintenance Procedures

1) General

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

Item	Maintenance Required
Engine Oil	Check oil level daily or after every 10 hours of use. Change oil and the oil filter after the first 50 to 150 hours of use, then at 500 hour or 6 month intervals thereafter. Engine oil capacity is approximately 11.6 quarts (11 liters).
Fuel/water Pre Filter	Drain filters daily. Change the filter elements every 500 hours or after 6 months of use, whichever comes first.
Coolant	Check coolant level daily. Service and maintain coolant system according to Section 2-2, paragraph 6. Engine coolant capacity is approximately 20 quarts (18.9 liters)
Coolant hoses and connections	Check coolant hoses and connections daily for leaks.
Air Cleaner	Change air cleaner filter as required when the fault code display on engine control panel shows the “Air” code.
Fan Belt	Check fan belt condition and tension every 1000 hours or 1 year of use.
Alternator	Alternator bearings are sealed and require no periodic lubrication.
Starter	Starter motor bearings are sealed and require no periodic lubrication.
Water Pump	The water pump is packed at assembly and requires no periodic lubrication.
Fan Hub	The fan hub is lubricated at assembly and requires no periodic lubrication.
AC Generator	Periodic cleaning – no lubrication or adjustment required
Generator Controls	No periodic maintenance is required. Adjustments are covered in Section 2-3.

Figure 2-2-1: Lubrication and Maintenance Chart

WARNING

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

2) Engine 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, recommended lubricants and filters are indicated in Figures 2-2-1 and 2-2-2.

This section incorporates the engine maker's, engine lubrication recommendations from their Operation and Maintenance Manual.

Lubrication schedule

Time schedules indicated on the Maintenance Schedule, Figure 2-2-1, are approximate and 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.

b) Oil specification

The engine lubricating oil that is 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 Type	Use oil specification API CF-4, HT/HS Viscosity 3.7cP minimum. Oil recommended for the diesel engines in this application is API Class CCMC. Refer to the manufacturer's operation manual.	
Capacity	Approximately 11.6 quarts (11 liters)	
Oil Filter Replacement Part Number	ITW GSE: 286897-029 Cummins: LF3970	
Lube Oil Viscosity Required as per Ambient Temperatures	**VISCOSITY**	**AMBIENT TEMPERATURE CONDITIONS**
	SAE 15W40 (Preferred)	0ºF (-18ºC) and above for most climates
	SAE 10W30	-10ºF to +50ºF (-23ºC to +10ºC) Winter conditions
	SAE 5W30	-20ºF to +50ºF (-29ºC to +10ºC) Arctic Conditions
	SAE 0W30	-20ºF and below to +50ºF (-29ºC and Below to +10ºC)
Synthetic Oils	See the engine manufacturer's operations manual for usable synthetic oils and instructions.	

Figure 2-2-2: Lubrication Specifications

c) **Changing engine oil**

Change the oil once after the first 50 - 150 hours of use and then every 500 hours of engine operation thereafter. The generator set is equipped with an hour meter to record actual engine operating time.

The ideal time to change engine oil is soon after a power delivery run, when the engine is at operating temperature. 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.

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

CAUTION

- High ash oils may produce harmful deposits on valves that can cause valve burning.
- Do not use solvents as flushing oils in running engines.
- Always use clean containers, funnels, etc.

Figure 2-2-2: Oil Fill and Check Locations

Change oil as follows:

(1) 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).

(2) The oil drain tube can be found by the muffler at the front of the unit.

(3) Remove the drain cap.

(4) While oil is draining, change the oil filter element. See instructions below.

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

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

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

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

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

(10) Clean the drain cap and install when engine oil has completely drained.

(11) Refill the engine with new, clean oil that meets engine manufacturer's recommendations. Use the oil fill tube by the filter or the oil fill opening at the top of the engine.

CAUTION

Remember to close the drain plug valve and install the new oil before starting the engine.

(12) Start engine and check oil pressure at once. Allow engine to idle for 5 minutes, check for leaks, then stop the engine.

(13) 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.

CAUTION

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

WARNING

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

Acceptable Lubricants

e) Engine Accessories Lubrication

(1) Alternator

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

(2) Starter

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

(3) Water Pump

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

(4) Fan Pulley

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

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

3) Servicing the Air Cleaner

A definite time schedule for cleaning or changing the air cleaner cannot be determined because of varying operating conditions. Pull the yellow tab out (about 1 inch) then rotate the hub counter-clockwise about one inch and pull it off of the housing to access the air cleaner filter. It may be inspected either at prescribed service intervals or at any time deemed necessary.

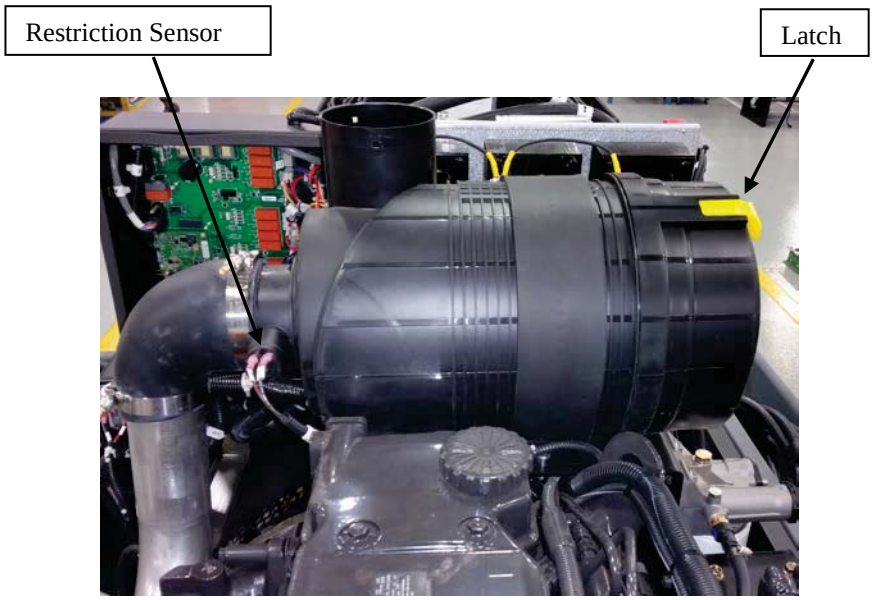
Replacement air filter element ITW GSE part numbers: Primary – P781039 Inspect regularly. Replace when the “Air Filter Clogged” warning appears on the display	

Figure 2-2-3: Air Cleaner Assembly

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) Pull out the latch and rotate the back cover to the unlocked position (counterclockwise as viewed from the rear). The cover has padlock symbols to show the locked and unlocked positions.

(2) Remove the end cover of housing.

(3) Pull out air filter elements and replace.

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

(5) Replace the end cover and rotate it to the locking position.

(6) Push the yellow latch back in to lock the cover.

c) Disposal

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

4) Engine Fuel

a) How to select Fuel—Quality

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

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

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

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

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

b) Cold Weather Operation

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

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

5) Engine Fuel System

The fuel system consists of five primary components: fuel tank, lubricity filter, primary fuel filter, fuel lift pump, and the fuel return line. The following are maintenance procedures for each of these items.

a) Fuel Tank

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

b) Fuel Water Separator or Lubricity Additive Filter

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

Replacement Filter Element:

- ITW GSE: FS9841

Drain the water daily.

Change the filter after every 500 hours of operation.

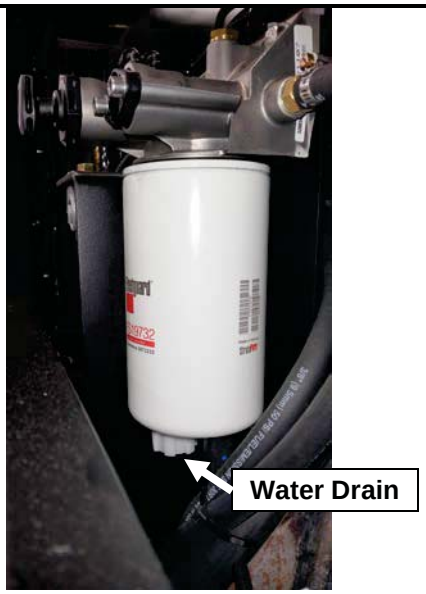


Figure 2-2-4: Lubricity Filter

To drain the water:

(1) Open drain valve.

(2) Drain accumulated water and contaminants.

(3) Close drain valve.

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

To change the lubricity filter:

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

(1) Place a pan underneath the fuel filter to catch spilled fuel.

(2) Shut off fuel valve.

(3) Drain off some fuel by opening the drain valve.

(4) Undo fuel filter with commercial tool and spin off.

(5) Clean any dirt from the filter carrier rim

(6) Apply a light film of oil or diesel on the rubber seal on the new filter.

(7) Fill new filter with diesel fuel.

(8) Screw in the new fuel filter “snug”.

(9) Check that the cartridge is seated correctly against the gasket and tighten with a final half turn.

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

(11) Open fuel valve.

(12) Start the engine and check for leaks. Correct as necessary with the engine off.

c) Primary Fuel Filter

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

Replacement fuel filter part number: • ITW GSE: 5288530 Change the fuel filter after every 500 hours of operation.	

Figure 2-2-5: Primary Fuel Filter

To change the fuel filter:

(1) Shut off fuel valve.

(2) Place a pan underneath the fuel filter to catch spilled fuel.

(3) Undo fuel filter with commercial tool and spin off.

(4) Catch any fuel.

(5) Clean any dirt from the filter carrier rim

(6) Apply a light film of oil or diesel on the rubber seal on the new filter.

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

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

(7) Fill new filter with diesel fuel. Screw in the new fuel filter "snug". Check that the cartridge is seated correctly against the gasket and tighten with a final half turn.

(8) Open fuel valve.

d) Fuel Pump

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

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

e) Fuel Return

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

6) Engine Cooling System

a) General

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

b) Radiator Cap

(1) General

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

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

(2) Removal

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

CAUTION	Allow engine to cool before adding coolant.

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

(3) Installation

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

c) Coolant

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

CAUTION	Never use soluble oil in the cooling system.

(1) General.

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

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

(2) Selecting antifreeze.

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

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

(3) Checking antifreeze solution.

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

d) Draining the Cooling System

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

(1) Remove radiator cap.

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

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

(4) Open the radiator drain valves.

(5) Allow the system to drain completely.

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

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

e) Flushing the Cooling System

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

f) Cleaning the Radiator Core

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

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

g) Filling the Cooling System

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

(1) Install coolant

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

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

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

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

(2) Inspection/Check

a Check system for evidence of leaks.

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

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

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

h) Thermostat

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

7) Engine Drive Belt

a) General

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

b) Preparation for Belt Check and Adjustment

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

c) Checking Belt Tension

WARNING

DO NOT Check belt tension with engine running

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

CAUTION

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

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

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

8) Generator Maintenance

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

a) Cleaning

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

WARNING

Never use solvents as this is a fire hazard

b) Adjustment

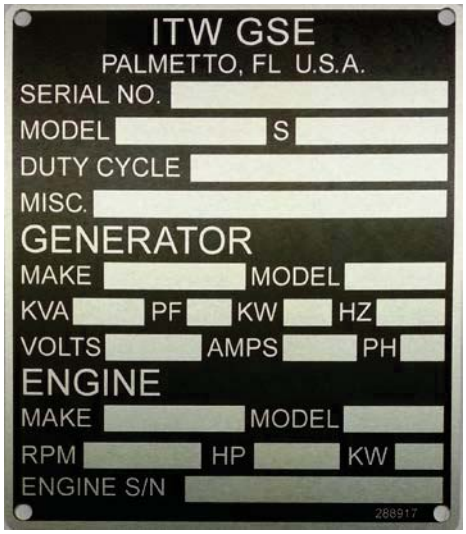
The generator itself requires no adjustment. Adjustment procedures for generator controls are covered in Section 2-3.

8. Preventive Maintenance

Here are the replacement filters for ACE4400 ground power unit (GPU). This list is provided as a quick reference chart for the maintenance technician or diesel mechanic in charge of routine preventative maintenance to the ground power unit.

Generator Set Model Number

Make sure your generator set is the model listed above. Identify the model number by looking on the data plate, which is located on the frame at the front right corner of the unit.



Filter Part Numbers

The table below lists the filter part numbers for your generator set.

Filter	**ITW GSE Part Number**
Oil Filter Element	3937736
Engine Primary Fuel Filter Element	5288530
Lubricity/Fuel Water Separator Element	FS9841
Air Filter Replacement Element	P781039

Hobart Ground Systems - Supply Contact Information

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

Contact the ITW GSE parts department staff for all the preventative maintenance parts:

e-mail: parts@itwgse.us

call (inside USA) (866) 845-0441

call (other countries) (941) 721-1000

For more information about maintenance procedures, refer to Chapter 2 of the manual.

Filter Pictures

Air Cleaner

Oil Filter

Fuel Filter

Lubricity Fuel/Water Separator

Section 3 Adjustment/Test

1) General

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

IMPORTANT	In order to perform most of the following test, a load bank with an EF interlock circuit is required. However, if no EF interlock is available on a load bank, see special procedure in the EF Bypass section (Chapter 1-3 paragraph 4.4) for disabling the EF circuit.

2) Testing the 400 Hz Generator Set

a) Pre-operational Test Procedures

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

2) Check radiator coolant level, if not full then fill with appropriate climate mix of ethylene glycol and water. Total capacity is 20 quarts.

3) Check tension of drive belt.

4) Verify that there is at least ¼ tank of diesel fuel.

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

6) Turn on battery disconnect switch.

7) Place unit in 'Engine Only' Diagnostic Mode. (See Menu Operating Instructions, Chapter 1-3 Paragraph 4.19) Return to home screen to view status. (Screen will display Generator Diagnostics.)

b) Engine Test Procedures

1) Press engine button to start engine. Engine should start and run at idle speed, 1000 RPM (±5).
2) Check for coolant, fuel and oil leaks. Listen for air leaks and other engine issues.
3) Verify display voltage is over 27 VDC. (Battery is charging.)
    a. Voltage _____VDC
4) Press Output button (any Output) to make engine go to rated speed, 2000 RPM (±5). (Output will not function.)
5) Check for coolant, fuel and oil leaks. Listen for air leaks and other engine issues.
6) Press engine button to shut down unit.

c) Generator Low Power Testing:

1) Place unit in 'AVR Battery Only' Diagnostic Mode.
2) Press engine button to start engine. Engine should start and run at idle speed, 1000 RPM.
3) Using the Parameters Screens, verify Output voltage is regulated to 28 volts (± 5V), line to N, on display.

DISPLAYED Voltage A_____ VAC B _____ VAC C _____ VAC

4) Check that the PWM Duty Cycle reads 35%. (± 5%)

Duty Cycle _____%

5) Press Output button (any Output) to make engine go to rated speed, 2000 RPM. (Output will not function.)
6) Verify Output voltage is regulated to 50 volts (± 5V), line to N, on display.

DISPLAYED Voltage A_____ VAC B _____ VAC C _____ VAC

7) Check PWM Duty Cycle reads 30%. (± 5%)

Duty Cycle _____%

8) Press engine button to shut down unit.
9) Disable Diagnostic Mode.

d) 400Hz Initial Testing and Setup:

1) Connect Output cable(s) to the appropriate load bank(s) with interlock enabled (as required)
2) Press engine button to start engine. Engine should go straight to rated speed.
3) Verify Output frequency on power analyzer. (400Hz, ±2Hz)

Measured Frequency: _____Hz

4) Verify Output voltage, line to N.
5) MEASURED Voltage A_____ VAC B _____ VAC C _____ VAC
6) Check PWM Duty Cycle reads 20%. (± 5%)

Duty Cycle _____%

e) Output 1 Verification:

1) Make sure that the EF switch is in the ON position on the load bank and turn on Output 1. Contactor must close and indicator on the display panel illuminate.
2) Verify 'ABC' phase rotation at the load bank.
3) Turn the EF switch OFF on the load bank and verify that contactor opens and fault is displayed. Red lamp on display should flash.
4) Reset Output 1 by pressing Output 1 button again. Display should resume normal operation with no faults.
5) If Output 2 is not available, skip to g) below.

f) Output 2 Verification:

1) Make sure that the EF switch is in the ON position on the load bank and turn on Output 2. Contactor must close and indicator on the display illuminate.
2) Verify 'ABC' phase rotation at the load bank.
3) Turn the EF switch OFF on the load bank and verify that contactor opens and fault is displayed. Red lamp on display should flash.
4) Reset Output 2 by pressing Output 2 button again. Display should resume normal operation with no faults.

g. Sensor Testing:

1) At rated speed, restrict the air cleaner intake to 5% of the normal inlet area. Blocked Filter warning shall appear with amber light flashing on display. Remove Restriction. Fault will reset automatically. (The left arrow will need to be pressed to remove it from the screen.)
2) Disconnect “Low Coolant” switch connector located on the top of the radiator and start your stopwatch. Verify Low Coolant Warning (amber) occurs in less than 1 minute.
3) Reconnect the low coolant switch and put on top canopy. Clear Low coolant warning by pressing the engine button.

h) Re-checking the entire unit after testing

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

(2) Check engine oil pressure at rated speed (2000 RPM). The oil pressure gauge should indicate at least 44.9 psi (3.1 bar) when engine is hot. Also at rated speed, check the engine coolant temperature. The temperature gage should indicate in the range of 180°F to 190°F (82ºC to 88ºC), depending upon operating conditions.

WARNING

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

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

3) Generator Set Adjustment

a) Generator Adjustment

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

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

(1) Output Voltage Adjustment

a Adjust Voltage Control

The output voltage, at which the generator is regulated, is adjustable using the "Output Voltage screen in the Setup Menu. (See Chapter 1-3, Paragraph 4.1)

Observe the output voltage using a true RMS multimeter. Set the output voltage at 115 VAC line-to-neutral (200 VAC line-to-line).

b Adjust Line-Drop Compensation

Adjustment of line-drop compensation is made using the "Output 1 (or 2) Compensation" screens in the Setup Menu. (See Chapter 1-3 Paragraph 4.2 & 4.3) To adjust the line-drop compensation, proceed as follows:

(i) Connect the generator set output cables to a load (typically a load bank). Load the generator set with the largest available three-phase load of rated power factor not exceeding the maximum rating of the generator set. (i.e. 72 kW for a 90 kVA at 0.8 pf generator)

(ii) Measure the output voltage at the load end of the cables as you increase the load from zero to the maximum full load rating of the unit. If the voltage at the end of the cable rises or drops more than 1%, decrease or increase the line-drop compensation until the regulation is flat (115 VAC line-to-neutral).

c) Basic Engine Adjustments

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

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

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

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

d) Engine Accessories Adjustment

Alternator and fan belt adjustment: Refer to Section 2-1 and engine manufacturer manual.

4) Generator and Exciter Test

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

a) Disconnect generator stator leads at the back of the unit.

b) Disconnect the two black exciter field leads (Connector J6/P6) that is located under the back right corner of the unit.

c) Check resistance and compare to values.

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

Figure 2-1-8: Generator and Exciter Test Readings

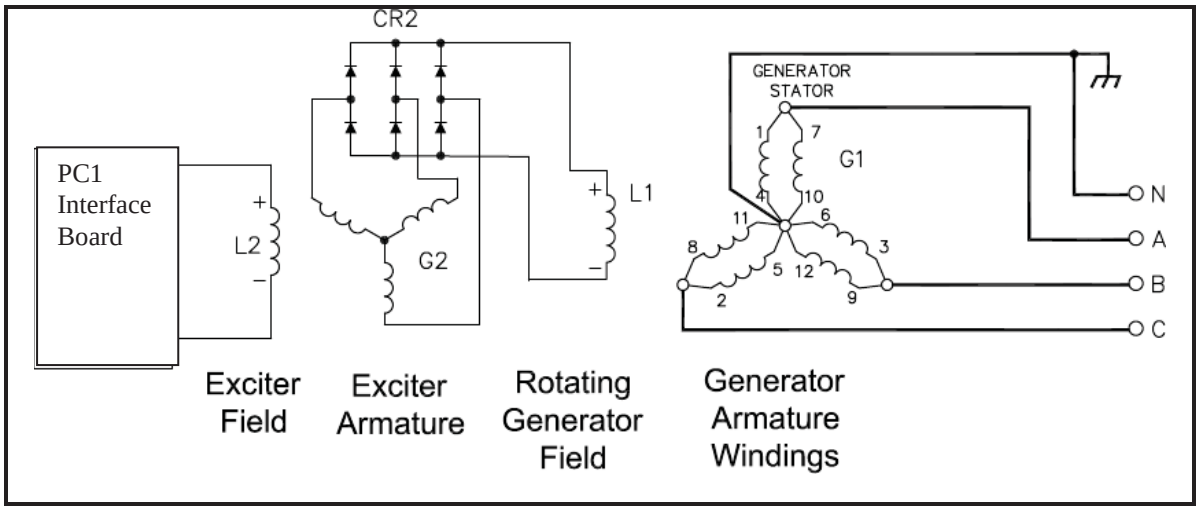


Figure 2-3-9: Generator Connections

5) Diode Test

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

a) Disconnect exciter windings from diode lead(s).

NOTE: Use a good quality ohmmeter or multimeter. Verify that the instrument is set on its lowest scale. Make certain the battery is in good condition and for analog meters that the pointer is adjusted to zero when the test leads are shorted together.

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

6) Testing the Active Rectifier Unit (ARU) (for units with the DC option)

The 28.5 VDC ARU is an optional add-on to the GPU. The following test procedures may be used for testing the ARU following repair, or for just checking performance.

a) Preparation for Testing

(1) Connect the ARU to a DC load bank.

(2) Start the GPU per the operating procedures in Chapter 1, Section 3.

b) Operational Test Procedure

(1) Power Delivery

a Press **"28 VDC**" pushbutton to close the DC output contactor. The green "**DC OUTPUT**" LED will glow indicating that DC power is being delivered to the load bank.

b Using a calibrated multimeter, measure the DC voltage at the load bank with no load. The voltage should be 28.5 VDC.

c Place a 600 amp load on the GPU. The measured DC voltage at the load bank should still be 28.5 VDC. Observe the DC voltage and amps on the output screen of the display for accuracy.

d If the full load voltage reading is more than 0.5 VDC from the desired output voltage (typically 28.5 VDC) then adjust the line drop compensation using the "28V Compensation" screen in the Setup menu. (See Chapter 1-3 Paragraph 4.18)

(2) Discontinue Power Delivery

Press "**28 VDC**" pushbutton to open the DC output contactor. The green LED will turn off, indicating that DC power has been removed from the load bank.

(3) Current Limiting / Soft Start Control

The Current Limit default value is set using the "**28V Current Limit"** screen in the Setup Menu (See Chapter 1-3 Paragraph 4.19). In order to change the value for the current aircraft (and this test), use the RIGHT and LEFT navigation buttons when the diesel is running, the 28VDC ARU is NOT on and the "default" operator screen is displayed. The current limit settings are from 200 amps to 1600 amps for the 400 amp version of the unit and from 400 amps to 2400 amps for the 600 amp version.

a Start the diesel engine.

b Once the engine has stabilized at its running speed, use the Right or Left navigation buttons to set the current limit to 1400 amps.

c Press the "**28VDC**" pushbutton to close the contactor to apply the load to the load bank.

d Press the "Engine Test" switch on the load bank. Verify that the current never exceeds 1400 amps.

e Press "**28 VDC**" pushbutton to open the DC output contactor. The green LED will turn off, indicating that DC power has been removed from the load bank.

7) Adjusting the Transformer-Rectifier (for units with DC option)

The T-R is design to be adjustment free. No adjustments required, other than periodically checking the output voltage and adjusting the 28.5 volts from the **"28V Voltage"** screen as necessary.

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Section 4 Troubleshooting Procedures

1) General

The Troubleshooting Chart located in this section covers the common faults and malfunctions that you may find during operation or maintenance of this equipment. The chart may not list all faults and malfunctions that may occur. If a fault or malfunction is not listed in the chart, start looking for the cause at the source of power in the affected circuit. Refer to the schematic and connection diagram in Chapter 5. Test the circuit systematically until the source of the malfunction is isolated.

The Troubleshooting Chart is arranged by Error code, Error text, Description and then four columns of possible corrective actions. Always try the 1st corrective action before proceeding to the next corrective action.

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.

2) Equipment for Troubleshooting

A good quality multimeter 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 24 VDC power source.

3) Parts Replacement

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

4) Normal Operational Parameters

The system specifications, which are listed in Chapter 1-1, provide useful information when troubleshooting abnormal operation. In particular, the Protective System Specifications and the Normal Operating Characteristics provide information about how the generator set should be operating.

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, it is assumed that connections and wiring have always been checked first and that power has not been lost as a result of defective wiring or connections.

6) Engine Troubleshooting

When troubleshooting the engine, remember that the ability of the engine to start and run properly depends upon the following:

- An adequate supply of 24 VDC power reaching a good starter and control board.
- An adequate supply of air, compressed to a sufficiently high pressure
- The injection of the correct amount of clean fuel at the proper time

7) GPU Control Monitoring

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

a) Operating Modes

(1) Self-Test Mode

When power is first applied to the control circuit, the GPU performs complete self-diagnostics of the internal circuitry. If a fault is detected during the self-test, the Alert/Failure LED will be lit and the first (if there are more than one) failure will be displayed on the LED display.

(2) Engine Run Mode

When the **ENGINE** pushbutton is activated, the engine's starter and the engine's ECM will be energized. After the engine reaches its rated speed (2000 rpm) the GPU is ready to supply power to the aircraft.

(3) Engine Shutdown Mode

When shutting the GPU down, pressing the **ENGINE** pushbutton starts the 5 minutes delayed shutdown period. The display will show "Idle Mode" and the engine returns to idle speed. The shutdown period is required to cool the engine's turbocharger.

(4) Engine Stop Mode

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

(5) System Off Mode

The power is removed from the GPU's entire control system when the battery disconnect is opened.

b) Faults

Faults result when any of the fault limits are exceeded, when an internal problem occurs, or under certain conditions that would cause injury to personnel or damage to an aircraft or the GPU. Faults are also stored in the Black Box memory as event records. (See Chapter 1-3 Paragraph 4.0.3) The fault limits and conditions are preset at the factory.

(1) Warning

Warning faults have no effect on the operation of the GPU. An example is an intake air restriction fault due to a dirty filter. Although the GPU continues to operate, the fault LED is lit and the fault text appears on the display. Pressing the **Engine** pushbutton or shutting down the GPU resets the fault.

(2) Run Mode

Run mode faults remove power form the aircraft but do not change the operating speed of the engine. An example is an over voltage fault. Although the contactors open and remove power from the aircraft, the engine remains at rated speed, the fault LED is lit and the fault text appears on the display. Pressing the **Engine** pushbutton or shutting down the GPU resets the fault.

(3) Stop Mode

Stop mode faults remove power form the aircraft and shut the engine down. An example is a low oil pressure fault. The contactors open and remove power from the aircraft, the engine shuts down, the Alert/Failure LED is lit and the fault text appears display. Pressing the **Engine** pushbutton or shutting down the GPU resets the fault.

8) Cummins Engine Fault Codes & Trouble Shooting

The best source of information to aid in trouble shooting Cummins engine issues is at the quickserve.cummins.com website. Go to this website and register up to five engine serial numbers for free. (It is recommended that if you have more than one engine type/size, that you register one serial number per type/size.) Once you are registered, this website gives you access to engine information, troubleshooting assistance by fault code, parts information and service bulletin information for each serial number/engine type that you have registered with the site.

9) Fuses

The following is a list of all of the fuses in the 4400 unit.

F1 to F9 are located on the interface board PC1.

Fuse #	Protects	rating	type	PN
F1	Display	2 amp	ATO	AP-SI2076
F2	Control Board	5 amp	ATO	AP-SI2075
F3	Exciter 24V	5 amp	ATO	AP-SI2075
F4	Contactor	5 amp	ATO	AP-SI2075
F5	Relays	2 amp	ATO	AP-SI2076
F6	Key switch (Ignition)	5 amp	ATO	AP-SI2075
F7	ECM (Dongle)	5 amp	ATO	AP-SI2075
F8	ECM Power	20 amp	ATO	AP-SI2083
F9	Exciter 180V (Out)	6.3amp	600V Cylindrical fuse	AP-SI2082
F10	Intake Air Heater Fuse	150 amp	ANL-150	FU11370

Fuse F10 is located on the Engine Air Cleaner Bracket

Troubleshooting Chart

Error Code	Error Text in display	Description	1st Corrective Action
For faults in this section: Disconnect from Aircraft (if connected). Do not stop engine (if running). Do not let engine start (if not running).			
100	LOGGING UNSUCCESSFUL	Communication Failure	Press Engine button to Reset
200	ID CHIP NOT DETECTED	ID chip is missing or unreadable	Inspect ID chip connection. for damage.
300	Fuel Level must be greater than 15% to start engine.	Fuel Level is too low to attempt an engine start.	Add Fuel
500	Starter Failure	Engine rotation is not detected when starter was activated.	Press Engine button to Reset
600	Unable to Start Engine	Engine did not start after 3 tries.	Press Engine button to Reset
700	Battery Level Too Low	Battery voltage level is too low to attempt startup sequence.	Press Engine button to Reset
1000	OUTPUT VOLTAGE TOO HIGH	400Hz voltage is greater than 130 volts for 250mS.	Press Output Button to Reset
1100	OUTPUT VOLTAGE TOO HIGH	400Hz voltage is greater than 140 volts for 15mS.	Press Output Button to Reset
1200	OUTPUT VOLTAGE TOO LOW	400Hz voltage is less than 104 volts for 6 seconds.	Press Output Button to Reset
1300	OVERLOAD: 100% < I < 125% - 600 s	Current was between 100% and 125% for 10 minutes.	Press Output Button to Reset
1400	OVERLOAD: 125% < I < 150% - 10 s	Current was between 125% and 150% for 10 seconds	Press Output Button to Reset
1500	OVERLOAD: 150% < I < 175% - 2 s	Current was between 150% and 175% for 2 seconds.	Press Output Button to Reset
1600	OVERLOAD: I > 175% - 1 s	Current was over 175% for 1 second.	Press Output Button to Reset
2000	EF OUTPUT 1 RIPPLE TOO HIGH	Ripple on EF from the aircraft on output 1 is beyond the defined limit.	Press Output 1 button to reset
2100	EF OUTPUT 2 RIPPLE TOO HIGH	Ripple on EF from the aircraft on output 2 is beyond the defined limit.	Press Output 2 button to reset
2200	PLUG 1 TEMPERATURE TOO HIGH	The temperature sensor in output 1 plug has tripped.	Press Output 1 button to reset
2300	PLUG 2 TEMPERATURE TOO HIGH	The temperature sensor in output 2 plug has tripped.	Press Output 2 button to reset
2400	28V PLUG TEMPERATURE TOO HIGH	The temperature sensor in output 2 plug has tripped.	Press ARU button to reset
2700	EF SIGNAL DROP OUT - OUTPUT 1	EF Signal Disappeared at Output 1	Press Output 1 button to reset
2800	EF SIGNAL DROP OUT - OUTPUT 2	EF Signal Disappeared at Output 2	Press Output 2 button to reset
2900	90% SIGNAL DROP OUT - OUTPUT 1	90% Signal Disappeared at Output 1	Press Output 1 button to reset
3000	90% SIGNAL DROP OUT - OUTPUT 2	90% Signal Disappeared at Output 2	Press Output 2 button to reset
3100	90% SIGNAL DROP OUT - 28 VDC	90% Signal Disappeared at ARU Output	Press ARU button to reset
3200	OUTPUT VOLTAGE TOO HIGH	Voltage > 32V - 4s	Press ARU button to reset
3300	OUTPUT VOLTAGE TOO HIGH	Voltage > 40V - 1s	Press ARU button to reset
3400	OUTPUT VOLTAGE TOO LOW	Voltage < 20V - 4s	Press ARU button to reset
3500	28V RECTIFIER TEMP TOO HIGH		Press ARU button to reset
For faults in this section: Disconnect from aircraft. Shut down engine after cool down.			
6000	CONTROL BOARD FAILURE	Watchdog Timeout	Press Engine Button to reset
6600	ECM error code xxxx has been received.	Engine Error Code Received from ECM	Service Engine
6700	Engine is out of Fuel		Add Fuel
For faults in this section: Disconnect from aircraft. Shut down engine immediately.			
8000	CONTROL VOLTAGE LOW	Control Voltage < 20V (Running)	Press Engine button to reset
8200	EMERGENCY STOP ACTIVATED		Release emergency stop and press Engine button to reset
8300	Catastrophic Generator Failure	Significant voltage imbalance between phases.	Contact ITWGSE. **DO NOT ATTEMPT TO RESTART ENGINE!**
8400	Unable to Communicate with ECM.	J1939 Communication Failure	Check ECM Power (Replace Interface Board)
8600	Engine shutting down for engine protection	ECM has shut down the engine	Service Engine

Error Code	2nd Corrective Action	3rd Corrective Action	4th Corrective Action
For faults in this section: Diconnect from Aircraft (if connected). Do not stop engine (if running). Do not let engine start (if not running).			
100			
200	Contact ITWGSE		
300	Inspect fuel Sender wiring	Inspect fuel Sender	
500	Check starter circuit to insure that it is properly energized. (Replace Starter Solenoid)	Replace Starter	
600	Check fuel valve to ensure it is open.	Service Engine	
700	Check battery cables	Charge Battery	Replace Battery
1000	Check voltage set-up value	Replace Control Board A1	Replace Interface Board A2
1100	Replace Control Board A1	Replace Interface Board A2	
1200	Check voltage set-up value	Replace Control Board A1	Replace Interface Board A2
1300	Remove overload and re-engage output	Replace Control Board A1	Replace Interface Board A2
1400	Remove overload and re-engage output	Replace Control Board A1	Replace Interface Board A2
1500	Remove overload and re-engage output	Replace Control Board A1	Replace Interface Board A2
1600	Remove overload and re-engage output	Replace Control Board A1	Replace Interface Board A2
2000	Check set-up value	Remove load and check output cabling	Replace Control Boards A1 & A2
2100	Check set-up value	Remove load and check output cabling	Replace Control Boards A1 & A2
2200	Remove load and let plug cool down	Check connector / output cabling for any malfunction	Replace Control Boards A1 & A2
2300	Remove load and let plug cool down	Check connector / output cabling for any malfunction	Replace Control Boards A1 & A2
2400	Remove load and let plug cool down	Check connector / output cabling for any malfunction	Replace Control Boards A1 & A2
2700	Is output cable correctly inserted?	Check / correct installation	Replace Control Boards A1 & A2
2800	Is output cable correctly inserted?	Check / correct installation	Replace Control Boards A1 & A2
2900	Is output cable correctly inserted?	Check / correct installation	Replace Control Boards A1 & A2
3000	Is output cable correctly inserted?	Check / correct installation	Replace Control Boards A1 & A2
3100	Is output cable correctly inserted?	Check / correct installation	Replace Control Boards A1 & A2
3200	Check output voltage setup value	Check ARU Module and wiring	
3300	Check output voltage setup value	Check ARU Module and wiring	
3400	Check output voltage setup value	Check ARU Module and wiring	
3500	Let the unit cool down and reset	Check airflow / air filters / fan	Check temp. sensor at rectifier heat sink.
For faults in this section: Disconnect from aircraft. Shut down engine after cool down.			
6000	Replace Control Board A1		
6600			
6700	Check Fuel sender unit.		
For faults in this section: Disconnect from aircraft. Shut down engine immediately.			
8000	Check Alternator	Check Battery	
8200	Check emergency stop	Check user EPO (A2:X14)	Replace Control Board A1
8300			
8400	Service Engine		
8600			

Engine Controls

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
1. The engine will not start, and the starter will not crank the engine.	**a. Emergency Stop** switch has been pressed.	• Make sure the **Emergency Stop** switch is pulled out.
	b. Battery Disconnect switch is in the **OFF** position.	• Make sure the battery disconnect switch is in the **ON** position.
	c. Battery discharged or loose battery or ground connection.	• Make sure the voltage across the batteries is approximately 25.6 VDC. • Check the battery terminals. • Be sure 25.6 volts DC is reaching the starter solenoid input terminal.
	d. Defective starter solenoid (SW3).	• Check if you can hear the starter solenoid activate when the start button is pressed. If not, check for voltage on the starter solenoid coil (see **e.** below). • Temporarily connect a large-capacity jumper cable (No. 1/0 minimum) between the hot side of the starter solenoid and the starter input terminal. If starter does not crank engine, the starter may be defective
	e. No voltage at starter solenoid coil.	• Check connector X5 on the PC1 Interface board. • Verify that there is 24 VDC across the starter solenoid + and – terminals when the engine start pushbutton is pressed. • Check and replace (if necessary) the Interface board.
	f. Defective starter.	Remove the starter motor from engine and apply 24VDC to test it. Replace the starter if it doesn't operate.
	g. Internal seizure.	If the starter is good, attempt to hand crank the engine using a 3/4-inch square drive on the crankshaft pulley. If engine cannot be turned one complete revolution, internal seizure is indicated. Remove engine and contact the engine manufacturer and/or nearest dealer.
	i. Defective Control Panel	Replace the Control Panel.
2. Engine will not start. Starter clicks on and off.	**a.** Low battery output	Check the battery and recharge or replace
	b. Loose starting circuit connections or faulty cables	Check all connections and cables. Tighten or replace as required.

