P-01a: Troubleshoot Furnace (Troms)

SAFETY FIRST

- ☐ Follow all Caterpillar facility safety standards when performing this task.
- ☐ Be aware of the hazards that are associated with quenching fluids. wear appropriate protective clothing.
- ☐ Be aware of the motions hazards presented bymotors, actuators and loading / unloading equipment associated with furnace operation.
- ☐ Combustion gases can be explosive. Ensure that the area is adequately ventilated.

EQUIPMENT

- ☐ Electrician's hand tools
- ☐ wiggy

RESOURCES

- ☐ manufacturer's specifications and manuals for all equipment
- ☐ design specifications for the furnace and quench processes
- ☐ temperature controls inspector

Troubleshoot Furnace (Troms)

Note: This troubleshooting procedure has five sections. Determine what system or piece of equipment is the source of the problem.

Ask the Operator or Electrician, if necessary, to read the Operator interface console.

Part I: Part and Tray Loading Devices
Part II: Furnace Rotary Table
Part III: Furnace Temperature Controls
Part IV: Tray and Part Discharge Devices
Part V: Quench Process

Part I: TROUBLESHOOT THE PART AND TRAY LOADING DEVICES:

A. Problem with the positioning mechanism that pushes the part onto the tray:

1. Verify hydraulic pump operation.
2. Check for required motor operating voltage at pump power terminals. If voltage is not present, go to step 3.
3. Check all motor line fuses to see if they are blown.
4. Check all connections for loose, broken, or shorted wires.
5. Check for output voltage at the PLC. If not present, go to step 6.
6. Check output fuses to see if they are blown.
7. Check to see if the solenoid valve is energizing. If not, go to step 8.
8. Check for solenoid operating voltage at the input terminals on the solenoid. If operating voltage is not present, go to step 9.
9. Inspect all connections for loose, broken, or shorted wires.
10. Check for output control voltage at the PLC. If control voltage is not present, go to step 11.
11. Check the PLC ladder logic. If the ladder logic is OK, continue to the next step.

B. Pusher is out there, but not registering:

1. Check to ensure that the limit swithes on the actuator are functioning.

   ☐ Actuate the home and overtravel limit switches.

2. Check for corresponding input on the PLC. If the inputs do not activate, go to step 3.

3. **Check all wiring for loose, shorted, or broken connections.**

4. **If the inputs do activate, check the PLC program for faults.**

C. **Problem with the hydraulic system that loads the tray and part into the furnace.**

1. **Visually check the hydraulic pump to see if it is operating correctly.**

   ☐ Check gages for pressure on the output side of the pump.

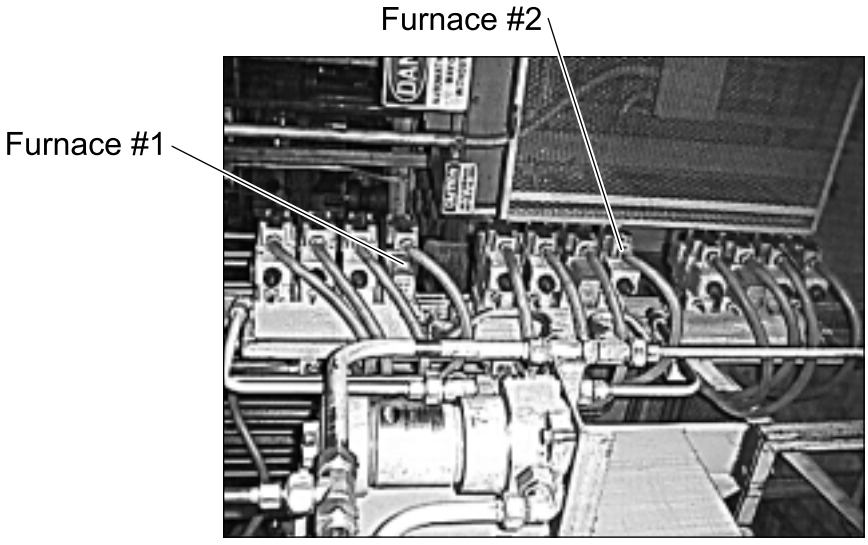
2. **Check for electric motor operation. If the motor is not operating, go to step 3.**

