SERVICE MANUAL SECTION

No Idle APU/HVAC System

Model: 9200i

Model: 9400i

Model: 9900i

Model: 9900ix

Unit Code: 12WTK

Unit Code: 16UZV

S16037

03/28/2007

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Table of Contents

1. INTRODUCTION

This Service Manual has been prepared to provide servicing personnel with information on the description, service and maintenance of this system.

All information, illustrations and specifications contained in this manual are based on the latest production information available at the time of publication.

The right is reserved to make changes in all information at any time without notice.

This manual is to be used in conjunction with Engine Service Manual S12020.

2. SAFETY PRECAUTIONS

You must understand all procedures and instructions before you begin maintenance and service procedures.

You must follow your company's maintenance and service guidelines.

You must use special tools, when required, to avoid personal injury and damage to components.

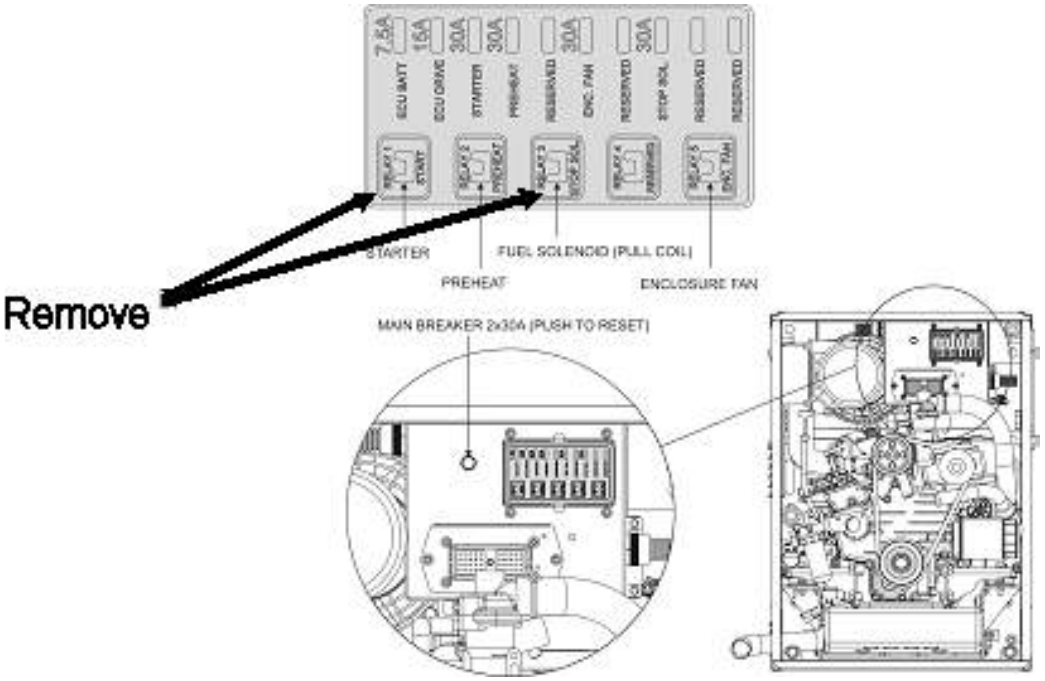
Throughout this manual you will find Cautions and Warnings:

CAUTION – Cautions will advise you of the proper care to be taken to avoid damage to your vehicle or property.

WARNING – Warnings advise you of hazards, the consequences and what to do to avoid them, not only to avoid damage to your vehicle or property, but also to help prevent situations and occurrences which could result in personal injury or death.

WARNING – Shock and entanglement hazard. Disable the starting circuit by removing the starter and fuel solenoid relays (Relay 1 and Relay 3) before servicing. Failure to follow this warning can result in property damage, personal injury or death.

WARNING – To prevent auto-restart when using the manual stop lever on the engine, the Starter and Fuel Solenoid relays must be removed immediately after shutdown. Failure to follow this warning could result in property damage, personal injury or death.



WARNING – To avoid property damage, personal injury or death, park the vehicle on a flat level surface, set the parking brake, chock the wheels and turn the ignition off.

WARNING – Shock Hazard. Only trained technicians should service the high voltage components in this unit. High voltage circuits and components contain voltage levels that may cause equipment damage, electrical shock and/or deadly electrocution if handled incorrectly.

WARNING – Exhaust gases from engines contain hazardous compounds. Do not operate engines in enclosed areas without abundant forced ventilation (with garage doors and windows wide open). Maintain exhaust system in good operating condition. Breathing exhaust gases could result in personal injury or death.

WARNING – Always use floor stands top support the vehicle before working under it. Using only a jack could allow the vehicle fall causing property damage, personal injury or death.

WARNING – To avoid property damage, personal injury or death, take care when performing any maintenance or making any check or repair. Some of the materials in this vehicle may also be hazardous if used, serviced or handled improperly. If you have any questions pertaining to service, have the work performed by a skilled technician.

WARNING – To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

3. LIST OF ABBREVIATIONS

Table 1

A: ampere	F: Fahrenheit	MFD: microfarads
AC: alternating current	FNPT: female national pipe thread	mm: millimetre
A/C: air conditioning	ft: feet	MNPT: male national pipe thread
APU: auxiliary power unit	ft.-lbs: foot pounds	N/A: not applicable
AWG: American wire gauge	GFCI: ground fault circuit integrator	Nm: Newton-meter
B Fan: bay fan	G L1: generator line 1	NPT: national pipe thread
BTU: British thermal units	G L2: generator line 2	psi: pounds per square inch
C: Celsius	Hz: Hertz	PTO: power take-off
CFM: cubic feet per minute	ID: identification	R Fan: radiator fan
C Fan: condenser fan	in: inch	RPM: revolutions per minute
CH: channel	K: thousand	RTV: room temperature vulcanizer
CLNT: coolant	kg: kilogram	S L1: shore power line 1
cm: centimetre	kW: kilowatt	SS: stainless steel
cond: condenser	lbs: pounds	SW: switch
dBa: decibel	LCD: liquid crystal display	V: volt
DC: direct current	LED: light emitting diode	VAC: volts alternating current
DSPL: display	l/hr: litre per hour	VDC: volts direct current
ECU: electronic control unit	m: meter	W: watt

4. SYSTEM IDENTIFICATION

The system consists of several components (some locations may vary):

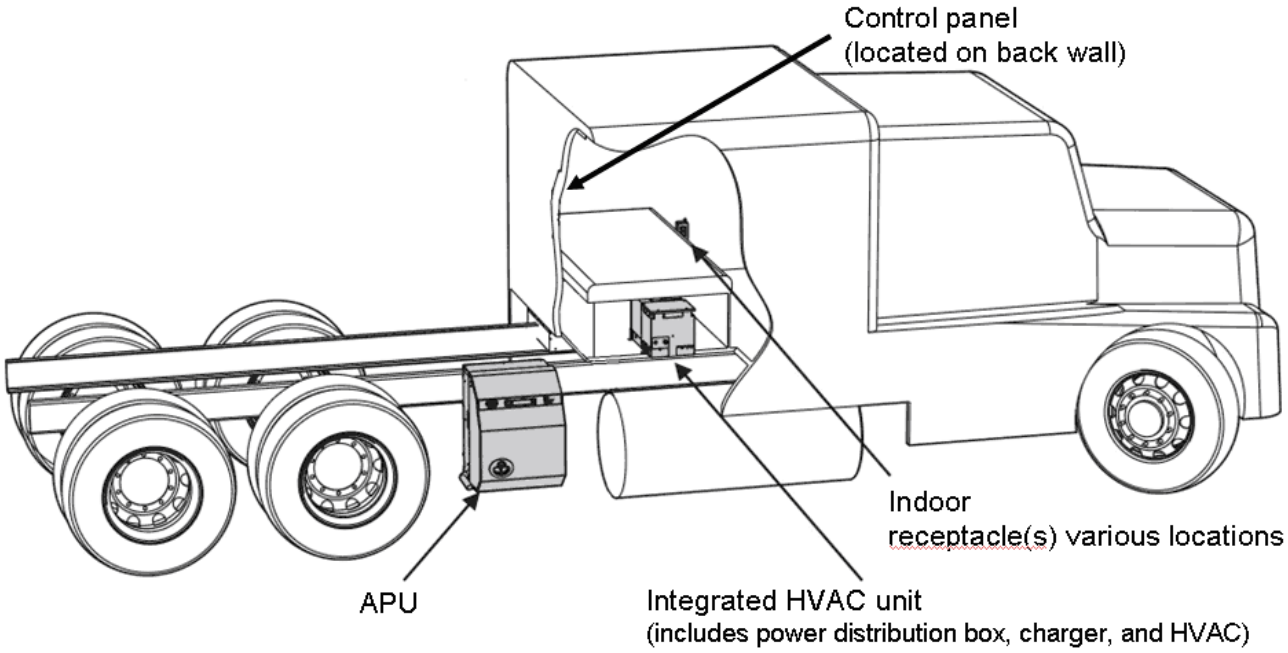


Figure 2 Component Locations

4.1. AUXILIARY POWER UNIT — APU

The APU is a two cylinder, diesel engine driven generator capable of producing 6000W of 120VAC power. This unit is bolted to the chassis of the truck behind the fuel tank on the passenger side of the truck.

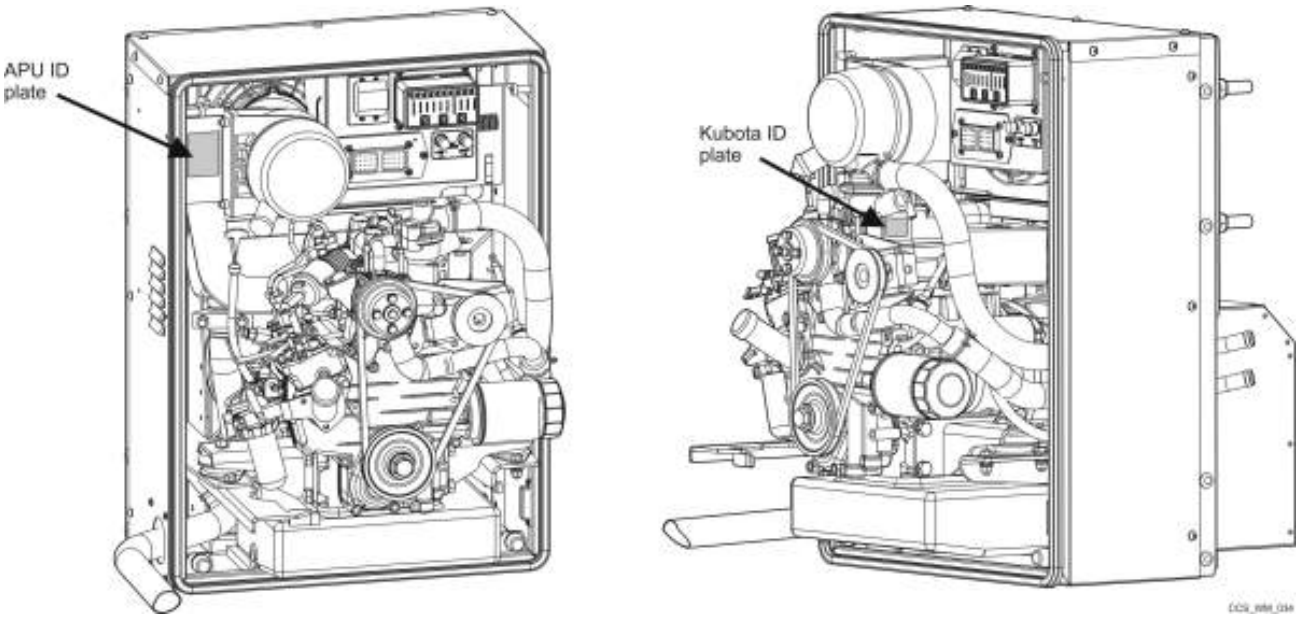


Figure 3 Auxiliary Power Unit

Table 2

Type	Liquid-cooled diesel engine driven AC generator Kubota Z482 engine Direct drive generator, not belt-driven
Power rating	6kW, 120VAC, and 60Hz
Weight	360 lbs (163kg); or 370 lbs (168kg) w/bright cover
Dimensions (WxHxD):	21” x 28.8” x 28.8” (53.4cm x 73.2cm x 73.2cm)
Battery charging	30A (optional 40A)
Operating temperature	-40ºF to 122ºF (-40ºC to +50ºC)
Fuel consumption	0.21 US Gallons per hour 0.8l/hr typical
Noise	65dBa @10’ (3m)

4.2. HVAC SYSTEM

The climate control system is on the Integrated HVAC Unit.

The HVAC unit: The HVAC Unit is a combined air conditioning and heating unit complete with a ventilation blower fan. This unit is installed in the truck's sleeper, beneath the sleeper bed.

***Power distribution, circuit breakers and battery charger are integrated into the HVAC unit.**

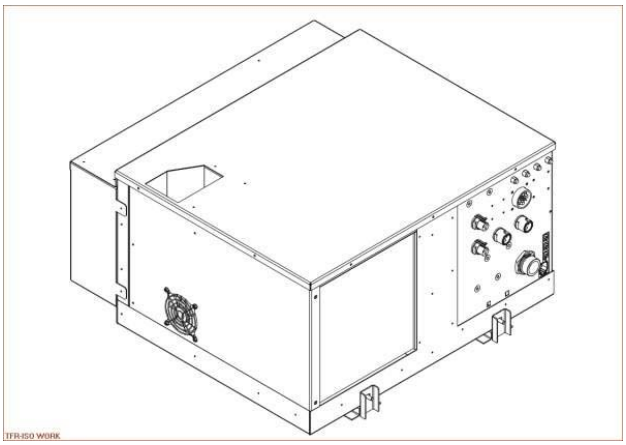


Figure 4 HVAC Unit

Table 3

Heating Capacity	Standard: 10,000 BTU/hr (High) / 3,330 BTU/hr (Low)
Cooling Capacity	Standard: 10,000 BTU/hr
Refrigerant	Environmentally friendly NU-22 (R417A) - pre-charged system

4.3. POWER DISTRIBUTION BOX

The power distribution box is the central electrical distribution/connection system to which all power is supplied and then distributed.

***The power distribution box is integrated into the HVAC module.**

4.4. BATTERY CHARGER

The battery charger is a 12VDC/50 Amp output unit. The input voltage is 120VAC (fed from the power distribution box), which allows the unit to operate while the APU is running or while the system is connected to shore power.

Battery charger features include:

- Over-current shutdown
- Reverse polarity protection
- Ignition protection

***The battery charger is integrated into the HVAC module.**

4.5. CONTROL PANEL

The control panel is the main interface, controlling all functions, complete with control knobs and an LCD display. This unit is installed in the sleeper, in an easy to access location.

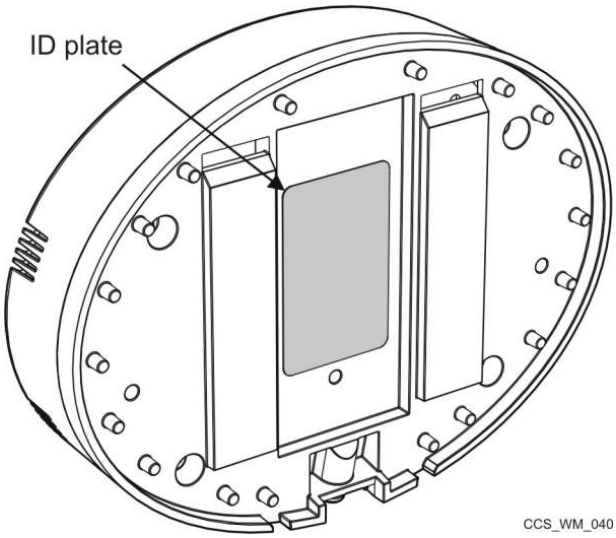


Figure 5 Control Panel

4.6. INDOOR AND OUTDOOR RECEPTACLES

The indoor and outdoor receptacles are integrated into the bulkhead, the outdoor receptacle is mounted on the back of the sleeper. The receptacle end is supplied with a circular connector, which plugs into the integrated Power Distribution/HVAC module.

