Heating Cable – Testing Procedures
September 1, 2010
Agenda

- System Overview
- System Start-up
- Mechanical Checks
- Electrical Tests
- Documentation
- Maintenance

- Testing
  - Megger Test
  - Cold Resistance Test
  - Stabilized Current Test
  - End of Circuit Voltage Test

- For Each Test
  - What is it
  - Why do it
  - When to do it
  - How to do it
Overview
System Start-up

• General Considerations
  – All parties involved should have a representative present for start-up.
  – All start-up info should be logged and signed off by appropriate parties.
  – All test equipment used for start-up testing should be in good repair and CALIBRATED!
  – Have all appropriate drawings, specifications, and instruction sheets on-hand for reference.

• Mechanical Inspection
  – Inspect all insulation and weatherproofing. (Wet insulation is Bad!)
  – Inspect all junction box, connection box and sensor connections
  – Verify sensors are in appropriate locations
  – Verify all circuits have been properly grounded
  – Verify all circuits are connected in proper panel locations
  – Verify proper circuit breakers are in place
  – Verify all circuit lengths are within manufacturers specified limits
  – Verify all proper safety warnings are in place
  – Verify all end seal, splice/tee locations are marked on lagging
System Start-up

• Electrical Tests
  – Insulation Resistance (Megger)
    • Before tracing pipes
    • After installing terminations
    • Before Insulating pipes
    • After Insulating pipes
    • Before Energizing System
  – Circuit Voltage
  – Initial Current
    • Note ambient temp and pipe temp
  – Stabilized Current (15 minutes of operation)
    • Note ambient temp and pipe temp
# Heat Trace Installation Inspection Record

**Inspection Date:** [ ]

**Signature:** [ ]

**Title of Inspector:** [ ]

**Inspected By:** [ ]

## Installation and Maintenance Log

<table>
<thead>
<tr>
<th>Reference Information</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuit Number</td>
<td></td>
</tr>
<tr>
<td>Circuit Breaker Number</td>
<td></td>
</tr>
<tr>
<td>Drawing Number</td>
<td></td>
</tr>
<tr>
<td>Circuit Length</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heat Tracing Visual Checks</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No Signs of Moisture, Corrosion or Damage</td>
<td>Initial</td>
</tr>
<tr>
<td>Proper Electrical Connection</td>
<td>Initial</td>
</tr>
<tr>
<td>Proper Grounding of the Braid</td>
<td>Initial</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heat Tracing Electrical Checks</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Megger Test (Bypass Controls) (2500VDC)</td>
<td>Meg Ohms</td>
</tr>
<tr>
<td>Amperage Draw Test</td>
<td>Ampereage</td>
</tr>
<tr>
<td>Compare to design Amperage Draw</td>
<td>Amt. Temp.</td>
</tr>
<tr>
<td>Voltage at end of Circuit*</td>
<td>Voltage</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Accessories/Control Checks</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Control Properly Set</td>
<td>Set Point</td>
</tr>
<tr>
<td>Sensors Protected and Undamaged</td>
<td>Initial</td>
</tr>
<tr>
<td>All Enclosures and Kits Closed and Sealed</td>
<td>Initial</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thermal Insulation Checks</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of Kits Visible on Outside of Insulation</td>
<td>Initial</td>
</tr>
<tr>
<td>Insulation is Complete, Dry and Weatherproof</td>
<td>Initial</td>
</tr>
</tbody>
</table>

*This test must be performed at installation or at any time the cable is cut or damaged in any way.*
Megger Test

• What is it???
  – Tests Insulation Resistance Between Conductive Core and Grounding Braid
  – Detects damage that can result in cable short to ground
    • Failure could trip circuit breaker or cause fire

• When to do??
  – Performed at the factory
  – After receipt at job site
  – After cable install
  – After Insulation
  – At Start-up
  – Periodically per maintenance procedure

• Equipment
  – Insulation Resistance Tester
    • Megger
  – 1000VDC Minimum
  – 2500VDC Best
  – Digital or Analog OK
  – Battery Operated Best

• How to do it
  – Disconnect cable from terminals in junction box
  – One lead to ground braid
  – One lead to buss wire
  – One minute
  – Must have 50 Meg Ohms Plus at 1000VDC
  – Record tested value
Megger Test

Remove braid and lead from terminal block
Megger Test

Test lead position

Result > 50Mohm
Cold Resistance Test

- **What is it??**
  - Tests Resistance Between Cable Buss wires
  - Quick test to verify cable output

- **When to do??**
  - Performed at the factory
  - After receipt at job site
  - Prior to installation

- **Equipment**
  - Standard Multi Meter
  - Auto Range to 50Kohm
  - Digital or Analog OK
  - Battery Operated Best

- **How to do it**
  - Take one foot sample
  - Condition for one hour at 70 Deg F +/- 2 deg F
  - One lead to each buss wire
  - Set on Ohms
  - Compare to known values
  - Record
Cold Resistance Test

Result = 2.2Kohms

Test lead position
Stabilized Current Test

• What is it???
  – Tests cable current at full voltage
  – Insures cable power output is correct for design and stable

• When to do It??
  – After Insulation
  – At Start-up
  – Periodically per maintenance procedure

• Equipment
  – Standard Multi Meter with clamp on current attachment
  – Auto Range to 100 amps
  – Digital or Analog OK
  – Battery Operated Best

• How to do it
  – Open UPC box
  – Clamp onto one buss wire
  – Energize circuit
  – Allow circuit to run for 20 minutes minimum
  – Take current reading / record
  – Divide by circuit length
  – Multiply by Voltage
  – Compare to output at pipe temp

Watts = Current * Voltage
Stabilized Current Test

- Open Cover
- Clamp on buss wire
- Read Result
- Watts = Current * Voltage
Stabilized Current Test

Watts = Current * Voltage

Compare calculated result to output chart at temp

Thermal Output Ratings on Insulated Metal Pipe

Heat Output (W/ft.) vs. Pipe Temperature (°F)
End of Circuit Voltage Test

- **What is it???
  - Tests Voltage at end of Line
  - Verifies proper Voltage Applied
  - Verifies Buss wires are good over entire length of cable

- **When to do??
  - At start-up
  - Periodically per maintenance procedure

- **Equipment
  - Standard Multi Meter
  - Auto Range to 600 Volts
  - Digital or Analog OK
  - Battery Operated Best

- **How to do it
  - De-energize circuit
  - Remove end cap
  - Expose buss wires
  - One test lead to each buss wire
  - Energize circuit
  - Read voltage
  - Compare to desired value
  - Record
End of Circuit Voltage Test

Remove Cap

Expose Buss Wires
End of Circuit Voltage Test

Result = 120Vac

Test lead position
• General Considerations
  – All personnel should be qualified and trained to perform maintenance work.
  – All test equipment used should be in good repair and calibrated.
  – All inspection and test results should be documented on circuit maintenance log.
  – Freeze Protection should be checked prior to cold weather each year as a minimum.
  – Process Lines should be checked as the process requires.

• Mechanical Inspections
  – Follow same procedure as system start-up

• Electrical Inspections
  – Follow same procedure as system start-up