3. **Check to see if motor starter is energized. If energized, check voltage from fuses that feed that motor.**

4. **If motorstarter is off, and you have voltage, you may have an overload kicked out. If not go to step 5.**

5. **Determine if the output from the PLC to turn on the motor is activating. If not, check the PLC program for faults (control voltage).**

6. **Check the operation of the solenoid valve.**



Solenoid Valve

- ☐ Check for output to the actuating solenoid for the hydraulic cylinder. If the output comes on, go to the next step. If not, check the PLC program for faults.
- ☐ Check the solenoid to see if it is energizing properly. If not, go to the next step.
- ☐ Check all wiring for loose, shorted, or broken connections.
- ☐ Check the fuses on the outputs from the PLC.
- ☐ Inspect the hydraulic system for obvious leaks.

D. Furnace door does not operate properly.

1. Check pneumatic actuator system.

2. Visually check to see if the pneumatic solenoid valve is operating. If not, go to step 3.

3. Check for voltage for the solenoid, in the panel and/or at the input terminals. If no voltage is present, go to step 4.

4. Check for output voltage at the PLC, and corresponding output indicator light. If no indication is present, go to step 5.

5. Check to see if the output fuses from the PLC are blown. If not, go to step 6.

6. Check logic in PLC to see what needs to be turned on for that solenoid output.

7. If you have voltage / indicator light, and no voltage at solenoid, check connections for loose, broken, or shorted wires.

8. If you have voltage at solenoid, the coil or the solenoid may be bad.

II. TROUBLESHOOT FURNACE ROTARY TABLE

A. Table not rotating:

1. Visually inspect the table driving chain for looseness or damage.

2. Inspect hydraulic pump to insure proper operation.

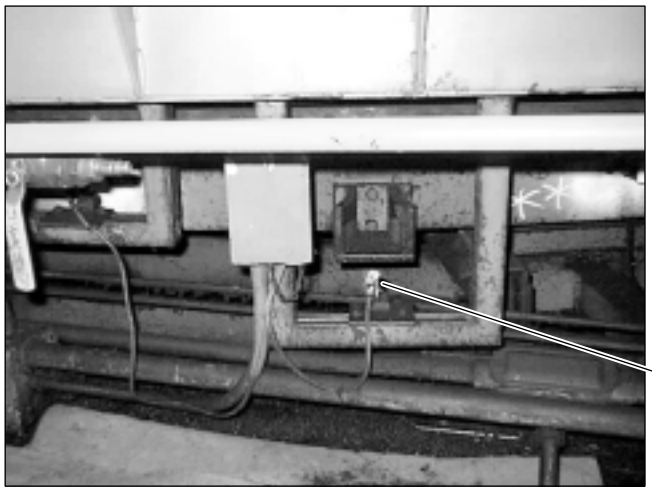
3. Inspect hydraulic system for obvious leaks.

4. Check for correct PLC output to start/stop the hydraulic motor. If you have output, go to step 5.

5. Check solenoid valve that turns on the fluid motor and check for voltage. If you have voltage present, call for mechanical assistance.

B. Table out of position:

1. Check for "in position photo switch".



2. Check to see if the switch mounting is out of adjustment.

3. Determine if the photoelectric sensor has operating voltage, if not go to step 4.

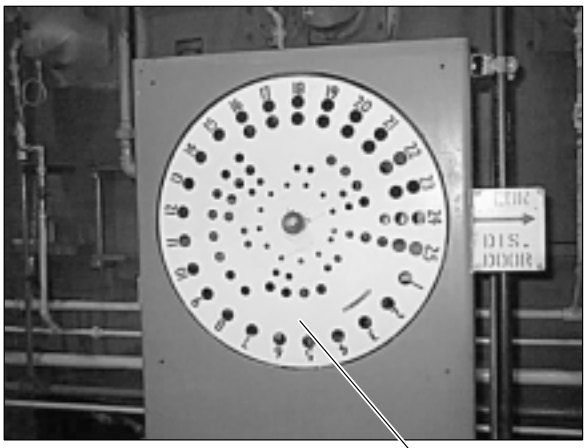
4. Check for loose, shorted, or broken wires on the supply voltage lines to the sensor.