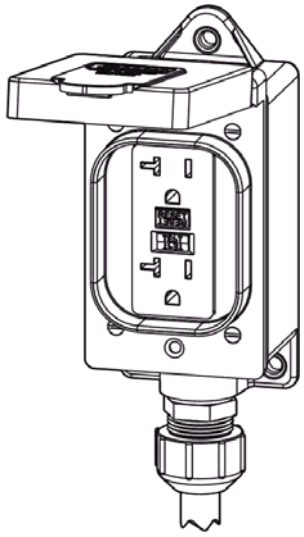


Figure 6 Indoor and Outdoor Receptacles

4.7. SHORE POWER

The shore power allows the user to connect the system to a 120V external source and power a portion of the equipment without running the APU.

When connected to a live source and the APU is not running, the system automatically:

- transfers incoming power to the shore power source
- disables the external receptacle
- disables “high” heat stage

The disabling of features allows the system to function on a basic 15A household electrical circuit. If the indoor receptacle is highly loaded while heat or cooling is being supplied, an overload condition could exist on the source feed, that might cause a shore power source breaker to trip.

4.8. KEYLESS REMOTE STARTER — OPTIONAL

The keyless remote start option allows the user to remotely start and stop the APU at a range of up to 1000 feet.

The keyless remote start option includes:

- 1 keychain transmitter
- 1 receiver module c/w input harness and antennae harness
- 1 extended range antenna

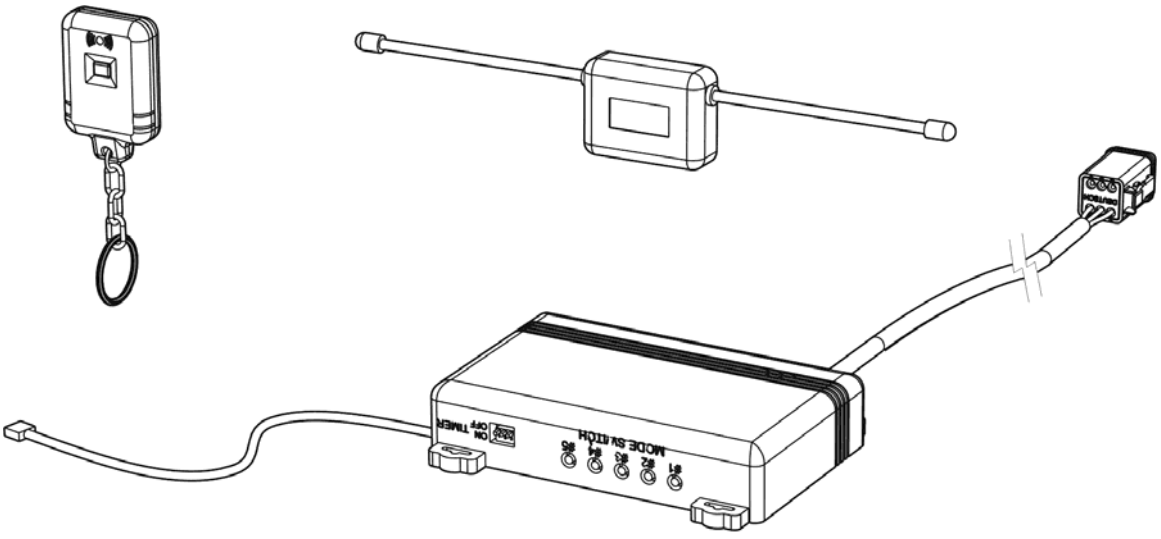


Figure 7 Keyless Remote Starter

5. TROUBLESHOOTING

5.1. ENGINE

Engine will not crank when attempting to start

a. Battery discharged or faulty – Check that the cable ends are clean and tight on the battery posts and engine.

b. Broken or disconnected wire – Check that the wire #12 (signal wire) is secure and clean on the starter solenoid and the engine to chassis ground strap is secure and clean.

c. Faulty starter relay – Check relay #1 for proper operation.

d. Faulty starter - see Engine Service Manual S12020.

e. Engine seized- see Engine Service Manual S12020.

Engine cranks but will not start

a. Lack of fuel – Inspect the fuel bowl to ensure it is full of fuel.

b. Faulty low-pressure fuel pump – see Engine Service Manual S12020.

c. Water in fuel system – Remove fuel bowl, drain and replace fuel filter.

d. Blown glow plug fuse – Replace 30A fuse

e. Faulty glow plug(s) – see Engine Service Manual S12020.

f. Faulty glow plug relay – Check relay #2 for proper operation.

g. Faulty fuel run solenoid relay – Check relay # 3 for proper operation.

h. Blown fuel run solenoid fuse – Check 30A fuse marked SOLENOID.

i. Faulty fuel run solenoid – Check that the harness connection is clean and properly connected and that the solenoid is adjusted properly.

j. Clogged / dirty air cleaner – Replace air filter, reset maintenance counter.

k. Clogged / dirty fuel filter – Replace fuel filter.

l. Air in fuel system – Bleed fuel system, inspect complete fuel system for leaks.

m. Wrong engine oil (for ambient temperature) – Change oil and filter, reset maintenance counter.

n. Broken valve spring, stuck valve, improper valve timing – see Engine Service Manual S12020.

o. Worn fuel camshaft, incorrect injection timing – see Engine Service Manual S12020.

p. Faulty injection pump, clogged injectors – see Engine Service Manual S12020.

q. Compression leak, worn piston ring – see Engine Service Manual S12020.

Engine does not run smoothly

a. Air in fuel system – Bleed fuel system, and inspect complete fuel system for leaks (ensure fuel in tanks is sufficient).

b. Clogged / dirty air cleaner – Replace engine air filter, reset maintenance counter.

c. Clogged / dirty fuel filter – Replace fuel filter.

d. Faulty fuel run solenoid – Replace run solenoid, see Engine Service Manual S12020.

e. Clogged injector nozzle – see Engine Service Manual S12020.

f. Governor defective / worn – see Engine Service Manual S12020.

Black or dark grey exhaust gas from engine

a. Excessive engine oil – Reduce to specified level.

b. Clogged / dirty air cleaner – Replace engine air filter, reset maintenance counter.

c. Clogged / dirty fuel filter – Replace fuel filter.

d. Worn or stuck piston ring – see Engine Service Manual S12020.

e. Incorrect injection timing – see Engine Service Manual S12020.

f. Poor engine compression – see Engine Service Manual S12020.

Excessive fuel consumption

a. Worn or stuck oil ring – see Engine Service Manual S12020.

b. Worn piston ring groove – see Engine Service Manual S12020.

c. Worn valve stem and guide – see Engine Service Manual S12020.

d. Worn crankshaft bearing and crank pin – see Engine Service Manual S12020.

Fuel mixed into oil

a. Worn injection pump plunger – see Engine Service Manual S12020.

Engine starts and quits

a. Clogged / dirty fuel filter – Replace fuel filter.

b. Clogged / dirty air filter – Replace air filter, reset maintenance counter.

c. Low oil pressure / oil pressure switch – Test / replace.

5.2. COOLING SYSTEM

Engine overheating

a. Insufficient coolant in system – Replenish coolant.

b. Water pump belt defective or not adjusted properly – Adjust / replace; reset maintenance counter.

c. Faulty engine thermostat – see Engine Service Manual S12020.

d. Faulty radiator fan driver – Replace fan driver.

e. Blown enclosure fan fuse – Replace 15A fuse.

f. Faulty enclosure fan – Test and replace.

g. Faulty radiator cap – Test and replace.

h. Defective water pump – see Engine Service Manual S12020.

i. Defective temperature switch – see Engine Service Manual S12020.

j. Contaminated engine coolant – Remove and replenish.

k. Obstructed or pinched coolant lines – Check / reroute / replace.

l. Air lock – Bleed cooling system.

Engine overcooling

a. Faulty engine thermostat – see Engine Service Manual S12020.

Water and oil mixed

a. Defective head gasket – see Engine Service Manual S12020.

b. Faulty crankcase / cylinder head – see Engine Service Manual S12020.

5.3. GENERATOR

No / low voltage output (16 to 24VAC)

a. Low engine RPM – Increase engine speed to 3750 RPM (no load).

b. Circuit breaker is tripped / failed – Reset / replace breaker.

c. Defective receptacle – Replace with 20A GFCI.

d. Failed stator – Test / replace.

e. Failed rotor – Test / replace.

f. Failed diode(s) – Test / replace rotor.

No / minimum power output (8 to 12VAC)

a. No load (correct RPM), failed diode or exciter winding - Test and replace.

b. Slightly low engine RPM – Increase engine speed to 3750 RPM (no load).

c. Rotor wire off at diode solder joint – Test / replace rotor.

d. Rotor slipping from engine – Replace rotor & PTO shaft.

e. Partially shorted rotor – Replace rotor.

High voltage output

a. High engine RPM – Reduce engine speed to 3750 RPM (no load).

Voltage output drops

a. Diode failure (diodes will test fine but they have a partial loss) – Replace rotor.

b. Low engine HP – see Engine Service Manual S12020.

c. Electrical load has a power factor below 0.7 – Remove inappropriate electrical load.

5.4. CHASSIS

Vibration

a. Loose / damaged vibration mount – Remove and replace.
b. Loose engine foot bolts – Remove thread locking compound, re-install and torque.
c. Loose / damaged drive pulley – Remove and replace pulley (install new key).
d. Loose / damaged generator – Replace generator.
e. Incorrect exhaust tail pipe position – Re-position to center of extraction point.
f. Internal engine damage – Engine Service Manual S12020.
g. Uneven generator mounting feet – Loosen generator bearing housing and re-align mounting feet.

Rattling, noise

a. Loose body panel / missing bolts – Replace / tighten.
b. Loose engine bolts / damaged part(s) – see Engine Service Manual S12020.
c. Loose / damaged generator – Inspect for damage replace and tighten.

5.5. HVAC SYSTEM

NOTE – Compressor and refrigerant loops are sealed and are not serviceable. If a failure occurs within the refrigerant loop or one of its components, the entire sealed loop must be replaced.

No operation at all (power at controller)

a. No function selected on control panel – Select HEAT or COOL function on control panel.
b. Selected temperature is insufficient – Adjust temperature.
c. No power – Tripped circuit breaker(s) / no power source (generator / shore power)

No or little cold air

a. Cool function not activated – Select COOL function on control panel.
b. Selected temperature too high – Adjust temperature.
c. Clogged / dirty evaporator filter – Clean / replace.
d. Faulty evaporator blower – Test and replace.
e. Blown condenser fan fuse – Replace.
f. Faulty condenser fan – Test and replace.
g. Clogged / dirty condenser coil – Clean.
h. Faulty condenser fan driver – Replace.
i. Blocked or insufficient return air – Unblock / increase return air.
j. Evaporator coil frozen up – Defrost.
k. Excessive heat transfer through cab windows – Close curtains.
l. Insufficient or leaking ducting – Increase or repair ducting.

m. Outlet temperature sensor failure – Test and replace.
n. Refrigerant temperature sensor failure – Test and replace.
o. Insufficient refrigerant – Test and replace.

No or little hot air

a. Heat function not activated – Select HEAT function on control panel.
b. Selected temperature too low – Adjust temperature.
c. Clogged / dirty evaporator filter – Clean / Replace.
d. Faulty evaporator blower – Test replace.
e. Blocked or insufficient return air – Unblock / increase return air.
f. Tripped HVAC 2 breaker – Reset breaker.
g. Faulty heater coil – Test and replace.
h. Insufficient or leaking ducting – Increase / repair ducting.
i. Faulty thermal breaker(s) – Test and replace.
j. Outlet temperature sensor failure – Test and replace.

5.6. ELECTRICAL SYSTEM

No 120V power at receptacles

a. 20A GFCI breaker tripped – Reset breaker.
b. 20A power distribution box breaker tripped – Reset breaker.
c. 30A main breaker tripped – Reset breaker.

No or poor battery charging

a. Blown 50A charger fuse – Replace fuse.
b. Excessive 12v load – Reduce load.
c. Tripped interior outlet 20A breaker – Reset breaker.

No power at controller

a. Blown 150A main fuse – Replace fuse.
b. Blown 7.5A ECU battery fuse – Replace fuse.
c. Unplugged / damaged controller cable – Replace cable.

No / loss of shore power

a. Tripped HVAC 1 breaker – Reset breaker.

b. Continuous tripping of HVAC 1 breaker – Reduce load / Check for correct source voltage.

c. Continuous tripping of shore power source breaker – Check for correct plug (20A) / cable length on extension cord.

d. Discharged batteries – Recharge.