Engine Controls (continued)

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
3. Engine will not start. Cranking speed is low.	**a.** Low battery output	Check the battery and recharge or replace
	b. Loose starting circuit connections or faulty cables	Check all connections and cables. Tighten or replace as required.
	c. Improper lubricating oil viscosity	Check the oil. Refer to Section 2-2. Remove and replace the oil as necessary.
4. Engine cranks but will not start. **Caution: To prevent damage to the starting motor, do not engage the starting motor for more than 30 seconds. Wait two (2) minutes between each attempt to start**.	**a.** Low fuel	Make sure there is sufficient fuel in the fuel tank. • If engine will not start, the fuel pump may be defective. • If engine starts and then stops after a short time, check fuel lines, and filters.
	b. Fuel shutoff valve closed	Open the shutoff valve on the fuel tank.
	c. Plugged or defective filter	Replace fuel filters. Also, check the gaskets for leaking or damaged condition.
	d. Loose connections, damaged hoses or fuel lines between tank and fuel pump	Tighten all fittings and connections. Replace any damaged hoses or fuel links.
5. Engine cranks, but will not start. Over-temperature indication appears immediately.	**a.** Defective engine temperature switch	Check wiring to engine high temperature switch (S49 on schematic), which is located on top of the engine block. 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 PC1 board	Replace the PC1 Interface board.
6. Engine is hard to start. Cranking speed is normal and the fuel supply is adequate.	**a.** Low compression, which may be caused by sticking or burned exhaust valves, worn or broken compression rings, leaking cylinder head gasket, or valve clearance adjustment.	Check the compression in accordance with instructions in the engine manufacturer's operation manual. Overhaul the engine to make repairs as necessary.
7. Engine starts but then stops after a few seconds by automatic shutdown.	**a.** Low oil pressure or defective oil pressure switch.	Restart the engine and observe oil pressure gauge. If oil pressure is 12 psi or more, disconnect wire from the normally-closed switch terminal on the oil pressure switch. Restart engine. If engine continues to run, the oil pressure switch is defective. Replace oil pressure switch. If engine stops, the PC1 Interface board might be defective.
	b. Defective PC1 board.	Replace PC1 Interface board.

Engine Controls (continued)

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
8. Engine either goes from rated speed to idle speed, or shuts down.	**a.** Low fuel was detected or the PC1 board could be defective.	Add No. 2 diesel fuel. Replace PC1 Interface board.
9. Engine has slow response time when a load is applied.	**a.** Engine needs tune-up.	Tune-up as required. Refer to engine manufacturer's operation manual.
10. Engine misses or runs unevenly.	**a.** Insufficient fuel.	Check fuel system in accordance with engine manufacturer's operation manual. Repair or replace parts as required.
	b. Faulty injector.	Check injectors in accordance with engine manufacturer's operation manual.
	c. Low compression pressure.	Check compression in accordance with engine manufacturer's operation manual.
	d. Air in fuel system.	Check all fittings to be sure they are tight and the thread sealant is still present. Tighten the fittings and add new thread sealant as required.
11. Engine lacks power	**a.** Improper engine adjustments and gear train timing.	Tune-up engine in accordance with engine manufacturer's operation manual.
	b. Insufficient fuel.	Check low fuel level in accordance with engine manufacturer's operation manual. Repair or replace parts as required.
	c. Insufficient inlet air due to damaged or dirty air cleaner.	Check air cleaner for plugging and/or damage.
	d. Restricted exhaust system.	Check exhaust pipes for restrictions. Check muffler for clogged condition. Replace as required.
12. Front clearance lights aren't ON.	**a.** Loose connection	• Check Interface board connector X9 terminal 3. • Check Ground plate connection of wire 79
	b. Defective Interface board.	Replace Interface board.
13. Rear clearance lights aren't ON.	**a.** Loose connection	• Check quick disconnect plug P4 • Check Interface board connector X9 terminal 4. • Check Interface board connector X45 wire 80.

Generator Excitation Circuits

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
1. No (or low) generator output voltage in all phases. Generator operating at 400 Hz.	**a.** Defective generator or excitation circuit.	In the Setup Menu, go to the Diagnostic Mode screen (Section 1-3 Paragraph 4.20) and set it to AVR Battery Only. This applies 24 VDC from the battery to the exciter field, which should produce an indicated output voltage of 100 +/- 20 VAC line to neutral.
	b. Verify 24 VDC across connector J6 terminals A & B.	Check X20 on the Interface board and connector J6 at the generator.
	c. Defective connector at voltage regulator, or defective wiring from regulator to exciter field	Disconnect the exciter wires at the terminal strip J6. Using jumper leads with clip terminals, connect 24 VDC to wires. If generator produces at least 80 VAC, replace or repair the connector and wiring between voltage regulator and exciter field as required.

Generator

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
1. No (or low) voltage output	**a.** Shorted diode in exciter rectifier (CR2).	Check diodes in accordance with Chapter 2-3 Section 4 and 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 diodes in accordance with Chapter 2-3 Section 4 and 5. If exciter rotor windings are good, proceed to step C.
	c. Open or shorted exciter field windings (L2).	Check field resistance. See Chapter 2-3 Section 4 for normal values.
	d. Open or shorted generator rotor windings (L1).	Check resistance with ohmmeter to determine if open or short circuited diodes in accordance with Chapter 2-3 Section 4 and 5.
2. Generator operates single phase.	**a.** Open or short circuited winding in generator stator (G1).	Check stator-winding resistances. See Chapter 2-3 Section 4 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 airflow. Provide adequate ventilation.
	c. Generator stator windings short circuited.	Check stator windings. See Chapter 2-3 Section 4.
4. Unbalanced output	**a.** Loose connection in output circuit.	Check all output connections. Discolored connectors indicate a loose connection. Tighten or replace as required.
	b. Open or short-circuited phase.	Check stator windings in accordance with Chapter 2-3 Section 4. Repair or replace as required.
	c. Defective connection in output circuit.	Check the plug and receptacle connectors at aircraft. Tighten, repair, or replace as required.
	d. Break or cut in output cable assembly.	Inspect the output cable for damage.
	e. Unbalanced load.	Check the aircraft 400-Hz components.

Load Contactor Operating Circuits

Output 1: Contactor K1

Output 2: Contactor K2

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
1. Load contactor will not close when the corresponding **Output** pushbutton is pressed. Generator is running at normal voltage.	**a.** Blown contactor fuse (F3) on regulator board.	Check the fuse and replace if blown. If it blows again, check the contactor.
	b. Defective display module	Check to make sure that the other pushbuttons on the control panel work. Replace the display board and test all buttons again.

Load Contactor Operating Circuit (Continued)

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
2. Load contactor closes when the **Output** pushbutton is pressed, but opens within 10 seconds.	**a.** The plug interlock EF circuit on Interface board could be defective.	Set 400 Hz Interlock to Bypassed. If load contactor remains closed, proceed to step **b.**
	b. 28.5 VDC is not reaching the plug interlock EF circuit from aircraft for following reasons:	Proceed as follows to find the cause of this malfunction.
	c. Generator-to-aircraft cable connector defective or not plugged into aircraft receptacle connector	Inspect cable connector plug thoroughly for damaged E and F terminals. Be sure plug is fully mated with aircraft receptacle connector and making good contact.
	d. Aircraft rejecting power.	Check aircraft on-board electrical equipment and controls.
	e. Defective contacts in switch mounted on side of contactor.	Connect a jumper lead between terminals of the normally-open auxiliary switch. If the contactor now remains closed, replace the auxiliary switch or the entire contactor.

Protective Circuit

NOTE: Protective monitoring is not completely functional until the load contactor is CLOSED. Since it is not advisable to vary voltages for test purposes while delivering power to an aircraft, the GPU should be connected to a load bank for trouble shooting protective circuits.

Trouble, Symptom, Condition	Probable Cause	Test, Check, and/or Remedy
1. Load contactor opens during power delivery. Over voltage fault indicated.	**a.** Over-voltage condition may have been the result of a sudden drop in load and may have been a normal action.	Press appropriate **Output** pushbutton and resume power delivery. Observe voltmeter to be certain voltage is normal (115 VAC). Adjust to normal if necessary. If load contactor is opened again and the fault message indicates an over-voltage condition, proceed to step **b**.
	b. Defective Interface or control board.	With load bank at no load, use the Output Voltage screen in the Setup menu (Chapter 1-3 Paragraph 4.1) to reduce the voltage to 110 VAC. Observe the voltmeter on the load bank and gradually increase voltage. If the load contactor opens at any value less than 125 VAC replace the interface and processor board.
2. Load contactor opens during power delivery. Under voltage fault indicated.	**a.** Under-voltage condition may have been result of a sudden shock load, or possible tampering with REG potentiometer, and may have been a normal action.	Press appropriate **Output** pushbutton and resume power delivery. Observe voltmeter to be certain voltage is normal (115 VAC). Adjust to normal if necessary. If load contactor is opened again and the fault message indicates an under-voltage condition, proceed to step **b**.
	b. Defective Interface or Control board.	With load bank at no load, use the Output Voltage screen in the Setup menu (Chapter 1-3 Paragraph 4.1) to slowly reduce the voltage to 100 VAC. If the load contactor opens at any value above 104 VAC, replace the interface and processor board.

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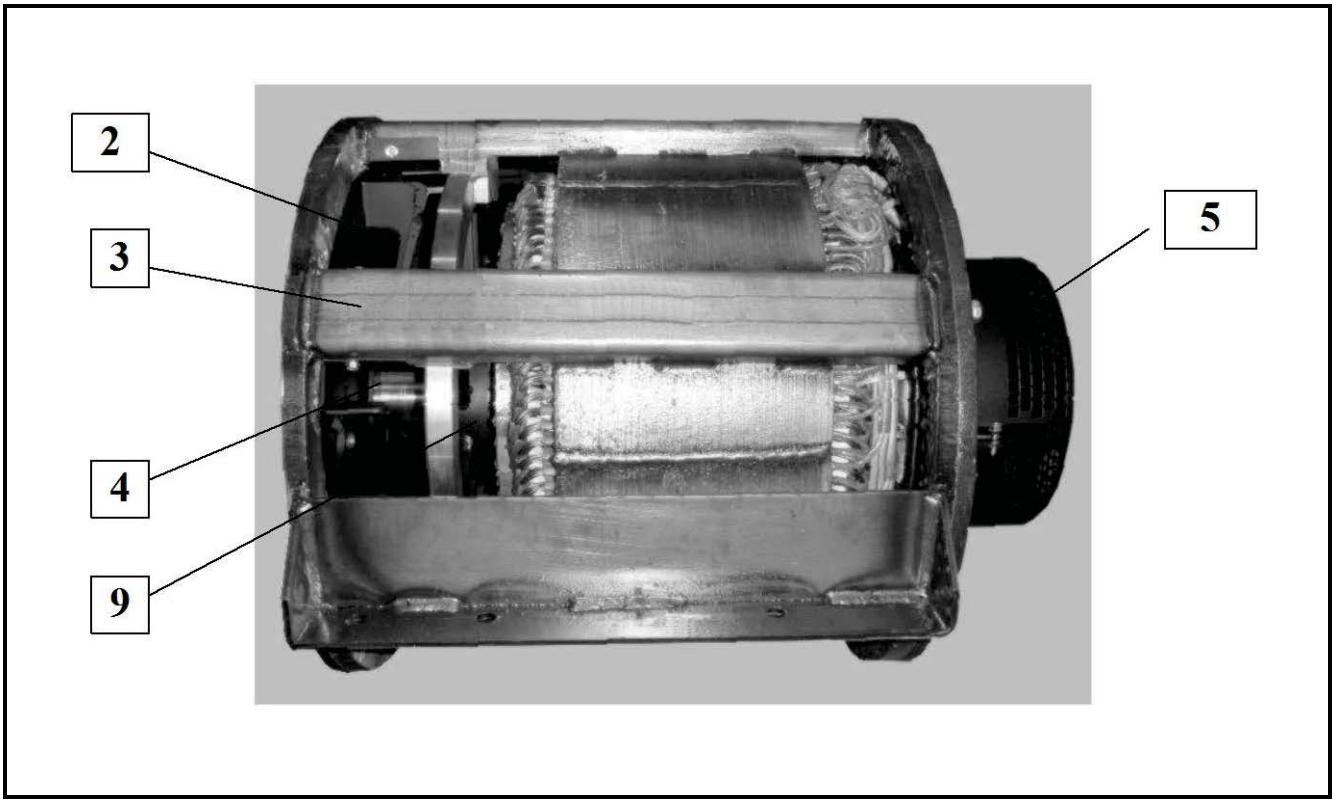
Chapter 3 Overhaul/Major Repair

Section 1 Exciter Armature

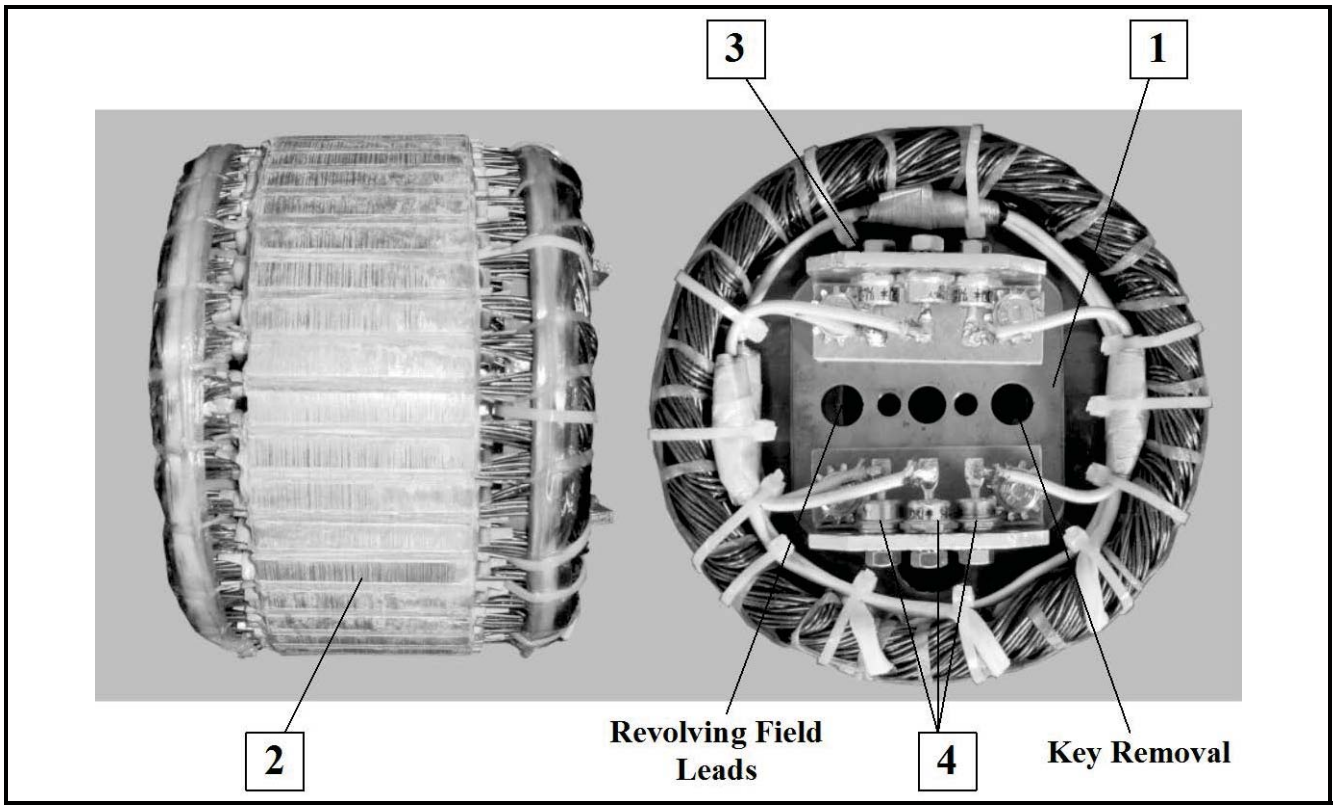
1) General

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



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

Figure 3-1-1 General Assembly



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

Figure 3-1-2 Exciter Armature

The exciter armature is mounted on the rear portion of the main generator armature shaft, which extends rearward beyond the rear generator bearing into the exciter housing (See Figure 3-1-1). Because of its location on the shaft, the exciter armature must be removed for rear main bearing replacement. The exciter armature has two M10-1.5 tapped holes in its diode mounting plate to accommodate pulling it off the shaft.

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

2) Exciter Armature

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

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

3) Exciter Armature Replacement

a) General

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

b) Tools needed for Exciter Armature Removal and Installation

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

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

A small, lightweight, sling-hammer puller is shown in Figure 3-1-3. This tool is necessary for removing the threaded machine key, which keeps the exciter armature from spinning on the generator armature shaft. You may have such a puller in your equipment inventory. If not, Figure 3-1-3 also illustrates components and dimensions for fabricating such a tool. Sling-hammer pullers are also commercially available. Instructions for using tool are provided in this manual.

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

c) Conditions for Exciter Removal

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

d) Preparation for Exciter Armature Removal

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

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

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

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

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

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

e) Exciter Armature Removal

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

Refer to Figure 3-1-2 for location of threaded machine key. Attachment of the assembled puller to the key in one operation is not recommended because the weight and bulk of the assembly make threading the 1/4 inch stud into the key rather clumsy. This could result in cross-threading and damage to key and stud. It is safer and easier to attach as follows:

a Thread stud (1, Figure 3-1-3) into adapter (2) until it bottoms, then thread this assembly (1) and (2) into key until stud bottoms in key threads. Tighten securely.

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

WARNING

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

CAUTION

Exercise care to prevent breaking or damaging stud.

c Position the hammer at the adapter end of the rod.

d Quickly move hammer to outer end of rod with a rapid, slinging motion. **HOLD** the hammer through the entire motion. If the hammer is allowed to slide free on the rod, the stud could be **DAMAGED** or **BROKEN.**

e Repeat step (c) and (d) as required to loosen key, then remove key and slide-hammer puller.

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

(2) Removing the Exciter Armature

CAUTION

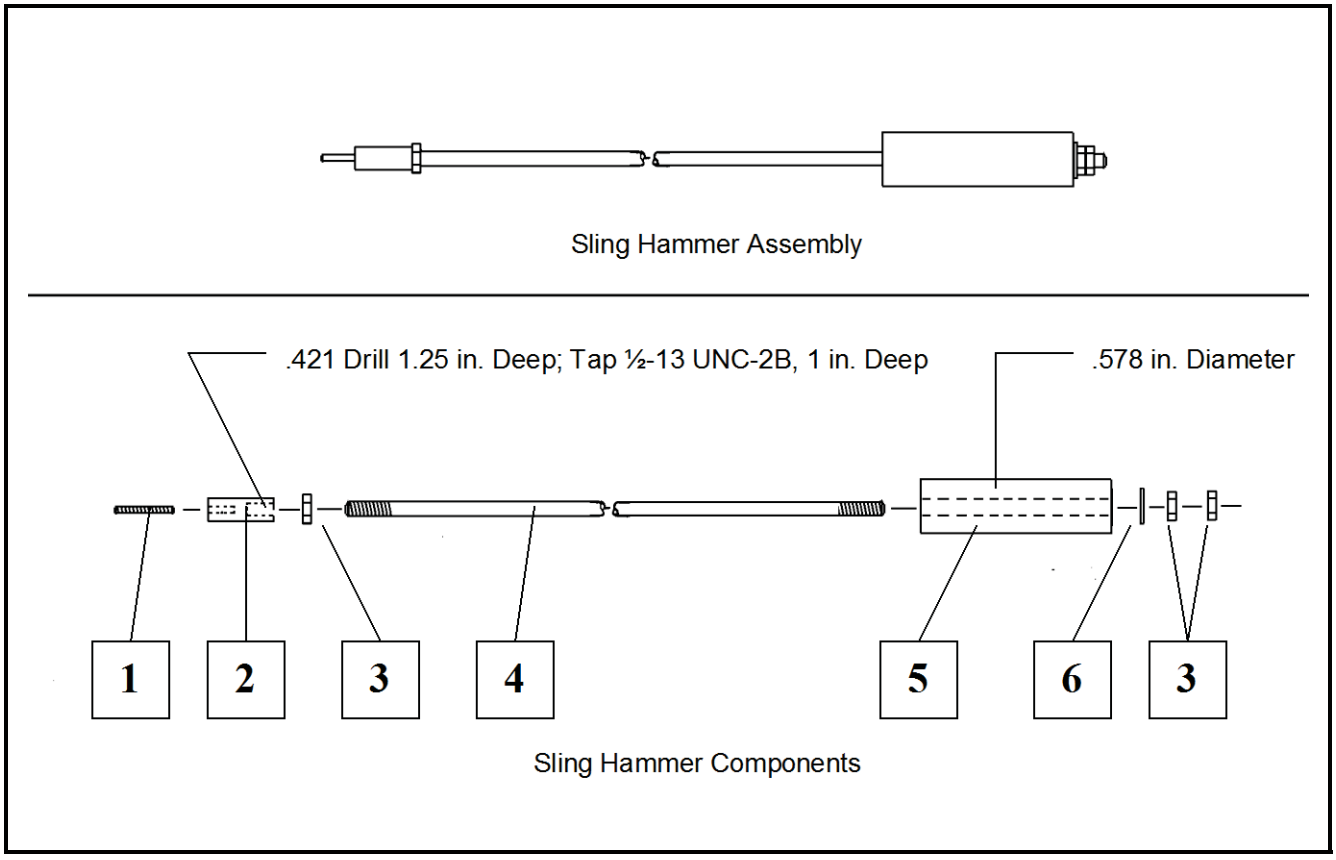
Leads may be damaged if armature is turned too far in either direction.

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

WARNING

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

b Attempt to loosen exciter armature on shaft by rotating it slightly back and forth. If armature cannot be loosened by hand, use two M10-1.5 hex-head bolts as shown in Figure 3-1-4 to force the exciter armature off the shaft. Turn each of the two screws a few turns at a time into the threaded holes of the diode mounting plate until the exciter armature is sufficiently loosened from the shaft to be removed from it by hand. Remove it slowly from the shaft and at the same time observe the following **CAUTION.**



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

Figure 3-1-3 Sling Hammer Puller

CAUTION	Pay close attention to field leads while pulling exciter armature from shaft. Make **CERTAIN** that the leads stay in the 1/2" keyway. One mechanic should watch them constantly while another operates the puller. Make certain that leads do not catch and be sure that they slide smoothly through the hole (Figure 3-1-2). Straighten leads and remove kinks as required to avoid damage to insulation.

4) Exciter Armature Installation

a) Preparation for Exciter Armature Installation

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

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

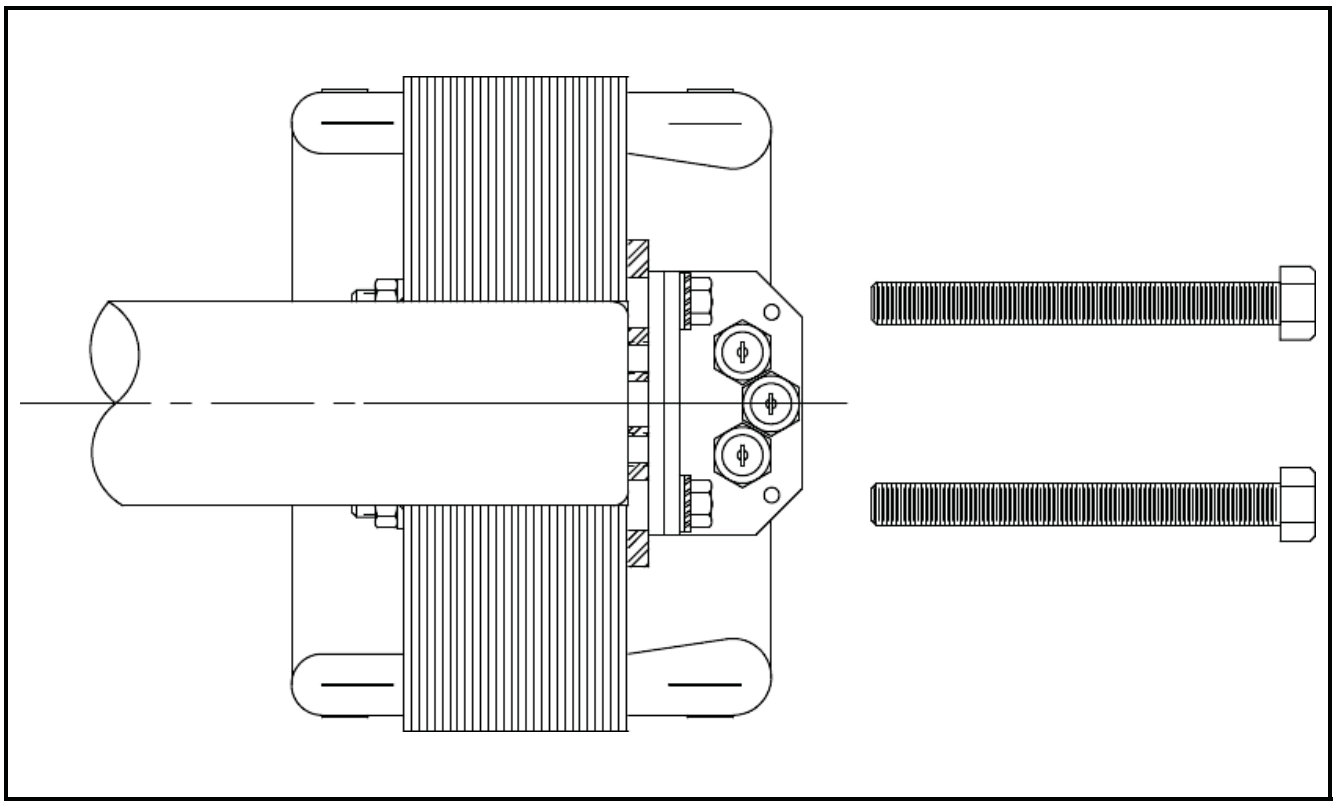


Figure 3-1-4 Exciter Armature Removal

(3) Route the revolving field leads (step 2 above) through exciter armature hole (Figure 3-1-2), which is opposite the keyway.

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

b) Exciter Armature Installation

(1) If the exciter armature-to-generator shaft fit is such that the exciter armature may be pushed on by hand, push it on very slowly while another mechanic carefully watches and pulls field leads through hole in the exciter armature diode mounting plate. Continue installation until the diode mounting plate contacts the end of the generator shaft. If the exciter armature cannot be pushed on by hand, use a M12-1.75 hex-head bolt and M12-1.75 nut as shown in Figure 3-1-5 to pull the exciter armature onto the generator shaft. Put the exciter armature on slowly and at the same time pull field leads through the hole (Figure 3-1-2) in the diode mounting plate. Screw the nut onto the bolt until it is near the head of the bolt. Insert the bolt through the hole in the center of the diode mounting plate as far as it will go, and screw it into the end of the armature shaft. Screw the nut up against the diode mounting plate. Continue turning the nut until the diode mounting plate contacts the end of the generator shaft, just as is shown in the lower portion of Figure 3-1-5. After installation, remove the bolt and nut.

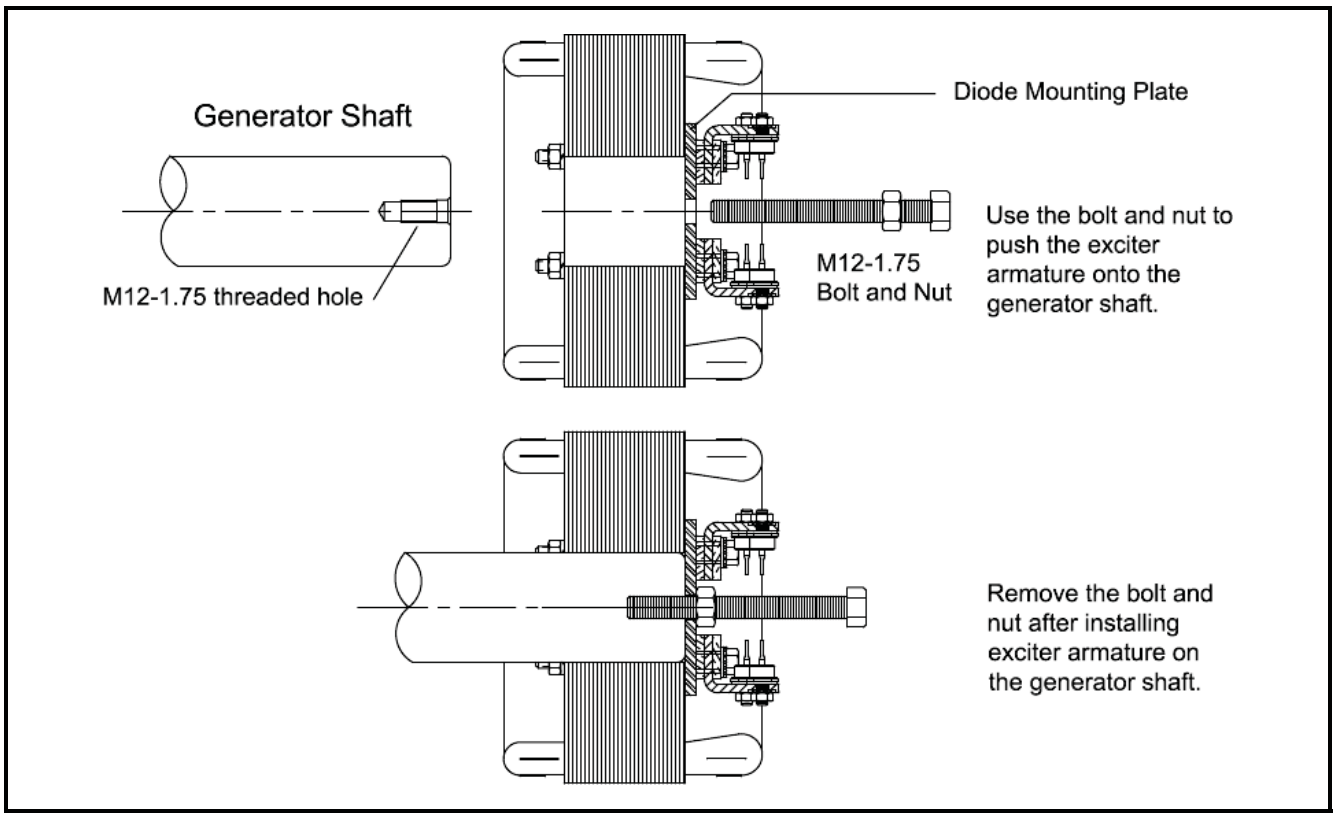


Figure 3-1-**5 Exciter Armature Installation**

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

a Connect lead with ring type terminal to the screw provided to the mounting plate (Figure 3-1-2).