5. Check for voltage at the PLC input terminals. If voltage is not present go to step 6.

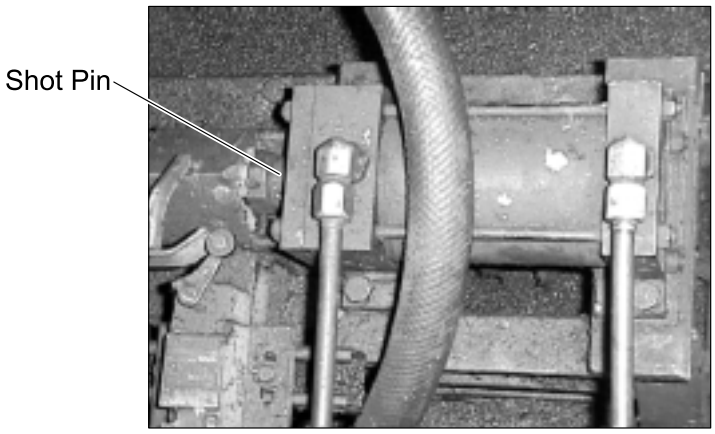
6. Check voltage from transformer or power supply. May have bad input card, transformer or power supply.

C. Not registering the right table position:

1. Visually check the photoelectric switch that registers tray slot positions.



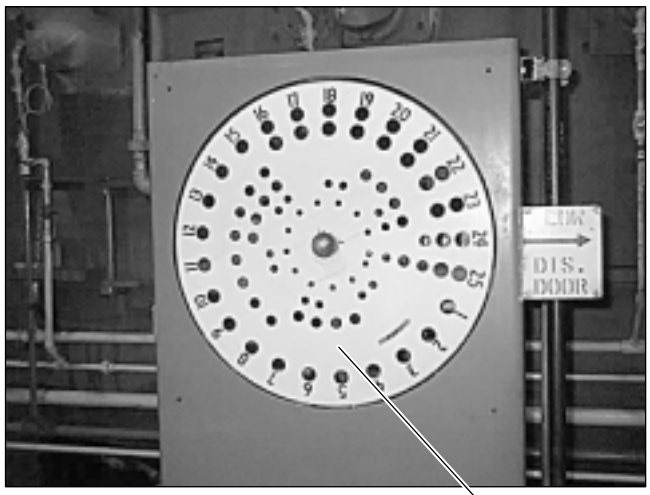
2. Make sure shot pin is in position.



Shot Pin Position

3. Visually inspect the photoelectric sensors to insure they are properly aligned to read the correct holes on the positioning wheel.

4. Check photoelectric inputs from the position wheel.



Photoelectric Input Leads
are Located Behind Wheel

5. Block the photoelectric beam and confirm the corresponding input light illuminates on the Allen Bradley PLC 3/10 unit. If the input light does not illuminate, go to step 6.

6. Insure that the photoelectric switches are getting required operating voltage. If not check wires for loose, broken, or shorted connections. If not go to step 7.

7. Check for voltage at the PLC input terminals. If voltage is not present, go to step 8.

8. Check voltage from transformer or power supply. May have bad transformer or power supply.

D. Shot pin cylinder problems:

1. Visually check lock on the table.

2. Visually check to see if the limit switch is actually made. If so go to appropriate inputs on PLC and check voltage and input light.

- ☐ Check all wiring connections for loose, broken, or sorted wires.

3. If shot pin is not physically in, check hydraulic solenoid valve to see if it is energizing. If not, check for solenoid operating voltage at the output terminals. If correct operating voltage is not present, go to the PLC.

4. Check for voltage at the outputs on the PLC. If no voltage is present, check output fuses to see if they are blown. If fuses are not blown, check power supply or transformer.