5.7. ELECTRICAL PROTECTION LOCATIONS

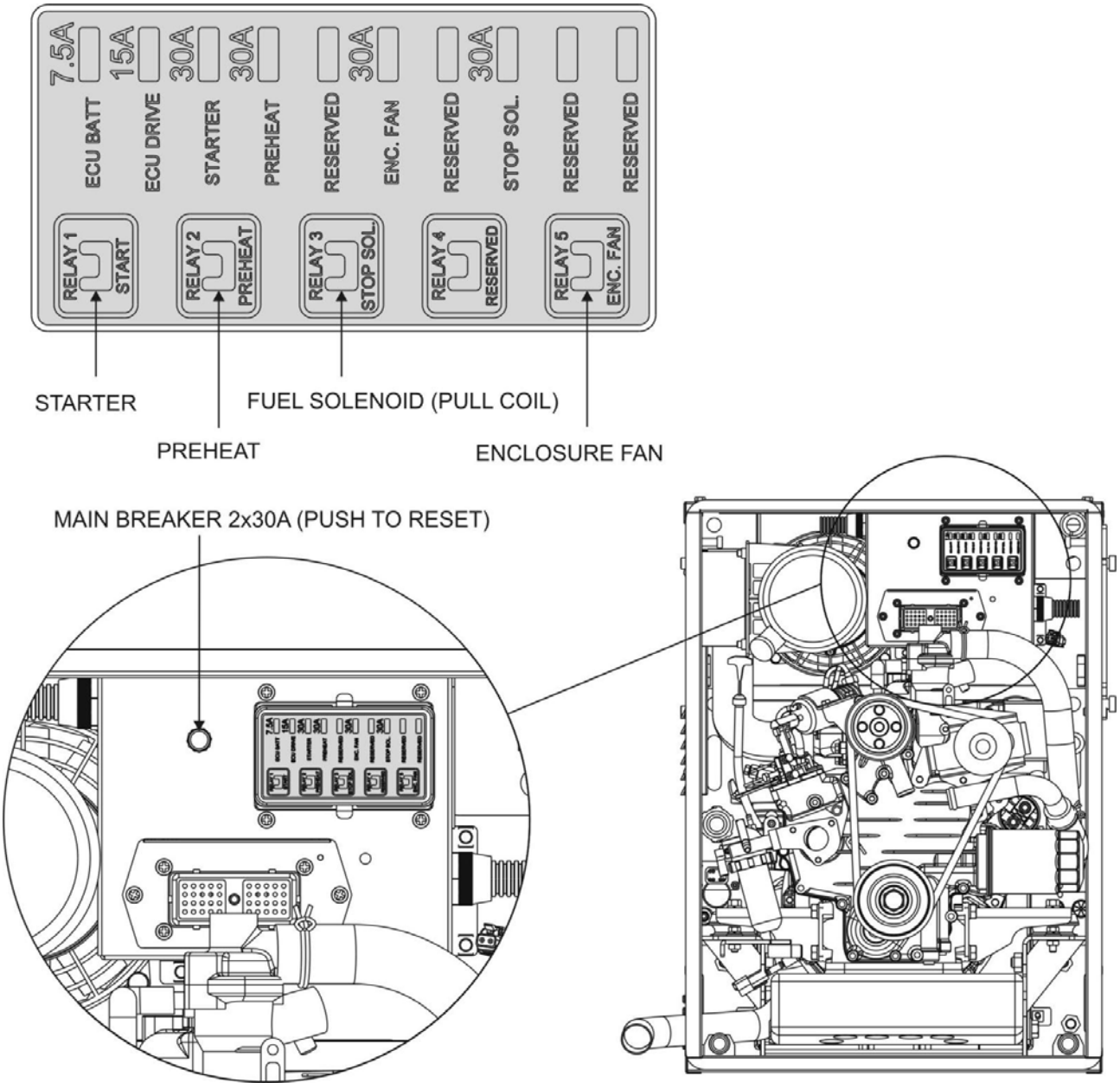


Figure 8 Circuit Breakers on APU

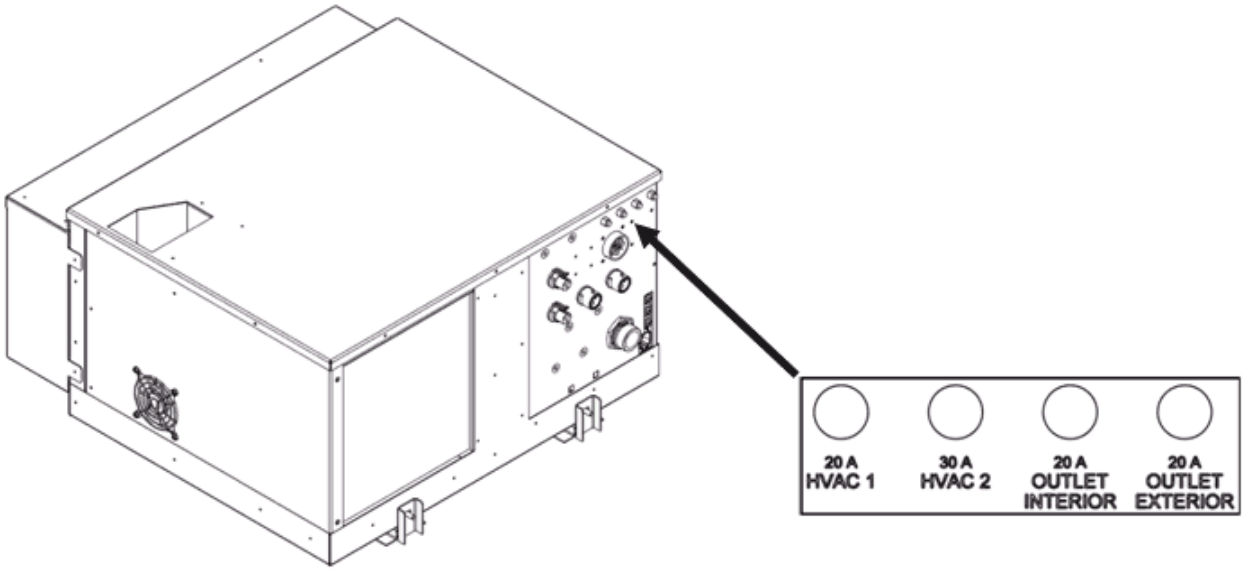


Figure 9 Circuit Breakers on HVAC Unit

Table 4

PDB Circuit Breaker	Rating	Equipment Powered
HVAC 1	20A	First stage heating element Blower circulation fan Air conditioning compressor
HVAC 2	30A	Second stage heating element
Outlet interior	20A	Indoor receptacle Battery charger
Outlet exterior	20A	Outdoor receptacle

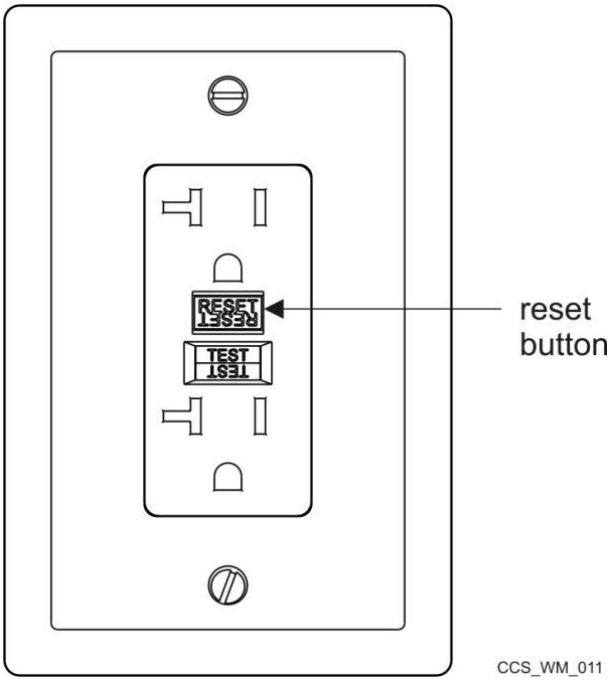


Figure 10 Indoor / Outdoor Receptacle – Ground Fault Circuit Interrupter

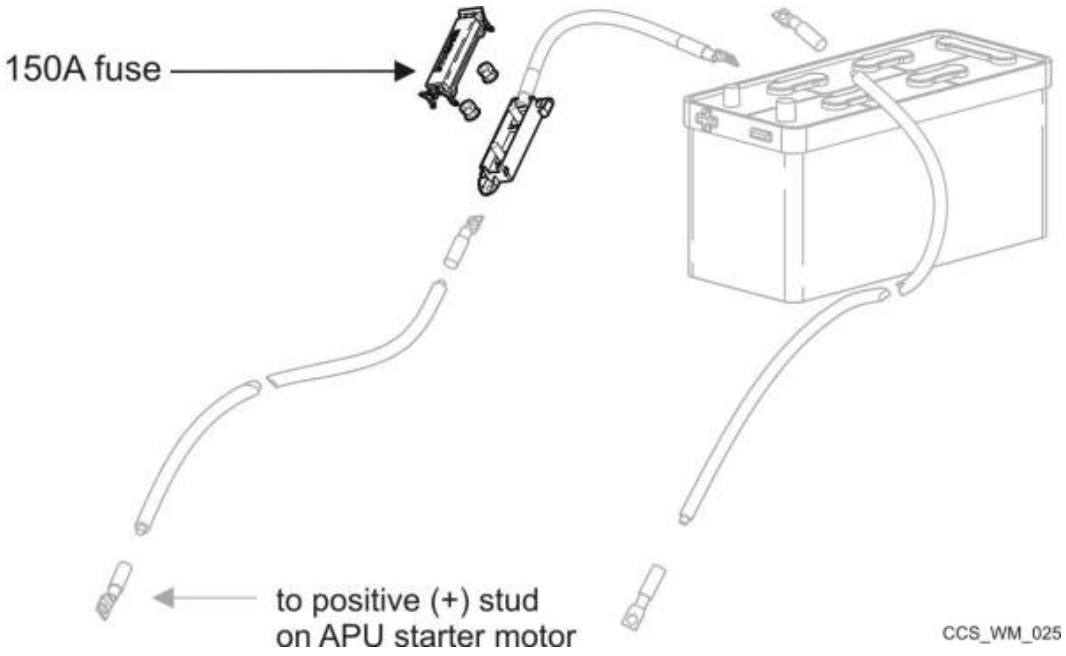


Figure 11 150A Fuse

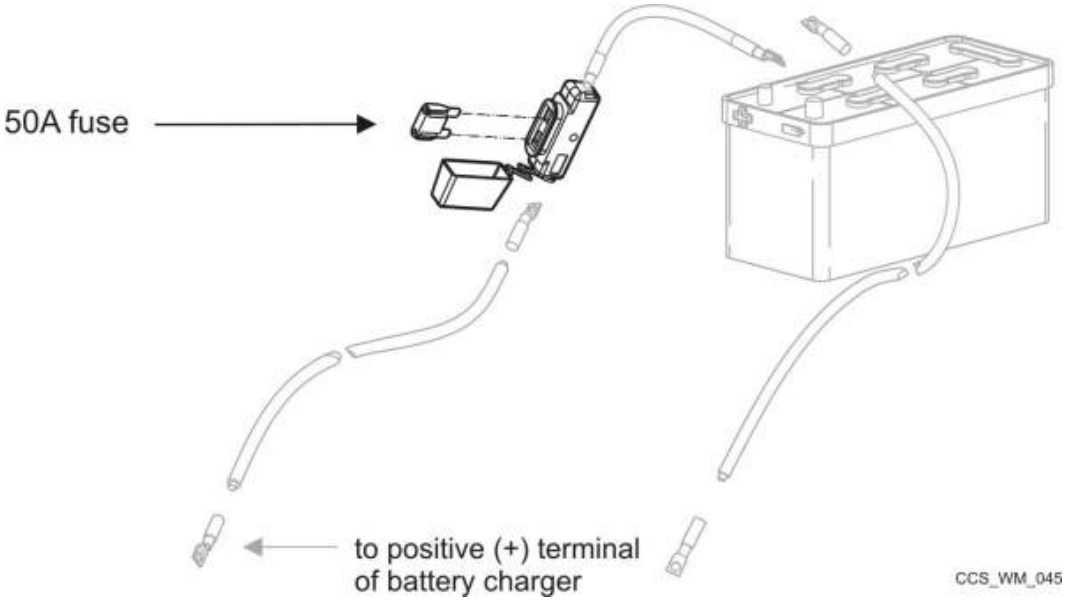


Figure 12 50A Fuse

5.8. SELF-DIAGNOSTIC FLASH CODES

The APU and HVAC unit are both equipped with a diagnostic LED to indicate system faults and shutdown conditions. When a fault is present, the LEDs will flash the relevant sequence to help the user/repair technician diagnose and repair the fault.

Each code will flash and will be separated by approximately 1 second long pause(s) between present codes. When the list of present fault codes has been displayed, the sequence will repeat itself until cleared.

Example: If the engine over temperature and generator AC over voltage faults occurred, the flash sequence would produce 3 quick flashes, a long pause, 5 quick flashes, long pause, 3 quick flashes, a long pause and so on.

Once the fault has been repaired, pressing the START/STOP button on the control panel will clear the fault message(s) on the screen. The LED will continue to flash until the system has gone through 3 consecutive start/stop cycles without any faults.

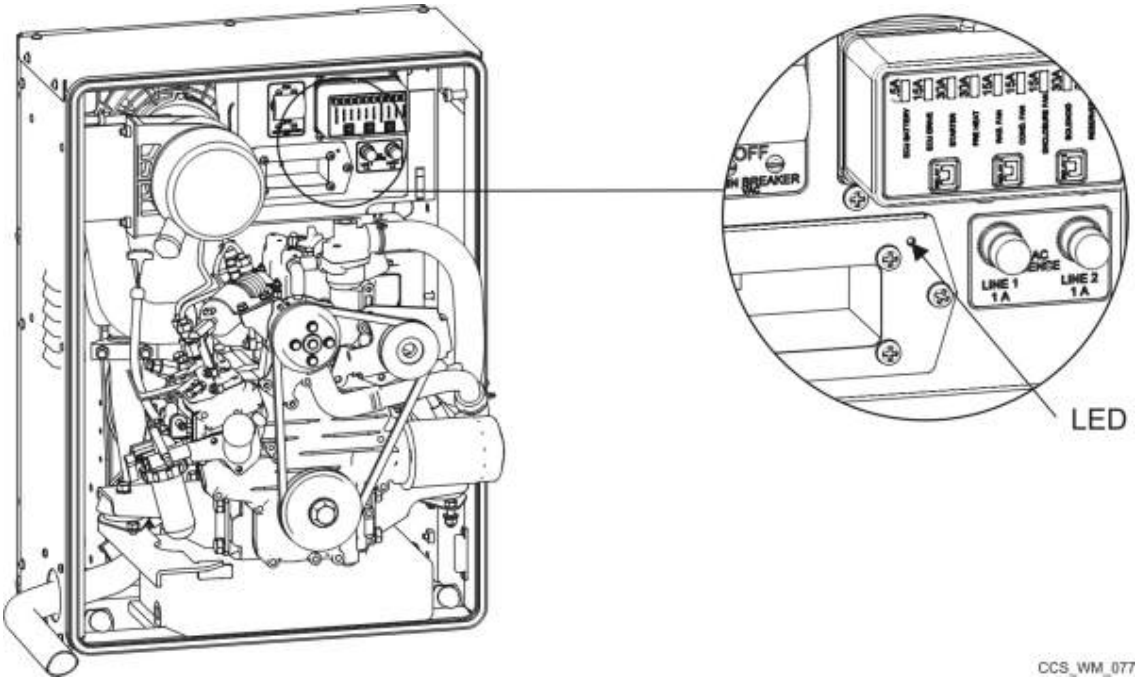


Figure 13 Diagnostic LED on APU

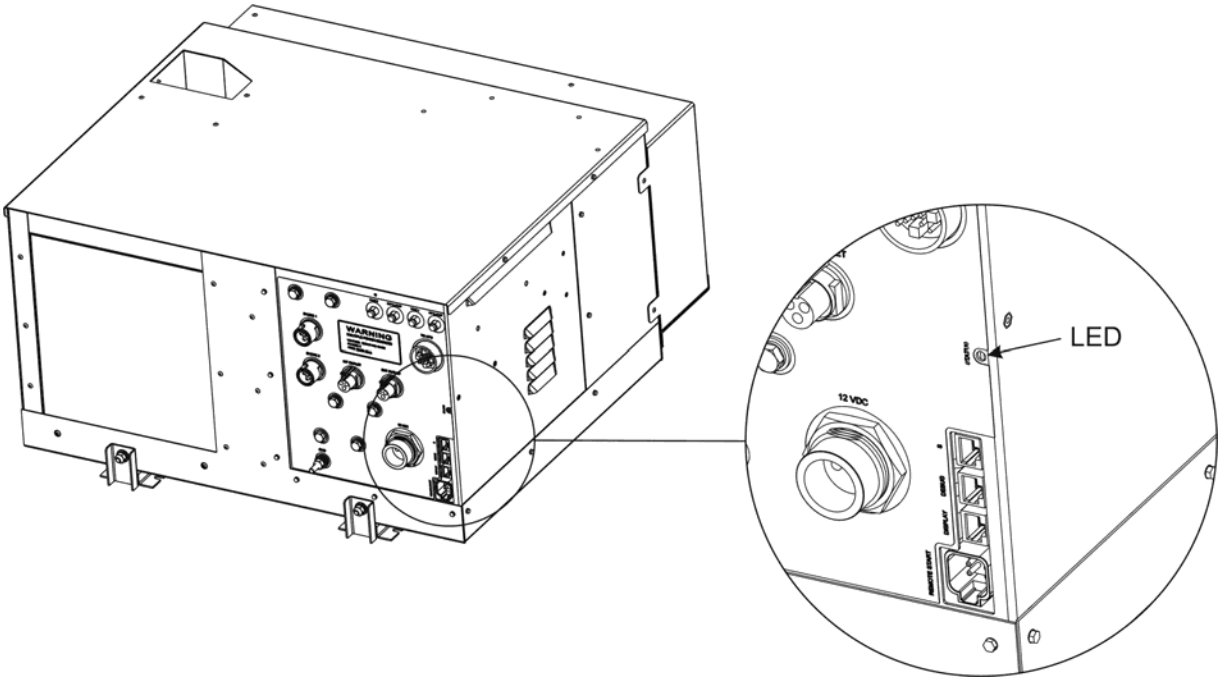


Figure 14 Diagnostic LED on Power Distribution Box

Table 5

Flash code		Possible causes
APU	PDB	
1	1	For International Truck use only
2	2	Unplugged / faulty coolant return temperature sensor Unplugged / faulty enclosure temperature sensor
—	2	Unplugged / faulty refrigerant temperature sensor Unplugged / faulty CHEB vent temperature sensor
—	3	Generator AC output over 138V Generator AC output under 100V Shore power AC output over 138V Shore power AC output under 100V
4	4	Batteries depleted (below 8VDC) Poor connection to batteries Faulty battery charger APU circuit board failure
5	5	Insufficient engine oil Poor fan belt tension Low coolant level Coolant air lock Contamination in coolant Defective radiator cap Faulty radiator fan / blown fuse Faulty engine thermostat Faulty enclosure fan Debris in engine compartment (air inlet/outlet) Circuit board overheated
—	5	HVAC vent overheated Refrigerant overheated

Table 5 (cont.)

