

## H-03: Troubleshoot and PM Starter

### SAFETY FIRST

- Follow all Caterpillar facility safety standards when performing this task.
- Locking out the supply power may be necessary before investigating possible motor starter problems.
- Use appropriate insulating gloves when working with high voltage equipment.

### EQUIPMENT

- DVM or other meter capable of reading resistance and AC and DC control voltages
- megohmmeter
- Arc chute/fuse puller tool
- flashlight
- cleaning supplies (rags, brushes, solvents, vacuum or air hose, etc.)
- oil can with lubricating oil
- replacement of main contacts and other components that may be necessary

### RESOURCES

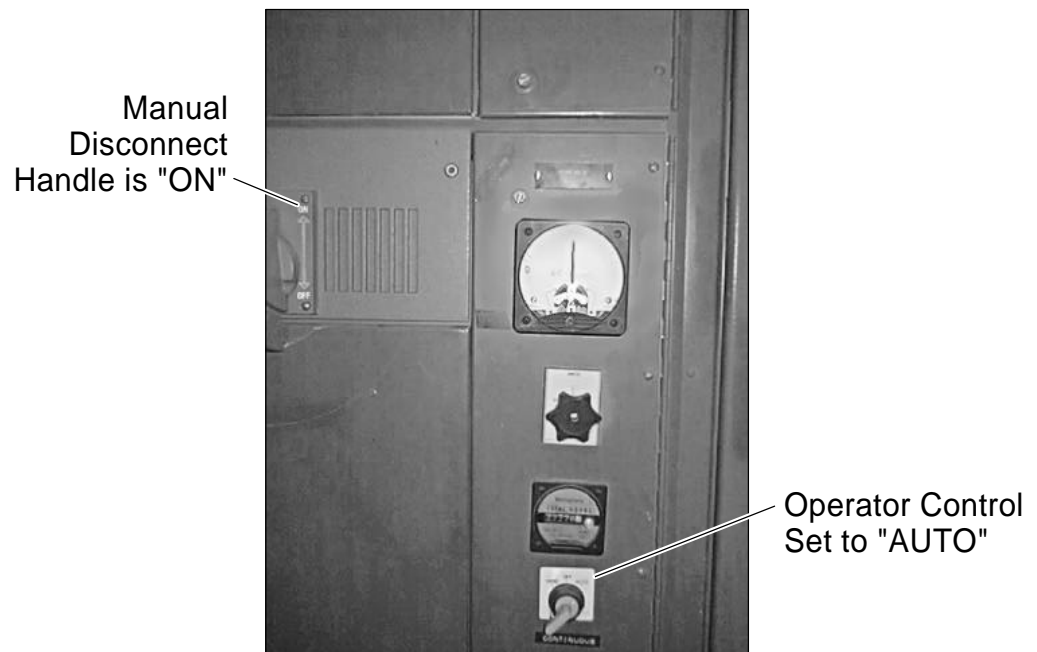
- motor starter specifications
- control circuit schematic
- operating and service instructions
- motor starter PM checkoff list



## Troubleshoot and PM Starter

## Part A: Troubleshoot Motor Starter (Westinghouse Ampgard 4160 Volt)

1. Check input conditions.
  - Verify that the operating control is set to AUTO and the manual disconnect handle is ON (up). See the figure below.



## Motor Starter and Controls

- Verify normal supply voltage on all three phases.
2. Identify and define the operating symptoms. Listed below are typical symptoms.
    - The starter will not activate.
    - The starter activates, but the motor will not start.
    - The motor runs on single phase only.
    - The starter chatters and/or drops out intermittently.
    - The starter will not drop out in response to a control signal.
    - Primary side control circuit fuses blow repeatedly.



- Secondary side control circuit fuses blow repeatedly.
  - Contact sets burn up repeatedly.
3. Open the starter front panels and inspect for obvious problems.
- Refer to the operating instructions on the inside of the door.
  - Inspect for burned, cracked, or missing wire insulation.
  - Inspect for burned or corroded terminals.
  - Inspect for burned terminal block insulation.
  - Check for blown fuses.
  - Check for a tripped overload located in the upper right corner (plunger type).

4. If there are no obvious problems, investigate the components or conditions that could be responsible for the operating symptoms.

- Use the decision table shown below to investigate starter components or conditions.



