



Service Manual



**APU Model
MTS-T4-6**



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S0.1 Preface

Scopes and Purpose

These are non-binding service procedures that are intended to support authorized “RigMaster APU” trained dealers and service personnel in the maintenance, installation and servicing of the Model MTS-T4-6 auxiliary power units.

These instructions apply to all class 8 O.T.R. vehicles, unless technical modifications on the vehicle influence the serviceability. Depending on the version and vehicle equipment, changes in procedure and diagnosis may be required that are set outside this manual. In any event the directives in the service manual must be followed and acknowledged engineering conventions must be observed when performing service and maintenance work. It is expected that the technician have a comprehensive set of tools and experience suited to automotive diagnostic and service work.

Definitions

NOTE

A **NOTE** describes important information necessary to properly complete a procedure, or information which will make the procedure easier to understand.

CAUTION

A **CAUTION** describes a special procedure or special steps which **must** be taken while completing a task. Disregarding a **CAUTION** may result in **damage** to the assembly.

WARNING!

A **WARNING** describes a special procedure or steps, which **must** be taken while completing the procedure where the warning is found. Disregarding a **WARNING** can result in **serious personal injury** or **death**.

Additional Publications

- “Model MTS-T4-6 APU Owners Manual”
- “Model MTS-T4-6 APU Installation Manual”
- “Model MTS-T4-6 APU Warranty Handbook”

Visit www.kohlerengines.com for Engine KDW702 Owner & Service Manuals.

Licensed dealerships may review and download additional publications by logging into their Dealer portal.

NOTE

Owner’s manuals and APU Parts Lists are publicly accessible and downloadable: go to www.rigmasterpower.com hold your cursor over the “customer support tab” and select “support materials”.

This manual is divided into sections by engine and assembly systems, with a section dedicated to the preventative maintenance of the APU. For detailed information on installation please refer to the “Model MTS-T4-6 APU Installation Manual”. For detailed information on engine service please refer to the Kohler Service Manual.

Read this entire manual prior to performing service and maintenance procedures. If you do not fully understand how to perform a process or procedure or require additional help please contact our Technical Support Department before proceeding.

Technical Assistance

Before calling for technical assistance please have ready the following:

1. Current MTS-T4-6 Service Manual
2. Model MTS-T4-6 Serial Number
3. Unit Hour Meter Reading
4. Service & Repair History (if available)

Technical Support is available by

Telephone: (888) 208-3101 or (416) 201-0040

Monday to Friday from 8:00 a.m. to 5:00 p.m. Eastern Standard Time

and

Website: www.rigmasterpower.com

(click: Customer Support, Support Materials, Technical Support)

S0.2 Safety

1. Zero Energy State

NOTE: ZERO ENERGY STATE

To perform service, maintenance and repairs you must disconnect the RigMaster from its battery source. In the recommended installation configuration the RigMaster shares the battery bank with the vehicle's main engine. Unplug the J1 harness at the power module before disconnecting the battery cables. After disconnecting the battery cables, check the battery posts inside the RigMaster engine cabinet to confirm there is no voltage to the auxiliary power unit (APU).

2. Safety Cover Switch

WARNING!: SAFETY COVER SWITCH

It is critical that this safety cover switch is never bypassed; failure to comply may result in serious injury.

Figure 0-1

Safety Cover Switch



The safety cover switch (See Figure 0-1) is designed to prevent the RigMaster Power APU from starting when the engine cover is loose or has been removed. When the cover is down, the switch is in the closed position. When the cover is open or loose, the switch is in the open position. The switch is located at the very top of the unit enclosure on the surge tank bracket.

3. AutoStart Automatic Start/Stop Feature

CAUTION: AUTOSTART FEATURE

Remember that a properly functioning RigMaster is capable of starting independently of its operator. If the AutoStart feature is enabled, battery voltage, temperature, and time of day can all cause the RigMaster's engine to start. Please see the cabin controller operating instructions for further information on the AutoStart feature. **You must deactivate this feature prior to refueling.**

4. Engine Hoist Points

NOTE: ENGINE HOIST POINTS

The Kohler engine has hoist points that are useful for removal and reinstallation of the engine. It is advised that these hoist points should only be used if no other means of lifting the unit are available.

5. Starting Aids

WARNING!

Do not use any type of starting aids such as ether. Such use could result in an explosion and personal injury, and will render the APU warranty null and void.

6. Starting with the Cover Off

CAUTION

Some installation or repair/diagnostic procedures require that the APU is started with the engine cover off. Do not deactivate or bypass the safety cover switch. Instead, have another individual assist by manually holding the safety cover switch down in the closed position for the duration of the procedure.

7. Inspection of the Safety Systems

The safety systems on the RigMaster APU should be examined and tested prior to performing any service work and at 50 hour intervals to ensure that they are in good condition and proper working order.

8. Safe Working Practices

Safe working practices are your responsibility. The use of protective safety equipment is mandatory when performing inspections, service, diagnostics and repairs on the RigMaster APU. Follow your local regulations and guidelines regarding occupational health and safety.

9. Contact Us

If you do not fully understand this safety information contact RigMaster's Technical Support Department toll free at (888) 208 – 3101 before proceeding with the operation or service of this APU.

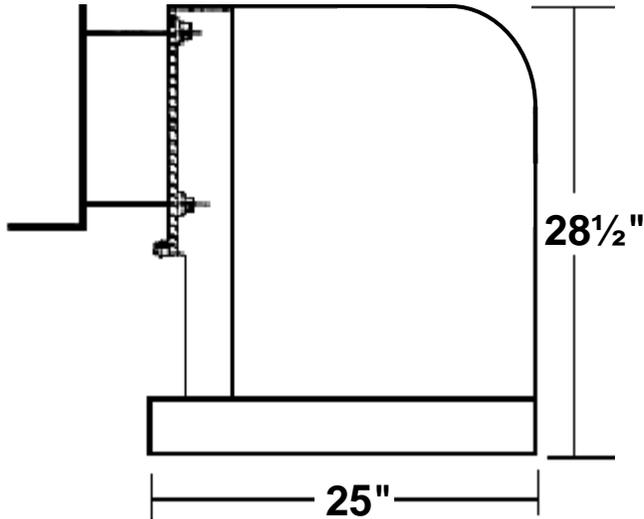
Section 1 Specifications

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S1.0 APU Dimensions

APU	SPECIFICATIONS
Certified Weight	410 lbs.
Heating Capacity	13,500 BTU
Air Conditioning Capacity	24,000 BTU
DC Charging Capacity	12 Volt, 60 Amp.

Figure 1-1



ENGINE ENCLOSURE

Width 25"
Height 28½"
Depth 25" Overall

Figure 1-2



HVAC UNIT

See Figure 1-2

24,000 BTU
Width 15½"
Height 8½"
Depth 12½"
Blower Motor 600 CFM

S1.1 Fluid Capacities and Requirements

OIL	S.A.E./(S.I.)
Volume	5 Liters / 5.3 US Quarts
Type	API CF4 - CG4 Oil
Viscosity	Variable: See Figure 1-3

NOTE

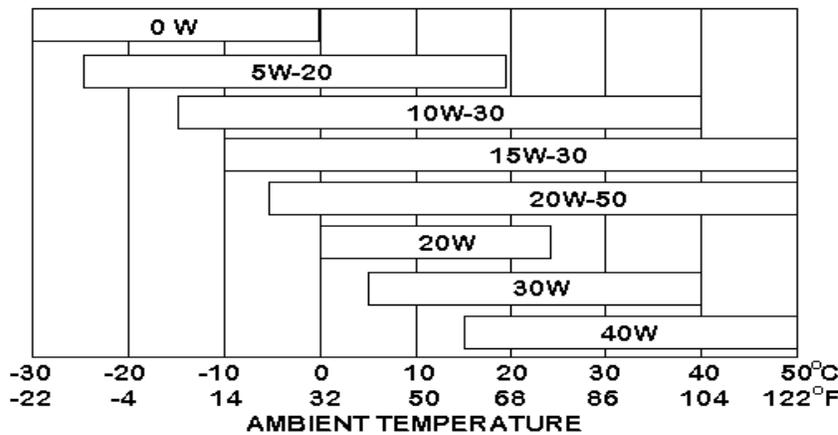
Recommended Lubricant for Fuel with Low Sulfur Content: API CF4 - CG4 (Regions in which diesel normally has a low sulfur content: Europe, North America, and Australia).

CAUTION

- Consult a RigMaster Dealer about the use of synthetic oil in your RigMaster.
- Service intervals for oil and oil filter replacements are 1000 hours.
- Synthetic oil is suitable for use; however, it is recommended that mineral-based oils are used for the break-in period.

Oil Viscosity vs. Temperature

Figure 1-3



10W30 and 15W40 are the most commonly used grades of oil.

Low viscosity oil must be used in lower temperatures.

ENGINE COOLANT	TYPE
Engine Coolant	50/50 mixture of ethylene glycol based, “low silica”, “diesel specific” antifreeze and distilled water. Use only coolants suitable for aluminum core radiators.

FUEL	SPECIFICATIONS
Fuel Type	Ultra Low Sulfur Diesel (ULSD)
Biodiesel	Tier 4 engines – 20% R.M.E.

Use of Biodiesel Fuel

Fuels containing less than 20% methyl ester or B20, are suitable for use in this engine. Biodiesel fuels meeting the specification of BQ-9000, EN 14214 or equivalent are recommended. Additionally:

- No mixture above the listed percentage for the Tier 4 engine is acceptable, as this can result in filter blocking.
- Fuel storage must be to recommended standards, to avoid the absorption of water, and degradation. In any event, storage should not exceed twelve (12) months. Fuel degradation, if allowed to occur, can result in the corrosion of metallic components, and the premature failure of seals.
- RME is a powerful solvent. Damage may occur if it comes into contact with paint.

CAUTION

DO NOT use vegetable oil as a biofuel for this engine.

No legal liability can be accepted for failure attributable to operating products with fuels for which the products were not designed, and no warranties or representations are made as to the possible effects of running these products with such fuels. Non-compliance of the fuel to agreed standards, whether being evident by appearance of the known degradation products of these fuels, or their effects within the fuel injection equipment, will render the manufacturer's guarantee null and void.

If you require further information, please contact your local RigMaster Dealer.

S1.2 Air Conditioning Specifications Quick Reference – See Section 11

The RigMaster air conditioner is also fully automatic. A constant comfort zone is maintained with the temperature selector setting (see Cabin Controller Operating Instructions). The RigMaster air conditioner is an R134a system that is not integrated into the vehicle's existing air conditioning system.

WARNING!

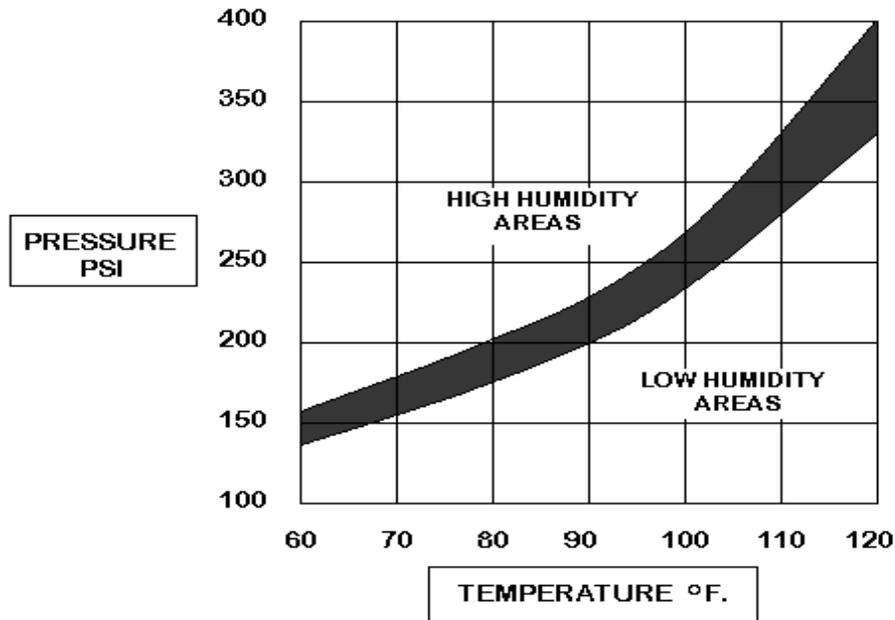
ONLY CERTIFIED AIR CONDITIONING TECHNICIANS SHOULD SERVICE THE AIR CONDITIONER.

HIGH PRESSURE VS. TEMPERATURE READINGS

High temperatures and pressures are approximate.
Readings within 10-15% (See Figure 1-4) will deliver acceptable performance.

Air Conditioning Performance

Figure 1-4



SUCTION PRESSURES – LOW SIDE

Usual low side pressure 15-40 PSI depending on outside temperature and humidity.

DISCHARGE PRESSURES – HIGH SIDE

Usual high side pressure 150-300+ PSI depending on outside temperature and humidity.

AIR CONDITIONING	SPECIFICATIONS
Refrigerant Type	R134a
Volume of Refrigerant (24,000 BTU HVAC)	1.0 lb.; (16 oz.; 0.4 Kg.)
Compressor Oil Type	SP46 to 100 PAG Compressor Oil
Compressor Oil Capacity (already filled with 3.3 oz.; add an extra 2 oz. at time of charging)	6.3 fl. oz.; (186.3 cc.; 186.3 mL.)
Evaporator Temperature Switch	Range = 30°F to 42°F (-1°C to 7°C)
Binary Pressure Switch	Range = 28 to 450 psi

S1.3 Other Technical Specifications

This section lists only basic information about the Kohler engine. Please see the Kohler Service Manual for detailed information on engine specifications.

KOHLER ENGINE		SPECIFICATIONS
Cylinders		Qty. 2
Bore		75 mm
Stroke		77.6 mm
Displacements		686 cm ³
Compression rate		22.8:1
APU HP		10.5
APU RPM		@ 2400
Maximum Power	N 80/1269/CEE-ISO 1585	12.5 (17.0)
	NB ISO 3046 - IFN	11.7 (16)
	NA ISO 3046 - ICXN	10.7 (14.5)
Maximum torque at NB power		40.5 Nm
		@ 2000 RPM
Maximum Torque Available @ N° 3 PTO 3600 RPM		37@1800 Nm
Specific fuel consumption referred to NB power		320 g/KWh
Oil consumption measured at NA power		0,009 Kg/h
Dry weight of engine		66 Kg (145.5 lbs.)
Combustion air volume at 3600 RPM		1240 l./1'
Cooling air volume at 3600 RPM		43 m ³ /mm
Axial load allowed on crankshaft (both directions)		300 Kg
Maximum Tilt	Instant operation (up to 1 min.)	35° α
	Intermittent operation (up to 30 min.)	25° α
	Permanent operation	Depends on application

SENSORS/SWITCHES		SPECIFICATIONS
Quick Reference		
Oil Pressure Switch (Normally Open)		Switch Open – Normal Pressure
		Switch Closed – Low Pressure (less than 5.7 psi)
Engine Temperature Switch (Normally Open)		Switch Open – Normal Temperature less than 230°F (110°C)
		Switch Closed – High Temperature more than 230°F ± 5°F (110°C ± -15°C)
Safety Cover Switch		Switch Open – Cover is Off
		Switch Closed – Cover is On
Coolant Low Volume Float Switch (Normally Open)		Switch Open – Coolant Full
		Switch Closed – Coolant Low
Evaporator Thermostatic Switch		Switch Open – Evaporator 31°F ± 2°F (-0.5°C ± -16°C)
		Switch Closed – Evaporator 39.5°F ± 2°F (4°C ± -16°C)
Binary Safety Pressure Switch		Closed between 28 and 450 psi



**Kohler Engine (KDW 702)
Figure 1-5**

Section 2 Maintenance

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S2.0 Introduction to Maintenance

The following service procedures describe the replacement of basic service components and general maintenance of the MTS-T4-6. The maintenance schedule must be adhered to in order to maintain the manufacturers' warranties. Do not use unapproved cross-reference parts while performing maintenance or repair.

The maintenance checklist S2.2 mentions service procedures for MTS-T4-6's equipped with the optional Diesel Particulate Filter (DPF). These DPF maintenance items only apply to MTS-T4-6 units equipped with DPF's.

S2.1 Maintenance Schedule

The first oil change must be performed at **100 hours** of service and at 1000 hour intervals thereafter. Please read the following chart for detailed information.

The maintenance schedules are for **Normal** road conditions and the specific hour intervals must be adhered to in order to maintain the manufacturers' warranties. For **SEVERE** conditions perform the scheduled maintenance sooner.

SCHEDULED INTERVALS IN HOURS				MAINTENANCE ITEMS
50	250	500	1000	
X	X	X	X	Check coolant level.
X				First Engine Oil Change.
X	X	X	X	Check APU for leaks/damage; repair if found.
	X			Inspect Fan Belt Condition/Adjustment.
	X			Inspect Serpentine Belt for wear.
X	X	X	X	Check all Fasteners for tightness.
		X		Valve Clearance Inspection. Intake and Exhaust valve clearance are both 0.0078".
		X	X	Vibration Mounts – pry up on the engine mount plates, there should be less than 1" of upward movement.
			X	Change Engine Oil and Filter. ¹
		X	X	Check HVAC unit filter; clean if necessary.
		X	X	Clean engine compartment, condenser, and radiator. Use compressed air or liquid degreaser.
		X		Check engine air filter; change if necessary.
			X	Check fuel filter; change if necessary.
	X	X	X	Check fan belt; change if necessary. ²
			X	Check serpentine belt; change if necessary. ²
			X	Check coolant concentration; renew if necessary.
*** 4000 Hrs. - Timing Belt Replacement ***				

NOTE

The use of conditioner may extend the service life of belts; consult the belt manufacturer for more information on the maintenance belt.

¹ Recommended Lubricant for Fuel with Low Sulfur Content: API CF4 - CG4
(Regions in which diesel normally has a low sulfur content: Europe, North America, and Australia).

² The use of conditioner may extend the service life of belts; consult the belt manufacturer for more information on belt maintenance.

S2.2 Maintenance Checklist

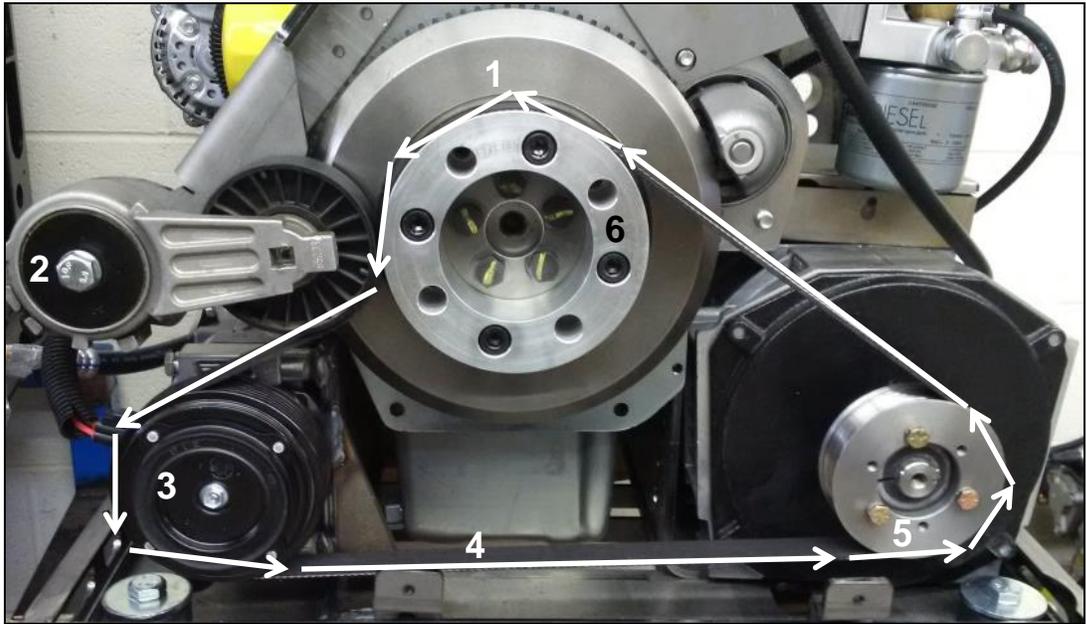
Date:	Model No:	Serial No:
Hours:	Performed By:	Work Order No.
Change Oil and Filters		Comments
Change oil and filter <input type="checkbox"/>		
Change fuel filter <input type="checkbox"/>		
Check air filter replace if needed <input type="checkbox"/>		
Use compressed air to clean radiator and condenser <input type="checkbox"/>		
Check for loose brackets, door seals and straps		
Compressor mounting bolts <input type="checkbox"/>		
Alternator mounting bolts <input type="checkbox"/>		
Check door seal and tie-down straps <input type="checkbox"/>		
Adjust Drive Belts		
Fan/Alternator belt <input type="checkbox"/>		
Serpentine belt <input type="checkbox"/>		
Inspect the engine mounts for wear <input type="checkbox"/>		
Check the engine mounts for wear <input type="checkbox"/>		
Check Electrical Connections		
Positive and negative post studs at the backing plate on the RigMaster for loose connections or corrosion <input type="checkbox"/>		
APU engine ground check for loose connections or corrosion <input type="checkbox"/>		
Check wiring harness for damage/corrosion i.e. fuses, relays, and other points of connection <input type="checkbox"/>		
Positive and negative cables at the truck's batteries for loose wires or corrosion <input type="checkbox"/>		
Cooling System		
Run APU with heating set to 85°F (29°C): check for leaks <input type="checkbox"/>		
Check coolant concentration <input type="checkbox"/>		
HVAC Unit		
Clean HVAC filter <input type="checkbox"/>		
Change the temperature on the controller and make sure the blower motor is blowing heat <input type="checkbox"/>		
Change the temperature on the controller and make sure the blower motor is blowing cold air <input type="checkbox"/>		
Check all cables at the HVAC unit making sure there is no stress on the cables <input type="checkbox"/>		
Re-assemble and run the unit		
Check alternator output (max output 13.5 - 14.8 DCV) <input type="checkbox"/>		
Exhaust System – Check for leaks, loose hardware loose brackets or physical damage to the filter itself <input type="checkbox"/>		
Driver Comments		

S2.4 Serpentine Drive Belt

RigMaster APU's are equipped with a serpentine drive belt that drives the air conditioning compressor and the generator from the flywheel of the engine.

Figure 2-1

Serpentine Belt rotation is Counter-clockwise.



#	COMPONENT	PART #
1	Flywheel	ED0098816150-S
2	Auto Tensioner	RP8-106
3	Compressor (includes pulley)	LG9-004
4	Serpentine Belt	KT8-001
5	Generator Pulley	KT8-002
6	Flywheel Drive Pulley	KL8-001

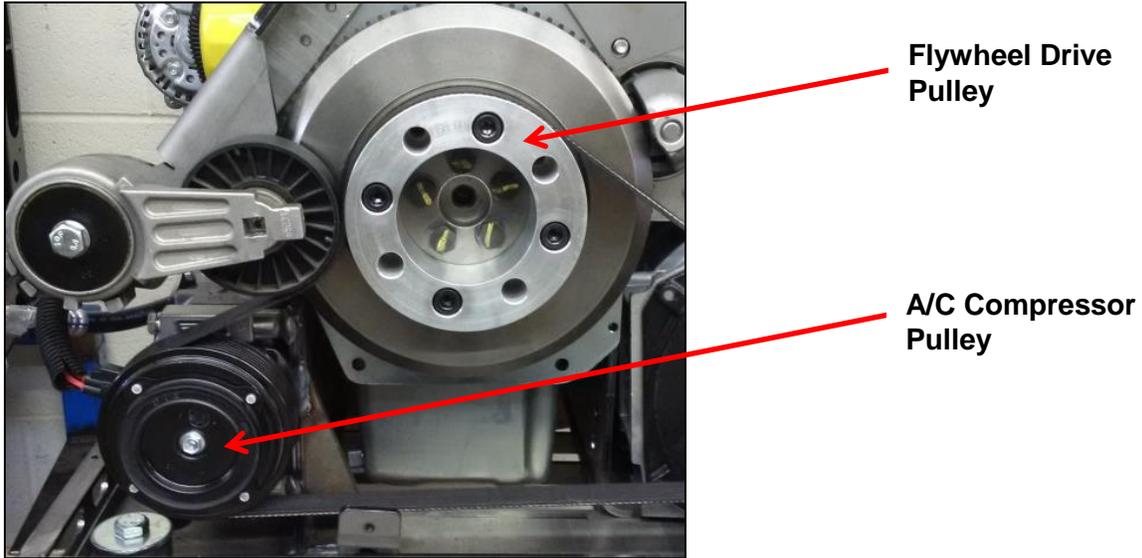
Procedure to Replace Serpentine Belt

WARNING!

A diesel engine may start at any time when its crankshaft is turned. This includes turning by wrench or hand!

TOOLS REQUIRED
 3/8" Ratchet
 1/2" Socket Wrench
 7/16" Socket Wrench

Figure 2-2



1. Remove front cover ensuring proper operation of the cover safety switch or disconnect battery prior to this step for your safety.
2. Remove belt guard with 7/16" Socket Wrench or 12mm Socket Wrench.
3. Using a 3/8" ratchet; insert into tensioner bracket.
4. Lift up on the tensioner bracket while sliding the belt off the main engine pulley.
 Note: exercise caution in this step to prevent possible personal injury.
5. Remove belt from the flywheel drive pulley using the shaft of a wrench or screwdriver to help pry the belt over the edge of the pulley.
6. Remove the belt and inspect for wear and cracking. If the belt looks good, clean and re-install the belt.
7. If the belt is worn, install a new serpentine belt onto the A/C compressor pulley, then over the flywheel pulley.
8. Rotate the engine with a ratchet wrench and socket wrench to ensure that the belt is properly positioned on all pulleys before starting the engine. **DO NOT USE YOUR HANDS OR A "J-BAR"!**
9. Reinstall the belt guard.

NOTE

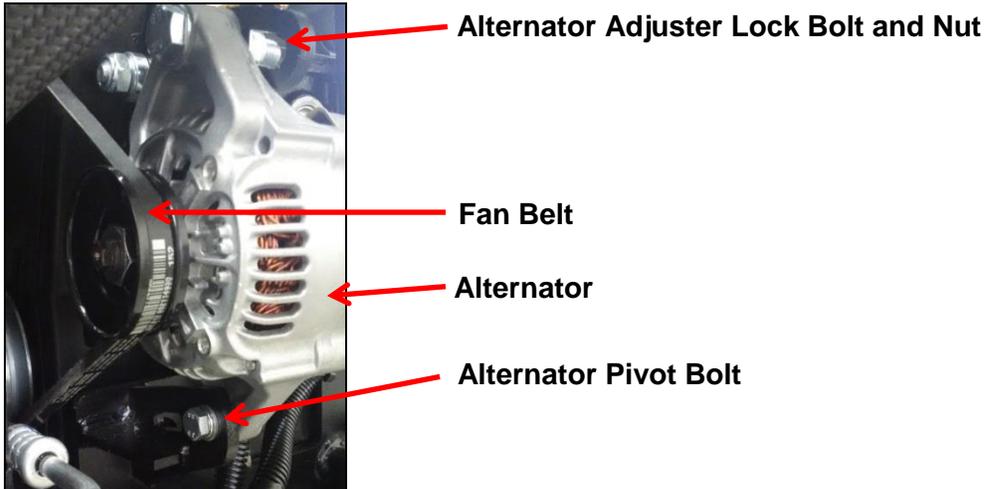
120V generator and the A/C compressor are fixed in place and the auto tensioner is self adjusting. The serpentine belt requires NO adjustments. The A/C compressor is in a fixed location so there is no need for adjustment brackets.

S2.5 Fan Belt Removal and Adjustment

WARNING!

A DIESEL ENGINE MAY START AT ANY TIME WHEN ITS CRANKSHAFT IS TURNED. THIS INCLUDES TURNING BY WRENCH OR BY HAND!

Figure 2-3

**TOOLS REQUIRED**

17mm Wrench or Ratchet (x 2)
13mm Socket Wrench

Procedure to Replace the Fan Belt

1. Remove the APU engine cover.
2. Loosen the alternator adjustment bolt and nut about 2 turns.
3. Loosen the alternator pivot bolt.
4. Slide the alternator down towards the engine and remove the belt.
5. Install the new fan belt and slide the alternator away from the engine using a 16-inch pry bar until the belt deflection is less than 6 mm. (1/4").
6. When the fan belt is tensioned, tighten the alternator adjustment lock bolt and nut, and tighten the alternator pivot bolt to 19 ft/lbs.
7. Reinstall the engine cover.

S2.6 Oil Change

TOOLS REQUIRED
 3/8" Ratchet
 22mm Socket Wrench
 7/16" Socket Wrench

OIL	S.A.E./(S.I.)
Volume	5 Liters / 5.3 US Quarts
Type	API CF4 - CG4 Oil
Viscosity	Variable: See Figure 2-4

NOTE

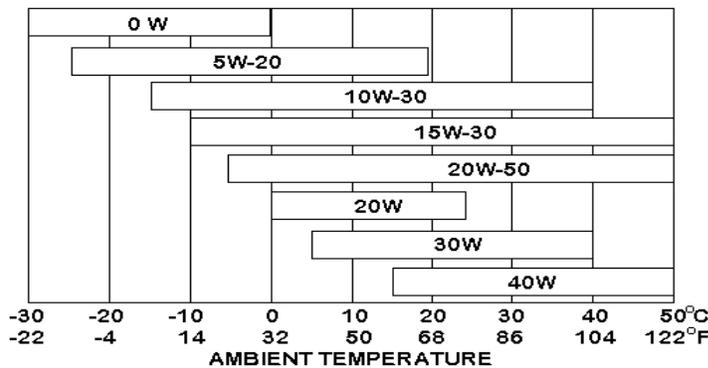
Recommended Lubricant for Fuel with Low Sulfur Content: API CF4 - CG4
 (Regions in which diesel normally has a low sulfur content:
 Europe, North America, and Australia).

CAUTION

Consult a RigMaster Dealer about the use of synthetic oil in your RigMaster.
 Service intervals for oil and oil filter replacements are 1000 hours.
 Synthetic oil is suitable for use; however, it is recommended that mineral-based oils are used for the break-in period.

Figure 2-4

Oil Viscosity vs. Temperature



10W30 and 15W40 are the most commonly used grades of oil.

Low viscosity oil must be used in lower temperatures.

ENGINE COOLANT	TYPE
Engine Coolant	50/50 mixture of ethylene glycol based, "low silica", "diesel specific" antifreeze and distilled water. Use only coolants suitable for aluminum core radiators.

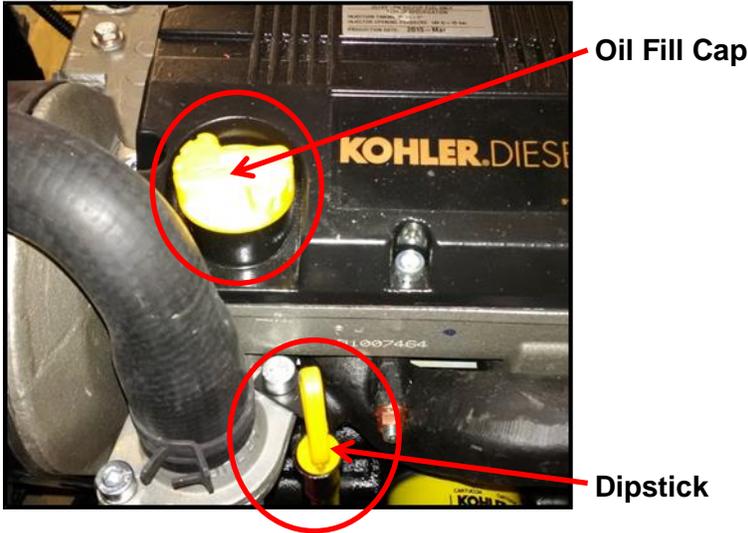
FUEL	SPECIFICATIONS
Fuel Type	Ultra Low Sulfur Diesel (ULSD)
Biodiesel	Tier 4 engines – 20% R.M.E.

Replacing the Engine Oil and Oil Filter

CAUTION

It is important to follow the recommendations below when changing or filling the lubricating oil system. This will avoid the possibility of a hydraulic lock within the cylinder(s) from occurring.

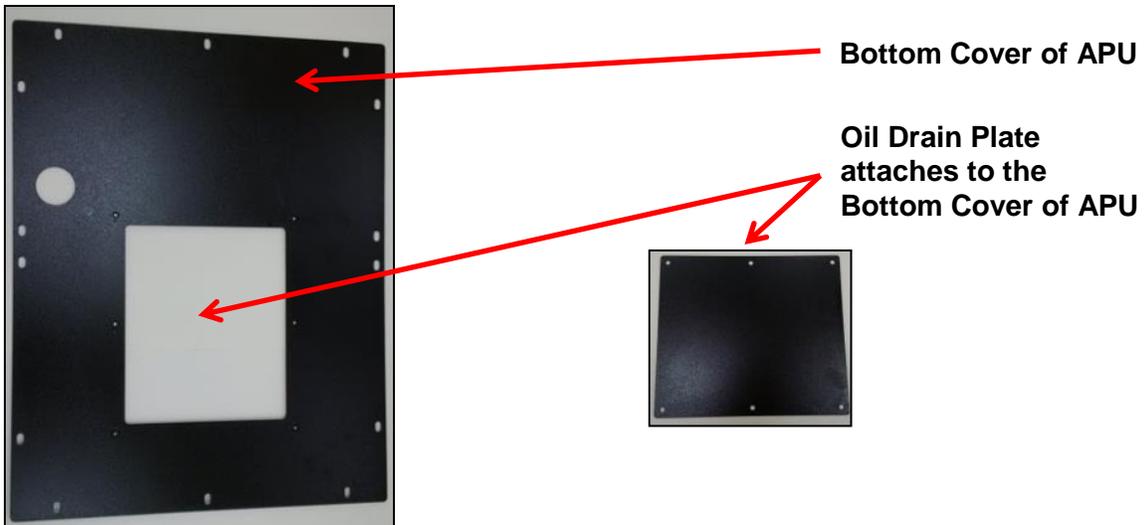
Figure 2-5



Oil Filter Replacement Procedure

1. Remove front cover ensuring proper operation of the cover safety switch or disconnect battery prior to this step for your safety.
2. Remove the oil fill cap.
3. Remove the oil dipstick from the dipstick tube and wipe clean; DO NOT REPLACE THE DIPSTICK AT THIS TIME.

Figure 2-6



4. Remove the oil drain plate using a $\frac{7}{16}$ " socket wrench from the bottom plate of the engine enclosure.
5. Remove oil drain plug using a 22mm socket wrench and drain the oil. Re-install the oil drain plug and tighten.
6. Remove the oil filter.
7. Install new oil filter.
8. Inspect drain plug gasket and replace if needed.
9. Install and tighten drain plug using a 22mm socket wrench.
10. Fill the lubricating oil system with the recommended quantity of engine oil through the fill port.

NOTE

Make sure engine is stopped, on a level grade and cool so oil has time to drain into the sump. It is very important to use the correct grade of oil for the operating conditions in which the unit will be working. Improper oil grade selection can result in engine damage. Use only type CF4 - CG4 engine oil.

11. Replace the oil fill cap.
12. Run the engine until operating temperature has been reached (approximately 5 minutes).
13. Stop the engine and allow oil to drain down to the oil pan.
14. Check the oil level on the dipstick and add as necessary.

NOTE

Replace engine oil and filter every 1000 Hours.

S2.7 Replacing the Fuel Filter

If proper procedures are followed during filter service, a minimal amount of air bleeding is required after changing the filter.

Figure 2-7



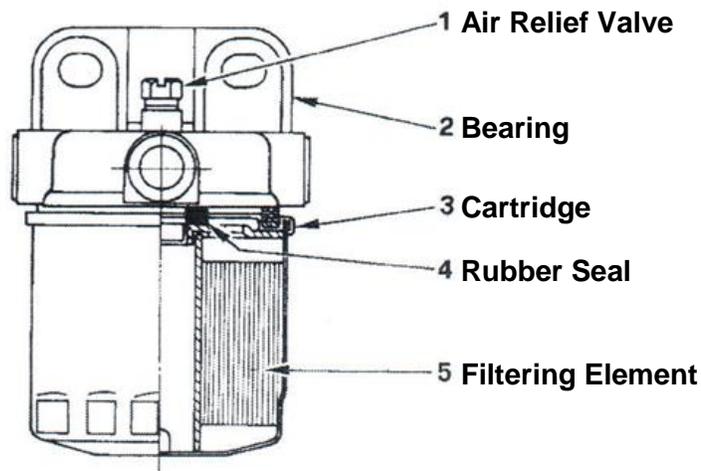
Fuel Filter Replacement Procedure

1. Shut unit off and ensure unit will not start up automatically.
2. Remove fuel filter on unit.
3. If possible fill up new fuel filter with clean diesel fuel to ensure the least amount of air is allowed to enter the fuel system.
4. Re-install fuel filter.
5. Tighten filter.

CAUTION

The Rubber Seal (See Figure 2-8, #4) must be present when installing a fuel filter.

**Figure 2-8
Fuel Filter**



Fuel System Bleeding Procedure

TOOLS REQUIRED

10mm Wrench
Oil Filter Wrench

NOTE

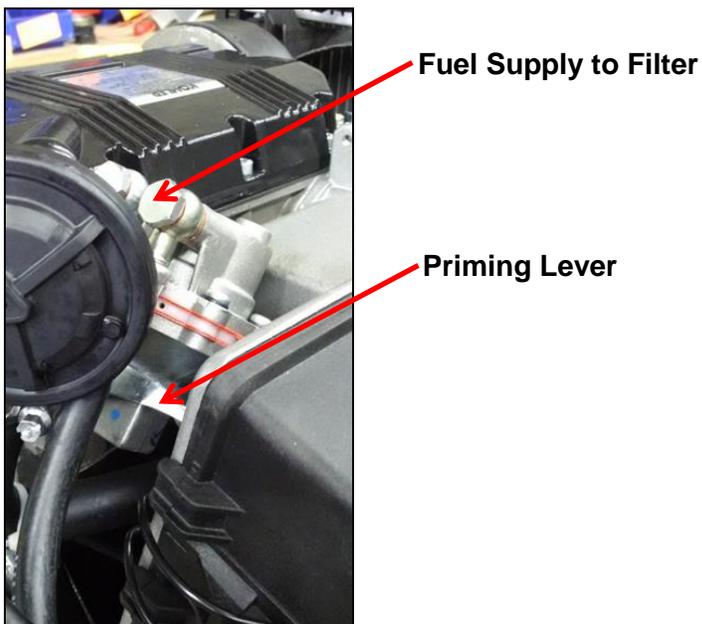
The low-pressure system must be free of air as much as possible before starting the engine. Running the engine will remove the little bit of air that could still be in the fuel system.

1. Position a container or shop wipe under the fuel filter to contain any spilled fuel.
2. Using a 10mm wrench loosen the Air Relief Valve (See Figure 2-8, Location 1).
3. Prime the system using the manual lift pump lever located on the lift pump (See Figure 2-9). Since the pump is mechanical and has a diaphragm it may be necessary to manually turn the engine by hand so that the engine camshaft allows full stroke on the lift pump.
4. Continue to pump the lever until the air relief valve shows signs of fuel passing out of the bleed screw.
5. Tighten the air relief valve bolt.
6. Bleeding low pressure system is complete.

WARNING!

Do **not** use priming lever when engine is cranking or running. Only use priming lever when engine is off.

Figure 2-9



S2.8 Replacing the Air Filter

NOTE

The air filter should be inspected every 500 hours of operation.

CAUTION

This unit accepts ONLY the RigMaster P/N K-001 (Kohler P/N ED0021751640-S) Air Filter. Do not use unapproved cross-referenced parts.

Figure 2-10



Procedure to Replace the Air Filter

1. Remove the cover from the air filter.
2. Remove the air filter element and clean the inside of the air cover. Allow the air cover to dry completely.
3. Replace air filter element. (Use only manufacturer-approved filters).
4. Reinstall the air filter cover and latches.

NOTE

Before test running the engine inspect the filter hoses for cracks or brittle sections. Damaged or deteriorating hoses should be replaced.

S2.9 Breaker Reset Instructions

Resetting the 20 Amp Breakers

The RigMaster APU is equipped with a GFI breaker on the electrical outlet installed in your sleeper. Unplug all items from the electrical outlets before pressing the reset button. This will reset the breaker for the power going to these outlets.

If resetting this breaker does not restore power, the main Generator breakers (located at the Generator itself) may also need to be reset (See Figure 2-12).

WARNING!

Correct the electrical overload prior to resetting either breaker.

