
Error Code 1 – Safety Cover Open
Error Code 2 – Low Oil Pressure
Error Code 3 – Battery Voltage Low
Error Code 4 – Engine Run Failure
Error Code 5 – Low Coolant/Engine Overheat
Error Code 6 – Module Failure
Error Code 7 – Engine Start Failure
Error Code 8 – No Communications Error
Error Code 9 – Main Engine Running
Error Code 10 – Run Timeout
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Engine Starting – No Engine Cranking
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Engine Systems – Engine Smokes
Charging System
HVAC – Poor or No Heat
HVAC – Poor or No AC
HVAC – Poor or No Air Flow
Generator

Step 1	Inspect the cover and ensure the cover is not bent or warped	If the cover is not bent or warped proceed to Step 2.	If the cover is bent or warped, replace the cover and retest.
Step 2	Inspect the door switch for damage and/or improper adjustment.	If the door switch is ok, proceed to Step 3.	<p>If the switch is damaged, replace the switch.</p> <p>If the switch is out of adjustment, loosen the bolts and readjust the switch.</p> <p>Note: If the tab on the switch is bent you can re-bend it back. Take care to support the switch so as not to snap the tab off.</p>
Step 3	Check the connector to the switch for 5V reference signal from the power module.	If 5V reference is present proceed to Step 4.	If no 5V reference signal is present at the connector to the switch proceed to Step 6.
Step 4	Connect a DMM to the switch and input and ground. Do a continuity check while operating the cover switch.	If the continuity of the switch to ground is good proceed to Step 5.	If the continuity to ground through the cover switch is open or high resistance, check the ground connection for the switch. If the ground connection is ok, replace the switch.
Step 5	Short the 5V reference wire from the power module to a good ground and retest.	If the module no longer registers an open cover, replace the switch.	If the module still registers an open cover, back probe a jumper wire to pin 2 on connector J4 at the power module to a good ground. If the module no longer registers an error code 1- safety cover open, repair the wire from J4, pin 2 of the module to the switch. If the module still registers an error code 1 – safety cover open, the module has an internal fault, replace the power module.

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Error Code 1 Safety Cover Open

Step 6	Check for a 5V reference signal from connector J4, pin 2 at the power module.	If a 5V reference signal is present at connector J4, Pin 2 at the module, repair the wire from J4 to the switch.	If no power is present at connector J4, pin 2 of the power module, replace the power module.
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NOTE

The most common cause of error code 2 – Low Oil Pressure is from engine stalling. When the engine stalls out, the power module will register the first fault that occurs. If you have an issue of the engine shutting down and the error code displayed varies between error code 2 and error code 4, the most likely cause is an engine stalling out or severely bogging do to overloading and, depending on whether the speed sensor or oil pressure sensor registers a fault first, issues one of the two error codes repeatedly. Check if the engine only shuts down or stalls out when a particular component, such as the ac compressor runs, and inspect that component for engine overloading.

Procedure

<p>Step 1</p>	<p>Check to the engine oil level. Ensure that the crankcase oil level is correct.</p> <p>14-6 and T4-6 Models Total capacity 3 qt (3 L)</p> <p>All older models Total capacity 2 qt (2 L)</p>	<p>If the engine oil level is correct proceed to Step 2.</p>	<p>If the engine oil level is incorrect, fill the crankcase to the full mark on the dip stick and retest. If the engine operates correctly, inspect the engine for oil leaks or oil consumption.</p> <p>If the engine still shuts down for error code 2, then proceed to Step 2.</p>
<p>Step 2</p>	<p>Disconnect the green wire from the oil pressure sending unit. Connect a suitable DMM and to the wire to the oil pressure sending unit and check for voltage to ground and compare with the spec.</p> <p>Specification: 11.70 – 12.6 VDC</p>	<p>If the voltage on the oil pressure circuit is correct, proceed to Step 3.</p>	<p>If the voltage on the oil pressure circuit is not within specification, proceed to Step 4.</p>
<p>Step 3</p>	<p>Connect an ammeter to the oil pressure sending unit and a jumper wire from the B+ terminal in the back of the APU. Measure the amperage through the sensor with no oil pressure and compare to spec.</p> <p>Spec: 0.30 to 0.42A</p>	<p>If the amperage draw through the oil pressure sending unit is within spec, inspect the oil pressure switch signal wire for shorts to ground. Repair the wire on the low oil pressure circuit.</p>	<p>If the amperage draw is out of spec, replace the oil pressure sending unit.</p>

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Error Code 2 Low Oil Pressure

Step 4	Check for voltage at the J4 connector, pin 1 to ground and compare to spec. Specification: 11.70 – 12.6 VDC	If there is a correct voltage signal at connector J4, pin 1 then repair the wire from J4 to the oil pressure sending unit. If there is no problem found with the low oil pressure circuit, check the engine for stalling due to overloading or lack of fuel/air.	If no voltage is present at connector J4, pin 1 then replace the power module.
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NOTE

This error code sets when the batteries have discharged to 12.0V. This code will only appear if the controller is turn on when the batteries are low. At no other time will this code appear as the AutoStart function for low batteries should activate. If the APU does not start or the alternator does not charge an error code 7 or an error code 12 would appear. If the controller is powered up and this code appears, start the APU to charge the batteries.

NOTE

Error code 4 – Engine Run Failure deals specifically with a loss of RPM signal. A stalling engine can trigger an error code 4. When investigating an error code 4, ensure the engine is operating correctly.