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

c Insulate with sleeving material or wrap with electrical tape.

(3) Install the Machine Key

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

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

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

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

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

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

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

Recommended Products Manufacturers:

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

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

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

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

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

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

Section 2 Dual Bearing Flexible Coupling

1) General

This manual provides basic instructions for removal, service and installation of a flexible coupling assembly, with generator fan, manufactured by **ITW GSE** as **Part Number 288481.** This assembly is illustrated in Figure 3-2-1. The primary function of this assembly is to couple a Hobart 2000 RPM Generator to a Diesel engine. The flexible coupling assembly compensates for slight misalignment between the engine and the generator, due to manufacturing tolerances. A tapered bushing and hub secures the coupling to the generator shaft.

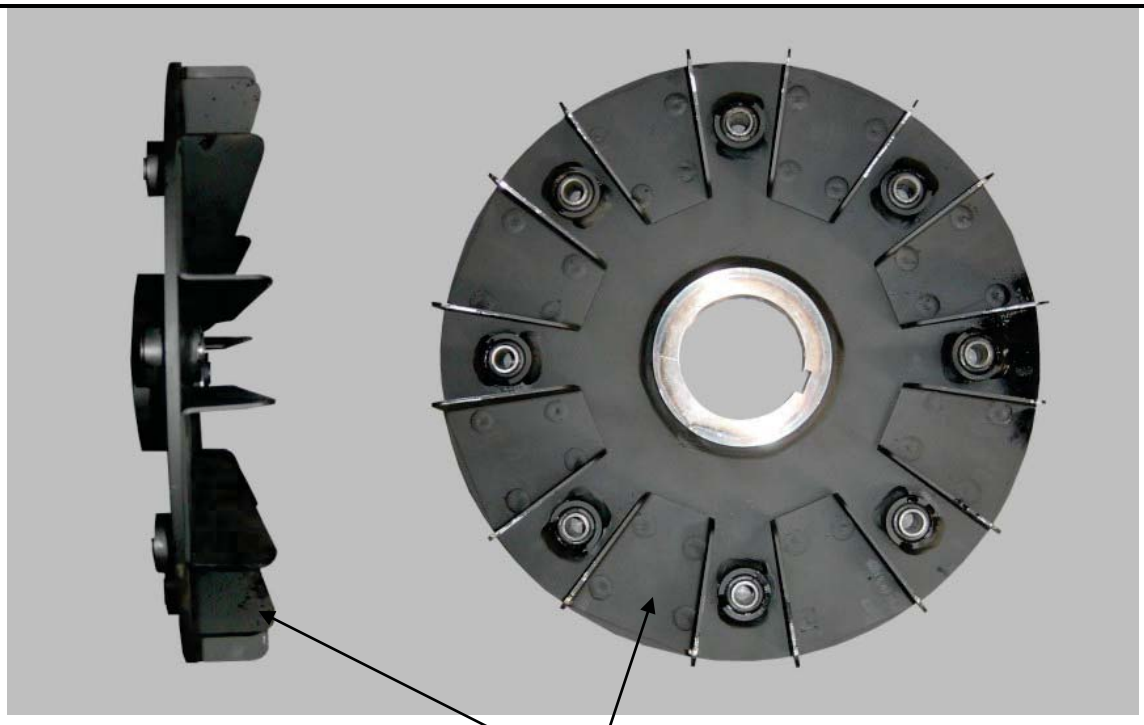


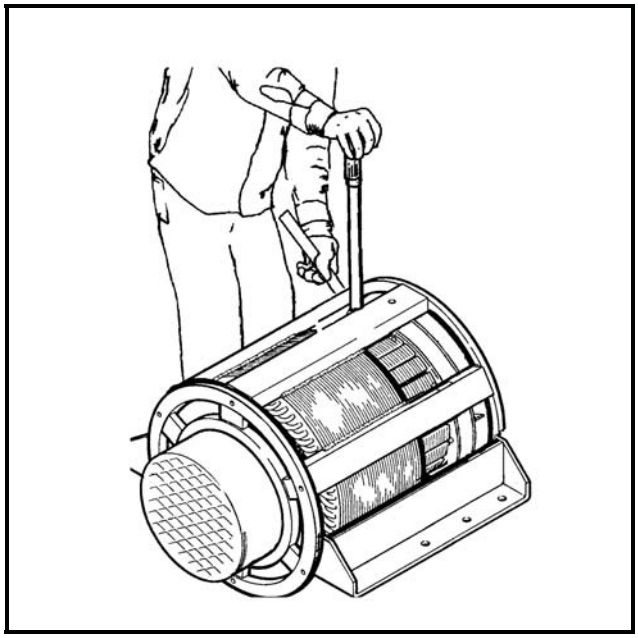
Figure 3-2-1
Coupling Assembly

2) Disassembly

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

a) Separate Engine and Generator.

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



Access to Coupling Bolts
(for removal or installation)
Figure 3-2-2

b) Remove Coupling Assembly

WARNING

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

(1) Refer to Figure 3-2-3. Using a socket wrench, remove all three of the 3/8-16 bolts that secure the bushing to the hub.

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

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

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

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

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

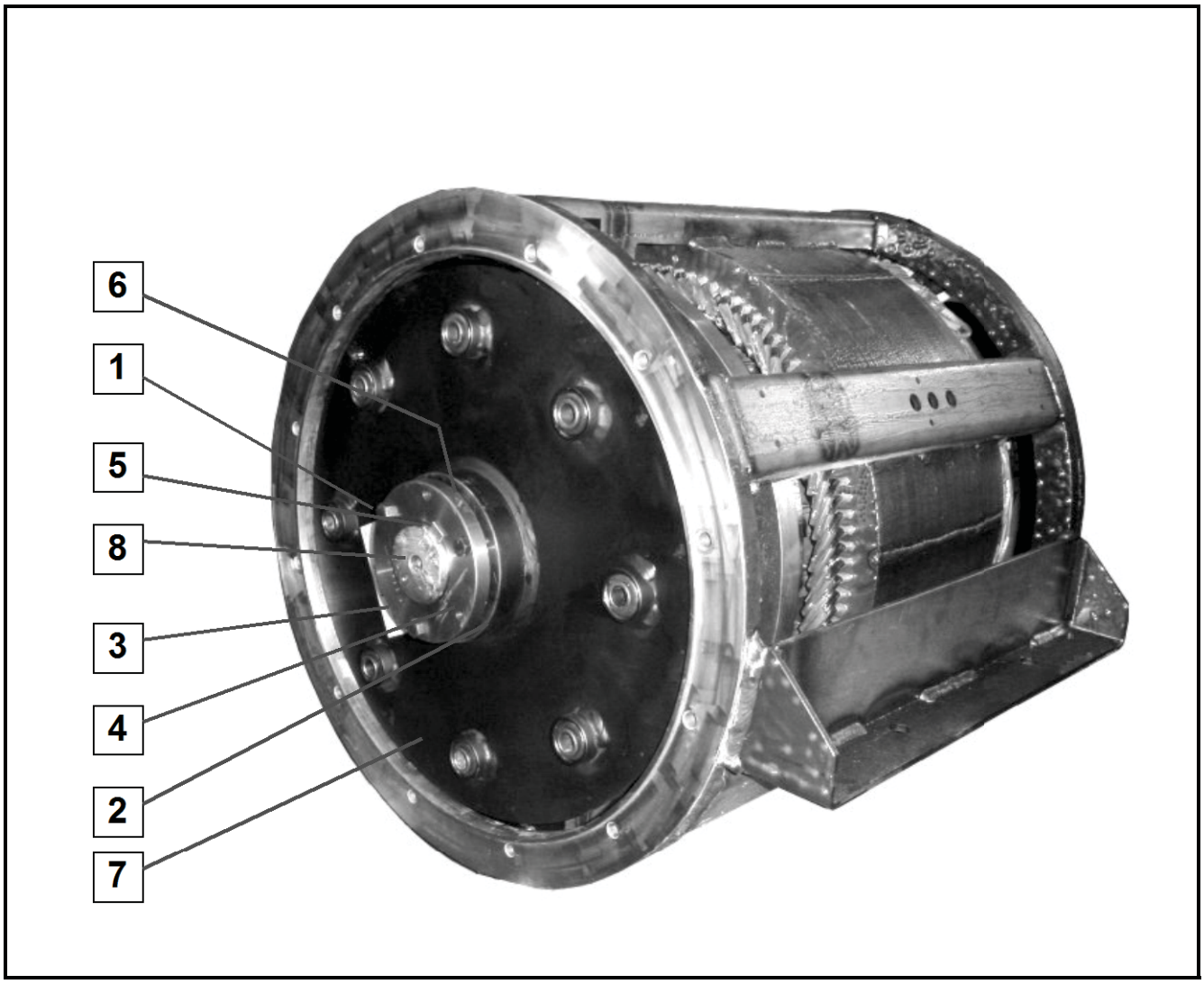
a Check for deformed fan blades and damage to the disk.

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

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

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

e Check rubber bushing alignment to make sure that the dimension illustrated in Figure 3-2-4 is maintained.



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

Figure 3-2-3 Hub and Bushing

3) Coupling Service

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

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

Write:	ITW GSE Service Department 11001 US Highway 41, North Palmetto, FL 34221 U.S.A.
Call Inside U.S.A.:	(866) 845-0441 (Parts) (877) 874-5322 (Service)
Call From Foreign Countries:	(941) 721-1092 (Technical Support) (941) 721-1000,1 (Spare Parts)
FAX inside U.S.A.	(800) 367-4945
FAX From Foreign Countries:	(941) 721-1091
E-Mail:	technicalsupport@itwgse.us parts@itwgse.us
Web Page:	www.itwgse.com

a) Replacement Coupling Kit

A replacement coupling kit is available from ITW GSE. The kit provides a replacement coupling assembly with attaching hardware and installation instructions.

b) Bushing Kit

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

c) Bushing Replacement

To replace bushings only, proceed as follows:

(1) Press out all old bushings.

(2) Refer to Figure 3-2-4. Clean each bushing socket thoroughly, removing all traces of old rubber. DO NOT scratch or deform the bore of the bushing socket.

(3) Shake the container of lubricant (supplied with kit) vigorously and pour it into a small shallow dish.

(4) Roll a bushing in the lubricant to coat it thoroughly. Press it into a socket (from the chamfered end) to the dimension shown in Figure 3-2-4.

(5) Repeat step 4 until all new bushings are installed.

(6) Balance the complete coupling assembly to 1/2 inch-ounce (360 mg-m) minimum.

4) Coupling Installation

WARNING

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

CAUTION

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

a) Cleaning

Refer to Figure 3-2-5. It is **VERY IMPORTANT** that the shaft, the bore and the outside of the split bushing, and the tapered inside of the hub be thoroughly **CLEANED FREE OF DIRT AND GRIT.**

CAUTION

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

b) Assembly

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

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

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

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

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

CAUTION

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

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

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

CAUTION

Do not rotate the armature while this block is installed.

(6) Install the key in the shaft keyway.

(7) Place the bushing in the hub over the installed key, and install the coupling assembly on the shaft, with the bushing approximately flush with the end of the shaft.

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

(9) Refer to Figure 3-2-7. Place a straightedge across the two adjacent bushings and measure the distance from the bushings to the mounting face of the generator fan housing. Slide the coupling assembly on the shaft until this dimension is met and then move the coupling 1/16-inch (1.6 mm) less than the dimension recorded from the adapter ring measurement. The tapered hub will be pulled onto the split bushing 1/16-inch (1.6 mm) when the 3/8-16 bolts are completely tightened.

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

a Set a torque wrench to 30 foot-pounds (41 N-m) and tighten all three 3/8-16 bolts to that value. Block the coupling against clockwise rotation with a bar, as illustrated in Figure 3-2-2. Observe the **CAUTION** above when it is necessary to rotate the shaft.

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

c Recheck the dimension in Figure 3-2-7 to be sure it is the same as the dimension in Figure 3-2-6.

5) Reassemble Engine and Generator

CAUTION

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

a) Insert the new coupling bolts with lock washers through the bushings from the fan side of the coupling.

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

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

d) Insert all remaining attaching bolts through the generator flange, engaging the tapped holes in the flywheel housing, and tighten them all securely.

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

CAUTION

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

6) Run-in and Periodic Check

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

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

c) Return the unit to normal service.

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

e) Return the unit to normal service.

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

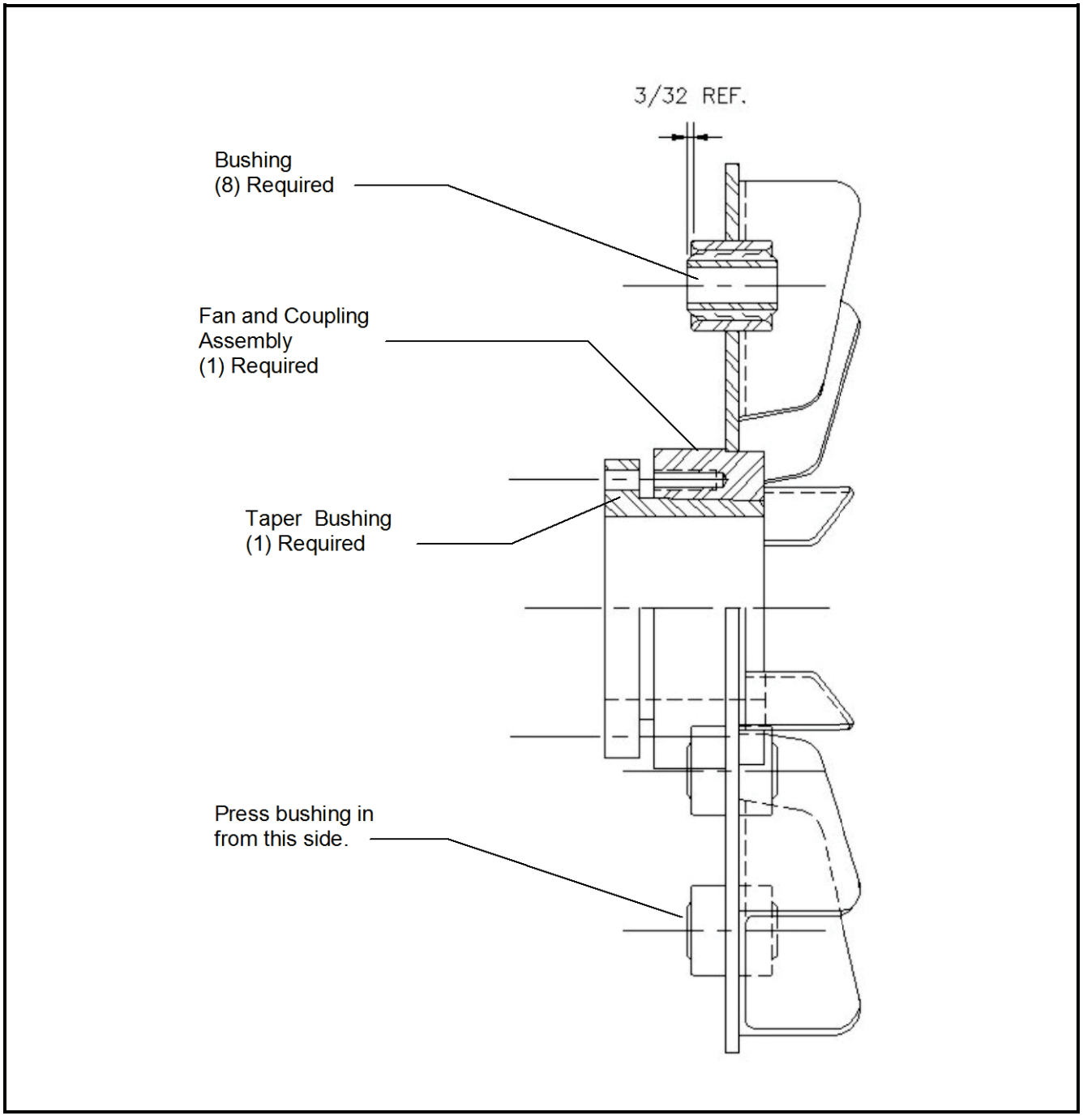


Figure 3-2-4 Bushing Installation

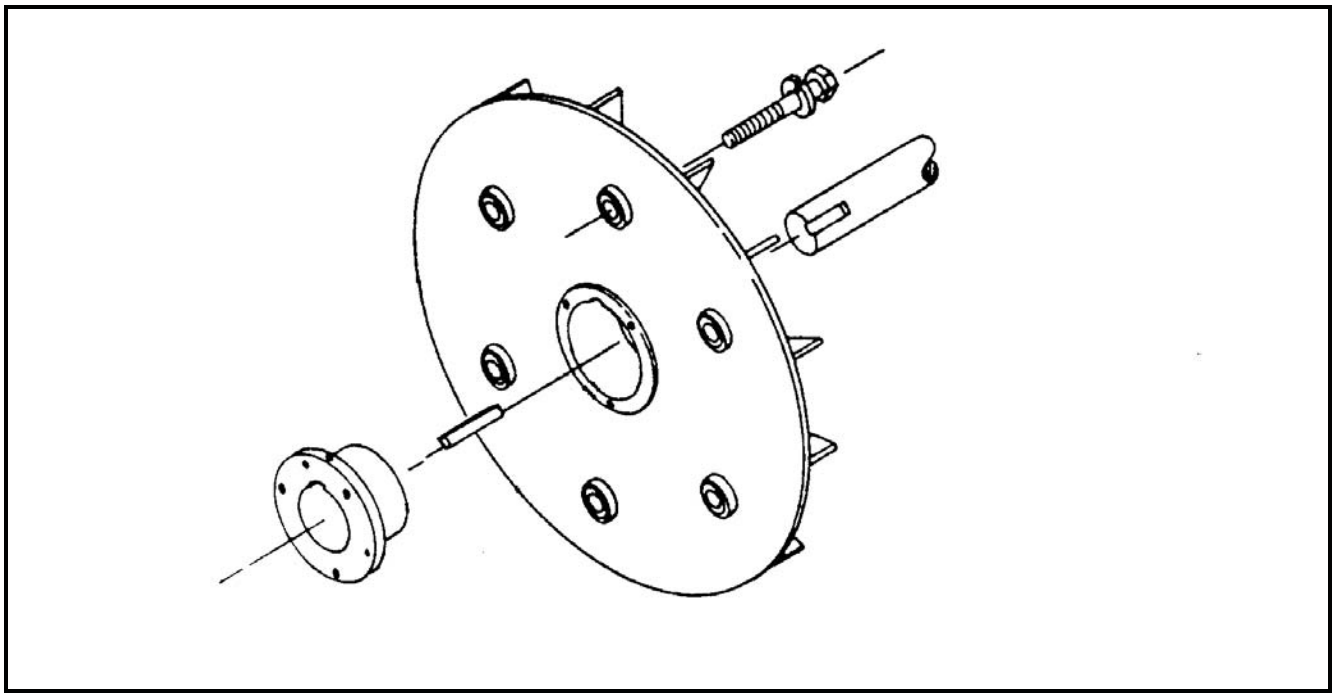


Figure 3-2-5 Assembly Procedure

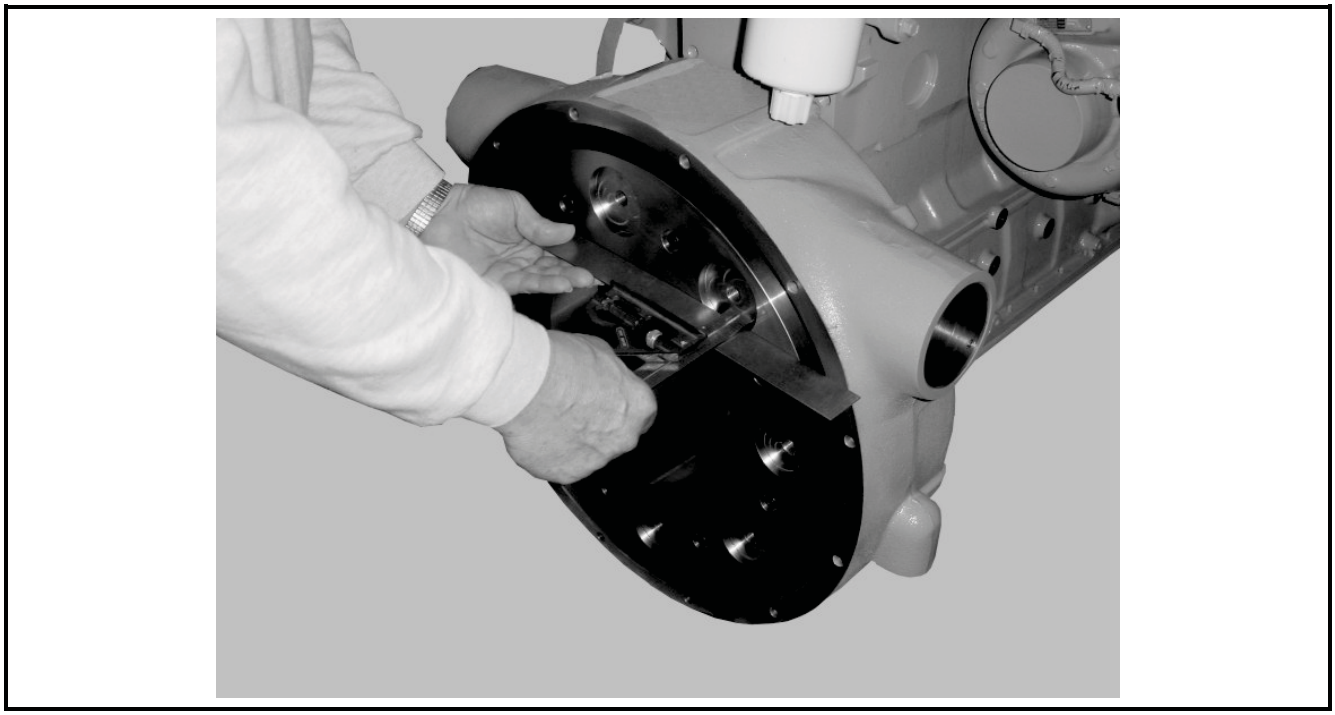


Figure 3-2-6 Measure from mounting face to adapter ring.

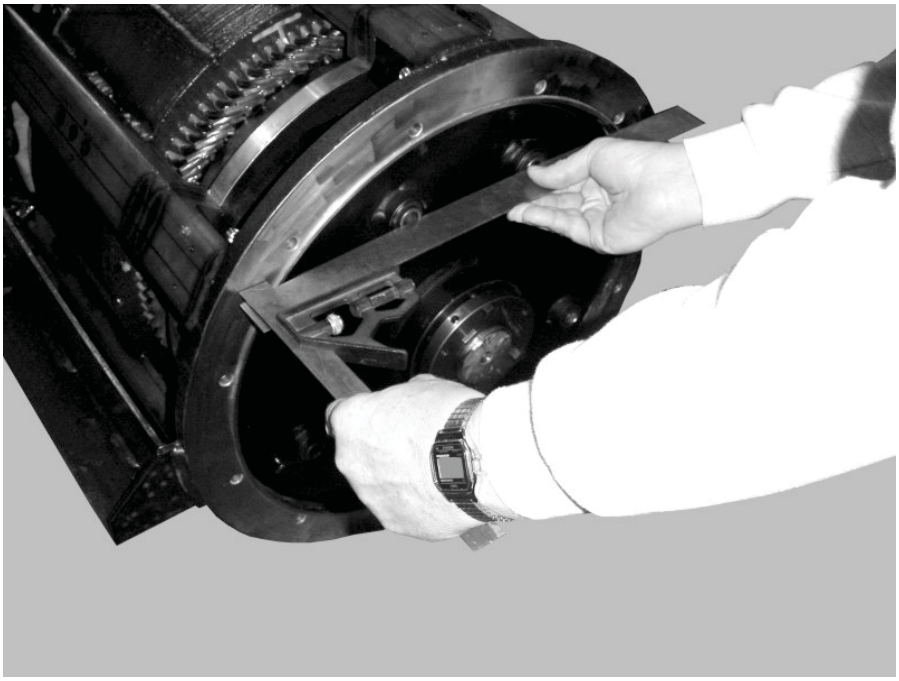


Figure 3-2-7 Measuring From Mounting Face To Bushing

Section 3 Generator Assembly

1) General

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

2) Generator Assembly Removal

a) Procedure for Gaining Access to the Generator

WARNING

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

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

(1) Disconnect battery leads from the generator set.

(2) Remove required canopy assembly components.

(3) Disconnect output cables from the power module load contactors.

(4) Disconnect plug connectors from the back of the control box and remove the control box

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

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

(6) Remove the generator stator leads from the power module and remove the power module.

(7) Remove required support table components above the generator.

(8) Remove generator housing cover.

b) Removing the Generator Assembly

(1) Remove the bolt that mounts the generator assembly to the frame of the generator set.

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

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

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

(5) Remove the bolts and detach the generator housing from the engine.

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

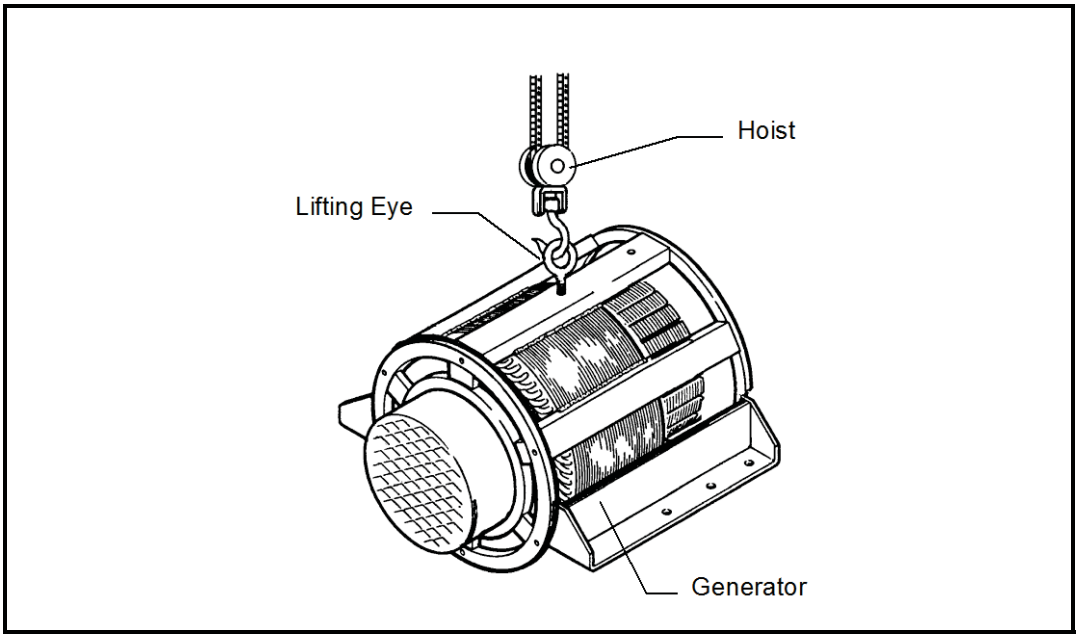


Figure 3-3-1 Generator Lifting Arrangement

3) Generator Assembly Installation

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

a) Remounting the Generator Assembly

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

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

(3) While still supporting the generator assembly with the hoist, attach the generator housing to the engine using the bolts removed earlier. Torque bolts to 30 ft-lb (41 N-m).

(4) Attach the flywheel coupling to the engine using the bolts removed earlier. Torque bolts to 85 ft-lb (115 N-m).

(5) Mount the generator housing to the frame of the generator set, using the bolts removed earlier. Torque bolts to 73.7 ft-lb (100 N-m).

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

b) Remounting the previously removed assemblies

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

Chapter 4 Illustrated Parts List

Section 1 Introduction

1) General

The Illustrated Parts List identifies, describes, and illustrates main assemblies, subassemblies, and detail parts of a Diesel Engine-Generator Set manufactured by ITW GSE, Palmetto, Florida.

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

3) Arrangement

Chapter 4 is arranged as follows:

Section 1 – Introduction,
Section 2 - Parts List,
Section 3 - Numerical index,

4) Explanation of Parts List

a) Contents

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

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

b) Parts List Form

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

(1) FIGURE- ITEM NO. Column

This column lists the figure number of the illustration applicable to a particular parts list and 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) ITW GSE NUMBER Column

All part numbers appearing in this column are ITW GSE 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 ITE GSE, will be identified as such in the "NOMENCLATURE" column. In case Hobart does not have an identifying part number for a purchased part, the "ITW GSE PART NUMBER" column will reflect "No Number" and the vendor's number if applicable will be shown in the "NOMENCLATURE" column. Parts manufactured by ITW GSE will reflect no vendor or part number in the "NOMENCLATURE" column.

(3) NOMENCLATURE Column

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

(4) EFF (Effective) Column

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

Part Code	Part Number	Output	Model Description	CE Certified
A	293105	400Hz	Single Output	--
B	293095	400Hz plus 28VDC	Single Output	--
C	293096	400Hz	Dual Output	--
D	293097	400Hz plus 28VDC	Dual Output	Yes

If the EFF column is blank, that part is used on all models.

(5) QTY. 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 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
#	-	Number or Part Number
A, or AMP	-	Ampere
AC	-	Alternating current
AR	-	As required
DC	-	Direct current
DIA		Diameter
Deg	-	Degree
Fig	-	Figure
hd.	-	Head
hex	-	Hexagon
Hz	-	Hertz (cycles-per-second)
ID	-	Inside diameter
IN	-	Inch
kVA	-	Kilovolt-ampere
lg		Long
uF	-	Microfarad
No Number		Not supplied by Hobart
No.	-	Number
NHA	-	Next higher assembly
OD		Outside Diameter
PRV	-	Peak reverse voltage
PSI	-	Pounds per square inch
Ref	-	Reference (the item has been listed previously)
RH	-	Right Hand
LH	-	Left Hand
TM	-	Technical Manual
T-R	-	Transformer-rectifier
V	-	Volt or used as a prefix indicating vendor code

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

3) Hierarchy

Part Number column lists the part number assigned. Sub- and /sub-assemblies are indicated by indenture level (., .., …, etc.) to the component next higher assembly (NHA). Line items with no part number assigned are listed as Non Applicable (No Number).

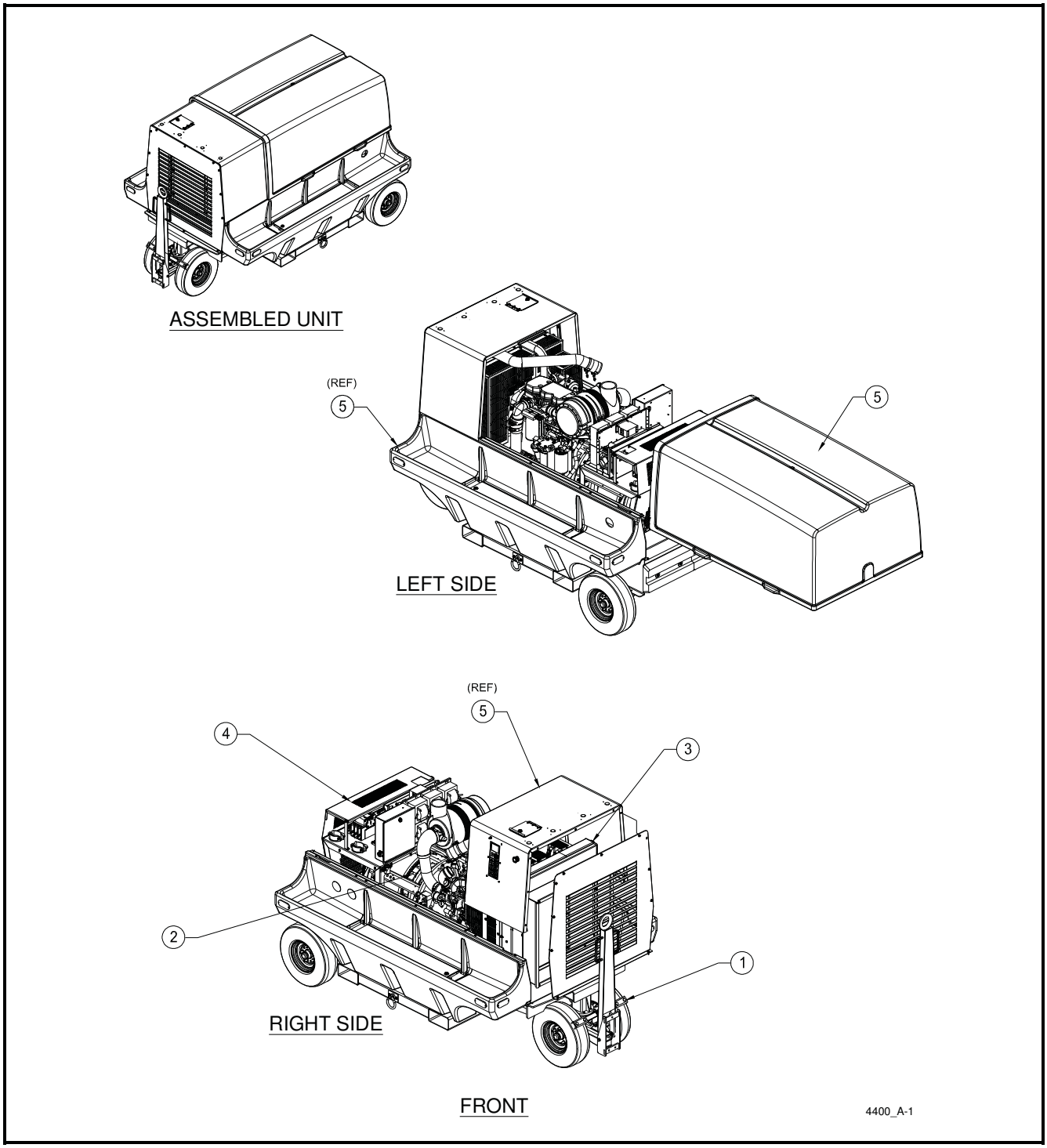


Figure 4-1. 4400, 60-90kVA, 3-Phase 115 Volt Generator Set (Sheet 1 of 2).