5. If you have voltage at PLC, check all wires for loose, shorted, or broken connections going out to the solenoid.

6. Inspect the hydraulic systems for damage or obvious leaks.

III. TROUBLE SHOOT FURNACE TEMPERATURE CONTROLS:

- ☐ Check for blown fuses and loose wiring.
- ☐ Go to furnace temperature monitoring panel.
- ☐ Observe readings on Barber Coleman 560 PID temperature controllers.
- ☐ Observe last calibration / test date. If the controller has not been checked in over a month, call inspector to check proper operation of PID temperature controller.

A. Thermocouple:

1. Thermocouples are replaced by Heat Treat Engineering.

B. Gas valve:

1. Check if alarm is due to main gas supply valve shut-off.

2. Inspect indicator on main combustion gas valve supplying the burners. If it is off, go to step 2.

3. Check high-pressure switch for excess pressure. If pressure is not to high, go to step 3.

4. Check low-pressure switch for indication of inadequate pressure.

5. Check prints for power failure to valve with items in series or parallel with the valve.

C. **Pilot gas valve:**

1. **Check to see if pilot gas valve has closed.**

2. **Observe mercury pressure switch to determine if blower is drawing in air.**

3. **Check blower intake filter for damage or blockages.**

4. **Check voltage at contactor. If no voltage is present, go to step 5.**

5. **Check for blown fuses, and overloads. If not go to step 6.**

6. **Check prints to see what energizes contactor.**

7. **Check at the PLC for control voltage at the output terminals to the blower drive motor. If no voltage is present, got to step 8.**

8. **Check the PLC output fuses to see if they are blown. If not, go to step 9.**

9. **Determine if the motor on the blower needs replaced.**

D. Burner exhaust blower on roof:

1. The ISMD crew presently does Work done on the blower on roof.

IV TROUBLESHOOT THE TRAY AND PART DISCHARGE DEVICES:

Note: Rotary table must be locked in position before door opens. If not refer to II. Troubleshooting Rotary Furnace Table.

A. Tray unloading cylinder does not operate:

1. Determine if the AC motor that drives the actuator is operating.

2. See if chain is still on. Motor not running, go to step 3.

3. Visually look in panel and check to see if motor starter is energized. If energized go to step 4. If not energized, then check PLC for output.

- ☐ Check the 480V motor fuses.

4. Check to see if you have 480V line voltage.

5. Check voltage at motor. If you have no voltage go to step 6. If you have voltage, then determine if motor should be replaced.

6. Check all connections for loose, broken, or shorted wires.

B. Tray transfer mechanism to and from carriage:

Hydraulic pump operation:

1. Check to see if hydraulic pump is operating. If not, go to step 2.

2. Check for required motor operating voltage at pump power terminals. If required voltage is not present, go to step 3.

3. Check all motor line fuses to see if they are blown.

4. Check all connections for loose, broken, or shorted wires.

5. Check for output voltage at the PLC, if not present, go to step 6.

6. Check output fuses to see if blown and limit switches to see if functioning.

Solenoid valve operation:

1. Check solenoid valve to see if energized. If not, go to step 2.

2. Check for solenoid operating voltage at the input terminals on the solenoid. If operating voltage is not present, go to step 3.

3. Inspect all connections for loose, broken, or shorted wires.

4. Check for output control voltage at the PLC. If control voltage is not present, go to step 5.

5. Check for blown fuses in the PLC outputs.

Photoelectric part sensor operation:

1. Check to see if the photoelectric switch has power. If not, go to step 2. If it does, go to step 4.

2. Check for required supply voltage at the photoelectric switch power terminals. If required voltage is not present, go to step 3.