Procedure

Step 1	Remove the air filter canister and inspect the air filter element. Ensure that the engine is not stalling due to lack of air.	If the engine air filter is ok, proceed to step 2.	If the engine air filter is plugged, replace the air filter and retest. If the engine still shuts down for code 4 proceed to Step 2.
Step 2	Inspect the speed sensor gap and ensure the sensor has not gone out of adjustment. Gap: 0.015" – 0.020"	If the sensor gap is within spec, proceed to step 3	If the sensor gap is out of spec, re-gap the sensor and test again.
Step 3	Disconnect the J4 connector and check circuit continuity from pin3 to pin 7 and compare with spec. Spec: 625Ω ± 75	If the circuit is within specification, inspect the wiring harness for shorts or corrosion that can interfere with the RPM signal. This is most often the cause of an intermittent code 4. If no fault found with the circuit or the sensor, replace the power module.	If the circuit is out of specification proceed to step 4.
Step 4	Disconnect the speed sensor from the harness and perform a continuity check of the sensor itself and compare with spec. Spec: 625Ω ± 75	If the sensor is within spec, repair any damaged wire between the power module and the speed sensor.	If the sensor is out of specification, replace the speed sensor and properly gap the sensor to spec. Gap: 0.015" - 0.020"

CAUTION

Personal Injury can result from hot coolant, steam. At or above operating temperatures, the engine coolant is under pressure. The radiator and all lines to the heaters or the engine contain hot coolant or steam. Any contact can cause severe burns.

Remove the filler cap slowly to relieve system pressure only when the engine is stopped and the radiator cap is cool enough to touch with your bare hand.

NOTE

The low coolant float sensor is tied in with the engine overheat shutdown sensor. Either of these sensors can set off an error code 5.

Operating the engine without the cover on can result in potential engine overheating due to lack of air flow through the radiator. Operate the electric cooling fan either by running the air conditioning system or jumping the fan to B+ to maintain radiator cooling with the cover off.

Procedure

Step 1	Check the coolant level in the overflow tank. Ensure there is enough coolant to raise the float sensor to open the circuit.	If the engine coolant in the overflow bottle is enough to raise and open the float sensor, proceed to Step 2.	If the coolant level in the overflow bottle is insufficient to raise and open the float sensor, top up the level and test again.
Step 2	With the engine cold and stopped, remove the radiator cap and check the coolant level in the radiator.	If the coolant level in the radiator is ok, proceed to Step 4.	If the coolant level in the radiator is low, top up the radiator and proceed to Step 3.
Step 3	Perform a visual inspection of the cooling system for any external leaks.	If no leaks are found through a visual inspection, proceed to Step 4.	If any leaks are found, repair the leaks in the cooling system and proceed to Step 4.
Step 4	Attempt to start the engine when cold. Does the error code 5 prevent the cold engine from starting?	If no error code 5 appears and the engine starts, run the engine up to operating temperature and proceed to Step 5.	If error code 5 resets and prevents the cold engine from starting, proceed to Step 7.
Step 5	Operate the air conditioning system and check for condenser fan operation.	If the electric cooling fan for the condenser is comes on, proceed to Step 6.	If the electric fan for the condenser does not operate, replace the electric fan and proceed to Step 6.

<p>Step 6</p>	<p>Observe the engine operation. Does the engine overheat and set error code 5?</p>	<p>If the engine does not overheat and the electric condenser fan was replaced, the cause of the overheating was due to the condenser fan failure.</p> <p>If the engine does not overheat and the electric condenser fan was not replaced, inspect the wiring for the engine overheat circuit for intermittent shorts to ground.</p>	<p>If the engine does overheat, refer to the engine cooling system troubleshooting guide.</p>
<p>Step 7</p>	<p>Disconnect the low coolant float sensor and test the sensor for continuity. The sensor should be open with the float raised.</p>	<p>If the float sensor is open circuit with the float raised, proceed to Step 8.</p>	<p>If the float sensor show continuity with the float raised, the sensor is shorted to ground. Replace the low coolant sensor.</p>
<p>Step 8</p>	<p>Disconnect the overheat sensor on the top of the water pump. Check the resistance of the coolant temperature sensor at room temperature and compare to spec.</p> <p>Spec: $54 \pm 2\Omega$</p>	<p>If the engine overheat sensor is within spec, test and inspect the wiring for the engine overheat circuit for a short to ground. Repair the wiring for the low coolant/overheat circuit.</p>	<p>If the sensor is out of specification, replace the engine overheat sensor.</p>

Procedure

Step 1	Power module has an internal failure. Replace the power module.		
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NOTE

Refer to the troubleshooting guide for the engine starting system.

NOTE

Vehicles using satellite tracking can interfere with the data communications between the controller and the module. If the satellite data cable is routed too close to the data cable for the power module, the high frequency signals can generate EMI that can interfere or generate false signals in the APU communications cable.

Procedure

Step 1	Inspect the data cable between the power module and the cabin controller. Ensure a good connection between the controller and the module. Inspect the cable for kinks, breaks or damage that can cause loss of communications.	If no problem is found with the data cable, proceed to step 2.	If the cable is damaged, replace the data cable and retest.
Step 2	Replace the controller and test again.	If communications with the power module resumes, the fault lay in the cabin controller.	If communications error is still present, replace the power module.

NOTE

This is an information code. This code sets when the RigMaster is running and the main engine is started or the RigMaster is manually started while the main engine is running. There is no fault with the system.

NOTE

Error code 10 – Engine Run Timeout is an information code and may not necessarily be an indication of a fault or problem. The AutoStart function has a default run timer set at maximum 3 hours of operation. If, for example, the APU started for temperature AutoStart but could not achieve the set temperature within the 3 hour time limit, the APU would shut down once the timer ran 3 hours and set error code 10. The timer for AutoStart running is adjustable. See programming option instructions for the controller.

Procedure

Step 1	Disconnect connector J1 and power down the power module. Remove and inspect the 20A fuse in the top of the power module.	If the fuse is good, reconnect the J1 connector, reboot the power module and retest. If the code resets then replace the power module as there is an intermittent internal fault on the circuit.	If the fuse is blown open, replace the fuse and retest. Check and test all circuits for a potential short to ground.
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NOTE

This code sets if any time after 2 minutes off running the battery voltage drops down to a set point of 11.5V. The following can be causes of this code;

- Bad batteries
- Loose or corroded battery cables preventing charging
- Damaged or missing engine ground cable
- Missing or disconnected ground wires to the HVAC box
- Failed Alternator.