FIGURE - ITEM NO.	ITW GSE PART NO.	DISCRIPTION	EFF.	QTY.
4-1	4400 Rev A	60-90kVA, 3-Phase 115 Volt Generator Set		REF
4-1- 1	293001	.Trailer Assembly, Common Platform (See Figure 4-2)		1
4-1- 2	293034	.Genset/Fuel Tank Install, 60/90 kVA (See Figure 4-4)		1
4-1- 3	293036	.Radiator/Exhaust Installation (See Figure 4-7)		1
4-1- 4	293038	.Electrical System Installation (See Figure 4-9)		1
4-1- 5	293073	.Cable Tray/Canopy Installation, 4400 (See Figure 4-15)		1

Figure 4-1. 4400, 60-90kVA, 3-Phase 115 Volt Generator Set (Sheet 2).

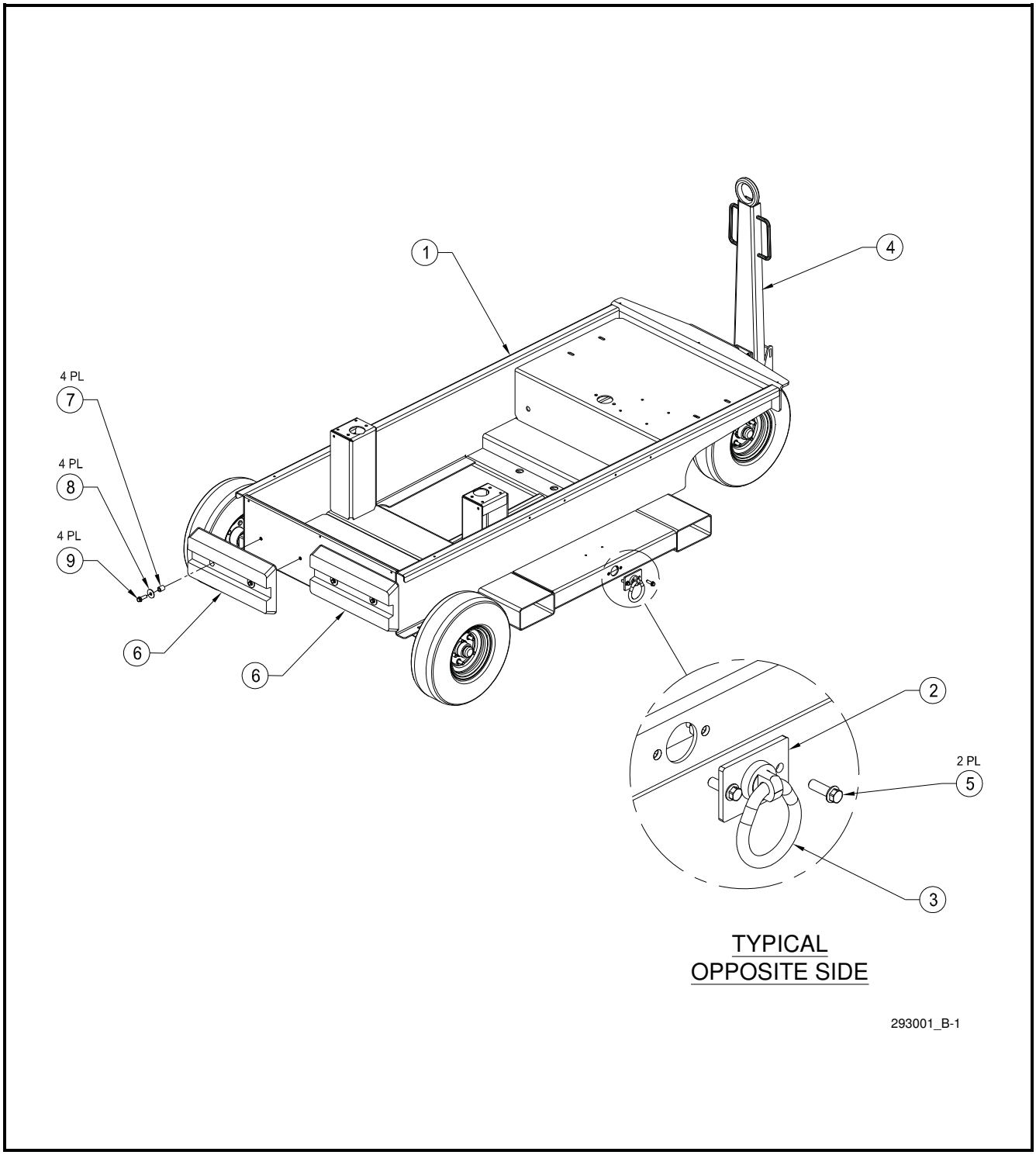


Figure 4-2. Trailer Assembly Common Platform (Sheet 1 of 2).

FIGURE - ITEM NO.	ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-2-	293001	Trailer Assembly, Common Platform		1
4-2- 1	293002	. Base Frame, Common Platform		1
4-2- 2	80-B1097	. . Tie Down Plate		2
4-2- 3	80B-1167	. . Tie Down Ring Assembly		2
4-2- 4	293003	. . Running Gear Assembly, 4400 Platform (See Figure 4-3)		1.
4-2- 5	No Number	… Hex Flg Bolt, M10-1.5 x 30 lg, GR10.9		4
4-2- 6	IN11393	. . Bumper, Hard Rubber		2
4-2- 7	No Number	…Spacer, Nyon, 1” OD x 1” lg		4
4-2- 8	No Number	…Washer, Snubbing		4
4-2- 9	No Number	… Hex Flg Bolt, M10-1.5 x 45 lg, GR10.9		4

Figure 4-2. Trailer Assembly, Common Platform Set (Sheet 2).

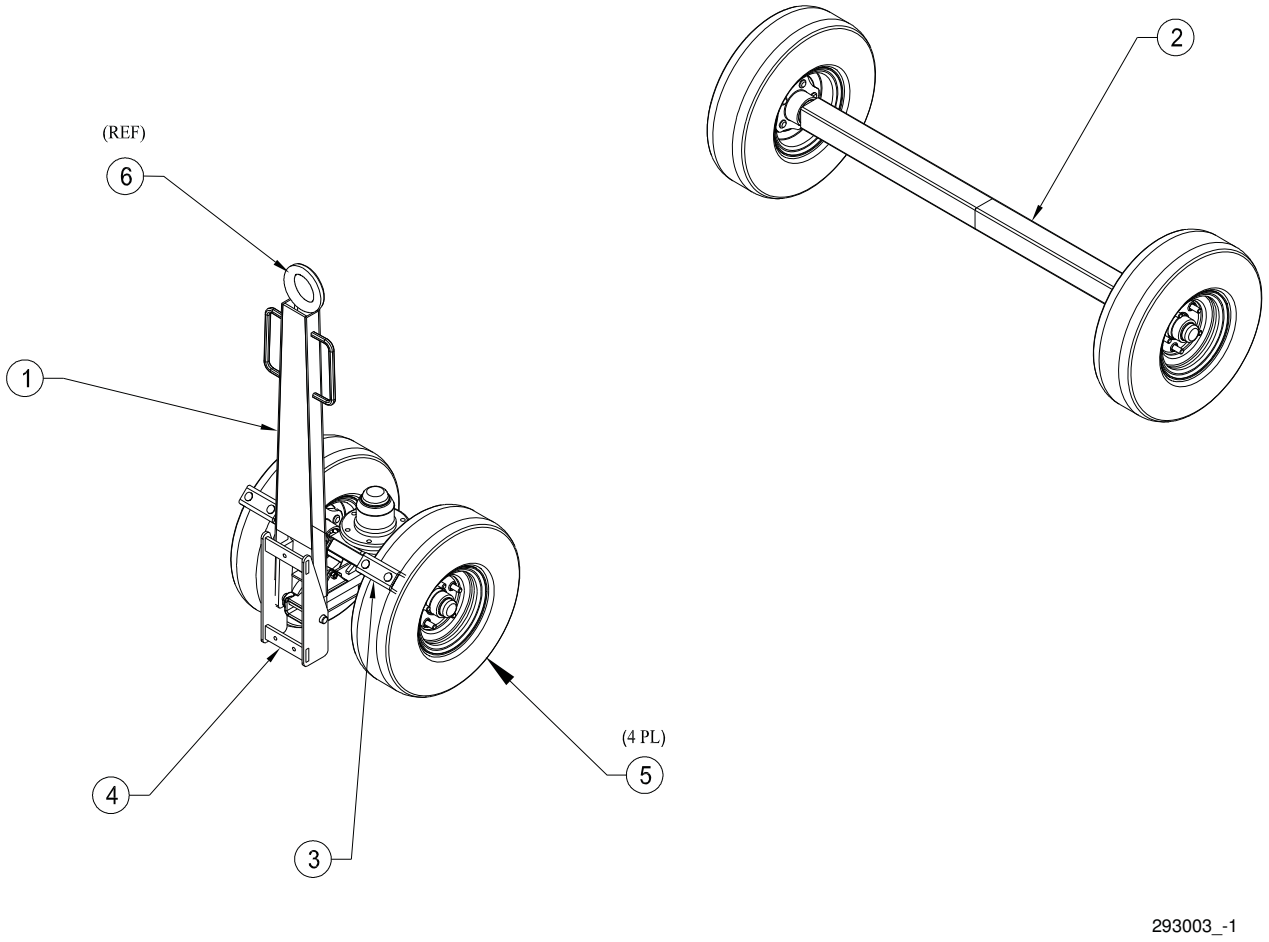


Figure 4-3. Running Gear Assembly, 4400 Platform. (Sheet 1 of 2).

FIGURE - ITEM NO.		ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-3-		293003 Rev-01	Running Gear Assembly, 4400 Platform		1
4-3-	1	293003-5th Wheel	…5th Wheel Assembly		1
4-3-	2	293003-Rear Axle	…Rear Axle Assembly		1
4-3-	3	293067	….Breaking Pad Kit Assembly, 18-1/2” Wheel		1
4-3-	4	288455	…Towbar Leveler Support		1
4-3-	5	TA11411	….Tire, Super Grip GSE 500/750-8 ply rated, 18.5 OD		4
4-4-	6	293148	…..DIN40 Tow Bar Eye (Optional)		1

Figure 4-3. Running Gear Assembly, 4400 Platform (Sheet 2).

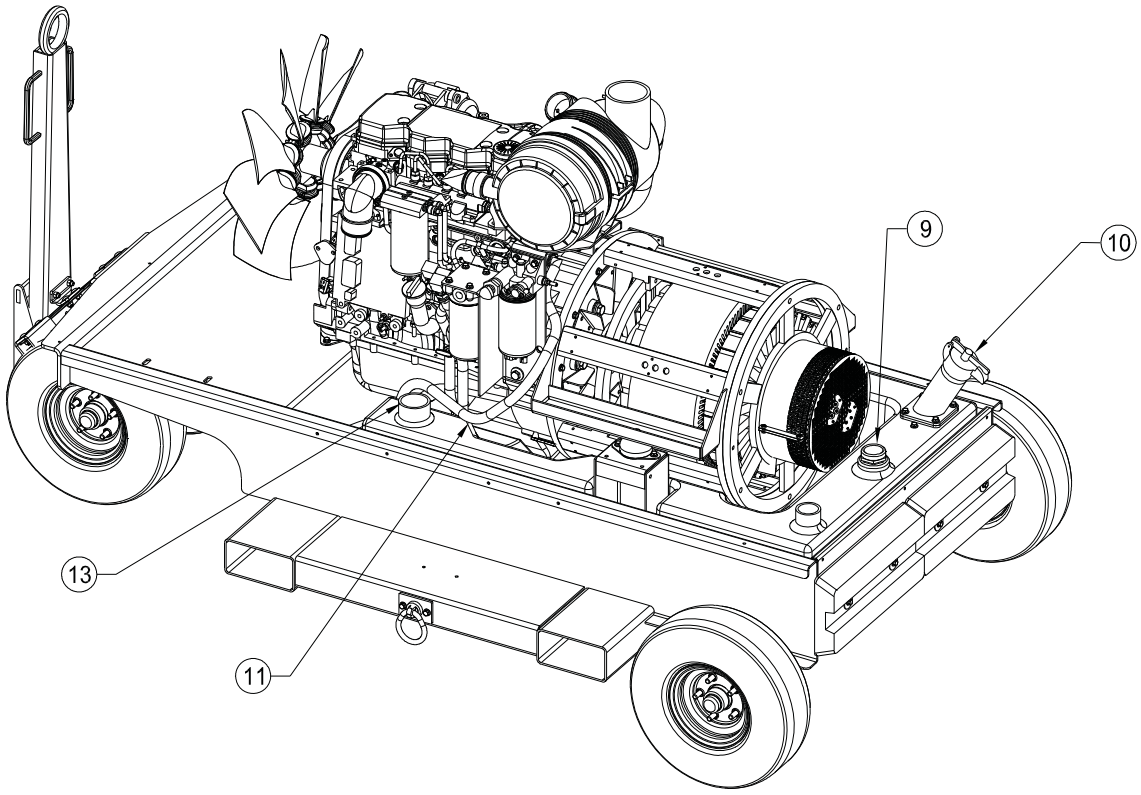


Figure 4-4. Genset/Fuel Tank Installation, 60/90 kVA (Sheet 1 of 3).

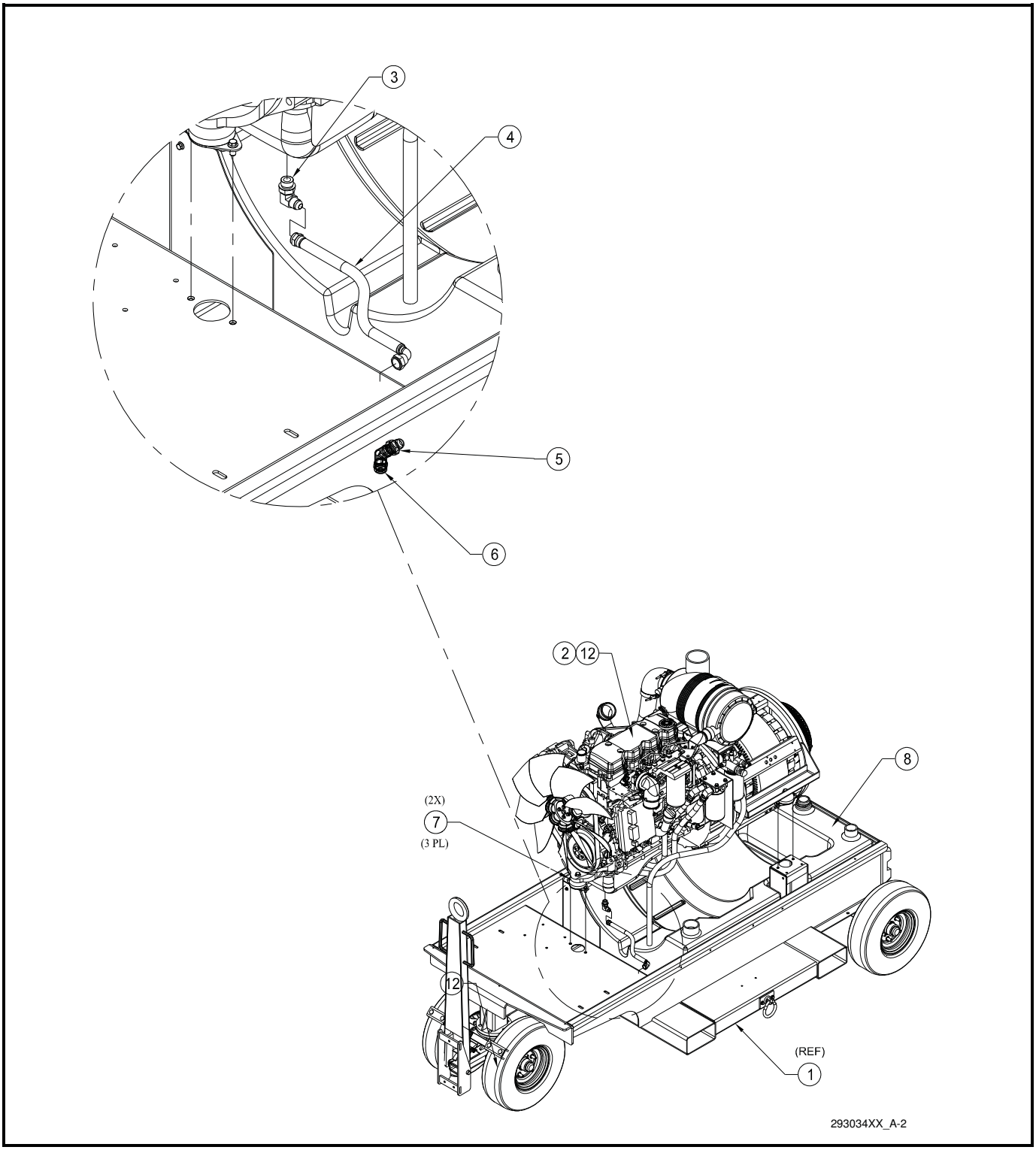


Figure 4-4. Genset/Fuel Tank Installation, 60/90 kVA (Sheet 2).

FIGURE - ITEM NO.		ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-4-		293034-XX	Genset/Fuel Tank Installation, 60/90kVA		REF
4-4-	1	293001	.Trailer Assembly, Common Platform		REF
4-4-	2	293027-02	.Genset Assembly, 90kVA (See Figure 4-5)		1
4-4-	3	FI11399	..Elbow, 90 De. W/O-Ring, ¾-16 X M22X1.5 Male		1
4-4-	4	293080	..Oil Drain Hose Assembly		1
4-4-	5	FI5182	.. ¾-16 Bulkhead Adapter		1
4-4-	6	FI0074	.. ½”Cap Nut		1
4-4-	7	No Number	…Hex Flg Bolt, M10-1.5 x 20 lg, GR10.9		6
4-4-	8	293091	..Fuel Tank Composite Assembly, CP (See Figure 4-6)		1
4-4-	9	IL11359	…Mechanical Fuel Gauge		1
4-4-	10	EB11367	…Protectoseal, Fuel Cap Filler		1
4-4-	11	056525	…Hose, ¾” ID x 1” OD		1
4-4-	12	203027-01	. Genset Assembly, 60kVA (See Figure 4-5)		1
4-4-	13	SRI377	..Fuel Sender		1

Figure 4-4. Genset/Fuel Tank Installation, 60/90 kVA (Sheet 3).

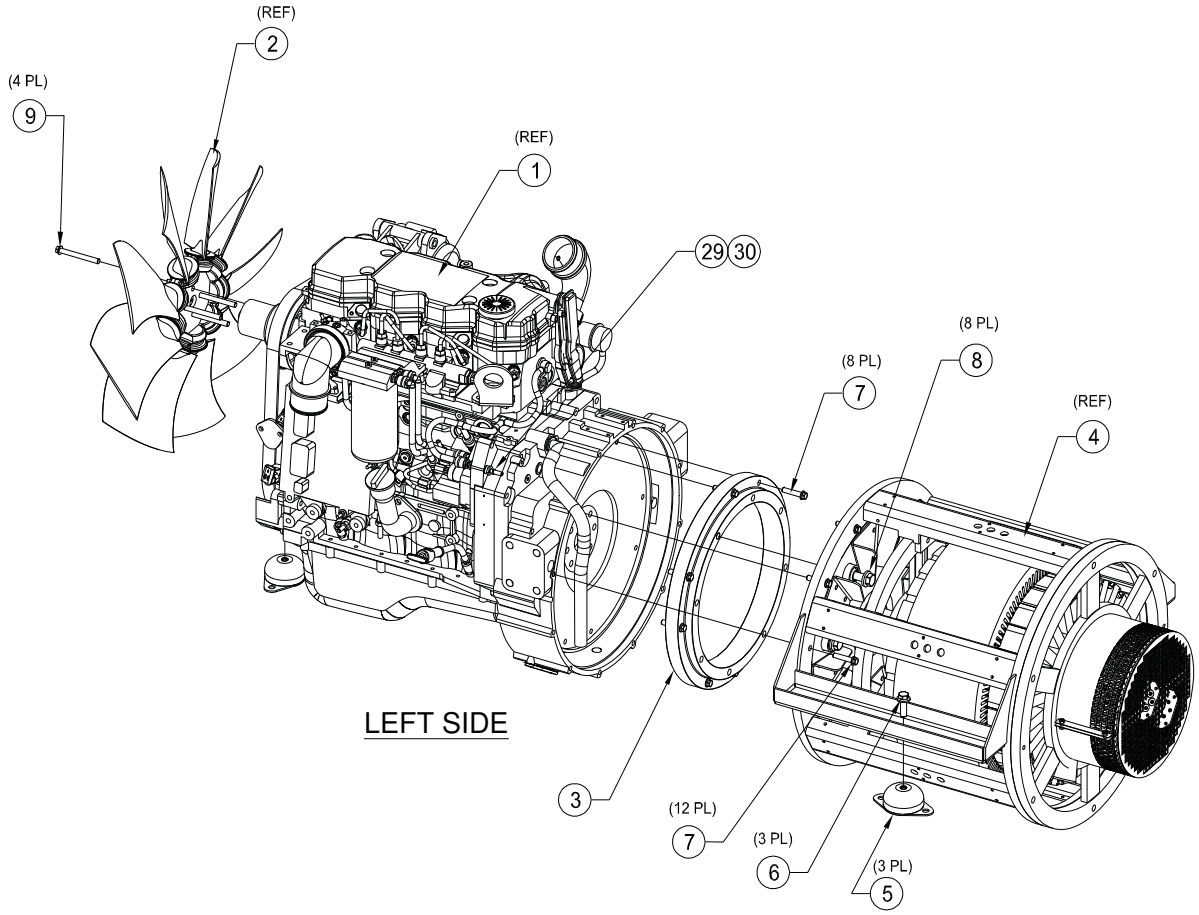
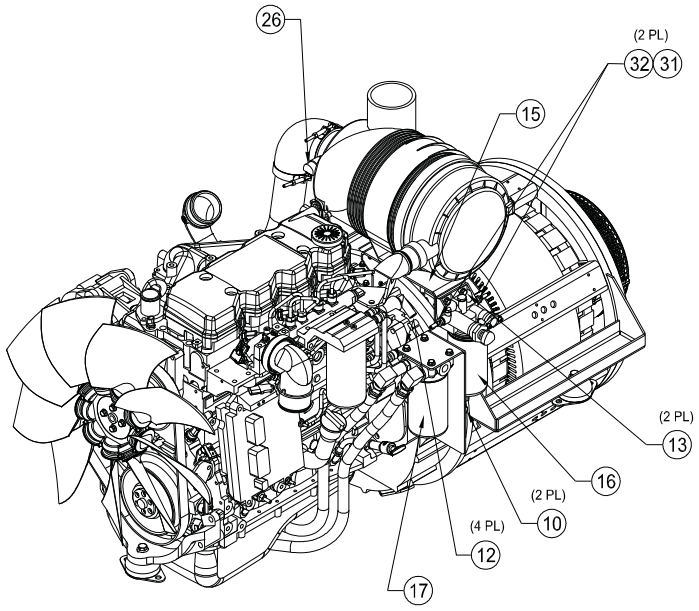
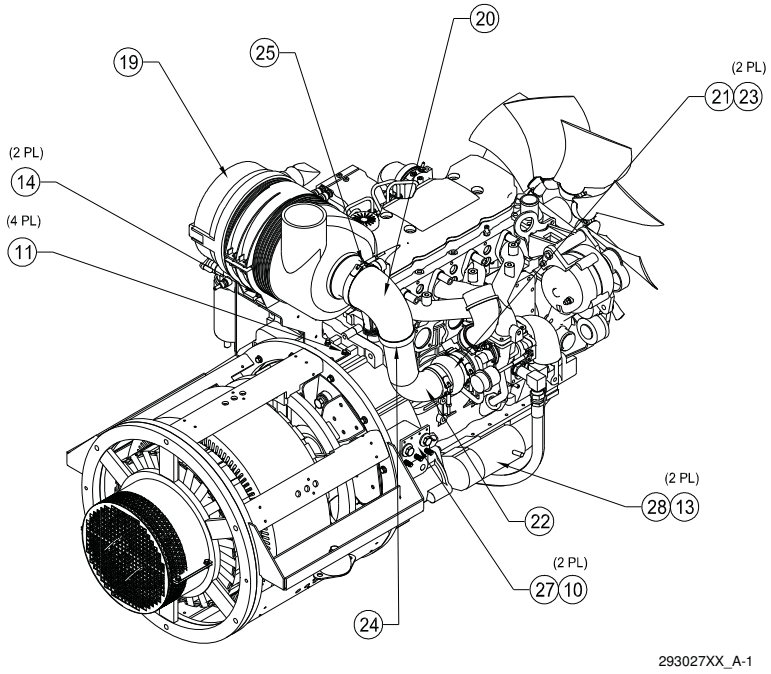


Figure 4-5. Genset Assembly, 60/90kVA (Sheet 1 of 4).



LEFT SIDE



RIGHT SIDE

Figure 4-5. Genset Assembly, 60/90kVA (Sheet 2).

FIGURE - ITEM NO.		ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-5-		293027-XX	Genset Assembly, 60/90kVA		Ref.
4-5-	1	293061	Engine, Cummins QSB4.5 Tier 3, 90kVA		1
		293126	Engine, Cummins QSB4.5 Tier 3, 60kVA		1
4-5-	2	FB11360	..Radiator Fan		1
4-5-	3	293004	..Flywheel Spacer Ring		1
4-5-	4	288460-004	..Generator Assembly, 2000 RPM		1
4-5-	5	VM11349	..Engine/Generator Mount		3
4-5-	6	No Number	… Hex Flg Bolt, 1/2-13 x 1.50 lg, GR8		3
4-5-	7	No Number	… Hex Flg Bolt, M10-1.5 x 45 lg, GR10.9		20
4-5-	8	No Number	… Hex Flg Bolt, 5/8-11 x 3 lg, GR8		8
4-5-	9	No Number	… Hex Flg Bolt, M10-1.5 x 90 lg, GR10.9		4
4-5-	10	No Number	… Hex Flg Bolt, M16-2 x 25 lg, GR8		4
4-5-	11	No Number	… Hex Flg Bolt, M6-1 x 12 lg, GR10.9		4
4-5-	12	No Number	… Hex Flg Bolt, M8-1.25 x 12 lg, GR10.9		4
4-5-	13	No Number	… Hex Flg Bolt, M10-1.5 x 30 lg, GR10.9		4
4-5-	14	No Number	… Hex Flg Bolt, M8-1.25 x 30 lg, GR10.9		2
4-5-	15	293028	..Filter Bracket, 90CU		1
4-5-	16	FS9841	..Fuel Filter/Water Separator		1
4-5-	17	LF9212	..Oil Filter Assembly		1
4-5-	18	CY11362	…Air Filter Band		1
4-5-	19	EB11361	..Air Intake Filter		1
4-5-	20	FI11363	..Elbow Reducer, 90Deg, 4-3		1
4-5-	21	AH11364	…Hump Hose Connector, 3” OD		1
4-5-	22	293031	..Air Filter Intake Tube, 3” ID		1
4-5-	23	290597-001	…Clamp, T-Bolt, 3.25 Dia		2
4-5-	24	290597-007	…Clamp, T-Bolt, 3.50 Dia		1
4-5-	25	290597-006	…Clamp, T-Bolt, 4.50 Dia		1
4-5-	26	282918	…Indicator, Restrictor, Electric		1
4-5-	27	293052	…Grounding Plate		1
4-5-	28	EC11368	..Motor Starter		1
4-5-	29	4894721	…Sealing Washer		1
4-5-	30	3964337	..Connector, Quick Disconnect		1
4-5-	31	EC11378	…Sealing Washer		2
4-5-	32	EC11379	..Connector, Quick Disconnect		2

Figure 4-5. Genset Assembly, 60/90kVA (Sheet 3).

FIGURE - ITEM NO.	ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-5- 33	*3863948	…Elbow, Male Adapter (Cummins P/N)		1
4-5- 34	*3864036	…Hose, Flexible (Cummins P/N)		1
4-5- 35	*3864172	…Hose, Flexible (Cummins P/N)		1
4-5- 36	*3903652	…Clamp, V Band (Cummins P/N)		1
4-5- 37	*3910131	…Spacer, Fan Pilot (Cummins P/N)		1
4-5- 38	*3937736	…Cartridge, Lube Oil Filter (Cummins P/N)		1
4-5- 39	*3963983	…Washer, Sealing (Cummins P/N)		1
4-5- 40	*3964337	…Connector, Quick Disconnect(Cummins P/N)		1
4-5- 41	*3974812	…Coupling, Plain Hose (Cummins P/N)		1
4-5- 42	*4021531	…QSB4.5/6.7 Operation and Maintenance Manual (Cummins P/N)		1
4-5- 43	*4894721	…Washer, Sealing (Cummins P/N)		1
4-5- 44	*4928800	…Head, Lube Oil Filter (Cummins P/N)		1
4-5- 45	*4995590	….Wiring Harness (Cummins P/N)		1
4-5- 46	*5259795	….Decal (Cummins P/N)		1
4-5- 47	*5288530	…Fuel Filter (Cummins P/N)		1
4-5- 48	*5312158	…Elbow, Male Adapter (Cummins P/N)		1
4-5- 49	*5318807	…Fuel Hose (Cummins P/N)		2

*Item not illustrated

Figure 4-5. Genset Assembly, 60/90kVA (Sheet 4).

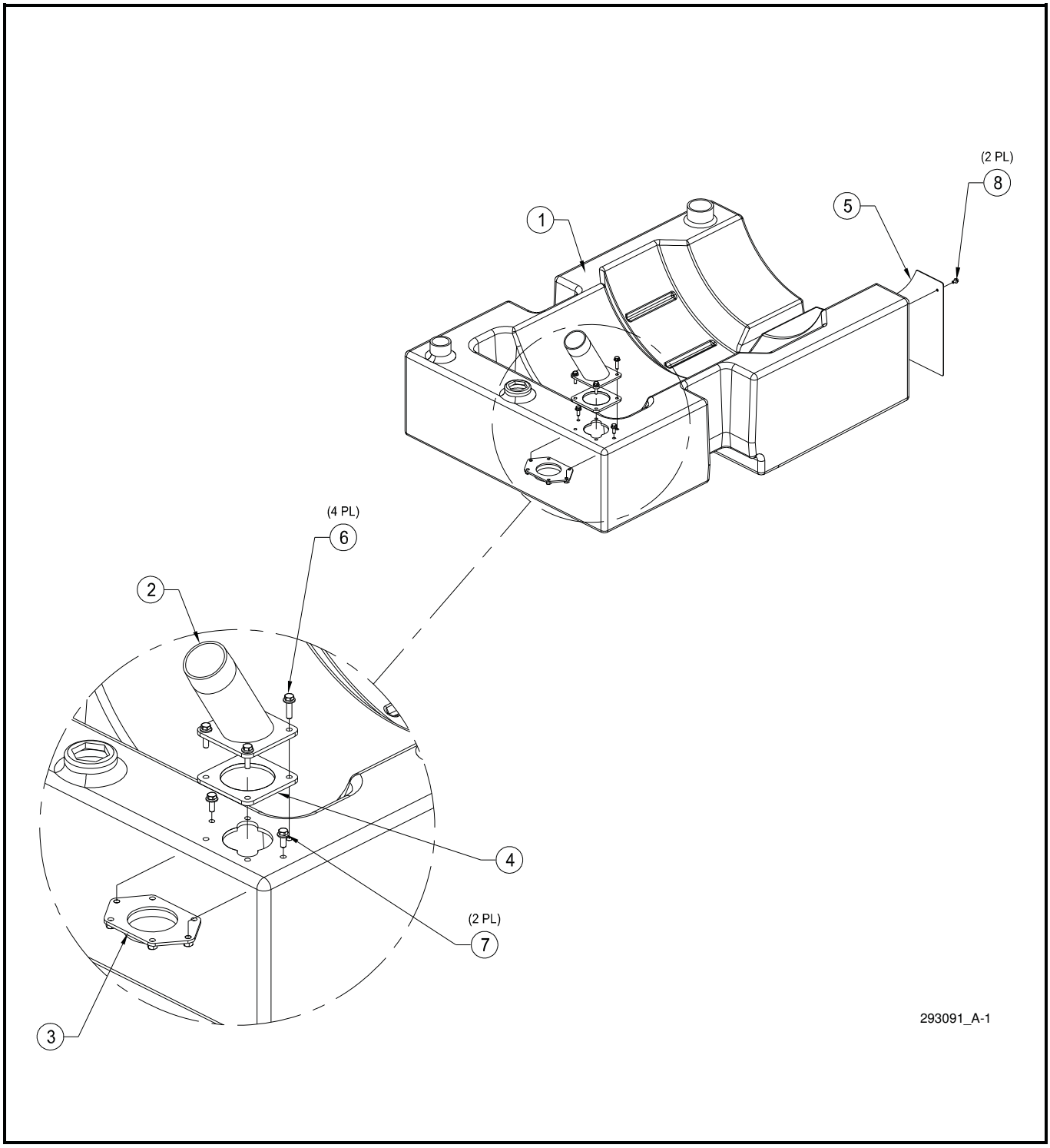


Figure 4-6. Fuel Tank Composite Assembly, CP (Sheet 1 of 2).