3. Check all connections for loose, broken, or shorted wires.

4. Manually block the photoelectric switch.

5. Check for the corresponding input on the PLC. If the input registers, go to step 7. If not, go to step 6.

6. Check all connections for loose, broke, or shorted wires.

7. Check the PLC program.

V. TROUBLESHOOT THE QUENCH PROCESS

A. Carriage, which moves the tray and part to quench elevator, not operating.

Chain drive operation:

1. Determine if chain drive operation is functioning properly.

2. Visually check chain for looseness, broken links, wear, or other damage. If so, go to step 4.

3. Visually check chain drive sprockets for missing teeth, or other damage. If so, go to step 4.

4. Call for mechanical assistance.

Chain drive motor operation:

1. Check to see if motor is running. If not, go to step 2.

2. Check motor line power fuses to see if they are blown. If not, go to step 3.

3. Check motor starter to see if energized. If not, check overloads and / or go to PLC and check to see if you have a control voltage output. If motor starter is energized, go to step 4.

4. Check for required motor voltage at the motor. If required voltage is present, go to step 5.

5. Check to see if motor needs replaced.

Limit switch operation:

1. Inspect both limit switches for damage. If damaged, determine if replacement is necessary. If not damaged, go to step 2.

2. Manually actuate the limit switches and check for corresponding input signals at the PLC. If the signal is not present, go to step 3.

3. Check all connections for loose, shorted, or damaged wires.

Actuator operation:

1. Visually check for any mechanical damage to actuator.

B. Actuator that moves part from tray to quench elevator not operating.

Drive chain operation:

1. Determine if the drive chain is functioning properly.

2. Visually check chain for looseness, broken links, wear, or any other damage. If so, go to step 4.

3. Visually check chain drive sprockets for missing teeth, or other damage. If so, go to step 4.

4. Call for mechanical assistance.

DC drive motor operation:

1. Check to see if motor is running. If not, go to step 2.

2. Check motor line power fuses to see if they are blown. If not, go to step 3.

3. Check power supply for motor operation.

4. Check Allen Bradley 1388 DC servo motor controller for proper operation.

5. Check for control voltage at Allen Bradley 1388 DC servo controller motor. If control voltage is not present, go to step 6.

6. Check all connections on the control circuit for loose, broken, or damaged wires.

7. Check the corresponding outputs on the PLC. If the outputs do not activate, go to step 8.

8. Check the PLC output fuses to see if they are blown. If they are not, go to step 9.

9. Check the PLC program for faults.

10. Check for required motor voltage at the motor input terminals. If required voltage is not present, go to step 11.

11. Check all connections on the power circuit for loose, broken, or damaged wires.

Limit switch operation:

1. Check home and overtravel limit switches for damage. If they are damaged, determine if replacement is necessary. If no damage, go to step 2.

2. Manually actuate the limit switches and check for corresponding inputs at the PLC. If input is not present, go to step 3.

3. Check all connections for loose, broken, or damaged wires.

Photoswitch operation:

1. Check resolver gear for broken or damaged teeth.

2. Check for resolver input at the PLC. If correct input is not present, go to step 3.

3. Check all connections for loose, broken, or shorted wires.

4. Determine if photoswitch must be replace.

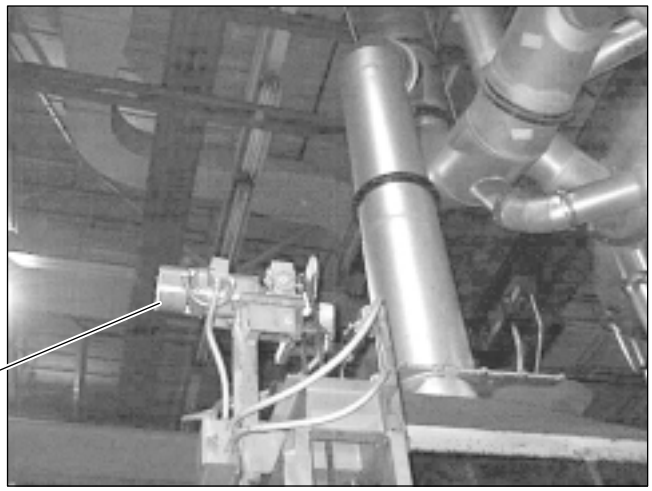
Actuator operation:

1. Visually check for any mechanical damage to actuator.

C. Quench elevator is malfunctioning:

AC motor for hydraulic stop positioning device:

1. Check to see if motor is operating. If not, go to step 2. Motor location is shown below.



2. Check motor power line fuses to see if they are blown. If not, go to step 3.

3. Check all connections for loose, broken, or shorted wires.

4. Check motor starter to see if energized. If not, check overloads and/or check the PLC for voltage output. If motor starter is energized, go to step 5.