Use the troubleshooting guide for charging systems to diagnose the cause of error code 12.

NOTE

This code sets if at any time the batteries discharge to a voltage of 11V. This is an indication of bad batteries and the system will enter into low power mode. Neither manual nor AutoStarts may occur until battery voltage is above 12V. Charge and test all batteries. Replace any failed batteries that are bad and restart the system.

Check External Temperature Sensor

Step 1	Check the external temperature sensor and ensure the sensor is plugged in.	If the sensor is still connected then replace the sensor. If the code still appears after sensor replacement, there is a fault with the power module. Replace the power module.	If the sensor has come unplugged, reconnect the sensor and retest.
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NOTE

Error Code 15 – External Temp Disable Limit is an information code and does not indicate a fault in the system. The APU has a programming option that is by default disabled that when active allows the user to set a temperature range under which the APU will not run. When the external temperature sensor reports the external ambient temperature within the programmed range the APU either will shut down if running or will not start up and flash Error Code 15.

NOTE

This error code is an informational code only and may not indicate a problem or fault with the system. This code appears when the power module has been unplugged or the batteries have been disconnected and then the power module is powered back up. The module reboots and flashes error code 16. Clear the code and reset the clock. If power loss was not intended then inspect the power circuit for damaged or loose wires and cables.

Note

Always check the batteries to ensure they are fully charged and in good condition. Weak or poor batteries can cause poor starting. Internal shorts in the motor can cause slow starting.

Procedure

<p>Step 1</p>	<p>Check the batteries for proper charge. If batteries are undercharged, recharge and test the batteries prior to testing the charging unit. .</p> <p>Note: Follow the testing procedure for the batteries in the manual supplied by the OEM manufacturer.</p>	<p>If the batteries test ok and are fully charged proceed to step 2.</p>	<p>If the batteries will not charge or, do not pass a battery test, replace any bad or weak batteries in the pack. Clean any/all corrosion from battery connections and ensure all battery cables are tight and secure. Replace any damaged battery cables and retest the batteries.</p>
<p>Step 2</p>	<p>Check the 100A Bussman fuse in the battery box.</p>	<p>If the Bussman fuse is ok proceed to Step 3</p>	<p>If the Bussman fuse is blown, inspect the battery cable for any potential shorts to ground. If no problem is found with the B+ cable to the APU, replace the Bussman fuse and proceed to Step 4.</p>
<p>Step 3</p>	<p>Activate the start sequence and observe the stare solenoid operation.</p>	<p>If the starter solenoid is operational proceed to Step 5.</p>	<p>If the starter solenoid is not operational, proceed to Step 6.</p>
<p>Step 4</p>	<p>Check the starter for proper operation.</p>	<p>If the starter works correctly, no further repairs required.</p>	<p>If the starter opens the Bussman fuse again, check for the following conditions that can be the cause of high engine load during cranking:</p> <p>Seized compressor, generator or alternator bearings. Too high an oil viscosity being used for the outside temperatures. Internal short in the starter or starting circuit. Possible seized engine.</p>

<p>Step 5</p>	<p>Check for B+ to the starter motor on the battery cable.</p>	<p>If the battery cable to the starter motor has B+ voltage then check if the engine can turn over by hand. If the engine can turn then replace the starter motor. If the engine will not turn over by hand check for the following.</p> <ul style="list-style-type: none"> • Seized component bearings • Hydraulic cylinder lock from recent service • Seized engine 	<p>If there is no B+ Voltage to the starter motor inspect all the B+ battery cables and connections for broken, corroded or poor connections.</p> <p>Inspect the ground cable for the engine.</p>
<p>Step 6</p>	<p>Check for B+ voltage from the starter relay on the green wire to the solenoid.</p>	<p>If B+ from the relay is present, the solenoid is faulty. Replace the starter motor.</p>	<p>If there is no B+ voltage from the starter relay proceed to Step 7.</p>
<p>Step 7</p>	<p>Remove the starter relay from the relay base. Connect a multi meter to pin 5 of the base to pin 2 and initiate the start sequence. When the power module cranks does the meter show B+.</p>	<p>If B+ is present on pin 5 to pin 2 of the relay base during cranking, check pin 1 to pin 2 for B+ from the battery. If no power is present, check the wire from the B+ terminal to the relay. If pin 1 has B+ then ohms test the wire on pin 5 to the starter solenoid. If the wire has greater than 0.01Ω resistance, repair the wire. If the wire is within spec, replace the relay.</p>	<p>If there is no B+ on pin 5 from the power module to pin 2 of the relay base, ohms test the ground wire on pin 2. If higher than 0.01Ω repair the ground wire. If the wire is within spec proceed to Step 8.</p>
<p>Step 8</p>	<p>Connect a multi meter to J1, pin 8 and check for B+ at the power module during cranking.</p>	<p>If power is present on J1, pin 8; repair the wire from the power module to the relay base.</p>	<p>If no power is present on J1, pin 8; replace the power module.</p>

Note

Always check the batteries to ensure they are fully charged and in good condition. Weak or poor batteries can cause poor starting. Ensure the air filter and fuel filter are in proper condition.