Figure 2-11

Electrical Outlet

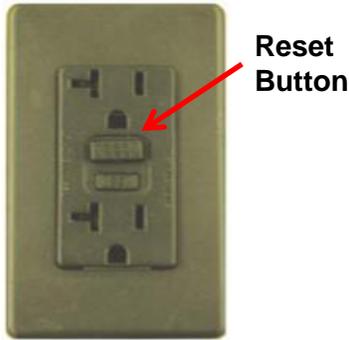
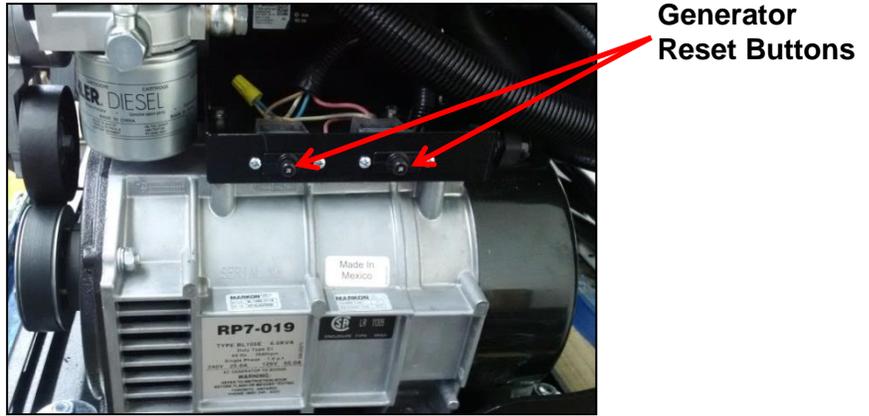


Figure 2-12

Breakers



The 20 Amp Main Generator breakers are located at the Generator, in the front of the APU. One breaker protects the circuit supplying the sleeper, the other protects the circuit supplying the block heater.

Resetting Breakers

1. With the RigMaster APU turned "OFF", remove the front cover of the RigMaster APU.
2. TO AVOID INJURY, CONFIRM THAT NONE OF THE RIGMASTER COMPONENTS ARE "HOT".
3. Look to the right of the engine to find the Generator; on top of the Generator there will be a breaker box. On the side facing the electrical fan there are two (2) breakers sticking out.
4. Depress the Generator reset buttons.

NOTE

Generator reset buttons are spring loaded:
 - when **set** the breakers are pushed in about ¼";
 - when **tripped** the breakers are sticking out about ½".

S2.10 Cleaning Instructions

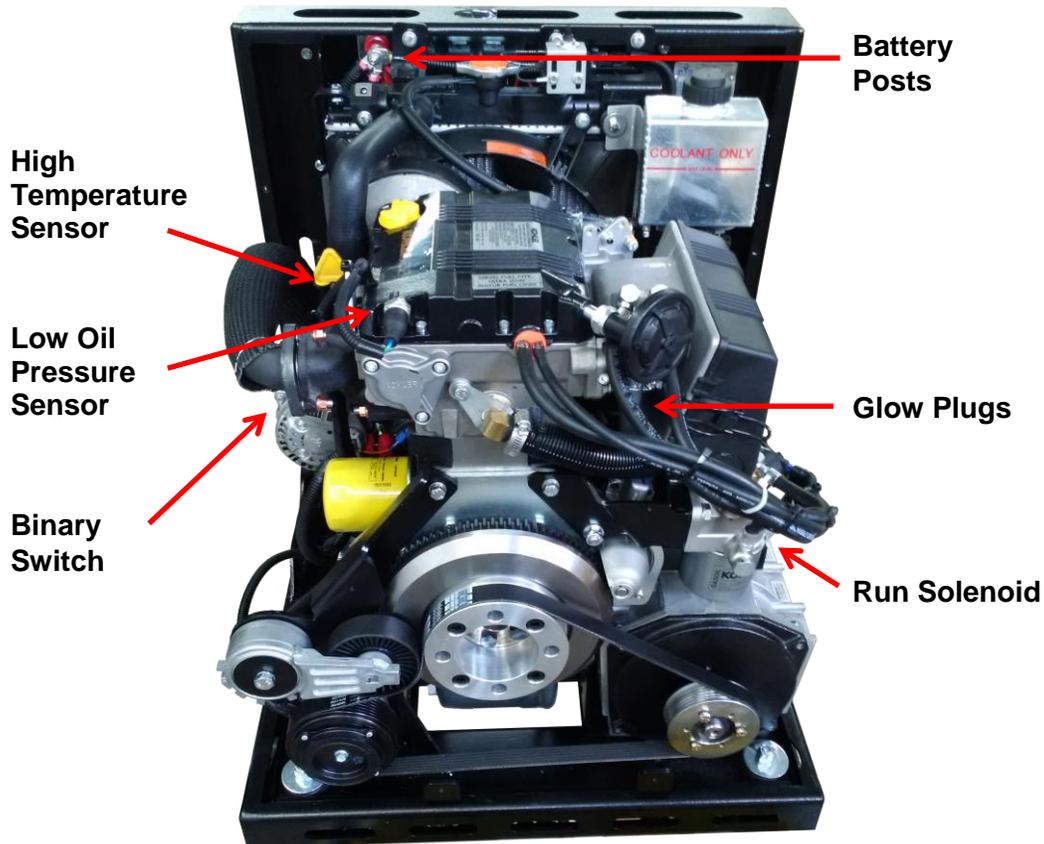
The RigMaster Auxiliary Power Unit should be periodically inspected and any accumulation of road contaminants (such as: paper; plastic; dirt; oil; etc.) must be removed. The main components, as outlined on the next page, must be kept clean and free of contaminants and/or debris.

NOTE

The following parts are not shown in the picture, but make sure that the wire to the starter solenoid & the positive post on the alternator & starter is sprayed with battery spray. Apply dielectric grease to the low oil sensor, high temperature sensor & the binary switch. For all other connections, use a silicon-based spray product.

Make sure the boots are installed back on to the sensors.

Figure 2-13
Main Unit



Main Unit General Cleaning

1. Wash the exterior of the main unit making sure that all louvered areas are clear (this is especially important so that air may easily enter and exit the APU).
2. Before washing the interior of the RigMaster APU, it is mandatory to cover the Generator's vented areas. The Generator exhaust vents are rectangular holes in the casting of the Generator body. They are located on both sides of the Generator body near the pulley. The rear exhaust vent and the vented black plastic Generator end cap are accessed from behind the APU by removing the Generator cover. These vents must be covered so that water will not be forced into the Generator interior during washing. If there is a possibility of water being present inside of the Generator, remove the black plastic vented end cap and dry the inside of the Generator before use. **OPERATION OF THE GENERATOR UNIT WITH WATER INSIDE WILL CAUSE THE FAILURE OF THE GENERATOR UNIT THAT WILL NOT BE COVERED BY WARRANTY.**

3. Remove the front cover and gently wash the interior of the APU being careful to keep sprayer 2 feet (24 inches) from any component.
4. Before replacing the front cover of the RigMaster unit, all electrical components and connections must be protected with a dielectric product (similar to silicone spray or grease) to prevent corrosion. When the engine compartment is dry, spray all electrical connectors and sensors with dielectric spray, including: the positive and negative posts, glow plugs and run solenoid. Be sure to spray the following components that are not shown in the picture below: the green wire to the starter solenoid and the positive posts on the alternator and starter. Apply dielectric grease directly to the terminals of the low oil sensor, high temperature sensor and the binary switch on the A/C Receiver Drier. Check that the boots are installed back on the sensors.

S2.11 Cleaning the 120 Volt AC Generator

It is important to maintain the interior of the Generator in a clean and dry state. If there is any possibility that water or dirt has entered the interior of the Generator, from either washing or prolonged exposure to an extremely wet environment, it should not be operated without being cleaned and dried. OPERATION OF THE GENERATOR UNIT WITH DIRT OR WATER INSIDE WILL CAUSE FAILURE OF THE GENERATOR UNIT THAT WILL NOT BE COVERED BY WARRANTY.

Procedure to Clean the Generator

1. Remove the APU engine cover.
2. Remove the Right hand side panel where the electrical fan is attached, using a 3/8" socket wrench. Inspect the generator surrounding area for any accumulation of dirt or oil especially at the generator air inlet and outlet openings.
3. Using a compressed air line and nozzle, blow out the generator compartment. (This can be done by removing the plastic end cap of the generator, or it can be done with the cover still in place.)
4. Using a clean cloth, soak up any oil or other liquids.
5. Replace the side panel and secure using a 3/8" socket wrench.

TOOLS REQUIRED
 3/8" Socket Wrench
 Phillips Screwdriver ⊕

**Figure 2-14
 Generator**



To clean generator: remove plastic end cap by unscrewing the two (2) bolts at the back.

**Figure 2-15
 Plastic End Cap**



NOTE

There are **two models of the HVAC Box**: with automotive-style heating (See Figure 2-16) and without automotive-style heating (See Figure 2-17). The HVAC filter does not need to be replaced unless it is damaged. The filter should be cleaned every 1000 hours of operation.

Figure 2-16



Coolant Control Valve for HVAC Box with Heat

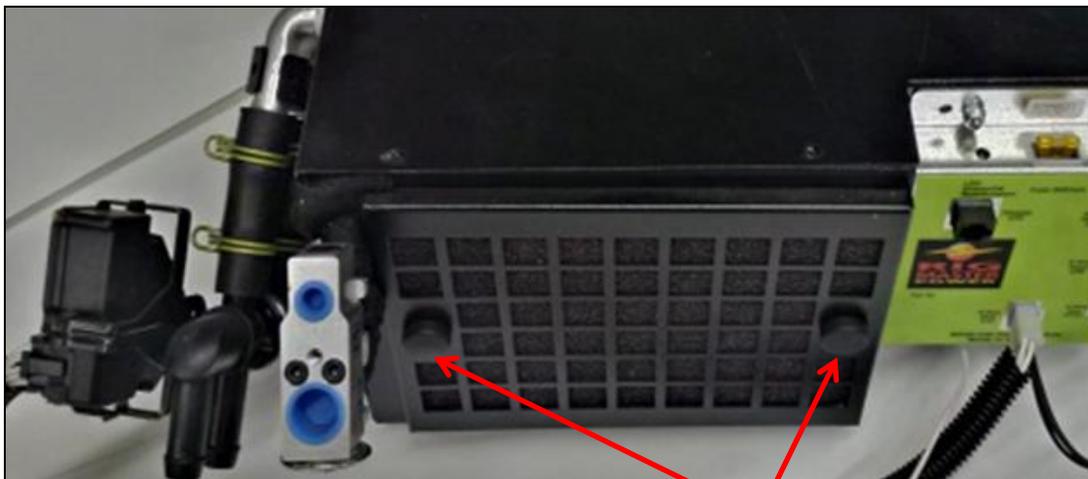
Figure 2-17



HVAC Box (No Heat)

S2.12 Cleaning the HVAC Filter

Figure 2-18



Thumb Nuts on HVAC Heating & Cooling Box

1. Unscrew the two thumb nuts (See Figure 2-18) and remove the foam air filter from the HVAC box.
2. Wash the air filter using soapy water or blow clean with compressed air and allow filter to dry completely.
3. Reinsert the air filter and hand tighten the two thumb nuts.

Section 3 Serpentine Drive

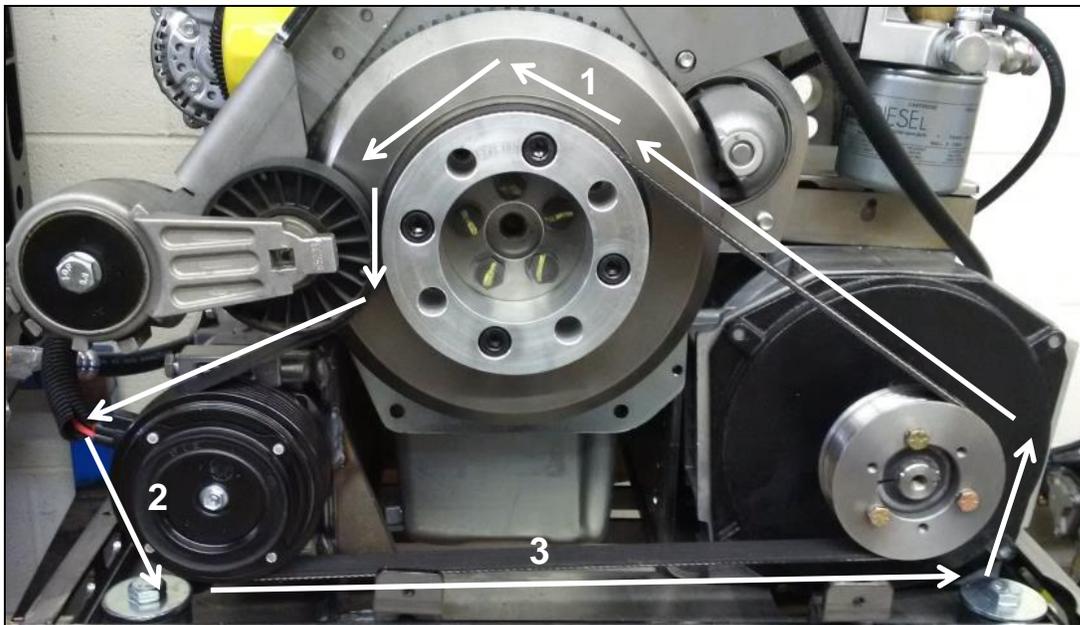
	Section	Page
Introduction to the A/C Compressor Serpentine Drive System	S3.0	23
Remove/Replace Flywheel Pulley	S3.1	24

S3.0 Introduction to the Air Conditioning Compressor Serpentine Drive System

RigMaster APU's are equipped with a serpentine drive belt that drives the air conditioning compressor from the flywheel of the engine.

Belt rotation is Counter-clockwise.

Figure 3-1



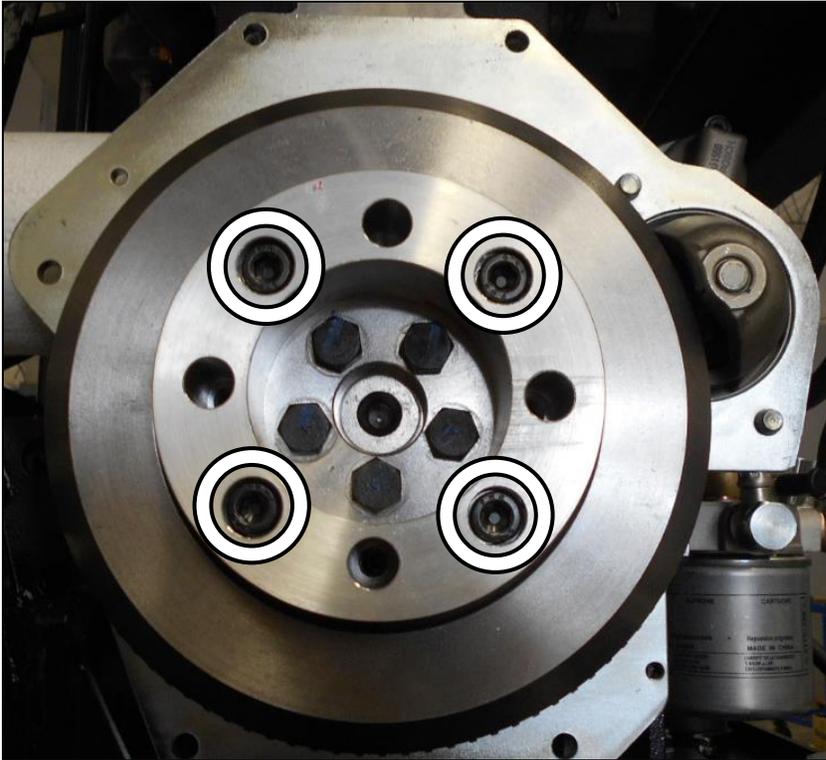
Serpentine Compressor Belt

#	COMPONENT	PART #
1	Flywheel Drive Pulley	KL8-001
2	Compressor	LG9-004
3	Serpentine Belt	KT8-001

S3.1 Remove/Replace Flywheel Pulley

Be sure that the flywheel and flywheel pulley are clean prior to installation; this will ensure that the flywheel drive pulley is not misaligned.

Figure 3-2



Flywheel Drive Pulley

Align the flywheel drive pulley with the four-point bolt pattern on the flywheel (See Figure 3-2), install the mounting bolts and torque them to 69 ft/lbs. (93 Nm).

Section 4 Frame & Enclosure

	Section	Page
Enclosure Introduction	S4.0	25
Frame and Enclosure Main Components	S4.1	25
Engine Mounting Bracket Assembly	S4.2	26
Rubber Engine Mount Assembly Sequence	S4.3	27
APU Side Panels	S4.4	28
APU Cover and Latches	S4.5	29
Bottom Cover and Oil Drain Plate	S4.6	30
Frame and Enclosure (Outside) Parts List	S4.7	31
Frame and Enclosure (Inside) Parts List	S4.8	33

S4.0 Enclosure Introduction

To perform many of the repair procedures in this manual it may be necessary to remove a portion of the enclosure to gain access to components.

NOTE

Due to the highly corrosive environment the MTS-T4-6 APU is exposed to, it is recommended that an anti-seize protection be applied to all hardware upon reassembly. It is also recommended that corrosion inhibitors be used on electrical and mechanical components as a preventative measure.

S4.1 Frame and Enclosure Main Components

Figure 4-1

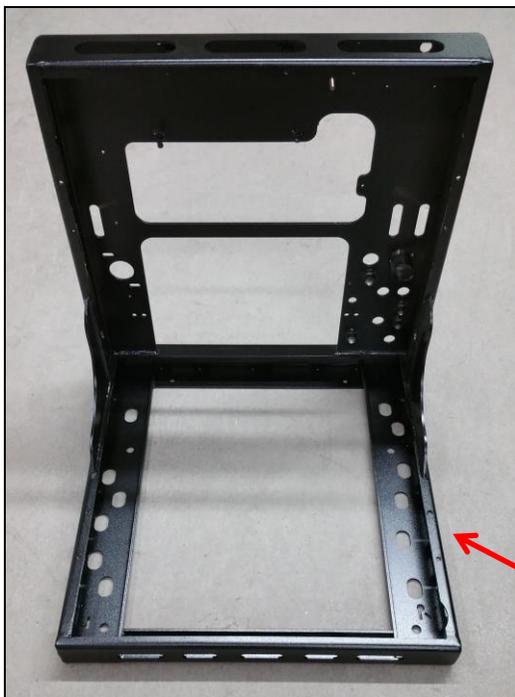


Figure 4-2



Main Engine Mount Plate

Right Engine Mount Plate

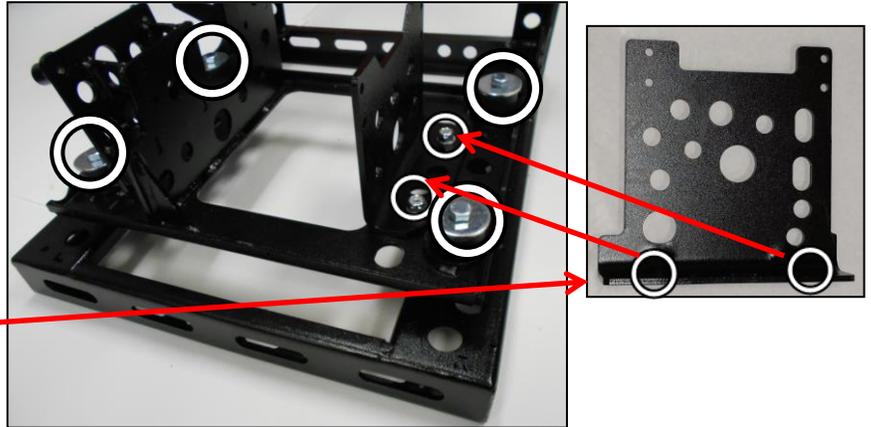
APU Frame

S4.2 Engine Mounting Bracket Assembly

Figure 4-3

The Main Engine Mount Plate and Right Engine Mount Plates are Mounted to the APU Frame using Nut, Bolt and a Rubber Mount Assembly in each corner of the Plate.

Right Engine Mount Plate is shown here. Short side mount holes align with the Main Engine Mount Plate holes then Rubber Mount Assemblies are installed.



Nut and Washer install on top of Rubber Mount Grommet

Figure 4-4

Right Engine Mount Bracket

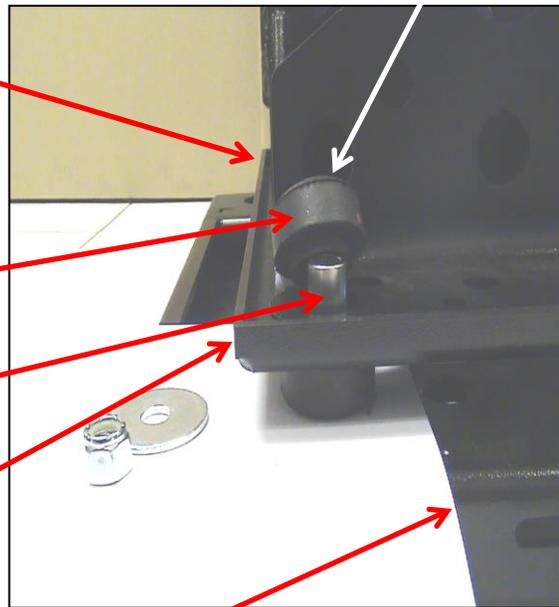
Rubber Mount Assembly is shown here installed through both Mount Plates and sitting on top of APU Frame rail.

Rubber Mount Grommet

Rubber Mount Assembly inner Spacer Sleeve

Right Engine Bracket sitting on Main Engine Mount Bracket with Grommet above and

APU Frame Rail (Black)
(Partially covered for illustration purpose)

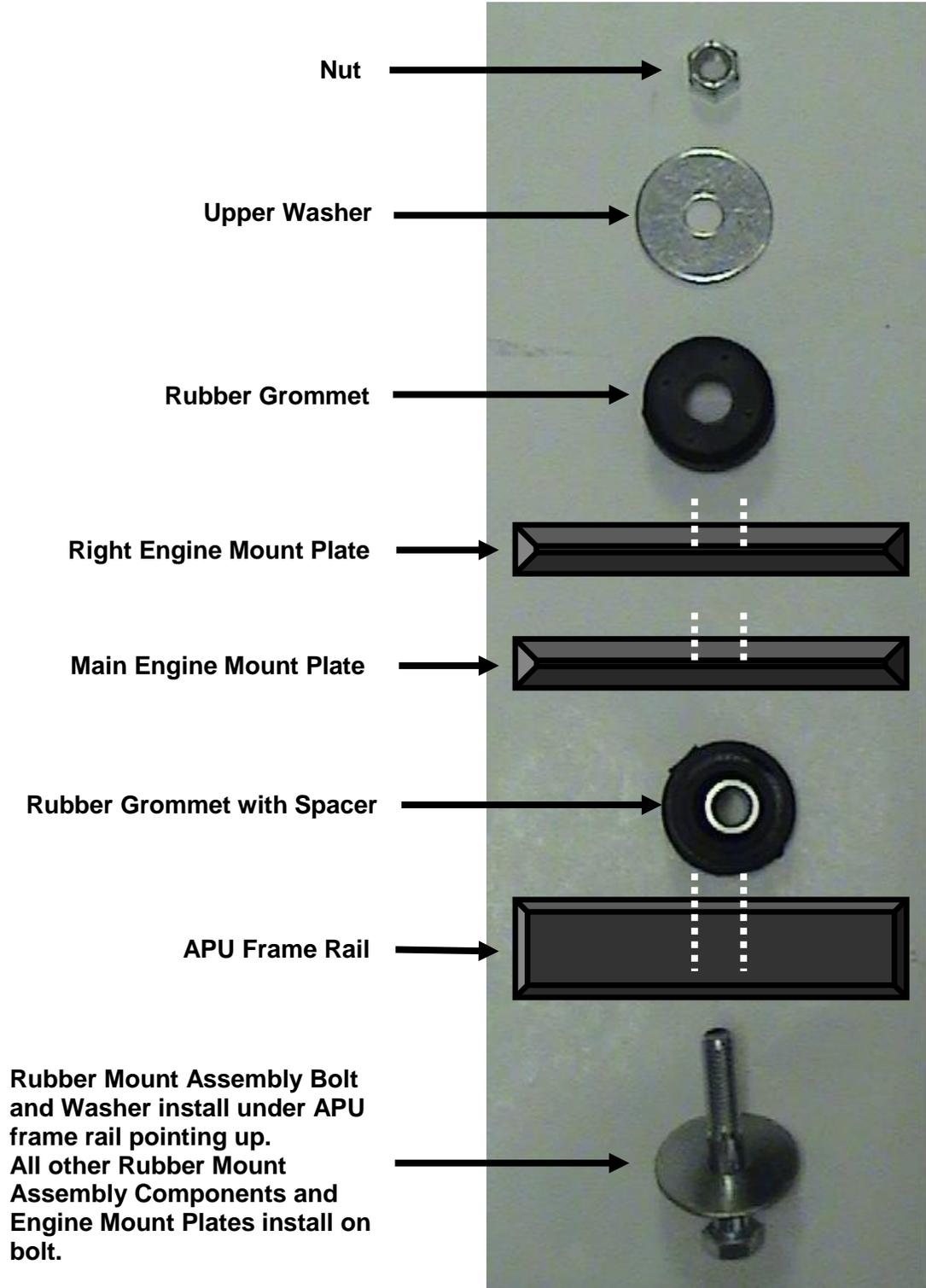


Engine Replacement

Inspect engine mount grommets and brackets when replacing an engine. Damage to these components or fastening hardware can transmit shock and vibration forces and premature failure. Replace any worn parts found.

S4.3 Rubber Engine Mount Assembly Sequence

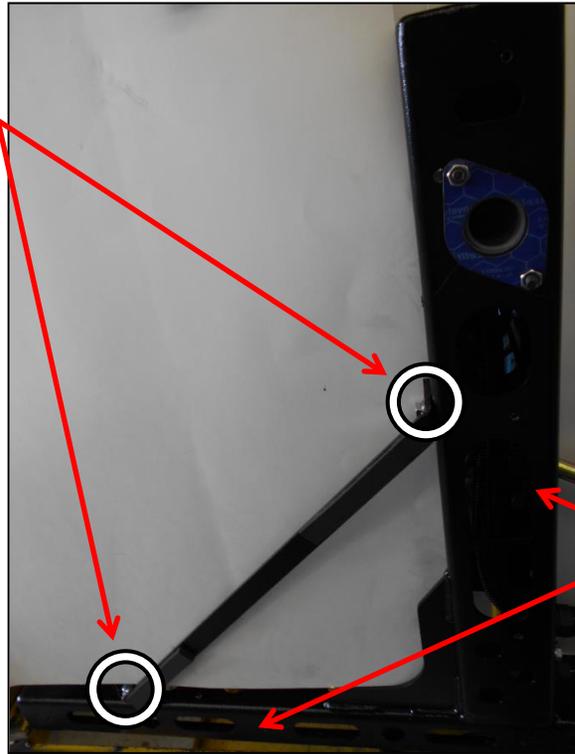
Figure 4-5



S4.4 APU Side Panels

Figure 4-6

APU Frame Side Braces have 2 Mount Bolts on each side (Left and Right)



APU Frame Rails

Figure 4-7



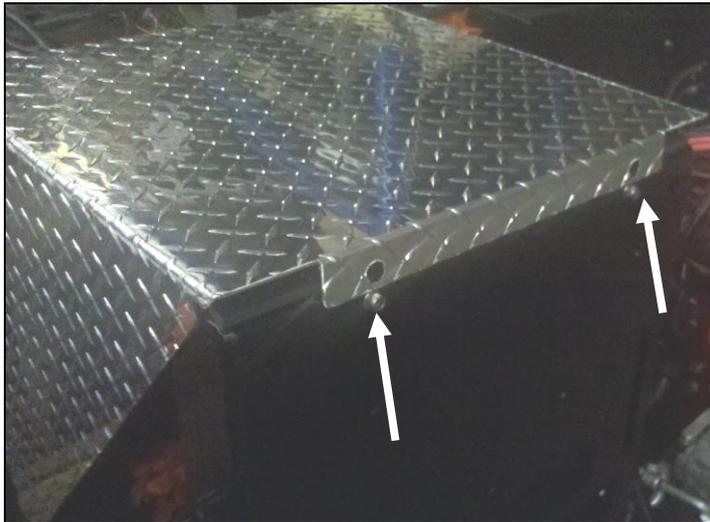
Figure 4-8



The APU Side Panels are mounted to the APU Frame with 1/4"-20 Bolts (x 12)

S4.5 APU Cover and Latches

Figure 4-9



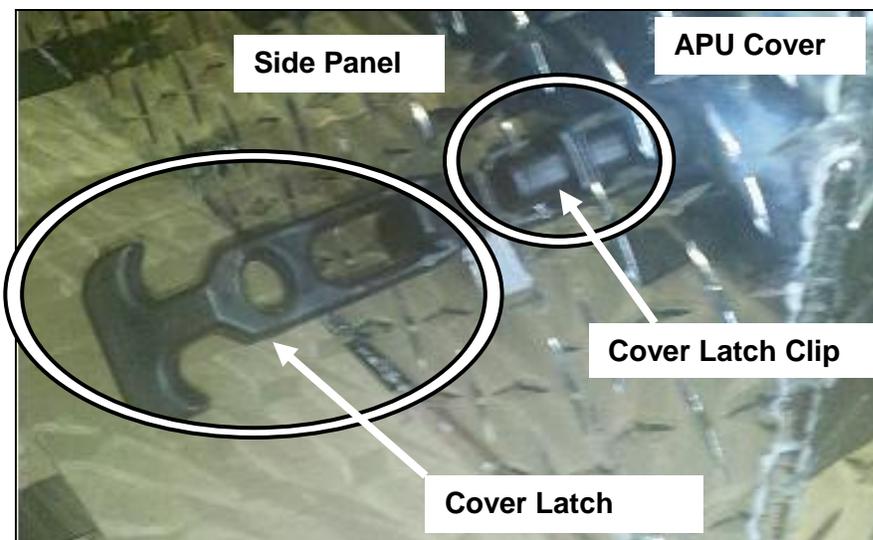
The back of the APU Cover has 2 holes that must first be installed over locating pins, after which, the Latches (See Figure 4-9) may be fastened.

Figure 4-10



Latch Assembly

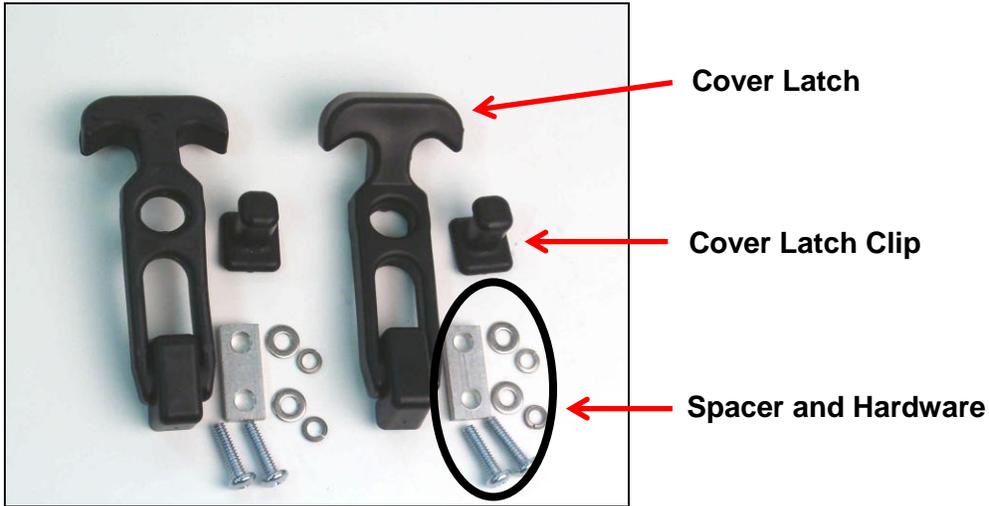
Figure 4-11



Latch Assembly Components

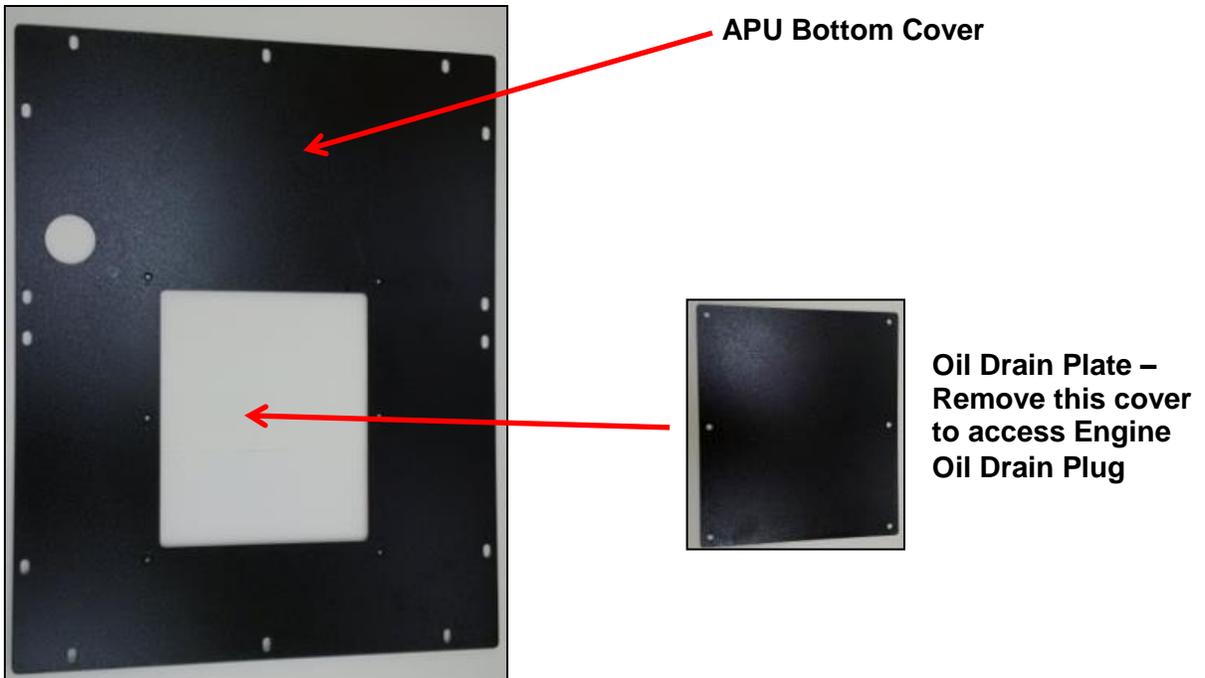
The cover latches should be examined frequently to ensure that they are in good condition. You may purchase the rubber tie downs in a kit (RP12-056K) (See Figure 4-12). You may also purchase a single latch and clip set under the part number RP12-056 (does not include hardware).