Flash code		Possible causes
APU	PDB	
6	6	Faulty speed sensor Faulty engine harness Starter relay / fuse blown Starter solenoid wire unplugged Faulty starter Blown ECU drive fuse Wrong speed setting Governor failure Clogged air filter Clogged fuel filter Faulty fuel solenoid Blown glow plug fuse Blown glow plug(s) Blown glow plug relay
7	7	Lack of fuel / clogged filter Faulty fuel solenoid Faulty fuel relay / fuse Faulty fuel pump Faulty glow fuse / relay Overcrank Glow plugs Low oil Low oil pressure / clogged filter Faulty oil pressure switch

Table 5 (cont.)

Flash code		Possible causes
APU	PDB	
		Plugged oil gallery / component in engine
—	7	Unplugged / faulty condenser fan or driver Excessive debris on condenser Incorrect amount of refrigerant Defective refrigerant pressure sensor Internal blockage of refrigerant paths

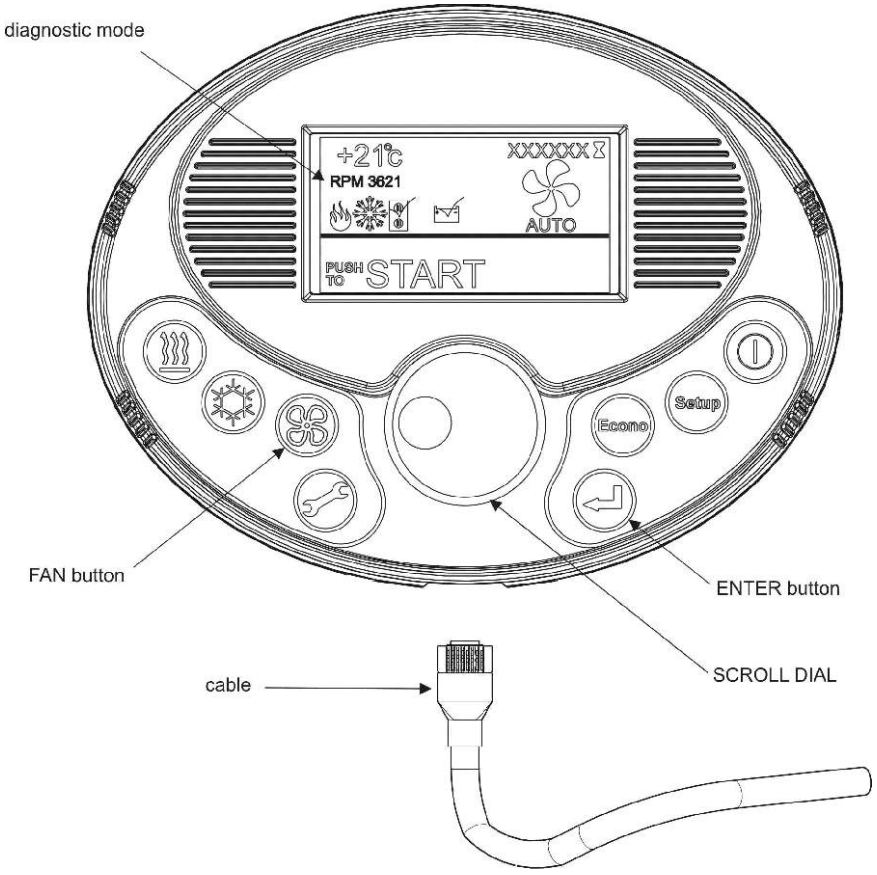


Figure 15 Cab Controller

Table 6

	Possible Causes
Battery voltage / hour meter display flashes	Unplugged / broken controller cable APU circuit board failure

	Possible Causes
Blank screen	APU circuit board failure Control panel circuit board failure
Set temperature flashes	HVAC circuit board failure Communication fault

5.9. DIAGNOSTIC MODE

To perform the test, proceed as follows:

1. Unplug the controller.
2. Press and hold the ENTER button while plugging the cable back into the controller.
3. Release the ENTER button, then push each button once to light up from left to right (starting with the HEAT button).
4. After all buttons are pressed in the correct sequence, the controller will perform a self-check and beep (if working).
5. Wait about 30s for the display to appear and adjust contrast if necessary (press and hold the ENTER button while turning the SCROLL DIAL counter clockwise).
6. The controller will now operate the condenser fan, enclosure fan and the radiator/heat exchanger fan for 30s (verify operation).
7. Press and hold the FAN button while turning the SCROLL DIAL to scroll through the operating parameters (displayed directly below the temperature setting).
8. Unplug controller cable from the controller and plug back in to exit diagnostic mode.

Refer to Figure 14 above.

Table 7

Line	Display	Parameter	
1	G L1	Generator power to cab	V
2	G L2	Generator power to outdoor receptacle	V
3	S L1	Shore power to cab	V
4	RPM	Engine speed	RPM
5	CLNT	Engine coolant temp.	°C
6	R FAN	Radiator / heat exchanger fan speed	%
7	COND	High side refrigerant line temp.	°C
8	C FAN	Condenser fan speed	%
9	BAY	Engine bay temperature	°C

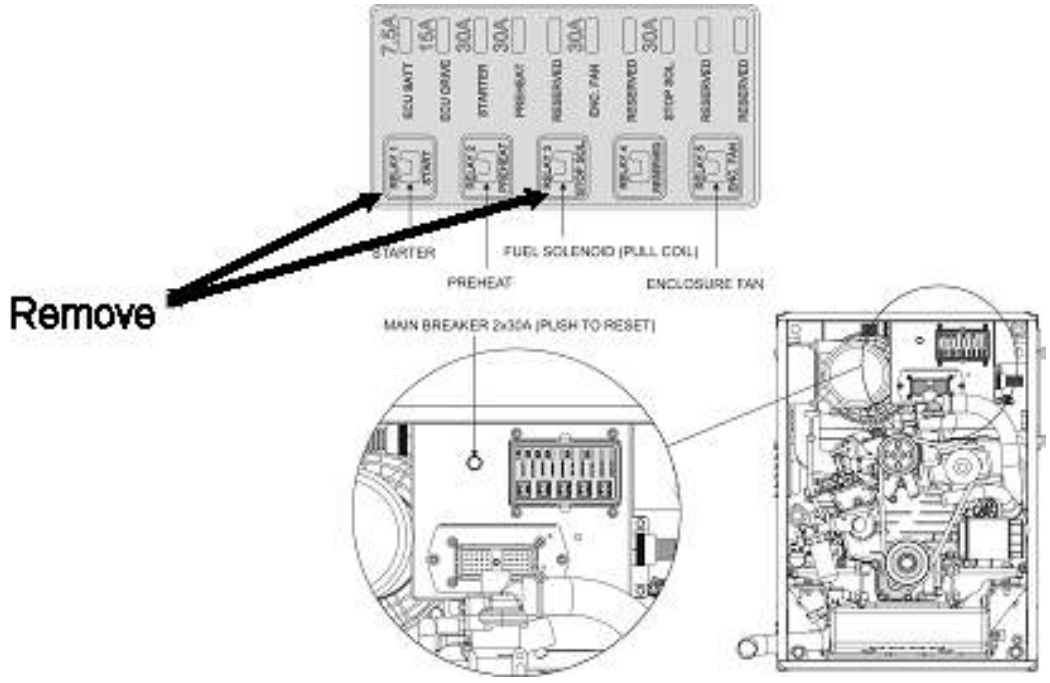
Line	Display	Parameter	
10	B FAN	Engine bay fan speed	%
11	DSPL	Sleeper temp. at display	°C
12	VENT	Sleeper vent temp.	°C

NOTE – If a faulty sensor is detected, the display will read "????"

6. MAINTENANCE

6.1. GENERAL PRECAUTIONS

WARNING – Shock and entanglement hazard. Disable the starting circuit by removing the starter and fuel solenoid relays (Relay 1 and Relay 3) before servicing. Failure to follow this warning can result in property damage, personal injury or death.



• Before disassembling or servicing live wires, make sure to always disconnect the battery first.

• During disassembly, carefully arrange removed parts in a clean area to prevent confusion later. Screws, bolts and nuts should be replaced in their original position to prevent reassembly errors.

• Gaskets and O-rings must be replaced during reassembly. Apply grease to new O-rings or oil seals before reassembling

6.2. MAINTENANCE SCHEDULE

Table 8

Maintenance Item	50 Hours	500 Hours	1000 Hours
Check oil and coolant level	daily		
Check fuel / coolant lines and clamps	√		
Check / adjust water pump belt tension	√		
Change engine oil and filter	after first 50 hrs	√	
Check air filter (replace as necessary)		√	
Change fuel filter element / drain sediment bowl		√	
Check / replace water pump belt		√	
Check HVAC filter		√	
Adjust valve lash	800 hours — Authorized dealer		
Clean remote radiator / heat exchanger fins			√
Clean condenser fins			√
Check injector nozzle opening pressure	every 2 years — Authorized dealer		
Change coolant, fuel hoses and clamps	every 2 years — Authorized dealer		

6.3. ENGINE OIL SPECIFICATIONS

Engine oil should be MIL-L-2104C or have properties of API classification CD grades or higher. Minimum recommendation is CD, CE or CF engine oil for Kubota diesel engine.

Table 9

API Classification	Application
CD	Oil suitable for the diesel engines operated under severe conditions, which will resist high temperature piston deposits, ring sticking and thermal breakdown
CE	Oil suitable for the diesel engine which is operated under the most severe conditions, having the property to restrain oil consumption, oil deposit, and oil viscosity increase, in addition to the properties of CD
CF	Oil suitable for the diesel engine to be mounted on the off-road vehicles, of which fuel is a high-sulphur (0.2%) fuel

NOTE – With the emission regulations now in effect, the CF-4 and CG-4 lubricating oils have been developed for use with low-sulphur fuel on on-road vehicle engines. When an off-road vehicle engine runs on a high-sulphur fuel, it is advisable to employ the CF, CD or CE lubricating oil with a high total base number.

Table 10

	Fuel	
Lubricating Oil Class	Low sulphur	High sulphur
CF	O	O
CF-4	O	X
CG-4	O	X
O = Recommended X = Not Recommended		

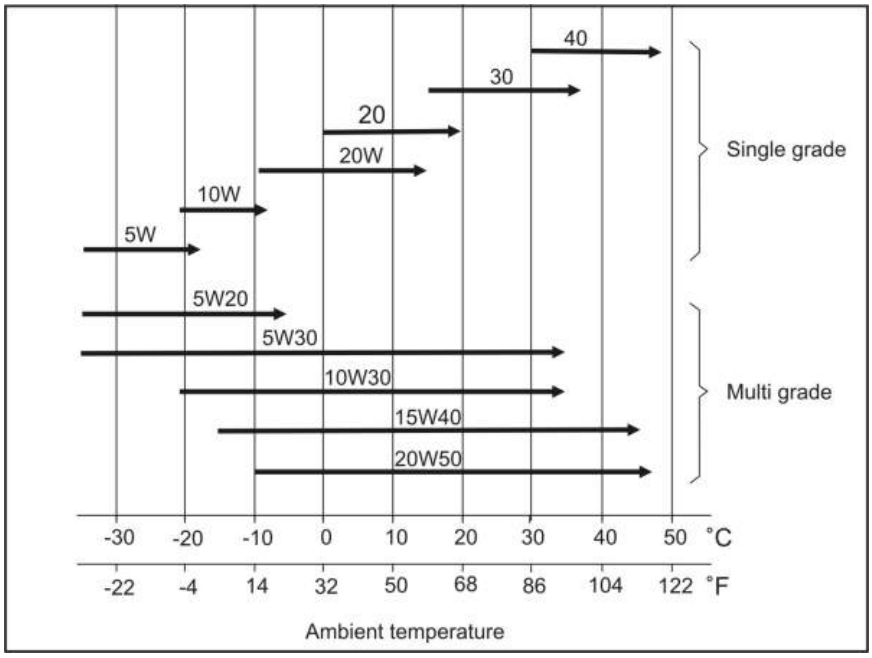


Figure 17 Suitable Oil Viscosity Chart

6.4. CHECKING LEVEL AND ADDING ENGINE OIL

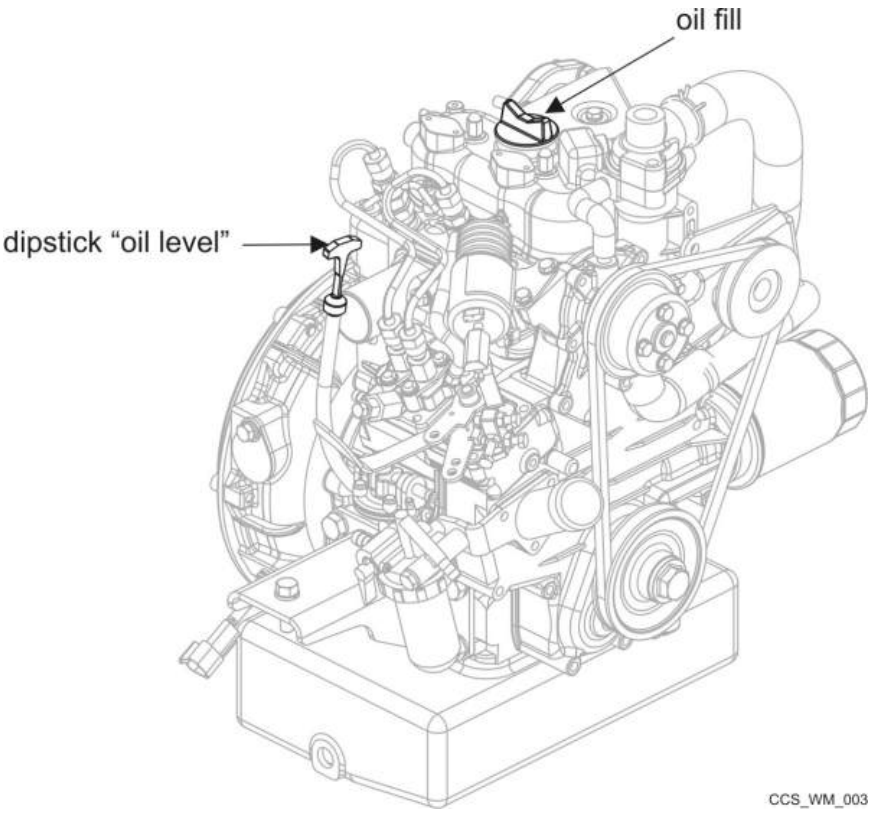


Figure 18 Checking/Adding Engine Oil

1. Check engine oil level before starting or more than 5 minutes after stopping engine.
2. Remove engine oil dipstick, wipe it clean and re-install it.
3. Remove dipstick and check oil level – see illustration.
4. If oil level is low, remove the oil filler plug and add new oil to the appropriate level.
5. After adding oil, wait more than 5 minutes to verify oil level. It takes some time for oil to fall into the oil pan.

NOTE – Be sure to check engine oil with engine on a horizontal surface. Placing the engine on gradients could result in inaccurate engine oil level readings.