Procedure

<p>Step 1</p>	<p>Inspect the glow plugs for proper operation. Connect a test light and check for B+ power from the glow plug relay during the glow plug cycle.</p>	<p>If power is present from the glow plug relay proceed to Step 2.</p>	<p>If no power is present at the glow plugs from the glow plug relay proceed to Step X.</p>
<p>Step 2</p>	<p>Using a suitable ohm meter, ohm test each glow plug and compare with the specification. Spec: 1.0 Ω</p>	<p>If both glow plugs are within specification, proceed to Step 3.</p>	<p>If either glow plug is out of specification, replace the bad glow plug and retest.</p>
<p>Step 3</p>	<p>Check for fuel distribution to the injectors. Loosen both injector nuts and check for fuel delivery to the injectors from the injection pump.</p>	<p>If fuel is being sent to the injectors from the injection pump proceed to Step 4.</p>	<p>If little or no fuel is being sent to the injection pump proceed to Step 5.</p>
<p>Step 4</p>	<p>Perform a compression test following the procedure in section 5B (Basic Engine Repair) Ensure the engine air filter is in suitable condition for the test. Replace any excessively dirty or plugged air filters before testing following the procedure in the service manual.</p>	<p>If the compression on both cylinders is within specifications, the most likely cause of the non starting is poor fuel quality. Inspect the diesel fuel following the procedure in section 5A (General Engine Diagnosis)</p>	<p>If the compression on either cylinder is below spec or the difference between cylinders is greater than 51 psi, the engine is in need of repair. Have an authorized service technician inspect the engine for the cause of low compression.</p>
<p>Step 5</p>	<p>Remove the fuel/run solenoid and connect a 12V battery to the terminal and a jumper wire from the body to ground.</p>	<p>If the plunger on the solenoid retracts fully, the solenoid is operational, proceed to Step 6.</p>	<p>If the solenoid does not fully retract the plunger replace the run solenoid.</p>

Step 6	<p>Open the right side bleeder screw on the fuel filter assembly and operate the priming pump lever.</p> <p>Note: It may be necessary to turn the engine over by hand to unload the piston in the lift pump to draw fuel from the tank.</p>	<p>If the lift pump is delivering fuel to the fuel bowl, inspect the fuel filter. Replace the filter if clogged or restricted and retest the fuel system. If the injection pump still does not deliver fuel to the injectors then proceed to Step 7.</p>	<p>If there is no fuel at the bleed screw from the priming lift pump, then inspect for:</p> <p>Faulty fuel tank vent. Collapsed or leaking fuel supply lines. Collapsed or block return lines. Faulty fuel check valve. Faulty lift pump.</p>
Step 7	<p>Insert a screw driver into the port for the fuel/run solenoid and press against the armature attached to the injection pump. Check for return spring action on the armature.</p>	<p>If there is return spring action on the injection pump armature, the governor throttle spring is in working order. The fault is within the injection pump. The pump requires inspection/replacement by and authorized technician.</p>	<p>If there is no spring action on the armature, the governor throttle spring has broken. Follow the replacement procedure in the Service Manual</p>

Note

Always check the batteries to ensure they are fully charged and in good condition. Weak or poor batteries can cause poor starting. Ensure the air filter and fuel filter are in proper condition.

Procedure

Step 1	Inspect the batteries for poor/loose connections or corrosion. Check the charge of the batteries and test batteries following the procedures outlined by the OEM manufacturer.	If the batteries and all cable connections are good proceed to Step 2.	If any cables are excessively corroded or damaged, replace the cables and ensure tight secure connections. Replace any bad batteries that fail and retest.
Step 2	Remove the belts from the engine and inspect for seized components such as compressor pulley, generator or alternator.	If no engine components are seized, check if the engine may be seized. If not replace the starter motor.	If any components are found to be seized and overloading the engine, replace the failed component and retest.

NOTE

Thoroughly inspect the cooling system prior to testing the system. Above normal coolant temperatures can be caused by many of the following conditions:

- Low coolant levels in the cooling system can allow air to enter the cooling system. Air in the cooling system causes a reduction in coolant flow and bubbles which can prevent the transfer of heat from hot engine parts to the coolant. Low coolant levels are caused by leaks or improper filling of the overflow tank.
 - Contamination of the coolant
 - Air in the cooling system. Air can enter the cooling system in many different ways. The most common causes of air in the cooling system are not filling the cooling system correctly and combustion gases leaking into the system through a damaged cylinder head or head gasket, or through inside cracks.
 - Check the engine overheat sensor or low coolant sensor. A fault in either sensor can shut the engine down for overheating. A short to ground in the wiring can cause a shut down for engine overheating (See Troubleshooting Guide for Error Code 5).
 - Check the radiator for debris, dirt or obstructions to air flow. Damaged or missing fins from the core. Check the radiator for restrictions to coolant flow through the radiator.
 - Check the electric cooling fan for proper operation.
 - Check the filler cap. A weak filler cap can cause a drop in system pressure resulting in a lower boiling point for the cooling system.
 - Check the engine fan and fan shroud. Ensure the shroud is in place and the fan has no broken or missing fan blades.
 - Check the cover and weather stripping. A loose cover or missing weather stripping can allow air to enter or escape without going through the radiator and thus reduce cooling efficiency.
 - Check the fan belt. A loose fan belt can allow the water pump to rotate slower causing lower coolant flow through the engine. Ensure the fan belt is tightened to 90-110 lb/ft for a new belt, or 60-80 lb/ft for a used belt.
 - Check all the cooling system hoses and clamps. Loose clamps can allow coolant to leak out and damaged hoses with leaks can normally be seen. Hoses that have no visible leaks can soften during operation. Soft hoses can become kinked or crushed restricting flow. Soft or cracked hoses that are damaged on the inside can cause loose particles that can cause a restriction to flow.
 - Check for a restriction in the air intake system. A restriction to air into the engine can cause the engine to run lean allowing higher than normal combustion temperatures.
 - Check for a restriction in the exhaust system. An exhaust restriction can cause higher than normal combustion temperatures.
 - Check the operation of the coolant thermostat. A thermostat that does not open or only opens part way can cause engine overheating.
 - Check the water pump. A water pump with a damaged or worn impeller causes reduced coolant flow.
 - Consider ambient operating temperatures for the cooling system. The maximum temperature of the ambient air entering the engine is 50° C (120° F).
 - Excessive engine loads applied to the engine can prevent the engine RPMs from increasing with the increase in fuel. This reduces the coolant flow causing overheating.
 - Timing of the engine. An engine with late timing of the injection pump can result in an increase in heat in the engine. Early timing of the injection pump can result in a decrease in heat in the engine.
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NOTE

If the timing of the engine is incorrect, the exhaust valves may be burned and damage may occur to the exhaust manifold.