FIGURE - ITEM NO.		ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-6-		293091	Fuel Tank Assembly Composite, CP		REF
4-6-	1	293090	.Fuel Tank, Machining, Composite, CP		1
4-6-	2	293094	..Fuel Filler Neck, 2-1/2” NPT, Weldment		1
4-6-	3	293092	..Plate, Fuel Neck, Internal		1
4-6-	4	293093	…Gasket, Fuel Neck		1
4-6-	5	293108	..Fuel Tank Heat Shield		1
4-6-	6	No Number	…Hex Flg Bolt, M8-1.25 x 30 lg, GR10.9		4
4-6-	7	No Number	…Hex Flg Bolt, M8-1.25 x 20 lg, GR10.9		2
4-6-	8	No Number	…Hex Flg Bolt, M6-1 x 12 lg, GR10.9		2

Figure 4-6. Fuel Tank Composite Assembly, CP (Sheet 2).

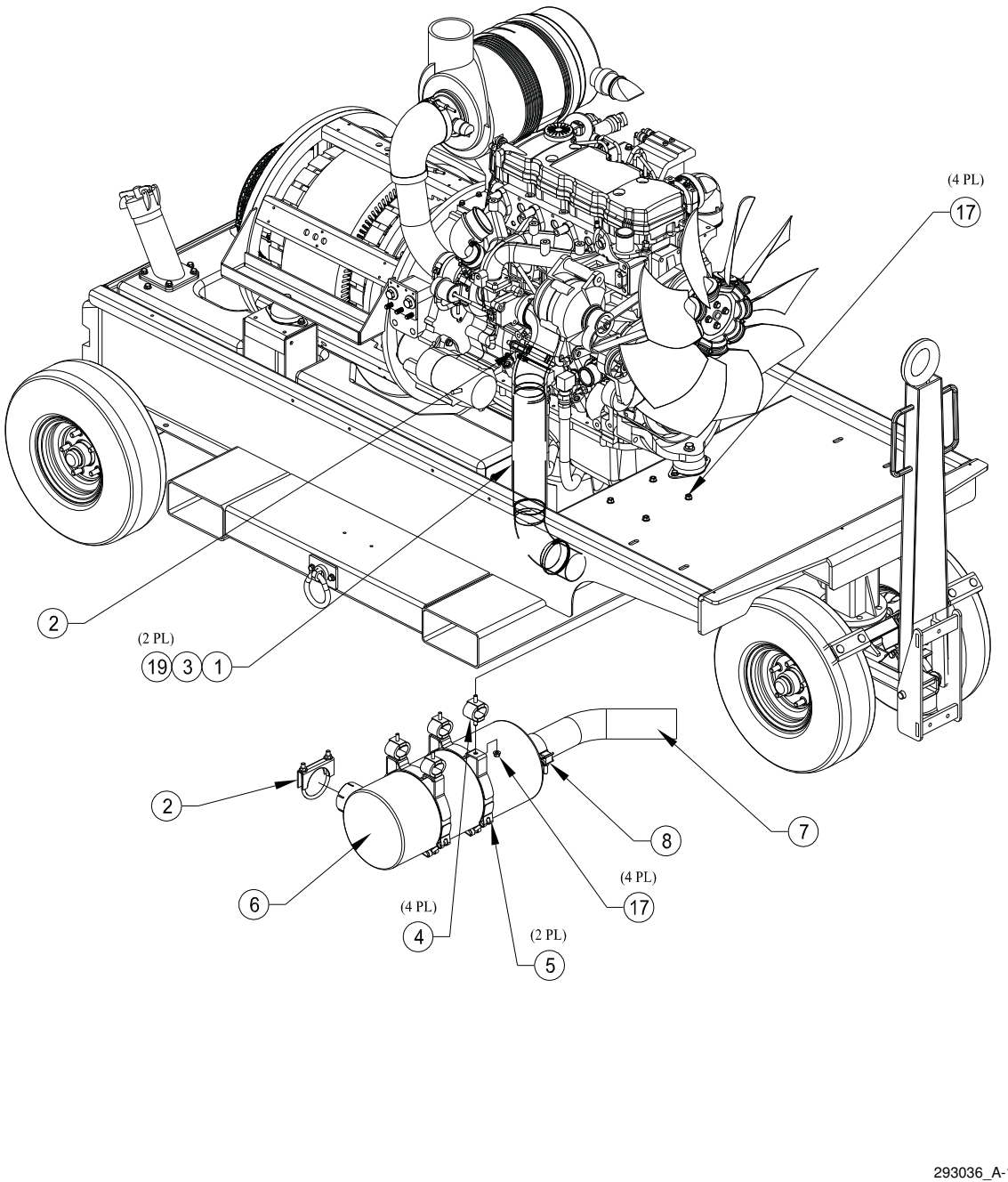


Figure 4-7. Radiator/Exhaust Installation (Sheet 1 of 3).

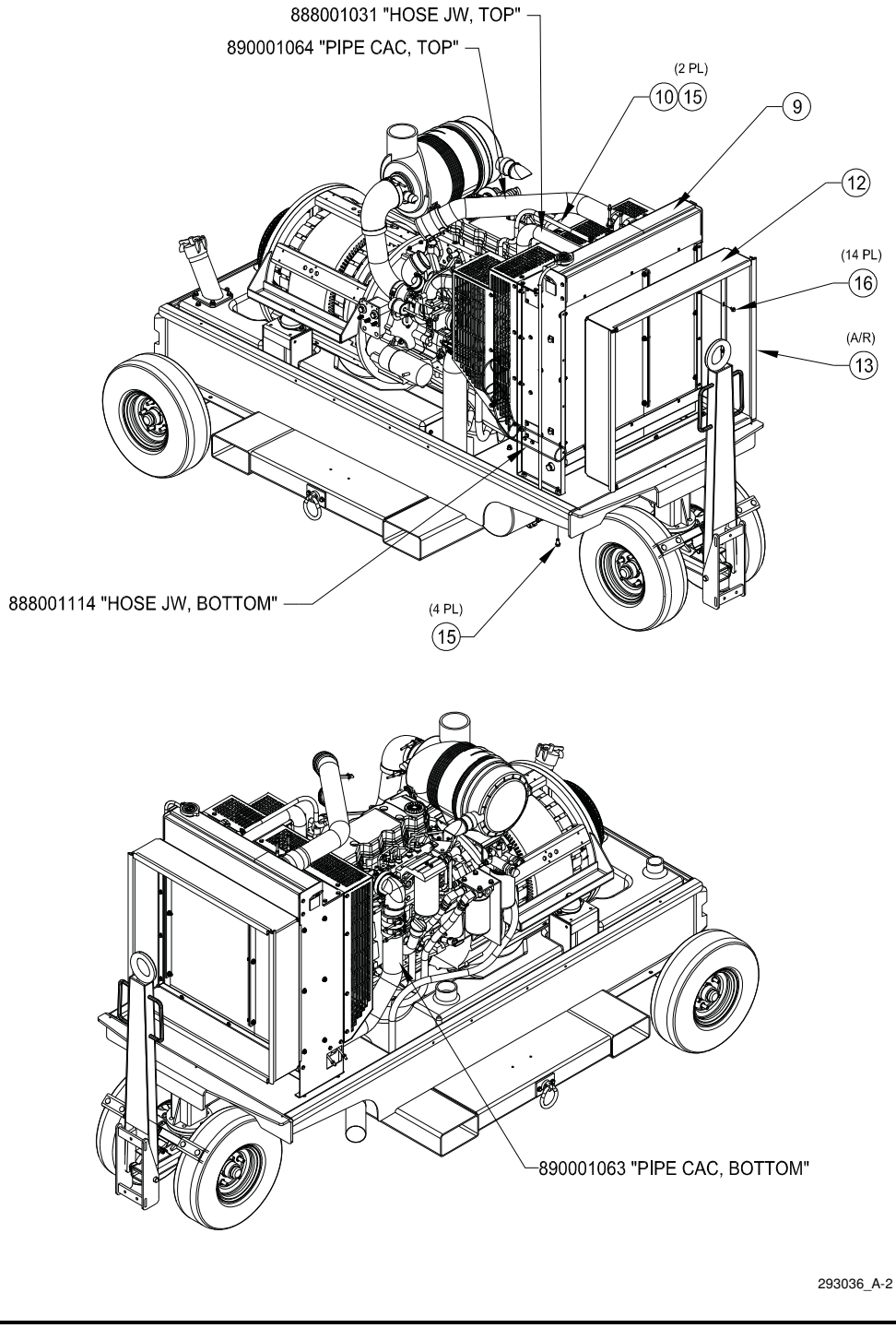


Figure 4-7. Radiator/Exhaust Installation, 4400 (Sheet 2).

IGURE - ITEM NO.		ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-7-		293036 Rev-A	Radiator/Exhaust Installation, 4400		REF
4-7-	1	293023	.Muffler Pipe		1
4-7-	2	404154-013	..Guillotine Clamp, 3” Dia		2
4-7-	3	IN11366	.Thermo Jacket		1
4-7-	4	VM11390	..Exhaust Hanger		4
4-7-	5	EB11365	…Muffler Mounting Band, 8.50” Dia		2
4-7-	6	291168	.Muffler		1
4-7-	7	EB11400	.Tail Pipe, 45 Deg 3” OD		1
4-7-	8	288052-002	..Clamp, Accuseal, 3.00 Dia		1
4-7-	9	293069	. Coolpack, 4400 (See Figure 4-8)		1
4-7-	10	056535	..Hose, 3/8” ID X 5/8” OD		1
4-7-	11	Not Shown			
4-7-	12	293009	. Radiator Exhaust Shroud		1
4-7-	13	IN5156	…Bulb Seal, Edge Grip, ¾” X 27.31” LG		2
4-7-	14	IN5156	…Bulb Seal, Edge Grip, ¾” X 28.00” LG		2
4-7-	15	No Number	…Hex Flg Bolt, M10-1.5 x 20 lg, GR10.9		4
4-7-	16	No Number	…Hex Flg Bolt, M6-1 x 12 lg, GR10.9		14
4-7-	17	No Number	…Hex Nut W/Spring Washer, M8 x 1.25		8
4-7-	18	WI10869-014	..Clamp, Hose Grip 7/32”– 5/8”		2
4-7-	19	WI10869-016	..Clamp, Hose Grip 2-13/16” – 3-3/4”		2

Figure 4-7. Radiator/Exhaust Installation, 4400 (Sheet 3).

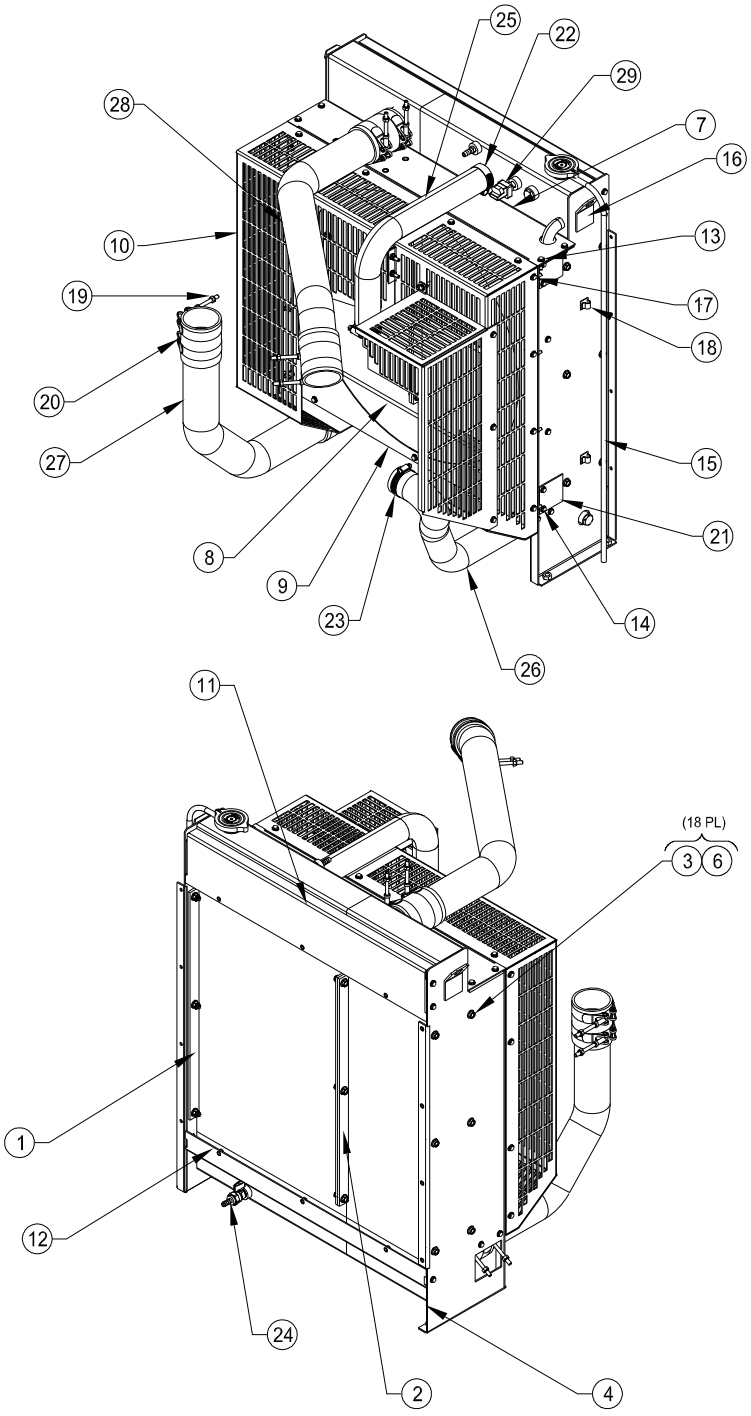


Figure 4-8. Coolpack (Sheet 1 of 2).

FIGURE - ITEM NO.		ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-8-		293069 Rev-A	Coolpack		REF
4-8-	1	912001205	.JW Slab Assembly		1
4-8-	2	911001072	.CA Slab Assembly		2
4-8-	3	No Number	… Screw, M8-1.25 x 25mm		18
4-8-	4	900001321	..LHS, Frame Assembly		1
4-8-	5	900001452	..RHS, Frame Assembly		1
4-8-	6	No Number	… Nylon Nut, M8		18
4-8-	7	897001225	..Top Cowl Section		1
4-8-	8	897001227	..Bottom, Fan Cowl Section		1
4-8-	9	899001279	..Fan Cowl, Front Section		1
4-8-	10	896001149	..Fan Guard Assembly		1
4-8-	11	812001224	..Front Cover, Top Plate		1
4-8-	12	812001226	..Front Cover, Bottom Plate		1
4-8-	13	No Number	…Hex Serr Flg Screw, M6-1 x 25mm		43
4-8-	14	869001061	…Fill Line Assembly		1
4-8-	15	857001062	…Overflow Hose		1
4-8-	16	812001228	..Lifting Bracket		2
4-8-	17	No Number	… Nylon Nut, M6		8
4-8-	18	812001282	…Vent Line Clip		2
4-8-	19	849001003	…T-Bolt Clamp, 84mm		8
4-8-	20	851001007	Connection Hose, Silicone, 76.2		4
4-8-	21	870001002	..Drain Tap		1
4-8-	22	876001002	…Hose Clamp, Grip 38- 58mm		2
4-8-	23	876001003	…Hose Clamp, Grip 44- 64mm		2
4-8-	24	881001004	...Hosed Barbed, ½" BSP		1
4-8-	25	888001031	..Hose, JW, Top		1
4-8-	26	888001114	..Hose, JW, Bottom		1
4-8-	27	890001063	..Pipe, CAC, Bottom		1
4-8-	28	890001064	..Pipe, CAC, Top		1
4-8-	29	AA6380	…Coolant Sensor Level, 3 Pin		1

Figure 4-8. Coolpack (Sheet 2).

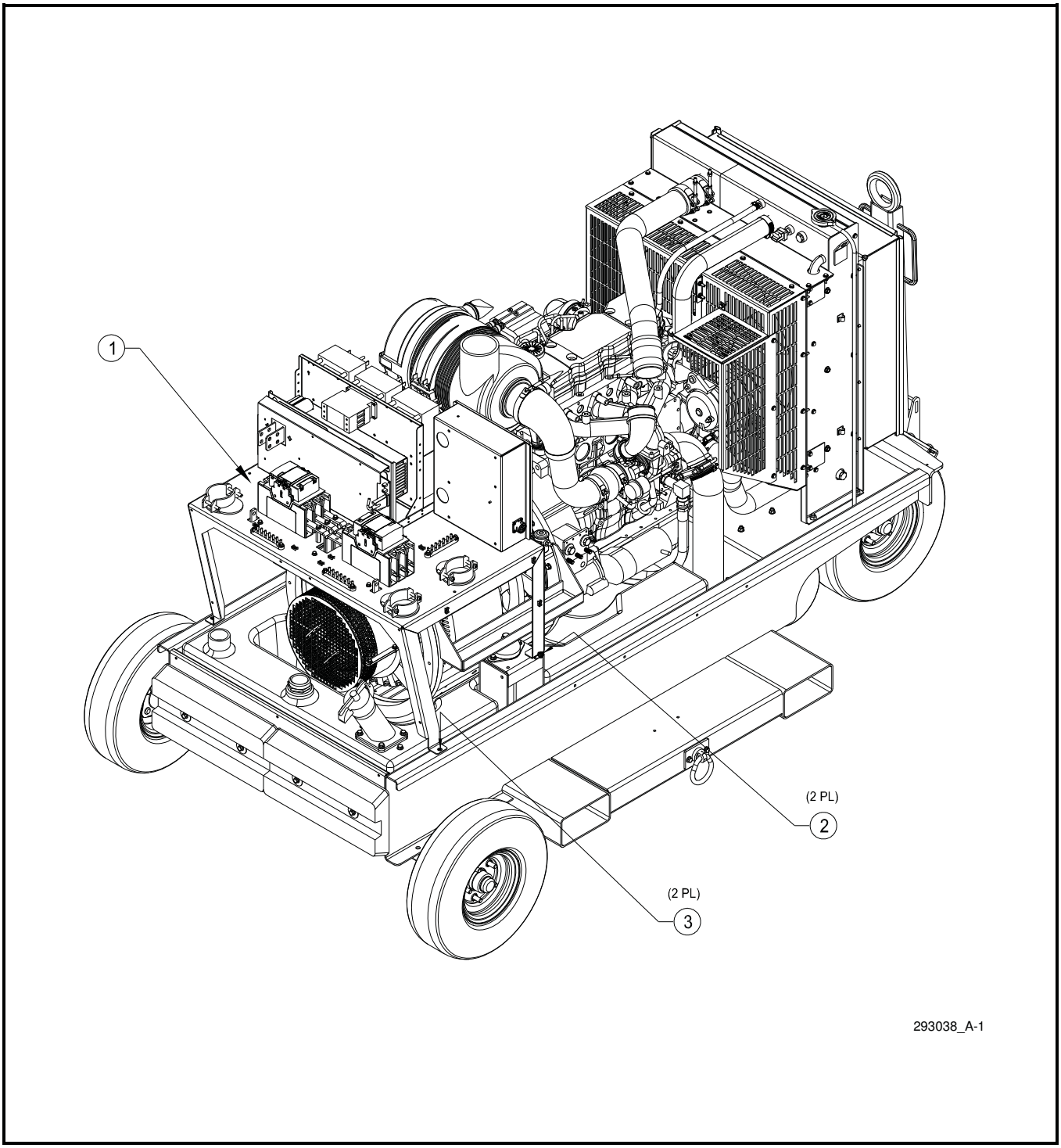


Figure 4-9. Electrical System Installation, 4400 (Sheet 1 of 3)

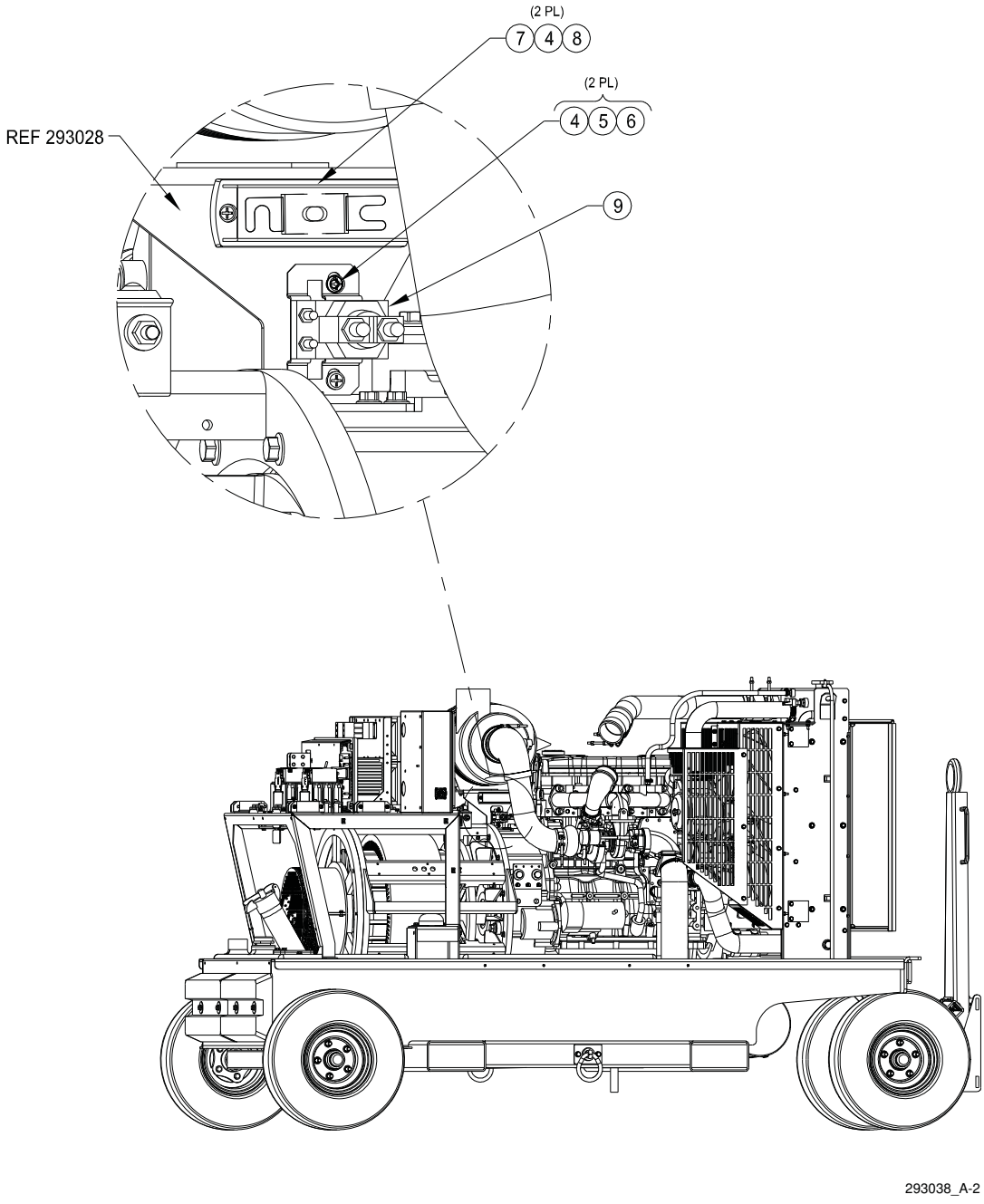


Figure 4-9. Electrical System Installation, 4400 (Sheet 2)

FIGURE - .ITEM NO.		ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-9-		293038 Rev-A	Electrical System Installation, 4400		REF
4-9-	1	293039-XX	.Output Table Assembly, 4400 (See Figure 4-10)		1
4-9-	2	No Number	…Hex Flg Bolt, M8-1.25 x 20 lg, GR10.9		2
4-9-	3	No Number	…Phl Flt Hd Screw, M6-1 x 20mm		2
4-9-	4	No Number	…Phl Pan Hd Soc Screw, M5-0.8 x 20mm		4
4-9-	5	No Number	…Flat Washer, M5		2
4-9-	6	No Number	…Split Lk Washer, M5		2
4-9-	7	FH11369	..Fuse Holder		1
4-9-	8	FU11370	..Fuse, Fast Acting		1
4-9-	9	RE11371	..Relay, Grid Power Heater		1
4-9-	10	*293054	..Harness, Exciter/Display		1
4-9-	11	*293059	...Harness, Jumper Kit, Power		1
4-9-	12	*293060	…Harness, Main Chassis		1
4-9-	13	*292083	Schematic, Engine Drive, 4400		REF

*Item not Illustrated

Figure 4-9. Electrical System Installation, 4400 (Sheet 3)

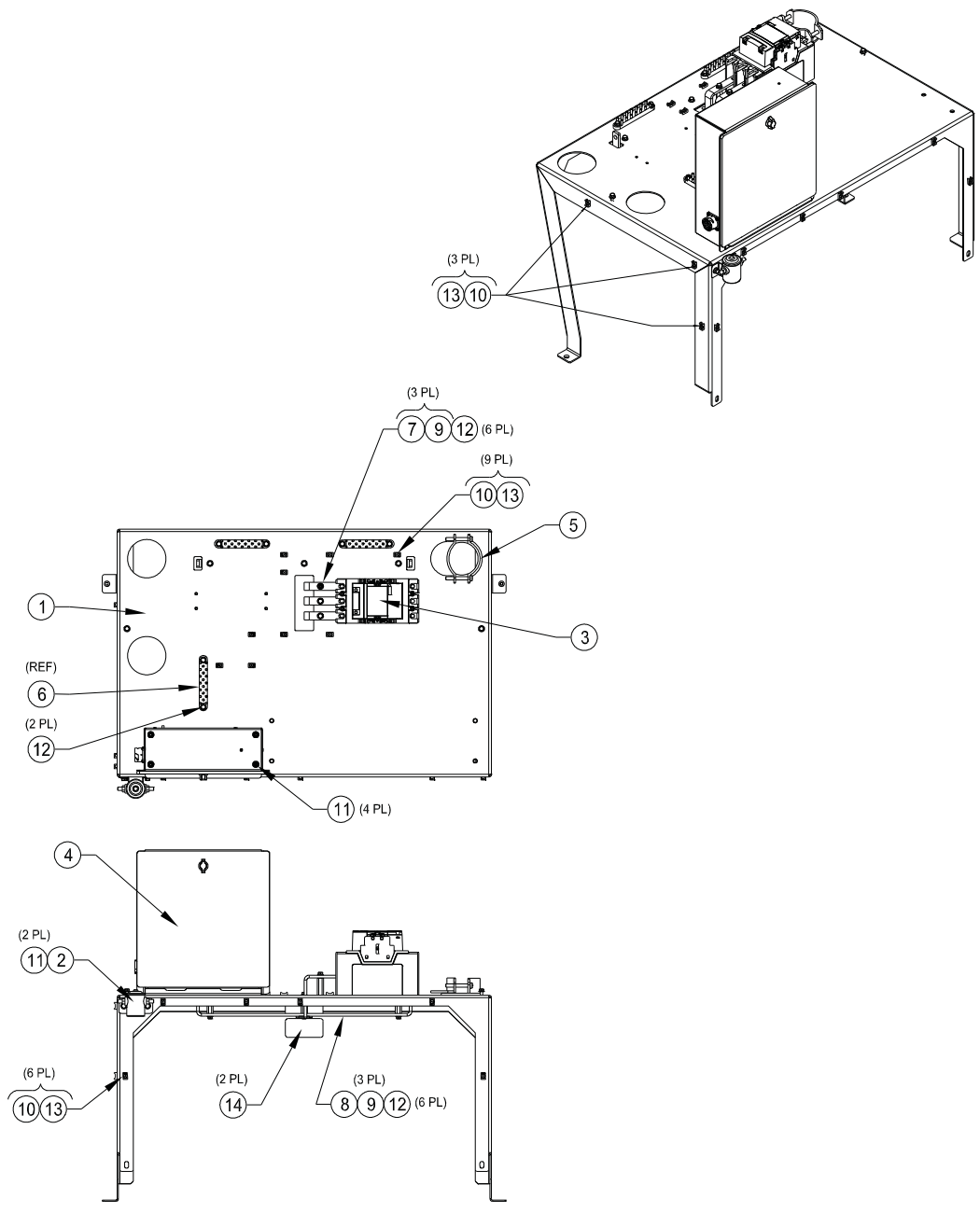


Figure 4-10. Output Table Assembly, 4400 (Sheet 1 of 2).

FIGURE - ITEM NO.		ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-10-		293039-01 Rev-A	Output Table Assembly, Single Output		REF
4-10-	1	293021	.Output Stand		1
4-10-	2	CA11386	..Contactor, Starter, 24VDC		1
4-10-	3	CA11372	..Contactor, 400Hz		1
4-10-	4	293024	..Control Module Box Assembly (See Figure 4-11)		1
4-10-	5	CY11387	…Strain Relief		1
4-10-	6	C5237-6	…Terminal Block, 6 Pos		REF
4-10-	7	293050	…Busbar, Contactor		3
4-10-	8	293051	…Busbar, Ground		1
4-10-	9	No Number	…Hex Standoff, M6 x 40mm, Nylon		6
4-10-	10	TM-258-MO	….Tie-Down, Black		18
4-10-	11	No Number	…Hex Flg Bolt, M6-1 x 12 lg, GR10.9		6
4-10-	12	No Number	…Hex Flg Bolt, M6-1 x 20 lg, GR10.9		20
4-10-	13	No Number	…Flt Hd Hex Soc Screw, M4-16mm		18
4-10-	14	293116	…Finger Guard, Busbar		2
4-10-	15	*293055	….Harness, Output Table		1
4-10-	16	*293058	….Harness, Options		1
4-10-	17	*292083	Schematic, Engine Drive, 4400		REF

*Item Not Illustrated

Figure 4-10. Output Table Assembly, Single Output, 4400 (Sheet 2).

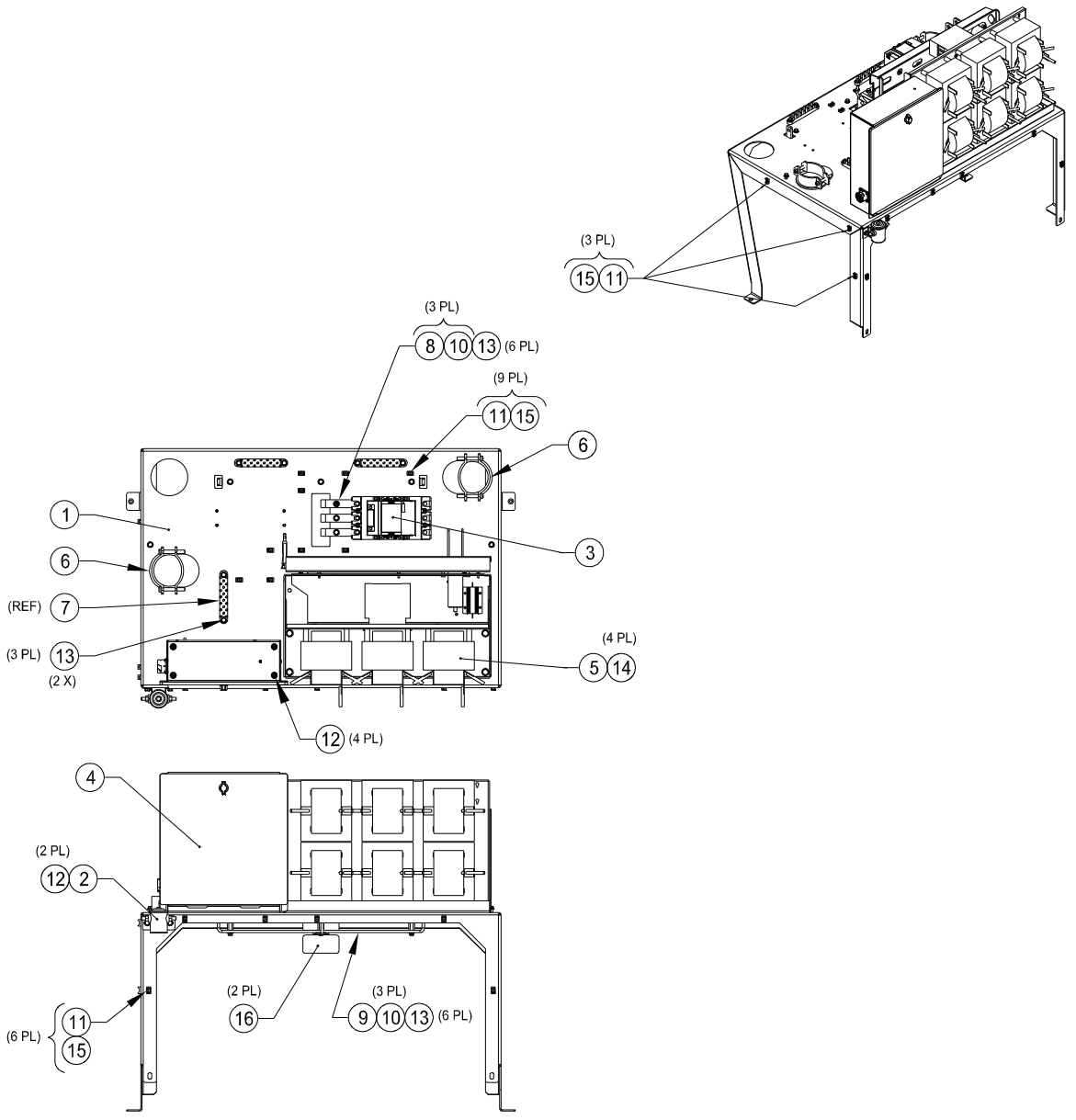


Figure 11. Output Table Assembly, Single Output W/28VDC ARU 4400 (Sheet 1 of 2).