Figure 4-12

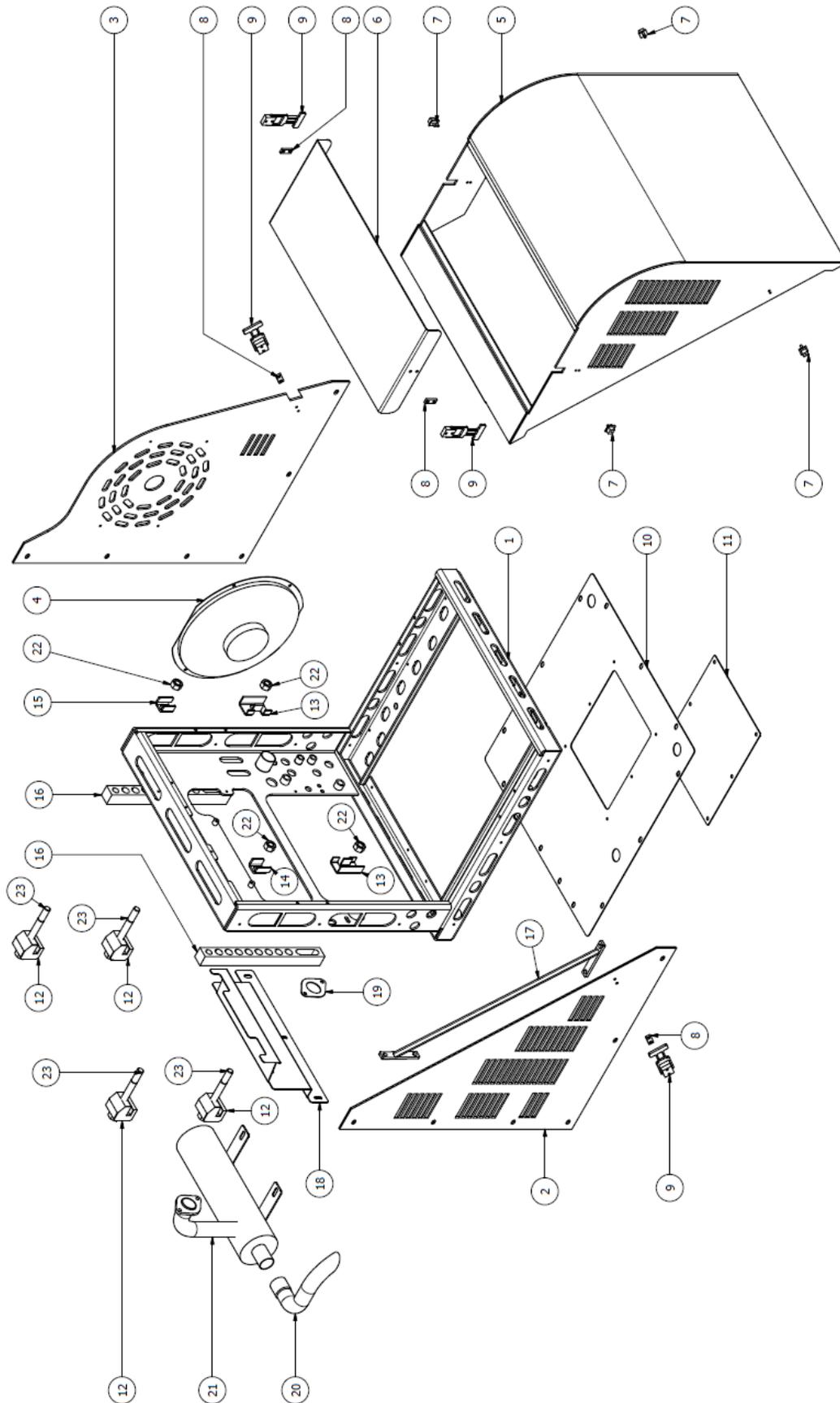


S4.6 Bottom Cover and Oil Drain Plate

Figure 4-13



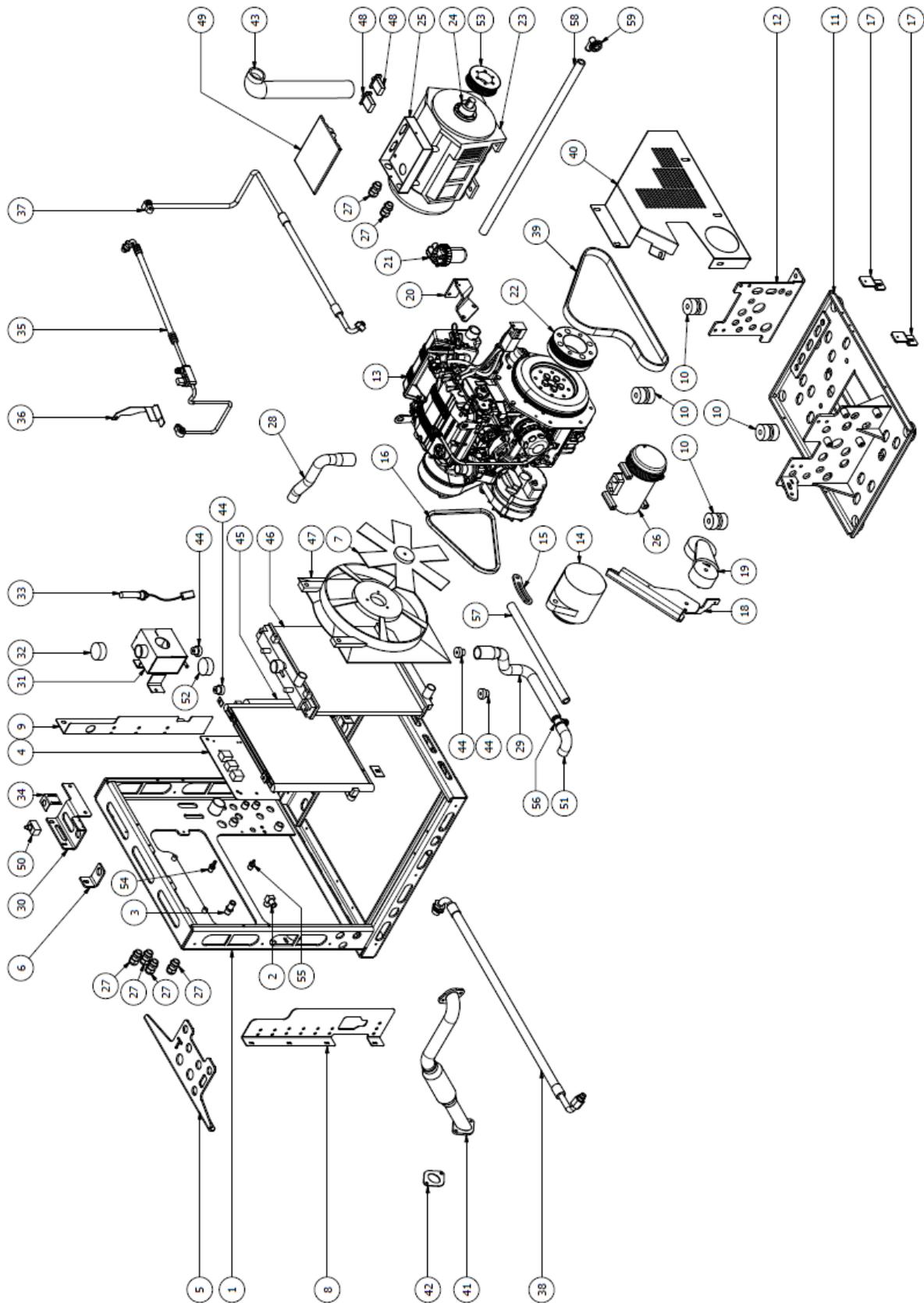
S4.7 Frame and Enclosure (Outside) Parts List



MTS-T4-6 Parts List – Outside

ITEM	PART NUMBER	DESCRIPTION	QTY.
1	KT10-001	Frame Assembly	1
2	KT10-012K	Frame Side Panel (Left) w. Louvers	1
3	KT10-013K	Frame Side Panel (Right) w. Electric Fan	1
4	RP7-230	12" Electric Fan	1
5	KT10-011K	Aluminum Front Cover Kit	1
6	KT10-014K	Aluminum Front Cover Access Panel Kit	1
7	RP12-056-K (RP12-056 for both)	Cover Latch Clip	4
8	RP10-001-11	Latch Spacer	4
9	RP12-056-L (RP12-056 for both)	Cover Latch	4
10	KT10-025	Bottom Plate	1
11	KL10-026	Bottom Plate Drain Hole Cover	1
12	LG10-014	Frame Grabber	4
13	LG10-019	Anchor	2
14	KL10-015	Nut Holder - Top (Left)	1
15	KL10-016	Nut Holder - Top (Right)	1
16	LG10-004	Spacer	2
17	LG10-002	Frame Side Support (Left)	1
18	KT10-009-R1	Back Panel	1
19	RP6-083	Exhaust Gasket	1
20	LG6-010	Exhaust Elbow	1
21	KT6-001	Muffler	1
22	Nut-013	5/8" - 11 All Metal Stover 'G' Flange Lock Nut Zinc	4
23	Bolt-001/LG12-025	HCS 5/8" - 11 UNC - 7 YZ8 Bolt	4

S4.8 Frame and Enclosure (Inside) Parts List



MTS-T4-6 Parts List – Inside

ITEM	PART NUMBER	DESCRIPTION	QTY.
1	KT10-001	Frame Assembly	1
2	RP5-007	90° Elbow Brass Fitting (½" Hose)	1
3	RP5-011	Straight Brass Fitting (½" Hose)	1
4	KT7-001	Main Wiring Harness	1
5	KT10-010-R1	Bottom Radiator Bracket	1
6	KT10-008-R1	Top Radiator Bracket	1
7	ED0097183310-S	Fan Blade	1
8	KT10-017-R1	Left Side Fan Shroud	1
9	KT10-018-R1	Right Side Fan Shroud	1
10	LG11-001	Armour Plated Mounts	4
11	KT10-005-R1	Engine Assembly Bracket	1
12	KT10-006	Engine Mount	1
13	KDW702	Kohler Engine	1
14	185046470	Alternator (60 Amp)	1
15	KT10-003	Alternator Bracket	1
16	KT8-003	V-Belt (Fan/Alternator Belt)	1
17	KT10-015	Belt Cover Brackets	2
18	KT10-004	Tensioner Bracket	1
19	RP8-106	Tensioner	1
20	KT10-002	Fuel Filter Bracket	1
21	K-003	Fuel Filter	1
22	KL8-001	Drive Pulley	1
23	RP7-019	Generator (6000W, 110 Volt)	1
24	RP8-002	Generator Pulley Bushing	1
25	KT10-069-R2	Generator Electric Box	1
26	LG9-004	Compressor	1
27	RP7-015A	Cable Support	6
28	KL5-001	Top Radiator Hose	1
29	KL5-002	Bottom Radiator Hose (Big)	1
30	KT10-007-R1	Surge Tank Bracket	1
31	RP5-1009	Surge Tank	1
32	RP5-1008-C	Surge Tank Cap	1
33	RP5-1011K	Coolant Level Sensor Kit	1
34	RP10-001-96	Safety Cover Switch Bracket	1
35	LG9-407K	Liquid Hose with Pressure Switch (Condenser to Frame #6)	1
36	KL10-022	Pressure Switch Bracket	1
37	LG9-405	Discharge Hose (Compressor to Condenser #8)	1
38	LG9-406	Suction Hose (Compressor to Frame #10)	1
39	KT8-001	Serpentine Belt (Compressor & Generator Belt)	1
40	KT10-031-R4	Belt Cover (Belt Guard)	1
41	KT6-002	Exhaust Flex Pipe	1
42	RP6-083	Exhaust Gasket	1

ITEM	PART NUMBER	DESCRIPTION	QTY.
43	KL5-006	Air Filter Hose	1
44	LG7-011	Condenser Mount/Grommet	4
45	LG9-001	Condenser	1
46	LG5-003	Radiator	1
47	LG7-002	Fan Shroud	1
48	RP7-090	Breakers (20 Amp)	2
49	KT10-070-R2	Generator Electric Box Cover	1
50	RP7-022	Safety Cover Switch Sensor	1
51	KL5-003	Bottom Radiator Hose (Small)	1
52	LG5-004	Radiator Cap	1
53	KT8-002	Generator Pulley	1
54	KL2-001	¼" Fuel Fitting	1
55	KL2-002	⅛" Fuel Fitting	1
56	KT2-003	Pex Tee (1" x 1" x ¾")	1
57	KT5-002	⅝" diameter Heater Hose (1.2 ft. length)	1
58	KT5-001	⅝" diameter Heater Hose (2.25 ft. length)	1
59	KT2-001	Cast Aluminum Fitting	1

Section 5 General Engine

	Section	Page
Introduction to Engine Repairs	S5.0	36
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Front and Rear Oil Seal Replacement	S5.4	42
Starter Motor	S5.5	43
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Timing Belt	S5.7	45

CAUTION

To perform service, maintenance and repairs you **must** disconnect the APU from its battery source. The APU shares the vehicle’s battery(s) with the truck engine. Locate the RigMaster Power Module (usually mounted to the HVAC blower box under the bunk) and disconnect the “J1” connector. After disconnecting the J1 connector, disconnect the vehicle’s battery cables then check the battery posts inside the RigMaster engine cabinet to confirm there is no voltage to the auxiliary power unit (APU).

WARNING!

The engine manufacturers require dealer Technical Training Certification in order to perform warranty engine work, otherwise warranty may be voided by the manufacturer. Disregarding a **WARNING** can result in **serious personal injury** or **death**.

S5.0 Introduction to Engine Repairs

This section of the service manual outlines some basic engine repairs. The Kohler KDW 702 Repair Manual contains more detailed information on these procedures and should be used as the primary reference when performing engine service and repairs. There may be some APU assembly components that need to be removed in order to service the engine as outlined by Kohler.

This section is intended to provide information about how to perform these engine repairs while it is installed in the APU. Please be aware that engine bolt sizes are metric, whereas the other APU components are fastened with SAE and Metric hardware.

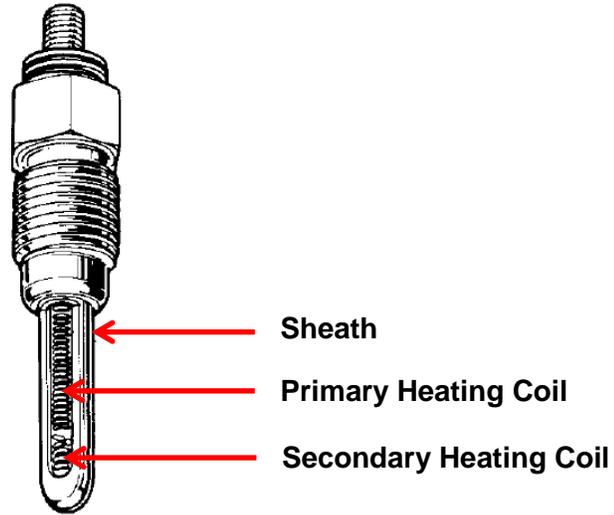
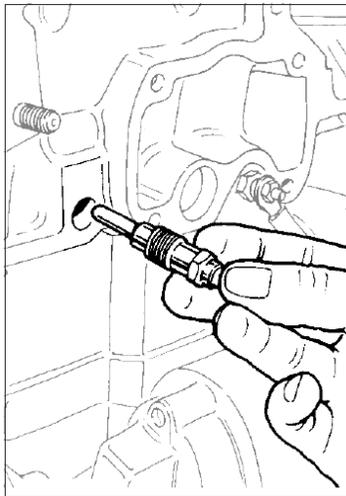
Be sure not to use impact guns to replace hardware on the engine. Always use a calibrated torque wrench and refer to the appropriate service and repair manual for torque specifications and proper installation methods.

WARNING!

A DIESEL ENGINE MAY START AT ANY TIME, disconnect J1 connection before beginning any engine repair.
 Disregarding a **WARNING** can result in **serious personal injury** or **death**.

S5.1 Glow Plugs

Figure 5-1



Pre-Heating Glow Plug	Specifications
Nominal Voltage	12.5 V
Current Absorption	12 A ÷ 14 A after 5 seconds
Sheath Surface Temperature	850°C after 5 seconds

NOTE

For circuit description please reference the electrical diagrams in Section 9.

Glow Plug Removal

CAUTION

Great care must be taken to ensure that contaminants do not enter the engines cylinders through the glow plug ports.

1. Remove the nuts and washers that secure the bus bar (bridge) to the glow plugs.
2. Remove the blue power supply wire from the glow plugs.
3. Remove the bus bar from the glow plugs.
4. Remove the glow plugs from the cylinder head.

Glow Plug Installation

1. Install the glow plugs in the cylinder head and torque to 8.9 ft/lbs. (11.5 Nm).
2. Reinstall the bus bar on the glow plugs.
3. Reinstall the washers and the nuts on the glow plugs.
4. Reinstall the nuts to a torque of 11 in/lbs. (1.2 Nm)

WARNING!

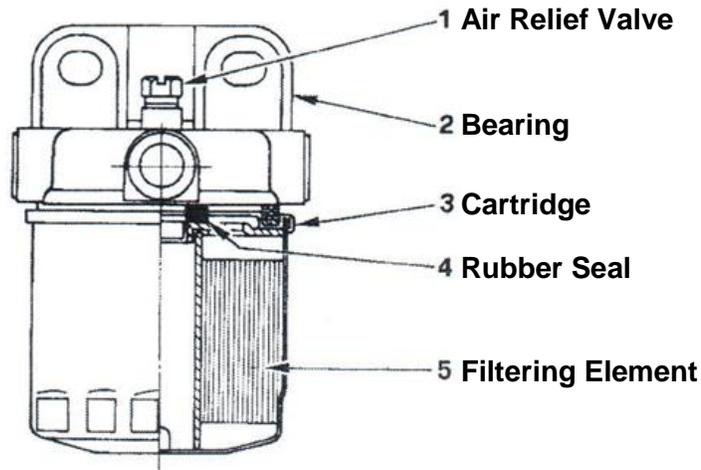
A DIESEL ENGINE MAY START AT ANY TIME, disconnect J1 connection before beginning any engine repair.
 Disregarding a **WARNING** can result in **serious personal injury** or **death**.

S5.2 Fuel Filter Assembly

CAUTION

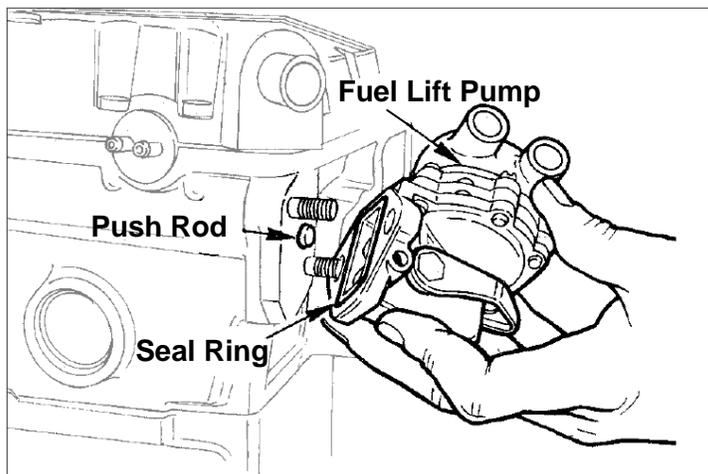
The Rubber Seal (See Figure 5-2, #4) must be present when installing a fuel filter.

**Figure 5-2
 Fuel Filter**



Cartridge	Specifications
Filtering Paper	PF 905
Filtering Surface	2400 cm ²
Degree of Filtration	2 ÷ 3 μ
Maximum Operating Pressure	4 bar

Figure 5-3



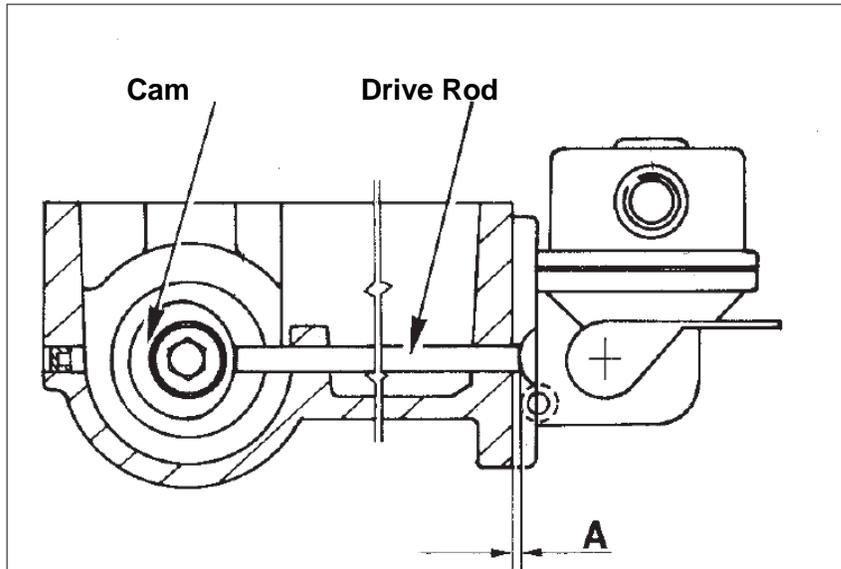
Fuel Lift Pump

The fuel pump is a membrane type. It is driven by a camshaft cam via a drive rod. It is equipped with an external manual fuel lever.

With the control cam at 1500 RPM the delivery rate is 75 l/hours and the self-adjusting pressure is at 0.55 to 0.65 bar.

Fuel Pump Drive Rod Projection

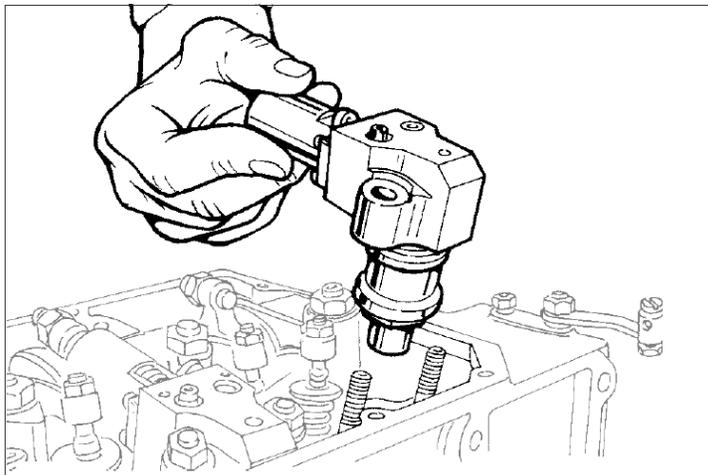
Figure 5-4



The protrusion A of the drive rod from the cylinder head surface is $1.66 \div 2.18$ mm. The check must be carried out with the cam idle as in the figure. Block the two fuel pump fastening nuts simultaneously at 24 Nm. Check the length of the drive rod and if it is not the right size, replace it. Drive rod length = $153.15 \div 153.35$ mm.

Fuel Pump/Injector Unit

Figure 5-5

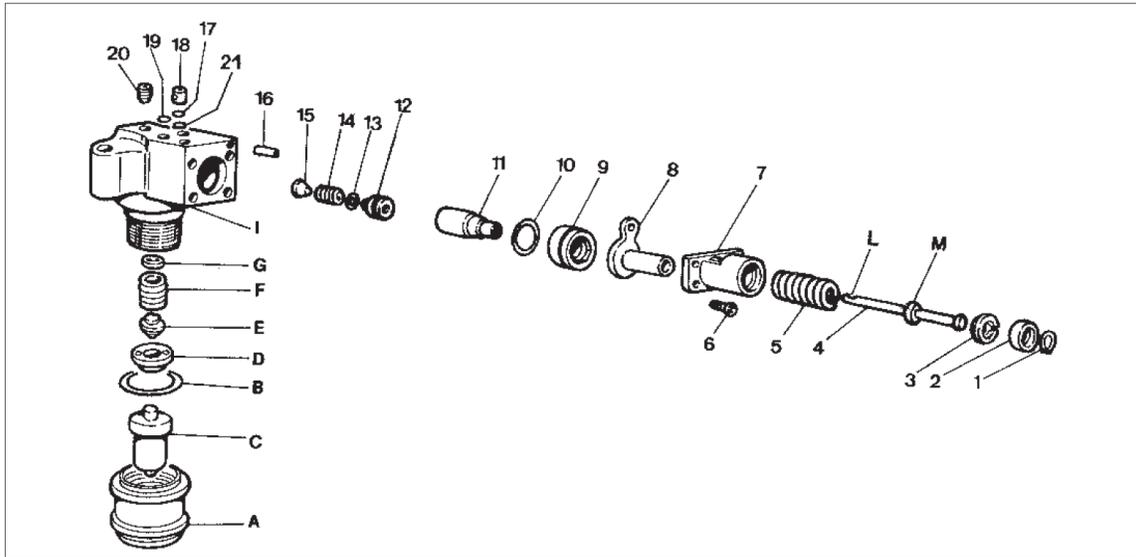


The injection system includes two, three, four identical pumps/injector units; each one feeds a cylinder.

Note:

On pumps/injectors of recent construction, the pump has been slightly modified. (See Kohler Service Manual for details).

Figure 5-6



Pump/Injector Components

1	Seeger Ring
2	Tappet
3	Stop Plate
4	Plunger
5	Spring
6	Screw
7	Bearing
8	Lever
9	Ring Nut
10	Plunger Guide O-Ring
11	Cylinder
12	Delivery Valve
13	Gasket
14	Spring
15	Filler
16	Pin
17	O-Ring
18	Non-Return Valve
19	O-Ring
20	Cap Screw (old type)
21	Metal Gasket (new type)
A	Ring Nut
B	O-Ring
C	Nozzle
D	Spacer
E	Pressure Rod
F	Spring
G	Spacer
I	Casing
L	Control Spiral
M	Plunger Guide
Note: When remounting the injector tighten ring nut A at 70 Nm	

WARNING!

A DIESEL ENGINE MAY START AT ANY TIME, disconnect J1 connection before beginning any engine repair.
Disregarding a **WARNING** can result in **serious personal injury** or **death**.

S5.3 Fuel Solenoid**Figure 5-7****Fuel Shut-Off Solenoid****Removal of the Fuel Solenoid**

1. Remove the right side panel.
2. Remove the Fuel (Run) Solenoid wire spade connector.
3. Unscrew the banjo bolt holding the run solenoid in place.
4. Reinstallation is the reverse of removal.

WARNING!

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 Disregarding a **WARNING** can result in **serious personal injury** or **death**.

S5.4 Front and Rear Oil Seal Replacement

Replacement of the Oil Seal

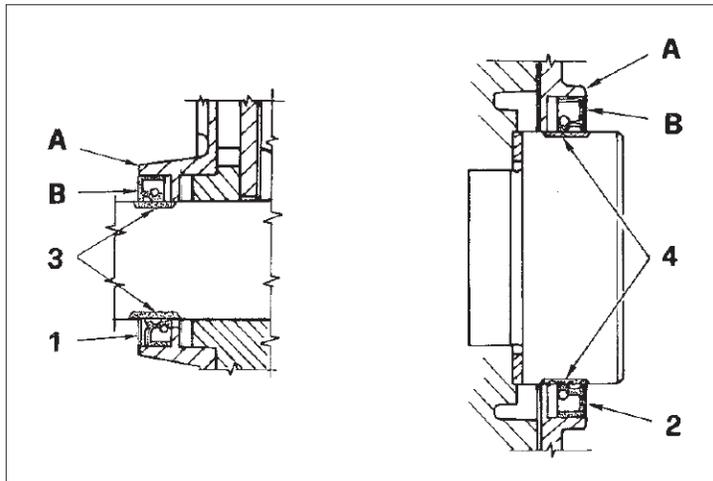
1. Carefully clean the housing.
2. Keep the ring immersed in engine oil for about half an hour.
3. Drive it into its housing with a buffer exercising a uniform pressure on the whole front surface. Be sure that the two surfaces A and B meet on the same level.
4. Refill the interior hollow with grease and lubricate the seal lip with thickened oil.

CAUTION

When refitting the flywheel backplate apply an RTV silicone sealant to the block and around the screw holes to improve the seal. An ambient temperature below -35°C may damage the rings.

COMPONENT	TORQUE SPEC.
Flywheel hex bolts	59 ft/lbs. (80 Nm)
Back-plate bolts	12 ft/lbs. (16 Nm)
Flywheel Drive Pulley bolts	69 ft/lbs. (93 Nm)

Figure 5-8



Crankshaft Front and Back Oil Seal Rings

The front oil seal ring 1 inserted into the oil pump cover and the back one 2, in the flywheel side flange. If warped, hardened, or cracked, replace them.

NOTE

Before major engine overhaul, in case of oil leakage in the seal area of rings 3 and 4, you can remedy this by replacing the rings and pushing them about 2 mm deeper with respect to the previous ones. If the rings are black it means zones 3 and 4 of the crankshaft are tempered. In this case it is necessary to remount a ring of the same colour. If the rings are brown it means that zones 3 and 4 of the crankshaft are not tempered. In this case it is necessary to remount brown coloured rings.

WARNING!

A DIESEL ENGINE MAY START AT ANY TIME, disconnect J1 connection before beginning any engine repair.
 Disregarding a **WARNING** can result in **serious personal injury** or **death**.

S5.5 Starter Motor

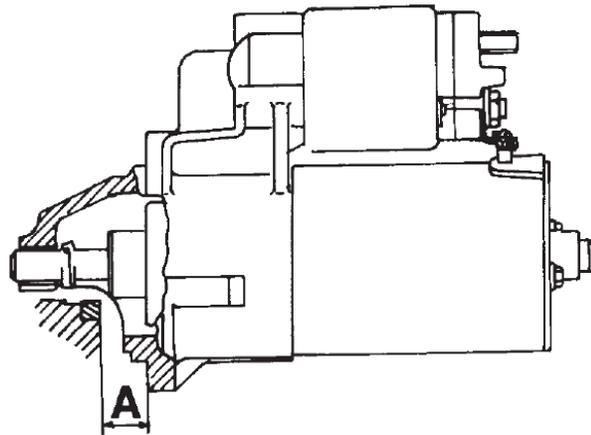
Removal of the Starter Motor

1. Remove the APU front cover.
2. Remove right side panel.
3. Disconnect the blue wire from the spade terminal of the starter motor.
4. Disconnect the positive battery cable.
5. Using the Allen key, remove the two (2) socket head cap bolts that fasten the starter motor to the flywheel back plate and remove the motor.
6. Reinstallation is the reverse of removal.
7. Torque starter mounting bolts to 20 ft/lbs. (50 Nm)
8. Torque battery terminal bolt to 6 ft/lbs. (15 Nm)

TOOLS REQUIRED

- 8mm Allen Key
- 1/2" Socket Wrench
- 3/8" Socket Wrench

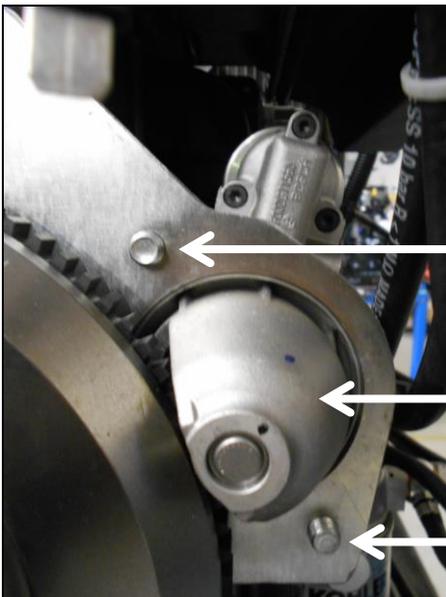
Figure 5-9



STARTER MOTOR - Bosch DW 12V 1,1 KW

Rotation: Clockwise
A = 17.5 ÷ 19.5 mm
 (distance from starter mounting flange to ring gear face)

Figure 5-10



Upper Mounting Bolt

Starter Motor

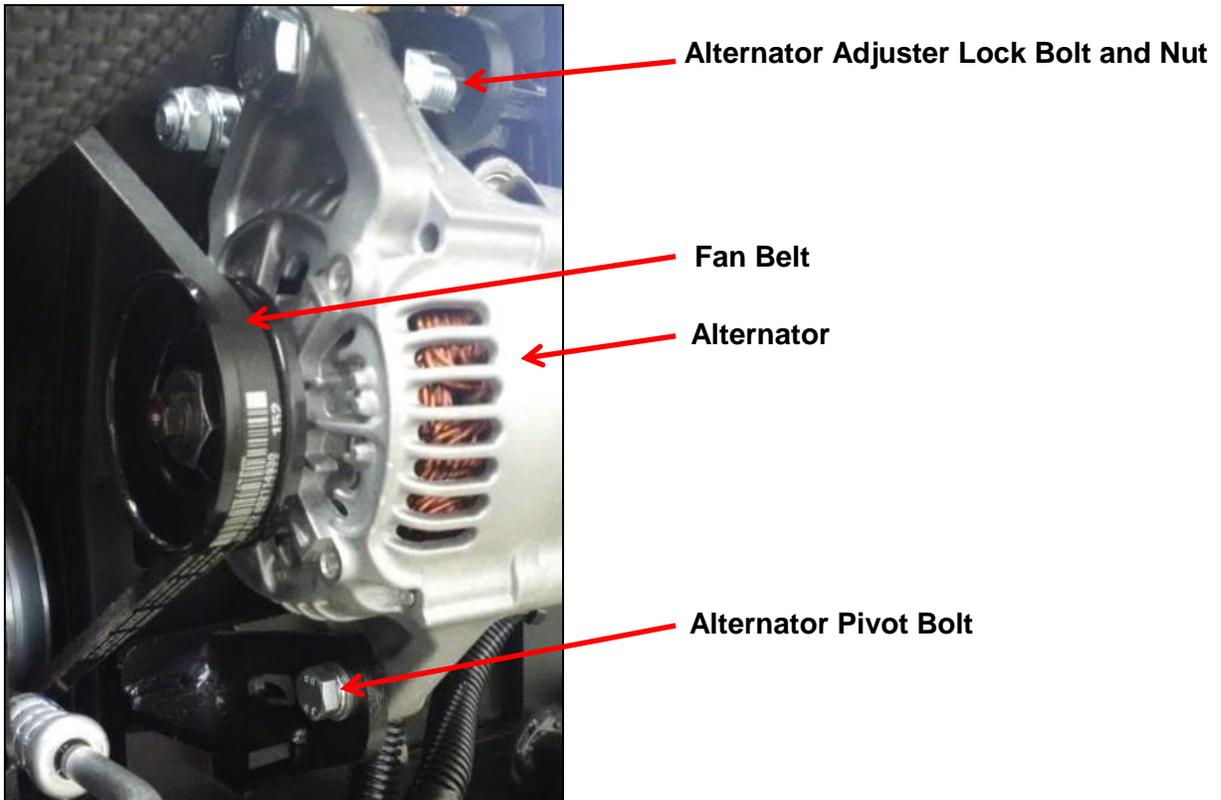
Lower Mounting Bolt

WARNING!

A DIESEL ENGINE MAY START AT ANY TIME, disconnect J1 connection before beginning any engine repair.
 Disregarding a **WARNING** can result in **serious personal injury** or **death**.

S5.6 Alternator

Figure 5-11



COMPONENT	TORQUE SPEC.
Pivot Bolt	19 ft/lbs. (25 Nm)
Adjustment Bolt	19 ft/lbs. (25 Nm)

Removal of the Alternator

1. Disconnect power module J1 connector.
2. Disconnect vehicle battery positive cable.
3. Remove the engine cover.
4. Remove muffler, side panel and side support brace.
5. Remove the alternator plug connector and the positive battery cable that are attached to the alternator.
6. Remove the alternator pivot bolt, adjustment bolt and nut.
7. Remove the alternator.
8. Remove the fan belt.
9. Reinstallation is the reverse of disassembly.

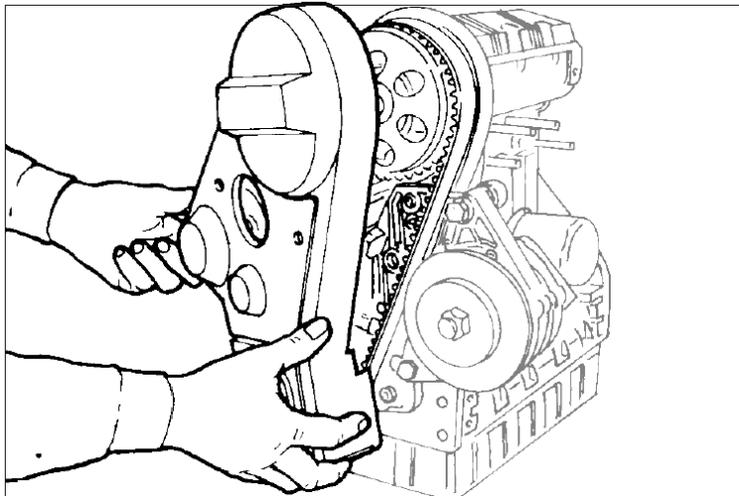
WARNING!

A DIESEL ENGINE MAY START AT ANY TIME, disconnect J1 connection before beginning any engine repair.
 Disregarding a **WARNING** can result in **serious personal injury** or **death**.

S5.7 Timing Belt

Timing Belt Cover

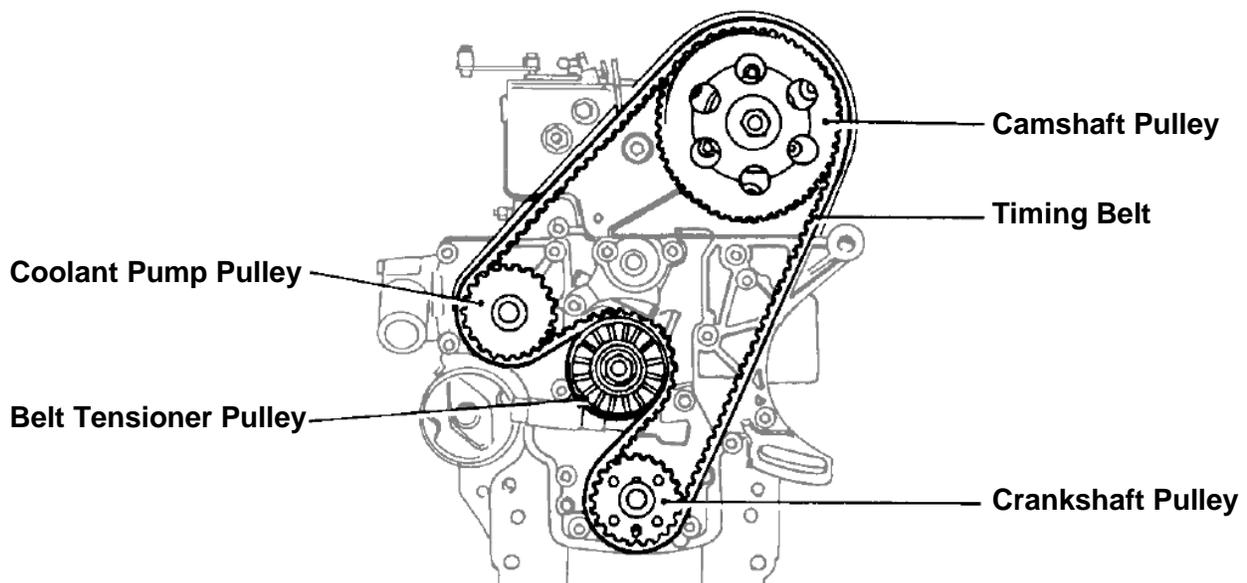
Figure 5-12



1. Loosen the five screws and remove the cover.
2. When refitting tighten the screws at a torque of 10 Nm.
3. Check the peripheral rubber sealing gasket and the two dust protection rings of the two pulleys, if mounted.

Component	Torque Spec.
Timing Belt Cover	7.38 ft/lbs. (10 Nm)

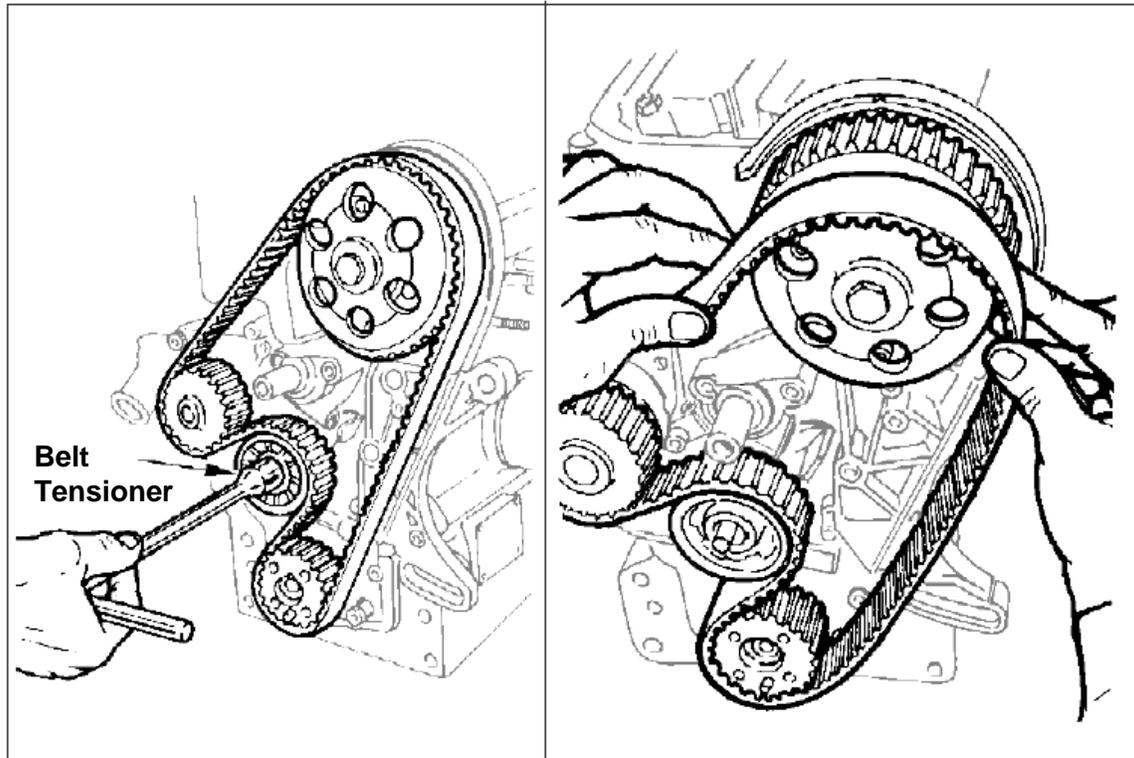
Figure 5-13



WARNING!

A DIESEL ENGINE MAY START AT ANY TIME, disconnect J1 connection before beginning any engine repair.
Disregarding a **WARNING** can result in **serious personal injury** or **death**.

Figure 5-14

**Timing Belt Removal****CAUTION**

When you remove the distributor belt, replace it even if its prescribed operation time has not expired yet.

WARNING!

Always check that the positive pole of the battery is insulated.

1. Remove the belt tensioner.
2. Remove the timing belt off the timing pulley.

WARNING!

A DIESEL ENGINE MAY START AT ANY TIME, disconnect J1 connection before beginning any engine repair.
 Disregarding a **WARNING** can result in **serious personal injury** or **death**.

Figure 5-15

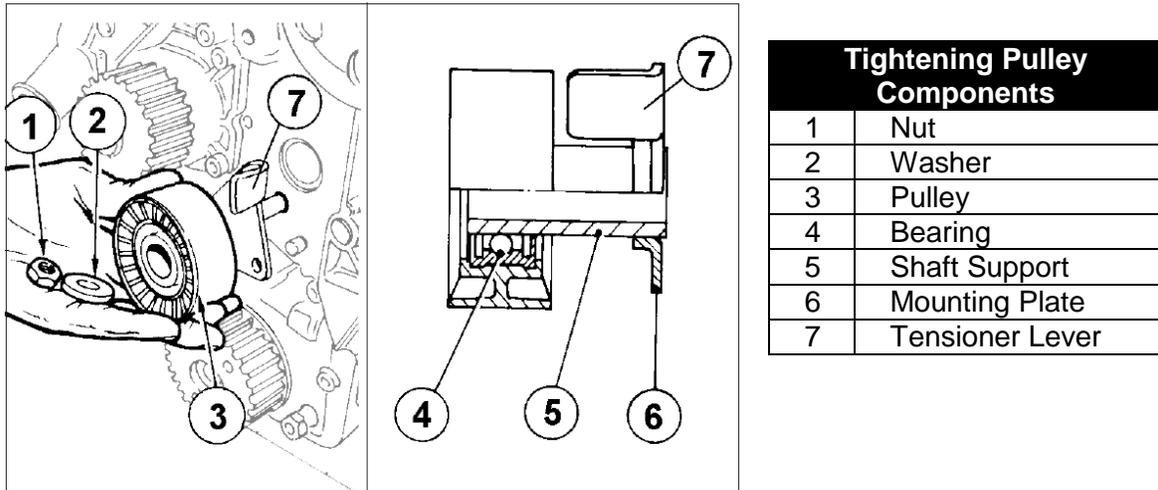
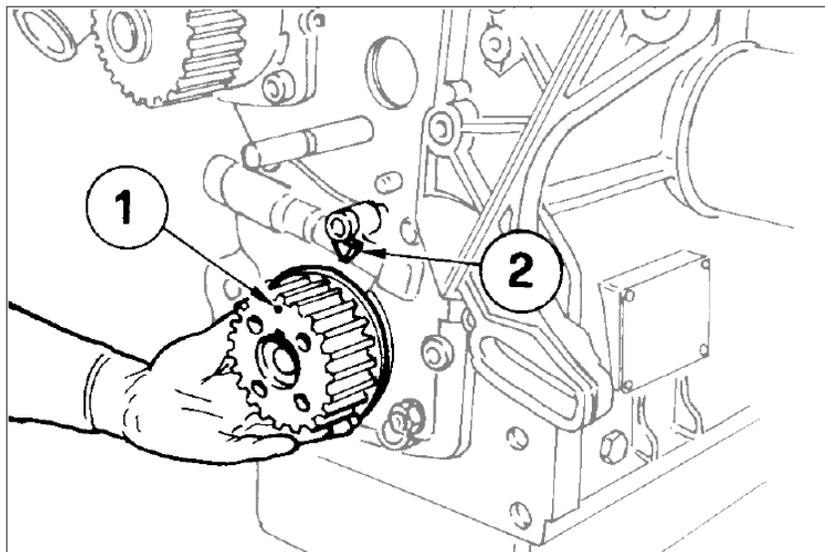


Figure 5-16



Crankshaft Timing Pulley

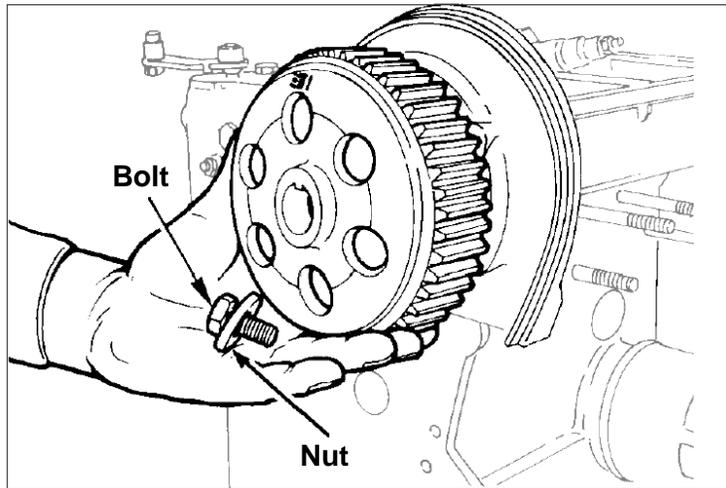
Important:
 When reassembling, make sure that the key remains inserted in its place.