6.5. CHECKING LEVEL AND ADDING COOLANT

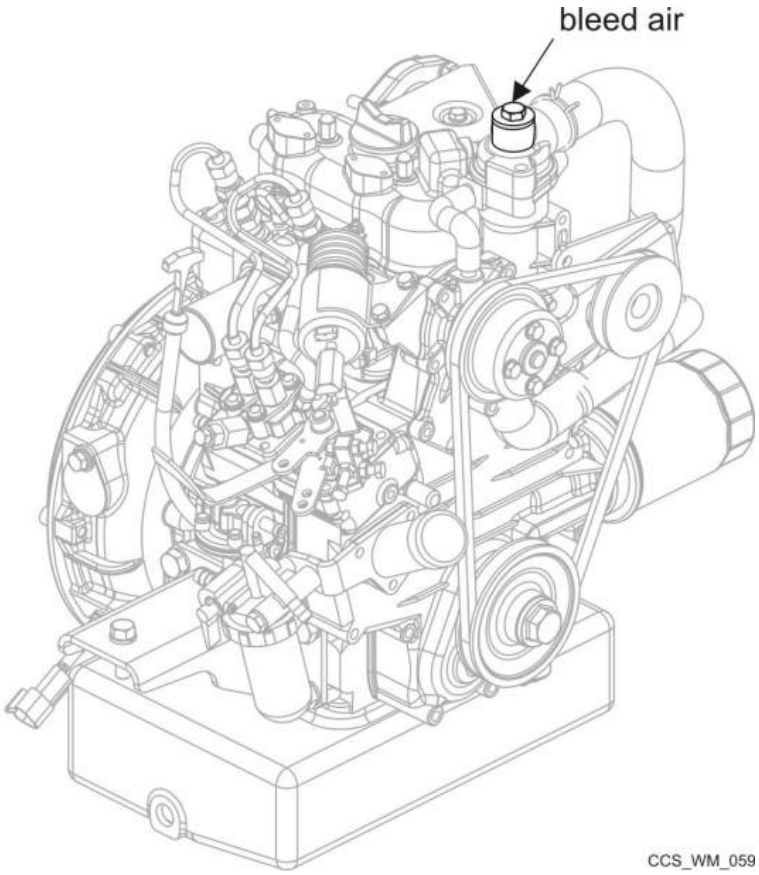


Figure 19 Checking/Adding Coolant

1. Fill truck's coolant reservoir.
2. Bleed air from APU engine.
3. Start truck and run for 5 minutes.
4. Start APU and run for 5 minutes.
5. Top up coolant.
6. Start APU and run for 30 minutes.
7. Check coolant level and top up if necessary.

6.6. CHECKING / ADJUSTING WATER PUMP BELT TENSION

To check water pump belt tension, proceed as follows:

1. Measure the deflection, depressing the belt halfway between the fan drive pulley and the belt tensioner pulley at 98N (10kgf, 22lbs) of force.
2. If the measurement is not the specified value, loosen the bolts and the nuts and relocate the belt tensioner to adjust.

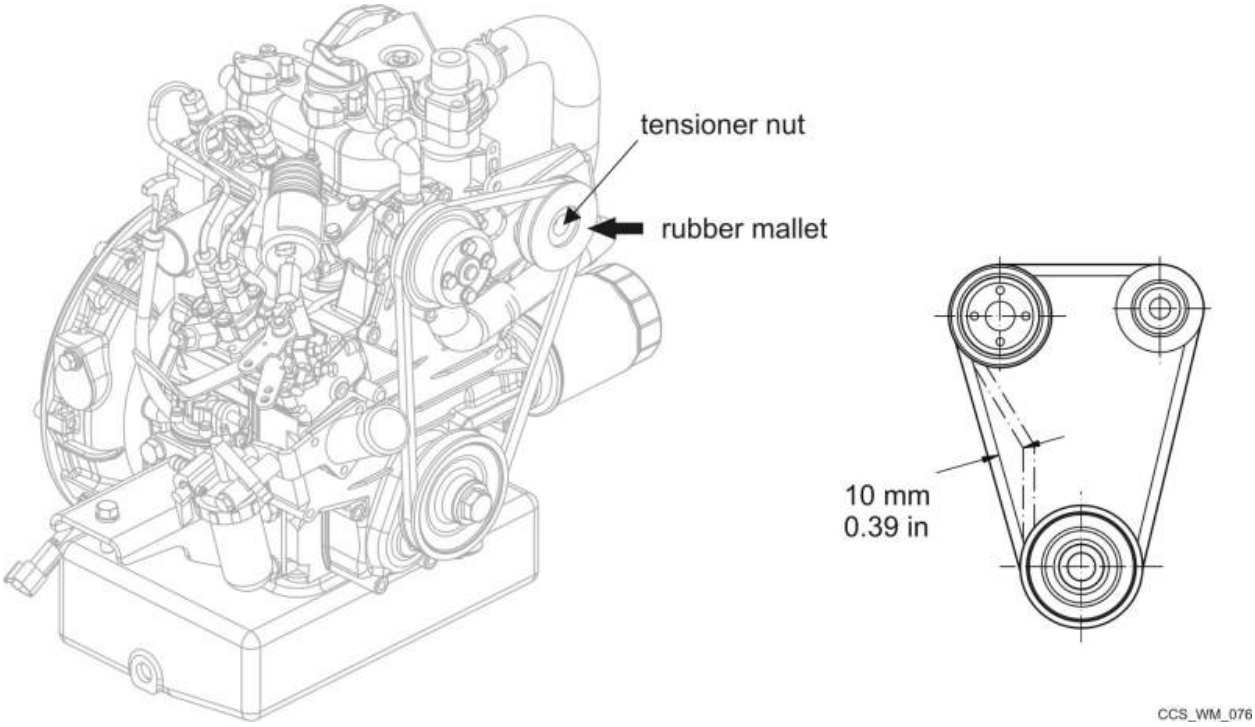


Figure 20 Checking/Adjusting Water Pump Belt Tension

To adjust water pump belt tension, proceed as follows:

1. Loosen tensioner nut using a 14mm wrench.
2. Tap the outside of the tensioner pulley using a rubber mallet to ensure proper spring tension.
3. Tighten tensioner nut using 14mm wrench.

6.7. REPLACING WATER PUMP BELT

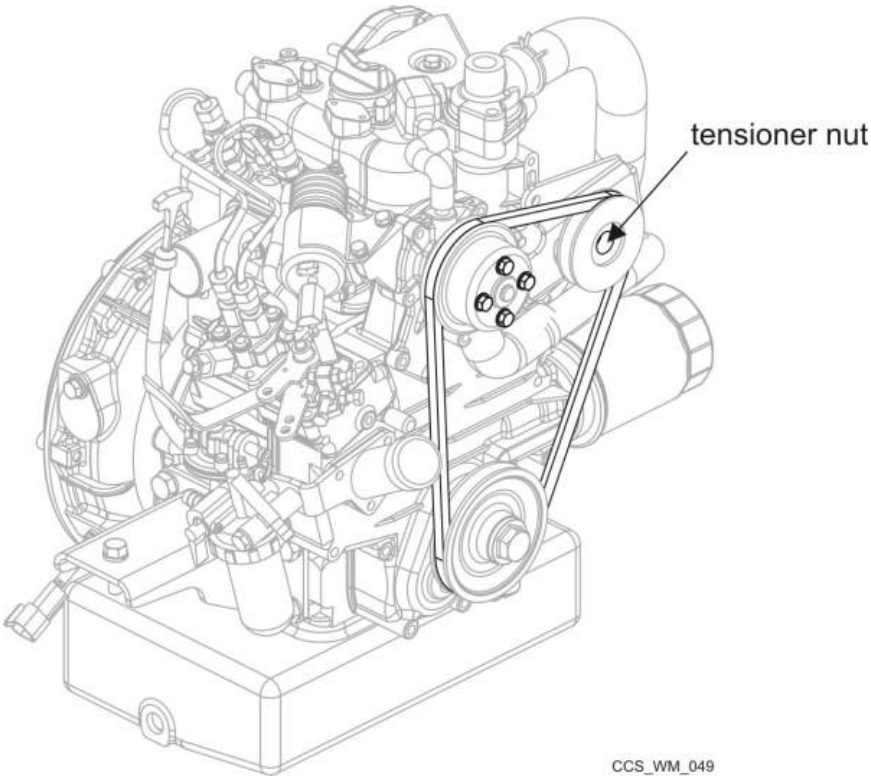


Figure 21 Replacing Water Pump Belt

To replace water pump belt, proceed as follows:

1. Loosen tensioner nut using a 14mm wrench.
2. Remove 4 water pump pulley bolts using 10mm wrench.
3. Replace belt.
4. Tighten 4 water pump pulley bolts using 10mm torque wrench.
5. Tighten tensioner nut using a 14mm wrench.

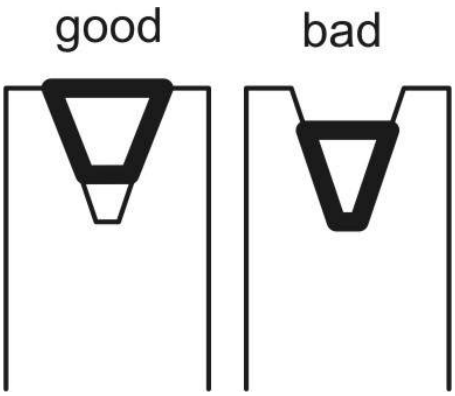


Figure 22 Belt Wear Determination

6.8. REPLACING AIR FILTER

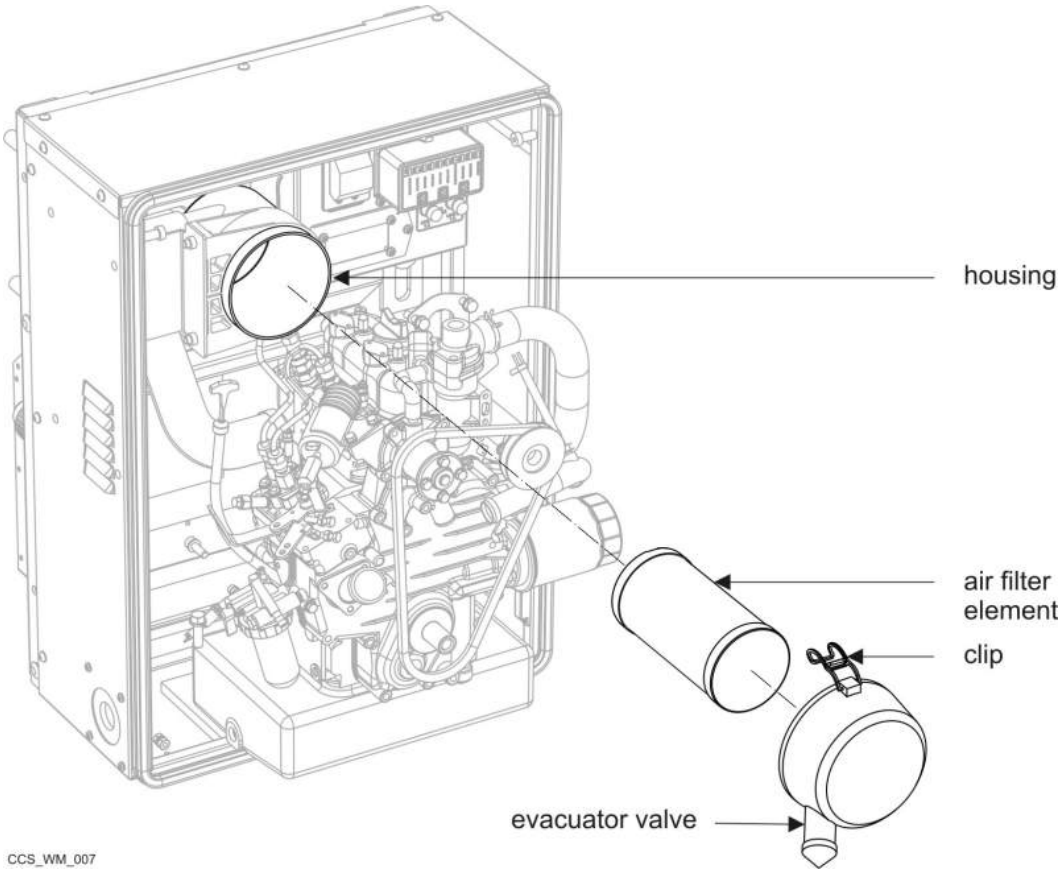


Figure 23 Replacing Air Filter

1. Replace engine air filter as per routine maintenance schedule or as necessary.
2. Release the two retaining clips on the side of the air cleaner housing cap.
3. Remove the old air filter element by pulling it straight out of housing.
4. Insert the new air filter.
5. Re-install air cleaner housing cap ensuring evacuator valve is pointing to the ground.

NOTE – Be careful not to knock dust from the dirty filter.

NOTE – Evacuator valve must point to the ground.

6.9. DRAINING WATER FROM SEDIMENT BOWL / CHANGING FUEL FILTER

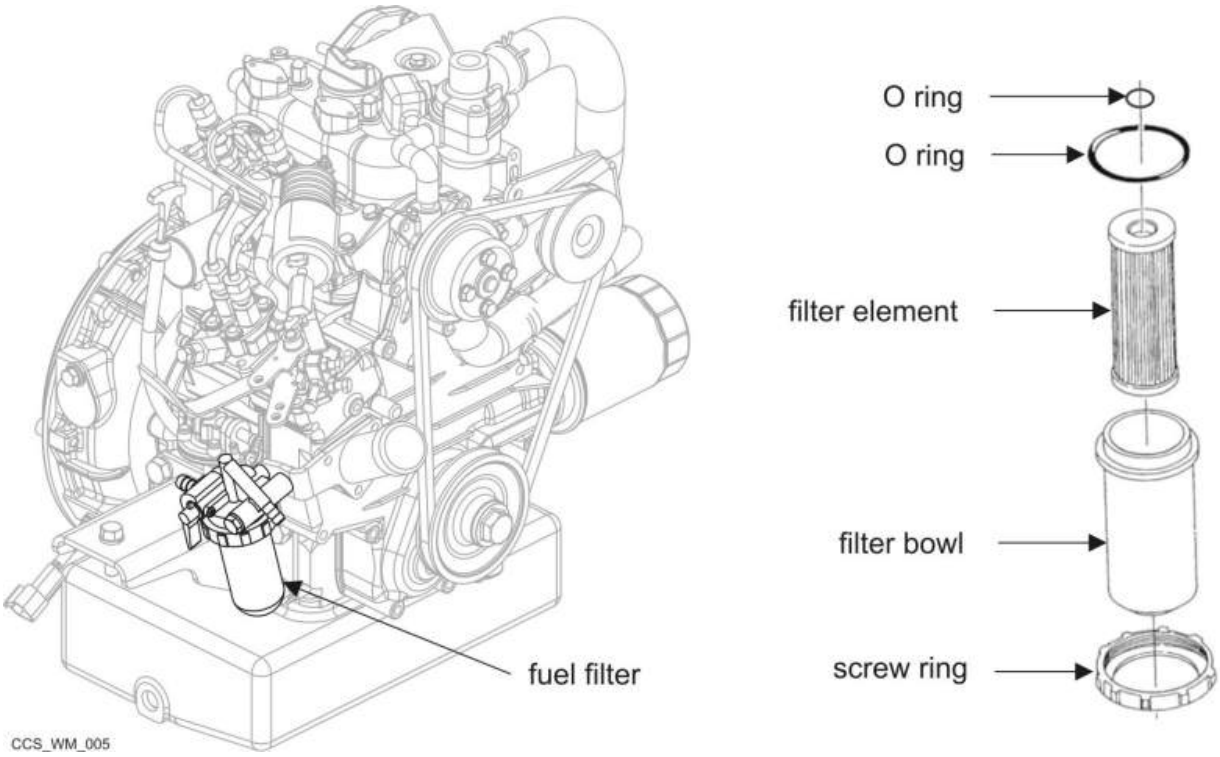


Figure 24 Draining Water From Sediment Bowl/Changing Fuel Filter

The fuel filter has been designed to trap water in the see-through fuel bowl. Periodically check bowl for presence of water.