CAUTION

Personal Injury can result from hot coolant, steam. At or above operating temperatures, the engine coolant is under pressure. The radiator and all lines to the heaters or the engine contain hot coolant or steam. Any contact can cause severe burns.

Remove the filler cap slowly to relieve system pressure only when the engine is stopped and the radiator cap is cool enough to touch with your bare hand.

Procedure

<p>Step 1</p>	<p>Inspect the coolant level in both the overflow bottle and radiator.</p>	<p>If the coolant level is ok, proceed to Step 2.</p> <p>If the level is low, top up the coolant first then proceed to Step 2.</p>	
<p>Step 2</p>	<p>Completely inspect the cooling system for any signs of visible leaks. Inspect all hoses for damage or softness. Check all hose clamps and ensure they are tight. Inspect the radiator for restrictions to air flow and or any damaged or missing fins.</p>	<p>If no damage or leaks are found, proceed to step 3.</p>	<p>If damage or leaks are found, repair the damage first then test the cooling system.</p> <p>Note: A small hole in the water pump is provided to allow for coolant to seep and lubricate the gaskets. This coolant seepage is not an indication of a water pump failure.</p>
<p>Step 3</p>	<p>Ensure the condenser fan is operational.</p>	<p>If the electric condenser fan is operational proceed to Step 4.</p>	<p>If the electric condenser fan is inoperable, replace the condenser fan.</p>
<p>Step 4</p>	<p>Connect a suitable coolant pressure tester to the radiator. Pressurize the cooling system to 16 lbs and inspect for any external leaks for 5 minutes.</p>	<p>If the system shows no signs of leakage and the pressure on the dial gauge does not drop the radiator has no leak. Proceed to Step 5.</p>	<p>If the system shows signs of external leaks, repair the cooling system and retest.</p> <p>If the system shows no signs of external coolant leaks but the system pressure on the dial</p>

			gauge drops after 5 minutes, the system may have an internal coolant leak. The engine needs to be checked by a manufacturer authorized dealer.
Step 5	Inspect the coolant cap carefully. Look for any damage to the filler cap seal, damage to the sealing surface, and for any debris or dirt that can interfere with the caps operation.	If the filler cap is ok proceed to Step 6.	If the cap shows signs of damage to the seal, replace the cap. If there is damage to the sealing surface on the neck of the radiator, replace the radiator.
Step 6	Connect a suitable pressurizing pump to the filler cap and pressurize the cap till it opens. Note the pressure at which the cap opens and compare with the spec. Spec: 13lbs	If the cap opens according to the pressure spec, the radiator cap is ok. Proceed to Step 7.	If the cap opens before the specified pressure spec, replace the radiator cap and retest the system.
Step 7	Remove the thermostat. Heat a pot of water to between 87°C (189°F). Place the thermostat completely into the heated water and wait ten minutes.	If after 10 minutes the thermostat is fully open there is no fault in the cooling system. Inspect the engine for overloading. Inspect all components and ensure no seized bearings are adding additional loads to the engine. Ensure that the generator and air conditioning system are not overloading the engine together at the same time. Inspect the air inlet and exhaust outlets for restrictions. Check the injection pump for correct timing.	If the thermostat does not open after ten minutes at 87°C (189°F) the engine thermostat is faulty. Replace the engine thermostat.

NOTE

Engine stalling will set a low oil pressure error code instead of a run failure error code. Check for causes of engine stalling if there is no fault found with the lubrication system.

Procedure

If an Error Code 2 – Low Oil Pressure has been set, first check to ensure there is a correct amount of oil in the crankcase.

<p>Step 1</p>	<p>Connect a volt meter to the oil pressure switch and turn on the controller. Check for B+ voltage to the sensor.</p>	<p>If B+ voltage is present, proceed to Step 2.</p>	<p>If there is no battery voltage present, check for voltage at J4, Pin 1 for B+. If B+ voltage is present there is a short to ground between the power module and the oil pressure switch. If there is no B+ voltage from the power module, replace the power module for internal fault.</p>
<p>Step 2</p>	<p>Remove the oil pressure switch from the engine. Using a 12 V battery connect the switch, the leads of a suitable ammeter and the battery together and measure the amperage draw on the switch.</p> <p>Spec: 0.30 to 0.42 A</p>	<p>If the draw through the switch is within spec, proceed to Step 3.</p>	<p>If the amperage draw is above spec, replace the switch.</p>
<p>Step 3</p>	<p>Connect a suitable oil pressure gauge and measure oil pressure at idle.</p> <p>Spec: 28 to 64 psi</p>	<p>If the oil pressure is within spec, the most likely cause of the low oil pressure code is a stalling engine. Follow the diagnostics for stalling engine.</p>	<p>If the oil pressure is below spec, check the oil for thinning due to contamination. If the oil is good, the engine requires further inspection by an authorized technician to determine the cause of low oil pressure.</p>

NOTE

Running the APU for sustained periods with light engine loads can cause oil burning. Oil burning can also be caused by oil that has been thinned out by excessive fuel. If an engine has been hard to start and it is believed excessive fuel has contaminated the oil, perform an oil change first before addressing any oil consumption issues.

Procedure

Inspect the engine for any external signs of oil leakage. External oil leaks are generally caused by excessive combustion gasses leaking past the piston rings. The following can cause external oil leaks:

- Plugged or dirty crankcase breather.
- Plugged exhaust causing high back pressure.
- Weak piston rings.