1. Reference mark 1 on the crankshaft timing pulley is a timing mark.
2. Reference mark 2 on the oil pump housing is a timing mark.
3. When aligned, No. 1 piston (flywheel side) is at TDC.

WARNING!

A DIESEL ENGINE MAY START AT ANY TIME, disconnect J1 connection before beginning any engine repair.
 Disregarding a **WARNING** can result in **serious personal injury or death.**

Figure 5-17



Camshaft timing pulley – Disassembly/Assembly

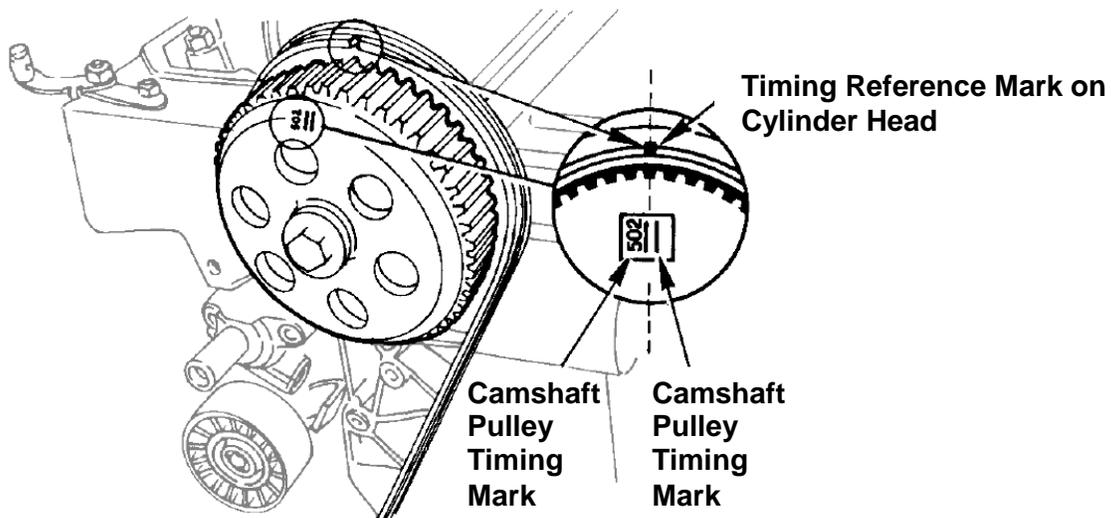
Unscrew Bolt and remove the pulley. No extractor is needed.

When refitting, tighten the screw at a torque of 80 Nm.

Assess any wear caused by the lip of the seal ring on the pulley tang.

Figure 5-18

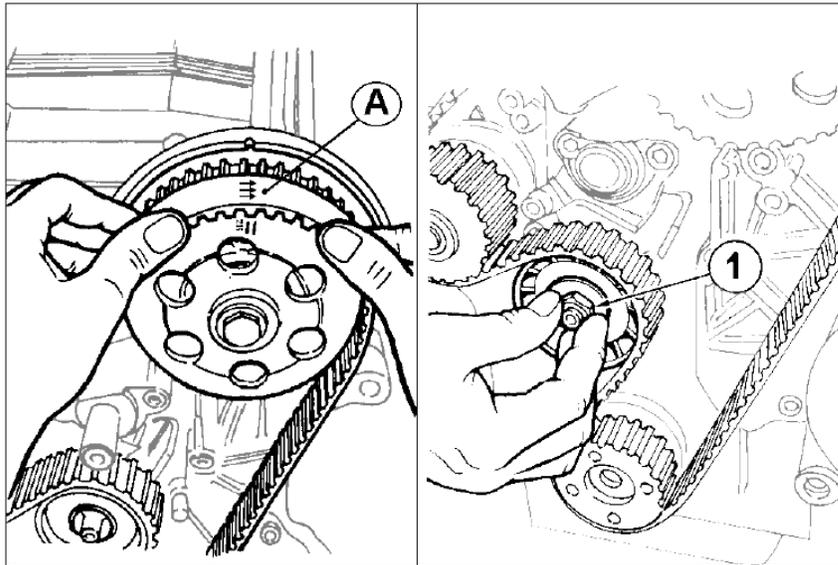
Camshaft Timing Pulley – Reference Marks



WARNING!

A DIESEL ENGINE MAY START AT ANY TIME, disconnect J1 connection before beginning any engine repair.
 Disregarding a **WARNING** can result in **serious personal injury** or **death**.

Figure 5-19

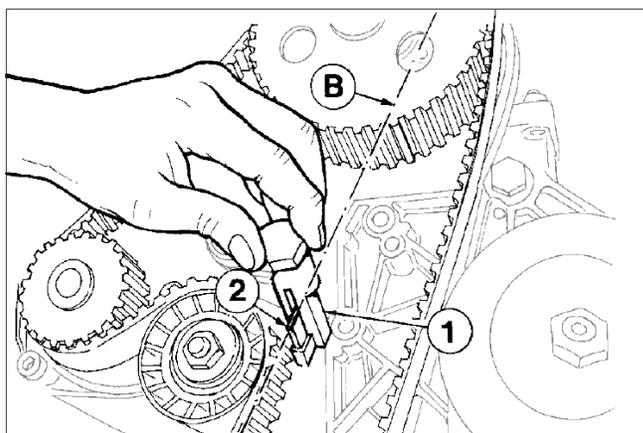


Camshaft Timing Belt Reassembly

Important:
 Remove the distributor toothed belt from its protective wrapping only when mounting it.

1. Make the connections for toothed belt and that of pulley fit together. See Figures 5-17 and 5-18
2. Insert the belt (See Figure 5-19) taking account of the direction of the arrows A impressed on it (direction of rotation).
3. Tighten Nut 1 by hand until the belt tightener rests on surface of the crankcase.
4. Start by mounting the camshaft pulley belt, then mount crankshaft's pulley. Do not mount driven belts.

Figure 5-20



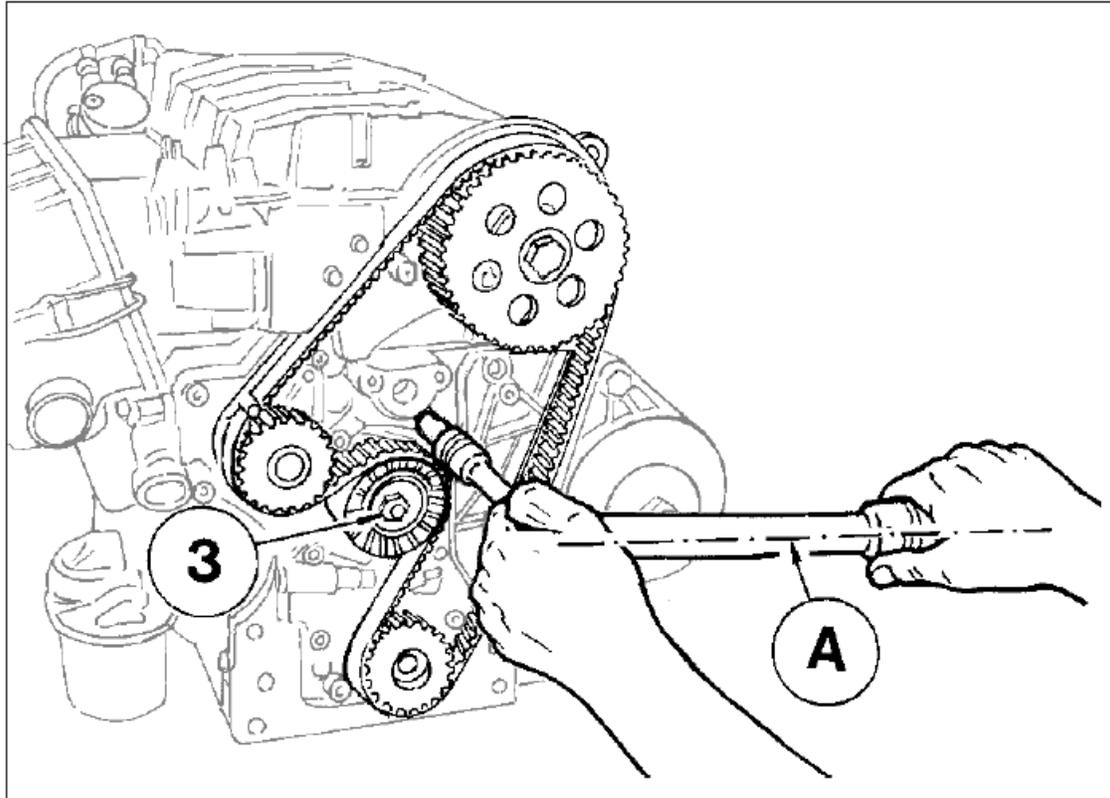
Camshaft Timing Belt Tightening Tool

Position belt preload tool 7107-1460-049 (1) over the timing belt idler adjustment ear (2).

See "Camshaft Timing Belt Tightening and Fastening" on next page.

WARNING!

A DIESEL ENGINE MAY START AT ANY TIME, disconnect J1 connection before beginning any engine repair.
Disregarding a **WARNING** can result in **serious personal injury** or **death**.

Figure 5-21**Camshaft Timing Belt Tightening and Fastening**

1. Insert the torque wrench in the suitable tool so that the A axis of the key (See Figure 5-21) is at 90° to the B axis of the Tightening Tool (See Figure 5-20).
2. Tighten in clockwise direction at 14.75 ft/lbs. (20 Nm.)
3. Remount the drive pulley.
4. Maintaining the belt tension, tighten nut 3 with another torque wrench at 29.5 ft/lbs. (40 Nm.)
5. Rotate the crankshaft a few times and check that the tension is as described above.
6. The check must be carried out with the appropriate Nippon.
7. Denso tension measuring instrument (halfway along the longest section of the belt), the value for a cold engine must be 15 ± 2 Kg.

Section 6 Fuel System

	Section	Page
Fuel System Introduction	S6.0	51
Bleeding Procedure: Low Pressure Fuel System	S6.1	53
Standard Fuel System Configuration	S6.2	54
Fuel System Test Procedures	S6.3	56

S6.0 Fuel System Introduction

WARNING!

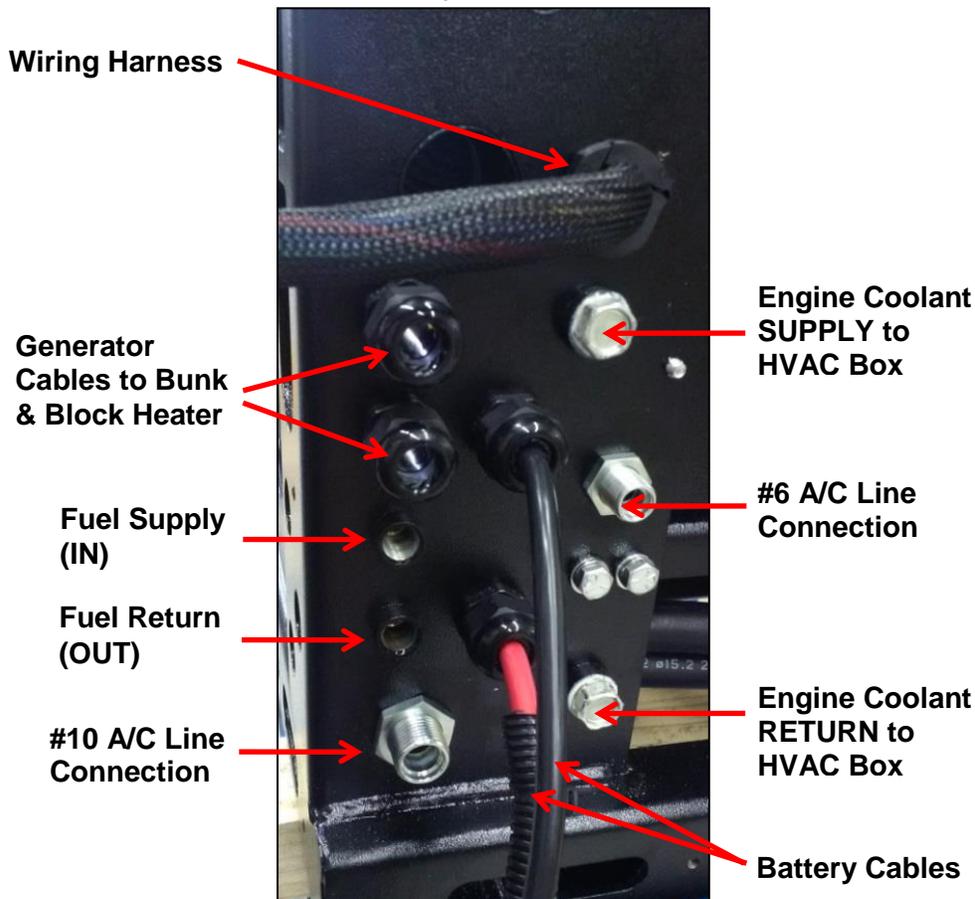
Do **not** use aerosol types of starting aids such as ether. Such use could result in an explosion and personal injury, and will render the warranty null and void.

The RigMaster incorporates a low/high pressure fuel system with fuel supply and return lines interconnected with the vehicle's fuel system. The engine lift pump supplies fuel to the filter assembly and then to the injection pump. When interconnected with the vehicle's fuel lines the APU's fuel supply line requires that a check valve be installed. If using the standard pick-up tube, a check valve is not necessary as the APU's fuel system is now independent of the vehicle. For additional information on fuel specifications, see Section 1 of this Manual.

NOTE

This type of fuel system de-aerates itself. There is an air bleed screw located on the filter assembly (See Figure 2-8 for location).

**Figure 6-1
Rear of Frame – Connection Layout**



**Figure 6-2
Engine Coolant**



SUPPLY from main unit

RETURN to main unit

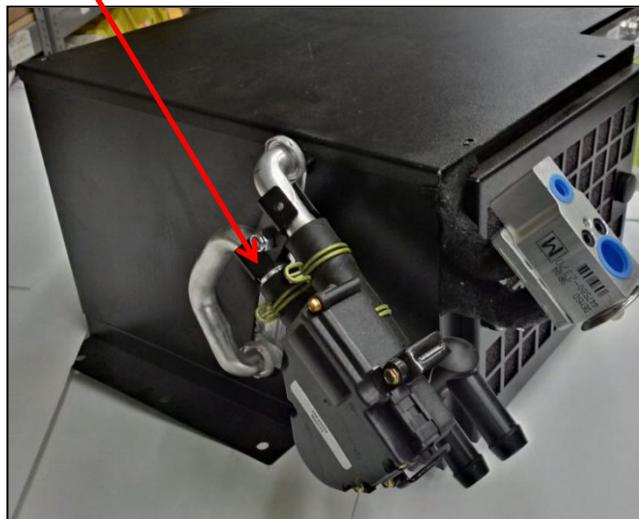
NOTE

When hooking up the engine coolant lines to the HVAC box it is very important to mark the lines and hook them up correctly. Improper connections will result in poor heating in the bunk.

Radiator Filling and Purging

1. Using a radiator pressure tester, pressurize the system to 7 PSI.
2. At the HVAC box, loosen the **lower** hose clamp located on the heater core.
3. Carefully insert a flat screwdriver between the hose and tube until air starts escaping.
4. Bleed air until coolant escapes.
5. Tighten hose clamp.
6. Remove pressure tester, and top up radiator and coolant reservoir.
7. Repeat if necessary.
8. Start the engine and turn heat on high setting.
9. Run the engine for 15 minutes and then allow engine to cool.
10. Top up the coolant.

**Figure 6-3
HVAC Box
Bleed from the return side of the heater core.**



NOTE

When purging the air from the HVAC box use some lubricant on the screw driver to slide between the heater core tube and rubber hose.

S6.1 Bleeding Procedure: Low Pressure Fuel System

If there is air in the line between the fuel filter assembly and the injection pump continue bleeding the low pressure system by performing the following additional steps:

Fuel System Bleeding Procedure:

TOOLS REQUIRED
 10mm Wrench
 Oil Filter Wrench

NOTE

The low-pressure system must be free of air as much as possible before starting the engine. Running the engine will remove the little bit of air that could still be in the fuel system.

1. Position a container or shop wipe under the fuel filter to contain any spilled fuel.
2. Using a 10mm wrench loosen the Air Relief Valve (See Figure 2-8, Location 1).
3. Prime the system using the manual lift pump lever located on the lift pump (See Figure 6-4). Since the pump is mechanical and has a diaphragm it may be necessary to manually turn the engine by hand so that the engine camshaft allows full stroke on the lift pump.
4. Continue to pump the lever until the air relief valve shows signs of fuel passing out of the bleed screw.
5. Tighten the air relief valve bolt.
6. Bleeding low pressure system is complete.

WARNING!

Do **not** use priming lever when engine is cranking or running. Only use priming lever when engine is off.

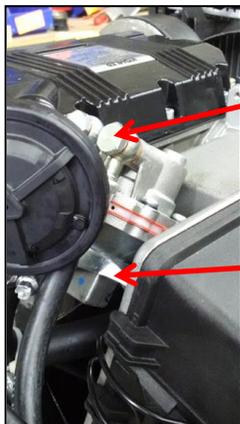


Figure 6-4
Fuel Supply to Filter
Priming Lever

1. Loosen the air bleed screw on the fuel filter assembly.
2. Operate the manual primer pump lever until a clear stream of fuel is seen coming from the fuel filter bleed screw.
3. Carefully tighten the bleed screw.

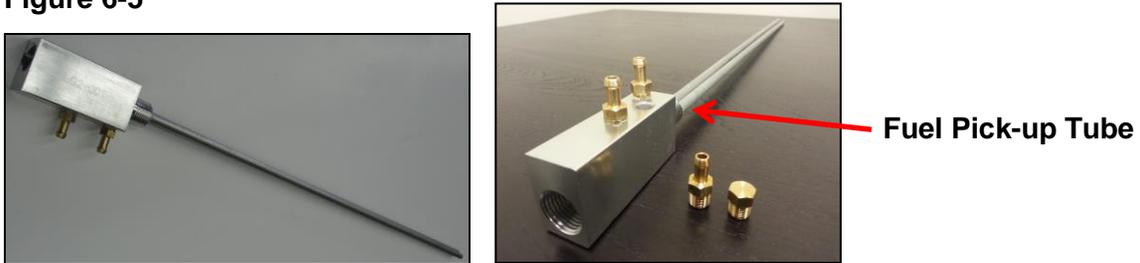
CAUTION

Do not over tighten this bleed screw as it has a hollow core and may break off.

S6.2 Standard Fuel System Configuration

A fuel pick-up tube is supplied with the APU.

Figure 6-5



NOTE

Since the fuel pick-up tube used for the RigMaster is independent of the trucks fuel pick-up tube no check valve is necessary for this configuration.

Installing a Fuel Pick-up Tube

Fuel can be drawn from one tank without causing any large imbalances in the fuel levels.

1. Remove the vent on the diesel tank.
2. Install pick-up tube through vent hole on tank.
3. Re-install vent onto the top of the fuel pick-up tube.
4. Suitable sealant should be used on pick-up tube threads and when re-installing the vent.

Optional Fuel Fittings Kit

On some applications the same “T” system can be used for side draw fuel tanks and at dual valves generally located on top of the transmission.

NOTE

A check valve must be installed when tying into fuel supply lines shared with the vehicle.

Figure 6-6
Fuel Pick-up Tube

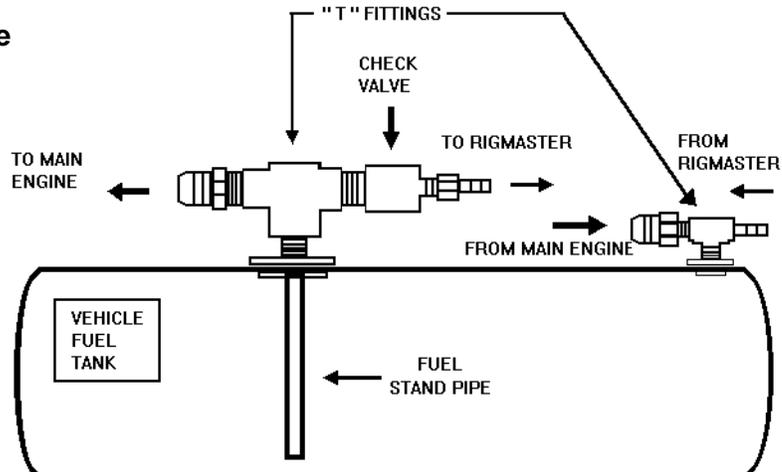
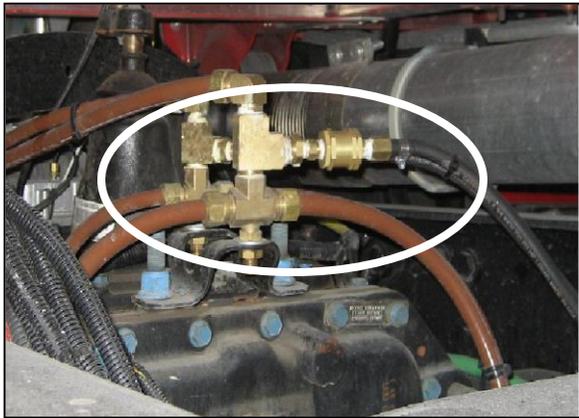
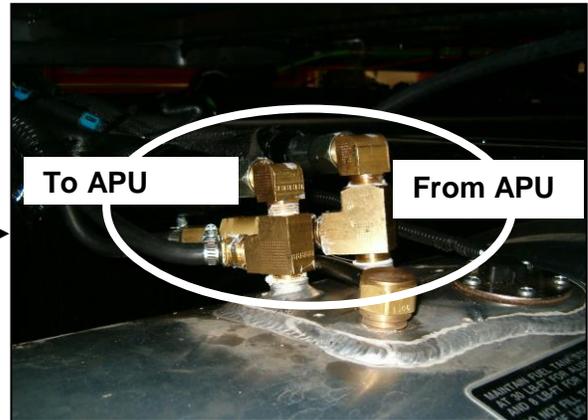


Figure 6-7



Fuel Fittings at the Crossover

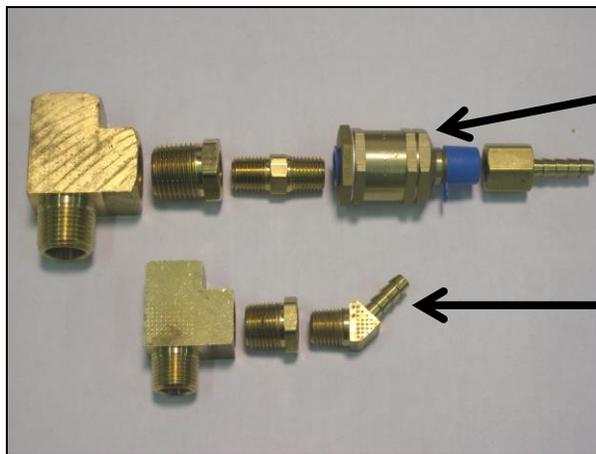
Figure 6-8



Fuel Fittings at the Tank

Figure 6-9

Fuel Fitting Hardware



Check Valve

Fuel Supply Fittings

Fuel Return Fittings

NOTE

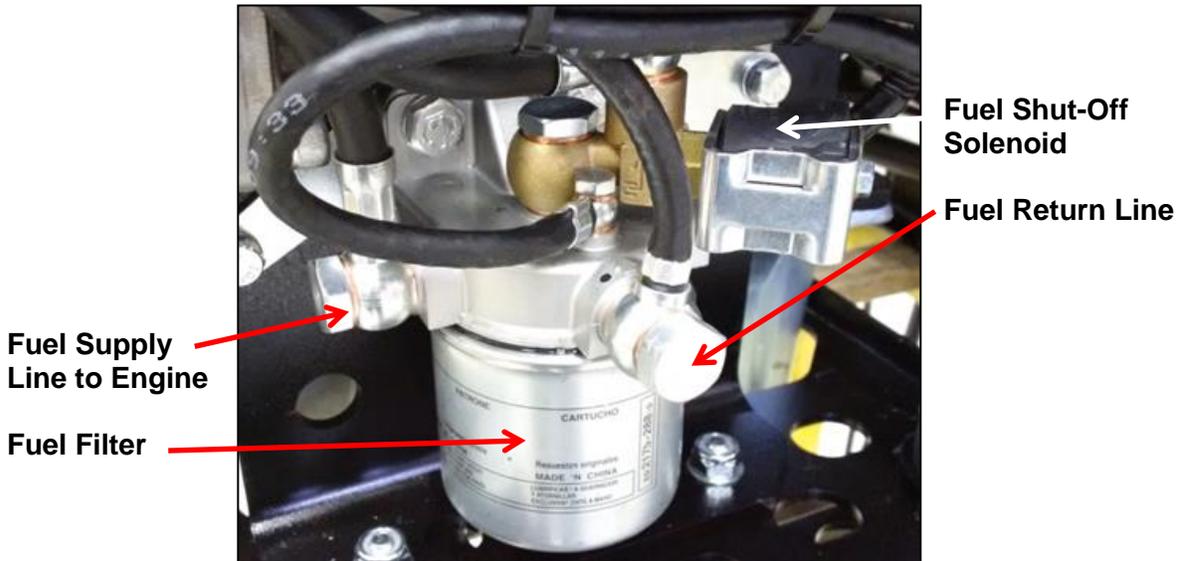
The check valve has an arrow indicating the correct direction of fuel flow. Try to keep the arrow on the valve in view; this will help when troubleshooting.

DESCRIPTION	QTY.
¼" check valve	1
¼" male NPT to hose fittings	2
12 ft. (3.5m) fuel hoses	2
Fuel line hose clamps	4
¼" female NPT to hose fitting	1

S6.3 Fuel System Test Procedures

1. Remove the fuel filter. If the components are full of water or there is sediment, the problem could be contaminated fuel or excessive water in the fuel. Replace filter.
2. Prime the low-pressure fuel lines.
3. Disconnect the fuel filter feed line from the feed pump (See Figure 6-10) and install a length of similar fuel hose long enough to reach into a can.
4. Start and run the engine.
5. Observe the output from the feed pump; the fuel should be free of air.
6. If air is still present, remove the supply hose from the feed pump and install a length of hose long enough to reach into a can (See Figure 6-10).
7. Insert both hoses into a can filled with diesel fuel and start the engine.
8. If there is no air present, check all the fuel hoses and connections between the fuel feed pump and the fuel tank.
9. If air bubbles are still present, replace the feed pump.

Figure 6-10



NOTE
 Lift Pump pressures should be between 4.4 and 10 psi (30 kPa - 69 kPa). Replace the lift pump if it produces a pressure less than 3 psi (21 kPa).

Section 7 Air Filter

	Section	Page
Air Filter	S7.0	57
Removing and Replacing the Air Filter	S7.1	57

S7.0 Air Filter

NOTE

The air filter should be inspected every 500 hours of operation.

S7.1 Removing and Replacing the Air Filter

CAUTION

This unit accepts ONLY the RigMaster P/N K-001 (Kohler P/N ED0021751640-S) Air Filter. Do not use unapproved cross-referenced parts.

Figure 7-1



Air Filter Box

Procedure to Replace the Air Filter

5. Remove the cover from the air filter.
6. Remove the air filter element and clean the inside of the air cover. Allow the air cover to dry completely.
7. Replace air filter element. (Use only manufacturer-approved filters).
8. Reinstall the air filter cover and latches.

NOTE

Before test running the engine inspect the filter hoses for cracks or brittle sections. Damaged or deteriorating hoses should be replaced.

Section 8 Exhaust System

	Section	Page
Engine Exhaust	S8.0	58
Removing/Installing the Exhaust Flex Pipe	S8.1	58
Horizontal Muffler Mounting	S8.2	59
Diesel Particulate Filter (DPF) System	S8.3	61

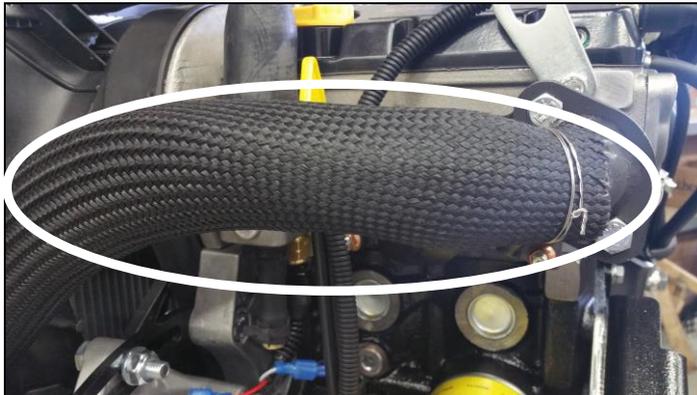
S8.0 Engine Exhaust

An inspection of the complete exhaust system should be performed regularly to find the condition of the flex pipe connecting the engine manifold and exhaust outlet tube and the condition of the muffler assembly.

S8.1 Removing/Installing the Exhaust Flex Pipe

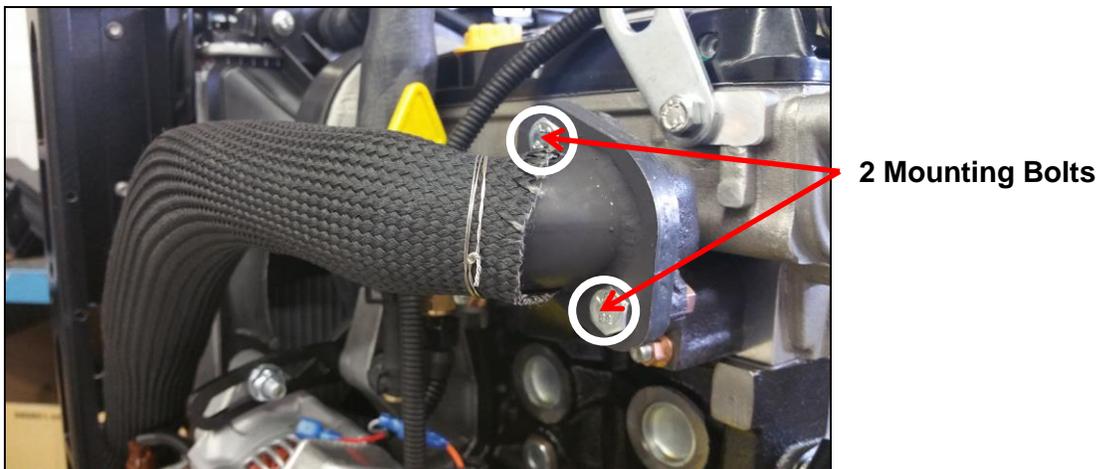
1. Exhaust heat blanket covering flex pipe is held with wire that can be undone.

Figure 8-1



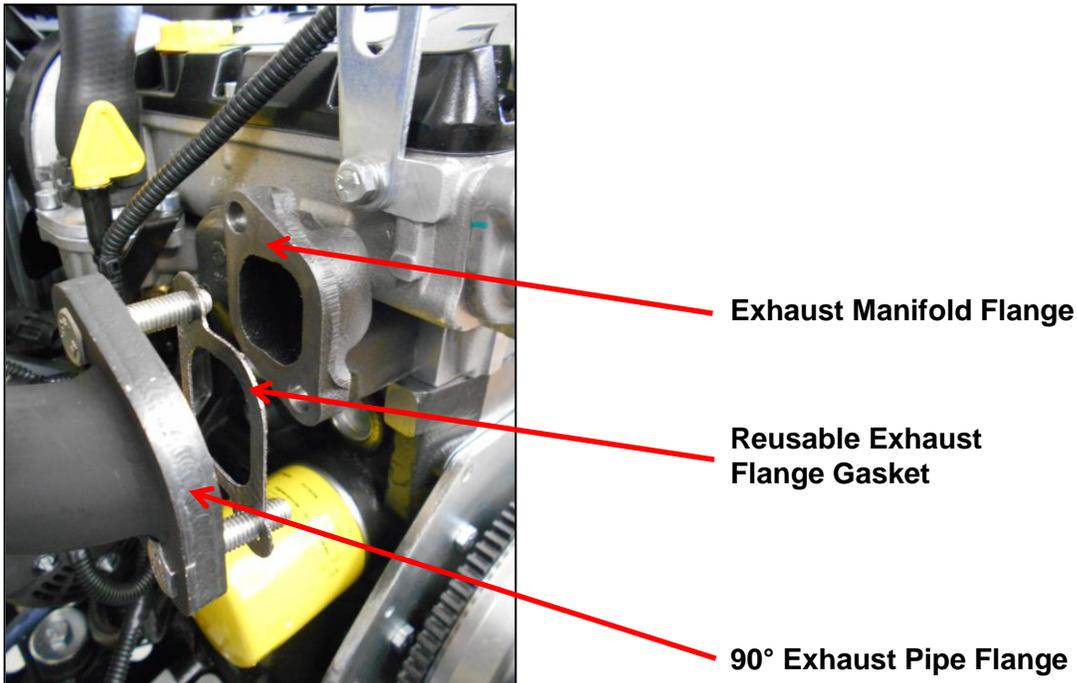
2. Two bolts mount the 90° flange to the exhaust manifold.

Figure 8-2



- Fit the flange gasket, install the braided flex pipe flange (LG6-003) to the exhaust manifold. Torque the two (2) bolts to 20-22 ft/lbs. (See Figure 8-3).

Figure 8-3



- Install flex pipe exit flange to bulkhead with gasket. (See Figure 8-4).

S8.2 Horizontal Muffler Mounting (KT6-001)

Figure 8-4



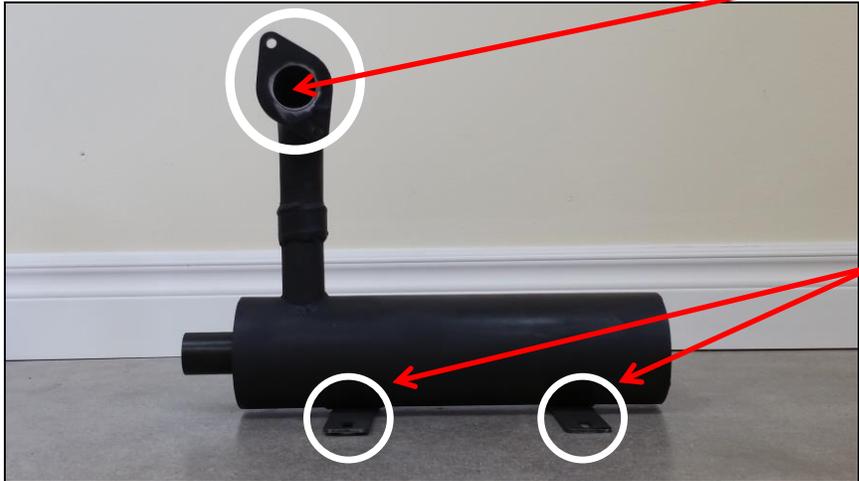
The muffler flange mounts to 2 holes in the Bulkhead with Gasket (only 1 hole is shown) (See Figure 8-4)

Install the 2 mounting bolts from inside the APU.

- Insert them through all 5 components to be held:
- Exhaust Flex Pipe Flange
 - Gasket
 - Bulkhead
 - Muffler Flange Gasket
 - Muffler Top Flange.

Install Nuts onto the Bolts and torque to 11.5 ft/lbs.

Figure 8-5



The Muffler Pipe Flange mounts with a Gasket onto 2 Bolts that are inserted through the Flex Pipe Flange and Bulkhead from inside the APU (See Figure 8-4, Figure 8-5, & Figure 8-6)

Lower Muffler mounting tabs mount to bottom of APU frame. (See Figure 8-6).

Bolt the Lower Muffler Mounting Tabs to the underside of the APU frame rail.

Figure 8-6



Muffler Lower Mounting Tabs (See Figure 8-6) are bolted to the bottom of the Left-side APU Frame rail.

NOTE

An Extension Pipe/Elbow (solid pipe, not a flex pipe) can be added to the exhaust system to direct the exhaust away from the sleeper. A maximum of 10 feet including the muffler can be added to the exhaust system without creating harmful back pressure. Ensure that any extension pipe is properly fastened with the correct hardware.

Exhaust Tip**Figure 8-7**

The exhaust tip included in the packaging of a new APU is not a mandatory component in this exhaust system. It must be removed to add an extension tail pipe. (See NOTE above). When installing this component use a 1½" pipe clamp to ensure that the connection stays tight on the muffler.

S8.3 Diesel Particulate Filter (DPF) System

The MTS-T4-6 model is designed to accommodate a Diesel Particulate Filter as an optional upgrade. Refer to the Diesel Particulate Filter Installation Instructions that will be supplied with the DPF kit.

NOTE

For additional information please contact RigMaster Power International Ltd.

Section 9 DC Electrical

	Section	Page
Engine Electrical and Control System (General Information)	S9.0	62
Operation of the Electronic Control System	S9.1	63
Electronic Control Operation and Fault Codes	S9.2	72
General Electrical System Information	S9.3	76
Power Module Connections	S9.4	76
System Schematics	S9.5	82
Testing the Electric Coolant Control	S9.6	86
Blower Motor Wiring	S9.7	87
Alternator Charging	S9.8	88
Sensors, Switches, and Sending Units	S9.9	89
Battery Fuse	S9.10	92

S9.0 Engine Electrical and Control System (General Information)

The MTS-T4-6 APU electronic control system consists of two main components, a Cabin Controller (CC) and a Power Module (PM), which are linked by an 8 wire, category 5e communication cable with (RJ-45) connectors at each end. The cabin controller is the interface sending user commands to the power module. The power module provides control intelligence to the unit by monitoring inputs and regulating outputs based on commands sent from the cabin controller and various engine sending units.

The cabin controller displays a number of error messages intended to act as diagnostic aids. These error messages do not indicate a specific problem, but rather provide general guidelines to aid in the troubleshooting process. (See S9.2 for a list of troubleshooting codes).

Pre-Start Inspection

with the RigMaster TURNED OFF

1. Remove the cover.
2. Visually inspect the unit for evidence of oil or coolant leakage.
3. Check the oil and add oil if necessary.
4. Check the tension and wear of all belts.
5. Check the mounting bolts and tighten if necessary.
6. Check for broken, corroded, or loose connectors and/or wires.
7. Check the physical condition and tightness of all hoses and hose clamps.
8. Replace and secure the cover.

S9.1 Operation of the Electronic Control System

NOTE

The cabin controller does not have any memory function to store codes. Once a button has been pushed the code will be cleared. Ensure you have the code written down prior to pressing a button as there is no way to retrieve the code once cleared.

Cabin Controller Operating Instructions

Before beginning the start-up procedure it is necessary to know how to operate the cabin controller.

Figure 9-1



**Open Cabin Controller
Cover to Access Controls**

Controls

The Cabin Controller consists of two sections:

1. LCD (Liquid Crystal Display) with basic control buttons.
2. Advanced control buttons.

The LCD and basic control buttons are always visible to the user. The advanced control buttons are concealed behind a semi-circular cover.

The controller also contains an LED indicator. When the LED is green, the system is active; if it glows red then the system is detecting a problem and an error message will scroll across the bottom of the LCD screen. The LED is turned off in low power mode.

1. Basic Controls and Functions

Basic controls contain the following buttons:

1. Start system.
2. Stop system.
3. Up arrow (Red triangular button).
4. Down arrow (Blue triangular button).

If the unit is in *advanced* mode, pressing any of the basic control buttons will return the unit to basic mode. Alternately, the control panel will return to basic mode after two minutes of inactivity.

If the unit shows the current temperature, pressing either the up or down button will show the set point temperature without changing it. Once the set point is indicated, pressing up or down buttons will adjust the set point. The new set point takes effect only when display is returned to show internal temperature.