To remove water/change fuel filter, proceed as follows:

1. Turn fuel valve on filter body to the horizontal “OFF” position.
2. Unscrew the fuel bowl retaining ring and remove the fuel bowl being careful not to spill any fuel.
3. Dispose of water in fuel bowl.
4. If fuel filter element is dirty or the running hours have reached the level in the routine maintenance schedule, remove the fuel filter element.
5. Install a new filter element if necessary. Make sure O-rings are properly re-installed.
6. Fill fuel bowl to approximately 2/3 before re-installing.
7. Install fuel bowl and tighten retaining ring.
8. Turn fuel valve to vertical “ON” position.
9. Run engine to check for fuel leaks. Repair if necessary.

6.10. BLEEDING THE FUEL SYSTEM

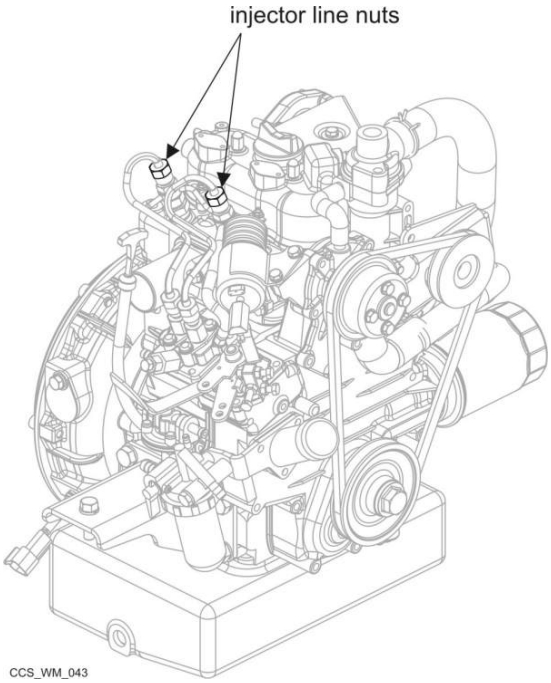


Figure 25 Bleeding the Fuel System

To bleed the fuel system, proceed as follows:

1. Loosen injection line nuts (using 17mm wrench).
2. Attempt to start the unit. Once fuel is observed, tighten both injector line nuts one at a time.

NOTE – The system will automatically attempt 3 start cycles. If it fails to start after 3 cycles, it will stop and display an “Over crank” message on the control panel display. Simply reset the system by pressing the START/STOP button. Press the START/STOP button again to re-initiate the start cycle.

6.11. CLEANING EVAPORATOR FILTER

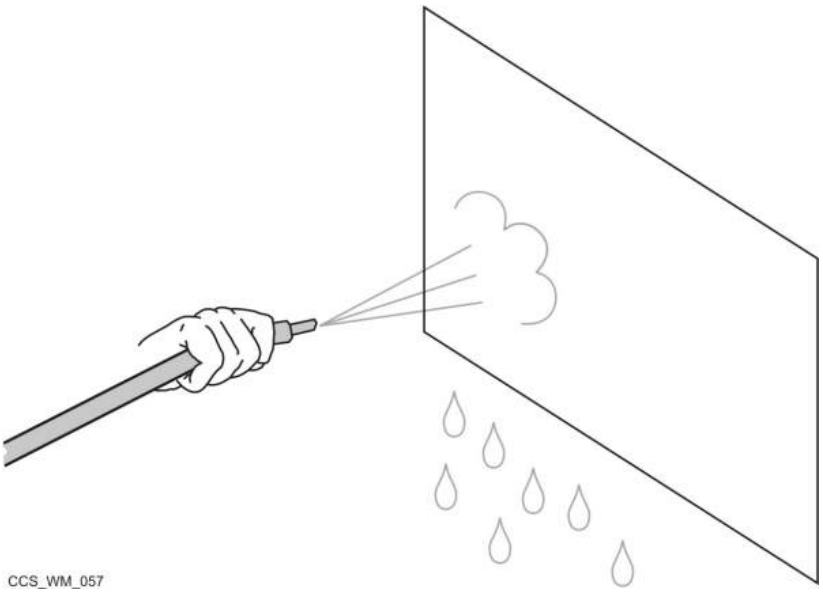
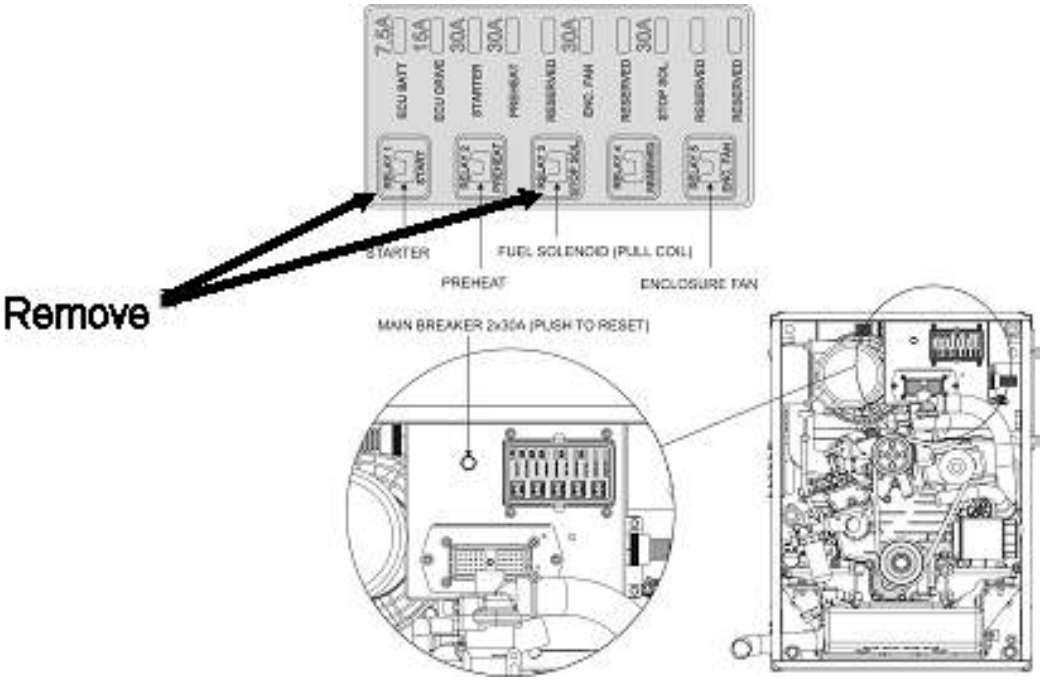


Figure 26 Cleaning Evaporator Filter

1. Pull out white filter retaining clips.
2. Remove filter.
3. Soak filter in soapy water.
4. Blow dry with compressed air.

7. TESTING

WARNING – Shock and entanglement hazard. Disable the starting circuit by removing the starter and fuel solenoid relays (Relay 1 and Relay 3) before servicing. Failure to follow this warning can result in property damage, personal injury or death.



7.1. APU

NOTE – The following must only be measured with the APU OFF and starting circuit disabled.

Table 11

Engine	3750RPM (no load)
Speed sensor	0 to 8.4VDC between signal (26) and ground (30)
Generator main windings*	0.343Ω to 0.348Ω between black wires #1 & #2 and between black wires #3 & #4 - no continuity to ground
Generator capacitor windings*	1.227Ω to 1.232Ω - no continuity to ground
Rotor windings*	0.735Ω to 0.755Ω - no continuity to ground
Diodes	- continuity in one direction, no continuity in other direction
Capacitor	50MFD at 370V - no continuity to ground
Oil pressure switch	Below 7 psi – switch is closed to ground Above 7 psi – switch is open

Overheat switch	Below 110ºC (230ºF) – switch is closed to ground Above 110ºC (230ºF) – switch is open
Engine bay temperature sensor	“Self-test”, use diagnostic mode
Coolant temperature sensor	“Self-test”, use diagnostic mode
Door switch	0 to 4.5VDC (no contact-contact)
Engine bay fan	5.6A, 75W, average 290cfm
Shutdown solenoid	V BATT / 46A (pull), 1.1A (hold) Rated: 20lbs pull / 40lbs hold
* These resistance values are very small and testing requires a good quality low resistance reading meter.	

7.2. HVAC

NOTE – The following must only be measured with the APU OFF and starting circuit disabled.

Table 12

Condenser fan	10K: 8 to 10A, 110W, 12VDC, average 600CFM 14K: 11 to 14.5A, 225W, 12VDC, average 1000CFM
Evaporator fan	1.6A, 185W, 115VAC, average 400CFM
Thermal heater breakers	Normally “closed”, open at 180, reset at 140°F
Thermal compressor breaker	Normally “closed”
Heat elements	10K: 14.4Ω, 1000W on low heat; 7.2Ω, 2000W on high heat 14K: 10.8Ω, 1333W on low heat, 5.4Ω, 2660W on high heat
Vent temp. sensor	“Self-test”, use diagnostic mode
Compressor line temp. sensor	“Self-test”, use diagnostic mode
Compressor	Check for continuity between the three windings and be sure there is no continuity from the winding to case.
NOTE – Compressor and refrigerant loops are sealed and are not serviceable. If a failure occurs within the refrigerant loop or one of its components, the entire sealed loop must be replaced.	

8. TABLES

8.1. GENERAL TORQUE SPECIFICATION

Table 13

Size	Grade 5		Grade 7		Grade 8	
	Lube	Dry	Lube	Dry	Lube	Dry
1/4-20	6.25 ft-lbs	8 ft-lbs	8 ft-lbs	10 ft-lbs	9 ft-lbs	12 ft-lbs
5/16-18	13 ft-lbs	17 ft-lbs	16 ft-lbs	21 ft-lbs	18 ft-lbs	25 ft-lbs
3/8-16	23 ft-lbs	30 ft-lbs	30 ft-lbs	40 ft-lbs	35 ft-lbs	45 ft-lbs
1/2-13	55 ft-lbs	75 ft-lbs	70 ft-lbs	95 ft-lbs	80 ft-lbs	110 ft-lbs
5/8-18	130 ft-lbs	170 ft-lbs	160 ft-lbs	210 ft-lbs	180 ft-lbs	240 ft-lbs

8.2. APU TORQUE SPECIFICATION

Table 14

Assembly	Thread	Setting
Flywheel bolts	M10 x 1.25	39.8 to 43.4 ft-lbs; 54.0 to 58.8 Nm
Stub shaft to flywheel bolts	M8 x 1.25	13.0 to 14.5 ft-lbs; 17.6 to 19.7 Nm
Rotor to stub shaft bolt	5/16” - 24	15 ft-lbs; 20.3 Nm
Flywheel housing bolts	M8 x 1.25	13.0 to 15.2 ft-lbs; 17.7 to 20.6 Nm
Engine feet bolts	M10 x 1.25	28.9 to 33.3 ft-lbs; 39.1 to 45.1 Nm
Stator bolts	1/4” - 20	8 ft-lbs; 10.8 Nm
Engine cradle bolts	5/16” x 18	18 ft-lbs; 24.4 Nm
Through frame bolts	5/8” - 18	100 ft-lbs; 135.6 Nm
Frame gripper bolts	5/8” - 18	30 ft-lbs; 47.5 Nm

***Consult engine service manual (S12020) for torque specifications of all engine components.**

9. DISASSEMBLING

9.1. REMOVING ENGINE AND GENERATOR FROM CHASSIS

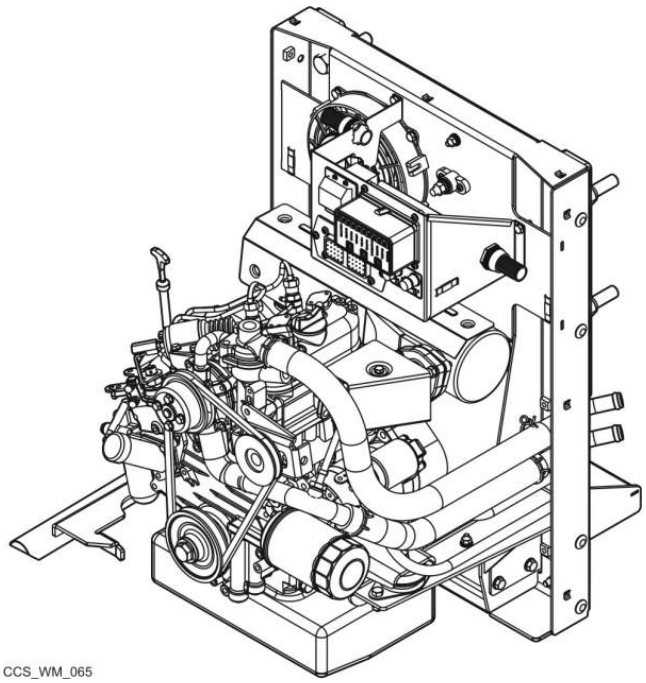


Figure 28 Engine and Generator

1. Pull out 150A main fuse at batteries.
2. Remove generator cover − eight bolts.
3. Remove alternator air intake shroud − four screws.
4. Disconnect capacitor plug.
5. Remove back plate − four stator nuts.
6. Re-install four stator nuts on to bearing housing assembly.
7. Disconnect stator wires from APU conduit wires by cutting apart the butt-splice insulated connectors. Be careful to mark the wires so that reconnections are correct.
8. Remove generator vibration mount bolts.
9. Remove negative cables from starter housing and re-install starter bolt.
10. Remove positive cables from starter solenoid.
11. Unplug starter solenoid signal wire #12.
12. Unplug coolant temperature sensor and cut wire tie.

13. Remove #17 wire from oil pressure switch.
14. Remove #15 wire from coolant temperature switch.
15. Unplug run solenoid (3-wire connector) and cut wire ties.

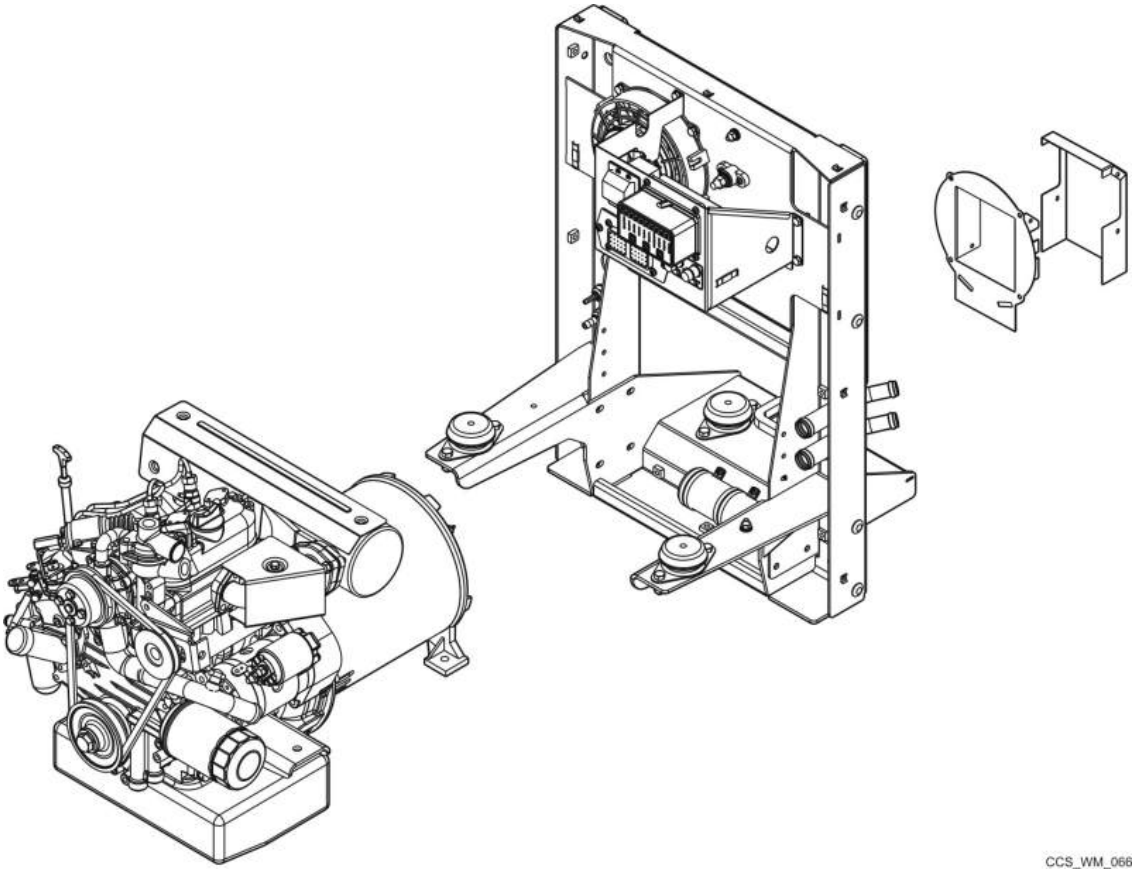


Figure 29 Removing Engine and Generator from Chassis

16. Unplug speed sensor (3 wires) and cut wire ties.
17. Pull main wire harness away from the engine and allow to hang from right side.
18. Remove air filter and intake hose (if necessary). Tape over engine intake to avoid debris from entering into the engine.
19. Undo spring clip and remove fuel inlet hose from low-pressure fuel pump. Cut wire ties.
20. Undo spring clip from fuel return hose from the tee closest to the truck frame.
21. Remove exhaust clamp from muffler and pry exhaust pipe from muffler.
22. Remove engine vibration mount bolts.
23. Drain APU/engine coolant.