If blue smoke is found to be coming from the exhaust, that is an indication that oil is entering the combustion chamber. The following can be the cause of oil entering the combustion chamber:

- Overfilling the crankcase
- Wrong dipstick or guide tube
- Worn valve guides
- Worn engine components (piston rings, pistons or dirty oil return holes)
- Incorrect installation of the compression ring or intermediate ring.
- Thin oil from fuel contamination.
- Thin oil from incorrect viscosity for operating temperatures.

CAUTION

Never disconnect any charging unit circuit or battery circuit cable from the battery when the charging unit is operated. A spark can cause an explosion from the flammable vapour mixture of hydrogen and oxygen that is released from the electrolyte through the battery outlets. Injury to personnel can result.

NOTE

The battery circuit is an electrical load on the charging unit. The load is variable because of the condition of the charge in the battery.

The charging unit will be damaged if the connections between the battery and the charging unit are broken while the battery is being charged. Damage occurs because the load from the battery is lost and because there is an increase in charging voltage. High voltage will damage the charging unit, the regulator, and other electrical components.

The correct test procedures to test the batteries can be found in the manual supplied by the OEM manufacturer.

Procedure

<p>Step 1</p>	<p>Check the batteries for proper charge. If batteries are undercharged, recharge and test the batteries prior to testing the charging unit. .</p> <p>Note: Follow the testing procedure for the batteries in the manual supplied by the OEM manufacturer.</p>	<p>If the batteries test ok and are fully charged, connect the positive lead of a suitable DMM to the B+ stud of the alternator and the negative lead to either the ground terminal or to the frame of the alternator. Connect a suitable ammeter clamp around the positive output cable from the alternator</p>	<p>If the batteries will not charge or, do not pass a battery test, replace any bad or weak batteries in the pack. Clean any/all corrosion from battery connections and ensure all battery cables are tight and secure. Replace any damaged battery cables and retest the batteries.</p>
<p>Step 2</p>	<p>Disconnect the fuel/run solenoid and using the controller attempt to start the engine and allow the engine to crank.</p>	<p>If the electrical system is operating correctly, allow the engine to crank again. Then reconnect the fuel/run solenoid, start the engine and proceed to step 3.</p> <p>Note: Operating the starter motor partially discharges the batteries in order to do a charging test. Ensure the that the batteries are fully charged prior to performing this step in the procedure.</p>	<p>If the electrical system does not appear to be operating correctly, inspect the integrity of the electrical system and follow the diagnostics in the troubleshooting guide for “Engine will not crank”.</p>

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Charging System

<p>Step 3</p>	<p>Check the output current of the alternator. The initial charging current should be equal to the minimum full load current or greater than the minimum full load current. Compare the reading with the specification listed.</p> <p>Specification: 55 Amps</p>	<p>If the amperage output of the alternator is within spec, continue running the engine for 10 minutes and proceed to step 4.</p> <p>If the output is intermittent but the engine is running, inspect the wire for the regulator for possible breaks or for loose terminal connections.</p>	<p>If the current at start-up is not within spec proceed to refer to the Fault Conditions and Possible Causes table below.</p> <p>If the output is intermittent but the engine is running, inspect the wire for the regulator for possible breaks or for loose terminal connections</p>
<p>Step 4</p>	<p>Check the voltage output on the DMM and compare with the specification.</p> <p>Spec: 14 VDC \pm 0.5 V</p>	<p>If the charging voltage is within spec, the alternator is good. Inspect the B+ battery cable for damaged/loose connections or corrosion that may prevent the batteries from charging. Inspect the engine ground strap and all ground connections for damage, loose connections, or corrosion. Repair/replace any bad cables and retest the system.</p>	<p>If the charging voltage is not within specifications, or falls out of the specifications after a period of time, refer to the Fault Conditions and Possible Causes table below.</p>

Fault Conditions And Possible Causes

Current At Start-up	The Voltage Is Below Specification After 10 Minutes	The Voltage Is Within Specification After 10 Minutes	The Voltage Is Above Specification After 10 Minutes
<p>Less than the specifications</p>	<p>Check for B+ voltage to the connector on the back of the alternator. If no B+ voltage is present, repair the wire to the alternator voltage regulator. If B+ voltage is present then replace the alternator.</p>	<p>Turn on all accessories. If the voltage decreases below specification, replace the alternator.</p>	<p>-</p>
<p>Decreasing after matching specifications</p>	<p>Replace the alternator.</p>	<p>The alternator and battery match the specifications. Turn on all accessories in order to verify that the voltage stays within spec.</p>	<p>Replace the alternator.</p>
<p>The voltage consistently exceeds specifications</p>	<p>Test the batteries. Test the alternator again.</p>	<p>The alternator operates within specifications. Test the batteries.</p>	<p>Replace the alternator. Inspect the batteries for damage.</p>

NOTE

If the blower fan is not running the power module will not activate the water valve circuit.

Ensure that the main engine block heater is plugged in using the 120 volt generator and that both the generator and engine block heater are both in good working order. The block heater places a 3 HP load on the engine through the use of the generator which results in increased heat output from the engine.

Poor air circulation due to restricted or blocked return vents can contribute to poor air flow or circulation.

Poor vent placement can result in poor air circulation. A properly installed vent should be pushing air upwards towards the ceiling.

Using the OEM ducts in the sleeper can result in too many outlets or too long a length of duct. This can result in poor air circulation

Low insulation levels in the sleeper can result in poor heat retention inside the cab.

Procedure

Step 1	Check the blower fan operation. Operate the blower fan on all speeds.	If the blower fan operates on all speeds proceed to Step 2.	If the blower fan does not operate on all speeds see the troubleshooting guide for little or no air flow.
Step 2	Inspect the HVAC filter.	If the HVAC filter is clean proceed to Step 3.	If the HVAC filter is dirty, remove and hand wash the filter, air dry and re-install. Retest the system.
Step 3	Start and run the APU. Set the temperature to the highest setting and turn on the blower fan. Check the outlet vent temperature for proper heat.	If there is sufficient heat from the outlet vent, refer to the note prior to the procedure.	If there is insufficient heat out of the outlet vent, proceed to Step 4.
Step 4	Feel the copper lines of the heater core (See the service manual to identify inlet and outlet). Are both lines hot?	If both lines are hot to the touch, there is coolant flow through the heater core. Proceed to Step 5.	If only the coolant supply pipe is hot, and the return pipe is cold, there is an air lock in the heater core. Follow the procedure in the service manual to bleed the air lock. If neither of the pipes are hot proceed to Step 6.