2. Advanced Controls and Functions

The advanced controls are as follows:

1. **Power** button controls whether the module is active. In *inactive* mode all system functions including engine start, climate control and AutoStart are disabled. You can still see the temperature reading, current time and use the alarm clock function.
2. **Fan** button is used to change fan setting. Pressing the button cycles between auto, high, med, low, and off settings.
3. **Clear** button will take you back to the main screen without saving any information.
4. **Clock** button is used to set the time/date/day menu features.
5. **Alarm** button is used to set the alarm menu features.
6. **AutoStart** button is used to access and set AutoStart menu features.
7. **Mode** button is used to activate the different operational modes. Pressing the mode button will back you out of a menu mode, but does not save the information just entered.
8. **Ext. Temp** button will display the external temperature on the LCD when pressed.
9. **Oprtg. Hours** button will display the total hours of use.
10. **Select** button enters the data and advances the program to the next menu step. Pressing the select button will save the information when entering operational data.
11. Left scroll button (◀).
12. Right scroll button (▶).

The left and right arrow buttons are used to locate the desired data and/or adjust those values.

NOTE

The operating hours of the APU are recorded within the cabin controller. Replacing the cabin controller will reset the operating hours to zero. There is no means of transferring the operating hours from the old controller to the new controller.

Cabin Controller LCD Display

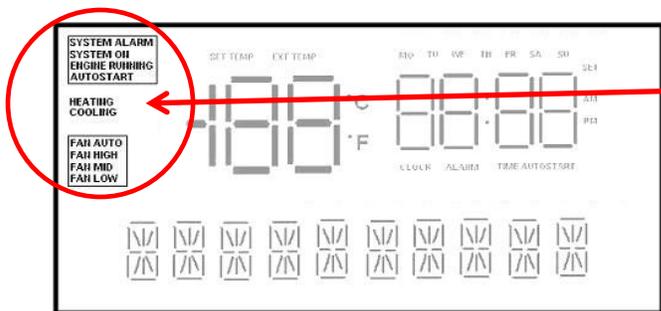
The Cabin Controller LCD has a white backlight that turns on each time a user presses a button and will remain on for 2 minutes after the last button has been pushed. The backlight will turn red when there is an alarm condition. A fault code will be displayed if the unit shuts down or fails to start.

The LCD displays 4 groups of information:

1. System information.
2. Temperature information.
3. Clock, day and alarm information.
4. Alphanumeric display for additional information.

1. System Information

Figure 9-2



Cabin Controller LCD Display – Controls

SYSTEM ALARM symbol will flash if an alarm condition has occurred. The alphanumeric display along the bottom of the display screen will show more information about the alarm. (Red status LED will be on.)

SYSTEM ON symbol will display if the unit is in ON mode. (Green status LED will be on.)

ENGINE RUNNING symbol will display when the engine is running.

AUTOSTART symbol will display and flash if temperature AutoStart is enabled (when engine is off). If the engine has been started through AutoStart, this symbol is constantly on while the engine is running.

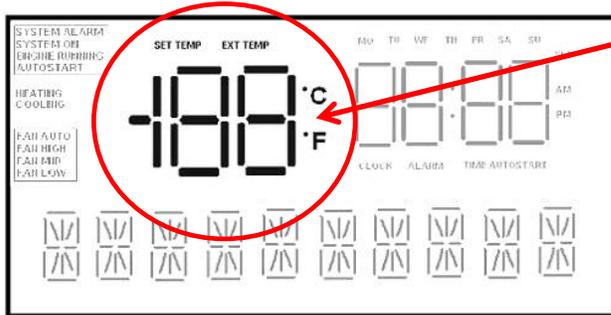
HEATING symbol will display when the system is in heating mode.

COOLING symbol will display when the system is in cooling mode.

FAN AUTO, FAN HIGH, FAN MED, or FAN LOW symbol will display depending on which setting has been selected. Nothing will display in this area if the fan is set to off.

2. Temperature Information

Figure 9-3



Cabin Controller LCD Display – Temperature

This area indicates the internal (or external) temperature and can be programmed to display in either “Celsius” or “Fahrenheit”.

Internal temperature is shown if **EXT TEMP** and **SET TEMP** symbols are not illuminated. Pressing the

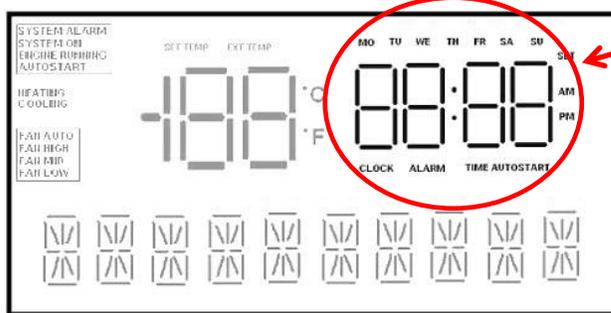
Ext. Temp button will momentarily display the outside temperature. After 5 seconds, the display will default back to showing the internal temperature.

EXT TEMP symbol will flash when showing external temperature. After a few seconds the display returns to show internal temperature.

SET TEMP symbol appears (and the numeric temperature value will flash) whenever adjusting temperature set point. A few seconds after adjusting the temperature, the display returns to show internal temperature.

3. Clock and Alarm

Figure 9-4



Cabin Controller LCD Display – Clock & Alarm

This is a 12:00 hour clock system with **AM/PM** symbols and 7 symbols indicating day of the week: **MO, TU, WE, TH, FR, SA, SU**.

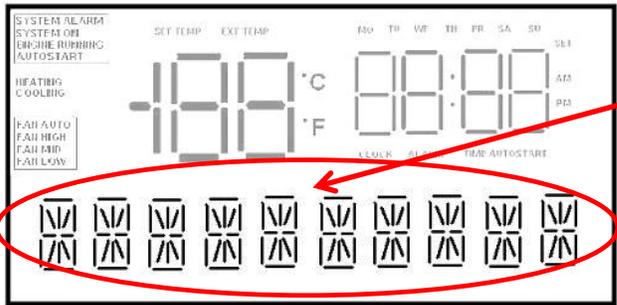
CLOCK symbol appears when the current time is showing.

ALARM symbol appears to indicate that the alarm setting is showing. Pressing the alarm button allows you to set the alarm. The alarm symbol flashes when the alarm has been set.

TIME AUTOSTART symbol appears if the display shows time AutoStart setting. It flashes if Time AutoStart is set.

4. Additional Information/Message Area

Figure 9-5



Cabin Controller LCD Display – Message Area

This line is used to show extra information in the basic mode; error messages to provide interface when going through menus in advanced mode. Longer text lines are scrolled to the left on the display.

Operation of the Cabin Controller (Functions)

To Turn Power On

Press the **POWER** button to activate the system. When the power switch is activated the LCD display will light and **SYSTEM ON** symbol will turn on (active mode). Press **POWER** button again for 2 seconds to switch the unit back to low power mode.

Engine Start

Press **START** button.
 The control panel will display the status of the operation as it occurs: *Glow Plug* and a countdown will display on the screen. Once the countdown is complete the display will read *Cranking* as the APU starts up and the **ENGINE RUNNING** symbol will blink. Once started the control will display *Engine Running* for 5 seconds (and **ENGINE RUNNING** symbol will turn on).

Engine Stop

Press **STOP** button.
 The screen will initially display *Stopping* and then change to *Stopped* once the operation is complete. The **Engine Running** symbol will turn off.

Temperature Control

Press UP or DOWN (red/blue) buttons to adjust temperature set point on the display. When editing the set point, the LCD display will show the set point instead of internal cabin temperature. The set point is stored without a need to press any other buttons.

NOTE

The manual temperature control ranges from 59°F to 90°F (15°C to 32°C).
 The system will remember the last set temperature when the APU is turned on. If the system is already running, the change will take effect a few seconds after the last UP or DOWN key is pressed and the display will switch back from set point to internal cabin temperature.

Clock and Date Set-Up

It is necessary to enter the time and date programming mode if the module has never been programmed or a different time zone is required. (**SET** symbol is flashing and **CLOCK** symbol is turned on during clock setup).

1. Press **CLOCK** button. (The display will read *Set Clock*.)
2. Press **SELECT** button to continue, **MODE** to exit. (*Clock hour* will start flashing.)
3. Press LEFT or RIGHT scroll button to adjust Clock hour.
4. Press **SELECT** button. (*Clock hour* will stop flashing and *Clock minutes* will start flashing.)
5. Press LEFT or RIGHT scroll button to adjust *Clock minutes*.
6. Press **SELECT** button. (*Clock minutes* will stop flashing and *AM/PM* will start flashing.)
7. Press LEFT or RIGHT scroll button to change.
8. Press **SELECT** button. (*AM/PM* will stop flashing and *Day of week* will start flashing.)
9. Press LEFT or RIGHT scroll button to change.
10. Press **SELECT** button. (*Day of week* will stop flashing and *Month* will start flashing.)
11. Press LEFT or RIGHT scroll button to change.
12. Press **SELECT** button. (*Month* will stop flashing and *Date* will start flashing.)
13. Press LEFT or RIGHT scroll button to change.
14. Press **SELECT** button to save settings and return to menu or press **MODE** to return to menu without saving.

Set Alarm Clock

1. Press **ALARM** button. (The display will read *Set Alarm*.)
2. Press **SELECT** button to continue, **MODE** to exit. (*Alarm Clock hour* will start flashing.)
3. Press LEFT or RIGHT scroll button to adjust Alarm Clock hour.
4. Press **SELECT** button. (*Alarm Clock hour* will stop flashing and *Alarm Clock minutes* will start flashing.)
5. Press LEFT or RIGHT scroll button to adjust *Alarm Clock minutes*.

6. Press **SELECT** button. (*Alarm Clock minutes* will stop flashing and *AM/PM* will start flashing.)
7. Press LEFT or RIGHT scroll button to change.
8. Press **SELECT** button.
9. Press LEFT or RIGHT scroll button to turn Alarm clock on/off.
10. Press **SELECT** button to save settings and return to menu or press **MODE** to return to menu without saving.

When enabled, **ALARM** symbol is flashing.

Fan Speed Control

1. Press **FAN** button to adjust fan speed.
2. Press the **FAN** button to cycle through fan settings. (*AUTO OFF, AUTO ON, FAN LOW, FAN MEDIUM, FAN HIGH, FAN OFF.*)

There is no need to press any other buttons to confirm.

AUTO OFF is for heating efficiency during winter operation.

AUTO ON is for air conditioning efficiency during summer operation.

NOTE

The air conditioning/heating system will only operate when the fan speed is in a setting other than *OFF*. To stop the operation of the air conditioning/heating system, the fan speed must be set to *OFF*. If the system was stopped by another method, the air conditioning/heating will start immediately when the system is restarted.

AutoStart Features and Operation

AutoStart Feature – Time/Day

Allows you to program a day and time for the APU to start automatically, up to 7 days in advance. This feature will run for three hours and shut down. At the end of the AutoStart program the cabin controller will display the error code #10, “Run Timeout”; this is normal.

Set Automatic Start-Up/Shut-Down – Time/Day

The user can adjust the time and day for the next timed AutoStart event. (*SET* symbol is flashing and *TIME AUTOSTART* symbol is turned on during alarm setup).

1. Press **AUTOSTART** button. (*Time AutoStart* will scroll across the screen.)
2. Press **SELECT** button to continue, **MODE** to exit.
3. Press LEFT or RIGHT scroll button to adjust *AutoStart hour* as required.

4. Press **SELECT** button.
5. Continue to set the *AutoStart Minutes* and *AM/PM* as you would set the clock. (See Section: *Clock and Date Set-Up*).
6. Press **SELECT** button after each entry.
7. Press LEFT or RIGHT scroll button to adjust *AutoStart Day* as required.
8. Press **SELECT** button.
9. Press LEFT or RIGHT scroll button to locate *On/Off*.
10. Press **SELECT** button to save settings or press **MODE** button to return to menu without saving.

NOTE: When enabled, **Time AutoStart** symbol will be flashing.

AutoStart Feature – Temperature

Allows you to program a comfortable temperature setting; the APU regulates the temperature giving you further fuel savings on extended absences from the cab.

Set Automatic Start-Up/Shut-Down – Temperature

1. Press **AUTOSTART** button twice. (*Temp AutoStart* will scroll across the screen.)
2. Press **SELECT** button to continue, **MODE** to exit.
3. Press LEFT or RIGHT scroll button to select mode of temperature control. (Mode options include *OFF, AUTO, HEAT or COOL only*.)
4. Press **SELECT** button to continue, **MODE** to exit.
5. Press LEFT or RIGHT scroll button to select AutoStart temperature set-point if *HEAT* or *COOL* have been selected.
6. Press **SELECT** button to save settings or press **MODE** to return to menu without saving.

NOTE: When enabled, the **AutoStart** symbol will flash.

AutoStart temperature start-up will engage when the inside temperature is more than 5°F (-15°C) lower or more than 5°F (-15°C) higher than the temperature control setting (in auto mode). It also engages at least 1 minute after enabling AutoStart temperature.

AutoStart Feature – Low Battery

Automatically starts up the APU to charge the truck battery if it gets low. This option is always enabled in active mode. The voltage sensitivity of the low battery AutoStart feature can be adjusted; however, this is a Dealer programmable feature and must be performed at a RigMaster trained facility.

Set Automatic Start-Up – Low Battery

Low Battery AutoStart does not require that it be set by the user in the same way as the time/date and temperature based AutoStart features. All that is necessary to ensure that low battery AutoStart functions is to leave the APU engine OFF and the cabin controller powered on (active mode). However, the battery voltage that the AutoStart engages at can be reset by a Dealer technician. The default voltage is $12V \pm 0.2V$.

Version Display

1. Press **MODE** button.
2. Current version of the Power Module software will appear on the screen.
3. Press **MODE** or **SELECT** to return.

S9.2 Electronic Control Operation and Fault Codes

FAULT CODES

The MTS-T4-6’s electronic control will display fault codes on the LCD display if the unit fails to start or shuts down. The following table contains fault codes and information on the cause and/or remedy. These fault codes will display one time only; if the code is cleared from the cabin controller, failure will have to reoccur for the code to be displayed again. For further troubleshooting and diagnostic information see Section 13 – Troubleshooting for more explanation, tests, and remedies.

CODE	REMEDY/CAUSE	REMEDY/COMMENT
Error Code 1 Safety Cover Open	Engine cover of APU unit is open. APU will not start or run until the cover is closed.	<ul style="list-style-type: none"> • Cover not seated. • Damaged wiring. • Failed cover switch. • Switch out of adjustment.
Error Code 2 Low Oil Pressure	Low oil pressure.	<ul style="list-style-type: none"> • Low oil level. • Wiring damaged. • Faulty switch. • Dirty oil filter.
Error Code 3 Battery Low Voltage	Low battery voltage. Start system immediately to charge batteries.	<ul style="list-style-type: none"> • Damaged or broken battery cables; failed battery. • Excessive load on batteries. • Faulty charging system.
Error Code 4 Engine Run Failure	Engine may have started but didn’t run properly. “AutoStart” is disengaged; attempt manual starting with START button.	<ul style="list-style-type: none"> • Speed sensor adjustment (set air gap at 0.015”). Damaged speed sensor wiring. • Failed speed sensor.
Error Code 5 Low Coolant/ Engine Overheated	Engine will not run until temperature becomes normal or coolant level is at full in surge tank.	<ul style="list-style-type: none"> • Low coolant or failed coolant level switch. • High engine temperature or failed engine temperature sensor (top of water pump, has single wire). • Damaged wire providing ground.
Error Code 6 Module Failure	Power Module is not responding.	<ul style="list-style-type: none"> • Failed power module.

CODE	REMEDY/CAUSE	REMEDY/COMMENT
<p>Error Code 7</p> <p>Engine Start Failure</p>	<p>Engine did not start. "AutoStart" is disabled until operator presses <i>Select</i> button.</p>	<ul style="list-style-type: none"> • Bad glow plugs or relay. • Bad starter relay. • Failed glow plug. • Possible speed sensor issue.
<p>Error Code 8</p> <p>No Communication Error</p>	<p>No communication between control panel and power module. Re-establish communication.</p>	<ul style="list-style-type: none"> • "Cat5e" communication cable possibly damaged (commonly available). • Poor connection at terminal; try plugging in a few times.
<p>Error Code 9</p> <p>Main Engine Running</p>	<p>APU will not run if the Truck's main engine is already running. This feature is "optional".</p>	<ul style="list-style-type: none"> • If a "switched 12 volt DC wire" is connected to the J4, Pin #4 (red) wire at the power module, the APU will not run. This is "optional".
<p>Error Code 10</p> <p>Run Timeout</p>	<p>APU shuts down at three (3) hours of running when the "AutoStart" Time/Day Setting is used.</p>	<ul style="list-style-type: none"> • Engine will only run for three (3) hours when set on AutoStart Time/Day.
<p>Error Code 11</p> <p>Check Power Module Fuse</p>	<p>Very low battery voltage detected at the power module.</p>	<ul style="list-style-type: none"> • Check 20 Amp. fuse and J1 connector at the power module (located under the bunk on the HVAC unit).
<p>Error Code 12</p> <p>Battery Charging Failure</p>	<p>Battery voltage still low two (2) minutes after cranking. Auto and manual starts can occur.</p>	<ul style="list-style-type: none"> • Faulty charging system; failed batteries; poor connection. • Engine harness ground wires disconnected at the HVAC unit.
<p>Error Code 13</p> <p>Battery Discharge</p>	<p>Alarm system will enter low power mode. No starting options given.</p>	<ul style="list-style-type: none"> • Failed batteries or connection. • Possible poor connection at power module.
<p>Error Code 14</p> <p>Check External Temperature Sensor</p>	<p>External temp. sensor may not be connected to the power module.</p>	<ul style="list-style-type: none"> • External temperature sensor disconnected or failed. • Connection loose or damaged.

CODE	REMEDY/CAUSE	REMEDY/COMMENT
<p>Error Code 15</p> <p>External Temp Disable Limit</p>	<p>Engine shut down due to external temperature outside the programmed range.</p>	<ul style="list-style-type: none"> The APU has been programmed not to start when the external temperature is outside a preprogrammed range.
<p>Error Code 16</p> <p>Module Reset – Set Clock</p>	<p>Power to the cabin controller has been lost.</p>	<ul style="list-style-type: none"> Reset clock.
<p>Error Code 17</p> <p>Service Exhaust Filter (for unit equipped with Diesel Particulate Filters)</p>	<p>Service exhaust filter if unit is DPF equipped; if not DPF equipped, then power module failure likely.</p>	<ul style="list-style-type: none"> See authorized Dealer for exhaust filter servicing or power module diagnosis/replacement.
<p>Error Code 18</p> <p>Replace Exhaust Filter (for unit equipped with Diesel Particulate Filters)</p>	<p>Replace exhaust filter if unit is DPF equipped; if not DPF equipped, then power module failure likely.</p>	<ul style="list-style-type: none"> See authorized Dealer for exhaust filter replacement or power module diagnosis/replacement.
<p>Error Code 19</p> <p>Please Register Unit</p>	<p>Unit will run for four (4) hours after installation. Registration code must be entered into the cabin controller display keypad.</p>	<ul style="list-style-type: none"> To obtain registration code, please call the APU Manufacturer (1-800-249-6222) with the serial # of your unit. There is no charge for this service.
<p>Error Code 20</p> <p>Water Valve Overcurrent</p>	<p>Electronic coolant control valve drawing excess amperage.</p>	<ul style="list-style-type: none"> Unplug J2 connector, turn POWER ON again. Code should not display when J2 is unplugged.
<p>Error Code 21</p> <p>GP Overcurrent</p>	<p>Glow plug relay drawing excess amperage.</p>	<ul style="list-style-type: none"> Glow plug relay operation is faulty or wire broken.

CODE	REMEDY/CAUSE	REMEDY/COMMENT
Error Code 22 Run or GP Overcurrent	Run solenoid or glow plug relay drawing excess amperage.	<ul style="list-style-type: none"> Unplug run solenoid; power with jumper wire; attempt again. If code returns, glow plug relay problem.
Error Code 23 Run Overcurrent	Run solenoid is drawing excess amperage.	<ul style="list-style-type: none"> Unplug run solenoid; power with jumper wire; attempt again; measure Amps. If code returns, broken wire.
Error Code 24 Start or Run Overcurrent	Starter relay or run solenoid drawing excess current.	<ul style="list-style-type: none"> Unplug run solenoid; power with jumper wire; attempt again. If code returns, starter relay problem.
Error Code 25 AC or Run Overcurrent	A/C clutch or run solenoid drawing excess current.	<ul style="list-style-type: none"> Unplug run solenoid; power with jumper wire; attempt again. If code returns, A/C clutch problem.
Error Code 26 BH Overcurrent	Phantom Code – block heater is not operated by power module output. (no output on J1 Pin #7).	<ul style="list-style-type: none"> May indicate damage to power module circuit board. Possible solution: Unplug J1 connector for 30 seconds.
Error Code 27 Power down to clear overcurrent	Power must be turned off with the power button then turned back on.	<ul style="list-style-type: none"> This message appears if engine start is attempted without turning POWER OFF. Turn power OFF then ON.
Error Code 28 Output Overcurrent	A power module output circuit sees a rise in amperage while trying to activate an electronic component. Output circuit shuts off to protect itself.	<ul style="list-style-type: none"> Similar to a circuit breaker function; caused by a stuck or failed relay, solenoid or servo. Power OFF with controller for a minute and function will return. Test each power module output circuit for amperage draw.

S9.3 General Electrical System Information

WARNING!

To perform maintenance and repairs you ***must*** disconnect the APU from its power source by first disconnecting the J1 connector at the Power Module. Disconnect the battery cables and check the battery posts inside the APU engine cabinet to confirm there is no voltage to the APU.

The MTS-T4-6 APU has a 12-Volt DC Electrical system that is connected to the vehicle’s Battery(s), which it and the Vehicle itself use as a power supply. When the APU is running, its alternator charges the vehicle battery.

General Electrical Troubleshooting

1. Ensure proper grounding of the APU unit and the vehicles electrical system.
2. Check the APU’s electrical connections including battery and vehicle connections; look for damaged wires and corrosion.
3. Check Fuses and Relays. (Starter and Glow Plugs).

S9.4 Power Module Connections

The power module has several connection points that are individually labeled on the face of the module itself. Please read the following section for detailed information on the function of these terminals.

J1 – Main Power Input, Relay Outputs, Air Conditioning Control

J2 – Electronic Coolant Control, Blower Motor Control

J3 – Cabin Control Power and Communication

J4 – Sensor Inputs

J5 – External Temperature Sensor

Figure 9-6



J1 Connector

Main Power Input, Relay Outputs, Air Conditioning Control

J1 PIN #	TYPE	COLOR
1	OUTPUT	White – Engine Run Solenoid 12V=ON, 0V=OFF (Max current 2A)
2	OUTPUT	Green – A/C Clutch Control 12V=ON, 0V=OFF (Max current 4A)
3		Not In Use
4	POWER	Black – Ground = 0V
5	POWER	Red/Black Stripe – Positive Supply = 12V
6	OUTPUT	Brown – Glow Plug Relay 12V=ON, 0V=OFF (Max current 200 mA)
7	OUTPUT	White – Block Heater Relay NOT USED
8	OUTPUT	Yellow – Starter Relay 12V=ON, 0V=OFF (Max 200mA)
9	POWER	Red – Positive Supply = 12V
10	POWER	Red – Positive Supply = 12V



NOTE

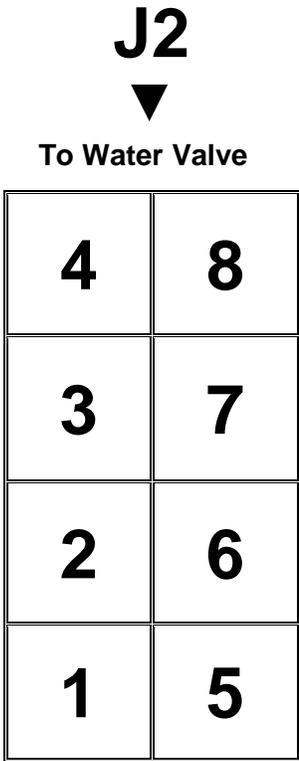
Pin output 7 is an option for a block heater for the engine and has a short white wire with a bullet connector.

J2 Connector

Electronic Coolant Control, Blower Motor Control

Note: "Cooling Only" Systems will not have an "Electric Coolant Control (Water) Valve"

J2 PIN #	TYPE	COLOR
1	INPUT	White – Feedback Signal from Water Valve 12V = Valve Open, 0V = Valve Closed
2	OUTPUT	Black – Fan Control Signal Max Current 9A, 12V=ON, 0V=OFF (output is 50% duty cycle for low speed)
3	OUTPUT	White – Drive Motor to Open/Close Water Valve. (Max 2A) 12V=ON, 0V=OFF
4	POWER	White – Water Valve Control Power =12V (Max 7A)
5	OUTPUT	Black – Fan Control Signal Max Current 9A, 12V=ON, 0V=OFF (output is 75% duty cycle for medium speed)
6	OUTPUT	Black – Fan Control Signal Max Current 9A, 12V=ON, 0V=OFF (output is 100% duty cycle for high speed)
7	OUTPUT	White – Drive Motor to Open/Close Water Valve. (Max 2A) 12V=ON, 0V=OFF
8		NOT IN USE



Harness Pin Outs



Power Module J2 Connection Point



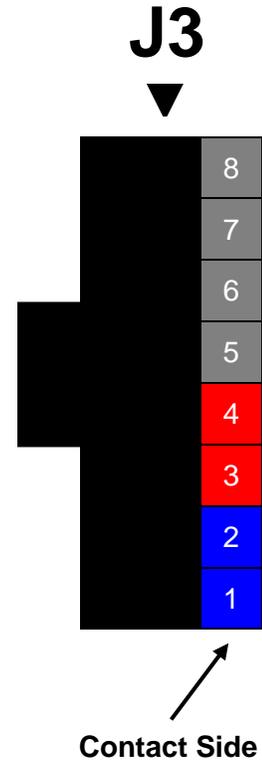
Water Valve Connection Point



J3 Connector

Cabin Control Power and Communication

J3 PIN #	TYPE	COLOR
1	INPUT/OUTPUT	(-) RS485 TRANSCEIVER (half duplex)
2	INPUT/OUTPUT	(+) RS485 TRANSCEIVER (half duplex)
3	POWER	=7V (LOGIC)
4	POWER	=7V (LOGIC)
5	GROUND	ISOLATED GROUND
6	GROUND	ISOLATED GROUND
7		NOT IN USE
8	SHIELD	NON-ISOLATED GROUND



NOTE
 The communication cable is a 28 AWG/Category 5 cable which uses the RJ-45 modular connector. The transceiver is half duplex and powered by 7VDC logic voltage.

J4 Connector

Sensor inputs

J4 Pin #	TYPE	COLOR
1	INPUT	Green – Oil Pressure Sensor 12V = Normal pressure, 0V = Low oil pressure
2	INPUT	Black – Safety Cover Sensor 12V = Cover OFF 0V = Cover ON
3 3	INPUT	Green/Yellow – Pickup Speed Sensor 7 - 10V A/C = Engine ON 0V A/C = Engine OFF
4	INPUT	Red – Main Engine Running (Optional) 12V = Main engine ON 0V = Main engine OFF
5	INPUT	Orange – Coolant Temperature Sensor 12V = normal temperature 0V = high temperature
6 6	INPUT	Blue/White – DPF (Optional) 0V = Normal backpressure 12V Pulse = Level 1 Cleaning 12V Constant = Level 2 Cleaning
7 7	INPUT	Red/Orange – Pickup Speed Sensor Ground
8		Not in Use (Plugged)



NOTE

Main Engine Running is optional and is spliced to a truck ignition source near the HVAC box. The source is usually from the truck’s factory HVAC box. When 12V ignition is applied to this input on Pin #4 it will NOT allow the MTS-T4-6 APU to start in any mode while the truck’s main engine is running.

NOTE

The Speed Sensor uses pin 7 as a return ground.

J5 Connector

External Temperature Sensor

J5 Pin #	TYPE	COLOR
1	INPUT	Red
2	INPUT	Black
3	GROUND	Black (heavier gage wire)

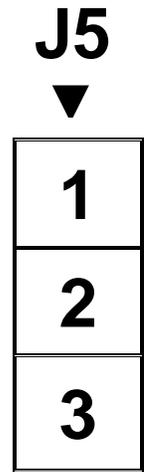


Figure 9-7

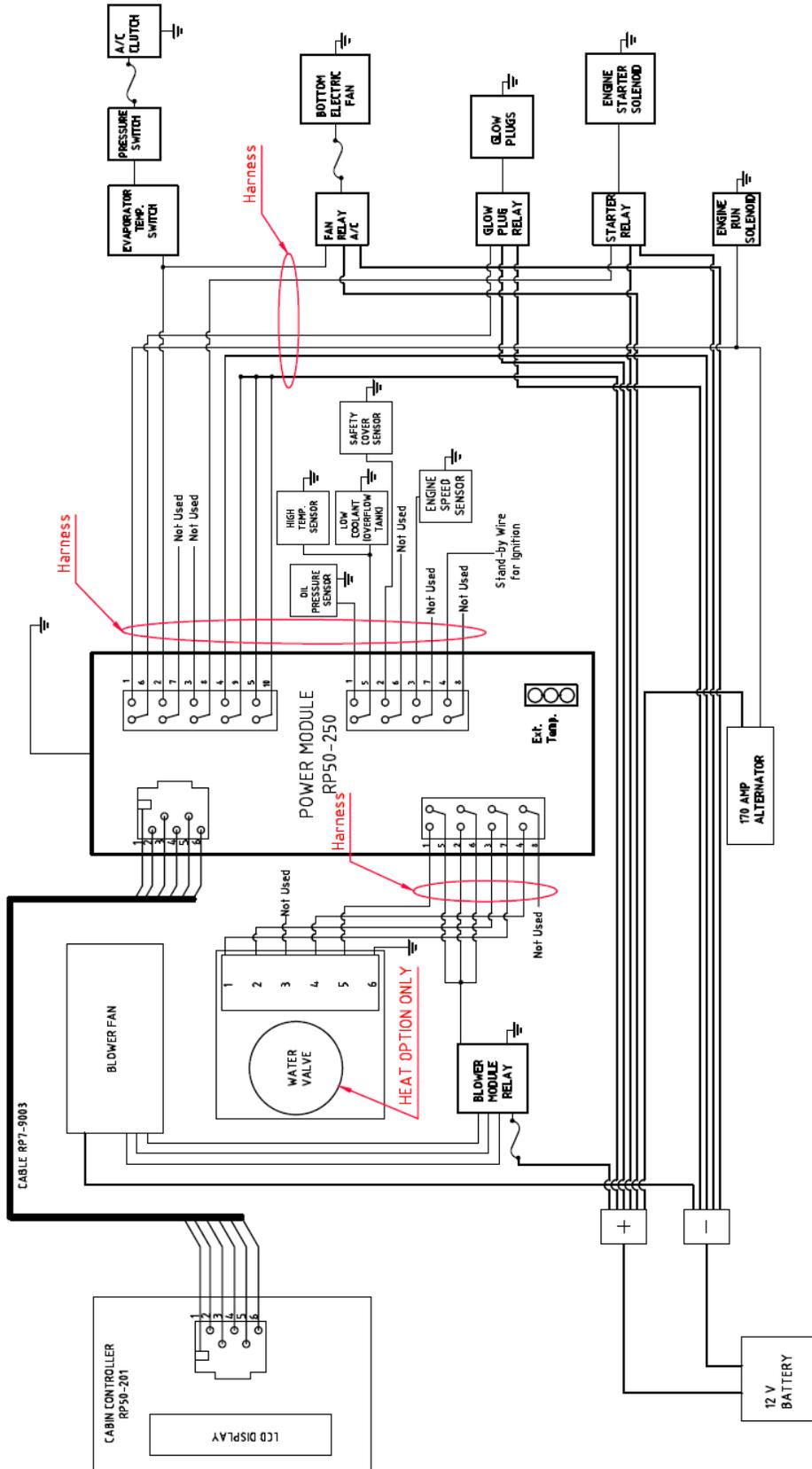
Temperature Sensor



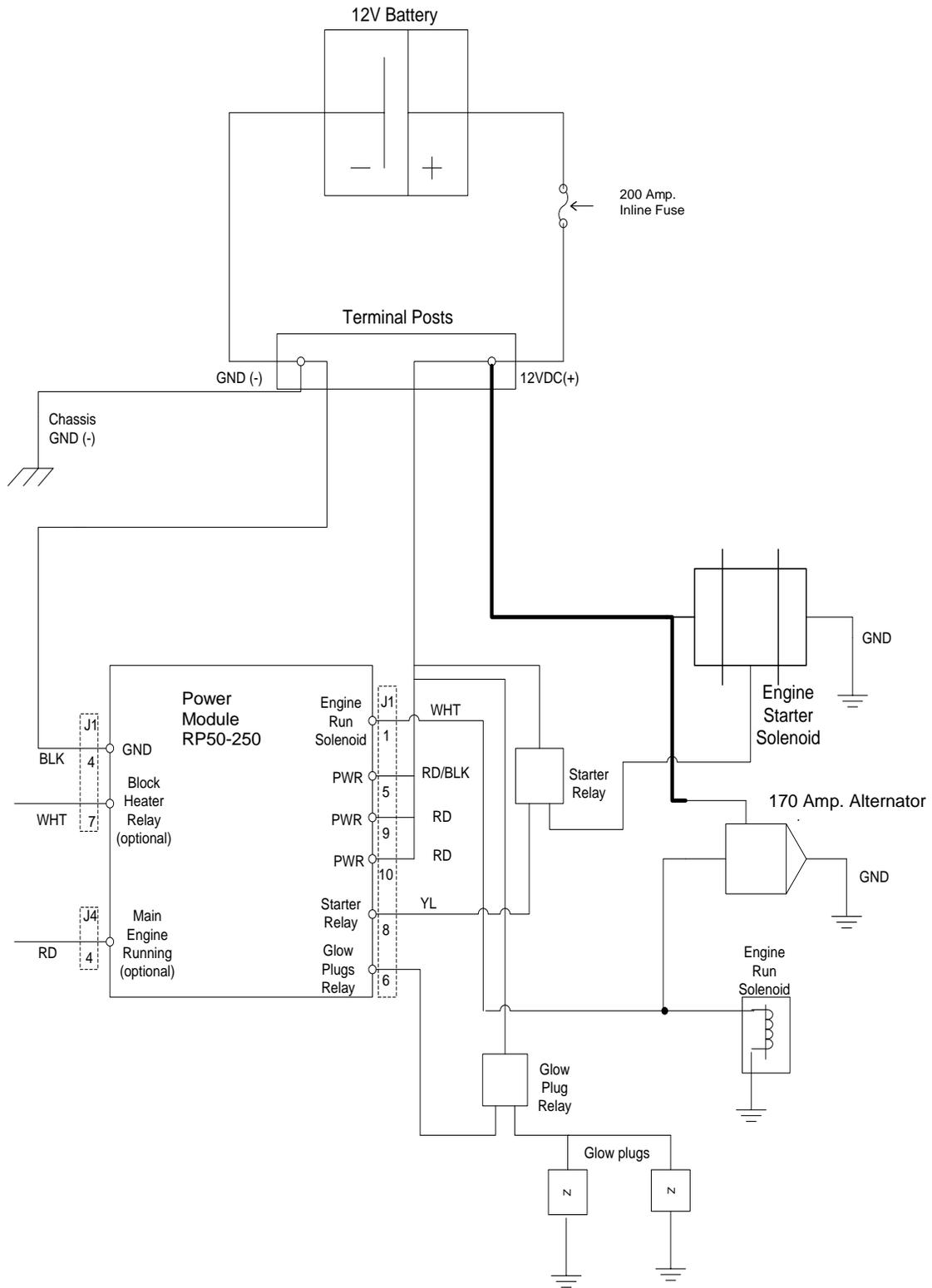
NOTE
The sensor hangs through the cabin floor with the other electrical wiring.

S9.5 System Schematics

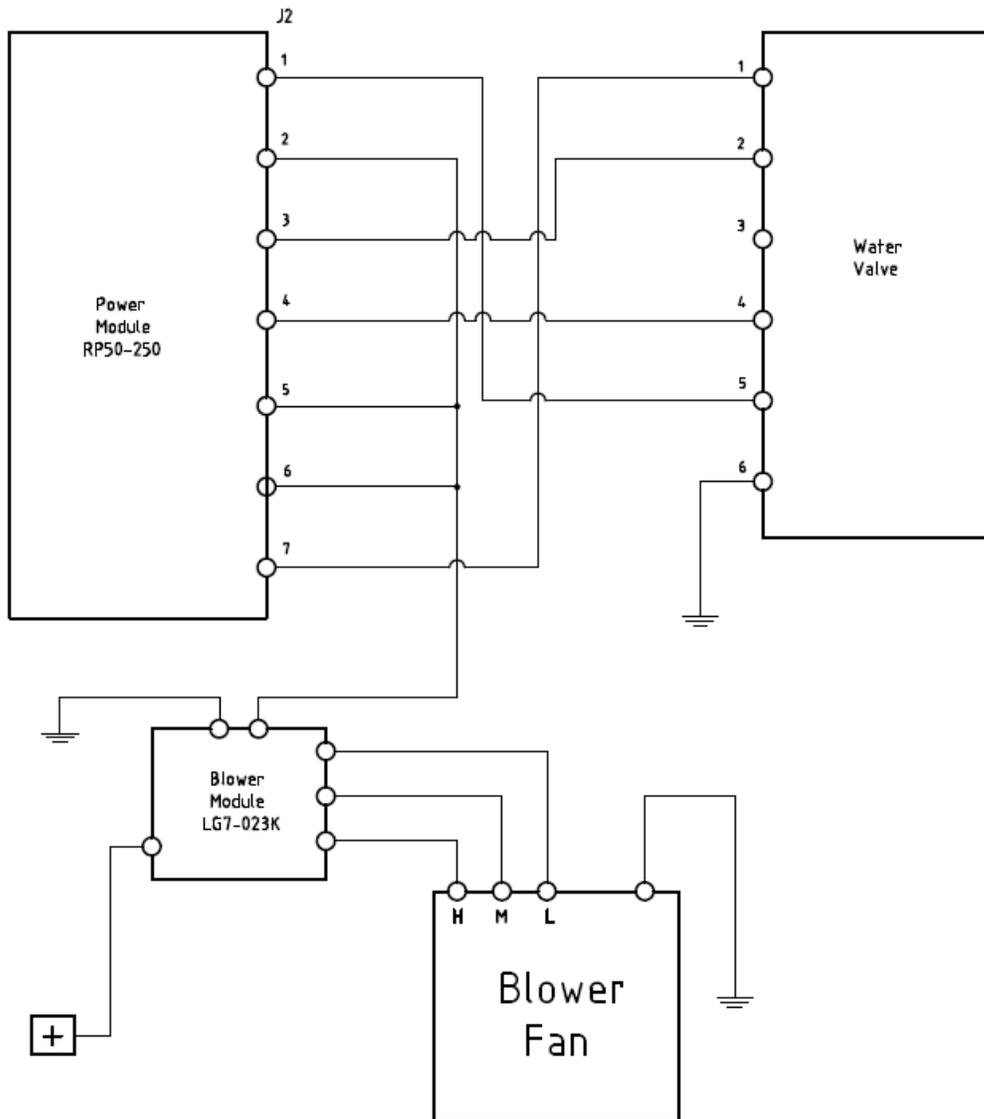
Engine Sensor Schematic



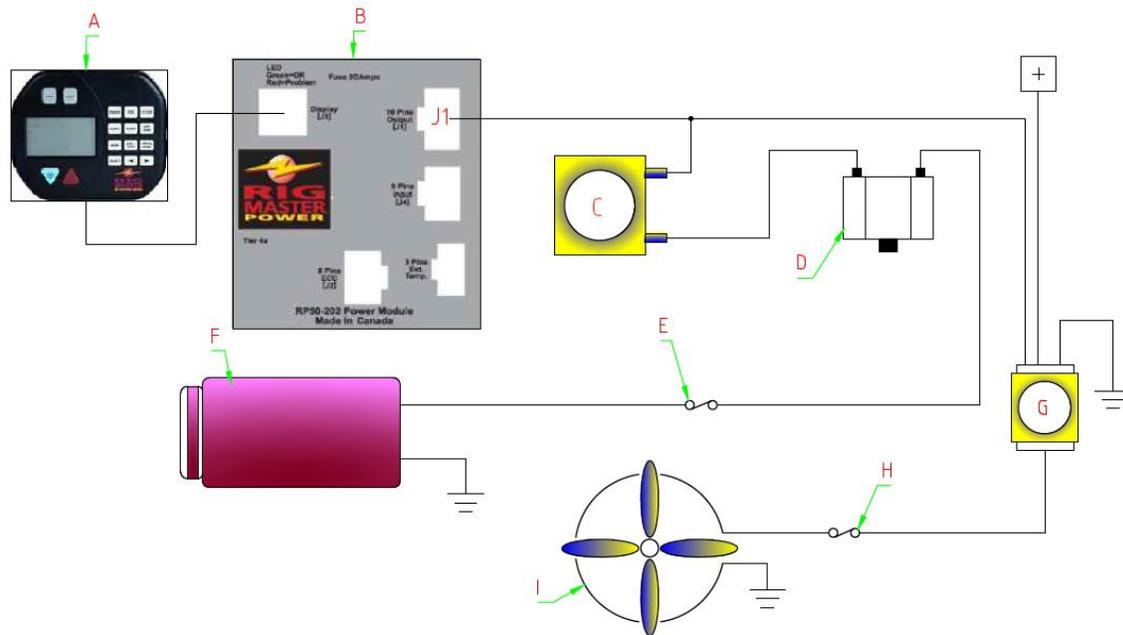
Starting and Charging Schematic



Water Valve Schematic



Air Conditioning and Cooling Fan Schematic



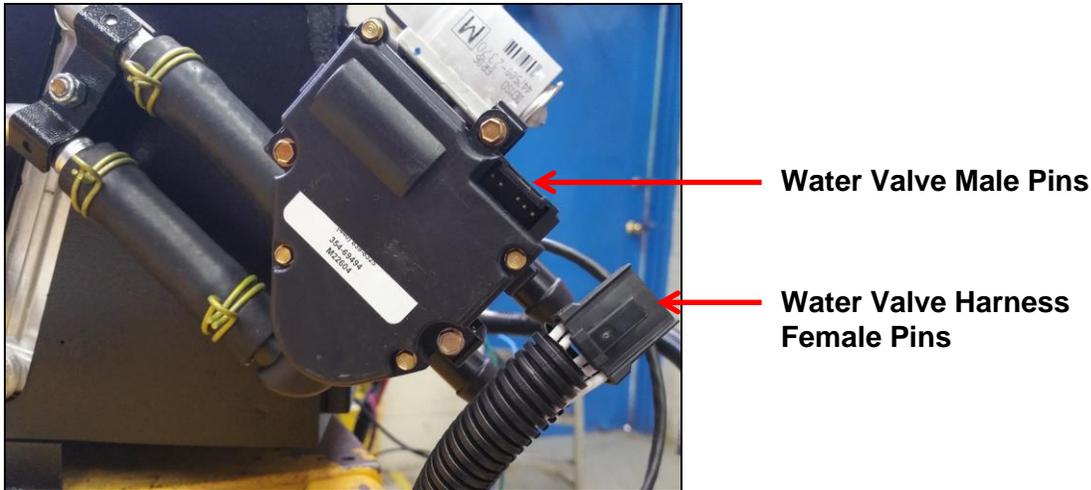
Air Conditioning Electrical Circuit

LOCATION	COMPONENT	OPERATION
A	Cabin Controller	Houses the climate control thermostat and sends signals to the power module to control the ON/Off cycle of the compressor.
B	Power Module	Receives inputs from the cabin controller and outputs voltage through the J1 connection point (green wire, pin #2) to the evaporator thermostatic switch to power the A/C system.
C	Evaporator Thermostatic Switch	Monitors the temperature of the evaporator and regulates power to the binary pressure switch to prevent the evaporator core from freezing.
D	Binary Pressure Switch	Allows voltage to pass to the compressor and A/C controlled fan relays when the pressure in the system is within an acceptable range (between 28 and 450 psi).
E	7.5 Amp. Compressor Fuse	Fuses the A/C compressor.
F	Compressor	Receives its power from the binary switch through 7.5 Amp. in-line fuse.
G	A/C Controlled Fan Relay 1	Receives its signal from the power module whenever the air conditioning is in operation.
H	35 Amp. Electric Fan Fuse	Fuses the electric fan.
I	A/C Controlled Fan Relay	Receives its signal from the power module whenever the air conditioning is in operation.