FIGURE - ITEM NO.		ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-11-		293039-02 Rev-A	Output Table Assembly, Single Output W/28VDC ARU, 4400		REF
4-11-	1	293021	.Output Stand		1
4-11-	2	CA11386	..Contactor, Starter, 24VDC		1
4-11-	3	CA11372	..Contactor, 400Hz		1
4-11-	4	293024	..Control Module Box Assembly (See Figure 4-11)		1
4-11-	5	AP-543280	..Rectifier		1
4-11-	6	CY11387	…Strain Relief		1
4-11-	7	C5237-6	…Terminal Block, 6 Pos		REF
4-11-	8	293050	…Busbar, Contactor		3
4-11-	9	293051	…Busbar, Ground		1
4-11-	10	No Number	…Hex Standoff, M6 x 40mm, Nylon		6
4-11-	11	TM-258-MO	….Tie-Down, Black		18
4-11-	12	No Number	…Hex Flg Bolt, M6-1 x 12 lg, GR10.9		6
4-11-	13	No Number	…Hex Flg Bolt, M6-1 x 20 lg, GR10.9		20
4-11-	14	No Number	…Hex Flg Bolt, M8-1.25 x 20 lg, GR10.9		4
4-11-	15	No Number	…Flt Hd Hex Soc Screw, M4-16mm		18
4-11-	16	293116	…Finger Guard, Busbar		2
4-11-	17	*293055	….Harness, Output Table		1
4-11-	18	*293058	….Harness, Options		1
4-11-	19	*292083	Schematic, Engine Drive, 4400		REF
4-11-	20	*293074	….Cable Assembly, ARU		1

* Item Not Illustrated

Figure 4-11. Output Table Assembly, Single Output W/28VDC ARU (Sheet 2).

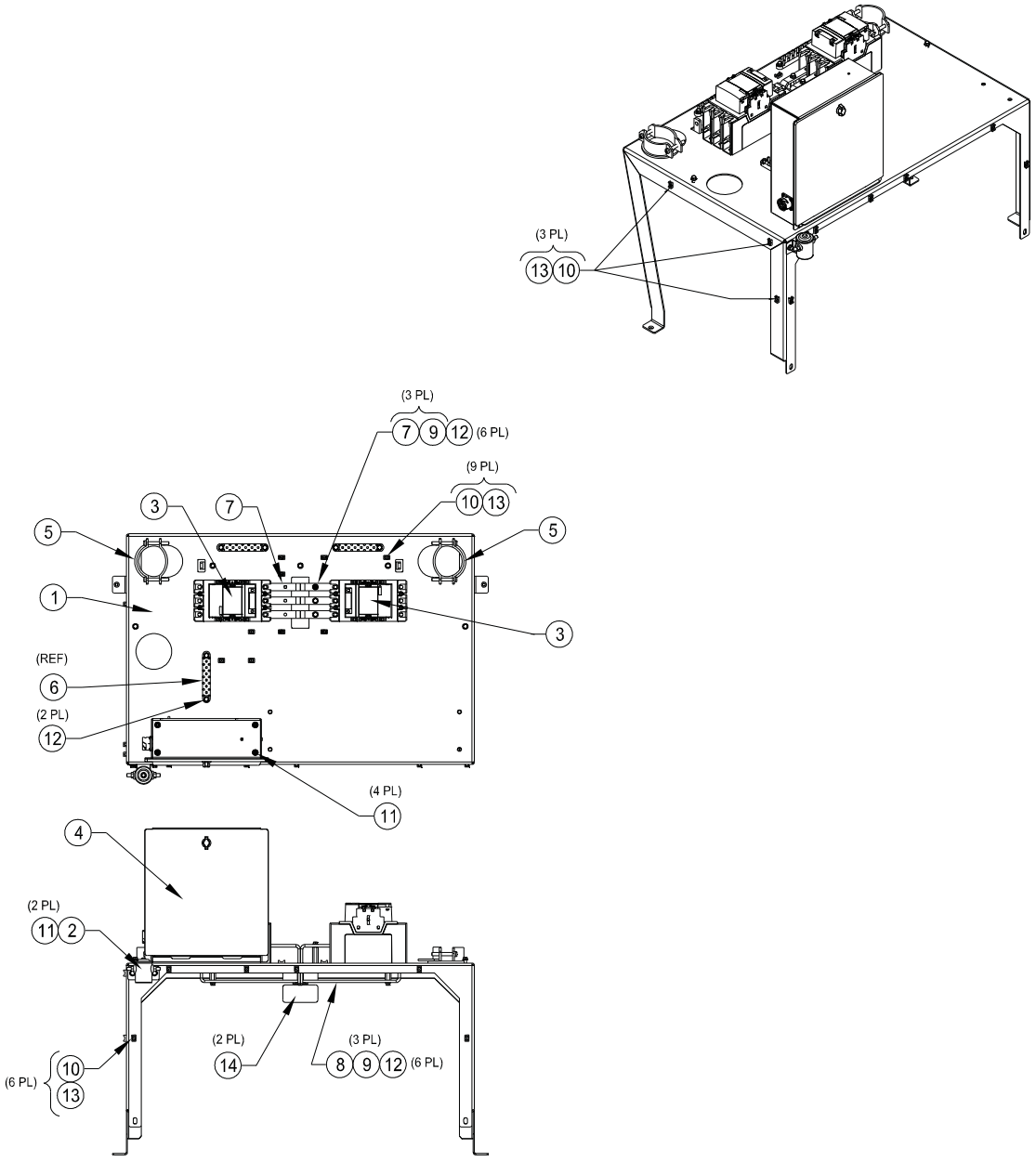


Figure 12. Output Table Assembly, Dual Output, 4400 (Sheet 1 of 2).

FIGURE - ITEM NO.		ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-12-		293039-03 Rev-A	Output Table Assembly, Dual Output		REF
4-12-	1	293021	.Output Stand		1
4-12-	2	CA11386	..Contactor, Starter, 24VDC		1
4-12-	3	CA11372	..Contactor, 400Hz		1
4-12-	4	293024	..Control Module Box Assembly (See Figure 4-11)		1
4-12-	5	CY11387	…Strain Relief		2
4-12-	6	C5237-6	…Terminal Block, 6 Pos		REF
4-12-	7	293050	…Busbar, Contactor		3
4-12-	8	293051	…Busbar, Ground		1
4-12-	9	No Number	…Hex Standoff, M6 x 40mm, Nylon		6
4-12-	10	TM-258-MO	….Tie-Down, Black		18
4-12-	11	No Number	…Hex Flg Bolt, M6-1 x 12 lg, GR10.9		9
4-12-	12	No Number	…Hex Flg Bolt, M6-1 x 20 lg, GR10.9		20
4-12-	13	No Number	…Flt Hd Hex Soc Screw, M4-16mm		18
4-12-	14	293116	…Finger Guard, Busbar		2
4-12-	15	*293055	….Harness, Output Table		1
4-12-	16	*293058	….Harness, Options		1
4-12-	17	*292083	Schematic, Engine Drive, 4400		REF

* Item Not Illustrated

Figure 4-12. Output Table Assembly, Dual Output, 4400 (Sheet 2).

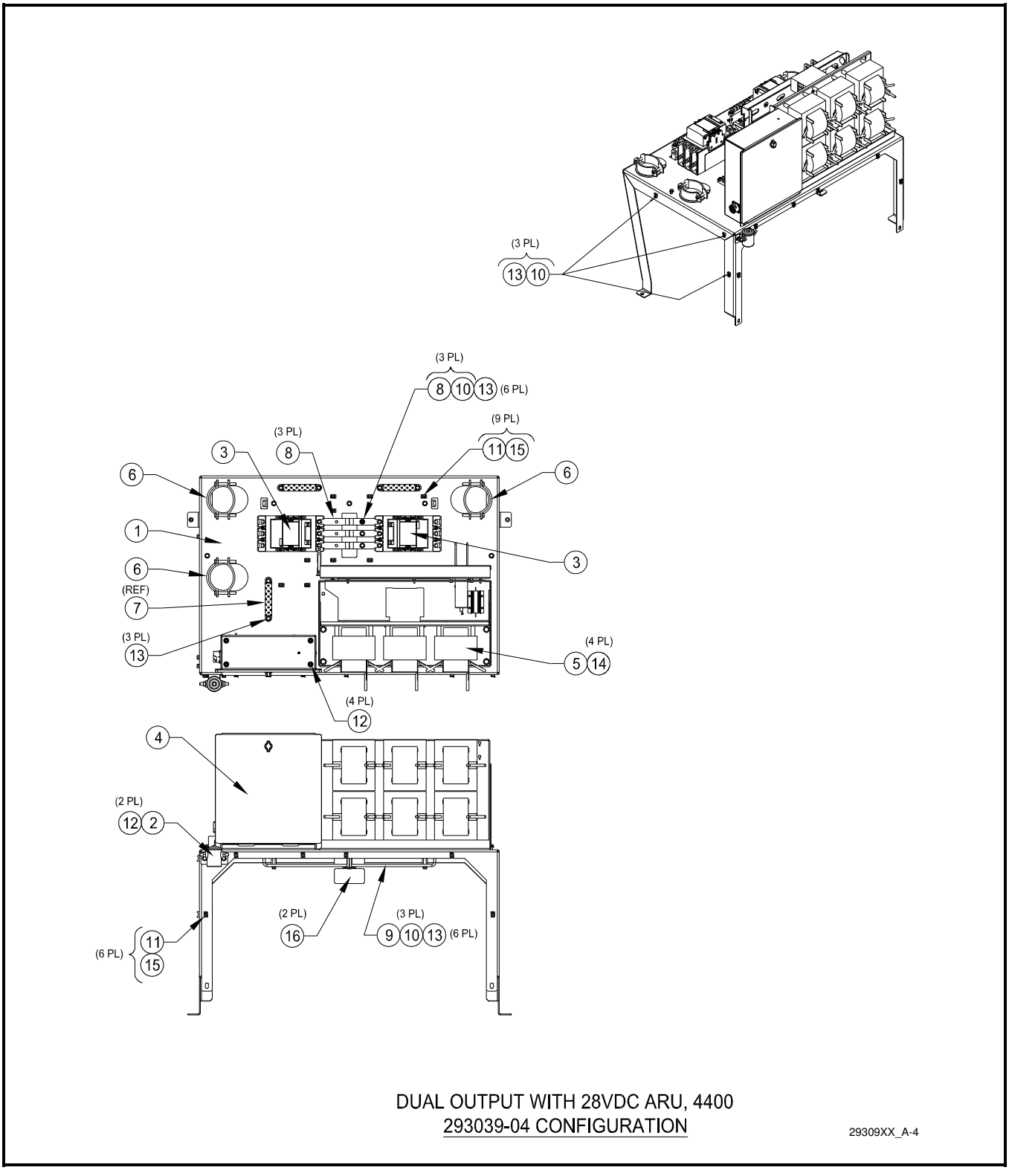


Figure 4-13. Output Table Assembly, Dual Output W/28VDC ARU, 4400 (Sheet 1 of 2).

FIGURE - ITEM NO.		ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-13-		293039-04 Rev-A	Output Table Assembly, Dual Output W/28VDC ARU, 4400		REF
4-13-	1	293021	.Output Stand		1
4-13-	2	CA11386	..Contactor, Starter, 24VDC		1
4-13-	3	CA11372	..Contactor, 400Hz		1
4-13-	4	293024	..Control Module Box Assembly (See Figure 4-11)		1
4-13-	5	AP-543280	..Rectifier	B	1
4-13-	6	CY11387	…Strain Relief		3
4-13-	7	C5237-6	…Terminal Block, 6 Pos		REF
4-13-	8	293050	…Busbar, Contactor		6
4-13-	9	293051	…Busbar, Ground		1
4-13-	10	No Number	…Hex Standoff, M6 x 40mm, Nylon		6
4-13-	11	TM-258-MO	….Tie-Down, Black		18
4-13-	12	No Number	…Hex Flg Bolt, M6-1 x 12 lg, GR10.9		6
4-13-	13	No Number	…Hex Flg Bolt, M6-1 x 20 lg, GR10.9		20
4-13-	14	No Number	…Hex Flg Bolt, M8-1.25 x 20 lg, GR10.9		4
4-13-	15	No Number	…Flt Hd Hex Soc Screw, M4-16mm		18
4-13-	16	293116	…Finger Guard, Busbar		2
4-13-	17	*293055	….Harness, Output Table		1
4-13-	18	*293058	….Harness, Options		1
4-13-	19	*293145	Schematic, Engine Drive, 4400		REF
4-13-	20	*293074	….Cable Assembly, ARU	B	1

* Item Not Illustrated

Figure 4-13. Output Table Assembly, Dual Output W/28VDC ARU, (Sheet 2).

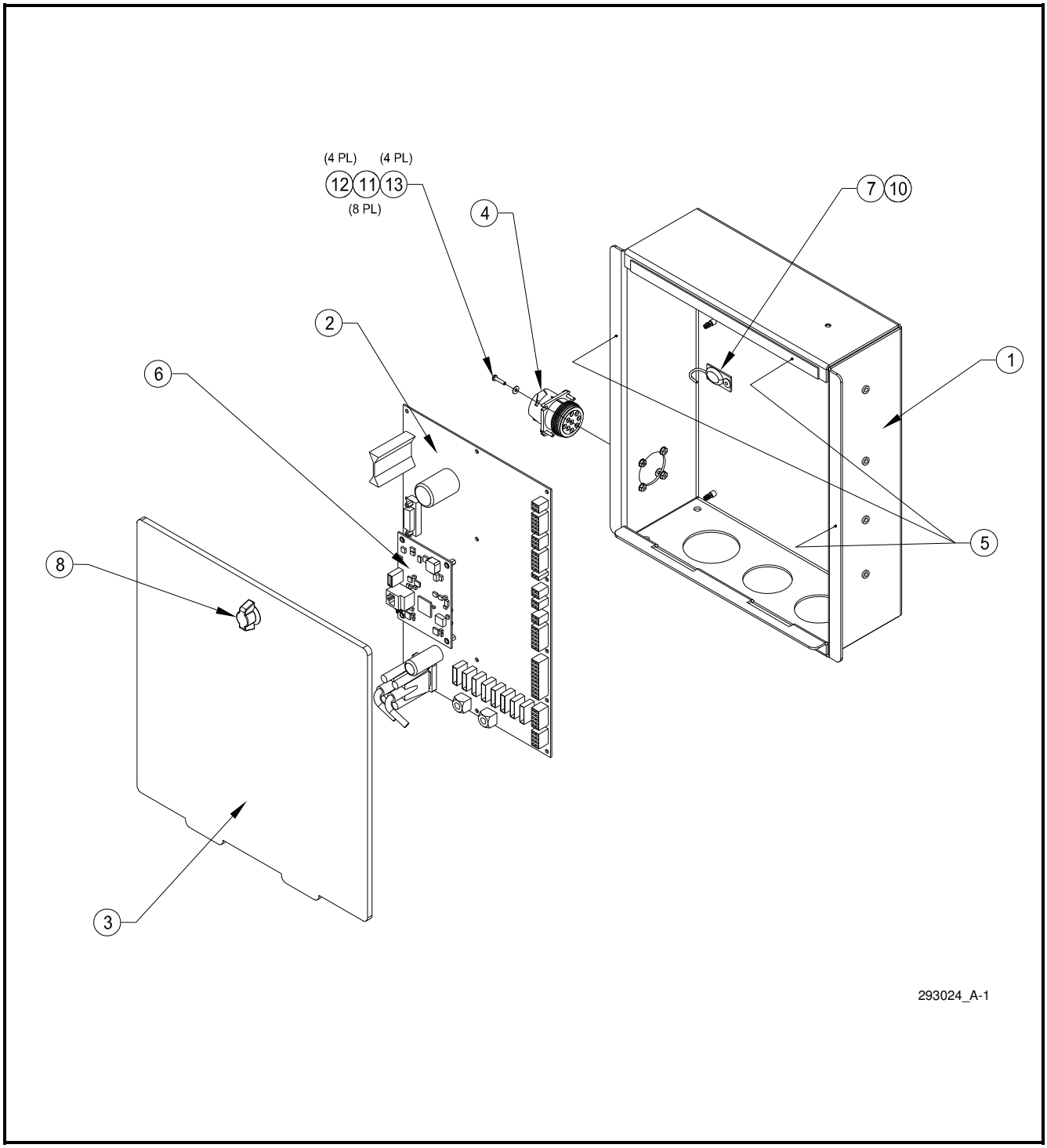


Figure 4-14. Control Module Box Assembly (Sheet 1 of 2).

FIGURE - ITEM NO.	ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-14-	293024 Rev-A	Control Module Box Assembly		REF
4-14- 1	293025	.Control Box		1
4-14- 2	579534	..Diesel Interface Board		1
4-14- 3	293026	..Control Box Cover		1
4-14- 4	293056	…Cummins Dongle Harness		1
4-14- 5	IN5066	…Closed Cell Sponge with Adhesive, ½" X 1/8"		A/R
4-14- 6	579526	..Control Board		1
4-14- 7	759533	..EEPROM Board		1
4-14- 8	288023	…Knob Wing Latch		1
4-14- 9	292083	.Engine Drive Schematic		REF
4-14- 10	No Number	..Pop Rivet, 3/16 Dia, (1/8-1/4 Grip)		1
4-14- 11	No Number	…Flt Washer-sm #4		8
4-14- 12	No Number	…Locknut-Nylon, #4-40, SS		4
4-14- 13	No Number	…Screw, PH Pan Hd, #4-40 x ½", M/S		4

* Item Not Illustrated

Figure 4-14. Control Module Box Assembly (Sheet 2).

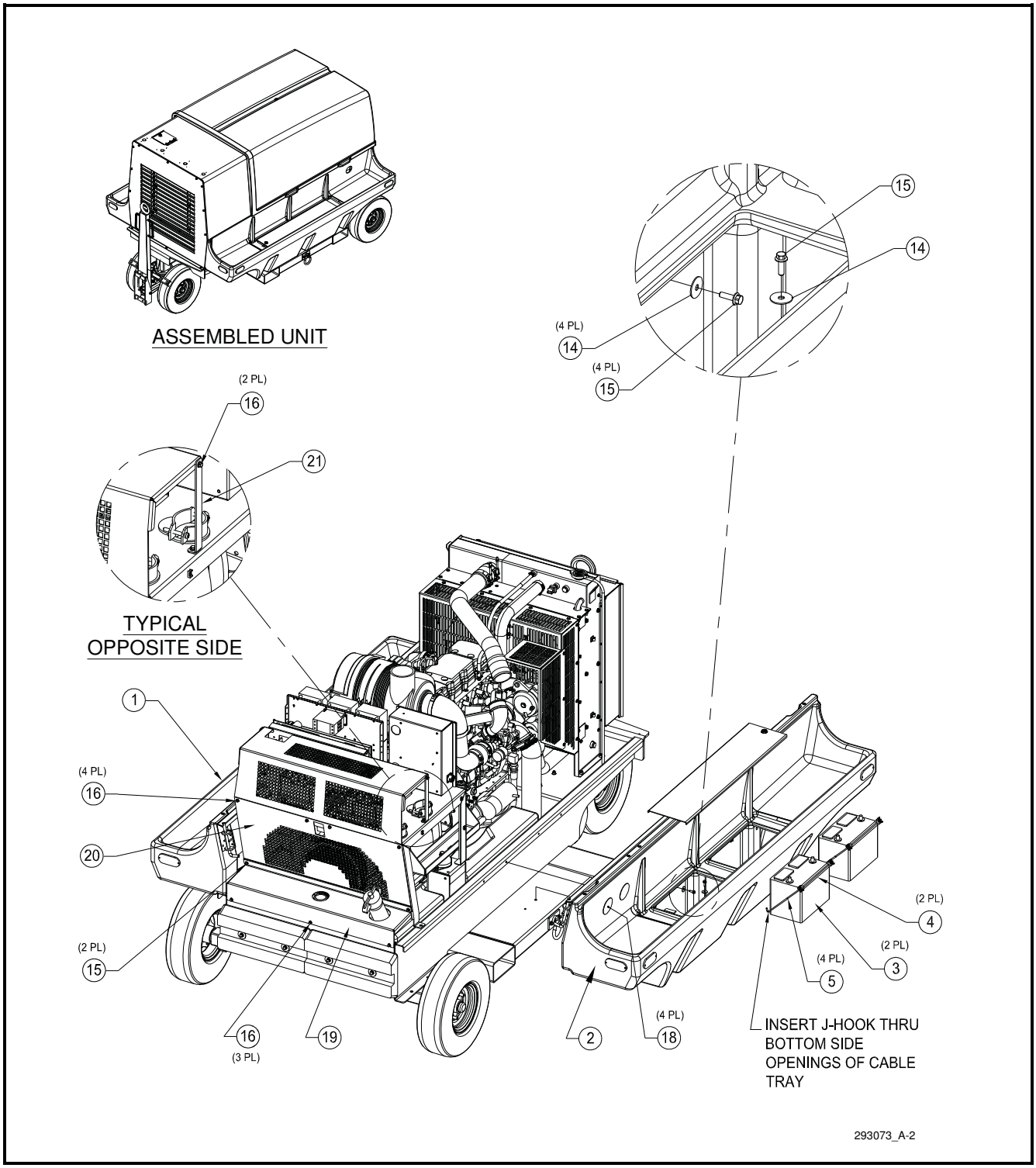


Figure 4-15. Cable Tray/Canopy Installation, 4400

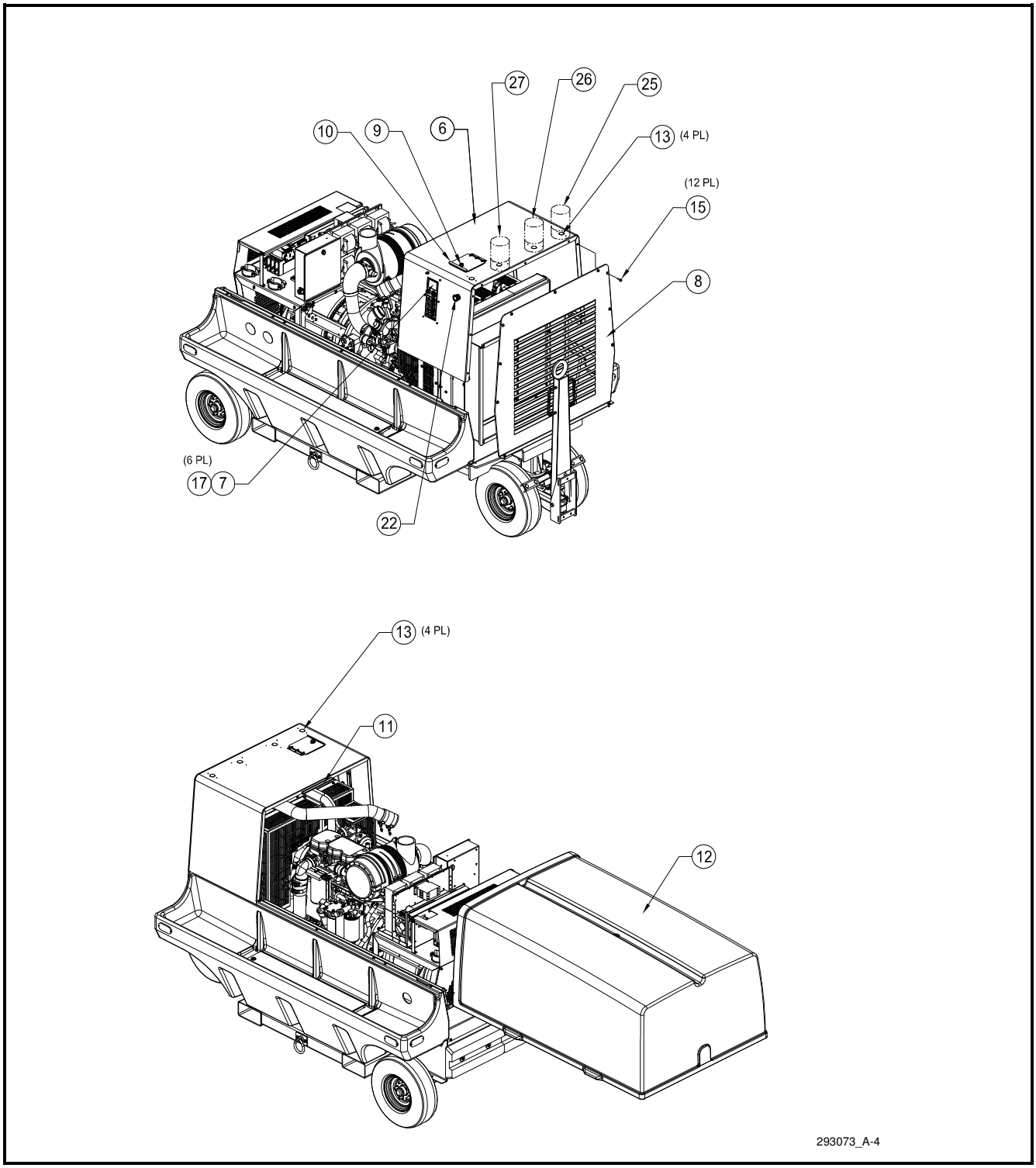


Figure 4-15. Cable Tray/Canopy Installation, 4400 (Sheet 2).

FIGURE - ITEM NO.	ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-15-	293073	Cable Tray/Canopy Installation, 4400		REF
4-15- 1	293086	..Cable Tray Assembly, Left Side (See Figure 4-16)		1
4-15- 2	293087	..Cable Tray Assembly, Right Side (See Figure 4-17)		1
4-15- 3	281881-001	..Battery, 12V		2
4-15- 4	293008	…Battery Retainer		2
4-15- 5	494295	…Battery Hold Down, J-Hook		4
4-15- 6	293047	..Front Canopy		1
4-15- 7	293017	..Display Controller Assembly, 4400 (See Figure 4-18)		1
4-15- 8	293048	..Front Panel, Radiator Exhaust		1
4-15- 9	288023	…Wing Knob Latch		1
4-15- 10	IN5066	…Closed Cell Sponge W/Adhesive, 1/2” X 1/8”		A/R
4-15- 11	IN5150	…Edge Grip Rubber Seal		1
4-15- 12	293084	.. Top Canopy, Composite, Assy (See Figure 4-19)		1
4-15- 13	FI11406	…Hole Plug, 1-1/8” OD, Nylon		4
4-14- 14	No Number	…Snubbing Washer		10
4-15- 15	No Number	…Hex Flg Bolt, M6-1 x 20 lg, GR10.9		26
4-15- 16	No Number	…Hex Flg Bolt, M6-1 x 12 lg, GR10.9		9
4-15- 17	No Number	…Hex Nut W/Spring Washer, M6 x 1.0		6
4-15- 18	287698-001	…Hole Plug, Plastic, 3” Dia		4
4-15- 19	293081	..Panel, Fuel Filler Cover		1
4-15- 20	293122	…Rear Panel, Contactors Guard		1
4-15- 21	293121	…Stiffener, Contactors Guard		2
4-15- 22	*293057	….Harness, E-Stop		1
4-15- 23	*293071	….Harness, Battery Cable Kit		1
4-15- 24	*292083	Schematic, Engine Drive, 4400		REF
4-15- 25		….Clearance Lights (Optional)		4
4-15- 26		….Low Fuel Beacon (Optional)		1
4-15- 27		….Operating Beacon (Optional)		1

Figure 4-15. Cable Tray/Canopy Installation, 4400 (Sheet 3).

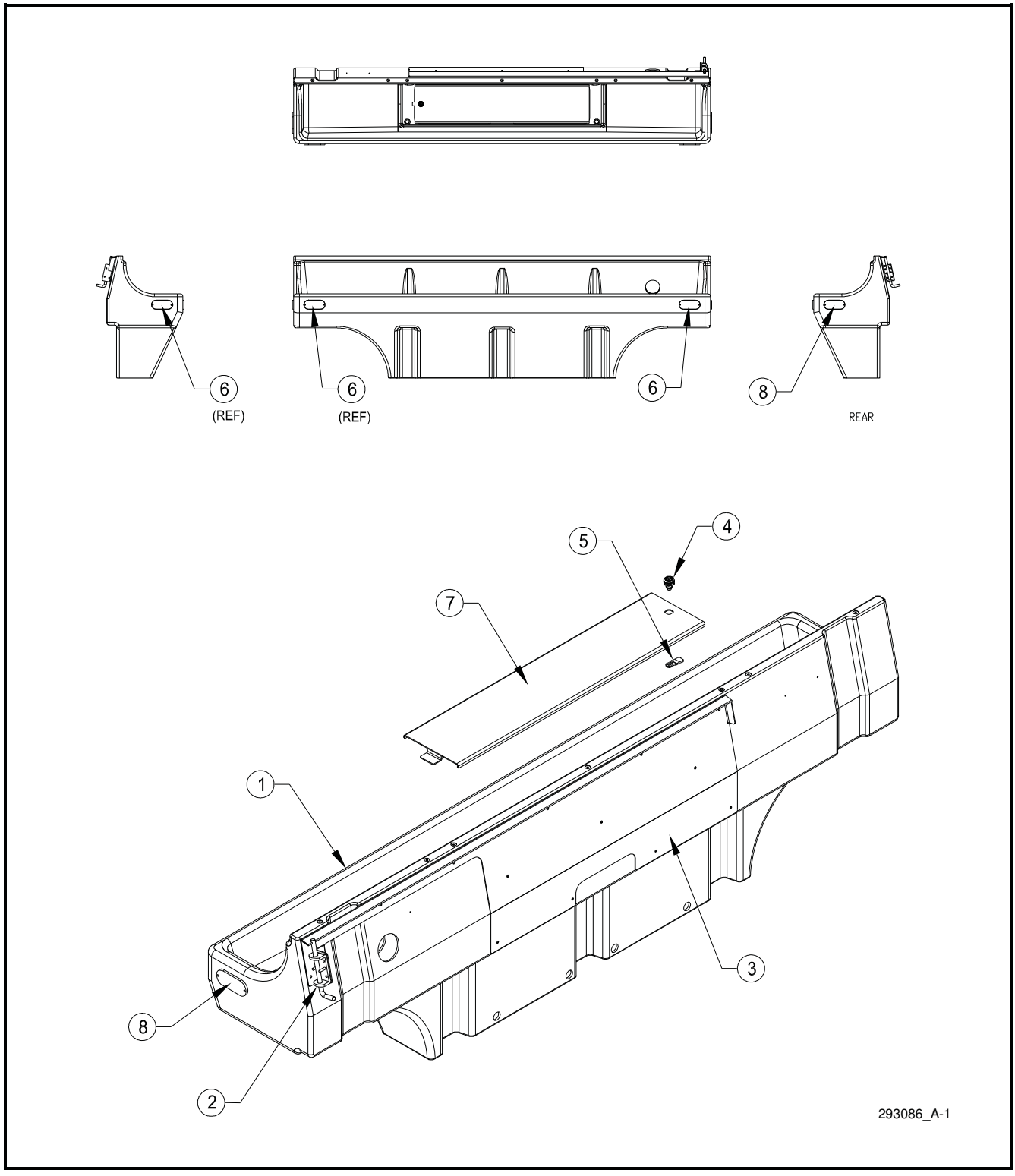


Figure 4-16. Cable Tray Assembly, Left Side (Sheet 1 of 2).

FIGURE - ITEM NO.	ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-16-	293086 Rev-A	Cable Tray, Assembly, Left Side		REF
4-16- 1	293085-01	.Cable Tray, Machining, Left Side		1
4-16- 2	KH11401	..Compression Latch		1
4-16- 3	293077-01	..Heat Shield, Cable Tray		1
4-16- 4	KH11192	…Cam Latch, Hex Head 8-32; NEMA 4		1
4-16- 5	KH11191	…Cam Grip Latch		1
4-16- 6	IL11391	..Reflector, Amber, Oblong		3
4-16- 7	293013	..Battery Cover		1
4-16- 8	IL11392	..Reflector, Red, Oblong		1

Figure 4-16. Cable Tray Assembly, Left Side (Sheet 2).