24. Remove coolant inlet and outlet hoses from engine.

25. Remove engine/generator assembly from chassis using either an engine hoist and chains or a jack under the oil pan. (Be sure to secure engine/generator so that it cannot fall off jack).

9.2. REMOVING GENERATOR FROM ENGINE

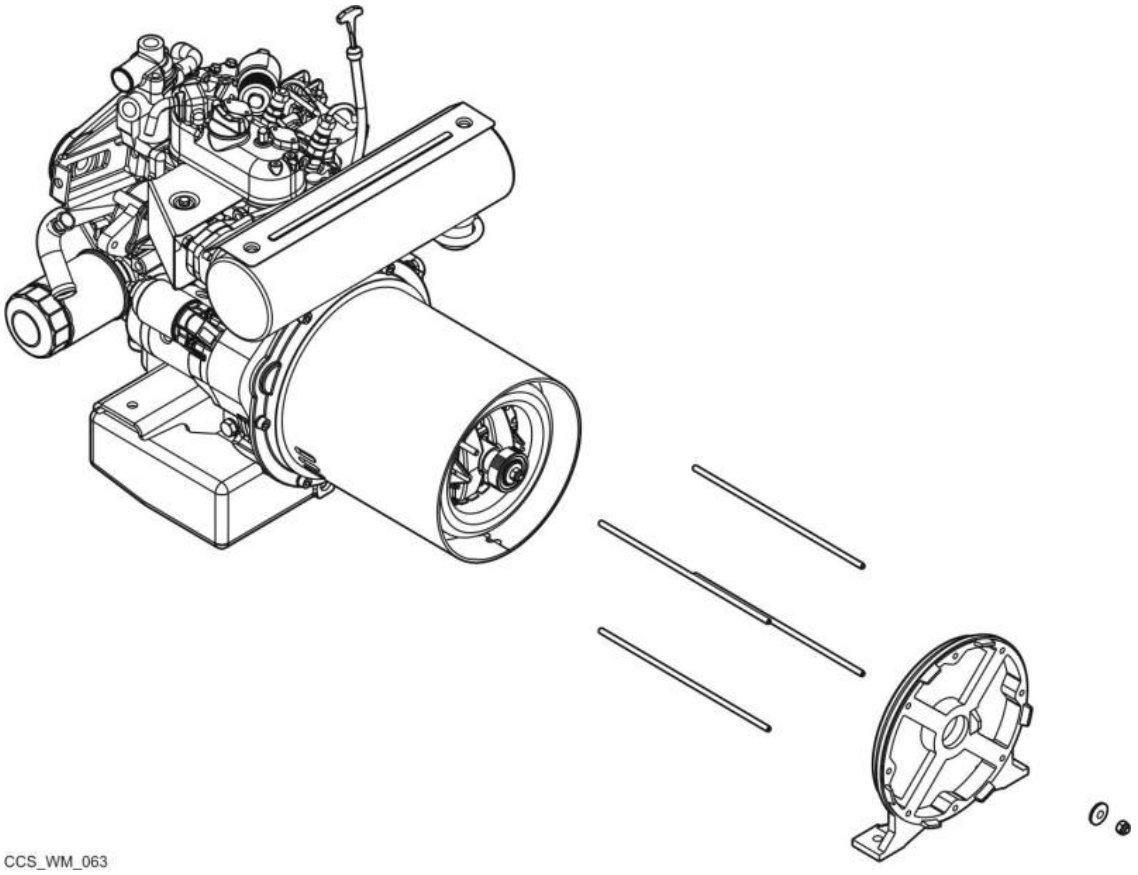


Figure 30 Removing Generator from Engine

1. Disconnect stator wires from conduit wires by cutting apart the butt-splice insulated connectors. Be careful to mark the wires so that reconnections are correct.

2. Remove all four stator through studs. Use two of the stator nuts to tighten one against the other and remove stud.

3. Support the stator with blocks of wood and remove the bearing housing. It is a tight fit on the stator so a puller may be required.

CAUTION – The stator is heavy and contact between the stator and rotor could damage the windings.

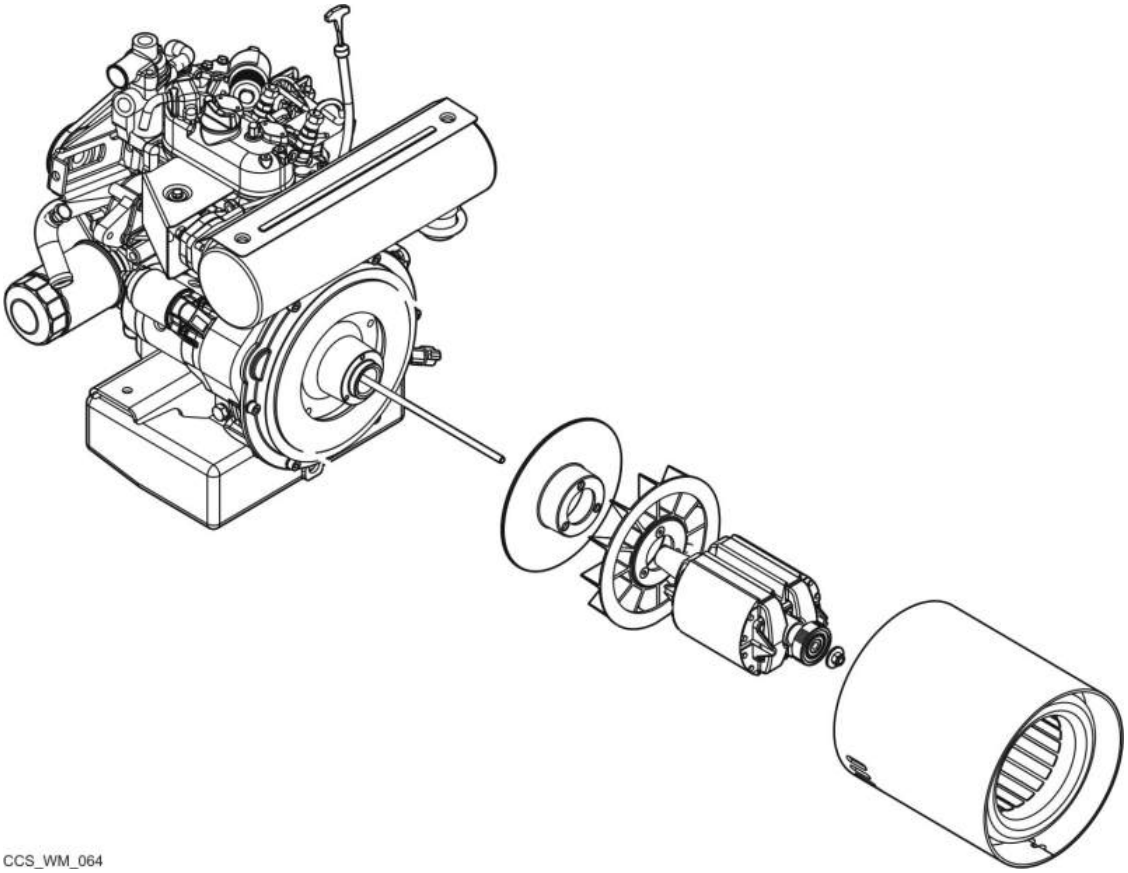


Figure 31 Removing Generator from Engine

4. Remove the stator. Pry the stator assembly away from the adapter plate using two small pry bars. Once the stator is free, remove the blocks and carefully pull the stator over the rotor and free it from the engine.

5. Remove the rotor nut.

6. Separate the tight fit of rotor shaft male taper and PTO shaft female taper using a dead blow plastic hammer. Give the rotor one or two sharp blows, and then alternate to the other side of the rotor with equal sharp blows. Repeat (switching sides) until the taper breaks free and the rotor can be removed.

7. If the rotor will not break free due to rust or corrosion between tapers, position the engine/rotor assembly straight up and spray penetrating oil straight down the hollow rotor shaft (it may be necessary to remove stud). Let sit overnight and proceed to repeat step 6.

9.3. HVAC UNIT

WARNING – Shock Hazard. Only trained technicians should service the high voltage components in this unit. High voltage circuits and components contain voltage levels that may cause equipment damage, electrical shock and/or deadly electrocution if handled incorrectly.