S9.6 Testing the Electric Coolant Control

To test the coolant control valve there are two things that need to be checked first. The male pins on the valve have to be straight. The connector on the J2 harness has 6 double pins holes. Make sure that the female connector pins on the J2 connector are plugged into the male pins on the valve. Note: See Figure 9-8 for the female connector. Make sure that the larger pin holes are facing to the outside of the water valve when making the connection.

Figure 9-8



Pin Number 1 on the power module is an input. This pin will tell you if the valve is open or closed. Put the red lead from the multi meter in pin number one on the power module connector and put the black lead from the multi meter to ground (the heater box is a good ground). If you have 0 volts \pm then the valve is closed. If you have 12.40 volts \pm then the valve is open. CHECK TO MAKE SURE THE VALVE IS OPENING & CLOSING.

Pin Number 2 on the power module is an output. This pin will have power when fan speed is LOW. To test the fan circuit, refer to Section S9.7.

Pin Number 3 on the power module is an output. This pin indicates if there is power going to the valve. **When the heat is needed** the power module will send power to the valve to open it and let the coolant flow through the heater core. The voltage will be present when the valve is opening. When the valve is open the voltage will disappear.

Pin Number 4 on the power module is a power wire. This pin has to provide power to the valve at all times (battery voltage \pm).

Pin Number 5 on the power module is an output. This pin will have power when the fan speed is MEDIUM. To test the fan circuit, refer to Section S9.7.

Pin Number 6 on the power module is an output. This pin will have power when the fan speed is HIGH. To test the fan circuit, refer to Section S9.7.

Pin Number 7 on the power module is an output. This pin indicates if there is power going to the valve. **When the air conditioning is needed** the power module will send power to the valve to close it & stop the coolant flow through the heater core. The voltage will be present when the valve is closing. When the valve is closed the voltage will disappear.

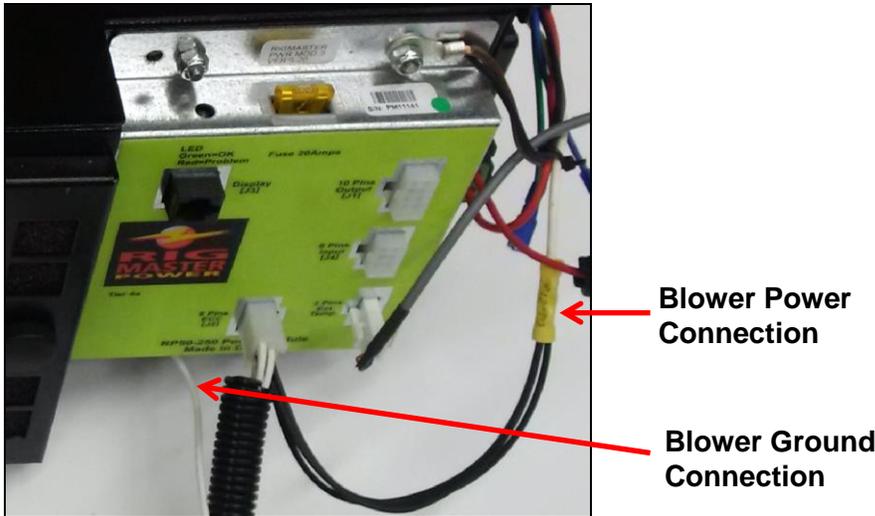
Pin Number 8 on the power module is not used.

Pin Number W6 on the water valve is the ground wire. The heater box is a good ground source.

S9.7 Blower Motor Wiring

The blower motor has three power input wires and a single black wire (See Figure 9-9). Power is supplied to the blower motor via the blower module. Each of the three power input wires will supply a different wattage to the blower module which will energize three relays corresponding to one of three fan speed settings. (See connector outputs for J2, S9.4). Only one of the three power input wires should be hot at any given time. The blower motor wire (black) is connected to a source of ground.

Figure 9-9



Remove and Replace the Blower Motor Assembly

1. Disconnect the power and neutral wires from the HVAC and J2 wiring harness.
2. Remove the ducting from the blower motor.
3. Remove the lid of the HVAC unit [six hex head screws]. (The hex head screws that secure the blower assembly are accessed from within the HVAC unit.)
4. Remove the fan assembly.
5. Reinstallation is the reverse of removal.

Figure 9-10



Figure 9-11



Dual Blower shown front and side views.

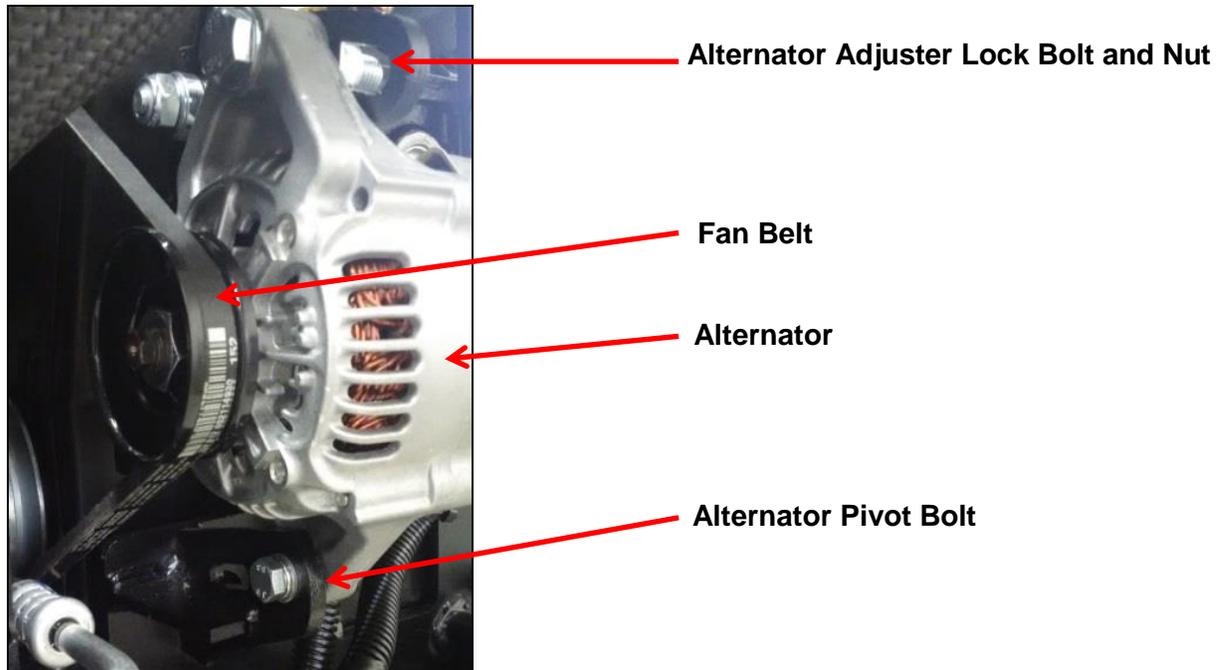
Figure 9-12



S9.8 Alternator Charging

The MTS-T4-6 APU is equipped with an automotive style alternator that has a built in regulator.

Figure 9-13



NOTE

It is recommended that dielectric grease be used on electrical connections.

Charging System Diagnostic Procedure

BELT TENSION CHART	
Initial Belt Tension (new belt)	Used Belt Tension (after 30 mins. use)
90 to 110 lbs. (400 to 489 N)	60 to 80 lbs. (267 to 356 N)

1. Check drive belt tension, ensure the alternator mounting bolts and adjusting belts are tight.
2. Check the positive and negative posts are in good condition and that all wiring connections are secure.
3. Check the positive cable between the alternator and the harness for a loose or damaged cable.
4. Before running the system, ensure the regulator power supply (white wire) has approximately 12V DC when system is on.
5. With the unit running check the charging output voltage at the battery. The battery reading should be approximately 13.5V DC.

NOTE

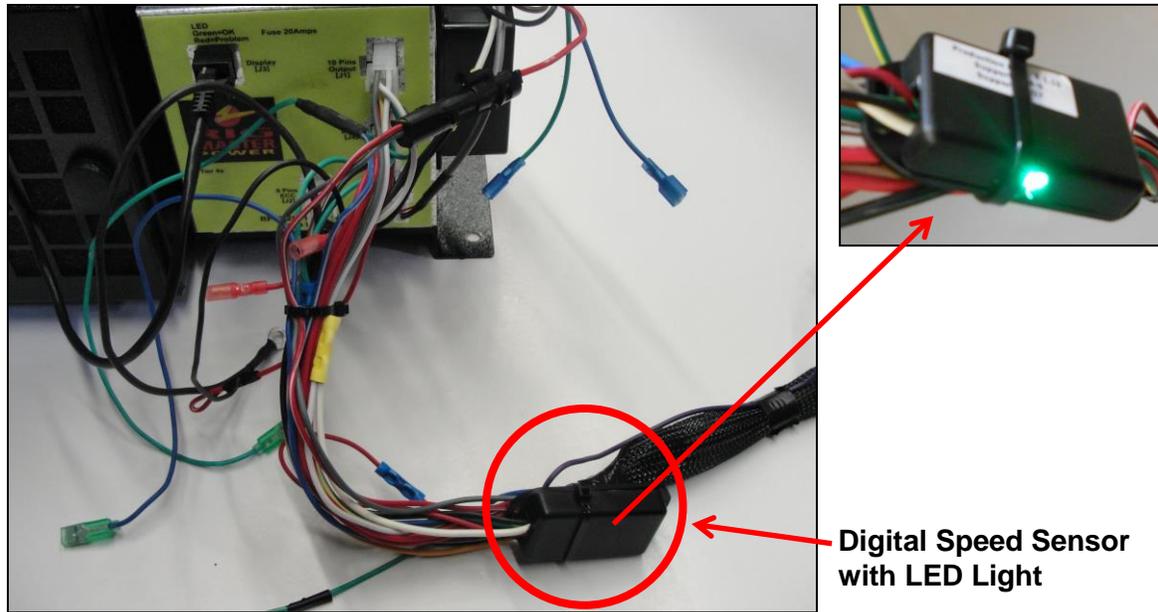
Check the condition and charge of the truck batteries prior to testing the alternator's output. Weak or discharged batteries will affect alternator output. Replace any failed batteries first.

S9.9 Sensors, Switches and Sending Units

Speed Sensor (LG7-105 or LG7-105K for Assembly)

- The APU is equipped with a digital speed sensor which utilizes the signal from the alternator.
- The MTS-T4-6 APU will not operate if the speed sensor is disconnected, faulty or disabled.

Figure 9-14



NOTE
Please see Section 13 for digital speed sensor troubleshooting.

Oil Pressure Switch (See Engine Manufacturer Parts)

The power module sends a signal to the oil pressure sensor from the J4 connector. When low oil pressure is detected, the oil pressure switch closes and grounds the signal to the engine.

VOLTAGE AT SWITCH	CONDITION
Battery Voltage	Normal Oil Pressure
0 Volts	Low Oil Pressure

The oil pressure switch screws into the engine block (See Figure 9-16). After reinstalling the switch it should be tightened to 13.3 ft/lbs. Ensure that thread sealant is used to prevent leaks.

High Temperature Switch

The power module sends a signal to the high coolant temperature sensor from the J4 connector. When high engine temperature is detected (230°F, 110°C), switch closes and grounds the signal to the engine.

VOLTAGE AT SWITCH	CONDITION
Battery Voltage	Normal Temperature
0 Volts	High Temperature

The high engine temperature switch screws into the thermostat housing (See Figure 9-15). After reinstalling the switch it should be tightened to 20 ft/lbs. Ensure that thread sealant is used to prevent leaks.

Figure 9-15

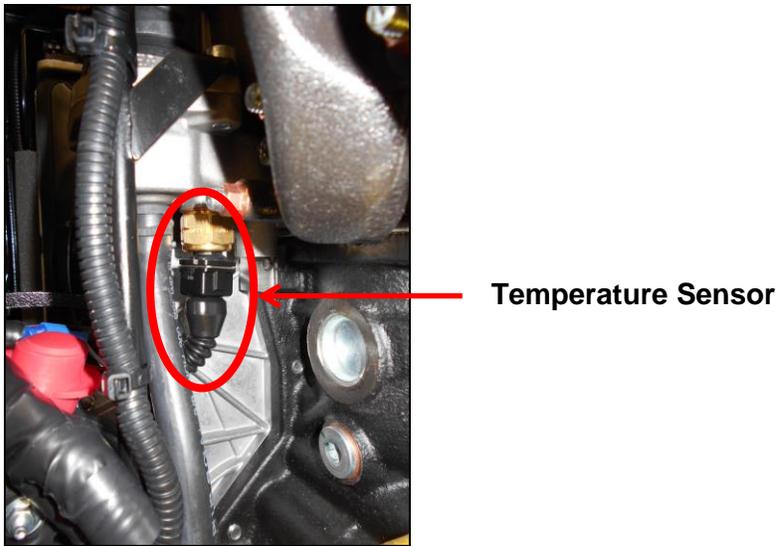


Figure 9-16



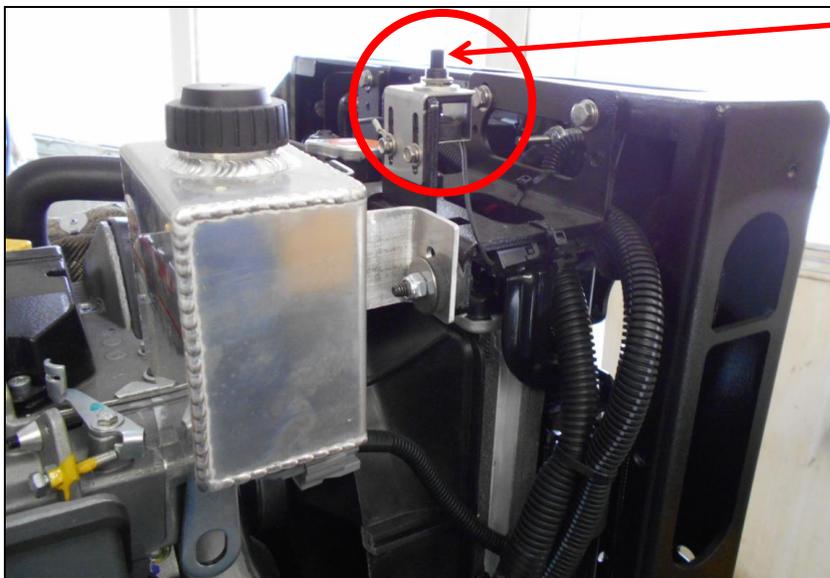
NOTE

Ensure that there is a rubber boot over the each switch to prevent corrosion and exposure to moisture which may cause the switches to malfunction. The use of dielectric grease is highly recommended at these points of connection.

Safety Cover Switch (RP7-022K)**WARNING!: SAFETY COVER SWITCH**

It is critical that this safety cover switch is never bypassed; failure to comply may result in serious injury.

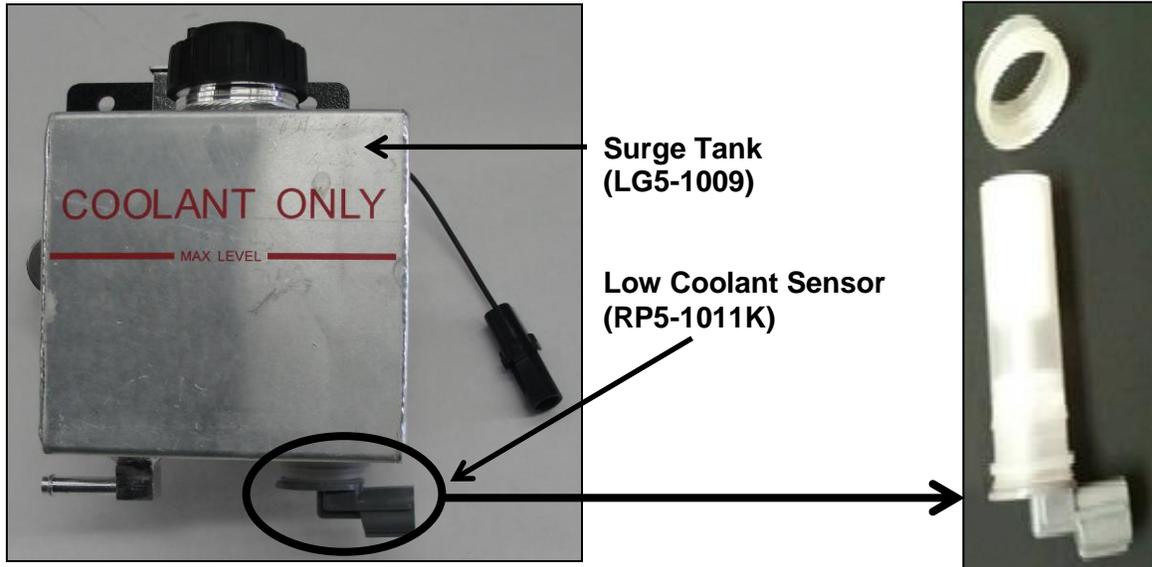
When the engine cover is in place the safety cover switch is closed and the signal travels to ground. 0 volts will be at the power module J4 Pin #2 when the cover is closed. Battery voltage will be at J4 Pin #2 when the door is open.

Figure 9-17**Safety Cover Switch****Low Coolant Sensor**

The low coolant sensor has a 30-second delay, so if coolant levels remain low for greater than 30 seconds, the APU will shut down. The low coolant sensor is connected to the same circuit as the high coolant temperature sensor. If low coolant and/or high temperatures are sensed the unit engine will shut down and display a fault code on the cabin controller. 12Volts normal volume, 0Volts low coolant volume.

Surge Tank Assembly

Figure 9-18



NOTE
 The low coolant sensor (RP5-1011) and seal (RP5-1011K-1) are sold as a separate parts.

S9.10 Battery Fuse

WARNING!
 The following procedures present hazards which can result in injury or death. Only persons qualified to carry out electrical and mechanical servicing should undertake this work.

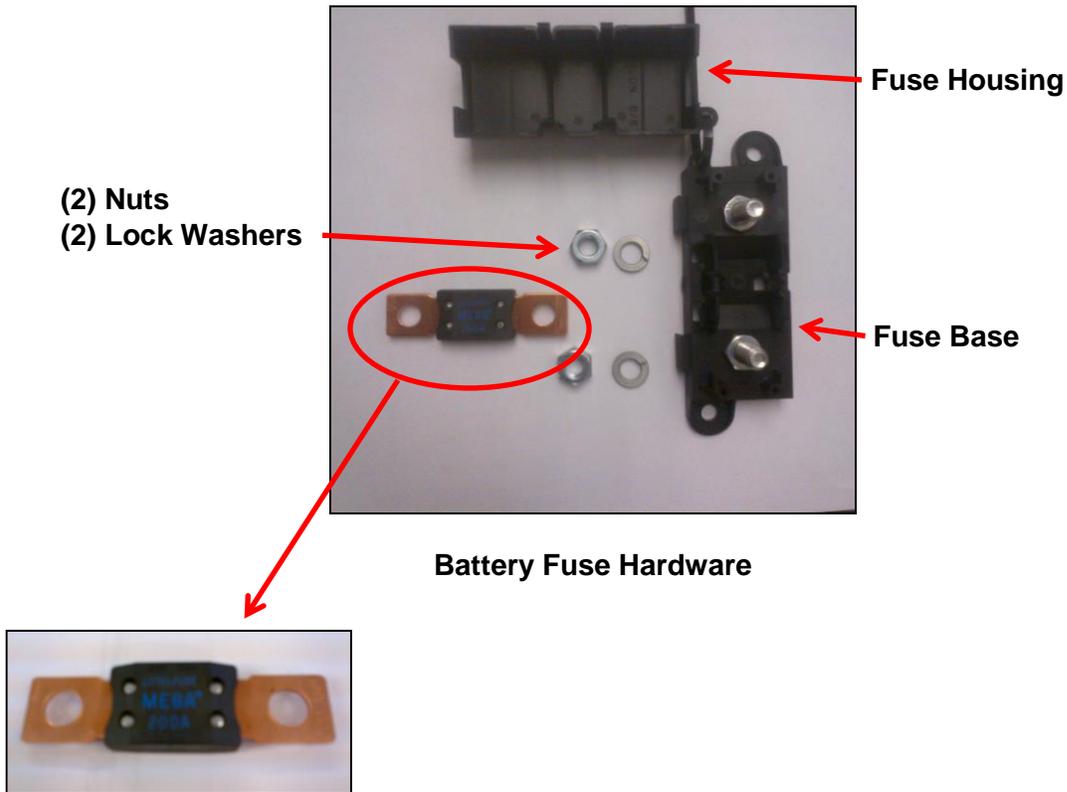
A 200 Amp. in-line DC fuse must be installed on the MTS-T4-6 APU's positive (+) battery cable. The fuse assembly kit and individual part numbers are listed below:

DESCRIPTION	PART NUMBER
Fuse Kit (Includes fuse holder with fuse, 18" Cable)	LG7-085
Fuse Holder with Fuse	LG7-014
200 Amp. Fuse only	LG7-009
18" positive battery cable	RP7-038

NOTE
 The APU positive battery cable should be located on a separate battery than the negative cable. The APU positive battery cable should also be on an independent post (i.e. no other terminals connected to the same stud as the APU's positive battery cable).

Installation of the Battery Fuse

Figure 9-19



1. Install the battery cables on the MTS-T4-6 APU engine compartment battery studs and route them to the battery box ensuring that the cables are protected from any hazards that may damage them.
2. Once the cables reach the battery box, find a suitable location to mount the in-line fuse base. Locate the fuse assembly in an area free of hazards and firmly secured (mounting hardware not included).

NOTE

Ensure that the 18 inch battery cable will reach the positive battery terminal and the fuse assembly prior to mounting the fuse assembly.

3. Cut back any excess cable that connects the MTS-T4-6 APU to the fuse assembly and secure the $\frac{5}{16}$ " eye terminal. The use of shrink tube and dielectric grease on all points of connection is highly recommended.
4. Connect the fuse assembly to the positive battery terminal with the 18 inch positive battery cable prior to connecting the MTS-T4-6 APU's negative terminal.
5. Check for battery voltage to the main unit terminal posts and at the power module.

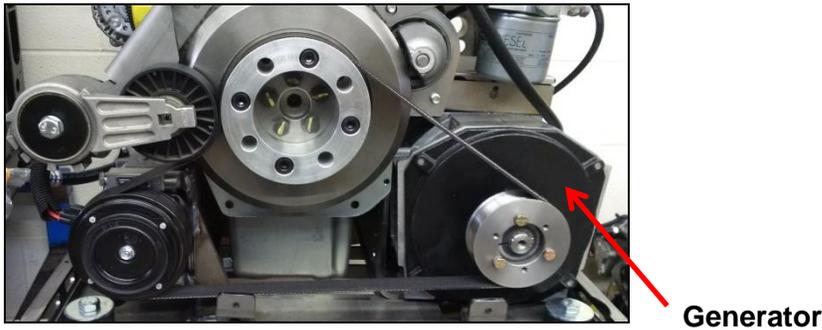
Section 10 120 Volt Generator

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S10.0 Generator Electrical System Specifications

The 6kW heavy-duty generator is located at the side of the RigMaster unit and is belt driven at 3600 RPM. The generator has two (2) factory supplied cords. One (1) block heater cord (complete with a plug), allows the vehicle's block heater to be plugged into the generator. This ensures that the vehicle's main engine will be warm when starting in cold weather. This provides a load on the RigMaster engine that allows the unit to run more efficiently and prolongs the RigMaster's service life. The block heater connection uses one (1) 20 AMP breaker. **It is recommended that the RigMaster remain plugged into the vehicle's block heater throughout the winter months and unplugged for the spring and summer months.** A second 20 AMP supply of 120V power is supplied for the driver's convenience. A multiple outlet cord is supplied and can be installed in the bunk area of the vehicle to provide power for 120V appliances.

Figure 10-1



NOTE

Each 20 Amp Breaker has a capacity of 2400 Watts.

WARNING!

- The following procedures present hazards which can result in injury or death. Only qualified persons should do this work.
- Always disconnect the APU’s power source prior to performing service work.
- Always wear safety goggles when cleaning the generator.

Generator Electrical System Specifications

Figure 10-2



Generator Specifications	
Generator	Markon: Model BL 105E
Output	6kW; 120 Volts [AC]; 60Hz

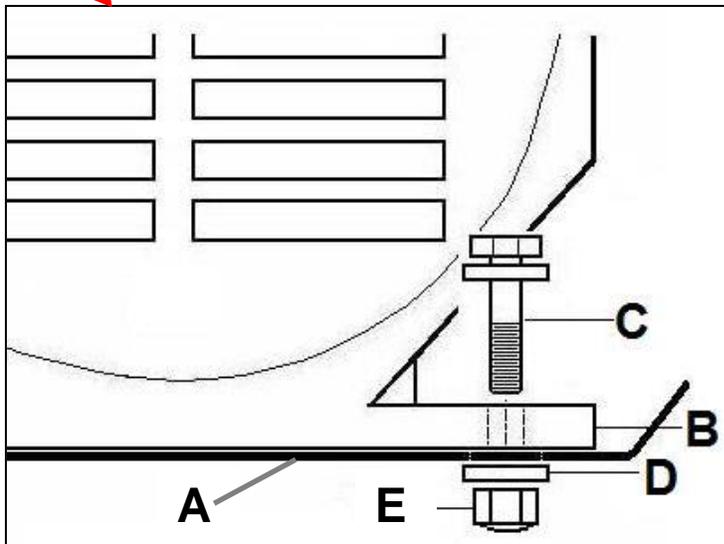
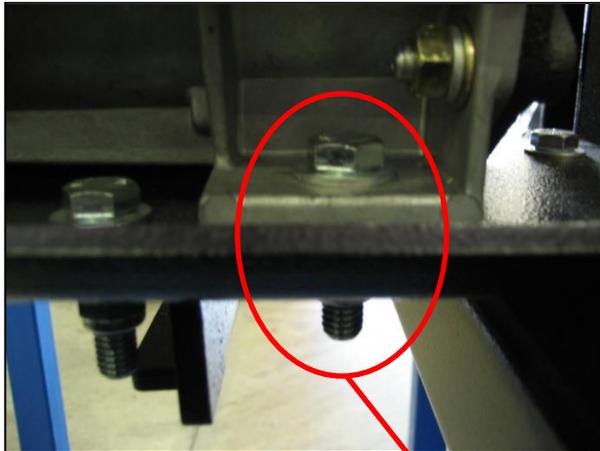
The RigMaster APU powers an independent 120 Volt alternating current generator. The output frequency is approximately 60 Hz (load factor dependent). Under zero load, the generator will produce between 110-120 AC volts. The generator must spin at the correct speed (~3600 RPM) in order for it to output within the acceptable range.

NOTE

The engine RPM must NOT be adjusted.

S10.1 Generator Mounting Diagrams

Figure 10-3



LEGEND		QTY.
A	Engine Mount Plate	1
B	Generator Housing	N/A
C	Bolts 3/8 -16 x 1½ "	4
D	Hardened Flat Washers	8
E	Nylon Lock Nut ¾" - 16	4

S10.2 Generator Removal and Installation**Removing the Generator**

1. Remove the front aluminum cover.
2. Remove the bottom plate using $\frac{7}{16}$ " socket wrench (12 bolts).
3. Remove the serpentine belt following the procedures in Section 3.1.
4. Remove the junction box lid and remove the tape and wire nuts.
5. Disconnect safety cover switch quick disconnect and remove right-side panel using $\frac{7}{16}$ " socket wrench (4 bolts).
6. Disconnect the 2 120V power cables from the junction box and remove the cables from the bulkhead.
7. Loosen and remove the 4 mounting bolts.
8. Remove generator from the engine mounting plate.
9. Remove the generator pulley with the woodruff key.

TOOLS REQUIRED

$\frac{7}{16}$ " Socket Wrench
Torque Wrench
Voltage Meter
Hertz Meter

Installing the Generator

1. Place generator on engine mount plate.
2. Install 4 mounting bolts and hardware and torque to 80 lbs. ft.
3. Install the power cords routing them back through the bulkhead connectors to the junction box connectors.
4. Wire the generator box using the wire nut connectors and secure with electrical tape. (See S10.7 for electrical diagram)
5. Install the junction box lid and screw.
6. Re-install the right-side panel using $\frac{7}{16}$ socket wrench (4 bolts) and re-connect the safety cover switch.
7. Install the generator pulley and perform the pulley alignment procedure (See S3.1).
8. Install the serpentine belt (See S3.0).
9. Install the bottom plate using $\frac{7}{16}$ " socket (12 bolts).
10. Re-install the front cover.
11. Test generator (See Testing the Generator below).

CAUTION

Dangerous AC voltages are present when the generator is running. Ensure care is taken not to ground wires when testing.

S10.3 Testing the Generator

1. Using a voltage meter test both block heater and bunk outlets. Position the test leads between hot and neutral. AC voltage with a 1500 watt load should NOT be lower than 110 volts and without a load should NOT be higher than 120 volts.
2. Using a volt meter capable of measuring frequency in Hz. Position the test leads across the hot and neutral of the block heater circuit and measure the frequency.

NOTE

The output should be 61 Hz with a 1500 watt load.

S10.4 Adjusting the Engine Idle

In order for the generator to produce the 6kW at 60 Hz, the generator must rotate at 3600 RPM. The proper method for setting this speed is to use a Hertz (Hz) meter to measure the alternating currents frequency. Measure the output at the receptacle by inserting the test leads into the hot and neutral openings. Ideally the generator should be tested under partial load (1500W) plugged into the block heater. Set the frequency to 61 Hz by adjusting the engine idle.

S10.5 Generator Diagnostics Procedures

Please read and understand this entire section prior to performing any work on the 120V generator. If the following tests fail to identify the cause of the generator failure (breaker, capacitor, field windings, outlet, wiring) the generator may need to be replaced.

1. If there is no power to the outlet, reset breakers on the generator. For the GFI (Ground Fault Interrupter) receptacle in the cabin, try to reset the breaker on the outlet before those on the generator.
2. See that the generator belt is in place and properly tensioned. ($\frac{1}{8}$ " to $\frac{1}{4}$ " deflection).
3. If breaker reset does not restore power to the receptacle, remove generator cover and junction box lid and see that there are no loose or broken connections.
4. Start engine. Test for 120V line power from the red lead T1 to neutral white lead T2 and brown lead T3 to neutral blue line T4. If there is continuous power through each breaker, but no power to the outlets, the cable or outlets may be the cause of the failure (See Figures 10-9 and 10-10).
5. If there is line power from the T1 and T3 to their respective breakers but no power on the load side, the breaker has either failed or requires that it be reset. Reset the power to the breakers.
6. If there is limited voltage to the breakers from leads T1 and T3, ensure that the RPM of the engine has not come out of adjustment. The generator should produce a hertz frequency of 61 Hz while under a 1500 watt load. If the generator produces less than this Hertz frequency, regardless of the voltage reading, the engine RPM must be confirmed between 2400 minimum and 2550 maximum.
7. If the hertz frequency is correct, remove the neutral line wire nut and measure the voltage across [red lead T1 and white lead T2] and between [brown lead T3 and the blue lead T4]; there should be a minimum voltage of 1.5 volts. If the reading is less than 1.5 Volts the capacitor may need to be flashed. (Refer to "Capacitor Flashing" below.)
8. If the voltage is less than 1.5 V check the insulation resistance of the windings. See below for the procedures.

NOTE

If the APU produces low voltage and/or has been stored or allowed to get damp or dirty, the insulation resistance of the windings should be checked.

S10.6 Generator Service Procedures

TOOLS REQUIRED

Megger Tester

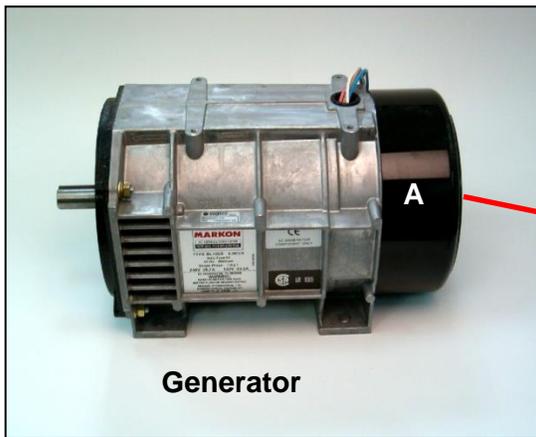
500V minimum capability
[for testing field windings]

Multi-meter

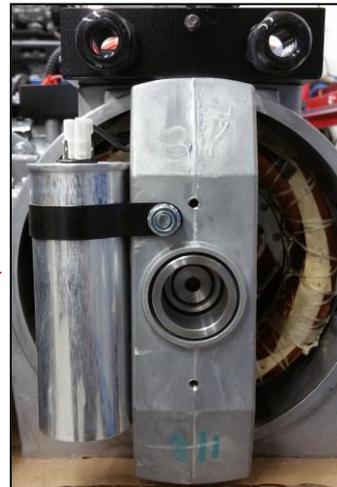
capable of measuring the following in micro Farads (μF)
Volts (V)
AC Frequency Hertz (Hz)
Capacitance
[for testing voltage, generator RPM and capacitance]

1. Remove the generator wiring cover to gain access to the generator breakers and wiring; and then remove the two bolts on the inside of the box. (See Figures 10-6 and 10-7).
2. Remove generator end cap (by removing the 12 phillips head bolts) to gain access to the capacitor.

Figure 10-4



Generator



End View (Cap Removed)

Capacitor Location (A)

Capacitor is located behind Generator End Cap

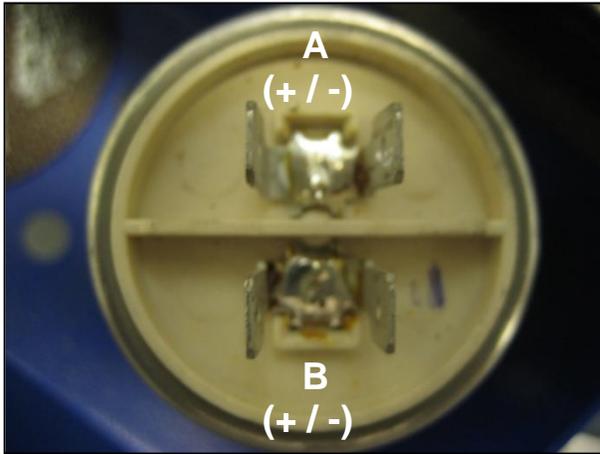
3. Remove the capacitor and refit new one. Install the capacitor holding clamp and install wire leads.
4. Mount hardware to the capacitor box.

Capacitor Flashing

The capacitor is non-polar until charged. To determine the polarity of a used capacitor test the Voltage between post A and post B (See Figure. 10-5). If the voltage reading is a positive number the red test lead represents the positive terminal. If the voltage reading is a negative number the red lead represents the negative terminal. The terminals may be positive or negative depending on how they were initially charged (See Figure 10-5). When flashing the capacitor determine the polarity before applying battery voltage.

Figure 10-5

Capacitor Terminals



If the voltage is below 1.5 volts or there is no voltage, reconnect the capacitor leads to the original position. A 12 volt battery should then be instantaneously flashed (that is connected for only one second) across the capacitor. The auxiliary leads must still be connected to the capacitor. Run the generator and the output voltage should then build up to normal off load voltage of 120 volts AC @ 61 Hz.

NOTE

For further information see the Markon Generator Manual supplied with the 120V Generator from the manufacturer.

Testing the Capacitor (40 μ F)

To check the capacitor first remove the end cover, disconnect the leads to the capacitor and with a suitable meter check the level of capacitance across the terminals on top of the capacitor from terminal A to terminal B. This should read 40 μ F \pm 5% (38-42 μ F); if the capacitor is outside these limits it should be replaced. (See Figure 10-5).

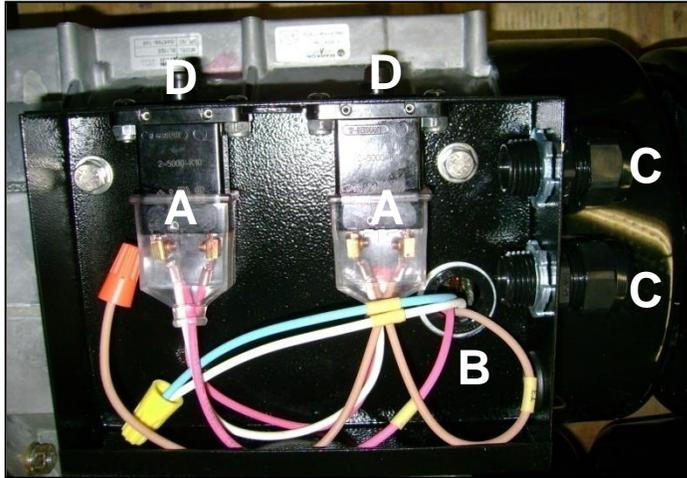
Insulation and Resistance Check (See Figure 10-5)

1. Disconnect the capacitor BEFORE carrying out this test.
2. The check should be carried out the stator windings between each winding group and the generator frame, and between the rotor windings and rotor core using a 500 volt tester or similar instrument.
3. The resistance value obtained should be at least one megaohm (one million Ohms Ω).
4. If the resistance is less than one mega ohm the windings should be cleaned of dirt by blowing with compressed air and dried out in a warm atmosphere. See section 2.10 for more information on this procedure.