RigMaster Troubleshooting Guide**HVAC System
Poor or No Heat**

Step 5	Mark the water valve following the procedure in the Cooling section of the manual and observe the valves operation.	If the valve stays open allowing coolant to flow through the heater core, there is no fault with the heating system.	If the valve closes before the cabin has reached its correct temperature, proceed to Step 7.
Step 6	Mark the water valve following the procedure in the Cooling section of the manual and observe the valves operation	If the valve is open under heat, proceed to Step 8.	If the valve does not open test for power to the water valve. If power is present, replace the water valve. If power is not present, replace the power module.
Step 7	Install and retest using another cabin controller. Does the heat work correctly?	If the heat works correctly, the cabin controller's thermostat is out of calibration. Replace the cabin controller.	If the water valve still does not operate correctly replace the water valve. If valve replacement does not correct the issue, replace the power module.
Step 8	Inspect the engine for causes of overcooling. Replace the engine thermostat.		

NOTE

When testing the AC systems performance it is important to note certain factors that can contribute to the cause of poor cooling:

- Colour of the truck. Black trucks have high heat loads in the summer do to their colour.
- Number and size of the windows. Ensure curtains are used to block out sunlight and reduce heat loads in the sleeper.
- Amount and thickness of the bunk insulation. Different models have different amounts and thickness of liner insulation. Base model trucks can have low levels of insulation and in some cases no insulation in the roof which can result in high thermal heat transfer into the bunk.
- Size of the sleeper. Sleepers come in many different sizes. Smaller bunks are easier to maintain cabin temperature than larger bunks.
- Vent placement and air circulation. The placement of the vent has a huge impact on the performance of the HVAC system. Poor placement of the outlet vent can result in air flow circulating around the floor and never allowing cooler air to push the hotter air around the ceiling down to the floor. If vent placement is an issue, try to relocate the vent so that the air flow is pointed towards the ceiling allowing hot air to be forced down to the floor. In some instances, an additional oscillating fan may be required to assist in promoting proper air circulation.
- Number of vents and the length of duct. The HVAC system is supplied with one 4” outlet vent. In some instances the HVAC may be ducted through the bunks factory ducts. If there are too many vents and/or the length of duct is over 4’ in length, this can severely impact the CFM of the blower fan reducing the effectiveness of the circulating air.
- Blocked or restricted air flow. If the return vent is not of sufficient size, is blocked or restricted, there will be insufficient air flow to promote proper circulation. A plugged HVAC filter can also restrict air flow reducing system performance.
- If the power module does not activate the blower fan, the AC circuit will not activate.
- For AC system failures refer to the AC service manuals for proper system diagnostics.

Procedure

Step 1	Check the blower fan operation. Operate the blower fan on all speeds.	If the blower fan operates on all speeds proceed to Step 2.	If the blower fan does not operate on all speeds see the troubleshooting guide for little or no air flow.
Step 2	Inspect the HVAC filter.	If the HVAC filter is clean proceed to Step 3.	If the HVAC filter is dirty, remove and hand wash the filter, air dry and re-install. Retest the system.
Step 3	Start the APU and set the temperature to the lowest setting. Check the compressor for proper operation.	If the compressor turns on, proceed to step 4.	If the compressor does not operate, refer to the AC section of the service manual or to the Sanden service manual for proper diagnosis.

RigMaster Troubleshooting Guide**HVAC System
Poor or No Air Conditioning**

Step 4	Run the system for 5 minutes with the blower fan on high. Measure the outlet vent temperature. Is the temperature at or below 45°F (7°C) or lower?	If the outlet vent temperature is within spec, refer to the notes prior to the procedures.	If the outlet vent temperature is not within spec, refer the AC section of the service manual or to the Sanden service manual for proper diagnosis.
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NOTE

Vent placement is extremely important, especially in large sleeper cabs. The vent outlet needs to be placed in a manner facing upwards towards the ceiling to push air up and create air circulation throughout the cab. If the vent is not placed correctly, air flow will only circulate around the floor and result in poor heating or cooling of the sleeper cab.

An excessive amount of vent outlets or long duct runs will result in poor air flow out of the vents.

Procedure

Step 1	Check the blower fan operation. Operate the blower fan on all speeds.	If the blower fan operates on all speeds proceed to Step 2.	If the blower fan does not operate on all speeds proceed to Step 3.
Step 2	Inspect the HVAC filter.	If the HVAC filter is clean proceed to Step 4.	If the HVAC filter is dirty, remove and hand wash the filter, air dry and re-install. Retest the system.
Step 3	Connect a test light to the fan circuit to a good ground. Operate the fan on all speeds again and note the test light operation.	If the test lamp lights up on all speeds, Replace the blower fan assembly.	If the test lamp does not light up on all speeds or only on certain speeds proceed to Step 5.
Step 4	Check the area around the HVAC box filter for obstructions to air flow. Inspect the air return holes for obstructions.	If there are no obstructions to air flow through either the filter or the return air vent, proceed to Step 6.	If there are any obstructions to air flow present, remove the obstructions and retest.
Step 5	Install another cabin controller and retest the fan speeds.	If the fan speeds work with another controller, the fault is in the cabin controller. Replace the cabin controller.	If there is no change in fan speed operation with another controller, the fault is in the fan circuits of the power module. Replace the power module.
Step 6	Inspect the air return vent. Ensure there is an adequate size return vent. No less than 4 - 1 ½” holes	If there is an adequate sized return air vent proceed to Step 7.	If there are not enough air return holes supplied or no return vent at all, increase the air return hole size and retest.