5. Check for required operating voltage at the motor terminals. If required voltage is present go to step 6.

6. Check motor to see if it needs replaced.

Positioning operation:

1. Check gear for broken or damaged teeth.

2. Check for photoswitch input at the PLC. If correct input is not present, go to step 3.

3. Check all connections for loose, shorted, or broken wires.

4. Determine if photoswitch needs to be replaced.

Limit switch operation:

1. Inspect home position limit switch for damage. If not, go to step 2. If damaged, determine if replacement is necessary.

2. Manually actuate the limit switch and check for corresponding input at the PLC. IF input is not present, then go to step 3.

3. Check all connections for loose, shorted, or broken wires.

Hydraulic pump operation:

1. Visually check to see if pump is operating. If not, go to step 2.

2. Check for required motor operating voltage at the motor starter. If required voltage is not present, go to step 3.

3. Check all motor line fuses to see if they are blown. If not, go to step 4.

4. Check to see if motor starter is energized. If not, check overloads and/or check the output voltage at the PLC. If motor starter is energized, go to step 6.

5. Check all connections for loose, broken, or shorted wires.

6. Determine if motor needs replaced.

Servo positioning valve:

1. Visually inspect servo valves for damage.

2. Check for power at the Parker servo positioning board. If power is on, go to step 3. If not, go to step 4.

3. Determine if the Parker board should be replaced.

4. Inspect all connections for loose, broken, or shorted wires. If not, go to step 5.

5. Check for output control voltage at the PLC. If control voltage is not present, go to step 6.

6. Check for blown fuses in the PLC output.

Hydraulic system:

1. Visually inspect hydraulic system for obvious leaks.

D. Quench agitator (fluid supply pump) malfunctioning:

Pump motor operation:

1. Go to control panel with Barber Coleman pump motor rpm readout LEDs.

2. Check for indication of motor rpm on the quench pump readout. If no readout is present, go to step 3.

3. Check to see if the motor is operating. If it is running, go to step 4. If not, go to step 6.

4. Check magnetic pickup signal from gear on motor to Barber Coleman controller. If pickup is operating correctly, go to step 5. If not, determine if the magnetic pickup mechanism should be replace.

5. Check all connections for loose, broken, or shorted wires.

6. Check motor power line fuses to see if they are blown and need replacement.

7. Check all motor connections for loose, broken, or shorted wires.

8. Check for correct operation of the Eaton AF510002-0480 pump motor controller. If it is malfunctioning, determine if replacement is necessary.

E. Quench coolant pump malfunctioning:

Coolant pump motor:

1. Go to control panel with Barber Coleman pump motor rpm LED readout.

2. Check for indication of motor rpm on the quench pump readout. If no readout is present, go to step 3.

3. Check to see if the motor is operating. If it is running, go to step 4. If not, go to step 6.

4. Check magnetic pickup signal from gear on motor to Barber Coleman controller. If pickup is operating correctly, go to step 5. If not, determine if the magnetic pickup mechanism should be replaced.

5. Check all connections for loose, broken, or shorted wires.

6. Check motor power line fuses to see if blown.

7. Check all motor connections for loose, broken, or shorted wires.

Coolant temperature:

1. Monitor temperature of coolant with Barber Coleman temperature controller on quench system. If display does not operate, go to step 2.

2. Check all connections to the controller for loose, broken, or shorted wires.

3. Check label to determine if controller has been calibrated within the past month. If it has not, call technician to calibrate.

4. Check to be certain valve that supplies mill water to the heat exchanger is operating when quench fluid temperature exceeds specified limits. If valve does not operate, go to step 5.

5. Check for loose, broken, or shorted connections to the pneumatic flow control valve to the heat exchanger.

6. Visually inspect valve for mechanical damage. Call for mechanical assistance if damage is found.