- If moisture is present within the generator the resistance values may be rechecked periodically until this value (1 MΩ) is obtained.

S10.7 Generator Wiring Electrical Schematics

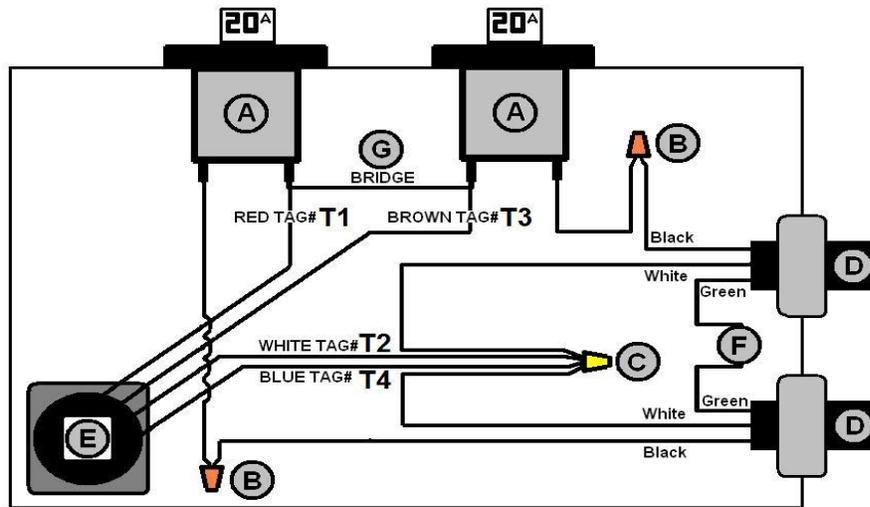
Figure 10-6



LEGEND	
A	Breakers
B	Wires from Generator
C	Output Connectors
D	Breaker Resets

Figure 10-7

Junction Box Wiring Schematic



LEGEND	
A	20 Amp Breakers
B	Small Wire Nut – Twist On
C	Large Wire Nut – Twist On
D	120 Volt Electrical Cables
E	Wiring from Generator
F	Green Wires Grounded Using Existing Junction Box Mounting Bolt
G	Breaker Interconnect Wire (Bridge)

S10.8 Cables and Outlets

1. Using a multimeter check the output voltage at the block heater cord and the bunk outlet without a load.
2. Output should be 120 VAC.
3. Outlets should also be checked with a 1500W load on one outlet while checking the other, and then reverse the procedure to check the opposite outlet.
4. Output should be 120 VAC.

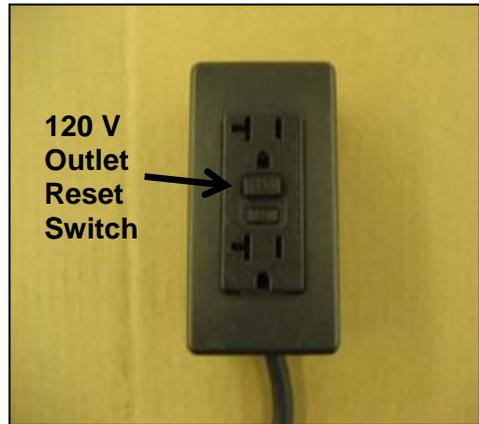
CAUTION

Vibrations can cause wire nuts to become loose or fall off. When wiring the generator it is important to use electrical tape to fully secure the wire nuts.

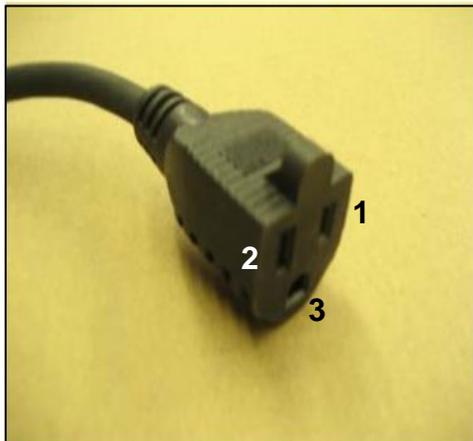
**Figure 10-8
Cabin AC Outlet Support Bracket**



**Figure 10-9
Mounted Cabin AC Outlet**



**Figure 10-10
Block Heater Cord**



LEGEND – Household Circuit Wiring			
1	(Hot)	Black =120V	[small prong]
2	(Neutral)	White =0V	[large prong]
3	(Ground)	Green =0V	[circle prong]

NOTE

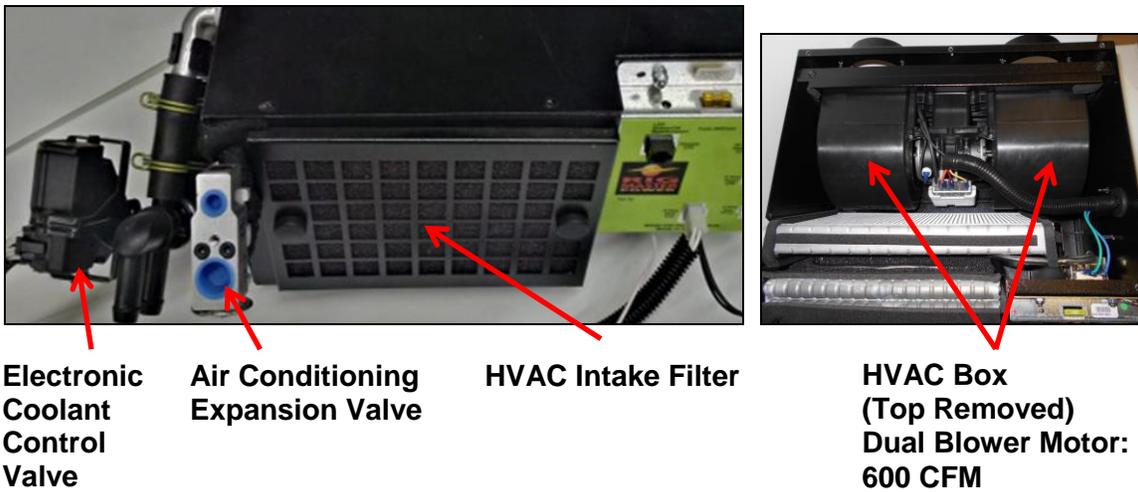
AC voltage check: when measuring between black and green =120V; and when measuring between white and green = 0V.
(If a voltage is present between neutral and ground there may be a voltage leak to ground.)

Section 11 Air Conditioning

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S11.0 Air Conditioning System Overview

Figure 11-1



The MTS-T4-6 APU air conditioning system is similar to most automotive systems, so you may use commonly practiced automotive air conditioning diagnostic techniques.

WARNING!

- This air conditioning system must be serviced by qualified personnel, familiar with air conditioning systems, refrigerants and the dangers of pressurized components.
- Do not breathe A/C refrigerants or lubricant vapor mist. Exposure may irritate eyes, nose and throat. To remove R134a from the system, use SAE j2210 certified equipment. If accidental discharge occurs, ventilate the area.

CAUTION

- Cross contamination with other refrigerants will cause damage to this air conditioning system.
- The MTS-T4-6 requires a large volume of airflow to maintain operating temperatures. Running the APU without its cover will result in system overheating.

NOTE

Replace the receiver drier filter cartridge whenever air conditioning system components are replaced or if the system is breeched for a number of hours. If the system becomes contaminated, flush it using an air conditioning system flushing agent. WD-40 should be used to prevent corrosion between aluminum and steel fittings.

The MTS-T4-6 is shipped with the air conditioning system sealed to prevent contamination which would occur during the storage of the unit.

An aluminum condenser is used in the air conditioning system for optimum heat exchange. Great care must be taken when working with the air conditioning line fittings because of the Condenser's Aluminum construction.

S11.1 Air Conditioning System Operation and Specifications

The A/C compressor operates only when its electro-magnetic clutch is activated, engaging its drive shaft to the belt driven by the diesel engine. The EPA approved R-134a refrigerant is compressed into a high pressure gas that flows through the A/C system, removing heat and moisture from the sleeper cab of the truck.

Compressing the R-134a refrigerant gas causes a great increase in its temperature. Compressed, heated gas is discharged from the compressor through a high pressure hose into the condenser that contains a receiver drier filter cartridge. Any moisture is removed from the refrigerant to prevent the freezing of the expansion valve, located further on in the system. An electric fan forces air through the body of the condenser removing heat from the compressed gas and condensing it into a high pressure liquid.

The liquid refrigerant flows from the condenser through a high pressure hose to the expansion valve that is mounted to the evaporator core, inside the HVAC box in the cabin of the truck.

The expansion valve separates the high and low pressure sides of the A/C system and allows a varying amount of refrigerant to flow through it. This chills the evaporator core to a regulated temperature between 30° and 42°F, which cools the cabin.

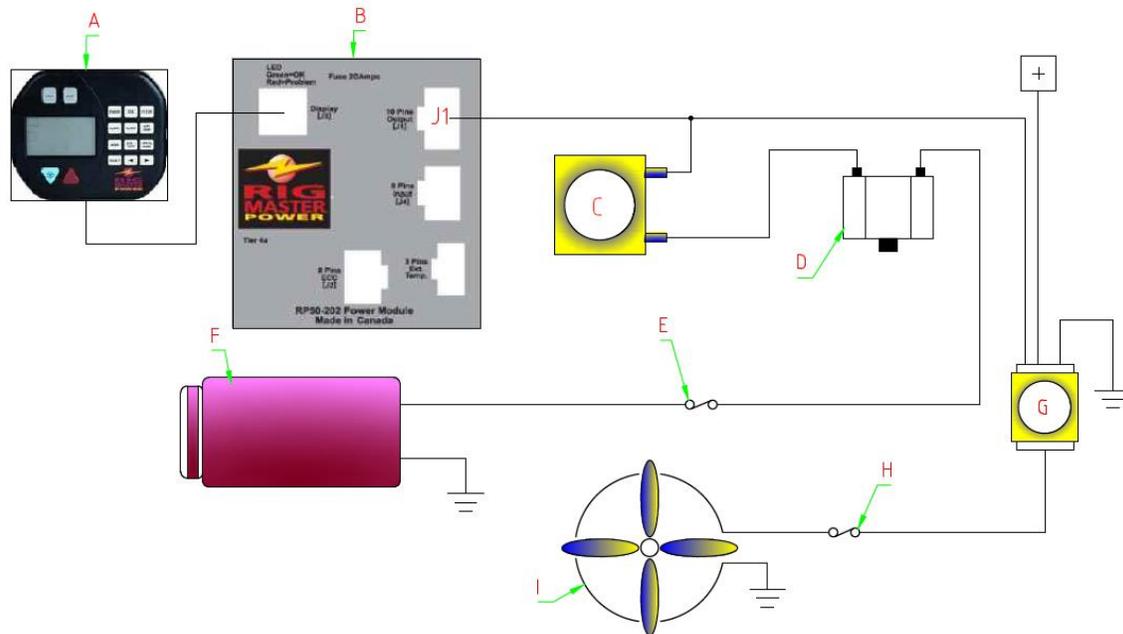
The expansion valve controls refrigerant flow by varying the size of its internal orifice according to the temperature of the low pressure gas exiting it. This precise control ensures that the liquid refrigerant "boils" completely into a low pressure gas as it enters the evaporator.

Room temperature air from the cabin is pulled into the HVAC box and through the evaporator core by the blower fan. Exposure of the refrigerant in the evaporator to the room temperature from the cabin air causes the low pressure liquid refrigerant to "boil"; giving off its "coldness", absorbing heat from the cabin air and drawing water vapor onto the core where it condenses into liquid water.

The refrigerant exits the evaporator and flows back to the compressor through the suction line as a cold, low pressure gas.

Air Conditioning Electrical Circuit Diagram
(Shows the supply of voltage to A/C compressor and electrical fan)

Figure 11-2



ITEM	COMPONENT	OPERATION
A	Cabin Controller	Has cabin temp. thermostat that controls power module engaging/disengaging of A/C compressor.
B	Power Module	Processes cabin controller commands, provides voltage to A/C system (J1 connector, green wire).
C	Evaporator Thermostatic Switch	Controls voltage to the binary pressure switch by monitoring the temperature of evaporator, preventing the freezing of evaporator core.
D	Binary Pressure Switch	Provides voltage to compressor when the high side pressure is between 28 and 450 psi.
E	7.5 Amp. Fuse	For A/C compressor.
F	Compressor	Voltage from power module must pass through switches "C" and "D" to engage compressor clutch.
G	A/C Controlled Rad Fan Relay (3 rd Relay)	Power module supplies voltage to relay when A/C is selected, activating the "radiator" electric fan.
H	35 Amp. Fuse	For electric fan.
I	A/C Controlled Side Fan (4 th Relay)	Power module supplies voltage to relay when A/C is selected, operates the engine cabinet side electric fan.

NOTE

For additional information on engine cooling refer to Section 12.

Use of Pressure Gauges

Connect pressure gauges and operate the A/C system for 10 minutes to confirm the customer complaint. Note the maximum high side pressure and minimum low side pressure. With the fan set to “high”, use a thermometer and record the air temperature coming out of the HVAC box vent. It should be 45°F to 50°F (7°C to 10°C) depending on the outside temperature.

A quick check of the A/C system operation can be done by touching the high and low pressure lines for an indication of their temperatures: The high pressure lines should be hot and the low pressure lines will feel ice cold.

Compare your gauge pressure readings of both, the high and low side of the A/C system, to those specified in the Service Manual.

Note: Climate temperature and humidity affect A/C system pressures, causing higher pressures on hotter days than on cooler days.

Match the recorded gauge pressures and temperature readings with the correct troubleshooting diagnostic sheet (Refer to S10.5) and the Air Conditioning Performance Chart below.

WARNING!

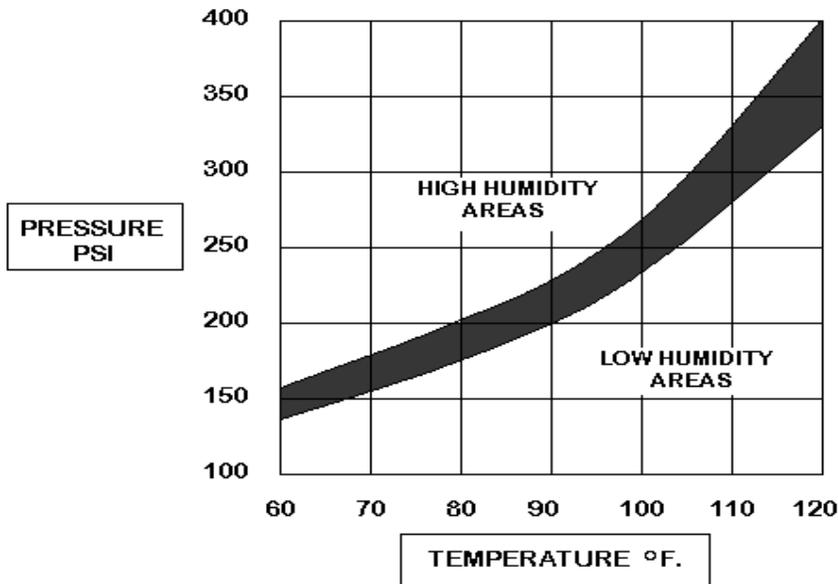
ONLY CERTIFIED AIR CONDITIONING TECHNICIANS SHOULD SERVICE THE AIR CONDITIONER.

HIGH PRESSURE VS. TEMPERATURE READINGS

High temperatures and pressures are approximate.
Readings within 10-15% (See Figure 11-3) will deliver acceptable performance.

Air Conditioning Performance

Figure 11-3



SUCTION PRESSURES – LOW SIDE

Usual low side pressure 15-40 PSI depending on outside temperature and humidity.

DISCHARGE PRESSURES – HIGH SIDE

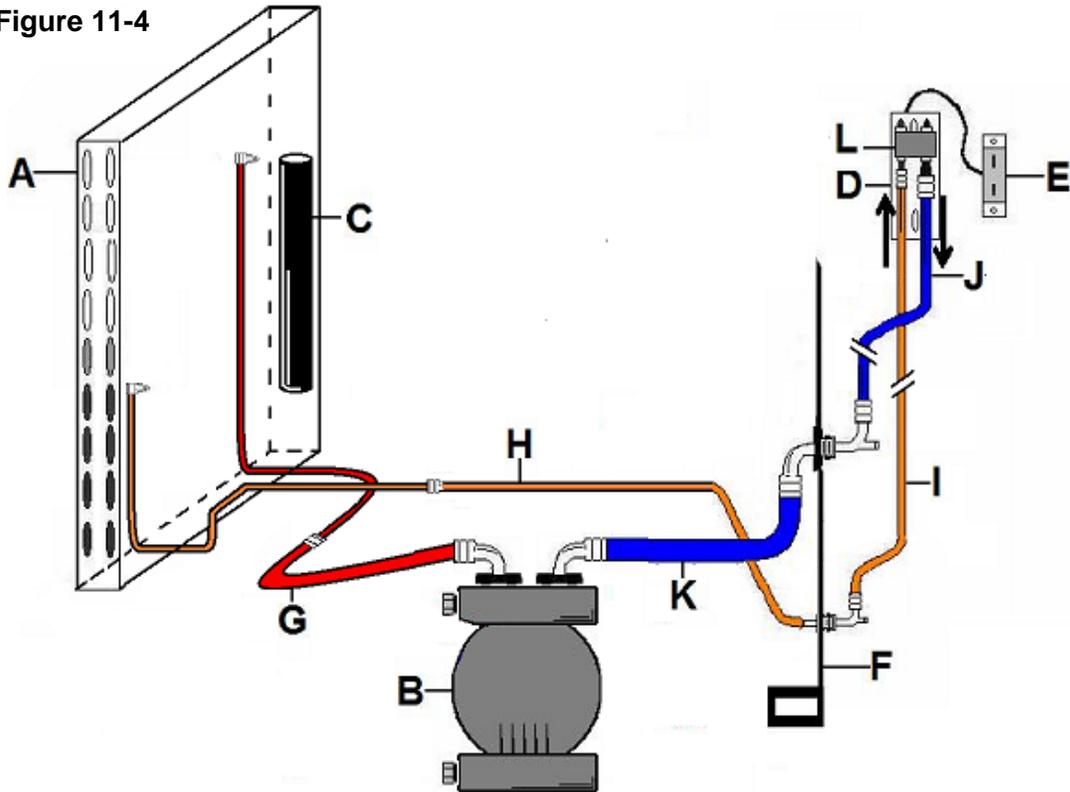
Usual high side pressure 150-300+ PSI depending on outside temperature and humidity.

AIR CONDITIONING	SPECIFICATIONS
Refrigerant Type	R134a
Volume of Refrigerant (24,000 BTU HVAC)	1.0 lb.; (16 oz.; 0.4 Kg.)
Compressor Oil Type	SP46 to 100 PAG Compressor Oil
Compressor Oil Capacity (already filled with 3.3 oz.; add an extra 2 oz. at time of charging)	6.3 fl. oz.; (186.3 cc.; 186.3 mL.)
Evaporator Temperature Switch	Range = 30°F to 42°F (-1°C to 6°C)
Binary Pressure Switch	Range = 28 to 450 psi

S11.2 MTS-T4-6 Air Conditioning System Hoses and Components Diagram

The compressor within the RigMaster unit pumps the refrigerant gas through the condenser that dissipates the heat and changes the refrigerant from a gas to a liquid. The liquid refrigerant passes through a filter (receiver drier), and then through the evaporator core located in the bunk heater/air conditioner unit. The heater/air conditioner blower motor (fan) then activates, and cool dry air is forced into the bunk area.

Figure 11-4



LEGEND		PRESSURE	PART #
A	Condenser	High	LG9-001
B	Compressor	High/Low	LG9-004
C	Receiver Drier	High	LG9-007K
D	Evaporator	High	LG9-002
E	Thermostatic Switch	High/Low	RP9-113-R2
F	Bulkhead Section of Frame	N/A	KT10-001-R2
G	A/C Line – Compressor to Condenser – #8	High	LG9-405
H	A/C Line – Condenser to Bulkhead – #6	High	LG9-407K
I	A/C Line – Bulkhead to Evaporator	High	LG9-404
J	A/C Line – Evaporator to Bulkhead	Low	LG9-403
K	A/C Line – Bulkhead to Compressor – #10	Low	LG9-406
L	Expansion Valve	High/Low	LG9-003

S11.3 Air Conditioning Hose Installation

CAUTION

Excess stress on air conditioning hoses will cause leaks and failures at fittings. Ensure that the hoses are not pinched in a way that restricts coolant or refrigerant flow.

NOTE

Fine particles of foreign matter can prevent an O-ring from sealing a connection properly. **Install only clean O-rings** and lubricate them to prevent damage during installation.

Bulkhead to HVAC Evaporator Lines

Note: Install all APU hoses and wiring with the cab air suspension inflated. Excess lengths must be secured but allow for movement of cab air suspension.

Figure 11-5

1. Route the #6 and #10 evaporator refrigerant hoses into the cabin and install the hose fittings into the expansion valve and install the 6mm clamping bolt only finger tight.



Figure 11-6

2. Lubricate the O-rings on the bulkhead end of #6 (LG9-407K) and #10 (LG9-406) evaporator refrigerant hoses and install the hoses to the bulkhead fittings only hand tight.

(Hose fittings are positioned for illustration purposes only).



Figure 11-7

3. Torque the 6mm clamping bolt holding the hoses on the expansion valve to 7 ft/lbs.



Figure 11-8

4. Torque the evaporator A/C hoses to the fittings at the bulkhead to 21 - 27 ft/lbs.

IMPORTANT:

Be sure to prevent misalignment and hose damage when tightening hose fittings at the bulkhead by using a wrench on each fitting on either side of the bulkhead, one to tighten, one to steady the other fitting.



5. After installation, deflate the cab air suspension and inspect hoses for potential clearance problems. To avoid hose failures from damage, A/C hoses should not be under twisting or flexing stresses after installation.

Compressor Hose Connections

Figure 11-9



Lubricate O-rings and install A/C hose fittings into the compressor ports.

Figure 11-10



Torque the A/C hose clamp bolts to 7 ft/lbs.

Engine Compartment Connections

Compressor to Condenser Hose (LG9-405K)

Note: Lubricate O-rings to prevent accidental tearing during installation.

Figure 11-11

1. Route the hose from compressor to condenser. Install the hose and clamping bolt finger tight in the compressor.

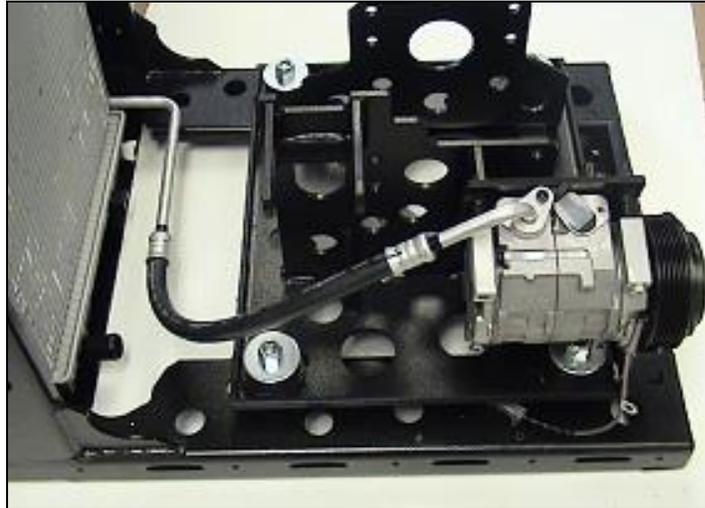


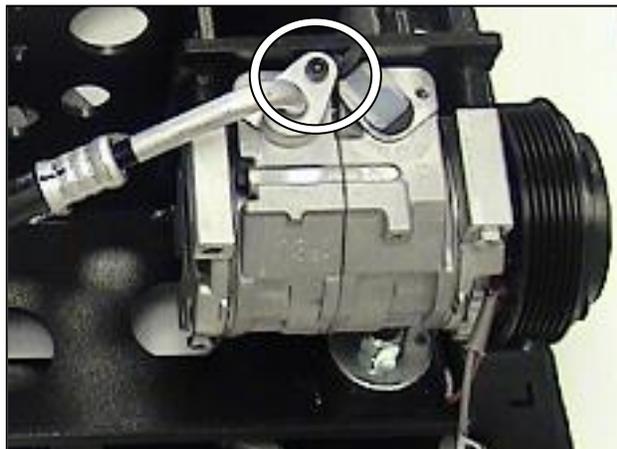
Figure 11-12

2. Install the condenser end of the hose and torque the clamping bolt to 7 ft/lbs.



Figure 11-13

3. Torque the hose clamping bolt at compressor port to 7 ft/lbs.



Condenser to Bulkhead #6 Hose (LG9-407K)

Figure 11-14

1. The condenser end of the LG9-407K condenser to bulk head hose is seen in these 2 pictures. They illustrate its shape and routing at the condenser end of the hose. Install and torque the clamping bolt to 7 ft/lbs.



Figure 11-15

2. Route the LG9-407K hose from the condenser to the bulkhead along the path shown.



Figure 11-16

3. LG9-407K hose shown attached to bulkhead in the lower left position.

IMPORTANT: Be sure to prevent misalignment and hose damage when tightening hose fittings at the bulkhead by using a wrench on each fitting on either side of the bulkhead, one to tighten, one to steady the other fitting.



Bulkhead to Compressor Hose (LG9-406)

Figure 11-17

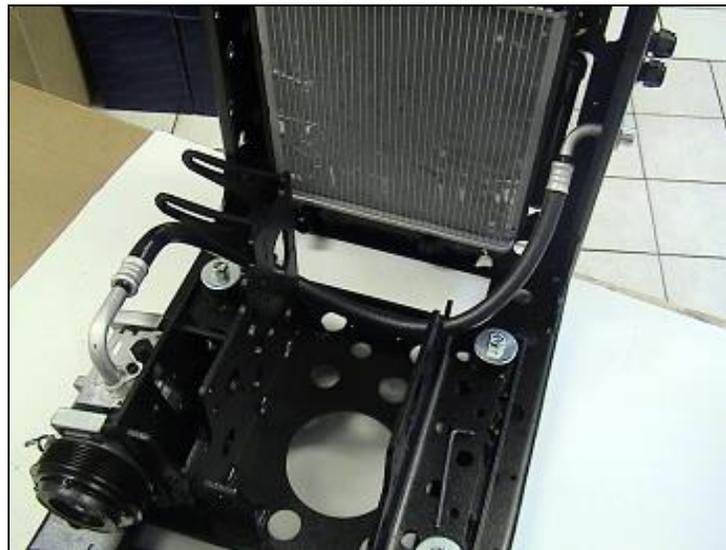
1. LG9-406 hose shown attached to bulkhead in the upper left position.

IMPORTANT: Be sure to prevent misalignment and hose damage when tightening hose fittings at the bulkhead by using a wrench on each fitting on either side of the bulkhead, one to tighten, one to steady the other fitting.



Figure 11-18

2. LG9-406 hose is shown routed from the compressor to the bulkhead.



Receiver/Drier Element LG9-007K (Inside Condenser)

The air conditioning system refrigerant must be recovered by vacuum equipment before the receiver drier cartridge can be removed.

Note: The pictures in the steps below may not exactly match the appearance of the MTS-T4-6 as it is installed on a vehicle. Panels and other components may be missing to help show the process clearly.

Figure 11-19

1. The air conditioning system receiver drier cartridge (LG9-007K) is housed inside of the condenser assembly. Remove the cap and pull the cartridge out with needle nose pliers.

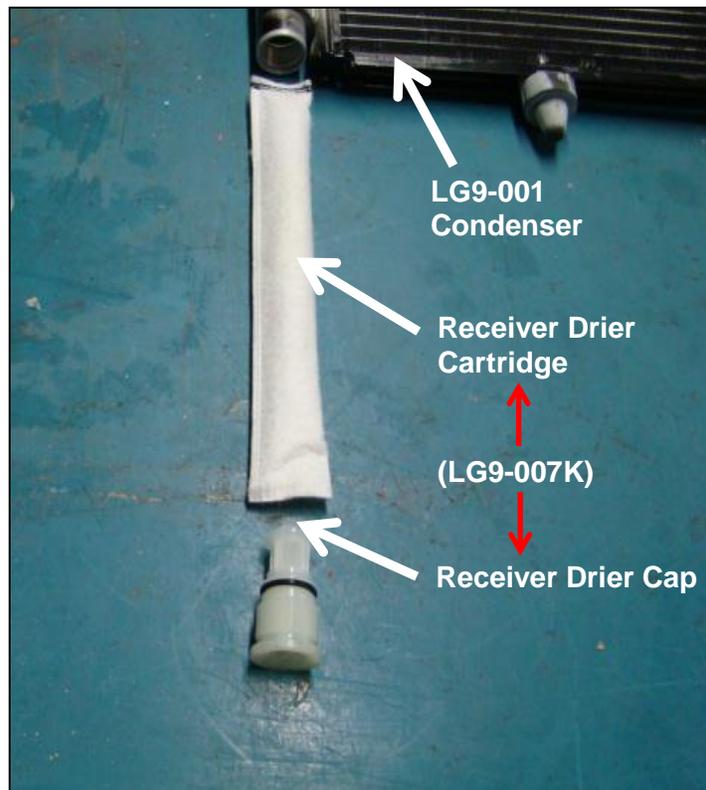


Figure 11-20

2. Remove the right side panel.
3. The receiver/drier plug location.
4. Receiver Drier plug is a hexagonal socket cap screw, requiring a 14mm Allen Key to remove.

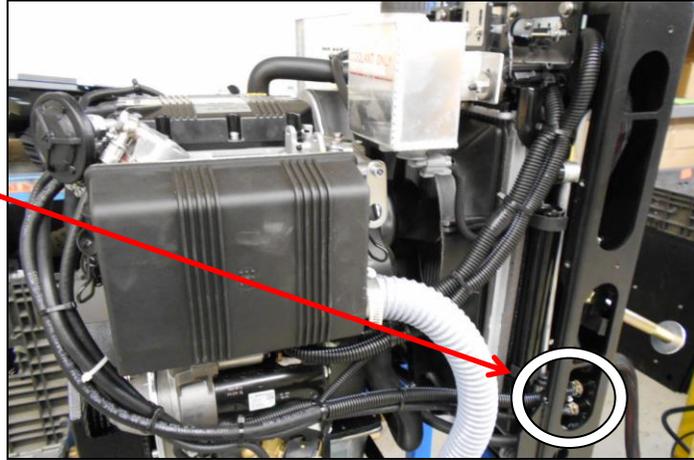
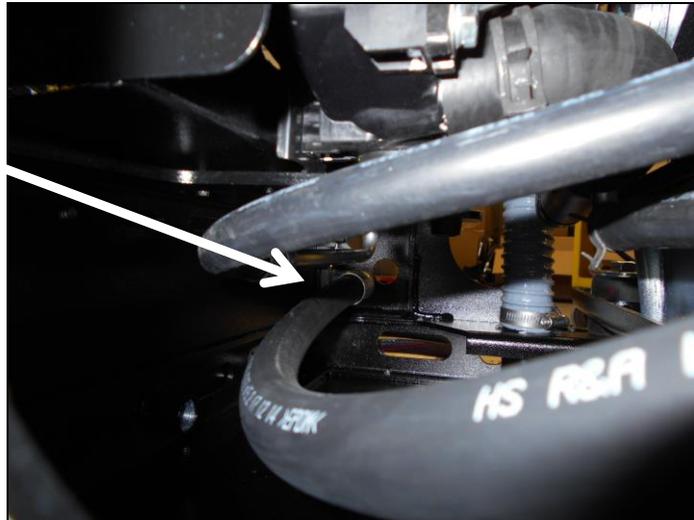


Figure 11-21

5. The ties attaching the LG9-405 compressor to condenser hose must be unhooked and moved to the side to allow the receiver drier cap to be removed.
6. Loosen the receiver drier plug and remove the receiver drier cartridge from where the cap was located.
7. Assembly of receiver drier is opposite of disassembly steps.



NOTE

When replacing the receiver drier cartridge, receiver drier cap should also be replaced.

Figure 11-22

8. The back and side panels must be removed to attach hose.
9. Unbolt the LG9-405 hose at the condenser end and move it aside to allow the receiver drier plug to be removed.
10. Remove the 2 bottom muffler mounting bolts.
11. Remove the 12 bottom plate mounting bolts.
12. Remove the bottom plate.

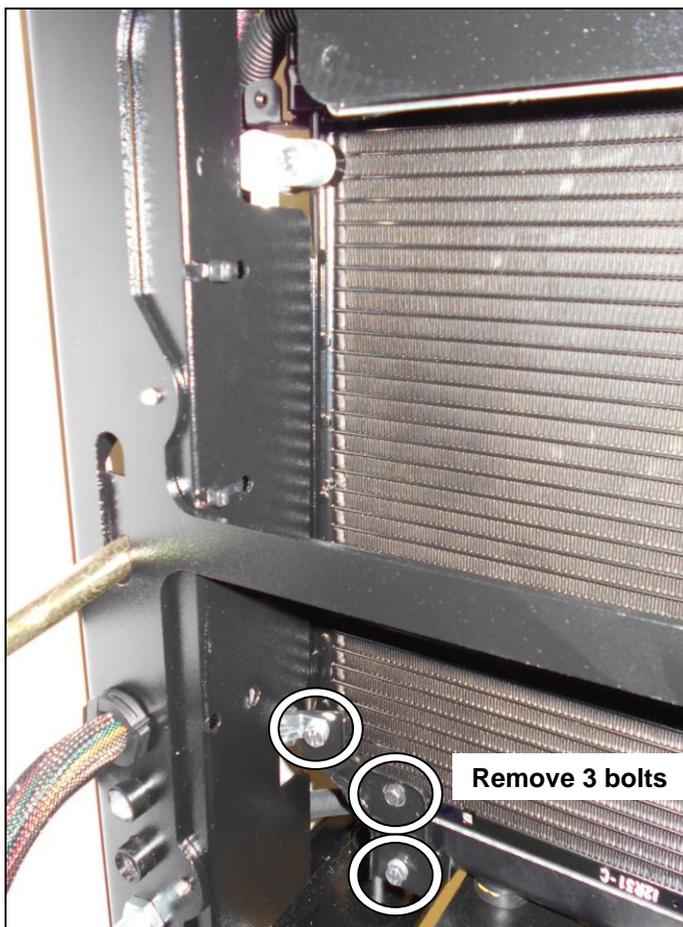


Figure 11-23

13. Loosen the receiver drier plug and remove it through the hole in the frame beneath it.

Note: Assembly of receiver drier is opposite of disassembly steps.



S11.4 Air Conditioning Diagnostics

Gather information about service history of the unit if possible, including service records.

1. Operate the system to verify the customer's complaint.
2. Check and note proper operation of the system. Does the A/C compressor turn on? Touch both the suction and discharge lines. Are the discharge lines hot? Are the suction lines cold? Does the compressor cycle? Does the electric fan turn on? What is the temperature at the vents?
3. Check belt tension and possible seizing components such as compressor, etc.
4. Check around compressor clutch and surrounding area for signs of oil leaks and dirt.
5. Check the A/C lines for visible signs of leaks or cuts.
6. Check for loose or broken electrical connections. Check for broken or worn wiring.
7. Check the drain tube. If the hose is pinched or the duck bill is missing this will cause the evaporator core to freeze and the vent will blow warm air.
8. Check compressor clutch to ensure that it is engaging properly.
9. Follow diagnostic chart A.

CAUTION

If you must jump power to the A/C compressor to operate the system, doing so directly at the clutch may damage the compressor. Use the terminals at the thermostatic switch on the HVAC box.

Jumping power to the circuit from this location will allow the binary switch to disable the compressor should system pressures exceed specifications. If bypassing the thermostatic switch, watch for frost build up on the expansion valve. This is a sign of the evaporator core freezing up.

NOTE

The most common air conditioning problem is leakage. If there is no obvious sign of leakage, test the system with either nitrogen or leak tracing dye.

Diagnostic Selection Sheets

Chart A

No A/C compressor operation.

Chart B

Low side and high side pressure normal but outlet temperature too warm.

Chart C

Low side pressure is higher than spec., high side pressure within or below spec.

Chart D

Both low and high side pressure higher than spec.

Chart E

High side pressure greater than spec, low side pressure within or lower than spec.

DIAGNOSTIC CHART A

Symptom

A/C compressor is inoperative.

Possible Causes

- Possible faulty power module.
- Possible faulty thermostatic switch.
- Possible faulty binary switch.
- Low gas pressures.
- A/C clutch or compressor failure.

Diagnostics

1. Check for voltage from the power module at connector J1, Pin #2 to the thermostatic switch. If no voltage is going to the switch, the power module is faulty. If no voltage is present after the switch, or if the compressor is short cycling “on and off”, the thermostatic switch is faulty and must be replaced.
2. If the power module and the thermostatic switch are ok, check for voltage at the binary switch on the LG9-407K hose (condenser to bulkhead). If no voltage is present on the blue wire to the binary switch, check for a broken wire or loose connection. If there is voltage to the binary switch on the blue wire but no power out of the switch, connect a set of pressure gauges to see if there is more than 28 psi pressure to close the binary switch. Use the chart below to determine static system pressure based on temperature.

TEMPERATURE (°F)	PRESSURE (PSI)
60	58
61	59
62	60
63	61
63.5	62
64	63
65	64
66	65
66.5	66
67	67
68	68
68.5	69
69	70
72.5	75

TEMPERATURE (°F)	PRESSURE (PSI)
76	80
79	85
82	90
85	95
86.5	100
90	105
93	110
95.5	115
98	120
100	125
102	130
105	135
107	140
109	145

If more than 28 psi is needed to close the binary switch, then it is faulty and must be replaced. If the system has less than 28 psi, follow the procedure to check for leaks and reseal the system.

3. If both the thermostatic switch and the binary switch test ok, inspect the 7.5 Amp. fuse in the fuse holder. If the fuse is ok, disconnect the harness at the A/C compressor and using a test light, check if power is going to the compressor clutch. If no power is going to the compressor clutch, inspect the wiring in the harness for breaks or chaffed wire and loose or poor connections. If there is power at the A/C clutch, it is faulty and the compressor must be replaced.

DIAGNOSTIC CHART B

Symptom

Low side and high side pressure normal but outlet temperature too warm.

Possible Causes

- Poor or restricted air delivery.
- Low system charge.
- Contaminated refrigerant.

Diagnosis

1. Check HVAC box and make sure air filter is not plugged. Check that the HVAC box has adequate air flow without blockage or restrictions. Check return air vent holes are not blocked or restricted.
2. Inspect and feel both high and low side A/C lines. The suction line should be cold to the touch. The discharge line should be hot.

If you find that the:

- Discharge line is hot
- Suction line is cool or warm

then it is an indication that the system refrigerant charge is low. Recover system refrigerant to determine how much is missing. Charge the system either with nitrogen or recharge with refrigerant and add leak dye to the oil to find the leak and repair it. Recharge the A/C system and proceed to step 3.

If you find that the:

- Discharge line warm to hot
- Suction line cool to warm

then it is an indication that the A/C system may have been contaminated with either foreign gas or possibly air. Using an A/C machine, test the refrigerant during recovery. If foreign gas is found, recover refrigerant to a scavenging tank. If the system has too much air simply recover and recharge, then proceed to step 3.

3. Run A/C system and check outlet temperatures.
 - Outlet temperatures still too high.

The A/C system has too much oil. Recover the system of refrigerant, drain the A/C compressor of all oil and replace filter/drier. Drain condenser of all oil. If it cannot be drained and cleared of oil, replace condenser. Vacuum A/C system and add 3.3 oz. of PAG oil to system then charge with refrigerant.

DIAGNOSTIC CHART C**Symptom**

Low side pressure is higher than spec., high side pressure within or below spec.

Possible Causes

- System is under charged.
- Malfunctioning A/C compressor.

Diagnosis

1. Touch the A/C discharge and suction lines. The suction line should be cold and the discharge line should be hot.

If you find the:

- Discharge line warm to hot.
- Suction line cool to warm.

then recover refrigerant from system using an A/C machine. If the system charge is low, check the system for leaks using either nitrogen or A/C leak dye. Repair leaks and recharge system.