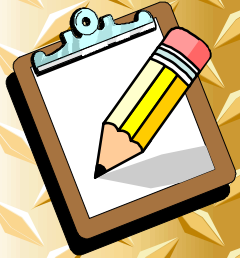
If:	Recommended Action:
The starter will not activate in AUTO mode	Switch to HAND mode.
The starter activates in the HAND mode	<ol style="list-style-type: none"> <li>1. Consult the starter control circuit schematic.</li> <li>2. Check the operation of any other devices (<i>i.e.</i> relays, timers, interlock switches) that must close to pass a control signal to the starter.</li> </ol>
The starter will not activate in any mode, and all fuses are good	<ol style="list-style-type: none"> <li>1. Check the resistance of the energizing coil.</li> <li>2. Check the forward and reverse resistances of the diodes in the rectifier.</li> <li>3. Check the resistances of the control transformer primary and secondary windings.</li> </ol>
The starter appears to activate but the motor will not start, and there is no current to the motor on any phase line	<ol style="list-style-type: none"> <li>1. Check for full and free movement of the starter armature assembly.</li> <li>2. Check continuity between each pair of lines to the motor (through the motor windings).</li> </ol>
The starter activates, but the motor hums and either will not start or runs on single-phase, and line fuses are good	<ol style="list-style-type: none"> <li>1. Use the arc chute/fuse puller tool to rotate the arc chutes out.</li> <li>2. Check for damaged line contacts.</li> <li>3. Check continuity between each pair of lines to the motor (through the motor windings).</li> </ol>

- Use the decision table below to investigate starter components or conditions.



If:	Recommended Action:
The starter chatters, makes unreliable contact, or drops out intermittently	<ol style="list-style-type: none"> <li>1. Inspect the activating mechanism closely for signs of wear, sticking, binding, etc.</li> <li>2. Inspect the line contact area for debris such as broken arc chute fin pieces.</li> <li>3. Compare the coil resistance to specifications, and examine the coil closely for signs of overheating.</li> <li>4. Measure the forward and reverse resistances of the diodes in the rectifier.</li> <li>5. Arrange test leads from the coil terminals, close the starter, attempt to start the motor, and monitor the DC control voltage at the coil.</li> <li>6. Arrange test leads from the rectifier input terminals, close the starter, attempt to start the motor, and monitor the AC control voltage at the rectifier input.</li> </ol>
The starter will not drop out in response to a control signal	<ol style="list-style-type: none"> <li>1. Use the arc chute/fuse puller tool to rotate the arc chutes out.</li> <li>2. Inspect the line contacts for welding.</li> <li>3. Inspect the activating mechanism and spring closely for signs of damage and malfunction.</li> <li>4. Consult the starter circuit schematic and check the operation of any relay that passes the control signal to the starter.</li> </ol>

- Use the decision table below to investigate the control circuit fuses and contacts.



If:	Recommended Action:
The primary side control circuit fuses blow repeatedly	Check the control transformer closely for ground faults, primary-to-secondary shorts, and shorted winding turns.
The secondary side control circuit fuses blow repeatedly	Check the rectifier, activating coil, and other control circuit components for correct resistances.
Line contact sets burn up repeatedly	<ol style="list-style-type: none"> <li>1. Check the operating mechanism for looseness, binding, or sticking.</li> <li>2. Monitor motor current at start-up and compare it to specified starter capacity.</li> <li>3. Check for chattering contacts.</li> <li>4. Check for frequent motor starting and stopping, motor shutdown under high load, and other operating conditions which could damage the contacts.</li> </ol>

**Note:** Symptoms such as frequent blown line fuses and overload tripping usually indicate a motor or load problem, rather than a motor starter problem.

5. When you have identified a component or condition that may be responsible for the problem, replace the component or correct the condition.
6. Verify that the motor starter operates normally.

## Part B: PM Motor Starter

1. Obtain the correct PM check sheet for the motor starter.
2. Inspect the specified points or components.
  - All line and control wiring connection points for looseness, corrosion, signs of overheating.
  - All line and control voltage wiring for damaged (burnt, brittle, discolored, cracked, missing) insulation.
  - All fuses and fuse holder assemblies for looseness, corrosion, signs of overheating.
  - All line contacts for pitting, arcing, burning, contamination.
  - The line contact area for dirt, debris, arc traces.
  - The arc chutes for dirt, broken fins, arc traces.
  - The activating mechanism for wear, looseness, bent or misaligned parts, sticking, binding, or hanging up.
  - The activating coil for discoloration, loose mounting, signs of overheating.
  - Any relays, timers, diode rectifier assemblies, and overload sensors for signs of damage.
  - All interlock mechanisms and switches for wear, misalignment, signs of tampering or damage.
  - Meters for consistent readings.
  - Meter and control switches for cracked cases, weak detents, loose knobs, incorrect operation.
3. Perform specified maintenance operations.
  - Clean out (preferably with a vacuum) all dirt and debris inside the motor starter, especially in the line contact and arc chute area.
  - Clean off meter faces, data plates, labels, operating and service instructions.
  - Lubricate the activating and interlock mechanisms.
  - Replace line contacts and any other components found to be worn, broken, damaged, etc.
4. Verify that the motor starter operates normally.