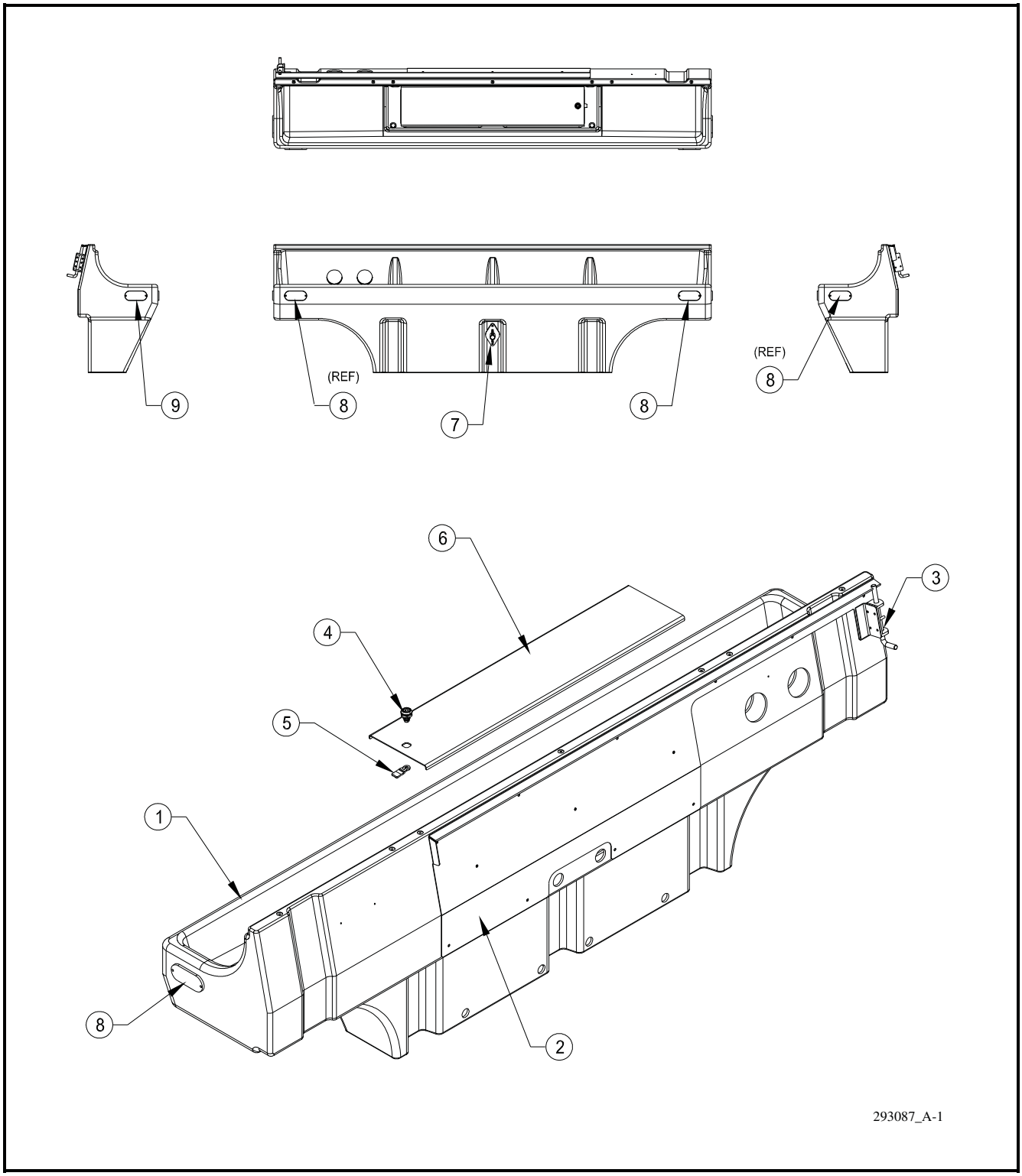


Figure 4-17. Cable Tray Assembly, Right Side (Sheet 1 of 2).

FIGURE - ITEM NO.		ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-17-		293087 Rev-B	Cable Tray Assembly, Right Side		REF
4-17-	1	293085-02	.Cable Tray, Machining, Left Side		1
4-17-	2	293077-02	..Heat Shield, Cable Tray		1
4-17-	3	KH11401	…Compression Latch		1
4-17-	4	KH11192	…Cam Latch, Hex Head 8-32; NEMA 4		1
4-17-	5	KH11191	…Cam Grip Latch		1
4-17-	6	293013	..Battery Cover		1
4-17-	7	291611	…Battery Switch Disconnect		1
4-17-	8	IL11391	..Reflector, Amber, Oblong		3
4-17-	9	IL11392	..Reflector, Red, Oblong		1

Figure 4-17. Cable Tray Assembly, Right Side (Sheet 2).

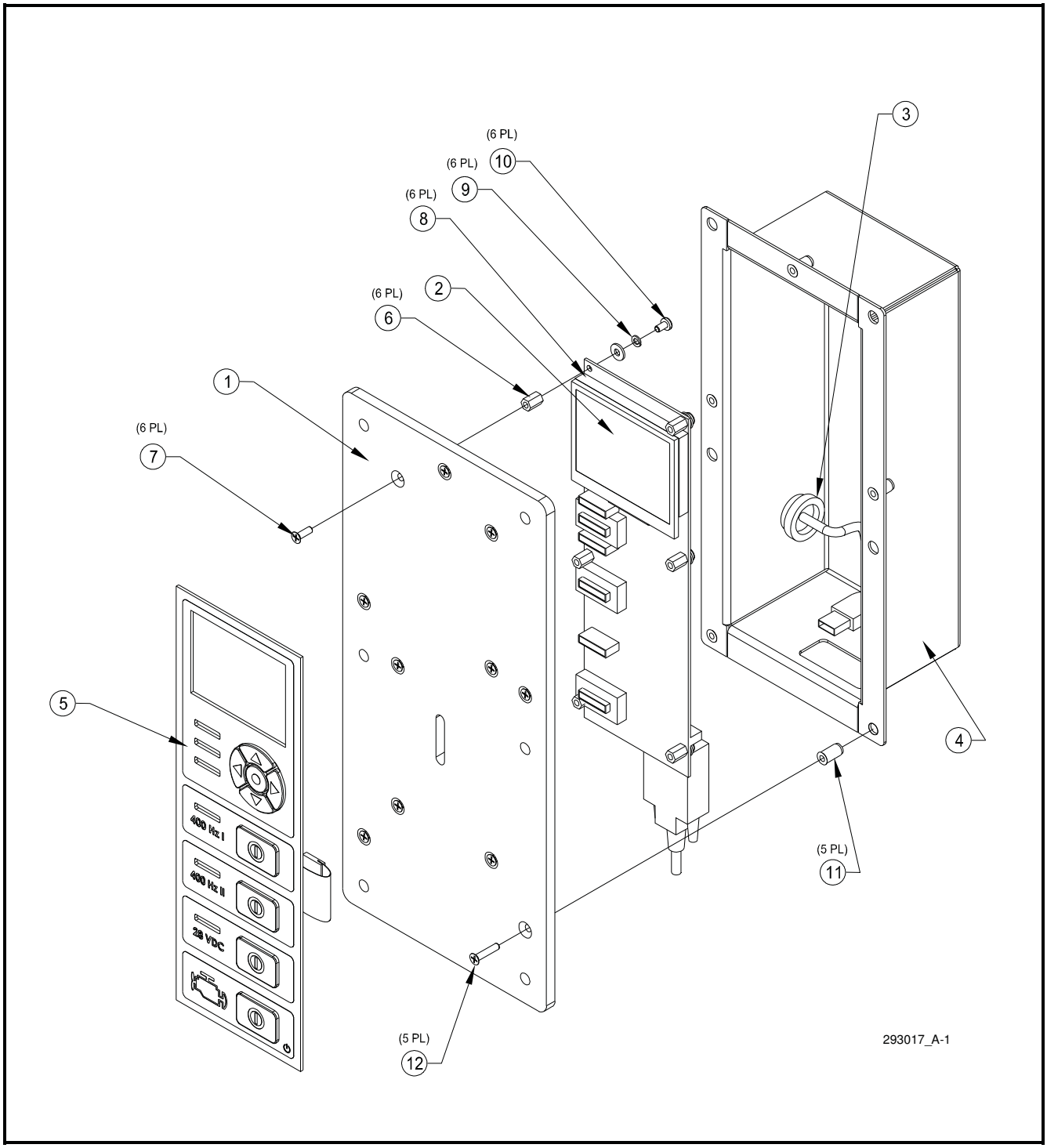


Figure 4-18. Display Controller Assembly, 4400 (Sheet 1 of 2).

FIGURE - ITEM NO.		ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-18-		293017 Rev-A	Display Controller Assembly, 4400		REF
4-18-	1	293015	..Glastic Display Panel		1
4-18-	2	579536	..Display Board		1
4-18-	3	CO11373	..USB. Extension		1
4-18-	4	293016	.Display Box		1
4-18-	5	275193	…Membrane, Dual 400Hz & 28VDC		REF
	5	293105	…Membrane,		REF
	5	293095	…Membrane,		REF
	5	203096	…Membrane,		REF
	5	293097	…Membrane,		REF
4-18-	6	No Number	…Hex Standoff, #6-32 x ¼ x 3/8” L, F/F		6
4-18-	7	No Number	...Ph Flt Hd Screw, #6-32 x 3/8”, M/S 100 Deg.		6
4-18-	8	No Number	…Washer, Flat, #6, lg		6
4-18-	9	No Number	…Washer, Split Lk, #6, Med, SS		6
4-18-	10	No Number	...Ph Pan Hd Screw, #6-32 x 1/4, M/S		6
4-18-	11	No Number	…Insert, #6-32, .080-.130 Grip, STL		5
4-18-	12	No Number	...Phl Flt Hd Screw, #6-32 x 5/8”, M/S 100 Deg		5

Figure 4-18. Display Controller Assembly (Sheet 2).

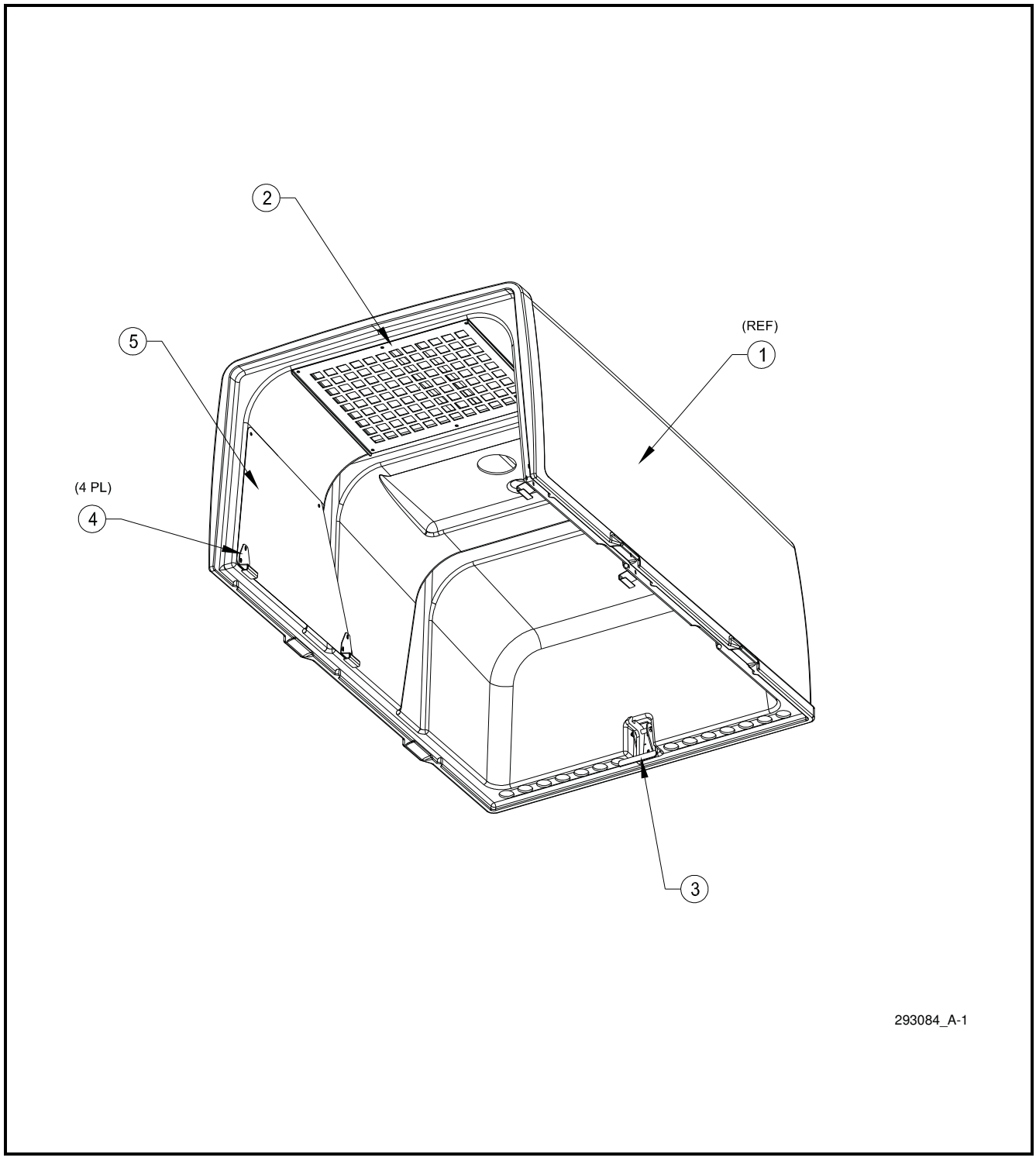


Figure 4-19. Top Canopy, Composite, Assembly (Sheet 1 of 2).

FIGURE - ITEM NO.	ITW GSE PART NO.	NOMENCLATURE	EFF.	QTY.
4-19-	286810-001 Rev-A	Top Canopy, Composite, Assembly		REF
4-19- 1	293083	.Top Canopy Composite, Machining		1
4-19- 2	293020	..Panel, Top Grid		1
4-19- 3	293078	…Latch Assembly, Top Canopy		1
4-19- 4	293018	…Hook Slide, Main Canopy		4
4-19- 5	293019	..Heat Shield, Side, Top Canopy		1

Figure 4-19. Top Canopy, Composite Assembly (Sheet 1 of 2).

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Section 3 Numerical Index

1) Explanation of Numerical Index

The purpose of this index is to assist the user in finding the illustration and description of a part when the part number is known. Part numbers are arranged in alphanumerical sequence.

FIGURE ITEM NO.	ITW GSE PART NO.	FIGURE ITEM NO.	ITW GSE PART NO.
4-2-2	0-B1097	4-5-16	FS9841
4-2-6	IN11393	4-5-17	LF9212
4-3-5	TA11411	4-5-18	CY11362
4-4-	293034-XX	4-5-19	EB11361
4-4-3	FI11399	4-5-20	FI11363
4-4-5	FI5182	4-5-21	AH11364
4-4-6	FI0074	4-5-28	EC11368
4-4-9	IL11359	4-5-31	EC11378
4-4-10	EB11367	4-5-32	EC11379
4-4-13	SRI377	4-7-3	IN11366
4-5-	293027-XX	4-7-4	VM11390
4-5-2	FB11360	4-7-5	EB11365
4-5-5	VM11349	4-7-7	EB11400

FIGURE ITEM NO.	ITW GSE PART NO.
4-7-13	IN5156
4-7-14	IN5156
4-8-29	AA6380
4-9-1	293039-XX
4-9-7	FH11369
4-9-8	FU11370
4-9-9	RE11371
14-10-2	CA11386
4-10-3	CA11372
4-10-5	CY11387
4-10-10	M-258-MO
4-11-2	CA11386
4-11-3	CA11372
4-11-6	CY11387
4-11-11	TM-258-MO
4-12-2	CA11386

FIGURE ITEM NO.	ITW GSE PART NO.
4-12-3	CA11372
4-12-5	CY11387
4-12-10	TM-258-MO
4-13-2	CA11386
4-13-3	CA11372
4-13-6	CY11387
4-13-11	TM-258-MO
4-14-5	IN5066
4-15-10	IN5066
4-15-11	IN5150
4-15-13	FI11406
4-16-2	KH11401
4-16-4	KH11192
4-16-5	KH11191
4-16-6	IL11391
4-16-8	IL11392

FIGURE ITEM NO.	ITW GSE PART NO.
4-17-3	KH11401
4-17-4	KH11192
4-17-5	H11191
4-17-8	IL11391
4-17-9	IL11392
4-18-3	CO11373
4-11-5	AP-543280
4-13-5	AP-543280
4-2-3	80B-1167
4-7-19	WI10869-016
4-7-18	WI10869-014
4-10-6	C5237-6
4-11-7	C5237-6
4-12-6	C5237-6
4-13-7	C5237-6
4-1	4400

FIGURE ITEM NO.	ITW GSE PART NO.
4-4-11	056525
4-7-10	056535
4-3-	93003
4-10-1	93021
4-11-8	93050
4-5-27	93052
4-15-22	93057
4-6-4	93093
4-4-12	203027-01
4-18-5	203096
4-18-5	275193
4-15-3	281881-001
4-5-26	282918
4-19-	286810-001
4-19-	286810-001
4-15-18	287698-001

FIGURE ITEM NO.	ITW GSE PART NO.
4-14-8	288023
4-15-9	288023
4-7-8	288052-002
4-3-4	288455
4-5-4	288460-004
4-5-24	290597-007
4-5-25	290597-006
4-5-23	290597-001
4-7-6	291168
4-17-7	291611
4-9-13	292083
4-10-17	292083
4-11-19	292083
4-12-17	292083
4-14-9	292083
4-15-24	292083

FIGURE ITEM NO.	ITW GSE PART NO.
4-3-1	293003-5th
4-1-1	293001
4-2-	293001
4-4-1	293001
4-2-1	293002
4-2-4	293003
4-3-2	293003
4-5-3	293004
4-15-4	293008
4-7-12	293009
4-16-7	293013
4-17-6	293013
4-18-1	293015
4-18-4	293016
4-15-7	293017
4-18-	293017

FIGURE ITEM NO.	ITW GSE PART NO.	FIGURE ITEM NO.	ITW GSE PART NO.
4-19-4	293018	4-5-15	293028
4-19-4	293018	4-5-22	293031
4-19-5	293019	4-1-2	293034
4-19-5	293019	4-13-	293039-04
4-11-1	293021	4-1-3	293036
4-12-1	293021	4-7-	293036
4-13-1	293021	4-12-	293039-03
4-7-1	293023	4-11-	293039-02
4-10-4	293024	4-1-4	293038
4-11-4	293024	4-9-	293038
4-12-4	293024	4-10-	293039-01
4-13-4	293024	4-15-6	293047
4-14-	293024	4-15-8	293048
4-4-2	293027-02	4-10-7	293050
4-14-1	293025	4-12-7	293050
4-14-3	293026	4-13-8	293050

FIGURE ITEM NO.	ITW GSE PART NO.
4-10-8	293051
4-11-9	293051
4-12-8	293051
4-13-9	293051
4-9-10	293054
4-10-15	293055
4-11-17	293055
4-12-15	293055
4-13-17	293055
4-14-4	293056
4-10-16	293058
4-11-18	293058
4-12-16	293058
4-13-18	293058
4-9-11	293059
4-9-12	293060

FIGURE ITEM NO.	ITW GSE PART NO.
4-5-1	293061
4-3-3	293067
4-7-9	293069
4-8-	293069
4-15-23	293071
4-1-5	293073
4-15-	293073
4-11-20	293074
4-13-20	293074
4-17-2	293077-02
4-16-3	293077-01
4-19-3	293078
4-19-3	293078
4-4-4	293080
4-15-19	293081
4-17-1	293085-02

FIGURE ITEM NO.	ITW GSE PART NO.	FIGURE ITEM NO.	ITW GSE PART NO.
4-19-1	293083	4-6-5	293108
4-19-1	293083	4-10-14	293116
4-15-12	293084	4-11-16	293116
4-16-1	293085-01	4-12-14	293116
4-15-1	293086	4-13-16	293116
4-16-	293086	4-15-21	293121
4-15-2	293087	4-15-20	293122
4-17-	293087	4-5-1	293126
4-6-1	293090	4-13-19	293145
4-4-8	293091	4-4-6	293148
4-6-	293091	4-7-2	404154-013
4-6-3	293092	4-15-5	494295
4-6-2	293094	4-14-6	579526
4-18-5	293095	4-14-2	579534
4-18-5	293097	4-18-2	579536
4-18-5	293105	4-14-7	759533

FIGURE ITEM NO.	ITW GSE PART NO.	FIGURE ITEM NO.	ITW GSE PART NO.
4-5-33	863948	4-5-48	5312158
4-5-39	963983	4-5-49	5318807
4-5-34	3864036	4-8-18	12001282
4-5-35	3864172	4-8-11	812001224
4-5-36	3903652	4-8-12	812001226
4-5-37	3910131	4-8-16	812001228
4-5-38	3937736	4-8-19	849001003
4-5-30	3964337	4-8-20	851001007
4-5-40	3964337	4-8-15	857001062
4-5-41	3974812	4-8-14	869001061
4-5-29	4894721	4-8-21	870001002
4-5-43	4894721	4-8-22	876001002
4-5-44	4928800	4-8-23	876001003
4-5-45	4995590	4-8-24	881001004
4-5-46	5259795	4-8-25	888001031
4-5-47	5288530	4-8-26	888001114

FIGURE ITEM NO.	ITW GSE PART NO.
4-8-27	890001063
4-8-28	890001064
4-8-10	896001149
4-8-7	897001225
4-8-8	897001227
4-8-9	899001279
4-8-4	900001321
4-8-5	900001452
4-8-2	911001072
4-8-1	912001205

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Chapter 5 Manufacturer's Literature

Vendor Literature

Type	Diagram Description
Engine	Operation and Maintenance Manual (Cummins Bulletin # 4021531) Parts Catalog (Cummins Bulletin # 4056563) - not Included -- purchased separately from Cummins.

Diagram Number	Diagram Description
293145	Diagram, Schematic & Connection

Contact ITW GSE if copies of these drawings or manuals are not with this manual (unless otherwise noted above). Refer to Appendix A for specific information on the ITW GSE 4400, 400 Hz. Generator Set, optional equipment.

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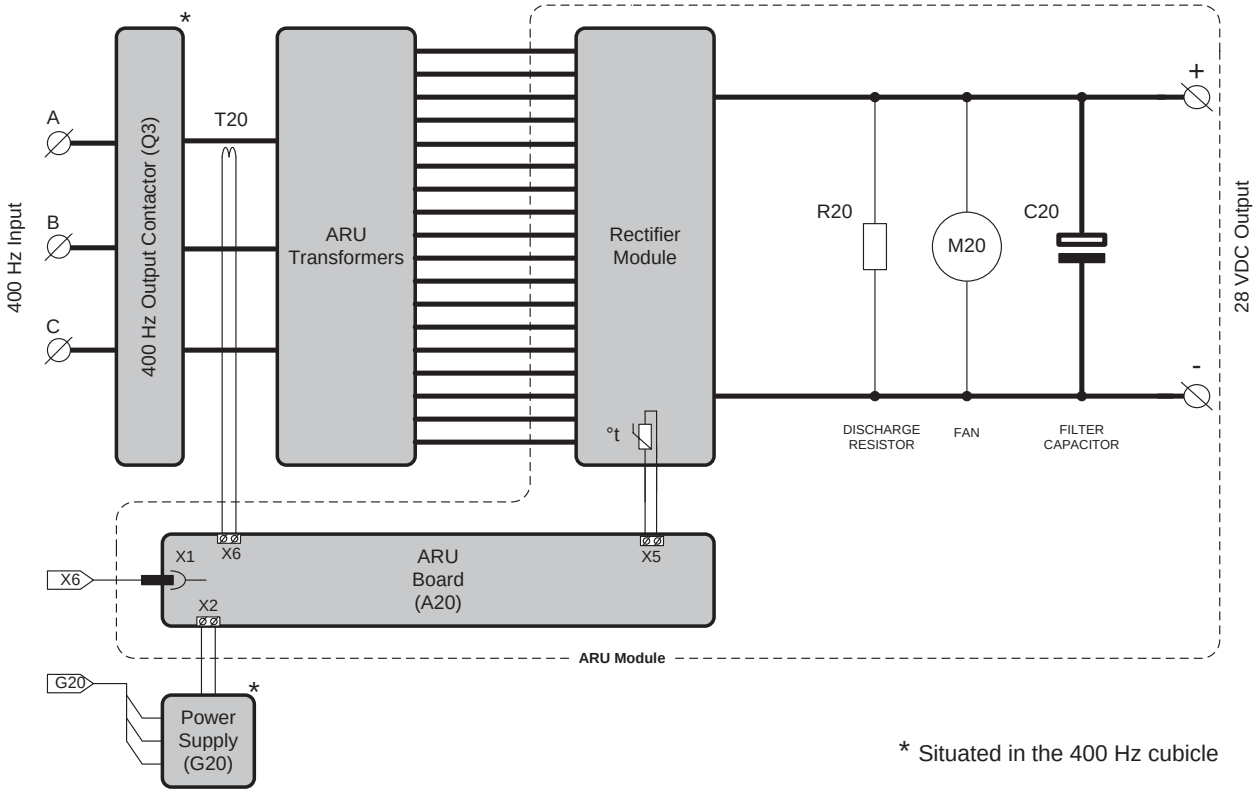
Appendix A Active Rectifier Unit (ARU)

All ITW GSE 4400 units can be equipped with a 28 VDC **A**ctive **R**ectifier **U**nit (ARU) output.

Both 400 Hz & 28 VDC outputs can be used simultaneously. The total continuous amount of power from the unit is calculated as the sum of 400 Hz and 28 VDC output and cannot exceed the total 400 Hz power rating of the unit.

A.1 General Description



A-1-1 Principle of 28 VDC ARU

The 28 VDC part is basically an Active Rectifier Unit and supplied from the 400 Hz part, where the 28 VDC output voltage is controlled regardless of the varying 400 Hz input voltage. The DC output current is calculated very precisely on the basis of the 400 Hz parameters and via the current transformer T20, located in phase A at the main power input.

Input Contactor(Q3):
The 400 Hz input power to the ARU is supplied and controlled via Q3.

Power Supply (G20):

24 VDC / 10 A (Factory adjustment = 25 Volt) regulated control voltage is supplied from the Power Supply G20. This module has a wide input range (340-575 VAC). It is supplied via the capacitor module and pre-fused from the 3-phase circuit breaker Q4 (shared with G1) and located in 400 Hz part.
Refer to Figure 16.0.1.for location diagram.

ARU Transformers (T20):

The ARU transformers steps down the 3 phased 400 Hz voltage (3 x 200 Vac) to an appropriate level for obtaining 28 VDC at the output.

ARU Rectifier (PM20):
The output voltage is kept at 28 VDC by using thyristors, regardless of the input voltage level and the load.

ARU Board (A20):
The ARU Board interfaces with the processor board and the rest of the 28 VDC unit.

- Supplied from G20 (X2)
- Connection to ARU control input on A2 (X1)
- Control of thyristors.
- Measures the output voltage.
- Interface for heatsink thermostat (X5)
- Input for current transformer T20 (X6)

Resistor (R20):
The discharge resistor R20 is part of the output filter stage and discharges the capacitor C20, when the unit is turned off.

Filter Capacitors (C20)
The output filter capacitors are also part of the output filter stage and secures that the AC ripple is kept to a minimum, less than 2% at the output.

Fan (M20)
The fan M20 is part of the total forced cooling of the unit, the primary task for the fan is to cool down the rectifier module. The air is drawn in via the filter grill on the left hand side of the base module. The ARU transformers are cooled by the fans located in the 400 Hz part.

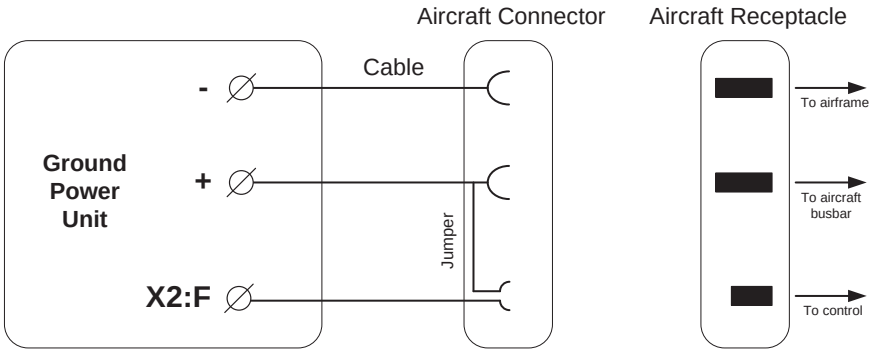
A.2 Connection of Cables

Fig. A-2-1 Connection of Cables

Recommended output cable to the aircraft is 2 x 4/0 (95 mm²) for continuous loads up to 400 amps (as shown above) and 4 x 4/0 (95 mm²) for higher continuous loads.

A.3 Interlock

To ensure personnel health and safety, the converter is equipped with an interlock system. The system ensures that the output only stays engaged as long as the plug is inserted into the aircraft receptacle. I.e. as long as 28 VDC is present at terminal X2:F.



A-3-1 Standard wiring diagram

For service, maintenance and test purposes, the interlock system can be by-passed via the display setup. To ensure personnel health and safety, the converter automatically returns into normal mode once it receives a 28 VDC voltage at terminal F2. (e.g. when the plug is connected to an aircraft.)

*This option requires a “split-F” connector, which is typically a special order from most aircraft manufactures.

Note!
The 90% switch is by-passed by connecting terminal + & 3

A.4 Operator’s Instruction

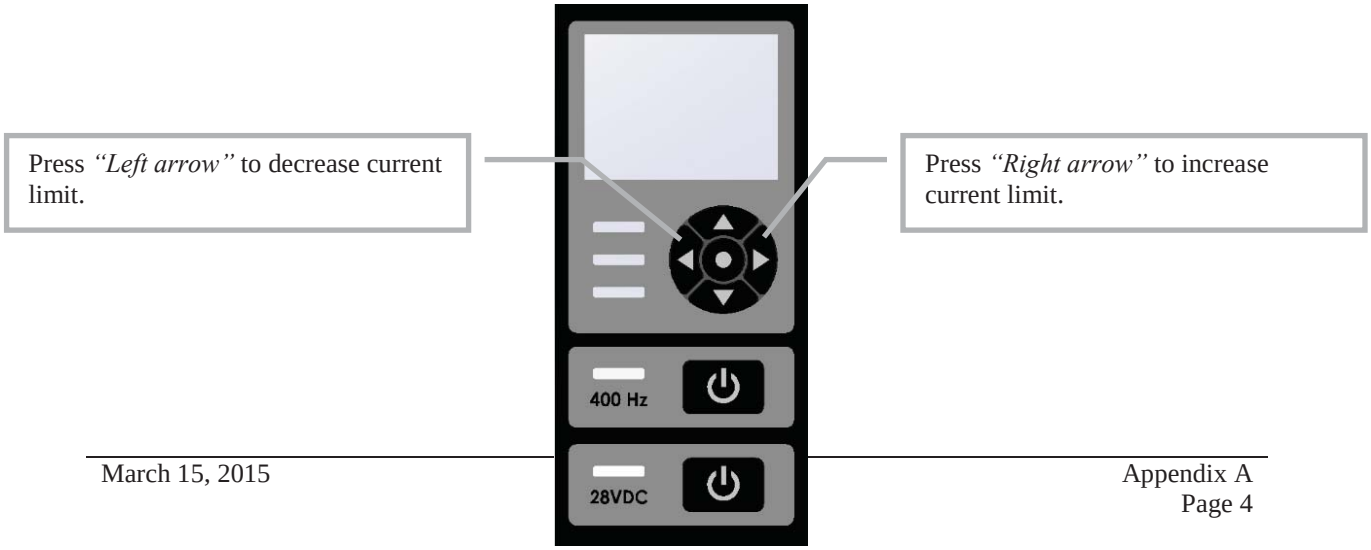
The 28 VDC ARU is operated by means of the Display / Keyboard Interface.
Please refer to Chapter 1-3 section 3 (ARU Operators Instructions).

A.5 Operating the unit

- To adapt the 28 VDC output power to different types of aircraft, it is possible to set a maximum DC current level in steps of 200 Amp (400 A unit) and 300 A (600 A unit). Depending on the rating of the GPU:

  400 A rating e.g. 200, 400, 600, 800, 1000, 1200, 1400, 1600 Amp
  600 A rating e.g. 300, 600, 900, 1200, 1500, 1800, 2100, 2400 Amp

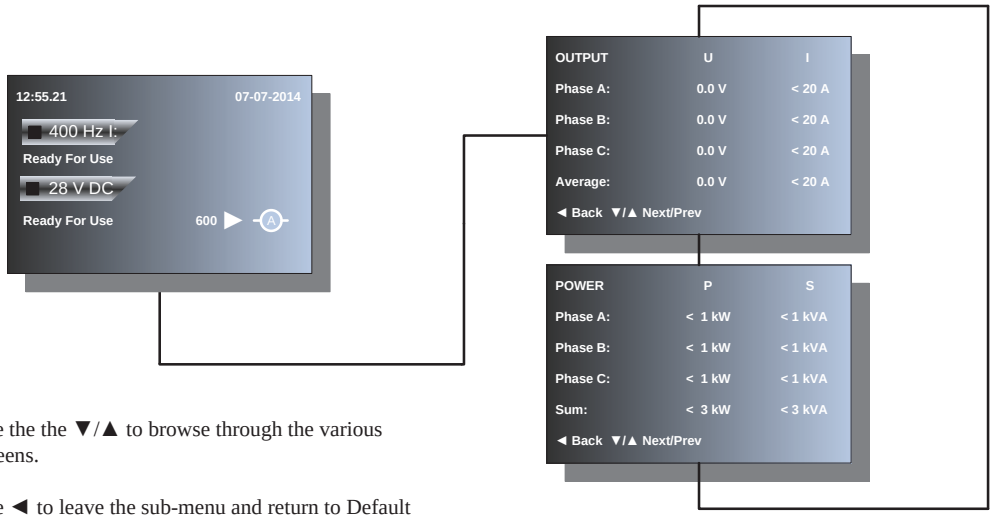
  To ensure hassle-free starting of the aircraft engine, the current limit function is delayed 0.7 seconds.