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HVAC System Little or No Air Flow

Step 8	Is the HVAC blower fan vented through the factory 4" vent or through the OEM ducting in the truck?	If the blower fan is vented through the supplied 4" duct and there is no blockage within the duct, proceed to Step 9.	If the blower fan is vented through the OEM ducting in the truck, the ducting may be too long or have too many vents. Install the 4" duct supplied with the fan and retest.
Step 9	Inspect the supplied duct placement for correct air flow. The 4" vent should be placed pointing up towards the ceiling on the floor or installed facing upwards around waist height to promote proper air circulation.	If the duct is installed correctly facing upwards towards the ceiling, replace the blower fan.	If the duct is not installed correctly and is only moving air around the floor, reinstall the duct pointing upwards or relocate to an area about half way up the cab and retest.

NOTE

The generator is fitted with sealed for life bearings and is brushless. The generator requires no regular maintenance. The generator must periodically be inspected and any accumulation of dirt or oil must be removed. Air inlet and outlet openings must be kept unobstructed. If kept in storage or sitting idle for long periods of time, the insulation on the windings should be inspected and checked. The winding insulation can be checked using a 500V Megger or equivalent tool and should be done with the capacitor disconnected. The resistance value obtained should be at least one megohm. If the resistance value is less, the windings should be dried out in a warm, dry environment and checked every 30 minutes until the specified value is reached.

Procedure

Step 1	Does the generator output voltage to either of the 120V outlets?	If voltage is present on both outlets proceed to the next step. If only one outlet has proper voltages proceed to step 4.	If no voltage is found on either outlet proceed to step 4.
Step2	Is the voltage on both outlets correct? Spec: 115-125 VAC >60Hz	If the voltage on both outlets is correct proceed to step 3.	If the voltage on both outlets is out of spec, proceed to step 6.
Step 3	Is the voltage on both outlets stable?	If the voltage produced is stable, there is no fault with the generator. Check the appliances/loads for correct operation. Note: Some appliances have a circuit that checks for earth ground on the neutral wires. These appliances will not work with the mobile generator as it is not possible to earth ground the neutral wires of the generator. A different appliance is required to work with the generator.	If the voltage produced is unstable check the engine for unstable idling.
Step 4	Check the serpentine belt to ensure the belt did not come off and that there is proper tension. Check the breakers on the generator including the GFCI breaker on the outlet in the bunk.	If the belt is loose or has come off go to step 5. If a breaker has tripped, reset and test again. If the breaker trips again, check the circuit for shorting or overloading.	If none of the breakers have tripped, proceed to step 6.

RigMaster Troubleshooting Guide**Generator**

Step 5	<p>Check the condition of the serpentine belt and belt tensioner. Check the alignment of the generator pulley using the alignment tool and the instructions in the service manual in section S3.</p>	<p>If the tensioner is ok, replace the serpentine belt and check the generator pulley alignment. Retest the generator output again.</p>	<p>If the tensioner is weak, replace the tensioner and if necessary the serpentine belt. Check the generator pulley alignment and retest the generator output again.</p>
Step 6	<p>Remove the generator cover. Remove the breaker box lid and run the generator. Check output voltage from wire T1 to T2 and from T3 to T4.</p> <p>Spec: 115-125 VAC >60 Hz</p>	<p>If the generator output is correct voltage, check for voltage after the breakers. If voltage is present, inspect the 120V cords to the outlets for damage. If no voltage is present, then replace the breakers.</p>	<p>If no output voltage is found going to the breakers, proceed to step 8.</p>
Step 7	<p>Check/correct the engine idle speed. Follow the procedure set in the service manual under Section S9.</p>	<p>If the engine idle is set correctly, test the circuits for correct output. There is no fault with the generator.</p>	<p>If the engine idle does not correct the generator output, replace the generator.</p>
Step 8	<p>Remove the end cover to the generator and disconnect the capacitor. Run the generator and check for a residual voltage of 1.5 VAC from the generator.</p>	<p>If the generator outputs a residual voltage of 1.5 V then proceed to step 9 and flash the capacitor.</p> <p>Note: All generators manufactured after 08/05/08 have permanent magnets installed and flashing the capacitor is not required. Test the capacitor by applying a charge and measure if the charge has been accepted and holds. Replace the capacitor if it fails.</p>	<p>If no residual voltage is found, proceed to step 10.</p>
Step 9	<p>Reconnect the capacitor and run the generator at normal no load speed. A 12V battery should then be instantly connected for only 1 second across the capacitor. The output voltage should build to normal no load level.</p>	<p>If the capacitor recharges and produces no load voltage, check/test the capacitor. If the capacitor holds a charge after 5 minutes, the capacitor is good. If the capacitor does not hold a charge, replace the capacitor.</p>	<p>If the generator does not produce no-load voltage, replace the capacitor and test again. If the generator still does not produce voltage, proceed to step 10.</p>

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Step 10	<p>Check the main stator winding resistance and the auxiliary winding resistance. Compare with specifications</p> <p>Main Stator: 0.29 Ω Auxiliary Winding: 0.75 Ω</p>	<p>If the main and auxiliary windings are in spec, proceed to step 11.</p>	<p>If the windings are out of spec, replace the generator.</p>
Step 11	<p>Check the resistance value of the rotor winding. Compare with specifications</p> <p>Rotor winding: 1.5 Ω each pole</p>	<p>If the rotor windings are within spec, inspect and test the capacitor. If the capacitor is good, replace the generator.</p>	<p>If the windings are not within spec, proceed to Step 12</p>
Step 12	<p>Disconnect the rotor windings from the diode assembly and check the continuity of the diodes and VDR. Perform a visual inspection of the diodes and VDR.</p>	<p>If the diodes on the VDR are good, replace the generator.</p>	<p>If the diodes of the VDR have failed, replace the diode assembly.</p>