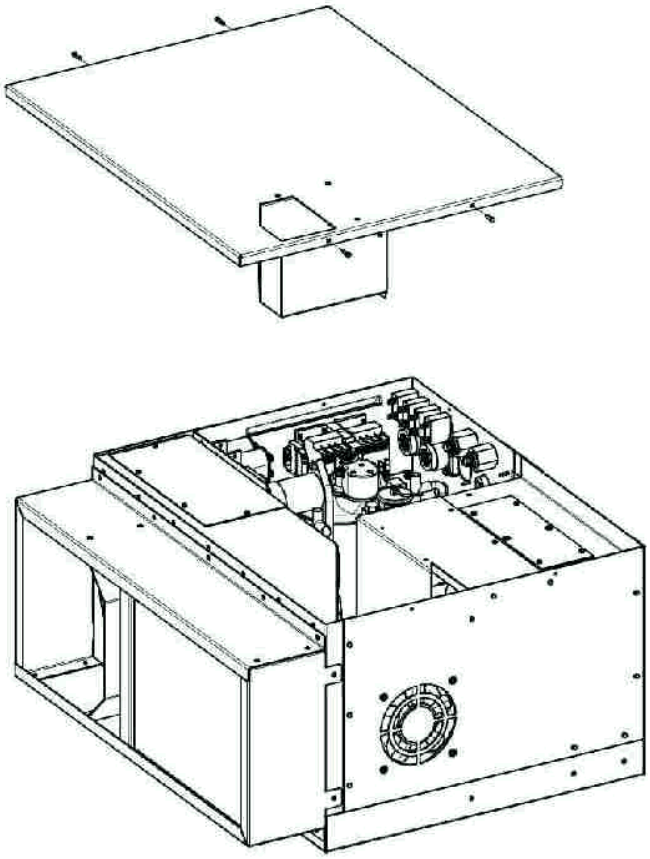


Figure 32 Disassembling HVAC Unit

1. Remove top cover - four screws

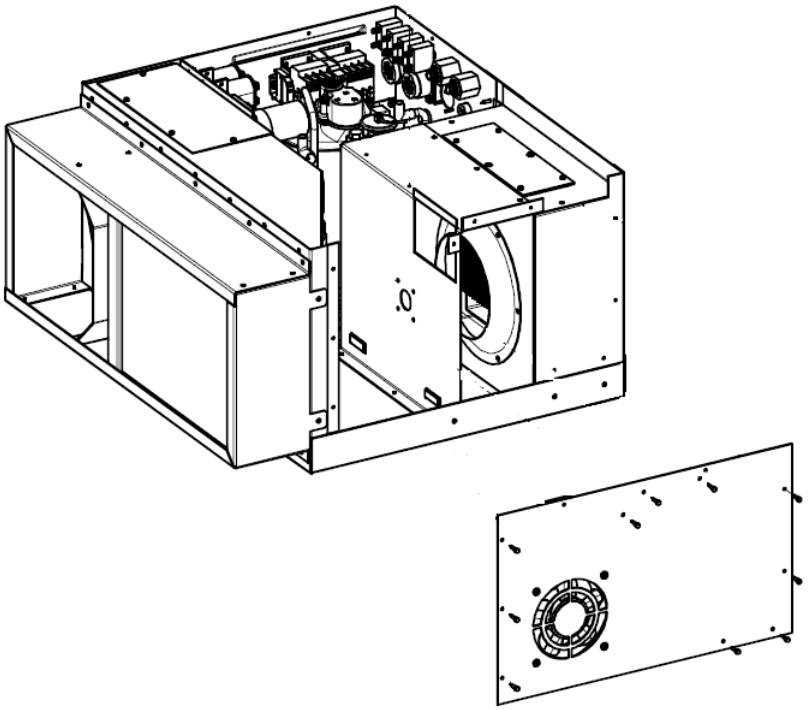


Figure 33 Disassembling HVAC Unit

2. Remove side cover − ten screws

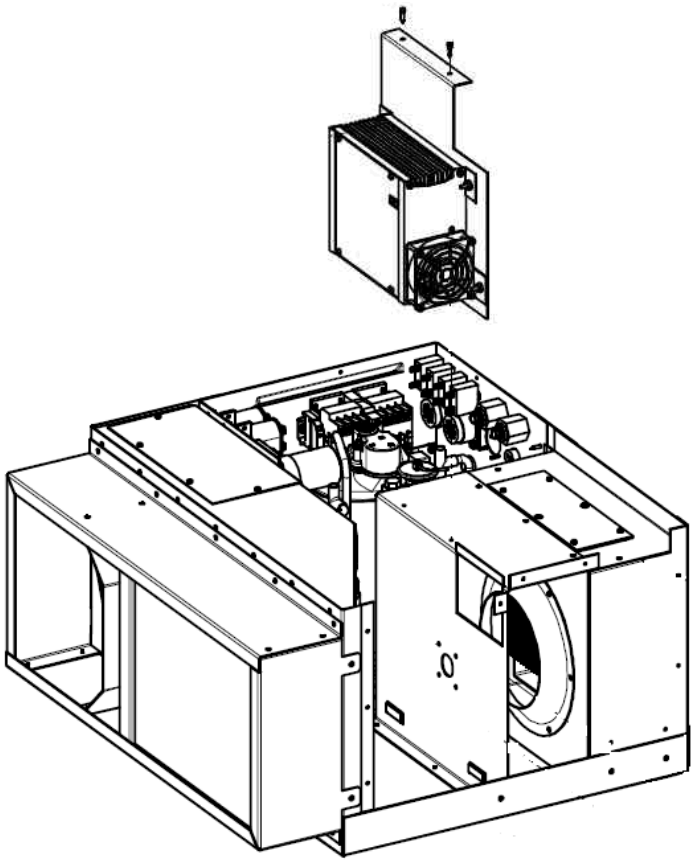


Figure 34 Disassembling HVAC Unit

3. Disconnect charger wiring.
4. Remove charger − two screws.

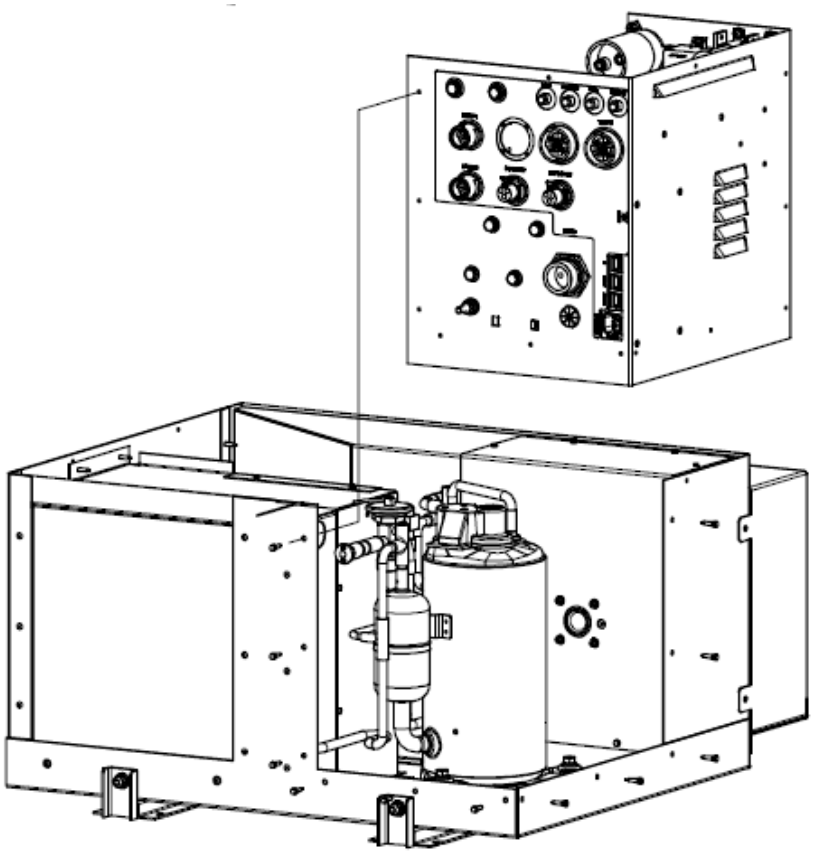


Figure 35 Disassembling HVAC Unit

5. Disconnect electronic mounting plate connections.
6. Remove electronic mounting plate − eleven screws.

10. REPAIR PROCEDURES

10.1. DIAGNOSING THE STATOR

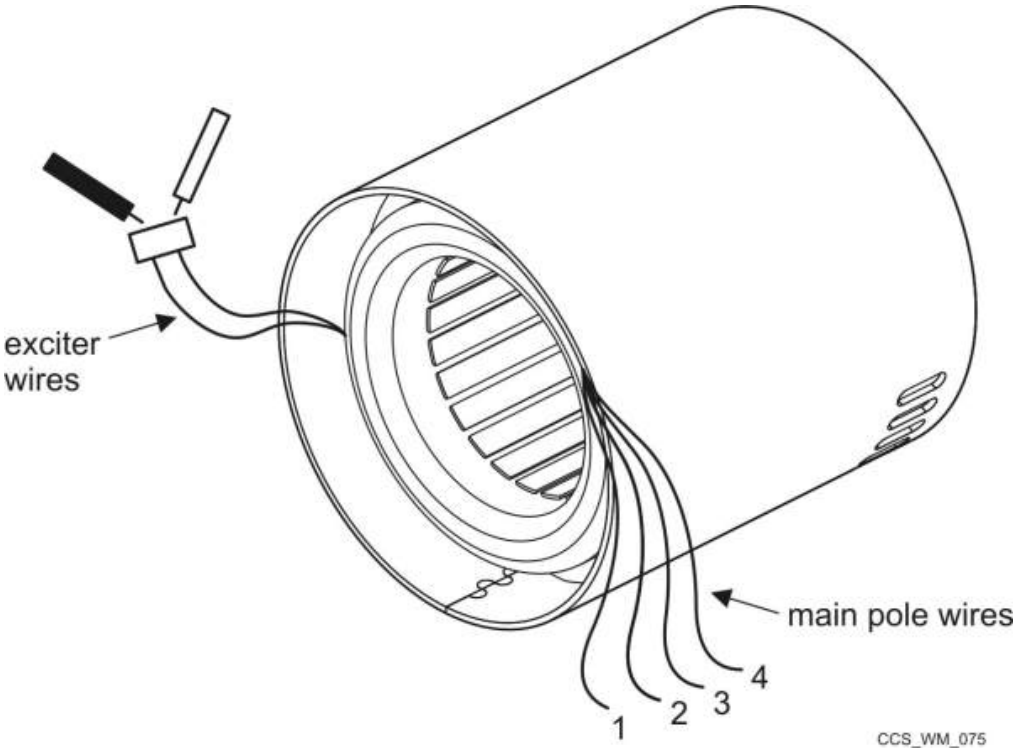


Figure 36 Diagnosing the Stator

The stator windings consist of two main poles and an exciter winding. There are four large black wires labelled 1-4 for the main poles and the exciter winding is connected to the capacitor via a short harness.

To test the stator, use an ohmmeter:

1. Place one meter lead on the main pole wire 1 and the other meter lead on the main pole wire 2 and compare the meter reading to the value found in the tests section of this manual.
2. Repeat this process using the main wires 3 and 4.
3. Repeat this process for the exciter winding using the pigtail harness that plugs into the capacitor.
4. Test for continuity between main pole wires and exciter winding.
5. Test for continuity between the two main poles.
6. Test all wires for continuity to case (ground).

10.2. DIAGNOSING THE ROTOR

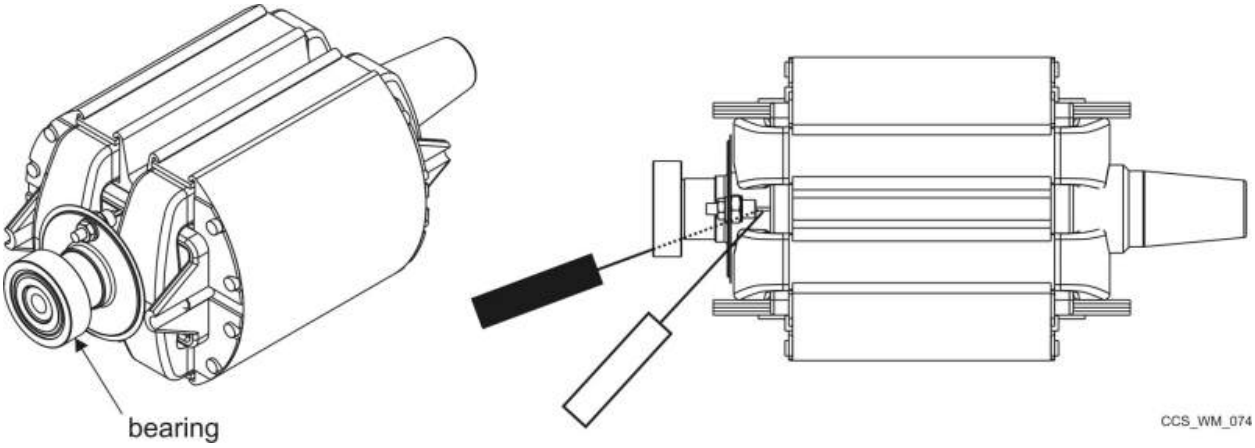


Figure 37 Diagnosing the Rotor

1. Visually inspect windings for dark streaks.

2. Place an ohmmeter across the solder connection of each diode. If the resistance does not compare with resistance values in test section of this manual, replace rotor.

3. Check bearing spin by hand. If it is rough, noisy or dry, replace bearing.

11. WIRING DIAGRAMS

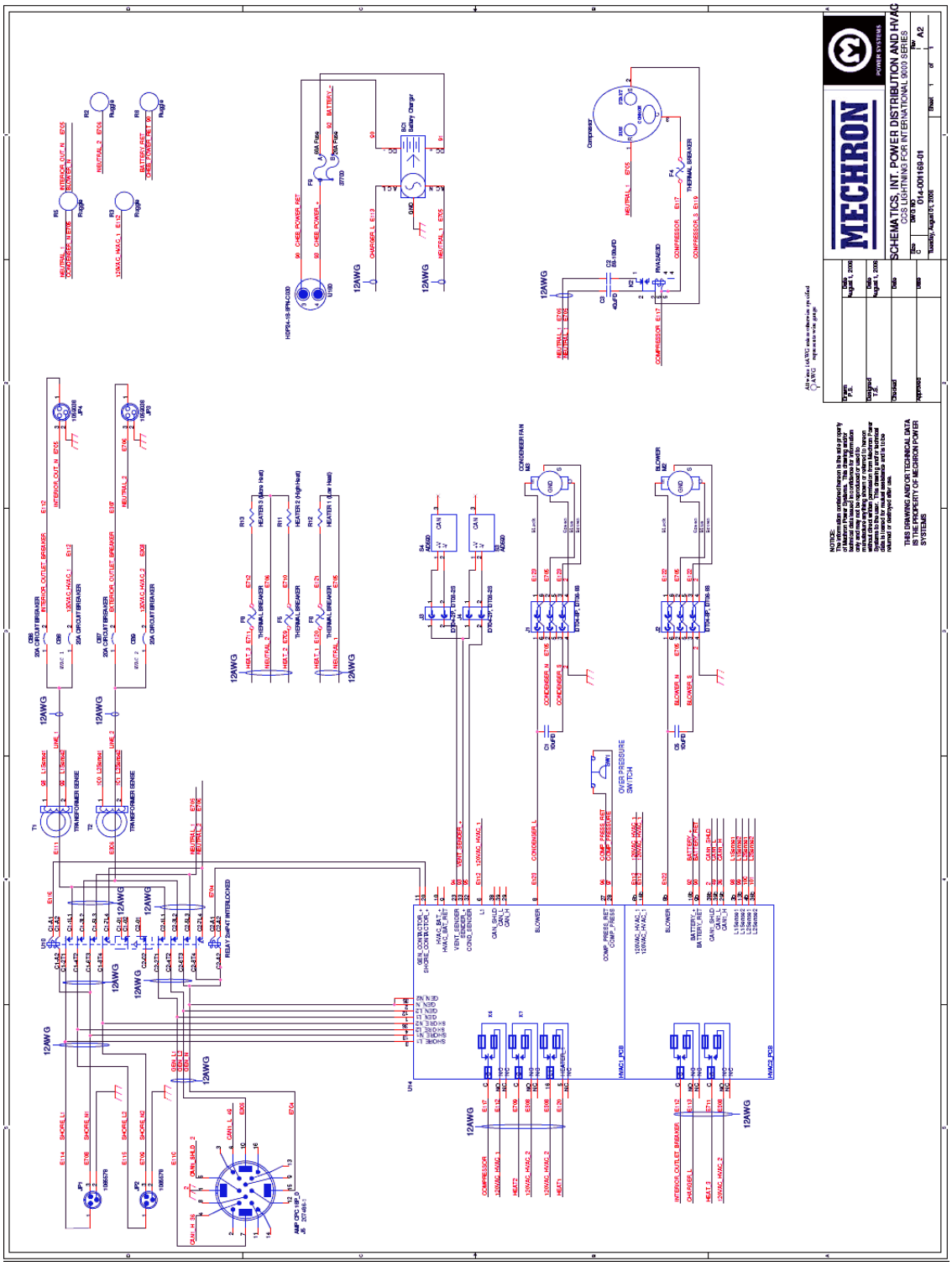
The wiring diagrams provided with this document are for reference purposes only.

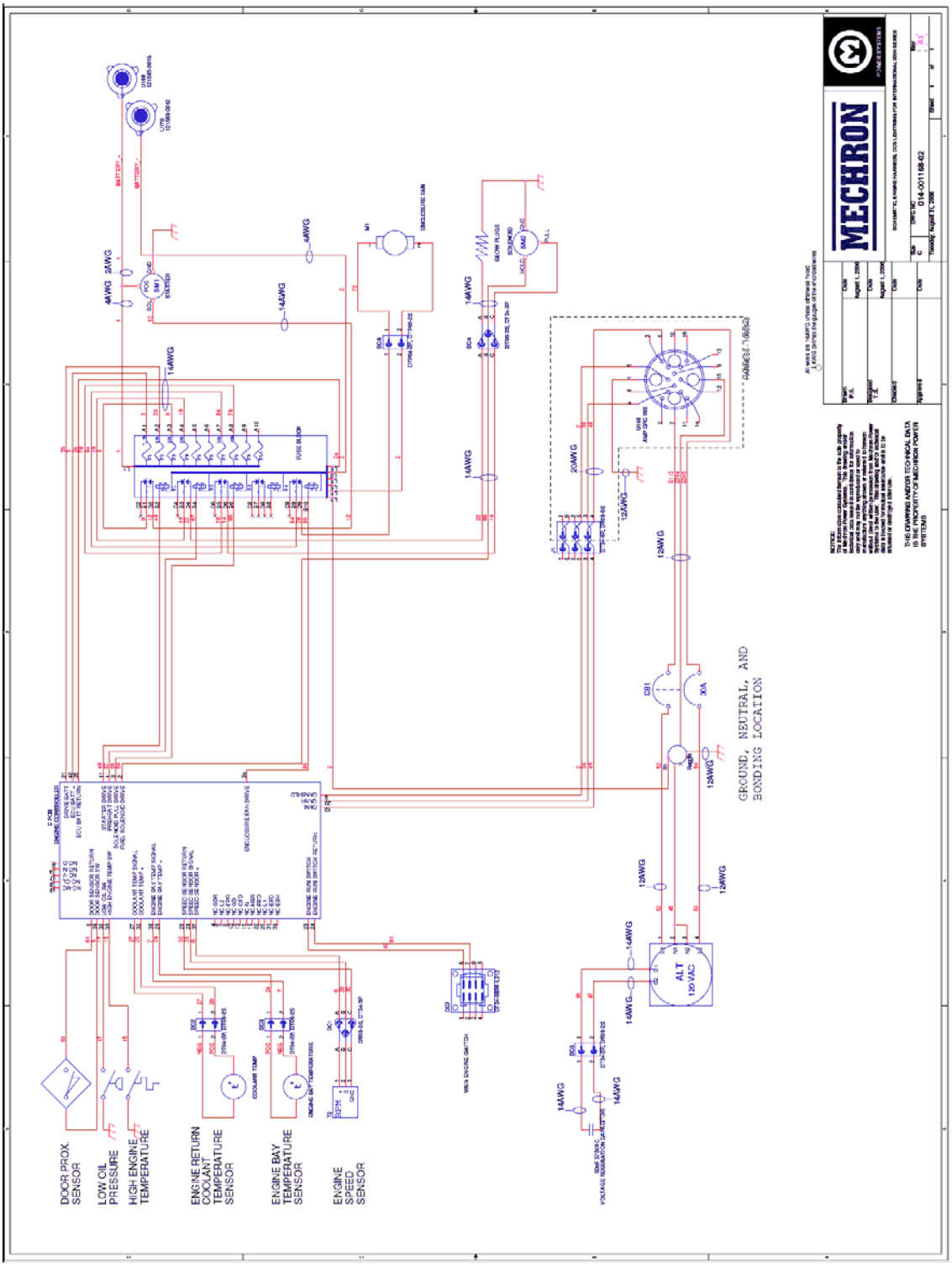
Before proceeding to diagnose or repair ANY wiring, call International Truck and Engine Corporation for approval.

Wiring diagnosis and repair should only be performed by a qualified technician or electrician.

NOTE – If the unit requires DC power for testing purposes, remove the relays to prevent unit from starting.

The following pages contain: HVAC UNIT WIRING DIAGRAM and POWER DISTRIBUTION WIRING DIAGRAM.


MECHRON
SCHEMATICS, INT. POWER DISTRIBUTION AND HVAC
COS LIGHTNING FOR INTERNATIONAL 9900 SERIES
014-001168-01
Tuesday, August 01, 2006
THIS DRAWING AND/OR TECHNICAL DATA IS THE PROPERTY OF MECHRON POWER SYSTEMS


MECHRON
DOOR PROX. SENSOR
LOW OIL PRESSURE
HIGH ENGINE TEMPERATURE
ENGINE RETURN COOLANT TEMPERATURE SENSOR
ENGINE BAY TEMPERATURE SENSOR
ENGINE SPEED SENSOR
GROUND, NEUTRAL, AND BONDING LOCATION
ALT 120 VAC
14AWG
12AWG
20AWG