- Insert the aircraft cable into the aircraft. Make sure the cable is inserted till you feel a natural resistance. The plug may be equipped with a 90% Insertion switch. In this case, the unit will not function if the plug is not fully inserted.
- Press the 28 VDC Start/Stop button 
- The unit is now in operation and ready to supply the aircraft with power. This is also indicated via the green LED located close to the 28 VDC Start/Stop button 

- If the unit shuts off and no longer is supplying power to the aircraft, this is reported in clear text in the display. Also a corrective action is displayed.
- During operation, various parameters can be viewed via the display. Use the navigation keys ▼▲ to browse through the available screens:

Default Display Screen Standby

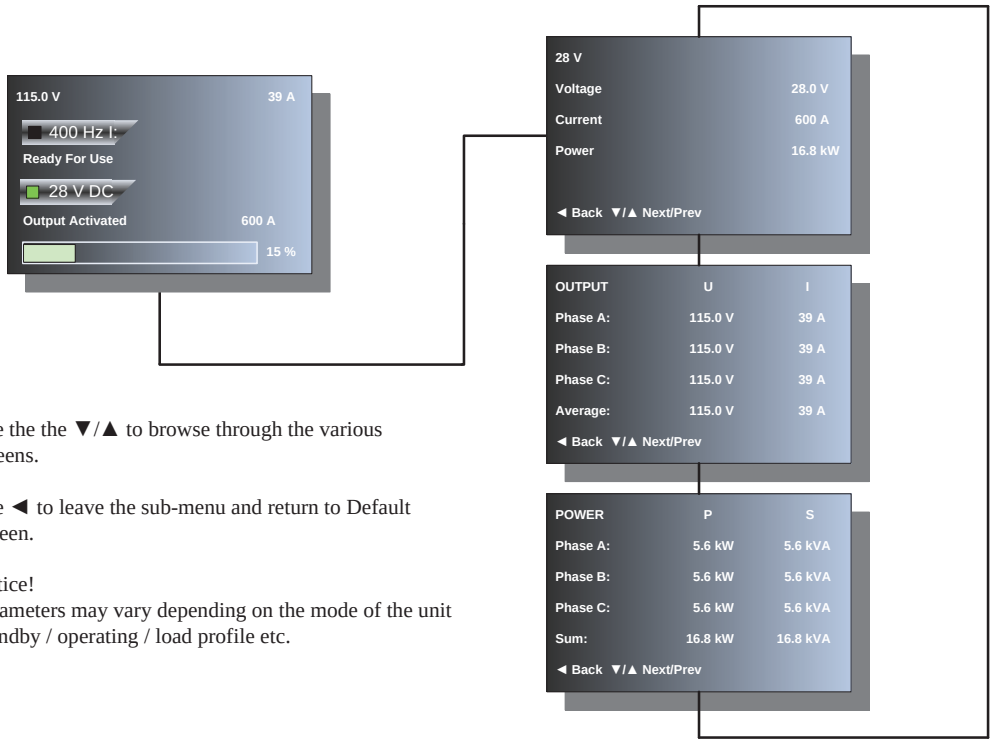


Use the the ▼/▲ to browse through the various screens.

Use ◄ to leave the sub-menu and return to Default Screen.

Notice!
Parameters may vary depending on the mode of the unit Standby / operating / load profile etc.

Default Display Screen Operating



Use the the ▼/▲ to browse through the various screens.

Use ◄ to leave the sub-menu and return to Default Screen.

Notice!
Parameters may vary depending on the mode of the unit Standby / operating / load profile etc.

- After operation, the unit has to be turned off before removing the aircraft plug.

  Press the 28 VDC Start/Stop button 

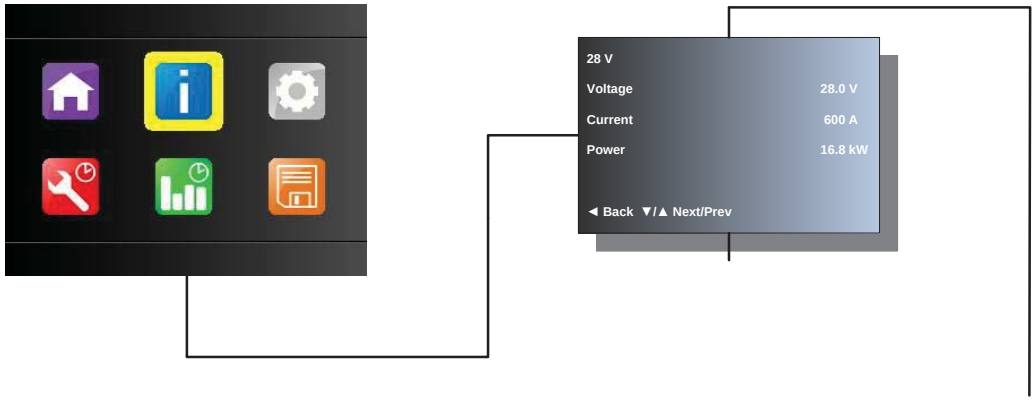
- The aircraft cable can now be removed from the aircraft and placed at the cable rest position.

Note!
Please note that the 28 VDC Start/Stop button also  functions as a Reset push button.

If, for some reason, the unit stops due to an error / failure, press the Start/Stop/Reset to reset the unit, once the fault number and message have been recorded and reported to maintenance. Note that this will remove the fault message from the screen if it is no longer active. (The Black Box will still have a record of the actual fault)

A.6 Additional menu items for ARU

Parameters – ARU additional parameters

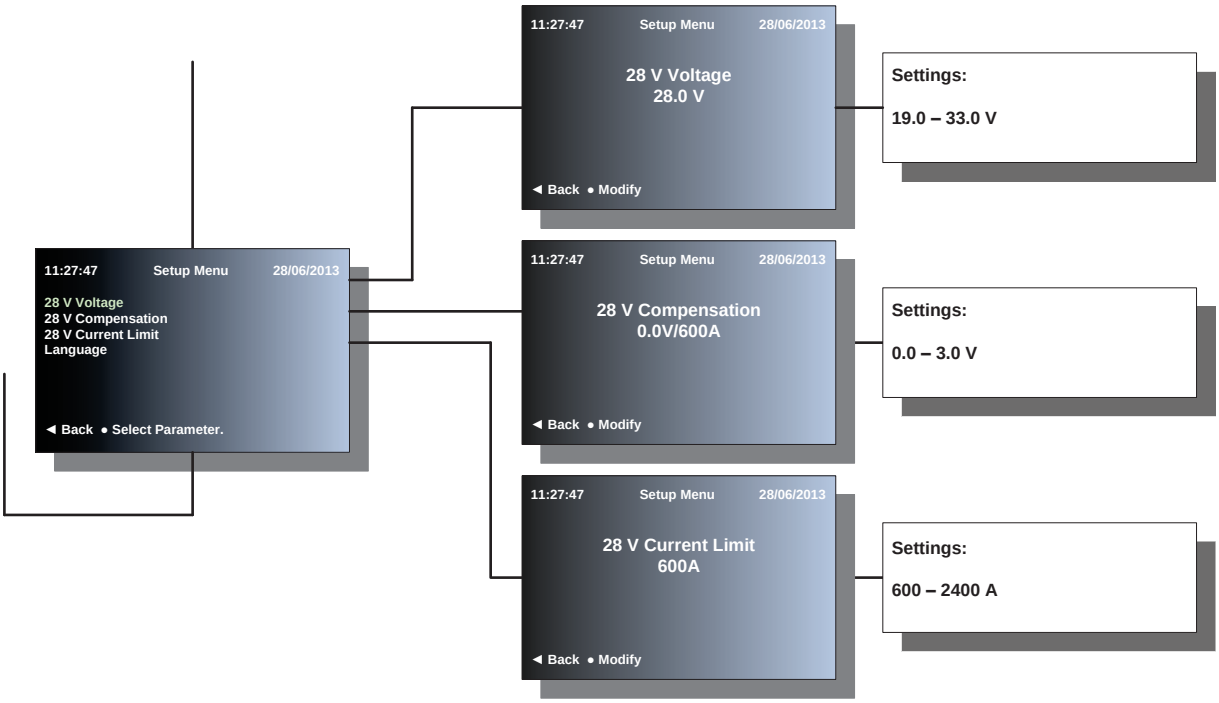


Use the the ▼/▲ to browse through the various screens.

Use ◄ to leave the sub-menu and return to basic Icon Menu.

Notice!
Parameters may vary depending on the mode of the unit Standby / operating / load profile etc.

Setup – ARU additional parameters



A.7 ARU Default Factory Settings:

28 V Voltage (V):	28.0
28 V Compensation (V/600 A):	0.0 (Set if GPU is supplied with cable)
28 V Current Limit (A):	1000 /1500 (400A / 600 A)
Output Mode:	Simultaneous
Fan Control:	Normal
Plug Temperature:	Normally Open

A.8 28V Voltage:

This Setup submenu allows the 28 volt output to be adjusted between 19.0 VDC and 33.0 VDC using the UP and DOWN navigation buttons. (Please note that the acceptable voltage range for all commercial DC powered aircraft is 26V to 29V.

Enter the Setup Menu and then scroll up or down to the 28V Voltage submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

A.9 28V Compensation:

DC voltage drops quickly as the current increases over a given length of cable. This Setup submenu allows the 28 volt output to be automatically adjusted as the load increases. The allowed setting is between 0.0 and 3.0 VDC at the rated continuous load of the unit. Note that the maximum output voltage of the unit is 33 VDC.

Enter the Setup Menu and then scroll up or down to the 28V Compensation submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

A.10 28V Current Limit:

If too much current is supplied to an engine, it is possible for the engine to shear the engines propeller shaft. This Setup submenu is used to set the default limit for the amount of current that the 28 VDC module will supply to start the aircrafts engine. Typically this value is set to the maximum current of the smallest aircraft the unit will service. If more current is required for larger aircraft, then the operator can adjust the current limit using the UP and Down buttons at the bottom of the operator panel. The current limit settings are from 200 amps to 1600 amps for the 400 amp version of the unit and from 400 amps to 2400 amps for the 600 amp version.

Enter the Setup Menu and then scroll up or down to the 28V Current Limit submenu. Press the center ● button to enter the submenu, and then press the ● button again to allow the value to be changed. Press the up or down arrow buttons to change the selection. Press the center ● button to record the new value. Press the LEFT arrow button to exit the submenu and return to the submenu list.

A.11 Specifications

Output:

Voltage	:	28 VDC
Current	:	400 A / 600 A continuously
Voltage regulation	:	< 0.5%
Voltage ripple	:	< 2%
Voltage transient recovery	:	Complies with ISO 6858 / MIL-704E

Overload capability :

400 A	**600 A**
800 A	1200 A for 30 seconds
1200 A	1800 A for 10 seconds
1400 A	2100 A for 5 seconds
1600 A	2400 A for 2 seconds

To protect the aircraft, the output voltage is decreased by 1 V per 300 A in the overload range (400-2400 A).

Setup:

Output voltage	:	19-33 V
Voltage compensation	:	0-3 V per 600 A
Current limit	:	200-1600 A in steps of 200 A (400 A version)
		400-2400 A in steps of 200 A (600 A version)

Protections:

Rectifier temperature to high

Short circuit at output

Over-and under voltage at output in case:

U < 20 VDC for more than 4 seconds

U > 32 VDC for more than 4 seconds

U > 40 VDC for more than 150 ms

Physical:

Additional weight to 400 Hz unit: 100 kg (220 pound)

For dimension please refer to Figure 5.0.2 (e.g. units equipped with base module).

Ambient:

Operating ambient for the 400 Hz and 28 VDC combination unit is -40°C to 45°C (-40 F to 113 F)

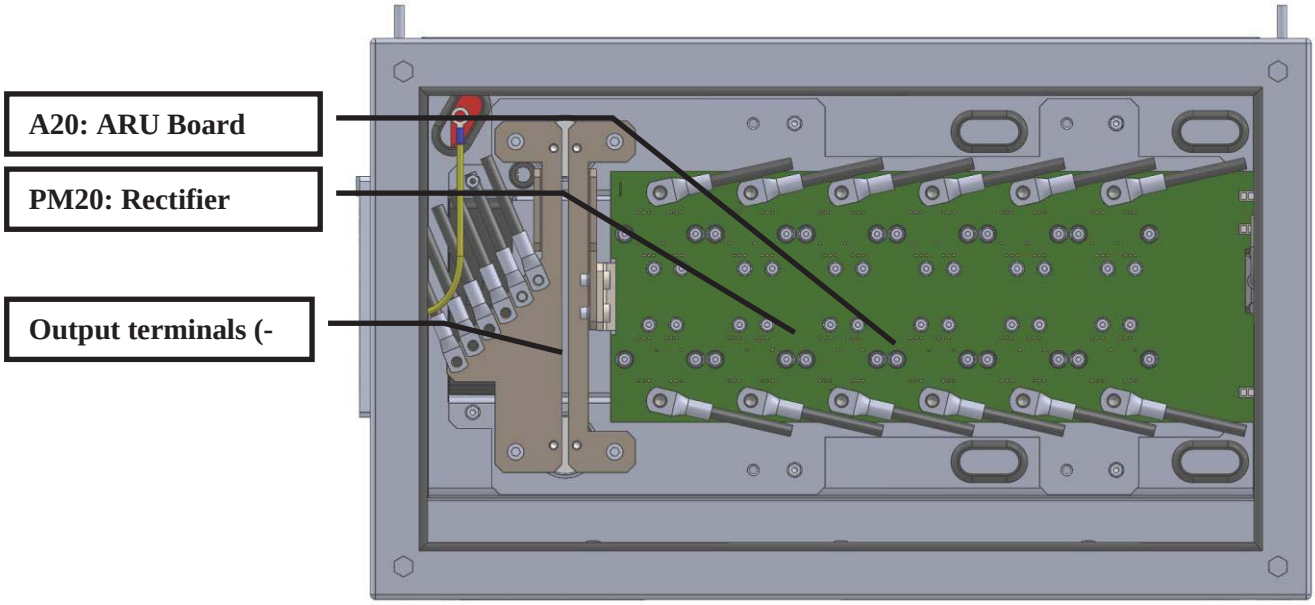


Figure A13-1 Front View (ARU)

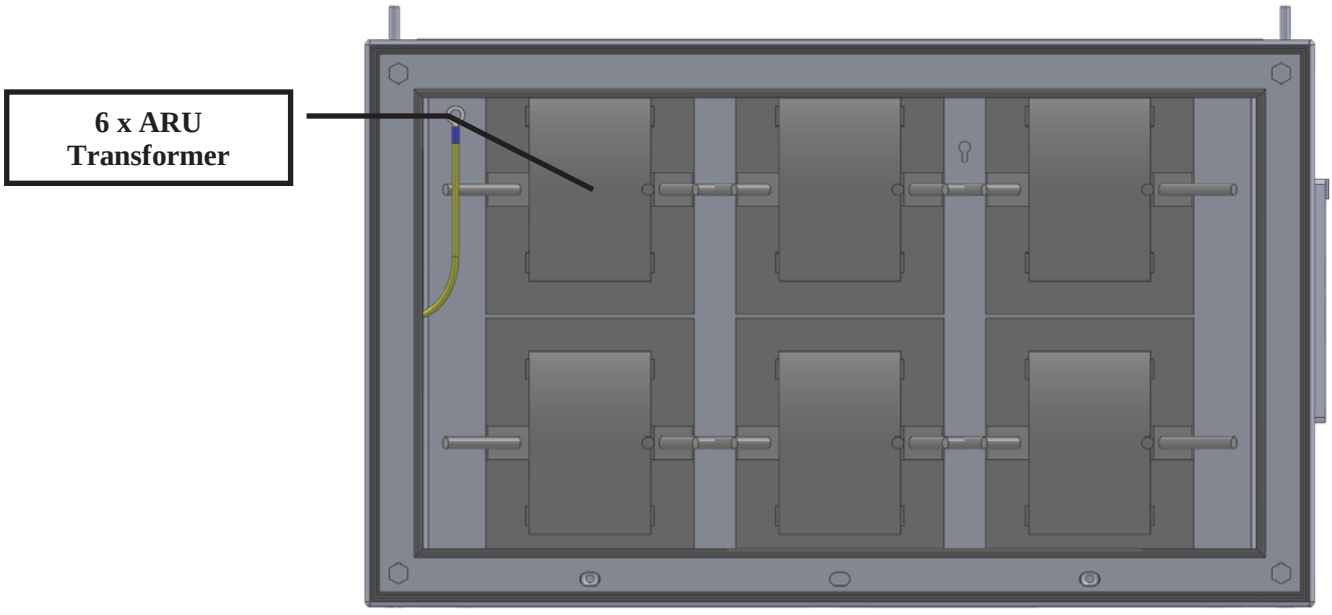


Figure A13-2 Rear View (ARU)

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Appendix B Options

The following is a list of options available for the ITW GSE 4400, 400 Hz. Generator Set. This chart contains the description and part number of the option. The description of each option follows on the pages below.

Option/Features Available	
Description	**Part Number**
DIN40 Towbar	293148
Kit, Clearance Lights	293098
Kit, Beacon, Unit Operating, Amber	293099-001
Kit, Beacon, Unit Operating, Blue	293099-002
Kit, Beacon, Unit Operating, Clear	293099-003
Kit, Beacon, Unit Operating, Red	293099-004
Kit, Beacon, Low Fuel, Amber	293100-001
Kit, Beacon, Low Fuel, Blue	293100-002
Kit, Beacon, Low Fuel, Clear	293100-003
Kit, Beacon, Low Fuel, Red	293100-004
Kit, Battery Blanket, 120V	287917
Kit, Battery Blanket 240 Volt	287917-001
Kit, Block Heater 120 V	289261-001
Kit, Block Heater 240V	289261-002

293143 DIN40 Tow bar

This option replaces the standard towbar with a 40mm diameter eye version.

293098 Kit, Clearance Lights

This option adds a blue clearance light to the four top corners of the canopy.

293099-001 Kit, Beacon, Unit Operating, Amber
293099-002 Kit, Beacon, Unit Operating, Blue
293099-003 Kit, Beacon, Unit Operating, Clear
293099-004 Kit, Beacon, Unit Operating, Red

This option adds the selected color beacon light to the top of the front canopy. These beacons are delivered with a flashing light. If a steady light is desired, the jumper in the bottom of the light should be cut.

293100-001 Kit, Beacon, Low Fuel, Amber
293100-002 Kit, Beacon, Low Fuel, Blue
293100-003 Kit, Beacon, Low Fuel, Clear
293100-004 Kit, Beacon, Low Fuel, Red

This option adds the selected color beacon light to the top of the front canopy. These beacons are delivered with a flashing light. If a steady light is desired, the jumper in the bottom of the light should be cut.

287917 Kit, Battery Blanket, 120V

This option adds an independently powered 120 VAC powered battery blanket on top of the batteries in the right cable tray.

287917-001 Kit, Battery Blanket, 240V

This option adds an independently powered 240 VAC powered battery blanket on top of the batteries in the right cable tray.

289261-001 Kit, Block Heater, 120V

This option adds an independently powered 120 VAC powered block heater to the engine.

289261-002 Kit, Block Heater, 240V

This option adds an independently powered 240 VAC powered block heater to the engine.

Appendix C Wet Stacking in Generator Set

Diesel Engines

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

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

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

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Appendix D Operating in Unusual Service Conditions

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

Among such conditions are:

1) Exposure to:

a) Combustible, explosive, abrasive or conducting dusts.

b) Environments where the accumulation of lint or excessive dirt will interfere with normal ventilation.

c) Chemical fumes, flammable, or explosive gases.

d) Nuclear radiation.

e) Steam, salt-laden air, or oil vapor.

f) Damp or very dry locations, radiant heat, vermin infestation, or atmospheres conducive to fungus growth.

g) Abnormal shock, vibration or mechanical loading from external sources during equipment operation.

h) Abnormal axial or side thrust imposed on rotating equipment shafts.

i) Low and/or high ambient temperatures.

j) High electromagnetic fields

2) Operation at:

a) Voltages above or below rated voltage.

b) Speeds other than rated speed.

c) Frequency other than rated frequency.

d) Standstill with rotating equipment windings energized.

e) Unbalanced voltages.

f) Operation at loads greater than rated.

3) Operation where low acoustical noise levels are required.

4) Operation with:

a) Improper fuel, lubricants or coolant.

b) Parts or elements unauthorized by the manufacturer.

c) Unauthorized modifications.

5) Operation in poorly ventilated areas.

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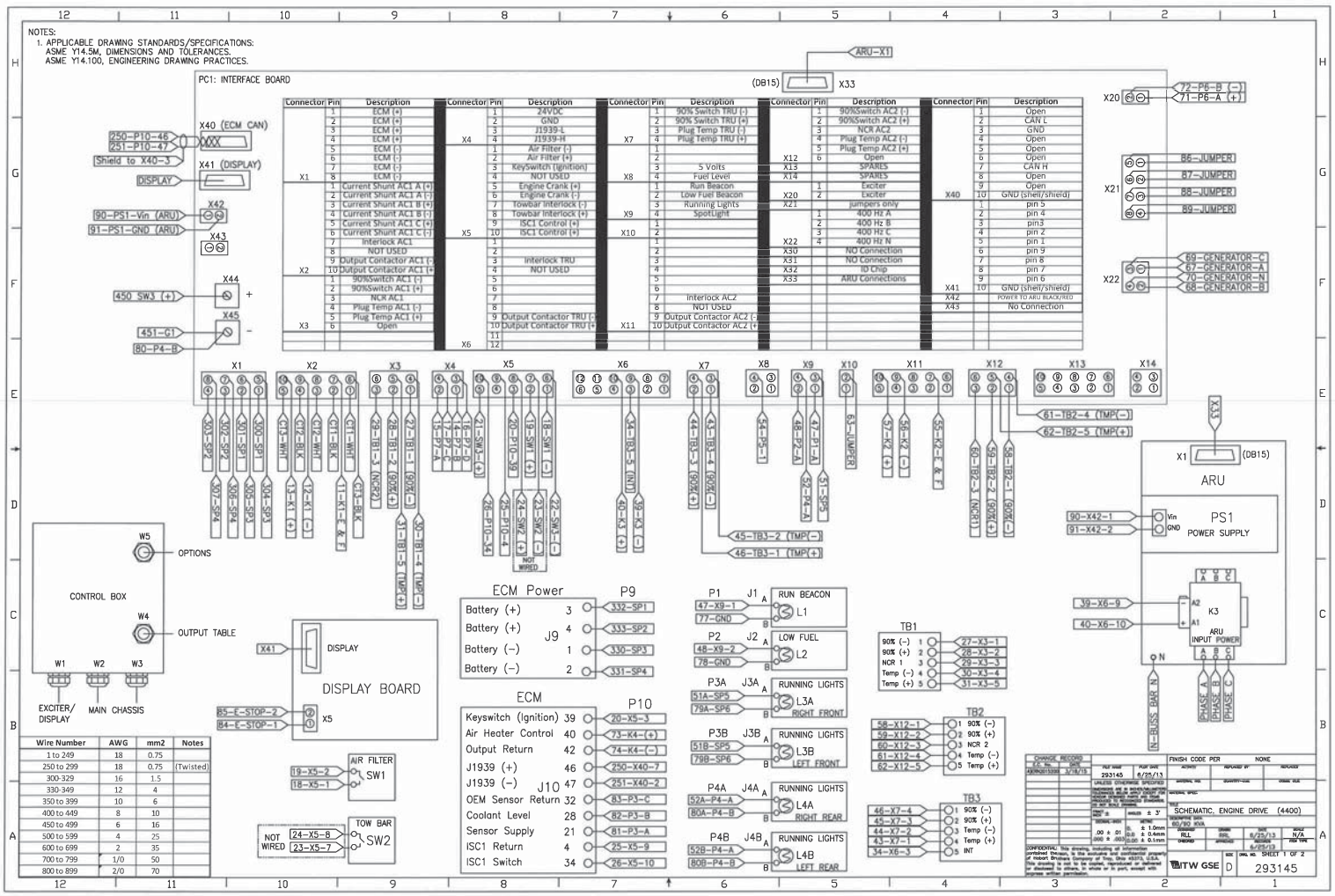
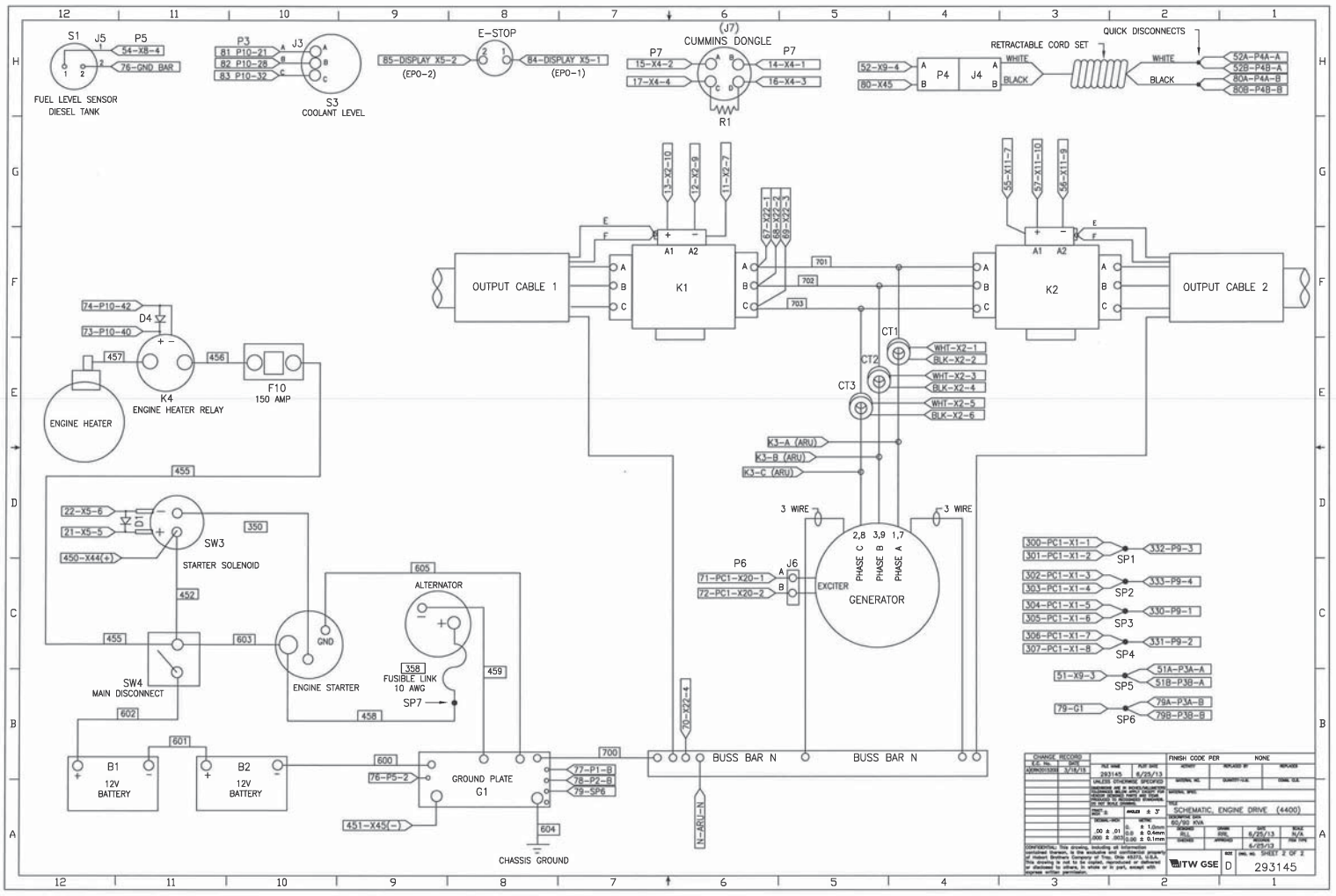

NOTES:
1. APPLICABLE DRAWING STANDARDS/SPECIFICATIONS:
ASME Y14.5M, DIMENSIONS AND TOLERANCES.
ASME Y14.100, ENGINEERING DRAWING PRACTICES.
PC1: INTERFACE BOARD
ARU-X1
(DB15)
X33
X40 (ECM CAN)
250-P10-46
251-P10-47
Shield to X40-3
X41 (DISPLAY)
DISPLAY
X42
90-PS1-Vin (ARU)
91-PS1-GND (ARU)
X43
X44
450 SW3 (+)
X45
451-G1
80-P4-B
X1
X2
X3
X4
X5
X6
X7
X8
X9
X10
X11
X12
X13
X14
X20
72-P6-B (-)
71-P6-A (+)
X21
86-JUMPER
87-JUMPER
88-JUMPER
89-JUMPER
X22
69-GENERATOR-C
67-GENERATOR-A
70-GENERATOR-N
68-GENERATOR-B
61-TB2-4 (TMP(-)
62-TB2-5 (TMP(+)
X34
ARU
PS1
POWER SUPPLY
90-X42-1
91-X42-2
K3
ARU INPUT POWER
39-X6-9
40-X6-10
N-BUSS BAR IN
PHASE A
PHASE B
PHASE C
CONTROL BOX
W5
OPTIONS
W4
OUTPUT TABLE
W1
W2
W3
EXCITER/ DISPLAY
MAIN CHASSIS
X41
DISPLAY
DISPLAY BOARD
85-E-STOP-2
84-E-STOP-1
X5
ECM Power
P9
Battery (+) 3 332-SP1
Battery (+) 4 333-SP2
Battery (−) 1 330-SP3
Battery (−) 2 331-SP4
J9
ECM
P10
Keyswitch (Ignition) 39 20-X5-3
Air Heater Control 40 73-K4-(+)
Output Return 42 74-K4-(−)
J1939 (+) 46 250-X40-7
J1939 (−) 47 251-X40-2
OEM Sensor Return 32 83-P3-C
Coolant Level 28 82-P3-B
Sensor Supply 21 81-P3-A
ISC1 Return 4 25-X5-9
ISC1 Switch 34 26-X5-10
J10
19-X5-2
18-X5-1
AIR FILTER SW1
NOT WIRED
24-X5-8
23-X5-7
TOW BAR SW2
P1 J1 RUN BEACON L1
47-X9-1
77-GND
P2 J2 LOW FUEL L2
48-X9-2
78-GND
P3A J3A RUNNING LIGHTS L3A RIGHT FRONT
51A-SP5
79A-SP6
P3B J3B RUNNING LIGHTS L3B LEFT FRONT
51B-SP5
79B-SP6
P4A J4A RUNNING LIGHTS L4A RIGHT REAR
52A-P4-A
80A-P4-B
P4B J4B RUNNING LIGHTS L4B LEFT REAR
52B-P4-A
80B-P4-B
TB1
90% (−) 1 27-X3-1
90% (+) 2 28-X3-2
NCR 1 3 29-X3-3
Temp (−) 4 30-X3-4
Temp (+) 5 31-X3-5
TB2
58-X12-1 1 90% (−)
59-X12-2 2 90% (+)
60-X12-3 3 NCR 2
61-X12-4 4 Temp (−)
62-X12-5 5 Temp (+)
TB3
46-X7-4 1 90% (−)
45-X7-3 2 90% (+)
44-X7-2 3 Temp (−)
43-X7-1 4 Temp (+)
34-X6-3 5 INT
Wire Number | AWG | mm2 | Notes
1 to 249 | 18 | 0.75 |
250 to 299 | 18 | 0.75 | (Twisted)
300-329 | 16 | 1.5 |
330-349 | 12 | 4 |
350 to 399 | 10 | 6 |
400 to 449 | 8 | 10 |
450 to 499 | 6 | 16 |
500 to 599 | 4 | 25 |
600 to 699 | 2 | 35 |
700 to 799 | 1/0 | 50 |
800 to 899 | 2/0 | 70
CHANGE RECORD
FINISH CODE PER NONE
SCHEMATIC, ENGINE DRIVE (4400)
60/50 KVA
CONFIDENTIAL: This drawing, including all information contained thereon, is the exclusive and confidential property of Hobart Brothers Company of Troy, Ohio 45373, U.S.A.
ITW GSE
D
293145
SHEET 1 OF 2


S1
J5
P5
54-X8-4
76-GND BAR
FUEL LEVEL SENSOR
DIESEL TANK
P3
81 P10-21
82 P10-28
83 P10-32
J3
S3
COOLANT LEVEL
E-STOP
85-DISPLAY X5-2
(EPO-2)
84-DISPLAY X5-1
(EPO-1)
(J7)
CUMMINS DONGLE
P7
15-X4-2
17-X4-4
14-X4-1
16-X4-3
R1
52-X9-4
80-X45
P4
J4
RETRACTABLE CORD SET
WHITE
BLACK
QUICK DISCONNECTS
52A-P4A-A
52B-P4B-A
80A-P4A-B
80B-P4B-B
OUTPUT CABLE 1
K1
OUTPUT CABLE 2
K2
CT1
CT2
CT3
WHT-X2-1
BLK-X2-2
WHT-X2-3
BLK-X2-4
WHT-X2-5
BLK-X2-6
K3-A (ARU)
K3-B (ARU)
K3-C (ARU)
74-P10-42
73-P10-40
D4
K4
ENGINE HEATER RELAY
F10
150 AMP
ENGINE HEATER
22-X5-6
21-X5-5
450-X44(+)
SW3
STARTER SOLENOID
SW4
MAIN DISCONNECT
ENGINE STARTER
ALTERNATOR
FUSIBLE LINK
10 AWG
SP7
3 WIRE
P6
J6
71-PC1-X20-1
72-PC1-X20-2
EXCITER
GENERATOR
PHASE C
PHASE B
PHASE A
300-PC1-X1-1
301-PC1-X1-2
SP1
302-PC1-X1-3
303-PC1-X1-4
SP2
304-PC1-X1-5
305-PC1-X1-6
SP3
306-PC1-X1-7
307-PC1-X1-8
SP4
51-X9-3
SP5
79-G1
SP6
B1
12V
BATTERY
B2
12V
BATTERY
GROUND PLATE
G1
76-P5-2
77-P1-B
78-P2-B
79-SP6
451-X45(-)
CHASSIS GROUND
BUSS BAR N
BUSS BAR N
70-X22-4
N-ARU-N
SCHEMATIC, ENGINE DRIVE (4400)
60/80 KVA
293145
TW GSE