2. If system charge is ok, the A/C Compressor is faulty and must be replaced.

DIAGNOSTIC CHART D

Symptom

Both low and high side pressure higher than spec.

Possible Causes

- Restricted condenser air flow.
- Inoperative cooling fan.
- Malfunctioning expansion valve.
- A/C system overcharged.

Diagnostics

1. Start the A/C system and check for:
Electric cooling fan operation. The power module supplies both electric fan relays directly.
2. Visually inspect condenser for:
 - Damaged or missing fins.
 - Blocked or restricted air flow.
3. Feel the high pressure liquid line both before and after the expansion valve.
 - If the liquid lines on either side of the valve have similar temperatures, the expansion valve is faulty and must be replaced.
 - If the high pressure liquid line on either side of the expansion valve has different temperatures, the A/C system is either overcharged or has air in the system. Recover system and recharge with correct amount of refrigerant. Operate the system to confirm repair.

DIAGNOSTIC CHART E

Symptom

High side pressure greater than spec., low side pressure within or lower than spec.

Possible Causes

- Restrictions in the lines.
- Debris in the system.

Diagnosis

1. Follow along and feel the following high side components:

- Compressor discharge hose.
- Condenser.
- Liquid line between the condenser and expansion valve.

Feel for an abrupt change in temperature throughout the lines. Any abrupt change in temperature would indicate a blockage. Remove the blockage or replace the component. If no abrupt change in temperature is felt then proceed to step 2.

2. Feel the liquid line at the expansion valve and inspect for:

- Extreme cold temperatures before the expansion valve.
- Warm temperatures after the expansion valve.
- Heavy frost buildup at the valve.

If this condition is found, replace the receiver/drier and expansion valve and inspect for metal flakes. If present, remove compressor hoses and blow out with shop air. If large amounts of metal flakes are present, replace the condenser and back flush the A/C system. If not, proceed to step 3.

3. Feel the suction line from evaporator to compressor as well as compressor discharge hose and condenser.

- If any of these components are mildly warm check for a restriction or blockage at the compressor suction port.
- If debris is found in the port, a complete flush of the air conditioning system is needed and some components may require replacement.

Back flush the A/C system and charge.

S11.5 New Installation and Compressor Replacement

This compressor does not pivot and the serpentine belt is tensioned with an auto tensioner. There is no need to tension the belt manually.

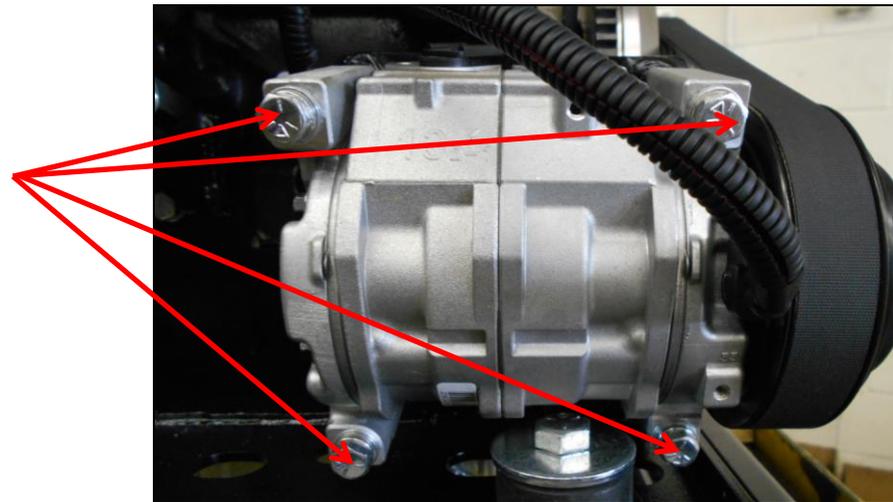
When replacing a compressor on an APU, perform the following procedure.

1. Remove serpentine belt.
2. Disconnect the connector from the compressor.
3. Evacuate the refrigerant and note the amount of oil drained from recovery.
4. Remove the high and low pressure lines from the suction and discharge ports.
5. Remove the Compressor's four (4) mounting bolts, flat washers and lock-washers.
6. Remove the old compressor.
7. Drain the oil from the old compressor into a graduated container and measure the amount of oil. Make note of how much oil has been drained.
8. Drain all of the oil from the new replacement compressor. Using the measured amount of oil you recorded from the old compressor, add the same amount of clean oil back into the new compressor.
9. Install compressor and torque to 37 ft/lbs. (50 Nm).
10. Inspect and reinstall the serpentine belt. (See Section 3).
11. Reinstall the high and low pressure hoses.
12. Reconnect the wiring harness.
13. Vacuum and recharge – pressure test if a leak is suspected.
14. Start the APU and test the air conditioning.

Compressor Mounting Hardware

Figure 11-24

**4 Compressor
Mounting Bolts,
4 Lock Washers,
4 Flat Washers**



COMPONENT	TORQUE SPEC.
Compressor Bolts	37 ft/lbs. (50 Nm)

S11.6 Air Conditioning System Flushing Procedure

1. If the air conditioning system becomes contaminated, all hoses, condenser, evaporator core, and expansion valve must be flushed separately.
2. Flush the system in the direction of refrigerant flow with either an A/C flushing agent or mineral spirits. Flush the component until the flushing agent flows from the opposite end. A flush kit or some other method may be necessary to get the flushing agent through the system correctly.
3. Using dry nitrogen, flush the system in the opposite direction of refrigerant flow to remove remaining flushing agent and moisture from the system.
4. Drain remaining oil from the compressor.

NOTE

Capture and measure the amount of oil drained from compressor. You will need to add the same amount of measured oil (using clean oil) back into the system prior to recharging.

5. Reassemble the air-conditioning system, replacing any components as well as the correct quantity and type of compressor oil.

CAUTION

If adding oil to the system, it is best to add oil to the low-pressure line at the expansion valve thereby reducing stress on the compressor.

6. Evacuate and recharge system to specified pressure.
7. Check for leaks and proper operation of the system.

Leak Testing

1. Charge the system.
(Nitrogen may also be used to charge the system if a large leak is suspected.)
2. Listen for hissing, use a soapy water solution to help identify leaks; look for bubbling.
3. If leaks are still not obvious, use a tracer dye, and operate the air conditioning normally to let the dye work its way through system.

Section 12 Engine Heating and Cooling

	Section	Page
Engine Cooling System Overview	S12.0	126
Cooling System Draining, Flushing and Refilling	S12.1	127
Cooling System Electrical Components	S12.2	128
Troubleshooting a Coolant Leak	S12.3	129
Heating System	S12.4	130

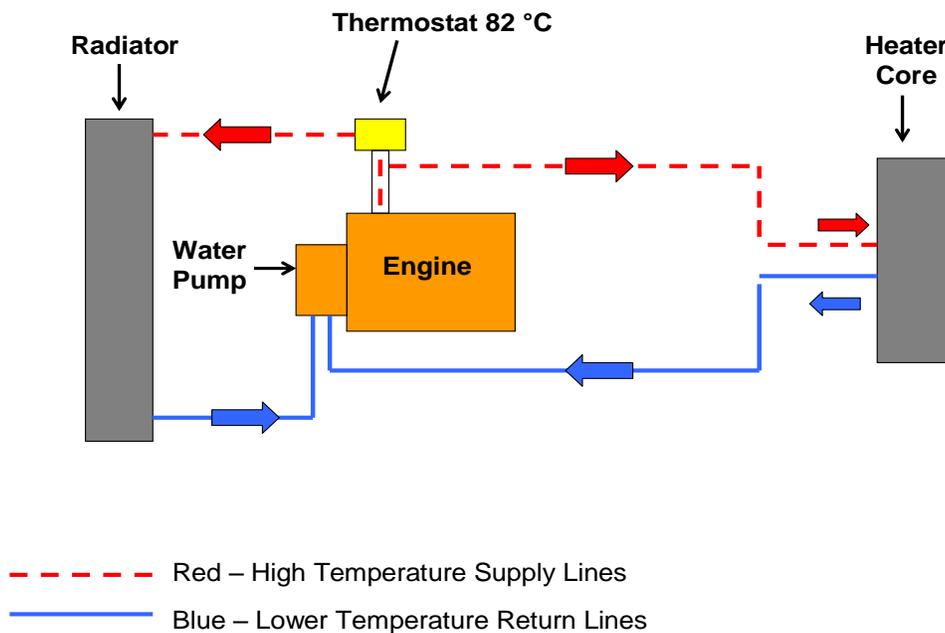
WARNING!

Engine coolant is under pressure and can be extremely hot in both the supply and return lines. Before servicing any component in the radiator/heating system allow the engine to cool completely.

S12.0 Engine Cooling System Overview

The MTS-T4-6 APU uses an automotive style heating and engine cooling system. The radiator is on-board within the APU engine compartment and heater core is located in the HVAC box in the vehicle. There is a coolant control valve (water valve) located on the HVAC unit that continuously receives coolant from the APU’s engine. If the coolant control valve is closed the coolant is directed back to the engine. The water valve is directional and the heating system will not function properly if the supply and return lines are connected in reverse at the water valve or engine bulkhead. The engine thermostat controls the supply of coolant to the radiator and is rated at 180°F (82°C).

Figure 12-1



S12.1 Cooling System Draining, Flushing and Refilling

Draining and Flushing

1. Stop the engine and allow the engine to cool completely.
2. Loosen the radiator filler cap slowly in order to relieve any pressure.
3. Remove the drain plug on the engine. (See Figure 12-2).
4. Open the drain cock on the bottom of the radiator and allow it to drain.
5. Fill the system with a flushing agent, following the manufacturer's guidelines.
6. Drain the flushing agent by following previous steps 1 to 4.
7. Refill the cooling system with 50/50 mixed standard life glycol antifreeze suitable for use in aluminum radiators.

Figure 12-2



Engine Coolant Drain Plug

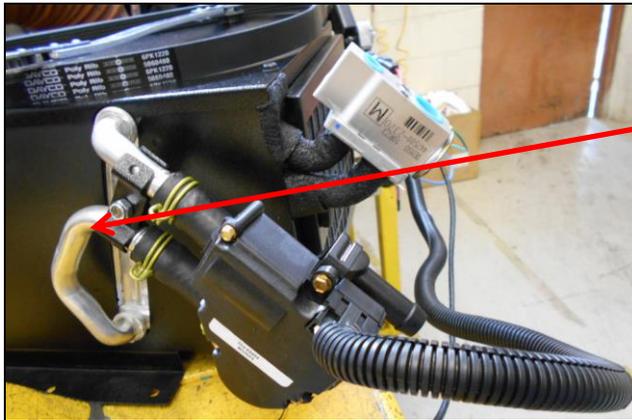
Radiator Filling and Purging

1. Using a radiator pressure tester, pressurize the system to 7 psi.
2. At the HVAC box, loosen the **left** hose clamp located on the top side of the electronic water valve. (See Figure 12-3).
3. Carefully insert a flat screwdriver between the hose and tube until air starts escaping.
4. Bleed air until coolant escapes.
5. Tighten hose clamp.
6. Remove pressure tester and top up radiator and coolant surge tank.
7. Repeat if necessary.
8. Start the engine and turn heat on high setting.
9. After the remaining air escapes from the system, allow engine to cool and then top up coolant.

NOTE

When purging the air from the HVAC box, use some lubricant on the screw driver to slide between the copper tube and rubber hose.

Figure 12-3



Bleed from the return side of the heater core, above the Electronic Coolant Control Valve.

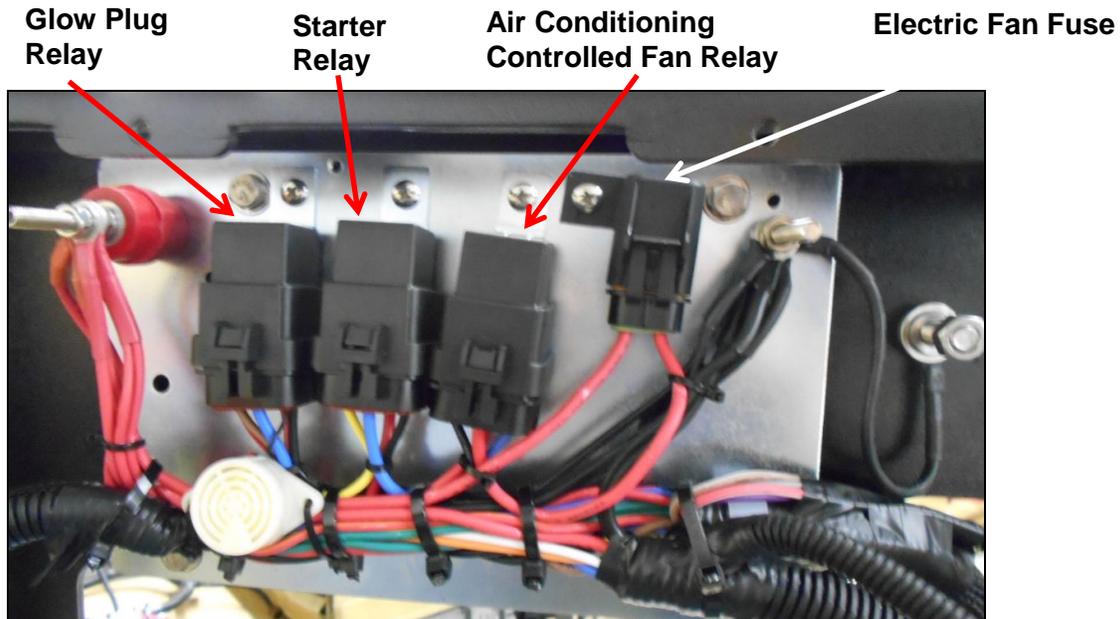
S12.2 Cooling System Electrical Components

WARNING!

The Electric fan can engage even if the MTS-T4-6 unit has been turned off.

Electric Fan Relay Locations

Figure 12-4



NOTE

The electric fan A/C controlled relay is located on the back wall of the APU Engine Cabinet. MTS-T4-6 APU activates its electric fan when air conditioning is selected, regardless of compressor clutch cycling.

DESCRIPTION	SPEC.
FUSE (RP7-074)	35 Amp.
RELAY (RP7-084)	40/50 Amp. (sealed)

Electric Fan Connectors

Figure 12-5

Electric Fan Connector
to Harness



S12.3 Troubleshooting a Coolant Leak

WARNING!

Do not remove the radiator cap or open the cooling system while the engine is hot or serious personal injuries will result.

1. Check for cooling system leaks. Loose hose clamps, damaged components or hoses may indicate the location of a leak.
2. Determine the amount of coolant loss from the system. Check if the expansion tank is losing just enough coolant to keep the float sensor in the closed position (coolant level under the add mark) or if the tank *AND* radiator are draining.
 - a. If the tank and radiator are losing coolant, perform a cooling system pressure test to identify the cause of the leak. With the engine cold, connect the pressure testing equipment to radiator and pressurize to 16 psi. Wait 15 minutes, then inspect for leaks (pressure testing the cooling system will not help find an expansion tank leak).
 - b. If the tank is only losing enough coolant to keep the float sensor in the closed position and there is some residual coolant in the tank, go to Step 3.
3. Check for residue around the coolant level sensor gasket. Inspect the gasket inside of the tank for poor sealing that might allow coolant to leak.
4. Inspect the tank for cracked seams or around any fittings. Replace the coolant surge tank (RP5-021) if any leaks are found.
5. Be sure that the cap is seated tightly on the tank; a loose cap might cause loss of coolant due to vehicle motion.

6. If there is no coolant leakage at the float sensor or the expansion tank cap install the radiator cap.
7. If there are any further leaks after replacing the radiator cap (LG5-004) with a 16 psi unit then you should allow the engine to cool, remove the radiator cap and pressure test it to ensure that it is working properly. The cap should hold a continuous 16 psi.

Figure 12-6

Radiator Cap

1.1 Bar = 16psi



S12.4 Heating System

For heating, the APU’s coolant flow is directed into the HVAC box mounted inside the bunk. A water valve mounted to the HVAC box regulates the flow of coolant through the heater core.

Voltage at the J2 Connector Pin-1 on the power module will indicate if the water valve is open or closed. (Closed=0 volts / Open=12.4 volts). See Section S9.6 for further information on troubleshooting this valve.

Figure 12-7

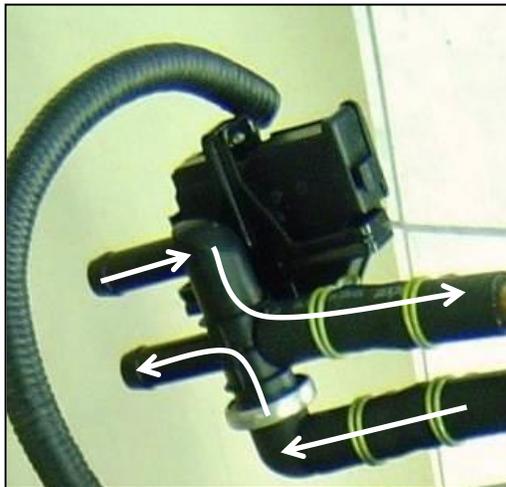


Figure 12-8



NOTE
 Notice the coolant flow when the valve is open. The coolant will travel to the HVAC box and then return on the opposite pipe.

Electronic Coolant Control Valve

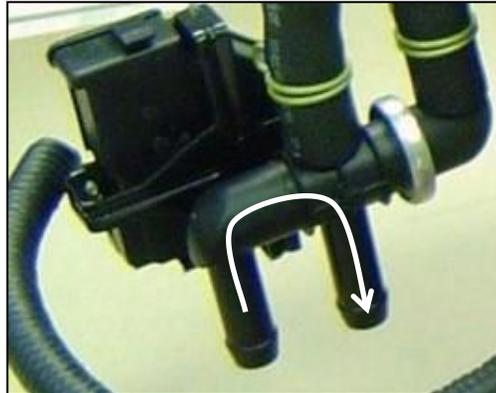
The electronic coolant control valve motor shaft is a good indication if the valve is opening when changing temperature modes. Marking the shaft with a black marker which will make the shaft rotation more visible. When the valve is closed coolant will loop back to the engine.

Figure 12-9



Control Valve Motor Shaft

Figure 12-10



Loop back to Engine

Section 13 Troubleshooting

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S13.0 Engine

Troubleshooting

Technical Support is available by calling (888) 208-3101 or (416) 201-0040 (Monday to Friday from 8:00 a.m. to 5:00 p.m. Eastern Standard Time)

Technical Support can also be accessed via the internet at www.rigmasterpower.com (click: Customer Support, Support Materials, Technical Support)

Troubleshooting – Engine

SYMPTOM	PROBABLE CAUSE	REMEDY/COMMENT
Engine does not Crank	<ol style="list-style-type: none"> 1. Low battery voltage. 2. Battery connections loose. 3. Starter relay problem. 4. Broken engine ground strap. 5. Starter motor faulty. 	<ol style="list-style-type: none"> 1. Check batteries. 2. Tighten connections. 3. Check for power at relay during starting sequence. 4. Replace strap. 5. Check for power at starter solenoid.
Engine Cranks but does not Start	<ol style="list-style-type: none"> 1. Clogged air filter. 2. Clogged fuel filter. 3. Run solenoid not operating. 4. Glow plug or glow plug relay. 5. Lift pump faulty. 6. Governor Assembly. 	<ol style="list-style-type: none"> 1. Replace air filter. 2. Replace fuel filter. 3. Check 12V at run solenoid. 4. Check for power at the glow plugs and relay. 5. See fuel system section. 6. See Kohler Service Manual.
Engine Hard to Start	<ol style="list-style-type: none"> 1. Air filter clogged. 2. Fuel. 3. Glow plugs. 4. Injectors clogged. 	<ol style="list-style-type: none"> 1. Replace air filter. 2. See fuel system section. 3. Check for power at the glow plugs. 4. Inspect/service fuel injectors.

SYMPTOM	PROBABLE CAUSE	REMEDY/COMMENT
Engine Cranks Slowly	<ol style="list-style-type: none"> 1. Weak or bad batteries. 2. Damaged/corroded battery connections. 3. Faulty starter. 4. Faulty A/C Compressor. 5. Faulty generator. 6. Belt driven component problem. 	<ol style="list-style-type: none"> 1. Inspect batteries. 2. Replace or clean the battery connections. 3. Check starter connections. 4. Generator seized. 5. Compressor or other belt driven component seized.
Engine Shuts Down	<ol style="list-style-type: none"> 1. Clogged air filter. 2. Clogged fuel filter. 3. Blown fuses. 4. Damaged or loose wiring. 	<ol style="list-style-type: none"> 1. Replace air filter. 2. Replace fuel filter. 3. Replace fuse. 4. Inspect condition of wiring and wiring connections.
Dark Gray/Black Smoke	<ol style="list-style-type: none"> 1. Engine over loaded. 2. Clogged air filter. 	<ol style="list-style-type: none"> 1. Seized belt driven component. 2. Check and/or replace air filter.
Engine Starts and Stalls	<ol style="list-style-type: none"> 1. Speed sensor. 2. Clogged fuel filter. 3. Damaged or loose wiring connections. 4. Excessive load on the engine; generator; alternator; or A/C compressor. 	<ol style="list-style-type: none"> 1. Check speed sensor resistance and gap. 2. Replace fuel filter. 3. Unplug the block heater when using the A/C compressor. 4. Inspect wiring connection and connectors.
White or Blue Smoke	<ol style="list-style-type: none"> 1. Engine oil too full. 2. Coolant in combustion chamber. 	<ol style="list-style-type: none"> 1. Inspect & correct oil level. 2. Possible failed head gasket.
Engine Runs Rough	<ol style="list-style-type: none"> 1. Air filter clogged. 2. Fuel filter clogged. 3. Fuel leak. 4. Worn/clogged fuel injectors. 5. Engine in poor condition. 	<ol style="list-style-type: none"> 1. Check air filter assembly. 2. Replace fuel filter. 3. Inspect all fuel hoses and clamps. 4. Inspect/service injectors. 5. Replace/rebuild the engine.
Loss of Engine Oil	<ol style="list-style-type: none"> 1. Oil seals leaking. 2. Leaking drain plug. 3. Pinched or clogged breather tube. 4. Engine worn or in poor condition. 	<ol style="list-style-type: none"> 1. Replace crankshaft seals. 2. Replace oil pan plug gasket. 3. Repair or replace breather tube. 4. Replace and/or rebuild the engine.

S13.1 Charging System

SYMPTOM	PROBABLE CAUSE	REMEDY/COMMENT
Batteries not Charging	<ol style="list-style-type: none"> 1. Loose or broken belt. 2. Damaged or loose battery connection. 3. Poor battery condition. 4. Faulty alternator. 	<ol style="list-style-type: none"> 1. Tighten or replace belt. 2. Inspect and/or replace battery connections. 3. Test batteries. 4. Check voltage at alternator field coil wire and truck batteries.
Batteries Overcharging	<ol style="list-style-type: none"> 1. Faulty alternator. 	<ol style="list-style-type: none"> 1. Check alternator output.

S13.2 Fuel System

SYMPTOM	PROBABLE CAUSE	REMEDY/COMMENT
Fuel Odor or Leak	<ol style="list-style-type: none"> 1. Loose fuel fittings. 2. Damaged fuel line. 3. Damaged fuel filter. 4. Fuel lift pump leak. 	<ol style="list-style-type: none"> 1. Tighten clamps. 2. Replace fuel hose. 3. Replace fuel filter assembly. 4. Replace lift pump.
No Start Condition (fuel getting to cylinders)	<ol style="list-style-type: none"> 1. Dirty fuel. 2. Clogged fuel filter. 	<ol style="list-style-type: none"> 1. Clean fuel system. 2. Replace fuel filter. (15% bio-diesel only)
Air in Fuel System	<ol style="list-style-type: none"> 1. Worn or crack in fuel line. 2. Lose hose clamps. 3. If pick-up tube was installed in tank, may draw air if fuel too low. 	<ol style="list-style-type: none"> 1. Replace fuel line. 2. Tighten clamps. 3. Add fuel to tank so pick-up tube is submerged.

S13.3 Cooling System

SYMPTOM	PROBABLE CAUSE	REMEDY/COMMENT
Engine Overheating	<ol style="list-style-type: none"> 1. Coolant level low. 2. Engine fan belts loose. 3. Radiator fins blocked. 4. Electric fan. 5. Electrical fan temperature switch. 6. Faulty engine thermostat. 7. Engine overloading. 	<ol style="list-style-type: none"> 1. Add coolant and leak test system. 2. Tighten or replace fan belt. 3. Clean radiator fins. 4. Replace electric fan. 5. Replace switch. 6. Replace thermostat. 7. Seized belt driven component.
Engine Overcooling	<ol style="list-style-type: none"> 1. Check coolant mixture. 2. Faulty engine thermostat. 	<ol style="list-style-type: none"> 1. Replace coolant. 2. Replace engine thermostat.
Coolant Loss	<ol style="list-style-type: none"> 1. System over-filled. 2. External hose leak. 3. Internal hose leak. 4. Failed head gasket. 	<ol style="list-style-type: none"> 1. Check coolant level. 2. Check coolant hoses from main unit to the HVAC box. 3. Check coolant hoses inside the engine compartment. 4. Check/replace head gasket.
Poor Circulation	<ol style="list-style-type: none"> 1. Water pump not operating properly. 2. Cooling system restricted. 	<ol style="list-style-type: none"> 1. Check water pump and belt tension. 2. Check for weak or kinked hoses.

S13.4 HVAC System

SYMPTOM	PROBABLE CAUSE	REMEDY/COMMENT
Poor Air Flow	<ol style="list-style-type: none"> 1. HVAC filter clogged. 2. HVAC air intake obstructed. 3. Excessive duct hose. 4. Poor placement of vent. 5. Faulty blower motor. 6. Ducted through truck's ventilation system. 	<ol style="list-style-type: none"> 1. Clean filter. 2. Remove obstruction. 3. Reduce the hose length. 4. Relocate the vent. 5. Replace blower motor. 6. See Installation Manual for mounting methods.
Little or No Hot Air	<ol style="list-style-type: none"> 1. Insufficient engine load. 2. Low electronic coolant control valve faulty. 3. Low coolant or air lock. 4. Cooling system blocked. 5. Engine overcooling. 	<ol style="list-style-type: none"> 1. Check if main engine block heater is plugged in. 2. Check water valve operation. 3. Bleed system of air and fill. 4. Flush cooling system. 5. Faulty engine thermostat.

SYMPTOM	PROBABLE CAUSE	REMEDY/COMMENT
Little or No Cold Air	<ol style="list-style-type: none"> 1. Cabin Controller not set to A/C mode. 2. No Output power to Pin #2 on connector J1. 3. A/C system leak. 4. Condenser/radiator dirty. 5. Compressor not working. 6. Evaporator core frozen. 7. Electric fan not operating. 8. Electronic coolant control valve faulty. 	<ol style="list-style-type: none"> 1. Set Controller temperature. 2. Check for 12V at A/C clutch control output. 3. Check system pressures. 4. Clean radiator/condenser. 5. Check the compressor and fuse. 6. Replace thermostatic switch. 7. Check fan relay and fuse. 8. Replace electronic coolant control valve.

S13.5 120 Volt Generator System

SYMPTOM	PROBABLE CAUSE	REMEDY/COMMENT
No Power to Receptacles (Bunk and block heater)	<ol style="list-style-type: none"> 1. Breakers tripped. 2. Wiring connections. 3. Faulty capacitor. 4. Internal damage to generator. 	<ol style="list-style-type: none"> 1. Reset breakers. 2. Repair connections. 3. Replace capacitor. 4. Replace generator
Breaker/Breakers Trip Continually	<ol style="list-style-type: none"> 1. Circuit overloaded. 2. Short circuit. 3. Faulty breaker. 	<ol style="list-style-type: none"> 1. Check rating of appliances. 2. Repair short. 3. Replace breaker.

S13.6 Serpentine Drive Belt

SYMPTOM	PROBABLE CAUSE	REMEDY/COMMENT
Belt has Premature Wear	<ol style="list-style-type: none"> 1. Use of incorrect belt. 2. Damage to pulleys. 3. Misalignment of pulleys. 	<ol style="list-style-type: none"> 1. Use correct belt. 2. Replace damaged pulleys. 3. Realign pulleys.
Belt is Loose and/or comes off repeatedly during Operation	<ol style="list-style-type: none"> 1. Use of incorrect belt. 2. Damage to pulleys. 3. Misalignment of pulleys. 4. Maladjusted Belt. 	<ol style="list-style-type: none"> 1. Use correct belt. 2. Replace damaged pulleys. 3. Realign pulleys. 4. Replace belt.
Auto tensioner does not Tension Belt Fully	<ol style="list-style-type: none"> 1. Use of incorrect belt. 2. Belt not seated on pulley properly. 3. Weak tensioner. 	<ol style="list-style-type: none"> 1. Use correct belt. 2. Reinstall belt. 3. Replace tensioner.

For additional diagnostic and troubleshooting information, please visit www.rigmasterpower.com and click on the “Customer Support” heading, “Support Materials” menu option.

S13.7 Digital Speed Sensor

Speed Sensor Module (SSM) – LED Lights

The Speed Sensor is a small plastic box with 4 wires attached to the wiring harness near the Power Module. This Sensor indicates to the Power Module whether the engine is “cranking” or “running”. An L.E.D. light on the side of the sensor indicates which function the sensor is performing.

LIGHT COLOUR	TYPE	DENOTES
Blue	Blinking	Cranking (Note: Begins blinking Blue then changes to Green)
Green	Solid	Running
Red	Solid	Problem with Voltage in Red/Orange wire from alternator

The Speed Sensor interprets the voltage in the Red/Orange wire that is connected to the back of the alternator and the Sensor tells the Power Module if the engine is cranking or running by producing an AC voltage in the Green/Yellow wire. The voltage on the Red/Orange wire must rise from 0.5 DC volts when cranking to approximately 13.5 DC volts when running. The voltage on the Green/Yellow wire will change from 0.05 AC volts to about 5 AC volts when running.

NOTE
Alternator must function for the speed sensing system to work. Alternator and belt problems will affect the Speed Sensor’s operation. Please ensure the belt is tensioned properly and not slipping.

SYMPTOM	REMEDY/CAUSE	REMEDY/COMMENT
Engine runs for 10 seconds with the starter motor engaged then shuts down.	Check volts on Red/Orange wire at speed sensor.	<ul style="list-style-type: none"> • Possible connection issue. • Slipping Alternator Belt. • Failing Alternator.
Engine cranks for a split second and stops.	Low battery volts possibly due to extremely cold climate.	<ul style="list-style-type: none"> • Possible connection problem. • Speed sensor failure.
Engine starts and runs for 2 seconds then stops with no LED’s illuminated.	White wire connection at Speed Sensor.	<ul style="list-style-type: none"> • Check wire connections.
Engine cranks sporadically.	Power module ground interruption.	<ul style="list-style-type: none"> • Check ground.

NOTE
Alternator must provide a ‘RISE’ in voltage on the Red/Orange wire during the starting process; simply “jumping” battery voltage into the Red/Orange wire does not produce “running” signal.

S13.8 Fault Codes

The APU’s electronic control will display fault codes on the LCD display if the unit fails to start or shuts down. The following table contains fault codes and information on the cause and/or remedy. These fault codes will display one time only; if the code is cleared from the cabin controller, failure will have to reoccur for the code to be displayed again. For further troubleshooting and diagnostic information see Section 13 – Troubleshooting for more explanation, tests, and remedies.

CODE	REMEDY/CAUSE	REMEDY/COMMENT
Error Code 1 Safety Cover Open	Engine cover of APU unit is open. APU will not start or run until the cover is closed.	<ul style="list-style-type: none"> • Cover not seated. • Damaged wiring. • Failed cover switch. • Switch out of adjustment.
Error Code 2 Low Oil Pressure	Low oil pressure.	<ul style="list-style-type: none"> • Low oil level. • Wiring damaged. • Faulty switch. • Dirty oil filter.
Error Code 3 Battery Low Voltage	Low battery voltage. Start system immediately to charge batteries.	<ul style="list-style-type: none"> • Damaged or broken battery cables; failed battery. • Excessive load on batteries. • Faulty charging system.
Error Code 4 Engine Run Failure	Engine may have started but didn’t run properly. “AutoStart” is disengaged; attempt manual starting with START button.	<ul style="list-style-type: none"> • Speed sensor adjustment (set air gap at 0.015”). • Damaged speed sensor wiring. • Failed speed sensor.
Error Code 5 Low Coolant/ Engine Overheated	Engine will not run until temperature becomes normal or coolant level is at full in surge tank.	<ul style="list-style-type: none"> • Low coolant or failed coolant level switch. • High engine temperature or failed engine temperature sensor (top of water pump, has single wire). • Damaged wire providing ground.
Error Code 6 Module Failure	Power Module is not responding.	<ul style="list-style-type: none"> • Failed power module.

CODE	REMEDY/CAUSE	REMEDY/COMMENT
<p>Error Code 7</p> <p>Engine Start Failure</p>	<p>Engine did not start. "AutoStart" is disabled until operator presses <i>Select</i> button.</p>	<ul style="list-style-type: none"> • Bad glow plugs or relay. • Bad starter relay. • Failed glow plug. • Possible speed sensor issue.
<p>Error Code 8</p> <p>No Communication Error</p>	<p>No communication between control panel and power module. Re-establish communication.</p>	<ul style="list-style-type: none"> • "Cat5e" communication cable possibly damaged (commonly available). • Poor connection at terminal; try plugging in a few times.
<p>Error Code 9</p> <p>Main Engine Running</p>	<p>APU will not run if the Truck's main engine is already running. This feature is "optional".</p>	<ul style="list-style-type: none"> • If a "switched 12 volt DC wire" is connected to the J4, Pin #4 (red) wire at the power module, the APU will not run. This is "optional".
<p>Error Code 10</p> <p>Run Timeout</p>	<p>APU shuts down at three (3) hours of running when the "AutoStart" Time/Day Setting is used.</p>	<ul style="list-style-type: none"> • Engine will only run for three (3) hours when set on AutoStart Time/Day.
<p>Error Code 11</p> <p>Check Power Module Fuse</p>	<p>Very low battery voltage detected at the power module.</p>	<ul style="list-style-type: none"> • Check 20 Amp. fuse and J1 connector at the power module (located under the bunk on the HVAC unit).
<p>Error Code 12</p> <p>Battery Charging Failure</p>	<p>Battery voltage still low two (2) minutes after cranking. Auto and manual starts can occur.</p>	<ul style="list-style-type: none"> • Faulty charging system; failed batteries; poor connection. • Engine harness ground wires disconnected at the HVAC unit.
<p>Error Code 13</p> <p>Battery Discharge</p>	<p>Alarm system will enter low power mode. No starting options given.</p>	<ul style="list-style-type: none"> • Failed batteries or connection. • Possible poor connection at power module.
<p>Error Code 14</p> <p>Check External Temperature Sensor</p>	<p>External temp. sensor may not be connected to the power module.</p>	<ul style="list-style-type: none"> • External temperature sensor disconnected or failed. • Connection loose or damaged.

CODE	REMEDY/CAUSE	REMEDY/COMMENT
<p>Error Code 15</p> <p>External Temp Disable Limit</p>	<p>Engine shut down due to external temperature outside the programmed range.</p>	<ul style="list-style-type: none"> The APU has been programmed not to start when the external temperature is outside a preprogrammed range.
<p>Error Code 16</p> <p>Module Reset – Set Clock</p>	<p>Power to the cabin controller has been lost.</p>	<ul style="list-style-type: none"> Reset clock.
<p>Error Code 17</p> <p>Service Exhaust Filter (for unit equipped with Diesel Particulate Filters)</p>	<p>Service exhaust filter if unit is DPF equipped; if not DPF equipped, then power module failure likely.</p>	<ul style="list-style-type: none"> See authorized Dealer for exhaust filter servicing or power module diagnosis/replacement.
<p>Error Code 18</p> <p>Replace Exhaust Filter (for unit equipped with Diesel Particulate Filters)</p>	<p>Replace exhaust filter if unit is DPF equipped; if not DPF equipped, then power module failure likely.</p>	<ul style="list-style-type: none"> See authorized Dealer for exhaust filter replacement or power module diagnosis/replacement.
<p>Error Code 19</p> <p>Please Register Unit</p>	<p>Unit will run for four (4) hours after installation. Registration code must be entered into the cabin controller display keypad.</p>	<ul style="list-style-type: none"> To obtain registration code, please call the APU Manufacturer (1-800-249-6222) with the serial # of your unit. There is no charge for this service.
<p>Error Code 20</p> <p>Water Valve Overcurrent</p>	<p>Electronic coolant control valve drawing excess amperage.</p>	<ul style="list-style-type: none"> Unplug J2 connector, turn POWER ON again. Code should not display when J2 is unplugged.
<p>Error Code 21</p> <p>GP Overcurrent</p>	<p>Glow plug relay drawing excess amperage.</p>	<ul style="list-style-type: none"> Glow plug relay operation is faulty or wire broken.

CODE	REMEDY/CAUSE	REMEDY/COMMENT
Error Code 22 Run or GP Overcurrent	Run solenoid or glow plug relay drawing excess amperage.	<ul style="list-style-type: none"> Unplug run solenoid; power with jumper wire; attempt again. If code returns, glow plug relay problem.
Error Code 23 Run Overcurrent	Run solenoid is drawing excess amperage.	<ul style="list-style-type: none"> Unplug run solenoid; power with jumper wire; attempt again; measure Amps. If code returns, broken wire.
Error Code 24 Start or Run Overcurrent	Starter relay or run solenoid drawing excess current.	<ul style="list-style-type: none"> Unplug run solenoid; power with jumper wire; attempt again. If code returns, starter relay problem.
Error Code 25 AC or Run Overcurrent	A/C clutch or run solenoid drawing excess current.	<ul style="list-style-type: none"> Unplug run solenoid; power with jumper wire; attempt again. If code returns, A/C clutch problem.
Error Code 26 BH Overcurrent	Phantom Code – block heater is not operated by power module output. (no output on J1 Pin #7).	<ul style="list-style-type: none"> May indicate damage to power module circuit board. Possible solution: Unplug J1 connector for 30 seconds.
Error Code 27 Power down to clear overcurrent	Power must be turned off with the power button then turned back on.	<ul style="list-style-type: none"> This message appears if engine start is attempted without turning POWER OFF. Turn power OFF then ON.
Error Code 28 Output Overcurrent	A power module output circuit sees a rise in amperage while trying to activate an electronic component. Output circuit shuts off to protect itself.	<ul style="list-style-type: none"> Similar to a circuit breaker function; caused by a stuck or failed relay, solenoid or servo. Power OFF with controller for a minute and function will return. Test each power module output circuit for amperage draw.

S13.9 Additional Information for E28 Error Code Troubleshooting

The E28 Error Code is similar to a circuit breaker function. It protects the power module power outputs in the case of a large current draw from an electrical component that it is attempting to activate. E28 would also display if an output wire is shorted. The appearance of the E28 Code on the Cabin Controller display will coincide with the activation of the problem circuit.

Note: Power Modules from late 2011 (p/n RP50-250, version 1.26) onwards will indicate the E28 Error Code problem circuit on the LCD display screen; previous versions will not.

E28 CODE when Turning Power ON:

When the APU is powered ON, the power module checks the position of the “water valve” (on the side of the HVAC box under the bunk – hoses with hot coolant connect to it). It does this by rotating the valve and reading its position. If an E28 code appears during this process, it indicates a higher current in one of the circuits moving the valve which is likely binding or seized.

To diagnose:

- Put a mark on the white plastic rotor of the valve and observe its movement.
- Unplug the water valve (J2 connector on power module) and turn power ON.

E28 CODE when Attempting to Start Engine:

1. Power module activates the glow plug relay and then counts down.
2. Activation of the “run” or “fuel solenoid”. It produces a pronounced “Click” when it activates (which allows fuel delivery).
3. Power module activates the starter relay to crank the engine.

Diagnostic Notes:

The relays are positioned from left to right as follows:

1. Glow Plugs Relay
2. Starter Relay
3. Electric Fan Relay (activated by selecting Air. Cond.)
4. Another Electric Fan Relay (activated by selecting Air. Cond.)
5. Engine Temp. Electric Fan Relay.

These relays are identical and may be swapped to aid diagnosis.

The run solenoid does not have a relay – it is wired directly to the power module.

Unplug the “run” solenoid (or “fuel” solenoid) and put 12 volts directly to it to activate it.

If a jumper wire activates the solenoid it could mean that a connection may be loose between the power module and the solenoid, or the run solenoid may be failing or sticking.

The problem may not be limited to only these components.

Note: The power module will crank the engine three (3) separate times while attempting the starting sequence. If the run solenoid is powered directly and the engine starts and runs in this state, the power module may still engage the starter two (2) more times. The run solenoid should only be jumped on the last cranking attempt to avoid possible damage to the starter motor.



MTS-T4-6 Service Manual

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